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J. H. R.	John Horace Round, M.A., LL.D. Balliol College, Oxford. Author of *Feudal England*; *Studies in Peerage and Family History*; *Peerage and Pedigree.*	**Percy:** *family* (*in part*); **Plantagenet.**
J. H. V. C.	John Henry Verrinder Crowe. Lieut.-Colonel, Royal Artillery. Commandant of the Royal Military College of Canada. Formerly Chief Instructor in Military Topography and Military History and Tactics at the Royal Military Academy, Woolwich. Author of *Epitome of the Russo-Turkish War, 1877–1878*; &c.	**Plevna.**
J. L. M.	John Linton Myres, M.A., F.S.A., F.R.G.S. Wykeham Professor of Ancient History in the University of Oxford, and Fellow of Magdalen College. Formerly Gladstone Professor of Greek and Lecturer in Ancient Geography, University of Liverpool. Lecturer in Classical Archaeology in University of Oxford, and Student and Tutor of Christ Church. Author of *A History of Rome*; &c.	**Pelasgians.**
J. L. W.	Jessie Laidlay Weston. Author of *Arthurian Romances unrepresented in Malory.*	**Perceval.**
J. Mt.	James Moffatt, M.A., D.D. Minister of the United Free Church of Scotland. Author of *Historical New Testament*; &c.	**Philemon;** **Philippians, Epistle to the.**
J. M. M.	John Malcolm Mitchell. Sometime Scholar of Queen's College, Oxford. Lecturer in Classics, East London College (University of London). Joint-editor of Grote's *History of Greece.*	**Peisistratus;** **Peloponnesian War;** **Persia:** *History* (*Transition Period*); **Plutarch** (*in part*).
J. P. P.	John Percival Postgate, M.A., Litt.D. Professor of Latin in the University of Liverpool. Fellow of Trinity College, Cambridge. Fellow of the British Academy. Editor of the *Classical Quarterly.* Editor-in-chief of the *Corpus Poetarum Latinorum*; &c.	**Phaedrus.**
J. R. C.	Joseph Rogerson Cotter, M.A. Assistant to the Professor of Natural and Experimental Philosophy, Trinity College, Dublin. Editor of 2nd edition of Preston's *Theory of Heat.*	**Phosphorescence.**
J. R. Gr.	Joseph Reynolds Green, M.A., D.Sc., F.L.S., F.R.S. Fellow, Lecturer and Librarian of Downing College, Cambridge. Formerly Hartley Lecturer on Plant Physiology, University of Liverpool. Author of *History of Botany*; &c.	**Plants:** *Physiology.*
J. S. F.	John Smith Flett, D.Sc., F.G.S. Petrographer to the Geological Survey of the United Kingdom. Formerly Lecturer on Petrology in Edinburgh University. Neill Medallist of the Royal Society of Edinburgh. Bigsby Medallist of the Geological Society of London.	**Pegmatite; Peridotite;** **Perlite; Petrology; Phonolite;** **Phosphates:** *Mineral Phosphates* (*in part*); **Phyllite;** **Picrite; Pitchstone;** **Pneumatolysis.**
J. T. Be.	John Thomas Bealby. Joint-author of Stanford's *Europe.* Formerly Editor of the *Scottish Geographical Magazine.* Translator of Sven Hedin's *Through Asia*, *Central Asia and Tibet*; &c.	**Perm** (*in part*); **Podolia** (*in part*); **Poland, Russian** (*in part*).
J. T. C.	Joseph Thomas Cunningham, M.A., F.Z.S. Lecturer on Zoology at the South-Western Polytechnic, London. Formerly Fellow of University College, Oxford. Assistant Professor of Natural History in the University of Edinburgh. Naturalist to the Marine Biological Association.	**Pearl;** **Pilchard.**
J. W.	James Williams, M.A., D.C.L., LL.D. All Souls' Reader in Roman Law in the University of Oxford, and Fellow of Lincoln College. Barrister of Lincoln's Inn. Author of *Wills and Succession*; &c.	**Personal Property.**
J. Wa.	James Waterhouse. Major-General, Indian Army (retired). Assistant Surveyor-General of India in charge of Photographic and Lithographic Branch, Calcutta, 1866–1897. President of the Royal Photographic Society, 1905–1906. Author of *The Preparation of Drawings for Photographic Purposes*; &c.	**Photography:** *Apparatus.*
J. Wal.*	James Walker, M.A. Christ Church, Oxford. Demonstrator in the Clarendon Laboratory. Formerly Vice-President of the Physical Society. Author of *The Analytical Theory of Light*; &c.	**Polarization of Light.**
J. W. D.	J. Whitly Dixon. Captain, R.N. Nautical Assessor to the Court of Appeal.	**Pilot** (*in part*).

K. G.	Karl Friedrich Geldner, Ph.D. Professor of Sanskrit and Comparative Philology in the University of Marburg. Author of *Vedische Studien*; &c.	**Persia:** *Language.*
K. L.	Rev. Kirsopp Lake, M.A. Lincoln College, Oxford. Professor of Early Christian Literature and New Testament Exegesis in the University of Leiden. Author of *The Text of the New Testament*; *The Historical Evidence for the Resurrection of Jesus Christ*; &c.	**Peter, Saint;** **Peter, Epistles of.**
K. S.	Kathleen Schlesinger. Editor of the *Portfolio of Musical Archaeology*. Author of *The Instruments of the Orchestra*.	**Pedal Clarinet;** **Philomel; Physharmonica;** **Pianoforte** (*in part*); **Piccolo; Pipe and Tabor;** **Platerspiel.**
L.	Count Lützow, Litt.D., Ph.D., F.R.G.S. Chamberlain of H.M. the Emperor of Austria, King of Bohemia. Hon. Member of the Royal Society of Literature. Member of the Bohemian Academy, &c. Author of *Bohemia, a Historical Sketch*; *The Historians of Bohemia* (Ilchester Lecture, Oxford, 1904); *The Life and Times of John Hus*; &c.	**Poděbrad, George of.**
L. C.	Rev. Lewis Campbell, D.C.L., LL.D. See the biographical article: Campbell, Lewis.	**Plato.**
L. F. V.-H.	Leveson Francis Vernon-Harcourt, M.A., M.Inst.C.E. (1839–1907). Professor of Civil Engineering at University College, London, 1882–1905. Author of *Rivers and Canals*; *Harbours and Docks*: *Civil Engineering as applied in Construction*; &c.	**Pier.**
L. J. S.	Leonard James Spencer, M.A. Assistant in Department of Mineralogy, British Museum. Formerly Scholar of Sidney Sussex College, Cambridge, and Harkness Scholar. Editor of the *Mineralogical Magazine*.	**Perovskite; Petalite;** **Pharmacosiderite;** **Phenacite; Phillipsite;** **Phlogopite; Phosgenite;** **Pitchblende; Plagioclase.**
M.	Lord Macaulay. See the biographical article: Macaulay, Thomas Babington Macaulay, Baron.	**Pitt.**
M. Be.	Malcolm Bell. Author of *Pewter Plate*; &c.	**Pewter.**
M. D.	Rev. Marcus Dods, D.D. See the biographical article: Dods, Marcus.	**Pelagius.**
M. N. T.	Marcus Niebuhr Tod, M.A. Fellow and Tutor of Oriel College, Oxford. University Lecturer in Epigraphy. Joint-author of *Catalogue of the Sparta Museum*.	**Perioeci.**
M. O. B. C.	Maximilian Otto Bismarck Caspari, M.A. Reader in Ancient History at London University. Lecturer in Greek at Birmingham University, 1905–1908.	**Pelopidas; Periander;** **Pericles; Phocion;** **Phocis; Plataea.**
M. V.	Max Verworn, D.Sc., M.D., Ph.D. Professor of Physiology and Director of the Physiological Institute in the University of Bonn. Author of *Allgemeine Physiologie*; &c.	**Physiology.**
N. D. M.	Newton Dennison Mereness, A.M., Ph.D. Author of *Maryland as a Proprietary Province*.	**Philippine Islands:** *Geography and Statistics*
N. M.	Norman McLean, M.A. Lecturer in Aramaic, Cambridge University. Fellow and Hebrew Lecturer, Christ's College, Cambridge. Joint-editor of the larger Cambridge *Septuagint*.	**Philoxenus.**
N. V.	Joseph Marie Noel Valois. Member of Académie des Inscriptions et Belles-Lettres, Paris. Honorary Archivist at the Archives Nationales. Formerly President of the Société de l'Histoire de France and the Société de l'École des Chartes. Author of *La France et le grand schisme d'Occident*; &c.	**Pisa, Council of.**
N. W. T.	Northcote Whitridge Thomas, M.A. Government Anthropologist to Southern Nigeria. Corresponding Member of the Société d'Anthropologie of Paris. Author of *Thought Transference*; *Kinship and Marriage in Australia*; &c.	**Physical Phenomena.**
O. A.	Osmund Airy, M.A., LL.D. H.M. Inspector of Schools and Inspector of Training Colleges, Board of Education, London. Author of *Louis XIV. and the English Restoration*; *Charles II.*; &c. Editor of the *Lauderdale Papers*; &c.	**Penn, William.**
O. Ba.	Oswald Barron, F.S.A. Editor of *The Ancestor*, 1902–1905. Hon. Genealogist to Standing Council of the Honourable Society of the Baronetage.	**Pole** (*family*).
O. C. W.	Rev. Owen Charles Whitehouse, M.A., D.D. Senior Theological Tutor and Lecturer in Hebrew, Cheshunt College, Cambridge. Principal of the Countess of Huntingdon's College, Cheshunt, 1895–1905.	**Pentecost.**
O. H.	Olaus Magnus Friedrich Henrici, Ph.D., LL.D., F.R.S. Professor of Mechanics and Mathematics in the Central Technical College of the City and Guilds of London Institute. Author of *Vectors and Rotors*; *Congruent Figures*; &c.	**Perspective.**
P. A. K.	Prince Peter Alexeivitch Kropotkin. See the biographical article: Kropotkin, Prince P. A.	**Perm** (*in part*); **Podolia** (*in part*); **Poland, Russian** (*in part*).

P. A. T.	P. A. Tiele. Formerly Librarian, Utrecht University. Author of *Biographical and Historical Memoir on the Voyages of the Dutch Navigators*; &c.	**Plantin.**
P. C. M.	Peter Chalmers Mitchell, M.A., F.R.S., F.Z.S., D.Sc., LL.D. Secretary of the Zoological Society of London. University Demonstrator in Comparative Anatomy and Assistant to Linacre Professor at Oxford, 1888–1891. Author of *Outlines of Biology*; &c.	**Phosphorescence:** *in Zoology.*
P. G.	Percy Gardner, LL.D., F.S.A., D.Litt. See the biographical article: Gardner, Percy.	**Pheidias.**
P. Gi.	Peter Giles, M.A., LL.D., Litt.D. Fellow and Classical Lecturer of Emmanuel College, Cambridge, and University Reader in Comparative Philology. Formerly Secretary of the Cambridge Philological Society.	**Philology** (*in part*).
P. La.	Philip Lake, M.A., F.G.S. Lecturer on Physical and Regional Geography in Cambridge University. Formerly of the Geological Survey of India. Author of *Monograph of British Cambrian Trilobites*. Translator and Editor of Keyser's *Comparative Geology*.	**Persia:** *Geology.*
P. Sm.	Preserved Smith, Ph.D. Rufus B. Kellogg University Fellow, Amherst College, U.S.A.	**Pius I. and II.**
P. V.	Pasquale Villari. See the biographical article: Villari, Pasquale.	**Pisa.**
R. C. J.	Sir Richard Claverhouse Jebb, LL.D., D.C.L. See the biographical article: Jebb, Sir Richard Claverhouse.	**Pindar** (*in part*).
R. G.	Richard Garnett, LL.D. See the biographical article: Garnett, Richard.	**Peacock, Thomas Love.**
R. I. P.	Reginald Innes Pocock, F.Z.S. Superintendent of the Zoological Gardens, London.	**Pedipalpi; Pentastomida.**
R. K. D.	Sir Robert Kennaway Douglas. Formerly Professor of Chinese, King's College, London. Keeper of Oriental Printed Books and MSS. at British Museum, 1892–1907. Member of the Chinese Consular Service, 1858–1865. Author of *The Language and Literature of China*; *China*; *Europe and the Far East*; &c.	**Peking.**
R. L.*	Richard Lydekker, F.R.S., F.Z.S., F.G.S. Member of the Staff of the Geological Survey of India, 1874–1882. Author of *Catalogues of Fossil Mammals, Reptiles and Birds in the British Museum*; *The Deer of all Lands*; &c.	**Peccary; Pecora; Père David's Deer; Perissodactyla; Phalanger; Phenacodus; Pica; Polecat.**
R. N. B.	Robert Nisbet Bain (d. 1909). Assistant Librarian, British Museum, 1883–1909. Author of *Scandinavia; the Political History of Denmark, Norway and Sweden, 1513–1900*; *The First Romanovs, 1613–1725*; *Slavonic Europe: The Political History of Poland and Russia from 1469 to 1796*; &c.	**Pazmány; Pechlin; Peter I. and III. of Russia; Petőfi, Alexander; Philaret; Piper, Carl; Poland:** *History* (*in part*).
R. Po.	René Poupardin, D. ès L. Secretary of the École des Chartes. Honorary Librarian at the Bibliothèque Nationale, Paris. Author of *Le Royaume de Provence sous les Carolingiens*; *Recueil des chartes de Saint-Germain*; &c.	**Philip the Bold; Philip the Good.**
R. P. S.	R. Phené Spiers, F.S.A., F.R.I.B.A. Formerly Master of the Architectural School, Royal Academy, London. Past President of Architectural Association. Associate and Fellow of King's College, London. Corresponding Member of the Institute of France. Editor of Fergusson's *History of Architecture*. Author of *Architecture: East and West*; &c.	**Pier** (*in architecture*).
R. S.*	Ralph Stockman, M.D., F.R.S.(Edin.), F.R.C.P.(Edin.). Professor of Materia Medica and Therapeutics in the University of Glasgow.	**Pharmacology.**
R. S. C.	Robert Seymour Conway, M.A., D.Litt. Professor of Latin and Indo-European Philology in the University of Manchester. Formerly Professor of Latin in University College, Cardiff, and Fellow of Gonville and Caius College, Cambridge. Author of *The Italic Dialects*.	**Picenum** (*in part*).
R. W.	Robert Wallace, F.R.S.(Edin.), F.L.S. Professor of Agriculture and Rural Economy at Edinburgh University, and Garton Lecturer on Colonial and Indian Agriculture. Professor of Agriculture, R.A.C., Cirencester, 1882–1885. Author of *Farm Live Stock of Great Britain*; *The Agriculture and Rural Economy of Australia and New Zealand*; *Farming Industries of Cape Colony*; &c.	**Pig** (*in part*).
S. A. C.	Stanley Arthur Cook, M.A. Lecturer in Hebrew and Syriac, and formerly Fellow, Gonville and Caius College, Cambridge. Editor for the Palestine Exploration Fund. Examiner in Hebrew and Aramaic, London University, 1904–1908. Author of *Glossary of Aramaic Inscriptions*; *The Law of Moses and the Code of Hammurabi*; *Critical Notes on Old Testament History*; *Religion of Ancient Palestine*; &c.	**Philistines.**
S. F. H.	Sidney Frederic Harmer, M.A., D.Sc., F.R.S., F.Z.S. Keeper of Zoology, Natural History Department, British Museum. Fellow, formerly Tutor and Lecturer, King's College, Cambridge. Joint-editor of *The Cambridge Natural History*.	**Phoronidea.**

S. H. V.*	Sydney Howard Vines, M.A., D.Sc., F.R.S. Sherardian Professor of Botany, University of Oxford and Fellow of Magdalen College. Fellow of the University of London. President of the Linnean Society, 1900–1904. Formerly Reader in Botany in the University of Cambridge and Fellow and Lecturer of Christ's College. Author of *A Student's Textbook of Botany*; &c.	**Plants:** *Morphology*.
S. N.	Simon Newcomb, D.Sc., LL.D. See the biographical article: Newcomb, Simon.	**Planet;** **Planets, Minor.**
T. As.	Thomas Ashby, M.A., D.Litt. Director of British School of Archaeology at Rome. Formerly Scholar of Christ Church, Oxford. Craven Fellow, 1897. Conington Prizeman, 1906. Member of the Imperial German Archaeological Institute. Author of *The Classical Topography of the Roman Campagna*.	**Perugia;** **Picenum** (*in part*); **Piperno.**
T. Ba.	Sir Thomas Barclay. Member of the Institute of International Law. Officer of the Legion of Honour. Author of *Problems of International Practice and Diplomacy*; &c. M.P. for Blackburn, 1910.	**Peace;** **Peace Conferences;** **Pirate and Piracy:** *Law*.
T. F. C.	Theodore Freylinghuysen Collier, Ph.D. Assistant Professor of History, Williams College, Williamstown, Mass., U.S.A.	**Pius III., IV. and V.**
T. G. Br.	Thomas Gregor Brodie, M.D., F.R.S. Professor Superintendent, Brown Animal Sanatory Institution, University of London. Professor of Physiology, Royal Veterinary College, London. Lecturer on Physiology, London School of Medicine for Women. Fellow of King's College, London. Author of *Essentials of Experimental Physiology*.	**Phagocytosis.**
T. M. L.	Rev. Thomas Martin Lindsay, LL.D., D.D. Principal of the United Free Church College, Glasgow. Formerly Assistant to the Professor of Logic and Metaphysics in the University of Edinburgh. Author of *History of the Reformation*; *Life of Luther*; &c.	**Plymouth Brethren** (*in part*)
Th. N.	Theodor Nöldeke, Ph.D. See the biographical article: Nöldeke, Theodor.	**Persepolis** (*in part*).
T. S.*	Sir Thomas Stevenson, M.D., F.R.C.P. (1838–1908). Formerly Senior Scientific Analyst to the Home Office. Lecturer on Chemistry and Forensic Medicine at Guy's Hospital, London.	**Poison.**
T. W.-D.	Walter Theodore Watts-Dunton. See the biographical article: Watts-Dunton, Walter Theodore.	**Poetry.**
T. W. H.	Thomas Wentworth Higginson, A.M., LL.D. Author of *Atlantic Essays*; *Cheerful Yesterdays*; *History of the United States*; &c.	**Phillips, Wendell.**
T. W. R. D.	Thomas William Rhys Davids, LL.D., Ph.D. Professor of Comparative Religion, Manchester University. President of the Pali Text Society. Fellow of the British Academy. Secretary and Librarian of Royal Asiatic Society, 1885–1902. Author of *Buddhism*; *Sacred Books of the Buddhists*; *Early Buddhism*; *Buddhist India*; *Dialogues of the Buddha*; &c.	**Piprāwa.**
W. C. Su.	Walter Coventry Summers, M.A. Professor of Latin in the University of Sheffield. Formerly Fellow of St John's College, Cambridge. Craven Scholar, 1890. Chancellor's Medallist, 1892. Author of *A Study of Valerius Flaccus*; &c.	**Persius;** **Petronius** (*in part*).
W. D. C.	William Douglas Caröe, M.A., F.S.A., F.R.I.B.A. Trinity College, Cambridge. Architect to the Ecclesiastical Commission and the Charity Commission, London.	**Pearson, John Loughborough.**
W. D. W.	William Dwight Whitney. See the biographical article: Whitney, William Dwight.	**Philology** (*in part*).
W. de W. A.	Sir William de Wiveleslie Abney, K.C.B., D.C.L., D.Sc., F.R.S. Adviser in Science to the Board of Education for England. Member of the Advisory Council for Education to the War Office. Formerly President of Royal Astronomical Society, Physical Society and Royal Photographic Society. Author of *Instruction in Photography*; *Colour Vision*; &c.	**Photography.**
W. E. G. F.	William Edward Garrett Fisher, M.A. Author of *The Transvaal and the Boers*.	**Phylloxera.**
W. Fr.	William Fream, LL.D. (d. 1906). Formerly Lecturer on Agricultural Entomology, University of Edinburgh, and Agricultural Correspondent of *The Times*.	**Pig** (*in part*).
W. F. C.	William Feilden Craies, M.A. Barrister-at-Law, Inner Temple and Lecturer on Criminal Law, King's College, London. Editor of Archbold's *Criminal Pleading* (23rd edition).	**Pleading.**
W. Ga.	Walter Garstang, M.A., D.Sc. Professor of Zoology in the University of Leeds. Formerly Fellow of Lincoln College, Oxford. Scientific Adviser to H.M. Delegates on the International Council for the Exploration of the Sea, 1901–1907. Author of *The Impoverishment of the Sea*; &c.	**Pisciculture.**
W. Hi.	Wheelton Hind, M.D., F.R.C.S., F.G.S. Surgeon, North Staffs Infirmary. Lyell Medallist, Geological Society, 1902. Author of *British Carboniferous Lamellibranchiata*; &c.	**Pendleside Series.**
W. H. F.	Sir William Henry Flower, F.R.S. See the biographical article: Flower, Sir W. H.	**Platypus** (*in part*).

W. M. R.	William Michael Rossetti. See the biographical article: Rossetti, Dante G.	**Perino del Vaga;** **Perugino, Pietro.**
W. M. Ra.	Sir William Mitchell Ramsay, LL.D., D.C.L., D.Litt. See the biographical article: Ramsay, Sir W. M.	**Phrygia; Pisidia.**
W. P. C.	William Prideaux Courtney. See the article: Courtney, Baron.	**Peterborough and Monmouth, Earl of.**
W. R. M.	William Richard Morfill, M.A. (d. 1910). Formerly Professor of Russian and the other Slavonic Languages in the University of Oxford. Curator of the Taylorian Institution, Oxford. Author of *Russia*; *Slavonic Literature*; &c.	**Poland:** ***Literature.***
W. R. S.	William Robertson Smith, LL.D. See the biographical article: Smith, William Robertson.	**Phylactery** *(in part).*
W. R. S.*	William Roy Smith, M.A., Ph.D. Associate Professor of History, Bryn Mawr College, Pennsylvania. Author of *Sectionalism in Pennsylvania during the Revolution*; &c.	**Polk, James Knox.**
W. S. R.	William Smyth Rockstro. Author of *A Great History of Music from the Infancy of the Greek Drama to the Present Period*; and other works on the history of music.	**Plain Song.**
W. T. T.-D.	Sir William Turner Thiselton-Dyer, F.R.S., K.C.M.G., C.I.E., D.Sc., LL.D., Ph.D., F.L.S. Hon. Student of Christ Church, Oxford. Director, Royal Botanic Gardens, Kew, 1885–1905. Botanical Adviser to Secretary of State for Colonies, 1902–1906. Joint-author of *Flora of Middlesex.*	**Plants:** ***Distribution.***
W. W. R.*	William Walker Rockwell, Lic.Theol. Assistant Professor of Church History, Union Theological Seminary, New York.	**Pius VI., VII., and VIII.**
W. Y. S.	William Young Sellar, LL.D. See the biographical article: Sellar, W. Y.	**Petronius** *(in part).*

PRINCIPAL UNSIGNED ARTICLES.

Pea.
Peach.
Pear.
Peat.
Peeblesshire.
Pembroke, Earls of.
Pembroke.
Pembrokeshire.
Pen.
Pencil.
Penitential.
Pennine Chain.
Pennsylvania.
Pennsylvania, University of.
Pensacola.
Pension.
Penzance.
Peoria.
Pepper.
Peppermint.
Perfumery.
Périer.
Perigueux.
Peripatetics.
Perjury.
Pernambuco.
Perrault.
Perrot.
Personality.
Perth (N.B.).
Perthshire.
Pessimism.
Peterborough.
Petition.
Philadelphia.
Philately.
Philostratus.
Phonograph.
Phormium.
Phosphorus.
Photius.
Photochemistry.
Physiocratic School.
Physiologus.
Piacenza.
Picardy.
Piccolomini.
Pichegru.
Pietism.
Pigeon-flying.
Pilgrim.
Pin.
Pink.
Pipe.
Piquet.
Pistoia.
Pitcher Plants.
Pittsburg.
Plantation.
Platinum.
Pleurisy.
Pleuro-Pneumonia.
Plock.
Plough and Ploughing.
Plum.
Plymouth (U.S.A.).
Pneumatic Gun.
Pneumonia.
Pnom-Penh.
Poitiers.
Poker.
Pola.

THE
ENCYCLOPÆDIA BRITANNICA

VOLUME 21

PAYN TO POLKA

PAYN, JAMES (1830–1898), English novelist, was born at Cheltenham, on the 28th of February 1830, his father being clerk to the Thames Commissioners and treasurer to the county of Berkshire. He was educated at Eton, and afterwards entered the Military Academy at Woolwich; but his health was not equal to the demands of a military career, and he proceeded in 1847 to Trinity College, Cambridge. He was among the most popular men of his time, and served as president of the Union. Before going to Cambridge he had published some verses in Leigh Hunt's *Journal*, and while still an undergraduate put forth a volume of *Stories from Boccaccio* in 1852, and in 1853 a volume of *Poems*. In the same year he left Cambridge, and shortly afterwards married Miss Louisa Adelaide Edlin, sister of Sir Peter Edlin. He then settled down in the Lake district to a literary career and contributed regularly to *Household Words* and *Chambers's Journal*. In 1858 he removed to Edinburgh to act as joint-editor of the latter periodical. He became sole editor in 1859, and conducted the magazine with much success for fifteen years. He removed to London in 1861. In the pages of the *Journal* he published in 1864 his most popular story, *Lost Sir Massingberd*. From this time he was always engaged in novel-writing, among the most popular of his productions being *Married Beneath Him* (1865), *Carlyon's Year* (1868), *By Proxy* (1878), and *The Talk of the Town* (1885). In 1883 he succeeded Leslie Stephen as editor of the *Cornhill Magazine* and continued in the post until the breakdown of his health in 1896. He was also literary adviser to Messrs Smith, Elder & Company. His publications included a *Handbook to the English Lakes* (1859), and various volumes of occasional essays, *Maxims by a Man of the World* (1869), *Some Private Views* (1881), *Some Literary Recollections* (1884). A posthumous work, *The Backwater of Life* (1899), revealed much of his own personality in a mood of kindly, sensible reflection upon familiar topics. He died in London, on the 25th of March 1898.

A biographical introduction to *The Backwater of Life* was furnished by Sir Leslie Stephen.

PAYNE, PETER (*c.* 1380–1455), English Lollard and Taborite, the son of a Frenchman by an English wife, was born at Hough-on-the-Hill near Grantham, about 1380. He was educated at Oxford, where he adopted Lollard opinions, and had graduated as a master of arts before the 6th of October 1406, when he was concerned in the irregular proceedings through which a letter declaring the sympathy of the university was addressed to the Bohemian reformers. From 1410 to 1414 Payne was principal of St Edmund Hall, and during these years was engaged in controversy with Thomas Netter of Walden, the Carmelite defender of Catholic doctrine. In 1414 he was compelled to leave Oxford and taught for a time in London. Ultimately he had to flee from England, and took refuge in Bohemia, where he was received by the university of Prague on the 13th of February 1417, and soon became a leader of the reformers. He joined the sect of the "Orphans," and had a prominent part in the discussions and conferences of the ten years from 1420 to 1430. When the Bohemians agreed to send representatives to the Council of Basel, Payne was naturally chosen to be one of their delegates. He arrived at Basel, on the 4th of January 1433, and his unyielding temper and bitter words probably did much to prevent a settlement. The Bohemians left Basel in April. The party of the nobles, who had been ready to make terms, were attacked in the Diet at Prague, by the Orphans and Taborites. Next year the dispute led to open war. The nobles were victorious at Lipau on the 29th of May 1434, and it was reported in England that Payne was killed. When soon afterwards the majority of the Orphans joined the moderate party, Payne allied himself with the more extreme Taborites. Nevertheless his reputation was so great that he was accepted as an arbitrator in doctrinal disputes amongst the reformers. In February 1437 the pope desired the emperor Sigismund to send Payne to be tried for heresy at Basel. Payne had to leave his pastorate at Saas, and took refuge with Peter Chelcicky, the Bohemian author. Two years later he was captured and imprisoned at Cutenstein, but was ransomed by his Taborite friends. Payne took part in the conferences of the Bohemian parties in 1443–1444, and again in 1452. He died at Prague in 1455. He was a learned and eloquent controversialist, and a faithful adherent to Wycliffe's doctrine. Payne was also known as Clerk at Oxford, as Peter English in Bohemia, and as Freyng, after his French father, and Hough from his birth place.

BIBLIOGRAPHY.—The chief facts of Payne's English career are given in the *Loci e libro veritatum* of T. Gascoigne (ed. Thorold Rogers, Oxford, 1881). For his later life the principal sources are contained in the *Monumenta conciliorum generalium saeculi v., Saeculi xv.*, or *saeculi quintodecimi*, vols. i.–iii. (Vienna, 1857–1894). For modern authorities consult Palacky, *Geschichte von Böhmen*, vii.–ix., and Creighton's *History of the Papacy*. The biography by James Baker, *A Forgotten Great Englishman* (London, 1894), is too partial. (C. L. K.)

PAYNTER (or PAINTER), **WILLIAM** (*c.* 1540–1594), English author, was a native of Kent. He matriculated at St John's College, Cambridge, in 1554. In 1561 he became clerk of the ordnance in the Tower of London, a position in which he appears to have amassed a fortune out of the public funds. In 1586 he confessed that he owed the government a thousand pounds, and in the next year further charges of peculation were brought against him. In 1591 his son Anthony owned that he and his father had abused their trust, but Paynter retained his office until his death, This event probably followed immediately upon his will, which was nuncupative and was dated the 14th of February 1594. The first volume of his *Palace of Pleasure* appeared in 1566, and was dedicated to the earl of Warwick. It included sixty tales, and was followed in the next year by a second volume containing thirty-four new ones. A second improved edition in 1575 contained seven new stories. Paynter borrows from Herodotus, Plutarch, Aulus Gellius, Aelian, Livy, Tacitus, Quintus Curtius; from Giraldi Cinthio, Matteo Bandello, Ser Giovanni Fiorentino, Straparola, Queen Margaret of Navarre and others. To the vogue of this and similar collections we owe the Italian setting of so large a proportion of the Elizabethan drama. The early tragedies of *Appius and Virginia*, and *Tancred and Gismund* were taken from *The Palace of Pleasure*; and among better-known plays derived from the book are the Shakespearian *Timon of Athens*, *All's Well that Ends Well* (from Giletta of Narbonne), Beaumont and Fletcher's *Triumph of Death* and Shirley's *Love's Cruelty*.

The Palace of Pleasure was edited by Joseph Haslewood in 1813. This edition was collated (1890) with the British Museum copy of 1575 by Mr Joseph Jacobs, who added further prefatory matter, including an introduction dealing with the importance of Italian *novelle* in Elizabethan drama.

PAYSANDÚ, or PAISANDÚ, a town and river port of Uruguay and capital of a department of the same name, on the left bank of the Uruguay River about 214 m. N.W. of Montevideo, with which it is connected by rail. Pop. (1908 estimate), 15,000. It has railway connexion with Rio Negro and Montevideo to the south-east, and with Salto and Santa Rosa, on the Brazilian frontier, on the north; it is at the head of low water navigation on the Uruguay River, and is in regular steamer communication with Montevideo and Buenos Aires.

There are some good public buildings, including two churches, a hospital, a theatre and the government offices. Paysandú exports cattle and sheep and salted meats, hides, ox tongues, wool and other animal products. There is a meat-curing establishment (*saladero*) at Guaviyú, in the vicinity. The town was named in honour of Pay, or Pai (Father) Sandú, a priest who settled there in 1772. It has suffered severely from revolutionary outbreaks, was bombarded by Rivera in 1846, and was partly destroyed in 1865 by a Brazilian bombardment, after which its gallant defenders, Leandro Gomez and his companions, were butchered in cold blood.

The department of Paysandú—area 5117 sq. m.; pop. (1907, estimate), 54,097—is one of the richest stock-raising regions of the republic.

PAYSON, EDWARD (1783–1827), American Congregational preacher, was born on the 25th of July 1783 at Rindge, New Hampshire, where his father, Seth Payson (1758–1820), was pastor of the Congregational Church. His uncle, Phillips Payson (1736–1801), pastor of a church in Chelsea, Massachusetts, was a physicist and astronomer. Edward Payson graduated at Harvard in 1803, was then principal of a school at Portland, Maine, and in 1807 became junior pastor of the Congregational Church at Portland, where he remained, after 1811, as senior pastor, until his death on the 22nd of October 1827.

The most complete collection of his sermons, with a memoir by Asa Cummings originally published in 1828, is the *Memoir, Select Thoughts and Sermons of the late Rev. Edward Payson* (3 vols., Portland, 1846; Philadelphia, 1859). Based on this is the volume, *Mementos of Edward Payson* (New York, 1873), by the Rev. E. L. Janes of the Methodist Episcopal Church.

PÁZMÁNY, PÉTER (1570–1637), Hungarian cardinal and statesman, was born at Nagyvárad on the 4th of October 1570, and educated at Nagyvárad and Kolozsvár, at which latter place he quitted the Calvinist confession for the Roman communion (1583). In 1587 he entered the Jesuit order. Pázmány went through his probation at Cracow, took his degree at Vienna, and studied theology at Rome, and finally completed his academic course at the Jesuit college at Graz. In 1601 he was sent to the order's establishment at Sellye, where his eloquence and dialectic won back hundreds to Rome, including many of the noblest families. Prince Nicholas Esterházy and Paul Rákóczy were among his converts. In 1607 he was attached to the archbishop of Esztergom, and in the following year attracted attention by his denunciation, in the Diet, of the 8th point of the peace of Vienna, which prohibited the Jesuits from acquiring landed property in Hungary. At about the same time the pope, on the petition of the emperor Matthias II., released Pázmány from his monkish vows. On the 25th of April 1616 he was made dean of Turócz, and on the 28th of September became primate of Hungary. He received the red hat from Urban VIII. in 1629. Pázmány was the soul of the Roman Catholic reaction in Hungary. Particularly remarkable is his *Igazságra vezetö Kalauz* (*Guide to Truth*), which appeared in 1613. This manual united all the advantages of scientific depth, methodical arrangement and popular style. As the chief pastor of the Hungarian church Pázmány used every means in his power, short of absolute contravention of the laws, to obstruct and weaken Protestantism, which had risen during the 16th century. In 1619 he founded a seminary for theological candidates at Nagyszombat, and in 1623 laid the foundations of a similar institution at Vienna, the still famous Pazmanaeum, at a cost of 200,000 florins. In 1635 he contributed 100,000 florins towards the foundation of a Hungarian university. He also built Jesuit colleges and schools at Pressburg, and Franciscan monasteries at Ersékújvár and Körmöczbánya. In politics he played a considerable part. It was chiefly due to him that the diet of 1618 elected the archduke Ferdinand to succeed the childless Matthias II. He also repeatedly thwarted the martial ambitions of Gabriel Bethlen, and prevented George Rákóczy I., over whom he had a great influence, from combining with the Turks and the Protestants. But Pázmány's most unforgetable service to his country was his creation of the Hungarian literary language. As an orator he well deserved the epithet of "the Hungarian purple Cicero." Of his numerous works the chief are: *The Four Books of Thomas à Kempis on the imitation of Christ* (Hung., 1603), of which there are many editions; *Diatribe theologica de visibili Christi in terris ecclesia* (Graz, 1615); *Vindiciae ecclesiasticae* (Vienna, 1620); *Sermons for every Sunday in the Year* (Hung., Pressburg, 1636); *The Triumph of Truth* (Hung., Pressburg, 1614).

See Vilmós Fraknói, *Peter Pázmány and his Times* (Hung. Pest, 1868–1872); *Correspondence of Pázmány* (Hung. and Latin), published by the Hungarian Academy (Pest, 1873). (R. N. B.)

PAZ SOLDAN, MARIANO FELIPE (1821–1886), Peruvian historian and geographer, was born at Arequipa, on the 22nd of August 1821. He studied law, and after holding some minor judicial offices, was minister to New Granada in 1853. After his return he occupied himself with plans for the establishment of a model penitentiary at Lima, which he was enabled to accomplish through the support of General Castilla. In 1860 Castilla made him director of public works, in which capacity he superintended the erection of the Lima statue of Bolivar. He was also concerned in the reform of the currency by the withdrawal of the debased Bolivian coins. In 1861 he published his great atlas of the republic of Peru, and in 1868 the first volume of his history of Peru after the acquisition of her independence. A second volume followed, and a third, bringing the history down to 1839, was published after his death by his son. In 1870 he was minister of justice and worship under President Balta, but shortly afterwards retired from public life to devote himself to his great geographical dictionary of Peru, which was published in 1877. During the disastrous war with Chile he sought refuge at Buenos Aires, where he was made professor in the National College, and where he wrote and published a history of the war (1884). He died on the 31st of December 1886.

PEA (*Pisum*), a genus of the order Leguminosae, consisting of herbs with compound pinnate leaves ending in tendrils, by means of which the weak stems are enabled to support themselves, and with large leafy stipules at the base. The flowers (fig. 1) are typically "papilionaceous," with a "standard" or large petal above, two side petals or wings, and two front petals below forming the keel. The stamens are ten—nine united, the tenth usually free or only slightly joined to the others.

This separation allows approach to the honey which is secreted at the base of the staminal tube. The ovary is prolonged into a long, thick, bent style, compressed from side to side at the tip and fringed with hairs. The fruit is a characteristic "legume" or pod (fig. 2), bursting when ripe into halves, which bear the large globular seeds (peas) on their edges. These seeds are on short stalks, the upper extremity of which is dilated into a shallow cup (*aril*); the two seed-leaves (*cotyledons*) are thick and fleshy, with a radicle bent along their edges on one side. The genus is exceedingly close to *Lathyrus*, being only distinguished technically by the style, which in the latter genus is compressed from above downwards and not thick. It is not surprising, therefore, that under the general name "pea" species both of *Pisum* and of *Lathyrus* are included. The common field pea with tan-coloured or compressed mottled seeds and two to four leaflets is *Pisum arvense*, which is cultivated in all temperate parts of the globe, but which, according to the Italian botanists, is truly a native of central and southern Italy: it has purple flowers. The garden pea, *P. sativum*, which has white flowers, is more tender than the preceding, and its origin is not known. It has not been found in a wild state anywhere, and it is considered that it may be a form of *P. arvense*, having, however, from four to six leaflets to each leaf and globular seeds of uniform colour.

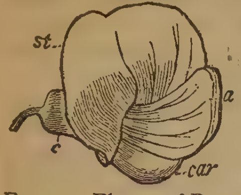
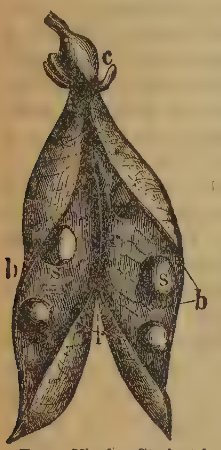


FIG. 1.—Flower of Pea.
c, Calyx.
st, Standard.
a, Alae, or wings.
car, Carina, or Keel.



From Vine's *Students' Text-book of Botany*, by permission of Swan, Sonnenschein & Co.

FIG. 2.—The Pod (legume) of the Pea.
r, The dorsal suture.
b, The ventral.
c, Calyx.
s, Seeds.

P. sativum was known to Theophrastus; and De Candolle (*Origin of Cultivated Plants*, p. 329) points out that the word "pison" or its equivalent occurs in the Albanian tongue as well as in Latin, whence he concludes that the pea was known to the Aryans, and was perhaps brought by them into Greece and Italy. Peas have been found in the Swiss lake-dwellings of the bronze period. The garden peas differ considerably in size, shape of pod, degree of productiveness, form and colour of seed, &c. The sugar peas are those in which the inner lining of the pod is very thin instead of being somewhat horny, so that the whole pod can be eaten. Unlike most papilionaceous plants, peaflowers are perfectly fertile without the aid of insects, and thus do not intercross so freely as most similar plants do. On the other hand, a case is known wherein the pollen from a purple-podded pea applied to the stigma of one of the green-podded sugar peas produced a purple pod, showing that not only the ovule but even the ovary was affected by the cross. The numerous varieties of peas in cultivation have been obtained by cross-fertilization, but chiefly by selection. Peas constitute a highly nutritious article of diet from the large quantity of nitrogenous materials they contain in addition to starchy and saccharine matters.

The sweet pea, cultivated for the beauty and fragrance of its flowers, is a species of the allied genus *Lathyrus* (*L. odoratus*), a native of southern Europe. The chick pea (*q.v.*) (*Cicer arietinum*), not cultivated in England, is still farther removed from the true peas. The everlasting pea of gardens is a species of *Lathyrus* (*L. latifolius*) with very deep fleshy roots, bold foliage, and beautiful but scentless flowers; the field pea (*Pisum arvense*) is better adapted than the bean to light soils, and is best cultivated in rows of such a width as to admit of horse-hoeing. The early stage at which the plants fall over, and forbid further culture, renders it even more needful than in the case of beans to sow them only on land already clean. If annual weeds can be kept in check until the peas once get a close cover, they then occupy the ground so completely that nothing else can live under them; and the ground, after their removal, is found in the choicest condition. A thin crop of peas should never be allowed to stand, as the land is sure to get perfectly wild. The difficulty of getting this crop well harvested renders it peculiarly advisable to sow only the early varieties.

The pea prefers a friable calcareous loam, deeply worked, and well enriched with good hotbed or farm-yard manure. The early crops require a warm sheltered situation, but the later are better grown 6 or 8 ft. apart, or more, in the open quarters, dwarf crops being introduced between the rows. The dwarf or early sorts may be sown 3 or 4 ft. apart. The deep working of the soil is of importance, lest the plants should suffer in hot dry weather from mildew or arrest of growth. The first sowing may be made about the beginning or middle of November, in front of a south wall, the plants being defended by spruce fir branches or other spray throughout the winter. In February sowings are sometimes made in private gardens, in flower-pots or boxes, and the young plants afterwards planted out. The main crop should be sown towards the end of February, and moderate sowings should be made twice a month afterwards, up to the beginning of July for the north, and about the third week in July for warmer districts. During dry hot weather late peas derive great benefit from mulching and watering. The latest sowings, at the middle or end of August, should consist of the best early sorts, as they are not so long in producing pods as the larger and finer sorts, and by this means the supply may be prolonged till October or November. As they grow the earth is drawn up to the stems, which are also supported by stakes, a practice which in a well-kept garden is always advisable, although it is said that the early varieties arrive sooner at maturity when recumbent.

Peas grown late in autumn are subject to mildew, to obviate which it has been proposed to dig over the ground in the usual way, and to soak the spaces to be occupied by the rows of peas thoroughly with water—the earth on each side to be then collected so as to form ridges 7 or 8 in. high, these ridges being well watered, and the seed sown on them in single rows. If dry weather at any time set in, water should be supplied profusely once a week.

To produce very early crops the French market-gardeners used to sow early in November, in frames, on a border having a good aspect, the seeds being covered very slightly. The young plants are transplanted into other frames in December, the ground inside being dug out so as to be 18 or 20 in. below the sashes, and the earth thus removed placed against the outside of the frames. The young plants, when 3 or 4 in. high, are planted in patches of three or four, 8 in. asunder, in four longitudinal rows. The sashes are covered at night with straw mats, and opened whenever the weather is sufficiently mild. When 8 or 10 in. high the stems are inclined towards the back of the frame, a little earth being drawn to their base, and when the plants come into blossom the tops are pinched out above the third or fourth flower to force them into bearing. As soon as they begin to pod, the soil may have a gentle watering, whenever sufficiently warmed by the sun, but a too vigorous growth at an earlier period would be detrimental. Thus treated the plants bear pods fit for gathering in the first fortnight in April.

A very convenient means of obtaining an early crop is to sow in 5-in. pots, a few seeds in each, the plants to be ultimately planted out on a warm border. Peas may also be obtained early if gently forced in frames, in the same way as kidney beans, the dwarfest varieties being preferable.

For the very early peas the rows should range east and west, but for the main crops north and south. The average depth of the drills should be about 2 in. for small sorts, and a trifle more for the larger kinds. The drills should be made wide and flat at bottom so that the seeds may be better separated in sowing. The large sorts are the better for being sown 3 in. apart. Chopped furze may be advantageously scattered in the drill before covering in, to check the depredations of mice, and before levelling the surface the soil should be gently trodden down over the seeds.

A good selection of sorts may be made from the following:—

Early.—William Hurst; Chelsea Gem; Sutton's Bountiful and Excelsior; Gradus.

Second Early.—Stratagem; Telephone; Telegraph; Carter's Daisy; Duke of York; Veitch's Autocrat.

Late.—Veitch's Perfection; Ne Plus Ultra, the finest of all late peas, but a little delicate in cold wet soils and seasons; British Queen; Champion of England; Duke of Albany.

PEABODY, ANDREW PRESTON (1811–1893), American clergyman and author, was born in Beverly, Massachusetts, on the 19th of March 1811, and was descended from Lieut. Francis Peabody of St Albans, who emigrated to Massachusetts in 1635. He learned to read before he was three years old, entered Harvard College at the age of twelve, and graduated in 1826, with the single exception of Paul Dudley (class of 1690) the youngest graduate of Harvard. In 1833 he became assistant pastor of the South Parish (Unitarian) of Portsmouth, New Hampshire; the senior pastor died before Peabody had been preaching a month, and he succeeded to the charge of the church, which he held until 1860. In 1852–1860 he was proprietor and editor of the *North American Review*. He was preacher to

Harvard University and Plummer professor of Christian morals from 1860 to 1881, and was professor emeritus from 1881 until his death in Boston, Massachusetts, on the 10th of March 1893. On the walls of Appleton Chapel, Cambridge, U.S.A., is a bronze tablet to his memory.

Besides many brief memoirs and articles, he wrote: *Christianity the Religion of Nature* (2nd ed., 1864), Lowell Institute Lectures; *Reminiscences of European Travel* (1868); *A Manual of Moral Philosophy* (1873); *Christian Belief and Life* (1875), and *Harvard Reminiscences* (1888). See the *Memoir* (Cambridge, 1890) by Edward J. Young.

PEABODY, ELIZABETH PALMER (1804–1894), American educationist, was born at Billerica, Massachusetts, on the 16th of May 1804. Early in life she was assistant in A. Bronson Alcott's school in Boston, Mass., the best account of which is probably her *Record of Mr Alcott's School* (1835). She had been instructed in Greek by Emerson at Concord when she was eighteen years old. She became interested in the educational methods of Froebel, and in 1860 opened in Boston a small school resembling a kindergarten. In 1867 she visited Germany for the purpose of studying Froebel's methods. It was largely through her efforts that the first public kindergarten in the United States was established in Boston in 1870. She died at Jamaica Plain, Boston, on the 3rd of January 1894. She was the sister-in-law of Nathaniel Hawthorne and of Horace Mann.

Among her publications are: *Kindergarten in Italy* (1872); *Reminiscences of William Ellery Channing* (1880); *Lectures in the Training Schools for Kindergartners* (1888); and *Last Evening with Allston, and other Papers* (1886).

PEABODY, GEORGE (1795–1869), American philanthropist, was descended from an old yeoman family of Hertfordshire, England, named Pabody or Pebody. He was born in the part of Danvers which is now Peabody, Mass., on the 18th of February 1795. When eleven years old he became apprentice at a grocery store. At the end of four years he became assistant to his brother, and a year afterwards to his uncle, who had a business in Georgetown, District of Columbia. After serving as a volunteer at Fort Warburton, Maryland, in the War of 1812, he became partner with Elisha Riggs in a dry goods store at Georgetown, Riggs furnishing the capital, while Peabody was manager. Through his energy and skill the business increased with astounding rapidity, and on the retirement of Riggs about 1830 Peabody found himself at the head of one of the largest mercantile concerns in the world. About 1837 he established himself in London as merchant and money-broker at Wanford Court, in the city, and in 1843 he withdrew from the American business. The number of his benefactions to public objects was very large. He gave £50,000 for educational purposes at Danvers; £200,000 to found and endow a scientific Institute in Baltimore; various sums to Harvard University; £700,000 to the trustees of the Peabody Educational Fund to promote education in the southern states; and £500,000 for the erection of dwelling-houses for the working-classes in London. He received from Queen Victoria the offer of a baronetcy, but declined it. In 1867 the United States Congress awarded him a special vote of thanks. He died in London on the 4th of November 1869; his body was carried to America in a British warship, and was buried in his native town.

See the *Life* (Boston, 1870) by Phebe A. Hanaford.

PEABODY, a township of Essex county, Massachusetts, U.S.A., in the eastern part of the state, 2 m. N.W. of Salem. Pop. (1905) 13,098; (1910) 15,721. It is served by the Boston & Maine railroad. The township covers an area of 17 sq. m. Its principal village is also known as Peabody. It contains the Peabody institute (1852), a gift of George Peabody; in 1909 the institute had a library of 43,200 vols., and in connexion with it is the Eben Dale Sutton reference library, containing 4100 vols. in 1909. In the institute is the portrait of Queen Victoria given by her to Mr Peabody. Among the places of interest in the township are the birthplace of George Peabody, the home of Rufus Choate (who lived here from 1823 to 1828), and the old burying-ground, where many soldiers of the War of Independence are buried; and the town has a Lexington monument, dedicated in 1835, and a soldiers' monument, dedicated in 1881. Manufacturing is the principal industry, and leather is the principal product; among other manufactures are shoes, gloves, glue and carriages. The value of the factory products in 1905 was $10,236,669, an increase of 47·4% over that for 1900, and of the total the leather product represented 77·3%.

Peabody was originally a part of the township of Salem. In 1752 the district of Danvers was created, and in 1757 this district was made a separate township. In 1855 the township was divided into Danvers and South Danvers, and in 1868 the name of South Danvers was changed to Peabody, in honour of George Peabody.

See *Old Naumkeag* (Salem, 1877), by C. H. Webber and W. H. Nevins.

PEACE, a river of western Canada. It rises in the Rocky Mountains near 55° N., and breaking through the mountains, flows N.E. into Slave River, near lake Athabasca. The district between 56° 40′ and 60° N., and between 112° W. and the Rocky Mountains is usually known as the Peace River district.

PEACE (Lat. *pax;* Fr. *paix*; Ger. *Friede*), the contrary of war, conflict or turmoil, and the condition which follows their cessation. Its sense in international law is the condition of not being at war. The word is also used as an abridgment for a treaty of peace, in such cases as the Peace of Utrecht (1713) and the Peace of Amiens (1802).

Introduction.—Peace until quite recently was merely the political condition which prevailed in the intervals between wars. It was a purely negative condition. Even Grotius, who reduced the tendencies existing in his time to a sort of orderly expression, addressed himself to the law of war as the positive part of international jurisprudence and dealt only with peace as its negative alternative. The very name of his historic treatise, *De jure belli ac pacis* (1625), shows the subordination of peace to the main subject of war. In our own time peace has attained a higher status. It is now customary among writers on international law to give peace at any rate a volume to itself. Peace in fact has become a separate branch of the subject. The rise of arbitration as a method of settling international difficulties has carried it a step further, and now the Hague Peace Conventions have given pacific methods a standing apart from war, and the preservation of peace has become an object of direct political effort. The methods for ensuring such preservation are now almost as precise as the methods of war. However reluctant some states may be to bind themselves to any rules excluding recourse to brute force when diplomatic negotiations have failed, they have nevertheless unanimously at the Hague Conference of 1907 declared their "firm determination to co-operate in the maintenance of general peace" (*la ferme volonté de concourir au maintien de la paix générale*)[1], and their resolution "to favour with all their efforts the amicable settlement of international conflicts" (preamble to Peace Convention). The offer of mediation by independent powers is provided for (Peace Convention: art. 3), and it is specifically agreed that in matters of a "legal character" such as "questions of interpretation and application" of international conventions, arbitration is the "most efficacious and at the same time most equitable method" of settling differences which have not been solved by diplomacy (Peace Convention: art. 38). In the final act, the conference went farther in agreeing to the "principle of compulsory arbitration," declaring that "certain disputes, in particular those relating to the interpretation and application of the provisions of international agreements, are suitable (susceptible) to be submitted to compulsory arbitration without any restriction."

These declarations were obviously a concession to the widespread feeling, among civilized nations, that peace is an object in itself, an international political condition requiring its code of methods and laws just as much as the domestic political conditions of nations require their codes of methods and laws. In other words peace among nations has now become, or is fast becoming, a positive subject of international regulation, while war is coming, among progressive peoples, to be regarded merely as an accidental disturbance of that harmony and concord among mankind which nations require for the fostering of their domestic welfare.

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[1] This has been incorrectly rendered in the English official translation as "the sincere desire to work for the maintenance of general peace."

Though the idea of preserving peace by general international regulation has had several exponents in the course of ages, no deliberate plan has ever yet been carried into effect. Indirectly, however, there have been many agencies which have operated towards this end. The earliest, known to history, is the Amphictyonic Council (*q.v.*) which grew out of the common worship of the Hellenes. It was not so much a political as a religious body. "If it had any claim," says Freeman,[1] "to the title of a general council of Greece, it was wholly in the sense in which we speak of general councils in modern Europe. The Amphictyonic Council represented Greece as an ecclesiastical synod represented western Christendom. Its primary business was to regulate the concerns of the temple of Apollo at Delphi. The Amphictyonic Council which met at Delphi was only the most famous of several bodies of the same kind." "It is easy, however," adds Freeman, "to understand how the religious functions of such a body might assume a political character. Thus the old Amphictyonic oath forbade certain extreme measures of hostility against any city sharing in the common Amphictyonic worship, and it was forbidden to raze any Amphictyonic city or to cut off its water. As the only deliberative body in which most Greek communities were represented, its decisions were those of the bulk of the Hellenic people. It sank eventually into a mere political tool in the hands first of Thebes, and then under Philip of Macedonia."

The so-called *pax romana* was merely peace within an empire governed from a central authority, the constituent parts of which were held together by a network of centralized authority.

The feudal system again was a system of offence and defence, and its object was efficiency for war, not the organized regulation of peace. Yet it had elements of federation within the bonds of its hierarchy.

The spiritual influence of the Church again was exerted to preserve relative peace among feudal princes. The "Truce of God" was established by the clergy (originally in Guyenne in 1031) to take advantage of holy days and festivals for the purpose of restricting the time available for bloodshed.

The "grand design" of Henry IV. (France), which some historians regard merely as the fantastic idea of a visionary, was probably a scheme of his great minister Sully to avert by a federation the conflict which he probably foresaw would break out sooner or later between Catholic and Protestant Europe, and which, in fact, broke out some fifteen years later in the Thirty Years' War.

The Holy Roman Empire itself was in some respects an agent for the preservation of peace among its constituent states. In the same way the federation of Swiss cantons, of the states of the North American Union and of the present German Empire have served as means of reducing the number of possible parties to war, and consequently that of its possible occasions.

Not only the number of possible war-making states but also the territorial area over which war can be made has been reduced in recent times by the creation of neutralized states such as Switzerland, Belgium, Luxemburg and Norway, and areas such as the Congo basin, the American lakes and the Suez Canal.

The "balance of power," which has played in the history of modern Europe such an important part, is inherent in the notion of the independence and stability of states. Just as in Italy the common weal of the different republics which were crowded within the limited area of the peninsula required that no one of them should become so powerful as to threaten the independence of the others, so western Europe had a similar danger to counteract. France, Spain and the Empire were competing with each other in power to the detriment of smaller states. Great Britain and the Netherlands, Prussia and Russia, had interests in the preservation of the *status quo*, and wars were waged and treaties concluded to adjust the strength of states in the common interest of preventing any one of them from obtaining undue predominance. Then came the break up of what remained of feudal Europe and a readjustment under Napoleon, which left the western world with five fairly balanced homogeneous nations. These now took the place of the old heterogeneous areas, governed by their respective sovereigns without reference to any idea of nationality or of national representation. The leading nations assumed the hegemony of the west, and in more recent times this combination has become known as the "concert of Europe." This concert of the great powers, as its name implies, in contradistinction to the "balance of power," was essentially a factor for the preservation of peace. For a century back it has played the part of an upper council in the management of Europe. In all matters affecting the Near East, it considers itself supreme. In matters of general interest it has frequently called conferences to which the minor states have been invited, such as the West African Conference in Berlin in 1885, and the Anti-Slavery Conference at Brussels in 1889–1890, and the Conference of Algeciras in 1906. Meanwhile the concert has admitted among its members first in 1856 Turkey, later in 1878 at the Congress of Berlin the United States, and now undoubtedly Japan will expect to be included as a great power in this controlling body. The essential feature of the concert has been recognition of the advantage to all the great powers of common action in reference to territorial changes in the Near East, of meeting together as a council, in preference to unconcerted negotiation by the powers acting severally.

A departure of more recent origin has been the calling together of the smaller powers for the settlement of matters of general administrative interest, conferences such as those which led to the conclusion of the conventions creating the Postal Union, the Copyright and Industrial Property Unions, &c.

These conferences of all the powers serve in practice as a sort of common council in the community of states, just as the concert of the great powers acts as a kind of senate. We have thus the nucleus of that international parliament which idealist peacemakers have dreamt of since the time of Henry IV.'s "grand design."

This brings us down to the greatest deliberate effort ever made to secure the peace of the world by a general convention. It was due to the initiative of the young tsar Nicolas II., who, in his famous rescript of the 24th of August 1898, stated that he thought that the then moment was "very favourable for seeking, by means of international discussion, the most effectual means of assuring to all peoples the benefits of a real and durable peace." "In the course of the last twenty years," added the rescript, "the preservation of peace had become an object of international policy." Economic crises, due in great part to the existing system of excessive armaments, were transforming armed peace into a crushing burden, which peoples had more and more difficulty in bearing. He therefore proposed that there should be an international conference for the purpose of focusing the efforts of all states which were "sincerely seeking to make the great idea of universal peace triumph over the elements of trouble and discord." The first conference was held in 1899, and another followed it in 1907: at the earlier one twenty-six powers were represented; at that of 1907 there were forty-four, this time practically the whole world. The conventions drawn up at the second conference were a deliberate codification of many branches of international law. By them a written law has been substituted for that unwritten law which nations had been wont to construe with a latitude more or less corresponding to their power. At the conference of 1899, moreover, a court of arbitration was instituted for the purpose of dealing judicially with such matters in dispute as the powers agreed to submit to it.

In the interval between the two Hague Conferences, Great Britain and France concluded the first treaty applicable to future difficulties, as distinguished from the treaties which had preceded it, treaties which related in all cases to difficulties already existing and confined to them. This treaty made arbitration applicable to all matters not affecting "national honour or vital interests." Since then a network of similar treaties, adopted by different nations with each other and based on the Anglo-French model, has made reference to the Hague Court of Arbitration practically compulsory for all matters which can be settled by an award of damages or do not affect any vital national interest. The third Hague Conference is timed to be held in 1917. Meanwhile a conference of the maritime powers was held in London in 1908–1909 for the elaboration of a code of international maritime law in time of war, to be applied in the international Court of Prize, which had been proposed in a convention signed *ad referendum* at the Hague Conference of 1907.

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[1] *History of Federal Government in Greece and Italy* (2nd ed., London, 1893), p. 97.

A further development in the common efforts which have been made by different powers to assure the reign of justice and judicial methods among the states of the world was the proposal of Secretary Knox of the United States to insert in the instrument of ratification of the International Prize Court Convention (adopted at the Hague in 1897) a clause stating that the International Prize Court shall be invested with the duties and functions of a court of arbitral justice, such as recommended by the first *Voeu* of the Final Act of the conference. The object of this proposal was to give effect to the idea that the existing "permanent" court lacked the essential characteristics of national courts of justice in not being ready at all times to hear cases, and in needing to be specially constituted for every case submitted to it. The new court would be permanently in session at the Hague, the full panel of judges to assemble in ordinary or extraordinary session once a year.

Thus, while armaments are increasing, and wars are being fought out in the press and in public discussion, the great powers are steadily working out a system of written law and establishing a judiciary to adjust their differences in accordance with it.[1]

The Current Grouping of Mankind and Nation-making.—In the consolidation of peace one of the most important factors is unquestionably the grouping of mankind in accordance with the final territorial and racial limitations of their apparent destiny. Language has played a vital part in the formation of Germany and Italy. The language question still disturbs the tranquillity of the Near East. The Hungarian government is regarded by the Slav, Ruman and German inhabitants of the monarchy as an oppressor for endeavouring to force everybody within the realm to learn the Magyar language. The "Young Turkish" government has problems to face which will be equally difficult, if it insists on endeavouring to institute centralized government in Turkey on the French model.

Whereas during the 19th century states were being cut out to suit the existing distribution of language, in the 20th the tendency seems to be to avoid further rearrangement of boundaries, and to complete the homogeneity, thus far attained, by the artificial method of forcing reluctant populations to adopt the language of the predominant or governing race. In the United States this artificial method has become a necessity, to prevent the upgrowth of alien communities, which might at some later date cause domestic trouble of a perilous character. For example, when a community of French Canadians, discontented with British rule, many years ago migrated and settled in Massachusetts, they found none of the tolerance they had been enjoying in Canada for their French schools and the French language they wished to preserve. In Alsace-Lorraine German-speaking immigrants are gradually displacing, under government encouragement, the French-speaking population. Poland is another case of the difficulty of managing a population which speaks a language not that of the governing majority, and Russia, in trying to solve one problem by absorbing Finland into the national system, is burdening herself with another which may work out in centuries of unrest, if not in domestic violence. Not very long ago Pan-Germans were paying much attention to the German settlers in the Brazilian province of Rio Grande do Sul, where large villages spoke nothing but German, and German, as the only language known on the spot, had become the tongue in which municipal business was transacted. The Brazilian government, in view of the danger to which such a state of things might give rise, followed the example of the United States in dealing with the language question.

Thus while in the one case homogeneity of language within state boundaries seems to be one of the conditions making for peace, the avoidance of interference with a well-marked homogeneous area like Finland would seem to contribute equally to the same end.

Meanwhile the difficulties in the way of contemporary nation-making are fostered by many extraneous influences, as well as by dogged resistance of the races in question. Not the least important of these influences is the sentimental sympathy felt for those who are supposed to be deprived of the use of their mother-tongue, and who are subjected to the hardship of learning an alien one. The hardship inflicted on those who have to learn a second language is very easily exaggerated, though it is to be regretted that in the case of Hungary the second language is not one more useful for international purposes.

Contemporary Statecraft.—Nation-making has hitherto been more or less unconscious—the outcome of necessity, a natural growth due to the play of circumstance and events. But in our own age conscious statecraft is also at work, as in Canada, where the genius of statesmen is gradually endowing that dominion with all the attributes of independence and power. Australia has not learnt the lesson of Canada in vain. Whatever value may attach to the consolidation of the British Empire itself as a factor in spreading the peace which reigns within it, it is also a great contribution to the peace of the world that the British race should have founded practically independent states like the Dominion of Canada, the Commonwealth of Australia, the South African Union and the Dominion of New Zealand. These self-governing colonies with their spheres of influence, with vast areas still unpeopled, have a future before them which is dissociated from the methods of an over-peopled Europe, and among them the preservation of peace is the direct object and condition of their progressive development. Like the United States, they have or will have their Monroe doctrine. Colonized by the steady industrial peoples of northern Europe, there is no danger of the turbulence of the industrially indolent but more passionate peoples of Central and South America. As in Europe, these northern peoples will hold the power which intelligent democracies are consciously absorbing, and the British faculty for statecraft is gradually welding new nations on the British model, without the obsolete traditions and without that human sediment which too frequently chokes the currents of national vitality in the older communities of Europe.

Militarism.—It is often stated, as if it were incontrovertible, that conscription and large standing armies are a menace to peace, and yet, although throughout the civilized world, except in the British Empire and the United States, conscription is the system employed for the recruiting of the national forces of both defence and offence, few of these countries show any particular disposition to make war. The exceptional position of the United States, with a population about equal to that of the rest of the American continent, and of Great Britain, an island state but little exposed to military invasion, places both beyond absolute need of large standing armies, and renders an enlisting system feasible which would be quite inadequate for the recruitment of armies on the French or German scale. Democratic progress on the Continent has, however, absorbed conscription as a feature in the equalization of the citizen's rights and liabilities. Just as in Anglo-Saxon lands a national ideal is gradually materializing in the principle of the equalization of chances for all citizens, so in continental Europe, along with this equalization of chances, has still more rapidly developed the ideal of an equalization of obligations, which in turn leads to the claim for an enlargement of political rights co-extensive with the obligations. Thus universal conscription and universal suffrage tend to become in continental political development complementary conditions of the citizen's political being. In Germany, moreover, the military service is designed not only to make the recruit a good soldier, but also to give him a healthy physical, moral and mental training. German statesmen, under the powerful stimulus of the emperor William II., have, in the eyes of some critics, carried this secondary object of conscript training to such excess as to be detrimental to military efficiency. To put it shortly, the Germans have taught their soldiers to think, and not merely to obey. The French, who naturally looked to German methods for inspiration, have come to apply them more particularly in the development of their cavalry and artillery, especially in that of the former, which has taken in the French army an ever higher place as its observing and thinking organ.

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[1] Schemes of thinkers, like William Penn's European Parliament (1693); the Abbé St Pierre's elaboration (*c.* 1700) of Henry IV.'s "grand design" (see *supra*); Jeremy Bentham's *International Tribunal* (1786–1789); Kant's *Permanent Congress of Nations and Perpetual Peace* (1796); John Stuart Mill's *Federal Supreme Court*; Seeley's, Bluntschli's, David Dudley Field's, Professor Leone Levi's, Sir Edmund Hornby's co-operative schemes for promoting law and order among nations, have all contributed to popularizing in different countries the idea of a federation of mankind for the preservation of peace.

Militarism on the Continent has thus become allied with the very factors which made for the reign of reason. No agitation for the development of national defences, no beating of drums to awaken the military spirit, no anti-foreign clamour or invasion panic, no parading of uniforms and futile clash of arms, are necessary to entice the groundling and the bumpkin into the service. In Germany patriotic waving of the flag, as a political method, is directed more especially to the strengthening of imperial, as distinguished from local, patriotism. Where conscription has existed for any appreciable time it has sunk into the national economy, and men do their military service with as little concern as if it were a civil apprenticeship.

As implied above, military training under conscription does not by any means necessarily tend to the promotion of the military spirit. In France, so far from taking this direction, it has resulted, under democratic government and universal suffrage, in a widespread abhorrence of war, and, in fact, has converted the French people from being the most militant into being the most pacific nation in Europe. The fact that every family throughout the land is a contributory to the military forces of the country has made peace a family, and hence a national, ideal. Paradoxical as it may seem, it is the logical conclusion of such comparisons that militarism only exists in countries where there are no citizen armies, and that, where there are citizen armies, they are one of the elements which make for permanent peace.

Normal Nature of Peace.—America has been the pioneer of the view that peace is the normal condition of mankind, and that, when the causes of war are eliminated, war ceases to have a *raison d'être.* The objects and causes of war are of many kinds. War for fighting's sake, although in the popular mind there may be, during most wars, only the excitement and the emotion of a great gamble, has no conscious place among the motives of those who determine the destinies of peoples. Apart, however, from self-defence, the main causes of war are four: (1) The desire for territorial expansion, due to the overgrowth of population, and insufficiency of the available food-supply; if the necessary territory cannot be obtained by negotiation, conquest becomes the only alternative to emigration to foreign lands. (2) The prompting of national ambition or a desire to wipe out the record of a humiliating defeat. (3) Ambitious potentates again may seek to deflect popular tendencies into channels more satisfactory for their dynasty. (4) Nations, on the other hand, may grow jealous of each other's commercial success or material power. In many cases the apparent cause may be of a nobler character, but historians have seldom been content to accept the allegations of those who have claimed to carry on war from disinterested motives.

On the American continent South and Central American states have had many wars, and the disastrous effects of them not only in retarding their own development, but in impairing their national credit, have led to earnest endeavours on the part of their leading statesmen to arrive at such an understanding as will banish from their international polity all excuses for resorting to armed conflicts. In 1881 Mr Blaine, then U.S. secretary of state, addressed an instruction to the ministers of the United States of America accredited to the various Central and South American nations, directing them to invite the governments of these countries to participate in a congress, to be held at Washington in 1882, "for the purpose of considering and discussing the methods of preventing war between the nations of America." Owing to different circumstances the conference was delayed till the autumn of 1889. At this conference a plan of arbitration was drawn up, under which arbitration was made obligatory in all controversies whatever their origin, with the single exception that it should not apply where, in the judgment of any one of the nations involved in the controversy, its national independence was imperilled, and even in this case arbitration, though optional for the nation so judging, was to be obligatory for the adversary power. At the second International Conference of American States, which sat in the city of Mexico from the 22nd of October 1901 to the 31st of January 1902, the same subject was again discussed, and a scheme was finally adopted as a compromise which conferred authority on the government of Mexico to ascertain the views of the different governments represented in the conference, regarding the most advanced form in which a general arbitration convention could be drawn up that would meet with the approval and secure ratification by all the countries represented, and afterwards to prepare a plan for such a general treaty. The third Pan-American Conference was held in the months of July and August 1906, and was attended by the United States, Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, the Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Salvador and Uruguay. Only Haiti and Venezuela were absent. The conference, being held only a year before the time fixed for the second Hague Conference, applied itself mainly to the question of the extent to which force might be used for the collection of pecuniary claims against defaulting governments, and the forwarding of the principle of arbitration under the Hague Conventions. The possible causes of war on the American continent had meanwhile been considerably reduced. Different states had adjusted their frontiers, Great Britain in British Guiana had settled an outstanding question with Venezuela, France in French Guiana another with Brazil, Great Britain in Newfoundland had removed time-honoured grievances with France, Great Britain in Canada others with the United States of America, and now the most difficult kind of international questions which can arise, so far as the American continent is concerned, have been removed from among existing dangers to peace. Among the Southern Republics Argentina and Chile concluded in 1902 a treaty of arbitration, for the settlement of all difficulties without distinction, combined with a disarmament agreement of the same date, to which more ample reference will be made hereafter. Thus in America progress is being rapidly made towards the realization of the idea that war can be superannuated by elimination of its causes and the development of positive methods for the preservation of peace (see PAN-AMERICAN CONFERENCES).

With the American precedent to inspire him, the emperor Nicolas II. of Russia in 1898 issued his invitation to the powers to hold a similar conference of European states, with a more or less similar object. In 1899 twenty-six states met at the Hague and began the work, which was continued at the second conference in 1907, and furthered by the Maritime Conference of London of 1908–1909. The creation of the Hague Court and of a code of law to be applied by it have further eliminated causes of difference.

These efforts in the two hemispheres are based on the idea that international differences can be adjusted without war, where the parties are honestly aggrieved. With this adjustment of existing cases the number of possible pretexts for the employment of force is being rapidly diminished.

Peace Procedure under the Hague Conventions.—The Hague Peace Convention of 1907, which re-enacts the essential parts of the earlier one of 1899, sets out five ways of adjusting international conflicts without recourse to war. Firstly, the signatory powers have undertaken to use their best efforts to ensure the pacific settlement of international difficulties. This is a general declaration of intention to lend themselves to the peaceable adjustment of difficulties and employ their diplomacy to this end. Secondly, in case of serious disagreement, diplomacy having failed, they agree to have recourse, as far as circumstances allow, to the good offices or mediation of one or more friendly powers. Thirdly, the signatory powers agree that it shall not be regarded as an unfriendly act if one or more powers, strangers to the dispute, on their own initiative offer their good offices or mediation to the states in disagreement, or even during hostilities, if war has already broken out. Fourthly, the convention recommends that in disputes of an international nature, involving neither national honour nor vital interests, and arising from a difference of opinion on points of fact, the parties who have not been able to come to an agreement by means of diplomacy should institute an international commission of inquiry to facilitate a solution of these disputes by an investigation of the facts. Lastly, the high contracting parties have agreed that in questions of a legal nature, and especially in interpretation or application of international conventions, arbitration is recognized as the most effective, and at the same time the most equitable, means of settling disputes which diplomacy has failed to adjust.

Down to 1910 no suggestion of mediation had actually been carried out, but a number of cases of arbitration had been tried by the Hague Court, created by the Hague Peace Convention (see ARBITRATION, INTERNATIONAL), and one case, viz. that of the Dogger Bank incident, was submitted to a commission of inquiry, which sat in January 1905.[1]

If Secretary Knox's proposal (see *supra*) to convert the International Prize Court into a permanently sitting court of arbitration is adopted, a detailed procedure and jurisprudence will no doubt grow out of a continuity which is lacking in the present system, under which the court is recruited from a large panel for each special case. Secretary Knox's idea, as expressed in the identical circular note addressed by him on the 18th of October 1909 to the powers, was to invest the International Prize Court, proposed to be established by the convention of the 18th of October 1907, with the functions of a "court of arbitral justice." The court contemplated by the convention was a court of appeal for reviewing prize decisions of national courts both as to facts and as to the law applied, and, in the exercise of its judicial discretion, not only to confirm in whole or in part the national decision or the contrary, but also to certify its judgment to the national court for enforcement thereof. The adoption of this jurisdiction would have involved a revision of the judicial systems of probably every country accepting it. The United States government therefore proposed that the signatories should insert in the act of ratification a reservation to the effect that resort to the International Prize Court, in respect of decisions of their national tribunals, should take the form of a direct claim for compensation. This in any case would remove the United States' constitutional objection to the establishment of the proposed court. In connexion with this enabling clause Mr Secretary Knox also proposed that a further enabling clause be inserted providing that the International Court of Prize be competent to accept jurisdiction in all matters, arising between signatories, submitted to it, the Court to sit at fixed periods every year and to be composed according to the panel which was drawn up at the Hague. This court, which the American government proposed to call a "Court of Arbitral Justice," would take the place of that which it was proposed to institute under *Vœu* No. 1 of the Final Act of the conference of 1907. The intention of the Hague draft annexed to the *Vœu* was to create a permanent court as distinguished from that established in 1899, which, though called permanent, was not so, having to be put together *ad hoc* as the occasion arose. The new court, if adopted, would hold regular and continuous sessions, consist of the same judges, and pay due heed to the precedents created by its prior decisions. The two courts would have separate spheres of activity, and litigants would practically have the option of submitting their differences to a judicial court which would regard itself as being bound by the letter of the law and by judicial methods or to a special court created *ad hoc* with a purely arbitrative character.

The Place of Diplomacy.—The utility of the diplomatic service has been considerably diminished through the increasing efficiency of the public press as a medium of information. It is not too much to say that at the present day an experienced journalist, in a place like Vienna or Berlin, can give more information to an ambassador than the ambassador can give to him. It is even true to say that an ambassador is practically debarred from coming into actual touch with currents of public feeling and the passing influences which, in this age of democracy, determine the course of events in the political life of peoples. The diplomatist has therefore lost one of his chief functions as an informant of the accrediting government. The other chief function of diplomacy is to be the courteous medium of conveying messages from one government to another. Even this function is losing its significance. The ciphered telegram leaves little discretion to the envoy, and written notes are exchanged which are practically a mere transcription of the deciphered telegram or draft prepared at the instructing foreign office. Nevertheless, the personality of an ambassador can play a great part, if he possesses charm, breadth of understanding and interest in the social, intellectual and industrial life of the country to which he is accredited. There are several instances of such men in Europe and America, but they are so rare that some reformers consider them as hardly justifying the large expenditure necessary to maintain the existing system. On the other hand, the utility of the consular service has concurrently increased. Administrative indifference to the eminently useful officials forming the service has led, in many cases, to diminishing instead of increasing their number and their salaries, but it is obvious that the extension of their duties and a corresponding raising of their status would be much more in accordance with the national interest. The French, with that practical sense which distinguishes so much of their recent administrative work, have connected the two services. A consul-general can be promoted to a diplomatic post, and take with him to his higher office the practical experience a consul gains of the material interests of the country to which he belongs.

There is thus still good work for diplomacy to do, and if, in the selection of diplomatic representatives, states followed on the one hand the above-mentioned French example, and on the other hand the American example of selecting for the heads of diplomatic missions men who are not necessarily *de la carrière*, diplomacy might obtain a new lease of activity, and become once more an extremely useful part of the administrative machinery by which states maintain good business relations as well as friendly political intercourse with one another.

International Regulation by Treaty.—It seems a truism to say that among the agencies which most effectively tend to the preservation of peace are treaties which regulate the relations of states in their intercourse with other states. Such treaties, however, are of quite recent origin. The first of a comprehensive character was the *general act* adopted at the South African Conference at Berlin in 1885, which laid down the principle, which has since become of still wider application, that "any Power which henceforth takes possession of a tract of land on the coast of the African continent outside of its present possessions or which, being hitherto without such possessions, shall acquire them . . . shall accompany the act relating to it with a notification thereof, addressed to the other Signatory Powers of the present act, in order to enable them, if need be, to make good any claims of their own," and, furthermore, that "the Signatory Powers of the present act recognize the obligation to ensure the establishment of authority in the regions occupied by them on the coasts of the African continent sufficient to protect existing rights, and, as the case may be, freedom of trade and transit under the conditions agreed upon." Under these articles occupation of unoccupied territory to be legal had to be effective. This led to the creation and determination of *spheres of influence.* By fixing the areas of these spheres of influence rival states in western and central Africa avoided conflicts and preserved their rights until they were able to take a more effective part in their development. The idea of "spheres of influence" has in turn been applied even to more settled and civilized countries, such as China and Persia.

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[1] The procedure adopted by the commission was afterwards incorporated in the convention of 1907. Under the rules adopted, the examination of witnesses is conducted by the president in accordance with the system prevailing in most continental countries; members of the commission may only put questions to witnesses for the eliciting of further information; and they may not interrupt the witness when he is in course of making his statement, but they may ask the president to put any additional questions. This seems likely to become the procedure also in cases before the Hague Court, where witnesses are examined.

Other cases of regulation by treaty are certain contractual engagements which have been entered into by states for the preservation of the *status quo* of other states and territories.

The Anglo-Japanese Treaty of the 12th of August 1905 sets out its objects as follows:—

> *a.* "The consolidation and maintenance of the general peace in the regions of Eastern Asia and India;
>
> *b.* "The preservation of the common interests of the Powers in China, of insuring the independence and the integrity of the Chinese empire, and the principle of equal opportunities for the commerce and industry of all nations in China;
>
> *c.* "The maintenance of the territorial rights of the high contracting parties in the regions of Eastern Asia and of India, and the defence of their special interests in such regions."

It is a treaty for the maintenance of the *status quo* in certain parts of Asia in which the parties to it have dominant interests. The same principle underlies different other self-denying arrangements and declarations made by the powers with reference to Chinese integrity.

The Treaty of Algeciras is essentially a generalization of the Franco-German agreement of the 28th of September 1905. By it all the powers represented agree to respect the territorial integrity of Morocco, subject to a possible intervention limited to the purpose of preserving order within it.

Differing from these *general acts* in not being contractual is the Monroe doctrine, which is a *policy* of ensuring the maintenance of the territorial *status quo* as regards non-American powers throughout the American continent. If necessary, the leading republics of South and Central America would no doubt, however, further ensure respect for it by treaty.

With these precedents and current instances of tendency to place the territorial relations of the powers on a permanent footing of respect for the existing *status quo*, it seems possible to go beyond the mere enunciation of principles, and to take a step towards their practical realization, by agreeing to respect the territorial *status quo* throughout still larger tracts of the world, neutralize them, and thus place them outside the area of possible wars.

A third contractual method of avoiding conflicts of interest has been the signing of agreements for the maintenance of the "open-door." The discussion on the question of the "open-door" in connexion with the Morocco difficulty was useful in calling general public attention once more to the undesirability of allowing any single power to exclude other nations from trading on territory over which it may be called to exercise a protectorate, especially if equality of treatment of foreign trade had been practised by the authority ruling over the territory in question before its practical annexation under the name of protectorate. The habitable parts of the world are a limited area, exclusion from any of which is a diminution of the available markets of the nations excluded. Every power, is, therefore, rightfully interested in the prevention of such exclusion.

The United States government in 1899 called attention to the subject as regards China, without, however, going into any question of principle. It thought that danger of international irritation might be removed by each power making a declaration respecting the "sphere of interest" in China to which it laid claim. Lord Salisbury informed Mr Choate that H.M. government were prepared to make a declaration in the sense desired. All the powers concerned eventually subscribed to the declaration proposed by the United States government.

The principle of the "open-door" in fact has already been consistently applied in connexion with certain non-European areas. As these areas are practically the only areas which of late years have come within the scope of European regulation, the time seems to be approaching when the principle may be declared to be of general application. From the point of view of diminishing the possible causes of conflict among nations, the adoption of this principle as one of international contractual obligation would be of great utility. While putting an end to the injustice of exclusion, it would obviously reduce the danger of nations seeking colonial aggrandizement with a view to imposing exclusion, and thus one of the chief temptations to colonial adventure would be eliminated.

In the fourth place, there is the self-denying ordinance against employment of arms for the enforcement of contractual obligations adopted at the Hague Conference of 1907. Under it the high contracting powers have agreed not to have recourse to armed force for the recovery of contractual debts claimed from the government of one country by the government of another country as due to its subjects. The only qualification admitted under the new convention is that it shall not apply when the debtor-state refuses or leaves unanswered an offer of arbitration, or in case of acceptance renders the settlement of the terms of arbitration impossible, or, after arbitration, fails to comply with the award. The theory on which this convention is based is known as the Drago theory, having taken a practical form during the administration of Dr L. M. Drago, when he filled the post of Argentine minister of foreign affairs. The doctrine, however, is not new, having already been enunciated a century before by Alexander Hamilton and reiterated since then by several American statesmen, such as Albert Gallatin, William L. Marcy and F. T. Frelinghuysen, as the view prevailing at Washington during their respective periods of office.

Limitations of Disarmament.—Disarmament, or to speak more correctly, the contractual limitation of armaments, has become, of late years, as much an economic as a humanitarian peace-securing object.

"The maintenance of universal peace and a possible reduction of the excessive armaments which weigh upon all nations, represent, in the present condition of affairs all over the world, the ideal towards which the efforts of all governments should be directed," were the opening words of the Note which the Russian Minister of Foreign Affairs, Count Mouraviev, handed to the diplomatic representatives of the different powers suggesting the first Hague Conference.

"The ever-increasing financial burdens," the Note went on, "strike at the root of public prosperity. The physical and intellectual forces of the people, labour and capital, are diverted for the greater part from their natural application and wasted unproductively. Hundreds of millions are spent in acquiring terrible engines of destruction, which are regarded to-day as the latest inventions of science, but are destined to-morrow to be rendered obsolete by some new discovery. National culture, economic progress and the production of wealth are either paralysed or developed in a wrong direction. Therefore the more the armaments of each power increase the less they answer to the objects aimed at by the governments. Economic disturbances are caused in great measure by this system of excessive armaments; and the constant danger involved in this accumulation of war material renders the armed peace of to-day a crushing burden more and more difficult for nations to bear. It consequently seems evident that if this situation be prolonged it will inevitably result in the very disaster it is sought to avoid, and the thought of the horrors of which makes every humane mind shudder. It is the supreme duty, therefore, of all states to place some limit on these increasing armaments, and find some means of averting the calamities which threaten the whole world."

A further Note submitting the programme proposed gave more precision to this item, which thereupon took the following form: "An understanding not to increase for a fixed period the present effectives of the armed military and naval forces, and at the same time not to increase the budgets pertaining thereto; and a preliminary examination of the means by which even a reduction might be effected in future in the forces and budgets above mentioned."

When the subject came on for discussion at the conference the German military delegate stated his view that the question of effectives could not be discussed by itself, as there were many others to which it was in some measure subordinated, such, for instance, as the length of service, the number of cadres whether existing in peace or made ready for war, the amount of training received by reserves, the situation of the country itself, its railway system, and the number and position of its fortresses. In a modern army all these questions went together, and national defence included them all. In Germany, moreover, the military system "did not provide for fixed numbers annually, but increased the numbers each year."

After many expressions of regret at finding no method of giving effect to the proposal, the commission confined itself to recording its opinion that "a further examination of the question by the Powers would prove a great benefit to humanity."

The Conference, however, were unanimous in the adoption of the following resolution:—

> "The Conference is of opinion that the restriction of military budgets, which are at present a heavy burden on the world, is extremely desirable for the increase of the material and moral welfare of mankind;"

and it passed also the following *vœu*:—

> "That governments, taking into account the proposals made at the Conference, should examine the possibility of an understanding concerning the limitation of military and naval armaments, and of war budgets."

The general public, more particularly in Great Britain and France, shows an ever-increasing distrust of the rapid growth of armaments as a possible cause of grave economic troubles. A high state of military preparedness of any one state obliges all the others to endeavour to be prepared on the same level. This process of emulation, very appropriately called by the late Sir H. Campbell-Bannerman "a policy of huge armaments," unfortunately is a policy from which it is impossible for any country to extricate itself without the co-operation, direct or indirect, of other nations.

The subject was brought forward in view of the second Hague Conference in both the French and Italian parliaments.

The declaration of the French government stated that:—

> "France hoped that other nations would grow, as she had done, more and more attached to solutions of international difficulties based upon the respect of justice, and she trusted that the progress of universal opinion in this direction would enable nations to regard the lessening of the present military budgets, declared by the states represented at the Hague to be greatly desirable for the benefit of the material and moral state of humanity, as a practical possibility." (Chamber of Deputies, June 12, 1906.)

In the Italian Chamber of Deputies, an interpellation was addressed to the minister of foreign affairs about the same time asking "whether the Government had knowledge of the motion approved by the British House of Commons, and of the undertaking of the British government that, in the programme of the coming Hague Conference, the question of the reduction of armaments should be inserted, and in what spirit the Italian government had taken or proposed to take the propositions of the British government, and what instructions it would give to the Italian representatives at the conference."

The minister of foreign affairs, M Tittoni, in reply expressed the adhesion of the Italian government to the humanitarian ideas which had met with such enthusiasm in the historic House of Parliament at Westminster. "I have always believed," he said, "that, as far as we are concerned, it would be a national crime to weaken our own armaments while we are surrounded by strongly armed European nations who look upon the improvement of armaments as a guarantee of peace. Nevertheless, I should consider it a crime against humanity not to sincerely co-operate in an initiative having for object a simultaneous reduction of armaments of the great powers. Italian practice has always aimed at the maintenance of peace; therefore, I am happy to be able to say that our delegates at the coming Hague Conference will be instructed to further the English initiative."

The only existing case of contractual reduction of armaments is that of the Disarmament Agreement of the 28th of May 1902 between the Chilian and Argentine republics, adopted "owing to the initiative and good offices of His Britannic Majesty," which is as follows:—

> Art. I.—In order to remove all cause of fear and distrust between the two countries, the governments of Chile and of the Argentine Republic agree not to take possession of the warships which they are having built, or for the present to make any other acquisitions. The two governments furthermore agree to reduce their respective fleets, according to an arrangement establishing a reasonable proportion between the two fleets. This reduction to be made within one year from the date at which the present agreement shall be ratified.
>
> Art. II.—The two governments respectively promise not to increase their maritime armaments during five years, unless the one who shall wish to increase them shall give the other eighteen months' notice in advance. This agreement does not include any armaments for the purpose of protecting the shore and ports, and each party will be at liberty to acquire any vessels (*maquina flotante*) intended for the protection thereof, such as submarines, &c.
>
> Art. III.—The reductions (*i.e.* ships disposed of) resulting from this agreement will not be parted with to countries having any dispute with either of the two contracting parties.
>
> Art. IV.—In order to facilitate the transfer of the pending orders the two governments agree to increase by two months the time stipulated for the beginning of the construction of the respective ships. They will give instructions accordingly.

An agreement of this kind is obviously more feasible as among states whose navies are small and of comparatively recent origin than among states whose navies are composed of vessels of many and widely different ages. It may be difficult to agree in the latter case on a principle for assessment of the proportionate fighting value of the respective fleets. The break-up or sale of obsolete warships is a diminution of the paper effective of a navy, and their purchase by another state a paper increase of theirs. Even comparatively slight differences in the ages of ships may make great differences in their fighting value. It would be a hard, though probably not insurmountable, task to establish "a reasonable proportion," such as provided for in Art. II. of the Chile-Argentina Agreement, as between large and old-standing navies like those of Europe.

On the other hand, as regards military power, it seems sometimes forgotten in the discussion of the question of armaments, that the conditions of the present age differ entirely from those of the time of the Napoleonic wars. With conscription a national army corresponds more or less numerically to the proportion of males in the national population. Great Britain, without conscription, has no means of raising troops in any such proportion. Thus, so long as she refrains from adopting conscription, she can only carry on defensive warfare. The object of her navy is therefore necessarily defensive, unless it act in co-operation with a foreign conscript army. As there are practically only three great armies available for the purpose of a war of aggression, the negotiation of contingent arrangements does not seem too remote for achievement by skilful and really well-meaning negotiation. The Hague Conference of 1907, owing to difficulties which occurred in the course of the preliminary negotiations for the conference, did not deal with the subject.

Principle and Capabilities of Neutralization.—Among the different methods which have grown up practically in our own time for the exclusion of war is neutralization. We have been dealing hitherto with the elimination of the causes of war; neutralization is a curtailment of the areas of war and of the factors in warfare, of territory on the one hand and states on the other. The neutralization of territory belonging to states which are not otherwise neutralized includes the neutralization of waterways such as the Suez and Panama canals.

Under the General Act of Berlin of the 26th of February 1885, “in case a power exercising rights of sovereignty or protectorate” in any of the regions forming the basin of the Congo and its affluents, including Lake Tanganyika, and extending away to the Indian Ocean, should be involved in a war, the parties to the General Act bound themselves to lend their good offices in order that the territories belonging to this power be placed during the war “under the rule of neutrality and considered as belonging to a neutral state, the belligerents thenceforth abstaining from extending hostilities to the territories thus neutralized, and from using them as a basis for warlike operations” (art. 2).

Neutralization is not necessarily of general application. Thus two states can agree to neutralize specific territory as between them. For example between Costa Rica and Nicaragua by a treaty of the 15th of April 1858 the parties agreed that “on no account whatever, not even in case of war,” should “any act of hostility be allowed between them in the port of San Juan del Norte nor on the river of that name nor on Lake Nicaragua” (art. 2).[1]

Again, the Straits of Magellan are neutralized as between Argentina and Chile under a treaty of the 23rd of July 1881. Article 5 provides that they are “neutralized for ever and their free navigation is guaranteed to the flags of all nations. To ensure this neutrality and freedom it is agreed that no fortifications or military defences which might interfere therewith shall be erected.”

Luxemburg was declared by the Treaty of London of the 11th of May 1867 (art. 1) to be a perpetually neutral state under the guarantee of Great Britain, Austria, Prussia and Russia. Switzerland, by a declaration confirmed by the Treaty of Vienna, of 1815 (art. 84), likewise enjoys perpetual neutrality. And now Norway has placed herself under a neutral régime of a similar character.

A neutralized state does not mean a state which is forbidden to have fortifications or an army; in this it differs from neutralized territory of a state not otherwise neutralized. Thus Belgium, which is a neutralized state, not only has an army but has fortifications, although by the treaties of 1831 and 1839 she was recognized as a “perpetually neutral state, bound to observe the same neutrality with reference to other states.”

Of waterways, international rivers have been the chief subject of neutralization. It has long been an established principle in the intercourse of nations, that where the navigable parts of a river pass through different countries their navigation is free to all. The rivers Scheldt and Meuse were opened up in this way to riparian states by a decree of the French Convention of the 16th of November 1792. By the treaty of Vienna of the 9th of June 1815, the powers whose territories were separated or traversed by the same navigable river, undertook to regulate by common consent all that regarded its navigation, and for this purpose to name commissioners who should adopt as the bases of their proceedings the principle that the navigation of such rivers along their whole course “from the point where each of them becomes navigable to its mouth, shall be entirely free, and shall not in respect of commerce be prohibited to anyone.” The only case in Europe in which this internationalization of rivers has been maintained is that of the Danube. On the other hand neutralization has made progress in respect of waterways, natural as well as artificial. Thus the Bosporus and Dardanelles under the Treaty of Paris of 1856 and by the Treaty of London 1871 were and remain closed to the passage of foreign armed vessels in time of war, though the Porte may permit their passage in time of peace in certain cases. The Suez and the Panama canals have been permanently neutralized, the former by a convention among the great powers, and the latter by a treaty between Great Britain and the United States.

Alongside this neutralization has grown up a collateral institution, the purpose of which is in some respects similar. We refer to “buffer” zones. “Buffer” zones are of quite recent origin as a political creation,[2] *i.e.* where their object is to establish upon the territory of two contiguous states a strip or zone on either side of the frontier which the respective states *agree to regard* as neutral, on which the parties undertake to erect no fortifications, and maintain no armed forces but those necessary to enforce the ordinary respect of government. The word “neutral” does not correctly describe the character of the zone. It is not neutral in the sense of being recognized as such by any third state, and it necessarily ceases to be neutral in case of war between the states concerned. The word “buffer” comes nearest to the object, but even this term implies more than is meant. Between Spain and Morocco a treaty of the 5th of March 1894 established between the Camp of Melilla and Moroccan territory a zone within which no new roads were to be made, no herds to be allowed to graze, no land to be cultivated, no troops of either party, or even private persons carrying arms, to set foot, no inhabitants to dwell, and all habitations to be razed. The zone between Burma and Siam, established by an agreement between Great Britain and France dated the 15th of January 1896, declared “the portion of Siam which is comprised within the drainage basin of the Menam, and of the coast streams of a corresponding longitude,” neutral as between them. Within this area the two powers undertook not to “operate by their military or naval forces, except in so far as they might do so in concert for any purpose requisite for maintaining the independence of Siam.” They also undertook not to acquire within that area any privileges or commercial facilities not extended to both of them.

“Buffer” zones might fulfil a useful purpose even in Europe. They would obviously react against the feeling known as “esprit de frontière,” and diminish the danger of incidents arising out of this feeling, and might attenuate the rivalry of neighbouring counter-armaments.

These considerations no doubt led the Swedish and Norwegian governments, in their settlement of September 1905, to establish a “buffer” zone of 15 kilometres on either side of the frontier between the two states in question. Within these 30 kilometres all existing fortresses are dismantled,[3] no new ones are to be erected, and no armed troops to be maintained; any question between the two states relative to the provisions respecting the “buffer” zone to be decided by arbitration.

A rather special case of neutralization of a territorial area is that of the practical neutralization of the Great Lakes in America. In 1817, at the instance of John Quincy Adams, the United States and Great Britain entered into a compact whereby the Great Lakes, and the waterways from them to the ocean by the St Lawrence river, which divide the United States from the Dominion of Canada, were practically excluded from any possible hostilities. Through a simple agreement, "conditions which make for peace and prosperity, and the absence of those which so often lead to disastrous war, have for nearly a century reigned over these great inland waters, whose commerce, conducted for the benefit of the states and nations of Europe and America, rivals that which passes through the Suez Canal or over the Mediterranean Sea, and with a result foreshadowed in these words of President Monroe in his communication to the Senate commending the proposed agreement: 'In order to avoid collision and save expense.' Forts which had been erected at salient points on either side of the lakes and rivers dividing the United States from Canada, which but for this agreement would, in the natural course of events, have been enlarged, increasingly garrisoned, and provided with modern implements of destruction, at large expense, have remained substantially as when the agreement was made, or now constitute but interesting or picturesque ruins; and the great cost of constructing and maintaining, through a long series of years, naval armaments of ever-increasing power has been avoided."[1]

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[1] Under the treaty of the 29th of March 1864, the courts of Great Britain, France and Russia in their character of guaranteeing powers of Greece declared with the assent of the courts of Austria and Prussia that the islands of Corfu and Paxo as well as their dependencies should, after their union to the Hellenic kingdom, enjoy the advantages of perpetual neutrality, and the king of the Hellenes undertook on his part to maintain such neutrality (Art. 2).

[2] The institution of “buffer” zones in a more strictly correct sense of the term is of very ancient origin. One is mentioned in the annals of China two centuries before our era, between the territories of the Huns in the west and those of the Tunguses in the east—a vast area of some 300 to 400 m. on the opposite margin of which the two peoples kept watch. In Europe, bands of territory from time to time have been made desert to better establish separation. The Romans and Germans protected themselves in this way. In the middle ages the Teutonic Order established a frontier belt on the side of Lithuania. Later, Austria dealt in the same way in her policy in regard to Turkey in the organization of a “military frontier.” See Nys, *Droit International* (Brussels, 1904), i. 418.

[3] It was stipulated that the dismantling should be controlled by a technical commission of three officers of foreign nationality, to be chosen, one by each of the contracting powers and the third by the two officers thus appointed, or, in default of an agreement on their part, by the president of the Swiss Confederation. The dismantling of the forts in question has now been carried out. The Commission was composed on the part of Sweden of an engineer on the staff of the Austrian army, and on the part of Norway of a colonel in the German army, and, by agreement of these, of a colonel in the Dutch army.

As we have already said, the Monroe doctrine is a means of excluding European warfare from the American continent and therefore is in the nature of a form of neutralization. A sort of Monroe doctrine is growing into popular favour also throughout the Australian Commonwealth, where it is felt that a continent so far removed from European rivalries ought not to be exposed to complications on account of them.

From time to time questions of adding to existing neutralized areas are raised. When it was announced in 1905 that a British fleet was about to manœuvre in the Baltic Sea, several German newspapers suggested that Germany should combine with other Baltic powers to assure its neutralization.[2] No official observation on the subject, however, was made on the part of any Baltic power. The Baltic is still an open sea for the whole world, without restriction of any kind; and even hostilities between any two non-Baltic powers could be carried on in the Baltic, as elsewhere on the high sea, under the existing practice.

When the Dogger Bank incident occurred, the possibility of operations of war being carried on within a few miles of British home ports, and amid the busy traffic of the North Sea, was brought vividly home to British minds.

A movement set on foot at the instance of Edward Atkinson, the well-known Boston economist, and warmly supported by the Massachusetts State Board of Trade, seeks to establish by treaty neutral zones from the ports of North America to the ports of Great Britain and Ireland and the continent of Europe, within which zones steamship and sailing vessels in the conduct of lawful commerce should be free to pass without seizure or interruption in time of war. There is however no precedent of neutralization of any such area of the high sea, and international rivers, ocean canals and neutralized states are obviously no criterion in discussing a proposal to neutralize a strip of the ocean, which may be defined accurately enough on the map and which skilful navigators could approximately determine, but which might be violated without any practical means of detection by a belligerent commander whenever he misread, or it suited him to misread, his bearings.

Connected with the principle of neutralization is that of guaranteeing the integrity of states. Several such guarantees have been given in quite recent times. In November 1907 a treaty was concluded between France, Germany, Great Britain and Russia on the one part and Norway on the other, for the maintenance of the integrity of Norway. This treaty differed from the older one of 1855 in which France and Great Britain guaranteed the integrity of Norway and Sweden, in the fact that whereas the older treaty was for the protection of these two states against Russia, the new treaty is intended, if it is to serve at all as a protection against invasion, to protect Norway against Sweden.

Another such guarantee of a vaguer character is that which the North Sea powers recently entered into for the maintenance of the *status quo* of their respective North Sea territories; and the similar one entered into by the Mediterranean powers for the same objects in the Mediterranean. Lastly in the same order of ideas Austria-Hungary and Russia are said to have concluded an arrangement between them for the maintenance of the *status quo* in the Balkans.

The future has no doubt still other extensions of the principle of neutralization in store for us. Not the least interesting of existing possibilities is the limitation of the area of visit and search in time of war itself, as a restriction of belligerent right. It seems contrary to common sense that neutral ships should be exposed to being detained, taken out of their course, and overhauled on mere suspicion of carrying contraband, when they are so far from the seat of war that there can be no presumption as to their destination. Neutrals have a right to carry on their ordinary business unmolested in so far as they do nothing to assist either belligerent. When they are beyond a certain distance from the seat of war it seems reasonable that the presumption that they are merely carrying on their legitimate business should be considered absolute. Such a limitation of the area of hostilities is not only feasible, but it was actually put in practice by the British government during the Boer War.[3]

In the course of the Russo-Japanese War the question came up again, being raised this time by Great Britain. Lord Lansdowne called the attention of the Russian foreign office to the extreme inconvenience to neutral commerce of the Russian search for contraband not only in the proximity of the scene of war, but over all the world, and especially at places at which neutral commerce could be most effectually intercepted. H.M. Government had become aware that a large addition was likely to be made to the number of Russian cruisers employed in this manner, and they had, therefore, to contemplate the possibility that such vessels would shortly be found patrolling the narrow seas which lie on the route from Great Britain to Japan in such a manner as to render it virtually impossible for any neutral vessel to escape their attention. The effect of such interference with neutral trade, he said, would be disastrous to legitimate commerce passing from a British port in the United Kingdom to a British port in the Far East. The British government had no desire to place obstacles in the way of a belligerent desiring to take reasonable precautions in order to prevent the enemy from receiving supplies, but they insisted that the right of taking such precautions did not imply a "consequential right to intercept at any distance from the scene of operations and without proof that the supplies in question were really destined for use of the enemy's forces, any articles which that belligerent might determine to regard as contraband of war."

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[1] *Memoir of Massachusetts State Board of Trade* (Feb. 13, 1905).

[2] This was merely reviving an idea which had come and gone many times before. See Barclay, *Problems of International Practice and Diplomacy* (1907).

[3] In January 1900 it was reported that the British government had issued instructions to British naval commanders not to stop or search German merchant vessels at any places not in the vicinity of the seat of war. There is no proper statement of the British position on this subject, the only official information having been given by the German chancellor in a speech to the Reichstag. According to this information, the area was ultimately limited as north of Aden, and afterwards it was agreed that the immunity from search should be extended to all places beyond a distance from the seat of war equal to the distance from it of Aden. This was substantially correct, though the telegrams sent by the Admiralty can hardly be said to have fixed any precise area. As a fact, the commanders-in-chief on the East Indies and Cape of Good Hope stations were instructed that in consequence of the great practical difficulty of proving—*at ports so remote from the scene of war operations as Aden and Perim*—the real destination of contraband of war carried by vessels visiting those parts, directions were to be given to the officers concerned to cease to search such vessels, and to merely report to the commander-in-chief at the Cape the names of ships suspected of carrying contraband, and the date of clearance.

The position thus assumed is not clear. On the one hand the British claim did not, it is seen, go the length of the restriction Great Britain consented to place on her own right of search during the Boer War, seeming to apply only to the case of ships carrying conditional contraband. On the other, the complaint is based on the "interference" with neutral trade, which means the stoppage and search of vessels to ascertain whether they have contraband of any kind on board or not.

It must not be forgotten in this connexion that restriction of the rights of the belligerent necessarily entails extension of the duties of the neutral. The belligerent has an unquestioned right to "interfere" with all neutral vessels navigating in the direction of the seat of war, for the purpose of ascertaining whether they are carrying any kind of contraband or not. Under the Declaration of London of the 26th of February 1909 it is provided under arts. 32 and 35 that a ship's papers are conclusive proof as to the voyage on which she is engaged unless she is clearly out of the course indicated by her papers and is unable to give adequate reasons to justify her deviation. Thus the interference, if the declaration is ratified, will be confined to an examination of the ship's papers where the ship is not bound for a belligerent port (cf. art. 30 of the same convention).

Standing Peace Agreements.—Foremost among standing peace agreements are, of course, the International Hague Conventions relating directly to peace, agreements which have not only created a special peace jurisdiction for the settlement of international difficulties by judicial methods but also a written law to apply within the scope of this jurisdiction.

Alongside the Hague Peace Conventions and more or less connected with them are standing treaties of arbitration which have been entered into by different nations for terms of years separately. The first of what may be called a new series was that between Great Britain and France. It has now been followed by over a hundred others forming a network of international relationships which shows that, at any rate, the wish for peace is universal among mankind.[1]

There are, however, a large number of conventions which, although not concluded with the direct object of assuring peace where difficulties have arisen, tend in a very practical manner to contract the area of possible difficulties. These are conventions for the regulation of intercourse between the subjects and citizens of different states. Such conventions obviously remove occasions for friction and are therefore among the most effective agencies contributing to the preservation of peace among civilized peoples. In most cases such conventions have created international unions of states for all matters which lend themselves to international co-operation. The first in order of date was the postal union. The system it inaugurated has now extended its scope to telegraphs, copyright, industrial property, railway traffic, the publication of customs tariffs, metric measures, monetary systems and agriculture. Berne, being the capital of the most central of the neutral European states, is the administrative centre of most of these unions. Customs tariffs and the monetary unions, however, are centralized at Brussels, the weights and measures union in Paris and the agricultural institute at Rome.

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[1] The following list of standing arbitration treaties concluded after the signing of the Anglo-French treaty of October 14th 1903 is as complete as possible down to June 1910:—

Argentina–Brazil, September 7, 1905.
,, Portugal, August 27, 1909.
Austria-Hungary–Switzerland, December 3, 1904.
Belgium–Denmark, April 26, 1905.
,, Greece, May 2, 1905.
,, Norway and Sweden, November 30, 1904.
,, Rumania, May 27, 1905.
,, Russia, October 30, 1904.
,, Spain, January 23, 1905.
,, Switzerland, November 15, 1904.
Brazil–Portugal, March 25, 1909.
,, Spain, April 8, 1909.
,, Mexico, April 11, 1909.
,, Honduras, April 26, 1909.
,, Venezuela, April 30, 1909.
,, Panama, May 1, 1909.
,, Ecuador, May 13, 1909.
,, Costa Rica, May 18, 1909.
,, Cuba, June 19, 1909.
,, Bolivia, June 25, 1909.
,, Nicaragua, June 28, 1909.
,, Norway, July 13, 1909.
,, China, August 3, 1909.
,, Salvador, September 3, 1909.
,, Peru, December 7, 1909.
,, Sweden, December 14, 1909.
Colombia–Peru, September 12, 1905.
,, France, December 16, 1908.
Denmark–France, September 15, 1905.
,, Italy, December 16, 1905.
,, Netherlands, February 12, 1904.
,, Russia, March 1, 1905.
,, Spain, December 1, 1905.
,, Norway, October 8, 1908.
France–Italy, December 26, 1903.
,, Netherlands, April 6, 1904.
,, Norway and Sweden, July 9, 1904.
,, Spain, February 26, 1904.
France–Sweden and Norway, July 9, 1904.
,, Switzerland, December 14, 1904.
,, Brazil, April 7, 1909.
Great Britain–France, October 14, 1903.
,, ,, Germany, July 12, 1904.
,, ,, Italy, February 1, 1907.
,, ,, Austria-Hungary, January 11, 1905.
,, ,, Netherlands, February 15, 1905.
,, ,, Colombia, December 30, 1908.
,, ,, Sweden and Norway, August 11, 1904.
,, ,, Denmark, October 25, 1904.
,, ,, Portugal, November 16, 1904.
,, ,, Spain, February 27, 1904.
,, ,, Switzerland, November 16, 1904.
,, ,, United States, April 4, 1908.
,, ,, Brazil, June 18, 1909.
Honduras–Spain, May 13, 1905.
Italy–Argentine, September 18, 1907.
,, Mexico, October 1, 1907.
,, Peru, April 18, 1907.
,, Portugal, May 11, 1905.
,, Switzerland, November 23, 1904.
,, Netherlands, November 21, 1909.
Netherlands–Portugal, October 26, 1905.
Norway–Sweden, October 26, 1905.
Norway and Sweden–Russia, December 9, 1904.
,, ,, Spain, January 23, 1905.
,, ,, Switzerland, December 17, 1904.
Portugal–Spain, May 31, 1904.
,, Austria-Hungary, February 13, 1906.
,, Denmark, March 20, 1907.
,, France, June 29, 1906.
,, Italy, May 11, 1905.
,, Netherlands, October 1, 1904.
,, Norway and Sweden, May 6, 1905. (Suspended for
,, Norway by a new one dated December 8, 1908.)
,, Spain, May 31, 1904.
,, Switzerland, August 18, 1905.
,, Nicaragua, July 17, 1909.
Russia–Norway and Sweden, November 26, 1904.
Spain–Greece, December 3–16, 1909.
,, Switzerland, May 14, 1907.
United States–Spain, April 20, 1908.
,, ,, Denmark, May 18, 1908.
,, ,, Italy, March 28, 1908.
,, ,, Japan, May 5, 1908.
,, ,, Netherlands, May 2, 1908.
,, ,, Portugal, April 6, 1908.
,, ,, Sweden, May 2, 1908.
,, ,, Switzerland, February 29, 1908.
,, ,, Argentina, December 23, 1908.
,, ,, Peru, December 3, 1908.
,, ,, Salvador, December 21, 1908
,, ,, Norway, April 4, 1908.
,, ,, Mexico, March 24, 1908.
,, ,, France, February 2, 1908.
,, ,, Ecuador, January 7, 1909.
,, ,, Bolivia, January 7, 1909.
,, ,, Haiti, January 7, 1909.
,, ,, Uruguay, January 9, 1909.
,, ,, Chile, January 13, 1909.
,, ,, Costa Rica, January 13, 1909.
,, ,, Austria-Hungary, January 15, 1909
,, ,, Brazil, January 23, 1909.
,, ,, Paraguay, March 13, 1909.
,, ,, China, October 8, 1908.

The general postal union was created by a convention signed at Berne in 1874. A convention for a similar union for telegraphs was signed in Paris in 1875 (revised at St Petersburg and replaced by another the same year). Both unions issue monthly bulletins and other publications giving useful information about these two services.[1]

The international bureau of weights and measures at Paris was created by a convention signed there in 1875, for the purpose of comparing and verifying weights and measures on the metric system, and preserving their identity for the contracting states.

The double-standard Latin union monetary system was founded by a convention of 1865, between Belgium, France, Italy and Switzerland. In 1868 it was joined by Greece. A single standard union exists between Sweden, Norway and Denmark under a convention of 1873.

The copyright union was created by an international convention signed in 1874. The official bureau of the union is at Berne. It issues a periodical publication called *Le Droit d'auteur* giving information respecting the laws of different states relating to published matter of all kinds.

The term "industrial property" covers patents, trade marks, merchandise marks, trade names, designs and models. The convention dealing with them signed in 1883 created a union with its central office at Berne. It, too, issues a bulletin and other publications which help to prevent misunderstandings.

The railway traffic union was formed by a convention of 1890. The central bureau at Berne issues a monthly bulletin. A subsequent convention was signed at Berne in 1886 relating to matters of technical unification.

Under the convention creating the customs tariffs union, signed in 1890, thirty states, including Great Britain and most British colonies, are associated for the purpose of prompt publication of custom tariffs and their modifications.

The agricultural institute, created by a convention of 1905 with its seat at Rome, as the latest in date is perhaps the most interesting of the series. It shows how deep and widespread the sense of the utility of international state co-operation has become. The convention sets out the scope and objects of the institute, which a recent British official publication states has been joined by 38 states, including Great Britain and all other great powers, as follows:—

> Whilst limiting its action to international questions, it shall be the duty of the institute: (*a*) To collect, elaborate and publish, with as little delay as possible, statistical, technical, or economic information regarding the cultivation of the soil, its productions, whether animal or vegetable, the trade in agricultural products, and the prices obtained on the various markets. (*b*) To communicate to interested parties, also without delay, full information of the nature above mentioned. (*c*) To indicate the wages of rural labour. (*d*) To notify all new diseases of plants which may appear in any part of the world, indicating the districts affected, the spread of the disease, and, if possible, the efficacious means of resistance. (*e*) To consider questions relating to agricultural co-operation, insurance and credit, in all their forms, collecting and publishing information which may be useful in the various countries for the organization of undertakings relating to agricultural co-operation, insurance and credit. (*f*) To present, if expedient, to the governments, for their approval, measures for the protection of the common interests of agriculturists and for the improvement of their condition, after having previously taken every means of obtaining the necessary information, *e.g.* resolutions passed by international congresses or other congresses relating to agriculture or to sciences applied to agriculture, agricultural societies, academies, learned societies, &c.
>
> All questions relating to the economic interests, the legislation and administration of any particular state, must be excluded from the sphere of the institute. (Art. 9).

Lastly, there is a class of difficulties which might arise from preferential treatment of trade from different countries. To obviate them statesmen have been led to adopt the principle of the "most-favoured-nation-clause"—that is to say, a clause providing that if any reductions of tariff or other advantages are granted by either contracting state to any third state, the others shall have the benefit of it. In Europe this clause has been uniformly treated as applying to all reductions of tariff without distinction. The United States interpretation, on the other hand, distinguishes between reductions of a general character and reductions made specifically in return for reductions by some other state. The latter do not come within the operation of the clause, and a co-contracting state is only entitled to obtain extension of them to itself on granting similar concessions. In other words, concessions to any co-contracting state are only allowed gratuitously to a third co-contracting state when nothing has been given for them, the clause not covering advantages granted in return for advantages. It is to be hoped that this special view of the meaning of the clause will be met in the future, as in some recent treaties, by specifically dealing with the exceptions.[2]

The Utility of Popular Effort.—Until quite recently it had been a distinctive mark of practical wisdom to treat private efforts for the improvement of international relations for the preservation of peace, with the patronizing tolerance courteous people of the world extend to half-crazy idealists. Since the opening of the century, an immense change has taken place in the attitude of the leaders of popular opinion towards the advocacy of peace. This new attitude has been contemporary with the greater interest displayed by the mercantile classes of England and the United States in the improvement of their political relations with their neighbours. It may be said to have begun with the visit of the Association of British Chambers of Commerce to Paris in 1900, at a time when France was still smarting from the humiliation of the Fashoda affair, and the Boer War was exciting hostile demonstrations against Great Britain throughout the continent of Europe. That some four hundred British manufacturers and merchants, representing about eighty chambers of commerce of the United Kingdom, should have swept aside all political objections and have boldly trusted to the efficacy of friendly advances as between man and man, appealed to the French people. It seems to have been the first great popular effort ever made deliberately by a representative body of the middle class of a nation for the promotion of international friendship without the aid of diplomacy and without official assistance or even countenance of any kind.

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[1] A subsidiary convention not quite falling within the scope of the above convention is the submarine telegraphs convention, which was signed in 1884. It applies outside territorial waters to all legally established submarine cables landed on the territories, colonies or possessions of one or more of the high contracting parties. Under its provisions it is a punishable offence "to break or injure a submarine cable wilfully or by culpable negligence in such manner as might interrupt or obstruct telegraphic communication either wholly or partially, such punishment being without prejudice to any civil action for damages. It also provides that:—"Vessels engaged in laying or repairing submarine cables shall conform to the regulations as to signals which have been, or may be, adopted by mutual agreement among the high contracting parties with the view of preventing collisions at sea. When a ship engaged in repairing a cable exhibits the said signals, other vessels which see them or are able to see them shall withdraw to or keep beyond a distance of one nautical mile at least from the ship in question so as not to interfere with her operations" (art. 5). "Owners of ships or vessels who can prove that they have sacrificed an anchor, a net or other fishing-gear in order to avoid injuring a submarine cable shall receive compensation from the owner of the cable," and "in order to establish a claim to such compensation a statement supported by the evidence of the crew should whenever possible be drawn up immediately after the occurrence and the master must within twenty-four hours after his return to or next putting into port make a declaration to the proper authorities" (art. 7). "The tribunals competent to take cognizance of infractions of the present convention are those of the country to which the vessel on board of which the offence was committed belongs" (art. 8). By art. 15 it is provided that the stipulations of the convention do not in any way restrict the action of belligerents. It may be remarked that the British representative at the time of signing the convention declared that his government understood that in the time of war a belligerent would be free to act in regard to submarine cables as though the convention did not exist. The act to carry into effect the above convention is the Submarine Telegraph Act 1885 (48 & 49 Vict. c. 49) which was slightly modified by 50 Vict. c. 3. Section 3 of the earlier act provides that a person who injures the cable either wilfully or by culpable negligence is "guilty of a misdemeanour and on conviction: (*a*) if he acted wilfully, shall be liable to penal servitude for a term not exceeding five years, or to imprisonment with or without hard labour for a term not exceeding two years, and to a fine either in lieu of or in addition to such penal servitude or imprisonment; and (*b*) if he acted by culpable negligence shall be liable to imprisonment for a term not exceeding three months without hard labour, and to a fine not exceeding £100 either in lieu of or in addition to such imprisonment."

See Board of Trade Correspondence on Protection of Submarine Cables, printed on the 24th of July 1882; and Parliamentary Paper C. 5910: 1890.

[2] See Barclay, *Problems of International Practice and Diplomacy* (1907), p. 137 seq.

Otherwise, private agencies of a standing character which contribute towards the promotion of peace may be divided into four classes, viz. (1) those which, without having peace for their direct object, promote friendship among men of different races and nationalities; (2) those which directly address themselves to the promoting of friendship and goodwill among peoples; (3) those which regarding peace as the immediate object of their efforts, endeavour to educate democracy in this sense; (4) those which endeavour to remove the causes of international friction by the codification of international law and the promotion of the international regulation of common interests. Lastly, there are two agencies which cannot be classed among the foregoing; one is the International Parliamentary Union and the other the Nobel Prize Committee.

1. Agencies which are indirectly making for peace are of many kinds. Science and medicine now bring men of all nations together in periodical congresses. Technology, electricity, mining, railways, navigation and many other subjects are now dealt with in international congresses. International exhibitions are always used as an occasion for holding many such meetings.

2. One of the most notable efforts directed to the deliberate cementing of friendship has been the interchange of official visits by municipal bodies. In the course of the Anglo-French agitation which culminated in March 1903 with the visit of King Edward to Paris, the French municipal councils passed many resolutions in favour of the *entente*. After the conclusion of the Anglo-French standing treaty of arbitration (Oct. 14, 1903) and the arrangements for the general settlement of outstanding difficulties with France (April 8, 1904), the municipal bodies in France were prepared to go a step farther, and in 1906 the Municipal Council of Paris was invited by the London County Council to pay an official visit to England. This visit was followed by a return visit to Paris and a similar exchange of visits between the London City Corporation and the Paris Municipal Council, exchange visits of the city corporations of Manchester, Glasgow and Edinburgh and Lyons, and a visit of the Manchester Corporation to Düsseldorf, Barmen and Cologne. A society, numbering many thousands of working men among its members, which has set itself the more special task of promoting the interchange of visits between working men of different nations, is called the "International Brotherhood Alliance," or, after the initials of its motto, *Fraternitas inter gentes*, the F.I.G. Another agency, called the "American Association for International Conciliation," seeks by the publication of essays on the different aspects of international friendship to promote the same cause.

3. The "peace societies," which are scattered over the whole world, number several hundreds.[1] Their first International Congress was held in London at the suggestion of Joseph Sturge in 1843. In 1848 a second congress was held at Brussels. The third in 1849 took place in Paris, and was presided over by Victor Hugo. Other congresses were held at Frankfurt, again in London, and in 1853 at Manchester, where Richard Cobden and John Bright took part in the discussions. Then followed an interval of wars during which the Pacifists were unable to raise their voices. At length in 1878 a congress was held at the Paris International Exhibition of that year, but it was not till the next Paris International Exhibition of 1889 that these international peace congresses became periodical. Since then numerous congresses have been held, the seventeenth having sat in London in 1908, and the eighteenth at Stockholm in 1910. These congresses have been supplemented by national congresses in both Great Britain and France. Such congresses are doing admirable work in the popularizing of thought upon the numerous questions which are discussed at the meetings, such as compulsory arbitration, the restriction of armaments, private property at sea in time of war, the position of subject races, airships in war, &c.[2]

4. First among the bodies which try to remove the causes of international friction is the Institute of International Law. This is a body of international lawyers, consisting of sixty members and sixty associates recruited by election—the members from those who "have rendered services to international law in the domain of theory or practice," and associates from those "whose knowledge may be useful to the Institute." It was formed in 1873, chiefly through the efforts of M. Rolin-Jaequemyns. The official language of the Institute is French, and its annual meetings are held wherever the members at the previous meeting decide to assemble. Its mode of operation is to work out the matters it deals with during the intervals between the sessions, in permanent commissions, among which the whole domain of international law is divided up. The commissions, under the direction of their *rapporteurs* or conveners, prepare reports and proposals, which are printed and distributed among the members some time before the plenary sittings at which they are to be discussed. If the members are not agreed, the subject is adjourned to another session, and still another, until they do agree. Thus the resolutions of the Institute have the authority attaching to a mature expression of the views of the leading international jurists of Europe. Another body having a more or less similar purpose is the International Law Association, which was founded in 1873 as the "Association for the Reform and Codification of the Law of Nations," with practically the same objects as those which led to the constitution of the Institute of International Law. It also meets in different countries, but it differs from the Institute in the number of its members being unlimited and in all respectable persons being eligible for membership. A report is published after each meeting. There are now numerous volumes of such reports, many of them containing most valuable materials for international jurists. In 1895 the name was changed to International Law Association.

A new society was recently (1906) formed in America called the American Society of International Law, "to foster the study of international law and promote the establishment of international relations on the basis of law and justice." "Membership in the society is not restricted to lawyers, and any man of good moral character interested in the objects of the society may be admitted to membership." The publications of this society have already taken an important place among the literature of international law.

Still more recently yet another society came into being in Switzerland with objects which seem to be similar to those of the Institute of International Law.

The Inter-Parliamentary Union, which dates back to 1887, owes its origin to the initiative of the late Sir W. R. Cremer. It is composed of groups of the different parliaments of the world, who meet periodically to "bring about the acceptance in their respective countries, by votes in parliament and by means of arbitration treaties, of the principle that differences between nations should be submitted to arbitration and to consider other questions of international importance."[3] The sixteenth conference was held at Brussels in August–September, 1910.

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[1] See *Annuaire du mouvement pacifiste pour l'année 1910*, published by the Bureau International de la Paix, at Bern.

[2] At the third congress of the new series, held at Rome in 1891, was created the Bureau International de la Paix. This most useful institution, which has its office at Bern, serves as a means of bringing and keeping together all the known peace societies. Its *Correspondance bimensuelle* and *Annuaire du mouvement pacifiste* are well known, and its obliging hon. secretary, Dr A. Gobat, is always ready to supply information from the now considerable archives of the Bureau. In this connexion we may mention that the secretary of the London Peace Society, Dr Evans Darby, has edited an exhaustive collection of materials called *International Tribunals*. His statements every two years on the progress of arbitration at the International Law Association meetings also form an excellent source of materials for reference.

[3] Art. 1 of Statutes revised Sept. 1908.

The Nobel Committee owes its existence to the will of the late Alfred B. Nobel (1833–1896), the inventor of dynamite, who left a considerable fortune for the encouragement of men who work for the benefit of humanity. The interest of this money was to be divided into five equal parts, to be distributed every year as rewards to the persons who had deserved best of mankind in five departments of human activity. The clauses of the will governing the distribution of these prizes are as follows:—

> "The entire sum shall be divided into five equal parts, one to go to the man who shall have made the most important discovery or invention in the domain of physical science; another to the man who shall have made the most important discovery or introduced the greatest improvement in chemistry; the third to the author of the most important discovery in the domain of physiology or medicine; the fourth to the man who shall have produced the most remarkable work of an idealistic nature; and, finally, the fifth to the man who shall have done the most or best work for the fraternity of nations, the suppression or reduction of standing armies, and the formation and propagation of peace congresses. The prizes shall be awarded as follows: For physical science and chemistry, by the Swedish Academy of Sciences; for physiological or medical work, by the Caroline Institution at Stockholm; for literature, by the Stockholm Academy, and for peace work, by a committee of five members elected by the Norwegian Storthing. It is my express desire that, in awarding the prizes, no account shall be taken of nationality, in order that the prize may fall to the lot of the most deserving, whether he be Scandinavian or not."

Peace v. War.—Peace is the ultimate object of all statecraft —peace in the development of the domestic activities of the nation administered, and peace in the relations of states with one another. For the purpose of ensuring peace an expensive diplomacy is maintained by all states, and to perpetuate it treaties are entered into by states with one another. Even war has no other avowed purpose than that of placing specific international relations on a definite footing. Ultimate peace is uniformly proclaimed by every dictator at home, by every conqueror abroad, as the goal to which he is directing his efforts. And yet dissentient voices are sometimes heard defending war as if it were an end in itself. Without going back to the well-known reply of Count Moltke to Professor Bluntschli respecting the *Manual of the Laws of War* drawn up by the Institute of International Law in 1880,[1] we need only quote that highly up-to-date philosopher, Nietzsche: "It is mere illusion and pretty sentiment," he observes, "to expect much (even anything at all) from mankind if it forgets how to make war. As yet no means are known which call so much into action as a great war, that rough energy born of the camp, that deep impersonality born of hatred, that conscience born of murder and cold-bloodedness, that fervour born of effort in the annihilation of the enemy, that proud indifference to loss, to one's own existence, to that of one's fellows, to that earthquake-like soul-shaking which a people needs when it is losing its vitality."[2]

It is pleasant to contrast this neurotic joy of one onlooker with the matter-of-fact reflexions of another, the late W. E. H. Lecky. "War" he says "is not, and never can be a mere passionless discharge of a painful duty. It is in its essence, and it is a main condition of its success, to kindle into fierce exercise among great masses of men the destructive and combative passions—passions as fierce and as malevolent as that with which the hound hunts the fox to its death or the tiger springs upon its prey. Destruction is one of its chief ends. Deception is one of its chief means, and one of the great arts of skilful generalship is to deceive in order to destroy. Whatever other elements may mingle with and dignify war, this at least is never absent; and however reluctantly men may enter into war, however conscientiously they may endeavour to avoid it, they must know that when the scene of carnage has once opened, these things must be not only accepted and condoned, but stimulated, encouraged and applauded. It would be difficult to conceive a disposition more remote from the morals of ordinary life, not to speak of Christian ideals, than that with which the soldiers most animated with the fire and passion that lead to victory rush forward to bayonet the foe. . . . It is allowable to deceive an enemy by fabricated despatches purporting to come from his own side; by tampering with telegraph messages; by spreading false intelligence in newspapers; by sending pretended spies and deserters to give him untrue reports of the numbers or movements of the troops; by employing false signals to lure him into an ambuscade. On the use of the flag and uniform of an enemy for purposes of deception there has been some controversy, but it is supported by high military authority. . . . Hardly any one will be so confident of the virtue of his rulers as to believe that every war which his country wages in every part of its dominions with uncivilized as well as civilized populations, is just and necessary, and it is certainly prima facie not in accordance with an ideal morality that men should bind themselves absolutely for life or for a term of years to kill without question, at the command of their superiors, those who have personally done them no wrong."[3]

Surely with all the existing activity in the removal of causes of war, in the reduction to precise expression of the rules of law governing the relations of states with one another, in the creation of international judicatures for the application of these rules, in the concluding of treaties specifically framed to facilitate the pacific settlement of difficulties diplomacy may have failed to adjust, in the promotion of democratic civilian armies with everything to lose by war, and all the other agencies which have been described above, the hope seems warranted that, in no distant future, life among nations will become still more closely assimilated to life among citizens of the same nation, with legislation, administration, reform all tending to the one great object of law, order and peace among men. (T. Ba.)

PEACE, BREACH OF THE. Theoretically all criminal offences cognizable by English law involve a breach of the king's peace, and all indictments whether for offences against the common law or by statute conclude "against the peace of our lord the king, his crown and dignity." Historically this phrase, now legally superfluous, represents the last trace of the process by which the royal courts assume jurisdiction over all offences, and gradually extruded the jurisdiction of the sheriff and of lords of manors and franchises, making crime a matter of national concern as distinguished from civil wrongs or infractions of the rights of local magnates, or of the rights of the tribal chiefs of the Teutonic conquerors of Britain. The peace of the king was sworn on his accession or full recognition, and the jurisdiction of his courts to punish all violations of that peace was gradually asserted. The completion of this process is marked by the institution of the office of justice of the peace.

In modern times the expression "breach of the peace" is usually limited to offences involving actual tumult, disturbances or disorder. As regards such offences, although they do not fall into the class of grave crimes described as felonies, officers of police and even private persons have larger powers and duties, as to immediate arrest without waiting for judicial warrant, than they possess as to other minor offences (see Arrest). Justices of the peace have under early statutes and the commission of the peace power to take sureties of the peace from persons who are threatening to commit a breach of the peace, and it is within the power of any court on conviction of any misdemeanour and of many felonies to require the offender to enter into a recognizance (*q.v.*) to keep the peace.

PEACE CONFERENCES, the official title of the two international conferences held at the Hague in 1899 and 1907. Both were organized at the instance of the emperor Nicholas II. of Russia. The chief object of the first conference, as set out in the note of Count Mouraviev, the Russian minister of foreign affairs (Jan. 11, 1899), was to arrive at an "understanding not to increase for a fixed period the present effectives of the armed military and naval forces, and at the same time not to increase the budgets pertaining thereto; and a preliminary examination of the means by which even a reduction might be effected in future in the forces and budgets above mentioned."[1] The conference, which was attended by representatives of 26 states, sat from the 18th of May to the 29th of July 1899.

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[1] "Perpetual peace," he said, "is a dream, and it is not even a beautiful dream. War is an element in the order of the world ordained by God . . . Without war the world would stagnate and lose itself in materialism."

[2] *Menschliches, Allzumenschliches*, No. 477.

[3] *The Map of Life*, 1902, pp. 92–97.

When the subject of excessive armaments came up for discussion, the objections of the German military delegate led to its abandonment. Other very important matters, however, were dealt with, and three momentous conventions were adopted, viz.—

I. A convention for the pacific settlement of international disputes.

II. A convention relating to the laws and customs of war by land.

III. A convention for the adaptation to maritime warfare of the principles of the Geneva Convention of the 22nd of August 1864.

Three declarations on the following matters were also adopted:—

a. Prohibition of the launching of projectiles and explosives from balloons or by other similar new methods.[2]

b. Prohibition of the use of projectiles the only object of which is the diffusion of asphyxiating or deleterious gases.

c. Prohibition of the use of bullets which expand or flatten easily in the human body, such as bullets with a hard envelope, of which the envelope does not entirely cover the core, or is pierced with incisions.

The conference furthermore passed the following resolutions:—

"The Conference is of opinion that the restriction of military budgets, which are at present a heavy burden on the world, is extremely desirable for the increase of the material and moral welfare of mankind."

"The Conference, taking into consideration the preliminary steps taken by the Swiss Federal Government for the revision of the Geneva Convention, expresses the wish that steps may be shortly taken for the assembling of a special Conference, having for its object the revision of that Convention."

The following *vœux* were adopted, but not unanimously:—

"1. The Conference expresses the wish that the question of the rights and duties of neutrals may be inserted in the programme of a conference in the near future.

"2. The Conference expresses the wish that the questions with regard to rifles and naval guns, as considered by it, may be studied by the Governments with the object of coming to an agreement respecting the employment of new types and calibres.

"3. The Conference expresses the wish that the Governments, taking into consideration the proposals made at the Conference, may examine the possibility of an agreement as to the limitation of armed forces by land and sea, and of war budgets.

"4. The Conference expresses the wish that the proposals which contemplate the declaration of the inviolability of private property in naval warfare may be referred to a subsequent conference for consideration.

"5. The Conference expresses the wish that the proposal to settle the question of the bombardment of ports, towns and villages by naval forces may be referred to a subsequent conference for consideration."

Great Britain signed and became a party to the three Conventions, but not to all the declarations, &c.

The Conference of 1907, which was attended by representatives of forty-four states, sat from the 15th of June to the 18th of October. Again, in spite of the resolution and *vœu* on armaments handed down from the Conference of 1899 this subject was waived, but still more important conventions than in 1899 were adopted on other matters. These were as follows:—

I. Convention for the pacific settlement of international disputes.[3]

II. Convention respecting the limitation of the employment of force for the recovery of contract debts.

III. Convention relative to the commencement of hostilities.

IV. Conventions concerning the laws and customs of war on land.[3]

V. Convention respecting the rights and duties of neutral powers and persons in war on land.

VI. Convention relative to the status of enemy merchant-ships at the outbreak of hostilities.

VII. Convention relative to the conversion of merchant-ships into war-ships.

VIII. Convention relative to the laying of automatic submarine contact mines.

IX. Convention respecting bombardment by naval forces in time of war.

X. Conventions for the adaptation of the principles of the Geneva Convention to maritime war.[4]

XI. Convention relative to certain restrictions on the exercise of the right of capture in maritime war.[4]

XII. Convention relative to the establishment of an international prize court.

XIII. Convention respecting the rights and duties of neutral powers in maritime war.

XIV. Declaration prohibiting discharge of projectiles, &c., from balloons.[5]

A draft Convention relative to the creation of a judicial arbitration court was also drawn up in connexion with the first of the four following *vœux*:—

1. The Conference calls the attention of the signatory powers to the advisability of adopting the annexed draft convention for the creation of a judicial arbitration court, and of bringing it into force as soon as an agreement has been reached respecting the selection of the judges and the constitution of the court.

2. The Conference expresses the opinion that, in case of war, the responsible authorities, civil as well as military, should make it their special duty to ensure and safeguard the maintenance of pacific relations, more especially of the commercial and industrial relations between the inhabitants of the belligerent states and neutral countries.

3. The Conference expresses the opinion that the powers should regulate, by special treaties, the position, as regards military charges, of foreigners residing within their territories.

4. The Conference expresses the opinion that the preparation of regulations relative to the laws and customs of naval war should figure in the programme of the next conference,[6] and that in any case the powers may apply, as far as possible, to war by sea the principles of the Convention relative to the laws and customs of war on land.

Finally, the Conference recommended to the powers the assembly of a Third Peace Conference, and it called their attention to the necessity of preparing the programme of this Third Conference a sufficient time in advance to ensure its deliberations being conducted with the necessary authority and expedition.

In order to attain this object the Conference considered that it "would be very desirable that, some two years before the probable date of the meeting, a preparatory committee should be charged by the governments with the task of collecting the various proposals to be submitted to the Conference, of ascertaining what subjects are ripe for embodiment in an international regulation, and of preparing a programme which the governments should decide upon in sufficient time to enable it to be carefully examined by the countries interested," and that this committee should further be entrusted with the task of proposing a system of organization and procedure for the Conference itself. (T. BA.)

PEACH, CHARLES WILLIAM (1800–1886), British naturalist and geologist, was born on the 30th of September 1800 at Wansford in Northamptonshire; his father at the time was a saddler and harness-maker, and afterwards became an innkeeper farming about 80 acres of land. He received an elementary education at Wansford and at Folkingham in Lincolnshire; and assisted for several years in the inn and farm. In 1824 he was appointed riding officer in the Revenue Coast-guard at Weybourn in Norfolk. Sea-weeds and other marine organisms now attracted his attention, and these he zealously collected. His duties during the next few years led him to remove successively to Sheringham, Hasboro (Happisburgh), Cromer and Cley, all in Norfolk. In the course of his rambles he met the Rev. James Layton, curate at Catfield, who lent him books and assisted in laying the foundations of accurate knowledge. About the year 1830 he was transferred to Charmouth in Dorset, thence to Beer, and Paignton in Devon, and to Gorran Haven near Mevagissey in Cornwall. Here he continued to pursue his zoological studies and supplied many specimens to G. Johnston, who was then preparing his *History of the British Zoophytes* (1838). It was here too that he first found fossils in some of the older rocks previously regarded as unfossiliferous—the discovery of which proved the presence of Bala Beds (Ordovician or Lower Silurian) in the neighbourhood of Gorran Haven. In 1841 he read a paper before the British Association at Plymouth "On the Fossil Organic Remains found on the south-east coast of Cornwall," and in 1843 he brought before the Royal Geological Society of Cornwall an account of his discovery of fish remains in the Devonian slates near Polperro. Peach was transferred for a time to Fowey; and in 1849 to Scotland, first to Peterhead and then to Wick (1853), where he made acquaintance with Robert Dick of Thurso. He collected the old red Sandstone fishes; and during a sojourn at Durness he first found fossils in the Cambrian limestone (1854). Peach retired from the government service in 1861, and died at Edinburgh on the 28th of February 1886.

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[1] At the Conference the Russian government, further developing the proposal, submitted the following details:—

"1. Establishment of an international understanding for a term of five years, stipulating non-increase of the present figures of the peace effective of the troops kept up for home use.

"2. Fixation, in case of this understanding being arrived at, and, if possible, of the figures of the peace effective of all the powers excepting colonial troops.

"3. Maintenance for a like term of five years of the amount of the military budgets at present in force."

[2] This Conference was held at Geneva in June–July 1906. The revised Convention, composed of 33 articles, is dated July 6, 1906.

[3] This is an amended edition of that of 1899.

[4] This is an amended edition of that of 1899.

[5] This was practically a re-enactment of that of 1899.

[6] This has since been done to a large extent by the Conference of London (1908–1909). See BLOCKADE, CONTRABAND, INTERNATIONAL LAW PEACE.

Biographical notice, with portrait, in S. Smiles's *Robert Dick, Baker, of Thurso, Geologist and Botanist* (1878).

PEACH, the name of a fruit tree which is included by Bentham and Hooker (*Genera plantarum*, i. 610) under the genus *Prunus* (*Prunus persica*); its resemblance to the plum is indeed obvious. Others have classed it with the almond as a distinct genus, *Amygdalus*; while others again have considered it sufficiently distinct to constitute a separate genus, *Persica*.

In general terms the peach may be said to be a medium-sized tree, with lanceolate, stipulate leaves, borne on long, slender, relatively unbranched shoots, and with the flowers arranged singly, or in groups of two or more, at intervals along the shoots of the previous year's growth. The flowers have a hollow tube at the base bearing at its free edge five sepals, an equal number of petals, usually concave or spoon-shaped, pink or white, and a great number of stamens. The pistil consists of a single carpel with its ovary, style, stigma and solitary ovule or twin ovules. The fruit is a drupe (fig. 1) having a thin outer skin (epicarp) enclosing the flesh of the peach (mesocarp), the inner layers of the carpel becoming woody to form the stone, while the ovule ripens into the kernel or seed. This is exactly the structure of the plum or apricot, and differs from that of the almond, which is identical in the first instance, only in the circumstance that the fleshy part of the latter eventually becomes dry and leathery and cracks open along a line called the suture.

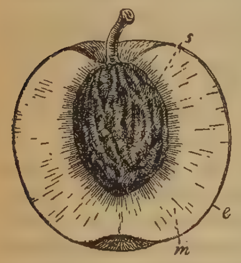


FIG. 1.—Fruit (drupe) of Peach cut lengthwise.
e, Skin or epicarp.
m, Flesh or mesocarp.
s, Stone or endocarp, within which is the seed or kernel.

The nectarine is a variation from the peach, mainly characterized by the circumstance that, while the skin of the ripe fruit is downy in the peach, it is shining and destitute of hairs in the nectarine. That there is no essential difference between the two is, however, shown by the facts that the seeds of the peach will produce nectarines, and vice versa, and that it is not very uncommon, though still exceptional, to see peaches and nectarines on the same branch, and fruits which combine in themselves the characteristics of both nectarines and peaches. The blossoms of the peach are formed the autumn previous to their expansion, and this fact, together with the peculiarities of their form and position, requires to be borne in mind by the gardener in his pruning and training operations. The only point of practical interest requiring mention here is the very singular fact attested by all peach-growers, that, while certain peaches are liable to the attacks of mildew, others are not. In the case of the peach this peculiarity is in some way connected with the presence of small glandular outgrowths on the stalk, or at the base of the leaf. Some peaches have globular, others reniform glands, others none at all, and these latter trees are much more subject to mildew than are those provided with glands.

The history of the peach, almond and nectarine is interesting and important as regards the question of the origin of species and the production and perpetuation of varieties. As to the origin of the peach two views are held, that of Alphonse de Candolle, who attributes all cultivated varieties to a distinct species, probably of Chinese origin, and that adopted by many naturalists, but more especially by Darwin, who looks upon the peach as a modification of the almond.

In the first place, the peach as we now know it has been nowhere recognized in the wild state. In the few instances where it is said to have been found wild the probabilities are that the tree was an escape from cultivation. Aitchison, however, gathered in the Hazārdarakht ravine in Afghanistan a form with different-shaped fruit from that of the almond, being larger and flatter. "The surface of the fruit," he observes, "resembles that of the peach in texture and colour; and the nut is quite distinct from that of the wild almond. The whole shrub resembles more what one might consider a wild form of the peach than that of the almond." It is admitted, however, by all competent botanists that the almond is wild in the hotter and drier parts of the Mediterranean and Levantine regions. Aitchison also mentions the almond as wild in some parts of Afghanistan, where it is known to the natives as "bēdām," the same word that they apply to the cultivated almond. The branches of the tree are carried by the priests in religious ceremonies. It is not known as a wild plant in China or Japan. As to the nectarine, of its origin as a variation from the peach there is abundant evidence, as has already been mentioned; it is only requisite to add the very important fact that the seeds of the nectarine, even when that nectarine has been produced by bud-variation from a peach, will generally produce nectarines, or, as gardeners say, "come true." Darwin brings together the records of several cases, not only of gradations between peaches and nectarines, but also of intermediate forms between the peach and the almond. So far as we know, however, no case has yet been recorded of a peach or a nectarine producing an almond, or vice versa, although if all have had a common origin such an event might be expected. Thus the botanical evidence seems to indicate that the wild almond is the source of cultivated almonds, peaches and nectarines, and consequently that the peach was introduced from Asia Minor or Persia, whence the name *Persica* given to the peach; and Aitchison's discovery in Afghanistan of a form which reminded him of a wild peach lends additional force to this view.

On the other hand, Alphonse de Candolle, from philological and other considerations, considers the peach to be of Chinese origin. The peach has not, it is true, been found wild in China, but it has been cultivated there from time immemorial; it has entered into the literature and folk-lore of the people; and it is designated by a distinct name, "to" or "tao," a word found in the writings of Confucius five centuries before Christ, and even in other writings dating from the 10th century before the Christian era. Though now cultivated in India, and almost wild in some parts of the north-west, and, as we have seen, probably also in Afghanistan, it has no Sanskrit name; it is not mentioned in the Hebrew text of the Scriptures, nor in the earliest Greek times. Xenophon makes no mention of the peach, though the Ten Thousand must have traversed the country where, according to some, the peach is native; but Theophrastus, a hundred years later, does speak of it as a Persian fruit, and De Candolle suggests that it might have been introduced into Greece by Alexander. According to his view, the seeds of the peach, cultivated for ages in China, might have been carried by the Chinese into Kashmir, Bokhara, and Persia between the period of the Sanskrit emigration and the Graeco-Persian period. Once established, its cultivation would readily extend westward, or, on the other hand, by Cabul to north-western India, where its cultivation is not ancient. While the peach has been cultivated in China for thousands of years, the almond does not grow wild in that country and its introduction is supposed not to go back farther than the Christian era.

On the whole, greater weight is due to the evidence from botanical sources than to that derived from philology, particularly since the discovery both of the wild almond and of a form like a wild peach in Afghanistan. It may, however, well be that both peach and almond are derived from some pre-existing and now extinct form whose descendants have spread over the whole geographic area mentioned; but this is a mere speculation, though indirect evidence in its support might be obtained from the nectarine, of which no mention is made in ancient literature, and which, as we have seen, originates from the peach and reproduces itself by seed, thus offering the characteristics of a species in the act of developing itself.

The treatment in horticulture of the peach and nectarine is the same in every respect. To perpetuate and multiply the choicer varieties, peaches and nectarines are budded upon plum or almond stocks. For dry situations almond stocks are preferable, but they are not long-lived, while for damp or clayey loams it is better to use certain kinds of plums. Double-working is sometimes beneficial; thus an almond budded on a plum stock may be rebudded with a tender peach, greatly to the advantage of the latter. The peach border should be composed of turfy mellow loam, such as is suitable for the vine and the fig; this should be used in as rough a state as possible, or not broken small and fine. The bottom should slope towards the outer edge, where a drain should be cut, with an outlet, and on this sloping bottom should be laid a thickness of from 9 in. to 12 in. of rough materials, such as broken bricks or mortar rubbish, over which should be placed a layer of rough turf with the grassy side downwards, and then the good loamy soil to form the border, which should have a depth of about 2 ft. 6 in. The peach-tree is most productive when the roots are kept near the surface, and the borders, which should be from 8 ft. to 12 ft. wide, should not be cropped heavily with culinary vegetables, as deep trenching is very injurious. Sickly and unfruitful trees may often be revived by bringing up their roots within 5 or 6 in. of the surface. It is questionable whether it is not better, in cold soils and bleak situations, to abandon outdoor peach culture, and to cover the walls with a casing of glass, so that the trees may be under shelter during the uncongenial spring weather.

The fruit of the peach is produced on the ripened shoots of the preceding year. If these be too luxuriant, they yield nothing but leaves; and if too weak, they are incapable of developing flower buds. To furnish young shoots in sufficient abundance, and of requisite strength, is the great object of peach training and pruning. Trees of slender-growing, twiggy habit naturally fall most readily into the fan form of training, and accordingly this has generally been adopted in the culture of peaches and nectarines (fig. 2). The young tree is, in many cases, procured when it has been trained for two or three years in the nursery; but it is generally better to begin with a maiden plant—that is, a plant of the first year after it has been budded. It is then in ordinary practice headed down to five or six buds, and in the following summer from two to four shoots, according to the vigour of the plant, are trained in, the laterals from which, if any, are thinned out and nailed to the wall. If there are four branches, the two central ones are shortened back at the subsequent winter pruning so as to produce others, the two lower ones being laid in nearly at full length. In the following season additional shoots are sent forth; and the process is repeated till eight or ten principal limbs or mother branches are obtained, forming, as it were, the frame-work of the future tree. The branches may be depressed or elevated, so as to check or encourage them, as occasion may arise; and it is highly advantageous to keep them thin, without their becoming in any part deficient of young shoots. Sometimes a more rapid mode of formation is now adopted, the main shoots being from the first laid in nearly at full length, instead of being shortened. The pruning for fruit consists in shortening back the laterals which had been nailed in at the disbudding, or summer pruning, their length depending on their individual vigour and the luxuriance of the tree. In well-developed shoots the buds are generally double, or rather triple, a wood bud growing between two fruit buds; the shoot must be cut back to one of these, or else to a wood bud alone, so that a young shoot may be produced to draw up the sap beyond the fruit, this being generally desirable to secure its proper swelling. The point of this leading shoot is subsequently pinched off, that it may not draw away too much of the sap. If the fruit sets too abundantly, it must be thinned, first when as large as peas, reducing the clusters, and then when as large as nuts to distribute the crop equally; the extent of the thinning must depend on the vigour of the tree, but one or two fruits ultimately left to each square foot of wall is a full average crop. The final thinning should take place after stoning.

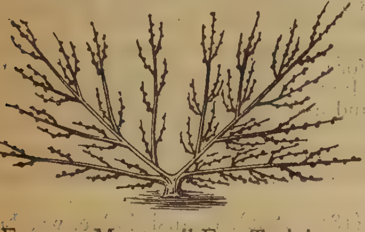


Fig. 2.—Montreuil Fan Training.

The best-placed healthy young shoot produced from the wood buds at the base of the bearing branch is to be carefully preserved and in due time nailed to the wall. In the following winter this will take the place of the branch which has just borne, and which is to be cut out. If there be no young shoot below, and the bearing branch is short, the shoot at the point of the latter may sometimes be preserved as a fruit bearer, though if the bearing branch be long it is better to cut it back for young wood. It is the neglect of this which constitutes the principal fault in carrying out the English fan system, as it is usually practised. Several times during summer the trees ought to be regularly examined, and the young shoots respectively topped or thinned out; those that remain are to be nailed to the wall, or braced in with pieces of slender twigs, and the trees ought occasionally to be washed with the garden engine or thoroughly syringed, especially during very hot summers. After gathering the fruit all the wood not needed for extending the tree or for fruit bearing next season should be cut out so as to give the shoots left full exposure to air and light.

The Montreuil form of training is represented by fig. 2. The principal feature is the suppression of the direct channel of the sap, and the substitution of four, or more commonly two, mother branches, so laid to the wall that the central angle contains about 90°. The other branches are all treated as subordinate members. This form is open to the objection that, if the under branch should die, the upper one cannot be brought down into its place.

The form à la Dumoutier (fig. 3), so called from its inventor, is merely a refinement on the Montreuil method. The formation of the tree begins with the inferior limbs and proceeds towards the centre, the branches being lowered from time to time as the tree acquires strength. What is most worthy of notice in this method is the management of the subordinates in the pruning for fruit. When a shoot promises blossom, it is generally at some distance from the point of insertion into the old wood, and the intermediate space is covered with wood buds. All the latter, therefore, which are between the old wood *a* and the blossoms *c* in fig. 4, except the lowest *b*, are carefully removed by rubbing them off with the finger. This never fails to produce a shoot *d*, the growth of which is favoured by destroying the useless spray *e* above the blossoms, and pinching off the points of those which are necessary to perfect the fruit. A replacing shoot is thus obtained, to which the whole is invariably shortened at the end of the year.

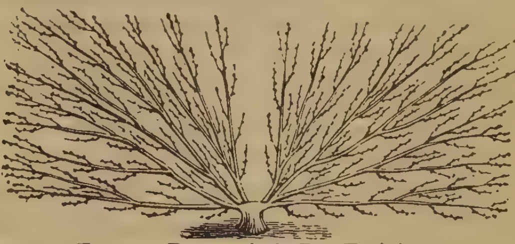


Fig. 3.—Dumoutier's Fan Training.

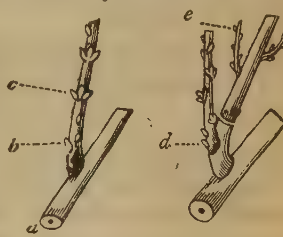


Fig. 4.—Pruning à la Dumoutier.

Seymour's form (fig. 5) approaches more nearly to the French method than any other practised in England; but the direct channel of the sap is not suppressed, and this results in the production of branches of unequal vigour, which is very undesirable.

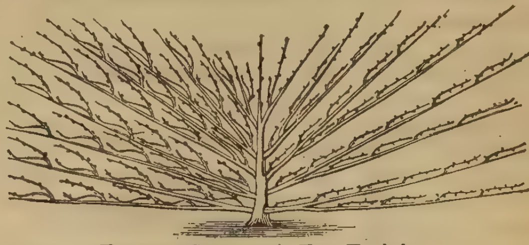


Fig. 5.—Seymour's Fan Training.

For cold and late situations, Thomas Andrew Knight recommended the encouragement of spurs on the young wood, as such spurs, when close to the wall, generate the best organized and most vigorous blossoms, and generally ensure a crop of fruit. They may be produced, by taking care, during the summer pruning or disbudding, to preserve a number of the little shoots emitted by the yearly wood, only pinching off the minute succulent points. On the spurs thus formed blossom buds will be developed early in the following season. This practice is well adapted to cold situations. Peach-trees require protection, especially at the period of blossoming, particularly in the north of England and in Scotland. Canvas or bunting screens are most effectual. By applying these early in the season, great benefit may be derived from retarding the blossom till the frosty nights of spring have passed. Wooden and glass copings are also very useful in warding off frosts. Care must be taken that the roots always have a sufficient supply of moisture and that the soil is moist wherever the roots run.

Forcing.—The pruning and training of the trees in the peach house do not differ materially from the methods practised out of doors. It may also be stated here that when occasion arises peach-trees well furnished with buds may be transplanted and forced immediately without risking the crop of fruit, a matter of some importance when, as sometimes happens, a tree may accidentally fail. In the forcing of peaches fire heat is commonly applied about December or January; but it may, where there is a demand, begin a month sooner. The trees must be got to start growth very gradually, and at first the house should be merely kept closed at a temperature of about 45°, but the heat should gradually increase to 50° at night by the time the trees are in flower, and to 60° when the fruit is set, after which the house should be kept moist by sprinkling the walls and paths, or by placing water troughs on the return pipes, and the temperature should range from 65° by day to 70° or more with sun heat. After the fruit has set, the foliage should be refreshed and cleansed by the daily use of the syringe or garden engine. When the fruit has stoned—that is, as soon as the kernels have been formed—the temperature should be raised to about 65° as a minimum, and to 70°, with 75° by sun heat, as a maximum. Water must now be copiously supplied to the border, and air admitted in abundance, but cold draughts which favour the attack of mildew must be avoided. After the end of April little fire heat is required. When the fruit begins to ripen, syringing must be discontinued till the crop is gathered, after which the syringe must be again occasionally used. If the leaves should happen to shade the fruit, not only during the ripening process but at any time after the stoning period, they should be gently turned aside, for, in order that the fruit may acquire good colour and flavour, it should be freely exposed to light and air when ripening; it will bear the direct rays of the sun, even if they should rise to 100°, but nectarines are much more liable to damage than peaches. The trees often suffer from mildew, which is best prevented by keeping the borders of the peach house clear and sufficiently moist and the house well ventilated, and if it should appear the trees should be sprayed with 1 oz. potassium sulphide dissolved in 3 gallons of water. Care must be taken in using this fungicide not to wet the painted wood, as it is sure to become discoloured.

Peaches and nectarines are frequently cultivated in well-drained pots, and are then usually trained as pyramids, and in some cases as half-standards. The potting must be done very firmly, using turfy loam with which a little mortar rubble has been mixed. The trees are to be top-dressed from time to time with well-decayed manure and turfy loam, and considerable space must be left in the pots for this and the watering.

The following are some of the best peaches and nectarines, arranged in the order of the times of their ripening:—

Peaches.

Early Beatrice	m.	July	Royal George	e. b.	Aug. Sept.
Early Louise	e.	July	Bellegarde	b.m.	Sept.
Hales's Early	b.	Aug.	Belle Bauce	m.	Sept.
Rivers's Early York	b.m.	Aug.	Dymond	m.	Sept.
A'bec	m.	Aug.	Late Admirable	m.e.	Sept.
Crimson Galande	e.	Aug.	Sea Eagle	e.	Sept.
Crawford's Early	e. b.	Aug. Sept.	Walburton Admirable	e. b.	Sept. Oct.
Grosse Mignonne	e. b.	Aug. Sept.	Salwey	e. b.	Oct. Nov.
Noblesse	e. b.	Aug. Sept.	Princess of Wales	e.	Oct.

Nectarines.

Cardinal (under glass)	e.	July	Pitmaston Orange	e. b.	Aug. Sept.
Lord Napier	b.	Aug.	Violette Hâtive	e. b.	Aug. Sept.
Darwin	m.	Aug.	Victoria (under glass)		Sept.
Early Rivers	m.	Aug.	Pineapple	b.	Sept.
Balgowan	e. b.	Aug. Sept.	Stanwick Elruge	b.	Sept.
Elruge	e. b.	Aug. Sept.	Humbolt	m.	Sept.

Stanwick (under glass) m.e. Sept.

PEACHAM, HENRY (*c.* 1576–*c.* 1643), English writer, was the son of Henry Peacham, curate of North Mimms, Hertfordshire, and author of a book on rhetoric called the *Garden of Rhetoric* (1577). The elder Peacham became in 1597 rector of Leverton, Lincolnshire. The son was educated at Trinity College, Cambridge, where he graduated B.A. in 1594–1595 and M.A. in 1598. He was for some time a schoolmaster at Wymondham, Norfolk, but settled in London in 1612, earning his living as tutor to young men preparing for the universities. His first book was *Graphice* (1606), a treatise on pen and water-colour drawing, which, as *The Gentleman's Exercise*, passed through three editions. The years 1613–1614 he spent abroad, part of the time as tutor to the three young sons of Thomas Howard (1585–1646), earl of Arundel, and partly on his own account. He travelled in Italy, France, Westphalia and the Netherlands. The table of Sir John Ogle, English governor of Utrecht, was, he says, a "little academy," where he met soldiers and scholars of all nationalities. When he returned to London he was accused of libel on the king. Incriminating papers had been discovered in the house of Edmond Peacham, rector of Hinton Saint George; who, on being charged with an attack on the king denied the authorship, stating that they were written by a namesake, "a divine, a scholar and a traveller." The change was, however, easily rebutted. Peacham had many friends in London, among them Thomas Dowland the musician, Inigo Jones, and Edward Wright the mathematician. In 1622 appeared Peacham's magnum opus, the *Compleat Gentleman.* Enlarged editions appeared in 1626 and 1627. The 1627 edition was reprinted in 1634; and a third, with additional notes on blazonry by Thomas Blount (1617–1679), appeared in 1661. The book is a text-book of manners and polite learning; it includes chapters on cosmography, geometry, poetry, music, antiquities, painting, the lives of the painters, the "art of limming" (Peacham himself was a proficient engraver), and the military art, including the order of "a maine battaile or pitched field in eight severall wayes." The book differs from the *Courtier* of Castiglione, which had been the guide of an earlier generation. Peacham was a Cavalier, even an ardent polemist in the royal cause, but the central point of his book is a more or less Puritan sentiment of duty. In his later years Peacham was reduced to extreme poverty, and is said to have written children's books at a penny each. His last book was published in 1642, and it may be concluded that he died soon afterwards.

His other works include: *Minerva Britanna* (1612), dedicated to Henry, prince of Wales; *The Period of Mourning* (1613), in honour of the same prince; *Thalia's Banquet* (1620), a book of epigrams; *The Art of Living in London* (1642), and *The Worth of a Peny* (1641), &c. There is a nearly complete collection of Peacham's works in the Bodleian, Oxford. Harleian MS. 6855 contains a translation by Peacham of James I.'s *Basilicon doron* into Latin verse, written in his own hand and ornamented with pen and ink drawings. His *Compleat Gentleman* was edited by G. S. Gordon in 1906 for the Clarendon Press; the *Art of Living* is reprinted in the *Harleian Misc.* ix.; *The Worth of a Peny* in E. Arber's *English Garner* (vol. vi. 1883).

PEACOCK, SIR BARNES (1810–1890), English judge, was born in 1810, the son of Lewis Peacock, a solicitor. After practising as a special pleader, he was called to the bar in 1836, and in 1844 obtained great reputation by pointing out the flaw which invalidated the conviction of Daniel O'Connell and his fellow defendants. In 1852 he went to India as legal member of the governor-general's council. He here displayed great activity as a law reformer, but sometimes manifested too little consideration for native susceptibilities. The legislative council was established soon after his arrival, and although no orator, he was so frequent a speaker that legislation enjoining councillors to deliver their speeches sitting was said to have been devised with the sole object of restraining him. As a member of Lord Dalhousie's council he supported the annexation of Oudh, and he stood by Lord Canning all through the Mutiny. In 1859 he became chief justice of the Supreme Court. He returned to England in 1870, and in 1872 was placed upon the judicial committee of the privy council, where his Indian experience rendered him invaluable. He died on the 3rd of December 1890.

PEACOCK, GEORGE (1791–1858), English mathematician, was born at Thornton Hall, Denton, near Darlington, on the 9th of April 1791. He was educated at Richmond, Yorkshire, and entered Trinity College, Cambridge, in 1809. He was second wrangler in 1812 (Sir J. F. W. Herschel being senior), was elected fellow of his college in 1814, became assistant tutor in 1815 and full tutor in 1823. While still an undergraduate he formed a league with John Herschel and Charles Babbage, to conduct the famous struggle of "d-ism *versus* dot-age," which ended in the introduction into Cambridge of the continental notation in the infinitesimal calculus to the exclusion of the fluxional notation of Sir Isaac Newton. This was an important reform, not so much on account of the mere change of notation (for mathematicians follow J. L. Lagrange in using both these notations), but because it signified the opening to the mathematicians of Cambridge of the vast storehouse of continental discoveries. The analytical society thus formed in 1813 published various memoirs, and translated S. F. Lacroix's *Differential Calculus* in 1816. Peacock powerfully aided the movement by publishing in 1820 *A Collection of Examples of the Application of the Differential and Integral Calculus.* In 1841 he published a pamphlet on the university statutes, in which he indicated the necessity for reform; and in 1850 and 1855 he was a member of the commission of inquiry relative to the university of Cambridge. In 1837 he was appointed Lowndean professor of astronomy. In 1839 he took the degree of D.D., and the same year was appointed by Lord Melbourne to the deanery of Ely. Peacock threw himself with characteristic ardour into the duties of this new position. He improved the sanitation of Ely, published in 1840 *Observations on Plans for Cathedral Reform*, and carried out extensive works of restoration in his own cathedral. He was twice prolocutor of the lower house of convocation for the province of Canterbury. He was also a prime mover in the establishment of the Cambridge Astronomical Observatory, and in the founding of the Cambridge Philosophical Society. He was a fellow of the Royal, Royal Astronomical, Geological and other scientific societies. In 1838, and again in 1843, he was one of the commissioners for standards of weights and measures; and he also furnished valuable information to the commissioners on decimal coinage. He died on the 8th of November 1858.

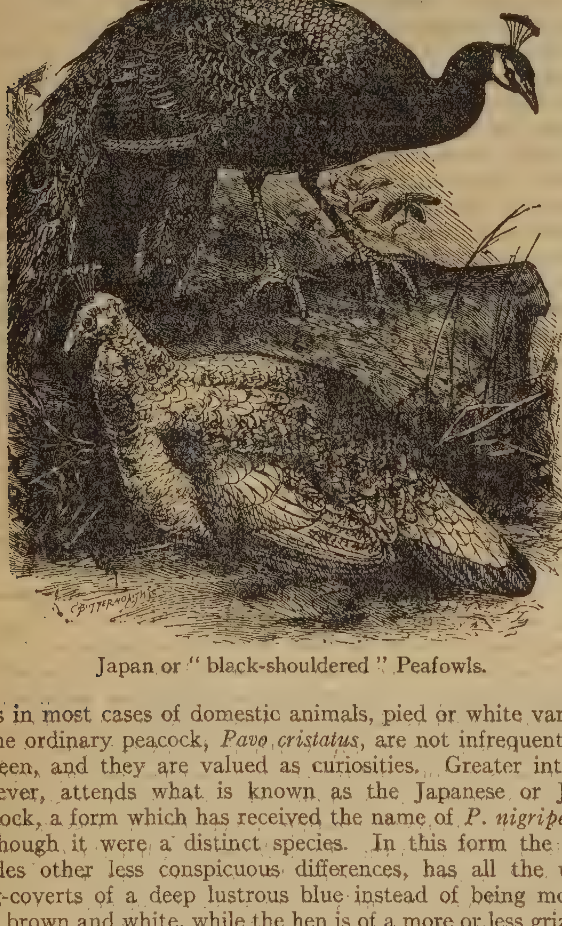
Peacock's original contributions to mathematical science were concerned chiefly with the philosophy of its first principles. He did good service in systematizing the operational laws of algebra, and in throwing light upon the nature and use of imaginaries. He published, first in 1830, and then in an enlarged form in 1842, a *Treatise on Algebra*, in which he applied his philosophical ideas concerning algebraical analysis to the elucidation of its elements. A second great service was the publication in the *British Association Reports* for 1833 of his "Report on the Recent Progress and Present State of certain branches of Analysis." Modern mathematicians may find on reading this brilliant summary a good many dicta which they will call in question, but, whatever its defects may be, Peacock's report remains a work of permanent value. In 1855 he published a memoir of Thomas Young, and about the same time there appeared Young's collected works in three volumes, for the first two of which Peacock was responsible.

PEACOCK, THOMAS LOVE (1785–1866), English novelist and poet, was born at Weymouth on the 18th of October 1785. He was the only son of a London glass merchant, who died soon after the child's birth. Young Peacock was educated at a private school at Englefield Green, and after a brief experience of business determined to devote himself to literature, while living with his mother (daughter of Thomas Love, a naval man) on their private means. His first books were poetical, *The Monks of St Mark* (1804), *Palmyra* (1806), *The Genius of the Thames* (1810), *The Philosophy of Melancholy* (1812)—works of no great merit. He also made several dramatic attempts, which were never acted. He served for a short time as secretary to Sir Home Popham at Flushing, and paid several visits to Wales. In 1812 he became acquainted with Shelley. In 1815 he evinced his peculiar power by writing his novel *Headlong Hall*. It was published in 1816, and *Melincourt* followed in the ensuing year. During 1817 he lived at Great Marlow, enjoying the almost daily society of Shelley, and writing *Nightmare Abbey* and *Rhododaphne*, by far the best of his long poems. In 1819 he was appointed assistant examiner at the India House. Peacock's nomination appears to have been due to the influence of his old schoolfellow Peter Auber, secretary to the East India Company, and the papers he prepared as tests of his ability were returned with the comment, "Nothing superfluous and nothing wanting." This was characteristic of the whole of his intellectual work; and equally characteristic of the man was his marriage about this time to Jane Griffith, to whom he proposed by letter, not having seen her for eight years. They had four children, only one of whom, a son, survived his father; one daughter was the first wife of George Meredith. His novel *Maid Marian* appeared in 1822, *The Misfortunes of Elphin* in 1829, and *Crotchet Castle* in 1831; and he would probably have written more but for the death in 1833 of his mother. He also contributed to the *Westminster Review* and the *Examiner*. His services to the East India Company, outside the usual official routine, were considerable. He defended it successfully against the attacks of James Silk Buckingham and the Liverpool salt interest, and made the subject of steam navigation to India peculiarly his own. He represented the company before the various parliamentary committees on this question; and in 1839 and 1840 superintended the construction of iron steamers, which not only made the voyage round the Cape successfully, but proved very useful in the Chinese War. He also drew up the instructions for the Euphrates expedition of 1835, subsequently pronounced by its commander, General F. R. Chesney, to be models of sagacity. In 1836 he succeeded James Mill as chief examiner, and in 1856 he retired upon a pension. During his later years he contributed several papers to *Fraser's Magazine*, including reminiscences of Shelley, whose executor he was. He also wrote in the same magazine his last novel, *Gryll Grange* (1860), inferior to his earlier writings in humour and vigour, but still a surprising effort for a man of his age. He died on the 23rd of January 1866 at Lower Halliford, near Chertsey, where, so far as his London occupations would allow him, he had resided for more than forty years.

Peacock's position in English literature is unique. There was nothing like his type of novel before his time; though there might have been if it had occurred to Swift to invent a story as a vehicle for the dialogue of his *Polite Conversation*. Peacock speaks as well in his own person as through his puppets; and his pithy wit and sense, combined with remarkable grace and accuracy of natural description, atone for the primitive simplicity of plot and character. Of his seven fictions, *Nightmare Abbey* and *Crotchet Castle* are perhaps on the whole the best, the former displaying the most *vis comica* of situation, the latter the fullest maturity of intellectual power and the most skilful grouping of the motley crowd of "perfectibilians, deteriorationists, statu-quo-ites, phrenologists, transcendentalists, political economists, theorists in all sciences, projectors in all arts, morbid visionaries, romantic enthusiasts, lovers of music, lovers of the picturesque and lovers of good dinners," who constitute the dramatis personae of the Peacockian novel. *Maid Marian* and *The Misfortunes of Elphin* are hardly less entertaining. Both contain descriptive passages of extraordinary beauty. *Melincourt* is a comparative failure, the excellent idea of an orang-outang mimicking humanity being insufficient as the sole groundwork of a novel. *Headlong Hall*, though more than foreshadowing the author's subsequent excellence, is marred by a certain bookish awkwardness characteristic of the recluse student, which reappears in *Gryll Grange* as the pedantry of an old-fashioned scholar, whose likes and dislikes have become inveterate and whose sceptical liberalism, always rather inspired by hatred of cant than enthusiasm for progress, has petrified into only too earnest conservatism. The book's quaint resolute paganism, however, is very refreshing in an age eaten up with introspection; it is the kindliest of Peacock's writings, and contains the most beautiful of his poems, "Years Ago," the reminiscence of an early attachment. In general the ballads and songs interspersed through his tales are models of exact and melodious diction, and instinct with true feeling. His more ambitious poems are worth little, except *Rhododaphne*, attractive as a story and perfect as a composition, but destitute of genuine poetical inspiration. His critical and miscellaneous writings are always interesting, especially the restorations of lost classical plays in the *Horae dramaticae*, but the only one of great mark is the witty and crushing exposure in the *Westminster Review* of Thomas Moore's ignorance of the manners and belief he has ventured to portray in his *Epicurean*. Peacock resented the misrepresentation of his favourite sect, the good and ill of whose tenets were fairly represented in his own person. Somewhat sluggish and self-indulgent, incapable of enthusiasm or self-sacrifice, he yet possessed a deep undemonstrative kindliness of nature; he could not bear to see anyone near him unhappy or uncomfortable; and his sympathy, no less than his genial humour, gained him the attachment of children, dependants, and friends. In official life he was upright and conscientious; his judgment was shrewd and robust. What Shelley justly termed "the lightness, strength and chastity" of his diction secures him an honourable rank among those English writers whose claims to remembrance depend not only upon matter but upon style.

Peacock's works were collected, though not completely, and published in three volumes in 1875, at the expense of his friend and former protégé, Sir Henry Cole, with an excellent memoir by his granddaughter Mrs Clarke, and a critical essay by Lord Houghton. His prose works were collected by Richard Garnett in ten volumes (1891). Separate novels are included in "Macmillan's Illustrated Standard Novels," with introductions by Mr Saintsbury. For an interesting personal notice, see *A Poet's Sketch Book*, by R. W. Buchanan (1884). (R. G.)

PEACOCK (Lat. *Pavo*, O. Eng. *Pawe*, Du. *pauuw*, Ger. *Pfau*, Fr. *Paon*), the bird so well known from the splendid plumage of the male, and as the proverbial personification of pride. It is a native of the Indian peninsula and Ceylon, in some parts of which it is very abundant. Setting aside its importation to Palestine by Solomon (1 Kings x. 22; 2 Chron. ix. 21), its assignment in classical mythology as the favourite bird of Hera testifies to the early acquaintance the Greeks must have had with it; but, though it is mentioned by Aristophanes and other older writers, their knowledge of it was probably very slight until after the conquests of Alexander. Throughout all succeeding time, however, it has never very freely rendered itself to domestication, and, though in earlier days highly esteemed for the table,[1] it is no longer considered the delicacy it was once thought; the young of the wild birds are, however, still esteemed in the East.



Japan or "black-shouldered" Peafowls.

As in most cases of domestic animals, pied or white varieties of the ordinary peacock, *Pavo cristatus*, are not infrequently to be seen, and they are valued as curiosities. Greater interest, however, attends what is known as the Japanese or Japan peacock, a form which has received the name of *P. nigripennis*, as though it were a distinct species. In this form the cock, besides other less conspicuous differences, has all the upper wing-coverts of a deep lustrous blue instead of being mottled with brown and white, while the hen is of a more or less grizzled-white. It "breeds true"; but occasionally a presumably pure stock of birds of the usual coloration throws out one or more having the Japan plumage. It is to be observed that the male has in the coloration of the parts mentioned no little resemblance to that of the second indubitably good species, the *P. muticus* (or *P. spicifer* of some writers) of Burma and Java, though the character of the latter's crest—the feathers of which are barbed along their whole length instead of at the tip only—and its golden-green neck and breast furnish a ready means of distinction. Sir R. Heron was confident that the Japan breed had arisen in England within his memory,[2] and C. Darwin (*Animals and Plants under Domestication*, i. 290–292) was inclined to believe it only a variety; but its abrupt appearance, which rests on indisputable evidence, is most suggestive in the light that it may one day throw on the question of evolution as exhibited in the origin of "species." It should be stated that the Japan bird is not known to exist anywhere as a wild race, though apparently kept in Japan. The accompanying illustration is copied from a plate drawn by J. Wolf, given in D. G. Elliot's *Monograph of the Phasianidae.*

The peafowls belong to the group *Gallinae*, from the normal members of which they do not materially differ in structure; and, though by some systematists they are raised to the rank of a family, *Pavonidae*, most are content to regard them as a sub-family of *Phasianidae* (PHEASANT, *q.v.*). Akin to the genus *Pavo* is *Polyplectrum*, of which the males are armed with two or more spurs on each leg, and near them is generally placed the genus *Argusianus*, containing the argus-pheasants, remarkable for their wonderfully ocellated plumage, and the extraordinary length of the secondary quills of their wings, as well as of the tail-feathers. It must always be remembered that the so-called "tail" of the peacock is formed not by the rectrices or true tail-feathers, but by the singular development of the tail-coverts. (A. N.)

PEAK, THE, a high table-land in the north of Derbyshire, England, included in the Pennine range of hills. The name, however, is extended, without definite limits, to cover the whole of the hilly district north of Buxton. The table-land reaches an elevation of 2088 ft. in Kinder Scout. The geological formation is millstone-grit, and the underlying beds are not domed, but cup-shaped, dipping inward from the flanks of the mass. The summit is a peaty moorland, through which masses of rock project at intervals. The name of this high plateau has from the 17th century been identified with "peak," the pointed or conical top of a mountain, but the very early references to the district and certain places in it show clearly, as the *New English Dictionary* points out, that this connexion is unwarranted. The name appears in the *Old English Chronicle* (924) as *Péaclond*, of the district governed from the castle of Peveril of the Peak (see DERBYSHIRE), and also in the name of the cavern under the hill at Castleton, *Péac's Arse*. Péac, it has been suggested, is the name of a local deity or demon, and possibly may be indentified with Puck. For the etymology of "peak," point, &c., and its variants or related words, "pick" and "pike," see PIKE.

PEALE, CHARLES WILLSON (1741–1826), American portrait painter, celebrated especially for his portraits of Washington, was born in Queen Anne county, Maryland, on the 16th of April 1741. During his infancy the family removed to Chestertown, Kent county, Maryland, and after the death of his father (a country schoolmaster) in 1750 they removed to Annapolis. Here, at the age of 13, he was apprenticed to a saddler. About 1764 he began seriously to study art. He got some assistance from Gustavus Hesselius, a Swedish portrait painter then living near Annapolis, and from John Singleton Copley in Boston; and in 1767–1770 he studied under Benjamin West in London. In 1770 he opened a studio in Philadelphia, and met with immediate success. In 1772, at Mount Vernon, Peale painted a three-quarters-length study of Washington (the earliest known portrait of him), in the uniform of a colonel of Virginia militia. This canvas is now in the Lee Memorial Chapel of Washington and Lee University. He painted various other portraits of Washington; probably the best known in a full-length, which was made in 1778, and of which Peale made many copies. This portrait had been ordered by the Continental Congress, which, however, made no appropriation for it, and eventually it was bought for a private collection in Philadelphia. Peale painted two miniatures of Mrs Washington (1772 and 1777), and portraits of many of the famous men of the time, a number of which are in Independence Hall, Philadelphia. His portraits of Washington do not appeal so strongly to Americans as do those of Gilbert Stuart, but his admitted skill as a draughtsman gives to all of his work considerable historical value. Peale removed to

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[1] Classical authors contain many allusions to its high appreciation at the most sumptuous banquets; and medieval bills of fare on state occasions nearly always include it. In the days of chivalry one of the most solemn oaths was taken "on the peacock," which seems to have been served up garnished with its gaudy plumage.

[2] A. Newton himself regarded this as probably incorrect.

Philadelphia in 1777, and served as a member of the committee of public safety; he aided in raising a militia company, became a lieutenant and afterwards a captain, and took part in the battles of Trenton, Princeton and Germantown. In 1779–1780 he was a member of the Pennsylvania assembly, where he voted for the abolition of slavery—he freed his own slaves whom he had brought from Maryland. In 1801 he undertook, largely at his own expense, the excavation of the skeletons of two mastodons in Ulster and Orange counties, New York, and in 1802 he established at Philadelphia Peale's Museum. He was one of the founders, in 1805, of the Pennsylvania Academy of the Fine Arts at Philadelphia. At the age of eighty-one Peale painted a large canvas, "Christ Healing the Sick at Bethesda," and at eighty-three a full-length portrait of himself, now in the Academy of the Fine Arts. He died at his country home, near Germantown, Pennsylvania, on the 22nd of February 1826.

His brother, James Peale (1749–1831), also an artist, painted two portraits of Washington (one now the property of the New York Historical Society, and the other in Independence Hall, Philadelphia), besides landscapes and historical compositions.

PEALE, REMBRANDT (1778–1860), American artist, was born in Bucks county, Pennsylvania, on the 22nd of February 1778, the son of Charles Willson Peale (*q.v.*). He studied under his father, under Benjamin West in London (1802–1803), and in Paris in 1807 and 1809. As early as 1795 he had begun from life a portrait of Washington. Of this he made many replicas, the latest in 1823, purchased by the United States government in 1832, and now in the Capitol of Washington. Peale was one of the first of American lithographers. He was an excellent draughtsman, but in colour his work cannot rank with his father's. In 1843 he devised for the Philadelphia public schools a system of teaching drawing and penmanship. His portraits include those of President Jefferson, Mrs Madison, Commodores Perry, Decatur, and Bainbridge, Houdon, the sculptor, General Armstrong, and an equestrian portrait of General Washington, now in Independence Hall, Philadelphia. His "Court of Death" (1820) is in the Detroit Art Gallery. In 1825 Peale succeeded John Trumbull as president of the American Academy of Fine Arts (founded in 1802 as the New York Academy of Fine Arts), and he was one of the original members of the National Academy of Design. He wrote several books, among them *Notes on Italy* (1831), *Reminiscences of Art and Artists* (1845). He died in Philadelphia on the 3rd of October 1860.

A brother, Raphaelle Peale (1774–1825), was one of the earliest of American still-life painters; and another brother, Titian Ramsey Peale (1800–1885), made numerous drawings, some of them in water-colour, in illustration of animal life.

See "Rembrandt Peale," partly autobiographical, in C. E. Lester's *The Artists of America* (New York, 1846).

PEAR (*Pyrus communis*), a member of the natural order Rosaceae, belonging to the same genus as the apple (*P. malus*), which it resembles in floral structure. In both cases the so-called fruit is composed of the receptacle or upper end of the flower-stalk (the so-called calyx tube) greatly dilated, and enclosing within its cellular flesh the five cartilaginous carpels which constitute the "core" and are really the true fruit. From the upper rim of the receptacle are given off the five sepals, the five petals, and the very numerous stamens. The form of the pear and of the apple respectively, although usually characteristic enough, is not by itself sufficient to distinguish them, for there are pears which cannot by form alone be distinguished from apples, and apples which cannot by superficial appearance be recognized from pears. The main distinction is the occurrence in the tissue of the fruit, or beneath the rind, of clusters of cells filled with hard woody deposit in the case of the pear, constituting the "grit," while in the apple no such formation of woody cells takes place. The appearance of the tree—the bark, the foliage, the flowers—is, however, usually quite characteristic in the two species. Cultivated pears, whose number is enormous, are without doubt derived from one or two wild species widely distributed throughout Europe and western Asia, and sometimes forming part of the natural vegetation of the forests. In England, where the pear is sometimes considered wild, there is always the doubt that it may not really be so, but the produce of some seed of a cultivated tree deposited by birds or otherwise, which has degenerated into the wild spine-bearing tree known as *Pyrus communis*.

The cultivation of the pear extends to the remotest antiquity. Traces of it have been found in the Swiss lake-dwellings; it is mentioned in the oldest Greek writings, and was cultivated by the Romans. The word "pear" or its equivalent occurs in all the Celtic languages, while in Slavonic and other dialects different appellations, but still referring to the same thing, are found—a diversity and multiplicity of nomenclature which led Alphonse de Candolle to infer a very ancient cultivation of the tree from the shores of the Caspian to those of the Atlantic. A certain race of pears, with white down on the under surface of their leaves, is supposed to have originated from *P. nivalis*, and their fruit is chiefly used in France in the manufacture of Perry (see Cider). Other small-fruited pears, distinguished by their precocity and apple-like fruit, may be referred to *P. cordata*, a species found wild in western France, and in Devonshire and Cornwall.

Karl Koch considered that cultivated pears were the descendants of three species—*P. persica* (from which the bergamots have descended), *P. elaeagrifolia* and *P. sinensis*. J. Decaisne, who made the subject one of critical study for a number of years, and not only investigated the wild forms, but carefully studied the peculiarities of the numerous varieties cultivated in the Jardin des Plantes at Paris, refers all cultivated pears to one species, the individuals of which have in course of time diverged in various directions, so as to form now six races: (1) the Celtic, including *P. cordata*; (2) the Germanic, including *P. communis*, *P. achras*, and *P. piraster*; (3) the Hellenic, including *P. parviflora*, *P. sinaica* and others; (4) the Pontic, including *P. elaeagrifolia*; (5) the Indian, comprising *P. Paschae*; and (6) the Mongolic, represented by *P. sinensis*. With reference to the Celtic race, *P. cordata*, it is interesting to note its connexion with Arthurian legend and the Isle of Avalon or Isle of Apples. An island in Loch Awe has a Celtic legend containing the principal features of Arthurian story; but in this case the word is "berries" instead of "apples." Dr Phené visited Armorica (Brittany) with a view of investigating these matters, and brought thence fruits of a small berry-like pear, which were identified with the *Pyrus cordata* of western France.

Cultivation.—The pear may be readily raised by sowing the pips of ordinary cultivated or of wilding kinds, these forming what are known as free or pear stocks, on which the choicer varieties are grafted for increase. For new varieties the flowers should be fertilized with a view to combine, in the seedlings which result from the union, the desirable qualities of the parents. The dwarf and pyramid trees, more usually planted in gardens, are obtained by grafting on the quince stock, the Portugal quince being the best; but this stock, from its surface-rooting habit, is most suitable for soils of a cold damp nature. The pear-stock, having an inclination to send its roots down deeper into the soil, is the best for light dry soils, as the plants are not then so likely to suffer in dry seasons. Some of the finer pears do not unite readily with the quince, and in this case double working is resorted to; that is to say, a vigorous-growing pear is first grafted on the quince, and then the choicer pear is grafted on the pear introduced as its foster parent.

In selecting young pear trees for walls or espaliers, some persons prefer plants one year old from the graft, but trees two or three years trained are equally good. The trees should be planted immediately before or after the fall of the leaf. The wall trees require to be planted from 25 to 30 ft. apart when on free stocks, and from 15 to 20 ft. when dwarfed. Where the trees are trained as pyramids or columns they may stand 8 or 10 ft. apart, but standards in orchards should be allowed at least 30 ft., and dwarf bush trees half that distance.

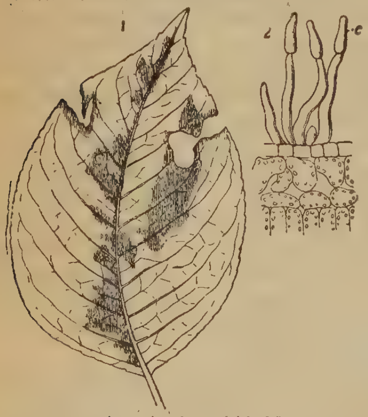
In the formation of the trees the same plan may be adopted as in the case of the apple. For the pear orchard a warm situation is very desirable, with a soil deep, substantial, and thoroughly drained. Any good free loam is suitable, but a calcareous loam is the best. Pear trees worked on the quince should have the stock covered up to its junction with the graft. This is effected by raising up a small mound of rich compost around it, a contrivance which induces the graft to emit roots into the surface soil, and also keeps the stock from becoming hard or bark-bound. The fruit of the pear is produced on spurs, which appear on shoots more than one year old. The mode most commonly adopted of training wall pear-trees is the horizontal. For the slender twiggy sorts the fan form is to be preferred, while for strong growers the half-fan or the horizontal is more suitable. In the latter form old trees, the summer pruning of which has been neglected, are apt to acquire an undue projection from the wall and become scraggy, to avoid which a portion of the old spurs should be cut out annually.

The summer pruning of established wall or espalier-rail trees consists chiefly in the timely displacing, shortening back, or rubbing off of the superfluous shoots, so that the winter pruning, in horizontal training, is little more than adjusting the leading shoots and thinning out the spurs, which should be kept close to the wall and allowed to retain but two or at most three buds. In fan-training the subordinate branches must be regulated, the spurs thinned out, and the young laterals finally established in their places. When horizontal trees have fallen into disorder, the branches may be cut back to within 9 in. of the vertical stem and branch, and trained in afresh, or they may be grafted with other sorts, if a variety of kinds is wanted.

Summer and autumn pears should be gathered before they are fully ripe, otherwise they will not in general keep more than a few days. The Jargonelle should be allowed to remain on the tree and be pulled daily as wanted, the fruit from standard trees thus succeeding the produce of the wall trees. In the case of the Crassane the crop should be gathered at three different times, the first a fortnight or more before it is ripe, the second a week or ten days after that; and the third when fully ripe. The first gathering will come into eating latest, and thus the season of the fruit may be considerably prolonged. It is evident that the same method may be followed with other sorts which continue only a short time in a mature state.

Diseases.—The pear is subject to several diseases caused by fungi. *Gymnosporangium sabinae*, one of the rusts (Uredineae) passes one stage of its life-history on living pear leaves, forming large raised spots or patches which are at first yellow but soon become red and are visible on both faces; on the lower face of each patch is a group of cluster-cups or aecidia containing spores which escape when ripe. This stage in the life-history was formerly regarded as a distinct fungus with the name *Roestelia cancellata*; it is now known, however, that the spores germinate on young juniper leaves, in which they give rise to this other stage in the plant's history known as *Gymnosporangium*. The gelatinous, generally reddish-brown masses of spores—the teleutospores—formed on the juniper in the spring germinate and form minute spores—*sporidia*—which give rise to the aecidium stage on the pear. Diseased pear leaves should be picked off and destroyed before the spores are scattered and the various species of juniper on which the alternate stage is developed should not be allowed near the pear trees.

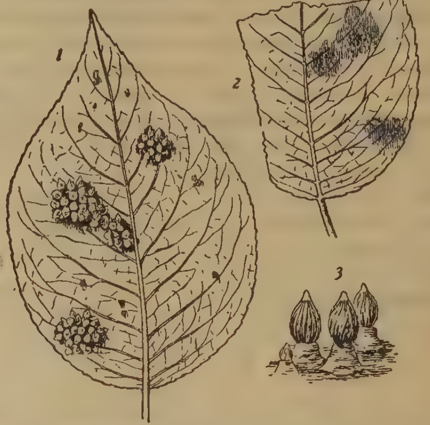
Pear scab is caused by a parasitic fungus, *Fusicladium pyrinum*, very closely allied and perhaps merely a form of the apple scab fungus, *F. dendriticum*. As in the case of the apple disease it forms large irregular blackish blotches on the fruit and leaves, the injury being often very severe especially in a cool, damp season. The fungus mycelium grows between the cuticle and the epidermis, the former being ultimately ruptured by numerous short branches bearing spores (conidia) by means of which the disease is spread. As a preventive repeated spraying with dilute Bordeaux mixture is recommended, during the flowering season and early development of the fruit. Similar spraying is recommended for pear-leaf blister caused by *Taphrina bullata*, which forms swollen areas on the leaves. Pear trees may also be attacked by a great variety of insect pests. Thus the younger branches are often injured by the pearl oyster scale (*Aspidiotus ostreaeformis*), which may be removed by washing in winter with soft soap and hot water. A number of larvae of *Lepidoptera* feed on the leaves—the remedy is to capture the mature insects when possible. The winter moth (*Cheimatobia brumata*) must be kept in check by putting greasy bands round the trunks from October till December or January, to catch the wingless females that crawl up and deposit their eggs in the cracks and crevices in the bark. The caterpillars of the leopard moth (*Zeuzera pyrina*) and of the goat moth (*Cossus ligniperda*) sometimes bore their way into the trunks and destroy the sap channels. If badly bored, the trees are useless; but in the early stages if the entrance of the caterpillars has been detected, a wire should be pushed into the hole. One of the worst pests of pear trees is the pear midge, known as *Diplosis pyrivora* or *Cecidomyia nigra*, the females of which lay their eggs in the flower-buds before they open. The yellow maggots devour the seeds and thus ruin the crop. When deformed fruits are noticed they should be picked off and burned immediately. Species of aphides may be removed by tobacco infusion, soapsuds or other solutions. A gall mite (*Phytoptus pyri*) sometimes severely injures the leaves, on which it forms blisters—the best remedy is to cut off and burn the diseased leaves.



(From a specimen in the British Museum.)

Pear Scab (*Fusicladium pyrinum*).

1, Leaf showing diseased areas.
2, Section of leaf surface showing the spores or *conidia*, *c*, borne on long stalks (conidiophores).



Pear-leaf Cluster-cups (*Gymnosporangium sabinae*).

1, Leaf showing groups of cups or aecidia. 2, Early stage of disease. 3, Cups.

The Alligator or Avocado Pear is *Persea gratissima*, a member of the natural order Lauraceae, and a native of the West Indies and other parts of tropical America. It is a tree of 25 to 30 ft. high and bears large pear-shaped fruits, green or deep purple in colour, with a firm yellowish-green marrow-like pulp surrounding a large seed. The pulp is much esteemed in the West Indies and is eaten as a salad, usually with the addition of pepper, salt and vinegar. The pulp contains much oil, which is used for lighting and soap-making, and the seeds yield a deep indelible black stain which is used for marking linen.

Prickly pear is the popular name for species of *Opuntia* (see Cactus).

The name wooden pear is applied to the fruits of *Xylomelum* (nat. ord. Proteaceae), an Australian genus of trees with very thick, woody, inversely pear-shaped fruits which split into two parts when ripe.

PEARCE, CHARLES SPRAGUE (1851–   ), American artist, was born at Boston, Massachusetts, on the 13th of October 1851. In 1873 he became a pupil of Léon Bonnat in Paris, and after 1885 he lived in Paris and at Auvers-sur-Oise. He painted Egyptian and Algerian scenes, French peasants, and portraits, and also decorative work, notably for the Congressional Library at Washington. He received medals at the Paris Salon and elsewhere, and was decorated with the Legion of Honour, the order of Leopold, Belgium, the order of the Red Eagle, Prussia, and the order of Dannebrog, Denmark. Among his best known paintings are "The Decapitation of St John the Baptist" (1881), in the Art Institute of Chicago; "Prayer" (1884), owned by the Massachusetts Charitable Mechanic Association; "The Return of the Flock," in the Bohemian Club, San Francisco; and "Meditation," in the New York Metropolitan Museum.

PEARL. Pearls are calcareous concretions of peculiar lustre, produced by certain molluscs, and valued as objects of personal ornament. The experience of pearl-fishers shows that those shells which are irregular in shape and stunted in growth, or which bear excrescences, or are honeycombed by boring parasites, are those most likely to yield pearls.

The substance of a pearl is essentially the same as that which lines the interior of many shells and is known as "mother-of-pearl." Sir D. Brewster first showed that the iridescence of this substance was an optical phenomenon due to the interference of rays of light reflected from microscopic corrugations of the surface—an effect which may be imitated by artificial striations on a suitable medium. When the inner laminated portion of a nacreous shell is digested in acid the calcareous layers are dissolved away, leaving a very delicate membranous pellicle, which, as shown by Dr Carpenter, may retain the iridescence as long as it is undisturbed, but which loses it when pressed or stretched.

It is obvious that if a pearl presents a perfectly spherical form it must have remained loose in the substance of the muscles or other soft tissues of the mollusc. Frequently, however, the pearl becomes cemented to the interior of the shell, the point of attachment thus interfering with its symmetry. In this position it may receive successive nacreous deposits, which ultimately form a pearl of hemispherical shape, so that when cut from the shell it may be flat on one side and convex on the other, forming what jewelers know as a "perle bouton." In the course of growth the pearl may become involved in the general deposit of mother-of-pearl, and be ultimately buried in the substance of the shell. It has thus happened that fine pearls have occasionally been unexpectedly brought to light in cutting up mother-of-pearl in the workshop.

When a pearl oyster is attacked by a boring parasite the mollusc protects itself by depositing nacreous matter at the point of invasion, thus forming a hollow body of irregular shape known as a "blister pearl." Hollow warty pearl is sometimes termed in trade "coq de perle." Solid pearls of irregular form are often produced by deposition on rough objects, such as small fragments of wood, and these, and in fact all irregular-shaped pearls, are termed "perles baroques," or "barrok pearls." It appears that the Romans in the period of the Decline restricted the name *unio* to the globular pearl, and termed the baroque *margaritum*. It was fashionable in the 16th and 17th centuries to mount curiously shaped baroques in gold and enamel so as to form ornamental objects of grotesque character. A valuable collection of such mounted pearls by Dinglinger is preserved in the Green vaults at Dresden.

A pearl of the first water should possess, in jewelers' language, a perfect "skin" and a fine "orient"; that is to say, it must be of delicate texture, free from speck or flaw, and of clear almost translucent white colour, with a subdued iridescent sheen. It should also be perfectly spherical, or, if not, of a symmetrical pear-shape. On removing the outer layer of a pearl the subjacent surface is generally dull, like a dead fish-eye, but it occasionally happens that a poor pearl encloses a "lively kernel," and may therefore be improved by careful peeling. The most perfect pearl in existence is said to be one, known as "La Pellegrina," in the museum of Zosima in Moscow; it is a perfectly globular Indian pearl of singular beauty, weighing 28 carats. The largest known pearl is one of irregular shape in the Beresford Hope collection at the Victoria and Albert Museum. This magnificent pearl weighs 3 oz., has a circumference of 4½ in., and is surmounted by an enamelled and jewelled gold crown, forming a pendant of great value.

Pearl Fisheries.—The ancients obtained their pearls chiefly from India and the Persian Gulf, but at the present time they are also procured from the Sulu seas, the coast of Australia, the shores of Central America and some of the South Pacific Islands. The ancient fisheries of Ceylon (Taprobane) are situated in the Gulf of Manaar, the fishing-banks lying from 6 to 8 m. off the western shore, a little to the south of the isle of Manaar. The Tinnevelly fishery is on the Madras side of the strait, near Tuticorin. These Indian fishing-grounds are under the control of government inspectors, who regulate the fisheries. The oysters yield the best pearls at about four years of age. Fishing generally commences in the second week in March, and lasts for from four to six weeks, according to the season. The boats are grouped in fleets of from sixty to seventy, and start usually at midnight so as to reach the oyster-banks at sunrise. Each boat generally carries ten divers. On reaching the bank a signal-gun is fired, and diving commences. A stone weighing about 40 lb is attached to the cord by which the diver is let down. The divers work in pairs, one man diving while the other watches the signal-cord, drawing up the sink-stone first, then hauling up the baskets of oysters, and finally raising the diver himself. On an average the divers remain under water from fifty to eighty seconds, though exceptional instances are cited of men remaining below for as long as six minutes. After resting for a minute or two at the surface, the diver descends again; and so on, until exhausted, when he comes on board and watches the rope, while his comrade relieves him as diver. The native descends naked, carrying only a girdle for the support of the basket in which he places the pearl oysters. In his submarine work the diver makes skilful use of his toes. To arm himself against the attacks of the sharks and other fishes which infest the Indian waters he carries spikes of iron-wood; and the genuine Indian diver never descends without the incantations of shark-charmers, one of whom accompanies the boat while others remain on shore. As a rule the diver is a short-lived man.

The diving continues from sunrise to about noon, when a gun is fired. On the arrival of the fleet at shore the divers carry their oysters to a shed, where they are made up into four heaps, one of which is taken by the diver. The oysters are then sold by auction in lots of 1000 each. The pearls, after removal from the dead oysters, are "classed" by passing through a number of small brass colanders, known as "baskets," the holes in the successive vessels being smaller and smaller. Having been sized in this way, they are sorted as to colour, weighed and valued.

Since the days of the Macedonians pearl-fishing has been carried on in the Persian Gulf. It is said that the oyster-beds extend along the entire Arabian coast of the gulf, but the most important are on sandbanks off the islands of Bahrein. The chief centre of the trade is the port of Lingah. Most of the products of this fishery are known as "Bombay pearls," from the fact that many of the best are sold there. The shells usually present a dark colour about the edges, like that of "smoked pearl." The yellow-tinted pearls are sent chiefly to Bombay, while the whitest go to Bagdad. Very small pearls, much below a pea in size, are generally known as "seed-pearls," and these are valued in India and China as constituents of certain electuaries, while occasionally they are calcined for *chunam*, or lime, used with betel as a masticatory. There is a small pearl-fishery near Karachi on the coast of Bombay.

From the time of the Ptolemies pearl-fishing has been prosecuted along the coast of the Red Sea, especially in the neighbourhood of Jiddah and Koseir. This fishery is now insignificant, but the Arabs still obtain from this district a quantity of mother-of-pearl shells, which are shipped from Alexandria, and come into the market as "Egyptians."

Very fine pearls are obtained from the Sulu Archipelago, on the north-east of Borneo. The mother-of-pearl shells from the Sulu seas are characterized by a yellow colour on the border and back, which unfits them for many ornamental purposes. Pearl oysters are also abundant in the seas around the Aru Islands to the south-west of New Guinea. From Labuan a good many pearl-shells are occasionally sent to Singapore. They are also obtained from the neighbourhood of Timor, and from New Caledonia. The pearl oyster occurs throughout the Pacific, mostly in the clear water of the lagoons within the atolls, though fine shells are also found in deep water outside the coral reefs. The Polynesian divers do not employ sink-stones, and the women are said to be more skilful than the men. They anoint their bodies with oil before diving. Fine pearl-shells are obtained from Navigators' Islands, the Society Islands, the Low Archipelago or Paumota Isles and the Gambier Islands. Many of the Gambier pearls present a bronzy tint.

Pearl-fishing is actively prosecuted along the western coast of Central America, especially in the Gulf of California, and to a less extent around the Pearl Islands in the Bay of Panama. The fishing-grounds are in water about 40 ft. deep, and the season lasts for four months. An ordinary fishing-party expects to obtain about three tons of shells per day, and it is estimated that one shell in a thousand contains a pearl. The pearls are shipped in barrels from San Francisco and Panama. Some pearls of rare beauty have been obtained from the Bay of Mulege, near Los Coyetes, in the gulf of California; and in 1882 a pearl of 75 carats, the largest on record from this district, was found near La Paz in California. The coast of Guayaquil also yields pearls. Columbus found that pearl-fishing was carried on in his time in the Gulf of Mexico, and pearls are still obtained from the Caribbean Sea. In the West Indies the best pearls are obtained from St Thomas and from the island of Margarita, off the coast of Venezuela. From Margarita Philip II. of Spain is said to have obtained in 1579 a famous pearl of 250 carats.

Of late years good pearls have been found in Shark's Bay, on the coast of West Australia, especially in an inlet termed Useless Harbour. Mother-of-pearl shells are also fished at many other points along the western coast, between the 15th and 25th parallels of south latitude. An important pearl-fishery is also established in Torres Strait and on the coast of Queensland. The shells occur in water from four to six fathoms deep, and the divers are generally Malays and Papuans, though sometimes native Australians. On the western coast of Australia the pearl-shells are obtained by dredging rather than by diving. Pearl-shells have also been found at Port Darwin and in Oakley Creek, New Zealand.

River pearls are produced by the species of *Unio* and *Anodonta*, especially by *Unio margaritiferus*. These species belong to the family Unionidae, order Eulamellebranchia. They inhabit the mountain-streams of temperate climates in the northern hemisphere—especially in Scotland, Wales, Ireland, Saxony, Bohemia, Bavaria, Lapland and Canada. The pearls of Britain are mentioned by Tacitus and by Pliny, and a breastplate studded with British pearls was dedicated by Julius Caesar to Venus Genetrix. As early as 1355 Scotch pearls are referred to in a statute of the goldsmiths of Paris; and in the reign of Charles II. the Scotch pearl trade was sufficiently important to attract the attention of parliament. The Scotch pearl-fishery, after having declined for years, was revived in 1860 by a German named Moritz Unger, who visited Scotland and bought up all the pearls he could find in the hands of the peasantry, thus leading to an eager search for more pearls the following season. It is estimated that in 1865 the produce of the season's fishing in the Scotch rivers was worth at least £12,000. This yield, however, was not maintained, and at the present time only a few pearls are obtained at irregular intervals by an occasional fisherman.

The principal rivers in Scotland which have yielded pearls are the Spey, the Tay and the South Esk; and to a less extent the Doon, the Dee, the Don, the Ythan, the Teith, the Forth and many other streams. In North Wales the Conway was at one time celebrated for its pearls; and it is related that Sir Richard Wynn, chamberlain to the queen of Charles II., presented her with a Conway pearl which is believed to occupy a place in the British crown. In Ireland the rivers of Donegal, Tyrone and Wexford have yielded pearls. It is said that Sir John Hawkins the circumnavigator had a patent for pearl-fishing in the Irt in Cumberland. Although the pearl-fisheries of Britain are now neglected, it is otherwise with those of Germany. The most important of these are in the forest-streams of Bavaria, between Ratisbon and Passau. The Saxon fisheries are chiefly confined to the basin of the White Elster, and those of Bohemia to the Horazdiowitz district of Wotawa. For more than two centuries the Saxon fisheries have been carefully regulated by inspectors, who examine the streams every spring, and determine where fishing is to be permitted. After a tract has been fished over, it is left to rest for ten or fifteen years. The fisher-folk open the valves of the mussels with an iron instrument, and if they find no pearl restore the mussel to the water.

River pearls are found in many parts of the United States, and have been systematically worked in the Little Miami river, Warren county, Ohio, and also on the Mississippi, especially about Muscatine, Iowa. The season extends from June to October. Japan produces fresh-water pearls, found especially in the *Anodonta japonica*. But it is in China that the culture of the pearl-mussel is carried to the greatest perfection. The Chinese also obtain marine pearls, and use a large quantity of mother-of-pearl for decorative purposes. More than twenty-two centuries before our era pearls are enumerated as a tribute or tax in China; and they are mentioned as products of the western part of the empire in the *Rh'ya*, a dictionary compiled earlier than 1000 B.C. A process for promoting the artificial formation of pearls in the Chinese river-mussels was discovered by Ye-jin-yang, a native of Hoochow, in the 13th century; and this process is still extensively carried on near the city of Teh-tsing, where it forms the staple industry of several villages, and is said to give employment to about 5000 people. Large numbers of the mussels are collected in May and June, and the valves of each are gently opened with a spatula to allow of the introduction of various foreign bodies, which are inserted by means of a forked bamboo stick. These "matrices" are generally pellets of prepared mud, but may be small bosses of bone, brass or wood. After a number of these objects have been placed in convenient positions on one valve, the unfortunate mollusc is turned over and the operation is repeated on the other valve. The mussels are then placed in shallow ponds connected with the canals, and are nourished by tubs of night-soil being thrown in from time to time. After several months, in some cases two or three years, the mussels are removed, and the pearls which have formed over the matrices are cut from the shells, while the molluscs themselves serve as food. The matrix is generally extracted from the pearl and the cavity filled with white wax, the aperture being neatly sealed up so as to render the appearance of the pearl as perfect as possible. Millions of such pearls are annually sold at Soo-chow. The most curious of these Chinese pearls are those which present the form of small seated images of Buddha. The figures are cast in very thin lead, or stamped in tin, and are inserted as previously described. Specimens of these Buddha pearls in the British Museum are referred to the species *Dipsas plicata*. It should be mentioned that Linnaeus, probably ignorant of what had long been practised in China, demonstrated the possibility of producing artificial pearls in the fresh-water mussels of Sweden.

Pink pearls are occasionally found in the great conch or fountain shell of the West Indies, *Strombus gigas*, L.; but these, though much prized, are not nacreous, and their tint is apt to fade. They are also produced by the chank shell, *Turbinella scolymus*, L.[1] Yellowish-brown pearls, of little or no value, are yielded by the *Pinna squamosa*, and bad-coloured concretions are formed by the *Placuna placenta*.[2] Black pearls, which are very highly valued, are obtained chiefly from the pearl oyster of the Gulf of Mexico. The common marine mussel *Mytilus edulis* also produces pearls, which are, however, of little value.

According to the latest researches the cause of pearl-formation is in most cases, perhaps in all, the dead body of a minute parasite within the tissues of a mollusc, around which nacreous deposit is secreted. The parasite is a stage in the life history of a Trematode in some cases, in others of a Cestode; that is to say of a form resembling the common liver-fluke of the sheep, or of a tapeworm. As long ago as 1852 Filippi of Turin showed that the species of Trematode *Distomum duplicatum* was the cause of a pearl formation in the fresh-water mussel *Anodonta*. Kuchenmeister subsequently investigated the question at Elster in Saxony and came to a different conclusion, namely that the central body of the pearl was a small specimen of a species of water mite which is a very common parasite of *Anodonta*. Filippi however states that the mite is only rarely found within a pearl, the Trematode occurring in the great majority of cases. R. Dubois and Dr H. Lyster Jameson have made special investigations of the process in the common mussel *Mytilus edulis*. The latter states that the pearl is produced in a sac which is situated beneath the epidermis of the mantle and is lined by an epithelium. This epithelium is not derived from the cells of the epidermis but from the internal connective-tissue cells. This statement, if correct, is contrary to what would be expected, for calcareous matter is usually secreted by the external epidermis only. The sac or cyst is formed by the larva of a species of Trematode belonging to the genus *Leucithodendrium*, a species closely resembling and probably identical with *L. somateriae*, which lives in the adult state in the eider duck. At Billiers, Morbihan, in France, the host of the adult Trematode is another species of duck, namely the common Scoter, *Oedemia nigra*, which is notorious in the locality for its avidity for mussels. Trematodes of the family Distomidae, to which the parasite under consideration belongs, usually have three hosts in each of which they pass different stages of the life history. In this case the first host at Billiers is a species of bivalve called *Tapes decussatus*, but at Piel in Lancashire there are no Tapes and the first stages of the parasite are found in the common cockle. The Trematode enters the first host as a minute newly hatched embryo and leaves it in the form called Cercaria, which is really an immature condition of the adult. The Cercaria makes its way into the tissues of a mussel and there becomes enclosed in the cyst previously described. If the mussel is then swallowed by the duck the Cercariae develop into adult Trematodes or flukes in the liver or intestines of the bird. In the mussels which escape being devoured the parasites cannot develop further, and they die and become embedded in the nacreous deposit which forms a pearl. Dr Jameson points out that, as in other cases, pearls in Mytilus are common in certain special localities and rare elsewhere, and that the said localities are those where the parasite and its hosts are plentiful.

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[1] *Strombus gigas*, L., is a Gastropod belonging to the family Strombidae, of the order Pectinibranchia. *Turbinella scolymus*, Lam., is a Gastropod of the same order.

[2] *Placuna placenta*, L., belongs to the family Anomiidae; it is found on the shores of North Australia. *Pinna squamosa*, Gmelin, belongs to the Ostreacea; it occurs in the Mediterranean. Both are Lamellibranchs.

The first suggestion that the most valuable pearls obtained from pearl oysters in tropical oceans might be due to parasites was made by Kelaart in reports to the government of Ceylon in 1857–1859. Recently a special investigation of the Ceylon pearl fishery has been organized by Professor Herdman. Herdman and Hornell find that in the pearl oyster of Ceylon *Margaritifera vulgaris*, Schum, the nucleus of the pearl is, in all specimens examined, the larva of a Cestode or tapeworm. This larva is of globular form and is of the type known as a cysticercus. As in the case of the mussel the larva dies in its cyst and its remains are enshrined in nacreous deposit, so that, as a French writer has said, the ornament associated in all ages with beauty and riches is nothing but the brilliant sarcophagus of a worm.

The cysticercus described by Herdman and Hornell has on the surface a muscular zone within which is a depression containing a papilla which can be protruded. It was at first identified as the larva of a tapeworm called Tetrarhynchus, and Professor Herdman concluded that the life-history of the pearl parasite consisted of four stages, the first being exhibited by free larvae which were taken at the surface of the sea, the second that in the pearl oyster, the third a form found in the bodies of file-fishes which feed on the oysters, and the fourth or adult stage living in some species of large ray. It has not however been proved that the pearl parasite is a Tetrarhynchus, nor that it is connected with the free larva or the form found in the file-fish, Balistes; nor has the adult form been identified. All that is certain is that the pearls are due to the presence of a parasite which is the larva of a Cestode; all the rest is probability or possibility. A French naturalist, M. Seurat, studying the pearl oyster of the Gambier Archipelago in the Pacific, found that pearl formation was due to a parasite quite similar to that described by Herdman and Hornell. This parasite was described by Professor Giard as characterized by a rostrum armed with a single terminal sucker and he did not identify it with Tetrarhynchus.

Genuine precious pearls and the most valuable mother-of-pearl are produced by various species and varieties of the genus *Meleagrina* of Lamarck, for which Dr Jameson in his recent revision of the species prefers the name *Margaritifera*. The genus is represented in tropical regions in all parts of the world. It belongs to the family Aviculidae, which is allied to the Pectens or scallop shells. In this family the hinge border is straight and prolonged into two auriculae; the foot has a very stout byssus. *Meleagrina* is distinguished by the small size or complete absence of the posterior auricula. The species are as follows. The type species is *Meleagrina margaritifera*, which has no teeth on the hinge. Geographical races are distinguished by different names in the trade. Specimens from the Malay Archipelago have a dark band along the margin of the nacre and are known as black-edged Banda shell; those from Australia and New Guinea and the neighbouring islands of the western Pacific are called Australian and New Guinea black-lip. Another variety occurs in Tahiti, Gambier Islands and Eastern Polynesia generally, yielding both pearls and shell. It occurs also in China, Ceylon, the Andaman Islands and the Maldives. Another form is taken at Zanzibar, Madagascar, and the neighbouring islands, and is called Zanzibar and Madagascar shell. Bombay shell is another local form fished in the Persian Gulf and shipped via Bombay. The Red Sea variety is known as Egyptian shell. Another variety occurs along the west coast of America and from Panama to Vancouver, and supplies Panama shell and some pearls. A larger form, attaining a foot in diameter and a weight of 10 ℔ per pair of shells, is considered as a distinct species by Dr Jameson and named *Margaritifera maxima*. It is found along the north coast of Australia and New Guinea and the Malay Archipelago. The nacreous surface of this shell is white, without the black or dark margin of the common species; it is known in the trade as the silver-lip, gold-lip and by other names. It is the most valuable species of mother-of-pearl oyster.

Dr Jameson distinguishes in addition to the above thirty-two species of *Margaritifera* or *Meleagrina*; all these have rudimentary teeth on the hinge. The most important species is *Meleagrina vulgaris*, to which belong the pearl oyster of Ceylon and southern India, the lingah shell of the Persian Gulf and the pearl oyster of the Red Sea. Since the opening of the Suez Canal the latter form has invaded the Mediterranean, specimens having been taken at Alexandria and at Malta, and attempts have been made to cultivate it on the French coast. The species occurs also on the coasts of the Malay Peninsula, Australia and New Guinea, where it is fished both for its shells (Australian lingah) and for pearls. Two species occur on the coasts of South Africa but have no market value. *Meleagrina carchariarum* is the Shark's Bay shell of the London market. It is taken in large quantities at Shark's Bay, Western Australia, and is of rather small value; it also yields pearls of inferior quality. The pearl oyster of Japan, known as Japan lingah, is probably a variety of *Meleagrina vulgaris*. *Meleagrina radiata* is the West Indian pearl oyster.

The largest and steadiest consumption of mother-of-pearl is in the button trade, and much is also consumed by cutlers for handles of fruit and dessert knives and forks, pocket-knives, &c. It is also used in the inlaying of Japanese and Chinese lacquers, European lacquered papier-mâché work, trays, &c., and as an ornamental inlay generally. The carving of pilgrim shells and the elaboration of crucifixes and ornamental work in mother-of-pearl is a distinctive industry of the monks and other inhabitants of Bethlehem. Among the South Sea Islands the shell is largely fashioned into fishing-hooks. Among shells other than those of *Meleagrina margaritifera* used as mother-of-pearl may be mentioned the Green Ear or Ormer shell (*Haliotis tuberculata*) and several other species of *Haliotis*, besides various species of *Turbo*.

Artificial pearls were first made in western Europe in 1680 by Jacquin, a rosary-maker in Paris, and the trade is now largely carried on in France, Germany and Italy. Spheres of thin glass are filled with a preparation known as "essence d'orient," made from the silvery scales of the bleak or "ablette," which is caused to adhere to the inner wall of the globe, and the cavity is then filled with white wax. Many imitation pearls are now formed of an opaline glass of nacreous lustre, and the soft appearance of the pearl obtained by the judicious use of hydrofluoric acid. An excellent substitute for black pearl is found in the so-called "ironstone jewelry," and consists of close-grained haematite, not too highly polished; but the great density of the haematite immediately destroys the illusion. Pink pearls are imitated by turning small spheres out of the rosy part of the conch shell, or even out of pink coral.

See Clements R. Markham, "The Tinnevelly Pearl Fishery," in *Journ. Soc. Arts* (1867), xv., 256; D. T. Macgowan, "Pearls and Pearl-making in China," ibid. (1854), ii. 72; F. Hague, "On the Natural and Artificial Production of Pearls in China," in *Journ. Roy. Asiatic Soc.* (1856), vol. xvi.; H. J. Le Beck, "Pearl Fishery in the Gulf of Manar," in *Asiatic Researches* (1798), v. 393; K. Möbius, *Die echten Perlen* (Hamburg, 1857); H. Lyster Jameson, "Formation of Pearls," *Proc. Zool. Soc.* (1902), pl. 1; idem, "On the Identity and Distribution of Mother-of-Pearl Oysters," *Proc. Zool. Soc.* (1901), pl. 1, pp. 372-394; Herdman and Hornell, *Rep. Ceylon Pearl Fisheries* (London, Royal Soc., 1903); and Kunz and Stevenson, *Book of the Pearl* (New York, 1908), with bibliography. (J. T. C.)

PEARL, THE. The Middle-English poem known as *Pearl*, or *The Pearl*, is preserved in the unique manuscript Cotton Nero Ax at the British Museum; in this volume are contained also the poems *Cleanness*, *Patience*, and *Sir Gawayne and the Green Knight*. All the pieces are in the same handwriting, and from internal evidences of dialect, style and parallel references, it is now generally accepted that the poems are all by the same author. The MS., which is quaintly illustrated, belongs to the end of the 14th or the beginning of the 15th century, and appears to be but little later than the date of composition; no line of *Pearl* or of the other poems is elsewhere to be found.

Pearl is a poet's lament for the loss of a girl-child, "who lived not upon earth two years"—the poet is evidently the child's father. In grief he visits the little grave, and there in a vision beholds his Pearl, now transfigured as a queen of heaven—he sees her beneath "a crystal rock," beyond a stream; the dreamer would fain cross over, but cannot. From the opposite bank Pearl, grown in wisdom as in stature, instructs him in lessons of faith and resignation, expounds to him the mystery of her transfiguration, and leads him to a glimpse of the New Jerusalem. Suddenly the city is filled with glorious maidens, who in long procession glide towards the throne, all of them clad in white, pearl-bedecked robes as Pearl herself. And there he sees, too, "his little queen." A great love-longing possesses him to be by her. He must needs plunge into the stream that keeps him from her. In the very effort the dreamer awakes, to find himself resting upon the little mound where his Pearl had "strayed below":—

> "I roused me, and fell in great dismay,
> And, sighing, to myself I said:
> Now all be to that Prince's pleasure."

The poem consists of one hundred and one stanzas, each of twelve lines, with four accents, rhymed *ab*, *ab*, *ab*, *ab*, *bc*, *bc*; the versification combines rhyme with alliteration; trisyllabic effects add to the easy movement and lyrical charm of the lines. Five stanzas (in one case six), with the same refrain, constitute a section, of which accordingly there are twenty in all, the whole sequence being linked together by the device of making the first line of each stanza catch up the refrain of the previous verse, the last line of the poem re-echoing the first line. The author was not the creator of this form, nor was he the last to use it. The extant pieces in the metre are short religious poems, some of the later (*e.g. God's Complaint*, falsely attributed to Scottish authorship) revealing the influence of *Pearl*.

The dialect is West Midland, or rather North-West Midland, and the vocabulary is remarkable for the blending of native speech with Scandinavian and Romance elements, the latter partly Anglo-French, and partly learned French, due to the author's knowledge of French literature.

"While the main part of the poem," according to Gollancz, "is a paraphrase of the closing chapters of the Apocalypse and the parable of the Vineyard, the poet's debt to the *Romaunt of the Rose* is noteworthy, more particularly in the description of the wonderful land through which the dreamer wanders; and it can be traced throughout the poem, in the personification of Pearl as Reason, in the form of the colloquy, in the details of dress and ornament, in many a characteristic word, phrase and reference. 'The river from the throne,' in the Apocalypse, here meets 'the waters of the wells' devised by Sir Mirth for the Garden of the Rose. From these two sources, the Book of Revelation, with its almost Celtic glamour, and *The Romaunt of the Rose*, with its almost Oriental allegory, are derived much of the wealth and brilliancy of the poem. The poet's fancy revels in the richness of the heavenly and the earthly paradise, but his fancy is subordinated to his earnestness and intensity."

The leading *motifs* of *Pearl* are to be found in the Gospel—in the allegory of the merchant who sold his all to purchase one pearl of great price, and in the words, so fraught with solace for the child-bereft, "for of such is the Kingdom of Heaven." Naturally arising from the theme, and from these *motifs*, some theological problems of the time are touched upon, or treated somewhat too elaborately perhaps, and an attempt has been made to demonstrate that *Pearl* is merely allegorical and theological, and not really a lament. Those who hold this view surely ignore or fail to recognize the subtle personal touches whereby the poem transcends all its theological interests, and makes its simple and direct appeal to the human heart. Herein, too, lies its abiding charm, over and above the poetical talent, the love of nature, colour and the picturesque, the technical skill, and the descriptive power, which in a high degree belonged to the unknown poet.

Various theories have been advanced as to the authorship of *Pearl* and the other poems in the manuscript. The claims of Huchown "of the Awle Ryale" have been vigorously (but unsuccessfully) advocated; the case in favour of Ralph Strode (Chaucer's "philosophical Strode")—the most attractive of all the theories—is still, unfortunately, "not proven." By piecing together the personal indications to be found in the poems an imaginary biography of the poet may be constructed. It may safely be inferred that he was born about 1330, somewhere in Lancashire, or a little to the north; that he delighted in open-air life, in woodcraft and sport; that his early life was passed amid the gay scenes that brightened existence in medieval hall and bower; that he availed himself of opportunities of study, theology and romance alike claiming him; that he wedded, and had a child named Margery or Marguerite—the Daisy, or the Pearl—at whose death his happiness drooped and life's joy ended.

The four poems are closely linked and belong to one period of the poet's career. In *Gawayne*, probably the first of the four, the poet is still the minstrel rejoicing in the glamour of the Arthurian tale, but using it, in almost Spenserian spirit, to point a moral. In *Pearl* the minstrel has become the elegiac poet, harmonizing the old Teutonic form with the newer Romance rhyme. In *Cleanness* he has discarded all attractions of form, and writes, in direct alliterative metre, a stern homily on chastity. In *Patience*—a homiletic paraphrase of Jonah—he appears to be autobiographical, reminding himself, while teaching others, that "Poverty and Patience are needs playfellows." He had evidently fallen on evil days.

It is noteworthy that soon after 1358 Boccaccio wrote his Latin eclogue *Olympia* in memory of his young daughter Violante. A comparative study of the two poems is full of interest; the direct influence of the Latin on the English poem is not so clear as has been maintained. *Pearl* cannot be placed earlier than 1360; it is most probably later than *Olympia*.

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PEARSALL, ROBERT LUCAS DE (1795–1856), English composer, was born on the 14th of March 1795, at Clifton. Educated for the bar, he practised till 1825, when he left England for Germany and studied composition under Panny of Mainz; with the exception of three comparatively short visits to England, during one of which he made the acquaintance of the English school of madrigals, he lived abroad, selling his family property of Willsbridge and settling in the castle of Wartensee, on the lake of Constance. He produced many works of lasting beauty, nearly all of them for voices in combination: from his part songs, such as "Oh, who will o'er the downs?" to his elaborate and scholarly madrigals, such as the admirable eight-part compositions, "Great God of Love" and "Lay a Garland," or the beautiful "Light of my Soul." His reception into the Roman Church in his later years may have suggested the composition of some beautiful sacred music, among other things a fine "Salve Regina." He wrote many valuable treatises on music, and edited a Roman Catholic hymn-book. He died on the 5th of August 1856.

PEARSON, CHARLES HENRY (1830–1894), British historian and colonial statesman, was born in London on the 7th of September 1830. After receiving his early education at Rugby and King's College, London, he went up to Oxford, where he was generally regarded as the most brilliant of an exceptionally able set, and in 1854 obtained a fellowship at Oriel College. His constitutional weakness and bad eyesight forced him to abandon medicine, which he had adopted as a career, and in 1855 he returned to King's College as lecturer in English language and literature, a post which he almost immediately quitted for the professorship of modern history. He made numerous journeys abroad, the most important being his visit to Russia in 1858, his account of which was published anonymously in 1859 under the title of *Russia, by a Recent Traveller*; an adventurous journey through Poland during the insurrection of 1863, of which he gave a sympathetic and much praised account in the *Spectator*; and a visit to the United States in 1868, where he gathered materials for his subsequent discussion of the negro problem in his *National Life and Character*. In the meantime, besides contributing regularly, first to the *Saturday Review* and then to the *Spectator*, and editing the *National Review*, he wrote the first volume of *The Early and Middle Ages of England* (1861). The work was bitterly attacked by Freeman, whose "extravagant Saxonism" Pearson had been unable to adopt. It appeared in 1868 in a revised form with the title of *History of England during the Early and Middle Ages*, accompanied by a second volume which met with general recognition. Still better was the reception of his admirable *Maps of England in the First Thirteen Centuries* (1870). But as the result of these labours he was threatened with total blindness; and, disappointed of receiving a professorship at Oxford, in 1871 he emigrated to Australia. Here he married and settled down to the life of a sheep-farmer; but finding his health and eyesight greatly improved, he came to Melbourne as lecturer on history at the university. Soon afterwards he became head master of the Presbyterian Ladies' College, and in this position practically organized the whole system of higher education for women in Victoria. On his election in 1878 to the Legislative Assembly he definitely adopted politics as his career. His views on the land question and secular education aroused the bitter hostility of the rich squatters and the clergy; but his singular nobility of character, no less than his powers of mind, made him one of the most influential men in the Assembly. He was minister without portfolio in the Berry cabinet (1880–1881), and as minister of education in the coalition government of 1886 to 1890 he was able to pass into law many of the recommendations of his report. His reforms entirely remodelled state education in Victoria. In 1892 a fresh attack of illness decided him to return to England. Here he published in 1893 the best known of his works, *National Life and Character*. It is an attempt to show that the white man can flourish only in the temperate zones, that the yellow and black races must increase out of all proportion to the white, and must in time crush out his civilization. He died in London on the 29th of May 1894.

A volume of his *Reviews and Critical Essays* was published in 1896, and was followed in 1900 by his autobiography, a work of great interest.

PEARSON, JOHN (1612–1686), English divine and scholar, was born at Great Snoring, Norfolk, on the 28th of February 1612. From Eton he passed to Queen's College, Cambridge, and was elected a scholar of King's in April 1632, and a fellow in 1634. On taking orders in 1639 he was collated to the Salisbury prebend of Nether-Avon. In 1640 he was appointed chaplain to the lord-keeper Finch, by whom he was presented to the living of Thorington in Suffolk. In the Civil War he acted as chaplain to George Goring's forces in the west. In 1654 he was made weekly preacher at St Clement's, Eastcheap, in London. With Peter Gunning he disputed against two Roman Catholics on the subject of schism, a one-sided account of which was printed in Paris by one of the Roman Catholic disputants, under the title *Scisme Unmask't* (1658). Pearson also argued against the Puritan party, and was much interested in Brian Walton's polyglot Bible. In 1659 he published in London his celebrated *Exposition of the Creed*, dedicated to his parishioners of St Clement's, Eastcheap, to whom the substance of the work had been preached several years before. In the same year he published the *Golden Remains of the ever-memorable Mr John Hales of Eton*, with an interesting memoir. Soon after the Restoration he was presented by Juxon, bishop of London, to the rectory of St Christopher-le-Stocks; and in 1660 he was created doctor of divinity at Cambridge, appointed a royal chaplain, prebendary of Ely, archdeacon of Surrey, and master of Jesus College, Cambridge. In 1661 he was appointed Lady Margaret professor of divinity; and on the first day of the ensuing year he was nominated one of the commissioners for the review of the liturgy in the conference held at the Savoy. There he won the esteem of his opponents and high praise from Richard Baxter. On the 14th of April 1662 he was made master of Trinity College, Cambridge. In 1667 he was admitted a fellow of the Royal Society. In 1672 he published at Cambridge *Vindiciae epistolarum S. Ignatii*, in 4to, in answer to Jean Daillé. His defence of the authenticity of the letters of Ignatius has been confirmed by J. B. Lightfoot and other recent scholars. Upon the death of John Wilkins in 1672, Pearson was appointed to the bishopric of Chester. In 1682 his *Annales cyprianici* were published at Oxford, with John Fell's edition of that father's works. He died at Chester on the 16th of July 1686. His last work, the *Two Dissertations on the Succession and Times of the First Bishops of Rome*, formed with the *Annales Paulini* the principal part of his *Opera posthuma*, edited by Henry Dodwell in 1688.

See the memoir in *Biographia Britannica*, and another by Edward Churton, prefixed to the edition of Pearson's *Minor Theological Works* (2 vols., Oxford, 1844). Churton also edited almost the whole of the theological writings.

PEARSON, JOHN LOUGHBOROUGH (1817–1897), English architect, son of William Pearson, etcher, of Durham, was born in Brussels on the 5th of July 1817. He was articled at the age of fourteen to Ignatius Bonomi, architect, of Durham, but soon removed to London, and worked under the elder Hardwicke. He revived and practised largely the art of vaulting, and acquired in it a proficiency unrivalled in his generation. He was, however, by no means a Gothic purist, and was also fond of Renaissance and thoroughly grounded in classical architecture. From the erection of his first church of Ellerker, in Yorkshire, in 1843, to that of St Peter's, Vauxhall, in 1864, his buildings are Geometrical in manner and exhibit a close adherence to precedent, but elegance of proportion and refinement of detail lift them out of the commonplace of mere imitation. Holy Trinity, Westminster (1848), and St Mary's, Dalton Holme (1858), are notable examples of this phase. St Peter's, Vauxhall (1864), his first groined church, was also the first of a series of buildings which brought Pearson to the forefront among his contemporaries. In these he applied the Early English style to modern needs and modern economy with unrivalled success. St Augustine's, Kilburn (1871), St John's, Red Lion Square, London (1874), St Alban's, Birmingham (1880), St Michael's, Croydon (1880), St John's, Norwood (1881), St Stephen's, Bournemouth (1889), and All Saints', Hove (1889), are characteristic examples of his matured work. He is best known by Truro Cathedral (1880), which has a special interest in its apt incorporation of the south aisle of the ancient church. Pearson's conservative spirit fitted him for the reparation of ancient edifices, and among cathedrals and other historical buildings placed under his care were Lincoln, Chichester, Peterborough, Bristol and Exeter Cathedrals, St George's Chapel, Windsor, Westminster Hall and Westminster Abbey, in the surveyorship of which last he succeeded Sir G. G. Scott. Except as to the porches, the work of Scott, he re-faced the north transept of Westminster Abbey, and also designed the vigorous organ cases. In his handling of ancient buildings he was repeatedly opposed by the ultra anti-restorers (as in the case of the west front of Peterborough Cathedral in 1896), but he generally proved the soundness of his judgment by his executed work. Pearson's practice was not confined to church building. Treberfydd House (1850), Quar Wood (1858), Lechlade Manor, an Elizabethan house (1873), Westwood House, Sydenham, in the French Renaissance style (1880), the Astor estate offices (1892) upon the Victoria

Embankment, London, the remodelling of the interiors of Clieveden House (1893) and No. 18 Carlton House Terrace (1894), with many parsonages, show his aptitude for domestic architecture. In general design he first aimed at form, embracing both proportion and contour; and his work may be recognized by accurate scholarship coupled with harmonious detail. Its keynotes are cautiousness and refinement rather than boldness. He died on the 11th of December 1897, and was buried in the nave of Westminster Abbey, where his grave is marked by the appropriate motto *Sustinuit et abstinuit.* He was elected A.R.A. in 1874, R.A. in 1880, was a fellow of the Society of Antiquaries, and a fellow and member of the Council of the Royal Institute of British Architects.

The following are some of Pearson's more important works, not already named: Ferriby church (1846); Stow, Lincolnshire (restoration, 1850); Weybridge, St James's (1853); Freeland church, parsonage and schools (1866); Kilburn, St Peter's Home (1868); Wentworth church (1872); Horsforth church (1874); Cullercoats, St George's (1882); Chiswick, St Michael's (restoration, 1882); Great Yarmouth church (restoration, 1883); Liverpool, St Agnes' (1883); Woking Convalescent Home (1884); Headingley church (1884); Torquay, All Saints (1884); Maidstone, All Saints (restoration, 1885); Shrewsbury Abbey (1886); Ayr, Holy Trinity (1886); Hythe church (restoration, 1887); Oxford, New College, reredos (completion, 1889); Cambridge University Library (additions, 1889); Friern Barnet, St John's (1890); Cambridge, Sidney Sussex College (additions, 1890); Middlesex Hospital chapel (1890); Bishopsgate, St Helen's (restoration, 1891); Maida Hill (Irvingite) church (1891); Barking, All Hallows (restoration, 1893); Cambridge, Emmanuel College (additions, 1893); Ledbury, St Michael's (restoration, 1894); Malta, Memorial church (1894); Port Talbot church (1895). (W. D. C.)

PEARY, ROBERT EDWIN (1856–), American Arctic explorer, was born at Cresson, Pennsylvania, on the 6th of May 1856. He graduated at Bowdoin College in 1877, and in 1881 became a civil engineer in the U.S. navy with the rank of lieutenant. In 1884 he was appointed assistant-engineer in connexion with the surveys for the Nicaragua Ship Canal, and in 1887–1888 he was in charge of these surveys. In 1886 he obtained leave of absence for a summer excursion to Disco Bay on the west coast of Greenland. From this point he made a journey of nearly a hundred miles into the interior, and the experience impressed him with the practicability of using this so-called inland ice-cap as a highway for exploration. In 1891 he organized an expedition under the auspices of the Academy of Natural Sciences of Philadelphia. The party of seven included Lieut. Peary's wife, the first white woman to accompany an Arctic expedition. After wintering in Inglefield Gulf on the north-west coast of Greenland, in the following spring Lieut. Peary, with a young Norwegian, Eivind Astrup, crossed the inland ice-cap along its northern limit to the north-east of Greenland and back. The practical geographical result of this journey was to establish the insularity of Greenland. Valuable work was also performed by the expedition in the close study which was made of the isolated tribe of the Cape York or Smith Sound Eskimos, the most northerly people in the world.[1] Lieut. Peary was able to fit out another Arctic expedition in 1893, and was again accompanied by Mrs Peary, who gave birth to a daughter at the winter quarters in Inglefield Gulf. The expedition returned in the season of 1894, leaving Peary with his coloured servant Henson and Mr Hugh G. Lee to renew the attempt to cross the inland ice in the next year. This they succeeded in doing, but without being able to carry the work of exploration any farther on the opposite side of Greenland. During a summer excursion to Melville Bay in 1894, Peary discovered three large meteorites, which supplied the Eskimos with the material for their iron implements, as reported by Sir John Ross in 1818, and on his return in 1895 he brought the two smaller ones with him. The remaining meteorite was brought to New York in 1897. In 1898 Lieut. Peary published *Northward over the Great Ice*, a record of all his expeditions up to that time, and in the same year he started on another expedition to the Arctic regions. In this and subsequent expeditions he received financial aid from Mr Morris Jesup and the Peary Arctic Club. The greatest forethought was bestowed upon the organization of the expedition, a four-years' programme being laid down at the outset and a system of relief expeditions provided for. A distinctive feature was the utilization of a company of Eskimos. Although unsuccessful as regards the North Pole, the expedition achieved the accurate survey (1900) of the northern limit of the Greenland continent and the demonstration that beyond it lay a Polar ocean. In 1902 Peary with Henson and an Eskimo advanced as far north as lat. 84° 17′ 27″, the highest point then reached in the western hemisphere. Lieut. Peary had now been promoted to the rank of Commander, and on his return he was elected president of the American Geographical Society. In November 1903 he went to England on a naval commission to inquire into the system of naval barracks in Great Britain, and was presented with the Livingstone Gold Medal of the Royal Scottish Geographical Society. Commander Peary then began preparations for another expedition by the construction of a special ship, named the "Roosevelt," the first ever built in the United States for the purpose of Arctic exploration. He sailed from New York on the 16th of July 1905, having two years' supplies on board. The "Roosevelt" wintered on the north coast of Grant Land, and on the 21st of February a start was made with sledges. The party experienced serious delay owing to open water between 84° and 85°, and farther north the ice was opened up during a six days' gale, which cut off communications and destroyed the dépôts which had been established. A steady easterly drift was experienced. But on the 21st of April, 1906, 87°6′ was reached—the "farthest north" attained by man—by which time Peary and his companions were suffering severe privations, and had to make the return journey in the face of great difficulties. They reached the north coast of Greenland and subsequently rejoined the ship, from which, after a week's rest, Peary made a sledge journey along the north coast of Grant Land. Returning home, the expedition reached Hebron, Labrador, on the 13th of October, the "Roosevelt" having been nearly wrecked *en route*. In 1907 the narrative of this journey, *Nearest the Pole*, was published.

In 1908 Peary started in the "Roosevelt" on the journey which was to bring him his final success. He left Etah on the 18th of August, wintered in Grant Land, and set forward over the ice from Cape Columbia on the 1st of March 1909. A party of six started with him, and moved in sections, one in front of another. They were gradually sent back as supplies diminished. At the end of the month Captain Bartlett was the only white man left with Peary, and he turned back in 87° 48′ N., the highest latitude then ever reached. Peary, with his negro servant and four Eskimos, pushed on, and on the 6th of April 1909 reached the North Pole. They remained some thirty hours, took observations, and on sounding, a few miles from the pole, found no bottom at 1500 fathoms. The party, with the exception of one drowned, returned safely to the "Roosevelt," which left her winter quarters on the 18th of July and reached Indian Harbour on the 5th of September. Peary's *The North Pole: Its Discovery in 1909* was published in 1910.

Just before the news came of Peary's success another American explorer, Dr F. A. Cook (b. 1865), returning from Greenland to Europe on a Danish ship, claimed that he had reached the North Pole on the 21st of April 1908. He had accompanied an expedition northward in 1907, prepared to attempt to reach the Pole if opportunity offered, and according to his own story had done so, leaving his party and taking only some Eskimos, early in 1908. Nothing had been heard of him since March of that year, and it was supposed that he had perished. Cook's claim to have forestalled Peary was at first credited in various circles, and he was given a rapturous reception at Copenhagen; but scientific opinion in England and America was more reserved, and eventually, after a prolonged dispute, a special committee of the university of Copenhagen, to whom his documents were submitted, declared that they contained no proof that he had reached the Pole. By that time most other people had come to an adverse conclusion and the sensation was over.

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[1] A narrative of the expedition written by Mrs Peary, and containing an account of the "Great White Journey across Greenland," by her husband, was published under the title of *My Arctic Journal*.

PEASANT (O. Fr. *paysant*, Mod. *paysan*; Lat. *pagensis*, belonging to the *pagus* or country; cf. "pagan"), a countryman or rustic, either working for others, or, more specifically, owning or renting and working by his own labour a small plot of ground. Though a word of not very strict application, it is now frequently used of the rural population of such countries as France, where the land is chiefly held by small holders, "peasant proprietors." (See ALLOTMENTS and METAYAGE).

PEASE, EDWARD (1767–1858), the founder of a famous industrial Quaker family in the north of England, was born at Darlington on the 31st of May 1767, his father, Joseph Pease (1737–1808), being a woollen manufacturer in that town. Having retired from this business Edward Pease made the acquaintance of George Stephenson, and with him took a prominent part in constructing the railway between Stockton and Darlington. He died at Darlington on the 31st of July 1858. His second son, Joseph Pease (1799–1872), who assisted his father in his railway enterprises, was M.P. for South Durham from 1832 to 1841, being the first Quaker to sit in parliament. He was interested in collieries, quarries and ironstone mines in Durham and North Yorkshire, as well as in cotton and woollen manufactures; and he was active in educational and philanthropic work. Another son, Henry Pease (1807–1881), was M.P. for South Durham from 1857 to 1865. Like all the members of his family he was a supporter of the Peace Society, and in its interests he visited the emperor Nicholas of Russia just before the outbreak of the Crimean War, and later the emperor of the French, Napoleon III.

Joseph Pease's eldest son, Sir Joseph Whitwell Pease (1828–1903), was made a baronet in 1882. He was M.P. for South Durham from 1865 to 1885 and for the Barnard Castle division of Durham from 1885 to 1903. His elder son, Sir Alfred Edward Pease (b. 1857), who succeeded to the baronetcy, became famous as a hunter of big game, and was M.P. for York from 1885 to 1892 and for the Cleveland division of Yorkshire from 1897 to 1902. A younger son, Joseph Albert Pease (b. 1860), entered parliament in 1892, and in 1908 became chief Liberal whip, being advanced to the cabinet as chancellor of the duchy of Lancaster in 1910.

Another son of Joseph Pease was Arthur Pease (1837–1898), member of parliament from 1880 to 1885 and again from 1895 to 1898. His son, Herbert Pike Pease (b. 1867), M.P. for Darlington 1898–1910, was one of the Unionist Whips.

The Diaries of Edward Pease were edited by Sir Alfred Pease in 1907.

PEAT (possibly connected with Med. Lat. *petia*, *pecia*, piece, ultimately of Celtic origin; cf. O. Celt. *pet*, O. Ir. *pit*, Welsh *peth*, portion), a product of decayed vegetation found in the form of bogs in many parts of the world. The continent of Europe is estimated to contain 212,700 sq. m. of bog; Ireland has 2,858,150 acres, Canada 30,000,000 acres, and the United States 20,000,000 acres. The plants which give origin to these deposits are mainly aquatic, including reeds, rushes, sedges and mosses. *Sphagnum* is present in most peats, but in Irish peat *Thacomitrum lanuginosum* predominates. It seems that the disintegration of the vegetable tissues is effected partly by moist atmospheric oxidation and partly by anaerobic bacteria, yeasts, moulds and fungi, in depressions containing fairly still but not stagnant water, which is retained by an impervious bed or underlying strata. As decomposition proceeds the products become waterlogged and sink to the bottom of the pool; in the course of time the deposits attain a considerable thickness, and the lower layers, under the superincumbent pressure of the water and later deposits, are gradually compressed and carbonized. The most favourable conditions appear to be a moist atmosphere, and a mean annual temperature of about 45° F.; no bogs are found between latitudes 45° N. and 45° S.

Peat varies from a pale yellow or brown fibrous substance, resembling turf or compressed hay, containing conspicuous plant remains, to a compact dark brown material, resembling black clay when wet, and some varieties of lignite when dry. Two typical forms may be noticed: "Hill peat" (the mountain or brown bogs of Ireland), found in mountainous districts, and consisting mainly of *Sphagnum* and *Andromeda*; and "Bottom peat" (the lowland or red bogs of Ireland), found in lakes, rivers, and brooks, and containing *Hypnum*. It always contains much water, up to 90%, which it is necessary to remove before the product can be efficiently employed as a fuel, and for most other purposes. A specimen dried at 100° C. had the composition: carbon = 60·48%, hydrogen = 6·10%, oxygen = 32·55%, nitrogen = 0·88%, ash = 3·30%; the ash is very variable—from 1 to 65%—and consists principally of clay and sand, with lesser amounts of ferric oxide, lime, magnesia, &c. The specific gravity has been variously given, owing to the variable water content and air spaces; when dried and compressed, however, it is denser than water.

Peat-winning presents certain special features. The general practice is to cut a trench about a foot deep with a peculiarly shaped spade, termed in Ireland a "slane," and remove sods from 3 to 4 ft. long. When one layer has been removed, the next is attacked, and so on. If the deposit be more solid step-working may be adopted, and should water be reached recourse may be had to long-handled slanes. The sods are allowed to drain, and then stacked for drying in the air, being occasionally turned so as to dry equally; this process may require about six weeks. The dried sods are known as "dug peat." Excavators and dredges are now extensively used, and the drying is effected in heated chambers, both fixed and revolving.

The low value of ordinary dug peat as a fuel has led to processes for obtaining a more useful product. In M. Ekenberg's process the wet peat is pulped and milled so as to make it of uniform composition, and the pulp passed into an oven maintained at 180°–200° F., where it is carbonized by superheated water. The pressed product, which resembles lignite, still contains 8 to 14% of water; this is driven off by heat, and the residue briquetted. The final product is nearly equal to coal in calorific value, and has the additional advantage of a lower sulphur content—0·2 to 0·4% against about 2% in ordinary coal. M. Zeigler's method leads to the production of a useful coke. Both these processes permit the recovery of valuable by-products, especially ammonium sulphate. Experiments for obtaining a gas suitable for consumption in gas-engines have been followed by commercial processes devised by the Mond Gas Corporation, London, and Crossley Bros. of Manchester, and by Caro and Frank in Germany. The processes essentially consist in destructively distilling peat in special retorts and under specified conditions, and, in addition to the gas, there is recovered a useful coke and also the nitrogen as ammonium sulphate.

The conversion of the nitrogen into ammonia has been the subject of much work, and is commercially pursued at a works at Carnlough, Co. Antrim, under patents held by H. C. Woltereck. The peat is treated with a mixture of air and water vapour in special furnaces, and the gaseous products, including paraffin tar, acetic acid and ammonia, are led through a special scrubber to remove the tar, then through a tower containing milk of lime to absorb the acid (the calcium acetate formed being employed for the manufacture of acetone, &c.), and finally through a sulphuric acid tower, where the ammonia is converted into ammonium sulphate which is recovered by crystallization.

Peat has also been exploited as a source of commercial alcohol, to be employed in motors. In the process founded on the experiments of R. W. Wallace and Sir W. Ramsay, which gives 25 to 26 gallons of spirit from a ton of peat, the peat is boiled with water containing a little sulphuric acid, the product neutralized with lime and then distilled; the ammonia is also recovered. In another process a yield of 40 gallons of spirit and 66 lb of ammonium sulphate per ton of peat is claimed.

Of other applications we may notice C. E. Nelson's process for making a paper, said to be better than ordinary wrapping; the first factory to exploit this idea was opened at Capac, Michigan, in 1906. Peat has been employed as a manure for many years, and recently attempts have been made to convert artificially its nitrogen into assimilable nitrates; such a process was patented by A. Müntz and A. G. Girard of Paris, in 1907.

See P. R. Björling and F. T. Gissing, *Peat and its Manufacture* (1907); F. T. Gissing, *Commercial Peat* (1909); E. Nystrom, *Peat and Lignite* (1908), published by Department of Mines of Canada.

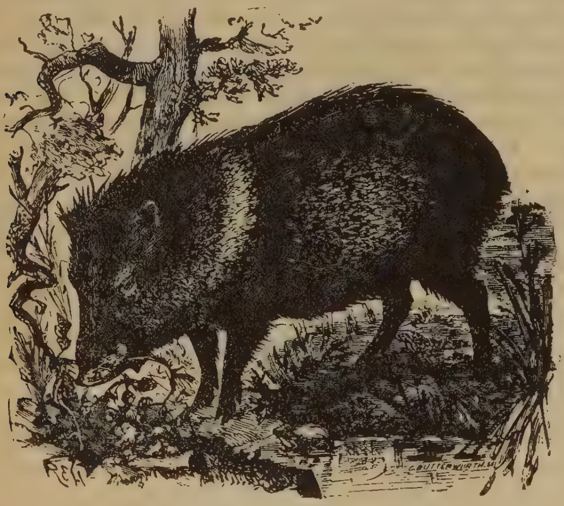
PÉCAUT, FELIX (1828–1898), French educationalist, a member of an old Huguenot family, was born at Salies de Béarn, in 1828. He was for some months evangelical pastor at Salies, but he had no pretence of sympathy with ecclesiastical authority

He was consequently compelled to resign his pastorate, and for some years occupied himself by urging the claims of a liberal Christianity. In 1879 he conducted a general inspection of primary education for the French government, and several similar missions followed. His fame chiefly rests in his successful organization of the training school for women teachers at Fontenoy-aux-Roses, to which he devoted fifteen years of ceaseless toil. He died on the 31st of July 1898.

A summary of his educational views is given in his *Public Education and National Life* (1897).

PECCARY, the name of the New World representatives of the swine (*Suidae*) of the E. hemisphere, of which they constitute the sub-family *Dicotylinae* (or *Tagassuinae*). (See ARTIODACTYLA and SWINE.)

The teeth of the peccaries differ from those of the typical Old World pigs (*Sus*), numerically, in wanting the upper outer incisor and the anterior premolar on each side of each jaw, the dental formula being: i. $\frac{2}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$, total 38. From those of all Old World swine or *Suinae*, the upper canines, or tusks, differ in having their points directed downwards, not outwards or upwards; these being very sharp, with cutting hinder edges, and completely covered with enamel until worn. The lower canines are large and directed upwards and outwards, and slightly curved backwards. The cheek-teeth form a continuous series, gradually increasing in size from the first to the last: the molars having square four-cusped crowns. The stomach is much more complex than in the true pigs, almost approaching that of a ruminant. In the feet the two middle (third and fourth) metacarpal and metatarsal bones, which are completely separate in the pigs, are united at their upper ends. On the fore-foot the two (second and fifth) outer toes are equally developed as in pigs, but on the hind-foot, although the inner (or second) is present, the outer or fifth toe is entirely wanting. As in all *Suidae* the snout is truncated, and the nostrils are situated in its flat, expanded, disk-like termination. The ears are rather small, ovate and erect; and there is no external appearance of a tail.



The Collared Peccary (*Dicotyles tajacu*).

Peccaries, which range from New Mexico and Texas to Patagonia, are represented by two main types, of which the first is the collared peccary, *Dicotyles* (or *Tagassu*) *tajacu*, which has an extensive range in South America. Generally it is found singly or in pairs, or at most in small herds of from eight to ten, and is not inclined to attack other animals or human beings. Its colour is dark grey, with a white or whitish band passing across the chest from shoulder to shoulder. The length of the head and body is about 36 in. The second form is typified by the white-lipped peccary or warri, *D.* (or *T.*) *labiatus*, or *pecari*, representing the sub-genus *Olidosus*. Typically it is rather larger than the collared species, being about 40 in. in length, of a blackish colour, with the lips and lower jaw white. It is not found farther north than Guatemala, or south of Paraguay. Generally met with in large droves of from fifty to a hundred, it is of a more pugnacious disposition than the former species, and a hunter who encounters a herd in a forest has often to climb a tree as his only chance of safety. Peccaries are omnivorous, living on roots, fallen fruits, worms and carrion, and often inflict great devastation upon crops. Both types are so nearly allied that they will breed together freely in captivity. Unlike pigs, they never appear to produce more than two young ones at a birth.

Remains of extinct peccaries referable to the modern genus occur in the caverns and superficial deposits of South America, but not in the earlier formations. This, coupled with the occurrence of earlier types in North America, indicates that the group is a northern one. Of the extinct North American peccaries, the typical *Dicotyles* occur in the Pliocene while the Miocene *Bothriolabis*, which has tusks of the peccary type, approximates in the structure of its cheek-teeth to the European Miocene genus among the *Suinae*. From this it may be inferred that the ancestral peccaries entered America in the Upper Oligocene. *Platygonus* is an aberrant type which died out in the Pleistocene. (R. L.*)

PECHLIN, KARL FREDRIK (1720–1796), Swedish politician and demagogue, son of the Holstein minister at Stockholm, was educated in Sweden, and entered the Swedish army. He rose to the rank of major-general, but became famous by being the type *par excellence* of the corrupt and egoistic Swedish parliamentarian of the final period of the Frihetstiden (see SWEDEN: *History*); he received for many years the sobriquet of "General of the Riksdag." Pechlin first appears prominently in Swedish politics in 1760, when by suddenly changing sides he contrived to save the "Hats" from impeachment. Enraged at being thus excluded from power by their former friend, the "Caps" procured Pechlin's expulsion from the two following Riksdags. In 1769 Pechlin sold the "Hats" as he had formerly sold the "Caps," and was largely instrumental in preventing the projected indispensable reform of the Swedish constitution. During the revolution of 1772 he escaped from Stockholm and kept quietly in the background. In 1786, when the opposition against Gustavus III. was gathering strength, Pechlin reappeared in the Riksdag as one of the leaders of the malcontents, and is said to have been at the same time in the pay of the Russian court. In 1789 he was one of the deputies whom Gustavus III. kept under lock and key till he had changed the government into a semi-absolute monarchy. It is fairly certain that Pechlin was at the bottom of the plot for murdering Gustavus in 1792. On the eve of the assassination (March 16) the principal conspirators met at his house to make their final preparations and discuss the form of government which should be adopted after the king's death. Pechlin undertook to crowd the fatal masquerade with accomplices, but took care not to be there personally. He was arrested on the 17th of March, but nothing definite could ever be proved against him. Nevertheless he was condemned to imprisonment in the fortress of Varberg, where he died four years later.

See R. N. Bain, *Gustavus III. and his Contemporaries* (London, 1905). (R. N. B.)

PECHORA, a river of N. Russia, rising in the Urals, almost on 62° N., in the government of Perm. It flows W. for a short distance, then turns N. and maintains that direction up to about 66° 20′ N. It then describes a double loop, to N. and to S., and after that resumes its N. course, finally emptying into the Gulf of Pechora, situated between the White Sea and the Kara Sea. Its total length is 970 m. At its mouth it forms an elongated delta. Although frozen in its upper reaches for 190 days in the year and for 138 days in its lower reaches, it is navigable throughout the greater part of its course. Its drainage basin covers an area of 127,200 sq. m. The principal tributaries are, on the right, the Ilych and the Usa, and on the left the Izhma, the Tsylma and the Sula.

PECK, a dry measure of capacity, especially used for grain. It contains 8 quarts or 2 gallons, and is $\frac{1}{4}$ of a bushel. The imperial peck contains 554·548 cub. in., in the United States of America 537·6 cub. in. The word is in M.E. *pek*, and is found latinized as *peccum* or *pekka*. In Med. Lat. are found *picotinus*, "mensura frumentaria," and *picotus*, "mensura liquidorum" (Du Cange, *Gloss. s.vv.*) These words seem to be connected with the Fr. *picoter*, to peck, of a bird, and this would identify the word with "peck," a variant of "pick," a tap or stroke of the beak, especially used of the action of a bird in picking up grain or other food. The sense-development in this case is very obscure, and the name of the measure is found much earlier than "peck" as a variant form of "pick."

PECKHAM, JOHN (d. 1292), archbishop of Canterbury, was probably a native of Sussex, and received his early education from the Cluniac monks of Lewes. About 1250 he joined the Franciscan order and studied in their Oxford convent. Shortly afterwards he proceeded to the university of Paris, where he took his degree under St Bonaventure and became regent in theology. For many years Peckham taught at Paris, coming into contact with the greatest scholars of the day, among others St Thomas Aquinas. About 1270 he returned to Oxford and taught there, being elected in 1275 provincial minister of the Franciscans in England, but he was soon afterwards called to Rome as *lector sacri palatii*, or theological lecturer in the schools of the papal palace. In 1279 he returned to England as archbishop of Canterbury, being appointed by the pope on the rejection of Robert Burnell, Edward I.'s candidate. Peckham was always a strenuous advocate of the papal power, especially as shown in the council of Lyons in 1274. His enthronement in October 1279 marks the beginning of an important epoch in the history of the English primacy. Its characteristic note was an insistence on discipline which offended contemporaries. Peckham's zeal was not tempered by discernment, and he had little gift of sympathy or imagination. His first act on arrival in England was to call a council at Reading, which met in July 1279. Its main object was ecclesiastical reform, but the provision that a copy of Magna Carta should be hung in all cathedral and collegiate churches seemed to the king a political action, and parliament declared void any action of this council touching on the royal power. Nevertheless Peckham's relations with the king were often cordial, and Edward called on him for help in bringing order into conquered Wales. The chief note of his activity was, however, certainly ecclesiastical. The crime of "plurality," the holding by one cleric of two or more benefices, was especially attacked, as also clerical absenteeism and ignorance, and laxity in the monastic life. Peckham's main instrument was a minute system of "visitation," which he used with a frequency hitherto unknown. Disputes resulted, and on some points Peckham gave way, but his powers as papal legate complicated matters, and he did much to strengthen the court of Canterbury at the expense of the lower courts. The famous quarrel with St Thomas of Cantilupe, bishop of Hereford, arose out of similar causes. A more attractive side of Peckham's career is his activity as a writer. The numerous manuscripts of his works to be found in the libraries of Italy, England and France, testify to his industry as a philosopher and commentator. In philosophy he represents the Franciscan school which attacked the teaching of St Thomas Aquinas on the "Unity of Form." He wrote in a quaint and elaborate style on scientific, scriptural and moral subjects and engaged in much controversy in defence of the Franciscan rule and practice. He was "an excellent maker of songs," and his hymns are characterized by a lyrical tenderness which seems typically Franciscan. Printed examples of his work as commentator and hymn writer respectively may be found in the *Firamentum trium ordinum* (Paris, 1512), and his office for Trinity Sunday in the "unreformed" breviary.

The chief authority on Peckham as archbishop of Canterbury, is the *Registrum fratris Johannis Peckham*, edited by C. Trice Martin for the Rolls Series (London, 1882–1885). A sympathetic account of his life as a Franciscan is to be found in L. Wadding, *Annales minorum* (Lyons, 1625, 1654). See also the article by C. L. Kingsford in *Dict. Nat. Biog.*, and Wilkin's *Concilia magnae Britanniae* (London, 1737). (E. O'N.)

PECOCK (or Peacock), **REGINALD** (*c.* 1395–*c.* 1460), English prelate and writer, was probably born in Wales, and was educated at Oriel College, Oxford. Having been ordained priest in 1421, he secured a mastership in London in 1431, and soon became prominent by his attacks upon the religious position of the Lollards. In 1444 he became bishop of St Asaph, and six years later bishop of Chichester. He was an adherent of the house of Lancaster and in 1454 became a member of the privy council. In attacking the Lollards Pecock put forward religious views far in advance of his age. He asserted that the Scriptures were not the only standard of right and wrong; he questioned some of the articles of the creed and the infallibility of the Church; he wished "bi cleer witte drawe men into consente of trewe feith otherwise than bi fire and swerd or hangement" and in general he exalted the authority of reason. Owing to these views the archbishop of Canterbury, Thomas Bourchier, ordered his writings to be examined. This was done and he was found guilty of heresy. He was removed from the privy council and he only saved himself from a painful death by privately, and then publicly (at St Paul's Cross, Dec. 4, 1457), renouncing his opinions. Pecock, who has been called "the only great English theologian of the 15th century," was then forced to resign his bishopric, and was removed to Thorney Abbey in Cambridgeshire, where he doubtless remained until his death. The bishop's chief work is the famous *Repressor of over-much weeting* [blaming] *of the Clergie*, which was issued about 1455. In addition to its great importance in the history of the Lollard movement the *Repressor* has an exceptional interest as a model of the English of the time, Pecock being one of the first writers to use the vernacular. In thought and style alike it is the work of a man of learning and ability.

A biography of the author is added to the edition of the *Repressor* published by C. Babington for the Rolls Series in 1860. Pecock's other writings include the *Book or Rule of Christian Religion*; the *Donet*, "an introduction to the chief truths of the Christian faith in the form of a dialogue between father and son"; and the *Folewer to the Donet*. The two last works are extant in manuscript. His *Book of Faith* has been edited from the manuscript in the library of Trinity College, Cambridge, by J. L. Morison (Glasgow, 1909). See also John Lewis, *Life of Pecock* (1744; new ed., 1820).

PECORA (plural of Lat. *pecus*, cattle), a term employed—in a more restricted sense—in place of the older title Ruminantia, to designate the group of ruminating artiodactyle ungulates represented by oxen, sheep, goats, antelopes, deer, giraffes, &c.

The leading characteristics of the Pecora are given in some detail in the article Artiodactyla (*q.v.*); but it is necessary to allude to a few of these here. Pecora, or true ruminants as they may be conveniently called, have complex stomachs and chew the cud; they have no upper incisor teeth; and the lower canines are approximated to the outer incisors in such a manner that the three incisors and the one canine of the two sides collectively form a continuous semicircle of four pairs of nearly similar teeth. In the cheek-teeth the component columns are crescent-shaped, constituting the selenodont type. In the fore-limbs the bones corresponding to the third and fourth metacarpals of the pig's foot are fused into a cannon-bone; and a similar condition obtains in the case of the corresponding metatarsals in the hind-limbs. There is generally no sagittal crest to the skull; and the condyle of the lower jaw is transversely elongated. Another general, although not universal, characteristic of the Pecora is the presence of simple or complex appendages on the forehead commonly known as horns. In a few existing species, such as the musk-deer and the water-deer, these appendages are absent, and they are likewise lacking in a large number of extinct members of the group, in fact in all the earlier ones. They are, therefore, a specialized feature, which has only recently attained its full development.

These horns present several distinct structural types, which may be classified as follows:—

I. The simplest type is that of the giraffe, in which three bony prominences—a single one in front and a pair behind—quite separate from the underlying bones and covered during life with skin, occupy the front surface of the skull. The summits of the hind pair are surmounted by bristly hairs. In the extinct

Sivatherium there are two pairs of such appendages, of which the hinder are large and were probably covered during life either with skin or thin horn. In the giraffes the separation of the horns from the skull may be a degenerate character.

II. In the Asiatic muntjac deer we find a pair of skin-covered horns, or "pedicles," corresponding to the paired horns of the giraffe, although welded to the skull. From the summits of these pedicles arise secondary outgrowths, at first covered with skin, which (owing to the growth of a ring of bone at the base arresting the flow of blood) eventually dries up and leaves bare bone incapable of further growth. In the muntjac the bare bony part, or "antler," is small in proportion to the skin-covered pedicle, and simple in structure; but in the majority of deer the antler increases in size at the expense of the pedicle—which dwindles—and in some species, like the Siamese deer (fig. 1), the sambar and the red deer, becomes very large and more or less branched. Owing to liability to necrosis, the permanent retention of such a mass of dead bone would be dangerous; and the antlers are consequently shed annually (or every few years), to be renewed the following year, when, till the animal becomes past its prime, they are larger than their predecessors. The periodical shedding is also necessary in order to allow of this increase in size. With the exception of the reindeer, antlers are confined to the males.

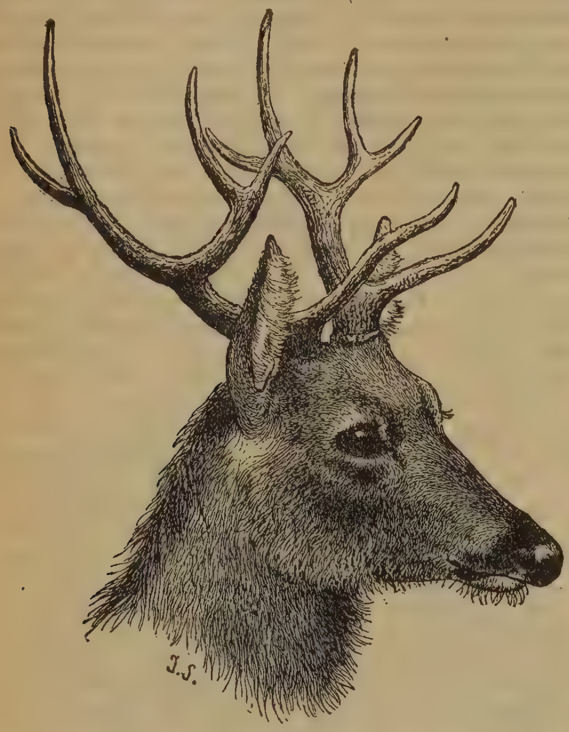


FIG. 1.—Head of Siamese Deer (*Cervus schomburgkii*), showing antlers.

III. The third type of horn is presented by the American prongbuck, or pronghorn, in which bony processes, or "cores," corresponding to the horns of the giraffe, have acquired a horny sheath, in place of skin; the sheath being in this instance forked, and annually shed and renewed, although the core is simple. The sheaths are akin to hair in structure, thus suggesting affinity with the hairs surmounting the giraffe's horns. Female prongbuck may or may not have horns.

IV. In the great majority of "Hollow-horned Ruminants," such as oxen, sheep, goats and antelopes (fig. 2), the horny sheath (or true "horn") forms a simple unbranched cone, which may be compressed, spirally twisted, or curved in one or more directions, but is permanently retained and continues to grow throughout life from the base, while it becomes worn away at the tip. Rarely, as in the four-horned antelope, there are two pairs of horns. In many cases these horns are present in both sexes.

Dr H. Gadow is of opinion that the antlers of the deer, the horn-like protuberances on the skull of the giraffe, and the true horns of the prongbuck and other hollow-horned ruminants (*Bovidae*) are all different stages of evolution from a single common type: the antlers of the deer being the most primitive, and the horns of the *Bovidae* the most specialized. From the fact that the bony horn-core of the hollow-horned ruminants first develops as a separate ossification, as do the horns of the giraffe, while the pedicle of the antlers of the deer grow direct from the frontal bone, it has been proposed to place the hollow-horned ruminants (inclusive of the prongbuck) and the giraffes in one group and the deer in another. This arrangement has the disadvantage of separating the deer from the giraffes, to which they are evidently nearly related; but Dr Gadow's work brings them more into line. Whether he is right in regarding the hollow-horned ruminants as derived from the primitive deer may, however, be a matter of opinion. One very important fact recorded by Dr Gadow is that calves and lambs shed their horns at an early age. The *Bovidae* are thus brought into nearer relationship with the American prongbuck (the only living ruminant which sheds its horn-cover in the adult condition) than has generally been supposed.

The above-mentioned four types of skull appendages are generally regarded as severally characteristic of as many family groups, namely the *Giraffidae*, *Cervidae*, *Antilocapridae* and *Bovidae*. The two last are, however, much more closely connected than are either of the others, and should perhaps be united.

Giraffidae.—In the *Giraffidae*, which include not only giraffes (*Giraffa*) but also the okapi (*Ocapia*) and a number of extinct species from the Lower Pliocene Tertiary deposits of southern Europe, Asia and North Africa, the appendages on the skull are of type No. I., and may well be designated "antler-horns." Another important feature is that the lower canine has a cleft or two-lobed crown, so that it is unlike the incisors to which it is approximated. There are no upper canines; and the cheek-teeth are short-crowned (brachyodont) with a peculiar grained enamel, resembling the skin of a slug in character. The feet have only two hoofs, all traces of the small lateral pair found in many other ruminants having disappeared.

The giraffes (*Giraffa*) are now an exclusively African genus, and have long legs and neck, and three horns—a single one in front and a pair behind—supplemented in some instances with a rudimentary pair on the occiput.

The okapi (*Ocapia*), which is also African but restricted to the tropical forest-region, in place of being an inhabitant of more or less open country, represents a second genus, characterized by the shorter neck and limbs, the totally different type of colouring, and the restriction of the horns to the male sex, in which they form a pair on the forehead; these horns being more compressed than the paired horns of the giraffe, and penetrating the skin at their summits (see GIRAFFE and OKAPI). Remains of extinct species of giraffe occur in the Lower Pliocene formations of Greece, Hungary, Persia, Northern India and China. From deposits of the same age in Greece, Samos and elsewhere have been obtained skulls and other remains of *Palaeotragus* or *Samotherium*, a ruminant closely allied to *Ocapia*, the males of which were armed with a very similar pair of dagger-shaped horns. *Helladotherium* was a much larger animal, known by a single hornless skull from the Pliocene of Greece, which may be that of a female. In the equally large

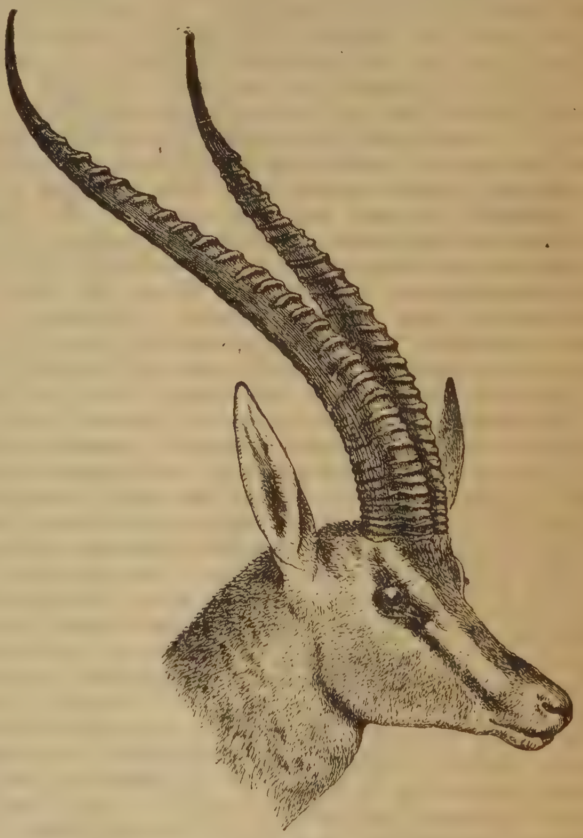


FIG. 2.—Head of Grant's Gazelle (*Gazella granti*), showing horns.

Bramatherium and *Hydaspitherium* of India the horns of the males were complex, those of the former including an occipital pair, while those of the latter arise from a common base. In both genera, as in the okapi, there is a vacuity in front of the orbit. Largest of all is *Sivatherium*, typically from the Lower Pliocene of Northern India, but also recorded from Adrianople, in which the skull of the male is short and wide, with a pair of simple conical horns above the eye, and a huge branching pair at the vertex. *Libytherium* is an allied form from North Africa. Whether the *Giraffidae* were originally an African or a Euro-Asiatic group there is not yet sufficient evidence to decide. The family is unrepresented in the western hemisphere.

Cervidae.—In the deer-tribe, or *Cervidae*, the lower canine, as in the two following families, is simple and similar to the incisors. The frontal appendages, when present, are confined (except in the case of the reindeer) to the males, and take the form of antlers, that is to say of type No. II. in the foregoing description. As a general rule, the molars, and more especially the first, are partially brachyodont (short-crowned); although they are taller in the chital (*Cervus axis*). In the skull there are two orifices to the lachrymal duct, situated on or inside the rim of the orbit. A preorbital vacuity of such dimensions as to exclude the lachrymal bone from articulation with the nasal. Upper canines usually present in both sexes, and sometimes attaining a very great size in the male (see fig. 3). Lateral digits of both fore and hind feet almost always present, and frequently the lower ends of the metacarpals and the metatarsals as well. Placenta with few cotyledons. Gall-bladder absent (except in the musk-deer, *Moschus*). This family contains numerous species, having a wide geographical distribution, ranging in the New World from the Arctic circle as far south as Patagonia, and in the Old World throughout the whole of Europe and Asia, but absent in Africa south of the Sahara, and, of course, Australasia. Evidently the family originated in the northern continent of the Old World, from which an entrance was effected by way of Bering Strait into America. Some of the more northern American deer, such as the wapiti, reindeer and elk (moose), are closely allied to Old World species; but there is also a group of exclusively American deer (*Mazama*)—the only one found in Central and South America—the members of which are unlike any living Old World deer; and these must be regarded as having reached the western hemisphere at an earlier date than the wapiti, reindeer and elk (see DEER, ELK, FALLOW-DEER, MUNTJAC, MUSK-DEER, PÈRE DAVID'S DEER, REINDEER, ROEBUCK, WATER-DEER, &c.).

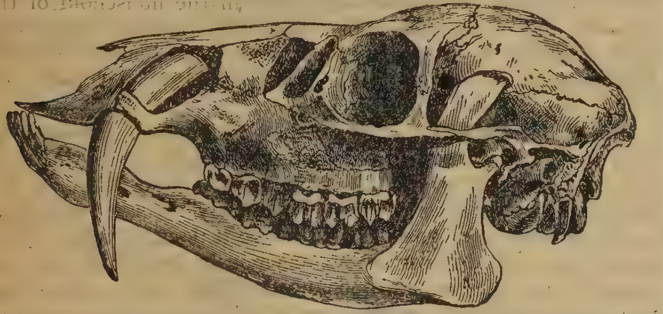


FIG. 3.—Skull of Chinese Water-Deer, *Hydrelaphus inermis* (adult male), a Deer without Antlers, but with largely developed upper canine teeth.

Remains of deer more or less nearly allied to species inhabiting the same districts are found over the greater part of the present habitat of the family. It is noteworthy, however, that certain Pliocene European deer (*Anoglochis*) appear to be closely allied to the modern American deer (*Mazama*). As we descend in the geological series the deer have simpler antlers, as in the European Miocene *Dicrocerus*; while in the Oligocene *Amphitragulus*, *Dremotherium* and *Palaeomeryx*, constituting the family *Palaeomerycidae*, antlers were absent, and the crowns of the molars so low that the whole depth of the hollows between the crescentic columns is completely visible. Most of these animals were of small size, and many had long upper canines, like those of the existing *Hydrelaphus*; while in all there was no depression for a gland in front of the eye.

From North America have been obtained remains of certain ruminants which seem in some degree intermediate between deer and the prongbuck. Of one of these a complete skeleton was obtained in 1901 from the Middle Miocene deposits of north-eastern Colorado, and as mounted stands 19 in. in height at the withers. With the exception that the right antler is malformed and partially aborted, and that the bones of the lateral toes have been lost, the skeleton is practically complete. The one complete antler has a well-marked burr and a long undivided beam, which eventually forks. After this there is a bifurcation of the hinder branch, thus producing three tines. From the presence of these well-marked antlers the skeleton would at first sight be set down as that of a small and primitive deer, conforming in regard to the structure of these appendages to the American type of the group. Mr W. D. Matthew shows, however, that the skeleton of *Merycodus*, as the extinct ruminant is called, differs markedly from that of all deer. The most noteworthy point of distinction is in the skull, in which the facial portion is sharply bent down on the posterior basal axis in the fashion characteristic of the hollow-horned ruminants (oxen, antelopes, &c.), and the American prongbuck, instead of running more or less nearly parallel to the same, as in deer. Again, the cheek-teeth have the tall crowns characteristic of a large number of representatives of the first group and of the prongbuck, thereby showing that *Merycodus* can scarcely be regarded as a primitive type. As regards the general structure of the rest of the skeleton, it must suffice to say that this agrees closely with that of the antelopes and the prongbuck, and differs markedly from the cervine type. In the absence of any trace of the lower extremities of the metacarpal and metatarsal bones of the lateral toes the skeleton differs from the American deer, and resembles those hollow-horned ruminants in which these toes persist.

As a whole *Merycodus* presents a curious mixture of cervine and antilopine character. To explain these, two alternatives are offered by the describer. Either we must regard *Merycodus* as a deer which parallels the antelopes and the prongbuck in every detail of skeletal structure, or else, like the prongbuck, an antelope separated from the main stock at a date sufficiently early to have permitted the development of a distinct type of cranial appendages, namely, antlers in place of true horns. The former alternative, it is urged, involves a parallelism too close and too uniform between unrelated types to have been probable. On the latter view *Merycodus*, the prongbuck (*Antilocapra*) and the antelopes must be regarded as representing three branches from an original common stock, divergent as regards the structure of their cranial appendages, but parallel in other respects. If, therefore, *Antilocapra* deserves to be separated as a family from the *Bovidae*, the same can scarcely be refused for *Merycodus*. But American extinct types appear to indicate signs of intimate relationship between antelopes, prongbuck and deer, and it may be necessary eventually to amend the current classification. As a temporary measure it seems preferable to regard *Merycodus* either as representing a distinct subfamily of *Antilocapridae* or a family by itself, the latter course being adopted by Mr Matthew.

Whatever be the ultimate verdict, the association of antlers—and these, be it noticed, conforming almost exactly with the forked type characteristic of American deer—with an antilopine type of skull, skeleton and teeth in *Merycodus* is a most interesting and unexpected feature. *Merycodus* was named many years ago by Professor J. Leidy on the evidence of imperfect materials, and other remains now known to belong to the same type were subsequently described as *Cosoryx*, to which *Blastomeryx* seems to be allied. Not till the discovery of the skeleton of the species described by Mr Matthew was it possible to arrive at an adequate conception of the affinities of this remarkable ruminant.

Antilocapridae.—By many modern writers the American prongbuck, pronghorn or "antelope," alone forming the genus *Antilocapra*, is regarded as representing merely a sub-family of the *Bovidae*, to which latter group the animal is structurally akin. In view of what has been stated in the preceding paragraph with regard to the extinct American genus *Merycodus*, it seems, however, at least provisionally advisable to allow the prongbuck to remain as the type of a family—*Antilocapridae*. The characteristic of this family—as represented by the prongbuck—is that the sheath of the horns is forked, and shed annually, or every few years. The cheek-teeth are tall-crowned (hypsodont), and lateral hoofs are wanting (see PRONGBUCK).

Bovidae.—Lastly, we have the great family of hollow-horned ruminants or *Bovidae*, in which the horns (present in the males at least of all the existing species) take the form of simple non-deciduous hollow sheaths growing upon bony cores. As a rule the molars are tall-crowned (hypsodont). Usually only one orifice to the lachrymal canal, situated inside the rim of the orbit. Lachrymal bone almost always articulating with the nasal. Canines absent in both sexes. The lateral toes may be completely absent, but more often are represented by the hoofs alone, supported sometimes by a very rudimentary skeleton, consisting of mere irregular nodules of bone. Lower ends of the lateral metacarpals and metatarsals never present. Gall-bladder almost always present. Placenta with many cotyledons.

The *Bovidae* form a most extensive family, with members widely distributed throughout the Old World, with the exception of the Australian region; but in America they are less numerous, and confined to the Arctic and northern temperate regions, no species being indigenous either to South or Central America. The home of the family was evidently the Old World, whence a small number of forms made their way into North America by way of what is now Bering Strait. It has already been pointed out that the *Cervidae* originated in the northern continent of the Old World; and it has been suggested that the *Bovidae* were developed in Africa. Unfortunately, we know at present practically nothing as to the past history of the group, all the fossil species at present discovered approximating more or less closely to existing types. While admitting, therefore, that there are several facts in favour of the theory of an African origin of the *Bovidae*, final judgment must for the present be suspended. For the various generic types see Bovidae, and the special articles referred to under that heading. (R. L.*)

PÉCS (Ger. *Fünfkirchen*), a town of Hungary, capital of the country of Baranya, 160 m. S.S.W. of Budapest by rail. Pop. (1900), 42,252. It lies on the outskirts of the Mecsek Hills, and is composed of the inner old town, which is laid out in an almost regular square, and four suburbs. Pécs is the see of a Roman Catholic bishop, and its cathedral, reputed one of the oldest churches in Hungary, is also one of the finest medieval buildings in the country. It was built in the 11th century in the Romanesque style with four towers, and completely restored in 1881–1891. In the Cathedral Square is situated the *Sacellum*, a subterranean brick structure, probably a burial-chapel, dating from the end of the 4th or the beginning of the 5th century. Other noteworthy buildings are the parish church, formerly a mosque of the Turkish period; the hospital church, also a former mosque, with a minaret 88 ft. high, and another mosque, the bishop's palace, and the town and county hall. Pécs has manufactories of woollens, porcelain, leather and paper, and carries on a considerable trade in tobacco, gall-nuts and wine. The hills around the town are covered with vineyards, which produce one of the best wines in Hungary. In the vicinity are valuable coal-mines, which since 1858 are worked by the Danube Steamship Company.

According to tradition Pécs existed in the time of the Romans under the name of *Sompiana*, and several remains of the Roman and early Christian period have been found here. In the Frankish-German period it was known under the name of *Quinque ecclesiae*; its bishopric was founded in 1009. King Ludwig I. founded here in 1367 a university, which existed until the battle of Mohács. In 1543 it was taken by the Turks, who retained possession of it till 1686.

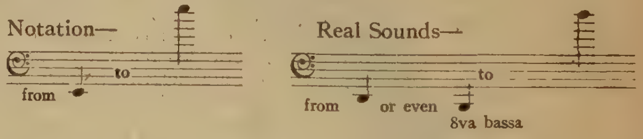
PECTORAL, a word applied to various objects worn on the breast (Lat. *pectus*); thus it is the name of the ornamental plate of metal or embroidery formerly worn by bishops of the Roman Church during the celebration of mass, the breastplate of the Jewish high priest, and the metal plate placed on the breast of the embalmed dead in Egyptian tombs. The "pectoral cross," a small cross of precious metal, is worn by bishops and abbots of the Roman, and by bishops of the Anglican, communion. The term has also been used for the more general "poitrel" or "peitrel" (the French and Norman French forms respectively), the piece of armour which protected the breast of the war-horse of the middle ages.

PECULIAR, a word now generally used in the sense of that which solely or exclusively belongs to, or is particularly characteristic of, an individual; hence strange, odd, queer. The Lat. *peculiaris* meant primarily "belonging to private property," and is formed from *peculium*, private property, particularly the property given by a *paterfamilias* to his children, or by a master to his slave, to enjoy as their own. As a term of ecclesiastical law "peculiar" is applied to those ecclesiastical districts, parishes, chapels or churches, once numerous in England, which were outside the jurisdiction of the bishop of the diocese in which they were situated, and were subject to a jurisdiction "peculiar" to themselves. They were introduced originally, in many cases by papal authority, in order to limit the powers of the bishop in his diocese. There were royal peculiars, *e.g.* the Chapel Royal St James's, or St George's Windsor, peculiars of the archbishop, over certain of which the Court of Peculiars exercised jurisdiction (see Arches, Court of), and peculiars of bishops and deans (see Dean). The jurisdiction and privileges of the "peculiars" were abolished by statutory powers given to the Ecclesiastical Commissioners, by the Ecclesiastical Commissioners Acts 1836 and 1850, by the Pluralities Act 1838, the Ecclesiastical Jurisdiction Act 1847, and other statutes.

PECULIAR PEOPLE, a small sect of Christian faith-healers founded in London in 1838 by John Banyard. They consider themselves bound by the literal interpretation of James v. 14, and in cases of sickness seek no medical aid but rely on oil, prayer and nursing. The community is in the main composed of simple working people, who, apart from their peculiarity, have a good reputation; but their avoidance of professional medical attendance has led to severe criticism at inquests on children who have died for want of it.

PEDAGOGUE, a teacher or schoolmaster, a term usually now applied with a certain amount of contempt, implying pedantry, dogmatism or narrow-mindedness. The Gr. παιδαγωγός (παῖς, boy, ἀγωγός, leader, ἄγειν, to lead), from which the English word is derived, was not strictly an instructor. He was a slave in an Athenian household who looked after the personal safety of the sons of the master of the house, kept them from bad company, and took them to and from school and the gymnasium. He probably sat with his charges in school. The boys were put in his charge at the age of six. The παιδαγωγός, being a slave, was necessarily a foreigner, usually a Thracian or Asiatic. The Romans adopted the *paedagogus* or *pedagogus* towards the end of the republic. He probably took some part in the instruction of the boys (see Schools). Under the empire, the *pedagogus* was specifically the instructor of the boy slaves, who were being trained and educated in the household of the emperor and of the rich nobles and other persons; these boys lived together in a *paedagogium*, and were known as *pueri paedagogiani*, a name which has possibly developed into "page" (*q.v.*).

PEDAL CLARINET, a contrabass instrument invented in 1891 by M. F. Besson to complete the quartet of clarinets, as the contrafagotto or double bassoon completes that of the oboe family; it is constructed on practically the same principles as the clarinet, and consists of a tube 10 ft. long, in which cylindrical and conical bores are so ingeniously combined that the acoustic principles remain unchanged. The tube is doubled up twice upon itself; at the upper end the beak mouthpiece stands out like the head of a viper, while at the lower a metal tube, in the shape of a U with a wide gloxinea-shaped bell, is joined to the wooden tube. The beak mouthpiece is exactly like that of the other clarinets but of larger size, and it is furnished with a single or beating reed. There are 13 keys and 2 rings on the tube, and the fingering is the same as for the B flat clarinet except for the eight highest semitones. The compass of the pedal clarinet is as follows:—



The instrument is in B flat two octaves below the B flat clarinet, and, like it, it is a transposing instrument, the music being written in a key a tone higher than that of the composition, and in order to avoid ledger lines a whole octave higher besides. The tone is rich and full except for the lowest notes, which are unavoidably a little rough in quality, but much more sonorous than the corresponding notes on the double bassoon. The upper register resembles the chalumeau register of the B flat clarinet, being reedy and sweet. The instrument is used as a fundamental bass for the wood wind at Kneller Hall, and it has also been used at Covent Garden to accompany the music of Fafner and Hunding in the *Nibelungen Ring*.

Many attempts have been made since the beginning of the 19th century to construct contra clarinets, but all possessed inherent faults and have been discarded (see Batyphone). A contrabass clarinet in F, an octave below the basset horn, constructed by Albert of Brussels in 1890, was, we believe, considered successful, but it differed in design from the pedal clarinet. (K. S.)

PEDANT, one who exaggerates the value of detailed erudition for its own sake; also a person who delights in a display of the exact niceties of learning, in an excessive obedience to theory without regard to practical uses. The word came into English in the latter part of the 16th century in the sense of schoolmaster, the original meaning of Ital. *pedante*, from which it is derived. The word is usually taken to be an adaptation of Gr. παιδεύειν, to teach. Others connect with an O. Ital. *pedare*, to tramp about (Lat. *pes*, foot), of an usher tramping about with his pupils.

PEDEN, ALEXANDER (*c.* 1626–1686), Scottish divine, one of the leading forces in the Covenant movement, was born at Auchincloich, Ayrshire, about 1626, and was educated at Glasgow University. He was ordained minister of New Luce in Galloway in 1660, but had to leave his parish under Middleton's Ejectment Act in 1663. For 23 years he wandered far and wide, bringing comfort and succour to his co-religionists, and often very narrowly escaping capture. He was indeed taken in June 1673 while holding a conventicle at Knockdow, and condemned by the privy council to 4 years and 3 months' imprisonment on the Bass Rock and a further 15 months in the Tolbooth at Edinburgh. In December 1678 he was, with sixty others, sentenced to banishment to the American plantations, but the party was liberated in London, and Peden made his way north again to divide the remaining years of his life between his own country and the north of Ireland. His last days were spent in a cave in the parish of Sorn, near his birthplace, and there he died in 1686, worn out by hardship and privation.

See A. Smellie, *Men of the Covenant*, ch. xxxiv.

PEDERSEN, CHRISTIERN (*c.* 1480–1554), Danish writer, known as the "father of Danish literature," was a canon of the cathedral of Lund, and in 1510 went to Paris, where he took his master's degree in 1515. In Paris he edited the proverbs of Peder Laale and (1514) the *Historia danica* of Saxo Grammaticus. He showed signs of the spirit of reform, asserting that the gospels should be translated into the vernacular so that the common people might understand. He worked at a continuation of the history of Saxo Grammaticus, and became secretary to Christian II., whom he followed into exile in 1525. In Holland he translated the New Testament (1529) and the Psalms (1531) from the Vulgate, and, becoming a convert to the reformed opinion, he issued several Lutheran tracts. After his return to Denmark in 1532 he set up a printing press at Malmö. He published a Danish version (*Krönike om Holger Danske*) of the French romance of Ogier the Dane, and another of the Charlemagne legends, which is probably derived immediately from the Norwegian *Karlamagnus saga*. His greatest work, the Danish version of the Holy Scriptures, which is known generally as "Christian III.'s Bible," is an important landmark in Danish literature. It was founded on Luther's version, and was edited by Peder Palladius, bishop of Zealand, and others.

See C. Pedersen's *Danske Skrifter*, edited by C. J. Brandt and B. T. Fenger (5 vols., Copenhagen, 1850–1856).

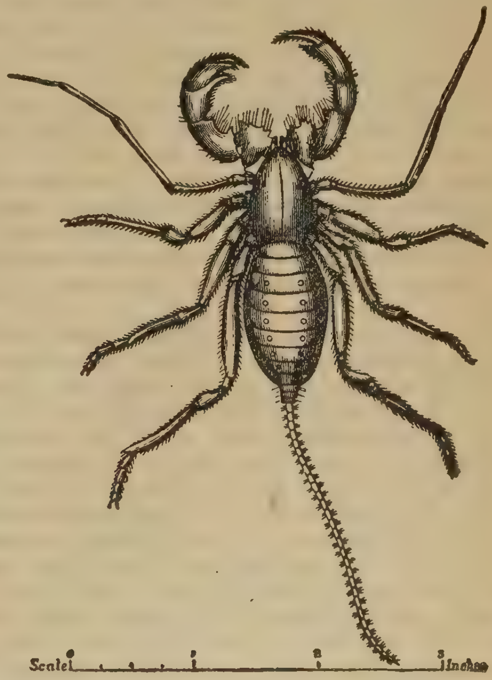
PEDESTAL (Fr. *piedestal*, Ital. *piedestallo*, foot of a stall), a term generally applied to a support, square, octagonal or circular on plan, provided to carry a statue or a vase. Although in Syria, Asia Minor and Tunisia the Romans occasionally raised the columns of their temples or propylaea on square pedestals, in Rome itself they were employed only to give greater importance to isolated columns, such as those of Trajan and Antoninus, or as a *podium* to the columns employed decoratively in the Roman triumphal arches. The architects of the Italian revival, however, conceived the idea that no order was complete without a pedestal, and as the orders were by them employed to divide up and decorate a building in several storeys, the cornice of the pedestal was carried through and formed the sills of their windows, or, in open arcades, round a court, the balustrade of the arcade. They also would seem to have considered that the height of the pedestal should correspond in its proportion with that of the column of pilaster it supported; thus in the church of St John Lateran, where the applied order is of considerable dimensions, the pedestal is 13 ft. high instead of the ordinary height of 3 to 5 ft.

PEDICULOSIS, or PHTHIRIASIS, the medical term for the pathological symptoms in man due to the presence of lice (*pediculi*), either on the head (*pediculus capitis*), body (*pediculus corporis*, or *vestimentorum*), or pubes (*pediculus pubis*).

PEDIGREE, a genealogical tree, a tabular statement of descent (see GENEALOGY). The word first appears at the beginning of the 15th century and takes an extraordinary variety of forms, *e.g. pedicree, pe de gre, petiegrew, petygru*, &c. It is generally accepted that these point to a corruption of Fr. *pied de grue*, foot of a crane, and that the probable reference is to the marks resembling the claw of a bird found in old genealogies showing the lines of descent. Such etymologies as Minshea's *par degrés*, by degrees, or *père degrés*, descent by the father, are mere guesses.

PEDIMENT (equivalents, Gr. ἀετός, Lat. *fastigium*, Fr. *ponton*), in classic architecture the triangular-shaped portion of the wall above the cornice which formed the termination of the roof behind it. The projecting mouldings of the cornice which surround it enclose the tympanum, which is sometimes decorated with sculpture. The pediment in classic architecture corresponds to the gable in Gothic architecture, where the roof is of loftier pitch. It was employed by the Greeks only as the front of the roof which covered the main building; the Romans, however, adopted it as a decorative termination to a doorway, niche or window, and occasionally, in a row of windows or niches, alternated the triangular with a segmental pediment. It was reserved for the Italian architects of the decadence to break the pediment in the centre, thus destroying its original purpose. The earliest English form of the word is *periment or peremint*, probably a workman's corruption of "pyramid."

PEDIPALPI, Arachnida (*q.v.*) related to the spiders, and serving in a measure to bridge over the structural interval between the latter and the scorpions. The appendages of the second pair are large and prehensile, as in scorpions, but are armed with spines, to impale and hold prey. The appendages of the third pair, representing the first pair of walking legs in spiders and scorpions, are, on the contrary, long, attenuated and many-jointed at the end. Like the antennae of insects, they act as feelers. It is from this structural feature that the term "pedipalpi" has been derived. In the tailless division of the Pedipalpi, namely the Amblypygi of which *Phrynus* is a commonly cited type, these tactile appendages are exceedingly long and lash-like, whereas in the tailed division, the Uropygi, of which *Thelyphonus* is best known, the limb is much shorter and less modified. *Thelyphonus* and its allies, however, have a long tactile caudal flagellum, the homologue of the scorpion's sting; but its exact use is unknown. A third division, the Tartarides, a subordinate group of the Uropygi, contains minute Arachnida differing principally from the typical Uropygi in having the caudal process unjointed and short. Apart from the Tartarides, the Pedipalpi



Mexican tailed Pedipalp (*Mastigoproetus giganteus*).

are large or medium-sized Arachnida, nocturnal in habits and spending the day under stones, logs of wood or loosened bark. Some species of the Uropygi (Thelyphonidae) dig burrows; and in the east there is a family of Amblypygi, the Charontidae, of which many of the species live in the recesses of deep caves. Specimens of another species have been found under stones between tide marks in the Andaman Islands. The Pedipalpi feed upon insects, and like spiders, are oviparous. The eggs after being laid are carried about by the mother, adhering in a glutinous mass to the underside of the abdomen.

Pedipalpi date back to the Carboniferous Period, occurring in deposits of that age both in Europe and North America. Moreover, the two main divisions of the order, which were as sharply differentiated then as they are now, have existed practically unchanged from that remote epoch.

In spite of the untold ages they have been in existence, the Pedipalpi are more restricted in range than the scorpions. The Uropygi are found only in Central and South America and in south and eastern Asia, from India and south China to the Solomon Islands. The absence of the entire order from Africa is an interesting fact. The distribution of the Amblypygi practically covers that of the Uropygi, but in addition they extend from India through Arabia into tropical and southern Africa. Both groups are unknown in Madagascar, in Australia, with the exception possibly of the extreme north, and in New Zealand. Very little can be said with certainty about the distribution of the Tartarides. They have been recorded from the Indian Region, West Africa and sub-tropical America. (R. I. P.)

PEDOMETER (Lat. *pes*, foot, and Gr. *μέτρον*, measure), an apparatus in the form of a watch, which, carried on the person of a walker, counts the number of paces he makes, and thus indicates approximately the distance travelled. The ordinary form has a dial-plate marked for yards and miles. The registration is effected by the fall of a heavy pendulum, caused by the percussion of each step. The pendulum is forced back to a horizontal position by a delicate spring, and with each stroke a fine-toothed ratchet-wheel connected with it is moved round a certain length. The ratchet communicates with a train of wheels which work the dial-hands. In using the apparatus a measured mile or other known distance is walked and the indication thereby made on the dial-plate observed. According as it is too great or too small, the stroke of the pendulum is shortened or lengthened by a screw. Obviously the pedometer is little better than an ingenious toy, depending even for rough measurements on the uniformity of pace maintained throughout the journey measured.

PEDRO II. (1825–1891), emperor of Brazil, came to the throne in childhood, having been born on the 2nd of December 1825, and proclaimed emperor in April 1831, upon the abdication of his father. He was declared of full age in 1840. For a long period few thrones appeared more secure, and his prosperous and beneficent rule might have endured throughout his life but for his want of energy and inattention to the signs of the times. The rising generation had become honeycombed with republicanism, the prospects of the imperial succession were justly regarded as unsatisfactory, the higher classes had been estranged by the emancipation of the slaves, and all these causes of discontent found expression in a military revolt, which in November 1889 overthrew the seemingly solid edifice of the Brazilian Empire in a few hours. Dom Pedro retired to Europe, and died in Paris on the 5th of December 1891. The chief events of his reign had been the emancipation of the slaves, and the war with Paraguay in 1864–70. Dom Pedro was a model constitutional sovereign, and a munificent patron of science and letters. He travelled in the United States (1876), and thrice visited Europe (1871–1872, 1876–1877, 1886–1889).

PEEBLES, a royal and police burgh and county town of Peeblesshire, Scotland, situated at the junction of Eddleston Water with the Tweed. Pop. (1901), 5266. It is 27 m. south of Edinburgh by the North British Railway (22 m. by road), and is also the terminus of a branch line of the Caledonian system from Carstairs in Lanarkshire. The burgh consists of the new town, the principal quarter, on the south of the Eddleston, and the old on the north; the Tweed is crossed by a handsome five-arched bridge. Peebles is a noted haunt of anglers, and the Royal Company of Archers shoot here periodically for the silver arrow given by the burgh. The chief public buildings are the town and county halls, the corn exchange, the hospital and Chambers Institution. The last was once the town house of the earls of March, but was presented to Peebles by William Chambers, the publisher, in 1859. The site of the castle, which stood till the beginning of the 18th century, is now occupied by the parish church, built in 1887. Of St Andrew's Church, founded in 1195, nothing remains but the tower, restored by William Chambers, who was buried beside it in 1883. The church of the Holy Rood was erected by Alexander III. in 1261, to contain a supposed remnant of the true cross discovered here. The building remained till 1784, when it was nearly demolished to provide stones for a new parish church. Portions of the town walls still exist, and there are also vaulted cellars constructed in the 16th and 17th centuries as hiding-places against Border freebooters. The old cross, which had stood for several years in the quadrangle of Chambers Institution, was restored and erected in High Street in 1895. The industries consist of the manufactures of woollens and tweeds, and of meal and flour mills. The town is also an important agricultural centre.

The name of Peebles is said to be derived from the *pebylls*, or tents, which the Gadeni pitched here in the days of the Romans. The place was early a favourite residence of the Scots kings when they came to hunt in Ettrick forest. It probably received its charter from Alexander III., was created a royal burgh in 1367 and was the scene of the poem of *Peblis to the Play*, ascribed to James I. In 1544 the town sustained heavy damage in the expedition led by the 1st earl of Hertford, afterwards the protector Somerset, and in 1604 a large portion of it was destroyed by fire. Though James VI. extended its charter, Peebles lost its importance after the union of the Crowns.

On the north bank of the Tweed, one mile west of Peebles, stands Neidpath Castle. The ancient peel tower dates probably from the 13th century. Its first owners were Tweeddale Frasers or Frisels, from whom it passed, by marriage, to the Hays of Yester in Haddingtonshire, earls of Tweeddale. It was besieged and taken by Cromwell in 1650. The third earl of Tweeddale (1645–1713) sold it to the duke of Queensberry in 1686. The earl of Wemyss succeeded to the Neidpath property in 1810.

PEEBLESSHIRE, or TWEEDDALE, a southern inland county of Scotland, bounded N. and N.E. by Edinburghshire, E. and S.E. by Selkirkshire, S. by Dumfriesshire, and W. by Lanarkshire. Its area is 222,599 acres or 547·8 sq. m. The surface consists of a succession of hills, which are highest in the south, broken by the vale of the Tweed and the glens formed by its numerous tributaries. South of the Tweed the highest points are Broad Law and Cramalt Craig on the confines of Selkirkshire (each 2723 ft.), while north of the river are, in the west centre, Broughton Heights (1872), Trahenna Hill (1792), Penvalla (1764) and Ladyurd Hill (1724), and in the north-west the Pentland eminences of Mount Maw (1753), Byrehope Mount (1752) and King Seat (1521). The lowest point above sea-level is on the banks of the Tweed, where it passes into Selkirkshire (about 450 ft.). The principal river is the Tweed, and from the fact that for the first 36 m. of its course of 97 m. it flows through the south of the shire, the county derives its alternative name of Tweeddale. Its affluents on the right are the Stanhope, Drummelzier, Manor and Quair; on the left, the Biggar, Lyne, Eddlestone and Leithen. The North Esk, rising in Cairnmuir, forms the boundary line between Midlothian and Peeblesshire for about four miles, during which it presents some very charming pictures, especially at Habbie's Howe, where Allan Ramsay laid the scene of the *Gentle Shepherd*. For 4 m. of its course the South Medwin divides the south-western part of the parish of Linton from Lanarkshire. Portmore Loch, a small sheet of water 2 m. north-east of Eddlestone church, lies at a height of 1000 ft. above the sea, and is the only lake in the county. The shire is in favour with anglers, its streams being well stocked and unpolluted, and few restrictions being placed on the fishing.

Geology.—The southern elevated portion of the county is occupied by Silurian rocks, mainly by shales and grits or greywackes of Llandovery age. Owing to the repeated folding and crumpling of the rocks in this region there are numerous elliptical exposures of Ordovician strata within the Silurian tract; but the principal area of Ordovician rocks lies north of a line running south-west from the Moorfoot Hills through Lyne and Stobo. Here these rocks form a belt some four to five miles in breadth; they are composed of radiolarian cherts and mudstones with associated contemporaneous volcanic rocks of Arenig age, and of shales, grits and limestones of Llandeilo and Caradoc age. The general direction of strike of all these formations is south-west–north-east, but the dips are sometimes misleading through occasional inversion of the strata. Patches of higher Silurian, with Wenlock and Ludlow fossils, are found in the north of the country in the Pentland Hills, and resting conformably upon the Silurian in the same district is the Lower Old Red Sandstone. The Old Red Sandstone here consists of a lower division, red and chocolate marls and sandstones; a middle division, volcanic rocks, porphyrites, tuffs, &c., which are unconformable on the lower marls in this area; and an upper division, sandstones and conglomerates. The south-west extremity of the Edinburgh coalfield just enters this county over the north-west border where a slice of Carboniferous strata is found let down between Silurian and Old Red rocks by two important faults. Both Calciferous sandstone and Carboniferous limestone occur, with useful beds of coal, limestone, ironstone, fireclay and alum shale. An outlier of Carboniferous limestone, surrounded by Lower Old Red Sandstone, lies south of Linton. Much glacial boulder clay with gravel and sand rests upon the higher ground, while morainic deposits are found in the valleys.

Climate and Industries.—The annual rainfall averages from 33 to 41 in.; the mean temperature for the year is 47·5° F., for January 38° F., and for July 59° F. The character of the soil varies considerably, peat, gravel and clay being all represented. The low-lying lands consist generally of rich loam, composed of sand and clay. The farming is pastoral rather than arable. The average holding is about 200 acres of arable land, with pasturage for from 600 to 800 sheep. Roughly speaking, one-fifth of the total area is under cultivation. Oats are the chief grain and turnips the chief root crop. The hill pastures are better suited to sheep than to cattle, but both flocks and herds are comparatively large. Cheviots and half-breds are preferred for the grass lands, the heathery ranges being stocked with black-faced sheep. Crosses of Cheviots, black-faced and half-bred ewes with Leicestershire rams are common. The favourite breed of cattle is a cross between Ayrshires and shorthorns, the cows being Ayrshire. Many of the horses are Clydesdales bred in the county. Pig-keeping is on the decline. A few acres have been laid down as nurseries and market gardens, and about 10,000 acres are under wood, especially at Dalwick, where larch and horse-chestnut were first grown in Scotland. Apart from agriculture, the only industries are the woollen factories and flour mills at Peebles and Innerleithen.

The North British railway crosses the county in the north from Leadburn to Dolphinton, and runs down the Eddlestone valley from Leadburn to Peebles and Thornielee, while in the south the Caledonian railway connects the county town with Biggar in Lanarkshire.

Population and Administration.—In 1901 the population numbered 15,066 or 43 persons to the sq. m. In 1901 one person spoke Gaelic only, 72 Gaelic and English. The chief towns are Peebles (pop. 5266) and Innerleithen (2181). West Linton, on Lyne Water, is a holiday resort. The shire combines with Selkirkshire to return one member to parliament, the electors of Peebles town voting with the county. Peeblesshire forms a sheriffdom with the Lothians and a sheriff-substitute sits in the county town. There is a high school in Peebles, and one or more schools in the county usually earn grants for secondary education.

History.—The country was originally occupied by the Gadeni, a British tribe, of whom there are many remains in the shape of camps and sepulchral mounds (in which stone coffins, axes and hammers have been found), while several place-names (such as Peebles, Dalwick and Stobo) also attest their presence. The standing stones near the confluence of the Lyne and Tweed are supposed to commemorate a Cymric chief. The natives were reduced by the Romans, who have left traces of their military rule in the fine camp at Lyne, locally known as Randal's Walls. The hill-side terraces at Romanno are conjectured, somewhat fancifully, to be remains of a Roman method of cultivation. On the retreat of the Romans the Gadeni came into their own again, and although they are said to have been defeated by King Arthur at Cademuir in 530, they held the district until the consolidation of the kingdom after Malcolm II.'s victory at Carham in 1018, before which the land, constantly harried by Danes, was nominally included in the territory of Northumbria. This tract of Scotland is closely associated with the legend of Merlin. David I. made the district a deanery in the archdeaconry of Peebles, and it afterwards formed part of the diocese of Glasgow. Towards the middle of the 12th century it was placed under the jurisdiction of two sheriffs, one of whom was settled at Traquair and the other at Peebles. At Happrew, in the valley of the Lyne, the English defeated Wallace in 1304. The Scottish sovereigns had a lodge at Polmood, and often hunted in the uplands and the adjoining forests. English armies occasionally invaded the county, but more frequently the people were harried by Border raiders. Many castles and peels were erected in the valley of the Tweed from the Bield to Berwick. Several were renowned in their day, among them Oliver Castle (built by Sir Oliver Fraser in the reign of David I.), Drumelzier, Tinnis or Thane's Castle, and Neidpath. Three miles south of Romanno stand the ruins of Drochil Castle, designed for the Regent Morton, who was beheaded at Edinburgh in 1581, and the building was never completed. Memories of the Covenanters cluster around Tweedhopefoot, Tweedshaws, Corehead, Tweedsmuir, Talla Linns and other spots. In the churchyard of Tweedsmuir is the tombstone of John Hunter, the martyr, which was relettered by "Old Mortality." The "men of the moss hags" did little fighting in Peeblesshire, but Montrose first drew rein at Traquair House after he was defeated at Philiphaugh on the Yarrow in 1645. The plain of Sheriffmuir near Lyne is the place where the Tweeddale wapinschaws used to be held in the 17th century. The Jacobite risings left the county untouched, and since the beginning of the 19th century the shire has been more conspicuous in literature than in politics.

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PEEKSKILL, a village of Westchester county, New York, U.S.A., on the E. bank of the Hudson river, about 41 m. N. of New York City. Pop. (1910, census), 15,245. It is served by the New York Central & Hudson River railway, and by passenger and freight steamboat lines on the Hudson river. The village is the home of many New York business men. At Peekskill are the Peekskill military academy (1833, non-sectarian); St Mary's school, Mount St Gabriel (Protestant Episcopal), a school for girls established by the sisterhood of St Mary; the Field memorial library; St Joseph's home (Roman Catholic); the Peekskill hospital, and several sanatoria. Near the village is the state military camp, where the national guard of the state meets in annual encampment. Peekskill has many manufactures, and the factory products were valued in 1905 at $7,251,897, an increase of 306·7% since 1900. The site was settled early in the 18th century, but the village itself dates from about 1760, when it took its present name from the adjacent creek or "kill," on which a Dutch trader, Jans Peek, of New York City, had established a trading post. During the latter part of the War of Independence Peekskill was an important outpost of the Continental Army, and in the neighbourhood several small engagements were fought between American and British scouting parties. The village was incorporated in 1816. Peekskill was the country home of Henry Ward Beecher.

PEEL, ARTHUR WELLESLEY PEEL, 1st Viscount (1829–), English statesman, youngest son of the great Sir Robert Peel, was born on the 3rd of August 1829, and was educated at Eton and Balliol College, Oxford. He unsuccessfully contested Coventry in 1863; in 1865 he was elected in the liberal interest for Warwick, for which he sat until his elevation to the peerage. In December 1868 he was appointed parliamentary secretary to the poor law board. This office he filled until 1871, when he became secretary to the board of trade, an appointment which he held for two years. In 1873–1874 he was patronage secretary to the treasury, and in 1880 he became under-secretary for the home department. On the retirement of Mr Brand (afterwards Viscount Hampden) in 1884, Peel was elected Speaker. He was thrice re-elected to the post, twice in 1886, and again in 1892. Throughout his career as Speaker he exhibited conspicuous impartiality, combined with a perfect knowledge of the traditions, usages and forms of the house, soundness of judgment, and readiness of decision upon all occasions; and he will always rank as one of the greatest holders of this important office. On the 8th of April 1895 he announced that for reasons of health he was compelled to retire. The farewell ceremony was of a most impressive character, and warm tributes were paid from all parts of the house. He was created a viscount and granted a pension of £4000 for life. He was presented with the freedom of the City of London in July 1895. The public interest in the ex-Speaker's later life centred entirely in his somewhat controversial connexion with the drink traffic. A royal commission was appointed in April 1896 to inquire into the operation and administration of the licensing laws, and Viscount Peel was appointed chairman. In July 1898 Lord Peel drew up a draft report for discussion, in five parts. Some differences of opinion arose in connexion with the report, and at a meeting of the commissioners on the 12th of April 1899, when part 5 of the draft report was to be considered, a proposal was made to substitute an alternative draft for Lord Peel's, and also a series of alternative drafts for the four sections already discussed. Lord Peel declined to put these proposals, and left the room. Sir Algernon West was elected to the chair, and ultimately two main reports were presented, one section agreeing with Lord Peel, and the other—including the majority of the commissioners—presenting a report which differed from his in several important respects. The Peel report recommended that a large reduction in the number of licensed houses should be immediately effected, and that no compensation should be paid from the public rates or taxes, the money for this purpose being raised by an annual licence-rental levied on the rateable value of the licensed premises; it at once became a valuable weapon in the hands of advanced reformers.

Lord Peel married in 1862, and had four sons and two daughters (married to Mr J. Rochfort Maguire and to Mr C. S. Goldman). His eldest son, William Robert Wellesley Peel (b. 1866), married the daughter of Lord Ashton; he was Unionist M.P. for South Manchester from 1900 to 1905, and later for Taunton, and also acted as Municipal Reform leader on the London County Council.

PEEL, SIR ROBERT, Bart. (1788–1850), English statesman, was born on the 5th of February 1788 at Chamber Hall, in the neighbourhood of Bury, Lancashire, or, less probably, at a cottage near the Hall. He was a scion of that new aristocracy of wealth which sprang from the rapid progress of mechanical discovery and manufactures in the latter part of the 18th century. His ancestors were Yorkshire yeomen in the district of Craven, whence they migrated to Blackburn in Lancashire. His grandfather, Robert Peel, first of Peeltold, and afterwards of Brookside, near Blackburn, was a calico-printer, who, appreciating the discovery of his townsman Hargreaves, took to cotton-spinning with the spinning-jenny and grew a wealthy man. His father, Robert Peel (1750–1830), third son of the last-named, carried on the same business at Bury with still greater success, in partnership with his uncle, Mr Haworth, and Mr Yates, whose daughter, Ellen, he married. He made a princely fortune, became the owner of Drayton Manor and member of parliament for the neighbouring borough of Tamworth, was a trusted and honoured, as well as ardent, supporter of Pitt, contributed munificently towards the support of that leader's war policy, and was rewarded with a baronetcy (1800).

At Harrow, according to the accounts of ~~his~~ contemporaries, Peel was a steady industrious boy, the best scholar in the school, fonder of country walks with a friend than of school games, but reputed one of the best football players. At Christ Church, where he entered as a gentleman commoner, he was the first who, under the new examination statutes, took a first class both in classics and in mathematics. His examination for his B.A. degree in 1808 was an academical ovation in presence of a numerous audience, who came to hear the first man of the day. From his classical studies Robert Peel derived not only the classical, though somewhat pompous, character of his speeches and the Latin quotations with which they were often happily interspersed but something of his lofty ideal of political ambition. To his mathematical training, which was then not common among public men, he no doubt owed in part his method, his clearness, his great power of grasping steadily and working out difficult and complicated questions. His speeches show that, in addition to his academical knowledge, he was well versed in English literature, in history, and in the principles of law, in order to study which he entered at Lincoln's Inn. But while reading hard he did not neglect to develop his tall and vigorous frame, and, though he lost his life partly through his bad riding, he was always a good shot and an untiring walker after game. His Oxford education confirmed his atachment to the Church of England. His practical mind remained satisfied with the doctrines of his youth, and he never showed that he had studied the great religious controversies of his day.

In 1809, being then in his twenty-second year, he was brought into parliament for the close borough of Cashel, which he afterwards exchanged for Chippenham, and commenced his parliamentary career under the eye of his father, then member for Tamworth, who fondly saw in him the future leader of the Tory party. In that House of Commons sat Wilberforce, Windham, Tierney, Grattan, Perceval, Castlereagh, Plunkett, Romilly, Mackintosh, Burdett, Whitbread, Horner, Brougham, Parnell, Huskisson, and, above all, George Canning. Lord Palmerston entered the house two years earlier, and Lord John Russell three years later. Among these men young Peel had to rise. And he rose, not by splendid eloquence, by profound political philosophy or by great originality of thought, but by the closest attention to all his parliamentary duties, by a study of all the business of parliament, and by a style of speaking which owed its force not to high flights of oratory, but to knowledge of the subject in hand, clearness of exposition, close reasoning, and tact in dealing with a parliamentary audience. With the close of the struggle against revolutionary France, political progress in England was soon to resume the march which that struggle had arrested. Young Peel's lot, however, was cast, through his father, with the Tory party. In his maiden speech in 1810, seconding the address, he defended the Walcheren expedition, which he again vindicated soon afterwards against the report of Lord Porchester's committee. It is said that even then his father had discerned in him a tendency to think for himself, and told Lord Liverpool that to make sure of his support it would be well to place him early in harness. At all events he began official life in 1810 as Lord Liverpool's under-secretary for war and the colonies under the administration of Perceval. In 1812 he was transferred by Lord Liverpool to the more important but unhappy post of secretary for Ireland. There he was engaged till 1818 in maintaining English ascendancy over a country heaving with discontent, teeming with conspiracy, and ever ready to burst into rebellion. A middle course between Irish parties was impossible, and Peel plied the established engines of coercion and patronage with a vigorous hand. At the same time, it was his frequent duty to combat Grattan, Plunkett, Canning and the other movers and advocates of Roman Catholic emancipation in the House of Commons. He, however, always spoke on this question with a command of temper wonderful in hot youth, with the utmost courtesy towards his opponents, and with warm expressions of sympathy and even of admiration for the Irish people. He also, thus early, did his best to advocate and promote joint education in Ireland as a means of reconciling sects and raising the character of the people. But his greatest service to Ireland as secretary was the institution of the regular Irish constabulary, nicknamed after him "Peelers," for the protection of life and property in a country where both were insecure. His moderation of tone did not save him from the violent abuse of O'Connell, whom he was ill advised enough to challenge—an affair which covered them both with ridicule. In 1817 he obtained the highest parliamentary distinction of the Tory party by being elected member for the university of Oxford—an honour for which he was chosen in preference to Canning on account of his hostility to Roman Catholic emancipation, Lord Eldon lending him his best support. In the following year he resigned the Irish secretaryship, of which he had long been very weary, and remained out of office till 1821. But he still supported the ministers, though in the affair of Queen Caroline he stood aloof, disapproving some steps taken by the government, and sensitive to popular opinion; and when Canning retired on account of this affair Peel declined Lord Liverpool's invitation to take the vacant place in the cabinet. During this break in his tenure of office he had some time for reflection, which there was enough in the aspect of the political world to move. But early office had done its work. It had given him excellent habits of business, great knowledge and a high position; but it had left him somewhat stiff and punctilious, too cold and reserved and over anxious for formal justifications when he might well have left his conduct to the judgment of men of honour and the heart of the people. At the same time he was no pedant in business; in corresponding on political subjects he loved to throw off official forms and communicate his views with the freedom of private correspondence; and where his confidence was given, it was given without reserve.

At this period he was made chairman of the bullion committee on the death of Horner. He was chosen for this important office by Huskisson, Ricardo and their fellow-economists, who saw in him a mind open to conviction, though he owed hereditary allegiance to Pitt's financial policy, and had actually voted with his Pittite father for a resolution of Lord Liverpool's government asserting that Bank of England notes were equivalent to legal coin. The choice proved judicious. Peel was converted to the currency doctrines of the economists, and proclaimed his conversion in a great speech on the 24th of May 1819, in which he moved and carried four resolutions embodying the recommendations of the bullion committee in favour of a return to cash payments. This laid the foundation of his financial reputation, and his co-operation with the economists tended to give a liberal turn to his commercial principles. In the course he took he somewhat diverged from his party, and particularly from his father, who remained faithful to Pitt's depreciated paper, and between whom and his schismatic son a solemn and touching passage occurred in the debate. The author of the Cash Payments Act had often to defend his policy, and he did so with vigour. The act is sometimes said to have been hard on debtors, including the nation as debtor, because it required debts to be paid in cash which had been contracted in depreciated paper; and Peel, as heir to a great fundholder, was even charged with being biased by his personal interests. But it is answered that the Bank Restriction Acts, under which the depreciated paper had circulated, themselves contained a provision for a return to cash payments six months after peace.

In 1820 Peel married Julia, daughter of General Sir John Floyd, who bore him five sons and two daughters. The writers who have most severely censured Sir Robert Peel as a public man have dwelt on the virtues and happiness of his private and domestic life. He was not only a most loving husband and father but a true and warm-hearted friend. In Whitehall Gardens or at Drayton Manor he gathered some of the most distinguished intellects of the day. He indulged in free and cheerful talk, and sought the conversation of men of science; he took delight in art, and was a great collector of pictures; he was fond of farming and agricultural improvements; he actively promoted useful works and the advancement of knowledge; he loved making his friends, dependants, tenants and neighbours happy. And, cold as he was in public, few men could be more bright and genial in private than Sir Robert Peel.

In 1821 Peel consented to strengthen the enfeebled ministry of Lord Liverpool by becoming home secretary; and in that capacity he had again to undertake the office of coercing the growing discontent in Ireland, of which he remained the real administrator, and had again to lead in the House of Commons the opposition to the rising cause of Roman Catholic emancipation. In 1825, being defeated on the Roman Catholic question in the House of Commons, he wished to resign office, but Lord Liverpool pleaded that his resignation would break up the government. He found a congenial task in reforming and humanizing the criminal law, especially those parts of it which related to offences against property and offences punishable by death. The five acts in which Peel accomplished this great work, as well as the great speech of the 9th of March 1826, in which he opened the subject to the house, will form one of the most solid and enduring monuments of his fame. Criminal law reform was the reform of Romilly and Mackintosh, from the hands of the latter of whom Peel received it. But the masterly bills in which it was embodied were the bills of Peel—not himself a creative genius, but, like the founder of his house, a profound appreciator of other men's creations, and unrivalled in the power of giving them practical and complete effect.

In 1827 the Liverpool ministry was broken up by the fatal illness of its chief, and under the new premier, George Canning, Peel, like the duke of Wellington and other high Tory members of Lord Liverpool's cabinet, refused to serve. Canning and Peel were rivals; but we need not interpret as mere personal rivalry that which was certainly, in part at least, a real difference of connexion and opinion. Canning took a Liberal line, and was supported by many of the Whigs; the seceders were Tories, and it is difficult to see how their position in Canning's cabinet could have been otherwise than a false one. Separation led to public coolness and occasional approaches to bitterness on both sides in debate. But there seems no ground for exaggerated complaints against Peel's conduct. Canning himself said to a friend that "Peel was the only man who had behaved decently towards him." Their private intercourse remained uninterrupted to the end; and Canning's son afterwards entered public life under the auspices of Peel. The charge of having urged Roman Catholic emancipation on Lord Liverpool in 1825, and opposed Canning for being a friend to it in 1827, made against Sir Robert Peel in the fierce corn-law debates of 1846, has been withdrawn by those who made it.

In January 1828, after Canning's death, the duke of Wellington formed a Tory government, in which Peel was home secretary and leader of the House of Commons. This cabinet, Tory as it was, did not include the impracticable Lord Eldon, and did include Huskisson and three more friends of Canning. Its policy was to endeavour to stave off the growing demand for organic change by administrative reform, and by lightening the burdens of the people. The civil list was retrenched with an unsparing hand, the public expenditure was reduced lower than it had been since the Revolutionary war, and the import of corn was permitted under a sliding scale of duties. Peel also introduced into London the improved system of police which he had previously established with so much success in Ireland. But the tide ran too strong to be thus headed. First the government were compelled, after a defeat in the House of Commons, to acquiesce in the repeal of the Test and Corporation Acts, Peel bringing over their High Church supporters, as far as he could. Immediately afterwards the question of Roman Catholic emancipation was brought to a crisis by the election of O'Connell for the county of Clare. In August Peel expressed to the duke of Wellington his conviction that the question must be settled. He wrote that out of office he would co-operate in the settlement but in his judgment it should be committed to other hands than his. To this the duke assented, but in January 1829, owing to the declared opinions of the king, of the House of Lords, and of the Church against a change of policy, Wellington came to the conclusion that without Peel's aid in office there was no prospect of success. Under that pressure Peel consented to remain, and all the cabinet approved. The consent of the king, which could scarcely have been obtained except by the duke and Peel, was extorted, withdrawn (the ministers being out for a few hours), and again extorted; and on the 5th of March 1829 Peel proposed Roman Catholic emancipation in a speech of more than four hours. The apostate was overwhelmed with obloquy. Having been elected for the university of Oxford as a leading opponent of the Roman Catholics, he had thought it right to resign his seat on being converted to emancipation. His friends put him again in nomination, but he was defeated by Sir R. H. Inglis. He took refuge in the close borough of Westbury, whence he afterwards removed to Tamworth, for which he sat till his death. Catholic emancipation was forced on Peel by circumstances; but it was mainly owing to him that the measure was complete, and based upon equality of civil rights. This great concession, however, did not save the Tory government. The French Revolution of July 1830 gave fresh strength to the movement against them, though, schooled by the past, they promptly recognized King Louis Philippe. The parliamentary reform movement was joined by some of their offended Protestant supporters. The duke of Wellington committed them fatally against all reform, and the elections went against them on the demise of the Crown; they were beaten on Sir H. Parnell's motion for a committee on the civil list, and Wellington took the opportunity to resign rather than deal with reform.

While in office, Peel succeeded to the baronetcy, Drayton Manor and a great estate by the death of his father (May 3, 1830). The old man had lived to see his fondest hopes fulfilled in the greatness of his son; but he had also lived to see that a father must not expect to fix his son's opinions—above all, the opinions of such a son as Sir Robert Peel, and in such an age as that which followed the French Revolution.

Sir Robert Peel's resistance to the Reform Bill won back for him the allegiance of his party. His opposition was resolute but it was temperate, and once only he betrayed the suppressed fire of his temper, in the historical debate of the 22nd of April 1831, when his speech was broken off by the arrival of the king to dissolve the parliament which had thrown out reform. He refused to join the duke of Wellington in the desperate enterprise of forming a Tory government at the height of the storm, when the Grey ministry had gone out on the refusal of the king to promise them an unlimited creation of peers. By this conduct he secured for his party the full benefit of the reaction which he no doubt knew was sure to ensue. The general election of 1832, after the passing of the Reform Bill, left him with barely 150 followers in the House of Commons; but this handful rapidly swelled under his management into the great Conservative party. He frankly accepted the Reform Act as irrevocable, taught his party to register instead of despairing, appealed to the intelligence of the middle classes, whose new-born power he appreciated, steadily supported the Whig ministers against the Radicals and O'Connell, and gained every moral advantage which the most dignified and constitutional tactics could afford. To this policy, and to the great parliamentary powers of its author, it was mainly due that, in the course of a few years, the Conservatives were as strong in the reformed parliament as the Tories had been in the unreformed. It is vain to deny the praise of genius to such a leader, though the skill of a pilot who steered for many years over such waters may sometimes have resembled craft. But the duke of Wellington's emphatic eulogy on him was, "Of all the men I ever knew, he had the greatest regard for truth." The duke might have added that his own question, "How is the king's government to be carried on in a reformed parliament?" was mainly solved by the temperate and constitutional policy of Sir Robert Peel, and by his personal influence on the debates and proceedings of the House of Commons during the years which followed the Reform Act.

In 1834, on the dismissal of the Melbourne ministry, power came to Sir Robert Peel before he expected or desired it. He hurried from Rome at the call of the duke of Wellington, whose sagacious modesty yielded him the first place, and became prime minister, holding the two offices of first lord of the treasury and chancellor of the exchequer. He vainly sought to include in his cabinet two recent seceders from the Whigs, Lord Stanley and Sir James Graham. A dissolution gave him a great increase of strength in the house, but not enough. He was outvoted on the election of the speaker at the opening of the session of 1835, and, after struggling on for six weeks longer, resigned on the question of appropriating part of the revenues of the Church in Ireland to national education. His time had not yet come; but the capacity, energy and resource he displayed in this short tenure of office raised him immensely in the estimation of the house, his party and the country. Of the great budget of practical reforms which he brought forward, the plan for the commutation of tithes, the ecclesiastical commission, and the plan for settling the question of dissenters' marriages bore fruit.

From 1835 to 1840 he pursued the same course of patient and far-sighted opposition. In 1837 the Conservative members of the House of Commons gave their leader a grand banquet at Merchant Taylors' Hall, where he proclaimed in a great speech the creed and objects of his party. In 1839, the Whigs having resigned on the Jamaica Bill, he was called on to form a government, and submitted names for a cabinet, but resigned the commission owing to the young queen's persistent refusal to part with any Whig ladies of her bedchamber (see **Victoria, Queen**). In 1840 he was hurried into a premature motion of want of confidence. But in the following year a similar motion was carried by a majority of one, and the Whigs ventured to appeal to the country. The result was a majority of ninety-one against them on a motion of want of confidence in the autumn of 1841, upon which they resigned, and Sir Robert Peel became first lord of the treasury, with a commanding majority in both Houses of Parliament.

The crisis called for a master-hand. The finances were in disorder. For some years there had been a growing deficit, estimated for 1842 at more than two millions, and attempts to supply this by additions to assessed taxes and customs duties had failed. The great financier took till the spring of 1842 to mature his plans. He then boldly supplied the deficit by imposing an income-tax on all incomes above £150 a year. He accompanied this tax with a reform of the tariff, by which prohibitory duties were removed and other duties abated on a vast number of articles of import, especially the raw materials of manufactures and prime articles of food. The increased consumption, as the reformer expected, countervailed the reduction of duty. The income-tax was renewed and the reform of the tariff carried still farther on the same principle in 1845. The result was, in place of a deficit of upwards of two millions, a surplus of five millions in 1845, and the removal of seven millions and a half of taxes up to 1847, not only without loss, but with gain to the ordinary revenue of the country. The prosperous state of the finances and of public affairs also permitted a reduction of the interest on a portion of the national debt, giving a yearly saving at once of £625,000, and ultimately of a million and a quarter to the public. In 1844 another great financial measure, the Bank Charter Act, was passed and, though severely controverted and thrice suspended at a desperate crisis, has ever since regulated the currency of the country. In Ireland O'Connell's agitation for the repeal of the Union had now assumed threatening proportions, and verged upon rebellion. The great agitator was prosecuted, with his chief adherents, for conspiracy and sedition; and, though the conviction was quashed for informality, repeal was quelled in its chief. At the same time a healing hand was extended to Ireland. The Charitable Bequests Act gave Roman Catholics a share in the administration of charities and legal power to endow their own religion. The allowance to Maynooth was largely increased, notwithstanding violent Protestant opposition. Three queen's colleges, for the higher education of all the youth of Ireland, without distinction of religion, were founded, notwithstanding violent opposition, both Protestant and Roman Catholic. The principle of toleration once accepted, was thoroughly carried out. The last remnants of the penal laws were swept from the statute-book, and justice was extended to the Roman Catholic Church in Canada and Malta. In the same spirit acts were passed for clearing from doubt Irish Presbyterian marriages, for settling the titles of a large number of dissenters' chapels in England, and removing the municipal disabilities of the Jews. The grant for national education was trebled, and an attempt was made, though in vain, to introduce effective education clauses into the factory bills. To the alienation of any part of the revenues of the Established Church Sir Robert Peel never would consent; but he had issued the ecclesiastical commission, and he now made better provision for a number of populous parishes by a redistribution of part of the revenues of the Church. The weakest part of the conduct of this great government, perhaps, was its failure to control the railway mania by promptly laying down the lines on a government plan. It passed an act in 1844 which gave the government a right of purchase, and it had prepared a palliative measure in 1846, but was compelled to sacrifice this, like all other secondary measures, to the repeal of the corn laws. It failed also, though not without an effort, to avert the great schism in the Church of Scotland. Abroad it was as prosperous as at home. It had found disaster and disgrace in Afghanistan. It speedily ended the war there, and in India the invading Sikhs were destroyed upon the Sutlej. The sore and dangerous questions with France, touching the right of search, the war in Morocco, and the Tahiti affair, and with the United States touching the Maine boundary and the Oregon territory, were settled by negotiation.

Yet there were malcontents in Sir Robert Peel's party. The Young Englanders disliked him because he had hoisted the flag of Conservatism instead of Toryism on the morrow of the Reform Bill. The strong philanthropists and Tory Chartists disliked him because he was a strict economist and an upholder of the new poor law. But the fatal question was protection. That question was being fast brought to a crisis by public opinion and the Anti-Corn-Law League. Sir Robert Peel had been recognized in 1841 by Cobden as a Free Trader, and after experience in office he had become in principle more and more so. Since his accession to power he had lowered the duties of the sliding scale, and thereby caused the secession from the cabinet of the duke of Buckingham. He had alarmed the farmers by admitting foreign cattle and meat under his new tariff, and by admitting Canadian corn. He had done his best in his speeches to put the maintenance of the corn laws on low ground, and to wean the landed interest from their reliance on protection. The approach of the Irish famine in 1845 turned decisively the wavering balance. When at first Sir Robert proposed to his cabinet the revision of the corn laws, Lord Stanley and the duke of Buccleuch dissented, and Sir Robert resigned. But Lord John Russell failed to form a new government. Sir Robert again came into office; and now, with the consent of all the cabinet but Lord Stanley, who retired, he, in a great speech on the 27th of January 1846, brought the repeal of the corn laws before the House of Commons. In the long and fierce debate that ensued he was assailed, both by political and personal enemies, with the most virulent invective, which he bore with his wonted calmness, and to which he made no retorts. His measure was carried; but immediately afterwards the offended protectionists, led by Lord George Bentinck and Benjamin Disraeli, coalesced with the Whigs, and threw him out on the Irish Coercion Bill. He went home from his defeat, escorted by a great crowd, who uncovered as he passed, and he immediately resigned. So fell a Conservative government which would otherwise have probably ended only with the life of its chief.

Though out of office he was not out of power. He had "lost a party, but won a nation." The Whig ministry which succeeded him leant much on his support, with which he never taxed them. He joined them in carrying forward free-trade principles by the repeal of the navigation laws. He helped them to promote the principle of religious liberty by the bill for the emancipation of the Jews. One important measure was his own. While in office he had probed, by the Devon commission of inquiry, the sores of Ireland connected with the ownership and occupation of land. In 1849, in a speech on the Irish Poor Laws, he first suggested, and in the next year he aided in establishing, a commission to facilitate the sale of estates in a hopeless state of encumbrance. The Encumbered Estates Act made no attempt, like later legislation, to secure by law the uncertain customary rights of Irish tenants, but it transferred the land from ruined landlords to solvent owners capable of performing the duties of property towards the people. On the 28th of June 1850 Sir Robert Peel made a great speech on the Greek question against Lord Palmerston's foreign policy of interference. This speech was thought to show that if necessary he would return to office. It was his last. On the following day he was thrown from his horse on Constitution Hill, and mortally injured by the fall. Three days he lingered and on the fourth (July 2, 1850) he died. All the tributes which respect and gratitude could pay were paid to him by the sovereign, by parliament, by public men of all parties, by the country, by the press, and, above all, by the great towns and the masses of the people to whom he had given "bread unleavened with injustice." He would have been buried among the great men of England in Westminster Abbey, but his will desired that he might be laid in Drayton church. It also renounced a peerage for his family, as he had before declined the garter for himself when it was offered him by the queen through Lord Aberdeen.

Those who judge Sir Robert Peel will remember that he was bred a Tory in days when party was a religion; that he entered parliament a youth, was in office at twenty-four and secretary for Ireland at twenty-five; that his public life extended over a long period rife with change; and that his own changes were all forward and with the advancing intellect of the time. They will enumerate the great practical improvements and the great acts of legislative justice of those days, and note how large a share Sir Robert Peel had, if not in originating, in giving thorough practical effect to all. They will reflect that as a parliamentary statesman he could not govern without a party, and that it is difficult to govern at once for a party and for the whole people. They will think of his ardent love of his country, of his abstinence from intrigue, violence and faction, of his boundless labour through a long life devoted to the public service. Whether he was a model of statesmanship may be doubted. Models of statesmanship are rare, if by a model of statesmanship is meant a great administrator and party leader, a great political philosopher and a great independent orator, all in one. But if the question is whether he was a ruler loved and trusted by the English people there is no arguing against the tears of a nation.

Those who wish to know more of him will consult his own posthumous *Memoirs* (1856), edited by his literary executors Earl Stanhope and Viscount Cardwell; his private correspondence, edited by C. S. Parker (1891–1899); the four volumes of his speeches; a sketch of his life and character by Sir Lawrence Peel (1860); an historical sketch by Lord Dalling (1874); Guizot's *Sir Robert Peel* (1857); Künzel's *Leben und Reden Sir Robert Peel's* (1851); Disraeli's *Life of Lord George Bentinck* (1858); Morley's *Life of Cobden*; monographs by F. C. Montague (1888), J. R. Thursfeld (1891), and the earl of Rosebery (1899); *Peel and O'Connell*, by Lord Eversley; the *Life of Sir J. Graham* (1907), by C. S. Parker; Lord Stanmore's *Life of Lord Aberdeen* (1893); and the general histories of the time. (C. S. P.)

Four of Sir Robert's five sons attained distinction. The eldest, **Sir Robert Peel** (1822–1895), who became the 3rd baronet on his father's death, was educated at Harrow and at Christ Church, Oxford. He was in the diplomatic service from 1844 to 1850, when he succeeded his father as member of parliament for Tamworth, and he was chief secretary to the lord-lieutenant of Ireland from 1861 to 1865. He represented Tamworth until the general election of 1880; in 1884 he became member for Huntingdon and in 1885 for Blackburn, but after 1886 he ceased to sit in the House of Commons. Sir Robert described himself as a Liberal-Conservative, but in his later years he opposed the policy of Gladstone, although after 1886 he championed the cause of home rule for Ireland. In 1871 he sold his father's collection of pictures to the National Gallery for £75,000, and in his later life he was troubled by financial difficulties. Sir Robert was interested in racing, and was known on the turf as Mr F. Robinson. He died in London on the 9th of May 1895, and was succeeded as 4th baronet by his son, Sir Robert Peel (b. 1867).

Sir Frederick Peel (1823–1906), the prime minister's second son, was educated at Harrow and at Trinity College, Cambridge, becoming a barrister in 1849. He entered parliament in that year, and with the exception of the period between 1857 and 1859 he remained in the House of Commons until 1865. In 1851–1852 and again in 1853–1855 he was under-secretary for the colonies; from 1855 to 1857 he was under-secretary for war; and from 1859 to 1865 he was secretary to the treasury. He became a privy councillor in 1857 and was knighted in 1869. Sir Frederick Peel's chief service to the state was in connexion with the railway and canal commission. He was appointed a commissioner on the inception of this body in 1873, and was its president until its reconstruction in 1888, remaining a member of the commission until his death on the 6th of June 1906.

The third son was Sir William Peel (1824–1858), and the youngest Viscount Peel (*q.v.*). Sir William was a sailor, who distinguished himself in the Crimea, where he gained the Victoria Cross, and also during the Indian Mutiny, being wounded at the relief of Lucknow. He died on the 27th of April 1858. Sir William wrote *A Ride through the Nubian Desert* (1852), giving an account of his travels in 1851.

Two of Sir Robert Peel's brothers were also politicians of note. William Yates Peel (1789–1858), educated at Harrow and at St John's College, Cambridge, was a member of parliament from 1817 to 1837, and again from 1847 to 1852; he was under-secretary for home affairs in 1828, and was a lord of the treasury in 1830 and again in 1834–1835. Jonathan Peel (1799–1879) was first a soldier and then a member of parliament during the long period between 1826 and 1868, first representing Norwich and then Huntingdon. From 1841 to 1846 he was surveyor-general of the ordnance, and in 1858–1859 and again in 1866–1867 he was a very competent and successful secretary of state for war. General Peel was also an owner of racehorses, and in 1844 his horse Orlando won the Derby, after another horse, Running Rein, had been disqualified.

For the history of the Peel family see Jane Haworth, *A Memoir of the Family of Peel from the year 1600* (1836).

PEEL, a seaport and watering-place of the Isle of Man, on the W. coast, 11½ m. W.N.W. of Douglas by the Isle of Man railway. Pop. (1901), 3304. It lies on Peel Bay, at the mouth of the small river Neb, which forms the harbour. The old town consists of narrow streets and lanes, but a modern residential quarter has grown up to the east. On the west side of the river-mouth St Patrick's Isle is connected with the mainland by a causeway. It is occupied almost wholly by the ruins of Peel castle. St Patrick is said to have founded here the first church in Man, and a small chapel, dedicated to him, appears to date from the 8th or 10th century. There is a round tower, also of very early date, resembling in certain particulars the round towers of Ireland. The ruined cathedral of St German has a transitional Norman choir, with a very early crypt beneath, a nave with an early English triplet at the west end, transepts, and a low and massive central tower still standing. There are remains of the bishops' palace, of the so-called Fenella's tower, famous through Scott's *Peveril of the Peak*, of the palace of the Lords of Man, of the keep and guardroom above the entrance to the castle, and of the Moare or great tower, while the whole is surrounded by battlements. There are also a large artificial mound supposed to be a defensive earthwork of higher antiquity than the castle, and another mound known as the Giant's Grave. The guardroom is associated with the ghostly apparition of the Moddey Dhoo (black dog), to which reference is made in *Peveril of the Peak*. In 1397 Richard II. condemned the earl of Warwick to imprisonment in Peel Castle for conspiracy, and in 1444 Eleanor, duchess of Gloucester, received a like sentence on the ground of having compassed the death of Henry VI. by magic. Peel has a long-established fishing industry, which, however, has declined in modern times. In the town the most notable building is the church of St German, with a fine tower and spire. Peel was called by the Northmen *Holen* (island, *i.e.* St Patrick's Isle); the existing name is Celtic, meaning "fort" (cf. the peel towers of the borderland of England and Scotland).

PEEL, (1) The skin or rind of a fruit; thus "to peel" is to remove the outer covering of anything. The etymology of the word is closely connected with that of "pill," to plunder, surviving in "pillage." Both words are to be referred to French and thence to Latin. In French *peler* and *piller*, though now distinguished in meaning (the first used of stripping bark or rind, the second meaning to rob), were somewhat confused in application, and a similar confusion occurs in English till comparatively late. The Latin words from which they are derived are *pellis*, skin, and *pilare*, to strip of hair (*pilus*). (2) The name of a class of small fortified dwelling-houses built during the 16th century on the borders between Scotland and England. They are also known as "bastel-houses," *i.e.* "bastille-houses," and consist of a square massive tower with high pitched roof, the lower part being vaulted, the upper part containing a few living rooms. The entrance is on the upper floor, access being gained by a movable ladder. The vaulted ground-floor chamber served for the cattle when there was danger of attack. The word appears in various forms, *e.g. pele, peil*, and Latinized as *pelum*, &c.; "pile" is also found used synonymously, but the *New English Dictionary* (*s.v. pile*) considers the two words distinct. It seems more probable that the word is to be identified with "pale," a stake (Lat. *palus*). The earlier meaning of "peel" is a palisaded enclosure used as an additional defence for a fortified post or as an independent stronghold.

PEELE, GEORGE (1558–*c.* 1598), English dramatist, was born in London in 1558. His father, who appears to have belonged to a Devonshire family, was clerk of Christ's Hospital, and wrote two treatises on book-keeping. George Peele was educated at Christ's Hospital, and entered Broadgates Hall (Pembroke College), Oxford, in 1571. In 1574 he removed to Christ Church, taking his B.A. degree in 1577, and proceeding M.A. in 1579. In 1579 the governors of Christ's Hospital requested their clerk to "discharge his house of his son, George Peele." It is not necessary to read into this anything more than that the governors insisted on his beginning to earn a livelihood. He went up to London about 1580, but in 1583 when Albertus Alasco (Albert Laski), a Polish nobleman, was entertained at Christ Church, Oxford, Peele was entrusted with the arrangement of two Latin plays by William Gager (*fl.* 1580–1619) presented on the occasion. He was also complimented by Dr Gager for an English verse translation of one of the *Iphigenias* of Euripides. In 1585 he was employed to write the *Device of the Pageant borne before Woolston Dixie*, and in 1591 he devised the pageant in honour of another lord mayor, Sir William Webbe. This was the *Descensus Astraeae* (printed in the *Harleian Miscellany*, 1808), in which Queen Elizabeth is honoured as Astraea. Peele had married as early as 1583 a lady who brought him some property, which he speedily dissipated. Robert Greene, at the end of his *Groatsworth of Wit*, exhorts Peele to repentance, saying that he has, like himself, "been driven to extreme shifts for a living." The sorry traditions of his reckless life were emphasized by the use of his name in connexion with the apocryphal *Merrie conceited Jests of George Peele* (printed in 1607). Many of the stories had done service before, but there are personal touches that may be biographical. He died before 1598, for Francis Meres, writing in that year, speaks of his death in his *Palladis Tamia*.

His pastoral comedy of *The Araygnement of Paris*, presented by the Children of the Chapel Royal before Queen Elizabeth perhaps as early as 1581, was printed anonymously in 1584. Charles Lamb, sending to Vincent Novello a song from this piece of Peele's, said that if it had been less uneven in execution Fletcher's *Faithful Shepherdess* "had been but a second name in this sort of writing." Peele shows considerable art in his flattery. Paris is arraigned before Jupiter for having assigned the apple to Venus. Diana, with whom the final decision rests, gives the apple to none of the competitors but to a nymph called Eliza, whose identity is confirmed by the further explanation, "whom some Zabeta call." *The Famous Chronicle of King Edward the first, sirnamed Edward Longshankes, with his returne from the holy land. Also the life of Lleuellen, rebell in Wales. Lastly, the sinking of Queen Elinor, who suncke at Charingcrosse, and rose again at Potters-hith, now named Queenehith* (printed 1593). This "chronicle history," formless enough, as the rambling title shows, is nevertheless an advance on the old chronicle plays, and marks a step towards the Shakespearian historical drama. *The Battell of Alcazar—with the death of Captaine Stukeley* (acted 1588–1589, printed 1594), published anonymously, is attributed with much probability to Peele. *The Old Wives Tale*, registered in Stationers' Hall, perhaps more correctly, as "The Owlde wifes tale" (printed 1595), was followed by *The Love of King David and fair Bethsabe* (written *c.* 1588, printed 1599), which is notable as an example of Elizabethan drama drawn entirely from scriptural sources. Mr Fleay sees in it a political satire, and identifies Elizabeth and Leicester as David and Bathsheba, Mary Queen of Scots as Absalom. *Sir Clyomon and Sir Clamydes* (printed 1599) has been attributed to Peele, but on insufficient grounds. Among his occasional poems are "The Honour of the Garter," which has a prologue containing Peele's judgments on his contemporaries, and "Polyhymnia" (1590), a blank-verse description of the ceremonies attending the retirement of the queen's champion, Sir Henry Lee. This is concluded by the "Sonnet," "His golden locks time hath to silver turn'd," quoted by Thackeray in the 76th chapter of *The Newcomes*. To the *Phoenix Nest* in 1593 he contributed "The Praise of Chastity." Mr F. G. Fleay (Biog. Chron. of the Drama) credits Peele with *The Wisdom of Doctor Doddipoll* (printed 1600), *Wily Beguiled* (printed 1606), *The Life and Death of Jack Straw, a notable rebel* (1587?), a share in the First and Second Parts of *Henry VI.*, and on the authority of Wood and Winstanley, *Alphonsus, Emperor of Germany*.

Peele belonged to the group of university scholars who, in Greene's phrase, "spent their wits in making playes." Greene went on to say that he was "in some things rarer, in nothing inferior," to Marlowe. Nashe in his preface to Greene's *Menaphon* called him "the chief supporter of pleasance now living, the *Atlas* of Poetrie and *primus verborum artifex*, whose first encrease, the *Arraignement of Paris*, might plead to your opinions his pregnant dexteritie of wit and manifold varietie of invention, wherein (*me judice*) hee goeth a step beyond all that write." This praise was not unfounded. The credit given to Greene and Marlowe for the increased dignity of English dramatic diction, and for the new smoothness infused into blank verse, must certainly be shared by Peele. Professor F. B. Gummere, in a critical essay prefixed to his edition of *The Old Wives Tale*, puts in another claim for Peele. In the contrast between the romantic story and the realistic dialogue he sees the first instance of humour quite foreign to the comic "business" of earlier comedy. *The Old Wives Tale* is a play within a play, slight enough to be perhaps better described as an interlude. Its background of rustic folk-lore gives it additional interest, and there is much fun poked at Gabriel Harvey and Stanyhurst. Perhaps Huanebango,[1] who parodies Harvey's hexameters, and actually quotes him on one occasion, may be regarded as representing that arch-enemy of Greene and his friends.

Peele's *Works* were edited by Alexander Dyce (1828, 1829–1839 and 1861); by A. H. Bullen (2 vols., 1888). An examination of the metrical peculiarities of his work is to be found in F. A. R. Lämmerhirt's *Georg Peele, Untersuchungen über sein Leben und seine Werke* (Rostock, 1882). See also Professor F. B. Gummere, in *Representative English Comedies* (1903); and an edition of *The Battell of Alcazar*, printed for the Malone Society in 1907.

PEEP-OF-DAY BOYS, an Irish Protestant secret society, formed about 1785. Its object was to protect the Protestant peasantry, and avenge their wrongs on the Roman Catholics. The "Boys" gained their name from the hour of dawn which they chose for their raids on the Roman Catholic villages. The Roman Catholics in return formed the society of "The Defenders."

PEEPUL, or PIPUL (*Ficus religiosa*), the "sacred fig" tree of India, also called the Bo tree. It is not unlike the banyan, and is venerated both by the Buddhists of Ceylon and the Vaishnavite Hindus, who say that Vishnu was born beneath its shade. It is planted near temples and houses; its sap abounds in caoutchouc, and a good deal of lac is obtained from insects who feed upon the branches. The fruit is about the size of a walnut and is not much eaten.

PEERAGE (Fr. *pairage*, med. Lat. *paragium*; M.E. *pere*, O. Fr. *per*, *peer*, later *pair*; Lat. *paris*, "equal"). Although in England the terms "peerage," "nobility," "House of Lords" are in common parlance frequently regarded as synonymous, in reality each expresses a different meaning. A man may be a peer and yet not a member of the House of Lords, a member of the House of Lords and yet not strictly a peer; though all peers (as the term is now understood) are members of the House of Lords either *in esse* or *in posse*. In the United Kingdom the rights, duties and privileges of peerage are centred in an individual; to the monarchial nations of the Continent nobility conveys the idea of family, as opposed to personal, privilege.

Origin of Peerage.

Etymologically "peers" are "equals" (*pares*), and in Anglo-Norman days the word was invariably so understood. The feudal tenants-in-chief of the Crown were all the peers of each other, whether lords of one manor or of a hundred; so too a bishop had his ecclesiastical peer in a brother bishop, and the tenants of a manor their peers in their fellow-tenants. That even so late as the reign of John the word was still used in this general sense is clear from Magna Carta, for the term "judicium parium" therein must be understood to mean that every man had a right to be tried by his equals. This very right was asserted by the barons as a body in 1233 on behalf of Richard, earl marshal, who had been declared a traitor by the king's command, and whose lands were forfeited without proper trial. In 1233 the French bishop Peter des Roches, Henry III.'s minister, denied the barons' right to the claim set up on the ground that the king might judge all his subjects alike, there being, he said, no peers in England (Math. Paris. 389). The English barons undoubtedly were using the word in the sense it held in Magna Carta, while the bishop probably had in his mind the French peers (*pairs de France*), a small and select body of feudatories possessed of exceptional privileges. In England the term was general, in France technical. The change in England was gradual, and probably gathered force as the gulf between the greater barons and the lesser widened, until in course of time, for judicial purposes, there came to be only two classes, the greater barons and the rest of the people. The barons remained triable by their own order (*i.e.* by their peers), whilst the rest of the people rapidly became subject to the general practice and procedure of the king's justices. The first use of the word "peers" as denoting those members of the baronage who were accustomed to receive regularly a writ of summons to parliament is found in the record of the proceedings against the Despensers in 1321 (Stubbs, *Const. Hist.* ii. 347), and from that time this restricted use of the word has remained its ordinary sense.

Anglo-Norman Baronage.

Properly to understand the growth and constitution of the peerage it is necessary to trace the changes which occurred in the position of the Anglo-Norman baronage, first through the gradual strengthening of royal supremacy with the consequent decay of baronial power locally, and subsequently by the consolidation of parliamentary institutions during the reigns of the first three Edwards.

The Saxon Witenagemot.

Before the conquest the national assembly of England (see PARLIAMENT) was the Witan, a gathering of notables owing their presence only to personal influence and standing. The imposition of a modified feudal system resulted in a radical alteration. Membership of the Great Councils of the Norman kings was primarily an incident of tenure, one of the obligations the tenants-in-chief were bound to perform, although this membership gradually became restricted by the operation of the Royal prerogative to a small section of the Baronial class and eventually hereditary by custom. The Norman Councils may have arisen from the ashes of a Saxon Witenagemot, but there is little evidence of any historical continuity between the two. The Church in England, as in Christendom generally, occupied a position of paramount importance and far-reaching influence; its leaders, not alone from their special sanctity as ecclesiastics, but as practically the only educated men of the period, of necessity were among the chief advisers of every ruler in Western Europe. In England churchmen formed a large proportion of the Witan, the more influential of the great landowners making up the rest of its membership.

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[1] Mr Fleay goes so far as to see in the preposterous names of Huanebango's kith and kin puns on Harvey's father's trade. "Polymachaeroplacidus" he interprets as "Polly-make-a-rope-lass"

Norman Feudal Tenure.

In place of the scattered individual and absolute ownership of Saxon days the Conqueror became practically the sole owner of the soil. The change, though not immediately complete, followed rapidly as the country settled down and the power of the Crown extended to its outlying frontiers. As Saxon land gradually passed into Norman hands the new owners became direct tenants of the king. Provided their loyal and military obligations were duly performed they had fixity of tenure for themselves and their heirs. In addition fixed money payments were exacted on the succession of the heir, when the king's eldest son was knighted, his eldest daughter married, or his person ransomed from captivity. In like manner and under similar conditions the king's tenants, or as they were termed tenants-in-chief, sub-granted the greater portion of their holdings to their own immediate followers. Under Norman methods the manor was the unit of local government and jurisdiction, and when land was given away by the king the gift invariably took the form of a grant of one or more manors.

When he brought England into subjection the Conqueror's main idea was to exalt the central power of the Crown at the expense of its feudatories, and the first two centuries following the conquest tell one long tale of opposition by the great tenants-in-chief to a steadily growing and unifying royal pressure. With this idea of royal supremacy firmly fixed in his mind, William's grants, excepting outlying territory such as the marches of Wales or the debateable ground of the Scottish border, which needed special consideration, were seldom in bulk, but took the form of manors scattered over many counties. Under such conditions it was practically impossible for a great tenant to set up a powerful *imperium in imperio* (such as the fiefs of Normandy, Brittany and Burgundy), as his forces were distributed over the country, and could be reached by the long arm of royal power, acting through the sheriff of every county, long before they could effectively come together for fighting purposes. The tenants-in-chief were termed generally barons (see BARON) and may be regarded historically as the parents of the peers of later days. The pages of Domesday (1086), the early Norman fiscal record of England, show how unevenly the land was distributed; of the fifteen hundred odd tenants mentioned the majority held but two or three manors, while a favoured few possessed more than a hundred each. Land was then the only source of wealth, and the number of a baron's manors might well be regarded as a correct index of his importance.

The King's Court.

The king's tenants owed yet another duty, the service of attending the King's Court (*curia regis*), and out of this custom grew the parliaments of later days. In theory all the king's tenants-in-chief, great and small, had a right to be present as incident to their tenure. It has therefore been argued by some authorities that as the Conqueror's system of tenure constituted him the sole owner of the land, attendance at his courts was solely an incident of tenure, the Church having been compelled to accept the same conditions as those imposed on laymen. But, as already pointed out, the change in tenure had not been immediate, and there had been no general forfeiture suffered by ecclesiastical bodies; consequently throughout the early years of William's reign some of the English bishops and abbots attended his courts as much by virtue of their personal and ecclesiastical importance as by right of tenure. The King's Court was held regularly at the three great festivals of the Church and at such other times as were deemed advisable. The assembly for several generations neither possessed nor pretended to any legislative powers. Legislative power was a product of later years, and grew out of the custom of the Estates granting supplies only on condition that their grievances were first redressed. The great bulk of the tenants were present for the purpose of assenting to special taxation above and beyond their ordinary feudal dues. When necessary a general summons to attend was sent through the sheriff of every county, who controlled a system of local government which enabled him to reach every tenant. In course of time to a certain number of barons and high ecclesiastics, either from the great extent of their possessions, their official duties about the king or their personal importance, it became customary to issue a personal writ of summons, thus distinguishing them from the general mass summoned through the sheriff. That this custom was in being within a century of the Conquest is clear from an incident in the bitter fight for supremacy between Archbishop Becket and Henry II. in 1164 (Stubbs, *Const. Hist.* i. 504), it being recorded that the king withheld the Archbishop's personal summons to parliament, and put upon him the indignity of a summons through the sheriff. During the succeeding fifty years the line becomes even more definite, though it is evident that the Crown sometimes disregarded the custom, as the barons are found complaining that many of their number deemed entitled to a personal summons had frequently been overlooked.

Magna Carta and Personal Summons to the Majores Barones.

The sequel to these complaints is found in Magna Carta, wherein it is provided that the archbishops, bishops, abbots, earls and greater barons are to be called up to the council by writ directed to each severally; and all who hold of the king in chief, below the rank of greater barons, are to be summoned by a general writ addressed to the sheriff of their shire.[1] Magna Carta thus indicates the existence of two definite sections of the king's tenants, a division which had evidently persisted for some time. The "greater barons" are the immediate parents of the peerages of later days, every member of which for more than four centuries had a seat in the House of Lords. As for the rest of the tenants-in-chief, poorer in estate and therefore of less consequence, it is sufficient here to note that they fell back into the general mass of country families, and that their representatives, the knights of the shire, after some hesitation, at length joined forces with the city and burgher representatives to form the House of Commons.

Parliament of 1254.

In 1254, instead of the general summons through the sheriff to all the lesser tenants-in-chief, the king requires them to elect two knights for each shire to attend the council as the accredited representative of their fellows. In the closing days of 1264 Simon de Montfort summoned to meet him early in 1265 the first parliament worthy of the name, a council in which prelates, earls and greater barons, knights of the shire, citizens and burghers were present, thus constituting a representation of all classes of people. It has been argued that this assembly cannot be regarded as a full parliament, inasmuch as Simon de Montfort summoned personally only such members of the baronage as were favourable to his cause, and issued writs generally only to those counties and cities upon which he could rely to return representatives in support of his policy. Stubbs holds the view that the first assembly we ought to regard as a full parliament was the Model Parliament which met at Westminster in 1295.

Model Parliament of 1295.

This parliament, unlike Simon's partisan assembly of 1265, was free and representative. To every spiritual and temporal baron accustomed to receive an individual writ, one was issued. Every county elected its knights and every city or borough of any importance was instructed by the sheriff to elect and to return its allotted number of representatives. Stubbs's view (*Const. Hist.* ii. 223) may probably be regarded as authoritative, inasmuch as it was adopted by Lord Ashbourne in the Norfolk peerage case of 1906 (*Law Reports* [1907], A.C. at p. 15). Edward I. held frequent parliaments throughout his reign, and although many must be regarded as merely baronial councils, nevertheless year after year, on all important occasions, the knights of the shire and the citizens appear in their places. The parliament of Shrewsbury in 1283, for instance, has been claimed as a full parliament in several peerage cases, but no clear decision on the point has ever been given by the Committee for Privileges. It may be taken for granted, however, that any assembly held since 1295, which did not conform substantially to the model of that year, cannot be regarded constitutionally as a full parliament. The point is even of modern importance, as in order to establish the existence of a barony by writ it must be proved that the claimant's ancestor was summoned by individual writ to a full parliament, and that either he himself or one of his direct descendants was present in parliament.

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[1] Et ab habendum commune consilium regni . . . summoneri faciemus archiepiscopos, episcopos, abbates, comites et *majores barones* sigillatim per litteras nostras et praeterea faciemus summoneri in generali per vicecomes et ballivos nostros omnes illos qui de nobis tenent in capite (cited in Stubbs, *Const. Hist.* i. 547 n.).

Grades of Peerage.

It is now convenient to consider the various grades into which the members of the peerage are grouped, and their relative positions. An examination of the early writs issued to individuals shows that the baronage consisted of archbishops, bishops, abbots, priors, earls and barons. In course of time every member of these classes came to hold his land by feudal tenure from the Crown, and eventually in every instance the writs issued as an incident of tenure. It is therefore necessary to discover, if possible, what combination of attributes clothed the greater baron with a right to receive the king's personal writ of summons. While the archbishops and bishops received their writs with regularity, the summonses to heads of ecclesiastical houses and greater barons were intermittent. The prelate held an office which lived on regardless of the fate of its temporary holder, and if by reason of death, absence or translation the office became vacant, a writ still issued to the "Guardian of the Spiritualities." The abbot, on the other hand, often outside the jurisdiction of the English Church, and owing allegiance to a foreign order, was but the personal representative of a land-holding community. It has already been pointed out that the amount of land held direct from the king by individuals varied greatly, and that the extent of his holding must have had something to do with a man's importance. A landless noble in those days was inconceivable. The conclusion, then, may be drawn that in theory the issue of a writ was at the pleasure of the Crown, and that in practice the moving factor in the case of the prelates was office and personal importance, and in the case of abbots and barons probably, in the main, extent of possession. There is nothing however to show that in the early years of the custom any person had a right to claim a writ if it were the king's pleasure or caprice to withhold it and to treat everyone not summoned individually as being duly summoned under the general writs issued to the sheriff of the county.

Hereditary Principle.

The next point for consideration is when did the peerage, as the baronage subsequently came to be called, develop into a body definitely hereditary? Here again growth was gradual and somewhat obscure. Throughout the reigns of the Edwards summonses were not always issued to the same individual for successive parliaments; and it is quite certain that the king never considered the issue of one writ to an individual bound the Crown to its repetition for the rest of his life, much less to his heirs in perpetuity. Again we must look to tenure for an explanation. The custom of primogeniture tended to secure estates in strict family succession, and if extent of possession had originally extracted the acknowledgment of a personal summons from the Crown it is more than probable that as successive heirs came into their inheritance they too would similarly be acknowledged. In early days the summons was a burden to be suffered of necessity, an unpleasant incident of tenure, in itself undesirable, and probably so regarded by the majority of recipients during at least the two centuries following the Conquest. The age of the Edwards was in the main a rule of settled law, of increase in population generally, of growing power in the large landowners and of opportunities for those about the person of the king. The times were changing, and in place of the idea of the writ being a burden, its receipt gradually came to be looked upon as a mark of royal favour, a recognition of position and an opportunity leading on to fortune. Once such a view was established it is easy to understand how desirous any individual would be to preserve so valuable a privilege for his posterity; and primogeniture with its strict settlement of estates pointed out an easy way. The Crown was itself an hereditary dignity; and what more natural than that it should be surrounded by an hereditary peerage? Thus the free and indiscriminate choice of the Crown became fettered by the custom that once a summons had been issued to an individual to sit in parliament and he had obeyed that summons he thereby acquired a right of summons for the rest of his lifetime; and in later years when the doctrine of nobility of blood became established his descendants were held to have acquired the same privilege by hereditary right.

Earldoms.

The earl's position in the baronage needs some explanation. Various suggestions have been made as to Saxon or Norman origin of a high official nature, but historical opinion seems generally to incline towards the theory that the term was a name of dignity conferred by royal prerogative on a person already classed among the greater barons. At first the dignity was official and certainly not hereditary, and the name of a county of which he is said to have been an officer in the king's name was not essential to his dignity as an earl. There were also men who, though Scottish and Norman earls, and commonly so addressed and summoned to parliament, were rated in England as barons (*Lords Reports*, ii. 116, 120; *Earldom of Norfolk Peerage Case*, *Law Reports* [1907], A.C. p. 18). Earls received individual summonses to parliament by the name of Earl (*q.v.*); but there is reason to believe, as already mentioned, that in early days at any rate they sat not in right of their earldoms but by tenure as members of the baronage.

Writ Supersedes Tenure.

If we review the political situation at the beginning of the 14th century a great change is evident. The line between those members of the baronage in parliament and the rest of the people is firmly and clearly drawn. Tenure as the sole qualification for presence in the national assembly has disappeared, and in its place there appears for the baronage a system of royal selection and for the rest of the people one of representation. The rules and customs of law relating to the baronage slowly crystallized so as to provide the House of Lords, the history of which for generations is the history of the peerage of England, whilst the representative part of parliament, after shedding the lower clergy, ultimately became the House of Commons.

Until the reign of Richard II. there is no trace of any use of the term baron (*q.v.*) as importing a personal dignity existing apart from the tenure of land, barons owing their seats in parliament to tenure and writ combined. This is borne out by the fact that a husband was often summoned to parliament in his wife's right and name, and while she lived fulfilled those feudal, military and parliamentary obligations attached to her lands which the physical disabilities of sex prevented her from carrying out in her own person (Pike, *House of Lords*, p. 103).

Peerage becomes a Personal Dignity.

Primogeniture, a custom somewhat uncertain in early Anglo-Norman days, had rapidly developed into a definite rule of law. As feudal dignities were in their origin inseparable from the tenure of land it is not surprising that they too followed a similar course of descent, although as the idea of a dignity being exclusively personal gradually emerged, some necessary deviations from the rules of law relating to the descent of land inevitably resulted. In the eleventh year of his reign Richard II. created by letters patent

John Beauchamp "Lord de Beauchamp and baron of Kyddermynster, to hold to him and the heirs of his body." These letters patent were not founded on any right by tenure of land possessed by Beauchamp, for the king makes him "for his good services and in respect of the place which he had holden at the coronation (*i.e.* steward of the household) and might in future hold in the king's councils and parliaments, and for his noble descent, and his abilities and discretion, one of the peers and barons of the kingdom of England; willing that the said John and the heirs-male of his body issuing, should have the state of baron and should be called by the name of Lord de Beauchamp and Baron of Kyddermynster." The grant rested wholly on the grace and favour of the Crown and was a personal reward for services rendered. Here then is a barony entirely a personal dignity and quite unconnected with land. From Richard's reign to the present day baronies (and indeed all other peerage honours) have continued to be conferred by patent. The custom of summons by writ was not in any way interfered with, the patent operating merely to declare the dignity and to define its devolution. Summons alone still continued side by side for many generations with summons founded on patent; but after the reign of Henry VIII. the former method fell into disuse, and during the last two hundred and fifty years there have been no new creations by writ of summons alone.[1] So from the reign of Richard II. barons were of two classes, the older, and more ancient in lineage summoned by writ alone, the honours descending to heirs-general, and the newer created by letters patent, the terms of which governed the issue of the summons and prescribed the devolution of the peerage in the line almost invariably of the direct male descendants of the person first ennobled. The principle of hereditary succession so clearly recognized in the Beauchamp creation is good evidence to show that a prescriptive right of hereditary summons probably existed in those families whose members had long been accustomed to receive individual writs. By the time the House of Lancaster was firmly seated on the throne it may be taken that the peerage had become a body of men possessing well-defined personal privileges and holding personal dignities capable of descending to their heirs.

Peerages by Tenure.

The early origin of peerages was so closely connected with the tenure of land that the idea long prevailed that there were originally peerages by tenure only, *i.e.* dignities or titles annexed to the possession (and so following it on alienation) of certain lands held in chief of the king. The older writers, Glanville (bk. ix. cc. 4, 6) and Bracton (bk. ii. c. 16), lend some colour to the view. They are followed, but not very definitely, by Coke, Selden and Madox. Blackstone, who discusses the question in his *Commentaries* (bk. i. c. xii.), seems to believe that such dignities existed in pre-parliamentary days but says further: "When alienations grew to be frequent, the dignity of peerage was confined to the lineage of the party ennobled, and instead of territorial became personal." The Earldom of Arundel case, in 1433, at first sight seems to confirm the theory, but it may be noted that when in later years this descent came to be discussed the high authority of an act of parliament was found necessary to confirm the succession to the dignity. The case is discussed at some length in the *Lords Reports* (ii. 115), the committee regarding it as an anomaly from which no useful precedent can be drawn. Other cases discussed in the same *Report* are those of De Lisle, Abergavenny, Fitzwalter and Berkeley. The Berkeley case of 1858–1861 (better reported 8 H.L.C. 21) is essential for the student who wishes to examine the question carefully; and may be regarded as finally putting an end to any idea of bare tenure as an existing means of establishing a peerage right (see also Cruise on *Dignities*, 2nd ed. pp. 60 et seq.).

The main attribute of a peerage is that hereditary and inalienable quality which ennobles the blood of the holder and his heirs, or, as a great judge put it in 1625 in the Earldom of Oxford case, "he cannot alien or give away this inheritance because it is a personal dignity annexed to the posterity and fixed in the blood" (Dodridge, J., at p. 123, Sir W. Jones's *Reports*). Were the theory of barony by tenure accepted it would be possible for the temporary holder of such a barony to sell it or even to will it away to a stranger possessing none of the holder's blood, with the effect that, in the words of Lord Chancellor Campbell (Berkeley case, 8 H.L.C. 77), "there might be various individuals and various lines of peers successively ennobled and created peers of parliament by a subject," an impossible condition of affairs in a country where the sovereign has always been the fountain of honour. Moreover, while no peerage honour can be extinguished or surrendered, the owner of lands can freely dispose of such rights as he possesses by sale or transfer. Finally we may accept the verdict in the Fitzwalter case of 1669 (Cruise, ibid. p. 66), which was adopted by the House of Lords in the Berkeley case: "and the nature of a barony by tenure being discussed, it was found to have been discontinued for many ages, and not in being, and so not fit to be revived or to admit any pretence or right of succession thereupon."

Peerages inalienable.

Dukes.

Until the reign of Edward III. the peerage consisted only of high ecclesiastics, earls and barons. The earls were barons with their special name of dignity added, and their names always appear on the rolls before those of the barons. In 1337 King Edward created his son, the Black Prince, duke of Cornwall, giving him precedence over the rest of the peerage. The letters patent (under which the present heir to the throne now holds the dukedom) limited the dignity in perpetuity to the first-born son of the king of England.[2] Subsequently several members of the royal family were created dukes, but no subject received such an honour until fifty years later, when Richard II. created his favourite Robert de Vere, earl of Oxford, duke of Ireland (for life). The original intention may have been to confine the dignity to the blood royal, as with the exception of de Vere it was some years before a dukedom was again conferred on a subject.

Marquesses.

In 1385 Richard II. had created Robert de Vere marquess of Dublin, thus importing an entirely new and unknown title into the peerage. The grant was, however, only for life, and was in fact resumed by the Crown in 1387, when its recipient was created duke of Ireland. It was not until 1397 that another creation was made, this time in favour of one of the blood royal, John de Beaufort, eldest legitimated son of John of Gaunt, who became marquess of Dorset. His title was shortly afterwards taken away by Henry IV.'s first parliament. Subsequently creations were made only at long intervals, that of Winchester (1551) being the only one (of old date) under which an English marquess at present sits in the House of Lords (see MARQUESS).

Viscounts.

Under the name of viscount (*q.v.*) Henry VI. added yet another order, and the last in point of time, to the peerage, creating in 1440, John, Baron Beaumont, Viscount Beaumont and giving him precedence next above the barons. The name of this dignity was also borrowed from the Continent, having been in use for some time as a title of honour in the king's French possessions. None of the new titles above mentioned ever carried with them any official position; they were conferred originally as additional honours on men who were already members of the peerage.

Spiritual Peers, &c.

The application of the hereditary principle to temporal peerages early differentiated their holders from the spiritual peers. Both spiritual and temporal peers were equally lords of parliament, but hereditary pretensions on the one side and ecclesiastical exclusiveness on the other soon drew a sharp line of division between the two orders. Gradually the temporal peers, strong in their doctrine of "ennobled" blood, came to consider that theirs was an order above and beyond all other lords of parliament, and before long, arrogated to themselves the exclusive right to be called peers, and as such the only persons entitled to the privileges of peerage.

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[1] Not intentional at any rate. In some cases where it was intended to call a son up in his father's barony, a mistake in the name has been made with the result that a new peerage by writ of summons has been created. The barony of Buller, of Moore Park (cr. 1663), now in abeyance, is said to be an instance of such a mistake.

[2] . . . . principi et ipsius et haeredum suorum Regum Angliae filiis primogenitis (*The Prince's Case*, 8 Co. Rep. 27a; 77 E.R. 513).

In early parliamentary days it had been the custom to summon regularly to attend the Lords for deliberative purposes another body of men—the judges. Less important than the prelates, they also owed their summons to official position, and like them were eventually overshadowed by the hereditary principle. The force of hereditary right gave to ennobled blood a position never possessed by either judge or prelate. It is true the prelate, in point of antiquity, was senior to both earl and baron, and in many cases superior in extent of possessions; but these attributes belonged to his office, the resignation or deprivation of which would at any time have caused him to lose his writ of summons. The writ issued really to the office. The judge's position was even worse. His judicial office evoked the writ, but at any moment he might be deprived of that office at the arbitrary pleasure of the Crown. It is doubtful whether the judges ever had voice and vote in the same sense as the other lords of parliament, and even if they had they soon came to be regarded merely as counsellors and assessors.

The pretensions of the lay peers were not admitted without a struggle on the part of the prelates, who made the mistake of aiming at the establishment of a privileged position for their own order while endeavouring to retain every right possessed by their lay brethren. They fell between two stools, lost their position as peers, and were beaten back in their fight for ecclesiastical privilege. In the reign of Richard II. the prelates are found clearly defining their position. Neville, archbishop of York, de Vere, duke of Ireland and others, were "appealed" for treason, and the archbishop of Canterbury took the opportunity in parliament of making clear the rights of his order. He said "of right and by the custom of the realm of England it belongeth to the Archbishop of Canterbury for the time being as well as others his suffragans, brethren and fellow bishops, abbots and priors and other prelates whatsoever, holding of our lord the king by barony, to be present in person in all the king's parliaments whatsoever as Peers of the Realm aforesaid, and there with the other Peers of the Realm, and with other persons having the right to be there present, to advise, treat, ordain, establish and determine as to the affairs of the realm and other matters there wont to be treated and to do all else which there presses to be done." After this he went on to say that as to the particular matters in question they intended to be present and to take their part in all matters brought before parliament "save our estate and order and that of each of the prelates in all things. But because in the present parliament there is question of certain matters, in which it is not lawful for us or anyone of the prelates according to the institute of the Holy Canons in any manner, to take part personally" we intend to retire "saving always the rights of our peerage" (*Rot. Parl.* 11 Rich. II. No. 6—printed iii. 236–237). At the desire of the prelates this statement of their rights was duly enrolled in parliament, but their claim to be peers was neither denied nor admitted, and the proceedings went on without them. For themselves Churchmen never claimed the privilege of trial by peers. Whenever they were arraigned they claimed to be altogether outside secular jurisdiction, and it was therefore a matter of small concern to them whether they were in the hands of peers or peasants. Such was the attitude of Becket towards Henry II. (Stubbs, *Const. Hist.* i. 504), of Archbishop Stratford towards Edward III. (Pike, pp. 188 seq.), and it was probably with the history of these two cases in his mind that the archbishop of Richard II.'s reign speaks of the saving rights of his order. These rights were never willingly admitted in England, and as the pope's power for interference waned so the prelates were forced under the ordinary law of the land. Henry VIII. certainly never regarded ecclesiastics as peers, as may be gathered from a grant early in his reign to the then abbot of Tavistock for himself and each succeeding abbot the right to be "one of the spiritual and religious lords of parliament." As to abbots, the subsequent dissolution of the monasteries put an end to the discussion. In this reign also Cranmer and Fisher, though the former was archbishop of Canterbury, were tried by a common jury, and they certainly claimed no privilege of peerage. The Standing Orders of the House of Lords for 1625 contain the statement that "Bishops are only Lords of Parliament and not Peers" (*Lords Journals*, iii. 349). In 1640 the "Lords Spiritual" were altogether excluded from the House of Lords by act of parliament, and were not brought back until the second year of the Restoration. From that period there has been no question as to their position. Peers and holders by barony when parliaments first met, by the end of the 15th century they had put themselves outside the pale of the peerage. To-day their ancient lands are vested in trustees (Ecclesiastical Commissioners), and office alone constitutes a bishop's qualification, and that only if he occupies one of the five great sees of Canterbury, York, London, Durham and Winchester, or is of sufficient seniority in appointment to fill one of the remaining twenty-one places on the bench of bishops in the house—for there are now only twenty-six seats for thirty-six prelates.

Henry VIII. and the Peerage.

Ennobled Blood.

The reign of Henry VIII. brought about far-reaching changes in the position of the peerage. When that king ascended the throne the hereditary element was in a decided minority, but the balance was gradually redressed until at length a bare hereditary majority was secured and the dissolution of the monasteries made possible. The peers, many now grown fat on abbey lands, at once began to consolidate their position; precedents were eagerly sought for, and the doctrine of ennobled blood began to find definite and vigorous expression. So long, the peers declared, as there is any ennobled blood, a peerage must exist; and it can be extinguished only by act of parliament, failure of heirs, or upon corruption of blood by attainder. Stubbs writes with some contempt of the doctrine (*Const. Hist.* iii. 458 n.), apparently on the ground that it is absurd to speak of ennobled blood so long as the children of a peer still remain commoners. The doctrine is neither unreasonable nor illogical. By it is meant blood in which there always exists a capacity to inherit a particular peerage, and every person in whose veins the ennobled blood runs is competent to occupy the peerage if the chances of nature should remove those who are senior to him in the line of descent. A good illustration is the popular use of the term "blood royal," which of course does not mean that an individual of the blood royal necessarily occupies a throne but that he or she is in the line of succession to it. Similarly, persons of "ennobled blood" are not necessarily peers but in the line of descent to peerages, to which they may or may not succeed. (See NOBILITY.)

The English peer is not like the continental noble the member of a caste, but the holder for life of an office clothed with high and exceptional legislative and judicial attributes entirely dependent on his office and exercisable only in conjunction with his fellow peers in parliament assembled. Such privileges as he possesses are due primarily to his office rather than to his blood. His children are commoners, who though accorded courtesy titles by the usage of society have no legal privileges not shared with the humblest of British subjects. It is this peculiar official quality of an English peerage which saved England from the curse of a privileged noble caste such as that which so long barred all progress in France and Germany. As a result there are hundreds of families in the United Kingdom who, commoners there, would yet, from their purity of blood, position and influence, be accounted noble in any continental country.

Surrender of Peerages.

From the doctrine of nobility of blood is derived the rule of law that no peerage (a Scots peerage is under Scots Law) can be surrendered, extinguished, or in any way got rid of unless the blood be corrupted. The rule is well illustrated by the earldom of Norfolk case (*Law Reports* [1907], A. C. 10) in which its development was traced, and the principle authoritatively confirmed. In 1302 the hereditary earldom of Norfolk (created in 1135) was in the possession of Hugh Bygod, one of the most powerful nobles of

Plantagenet days. The earl got into difficulties, and as some say, for a consideration, and others, to spite his brother and debtor, surrendered his earldom and all the lands thereto belonging, to King Edward I. from whom he subsequently received it back with an altered limitation to himself and the heirs of his body. As he was a childless old man this was practically a short life interest to the exclusion of all his relatives, the nearest of whom but for the surrender would have succeeded. Soon after Bygod died, and the earldom fell into the hands of Edward II. who granted it to his brother Thomas of Brotherton in 1312. Lord Mowbray, the lineal descendant of this Thomas, recently came forward and claimed the earldom, but in 1906 the House of Lords decided against his claim on the ground that in law Bygod's surrender was invalid, and that therefore Edward II. had no valid power to grant this particular earldom to Thomas of Brotherton. Historically there is little to support such a decision, and indeed this rigid application of the law is of comparatively recent date. Without doubt king, nobles and lawyers alike were all agreed, right down to Tudor days, that such surrenders were entirely valid. Many certainly were made, but, according to the decision of 1906, any living heirs of line of those nobles who thus got rid of their peerage honours can, if their pedigrees be provable, come to the House of Lords with a fair chance of reviving the ancient honours. Even as late as 1663 we find the Crown, naturally with the concurrence of its legal advisers, stating in the barony of Lucas patent (1663) that, on the appearance of co-heirs to a barony, the honour may be suspended or extinguished at the royal pleasure. The royal view of the law (at any rate as to extinction) was strongly objected to by the Lords, who guarded their privileges in Stuart days even more strictly than did the Commons. As early as 1626, in the celebrated dispute over the earldom of Oxford, the lord great chamberlainship and the baronies of Bolebec, Badlesmere and Sandford, Mr Justice Dodridge, who had been called in by the Lords to advise them, said that an earl could not give away or alien his inheritance, because it was "a personal dignity annexed to the posterity and fixed in the blood." Fourteen years later, in the Grey de Ruthyn case, the Lords solemnly resolved, "That no peer of the realm can drown or extinguish his honour (but that it descends unto his descendants), neither by surrender, grant, fine nor any other conveyance to the king." In 1678 the Lords became, if possible, even more definite, in view probably of the fact that the Crown had disregarded the Grey de Ruthyn resolution, having in 1660 taken into its hands, by surrender of Robert Villiers, 2nd viscount, the viscounty of Purbeck. In 1676 the son of the second viscount applied for his writ of summons, and on the advice of Sir William Jones, the attorney-general, who reported that "this (surrender) was a considerable question, never before resolved that he knew of," the king referred the whole matter to the Lords. The Lords were very explicit, being "unanimously of the opinion, and do resolve that no fine now levied, or at any time hereafter to be levied by the king, can bar such title of honour (*i.e.* of a peer of the realm), or the right of any person claiming under him that levied, or shall levy such fine." On these resolutions passed in the seventeenth century, the Lords of 1906 find illegal a surrender of 1302. The result seems strange, but it is, at any rate, logical from the legal point of view. It was urged that in 1302 no real parliament, in the sense applied to those of later years, was in existence; and consequently, a resolution founded on parliamentary principles should not apply. To this answer was made: Although it may be true that the law and practice of parliament had not then crystallized into the definite shape of even a hundred years later, the "Model Parliament" was summoned seven years before Bygod's surrender, and it is necessary to have some definite occurrence from which to date a legal beginning—a point of law with which an historian can have little sympathy.

Briefly, perhaps, from the teaching of the case it may be permissible to state the rule as follows: In early days the Norman and Plantagenet kings took upon themselves to deal with the barons in a manner which, though illegal, was suffered because no one dared oppose them; but as time went on, becoming stronger and more determined to enforce their privileges and exalt their order the peers were able to compel recognition of their rights, and their resolutions in Stuart days were only declaratory of law which had always existed, but had been systematically disregarded by the Crown. This being so, resolutions of the peers deliberately and expressly laid down must, when in point, always be followed.

Attainder and Corruption of Blood.

The application of the doctrine of corruption of blood to peerages arises out of their close connexion with the tenure of land, peerage dignities never having been regarded as personal until well on into the 14th century. Conviction for any kind of felony—and treason originally was a form of felony—was always followed by attainder. This resulted in the immediate corruption of the blood of the offender, and its capacity for inheritance was lost for ever. Such corruption with all its consequences could be set aside only by act of parliament. This stringent rule of forfeiture was to some extent mitigated by the passing in 1285 of the statute De Donis Conditionalibus (Blackstone's *Commentaries*, ii. 116) which made possible the creation of estates tail, and when a tenant-in-tail was attainted forfeiture extended only to his life interest. The statute De Donis was soon applied by the judges to such dignities as were entailed (*e.g.* dignities conferred by patent with limitations in tail), but it never affected baronies by writ, which were not estates in tail but in the nature of estates in fee simple descendible to heirs general. In the reign of Henry VIII. an act was passed (1534) which brought estates tail within the law of forfeiture, but for high treason only. The position then became that peerages of any kind were forfeitable by attainder following on high treason, while baronies by writ remained as before forfeitable for attainder following on felony. In 1708, just after the Union with Scotland, an act was passed by which on the death of the Pretender and three years after Queen Anne's death the effects of corruption of blood consequent on attainder for high treason were to be abolished, and the actual offender only to be punished (stat. 7 Anne, c. 21, § 10). Owing to the 1745 rising, the operation of this act was postponed until the decease of the Pretender and all his sons (stat. 17 Geo. II. c. 39, § 3). In 1814 forfeiture for every crime other than high and petty treason and murder was restricted to the lifetime of the person attainted (stat. 54 Geo. III. c. 145). Finally in 1870 forfeiture, except upon outlawry, was altogether abolished and it was provided that "no judgment of or for any treason or felony should cause any attainder or corruption of blood, or any forfeiture or escheat." The necessity for ascertaining the exact condition of the law with regard to attainder throughout the whole period of English parliamentary history will be realized when it is remembered that there still exist dormant and abeyant peerages dating from 1295 onwards which may at any time be the subject of claim before the House of Lords, and if any attainders exist in the history of such peerages the law governing their consequences is not the law as it exists to-day but as it existed when the attainder occurred. The dukedom of Atholl case of 1764 is interesting as showing the effect of attainder on a peerage where the person attainted does not actually succeed. John first duke of Atholl died in 1725 leaving two sons James and George. George the younger was attainted of treason in 1745 and died in 1760, leaving a son John. James, the second son of the first duke, who had succeeded his father in 1725 died in 1764 without issue. John his nephew then claimed the dukedom, and was allowed it on the ground that his father never having been in the possession of the dukedom his attainder could not bar his son, who succeeds by reason of his heirship to his uncle. It would have been otherwise had the younger son outlived his brother, for he would then have succeeded to the dukedom and so destroyed it by his attainder.

In many cases there have been passed special parliamentary acts of attainder and forfeiture, and these, of course, operate apart from the general law. In any event, attainder and forfeiture of a dignity, whether resulting from the rules of the common law or from special or general acts of parliament can only be reversed by act of parliament. The procedure in reversing an attainder and recovering a dignity is as follows. The Crown signifies its pleasure that a bill of restoration shall be prepared and signs it. The bill is then brought in to the House of Lords, passed there, and sent to the Commons for assent. The last bills of the kind became law in 1876, when Earl Cowper procured the removal of the attainder on one of his Ormond ancestors and so by purging the blood of corruption became entitled to, and was allowed, the barony of Butler of Moore Park (created in 1663). There should also be noted the Earldom of Mar Restitution Act 1885, which, while mainly confirmatory of a disputed succession, at the same time reversed any attainders that existed.

Commonwealth Abolition of the Lords.

Cromwell's House of Lords.

The House of Lords grew steadily throughout the Tudor period, and during the reign of the first two Stuarts underwent a still greater increase. In the Great Rebellion the majority of the peers were the king's stoutest supporters and thus inevitably involved themselves in the ruin of the royal cause. Immediately after the execution of Charles I. the Republicans proceeded to sweep away everything which savoured of monarchy and aristocracy. The House of Commons voted the Lords "useless and dangerous," got rid of them as a part of parliament by the simple expedient of a resolution (*Comms. Journs.* 1648–1649, vi. 111) and placed the sole executive power in Cromwell's hands, but there was no direct abolition of the peerage as such. Evidently it took Cromwell but little time to realize the fallacy, in practice, of single-chamber government, as he is found ten years after the "useless and dangerous" resolution busy establishing a second chamber.[1] What to call it aroused much discussion, and eventually the unruly Commons consented to speak of and deal with "the other house." It is very difficult to realize what was the constitution of this body, so short was its life and so contemptuous its treatment by the Commons. The members of "the other house" were summoned by writs under the Great Seal, similar in form to those used to summon peers of past days. Some sixty writs were issued, and presumably their recipients were entitled thereby to sit for the duration of the parliament to which they were summoned; but it may be considered as certain that Cromwell's lords were never regarded as hereditary peers. They were entitled to the courtesy appellation "Lord" and appear to have been in the main substantial men—existing peers, judges, distinguished lawyers and members of well-known county families. Judging from Cromwell's speech at the opening of parliament, and subsequent entries in Whitelock's diaries, the new house appears to have had revising functions both of a legislative and judicial nature and also the duty of taking cognizance of foreign affairs. Cromwell certainly issued two patents of hereditary peerage—the barony of Burnell and the barony of Gilsland (with which went the viscounty of Howard of Morpeth), but neither title was recognized on the Restoration, and it does not appear that the possession of these titles ever conferred on their holders any hereditary right to a writ of summons to sit in "the other house." Whitelock himself was promised a viscounty by Cromwell, but no patent ever appears to have passed the Great Seal. Eventually business between the two houses grew impossible, and Cromwell was compelled to dissolve parliament. Richard's first parliament also contained Lords as well as Commons, the latter considerately voting "to transact business with the persons sitting in the other house as an House of Parliament, saving the right of the peers who had been faithful to the parliament," the saving clause evidently a loophole for the future. The dissolution of this parliament and the retirement of the protector Richard into private life preceded by only a few months the restoration to the throne of Charles II. With the king the peers returned to their ancient places.

Scottish Representative Peers.

Irish Representative Peers.

From the reign of William of Orange the peerage has been freshened by a steady stream of men who as a rule have served their country as statesmen, lawyers and soldiers. Little of note occurred in the history of the peerage until the reign of Anne. By the Act of Union with Scotland (1707) the Scottish parliament was abolished; but the Scottish peerage were given the privilege of electing, for each parliament of Great Britain, sixteen of their number to represent them in the House of Lords. Further creations in the Scottish peerage were no longer to be made. The effect of this act was to leave the great majority of the Scottish peers outside the House of Lords, as only sixteen of their number were to become lords of parliament. Close upon a hundred years later Ireland was united with Great Britain, the Irish parliament being merged in the parliament of the United Kingdom of Great Britain and Ireland. Twenty-eight Irish peers were to be elected for life by their order to represent it in the House of Lords. One archbishop and three bishops were also chosen in turn to represent the Irish Church in the House of Lords, but when that Church was disestablished in 1867 the spiritual lords lost their seats. The merger of the three kingdoms had an important effect on their peerages. Every peer in his own country had been a lord of parliament by hereditary right. The English peer (and, as the Acts of Union were passed, the peer of Great Britain and the peer of the United Kingdom) continued by hereditary right a lord of parliament. The Scottish and Irish peers lost this right though by the two Acts of Union they retained every other privilege of peerage. Henceforth they were lords of parliament only as and when their fellow peers elected them. Thus though not all were lords of parliament *in esse*, every one was always so *in posse*, and in any case it was the hereditary quality of the peerage which either actually seated its holder in the House of Lords or made it possible for him to get there by the votes of his fellows.

Modern Meaning of "Peerage."

It now becomes possible to arrive at the modern meaning of the term "a peerage," and we may define it as a dignity of England, Scotland or Ireland, which, by its hereditary quality, confers on its holder for the time being the right to be or not to be elected a lord of parliament. The term "peerage" is also used in a collective sense.

Queen Anne and Peerage Limitation.

The reign of Anne is remarkable for an attempt made by the House of Lords to limit its numbers by law. The queen, in order to secure a majority for the court party, had created a batch of twelve peers at one time, a considerable number in relation to existing peerages; and it was feared this expedient might be used as a precedent. A peerage limitation bill was introduced into the House of Lords in 1719. Six new creations were to be allowed, but after these the Crown, except in the case of royal princes, was to create a new peerage only when an old one became extinct. Twenty-five hereditary peerages in Scotland were to take the place of the sixteen representative peers for all time. The bill passed the Lords, but was eventually thrown out in the House of Commons, though not by an overwhelming majority.

Wensleydale Case.

In 1856 it was desired to strengthen the judicial element in the House of Lords, and the Crown issued letters patent creating Sir James Parke, one of the barons of the exchequer, Baron Wensleydale and a peer "for and during the term of his natural life." The burden of an hereditary peerage is heavy, and many men thoroughly well qualified in legal attainments have been known to refuse it on the ground of expense alone. This life-peerage was thought to be a way out of the difficulty, and it was on Lord Chancellor Cranworth's advice that the Crown issued the Wensleydale patent. The House of Lords at once realized that the creation of life-peers, at the will of the ministry of the day, might put the hereditary section into an absolute minority, and possibly in time, by form of law, get rid of it altogether. Eventually it was decided by the house that "neither the said letters patent nor the said letters patent with the usual writ of summons enable the grantee to sit and vote in parliament," a formal resolution which closed the door in the face of every person whom the Crown might endeavour to make a life-peer. The government of the day accepted the situation, and soon afterwards a new patent was made out which followed the usual limitation to heirs-male. The precedents in favour of the Crown's action were not strong. The essential and outstanding attribute of the house was its hereditary character. The whole balance of the constitution worked on the pivot of the independence of the peers. They existed as a moderating force in the counsels of parliament, and the alteration of the hereditary character of the House of Lords might easily have rendered it amenable to whatever pressure the government of the day might see fit to exercise. In such circumstances its position as arbiter between people and government would tend to disappear. A change fraught with so many serious possibilities ought not, it was said, to be made by the simple prerogative of the Crown. If so far-reaching an alteration in the law were justifiable it was for parliament to make it. Further, it was pointed out, there had been no life-creations for centuries, and those that are recorded to have been conferred since the crystallization of our parliamentary system were of such a nature that the grantees never sat in the house by virtue of their life-honours, inasmuch as they were existing peers or women. Soon after the Wensleydale debates the government introduced a bill into the House of Lords to authorize the creation of two life-peers, who were to be persons of at least five years' standing as judges. They were to sit as lords of appeal but to be peers for life. Eventually the bill disappeared in the House of Commons. In 1869 Earl Russell introduced another life-peerage bill of far wider scope. Twenty-eight life-peerages might be in existence at any one time, but not more than four were to be created in any one year. The life peers would be lords of parliament for life. They were to be selected by the Crown from the peerages of Scotland and Ireland, persons who had sat for ten years in the Commons, distinguished soldiers, sailors, civil servants and judges or persons distinguished in science, literature or art. The bill received a rough handling in committee of the Lords, and the time was evidently not ripe for change, as the bill failed to pass its third reading.

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[1] Whitelock's *Memorials of English Affairs* (in the reign of Charles I. and up to the Restoration) (1853 ed. iv. 313).

Judicial Peers.

Suggested Reforms and Alterations.

In 1870 attempts were made in the House of Lords to alter the position of the Scottish and Irish representative peers. In 1876 the need of further judicial strength in the Lords was tardily admitted, and an act was passed authorizing the creation of two lords of appeal in ordinary, and power was reserved to appoint two more as certain judicial vacancies occurred. They were to be entitled to the rank of baron during their lives but were to sit and vote in parliament only so long as they held their judicial office. Their dignities lasted for life only. Eleven years later another act enabled all retired lords of appeal to sit and vote as members of the House of Lords for life. To those interested in House of Lords reform the pages of *Hansard's Parliamentary Debates* are the best authority. In 1888 reform bills were introduced by Lords Dunraven and Salisbury, and in 1907 by Lord Newton. In December 1908 the publication of a long report with sweeping recommendations for reform ended the labours of a House of Lords committee which had been appointed to consider the question in detail. In the session of 1910, following the general election, long discussions took place in both houses of parliament. Opinion generally was freely expressed that the time had arrived for diminishing the number of lords of parliament and for putting into practice the principle that hereditary right alone should no longer confer lordship of parliament. (See PARLIAMENT.)

Scottish Peerage.

The Scottish peerage, like that of England, owes its origin to feudalism. In Anglo-Norman days Scotland was a small country, and for some generations after England was settled the Scottish king's writ ran little beyond the foot of the Highlands, and even the Lord of the Isles reckoned himself an independent sovereign until the beginning of the 15th century. The weak and usually ineffective control of the Crown resulted in opportunities for acquiring personal power which the nobles were not slow to take advantage of. Seldom accustomed to act in concert, they soon developed particularist tendencies which steadily increased the strength of their territorial position. These conditions of existence were entirely unfavourable to the establishment of any system of parliamentary government such as centralization had made possible in England, therefore it is not surprising to find that the lesser barons were not relieved of their attendance at the national assemblies until well on in the 15th century (Burton's *Scotland*, iii. 111). Again, when the Scottish earls and barons came to parliament, they did not withdraw themselves from the rest of the people, it being the custom for the estates of Scotland to deliberate together, and this custom persisted until the abolition of their parliament by the Act of Union in 1707. The territorial spirit of the nobles inevitably led them to regard the honour as belonging to, and inseparable from, their land, and until comparatively late in Scottish history there is nowhere any record of the conferment of a personal dignity unattached to land such as that conferred in England on Beauchamp by Richard II. This explains the frequent surrenders and altered grants which are so common in Scottish peerage history, and which, in sharp distinction to the English rule of law, are there regarded as perfectly legal. To-day there exists no Scottish dukedom (except the royal dukedom of Rothesay), marquessate or viscounty created before the reign of James VI. of Scotland (and I. of England). Of the existing Scottish peerages sixty-three were created in the period between James's accession to the English throne and the Act of Union. There are now only eighty-seven in all. Unlike one of the English peerages owing its origin exclusively to a writ of summons, ancient Scottish peerages do not fall into abeyance, and when there are only heirs-general, the eldest heir of line succeeds.

Whenever a new parliament is summoned, proclamation is made in Scotland summoning the peers to meet at Holyrood to elect sixteen of their number to represent them in such parliament. The Scottish peerages are recorded on a roll, and this is called over by the lord clerk register before the assembled peers seated at a long table. Each peer answers to the name of the peerage (it may be one or more) he possesses. The roll is then read again and each peer in turn (but only once) rises and reads out the list of those sixteen peers for whom he votes. Proxies are allowed for absent peers and are handed in after the second roll-call. The votes are counted and the lord clerk register reads out the names of those elected, makes a return, and signs and seals it in the presence of the peers assembled. The return eventually finds its way to the House of Lords. The Scottish representative peer so elected receives no writ of summons to parliament, but attends the House of Lords to take the oath, his right to sit being evidenced by the return made. It might be thought that the rules of election in so important a matter would be more stringent, but the fact remains that it is quite possible for an entirely unqualified person to attend and vote at Holyrood. No evidence of identity or of a man's right to be present is required and the lord clerk register is compelled to receive any vote tendered except in respect of peerages for which no vote has been given since 1800, these being struck off the roll (10 & 11 Vict. c. 52). Any person claiming to represent such a peerage must prove his right before the House of Lords, as was done in the case of the barony of Fairfax in 1908. It is true that by the act last cited any two peers may protest against a vote at Holyrood, and the lord clerk register thereupon reports the proceedings to the House of Lords, who will consider the question if application be made for an inquiry, but nothing is done unless an application is made. The right to vote certainly needs better proof than that now accepted. For many years the House of Lords maintained that the Crown could not confer a new peerage of Great Britain on a Scottish peer, the ground being that the Scottish peerage was only entitled to the sixteen representative peers given it by the Act of Union, but eventually in 1782 in the case of the duke of Hamilton this contention was given up.

The Anglo-Norman conquerors of Ireland carried with them the laws and the system of tenure to which they were accustomed

Irish Peerage.

in England, and consequently the growth of the baronage and the establishment of parliamentary government in Ireland proceeded on parallel lines with the changes which occurred in England. Until the reign of Henry VIII. the Irish were without representation in parliament, but gradually the Irish were admitted, and by the creation of new parliamentary counties and boroughs were enabled to elect representatives. In 1613 the whole country shared in representation (Ball's *Legislative Systems of Ireland*). Just as James I. had added many members to the Scottish peerage, so he increased the number of Irish peers.

In 1800 the Union of Great Britain and Ireland abolished the parliament of Ireland. By the Act of Union the Irish peers became entitled to elect twenty-eight of their number to represent them in the House of Lords. The election is for life, and only those peers are entitled to vote at elections of representative peers who have proved their right of succession to the satisfaction of the lord chancellor, who issues his notice to that effect after each individual proof. The names of such peers are added to the voting-roll of the peerage, and when voting papers are distributed—the Irish peers do not meet for election purposes as do those of Scotland—they are sent only to those peers who have proved their right to vote. If any claim to the right to vote is rejected by the lord chancellor the claimant must prove his case before the Committee for Privileges (barony of Graves, 1907). When an Irish peer has been elected a representative peer he receives, as a matter of course, a writ of summons at the beginning of each parliament. The great bulk of the Irish peerage owes its existence to creations during the last two centuries, only seven of the existing peerages dating back beyond the 17th century; of the rest twenty-two were created during the year of Union, and thirty-three have been added since that date. Some hundred or more years ago ministers found the Irish peerage a useful means of political reward, in that it was possible to bestow a title of honour, with all its social prestige, and yet not to increase the numbers of the House of Lords.

On the death of a representative peer of Scotland or Ireland a vacancy occurs and a new election takes place, but in accordance with modern practice promotion to a United Kingdom peerage does not vacate the holder's representative position (May's *Parliamentary Practice*, p. 11 n.). Scottish and Irish peers, if representative, possess all the privileges of peerage and parliament enjoyed by peers of the United Kingdom; if non-representative all privileges of peerage, except the right to a writ of summons to attend parliament and to be present at and vote in the trial of peers. A Scottish peer, if non-representative, is in the anomalous position of being disabled from serving his country in either house of parliament, but an Irish peer may sit for any House of Commons constituency out of Ireland, though while a member of the Commons his peerage privileges abate.

Though many peers possess more than one peerage, and frequently of more than one country, only that title is publicly used which is first in point of precedence. It was once argued that whenever a barony by writ came into the possession of a person already a peer of higher rank, the higher peerage "attracted" or overshadowed the lower, which thenceforth followed the course of descent of the dignity which had attracted it. This doctrine is now exploded and cannot be regarded as applying to any case except that of the Crown (*Baronies of Fitzwalter*, 1660, and *De Ros*, 1666; Collins's *Claims*, 168, 261). Every peerage descends according to the limitations prescribed in its patent of creation or its charter, and where these are non-existent (as in the case of baronies by writ) to heirs-general. (See ABEYANCE.)

Creations must be according to Law.

In dealing with English dignities it is essential to realize the difference between a mere title of honour and a peerage. The Crown as the fountain of honour is capable of conferring upon a subject not only any existing title of honour, but may even invent one for the purpose. So James I. instituted an order of hereditary knights which he termed baronets, and Edward VII. created the duchess of Fife "Princess Royal"—a life dignity. The dignities of prince of Wales, earl marshal and lord great chamberlain have been for centuries hereditary, and though of high court and social precedence, of themselves confer no right to a seat in the House of Lords—they are not peerages. The grant of a peerage is a very different matter; its holder becomes thereby a member of the Upper House of Parliament, and therefore the prerogative of the Crown in creating such an office of honour must be exercised strictly in accordance with the law of the land. The Crown's prerogative is limited in several directions. The course of descent must be known to the law; and so, in the first place, it follows that a peer cannot be created for life with a denial of succession to his descendants (unless it be as one of the lords of appeal in ordinary under the acts of 1876 and 1887). The courses of descent of modern patents are invariably so marked out as ultimately to fix the peerage in some male line according to the custom of primogeniture, though the immediate successor of the first holder may be a woman or even a stranger in blood. The following instances may be cited; Amabell, Baroness Lucas, was in 1816 created Countess de Grey with a limitation to the heirs-male of her sister; a nephew afterwards succeeded her and the earldom is now held by the marquess of Ripon. Other courses of descent known to the law are as follows: Fee simple, which probably operates as if to heirs-general, earldoms of Oxford (1155) and Norfolk (1135), both probably now in abeyance; and Bedford (1367), extinct; to a second son, the eldest being alive, dukedom of Dover (1708), extinct, and earldom of Cromartie (1861) called out of abeyance in 1895; a son-in-law and his heirs-male by the daughter of the first grantee, earldom of Northumberland (1747); to an elder daughter and her heirs-male, earldom of Roberts (1901); to an elder or younger brother and his heirs-male, viscounty of Kitchener (1902) and barony of Grimthorpe (1886). It is, however, not lawful for the Crown to make what is called a shifting limitation to a peerage, *i.e.* one which might vest a peerage in an individual, and then on a certain event happening (*e.g.* his succession to a peerage of higher rank) shift it from him to the representative of some other line. Such a limitation was held illegal in the Buckhurst case (1864). A peerage may not be limited to the grantee and "his heirs-male for ever." Such a grant was that of the earldom of Wiltes in 1398. The original grantee died without issue, but left a male heir-at-law, whose descendants in 1869 claimed the earldom, but the original limitation was held invalid.

There is no limitation on the power of the Crown as to the number of United Kingdom peerages which may be created. As to Scotland, the Act of Union with that country operates to prevent any increase in the number of Scottish peerages, and consequently there have been no creations since 1707, with the result that the Scottish peerage, as a separate order, is gradually approaching extinction. The Irish peerage is supposed always to consist of one hundred exclusively Irish peers, and the Crown has power to grant Irish peerages up to the limit. When the limit is reached no more peerages may be granted until existing ones become extinct or their holders succeed to United Kingdom peerages. Only four lords of appeal in ordinary may hold office at any one time. The number of archbishops and bishops capable of sitting in the House of Lords is fixed by various statutes at twenty-six, but, as pointed out previously, the spiritual lords are not now regarded as peers.

Growth in Numbers.

Since party government became the rule, the new peerages have usually been created on the recommendation of the prime minister of the day, though the Crown, especially in considering the claims of royal blood, is believed in some instances to take its own course; and constitutionally such action is entirely legal. By far the greater number of peerage honours granted during the last two centuries have been rewards for political services. Usually these services are well known, but there exists several instances in which the reasons for conferring the honour have not been quite clear. Until the reign of George III. the peerage was comparatively small, but that monarch issued no fewer than 388 patents of peerage. Many of these have become extinct or obscured by higher titles, but the general tendency is in the direction of a steady increase, and where the peers of Tudor times might be counted by tens their successors of 1910 were numbered in hundreds. The full body would be 546 English peers. There are also 12 ladies holding English peerages. The Irish peerage has 175 members, but 82 of these are also peers of the United Kingdom, leaving 28 representative and 65 without seats in the House of Lords. Of 87 Scottish peers 51 hold United Kingdom peerages, the remainder consisting of 16 representative and 20 without seats.

Privileges of Peerage.

As centuries have gone by and customs changed, many privileges once keenly asserted have either dropped out of use or been forgotten. The most important now in being are a seat in the House of Lords and the right to trial by peers. The right to a seat in parliament is one sanctioned by centuries of constitutional usage. The right of a peer in England to a seat in parliament was not, as pointed out in the early part of this article, entirely admitted by the Crown until late in the Plantagenet period, the king's pleasure as to whom he should summon always having been a very material factor in the question. Charles I. made a deliberate attempt to recover the ancient discretion of the Crown in the issue of writs of summons. The earl of Bristol was the subject of certain treasonable charges, and though he was never put on his trial the king directed that his writ of summons should not issue. The excluded peer petitioned the Lords, as for a breach of privilege, and a committee to whom the matter was referred reported that there was no instance on record in which a peer capable of sitting in parliament had been refused his writ. There was a little delay, but the king eventually gave in, and the earl had his writ (*Lords Journals*, iii. 544).

At the beginning of a new parliament every peer entitled receives a writ of summons issued under the authority of the Great Seal; he presents his writ at the table of the House of Lords on his first attendance, and before taking the oath. If the peer be newly created he presents his letters-patent creating the peerage to the lord chancellor on the woolsack, together with the writ of summons which the patent has evoked. A peer on succession presents his writ in the ordinary way, the *Journals* recording, *e.g.* that Thomas Walter, Viscount Hampden, sat first in Parliament after the death of his father (*Lords Journals*, cxxxix. 4). The form of writ now issued (at the beginning of a parliament: for the variation when parliament is sitting see *Lords Journals*, cxxxix. 185) corresponds closely to that in use so long ago as the 14th century. It runs as follows:—

> George the Fifth by the Grace of God of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the seas King Defender of the Faith to our right trusty and well-beloved Greeting Whereas by the advice and consent of our Council for certain arduous and urgent affairs concerning us the state and the defence of our said United Kingdom and the Church we have ordered a certain Parliament to be holden at our City of Westminster on the . . . day of . . . next ensuing and there to treat and have conference with the prelates great men and peers of our realm We strictly enjoining command you upon the faith and allegiance by which you are bound to us that the weightiness of the said affairs and imminent perils considered (waiving all excuses) you be at the said day and place personally present with us and with the said prelates great men and peers to treat and give your counsel upon the affairs aforesaid. And this as you regard us and our honour and the safety and defence of the said United Kingdom and Church and despatch of the said affairs in no wise do you omit.

Formerly all peers were required to attend parliament, and there are numerous recorded instances of special grants of leave of absence, but nowadays there is no compulsion.

Peers Tried by Peers.

After the right to a summons the principal privilege possessed by a peer is his right to be tried by his peers on a charge of treason or felony. Whatever the origin of this right, and some writers date it back to Saxon times (Trial of Lord Morley, 1678, *State Trials* vii. 145), Magna Carta has always been regarded as its confirmatory authority. The important words are:—

> "nullus liber homo capiatur imprisonetur aut disseisiatur de libero tenemento suo vel libertatibus seu liberis consuetudinibus suis, aut utlagetur aut exuletur nec aliquo modo distruatur nec dominus rex super ipsum ibit nec super eum mittet nisi per legale *judicium parium suorum* vel per legem terrae."

The peers have always strongly insisted on this privilege of trial by their own order, and several times the heirs of those wrongly condemned recovered their rights and heritage on the ground that there had been no proper trial by peers (*R.D.P.*, v. 24). In 1442 the privilege received parliamentary confirmation (stat. 20 Henry VI. c. 9). If parliament is sitting the trial takes place before the House of Lords in full session, *i.e.* the court of our lord the king in parliament, if not then before the court of the lord high steward. The office of lord high steward was formerly hereditary, but has not been so for centuries and is now only granted *pro hac vice*. When necessity arises the Crown issues a special commission naming some peer (usually the lord chancellor) lord high steward *pro hac vice* (Blackstone's *Comm.* iv. 258). When a trial takes place in full parliament a lord high steward is also appointed, but his powers there are confined to the presidency of the court, all the peers sitting as judges of law as well as of fact. Should the lord high steward be sitting as a court out of parliament he summons a number of peers to attend as a jury, but rules alone on all points of law and practice, the peers present being judges of fact only. Whichever kind of trial is in progress it is the invariable practice to summon all the judges to attend and advise on points of law. The distinction between the two tribunals was fully discussed and recognized in 1760 (Trial of Earl Ferrers, Foster's *Criminal Cases*, 139). The most recent trial was that of Earl Russell for bigamy (reported 1901, A.C. 446). Among others are the Kilmarnock, Cromarty and Balmerino treason trials in parliament in 1746 (*State Trials* xviii. 441), and in the court of the lord high steward, Lord Morley (treason, 1666, *State Trials* vi. 777), Lord Cornwallis (murder, 1678 *State Trials* vii. 145), Lord Delamere (1686, treason, *State Trials* xi. 510). Recently some doubt has been expressed as to the origin of the court of the lord high steward. It is said that the historical document upon which the practice is founded is a forgery. The conflicting views are set forth in Vernon Harcourt's *His Grace the Steward and Trial of Peers*, p. 429, and in Pike's *Constitutional History of the House of Lords*, p. 213. In any case, whatever its historical origin, the court for centuries as a matter of fact has received full legal recognition as part of the constitution. The right to trial by peers extends only to cases of treason and felony, and not to those of misdemeanour; nor can it be waived by any peer (Co. 3 Inst. 29; Kelyng's Rep. 56). In the case of *R.* v. *Lord Graves* (1887), discussed in *Hansard's Parliamentary Debates*, 3rd series, vol. cccx. p. 246, Lord Halsbury points out that the question of trial by peers is one of jurisdiction established by law rather than a claim of privilege in the discretion of the accused. Scottish and Irish peers, whether possessing seats in the House of Lords or not, are entitled to trial by peers, the same procedure being followed as in the case of members of the House of Lords.

Peers with a seat in the House of Lords possess practically the same parliamentary privileges as do members of the House of Commons. Among other privileges peculiar to themselves they have the right of personal access to the sovereign (Anson's *Law of the Constitution*, i. 227). In the House of Lords, when a resolution is passed contrary to his sentiments, any peer, by leave of the house, may "protest," that is, enter his dissent on the journals of the house (Blackstone, *Comm.* i. 162). Formerly a peer might vote by proxy (Blackstone, ibid.), but since 1868 there has been a standing order discontinuing this right. In accordance with resolutions passed by the two houses, neither house has power by any vote or declaration to clothe itself with new privileges unknown to the law and customs of parliament (*Commons Journal*, xiv. 555). Peeresses and non-representative peers of Ireland and Scotland have, with the exception of the right to sit in the House of Lords and its attendant parliamentary privileges, every peerage privilege: a widowed peeress retains her privilege of peerage while unmarried, but loses it if she marries a commoner (Co. Litt. 166; *Cowley* v. *Cowley* [1901] A.C. 450). Dissolution of marriage probably deprives a peeress of all peerage privileges which she acquired by marriage.

Position of Families of Peers.

The children of peers are commoners. The eldest son of a peer of the rank of earl (and above) is usually known socially by the name of his father's next peerage, but the courtesy nature of such title is clearly indicated in every public or legal document, the phraseology employed being "John Smith, Esq., commonly known as Viscount Blackacre." Several cases are on record in which peers' eldest sons have actually borne courtesy titles not possessed as peerage honours by their fathers, but inasmuch as such are only accorded by courtesy, no question of peerage privilege arises. The younger sons of dukes and marquesses are entitled to the prefix "Lord" before their Christian names, and all the daughters of earls as well as of dukes and marquesses are entitled similarly to style themselves "Lady," on the principle that all the daughters are equal in rank and precedence. The younger sons of earls and all the younger children of viscounts and barons are entitled to the prefix "Honourable." Usually when the direct heir of a peer dies his children are given, by the Crown, on the death of the peer, the courtesy titles and precedence they would have enjoyed had their father actually succeeded to the peerage.

Creation of Peerages.

An alien may be created a peer, but while remaining an alien cannot sit in the House of Lords, nor, if a Scottish or Irish peer, can he vote at elections for representative peers. Peerages may be created (1) by writ of summons, (2) by patent. The writ of summons method is not now used except in the case of calling up an eldest son in the barony of his father. This does not create a new peerage but only accelerates the heir's appearance in the House of Lords. On the father's death the peerage remains vested in the son. Should the son die without heir the peerage revests in the father. The invariable method of creation in all ordinary cases is by patent. The letters patent describe the name of the dignity, the person upon whom it is conferred, and specify its course of descent.

Claims to Peerages.

Claims to peerages are of two kinds: (1) of right, (2) of grace. In theory the Crown, as the fountain of honour, might settle any claim without reference to the House of Lords and issue a writ of summons to its petitioner. This would not in any way prevent the House of Lords from examining the patent and writ of summons when the favoured petitioner or any heir claiming through him came to take his seat. If of opinion that the patent was illegal the house might refuse admittance, as it did in the Wensleydale case. In the case of a petitioner who has persuaded the Crown to terminate in his favour as a co-heir the abeyance of an ancient barony and who has received his writ of summons, the matter is more difficult. The house cannot refuse to admit any person properly summoned by the Crown, as the prerogative is unlimited in point of numbers; but it can take into account the precedence of the newcomer. If he has an old barony he naturally expects its proper place on the bench of barons; but if the house thought fit they might compel him to prove his pedigree before according any precedence. If he refused to do this they would still be bound to admit him, but it would be as the junior baron of the house with a peerage dating, for parliamentary purposes, from the day of his summons. The general result is that the Crown, unless there can be no question as to pedigree, seldom terminates an abeyance without referring the matter to the House of Lords, and invariably so refers all claims which are disputed or which involve any question of law.[1] The procedure is as follows: The claimant petitions the Crown through the home secretary, setting forth his pedigree and stating the nature of his claim. The Crown then refers the petition to its legal adviser, the attorney-general. The petitioner then in course of time appears before the attorney-general with his proofs. Finally the attorney-general reports that a prima facie case is, or is not, made out. If a case be made out, the Crown, if it does not take immediate action, refers the whole matter to the House of Lords, who pass it on to their Committee for Privileges for examination and report.

Committee for Privileges.

The Committee for Privileges, which for peerage claims is usually constituted of the law lords and one or two other lords interested in peerage history, sits as an ordinary court of justice and follows all the rules of law and evidence. The attorney-general attends as adviser to the committee and to watch the interests of the Crown. According to the nature of the case the Committee reports to the house, and the house to the Crown, that the petitioner (if successful) (1) has made out his claim and is entitled to a writ of summons, or (2) has proved his co-heirship to an existing peerage, and has also proved the descent of all existing co-heirs. In the first case the writ of summons is issued forthwith, but the second, being one of abeyance, is a matter for the pleasure of the Crown, which need not be exercised at all, but, if exercised, may terminate the abeyance in favour of any one of the co-heirs. The seniority of a co-heir (though this alone is of little moment), his power to support the dignity, and the number of existing co-heirs, are all factors which count in the chances of success.

Peers of France.

Reference has already been made in the earlier part of this article to the reply of Bishop Peter de Roches to the English barons who claimed trial by their peers, and, as was suggested the bishop probably had in his mind the peers of France. Possibly the word *pares*, as eventually used in England, was borrowed from this source, but this is uncertain. The great men known originally as the twelve pairs de France, were the feudal holders of large territories under the nominal sway of the king of France. They were the (archbishop) duke of Rheims, the (bishop) dukes of Langres and Laon, the (bishop) counts of Beauvais, Noyon and Chalons, the dukes of Burgundy, Normandy and Aquitaine, and the counts of Flanders, Toulouse and Champagne. These magnates, nominally feudatories, were practically independent rulers, and their position can in no way be compared to that of the English baronage. It is said that this body of peers was instituted in the reign of Philip Augustus, though some writers even ascribe its origin to Charlemagne. Some of the peers were present at Philip's coronation in 1179, and later again at the alleged trial of John of England when his fief of Normandy was adjudged forfeit to the French Crown.

As the central power of the French kings grew, the various fiefs lost their independence and became united to the Crown, with the exception of Flanders which passed into the hands of the emperor Charles V. In the 14th century the custom arose for the sovereign to honour his more important nobles by granting them the title of Peer of France. At first the grant was confined to the royal dukes, but later it was conferred on others, amongst whom late in the 17th century appears the archbishop of Paris. To several counties and baronies the honour of a peerage was added, but most of these eventually became reunited with the Crown. As a legislative body a chamber of peers in France was first founded by Louis XVIII. in 1814; it was hereditary and modelled on the English House of Lords. The revolution of 1830 reduced its hereditary quality to life tenure, and in the troubles of 1848 the chamber itself finally disappeared.

Other Peerages.

Austria, Hungary and Portugal are other countries possessing peerages which to some extent follow the English model. In Austria there is a large hereditary nobility and those members of it in whose families the legislative dignity is hereditary by nomination of the emperor sit in the Herrenhaus or Austrian Upper Chamber, together with certain prelates and a large number of nominated life-members. In Hungary all those nobles who possess the right of hereditary peerage (as admitted by the act of 1885 and subsequent acts) and who pay a land tax of certain value, are members of the House of Magnates, of which they form a large majority, the remainder of the members being Roman Catholic prelates, representatives of Protestant churches and life-peers. In Portugal until recent years the House of Peers was an hereditary body, but it is now practically a chamber of life-peers. (G. E.*)

PEERLKAMP, PETRUS HOFMAN (1786–1865), Dutch classical scholar and critic, descended from a family of French refugees named Perlechamp, was born at Groningen on the 2nd of February 1786. He was professor of ancient literature and universal history at Leiden from 1822 to 1849, when he resigned his post and retired to Hilversum near Utrecht, where he died on the 27th of March 1865. He was the founder of the subjective method of textual criticism, which consisted in rejecting in a classical author whatever failed to come up to the standard of what that author, in the critic's opinion, ought to have written. His ingenuity in this direction, in which he went much farther than Bentley, was chiefly exercised on the *Odes* of Horace (the greater part of which he declared spurious), and the *Aeneid* of Virgil. He also edited the *Ars poetica* and *Satires* of Horace, the *Agricola* of Tacitus, the romance of Xenophon of Ephesus, and was the author of a history of the Latin poets of the Netherlands (*De vita, doctrina, et facultate Nederlandorum qui carmina latina composuerunt*, 1838).

See L. Müller, *Gesch. der klassischen Philologie in den Niederlanden* (1869), and J. E. Sandys, *Hist. of Class. Schol.* (1908), iii. 276.

PEESEMSKY, ALEXEY FEOFILACTOVICH (1820–1881), Russian novelist, was born on his father's estate, in the province of Kostroma, on the 10th/22nd of March 1820. In his autobiography he describes his family as belonging to the ancient

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[1] This was not done in the case of the earldom of Cromartie called out of abeyance in 1895. The holder of the title being a lady the house has had, as yet, no opportunity of considering the validity of the Crown's action.

Russian nobility, but his more immediate progenitors were all very poor, and unable to read or write. His grandfather ploughed the fields as a simple peasant, and his father, as Peesemsky himself said, was washed and clothed by a rich relative, and placed as a soldier in the army, from which he retired as a major after thirty years' service. During childhood Peesemsky read eagerly the translated works of Walter Scott and Victor Hugo, and later those of Shakespeare, Schiller, Goethe, Rousseau, Voltaire and George Sand. From the gymnasium of Kostroma he passed through Moscow University, and in 1884 entered the government service as a clerk in the office of the Crown domains in his native province. Between 1854 and 1872, when he finally quitted the civil service, he occupied similar posts in St Petersburg and Moscow. His early works exhibit a profound disbelief in the higher qualities of humanity, and a disdain for the other sex, although he appears to have been attached to a particularly devoted and sensible wife. His first novel, *Boyarstchina*, was forbidden for its unflattering description of the Russian nobility. His principal novels are *Tufak* ("A Muff"), 1850; *Teesicha doush* ("A Thousand Souls"), 1862, which is considered his best work of the kind; and *Vzbalomoucheneoe more* ("A Troubled Sea"), giving a picture of the excited state of Russian society about the year 1862. He also produced a comedy, *Gorkaya soudbina* ("A Bitter Fate"), depicting the dark sides of the Russian peasantry, which obtained for him the Ouvaroff prize of the Russian Academy. In 1856 he was sent, together with other literary men, to report on the ethnographical and commercial condition of the Russian interior, his particular field of inquiry having been Astrakhan and the region of the Caspian Sea. His scepticism in regard to the liberal reforms of the 'sixties made him very unpopular among the more progressive writers of that time. He died at Moscow on the 2nd of February 1881 (Jan. 21, Russian style).

PEGASUS (from Gr. πηγός, compact, strong), the famous winged horse of Greek fable, said to have sprung from the trunk of the Gorgon Medusa when her head was cut off by Perseus. Bellerophon caught him as he drank of the spring Peirene on the Acrocorinthus at Corinth, or received him tamed and bridled at the hands of Athena (Pindar, *Ol.* xiii. 63; Pausanias ii. 4). Mounted on Pegasus, Bellerophon slew the Chimaera and overcame the Solymi and the Amazons, but when he tried to fly to heaven on the horse's back he threw him and continued his heavenward course (Apollodorus ii. 3). Arrived in heaven, Pegasus served Zeus, fetching for him his thunder and lightning (Hesiod, *Theog.* 281). Hence some have thought that Pegasus is a symbol of the thundercloud. According to O. Gruppe (*Griechische Mythologie*, i. 75, 123) Pegasus, like Arion the fabled offspring of Demeter and Poseidon, was a curse-horse, symbolical of the rapidity with which curses were fulfilled. In later legend he is the horse of Eos, the morning. The erroneous derivation from πηγή, "a spring of water," may have given birth to the legends which connect Pegasus with water; *e.g.* that his father was Poseidon, that he was born at the springs of Ocean, and that he had the power of making springs rise from the ground by a blow of his hoof. When Mt Helicon, enchanted by the song of the Muses, began to rise to heaven, Pegasus stopped its ascent by stamping on the ground (Antoninus Liberalis 9), and where he struck the earth Hippocrene (horse-spring), the fountain of the Muses, gushed forth (Pausanias ii. 31, ix. 31). But there are facts that speak for an independent mythological connexion between horses and water, *e.g.* the sacredness of the horse to Poseidon, the epithets Hippios and Equester applied to Poseidon and Neptune, the Greek fable of the origin of the first horse (produced by Poseidon striking the ground with his trident), and the custom in Argolis of sacrificing horses to Poseidon by drowning them in a well. From his connexion with Hippocrene Pegasus has come to be regarded as the horse of the Muses and hence as a symbol of poetry. But this is a modern attribute of Pegasus, not known to the ancients, and dating only from the *Orlando innamorato* of Boiardo.

See monograph by F. Hannig, *Breslauer philologische Abhandlungen* (1902), vol. viii., pt. 4.

PEGAU, a town of Germany, in the kingdom of Saxony, situated in a fertile country, on the Elster, 18 m. S.W. from Leipzig by the railway to Zeitz. Pop. (1905), 5656. It has two Evangelical churches, that of St Lawrence being a fine Gothic structure, a 16th-century town-hall; a very old hospital and an agricultural school. Its industries embrace the manufacture of felt, boots and metal wares.

Pegau grew up round a monastery founded in 1096, but does not appear as a town before the close of the 12th century. Markets were held here and its prosperity was further enhanced by its position on a main road running east and west. In the monastery, which was dissolved in 1539, a valuable chronicle was compiled, the *Annales pegavienses*, covering the period from 1039 to 1227.

See Füssel, *Anfang und Ende des Klosters St Jacob zu Pegau* (Leipzig, 1857); and Dillner, Grössel and Günther, *Altes und neues aus Pegau* (Leipzig, 1905). The *Annales pegavienses* are published in Bd. XVI. of the *Monumenta Germaniae historica. Scriptores.*

PEGMATITE (from Gr. πῆγμα, a bond), the name given by Haüy to those masses of graphic granite which frequently occur in veins. They consist of quartz and alkali feldspars in crystalline intergrowth (see PETROLOGY, Plate II. fig. 6). The term was subsequently used by Naumann to signify also the coarsely crystalline veins rich in quartz, feldspar and muscovite, which often in great numbers ramify through outcrops of granite and the surrounding rocks. This application of the name has now obtained general acceptance, and has been extended by many authors to include vein-rocks of similar structure and geological relationships, which occur with syenites, diorites and gabbros. Only a few of these pegmatites have graphic structure or mutual intergrowth of their constituents. Many of them are exceedingly coarse-grained; in granite-pegmatites the feldspars may be several feet or even yards in diameter, and other minerals such as apatite and tourmaline often occur in gigantic crystals. Pegmatites consist of minerals which are found also in the rocks from which they are derived, *e.g.* granite-pegmatites contain principally quartz and feldspar while gabbro-pegmatites consist of diallage and plagioclase. Rare minerals, however, often occur in these veins in exceptional amount and as very perfect crystals. The minerals of the pegmatites are always those which were last to separate out from the parent rock. As the basic minerals are the first formed the pegmatites contain a larger proportion of the acid or more siliceous components which were of later origin. In granite-pegmatites there is little hornblende, biotite or sphene, but white mica, feldspar and quartz make up the greater part of the veins. In gabbro-pegmatites olivine seldom occurs, but diallage and plagioclase occur in abundance. In this respect the pegmatites and aplites agree; both are of more acid types than the average rock from which they came, but the pegmatites are coarsely crystalline while the aplites are fine-grained. Segregations of the early minerals of a rock are frequent as nodules, lumps and streaks scattered through its mass, and often dikes of basic character (lamprophyres, &c.) are injected into the surrounding country. These have been grouped together as intrusions of *melanocrate* facies (μέλας, black, κράτος, strength, predominance) because in them the dark basic minerals preponderate. The aplites and pegmatites, on the other hand, are *leucocrate* (λευκός, white), since they are of acid character and contain relatively large amounts of the white minerals quartz and feldspar.

Pegmatites are associated with plutonic or intrusive rocks and were evidently formed by slow crystallization at considerable depths below the surface: nothing similar to them is known in lavas. They are very characteristic of granites, especially those which contain muscovite and much alkali feldspar; in gabbros, diorites and syenites pegmatite dikes are comparatively rare. The coarsely crystalline structure may be ascribed to slow crystallization; and is partly the result of the rocks, in which the veins lie, having been at a high temperature when the minerals of the pegmatites separated out. In accordance with this we find that pegmatite veins are nearly always restricted to the area occupied by the parent rock (*e.g.* the granite), or to its immediate vicinity, and within the zone which has been greatly heated by the plutonic intrusion, viz. the contact aureole. Another very important factor in producing the coarse crystallization of the pegmatite veins is the presence of abundant water vapour and other gases which served as mineralizing agents and facilitated the building together of the rock molecules in large crystalline individuals.

Proof that these vapours were important agents in the formation of pegmatites is afforded by many of the minerals contained in the veins. Boron, fluorine, hydrogen, chlorine and other volatile substances are essential components of some of these minerals. Thus tourmaline, which contains boron and fluorine, may be common in the pegmatites but rare in the granite itself. Fluorine or chlorine are present in apatite, another frequent ingredient of granite pegmatites. Muscovite and gilbertite both contain hydrogen and fluorine; topaz is rich in fluorine also and all of these are abundant in some pegmatites. The stimulating effect which volatile substances exert on crystallizing molten masses is well known to experimental geologists who, by mixing tungstates and fluorides with fused powders, have been able to produce artificial minerals which they could not otherwise obtain. Most pegmatites are truly igneous rocks so far as their composition goes, but in their structure they show relations to the aqueous mineral veins. Many of them for example have a comby structure, that is to say, their minerals are columnar and stand perpendicular to the walls of the fissure occupied by the vein. Sometimes they have a banding owing to successive deposits having been laid down of different character; mica may be external, then feldspar, and in the centre a leader or string of pure quartz. In pegmatite veins also there are very frequently cavities or vugs, which are lined by crystals with very perfect faces. These bear much resemblance to the miarolitic or drusy cavities common in granite, and like them were probably filled with the residual liquid which was left over after the mineral substances were deposited in crystals.

Pegmatites are very irregular not only in distribution, width and persistence, but also in composition. The relative abundance of the constituent minerals may differ rapidly and much from point to point. Sometimes they are rich in mica, in enormous crystals for which the rock is mined or quarried (India). Other pegmatites are nearly pure feldspar, while others are locally (especially near their terminations) very full of quartz. They may in fact pass into quartz veins (alaskites) some of which are auriferous (N. America). Quartz veins of another type are very largely developed, especially in regions of slate and phyllite; they are produced by segregation of dissolved silica from the country rock and its concentration into cracks produced by stretching of the rock masses during folding. In these segregation veins, especially when the beds are of feldspathic nature, crystals of albite and orthoclase may appear, in large or small quantity. In this way a second type of pegmatite (segregation pegmatite) is formed which is very difficult to distinguish from true igneous veins. These two have, however, much in common as regards the conditions under which they were formed. Great pressures, presence of water, and a high though not necessarily very high temperature were the principal agencies at work.

Granite pegmatites are laid down after their parent mass had solidified and while it was cooling down: sometimes they contain such minerals as garnet, not found in the main mass, and showing that the temperature of crystallization was comparatively low. Another special feature of these veins is the presence of minerals containing precious metals or rare earths. Gold occurs in not a few cases; tin in others, while sulphides such as copper pyrites are found also. Beryl is the commonest of the minerals of the second group: spodumene is another example, and there is much reason to hold that diamond is a native of some of the pegmatites of Brazil and India, though this is not yet incontestably proved. The syenite-pegmatites of south Norway are remarkable both for their coarse crystallization and for the great number of rare minerals they have yielded. Among these may be mentioned laavenite, rinkite, rosenbuschite, mosandrite, pyrochlore, perofskite and lamprophyllite.

(J. S. F.)

PEGNITZ, a river of Germany. It rises near Lindenhard in Upper Franconia (Bavaria) from two sources. At first it is called the Fichtenohe, but at Buchau it takes the name of the Pegnitz, and flowing in a south-westerly direction disappears below the small town of Pegnitz in a mountain cavern. It emerges through three orifices, enters Middle Franconia, and after flowing through the heart of the city of Nuremberg falls into the Regnitz at Fürth.

See Specht, *Das Pegnitzgebiet in Bezug auf seinen Wasserhaushalt* (Munich, 1905).

The *Pegnitz Order* (Order of the society of Pegnitz shepherds), also known as "the crowned flower order on the Pegnitz," was one of the societies founded in Germany in the course of the 17th century for the purification and improvement of the German language, especially in the domain of poetry. Georg Philipp Harsdörffer and Johann Klaj instituted the order in Nuremberg in 1644, and named it after the river. Its emblem was the passion flower with Pan's pipes, and the motto *Mit Nutzen erfreulich*, or *Alle zu einem Ton einstimmig.* The members set themselves the task of counteracting the pedantry of another school of poetry by imagination and gaiety, but lacking imagination and broad views they took refuge in allegorical subjects and puerile trifling. The result was to debase rather than to raise the standard of poetic art in Germany. At first the meetings of the order were held in private grounds, but in 1681 they were transferred to a forest near Kraftshof or Naunhof. In 1794 the order was reorganized, and it now exists merely as a literary society.

See Tittman, *Die nürnberger Dichterschule* (Göttingen, 1847); and the *Festschrift zur 250-jährigen Jubelfeier des pegnesischen Blumenordens* (Nuremberg, 1894).

PEGOLOTTI, FRANCESCO BALDUCCI (*fl.* 1315–1340), Florentine merchant and writer, was a factor in the service of the mercantile house of the Bardi, and in this capacity we find him at Antwerp from 1315 (or earlier) to 1317; in London in 1317 and apparently for some time after; in Cyprus from 1324 to 1327, and again (or perhaps in unbroken continuation of his former residence) in 1335. In this last year he obtained from the king of Little Armenia (*i.e.* medieval Cilicia, &c.) a grant of privileges for Florentine trade. Between 1335 and 1343, probably in 1339–1340, he compiled his *Libro di divisamenti di paesi e di misuri di mercatanzie e d'altre cose bisognevoli di sapere a' mercatanti*, commonly known as the *Pratica della mercatura* (the name given it by Pagnini). Beginning with a sort of glossary of foreign terms then in use for all kinds of taxes or payments on merchandise as well as for "every kind of place where goods might be bought or sold in cities," the *Pratica* next describes some of the chief trade routes of the 14th century, and many of the principal markets then known to Italian merchants; the imports and exports of various important commercial regions; the business customs prevalent in each of those regions; and the comparative value of the leading moneys, weights and measures. The most distant and extensive trade routes described by Pegolotti are: (1) that from Tana or Azov to Peking via Astrakhan, Khiva, Otrar, Kulja and Kanchow (Gittarchan, Organci, Ottrarre, Armalecco and Camexu in the *Pratica*); (2) that from Lajazzo on the Cilician coast to Tabriz in north Persia via Sivas, Erzingan and Erzerum (Salvastro, Arzinga and Arzerone); (3) that from Trebizond to Tabriz. Among the markets enumerated are: Tana, Constantinople, Alexandria, Damietta, and the ports of Cyprus and the Crimea. Pegolotti's notices of ports on the north of the Black Sea are very valuable; his works show us that Florentine exports had now gained a high reputation in the Levant. In other chapters an account is given of 14th-century methods of packing goods (ch. 29); of assaying gold and silver (ch. 35); of shipment; of "London in England in itself" (ch. 62); of monasteries in Scotland and England ("Scotland of England," *Scozia di Inghilterra*) that were rich in wool (ch. 63). Among the latter are Newbattle, Balmerino, Cupar, Dunfermline, Dundrennan, Glenluce, Coldingham, Kelso, Newminster near Morpeth, Furness, Fountains, Kirkstall, Kirstead, Swineshead, Sawley and Calder. Pegolotti's interest in England and Scotland is chiefly connected with the wool trade.

There is only one MS. of the *Pratica*, viz. No. 2441 in the Riccardian Library at Florence (241 fols., occupying the whole volume), written in 1471; and one edition of the text, in vol. iii. of Gian Francesco Pagnini's *Della Decima e delle altre gravezze imposte dal commune di Firenze* (Lisbon and Lucca—really Florence—1766); Sir Henry Yule, *Cathay*, ii. 279–308, translated into English the most interesting sections of Pegolotti, with valuable commentary (London, Hakluyt Society, 1866). See also W. Heyd, *Commerce du Levant*, ii., 12, 50, 58, 78–79, 85–86, 112–119 (Leipzig, 1886); H. Kiepert, in *Sitzungsberichte der philos.-hist. Cl. der berliner Akad.*, p. 901, &c. (Berlin, 1881); C. R. Beazley, *Dawn of Modern Geography*, iii. 324–332, 550, 555 (Oxford, 1906).

PEGU, a town and former capital of Lower Burma, giving its name to a district and a division. The town is situated on a river of the same name, 47 m. N.E. of Rangoon by rail; pop. (1901), 14,132. It is still surrounded by the old walls, about 40 ft. wide, on which have been built the residences of the British officials. The most conspicuous object is the Shwemaw-daw pagoda, 324 ft. high, considerably larger and even more holy than the Shwe-dagon pagoda at Rangoon. Pegu is said to have been founded in 573, as the first capital of the Talaings; but it was as the capital of the Toungoo dynasty that it became known to Europeans in the 16th century. About the middle of the 18th century it was destroyed by Alompra; but it rose again, and was important enough to be the scene of fighting in both the first and second Burmese Wars. It gave its name to the province (including Rangoon) which was annexed by the British in 1852.

The district, which was formed in 1883, consists of an alluvial tract between the Pegu Yoma range and the Sittang river: area, 4276 sq. m.; pop. (1901), 339,572, showing an increase of 43% in the decade. Christians numbered nearly 9000, mostly Karens. Almost the only crop grown is rice, which is exported in large quantities to Rangoon. The district is traversed by the railway, and also crossed by the Pegu-Sittang canal, navigable for 85 m., with locks.

The division of Pegu comprises the five districts of Rangoon city, Hanthawaddy, Tharrawaddy, Pegu and Prome, lying east of the Irrawaddy: area 13,084 sq. m.; pop. (1901), 1,820,638.

Pegu has also given its name to the Pegu Yoma, a range of hills running north and south for about 200 m., between the Irrawaddy and Sittang rivers. The height nowhere exceeds 2000 ft. but the slopes are steep and rugged. The forests yield teak and other valuable timber. The Pegu river, which rises in this range, falls into the Rangoon river just below Rangoon city, after a course of about 180 m.

PEILE, JOHN (1838–1910), English philologist, was born at Whitehaven on the 24th of April 1838. He was educated at Repton and Christ's College, Cambridge. After a distinguished career (Craven scholar, senior classic and chancellor's medallist), he became fellow and tutor of his college, reader of comparative philology in the university (1884–1891), and in 1887 was elected master of Christ's. He took a great interest in the higher education of women and became president of Newnham College. He was the first to introduce the great philological works of George Curtius and Wilhelm Corssen to the English student in his *Introduction to Greek and Latin Etymology* (1869). He died at Cambridge on the 9th of October 1910, leaving practically completed his exhaustive history of Christ's College.

PEINE, a town of Germany, in the Prussian province of Hanover, 16 m. by rail N.W. of Brunswick, on the railway to Hanover and Hamburg. Pop. (1905), 15,421. The town has a Roman Catholic and a Protestant church and several schools. Its industries include iron and steel works, breweries, distilleries and brickyards, and the manufacture of starch, sugar, malt, machinery and artificial manure. There are also large horse and cattle markets held here. Peine was at one time a strongly fortified place, and until 1803 belonged to the bishopric of Hildesheim.

PEINE FORTE ET DURE (French for "hard and severe punishment"), the term for a barbarous torture inflicted on those who, arraigned of felony, refused to plead and stood silent, or challenged more than twenty jurors, which was deemed a contumacy equivalent to a refusal to plead. By early English law a prisoner, before he could be tried, must plead "guilty" or "not guilty." Before the 13th century it was usual to imprison and starve till submission, but in Henry IV.'s reign the *peine* was employed. The prisoner was stretched on his back, and stone or iron weights were placed on him till he either submitted or was pressed to death. Pressing to death was abolished in 1772; "standing mute" on an arraignment of felony being then made equivalent to conviction. By an act of 1828 a plea of "not guilty" was to be entered against any prisoner refusing to plead, and that is the rule to-day. An alternative to the *peine* was the tying of the thumbs tightly together with whipcord until pain forced the prisoner to speak. This was said to be a common practice at the Old Bailey up to the 19th century.

Among recorded instances of the infliction of the *peine* are: Juliana Quick (1442) for high treason in speaking derisively of Henry VI.; Margaret Clitherow, "the martyr of York" (1586); Walter Calverly, of Calverly, Yorks, for the murder of his children (1605); and Major Strangways at Newgate, charged with murder of his brother-in-law (1657). In this last case it is said that upon the weights being placed in position several cavalier friends of Strangways sprang on his body and put him out of his pain. In 1721 one Nathaniel Hawes lay under a weight of 250 ℔ for seven minutes, finally submitting. The *peine* was last employed in 1741 at Cambridge assizes, when a prisoner was so put to death; the penalty of thumb-tying having first been tried. In 1692 at Salem, Massachusetts, Giles Corey, accused of witchcraft, refusing to plead, was pressed to death. This is believed to be the only instance of the infliction of the penalty in America.

PEIPUS, or Chudskoye Ozero, a lake of north-west Russia, between the governments of St Petersburg, Pskov, Livonia and Esthonia. Including its southern extension, sometimes known as Lake Pskov, it has an area of 1356 sq. m. Its shores are flat and sandy, and in part wooded; its waters deep, and they afford valuable fishing. The lake is fed by the Velikaya, which enters it at its southern extremity, and by the Embach, which flows in half way up its western shore; it drains into the Gulf of Finland by the Narova, which issues at its north-east corner.

PEIRAEUS, or Piraeus (Gr. Πειραιεύς), the port town of Athens, with which its history is inseparably connected. Pop. (1907), 67,982. It consists of a rocky promontory, containing three natural harbours, a large one on the north-west which is still one of the chief commercial harbours of the Levant, and two smaller ones on the east, which were used chiefly for naval purposes. Themistocles was the first to urge the Athenians to take advantage of these harbours, instead of using the sandy bay of Phaleron; and the fortification of the Peiraeus was begun in 493 B.C. Later on it was connected with Athens by the Long Walls in 460 B.C. The town of Peiraeus was laid out by the architect Hippodamus of Miletus, probably in the time of Pericles. The promontory itself consisted of two parts—the hill of Munychia, and the projection of Acte; on the opposite side of the great harbour was the outwork of Eetioneia. The most stirring episode in the history of the Peiraeus is the seizure of Munychia by Thrasybulus and the exiles from Phyle, and the consequent destruction of the "30 tyrants" in 404 B.C. The three chief arsenals of the Peiraeus were named Munychia, Zea and Cantharus, and they contained galley slips for 82, 196 and 94 slips respectively in the 4th century B.C.

See under Athens. Also Angelopoulos, *Περὶ Πειραιῶς καὶ τῶν λιμένων αὐτοῦ* (Athens, 1898).

PEIRCE, BENJAMIN (1809–1880), American mathematician and astronomer, was born at Salem, Massachusetts, on the 4th of April 1809. Graduating at Harvard College in 1829, he became mathematical tutor there in 1831 and professor in 1833. He had already assisted Nathaniel Bowditch in his translation of the *Mécanique céleste*, and now produced a series of mathematical textbooks characterized by the brevity and terseness which made his teaching unattractive to inapt pupils. Young men of talent, on the contrary, found his instruction most stimulating, and after Bowditch's death in 1838 Peirce stood first among American mathematicians. His researches into the perturbations of Uranus and Neptune (*Proc. Amer.*

Acad., 1848) gave him a wider fame; he became in 1849 consulting astronomer to the *American Nautical Almanac*, and for this work prepared new tables of the moon (1852). A discussion of the equilibrium of Saturn's rings led him to conclude in 1855 that they must be of a fluid nature. From 1867 to 1874 he was superintendent of the Coast Survey. In 1857 he published his best known work, the *System of Analytical Mechanics*, which was, however, surpassed in brilliant originality by his *Linear Associative Algebra* (lithographed privately in a few copies, 1870; reprinted in the *Amer. Journ. Math.*, 1882). He died at Cambridge, Mass., on the 6th of October 1880.

See *New Amer. Cyclopaedia* (Ripley and Dana), vol. xiii. (1861); T. J. J. See, *Popular Astronomy*, iii. 49; *Nature*, xxii. 607; R. Grant, *Hist. of Phys. Astronomy*, pp. 205, 292; J. C. Poggendorff, *Biog. lit. Handwörterbuch; Month. Notices Roy. Astr. Society*, xli. 191.

PEISANDER, of Camirus in Rhodes, Greek epic poet, supposed to have flourished about 640 B.C. He was the author of a *Heracleia*, in which he introduced a new conception of the hero, the lion's skin and club taking the place of the older Homeric equipment. He is also said to have fixed the number of the "labours of Hercules" at twelve. The work, which according to Clement of Alexandria (*Stromata*, vi. ch. 2) was simply a plagiarism from an unknown Pisinus of Lindus, enjoyed so high a reputation that the Alexandrian critics admitted the author to the epic canon. From an epigram (20) of Theocritus we learn that a statue was erected in honour of Peisander by his countrymen. He is to be distinguished from Peisander of Laranda in Lycia, who lived during the reign of Alexander Severus (A.D. 222–235), and wrote a poem on the mixed marriages of gods and mortals, after the manner of the *Eoiai* of Hesiod.

See fragments in G. Kinkel, *Epicorum graecorum fragmenta* (1878); also F. G. Welcker, *Kleine Schriften*, vol. i. (1844), on the twelve labours of Hercules in Peisander.

PEISISTRATUS, (605?–527 B.C.), Athenian statesman, was the son of Hippocrates. He was named after Peisistratus, the youngest son of Nestor, the alleged ancestor of his family; he was second cousin on his mother's side to Solon, and numbered among his ancestors Codrus the last great king of Athens. Thus among those who became "tyrants" in the Greek world he gained his position as one of the old nobility, like Phalaris of Agrigentum, and Lygdamis of Naxos; but unlike Orthagoras of Sicyon, who had previously been a cook. Peisistratus, though Solon's junior by thirty years, was his lifelong friend (though this is denied), nor did their friendship suffer owing to their political antagonism. From this widely accepted belief arose the almost certainly false statement that Peisistratus took part in Solon's successful war against Megara, which necessarily took place before Solon's archonship (probably in 600 B.C.). Aristotle's *Constitution of Athens* (ch. 17) carefully distinguishes Solon's Megarian War from a second in which Peisistratus was no doubt in command, undertaken between 570 and 565 to recapture Nisaea (the port of Megara) which had apparently been recovered by the Megarians since Solon's victory (see Sandys on *The Constitution of Athens*, ch. 14, 1, note, and E. Abbott, *History of Greece*, vol. i. app. p. 544). Whatever be the true explanation of this problem, it is certain (1) that Peisistratus was regarded as a leading soldier, and (2) that his position was strengthened by the prestige of his family. Furthermore (3) he was a man of great ambition, persuasive eloquence and wide generosity; qualities which especially appealed at that time to the classes from whom he was to draw his support—hence the warning of Solon (Frag. II. B): "Fools, you are treading in the footsteps of the fox; can you not read the hidden meaning of these charming words?" Lastly, (4) and most important, the times were ripe for revolution. In the article on SOLON (*ad fin.*) it is shown that the Solonian reforms, though they made a great advance in some directions, failed on the whole. They were too moderate to please the people, too democratic for the nobles. It was found that the government by Boulē and Ecclesia did not mean popular control in the full sense; it meant government by the leisured classes, inasmuch as the industrious farmer or herdsman could not leave his work to give his vote at the Ecclesia, or do his duty as a councillor. Partly owing to this, and partly to ancient feuds whose origin we cannot trace, the Athenian people was split up into three great factions known as the Plain (*Pedieis*) led by Lycurgus and Miltiades, both of noble families; the Shore (*Parali*) led by the Alcmaeonidae, represented at this time by Megacles, who was strong in his wealth and by his recent marriage with Agariste, daughter of Cleisthenes of Sicyon; the Hill or Upland (*Diacreis, Diacrii*) led by Peisistratus, who no doubt owed his influence among these hillmen partly to the possession of large estates at Marathon. In the two former divisions the influence of wealth and birth predominated; the hillmen were poorly housed, poorly clad and unable to make use of the privileges which Solon had given them.[1] Hence their attachment to Peisistratus, the "man of the people," who called upon them to sweep away the last barriers which separated rich and poor, nobles and commoners, city and countryside. Lastly, there was a class of men who were discontented with the Solonian constitution: some had lost by his Seisachtheia, others had vainly hoped for a general redistribution. These men saw their only hope in a revolution. Such were the factors which enabled him to found his tyranny.

To enter here into an exhaustive account of the various theories which even before, though especially after, the appearance of the *Constitution of Athens* have been propounded as to the chronology of the Peisistratean tyranny, is impossible. For a summary of these hypotheses see J. E. Sandys's edition of the *Constitution of Athens* (p. 56, c. 14 note). The following is in brief the sequence of events: In 560 B.C. Peisistratus drove into the market-place, showed to an indignant assembly marks of violence on himself and his mules, and claimed to be the victim of assault at the hands of political enemies. The people unhesitatingly awarded their "champion" a bodyguard of fifty men (afterwards four hundred) armed with clubs. With this force he proceeded to make himself master of the Acropolis and tyrant of Athens. The Alcmaeonids fled and Peisistratus remained in power for about five years, during which Solon's death occurred. In 555 or 554 B.C. a coalition of the Plain and the Coast succeeded in expelling him. His property was confiscated and sold by auction, but in his absence the strife between the Plain and the Coast was renewed, and Megacles, unable to hold his own, invited him to return. The condition was that their families should be allied by the marriage of Peisistratus to Megacles' daughter Coesyra. A second *coup d'état* was then effected. A beautiful woman, it is said, by name Phya, was disguised as Athena and drove into the Agora with Peisistratus at her side, while proclamations were made that the goddess herself was restoring Peisistratus to Athens. The ruse was successful, but Peisistratus soon quarrelled with Megacles over Coesyra. By a former marriage he already had two sons, Hippias and Hipparchus, now growing up, and in his first tyranny or his first exile he married an Argive, Timonassa, by whom he had two other sons Iophon and Hegesistratus, the latter of whom is said to be identical with Thessalus (*Ath. Pol.* c. 17), though from Thucydides and Herodotus we gather that they were distinct—*e.g.* Herodotus describes Hegesistratus as a bastard, and Thucydides says that Thessalus was legitimate. Further it is suggested that Peisistratus was unwilling to have children by one on whom lay the curse of the Cylonian outrage. The result was that in the seventh year (or month, see *Ath. Pol.* c. 15. 1, Sandys's note) Megacles accused him of neglecting his daughter, combined once more with the third faction, and drove the tyrant into an exile lasting apparently for ten or eleven years. During this period he lived first at Rhaecelus and later near Mt Pangaeus and on the Strymon collecting resources of men and money. He came finally to Eretria, and, with the help of the Thebans and Lygdamis of Naxos, whom he afterwards made ruler of that island, he passed over to Attica and defeated the Athenian forces at the battle of Pallenis or Pellene. From this time till his death he remained undisputed master of Athens. The Alcmaeonids were compelled to leave Athens, and from the other noble families which remained he exacted 400 hostages whom he put in the care of his ally Lygdamis.

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[1] It is suggested with probability that the Diacrii were rather the miners of the Laurium district (P. M. Ure, *Journ. Hell. Stud.*, 1906, pp. 131–142).

In the heyday of the Athenian democracy, citizens both conservative and progressive, politicians, philosophers and historians were unanimous in their denunciation of "tyranny." Yet there is no doubt that the rule of Peisistratus was most beneficial to Athens both in her foreign and in her internal relations. (1) During his enforced absence from Athens he had evidently acquired a far more extended idea of the future of Athens than had hitherto dawned on the somewhat parochial minds of her leaders. He was friendly with Thebes and Argos; his son Hegesistratus he set in power at Sigeum (see E. Abbott, *Hist. of Gr.* vol. i. xv. 9) and his friend Lygdamis at Naxos. From the mines of Thrace, and perhaps from the harbour dues and from the mines of Laurium, he derived a large revenue; under his encouragement, Miltiades had planted an Athenian colony on the shores of the Thracian Chersonese; he had even made friends with Thessaly and Macedonia, as is evidenced by the hospitality extended by them to Hippias on his final expulsion. Finally, he did not allow his friendliness with Argos to involve him in war with Sparta, towards whom he pursued a policy of moderation. (2) At home it is admitted by all authorities that his rule was moderate and beneficent, and that he was careful to preserve at least the form of the established constitution. It is even said that, being accused of murder, he was ready to be tried by the Areopagus. Everything which he did during his third period of rule was in the interests of discipline and order. Thus he hired a mercenary bodyguard, and utilized for his own purposes the public revenues; he kept the chief magistracies (through which he ruled) in the hands of his family; he imposed a general tax[1] of 10% (perhaps reduced by Hippias to 5%) on the produce of the land, and thus obtained control over the fleet and spread the burden of it over all the citizens (see the spurious letter of Peisistratus to Solon, *Diog. Laërt.* i. 53; Thuc. vi. 54 and Arnold's note *ad loc.*; Boeckh iii. 6; Thirlwall c. xi., pp. 72–74; and Grote). But the great wisdom of Peisistratus is shown most clearly in the skill with which he blinded the people to his absolutism. Pretending to maintain the Solonian constitution (as he could well afford), he realized that people would never recognize the deception if a sufficient degree of prosperity were ensured. Secondly, he knew that the greater the proportion of the Athenians who were prosperously at work in the country and therefore did not trouble to interfere in the work of government the less would be the danger of sedition, whose seeds are in a crowded city. Hence he appears to have encouraged agriculture by abating the tax on small farms, and even by assisting them with money and stock. Secondly, he established deme law-courts to prevent people from having recourse to the city tribunals; it is said that he himself occasionally "went on circuit," and on one of these occasions was so struck by the plaints of an old farmer on Hymettus, that he remitted all taxation on his land. Thus Athens enjoyed immunity from war and internecine struggle, and for the first time for years was in enjoyment of settled financial prosperity (see *Constitution of Athens*, c. 16. 7 *ὁ ἐπὶ Κρόνου βίος*).

The money which he accumulated he put to good use in the construction of roads and public buildings. Like Cleisthenes of Sicyon and Periander of Corinth, he realized that one great source of strength to the nobles had been their presidency over the local cults. This he diminished by increasing the splendour of the Panathenaic festival every fourth year and the Dionysiac[2] rites, and so created a national rather than a local religion. With the same idea he built the temple of the Pythian Apollo and began, though he did not finish, the temple of Zeus (the magnificent columns now standing belong to the age of Hadrian). To him are ascribed also the original Parthenon on the Acropolis, afterwards burned by the Persians, and replaced by the Parthenon of Pericles. It is said that he gave a great impetus to the dramatic representations which belonged to the Dionysiac cult, and that it was under his encouragement that Thespis of Icaria, by impersonating character, laid the foundation of the great Greek drama of the 5th and 4th centuries. Lastly, Peisistratus carried out the purification of Delos, the sacred island of Apollo of the Ionians; all the tombs were removed from the neighbourhood of the shrine, the abode of the god of light and joy.

We have spoken of his services to the state, to the poor, to religion. It remains to mention his alleged services to literature. All we can reasonably believe is that he gave encouragement to poetry as he had done to architecture and the drama; Onomacritus, the chief of the Orphic succession, and collector of the oracles of Musaeus, was a member of his household. Honestly, or to impress the people, Peisistratus made considerable use of oracles (*e.g.* at the battle of Pellene), and his descendants, by the oracles of Onomacritus, persuaded Darius to undertake their restoration. As to the library of Peisistratus, we have no good evidence; it may perhaps be a fiction of an Alexandrian writer. There is strong reason for believing the story that he first collected the Homeric poems and that his was the text which ultimately prevailed (see HOMER).

It appears that Peisistratus was benevolent to the last, and, like Julius Caesar, showed no resentment against enemies and calumniators. What Solon said of him in his youth was true throughout, "there is no better-disposed man in Athens, save for his ambition." He was succeeded by his sons Hippias and Hipparchus, by whom the tyranny was in various ways brought into disrepute.

It should be observed that the tyranny of Peisistratus is one of the many epochs of Greek history on which opinion has almost entirely changed since the age of Grote. Shortly, his services to Greece and to the world may be summed up under three heads: In foreign policy, he sketched out the plan on which Athens was to act in her external relations. He advocated (*a*) alliances with Argos, Thessaly and Macedon, (*b*) ascendancy in the Aegean (Naxos and Delos), (*c*) control of the Hellespontine route (Sigeum and the Chersonese), (*d*) control of the Strymon valley (Mt Pangaeus and the Strymon). Further, his rule exemplifies what is characteristic of all the Greek tyrannies—the advantage which the ancient monarchy had over the republican form of government. By means of his sons and his deputies (or viceroys) and by his system of matrimonial alliances he gave Athens a widespread influence in the centres of commerce, and brought her into connexion with the growing sources of trade and production in the eastern parts of the Greek world. (2) His importance in the sphere of domestic policy has been frequently underrated. It may fairly be held that the reforms of Solon would have been futile had they not been fulfilled and amplified by the genius of Peisistratus. (3) It was under his auspices that Athens began to take the lead in literature. From this period we must date the beginning of Athenian literary ascendancy. But see ATHENS.

AUTHORITIES.—*Ancient*: Herod. i. 59; Plut. *Solon* 30; Arist. *Politics*, v. 12, 5-1315 b.; *Constitution of Athens* (*Ath. Pol.*) cc. 14–19. On the chronological problems see also P. Meyer, *Arist. Pol. and the Ath. Pol.* pp. 48–9; Gomperz, *Die Schrift v. Staatswesen*, &c. (1891); Bauer, *Lit. und hist. Forsch. z. Arist. Ath. Pol.* (50 sqq.). On the characteristics of the Peisistratid tyranny see Greenidge, *Handbook of Greek Constitutional History*, pp. 26 sqq.; and the histories of Greece. On the question of the family of Peisistratus see Wilamowitz-Moellendorff, *Aristoteles und Athen* (Berlin, 1893) and a criticism by E. M. Walker in the *Classical Review*, vol. viii. p. 206, col. 2.

(J. M. M.)

PEKIN, a city and the county-seat of Tazewell county, Illinois, U.S.A., on the Illinois river, in the central part of the state, about 11 m. S. of Peoria, and about 56 m. N. of Springfield. Pop. (1910), 9897. It is served by the Atchison, Topeka & Santa Fé, the Chicago & Alton, the Chicago, Peoria & St Louis, the Illinois Central, the Cleveland, Cincinnati, Chicago & St Louis, the Peoria Railway Terminal Company, the Peoria

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[1] It should be noted as against this, the general account, that Thucydides, speaking apparently with accuracy, describes the tax as *εἰκοστή* (5%); the *Constitution of Athens* speaks of (the familiar) *δεκατή* (10%).

[2] Dionysus, as the god of the rustics, was especially worshipped at Icaria, near Marathon, and so was the god of the Diacrii. It seems likely that Peisistratus, to please his supporters, originated the City-Dionysia.

& Pekin Union and (for freight between Peoria and Pekin) the Illinois Valley Belt railways. Situated in a rich agricultural region and in the Illinois coalfields, Pekin is a shipping point and grain market of considerable importance, and has various manufactures. The value of the factory products in 1905 was $1,121,130. Pekin was first settled about 1830, was incorporated in 1839, and re-incorporated in 1874.

PEKING, or PEKIN, the capital of the Chinese Empire, situated in 39° 57′ N. and 116° 29′ E., on the northern extremity of the great alluvial delta which extends southward from its walls for 700 m. For nine centuries Peking, under various names and under the dominion of successive dynasties, has, with some short intervals, remained an imperial city. Its situation near the northern frontier recommended it to the Tatar invaders as a convenient centre for their power, and its peculiarly fortunate position as regards the supernatural terrestrial influences pertaining to it has inclined succeeding Chinese monarchs to accept it as the seat of their courts. In 986 it was taken by an invading force of Khitan Tatars, who adopted it as their headquarters and named it Nanking, or the "southern capital." During the early part of the 12th century the Chinese recaptured it and reduced it from the rank of a metropolis to that of a provincial city of the first grade, and called it Yen-shan Fu. In 1151 it fell into the hands of the Kin Tatars, who made it a royal residence under the name of Chung-tu, or "central capital." Less than a century later it became the prize of Jenghiz Khan, who, having his main interests centred on the Mongolian steppes, declined to move his court southwards. His great successor, Kublai Khan (1280–1294), rebuilt the town, which he called Yenking, and which became known in Chinese as Ta-tu, or "great court," and in Mongolian as Khanbalik (Cambaluc), or "city of the khan." During the reign of the first emperor of the dynasty (1368–1399) which succeeded that founded by Jenghiz Khan the court resided at the modern Nanking, but the succeeding sovereign Yung-lo (1403–1425) transferred his court to Pe-king (*i.e.* "north-court"), which has ever since been the seat of government. For further history see CAMBALUC.

During the periods above mentioned the extent and boundaries of the city varied considerably. Under the Kin dynasty the walls extended to the south-west of the Tatar portion of the present city, and the foundations of the northern ramparts of the Khan-balik of Kublai Khan are still to be traced at a distance of about 2 m. north beyond the existing walls. The modern city consists of the *nei ch'êng*, or inner city, commonly known to foreigners as the "Tatar city," and the *wai ch'êng*, or outer city, known in the same way as the "Chinese city." These names are somewhat misleading, as the inner city is not enclosed within the outer city, but adjoins its northern wall, which, being longer than the *nei ch'êng* is wide, outflanks it considerably at both ends. The outer walls of the double city contain an area of about 25 sq. m., and measure 30 m. in circumference. Unlike the walls of most Chinese cities, those of Peking are kept in perfect order. Those of the Tatar portion, which is the oldest part of the city, are 50 ft. high, with a width of 60 ft. at the base and 40 ft. at the top, while those of the Chinese city, which were built by the emperor Kia-tsing in 1543, measure 30 ft. in height, and have a width of 25 ft. at the base and 15 ft. at the top. The terre-plein is well and smoothly paved, and is defended by a crenellated parapet. The outer faces of the walls are strengthened by square buttresses built out at intervals of 60 yds., and on the summits of these stand the guard-houses for the troops on duty. Each of the sixteen gates of the city is protected by a semi-circular enceinte, and is surmounted by a high tower built in galleries and provided with countless loopholes.

Peking suffered severely during the Boxer movement and the siege of the legations in the summer of 1900. Not only were most of the foreign buildings destroyed, but also a large number of important Chinese buildings in the vicinity of the foreign quarter, including the ancient Hanlin Yuen, the boards of war, rites, &c. Almost the whole of the business quarter, the wealthiest part of the Chinese city, was laid in ashes (see CHINA: *History*).

The population of Peking is reckoned to be about 1,000,000, a number which is out of all proportion to the immense area enclosed within its walls. This disparity is partly accounted for by the facts that large spaces, notably in the Chinese city, are not built over, and that the grounds surrounding the imperial palace, private residences and temples are very extensive. One of such enclosures constitutes the British legation, and most of the other foreign legations are similarly, though not so sumptuously, lodged. Viewed from the walls Peking looks like a city of gardens. Few crowded neighbourhoods are visible, and the characteristic features of the scene which meets the eye are the upturned roofs of temples, palaces, and mansions, gay with blue, green and yellow glazed tiles, glittering among the groves of trees with which the city abounds. It is fortunate that the city is not close-built or crowded, for since the first advent of foreigners in Peking in 1860 nothing whatever had been done until 1900 to improve the streets or the drainage. The streets as originally laid out were wide and spacious, but being unpaved and undrained they were no better than mud tracks diversified by piles of garbage and foul-smelling stagnant pools. Such drainage as had at one time existed was allowed to get choked up, giving rise to typhoid fever of a virulent type. Some attempt has been made to improve matters by macadamizing one of the principal thoroughfares, but it will be the labour of a Hercules to cleanse this vast city from the accumulated filth of ages of neglect.

Enclosed within the Tatar city is the *Hwang ch'êng*, or "Imperial city," which in its turn encloses the *Tsze-kin ch'êng*, or "Forbidden city," in which stands the emperor's palace. On the north of the *Tsze-kin ch'êng*, and separated from it by a moat, is an artificial mound known as the *King shan*, or "Prospect Hill." This mound, which forms a prominent object in the view over the city, is about 150 ft. high, and is topped with five summits, on each of which stands a temple. It is encircled by a wall measuring upwards of a mile in circumference, and is prettily planted with trees, on one of which the last emperor of the Ming dynasty (1644), finding escape from the Manchu invaders impossible, hanged himself. On the west of Prospect Hill is the *Si yuan*, or "Western Park," which forms part of the palace grounds. This park is tastefully laid out, and is traversed by a lake, which is mainly noticeable from the remarkably handsome marble bridge which crosses it from east to west. Directly northwards from Prospect Hill stands the residence of the T'itu, or "governor of the city," and the Bell and the Drum Towers, both of which have attained celebrity from the nature of their contents—the first from the huge bell which hangs in it, and the second from the appliances it contains for marking the time. The bell is one of five which the emperor Yung-lo ordered to be cast. In common with the others, it weighs 120,000 ℔, is 14 ft. high, 34 ft. in circumference at the rim, and 9 in. thick. It is struck by a wooden beam swung on the outside, and only at the changes of the night-watches, when its deep tone may be heard in all parts of the city. In the Drum Tower incense-sticks, specially prepared by the astronomical board, are kept burning to mark the passage of time, in which important duty their accuracy is checked by a clepsydra. Another of Yung-lo's bells is hung in a Buddhist temple outside the north-west angle of the city wall, and is covered both on the inside and outside with the Chinese texts of the *Lankāvatāra Sūtra*, and the *Saddharma pundarika Sūtra*.

Turning southwards we come again to the Forbidden City, the central portion of which forms the imperial palace, where, in halls which for the magnificence of their proportions and barbaric splendour are probably not to be surpassed anywhere, the Son of Heaven holds his court. In the eastern and western portions of this city are situated the residences of the highest dignitaries of the empire; while beyond its confines on the south stand the offices of the six official boards which direct the affairs of the eighteen provinces. It was in the "yamên" of one of these boards—the *Li Pu* or board of rites—that Lord Elgin signed the treaty at the conclusion of the war in 1860—an event which derives especial interest from the fact of its having been the first occasion on which a European plenipotentiary ever entered Peking accompanied by all the pomp and circumstance of his rank.

Outside the Forbidden City the most noteworthy building is the Temple of Heaven, which stands in the outer or Chinese city. Here at early morning on the 21st of December the emperor offers sacrifice on an open altar to Shang-ti, and at periods of drought or famine presents prayers for relief to the same supreme deity. The altar at which these solemn rites are performed consists of a triple circular marble terrace, 210 ft. wide at the base, 150 in the middle and 90 at the top. The uppermost surface is paved with blocks of the same material forming nine concentric circles, the innermost consisting of nine blocks, and that on the outside of eighty-one blocks. On the central stone, which is a perfect circle, the emperor kneels. In the same temple stands the altar of prayer for good harvests, which is surmounted by a triple-roofed circular structure 99 ft. in height. The tiles of these roofs are glazed porcelain of the most exquisite deep-blue colour, and add a conspicuous element of splendour to the shrine.

The other powers of nature have shrines dedicated to them in the altar: to the Earth on the north of the city, the altars to the Sun and Moon outside the north-eastern and north-western angles respectively of the Chinese city, and the altar of agriculture inside the south gate of the Chinese city. Next to these in religious importance comes the Confucian temple, known as the *Kwo-tsze-kien*. Here there is no splendour; everything is quite plain; and one hall contains all that is sacred in the building. There the tablets of "the soul of the most holy ancestral teacher, Confucius," and of his ten principal disciples stand as objects of worship for their countless followers. In one courtyard of this temple are deposited the celebrated ten stone drums which bear poetical inscriptions commemorative of the hunting expeditions of King Sūan (827–781 B.C.), in whose reign they are believed, though erroneously, to have been cut; and in another stands a series of stone tablets on which are inscribed the names of all those who have obtained the highest literary degree of *Tsin-shi* for the last five centuries.

In the south-eastern portion of the Tatar city used to stand the observatory, which was built by order of Kublai Khan in 1296. During the period of the Jesuit ascendancy in the reign of K'ang-hi (1661–1721), the superintendence of this institution was confided to Roman Catholic missionaries, under whose guidance the bronze instruments formerly existing were constructed. The inhabitants of Peking being consumers only, and in no way producers, the trade of the city is very small, though the city is open to foreign commerce. In 1897 a railway was opened between Tientsin and Peking. This was only effected after great opposition from the ultra-Conservatives, but once accomplished the facilities were gladly accepted by all classes, and the traffic both in goods and passengers is already enormous. Out of deference to the scruples of the ultra-Conservatives, the terminus was fixed at a place called Lu-Kou-ch'iao, some 4 m. outside the walls, but this distance has since been covered by an electric tramway. The trunk line constructed by the Franco-Belgian syndicate connects Lu-Kou-ch'iao, the original terminus, with Hankow—hence the name Lu-Han by which this trunk line is generally spoken of, Lu being short for Lu-Kou-ch'iao and Han for Hankow.

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PELAGIA, ST. An Antiochene saint of this name, a virgin of fifteen years, who chose death by a leap from the housetop rather than dishonour, is mentioned by Ambrose (*De virg.* iii. 7, 33; *Ep. xxxvii. ad Simplic.*), and is the subject of two sermons by Chrysostom. Her festival was celebrated on the 8th of October (Wright's *Syriac Martyrology*). In the Greek *synaxaria* the same day is assigned to two other saints of the name of Pelagia—one, also of Antioch, and sometimes called Margarito and also "the sinner"; the other, known as Pelagia of Tarsus, in Cilicia. The legend of the former of these two is famous. She was a celebrated dancer and courtesan, who, in the full flower of her beauty and guilty sovereignty over the youth of Antioch, was suddenly converted by the influence of the holy bishop Nonnus, whom she had heard preaching in front of a church which she was passing with her gay train of attendants and admirers. Seeking out Nonnus, she overcame his canonical scruples by her tears of genuine penitence, was baptized, and, disguising herself in the garb of a male penitent, retired to a grotto on the Mount of Olives, where she died after three years of strict penance. This story seems to combine with the name of the older Pelagia some traits from an actual history referred to by Chrysostom (*Hom. in Matth.* lxvii. 3). In associating St Pelagia with St Marina, St Margaret (*q.v.*), and others, of whom either the name or the legend recalls Pelagia, Hermann Usener has endeavoured to show by a series of subtle deductions that this saint is only a Christian travesty of Aphrodite. But there is no doubt of the existence of the first Pelagia of Antioch, the Pelagia of Ambrose and Chrysostom. The legends which have subsequently become connected with her name are the result of a very common development in literary history.

See *Acta sanctorum*, October, iv. 248 seq.; H. Usener, *Legenden der heiligen Pelagia* (Bonn, 1879); H. Delehaye, *The Legends of the Saints* (London, 1907), pp. 197–205. (H. De.)

PELAGIUS, the name of two popes.

Pelagius I., pope from 555 to 561, was a Roman by birth, and first appears in history at Constantinople in the rank of deacon, and as apocrisiarius of Pope Silverius, whose overthrow in favour of Vigilius his intrigues promoted. Vigilius continued him in his diplomatic appointment, and he was sent by the emperor Justinian in 542 to Antioch on ecclesiastical business; he afterwards took part in the synod at Gaza which deposed Paul of Alexandria. He had amassed some wealth, which on his return to Rome he so employed among the poor as to secure for himself great popularity; and, when Vigilius was summoned to Byzantium in 544, Pelagius, now archdeacon, was left behind as his vicar, and by his tact in dealing with Totila, the Gothic invader, saved the citizens from murder and outrage. He appears to have followed his master to Constantinople, and to have taken part in the Three Chapters controversy; in 553, at all events, he signed the "constitutum" of Vigilius in favour of these, and for refusing, with him, to accept the decrees of the fifth general council (the 2nd of Constantinople, 553) shared his exile. Even after Vigilius had approved the comdemnation of the Three Chapters, Pelagius defended them, and even published a book on the subject. But when Vigilius died (June 7, 555), he accepted the council, and allowed himself to be designated by Justinian to succeed the late pope. It was in these circumstances that he returned to Rome; but most of the clergy, suspecting his orthodoxy, and believing him to have had some share in the removal of his predecessor, shunned his fellowship. He enjoyed, however, the support of Narses, and, after he had publicly purged himself of complicity in Vigilius's death in the church of St Peter, he met with toleration in his own immediate diocese. The rest of the western bishops, however, still held aloof, and the episcopate of Tuscany caused his name to be removed from the diptychs. This elicited from him a circular, in which he asserted his loyalty to the four general councils, and declared that the hostile bishops had been guilty of schism. The bishops of Liguria and Aemilia, headed by the archbishop of Milan, and those of Istria and Venice, headed by Paulinus of Aquileia, also withheld their fellowship; but Narses resisted the appeals of Pelagius, who would have invoked the secular arm. Childebert, king of the Franks, also refused to interfere. Pelagius died on the 4th of March 561, and was succeeded by John III.

Pelagius II., a native of Rome, but of Gothic descent, was pope from 579 to 590, having been consecrated successor of Benedict I., without the sanction of the emperor, on the 26th of

November. To make his apologies for this irregularity he sent Deacon Gregory, who afterwards became Pope Gregory the Great, as his apocrisiarius to Constantinople. In 585 he sought to heal the schism which had subsisted since the time of Pelagius I. in connexion with the Three Chapters, but his efforts were without success. In 588 John, patriarch of Constantinople, by reviving the old and disputed claim to the title of oecumenic patriarch, elicited a vigorous protest from Pelagius; but the decretal which professes to convey the exact words of the document is now known to be false. He died in January 590, and was succeeded by Gregory I.

PELAGIUS (*c.* 360–*c.* 420), early British theologian. Of the origin of Pelagius almost nothing is known. The name is supposed to be a graecized form of the Cymric *Morgan* (sea-begotten). His contemporaries understood that he was of British (probably of Irish) birth, and gave him the appellation *Brito*. He was a large ponderous person, heavy both in body and mind (Jerome, "stolidissimus et Scotorum pultibus praegravatus"). He was influenced by the monastic enthusiasm which had been kindled in Gaul by Athanasius (336), and which, through the energy of Martin of Tours (361), rapidly communicated itself to the Britons and Scots. For, though Pelagius remained a layman throughout his life, and though he never appears in any strict connexion with a coenobite fraternity, he yet adhered to monastic discipline ("veluti monachus"), and distinguished himself by his purity of life and exceptional sanctity ("egregie Christianus"). He seems to have been one of the earliest, if not the very earliest, of that remarkable series of men who issued from the monasteries of Scotland and Ireland, and carried back to the Continent in a purified form the religion they had received from it. Coming to Rome in the beginning of the 5th century (his earliest known writing is of date 405), he found a scandalously low tone of morality prevalent. But his remonstrances were met by the plea of human weakness. To remove this plea by exhibiting the actual powers of human nature became his first object. It seemed to him that the Augustinian doctrine of total depravity and of the consequent bondage of the will both cut the sinew of all human effort and threw upon God the blame which really belonged to man. His favourite maxim was, "If I ought, I can."

The views of Pelagius did not originate in a conscious reaction against the influence of the Augustinian theology, although each of these systems was developed into its ultimate form by the opposition of the other. Neither must too much weight be allowed to the circumstance that Pelagius was a monk, for he was unquestionably alive to the delusive character of much that passed for monkish sanctity. Yet possibly his monastic training may have led him to look more at conduct than at character, and to believe that holiness could be arrived at by rigour of discipline. This view of things suited his matter-of-fact temperament. Judging from the general style of his writings, his religious development had been equable and peaceful, not marked by the prolonged mental conflict, or the abrupt transitions, which characterized the experience of his great opponent. With no great penetration he saw very clearly the thing before him, and many of his practical counsels are marked by sagacity, and are expressed with the succinctness of a proverb ("corpus non frangendum, sed regendum est"). His interests were primarily ethical; hence his insistence on the freedom of the will and his limitation of the action of divine grace.

The peculiar tenets of Pelagius, though indicated in the commentaries which he published at Rome previous to 409, might not so speedily have attracted attention had they not been adopted by Coelestius, a much younger and bolder man than his teacher. Coelestius, probably an Italian, had been trained as a lawyer, but abandoned his profession for an ascetic life. When Rome was sacked by the Goths (410) the two friends crossed to Africa. There Pelagius once or twice met with Augustine, but very shortly sailed for Palestine, where he justly expected that his opinions would be more cordially received. Coelestius remained in Carthage with the view of receiving ordination. But Aurelius, bishop of Carthage, being warned against him, summoned a synod, at which Paulinus, a deacon of Milan, charged Coelestius with holding the following six errors: (1) that Adam would have died even if he had not sinned; (2) that the sin of Adam injured himself alone, not the human race; (3) that new-born children are in the same condition in which Adam was before the fall; (4) that the whole human race does not die because of Adam's death or sin, nor will the race rise again because of the resurrection of Christ; (5) that the law gives entrance to heaven as well as the gospel; (6) that even before the coming of Christ there were men who were entirely without sin. To these propositions a seventh is sometimes added, "that infants, though unbaptized, have eternal life," a corollary from the third. Coelestius did not deny that he held these opinions, but he maintained that they were open questions, on which the Church had never pronounced. The synod, notwithstanding, condemned and excommunicated him. Coelestius, after a futile appeal to Rome, went to Ephesus, and there received ordination.

In Palestine Pelagius lived unmolested and revered, until in 415 Orosius, a Spanish priest, came from Augustine, who in the meantime had written his *De peccatorum meritis*, to warn Jerome against him. The result was that in June of that year Pelagius was cited by Jerome before John, bishop of Jerusalem, and charged with holding that man may be without sin, if only he desires it. This prosecution broke down, and in December of the same year Pelagius was summoned before a synod of fourteen bishops at Diospolis (Lydda). The prosecutors on this occasion were two deposed Gallican bishops, Heros of Arles and Lazarus of Aix, but on account of the illness of one of them neither could appear. The proceedings, being conducted in various languages and by means of interpreters, lacked certainty, and justified Jerome's application to the synod of the epithet "miserable." But there is no doubt that Pelagius repudiated the assertion of Coelestius, that "the divine grace and help is not granted to individual acts, but consists in free will, and in the giving of the law and instruction." At the same time he affirmed that a man is able, if he likes, to live without sin and keep the commandments of God, inasmuch as God gives him this ability. The synod was satisfied with these statements, and pronounced Pelagius to be in agreement with Catholic teaching. Pelagius naturally plumed himself on his acquittal, and provoked Augustine to give a detailed account of the synod, in which he shows that the language used by Pelagius was ambiguous, but that, being interpreted by his previous written statements, it involved a denial of what the Church understood by *grace* and by man's dependence on it. The North African Church as a whole resented the decisions of Diospolis, and in 416 sent up from their synods of Carthage and Mileve (in Numidia) an appeal to Innocent, bishop of Rome, who, flattered by the tribute thus paid to the see of Rome, decided the question in favour of the African synods. And, though his successor Zosimus wavered for some time, he at length fell in with what he saw to be the general mind of both the ecclesiastical and the civil powers. For, simultaneously with the largely attended African synod which finally condemned Pelagianism in the West, an imperial edict was issued at Ravenna by Honorius on the 30th of April 418, peremptorily determining the theological question and enacting that not only Pelagius and Coelestius but all who accepted their opinions should suffer confiscation of goods and irrevocable banishment. Thus prompted, Zosimus drew up a circular inviting all the bishops of Christendom to subscribe a condemnation of Pelagian opinions. Nineteen Italian bishops refused, among them Julian of Eclanum in Apulia, a man of good birth, approved sanctity and great capacity, who now became the recognized leader of the movement. But not even his acuteness and zeal could redeem a cause which was rendered hopeless when the Eastern Church (Ephesus, 431) confirmed the decision of the West. Pelagius himself disappears after 420; Coelestius was at Constantinople seeking the aid of Nestorius in 428.

Pelagianism.—The system of Pelagius is a consistent whole, each part involving the existence of every other. Starting from the idea that "ability limits obligation," and resolved that men should feel their responsibility, he insisted that man is able to do all that God commands, and that there is, and can be, no sin where the will is not absolutely free—able to choose good or evil. The favourite Pelagian formula, "Si necessitatis est, peccatum non est; si voluntatis, vitari potest," had an appearance of finality which imposed on superficial minds. The theory of the will involved in this fundamental axiom of Pelagianism is that which is commonly known as the "liberty of indifference," or "power of contrary choice"—a theory which affirms the freedom of the will, not in the sense that the individual is self-determined, but in the sense that in each volition and at each moment of life, no matter what the previous career of the individual has been, the will is in equipoise, able to choose good or evil. We are born characterless (non pleni), and with no bias towards good or evil (ut sine virtute, ita et sine vitio). It follows that we are uninjured by the sin of Adam, save in so far as the evil example of our predecessors misleads and influences us (non propagine sed exemplo). There is, in fact, no such thing as original sin, sin being a thing of will and not of nature; for if it could be of nature our sin would be chargeable on God the creator. This will, capable of good as of evil, being the natural endowment of man, is found in the heathen as well as in the Christian, and the heathen may therefore perfectly keep such law as they know. But, if all men have this natural ability to do and to be all that is required for perfect righteousness, what becomes of grace, of the aid of the Holy Spirit, and, in a word, of Christianity? Pelagius vacillates considerably in his use of the word "grace." Sometimes he makes it equivalent to natural endowment. Indeed one of his most careful statements is to this effect: "We distinguish three things—the ability, the will, the act (posse, velle, esse). The ability is in nature, and must be referred to God, who has bestowed this on His creature; the other two, the will and the act, must be referred to man, because they flow from the fountain of free will" (Aug., *De gr. Christi*, ch. 4). But at other times he admits a much wider range to grace, so as to make Augustine doubt whether his meaning is not, after all, orthodox. But, when he speaks of grace "sanctifying," "assisting," and so forth, it is only that man may "more easily" accomplish what he could with more difficulty accomplish without grace. A decisive passage occurs in the letter he sent to the see of Rome along with his *Confessio fidei*: "We maintain that free will exists generally in all mankind, in Christians, Jews and Gentiles; they have all equally received it by nature, but in Christians only is it assisted by grace. In others this good of their original creation is naked and unarmed. They shall be judged and condemned because, though possessed of free will, by which they might come to the faith and merit the grace of God, they make an ill use of their freedom; while Christians shall be rewarded because, by using their free will aright, they merit the grace of the Lord and keep His commandments" (ibid. chs. 33, 34). Pelagius allowed to grace everything but the initial determining movement towards salvation. He ascribed to the unassisted human will power to accept and use the proffered salvation of Christ. It was at this point his departure from the Catholic creed could be made apparent: Pelagius maintains, expressly and by implication, that it is the human will which takes the initiative, and is the determining factor in the salvation of the individual; while the Church maintains that it is the divine will that takes the initiative by renewing and enabling the human will to accept and use the aid or grace offered.

Semipelagianism.—It was easy for Augustine to show that this was an "impia opinio"; it was easy for him to expose the defective character of a theory of the will which implied that God was not holy because He is *necessarily* holy; it was easy for him to show that the positions of Pelagius were anti-Scriptural (see AUGUSTINE); but, though his arguments prevailed, they did not wholly convince, and the rise of Semipelagianism—an attempt to hold a middle course between the harshness of Augustinianism and the obvious errors of Pelagianism—is full of significance. This earnest and conciliatory movement discovered itself simultaneously in North Africa and in southern Gaul. In the former Church, which naturally desired to adhere to the views of its own great theologian, the monks of Adrumetum found themselves either sunk to the verge of despair or provoked to licentiousness by his predestinarian teaching. When this was reported to Augustine he wrote two elaborate treatises to show that when God ordains the end He also ordains the means, and if any man is ordained to life eternal he is thereby ordained to holiness and zealous effort. But meanwhile some of the monks themselves had struck out a *via media* which ascribed to God sovereign grace and yet left intact man's responsibility. A similar scheme was adopted by Cassian of Marseilles (hence Semipelagians are often spoken of as *Massilians*), and was afterwards ably advocated by Vincent of Lerins and Faustus of Rhegium. These writers, in opposition to Pelagius, maintained that man was damaged by the fall, and seemed indeed disposed to purchase a certificate of orthodoxy by the abusive epithets they heaped upon Pelagians (ranae, muscae moriturae, &c.). The differentia of Semipelagianism is the tenet that in regeneration, and all that results from it, the divine and the human will are co-operating (synergistic) coefficient factors. After finding considerable acceptance, this theory was ultimately condemned, because it retained the root-principle of Pelagianism—that man has some ability to will good and that the beginning of salvation *may* be with man. The Councils of Orange and Valence (529), however, which condemned Semipelagianism, did so with the significant restriction that predestination to evil was not to be taught—a restriction so agreeable to the general feeling of the Church that, three centuries after, Gottschalk was sentenced to be degraded from the priesthood, scourged and imprisoned for teaching reprobation. The questions raised by Pelagius continually recur, but, without tracing the strife as sustained by Thomists and Jansenists on the one side and the Jesuits and Arminians on the other, this article can only indicate the general bearing of the controversy on society and the Church.

The anthropology of Pelagius was essentially naturalistic. It threatened to supersede grace by nature, to deny all immediate divine influence, and so to make Christianity practically useless. Pelagius himself did not carry his rationalism through to its issues; but the logical consequence of his system was, as Augustine perceived, the denial of the atonement and other central truths of revealed religion. And, while the Pelagians never existed as a sect separate from the Church Catholic, yet wherever rationalism has infected any part of the Church there Pelagianism has sooner or later appeared; and the term "Pelagian" has been continued to denote views which minimize the effects of the fall and unduly magnify man's natural ability. These views and tendencies have appeared in theologies which are not in other respects rationalistic, as, *e.g.* in Arminianism; and their presence in such theologies is explained by the desire to remove everything which might seem to discourage human effort.

It is not easy to determine how far the vices which ate so deeply into the life of the Church of the middle ages were due to the sharpness with which some of the severer features of the Augustinian theology were defined during the Pelagian controversy. The pernicious belief in the magical efficacy of the sacraments and the consequent defective ethical power of religion, the superstitious eagerness to accept the Church's creed without examining or really believing it, the falsity and cruelty engendered and propagated by the idea that in the Church's cause all weapons were justifiable, these vices were undoubtedly due to the belief that the visible church was the sole divinely-appointed repository of grace. And the sharply accentuated tone in which Augustinianism affirmed man's inability quickened the craving for that grace or direct agency of God upon the soul which the Church declared to be needful and administered through her divinely appointed persons and sacraments, and thus brought a decided impulse to the development of the sacerdotal system.

Again, although it may fairly be doubted whether, as Baur supposes, Augustine was permanently tainted with the Manichaean notion of the inherent evil of matter, it can scarcely be questioned that his views on marriage as elicited by the Pelagian controversy gave a considerable impulse to the already prevalent idea of the superiority of virginity. When the Pelagians declared that Augustine's theory of original sin discredited marriage by the implication that even the children of the regenerate were born in sin, he could only reply (*De nuptiis et concupiscentia*) that marriage now cannot partake of the spotless purity of the marriage of unfallen man, and that, though what is evil in concupiscence is made a good use of in marriage, it is still a thing to be ashamed of—not only with the shame of natural modesty (which he does not take into account) but with the shame of guilt. So that, even although he is careful to point out the advantages of marriage, an indelible stigma is still left even on the lawful procreation of children.

"The Pelagians deserve respect," says Harnack, "for their purity of motive, their horror of the Manichaean leaven and the *opus operatum*, their insistence on clearness, and their intention to defend the Deity. But we cannot but decide that their doctrine fails to recognize the misery of sin and evil, that in its deepest roots it is godless, that it knows, and seeks to know, nothing of redemption and that it is dominated by an empty formalism (a notional mythology), which does justice at no single point to actual quantities, and on a closer examination consists of sheer contradictions. In the *form* in which this doctrine was *expressed* by Pelagius—and in fact also by Julian—*i.e.* with all the accommodations to which he condescended, it was not a novelty. But in its fundamental thought it was; or rather, it was an innovation because it abandoned in spite of all accommodations in expression, the pole of the mystical doctrine of redemption, which the Church had steadfastly maintained side by side with the doctrine of freedom."

In the Pelagian controversy some of the fundamental differences between the Eastern and Western theologies appear. The former laid stress on "the supernatural character of Christianity as a fact in the objective world" and developed the doctrines of the Trinity and the Incarnation; the Western emphasized "the supernatural character of Christianity as an agency in the subjective world" and developed the doctrines of sin and grace. All the Greek fathers from Origen to Chrysostum had been jealous for human freedom and loath to make sin a natural power, though of course admitting a general state of sinfulness. The early British monasteries had been connected with the Orient. Pelagius was familiar with the Greek language and theology, and when he came to Rome he was much in the company of Rufinus and his circle who were endeavouring to propagate Greek theology in the Latin Church.

LITERATURE.—Pelagius's *Commentarii in epistolas Pauli, Libellus*

fidei ad Innocentium and *Epistola ad Demetriadem* are preserved in Jerome's works (vol. v. of Martiani's ed., vol. xi. of Vallarsi's). The last-named was also published separately by Semler (Halle, 1775). There are of course many citations in the Anti-Pelagian Treatises of Augustine. On the *Commentaries* see *Journal of Theol. Studies*, vii. 568, viii. 526; an edition is being prepared for the Cambridge *Texts and Studies* by A. Souter.

See also F. Wiggers, *Darstellung des Augustinismus und Pelagianismus* (2 vols., Berlin, 1831–1832; Eng. trans. of vol. i., by R. Emerson, Andover, 1840); J. L. Jacobi, *Die Lehre d. Pelagius* (Leipzig, 1842); F. Klasen, *Die innere Entwickelung des Pelagianismus* (Freiburg, 1882); B. B. Warfield, *Two Studies in the History of Doctrine* (New York, 1893); A. Harnack, *History of Dogma*, Eng. trans., v. 168–202; F. Loofs, *Dogmengeschichte* and art. in Hauck-Herzog's *Realencyklo. für prot. Theologie u. Kirche* (end of vol. xv.), where a full bibliography is given. (M. D.)

PELASGIANS, a name applied by Greek writers to a prehistoric people whose traces were believed to exist in Greek lands. If the statements of ancient authorities are marshalled in order of their date it will be seen that certain beliefs cannot be traced back beyond the age of this or that author. Though this does not prove that the beliefs themselves were not held earlier, it suggests caution in assuming that they were. In the Homeric poems there are Pelasgians among the allies of Troy: in the catalogue, *Iliad*, ii. 840–843, which is otherwise in strict geographical order, they stand between the Hellespontine towns and the Thracians of south-east Europe, *i.e.* on the Hellespontine border of Thrace. Their town or district is called Larissa and is fertile, and they are celebrated for their spearmanship. Their chiefs are Hippothous and Pylaeus, sons of Lethus son of Teutamus. *Iliad*, x. 428–429, describes their camping ground between the town of Troy and the sea; but this obviously proves nothing about their habitat in time of peace. *Odyssey*, xvii. 175–177, notes Pelasgians in Crete, together with two apparently indigenous and two immigrant peoples (Achaeans and Dorians), but gives no indication to which class the Pelasgians belong. In Lemnos (*Iliad*, vii. 467; xiv. 230) there are no Pelasgians, but a Minyan dynasty. Two other passages (*Iliad*, ii. 681–684; xvi. 233–235) apply the epithet "Pelasgic" to a district called Argos about Mt Othrys in south Thessaly, and to Zeus of Dodona. But in neither case are actual Pelasgians mentioned; the Thessalian Argos is the specific home of Hellenes and Achaeans, and Dodona is inhabited by Perrhaebians and Aenianes (*Iliad*, ii. 750) who are nowhere described as Pelasgian. It looks therefore as if "Pelasgian" were here used connotatively, to mean either "formerly occupied by Pelasgian" or simply "of immemorial age."

Hesiod expands the Homeric phrase and calls Dodona "seat of Pelasgians" (fr. 225); he speaks also of a personal Pelasgus as father of Lycaon, the culture-hero of Arcadia; and a later epic poet, Asius, describes Pelasgus as the first man, whom the earth threw up that there might be a race of men. Hecataeus makes Pelasgus king of Thessaly (expounding *Iliad*, ii. 681–684); Acusilaus applies this Homeric passage to the Peloponnesian Argos, and engrafts the Hesiodic Pelasgus, father of Lycaon, into a Peloponnesian genealogy. Hellanicus a generation later repeats this blunder, and identifies this Argive and Arcadian Pelasgus with the Thessalian Pelasgus of Hecataeus. For Aeschylus (*Supplices* 1, sqq.) Pelasgus is earthborn, as in Asius, and rules a kingdom stretching from Argos to Dodona and the Strymon; but in *Prometheus* 879, the "Pelasgian" land simply means Argos. Sophocles takes the same view (*Inachus*, fr. 256) and for the first time introduces the word "Tyrrhenian" into the story, apparently as synonymous with Pelasgian.

Herodotus, like Homer, has a denotative as well as a connotative use. He describes actual Pelasgians surviving and mutually intelligible (*a*) at Placie and Scylace on the Asiatic shore of the Hellespont, and (*b*) near Creston on the Strymon; in the latter area they have "Tyrrhenian" neighbours. He alludes to other districts where Pelasgian peoples lived on under changed names; Samothrace and Antandrus in Troas are probably instances of this. In Lemnos and Imbros he describes a Pelasgian population who were only conquered by Athens shortly before 500 B.C., and in this connexion he tells a story of earlier raids of these Pelasgians on Attica, and of a temporary settlement there of Hellespontine Pelasgians, all dating from a time "when the Athenians were first beginning to count as Greeks." Elsewhere "Pelasgian" in Herodotus connotes anything typical of, or surviving from, the state of things in Greece before the coming of the Hellenes. In this sense all Greece was once "Pelasgic"; the clearest instances of Pelasgian survival in ritual and customs and antiquities are in Arcadia, the "Ionian" districts of north-west Peloponnese, and Attica, which have suffered least from hellenization. In Athens itself the prehistoric wall of the citadel and a plot of ground close below it were venerated in the 5th century as "Pelasgian"; so too Thucydides (ii. 17). We may note that all Herodotean examples of *actual* Pelasgi lie round, or near, the *actual* Pelasgi of Homeric Thrace; that the most distant of these is confirmed by the testimony of Thucydides (iv. 106) as to the Pelasgian and Tyrrhenian population of the adjacent seaboard: also that Thucydides adopts the same general Pelasgian theory of early Greece, with the refinement that he regards the Pelasgian name as originally specific, and as having come gradually into this generic use.

Ephorus, relying on Hesiodic tradition of an aboriginal Pelasgian type in Arcadia, elaborated a theory of the Pelasgians as a warrior-people spreading (like "Aryans") from a "Pelasgian home," and annexing and colonizing all the parts of Greece where earlier writers had found allusions to them, from Dodona to Crete and the Troad, and even as far as Italy, where again their settlements had been recognized as early as the time of Hellanicus, in close connexion once more with "Tyrrhenians."

The copious additional information given by later writers is all by way either of interpretation of local legends in the light of Ephorus's theory, or of explanation of the name "Pelasgoi"; as when Philochorus expands a popular etymology "stork-folk" (πελασγοί—πελαργοί) into a theory of their seasonal migrations; or Apollodorus says that Homer calls Zeus Pelasgian "because he is not far from every one of us," ὅτι τῆς γῆς πέλας ἐστίν. The connexion with Tyrrhenians which began with Hellanicus, Herodotus and Sophocles becomes confusion with them in the 3rd century, when the Lemnian pirates and their Attic kinsmen are plainly styled Tyrrhenians, and early fortress-walls in Italy (like those on the Palatine in Rome) are quoted as "Arcadian" colonies.

Modern writers have either been content to restate or amplify the view, ascribed above to Ephorus, that "Pelasgian" simply means "prehistoric Greek," or have used the name Pelasgian at their pleasure to denote some one element in the mixed population of the Aegean—Thracian, Illyrian (Albanian) or Semitic. G. Sergi (*Origine e diffusione della stirpe mediterranea*, Rome, 1895; Eng. trans. *The Mediterranean Race*, London, 1901), followed by many anthropologists, describes as "Pelasgian" one branch of the Mediterranean or Eur-African race of mankind, and one group of types of skull within that race. The character of the ancient citadel wall at Athens, already mentioned, has given the name "Pelasgic masonry" to all constructions of large unhewn blocks fitted roughly together without mortar, from Asia Minor to Spain.

For another view than that here taken see ACHAEANS; also GREECE: *Ancient History*, § 3, "Homeric Age."

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PELEUS, in Greek legend, king of the Myrmidones of Phthia in Thessaly, son of Aeacus, king of Aegina, and brother (or intimate friend) of Telamon. The two brothers, jealous of the athletic prowess of their step-brother Phocus, slew him; but the crime was discovered, and Peleus and Telamon were banished. Peleus took refuge in Phthia with his uncle Eurytion, who purified him from the guilt of murder, and gave him his daughter Antigone to wife, and a third of the kingdom as her dowry. Having accidentally killed his father-in-law at the Calydonian boar-hunt, Peleus was again obliged to flee, this time to Iolcus, where he was purified by Acastus. The most famous event in the life of Peleus was his marriage with the sea-goddess Thetis, by whom he became the father of Achilles. The story ran that both Zeus and Poseidon had sought her hand, but, Themis (or Prometheus or Proteus) having warned the former that a son of Thetis by Zeus would prove mightier than his father, the gods decided to marry her to Peleus. Thetis, to escape a distasteful union, changed herself into various forms, but at last Peleus, by the instructions of Chiron, seized and held her fast till she resumed her original shape, and was unable to offer further resistance. The wedding (described in the fine *Epithalamium* of Catullus) took place in Chiron's cave on Mt Pelion. Peleus survived both his son Achilles and his grandson Neoptolemus, and was carried away by Thetis to dwell for ever among the Nereids.

See Apollodorus iii. 12, 13; Ovid, *Metam.* xi; Pindar, *Isthmia*, viii. 70, *Nemea*, iv. 101; Catullus, lxiv.; schol. Apoll. Rhod. iv. 816; Euripides, *Andromache*, 1242–1260.

PELEW ISLANDS (Ger. *Palauinseln*, also *Palao*), a group of twenty-six islands in the western Pacific Ocean, between 2° 35′ and 9° N., and 130° 4′ and 134° 40′ E., belonging to Germany. They lie within a coral barrier reef, and in the south the islands are of coral, but in the north of volcanic rocks. They are well wooded, the climate is healthy, and the water-supply good. A few rats and bats represent the indigenous mammals, but the sea is rich in fish and molluscs; and Dr Otto Finsch (*Journ. des Museum Godeffroy*, 1875) enumerated 56 species of birds, of which 12 are peculiar to the group. The total area is 175 sq. m., the largest islands being Babeltop (Babelthuap, Baobeltaob and other variants), Uruktapi (Urukthopel), Korror, Nyaur, Peleliu and Eilmalk (Irakong). The population is about 3100. The natives are Micronesians, and are darker and shorter than their kinsmen, the Caroline Islanders. They usually have the frizzly hair of the Melanesians, and paint their bodies in brilliant colours, especially yellow. The men vary in height from 5 ft. to 5 ft. 5 in., the women from 4 ft. 9 to 5 ft. 2 in. The skull shows a strong tendency to brachycephalism. Two curious customs may be noted—the institution of an honourable order bestowed by the king, called *klilt*; and a species of mutual aid society, sometimes confined to women, and possessing considerable political influence. There are five kinds of currency in the islands, consisting of beads of glass and enamel, to which a supernatural origin is ascribed.

The islands were sighted in 1543 by Ruy Lopez de Villalobos, who named them the Arrecifos. The origin of the name Islas Palaos is doubtful. The islands were bought by Germany from Spain in 1899, and are administered together with the western Carolines, Yap being the administrative centre.

See K. Semper, *Die Palau-Inseln* (Leipzig, 1873); J. S. Kubary, *Die sozialen Einrichtungen der Palauer* (Berlin, 1885); A. A. Marche, *Luçon et Palouan* (Paris, 1887).

PELF, a term now chiefly used of money and always in a derogatory sense. The word originally meant plunder, pillage (O. Fr. *pelfre*, probably from Lat. *pilare*, to deprive of hair, *pilus*), and this significance is still kept in the related word "pilfer," to make petty thefts.

PELHAM, the name of an English family, derived from Pelham in Hertfordshire, which was owned by a certain Walter de Pelham under Edward I., and is alleged to have been in the possession of the same family before the Norman conquest. The family dignities included the barony of Pelham of Laughton (1706–1768), the earldom of Clare (1714–1768), the dukedom of Newcastle (1715–1768), the barony of Pelham of Stanmer from 1762, the earldom of Chichester from 1801 and the earldom of Yarborough from 1837.

John de Pelham, who was one of the captors of John II. of France at Poitiers, acquired land at Winchelsea by his marriage with Joan Herbert, or Finch. His son, John de Pelham (d. 1429), was attached to the party of John of Gaunt and his son Henry IV. In 1393 he received a life appointment as constable of Pevensey Castle, an honour subsequently extended to his heirs male, and he joined Henry on his invasion in 1399, if he did not actually land with him at Ravenspur. He was knighted at Henry's coronation, and represented Sussex in parliament repeatedly during the reign of Henry IV., and again in 1422 and 1427. As constable of Pevensey he had at different times the charge of Edward, duke of York, in 1405; Edmund, earl of March, with his brother Roger Mortimer in 1406; James I. of Scotland in 1414; Sir John Mortimer in 1422, and the queen dowager, Joan of Navarre, from 1418 to 1422. He was constantly employed in the defence of the southern ports against French invasion, and his powers were increased in 1407 by his appointment as chief butler of Chichester and of the Sussex ports, and in 1412 by the grant of the rape of Hastings. He was treasurer of England in 1412–1413, and although he was superseded on the accession of Henry V. he was sent in the next year to negotiate with the French court. He was included among the executors of the wills of Henry IV., of Thomas, duke of Clarence, and of Henry V. He died on the 12th of February 1429, and was succeeded by his son John, who took part in Henry V.'s expedition to Normandy in 1417.

In the reign of Queen Elizabeth Sir William Pelham (*c.* 1530–1587), third son of Sir William Pelham (d. 1538) of Laughton, Sussex, became lord justice of Ireland. He was captain of pioneers at the siege of Leith in 1560, and served at the siege of Havre in 1562, and with Coligny at Caen in 1563. He then returned to Havre, at that time occupied by English troops, and was one of the hostages for the fulfilment of its surrender to Charles IX. in 1564. After his return to England he fortified Berwick among other places, and was appointed lieutenant-general of ordnance. He was sent to Ireland in 1579, when he was knighted by Sir William Drury, the lord justice. Drury died in October, and Pelham was provisionally made his successor, an appointment subsequently confirmed by Elizabeth. Alarmed by the proceedings of Gerald Fitzgerald, 15th earl of Desmond, and his brother John Desmond, he proclaimed the earl a traitor. Elizabeth protested strongly against Pelham's action, which was justified by the sack of Youghal by Desmond. Thomas Butler, 10th earl of Ormonde, was entrusted with the campaign in Munster, but Pelham joined him in February 1580, when it was believed that a Spanish descent was about to be made in the south-west. The English generals laid waste northern Kerry, and proceeded to besiege Carrigafoyle Castle, which they stormed, giving no quarter to man, woman or child. Other strongholds submitted on learning the fate of Carrigafoyle, and were garrisoned by Pelham, who hoped with the concourse of Admiral Winter's fleet to limit the struggle to Kerry. He vainly sought help from the gentry of the county, who sympathized with Desmond, and were only brought to submission by a series of "drives." After the arrival of the new deputy, Lord Grey of Wilton, Pelham returned to England on the ground of health. He had retained his office as lieutenant-general of ordnance, and was now made responsible for debts incurred during his absence. Leicester desired his services in the Netherlands, but it was only after much persuasion that Elizabeth set him free to join the army by accepting a mortgage on his estates as security for his liabilities. The favour shown by Leicester to Pelham caused serious jealousies among the English officers, and occasioned a camp brawl in which Sir Edward Norris was injured. Pelham was wounded at Doesburg in 1586, and accompanied Leicester to England in 1587. Returning to the Netherlands in the same year he died at Flushing on the 24th of November 1587. His half-brother, Sir Edmund Pelham (d. 1606), chief baron of the exchequer in Ireland, was the first English judge to go on circuit in Ulster.

Sir William married Eleanor, daughter of Henry Neville, earl of Westmorland, and was the ancestor of the Pelhams of Brocklesby, Lincolnshire. In the fourth generation Charles Pelham died in 1763 without heirs, leaving his estates to his great-nephew Charles Anderson (1749–1823), who thereupon assumed the additional name of Pelham, and was created Baron Yarborough in 1794. His son Charles (1781–1846), who was for many years commodore of the Royal Yacht Squadron, was created earl of Yarborough and Baron Worsley in 1837. Charles Alfred Worsley, the 4th earl (b. 1859), exchanged the name of Anderson-Pelham for that of Pelham in 1905. He married in 1886 Marcia Lane-Fox, eldest daughter of the 12th Baron Conyers, who became in 1892 Baroness Conyers in her own right.

Sir NICHOLAS PELHAM (1517–1560), an elder half-brother of Sir William Pelham, defended Seaford against the French in 1545, and sat for Arundel and for Sussex in parliament. He was the ancestor of the earls of Chichester. His second son, Sir THOMAS PELHAM (d. 1624), was created a baronet in 1611. His descendant, Sir THOMAS PELHAM, 4th baronet (*c.* 1650–1712), represented successively East Grinstead, Lewes and Sussex in parliament, and was raised to the House of Lords as Baron Pelham of Laughton in 1706. By his second marriage with Grace (d. 1700), daughter of Gilbert Holles, 3rd earl of Clare, and sister of John Holles, duke of Newcastle, he had five daughters, and two sons—Thomas Pelham, earl of Clare, duke of Newcastle-on-Tyne and 1st duke of Newcastle-under-Lyme (see NEWCASTLE, DUKES OF), and Henry Pelham (*q.v.*). The duke of Newcastle died without heirs, and the dukedom of Newcastle-under-Lyme descended to his nephew, Henry Fiennes Clinton, afterwards known as Pelham-Clinton, and his heirs, but the barony of Pelham of Laughton became extinct. In 1762 Newcastle had been created Baron Pelham of Stanmer, with reversion to his cousin and heir-male, THOMAS PELHAM (1728–1805), who became commissioner of trade (1754), lord of the admiralty (1761–1764), comptroller of the household (1765–1774), privy councillor (1765), surveyor-general of the customs of London (1773–1805), chief justice in eyre (1774–1775) and keeper of the wardrobe (1775–1782), and was created earl of Chichester in 1801. His third son, George (1766–1827), was successively bishop of Bristol, Exeter and Lincoln. THOMAS PELHAM, 2nd earl of Chichester (1756–1826), son of the 1st earl, was surveyor-general of ordnance in Lord Rockingham's ministry (1782), and chief secretary for Ireland in the coalition ministry of 1783. In 1795 he became Irish chief secretary under Pitt's government, retiring in 1798; he was home secretary from July 1801 to August 1803 under Addington, who made him chancellor of the duchy of Lancaster in 1803. Pelham went out of office in 1804, and in the next year succeeded to the earldom. He was joint postmaster-general from 1807 to 1823, and for the remaining three years of his life postmaster-general. His son and heir, HENRY THOMAS PELHAM (1804–1886), 3rd earl, was an ecclesiastical commissioner from 1850 until his death, and was greatly interested in various religious, philanthropic and educational movements; and two other sons were well-known men—Frederick Thomas Pelham (1808–1861), who became a rear-admiral in 1858, and subsequently lord-commissioner of the admiralty, and John Thomas Pelham (1811–1894), who was bishop of Norwich from 1857 to 1893. The third earl's son, Walter John Pelham (1838–1892), succeeded his father in 1886, and his nephew Jocelyn Brudenell Pelham (b. 1871) became 6th earl of Chichester in 1905.

PELHAM, HENRY (1696–1754), prime minister of England, younger brother of Thomas Holles Pelham, duke of Newcastle, was born in 1696. He was a younger son of Thomas, 1st Baron Pelham of Laughton (1650–1712; cr. 1706) and of Lady Grace Holles, daughter of the 3rd earl of Clare (see above). He was educated by a private tutor and at Christ Church, Oxford, which he entered in July 1710. As a volunteer he served in Dormer's regiment at the battle of Preston in 1715, spent some time on the Continent, and in 1717 entered parliament for Seaford, Sussex. Through strong family influence and the recommendation of Walpole he was chosen in 1721 a lord of the Treasury. The following year he was returned for Sussex county. In 1724 he entered the ministry as secretary of war, but this office he exchanged in 1730 for the more lucrative one of paymaster of the forces. He made himself conspicuous by his support of Walpole on the question of the excise, and in 1743 a union of parties resulted in the formation of an administration in which Pelham was prime minister, with the office of chancellor of the exchequer; but rank and influence made his brother, the duke of Newcastle, very powerful in the cabinet, and, in spite of a genuine attachment, there were occasional disputes between them, which led to difficulties. Being strongly in favour of peace, Pelham carried on the war with languor and indifferent success, but the country, wearied of the interminable struggle, was disposed to acquiesce in his foreign policy almost without a murmur. The king, thwarted in his favourite schemes, made overtures in 1746 to Lord Bath, but his purpose was upset by the resignation of the two Pelhams (Henry and Newcastle), who, however, at the king's request, resumed office. Pelham remained prime minister till his death on the 6th of March 1754, when his brother succeeded him. His very defects were among the chief elements of Pelham's success, for one with a strong personality, moderate self-respect, or high conceptions of statesmanship could not have restrained the discordant elements of the cabinet for any length of time. Moreover, he possessed tact and a thorough acquaintance with the forms of the house. Whatever quarrels or insubordination might exist within the cabinet, they never broke out into open revolt. Nor can a high degree of praise be denied to his financial policy, especially his plans for the reduction of the national debt and the simplification and consolidation of its different branches. He had married in 1726 Lady Catherine Manners, daughter of the 2nd duke of Rutland; and one of his daughters married Henry Fiennes Clinton, 2nd duke of Newcastle.

See W. Coxe, *Memoirs of the Pelham Administration*, (2 vols., 1829). For the family history see Lower, *Pelham Family* (1873); also the Pelham and Newcastle MSS. in the British Museum.

PELHAM, HENRY FRANCIS (1846–1907), English scholar and historian, was born at Berg Apton, Norfolk, on the 19th of September 1846, son of the Hon. John Thomas Pelham (1811–1894), bishop of Norwich, third son of the 2nd earl of Chichester. He was educated at Harrow and at Trinity College, Oxford, where he took a first class in *literae humaniores* in 1869. He was a tutor of Exeter College from 1869 to 1890. In 1887 he became university reader in ancient history, and two years later was elected to the Camden professorship. He became curator of the Bodleian library in 1892, and in 1897 president of Trinity College. He was also a fellow of Brasenose College, honorary fellow of Exeter, a fellow of the British Academy and of other learned societies, and a governor of Harrow School. His chief contribution to ancient history was his article on Roman history in the 9th edition of the *Encyclopaedia Britannica* (1886), which was republished with additions as the *Outlines of Roman History* (1890). His university lectures, though perhaps lacking in inspiration, were full of original research and learning. His death on the 13th of February 1907 not only prevented the publication in systematic form of his own important researches, but also delayed the appearance of much that had been left in MS. by H. Furneaux and A. H. J. Greenidge, and was at the time under his charge. Apart from the *Outlines* he published only *The Imperial Domains and the Colonate* (1890), *The Roman Frontier System* (1895), and articles in periodicals of which the most important was an article in the *Quarterly Review* on the early Caesars (April, 1905). He did much for the study of archaeology at Oxford, materially assisted the Hellenic Society and the British School at Athens, and was one of the founders of the British School at Rome. He married in 1873 Laura Priscilla, daughter of Sir Edward North Buxton.

PELIAS, in Greek legend, son of Poseidon and Tyro, daughter of Salmoneus. Because Tyro afterwards married her father's brother Cretheus, king of Iolcus in Thessaly, to whom she bore Aeson, Pheres and Amythaon, Pelias was by some thought to be the son of Cretheus. He and his twin-brother Neleus were exposed by their mother, but were nurtured by a herdsman. When grown to manhood they were acknowledged by their mother. After the death of Cretheus, Pelias made himself master of the kingdom of Iolous, having previously quarrelled with Neleus, who removed to Messenia, where he founded Pylos. In order to rid himself of Jason, Pelias sent him to Colchis in quest of the golden fleece, and took advantage of his absence to put to death his father, Aeson, his mother and brother. When Jason returned he sought to avenge the death of his parents, and Medea persuaded the daughters of Pelias to cut in pieces and boil their father, assuring them that he would thus be restored to youth. Acastus, son of Pelias, drove out Jason and Medea and celebrated funeral games in honour of his father, which were celebrated by the poet Stesichorus and represented on the chest of Cypselus. The death of Pelias was the subject of Sophocles' *Rhizotomoi* (Root-cutters), and in the *Tyro* he treated another portion of the legend. *Peliades* (the daughters of Pelias) was the name of Euripides' first play.

PELICAN (Fr. *Pélican*; Lat. *Pelecanus* or *Pelicanus*), a large fish-eating water-fowl, remarkable for the enormous pouch formed by the extensible skin between the lower jaws of its long, and apparently formidable but in reality very weak, bill. The ordinary pelican, the *Onocrotalus* of the ancients, to whom it was well known, and the *Pelecanus onocrotalus* of ornithologists, is a very abundant bird in some districts of south-eastern Europe, south-western Asia and north-eastern Africa, occasionally straying, it is believed, into the northern parts of Germany and France; but the possibility of such wanderers having escaped from confinement is always to be regarded,[1] since few zoological gardens are without examples. Its usual haunts are the shallow margins of the larger lakes and rivers, where fishes are plentiful, since it requires for its sustenance a vast supply of them. The nest is formed among reeds, placed on the ground and lined with grass. Therein two eggs, with white, chalky shells, are commonly laid. The young during the first twelvemonth are of a greyish-brown, but when mature almost the whole plumage, except the black primaries, is white, deeply suffused by a rich blush of rose or salmon-colour, passing into yellow on the crest and lower part of the neck in front. A second and somewhat larger species, *Pelecanus crispus*, also inhabits Europe, but has a more eastern distribution. This, when adult, is readily distinguishable from the ordinary bird by the absence of the blush from its plumage, and by the curled feathers that project from and overhang each side of the head, which with some difference of coloration of the bill, pouch, bare skin round the eyes and irides give it a wholly distinct expression. Two specimens of the humerus have been found in the English fens (*Ibis*, 1868, p. 363; *Proc. Zool. Society*, 1871, p. 702), thus proving the existence of the bird in England at no very distant period, and one of them being that of a young example points to its having been bred in this country. It is possible from their large size that they belonged to *P. crispus*. Ornithologists have been much divided in opinion as to the number of living species of the genus *Pelecanus* (cf. *op. cit.*, 1868, p. 264; 1869, p. 571; 1871, p. 631)—the estimate varying from six to ten or eleven; but the former is the number recognized by M. Dubois (*Bull. Mus. de Belgique*, 1883). North America has one, *P. erythrorhynchus*, very similar to *P. onocrotalus* both in appearance and habits, but remarkable for a triangular, horny excrescence developed on the ridge of the male's bill in the breeding season, which falls off without leaving trace of its existence when that is over. Australia has *P. conspicillatus*, easily distinguished by its black tail and wing-coverts. Of more marine habit are *P. philippensis* and *P. fuscus*, the former having a wide range in Southern Asia, and, it is said, reaching Madagascar, and the latter common on the coasts of the warmer parts of both North and South America.

The genus *Pelecanus* as instituted by Linnaeus included the cormorant (*q.v.*) and gannet (*q.v.*) as well as the true pelicans, and for a long while these and some other distinct groups, as the snake-birds (*q.v.*), frigate-birds (*q.v.*) and tropic-birds (*q.v.*), which have all the four toes of the foot connected by a web, were regarded as forming a single family, *Pelecanidae*; but this name has now been restricted to the pelicans only, though all are still usually associated in the suborder *Steganopodes* of Ciconiiform birds. It may be necessary to state that there is no foundation for the venerable legend of the pelican feeding her young with blood from her own breast, which has given it an important place in ecclesiastical heraldry, except that, as A. D. Bartlett suggested (*Proc. Zool. Society*, 1869, p. 146), the curious bloody secretion ejected from the mouth of the flamingo may have given rise to the belief, through that bird having been mistaken for the "Pelican of the wilderness."[2] (A. N.)

PELION, a wooded mountain in Thessaly in the district of Magnesia, between Volo and the east coast. Its highest point (mod. Plessidi) is 5340 ft. It is famous in Greek mythology; the giants are said to have piled it on Ossa in order to scale Olympus, the abode of the gods; it was the home of the centaurs, especially of Chiron, who had a cave near its summit, and educated many youthful heroes; the ship "Argo" was built from its pine-woods. On its summit was an altar of Zeus Actaeus, in whose honour an annual festival was held in the dog-days, and worshippers clad themselves in skins.

PELISSE (through the Fr. from Lat. *pellicia*: sc. *vestis*, a garment made of fur, *pellis*, skin), properly a name of a cloak made of or lined with fur, hence particularly used of the fur-trimmed "dolman" worn slung from the shoulders by hussar regiments. The word is now chiefly employed as the name of a long-sleeved cloak of any material worn by women and children.

PÉLISSIER, AIMABLE JEAN JACQUES (1794–1864), duke of Malakoff, marshal of France, was born on the 6th of November 1794 at Maromme (Seine Inférieure), of a family of prosperous artisans or yeoman, his father being employed in a powder-magazine. After attending the military college of La Flèche and the special school of St Cyr, he in 1815 entered the army as sub-lieutenant in an artillery regiment. A brilliant examination in 1819 secured his appointment to the staff. He served as aide-de-camp in the Spanish campaign of 1823, and in the expedition to the Morea in 1828–29. In 1830 he took part in the expedition to Algeria, and on his return was promoted to the rank of *chef d'escadron*. After some years' staff service in Paris he was again sent to Algeria as chief of staff of the province of Oran with the rank of lieutenant-colonel, and remained there till the Crimean War, taking a prominent part in many important operations. The severity of his conduct in suffocating a whole Arab tribe in the Dahra or Dahna caves, near Mustaganem, where they had taken refuge (June 18, 1845), awakened such indignation in Europe that Marshal Soult, the minister of war, publicly expressed his regret; but Marshal Bugeaud, the governor-general of Algeria, not only gave it his approval, but secured for Pélissier the rank of general of brigade, which he held till 1850, when he was promoted general of division. After the battles of October and November 1854 before Sevastopol, Pélissier was sent to the Crimea, where on the 16th of May 1855 he succeeded Marshal Canrobert as commander-in-chief of the French forces before Sevastopol (see Crimean War). His command was marked by relentless pressure of the enemy and unalterable determination to conduct the campaign without interference from Paris. His perseverance was crowned with success in the storming of the Malakoff on the 8th of September. On the 12th he was promoted to be marshal. On his return to Paris he was named senator, created duke of Malakoff (July 22, 1856), and rewarded with a grant of 100,000 francs per annum. From March 1858 to May 1859 he was French ambassador in London, whence he was recalled to take command of the army of observation on the Rhine. In the same year he became grand chancellor of the Legion of Honour. In 1860 he was appointed governor-general of Algeria, and he died there on the 22nd of May 1864.

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[1] This caution was not neglected by the prudent, even so long ago as Sir Thomas Browne's days; for he, recording the occurrence of a pelican in Norfolk, was careful to notice that about the same time one of the pelicans kept by the king (Charles II.) in St James's Park, had been lost.

[2] The legend was commonly believed in the middle ages. Epiphanius, bishop of Constantia, in his *Physiologus* (1588), writes that the female bird, in cherishing her young, wounds them with loving, and pierces their sides, and they die. After three days the male pelican comes and finds them dead, and his heart is pained. He smites his own side, and as he stands over the wounds of the dead young ones the blood trickles down, and thus are they made alive again. The pelican "in his piety"—*i.e.* in this pious act of reviving his offspring—was a common subject for 15th-century emblem books; it became a symbol of self-sacrifice, a type of Christian redemption and of the Eucharistic doctrine. The device was adopted by Bishop Fox in 1516 for his new college of Corpus Christi Oxford.—[H. Ch.]

See Marbaud, *Le Maréchal Pélissier* (1863); Castille, *Portraits historiques*, 2nd series (1859).

PELL, JOHN (1610–1685), English mathematician, was born on the 1st of March 1610 at Southwick in Sussex, where his father was minister. He was educated at Steyning, and entered Trinity College, Cambridge, at the age of thirteen. During his university career he became an accomplished linguist, and even before he took his M.A. degree (in 1630) corresponded with Henry Briggs and other mathematicians. His great reputation and the influence of Sir William Boswell, the English resident, with the states-general procured his election in 1643 to the chair of mathematics in Amsterdam, whence he removed in 1646, on the invitation of the prince of Orange, to Breda, where he remained till 1652.

From 1654 to 1658 Pell acted as Cromwell's political agent to the Protestant cantons of Switzerland. On his return to England he took orders and was appointed by Charles II. to the rectory of Fobbing in Essex, and in 1673 he was presented by Bishop Sheldon to the rectory of Laindon in the same county. His devotion to mathematical science seems to have interfered alike with his advancement in the Church and with the proper management of his private affairs. For a time he was confined as a debtor in the king's bench prison. He lived, on the invitation of Dr Whistler, for a short time in 1682 at the College of Physicians, but died on the 12th of December 1685 at the house of Mr Cothorne, reader of the church of St Giles-in-the Fields. Many of Pell's manuscripts fell into the hands of Dr Busby, master of Westminster School, and afterwards came into the possession of the Royal Society; they are still preserved in something like forty folio volumes, which contain, not only Pell's own memoirs, but much of his correspondence with the mathematicians of his time.

The Diophantine analysis was a favourite subject with Pell; he lectured on it at Amsterdam; and he is now best remembered for the indeterminate equation $ax^2+1=y^2$, which is known by his name. This problem was proposed by Pierre de Fermat first to Bernhard Frenicle de Bessy, and in 1657 to all mathematicians. Pell's connexion with the problem simply consists of the publication of the solutions of John Wallis and Lord Brounker in his edition of *Branker's Translation of Rhonius's Algebra* (1668). His chief works are: *Astronomical History of Observations of Heavenly Motions and Appearances* (1634); *Ecliptica prognostica* (1634); *Controversy with Longomontanus concerning the Quadrature of the Circle* (1646?); *An Idea of the Mathematics*, 12mo (1650); *A Table of Ten Thousand Square Numbers* (fol.; 1672).

PELLA, the capital of ancient Macedonia under Philip II. (who transferred the seat of government hither from Edessa) and Alexander the Great, who was born here. It seems to have retained some importance up to the time of Hadrian. Scanty remains exist and some springs in the neighbourhood are still known as the baths of Pel. The site (identified by Leake) is occupied by the village of Neochori (Turk. *Yeni-Keui*) about 32 m. north-west of Salonika.

PELLAGRA (Ital. *pelle agra*, smarting skin), the name given, from one of its early symptoms, to a peculiar disease, of comparatively modern origin. For some time it was supposed to be practically confined to the peasantry in parts of Italy (particularly Lombardy) and France, and in the Asturias (*mal de la rosa*), Rumania and Corfu. But it has recently been identified in various outlying parts of the British Empire (Barbadoes, India) and in both Lower and Upper Egypt; also among the Zulus and Basutos. In the United States sporadic cases had been observed up to 1906, but since then numerous cases have been reported. It is in Italy, however, that it has been most prevalent. The malady is essentially chronic in character. The indications usually begin in the spring of the year, declining towards autumn, and recurring with increasing intensity and permanence in the spring seasons following. A peasant who is acquiring the malady feels unfit for work, suffers from headaches, giddiness, singing in the ears, a burning of the skin, especially in the hands and feet, and diarrhoea. At the same time a red rash appears on the skin, of the nature of erysipelas, the red or livid spots being tense and painful, especially where they are directly exposed to the sun. About July or August of the first season these symptoms disappear, the spots on the skin remaining rough and dry. The spring attack of the year following will probably be more severe and more likely to leave traces behind it; with each successive year the patient becomes more like a mummy, his skin shrivelled and sallow, or even black at certain spots, as in Addison's disease, his angles protruding, his muscles wasted, his movements slow and languid, and his sensibility diminished. Meanwhile there are more special symptoms relating to the nervous system, including drooping of the eyelid, dilatation of the pupil, and other disorders of vision, together with symptoms relating to the digestive system, such as a red and dry tongue, a burning feeling in the mouth, pain on swallowing, and diarrhoea. After a certain stage the disease passes into a profound disorganization of the nervous system; there is a tendency to melancholy, imbecility, and a curious mummified condition of body. After death a general tissue degeneration is observed.

The causation of this obscure disease has recently come up for new investigation in connexion with the new work done in relation to sleeping-sickness and other tropical diseases. So long as it was supposed to be peculiar to the Italian peasantry, it was associated simply with their staple diet, and was regarded as due to the eating of mouldy maize. It was by his views in this regard that Lombroso (*q.v.*) first made his scientific reputation. But the area of maize consumption is now known to be wider than that of pellagra, and pellagra is found where maize is at least not an ordinary diet. In 1905 Dr L. W. Sambon, at the meeting of the British Medical Association, suggested that pellagra was probably protozoal in origin, and subsequently he announced his belief that the protozoon was communicated by sand-flies, just as sleeping-sickness by the tsetse fly; and this opinion was supported by the favourable action of arsenic in the treatment of the disease. His hypothesis was endorsed by Sir Patrick Manson, and in January 1910 an influential committee was formed, to enable Dr Sambon to pursue his investigations in a pellagrous area.

PELLETAN, CHARLES CAMILLE (1846–), French politician and journalist, was born in Paris on the 28th of June 1846, the son of Eugène Pelletan (1813–1884), a writer of some distinction and a noted opponent of the Second Empire. Camille Pelletan was educated in Paris, passed as licentiate in laws, and was qualified as an "archiviste paléographe." At the age of twenty he became an active contributor to the press, and a bitter critic of the Imperial Government. After the war of 1870–71 he took a leading place among the most radical section of French politicians, as an opponent of the "opportunists" who continued the policy of Gambetta. In 1880 he became editor of *Justice*, and worked with success to bring about a revision of the sentences passed on the Communards. In 1881 he was chosen member for the tenth arrondissement of Paris, and in 1885 for the Bouches du Rhone, being re-elected in 1889, 1893 and 1898; and he was repeatedly chosen as "reporter" to the various bureaus. During the Nationalist and Dreyfus agitations he fought vigorously on behalf of the Republican government and when the coalition known as the "Bloc" was formed he took his place as a Radical leader. He was made minister of marine in the cabinet of M. Combes, June 1902 to January 1905, but his administration was severely criticized, notably by M. de Lanessan and other naval experts. During the great sailors' strike at Marseilles in 1904 he showed pronounced sympathy with the socialistic aims and methods of the strikers, and a strong feeling was aroused that his Radical sympathies tended to a serious weakening of the navy and to destruction of discipline. A somewhat violent controversy resulted, in the course of which M. Pelletan's indiscreet speeches did him no good; and he became a common subject for ill-natured caricatures. On the fall of the Combes ministry he became less prominent in French politics.

PELLICANUS, CONRAD (1478–1556), German theologian, was born at Ruffach in Alsace, on the 8th of January 1478. His German name, Kürsner, was changed to Pellicanus by his mother's brother Jodocus Gallus, an ecclesiastic connected with the university of Heidelberg, who supported his nephew for sixteen months at the university in 1491–1492. On returning to Ruffach, he taught gratis in the Minorite convent school that he might borrow books from the library, and in his sixteenth year resolved to become a friar. This step helped his studies, for he was sent to Tübingen in 1496 and became a favourite pupil of the guardian of the Minorite convent there, Paulus Scriptoris, a man of considerable general learning. There seems to have been at that time in south-west Germany a considerable amount of sturdy independent thought among the Franciscans; Pellicanus himself became a Protestant very gradually, and without any such revulsion of feeling as marked Luther's conversion. At Tübingen the future "apostate in three languages" was able to begin the study of Hebrew. He had no teacher and no grammar; but Paulus Scriptoris carried him a huge codex of the prophets on his own shoulders all the way from Mainz. He learned the letters from the transcription of a few verses in the *Star of the Messiah* of Petrus Niger, and, with a subsequent hint or two from Reuchlin, who also lent him the grammar of Moses Ḳimḥī, made his way through the Bible for himself with the help of Jerome's Latin. He got on so well that he was not only a useful helper to Reuchlin but anticipated the manuals of the great Hebraist by composing in 1501 the first Hebrew grammar in the European tongue. It was printed in 1503, and afterwards included in Reysch's *Margarita philosophica*. Hebrew remained a favourite study to the last. Pellican's autobiography describes the gradual multiplication of accessible books on the subjects, and he not only studied but translated a vast mass of rabbinical and Talmudic texts, his interest in Jewish literature being mainly philological. The chief fruit of these studies is the vast commentary on the Bible (Zürich, 7 vols., 1532–1539), which shows a remarkably sound judgment on questions of the text, and a sense for historical as opposed to typological exegesis.

Pellicanus became priest in 1501 and continued to serve his order at Ruffach, Pforzheim, and Basel till 1526. At Basel he did much laborious work for Froben's editions, and came to the conclusion that the Church taught many doctrines of which the early doctors of Christendom knew nothing. He spoke his views frankly, but he disliked polemic; he found also more toleration than might have been expected, even after he became active in circulating Luther's books. Thus, supported by the civic authorities, he remained guardian of the convent of his order at Basel from 1519 till 1524, and even when he had to give up his post, remained in the monastery for two years, professing theology in the university. At length, when the position was becoming quite untenable, he received through Zwingli a call to Zürich as professor of Greek and Hebrew, and formally throwing off his monk's habit, entered on a new life. Here he remained till his death on the 6th of April 1556.

Pellicanus's scholarship, though not brilliant, was really extensive; his sound sense, and his singularly pure and devoted character gave him a great influence. He was remarkably free from the pedantry of the time, as is shown by his views about the use of the German vernacular as a vehicle of culture (*Chron.* 135, 36). As a theologian his natural affinities were with Zwingli, with whom he shared the advantage of having grown up to the views of the Reformation, by the natural progress of his studies and religious life. Thus he never lost his sympathy with humanism and with its great German representative, Erasmus.

Pellicanus's Latin autobiography (*Chronicon C.P.R.*) is one of the most interesting documents of the period. It was first published by Riggenbach in 1877, and in this volume the other sources for his life are registered. See also Emil Silberstein, *Conrad Pellicanus; ein Beitrag zur Geschichte des Studiums der hebr. Sprache* (Berlin, 1900).

PELLICIER, GUILLAUME (*c.* 1490–1568), French prelate and diplomatist, was educated by his uncle, the bishop of Maguelonne, whom he succeeded in 1529. In 1536 he had the seat of his bishopric transferred to Montpellier. Appointed ambassador at Venice in 1539, he fulfilled his mission to the entire satisfaction of Francis I., but on the discovery of the system of espionage he had employed the king had to recall him in 1542. Returning to his diocese, he was imprisoned in the château of Beaucaire for his tolerance of the Reformers, so he replaced his former indulgence by severity, and the end of his episcopate was disturbed by religious struggles. He was a man of wide learning, a humanist and a friend of humanists, and took a keen interest in the natural sciences.

See J. Zeller, *La Diplomatie française . . . d'après le correspondance de G. Pellicier* (Paris, 1881); and A. Tausserat-Radel, *Correspondance politique de Guillaume Pellicier* (Paris, 1899).

PELLICO, SILVIO (1788–1854), Italian dramatist, was born at Saluzzo in Piedmont on the 24th of June 1788, the earlier portion of his life being passed at Pinerolo and Turin under the tuition of a priest named Manavella. At the age of ten he composed a tragedy under the inspiration of Caesarotti's translation of the Ossianic poems. On the marriage of his twin sister Rosina with a maternal cousin at Lyons he went to reside in that city, devoting himself during four years to the study of French literature. He returned in 1810 to Milan, where he became professor of French in the Collegio degli Orfani Militari. His tragedy *Francesca da Rimini*, was brought out with success by Carlotta Marchionni at Milan in 1818. Its publication was followed by that of the tradegy *Eufemio da Messina*, but the representation of the latter was forbidden. Pellico had in the meantime continued his work as tutor, first to the unfortunate son of Count Briche, and then to the two sons of Count Porro Lambertenghi. He threw himself heartily into an attempt to weaken the hold of the Austrian despotism by indirect educational means. Of the powerful literary executive which gathered about Counts Porro and Confalonieri, Pellico was the able secretary—the management of the *Conciliatore*, which appeared in 1818 as the organ of the association, resting largely upon him. But the paper, under the censorship of the Austrian officials, ran for a year only, and the society itself was broken up by the government. In October 1820 Pellico was arrested on the charge of carbonarism and conveyed to the Santa Margherita prison. After his removal to the Piombi at Venice in February 1821, he composed several *Cantiche* and the tragedies *Ester d'Engaddi* and *Iginia d'Asti*. The sentence of death pronounced on him in February 1822 was finally commuted to fifteen years *carcere duro*, and in the following April he was placed in the Spielberg at Brünn. His chief work during this part of his imprisonment was the tragedy *Leoniero da Dertona*, for the preservation of which he was compelled to rely on his memory. After his release in 1830 he commenced the publication of his prison compositions, of which the *Ester* was played at Turin in 1831, but immediately suppressed. In 1832 appeared his *Gismonda da Mendrizio*, *Erodiade* and the *Leoniero*, under the title of *Tre nuovi tragedie*, and in the same year the work which gave him his European fame, *Le Mie prigioni*, an account of his sufferings in prison. The last gained him the friendship of the Marchesa di Barolo, the reformer of the Turin prisons, and in 1834 he accepted from her a yearly pension of 1200 francs. His tragedy *Tommaso Moro* had been published in 1833, his most important subsequent publication being the *Opere inedite* in 1837. On the decease of his parents in 1838 he was received into the Casa Barolo, where he remained till his death, assisting the marchesa in her charities, and writing chiefly upon religious themes. Of these works the best known is the *Dei Doveri degli uomini*, a series of trite maxims which do honour to his piety rather than to his critical judgment. A fragmentary biography of the marchesa by Pellico was published in Italian and English after her death. He died on the 31st of January 1854, and was buried in the Campo Santo at Turin. His writings are defective in virility and breadth of thought, and his tragedies display neither the insight into character nor the constructive power of a great dramatist. It is in the simple narrative and naive egotism of *Le Mie prigioni* that he has established his strongest claim to remembrance, winning fame by his misfortunes rather than by his genius.

See Piero Maroncelli, *Addizioni alle mie prigioni* (Paris, 1834); the biographies by Latour; Gabriele Rosselli; Didier, *Revue des deux mondes* (September 1842); De Loménie, *Galerie des contemp. illustr.* iv. (1842); Chiala (Turin, 1852); Nollet-Fabert (1854); Giorgio Briano (1854); Bourdon (1868); Rivieri (1899–1901).

PELLISSON, PAUL (1624–1693), French author, was born at Béziers on the 30th of October 1624, of a distinguished Calvinist family. He studied law at Toulouse, and practised at the bar of Castres. Going to Paris with letters of introduction to Valentin Conrart, who was a co-religionist, he became through him acquainted with the members of the academy. Pellisson undertook to be their historian, and in 1653 published a *Relation contenant l'histoire de l'académie française*. This panegyric was rewarded by a promise of the next vacant place and by permission to be present at their meetings. In 1657 Pellisson became secretary to the minister of finance, Nicolas Fouquet, and when in 1661 the minister was arrested, his secretary was imprisoned in the Bastille. Pellisson had the courage to stand by his fallen patron, in whose defence he issued his celebrated *Mémoire* in 1661, with the title *Discours au roi, par un de ses fidèles sujets sur le procès de M. de Fouquet*, in which the facts in favour of Fouquet are marshalled with great skill. Another pamphlet, *Seconde défense de M. Fouquet*, followed. Pellisson was released in 1666, and from this date sought the royal favour. He became historiographer to the king, and in that capacity wrote a fragmentary *Histoire de Louis XIV.*, covering the years 1660 to 1670. In 1670 he was converted to Catholicism and obtained rich ecclesiastical preferment. He died on the 7th of February 1693. He was very intimate with Mlle de Scudéry, in whose novels he figures as Herminius and Acante. His sterling worth of character made him many friends and justified Bussy-Rabutin's description of him as "encore plus honnête homme que bel esprit."

See Sainte-Beuve, *Causeries du lundi*, vol. xiv.; and F. L. Marcon, *Étude sur la vie et les œuvres de Pellisson* (1859).

PELLITORY, in botany, the common name for a small hairy perennial herb which grows on old walls, hedgebanks and similar localities, and is known botanically as *Parietaria officinalis* (Lat. *paries*, a wall). It has a short woody rootstock from which spring erect or spreading stems 1 to 2 ft. long, bearing slender leafy branches, and axillary clusters of small green flowers. It belongs to the nettle order (*Urticaceae*), and is nearly allied to the nettle, *Urtica*, but its hairs are not stinging.

PELLOUX, LUIGI (1839–), Italian general and politician, was born on the 1st of March 1839, at La Roche, in Savoy, of parents who retained their Italian nationality when Savoy was annexed to France. Entering the army as lieutenant of artillery in 1857, he gained the medal for military valour at the battle of Custozza in 1866, and in 1870 commanded the brigade of artillery which battered the breach in the wall of Rome at Porta Pia. He was elected to the Chamber in 1881 as deputy for Leghorn, which he represented until 1895, and joined the party of the Left. He had entered the war office in 1870, and in 1880 became general secretary, in which capacity he introduced many useful reforms in the army. After a succession of high military commands he received the appointment of chief of the general staff in 1896. He was minister of war in the Rudini and Giolitti cabinets of 1891–1893. In July 1896 he resumed the portfolio of war in the Rudini cabinet, and was appointed senator. In May 1897 he secured the adoption of the Army Reform Bill, fixing Italian military expenditure at a maximum of £9,560,000 a year, but in December of that year he was defeated in the Chamber on the question of the promotion of officers. Resigning office, he was in May 1898 sent as royal commissioner to Bari, where, without recourse to martial law, he succeeded in restoring public order. Upon the fall of Rudini in June 1898, General Pelloux was entrusted by King Humbert with the formation of a cabinet, and took for himself the post of minister of the interior. He resigned office in May 1899, but was again entrusted with the formation of the ministry. He took stern measures against the revolutionary elements in southern Italy, and his new cabinet was essentially military and conservative. The Public Safety Bill for the reform of the police laws, taken over by him from the Rudini cabinet, and eventually promulgated by royal decree, was fiercely obstructed by the Socialist party, which, with the Left and Extreme Left, succeeded in forcing General Pelloux to dissolve the Chamber in May 1900, and to resign office after the general election in June. In the autumn of 1901 he was appointed to the command of the Turin army corps.

PELOMYXA, so named by R. Greeff, a genus of Lobose Rhizopoda (*q.v.*), naked, multinucleate, with very blunt rounded pseudopodia, formed by eruption (see Amoeba), often containing peculiar vesicles (glycogen?), and full of a symbiotic bacterium. It inhabits the ooze of decomposing organic matter at the bottom of ponds and lakes.

PELOPIDAS (d. 364 B.C.), Theban statesman and general. He was a member of a distinguished family, and possessed great wealth which he expended on his friends, while content to lead the life of an athlete. In 385 B.C. he served in a Theban contingent sent to the support of the Spartans at Mantineia, where he was saved, when dangerously wounded, by Epaminondas (*q.v.*). Upon the seizure of the Theban citadel by the Spartans (383 or 382) he fled to Athens, and took the lead in a conspiracy to liberate Thebes. In 379 his party surprised and killed their chief political opponents, and roused the people against the Spartan garrison, which surrendered to an army gathered by Pelopidas. In this and subsequent years he was elected *boeotarch*, and about 375 he routed a much larger Spartan force at Tegyra (near Orchomenus). This victory he owed mainly to the valour of the Sacred Band, a picked body of 300 infantry. At the battle of Leuctra (371) he contributed greatly to the success of Epaminondas's new tactics by the rapidity with which he made the Sacred Band close with the Spartans. In 370 he accompanied his friend Epaminondas as *boeotarch* into Peloponnesus. On their return both generals were unsuccessfully accused of having retained their command beyond the legal term. In 369, in response to a petition of the Thessalians, Pelopidas was sent with an army against Alexander, tyrant of Pherae. After driving Alexander out, he passed into Macedonia and arbitrated between two claimants to the throne. In order to secure the influence of Thebes, he brought home hostages, including the king's brother, afterwards Philip II., the conqueror of Greece. Next year Pelopidas was again called upon to interfere in Macedonia, but, being deserted by his mercenaries, was compelled to make an agreement with Ptolemaeus of Alorus. On his return through Thessaly he was seized by Alexander of Pherae, and two expeditions from Thebes were needed to secure his release. In 367 Pelopidas went on an embassy to the Persian king and induced him to prescribe a settlement of Greece according to the wishes of the Thebans. In 364 he received another appeal from the Thessalian towns against Alexander of Pherae. Though an eclipse of the sun prevented his bringing with him more than a handful of troops, he overthrew the tyrant's far superior force on the ridge of Cynoscephalae; but wishing to slay Alexander with his own hand, he rushed forward too eagerly and was cut down by the tyrant's guards.

Plutarch and Nepos, *Pelopidas*; Diodorus xv. 62–81; Xenophon, *Hellenica*, vii. 1. See also Thebes. (M. O. B. C.)

PELOPONNESIAN WAR, in Greek history, the name given specially to the struggle between Athens at the head of the Delian League and the confederacy of which Sparta was the leading power.[1] According to Thucydides the war, which was in his view the greatest that had ever occurred in Greece, lasted from 431 to the downfall of Athens in 404. The genius of Thucydides has given to the struggle the importance of an epoch in world history, but his view is open to two main criticisms—(1) that the war was in its ultimate bearings little more than a local disturbance, viewed from the standpoint of universal history; (2) that it cannot be called a war in the strict sense. The former of these criticisms is justified in the article on Greece: *History* (*q.v.*). Unless we are to believe that the Macedonian supremacy is directly traceable to the mutual weakening of the Greek cities in 431–403, it is difficult to see what lasting importance attaches to the war. As regards the second, a few chief difficulties may be indicated. The very narrative even of Thucydides himself shows that the "war" was not a connected whole. It may be divided into three main periods—(1) from 431 to 421 (Lysias calls it the "Archidamian" War), when the Peace of Nicias, not merely formally, but actually produced a cessation of hostilities; (2) from 421 till the intervention of Sparta in the Sicilian War; during these years there was no "Peloponnesian War," and there were several years in which there was in reality no fighting at all: the Sicilian expedition was in fact a side issue; (3) from 413 to 404, when fighting was carried on mainly in the Aegean Sea (Isocrates calls this the "Decelean" War). The disjointed character of the struggle is so obvious from Thucydides himself that historians have come to the conclusion that the idea of treating the whole struggle as a single unit was *ex post facto* (see Greece: *History*, § A, "Ancient" *ad fin.*).

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[1] Some historians prefer to call it the Second Peloponnesian War, the first being that of 457, which ended with the Thirty Years' Peace.

The book itself affords evidence which goes far to justify this view. A very important problem is presented by bk. v., which is obviously put in as a connecting link to prove a theory. Thucydides expressly warns us not to regard the period of this book as one of peace, and yet the very contents of the book refute his argument. In 419 and 417 there is practically no fighting: the Mantinean War of 418 is a disconnected episode which did not lead to a resumption of hostilities: in 420 there are only obscure battles in Thrace: in 416 there is only the expedition to Melos; and finally from 421 to 413 there is official peace. Other details may be cited in corroboration. Book v. (ch. 26) contains a second introduction to the subject; *ὅδε ὁ πόλεμος* in i. 23 and iv. 48 is the Archidamian or Ten Years' War; in v. 26 we read of a *πρῶτος πόλεμος*, a *ὕστερος πόλεμος* and an *ἀνακωχή*. Some critics think on these and other grounds that Thucydides wrote and published bks. i.–v. 25 by itself, then bks. vi. and vii. (Sicilian expedition), and finally revising his view joined them into one whole by the somewhat unsatisfactory bk. v. 26 and following chapters, and began to round off the story with the incomplete bk. viii. (on this see Greece: *History*, as above). It is perhaps most probable that he retained notes made contemporarily and worked them up some time after 404, in a few passages failing to correct inconsistencies and dying before bk. viii. was completed. The general introduction in bk. i. was unquestionably written shortly after 404.

The causes of the war thus understood are complex. The view taken by Thucydides that Sparta was the real foe of Athens has been much modified by modern writers. The key to the situation is in fact the commercial rivalry of the Corinthians, whose trade (mainly in the West) had been seriously limited by the naval expansion of the Delian League. This rivalry was roused to fever heat by the Athenian intervention in 434–33 on behalf of Corcyra, Corinth's rebellious colony (see Corfu) and from that time the Corinthians felt that the Thirty Years' Truce was at an end. An opportunity soon offered for making a counter attack. Potidaea, a Dorian town on the western promontory of Chalcidice in Thrace, a tributary ally of Athens—to which however Corinth as metropolis still sent annual magistrates—was induced to revolt,[1] with the support of the Macedonian king Perdiccas, formerly an Athenian ally. The Athenian Phormio succeeded in blockading the city so that its capture was merely a question of time, and this provided the Corinthians with an urgent reason for declaring war.

Prior to these episodes Athens had not been in hostile contact with any of the Peloponnesian confederate states for more than ten years, and Pericles had abandoned a great part of his imperial policy. He now laid an embargo upon Megara by which the Megarians were forbidden on pain of death to pursue trading operations with any part of the Athenian Empire. The circumstances of this decree (or decrees) are not material to the present argument (see Grote, *History of Greece*, ed. 1907, p. 370 note) except that it turned special attention to the commercial supremacy which Athens claimed to enjoy. In 432 a conference of Peloponnesian allies was summoned and the Corinthian envoys urged the Spartans to declare war on the ground that the power of Athens was becoming so great as to constitute a danger to the other states. This might have been urged with justice before the Thirty Years' Truce (447); but by that truce Athens gave up all her conquests in Greece proper except Naupactus and Plataea, while her solitary gains in Amphipolis and Thurii were compensated by other losses. The fact that the Corinthian argument failed to impress Sparta and many of the delegates is shown by the course of the debate. What finally impelled the Spartans to agree to the war was the veiled threat by the Corinthians that they would be driven into another alliance (*i.e.* Argos, i. 71). We can hardly regard Sparta as the determined enemy of Athens at this time. Only twice since 461 had she been at war with Athens—in 457 (Tanagra) and 447, when she deliberately abstained from pushing the advantage which the revolt in Euboea provided; she had refused to help the oligarchs of Samos in 440. Corinth however had not only strong, but also immediate and urgent reasons (Potidaea and Corcyra) for desiring war. It has been argued that the war was ultimately a struggle between the principles of oligarchy and democracy. This view, however, cannot be taken of the early stages of the war when there was democracy and oligarchy on both sides (see *ad fin.*); it is only in the later stages that the political difference is prominent.

The Opposing Forces.—The permanent strength of the Peloponnesian confederacy lay in the Peloponnesian states, all of which except Argos and Achaea were united under Sparta's leadership. But it included also extra-Peloponnesian states—viz. Megara, Phocis, Boeotia and Locris (which had formed part of the Athenian land empire), and the maritime colonies round the Ambracian Gulf. The organization was not elaborate. The federal assembly with few exceptions met only in time of war, and then only when Sparta agreed to summon it. It met in Sparta and the delegates, having stated their views before the Spartan Apella, withdrew till the Apella had come to a decision. The delegates were then invited to return and to confirm that decision. It is clear that the link was purely one of common interest, and that Sparta had little or no control over, *e.g.* so powerful a confederate as Corinth. Sparta was the chief member of the confederacy (*hegemon*), but the states were autonomous. In time of war each had to provide two-thirds of its forces, and that state in whose territory the war was to take place had to equip its whole force.

The Athenian Empire is described elsewhere (Delian League, Athens). Here it must suffice to point out that there was among the real and technical allies no true bond of interest, and that many of the states were in fact bound by close ties to members of the Peloponnesian confederacy (*e.g.* Potidaea to Corinth). Sparta could not only rely on voluntary co-operation but could undermine Athenian influence by posing as the champion of autonomy. Further, Thucydides is wrong on his own showing in saying that Sparta refused to tolerate democratic government in confederate cities: it was not till after 418 that this policy was adopted. Athens, on the other hand, had undoubtedly interfered in the interest of democracy in various allied states (see Delian League).

No detailed examination of the comparative military and naval resources of the combatants can here be attempted. On land the Peloponnesians were superior: they had at least 30,000 hoplites not including 10,000 from Central Greece and Boeotia: these soldiers were highly trained. The Athenian army was undoubtedly smaller. There has been considerable discussion as to the exact figures, the evidence in Thucydides being highly confusing, but it is most probable that the available fighting force was not more than half that of the Peloponnesian confederacy. Even of these we learn (Thuc. iii. 87) that 4400 died in the great plague. The only light-armed force was that of Boeotia at Delium (10,000 with 500 peltasts). Of cavalry Athens had 1000, Boeotia a similar number. The only other cavalry force was that of Thessaly, which, had it been loyal to Athens, would have meant a distinct superiority. In naval power the Athenians undoubtedly had an overwhelming advantage at the beginning, both in numbers and in training.

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[1] The importance of this revolt lay in the fact that it immediately involved danger to Athens throughout the Chalcidic promontories, and her north-east possessions generally.

Financially Athens had an enormous apparent advantage. She began with a revenue of 1000 talents (including 600 from σύμμαχοι), and had also, in spite of the heavy expense which the building schemes of Pericles had involved, a reserve of 6000 talents. The Peloponnesians had no reserve and no fixed revenue assessment. On the other hand the Peloponnesian armies were unpaid, while Athens had to spend considerable sums on the payment of crews and mercenaries. In the last stages of the war the issue was determined by the poverty of Athens and Persian gold.

The events of the struggle from 431 to 404 may be summarized in the three periods distinguished above.

1. *The Ten Years' or Archidamian War.*—The Spartans sent to Athens no formal declaration of war but rather sought first to create some specious *casus belli* by sending requisitions to Athens. The first, intended to inflame the existing hostilities against Pericles (*q.v.*) in Athens, was that he should be expelled the city as being an Alcmaeonid (grand-nephew of Cleisthenes) and so implicated in the curse pronounced on the murderers of Cylon nearly 200 years before. This outrageous demand was followed by three others—that the Athenians should (1) withdraw from Potidaea, (2) restore autonomy to Aegina, and (3) withdraw the embargo on Megarian commerce. Upon the refusal of all these demands Sparta finally made the maintenance of peace contingent upon the restoration by Athens of autonomy to all her allies. Under the guidance of Pericles Athens replied that she would do nothing on compulsion, but was prepared to submit difficulties to amicable arbitration on the basis of mutual concessions. Before anything could come of this proposal, matters were precipitated (end of March 431) by the attack of Thebes upon Plataea (*q.v.*), which immediately sought and obtained the aid of Athens. War was begun. The Spartan king Archidamus assembled his army, sent a herald to announce his approach, marched into Attica and besieged Oenoe.

Meanwhile Pericles had decided to act on the defensive, *i.e.* to abandon Attica, collect all its residents in Athens and treat Athens as an island, retaining meanwhile command of the sea and making descents on Peloponnesian shores. The policy, which Thucydides and Grote commend, had grave defects—though it is by no means easy to suggest a better; *e.g.* it meant the ruin of the landed class, it tended to spoil the *moral* of those who from the walls of Athens annually watched the wasting of their homesteads, and it involved the many perils of an overcrowded city—a peril increased by, if not also the cause of, the plague. Moreover sea power was not everything, and delay exhausted the financial reserves of the state, while financial considerations, as we have seen, were comparatively unimportant to the Peloponnesians. The descents on the Peloponnese were futile in the extreme.

Archidamus, having wasted much territory, including Acharnae, retired at the end of July. The Athenians retaliated by attacking Methone (which was secured by Brasidas), by successes in the West, by expelling all Aeginetans from Aegina (which was made a cleruchy), and by wasting the Megarid.

In 430 Archidamus again invaded Attica, systematically wasting the country. Shortly after he entered Attica plague broke out in Athens, borne thither by traders from Carthage or Egypt (Holm, *Greek History*, ii. 346 note). The effect upon the overcrowded population of the city was terrible. Of the 1200 cavalry (including mounted archers) 300 died, together with 4400 hoplites: altogether the estimate of Diodorus (xii. 58) that more than 10,000 citizens and slaves succumbed is by no means excessive. None the less Pericles sailed with 100 triremes, and ravaged the territory near Epidaurus. Subsequently he returned and the expedition proceeded to Potidaea. But the plague went with them and no results were achieved. The enemies of Pericles, who even with the aid of Spartan intrigue had hitherto failed to harm his prestige, now succeeded in inducing the desperate citizens to fine him for alleged malversation. The verdict, however, shocked public feeling and Pericles was reinstated in popular favour as strategus (*c.* Aug. 430). About a year later he died. In the autumn of 430 a Spartan attack on Zacynthus failed and the Ambraciots were repulsed from Amphilochian Argos. In reply Athens sent Phormio to Naupactus to watch her interests in that quarter. In the winter Potidaea capitulated, receiving extremely favourable terms.

In 429 the Peloponnesians were deterred by the plague from invading Attica and laid siege to Plataea in the interests of Thebes. The Athenians failed in an expedition to Chalcidice under Xenophon, while the Spartan Cnemus with Chaonian and Epirot allies was repulsed from Stratus, capital of Acarnania, and Phormio with only 20 ships defeated the Corinthian fleet of 47 sail in the Gulf of Corinth. Orders were at once sent from Sparta to repair this disaster and 77 ships were equipped. Help sent from Athens was diverted to Crete, and after much manœuvring Phormio was compelled to fight off Naupactus. Nine of his ships were driven ashore, but with the other 11 he subsequently defeated the enemy and recovered the lost nine. With the reinforcement which arrived afterwards he established complete control of the western seas. A scheme for operating with Sitalces against the Chalcidians of Thrace fell through, and Sitalces joined Perdiccas.

The year 428 was marked by a third invasion of Attica and by the revolt of Lesbos from Athens. After delay in fruitless negotiations the Athenian Cleippides, and afterwards Paches, besieged Mytilene, which appealed to Sparta. The Peloponnesian confederacy resolved to aid the rebels both directly and by a counter demonstration against Athens. The Athenians, though their reserve of 6000 talents was by now almost exhausted (except for 1000 talents in a special reserve), made a tremendous effort (raising 200 talents by a special property tax), and not only prevented an invasion by a demonstration of 100 triremes at the Isthmus, but sent Asopius, son of Phormio, to take his place in the western seas. In spring 427 the Spartans again invaded Attica without result. The winter of 428–427 was marked by the daring escape of half the Plataean garrison under cover of a stormy night, and by the capitulation of Mytilene, which was forced upon the oligarchic rulers by the democracy. The Spartan fleet arrived too late and departed without attempting to recover the town. Paches cleared the Asiatic seas of the enemy, reduced the other towns of Mytilene and returned to Athens with upwards of 1000 prisoners. An assembly was held and under the invective of Cleon (*q.v.*) it was decided to kill all male Mytileneans of military age and to sell the women and children as slaves. This decree, though in accordance with the rigorous customs of ancient warfare as exemplified by the treatment which Sparta shortly afterwards meted out to the Plataeans, shocked the feelings of Athens, and on the next day it was (illegally) rescinded just in time to prevent Paches carrying it out. The thousand[1] oligarchic prisoners were however executed, and Lesbos was made a cleruchy.

Meanwhile there occurred civil war in Corcyra, in which ultimately, with the aid of the Athenian admiral Eurymedon, the democracy triumphed amid scenes of the wildest savagery. In the autumn of the year Nicias fortified Minoa at the mouth of the harbour of Megara. Shortly afterwards the Spartans planted an unsuccessful colony at Heraclea in the Trachinian territory north-west of Thermopylae.

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[1] So Thuc. iii. 50. It is suggested that this number is an error for 30 or 50 (*i.e.*, Α or Ν for Α). It seems incredible that 1000 could be described as "ringleaders" out of a population of perhaps 5000.

In the summer of 426 Nicias led a predatory expedition along the north-west coast without achieving any positive victory. More important, though equally ineffective, was the scheme of Demosthenes to march from Naupactus through Aetolia, subduing the wild hill tribes, to Cytinium in Doris (in the upper valleys of the Cephissus) and thence into Boeotia, which was to be attacked simultaneously from Attica. The scheme was crushed by the courage and skill of the Aetolians, who thereupon summoned Spartan and Corinthian aid for a counter attack on Naupactus. Demosthenes averted this, and immediately afterwards by superior tactics inflicted a complete defeat at Olpae in Acarnania on Eurylochus at the head of a Spartan and Ambracian force. An Ambracian reinforcement was annihilated at one of the peaks called Idomene, and a disgraceful truce was accepted by the surviving Spartan leader Menedaeus. This was not only the worst disaster which befell any powerful state up to the peace of Nicias (as Thucydides says), but was a serious blow to Corinth, whose trade on the West was, as we have seen, one of the chief causes of the war.

The year 425 is remarkable for the Spartan disaster of Pylos (*q.v.*). The Athenians had despatched 40 triremes under Eurymedon and Procles to Sicily with orders to call first at Corcyra to prevent an expected Spartan attack. Meantime Demosthenes had formed the plan of planting the Messenians of Naupactus in Messenia—now Spartan territory—and obtained permission to accompany the expedition. The fleet was, as it chanced, delayed by a storm in the Bay of Navarino, and rough fortifications were put up by the sailors on the promontory of Pylos. Demosthenes was left behind in this fort, and the Spartans promptly withdrew from their annual raid upon Attica and their projected attack on Corcyra to dislodge him. After a naval engagement (see Pylos) a body of Spartan hoplites were cut off on Sphacteria. So acutely did Sparta feel their position that an offer of peace was made on condition that the hoplites should go free. The eloquence of Cleon frustrated the peace party's desire to accept these terms, and ultimately to the astonishment of the Greek world the Spartan hoplites to the number of 292 surrendered unconditionally (see Cleon).

Thus in 424 the Athenians had seriously damaged the prestige of Sparta, and broken Corinthian supremacy in the north-west, and the Peloponnesians had no fleet. This was the zenith of their success, and it was unfortunate for them that they declined the various offers of peace which Sparta made. The next two years changed the whole position. The doubling of the tribute in 425 pressed hardly on the allies (see Delian League): Nicias failed in a plot with the democratic party in Megara to seize that town; and the brilliant campaigns of Brasidas (*q.v.*) in the north-east, culminating in the capture of Amphipolis (422), finally destroyed the Athenian hopes of recovering their land empire, and entirely restored the balance of success and Spartan prestige. Moreover, the admirably conceived scheme for a simultaneous triple attack upon Boeotia at Chaeronea in the north, Delium in the south-east, and Siphae in the south-west had fallen through owing to the inefficiency of the generals. The scheme, which probably originated with the atticizing party in Thebes, resulted in the severe defeat of Hippocrates at Delium by the Boeotians under Pagondas, and was a final blow to the policy of an Athenian land empire.

These disasters at Megara, Amphipolis and Delium left Athens with only one trump card—the possession of the Spartan hoplites captured in Sphacteria. This solitary success had already in the spring of 423 induced Sparta in spite of the successes which Brasidas was achieving in Thrace to accept the "truce of Laches"—which, however, was rendered abortive by the refusal of Brasidas to surrender Scione. The final success of Brasidas at Amphipolis, where both he and Cleon were killed, paved the way for a more permanent agreement, the peace parties at Athens and Sparta being in the ascendant.

2. *From* 421 *to* 413.—Peace was signed in March 421 on the basis of each side's surrendering what had been acquired by the war, not including those cities which had been acquired by capitulation. It was to last for fifty years. Its weak points, however, were numerous. Whereas Sparta had been least of all the allies interested in the war, and apart from the campaigns of Brasidas had on the whole taken little part in it, her allies benefited least by the terms of the Peace. Corinth did not regain Sollium and Anactorium, while Megara and Thebes respectively were indignant that Athens should retain Nisaea and receive Panactum. These and other reasons rapidly led to the isolation of Sparta, and there was a general refusal to carry out the terms of agreement. The history of the next three years is therefore one of complex inter-state intrigues combined with internal political convulsions. In 421 Sparta and Athens concluded a defensive alliance; the Sphacterian captives were released and Athens promised to abandon Pylos. Such a peace, giving Sparta everything and Athens nothing but Sparta's bare alliance, was due to the fact that Nicias and Alcibiades were both seeking Sparta's friendship. At this time the Fifty Years' Truce between Sparta and Argos was expiring. The Peloponnesian malcontents turned to Argos as a new leader, and an alliance was formed between Argos, Corinth, Elis, Mantinea and the Thraceward towns (420). This coalition between two different elements—an anti-oligarchic party and a war party—had no chance of permanent existence. The war party in Sparta regained its strength under new ephors and negotiations began for an alliance between Sparta, Argos and Boeotia. The details cannot here be discussed. The result was a re-shuffling of the cards. The democratic states of the Peloponnese were driven, partly by the intrigues of Alcibiades, now anti-Laconian, into alliance with Athens, with the object of establishing a democratic Peloponnese under the leadership of Argos. These unstable combinations were soon after upset by Alcibiades himself, who, having succeeded in displacing Nicias as strategus in 419, allowed Athenian troops to help in attacking Epidaurus. For a cause not easy to determine Alcibiades was defeated by Nicias in the election to the post of strategus in the next year, and the suspicions of the Peloponnesian coalition were roused by the inadequate assistance sent by Athens, which arrived too late to assist Argos when the Spartan king Agis marched against it. Ultimately the Spartans were successful over the coalition at Mantinea, and soon afterwards an oligarchic revolution at Argos led to an alliance between that city and Sparta (*c.* Feb. 417). This oligarchy was overthrown again in June, and the new democracy having vainly sought an agreement with Sparta rejoined Athens. It was thus left to Athens to expend men and money on protecting a democracy by the aid of which she had hoped practically to control the Peloponnesus. All this time, however, the alliance between her and Sparta was not officially broken.

The unsatisfactory character of the Athenian Peloponnesian coalition was one of the negative causes which led up to the Sicilian Expedition of 415. Another negative cause may be found in the failure of an attempt or attempts to subdue the Thraceward towns. By combining the evidence of Plutarch (in his comparison of Nicias and Crassus), Thuc. v. 83, and the inscription which gives the treasury payments for 418–415 (Hicks and Hill, *Gr. Hist. Inscr.* 70), we can scarcely doubt that there were expeditions in 418 (Euthydemus) and the summer of 417 (Nicias), and that in the winter of 417 a blockading squadron under Chaeremon was despatched. This policy—which was presumably that of Nicias in opposition to Alcibiades—having failed, the way was cleared for a reassertion of that policy of western conquest which had always had advocates from Themistocles onward in Athens,[1] and was part of the democratic programme.

The tragic fiasco of the Sicilian expedition, involving the death of Nicias and the loss of thousands of men and hundreds of ships, was a blow from which Athens never recovered (see under Syracuse and Sicily). Even before the final catastrophe the Spartans had reopened hostilities. On the advice of Alcibiades (*q.v.*), exiled from Athens in 415, they had fortified Decelea in Attica within fifteen miles of Athens. This place not only served as a permanent headquarters for predatory expeditions, but cut off the revenue from the Laurium mines, furnished a ready asylum for runaway slaves, and rendered the transference of supplies from Euboea considerably more difficult (*i.e.* by the sea round Cape Sunium). Athens thus entered upon the third stage of the conflict with exceedingly poor prospects.

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[1] In 454 Athens made a treaty with Segesta (inscr. Hicks and Hill, *Greek Hist. Inscr.* 34): in 433 with Rhegium and Leontini (Hicks and Hill, 51 and 52; cf. Thuc. iii. 86, *παλαιὰ συμμαχία* with Chalcidic towns in Sicily): in 444 the colony of Thurii was founded: in 427 (see above) 60 ships were sent to Sicily; and if we may believe Aristophanes (*Eq.* 1302) Hyperbolus asked for 100 triremes for Carthage.

3. *The Ionian or Decelean War.*—From the Athenian standpoint this war may be broken up into three periods: (1) period of revolt of allies (413–411), (2) the rally (410–408), (3) the relapse (407–404). As contrasted with the Archidamian War, this war was fought almost exclusively in the Aegean Sea, the enemy was primarily Sparta, and the deciding factor was Persian gold. Furthermore, apart from the gradual disintegration of the empire, Athens was disturbed by political strife.

In 412 many Ionian towns revolted, and appealed either to Agis at Decelea or to Sparta direct. Euboea, Lesbos, Chios, Erythrae led the way in negotiation and revolt, and simultaneously the court of Susa instructed the satraps Pharnabazus and Tissaphernes to renew the collection of tribute from the Greek cities of Asia Minor. The satraps likewise made overtures to Sparta. The revolt of the Ionian allies was due in part to Alcibiades also, whose prompt action in co-operation with his friend the ephor Endius finally confirmed the Chian oligarchs in their purpose. In 411 a treaty was signed by Sparta and Tissaphernes against Athens: the treaty formally surrendered to the Persian king all territory which he or his predecessors had held. It was subsequently renewed in a form somewhat less disgraceful to Greek patriotism by the Spartans Astyochus and Theramenes. On the other hand, a democratic rising in Samos prevented the rebellion of that island, which for the remainder of the war was invaluable to Athens as a stronghold lying between the two great centres of the struggle.

After the news of the Sicilian disaster Athens was compelled at last to draw on the reserve of 1000 talents which had lain untouched in the treasury.[1] The revolt of the Ionian allies, and (in 411) the loss of the Hellespontine, Thracian and Island tributes (see Delian League), very seriously crippled her finances. On the other hand, Tissaphernes undertook to pay the Peloponnesian sailors a daily wage of one Attic drachma (afterwards reduced to $\frac{1}{2}$ drachma). In Attica itself Athens lost Oenoe and Oropus, and by the end of 411 only one quarter of the empire remained. In the meanwhile Tissaphernes began to play a double game with the object of wasting the strength of the combatants. Moreover Alcibiades lost the confidence of the Spartans and passed over to Tissaphernes, at whose disposal he placed his great powers of diplomacy, at the same time scheming for his restoration to Athens. He opened negotiations with the Athenian leaders in Samos and urged them to upset the democracy and establish a philo-Persian oligarchy. After elaborate intrigues, in the course of which Alcibiades played false to the conspirators by forcing them to abandon the idea of friendship with Tissaphernes owing to the exorbitant terms proposed, the new government by the Four Hundred was set up in Athens (see Theramenes). This government (which received no support from the armament in Samos) had a brief life, and on the final revolt of Euboea was replaced by the old democratic system. Alcibiades (*q.v.*) was soon afterwards invited to return to Athens.

The war, which, probably because of financial trouble, the Spartans had neglected to pursue when Athens was thus in the throes of political convulsion, was now resumed. After much manœuvring and intrigues a naval battle was fought at Cynossema in the Hellespont in which victory on the whole rested with the Athenians (Aug. 411), though the net result was inconsiderable. About this time the duplicity of Tissaphernes—who having again and again promised a Phoenician fleet and having actually brought it to the Aegean finally dismissed it on the excuse of trouble in the Levant—and the vigorous honesty of Pharnabazus definitely transferred the Peloponnesian forces to the north-west coast of Asia Minor and the Hellespont. There they were regularly financed by Pharnabazus, while the Athenians were compelled to rely on forced levies. In spite of this handicap Alcibiades, who had been seized and imprisoned by Tissaphernes at Sardis but effected his escape, achieved a remarkable victory over the Spartan Mindarus at Cyzicus (about April 410). So complete was the destruction of the Peloponnesian fleet that, according to Diodorus, peace was offered by Sparta (see *ad fin.*)and would have been accepted but for the warlike speeches of the "demagogue" Cleophon representing the extreme democrats.[2] Another result was the return to allegiance (409) of a number of the north-east cities of the empire. Great attempts were made by the Athenians to hold the Hellespont and then to protect the corn-supply from the Black Sea. In Greece these gains were compensated by the loss of Pylos and Nisaea.

In 408 Alcibiades effectively invested Chalcedon, which surrendered by agreement with Pharnabazus, and subsequently Byzantium also fell into his hands with the aid of some of its inhabitants.

Pharnabazus, weary of bearing the whole cost of the war for the Peloponnesians, agreed to a period of truce so that envoys might visit Susa, but at this stage the whole position was changed by the appointment of Cyrus the Younger as satrap of Lydia, Greater Phrygia and Cappadocia. His arrival coincided with the appointment of Lysander (*c.* Dec. 408) as Spartan admiral—the third of the three great commanders (Brasidas and Gylippus being the others) whom Sparta produced during the war. Cyrus promptly agreed on the special request of Lysander (*q.v.*) to pay slightly increased wages to the sailors, while Lysander established a system of anti-Athenian clubs and oligarchic governments in various cities. Meanwhile Alcibiades (May 407), having exacted levies in Caria, returned at length to Athens and was elected strategus with full powers (see Strategus). He raised a large force of men and ships and endeavoured to draw Lysander (then at Ephesus) into an engagement. But Cyrus and Lysander were resolved not to fight till they had a clear advantage, and Alcibiades took a small squadron to Phocaea. In spite of his express orders his captain Antiochus in his absence provoked a battle and was defeated and killed at Notium. This failure and the refusal of Lysander to fight again destroyed the confidence which Alcibiades had so recently regained. Ten strategi were appointed to supersede him and he retired to fortified ports in the Chersonese which he had prepared for such an emergency (*c.* Jan. 406). At the same time Lysander's year of office expired and he was superseded by Callicratidas, to the disgust of all those whom he had so carefully organized in his service. Callicratidas, an honourable man of pan-Hellenic patriotism, was heavily handicapped in the fact that Cyrus declined to afford him the help which had made Lysander powerful, and had recourse to the Milesians and Chians, with whose aid he fitted out a fleet of 140 triremes (only 10 Spartan). With these he pursued Conon (chief of the ten new Athenian strategi), captured 30 of his 70 ships and besieged him in Mytilene. Faced with inevitable destruction, Conon succeeded in sending the news to Athens, where by extraordinary efforts a fleet of 110 ships was at once equipped. Callicratidas, hearing of this fleet's approach, withdrew from Mytilene, leaving Eteonicus in charge of the blockade. Forty more ships were collected by the Athenians, who met and defeated Callicratidas at Arginusae with a loss of more than half his fleet. The immediate result was that Eteonicus left Mytilene and Conon found himself free. Unfortunately the victorious generals at Arginusae, through negligence or owing to a storm, failed to recover the bodies of those of their crews who were drowned or killed in the action. They were therefore recalled, tried and condemned to death, except two who had disobeyed the order to return to Athens.

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[1] She had already abolished the system of tribute in favour of a 5% *ad valorem* tax on all imports and exports carried by sea between her ports and those of the allies.

[2] Xenophon, *Hell.* does not mention it: Thucydides's history had by this time come to an end.

At this point Lysander was again sent out, nominally as secretary to the official admiral Aracus. Cyrus, recalled to Susa by the illness of Darius, left him in entire control of his satrapy. Thus strengthened he sailed to Lampsacus on the Hellespont and laid siege to it. Conon, now in charge of the Athenian fleet, sailed against him, but the fleet was entirely destroyed while at anchor at Aegospotami (Sept. 405), Conon escaping with only 12 out of 180 sail to Cyprus. In April 404 Lysander sailed into the Peiraeus, took possession of Athens, and destroyed the Long Walls and the fortifications of Peiraeus. An oligarchical government was set up (see CRITIAS), and Lysander having compelled the capitulation of Samos, the last Athenian stronghold, sailed in triumph to Sparta.

Two questions of considerable importance for the full understanding of the Peloponnesian War may be selected for special notice: (1) how far was it a war between two antagonistic theories of government, oligarchic and democratic? and (2) how far was Athenian statesmanship at fault in declining the offers of peace which Sparta made?

1. A common theory is that Sparta fought throughout the war as an advocate of oligarchy, while Athens did not seek to interfere with the constitutional preferences of her allies. The view is based partly on Thuc. i. 19, according to which the Spartans took care that their allies should adhere to a policy convenient to themselves. This idea is disproved by Thucydides' own narrative, which shows that down to 418 (the battle of Mantinea) Sparta tolerated democratic governments in Peloponnesus itself—*e.g.* Elis, Mantinea, Sicyon, Achaea. It was only after that date that democracy was suppressed in the Peloponnesian League, and even then Mantinea remained democratic. In point of fact, it was only when Lysander became the representative of Spartan foreign policy—*i.e.* in the last years of the war—that Sparta was identified with the oligarchic policy. On the other hand, there is strong evidence that the Athenian Empire at a much earlier date was based upon a uniform democratic type of government (cf. Thuc. i. 19, viii. 64; Xen. *Pol.* i. 14, *Hell.* iii. 47; Arist. *Pol.* viii. 69). It is true that we find oligarchic government in Chios and Lesbos (up to 428) and in Samos (up to 440), but this is discounted by the fact that all three were "autonomous" allies. Moreover, in the case of Samos there was a democracy in 439, though in 412 the government was again oligarchic. The case of Selymbria (see Hicks and Hill, *op. cit. 77*) is of little account, because at that time (409) the Empire was *in extremis*. In general we find that Athenian orators take special credit on the ground that the Athenian had given to her allies the constitutional advantages which they themselves enjoyed.

2. In view of the disastrous issue of the war, it is important to notice that on three occasions—(*a*) after Pylos, (*b*) after Cyzicus, (*c*) after Arginusae—Athens refused formal peace proposals from Sparta. (*a*) Though Cleon was probably wise in opposing peace negotiations before the capture of the Spartans in Sphacteria, it seems in the light of subsequent events that he was wrong to refuse the terms which were offered after the hoplites had been captured. No doubt, however, the temper in Athens was at that time predominantly warlike, and the surrender of the hoplites was a unique triumph. Possibly, too, Cleon foresaw that peace would have meant a triumph for the philo-Laconian party. (*b*) The peace proposals of 410 are given by Diodorus, who says that the ephor Endius proposed that a peace should be made on the basis of *uti possidetis*, except that Athens should evacuate Pylos and Cythera, and Sparta, Decelea. Cleophon, however, perhaps doubting whether the offer was sincere (cf. Philochorus in Schol. *ap.* Eurip. *Orest.* 371; *Fragm.* ed. Didot, 117, 118), demanded the *status quo ante* (413 or 431). (*c*) The proposals of 406, mentioned by *Ath. Pol.* 34, were on the same lines, except that Athens no longer had Pylos and Cythera, and had lost practically half her empire. At this time peace must therefore have been advantageous to Athens as showing the world that in spite of her losses she was still one of the great powers of Greece. Moreover, an alliance with Sparta would have meant a check to Persian interference. It is probable, again, that party interest was a leading motive in Cleophon's mind, since a peace would have meant the return of the oligarchic exiles and the establishment of a moderate oligarchy.

AUTHORITIES.—G. Busolt, *Griech. Gesch.*, Bd. iii., Teil ii. (1904), "Der Peloponnesische Krieg" is essential. All histories of Greece may be consulted (see GREECE: *History, Ancient*, section "Authorities"). (J. M. M.)

PELOPONNESUS ("Island of Pelops"), the ancient and modern Greek official name for the part of Greece south of the Isthmus of Corinth. In medieval times it was called the Morea, from its resemblance to a mulberry-leaf in shape, and this name is still current in popular speech.

PELOPS, in Greek legend, the grandson of Zeus, son of Tantalus and Dione, and brother of Niobe. His father's home was on Mt Sipylus in Asia Minor, whence Pelops is spoken of as a Lydian or a Phrygian. Tantalus one day served up to the gods his own son Pelops, boiled and cut in pieces. The gods detected the crime, and none of them would touch the food except Demeter (according to others, Thetis), who, distracted by the loss of her daughter Persephone, ate of the shoulder. The gods restored Pelops to life, and the shoulder consumed by Demeter was replaced by one of ivory. Wherefore the descendants of Pelops had a white mark on their shoulder ever after (Ovid, *Metam.* vi. 404; Virgil, *Georgics*, iii. 7). This tale is perhaps reminiscent of human sacrifice amongst the Greeks. Poseidon carried Pelops off to Olympus, where he dwelt with the gods, till, for his father's sins, he was cast out from heaven. Then, taking much wealth with him, he crossed over from Asia to Greece. He went to Pisa in Elis as suitor of Hippodameia, daughter of king Oenomaus, who had already vanquished in the chariot-race and slain many suitors for his daughter's hand. But by the help of Poseidon, who lent him winged steeds, or of Oenomaus's charioteer Myrtilus, whom he or Hippodameia bribed, Pelops was victorious in the race, wedded Hippodameia, and became king of Pisa (Hyginus, *Fab.* 84). The race of Pelops for his wife may be a reminiscence of the early practice of marriage by capture. When Myrtilus claimed his promised reward, Pelops flung him into the sea near Geraestus in Euboea, and from his dying curse sprang those crimes and sorrows of the house of Pelops which supplied the Greek tragedians with such fruitful themes (Sophocles, *Electra*, 505, with Jebb's note). Among the sons of Pelops by Hippodameia were Atreus, Thyestes and Chrysippus. From Pisa Pelops extended his sway over the neighbouring Olympia, where he celebrated the Olympian games with a splendour unknown before. His power and fame were so great that henceforward the whole peninsula was known to the ancients as Peloponnesus, "island of Pelops" (νῆσος, island). In after times Pelops was honoured at Olympia above all other heroes; a temple was built for him by Heracles, his descendant in the fourth generation, in which the annual magistrates sacrificed to him a black ram.

From the reference to Asia in the tales of Tantalus, Niobe and Pelops it has been conjectured that Asia was the original seat of these legends, and that it was only after emigration to Greece that the people localized a part of the tale of Pelops in their new home. In the time of Pausanias the throne of Pelops was still shown on the top of Mt Sipylus. The story of Pelops is told in the first Olympian ode of Pindar and in prose by Nicolaus Damascenus.

PELOTA (Sp. "little ball," from Lat. *pila*), a ball game which, originating centuries ago in the Basque provinces, has developed into several forms of the sport. Epigrams of Martial show that there were at least three kinds of pelota played in his time. *Blaid*, practically hand fives against the back wall of a court, is still played on both sides of the Pyrenees. It is so popular that the authorities had to forbid its being played against the walls of the cathedral at Barcelona. In uncovered courts of large size there are two varieties of pelota. One, the favourite pastime of the Basque, is played against a front wall (*fronton*), either barehanded, with a leather or wooden long glove-like protector (*cesta*), or with a *chistera* strapped to the wrist, a sickle-shaped wicker-work implement three feet long, much like a hansom-wheel basket mud-guard, in the narrow groove of which the ball is caught and from which, thanks to the leverage afforded, it can be hurled with tremendous force. There are several players to a side, frequently an uneven number to allow a handicap. The score is announced by a *cantara*, whose melodious vocal efforts make him not the least appreciated participant in the game. In the other form of the game, played nearly exclusively by professionals (*pelotaris*), there are usually three players on each side, two forwards and a back, distinguished by a coloured sash or cap. The server (*butteur*) slips off his *chistera* to serve, bouncing the ball on the *but*, a kind of stool, about 30 ft. from the wall, and striking it low against the wall. The side that wins the toss has the first service. The ball must be replayed by the opposing side at the wall, which it must hit over a line 3 ft. from the base of the wall and under the net fixed at the top of the wall. The game is counted 15, 30, 40, game, reckoned by the number of faults made by the opposing side. A fault is scored (*a*) when after the service the ball is not caught on the volley or first bounce, (*b*) when it does not on the return strike the wall within the prescribed limits, (*c*) when it goes out of the prescribed limits of the court, (*d*) when it strikes the net fixed at the top of the court. The side making the fault loses the service. A game like this has been played in England by Spanish professionals on a court 250 ft. long, against a wall 30 ft. high and 55 ft. wide. The ball used, a trifle smaller than a base-ball, is hard rubber wound with yarn and leather-covered, weighing 5 ounces. The server bounces the ball on the concrete floor quite near the *fronton*, and hits it with his *chistera* against the wall with a force to make it rebound beyond a line 80 ft. back. It usually goes treble that distance.

PELOTAS, a city of the state of Rio Grande do Sul, Brazil, on the left bank of the São Gonçalo river near its entrance into the Lagôa dos Patos, about 30 m. N.W. of the city of Rio Grande. Pop. (1900), city, about 24,000; *municipio* (commune, 1037 sq. m.), 43,091. The Rio Grande-Bagé railway communicates with the city of Rio Grande, and with the railways extending to Bagé, Cacequy, Santa Maria, Passo Fundo and Porto Alegre. The São Gonçalo river is the outlet of Lagôa Mirim, and Pelotas is therefore connected with the inland water routes. The city is built on an open grassy plain (*campo*) little above the level of the lake (28 ft. above sea-level). The public buildings include the church of São Francisco, dating from the early part of the 19th century, the municipal hall, a fine theatre, the Misericordia hospital, a public library containing about 25,000 volumes and a great central market. Pelotas is the centre of the *xarque* or *carne secca* (jerked beef) industry of Rio Grande do Sul. In its outskirts and the surrounding country are an immense number of *xarqueadas* (slaughter-houses), with large open yards where the dressed beef, lightly salted, is exposed to the sun and air. There are many factories or packing houses where the by-products are prepared for market. Pelotas was only a small settlement at the beginning of the 19th century and had no parochial organization until 1812. It became a *villa* in 1830 and a city in 1835.

PELOUZE, THÉOPHILE JULES (1807–1867), French chemist, was born at Valognes, in Normandy, on the 26th (or 13th) of February 1807. His father, Edmond Pelouze (d. 1847), was an industrial chemist and the author of several technical handbooks. The son, after spending some time in a pharmacy at La Fère, acted as laboratory assistant to Gay-Lussac and J. L. Lassaigne (1800–1859) at Paris from 1827 to 1829. In 1830 he was appointed associate professor of chemistry at Lille, but returning to Paris next year became repétiteur, and subsequently professor, at the École Polytechnique. He also held the chair of chemistry at the Collège de France, and in 1833 became assayer to the mint and in 1848 president of the Commission des Monnaies. After the *coup d'état* in 1851 he resigned his appointments, but continued to conduct a laboratory-school he had started in 1846. He died in Paris on the 1st of June 1867. Though Pelouze made no discovery of outstanding importance, he was a busy investigator, his work including researches on salicin, on beetroot sugar, on various organic acids—gallic, malic, tartaric, butyric, lactic, &c.—on oenanthic ether (with Liebig), on the nitrosulphates, on gun-cotton, and on the composition and manufacture of glass. He also carried out determinations of the atomic weights of several elements, and with E. Frémy, published *Traité de chimie générale* (1847–1850); *Abrégé de chimie* (1848); and *Notions générales de chimie* (1853).

PELTIER, JEAN CHARLES ATHANASE (1785–1845), French physicist, was born at Ham (Somme) on the 22nd of February 1785. He was originally a watchmaker, but retired from business about the age of thirty and devoted himself to experimental and observational science. His papers, which are numerous, are devoted in great part to atmospheric electricity, waterspouts, cyanometry and polarization of skylight, the temperature of water in the spheroidal state, and the boiling-point at great elevations. There are also a few devoted to curious points of natural history. But his name will always be associated with the thermal effects at junctions in a voltaic circuit. His great experimental discovery, known as the "Peltier effect," was that if a current pass from an external source through a circuit of two metals it *cools* the junction through which it passes in the same direction as the thermo-electric current which would be caused by directly heating that junction, while it heats the other junction (see THERMO-ELECTRICITY). Peltier died in Paris on the 27th of October 1845.

PELTUINUM [mod. Civita Ansidonia], a town of the Vestini, on the Via Claudia Nova, 12 m. E.S.E. of Aquila. It was apparently the chief town of that portion of the Vestini who dwelt west of the main Apennine chain. Remains of the town walls, of an amphitheatre, and of other buildings still exist.

PELUSIUM, an ancient city and port of Egypt, now represented by two large mounds close to the coast and the edge of the desert, 20 m. E. of Port Said. It lay in the marshes at the mouth of the most easterly (Pelusiac) branch of the Nile, which has long since been silted up, and was the key of the land towards Syria and a strong fortress, which, from the Persian invasion at least, played a great part in all wars between Egypt and the East. Its name has not been found on Egyptian monuments, but it may be the Sin of the Bible and of Assur-bani-pal's inscription. Pelusium ("the muddy") is the Faramā of the Arabs, Peremoun in Coptic; the name Ṭīna which clings to the locality seems etymologically connected with the Arabic word for clay or mud. The site, crowned with extensive ruins of burnt brick of the Byzantine or Arab period, has not yielded any important remains. (F. Ll. G.)

PELVIS (Lat. for "basin," cf. Gr. πέλλις), in anatomy, the bony cavity at the lower part of the abdomen in which much of the genito-urinary apparatus and the lower part of the bowels are contained (see SKELETON, § *Appendicular*).

PEMBA, an island in the Indian Ocean off the east coast of Africa, forming part of the sultanate of Zanzibar. Pemba lies 30 m. N.N.E. of Zanzibar island between 4° 80′ and 5° 30′ S., and 39° 35′ and 39° 50′ E. It is some 40 m. long and 10 across at its broadest part, and has an area of 380 sq. m. It is of coralline formation. On the side facing the mainland the coast is much indented. From its luxuriant vegetation it gets its Arabic name of Al-huthera—"The Green." The interior is diversified by hills, some of which exceed 600 ft. The land is chiefly owned by great Arab proprietors, who work their plantations with Swahili labour, and with negroes from the mainland. Prior to 1897 the labourers were all slaves. Their gradual manumission was accomplished without injury to the prosperity of the island. The population is estimated at between 50,000 and 60,000, of whom 2000 to 3000 are Arabs. Most of the inhabitants are of Bantu stock, and are known as Wapemba. In the ports there are many Hindu traders and a few Europeans. The plantations are nearly all devoted to cloves (the annual average output being 10,000,000 ℔) and coco-nut palms (for the preparation of copra). The number of coco-nut plantations is very small compared with those devoted to cloves. Yet cloves need much care and attention and yield small profit, while the coco-nut palm yields a fairly uniform crop of nuts and will grow almost anywhere. The preponderance of clove plantations dates from a cyclone which in 1872 destroyed nearly all the clove-trees in the island of Zanzibar. Thereupon, to benefit from the great rise in the price of cloves, the Pemba planters cut down their palms and planted cloves. The value of the cloves exported in 1907 was £339,000, or 92% of the total exports. India, Germany and Great Britain are, in the order named, the chief purchasers. Other exports include fire-wood, skins and hides, mother-of-pearl, wax and small quantities of rubber, cowries, tortoiseshell and so-called tortoise-nail. The "tortoise-nail" is the valve with which a shell-fish closes its shell. The Llandolphia rubber-vine is indigenous, and since 1906 Ceara rubber-trees have been extensively planted. Rice, the chief of Pemba's imports, could easily be grown on the island. Cotton cloths (Kangas) form the next most considerable item in the imports.

Pemba has three ports, all on the west side of the island. Shaki-Shaki, the capital and the centre of trade, is centrally situated at the head of a shallow tidal creek partly blocked by dense growths of mangroves. Mkoani is on the south-west coast, Kishi-Kashi on the north-west coast; at the last-named port there is a deep and well-sheltered harbour, approached however by a narrow and dangerous channel.

Pemba is administered as an integral part of the Zanzibar dominions, and yields a considerable surplus to the exchequer, mainly from a 25% duty imposed on cloves exported. There is a weekly steamship service to Zanzibar, and in 1907 the two islands were connected by wireless telegraphy (see Zanzibar).

PEMBROKE, EARLS OF. The title of earl of Pembroke has been held successively by several English families, the jurisdiction and dignity of a palatine earldom being originally attached to it. The first creation dates from 1138, when the earldom of Pembroke was conferred by King Stephen on Gilbert de Clare (d. 1148), son of Gilbert Fitz-Richard, who possessed the lordship of Strigul (Estrighoiel, in *Domesday Book*), the modern Chepstow. After the battle of Lincoln (1141), in which he took part, the earl joined the party of the empress Matilda, and he married Henry I.'s mistress, Isabel, daughter of Robert de Beaumont, earl of Leicester.

Richard de Clare, 2nd earl of Pembroke (d. 1176), commonly known as "Strongbow," son of the first earl, succeeded to his father's estates in 1148, but had forfeited or lost them by 1168. In that year Dermot, king of Leinster, driven out of his kingdom by Roderick, king of Connaught, came to solicit help from Henry II. He secured the services of Earl Richard, promising him the hand of his daughter Eva and the succession to Leinster. The earl crossed over in person (1170), took both Waterford and Dublin, and was married to Eva. But Henry II., jealous of this success, ordered all the troops to return by Easter 1171. In May Dermot died; this was the signal of a general rising, and Richard barely managed to keep Roderick of Connaught out of Dublin. Immediately afterwards he hurried to England to solicit help from Henry II., and surrendered to him all his lands and castles. Henry crossed over in October 1172; he stayed in Ireland six months, and put his own men into nearly all the important places, Richard keeping only Kildare. In 1173 he went in person to France to help Henry II., and was present at Verneuil, being reinstated in Leinster as a reward. In 1174 he advanced into Connaught and was severely defeated, but fortunately Raymond le Gros re-established his supremacy in Leinster. Early in 1176 Richard died, just as Raymond had taken Limerick for him. Strongbow was the statesman, as the Fitzgeralds were the soldiers, of the conquest. He is vividly described by Giraldus Cambrensis as a tall and fair man, of pleasing appearance, modest in his bearing, delicate in features, of a low voice, but sage in council and the idol of his soldiers. He was buried in the cathedral church of Dublin, where his effigy and that of his wife are still preserved.

See Giraldus Cambrensis, *Expugnatio hibernica*; and the *Song of Dermot*, edited by G. H. Orpen (1892).

Strongbow having died without male issue, his daughter Isabel became countess of Pembroke in her own right, and the title was borne by her husband, Sir William Marshal, or Le Maréchal, second son of John le Maréchal, by Sibylle, the sister of Patrick, earl of Salisbury. John le Maréchal was a partisan of the empress Matilda, and died about 1164.

The date of Sir William Marshal's birth is uncertain, but his parents were married not earlier than 1141, and he was a mere child in 1152, when he attracted the notice of King Stephen. In 1170 he was selected for a position in the household of Prince Henry, the heir-apparent, and remained there until the death of his young patron (1183). He undertook a pilgrimage to the Holy Land, where he served as a crusader with distinction for two years. Although he had abetted the prince in rebellion he was pardoned by Henry II. and admitted to the royal service about 1188. In 1189 he covered the flight of Henry II. from Le Mans to Chinon, and, in a skirmish, unhorsed the undutiful Richard Cœur de Lion. None the less Richard, on his accession, promoted Marshal and confirmed the old king's licence for his marriage with the heiress of Strigul and Pembroke. This match gave Marshal the rank of an earl, with great estates in Wales and Ireland, and he was included in the council of regency which the king appointed on his departure for the third crusade (1190). He took the side of Prince John when the latter expelled the justiciar, William Longchamp, from the kingdom, but he soon discovered that the interests of John were different from those of Richard. Hence in 1193 he joined with the loyalists in making war upon the prince. Richard forgave Marshal his first error of judgment, allowed him to succeed his brother, John Marshal, in the hereditary marshalship, and on his death-bed designated him as custodian of Rouen and of the royal treasure during the interregnum. Though he quarrelled more than once with John, Marshal was one of the few English laymen who clung to the royal side through the Barons' War. He was one of John's executors, and was subsequently elected regent of the king and kingdom by the royalist barons in 1216. In spite of his advanced age he prosecuted the war against Prince Louis and the rebels with remarkable energy. In the battle of Lincoln (May 1217) he charged and fought at the head of the young king's army, and he was preparing to besiege Louis in London when the war was terminated by the naval victory of Hubert de Burgh in the straits of Dover. He was criticized for the generosity of the terms he accorded to Louis and the rebels (September 1217); but his desire for an expeditious settlement was dictated by sound statesmanship. Self-restraint and compromise were the key-notes of Marshal's policy. Both before and after the peace of 1217 he reissued Magna Carta. He fell ill early in the year 1219, and died on the 14th of May at his manor of Caversham near Reading. He was succeeded in the regency by Hubert de Burgh, in his earldom by his five sons in succession.

See the metrical French life, *Histoire de Guillaume le Maréchal* (ed. P. Meyer, 3 vols., Paris, 1891–1901); the *Minority of Henry III.*, by G. J. Turner (*Trans. Royal Hist. Soc.*, new series, vol. xviii. pp. 245–295); and W. Stubbs, *Constitutional History*, chs. xii. and xiv. (Oxford, 1896–1897).

Marshal's eldest son, William Marshal (d. 1231), 2nd earl of Pembroke of this line, passed some years in warfare in Wales and in Ireland, where he was justiciar from 1224 to 1226; he also served Henry III. in France. His second wife was the king's sister, Eleanor, afterwards the wife of Simon de Montfort, but he left no children. His brother Richard Marshal (d. 1234), 3rd earl, came to the front as the leader of the baronial party, and the chief antagonist of the foreign friends of Henry III. Fearing treachery he refused to visit the king at Gloucester in August 1233, and Henry declared him a traitor. He crossed to Ireland, where Peter des Roches had instigated his enemies to attack him, and in April 1234 he was overpowered and wounded, and died a prisoner. His brother Gilbert (d. 1241), who became the 4th earl, was a friend and ally of Richard, earl of Cornwall. When another brother, Anselm, the 6th earl, died in December 1245, the male descendants of the great earl marshal became extinct. The extensive family possessions were now divided among Anselm's five sisters and their descendants, the earldom of Pembroke reverting to the Crown.

The next holder of the lands of the earldom of Pembroke was William de Valence (d. 1296), a younger son of Hugh de Lusignan, count of La Marche, by his marriage with Isabella of Angoulême (d. 1246), widow of the English king John, and was born at Valence, near Lusignan. In 1247 William and his brothers, Guy and Aymer, crossed over to England at the invitation of their half-brother, Henry III. In 1250 Aymer (d. 1260) was elected bishop of Winchester, and in 1247 Henry arranged a marriage between William and Joan de Munchensi (d. 1307) a granddaughter of William Marshal, 1st earl of Pembroke. The custody of Joan's property, which included the castle and lordship of Pembroke, was entrusted to her husband, who in 1295 was summoned to parliament as earl of Pembroke. In South Wales

Valence tried to regain the palatine rights which had been attached to the earldom of Pembroke. But his energies were not confined to South Wales. Henry III. heaped lands and honours upon him, and he was soon thoroughly hated as one of the most prominent of the rapacious foreigners. Moreover, some trouble in Wales led to a quarrel between him and Simon de Montfort, and this soon grew more violent. He would not comply with the provisions of Oxford, and took refuge in Wolvesey Castle at Winchester, where he was besieged and compelled to surrender and leave the country. In 1259 he and Earl Simon were formally reconciled in Paris, and in 1261 he was again in England and once more enjoying the royal favour. He fought for Henry at the battle of Lewes, and then, after a stay in France, he landed in Pembrokeshire, and took part in 1265 in the siege of Gloucester and the battle of Evesham. After the royalist victory he was restored to his estates and accompanied Prince Edward, afterwards Edward I., to Palestine. He went several times to France on public business; he assisted in the conquest of North Wales; and he was one of Edward's representatives in the famous suit over the succession to the crown of Scotland in 1291 and 1292. He died at Bayonne on the 13th of June 1296, his body being buried in Westminster Abbey. His eldest surviving son, Aymer (*c.* 1265–1324), succeeded to his father's estates, but was not formally recognized as earl of Pembroke until after the death of his mother Joan about 1307. He was appointed guardian of Scotland in 1306, but with the accession of Edward II. to the throne and the consequent rise of Piers Gaveston to power, his influence sensibly declined; he became prominent among the discontented nobles and was one of those who were appointed to select the lord ordainers in 1311. In 1312 he captured Gaveston at Scarborough, giving the favourite a promise that his life should be spared. Ignoring this undertaking, however, Guy Beauchamp, earl of Warwick, put Gaveston to death, and consequently Pembroke left the allied lords and attached himself to Edward II. Valence was present at Bannockburn; in 1317, when returning to England from Rome, he was taken prisoner and was kept in Germany until a large ransom was paid. In 1318 he again took a conspicuous part in making peace between Edward and his nobles, and in 1322 assisted at the formal condemnation of Earl Thomas of Lancaster, and received some of his lands. His wife, Mary de Chatillon, a descendant of King Henry III., was the founder of Pembroke College, Cambridge.

In 1339 Laurence, Lord Hastings (d. 1348), a great-grandson of William de Valence, having inherited through the female line a portion of the estates of the Valence earls of Pembroke was created, or recognized as, earl of Pembroke. His son John (d. 1376) married Margaret Plantagenet, daughter of King Edward III., and on the death without issue of his grandson in 1389 the earldom of Pembroke reverted again to the Crown, while the barony of Hastings became dormant and so remained till 1840.

In 1414 Humphrey Plantagenet, fourth son of King Henry IV., was created duke of Gloucester and earl of Pembroke for life, these titles being subsequently made hereditary, with a reversion as regards the earldom of Pembroke, in default of heirs to Humphrey, to William de la Pole, earl of Suffolk. Accordingly, on the death of Humphrey, without issue, in 1447 this nobleman became earl of Pembroke. He was beheaded in 1450 and his titles were forfeited. In 1453 the title was given to Sir Jasper Tudor, half-brother of King Henry VI. Sir Jasper being a Lancastrian, his title was forfeited during the predominance of the house of York, but was restored on the accession of Henry VII. On his death without heirs in 1495, his title became extinct.

During his attainder Sir Jasper was taken prisoner by Sir William Herbert (d. 1469), a zealous Yorkist, who had been raised to the peerage as Baron Herbert by Edward IV., and for this service Lord Herbert was created earl of Pembroke in 1468. His son William (d. 1491) received the earldom of Huntingdon in lieu of that of Pembroke, which he surrendered to Edward IV., who thereupon conferred it (1479) on his son Edward, prince of Wales; and when this prince succeeded to the throne as Edward V., the earldom of Pembroke merged in the crown. Anne Boleyn, a few months previous to her marriage with Henry VIII., was created marchioness of Pembroke in 1532. It is doubted by authorities on peerage law whether the title merged in the royal dignity on the marriage of the marchioness to the king, or became extinct on her death in 1536.

The title of earl of Pembroke was next revived in favour of Sir William Herbert (*c.* 1501–1570), whose father, Richard, was an illegitimate son of the 1st earl of Pembroke of the house of Herbert. He had married Anne Parr, sister of Henry VIII.'s sixth wife, and was created earl in 1551. The title has since been held by his descendants.

An executor of Henry VIII.'s will and the recipient of valuable grants of land, Herbert was a prominent and powerful personage during the reign of Edward VI., both the protector Somerset and his rival, John Dudley, afterwards duke of Northumberland, angling for his support. He threw in his lot with Dudley, and after Somerset's fall obtained some of his lands in Wiltshire and a peerage. It has been asserted that he devised the scheme for settling the English crown on Lady Jane Grey; at all events he was one of her advisers during her short reign, but he declared for Mary when he saw that Lady Jane's cause was lost. By Mary and her friends Pembroke's loyalty was at times suspected, but he was employed as governor of Calais, as president of Wales and in other ways. He was also to some extent in the confidence of Philip II. of Spain. The earl retained his place at court under Elizabeth until 1569, when he was suspected of favouring the projected marriage between Mary, queen of Scots, and the duke of Norfolk. Among the monastic lands granted to Herbert was the estate of Wilton, near Salisbury, still the residence of the earls of Pembroke.

His elder son Henry (*c.* 1534–1601), who succeeded as 2nd earl, was president of Wales from 1586 until his death. He married in 1577 Mary Sidney, the famous countess of Pembroke (*c.* 1561–1621), third daughter of Sir Henry Sidney and his wife Mary Dudley. Sir Philip Sidney to whom she was deeply attached through life, was her eldest brother. Sir Philip Sidney spent the summer of 1580 with her at Wilton, or at Ivychurch, a favourite retreat of hers in the neighbourhood. Here at her request he began the *Countess of Pembroke's Arcadia*, which was intended for her pleasure alone, not for publication. The two also worked at a metrical edition of the Psalms. When the great sorrow of her brother's death came upon her she made herself his literary executor, correcting the unauthorized editions of the *Arcadia* and of his poems, which appeared in 1590 and 1591. She also took under her patronage the poets who had looked to her brother for protection. Spenser dedicated his *Ruines of Time* to her, and refers to her as Urania in *Colin Clout's come home againe*; in Spenser's *Astrophel* she is "Clorinda." In 1599 Queen Elizabeth was her guest at Wilton, and the countess composed for the occasion a pastoral dialogue in praise of Astraea. After her husband's death she lived chiefly in London at Crosby Hall, where she died.

The Countess's other works include: *A Discourse of Life and Death*, translated from the French of Plessis du Mornay (1593), and *Antoine* (1592), a version of a tragedy of Robert Garnier.

William Herbert, 3rd earl of Pembroke (1580–1630), son of the 2nd earl and his famous countess, was a conspicuous figure in the society of his time and at the court of James I. Several times he found himself opposed to the schemes of the duke of Buckingham, and he was keenly interested in the colonization of America. He was lord chamberlain of the royal household from 1615 to 1625 and lord steward from 1626 to 1630. He was chancellor of the university of Oxford in 1624 when Thomas Tesdale and Richard Wightwick refounded Broadgates Hall and named it Pembroke College in his honour. By some Shakespearian commentators Pembroke has been identified with the "Mr W. H." referred to as "the onlie begetter" of Shakespeare's sonnets in the dedication by Thomas Thorpe, the owner of the published manuscript, while his mistress, Mary Fitton (*q.v.*), has been identified with the "dark lady" of the sonnets. In both cases the identification rests on very questionable evidence (see SHAKESPEARE, WILLIAM). He and his brother Philip are the "incomparable pair of brethren" to whom the first folio of Shakespeare is inscribed. The earl left no sons when he died in London on the 10th of April 1630. Clarendon gives a very eulogistic account of Pembroke, who appears, however, to have been a man of weak character and dissolute life. Gardiner describes him as the Hamlet of the English court. He had literary tastes and wrote poems; one of his closest friends was the poet Donne, and he was generous to Ben Jonson, Massinger and others.

His brother, PHILIP HERBERT, the 4th earl (1584–1650), was for some years the chief favourite of James I., owing this position to his comely person and his passion for hunting and for field sports generally. In 1605 the king created him earl of Montgomery and Baron Herbert of Shurland, and since 1630, when he succeeded to the earldom of Pembroke, the head of the Herbert family has carried the double title of earl of Pembroke and Montgomery. Although Philip's quarrelsome disposition often led him into trouble he did not forfeit the esteem of James I., who heaped lands and offices upon him, and he was also trusted by Charles I., who made him lord chamberlain in 1626 and frequently visited him at Wilton. He worked to bring about peace between the king and the Scots in 1639 and 1640, but when in the latter year the quarrel between Charles and the English parliament was renewed, he deserted the king who soon deprived him of his office of chamberlain. Trusted by the popular party, Pembroke was made governor of the Isle of Wight, and he was one of the representatives of the parliament on several occasions, notably during the negotiations at Uxbridge in 1645 and at Newport in 1648, and when the Scots surrendered Charles in 1647. From 1641 to 1643, and again from 1647 to 1650, he was chancellor of the university of Oxford; in 1648 he removed some of the heads of houses from their positions because they would not take the solemn league and covenant, and his foul language led to the remark that he was more fitted "by his eloquence in swearing to preside over Bedlam than a learned academy." In 1649, although a peer, he was elected and took his seat in the House of Commons as member for Berkshire, this "ascent downwards" calling forth many satirical writings from the royalist wits. The earl was a great collector of pictures and had some taste for architecture. His eldest surviving son, Philip (1621–1669), became 5th earl of Pembroke, and 2nd earl of Montgomery; he was twice married, and was succeeded in turn by three of his sons, of whom Thomas, the 8th earl (c. 1656–1733), was a person of note during the reigns of William III. and Anne. From 1690 to 1692 he was first lord of the admiralty; then he served as lord privy seal until 1699, being in 1697 the first plenipotentiary of Great Britain at the congress of Ryswick. On two occasions he was lord high admiral for a short period; he was also lord president of the council and lord-lieutenant of Ireland, while he acted as one of the lords justices seven times; and he was president of the Royal Society in 1689–1690. His son Henry, the 9th earl (c. 1689–1750), was a soldier, but was better known as the "architect earl." He was largely responsible for the erection of Westminster Bridge. The title descended directly to Henry, 10th earl (1734–1794), a soldier, who wrote the *Method of Breaking Horses* (1762); George Augustus, 11th earl (1759–1827), an ambassador extraordinary to Vienna in 1807; and Robert Henry, 12th earl (1791–1862), who died without issue. George Robert Charles, the 13th earl (1850–1895), was a grandson of the 11th earl and a son of Baron Herbert of Lea (*q.v.*), whose second son Sidney (b. 1853) inherited all the family titles at his brother's death.

See G. T. Clark, *The Earls, Earldom and Castle of Pembroke* (Tenby, 1880); J. R. Planché, "The Earls of Strigul" in vol. x. of the *Proceedings of the British Archaeological Association* (1855); and G. E. C(okayne), *Complete Peerage*, vol. vi. (London, 1895).

PEMBROKE, a town of Ontario, Canada, capital of Renfrew county, 74 m. W.N.W., of Ottawa by rail on the south shore of Allumette Lake, an expansion of the Ottawa river, and on the Canadian Pacific and Canada Atlantic railways. Pop. (1901), 5156. It is the seat of a Roman Catholic bishopric, an important centre in the lumber trade, and contains saw, grist and woollen mills, axe factory, &c. The Muskrat river affords excellent water-power.

PEMBROKE (*Penfro*), an ancient municipal borough, a contributory parliamentary borough and county-town of Pembrokeshire, Wales, situated on a narrow peninsula at the head of the Pennar tidal inlet or "pill" of Milford Haven. Pop. (1901), 4487; together with Pembroke Dock 15,853. Pembroke is a station on the South Wales system of the Great Western railway. The old-fashioned town, consisting chiefly of one long broad street, retains portions of its ancient walls. A large mill-dam is a conspicuous feature on the north of the town. St Mary's church in the centre of the town possesses a massive tower of the 12th century. Near the ruined West Gate is the entrance to Pembroke Castle, a splendid specimen of medieval fortified architecture. The circular vaulted keep erected by Earl William Marshal (c. 1200), remains almost intact. Close to the keep stands the ruined chamber wherein, according to local tradition, Henry VII. was born in 1457. Beneath the fine banqueting hall, a flight of steps descends into "the Wogan," a vast subterranean chamber giving access to the harbour. Facing the castle, on the western side of the pill, stand the considerable remains of Monkton Priory, a Benediction house founded by Earl William Marshal as a cell to the abbey of Séez or Sayes in Normandy, but under Henry VI. transferred to the abbey of St Albans. The priory church, now the parish church of the suburb of Monkton, contains monuments of the families of Meyrick of Bush and Owen of Orielton. St Daniel's chapel forms a prominent landmark on the ridge south of the town.

PEMBROKE DOCK (formerly known as Pater, or Paterchurch), a naval dockyard and garrison town, is situated close to Hobb's Point, at the eastern extremity of Milford Haven. It forms the Pater Ward of Pembroke, from which it is distant 2 m. to the north-west. The place owes its origin to the decision of the government in 1814 to form a naval dépôt on Milford Haven. The dockyard, enclosed by high walls and covering 80 acres, is protected by a powerful fort—the construction and repairing of ironclads are extensively carried on here. There is a submarine dépôt at Pennar Gut, and also accommodation for artillery and infantry. Ferry boats ply frequently between Pembroke Dock and Neyland on the opposite shore of the Haven.

Pembroke is probably an Anglo-Norman form of the Cymric *Penfro*, the territory lying between Milford Haven and the Bristol Channel, now known as the Hundred of Castlemartin. During the invasion of South Wales under William Rufus, Arnulf de Montgomeri, fifth son of Roger earl of Shrewsbury, seems to have erected a fortress of stone (c. 1090) on the site of the castle. The first castellan of this new stronghold was Giraldus de Windsor, husband of the Princess Nest of South Wales and grandfather of Giraldus Cambrensis. Throughout the 12th and 13th centuries the castle was strengthened and enlarged under successive earls palatine of Pembroke, who made this fortress their chief seat. As the capital of the palatinate and as the nearest port for Ireland, Pembroke was in Plantagenet times one of the most important fortified cities in the kingdom. The town, which had grown up under the shadow of the almost impregnable castle, was first incorporated by Henry I. in 1109 and again by Earl Richard de Clare in 1154 (who also encircled the town with walls), and these privileges were confirmed and extended under succeeding earls palatine and kings of England. In 1835 the corporation was remodelled under the Municipal Corporations Act. Henry II. occasionally visited Pembroke, notably in 1172, and until the close of the Wars of the Roses, both town and castle played a prominent part in the history of Britain. With the passing of the Act of Union of Wales and England in 1536 however, the *jura regalia* of the county palatine of Pembroke were abolished, and the prosperity of the town began to decline. Although acknowledged as the county town of Pembrokeshire, Pembroke was superseded by Haverfordwest as the judicial and administrative centre of the shire on account of the more convenient position of the latter place. By the act of 1536 Pembroke was declared the leading borough in the

Pembroke parliamentary district, yet the town continued to dwindle until the settlement of the government dockyard and works on Milford Haven. At the outbreak of the Civil Wars the town and castle were garrisoned for parliament by the mayor, John Poyer, a leading Presbyterian, who was later appointed governor, with Rowland Laugharne of St Brides for his lieutenant. But at the time of the Presbyterian defection in 1647, Poyer and his lieutenant-governors, Laugharne and Powell, declared for Charles and held the castle in the king's name. In June 1648 Cromwell himself proceeded to invest Pembroke Castle, which resisted with great obstinacy. But after the water-supply of the garrison had been cut off, the besieged were forced to capitulate, on the 11th of July 1648, on the condition of surrendering up the three chief defenders of the castle. Poyer, Laugharne and Powell were accordingly brought to London, but finally only Poyer was executed. The magnificent ruin of Pembroke Castle is the nominal property of the Crown, but has been held on lease since the reign of James II. by the family of Pryse of Gogerddan in Cardiganshire.

PEMBROKESHIRE (*Sîr Benfro, Dyfed*), the most westerly county of South Wales, bounded N.E. by Cardigan, E. by Carmarthen, S. by the Bristol Channel and W. and N.W. by St Bride's Bay and Cardigan Bay of St George's Channel. Area 615 sq. m. The whole coast is extremely indented, extending over 140 m. in length. The principal inlets are Milford Haven, St Bride's Bay, Freshwater Bay, Fishguard Bay and Newport Bay. The chief promontories are Cemmaes, Dinas, Strumble, St David's, St Ann's and St Gowan's Heads. Five islands of moderate size lie off the coast, viz. Ramsey, Grassholm, Skomer and Skokholm in St Bride's Bay, and Caldy Island (Ynys Pyr) opposite Tenby; the last named having a population of about 70 persons. Rare birds, such as peregrine falcons, ravens and choughs are not uncommon, while guillemots, puffins and other sea-fowl breed in immense numbers on the Stack Rocks, on Ramsey Island and at various points of the coast. Seals are plentiful in the caves of St Bride's Bay and Cardigan Bay. The county is undulating, and large tracts are bare, but the valleys of the Cleddau, the Nevern, the Teifi and the Gwaun are well-wooded. The Preselley Mountains stretch from Fishguard to the border of Carmarthen, the principal heights being Preselley Top (1760 ft.) and Carn Englyn (1022 ft.). Treffgarn Rock in the Plumstone Mountains is popularly supposed to mark the northern limit of the ancient settlement of the Flemings. The principal rivers are the Teifi, forming the northern boundary of the county from Abercych to Cardigan Bay; the Nevern and the Gwaun, both falling into Cardigan Bay; and the Eastern and Western Cleddau, forming the Daugleddau after their junction below Haverfordwest. All these streams contain trout and salmon. There are no lakes, but the broad tidal estuaries of the Daugleddau and other rivers, which fall into Milford Haven and are locally called "pills," constitute a peculiar feature of south Pembrokeshire scenery.

Geology.—Pembrokeshire is divisible into a northern portion occupied mainly by Ordovician and Silurian strata, which have been subjected to pressures from the north, the strike of the beds being south-west–north-east; and a southern portion, the westerly continuation of the South Wales coalfield, with associated Lower Carboniferous, Old Red Sandstone and narrow belts of Silurian rocks, the whole having been considerably folded and faulted by pressure from the south, which has produced a general north-west–south-east strike. In the neighbourhood of St Davids are the Pre-Cambrian granitic rocks (Dimetian) and volcanic rocks (Pebedian). These are surrounded by belts of unconformable Cambrian strata (Lingula Flags, Tremadoc beds), followed by Ordovician (Arenig, Llandeilo and Bala beds) with associated igneous rocks. These comprise gabbros and diabases of Strumble Head, Fishguard, Llanwnda, Prescelly; diorites north-west of St Davids, bostonites and porphyrites about Abercastle and the basaltic laccolite of Pen Caer, besides various contemporaneous acid lavas and tuffs. The Ordovician and Silurian rocks extend southward to the neighbourhood of Narberth and Haverfordwest, where Arenig, Llandeilo and Bala beds (Slade and Red Hill beds; Sholeshook and Robeston Walthen Limestone) and Llandovery beds are recorded. The Coal Measures, highly inclined and anthracitic, stretch across from Carmarthen Bay to the shore of St Bride's Bay; they are bordered on the north and south-east by the Millstone Grits, Carboniferous Limestone series and Old Red Sandstone. On account of the folding the limestone appears again farther south at Pembroke, Caldy Island and St Gowan's Head; most of the remaining ground about Milford Haven being occupied by Old Red Sandstone with infolded strips of Silurian. A fairly large tract of blown-sand occurs in Freshwater Bay south of Milford Haven. Silver-bearing lead has been mined at Llanfyrnach.

Climate and Industries.—The climate is everywhere mild, and in the sheltered valleys near the coast sub-tropical vegetation flourishes in the open air. In the south the rainfall is small, and the districts round Pembroke suffer from occasional droughts. The chief industry is agriculture, wherein stock-raising is preferred to the growing of cereals. Of cattle the long-horned, jet-black Castlemartin breed is everywhere conspicuous. South Pembroke has long been celebrated for its horses, which are bred in great numbers by the farmers. The deep-sea fisheries of Tenby and Milford are valuable; and fresh fish of good quality is exported by rail to the large towns. Oysters are found at Langwm and near Tenby; lobsters and crabs abound on the western coast. The South Wales coalfield extends into south Pembroke, and coal is worked at Saundersfoot, Begelly, Templeton, Kilgetty and other places. There are slate quarries at Glogue, Cilgerran and elsewhere; copper has been worked near St Davids, and lead at Llanfyrnach.

Communications.—The South Wales branch of the Great Western railway enters Pembrokeshire from the east near Clynderwen Junction, whence the main line leads to Fishguard Harbour with its important Irish traffic. Other lines proceed to Neyland and Milford Haven by way of Haverfordwest, and a branch line from Clynderwen to Goodwick joins the main line at Letterston. The Whitland-Cardigan branch traverses the north-east by way of Crymmych and Cilgerran. Another line running south-west from Whitland proceeds by way of Narberth and Tenby to Pembroke Dock.

Population and Administration.—The area of Pembrokeshire is 395,151 acres with a population in 1891 of 89,138 and 1901 of 88,732, showing a slight decrease. The municipal boroughs are Pembroke (pop. 15,853); Haverfordwest (6007); and Tenby (4400). The hamlet of Bridgend and a part of St Dogmell's parish are included within the municipal limits of Cardigan. Newport (Trêfdraeth) (1222), the chief town of the barony of Kemes, or Cemmaes, still possesses a mayor and corporation under a charter granted in 1215 by Sir Nicholas Marteine, lord of Kemes, whose hereditary representative still nominates the mayor and aldermen, but its surviving municipal privileges are practically honorary. Milford Haven (5102), Narberth (1070) and Fishguard (2002) are urban districts. Other towns are St Davids (1710), St Dogmells (Llandudoch) (1286); and Cilgerran (1038). Pembrokeshire lies in the South Wales circuit, and assizes are held at Haverfordwest. Two members are returned to parliament; one for the county, and one for the united boroughs of Pembroke, Haverfordwest, Tenby, Fishguard, Narberth, Neyland, Milford and Wiston (Castell Gwys). Ecclesiastically, the county contains 153 parishes and lies wholly in the diocese of St Davids.

History.—Pembrokeshire, anciently known to the Welsh as Dyfed, was originally comprised in the territory of the Dimetae, conquered by the Romans. During the 6th century St David, or Dewi Sant, moved the chief seat of South Welsh monastic and ecclesiastical life from Caerleon-on-Usk to his native place Menevia, which, known in consequence as Tyddewi, or St Davids, continued a centre of religious and educational activity until the Reformation, a period of 1000 years. On the death of Rhodri Mawr in 877, Dyfed fell nominally under the sway of the princes of Deheubarth, or South Wales; but their hold was never very secure, nor were they able to protect the coast towns from the Scandinavian pirates. In 1081 William the Conqueror penetrated west as far as St Davids, where he is said to have visited St David's shrine as a devout pilgrim. In 1092 Arnulf de Montgomeri, son of Roger, earl of Shrewsbury, did homage to the king for the Welsh lands of Dyfed. With the building of Pembroke Castle, of which Gerald de Windsor was appointed castellan, the Normans began to spread over southern Dyfed; whilst Martin de Tours, landing in Fishguard

Bay and building the castle of Newport at Trêfdraeth, won for himself the extensive lordship of Kemes (Cemmaes) between the river Teifi and the Preselley Mountains. The systematic planting of Flemish settlers in the hundred of Rhôs, or Roose, in or about the years 1106, 1108 and 1111 with the approval of Henry I., and again in 1156 under Henry II., marks an all-important episode in the history of Pembrokeshire. The castles of Haverfordwest and Tenby were now erected to protect these aliens, and despite the fierce attacks of the Welsh princes their domain grew to be known as "Little England beyond Wales," a district whereof the language, customs and people still remain characteristic. In 1138 Gilbert de Clare, having previously obtained Henry I.'s permission to enjoy all lands he might win for himself in Wales, was created earl of Pembroke in Stephen's reign with the full powers of an earl palatine in Dyfed. The devolution of this earldom is dealt with in a separate article.

In 1536, by the Act of Union (27 Henry VIII.), the king abolished all special jurisdiction in Pembrokeshire, which he placed on an equal footing with the remaining shires of Wales, while its borders were enlarged by the addition of Kemes, Dewisland and other outlying lordships. By the act of 1536 the county returned to parliament one knight for the shire and two burgesses; one for the Pembroke boroughs and one for the town and county of Haverfordwest, both of which since 1885 have been merged in the Pembroke-and-Haverfordwest parliamentary division. The Reformation deprived the county of the presence of the bishops of St Davids, who on the partial dismantling of the old episcopal palace at St Davids removed their chief seat of residence to Abergwiliy, near Carmarthen. Meanwhile the manor of Lamphey was granted to the family of Devereux, earls of Essex, and other episcopal estates were alienated to court favourites, notably to Sir John Perrot of Haroldstone (1517–1592), afterwards lord-deputy of Ireland. During the Civil Wars the forces of the parliament, commanded by Colonel Laugharne and Captain Swanley, reduced the royal forts at Tenby, Milford and Haverfordwest. In February 1797 some French frigates appeared off Fishguard Bay and landed about 1400 Frenchmen at Llanwnda. The invaders soon capitulated to the local militia, practically without striking a blow. The 19th century saw the establishment of the naval dockyard at Paterchurch and the building of docks and quays at Neyland and Milford. In 1906 extensive works for cross-traffic with Ireland were opened at Fishguard Harbour.

Many of the old Pembrokeshire families, whose names appear prominent in the county annals, are extinct in the county itself. Amongst these may be mentioned Perrot of Haroldstone, Devereux of Lamphey, Barlow of Slebech, Barrett of Gilliswick, Wogan of Wiston, Elliot of Amroth and Owen of Henllys. Amongst ancient families still existing are Philipps of Lydstep and Amroth (descendants of the old Welsh lords of Cilsant); Philipps of Picton Castle (a branch of the same house in the female line); Lort of Stackpole Court, now represented by Earl Cawdor; Scourfield of Moate; Bowen of Llwyngwair; Edwardes, Lords Kensington, of St Brides; Meyrick of Bush; Lort-Philipps of Lawrenny; Colby of Ffynone; Stokes of Cuffern; Lloyd of Newport Castle (in which family is vested the hereditary lordship of the barony of Kemes); Saunders-Davies of Pentre; and Gower of Castle Malgwyn.

Antiquities.—There are few remaining traces in the county of the Roman occupation of Dimetia, but in British encampments, tumuli, cromlechs and monumental stones Pembrokeshire is singularly rich. Of the cromlechs the best preserved are those at Longhouse, near Mathry; at Pentre Evan in the Nevern Valley; and at Llech-y-dribedd, near Moylgrove; whilst of the many stone circles and alignments, that known as Pare-y-Marw, or "The Field of the Dead," near Fishguard, is the least injured. Stones inscribed in Ogam characters are not uncommon, and good examples exist at Caldy Island, Bridell, St Dogmells and Cilgerran. There are good specimens of Celtic floriated churchyard crosses at Carew, Penally and Nevern. Interesting examples of medieval domestic architecture are the ruins of the former episcopal mansions at Llawhaden, St Davids and Lamphey, the two latter of which were erected by Bishop Gower between the years 1328–1347. With the exception of the cathedral at St Davids and the principal churches of Haverfordwest and Tenby, the parish churches of Pembrokeshire are for the most part small, but many are ancient and possess fine monuments or other objects of interest, especially in "Little England beyond Wales." Amongst the more noteworthy are the churches at Stackpole Elidur, Carew, Burton, Gumfreston, Nevern, St Petrox and Rudbaxton, the last-named containing a fine Jacobean monument of the Hayward family. Pembrokeshire has long been famous for its castles, of which the finest examples are to be observed at Pembroke; Manorbier, built in the 12th century and interesting as the birthplace and home of Giraldus Cambrensis; Carew, exhibiting many interesting features both of Norman and Tudor architecture; and Picton, owned and inhabited by a branch of the Philipps family. Other castles are the keep of Haverfordwest and the ruined fortresses at Narberth, Tenby, Newport, Wiston, Benton, Upton and Cilgerran. There are some remains of monastic houses at Tenby and Pembroke, but the most important religious communities were the priory of the Augustinian friars at Haverfordwest and the abbey of the Benedictines at St Dogmells. Of this latter house, which was founded by Martin de Tours, first lord of Kemes, at the close of the 11th century, and who owned the priories of Pill and Caldy, considerable ruins exist near the left bank of the Teifi about 1 m. below Cardigan. Of the ancient preceptory of the Knights of St John at Slebech scarcely a trace remains, but of the college of St Mary at St Davids founded by Bishop Houghton in 1377, the shell of the chapel survives in fair preservation. Pembrokeshire contains an unusually large number of county seats, particularly in the south, which includes Stackpole Court, the residence of Earl Cawdor, a fine mansion erected in the 18th century; Picton Castle; Slebech, once the seat of the Barlows; Orielton, formerly belonging to the Owens; and Ffynone, the residence of the Colby family.

Customs, &c.—The division of Pembrokeshire ever since the 12th century into well-defined Englishry and Welshry has produced two distinct sets of languages and customs within the county. Roughly speaking, the English division, the *Anglia Transwalliana* of Camden, occupies the south-eastern half and comprises the hundreds of Roose, Castlemartin, Narberth and Dungleddy. In the Welshry, which includes the hundreds of Dewisland and Cilgerran together with the old barony of Kemes, the language, customs, manners and folk-lore of the inhabitants are almost identical with those of Cardigan and Carmarthen. The old Celtic game of *Knappan*, a pastime partaking of the nature both of football and hockey, in which whole parishes and even hundreds were wont to take an active part, was prevalent in the barony of Kemes so late as the 16th century, as George Owen of Henllys, the historian and antiquary, records; and the playing of *knappan* lingered on after Owen's day. Amongst the settlers of the Englishry, who are of mingled Anglo-Saxon, Flemish, Welsh and perhaps Scandinavian descent, many interesting superstitions and customs survive. The English spoken by these dwellers in "Little England beyond Wales" contains many curious idioms and words and the pronunciation of some of the vowels is peculiar. Certain picturesque customs, many of them dating from pre-Reformation times, are still observed, notably in the neighbourhood of Tenby. Such are the sprinkling of persons with dewy evergreens on New Year's morning; the procession of the Cutty Wren on St Stephen's day, and the constructing of little huts at Lammastide by the farm boys and girls. As early as the opening years of the 19th century, cripples and ophthalmic patients were in the habit of visiting the ancient hermitage at St Gowan's Head to bathe in its sacred well; and Richard Fenton, the county historian alludes (*c.* 1808) to the many crutches left at St Gowan's chapel by grateful devotees. Belief in ghosts, fairies, witches, &c., is still prevalent in the more remote places, and the dress of the fishwives of Langwm near Haverfordwest is highly picturesque with its short skirt, scarlet shawl and buckled shoes.

AUTHORITIES.—Richard Fenton, *A Historical Tour through Pembrokeshire* (London, 1810); Edward Laws, *History of Little England beyond Wales* (London, 1888); Basil Jones and E. A. Freeman, *History and Antiquities of St David's* (London, 1856), &c.

PEMMICAN, a North American Indian (Cree) word for a meat prepared in such a way as to contain the greatest amount of nourishment in the most compact form. As made by the Indians it was composed of the lean parts of the meat, dried in the sun, and pounded or shredded and mixed into a paste with melted fat. It is flavoured with acid berries. If kept dry it will keep for an indefinite time, and is thus particularly serviceable in arctic or other explorations.

PEMPHIGUS (Gr. πέμφιξ, a bubble), a skin disease, in which large blebs appear, on a red base, containing a clear or yellowish fluid; the blebs occasion much irritation, and when they burst leave raw ulcerated surfaces. The disease is principally known in unhealthy or neglected children. A variety of the malady, *pemphigus foliaceous*, affects the whole body, and gradually proves fatal. Pemphigus of an acute septicaemic type occurs in butchers or those who handle hides, and a diplococcus has been isolated by William Bullock. The treatment is mainly constitutional, by means of good nourishment, warm baths, local sedatives and tonics. In chronic pemphigus, streptococci have been found in the blebs, and the opsonic index was low to streptococci. Improvement has been known to take place on the injection of a vaccine of streptococci.

PEN (Lat. *penna*, a feather, pen), an instrument for writing or for forming lines with an ink or other coloured fluid. The English word, as well as its equivalents in French (*plume*) and in German (*Feder*), originally means a wing-feather, but in ancient times the implements used for producing written characters were not quills. The earliest writing implement was probably the stilus (Gr. γραφίς), a pointed bodkin of metal, bone or ivory, used for producing incised or engraved letters on boxwood tablets covered with wax. The calamus (Gr. κάλαμος) or arundo, the hollow tubular stalk of grasses growing in marshy lands, was the true ancient representative of the modern pen; hollow joints of bamboo were similarly employed.

An early specific allusion to the quill pen occurs in the writings of St Isidore of Seville (early part of the 7th century),[1] but there is no reason to assume that it was not in use at a still more remote date. The quills still largely employed among Western communities as writing instruments are obtained principally from the wings of the goose (see FEATHER). In 1809 Joseph Bramah devised and patented a machine for cutting up the quill into separate nibs by dividing the barrel into three or even four parts, and cutting these transversely into "two, three, four and some into five lengths." Bramah's invention first familiarized the public with the appearance and use of the nib slipped into a holder. In 1818 Charles Watt obtained a patent for gilding and preparing quills and pens, which may be regarded as the precursor of the gold pen. But a more distinct advance was effected in 1822, when J. I. Hawkins and S. Mordan patented the application of horn and tortoise-shell to the formation of pen-nibs, the points of which were rendered durable by small pieces of diamond, ruby or other very hard substance, or by lapping a small piece of thin sheet gold over the end of the tortoise-shell.

Steel Pens.

Metallic pens, though not unknown in classical times—a bronze pen found at Pompeii is in the Naples Museum—were little used until the 19th century and did not become common till near the middle of that century. It is recorded that a Birmingham split-ring manufacturer, Samuel Harrison, made a steel pen for Dr Joseph Priestley in 1780. Steel pens made and sold in London by a certain Wise in 1803 were in the form of a tube or barrel, the edges of which met to form the slit, while the sides were cut away as in the case of an ordinary quill. Their price was about five shillings each, and as they were hard, stiff and unsatisfactory instruments they were not in great demand. A metallic pen patented by Bryan Donkin in 1808 was made of two separate parts, flat or nearly so, with the flat sides placed opposite each other to form the slit, or alternatively of one piece, flat and not cylindrical as in the usual form, bent to the proper angle for insertion in the tube which constituted the holder. To John Mitchell probably belongs the credit of introducing machine-made pens, about 1822, and James Perry is believed to have been the first maker of steel slip pens. In 1828 Josiah Mason, who had been associated with Samuel Harrison, in the manufacture of split rings, saw Perry's pens on sale in Birmingham, and after examining them saw his way both to improve and to cheapen the process of making them. He therefore put himself in communication with Perry, and the result was that he began to make barrel pens for him in 1828 and slip pens in 1829. Perry, who did much to popularize the steel pen and bring it into general use, in his patent of 1830 sought to obtain greater flexibility by forming a central hole between the points and the shoulders and by cutting one or more lateral slits on each side of the central slit; and Joseph Gillot, in 1831 described an improvement which consisted in forming elongated points on the nibs of the pens.

The metal used consists of rolled sheets of cast steel of the finest quality made from Swedish charcoal iron. These sheets, after being cut into strips of suitable width, annealed in a muffle-furnace and pickled in a bath of dilute sulphuric acid to free the surface from oxidized scale, are rolled between steel rollers till they are reduced to ribbons of an even thickness, about $\frac{1}{160}$ in. From these ribbons the pen blanks are next punched out, and then, after being embossed with the name of the maker or other marks, are pierced with the central perforation and the side or shoulder slits by which flexibility is obtained. After another annealing, the blanks, which up to this point are flat, are "raised" or rounded between dies into the familiar semi-cylindrical shape. The next process is to harden and temper them by heating them in iron boxes in a muffle-furnace, plunging them in oil, and then heating them over a fire in a rotating cylindrical vessel till their surfaces attain the dull blue tint characteristic of spring-steel elasticity. Subsequently they are "scoured" in a bath of dilute acid, and polished in a revolving cylinder. The grinding of the points with emery follows, and then the central slit is cut by the aid of two very fine-edged cutters. Finally the pens are again polished, are coloured by being heated over a fire in a revolving cylinder, and in some cases are coated with a varnish of shellac dissolved in alcohol. Birmingham was the first home of the steel-pen industry, and continues its principal centre. The manufacture on a large scale was begun in the United States about 1860 at Camden, N. J., where the Esterbrook Steel Pen Manufacturing Company was incorporated in 1866.

Gold Pens.

Metals other than steel have frequently been suggested by inventors, those most commonly proposed being gold, silver, zinc, German silver, aluminium and aluminium bronze. Dr W. H. Wollaston, it is recorded, had a gold pen composed of two thin strips of gold tipped with rhodium, apparently made on the principle patented by Donkin in 1808, and Lord Byron used one in 1810. Gold being extremely resistant to corrosion, pens made of it are very durable, but the metal is too soft for the points, which wear quickly unless protected by some harder material. For this purpose iridium is widely employed, by fusing the gold round it with a blowpipe.

Reservoir Pens.

Various devices have been adopted in order to increase the time for which a pen can be used without a fresh supply of ink. These fall into two main classes. In one, the form of the nib itself is modified, or some attachment is added, to enlarge the ink capacity; in the other, which is by far the more important, the holder of the pen is utilized as a cistern or reservoir from which ink is supplied to the nib. Pens of the second class, which have the further advantage of being portable, are heard of under the name of "fountain inkhorns" or "fountain pens" so far back as the beginning of the 18th century, but it was not till a hundred years later that inventors applied themselves seriously to their construction. Joseph Bramah patented several plans; one was to employ a tube of silver or other metal so thin that it could be readily squeezed out of shape, the ink within it being thus forced out to the nib, and another was to fit the tube with a piston that could slide down the interior and thus eject ink. In modern fountain pens a feed bar conveys, by capillary action, a fresh supply of ink to replace that which has been left on the paper in the act of writing, means being also provided by which air can pass into the reservoir and fill the space left empty by the outflowing ink. In another form of reservoir pen, which is usually distinguished by the name stylograph, there is no nib, but the ink flows out through a minute hole at the end of the holder, which terminates in a conical point. An iridium needle, held in place by a fine spring, projects slightly through the hole and normally keeps the aperture closed; but when the pen is pressed on the paper, the needle is pushed back and allows a thin stream of ink to flow out.

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[1] "Instrumenta scribae calamus et penna; ex his enim verba paginis infiguntur; sed calamus arboris est, penna avis, cujus acumen dividitur in duo."

See J. P. Maginnis, "Reservoir, Stylographic and Fountain Pens," *Cantor Lectures*, Society of Arts (1905).

PENALTY (Lat. *poena*, punishment), in its original meaning, a punishment inflicted for some violation of the law or rule of conduct. Although still freely used in its original sense in such phrases, for example, as "the death penalty," "the penalty of rashness," &c., the more usual meaning attached to the word is that of a pecuniary mulct. Penalty is used specifically for a sum of money recovered by virtue of a penal statute, or recoverable in a court of summary jurisdiction for infringement of a statute. A sum of money agreed upon to be paid in case of non-performance of a condition in a bond or in breach of a contract or any stipulation of it is also termed a penalty (see DAMAGES).

PENANCE (Old Fr. *penance*, fr. Lat. *poenitentia*, penitence), strictly, repentance of sins. Thus in the Douai version of the New Testament the Greek word *μετάνοια* is rendered "penance," where the Authorized Version has "repentance." The two words, similar in their derivation and original sense, have however come to be symbolical of conflicting views of the essence of repentance, arising out of the controversy as to the respective merits of "faith" and "good works." The Reformers, upholding the doctrine of justification by faith, held that repentance consisted in a change of the whole moral attitude of the mind and soul (*ἐπιστρέφεσθαι*, Matt. xiii. 15; Luke xxii. 32), and that the Divine forgiveness followed true repentance and confession to God without any reparation of "works." This is the view generally held by Protestants. In the Roman Catholic Church the sacrament of penance consists of three parts: *contritio*, *confessio*, *satisfactio*. *Contritio* is in fact repentance as Protestant theologians understand it, *i.e.* sorrow for sin arising from love of God, and long before the Reformation the schoolmen debated the question whether complete "contrition" was or was not in itself sufficient to obtain the Divine pardon. The Council of Trent, however, decided that "reconciliation" could not follow such contrition without the other parts of the sacrament, which form part of it (*sine sacramenti voto, quod in illa includatur*). Contrition is also distinguished from "attrition" (*attritio*), *i.e.* repentance due to fear of punishment. It was questioned whether a state of mind thus produced would suffice for obtaining the benefits of the sacrament; this point was also set at rest by the Council of Trent, which decided that attrition, though not in itself capable of obtaining the justification of the sinner, is also inspired by God and thus disposes the soul to benefit by the grace of the sacrament.

The word "penance," applied to the whole sacrament, is also used of the works of satisfaction imposed by the priest on the penitent, *i.e.* the temporal punishment (*poena*). This varies with the character and heinousness of the offences committed. In the middle ages "doing penance" was often a process as terrible and humiliating to the penitent as it was possibly edifying to the Church. Public penances have, however, long been abolished in all branches of the Christian Church. (See CONFESSION.)

PENANG (*Pulau Pinang, i.e.* Areca-nut Island), the town and island which, after Singapore, form the most important portion of the crown colony of the Straits Settlements. The island is situated in 5° 24′ N. and 100° 21′ E., and distant about 2½ m. from the west coast of the Malay Peninsula. The island is about 15½ m. long by 10½ m. wide at its broadest point. Its area is something over 107 sq. m. The town, which is built on a promontory at a point nearest to the mainland, is largely occupied by Chinese and Tamils, though the Malays are also well represented. Behind the town, Penang Hill rises to a height of some 2700 ft., and upon it are built several government and private bungalows. The town possesses a fine European club, a racecourse, and good golf links. Coco-nuts are grown in considerable quantities along the seashore, and rice is cultivated at Bālek Pūlau and in the interior, but the jungle still spreads over wide areas. Penang has an excellent harbour, but has suffered from its proximity to Singapore. There are a Church of England and a Roman Catholic church in the town, and a training college under the Roman Catholic missionaries of the Société des Missions Étrangères at Pūlau Tīkus, a few miles outside the town.

Administration.—Since 1867 Penang has been under the administrative control of a resident councillor who is responsible to the governor of the Straits. He is aided in his duties by officers of the Straits Civil Service. Two unofficial members of the legislative council of the colony, which holds its sittings in Singapore, are nominated by the governor, with the sanction of the secretary of state for the colonies, to represent Penang. Their term of office is for five years. The official name of the island is Prince of Wales Island and that of the town is Georgetown; neither of these names, however, is in general use. Among the Malays Penang is usually spoken of as *Tanjong* or "The Cape," on account of the promontory upon which the town is situated. The town is administered by a municipal council composed of *ex officio*, nominated, and elected members.

Population.—The population of Penang at the time of the census of 1901 was 128,830, of whom 85,070 were males (69,210 over and 15,860 under 15 years of age), and 43,760 were females (28,725 over and 15,035 under 15 years of age). The population was composed of 71,462 Chinese, 34,286 Malays, 18,740 Tamils and other natives of India, 1649 Eurasians, 993 Europeans and Americans, and 1699 persons of other nationalities. As in other parts of the Straits Settlements the men are far more numerous than the women. The total population of the settlement of Penang, which includes not only the island but Province Wellesley and the Dindings, was 248,207 in 1901.

Shipping.—The number of ships which entered and left the port of Penang during 1906 was 2324 with an aggregate tonnage of 2,868,459. Of these 1802 were British with an aggregate tonnage of 1,966,286. These figures reveal a considerable falling-off during the past decade, the number of vessels entering and leaving the port in 1898 being 5114 with an aggregate tonnage of 3,761,094. This is mainly due to the construction of the railway which runs from a point on the mainland opposite to Penang, through the Federated Malay States of Pērak, Selāngor and the Nēgri Sēmbīlan to Malacca, and has diverted to other ports and eventually to Singapore much of the coastal traffic which formerly visited Penang.

Finance and Trade.—The revenue of Penang, that is to say, not only of the island but of the entire settlement, amounted in 1906 to $6,031,917, of which $2,014,033 was derived from the revenue farms for the collection of import duties on opium, wine and spirits; $160,047 from postal revenue; $119,585 from land revenue; $129,151 from stamps. The expenditure for 1906 amounted to $5,072,406, of which $836,097 was spent on administrative establishments, $301,252 on the upkeep of existing public works; $415,175 on the construction of works and buildings, and of new roads, streets, bridges, &c. The imports in 1906 were valued at $94,546,112; the exports at $90,709,225. Of the imports $57,880,889 worth came from the United Kingdom or from British possessions or protectorates; $23,937,737 worth came from foreign countries; and $3,906,241 from the Dindings, Malacca and Singapore. Of the exports, $23,122,947 went to the United Kingdom, or to British possessions or protectorates; $37,671,033 went to foreign countries; and $2,754,238 went to the Dindings, Malacca or Singapore.

History—Penang was founded on the 17th of July 1786, having been ceded to the East India Company by the Sultan of Kēdah in 1785 by an agreement with Captain Light, for an annuity of $10,000 for eight years. In 1791 the subsidy was changed to $6000, in perpetuity; for some years later this was raised to $10,000, and is still annually paid. This final addition was made when Province Wellesley was purchased by the East India Company for $2000 in 1798. At the time of the cession Penang was almost uninhabited. In 1796 it was made a penal settlement, and 700 convicts were transferred thither from the Andaman Islands. In 1805 Penang was made a separate presidency, ranking with Bombay and Madras; and when in 1826 Singapore and Malacca were incorporated with it, Penang continued to be the seat of government. In 1829 Penang was reduced from the rank of a presidency, and eight years later the town of Singapore was made the capital of the Settlements. In 1867 the Straits Settlements were created a Crown colony, in which Penang was included.

See *Straits Settlements Blue Book 1906* (Singapore, 1907); *The Straits Directory* (Singapore, 1907); Sir Frank Swettenham, *British Malaya* (London, 1906). (H. Cl.)

PENARTH, an urban district and seaport in the southern parliamentary division of Glamorganshire, Wales, 166 m. by rail from London, picturesquely situated on rising ground on the south side of the mouth of the Ely opposite Cardiff, from which it is 4 m. distant by rail and 2 m. by steamer. Pop. (1901), 14,228. The place derives its name from two Welsh words, "pen," a head, and "garth," an enclosure. Penarth was a small and unimportant village until a tidal harbour at the mouth of the Ely was opened in 1859, and a railway, 6 m. long, was made about the same time, connecting the harbour with the Taff Vale railway at Radyr. A dock, authorized in 1857, was opened in 1865, when all three undertakings, which had cost £775,000, were leased in perpetuity to the Taff Vale Railway Company. The monopoly which the Bute Docks at Cardiff had previously enjoyed in shipping coal from the valleys of the Taff and Rhondda was thus terminated. The town is frequented in summer as a bathing-place, and the Rhaetic beds at the head are of special interest to geologists. On this head there stood an old church, probably Norman, which served as a landmark for sailors. The remains of an old chantry have been converted into a barn. Besides two Established and one Roman Catholic church, the principal buildings of Penarth are its various Nonconformist chapels, intermediate and technical school (1894), custom house, dock offices, and Turner House with a private art gallery which is thrown open on certain days to the public. Three miles to the west is Dinas Powis Castle. In 1880–1883 gardens were laid out along the cliff, in 1894 a promenade and landing-pier with a length of 630 ft. were constructed, and in 1900 a marine subway open at all times for foot passengers was made under the river Ely. The dock, as first constructed, comprised 17½ acres, was extended in 1884 at a cost of £250,000, and now covers 23 acres with a basin of 3 acres. It is 2900 ft. in length, has a minimum depth of 26 ft., and is furnished with every modern appliance for the export of coal, of which from 20,000 to 30,000 tons can be stored in the sidings near by. The Penarth-Ely tidal harbour has a water area of 55 acres with a minimum depth of 20 ft., and a considerable import trade is carried on here mainly by coasting vessels; but as only one of its sides has wharves (about 3000 ft. along) scarcely more than 5% of the total shipping of the port is done here. It has commodious warehouses, also tanks to hold about 6000 tons of oil.

PENATES (from Lat. *penus*, eatables, food), Roman gods of the store-room and kitchen. The store-room over which they presided was, in old times, beside the *atrium*, the room which served as kitchen, parlour, and bedroom in one; but in later times the store-room, was in the back part of the house. It was sanctified by the presence of the Penates, and none but pure and chaste persons might enter it, just as with the Hindus the kitchen is sacred and inviolable. They had no individual names, but were always known under the general designation, Penates. Closely associated with the Penates were the Lares (*q.v.*) another species of domestic deity, who seem to have been the deified spirits of deceased ancestors. But while each family had two Penates it had but one Lar. In the household shrine the image of the Lar (dressed in a toga) was placed between the two images of the Penates, which were represented as dancing and elevating a drinking-horn in token of joy and plenty. The three images together were sometimes called Penates, sometimes Lares, and either name was used metaphorically for "home." The shrine stood originally in the *atrium*, but when the hearth and the kitchen were separated from the *atrium* and removed to the back of the house, and meals were taken in an upper storey, the position of the shrine was also shifted. In the houses at Pompeii it is sometimes in the kitchen, sometimes in the rooms. In the later empire it was placed behind the house-door, and a taper or lamp was kept burning before it. But the worship in the interior of the house was also kept up even into Christian times; it was forbidden by an ordinance of Theodosius (A.D. 392). The old Roman used, in company with his children and slaves, to offer a morning sacrifice and prayer to his household gods. Before meals the blessing of the gods was asked, and after the meal, but before dessert, there was a short silence, and a portion of food was placed on the hearth and burned. If the hearth and the images were not in the eating-room, either the images were brought and put on the table, or before the shrine was placed a table on which were set a salt-cellar, food and a burning lamp. Three days in the month, viz. the Calends, Nones and Ides (*i.e.* the first, the fifth or seventh, and the thirteenth or fifteenth), were set apart for special family worship, as were also the *Caristia* (Feb. 22) and the *Saturnalia* in December. On these days as well as on such occasions as birthdays, marriages, and safe returns from journeys, the images were crowned and offerings made to them of cakes, honey, wine, incense, and sometimes a pig. As each family had its own Penates, so the state, as a collection of families, had its public Penates. Intermediate between the worship of the public and private Penates were probably the rites (*sacra*) observed by each clan (*gens*) or collection of families supposed to be descended from a common ancestor. The other towns of Latium had their public Penates as well as Rome. The sanctuary of the whole Latin league was at Lavinium. To these Penates at Lavinium the Roman priests brought yearly offerings, and the Roman consuls, praetors and dictators sacrificed both when they entered on and when they laid down their office. To them, too, the generals sacrificed before departing for their province. Alba Longa, the real mother-city of Latium, had also its ancient Penates, and the Romans maintained the worship on the Alban mount long after the destruction of Alba Longa. The Penates had a temple of their own at Rome. It was on the Velia near the Forum, and has by some been identified with the round vestibule of the church of SS. Cosma e Damiano. In this and many other temples the Penates were represented by two images of youths seated holding spears. The Penates were also worshipped in the neighbouring temple at Vesta. To distinguish the two worships it has been supposed that the Penates in the former temple were those of Latium, while those in the temple of Vesta were the Penates proper of Rome. Certainly the worship of the Penates, whose altar was the hearth and to whom the kitchen was sacred, was closely connected with that of Vesta, goddess of the domestic hearth.

The origin and nature of the Penates was a subject of much discussion to the Romans themselves. They were traced to the mysterious worship of Samothrace; Dardanus, it was said, took the Penates from Samothrace to Troy, and after the destruction of Troy, Aeneas brought them to Italy and established them at Lavinium. From Lavinium Ascanius carried the worship to Alba Longa, and from Alba Longa it was brought to Rome. Equally unsatisfactory with this attempt to connect Roman religion with Greek legend are the vague and mystic speculations in which the later Romans indulged respecting the nature of the Penates. Some said they were the great gods to whom we owe breath, body and reason, viz. Jupiter representing the middle ether, Juno the lowest air and the earth, and Minerva the highest ether, to whom some added Mercury as the god of speech (Servius, on *Aen.* ii. 296; Macrobius, *Sat.* iii. 4, 8; Arnobius, *Adv. Nat.* iii. 40). Others identified them with Apollo and Neptune (Macrob. iii. 4, 6; Arnob. *loc. cit.*; Servius, on *Aen.* iii. 119). The Etruscans held the Penates to be Ceres, Pales and Fortuna, to whom others added Genius Jovialis (Servius on *Aen.* ii. 325; Arnob. *loc. cit.*). The late writer Martianus Capella records the view that heaven was divided into sixteen regions, in the first of which were placed the Penates, along with Jupiter, the Lares, &c. More fruitful than these misty speculations is the suggestion, made by the ancients themselves, that the worship of these family gods sprang from the ancient Roman custom (common to many savage tribes) of burying the dead in the house. But this would account for the worship of the Lares rather than of the Penates. A comparison with other primitive religious beliefs suggests the conjecture that the Penates may be a remnant of fetishism or animism. The Roman genii seem certainly to have been fetishes and the Penates were perhaps originally a species of genii. Thus the Penates, as simple gods of food, are probably much more ancient than deities like Jupiter, Neptune, Apollo and Minerva.

With the Penates we may compare the kindly household gods of old Germany; they too had their home on the kitchen hearth and received offerings of food and clothing. In the castle of Hudemühlen (Hanover) there was a kobold for whom a cover was always set on the table. In Lapland each house had one or more spirits. The souls of the dead are regarded as house-spirits by the Russians; they are represented as dwarfs, and are served with food and drink. Each house in Servia has its patron-saint. In the mountains of Mysore every house has its bhuta or guardian deity, to whom prayer and sacrifices are offered. The Chinese god of the kitchen presents some curious analogies to the Penates: incense and candles are burnt before him on the first and fifteenth of the month; some families burn incense and candles before him daily; and on great festivals, one of which is at the winter solstice (nearly corresponding to the Saturnalia), he is served with cakes, pork, wine, incense, &c., which are placed on a table before him.

See ROMAN RELIGION. (J. G. FR.; X.)

PENCIL (Lat. *penicillus*, brush, literally little tail), a name originally applied to a small fine-pointed brush used in painting, and still employed to denote the finer camel's-hair and sable brushes used by artists, but now commonly signifying solid cones or rods of various materials used for writing and drawing. It has been asserted that a manuscript of Theophilus, attributed to the 13th century, shows signs of having been ruled with a black-lead pencil; but the first distinct allusion occurs in the treatise on fossils by Conrad Gesner of Zurich (1565), who describes an article for writing formed of wood and a piece of lead, or, as he believed, an artificial composition called by some *stimmi anglicanum* (English antimony). The famous Borrowdale mine in Cumberland having been discovered about that time, it is probable that we have here the first allusion to that great find of graphite. While the supply of the Cumberland mine lasted, the material for English pencils consisted simply of the native graphite as taken from the mine. The pieces were sawn into thin sheets, which again were cut into the slender square rods forming the "lead" of the pencil.

Strenuous efforts were made on the continent of Europe and in England to enable manufacturers to become independent of the product of the Cumberland mine. In Nuremberg, where the great pencil factory of the Faber family (*q.v.*) was established in 1760, pencils were made from pulverized graphite cemented into solid blocks by means of gums, resins, glue, sulphur and other such substances, but none of these preparations yielded useful pencils. In the year 1795 N. J. Conté (*q.v.*), of Paris, devised the process by which now all black-lead pencils, and indeed pencils of all sorts, are manufactured. In 1843 William Brockedon patented a process for compressing pure black-lead powder into solid compact blocks by which he was enabled to use the dust, fragments, and cuttings of fine Cumberland lead. Brockedon's process would have proved successful but the exhaustion of the Borrowdale supplies and the excellence of Conté's process rendered it more of scientific interest than of commercial value.

The pencil leads prepared by the Conté process consist of a mixture of graphite and clay. The graphite, having been pulverized and subjected to any necessary purifying processes, is "floated" through a series of settling tanks, in each of which the comparatively heavy particles sink, and only the still finer particles are carried over. That which sinks in the last of the series is in a condition of extremely fine division, and is used for pencils of the highest quality. The clay, which must be free from sand and iron, is treated in the same manner. Clay and graphite so prepared are mixed together in varying proportions with water to a paste, passed repeatedly through a grinding mill, then placed in bags and squeezed in a hydraulic press till they have the consistency of stiff dough, in which condition they are ready for forming pencil rods. For this purpose the plastic mass is placed in a strong upright cylinder, from which a plunger or piston, moved by a screw, forces it out through a perforated base-plate in a continuous thread. This thread is finally divided into suitable lengths, which are heated in a closed crucible for some hours. The two factors which determine the comparative hardness and blackness of pencils are the proportions of graphite and clay in the leads and the heat to which they are raised in the crucible. According as the proportion of graphite is greater and the heat lower the pencil is softer and of deeper black streak.

The wood in which the leads are cased is pencil cedar from *Juniperus virginiana* for the best qualities, and pine for the cheaper ones. A board of the selected wood, having a thickness about equal to half the diameter of the finished pencil and as wide as four or six pencils, is passed through a machine which smooths the surface and cuts round or square grooves to receive the leads. The leads being placed in the grooves the board is covered with another similarly grooved board, and the two are fastened together with glue. When dry they are taken to rapidly revolving cutters which remove the wood between the leads. The individual pencils thus formed only need to be finished by being dyed and varnished and stamped with name, grade, &c. Instead of wood, paper has been tried for the casings, rolled on in narrow strips which are torn off to expose fresh lead as the point becomes worn down by use.

Black pencils of an inferior quality are made from the dust of graphite melted up with sulphur and run into moulds. Such, with a little tallow added to give them softness, are the pencils commonly used by carpenters. Coloured pencils consist of a mixture of clay, with appropriate mineral colouring matter, wax, and tallow, treated by the Conté method, as in making lead pencils. In indelible and copying pencils the colouring matter is an aniline preparation mixed with clay and gum. The mixture not only makes a streak which adheres to the paper, but, when the writing is moistened with water, it dissolves and assumes the appearance and properties of an ink.

PENDA, king of Mercia (d. 654 or 655), son of Pybba, probably came to the throne in 626, but it is doubtful whether he actually became king of Mercia until 633, the year of the defeat and death of Edwin of Northumbria. According to the Anglo-Saxon Chronicle he was eighty years old at his death, but the energy of his administration and the evidence with regard to the ages of his children and relatives render it almost impossible. In 628 the Chronicle records a battle between him and the West Saxons at Cirencester in that year. In 633 Penda and Ceadwalla overthrew Edwin at Hatfield Chase; but after the defeat of the Welsh king at Oswald at "Hefenfelth" in 634, Mercia seems to have been for a time subject to Northumbria. In 642 Penda slew Oswald at a place called Maerfeld. He was continually raiding Northumbria and once almost succeeded in reducing Bamborough. He drove Cenwalh of Wessex, who had divorced his sister, from his throne. In 654 he attacked the East Angles, and slew their king Anna (see EAST ANGLIA). In 654 or 655 he invaded Northumbria in spite of the attempts of Oswio to buy him off, and was defeated and slain on the banks of the "Winwaed." In the reign of Penda the districts corresponding to Cheshire, Shropshire and Herefordshire were probably acquired, and he established his son Peada as a dependent prince in Middle Anglia. Although a pagan, he allowed his daughter Cyneburg to marry Alchfrith, the son of

Oswio, and it was in his reign that Christianity was introduced into Middle Anglia by his son Peada.

See Bede, *Hist. Eccl.* (ed. C. Plummer, Oxford, 1896); *Anglo-Saxon Chronicle* (ed. Earle and Plummer, Oxford, 1899).

PENDANT (through Fr. from Lat. *pendere*, to hang), any hanging object, such as a jewel or other ornament hanging from a brooch, bracelet, &c., or the loose end of a knight's belt left hanging after passing through the buckle, and terminating in an ornamental end. In architecture the word is applied to an elongated boss, either moulded or foliated, such as hangs down from the intersection of ribs, especially in fan tracery, or at the end of hammer beams. Sometimes long corbels, under the wall pieces, have been so called. The name has also been given to the large masses depending from enriched ceilings, in the later works of the Pointed style. "Pendants" or "Pendent posts" are those timbers which are carried down the side of the wall from the plate, and receive the hammer braces.

PENDENTIVE, the term given in architecture to the bridging across the angles of a square hall, so as to obtain a circular base for a dome or drain. This may be done by corbelling out in the angles, in which case the pendentive may be a portion of a hemisphere of which the half diagonal of the square hall is the radius; or by throwing a series of arches across the angle, each ring as it rises advancing in front of the one below and being carried by it during its construction; in this case the base obtained is octagonal, so that corbels or small pendentives are required for each angle of the octagon, unless as in the church of SS. Sergius and Bacchus at Constantinople a portion of the dome is set back; or again, by a third method, by sinking a semicircular niche in the angle. The first system was that employed in St Sophia at Constantinople, and in Byzantine churches generally, also in the domed churches of Perigord and Aquitaine. The second is found in the Sassanian palaces of Serbistan and Firuzabad, and in medieval architecture in England, France and Germany, where the arches are termed "squinches." The third system is found in the mosque at Damascus, and was often adopted in the churches in Asia Minor. There is still another method in which the pendentive and cupola are part of the same hemispherical dome, and in this case the ring courses lie in vertical instead of horizontal planes, examples of which may be found in the vault of Magnesia on Maeander in Asia Minor, and in the tomb at Valence known as *le pendentif de Valence*. The problem is one which has taxed the ingenuity of many builders in ancient times; the bas-reliefs found at Nimrud show that in the 9th century B.C. domes were evidently built over square halls, and must have been carried on pendentives of some kind.

PENDER, SIR JOHN (1816–1896), British cable pioneer, was born in the Vale of Leven, Scotland, on the 10th of September 1816, and after attending school in Glasgow became a successful merchant in textile fabrics in that city and in Manchester. His name is chiefly known in connexion with submarine cables, of which on the commercial side he was an important promoter. He was one of the 345 contributors who each risked a thousand pounds in the Transatlantic Cable in 1857, and when the Atlantic Telegraph Company was ruined by the loss of the 1865 cable he formed the Anglo-American Telegraph Company to continue the work, but it was not till he had given his personal guarantee for a quarter of a million pounds that the makers would undertake the manufacture of a new cable. But in the end he was justified, and telegraphic communication with America became a commercial success. Subsequently he fostered cable enterprise in all parts of the world, and at the time of his death, which occurred at Footscray Place, Kent, on the 7th of July 1896, he controlled companies having a capital of 15 millions sterling and owning 73,640 nautical miles of cables. He represented Wick Burghs in parliament from 1872 to 1885 and from 1892 to 1896. He was made a K.C.M.G. in 1888 and was promoted in 1892 to be G.C.M.G. His eldest son James (b. 1841), who was M.P. for Mid Northamptonshire in 1895–1900, was created a baronet in 1897; and his third son, John Denison (b. 1855), was created a K.C.M.G. in 1901.

PENDLESIDE SERIES, in geology, a series of shales between the upper division of the Carboniferous Limestone and the Millstone Grits occurring in the Midlands between Stoke-on-Trent and Settle. It consists of black limestones at the base, followed by black shales with calcareous nodules, which pass into sandy shales with ganister-like sandstones. In places the series attains a thickness of 1500–1000 ft., and where it is thickest the Millstone Grits also attain their maximum thickness. The peculiarities of the series, which is characterized by a rich fauna with *Productus giganteus*, *P. striatus*, *Dibunophyllum*, *Cyathaxonia cornu* and *Lonsdaleia floriformis*, can be best studied on the western slope of Pendle Hill, Lancashire, in the valley of the Hodder, dividing the counties of Lancashire and Yorkshire, at Mam Tor and the Edale valley in Derbyshire, and Morredge, the Dane valley in north Staffordshire, Bagillt and Teilia in North Wales, and Scarlett and Poolvash, Isle of Man. The limestones at the base are hard, compact and fissile, often cherty, and vary much in the amount of calcium carbonate which they contain, at times passing into calcareous shales.

These limestones and shales contain a distinct fauna which appears for the first time in the Midlands, characterized by *Pterinopecten papyraceus*, *Posidoniella laevis*, *Posidonomya Becheri*, *Posidonomya membranacea*, *Nomismoceras rotiforme* and *Glyphioceras striatus*. Immediately below beds with this fauna are thin limestones with *Prolecanites compressus*, *Stroboceras bisulcatus*, many trilobites, and corals referable to the genera *Cyathaxonia*, *Zaphrentis* and *Amplexizaphrentis*. The fauna characteristic of the Carboniferous Limestone becomes largely extinct and is replaced by a shale fauna, but the oncoming of the age of Goniatites is shown by the presence in the upper part of the Carboniferous Limestone of numerous species and genera of this group, *Glyphioceras crenestria* being the most common and having the wider horizontal range. The whole Pendleside series can be divided into zones by the different species of Goniatites. At the base *Prolecanites compressus* characterizes the passage beds between the Carboniferous Limestone and the Pendlesides; *Nomismoceras rotiforme* and *Glyphioceras striatus* are found in a narrow zone immediately above. Then *Glyphioceras reticulatum* appears and reaches its maximum, and is succeeded by *Glyphioceras diadema* and *Glyphioceras spirale*, while immediately below the Millstone Grits *Glyphioceras bilingue* appears and passes up in that series. The Millstone Grits are characterized by the presence of *Gastrioceras Listeri*. The Pendleside series is therefore characterized by an Upper Carboniferous fauna, *Pterinopecten papyraceus*, *Posidoniella laevis* and some other species which pass up right through the Coal Measures appearing for the first time, and the base of the series marks the division between Upper and Lower Carboniferous times.

The series passes eastward into Belgium and thence into Germany, when the same fossil zones are found in the basin of Namur and the valley of the Dill. Traced westward the series is well developed in Co. Dublin and on the west coast of Cos. Clare and Limerick. There can be no doubt that the Pendleside series of the Midlands represents the Lower Culm of Codden Hill, north Devon, and the Lower Culm of the continent of Europe. The faunas in these localities have the same biological succession as in the midlands.

See Wheelton Hind and J. Allen Howe, *Quart. Journ. Geog. Soc.* vol. lvii. (1901), and numerous other papers by the first-named author. (W. Hi.)

PENDLETON, EDMUND (1721–1803), American lawyer and statesman, was born, of English Royalist descent, in Caroline county, Virginia, on the 9th of September 1721. He was self-educated, but after reading law and being admitted to the bar (1744) his success was immediate. He served in the Virginia House of Burgesses from 1752 until the organization of the state government in 1776, was the recognized leader of the conservative Whigs, and took a leading part in opposing the British government. He was a member of the Virginia committee of correspondence in 1773, in 1774 was president of the Virginia provincial convention, and a member of the first

Continental Congress. In 1776, as president of the provincial convention, which adopted a state constitution for Virginia, he drew up the instructions to the Virginia members of Congress directing them to advocate the independence of the American colonies. In the same year he became president of the Virginia committee of safety, and in October was chosen the first speaker of the House of Delegates. With Jefferson and Chancellor George Wythe he drew up a new law code for Virginia. He was president of the court of chancery in 1777–1788, and from 1779 until his death was president of the Virginia court of appeals. He was an enthusiastic advocate of the Federal constitution, and in 1788 exerted strong influence to secure its ratification by his native state. He was a leader of the Federalist party in Virginia until his death at Richmond, Va., on the 23rd of October 1803.

PENDLETON, GEORGE HUNT (1825–1889), American lawyer and legislator, was born in Cincinnati, Ohio, on the 25th of July 1825. He was educated at the university of Heidelberg, studied law, was admitted to the bar, and began to practise at Cincinnati. He was a member of the Ohio Senate in 1854 and 1855, and from 1857 to 1865 was a Democratic member of the national House of Representatives, in which he opposed the war policy of Lincoln. In 1864 he was the Democratic candidate for vice-president. After leaving Congress he became one of the earliest champions of the "Ohio idea" (which he is said to have originated), demanding that the government should pay the principal of its 5–20-year 6% bonds in the "greenback" currency instead of in coin. The agricultural classes of the West regarded this as a means of relief, and Pendleton became their recognized leader and a candidate for the Democratic nomination to the presidency in 1868, but he failed to receive the requisite two-thirds majority. In 1869 he was the Democratic candidate for governor of Ohio, but was defeated by Rutherford B. Hayes. For the next ten years he devoted himself to the practice of law and to the supervision of the Kentucky Railroad Company, of which he had become president in 1869. From 1879 to 1885 he was a Democratic member of the United States Senate, and introduced the so-called Pendleton Act of 1883 for reforming the civil service, hostility to which lost him his seat in 1885. He was minister to Germany from 1885 to the summer of 1889, and died at Brussels on the 24th of November 1889.

PENELOPE, in Greek legend, wife of Odysseus, daughter of Icarius and the nymph Periboea. During the long absence of her husband after the fall of Troy many chieftains of Ithaca and the islands round about became her suitors; and, to rid herself of the importunities of the wooers, she bade them wait till she had woven a winding-sheet for old Laërtes, the father of Odysseus. But every night she undid the piece which she had woven by day. This she did for three years, till her maids revealed the secret. She was relieved by the arrival of Odysseus, who returned after an absence of twenty years, and slew the wooers. The character of Penelope is less favourable in late writers than in the Homeric story. During her husband's absence she is said to have become the mother of Pan by Hermes, and Odysseus, on his return, repudiated her as unfaithful (Herodotus ii. 145 and schol.). She thereupon withdrew to Sparta and thence to Mantineia, where she died and where her tomb was shown. According to another account she married Telegonus the son of Odysseus and Circe, after he had killed his father, and dwelt with him in the island of Aeala or in the Islands of the Blest (Hyginus, *Fab.* 127).

PENGELLY, WILLIAM (1812–1894), English geologist and anthropologist, was born at East Looe in Cornwall on the 12th of January 1812, the son of the captain of a small coasting vessel. He began life as a sailor, after an elementary education in his native village, but in 1828 he abandoned a seafaring life. He had developed a passion for learning, and about 1836 he removed to Torquay and started a school; in 1846 he became a private tutor in mathematics and natural science. Geology had in early years attracted his attention, but it was not until he was about 30 years of age that he began seriously to cultivate the study. In 1837 he was instrumental in the reorganization of the Torquay Mechanics' Institute, in 1844 mainly owing to his energy the Torquay Natural History Society was founded, and in 1862 he assisted in founding the Devonshire Association for the Advancement of Literature, Science and Art. Meanwhile he had been occupied in collecting fossils from many parts of Devon and Cornwall, and in 1860 the Baroness Burdett-Coutts acquired and presented them to the Oxford Museum, where they form "The Pengelly Collection." Through the generosity of the same lady he was called upon to examine the lignites and clays of Bovey Tracey, in conjunction with Dr Oswald Heer, who undertook the determination of the plant-remains. Their report was published by the Royal Society (1862), and Pengelly was elected F.R.S. in 1863. He aided in the investigations of the Brixham bone-cavern from the date of its discovery in 1858, the full report being issued in 1873; and he was the main explorer of Kent's Hole, Torquay, and from 1864 for more than fifteen years he laboured with unflagging energy in examining and recording the exact position of the numerous organic remains that were disinterred during a systematic investigation of this cave, carried on with the aid of grants from the British Association. He first attended the British Association at the Cheltenham meeting in 1856, and was present at subsequent meetings (except that at Montreal in 1884) until 1889. His observations assisted in establishing the important fact of the contemporaneity of Palaeolithic man with various Pleistocene mammalia, such as the mammoth, cave-bear, cave-lion, &c. He was awarded the Lyell medal by the Geological Society of London in 1886. He died at Torquay on the 16th of March 1894.

See *Memoir of William Pengelly*, edited by his daughter Hester Pengelly, with a summary of his scientific work by the Rev. Professor T. G. Bonney (1897).

PENGUIN, the name of a flightless sea-bird,[1] but, so far as is known, first given to one inhabiting the seas of Newfoundland as in Hore's "Voyage to Cape Breton," 1536 (Hakluyt, *Researches*, iii. 168–170), which subsequently became known as the great auk or garefowl (*q.v.*); though the French equivalent *Pingouin*[2] preserves its old application, the word penguin is by English ornithologists always used for certain birds inhabiting the Southern Ocean, called by the French *Manchots*, the *Spheniscidae* of ornithologists. For a long while their position was very much misunderstood, some systematists having placed them with the *Alcidae* or Auks, to which they bear only a relationship of analogy, as indeed had been perceived by a few ornithologists, who recognized in the penguins a very distinct order, *Impennes*. L. Stejneger (*Standard Nat. Hist.* vol. iv., Boston, 1885) gave the *Impennes* independent rank equivalent to the rest of Carinate birds; M. A. Menzbier (*Vergl. Osteol. d. Penguine*, Moscow, 1887) took a similar view; M. Fürbringer was first to show their relation to *Procellariformes*, and this view is now generally accepted.

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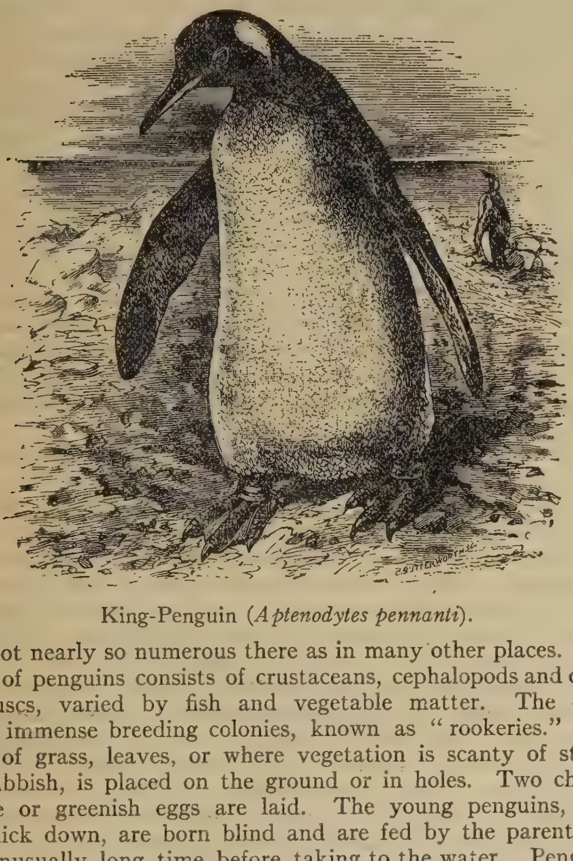
[1] Of the three derivations assigned to this name, the first is by Drayton in 1613 (*Polyolbion*, Song 9), where it is said to be the Welsh *pen gwyn*, or "white head"; the second, which seems to meet with Littré's approval, deduces it from the Latin *pinguis* (fat), which idea has given origin to the German name, *Fettgänse*, for these birds; the third supposes it to be a corruption of "pin-wing" (*Ann. Nat. History*, 4th series, vol. iv. p. 133), meaning a bird that has undergone the operation of pinioning or, as in one part at least of England it is commonly called, "pin-winging." The first hypothesis has been supported on the ground that Breton sailors speaking a language closely allied to Welsh were acquainted with the great auk, and that the conspicuous white patches on the head of that bird justified the name "white head." To the second hypothesis Skeat (*Dictionary*, p. 433) objects that it "will not account for the suffix *-in*, and is therefore wrong; besides which the 'Dutchmen' [who were asserted to be the authors of the name] turn out to be Sir Francis Drake" and his men. In support of the third hypothesis Mr Reeks wrote (*Zoologist*, 2nd series, p. 1854) that the people in Newfoundland who used to meet with this bird always pronounced its name "pin wing." Skeat's inquiry (*loc. cit.*), whether the name may not after all be South American, is to be answered in the negative, since, so far as evidence goes, it was given to the North-American bird before the South-American was known in Europe.

[2] *Gorfou* has also been used by some French writers, being a corruption of *Geirfugl* or Garefowl.

There is a total want of quills in their wings, which are incapable of flexure, though they move freely at the shoulder-joint, and some at least of the species occasionally make use of them for progressing on land. In the water they are most efficient paddles. The plumage, which clothes the whole body, generally consists of small scale-like feathers, many of them consisting only of a simple shaft without the development of barbs; but several of the species have the head decorated with long cirrhous tufts, and in some the tail-quills, which are very numerous, are also long.[1] In standing these birds preserve an upright position, sometimes resting on the "tarsus"[2] alone, but in walking or running this is kept nearly vertical, and their weight is supported by the toes alone.

The most northerly limit of the penguins' range in the Atlantic is Tristan d'Acunha, and in the Indian Ocean Amsterdam Island, but they also occur off the Cape of Good Hope and along the coast of Australia, as well as on the south and east of New Zealand, while in the Pacific one species at least extends along the west coast of South America and to the Galapagos; but north of the equator none are found. In the breeding season they resort to the most desolate lands in higher southern latitudes, and indeed have been met with as far to the southward as navigators have penetrated. Possibly the Falkland Islands are richest in species, though, as individuals, they are not nearly so numerous there as in many other places. The food of penguins consists of crustaceans, cephalopods and other molluscs, varied by fish and vegetable matter. The birds form immense breeding colonies, known as "rookeries." The nest of grass, leaves, or where vegetation is scanty of stones or rubbish, is placed on the ground or in holes. Two chalky white or greenish eggs are laid. The young penguins, clad in thick down, are born blind and are fed by the parents for an unusually long time before taking to the water. Penguins bite savagely when molested, but are easily trained and display considerable intelligence.



King-Penguin (*Aptenodytes pennanti*).

The *Spheniscidae* have been divided into at least eight genera, but three, or at most four, seem to be all that are needed, and three can be well distinguished, as pointed out by E. Coues in *Proc. Acad. of Nat. Sci. of Philadelphia, 1872* (pp. 170–212), by anatomical as well as by external characters. They are: (1) *Aptenodytes*, easily recognized by its long and thin bill, slightly decurved, from which *Pygoscelis*, as M. Watson has shown, is hardly distinguishable; (2) *Eudyptes*, in which the bill is much shorter and rather broad; and (3) *Spheniscus*, in which the shortish bill is compressed and the maxilla ends in a conspicuous hook. *Aptenodytes* contains the largest species, among them those known as the "Emperor" and "King" penguins *A. patagonica* and *A. longirostris*. Three others belong also to this genus, if *Pygoscelis* be not recognized, but they seem not to require any particular remark. *Eudyptes*, containing the crested penguins, known to sailors as "Rock-hoppers" or "Macaronis," would appear to have five species, and *Spheniscus* four, among which S. *mendiculus*, which occurs in the Galapagos, and therefore has the most northerly range of the whole group, alone needs notice here. (A. N.)

The generic and specific distribution of the penguins is the subject of an excellent essay by Alphonse Milne-Edwards in the *Annales des sciences naturelles* for 1880 (vol. ix. art. 9, pp. 23–81); see also the Records of the Antarctic Expedition, 1901–1904.

PENHALLOW, SAMUEL (1665–1726), American colonist and historian, was born at St Mabon, Cornwall, England, on the 2nd of July 1665. From 1683 to 1686 he attended a school at Newington Green (near London) conducted by the Rev. Charles Morton (1627–1698), a dissenting clergyman, with whom he emigrated to Massachusetts in 1686. He was commissioned by the Society for the Propagation of the Gospel in New England to study the Indian languages and to preach to the Indians; but he was soon diverted from this work. Removing to Portsmouth, New Hampshire, he there married a daughter of John Cutt (1625–1681), president of the province of New Hampshire in 1679–1680, a successful merchant and mill-owner, and thus came into possession of considerable property (including much of the present site of Portsmouth). In 1700 he was speaker of the Assembly and in 1702 became a member of the Provincial Council, but was suspended by Lieut.-Governor George Vaughan (1676–1724). Penhallow, however, was sustained by Governor Samuel Shute (1662–1742), and Vaughan was removed from office in 1716. In 1714 Penhallow was appointed a justice of the superior court of judicature, and from 1717 until his death was chief justice of that court; and he also served as treasurer of the province in 1699–1726, and as secretary of the province in 1714–1726. He died at Portsmouth on the 2nd of December 1726. He wrote a valuable *History of the War of New England with the Eastern Indians, or a Narrative of their Continued Perfidy and Cruelty* (1726; reprinted in the *Collections* of the New Hampshire Historical Society, vol. i., 1824, and again at Cincinnati in 1859), which covers the period from 1703 to 1726, and is a standard contemporary authority.

PENINGTON, SIR ISAAC (*c.* 1587–1661), lord mayor of London, eldest son of Robert Penington, a London fishmonger, was born probably in 1587. His father besides his London business had landed estates in Norfolk and Suffolk, which Isaac inherited in addition to a property in Buckinghamshire which he himself purchased. In 1638 Isaac became an alderman and high sheriff of London. In 1640 he was elected to the House of Commons as member for the city of London, and immediately took a prominent place among the Puritan party. In 1642 he was elected lord mayor of London, but retained his seat in parliament by special leave of the Commons; and he was elected lord mayor for a second term in the following year, continuing while in office to raise large sums of money for the opposition to the Court party. From 1642 to 1645 he was lieutenant of the Tower, in which capacity he was present at the execution of Laud; but, though one of the commissioners for the trial of Charles I., he did not sign the death warrant. After the king's death Penington served on Cromwell's council of state, and on several committees of government. His services were rewarded by considerable grants of land, and a knighthood conferred in 1649. He was tried and convicted of treason at the Restoration, and died while a prisoner in the Tower on the 17th of December 1661. He was twice married, and had six children by his first wife, several of whom became Quakers.

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[1] The pterylographical characters of the penguins are well described by A. Hyatt (*Proc. Boston Soc. Nat. History*, 1871). A. D. Bartlett has observed (*Proc. Zool. Soc.*, 1879, pp. 6–9) that, instead of moulting in the way that birds ordinarily do, penguins, at least in passing from the immature to the adult dress, cast off the short scale-like feathers from their wings in a manner that he compares to "the shedding of the skin in a serpent."

[2] The three metatarsals in the penguins are not, as in other birds, united for the whole of their length, but only at the extremities, thus preserving a portion of their originally distinct existence, a fact probably attributable to arrest of development, since the researches of C. Gegenbaur show that the embryos of all birds, so far as is known, possess these bones in an independent condition.

Isaac Penington (1616–1679), Sir Isaac's eldest son, was one of the most notable of the 17th-century Quakers. He was early troubled by religious perplexities, which found expression in many voluminous writings. No less than eleven religious works, besides a political treatise in defence of democratic principles, were published by him in eight years. He belonged for a time to the sect of the Independents; but about 1657, influenced probably by the preaching of George Fox, whom he heard in Bedfordshire, Penington and his wife joined the Society of Friends. His wife was daughter and heiress of Sir John Proude, and widow of Sir William Springett, so that the worldly position of the couple made them a valuable acquisition to the Quakers. Isaac Penington was himself a man of very considerable gifts and sweetness of character. In 1661 he was imprisoned for refusing to take the oath of allegiance, and on several subsequent occasions he passed long periods in Reading and Aylesbury gaols. He died on the 8th of October 1679; his wife, who wrote an account of his imprisonments, survived till 1682. In 1681 Penington's writings were published in a collected edition, and several later editions were issued before the end of the 18th century. His son John Penington (1655–1710) defended his father's memory against attack, and published some controversial tracts against George Keith. Edward Penington (1667–1711), another of Isaac Penington's sons, emigrated to Pennsylvania, where he founded a family. Isaac Penington's stepdaughter, Gulielma Springett, married William Penn.

See Maria Webb, *The Penns and Peningtons of the 17th Century* (London, 1867); Lord Clarendon, *History of the Rebellion and Civil Wars in England* (7 vols., Oxford, 1839); Bulstrode Whitelocke, *Memorials of English Affairs: Charles I. to the Restoration* (London, 1732); J. Gurney Bevan, *Life of Isaac Penington* (London, 1784); Thomas Ellwood, *History of the Life of Ellwood by his own hand* (London, 1765); Willem Sewel, *History of the Quakers* (6th ed., 2 vols., London, 1834).

PENINSULA (Lat. *paeninsula*, from *paene*, almost, and *insula*, an island), in physical geography, a piece of land nearly surrounded by water. In its original sense it connotes attachment to a larger land-mass by a neck of land (isthmus) narrower than the peninsula itself, but it is often extended to apply to any long promontory, the coast-line of which is markedly longer than the landward boundary.

PENINSULAR WAR (1808–14). This important war, the conduct and result of which greatly enhanced the prestige of British arms, had for its main object the freedom of the Peninsula of Spain and Portugal from the domination of Napoleon; and hence it derives its name, though it terminated upon the soil of France.

Nelson having destroyed the French fleet at Trafalgar, Napoleon feared the possibility of a British army being landed on the Peninsular coasts, whence in conjunction with Portuguese and Spanish forces it might attack France from the south. He therefore called upon Portugal, in August 1807, to comply with his Berlin decree of the 21st of November 1806, under which continental nations were to close their ports to British subjects, and have no communication with Great Britain. At the same time he persuaded the weak king of Spain (Charles IV.) and his corrupt minister Godoy to permit a French army to pass through Spain towards Portugal; while under a secret treaty signed at Fontainebleau on the 27th of October 1807 Spanish troops were to support the French. Portugal was to be subsequently divided between Spain and France, and a new principality of the Algarve was to be carved out for Godoy. Portugal remonstrated against Napoleon's demands, and a French corps (30,000) under General Junot was instantly despatched to Lisbon. Upon its approach the prince regent fled, and the country was occupied by Junot, most of the Portuguese troops being disbanded or sent abroad. Napoleon induced the king of Spain to allow French troops to occupy the country and to send the flower of the Spanish forces (15,000) under the marquis of Romana[1] to assist the French on the Baltic. Then Dupont de l'Etang (25,000) was ordered to cross the Bidassoa on the 22nd of November 1807; and by the 8th of January 1808 he had reached Burgos and Valladolid. Marshal Moncey with a corps occupied Biscay and Navarre; Duhesme with a division entered Catalonia; and a little later Bessières with another corps had been brought up. There were now about 100,000 French soldiers in Spain, and Murat, grand duke of Berg, as "lieutenant for the emperor," entered Madrid. During February and March 1808 the frontier fortresses of Pampeluna, St Sebastian, Barcelona and Figueras were treacherously occupied and Spain lay at the feet of Napoleon. The Spanish people, in an outburst of fury against the king and Godoy, forced the former to abdicate in favour of his son Ferdinand; but the inhabitants of Madrid having (May 2, 1808) risen against the French, Napoleon refused to recognize Ferdinand; both he and the king were compelled to renounce their rights to the throne, and a mercenary council of regency having been induced to desire the French emperor to make his brother, Joseph Bonaparte, king, he acceded to their request.[2]

The mask was now completely thrown off, and Spain and Portugal rose against the French. Provincial "juntas" (committees of government) were organized; appeals for assistance made to the British government, which granted arms, money and supplies, and it was resolved to despatch a British force to the Peninsula. Before it landed, the French under Dupont, Moncey and Marshal Bessières (75,000) had occupied parts of Biscay, Navarre, Aragon and the Castiles, holding Madrid and Toledo, while General Duhesme (14,000) was in Catalonia. Moncey (7000) had marched towards the city of Valencia, but been repulsed in attempting to storm it (June 28); Bessières had defeated the Spanish general Joachim Blake at Medina de Rio Seco (June 14, 1808) and Dupont (13,000) had been detached (May 24) from Madrid to reduce Seville and Cadiz in Andalusia. Spanish levies, numbering nearly 100,000 regulars and militia, brave and enthusiastic, but without organization, sufficient training, or a commander-in-chief, had collected together; 30,000 being in Andalusia, a similar number in Galicia, and others in Valencia and Estremadura, but few in the central portion of Spain.

At this juncture Dupont, moving upon Cadiz, met with a reverse which greatly influenced the course of the Peninsular War. On the 7th of June 1808 he had sacked Cordova; but while he was laden with its spoils the Spanish general Castaños with the army of Andalusia (30,000), and also a large body of armed peasantry, approached. Falling back to Andujar, where he was reinforced to 22,000 strong, Dupont detached a force to hold the mountain passes in his rear, whereupon the Spaniards interposed between the detachment and the main body and seized Baylen. Failing to dislodge them, and surrounded by hostile troops and an infuriated peasantry, Dupont capitulated with over 20,000 men. This victory, together with the intrepid defence of Saragossa by the Spanish general José Palafox (June 15 to August 13, 1808) temporarily paralysed the French and created unbounded enthusiasm in Spain. Duhesme, having failed to take Gerona, was blockaded in Barcelona, Joseph fled from Madrid (Aug. 1, 1808), and the French forces closed to their rear to defend their communications with France. The British troops were directed towards Lisbon and Cadiz, in order to secure these harbours, to prevent the subjugation of Andalusia, and to operate up the basins of the Guadiana, Tagus and Douro into Spain. The British force consisted of 9000 men from Cork, under Sir Arthur Wellesley—at first in chief command; 5000 from Gibraltar, under General (Sir Brent) Spencer; and 10,000 under Sir John Moore coming from Sweden; Wellesley and Moore being directed towards Portugal, and Spencer to Cadiz. On the 1st of August 1808

Battle of Baylen, July 19, 1808.

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[1] They subsequently escaped from Jutland, on British vessels, and reached Santander in October 1808.

[2] The king, the queen and Godoy were eventually removed to Rome, and Ferdinand to Valençay in France.

Wellesley began to land his troops, unopposed, near Figueira da Foz at the mouth of the Mondego; and the Spanish victory of Baylen having relieved Cadiz from danger, Spencer now joined him, and, without waiting for Moore the army, under 15,000 in all (which included some Portuguese)[1] with 18 guns, advanced towards Lisbon.

Battle of Vimiera, August 21, 1808.

Campaign in Portugal, 1808.—The first skirmish took place at Obidos on the 15th of August 1808, against Delaborde's division (5000 men with 5 guns), which fell back to Roleia (Roriça or Roliça). A battle took place here (Aug. 17) in which Sir Arthur Wellesley attacked and drove him from two successive positions. The allied loss was about 500: the French 600 and three guns.[1] On the 20th of August the Allies, strengthened by the arrival of two more brigades (4000 men), occupied some heights north of Vimiera (Vimeira or Vimeiro) where the roads branch off to Torres Vedras and Mafra. Wellesley meant to turn the defile of Torres Vedras by Mafra at once if possible; but on this night Sir Harry Burrard, his senior, arrived off Vimiera, and though he did not land, gave instructions to wait for Sir John Moore. On the 21st of August the Allies were attacked by Junot at Vimiera, who, leaving a force at Lisbon, had come up to reinforce Delaborde. In this battle the Allies numbered about 18,000 with 18 guns, French nearly 14,000, with 20 guns. Junot, believing the allied left to be weakly held, attacked it without reconnoitring, but Wellesley's regiments, marched thither behind the heights, sprang up in line; and under their volleys and bayonet charge, supported by artillery fire, Junot's deep columns were driven off the direct road to Lisbon. The losses were: Allies about 800, French 2000 and 13 guns. It was now again Wellesley's wish to advance and seize Torres Vedras; but Sir Hew Dalrymple, having at this moment assumed command, decided otherwise. On the 2nd of August Junot, knowing of the approach of Moore with reinforcements, and afraid of a revolt in Lisbon, opened negotiations, which resulted in the Convention of Cintra[2] (Aug. 30, 1808), under which the French evacuated Portugal, on condition that they were sent with their artillery and arms to France. Thus this campaign had been rapidly brought to a satisfactory conclusion; and Sir Arthur Wellesley had already given proof of his exceptional gifts as a leader. In England however a cry was raised that Junot should have been forced to an absolutely unconditional surrender; and Sir Arthur Wellesley, Sir Hew Dalrymple and Sir Harry Burrard[3] were brought before a court of inquiry in London. This acquitted them of blame, and Sir John Moore in the meantime after the departure of Dalrymple (Oct. 6, 1808) had assumed command of the allied army in Portugal, now about 32,000 strong.

Moore's Campaign in Spain, 1808–9.—The British government notified to Sir John Moore that some 10,000 men were to be sent to Corunna under Sir David Baird; that he, with 20,000, was to join him, and then both act in concert with the Spanish armies. As the conduct of this campaign was largely influenced by the operations of the Spanish forces, it is necessary to mention their positions, and also the fact that greater reliance had been placed, both in England and Spain, upon them than future events justified. On the 26th of October 1808, when Moore's troops had left Lisbon to join Baird, the French still held a defensive position behind the Ebro; Bessières being in the basin of Vitoria, Marshal Ney north-west of Logroño, and Moncey covering Pampeluna, and near Sanguessa. With the garrisons of Biscay, Navarre, and a reserve at Bayonne, their strength was about 75,000 men. Palafox (20,000) was near Saragossa and observing Sanguessa; Castaños with the victors of Baylen (34,000) west and south of Tudela and near Logroño; Blake (32,000) east of Reynosa, having captured Bilbao; Count de Belvedere (11,000) near Burgos; reserves (57,000) were assembling about Segovia, Talavera and Cordova; Catalonia was held by 23,000, and Madrid had been reoccupied.

Moore had to decide whether to join Baird by sea or land. To do so by sea at this season was to risk delay, while in moving by land he would have the Spanish armies between him and the French. For these reasons he marched by land; and as the roads north of the Tagus were deemed impassable for guns, while transport and supplies for a large force were also difficult to procure, he sent Sir John Hope, with the artillery, cavalry and reserve ammunition column, south of the river, through Badajoz to Almaraz, to move thence through Talavera, Madrid and the Escurial Pass, involving a considerable détour; while he himself with the infantry, marching by successive divisions, took the shorter roads north of the Tagus through Coimbra and Almeida, and also by Alcantara and Coria to Ciudad Rodrigo and Salamanca. Baird was to move south through Galicia to meet him, and the army was to concentrate at Valladolid, Burgos, or whatever point might seem later on to be best. But as Moore was moving forward, the whole situation in Spain changed. Napoleon's forces, now increased to some 200,000 men present and more following, were assuming the offensive, and he himself on the 30th of October—had left Paris to place himself at their head. Before them the Spaniards were routed in every direction: Castaños was defeated near Logroño (Oct. 27); Castaños and Palafox at Tudela (Nov. 23); Blake at Zornoza (Oct. 29), Espinosa (Nov. 11) and Reynosa (Nov. 13); and Belvedere at Gamonal, near Burgos (Nov. 10). Thus when Moore reached Salamanca (Nov. 28) Baird was at Astorga; Hope at the Escurial Pass; Napoleon himself at Aranda; and French troops at Valladolid, Arevalo and Segovia; so that the French were nearer than either Baird or Hope to Moore at Salamanca. Moore was ignorant of their exact position and strength, but he knew that Valladolid had been occupied, and so his first orders were that Baird should fall back to Galicia and Hope to Portugal. But these were soon changed, and he now took the important resolution of striking a blow for Spain, and for the defenders of Madrid, by attacking Napoleon's communications with France. Hope having joined him through Avila, and magazines having been formed at Benavente, Astorga and Lugo, in case of retreat in that direction, he moved forward, and on the 13th of December approached the Douro, at and near Rueda east of Toro. Here he learnt that Madrid had fallen to Napoleon (Dec. 3) after he had by a brilliant charge of the Polish lancers and chasseurs of the Guard forced the Somosierra Pass (Nov. 30) and in another action stormed the Retiro commanding Madrid itself (Dec. 3); that the French were pressing on towards Lisbon and Andalusia; that Napoleon was unaware of his vicinity, and that Soult's corps, isolated on the Carrion River, had been ordered towards Benavente. He then finally decided to attack Soult (intending subsequently to fall back through Galicia) and ordered up transports from Lisbon to Corunna and Vigo; thus changing his base from Portugal to the north-west of Spain; Blake's Spanish army, now rallying under the marquis de la Romaña near Leon, was to co-operate, but was able to give little effective aid.

On the 20th of December Baird joined Moore near Mayorga, and a brilliant cavalry combat now took place at Sahagun, in which the British hussar brigade distinguished itself. But on the 23rd of December, when Moore was at Sahagun and about to attack Soult, he learnt that overwhelming French forces were hastening towards him, so withdrew across the Esla, near Benevente (Dec. 28), destroying the bridge there. Napoleon, directly he realized Moore's proximity, had ordered Soult to Astorga to cut him off from Galicia; recalled his other troops from their march towards Lisbon and Andalusia, and, with 50,000 men and 150 guns, had left Madrid himself (Dec. 22). He traversed over 100 m. in less than five days across the snow-covered Escurial Pass, reaching Tordesillas on the Douro on the 26th of December. Hence he wrote to Soult, "If the English pass to-day in their position (which he believed to be Sahagun) they are lost." But Moore had passed Astorga by the 31st of December, where Napoleon arrived on the 1st of January 1809. Thence he turned back, with a large portion of his army towards France, leaving Soult with over 40,000 men to follow Moore.

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[1] In this account of the war the losses and numbers engaged in different battles are given approximately only; and the former include killed, wounded and missing. Historians differ much on these matters.

[2] It was not, however, signed at Cintra, but at Lisbon, and was mainly negotiated near Torres Vedras.

[3] The two latter were recalled from the Peninsula; Sir Arthur Wellesley had proceeded to London upon leave, and had only signed the armistice with Junot, not the convention itself.

Battle of Corunna, January 16, 1809.

On the "Retreat to Corunna" fatigue, wet and bitter cold, combined with the sense of an enforced retreat, shook the discipline of Moore's army; but he reached Corunna on the 11th of January 1809, where he took up a position across the road from Lugo, with his left on the river Mero. On the 14th of January the transports arrived; and on the 16th Soult attacked. In this battle the French numbered about 20,000 with 40 guns; the British 15,000 with 9 very light guns. Soult failed to dislodge the British, and Moore was about to deliver a counter-attack when he himself fell mortally wounded. Baird was also wounded, and as night was approaching, Hope suspended the advance, and subsequently embarked the army, with scarcely any further loss. The British casualties were about 1000, the French 2000. When the troops landed in England, half clothed and half shod, their leader's conduct of the campaign was at first blamed, but his reputation as a general rests solidly upon these facts, that when Napoleon in person, having nearly 300,000 men in Spain, had stretched forth his hand to seize Portugal and Andalusia, Moore with 30,000, forced him to withdraw it, and follow him to Corunna, escaping at the same time from his grasp. Certainly a notable achievement.

Campaign in Portugal and Spain, 1809.—On the 22nd of April 1809 Sir Arthur Wellesley reached Lisbon. By this time, French armies, to a great extent controlled by Napoleon from a distance, had advanced—Soult from Galicia to capture Oporto and Lisbon (with General Lapisse from Salamanca moving on his left towards Abrantes) and Marshal Victor, still farther to the left, with a siege train to take Badajoz, Merida and subsequently Cadiz. Soult (over 20,000), leaving Ney in Galicia, had taken and sacked Oporto (March 29, 1809); but the Portuguese having closed upon his rear and occupied Vigo, he halted, detaching a force to Amarante to keep open the road to Braganza and asked for reinforcements. Victor had crossed the Tagus, and defeated Cuesta at Medellin (March 28, 1809); but, surrounded by insurgents, he also had halted; Lapisse had joined him, and together they were near Merida, 30,000 strong. On the allied side the British (25,000), including some German auxiliaries, were about Leiria: the Portuguese regular troops (16,000) near Thomar; and some thousands of Portuguese militia were observing Soult in the north of Portugal, a body under Silveira being at Amarante, which Soult was now approaching. Much progress had been made in the organization and training of the Portuguese levies; Major-General William Carr Beresford, with the rank of marshal, was placed at their head. Of the Spaniards, Palafox, after his defeat at Tudela had most gallantly defended Saragossa a second time (Dec. 20, 1808–Feb. 20, 1809); the Catalonians, after reverses at Molins de Rey (Dec. 21, 1808) and at Valls (Feb. 25, 1809) had taken refuge in Tarragona; and Rosas had fallen (Dec. 5, 1808) to the French general Gouvion St Cyr who, having relieved Barcelona, was besieging Gerona. Romaña's force was now near Orense in Galicia. A supreme junta had been formed which could nominally assemble about 100,000 men, but jealousy among its members was rife, and they still declined to appoint any commander-in-chief.

Passage of the Douro, May 12, 1809.

On the 5th of May 1809, Wellesley moved towards the river Douro, having detached Beresford to seize Amarante, from which the French had now driven Silveira. Soult expected the passage of the Douro to be attempted near its mouth, with fishing craft; but Wellesley, by a daring surprise, crossed (May 12) close above Oporto, and also by a ford higher up. After some fighting Oporto was taken, and Soult driven back. The Portuguese being in his rear, and Wellesley closing with him, the only good road of retreat available lay through Amarante, but he now learned that Beresford had taken this important point from Silveira; so he was then compelled, abandoning his guns and much baggage, to escape, with a loss of some 5000 men, over the mountains of the Sierra Catalina to Salamonde, and thence to Orense.

During the above operations, Victor, with Lapisse, had forced the passage of the Tagus at Alcantara but, on Wellesley returning to Abrantes, he retired. News having been received that Napoleon had suffered a serious check at the battle of Aspern, near Vienna (May 22, 1809), Wellesley next determined—leaving Beresford (20,000) near Ciudad Rodrigo—to move with 22,000 men, in conjunction with Cuesta's Spanish army (40,000) towards Madrid against Victor, who, with 25,000 supported by King Joseph (50,000) covering the capital, was near Talavera. Sir Robert Wilson with 4000 Portuguese from Salamanca, and a Spanish force under Venegas (25,000) from Carolina, were to co-operate and occupy Joseph, by closing upon Madrid. Cuesta, during the advance up the valley of the Tagus, was to occupy the pass of Baños on the left flank; the Spanish authorities were to supply provisions, and Venegas was to be at Arganda, near Madrid, by the 22nd or 23rd of July; but none of these arrangements were duly carried out, and it was on this that the remainder of the campaign turned. Writing to Soult from Austria, Napoleon had placed the corps of Ney and Mortier under his orders, and said: "Wellesley will most likely advance by the Tagus against Madrid; in that case, pass the mountains, fall on his flank and rear, and crush him."

Battle of Talavera, July 27, 28, 1809.

By the 20th of July Cuesta had joined Wellesley at Oropesa; and both then moved forward to Talavera, Victor falling back before them: but Cuesta, irritable and jealous, would not work cordially with Wellesley; Venegas—counter-ordered it is said by the Spanish junta—did not go to Arganda, and Wilson, though he advanced close to Madrid, was forced to retire, so that Joseph joined Victor, and the united force attacked the Allies at Talavera de la Reina on the Tagus. The battle lasted for two days, and ended in the defeat of the French, who fell back towards Madrid.[1] Owing to want of supplies, the British had fought in a half-starved condition; and Wellesley now learnt to his surprise that Soult had passed the mountains and was in his rear. Having turned about, he was on the march to attack him, when he heard (Aug. 23) that not Soult's corps alone, but three French corps, had come through the pass of Baños without opposition; that Soult himself was at Naval Moral, between him and the bridge of Almaraz on the Tagus, and that Cuesta was retreating from Talavera. Wellesley's force was now in a dangerous position: but by withdrawing at once across the Tagus at Arzobispo, he reached Jaraicejo and Almaraz (by the south bank) blowing up the bridge at Almaraz, and thence moved, through Merida, northwards to the banks of the Agueda, commencing to fortify the country around Lisbon.

Elsewhere in the Peninsula during this year, Blake, now in Catalonia, after routing Suchet at Alcaniz (May 23, 1809), was defeated by him at Maria (June 15) and at Belchite (June 18); Venegas, by King Joseph and Sébastiani, at Almonacid on the 11th of August; Del Parque (20,000), after a previous victory near Salamanca (Oct. 18), was overthrown at Alba de Tormes by General Marchand (Nov. 28); the old forces of Venegas and Cuesta (50,000), now united under Areizaga, were decisively routed by King Joseph at Ocaña (Nov. 19); and Gerona after a gallant defence, had surrendered to Augereau (Dec. 10).

Sir Arthur Wellesley was for this campaign created Baron Douro and Viscount Wellington. He was made captain-general by Spain, and marshal-general by Portugal. But his experience after Talavera had been akin to that of Moore; his expectations from the Spaniards had not been realized; he had been almost intercepted by the French, and he had narrowly escaped from a critical position. Henceforth he resisted all proposals for joint operations, on any large scale, with Spanish armies not under his own direct command.

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[1] After the battle the Light Division, under Robert Craufurd, joined Wellesley. In the endeavour to reach the field in time it had covered, in heavy marching order, over 50 m. in 25 hours, in hot July weather.

Campaign in Portugal, 1810.—Napoleon, having avenged Aspern by the victory of Wagram (July 6, 1809), despatched to Spain large reinforcements destined to increase his army there to about 370,000 men. Marshal Masséna with 120,000, including the corps of Ney, Junot, Reynier and some of the Imperial Guard, was to operate from Salamanca against Portugal; but first Soult, appointed major-general of the army in Spain (equivalent to chief of the staff), was, with the corps of Victor, Mortier and Sébastiani (70,000), to reduce Andalusia. Soult (Jan. 31, 1810) occupied Seville and escaping thence to Cadiz, the Supreme Junta resigned its powers to a regency of five members (Feb. 2, 1810). Cadiz was invested by Victor's corps (Feb. 4), and then Soult halted, waiting for Masséna, who arrived at Valladolid on the 15th of May.

In England a party in parliament were urging the withdrawal of the British troops, and any reverse to the allied arms would have strengthened its hands. Wellington's policy was thus cautious and defensive, and he had already commenced the since famous lines of Torres Vedras round Lisbon. In June 1810 his headquarters were at Celorico. With about 35,000 British, 30,000 Portuguese regular troops and 30,000 Portuguese militia, he watched the roads leading into Portugal past Ciudad Rodrigo to the north, and Badajoz to the south of the Tagus, as also the line of the Douro and the country between the Elga and the Ponsul.

Battle of Busaco, September 27, 1810.

Soult having been instructed to co-operate by taking Badajoz and Elvas, Masséna, early in June 1810, moved forward, and Ciudad Rodrigo surrendered to him (June 10). Next pushing back a British force under Craufurd, he invested Almeida, taking it on the 27th of August. Then calling up Reynier, who during this had moved on his left towards Alcantara, he marched down the right bank of the Mondego, and entered Viseu (Sept. 21). Wellington fell back before him down the left bank, ordering up Rowland Hill's force from the Badajoz road, the peasantry having been previously called upon to destroy their crops and retire within the lines of Torres Vedras. A little north of Coimbra, the road which Masséna followed crossed the Sierra de Bussaco (Busaco), a very strong position where Wellington resolved to offer him battle. Masséna, superior in numbers and over-confident, made a direct attack upon the heights on the 27th of September 1810: his strength being about 60,000, while that of the Allies was about 50,000, of whom nearly half were Portuguese. After a stern conflict the French were repulsed, the loss being five generals and nearly 5000 men, while the Allies lost about 1300. The next day Masséna turned the Sierra by the Boyalva Pass and Sardao, which latter place, owing to an error, had not been occupied by the Portuguese, and Wellington then retreated by Coimbra and Leiria to the lines, which he entered on the 11th of October, having within them fully 100,000 able-bodied men.

Lines of Torres Vedras, 1810-11.

The celebrated "Lines of Torres Vedras" were defensive works designed to resist any army which Napoleon could send against them. They consisted of three great lines, strengthened by about 150 redoubts, and earthworks of various descriptions, mounting some 600 cannon; the outer line, nearly 30 m. long, stretching over heights north of Lisbon, from the Tagus to the sea. As Masséna advanced, the Portuguese closing upon his rear retook Coimbra (Oct. 7), and when he neared the lines, astounded at their strength, he sent General Foy to the emperor to ask for reinforcements. After an effort, defeated by Hill, to cross the Tagus, he withdrew (Nov. 15) to Santarem. This practically closed Wellington's operations for the year 1810, his policy now being not to lose men in battle, but to reduce Masséna by hunger and distress.

In other parts of Spain, Augereau had taken Hostalrich (May 10); captured Lerida (May 14); Mequinenza (June 8); and invested Tortosa (Dec. 15). The Spanish levies had been unable to contribute much aid to the Allies; the French having subdued almost all Spain, and being now in possession of Ciudad Rodrigo and Almeida. On the other hand Wellington still held Lisbon with parts of Portugal, Elvas and Badajoz, for Soult had not felt disposed to attempt the capture of the last two fortresses.

Battle of Barrosa, March 5, 1811.

Campaign of 1811.—Napoleon, whose attention was now directed towards Russia, refused to reinforce Masséna, but enjoined Soult to aid him by moving against Badajoz. Soult, therefore, leaving Victor before Cadiz, invested Badajoz (Jan. 26, 1811) and took it from the Spaniards (March 10). With the hope of raising the blockade of Cadiz, a force under Sir Thomas Graham (afterwards Lord Lynedoch [*q.v.*]) left that harbour by sea, and joining with Spanish troops near Tarifa, advanced by land against Victor's blockading force, a Spanish general, La Peña, being in chief command. As they neared Barrosa, Victor attacked them, the Allies numbering in the battle about 13,000 with 24 guns, 4000 being British; the French 9000, actually engaged, with 14 guns; but with 5000 more a few miles off and others in the French lines. Hard fighting, chiefly between the French and British, now ensued, and at one time the Barrosa ridge, the key of the position left by La Peña's orders, practically undefended, fell into the French hands: but Graham by a resolute counter-attack regained it, and Victor was in the end driven back. La Peña, who had in the battle itself failed to give proper support to Graham, would not pursue, and Graham declining to carry on further operations with him, re-entered Cadiz. The French afterwards resumed the blockade, so that although Barrosa was an allied victory, its object was not attained. The British loss was about 1200; the French 2000, 6 guns and an eagle.

Masséna's Retreat.

On the day of the above battle Masséna, having destroyed what guns he could not horse, and skilfully gained time by a feint against Abrantes, began his retreat from before the lines, through Coimbra and Espinhal. His army was in serious distress; he was in want of food and supplies; most of his horses were dead, and his men were deserting. Wellington followed, directing the Portuguese to remove all boats from the Mondego and Douro, and to break up roads north of the former river. Beresford was detached to succour Badajoz, but was soon recalled, as it had fallen to Soult. Ney, commanding Masséna's rearguard, conducted the retreat with great ability. In the pursuit, Wellington adhered to his policy of husbanding his troops for future offensive operations, and let sickness and hunger do the work of the sword. This they effectually did. Nothing could well exceed the horrors of Masséna's retreat. Rearguard actions were fought at Pombal (March 10), Redinha (March 12) and Condeixa (March 13). Here Ney was directed to make a firm stand; but, ascertaining that the Portuguese were at Coimbra and the bridge there broken, and fearing to be cut off also from Murcella, he burnt Condeixa, and marched to Cazal Nova. An action took place here (March 14) and at Foz d'Arouce (March 15). Wellington now sent off Beresford with a force to retake Badajoz; and Masséna, sacrificing much of his baggage and ammunition, reached Celorico and Guarda (March 21). Here he was attacked by Wellington (March 29) and, after a further engagement at Sabugal (April 3, 1811), he fell back through Ciudad to Salamanca, having lost in Portugal nearly 30,000 men, chiefly from want and disease, and 6000 in the retreat alone.

Battle of Fuentes d'Onor, May 5, 1811.

The key to the remaining operations of 1811 lies in the importance attached by both Allies and French to the possession of the fortresses which guarded the two great roads from Portugal into Spain—Almeida and Ciudad Rodrigo on the northern, and Badajoz and Elvas on the southern road; all these except Elvas were in French hands. Wellington, on the 9th of April 1811, directed General Spencer to invest Almeida; he then set off himself to join Beresford before Badajoz, but after reconnoitring the fortress with his lieutenant he had at once to return north on the news that Masséna was moving to relieve Almeida. On the 3rd of May Loison attacked him at Fuentes d'Onor near Almeida, and Masséna coming up himself made a more serious attack on the 5th of May. The Allies numbered about 33,000, with 42 guns; the French 45,000 with 30 guns. The battle is chiefly notable for the steadiness with which the allied right, covered by the Light Division in squares, changed position in presence of the French cavalry; and for the extraordinary feat of arms of Captain Norman Ramsay, R.H.A., in charging through the French cavalry with his guns. Masséna failed to dislodge the Allies, and on the 8th of May withdrew to Salamanca, Almeida falling to Wellington on the 11th of May 1811. The allied loss in the fighting on both days at Fuentes d'Onor was about 1500: the French 3000.

Battle of Albuera, May 16, 1811.

In the meantime Soult (with 23,000 men and 50 guns), advancing to relieve Badajoz, compelled Beresford to suspend the siege, and to take up a position with about 30,000 men (of whom 7000 were British) and 38 guns behind the river Albuhera (or Albuera). Here Soult attacked him on the 16th of May. An unusually bloody battle ensued, in which the French efforts were chiefly directed against the allied right, held by the Spaniards. At one time the right appeared to be broken, and 6 guns were lost, when a gallant advance of Sir Lowry Cole's division restored the day, Soult then falling back towards Seville. The allied loss was about 7000 (including about half the British force); the French about 8000.

After this Wellington from Almeida rejoined Beresford and the siege of Badajoz was continued: but now Marshal Marmont, having succeeded Masséna, was marching southwards to join Soult, and, two allied assaults of Badajoz having failed, Wellington withdrew. Subsequently, leaving Hill in the Alemtejo, he returned towards Almeida, and with 40,000 men commenced a blockade of Ciudad Rodrigo, his headquarters being at Fuente Guinaldo. Soult and Marmont now fell back, the former to Seville, the latter to the valley of the Tagus, south of the pass of Baños.

In September, Marmont joined with the army of the north under General Dorsenne, coming from Salamanca—their total force being 60,000, with 100 guns—and succeeded (Sept. 25) in introducing a convoy of provisions into Ciudad Rodrigo. Before so superior a force, Wellington had not attempted to maintain the blockade; but on Marmont afterwards advancing towards him, he fought a rearguard action with him at El Bodon (Sept. 25), notable, as was Fuentes d'Onor, for the coolness with which the allied squares retired amidst the enemy's horsemen; and again at Fuente Guinaldo (Sept. 25 and 26) he maintained for 30 hours, with 15,000 men, a bold front against Marmont's army of 60,000, in order to save the Light Division from being cut off. At Aldea de Ponte there was a further sharp engagement (Sept. 27), but Wellington taking up a strong position near Sabugal, Marmont and Dorsenne withdrew once more to the valley of the Tagus and Salamanca respectively, and Wellington again blockaded Ciudad Rodrigo.

Thus terminated the main operations of this year. On the 28th of October 1811, Hill, by a very skilful surprise, captured Arroyo de los Molinos (between Badajoz and Trujillo), almost annihilating a French corps under Gérard; and in December 1811 the French were repulsed in their efforts to capture Tarifa near Cadiz. In the east of Spain Suchet took Tortosa (Jan. 1, 1811); Tarragona (June 28); and Murviedro (Oct. 26), defeating Blake's relieving force, which then took refuge in Valencia. Macdonald also retook Figueras which the Spaniards had taken on the 9th of April 1811 (Aug. 19). Portugal had now been freed from the French, but they still held Ciudad Rodrigo and Badajoz, the two main gates into Spain.

Campaign in Spain, 1812.—The campaign of 1812 marks an important stage in the war. Napoleon, with the Russian War in prospect, had early in the year withdrawn 30,000 men from Spain; and Wellington had begun to carry on what he termed a war of "magazines." Based on rivers (the navigation of which greatly improved) and the sea, he formed dépôts or magazines of provisions at many points, which enabled him always to take and keep the field. The French, on the other hand, had great difficulty in establishing any such reserves of food, owing to their practice of depending for sustenance entirely upon the country in which they were quartered. Wellington assumed the offensive, and by various movements and feints, aided the guerrilla bands by forcing the French corps to assemble in their districts, which not only greatly harassed them but also materially hindered the combination of their corps for concerted action. Having secretly got a battering train into Almeida and directed Hill, as a blind, to engage Soult by threatening Badajoz, he suddenly (Jan. 8, 1812) besieged Ciudad Rodrigo.

The French, still numbering nearly 200,000, now held the following positions: the Army of the North—Dorsenne (48,000)—was about the Pisuerga, in the Asturias, and along the northern coast; the Army of Portugal—Marmont (50,000)—mainly in the valley of the Tagus, but ordered to Salamanca; the Army of the South—Soult (55,000)—in Andalusia; the Army of the Centre—Joseph (19,000)—about Madrid.

Siege of Ciudad Rodrigo, January 8-19, 1812.

Siege of Badajoz, March 17 to April 7, 1812.

The siege of Ciudad Rodrigo was calculated in the ordinary course to require twenty-four days: but on it becoming known that Marmont was moving northward, the assault was delivered after twelve days only (Jan. 19). The gallantry of the troops made it successful, though with the loss of Generals Craufurd and McKinnon, and 1300 men, and Marmont's battering train of 150 guns here fell into the allied hands. Then, after a feint of passing on into Spain, Wellington rapidly marched south and, with 22,000 men, laid siege to Badajoz (March 17, 1812), Hill with 30,000 covering the siege near Merida. Wellington was hampered by want of time, and had to assault prematurely. Soult and Marmont having begun to move to relieve the garrison, the assault was delivered on the night of the 7th of April, and though the assailants failed at the breaches, the carnage at which was terrible, a very daring escalade of one of the bastions and of the castle succeeded, and Badajoz fell, Soult's pontoon train being taken in it. After the assault, some deplorable excesses were committed by the victorious troops. The allied loss was 3600 in the assault alone and 5000 in the entire siege.

The Allies had now got possession of the two great gates into Spain: and Hill, by an enterprise most skilfully carried out, destroyed (May 19) the Tagus bridge at Almaraz, by which Soult to the south of the river chiefly communicated with Marmont to the north. Wellington then, ostentatiously making preparations to enter Spain by the Badajoz line, once more turned northward, crossed the Tormes (June 17, 1812), and advanced to the Douro, behind which the French were drawn up. Marmont had erected at Salamanca some strong forts, the reduction of which occupied Wellington ten days, and cost him 600 men. The Allies and French now faced each other along the Douro to the Pisuerga. The river was high, and Wellington hoped that want of supplies would compel Marmont to retire, but in this he was disappointed.

Battle of Salamanca, July 22, 1812.

On the 15th of July 1812, Marmont, after a feint against Wellington's left, suddenly, by a forced march, turned his right, and made rapidly towards the fords of Huerta and Alba on the Tormes. Some interesting manœuvres now took place, Wellington moving parallel and close to Marmont, but more to the north, making for the fords of Aldea Lengua and Santa Marta on the Tormes nearer to Salamanca, and being under the belief that the Spaniards held the castle and ford at Alba on that river. But Marmont's manœuvring and marching power had been underestimated, and on the 21st of July while Wellington's position covered Salamanca, and but indirectly his line of communications through Ciudad Rodrigo, Marmont had reached a point from which he hoped to interpose between Wellington and Portugal, on the Ciudad Rodrigo road. This he endeavoured to do on the 22nd of July 1812, which brought on the important battle of Salamanca (*q.v.*) in which Wellington gained a decisive victory, the French falling back to Valladolid and thence to Burgos. Wellington entered Valladolid (July 30), and thence marched against Joseph, who (July 21) had reached Blasco Sancho with reinforcements for Marmont. Joseph retired before him, and Wellington entered Madrid (Aug. 12, 1812), where, in the Retiro, 1700 men, 180 cannon, two eagles, and a quantity of stores were captured. Soult now raised the siege of Cadiz (Aug. 26), and evacuating Andalusia joined Suchet with some 55,000 men. Wellington then brought up Hill to Madrid.

Siege of the Castle of Burgos, Sept. 19 to Oct. 21.

Retreat from Burgos.

On the 1st of September 1812, the French armies having begun once more to collect together, Wellington marched against the Army of the North, now under General Clausel, and laid siege to the castle of Burgos (Sept. 19) to secure the road towards Santander on the coast. But the strength of the castle had been underrated; Wellington had insufficient siege equipment and transport for heavy guns; five assaults failed, and Soult (having left Suchet in Valencia) and also the Army of Portugal were both approaching, so Wellington withdrew on the night of the 21st of October, and, directing the evacuation of Madrid, commenced the "Retreat from Burgos." In this retreat, although military operations were skilfully conducted, the Allies lost 7000 men, and discipline, as in that to Corunna, became much relaxed.

By November 1812, Hill having joined him at Salamanca, Wellington once more had gone into cantonments near Ciudad Rodrigo, and the French armies had again scattered for convenience of supply. In spite of the failure before Burgos, the successes of the campaign had been brilliant. In addition to the decisive victory of Salamanca, Madrid had been occupied, the siege of Cadiz raised, Andalusia freed, and Ciudad Rodrigo and Badajoz stormed. Early in January also the French had abandoned the siege of Tarifa, though Valencia had surrendered to them (Jan. 9). One important result of the campaign was that the Spanish Cortes nominated Wellington (Sept. 22, 1812) to the unfettered command of the Spanish armies. For the operations of this campaign Wellington was created earl, and subsequently marquess of Wellington; duke of Ciudad Rodrigo by Spain, and marquis of Torres Vedras by Portugal.

Campaign in Spain and the South of France, 1813.—At the opening of 1813, Suchet, with 63,000 men, had been left to hold Valencia, Aragon and Catalonia; and the remainder of the French (about 137,000) occupied Leon, the central provinces and Biscay, guarding also the communications with France. Of these about 60,000 under Joseph were more immediately opposed to Wellington, and posted, in scattered detachments, from Toledo and Madrid behind the Tormes to the Douro, and along that river to the Esla. Wellington had further organized the Spanish forces—Castaños (40,000), with the guerrilla bands of Mina, Longa and others, was in Galicia, the Asturias and northern Spain; Copons (10,000) in Catalonia; Elio (20,000) in Murcia; Del Parque (12,000) in the Sierra Morena, and O'Donell (15,000) in Andalusia. More Portuguese troops had been raised, and reinforcements received from England, so that the Allies, without the Spaniards above alluded to, now numbered some 75,000 men, and from near the Coa watched the Douro and Tormes, their line stretching from their left near Lamego to the pass of Baños, Hill being on the right. The district of the Tras-os-Montes, north of the Douro, about the Tamega, Tua and Sabor, was so rugged that Wellington was convinced that Joseph would expect him to advance by the south of the river. He therefore, moving by the south bank himself with Hill, to confirm Joseph in this expectation, crossed the Tormes near and above Salamanca, having previously—which was to be the decisive movement—detached Graham, with 40,000 men, to make his way, through the difficult district above mentioned, towards Braganza, and then, joining with the Spaniards, to turn Joseph's right. Graham, crossing the Douro near Lamego, carried out his laborious march with great energy, and Joseph retired precipitately from the Douro, behind the Pisuerga. The allied army, raised by the junction of the Spanish troops in Galicia to 90,000, now concentrated near Toro, and moved towards the Pisuerga, when Joseph, blowing up the castle of Burgos, fell back behind the Ebro. Once more Wellington turned his right, by a sweeping movement through Rocamunde and Puente Arenas near the source of the Ebro, when he retreated behind the Zadorra near the town of Vitoria.

Battle of Vitoria, June 21, 1813.

Santander was now evacuated by the French, and the allied line of communications was changed to that port. On the 20th of June Wellington encamped along the river Bayas, and the next day attacked Joseph. For a description of the decisive battle of Vitoria (June 21, 1813), see VITORIA. In it King Joseph met with a crushing defeat, and, after it, the wreck of his army, cut off from the Vitoria-Bayonne road, escaped towards Pampeluna. Within a few days Madrid was evacuated, and all the French forces, with the exception of the garrisons of San Sebastian (3000), Pampeluna (3000), Santona (1500), and the troops under Suchet holding posts in Catalonia and Valencia, had retired across the Pyrenees into France. The Spanish peninsula was, to all intents and purposes, free from foreign domination, although the war was yet far from concluded. The French struggled gallantly to the close: but now a long succession of their leaders—Junot, Soult, Victor, Masséna, Marmont, Joseph—had been in turn forced to recoil before Wellington; and while their troops fought henceforward under the depressing memory of many defeats, the Allies did so under the inspiring influence of great successes, and with that absolute confidence in their chief which doubled their fighting power.

Siege of San Sebastian, July 10-24, 1813.

Battles of the Pyrenees, July 25 to August 2, 1813.

Storm of San Sebastian, August 31, 1813.

For this decisive campaign, Wellington was made a field marshal in the British army, and created duke of Victory[1] by the Portuguese government in Brazil. He now, with about 80,000 men, took up a position with his left (the Spaniards) on the Bidassoa near San Sebastian. Thence his line stretched along the Pyrenees by the passes of Vera, Echallar, Maya and Roncesvalles, to Altobiscar; his immediate object now being to reduce the fortresses of San Sebastian and Pampeluna. Not having sufficient *matériel* for two sieges, he laid siege to San Sebastian only, and blockaded Pampeluna. Sir Thomas Graham commenced the active siege of San Sebastian on the 10th of July 1813, but as Soult was approaching to its relief, the assault was ordered for daylight on the 24th. Unfortunately a conflagration breaking out near the breaches caused it to be postponed until nightfall, when, the breaches in the interval having been strengthened, it was delivered unsuccessfully and with heavy loss. Wellington then suspended the siege in order to meet Soult, who endeavoured (July 25) to turn the allied right, and reach Pampeluna. Attacking the passes of Maya and Roncesvalles, he obliged their defenders to retire, after sharp fighting, to a position close to Sorauren, which, with 25,000 men, he attempted to carry (July 28). By this time Wellington had reached it from the allied left; reinforcements were pressing up on both sides, and about 12,000 allied troops faced the French. A struggle, described by Wellington as "bludgeon work," now ensued, but all efforts to dislodge the Allies having failed, Soult, withdrawing, manœuvred to his right towards San Sebastian. Wellington now assumed the offensive, and, in a series of engagements, drove the French back (Aug. 2) beyond the Pyrenees. These included Roncesvalles and Maya (July 25); Sorauren (July 28 and 30); Yanzi (Aug. 1); and Echallar and Ivantelly (Aug. 2), the total losses in them being about—Allies under 7000, French 10,000. After this, Wellington renewing the siege of San Sebastian carried the place, excepting the castle, after a heavy expenditure of life (Aug. 31). Upon the day of its fall Soult attempted to relieve it, but in the combats of Vera and St Marcial was repulsed. The castle surrendered on the 9th of September, the losses in the entire siege having been about—Allies 4000, French 2000. Wellington next determined to throw his left across the river Bidassoa to strengthen his own position, and secure the port of Fuenterrabia.

Now commenced a series of celebrated river passages, which had to be effected prior to the further invasion of France. At daylight on the 7th of October 1813 he crossed the Bidassoa in seven columns, and attacked the entire French position, which stretched in two heavily entrenched lines from north of the Irun-Bayonne road, along mountain spurs to the Great Rhune, 2800 ft. high. The decisive movement was a passage in strength near Fuenterrabia, to the astonishment of the enemy, who in view of the width of the river and the shifting sands, had thought the crossing impossible at that point. The French right was then rolled back, and Soult was unable to reinforce his right in time to retrieve the day. His works fell in succession after hard fighting, and he withdrew towards the river Nivelle. The loss was about—Allies, 1600; French, 1400. The passage of the Bidassoa "was a general's not a soldiers' battle" (Napier).

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[1] *Duque da Victoria*, often incorrectly duke of Vitoria. The coincidence of the title with the place-name of the battle which had not yet been fought when the title was conferred, is curious, but accidental.

Passage of the Bidassoa, October 7, 1813.

On the 31st of October Pampeluna surrendered, and Wellington was now anxious to drive Suchet from Catalonia before further invading France. The British government, however, in the interests of the continental powers, urged an immediate advance, so on the night of the 9th of November 1813 he brought up his right from the Pyrenean passes to the northward of Maya and towards the Nivelle. Soult's army (about 79,000), in three entrenched lines, stretched from the sea in front of St Jean de Luz along commanding ground to Amotz and thence, behind the river, to Mont Mondarin near the Nive. Each army had with it about 100 guns; and, during a heavy cannonade, Wellington on the 10th of November 1813 attacked this extended position of 16 m. in five columns, these being so directed that after carrying Soult's advanced works a mass of about 50,000 men converged towards the French centre near Amotz, where, after hard fighting, it swept away the 18,000 of the second line there opposed to it, cutting Soult's army in two. The French right then fell back to St Jean de Luz, the left towards points on the Nive. It was now late and the Allies, after moving a few miles down both banks of the Nivelle, bivouacked, while Soult, taking advantage of the respite, withdrew in the night to Bayonne. The allied loss was about 2700; that of the French 4000, 51 guns, and all their magazines. The next day Wellington closed in upon Bayonne from the sea to the left bank of the Nive.

Passage of the Nivelle, Nov. 10, 1813.

After this there was a period of comparative inaction, though during it the French were driven from the bridges at Urdains and Cambo. The weather had become bad, and the Nive unfordable; but there were additional and serious causes of delay. The Portuguese and Spanish authorities were neglecting the payment and supply of their troops. Wellington had also difficulties of a similar kind with his own government, and also the Spanish soldiers, in revenge for many French outrages, had become guilty of grave excesses in France, so that Wellington took the extreme step of sending 25,000 of them back to Spain and resigning the command of their army, though his resignation was subsequently withdrawn. So great was the tension at this crisis that a rupture with Spain seemed possible. These matters, however, having been at length adjusted, Wellington, who in his cramped position between the sea and the Nive could not use his cavalry or artillery effectively, or interfere with the French supplies coming through St Jean Pied de Port, determined to occupy the right as well as the left bank of the Nive. He could not pass to that bank with his whole force while Soult held Bayonne, without exposing his own communications through Irun. Therefore, on the 9th of December 1813, after making a demonstration elsewhere, he effected the passage with a portion of his force only under Hill and Beresford, near Ustaritz and Cambo, his loss being slight, and thence pushed down the river towards Villefranque, where Soult barred his way across the road to Bayonne. The allied army was now divided into two portions by the Nive; and Soult from Bayonne at once took advantage of his central position to attack it with all his available force, first on the left bank and then on the right. On the morning of the 10th of December he fell, with 60,000 men and 40 guns, upon Hope, who with 30,000 men and 24 guns held a position from the sea, 3 m. south of Biarritz on a ridge behind two lakes (or tanks) through Arcangues towards the Nive. Desperate fighting now ensued, but fortunately, owing to the intersected ground, Soult was compelled to advance slowly, and in the end, Wellington coming up with Beresford from the right bank, the French retired baffled. On the 11th and 12th of December there were engagements of a less severe character, and finally on the 13th of December Soult with 35,000 men made a vehement attack up the right bank of the Nive against Hill, who with about 14,000 men occupied some heights from Villefranque past St Pierre (Lostenia) to Vieux Moguerre. The conflict about St Pierre (Lostenia) was one of the most bloody of the war; but for hours Hill maintained his ground, and finally repulsed the French before Wellington, delayed by his pontoon bridge over the Nive having been swept away, arrived to his aid. The losses in the four days' fighting in the battles before Bayonne (or battles of the Nive) were—Allies about 5000, French about 7000. Both the British and Portuguese artillery, as well as infantry, greatly distinguished themselves in these battles.

Passage of the Nive, Dec. 9, 1813.

Battles before Bayonne, or Battles of the Nive, Dec. 10-13, 1813.

In eastern Spain Suchet (April 11, 1813) had defeated Elio's Murcians at Yecla and Villena, but was subsequently routed by Sir John Murray[1] near Castalla (April 13), who then besieged Tarragona. The siege was abandoned after a time, but was later on renewed by Lord W. Bentinck. Suchet, after the battle of Vitoria, evacuated Tarragona (Aug. 17) but defeated Bentinck in the combat of Ordal (Sept. 13).

Campaign in the South of France, 1814.—When operations recommenced in February 1814 the French line extended from Bayonne up the north bank of the Adour to the Pau, thence bending south along the Bidouze to St Palais, with advanced posts on the Joyeuse and at St Jean Pied de Port. Wellington's left, under Hope, watched Bayonne, while Beresford, with Hill, observed the Adour and the Joyeuse, the right trending back till it reached Urcuray on the St Jean Pied de Port road. Exclusive of the garrison of Bayonne and other places, the available field force of Soult numbered about 41,000, while that of the Allies, deducting Hope's force observing Bayonne, was of much the same strength. It had now become Wellington's object to draw Soult away from Bayonne, in order that the allied army might, with less loss, cross the Adour and lay siege to the place on both banks of the river.

At its mouth the Adour was about 500 yds. wide, and its entrance from the sea by small vessels, except in the finest weather, was a perilous undertaking, owing to the shifting sands and a dangerous bar. On the other hand, the deep sandy soil near its banks made the transport of bridging *matériel* by land laborious, and almost certain of discovery. Wellington, convinced that no effort to bridge below Bayonne would be expected, decided to attempt it there, and collected at St Jean Pied de Port and Passages a large number of country vessels (termed *chasse-marées*). Then, leaving Hope with 30,000 men to watch Bayonne, he began an enveloping movement round Soult's left. Hill on the 14th and 15th of February, after a combat at Garris, drove the French posts beyond the Joyeuse; and Wellington then pressed these troops back over the Bidouze and Gave[2] de Mauleon to the Gave d'Oleron. Wellington's object in this was at once attained, for Soult, leaving only 10,000 men in Bayonne, came out and concentrated at Orthes on the Pau. Then Wellington (Feb. 19) proceeded to St Jean de Luz to superintend the despatch of boats to the Adour. Unfavourable weather, however, compelled him to leave this to Sir John Hope and Admiral Penrose, so returning to the Gave d'Oleron he crossed it, and faced Soult on the Pau (Feb. 25). Hope in the meantime, after feints higher up the Adour, succeeded (Feb. 22 and 23) in passing 600 men across the river in boats. The nature of the ground, and there being no suspicion of an attempt at this point, led to the French coming out very tardily to oppose them; and when they did, some Congreve rockets (then a novelty) threw them into confusion, so that the right bank was held until, on the morning of the 24th, the flotilla of

Passage of the Adour, Feb. 22 to 26, 1814.

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[1] Commander of a British expedition from the Mediterranean islands.

[2] "Gave" in the Pyrenees means a mountain stream or torrent.

chasse-marées appeared from St Jean de Luz, preceded by men-of-war boats. Several men and vessels were lost in crossing the bar; but by noon on the 26th of February the bridge of 26 vessels had been thrown and secured; batteries and a boom placed to protect it, 8000 troops passed over, and the enemy's gunboats driven up the river. Bayonne was then invested on both banks as a preliminary to the siege.

Battle of Orthes, Feb. 27, 1814.

On the 27th of February Wellington, having with little loss effected the passage of the Pau below Orthes, attacked Soult. In this battle the Allies and French were of about equal strength (37,000): the former having 48 guns, the latter 40. Soult held a strong position behind Orthes on heights commanding the roads to Dax and St Sever. Beresford was directed to turn his right, if possible cutting him off from Dax, and Hill his left towards the St Sever road. Beresford's attack, after hard fighting over difficult ground, was repulsed, when Wellington, perceiving that the pursuing French had left a central part of the heights unoccupied, thrust up the Light Division into it, between Soult's right and centre. At the same time Hill, having found a ford above Orthes, was turning the French left, when Soult retreated just in time to save being cut off, withdrawing towards St Sever, which he reached on the 28th of February. The allied loss was about 2000; the French 4000 and 6 guns.

Battle of Toulouse, April 10, 1814.

From St Sever Soult turned eastwards to Aire, where he covered the roads to Bordeaux and Toulouse. Beresford, with 12,000 men, was now sent to Bordeaux, which opened its gates as promised to the Allies. Driven by Hill from Aire on the 2nd of March 1814, Soult retired by Vic Bigorre, where there was a combat (March 19), and Tarbes, where there was a severe action (March 20), to Toulouse behind the Garonne. He endeavoured also to rouse the French peasantry against the Allies, but in vain, for Wellington's justice and moderation afforded them no grievances. Wellington wished to pass the Garonne above Toulouse in order to attack the city from the south—its weakest side—and interpose between Soult and Suchet. But finding it impracticable to operate in that direction, he left Hill on the west side and crossed at Grenade below Toulouse (April 3). When Beresford, who had now rejoined Wellington, had passed over, the bridge was swept away, which left him isolated on the right bank. But Soult did not attack; the bridge (April 8) was restored; Wellington crossed the Garonne and the Ers, and attacked Soult on the 10th of April. In the battle of Toulouse the French numbered about 40,000 (exclusive of the local National Guards) with 80 guns; the Allies under 52,000 with 64 guns. Soult's position to the north and east of the city was exceedingly strong, consisting of the canal of Languedoc, some fortified suburbs, and (to the extreme east) the commanding ridge of Mont Rave, crowned with redoubts and earthworks. Wellington's columns, under Beresford, were now called upon to make a flank march of some two miles, under artillery, and occasionally musketry, fire, being threatened also by cavalry, and then, while the Spanish troops assaulted the north of the ridge, to wheel up, mount the eastern slope, and carry the works. The Spaniards were repulsed, but Beresford gallantly took Mont Rave and Soult fell back behind the canal. On the 12th of April Wellington advanced to invest Toulouse from the south, but Soult on the night of the 11th had retreated towards Villefranque, and Wellington then entered the city. The allied loss was about 5000; the French 3000. Thus, in the last great battle of the war, the courage and resolution of the soldiers of the Peninsular army were conspicuously illustrated.

On the 13th of April 1814 officers arrived with the announcement to both armies of the capture of Paris, the abdication of Napoleon, and the practical conclusion of peace; and on the 18th a convention, which included Suchet's force, was entered into between Wellington and Soult. Unfortunately, after Toulouse had fallen, the Allies and French, in a sortie from Bayonne on the 14th of April, each lost about 1000 men: so that some 10,000 men fell after peace had virtually been made.

In the east, during this year (1814), Sir W. Clinton had, on the 16th of January, attacked Suchet at Molins de Rey and blockaded Barcelona (Feb. 7); the French posts of Lerida, Mequinenza and Monzon had also been yielded up, and Suchet, on the 2nd of March, had crossed the Pyrenees into France. Figueras surrendered to Cuesta before the end of May; and peace was formally signed at Paris on the 30th of May.

Thus terminated the long and sanguinary struggle of the Peninsular War. The British troops were partly sent to England, and partly embarked at Bordeaux for America, with which country war had broken out (see AMERICAN WAR OF 1812–15): the Portuguese and Spanish recrossed the Pyrenees: the French army was dispersed throughout France: Louis XVIII. was restored to the French throne: and Napoleon was permitted to reside in the island of Elba, the sovereignty of which had been conceded to him by the allied powers. For the operations of this campaign Wellington was created marquess of Douro and duke of Wellington, and peerages were conferred upon Beresford, Graham and Hill.

The events of the Peninsular War, especially as narrated in the Wellington Despatches, are replete with instruction not only for the soldier, but also for the civil administrator. Even in a brief summary of the war one salient fact is noticeable, that all Wellington's reverses were in connexion with his sieges, for which his means were never adequate. In his many battles he was always victorious, his strategy eminently successful, his organizing and administrative power exceptionally great, his practical resource unlimited, his soldiers most courageous; but he never had an army fully complete in its departments and warlike equipment. He had no adequate corps of sappers and miners, or transport train. In 1812 tools and material of war for his sieges were often insufficient. In 1813, when he was before San Sebastian, the ammunition ran short; a battering train, long demanded, reached him not only some time after it was needed, but even then with only one day's provision of shot and shell. For the siege of Burgos heavy guns were available in store on the coast; but he neither had, nor could procure, the transport to bring them up. By resource and dogged determination Wellington rose superior to almost every difficulty, but he could not overcome all; and the main teaching of the Peninsular War turns upon the value of an army that is completely organized in its various branches before hostilities break out. (C. W. R.)

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PEÑISCOLA, a town of eastern Spain, in the province of Castellón de la Plana, and on the Mediterranean Sea, 5 m. by road S. of Benicarló. Pop. (1900), 3142. Peñiscola, often called the Gibraltar of Valencia, is a fortified seaport, with a lighthouse, built on a rocky headland about 220 ft. high, and only joined to the mainland by a narrow strip of sand. Originally a Moorish stronghold, it was captured in 1233 by James I. of Aragon, who entrusted it to the Knights Templar. In the 14th century it was garrisoned by the knights of Montesa, and in 1420 it reverted to the Crown. From 1415 it was the home of the schismatic pope Benedict XIII. (Pedro de Luna), whose name is commemorated in the Bufador de Papa Luna, a curious cavern with a landward entrance through which the sea-water escapes in clouds of spray.

PENITENTIAL (Lat. *poenitentiale*, *libellus poenitentialis*, &c.), a manual used by priests of the Catholic Church for guidance in assigning the penance due to sins. Such manuals played a large rôle in the early middle ages, particularly in Ireland, England and Frankland, and their influence in the moral education of the barbarian races has not received sufficient attention from historians. They were mainly composed of canons drawn from various councils and of *dicta* from writings of some of the fathers. Disciplinary regulations in Christian communities are referred to from the very borders of the apostolic age, and a system of careful oversight of those admitted to the mysteries developed steadily as the membership grew and dangers of contamination with the outside world increased. These were the elaborate precautions of the catechumenate, and —as a bulwark against the persecutions—the rigid system known as the Discipline of the Secret (*disciplina arcani*). The treatment of the lapsed, which produced the Novatian heresy, was also responsible for what has frequently been referred to as the first penitential. This is the *libellus* in which, according to Cyprian (*Ep.* 51), the decrees of the African synods of 251 and 255 were embodied for the guidance of the clergy in dealing with their repentant and returning flocks. This manual, which has been lost, was evidently not like the code-like compilations of the 8th century, and it is somewhat misleading to speak of it as a penitential. Jurisdiction in penance was still too closely limited to the upper ranks of the clergy to call forth such literature. Besides the bishop an official well versed in the penitential regulations of the Church, called the *poenitentiarius*, assigned due penalties for sins. For their guidance there was considerable conciliar legislation (*e.g.* Ancyra, Nicaea, Neocaesarea, &c.), and certain patristic letters which had acquired almost the force of decretals. Of the latter the most important were the three letters of St Basil of Caesarea (d. 379) to Bishop Amphilochus of Iconium containing over eighty headings.

Three things tended to develop these rules into something like a system of penitential law. These were the development of auricular confession and private penance; the extension of the penitential jurisdiction among the clergy owing to the growth of a parochial priesthood; and the necessity of adapting the penance to the primitive ideas of law prevailing among the newly converted barbarians, especially the idea of compensation by the *wergild*. In Ireland in the middle of the 5th century appeared the "canons of St Patrick." In the first half of the next century these were followed by others, notably those of St Finian (d. 552). At the same time the Celtic British Church produced the penitentials of St David of Menevia (d. 544) and of Gildas (d. 583) in addition to synodal legislation. These furnished the material to Columban (d. 615) for his *Liber de poenitentia* and his monastic rule, which had a great influence upon the continent of Europe. The Anglo-Saxon Church was later than the Irish, but under Theodore of Tarsus (d. 690), archbishop of Canterbury, the practice then in force was made the basis of the most important of all penitentials. The *Poenitentiale Theodori* became the authority in the Church's treatment of sinners for the next four centuries, both in England and elsewhere in Europe. The original text, as prepared by a disciple of Theodore, and embodying his decisions, is given in Haddan and Stubbs's *Councils and Ecclesiastical Documents relating to Great Britain and Ireland* (iii. 173 seq.). A *Penitentiale Commeani* (St Cumian), dating apparently from the early 8th century, was the third main source of Frankish penitentials. The extent and variety of this literature led the Gallican Church to exercise a sort of censorship in order to secure uniformity. After numerous synods, Bishop Haltigar of Cambrai was commissioned by Ebo of Reims in 829 to prepare a definitive edition. Haltigar used, among his other materials, a so-called *poenitentiale romanum*, which was really of Frankish origin. The canons printed by David Wilkins in his *Concilia* (1737) as being by Ecgbert of York (d. 767) are largely a translation into Anglo-Saxon of three books of Haltigar's penitentials. In 841 Hrabanus Maurus undertook a new *Liber poenitentium* and wrote a long letter on the subject to Heribald of Auxerre about 853. Then followed the treatise of Reginon of Prum in 906, and finally the collection made by Burchard, bishop of Worms, between 1012 and 1023. The codification of the canon law by Gratian and the change in the sacramental position of penance in the 12th century closed the history of penitentials.

Much controversy has arisen over the question whether there was an official papal penitential. It is claimed that (quite apart from Haltigar's *poenitentiale romanum*) such a set of canons existed early in Rome, and the attempt has been made by H. J. Schmitz in his learned treatise on penitentials (*Buszbücher und das kanonische Buszverfahren*, 1883 and 1898) to establish their pontifical character. The matter is still in dispute, Schmitz's thesis not having met with universal acceptance.

In addition to the works mentioned above the one important work on the penitentials was L. W. H. Wasserschleben's epoch-making study and collection of texts, *Die Buszordnungen der abendländischen Kirche nebst einer rechtsgeschichtlichen Einleitung* (Halle, 1851). See articles in Wetzer and Welte's *Kirchenlexikon*, Hauck's *Realencyklopädie*, and Haddan and Stubbs's *Councils*. See also Seebasz in *Zeitschrift für Kirchengeschichte*, xviii. 58. On the canons of St Patrick see the *Life of St Patrick* by J. B. Bury (pp. 233–275).

PENITENTIARY (med. Lat. *poenitentiarius*, from *poenitentia*, penance, *poena*, punishment, a term used both as adjective and substantive, referring either to the means of repentance or that of punishment. In its ecclesiastical use the word is used as the equivalent both of the Latin *poenitentiarius*, "penitentiary priest," and *poenitentiaria*, the dignity or office of a *poenitentiarius*. By an extension of the latter sense the name is applied to the department of the Roman Curia known as the apostolic penitentiary (*sacra poenitentiaria apostolica*), presided over by the cardinal grand penitentiary (*major poenitentiarius*, Ital. *penitenziere maggiore*) and having jurisdiction more particularly in all questions *in foro interno* reserved for the Holy See (see CURIA ROMANA). In general, the *poenitentiarius*, or penitentiary priest, is in each diocese what the grand penitentiary is at Rome, *i.e.* he is appointed to deal with all cases of conscience reserved for the bishop. In the Eastern Church there are very early notices of such appointments; so far as the West is concerned, Hinschius (*Kirchenrecht*, i. 428, note 2) quotes from the chronicle of Bernold, the monk of St Blase (*c.* 1054–1100), as the earliest record of such appointment, that made by the papal legate Odo of Ostia in 1054. In 1215 the fourth Lateran Council, by its 10th canon, ordered suitable men to be ordained in all cathedral and conventual churches, to act as coadjutors and assistants to the bishops in hearing confessions and imposing penances. The rule was not immediately nor universally obeyed, the bishops being slow to delegate their special powers. Finally, however, the council of Trent (Sess. xxiv. cap. viii. *de reform.*) ordered that, "wherever it could conveniently be done," the bishop should appoint in his cathedral a *poenitentiarius*, who should be a doctor or licentiate in theology or canon law and at least forty years of age.

See P. Hinschius, *Kirchenrecht*, i. 427, &c. (Berlin, 1869); Du Cange, *Glossarium s.v.* "Poenitentiarius"; Herzog-Hauck, *Realencyklopädie* (ed. 1904), *s.v.* "Pönitentiarius."

PENKRIDGE, a town in the western parliamentary division of Staffordshire, England; 134 m. N.W. from London by the London & North-Western railway, on the small river Penk. Pop. (1901), 2347. Trade is chiefly agricultural and there are stone-quarries in the vicinity. The church of St Michael and All Angels, formerly collegiate and dedicated to St Mary, is a fine building principally Perpendicular, but with earlier portions. The Roman Watling Street passes from east to west 3 m. south of Penkridge. In the neighbourhood is Pillaton Hall, retaining a picturesque chapel of the 15th century.

PENLEY, WILLIAM SYDNEY (1852–), English actor, was born at Broadstairs, and educated in London, where his father had a school. He first made his mark as a comedian by his exceedingly amusing performance as the curate in *The Private Secretary,* a part in which he succeeded Beerbohm Tree; but he is even more associated with the title rôle in Brandon Thomas's *Charley's Aunt* (1892), a farce which had an unprecedentedly long run and was acted all over the world.

PENMARC'H, a village of western France in the department of Finistère, 18 m. S.W. of Quimper by road. Pop. (1906), of the village, 387; of the commune, 5702. On the extremity of the peninsula on which it is situated are fortified remains of a town which was of considerable importance from the 14th to the 16th centuries and included, besides Penmarc'h, St Guénolé and Kerity. It owed its prosperity to its cod-banks, the disappearance of which together with the discovery of the Newfoundland cod-banks and the pillage of the place by the bandit La Fontenelle in 1595 contributed to its decadence. The church of St Nouna, a Gothic building of the early 16th century at Penmarc'h, and the church of St Guénolé, an unfinished tower of the 15th century and the church of Kerity (15th century) are of interest. The coast is very dangerous. On the Point de Penmarc'h stands the Phare d'Eckmuhl, with a light visible for 60 miles. There are numerous megalithic monuments in the vicinity.

PENN, WILLIAM (1621–1670), British admiral, was the son of Giles Penn, merchant and seaman of Bristol. He served his apprenticeship at sea with his father. In the first Civil War he fought on the side of the parliament, and was in command of a ship in the squadron maintained against the king in the Irish seas. The service was arduous and called for both energy and good seamanship. In 1648 he was arrested and sent to London, but was soon released, and sent back as rear admiral in the "Assurance" (32). The exact cause of the arrest is unknown, but it may be presumed to have been that he was suspected of being in correspondence with the king's supporters. It is highly probable that he was, for until the Restoration he was regularly in communication with the Royalists, while serving the parliament, or Cromwell, so long as their service was profitable, and making no scruple of applying for grants of the confiscated lands of the king's Irish friends. The character of "mean fellow" given him by Pepys is borne out by much that is otherwise known of him. But it is no less certain that he was an excellent seaman and a good fighter. After 1650 he was employed in the Ocean, and in the Mediterranean in pursuit of the Royalists under Prince Rupert. He was so active on this service that when he returned home on the 18th of March 1651 he could boast that he had not put foot on shore for more than a year. When the first Dutch War broke out Penn was appointed vice-admiral to Blake, and was present at the battle of the 28th of September off the Kentish Knock. In the three days' battle off Portland, February 1653, he commanded the Blue squadron, and he also served with distinction in the final battles of the war in June and July. In December he was included in the commission of admirals and generals at sea, who exercised the military command of the fleet, as well as "one of the commissioners for ordering and managing the affairs of the admiralty and navy." In 1654 he offered to carry the fleet over to the king, but in October of the same year he had no scruple in accepting the naval command in the expedition to the West Indies sent out by Cromwell, which conquered Jamaica. He was not responsible for the shameful repulse at San Domingo, which was due to a panic among the troops. On their return he and his military colleague Venables were sent to the Tower. He made humble submission, and when released retired to the estate he had received from confiscated land in Ireland. He continued in communication with the Royalists, and in 1660 had a rather obscure share in the Restoration. He was reappointed commissioner of the navy by the king, and in the second Dutch War served as "great captain commander" or captain of the fleet, with the duke of York (afterwards King James II.) at the battle of Lowestoft (June 3, 1665). When the duke withdrew from the command, Penn's active service ceased. He continued however to be a commissioner of the navy. His death occurred on the 16th of September 1670, and he was buried in the church of St Mary Redcliffe, Bristol. His portrait by Lely is in the Painted Hall at Greenwich. By his wife Margaret Jasper, he was the father of William Penn, the founder of Pennsylvania. Though Sir William Penn was not a high-minded man, he is a figure of considerable importance in British naval history. As admiral and general for the parliament he helped in 1653 to draw up the first code of tactics provided for the navy. It was the base of the "Duke of York's Sailing and Fighting Instructions," which continued for long to supply the orthodox tactical creed of the navy.

See the *Memorials of the Professional Life and Times of Sir William Penn,* by Granville Penn. (D. H.)

PENN, WILLIAM (1644–1718), English Quaker and founder of Pennsylvania, son of Admiral Sir William Penn (1621–1670) and Margaret Jasper, a Dutch lady, was born at Tower Hill, London, on the 14th of October 1644. During his father's absence at sea he lived at Wanstead in Essex, and went to school at Chigwell close by, in which places he was brought under strong Puritan influences. Like many children of sensitive temperament, he had times of spiritual excitement; when about twelve he was "suddenly surprised with an inward comfort, and, as he thought, an external glory in the room, which gave rise to religious emotions, during which he had the strongest conviction of the being of a God, and that the soul of man was capable of enjoying communication with Him." Upon the death of Cromwell, Penn's father, who had served the Protector because there was no other career open, remained with his family on the Irish estates which Cromwell had given him, of the value of £300 a year. On the resignation of Richard Cromwell he at once declared for the king and went to the court in Holland, where he was received into favour and knighted; and at the elections for the convention parliament he was returned for Weymouth. Meanwhile young Penn studied under a private tutor on Tower Hill until, in October 1660, he was entered as a gentleman commoner at Christ Church. He appears in the same year to have contributed to the *Threnodia,* a collection of elegies on the death of the young duke of Gloucester.

The rigour with which the Anglican statutes were revived, and the Puritan heads of colleges supplanted, roused the spirit of resistance at Oxford to the uttermost. With this spirit Penn, who was on familiar terms with John Owen (1616–1683), and who had already fallen under the influence of Thomas Loe the Quaker, then at Oxford, actively sympathized. He and others refused to attend chapel and church service, and were fined in consequence. How far his leaving the university resulted from this cannot be clearly ascertained. Anthony Wood has nothing regarding the cause of his leaving, but says that he stayed at Oxford for two years, and that he was noted for proficiency in manly sports. There is no doubt that in January 1662 his father was anxious to remove him to Cambridge, and consulted Pepys on the subject; and in later years he speaks of being "banished" the college, and of being whipped, beaten and turned out of doors on his return to his father, in the anger of the latter at his avowed Quakerism. A reconciliation, however, was effected; and Penn was sent to France to forget this folly. The plan was for a time successful. Penn appears to have entered more or less into the gaieties of the court of Louis XIV., and while there to have become acquainted with Robert Spencer, afterwards earl of Sunderland, and with Dorothy, sister to Algernon Sidney. What, however, is more certain is that he somewhat later placed himself under the tuition of Moses Amyraut, the celebrated president of the Protestant college of Saumur, and at that time the exponent of liberal Calvinism, from whom he gained the patristic knowledge which is so prominent in his controversial writings. He afterwards travelled in Italy, returning to England in August 1664, with "a great deal, if not too much, of the vanity of the French garb and affected manner of speech and gait."[1]

Until the outbreak of the plague Penn was a student of Lincoln's Inn. For a few days also he served on the staff of his father—now great captain commander—and was by him sent back in April 1665 to Charles with despatches. Returning after the naval victory off Lowestoft in June, Admiral Penn found that his son had again become settled in seriousness and Quakerism. To bring him once more to views of life not inconsistent with court preferment, the admiral sent him in February 1666 with introductions to Ormonde's pure but brilliant court in Ireland, and to manage his estate in Cork round Shannangarry Castle, his title to which was disputed. Penn appears also later in the year to have been "clerk of the cheque" at Kinsale, of the castle and fort of which his father had the command. When the mutiny broke out in Carrickfergus Penn volunteered for service, and acted under Arran so as to gain considerable reputation. The result was that in May 1666 Ormonde offered him his father's company of foot, but, for some unexplained reason, the admiral demurred to this arrangement. It was at this time that the well-known portrait was painted of the great Quaker in a suit of armour; and it was at this time, too, that the conversion, begun when he was a boy by Thomas Loe in Ireland, was completed at the same place by the same agency.[2]

On the 3rd of September 1667 Penn attended a meeting of Quakers in Cork, at which he assisted to expel a soldier who had disturbed the meeting. He was in consequence, with others present, sent to prison by the magistrates. From prison he wrote to Lord Orrery, the president of Munster, a letter, in which he first publicly makes a claim for perfect freedom of conscience. He was immediately released, and at once returned to his father in London, with the distinctive marks of Quakerism strong upon him. Penn now became a minister of the denomination, and at once entered upon controversy and authorship. His first book, *Truth Exalted*, was violent and aggressive in the extreme. The same offensive personality is shown in *The Guide Mistaken*, a tract written in answer to John Clapham's *Guide to the True Religion*. It was at this time, too, that he appealed, not unsuccessfully, to Buckingham, who on Clarendon's fall was posing as the protector of the Dissenters, to use his efforts to procure parliamentary toleration.

Penn's first public discussion was with Thomas Vincent, a London Presbyterian minister, who had reflected on the "damnable" doctrines of the Quakers. The discussion, which had turned chiefly upon the doctrine of the Trinity, ended uselessly, and Penn at once published *The Sandy Foundation Shaken*, a tract of ability sufficient to excite Pepys's astonishment, in which orthodox views were so offensively attacked that Penn was placed in the Tower, where he remained for nearly nine months. The imputations upon his opinions and good citizenship, made as well by Dissenters as by the Church, he repelled in *Innocency with her Open Face*, in which he asserts his full belief in the divinity of Christ, the atonement, and justification through faith, though insisting on the necessity of good works. It was now, too, that he published the most important of his books, *No Cross, No Crown*, which contained an able defence of the Quaker doctrines and practices, and a scathing attack on the loose and unchristian lives of the clergy.

While completely refusing to recant Penn addressed a letter to Arlington in July 1669, in which, on grounds of religious freedom, he asked him to interfere. It is noteworthy, as showing the views then predominant, that he was almost at once set at liberty.

An informal reconciliation now took place with his father, who had been impeached through the jealousy of Rupert and Monk (in April 1668), and whose conduct in the operations of 1665 he had publicly vindicated; and Penn was again sent on family business to Ireland. At the desire of his father, whose health was fast failing, Penn returned to London in 1670. Having found the usual place of meeting in Gracechurch Street closed by soldiers, Penn, as a protest, preached to the people in the open street. With William Mead he was at once arrested and indicted at the Old Bailey on the 1st of September for preaching to an unlawful, seditious and riotous assembly, which had met together with force and arms. The Conventicle Act not touching their case, the trial which followed, and which may be read at length in Penn's *People's Ancient and Just Liberties Asserted*, was a notable one in the history of trial by jury. With extreme courage and skill Penn exposed the illegality of the prosecution, while the jury, for the first time, asserted the right of juries to decide in opposition to the ruling of the court. They brought in a verdict declaring Penn and Mead "guilty of speaking in Gracechurch Street," but refused to add "to an unlawful assembly"; then, as the pressure upon them increased, they first acquitted Mead, while returning their original verdict upon Penn, and then, when that verdict was not admitted, returned their final answer "not guilty" for both. The court fined the jurymen 40 marks each for their contumacy, and, in default of payment, imprisoned them, whereupon they vindicated and established for ever the right they had claimed in an action (known as Bushell's case from the name of one of the jurymen) before the court of common pleas, when all twelve judges unanimously declared their imprisonment illegal.

Penn himself had been fined for not removing his hat in court, had been imprisoned on his refusal to pay, and had earnestly requested his family not to pay for him. The fine, however, was settled anonymously, and he was released in time to be present at his father's death on the 16th of September 1670, at the early age of forty-nine. Penn now found himself in possession of a fortune of £1500 a year, and a claim on the Crown for £16,000, lent to Charles II. by his father. Upon his release Penn at once plunged into controversy, challenging a Baptist minister named Jeremiah Ives, at High Wycombe, to a public dispute and, according to the Quaker account, easily defeating him. No account is forthcoming from the other side. Hearing at Oxford that students who attended Friends' meeting were rigorously used, he wrote a vehement and abusive remonstrance to the vice-chancellor in defence of religious freedom. This found still more remarkable expression in the *Seasonable Caveat against Popery* (Jan. 1671).

In the beginning of 1671 Penn was again arrested for preaching in Wheeler Street meeting-house by Sir J. Robinson, the lieutenant of the Tower, formerly lord mayor, and known as a brutal and bigoted churchman. Legal proof being wanting of any breach of the Conventicle Act, and the Oxford or Five Mile Act also proving inapplicable, Robinson, who had some special cause of enmity against Penn, urged upon him the oath of allegiance. This, of course, the Quaker would not take, and consequently was imprisoned for six months. During this imprisonment Penn wrote several works, the most important being *The Great Case of Liberty of Conscience* (Feb. 1671), a noble defence of complete toleration. Upon his release he started upon a missionary journey through Holland and Germany; at Emden he founded a Quaker society, and established an intimate friendship with the princess palatine Elizabeth.

Upon his return home in the spring of 1672 Penn married Gulielma Springett, daughter of Mary Pennington by her first husband, Sir William Springett; she appears to have been equally remarkable for beauty, devotion to her husband, and firmness to the religious principles which she had adopted when little more than a child.[1] He now settled at Rickmansworth in Hertfordshire, and gave himself up to controversial writing. To this year, 1672, belong the *Treatise on Oaths* and *England's Present Interest Considered.* In the year 1673 Penn was still more active. He secured the release of George Fox, addressed the Quakers in Holland and Germany, carried on public controversies with Thomas Hicks, a Baptist, and John Faldo, an Independent, and published his treatise on the *Christian Quaker and his Divine Testimony Vindicated*, the *Discourse of the General Rule of Faith and Practice*,[2] *Reasons against Railing* (in answer to Hicks), *Counterfeit Christianity Detected*, and a *Just Rebuke to One-and-twenty Learned Divines* (an answer to Faldo and to *Quakerism no Christianity*). His last public controversy was in 1675 with Richard Baxter, in which, of course, each party claimed the victory.

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[1] Pepys, August 30, 1664.

[2] Webb, *The Penns and Penningtons* (1867), p. 174.

At this point Penn's connexion with America begins. The province of New Jersey, comprising the country between the Hudson and Delaware rivers on the east and west, had been granted in March 1663–1664 by Charles II. to his brother; James in turn had in June of the same year leased it to Lord Berkeley and Sir G. Carteret in equal shares. By a deed, dated 18th of March 1673–1674, John Fenwick, a Quaker, bought one of the shares, that of Lord Berkeley (Stoughton erroneously says Carteret's) in trust for Edward Byllinge, also a Friend, for £1000. This sale was confirmed by James, after the second Dutch War, on the 6th of August 1680. Disputes having arisen between Fenwick and Byllinge, Penn acted as arbitrator; and then, Byllinge being in money difficulties, and being compelled to sell his interest in order to satisfy his creditors, Penn was added, at their request, to two of themselves, as trustee. The disputes were settled by Fenwick receiving ten out of the hundred parts into which the province was divided,[3] with a considerable sum of money, the remaining ninety parts being afterwards put up for sale. Fenwick sold his ten parts to two other Friends, Eldridge and Warner, who thus, with Penn and the other two, became masters of West Jersey, West New Jersey, or New West Jersey, as it was indifferently called.[4] The five proprietors appointed three commissioners, with instructions dated from London the 6th of August 1676, to settle disputes with Fenwick (who had bought fresh land from the Indians, upon which Salem was built, Penn being himself one of the settlers there) and to purchase new territories, and to build a town—New Beverley, or Burlington, being the result. For the new colony Penn drew up a constitution, under the title of "Concessions." The greatest care is taken to make this constitution "as near as may be conveniently to the primitive, ancient and fundamental laws of the nation of England." But a democratic element is introduced, and the new principle of perfect religious freedom stands in the first place (ch. xvi.). With regard to the liberty of the subject, no one might be condemned in life, liberty or estate, except by a jury of twelve, and the right of challenging was granted to the uttermost (ch. xvii.). Imprisonment for debt was not abolished (as Dixon states), but was reduced to a minimum (ch. xviii.), while theft was punished by twofold restitution either in value or in labour to that amount (ch. xxviii.). The provisions of ch. xix. deserve special notice. All causes were to go before three justices, with a jury. "They, the said justices, shall pronounce such judgment as they shall receive from, and be directed by the said twelve men, in whom only the judgment resides, and not otherwise. And in case of their neglect and refusal, that then one of the twelve, by consent of the rest, pronounce their own judgment as the justices should have done." The justices and constables, moreover, were elected by the people, the former for two years only (ch. xli.). Suitors might plead in person, and the courts were public (ch. xxii.). Questions between Indians and settlers were to be arranged by a mixed jury (ch. xxv.). An assembly was to meet yearly, consisting of a hundred persons, chosen by the inhabitants, freeholders and proprietors, one for each division of the province. The election was to be by ballot, and each member was to receive a shilling a day from his division, "that thereby he may be known to be the servant of the people." The executive power was to be in the hands of ten commissioners[5] chosen by the assembly. Such a constitution soon attracted large numbers of Quakers to West Jersey.

It was shortly before these occurrences that Penn inherited through his wife the estate of Worminghurst in Sussex, whither he removed from Rickmansworth. He now (July 25, 1677) undertook a second missionary journey to the continent along with George Fox, Robert Barclay and George Keith. He visited particularly Rotterdam and all the Holland towns, renewed his intimacy with the princess Elizabeth at Herwerden, and, under considerable privations, travelled through Hanover, Germany, the lower Rhine and the electorate of Brandenburg, returning by Bremen and the Hague. It is worthy of recollection that the Germantown (Philadelphia) settlers from Kirchheim, one of the places which responded in an especial degree to Penn's teaching, are noted as the first who declared it wrong for Christians to hold slaves. Penn reached England again on the 24th of October. He tried to gain the insertion in the bill for the relief of Protestant Dissenters of a clause enabling Friends to affirm instead of taking the oath, and twice addressed the House of Commons' committee with considerable eloquence and effect. The bill, however, fell to the ground at the sudden prorogation.

In 1678 the popish terror came to a head, and to calm and guide Friends in the prevailing excitement Penn wrote his *Epistle to the Children of Light in this Generation.* A far more important publication was *An Address to Protestants of all Persuasions*, by William Penn, Protestant, in 1679; a powerful exposition of the doctrine of pure tolerance and a protest against the enforcement of opinions as articles of faith. This was succeeded, at the general election which followed the dissolution of the pensionary parliament, by an important political manifesto, *England's Great Interest in the Choice of this New Parliament*, in which he insisted on the following points: the discovery and punishment of the plot, the impeachment of corrupt ministers and councillors, the punishment of "pensioners," the enactment of frequent parliaments, security from popery and slavery, and ease for Protestant Dissenters. Next came *One Project for the Good of England*, perhaps the most pungent of all his political writings. But he was not merely active with his pen. He was at this time in close intimacy with Algernon Sidney, who stood successively for Guildford and Bramber. In each case, owing in a great degree to Penn's eager advocacy, Sidney was elected, only to have his elections annulled by court influence. Toleration for Dissenters seemed as far off as ever. Encouraged by his success in the West Jersey province, Penn again turned his thoughts to America. In repayment of the debt mentioned above he now asked from the Crown, at a council held on the 24th of June 1680, for "a tract of land in America north of Maryland, bounded on the east by the Delaware, on the west limited as Maryland [*i.e.* by New Jersey], northward as far as plantable"; this latter limit Penn explained to be "three degrees northwards." This formed a tract of 300 m. by 160, of extreme fertility, mineral wealth and richness of all kinds. Disputes with James, duke of York, and with Lord Baltimore, who had rights over Maryland, delayed the matter until the 14th of March 1681, when the grant received the royal signature, and Penn was made master of the province of Pennsylvania. His own account of the name is that he suggested "Sylvania," that the king added the "Penn" in honour of his father, and that, although he strenuously objected and even tried to bribe the secretaries, he could not get the name altered. It should be added that early in 1682 Carteret, grandson of the original proprietor, transferred his rights in East Jersey to Penn and eleven associates, who soon afterwards conveyed one-half of their interest to the earl of Perth and eleven others. It is uncertain to what extent Penn retained his interest in West and East Jersey, and when it ceased. The two provinces were united under one governor in 1699, and Penn was a proprietor in 1700. In 1702 the government of New Jersey was surrendered to the Crown.

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[1] For a very charming account of her, and the whole Pennington connexion, see Maria Webb's *The Penns and Penningtons.*

[2] See on this Stoughton's *Penn*, p. 113.

[3] The deed by which Fenwick and Byllinge conveyed West New Jersey to Penn, Lawry and Nicholas Lucas is dated the 10th of February 1674–1675.

[4] The line of partition was "from the east side of Little Egg Harbour, straight north, through the country, to the utmost branch of Delaware River."

[5] Penn's letter of the 26th of August 1676 says twelve, and Clarkson has followed this; but the Concessions, which were not assented to by the inhabitants until the 3rd of March 1676–1677, say ten.

By the charter for Pennsylvania Penn was made proprietary of the province. He was supreme governor; he had the power of making laws with the advice, assent and approbation of the freemen, of appointing officers, and of granting pardons. The laws were to contain nothing contrary to English law, with a saving to the Crown and the privy council in the case of appeals. Parliament was to be supreme in all questions of trade and commerce; the right to levy taxes and customs was reserved to England; an agent to represent Penn was to reside in London; neglect on the part of Penn was to lead to the passing of the government to the Crown (which event actually took place in 1692); no correspondence might be carried on with countries at war with Great Britain. The importunity of the bishop of London extorted the right to appoint Anglican ministers, should twenty members of the colony desire it, thus securing the very thing which Penn was anxious to avoid—the recognition of the principle of an establishment.

Having appointed Colonel (Sir William) Markham, his cousin, as deputy, and having in October sent out three commissioners to manage his affairs until his arrival, Penn proceeded to draw up proposals to adventurers, with an account of the resources of the colony. He negotiated, too, with James and Lord Baltimore with the view, ultimately successful, of freeing the mouth of the Delaware, wrote to the Indians in conciliatory terms, and encouraged the formation of companies to work the infant colony both in England and Germany, especially the "Free Society of Traders in Pennsylvania," to whom he sold 20,000 acres, absolutely refusing, however, to grant any monopolies. In July he drew up a body of "conditions and concessions." This constitution, savouring strongly of Harrington's *Oceana*, was framed, it is said, in consultation with Sidney, but the statement is doubtful. Until the council of seventy-two (chosen by universal suffrage every three years, twenty-four retiring each year), and the assembly (chosen annually) were duly elected, a body of provisional laws was added.

It was in the midst of this extreme activity that Penn was made a Fellow of the Royal Society. Leaving his family behind him, Penn sailed with a hundred comrades from Deal in the "Welcome" on the 1st of September 1682. His *Last Farewell to England* and his letter to his wife and children contain a beautiful expression of his pious and manly nature. He landed at New Castle on the Delaware on the 27th of October, his company having lost one-third of their number by small-pox during the voyage. After receiving formal possession, and having visited New York, Penn ascended the Delaware to the Swedish settlement of Upland, to which he gave the name of Chester. The assembly at once met, and on the 7th of December passed the "Great Law of Pennsylvania." The idea which informs this law is that Pennsylvania was to be a Christian state on a Quaker model. Philadelphia was now founded, and within two years contained 300 houses and a population of 2500. At the same time an act was passed, uniting under the same government the territories which had been granted by feoffment by James in 1682. Realistic and entirely imaginative accounts (cf. Dixon, p. 270), inspired chiefly by Benjamin West's picture, have been given of the treaty which there seems no doubt Penn actually made in November 1683 with the Indians. His connexion with them was one of the most successful parts of his management, and he gained at once and retained through life their intense affection.

Penn now wrote an account of Pennsylvania from his own observation for the "Free Society of Traders," in which he shows considerable power of artistic description. Tales of violent persecution of the Quakers, and the necessity of settling disputes, which had arisen with Lord Baltimore, his neighbour in Maryland, brought Penn back to England (Oct. 2, 1684) after an absence of two years. In the spring of 1683 he had modified the original charter at the desire of the assembly, but without at all altering its democratic character.[1] He was, in reference to this alteration, charged with selfish and deceitful dealing by the assembly. Within five months after his arrival in England Charles II. died, and Penn found himself at once in a position of great influence. Penn now took up his abode at Kensington in Holland House, so as to be near the court. His influence there was great enough to secure the pardon of John Locke, who had been dismissed from Oxford by Charles, and of 1200 Quakers who were in prison. At this time, too, he was busy with his pen once more, writing a further account of Pennsylvania, a pamphlet in defence of Buckingham's essay in favour of toleration, in which he is supposed to have had some share, and his *Persuasive to Moderation to Dissenting Christians*, very similar in tone to the *One Project for the Good of England*. When Monmouth's rebellion was suppressed he appears to have done his best to mitigate the horrors of the western commission, opposing Jeffreys to the uttermost.[2] Macaulay has accused Penn of being concerned in some of the worst actions of the court at this time. His complete refutation by Forster, Paget, Dixon and others renders it unnecessary to do more than allude to the cases of the Maids of Taunton, Alderman Kiffin, and Magdalen College (Oxford).

In 1686, when making a third missionary journey to Holland and Germany, Penn was charged by James with an informal mission to the prince of Orange to endeavour to gain his assent to the removal of religious tests. Here he met Burnet, from whom, as from the prince, he gained no satisfaction, and who greatly disliked him. On his return he went on a preaching mission through England. His position with James was undoubtedly a compromising one, and it is not strange that, wishing to tolerate Papists, he should, in the prevailing temper of England, be once more accused of being a Jesuit, while he was in constant antagonism to their body. Even Tillotson took up this view strongly, though he at once accepted Penn's vehement disavowal. In 1687 James published the Declaration of Indulgence, and Penn probably drew up the address of thanks on the part of the Quakers. It fully reflects his views, which are further ably put in the pamphlet *Good Advice to the Church of England, Roman Catholics, and Protestant Dissenters*, in which he showed the wisdom and duty of repealing the Test Acts and Penal Laws. At the Revolution he behaved with courage. He was one of the few friends of the king who remained in London, and, when twice summoned before the council, spoke boldly in his behalf. He admitted that James had asked him to come to him in France; but at the same time he asserted his perfect loyalty. During the absence of William in 1690 he was proclaimed by Mary as a dangerous person, but no evidence of treason was forthcoming. It was now that he lost by death two of his dearest friends, Robert Barclay and George Fox. It was at the funeral of the latter that, upon the information of the notorious informer William Fuller (1670–1717?), an attempt was made to arrest him, but he had just left the ground; the fact that no further steps were then taken shows how little the government believed in his guilt. He now lived in retirement in London, though his address was perfectly well known to his friends in the council. In 1691, again on Fuller's evidence, a proclamation was issued for the arrest of Penn and two others as being concerned in Preston's plot. In 1692 he began to write again, both on questions of Quaker discipline and in defence of the sect. *Just Measures in an Epistle of Peace and Love*, *The New Athenians* (in reply to the attacks of the *Athenian Mercury*), and *A Key opening the Way to every Capacity* are the principal publications of this year.

Meantime matters had been going badly in Pennsylvania

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[1] Dixon, p. 276.

[2] Burnet, iii. 66; Dalrymple, i. 282.

Penn had, in 1686, been obliged to make changes in the composition of the executive body, though in 1689 it reverted to the original constitution; the legislative bodies had quarrelled; and Penn could not gain his rents. The chief difficulty in Pennsylvania was the dispute between the province—*i.e.* the country given to Penn by the charter—and the "territories," or the lands granted to him by the duke of York by feoffment in August 1682, which were under the same government but had differing interests. The difficulties which Quaker principles placed in the way of arming the colony—a matter of grave importance in the existing European complications—fought most hardly against Penn's power. On the 21st of October 1692 an order of council was issued depriving Penn of the governorship of Pennsylvania and giving it to Colonel Benjamin Fletcher, the governor of New York. To this blow were added the illness of his wife and a fresh accusation of treasonable correspondence with James. In his enforced retirement he wrote the most devotional and most charming of his works—the collection of maxims of conduct and religion entitled *The Fruits of Solitude.* In December, thanks to the efforts of his friends at court, among whom were Buckingham, Somers, Rochester, and Henry Sidney, he received an intimation that no further steps would be taken against him. The accusation, however, had been public, and he insisted on the withdrawal being equally public. He was therefore heard in full council before the king, and honourably acquitted of all charges of treason. It was now that he wrote an *Essay towards the Present and Future Peace of Europe,* in which he puts forth the idea of a great court of arbitration, a principle which he had already carried out in Pennsylvania.

In 1694 (Feb. 23) his wife Gulielma died, leaving two sons, Springett and William, and a daughter Letitia, afterwards married to William Aubrey. Two other daughters, Mary and Hannah, died in infancy. He consoled himself by writing his *Account of the Rise and Progress of the People called Quakers.* The coldness and suspicion with which he had been regarded by his own denomination had now ceased, and he was once more regarded by the Quaker body as their leader. About the same time (Aug. 20) he was restored to the governorship of Pennsylvania; and he promised to supply money and men for the defence of the frontiers. In 1695 he went on another preaching mission in the west, and in March 1696 he formed a second marriage, with Hannah Callowhill, his son Springett dying five weeks later. In this year he wrote his work *On Primitive Christianity,* in which he argues that the faith and practice of the Friends were those of the early Church. In 1697 Penn removed to Bristol, and during the greater part of 1698 was preaching with great success against oppression in Ireland, whither he had gone to look after the property at Shannangarry.

In 1699 he was back in Pennsylvania, landing near Chester on the 30th of November, where the success of Colonel Robert Quary, judge of the admiralty in Pennsylvania—who was in the interests of those who wished to make the province an imperial colony—and the high-handed action of the deputy Markham in opposition to the Crown, were causing great difficulties. Penn carried with him particular instructions to put down piracy, which the objections of the Quakers to the use of force had rendered audacious and concerning which Quary had made strong representations to the home government, while Markham and the inhabitants apparently encouraged it. Penn and Quary, however, came at once to a satisfactory understanding on this matter, and the illegal traffic was vigorously and successfully attacked. In 1696 the Philadelphian Yearly Meeting had passed a resolution declaring slavery contrary to the first principles of the gospel. Penn, however, did not venture upon emancipation; but he insisted on the instruction of negroes, permission for them to marry, repression of polygamy and adultery, and proposed regulations for their trial and punishment. The assembly, however, a very mixed body of all nations, now refused to accept any of these proposals except the last-named. His great success was with the Indians; by their treaty with him in 1700 they promised not to help any enemy of England, to traffic only with those approved by the governor, and to sell furs or skins to none but inhabitants of the province. At the same time he showed his capacity for legislation by the share he took with Lord Bellomont at New York in the consolidation of the laws in use in the various parts of America.

Affairs now again demanded his presence in England. The king had in 1701 written to urge upon the Pennsylvania government a union with other private colonies for defence, and had asked for money for fortifications. The difficulty felt by the Crown in this matter was a natural one. A bill was brought into the lords to convert private into Crown colonies. Penn's son appeared before the committee of the house and managed to delay the matter until his father's return. On the 15th of September Penn called the assembly together, in which the differences between the province and the territories again broke out. He succeeded, however, in calming them, appointed a council of ten to manage the province in his absence, and gave a borough charter to Philadelphia. In May 1700, experience having shown that alterations in the charter were advisable, the assembly had, almost unanimously, requested Penn to revise it. On the 28th of October 1701 he handed it back to them in the form in which it afterwards remained. An assembly was to be chosen yearly, of four persons from each county, with all the self-governing privileges of the English House of Commons. Two-thirds were to form a quorum. The nomination of sheriffs, coroners, and magistrates for each county was given to the governor, who was to select from names handed in by the freemen. Moreover, the council was no longer elected by the people, but nominated by the governor, who was thus practically left single in the executive. The assembly, however, who, by the first charter, had not the right to propound laws, but might only amend or reject them, now acquired that privilege. In other respects the original charter remained, and the inviolability of conscience was again emphatically asserted. Penn reached England in December 1701. He once more assumed the position of leader of the Dissenters and himself read the address of thanks for the promise from the Throne to maintain the Act of Toleration. He now took up his abode again at Kensington, and published while here his *More Fruits of Solitude.*

In 1703 he went to Knightsbridge, where he remained until 1706, when he removed to Brentford, his final residence being taken up in 1710 at Field Ruscombe, near Twyford. In 1704 he wrote his *Life of Bulstrode Whitelocke.* He had now much trouble from America. The territorialists were openly rejecting his authority, and doing their best to obstruct all business in the assembly; and matters were further embarrassed by the injudicious conduct of Governor John Evans in 1706. Moreover, pecuniary troubles came heavily upon him, while the conduct of his son William, who became the ringleader of all the dissolute characters in Philadelphia, was another and still more severe trial. This son was married, and had a son and daughter, but appears to have been left entirely out of account in the settlement of Penn's proprietary rights on his death.

Whatever were Penn's great qualities, he was deficient in judgment of character. This was especially shown in the choice of his steward Ford, from whom he had borrowed money, and who, by dexterous swindling, had managed, at the time of his death, to establish, and hand down to his widow and son, a claim for £14,000 against Penn. Penn, however, refused to pay, and spent nine months in the Fleet rather than give way. He was released at length by his friends, who paid £7500 in composition of all claims. Difficulties with his government of Pennsylvania continued to harass him. Fresh disputes took place with Lord Baltimore, the owner of Maryland, and Penn also felt deeply what seemed to him the ungrateful treatment which he met with at the hands of the assembly. He therefore in 1710 wrote, in earnest and affectionate language, an address to his "old friends," setting forth his wrongs. So great was the effect which this produced that the assembly which met in October of that year was entirely in his interests; revenues were properly paid; the disaffected were silenced and complaints were hushed; while an advance in moral sense was shown by the fact that a bill was passed prohibiting the importation of negroes. This, however, when submitted to the British parliament, was cancelled. Penn now, in February 1712, being in failing health, proposed to surrender his powers to the Crown. The commission of plantations recommended that Penn should receive £12,000 in four years from the time of surrender, Penn stipulating only that the queen should take the Quakers under her protection; and £1000 was given him in part payment. Before, however, the matter could go further he was seized with apoplectic fits, which shattered his understanding and memory. A second attack occurred in 1713. He died on the 30th of May 1718, leaving three sons by his second wife, John, Thomas and Richard, and was buried along with his first and second wives at Jourdans meeting-house, near Chalfont St Giles in Buckinghamshire. In 1790 the proprietary rights of Penn's descendants were bought up for a pension of £4000 a year to the eldest male descendant by his second wife, and this pension was commuted in 1884 for the sum of £67,000.

Penn's *Life* was written by Joseph Besse, and prefixed to the collected edition of Penn's *Works* (1726); see also the bibliographical note to the article in *Dict. Nat. Biog.* W. Hepworth Dixon's biography, refuting Macaulay's charges, appeared in 1851. In 1907 Mrs Colquhoun Grant, one of Penn's descendants, brought out a book, *Quaker and Courtier: the Life and Work of William Penn.* (O. A.)

PENNANT, THOMAS (1726–1798), British naturalist and antiquary, was descended from an old Welsh family, for many generations resident at Downing, Flintshire, where he was born on the 14th of June 1726. He received his early education at Wrexham, and afterwards entered Queen's College, Oxford, but did not take a degree. At twelve years of age he was inspired with a passion for natural history through being presented with Francis Willughby's *Ornithology*; and a tour in Cornwall in 1746–1747 awakened his strong interest in minerals and fossils. In 1750 his account of an earthquake at Downing was inserted in the *Philosophical Transactions*, where there also appeared in 1756 a paper on several coralloid bodies he had collected at Coalbrookdale, Shropshire. In the following year, at the instance of Linnaeus, he was elected a member of the Royal Society of Upsala. In 1766 he published the first part of his *British Zoology*, a work meritorious rather as a laborious compilation than as an original contribution to science. During its progress he visited the continent of Europe and made the acquaintance of Buffon, Voltaire, Haller and Pallas. In 1767 he was elected F.R.S. In 1771 was published his *Synopsis of Quadrupeds*, afterwards extended into a *History of Quadrupeds.* At the end of the same year he published *A Tour in Scotland in 1769*, which proving remarkably popular was followed in 1774 by an account of another journey in Scotland, in two volumes. These works have proved invaluable as preserving the record of important antiquarian relics which have now perished. In 1778 he brought out a similar *Tour in Wales*, which was followed by a *Journey to Snowdon* (pt. i. 1781; pt. ii. 1783), afterwards forming the second volume of the *Tour.* In 1782 he published a *Journey from Chester to London.* He brought out *Arctic Zoology* in 1785–1787. In 1790 appeared his *Account of London*, which went through a large number of editions, and three years later he published the *Literary Life of the late T. Pennant, written by himself.* In his later years he was engaged on a work entitled *Outlines of the Globe*, vols. i. and ii. of which appeared in 1798, and vols. iii. and iv., edited by his son David Pennant, in 1800. He was also the author of a number of minor works, some of which were published posthumously. He died at Downing on the 16th of December 1798.

PENNAR, or PENNER, two rivers of southern India, distinguished as North and South. The native name is Pinakini. Both rise near the hills of Nandidrug in Mysore state, and flow eastward into the Bay of Bengal. The northern is the more important and has a total length of 355 m., that of the southern being 245 m. This latter bears the alternative name of the Ponniar. The Pennar (northern) river canal system comprises more than 30 m. of canals, irrigating 155,500 acres.

PENNE, a town and episcopal see of Italy, in the province of Teramo, 26 m. S.E. of Teramo, and 16 m. inland from the Adriatic, 1437 ft. above sea-level. Pop. (1901), 10,394. The cathedral has been much altered; in its treasury is some fine 13th (?) century silversmiths' work; the church of S. Giovanni has a fine cross by Nicola di Guardiagrele, and that of S. Maria in Colleromano, outside the town, a Romanesque portal. Many of the houses have fine terra-cotta friezes. It occupies the site of the ancient Pinna, the chief city of the Vestini, who entered into alliance with Rome in 301 B.C. and remained faithful to her through the Hannibalic wars and even during the revolt of the Italian allies in 90 B.C. No remains of the Roman period exist, even the city walls being entirely medieval.

See G. Colasanti, *Pinna* (Rome, 1907); V. Bindi, *Monumenti degli Abruzzi* (Naples, 1889, pp. 565 sqq.).

PENNELL, JOSEPH (1860–), American artist and author, was born in Philadelphia on the 4th of July 1860, and first studied there, but like his compatriot and friend, J. M. Whistler, he afterwards went to Europe and made his home in London. He produced numerous books (many of them in collaboration with his wife, Elizabeth Robins Pennell), but his chief distinction is as an original etcher and lithographer, and notably as an illustrator. Their close acquaintance with Whistler led to Mr and Mrs Pennell undertaking a biography of that artist in 1906, and, after some litigation with his executrix on the right to use his letters, the book was published in 1908.

PENNI, GIANFRANCESCO (1488–1528), Italian painter, surnamed "Il Fattore," from the relation in which he stood to Raphael, whose favourite disciple he was after Giulio Romano, was a native of Florence, but spent the latter years of his life in Naples. He painted in oil as well as in fresco, but is chiefly known for his work in the Loggie of the Vatican.

PENNINE CHAIN, an extensive system of hills in the north of England. The name is probably derived from the Celtic *pen*, high, appearing in the Apennines of Italy and the Pennine Alps. The English system is comprised within the following physical boundaries. On the N. a well-marked depression, falling below 500 ft. in height, between the upper valleys of the Irthing and the south Tyne, from which it is known as the Tyne Gap, separates the Pennines from the system of the Cheviots. On the N.E., in Northumberland, the foothills extend to the North Sea. On the N.W. the Eden valley forms part of the boundary between the Pennines and the hills of the Lake District, and the division is continued by the upper valley of the Lune. For the rest the physical boundaries consist of extensive lowlands—on the E. the vale of York, on the W. the coastal belt of Lancashire and the plain of Cheshire, and on the S. and S.E. the valley of the river Trent. The Pennines thus cover parts of Cumberland, Westmorland and Northumberland, Lancashire and Yorkshire, Cheshire and Derbyshire, while the southern foothills extend into Staffordshire and Nottinghamshire.

The Pennine system is hardly a range, but the hills are in effect broken up into numerous short ranges by valleys cut back into them in every direction, for the Pennines form a north and south watershed which determines the course of all the larger rivers in the north of England. The chain is divided into two sections by a gap formed by the river Aire flowing east, a member of the Humber basin, and the Ribble flowing west and entering the Irish Sea through a wide estuary south of Morecambe Bay.

The northern section of the Pennine system is broader and generally higher than the southern. Its western slope is generally short and steep, the eastern long and gradual; this distinction applying to the system at large. In the north-west a sharp escarpment overlooks the Eden valley. This is the nearest approach to a true mountain range in the Pennine system and indeed in England. It is known as the Cross Fell Edge from its highest point, Cross Fell (2930 ft.), to the south-east of which a height of 2780 ft. is reached in Milburn Forest, and of 2591 ft. in Mickle Fell. This range is marked off eastward by the upper valleys of the south Tyne and the Tees, and, from the divide between these two, branch ranges spring eastward, separated by the valley of the Wear, at the head of which are Burnhope Seat (2452 ft.) and Dead Stones (2326 ft.). In the northern range the highest point is Middlehope Moor (2206 ft.), and in the southern, Chapel Fell Top (2294 ft.). It is thus seen that the higher elevations, like the steeper slopes, lie towards the west. Cross Fell Edge terminates southward at a high pass (about 1400 ft.) between the head of the Belah, a tributary of the Eden, and the Greta, a tributary of the Tees. This pass is followed by the Tebay and Barnard Castle line of the North Eastern railway. The hills between the Lune valley on the west and the headstream of the Eden and the Ribble on the east are broken into masses by the dales of tributaries to the first-named river—here the chief elevations are Wild Boar Fell (2323 ft.), Whernside (2414 ft.), and Ingleborough (2373 ft.). The Ribble and Eden valleys afford a route for the main line of the Midland railway. Well-marked eastward ranges occur here between Swaledale and the river Ure, which traverses the celebrated Wensleydale (*q.v.*), and between the Ure and Wharfe. In the first the highest points are High Seat (2328 ft.) and Great Shunner Fell (2340 ft.); and in the second Buckden Pike (2302 ft.) and Great Whernside (2310 ft.). There is then a general southerly slope to the Aire gap.

The southern section of the system calls for less detailed notice. Heights exceeding 2000 ft. are rare. The centre of the section is the well-known Peak (*q.v.*) of Derbyshire. Both here and throughout the system the summits of the hills are high uplands, rounded or nearly flat, consisting of heathery, peaty moorland or hill pasture. The profile of the Pennines is thus not striking as a rule, but much fine scenery is found in the narrow dales throughout; Wensleydale, Wharfedale and other Yorkshire dales being no less famous than the dales of Derbyshire. In the parts about Settle below Ingleborough, in Derbyshire, and elsewhere, remarkable caverns and subterranean watercourses in the limestone have been explored to great depths. In Ingleborough itself are the Ingleborough cave, near Clapham; the chasm of Gaping Ghyll, over 350 ft. deep; Helln or Hellan Pot, a vast swallow-hole 359 ft. deep, only exceeded by Rowten Pot (365 ft.) near Whernside; and many others. Malham Tarn, near the head of the Aire, is drained by a stream which quickly disappears below ground, and the Aire itself is fed by a brook gushing forth in full stream at the foot of the cliffs of Malham Cove. A notable example in Derbyshire is the disappearance of the Wye into Plunge Hole, after which it traverses Poole's Cave, close to Buxton. There may also be noted the remarkable series of caverns near Castleton (*q.v.*). Lakes are few and small in the Pennine district, but in some of the upland valleys, such as those of the Nidd and the Etherow, reservoirs have been formed for the supply of the populous manufacturing districts of Lancashire and the West Riding of Yorkshire, which lie on either flank of the system between the Aire gap and the Peak. (For geology see ENGLAND and articles on the several counties.)

PENNSYLVANIA, a North Atlantic state of the United States of America and one of the original thirteen, lying for the most part between latitudes 39° 43′ 26·3″ and 42° N. and between longitudes 74° 40′ and 80° 31′ 36″ W. The state is in the form of a rectangle, except in the north-west where a triangular projection, extending to 42° 15′ N. lat., gives it a shore-line of almost 40 m. on Lake Erie, on the east where the Delaware river with two large bends separates it from New York and New Jersey, and in the south-east where the arc of a circle which was described with a 12-m. radius from New Castle, Delaware, forms the boundary between it and Delaware. The forty-second parallel of N. latitude forms the boundary between it and New York on the N.; Mason and Dixon's line is the border between it and Maryland and West Virginia on the south and a north and south line marks the boundary between it and West Virginia and Ohio on the west. The total area is 45,126 sq. m. and of this 294 sq. m. are water surface.

Physical Features.—Pennsylvania skirts the coastal plain in the south-east below Philadelphia, is traversed from north-east to south-west by the three divisions of the Appalachian province—Piedmont or older Appalachian belt, younger Appalachian ridges and valleys and Alleghany plateau—and in the north-west corner is a small part of the Erie plain. The entire surface has a mean elevation of about 1100 ft. above the sea. It rises from 20 ft. or less on the bank of the Delaware between Philadelphia and Chester to 2000–3000 ft. on the higher ridges in the middle section (3136 ft. on Blue Knob in Bedford county), and falls again to 900–1000 ft. on the Ohio border and to 750 ft. or less on the Erie plain; in the south-east is an area of about 6100 sq. m. that is less than 500 ft. above the sea, while on the ridges in the middle of the state is an aggregate area of about 2000 sq. m. that everywhere exceeds 2000 ft. in elevation. The area below 500 ft. is mostly in the Triassic lowland of the Piedmont region, or, as the Pennsylvania portion of it is called, the south-east province. This is an undulating plain which has been produced by the wearing away of weak sandstones, &c. On the north and west borders of this plain are two parts of a chain of semi-detached and usually rounded hills, known as the South Mountains. The north-east part is a south-westward arm of the New England uplands, is known as the Reading Prong, and extends from New Jersey through Easton to Reading. The south-west part is a north-eastern prolongation of the Virginia Piedmont, is known as the Cumberland Prong, and extends N.N.E. through the south part of Cumberland county. In the Reading Prong most of the hills rise 900–1000 ft. above the sea and about one-half that height above the surrounding country; in the Cumberland Prong their height increases to the southward until, on the Maryland border, they rise 2100 ft. above the sea and 1400 ft. above the adjoining plain. Another range of hills, known as the Trenton Prong, extends from the northern suburbs of Philadelphia both westward and southward through Chester, Delaware, Lancaster and York counties, but these rise only 400–600 ft. above the sea and have few steep slopes. Both of these ranges of hills are composed of hard crystalline rocks, and between them lies the lowland eroded on the weaker sandstones and sediments. In Bucks and Montgomery counties is a large sandstone area; traversing Chester county is the narrow Chester Valley with a limestone bottom, and in Lancaster county is the most extensive limestone plain. The Pennsylvania portion of the younger Appalachian ridges and valleys, known as the central province of the state, embraces the region between the South Mountains, on the south-east, and the crest of the Alleghany plateau or Alleghany Front, on the north-west. It extends from south-west to north-east about 230 m. and has a nearly uniform width of 50 m. except that it narrows rapidly as it approaches the north-east corner of the state. The ridges and intervening valleys, long parts of which have an approximately parallel trend from south-west to north-east, were formed by the erosion of folded sediments of varying hardness, the weak belts of rock being etched out to form valleys and the hard belts remaining as mountain ridges. After the folding the whole region was worn down nearly to sea-level, forming a low plain which bevelled across the geological structure of the entire state, including the Piedmont area to the south-east and the plateau area to the north-west. Then came a broad uplift followed by the erosion which carved out the valleys, leaving hard rocks as mountain ridges which rise about to the level of the old erosion plain. In Bedford county and elsewhere the ridges rise to 2400 ft. or more above the sea, but their more usual height is 1400 to 2000 ft. above the sea and 500 to 1000 ft. above the intervening valleys. Their crest lines are often of nearly uniform height for miles and generally are little broken except by an occasional V-shaped wind gap, a narrow water gap or a rounded knob. The valleys rarely exceed more than a few miles in width, are usually steep-sided, and frequently are traversed by longitudinal ranges of hills and cross ridges; but the Pennsylvania portion of the Appalachian or Great Valley, which forms a distinct division of the central province and lies between the South Mountains and the long rampart of Blue Mountain, is about 10 m. in width on the Maryland border and to the north-east its width increases to 20 m. The north-west part of it is a slate belt that has been much dissected by eroding streams, but the south-east part is a gently rolling belt of limestone to which occasionally a steep hill descends from the slate belt. The Pocono plateau, into which the central province merges at its north-east extremity, is a continuation of the Catskill plateau southward from New York and covers Wayne, Pike and Monroe counties and the east portion of Carbon county. Its surface is underlaid by a hard sandstone and conglomerate which erode slowly, and the general upland level, which is 1400–1800 ft. above the sea, is little broken except by shallow valleys and occasional knobs. The Alleghany plateau, which extends from the crest of the Alleghany Front to and beyond the west and north borders of Pennsylvania and covers more than one-half of the state, is much more dissected. In Tioga and Potter counties on the north middle border, it rises 2400–2500 ft. above the sea, but from this height the general upland level falls gradually to 1200–1300 ft. in the south-west and 900–1000 ft. along the Ohio border, and in Erie county there is a sudden fall of about 200 ft. to the Erie plain. In the northern, middle and south-west portions of this plateau province the upland is cut by an intricate network of narrow valleys and ravines that are commonly 300–600 ft. deep and occasionally 800–1000 ft. deep, but west of the Allegheny river, where harder rocks have resisted such deep dissection and glacial drift has filled depressions or smoothed rough surfaces, the uplands are broader and the valleys wider and shallower. Most of the Pennsylvania shore of Lake Erie is lined with a wall of sand and clay 50–100 ft. in height and along the foot of this is only a narrow beach, but in front of the city of Erie the shore currents have formed a spit, known as Presque Isle, which affords a good harbour.

The Pocono plateau, nearly all of the central and south-east provinces and the north-east portion of the Alleghany plateau are drained by the Susquehanna and Delaware river-systems into the Chesapeake and Delaware Bays; the greater part of the Alleghany plateau is drained by the Allegheny and Monongahela rivers into the Ohio river; the extreme southern portion of the central province and the extreme western portion of the south-east province are drained by tributaries of the Potomac; the Erie plain is drained by short streams into Lake Erie; and a very small section of the Alleghany plateau, in the northern part of Potter county, is drained by the Genesee river into Lake Ontario. The Susquehanna drains about 21,000 sq. m. of the state; the Ohio, Allegheny and Monongahela

14,747 sq. m.; and the Delaware 6443 sq. m. The Susquehanna is a wide and shallow stream with a zigzag course and numerous islands, but both the Susquehanna and the Delaware, together with their principal tributaries, flow for the most part transverse to the geological structure, and in the gorges and water-gaps through which they pass ridges in the mountain region, is some of the most picturesque scenery in the state; a number of these gorges, too, have been of great economic importance as passages for railways. The lower portion of the Delaware river has been entered by the sea as the result of the depression of the land, giving a harbour, at the head of which developed the city of Philadelphia. The present course of the Upper Allegheny river is the result of the glacier which blocked the northward drainage of the region through which it flows and turned it southward. The Monongahela is an older stream, but like the Allegheny, it meanders much, and both rivers flow in deeply intrenched valleys. The few small lakes of the state are mostly on the Pocono plateau, where they were formed by glaciation; here, too, are some streams with picturesque cascades.

Fauna.—Under the protection of a game commission which was created in 1895, of some game preserves which have been established by this commission, and of various laws affecting wild animals and birds, the numbers of Virginia deer, black bear, rabbits, ruffed grouse, quail and wild turkeys have increased until in some of the wilder sections they are quite plentiful, while the numbers of weasels, minks, lynx and foxes have been diminished. Squirrels, racoons, woodchucks and skunks are common, and musk-rats, porcupines and opossums are found in some sections. Two species of venomous snakes—the rattlesnake and the copper-head—occur in the sparsely settled regions. The avifauna include—among the birds of prey—the red-shouldered hawk, red-tailed hawk, marsh hawk, Cooper's hawk, sharp-shinned hawk and sparrow hawk; the great horned owl, the barn owl and the screech owl; and bald eagles are not uncommon in the mountainous regions along the larger rivers. The "turkey-buzzard"—turkey-vulture—(very valuable as a scavenger) is seen occasionally, especially in the south and south-west. The game birds include the ruffed grouse, quail and English pheasant (which have increased rapidly under protection), besides woodcock, snipe, many species of ducks and a few Canada geese. The song and insectivorous birds—thrushes, flycatchers, vireos and woodpeckers—of this latitude, are well represented, and the high plateaus (particularly the Pocono plateau) have especial ornithological interest as the tarrying-places, during the migratory seasons, of many species of birds whose natural breeding ground is much farther north. Perch, sunfish, trout, bass, pike and pickerel abound in many of the streams. Yellow perch are especially plentiful in the lakes on the Pocono plateau. Pike-perch and a few blue pike are taken in the Susquehanna, where shad are no longer plentiful since work was begun on McCall's Ferry dam, and in 1908 the entire catch for the river was valued at about $20,000, but in the Delaware there are valuable shad and herring fisheries. The blue pike, whitefish and herring, obtained on Lake Erie are of considerable commercial importance. In 1908 the total catch on Lake Erie was valued at $200,869, the principal items being herring ($90,108), blue pike ($13,657) and whitefish ($31,580). The catch of herring was twice as much in 1908 as in 1907 and that of whitefish nearly four times as much in 1908 as in 1907; this increase was attributed to the work of the state hatcheries. There were eight hatcheries in 1910 and the number of fish distributed from these during 1908 was about 662,000,000; they consisted chiefly of pickerel, yellow perch, wall-eyed pike, white fish, herring, blue pike, trout and shad.

Flora.—Except on some portions of the Pocono plateau, Pennsylvania was originally well forested, and, although most of the merchantable timber has been cut, about one-half of the state is still woodland. On the higher elevations the trees are mostly white pine, yellow pine and hemlock, but in the valleys and lower levels are oaks, hickories, maples, elms, birches, locusts, willows, spruces, gums, buckeyes, the chestnut, black walnut, butternut, cedar, ash, linden, poplar, buttonwood, hornbeam, holly, catalpa, magnolia, tulip-tree, Kentucky coffee-tree, sassafras, wild cherry, pawpaw, crab-apple and other species. The flora is most varied in the Susquehanna Valley below Harrisburg, and on Presque Isle are some plants peculiar to the Lake region. The state has forest reserves (918,000 acres in 1910) in 26 counties, the largest areas being in Potter, Clinton, Center, Cameron, Lycoming, Huntingdon, Union and Mifflin counties; and there is an efficient department of forestry under a state commissioner of forestry. A state forest academy (the only one in the United States) is at Mont Alto, where there is one of the three state nurseries; its first class graduated in 1906. In 1909 the state legislature passed an act authorizing any city, borough or township of the first class to acquire, subject to the approval of the commissioner of forestry, a municipal forest; and it authorized the distribution of seedling forest trees, at cost, to those who would plant and protect them, for growing private forests.

Climate.—The temperature is quite mild and equable in the south-east province where the ocean influences it and where the mountains bounding it on the north and north-west are some protection from the colder winds. The crests of the higher ridges in the central province are delightfully cool in summer, but the adjacent valleys are subject to excessive heat in summer and severe cold in winter. The mean annual temperature decreases to the north-westward on the Alleghany plateau, but on the Erie plain, in the extreme north-west, Lake Erie exerts its moderating influence, the mean temperature rises, and extremes shorten. The mean annual temperature in the south-east province is about 52° F.; it decreases to 50° in the central province and to 47° or less in some of the north-west counties of the Alleghany plateau, but rises to 49° on the shore of Lake Erie. At Philadelphia the mean temperature in winter (December, January and February) is 34°, the mean temperature in summer (June, July and August) is 74°, and the range of extremes here for a long period of years ending with 1907 was within 103° and 6°. At Huntingdon, Huntingdon county, in the Juniata Valley, the winter mean is 30°, the summer mean 71°, and within the period from 1888 to 1907 extremes ranged from 104° to 23°. The summer maxima on the mountains are usually 8° to 10° less than in the valleys directly below them; Saegerstown, Crawford county, is nearly 30 m. south of Erie, on Lake Erie, and yet the winter mean is 28° at Erie and only 25° at Saegerstown, and the lowest temperature on record for Erie is −16° while for Saegerstown it is −27°. During the period from 1875 to 1905 inclusive, extremes within the state ranged from 107° at York, York county, in July 1901, to −42° at Smithport, McKean county, in January 1904. July is the warmest month in all parts of the state. January is the coldest in some and February in others. The average annual rainfall is 44 in. It is 50 in. or more in some regions along the south-east border of the mountain district or farther south-east where the rains are occasionally heavy, and it is less than 40 in. in some of the north-east and south-west counties. The amount of rainfall during the summer is about 3 in. more than that during either autumn or winter and 2 in. more than that during spring. In the mountain region and in the vicinity of Lake Erie there is often a fall of several inches of snow during the winter months and the rapid melting of this produces floods on the Delaware, Susquehanna and Ohio rivers and some of their tributaries. The prevailing winds are westerly, but they are frequently interrupted by warm breezes from the south, or moisture-bearing currents from the east.

Soils.—The most productive soil is that in the south-east section of the Great Valley and in Chester Valley where it is derived largely from limestone. There is some of the same formation as well as that derived from red shales on the sandstone hills in the south-east province and in many of the middle and western valleys, but often a belt of inferior slate soil adjoins a limestone belt, and many of the ridges are covered with a still more sterile soil derived from white and grey sandstones. The north-west and north-east sections contain some glacial drift but the soil in these parts is not suitable for cultivation except in the larger valleys in the north-west where it is drained by glacial gravel or there is some sandy loam mixed with clay.

Agriculture.—Pennsylvania is noted for its mineral wealth and manufactures rather than for its agricultural resources, but in 1900 about two-thirds of its land was included in farms, a little more than two-thirds of its farm-land was improved, and in several crops the state has long ranked high. The number of farms increased from 127,577 in 1850 to 224,248 in 1900, the increase resulting in part from a reduction of their size but more largely from the appropriation of new lands for farming purposes. The average size in 1900 was 86·4 acres. Nearly 60% of them contained less than 100 acres and only about 2·7% contained 260 acres or more. More than seven-tenths (160,105) were worked by owners or part owners, and only 34,529 by share tenants, and 23,737 by cash tenants. Hay, Indian corn, wheat, oats, potatoes, fruits, vegetables and tobacco are the principal crops. Of the total crop acreage in 1899 nearly two-fifths was devoted to hay and forage, and the value of the hay crop in 1909[1] (when the crop was 3,742,000 tons, valued at $54,633,000) was greater than that of any other state in the Union except New York. Hay is grown in largest quantities in the north, and in the section south-east of Blue Mountain. More than one-half of the crop acreage in 1899 was devoted to cereals, and of the total cereal acreage 32% was of wheat, 31·2% was of Indian corn, 24·8% was of oats, 6·5% was of rye, and 5·3% was of buckwheat. The product of Indian corn was 48,800,000 bushels in 1909; of wheat 26,265,000 bushels; of oats 25,948,000 bushels; of barley 196,000 bushels; of rye 5,508,000 bushels; and of buckwheat 5,665,000 bushels.

Indian corn, wheat and rye, are cultivated most extensively in the south-east counties. Some of the larger oat-producing counties also are in the south-east, but most of the buckwheat, barley and oats are grown in the north and west counties. The dairy business, for which much of the hay crop is needed, has grown with the growth of the urban population as is shown in part by a steady increase in the number of dairy cows from 530,224 in 1850 to 1,140,000 in 1910; the value of the dairy products in 1899 ($35,860,110) was exceeded only in New York. The number of other cattle has fluctuated somewhat, but there were 917,000 in 1910 as against 623,722 in 1850. Horses increased in number from 350,398 in 1850 to 619,000 in 1910. The number of mules increased steadily from 2259 in 1850 to 43,000 in 1910. The raising of sheep and swine was of considerably less relative importance in 1910 than in 1850, there being 1,882,357 sheep and 1,040,366 swine in 1850 and 1,112,000 sheep and 931,000 swine in 1910. The dairy business is largest in the regions around Philadelphia and Pittsburg, and in Erie and Bradford counties. Cattle other than dairy cows as well as horses and sheep are most numerous in the western counties, in Bradford county on the north border, and in some of the counties of the south-east. Swine are most numerous in the south-east and south-west counties. The state ranks high in the production of potatoes, cabbages, lettuce and turnips, and it produces large crops of sweet Indian corn, tomatoes, cucumbers, musk-melons, asparagus and celery. The total value of all vegetables produced in 1899 was $15,832,904, an amount exceeding that of any other state except New York. A large portion of the vegetables are grown in the vicinity of Philadelphia or in the vicinity of Pittsburg. The culture of tobacco, which was introduced as early as 1689, was a small industry until the middle of the 19th century, but it then developed rapidly except during a brief interruption caused by the Mexican War. In 1909 the crop was 30,732,000 ℔. More than two-thirds of the state's crop of 1899 was produced in Lancaster county, which is one of the largest tobacco-producing counties in the United States, and most of the other third was produced in York, Tioga, Bradford and Clinton counties. Apples, cherries and pears are the principal orchard fruits. Grapes, peaches, plums and prunes, apricots, strawberries, raspberries and loganberries, blackberries and dewberries, currants and gooseberries are also grown. Orchard fruits are most abundant south-east of Blue Mountain, and small fruits near the larger cities, but about two-thirds of the grapes are grown in Erie county. Floriculture is an important industry in Philadelphia and its vicinity. The sale of nursery products, more than one-half of which were grown in Chester and Montgomery counties, amounted in 1899 to $541,032, and although this was less than one-third that of New York it was exceeded in only three other states.

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[1] Statistics for 1909 and 1910 are from the *Year Book* of the United States Department of Agriculture.

Minerals.—Pennsylvania is by far the most important coal-producing state in the Union, and as much of the iron ore of the Lake Superior region is brought to its great bituminous coal-field for rendering into pig-iron, the value of the state's mineral products constitutes a large fraction of the total value for the entire country; in 1907, when the value of the mineral products of the state was $657,783,345, or nearly one-third that of all the United States, and in 1908 when the total for the state was $473,083,212, or more than one-fourth that of the whole United States, more than four-fifths of it was represented by coal and pig-iron. With the exception of two small areas in Colorado and New Mexico, Pennsylvania contains the only anthracite-coal region in the country. This is in the east of the state, and although it has a total area of about 3300 sq. m., its workable measures are mostly in Lackawanna, Luzerne, Carbon, Schuylkill and Northumberland counties in an area of less than 500 sq. m. This coal was discovered as early as 1762 near the site of the present city of Wilkes-Barré and during the War of Independence it was used at Carlisle in the manufacture of war materials, but it was of little commercial importance until early in the next century. In 1815 the output was reported as only 50 tons, but it steadily rose to 74,347,102 tons (valued at $158,178,849) in 1908. Besides having practically all the anthracite, Pennsylvania has the thickest bituminous coal-measures, and most of the coal obtained from these is of the best quality. They form the northern extremity of the great Appalachian coal-field and underlie an area of 15,000 sq. m. or more in the west of the state. The Pittsburg district, comprising the counties of Allegheny, Washington, Fayette and Westmoreland, is exceptionally productive, and the coal in Allegheny and Washington counties is noted for its gas-producing qualities, while in Fayette and Westmoreland counties is obtained the famous Connellsville coking coal. The bituminous coal was first used at nearly the same time as the anthracite and it was first shipped from Pittsburg in 1803. In 1840 the state's output was 464,826 tons. It increased to 1,000,000 tons in 1850, to 11,760,000 tons in 1875, to 79,842,326 tons in 1900, to 150,143,177 tons in 1907; and was 117,179,527 tons in 1908, when it was 35·2% of that of the entire country and was valued at $118,816,303. In 1880 the output of coal (anthracite and bituminous) in Pennsylvania was 66% of that of the entire country; in 1908 it was 48·2%; but in the latter year the Pennsylvania mines produced more coal than the combined production of all the countries of the world excepting Great Britain, Germany and Austria-Hungary, and it was nearly four times as much as the total mined in Austria, nearly five times as much as that mined in France, and seven times as much as the output of Russia in that year. Extending from the south-west corner of the state through Greene, Washington, Allegheny, Beaver, Butler, Venango, Clarion, Forest, Elk, Warren, McKean and Tioga counties is the Pennsylvania section of the Appalachian oil-field which, with the small section in New York, furnished nearly all of the country's supply of petroleum for some years following the discovery of its value for illuminating purposes. The mineral was made known to white men by the Indians, who sold it, under the name of Seneca oil, as a cure for various ills, and burned it at some of their ceremonies. The early settlers in west Pennsylvania also found that some unknown people had dug pits several feet in depth around the oil springs apparently for the purpose of collecting the oil. But it was not until the middle of the 19th century that its value as an illuminating oil became known and not until 1859 was the first petroleum well drilled. This was the Drake well, on the flats of Oil Creek at Titusville; it was about 70 ft. in depth, and when 25 barrels were pumped from it in a day its production was considered enormous. By the close of 1861 wells had been drilled from which 2000 to 3000 barrels flowed in a day without pumping, and the state's yearly output continued to increase until 1891, when it amounted to 31,424,206 barrels. Since then, however, wells have been going dry, and when, in 1895, the output fell to 19,144,390 barrels it was exceeded by that of Ohio. It went down quite steadily to 9,424,325 in 1908, and in that year Pennsylvania was out-ranked as an oil-producing state by Oklahoma, California, Illinois, Texas and Ohio. In drilling for some of the first oil wells gas escaped, and in a few instances this was used as a fuel for generating steam in the boilers of the drilling-engines. In some instances, too, wells which were drilled for oil produced only gas. A little later, about 1868, successful experiments were made with gas as a manufacturing fuel, and in 1872 the gas industry was fairly well established near Titusville by drilling a well and piping the gas for consumption both as fuel and light. The value of the state's output increased from approximately $75,000 in 1882 to approximately $19,282,000 in 1888, and the total value of its output during these and the intervening years was more than 80% that of all the United States. The industry then became of greater importance in several other states and declined in Pennsylvania until in 1896 the value of Pennsylvania's product amounted to only $5,528,610, or 42·5% of that of the United States. This temporary decline was, however, followed by a rather steady rise and in 1908 the output was valued at $19,104,944, which was still far in excess of that of any other state and nearly 35% of that of the entire country. The gas region has an area of about 15,000 sq. m. and embraces about all of the Pennsylvania section of the Alleghany plateau except a narrow belt along its east and south-east border. There are deposits of various kinds of iron ore in the eastern, south-eastern, middle and some of the western counties, and from the middle of the 18th century until near the close of the 19th Pennsylvania ranked high among the iron-ore-producing states. As late as 1880 it ranked first, with a product amounting to 1,951,496 long tons. But the state's iron foundries moved rapidly westward after the first successful experiments in making pig-iron with bituminous coal, in 1845, and the discovery, a few years later, that rich ore could be obtained there at less cost from the Lake Superior region resulted in a decline of iron-mining within the state until, in 1902, the product amounted to only 822,932 long tons, 72·2% of which was magnetite ore from the Cornwall mines in Lebanon county which have been among the largest producers of this kind of ore since the erection of the Cornwall furnace in 1742. In 1908 the entire iron-ore product of the state, amounting to 443,161 long tons, was not 1·3% of that of the United States, but the production of the magnetite-ore alone (343,998 long tons) was more than one-fifth that of all the United States. In the manufacture of pig-iron Pennsylvania is easily first among the states, with a product value in 1908 of $111,385,000, nearly 43·8% of that of the entire country. Pennsylvania has extensive areas of limestone rock suitable for making cement, and in Northampton and Lehigh counties enormous quantities of it are used in this industry. Natural-rock cement was first made in the state soon after the discovery, in 1831, of deposits of cement rock near Williamsport, Lycoming county, and the industry was greatly promoted in 1850 when the vast deposits in the lower Lehigh Valley were discovered and large quantities of cement were required in the rebuilding of the Lehigh Canal. Competition produced in Lehigh county the first successful Portland cement plant in the United States in 1870. The output of the natural-rock cement continued greater than that of the Portland until 1896, but for the succeeding ten years the enormous development of the cement industry was almost entirely in the Portland branch, its production in the state increasing from 825,054 barrels in 1896 to 8,770,454 barrels in 1902, and to 18,254,806 barrels (valued at $13,899,807) in 1908, when it was more than 30% of that of the United States. The production of natural-rock cement was 608,000 barrels in 1896 and only 252,479 barrels (valued at $87,192) in 1908. Limestones and dolomites suitable for building purposes are obtained chiefly in Montgomery, Chester and Lancaster counties, and even these are generally rejected for ornamental work on account of their colour, which is usually bluish, grey or mottled. However until increased facilities of transport brought more desirable stones into competition they were used extensively in Philadelphia and with them the main building of Girard College and the United States Naval Asylum were erected and the long rows of red-brick residences were trimmed. There are limestone quarries in nearly two-thirds of the counties and great quantities of the stone are used for flux in the iron furnaces, for making quicklime, for railway ballast and for road making. The total value of the limestone output in 1908 amounted to $4,057,471, and the total value of all stone quarried was $6,371,152. In Dauphin county is a quarry of bluish-brown Triassic sandstone that has been used extensively especially in Philadelphia, for the erection of the so-called brown stone fronts. On the Pocono plateau is a large deposit of a fine-grained dark-blue stone of the Devonian formation which is known as the Wyoming Valley stone, and, like the New York "bluestone," which it closely resembles, is much used for window and door trimmings, steps and flagging. Several of the western counties contain Carboniferous or sub-Carboniferous sandstones that are used locally for building and for various other purposes. In 1908 the value of Pennsylvania sandstone and bluestone was $1,368,784. Northampton, Lehigh and York counties contain the most productive slate quarries in the country, and in 1908 the value of their output was $3,902,958; the Northampton and Lehigh slate is the only kind in the United States used for school blackboards. There is an extensive area in the south-east part of the state containing shale clay of a superior quality for making common brick. Kaolin abounds in Chester and Delaware counties, and fire-clay in several of the western counties. In 1908 the state ranked first in the value of its output of brick and tile ($18,981,743), which was 14·74 % of the entire product of the United States, and was second only to Ohio in the total value of its clay products ($14,842,982), which was 11·14% of that for the entire country. Glass sand abounds both in the eastern and in the western sections and for many years Pennsylvania has used this more extensively in the manufacture of glass than any other state. Deposits of crystalline graphite are found in Chester and Berks counties. In Chester county, also, is one of the most productive deposits of feldspar, second in importance only to those of Maine. Soapstone is quarried in Montgomery and Northampton counties, phosphate rock, in Juniata county; rocks from which mineral paints are made, in several counties, and there is some garnet in Delaware county.

Manufactures.—The state ranks second to New York in the value of its manufactures, which increased from $155,044,910 in 1850 to $1,955,551,332 (factory products alone) in 1905, a growth which has been promoted by an abundance of fuel, by a good port on the Atlantic seaboard, by a network of canals which in the early years was of much importance in connecting the port with the Mississippi river system, by its frontage on Lake Erie which makes the ores of the Lake Superior region easily accessible, and by a great railway system which has been built to meet the demands arising from the natural resources. By far the most important industry is the production of iron and steel. The manufacture of iron was established on a commercial basis in 1716–1718, when a furnace was built on Manatawney Creek above Pottstown, and before the close of the colonial era Pennsylvania had risen to first rank among the iron-producing colonies, a position which it has always held among the states of the Union. So long as charcoal only was used in the furnaces (until about 1840) and during the brief period in which this was replaced largely by anthracite, the industry was of chief importance in the eastern section, but with the gradual increase in the use of bituminous coal, or of coke made from it, the industry moved westward, where, especially in the Pittsburg district, it received a new impetus by the introduction of iron ore from the Lake Superior region. The value of the output of iron and steel increased from $264,571,624 in 1890 to $471,228,844 in 1905, and the state furnished 46·5 % of the pig-iron and 54 % of the steel and malleable iron produced in the entire country. The manufacture of great quantities of coke has resulted from the demand for this product in the iron and steel industry and from the abundance of coking coal; the manufacture of glass has been promoted by the supply of glass sand and natural gas in the west of the state; the manufacture of leather by the abundance of hemlock bark; the manufacture of pottery, terra-cotta and fire-clay products by the abundance of raw material; the manufacture of silk and silk goods by the large number of women and girls who came into the state in families of which the men and boys were employed in mining and picking anthracite coal; and in each of these industries as well as in a few others the state has for many years produced a large portion of the country's product.

In 1905 the twelve leading manufactures, with the value of each, were: steel and malleable iron, $363,773,577; foundry and machine-shop products, consisting most largely of steam locomotives, metal-working machinery and pumping machinery, $119,650,913; pig-iron, $107,435,267; leather, $69,427,852; railway cars and repairs by steam railway companies, $61,021,374; refined petroleum, $47,459,502; silk and silk goods, $39,333,520; tobacco, cigars and cigarettes, $39,079,122; flour and grist-mill products, $38,518,702; refined sugar and molasses, $37,182,504; worsted goods, $35,683,015; and malt liquors, $34,863,823. The most marked advances from 1900 to 1905 were in worsted goods (61·4 %) structural iron-work (60 %), and tin and terne-plate (54·4 %). Philadelphia is the great manufacturing centre. Within its limits, in 1905, all the sugar and molasses were manufactured and much of the petroleum was refined, nearly all of the iron and steel ships and steam locomotives were built, and 93 % of the carpets and rugs were made, and the total value of the manufactures of this city in that year was nearly one-third of that for the entire state. Nearly 20 % of the iron and steel was produced by Pittsburg together with Allegheny, with which it has since been consolidated, and the production of these is the leading industry of New Castle, Johnstown, Duquesne, McKeesport, Sharon, Braddock and Dubois, also in the west part of the state and of Reading, Harrisburg, Steelton, South Bethlehem, Pottstown, Lebanon, Phoenixville and Danville in the east part. The silk and cement industries are confined largely to the eastern cities and boroughs; the coke, tin and terne-plate, and pickling industries to the western; and the construction and repair of railway cars to Altoona, Meadville, Dunmore, and repair of railway cars to Altoona, Meadville, Dunmore, Chambersburg, Butler and Philadelphia.

Transport and Commerce.—The new road cut through the Juniata region in the march of the army of Brigadier-General John Forbes, against Fort Duquesne in 1758, was a result of the influence of Pennsylvania, for it was considered even then a matter of great importance to the future prosperity of the province that its seaport, Philadelphia, be connected with navigation on the Ohio by the easiest line of communication that could be had wholly within its limits. As early as 1762 David Rittenhouse and others made a survey for a canal to connect the Schuylkill and the Susquehanna rivers, and in 1791 a committee of the state legislature reported in favour of a project for establishing communication by canals and river improvement from Philadelphia to Lake Erie by way of the Susquehanna river. Before anything was done, the need of improved means of transportation between Philadelphia and the anthracite coal-fields became the more pressing. The Schuylkill Canal Company, chartered in 1815, began the construction of a canal along the Schuylkill river from Philadelphia to Mount Carbon, Schuylkill county, in 1816, and completed it in 1826. In 1818 the Lehigh Navigation Company was formed to improve the navigation of the Lehigh river from its confluence with the Delaware to Coalport, and two years later coal was successfully carried down the Lehigh and Delaware rivers to Philadelphia in "arks" or rectangular boxes, two or more of which were joined together and steered by a long oar. So prosperous was the business that in 1827–1829 the company built a number of locks which made the Lehigh navigable in either direction, and in 1827–1832 the state did the same for the Delaware between the mouth of the Lehigh and Bristol. The Union Canal Company, incorporated in 1811, completed a canal from Middletown on the Susquehanna to Reading on the Schuylkill in 1827. In 1824 the state legislature authorized the appointment of a commission to explore routes from the Schuylkill to Pittsburg, and from the West Branch of the Susquehanna to the Allegheny, and in the three or four succeeding years the state committed itself to a very extensive system of internal improvements. Work was begun on the system in 1826 and was continued without interruption until 1840, when the completed or nearly completed portions embraced a railway from Philadelphia to Columbia on the Susquehanna, a canal up the Susquehanna and the Juniata from Columbia to Hollidaysburg, a portage railway from Hollidaysburg through Blair's Gap in the Alleghany Front to Johnstown on the Conemaugh river, a canal down the Conemaugh, Kiskiminetas, and Allegheny rivers to Pittsburg, a canal up the Susquehanna and its west branch from the mouth of the Juniata to Farrandsville, in Clinton county, a canal up the Susquehanna and its north branch from Northumberland nearly to the New York border, and a canal up the Delaware river from Bristol to the mouth of the Lehigh; considerable work had also been done on two canals to connect the Ohio river with Lake Erie. Work was stopped, in 1840, before the system was completed because of the intense popular discontent arising from the burden of debt which had been assumed and because the success of competing railways was then fully assured. In 1845 the state began to sell its canals and railways to private corporations and the sale was completed in 1859. The western division of the system was abandoned by the new owners in 1865 and the worked portion of the east division gradually decreased until it, too, was wholly abandoned in 1904, with the exception of the Delaware Division Canal, which since 1866 has been worked by the Lehigh Coal & Navigation Company in connexion with the Lehigh Canal. In its natural condition there were bars in the Delaware river below Philadelphia which obstructed the navigation of vessels drawing more than 17–20 ft. of water, but in 1899 the Federal government adopted a project for obtaining a channel having a minimum depth of 30 ft. The Federal government has much improved the navigation of the Monongahela and Allegheny rivers and is committed to a project for slack-water navigation on the Ohio which is expected to give Pittsburg communication with the sea by vessels drawing 9 ft. of water.

The first railway in the state was that built in 1827 by the Lehigh Coal & Navigation Company from Mauch Chunk to its mines, 9 m. distant; but this was only a gravity road down which cars loaded with coal descended by their own gravity and up which the empty cars were drawn by mules. In 1823 a company was incorporated to build a railway from Philadelphia to Columbia, but nothing further was done until 1828, when the state canal commissioners were directed to build this road and the Allegheny Portage railway from Hollidaysburg to Johnstown. The latter was built with ten inclined planes, five on each side of the summit at Blair's Gap and cars were drawn up these by stationary engines. Both the Philadelphia & Columbia and the Allegheny Portage railways were completed in 1834. From these and other beginnings the state's railway mileage gradually increased to 1240 m. in 1850, to 4656 m. in 1870, to 8639 m. in 1890 and to 11,373 m. at the end of 1908, when it was exceeded by only two states in the Union, Texas and Illinois. The principal railways are the lines operated by the Pennsylvania Railroad Company from New York to Washington through Philadelphia; from Philadelphia to Cincinnati, Cleveland, Chicago and St Louis through Harrisburg and Pittsburg; from Baltimore, Maryland, to Sodus Point on Lake Ontario (Northern Central) through Harrisburg and Williamsport; from Williamsport to Buffalo and to Erie, and from Pittsburg to Buffalo; the Philadelphia & Reading; the Lehigh Valley; the Erie; the Delaware, Lackawanna & Western; the Baltimore & Ohio; and the Buffalo, Rochester & Pittsburg.

The state has one port of entry along the Atlantic coast, one on the Ohio river, and one on the Great Lakes. Philadelphia, the Atlantic port, exports chiefly petroleum, coal, grain and flour, and imports chiefly iron ore, sugar, drugs and chemicals, manufactured iron, hemp, jute and flax. In 1909 the value of its exports, $80,650,274, was greater than that of any other Atlantic port except New York, and the value of its imports, $78,003,464, was greater than that of any except New York and Boston. Pittsburg ranks high among the interior ports of the country in foreign commerce and first among the cities of the United States in the tonnage of its domestic commerce. Erie is quite unimportant among the lake ports in foreign commerce, but has a large domestic trade in iron ore, copper, wheat and flour.

Population.—The population of Pennsylvania was 434,373 in 1790; 602,365 in 1800; 810,091 in 1810; 1,049,458 in 1820; 1,348,233 in 1830; 1,724,033 in 1840; 2,311,786 in 1850; 2,906,215 in 1860; 3,521,951 in 1870; 4,282,891 in 1880; 5,258,014 in 1890; 6,302,115 in 1900; 7,665,111 in 1910. Of the total in 1900, 985,250, or 15·6%, were foreign-born, 156,845 were negroes, 1639 were Indians, 1927 were Chinese and 40 were Japanese. Nearly 95% of the foreign-born was composed of natives of Germany (212,453), Ireland (205,909), Great Britain (180,670), Poland (76,358), Austria (67,492), Italy (66,655), Russia (50,959), Hungary (47,393) and Sweden (24,130). Of the native population (5,316,865) 90·7% were born within the state and a little more than two-fifths of the remainder were natives of New York, Maryland, Ohio, New Jersey, Virginia, New England, Delaware and West Virginia. Almost two-thirds of the Indians were in Cumberland county where, at Carlisle, is a United States Indian Industrial School. In 1906 the total number of communicants of different religious denominations in the state was 2,977,022, of whom 1,717,037 were Protestants and 1,214,734 were Roman Catholics. There is a large number of the smaller religious sects in the state; the principal denominations, with the number of communicants of each in 1906, are: Methodist (363,443), Lutheran (335,643), Presbyterian (322,542), Reformed Church (177,270), Baptist (141,694), Protestant Episcopalian (99,021), United Brethren (55,574), United Evangelical Church (45,480), Disciples of Christ (26,458), German Baptist Brethren (23,176), Eastern Orthodox Churches (22,123), Mennonites (16,527), Congregational (14,811), Evangelical Association (13,294), Friends (12,457), Church of God or "Winnebrennerians" (11,157), and Moravian (5322).

Of the total population in 1900, 3,223,337, or 51·1 %, were urban (*i.e.* in places having a population of 4000 or more), 762,846, or 12·15 %, were semi-urban (*i.e.* in incorporated places having a population less than 4000) and 2,315,932, or 36·75 %, were rural (*i.e.* outside of the incorporated places). From 1890 to 1900 the urban population increased 854,730, or 36 %, and the semi-urban 134,077, or 18·4 %, but the rural increased only 55,195, or 2·4 %. The populations of the principal cities in 1900 were as follows: Philadelphia, 1,293,697; Pittsburg, 321,616; Allegheny, 129,896 (subsequently annexed to Pittsburg); Scranton, 102,026; Reading, 78,961; Erie, 52,733; Wilkes-Barré, 51,721; Harrisburg, 50,167; Lancaster, 41,459; Altoona, 38,973; Johnstown, 35,936; Allentown, 35,416; McKeesport, 34,227; Chester, 33,988; York, 33,708; Williamsport, 28,757; New Castle, 28,339; Easton, 25,238; Norristown, 22,265; Shenandoah, 20,321; Shamokin (borough), 18,202; Lebanon, 17,628.

Administration.—Pennsylvania has been governed under constitutions of 1776, 1790 and 1838; the present government is under the constitution of the 16th of December 1873 with amendments adopted on the 5th of November 1901. An amendment to the constitution to be adopted must be approved by a majority of the members elected to each house of the general assembly in two successive legislatures and then, at least three months after the second approval of the general assembly, by a majority of the popular vote cast on the adoption of the amendment. All male citizens over 21 years of age, who have been citizens of the United States for one month, residents of the state for one year and of the election district for two months immediately preceding the election, have the right of suffrage, provided they have paid within two years a state or county tax, which shall have been assessed at least two months and paid at least one month before the election. The Australian or "Massachusetts" ballot, adopted in 1891 under a law which fails to require personal registration, by a provision like that in Nebraska makes it easy to vote a straight ticket; party names are arranged on the ballot according to the number of votes secured by each party at the last preceding election.

Executive.—The office of governor, superseded in 1776 by a president and council of twelve, was restored in 1790. Under the present constitution the governor serves for four years and is ineligible for the next succeeding term. The governor and lieutenant-governor must be at least 30 years old, citizens of the United States, and inhabitants of the state for seven years last preceding election; no member of Congress or person holding any office under the United States or Pennsylvania may be governor or lieutenant-governor. The governor controls a large amount of patronage, appointing, subject to the advice and consent of two-thirds of the senate, a secretary of the commonwealth and an attorney-general during pleasure, and a superintendent of public instruction for four years, and may fill vacancies in various offices which occur during the recess of the senate. He has a right of veto, extending to items in appropriation bills, which may be overridden by a two-thirds vote in each house. His power of pardon is limited, being subject to the recommendation of three members of a board which consists of the lieutenant-governor, secretary of the commonwealth, attorney-general and secretary of internal affairs. The other executive officials are the lieutenant-governor and the secretary of internal affairs, elected for four years, the auditor-general, elected for three years, the treasurer, elected for two years, and (all appointed by the governor) the secretary of the commonwealth, the attorney-general and a superintendent of public instruction. All those chosen by election are ineligible for a second consecutive term except the secretary of internal affairs. The department of internal affairs consists of six bureaus: the land office, vital statistics, weather service, assessments, industrial statistics, and railroads, canals, telegraphs and telephones. There are also many statutory administrative officials and boards, such as the adjutant-general, insurance commissioner, board of health, board of agriculture, board of public grounds and buildings, commissioners of fisheries, and factory and mining inspectors.

Legislature.—During the colonial period and the early years of statehood the legislature was composed of one house, but the bicameral system was adopted in the constitution of 1790. There are fifty senators, elected for four years, and approximately two hundred representatives, elected for two years. Senators must be at least 25 years old, citizens and inhabitants of the state for four years next before election and inhabitants of the senatorial districts from which each is elected for one year next before election; representatives must be at least 21 years old and must have lived in the state three years and in the district from which elected one year next before election. To avoid the possibility of metropolitan domination provision is made that no city or county shall be entitled to more than one-sixth of the total number of senators. Sessions are biennial. The powers of the two houses are the same except that the senate exercises the usual right of confirming appointments and of sitting as a court of impeachment, while the House of Representatives initiates money bills and impeachment cases.

Judiciary.—The supreme court consists of seven judges elected by the voters of the state at large. Minority representation is secured by the provision that each elector shall vote for one less than the number of judges to be chosen at each election. The state is divided into three supreme judicial districts, the eastern, the middle and the western. This court was formerly very much overworked, but it was relieved by an act of the 24th of June 1895 establishing a superior court (now of seven judges) with appellate jurisdiction. There were in 1910 fifty-six district courts of common pleas, one for each county of forty thousand inhabitants and not more than four counties in a district. The judges of the common pleas are also judges of the courts of oyer and terminer, quarter sessions of the peace and general gaol delivery, and the orphans' courts, although there are separate orphans' courts in the counties (ten in 1909) having a population of more than one hundred and fifty thousand. Justices of the peace are elected in wards, districts, boroughs and townships. In the colonial period all judges were appointed by the governor during good behaviour. The constitution of 1776 provided for terms of seven years, that of 1790 restored the life term, and that of 1838 fixed the terms for judges of the common pleas at ten years and judges of the supreme court at fifteen. A constitutional amendment of 1850 provided that all judges should be elected by the people.[1]

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[1] The constitution of 1873 made provision for minority representation as follows: "Whenever two judges of the supreme court are

At present supreme court judges serve for twenty-one years and are ineligible for re-election. Superior court and common pleas judges serve for ten years, and justices of the peace for five. Judges may be impeached for misdemeanour in office or they may be removed by the governor, with the consent of two-thirds of each house of the general assembly, for any reasonable cause which shall not be sufficient ground for impeachment.

Local Government.—The local government is a combination of the county system of the South and the township system of New England. The county officers are sheriffs, coroners, prothonotaries, registers of wills, recorders of deeds, commissioners, treasurers, surveyors, auditors or comptrollers, clerks of the courts, and district attorneys, elected for three years. The three commissioners and the three auditors in each county are chosen by the same limited vote process as the supreme-court judges, thus allowing a representation to the minority party. Pennsylvania has suffered more perhaps than any other state in the Union from legislative interference in local affairs. Under an act of the general assembly passed in 1870 the people of Philadelphia were forced to contribute more than $20,000,000 for the construction of a city-hall. To guard against such encroachments in the future the constitution of 1873 imposed the most detailed limitations upon special legislation. The object of the provision, however, has been in a large measure nullified by the system of city classification, under which Philadelphia is the only city of the first class. The passage of the "Ripper Bill" of 1901 shows that the cities of the second class are by no means secure. The apparent object of the measure was to deprive the people of Pittsburg temporarily of the privileges of self-government by empowering the governor to appoint a recorder (in 1903 the title of mayor was again assumed) to exercise (until 1903, when the municipal executive should be again chosen by the people) the functions of the mayor, thus removed by the governor under this statute; and this act applied to the other cities of the second class, Allegheny and Scranton, although they had not offended the party managers.

Miscellaneous Laws.—A woman's right to hold, manage and acquire property in her own right is not affected by marriage, but for a married woman to mortgage or convey her real estate the joint action of herself and her husband is necessary. The rights of dower and courtesy both obtain. When a husband dies intestate leaving a widow and issue, the widow has the use of one-third of his real estate for life and one-third of his personal estate absolutely; if he leaves no issue but there be collateral heirs or other kindred, the widow has the real or personal estate or both to the value of $5000, the use of one-half the remaining real estate for life, and one-half the remaining personal estate absolutely; if the husband leaves a will the widow has the choice between her dower right and the terms of the will. When a wife dies intestate leaving a husband and issue the husband has the use of all her real estate for life, and the personal estate is divided among the husband and children share and share alike; if there be no issue the husband has the use of all her real estate for life and all her personal estate absolutely; if the wife leaves a will the husband has the choice between its terms and his right by courtesy. Whenever there is neither issue nor kindred the surviving husband or wife has all the estate. The principal grounds for an absolute divorce are impotency, adultery, wilful or malicious desertion, cruel and barbarous treatment, personal abuse and conviction of any such crime as arson, burglary, embezzlement, forgery, kidnapping, larceny, murder, perjury or assault with intent to kill. Before filing a petition for a divorce the plaintiff must have resided within the state at least one year. A suit for a divorce on the ground of desertion may be commenced when the defendant has been absent six months, but the divorce may not be granted until the desertion has continued two years. The party convicted of adultery is forbidden to marry the co-respondent during the lifetime of the other party. A marriage of first cousins or a bigamous marriage may be declared void. Pennsylvania has no homestead law, but the property of a debtor amounting to $300 in value, exclusive of the wearing apparel of himself and family and of all Bibles and school-books in use, is exempt from levy and sale on execution or by distress for rent; and the exemption extends to the widow and children unless there is a lien on the property for purchase money. The child-labour law of 1909 forbids the employment of children under eighteen years of age in blast furnaces, tanneries, quarries, in managing elevator lifts or hoisting machines, in oiling dangerous machinery while in motion, at switch tending, as brakesmen, firemen, engineers, motormen and in other positions of similar character. The same law prescribes conditions under which children between fourteen and eighteen years of age may be employed in the manufacture of white-lead, red-lead, paints, phosphorus, poisonous acids, tobacco or cigars, in mercantile establishments, stores, hotels, offices or in other places requiring protection to their health or safety; and it forbids the employment of boys under sixteen years of age or of girls under eighteen years of age in such factories or establishments more than ten hours a day (unless it be to prepare for a short day) or for more than fifty-eight hours a week, or their employment there between nine o'clock in the evening and six o'clock in the morning, except that in the factories requiring continuous night and day employment boys not under fourteen years of age may be employed partly by day and partly by night not exceeding nine hours in any twenty-four. The employment of children under fourteen years of age in coal-mines is forbidden, as is also the employment of children under fourteen years of age in any cotton, woollen, silk, paper, bagging or flax factory, or in any laundry, or the employment of children under twelve years of age in any mill or factory whatever within the commonwealth.

Prisons and Charities.—Penal and charitable institutions are under the supervision of a board of public charities of ten members, established in 1869, and a committee in lunacy, composed of five members of this board, appointed under an act of 1883. An agitation begun by the Philadelphia society for assisting distressed prisoners in 1776, checked for a time by the War of Independence, led ultimately to the passage of a statute in 1818 for the establishment of the Western Penitentiary at Allegheny (opened 1826) and another of 1821 for the establishment of the Eastern Penitentiary in Philadelphia (opened 1829). In the former penitentiary prisoners are congregated; in the latter they are kept in solitary confinement. An act of 1878 provided for a third penitentiary in the middle district, but through the efforts of Governor Henry M. Hoyt the plans were changed and instead the Industrial Reformatory was established at Huntingdon (opened 1889). The House of Refuge of western Pennsylvania, located in Allegheny in 1854 (act of 1850), became the Pennsylvania Reform School in 1872, and was removed to Morganza, Washington county, in 1876. Few states have done so much as Pennsylvania for the humane and scientific treatment of its dependent and defective classes. Largely as a result of the efforts of Dorothea Lynde Dix (*q.v.*), a hospital for the insane was established at Harrisburg in 1851 (act of 1845). A second hospital was opened at Pittsburg in 1853 (act of 1848), but the location was ruined by Pennsylvania railway improvements, and in 1862 it was removed to a new site about 7 m. from the city, which was called Dixmont in honour of Miss Dix; the hospital is not a state institution, but the state provides for the maintenance there of patients committed by the courts or the poor authorities in the thirteen counties forming the western district. For three other districts three state institutions have been established—at Danville, 1872 (act of 1868), Warren, 1880 (act of 1873), and Norristown, 1880 (act of 1876). An act of 1901 established a homoeopathic hospital for the insane at Allentown. A distinction is made between hospitals and asylums. The asylum for the chronic insane is at South Mountain, 1894 (act of 1891). A state institution for feeble-minded of western Pennsylvania at Polk, Venango county, was opened in 1897 (act of 1893), and the eastern Pennsylvania state institution for feeble-minded and epileptic at Spring City, Chester county, was opened in 1908 (act of 1903). There are institutes for the blind at Overbrook and Pittsburg, and for the deaf and dumb at Philadelphia and Edgewood Park, an oral school for the deaf at Scranton, a home for the training of deaf children at Philadelphia, a soldiers' and sailors' home at Erie (1886), a soldiers' orphans' industrial school (1895) at Scotland, Franklin county, the Thaddeus Stevens industrial school (1905) at Lancaster, hospitals for the treatment of persons injured in the mines, at Ashland (1879), Hazleton (1887) and Shamokin (1907), and cottage hospitals at Blossburg, Connellsville, Mercer and Philipsburg (all 1887). In addition to the institutions under state control a large number of local charities receive aid from the public treasury. In 1907–1908, $14,222,440 was appropriated for institutions: $7,479,732 for state institutions, $1,240,108 for semi-state institutions, $4,757,100 for general hospitals, $149,500 for hospitals for consumptives, and $745,900 for homes, asylums, &c. The system of juvenile courts, created under a statute of 1901, has done much to ameliorate the condition of dependent and delinquent children.

Education.—During the colonial period there were many sectarian and neighbourhood subscription schools in which the poor could receive a free education, but public schools in the modern American sense were unknown. The famous Friends' public school, founded in Philadelphia in 1689 and chartered in 1697, still exists as the William Penn charter school. An agitation begun soon after the War of Independence resulted in the creation of a school fund in 1831 and the final establishment of the present system of public schools in 1834. The attempt to repeal the law in 1835 was defeated largely through the efforts of Thaddeus Stevens, who was then a member of the state house of representatives. During the years 1852–1857 the educational department became a separate branch of the state government, the office of county school superintendent was created, the state teachers' association (known since 1900 as the Pennsylvania educational association) was organized, and a law was enacted for the establishment of normal schools. Since 1893 the state has furnished textbooks and other necessary supplies free of charge, and since 1895 education has been compulsory for all children between the ages of eight and thirteen. Schools must be kept open not less than seven and not more than ten months in the year. Out of a total expenditure of $30,021,774 for the fiscal year 1909, $7,875,083 was for educational purposes, of which $6,810,906 was for common schools, being appropriations to the

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to be chosen for the same term of service each voter shall vote for one only, and when three are to be chosen he shall vote for no more than two; candidates highest in vote shall be declared elected."

counties. There is a biennial school appropriation of $15,000,000. In addition the district directors levy local rates which must not be greater than the state and county taxes combined. The Pennsylvania state college at State College, Center county, was established in 1855 as the farmers' high school of Pennsylvania, in 1862 became the Agricultural College of Pennsylvania, and received its present name in 1874 after the income from the national land grant had been appropriated to the use of the institutions; in 1909–1910 it had 147 instructors, 1400 students and a library of 37,000 volumes. Other institutions for higher education are the University of Pennsylvania, at Philadelphia (1749), an endowed institution which receives very little support from the state; the University of Pittsburgh (1819), at Pittsburg (*q.v.*); Dickinson College (Methodist Episcopal, 1783), at Carlisle; Haverford College (Society of Friends, 1833), at Haverford; Franklin and Marshall (German Reformed, 1853), at Lancaster; Washington and Jefferson (Presbyterian, 1802), at Washington; Lafayette (Presbyterian, 1832), at Easton; Bucknell University (Baptist, 1846), at Lewisburg; Waynesburg (Cumberland Presbyterian, 1851), at Waynesburg; Ursinus (German Reformed, 1870), at Collegeville; Allegheny College (Methodist Episcopal, 1815), at Meadville; Swarthmore (Society of Friends (Hicksites), 1866), at Swarthmore: Muhlenberg (Lutheran, 1867), at Allentown; Lehigh University (non-sectarian, 1867), at Bethlehem; and for women Bryn Mawr College (Society of Friends, 1885), at Bryn Mawr; the Allentown College (German Reformed, 1867), at Allentown; Wilson College (Presbyterian, 1870), and the Pennsylvania College for women (1869), at Pittsburg. There are theological seminaries at Pittsburg, the Allegheny Seminary (United Presbyterian, 1825), Reformed Presbyterian (1856), and Western Theological Seminary (Presbyterian, 1827); at Lancaster (German Reformed, 1827); at Meadville (Unitarian, 1844); at Bethlehem (Moravian, 1807); at Chester, the Crozer Theological Seminary (Baptist, 1868); at Gettysburg (Lutheran, 1826); and in Philadelphia several schools, notably the Protestant Episcopal Church divinity school (1862) and a Lutheran seminary (1864), at Mount Airy. There are many technical and special schools, such as Girard College, Drexel institute and Franklin institute at Philadelphia, the Carnegie institute at Pittsburg and the United States Indian school at Carlisle (1891).

Finance.—The revenues of the state are derived primarily from corporation taxes, business licences, and a 5% rate on collateral inheritance. Taxes on real estate have been abolished and those on personal property are being reduced, although the heavy expenditures on the new capitol at Harrisburg checked the movement temporarily. The total receipts for the year ending on the 30th of November 1909 were $28,945,210, and the expenditure was $30,021,774. During the provincial period Pennsylvania, in common with the other colonies, was affected with the paper money craze. From 1723 to 1775 it issued £1,094,650 and from 1775 to 1785 £1,172,000 plus $1,550,000. Acts were passed in 1781, 1792, 1793 and 1794 to facilitate redemption at depreciated rates, and the last bills were called in on the 1st of January 1806. The state was also carried along by the movement which began about 1825 for the expenditure of public funds on internal improvements. On turnpikes, bridges, canals and railways $53,352,649 was spent between 1826 and 1843, the public debt in the latter year reaching the high-water mark of $42,188,434. An agitation was then begun for retrenchment, the public works were put up for sale, and were finally disposed of in 1858 (when the debt was $39,488,244) to the Pennsylvania Railroad Company for $7,500,000. Under authority of a constitutional amendment of 1857 a sinking fund commission was established in 1858. Aside from a temporary increase during the Civil War (1861–65) the debt has been rapidly reduced. The constitution of 1873 and subsequent legislation have continued the commission, but the sources of revenue have been very much curtailed, being restricted to the interest on the deposits of the fund and interest on certain Allegheny Railroad bonds. The total debt on the 30th of November 1909 was $2,643,917, of which the greater part were 3½ and 4% bonds, maturing on the 1st of February 1912. The sinking fund at the same date amounted to $2,652,035, leaving a net surplus in the sinking fund of $8118. The sinking fund was formerly divided among certain favoured banks in such manner as would best advance the political interests of the organization which controlled the state; but just after the reform victory in the election of 1905 the sinking fund commission instituted the policy of buying bonds at the market price, and the debt is now being reduced by that method. The financial institutions of Pennsylvania other than national banks are created by state charters limited to twenty years and are subject to the supervision of a commissioner of banking.

History.—The chief features of Pennsylvania history in colonial days were the predominance of Quaker influence, the heterogeneous character of the population, liberality in matters of religion, and the fact that it was the largest and the most successful of proprietary provinces. The earliest European settlements within the present limits of the state were some small trading posts established by the Swedes and the Dutch in the lower valley of the Delaware River in 1623–1681. Between 1650 and 1660 George Fox and a few other prominent members of the Society of Friends had begun to urge the establishment of a colony in America to serve as a refuge for Quakers who were suffering persecution under the "Clarendon Code." William Penn (*q.v.*) became interested in the plan at least as early as 1666. For his charters of 1680–1682 and the growth of the colony under him see PENN, WILLIAM.

During Penn's life the colony was involved in serious boundary disputes with Maryland, Virginia and New York. A decree of Lord Chancellor Hardwicke, in 1750, settled the Maryland-Delaware dispute and led to the survey in 1763–1767 of the boundary between Pennsylvania and Maryland (lat. 39° 43′ 26·3″ N.), called the Mason and Dixon line in honour of the surveyors; it acquired considerable importance later as separating the free and the slave states. In 1784 Virginia agreed to the extension of the line and to the establishment of the western limit (the present boundary between Pennsylvania and Ohio) as the meridian from a point on the Mason and Dixon line five degrees of longitude west of the Delaware river. The 42nd parallel was finally selected as the northern boundary in 1789, in 1792 the Federal government sold to Pennsylvania the small triangular strip of territory north of it on Lake Erie. A territorial dispute with Connecticut over the Wyoming Valley was settled in favour of Pennsylvania in 1782 by a court of arbitration appointed by the Continental Congress.

Upon William Penn's death, his widow became proprietary. Sir William Keith, her deputy, was hostile to the council, which he practically abolished, and was popular with the assembly, which he assiduously courted, but was discharged by Mrs Penn after he had quarrelled with James Logan, secretary of the province. His successors, Patrick Gordon and George Thomas, under the proprietorship of John, Thomas and Richard Penn, continued Keith's popular policy of issuing a plentiful paper currency; but with Thomas the assembly renewed its old struggle, refusing to grant him a salary or supplies because of his efforts to force the colony into supporting the Spanish War. Again, during the Seven Years' War the assembly withstood the governor, Robert Hunter Morris, in the matter of grants for military expenses. But the assembly did its part in assisting General Braddock to outfit; and after Braddock's defeat all western Pennsylvania suffered terribly from Indian attacks. After the proprietors subscribed £5000 for the protection of the colony the assembly momentarily gave up its contest for a tax on the proprietary estates and consented to pass a money bill, without this provision, for the expenses of the war. But in 1760 the assembly, with the help of Benjamin Franklin as agent in England, won the great victory of forcing the proprietors to pay a tax (£566) to the colony; and thereafter the assembly had little to contest for, and the degree of civil liberty attained in the province was very high. But the growing power of the Scotch-Irish, the resentment of the Quakers against the proprietors for having gone back to the Church of England and many other circumstances strengthened the anti-proprietary power, and the assembly strove to abolish the proprietorship and establish a royal province; John Dickinson was the able leader of the party which defended the proprietors; and Joseph Galloway and Benjamin Franklin were the leaders of the anti-proprietary party, which was greatly weakened at home by the absence after December 1764 of Franklin in England as its agent. The question lost importance as independence became the issue.

In 1755 a volunteer militia had been created and was led with great success by Benjamin Franklin; and in 1756 a line of forts was begun to hold the Indians in check. In the same year a force of pioneers under John Armstrong of Carlisle surprised and destroyed the Indian village of Kittanning (or Atiqué) on the Allegheny river. But the frontier was disturbed by Indian attacks until the suppression of Pontiac's conspiracy. In December 1763 six Christian Indians, Conestogas, were massacred by the "Paxton boys" from Paxton near the present Harrisburg; the Indians who had escaped were taken to Lancaster for safe keeping but were seized and killed by the "Paxton boys," who with other backwoodsmen marched upon Philadelphia early in 1764, but Quakers and Germans gathered quickly to protect it and civil war was averted, largely by the diplomacy of Franklin. The Paxton massacre marked the close of Quaker supremacy and the beginning of the predominance of the Scotch-Irish pioneers.

Owing to its central position, its liberal government, and its policy of religious toleration, Pennsylvania had become during the 18th century a refuge for European immigrants, especially persecuted sectaries. In no other colony were so many different races and religions represented. There were Dutch, Swedes, English, Germans, Welsh, Irish and Scotch-Irish; Quakers, Presbyterians, Episcopalians, Catholics, Lutherans (Reformed), Mennonites, Dunkers, Schwenkfelders, and Moravians. Most of these elements have now become merged in the general type, but there are still many communities in which the popular language is a corrupt German dialect, largely Rheno-Franconian in its origin, known as "Pennsylvania Dutch." Before the Seven Years' War the Quakers dominated the government, but from that time until the failure of the Whisky Insurrection (1794) the more belligerent Scotch-Irish (mostly Presbyterians) were usually in the ascendancy, the reasons being the growing numerical strength of the Scotch-Irish and the increasing dissatisfaction with Quaker neglect of means of defending the province.

As the central colony, Pennsylvania's attitude in the struggle with the mother country was of vast importance. The British party was strong because of the loyalty of the large Church of England element, the neutrality of many Quakers, Dunkers, and Mennonites, and a general satisfaction with the liberal and free government of the province, which had been won gradually and had not suffered such catastrophic reverses as had embittered the people of Massachusetts, for instance. But the Whig party under the lead of John Dickinson, Thomas Mifflin and Joseph Reed was successful in the state, and Pennsylvania contributed greatly to the success of the War of Independence, by the important services rendered by her statesmen, by providing troops and by the financial aid given by Robert Morris (*q.v.*). The two Continental Congresses (1774, and 1775–1781) met in Philadelphia, except for the months when Philadelphia was occupied by the British army and Congress met in Lancaster and York, Pennsylvania, and then in Princeton, New Jersey. In Philadelphia the second Congress adopted the Declaration of Independence, which the Pennsylvania delegation, excepting Franklin, thought premature at the time, but which was well supported by Pennsylvania afterwards. During the War of Independence battles were fought at Brandywine (1777), Paoli (1777), Fort Mifflin (1777) and Germantown (1777), and Washington's army spent the winter of 1777–1778 at Valley Forge; and Philadelphia was occupied by the British from the 26th of September 1777 to the 18th of June 1778. The Penns lost their governmental rights in 1776, and three years later their territorial interests were vested in the commonwealth in return for a grant of £120,000 and the guarantee of titles to private estates held in severalty. They still own considerable property in and around Wilkes-Barré, in Luzerne county, and in Philadelphia. The first state constitution of September 1776 was the work of the Radical party. It deprived the Quakers of their part in the control of the government and forced many Conservatives into the Loyalist party. This first state constitution was never submitted to popular vote. It continued the unicameral legislative system, abolished the office of governor, and provided for an executive council of twelve members. It also created a curious body, known as the council of censors, whose duty it was to assemble once in seven years to decide whether there had been any infringements of the fundamental law. The party which had carried this constitution through attacked its opponents by withdrawing the charter of the college of Philadelphia (now the university of Pennsylvania) because its trustees were anti-Constitutionalists and creating in its place a university of the state of Pennsylvania. The Constitutional party in 1785 secured the annulment by the state assembly of the charter of the Bank of North America, which still retained a congressional charter; and the cause of this action also seems to have been party feeling against the anti-Constitutionalists, among whom Robert Morris of the bank was a leader, and who, especially Morris, had opposed the paper money policy of the Constitutionalists. These actions of the state assembly against the college and the bank probably were immediate causes for the insertion in the Federal Constitution (adopted by the convention in Philadelphia in 1787) of the clause (proposed by James Wilson of Pennsylvania, a friend of the college and of the bank) forbidding any state to pass a law impairing the obligation of contracts. The state ratified the Federal Constitution, in spite of a powerful opposition—largely the old (state) Constitutional party—on the 22nd of December 1787, and three years later revised its own constitution to make it conform to that document. Under the constitution of 1790 the office of governor was restored, the executive council and the council of censors were abolished, and the bicameral legislative system was adopted. Philadelphia was the seat of the Federal government, except for a brief period in 1789–1790, until the removal to Washington in 1800. The state capital was removed from Philadelphia to Lancaster in 1799 and from Lancaster to Harrisburg in 1812.

The state was the scene of the Scotch-Irish revolt of 1794 against the Federal excise tax, known as the Whisky Insurrection (*q.v.*) and of the German protest (1799) against the house tax, known as the Fries Rebellion from its leader John Fries (*q.v.*). In 1838 as the result of a disputed election to the state house of representatives two houses were organized, one Whig and the other Democratic, and there was open violence in Harrisburg. The conflict has been called the "Buckshot War." The Whig House of Representatives gradually broke up, many members going over to the Democratic house, which had possession of the records and the chamber and was recognized by the state Senate. Pennsylvania was usually Democratic before the Civil War owing to the democratic character of its country population and to the close commercial relations between Philadelphia and the South. The growth of the protectionist movement and the development of anti-slavery sentiment, however, drew it in the opposite direction, and it voted the Whig national ticket in 1840 and in 1848, and the Republican ticket for Lincoln in 1860. A split among the Democrats in 1835, due to the opposition of the Germans to internal improvements and to the establishment of a public school system, resulted in the election as governor of Joseph Ritner, the anti-Masonic candidate. The anti-Masonic excitement subsided as quickly as it had risen, and under the leadership of Thaddeus Stevens the party soon became merged with the Whigs. During the Civil War (1861–65) the state gave to the Union 336,000 soldiers; and Generals McClellan, Hancock, Meade and Reynolds and Admirals Porter and Dahlgren were natives of the state. Its nearness to the field of war made its position dangerous. Chambersburg was burned in 1862; and the battle of Gettysburg (July 1863), a defeat of Lee's attempt to invade the North in force was a turning point in the war.

The development of the material resources of the state since 1865 has been accompanied by several serious industrial disturbances. The railway riots of 1877, which centred at Pittsburg and Reading, resulted in the destruction of about two thousand freight cars and a considerable amount of other property. An organized association, known as the Molly Maguires (*q.v.*), terrorized the mining regions for many years, but was finally suppressed through the courageous efforts of President Franklin Benjamin Gowen (1863–1889) of the Philadelphia & Reading railroad with the assistance of Allan Pinkerton and his detectives. There have been mining strikes at Scranton (1871), in the Lehigh and Schuylkill regions (1875), at Hazleton (1897), and one in the anthracite fields (1902) which was settled by a board of arbitrators appointed by President Roosevelt; and there were street railway strikes at Chester in 1908 and in Philadelphia in 1910. The calling in of Pinkerton detectives from Chicago and New

York to settle a strike in the Carnegie steel works at Homestead in 1892 precipitated a serious riot, in which about twenty persons were killed. It was necessary to call out two brigades of the state militia before the disorder was finally suppressed. The labour unions took advantage of this trouble to force Pennsylvania, Indiana, Illinois, Minnesota, Colorado and several other states to pass anti-Pinkerton statutes making it illegal to import irresponsible armed men from a distance to quell local disturbances. On the political side the chief features in the history of the state since 1865 have been the adoption of the constitution of 1873, the growth of the Cameron-Quay-Penrose political machine, and the attempts of the reformers to overthrow its domination. The constitution of 1838, which superseded that of 1790, extended the functions of the legislature, limited the governor's power of appointment, and deprived negroes of the right of suffrage. The provision last mentioned was nullified by the fourteenth and fifteenth amendments to the constitution of the United States. The chief object of the present state constitution (1873) was to prohibit local and special legislation. It increased the number of senators and representatives, created the office of lieutenant-governor, substituted biennial for annual sessions of the legislature, introduced minority representation in the choice of the higher judiciary and of the county commissioners and auditors and provided (as had an amendment adopted in 1850) for the election of all judges by popular vote. The political organization founded by Simon Cameron (*q.v.*) and strengthened by his son, James Donald Cameron, Matthew Stanley Quay and Boies Penrose (b. 1860), is based upon the control of patronage, the distribution of state funds among favoured banks, the support of the Pennsylvania railway and other great corporations, and upon the ability of the leaders to persuade the electors that it is necessary to vote the straight Republican ticket to save the protective system. Robert E. Pattison (1850–1904), a Democrat, was elected governor in 1883 and again in 1891, but he was handicapped by Republican legislatures. In 1905 a Democratic state treasurer was elected.

PENNSYLVANIA GOVERNORS.

Under Dutch Rule (1624–1664).[1]

Cornelis Jacobsen Mey	Director	1624–1625
William van Hulst	„	1625–1626
Peter Minuit	Governor	1626–1632
David Pieterzen de Vries	„	1632–1633
Wouter van Twiller	„	1633–1638
William Kieft	„	1638–1647
Peter Stuyvesant	„	1647–1664

Under Swedish Rule (1638–1655).[2]

Peter Minuit	1638–1641
Peter Hollender	1641–1642
John Printz	1642–1653
John Pappegoya	1653–1654
John Claude Rysingh	1654–1655

Under the Duke of York (1664–1673).

Richard Nicolls		1664–1667
Robert Carr	Deputy	1664–1667
Robert Needham	Commander on the Delaware	1664–1668
Francis Lovelace		1667–1673
John Carr	Commander on the Delaware	1668–1673

Under Dutch Rule (1673–1674).

Anthony Colve		1673–1674
Peter Alrichs	Deputy on the Delaware	1673–1674

Under the Duke of York (1674–1681).

Sir Edmund Andros	1674–1681

Under the Proprietors (1681–1693).

William Markham	Deputy-Governor	1681–1682
William Penn		1682–1684
Thomas Lloyd	President of the Council	1684–1686
Thomas Lloyd Robert Turner Arthur Cook John Simcock John Eckley	Executive Commissioners	1686–1688
John Blackwell	Deputy-Governor	1688–1690
Thomas Lloyd	President of the Council	1690–1691
Thomas Lloyd	Deputy-Governor	1691–1693
William Markham[3]	„	1691–1693

Under the Crown (1693–1695).

Benjamin Fletcher		1693–1695
William Markham	Deputy-Governor	1693–1695

Under the Proprietors (1695–1776).

William Markham	Deputy-Governor	1695–1699
William Penn		1699–1701
Andrew Hamilton	Deputy-Governor	1701–1703
Edward Shippen	President of the Council	1703–1704
John Evans	Lieutenant-Governor	1704–1709
Charles Gookin	„	1709–1717
Sir William Keith	„	1717–1726
Patrick Gordon	„	1726–1736
James Logan	President of the Council	1736–1738
George Thomas	Deputy-Governor	1738–1747
Anthony Palmer	President of the Council	1747–1748
James Hamilton	Lieutenant-Governor	1748–1754
Robert H. Morris	Deputy-Governor	1754–1756
William Denny	„	1756–1759
James Hamilton	„	1759–1763
John Penn	„	1763–1771
James Hamilton	President of the Council	1771
Richard Penn	Lieutenant-Governor	1771–1773
John Penn	„	1773–1776

Period of Statehood (1776–).

Benjamin Franklin, Chairman of the Committee of Safety		1776–1777
Thomas Wharton, Jr.	President of the Council	1777–1778
George Bryan[4]	Acting President of the Council	1777
Joseph Reed	President of the Council	1778–1781
William Moore	„	1781–1782
John Dickinson	„	1782–1785
Benjamin Franklin	„	1785–1788
Thomas Mifflin	„	1788–1790
Thomas Mifflin	Federalist	1790–1799
Thomas McKean	Democratic-Republican	1799–1808
Simon Snyder	„	1808–1817
William Finley	„	1817–1820
Joseph Heister	„	1820–1823
John A. Shulze	„	1823–1829
George Wolf	Democrat	1829–1835
Joseph Ritner	Anti-Masonic	1835–1839
D. R. Porter	Democrat	1839–1845
F. R. Shunk	„	1845–1848
W. F. Johnston[5]	Whig	1848–1852
William Bigler	Democrat	1852–1855
James Pollock	„	1855–1858
W. F. Packer	„	1858–1861
A. G. Curtin	Republican	1861–1867
John W. Geary	„	1867–1873
John F. Hartranft	„	1873–1879
Henry M. Hoyt	„	1879–1883
Robert E. Pattison	Democrat	1883–1887
James A. Beaver	Republican	1887–1891
Robert E. Pattison	Democrat	1891–1895
Daniel H. Hastings	Republican	1895–1899
William A. Stone	„	1899–1903
Samuel W. Pennypacker	„	1903–1907
Edwin S. Stuart	„	1907–1911
John K. Tener	„	1911–

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For the administration of the state see: *The Constitution of the Commonwealth of Pennsylvania*, adopted December 16, 1873, amended November 5, 1901 (Harrisburg, 1902); S. George *et al.* (editors), *Laws of Pennsylvania, 1682–1700, preceded by the Duke of York's Laws, 1676–1682* (Harrisburg, 1879); A. J. Dallas (editor), *Laws of Pennsylvania, 1700–1801* (Philadelphia and Lancaster, 1797–1801); *Laws of the General Assembly of Pennsylvania*

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[1] Governors of New Netherland and of the Dutch settlements on the Delaware.

[2] The Swedish colonies on the Delaware conquered by the Dutch in 1655.

[3] Lloyd was deputy-governor of the province, the present state of Pennsylvania; Markham of the lower counties, the present state of Delaware.

[4] The state was governed by a supreme executive council in 1777–1790.

[5] Governor Shunk resigned in July 1848 and was succeeded by W. F. Johnston, president of the state senate.

(Philadelphia, 1801 sqq. and Harrisburg, 1802 sqq.); and *The Statutes at Large of Pennsylvania* (Philadelphia, 1896 sqq.), published under an act of 1887. Some valuable information is to be found in B. A. and M. L. Hinsdale, *History and Civil Government of Pennsylvania . . .* (Chicago, 1899); and in the various editions of Smull's *Legislative Handbook and Manual.* For the history of penal and charitable institutions, see the *Annual Reports of the Board of Commissioners of Public Charities* (Harrisburg, 1871 sqq.); the *Annual Reports of the Committee on Lunacy* (Harrisburg, 1883 sqq.); and Amos H. Mylin, *Penal and Charitable Institutions of Pennsylvania* (2 vols., Harrisburg, 1897), an official publication, well written and handsomely illustrated. For educational history, see N. C. Schaeffer, *The Common School Laws of Pennsylvania* (Harrisburg, 1904); B. A. Hinsdale, *Documents Illustrative of American Educational History* (Washington, 1895); and J. P. Wickersham, *History of Education in Pennsylvania* (Lancaster, 1886), one of the best state histories of education. For finance and banking, see the annual reports of the state treasurer, auditor-general, sinking fund commissioners, and the commissioner of banking, all published at Harrisburg; *An Historical Sketch of the Paper Money of Pennsylvania*, by a member of the Numismatic Society of Philadelphia (Philadelphia, 1862); and B. M. Mead, *A Brief Review of the Financial History of Pennsylvania . . . to the Present Time (1682–1881)* (Harrisburg, 1881).

The only complete history of the entire period is Howard M. Jenkins, *et al.*, *Pennsylvania, Colonial and Federal* (3 vols., Philadelphia, 1903). This is especially valuable for the detailed histories of gubernatorial administrations from 1790 to 1903. The third volume contains useful chapters on education, the judiciary, the medical profession, journalism, military affairs, internal improvements, &c. S. G. Fisher, *Pennsylvania, Colony and Commonwealth* (Philadelphia, 1897) contains the best short account of the colonial and revolutionary history, but it gives only a very brief summary of the period since 1783. W. R. Shepherd, *History of Proprietary Government in Pennsylvania* (New York, 1896), a detailed study of the proprietary from the political, governmental and territorial points of view, is scholarly, and gives a good account of the boundary disputes with Maryland, Virginia, New York and Connecticut. Among the older standard works are Samual Hazard, *Annals of Pennsylvania from the Discovery of the Delaware, 1609–1682* (Philadelphia, 1850), an elaborate account of the early Dutch and Swedish settlements on the Delaware river and bay; and Robert Proud, *History of the Pennsylvania from 1681 until after the year 1742* (2 vols., Philadelphia, 1797–1798), written from the Quaker standpoint. For early literary history, see M. K. Jackson, *Outline of the Literary History of Colonial Pennsylvania* (New York, 1908). W. H. Egle, *Illustrated History of the Commonwealth of Pennsylvania* (Harrisburg, 1877), contains trustworthy histories of individual counties by various writers. J. B. McMaster and F. D. Stone, *Pennsylvania and the Federal Constitution, 1787–1788* (Philadelphia, 1888), is a useful work. For the anti-Masonic movement, see Charles McCarthy, *The Anti-Masonic Party* (Washington, 1903). S. G. Fisher, *The Making of Pennsylvania* (Philadelphia, 1896), introductory to the same author's *Colony and Commonwealth*, is an interesting study of the various nationalities and religions represented among the settlers of the state. For the period of Quaker predominance (1681–1756), see Isaac Sharpless, *History of Quaker Government in Pennsylvania* (2 vols., Philadelphia, 1898–1899). See also J. Taylor Hamilton's " History of the Moravian Church " (Nazareth, Pa., 1900), vol. vi. of the *Transactions of the Moravian Historical Society*; *Proceedings and Addresses of the Pennsylvania German Society*, vols. vii. and viii. (Reading, 1897–1898); J. F. Sachse, *German Pietists of Provincial Pennsylvania, 1694–1708* (Philadelphia, 1895), and *German Sectarians of Pennsylvania, 1708–1800* (2 vols., Philadelphia, 1899–1901). The chief sources are the *Pennsylvania Archives* (first series, 12 vols., Philadelphia, 1852–1856; second series, 19 vols., Harrisburg, 1874–1893; and third series, 4 vols., Harrisburg, 1894–1895); *Colonial Records, 1683–1790* (16 vols., Philadelphia, 1852); and Samuel Hazard, *Register of Pennsylvania* (16 vols., Philadelphia, 1828–1836). The Pennsylvania Historical Society, organized in Philadelphia in 1825, has published 14 vols. of *Memoirs* (1826–1895), a *Bulletin* of 13 numbers (1845–1847), one volume of *Collections* (1853), and the *Pennsylvania Magazine of History and Biography*, a Quarterly (1877 sqq.). There is a good account of the public archives, both printed and manuscript, in the first report of the Public Archives Commission of the American Historical Association, published in vol. ii. of the annual report of the association for the year 1900 (Washington, 1901).

PENNSYLVANIA, UNIVERSITY OF, an American institution of higher learning, in Philadelphia, occupying about 60 acres, near the west bank of the Schuylkill river, north-east of the Philadelphia Hospital, east of 39th Street, south-east of Woodland Avenue, and south of Chestnut Street. In this irregular area are all the buildings except the Flower Astronomical Observatory (1896), which is 2 m. beyond the city limits on the West Chester Pike. The northernmost of these buildings is the law school, between Chestnut and Sansom Streets, on 34th Street. In a great triangular block bounded by Woodland Avenue, Spruce Street, and 34th Street are: the university library, which had in 1909 about 275,000 bound volumes and 50,000 pamphlets, including the Biddle Memorial law library (1886) of 40,000 volumes, the Colwell and Henry C. Carey collections in finance and economics, the Francis C. Macauley library of Italian, Spanish and Portuguese authors, with an excellent Dante collection, the classical library of Ernst von Leutsch of Göttingen, the philological library of F. A. Pott of Halle, the Germanic library of R. Bechstein of Rostock, the Semitic library of C. P. Caspari of Copenhagen, the (Hebrew and Rabbinical) Marcus Jastrow Memorial library, the ethnological library of D. G. Brinton, and several special medical collections; College Hall, with the university offices; Howard Houston Hall (1896) the students' club; Logan Hall; the Robert Hare chemical laboratory; and (across 36th Street) the Wistar institute of anatomy and biology. Immediately east of this triangular block are: Bennett House; the Randal Morgan laboratory of physics; the engineering building (1906); the laboratory of hygiene (1892); dental hall; and the John Harrison laboratory of chemistry. Farther east are the gymnasium, training quarters and Franklin (athletic) field, with brick grand-stands. South of Spruce Street are: the free museum of science and art (1899), the north-western part of a projected group, with particularly valuable American, Egyptian, Semitic and Cretan collections, the last two being the results in part of university excavations at Nippur (1888–1902) and at Gournia (1901–1904); between 34th and 36th Streets the large and well-equipped university hospital (1874); large dormitories, consisting in 1909, of 29 distinct but connected houses; medical laboratories; a biological hall and vivarium; and across Woodland Avenue, a veterinary hall and hospital.

The university contains various departments, including the college (giving degrees in arts, science, biology, music, architecture, &c.), the graduate school (1882), a department of law (founded in 1790 and re-established in 1850) and a department of medicine (first professor, 1756; first degrees granted, 1768), the oldest and probably the most famous medical school in America. Graduation from the school of arts in the college is dependent on the successful completion of 60 units of work (the unit is one hour's work a week for a year in lectures or recitations or two hours' work a week for a year in laboratory courses); this may be done in three, four or five years; of the 60 counts: 22 must be required in studies (chemistry, 2 units; English, 6; foreign languages, 6; history, logic and ethics, mathematics, and physics, 2 each); 18 must be equally distributed in two or three " groups "—the 19 groups include astronomy, botany, chemistry, economics, English, fine arts, French, geology, German, Greek, history, Latin, mathematics, philosophy, physics, political science, psychology, sociology and zoology; and in the remaining 20 units the student's election is practically free. Special work in the senior year of the college counts 8 units for the first year's work in the department of medicine. College scholarships are largely local, two being in the gift of the governor of the state, fifty being for graduates of the public schools of the city of Philadelphia, and five being for graduates of Pennsylvania public schools outside Philadelphia; in 1909 there were twenty-eight scholarships in the college not local. In the graduate school there are five fellowships for research, each with an annual stipend of $800, twenty-one fellowships valued at $500 each, for men only, and five fellowships for women, besides special fellowships and 39 scholarships.

The corporation of the university is composed of a board of twenty-four trustees, of which the governor of Pennsylvania is *ex-officio* president. The directing head of the university, and the head of the university faculty and of the faculty of each department is the provost—a title rarely used in American universities; the provost is president *pro tempore* of the board of trustees.

In 1908–1909 the university had 454 officers of instruction, of whom 220 were in the college and 157 in the department of medicine, and an enrolment of 4570 students, of whom 2989 were in the college (412 in the school of arts; 987 in the Towne scientific school; 472 in the Wharton school, and 253 in the evening school of accounts and finance; 384 in courses for teachers; and 481 in the summer school), 353 in the graduate school, 327 in the department of law, 559 in the department of medicine, 385 in the department of dentistry, and 150 in the department of veterinary medicine.

In August 1907 the excess of the university's assets over its liabilities was $13,239,408 and the donations for the year were $305,814. A very large proportion of the university's investments is in real estate, especially in Philadelphia. In 1907 the total value of real estate (including the university buildings) was $6,829,154; and libraries, museums, apparatus and furniture were valued at $2,025,357. Students' tuition fees vary from $150 to $200 a year in the college; and are $160 in the department of law, $200 in the department of medicine, $150 in the department of dentistry and $100 in the department of veterinary science. The income from tuition fees in 1906–1907 was $458,396; the payments for "educational salaries" amounted to $433,311, and for "administration salaries" to $135,314.

The university publishes the following series: *Astronomical Series* (1899 sqq.); *Contributions from the Botanical Laboratory* (1892 sqq.); *Contributions from the Laboratory of Hygiene* (1898 sqq.); *Contributions from the Zoological Laboratory* (1893 sqq.); *Series in History* (1901 sqq.); *Series in Mathematics* (1897 sqq.); *Series in Philology and Literature* (1891 sqq.); *Series in Romanic Languages and Literatures* (1907 sqq.); *Series in Philosophy* (1890 sqq.); *Series in Political Economy and Public Law* (1885 sqq.); *The American Law Register* (1852 sqq.); *The University of Pennsylvania Medical Bulletin* (1888 sqq.); *Transactions of the Department of Archaeology* (1904 sqq.); the *Journal of Morphology* (1887 sqq.); and *Transactions and Proceedings of the Botanical Society of Pennsylvania* (1897 sqq.). There are also occasional publications by institutes and departments connected with the university. Student publications include: a daily, *The Pennsylvanian* (1885); the weekly, *Old Penn* (1902); a comic monthly, *The Punch Bowl*; a literary monthly, *The Red and Blue*; a quarterly of the department of dentistry, *The Penn Dental Journal*; an annual, *The Record*; and *The Alumni Register* (1896), a monthly.

Benjamin Franklin in 1749 published a pamphlet, entitled *Proposals Relating to the Education of Youth in Pensilvania*, which led to the formation of a board of twenty-four trustees, nineteen of whom, on the 13th of November 1749, met for organization and to promote "the Publick Academy in the City of Philadelphia," and elected Benjamin Franklin president of the board, an office which he held until 1756. So closely was Franklin identified with the plan that Matthew Arnold called the institution "the University of Franklin." On the 1st of February 1750 there was conveyed to this board of trustees the "New Building" on Fourth Street, near Arch, which had been erected in 1740 for a charity school—a use to which it had not been put—and as a "house of Publick Worship," in which George Whitefield had preached in November 1740; the original trustees (including Franklin) of the "New Building" and of its projected charity school date from 1740, and therefore the university attaches to its seal the words "founded 1740." In the "New Building" the academy was opened on the 7th of January 1751, the city having voted £200 in the preceding August for the completion of the building. On the 16th of September 1751 a charitable school "for the instruction of poor Children *gratis* in *Reading, Writing*, and *Arithmetick*" was opened in the "New Building." The proprietaries, Thomas and Richard Penn, incorporated "The Trustees of the Academy and Charitable School in the Province of Pennsylvania" in 1753; and in 1755 issued a confirmatory charter, changing the corporate name to "The Trustees of the College, Academy and Charitable School," &c., whereupon William Smith (1727–1803) of the university of Aberdeen, who had become rector of the academy in 1752 and had taken orders in the Church of England in 1753, became provost of the college. In 1756 Dr Smith established a complete and liberal curriculum which was adopted by Bishop James Madison in 1777 when he became president of the College of William and Mary. In 1757 the first college class graduated. Under Smith's control the Latin school grew in importance at the expense of the English school, to the great annoyance of Franklin. In 1762–1764 Dr Smith collected for the college in England about £6900; and in 1764 his influence had become so strong that it was feared that the college would become sectarian. The Penns and others deprecated this and the trustees bound themselves (1764) to "use their utmost endeavours that . . . (the original plan) be not narrowed, nor the members of the Church of England, nor those dissenting from them . . . be put on any worse footing in this seminary than they were at the time of receiving the royal brief." From September 1777 to June 1778 college exercises were not held because Philadelphia was occupied by British troops. In 1779 the state legislature, on the ground that the trustees' declaration in 1764 was a "narrowing of the foundation,"[1] confiscated the rights and property of the college and chartered a new corporation "the Trustees of the University of the State of Pennsylvania"; in 1789 the college was restored to its rights and property and Smith again became its provost; in 1791 the college and the university of the State of Pennsylvania were united under the title, "the University of Pennsylvania," whose trustees were elected from their own members by the board of trustees of the college and that of the university. In 1802 the university purchased new grounds on Ninth Street, between Market and Chestnut, where the post office building now is; there until 1829 the university occupied the building erected for the administrative mansion of the president of the United States; there new buildings were erected after 1829; and from these the university removed to its present site in 1872.

The provosts have been: in 1755–1779 and in 1789–1803, William Smith; in 1779–1791, of the university of the state of Pennsylvania, John Ewing (1732–1802); in 1807–1810, John McDowell (1750–1820); in 1810–1813, John Andrews (1746–1813); in 1813–1828, Frederick Beasley (1777–1845); in 1828–1833, William Heathcote De Lancey (1797–1865); in 1834–1853, John Ludlow (1793–1857); in 1854–1859, Henry Vethake (1792–1866); in 1860–1868, Daniel Raynes Goodwin (1811–1890); in 1868–1880, Charles Janeway Stillé (1819–1899); in 1881–1894, William Pepper (1843–1898); in 1894–1910, Charles Custis Harrison (b. 1844), and in 1911 sqq. Edgar Fahs Smith (b. 1856).

See T. H. Montgomery, *A History of the University of Pennsylvania from its Foundation to A.D. 1770* (Philadelphia, 1900); George B. Wood, *Early History of the University of Pennsylvania* (3rd ed., ibid., 1896); J. B. McMaster, *The University of Pennsylvania* (ibid. 1897); G. E. Nitzsche, *Official Guide to the University of Pennsylvania* (ibid., 1906); and Edward P. Cheyney, "University of Pennsylvania," in vol. i. of *Universities and their Sons* (Boston, 1901).

PENNY (Mid. Eng. *peni* or *peny*, from O. Eng. form *penig*, earlier *penning* and *pending*; the word appears in Ger. *Pfennig* and Du. *penning*; it has been connected with Du. *pand*, Ger. *Pfand*, and Eng. "pawn," the word meaning a little pledge or token, or with Ger. *Pfanne*, a pan), an English coin, equal in value to the one-twelfth of a shilling. It is one of the oldest of English coins, superseding the sceatta or sceat (see NUMISMATICS; and BRITAIN: *Anglo Saxon*, § "Coins"). It was introduced into England by Offa, king of Mercia, who took as a model a coin first struck by Pippin, father of Charlemagne, about 735, which was known in Europe as *novus denarius*. Offa's penny was made of silver and weighed 22½ grains, 240 pennies weighing one Saxon pound (or Tower pound, as it was afterwards called), hence the term pennyweight (dwt.). In 1527 the Tower pound of 5400 grains was abolished, and the pound of 5760 grains adopted instead. The penny remained, with some few exceptions, the only coin issued in England until the introduction of the gold florin by Edward III. in 1343. It was not until the reign of Edward I. that halfpence and farthings became a regular part of the coinage, it having been usual to subdivide the penny for trade purposes by cutting it into halves and quarters, a practice said to have originated in the reign of Æthelred II. In 1257, in the reign of Henry III., a gold penny, of the value of twenty silver pence, was struck. The weight and value of the silver penny steadily declined from 1300 onwards, as will be seen from the following table:—

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[1] Probably the actual reason was that the assembly, dominated by the advocates of the radical constitution of 1776, was attempting to punish the trustees of the college, who were almost all "anti-constitutionalists."

Reign.	Weight.	Value in silver 925 fine, at 5s. 6d. per oz.
	Grains.	Penny.
William I., 1066	22½	3·09
Edward I., 1300	22	3·02
„ III., 1344	20¼	2·78
„ III., 1346	20	2·75
„ III., 1351	18	2·47
Henry IV., 1412	15	2·06
Edward IV., 1464	12	1·65
Henry VIII., 1527	10½	1·44
„ VIII., 1543	10	1·37
Edward VI., 1552	8	1·10
Elizabeth, 1601	7¾	1·06

The last coinage of silver pence for general circulation was in the reign of Charles II. (1661–1662), since which time they have only been coined for issue as royal alms on Maundy Thursdays. Copper halfpence were first issued in Charles II.'s reign,[1] but it was not until 1797, in the reign of George III., that copper pence were struck. This copper penny weighed 1 oz. avoirdupois. In the same year copper twopences were issued weighing 2 oz., but they were found too cumbersome and were discontinued. In 1860 bronze was substituted for the copper coinage, the alloy containing 95 parts of copper, 4 of tin, and 1 of zinc. The weight was also reduced, 1 ℔ of bronze being coined into 48 pennies, as against 24 pennies into which 1 ℔ of copper was coined.

PENN YAN, a village and the county-seat of Yates county, New York, U.S.A., situated N. of Keuka Lake, on the outlet extending to Lake Seneca, about 170 m. W. of Albany, and about 95 m. E. by S. of Buffalo. Pop. (1905), 4504; (1910) 4597. It is served by the New York Central & Hudson River and the Northern Central railways and by electric railway to Branchport, and has steamboat connexions with Hammondsport at the head of Keuka Lake. The lake, one of the most beautiful of the so-called "finger lakes" of central New York, abounds in lake and rainbow trout, black bass, pickerel and pike, and there are many summer cottages along its shores. At Keuka Park, on the west shore of the lake, is Keuka College (1890), and at Eggleston's Point is held a summer "natural science camp" for boys. The village is the seat of the Penn Yan Academy (1859). The lake furnishes water-power, and among the manufactures are paper, lumber, carriages, shoes, &c. Much ice is shipped from the village. Penn Yan is an important shipping point in the apple and grape-growing region of central New York, and winemaking is an important industry. The first frame dwelling at Penn Yan was built in 1799; the village became the county-seat in 1823, when Yates county was created, and was incorporated in 1833. The first settlers were chiefly followers of Jemima Wilkinson (1753–1819), a religious enthusiast, born in Cumberland township, Providence county, Rhode Island, who asserted that she had received a divine commission. She preached in Rhode Island, Connecticut, Massachusetts and Pennsylvania. Obtaining a large tract (which was called Jerusalem in 1789) in the present Yates county, she founded in 1788 the village of Hopeton on the outlet of Keuka Lake about a mile from Seneca Lake. Many followers settled there, and she herself lived there after 1790. Some of her followers left her before 1800, and then the community gradually broke up. The name of the village is said to have been derived from the first syllables of "Pennsylvania" and "Yankee," as most of the early settlers were Pennsylvanians and New Englanders.

See Lewis C. Aldrich, *History of Yates County, New York* (Syracuse, 1892).

PENNYROYAL, in botany, a herb formerly much used in medicine, the name being a corruption of the old herbalist's name "Pulioll-royall," *Pulegium regium.* It is a member of the mint genus, and has been known to botanists since the time of Linnaeus as *Mentha pulegium.* It is a perennial herb with a slender branched stem, square in section, up to a foot in length and rooting at the lower nodes, small opposite stalked oval leaves about half-inch long, and dense clusters of small reddish-purple flowers in the leaf axils, forming almost globular whorls. It grows in damp gravelly places, especially near pools, on heaths and commons. It has a strong smell somewhat like that of spearmint, due to a volatile oil which is readily obtained by distillation with water, and is known in pharmacy as *Oleum pulegii.* The specific name recalls its supposed property of driving away fleas (*pulices*). Like the other mints it has carminative and stimulant properties.

PENOBSCOT, a tribe of North American Indians of Algonquian stock. Their old range was the country around the river Penobscot in Maine. They sided with the French in the colonial wars, but made a treaty of peace with the English in 1749. They fought against the English in the War of Independence, and were subsequently settled on an island in the Penobscot river, near Oldtown.

PENOLOGY (Lat. *poena*, punishment), the modern name given to penitentiary science, that concerned with the processes devised and adopted for the repression and prevention of crime. (See CRIME; CRIMINOLOGY; PRISON; JUVENILE OFFENDERS; RECIDIVISM, &c.)

PENRHYN, GEORGE SHOLTO GORDON DOUGLAS-PENNANT, 2nd BARON (1836–1907), was the son of Colonel Edward Gordon Douglas (1800–1886), brother of the 19th earl of Morton, who, through his wife, Juliana, elder daughter and coheir of George Hay Dawkins-Pennant, of Penrhyn Castle, Carnarvon, had large estates in Wales and elsewhere, and was created Baron Penrhyn in 1866. Dawkins had inherited the estates from Richard Penryn, who was created Baron Penryn in 1763, the title becoming extinct on his death in 1808.

George Douglas-Pennant was conservative M.P. for Carnarvonshire in 1866–1868 and 1874–1880, and succeeded his father in the title in 1886. A keen sportsman, a benevolent landlord, a kind and considerate employer, Lord Penrhyn came of a proud race, and was himself of an imperious disposition. He came prominently before the public in 1897 and subsequent years in connexion with the famous strike at his Welsh slate-quarries. During his father's lifetime the management of the Penrhyn quarry had been left practically to an elective committee of the operatives, and it was on the verge of bankruptcy when in 1885 he took matters in hand; he abolished the committee, and with the help of Mr E. A. Young, whom he brought in from London as manager, he so reorganized the business that this slate-quarry yielded a profit of something like £150,000 a year. The new men and new methods were, however, not to the taste of the trade unionist leaders of the quarrymen, and in 1897, when the "new unionism" was rampant in labour questions throughout England, a strike was deliberately fomented. Lord Penrhyn refused to recognize the union or its officials, though he was willing to consider any grievances from individual quarrymen, and a protracted struggle ensued, in which his determination was invincible. He became the object of the bitterest political hostility, and trade unionism exerted itself to the utmost, but vainly, to bring about some form of government intervention. Penrhyn strikers perambulated the country, singing and collecting contributions to their funds. But in spite of every pressure Lord Penrhyn insisted on being master of his own property, and by degrees the agitation collapsed. His death on the 10th of March 1907 evoked general and genuine regret. Lord Penrhyn was twice married, and had fifteen surviving children. He was succeeded in the title by his eldest son, Edward Sholto (b. 1864), who was Unionist M.P. for South Northamptonshire from 1895 to 1900.

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[1] The figure of Britannia first appeared on this issue of copper coins. The original of Britannia is said to have been Frances Stewart, afterwards duchess of Richmond (Pepys, *Diary*, Feb. 25, 1667). It was in Charles II.'s reign, too, that the practice was established of placing the sovereign's bust in a direction contrary to that of his predecessor.

PENRITH, a municipality of Cumberland county, New South Wales, Australia, on the Nepean River, 34 m. by rail W. by N. of Sydney. Penrith and the adjoining township of St Mary's are chiefly remarkable for their connexion with the railway. The iron tubular bridge which carries the line over the Nepean is the best of its kind in the colony, while the viaduct over Knapsack Gulley is the most remarkable erection of its kind in Australia. There are large engineering works and railway fitting shops at Penrith, which is also the junction for all the western goods traffic. The inhabitants of both towns are mainly railway employés. Pop. (1901), of Penrith 3539, of St Mary's 1840.

PENRITH, a market town in the Penrith parliamentary division of Cumberland, England, in a valley near the river Eamont, on the Cockermouth, Keswick & Penrith, London & North Western and North Eastern railways. Pop. of urban district (1901), 9182. It contains some interesting brasses. A 14th-century grammar school was refounded by Queen Elizabeth; and there are two mansions dating from the same reign, which have been converted into inns. Though there are breweries, tanneries and saw-mills, the town depends mainly on agriculture. There are some ruins of a castle erected as a protection against the Scots. Near Penrith on the south, above the precipitous bank of the Eamont, stands a small but beautiful old castellated house, Yanwath Hall. To the north-east of the town is Eden Hall, rebuilt in 1824. Among many fine paintings, it contains portraits by Hoppner, Kneller, Lely, Opie and Reynolds. The "Luck of Eden Hall," which has been celebrated in a ballad by the duke of Wharton, and in a second ballad written by Uhland, the German poet, and translated by Longfellow, is an enamelled goblet, kept in a leathern case dating from the times of Henry IV. or Henry V. It was long supposed to be Venetian, but has been identified as of rare Oriental workmanship. The legend tells how a seneschal of Eden Hall one day came upon a company of fairies dancing at St Cuthbert's Well in the park. These flew away, leaving their cup at the water's edge, and singing "If that glass either break or fall, Farewell to the luck of Eden Hall." Its true history is unknown.

Penrith, otherwise Penreth, Perith, Perath, was founded by the Cambro-Celts, but on a site farther north than the present town. In 1222 Henry III. granted a yearly fair extending from the eve of Whitsun to the Monday after Trinity and a weekly market on Wednesday, but some time before 1787 the market day was changed to Tuesday. The manor in 1242 was handed over to the Scottish king who held it till 1295, when Edward I. seized it. In 1397 Richard II. granted it to Ralph Neville, first earl of Westmorland; it then passed to Warwick the kingmaker and on his death to the crown. In 1694 William III. granted the honour of Penrith to the earl of Portland, by whose descendant it was sold in 1787 to the duke of Devonshire. A court leet and view of frankpledge have been held here from time immemorial. In the 18th and early part of the 19th century Penrith manufactured checks, linen cloth and ginghams, but the introduction of machinery put an end to this industry, only the making of rag carpets surviving. Clock and watch-making seems to have been an important trade here in the 18th century. The town suffered much from the incursions of the Scots, and Ralph, earl of Westmorland, who died 1426, built the castle, but a tower called the Bishop's Tower had been previously erected on the same site. In 1597–1598 a terrible visitation of plague attacked the town, in which, according to an old inscription on the church, 2260 persons perished in Penrith, by which perhaps is meant the rural deanery. During the Civil War the castle was dismantled by the Royalist commandant. In 1745 Prince Charles Edward twice marched through Penrith, and a skirmish took place at Clifton. The church of St Andrew is of unknown foundation, but the list of vicars is complete from 1223.

PENRY, JOHN (1559–1593), Welsh Puritan, was born in Brecknockshire in 1559; tradition points to Cefn Brith, a farm near Llangammarch, as his birthplace. He matriculated at Peterhouse, Cambridge, in December 1580, being then almost certainly a Roman Catholic; but soon became a convinced Protestant, with strong Puritan leanings. Having graduated B.A., he migrated to St Alban's Hall, Oxford, and proceeded M.A. in July 1586. He did not seek episcopal ordination, but was licensed as University Preacher. The tradition of his preaching tours in Wales is slenderly supported; they could only have been made during a few months of 1586 or the autumn of 1587. At this time ignorance and immorality abounded in Wales. In 1562 an act of parliament had made provision for translating the Bible into Welsh, and the New Testament was issued in 1567; but the number printed would barely supply a copy for each parish church. Indignant at this negligence, Penry published, early in 1587, *The Æquity of an Humble Supplication—in the behalf of the country of Wales, that some order may be taken for the preaching of the Gospel among those people.* Archbishop Whitgift, angry at the implied rebuke, caused him to be brought before the High Commission and imprisoned for about a month. On his release Penry married a lady of Northampton, which town was his home for some years. With the assistance of Sir Richard Knightley and others, he set up a printing press, which for nearly a year from Michaelmas 1588 was in active operation. It was successively located at East Moulsey (Surrey), Fawsley (Northampton), Coventry and other places in Warwickshire, and finally at Manchester, where it was seized in August 1589. On it were printed Penry's *Exhortation to the governours and people of Wales*, and *View of . . . such publike wants and disorders as are in the service of God . . . in Wales*; as well as the celebrated *Martin Marprelate* tracts. In January 1590 his house at Northampton was searched and his papers seized, but he succeeded in escaping to Scotland. There he published several tracts, as well as a translation of a learned theological work known as *Theses Genevenses*. Returning to England in September 1592, he joined the Separatist Church in London, in which he declined to take office, though after the arrest of the ministers, Francis Johnson and John Greenwood, he seems to have been the regular preacher. He was arrested in March 1593, and efforts were made to find some pretext for a capital charge. Failing this a charge of sedition was based on the rough draft of a petition to the queen that had been found among his private papers; the language of which was indeed harsh and offensive, but had been neither presented nor published. He was convicted by the Queen's Bench on the 21st of May 1593, and hanged on the 29th at the unusual hour of 4 p.m., the signature of his old enemy Whitgift being the first of those affixed to the warrant.

See the *Life*, by John Waddington (1854).

PENRYN, a market town and port, and municipal and contributary parliamentary borough of Cornwall, England, 2 m. N.W. of Falmouth, on a branch of the Great Western railway. Pop. (1901), 3190. It lies at the head of the estuary of the Penryn River, which opens from the main estuary of the Fal at Falmouth. Granite, which is extensively quarried in the neighbourhood, is dressed and polished at Penryn, and there are also chemical and bone manure works, engineering, iron and gunpowder works, timber-yards, brewing, tanning and paper-making. The harbour dries at low tide, but at high tide has from 9 to 12½ ft. of water. Area, 291 acres.

Penryn owed its development to the fostering care of the bishops of Exeter within whose demesne lands it stood. These lands appear in Domesday Book under the name of Trelivel. In 1230 Bishop Briwere granted to his burgesses of Penryn that they should hold their burgages freely at a yearly rent of 12d. by the acre for all service. Bishop Walter de Stapeldon secured a market on Thursdays and a fair at the Feast of St Thomas. The return to the bishop in 1307 was £7, 13s. 2½d. from the borough and £26, 7s. 5d. from the forum. In 1311 Bishop Stapeldon procured a three days' fair at the Feast of St Vitalis. Philip and Mary gave the parliamentary franchise to the burgesses in 1553. James I. granted and renewed the charter of incorporation, providing a mayor, eleven aldermen and twelve councillors, markets on Wednesdays and Saturdays, and fairs on the 1st of May, the 7th of July and the 21st of December. The charter having been surrendered, James II. by a new charter *inter alia* confined the parliamentary franchise to members of the corporation. This proviso however was soon disregarded, the franchise being freely exercised by all the inhabitants paying scot and lot. An attempt to deprive the borough of its members, owing to corrupt practices, was defeated by the House of Lords in 1827. The act of 1832 extended the franchise to Falmouth in spite of the rivalry existing between the two boroughs, which one of the sitting members asserted was so great that no Penryn man was ever known to marry a Falmouth woman. In 1885 the united borough was deprived of one of its members. The corporation of Penryn was remodelled in 1835, the aldermen being reduced to four. Its foreign trade, which dates from the 14th century, is considerable. The extra-parochial collegiate church of Glasney, founded by Bishop Bronescombe in 1265, had a revenue at the time of its suppression under the act of 1545 of £221,18s. 4d.

See *Victoria County History, Cornwall*; T. C. Peter, *Glasney Collegiate Church.*

PENSACOLA, a city, port of entry, and the county-seat of Escambia county, Florida, U.S.A., in the N.W. part of the state, on Pensacola Bay, about 6 m. (11 m. by channel) N. of the Gulf of Mexico. Pop. (1900) 17,747; (1910) 22,982. It ranks second in size among the cities of Florida. The city is served by the Louisville & Nashville and the Pensacola, Alabama & Tennessee railways, and by steamers to West Indian, European and United States ports. The harbour[1] is the most important deep-water harbour south of Hampton Roads. The narrow entrance is easily navigable and is defended by Fort Pickens on the west end of Santa Rosa Island, with a great sea-wall on the Gulf side (completed in 1909), Fort McRee on a small peninsula directly opposite, and Fort Barrancas on the mainland immediately north-east of Fort McRee. On the mainland 1 m. east of Fort Barrancas are a United States Naval Station, consisting of a yard (84 acres enclosed) with shops, a steel floating dry dock and marine barracks; and a reservation (1800 acres) on which are a naval hospital, a naval magazine, two timber ponds, a national cemetery, and the two villages of Warrington and Woolsey, with a population of about 1500, mostly employés of the yard. The city's principal public buildings are the state armoury, the Federal building, and the city hall. The mean annual temperature is about 72° F., and breezes from the Gulf temper the heat. Pensacola is a shipping point for lumber, naval stores, tobacco, phosphate rock, fish, cotton and cotton-seed oil, meal and cake, and is one of the principal markets in the United States for naval stores. In 1895 the foreign exports were valued at $3,196,609, in 1897 at $8,436,679, and in 1909 at $20,971,670; the imports in 1909 were valued at $1,479,017. The important factor in this vast development has been the Louisville & Nashville railway, which after 1895 built extensive warehouses and docks at Pensacola. There are excellent coaling docks—good coal is brought hither from Alabama—and a grain elevator. Among the manufactures are sashes, doors and blinds, whiting, fertilizers, rosin and turpentine, and drugs.

Pensacola Bay may have been visited by Ponce de Leon in 1513 and by Panfilo de Narvaez in 1528. In 1540 Maldonado, the commander of the fleet that brought De Soto to the Florida coast, entered the harbour, which he named Puerta d'Auchusi, and on his recommendation De Soto designated it as a basis of supplies for his expedition into the interior. In 1559 a permanent settlement was attempted by Tristan de Luna, who renamed the harbour Santa Maria, but two years later this settlement was abandoned. In 1696 another settlement was made by Don Andres d'Arriola, who built Fort San Carlos near the site of the present Fort Barrancas, and seems to have named the place Pensacola. In 1719, Spain and France, being at war, Pensacola was captured by Sieur de Bienville, the French governor of Louisiana. Later in the same year it was successively re-taken by a Spanish force from Havana and recaptured by Bienville, who burned the town and destroyed the fort. In 1723, three years after the close of hostilities, Bienville relinquished possession. The Spanish then transferred their settlement to the west end of Santa Rosa Island, but after a destructive hurricane in 1754 they returned to the mainland. In 1763, when the Floridas were ceded to Great Britain, Pensacola became the seat of administration for West Florida and most of the Spanish inhabitants removed to Mexico and Cuba. During the War of American Independence the town was a place of refuge for many Loyalists from the northern colonies. On the 9th of May 1781 it was captured by Don Bernardo de Galvez, the Spanish governor at New Orleans. Most of the English inhabitants left, but trade remained in the hands of English merchants. During the War of 1812 the British made Pensacola the centre of expeditions against the Americans, and in 1814 a British fleet entered the harbour to take formal possession. In retaliation General Andrew Jackson attacked the town, driving back the British. In 1818, on the ground that the Spanish encouraged the Seminole Indians in their attacks upon the American settlements in the vicinity, Jackson again captured Pensacola, and in 1821 Florida was finally transferred to the United States. On the 12th of January 1861 the Navy Yard was seized by order of the state government, but Fort Pickens, defended first by an insignificant force under Lieut. Adam J. Slemmer (1828–68) and afterwards by a larger force under Lieut.-Colonel Harvey Brown (1796–1874), remained in the hands of the Union forces, and on the 8th of May 1862 the Confederates abandoned Pensacola. Pensacola was chartered as a city in 1895.

PENSHURST, a village in the south-western parliamentary division of Kent, England, at the confluence of the Eden and Medway, 4½ m. S.W. of Tonbridge. Pop. (1901), 1678. The village is remarkable for some old houses, including a timbered house of the 15th century, and for a noted factory of cricket implements. The church, chiefly late Perpendicular, contains a large number of monuments of the Sidney family and an effigy of Sir Stephen de Penchester, Warden of the Cinque Ports in the time of Edward I. Penshurst Place is celebrated as the home of the Sidney family. Anciently the residence of Sir Stephen de Penchester, Penshurst was granted to Henry VIII.'s chamberlain, Sir William Sidney, whose grandson, Sir Philip Sidney, was born here in 1554. It passed to Sir Philip's younger brother Robert, who in 1618 was created earl of Leicester. On the death of the seventh earl in 1743 the estates devolved upon his niece Elizabeth, whose only child married Sir Bysshe Shelley of Castle Goring. Their son was created a baronet in 1818 as Sir John Shelley-Sidney, and his son was created Baron de L'Isle and Dudley in 1835. The mansion is quadrangular, and has a fine court, chapel and hall (*c.* 1341) with open timber roof and a minstrels' gallery. The various rooms contain an interesting collection of portraits, armour and other family relics. The praises of the park and the house have been sung in Sir Philip Sidney's *Arcadia*, and by Ben Jonson, Edmund Waller and Robert Southey.

PENSION (Lat. *pensio*, a payment, from *pendere*, to weigh, to pay), a regular or periodical payment made by private employers, corporations or governments, in consideration either of past services or of the abolition of a post or office. Such a pension takes effect on retirement or when the period of service is over. The word is also used in the sense of the payment by members of a society in respect of dues.

United Kingdom.

In the United Kingdom the majority of persons in the employ of the government are entitled to pensions on reaching a certain age and after having served the state for a certain minimum number of years. That such is the case, and moreover that it is usual to define such pensions as being given in consideration of past services, has led to the putting forward very generally the argument that pensions, whether given by a government or by private employers, are in the nature of deferred pay, and that holders of posts which carry pensions must therefore be rewarded by a remuneration less than the full market rate, by the difference of the value of the pension. This view is hardly correct, for the object of attaching a pension to a post is not merely to reward past services, but to attract continuity of service by the holder as well as to enable the employer to dispense with the services of the employé without hardship to him should age or infirmity render him less efficient. Dissatisfaction had been expressed from time to time by members of the English civil service with the system in force, viz. that the benefit of long service was confined only to survivors, and that no advantage accrued to the representatives of those who died in service. This was altered by an act of 1909. See *Royal Commission on Superannuation in the Civil Service: Report and Evidence* (1903). For the general pensions given by the state to the aged poor see OLD AGE PENSIONS.

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[1] In 1881 the United States government began to improve the harbour by dredging, and in June 1909 the depth of the channel, for a minimum width of about 300 ft., was 30 ft. at mean low water.

Civil Service.—In the English civil service the grant of pensions on superannuation is regulated by statute, the four principal acts being the Superannuation Acts of 1834, 1859, 1887 and 1909. To qualify for a pension it is necessary (1) that a civil servant should have been admitted to the service with a certificate from the civil service commissioners, or hold an office specially exempted from this requirement; (2) that he should give his whole time to the public service; (3) that he should draw the emoluments of his office from public funds exclusively; (4) that he should have served for not less than ten years; (5) that if under the age of 60 years he should be certified to be permanently incapable, from infirmity of body or mind, of discharging his official duties, or have been removed from his office on the ground of his inability to discharge his duties efficiently. On retirement on these conditions a civil servant is qualified for a pension calculated at one-eightieth of his retiring salary (or, in certain cases, of his average salary for the last three years) for each complete year of service, subject to a maximum of forty-eightieths. Civil servants retiring on the ground of ill health after less than ten years' service qualify for a gratuity of one month's pay for each year of service. Previous to the Superannuation Act of 1909 the pension was calculated at the rate of one-sixtieth of the retiring salary for each completed year of service, subject to a maximum of forty-sixtieths. This is still the rate for those who entered the service previous to the passing of the act (September 20, 1909) unless they availed themselves of the permission in the act to take advantage of its provisions, which were more than a compensation for the lowering of the rate. The act gave power to the treasury to grant by way of additional allowance to a civil servant who retired after not less than two years' service, in addition to his superannuation, a lump sum equal to one-thirtieth of his annual salary and emoluments multiplied by the number of completed years he has served, so however that such lump sum does not exceed one and a half times his salary, while if he retires after attaining the age of sixty-five years, there must be deducted from that lump sum one-twentieth for every completed year that he has served after attaining that age. In the case of those who entered the service before the passing of the act, and take advantage of the act, this additional allowance is increased by one-half per cent. for each completed year served at the passing of the act. The act also provided that where a civil servant died after serving five years or upwards, a gratuity equal to his annual salary and emoluments might be granted to his legal personal representatives. Where the civil servant attains the age of sixty-five this gratuity is reduced by one-twentieth for each completed year beyond that age. On the other hand, where the civil servant has retired from the service and all the sums received by him at his death on account of superannuation are less than his annual salary his representatives may receive the difference as a gratuity. Provision was also made in the act for granting compensation on abolition of office, provided that such compensation does not exceed what the recipient might be granted or be entitled to if he retired on the ground of ill health. Pensions are also sometimes awarded in excess of the scale as a reward for special services, as compensation for injury in certain cases, or to holders of professional offices, appointed at an age exceeding that at which public service ordinarily begins. In the estimates for civil services for the year 1909–1910, there was provided for non-effective and charitable services (as pensions and gratuities in lieu of pensions are known as) the sum of £9,625,920; this, however, included an item of £8,750,000 for old-age pensions, leaving a sum of £875,920. There was charged on the Consolidated Fund, on account of pensions and compensation allowance for civil, judicial and other services, a sum of £142,767, while the following sums for civil pensions were provided in the estimates of the several departments: War Office, £158,000; Admiralty, £369,800; Customs and Excise, £412,358; Inland Revenue, £116,096; Post Office, £649,000; Royal Irish Constabulary, £416,500; Dublin Metropolitan Police, £33,646, making a total of £2,298,167, or a gross total for civil pensions of £3,174,087. A return is published annually containing a complete list of the various pensions.

Perpetual or Hereditary Pensions.—Perpetual pensions were freely granted either to favourites or as a reward for political services from the time of Charles II. onwards. Such pensions were very frequently attached as "salaries" to places which were sinecures, or, just as often, posts which were really necessary were grossly overpaid, while the duties were discharged by a deputy at a small salary. Prior to the reign of Queen Anne such pensions and annuities were charged on the hereditary revenues of the sovereign and were held to be binding on the sovereign's successors (*The Bankers' Case*, 1691; *State Trials*, xiv. 3-43). By 1 Anne c. 7 it was provided that no portion of the hereditary revenues could be charged with pensions beyond the life of the reigning sovereign. This act did not affect the hereditary revenues of Ireland and Scotland, and many persons were quartered, as they had been before the act, on the Irish and Scottish revenues who could not be provided for in England—for example, the duke of St Albans, illegitimate son of Charles II., had an Irish pension of £800 a year; Catherine Sedley, mistress of James II., had an Irish pension of £5000 a year; the duchess of Kendall and the countess of Darlington, mistresses of George I., had pensions of the united annual value of £5000, while Madame de Walmoden, a mistress of George II., had a pension of £3000 (Lecky, *History of Ireland in the Eighteenth Century*). These pensions had been granted in every conceivable form—during the pleasure of the Crown, for the life of the sovereign, for terms of years, for the life of the grantee, and for several lives in being or in reversion (Erskine May, *Constitutional History of England*). On the accession of George III. and his surrender of the hereditary revenues in return for a fixed civil list, this civil list became the source from which the pensions were paid. The subsequent history of the civil list will be found under that heading (CIVIL LIST), but it may be here mentioned that the three pension lists of England, Scotland and Ireland were consolidated in 1830, and the civil pension list reduced to £75,000, the remainder of the pensions being charged on the Consolidated Fund.

In 1887, Charles Bradlaugh, M.P., protested strongly against the payment of perpetual pensions, and as a result a Committee of the House of Commons inquired into the subject (*Report of Select Committee on Perpetual Pensions*, 248, 1887). An appendix to the *Report* contains a detailed list of all hereditary pensions, payments and allowances in existence in 1881, with an explanation of the origin in each case and the ground of the original grant; there are also shown the pensions, &c., redeemed from time to time, and the terms upon which the redemption took place. The nature of some of these pensions may be gathered from the following examples: To the duke of Marlborough and his heirs in perpetuity, £4000 per annum; this annuity was redeemed in August 1884 for a sum of £107,780, by the creation of a ten years' annuity of £12,796, 17s. per annum. By an act of 1806 an annuity of £5000 per annum was conferred on Lord Nelson and his heirs in perpetuity. In 1793 an annuity of £2000 was conferred on Lord Rodney and his heirs. All these pensions were for services rendered, and although justifiable from that point of view, a preferable policy is pursued in the 20th century, by parliament voting a lump sum, as in the cases of Lord Kitchener in 1902 (£50,000) and Lord Cromer in 1907 £50,000). Charles II. granted the office of receiver-general and controller of the seals of the court of king's bench and common pleas to the duke of Grafton. This was purchased in 1825 from the duke for an annuity of £843, which in turn was commuted in 1883 for a sum of £22,714, 12s. 8d. To the same duke was given the office of the pipe or remembrancer of first-fruits and tenths of the clergy. This office was sold by the duke in 1765, and after passing through various hands was purchased by one R. Harrison in 1798. In 1835 on the loss of certain fees the holder was compensated by a perpetual pension of £62, 9s. 8d. The duke of Grafton also possessed an annuity of £6870 in respect of the commutation of the dues of butlerage and prisage. To the duke of St Albans was granted in 1684 the office of master of the hawks. The sums granted by the original patent were: master of hawks, salary, £391, 1s. 5d.; four falconers at £50 per annum each, £200; provision of hawks, £600; provision of pigeons, hens and other meats, £182, 10s.; total, £1373, 11s. 5d. This amount was reduced by office fees and other deductions to £965, at which amount it stood, until commuted in 1891 for £18,335. To the duke of Richmond and his heirs was granted in 1676 a duty of one shilling per ton on all coals exported from the Tyne for consumption in England. This was redeemed in 1799 for an annuity of £19,000 (chargeable on the consolidated fund), which was afterwards redeemed for £633,333. The duke of Hamilton, as hereditary keeper of the palace, Holyrood House, received a perpetual pension of £45, 10s., and the descendants of the heritable usher of Scotland drew a salary of £242, 10s. The conclusions of the committee were that pensions, allowances and payments should not in future be granted in perpetuity, on the ground that such grants should be limited to the persons actually rendering the services, and that such rewards should be defrayed by the generation benefited; that offices with salaries and without duties, or with merely nominal duties, ought to be abolished; that all existing perpetual pensions and payments and all hereditary offices should be abolished: that where no service or merely nominal service is rendered by the holder of an hereditary office or the original grantee of a pension, the pension or payment should in no case continue beyond the life of the present holder and that in all cases the method of commutation ought to ensure a real and substantial saving to the nation (the existing rate, about 27 years' purchase, being considered by the committee to be too high). These recommendations of the committee were adopted by the government and outstanding hereditary pensions were gradually commuted, the only ones left outstanding being those to Lord Rodney (£2000) and to Earl Nelson (£5000), both chargeable on the consolidated fund.

Political Pensions.—By the Political Offices Pension Act 1869, pensions were instituted for those who had held political office. For the purposes of the act political offices were divided into three classes: (1) those with a yearly salary of not less than £5000; (2) those with a salary of less than £5000 and not less than £2000; (3) those with a salary of less than £2000 and more than £1000. For service in these offices there may be awarded pensions for life in the following scale: (1) a first class pension not exceeding £2000 a year, in respect of not less than four years' service or its equivalent, in an office of the first class; (2) a second class pension not exceeding £1200, in respect of service of not less than six years or its equivalent, in an office of the second class; (3) a third class pension not exceeding £800 a year, in respect of service of not less than ten years in an office of the third class. The service need not be continuous, and the act makes provision for counting service in lower classes as a qualification for pension in a higher class. These pensions are limited in number to twelve, but a holder must not receive any other pension out of the public revenue, if so, he must inform the treasury and surrender it if it exceeds his political pension, or if under he must deduct the amount. He may, however, hold office while a pensioner, but the pension is not payable during the time he holds office. To obtain a political pension, the applicant must file a declaration stating the grounds upon which he claims it and that his income from other sources is not sufficient to maintain his station in life.

Civil List Pensions.—These are pensions granted by the sovereign from the civil list upon the recommendation of the first lord of the treasury. By 1 & 2 Vict. c. 2 they are to be granted to "such persons only as have just claims on the royal beneficence or who by their personal services to the Crown, or by the performance of duties to the public, or by their useful discoveries in science and attainments in literature and the arts, have merited the gracious consideration of their sovereign and the gratitude of their country." A sum of £1200 is allotted each year from the civil list, in addition to the pensions already in force. From a *Return* issued in 1908 the total of civil list pensions payable in that year amounted to £24,665.

Judicial, Municipal, &c.—There are certain offices of the executive whose pensions are regulated by particular acts of parliament. Judges of the Supreme Court, on completing fifteen years' service or becoming permanently incapacitated for duty, whatever their length of service, may be granted a pension equal to two-thirds of their salary (Judicature Act 1873). The lord chancellor of England however short a time he may have held office, receives a pension of £5000, but he usually continues to sit as a law lord in the House of Lords—so also does the lord chancellor of Ireland, who receives a pension of £3,692 6s. 1d. A considerable number of local authorities have obtained special parliamentary powers for the purpose of superannuating their officials and workmen who have reached the age of 60–65. Poor law officers receive superannuation allowances under the Poor Law Officers Superannuation Acts 1864–1897.

Ecclesiastical Pensions.—Bishops, deans, canons or incumbents who are incapacitated by age or infirmity from the discharge of their ecclesiastical duties may receive pensions which are a charge upon the revenues of the see or cure vacated.

Navy pensions were first instituted by William III. in 1693 and regularly established by an order in council of Queen Anne in 1700. Since then the rate of pensions has undergone various modifications and alterations; the full regulations concerning pensions to all ranks will be found in the quarterly *Navy List,* published by the authority of the Admiralty. In addition to the ordinary pensions there are also good-service pensions, Greenwich Hospital pension and pensions for wounds. An officer is entitled to a pension when he is retired at the age of 45, or if he retires between the ages of 40 and 45 at his own request, otherwise he receives only half pay. The amount of his pension depends upon his rank, length of service and age. The maximum retired pay of an admiral is £850 per annum, for which 30 years' service or its equivalent in half-pay time is necessary; he may, in addition, hold a good service pension of £300 per annum. The maximum retired pay of a vice-admiral, with 29 years' service is £725; of rear-admirals with 27 years' service £600 per annum. Pensions of captains who retire at the age of 55, commanders, who retire at 50, and lieutenants who retire at 45, range from £200 per annum for 17 years' service to £525 for 24 years' service. The pensions of other officers are calculated in the same way according to age and length of service. The good-service pensions consist of ten pensions of £300 per annum for flag-officers, two of which may be held by vice-admirals and two by rear-admirals; twelve of £150 for captains; two of £200 a year and two of £150 a year for engineer officers; three of £100 a year for medical officers of the navy; six of £200 a year for general officers of the Royal Marines and two of £150 a year for colonels and lieut.-colonels of the same. Greenwich Hospital pensions range from £150 a year for flag officers to £25 a year for warrant officers. All seamen and marines who have completed twenty-two years' service are entitled to pensions ranging from 10d. a day to a maximum of 1s. 2d. a day, according to the number of good-conduct badges, together with the good-conduct medal possessed. Petty officers, in addition to the rates of pension allowed them as seamen, are allowed for each year's service in the capacity of superior petty officer, 15s. 2d. a year, and in the capacity of inferior petty officer 7s. 7d. a year. Men who are discharged the service on account of injuries and wounds or disability attributable to the service are pensioned with sums varying from 6d. a day to 2s. a day. Pensions are also given to the widows of officers in certain circumstances and compassionate allowances made to the children of officers. In the Navy estimates for 1908–1909 the amount required for half-pay and retired-pay was £868,800, and for pensions, gratuities and compassionate allowances £1,334,600, a total of £2,203,400.

Army.—The system of pensions in the British Army is somewhat intricate, provision being made for dealing with almost every case separately. As a general rule officers can retire after eight years' service on a pension of £100 per annum for ten years, provided that they take commissions in either the Imperial Yeomanry or Special Reserve and attend the annual trainings during that period. The other pensions are as follows: 2nd lieutenants, lieutenants, captains and majors after 15 years' service (or 12 years in the West India regiment), £120, if 45 years of age £200; majors, after 25 years' service, £200. Royal artillery or royal engineers if commissioned, after 21 years of age, £300, if 48 years of age, £300; lieutenant-colonels, after 3 years as such, with 15 years' service, £250, with 27 years' service, £300, with 30 years' service, £365, after term of employment as lieutenant-colonel commanding a unit, or staff appointment as lieutenant-colonel, or after 5 years as lieutenant-colonel cavalry and infantry, £420. Royal artillery, royal engineers and army service corps, £450; *Colonels,* after 5 years as colonel, cavalry and infantry, £420. Royal artillery, royal engineers and army service corps, £450, after completing the term of command of a regimental district or a regiment of foot-guards, or employed in any other capacity for three years, £450–£500 according to age; Brevet-colonels, with the substantive rank of lieutenant-colonel, receive, cavalry or infantry, £420; royal artillery, royal engineers and army service corps, £450. Major-generals retire at the age of 62 with a pension of £700; lieutenant-generals at 67 with £850; generals at 67 with £1000.

Officers whose first permanent commission bears date prior to the 1st of January, 1887, retire with a gratuity in lieu of pension.

Officers of the departmental corps retire either with pensions ranging from £1125 yearly to 10s. daily, or with gratuities ranging from £2500 to £1000.

Warrant officers with 5 years' service as such, and 20 years' total service, receive 3s. 6d. per diem if discharged from the service on account of disability, reduction of establishment or age. On discharge for any reasons (except misconduct or inefficiency) they receive from 3s. 6d. to 5s. per diem, according to length of service and corps. If they have less than 5 years' service as warrant officers, but not less than 21 years' total service, they receive at least 3s. per diem; and if discharged at their own request after 18 years' total service, 2s. 7½d.

Additional pensions are given at the rate of 6d. per diem for gallant conduct, and 1½d. to 1s. per diem for re-employed pensioners on completing their second term of employment, with 3d. per diem extra if promoted while so serving. Special pensions are also granted in exceptional cases.

For the purposes of pensions, non-commissioned officers are divided into four classes, corresponding roughly to quartermaster-sergeants, colour-sergeants, sergeants and corporals.

With not more than 21 years' total service, and with the following continuous service in one of the above classes, the rates of pensions (per diem) are:—

Class.	12 years' Service.	9 years' Service.	6 years' Service.	3 years' Service.
	s. d.	s. d.	s. d.	s. d.
I.	2 9	2 6	2 3	2 0
II.	2 6	2 3	2 0	1 9
III.	2 3	2 0	1 9	1 6
IV.	1 8	1 6	1 4	1 0

Privates (Class V.) receive the following pensions:—

21 years' Service.	20 years' Service.	19 years' Service.	18 years' Service.	14 to 18 years' Service.
1s. 1d.	1s. 0d.	11d.	10d.	8d. to 10d.

For service in excess of 21 years, the following amounts are added to the pensions enumerated above:—

	For each complete year in excess of 21 years.
Classes I. to III.	1d. per diem to 9d. per diem.
Classes IV. and V.	½d. per diem to 5d. per diem.

A man promoted to higher rank within one year of his completing 21 years' service, receives, on his discharge in the higher rank, an extra 3d. per diem, provided that he has completed 25 years' service in all. An additional pension of 6d. per diem is awarded for gallant conduct, as in the case of warrant officers.

N.C.O.'s and men disabled through military service are granted the following pensions:—

If partially capable of earning a livelihood	Per diem.
Class I. to III.	1s. to 3s.
,, IV.	9d. to 2s.
,, V.	6d. to 1s. 6d.
If totally incapable of earning a livelihood	Per diem.
Class I. to III.	2s. 6d. to 3s. 6d.
,, IV.	2s. 0d. to 3s. 0d.
,, V.	1s. 6d. to 2s. 6d.

Pensions may also be granted to N.C.O.'s and men who are disabled by causes other than military service, according to circumstances.

United States.

In the ordinary sense of the word, pensions in the United States are confined to federal judges and officers of the army and navy, but the United States "Pension Fund" is so singular a feature of the national budget, that it is desirable to give an account of the different classes of allowances which are granted. In the United States allowances for services in wars prior to the 4th of March 1861 are called "old war" pensions, and may be divided into three classes, viz.,(1) invalid pensions, based upon wounds or injuries received, or disease contracted in the course of duty, (2) "service" pensions, and (3) land bounties, both granted for service irrespective of injuries.

The first provision made by Congress for pensions was a resolution passed on the 26th of August 1776, promising invalid pensions to officers and men of the army or navy who lost a limb or were otherwise disabled in the War of Independence, at a rate equal to half of their monthly pay as officers or soldiers during life or continuance of the disability, those not totally disabled to receive an adequate monthly pension not to exceed half of their pay. Then followed various Acts of Congress enlarging the provisions for invalid pensions and extending them to those who had been in the war of 1812, and to the widows and children of those who died in the war or from wounds received in the war. The act of the 3rd of May 1846, provided for the prosecution of the war with Mexico and for pensioning those volunteers wounded or otherwise disabled in service. Other acts were subsequently passed making further provision for pension on account of service in the Mexican war. The first general law granting "service" pensions was not passed until the 18th of March 1818, thirty-five years after the termination of the War of Independence. Its beneficiaries were required to be in indigent circumstances and in need of assistance from their country. Two years later Congress became alarmed by reason of the large number of claims filed (about 8000), and enacted what was known as the "Alarm Act," requiring each applicant for pension and each pensioner on the rolls to furnish a schedule of his whole estate and income, clothing and bedding excepted. Many pensioners were dropped who were possessed of as much as $150 worth of property. Numerous acts were, however, passed from time to time liberalizing the law or dealing more generously with the survivors of the Revolution. Service pensions were not granted to widows of the soldiers of this war until 1836, and then only for a period of five years and on condition that the marriage of the soldier was prior to his last service, and that the soldier's service was not less than six months. In 1853, seventy years after the close of the war, the limitation as to the time of marriage was removed. The rolls in 1901 contained nine and in 1908 two pensions based upon service in the War of Independence. The last survivor was Daniel F. Bakeman, who died on the 5th of April 1869, aged 109 years and 6 months.

The first law granting service pensions on account of the war of 1812 was passed in 1871, fifty-six years after the close of the war. This act required sixty days' service. Widows were not pensionable unless the marriage to the soldier had taken place prior to the treaty of peace of 15th February 1815. On 9th March 1878, sixty-three years after the war, an act was passed reducing the requisite period of service to fourteen days and removing the limitations as to date of marriage. In 1908 the pension rolls contained the names of 471 widows of this war, the last male survivor having died in 1905, at the age of 105 years. Service pensions were provided for those who served in the Black Hawk war, Creek war, Cherokee disturbances and the Seminole war (1832 to 1842), on the 27th of July 1892, fifty years after the period embraced in the act; they were granted to those who had served for thirty days and were honourably discharged, and to their widows. In 1908 there were 1820 survivors and 3018 widows, pensioners of the Indian wars. Service pensions were granted to the survivors of the war with Mexico by an act passed on the 29th of January 1887, thirty-nine years after the Guadeloupe-Hildalgo treaty. The pensions were granted to those who were honourably discharged and to the widows, for service of sixty days, if sixty-two years of age, or disabled or dependent. This law was liberalized by the acts of the 5th of January 1893, 23rd of April 1900, 6th of February 1907, and 19th of April 1908, increasing the pension to $15 for those who have reached the age of seventy years, and to $20 for those seventy-five years and over. In 1908 the pension rolls contained the names of 2932 survivors and 6914 widows on account of service in the Mexican war. To give title to bounty land, service must have been for at least fourteen days or in a battle prior to 3rd March 1855; and if in the navy or regular army, must have been in some war in which the United States was engaged. Bounty land warrants are issued for 160 acres, and over 70,000,000 acres have been granted under the different Bounty Land Acts.

For services rendered in the Civil War (1861–65) in the army or navy of the United States, or in their various branches, the law provided two distinct systems of pensioning—(1) the general laws, granting pensions for wounds or injuries received, or disease contracted in service in the line of duty, the pensions ranging from $6 to $100 per month; and (2) the so-called Dependent Pension Act and amending acts, granting pensions for permanent disabilities regardless of the time and manner of their origin, provided they were not the result of vicious habits, the pensions ranging from $6 to $12 per month. What is known as the general law for disabilities incurred in service and in the course of duty was constituted in the act of the 14th of July 1862, as amended by the act of the 3rd of March 1873. Under its provisions the following classes of persons are entitled to benefit, viz. any officer of the army, navy or marine corps, or any enlisted man in the military or naval service of the United States, whether regularly mustered or not; any master or any pilot, engineer, sailor or other person not regularly mustered, serving upon any gunboat or war-vessel of the United States; any acting assistant or contract surgeon; any provost-marshal, deputy provost-marshal or enrolling officer; subject to the several conditions in each particular case prescribed in the law. This law also embraces in its provisions the following classes, each class being subject to certain specified conditions, viz. widows, children under sixteen years of age, dependent parents, and brothers and sisters. This act has been the subject of numerous amendments along more liberal lines. As an illustration a case may be cited where a soldier lost both hands in the service in the course of duty, and was discharged in 1862. He is entitled to a pension of $8 per month from the date of his discharge. Under subsequent acts he is entitled to $25 per month from 4th July 1864; $31·25 from 4th June 1872; $50 from 4th June 1874; $72 from 17th June 1878, and $100 from 12th February 1889.

Under the general law a widow or dependent relative could not be pensioned unless the cause of the soldier's death originated in service in the line of duty; if it were so shown, a widow might be pensioned whether she were rich or poor. Upon the death or remarriage of the widow the minor children of the soldier under the age of sixteen years become entitled to pension. If the soldier died of causes due to his service, and left no widow or minor children, his other relatives become entitled, if dependent, in the following order, viz; first, the mother; secondly, the father; thirdly, orphan sisters and brothers under sixteen years of age, who shall be pensioned jointly. In 1908 the number of invalids pensioned under the general law was 142,044, and the number of widows and dependent relatives was 81,168.

The so-called Dependent Pension Act was based upon an Act of Congress approved 27th June 1890, which was amended on 9th May 1900. Properly speaking, it might be called "dependent" only as regards widows and parents. The main conditions as to the soldier or sailor were, ninety days' service, an honourable discharge, and a permanent disability from disease or otherwise, not the result of his own vicious habits, to such an extent as to render him unable to maintain himself by manual labour. The rates of pension under this act were $6, $8, $10 and $12 per month. Widows became entitled under this law if they married the soldier or sailor prior to 27th June 1890, provided they were without means of support other than their daily labour, and an actual net income not exceeding $250 per year, and had not remarried. Claims of children under sixteen years of age were governed by the same conditions as applied to claims of widows, except that their dependence was presumed, and need not be shown by evidence. If a minor child was insane, idiotic or otherwise physically or mentally helpless, the pension continued during the life of said child or during the period of disability. Further acts made more liberal provisions. That of the 6th of February 1907, granted pensions to persons who had served ninety days or more in the military or naval service in the civil war, or sixty days in the Mexican war, and were honourably discharged, no other conditions being attached. The rate of pension was fixed at $12 per month when sixty-two years of age, $15 per month when seventy years of age and $20 per month when seventy-five years of age. The act of April 1908, fixed the rate of pension for widows, minor children under the age of sixteen and helpless minors on the roll or afterwards to be placed on it at $12 per month, and granted pensions at the same rate to the widows of persons who served ninety days or more during the civil war, without regard to their pecuniary condition. In 1908 there were 140,600 invalids on the roll, and 4294 minor and helpless children. In the same year under the act of 1907 there were 338,341 dependants, while under the act of 1908, 188,445 widows were put on the roll. All women employed by competent authority as nurses during the Civil War for six months or more, who are unable to earn a support, are granted a pension of $12 per month by an act of the 5th of August 1892. In 1908 the pension rolls contained the names of 3110 pensioners under this act.

There were on the roll in 1908 on account of the Spanish war, 11,786 invalids and 3722 dependants. The total amount paid in pensions in 1908 on account of that war and the insurrection in the Philippine Islands was $3,654,122. The grand total of pensioners on the roll for all wars was, in 1908, 951,687.

In addition to pensions, the United States government grants the following gratuities: *First:* If a soldier lost a limb in the service, or as a result of his service in line of duty, he is furnished with an artificial limb free of cost every three years, or commutation therefor, and transportation to and from a place where he shall select the artificial limb. *Second:* An honourably discharged soldier or sailor is given preference for appointment to places of trust and profit, and preference for retention in all civil service positions. *Third:* There are ten National Soldiers' Homes situated at convenient and healthy points in different parts of the country, where comfortable quarters, clothing, medical attendance, library and amusements of different kinds are provided free of all expense; government providing the soldiers free transportation to the home, continuing payments of pension while they are members of the home, and increasing the same as disabilities increase. *Fourth:* There are thirty homes maintained by the different states, which are similar in their purpose to the National Homes, the sum of $100 per year being paid by the general government for each inmate. Many of these state homes also provide for the wives and children of the inmates, so that they need not be separated while they are members of such home. *Fifth:* Schools are established by the different states for the maintenance and education of soldiers' orphans until they attain the age of sixteen years.

From the close of the Civil War in 1865 to 1908, the government of the United States paid to its pensioners for that war the sum of $3,533,593,025. The payments on account of all wars for the fiscal year ended on the 30th of June 1908 were $153,093,086. Over $17,000,000 has been paid to surgeons for making medical examinations of pensioners and applicants for pensions. The total disbursement for pensions from 1790 to 1908 amounted to $3,751,108,809. No other nation or government in all time has dealt so liberally with its defenders.

The money appropriated by Congress for the payment of pensions is disbursed by eighteen pension agents established in different parts of the country. Pensions are paid quarterly, and the agencies are divided into three classes, one of which pays on the 4th of every month.

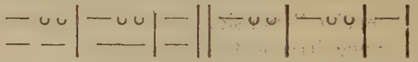
PENSIONARY, a name given to the leading functionary and legal adviser of the principal town corporations of Holland, because they received a salary, or pension. At first this official was known by the name of "clerk" or "advocate." The office originated in Flanders. The earliest "pensionaries" in Holland were those of Dort (1468) and of Haarlem (1478). The pensionary conducted the legal business of the town, and was the secretary of the town council and its representative and spokesman at the meetings of the Provincial States. The post of pensionary was permanent and his influence was great.

In the States of the province of Holland pensionary of the order of nobles (*Ridderschap*) was the foremost official of that assembly and he was named—until the death of Oldenbarneveldt in 1619—the land's advocate, or more shortly, the advocate. The importance of the advocate was much increased after the outbreak of the revolt in 1572, and still more so during the long period 1586–1619 when John van Oldenbarneveldt held the office. The advocate drew up and introduced all resolutions, concluded debates and counted the votes in the Provincial Assembly. When it was not in session he was a permanent member of the college of deputed councillors who carried on the administration. He was minister of justice and of finance. All correspondence passed through his hands, and he was the head and the spokesman of the deputation, who represented the province in the States General. The conduct of foreign affairs in particular was entrusted almost entirely to him.

After the downfall of Oldenbarneveldt the office of lands'-advocate was abolished, and a new post, tenable for five years only, was erected in its place with the title of *Raad-Pensionaris*, or Pensionary of the Council, usually called by English writers Grand Pensionary. The first holder of this office was Anthony Duyck. Jacob Cats and Adrian Pauw, in the days of the stadtholders Frederick Henry and William of Orange II. had to be content with lessened powers, but in the stadtholderless régime 1650–1672 the grand pensionary became even more influential than Oldenbarneveldt himself, since there was no prince of Orange filling the offices of stadtholder, and of admiral and captain-general of the Union. From 1653–1672 John de Witt, re-elected twice, made the name of grand pensionary of Holland for ever famous during the time of the wars with England. The best known of his successors was Anthony Heinsius, who held the office from 1688 to his death in 1720. He was the intimate friend of William III., and after the decease of the king continued to carry out his policy during the stadtholderless period that followed. The office was abolished after the conquest of Holland by the French in 1795.

See Robert Fruin, *Geschiedenis der Staats-Instellingen in Nederland*, The Hague, 1901; G. W. Vreede, *Inleiding tot eene Gesch. der Nederlandsche Diplomatic* (Utrecht, 1858). (G. E.)

PENTAMETER, the name given to the second and shorter line of the classical elegaic verse. It is composed of five (πέντε) feet or measures (μέτρα), and is divided into two equal parts of two and a half feet each: the second of these parts must be dactylic, and the first may be either dactylic or spondaic. The first part must never overlap into the second, but there must be a break between them. Thus:



In the best Latin poets, the first foot of each part of the pentameter is a dactyl. The pentameter scarcely exists except in conjunction with the hexameter, to which it always succeeds in elegaic verse. The invention of the rigidly dactylic form was attributed by the Greeks to Archilochus. Schiller described the sound and method of the elegaic couplet in two very skilful verses, which have been copied in many languages:

Im Hexameter steigt des Springquells flüssige Säule,
Im Pentameter drauf fällt sie melodisch herab.

The pentameter was always considered to add a melancholy air to verse, and it was especially beloved by the Greeks in those recitations (ῥαψῳδεῖται) to the sound of the flute, which formed the earliest melodic performances at Delphi and elsewhere.

PENTASTOMIDA, or LINGUATULINA, vermiform entoparasitic animals, of which the exact zoological position is unknown, although they are usually regarded as highly modified degenerate Arachnida of the order Acari.

The body is sub-cylindrical or somewhat convex above, flatter below, broad and oval in front and narrowed and elongate behind. Its integument is marked by a large number of transverse grooves simulating the segmentation of Annelids, and near the anterior extremity close to the mouth are two pairs of recurved chitinous hooks. The alimentary canal is a simple tube traversing the body from end to end, the anus opening at the extremity of its narrowed tail-like termination. The nervous system is represented by an oesophageal collar and a suboesophageal ganglion, whence paired nerves pass outwards to innervate the anterior extremity and backwards towards its posterior end. No respiratory or circulatory organs are known. The sexes are distinct but dissimilar in size, the female being usually much larger than the male. The generative organs occupy a large part of the body cavity. In the female the ovary is a large unpaired organ from the anterior end of which arise two oviducts, and connected with the latter are a pair of large so-called copulatory pouches, which perhaps act as receptacula seminis. These and the oviducts lie on the anterior half of the body; but the oviducts themselves soon unite to form a single tube of great length, which runs backwards to its posterior extremity, terminating in the genital orifice close to the anus, In the male, on the contrary, this orifice is situated in the anterior half of the body, not far behind the mouth. The orifice leads into a large pouch lodging a pair of very long penes, which are coiled up when not in use. The two testicles, which extend far back into the posterior part of the body, are long and tubular. Anteriorly their vasa deferentia soon unite into a common duct, which opens into the pouch containing the penes. Also communicating with this pouch is a pair of long slender flagelliform tubes, of which the function is unknown.

The structure of the adult *Linguatula* or *Pentastomum*, above described, does not supply convincing evidence of relationship with the Acari. At the same time some Acari, like *Eriophyes* (*Phytoptus*) and *Demodex*, have the body elongated and annulated, but in these groups the elongation of the body is caudal or post-anal, as is attested by the position of the anus far forwards on its ventral surface. Again, the adult *Pentastomum* shows no trace of appendages, unless the two pairs of chitinous hooks are to be regarded as the vestiges of jaws or ambulatory limbs. In the embryo, however, what have been regarded as remnants of limbs may be seen.

In the mature stage Pentastomida live in the respiratory passages of mammalia, principally in the nasal cavities. The remarkable life-history of one species, *Linguatula taenioides*, has been worked out in detail and presents a close analogy to that of some Cestodes. The adults live in the nose of dogs, where they have been known to survive over fifteen months. Each female lays a vast number of eggs, about 500,000 being the estimated amount. These are expelled along with mucus by the sneezing of the host. If they fall on pasture land or fodder of any kind and are eaten by any herbivorous animal, such as a hare, rabbit, horse, sheep or ox, the active embryos or larvae are set free in the alimentary canal of the new host.

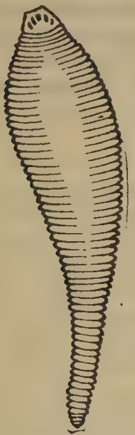


FIG. 1.—*Linguatula taenioides*, Rud. adult.

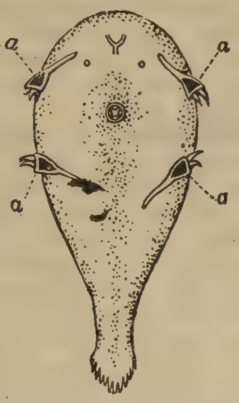


FIG. 2.—The same, in the first larval stage; under side.
a . . . *a*, Leg-like processes.

These larvae are minute oval creatures with a comparatively short apically fringed caudal prolongation and furnished with two pairs of short two-clawed processes, which may represent the limbs of anthropods and possibly the two pairs of legs found in Acari of the family Eriophyidae. The larva is also armed anteriorly with a median piercing probe and a pair of sharp hooks by means of which it perforates the walls of the alimentary tract and makes its way into the body cavity, lungs or liver. Here it becomes encysted, and losing its boring apparatus and claw-bearing processes remains for a time quiescent. After a series of moults it passes into the second larval stage, somewhat like the parent but differing in having each integumental ring armed with a fringe of backwardly directed short bristles. This sexually immature stage, regarded at one time as representing a distinct species and named *Linguatula denticulata*, is reached in about six or seven months and measures from 6 to 8 mm. in length. In the event of the host escaping being killed and eaten it is believed that some of these larvae wander about or ultimately make their way to the exterior, possibly through the bronchi; nevertheless it seems to be certain that they can only reach sexual maturity in the nasal passages of some carnivorous animal, and the chance of attaining this environment is afforded when the viscera of the host are devoured by some flesh-eating mammal.

The adult female of *L. taenioides* measures about 4 in. long and the male barely one-fourth of that. The adult and immature stages are, however, by no means confined respectively to carnivorous and herbivorous species of mammals. The adult stage, for example, has been found in the nasal passages of sheep, goats, horses and even of man, and the larval stage in the pleural and peritoneal cavities of dogs and cats. (R. I. P.)

PENTATEUCH, the name found as early as in Tertullian and Origen corresponding to the Jewish חמשה חומשי התורה (the five-fifths of the Torah, or Law), and applied to the first five books of the Old Testament (Genesis, Exodus, Leviticus, Numbers, Deuteronomy). The several books were named by the Jews from their initial words, though at least Leviticus, Numbers, and Deuteronomy had also titles resembling those we use, viz. הורת כהנים, חמש הפקודים (Αμμεσφεκωδειμ, Origen, in Eus., *H. E.* vi. 25), and משנה תורה. The Pentateuch, together with Joshua, Judges and Ruth, with which it is usually united in Greek MSS., makes up the Octateuch; the Pentateuch and Joshua together have recently been named the Hexateuch. On the critical questions arising from the Pentateuch or Hexateuch, see BIBLE and the articles on the several books.

PENTECOST, a feast of the Jews, in its original meaning a "harvest feast," as consisting of the first-fruits of human toil (Exod. xxiii. 16), extending over the seven weeks which fairly correspond with the duration of the Canaanite harvest. Hence it was the closing feast of the harvest gladness.

The agricultural character of this feast clearly reveals its Canaanite origin (see HEBREW RELIGION). It does not, however, rank equal in importance with the other two agricultural festivals of pre-exilian Israel, viz. the *Maṣṣōth* or feast of unleavened cakes (which marked the beginning of the corn-harvest), and the *Asīph* ("ingathering," later called *succōth*, "booths") which marked the close of all the year's ingathering of vegetable products. This is clear in the ideal scheme of Ezekiel (xlv. 21 seq.) in which according to the original text, Pentecost is omitted (see Cornill's revised text and his note *ad loc.*). It is a later hand that has inscribed a reference to the "feast of weeks" which is found in our Massoretic Hebrew text. Nevertheless occasional allusions to this feast, though secondary, are to be found in Hebrew literature, *e.g.* Isa. ix. 3 (2 Heb.) and Ps. iv. 7 (8 Heb.).

In both the early codes, viz. in Exod. xxiii. 16 (E) and in Exod. xxxiv 22 (J, in which the harvest festival is called "feast of weeks") we have only a bare statement that the harvest festival took place some weeks after the opening spring festival called *Maṣṣōth*. It is in Deut. xvi. 9 that we find it explicitly stated that *seven* weeks elapsed between the beginning of the corn-harvest ("when thou puttest the sickle to the corn") and the celebration of the harvest festival (*Ḳāṣīr*). We also note the same generous inclusion of the household slaves and of the resident alien as well as the fatherless and widow that characterizes the autumnal festival of "Booths."

But when we pass to the post-exilian legislation (Lev. xxiii. 10–21; cf. Num. xxviii. 26 seq.) we enter upon a far more detailed and specific series of ritual instructions. (1) A special ceremonial is described as taking place on "the morrow after the Sabbath," *i.e.* in the week of unleavened cakes. The first-fruits of the harvest here take the form of a sheaf which is waved by the priest before Yahweh. (2) There is the offering of a male lamb of the first year without blemish and also a meal offering of fine flour and oil mixed in defined proportions as well as a drink-offering of wine of a certain measure. After this "morrow after the Sabbath" seven weeks are to be reckoned, and when we reach the morrow after the seventh Sabbath fifty days have been enumerated. Here we must bear in mind that Hebrew numeration always includes the day which is the *terminus a quo* as well as that which is *term. ad quem.* On this fiftieth day two wave-loaves made from the produce of the fields occupied by the worshipper ("your habitations") are offered together with seven unblemished lambs of the first year as well as one young bullock and two rams as a burnt offering. We have further precise details respecting the sin-offering and the peace-offerings which were also presented.[1] This elaborate ceremonial connected with the wave-offering (developed in the post-exile period) took place on the morrow of the seventh Sabbath called a "day of holy convocation" on which no servile work was to be done. It was called a "fiftieth-day feast." Pentecost or "Fiftieth" day is only a Greek equivalent of the last name (*πεντηκοστή*) in the Apocrypha and New Testament. The orthodox later Jews reckoned the fifty days from the 16th of Nisan, but on this there has been considerable controversy among Jews themselves. The orthodox later Jews assumed that the Sabbath in Lev. xxiii. 11, 15 is the 15th Nisan, or the first day of the feast of Maṣṣōth. Hitzig maintained that in the Hebrew calendar 14th and 21st Nisan were always Sabbaths, and that 1st Nisan was always a Sunday, which was the opening day of the year. "The morrow after the Sabbath" means, according to Hitzig, the day after the weekly Sabbath, viz. 22nd Nisan. Knobel (*Comment. on Leviticus*) and Kurtz agree with Hitzig's premises but differ from his identification of the Sabbath. They identify it with the 14th Nisan. Accordingly the "day after" falls on the 15th. (See Purves's article, "Pentecost," in Hastings's *Dict. of the Bible*, and also Ginsburg's article in Kitto's *Cyclopaedia*). Like the other great feasts, it came to be celebrated by fixed special sacrifices. The amount of these is differently expressed in the earlier and later priestly law (Lev. xxiii. 18 seq.; Num. xxviii. 26 seq.); the discrepancy was met by adding the two lists. The later Jews also extended the one day of the feast to two. Further, in accordance with the tendency to substitute historical for economic explanations of the great feasts, Pentecost came to be regarded as the feast commemorative of the Sinaitic legislation.

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[1] On the critical questions involved in these ritual details of Lev. xxiii. 18 as compared with Num. xxviii. 27–30 cf. Driver and White in *S. B. O. T.*, note on Lev. xxiii. 18.

To the Christian Church Pentecost acquired a new significance through the outpouring of the Spirit (Acts ii.). (See WHITSUNDAY.)

It is not easy to find definite parallels to this festival in other ancient religious cults. The Akitu festival to Marduk was a spring festival at the beginning of the Babylonian year (Nisan). It therefore comes near in time to the feast of unleavened cakes rather than to the later harvest festival in the month Sivan called "feast of weeks." Zimmern indeed connects the Akitu festival with that of Purim on the 15th Adar (March); see *K.A.T.*^{3} p. 514 seq. Also the Roman Cerealia of April 12th–19th rather correspond to *Maṣṣōth* than to *Ḳāṣīr*. (O. C. W.)

PENTELICUS (Βριλησσός, or Πεντελικὸν ὄρος from the deme Πεντέλη; mod. Mendeli), a mountain to the N.E. of the Athenian plain, height 3640 ft. Its quarries of white marble were not regularly worked until after the Persian wars; of this material all the chief buildings of Athens were constructed, as well as the sculpture with which they were ornamented. The ancient quarries are mostly on the south side of the mountain. The best modern quarries are on the north side. The top of Pentelicus commands a view over the plain of Marathon, and from it the Athenian traitors gave the signal to the Persians by a flashing shield on the day of the battle. There was a statue of Athena on the mountain.

PENTHEUS, in Greek legend, successor of Cadmus as king of Thebes. When Dionysus, with his band of frenzied women (Maenads) arrived at Thebes (his native place and the first city visited by him in Greece), Pentheus denied his divinity and violently opposed the introduction of his rites. His mother Agāvē having joined the revellers on Mount Cithaeron, Pentheus followed and climbed a lofty pine to watch the proceedings. Being discovered he was torn to pieces by Agave and others, who mistook him for some wild beast. His head was carried back to Thebes in triumph by his mother. Labdacus and Lycurgus, who offered a similar resistance, met with a like fearful end. Some identify Pentheus with Dionysus himself in his character as the god of the vine, torn to pieces by the violence of winter. The fate of Pentheus was the subject of lost tragedies by Thespis and Pacuvius.

See Euripides, *Bacchae*, *passim*; Ovid, *Metam.* iii. 511; Theocritus xxvi; Apollodorus iii. 5, 2; Nonnus, *Dionysiaca*, xliv–xlvi; on representations in art see O. Jahn, *Pentheus und die Mainaden* (1841).

PENTHIÈVRE, COUNTS OF. In the 11th and 12th centuries the countship of Penthièvre in Brittany (dep. of Côtes-du-Nord) belonged to a branch of the sovereign house of Brittany. Henry d'Avaugour, heir of this dynasty, was dispossessed of the countship in 1235 by the duke of Brittany, Pierre Mauclerc, who gave it as dowry to his daughter, Yolande, on her marriage in 1238 to Hugh of Lusignan, count of La Marche. Duke John I. of Brittany, Yolande's brother, seized the countship on her death in 1272. In 1337 Joan of Brittany brought Penthièvre to her husband, Charles de Châtillon-Blois. In 1437 Nicole de Blois, a descendant of this family, married Jean de Brosse, and was deprived of Penthièvre by the duke of Brittany, Francis II., in 1465. The countship, which was restored to Sebastian of Luxemburg, heir of the Brosses through his mother, was erected for him into a duchy in the peerage of France (*duché-pairie*) in 1569, and was afterwards held by the duchess of Mercœur, daughter of the first duke of Penthièvre, and then by her daughter, the duchess of Vendôme. The duchess of Vendôme's grandson, Louis Joseph, inherited Penthièvre in 1669, but it was taken from him by decree in 1687 and adjudged to Anne Marie de Bourbon, princess of Conti. In 1696 it was sold to the count of Toulouse, whose son bore the title of duke of Penthièvre. This title passed by inheritance to the house of Orleans.

PENTHOUSE, a sloping roof attached to a building either to serve as a porch or a covering for an arcade, or, if supported by walls, as a shed, a "lean-to." In the history of siegecraft, the word is particularly applied to the fixed or movable constructions used to protect the besiegers when mining, working battering-rams, catapults, &c., and is thus used to translate Lat. *vinea* and *pluteus*, and also *testudo*, the shelter of locked shields of the Romans. The Mid. Eng. form of the word is *pentis*, an adaptation of O. Fr. *apentis*, Med. Lat. *appenditium* or *appendicium*, a small structure attached to, or dependent on, another building, from *appendere*, to hang on to. The form "penthouse" is due to a supposed connexion with "house" and Fr. *pente*, sloping roof. The more correct form "pentice" is now frequently used.

PENTSTEMON, in botany, a genus of plants (nat. order Scrophulariaceae), chiefly natives of North America, with showy open-tubular flowers. The pentstemon of the florist has, however, sprung from *P. Hartwegii* and *P. Cobaea*, and possibly some others. The plants endure English winters unharmed in favoured situations. They are freely multiplied by cuttings, selected from the young side shoots, planted early in September, and kept in a close cold frame till rooted. They winter safely in cold frames, protected by mats or litter during frost. They produce seed freely, new kinds being obtained by that means. When special varieties are not required true from cuttings, the simplest way to raise pentstemons is to sow seed in heat (65° F.) early in February, afterwards pricking the seedlings out and hardening them off, so as to be ready for the open air by the end of May. Plants formerly known under the name of Chelone (*e.g. C. barbata, C. campanulata*) are now classed with the pentstemons.

PENUMBRA (Lat. *paene*, almost, *umbra*, a shadow), in astronomy, the partial shadow of a heavenly body as cast by the sun. It is defined by the region in which the light of the sun is partially but not wholly cut off through the interception of a dark body. (See ECLIPSE.)

PENZA, a government of eastern Russia, bounded N. by the government of Nizhniy-Novgorod, E. by Simbirsk, and S. and W. by Saratov and Tambov; area 14,992 sq. m.; pop. (est. 1906) 1,699,000. The surface is undulating, with deep valleys and ravines, but does not exceed 900 ft. above sea-level. It is principally made up of Cretaceous sandstones, sands, marls and chalk, covered in the east by Eocene deposits. Chalk, potter's clay, peat and iron are the chief mineral products in the north. The soil is a black earth, more or less mixed with clay and sand; marshes occur in the Krasnoslobodsk district; and expanses of sand in the river valleys. There are extensive forests in the north, but the south exhibits the characteristic features of a steppeland. The government is drained by the Moksha, the Sura (both navigable), and the Khoper, belonging to the Oka, Volga and Don systems. Timber is floated down several smaller streams, while the Moksha and Sura are important means of conveyance. The climate is harsh, the average temperature at the city of Penza being only 38°. The population consists principally of Russians, together with Mordvinians, Meshcheryaks and Tatars. The Russians profess the Orthodox Greek faith, and very many, especially in the north, are Raskolniks or Nonconformists. The chief occupation is agriculture. The principal crops are rye, oats, buckwheat, hemp, potatoes and beetroot. Grain and flour are considerable exports. The local authorities have established dépôts for the sale of modern agricultural machinery. There are several agricultural and horticultural schools, and two model dairy-farms. Cattle breeding and especially horse-breeding are comparatively flourishing. Market-gardening is successfully carried on, and improved varieties of fruit-trees have been introduced through the imperial botanical garden at Penza and a private school of gardening in the Gorodishche district. Sheep-breeding is especially developed in Chembar and Insar. The Mordvinians devote much attention to bee-keeping. The forests (22% of the total area) are a considerable source of wealth, especially in Krasnoslobodsk and Gorodishche. The manufactures are few. Distilleries come first, followed by beet sugar and oil mills, with woollen cloth and paper mills, tanneries, soap, glass, machinery and iron-works. Trade is limited to the export of corn, spirits, timber, hempseed-oil, tallow, hides, honey, wax, woollen cloth, potash and cattle, the chief centres for trade being Penza, Nizhni-Lomov, Mokshany, Saransk and Krasnoslobodsk.

The government is divided into ten districts, the chief towns of which are Penza, Gorodishche, Insar, Kerensk, Krasnoslobodsk, Mokshany, Narovchat, Nizhni-Lomov, Saransk and Chembar. The present government of Penza was formerly inhabited by Mordvinians, who had the Mescheryaks on the W. and the Bulgars on the N. In the 13th century these populations fell under the dominion of the Tatars, with whom they fought against Moscow. The Russians founded the town of Mokshany in 1535. Penza was founded in the beginning of the 17th century, the permanent Russian settlement dating as far back as 1666. In 1776 it was taken by the rebel Pugashev. The town was almost totally destroyed by conflagrations in 1836, 1839 and 1858.

PENZA, a town of Russia, capital of the government of the same name, 492 m. by rail S.E. from Moscow. It stands on a plateau 567 ft. above the sea, at the confluence of the Penza with the navigable Sura. Pop. (1897), 61,851. The older parts of the town are constructed of wood, but the newer parts are well built. The cathedral was erected in 1820–1821. Penza has technical schools, public libraries, a museum of antiquities, and a theatre which has played some part in the history of the Russian stage. The bulk of the inhabitants support themselves by agriculture or fishing in the Sura. An imperial botanical garden is situated within two miles of the town. Apart from paper-mills and steam flour-mills, the manufacturing establishments are small. There is a trade in corn, oil, tallow, timber and spirits, and two fairs where cattle and horses are sold.

PENZANCE, a municipal borough, market town and seaport in the St Ives parliamentary division of Cornwall, England, the terminus of the Great Western railway, 325½ m. W.S.W. of London. Pop. (1901), 13,136. It is finely situated on the western shore of Mount's Bay, opposite St Michael's Mount, being the westernmost port in England. The site of the old town slopes sharply upward from the harbour, to the west of which there extends an esplanade and modern residential quarter; for Penzance, with its mild climate, is in considerable favour as a health resort. The town has no buildings of great antiquity, but the public buildings (1867), in Italian style, are handsome. By the market house is a statue of Sir Humphry Davy, who was born here in 1778. Among institutions there are a specially fine public library, museums of geology and natural history and antiquities, mining and science schools, the West Cornwall Infirmary and a meteorological station. The harbour, enclosed within a breakwater, has an area of 24 acres, with 12 to 16 ft. depth of water, and floating and graving docks. There is a large export trade in fish, including that of pilchards to Italy. Other exports are tin and copper, granite, serpentine, vegetables and china clay. Imports are principally coal, iron and timber. Great quantities of early potatoes and vegetables, together with flowers and fish, are sent to London and elsewhere. The borough is under a mayor, 6 aldermen and 18 councillors. Area, 355 acres.

Nearly two miles inland to the north-west is Madron (an urban district with a population of 3486). The church of St Maddern is principally Perpendicular, with earlier portions and a Norman front. Near the village a "wishing well" of ancient fame is seen, and close to it the ruins of a baptistery of extreme antiquity. Monoliths and cromlechs are not uncommon in the neighbourhood. Three miles north-east is the urban district of Ludgvan (pop. 2274), and to the south is Paul (6332), which includes the village of Newlyn (*q.v.*).

Penzance (Pensans) was not recognized as a port until the days of the Tudors, but its importance as a fishing village dates from the 14th century. In 1327 thirty burgesses in Penzance and thirteen boats paying 13s. yearly are found among the possessions of the lords of Alverton, of which manor it formed a portion of the demesne lands. The year 1512 marks the beginning of a new era. Until then St Michael's Mount had been regarded as the port of Mounts Bay; but in that year Henry VIII. granted the tenants of Penzance whatever profits might accrue from the "ankerage, kylage and busselage" of ships resorting thither, so long as they should repair and maintain the quay and bulwarks for the safeguard of the ships and town. Nevertheless thirty years later it is described by Leland as the westernmost market town in Cornwall "with no socur for Botes or shippes but a forsed Pere or Key." During the war with Spain the town was devastated in 1595. The charter of incorporation granted in 1614 states that by the invasion of the Spaniards it had been treacherously spoiled and burnt but that its strength, prosperity and usefulness for navigation, and the acceptable and laudable services of the inhabitants in rebuilding and fortifying it, and their enterprise in erecting a pier, have moved the king to grant the petition for its incorporation. This charter provides for a mayor, eight aldermen and twelve assistants to constitute the common council, the mayor to be chosen by the council from the aldermen, the aldermen to be chosen from the assistants, and the assistants from the most sufficient and discreet of the inhabitants. It also ratified Henry's grant of anchorage, keelage and busselage. In 1663 Penzance was constituted a coinage town for tin. It has never enjoyed independent parliamentary representation. In 1332 a market on Wednesdays and a fair at the Feast of St Peter ad Vincula were granted to Alice de Lisle and in 1405 this market was ratified and three additional fairs added, viz. at the feasts of St Peter in Cathedra and the Conception and Nativity of the Blessed Virgin. The charter of 1614 substituted markets on Tuesdays and Thursdays for the Wednesday market and added two fairs one at Corpus Christi and the other on the Thursday before St Andrew. Of the fairs only Corpus Christi remains; markets are now held on Tuesday, Thursday and Saturday. Apart from fishing and shipping, Penzance has never been an industrial centre.

PEONAGE (Span. *peon*; M. Lat. *pedo* (*pes*), primarily a foot-soldier, then a day-labourer), a system of agricultural servitude common in Spanish America, particularly in Mexico. In the early days the Spanish government, with the idea of protecting the Indians, exempted them from compulsory military service, the payment of tithes and other taxes, and regulated the system of labour; but left them practically at the mercy of the Spanish governors. The peons, as the Indian labourers were called, were of two kinds: (1) the agricultural workman who was free to contract himself, and (2) the criminal labourers who, often for slight offences, or more usually for debt, were condemned to practical slavery. Though legally peonage is abolished, the unfortunate peon is often lured into debt by his employer and then kept a slave, the law permitting his forcible detention till he has paid his debt to his master.

PEOPLE, a collective term for persons in general, especially as forming the body of persons in a community or nation, the "folk" (the O.E. and Teut. word, cf. Ger. *Volk*). The earlier forms of the word were *peple*, *poeple*, *puple*, &c.; the present form is found as early as the 15th century, but was not established till the beginning of the 16th. Old French, from which it was adapted, had many of these forms as well as the mod. Fr. *peuple*. The Lat. *populus* is generally taken to be a reduplication from the root *ple*,—fill, seen in *plenus*, full; *plebs*, the commons; Gr. πλῆθος, multitude.

PEORIA, a city, port of entry, and the county-seat of Peoria county, Illinois, U.S.A., in the north central part of the state, on the lower end of Lake Peoria, an expansion of the Illinois river, and about 150 m. S.W. of Chicago. Pop. (1900) 56,100; (1910) 66,950. It is served by 13 railways, of which the most important are the Chicago, Burlington & Quincy, the Chicago, Rock Island & Pacific, the Chicago & Alton, the Illinois Central, the Cleveland, Cincinnati, Chicago & St Louis, and the Chicago & North-Western. The Illinois river is navigable to its mouth, and at La Salle, above Peoria, connects with the Illinois & Michigan Canal extending to Chicago. The river is spanned at Peoria by two railway bridges and a wagon bridge. The residential portion of the city is situated on bluffs overlooking Lake Peoria, and the business streets lie on the plain between these elevations and the water front. The park system includes more than 400 acres; Bradley Park (140 acres), the largest, was given to the city by Mrs Lydia Moss Bradley (1816–1908) and was named in her honour. On a bluff north-east of the city is Glen Oak Park (103 acres), modelled after Forest Park, St Louis, Missouri; in the south-western part of the city is Madison Park (88 acres); and in the lower part of the city is South Park (10 acres). In the Court House Square there are two monuments in honour of the Federal soldiers and sailors of Peoria county who perished in the Civil War; in Springdale Cemetery there are two similar memorials, one of which (a large granite boulder) is in memory of the unknown dead; and in the same cemetery there is a monument erected by the state (1906) to mark the grave of Thomas Ford (d. 1851), governor of Illinois in 1842–1846. Among the principal public buildings and institutions are the Peoria Public Library founded in 1855, the City Hall, the Court House, the Federal building, St Mary's Cathedral, the Bradley Polytechnic Institute (affiliated with the university of Chicago), founded in 1896 by Mrs Lydia Moss Bradley, who gave it an endowment of $2,000,000; Spalding Institute, founded through the efforts of John L. Spalding (b. 1840), who was Bishop of the Roman Catholic diocese of Peoria in 1877–1908; an Evangelical Lutheran Orphans' Home (1902), an Industrial School for girls (1892), Cottage Hospital (1876), St Francis Hospital (1875), a Florence Crittenton Home (1902), a Home for the Friendless (1876), and a House of the Good Shepherd (1891), and the Guyer Memorial (1889), St Joseph's (1892), and John C. Proctor homes for the aged and infirm (1907). At Bartonville, a suburb, there is a state hospital for the incurable insane.

In 1900 and in 1905 Peoria ranked second among the cities of Illinois in the value of its manufactures. The invested capital amounted in 1905 to $22,243,821, and the factory products were valued at $60,920,411. The principal industry is the manufacture of distilled liquors, which were valued in 1905 at $42,170,815. Other important manufactures are agricultural implements ($2,309,962), slaughter-house and meat-packing products ($1,480,398), glucose, cooperage ($1,287,742), malt liquors ($887,570), foundry and machine-shop products, strawboard, automobiles, brick and stone, and flour and grist mill products. Peoria is also an important shipping point for grain and coal.

Peoria was named from one of the five tribes of the Illinois Indians. In 1680 La Salle, the explorer, built Fort Crèvecœur, on the lake shore bluffs, opposite the present city; this fort, however, was destroyed and deserted in the same year by La Salle's followers after he had set out to return to Fort Frontenac. There is evidence that a French mission was established on or near the site of Peoria as early as 1711; and certainly by 1725 a settlement, known as Peoria, and composed of French and "breed" traders, trappers and farmers, had been established about 1½ m. above the foot of the lake, on its west shore. This village was practically deserted during the later years (1781–1783) of the War of Independence, and when its inhabitants returned after the peace they settled in a village which had been established about 1778, on the present site of Peoria, by Jean Baptiste Maillet (d. 1801), and was at first called La Ville de Maillet. It is probable that Jean Baptiste Point de Saible, believed to have been a Santo Domingan negro, and jocularly spoken of "as the first white settler in Chicago," lived in the "old village" of Peoria as early as 1773—or six years before he settled on the present site of Chicago—and again about 1783. In November 1812 about half of the town was burned by a company of Illinois militia who had been sent thither to build a fort, and whose captain asserted that his boats had been fired upon at night by the villagers. In the following year a fort, named Fort Clark in honour of George Rogers Clark, was erected on the site of the old village; it was evacuated in 1818, and soon afterwards was burned by the Indians. After the town was burned there was no serious attempt to rebuild until 1819. Peoria was incorporated as a town in 1835 and was chartered as a city in 1845. In 1900 North Peoria was annexed.

See David McCulloch, *Early Days of Peoria and Chicago*, an address read before the Chicago Historical Society in 1904, and published by that society, (n.d.), and "Old Peoria," by the same author, in publication No. 6 of the Illinois State Historical Society *Transactions* (Springfield, Ill., 1901); also *Historical Encyclopaedia of Illinois* (Chicago, 1900), ed. by Newton Bateman and Paul Selby; *History of Peoria County, Ill.* (Chicago, 1880); and C. Ballance, *History of Peoria* (Peoria, 1870).

PEPE, GUGLIELMO (1783–1855), Neapolitan general, was born at Squillace in Calabria. He entered the army at an early age, but in 1799 he took part in the republican movement at Naples inspired by the French Revolution; he fought against the Bourbon troops under Cardinal Ruffo, was captured and exiled to France. He entered Napoleon's army and served with distinction in several campaigns, including those in the Neapolitan kingdom, first under Joseph Bonaparte and later under Joachim Murat. After commanding a Neapolitan brigade in the Peninsular campaign, Pepe returned to Italy in 1813, with the rank of general, to help to reorganize the Neapolitan army. When the news of the fall of Napoleon (1814) reached Italy Pepe and several other generals tried without success to force Murat to grant a constitution as the only means of saving the kingdom from foreign invasion and the return of the Bourbons. On Napoleon's escape from Elba (1815) Murat, after some hesitation, placed himself on the emperor's side and waged war against the Austrians, with Pepe on his staff. After several engagements the Neapolitans were forced to retire, and eventually agreed to the treaty of Casalanza by which Murat was to abandon the kingdom; but the Neapolitan officers retained their rank under Ferdinand IV. who now regained the throne of Naples. While engaged in suppressing brigandage in the Capitanata, Pepe organized the carbonari (*q.v.*) into a national militia, and was preparing to use them for political purposes. He had hoped that the king would end by granting a constitution, but when that hope failed he meditated seizing Ferdinand, the emperor of Austria, and Metternich, who were expected at Avellino, and thus compelling them to liberate Italy (1819). The scheme broke down through an accident, but in the following year a military rising broke out, the mutineers cheering for the king and the constitution. Pepe himself was sent against them, but while he was hesitating as to what course he should follow Ferdinand promised a constitution (July 1820). A revolt in Sicily having been repressed, Pepe was appointed inspector-general of the army. In the meanwhile the king, who had no intention of respecting the constitution, went to Laibach to confer with the sovereigns of the holy alliance assembled there, leaving his son as regent. He obtained the loan of an Austrian army with which to restore absolute power, while the regent dallied with the Liberals. Pepe, who in parliament had declared in favour of deposing the king, now took command of the army and marched against the Austrians. He attacked them at Rieti (March 7, 1821), but his raw levies were repulsed. The army was gradually disbanded, and Pepe spent several years in England, France and other countries, publishing a number of books and pamphlets of a political character and keeping up his connexion with the Carbonari. When in 1848 revolution and war broke out all over Italy, Pepe returned to Naples, where a constitution had again been proclaimed. He was given command of the Neapolitan army which was to co-operate with Piedmont against the Austrians, but when he reached Bologna the king, who had already changed his mind, recalled him and his troops. Pepe, after hesitating between his desire to fight for Italy, and his oath to the king, resigned his commission in the Neapolitan service and crossed the Po with 2000 volunteers to take part in the campaign. After a good deal of fighting in Venetia, he joined Manin in Venice and took command of the defending army. When the city was forced by hunger to surrender to the Austrians, Pepe and Manin were among those excluded from the amnesty; he again went into exile and died in Turin in 1855.

The story of Pepe's life down to 1846 is told in his own interesting *Memorie* (Lugano, 1847), and his *Narrative of the Events . . . at Naples in 1820 and 1821* (London, 1821); for the later period of his life see the general histories of the Risorgimento, and the biographical sketch in vol. ii. of L. Carpi's *Risorgimento* (Milan, 1886).

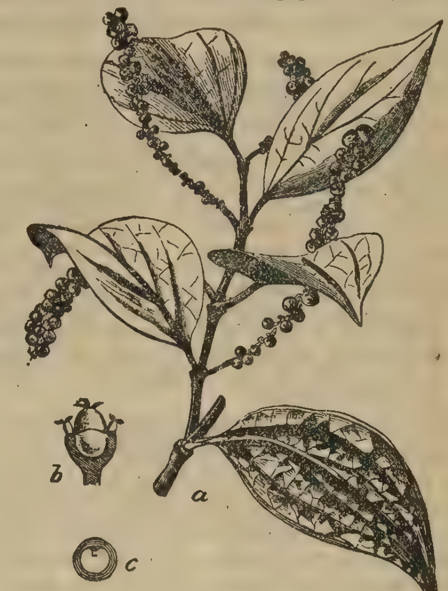
PEPERINO, an Italian name applied to a brown or grey volcanic tuff, containing fragments of basalt and limestone, with disseminated crystals of augite, mica, magnetite, leucite, &c. The typical peperino occurs in the Alban Hills, near Rome, and was used by the ancients, under the name of lapis albanus, as a building stone and for the basins of fountains. Other tuffs and conglomerates in Auvergne and elsewhere are also called peperino. The name originally referred to the dark coloured inclusions, suggestive of pepper-corns. In English the word has sometimes been written peperine.

PEPPER, WILLIAM (1843–1898), American physician, was born in Philadelphia, on the 21st of August 1843. He was educated at the university of Pennsylvania, graduating from the academic department in 1862 and from the medical department in 1864. In 1868 he became lecturer on morbid anatomy in the same institution, and in 1870 lecturer on clinical medicine. From 1876 to 1887 he was professor of clinical medicine, and in 1887 succeeded Dr Alfred Stillé as professor of theory and practice of medicine. He was elected provost of the university in 1881, resigning that position in 1894. For his services as medical director of the Centennial Exhibition in 1876 he was made knight commander of St Olaf by the king of Sweden. He founded the *Philadelphia Medical Times,* and was editor of that journal in 1870–1871. He was known particularly for his contributions on the subject of the theory and practice of medicine, and the *System of Medicine* which he edited in 1885–1886 became one of the standard textbooks in America. Among his contributions to the medical and scientific journals of the day, were "Trephining in Cerebral Disease" (1871); "Local Treatment in Pulmonary Cavities" (1874); "Catarrhal Irrigation" (1881); "Epilepsy" (1883); and "Higher Medical Education: the True Interest of the Public and the Profession." He died on the 28th of July 1898 at Pleasanton, California.

PEPPER, a name applied to several pungent spices known respectively as black, white, long, red, or cayenne, Ashanti, Jamaica, and melegueta pepper, but derived from at least three different natural orders of plants.

Black pepper is the dried fruit of *piper nigrum,* a perennial climbing shrub indigenous to the forests of Travancore and Malabar, from whence it has been introduced into Java, Sumatra, Borneo, the Malay Peninsula, Siam, the Philippines, and the West Indies. It climbs on tree-trunks by roots in the same way as ivy, and from its climbing habit is known as the pepper vine. It is one of the earliest spices known to mankind, and for many ages formed a staple article of commerce between India and Europe. Tribute has been levied in pepper; one of the articles demanded in 408 by Alaric as part of the ransom of Rome was 3000 ℔ of pepper. Its exorbitant price during the middle ages was one of the inducements which led the Portuguese to seek a sea-route to India. The discovery of the passage round the Cape of Good Hope led (1498) to a considerable fall in the price, and about the same time the cultivation of the plant was extended to the western islands of the Malay Archipelago. Pepper, however, remained a monopoly of the Portuguese crown as late as the 18th century. In Great Britain it was formerly taxed very heavily, the impost in 1623 amounting to 5s., and as late as 1823 to 2s. 6d. ℔.

The largest quantities of pepper are produced in Penang, the island of Riouw, and Johore near Singapore—Penang affording on an average about half of the entire crop. Singapore is the great emporium for this spice in the East, the largest proportion being shipped thence to Great Britain. The varieties of black pepper met with in commerce are known as Malabar, Aleppy or Tellicherry, Cochin, Penang, Singapore and Siam.



Piper nigrum.

a, Twig with fruit (about ½ nat. size); *b,* longitudinal section of flower much enlarged; *c,* section of fruit.

It owes its pungency to a resin, and its flavour to a volatile oil, of which it yields from 1·6 to 2·2%. The oil agrees with oil of turpentine in composition as well as in specific gravity and boiling point. In polarized light it deviates the ray, in a column 50 mm. long, 1·2° to 3·4° to the left. Pepper also contains a yellow crystalline alkaloid, called piperine, to the extent of 2 to 8%. This substance has the same empirical formula as morphine, $C_{17}H_{19}NO_3$, but differs in constitution and properties. It is insoluble in water when pure, is devoid of colour, flavour and odour, and may be resolved into piperic acid, $C_{12}H_{10}O_4$, and piperidine, $C_5H_{11}N$. The latter is a liquid colourless alkaloid, boiling at 106° C., has an odour of pepper and ammonia, and yields crystallizable salts. A fatty oil is found in the pericarp of pepper, and the berries yield on incineration from 4·1 to 5·7 of ash. The only use of black pepper is as a condiment, but it may be given therapeutically in doses of 5 to 20 grains. It has the pharmacological actions of a volatile oil.

In the south-west of India, where the pepper-plant grows wild, it is found in rich, moist, leafy soil, in narrow valleys, propagating itself by running along the ground and giving off roots into the soil. The only method of cultivation adopted by the natives is to tie up the end of the vines to the neighbouring trees at distances of at least 6 ft., especially to those having a rough bark, in order that the roots may easily attach themselves to the surface. The underwood is then cleared away, leaving only sufficient trees to provide shade and permit free ventilation. The roots are manured with a heap of leaves, and the shoots are trained twice a year. In localities where the pepper does not grow wild, ground is selected which permits of free drainage, but which is not too dry nor liable to inundation, and cuttings are planted at about a foot from the trees either in the rainy season in June or in the dry season in February. Sometimes several cuttings about 18 in. long are placed in a basket and buried at the root of the tree, the cuttings being made to slope towards the trunk. In October or November the young plants are manured with a mixture of leaves and cow-dung. On dry soils the young plants require watering every other day during the dry season for the first three years. The plants bear in the fourth or fifth year, and if raised from cuttings are fruitful for seven years, if from seed for fourteen years. The pepper from plants raised from cuttings is said to be superior in quantity and quality, and this method is in consequence most frequently adopted. Where there are no trees the ground is made into terraces and enclosed by a mud wall, and branches of *Erythrina indica* are put into the ground in the rainy season and in the course of a year are capable of supporting the young pepper plants. In the meantime mango trees are planted, these being preferred as supports, since their fruit is not injured by the pepper plant, while the *Erythrina* is killed by it in fourteen or fifteen years.

In Sumatra the ground is cleared, ploughed, and sown with rice, and cuttings of the vine are planted in September, 5 ft. apart each way, together with a sapling of quick growth and rough bark. The plants are now left for twelve or eighteen months and then entirely buried, except a small piece of bent stem, whence new shoots arise, three or four of which are allowed to climb the tree near which they are planted. These shoots generally yield flowers and fruits the next year. Two crops are collected every year, the principal one being in December and January and the other in July and August, the latter yielding pepper of inferior quality and in less quantity.

Two or three varieties are met with in cultivation; that yielding the best kinds has broadly ovate leaves, five to seven in number, nerved and stalked. The flower-spikes are opposite the leaves, stalked and from 3 to 6 in. long; the fruits are sessile and fleshy. A single stem will bear from twenty to thirty of these spikes. The harvest begins as soon as one or two berries at the base of the spikes begin to turn red, and before the fruit is mature, but when full-grown and still hard; if allowed to ripen, the berries lose pungency, and ultimately fall off and are lost. The spikes are collected in bags or baskets and dried in the sun. When dry the pepper is put into bags containing from 64 to 128 ℔. In Sumatra the yield is estimated at about 1½ ℔ per plant per annum. In Malabar each vine gives 2 ℔ a year up to the fifteenth or twentieth year, or about 24 ℔ from each tree, a single tree sometimes supporting eight or twelve vines; an acre is calculated to bear 2500 plants, to cost about £4 in outlay to bring it into bearing, and to yield a produce of £80 when in its best condition.

White pepper differs only in being prepared from the ripe fruits. These, after collection, are kept in the house three days and then bruised and washed in a basket with the hand until the stalks and pulpy matter are removed, after which the seeds are dried. It is, however, sometimes prepared from the dried black pepper by removing the dark outer layer. It is less pungent than the black but possesses a finer flavour. It is chiefly prepared at the island of Riouw, but the finest comes from Tellicherry.

White pepper affords on an average not more than 1·9% of essential oil; but, according to Cazeneuve, as much as 9% of piperine, and of ash not more than 1·1%.

Long pepper is the fruit-spike of *Piper officinarum* and *P. longum*, gathered shortly before it reaches maturity and dried. The former is a native of the Indian Archipelago, and has oblong-ovate, acuminate leaves, which are pinnately veined. The latter is indigenous in the hotter provinces of India, Ceylon, Malacca and the Malay Islands; it is distinguished from *P. officinarum* by the leaves being cordate at the base and five-veined.

Long pepper appears to have been known to the ancient Greeks and Romans under the name of *πέπερι μακρόν*; and in the 10th century mention is made of long pepper, or macropiper, in conjunction with black and white peppers. The spice consists of a dense spike of minute baccate fruits closely packed around the central axis, the spike being about 1½ in. long and ¼ in. thick; as met with in commerce they have the appearance of having been limed. In Bengal the plants are cultivated by suckers, which are planted about 5 ft. apart on dry rich soil on high ground. An English acre will yield about 3 maunds (80 ℔) the first year, 12 the second, and 18 the third year; after this time the yield decreases, and the roots are therefore grubbed up and sold as *pipli mul*, under which name they are much used as a medicine in India. After the fruit is collected, which is usually in January, the stem and leaves die down to the ground. Long pepper contains piperine, resin and volatile oil and yields about 8% of ash. Penang and Singapore are the principal centres in the East for its sale.

Ashanti or *West African pepper* is the dried fruit of *Piper Clusii*, a plant widely distributed in tropical Africa, occurring most abundantly in the country of the Niam-niam. It differs from black pepper in being rather smaller, less wrinkled, and in being attenuated into a stalk, like cubebs (the dried unripe fruits of *P. Cubeba*), to which it bears considerable resemblance externally. The taste, however, is pungent, exactly like that of pepper, and the fruit contains piperine. It was imported from the Grain Coast by the merchants of Rouen and Dieppe as early as 1364 and was exported from Benin by the Portuguese in 1485; but, according to Clusius, its importation was forbidden by the king of Portugal for fear it should depreciate the value of the pepper from India. In tropical Africa it is extensively used as a condiment, and it could easily be collected in large quantities if a demand for it should arise.

Jamaica pepper is the fruit of *Pimenta officinalis*, an evergreen tree of the Myrtle family. It is more correctly termed "pimento" or "allspice," as it is not a true pepper.

Melegueta pepper, known also as "Guinea grains," "grains of paradise" (*q.v.*) or "alligator pepper," is the seed of *Amomum Melegueta*, a plant of the ginger family; the seeds are exceedingly pungent, and are used as a spice throughout central and northern Africa.

For *Cayenne pepper*, see that article.

PEPPER-CORN, the fruit or seed of the pepper plant; hence anything very small or insignificant. *Pepper-corn rent* is a merely nominal rent, reserved for the purpose of having the tenancy acknowledged by the tenant. Building leases frequently reserve a pepper-corn as rent for the first few years. See RENT.

PEPPERMINT, an indigenous perennial herb of the natural order Labiatae, and genus *Mentha* (see MINT), the specific name being *Mentha piperita*, is distinguished from other species of the genus by its stalked leaves and oblong-obtuse spike-like heads of flowers. It is met with, near streams and in wet places, in several parts of England and on the European continent, and is also extensively cultivated for the sake of its essential oil in England,[1] in several parts of continental Europe, and in the United States. Yet it was only recognized as a distinct species late in the 17th century, when Dr Eales discovered it in Hertfordshire and pointed it out to Ray, who published it in the second edition of his *Synopsis stirpium britannicarum* (1696). The medicinal properties of the plant were speedily recognized and it was admitted into the *London Pharmacopoeia* in 1721, under the name of *Mentha piperitis sapore*.

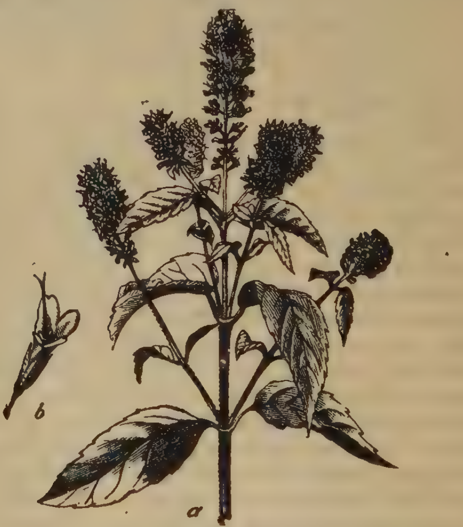


FIG. 1.—*Mentha piperita*.
a, Flowering branch (about ½ nat. size); *b*, flower showing form of calyx teeth (enlarged).

Two varieties are recognized by growers, the white and the black mint. The former has purplish and the latter green stems; the leaves are more coarsely serrated in the white. The black is more generally cultivated, probably because it is found to yield more oil, but that of the white variety is considered to have a more delicate odour, and obtains a higher price. The white is the kind chiefly dried for herbalists. The flavour varies to a slight extent even with particular plots of land, badly drained ground being known to give unfavourable results both as to the quantity and quality of the oil. That of the Japanese and Chinese oil also differs slightly from the English, and is thus distinguishable by experts. In America the oil is liable to be injured in flavour by aromatic weeds which grow freely among the crop, the most troublesome of these being *Erigeron canadense*, and *Erechthites hieracifolia*. When pure the oil is nearly colourless and has an agreeable odour and powerful aromatic taste, followed by a sensation of cold when air is drawn into the mouth. It has a specific gravity of 0·84 to 0·92, and boils at 365° F. Mitcham oil, when examined by polarized light in a column 50 mm. long, deviates from 14·2° to 10·7° to the left, the American 4·3°. When oil of peppermint is cooled to 4° C. it sometimes deposits colourless hexagonal prisms of menthol, $C_{10}H_{20}O$, which are soluble in alcohol and ether, almost insoluble in water, and fusible at 92° F. The oil consists chiefly of menthol and a terpene called menthene, $C_{10}H_{18}$. Oil of peppermint is often adulterated with a third part of rectified spirit, which may be detected by the milkiness produced when the oil is agitated with water. Oil of rosemary and rectified oil of turpentine are sometimes used for the same purpose. If the oil contains turpentine it will explode with iodine. If quite pure it dissolves in its own weight of rectified spirits of wine. Peppermint oil is largely distilled at Canton, a considerable quantity being sent to Bombay, also a large quantity of menthol. The species cultivated in the neighbourhood of Canton, is *Mentha arvensis*, var. *glabrata*. Peppermint is chiefly cultivated in the province of Kiang-si; and according to native statements as much as 40 piculs of oil of peppermint are sent annually to ports on the coast. In Japan also the distillation of oil of peppermint forms a considerable industry, the plant cultivated being *M. arvensis*, var. *piperascens*. The oil, under the name of *hakka no abura*, is exported from Hiogo and Ozaka, but is said to be frequently adulterated. The menthol is obtained by subjecting the oil to a low temperature, when it crystallizes out and is separated. The two varieties of *M. arvensis* just named yield much more menthol than *M. piperita*. It is remarkable, however, that the *M. arvensis*, var. *javanica*, growing in Ceylon, has not the flavour of peppermint but that of garden mint, while typical form of *M. arvensis* grown in Great Britain has an odour so different from peppermint that it has to be carefully removed from the field lest it should spoil the flavour of the peppermint oil when the herb is distilled. *M. incana*, cultivated near Bombay as a herb, also possesses the flavour of peppermint. In the form in which menthol is imported it bears some resemblance to Epsom salts, with which it is sometimes adulterated.

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[1] Near Mitcham in Surrey, Wisbech in Cambridgeshire, Market Deeping in Lincolnshire and Hitchin in Hertfordshire.

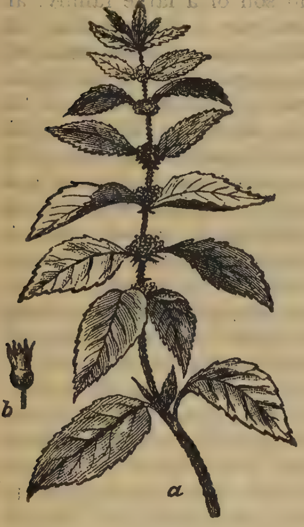


FIG. 2.—*Mentha arvensis*, var. *piperascens*.
a, Flowering branch reduced); *b*, calyx showing form of teeth (enlarged).

The volatile oil of *Mentha piperita* is a valuable and widely used drug. Its chief constituents are menthol and menthene, which is a liquid terpene. The British pharmacopoeia contains two preparations of this oil, the *Aqua menthae piperitae* and the *Spiritus menthae piperitae*. The oil has the characters of its class, with certain special features. Its local anaesthetic action is exceptionally strong. It is also powerfully antiseptic. These two properties make it valuable in the relief of toothache and in the treatment of carious cavities in the teeth. They also render the drug valuable in certain forms of dyspepsia and in colic generally, "soda-mint lozenges" being a familiar form. The characteristic anti-spasmodic action of the volatile oils is perhaps more marked in this than in any other oil, and greatly adds to its power of relieving pains arising in the alimentary canal. The volatile oil of spearmint is also official in Great Britain and the United States, being given in the same doses and for the same purposes as oil of peppermint. It is of less value medicinally, not containing any appreciable quantity of menthol, the place of which is taken in the *oleum menthae viridis*—the pharmacopoeial name—by carvone, $C_{10}H_{14}O$, found in caraway oil, and isomeric with thymol.

The following mode of cultivation of peppermint is adopted at Market Deeping. A rich friable soil, retentive of moisture, is selected, and the ground is well tilled 8 to 10 in. deep. The plants are propagated in the spring, usually in April and May. When the young shoots from the crop of the previous year have attained a height of about 4 in. they are pulled up and transplanted into new soil. They grow vigorously the first year, and throw out numerous stolons on the surface of the ground. After the crop has been removed these are allowed to harden or become woody, and then farm-yard manure is scattered over the field and ploughed in. In this way the stolons are divided into numerous pieces, and covered with soil before the frost sets in. If the autumn is wet they are liable to become sodden, and rot, and the next crop fails. In the spring the fields are dressed with Peruvian guano. In new ground the peppermint requires hand-weeding two or three times, as the hoe cannot be used without injury to the plants. Moist heavy weather in August is apt to cause the foliage to drop off and leave the stems almost bare. In these circumstances rust (*Puccinia menthae*) also is liable to attack the plants. This is prevented to a certain extent by a rope being drawn across the plants, by two men walking in the furrows, so as to remove excessive moisture. The average yield of peppermint is about 165 cwt. per acre. The first year's crop is always cut with the sickle to prevent injury to the stolons. The herb of the second and third year is cut with scythes, and then raked by women into loose heaps ready for carting. The field is then gleaned by boys, who add what they collect to the heaps. The plants rarely yield a fourth crop on the same land. The harvest usually commences in the beginning or middle of August, or as soon as the plants begin to flower, and lasts for six weeks, the stills being kept going night and day. The herb is carted direct from the field to the stills, which are made of copper, and contain about 5 cwt. of the herb. Before putting the peppermint into the still water is poured in to a depth of about 2 ft., at which height a false bottom is placed, and on this the herb is thrown and trodden down by men. The lid, which fits into a water-joint, is then let down by pulleys and fastened by two bars, any excess of pressure or temperature being indicated by the water that is ejected at the joint. The distillation is conducted by the application of direct heat at the lowest possible temperature, and is continued for about four and a half hours. When this operation is completed, the lid is removed and a rope is attached to a hook on the false bottom, which, as well as the herb resting on it, is raised bodily by a windlass and the peppermint carried away in the empty carts on their return journey to the fields, where it is placed in heaps and allowed to rot, being subsequently mixed with the manure applied in the autumn as above stated. The usual yield of oil, if the season be warm and dry, is said to be 1 oz. from 5 ℔ of the fresh flowering herb, but, if wet and unfavourable, the product is barely half that quantity. The yield of a charge of the still is estimated at from 1 ℔ 12 oz. to 5 ℔. The oil improves in mellowness even if kept as long as ten or fourteen years. The green colour sometimes present in the oil is stated to be due to a quantity of water larger than necessary having been used in the distillation; on the other hand, if the herb be left in the still from Saturday to Monday, the oil assumes a brown tint.

In France peppermint is cultivated on damp rich ground at Sens, in the department of the Yonne. In Germany it is grown in the neighbourhood of Leipzig, where the little town of Cölleda produces annually as much as 40,000 cwt. of the herb. In the United States peppermint is cultivated on a most extensive scale, chiefly in south-west Michigan, the west districts of New York state, and Ohio. The yield averages from 10 to 30 ℔ per acre. In Michigan the plant was introduced in 1855.

PEPPERRELL, SIR WILLIAM (1696–1759), American soldier, was born in Kittery, Maine, then a part of Massachusetts, on the 27th of June 1696. He studied surveying and navigation, and joined his father in his ship-building, fishing and general trading business, quickly becoming one of the wealthiest and most influential men in the province. He was commissioned captain (1717), major, lieutenant-colonel, and in 1726 colonel of militia. Pepperrell served in the Massachusetts general court (1726–1727), and in the governor's council (1727–1759), of which for eighteen years he was president. Although not a trained lawyer, he was chief justice of the court of common pleas from 1730 until his death. In 1745 he was commander-in-chief of the New England force of about 4000, which, with the assistance of a British squadron under Commodore Peter Warren, besieged and captured the French fortress of Louisburg, the garrison surrendering on the 16th of June and Pepperrell and Warren taking possession on the following day. For his services Pepperrell, in November 1746, was created a baronet—the only New Englander so honoured. He was active in raising troops during the "French and Indian War," and received the rank of lieutenant-general in February 1759. He died in Kittery, Maine, on the 6th of July in the same year.

See Usher Parsons, *Life of Sir William Pepperrell, Bart.* (Cambridge, Mass., 1855), based on the family papers.

PEPPER TREE, a tree which has no proper connexion with the true pepper (*Piper*), and is really a member of the natural order Anacardiaceae, being known botanically as *Schinus Molle*, from the Peruvian name *Mulli*. It is a native of tropical South America and is grown in the open air in the south of Europe. It is a small tree with unequally pinnate leaves, the segments linear, entire or finely saw-toothed, the terminal one longer than the rest, and all filled with volatile oil stored in large cells or cysts, which are visible to the naked eye and appear like holes when the leaf is held up to the light. When the leaves are thrown upon the surface of water the resinous or oily fluid escapes with such force as violently to agitate them. The flowers are small, whitish, arranged in terminal clusters and polygamous or unisexual, with five sepals, as many petals, ten stamens (as large as the petals in the case of the male flower, very small in the female flower, but in both springing from a cushion-like disk surrounding the base of the three-celled ovary). The style is simple or three-cleft, and the fruit a small, globose, pea-like drupe with a bony kernel enclosing a single seed. The fleshy portion of the fruit has a hot aromatic flavour from the abundance of the resin it contains. The resin is used for medicinal purposes by the Peruvians, and has similar properties to mastic. The Japan pepper tree is *Xanthoxylum piperitum* the fruits of which have also a hot taste. Along the Riviera the tree known as *Melia Azedarach*, or the "Pride of India," is also incorrectly called the pepper tree by visitors.

PEPSIN, an enzyme or ferment obtained by drying the mucous lining of the fresh and healthy stomach of a pig, sheep or calf. As used in medicine it consists of a light yellow-brown or white powder or of pale yellow translucent grains or scales. It is only slightly soluble in water and alcohol. Pepsin is used to help gastric digestion in old people and in those in whom there is a deficient secretion of the gastric juice. It is useful in chronic catarrhal conditions of the stomach, the dyspepsia of alcoholism, and in gastric ulcer and cancer of the stomach.

Pepsin digests the albumens but is useless in the digestion of fats or carbohydrates. It may also be used to predigest albuminous foods. The following is a method of peptonizing beef. Take ¼ ℔ of minced raw lean beef, ½ pint of water containing 0·2 % of hydrochloric acid, place in a jar with 30 grs. of pepsin, set in a warm place at 110° F. for 3 hours, stirring occasionally. Then quickly boil it. It is usually unnecessary to strain it, as the meat is reduced to a fine almost impalpable powder which is readily assimilated. Many varieties of proprietary peptonizing tablets are on the market and are convenient for the preparation of peptonized milk. The following is a method of preparing it. Take a clean glass quart bottle, pour in a pint of perfectly fresh cold milk, then add a teacupful of cold water in which a peptonizing tablet has been dissolved. Submerge the bottle in a can of water at 100° F. for from 5 to 10 minutes, take out the bottle and place on ice to prevent the further action of the pepsin. If no ice is convenient bring the milk to a boil for the same purpose. If the action of the pepsin be continued for a much longer period the milk becomes bitter to the taste from the development of excess of peptones. Predigested foods should not be used over a long period or the digestive functions of the stomach may atrophy from disuse.

Pancreatic solution, derived from the pancreas of a pig digested in alcohol, has the power of converting starch into sugar, and albumen and fibrin into peptones. It only acts in an alkaline medium and at a temperature under 140° F. If used to peptonize milk sodium bicarbonate should be added. Many commercial preparations are on the market. Trypsin, the principal ferment of the pancreas, also changes proteids into peptones.

PEPUSCH, JOHN CHRISTOPHER (1667–1752), English musician, of German parentage, was born in Berlin. He began his study of music at an early age, and about 1700 left Berlin and went to England, where he had various engagements, and where he went on with his researches into ancient music. He composed a number of church services and instrumental pieces, besides music for masques and plays, but he is best known in connexion with the founding in 1710 of the Academy of Ancient Music. In 1713 he was made a Mus.D. of Oxford, and in 1746 F.R.S. In 1718 he married Margarita de l'Épine (d. 1746), who, as the first Italian to sing in England, was described in 1692 in the *London Gazette* simply as "the Italian woman." Pepusch died in London on the 20th of July 1752. His *Treatise on Harmony* (anonymous 1st ed. 1730) is believed to have been an embodiment of his rules drafted by his pupil Viscount Paisley, afterwards earl of Abercorn.

PEPYS, SAMUEL (1633–1703), English diarist, was born on the 23rd of February 1633. The place of his birth is not known. The name was pronounced in the 17th century, and has always been pronounced by the family, "Peeps." The family can be traced in Cambridgeshire as far back as the reign of Edward I. They rose by slow degrees from the class of small copyholders and yeoman farmers to the position of gentry. In 1563 they had a recognized right to use a coat of arms. John Pepys, Samuel's father, was a younger son, who, like other gentlemen in his position in that age, went into trade. He was for a time established as a tailor in London, but in 1661 he inherited a small estate at Brampton near Huntingdon, where he lived during the last years of his life.

Samuel was fifth child and second son of a large family, all of whom he survived. His first school was in Huntingdon, but he was afterwards sent to St Paul's in London, where he remained till 1650. While at St Paul's he was an eye-witness of the execution of King Charles I. On the 21st of June in that year his name was entered as a sizar on the books of Trinity Hall, Cambridge, but it was transferred to Magdalene on the 1st of October. On the 5th of March he entered into residence, and he remained there till 1654 or 1655. He obtained a Spendluffe scholarship a month after entering, and one on Dr John Smith's foundation on the 14th of October 1653. Nothing is known of his university career except that on the 21st of October 1653 he was publicly admonished with another undergraduate for having been "scandalously overserved with drink." At Cambridge he wrote a romance, *Love is a Cheat*, which he afterwards destroyed. On the 1st of December 1655 he was married at St Margaret's church, Westminster, to Elizabeth, daughter of Alexander Marchant, Sieur de St Michel, a French Huguenot exile from Anjou who had married an English lady named Kingsmill. Pepys had at this time no independent means, and probably relied on his cousins, the Montagues, to provide for him. On the 26th of March 1658 he was cut for the stone, an event which he always kept in memory by a solemn anniversary. In 1659 he went as secretary with his cousin, Edward Montagu, afterwards earl of Sandwich, on a voyage to the Sound. On his return he was engaged as a clerk under Mr (afterwards Sir) Edward Downing, one of the four tellers of the exchequer. In 1660 he accompanied his cousin, who commanded the fleet which brought King Charles II. back from exile. In that year, by the interest of his cousin, he was named "clerk of the acts" in the navy office, but was compelled to buy off a competitor, one Barlow, by an annuity of £100.

Pepys was now fairly established in the official career which led him to honour. On the 1st of January 1660 he had begun his second and hidden life as a diarist. It is in that capacity that he is of such unique interest. But if his diary had never been written, or had been lost, he would still be a notable man, as an able official, the author of valuable *Memoirs of the Navy* (1690), an amateur musician and protector of musicians, a gentleman who took an enlightened interest in science, and was elected president of the Royal Society. To his contemporary diarist, John Evelyn, he appeared as "a worthy, industrious and curious person." It is true that Andrew Marvel accused him of having accumulated a fortune of £40,000 by "illegal wages." But this charge, made in a pamphlet called *A List of the principal Labourers in the great design of Popery and Arbitrary Power*, was attributed to political animosity. To the world he appeared as an honourable and religious man, and so he would seem to have been to us if he had not recorded in his diary all those weaknesses of character and sins of the flesh which other men are most careful to conceal.

His place of clerk to the Navy Board was equivalent to the post of permanent under secretary in modern times. It made him chief of the secretariat and a member of the administrating body of the navy. Though he was so ignorant of business that he did not even know the multiplication table when he first took office, he soon mastered the needful mechanical details by working early and late. He had other posts and honours, which came to him either as consequential on his clerkship or because he was a useful official. On the 23rd of July 1660 he was appointed one of the clerks of the privy seal, an office which returned him £3 a day in fees. He was made a justice of the peace. In 1662 he was appointed a younger brother of the Trinity House, and was named a commissioner for managing the affairs of Tangier, then occupied by an English garrison. In 1664 he became a member of the corporation of the Royal Fishery, to which body he was named treasurer when another official had brought the accounts into confusion. In that year he also joined the Royal Society. During the naval war with Holland (1664–67) he proved himself an indefatigable worker. As surveyor of the victualling, the whole burden of a most important department was thrown on him in addition to his regular duties. He in fact organized the department. While the plague was raging in London in 1666 he remained at his post when many of his colleagues ran away, and he manfully avowed his readiness to take the risk of disease, as others of the king's servants faced the dangers of war. He had now gained the full confidence of the lord high admiral, the duke of York, afterwards King James II. When, on the termination of the war, the navy office was violently attacked in parliament, he was entrusted with its defence. The speech which he delivered at the bar of the House of Commons on the 5th of March 1668 passed for a complete vindication. In sober fact the charges of mismanagement were well founded, but the fault was not in the officials of the navy office only, and Pepys, who was master of the details, had no difficulty in throwing dust in the eyes of the House of Commons, which was ignorant. Nobody indeed was better acquainted with the defects of the office, for in 1668 he drew up for the duke of York two papers of inquiry and rebuke, "The Duke's Reflections on the severall Members of the Navy Board's Duty" and "The Duke's answer to their severall excuses" (Harleian MS. 6003). In 1669 he travelled abroad. His success in addressing parliament gave him the ambition to become a member of the House of Commons. He stood for Aldborough, but the death of his wife, on the 10th of November 1669, prevented him from conducting his canvass in person, and he was not elected. In 1673 he was returned for Castle Rising. The validity of his election was questioned by his opponent, Mr Offley, and the committee of privilege decided against him, but the prorogation of the house prevented further action. The no-popery agitation was now growing in strength. The duke of York was driven from office by the Test Act, and Pepys was accused of "popery," partly on the ground that he was said to keep a crucifix and altar in his house, partly because he was accused of having converted his wife to Roman Catholicism. The crucifix story broke down on examination, but there is some reason to believe that Mrs Pepys did become a Roman Catholic. Pepys was transferred by the king from the navy office to the secretaryship of the admiralty in 1673. In 1679 he was member for Harwich, and in the height of the popish plot mania he was accused, manifestly because he was a trusted servant of the duke of York, of betraying naval secrets to the French, but the charges were finally dropped. Pepys was released on bail on the 12th of February 1680. In that year he accompanied the king to Newmarket, and took down the narrative of his escape after the battle of Worcester. A proposal to make him head of King's College, Cambridge, in 1681, came to nothing. In 1682 he accompanied the duke of York to Scotland, where the uncleanly habits of the people caused him great offence. In 1683–1684 he was engaged in arranging for the evacuation of Tangier. He visited the place and kept a diary of his voyage. In 1684 he was elected president of the Royal Society. On the accession of King James II. in 1685 he retained his place as secretary to the admiralty, to which he had been appointed by patent when James resumed the lord high admiralship (June 10, 1684), and Pepys was in effect minister for the navy. The revolution of 1688 ended his official career. He was dismissed on the 9th of March 1689, and spent the rest of his life in retirement, and, except for a brief imprisonment on the charge of Jacobite intrigue in 1690, in peace. He died at his house in Clapham on the 25th of May 1703. His last years were passed in correspondence with his friends, who included Evelyn and Dryden, or in arranging his valuable library. It was left on his death to his nephew, John Jackson, son of his sister Pauline, and in 1724, by the terms of his will, was transferred to Magdalene College, Cambridge, where it is still preserved.

Such was the outward and visible life of Samuel Pepys, the public servant whose diligence was rewarded by success. The other Pepys, whom Sir Walter Scott called "that curious fellow," was revealed in 1825, when his secret diary was partly published. The first entry was made on the 1st of January 1660, the last on the 31st of May 1669, when the increasing weakness of his eyes, which had given him trouble since 1664, compelled him to cease writing in the conditions he imposed upon himself. If there is in all the literature of the world a book which can be called "unique" with strict propriety it is this. Confessions, diaries, journals, autobiographies abound, but such a revelation of a man's self has not yet been discovered. The diary is a thing apart by virtue of three qualities which are rarely found in perfection when separate and nowhere else in combination. It was secret; it was full; and it was honest. That Pepys meant it for his own eye alone is clear. He wrote it in Shelton's system of tachygraphy published in 1641, which he complicated by using foreign languages or by varieties of his own invention whenever he had to record the passages least fit to be seen by his servants or by "all the world." Relying on his cypher he put down whatever he saw, heard, felt or imagined, every motion of his mind, every action of his body. And he noted all this, not as he desired it to appear to others, but as it was to his seeing. The result is "a human document" of amazing vitality. The man who displays himself to himself in the diary is often odious, greedy, cowardly, casuistical, brutal. He tells how he kicked his cook, and blacked his wife's eye, and was annoyed when others saw what he had done. He notes how he compelled the wives of unfortunate men who came to draw their husband's pay at the navy office to prostitute themselves; how he took "compliments," that is to say gifts, from all who had business to do with the navy office; how he got tipsy and suffered from sick headache; how he repented, made vows of sobriety, and found casuistical excuses for breaking them. The style is as peculiar as the matter—colloquial, garrulous, racy from simplicity of language, and full of the unconscious humour which is never absent from a truthful account of the workings of nature in the average sensual man. His position enabled him to see much. His complete harmony with the animalism and vulgarity of the Restoration makes him a valuable witness for his time. To his credit must be put the facts that he knew the animalism and vulgarity to be what they were; that he had a real love of music and gave help to musicians, Cesare Morelli for instance; that though he made money out of his places he never allowed bad work to be done for the navy if he could help it; that he was a hard worker; and that he had a capacity for such acts of kindness and generosity as are compatible with a gross temperament and a pedestrian ambition.

The diary, written in a very small hand in six volumes, was included among his books at Magdalene. On the publication of Evelyn's diary in 1818, the then head of Magdalene, the Hon. and Rev. George Neville, decided to publish Pepys's. Part of the MS. was deciphered by his cousin Lord Grenville. The library contained both the short and the long-hand copies of Pepys's account of King Charles's adventures, but its books were so little known by the curators that this key was overlooked. The MS. was deciphered by John Smith, afterwards rector of Baldock in Hertfordshire, between 1819 and 1822. The first and partial edition, edited by Richard Neville Griffin, 3rd Lord Braybrooke, appeared in 1825 in two volumes quarto (London). It attracted great attention and was reviewed by Sir Walter Scott in the *Quarterly* for January 1826. A second edition in two octavo volumes followed in 1828 (London). A third and enlarged edition in five volumes octavo appeared in 1848–1849, and a fourth in four in 1854 (London). In 1875–1879 Dr Minors Bright published a still fuller edition in six volumes octavo (London). Many portraits of Pepys are known to have been taken and several can be traced. One was taken by Savill (1661), another by John Hales (1666), now in the National Portrait Gallery. A portrait by Sir Peter Lely is in the Pepysian library, Magdalene College, Cambridge. Three portraits were taken by Sir Godfrey Kneller, of which one belongs to the Royal Society, and another is in the Hall of Magdalene. Pepys's only known publication in his life was the *Memoirs of the Navy*, but other writings have been attributed to him.

AUTHORITIES.—The standard edition of *Pepys's Diary* is that by H. B. Wheatley, in nine volumes octavo, with a supplementary volume of *Pepysiana* (London, 1893–1899). See also Wheatley's *Samuel Pepys, and the world he lived in* (London, 1880); *The Life, Journals and Correspondence of Pepys*, by J. Smith (London, 1841); E. H. Moorhouse, *Samuel Pepys, Administrator, Observer, Gossip* (1909); and P. Lubbock, *Samuel Pepys* (1909). (D. H.)

PEQUOT, an Algonquian tribe of North-American Indians, a branch of the Mohicans. They occupied the coast of Connecticut from Niantic river to the Rhode Island boundary. Together with their kinsmen, the Mohegans, they formed a powerful and warlike people, bitterly hostile to the early settlers. In 1637 the Pequots were surprised by the whites at their fort on the Mystic river, and suffered so completely a defeat that the tribe was broken up, and its remnants took refuge with neighbouring tribes. The Pequot country passed under the control of the Mohegans. At the height of their power the Pequots numbered, it is estimated, some 3000.

PERCEPTION (from Lat. *percipere*, to perceive), in psychology, the term specially applied to the mental process by which the mind becomes conscious of an external object; it is the mental completion of a sensation, which would otherwise have nothing but a momentary existence coextensive with the duration of the stimulus, and is intermediate between sensation and the "ideal revival," which can reinstate a perceptual consciousness when the object is no longer present. This narrow and precise usage of the term "perception" is due to Thomas Reid, whose view has been generally adopted in principle by modern psychologists. On the other hand some psychologists decline to accept the view that the three processes are delimited by sharp lines of cleavage. It is held on the one hand that sensation is in fact impossible as a purely subjective state without cognition; on the other that sensation and perception differ only in degree, perception being the more complex. The former view admits, which the latter practically denies, the distinction in principle. Among those who adopt the second view are E. B. Titchener and William James. James (*Principles of Psychology*, ii. 76) compares sensation and perception as "the barer and the richer consciousness," and says that "beyond the first crude sensation all our consciousness is a matter of suggestion, and the various suggestions shade gradually into each other, being one and all products of the same psychological machinery of association." Similarly Wundt and Titchener incline to obliterate the distinction between perception and ideal revival. Prior to Reid, the word perception had a long history in the wider sense of cognition in general. Locke and Hume both use it in this sense, and regard thinking as that special kind of perception which implies deliberate attention. (See PSYCHOLOGY.)

PERCEVAL, or PERCYVELLE (Ger. *Parzival*, Fr. *Perlesvaus*, Welsh, *Peredur*), the hero of a comparatively small, but highly important, group of romances, forming part of the Arthurian cycle. Originally, the story of Perceval was of the character of a folk-tale, and that one of remarkable importance and world-wide diffusion. He is represented as the son of a widow, "la dame veuve," his father having been slain in tourney, battle or by treachery, either immediately before, or shortly after his birth. The mother, fearful lest her son should share his father's fate, flies to the woods, either alone with one attendant, or with a small body of faithful retainers, and there brings up her son in ignorance of his name, his parentage and all knightly accomplishments. The youth grows up strong, swift-footed and of great personal beauty, but, naturally enough, of very limited intelligence. This last is one of the most characteristic traits of the Perceval story, connecting it alike with the Irish *Lay of the Great Fool*, and the Teutonic *Dümmling* tales. He spends his days chasing the beasts of the forest, running them down by sheer speed, or killing them with darts (javelots) or bow and arrows, the only weapons he knows.

One day, however, he meets a party of knights in armour; he first adores the leader as God, and then takes them to be some new and wondrous kind of animal, asking the most naïve questions as to their armour and equipment. Being told that they are knights he determines that he too will be one, and returns to his mother announcing his intention of at once setting forth into the world to seek for knighthood. Dressed as a peasant (or a fool), he departs (his mother, in some versions, dying of grief), and comes to the king's court. Of course in the romance it is the court of Arthur; probably in the original tale it was simply "the king." Here his uncouth behaviour and great personal beauty attract general attention, and he is alike mocked by Kay, and his future distinction mysteriously foretold. He slays a foe of Arthur's, the Red Knight, who has insulted the king, and challenged the knights of the court, who, for some mysterious reason, are unable to respond to the challenge. Dressing himself in the armour of the slain knight, which he has great difficulty in handling and eventually puts on over his peasant's garb, he sets out on a series of adventures which differ greatly in the various versions, but the outcome of which is that he becomes a skilful and valiant knight and regains the heritage of his father.

This, the Perceval story proper, has been recognized by scholars as a variant of a widespread folk-tale theme, designated by J. C. von Hahn as the *Aryan Expulsion and Return* formula, which counts among its representatives such heroes as Perseus, Cyrus, Romulus and Remus, Siegfried, and, as Alfred Nutt has pointed out, Arthur himself. This particular variant appears to be of British-Celtic origin, and the most faithful representative of the original tale is now very generally held to be the English *Syr Percyvelle of Galles*, a poem preserved in the Thornton manuscript. Here the hero is nephew to Arthur on the mother's side, and his father, of the same name as himself, is a valiant knight of the court. A noticeable feature of the story is the uncertainty as to the hero's parentage; the mother is always a lady of rank, a queen in her own right, or sister of kings (as a rule of the Grail kings); but the father's rank varies, he is never a king, more often merely a valiant knight, and in no instance does he appear to be of equal rank with his wife. This distinguishes the story from that of Lancelot, with which some modern scholars have been inclined to identify it; for Lancelot's parentage is never in doubt, he is *fis du roi*.

The connexion of the story with Arthur and his court brought about a speedy and more important development, the precise steps of which are not yet clear: Perceval became the hero of the Grail quest, in this ousting Gawain, to whom the adventure originally belonged, and the Perceval became merged in the Grail tradition. Of the *Perceval-Grail* romances the oldest from the point of view of manuscript preservation is the *Perceval* or *Conte del Graal* of Chrétien de Troyes. Two manuscripts, indeed, the British Museum and Mons texts, preserve a fragment relating the birth and infancy of the hero, which appears to represent the source at the root alike of Chrétien and of the German *Parzival*, but it is only a fragment, and so far no more of the poem has been discovered. Chrétien left his poem unfinished, and we do not know how he intended to complete the adventures of his hero; but those writers who undertook the task, Wauchier de Denain, Gerbert de Montreuil and Manessier, carried it out with such variety of detail, and such a bewildering indifference to Chrétien's version, that it seems practically certain that there must have been, previous to Chrétien's work, more than one poem dealing with the same theme. The German poet, Wolfram von Eschenbach, whose *Parzival* in parts closely agrees with the *Perceval* and who was long held to be a mere translator of Chrétien, differs widely in the setting of his story. He gives an introduction, in which the adventures of the father, here a prince of Anjou, are related; a conclusion, in which the Swan-Knight, Lohengrin, is made Parzival's son; he represents the inhabitants of the Grail castle as Templars (Templeisen); and makes the Grail itself a stone. Finally, he reproaches Chrétien with having told the story amiss, whereas Kiot, the Provençal, whose version Wolfram was following, had told it aright from beginning to end. It is certain that Gerbert knew, and used, a *Perceval* which, if not Kiot's poem, must have been closely akin to it; as he too makes the Swan-Knight a descendant of the Grail hero. The probability seems to be that the earliest Perceval-Grail romance was composed at Fescamp, and was coincident with the transformation, under the influence of the *Saint-Sang* legend, of the originally Pagan talisman known as the Grail into a Christian relic, and that this romance was more or less at the root of all subsequent versions.

Besides the poems, we have also two prose Perceval romances, the relative position of which has not yet been satisfactorily determined. The first is found in two manuscripts only, the so-called "Didot" (from its original possessor M. Firmin-Didot), now in the Bibliothèque Nationale, Paris; the other, and much superior text, in the Biblioteca Estense, Modena. In both cases the romance follows the prose rendering of Borron's *Joseph of Arimathea* and *Merlin*, and precedes a *Mort Artus*, thus forming part of a complete cycle. The text shows a curious mingling of sources; the real primitive Perceval story, the *Enfances*, is omitted; he grows up in his father's house and goes to court at his wish. Later, however, stories which certainly derive from an early non-Grail tradition are introduced, and there are references which imply a knowledge of the prose *Lancelot* and of Chrétien's poem. The romance is probably a somewhat late, and not very skilful, compilation. The other prose romance, the *Perlesvaus*, is decidedly superior in literary form, but here too we have a mingling of old and new elements. The *Enfances* story is omitted, and there are parallels with the German *Parzival*, with Wauchier de Denain and with Gerbert, while much is peculiar to the *Perlesvaus* itself. It is not improbable that it represents a free and individual working over of the original Fescamp version, and that in its later shape it was intended to form, and did at one time form, the *Quest* section of the cyclic redaction of the Arthurian prose romances, being dislodged from this position by the Galahad *Quête*. It is a curious fact that the printed editions always give it in conjunction with this latter and that the two have also been preserved together in a Welsh manuscript translation. We also possess in one of the so-called *Mabinogi* a Welsh version of the tale, *Peredur, son of Evrawc*. This appears to be a free rendering of the adventures found in Chrétien combined with incidents drawn from Welsh tradition. This was at one time claimed as the original source of all the Perceval romances, but this theory cannot be maintained in face of the fact that the writer gives in one place what is practically a literal translation of Chrétien's text in a passage which there is strong reason to believe was borrowed by Chrétien from an earlier poem. In order of time the *Peredur* probably ranks latest in the series of Perceval romances, which, however, does not detract from its interest as a possible representative of genuine Welsh traditions, unknown to other writers.

The value and interest of the Perceval romances stand very high, not alone for their intrinsic merit, though that is considerable—Chrétien's *Perceval*, though not his best poem, is a favourable specimen of his work, and von Eschenbach's *Parzival*, though less elegant in style, is by far the most humanly interesting, and at the same time, most deeply spiritual, of the Grail romances—but also for the interest of the subject matter. The Perceval story is an admirable folk-tale, the Grail problem is the most fascinating problem of medieval literature; the two combined form a romance of quite unique charm and interest. This has been practically proved by the extraordinary success which has attended Richard Wagner's dramatic re-telling of the legend in his *Parsifal*. The immediate source of this version is the poem of Wolfram von Eschenbach, though the Grail, of course, is represented in the form of the Christian relic, not as the jewel talisman of the *Parzival*; but the psychological reading of the hero's character, the distinctive note of von Eschenbach's version, has been adapted by Wagner with marvellous skill, and his picture of the hero's mental and spiritual development, from extreme simplicity to the wisdom born of perfect charity, is most striking and impressive.

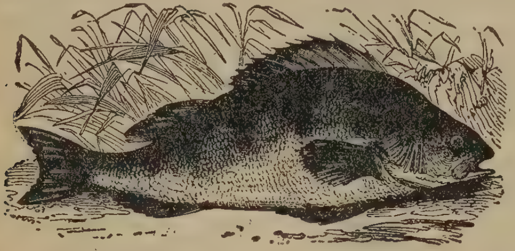
BIBLIOGRAPHY.—There are early printed editions of the *Perceval* (1530) and of the *Perlesvaus* (1516 and 1523). The *Perceval* was edited from the Mons text by Potvin (6 vols., 1866–1871); *Syr Percyvelle of Galles*, in *The Thornton Romances*, by Halliwell (1844) for the Camden Society. *Parzival* exists in numerous editions; critical texts have been edited by Lachmann (1891), Martin (1903) and Leitzmann (1902–1903). For the general reader the most useful text is that of Bartsch in *Deutsche Classiker des Mittelalters*, as it includes notes and a glossary. Modern German versions are by Simrock (very close to the original) and Hertz (freer, but with excellent notes and appendices); Eng. trans. by J. L. Weston (1894). The "Didot" *Perceval* was published by Hucher in vol. i. of *Le Saint Graal* (1875–1878); an edition of the Modena text has also been prepared. *Perlesvaus* was published by Potvin in vol. i. of his edition of Chrétien's poem. The Welsh text, with translation, has been edited by Canon Williams. A fine translation by Dr Sebastian Evans is published in "The Temple Classics," under the title of *The High History of the Holy Grail*. *Peredur* will be found in Alfred Nutt's edition of the *Mabinogion* (1902). For the critical treatment of the subject see *The Legend of Sir Perceval* (Grimm Library, vol. xvii.); *Perlesvaus* by Nitze (1902); *Legends of the Wagner Drama* by J. L. Weston. (J. L. W.)

PERCEVAL, SPENCER (1762–1812), prime minister of England from 1809 to 1812, second son of John, 2nd earl of Egmont, was born in Audley Square, London, on the 1st of November 1762. He was educated at Harrow and at Trinity College, Cambridge, and was called to the bar at Lincoln's Inn in 1786. A very able speech in connexion with a famous forgery case having drawn attention to his talents, his success was from that time rapid, he was soon regarded as the leading counsel on the Midland circuit, and in 1796 became a K.C. Entering parliament for Northampton in April of that year, he distinguished himself by his speeches in support of the administration of Pitt. In 1801, on the formation of the Addington administration, he was appointed solicitor-general, and in 1802 he became attorney-general. An ardent opponent of Catholic Emancipation, he delivered in 1807 a speech on the subject which helped to give the deathblow to the Grenville administration, upon which he became chancellor of the exchequer under the duke of Portland, whom in 1809 he succeeded in the premiership. Notwithstanding that he had the assistance in the cabinet of no statesman of the first rank, he succeeded in retaining office till he was shot by a man named Bellingham, a bankrupt with a grievance, who had vainly applied to him for redress, in the lobby of the House of Commons on the 11th of May 1812. Bellingham was certainly insane, but the plea was set aside and he was hanged. Perceval was a vigorous debater, specially excelling in replies, in which his thorough mastery of all the details of his subject gave him a great advantage. He married in 1790 and had six sons and six daughters; one of the latter married Spencer Horatio Walpole (d. 1898), home secretary, and their son Sir Spencer Walpole, the well-known historian, published an excellent biography of Perceval in 1874.

See also P. Treherne, *Spencer Perceval* (1909).

PERCH (through Fr. from Lat. *perca*, Gr. πέρκη; the last word is connected with περκνός, dark-coloured, spotted), a fresh-water fish (*Perca fluviatilis*), generally distributed over Europe, northern Asia and North America, and so well known as to have been selected for the type of an entire family of spiny-rayed fishes, the *Percidae*, which is represented in European fresh-waters by several other fishes such as the pope (*Acerina cernua*) and the pike-perch (*Lucioperca*). It inhabits rivers as well as lakes, but thrives best in waters with a depth of not less than 3 ft.; in large deep lakes it frequently descends to depths of 50 fathoms and more. It occurs in Scandinavia as far north as the 69th parallel, but does not extend to Iceland or any of the islands north of Europe. In the Alps it ascends to an altitude of 4000 ft.

The shape of its body is well proportioned, but many variations occur, some specimens being singularly high-backed, others low and long-bodied; sometimes such variations are local, and Agassiz and other naturalists at one time thought it possible to distinguish two species of the common perch of Europe; there are not even sufficient grounds, however, for separating specifically the North-American form, which in the majority of ichthyological works is described as *Perca flavescens*. The brilliant and striking colours of the perch render it easily recognizable even at a distance. A rich greenish-brown with golden reflections covers the back and sides, which are ornamented with five or seven dark cross-bands. A large black spot occupies the membrane between the last spines of the dorsal fin; and the ventral, anal and lower part of the caudal are bright vermilion. In the large peaty lakes of north Germany a beautiful variety is not uncommon, in which the golden tinge prevails, as in a goldfish.



The Perch, *Perca fluviatilis*.

The perch is strictly carnivorous and most voracious; it wanders about in small shoals within a certain district, playing sad havoc among small fishes, and is therefore not to be tolerated in waters where valuable fry is cultivated. Perch of three pounds in weight are not infrequently caught in suitable localities; one of five would now be regarded as an extraordinarily large specimen, although in older works we read of individuals exceeding even that weight.

Perch are good, wholesome food, and highly esteemed in inland countries where marine fish can be obtained only with difficulty. The nearly allied pike-perch is one of the best European food-fishes. The perch is exceedingly prolific; it begins to spawn when three years old, in April or in the first half of May, depositing the ova, which are united by a viscid matter in lengthened or net-shaped bands, on water plants.

PERCH (through Fr. *perche* from Lat. *pertica*, a pole or rod used for measurement), a bar or rod used for various purposes, as *e.g.* for a navigation mark in shallow waters, for a support on which a bird may rest, or for a pole which joins the back with the fore part of a wagon or other four-wheeled vehicle. As a term of linear measurement, "perch," also "rod" or "pole," = 16½ ft., 5½ yds.; of superficial area, = 30¼ sq. yds.; 160 perches = 1 acre. As a stonemason's measure, a "perch" = 1 linear perch in length by 1½ ft. in breadth and 1 ft. in thickness.

PERCHE, a region of northern France extending over the departments of Orne, Eure, Eure-et-Loir and Sarthe. Its boundaries are Normandy on the N. and W., Maine on the S.W., Vendômois and Dunois on the S., Beauce on the E. and Thimerais on the N.E. The greater part of the district is occupied by a semicircle of heights (from 650 to 1000 ft. in height) stretching from Moulins-la-Marche on the north-west to Montmirail on the south; within the basin formed thereby the shape of which is defined by the Huisne, an affluent of the Sarthe, lie the chief towns—Mortagne, Nogent-le-Rotrou and Bellême. Stock-raising and dairy-farming are flourishing in the Perche, which is famous for the production of a breed of large and powerful horses. Cider-apples and pears are grown throughout the district. In the middle ages the Perche constituted a countship of which Corbon, Mortagne and Nogent-le-Rotrou were successively the capitals. Under the *ancien régime* it formed, together with Maine, a *gouvernement* of which Mortagne was the capital.

PERCIVAL, JAMES GATES (1795–1856), American poet, philologist and geologist, was born in Kensington parish, Berlin, Connecticut, on the 15th of September 1795. He graduated at Yale in 1815, and in 1820 took the degree of M.D., and started practice in Berlin. He contributed verse to the *Microscope*, a semi-weekly paper, founded at New Haven in 1820. In this first appeared his best-known poem, "The Suicide," which reflects his chronic melancholy, due doubtless to ill-health; it was begun in 1816 and finished in 1820, after he had actually made two attempts on his own life. In 1823 Percival became an editor of the *Connecticut Herald* at New Haven; and in 1824 he was in turn an assistant-surgeon and lecturer on chemistry at West Point, and an inspector of recruits at the Charlestown (Mass.) Navy Yard. He prepared (1826–1831) an English edition of Malte-Brun's *Geography* (published 1834); and in 1827–1829 read the manuscripts and proof-sheets of *Webster's Dictionary*, giving special attention to scientific words. In 1835–1840, with Professor Charles U. Shepard (1804–1886), he made a geological survey of Connecticut; his *Report* (1842) showed great learning and much patient research. In 1854 he became state geologist of Wisconsin, and in 1855 published one volume of his *Report*; the second he had nearly completed at the time of his death, on the 22nd of May 1856, at Hazel Green, Wisconsin.

See his *Poetical Works* (2 vols., Boston, 1859), with a biographical sketch by L. W. Fitch; and Julius H. Ward, *Life and Letters of James Gates Percival* (Boston, 1866).

PERCY (Family). This family, whose deeds are so prominent in English history, was founded by William de Perci (*c.* 1030–1096), a follower of the Conqueror, who bestowed on him a great fief in Yorkshire and Lincolnshire. The register of Whitby Abbey, which he founded anew, and in later days the heralds, were responsible for the fabulous origin and pedigree of the family which are still current. By Emma, daughter of Hugh de Port, a great Hampshire baron, William was father of several sons, of whom Alan the eldest succeeded him. His grandson William was the last of the house in the direct line, and left two sisters and coheiresses, Maud countess of Warwick, who died childless, and Agnes. Agnes de Perci had married Josceline, styled "brother of the queen" (*i.e.* Adeliza of Louvain, second wife of Henry I.), whose legitimacy has been questioned, and from this marriage descended the second house of Percy (which name it assumed), till its own extinction in the male line five centuries later (1670). By it was brought into the family the great Petworth estate in Sussex, which Josceline had obtained from his sister, who was holding Arundel and its fief. His son Richard (*c.* 1170–1244) and Richard's nephew William (*c.* 1183–1245) were among the barons who rose in arms against John, but the latter made his peace with Henry III., and had his lands restored to him. Richard de Percy was one of the twenty-five barons appointed to enforce the observance of Magna Carta.

The next important member of the family is William's grandson Henry de Percy (*c.* 1272–1315), whom Edward I., after the deposition of John Baliol, appointed governor of Galloway, and who was one of his most active agents in the subjugation of Scotland till the success of Robert Bruce drove him out of Turnberry Castle, and made him withdraw into England. He was rewarded by Edward II. with the barren title of earl of Carrick, declared to be forfeited by the Scottish hero; and the same king appointed him governor of the castles of Bamburgh and Scarborough. But in 1309 he himself made his position strong in the north of England by purchasing lands from Anthony Bek, bishop of Durham, among which was the honour of Alnwick, the principal seat of the family ever since. The Percies had chiefly resided till then at Spofforth in Yorkshire, and their connexion with Northumberland dates from this acquisition. Henry's son, another Henry (*c.* 1299–1352), took part in the league against Edward II.'s favourites the Despensers, was in favour with Edward III., and obtained from Edward Baliol as king of Scotland grants of Lochmaben, Annandale and Moffatdale, which he surrendered to the English king for the castle and constableship of Jedburgh, or Jedworth, with the forest of Jedworth and some neighbouring towns. A few years later, in fuller recompense of the unprofitable gift of Baliol, a grant of 500 marks a year was made to him out of the old customs at Berwick;

and in 1346 he did splendid service to his sovereign by defeating and taking prisoner David II., king of Scotland, at the battle of Neville's Cross.

To him succeeded another Henry Percy (1322–1368), a feudal baron like his predecessors, who fought at Crécy during his father's lifetime and whose brother Thomas Percy (1333–1369) was bishop of Norwich from 1356–1369. The next head of the Percys was Henry's son, another Henry, who was made earl of Northumberland at the coronation of Richard II., and whose younger brother Thomas (d. 1403) was created earl of Worcester in 1397. The 1st earl of Northumberland, father of the famous Hotspur, Sir Henry Percy (*q.v.*), was killed at Bramham Moor in 1408, while in arms against the king, and his title and estates were forfeited. But, by an act no less gracious than politic, Henry V. restored them in 1414 to this earl's grandson, Henry (1394–1455), then a prisoner with the Scots, whose liberation he had no difficulty in procuring from the duke of Albany during the time of James I.'s captivity. From that day the loyalty of the family to the house of Lancaster was steadfast and undeviating. The 2nd earl died fighting for Henry VI. at the first battle of St Albans in 1455; the 3rd, Henry (1421–1461), was slain on the bloody field of Towton; the 4th, Henry (1446–1489), was killed in quelling an insurrection in the time of Henry VII. So strong was the Lancastrian feeling of the family that even Sir Ralph Percy (1425–1464), a brother of the earl who fell at Towton, though he had actually submitted once to Edward IV., turned again, and when he fell at Hedgley Moor in April 1464 consoled himself with the thought that he had, as he phrased it, "saved the bird in his bosom."

No wonder, then, that in Edward IV.'s days the title and estates of the family were for a time taken away and given to John Neville Lord Montagu, brother of Warwick the king-maker. But the north of England was so accustomed to the rule of the Percys that in a few years Edward saw the necessity of restoring them, and did so even at the cost of alienating still further the powerful family of the Nevilles, who were then already on the point of rebellion.

A crisis occurred in the fortunes of the family in the reign of Henry VIII. on the death of Henry, the 6th earl (*c.* 1502–1537), whose brothers Sir Thomas and Sir Ingelram Percy, much against his will, had taken part in the great insurrection called the Pilgrimage of Grace. A thriftless man, of whom it is recorded that in his youth he was smitten with the charms of Anne Boleyn, but was forced to give her up and marry a woman he did not love, he died childless, after selling many of the family estates and granting the others to the king. The title was forfeited on his death, and was granted by Edward VI. to the ambitious John Dudley, earl of Warwick, who was attainted in the succeeding reign. It was restored in the days of Queen Mary to Thomas Percy (1528–1572), a nephew of the 6th earl, who, being a stanch Roman Catholic, was one of the three earls who took the lead in the celebrated rising of 1572, and was beheaded at York. His brother Henry (*c.* 1532–1585), who succeeded him, was no less unhappy. Involved in Throgmorton's conspiracy, he was committed to the Tower of London, and was supposed to have shot himself in bed with a pistol found beside him; but there were grave suspicions that it had been discharged by another hand. His son, Henry (1567–1632), the next earl, suffered like his two predecessors for his attachment to the religion of his forefathers. The Crown lawyers sought in vain to implicate him in the Gunpowder Plot, but he was imprisoned for fifteen years in the Tower and compelled to pay a fine of £30,000. Algernon (1602–1668), the son who next succeeded, was a parliamentary general in the Civil War. At length, in 1670, the male line of this illustrious family became extinct, at least in the direct line, about five hundred years after the marriage of Agnes de Perci with Josceline of Louvain.

The representation of the earlier Percys had passed away through the daughters of Earl Thomas, beheaded in 1572, but his earldom of Northumberland (created anew for him in 1557) had passed to his brother Henry, under a special remainder, and appears to have become extinct in 1670, though persistently claimed by James Percy, "the trunk-maker." The last earl's daughter Elizabeth, a great heiress, was mother by Charles Seymour, 6th duke of Somerset, of Algernon, 7th duke, who was summoned (in error) as Lord Percy in 1722 and created earl of Northumberland in 1749. On the duke's death in 1750 his earldom of Northumberland passed under a special remainder, with the main inheritance of the Percys, to Sir Hugh Smithson, bart. (1715–1786); who had married his daughter and eventual heiress in 1740, and was created duke of Northumberland and Earl Percy in 1766. From this marriage descends the present ducal house, which bears the name of Percy in lieu of Smithson, and owns vast estates in Northumberland.

Alnwick Castle, their chief seat, where much state is still kept up, has been described by Mr Clark as "probably the finest extant example of a Norman castle of this type, having an open keep and a complete enceinte." It had been hardly occupied and in decay for some two centuries when the present family succeeded to it, but was restored by them to its former splendour between 1750 and 1786. "Princely Petworth," however, the seat of the later Percys, with their ancient Sussex estates and those in Yorkshire (Leconfield) and Cumberland (Cockermouth), all passed away in 1750 with the earldom of Egremont and barony of Cockermouth to Charles Wyndham, nephew of the 7th duke of Somerset, and these estates are now held by Lord Leconfield. The actual representation in blood of the later Percys (*i.e.* from 1572) passed in 1865, on the death of the 4th duke, to the dukes of Atholl, who in virtue of it are Lords Percy, under the writ of 1722, the oldest of the family titles now remaining. The ancient London residence of the Percys, Northumberland House, Charing Cross, was removed to make way for Northumberland Avenue. Above it stood the Percy crest, a (blue) lion with stiffly extended tail; but the famous badge of the house was the white crescent or half moon—"the Half-Moone shining all soe faire" of "the Northern Rising" ballad—with a pair of manacles. Their coat of arms was a blue lion rampart on a yellow ground—"Jaune o un bleu lyon rampart" of the Carlaverock roll, stated, but wrongly, to have been derived from the dukes of Louvain and Brabant. With it they quartered the "Luces" coat of the Lucys of Cockermouth after succeeding to their estates, whence the lines in *The Battle of Otterbourne*:—

"The Lucetts and the Cressaunts both,
The Skotts fought them agayne."

See E. B. De Fonblanque, *Annals of the House of Percy* (1887), and G. Brenan, *History of the House of Percy* (edited by W. A. Lindsay, 1902), both somewhat adulatory and needing critical revision; Tate, *History of Alnwick* (1866); Hartshorne's paper on the Percys and their Castles in the Newcastle volume of the *Archaeological Institute* (1852); E. A. Freeman, "The Percy Castles" (1875) in *English Towns and Districts*; G. T. Clark, *Medieval Military Architecture* (1884); G. E. C(okayne), *Complete Peerage* (1895), vol. vi.; Bishop Percy, *Northumberland Household Book*. See also the article *Northumberland, Earls and Dukes of*. (J. Ga.; J. H. R.)

PERCY, SIR HENRY, called Hotspur (1364–1403), eldest son of Henry, 1st earl of Northumberland, was born on the 20th of March 1364. He saw active service when he was fourteen at the siege of Berwick. Six years later he was associated with his father in the wardenship of the eastern march of Scotland, and his zeal in border warfare won the name of Hotspur for him from his opponents. In 1386 he was sent to Calais, and raided French territory, but was shortly afterwards recalled to defend England against a naval attack by France. In popular story and ballad he is known as one of the heroes of Otterburn or Chevy Chase, which is the subject of one of the most stirring recitals of Froissart. In the summer of 1388 the Scots invaded England by way of Carlisle, sending a small body under the earls of Douglas, Mar and Moray to invade Northumberland. The earl of Northumberland remained at Alnwick, but sent his sons Sir Henry and Sir Ralph against the enemy. In hand-to-hand fighting before the walls of Newcastle, Douglas is said to have won Sir Henry's pennon, which he swore to fix upon the walls of Dalkeith. The Scots then retreated to Otterburn, where Percy, who was bent on recovering his pennon, attacked them on a fine August evening in 1388. Douglas was slain in the battle, though not, as is stated by Walsingham, by Percy's hand: Henry Percy was captured by Sir John Montgomery, and his brother Ralph by Sir John Maxwell. Hotspur was released on the payment of a heavy ransom, to which Richard II. contributed £3000, and in the autumn his term as warden of Carlisle and the West March was extended to five years. In 1399 together with his father he joined Henry of Lancaster. Henry IV. gave the charge of the West March to Northumberland, while Henry Percy received the castles of Bamburgh, Roxburgh and Berwick, and the wardenship of the East March, with a salary of £3000 in peace time and £12,000 in war. During the first year of Henry's reign Hotspur further was appointed justiciar of North Wales and constable of the castles of Chester, Flint, Conway, Denbigh and Carnarvon. Henry also gave him a grant of the island of Anglesey, with the castle of Beaumaris. William and Rees ap Tudor captured Conway Castle on the 1st of April 1401, and Percy in company with the prince of Wales set out to recover the place, Percy providing the funds. In May he reported to the king the pacification of Merioneth and Carnarvon, and before the end of the month Conway was surrendered to him. Meanwhile he wrote demanding arrears of pay, with the threat of resignation if the money were not forthcoming, but the king intimated that the loss of Conway had been due to his negligence, and only sent part of the money. He had the same difficulty in obtaining money for his northern charge that he had experienced in Wales.[1] Anglesey was taken from him, and he was deprived of Roxburgh Castle in favour of his rival, the earl of Westmorland. The Scots again invaded England in the autumn of 1402, headed by the earl of Douglas and Murdoch Stewart, son of the duke of Albany. Northumberland and Hotspur barred their way at Millfield, near Wooler, and the Scots were compelled to fight at Humbledon, or Homildon Hill, on the 14th of September. The English archers were provided with a good target in the masses of the Scottish spearmen, and Hotspur was restrained from charging by his ally, George Dunbar, earl of March. The Scottish army was almost destroyed, while the English loss is said to have been five men. Disputes with the king arose over the disposal of the Scottish prisoners, Percy insisting on his right to hold Douglas as his personal prisoner, and he was summoned to court to explain. It is related that when he arrived Henry asked for Douglas, and Hotspur demanded in return that his brother-in-law, Edmund Mortimer, should be allowed to ransom himself from Owen Glendower, with whom he was a prisoner. High words followed, in the course of which Henry called Percy a traitor, struck him on the face, and drew his sword on him Percy is said to have answered this defiance with the words, "Not here, but on the field." This was late in 1402, and in 1403 Hotspur issued a proclamation in Cheshire stating that Richard II. was alive, and summoning the inhabitants to his standard. He made common cause with his prisoner Douglas, and marched south to join forces with Glendower, who was now reconciled with Mortimer. He was reinforced by his uncle Thomas, earl of Worcester, who, although steward to the household of the prince of Wales, joined his family in rebellion. The mythical Richard II. was heard of no more, and Percy made himself the champion of the young earl of March. When he arrived at the Castle Foregate, Shrewsbury, early on the 21st of July, and demanded provisions, he found the king's forces had arrived before him. He retired in the direction of Whitchurch, and awaited the enemy about 3½ m. from Shrewsbury. After a long parley, in which a truce of two days was even said to have been agreed on, the Scottish earl of March, fighting on the royal side, forced on the battle in the afternoon, the royal right being commanded by the prince of Wales. Hotspur was killed, the earls of Douglas and Worcester, Sir Richard Venables of Kinderton, and Sir Richard Vernon were captured, and the rebel army dispersed. Worcester, Venables and Vernon were executed the next day. Percy's body was buried at Whitchurch, but was disinterred two days later to be exhibited in Shrewsbury. The head was cut off, and fixed on one of the gates of York.

See NORTHUMBERLAND, EARLS AND DUKES OF; and PERCY: (*Family*). Also *Chronique de la traïson et mort de Richard II.*, ed. B. Williams (Eng. Hist. Soc., 1846); J. Creton, *Histoire du roy Richard II.*, ed. John Webb, in *Archaeologia* (xx., 1824); and Adam of Usk's *Chronicon*, 1377–1404, ed. E. M. Thompson (1876); the authorities are cited in detail in J. H. Wylie's *England under Henry IV.* (1884–1898), and Sir J. H. Ramsay's *Lancaster and York* (Oxford, 1892). Holinshed's *Chronicle* was the chief source of Shakespeare's account of Hotspur in *Henry IV.*

PERCY, THOMAS (*c.* 1560–1605), one of the Gunpowder Plot conspirators, was a son of Edward Percy of Beverley, who was grandson of Henry Percy, 4th earl of Northumberland. Though brought up a Protestant, he early became well-affected to the Roman Catholics and finally an adherent. He entered the service of his cousin, Henry Percy, 9th earl of Northumberland, and was appointed by him constable of Alnwick Castle and agent for his northern estates, in which capacity he showed himself tyrannical and extortionate. In 1602 he was sent by Northumberland to James in Scotland to secure toleration for the Roman Catholics and returned announcing favourable promises from the king, the extent of which he probably greatly exaggerated; and when James, after his succession to the English throne, did not immediately abrogate the penal laws, Percy, although he had accepted the court appointment of gentleman pensioner, professed himself highly indignant and indulged himself in thoughts of revenge. Some time in May 1603 Percy angrily declared his intention to Catesby of killing the king, and in April 1604 he met Catesby with John Wright, Thomas Winter and Guy Fawkes, and was then initiated into Catesby's gunpowder plot, which met with his zealous approval and support. To Percy was allotted the special duty after the explosion of seizing the infant prince Charles and riding off with him on his saddle to Warwickshire. All the preparations being complete, Percy went to Alnwick in October and collected £3000 of the earl of Northumberland's rents which he intended using in furtherance of the plot, returning to London on the 1st of November. Meanwhile the plot had been revealed through the letter to Lord Monteagle on the 26th of October, and it was Percy's insistence at the last meeting of the conspirators on the 3rd that decided them not to fly but to hazard the attempt. On the news of Guy Fawkes's arrest, Percy with the rest of the conspirators, except Tresham, fled on horseback, taking refuge ultimately at Holbeche, near Stourbridge, in Staffordshire, where on the 8th of November, during the attack of the sheriff's men upon the house, he was struck down by a bullet, fighting back to back with Catesby, and died two days later. Percy married a sister of the conspirator John Wright and left a son Robert and two daughters, one of whom is said to have married Robert, the son of Catesby.

PERCY, THOMAS (1729–1811), bishop of Dromore, editor of the *Percy Reliques*, was born at Bridgnorth on the 13th of April 1729. His father, Arthur Lowe Percy, a grocer, was of sufficient means to send his son to Christ Church, Oxford, in 1746. He graduated in 1750 and proceeded M.A. in 1753. In the latter year he was appointed to the vicarage of Easton Maudit, Northamptonshire, and three years later was instituted to the rectory of Wilby in the same county, benefices which he retained until 1782. In 1759 he married Anne, daughter of Barton Gutteridge. At Easton Maudit most of the literary work for which he is now remembered—including the *Reliques*—was completed. When his name became famous he was made domestic chaplain to the duke and duchess of Northumberland, and was tempted into the belief that he belonged to the illustrious house of Percy. Through his patron's influence he became dean of Carlisle in 1778 and bishop of Dromore in Ireland in 1782. His wife died before him in 1806; the good bishop, blind but otherwise in sound health, lived until the 30th of September 1811. Both were buried in the transept which Percy added to Dromore Cathedral.

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[1] The dissatisfaction of the Percys seems to have been chiefly due to the money question. Sir J. H. Ramsay (*Lancaster and York*) estimates that in the four years from 1399 to 1403 they had received from the king the sum of £41,750, which represented a very large capital in the 14th century, and they had also received considerable grants of land. King Henry IV. was about to march north himself to look into the real relations between the Percys and the Scots, when on the 6th of July 1403 Henry Percy was in open rebellion.

Dr Percy's first work was a translation from a Portuguese manuscript of a Chinese story, published in 1761. Two years later he published *Five Pieces of Runic Poetry, translated from the Islandic.* In 1763 he edited the earl of Surrey's poems with an essay on early blank verse, translated the Song of Solomon, and published a key to the New Testament. His *Northern Antiquities* (1770) is a translation from the French of Paul Henri Mallet. His reprint of *The Household Book of the Earl of Northumberland in 1512* is of the greatest value for the illustrations of domestic life in England at that period. But these works are of little estimation when compared with the *Reliques of Ancient English Poetry* (1765). This was based on an old manuscript collection of poetry, rescued by Percy in Humphrey Pitt's house at Shifnal, Shropshire, from the hands of the housemaid who was about to light the fire with it. The manuscript was edited in its complete form by J. W. Hales and F. J. Furnivall in 1867–1868.

See A. C. C. Gaussen, *Percy: Prelate and Poet* (1908). The *Reliques* has been edited by various hands, notably by H. B. Wheatley (1876). The fourth edition was by Percy's nephew, Thomas Percy (1768–1808), himself a writer of verse.

PERDICCAS, the name of three kings of Macedonia, who reigned respectively *c.* 700 B.C., *c.* 454–413 B.C., and 364–359 B.C., and of one of Alexander the Great's generals, son of Orontes, a descendant of the independent princes of the province of Orestis. The last named distinguished himself at the conquest of Thebes (335 B.C.), and held an important command in the Indian campaigns of Alexander. In the settlement made after Alexander's death (323) it was finally agreed that Philip Arrhidaeus, an insane son of the great Philip, and Roxana's unborn child (if a son) should be recognized as joint kings, Perdiccas being appointed, according to one account, guardian and regent, according to another, chiliarch under Craterus. He soon showed himself intolerant of any rivals, and acting in the name of the two kings (for Roxana gave birth to a son, Alexander IV.) sought to hold the empire together under his own hand. His most loyal supporter was Eumenes, governor of Cappadocia and Paphlagonia. These provinces had not yet been conquered by the Macedonians, and Antigonus (governor of Phrygia, Lycia and Pamphylia) refused to undertake the task at the command of Perdiccas. Having been summoned to the royal presence to stand his trial for disobedience, Antigonus fled to Europe and entered into alliance with Antipater, Craterus and Ptolemy, the son of Lagus. Perdiccas, leaving the war in Asia Minor to Eumenes, marched to attack Ptolemy in Egypt. He reached Pelusium, but failed to cross the Nile. A mutiny broke out amongst the troops, disheartened by failure and exasperated by his severity, and Perdiccas was assassinated by some of his officers (321). (E. R. B.)

See Macedonian Empire.

PEREDA, JOSÉ MARÍA DE (1833–1906), one of the most distinguished of modern Spanish novelists, was born at Polanco near Santander on the 6th of February 1833. He was educated at the Instituto Cántabro of Santander, whence he went in 1852 to Madrid, where he studied with the vague purpose of entering the artillery corps. Abandoning this design after three years' trial, he returned home and began his literary career by contributing articles to a local journal, *La Abeja montañesa* in 1858. He also wrote much in a weekly paper, *El Tío Cayetán*, and in 1864 he collected his powerful realistic sketches of local life and manners under the title of *Escenas montañesas.* Pereda fought against the revolution of 1868 in *El Tío Cayetán*, writing the newspaper almost single-handed. In 1871 he was elected as the Carlist deputy for Cabuérniga. In this same year he published a second series of *Escenas montañesas* under the title of *Tipos y paisajes*; and in 1876 appeared *Bocetos al temple*, three tales, in one of which the author describes his disenchanting political experiences. The *Tipos trashumantes* belongs to the year 1877, as does *El Buey suelto*, which was intended as a reply to the thesis of Balzac's work, *Les Petites misères de la vie conjugale.* More and more pessimistic as to the political future of his country, Pereda took occasion in *Don Gonzalo González de la Gonzalera* (1879) to ridicule the Revolution as he had seen it at work, and to pour scorn upon the *nouveaux riches* who exploited Liberalism for their personal ends. Two novels by his friend Pérez Galdós, *Doña Perfecta* and *Gloria*, drew from Pereda a reply, *De Tal palo tal astilla* (1880), in which he endeavours to show that tolerance in religious matters is disastrous alike to nations and to individuals. The *Esbozos y rasguños* (1881) is of lighter material, and is less attractive than *El Sabor de la Tierruca* (1882), a striking piece of landscape which won immediate appreciation. New ground was broken in *Pedro Sánchez* (1883), where Pereda leaves his native province to portray the disillusion of a sincere enthusiast who has plunged into the political life of the capital. Pereda's masterpiece is *Sotileza* (1884), a vigorous rendering of marine life by an artist who perceives and admires the daily heroisms of his fisher-folk. It has often been alleged against the author that he confines himself to provincial life, to lowly personages and to unrefined subjects, and no doubt an anxiety to clear himself from this absurd reproach led him to attempt a description of society at the capital in *La Montálvez* (1888), which is certainly the least interesting of his performances. In *La Puchera* (1889) he returned to the marine subjects which he knew and loved best. Again, in *Peñas arriba* (1895), the love of country life is manifested in the masterly contrast between the healthy, moral labour of the fields and the corrupt, squalid life of cities. Pereda's fame was now established; the statutes of the Spanish Academy, which require members to reside at Madrid, were suspended in his favour (1896). But his literary career was over. The tragic death of his eldest son, the disastrous campaign in Cuba and the Philippines, darkened his closing years, and his health failed long before his death at Polanco on the 1st of March 1906.

Pereda belongs to the native realistic school of Spain, which, founded by the unknown author of *Lazarillo de Tormes*, was continued by Meteo Alemán, Cervantes, Quevedo, Castillo Solórzano and many others. With the single exception of Cervantes, however, the picaresque writers are almost entirely wanting in the spirit of generous sympathy and tenderness which constitutes a great part of Pereda's charm. His realism is purely Spanish, as remote from Zola's moroseness as from the graceful sentimentality of Pierre Loti. Few 19th-century writers possessed the virile temperament of Pereda, and, with the single exception of Tolstoy, none kept a moral end more steadily in view. This didactic tendency unquestionably injures his effects. Moreover, his grim satire occasionally degenerates into somewhat truculent caricature, and the excessive use of dialect and technical terms (which caused him to supply *Sotileza* with a brief vocabulary) is a grave artistic blemish. But he saw, knew, understood character; he created not only types, but living personages, such as Andrés, Cleto and Muergo in *Sotileza*, Pedro Juan and Pilara in *La Puchera*; and he personified the tumult and calm of the sea with more power than Victor Hugo displayed in *Les Travailleurs de la mer.* His descriptive powers were of the highest order, and his style, pure of all affectations and embellishments, is of singular force and suppleness. With all his limitations, he was as original a genius as Spain produced during the 19th century. (J. F.-K.)

PÈRE DAVID'S DEER, the *mi-lou* of the Chinese, an aberrant and strangely mule-like deer (*q.v.*), the first evidence of whose existence was made known in Europe by the Abbé (then Père) David, who in 1865 obtained the skin of a specimen from the herd kept at that time in the imperial park at Pekin. This skin, with the skull and antlers, was sent to Paris, where it was described in 1866 by Professor Milne-Edwards. In lacking a brow-tine, and dividing in a regular fork-like manner some distance above the burr, the large and cylindrical antlers of this species conform to the general structural type characteristic of the American deer. The front prong of the main fork, however, curves somewhat forward and again divides at least once; while the hind prong is of great length undivided, and directed backwards in a manner found in no other deer. As regards general form, the most distinctive feature is the great relative length of the tail, which reaches the hocks, and is donkey-like rather than deer-like in form. The head is long and narrow, with a prominent ridge for the support of the antlers, moderate-sized ears, and a narrow and pointed muzzle. A gland and tuft are present on the skin of the outer side of the upper part of the hind cannon-bone; but, unlike American deer, there is no gland on the inner side of the hock. Another feature by which this species differs from the American deer is the conformation of the bones of the lower part of the fore-leg, which have the same structure as in the red deer group. The coat is of moderate length, but the hair on the neck and throat of the old stags is elongated to form a mane and fringe. Although new-born fawns are spotted, the adults are in the main uniformly coloured; the general tint of the coat at all seasons being reddish tawny with a more or less marked tendency to grey. It has been noticed at Woburn Abbey that the antlers are shed and replaced twice a year.

The true home of this deer has never been ascertained, and probably never will be; all the few known specimens now living being kept in confinement—the great majority in the duke of Bedford's park at Woburn, Bedfordshire. (R. L.*)

PEREGRINUS PROTEUS (2nd cent. A.D.), Cynic philosopher, of Parium in Mysia. At an early age he was suspected of parricide, and was obliged to leave his native place. During his wanderings he reached Palestine, where he ingratiated himself with the Christian community, and became its virtual head. His fanatical zeal and craving for notoriety led to his imprisonment, but the governor of Syria let him go free, to prevent his posing as a martyr. He then returned to Parium to claim his paternal inheritance, but finding that the circumstances of his father's death were not yet forgotten, he publicly surrendered all claims to the property in favour of the municipality. He resumed his wandering life, at first assisted by the Christians, but having been detected profaning the rites of the Church, he was excommunicated. During a visit to Egypt he made the acquaintance of the famous Cynic Agathobulus and joined the sect. Meeting with little encouragement, he made his way to Rome, whence he was expelled for insulting the emperor Antoninus Pius. Crossing to Greece, he finally took up his abode at Athens. Here he devoted himself to the study and teaching of philosophy, and obtained a considerable number of pupils, amongst them Aulus Gellius, who speaks of him in very favourable terms. But, having given offence by his attacks on Herodes Atticus and finding his popularity diminishing, he determined to create a sensation. He announced his intention of immolating himself on a funeral pyre at the celebration of the Olympian games in 165, and actually carried it out. Lucian, who was present, has given a full description of the event.

C. M. Wieland's *Geheime Geschichte des Philosophen Peregrinus Proteus* (Eng. trans., 1796) is an attempt to rehabilitate his character. See also Lucian, *De morte Peregrini*; Aulus Gellius xii. 11; Ammianus Marcellinus xxix.; Philostratus, *Vit. Soph.* ii. 1, 33; J. Bernays, *Lucian und die Kyniker* (1875); E. Zeller, "Alexander und Peregrinus," in his *Vorträge und Abhandlungen*, ii. (1877).

PEREIRE [PEREIRA], **GIACOBBO RODRIGUEZ** (1715–1780), one of the inventors of deaf-mute language, a member of a Spanish-Jewish family, was born at Estremadura, Spain, on the 11th of April 1715. At the age of eighteen he entered a business at Bordeaux. Here he fell in love with a young girl who had been dumb from birth, and henceforth devoted himself to discover a method of imparting speech to deaf-mutes. His first subject was Aaron Baumann, a co-religionist, whom he taught to enunciate the letters of the alphabet, and to articulate certain ordinary phrases. He next devised a sign alphabet for the use of one hand only, and in 1749 he brought his second pupil before the Paris Academy of Sciences, the members of which were astonished at the results he had accomplished. In 1759 Pereire was made a member of the Royal Society of London. He died at Paris on the 15th of September 1780.

PEREKOP, a town of Russia, in the government of Taurida, 60 m. S.E. of Kherson, on the isthmus which connects the Crimea with the Continent, and commanding the once defensive ditch and dike which cross from the Black Sea to the Sivash (putrid) lagoon. Pop. about 5000. It was formerly an important place, with a great transit trade in salt, obtained from salt lakes in the immediate neighbourhood. Since the opening of the railway route from Kharkov to Simferopol in the Crimea Perekop has greatly declined. In ancient times the isthmus was crossed (about $1\frac{1}{2}$ m. south of the present town) by a ditch which gave the name of Taphros to a Greek settlement. This line of defence having fallen into decay, a fort was erected and a new ditch and dike constructed in the 15th century by the Tatar khan of the Crimea, Mengli Ghirai, and by his son and successor Sahib Ghirai. The fort, known as Kapu or Or-Kapu, became the nucleus of the town. In the middle ages Perekop was known as Tuzla. In 1736 it was captured by the Russians under Münnich, and again in 1738 under Lascy (Lacy), who blew up the fort and destroyed a great part of the dike. In 1754 the fort was rebuilt by Krim Ghirei; but the Greek and Armenian inhabitants of Perekop formed a new settlement at Armyanskiy Bazar (Armenian Market), 3 m. farther south. Captured by the Russians in 1771, the town passed into Russian possession with the rest of the Crimea in 1783.

PEREMPTORY, an adjective adapted from the Roman law term *peremptorium edictum*, *peremptoria exceptio*, a decree or plea which put an end to or quashed (Lat. *perimere*, to destroy) an action, hence decisive, final. A similar use is found in English law in "peremptory challenge," a challenge to a jury allowed to a prisoner without cause shown, or "peremptory mandamus," an absolute command. The natural repugnance to a final order has given this word in its ordinary usage a sense of objectionable and intolerant emphasis.

PEREYASLAVL, a town of Russia, in the government of Poltava, 26 m. S.E. of the city of Kiev, at the confluence of the Trubezh and the Alta, which reach the Dnieper 5 m. lower down at the town's port, the village of Andrushi. Pop. 14,609. Besides the town proper there are three considerable suburbs. Though founded in 993 by Vladimir the Great of Moscow in memory of his signal success over the Turkish Pechenegs, Pereyaslavl has now few remains of antiquity. The town has a trade in grain, salt, cattle and horses, and some manufactures—tallow, wax, tobacco, candles and shoes.

From 1054 Pereyaslavl was the chief town of a separate principality. As a southern outpost it often figures in the 11th, 12th and 13th centuries, and was plundered by the Mongols in 1239. In later times it was one of the centres of the Cossack movement; and in 1628 the neighbourhood of the town was the scene of the extermination of the Polish forces known as "Tara's Night." It was by the Treaty of Pereyaslavl that in 1654 the Cossack chieftain Bogdan Chmielnicki acknowledged the supremacy of Tsar Alexis of Russia.

PEREYASLAVL (called *Zalyeskiy*, or "Beyond the Forest," to distinguish it from the older town in Poltava after which it was named), one of the oldest and most interesting cities in middle Russia, situated in the government of Vladimir, 45 m. N.E. of Moscow on the road to Yaroslavl, and on both banks of the Trubezh near its entrance into Lake Pleshchéevo. Pop. 8662. Pereyaslavl was formerly remarkable for the number and importance of its ecclesiastical foundations. Among those still standing are the 12th-century cathedral, with ancient wall-paintings and the graves of Demetrius, son of Alexander Nevsky, and other princes, and a church founded by Eudoxia (Euphrosyne), wife of Demetrius Donskoi, in the close of the 14th century. It is by its extensive cotton manufactures that Pereyaslavl is now best known. The fisheries in the lake (20 m. sq. in extent and 175 ft. deep) have long been of great value.

Founded in 1152 by Yuryi Dolgoruki, prince of Suzdal, Pereyaslavl soon began to play a considerable part in the history of the country. From 1195 till 1302 it had princes of its own; and the princes of Moscow, to whom it was at the latter date bequeathed, kept it (apart from some temporary alienations in the 14th century) as part of their patrimony throughout the 15th and 16th centuries. Lake Pleshchéevo was the scene of Peter the Great's first attempts (1691) at creating a fleet.

PEREZ, ANTONIO (*c.* 1540–1611), for some years the favourite minister of Philip II. of Spain and afterwards for many more the object of his unrelenting hostility, was by birth an Aragonese. His reputed father, Gonzalo Perez, an ecclesiastic, has some place in history as having been secretary both to Charles V. and to Philip II., and in literature as author of a Spanish translation of the *Odyssey* (*La Ulyxea de Homero*, Antwerp, 1556). Antonio Perez, who was legitimated by an imperial diploma issued at Valladolid in 1542, was, however, believed by many to be in reality the son of Philip's minister, Ruy Gomez de Silva, prince of Eboli, to whom, on the completion of a liberal education at home and abroad, he appears at least to have owed his first introduction to a diplomatic career.[1] In 1567 he became one of the secretaries of state, receiving also about the same time the lucrative appointment of protonotary of Sicily, and in 1573 the death of Ruy Gomez himself made room for Perez's promotion to be head of the "despacho universal," or private bureau, from which Philip attempted to govern by assiduous correspondence the affairs of his vast dominions. Another of the king's secretaries at this time, though in a less confidential relation, was a friend and contemporary of Perez, named Juan de Escovedo, who, however, after the fall of Tunis in 1574, was sent off to supersede Juan de Soto as secretary and adviser of Don John of Austria, thus leaving Perez without a rival. Some time after Don John's appointment to the governorship of the Netherlands Perez accidentally became cognisant of his inconveniently ambitious "empresa de Inglaterra," in which he was to rescue Mary Queen of Scots, marry her, and so ascend the throne of England. The next step might even be against Spain itself. This secret scheme the faithful secretary at once carried to Philip, who characteristically resolved to meet it by quietly removing his brother's aider and abettor. With the king's full cognisance, accordingly, Perez, after several unsuccessful attempts to poison Escovedo, succeeded in procuring his assassination in a street of Madrid on the 31st of March 1578. The immediate effect was to raise Perez higher than ever in the royal confidence and favour, but, wary though the secretary had been, he had not succeeded in obliterating all trace of his connexion with the crime, and very soon a prosecution was set on foot by the representatives of the murdered man. For a time Philip was both willing and able to protect his accomplice, but ultimately he appears to have listened to those who, whether truly or falsely, were continually suggesting that Perez had had motives of his own, arising out of his relations with the princess of Eboli, for compassing the assassination of Don John's secretary; be this as it may, from trying to screen Perez the king came to be the secret instigator of those who sought his ruin. The process, as such matters often have been in Spain, was a slow one, and it was not until 1589 that Perez, after more than one arrest and imprisonment on a variety of charges, seemed on the eve of being convicted and condemned as the murderer of Escovedo. At this juncture he succeeded in making his escape from prison in Castile into Aragon, where, under the ancient "fueros" of the kingdom he could claim a public trial in open court, and so bring into requisition the documentary evidence he possessed of the king's complicity in the deed. This did not suit Philip, who, although he instituted a process in the supreme tribunal of Aragon, speedily abandoned it and caused Perez to be attacked from another side, the charge of heresy being now preferred, arising out of certain reckless and even blasphemous expressions Perez had used in connexion with his troubles in Castile. But all attempts to remove the accused from the civil prison in Saragossa to that of the Inquisition raised popular tumults, which in the end led to Perez's escape across the Pyrenees, but unfortunately also furnished Philip with a pretext for sending an army into Aragon and suppressing the ancient "fueros" altogether (1591). From the court of Catherine de Bourbon, at Pau, where he was well received, Perez passed to that of Henry IV. of France, and both there and in England his talents and diplomatic experience, as well as his well-grounded enmity to Philip, secured him much popularity. While in England he became the "intimate coach-companion and bed-companion" of Francis Bacon, and was also much in the society of the earl of Essex. The peace of Vervins in 1598 greatly reduced his apparent importance abroad, and Perez now tried to obtain the pardon of Philip III., that he might return to his native country. His efforts, however, proved vain, and he died in comparative obscurity in Paris on the 3rd of November 1611.

Perez's earliest publication was a small quarto, dedicated to the earl of Essex, written and apparently printed in England about 1594, entitled *Pedazos de historia*, and professedly published at Leon. A Dutch translation appeared in 1594, and in 1598 he published his *Relaciones*, including the *Memorial del hecho de su causa*, drawn up in 1590, and many of his letters. Much has been done, by Mignet (*Antonio Perez et Philippe II*, 1845; 4th ed., 1874) and by Froude ("An Unsolved Historical Riddle," *Nineteenth Cent.*, 1883) among others, towards the elucidation of various difficult points in Perez's somewhat perplexing story. For the murder of Escovedo, see Andrew Lang's discussion of it in his *Historical Mysteries* (1904); and the *Españoles é ingleses* (1903) of Major Martin Hume, who had access to various newly discovered MSS.

PÉREZ GALDÓS, BENITO (1845–), was born at Las Palmas, in the Canary Islands, on the 10th of May 1845. In 1863 he was sent to Madrid to study law, drifted into literature, and was speedily recognized as one of the most promising recruits on the Liberal side. Shortly after the Revolution of 1868 he abandoned journalism, and employed fiction as the vehicle for propagating advanced opinions. His first novel, *La Fontana de oro*, was printed in 1871, and later in the same year appeared *El Audaz*. The reception given to these early essays encouraged the writer to adopt novel-writing as a profession. He had already determined upon the scheme of his *Episodios nacionales*, a series which might compare with the *Comédie humaine*. Old charters, old letters, old newspapers were collected by him with the minuteness of a German archivist; no novelist was ever more thoroughly equipped as regards the details of his period. *Trafalgar*, the first volume of the *Episodios nacionales*, appeared in 1879; the remaining books of this first series are entitled *La Cort de Carlos IV.*, *El 19 de marzo y el 2 de mayo*, *Bailén*, *Napoleón en Chamartin*, *Zaragoza*, *Gerona*, *Cadiz*, *Juan Martin el Empecinado* and *La Batalla de Arpiles*. As the titles suffice to show, the author's aim was to write the national epic of the 19th century in prose; and he so completely succeeded that, long before the first series ended in 1881, he took rank among the foremost novelists of his time. A second series of *Episodios nacionales*, beginning with *El Equipaje del rey José* and ending with a tenth volume, *Un Faccioso más y algunas frailes menos*, was brought to a close in 1883, and was, like its predecessor, a monument of industry and exact knowledge, of realism and romantic conception; and he carried on the *Episodios nacionales* into a fourth series, raising the total of volumes to forty. In fecundity and in the power of creating characters, Pérez Galdós vies with Balzac. Parallel with his immense achievement in historical fiction, Pérez Galdós published a collection of romances dealing with contemporary life, its social problems and religious difficulties. Of these the best known, and perhaps the best, are *Doña Perfecta* (1876); *Gloria* (1877); *La Familia de León Roch* (1878); *Marianela* (1878); *Fortunata y Jacinta* (1887); and *Angel Guerra* (1891). Nor does this exhaust his prodigious activity. Besides adapting several of his novels for stage purposes, he wrote original dramas such as *La Loca de la casa* (1893), *San Quintín* (1894), *Electra* (1900) and *Mariucha* (1904); but his diffuse, exuberant genius was scarcely accommodated to the convention of theatrical form. Pérez Galdós became a member of the Spanish Academy, and was also elected to the Cortes; but it is solely as a romancer that his name is familiar wherever Spanish is spoken, as a national novelist of fertile talent, and a most happy humorist who in his eccentrics and oddities is hardly inferior to Dickens. (J. F.-K.)

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[1] On the other hand it is suggested that this story of his being the son of Gomez was only circulated by Ruy Gomez's wife, Ana de Mendoza, as a refutation of the possibility of a supposed amour between her and Perez. It is contended by Mignet that this intrigue between her and Perez was known to Escovedo, and that this accounts for the part played by Perez in Escovedo's murder, because Ana had also been Philip's mistress, and Escovedo might have made mischief between Philip and Perez. Major Hume appears to combine the latter theory with Philip's political objection to Escovedo.

PERFUMERY (Lat. *per*, through, and *fumare*, to smoke), the preparation of perfumes, or substances which are pleasing to the sense of smell. Perfumes may be divided into two classes, the first of which includes all primitive or simple odoriferous bodies derived from the animal or vegetable kingdom, as well as the definite chemical compounds specially manufactured, while the second comprises the various "bouquets" or "mélanges" made by blending two or more of the foregoing in varying proportions—toilet powders, dentifrices, sachets, &c. To the former class belong (1) the animal products, ambergris, castor, civet, musk; (2) the essential oils (also called attars), mostly procured by the distillation of the stems, leaves, flowers and other parts of plants; (3) the philicome butters or oils, which are either solid or liquid fats charged with odours by the processes of inflowering or maceration; (4) the odoriferous gum-resins or balsams which exude naturally or from wounds in the trunks of various trees and shrubs, such as benzoin, opoponax, Peru, Tolu, storax, myrrh; (5) the large number of synthetic perfumes which simulate the odour of the natural scents. The second class contains the endless combination of tinctures sold under fancy names which may or may not afford a clue to their composition, such as "comédie française," "eau de senteur," "eau de Cologne," "lavendre ambrée," "blumengeist." In general, they are mixtures of a number of perfumes dissolved in alcohol. Strictly speaking, most of the perfumes on the market belong to the second class, since, in most cases, they are prepared by blending various natural or artificial odorous principles.

Natural Perfumes.—The animal perfumes are extremely limited in number. Ambergris (*q.v.*), one of the most important, is secreted by the sperm whale; musk (*q.v.*), the best known scent of this class, is secreted by the male musk-deer and other animals—musk-ox, musk-rat, &c.; civet (*q.v.*) is a musky scent named from the animal which secretes it; and castor or castoreum is a somewhat similar secretion of the beaver (*q.v.*). More important are the scents yielded by flowering plants. As a general rule fragrant flowers flourish in hot climates, but the more delicate perfumes are yielded by plants having a colder habitat; it must be remembered, however, that some costly perfumes are obtained from the plants of Ceylon, the East Indies, Mexico and Peru. In Europe, Grasse, Cannes and Nice are the centres of the natural perfume industry. Cannes is famous for its rose, acacia, jasmine and neroli oil; Nîmes for its thyme, rosemary and lavender; and Nice for its violets. Citron and orange oil come from Sicily; iris and bergamot from Italy; and roses are extensively cultivated in Bulgaria, and in European Turkey. England is unsurpassed for its lavender and peppermint, which flourish at Mitcham and Hitchin.

The natural sources of the attars or essential oils are the different parts of the plants which yield them—the wood (lign, aloe, santal, cedar), the bark (cinnamon, cascarilla), the leaves (patchouli, bay, thyme), the flowers (rose, lavender, orange-blossom), the fruit (nutmeg, citron), or the seeds (caraway, almond). Some plants yield more than one, such as lemon and bergamot. They are mostly obtained by distilling that part of the plant in which they are contained with water, or with high-pressure or superheated steam; but some few, as those from the rind of bergamot (from *Citrus bergamia*), lemon (citron zeste, from *C. Limonum*), lime (*C. Limetta*), by "expression." The outer layer of the cortex is rasped off from the unripe fruits, the raspings placed in a canvas bag, and squeezed in a screw or hydraulic press. The attars so obtained are separated from the admixed water by a tap-funnel, and are then filtered. Certain flowers, such as jasmine, tuberose, violet, cassia, either do not yield their attars by distillation at all, or do it so sparingly as not to admit of its collection for commercial purposes; and sometimes the attar, as in the case of orange (neroli), has an odour quite different from that of the fresh blossoms. In these cases the odours are secured by the processes of inflowering (enfleurage) or by maceration. Both depend upon the remarkable property which fats and oils possess of absorbing odours. Enfleurage consists in laying the leaves or flowers on plates covered with a layer of fat. The flowers are renewed every morning, and when the fat has sufficient odour it is scraped off, melted and strained. Maceration consists in soaking the flowers in heated fat; in due time they are strained off and replaced by fresh ones, as in the enfleurage process. The whole of the necessary meltings and heatings of the perfumed greases are effected by means of water-baths, whereby the temperature is kept from rising too high. For the manufacture of perfumes for the handkerchief the greases now known as pomades, butters or philocomes are treated with rectified spirit of wine 60° over-proof, *i.e.* containing as much as 95% of absolute alcohol by volume, which practically completely abstracts the odour.

The gum-resins and resins have been employed as perfumes from the earliest times. The more important are incense, frankincense and myrrh (*q.v.*). They are largely used in the manufacture of perfumes, both for burning as pastilles, ribbon of Bruges, incenses, &c., and in tinctures, to which they impart their characteristic odours, affording, at the same time, a certain fixity to other perfumes of a more fleeting nature when mixed with them.

Synthetic Perfumes.—Under this heading are included all perfumes in which artificial substances are odorous ingredients. Although the earliest perfumes of this class were introduced in about the middle of the 19th century, the important industry which now prevails is to be regarded as dating from the 'seventies and 'eighties. Three main lines of development may be distinguished: (1) the chance discovery of substances which have odours similar to natural perfumes; (2) the elucidation of the composition of the natural scents, and the chemical constitution of their ingredients, followed by the synthetic preparation of the substances so determined; and (3), which may be regarded as connected with (2), the extraction and separation of the essential oils yielded by less valuable plants, and their reblending to form marketable perfumes.

The first synthetic perfume was the "essence of Mirbane" introduced by Collas in about 1850; this substance was the nitro-benzene discovered by E. Mitscherlich in 1834. Soon afterwards many esters of the fatty acids simulating the odours of fruits were introduced; and in 1888 Baur discovered the "artificial musks," which are derivatives of *s*-trinitrobenzene. The above are instances of the first line of progress. The second line has for early examples the cases of artificial oil of wintergreen, which followed Cahour's discovery that the natural oil owed its odour, in the main, to methyl salicylate, and of artificial oil of bitter almonds which followed the preparation of benzaldehyde from benzal chloride in 1868. The synthesis of coumarin, the odorous principle of hay and woodruff, by Sir W. H. Perkin in 1868; of vanillin, the odorous principle of vanilla, by F. Tiemann and W. Haarmann in 1875; and of ionone, almost identical with the natural irone, the odorous principle of violets, by Tiemann and P. Krüger in 1898, are to be regarded as of the highest importance. Equally important are the immense strides made in the elucidation of the constitution and syntheses of the terpenes (*q.v.*), a group of compounds which are exceptionally abundant as odorous principles in the essential oils.

The present state of our knowledge does not permit a strict correlation of odour and chemical constitution. One theory regards odour as due to "osmophores," or odour-producing groups, in much the same way as colour is associated with chromophores. Such osmophores are hydroxyl (OH), aldehyde (CHO), ketone (CO), ether ($\cdot O \cdot$), nitrile (CN), nitro (NO_2), &c.; we may also notice the isonitrile group ($\cdot NG$) associated with an unpleasant odour, and the iso-thiocyanate group ($\cdot NCS$) to which the mustard oils owe their characteristic smell. The same group, however, is not invariably associated with the same odour, or even any odour at all, as, for instance, in such closely related compounds as the members of a homologous series. For example, the lower fatty aldehydes have unpleasant odours, those with ten carbon atoms (and also double linkages, which in itself may affect odour) form some of the most delicate scents, while the higher members are odourless. The absence of odour in the higher members may be possibly associated with the low volatility exhibited by compounds of high molecular weight. Certain osmophores have practically equal effects; for example, benzaldehyde, nitrobenzene, benzonitrile, and phenyl azoimide have practically identical odours, and among the "artificial musks," a nitro group may be replaced by the azoimido group without the odour being modified. As a general rule, homologues have similar odours, but many exceptions are known. For example the methyl and ethyl ethers of β-naphthol have the odour of neroli; on the other hand, of the esters of anthranilic acid, the methyl has the odour of orange blossoms, the ethyl has a slight odour, and the isobutyl is odourless. The introduction of a methyl group into the benzene ring generally involves little or no change in odour; but when it (and more especially higher alkyl radicals) is introduced into side chains the odour may be entirely changed. For example, benzene and its homologues have similar odours; phthalide is odourless, but the isopropyl and butyl phthalides, in which substitution occurs in the side chain, smell of celery. Especially characteristic are the derivatives of phenylacetylene. This hydrocarbon is distinctly unpleasant; on the other hand, para-ethyl and para-methyl phenylacetylene smell of anise. While the triply-linked carbon system is generally associated with strong and unpleasant odours, the doubly linked system gives pleasant ones. Thus the unpleasant phenylacetylene, $C_6H_5\cdot C{:}CH$, is contrasted with styrolene, $C_6H_5\cdot CH{:}CH_2$, which occurs in storax, and phenylpropiolic aldehyde with cinnamic aldehyde, $C_6H_5\cdot CH{:}CH\cdot CHO$, which occurs in cassia and cinnamon. The reduction of a double to a single linkage may not destroy odour. Thus hydrocinnamic aldehyde, the reduction product of cinnamic aldehyde, smells of jasmine and lilac, and melilotin, which occurs in yellow melilot (*Melilotus officinalis*), has the same odour (woodruff) as its oxidation product coumarin. The orientation of the substituent groups in the benzene nucleus also affects odour. In general, the meta compounds are odourless, while the ortho and para may have odour. Thus *p*-methoxyacetophenone has a pleasant odour, the meta compound is odourless, *o*-aminoacetophenone, *o*-aminobenzaldehyde, and *o*-nitrophenol have strong odours, while the meta and para bodies are odourless. Of the three trinitrobenzenes only the symmetrical form gives origin to perfumes.

The concentration and even the solvent has considerable effect on the odour of a substance. Many of the artificial principles—vanillin, heliotropine, ionone, &c.—have very different odours in strong and in dilute solution; phenyl acetic acid and β-naphthylamine are odourless when solid, but have disagreeable odours when dissolved. Traces of impurities often have the effect of making odourless or pleasant-smelling compounds quite intolerable. Acetylene as generated from calcium carbide, and carbon disulphide prepared from its elements are quite intolerable, though when pure they are, at least, not unpleasant; artificial benzaldehyde must be very carefully purified before it can be used in the preparation of the more delicate scents. In all cases the natural scents are complex mixtures of many ingredients, and a variation in the amount of any one may completely alter the scent. Such mixtures would be difficult to reproduce economically; the perfumer is content with a product having practically an identical odour, with or without the natural substance which it is designed to compete with.

We now give an account of the artificial scents, principally arranged according to their chemical relations. The *fatty esters* are interesting as providing many of the fruit essences; in fact, by appropriate blending, any fruit odour can be reproduced. Their use, however, is inhibited by the fact that they irritate the respiratory organs, producing coughing and headaches. Isobutyl carbinol acetic ester (amyl acetate), $(CH_3)_2\cdot CH\cdot CH_2\cdot CH_2\cdot OC\cdot CH_3$, forms when in dilute alcoholic solution the artificial pear oil; a similar odour is possessed by isoamyl-*n*-butyrate, $C_3H_7\cdot CO_2\cdot C_5H_{11}$. *n*-Octyl acetate, $C_8H_{17}\cdot O_2C\cdot CH_3$, has the odour of oranges. Isoamyl propionate, $C_5H_{11}\cdot O_2C\cdot C_2H_5$, and ethyl-*n*-butyrate, $C_3H_7\cdot O_2C\cdot C_2H_5$, have the odour of pineapple, the latter constituting the artificial pineapple oil of commerce. Isoamyl isovalerate, $C_5H_{11}\cdot O_2C\cdot C_4H_9$, is the artificial apple oil. Of the fatty ketones, methyl nonyl ketone, $CH_3\cdot CO\cdot C_9H_{19}$, which is the scent of oil of rue, and methylethyl acetone, $CH_3\cdot CO\cdot CH(CH_3)\,(C_2H_5)$, which has the odour of peppermint, receive commercial application. Of exceptional importance in the chemistry of perfumes are the unsaturated open chain compounds containing at least eight carbon atoms. These are chemically considered, along with the related cyclic compounds, in the article TERPENES; here we notice their odours and occurrence in perfumes. Of the alcohols, *l*-linalol occurs in oil of lavender, bergamot, limet and origanum; *d*-linalol in coriander; citronellol and geraniol in rose, geranium and pelargonium oils. Of the aldehydes, citral or geranial has the odour of lemons; citronellal is the chief constituent of citronella oil. By condensing citral with acetone and treating the product with dilute sulphuric acid, the valuable violet substitute *ionone* results. This substance is a hydroaromatic ketone, and closely resembles the natural principle irone. By successive treatment with acetic anhydride (to form isopulegol), oxidation to isopulegone, and treatment with baryta citronellal yields the cyclic compound *pulegone*, the chief constituent of oil of pennyroyal. The olefinic terpenes are generally convertible into methyl heptenone, $(CH_3)_2C{:}CH(CH_2)_2\cdot CO\cdot CH_3$, which has been synthesized from sodium acetonylacetone and amylene dibromide; this ketone occurs in several essential oils, and has the odour of rue. For the occurrence of cyclic terpenes in the essential oils reference should be made to the table below, which contains the names, sources and chief ingredients of the more important essential oils.[1] The terpenes are printed in italics, the aliphatic and benzenoid compounds in ordinary type.

Name of Oil.	Source.	Constituents.
Anise	*Pimpinella anisum*	Anethole, estragole.
Bay	*Pimenta acris*	Eugenol, methyl eugenol, chavicol, estragole, *myrcene*, *phellandrene*.
Bergamot	*Citrus bergamia*	*Linalol*, *linalyl acetate*, d-*limonene*, *bergaptene*.
Cajaput	*Melaleuca*, sp.	*Cineol*.
Cassia	*Cinnamonum cassia*	Cinnamic aldehyde, cinnamyl acetate.
Caraway	*Carum carvi*	*Carvone*, d-*limonene*.
Camphor	*Cinnamonum camphor*	d-*Pinene*, *phellandrene*, *terpineol*, eugenol, safrole.
Chamomile	*Anthemis nobilis*	Isobutyl and isoamyl esters of angelic and tiglic acids.
Cinnamon	*Cinnamonum Zeylanicum*	Cinnamic aldehyde.
Clove	*Eugenia caryophyllata*	Eugenol.
Coriander	*Coriandum sativum*	*Linalol*.
Cumin	*Cuminum cymium*	Cumic aldehyde, cymene.
Eucalyptus	*Eucalyptus globulus*	*Cineol*, d-*pinene*, and fatty aldehydes.
Fennel	*Foeniculum vulgare*	Anethole, *fenchone*, d-*pinene*.
Geranium	*Andropogon schoenanthus*	*Geraniol*, *citronellol*.
Jasmine	*Jasminum grandiflorum*	Methyl anthranilate, indol, benzyl alcohol, benzyl acetate, *linalol*, *linalyl acetate*.
Lavender	*Lavendula vera*	*Linalol*, l-*linalyl acetate*.
Lemon	*Citrus limonum*	*Limonene*, *phellandrene*, *citral*, *citronellal*, *geranyl acetate*, *linalol*.
Lemon-grass	*Andropogon citratus*	*Citral*.
Neroli	*Citrus bigardia*	l-*Linalol*, *geraniol*, *limonene*, methyl anthranilate.
Orange	*Citrus aurantium*	d-*Limonene*.
Peppermint	*Mentha piperita*	*Menthol*, *menthyl acetate* and *valerate*.
Pine-needle	*Pinus sylvestris*	d-*Pinene*, d-*sylvestrene*.
Rose	*Rosa damascena*	*Geraniol*, l-*citronellol*.
Rose Geranium	*Pelargonium odoratissemum*	*Geraniol*, *citronellol*.
Rosemary	*Rosamarinus officinalis*	*Pinene*, *camphene*, *camphor*, *cineol*, *borneol*.
Sage	*Salvia officinalis*	*Pinene*, *cineol*, *thujone*, *borneol*.
Sassafras	*Sassafras officinalis*	Safrole.
Spearmint	*Mentha viridis*	l-*Linalol*, l-*carvone*.
Star anise	*Illicium anisatum*	Anethole.
Tansy	*Tanacetum vulgare*	*Thujone*.
Thyme	*Thymus vulgaris*	Thymol.
Wormwood	*Artemisia absinthum*	*Thujone* and *thujyl esters*.
Ylang-ylang	*Cananga odorata*	l-*Linalol*, *geraniol*.

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[1] See J. B. Cohen, *Organic Chemistry*, p. 532; or J. Parry, *Chemistry of Perfumes* (1908).

The chief benzenoid compounds used as perfumes are aldehydes, oxyaldehydes, phenols and phenol ethers. Benzaldehyde has the odour of almonds, cinnamic aldehyde of cinnamon, and cumin aldehyde gives the odour to cumin oil. Of oxyaldehydes salicylaldehyde gives the odour to spiraea oil, and vanillin is the active ingredient of vanilla (*q.v.*). Anisaldehyde smells like hawthorn, and is extensively used under the name aubépine for scenting soaps and extracts. Carvacrol and thymol are isomeric methyl propyl phenols; both have the odour of thyme. Of phenol ethers eugenol (allyl guaiacol) has the odour of cloves, and anethole (allyl phenyl methyl ether) is the chief constituent of anise oil, being chiefly used in the manufacture of liqueurs. Several piperonyl compounds are of commercial importance. The aldehyde, $CH_2[O]_2:C_6H_3\cdot CHO(1,2,4)$, piperonal, has the odour of heliotrope; an allyl derivative, safrole $CH_2[O]_2:C_6H_3\cdot C_3H_5(1,2,4)$, occurs in sassafras, while apiole or dimethoxy safrole has the odour of parsley oil. Of other synthetic perfumes amyl salicylate is used under the names of *orchidèe* or *trefol* as the basis of many perfumes, in particular of clover scents; methyl anthranilate occurs in the natural neroli and other oils, and has come into considerable use in the preparation of artificial bergamot, neroli, jasmine and other perfumes (the Trolene, Marceol and Amanthol of the *Actien Gesellschaft für Anilin Fabrikation* have this substance as a base); the "artificial musks" are derivatives of *s*-trinitrobenzene; coumarin is the principle of woodruff; and β-naphthol methyl ether is used for the preparation of artificial neroli.

The Odophone.—The most important element in the perfumer's art is the blending of the odorous principles to form a mixture which gratifies the sense of smell. Experience is the only guide. It is impossible to foretell the odour of a mixture from the odours of its components. Septimus Piesse endeavoured to show that a certain scale or gamut existed amongst odours as amongst sounds, taking the sharp smells to correspond with high notes and the heavy smells with low. He illustrated the idea by classifying some fifty odours in this manner, making each to correspond with a certain note, one-half in each clef, and extending above and below the lines. For example, treble clef note E (4th space) corresponds with Portugal (orange), note D (1st space below clef) with violet, note F (4th space above clef) with ambergris. It is readily noticed in practice that ambergris is much sharper in smell (higher) than violet, while Portugal is intermediate. He asserted that properly to constitute a bouquet the odours to be taken should correspond in the gamut like the notes of a musical chord—one false note among the odours as among the music destroying the harmony. Thus on his odophone, santal, geranium, acacia, orange-flower, camphor, corresponding with C (bass 2nd line below), C (bass 2nd space), E (treble 1st line), G (treble 2nd line), C (treble 3rd space), constitute the bouquet of chord C.

Other Branches of Perfumery.—As a natural outcome of the development of the perfume industry, scented articles for toilet and other uses are now manufactured in large quantities. Soaps, toilet powders, tooth powders, hair-washes, cosmetics generally, and note-paper have provided material on which the perfumer works. For the preparation of *scented soaps* two methods are in use; both start with a basis either of fine yellow soap (which owes its odour and colour to the presence of resin), or of curd soap (which is hard, white and odourless, and is prepared without resin). In one process the soap is melted by superheated steam, and while still hot and semi-fluid mixed by means of a stirrer of wood with iron cross-bar, technically called a "crutch," with the attars and colouring matter. It is then removed from the melting pan to a rectangular iron mould or box, the sides of which can be removed by unscrewing the tie-rods which hold them in position; when cold the mass is cut into slabs and bars with a thin brass wire. In the other or cold process the soap is first cut into chips or shavings by a plane or "chipping machine," then the colouring matters are added and thoroughly incorporated by passing the soap between rollers; the tinted soap emerges in a continuous sheet but little thicker than paper. The perfumes are then added, and after standing for about twelve hours the soap is again sent through the rolling machine. It is next transferred to a bar-forming machine, from which it emerges as a continuous bar almost as hard as wood. Soap thus worked contains less than 10% of water; that prepared by melting contains 20 and even 30%. The amount of perfume added depends upon its nature, and amounts usually to about 7 or 8%. The finest soaps are always manufactured by the cold process.

Toilet Powders are of various sorts. They consist of rice-starch or wheat-starch, with powdered orris-root in varying proportions, and with or without the addition of zinc oxide, bismuth oxide or French chalk. The constituent powders, after the addition of the perfume, are thoroughly incorporated and mixed by sifting through a fine sieve. Violet powder for the nursery should consist entirely of powdered violet root (*Iris florentina*), from the odour of which the powder is named. It is of a yellowish tint, soft and pleasant to the touch. The white common so-called "violet powders" consist of starch scented with bergamot, and are in every sense inferior.

Tooth Powders consist for the most part of mixtures of powdered orris-root with precipitated chalk, and some other constituent destined to particularize it as to properties or flavour, such as charcoal, finely pulverized pumice, quassia, sugar, camphor, &c. The perfume of the contained orris-root is modified, if required, by the addition of a little of some perfume. *Tooth Pastes* are formed of the same constituents as the powders, and are worked into a paste by the addition of a little honey or glucose syrup, which substances are usually believed ultimately to have an injurious effect on the teeth.

Perfume Sachets consist either of a powder composed of a mixture of vanilla, musk, Tonqua beans, &c., one or other predominating as required, contained in an ornamental silk sac; or of some of the foregoing substances spread upon card or chamois leather or flannel after being made into a paste with mucilage and a little glycerin. When dry the card so prepared is daintily covered with various parti-coloured silks for sale. Where the ingredients employed in their manufacture are of good quality these cards, known as "peau d'Espagne" sachets, retain their odour unimpaired for years.

Adulterations.—There is, as might be expected, considerable scope for the adulteration of the "matières premières" employed in perfumery. Thus, in the case of musk, the "pods" are frequently found to be partially emptied of the grain, which has been replaced by hide or skin, while the weight has been increased by the introduction of lead, &c. In other instances the fraud consists in the admixture of refuse grain, from which the odour has been exhausted with spirit, with dried blood, and similar substances, whilst pungency is secured by the addition of ammonium carbonate. Attar of rose is diluted with attar of *Palma rosa*, a variety of geranium of only a quarter or a fifth of the value. The main adulterant of all the natural essential oils, however, is castor oil. This is a bland neutral body, practically odourless, and completely soluble in alcohol; it therefore presents all the requisites for the purpose.

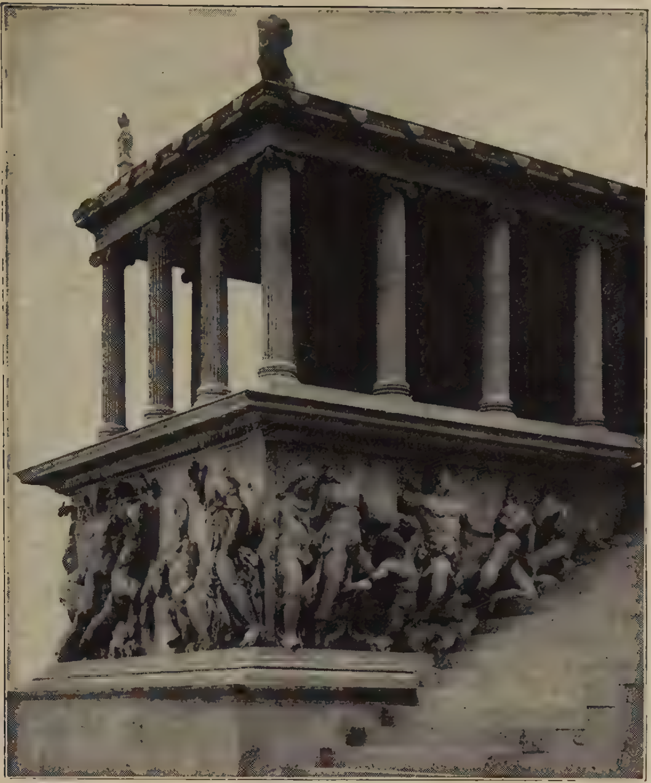
BIBLIOGRAPHY.—See generally, J. C. Sawyer, *Odorographia*, vol. i. (1892), vol. ii. (1894); G. W. Askinson, *Perfumes* (Eng. trans. by Isidor Fürst, 1892); S. Piesse, *Art of Perfumery* (1891); Paul Hubert, *Plantes à parfumes* (1909); M. Otto, *L'Industrie des parfums* (1909). Synthetic perfumes are treated in detail in C. Deite, *Manual of Toilet Soap-making* (Eng. trans. by S. I. King, 1905), and in E. J. Parry, *Chemistry of the Essential Oils and Artificial Parfumes* (2nd ed., 1908). Reference may also be made to T. Koller, *Cosmetics* (1902). The standard works on the essential oils are given in the article OILS. G. Cohn, *Die Riechstoffe* (1904), treats the chemistry, and Zwaardemaker, *Physiologie des Geruchs* (1895), the physiology of perfumes. See also the reports and bulletins of Schimmel & Co. and Rouse Bertrand et Fils.

PERGA (mod. *Murtana*), an ancient city of Pamphylia, situated about 8 m. inland, at the junction of a small stream (Sari Su) with the Cestrus. It was a centre of native influences as contrasted with the Greek, which were predominant in Attalia, and it was a great seat of the worship of "Queen" Artemis, here represented as a human-headed cone and a purely Anatolian nature goddess. There Paul and Barnabas began their first mission in Asia Minor (Acts ix. 13). A much frequented route into Phrygia and the Maeander valley began at Perga, and Alexander made it the starting-point of his invasion of inner Asia Minor. Long the metropolis of Pamphylia Secunda, it was superseded in Byzantine times by its port, Attalia, which became a metropolis in 1084. The extensive ruins all lie in the plain south of the Acropolis. The walls are well preserved, but of late Roman or Byzantine reconstruction. The lines of intersecting streets can be easily made out, and there are ruins of two sets of baths, two basilicas and a forum. But the most notable monument is the theatre, which lies outside the walls on the south-west, near the stadium. This is as perfect as those of Myra and Patara, but larger than either, and yields the palm only to those of Aspendus and Side. Modern Murtana is a large village, long under the dominion of the Dere Beys of the Tekke Oglu family.

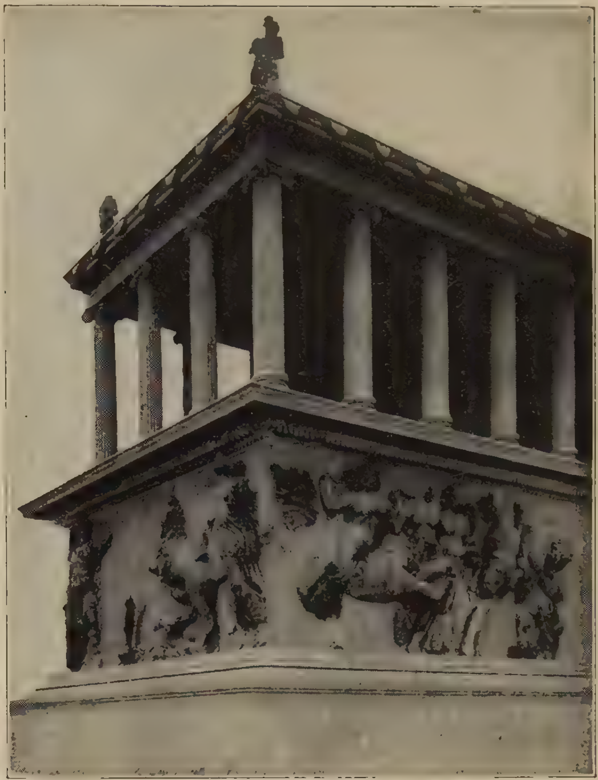
See C. Lanckoronski, *Villes de la Pamphylie et de la Pisidie*, vol. i. (1890); Sir W. M. Ramsay, *Church in the Roman Empire* (1893). (D. G. H.)

PERGAMENEOUS (Lat. *pergamena*, parchment), a technical term used of anything of the texture of parchment, as in zoology of the wing-covers of insects.

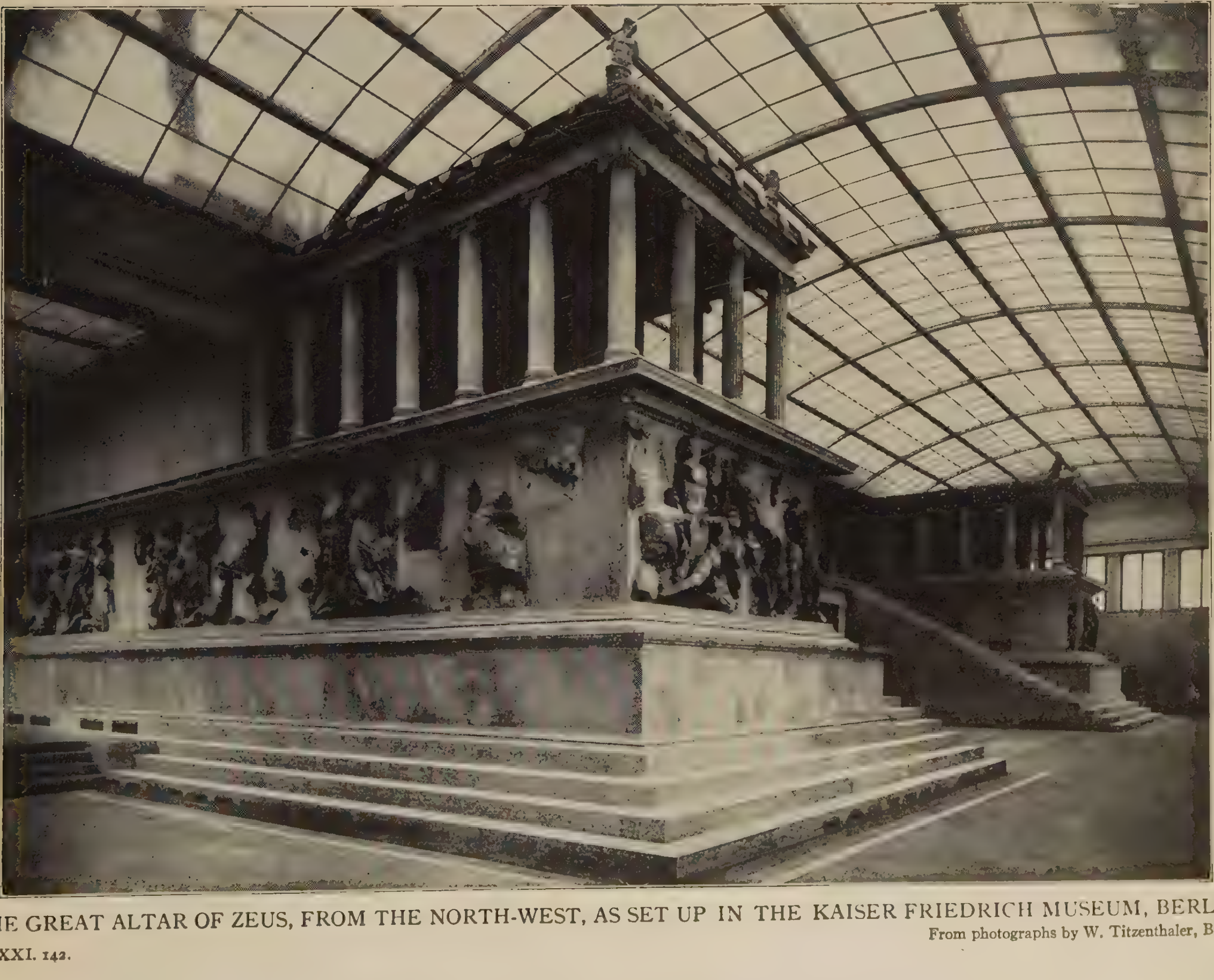
PERGAMUM, or PERGAMUS (mod. *Bergama*), an ancient city of Teuthrania, a district in Mysia. It is usually named Πέργαμον by Greek writers, but Ptolemy has the form Πέργαμος. The name, which is related to the German *burg*, is appropriate to the situation on a lofty isolated hill in a broad fertile valley, less than 15 m. from the mouth of the Caïcus. According to the belief of its inhabitants, the town was founded by Arcadian colonists, led by Telephus, son of Heracles. Auge, mother of



THE NORTH WING, WEST AND SOUTH SIDES.



THE SOUTH WING, WEST AND SOUTH SIDES.

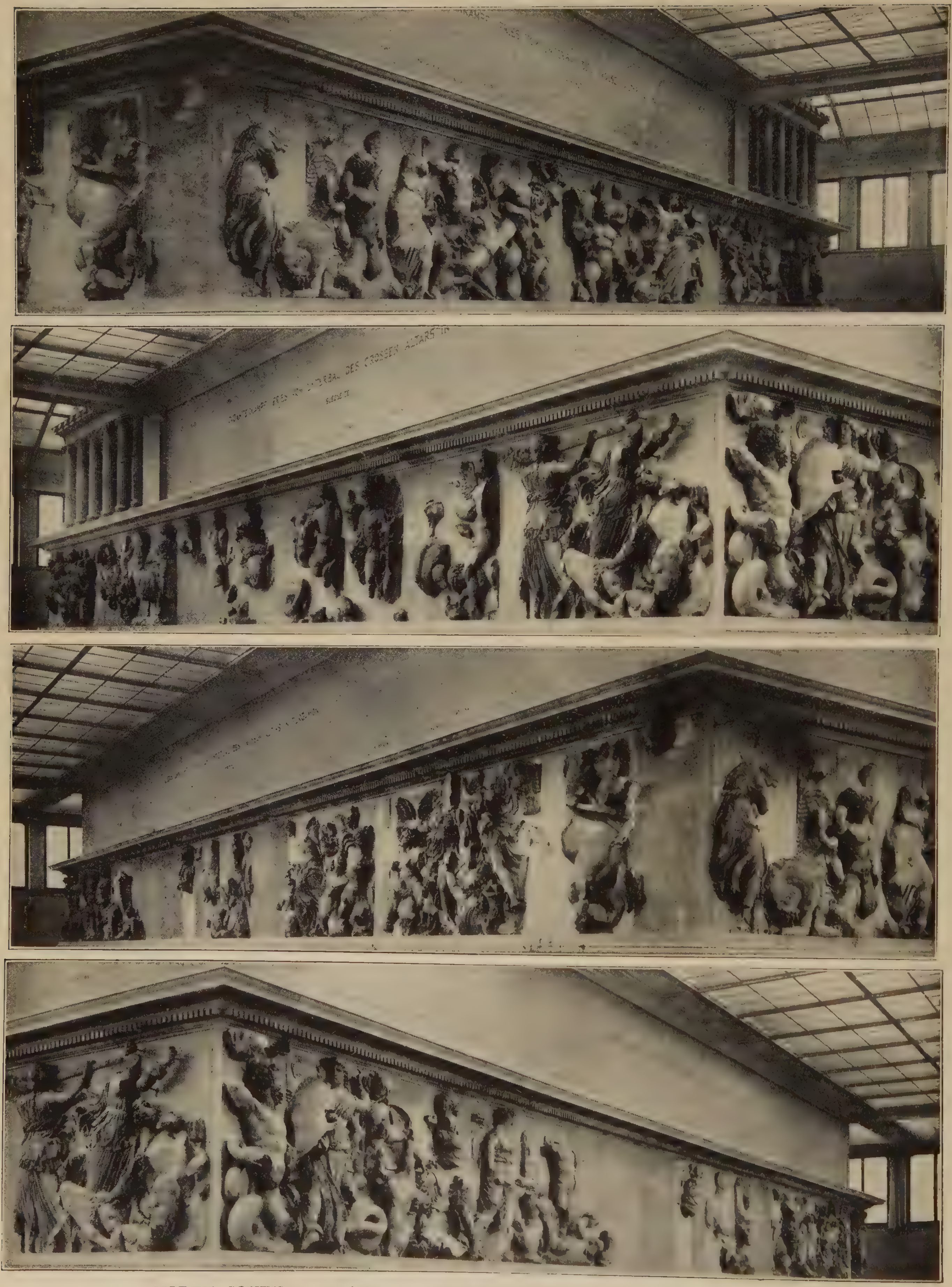


THE GREAT ALTAR OF ZEUS, FROM THE NORTH-WEST, AS SET UP IN THE KAISER FRIEDRICH MUSEUM, BERLIN.

From photographs by W. Titzenthaler, Berlin.

PLATE II.

PERGAMUM



NORTH, SOUTH, EAST, AND WEST SIDES OF THE GREAT ALTAR OF ZEUS.

From photographs by W. Titzenthaler, Berlin.

Telephus, was priestess of Athena Alea at Tegea, and daughter of Aleus; fleeing from Tegea, she became the wife of Teuthras, the eponymous king of Teuthrania, and her son Telephus succeeded him. Athena Polias was the patron-goddess of Pergamum, and the legend combines the ethnological record of the connexion claimed between Arcadia and Pergamum with the usual belief that the hero of the city was son of its guardian deity, or at least of her priestess. Nothing more is recorded of the city till the time of Xenophon, when it was a small fortified town on the summit of the hill; but it had been striking coins since 420 B.C. at latest. Its importance began under Lysimachus, who deposited his treasures, 9000 talents, in this strong fortress under the charge of a eunuch, Philetaerus of Tium. In 283 B.C. Philetaerus rebelled, Lysimachus died without being able to put down the revolt, and Pergamum became the capital of a little principality. Partly by clever diplomacy, partly through the troubles caused by the Gaulish invasion and by the dissensions among the rival kings, Philetaerus contrived to keep on good terms with his neighbours on all sides (283–263 B.C.). His nephew Eumenes (263–241) succeeded him, increased his power, and even defeated Antiochus II. of Syria in a pitched battle near Sardis. His successor Attalus I. (241–197) won a great battle over the Gauls, and assumed the title of king. The other Greek kings who aimed at power in Asia Minor were his natural enemies, and about 222 reduced Pergamenian power to a very low ebb. On the other hand, the influence of the Romans was beginning to make itself felt in the East. Attalus prudently connected himself with them and shared in their continuous success. Pergamum thus became the capital of a considerable territory and a centre of art and regal magnificence. The wealth of the state and the king's desire to celebrate his victories by monuments of art led to the rise of the "Pergamenian school" in sculpture. The splendour of Pergamum was at its height under Eumenes II. (197–159). He continued true to the Romans during their wars with Antiochus and Perseus, and his kingdom spread over the greater part of western Asia Minor, including Mysia, Lydia, great part of Phrygia, Ionia and Caria. To celebrate the great achievement of his reign, the defeat of the barbarian Gauls, he built in the agora a vast altar to Zeus Soter (see below). He left an infant son, Attalus (III.), and a brother, Attalus II. (Philadelphus), who ruled 159–138, and was succeeded by his nephew, Attalus III. (Philometor). The latter died in 133, and bequeathed his kingdom to the Romans, who erected part of it (excluding Great Phrygia, which they gave to Mithradates of Pontus) into a province under the name of Asia. Pergamum continued to rank for two centuries as the capital, and subsequently, with Ephesus and Smyrna, as one of the three great cities of the province; and the devotion of its former kings to the Roman cause was continued by its citizens, who erected on the Acropolis a magnificent temple to Augustus. It was the seat of a *conventus*, including the cities of the Caïcus valley and some of those in the northern part of the Hermus valley. Under the Roman Empire Pergamum was one of the chief seats of the worship of Asclepius "the Saviour"; invalids came from distant parts of the country to ask advice from the god and his priests. The temple and the curative establishment of the god were situated outside the city. Pergamum was the chief centre of the imperial cult under the early empire, and, in W. M. Ramsay's opinion, was for that reason referred to in Rev. ii. 13 as the place of "Satan's throne." It was also an early seat of Christianity, and one of the Seven Churches. The place, re-fortified by the Byzantines, and still retaining its name as Bergama, passed into Moslem hands early in the 14th century. The lower town was rebuilt, and in the 17th and 18th centuries became a chief seat of the great Dere Bey family of Kara Osman Oglu (see MANISA), which did not resign it to direct Ottoman control until about 1825. It is still an administrative and commercial centre of importance, having some 20,000 inhabitants.

Excavations.—The site of the ancient city has been the scene of extensive excavations promoted by the Berlin museum since 1878, and directed first by K. Humann and A. Conze, and afterwards by W. Dörpfeld. The first impulse to them was given in 1873 by the reception in Berlin of certain reliefs, extracted by Humann from the walls of Bergama. These were recognized as probably parts of the Great Altar of Zeus erected by Eumenes II. in 180 B.C. and decorated with a combat of gods and giants, symbolic of the struggle between the Pergamene Greeks and the Gaulish barbarians. Excavation at the south end of the Acropolis led to the discovery of the Altar itself and the rest of its surviving reliefs, which, now restored and mounted in Berlin, form one of the glories of that city. In very high relief and representing furious action, these sculptures are the finest which survive from the Pergamene school, which replaced the repose and breadth of earlier schools by excess of emphasis and detail. The summit of the Acropolis is crowded with public buildings, between the market place, which lies at the southern point, and the Royal Gardens on the north. In the interval are the Zeus altar; the great hexastyle Doric temple of Athena flanked by the palace on the east, by the theatre and its long terrace on the west, and by a library on the north; and a large Corinthian temple of Trajan. The residential part of the Greek, and practically all the Roman city lay below the Acropolis on ground now mostly occupied by modern Bergama; but west of the river Selinus, on rising ground facing the Acropolis, are to be seen notable remains of a Roman theatre, an amphitheatre and a circus.

See, beside general authorities for Asia Minor, J. Dallaway, *Constantinople*, &c. (1797); W. M. Ramsay, *Letters to the Seven Churches* (1904); and especially the publication by the Royal Museum of Berlin, *Alterthümer von Pergamon* (1885 sqq.); "Operations at Pergamon 1906–1907," in *Athenische Mitteil.* (1908), xxxiii. 4; G. Leroux, "La Prétendue basilique de Pergame" in *Bull. Corr. Hell.* (1909), pp. 238 sqq. (D. G. H.)

PERGOLA (Lat. *pergula*, a projecting roof, shed, from *pergere*, to reach forward, project), a term adopted from the Italian for an arbour of trellis-work over which are trained creeping plants, vines, &c., and especially for a trellis-work covering a path, walk or balcony in a garden.

PERGOLESI (or PERGOLESE), **GIOVANNI BATTISTA** (1710–1736), Italian musical composer, was born at Jesi near Ancona on the 3rd of January 1710, and after studying music under local masters until he was sixteen was sent by a noble patron to complete his education at Naples, where he became a pupil of Greco, Durante and Feo for composition and of Domenico de Matteis for the violin. His earliest known composition was a sacred drama, *La Conversione di S. Guglielmo d'Aquitania*, between the acts of which was given the comic intermezzo *Il Maestro di musica*. These works were performed in 1731, probably by fellow pupils, at the monastery of St Agnello Maggiore. Through the influence of the prince of Stigliano and other patrons, including the duke of Maddaloni, Pergolesi was commissioned to write an opera for the court theatre, and in the winter of 1731 successfully produced *La Sallustia*, followed in 1732 by *Ricimero*, which was a failure. Both operas had comic intermezzi, but in neither case were they successful. After this disappointment he abandoned the theatre for a time and wrote thirty sonatas for two violins and bass for the prince of Stigliano. He was also invited to compose a mass on the occasion of the earthquake of 1731, and a second mass, also for two choirs and orchestra, is said to have been praised by Leo. In September 1732 he returned to the stage with a comic opera in Neapolitan dialect, *Lo Fratè inammorato*, which was well received; and in 1733 he produced a serious opera, *Il Prigionier*, to which the celebrated *Serva padrona* furnished the intermezzi. There seems, however, no ground for supposing that this work made any noticeable difference to the composer's already established reputation as a writer of comic opera. About this time (1733–1734) Pergolesi entered the service of the duke of Maddaloni, and accompanied him to Rome, where he conducted a mass for five voices and orchestra in the church of St Lorenzo in Lucina (May 1734). There is no foundation for the statement that he was appointed maestro di cappella at the Holy House of Loreto; he was, in fact, organist of the royal chapel at Naples in 1735. The complete failure of *L'Olimpiade* at Rome in January 1735 is said to have broken his health, and determined him to abandon the theatre for the Church; this statement is, however, incompatible with the fact that his comic opera *Il Flaminio* was produced in Naples in September of the same year with undoubted success. His ill health was more probably due to his notorious profligacy. In 1736 he was sent by the duke of Maddaloni to the Capuchin monastery at Pozzuoli, the air of the place being considered beneficial to cases of consumption. Here he is commonly supposed to have written the celebrated *Stabat Mater*; Paisiello, however, stated that this work was written soon after he left the *Conservatorio dei poveri di Gesù Cristo* in 1729. We may at any rate safely attribute to this period the *Scherzo fatto ai Cappuccini di Pozzuoli*, a musical jest of a somewhat indecent nature. He died on the 17th of March 1736, and was buried in the cathedral of Pozzuoli.

Pergolesi's posthumous reputation has been exaggerated beyond all reason. This was due partly to his early death, and largely to the success of *La Serva padrona* when performed by the *Bouffons Italiens* at Paris in 1752. Charming as this little piece undoubtedly is, it is inferior both for music and for humour to Pergolesi's three-act comic operas in dialect, which are remembered now only by the air "Ogni pena più spietata" from *Lo Fratè inammorato*. As a composer of sacred music Pergolesi is effective, but essentially commonplace and superficial, and the frivolous style of the *Stabat Mater* was rightly censured by Paisiello and Padre Martini. His best quality is a certain sentimental charm, which is very conspicuous in the cantata *L'Orfeo* and in the genuinely beautiful duets "Se cerca, se dice" and "Ne' giorni tuoi felici" of the serious opera *L'Olimpiade*; the latter number was transferred unaltered from his early sacred drama *S. Guglielmo*, and we can thus see that his natural talent underwent hardly any development during the five years of his musical activity. On the whole, however, Pergolesi is in no way superior to his contemporaries of the same school, and it is purely accidental that a later age should have regarded him as its greatest representative.

Bibliography.—The most complete life of Pergolesi is that by E. Faustini Fasini (*Gazzetta musicale di Milano*, 31st of August 1899, &c., published by Ricordi in book form, 1900); G. Annibaldi's *Il Pergolesi in Pozzuoli, vita intima* (Jesi, 1890) gives some interesting additional details derived from documents at Jesi, but is cast in the form of a romantic novel. H. M. Schletterer's lecture in the *Sammlung musikalischer Vorträge*, edited by Count P. von Waldersee, is generally inaccurate and uncritical, but gives a good account of later performances of Pergolesi's works in Italy and elsewhere. Various portraits are reproduced in the *Gazz. mus. di Milano* for the 14th of December 1899, and in *Musica e musicisti*, December 1905. Complete lists of his compositions are given in Eitner's *Quellen-Lexicon* and in Grove's *Dictionary* (new ed.). (E. J. D.)

PERGOLESI, MICHAEL ANGELO, an 18th-century Italian decorative artist, who worked chiefly in England. Biographical details are almost entirely lacking, but like Cipriani he was brought, or attracted, to England by Robert Adam after his famous continental tour. He worked so extensively for the Adams, and his designs are so closely typical of much upon which their reputation rests, that it is impossible to doubt his influence upon their style. His range, like theirs, was catholic. He designed furniture, mantelpieces, ceilings, chandeliers, doors and mural ornament with equal felicity, and as an artist in plaster work in low relief he was unapproached in his day. He delighted in urns and sphinxes and interlaced gryphons, in *amorini* with bows and torches, in trophies of musical instruments and martial weapons, and in flowering arabesques which were always graceful if sometimes rather thin. The centre panels of his walls and ceilings were often occupied by classical and pastoral subjects painted by Cipriani, Angelica Kauffmann, Antonio Zucchi, her husband, and sometimes by himself. These nymphs and amorini, with their disengaged and *riant* air and classic grace, were not infrequently used as copies for painting upon that satinwood furniture of the last quarter of the 18th century which has never been surpassed for dainty elegance, and for the popularity of which Pergolesi was in large measure responsible; they were even reproduced in marquetry. Some of this painted work was, apparently, executed by his own hand; most of the pieces attributed to him are remarkable examples of artistic taste and technical skill. His satin-wood table-tops, china cabinets and side-tables are the last word in a daintiness which here and there perhaps is mere prettiness. Pergolesi likewise designed silver plate, and many of his patterns are almost instinctively attributed to the brothers Adam by the makers and purchasers of modern reproductions. There is, moreover, reason to believe that he aided the Adam firm in purely architectural work. In later life Pergolesi appears, like Angelica Kauffmann, to have returned to Italy.

Our chief source of information upon his works is his own publication, *Designs for Various Ornaments on Seventy Plates*, a series of folio sheets, without text, published between 1777 and 1801.

PERI, JACOPO (1561–16 ?), Italian musical composer, was born at Florence on the 20th of August 1561, of a noble family. After studying under Cristoforo Malvezzi of Lucca, he became maestro di cappella, first to Ferdinand, duke of Tuscany, and later to Cosmo II. He was an important member of the literary and artistic circle which frequented the house of Giovanni Bardi, conte de Vernio, where the revival of Greek tragedy with its appropriate musical declamation was a favourite subject of discussion. With this end in view the poet Ottavio Rinuccini supplied a drama with the title of *Dafne*, to which Peri composed music, and this first attempt at opera was performed privately in 1597 in the Palazzo Corsi at Florence. This work was so much admired that in 1600 Rinuccini and Peri were commissioned to produce an opera on the occasion of the marriage of Henry IV. of France with Maria di' Medici. This work (*L'Euridice*) attracted a great deal of attention, and the type once publicly established, the musical drama was set on the road to success by the efforts of other composers and the patronage of other courts. Peri himself seems never to have followed up his success with other operas; he became maestro di cappella to the duke of Ferrara in 1601, but after the publication of his *Varie musiche a una, due e tre voci* at Florence in 1609, nothing more is known of him.

Peri's *Dafne* (which has entirely disappeared) and *Euridice* (printed at Florence 1600; reprinted Venice 1608 and Florence 1863) are of the greatest importance not only as being the earliest attempts at opera, but as representing the new monodic and declamatory style which is the basis of modern music as opposed to the contrapuntal methods of Palestrina and his contemporaries. Peri's work is of course primitive in the extreme, but it is by no means without beauty, and there are many scenes in *Euridice* which show a considerable dramatic power.

PERIANDER (Gr. Περίανδρος), the second tyrant of Corinth (625–585 B.C.). In contrast with his father Cypselus, the founder of the dynasty, he is generally represented as a cruel despot, or at any rate as having used all possible devices for keeping his city in subjection. Among numerous anecdotes the following is characteristic. Periander, on being consulted by the tyrant Thrasybulus of Miletus as to the best device for maintaining himself in power, by way of reply led the messenger through a cornfield, and as he walked struck off the tallest and best-grown ears (a legend applied to Roman circumstances in Livy i. 54). It seems, however, that the prevalent Greek tradition concerning him was derived from the versions of the Corinthian aristocracy, who had good reasons for giving a prejudiced account, and the conflicting character of the various legends further shows that their historical value is slight. A careful sifting of the available evidence would rather tend to represent Periander as a ruler of unusual probity and insight, and the exceptional firmness and activity of his government is beyond dispute. His home administration was so successful that he was able to dispense with direct taxation. He fostered wealth by the steady encouragement of industry and by drastic legislation against idleness, luxury and vice; and the highest prosperity of the Corinthian handicrafts may be assigned to the period of his rule (see Corinth). At the same time he sought to check excessive accumulation of wealth in individual hands and restricted the influx of population into the town. Employment was found for the proletariat in the erection of temples and of public works. Periander further appears as a patron of literature, for it was by his invitation that the poet Arion came to Corinth to organize the dithyramb. He devoted no less attention to the increase of Corinthian commerce, which in his days plied busily on both eastern and western seas. With this end in view he established colonies at Potidaea and Apollonia in Macedonia, at Anactorium and Leucas in north-western Greece, and he is said to have projected a canal through the Isthmus, In Greece proper he conquered Epidaurus, and with the help of his fleet of triremes brought the important trading centre of Corcyra under his control, while his interest in the Olympian festival is perhaps attested by a dedication which may be ascribed to him—the famous "chest of Cypselus." He cultivated friendly relations with the tyrants of Miletus and Mytilene, and maintained a connexion with the kings of Lydia, of Egypt and, possibly, of Phrygia. In spite of these varied achievements Periander never entirely conciliated his subjects, for he could not trust himself without a bodyguard. Moreover his family life, according to all accounts, was unfortunate. His sons all died or were estranged from him, and the murder of his last remaining child Lycophron, the governor of Corcyra, is said to have broken his spirit and hastened on his death.

Periander was reckoned one of the seven sages of Greece, and was the reputed author of a collection of maxims (Ὑποθῆκαι) in 2000 verses. The letters ascribed to him by Diogenes Laërtius are undoubtedly spurious.

Herodotus iii. 48–53, v. 92; Aristotle, *Politics*, v. 6, 10–12; Heracleides Ponticus in C. Müller's *Frag. hist. graec.* ii. 212; Nicolaus Damascenus, ibid., iii. 393; Diogenes Laërtius, *De vitis clarorum philosophorum*, i. ch. 7. (M. O. B. C.)

PERICLES (490–429 B.C.), Athenian statesman, was born about 490 B.C., the son of Xanthippus and Agariste. His father[1] took a prominent part in Athenian politics, and in 479 held high command in the Greek squadron which annihilated the remnants of Xerxes' fleet at Mycale; through his mother, the niece of Cleisthenes, he was connected with the former tyrants of Sicyon and the family of the Alcmaeonidae. His early training was committed to the ablest and most advanced teachers of the day: Damon instructed him in music, Zeno the Eleatic revealed to him the powers of dialectic; the philosopher Anaxagoras, who lived in close friendship with Pericles, had great influence on his cast of thought and was commonly held responsible for that calm and undaunted attitude of mind which he preserved in the midst of the severest trials.

The first important recorded act of Pericles falls in 463, when he helped to prosecute Cimon on a charge of bribery, after the latter's Thasian campaign; but as the accusation could hardly have been meant seriously Pericles was perhaps put forward only as a lay-figure. Undue prominence has commonly been assigned to him in the attack upon the Areopagus in 462 or 461 (see Areopagus, Cimon). The Aristotelian *Constitution of Athens* shows conclusively that Pericles was not the leader of this campaign, for it expressly attributes the bulk of the reforms to Ephialtes (ch. 25), and mentions Ephialtes and Archestratus as the authors of the laws which the reactionaries of 404 sought to repeal (ch. 35): moreover, it was Ephialtes,[2] not Pericles, on whom the Conservatives took revenge as the author of their discomfiture. To Ephialtes likewise we must ascribe the renunciation of the Spartan alliance and the new league with Argos and Thessaly (461).

Not long after, however, when Ephialtes fell by the dagger, Pericles undoubtedly assumed the leading position in the state. The beginning of his ascendancy is marked by an unprecedented outward expansion of Athenian power. In continuance of Cimon's policy, 200 ships were sent to support the Egyptian insurgents against Persia (459),[3] while detachments operated against Cyprus and Phoenicia. At the same time Athens embarked on several wars in Greece Proper. An alliance with the Megarians, who were being hard pressed by their neighbours of Corinth, led to enmity with this latter power, and before long Epidaurus and Aegina were drawn into the struggle. On sea the Athenians, after two minor engagements, gained a decisive victory which enabled them to blockade Aegina. On land their general Myronides beat off two Corinthian attacks on Megara, which had been further secured by long walls drawn between the capital and its port Nisaea, nearly a mile distant. In 457 the Athenians and their allies ventured to intercept a Spartan force which was returning home from central Greece. At Tanagra in Boeotia a pitched battle was fought, in which both Pericles and the partisans of Cimon distinguished themselves. The Spartans were successful but did not pursue their advantage, and soon afterwards the Athenians, seizing their opportunity, sallied forth again, and, after a victory under Myronides at Oenophyta, obtained the submission of all Boeotia, save Thebes, and of Phocis and Locris. In 455 Tolmides ravaged Laconia and secured Naupactus on the Corinthian gulf; in 454[4] Pericles himself defeated the Sicyonians, and made a descent upon Oeniadae at the mouth of the gulf, and in 453 conducted a cleruchy to the Thracian Chersonese. These years mark the zenith of Athenian greatness. Yet the drain on the country's strength was severe, and when news arrived in 453 that the whole of the Egyptian armament, together with a reserve fleet, had been destroyed by the Persians, a reaction set in, and Cimon, who was recalled on Pericles' motion (but see Cimon), was empowered to make peace with Sparta on the basis of the *status quo*. For a while the old anti-Persian policy again found favour in Athens, and Cimon led a great expedition against Cyprus; but on Cimon's death hostilities were suspended, and a lasting arrangement with Persia was brought about.[5] It was probably in order to mark the definite conclusion of the Persian War and to obtain recognition for Athens' work in punishing the Mede that Pericles now[6] proposed a pan-Hellenic congress at Athens to consult about the rebuilding of the ruined temples and the policing of the seas; but owing to the refusal of Sparta the project fell through.

Pericles may now have hoped to resume his aggressive policy in Greece Proper, but the events of the following years completely disillusioned him. In 447 an Athenian army, which had marched into Boeotia to quell an insurrection, had to surrender in a body at Coronea, and the price of their ransom was the evacuation of Boeotia. Upon news of this disaster Phocis, Locris and Euboea revolted, and the Megarians massacred their Athenian garrison, while a Spartan army penetrated into Attica as far as Eleusis. In this crisis Pericles induced the Spartan leaders to retreat, apparently by means of a bribe, and hastened to reconquer Euboea; but the other land possessions could not be recovered, and in a thirty years' truce which was arranged in 445 Athens definitely renounced her predominance in Greece Proper. Pericles' foreign policy henceforward underwent a profound change—to consolidate the naval supremacy, or to extend it by a cautious advance, remained his only ambition.

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[1] He must have been born before 485–484, in which years his father was ostracized. On the other hand, Plutarch describes him as νέος ὤν, *i.e.* not yet 30, in 463.

[2] The later eminence of Pericles has probably misled historians into exaggerating his influence at this time. Even the *Const. Ath.* (ch. 27) says that Pericles took "some" prerogatives from the Areopagus; this looks like a conjecture based on Arist. Pol. ii. 9 (12), 1273; τὴν ἐν Ἀρείῳ πάγῳ βουλὴν Ἐφιάλτης ἐκόλουσε καὶ Περικλῆς, a passage which really proves nothing. Plutarch, who is clearly blinded by Pericles' subsequent brilliance, makes him suddenly burst into prominence and hold the highest place for 40 years (*i.e.* from 469); he degrades Ephialtes into a tool of Pericles.

[3] The chronology of these years down to 449 is not quite certain.

[4] An abortive expedition to reinstate a Thessalian prince probably also belongs to this year; there is also evidence that Athens interfered in a war between Selinus and Segesta in Sicily about this time.

[5] The "peace of Callias" is perhaps a fiction of the 4th century orators. All the earlier evidence goes to show that only an informal understanding was arrived at, based on the *de facto* inability of either power to cripple the other (see Cimon).

[6] 448 seems the most likely date. Before 460 Pericles' influence was as yet too small; 460–451 were years of war. After 445 Athens was hardly in a position to summon such a congress, and would not have sent 10 envoys out of 20 to northern and central Greece, where she had just lost all her influence; nor is it likely that the building of the Parthenon (begun not later than 447) was entered on before the congress.

While scouting the projects of the extreme Radicals for interfering in distant countries, he occasionally made a display of Athens' power abroad, as in his expedition to the Black Sea,[1] and in the colonization of Thurii,[2] which marks the resumption of a Western policy.

The peaceful development of Athenian power was interrupted by the revolt of Samos in 440. Pericles himself led out a fleet against the seceders and, after winning a first engagement, unwisely divided his armament and allowed one squadron to be routed. In a subsequent battle he retrieved this disaster, and after a long blockade reduced the town itself. A demand for help which the Samians sent to Sparta was rejected at the instance of the Corinthians.

Turning to Pericles' policy towards the members of the Delian League, we find that he frankly endeavoured to turn the allies into subjects (see Delian League). A special feature of his rule was the sending out of numerous cleruchies (*q.v.*), which served the double purpose of securing strategic points to Athens and converting the needy proletariate of the capital into owners of real property. The land was acquired either by confiscation from disaffected states or in exchange for a lowering of tribute. The chief cleruchies of Pericles are: Thracian Chersonese (453–452), Lemnos and Imbros, Andros, Naxos and Eretria (before 447);[3] Brea in Thrace (446); Oreus (445); Amisus and Astacus in the Black Sea (after 440); Aegina (431).

In his home policy Pericles carried out more fully Ephialtes' project of making the Athenian people truly self-governing. His chief innovation was the introduction of payment from the public treasury for state service. Chief of all, he provided a remuneration of 1 to 2 obols a day for the jurymen, probably in 451.[4] Similarly he created a "theoricon" fund which enabled poor citizens to attend the dramatic representations of the Dionysia. To him we may also attribute the 3 obols pay which the soldiers received during the Peloponnesian War in addition to the old-established provision-money. The archons and members of the boulê, who certainly received remuneration in 411, and also some minor magistrates, were perhaps paid for the first time by Pericles. In connexion with this system of salaries should be mentioned a somewhat reactionary law carried by Pericles in 451, by which an Athenian parentage on both sides was made an express condition of retaining the franchise and with it the right of sitting on paid juries. The measure by which the archonship was opened to the third and (practically) to the fourth class of citizens (the Zeugitae and Thetes) may also be due to Pericles; the date is now known to be 457 (*Const. Ath.* 26; and see Archon).

The last years of his life were troubled by a new period of storm and stress which called for his highest powers of calculation and self-control. A conflict between Corcyra and Corinth, the second and third naval powers of Greece, led to the simultaneous appearance in Athens of an embassy from either combatant (433). Pericles had, as it seems, resumed of late a plan of Western expansion by forming alliances with Rhegium and Leontini, and the favourable position of Corcyra on the trade-route to Sicily and Italy, as well as its powerful fleet, no doubt helped to induce him to secure an alliance with that island, and so to commit an unfriendly act towards a leading representative of the Peloponnesian League. Pericles now seemed to have made up his mind that war with Sparta, the head of that League, had become inevitable. In the following spring he fastened a quarrel upon Potidaea, a town in Chalcidice, which was attached by ancient bonds to Corinth, and in the campaign which followed Athenian and Corinthian troops came to blows. A further *casus belli* was provided by a decree forbidding the importation of Megarian goods into the Athenian Empire,[5] presumably in order to punish Megara for her alliance with Corinth (spring 432). The combined complaints of the injured parties led Sparta to summon a Peloponnesian congress which decided on war against Athens, failing a concession to Megara and Corinth (autumn 432). In this crisis Pericles persuaded the wavering assembly that compromise was useless, because Sparta was resolved to precipitate a war in any case. A further embassy, calling upon the Athenians to expel the accursed family of the Alcmaeonidae, clearly aimed at Pericles himself as its chief representative, was left unheeded, and early in 431 hostilities began between Athens and Sparta and their respective allies (see Peloponnesian War).

At the same time, Pericles was being sorely hampered by his adversaries at home. The orthodox Conservatives and some democrats who were jealous of his influence, while afraid to beard the great statesman himself, combined to assail his nearest friends. The sculptor Pheidias (*q.v.*) was prosecuted on two vexatious charges (probably in 433), and before he could disprove the second he died under arrest. Anaxagoras was threatened with a law against atheists, and felt compelled to leave Athens. A scandalous charge against his mistress Aspasia, which he defeated by his personal intercession before the court, was taken very much to heart by Pericles. His position at home scarcely improved during the war. His policy of abandoning the land defence was unpopular with the land-owning section of the people, who from the walls of Athens could see their own property destroyed by the invaders. At the end of the first year of war (early in 430) Pericles made a great appeal to the pride of his countrymen in his well-known funeral speech. But in the ensuing summer, after a terrible outbreak of plague had ravaged the crowded city, the people became thoroughly demoralized. Pericles led a large squadron to harry the coasts of the Peloponnese, but met with little success. On his return the Athenians sued for peace, though without success, and a speech by Pericles had little effect on their spirits. Late in 430 they deposed him from his magistracy. In addition to this they prosecuted him on a charge of embezzlement, and imposed a fine of 50 talents. A revulsion of feeling soon led to his reinstatement, apparently with extraordinary powers. But the plague, which had carried off two of his sons and a sister, had left its mark also on Pericles himself. In the autumn of 429 he died[6] and was buried near the Academia, where Pausanias (150 A.D.) saw his tomb. A slightly idealized portrait of Pericles as *strategus* is preserved to us in the British Museum bust, No. 549, which is a good copy of the well-known bronze original by Cresilas.

If we now endeavour to give a general estimate of Pericles' character and achievements, it will be well to consider the many departments of his activity one by one. In his foreign policy Pericles differs from those statesmen of previous generations who sought above all the welfare of Greece as a whole. His standpoint was at all times purely Athenian. Nor did he combine great statesmanlike qualities with exceptional ability in the field. We may clearly distinguish two periods in his administration of foreign affairs. At first, joining to Cimon's anti-Persian ambitions and Themistocles' schemes of Western expansion a new policy of aggression on the mainland, he endeavoured to push forward Athenian power in every direction, and engaged himself alike in Greece Proper, in the Levant and in Sicily. After Cimon's death he renounced the war against Persia, and the collapse of 447–445 had the effect of completing his change of attitude. Henceforward he repressed all projects of reckless enterprise, and confined himself to the gradual expansion and consolidation of the empire. It is not quite easy to see why he abandoned this successful policy in order to hasten on a war with Sparta, and neither the Corcyrean alliance nor the Megarian decree seems justified by the facts as known to us, though commercial motives may have played a part which we cannot now gauge. In his adoption of a purely defensive policy at the beginning of the Peloponnesian War, he miscalculated the temper of the Athenians, whose morale would have been better sustained by a greater show of activity. But in the main his policy in 431–429 was sound, and the disasters of the war cannot fairly be laid to his charge. The foundation of cleruchies was an admirable device, which in many ways anticipated the colonial system of the Romans.

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[1] The date can hardly be fixed; probably it was after 440.

[2] It has been doubted whether Pericles favoured this enterprise, but among its chief promoters were two of his friends, Lampon the soothsayer and Hippodamus the architect. The oligarch Cratinus (in a frag. of the *Φυγάδες*) violently attacks the whole project.

[3] These dates are suggested by the decrease of tribute which the inscriptions prove for this year.

[4] This is the date given by the *Const. Ath.*, which also mentions a *διαψη[φισμὸς τῶν δικαστῶν]* (Blass' restoration) in frag. c. 18. The confused story of Philochorus and Plutarch, by which 4760 citizens were disfranchised or even sold into slavery in 445, when an Egyptian prince sent a largess of corn, may refer to a subsequent application of Pericles' law, though probably on a much milder scale than is here represented.

[5] The general impression in Greece was that this decree was the proximate cause of the war. The scurrilous motives which Aristophanes suggests for this measure can be entirely disregarded.

[6] His dying boast, that "no Athenian had put on mourning through his doing," perhaps refers to his forbearance towards his political rivals, whom he refused to ruin by prosecution.

In his attitude towards the members of the Delian League Pericles likewise maintained a purely Athenian point of view. But he could hardly be said seriously to have oppressed the subject cities, and technically all the League money was spent on League business, for Athena, to whom the chief monuments in Athens were reared, was the patron goddess of the League. Under Pericles Athens also attained her greatest measure of commercial prosperity, and the activity of her traders all over the Levant, the Black Sea and the West, is attested not only by literary authority, but also by numerous Attic coins, vases, &c.

Pericles' home policy has been much debated since ancient times. His chief enactments relate to the payment of citizens for State service. These measures have been interpreted as an appeal to the baser instincts of the mob, but this assumption is entirely out of keeping with all we know of Pericles' general attitude towards the people, over whom Thucydides says he practically ruled as a king. We must, then, admit that Pericles sincerely contemplated the good of his fellow-countrymen, and we may believe that he endeavoured to realize that ideal Athens which Thucydides sketches in the Funeral Speech—an Athens where free and intelligent obedience is rendered to an equitable code of laws, where merit finds its way to the front, where military efficiency is found along with a free development in other directions and strangles neither commerce nor art. In accordance with this scheme Pericles sought to educate the whole community to political wisdom by giving to all an active share in the government, and to train their aesthetic tastes by making accessible the best drama and music. It was most unfortunate that the Peloponnesian War ruined this great project by diverting the large supplies of money which were essential to it, and confronting the remodelled Athenian democracy, before it could dispense with his tutelage, with a series of intricate questions of foreign policy which, in view of its inexperience, it could hardly have been expected to grapple with successfully.

Pericles also incurred unpopularity because of his rationalism in religious matters; yet Athens in his time was becoming ripe for the new culture, and would have done better to receive it from men of his circle—Anaxagoras, Zeno, Protagoras and Meton—than from the more irresponsible sophists. The influence of Aspasia on Athenian thought, though denounced unsparingly by most critics, may indeed have been beneficial, inasmuch as it tended towards the emancipation of the Attic woman from the over-strict tutelage in which she was kept. As a patron of art Pericles was a still greater force. His policy in encouraging the drama has already been mentioned: among his friends he could count three of the greatest Greek writers—the poet Sophocles and the historians Herodotus and Thucydides. Pericles likewise is responsible for the epoch-making splendour of Attic art in his time, for had he not so fully appreciated and given such free scope to the genius of Pheidias, Athens would hardly have witnessed the raising of the Parthenon and other glorious structures, and Attic art could not have boasted a legion of first-rate sculptors of whom Alcamenes, Agoracritus and Paeonius are only the chief names. (See also Greek Art.)

Of Pericles' personal characteristics we have a peculiarly full and interesting record. He was commonly compared to Olympian Zeus, partly because of his serene and dignified bearing, partly by reason of the majestic roll of the thundering eloquence, with its bold poetical imagery, with which he held friend and foe spellbound. The same dignity appeared in the grave beauty of his features, though the abnormal height of his cranium afforded an opportunity for ridicule of which the comedians made full use. In spite of an unusually large crop of scandals about him we cannot but believe that he bore an honourable character, and his integrity is vouched for by Thucydides in such strong terms as to exclude all further doubt on the question.

Ancient Authorities.—Our chief source must always remain Thucydides (i. and ii. 1–65), whose insight into the character and ideals of Pericles places him far above all other authorities. The speeches which he puts into his mouth are of special value in disclosing to us Pericles' inmost thoughts and aspirations (i. 140–144; ii. 35–46; ii. 60–64). Thucydides alone shows sympathy with Pericles, though, as J. B. Bury points out (*Ancient Greek Historians*, 1909, pp. 133 seq.), he was by no means a blind admirer. Of other 5th-century sources, Aristophanes is obviously a caricaturist, pseudo-Xenophon (*de republica Atheniensium*) a mere party pamphleteer. Plato, while admiring Pericles' intellect, accuses him of pandering to the mob; Aristotle in his *Politics* and especially in the *Constitution of Athens*, which is valuable in that it gives the dates of Pericles' enactments as derived from an official document, accepts the same view. Plutarch (*Pericles*) gives many interesting details as to Pericles' personal bearing, home life, and patronage of art, literature and philosophy, derived in part from the old comic poets, Aristophanes, Cratinus, Eupolis, Hermippus, Plato and Teleclides; in part from the contemporary memoirs of Stesimbrotus and Ion of Chios. At the same time he reproduces their scandalous anecdotes in a quite uncritical spirit, and accepts unquestioningly the 4th-century tradition. He quotes Aristotle, Heraclides Ponticus, Aeschines Socraticus, Idomeneus of Lampsacus and Duris of Samos, and is also indebted through some Alexandrine intermediary to Ephorus and Theopompus. Diodorus (xi. and xii.), who copied Ephorus, contains nothing of value.

Modern Works.—Historians are agreed that Pericles was one of the most powerful personalities of ancient times, and generally allow him to have been a man of probity. J. Beloch, *Griech. Gesch.* vols. i. and ii. (Strassburg and Bonn, 1893–1896), and *Die attische Politik seit Perikles* (Leipzig, 1884) takes the most disparaging view; E. Abbott, *Greek Hist.*, vol. ii. (London, 1892), and M. Duncker, *Gesch. d. Altertums*, vols. viii., ix. (Leipzig, 1884–1886), are on the whole unfavourable; Adolf Schmidt, *Das Perikleische Zeitalter* (Jena, 1877), V. Duruy, *History of Greece* (Eng. trans., London, 1892), G. Busolt, *Griech. Gesch.*, vol. iii. (Gotha, 1897, 1904), and E. Meyer, *Gesch. d. Altertums*, vols. iii. and iv. (Stuttgart, 1901), *Forschungen*, vol. ii. (Halle, 1899; London, 1902), apportion praise and blame more equally; J. B. Bury and E. Curtius, *Hist. of Greece* (Eng. trans., vols. ii. and iii., London, 1869, 1870), A. Holm, *Hist. of Greece* (Eng. trans., vol. ii., London, 1895), W. Lloyd, *The Age of Pericles* (London, 1875), and especially G. Grote, *Hist. of Greece*, vols. iv. and v. (see also additional notes in the edition by J. M. Mitchell and M. Caspari, 1907) take a favourable view. For Pericles' buildings, see C. Wachsmuth, *Gesch. d. Stadt Athen*, i. 516–560 (Leipzig, 1874); E. A. Gardner, *Ancient Athens* (London, 1902), for his strategy, H. Delbrück, *Die Strateg. d. Perikles* (Berlin, 1890). See Athens: *History*; Greece: *Ancient History*; and Greek Art. (M. O. B. C.)

PERIDOT, sometimes written peridote, a name applied by jewelers to "noble olivine," or that kind of olivine which can be used as a gem-stone (see Olivine). The word peridot is an old trade-term, of unknown origin, used by French jewelers and introduced into science by J. R. Haüy. Peridot is practically the same stone as chrysolite (*q.v.*), though it is convenient to restrict that term to transparent olivine of pale yellowish green colour, and to apply the term peridot to those kinds which are darker and decidedly green: the colour, which is due to the presence of ferrous iron, is never vivid, like that of emerald, but is usually some shade of olive-, pistachio- or leek-green. Although the stone is sometimes cut *en cabochon*, and in rose-form, the cutting best adapted to display the colour is that of a table or a step-cut stone. Unfortunately the hardness of peridot is only about 6·5, or but little above that of glass, so that the polished stone readily suffers abrasion by wear. In polishing peridot the final touch is given on a copper wheel moistened with sulphuric acid.

Although olivine has a fairly wide distribution in nature, the varieties used as gem-stones are of very limited occurrence. Much mystery for a long time surrounded the locality which yields most of the peridot of commerce but it is now identified with the island of St John, or Isle Zeboiget, in the Red Sea, where it occurs, as shown by M. J. Couyat, in an altered dunite, or olivine rock (*Bull soc. franç. min.*, 1908). This is probably the Topaz Isle, *τοπάζιος νῆσος*, of the ancients. It is generally held that the mineral now called topaz was unknown to ancient and mediaeval writers, and that their *τοπάζιον* was our peridot. Such was probably the Hebrew *pitdah*, translated topaz in the Old Testament. Dr G. F. Kunz has suggested that the peridots of modern trade are largely derived from old jewelry. The famous shrine of the Three Kings in Cologne Cathedral contains a large peridot, which has commonly been regarded as an emerald. It is notable that pebbles of transparent olivine, fit for cutting, are found in the United States in Montana, Arizona and New Mexico; in consequence of their shape and curiously pitted surface they are known as "Job's tears." (F. W. R.*)

PERIDOTITE, a plutonic holo-crystalline rock composed in large part of olivine, and almost or entirely free from feldspar. The rocks are the most basic, or least siliceous plutonic rocks, and contain much iron oxide and magnesia. Hence they have dark colours and a high specific gravity (3·0 and over). They weather readily and are changed to serpentine, in which process water is absorbed and enters into chemical combination with the silicates of magnesia and iron. In some peridotites, such as the dunites, olivine greatly preponderates over all other minerals. It is always in small, rather rounded crystals without good crystalline form, and pale green in colour. Most of the rocks of this group, however, contain other silicates such as augite, hornblende, biotite or rhombic pyroxene, and often two or three of these are present. By the various mineral combinations different species are produced, *e.g.* mica-peridotite, hornblende-peridotite, enstatite-peridotite. Of the accessory minerals the commonest are iron oxides and chromite or picotite. In some peridotites these form segregations or irregular masses which are of importance as sources of the ores of chromium. Corundum occurs in small crystals in many North American peridotites and platinum and the nickel-iron compound awaruite are found in rocks of this class in New Zealand. Red garnet (pyrope) characterizes the peridotites of Bohemia. The diamond mines of South Africa are situated in pipes or volcanic necks occupied by a peridotite breccia which has been called kimberlite. In this rock in addition to diamond the following minerals are found, hypersthene, garnet, biotite, pyroxene (chrome-diopside), ilmenite, zircon, &c.

Some peridotites have a granular structure, *e.g.* the dunites, all the crystal grains being of rounded shape and nearly equal size; a few are porphyritic with large individuals of diallage, augite or hypersthene. Some are banded with parallel bands of dissimilar composition, the result probably of fluxion in a magma which was not quite homogeneous. The great majority of the rocks of this group are poikilitic, that is to say, they contain olivine in small rounded crystals embedded in large irregular masses of pyroxene or hornblende. The structure is not unlike that known as ophitic in the dolerites, and arises from the olivine having first separated out of the liquid magma while the pyroxene or amphibole succeeded it and caught up its crystals. In hand specimens of the rocks the smooth and shining cleavage surfaces of hornblende and augite are dotted over with dull blackish green spots of olivine; to this appearance the name "lustre-mottling" has been given.

Mica-peridotites are not of frequent occurrence. A well-known rock from Kaltes Thal, Harzburg, contains much biotite, deep brown in thin section. Other examples are found in India and in Arkansas. Poikilitic structure is rarely well developed in this group. The "blue-ground" of Kimberley which contains the diamonds is a brecciform biotite-hypersthene-peridotite with augite. In the north of Scotland, in several places in Sutherland and Ross, there are peridotites with silvery yellow green biotite and large plates of pale green hornblende: these have been called scyelites. In the hornblende-peridotites lustre-mottling is often very striking. The amphibole may be colourless tremolite in small prisms, as in some varieties of serpentine from the Lizard (Cornwall); or pale green hornblende as in scyelite. In both these cases there is some probability that the hornblende has developed, partly at least, from olivine or augite. In sheared peridotites tremolite and actinolite are very frequent. Other rocks contain dark brown hornblende, with much olivine; there may also be augite which is often intergrown perthitically with the hornblende. Examples of this type occur in North Wales, Anglesey, Cornwall, Cortland, New York, and many other localities. A well-known peridotite from Schriesheimer Tal in the Odenwald has pale brownish green amphibole in large crystals filled with small grains of olivine which are mostly serpentinized. Very often primary brown hornblende in rocks of this type is surrounded by fringes and outgrowths of colourless tremolite which has formed as a secondary mineral after olivine. Complete pseudomorphs after olivine composed of a matrix of scaly talc and chlorite crossed by a network of tremolite needles, are also very common in some peridotites, especially those which have undergone pressure or shearing: these aggregates are known as pilite.

The peridotites which contain monoclinic pyroxene may be divided into two classes, those rich in diallage and those in which there is much augite. The diallage-peridotites have been called wehrlites; often they show excellent lustre-mottling. Brown or green hornblende may surround the diallage, and hypersthene may occur also in lamellar intergrowth with it. Some of these rocks contain biotite, while a little feldspar (often saussuritic) may often be seen in the sections. Rocks of this kind are known in Hungary, in the Odenwald and in Silesia. In Skye the pyroxene-bearing peridotites usually contain green chrome-diopside (a variety of augite distinguished by its pale colour and the presence of a small amount of chromium). The augite-peridotites are grouped by German petrographers under the picrites, but this term has a slightly different signification in the English nomenclature (see Picrite).

The enstatite-peridotites are an important group represented in many parts of the world. Their rhombic pyroxene is often very pale coloured but may then be filled with platy enclosures which give it a metallic or bronzy lustre. These rocks have been called saxonites or harzburgites. When weathered the enstatite passes into platy masses of bastite. Picotite and chromite are common accessory minerals and diallage or hornblende may also be present. Many of the serpentine rocks of the Lizard (Cornwall) Ayrshire and north-western Scotland are of this type. Examples are known also from Baste near Harzburg, New York and Maryland, Norway, Finland, New Zealand, &c. Often the enstatite crystals are of large size and are very conspicuous in the hand specimens. They may be porphyritic, or may form a coarsely crystalline matrix enclosing innumerable olivine grains, and then lustre-mottling is as a rule very well shown.

The lherzolites are rocks, first described from Lherz in the Pyrenees, consisting of olivine, chrome-diopside and enstatite, and accessory picotite or chromite. They are fine-grained, bright green in colour, often very fresh, and may be somewhat granulitic. The dunites are peridotites, similar to the rock of Dun Mountain, New Zealand, composed essentially of olivine in a finely granular condition. Many examples of this type are known in different parts of the world, usually as local facies of other kinds of peridotite. In olivine-basalts of Tertiary age in the Rhine district small nodules of green olivine occur frequently. They are of rounded shapes and may be a foot in diameter. The structure is granular and in addition to olivine they may contain chromite, spinel and magnetite, enstatite and chrome-diopside. Some geologists believe these to be fragments of dunite detached from masses of that rock not exposed at the surface; others consider that they are aggregations of the early minerals of the basalt magma, which were already crystallized before the liquid rock was emitted.

The great majority of stony or lithoidal meteorites (aerolites) are rich in olivine and present many analogies to the terrestrial peridotites. Among their minerals are hypersthene (enstatite) augite and chrome-diopside, chromite, pyrite and troilite, nickeliferous iron and basic plagioclase feldspar. The structure of these meteorites is described as "chondritic"; their minerals often occur as small rounded grains arranged in radiate clusters; this has very rarely been observed in ordinary peridotites.

Although many peridotites are known in which the constituent minerals are excellently preserved, the majority show more or less advanced decomposition. The olivine is especially unstable and is altered to serpentine, while augite, hornblende and biotite are in large measure fresh. In other cases the whole rock is changed to an aggregate of secondary products. Most serpentines (*q.v.*) arise in this way. (J. S. F.)

PÉRIER, CASIMIR PIERRE (1777–1832), French statesman, was born at Grenoble on the 11th of October 1777, the fourth son of a rich banker and manufacturer, Claude Périer (1742–1801), in whose house the estates of Dauphiny met in 1788. Claude Périer was one of the first directors of the Bank of France; of his eight sons, Augustin (1773–1833), Antoine Scipion (1776–1821), Casimir Pierre and Camille (1781–1844), all distinguished themselves in industry and in politics. The family removed to Paris after the revolution of Thermidor, and Casimir joined the army of Italy in 1798. On his father's death he left the army and with his brother Scipion founded a bank in Paris, the speculations of which he directed while Scipion occupied himself with its administration. He opposed the ruinous methods by which the duc de Richelieu sought to raise the war indemnity demanded by the Allies, in a pamphlet *Réflexions sur le projet d'emprunt* (1817), followed in the same year by *Dernières réflexions . . .* in answer to an inspired article in the *Moniteur*. In the same year he entered the chamber of deputies for Paris, taking his seat in the Left Centre with the moderate opposition, and making his first speech in defence of the freedom of the press. Re-elected for Paris in 1822 and 1824, and in 1827 for Paris and for Troyes, he elected to represent Troyes, and sat for that constituency until his death. Périer's violence in debate was not associated with any disloyalty to the monarchy, and he held resolutely aloof from the republican conspiracies and intrigues which prepared the way for the revolution of 1830. Under the Martignac ministry there was some prospect of a reconciliation with the court, and in January 1829 he was nominated a candidate for the presidency of the chamber; but in August with the elevation to power of Polignac the truce ceased, and on the 15th of March 1830 he was one of the 221 deputies who repudiated the pretensions put forward by Charles X. Averse by instinct and by interest to popular revolution he nevertheless sat on the provisory commission of five at the hôtel-de-ville during the days of July, but he refused to sign the declaration of Charles X.'s dethronement. Périer reluctantly recognized in the government of Louis Philippe the only alternative to the continuance of the Revolution; but he was no favourite with the new king, whom he scorned for his truckling to the mob. He became president of the chamber of deputies, and sat for a few months in the cabinet, though without a portfolio. On the fall of the weak and discredited ministry of Laffitte, Casimir Périer, who had drifted more and more to the Right, was summoned to power (March 13, 1831), and in the short space of a year he restored civic order in France and re-established her credit in Europe. Paris was in a constant state of disturbance from March to September, and was only held in check by the premier's determination; the workmen's revolt at Lyons was suppressed after hard fighting; and at Grenoble, in face of the quarrels between the military and the inhabitants, Périer declined to make any concession to the townsfolk. The minister refused to be dragged into armed intervention in favour of the revolutionary government of Warsaw, but his policy of peace did not exclude energetic demonstrations in support of French interests. He constituted France the protector of Belgium by the prompt expedition of the army of the north against the Dutch in August 1831; French influence in Italy was asserted by the audacious occupation of Ancona (Feb. 23, 1832); and the refusal of compensation for injuries to French residents by the Portuguese government was followed by a naval demonstration at Lisbon. Périer had undertaken the premiership with many forebodings, and overwork and anxiety prepared the way for disease. In the spring of 1832 during the cholera outbreak in Paris, he visited the hospitals in company with the duke of Orleans. He fell ill the next day of a violent fever, and died six weeks later, on the 16th of May 1832.

His *Opinions et discours* were edited by A. Lesieur (2 vols., 1838); C. Nicoullaud published in 1894 the first part (*Casimir-Périer, député de l'opposition, 1817–1830*) of a study of his life and policy; and his ministry is exhaustively treated by Thureau-Dangin in vols. i. and ii. (1884) of his *Histoire de la monarchie de juillet*.

His elder son, Auguste Victor Laurent Casimir Périer (1811–1876), the father of President Casimir-Périer (see Casimir-Périer), entered the diplomatic service, being attached successively to the London, Brussels and St Petersburg embassies, and in 1843 became minister plenipotentiary at Hanover. In 1846 he resigned from the service to enter the legislature as deputy for the department of Seine, a constituency which he exchanged for Aube after the Revolution of 1848. On the establishment of the Second Empire he retired temporarily from public life, and devoted himself to economic questions on which he published a series of works, notably *Les Finances et la politique* (1863), dealing with the interaction of political institutions and finance. He contested Grenoble unsuccessfully in 1863 against the imperial candidate, Casimir Royer; and failed again for Aube in 1869. In 1871 he was returned by three departments to the National Assembly, and elected to sit for Aube. He was minister of the interior for a few months in 1871–1872, and his retirement deprived Thiers of one of the strongest elements in his cabinet. He also joined the short-lived ministry of May 1873. He consistently opposed all efforts in the direction of a monarchical restoration, but on the definite constitution of the republic became a life senator, declining MacMahon's invitation to form the first cabinet under the new constitution. He died in Paris on the 6th of June 1876.

For the family in general see E. Choulet, *La Famille Casimir-Périer* (Grenoble, 1894).

PERIGEE (Gr. περί, near, γῆ, the earth), in astronomy that point of the moon's orbit or of the sun's apparent orbit at which the moon or sun approach nearest to the earth. The sun's perigee and the earth's perihelion are so related that they differ 180° in longitude, the first being on the line from the earth toward the sun, and the second from the sun toward the earth. The longitude of the solar perigee is now 101°, that of the earth's perihelion 281°.

PÉRIGORD, one of the old provinces of France, formed part of the military government of Guienne and Gascony, and was bounded on the N. by Angoumois, on the E. by Limousin and Quercy, on the S. by Agenais and Bazadais, and on the W. by Bordelais and Saintonge. It is now represented by the departments of Dordogne and part of Lot-et-Garonne. Périgord was in two divisions: Périgord blanc (cap. Périgueux) and Périgord noir (cap. Sarlat). In the time of Caesar it formed the *civitas Petrocoriorum*, with Vesunna (Périgueux) as its capital. It became later part of *Aquitania secunda* and formed the *pagus petragoricus*, afterwards the diocese of Périgueux. Since the 8th century it had its own counts (see the *Histoire généalogique* of P. Anselme, tome iii.), who were feudatories of the dukes of Aquitaine and in the 13th century were the vassals of the king of England. In the 15th century the county passed into the hands of the dukes of Orleans, and in the 16th came to the family of d'Albret, becoming Crown land again on the accession of Henry IV.

See Dessalles, *Histoire du Périgord* (1888), the Bulletin of the *Société historique et archéologique du Périgord* (1874 seq.), *l'Inventaire sommaire de la "Collection de Périgord"* in the Bibliothèque nationale (1874); the *Dictionnaire topographique du département de la Dordogne* by the Vicomte de Gourgues (1873).

PÉRIGUEUX, a town of south-western France, formerly capital of the old province of Périgord, now chief town of the department of Dordogne, 79 m. E.N.E. of Bordeaux, on the railway between that city and Limoges. Pop. (1906), 28,199. The town, situated on an eminence on the right bank of the Isle, is divided into three parts. On the slope of the hill is the medieval town, bordered south-east by the river and on the other three sides by esplanades and promenades; to the west is the modern town, which stretches to the station; to the south of the modern town is the old Roman town or *cité*, now traversed by the railway.

Three bridges connect Périgueux with the left bank of the Isle, where stood Vesunna, the capital of the Petrocorii. Hardly a trace of this old Gallic town remains, but not far off, on the Plateau de la Boissière, the rampart of the old Roman camp can still be traced. On the right bank of the Isle, in the Roman city, there have been discovered some baths of the 1st or 2nd century, supplied by an aqueduct four miles long, which spanned the Isle. A circular building, called the "Tower of Vesunna," 68 ft. in diameter and 89 ft. in height, stands at what was formerly the centre of the city, where all the chief streets met. It is believed to have been originally the cella or main part of a temple, probably dedicated to the tutelary deities of Vesunna. Of the amphitheatre there still remain huge fragments of wall and vaulting. The building had a diameter of 1312 ft., that of the arena being 870 ft.; and, judging from its construction, must be as old as the 3rd or even the 2nd century. The counts of Périgueux used it for their château, and lived in it from the 12th to the end of the 14th century. In 1644 it was given over by the town to the Order of the Visitation, and the sisters took from it the stones required for the construction of their nunnery. The most remarkable, however, of the ruins of the *cité* is the Château Barrière, an example of the fortified houses formerly common there. Two of its towers date from the 3rd or 4th century, and formed part of the fortified enceinte; the highest tower is of the 10th century; and the part now inhabited is of the 11th or 12th century, and was formerly used as a burial chapel. The bulk of the château is of the 12th, and some of the windows of the 16th century.

The chief medieval building in the *cité* is the church of St Étienne, once the cathedral. It dates from the 11th and 12th centuries, but suffered much injury at the hands of the Protestants in the religious wars when the tower and two of the three cupolas were destroyed. The choir and its cupola were skilfully restored in the 17th century. A fine carved wooden reredos of the 17th century and a tomb of a bishop of the 12th century are to be seen in the interior. In the medieval town, known as Le Puy-St-Front, the most remarkable building is the cathedral of St Front, which, till its restoration, or rather rebuilding, in the latter half of the 19th century when the old features were to a great extent lost, was of unique architectural value. It bears a striking resemblance to the Byzantine churches and to St Mark's at Venice, and according to one theory was built from 984 to 1047, contemporaneously with the latter (977–1085). It consists of five great cupolas, arranged in the form of a Greek cross, and conspicuous from the outside. The arms of the cross are 69 ft. in width, and the whole is 184 ft. long. These cupolas, 89 ft. high from the keystone to the ground, are supported on a vaulted roof with pointed arches after the manner characteristic of Byzantine architecture. The pointed arches imitated from it prepared the way for the introduction of the Gothic style. Adjoining St Front on the west are the remains of an old basilica of the 6th century, above which rises the belfry, the only one in the Byzantine style now extant. It dates from the 11th century, and is composed of two massive cubes, placed the one above the other in retreat, with a circular colonnade surmounted by a dome. To the south-west of St Front, the buildings of an old abbey (11th to 16th century) surround a cloister dating chiefly from the 13th century. Of the fortifications of Puy St Front, the chief relic is the Tour Mataguerre (14th century).

Périgueux is seat of a bishop, prefect and court of assizes, and has tribunals of first instance and of commerce, a chamber of commerce and a branch of the Bank of France. Its educational establishments include a lycée for boys, training colleges for both sexes and a school of drawing. The trade of the town is in pigs, truffles, flour, brandy, poultry and pies known as *pâtés de Périgord.*

Vesunna was the capital of the Petrocorii, allies of Vercingetorix when Caesar invaded Gaul. The country was afterwards occupied by the Romans, who built a second city of Vesunna on the right bank of the Isle opposite the site of the Gallic town. The barbarian invasion brought this prosperity to a close. St Front preached Christianity here in the 4th century and over his tomb there was raised a monastery, which became the centre of the new town called Le Puy St Front. The *cité* was pillaged by the Saracens about 731, and in 844 the Normans devastated both quarters. The new town soon began to rival the old city in importance, and it was not until 1240 that the attempts of the counts of Périgord and the bishops to infringe on their municipal privileges brought about a treaty of union. During the Hundred Years' War, Périgueux was twice attacked by the English, who took the *cité* in 1356; and the whole town was ceded to them by the Treaty of Brétigny, but returned to the French Crown in the reign of Charles V. The county passed by marriage into the hands of Anthony of Bourbon, father of Henry IV., and was converted by the latter into royal domain. During the Huguenot wars Périgueux was frequently a stronghold of the Calvinists, who in 1575 did great destruction there, and it also suffered during the troubles of the Fronde.

PERIHELION (Gr. *περί*, near, *ἥλιος*, sun), in astronomy, the point of nearest approach of a body to the sun. (See ORBIT.)

PERIM, a British island in the strait of Bab-el-Mandeb, at the entrance to the Red Sea, and 96 m. W. by S. of Aden. Perim is 2 m. from the Arabian shore, is about 3½ m. long with an average breadth of over a mile and covers some 7 sq. m. There is a good harbour with easy entrance on the south side with a depth of water from 25 to 30 ft. It is largely used by mercantile vessels as a coaling-station and for taking in stores, including fresh water and ice. Perim, the Diodoros island of the *Periplus*, was, in consequence of the French occupation of Egypt, garrisoned from 1799 to 1801 by a British force. In view of the construction of the Suez Canal and the increasing importance of the Red Sea route to India the island was annexed to Great Britain in 1857, fortified and placed under the charge of the Aden residency. In 1861 a lighthouse was built at its eastern end. Submarine cables connect the island with Aden, Egypt and Zanzibar. Population, including a garrison of 50 sepoys, about 200.

PERINO DEL VAGA (1500–1547), a painter of the Roman school, whose true name was PERINO (or PIERO) BUONACCORSI. He was born near Florence on the 28th of June 1500. His father ruined himself by gambling, and became a soldier in the invading army of Charles VIII. His mother dying when he was but two months old, he was suckled by a she-goat; but shortly afterwards he was taken up by his father's second wife. Perino was first apprenticed to a druggist, but soon passed into the hands of a mediocre painter, Andrea da Ceri, and, when eleven years of age, of Ridolfo Ghirlandajo. Perino rapidly surpassed his fellow-pupils, applying himself especially to the study of Michelangelo's great cartoon. Another mediocre painter, Vaga from Toscanella, undertook to settle the boy in Rome, but first set him to work in Toscanella. Perino, when he at last reached Rome, was utterly poor, and with no clear prospect beyond journey-work for trading decorators. He, however, studied with great severity and spirit from Michelangelo and the antique, and was eventually entrusted with some of the subordinate work undertaken by Raphael in the Vatican. He assisted Giovanni da Udine in the stucco and arabesque decorations of the loggie of the Vatican, and executed some of those small but finely composed scriptural subjects which go by the name of "Raphael's Bible"—Raphael himself furnishing the designs. Perino's examples are: "Abraham about to sacrifice Isaac," "Jacob wrestling with the Angel," "Joseph and his Brethren," the "Hebrews crossing the Jordan," the "Fall and Capture of Jericho," "Joshua commanding the Sun to stand still," the "Birth of Christ," "His Baptism" and the "Last Supper." Some of these are in bronze-tint, while others are in full colour. He also painted, after Raphael's drawings, the figures of the planets in the great hall of the Appartamenti Borgia. Perino exhibited very uncommon faculty in these works and was soon regarded as second only to Giulio Romano among the great painter's assistants. To Raphael himself he was always exceedingly respectful and attentive, and the master loved him almost as a son. He executed many other works about Rome, always displaying a certain mixture of the Florentine with the Roman style.

After Raphael's death in 1520 a troublous period ensued for Perino, with a plague which ravaged Rome in 1523, and again with the sack of that city in 1527. Then he accepted an invitation to Genoa, where he was employed in decorating the Doria Palace, and rapidly founded a quasi-Roman school of art in the Ligurian city. He ornamented the palace in a style similar to that of Giulio Romano in the Mantuan Palazzo del Tè, and frescoed historical and mythological subjects in the apartments, fanciful and graceful arabesque work, sculptural and architectural details—in short, whatever came to hand. Among the principal works are: the "War between the Gods and Giants," "Horatius Cocles defending the Bridge," and the "Fortitude of Mutius Scaevola." The most important work of all, the "Shipwreck of Aeneas," is no longer extant. From Genoa Perino twice visited Pisa, and began some painting in the cathedral. Finally he returned to Rome, where Paul III. allowed him a regular salary till the painter's death. He retouched many of the works of Raphael, and laboured hard on his own account, undertaking all sorts of jobs, important or trivial. Working for any price, he made large gains, but fell into mechanical negligence. Perino was engaged in the general decoration of the Sala Reale, begun by Paul III., when his health, undermined by constant work and as constant irregularities, gave way, and he fell down dead on the 19th of October 1547. He is buried in the Pantheon.

Perino produced some excellent portraits, and his smaller oil pictures combine with the manner of Raphael something of that of Adrea del Sarto. Many of his works were engraved, even in his own lifetime. Daniele Ricciarelli, Girolamo Siciolante da Sermoneta, Luzio Romano and Marcello Venusti (Mantovano) were among his principal assistants. (W. M. R.)

PERINTHUS (Turk. *Eski Eregli*, old Heraclea), an ancient town of Thrace, on the Propontis, 22 m. W. of Selymbria, strongly situated on a small peninsula on the bay of that name. It is said to have been a Samian colony, founded about 599 B.C. According to Tzetzes, its original name was Mygdonia; later it was called Heraclea (Heraclea Thraciae, Heraclea Perinthus). It is famous chiefly for its stubborn and successful resistance to Philip II. of Macedon in 340; at that time it seems to have been more important than Byzantium itself.

PERIOD (Gr. περίοδος, a going or way round, circuit, περί, round, and ὁδός, way, road), a circuit or course of time, a cycle; particularly the duration of time in which a planet revolves round its sun, or a satellite round its primary, a definite or indefinite recurring interval of time marked by some special or peculiar character, *e.g.* in history, literature, art, &c.; it is so used of a division of geological time. Particular uses of the word are for the various phases through which a disease passes, the termination or conclusion of any course of events, the pause at the end of a completed sentence, and the mark (.) used to signify the same (see PUNCTUATION).

PERIODICALS, a general term for literary publications which appear in numbers or parts at regular intervals of time—as a rule, weekly, monthly or quarterly. The term strictly includes "newspapers" (*q.v.*), but in the narrower sense usually intended it is distinguished as a convenient expression for periodical publications which differ from newspapers in not being primarily for the circulation of news or information of ephemeral interest, and in being issued at longer intervals. In modern times the weekly journal has become so much of the nature of a newspaper that it seldom can be called a periodical in this sense. The present article chiefly deals with publications devoted to general literature, literary and critical reviews and magazines for the supply of miscellaneous reading. In the article SOCIETIES (*q.v.*) an account is separately given of the transactions and proceedings of learned and scientific bodies. Year-books, almanacs, directories and other annuals belong to a distinct type of publication, and are not referred to here.

BRITISH

The first literary periodical in English was the *Mercurius librarius, or a Faithful Account of all Books and Pamphlets* (1680), a mere catalogue, published weekly or fortnightly in London, followed by *Weekly Memorials for the Ingenious* (Jan. 16, 1681–1682 to Jan. 15, 1683), which was more of the type of the *Journal des Savants* (see under FRANCE below), whence it borrowed many contributions. Of the *History of Learning* (1691)—another with the same title came out in 1694—only a few numbers appeared, as the conductor, De la Crose, started the monthly *Works of the Learned* (Aug. 1691 to April 1692), devoted principally to continental scholarship. The monthly *Compleat Library* (1692 to 1694) was a venture of John Dunton; the monthly *Memoirs for the Ingenious* (1693), edited by J. de la Crose, ran for 12 months, and another with the same title appeared in the following year, only to enjoy a briefer career. The first periodical of merit and influence was the *History of the Works of the Learned* (1699–1712), largely consisting of descriptions of foreign books. The *Memoirs of Literature*, the first English review consisting entirely of original matter, published in London from 1710 to 1714, had for editor Michel de la Roche, a French Protestant refugee, who also edited at Amsterdam the *Bibliothèque angloise* (1717–1719), and subsequently *Mémoires littéraires de la Grande Bretagne* (1720–1724). Returning to England in 1725, he recommenced his *New Memoirs of Literature* (1725–1728), a monthly, and in 1730 a *Literary Journal*. Dr Samuel Jebb started *Bibliotheca literaria* (1722–1724), to appear every two months, which dealt with medals and antiquities as well as with literature, but only ten numbers appeared. *The Present State of the Republick of Letters* was commenced by Andrew Reid in January 1728, and completed in December 1736. It contained not only excellent reviews of English books but papers from the works of foreigners. Two volumes came out each year. It was successful, as also was the *Historia literaria* (1730–1734) of Archibald Bower.[1] The *Bee, or Universal Weekly Pamphlet* (1733–1735) of the unfortunate Eustace Budgell, and the *Literary Magazine* (1735–1736), with which Ephraim Chambers had much to do, were short-lived. The last named was continued in 1737 as the *History of the Works of the Learned*, and was carried on without intermission until 1743, when its place was taken by *A Literary Journal* (Dublin, 1744–1749), the first review published in Ireland. The *Museum* (1746) of R. Dodsley united the character of a review of books with that of a literary magazine. It came out fortnightly to the 12th of September 1747. Although England can show nothing like the *Journal des savants*, which has flourished almost without a break for two and a half centuries, a nearly complete series of reviews of English literature may be made up from 1681 to the present day.

After the close of the first quarter of the 18th century the literary periodical began to assume more of the style of the modern review, and in 1749 the title and the chief features were united in the *Monthly Review*, established by Ralph Griffiths,[2] who conducted it until 1803, whence it was edited by his son down to 1825. It came to an end in 1845. From its commencement the *Review* dealt with science and literature, as well as with literary criticism. It was Whig in politics and Nonconformist in theology. The first series ran from 1749 to December 1789, 81 vols.; the second from 1790 to 1815, 108 vols.; the third or new series from 1826 to 1830, 15 vols.; and the fourth from 1831 to 1845, 45 vols., when the magazine stopped. There is a general index (1749–1789) 3 vols., and another (1790–1816), 2 vols.

The Tory party and the established church were defended in the *Critical Review* (1756–1817), founded by Archibald Hamilton and supported by Smollett, Dr Johnson and Robertson. Johnson contributed to fifteen numbers of the *Literary Magazine* (1756–1758). The reviews rapidly increased in number towards the end of the century. Among the principal were the *London Review* (1775–1780), *A New Review* (1782–1786), the *English Review* (1783–1796), incorporated in 1797 with the *Analytical Review* (1788–1799), the *Anti-Jacobin Review and Magazine* (1798–1821), and the *British Critic* (1793–1843), the organ of the High Church party, and first edited by Archdeacon Nares and Beloe.

Quarterlies.

These periodicals had now become extremely numerous, and many of the leading London publishers found it convenient to maintain their own particular organs. It is not a matter of surprise, therefore, that the authority of the reviews should have fallen somewhat in public estimation. The time was ripe for one which should be quite independent of the booksellers, and which should also aim at a higher standard of excellence. As far back as 1755 Adam Smith, Blair and others had produced an *Edinburgh Review* which only ran to two numbers, and in 1773 Gilbert Stuart and William Smellie issued during three years an *Edinburgh Magazine and Review*. To Edinburgh is also due the first high-class critical journal, the *Edinburgh Review*, established in October 1802 by Jeffrey, Scott, Horner, Brougham and Sydney Smith. It created a new era in periodical criticism, and assumed from the commencement a wider range and more elevated tone than any of its predecessors. The first editor was Sydney Smith, then Jeffrey for many years, and later editors were Macvey Napier, William Empson, Sir G. C. Lewis, Henry Reeve and the Hon. Arthur Elliot. Its buff and blue cover was adopted from the colours of the Whig party whose political principles it advocated. Among its more famous contributors were Lord Brougham, Sir Walter Scott, Carlyle, Hazlitt and Macaulay. Scott, being dissatisfied with the new review, persuaded John Murray, his London publisher, to start its brilliant Tory competitor, the *Quarterly Review* (Feb. 1809), first edited by William Gifford, then by Sir J. T. Coleridge, and subsequently by J. G. Lockhart, Rev. Whitwell Elwin, W. M. Macpherson, Sir Wm. Smith, Rowland Prothero and G. W. Prothero. Among the contributors in successive years were Canning, Scott (who reviewed himself), Robert Southey,

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[1] Archibald Bower (1686–1766) was educated at Douai, and became a Jesuit. He subsequently professed himself a convert to the Anglican Church, and published a number of works, but was more esteemed for his ability than for his moral character.

[2] The biographers of Goldsmith have made us familiar with the name of Griffiths (1720–1803), the prosperous publisher, with his diploma of LL.D. granted by an American university, and with the quarrels between him and the poet.

Sir John Barrow, J. Wilson Croker, Isaac Disraeli, A. W. Kinglake, Lord Salisbury and W. E. Gladstone.[1] The *Westminster Review* (1824), established by the followers of Jeremy Bentham, advocated radical reforms in church, state and legislation. In 1836 it was joined to the *London Review* (1829), founded by Sir William Molesworth, and then bore the name of the *London and Westminster Review* till 1851, when it returned to the original title. Other quarterly reviews worth mentioning are the *Eclectic Review* (1805–1868), edited down to 1834 by Josiah Conder (1789–1855) and supported by the Dissenters; the *British Review* (1811–1825; the *Christian Remembrancer* (1819–1868); the *Retrospective Review* (1820–1826, 1828, 1853–1854), for old books; the *Foreign Quarterly Review* (1827–1846), afterwards incorporated with the *Westminster*; the *Foreign Review* (1828–1829); the *Dublin Review* (1836), a Roman Catholic organ; the *Foreign and Colonial Quarterly Review* (1843–1847); the *Prospective Review* (1845–1855), given up to theology and literature, previously the *Christian Teacher* (1835–1844); the *North British Review* (1844–1871); the *British Quarterly Review* (1845), successor to the *British and Foreign Review* (1835–1844); the *New Quarterly Review* (1852–1861), the *Scottish Review* (1853–1862), published at Glasgow; the Wesleyan *London Quarterly Review* (1853–); the *National Review* (1855–1864); the *Diplomatic Review* (1855–1881); the *Irish Quarterly Review* (1851–1859), brought out in Dublin; the *Home and Foreign Review* (1862–1864); the *Fine Arts Quarterly Review* (1863–1865); the *New Quarterly Magazine* (1873–1880); the Catholic *Union Review* (1863–1874); the Anglican *Church Quarterly Review* (1875); *Mind* (1876), dealing with mental philosophy; the *Modern Review* (1880–1884); the *Scottish Review* (1882); the *Asiatic Quarterly Review* (1886; since 1891 the *Imperial and Asiatic Quarterly Review*); and the *Jewish Quarterly Review*.

Monthlies. The monthly reviews include the *Christian Observer* (1802–1857), conducted by members of the established church upon evangelical principles, with Zachary Macaulay as the first editor; and the *Monthly Repository* (1806–1837), originally purely theological, but after coming into the hands of the Rev. W. J. Fox made entirely literary and political. The *Fortnightly Review* (1865), edited successively by G. H. Lewes, John Morley, T. H. S. Escott, Frank Harris, Oswald Crawfurd and W. L. Courtney, was intended as a kind of English *Revue des deux mondes*. Since 1866 it has appeared monthly. The *Contemporary Review* (1866), long edited by Sir Percy Bunting, and the *Nineteenth Century* (1877), founded and edited by Sir James Knowles (*q.v.*), and renamed *Nineteenth Century and After* in 1900, are similar in character, consisting of signed articles by men of mark of all opinions upon questions of the day. The *National Review* (1883), edited successively by Alfred Austin, W. Earl Hodgson, and L. J. Maxse, is alone in taking editorially a pronounced party line in politics as a Conservative organ. *Modern Thought* (1879–1884), for the free discussion of political, religious and social subjects, and the *Modern Review* (1892–1894) may also be mentioned. Other monthlies are the *Indian Magazine* (1871); the *Irish Monthly* (Dublin, 1873); the *Gaelic Journal* (Dublin, 1882); the *African Review* (1892) and the *Empire Review* (1900). The *Monthly Review* (1900–1908), edited till 1904 by Henry Newbolt, was for some years a notable addition to the high class literary monthlies.

Weeklies. The weekly reviews dealing generally with literature, science and art are the *Literary Gazette* (1817–1862), first edited by William Jerdan; the *Athenaeum* (1828), founded by James Silk Buckingham, but successfully established by C. W. Dilke, and long edited in later years by Norman MacColl (1843–1904), and afterwards by Mr Vernon Rendall; and the *Academy* (1869). Among those which also include political and social topics, and are more particularly dealt with under NEWSPAPERS, may be mentioned, the *Examiner* (1808–1881), the *Spectator* (1828), the *Saturday Review* (1855), the *Scots* or *National Observer* (1888–1897), *Outlook* (1898), *Pilot* (1900–1903), and *Speaker* (1890), which became the *Nation*.

Tatler, &c. Soon after the introduction of the literary journal in England, one of a more familiar tone was started by the eccentric John Dunton in the *Athenian Gazette, or Casuistical Mercury, resolving all the most Nice and Curious Questions* (1689–1690 to 1695–1696), afterwards called *The Athenian Mercury*, a kind of forerunner of *Notes and Queries*, being a penny weekly sheet, with a quarterly critical supplement. In the last part the publisher announces that it will be continued "as soon as ever the glut of news is a little over." Dunton was assisted by Richard Sault and Samuel Wesley. Defoe's *Review* (1704–1713) dealt chiefly with politics and commerce, but the introduction in it of what its editor fittingly termed the "scandalous club" was another step nearer the papers of Steele and the periodical essayists, the first attempts to create an organized popular opinion in matters of taste and manners. These little papers, rapidly thrown off for a temporary purpose, were destined to form a very important part of the literature of the 18th century, and in some respects its most marked feature. Although the frequenters of the clubs and coffee-houses were the persons for whom the essay-papers were mainly written, a proof of the increasing refinement of the age is to be found in the fact that now for the first time were women specially addressed as part of the reading public. The *Tatler* was commenced by Richard Steele in 1709, and issued thrice a week until 1711. The idea was at once extremely popular, and a dozen similar papers were started within the year, at least one half bearing colourable imitations of the title. Addison contributed to the *Tatler*, and together with Steele established and carried on the *Spectator* (1710–1714), and subsequently the *Guardian* (1713). The newspaper tax enforced in 1712 dealt a hard blow at these. Before this time the daily issue of the *Spectator* had reached 3000 copies; it then fell to 1600; the price was raised from a penny to twopence, but the paper came to an end in 1714. Dr Drake (*Essays illustr. of the Rambler*, &c., ii. 490) drew up an imperfect list of the essayists, and reckoned that from the *Tatler* to Johnson's *Rambler*, during a period of forty-one years, 106 papers of this description were published. Dr Drake continued the list down to 1809, and described altogether 221 which had appeared within a hundred years. The following is a list of the most considerable, with their dates, founders and chief contributors:—

Tatler (April 12, 1709 to Jan. 2, 1710–1711), Steele, Addison, Swift, Hughes, &c.; *Spectator* (March 1, 1710–1711 to Dec. 20, 1714), Addison, Steele, Budgell, Hughes, Grove, Pope, Parnell, Swift, &c.; *Guardian* (March 12, 1713 to Oct. 1, 1713), Steele, Addison, Berkeley, Pope, Tickell, Budgell, &c.; *Rambler* (March 20, 1750 to March 14, 1752), Johnson; *Adventurer* (Nov. 7, 1752 to March 9, 1754), Hawkesworth, Johnson, Bathurst, Warton, Chapone; *World* (Jan. 4, 1753 to Dec. 30, 1756), E. Moore, earl of Chesterfield, R. O. Cambridge, earl of Orford, Soame Jenyns, &c.; *Connoisseur* (Jan. 31, 1754 to Sept. 30, 1756), Colman, Thornton, Warton, earl of Cork, &c.; *Idler* (April 15, 1758 to April 5, 1760), Johnson, Sir J. Reynolds and Bennet Langton; *Bee* (Oct. 6, 1759 to Nov. 24, 1759), O. Goldsmith; *Mirror* (Jan. 23, 1779 to May 27, 1780), Mackenzie, Craig, Abercromby, Home, Bannatyne, &c.; *Lounger* (Feb. 5, 1785 to Jan. 6, 1787), Mackenzie, Craig, Abercromby, Tytler; *Observer* (1785 to 1790), Cumberland; *Looker-on* (March 10, 1792 to Feb. 1, 1794), W. Roberts, Beresford, Chalmers.

Modern Magazines. As from the "pamphlet of news" arose the weekly paper wholly devoted to the circulation of news, so from the general newspaper was specialized the weekly or monthly review of literature, antiquities and science, which, when it included essay-papers, made up the magazine or miscellaneous repository of matter for information and amusement. Several monthly publications had come into existence since 1681, but perhaps the first germ of the magazine is to be found in the *Gentleman's Journal* (1691–1694) of Peter Motteux, which, besides the news of the month, contained miscellaneous prose and poetry. Dr Samuel Jebb included antiquarian notices as well as literary reviews in his *Bibliotheca literaria* (1722–1724), previously mentioned, but the *Gentleman's Magazine*, founded in 1731, fully established, through the tact and energy of the publisher Edward Cave (*q.v.*), the type of the magazine, from that time so marked a feature of English periodical literature. The first idea is due to Motteux, from whom the title, motto and general plan were borrowed. The chief feature in the new venture at first consisted of the analysis of the journals, which Cave undertook personally. Prizes were offered for poetry. In April 1732 the leading metropolitan publishers, jealous of the interloper Cave, started the *London Magazine, or Gentleman's Monthly Intelligencer* (1732–1784), which had a long and prosperous career. The new magazine closely copied Cave's title, plan and aspect, and bitter war was long waged between the two. The rivalry was not without benefit to the literary public, as the conductors of each used every effort to improve their own review. Cave introduced the practice of giving engravings, maps and portraits, but his greatest success was the addition of Samuel Johnson (*q.v.*) to the regular staff. This took place in 1738, when the latter wrote the preface to the volume for that year, observing that the magazine had "given rise to almost twenty imitations of it, which are either all dead or very little regarded." The plan was also imitated in Denmark, Sweden and Germany. The *Gentleman's Magazine* was continued by Cave's brother-in-law, David Henry, afterwards by John Nichols and his son.[2] Cave appears to have been the first to use the word magazine in the sense of a periodical of miscellaneous literature. The specially antiquarian, biographical and historical features, which make this magazine so valuable a store-house for information for the period it covers, were dropped in 1868, when an "entirely new series," a miscellany of light literature was successively edited by Gowing, Joseph Hatton and Joseph Knight.

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[1] The centenary of the *Edinburgh Review* was celebrated in an article in October 1902, and that of the *Quarterly Review* in two articles April and July 1909. See also *On the Authorship of the First Hundred Numbers of the Edinburgh Review* (1895), by W. A. Copinger, and *The First Edinburgh Reviewers in Literary Studies* (1879), vol. i., by W. Bagehot.

[2] The first series of the *Gentleman's Magazine or Trader's Monthly Intelligencer*, extended from January 1731 to December 1735, 5 vols.; the *Gentleman's Magazine and Historical Chronicle* from January 1736 to December 1807, vols. 6–77; new series, January 1808 to December 1833, vols. 78–103; new series, 1834–1856, 45 vols.; new (third) series, 1856–1865, 19 vols.; new (fourth) series, 1866–1868, 5 vols. A general index to the first twenty vols. appeared in 1753. S. Ayscough brought out an index to the first fifty-six vols., 1731–1786 (1789), 2 vols., and one by J. Nichols, 1787–1818 (1821), 2 vols. A complete list of the plates and woodcuts (1731–1813) was published in 1814, and another list (1731–1818), in 1821. The *Gentleman's Magazine Library, being a classified collection of the chief contents of the Gentleman's Magazine*, from 1731 to 1868, is now being edited by Mr G. L. Gomme (1883, &c., vols. 1–17).

Many other magazines were produced in consequence of the success of these two. It will be sufficient to mention the following: The *Scots Magazine* (1739–1817) was the first published in Scotland; from 1817 to 1826 it was styled the *Edinburgh Magazine*. *The Universal Magazine* (1747) had a short, if brilliant, career; but the *European Magazine*, founded by James Perry in 1782, lasted down to 1826. Of more importance than these, or than the *Royal Magazine* (1759–1771) was the *Monthly Magazine* (1796–1843), with which Priestley and Godwin were originally connected. During thirty years the *Monthly* was conducted by Sir Richard Phillips, under whom it became more statistical and scientific than literary. Class magazines were represented by the Edinburgh *Farmer's Magazine* (1800–1825) and the *Philosophical Magazine* (1798), established in London by Alexander Tilloch; the latter at first consisted chiefly of translations of scientific articles from the French. The following periodicals, all of which date from the 18th century, are still published: the *Gospel Magazine* (1766, with which is incorporated the *British Protestant*), the *Wesleyan Methodist Magazine* (1778), *Curtis's Botanical Magazine* (1786), *Evangelical Magazine* (1793; since 1905 the *Evangelical British Missionary*), the *Philosophical Magazine* (1798), now known as the *London, Edinburgh and Dublin Philosophical Magazine*.

The increased influence of this class of periodical upon public opinion was first apparent in *Blackwood's Edinburgh Magazine*, founded in 1817 by the publisher of that name, and carried to a high degree of excellence by the contributions of Scott, Lockhart, Hogg, Maginn, Syme and John Wilson ("Christopher North"), John Galt and Samuel Warren. It has always remained Liberal in literature and Conservative in politics. The *New Monthly Magazine* is somewhat earlier in date. It was founded in 1814 by the London publisher, Colburn, and was edited in turn by Campbell, Theodore Hook, Bulwer-Lytton and Ainsworth. Many of Carlyle's and Thackeray's pieces first appeared in *Fraser's Magazine* (1830), long famous for its personalities and its gallery of literary portraits. The *Metropolitan Magazine* was started in opposition to *Fraser*, and was first edited by Campbell, who had left its rival. It subsequently came into the hands of Captain Marryatt, who printed in it many of his sea-tales. The *British Magazine* (1832–1849) included religious and ecclesiastical information. From Ireland came the *Dublin University Magazine* (1833). The regular price of these magazines was half a crown; the first of the cheaper ones was *Tait's Edinburgh Magazine* (1832–1861) at a shilling. It was Radical in politics, and had Roebuck as one of its founders. *Bentley's Miscellany* (1837–1868) was exclusively devoted to novels, light literature and travels. Several of Ainsworth's romances, illustrated by Cruikshank, first saw the light in *Bentley*. The *Nautical Magazine* (1832) was addressed specially to sailors, and Colburn's *United Service Journal* (1829) to both services. The *Asiatic Journal* (1816) dealt with Oriental subjects.

Cheap Publications.

From 1815 to 1820 a number of low-priced and unwholesome periodicals flourished. The *Mirror* (1823–1849), a two-penny illustrated magazine, begun by John Limbird,[1] and the *Mechanics Magazine* (1823) were steps in a better direction. The political agitation of 1831 led to a further popular demand, and a supply of cheap and healthy serials for the reading multitude commenced with *Chambers's Journal* (1832), the *Penny Magazine* (1832–1845) of Charles Knight, and the *Saturday Magazine* (1832–1844), begun by the Society for Promoting Christian Knowledge. The first was published at 1½d. and the last two at 1d. Knight secured the best authors and artists of the day to write for and illustrate his magazine, which, though at first a commercial success, may have had the reason of its subsequent discontinuance in its literary excellence. At the end of 1832 it had reached a sale of 200,000 in weekly numbers and monthly parts. It came to an end in 1845 and was succeeded by *Knight's Penny Magazine* (1845), which was stopped after six monthly parts. These periodicals were followed by a number of penny weeklies of a lower tone, such as the *Family Herald* (1843), the *London Journal* (1845) and *Lloyd's Miscellany*. In 1850 the sale of the first of them was placed at 175,000 copies, the second at 170,000, and *Lloyd's* at 95,000. In 1846 fourteen penny and three half-penny magazines, twelve social journals, and thirty-seven book-serials were produced every week in London. A further and permanent improvement in cheap weeklies for home reading may be traced from the foundation of *Howitt's Journal* (1847–1849), and more especially *Household Words* (1850), conducted by Charles Dickens, *All the Year Round* (1859), by the same editor, and afterwards by his son, *Once A Week* (1859), and the *Leisure Hour* (1852). The plan of *Notes and Queries* (1849), for the purpose of inter-communication among those interested in special points of literary and antiquarian character, has led to the adoption of similar departments in a great number of newspapers and periodicals, and, besides several imitators in England, there are now parallel journals in Holland, France, and Italy.

Shilling monthlies began with *Macmillan* (1859), the *Cornhill* (1860), first edited by Thackeray, and *Temple Bar* (1860). *St James's Magazine* (1861), *Belgravia* (1866), *St Paul's* (1867–1874), London Society (1862), and *Tinsley's* (1867) were devoted chiefly to novels and light reading. Sixpenny illustrated magazines commenced with *Good Words* (1860) and the *Quiver* (1861), both religious in tendency. In 1882 *Fraser* changed its name to *Longman's Magazine*, and was popularized and reduced to sixpence. The *Cornhill* followed the same example in 1883, reducing its price to sixpence and devoting its pages to light reading. The *English Illustrated Magazine* (1883) was brought out in competition with the American *Harper's* and *Century*. The *Pall Mall Magazine* followed in 1893. Of the artistic periodicals we may signalize the *Art Journal* (1849), *Portfolio* (1870), *Magazine of Art* (1878–1904), *Studio* (1893), *Connoisseur* (1901), and *Burlington* (1903). The *Bookman* (1886), for a combination of popular and literary qualities, and the *Badminton* (1895), for sport, also deserve mention. One of the most characteristic developments of later journalism was the establishment in 1890 of the *Review of Reviews* by W. T. Stead. Meanwhile the number of cheap periodicals increased enormously, such as the weekly *Tit-bits* (1881), and *Answers* (1888), and profusely illustrated magazines appeared, like the *Strand* (1891), *Pearson's* (1896), or *Windsor* (1895). Professions and trades now have not only their general class-periodicals, but a special review or magazine for every section. In 1910 the magazines and reviews published in the United Kingdom numbered 2795. Religious periodicals were 668; 338 were devoted to trade; 361 to sport; 691 represented the professional classes; 51 agriculture; and 218 were juvenile periodicals. The London monthlies were 797 and the quarterlies 155.

Indexes to English Periodicals.—A large number of periodicals do not preserve literary matter of permanent value, but the high-class reviews and the archaeological, artistic and scientific magazines contain a great mass of valuable facts, so that general and special indexes have become necessary to all literary workers. Lists of the separate indexes to particular series are given in H. B. Wheatley's *What is an Index?* (1879), W. P. Courtney's *Register of National Bibliography* (1905, 2 vols.), and the *List of Books forming the Reference Library* in the reading room of the British Museum (4th ed. 1910, 2 vols).

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[1] John Limbird, to whom even before Chambers or Knight is due the carrying out the idea of a cheap and good periodical for the people, died on the 31st of October 1883, without having achieved the worldly prosperity of his two followers.

UNITED STATES

The two earliest American miscellanies were produced almost simultaneously. Spurred by the success of the *Gentleman's Magazine* in England Benjamin Franklin founded the *General Magazine* (1741) at Philadelphia, but it expired after six monthly numbers had appeared. Franklin's rival, Andrew Bradford, forestalled him by three days with the *American Magazine* (1741) edited by John Webbe, which ran only to two numbers. Further attempts at Philadelphia in 1757 and 1769 to revive periodicals with the same name were both fruitless. The other pre-revolutionary magazines were the Boston *American Magazine* (1743–1747), in imitation of the *London Magazine*; the *Boston Weekly Magazine* (1743); the *Christian History* (1743–1744); the New York *Independent Reflector* (1752–1754); the Boston *New England Magazine* (1758–1760), a collection of fugitive pieces; the Boston *Royal American Magazine* (1774–1775); and the *Pennsylvania Magazine* (1775–1776), founded by Robert Aitken, with the help of Thomas Paine. The *Columbian Magazine* (1786–1790) was continued as the *Universal Asylum* (1790–1792). Matthew Carey brought out the *American Museum* in 1787, and it lasted until 1792. Among the other magazines which ran out a brief existence before the end of the century was the Philadelphia *Political Censor or Monthly Review* (1796–1797) edited by William Cobbett. One of the most successful was the *Farmer's Weekly Museum* (1790–1799), supported by perhaps the most brilliant staff of writers American periodical literature had yet been able to show, and edited by Joseph Dennie, who in 1801 began the publication of the *Portfolio*, carried on to 1827 at Philadelphia. For five years it was a weekly miscellany in quarto, and afterwards an octavo monthly; it was the first American serial which could boast of so long an existence. Charles Brockden Brown established the New York *Monthly Magazine* (1799), which, changing its title to *The American Review*, was continued to 1802. Brown founded at Philadelphia the *Literary Magazine* (1803–1808); he and Dennie may be considered as having been the first American professional men of letters. The Anthology Club was established at Boston in 1803 by Phineas Adams for the cultivation of literature and the discussion of philosophy. Ticknor, Everett and Bigelow were among the members, and were contributors to the organ of the club, the monthly *Anthology and Boston Review* (1803–1811), the forerunner of the *North American Review*. In the year 1810 Thomas (*Printing in America*, ii. 292) informs us that 27 periodicals were issued in the United States. The first serious rival of the *Portfolio* was the *Analectic Magazine* (1813–1820), founded at Philadelphia by Moses Thomas, with the literary assistance of W. Irving (for some time the editor), Paulding, and the ornithologist Wilson. In spite of a large subscription list it came to an end on account of the costly style of its production. The first southern serial was the *Monthly Register* (1805) of Charleston. New York possessed no periodical worthy of the city until 1824, when the *Atlantic Magazine* appeared, which changed its name shortly afterwards to the *New York Monthly Review*, and was supported by R. C. Sands and W. C. Bryant. N. P. Willis was one of the editors of the *New York Mirror* (1823–1842). Between 1840 and 1850 *Graham's Magazine* was the leading popular miscellany in the country, reaching at one time a circulation of about 35,000 copies. The first western periodical was the *Illinois Monthly Magazine* (1830–1832), published, owned, edited and almost entirely written by James Hall, who followed with his *Western Monthly Magazine* (1833–1836), produced in a similar manner. In 1833 the novelist C. F. Hoffman founded at New York the *Knickerbocker* (1833–1860), which soon passed under the control of Timothy Flint and became extremely successful, most of the leading native writers of the next twenty years having been contributors. Equally popular was *Putnam's Monthly Magazine* (1853–1857, 1867–1869). It was revived in 1906–1910. The *Dial* (1840–1844), Boston, the organ of the transcendentalists, was first edited by Margaret Fuller, and subsequently by R. W. Emerson and G. Ripley. Other magazines were the *American Monthly Magazine* (1833–1838), the *Southern Literary Messenger* (1834), Richmond, the *Gentleman's Magazine* (1837–1840), and the *International Magazine* (1850–1852), edited by R. W. Griswold. The *Yale Literary Magazine* dated from 1836. The *Merchants' Magazine* was united in 1871 with the *Commercial and Financial Chronicle*. First in order of date among the current monthly magazines comes the New York *Harper's New Monthly Magazine* (1850), the earliest existing illustrated American serial, then the Boston *Atlantic Monthly* (1857), with which was incorporated the *Galaxy* (1866) in 1878, famous for its editors Lowell, Howells and T. B. Aldrich, and its contributors O. W. Holmes, Longfellow, Whittier and others. Next came *Lippincott's Magazine* (1868) from Philadelphia, and the *Cosmopolitan* (1886) and *Scribner's Monthly* (1870, known as the *Century Illustrated Magazine* since 1881) from New York. These were followed by *Scribner's Magazine* (1887), the *New England Magazine* (1889), the *Illustrated Review of Reviews* (1890), *McClure's Magazine* (1893), the *Bookman* (1895), the *World's Work* (1902), the *American Magazine* (1906) succeeding Frank Leslie's *Popular Monthly*, and *Munsey's Magazine* (1889). All are illustrated, and three in particular, the *Century*, *Scribner's* and *Harper's*, carried the art of wood-engraving to a high standard of excellence.

The first attempt to carry on an American review was made by Robert Walsh in 1811 at Philadelphia with the quarterly *American Review of History and Politics*, which lasted only a couple of years. Still more brief was the existence of the *General Repository and Review* (1812), brought out at Cambridge by Andrews Norton with the help of the professors of the university, but of which only four numbers appeared. Niles's *Weekly Register* (1811–1848) was political, historical and literary. The *North American Review*, the oldest and most famous of all the American reviews, dates from 1815, and was founded by William Tudor, a member of the previously mentioned Anthology Club. After two years' control Tudor handed over the review to the club, then styled the North American Club, whose most active members were E. T. Channing, R. H. Dana and Jared Sparks. In 1819 E. Everett became the editor; his brother Alexander acquired the property in 1829. The roll of contributors numbers almost every American writer of note. Since 1879 it has been published monthly (except in Sept. 1906–Sept. 1907, when it appeared semi-monthly). The *American Quarterly Review* (1827–1837), established at Philadelphia by Robert Walsh, came to an end on his departure for Europe. The *Southern Quarterly Review* (1828–1832), conducted by H. Legaré, S. Elliot and G. W. Simms in defence of the politics and finance of the South, enjoyed a shorter career. It was resuscitated in 1842, and lived another thirteen years. These two were followed by the *Democratic Review* (1838–1852), the *American Review* (1845–1849), afterwards the *American Whig Review* (1850–1852), the *Massachusetts Quarterly Review* (1847–1850), and a few more. The *New Englander* (1843–1892), the *Biblical Repertory and Princeton Review* (1825), the *National Quarterly Review* (1860) and the New York *International Review* (1874–1883), may also be mentioned. The critical weeklies of the past include the New York *Literary Gazette* (1834–1835, 1839), *De Bow's Review* (1846), the *Literary World* (1847–1853), the *Criterion* (1855–1856), the *Round Table* (1863–1864), the *Citizen* (1864–1873), and *Appleton's Journal* (1869). The leading current monthlies include the New York *Forum* (1886), *Arena* (1890), *Current Literature* (1888), and *Bookman*, the Chicago *Dial* (1880), and the Greenwich, Connecticut, *Literary Collector*. Foremost among the weeklies comes the New York *Nation* (1865).

Religious periodicals have been extremely numerous in the United States. The earliest was the *Theological Magazine* (1796–1798). The *Christian Examiner* dates from 1824 and lasted down to 1870. The *Panoplist* (1805) changed its name to the *Missionary Herald*, representing the American Board of Missions. The *Methodist Magazine* dates from 1818 and the *Christian Disciple* from 1813. The *American Biblical Respository* (1831–1850), a quarterly, was united with the Andover *Bibliotheca Sacra* (1843) and with the *Theological Eclectic* (1865). *Brownson's Quarterly Review* began as the *Boston Quarterly Review* in 1838, and did much to introduce to American readers the works of the modern French philosophical school. Other serials of this class are the *Protestant Episcopal Quarterly Review* (1854), the *Presbyterian Magazine* (1851–1860), the *Catholic World* (1865), the *Southern Review* (1867), the *New Jerusalem Magazine* (1827), *American Baptist Magazine* (1817), the *Church Review* (1848), the *Christian Review* (1836), the *Universalist Quarterly* (1844). Current religious quarterlies are the Chicago *American Journal of Theology* and the Oberlin *Bibliotheca Sacra*. The Chicago *Biblical World* is published monthly.

Among historical periodicals may be numbered the *American Register* (1806–1811), Stryker's *American Register* (1848–1851), Edwards's *American Quarterly Register* (1829–1843), the *New England Historical and Genealogical Register* (1847), Folsom's *Historical Magazine* (1857), the *New York Genealogical Record* (1869), and the *Magazine of American History* (1877). There is also the Lancaster, Pennsylvania, *American Historical Review*, issued quarterly.

Many serial publications have been almost entirely made up of extracts from English sources. Perhaps the earliest example is to be found in *Select Views of Literature* (1811–1812). The *Eclectic Magazine* (1844) and *Littell's Living Age* (1844) may be mentioned.

In 1817 America possessed only one scientific periodical, the *Journal of Mineralogy*. Professor Silliman established the journal known by his name in 1818. Since that time the *American Journal of Science* has enjoyed unceasing favour. The special periodicals of the day are very numerous. Among the most representative are: the *Popular Science Monthly*, New York; the monthly *Boston Journal of Education*; the quarterly *American Journal of Mathematics*, Baltimore; the monthly *Cassier's Magazine* (1891), New York; the monthly *American Engineer* (1893), New York; the monthly *House and Garden*, Philadelphia; the monthly *Astrophysical Journal*, commenced as *Sidereal Messenger* (1882), Chicago; the monthly *American Chemical Journal*, Baltimore; the monthly *American Naturalist*, Boston; the monthly *American Journal of the Medical Sciences*, Philadelphia; the monthly *Outing*, New York; the weekly *American Agriculturist*, New York; the quarterly *Metaphysical Magazine* (1895) New York; the bi-monthly *American Journal of Sociology*, Chicago; the bi-monthly *American Law Review*, St Louis; the monthly *Banker's Magazine*, New York; the quarterly *American Journal of Philology* (1880), Baltimore; the monthly *Library Journal* (1876), New York; the monthly *Public Libraries*, Chicago; the weekly *Scientific American*, New York; the quarterly *American Journal of Archaeology* (1885), New York.

The number of periodicals devoted to light literature and to female readers has been, and still remains, extremely large. The earliest in the latter class was the *Lady's Magazine* (1792) of Philadelphia. The *Lowell Offering* (1841) was written by factory girls of Lowell (*q.v.*), Mass. *Godey's Lady's Book* was long popular, and the *Ladies Home Journal* (1883) and the *Woman's Home Companion* (1893) are now current. Children's magazines originated with the *Young Misses' Magazine* (1806) of Brooklyn; the New York *St Nicholas* (monthly) and the Boston *Youth's Companion* (weekly) are prominent juveniles.

The total of American periodicals mentioned in the *Guide* by H. O. Severance and C. H. Walsh (1909, Ann Arbor), is 5136 for the year 1908.

Authorities.—The eighth volume of the *Tenth Report of the United States Census* (1884) contains a statistical report on the newspaper and periodical press of America by S. N. D. North. See also Cucheval Clarigny, *Histoire de la presse en Angleterre et aux États Unis* (1857); H. Stevens, *Catalogue of American Books in the Library of the British Museum* (1866), and *American Books with Tails to 'em* (1873); I. Thomas, *History of Printing in America* (Albany, 1874); J. Nichol, *American Literature* (1882); "Check List of American Magazines," in *Library Journ.*, xiv. 373; G. P. Rowell & Co.'s *American Newspaper Directory* (New York); A. R. Spofford, *Book for all Readers* (1900); F. W. Faxon's *Check list of American and English Periodicals* (Boston, 1908). Many American libraries co-operate in issuing joint or union lists of periodicals. See list of these as well as lists of special indexes in A. B. Kroeger's *Guide to Reference Books* (2nd ed., Boston, 1908).

Indexes to Periodicals.—The contents of English and American periodicals of the last 100 years are indexed in the following publications: W. F. Poole's *Index to Periodical Literature* (1802–1881, revised ed., Boston, 1891); 1st supplement, 1882–1887, by W. F. Poole and W. I. Fletcher, 1888; 2nd supplement, 1887–1892, by W. I. Fletcher, 1893; 3rd supplement, 1892–1896, by W. I. Fletcher and F. O. Poole, 1898; 4th supplement, 1897–1902, 1902; 5th supplement, 1902–1907, 1908; *Poole's Index*, abridged edition, by W. I. Fletcher and M. Poole (Boston, 1901); 1st supplement, 1900–1904 (Boston, 1905); *The Co-operative Index to Periodicals* (1885–1894, ed. W. I. Fletcher, 1886–1894); *The Annual Literary Index, including Periodicals*, ed. by W. I. Fletcher and R. R. Bowker (New York, 10 vols., 1892–1907); "Index of Periodicals for 1890," &c. (*Review of Reviews*), by Miss Hetherington (13 vols., 1891–1902); *Q. P. Indexes*; Cotgreave's *Contents Subject Index to General and Periodical Literature* (1900); *Cumulative Index to a Selected list of Periodicals*, begun in the Cleveland Public Library in 1896 and 1897 by W. H. Brett, merged in 1903 with the *Reader's Guide to Periodical Literature* (8 vols., 1901–1908, ed. by A. L. Guthrie, Minneapolis, U.S.); *Magazine Subject Index*, by F. W. Faxon (Boston, 1908), continued quarterly in *Bulletin of Bibliography*, which in 1907 began a magazine subject index; *Eclectic Library Catalogue* (Minneapolis, 1908), issued quarterly.

Canada

Canadian periodicals have reached a higher standard than in any other British self-governing colony. Like that of South Africa, the press is bi-lingual. The first Canadian review, the *Quebec Magazine* (1791–1793), was published quarterly in French and English. It was followed by the *British American Register* (Quebec, 1803), *L'Abeille canadienne* (Montreal, 1818), edited by H. Mezière, the *Canadian Magazine* (Montreal, 1823–1825), the *Canadian Review* (Montreal, 1824–1826), *La Bibliothèque canadienne* (Montreal, 1825–1830), continued as *L'Observateur* (1830–1831), and the *Magasin du Bas-Canada* (Montreal, 1832). The three latter were edited by Michel Bibaud. The *Literary Garland* (Montreal, 1838–1850), edited by John Gibson, was for some time the only English magazine published in Canada. Later magazines were *L'Echo du cabinet du lecture paroissial* (Montreal, 1859), 15 vols.; *Le Foyer canadien* (Quebec, 1863–1866), one of the most interesting French-Canadian reviews; *La Revue canadienne*, which was started at Montreal in 1864, and contained the best writings of contemporary French-Canadian littérateurs; *La Revue de Montréal* (1877–1881), edited by the abbé T. A. Chandonnet; the *Canadian Journal* (Toronto), commenced in 1852 under Henry Youle Hind and continued by Daniel Wilson; *L'Abeille* (Quebec, 1848–1881), and the *Canadian Monthly* (Toronto, 1872–1882). The *Bystander* (Toronto, 1880–1883), was edited by Goldwin Smith. *Le Canada français* (Quebec, 1888–1891), edited by the staff of the Laval University, and *Canadiana* (1889–1890), were important historical and literary reviews. Contemporary magazines are the *Canadian Magazine* (1893), the *Westminster*, both produced at Toronto, *La Nouvelle-France* (Quebec), the *Canada Monthly* (London, Ontario), and the *University Magazine*, edited by Professor Macphail, of the McGill University.

See H. J. Morgan, *Bibliotheca canadensis* (1867), "Canadian Magazines," by G. Stewart, *Canadian Monthly*, vol. xvii.; "Periodical Literature in Canada," by J. M. Oxley, *North Am. Rev.* (1888); P. Gagnon, *Essai de bibliographie canadienne* (1895), and S. E. Dawson, *Prose Writers of Canada* (1901).

South Africa

The earliest magazine was the *South African Journal*, issued by the poet Pringle and John Fairbairn in 1824. It was followed by the *South African Quarterly Journal* (1829–1834), the *Cape of Good Hope Literary Gazette* (1830–1833), edited by A. J. Jardine, the *Cape of Good Hope Literary Magazine* (1847–1848), edited by J. L. Fitzpatrick, and the *Eastern Province Monthly Magazine*, published at Grahamstown in 1857–1858. A Dutch periodical called *Elpis, algemeen tijdschrift voor Zuid Afrika* (1857–1861) appealed to the farming community. The *Eastern Province Magazine* was issued at Port Elizabeth in 1861–1862, and the *South African Magazine* appeared in 1867–1868. The *Orange Free State Magazine*, the only English magazine published at Bloemfontein, was issued in 1877–1878; and the *E. P. Magazine* was published at Grahamstown in 1892–1897. The *Cape Monthly Magazine*, the most important of the periodicals, was issued from 1857 to 1862, and was again continued under the editorship of Professor Noble from 1870 to 1881. The *Cape Illustrated Magazine* (1890–1899) was edited by Professor J. Gill. In Durban the *Present Century* was started in 1903, and the *Natal Magazine* was issued at Pietermaritzburg in 1877. The weekly *New Era* (1904–1905) was succeeded by the *South African Magazine* (1906–1907); both were edited by C. H. Crane. The *African Monthly* (Grahamstown, 1907) and the *State of South Africa* (Cape Town, 1909) are monthly reviews, while the *South African Railway Magazine* (1907) is of wider interest than its name denotes.

See S. Mendelssohn, *South African Bibliography* (2 vols., 1910); and P. E. Lewin, *Catalogue of the Port Elizabeth Library* (2 vols., 1906).

Australia and New Zealand

New South Wales.—The *Australian Magazine* was published monthly at Sydney in 1821–1822. This was followed by the *South Asian Register* (1827), the *Australian Quarterly Journal* (1828), edited by the Rev. P. N. Wilton, the *New South Wales Magazine* (1833), the *New South Wales Literary, Political and Commercial Advertiser* (1835), edited by the eccentric Dr Lhotsky, *Tegg's Monthly Magazine* (1836), the *Australian Magazine* (1838), the *New South Wales Magazine* (1843), the *Australian Penny Journal* (1848) and many others. The *Sydney University Magazine* (1855), again published in 1878–1879, and continued as the *Sydney University Review*, is the first magazine of a high literary standard. The *Sydney Magazine of Science and Art* (1857) and the *Month* (1857) were short-lived. Of later magazines the *Australian* (1878–1881), *Aurora australis* (1868), and the *Sydney Magazine* (1878), were the most noteworthy. Of contemporary magazines *Dalgety's Review* is mainly agricultural, the *Australian Magazine* (1909) and the *Lone Hand* (1907) are popular, and the *Science of Man* is an anthropological review.

See *Australasian Bibliography* (Sydney, 1893); G. B. Barton, *Literature of N. S. W.* (1866); E. A. Petherick, *Catalogue of Books Relating to Australasia* (1899).

Victoria.—The *Port Phillip Magazine* (1843) must be regarded as the first literary venture in Victoria. This was followed by the *Australia Felix Magazine* (1849), and the *Australasian Quarterly Reprint* (1850–1851) both published at Geelong, the *Illustrated Australian Magazine* (1850–1852), the *Australian Gold-Digger's Monthly Magazine* (1852–1853), edited by James Bonwick, and the *Melbourne Monthly Magazine* (1855–1856). The *Journal of Australasia* (1856–1858), the *Australian Monthly Magazine* (1865–1867), which contained contributions from Marcus Clarke and was continued as the *Colonial Monthly* (1867–1869), the *Melbourne Review* (1876–1885) and the *Victorian Review* (1879–1886) may also be mentioned. The *Imperial Review*, apparently the work of one pen, has been published since 1879; the *Pastoralists' Review* appeals more especially to the agricultural community. A *Library Record of Australasia* was published in 1901–1902. An Australian edition of the *Review of Reviews* is published at Melbourne.

See "Some Magazines of Early Victoria," in the *Library Record of Australasia*, Nos. 2–4 (1901).

South Australia.—The *South Australian Magazine* was issued monthly in 1841–1843, the *Adelaide Magazine* (1845), the *Adelaide Miscellany* (1848–1849), and the *Wanderer* in 1853. The *South Australian Twopenny Magazine* was published at Plymouth, England, in 1839, and the *South Australian Miscellany and New Zealand Review* at London in the same year.

See T. Gill, *Bibliography of South Australia* (1886).

Tasmania.—The first magazine was Murray's *Austral-Asiatic Review*, published at Hobart in 1828. The *Hobart Town Magazine* appeared in 1833–1834, and the *Van Diemen's Land Monthly Magazine* in 1835.

New Zealand.—The *New Zealand Magazine*, a quarterly, was published at Wellington in 1850. In 1857 appeared the *New Zealand Quarterly Review*, of little local interest, followed by *Chapman's New Zealand Monthly Magazine* (1862), the *Southern Monthly Magazine* (1863), the *Delphic Oracle* (1866–1870), the *Stoic* (1871), the *Dunedin Review* (1885), the *Literary Magazine* (1885), the four latter being written by J. G. S. Grant, an eccentric genius, the *Monthly Review* (1888–1890), the *New Zealand Illustrated Magazine* (1899–1905), chiefly devoted to the light literature of New Zealand subjects, the *Maori Record* (1905–1907), and the *Red Funnel*, published since 1905.

See T. M. Hocken, *Bibliography of New Zealand* (1909).

West Indies and British Crown Colonies

In Jamaica the *Columbian Magazine* was founded at Kingston in 1796 and ceased publication in 1800. Two volumes were published of a *New Jamaica Magazine* which was started about 1798. The *Jamaica Magazine* (1812–1813), the *Jamaica Monthly Magazine* (1844–1848), and the *Victoria Quarterly* (1889–1892), which contained many valuable articles on the West Indies, were other magazines. The *West Indian Quarterly* was published at Georgetown, British Guiana, from 1885 to 1888. At Georgetown was also published the well-known *Timehri* (1882–1898) which contained many important historical articles. In Trinidad the *Trinidad Monthly Magazine* was started in 1871, and the *Union Magazine* in 1892.

Malta had a *Malta Penny Magazine* in 1839–1841, and the *Revue historique et littéraire* was founded in Mauritius in 1887. Many magazines dealing with the colonies have been published in England, such as the *Colonial Magazine* (1840–1843).

See F. Cundall, *Bibliographia Jamaicensis* (1902–1908).

India and Ceylon

Calcutta.—The first Indian periodical was the *Asiatick Miscellany* (Calcutta, 1785–1789), probably edited by F. Gladwin. The *Calcutta Monthly Register* was published in 1790, and the *Calcutta Monthly Journal* from 1798 to 1841. Among other early Calcutta magazines were the *Asiatic Observer* (1823–1824), the *Quarterly Oriental Magazine* (1824–1827), and the *Royal Sporting Magazine* (1833–1838). The *Calcutta Literary Gazette* was published in 1830–1834, and the *Calcutta Review*, still the most important serial of the Indian Empire, first appeared in 1846 under the editorship of Sir J. W. Kaye.

Bombay.—The *Bombay Magazine* was started in 1811 and lasted but a short time. The *Bombay Quarterly Magazine* (1851–1853) gave place to the *Bombay Quarterly Review*, issued in 1855.

Madras.—Madras had a *Journal of Literature and Science* and the *Oriental Magazine and Indian Hurkuru* (1819). The *Indian Antiquary* was started at Bombay in 1872 and still continues. Of other contemporary magazines the *Hindustan Review* (Allahabad), the *Modern Review* (Calcutta), the *Indian Review* (Madras), the *Madras Review*, a quarterly first published in 1895, and the *Calcutta University Magazine* (1894), are important.

Ceylon.—In Ceylon the *Religious and Theological Magazine* was started at Colombo in 1833, the *Colombo Magazine* in 1839, the *Ceylon Magazine* in 1840, and the *Investigator* at Kandy in 1841. Of contemporary magazines the *Tropical Agriculturist* was started in 1881, the *Ceylon Literary Register* (1886–1896), afterwards the *Monthly Literary Register* and the *Ceylon National Review* in 1893. In Burma the quarterly *Buddhism* appeared in 1904. Singapore had a *Journal of the Indian Archipelago* from 1847 to 1859, and the *Chinese Repository* (1832–1851) was edited at Canton by Morrison.

See "Periodical Literature in India," in *Dark Blue* (1872–1873).

France

We owe the literary journal to France, where it soon attained to a degree of importance unapproached in any other country. The first idea may be traced in the *Bureau d'adresse* (1633–1642) of Théophraste Renaudot, giving the proceedings of his conferences upon literary and scientific matters. About the year 1663 Mézeray obtained a privilege for a regular literary periodical, which came to nothing, and it was left to Denis de Sallo, counsellor of the parliament of Paris and a man of rare merit and learning, to actually carry the project into effect. The first number of the *Journal des savants* appeared on the 5th of January 1665, under the assumed name of the sieur d'Hédouville. The prospectus promised to give an account of the chief books published throughout Europe, obituary notices, a review of the progress of science, besides legal and ecclesiastical information and other matters of interest to cultivated persons. The criticisms, however, wounded alike authors and the clergy, and the journal was suppressed after a career of three months. Colbert, seeing the public utility of such a periodical, ordered the abbé Gallois, a contributor of De Sallo's, to re-establish it, an event which took place on the 4th of January 1666. It lingered nine years under the new editor, who was replaced in 1675 by the abbé de la Roque, and the latter in his turn by the president Cousin, in 1686. From 1701 commenced a new era for the *Journal*, which was then acquired by the chancellor de Pontchartrain for the state and placed under the direction of a commission of learned men. Just before the Revolution it developed fresh activity, but the troubles of 1792 caused it to be discontinued until 1796, when it again failed to appear after twelve numbers had been issued. In 1816 it was definitely re-established and replaced under government patronage, remaining subject to the chancellor or garde-des-sceaux until 1857, when it was transferred to the control of the minister of public instruction. Since 1903 the organization of the publication has changed. The state subsidy having been withdrawn, the Institute voted a yearly subscription of 10,000 francs and nominated a commission of five members, one for each section, who managed the *Journal*. Since 1909, however, the various sections have left to the Académie des Inscriptions et Belles Lettres the entire direction of the *Journal*, while still paying the annual subsidy. It now restricts itself to publishing contributions relating to antiquities and the middle ages and Oriental studies.

Louis Auguste de Bourbon, sovereign prince of Dombes, having transferred his parliament to Trévoux, set up a printing press, and was persuaded by two Jesuits, Michel le Tellier and Philippe Lalleman, to establish the *Mémoires pour servir à l'histoire des sciences et des arts* (1701–1767), more familiarly known as the *Journal des Trévoux*, long the best-informed and best-written journal in France. One feature of its career was its constant appeal for the literary assistance of outsiders. It was continued in a more popular style as *Journal des sciences et des beaux-arts* (1768–1775) by the abbé Aubert and by the brothers Castilhon (1776–1778), and as *Journal de littérature, des sciences, et des arts* (1779–1782) by the abbé Grosier.

The first legal periodical was the *Journal du palais* (1672) of Claude Blondeau and Gabriel Guéret, and the first devoted to medicine the *Nouvelles découvertes dans toutes les parties de la médecine* (1679) of Nicolas de Blégny, frequently spoken of as a charlatan, a term which sometimes means simply a man of many ideas. Religious periodicals date from 1680, and the *Journal ecclésiastique* of the abbé de la Roque, to whom is also due the first medical journal (1683). The prototype of the historico-literary periodical may be discovered in *La Clef du cabinet des princes de l'Europe* (1704–1706), familiarly known as *Journal de Verdun*, and carried on under various titles down to 1794.

Literary criticism was no more free than political discussion, and no person was allowed to trespass either upon the domain of the *Journal des savants* or that of the *Mercure de France* (see Newspapers) without the payment of heavy subsidies. This was the origin of the clandestine press of Holland, and it was that country which for the next hundred years supplied the ablest periodical criticism from the pens of French Protestant refugees. During that period thirty-one journals of the first class proceeded from these sources. From its commencement the *Journal des savants* was pirated in Holland, and for ten years a kind of joint issue made up with the *Journal des Trévoux* appeared at Amsterdam. From 1764 to 1775 miscellaneous articles from different French and English reviews were added to this reprint. Bayle, a born journalist and the most able critic of the day, conceived the plan of the *Nouvelles de la république des lettres* (1684–1718), which at once became entirely successful and obtained for him during the three years of his control the dictatorship of the world of letters. He was succeeded as editor by La Roque, Barrin, Bernard and Leclerc. Bayle's method was followed in an equally meritorious periodical, the *Histoire des ouvrages des Savants* (1687–1704) of H. Basnage de Beauval. Another continuator of Bayle was Jean Leclerc, one of the most learned and acute critics of the 18th century, who carried on three reviews—the *Bibliothèque universelle et historique* (1686–1693), the *Bibliothèque choisie* (1703–1713), and the *Bibliothèque ancienne et moderne* (1714–1727). They form one series, and, besides valuable estimates of new books, include original dissertations, articles and biographies like our modern learned magazines. The *Journal littéraire* (1713–1722, 1729–1736) was founded by a society of young men, who made it a rule to discuss their contributions in common. Specially devoted to English literature were the *Bibliothèque anglaise* (1716–1728), the *Mémoires littéraires de la Grande Bretagne* (1720–1724), the *Bibliothèque britannique* (1733–1734), and the *Journal britannique* (1750–1757) of Maty,[1] who took for his principle, "pour penser avec liberté il faut penser seul." One of these Dutch-printed reviews was *L'Europe savante* (1718–1720), founded chiefly by Themiseul de Saint-Hyacinthe, with the intention of placing each separate department under the care of a specialist. The *Bibliothèque germanique* (1720–1740) was established by Jacques Lenfant to do for northern Europe what the *Bibliothèque britannique* did for England. It was followed by the *Nouvelle bibliothèque germanique* (1746–1759). The *Bibliothèque raisonnée des ouvrages des savants* (1728–1758) was supplementary to Leclerc, and was succeeded by the *Bibliothèque des sciences et des beaux-arts* (1754–1780). Nearly all of the preceding were produced either at Amsterdam or Rotterdam, and, although out of place in a precise geographical arrangement, really belong to France by the close ties of language and of blood.

Taking up the exact chronological order again, we find the success of the English essay-papers led to their prompt introduction to the Continent. An incomplete translation of the *Spectator* was published at Amsterdam in 1714, and many volumes of extracts from the *Tatler*, *Spectator* and *Guardian* were issued in France early in the 18th century. Marivaux brought out a *Spectateur Français* (1722), which was coldly received; it was followed by fourteen or fifteen others, under the titles of *La Spectatrice* (1728–1730), *Le Radoteur* (1775), *Le Babillard* (1778–1779), &c. Of a similar character was *Le Pour et le contre* (1723–1740) of the abbé Prévost, which contained anecdotes and criticism, with special reference to Great Britain. Throughout the 18th century, in France as in England, a favourite literary method was to write of social subjects under the assumed character of a foreigner, generally an

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[1] Matthew Maty, M.D., born in Holland, 1718, died principal librarian of the British Museum, 1776. He settled in England in 1740, published several books, and wrote the preface to Gibbon's first work, *Étude de la littérature.*

Oriental, with the title of *Turkish Spy*, *Lettres chinoises*, &c. These productions were usually issued in periodical form, and, besides an immense amount of worthless tittle-tattle, contain some valuable matter.

During the first half of the century France has little of importance to show in periodical literature. The *Nouvelles ecclésiastiques* (1728–1803) were first printed and circulated secretly by the Jansenists in opposition to the *Constitution unigenitus*. The Jesuits retaliated with the *Supplément des nouvelles ecclésiastiques* (1734–1748). The promising title may have had something to do with the temporary success of the *Mémoires secrets de la république des lettres* (1744–1748) of the marquis d'Argens. In the *Observations sur les écrits modernes* (1735–1743) Desfontaines held the gates of Philistia for eight years against the Encyclopaedists, and even the redoubtable Voltaire himself. It was continued by the *Jugements sur quelques ouvrages nouveaux* (1744–1745). The name of Fréron, perhaps the most vigorous enemy Voltaire ever encountered, was long connected with *Lettres sur quelques écrits de ce temps* (1749–1754), followed by *L'Année littéraire* (1754–1790). Among the contributors of Fréron was another manufacturer of criticism, the abbé de la Porte, who, having quarrelled with his *confrère*, founded *Observations sur la littérature moderne* (1749–1752) and *L'Observateur littéraire* (1758–1761).

A number of special organs came into existence about this period. The first, treating of agriculture and domestic economy, was the *Journal économique* (1751–1772); a *Journal de commerce* was founded in 1759; periodical biography may be first seen in the *Nécrologe des hommes célèbres de France* (1764–1782); the political economists established the *Éphémérides du citoyen* in 1765; the first *Journal d'éducation* was founded in 1768, and the *Courrier de la mode* in the same year; the theatre had its first organ in the *Journal des théâtres* (1770); in the same year were produced a *Journal de musique* and the *Encyclopédie militaire*; the sister service was supplied with a *Journal de marine* in 1778. We have already noticed several journals specially devoted to one or other foreign literature. It was left to Fréron, Grimm, Prévost and others in 1754 to extend the idea to all foreign productions, and the *Journal étranger* (1754–1762) was founded for this purpose. The *Gazette littéraire* (1764–1766), which had Voltaire, Diderot and Saint-Lambert among its editors, was intended to swamp the small fry by criticism; the *Journal des dames* (1759–1778) was of a light magazine class; and the *Journal de monsieur* (1776–1783) had three phases of existence, and died after extending to thirty volumes. The *Mémoires secrets pour servir à l'histoire de la république des lettres* (1762–1787), better known as *Mémoires de Bachaumont*, from the name of their founder, furnish a minute account of the social and literary history for a period of twenty-six years. Of a similar character was the *Correspondance littéraire secrète* (1774–1793), to which Métra was the chief contributor. *L'Esprit des Journaux* (1772–1818) forms an important literary and historical collection, which is rarely to be found complete.

The movement of ideas at the close of the century may best be traced in the *Annales politiques, civiles, et littéraires* (1777–1792) of Linguet. The *Décade philosophique* (year V., or 1796/1797), founded by Ginguené, is the first periodical of the magazine class which appeared after the storms of the Revolution. It was a kind of resurrection of good taste; under the empire it formed the sole refuge of the opposition. By a decree of the 17th of January 1800 the consulate reduced the number of Parisian journals to thirteen, of which the *Décade* was one; all the others, with the exception of those dealing solely with science, art, commerce and advertisements, were suppressed. A report addressed to Bonaparte by Fiévée[1] in the year XI. (1802/1803) furnishes a list of fifty-one of these periodicals. In the year XIII. (1804/1805) only seven non-political serials were permitted to appear.

Between 1815 and 1819 there was a constant struggle between freedom of thought on the one hand and the censure, the police and the law officers on the other. This oppression led to the device of "semi-periodical" publications, of which *La Minerve française* (1818–1820) is an instance. It was the *Satire Ménippée* of the Restoration, and was brought out four times a year at irregular intervals. Of the same class was the *Bibliothèque historique* (1818–1820), another anti-royalist organ. The censure was re-established in 1820 and abolished in 1828 with the monopoly. It has always seemed impossible to carry on successfully in France a review upon the lines of those which have become so numerous and important in England. The *Revue britannique* (1825–1901) had, however, a long career. The short-lived *Revue française* (1828–1830), founded by Guizot, Rémusat, De Broglie, and the *doctrinaires*, was an attempt in this direction. The well-known *Revue des deux mondes* was established in 1829 by Ségur-Dupeyron and Mauroy, but it ceased to appear at the end of the year, and its actual existence dates from its acquisition in 1831 by François Buloz,[2] a masterful editor, under whose energetic management it soon achieved a world-wide reputation. The most distinguished names in French literature have been among its contributors, for whom it has been styled the "vestibule of the Academy." It was preceded by a few months by the *Revue de Paris* (1829–1845), founded by Véron, who introduced the novel to periodical literature. In 1834 this was purchased by Buloz, and brought out concurrently with his other *Revue*. While the former was exclusively literary and artistic, the latter dealt more with philosophy. The *Revue indépendante* (1841–1848) was founded by Pierre Leroux, George Sand and Viardot for the democracy. The times of the consulate and the empire were the subjects dealt with by the *Revue de l'empire* (1842–1848). In *Le Correspondant* (1843), established by Montalembert and De Falloux, the Catholics and Legitimists had a valuable supporter. The *Revue contemporaine* (1852), founded by the comte de Belval as a royalist organ, had joined to it in 1856 the *Athenaeum français*. The *Revue germanique* (1858) exchanged its exclusive name and character in 1865 to the *Revue moderne*. The *Revue européenne* (1859) was at first subventioned like the *Revue contemporaine*, from which it soon withdrew government favour. The *Revue nationale* (1860) appeared quarterly, and succeeded to the *Magazin de librairie* (1858).

The number of French periodicals, reviews and magazines has enormously increased, not only in Paris but in the provinces. In Paris the number of periodicals published in 1883 was 1379; at the end of 1908 there were more than 3500 of all kinds. The chief current periodicals may be mentioned in the following order. The list includes a few no longer published.

Archaeology.—*Revue archéologique* (1860), bi-monthly; *Ami des monuments* (1887); *Bulletin de numismatique* (1891); *Revue biblique* (1892); *L'Année épigraphique* (1880)—a sort of supplement to the *Corpus inscriptionum latinarum*; *Celtica* (1903)—common to France and England; *Gazette numismatique française* (1897); *Revue sémitique d'épigraphie et d'histoire ancienne* (1893); *Bulletin monumental*, bi-monthly; *L'Intermédiaire*, weekly, the French "Notes and Queries," devoted to literary and antiquarian questions.

Astronomy.—*Annuaire astronomique et météorologique* (1901); *Bulletin astronomique* (1884), formerly published under the title *Bulletin des sciences mathématiques et astronomiques*.

Bibliography.—*Annales de bibliographie théologique* (1888); *Le bibliographe moderne* (1897); *Bibliographie anatomique* (1893); *Bibliographie scientifique française* (1902); *Bulletin des bibliothèques et des archives* (1884); *Bulletin des livres relatifs à l'Amérique* (1899); *Courrier des bibliothèques* (1910); *Répertoire méthodique de l'histoire moderne et contemporaine de la France* (1898); *Répertoire méthodique du moyen âge français* (1894); *Revue bibliographique et critique des langues et littératures romanes* (1889); *Revue des bibliothèques* (1891); *Polybiblion: revue bibliographique universelle*, monthly; *Revue générale de bibliographie française*, bi-monthly.

Children's Magazines.—*L'Ami de la jeunesse*; *Le Jeudi de la jeunesse*, weekly.

Fashions.—*La Mode illustrée*; *Les Modes*, monthly.

Fine Arts.—*Les Arts* (1902); *Gazette des beaux-arts* (1859), monthly, with *Chronique des arts*; *Revue de l'art ancien et moderne* (1897) monthly; *L'Art décoratif*, monthly, *Art et décoration*, monthly; *L'Art pour tous*, monthly; *La Décoration*, monthly; *L'Architecture*—journal of the Soc. centrale des Architectes français, weekly; *L'Art* (1875) is no longer published.

Geography and Colonies.—*Bulletin de géographie historique*; *Annales de géographie* (1891), with useful quarterly bibliography; *Nouvelles géographiques*—supplement to the *Tour du monde* (1891); *La Vie coloniale* (1902); *La Géographie*, monthly, published by the Soc. de Géographie (1900); *Revue de géographie*, monthly; *Revue géographique internationale*, monthly.

History.—For long the chief organs for history and archaeology were the *Bibliothèque de l'école des chartes* (1835), appearing every two months and dealing with the middle ages, and the *Cabinet historique* (1855), a monthly devoted to MSS. and unprinted documents. The *Revue historique* (1876) appears bi-monthly; there is also the *Revue d'histoire moderne et contemporaine*.

Law and Jurisprudence.—*Annales de droit commercial* (1877); *Revue algérienne et tunisienne de législation et de jurisprudence* (1885); *Revue du droit public et de la science politique* (1894); *Revue générale du droit international public* (1894).

Literary Reviews.—The *Revue des deux mondes* and the *Correspondant* have already been mentioned. One of the first of European weekly reviews is the *Revue critique* (1866). The *Revue politique et littéraire*, successor to the *Revue des cours littéraires* (1863) and known as the *Revue bleue*, also appears weekly. Others of interest are: *Antée, revue mensuelle de littérature* (1904); *L'Art et la vie* (1892); *Cosmopolis* (1896); *L'Ermitage* (1890); *Le Mercure de France*, série moderne (1890), a magazine greatly valued in literary circles; *La Revue de Paris*, fortnightly (1894), and the *Nouvelle Revue* (1879)—

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[1] The novelist and publicist Joseph Fiévée (1767–1839), known for his relations with Napoleon I., has been made the subject for a study by Sainte-Beuve (*Causeries*, v. 172).

[2] This remarkable man (1804–1877) began life as a shepherd. Educated through the charity of M. Naville, he came to Paris as a compositor, and by translating from the English earned sufficient to purchase the moribund *Revue des deux mondes*, which acquired its subsequent position in spite of the tyrannical editorial behaviour of the proprietor. Buloz is said to have eventually enjoyed an income of 365,000 francs from the *Revue*.

both serious rivals of the *Revue des deux mondes; Revue française d'Édimbourg* (1897); *Revue germanique* (1905); *Le Livre* (1880), dealing with bibliography and literary history, and *La Revue latine* (1902), no longer published; *La Revue*, monthly.

Mathematics.—Intermédiaire des mathématiciens (1894); *Bulletin des sciences mathématiques* (1896); *Revue de mathématiques spéciales* (1890); *Journal de mathématiques pures et appliquées*, quarterly.

Medicine.—Revue de médecine (1881); *Annales de l'École de plein exercise de médicine et de pharmacie de Marseille* (1891); *La Chronique médecale* (1893); *Revue de gynécologie*, bi-monthly; *La Semaine médicale*, weekly; *Journal d'hygiène*, monthly.

Military.—Revue des troupes coloniales, monthly; *La Revue d'infantrie*, monthly.

Music.—Musica (1902); *Revue d'histoire et de critique musicale* (1901); *Annales de la musique; Le Ménestral*, weekly.

Philology.—L'Année linguistique (1901–1902); *Bulletin de la société des parlers de France* (1893); *Bulletin des humanités français* (1894); *Bulletin hispanique* (1899); *Bulletin italien* (1901); *Lou-Gai-Sabé-Antoulongio prouvençalo* (1905); *Le Maître phonétique* (1886); *Le Moyen Age* (1888); *Revue de la renaissance* (1901); *Revue de métrique et de versification* (1894–1895); *Revue des études grecques* (1888); *Revue des études rabelaisiennes* (1903); *Revue des parlers populaires* (1902); *Revue des patois* (1887); *Revue hispanique* (1894); *Revue celtique*, quarterly; *Revue de philologie française et de littérature.*

Philosophy and Psychology.—Revue philosophique (1876), monthly; *Annales des sciences psychiques* (1891); *L'Année philosophique* (1890), critical and analytical review of all philosophical works appearing during the year; *L'Année psychologique* (1894); *Journal de psychologie normale et pathologie* (1904); *Bulletin de l'institut général de psychologie* (1903); *Revue de l'hypnotisme et de la psychologie physiologique* (1900); *Revue de métaphysique et de morale* (1893); *Revue de philosophie* (1900); *Revue de psychiatrie* (1897).

Physics and Chemistry.—Bulletin des sciences physiques (1888); *L'Éclairage électrique* (1894); *Le Radium* (1904); *Revue générale des sciences pures et appliquées* (1890); *Revue pratique de l'électricité* (1892).

Popular and Family Reviews.—A travers le monde (1898); *Femina* (1901); *Je sais tout* (1905); *La Lecture moderne* (1901); *La Revue hebdomadaire* (1892); *Les Lectures pour tous* (1898); *Mon bonheur* (1902); *La Vie heureuse* (1902).

Science (General).—*La Nature*, weekly; *Revue scientifique* (1863), weekly; *La Science française*, monthly.—*Science* (Applied): *Les inventions illustrées*, weekly; *Revue industrielle*, weekly.—*Science* (Natural): *Archives de biologie; Journal de botanique* (1887); *L'Année biologique* (1895); *Revue des sciences naturelles de l'ouest* (1891); *Revue générale de botanique* (1889); *La Pisciculture pratique* (1895).—*Science* (Political, Sociological and Statistical): *Annales économiques* (founded as *La France commerciale* in 1885); *L'Année sociologique* (1896–1897); *Bulletin de l'office du travail* (1894); *Bulletin de l'office international du travail* (1902); *Le Mouvement socialiste*—international bi-monthly (1899); *Notices et comptes rendus de l'office du travail* (1892); *L'Orient et l'abeille du Bosphore* (1889); *Revue politique et parlementaire* (1894); *Revue international de sociologie*, monthly.

SPORTS.—*L'Aérophile* (1893); *L'Aéronautique* (1902); *L'Aérostation* (1904); *La Vie au grand air* (1898); *La Vie automobile* (1901); *Revue de l'aéronautique* (1888).

AUTHORITIES.—The subject of French periodicals has been exhaustively treated in the valuable works of Eugène Hatin—*Histoire de la presse en France* (8 vols., 1859–1861), *Les Gazettes de Hollande et la presse clandestine aux* 17^{e} *et* 18^{e} *siècles* (1865), and *Bibliographie de la presse périodique française* (1866). See also *Catalogue de l'histoire de France* (11 vols., 1855–1879), V. Gébé, *Catalogue des journaux, &c., publiés à Paris* (1879); Brunet, *Manuel du libraire, avec supplément* (8 vols., 1860–1880); F. Mège, *Les Journaux et écrits périodiques de la Basse Auvergne* (1869); *Bulletin des sommaires des journaux* (1888); D. Jordell, *Répertoire bibliographique des principales revues françaises* (3 vols., 1897–1899, 1898–1900), indexes about 350 periodicals; *Annuaire de la presse française et du monde politique* (1909–1910); Le Soudier, *Annuaire des journaux, revues et publications périodiques parus à Paris jusqu'en 1909* (1910). For lists of general indexes consult Stein, *Manuel de bibliographie générale* (1897), pp. 637–710.

GERMANY

The earliest trace of the literary journal in Germany is to be found in the *Erbauliche Monatsunterredungen* (1663) of the poet Johann Rist and in the *Miscellanea curiosa medico-physica* (1670–1704) of the Academia naturae curiosorum Leopoldina-Carolina, the first scientific annual, uniting the features of the *Journal des savants* and of the *Philosophical Transactions.* D. G. Morhof, the author of the well-known *Polyhistor*, conceived the idea of a monthly serial to be devoted to the history of modern books and learning, which came to nothing. While professor of morals at Leipzig, Otto Mencke planned the *Acta eruditorum*, with a view to make known, by means of analyses, extracts and reviews, the new works produced throughout Europe. In 1680 he travelled in England and Holland in order to obtain literary assistance, and the first number appeared in 1682, under the title of *Acta eruditorum lipsiensium*, and, like its successors, ~~was~~ written in Latin. Among the contributors to subsequent numbers were Leibnitz, Seckendorf and Cellarius. A volume came out each year, with supplements. After editing about thirty volumes Mencke died, leaving the publication to his son, and the *Acta* remained in the possession of the family down to 1745, when they extended to 117 volumes, which form an extremely valuable history of the learning of the period. A selection of the dissertations and articles was published at Venice in 7 vols. 4to (1740). The *Acta* soon had imitators. The *Ephemerides litterariae* (1686) came out at Hamburg in Latin and French. The *Nova litteraria maris Balthici et Septentrionis* (1698–1708) was more especially devoted to north Germany and the universities of Kiel, Rostock and Dorpat. Supplementary to the preceding was the *Nova litteraria Germaniae collecta Hamburgi* (1703–1709), which from 1707 widened its field of view to the whole of Europe. At Leipzig was produced the *Teutsche acta eruditorum* (1712), an excellent periodical, edited by J. G. Rabener and C. G. Jöcher, and continued from 1740 to 1758 as *Zuverlässige Nachrichten.* It included portraits.

The brilliant and enterprising Christian Thomasius brought out periodically, in dialogue form, his *Monatsgespräche* (1688–1690), written by himself in the vernacular, to defend his novel theories against the alarmed pedantry of Germany, and, together with Strahl, Buddeus and others, *Observationes selectae ad rem litterariam spectantes* (1700), written in Latin. W. E. Tenzel also published *Monatliche Unterredungen* (1689–1698), continued from 1704 as *Curieuse Bibliothek*, and treating various subjects in dialogue form. After the death of Tenzel the *Bibliothek* was carried on under different titles by C. Woltereck, J. G. Krause and others, down to 1721. Of much greater importance than these was the *Monatlicher Auszug* (1701), supported by J. G. Eccard and Leibnitz. Another periodical on Thomasius's plan was *Neue Unterredungen* (1702), edited by N. H. Gundling. The *Gundlingiana* of the latter person, published at Halle (1715–1732), and written partly in Latin and partly in German by the editor, contained a miscellaneous collection of juridical, historical and theological observations and dissertations.

Nearly all departments of learning possessed their several special periodical organs about the close of the 17th or the beginning of the 18th century. The *Anni franciscanorum* (1680) was edited by the Jesuit Stiller; and J. S. Adami published, between 1690 and 1713, certain theological repertories under the name of *Deliciae.* Historical journalism was first represented by *Electa juris publici* (1709), philology by *Neue acerra philologica* (1715–1723), philosophy by the *Acta philosophorum* (1715–1727), medicine by *Der patriotische Medikus* (1725), music by *Der musikalische Patriot* (1725), and education by *Die Matrone* (1728). Reference has already been made to the *Miscellanea curiosa medico-physica* (1670–1704); the *Monatliche Erzählungen* (1689) was also devoted to natural science.

Down to the early part of the 18th century Halle and Leipzig were the headquarters of literary journalism in Germany. Other centres began to feel the need of similar organs of opinion. Hamburg had its *Niedersächsische neue Zeitungen*, styled from 1731 *Niedersächsische Nachrichten*, which came to an end in 1736, and Mecklenburg owned in 1710 its *Neuer Vorrath*, besides others brought out at Rostock. Prussia owes the foundation of its literary periodicals to G. P. Schulze and M. Lilienthal, the former of whom began with *Gelehrtes Preussen* (1722), continued under different titles down to 1729; the latter helped with the *Erläutertes Preussen* (1724), and was the sole editor of the *Acta borussica* (1730–1732). Pomerania and Silesia also had their special periodicals in the first quarter of the 18th century. Franconia commenced with *Nova litteraria*, and Hesse with the *Kurze Historie*, both in 1725. In south Germany appeared the *Württembergische Nebenstunden* (1718), and the *Parnassus boicus*, first published at Munich in 1722. The *Frankfürter gelehrte Zeitungen* was founded in 1736 by S. T. Hocker, and existed down to 1790. Austria owned *Das merkwürdige Wien.*

In 1715 the *Neue Zeitungen von gelehrten Sachen* was founded by J. G. Krause at Leipzig and carried on by various editors down to 1797. It was the first attempt to apply the form of the weekly political journal to learned subjects, and was imitated in the *Vermischte Bibliothek* (1718–1720) and the *Bibliotheca novissima* (1718–1721), both founded by J. G. Francke in Halle. Shortly after the foundation of the university of Göttingen appeared *Zeitungen von gelehrten Sachsen* (1739), still famous as the *Göttingische gelehrte Anzeigen*, which during its long and influential career has been conducted by professors of that university, and among others by Haller, Heyne and Eichhorn.

Influenced by a close study of English writers, the two Swiss, Bodmer and Breitinger, established *Die Discurse der Maler* (1721), and by paying more attention to the matter of works reviewed than to their manner, commenced a critical method new to Germany. The system was attacked by Gottsched, who, educated in the French school, erred in the opposite direction. The struggle between the two parties gave fresh life to the literature of the country but German criticism of the higher sort can only be said really to begin with Lessing. The Berlin publisher Nicolai founded the *Bibliothek der schönen Wissenschaften*, and afterwards handed it over to C. F. Weisse in order to give his whole energy to the *Briefe, die neueste Literatur betreffend* (1759–1765), carried on by the help of Lessing, Mendelssohn and Abbt. To Nicolai is also due the *Allgemeine deutsche Bibliothek* (1765–1806), which embraced a much wider field and soon became extremely influential. Herder founded the *Kritische Wälder* in 1766. *Der deutsche Merkur* (1773–1789, revived 1790–1810) of Wieland was the solitary representative of the French school of criticism. A new era in German periodical literature began when Bertuch brought out at Jena in 1785 the *Allgemeine Literaturzeitung*, to which the leading writers of the country were contributors. On being transferred to Halle in 1804 it was replaced by the *Jenaische allgemeine Literaturzeitung*, founded by Eichstädt. Both reviews enjoyed a prosperous career down to the year 1848.

At the beginning of the 19th century we find the *Erlanger Literaturzeitung* (1799–1810), which had replaced a *Gelehrte Zeitung* (1746); the *Leipziger Literaturzeitung* (1800–1834); the *Heidelbergische Jahrbücher der Literatur* (1808–1872); and the *Wiener Literaturzeitung* (1813–1816), followed by the *Wiener Jahrbücher der Literatur* (1818–1848), both of which received government support and resembled the English *Quarterly Review* in their conservative politics and high literary tone. *Hermes*, founded at Leipzig in 1819 by W. T. Krug, was distinguished for its erudition, and came out down to 1831. One of the most remarkable periodicals of this class was the *Jahrbücher für wissenschaftliche Kritik* (1827–1846), first published by Cotta. The *Hallische Jahrbücher* (1838–1842) was founded by Ruge and Echtermeyer, and supported by the government. The *Repertorium der gesammten deutschen Literatur*, established by Gersdorf in 1834, and known after 1843 as the *Leipziger Repertorium der deutschen und ausländischen Literatur*, existed to 1860. Buchner founded the *Literarische Zeitung* at Berlin in 1834. It was continued by Brandes down to 1849. The political troubles of 1848 and 1849 were most disastrous to the welfare of the literary and miscellaneous periodicals. Gersdorf's *Repertorium*, the *Gelehrte Anzeigen* of Göttingen and of Munich, and the *Heidelbergische Jahrbücher* were the sole survivors. The *Allgemeine Monatschrift für Literatur* (1850), conducted after 1851 by Droysen, Nitzsch and others, continued only down to 1854; the *Literarisches Centralblatt* (1850) is still published. The *Blätter für literarische Unterhaltung* sprang out of the *Literarisches Wochenblatt* (1818), founded by Kotzebue; after 1865 it was edited by R. Gottschall with considerable success. Many of the literary journals did not disdain to occupy themselves with the fashions, but the first periodical of any merit specially devoted to the subject was the *Bazar* (1855). The first to popularize science was *Natur* (1852). The *Hausblätter* (1855), a bi-monthly magazine, was extremely successful. The *Salon* (1868) followed more closely the type of the English magazine. About this period arose a great number of weekly serials for popular reading, known as "Sonntagsblätter," of which the *Gartenlaube* (1858) and *Daheim* (1864) are surviving examples.

In course of time a large number of similar publications were issued, some illustrated, for instance: *Illustrierte Zeitung* (Leipzig, 1843), *Berliner Illustrierte Zeitung* (1892), *Die Woche* (1899) the last the most widely circulated of the kind, 500,000 being printed.

At a somewhat earlier date commenced a long series of weekly and monthly periodicals of a more solid character, of which the following list indicates the more important in chronological order: *Die Grenzboten* (1862), weekly; the *Deutsches Museum* (1851–1857), of Prutz and Frenzel; *Berliner Revue* (1855–1873); *Westermanns Monatshefte* (1856), monthly; *Unsere Zeit* (1857–1891), beginning as a kind of supplement to Brockhaus's *Conversationslexikon*; *Preussische Jahrbücher* (1858), monthly; *Deutsches Magazin* (1861–1863); *Die Gegenwart* (1873), weekly; *Konservative Monatsschrift* (1873), preceded by the *Volksblatt für Stadt und Land* (1843); *Deutsche Rundschau* (1874), fortnightly, conducted upon the method of the *Revue des deux mondes*; *Deutsche Revue* (1876), monthly; *Nord und Süd* (1877), monthly; *Das Echo* (1882), weekly; *Die Zukunft* (1882), weekly; *Die neue Zeit* (1883), weekly; *Reclams Universum* (1884), weekly; *Velhagen und Klasings Monatshefte* (1889), monthly; *Die deutsche Rundschau* (1890), monthly; *Die Wahrheit* (1893–1897); *Kritik* (1894–1902); *Die Umschau* (1897), weekly; *Das literarische Echo* (1898), fortnightly; *Kynast* (1898–1899), known later as *Deutsche Zeitschrift* (1899–1903) and *Iduna* (1903–1906); *Der Türmer* (1898), monthly; *Die Warte* (1900), weekly; *Deutschland* (1902–1907); *Deutsche Monatsschrift* (1902–1907); *Hochland* (1903), monthly; *Charon* (1904), monthly; *Süddeutsche Monatshefte* (1904); *Der Deutsche* (1905–1908); *Deutsche Kultur* (1905–1908); *Arena* (1906), monthly; *Das Blaubuch* (1906), weekly; *Eckart* (1906), monthly; *Die Standarte* (1906), weekly; *März* (1907), fortnightly; *Morgen* (1907), weekly; *Neue Revue* (1907), weekly; *Internationale Wochenschrift für Wissenschaft, Kunst, und Technik* (1907), weekly supplement to the *Münchener allgemeine Zeitung*; *Wissen* (1907), weekly; *Unsere Zeit* (1907), monthly; *Hyperion* (1908), bi-monthly; *Xenien* (1908), monthly; *Das neue Jahrhundert* (1909), monthly; *Die Tat* (1909), monthly.

Periodicals have been specialized in Germany to an extent perhaps unequalled in any other country. No subject of human interest is now without one or indeed several organs. Full details of these serials are supplied by a special class of periodical with which every department of science, art and literature in German-speaking countries is equipped, the *Jahresberichte* and *Bibliographien*, which give each year a full account of the literature of the subject with which they are concerned. The chief of these are:—

Bibliography and Librarianship: *Bibliographie des Buch- und Bibliothekswesens* (1905); Chemistry: *Jahresbericht über die Fortschritte der Chemie* (1847); Classical Archaeology and Philology: *Jahresbericht über die Fortschritte der klassischen Altertumswissenschaft* (1873); Education: *Jahrbuch der pädagogischen Literatur* (1901); Geography: *Geographisches Jahrbuch* (1874); *Bibliotheca geographica* (1891); History: *Jahresberichte der Geschichtswissenschaft* (1878); Fine Arts: *Internationale Bibliographie der Kunstwissenschaft* (1902); Law and Political Economy: *Uebersicht der gesamten staats- und rechtswissenschaftlichen Literatur* (1868); *Jurisprudentia Germaniae* (1905); *Bibliographie des bürgerlichen Rechts* (1888); *Bibliographie der Sozialwissenschaften* (1905); *Bibliographie für Sozial- und Wirtschaftsgeschichte* (1903); *Bibliographie für Volkswirtschaftslehre und Rechtswissenschaft* (1906); Literature and Languages: *Bibliographie der vergleichenden Literaturgeschichte* (1903); *Jahresberichte für neuere deutsche Literaturgeschichte* (1890); *Jahresbericht über die Erscheinungen auf dem Gebiete der germanischen Philologie* (1879); *Uebersicht über die auf dem Gebiete der englischen Philologie erschienenen Bücher, Schriften, und Aufsätze* (1878); *Kritischer Jahresbericht über die Fortschritte der romanischen Philologie* (1875); *Bibliographie für romanische Philologie—Supl. zur Zeitschr. f. roman. Philologie* (1875); *Orientalische Bibliographie* (1888); Mathematics: *Jahrbuch über die Fortschritte der Mathematik* (1869); Medicine and Surgery: *Jahresbericht über die Leistungen und Fortschritte der gesamten Medizin* (1866); *Jahresbericht über die Leistungen auf dem Gebiete der Veterinärmedizin* (1881); Military: *Jahresbericht über Veränderungen und Fortschritte im Militärwesen* (1874); *Jahresbericht über die Leistungen und Fortschritte auf dem Gebiete des Militärsanitätswesens* (1873); Natural Science: *Naturae novitates* (1879), fortnightly; *Bibliographie der deutschen naturwissenschaftlichen Literatur* (1901); *Bibliographia zoologica* (1896); *Zoologischer Jahresbericht* (1879); *Justs botanischer Jahresbericht* (1873); *Die Fortschritte der Physik* (1847); Technicology: *Repertorium der technischen Journalliteratur* (1874); Theology: *Theologischer Jahresbericht* (1881); *Bibliographie der Kirchengeschichtlichen Literatur* (1877).

AUSTRIA

The most notable periodicals of a general character have been the *Wiener Jahrbücher der Literatur* (1818–1848) and the *Oesterreichische Revue* (1863–1867). Among current examples the following may be mentioned: *Heimgarten* (1877), monthly; *Oesterreichisch-Ungarische Revue* (1886), monthly; *Allgemeines Literaturblatt* (1892), fortnightly; *Die Kultur* (1899), quarterly; *Deutsche Arbeit* (1900), monthly; *Oesterreichische Rundschau* (1904), fortnightly; *Die Karpathen* (1907); fortnightly.

There were in Austria 22 literary and 41 special periodicals in 1848, and 110 literary and 413 special periodicals in 1873 (see the statistical inquiry of Dr Johann Winckler, *Die period. Presse Oesterreichs*, 1875). In 1905 the total number had increased to 806, of which 564 were published in Vienna.

According to the *Deutscher Zeitschriften-Katalog* (1874), 2219 periodicals were published in Austria, Germany and Switzerland in 1874 in the German language. In 1905 the number of periodicals in German-speaking countries was 5066, of which 4019 appeared in Germany (in Berlin alone 1107) 806 in Austria and 218 in Switzerland (*Börsenblatt für den deutschen Buchhandel*, 1909, No. 124).

AUTHORITIES.—C. Juncker, *Schediasma de ephemeridibus eruditorum* (Leipzig, 1692); H. Kurz, *Geschichte der deutschen Literatur* (Leipzig, 1852); R. Prutz, *Geschichte des deutschen Journalismus* (1845) vol. i.,—unfortunately it does not go beyond 1713); H. Wuttke, *Die deutschen Zeitschriften* (1875); P. E. Richter, *Verzeichnis der Periodica im Besitze der k. off. Bibl. zu Dresden* (1880); *Generalkatalog der laufenden periodischen Druckschriften an den oesterr. Universitäts- und Studienbibliotheken hrsg. von F. Grassauer* (Vienna, 1898); Königliche Bibliothek zu Berlin, *Alphabetisches Verzeichnis der laufenden Zeitschriften* (1908); *Systematisches Verzeichnis der laufenden Zeitschriften* (1908); *Alphabetisches Verzeichnis der laufenden Zeitschriften, welche von der K. Hof- und Staatsbibliothek München und einer Anzahl anderer Bibliotheken Bayern gehalten werden* (München, 1909); Kürschner, *Jahrbuch der Presse* (1902); *Sperlings Zeitschriften Adressbuch* (Stuttgart, 1910); Bibliographisches Repertorium, Berlin: Walzel-Houben, *Zeitschriften der Romantik* (1904); Houben, *Zeitschriften des jungen Deutschlands* (1906); Luck, *Die deutsche Fachpresse* (Tübingen, 1908). The *Bibliographie der deutschen Zeitschriftenliteratur*, edited by F. Dieterich, which has appeared annually since 1896, describes about 1300 periodicals (mostly scientific) by subjects and titles; from 1900 it has been supplemented by *Bibliographie der deutschen Recensionen*, which indexes notices and reviews in over 1000 serials each year, chiefly scientific and technical.

SWITZERLAND

The *Nova litteraria helvetica* (1703–1715) of Zurich is the earliest literary periodical which Switzerland can show. From 1728 to 1734 a *Bibliothèque italique*, and towards the end of the century the *Bibliothèque britannique* (1796–1815), dealing with agriculture, literature, and science, in three separate series, were published at Geneva. The latter was followed by the leading periodical of French-speaking Switzerland, the *Bibliothèque universelle* (1816), which has also had a scientific and a literary series. The *Revue suisse* (1838) was produced at Neuchâtel. These two have been amalgamated and appear as the *Bibliothèque universelle et revue suisse*. *La Suisse romande* (1885) only lasted twelve months. *Théologie et philosophie* (1868–1872), an account of foreign literature on those subjects, was continued as *Revue de théologie et de philosophie* (1873) at Lausanne. Among current serials may be mentioned *Archives de psychologie de la Suisse romande* (1901) edited by Flournoy and Claparède; *Jahresverzeichnis der schweizerischen Universitätsschriften* (1897–1898); *Untersuchungen zur neueren Sprach- und Literaturgeschichte* (1903); *Zwingliana: Mitteilungen zur Geschichte Zwingli und der Reformation* (1897).

Italy

Prompted by M. A. Ricci, Francesco Nazzari, the future cardinal, established in 1668 the *Giornale de' letterati* upon the plan of the French *Journal des savants*. His collaborateurs each agreed to undertake the criticism of a separate literature while Nazzari retained the general editorship and the analysis of the French books. The journal was continued to 1675, and another series was carried on to 1769. Bacchini brought out at Parma (1688–1690) and at Modena (1692–1697) a periodical with a similar title. A much better known *Giornale* was that of Apostolo Zeno, founded with the help of Maffei and Muratori (1710), continued after 1718 by Pietro Zeno, and after 1728 by Mastraca and Paitoni. Another *Giornale*, to which Fabroni contributed, was published at Pisa from 1771 onwards. The *Galleria di Minerva* was first published at Venice in 1696. One of the many merits of the antiquary Lami was his connexion with the *Novelle letterarie* (1740–1770), founded by him, and after the first two years almost entirely written by him. Its learning and impartiality gave it much authority. The *Frusta letteraria* (1763–1765) was brought out at Venice by Giuseppe Baretti under the pseudonym of Aristarco Scannabue. The next that deserve mention are the *Giornale enciclopedico* (1806) of Naples, followed by the *Progresso delle scienze* (1833–1848) and the *Museo di scienze e letteratura* of the same city, and the *Giornale arcadico* (1819) of Rome. Among the contributors to the *Poligrafo* (1811) of Milan were Monti, Perticari, and some of the first names in Italian literature. The *Biblioteca italiana* (1816–1840) was founded at Milan by the favour of the Austrian government, and the editorship was offered to and declined by Ugo Foscolo. It rendered service to Italian literature by its opposition to the Della-Cruscan tyranny. Another Milanese serial was the *Conciliatore* (1818–1820), which although it only lived two years, will be remembered for the endeavours made by Silvio Pellico, Camillo Ugoni and its other contributors to introduce a more dignified and courageous method of criticism. After its suppression and the falling off in interest of the *Biblioteca italiana* the next of any merit to appear was the *Antologia*, a monthly periodical brought out at Florence in 1820 by Gino Capponi and Giampetro Vieusseux, but suppressed in 1833 on account of an epigram of Tommaseo, a principal writer. Some striking papers were contributed by Giuseppe Mazzini. Naples had in 1832 *Il Progresso* of Carlo Troya, helped by Tommaseo and Centofanti, and Palermo owned the *Giornale di statistica* (1834), suppressed eight years later. The *Archivio storico*, consisting of reprints of documents with historical dissertations, dates from 1842, and was founded by Vieusseux and Gino Capponi. The *Civiltà cattolica* (1850), fortnightly, is still the organ of the Jesuits. The *Rivista contemporanea* (1852) was founded at Turin in emulation of the French *Revue des deux mondes*, which has been the type followed by so many continental periodicals. The *Politecnico* (1839) of Milan was suppressed in 1844 and revived in 1859. The *Nuova antologia* (1866) soon acquired a well-deserved reputation as a high-class review and magazine; its rival, the *Rivista europea*, being the special organ of the Florentine men of letters. The *Rassegna settimanale* was a weekly political and literary review, which after eight years of existence gave place to a daily newspaper, the *Rassegna*. The *Archivio trentino* (1882) was the organ of "Italia Irredenta." The *Rassegna nazionale*, conducted by the marchese Manfredo di Passano, a chief of the moderate clerical party, the *Nuova rivista* of Turin, the *Fanfulla della Domenica*, and the *Gazzetta letteraria* may also be mentioned.

Some of the following are still published: *Annali di matematica* (1867); *Annuario di giurisprudenza* (1883); *Archivio di statistica* (1876); *Archivio storico lombardo* (1874); *Archivio veneto* (1871); *Archivio per lo studio delle tradizioni popolari*; *Archivio per la zoologia*; *Il Bibliofilo*; *Il Filangieri* (1876); *La Natura* (1884); *Nuovo giornale botanico* (1869); *Giornale degli eruditi* (1883); *Giornale di filologia romanza*; *Nuova rivista Internazionale* (1879); *La Rassegna italiana* (1881); *Revue internationale* (1883). In more recent years a great expansion has been witnessed. Local reviews have largely increased, as well as those devoted to history, science and university undertakings. Among representative serials are the following—Archaeology: *Museo italiano di antichita classica* (1885) with atlas in folio; *Oriens christianus* (1901); *Nuovo bollettino di archeologia cristiana*, quarterly at Rome (1895). Bibliography: *Rivista delle biblioteche e degli archivi* (1888), published monthly at Rome and Florence, the official organ of librarians and archivists; *Giornale della libreria della tipografia* (1888), supplement to the *Bibliografia italiana*; *Bollettino di bibliografia e storia delle scienze matematiche* (1898); *La Bibliofilia* (1899), Florence, monthly; *Raccolta Vinciana* (1904). Philology: *Bollettino di filologia classica* (1894); *Giornale italiano di filologia e linguistica classica* (1886); *Studi di filologia romanza* (1885); *Studi italiani di filologia classica* (1893); *Bessarione*, bi-monthly. No class has developed more usefully than the historical, among them being: *Bollettino dell' instituto storico italiano* (1886); *Nuovo archivio veneto* (1890); *Rivista di storia antica e scienze affini* (1895); *Rivista storica italiana* (1884). New literary and scientific reviews are: *L'Alighieri, rivista di cose dantesche* (1889); *Giornale dantesco* (1894); *Giornale storico della letteratura italiana* (1883); *Studi di letteratura italiana* (1899); *Studi medievali* (1904); *L'Arcadia, periodico mensile di scienze, lettere, ed arti* (1889); *Periodico di matematica per l'insegnamento secondario* (1885); *Rivista di matematica* (1891); *Rivista philosofica* (1899); *Rivista d'Italia*, monthly at Rome. Fine Arts: *L'Arte*, monthly; *Arte italiana*, monthly; *Rassegna d'arte*, monthly.

Authorities.—See G. Ottino, *La Stampa periodica in Italia* (Milan, 1875); *Raccolta dei periodici presentata all' esposizione in Milano* (1881); A. Roux, *La Littérature contemporaine en Italie* (1871–1883), Paris, 1883.

Belgium

The *Journal encyclopédique* (1756–1793) founded by P. Rousseau, made Liége a propagandist centre for the philosophical party. In the same city was also first established *L'Esprit des journaux* (1772–1818), styled by Sainte-Beuve "cette considérable et excellente collection," but "journal voleur et compilateur." The *Journal historique et littéraire* (1788–1790) was founded at Luxemburg by the Jesuit De Feller; having been suppressed there, it was transferred to Liége, and subsequently to Maestricht. It is one of the most curious of the Belgian periodicals of the 18th century, and contains most precious materials for the national history. A complete set is very rare and much sought after. The *Revue belge* (1835–1843), in spite of the support of the best writers of the kingdom, as well as its successor the *Revue de Liége* (1844–1847), the *Trésor national* (1842–1843), published at Brussels, and the *Revue de Belgique* (1846–1851) were all short-lived. The *Revue de Bruxelles* (1837–1848), supported by the nobility and the clergy, had a longer career. The *Revue nationale* was the champion of Liberalism, and came to an end in 1847. The *Messager des sciences historiques* (1833), at Ghent, was in repute on account of its historical and antiquarian character. The *Revue catholique*, the organ of the professors of the university of Louvain, began in 1846 a controversy with the *Journal historique et littéraire* of Kersten (1834) upon the origin of human knowledge, which lasted for many years and excited great attention. The *Annales des travaux publics* (1843), the *Bulletin de l'industrie* (1842), the *Journal des beaux-arts* (1858), and the Catholic *Précis historiques* (1852), the Protestant *Chrétien belge* (1850), are other examples. The *Revue trimestrielle* was founded at Brussels by Van Bemmel in 1854. The *Athenaeum belge* (1868) did not last long.

Among current periodicals in French are the following—Bibliography: *Bulletin bibliographique et pédagogique du musée belge* (1897); *La Revue des bibliothèques et archives de Belgique* (1903); *Le Glaneur littéraire, musical et bibliographie* (1901); *Archives des arts et de la bibliographie de Belgique* (Tables 1833–1853 and 1875–1894). Philosophy and ecclesiastical history: *Revue neo-scholastique publiée par la société philosophique de Louvain* (1894); *Revue d'histoire ecclésiastique* (1900), the organ of the Catholic university of Louvain; *Revue bénédictine* (1884); *Analectes pour servir à l'histoire ecclésiastique de la Belgique*, 2^{e} série (1881–1904) and 3^{e} série 1905); with an *Annexe* for Cartularies. Science: *Archives internationales de physiologie* (1902), published by Léon Fredericq; *La Cellule, recueil de cytologie et d'histologie générale* (1884); *Le Muséon* (1882); *Le Mouvement géographique* (1884); *Le Musée belge* (1897); *Revue chirurgicale belge et du nord de la France* (1901). *Annales des mines belgiques* appears quarterly, and *L'Art moderne* weekly at Brussels.

Among Flemish serials may be mentioned the *Nederduitsche Letteroefeningen* (1834); the *Belgisch Museum* (1836–1846), edited by Willems; the *Broederhand*, which did not appear after 1846; the *Taalverbund* of Antwerp; the *Kunst- en Letterblad* (1840–1843); and the *Vlaemsche Rederyker* (1844). Current Flemish periodicals include: *Onze kunst geïllustreed maandschrift voor beeldende kunst* (1900); *Averbode's weekblad Godsdienst huisgezin moedertaal* (1907); *De Raadselbode tolk van den vlamschen raadselliefhebber* (1901); *Rechtskundig tijdschrift voor vlamsch Belgie* (1901).

It has been calculated that in 1860 there were 51 periodicals published in Belgium. In 1884 the number had increased to 412, and in 1908 to 1701.

See U. Capitaine, *Recherches sur les journaux et les écrits périodiques liégeois* (1850); *Relevé de tous les écrits périodiques qui se publient dans le royaume de Belgique* (1875); *Catalogue des journaux, revues, et publications périodiques de la Belgique* (1910); *Revue bibliographique belge*.

Holland

The first serial written in Dutch was the *Boekzaal van Europa* (1692–1708, and 1715–1748), which had several changes of name during its long life. The next of any note was the *Republijk der Geleerden* (1710–1748). The English *Spectator* was imitated by J. van Effen in his *Misanthrope* (1711–1712), written in French, and in the *Hollandsche Spectator* (1731–1735), in Dutch. An important serial was the long-lived *Vaderlandsche Letteroefeningen* (1761). The *Algemeene Kunst en Letterbode* (1788) was long the leading review of Holland; in 1860 it was joined to the *Nederlandsch Spectator* (1855). Of those founded in the 19th century may be mentioned the *Recensent* (1803), and *Nieuwe Recensent*; the *Nederlandsch Museum* (1835); the *Tijdstroom* (1857); the *Tijdspiegel*, a literary journal of Protestant tendency; the *Theologisch Tijdschrift* (1867), the organ of the Leiden school of theology; and the *Dietsche Warande*, a Roman Catholic review devoted to the national antiquities. Colonial interests have been cared for by the *Tijdschrift voor nederlandsch Indie* (1848). Current periodicals are *Hollandsche revue*, monthly; *De Gids* (1837), monthly; *De nieuwe Gids* (1886), monthly; *De Architect*, bi-monthly; *Caecilia* (for music); *Tijdschrift voor Strafrecht*; *Museum*, for philology (1893), monthly; *Tijdschrift voor nederlandsche taal en letterkunde*; *Nederlandsch Archievenblad*; *De Paleograaf*; *Elseviers geïllustreerd Maandschrift*, monthly; *Groot Nederland*, monthly.

DENMARK

Early in the 18th century Denmark had the *Nye Tidender* (1720), continued down to 1836 under the name of *Danskliteraturtidende*. The *Minerva* (1785) of Rahbek was carried on to 1819, and the *Skandinavisk Museum* (1798–1803) was revived by the *Litteratur-Selskabs Skrifter* (1805). These were followed by the *Laerde Efterretninger* (1799–1810), afterwards styled *Litteratur-Tidende* (1811–1836), the *Athene* (1813–1817), and *Historisk Tidsskrift* (1840). In more modern times appeared *Tidsskrift for Litteratur og Kritik* (1832–1842, 1843); *Maanedsskrift for Litteratur* (1829–1838); *Nord og Syd* (1848–1849) of Goldschmidt, succeeded by *Ude og Hjemme*, and the *Dansk Maanedsskrift* (1858) of Steenstrup, with signed historical and literary articles. One of the most noteworthy Scandinavian periodicals has been the *Nordisk Universitets Tidsskrift* (1854–1864), a bond of union between the universities of Christiania, Upsala, Lund and Copenhagen. Current periodicals are: *Studier fra Sprog- og Oldtidsforskning* (1891), quarterly; *Danske Magazin*, yearly; *Nyt Tidsskrift for Mathematik*, monthly; *Theologisk Tidsskrift*, monthly; *Nationalökonomisk Tidsskrift*, bi-monthly; *Dansk bogfortegnelse*, bi-monthly for bibliography; *Athenaeum finsk*; *Tilskueren*, monthly; *Aarboger for Nordisk Oldkyndighed* (archaeology) quarterly.

Iceland has had the *Islenzk Sagnablöd* (1817–1826), *Ný Fjelagsrit* (1841–1873), and *Gefn* (1870–1873). *Skirnir* (1831), which absorbed in 1905 *Timarit hins islenska Bokmentafélags* (1880–1904), is still published.

NORWAY

The first trace of the serial form of publication to be found in Norway is in the *Ugentlige korte Afhandlinger* (1760–1761), "Weekly Short Treatises," of Bishop Fr. Nannestad, consisting of moral and theological essays. The *Maanedlige Afhandlinger* (1762), "Monthly Treatises," was supported by several writers and devoted chiefly to rural economy. These two were followed by *Politik og Historie* (1807–1810); *Saga* (1816–1820), a quarterly review edited by J. S. Munch; *Den norske Tilskuer* (1817–1821), a miscellany brought out at Bergen; *Hermoder* (1821–1827), a weekly aesthetic journal; *Iduna*, (1822–1823), of the same kind but of less value; *Vidar* (1832–1834), a weekly scientific and literary review; *Nor* (1840–1846), of the same type; *Norsk Tidsskrift for Videnskab og Litteratur* (1847–1855); *Illustreret Nyhedsblad* (1851–1866), "Illustrated News"; *Norsk Maanedsskrift* (1856–1860), "Monthly Review for Norway," devoted to history and philology; and *Norden* (1866), a literary and scientific review. Popular serials date from the *Skilling Magazin* (1835), which first introduced wood-engraving. Representative current periodicals are: *Samtiden*, monthly; *Elektroteknisk tidsskrift*; *nordisk musik-revue*, fortnightly; *Naturen*; *Norsk havetidende*, monthly; *Urd*; *Norvegia*.

SWEDEN

The *Swenska Argus* (1733–1734) of Olof Dalin is the first contribution of Sweden to periodical literature. The next were the *Tidningar om den Lärdas Arbeten* (1742) and the *Lärda Tidningar*. The patriotic journalist C. C. Gjörwell established about twenty literary periodicals of which the most important was the *Swenska Mercurius* (1755–1789). Atterbom and some fellow-students founded about 1810 a society for the deliverance of the country from French pedantry, which with this end carried on a periodical entitled *Phosphoros* (1810–1813), to propagate the opinions of Schlegel and Schelling. The *Svensk Literatur-Tidning* (1813–1825) of Palmblad and the *Polyfem* (1810–1812) had the same objects. Among later periodicals we may mention *Skandia* (1833–1837); *Literaturbladet* (1838–1840); *Ställningar och Forhallanden* (1838) of Crusenstolpe, a monthly review of Scandinavian history; *Tidskrift för Litteratur* (1850); *Norsk Tidsskrift* (1852), weekly, *Förr och Nu*; and the *Revue suédoise* (1858) of Kramer, written in French. Among the monthlies which now appear are the following: *Social Tidskrift*, *Nordisk Tidskrift* and *Ord och Bild*

SPAIN

Spain owes her intellectual emancipation to the monk Benito Feyjóo, who in 1726 produced a volume of dissertations somewhat after the fashion of the *Spectator*, but on graver subjects, entitled *Teatro critico*, which was continued down to 1739. His *Cartas eruditas* (1742–1760) were also issued periodically. The earliest critical serial, the *Diario de los literatos* (1737–1742), kept up at the expense of Philip V., did not long survive court favour. Other periodicals which appeared in the 18th century were Mañer's *Mercurio* (1738); the *Diario noticioso* (1758–1781); *El Pensador* (1762–1767) of Joseph Clavijo y Fajardo; *El Belianis literario* (1765), satirical in character; the *Semanario erudito* (1778–1791), a clumsy collection of documents; *El Correo literario de la Europa* (1781–1782); *El Censor* (1781); the valuable *Memorial literario* (1784–1808); *El Correo literario* (1786–1791), devoted to literature and science; and the special organs *El Correo mercantil* (1792–1798) and *El Semanario de agricultura* (1797–1805). In the 19th century were *Variedades de ciencias, literatura, y artes* (1803–1805), among whose contributors have been the distinguished names of Quintana, Moratin and Antillon; *Miscelánea de comercio* (1819); and *Diario general de las ciencias medicas*. The Spanish refugees in London published *Ocios de españoles refugiados* (1823–1826) and *Miscelánea hispano-americana* (1824–1828), and at Paris *Miscelánea escojida americana* (1826). The *Crónica científica y literaria* (1817–1820) was afterwards transformed into a daily newspaper. Subsequently to the extinction of *El Censor* (1820–1823) there was nothing of any value until the *Cartas españolas* (1832), since known as the *Revista española* (1832–1836) and as the *Revista de Madrid* (1838). Upon the death of Ferdinand VII. periodicals had a new opening; in 1836 there were published sixteen journals devoted to science and art. The fashion of illustrated serials was introduced in the *Semanario pintoresco español* (1836–1857), noticeable for its biographies and descriptions of Spanish monuments. *El Panorama* (1839–1841) was another literary periodical with engravings. Of later date have been the *Revista ibérica* (1861–1863), conducted by Sanz del Rio; *La America* (1857–1870), specially devoted to American subjects and edited by the brothers Asquerino; *Revista de Cataluña*, published at Barcelona; *Revista de España*; *Revista contemporánea*; *España moderna* (1889), and *Revista critica* (1895). Current special periodicals are: *Euskal-erria, revista bascongada* (1880, San Sebastian); *Monumenta historica societatis Jesu* (1894); *El Progreso matematico*, afterwards *Revista de matematicas puras y aplicadas* (1891); *Revista de bibliografia Catalano* (Catalunya, Baleares, Rosselò, Valencia, 1901); *La Naturaleza*, fortnightly; *La Energia eléctrica*, fortnightly; *Revista minera*, weekly; *Revista de medicina*, weekly; *Bibliografia española*, fortnightly; *La Lectura*; *España y America*, monthly.

See E. Hartzenbusch, *Periódicos de Madrid* (1876); Lapeyre, *Catalogo-tarifa de los periódicos, revistas, y ilustraciones en España* (1882); Georges le Gentil, *Les Revues littéraires de l'Espagne pendant la première moitié du XIX^e siècle* (Paris, 1909).

PORTUGAL

Portugal could long boast of only one review, the *Jornal enciclopedico* (1779–1806), which had many interruptions; then came the *Jornal de Coimbra* (1812–1820); the *Panorama* (1836–1857), founded by Herculano; the *Revista universal lisbonense* (1841–1853), established by Castilho; the *Instituto* (1853) of Coimbra; the *Archivo pittoresco* (1857) of Lisbon; and the *Jornal do sociedade dos amigos das letteras*. In 1868 a review called *Vox femenina*, and conducted by women, was established at Lisbon. Current periodicals include: *O Archeologo portuguès* (1895); *Jornal de sciencias mathematicas et astronomicas* (1877); *Revista lusitana, Archivo de estudos philologicos e ethnologicos relativos á Portugal* (1887); *Ta-ssi-Yang-Kuo, Archivos e annaes de extremo oriente portuguez* (1899); *Portugal artistico*, fortnightly; *Revista militar*; *Arte musical*, fortnightly; *Boletim do agricultor*, monthly; *Archivo historico portuguez*, monthly.

GREECE

The periodical literature of modern Greece commences with Ὁ Λόγιος Ἑρμῆς, brought out at Vienna in 1811 by Anthimos Gazi and continued to 1821. In Aegina the Αἰγιναῖα appeared in 1831, edited by Mustoxidis; and at Corfu, in Greek, Italian and English, the Ἀνθολογία (1834). After the return of King Otho in 1833 a literary review called Ἶρις was commenced. *Le Spectateur de l'Orient*, in French, pleaded the national cause before Europe for three years from 1853. A military journal was published at Athens in 1855, and two years later the archaeological periodical conducted by Pittakis and Rangabes. For many years Πανδώρα (1850–1872), edited by Rangabes and Paparrigopoulos, was the leading serial. Φύσις dealt with natural science, the Γεωπονικά with agriculture, and Ἱερομνήμων with theology. Ἐθνικὸν πανεπιστήμιον (1831) and Φιλολογικὸς σύλλογος Παρνασσός (1863) appear annually, and Ἀθηνᾶ (1899) quarterly.

See A. R. Rangabé, *Hist. littéraire de la Grèce moderne* (Paris, 1879); R. Nicolai, *Geschichte der neugriechischen Literatur* (1876).

RUSSIA

The historian Gerhard Friedrich Müller made the first attempt to establish periodical literature in Russia in his *Yejem'yesyatchniya*

Sotchineniya (1755–1764), or "Monthly Works." In 1759 Sumarakov founded the *Trudolyubivaya Ptchelá*, or "Industrious Bee," giving translations from the *Spectator*, and, for the first time, critical essays. Karamsin brought out in 1802 the *V'yestnik Evropi*, an important review with Liberal tendencies. The Conservative *Russkoi V'yestnik* (1808) was revived at Moscow in 1856 by Kattkov. The two last named are still published each month. The romantic school was supported by *Sin Otetchestva* (1812), "Son of the Fatherland," united in 1825 to the *Severnoi Arkhiv* (1822), which dwindled and came to an end soon after 1839. One of the most successful Russian reviews has been the *Biblioteka dl'ya Tchtenia* (1834) or "Library of Reading." The *Russkaya Missl*, "Russian Thought," published in Moscow, represented the Slavophil party. The following are some representative periodicals of the day: *Zurnal ministersva narodnago prosvescenija*, monthly; *Baltische Monatsschrift* (1860), monthly; *V'yestnik vospitania* (for education); *Mir iskusstra* (for fine art); *Russkoie bogatstvo* (for literature); *Russki arkhiv* (archives); *Mir Boji*, monthly; *Istorichesky v'yestnik* (history); *Russkaia starina* (archaeology). In Finland *Suomi* (1841), written in Swedish, is still published.

OTHER COUNTRIES

Bohemia has the *Časopis musea království českého* (1827), quarterly, founded by Palacky; *Naše doba*, monthly; *Čechische Revue* (1907) quarterly. Hungary can show the *Ungarisches Magazin* (1781–1787, 1791), published at Pressburg, and the *Magyar Muzeum* (1788). The *Tudományos gyüjetémény* (1817–1841) and the *Figyelmezö* (1837–1843) deserve mention. *Uj Magyar Muzeum* was a scientific magazine, and the *Budapesti Szemle* (1857) of a more general character. Among current Hungarian periodicals are: *Magyar Könyvszemle* (1876), and *Magyar Nyomdászat.* Before the revolution of 1830 Poland had the *Pamietnik Warszawski* of Lach Szyrma. Among other Polish reviews may be mentioned the *Dziennik Literacki* of Lemberg; the *Biblioteka Warszawska* (1841), monthly; *Przeglad Polski* (1866), monthly; *Przewodnik naukowy i literacki* (1873), monthly; *Przewodnik bibliograficzny* (1878), monthly; *Przeglad powzechny* (1884), monthly. Rumania commenced with the *Magasinal istorica pentru Dacia* (1845), containing valuable historical documents; and Moldavia with *Dacia Literaria* (1840) and *Archiva Romanesca* (1841). Rumania now has the *Convorbiri literare* (1868), monthly, and *Romanul, revistă literară illustrata septemânală.* The best literary review Servia has had was the *Wila*, edited by Novakovic.

Japan now possesses native periodicals of the European type, of which the following are representative examples: *Fudzoku-Gaho* (native customs); *The Kokka* (art); *Toyo-Gakugei–Zasshi* (science); *Jogaku-Zasshi* (domestic economy); *Tetsugaku-Zasshi* (philosophy); *Keizai-Zasshi* (political economy); *Taiyo* (literature).

GENERAL INDEXES TO PERIODICALS.—The most complete collection of periodicals in all languages ever brought together is that preserved in the British Museum, and the excerpt from the printed catalogue of the library, entitled *Periodical Publications* (London, 1899–1900, 2nd ed. 6 parts folio, with index), includes journals, reviews, magazines and other works issued periodically, with the exception of transactions and proceedings of learned societies and of British and Colonial newspapers later than 1700. The titles of these periodicals, which number about 23,000, are arranged under the town or place of their publication.

The *Edinburgh* and *Quarterly Reviews*, the *Revue des deux mondes*, the *Revue historique*, *Deutsche Rundschau* and others issue from time to time general indexes of their contents, while the periodical literature of special departments of study and research are noted in the various *Jahresberichte* published in Germany, and indexed monthly in such English and American magazines as the *Engineering Magazine*, the *Geographical Journal*, *English Historical Review*, *American Historical Review*, *Economic Journal* (for political economy), *Library Journal* and *Library Association Record* (for bibliography) and the *Educational Review.* The *Cat. of Scientific Papers* (1800–1900) of the Royal Society (1867–1908), and the *Repertorium der techn. Journ. Literatur* (1879–1899) of the German Patent Office, are specimens of indexes of special periodicals. There are also annual indexes such as those in the *Zoological Record* and *Annales de géographie.* Complete lists are given by A. B. Kroeger (*Guide to Reference Books*, 1908) and Stein (*Manuel de bibliographie générale*, 1897). See also *Bibliography of Books reviewed in American Periodicals*, by G. F. Danforth (1902–1903); *Book Review Digest* (1906), &c.; H. C. Bolton's *Cat. of Scientific and Technical Periodicals 1665–1895*, Smithsonian Inst. (2nd ed., 1897); Harrison's *Int. Cat. of Scientific Lit.* (1903–1904); S. H. Scudder's *Cat. of Scientific Serials, 1633–1876* (Camb. [Harvard Univ.] 1876); *Cat. of Periodicals* (English and Foreign) *in Bod. Lib., 1878–1880*; Bibliothèque Nationale, *Liste des périodiques étrangers* (1896). A useful select list, including all languages, is J. D. Brown's *Classified List of Current Periodicals* (1904). (H. R. T.)

PERIOECI (*περίοικοι*, those who dwell around, in the neighbourhood), in ancient Laconia the class intermediate between the Spartan citizens and the serfs or helots (*q.v.*). Ephorus says (Strabo viii. 364 seq.) that they were the original Achaean inhabitants of the country, that for the first generation after the Dorian invasion they shared in the franchise of the invaders, but that this was afterwards taken from them and they were reduced to a subject condition and forced to pay tribute. The term, however, came to denote not a nationality but a political status, and though the main body of the perioeci may have been Achaean in origin, yet they afterwards included Arcadians on the northern frontier of Laconia, Dorians, especially in Cythera and in Messenia, and Ionians in Cynuria. They inhabited a large number of settlements, varying in size from important towns like Gythium to insignificant hamlets (Isocrates xii. 179); the names of these, so far as they are known, have been collected by Clinton (*Fasti hellenici*, 2nd ed. i. 401 sqq.). They possessed personal freedom and some measure of communal independence, but were apparently under the immediate supervision of Spartan harmosts (governors) and subject to the general control of the ephors, though Isocrates is probably going too far in saying (xii. 181) that the ephors might put to death without trial as many of the perioeci as they pleased. Certain it is that they were excluded not merely from all Spartan offices of state, but even from the assembly, that they were absolutely subject to Spartan orders, and that, owing to the absence of any legal right of marriage (*ἐπιγαμία*) the gulf between the two classes was impassable. They were also obliged to pay the "royal tribute," perhaps a rent for domain-land which they occupied, and to render military service. This last burden grew heavier as time went on; 5000 Spartiates and 5000 perioec hoplites fought at Plataea in 479 B.C., but the steady decrease in the number of the Spartiates necessitated the increasing employment of the perioeci. Perioeci might serve as petty officers or even rise to divisional commands, especially in the fleet, but seemingly they were never set over Spartiates. Yet except at the beginning of the 4th century the perioeci were, so far as we can judge, fairly contented, and only two of their cities joined the insurgent helots in 464 B.C. (Thuc. i. 101). The reason of this was that, though the land which they cultivated was very unproductive, yet the prohibition which shut out every Spartiate from manufacture and commerce left the industry and trade of Laconia entirely in the hands of the perioeci. Unlike the Spartiates they might, and did, possess gold and silver and the iron and steel wares from the mines on Mt Taÿgetus, the shoes and woollen stuffs of Amyclae, and the import and export trade of Laconia and Messenia probably enabled some at least of them to live in an ease and comfort unknown to their Spartan lords.

See G. Grote, *History of Greece*, pt. ii., ch. 6; C. O. Müller, *Dorians* (Eng. trans.), bk. iii., ch. 2; A. H. J. Greenidge, *Greek Constitutional History*, p. 78 sqq.; G. Gilbert, *Greek Constitutional Antiquities* (Eng. trans.) p. 35 sqq.; G. F. Schömann, *Antiquities of Greece* (Eng. trans.) p. 201 sqq.; G. Busolt, *Die griech. Staats- und Rechtsaltertümer*, § 84; *Griech. Geschichte*, i. 528 seq. (2nd ed.); V. Thumser, *Lehrbuch der griech. Staatsaltertümer* (6th ed.), § 19; B. Niese, *Nachrichten von der wissenschaftlichen Gesellschaft zu Göttingen*, Phil.-Hist. Klasse, (1906), 101 sqq. (M. N. T.)

PERIPATETICS (from Gr. *περιπατεῖν*, to walk about), the name given in antiquity to the followers of Aristotle (*q.v.*), either from his habit of walking up and down as he lectured to his pupils, or from the *περίπατος* (covered walk) of the Lyceum.

Theophrastus.

Aristotle's immediate successors,[1] Theophrastus and Eudemus of Rhodes, were diligent scholars rather than original thinkers. They made no innovations upon the main doctrines of their master, and their industry is chiefly directed to supplementing his works in minor particulars. Thus they amplified the Aristotelian logic by the theory of the hypothetical and disjunctive syllogism, and added to the first figure of the categorical syllogism the five moods out of which the fourth figure was afterwards constructed. The impulse towards natural science and the systematizing of empirical details which distinguished Aristotle from Plato was shared by Theophrastus (*q.v.*). The same turn for detail is observable in his ethics, where, to judge from the imperfect evidence of the *Characters*, he elaborated still farther Aristotle's portraiture of the virtues

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[1] See Gellius, *Noct. Att.* xiii. 5, for the story of how Aristotle chose Theophrastus as his successor.

Eudemus of Rhodes.

and their relative vices. In his doctrine of virtue the distinctive Peripatetic position regarding the importance of external goods was defended by him with emphasis against the assaults of the Stoics. He appears to have laid even more stress on this point than Aristotle himself, being doubtless led to do so, partly by the heat of controversy and partly by the importance which leisure and freedom from harassing cares naturally assumed to a man of his studious temperament. The metaphysical ἀπορίαι of Theophrastus which have come down to us show that he was fully alive to the difficulties that beset many of the Aristotelian definitions. But we are ignorant how he proposed to meet his own criticisms; and they do not appear to have suggested to him an actual departure from his master's doctrine, much less any radical transformation of it. In the difficulties which he raises we may perhaps detect a leaning towards a naturalistic interpretation. The tendency of Eudemus, on the other hand, is more towards the theological or Platonic side of Aristotle's philosophy. The *Eudemian Ethics* (which, with the possible exception of the three books common to this treatise and the *Nicomachean Ethics*, there need be no hesitation in ascribing to Eudemus) expressly identify Aristotle's ultimate ethical ideal of θεωρία with the knowledge and contemplation of God. And this supplies Eudemus with a standard for the determination of the mean by reason, which Aristotle demanded, but himself left vague. Whatever furthers us in our progress towards a knowledge of God is good; every hindrance is evil. The same spirit may be traced in the author of the chapters which appear as an appendix to book i. of Aristotle's *Metaphysics*. They have been attributed to Pasicles, the nephew of Eudemus. For the rest, Eudemus shows even less philosophical independence than Theophrastus. Among the Peripatetics of the first generation who had been personal disciples of Aristotle, the other chief names are those of Aristoxenus (*q.v.*) of Tarentum and Dicaearchus (*q.v.*) of Messene. Aristoxenus, who had formerly belonged to the Pythagorean school, maintained the position, already combated by Plato in the *Phaedo*, that the soul is to be regarded as nothing more than the harmony of the body. Dicaearchus agreed with his friend in this naturalistic rendering of the Aristotelian entelechy, and is recorded to have argued formally against the immortality of the soul.

Strato of Lampsacus.

The naturalistic tendency of the school reached its full expression in Strato of Lampsacus, the most independent, and probably the ablest, of the earlier Peripatetics. His system is based upon the formal denial of a transcendent deity. Cicero attributes to him the saying that he did not require the aid of the gods in the construction of the universe; in other words, he reduced the formation of the world to the operation of natural forces. We have evidence that he did not substitute an immanent world-soul for Aristotle's extra-mundane deity; he recognized nothing beyond natural necessity. He was at issue, however, with the atomistic materialism of Democritus in regard to its twin assumptions of absolute atoms and infinite space. His own speculations led him rather to lay stress on the qualitative aspect of the world. The true explanation of things was to be found, according to Strato, in the forces which produced their attributes, and he followed Aristotle in deducing all phenomena from the fundamental attributes or elements of heat and cold. His psychological doctrine explained all the functions of the soul as modes of motion, and denied any separation of the reason from the faculties of sense-perception. He appealed in this connexion to the statement of Aristotle that we are unable to think without a sense-image.

The successors of Strato in the headship of the Lyceum were Lyco, Aristo of Ceos, Critolaus (*q.v.*), Diodorus of Tyre, and Erymneus, who brings the philosophic succession down to about 100 B.C. Other Peripatetics belonging to this period are Hieronymus of Rhodes, Prytanis and Phormio of Ephesus, the *delirus senex* who attempted to instruct Hannibal in the art of war (Cic. *De orat.* ii. 18). Sotion, Hermippus and Satyrus were historians rather than philosophers. Heraclides Lembus, Agatharchides and Antisthenes of Rhodes are names to us and nothing more. The fact is that, after Strato, the Peripatetic school has no thinker of any note for about 200 years.

Andronicus.

Early in the 1st century B.C. all the philosophic schools began to be invaded by a spirit of eclecticism. This was partly due to the influence of the practical Roman spirit. This influence is illustrated by the proconsul Lucius Gellius Publicola (about 70 B.C.), who proposed to the representatives of the schools in Athens that he should help them to settle their differences (Cic. *De leg.* i. 20). This atmosphere of indifference imperceptibly influenced the attitude of the contending schools to one another, and we find various movements towards unity in the views of Boethus the Stoic, Panaetius and Antiochus of Ascalon, founder of the so-called "Fifth Academy." Meanwhile the Peripatetic school may be said to have taken a new departure and a new lease of life. The impulse was due to Andronicus of Rhodes. His critical edition of Aristotle indicated to the later Peripatetics the direction in which they could profitably work, and the school devoted itself henceforth almost exclusively to the writing of commentaries on Aristotle, *e.g.* those of Boethus of Sidon, Aristo of Alexandria, Staseas, Cratippus, and Nicolaus of Damascus. The most interesting Peripatetic work of the period is the treatise *De mundo*, which is a good example within the Peripatetic school of the eclectic tendency which was then in the air. The admixture of Stoic elements is so great that some critics have attributed the work to a Stoic author; but the writer's Peripateticism seems to be the more fundamental constituent of his doctrine.

Alexander of Aphrodisias.

Our knowledge of the Peripatetic school during the first two centuries of the Christian era is very fragmentary; but those of its representatives of whom anything is known confined themselves entirely to commenting upon the different treatises of Aristotle. Thus Alexander of Aegae, the teacher of Nero, commented on the *Categories* and the *De caelo*. In the 2nd century Aspasius (*q.v.*) and Adrastus of Aphrodisias wrote numerous commentaries. The latter also treated of the order of the Aristotelian writings in a separate work. Somewhat later, Herminus, Achaicus and Sosigenes commented on the logical treatises. Aristocles of Messene, the teacher of Alexander of Aphrodisias, was the author of a complete critical history of Greek philosophy. This second phase of the activity of the school closes with the comprehensive labours of Alexander of Aphrodisias (Scholarch, *c.* 200), the exegete *par excellence*, called sometimes the second Aristotle. Alexander's interpretation proceeds throughout upon the naturalistic lines which have already become familiar to us. Aristotle had maintained that the individual alone is real, and had nevertheless asserted that the universal is the proper object of knowledge. Alexander seeks consistency by holding to the first position alone. The individual is prior to the universal, he says, not only "for us," but also in itself, and universals are abstractions which have merely a subjective existence in the intelligence which abstracts them. Even the deity must be brought under the conception of individual substance. Such an interpretation enables us to understand how it was possible, at a later date, for Aristotle to be regarded as the father of Nominalism. Form, Alexander proceeds, is everywhere indivisible from matter. Hence the soul is inseparable from the body whose soul or form it is. Reason or intellect is bound up with the other faculties. Alexander's commentaries formed the foundation of the Arabian and Scholastic study of Aristotle. Soon after Alexander's death the Peripatetic school was merged, like all others, in Neoplatonism (*q.v.*).

PERIPATUS, a genus of animals belonging to the air-breathing division of the phylum Arthropoda. It differs, however, from all other Arthropoda in such important respects that a special class, equivalent in rank to the old-established Arthropod classes, had been created for its sole occupancy. This class has been named the Prototracheata or Onychophora (see ARTHROPODA), and may be most appropriately placed in the system in the neighbourhood of the Myriapoda, though it must not be forgotten that it differs from the Myriapoda more than the Myriapoda differ from other Arthropoda, and that in some respects it presents features which recall the segmented worms (Annelida). The genus has a wide distribution (see below), but it has not been found in Europe or in North America. There is but little variety of structure in the genus, and the species are limited in number. They live beneath the bark of trees, in the crevices of rock and of rotten stumps of trees, and beneath stones. They require a moist atmosphere, and are exceedingly susceptible to drought. They avoid light, and are therefore rarely seen. They move slowly, picking their course by means of their antennae. When irritated they eject with considerable force the contents of their slime reservoirs by means of the sudden contraction of the muscular body-wall. The slime, which appears to be harmless, is extremely sticky, but it easily comes away from the skin of the animal itself. Locomotion is effected by means of the legs, with the body fully extended. Hutton describes his specimens as sucking the juices of flies, which they had stuck down with their slime, and they have been observed in captivity to devour the entrails which have been removed from their fellows, and to eat raw sheep's liver. They move their mouths in a suctorial manner, tearing the food with their jaws. They have the power of extruding their jaws from the mouth, and of working them alternately backwards and forwards. They are viviparous; the young are fully formed at birth, and differ from the adult only in size and colour. The mother does not appear to pay any special attention to her offspring, which wander away and get their own living. It has lately been stated that some of the Australian species are normally oviparous, but this has not been fully proved. Sexual differences are not strongly marked, and are sometimes absent. There does not appear to be any true copulation. In some species the male deposits small oval spermatophores indiscriminately on any part of the body of the female. It seems probable that in such cases the spermatozoa make their way from the adherent spermatophore through the body-wall into the body, and so by traversing the tissues reach the ovary. In other species which possess *receptacula seminis* it is probable that fertilization is effected once only in early life before any ova pass into the uterus.

External Features.—The anterior part of the body may be called the head, though it is not sharply marked off from the rest of the body (fig. 1). The head carries three pairs of appendages, a pair of simple eyes, and a ventrally placed mouth. The body is elongated and vermiform; it bears a number of paired appendages, each terminating in a pair of claws, and all very much alike. The number varies in the different species. The anus is always at the posterior end of the body, and the generative opening is on the ventral surface, just in front of the anus; it may be between the legs of the penultimate pair, or between the legs of the last pair, or it may be subterminal. The colour varies considerably in the different species, and even in different individuals of the same species. The skin has a velvety appearance, and is thrown into a number of transverse ridges, along which wart-like papillae are placed. These papillae, which are found everywhere, are the *primary* papillae; they are covered with small, scale-like projections called *secondary* papillae, and are specially developed on the dorsal surface, less so on the ventral. Each papilla carries at its extremity a well-marked spine. Among the primary papillae smaller *accessory* papillae are sometimes present.

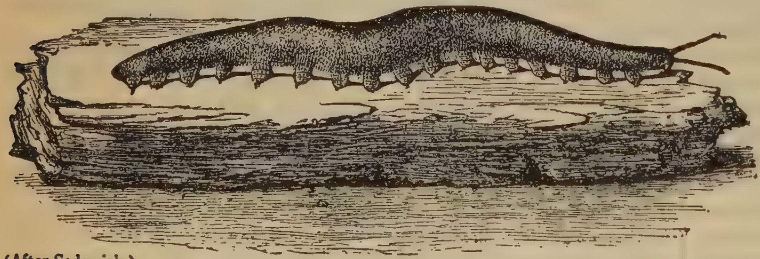
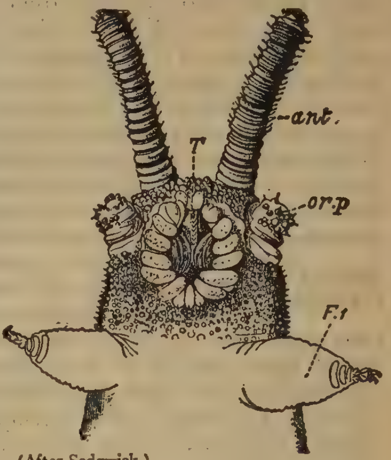

(After Sedgwick.)

FIG. 1.—*Peripatus capensis*, drawn from life. Life size.

The appendages of the head are the antennae, the jaws and the oral papillae. The mouth is at the hinder end of a depression called the buccal cavity, and is surrounded by an annular tumid lip, raised into papilliform ridges and bearing a few spines (fig. 2). Within the buccal cavity are the two jaws. They are short, stump-like, muscular structures, armed at their free extremities by a pair of cutting blades or claws, and are placed one on each side of the mouth. In the median line of the buccal cavity in front is placed a thick muscular protuberance, which may be called the tongue, though attached to the dorsal instead of to the ventral wall of the mouth (fig. 2). The tongue bears a row of small, chitinous teeth. The jaw-claws (figs. 3 and 4), which resemble in all essential points the claws borne by the feet, and, like these, are thickenings of the cuticle, are sickle-shaped. They have their convex edge directed forwards, and their concave, or cutting edge, turned backwards. The inner cutting plate (fig. 3) usually bears a number of cutting teeth. The oral papillae are placed at the sides of the head (fig. 2). The ducts of the slime-glands open at their free end. They possess two main rings of projecting tissue, and their extremities bear papillae irregularly arranged. The ambulatory appendages vary in number. There are seventeen pairs in *P. capensis* and eighteen in *P. balfouri*, while in *P. jamaicensis* the number varies from twenty-nine to forty-three. They consist of two main divisions, which we may call the leg and the foot (fig. 5). The leg (*l*) has the form of a truncated cone, the broad end of which is attached to the ventro-lateral wall of the body, of which it is a prolongation. It is marked by a number of rings of papillae placed transversely to its long axis, the dorsal of which are pigmented like the dorsal surface of the body, and the ventral like the ventral surface. At the narrow distal end of the leg there are on the ventral surface three or four (rarely five) spiniferous pads, each of which is continued dorsally into a row of papillae. The foot is attached to the distal end of the leg. It is slightly narrower at its attached extremity than at its free end. It bears two sickle-shaped claws, and at its distal end three (rarely four) papillae. The part of the foot which carries the claws is especially retractile, and is generally found more or less telescoped into the proximal part. The legs of the fourth and fifth pairs differ from the others in the fact that the third pad (counting from the distal end of the leg) carries the opening of the enlarged nephridia of these segments. In some species certain of the legs bear on their ventral sides furrows with tumid lips and lined by smooth non-tuberculate epithelium; they are called coxal organs, and it appears that they can be everted. The males are generally rather smaller and less numerous than the females. In those species in which the number of legs varies the male has a smaller number of legs than the female.



(After Sedgwick.)

FIG. 2.—Ventral view of the head of *P. capensis*.

ant, Antennae; *or.p*, Oral papillae; *F.1*, First leg; *T*, Tongue.

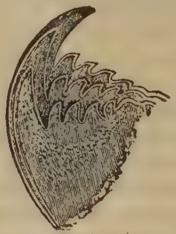

(After Balfour.)

FIG. 3.—Inner jaw-claw of *P. capensis*.

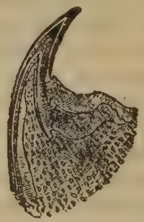
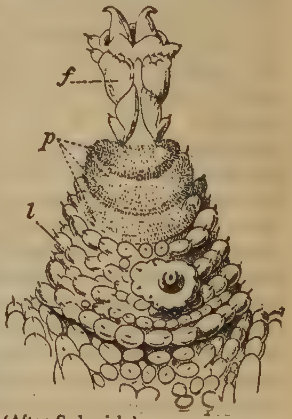

(After Balfour.)

FIG. 4.—Outer jaw-claw of *P. capensis*.



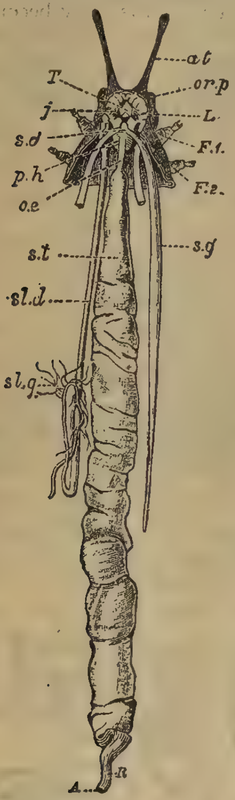
(After Sedgwick.)

FIG. 5.—Ventral view of last leg of a male *P. capensis*.

f, Foot; *l*, leg; *p*, spiniferous pads. The white papilla of the proximal part of this leg is characteristic of the male of this species.

Breeding.—As already stated, *Peripatus* is viviparous. The Australasian species come nearest to laying eggs, inasmuch as the eggs are large, full of yolk, and enclosed in a shell; but development normally takes place in the uterus, though abnormally, incompletely developed eggs are extruded. The uterus always contains several young, which are usually at different stages of development and are born at different times of the year. In most of the African species, however, the embryos of the uterus are almost of the same age and are born at a definite season. The young of *P. capensis* are born in April and May. They are almost colourless at birth, excepting the antennae, which are green, and their length is 10 to 15 mm. A large female will produce thirty to forty young in one year. The period of gestation is thirteen months, that is to say, the ova pass into the oviducts about one month before the young of the preceding year are born.

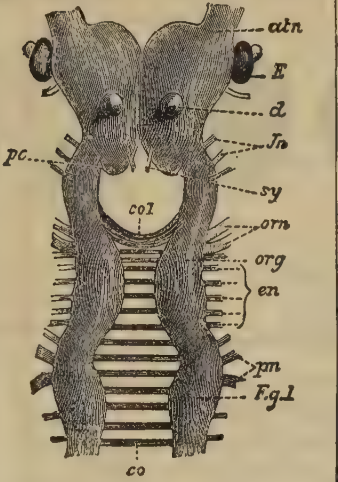
Anatomy.—The alimentary canal (fig. 6). The buccal cavity, as explained above, is a secondary formation around the true mouth, which is at its dorsal posterior end. It contains the tongue and the jaws, which have already been described, and into the hind end of it there open ventrally by a median opening the salivary glands. The mouth leads into a muscular pharynx, which is connected by a short oesophagus with the stomach. The stomach forms by far the largest part of the alimentary canal. It is a dilated soft-walled tube, and leads behind into the short narrow rectum, which opens at the anus. There are no glands opening into the alimentary canal. The central nervous system, the anterior part of which is shown in fig. 7, is of the "rope-ladder" type, and the ventral cords meet over the rectum. The cuticle is a thin layer, of which the spines, jaws and claws are special developments. Its surface is not, however, smooth, but is everywhere, with the exception of the perioral region, raised into minute secondary papillae, which in most instances bear at their free extremity a somewhat prominent spine. The epidermis, placed immediately within the cuticle, is composed of a single row of cells. The pigment which gives the characteristic colour to the skin is deposited in the protoplasm of the outer ends of the cells in the form of small granules. Beneath the epidermis is a thin cutis, which is followed by the muscular layers (external circular and internal longitudinal). The muscular fibres of the jaws are transversely striated, the other muscles are unstriated.



(After Balfour.)

FIG. 6.—*Peripatus capensis* dissected so as to show the alimentary canal, slime glands and salivary glands. The dissection is viewed from the ventral side, and the lips (*L*) have been cut through in the middle line behind and pulled outwards so as to expose the jaws (*j*), which have been turned outwards, and the tongue (*T*) bearing a median row of chitinous teeth, which branches behind into two. The muscular pharynx, extending back into the space between the first and second pairs of legs, is followed by a short tubular oesophagus. The latter opens into the large stomach with plicated walls, extending almost to the hind end of the animal. The stomach at its point of junction with the rectum presents an **S**-shaped ventro-dorsal curve.

A, Anus; *at*, antenna; *F.1*, *F.2*, first and second feet; *j*, jaws; *L*, lips; *oe*, oesophagus; *or.p*, oral papilla; *ph*, pharynx; *R*, rectum; *s.d*, salivary duct; *s.g*, salivary gland; *sl.d*, slime reservoir; *sl.g*, portion of tubules of slime gland; *st*, stomach; *T*, tongue in roof of mouth.

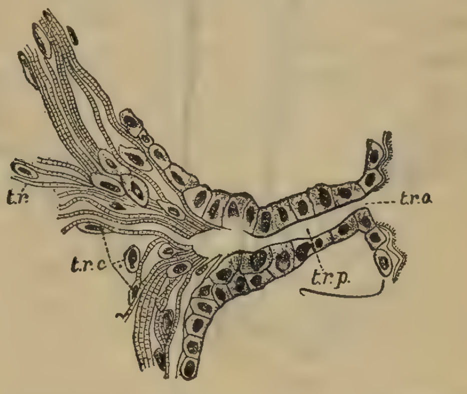


(After Balfour.)

FIG. 7.—Brain and anterior part of the ventral nerve-cords of *Peripatus capensis* enlarged and viewed from the ventral surface.

atn, Antennary nerves; *co*, commissures between ventral cords; *d*, ventral appendages of brain; *E*, eye; *en*, nerves passing outwards from ventral cord; *F.g.1*, ganglionic enlargements from which nerves to feet pass off; *jn*, nerves to jaws; *org*, ganglionic enlargement from which nerves to oral papillae pass off; *orn*, nerves to oral papillae; *pc*, posterior lobe of brain; *pn*, nerves to feet; *sy*, sympathetic nerves.

The apertures of the tracheal system are placed in the depressions between the papillae or ridges of the skin. Each of them leads into a tube, which may be called the tracheal pit (fig. 8); the walls of this are formed of epithelial cells, bounded towards the lumen of the pit by a very delicate cuticular membrane continuous with the cuticle covering the surface of the body. Internally it expands in the transverse plane, and from the expanded portion the tracheal tubes arise in diverging bundles. The tracheae are minute tubes exhibiting a faint transverse striation which is probably the indication of a spiral fibre. They appear to branch, but only exceptionally. The tracheal apertures are diffused over the surface of the body, but are especially developed in certain regions.



(After Balfour.)

FIG. 8.—Section through a tracheal pit and diverging bundles of tracheal tubes taken transversely to the long axis of the body.

tr, Tracheae, showing rudimentary spiral fibre; *tr.c*, Cells resembling those lining the tracheal pits, which occur at intervals along the course of the tracheae; *tr.o*, Tracheal stigma; *tr.p*, Tracheal pit.

The vascular system consists of a dorsal tubular heart with paired ostia leading into it from the pericardium, of the pericardium, and the various other divisions of the perivisceral cavity (fig. 12, D). As in all Arthropoda, the perivisceral cavity is a haemocoele, *i.e.* contains blood, and forms part of the vascular system. It is divided by septa into chambers (fig. 12, D), of which the most important are the central chamber containing the alimentary canal and the dorsal chamber or pericardium. Nephridia are present in all the legs. In all of them (except the first three) the following parts may be recognized (fig. 9): (1) a vesicular portion (*s*) opening to the exterior on the ventral surface of the legs by a narrow passage (*s.d*); (2) a coiled portion, which is again subdivided into several sections (*s.c*); (3) a section with closely-packed nuclei ending by a somewhat enlarged opening (*p.f*); (4) the terminal portion, which consists of a thin-walled vesicle. The nephridia of the first three pairs of legs are smaller than the rest, consisting only of a vesicle and duct. The fourth and fifth pairs are larger than those behind, and are in other respects peculiar; for instance, they open on the third pad (counting from the distal end of the

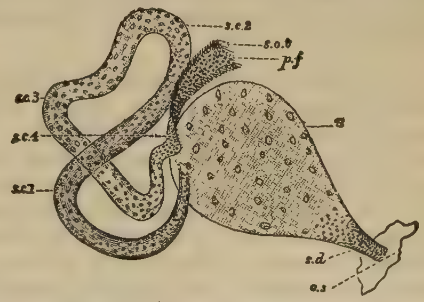
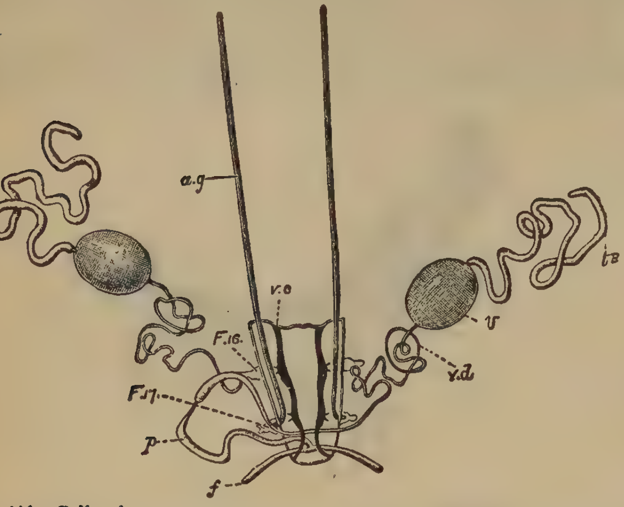


FIG. 9.—Nephridium from the ninth pair of legs of *P. capensis*.

o.s, External opening of segmental organ.
p.f, Internal opening of nephridium into the body cavity (lateral compartment).
s, Vesicle of segmental organ.
s.c.1, *s.c.2*, *s.c.3*, *s.c.4*, Successive regions of coiled portion of nephridium.
s.o.t, Third portion of nephridium broken off at *p.f* from the internal vesicle, which is not shown.

leg), and the external vesicular portion is not dilated. The external opening of the other nephridia is placed at the outer end of a transverse groove at the base of the legs. The salivary glands are the modified nephridia of the segment of the oral papillae.

The male generative organs (fig. 10) consist of a pair of testes (*te*), a pair of seminal vesicles (*v*), vasa deferentia (*v.d.*), and accessory glandular tubules (*f*). All the above parts lie in the central compartment of the body cavity. The ovaries consist of a pair of tubes closely applied together, and continued posteriorly into the oviducts. Each oviduct, after a short course, becomes dilated into the uterus. The two uteri join behind and open to the exterior by a median opening. The ovaries always contain spermatozoa, some of which project through the ovarian wall into the body cavity. Spermatozoa are not found in the uterus and oviducts, and it appears probable, as we have said, that they reach the ovary directly by boring through the skin and traversing the body cavity. In all the species except the African species there is a globular receptaculum seminis opening by two short ducts close together into the oviduct, and in the neotropical species there is in addition a small receptaculum ovorum, with extremely thin walls, opening into the oviduct by a short duct just in front of the receptaculum seminis. The epithelium of the latter structure is clothed with actively moving cilia. There appear to be present in most, if not all, of the legs some accessory glandular structures opening just externally to the nephridia. They are called the crural glands.



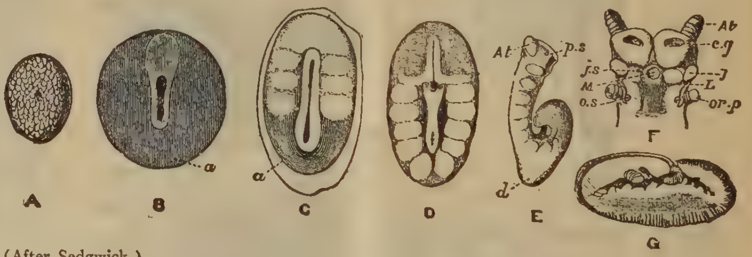
(After Balfour.)

FIG. 10.—Male Generative Organs of *Peripatus capensis*. Dorsal view.

a.g, Enlarged crural glands of last pair of legs.
F. 16, 17, Last pair of legs.
f, Small accessory glandular tubes.
p, Common duct into which vasa deferentia open.
te, Testes. *v*, Seminal vesicles.
v.c, Nerve-cord.
v.d, Vas deferens.

Development.—*Peripatus* is found in Africa, in Australasia, in South America and the West Indies, in New Britain, and in the Malay Peninsula and Sumatra. The species found in these various localities are closely similar in their anatomical characters, the principal differences relating to the structure of the female generative organs and to the number of the legs. They, however, differ in the most striking manner in the structure of the ovum and the early development. In all the Australasian species the egg is large and heavily charged with food-yolk, and is surrounded by a tough membrane. In the Cape species the eggs are smaller, though still of considerable size; the yolk is much less developed, and the egg membrane is thinner though dense. In the New Britain species the egg is still smaller (·1 mm.), and there is a large trophic vesicle. In the neotropical species the egg is minute, and almost entirely devoid of yolk. The unsegmented uterine ovum of *P. novae zealandiae* measures 1·5 mm. in length by ·8 mm. in breadth; that of *P. capensis* is ·56 mm. in length: and that of *P. trinidadensis* ·04 mm. in diameter. In correspondence with these differences in the ovum there are differences in the early development, though the later stages are closely similar.

The development has been worked out in *P. capensis*, to which species the following description refers. The segmentation is peculiar, and leads to the formation of a solid gastrula, consisting of a cortex of ectoderm nuclei surrounding a central endodermal mass, which is exposed at one point—the blastopore. The enteron arises as a space in the endoderm, and an opacity—the primitive streak—appears at the hind end of the blastopore (fig. 11, B). The elongation of the embryo is accompanied by an elongation of the blastopore, which soon becomes dumb-bell shaped (fig. 11, C). At the same time the mesoblastic somites (embryonic segments of mesoderm) make their appearance in pairs at the hind end, and gradually travel forwards on each side of the blastopore to the front end, where the somites of the anterior pair soon meet in front of the blastopore (fig. 11, D). Meanwhile the narrow middle part of the blastopore has closed by a fusion of its lips, so that the blastopore is represented by two openings, the future mouth and anus. A primitive groove makes its appearance behind the blastopore (fig. 11, D). At this stage the hind end of the body becomes curved ventrally into a spiral (fig. 11, E), and at the same time the appendages appear as hollow processes of the body-wall, a mesoblastic somite being prolonged into each of them. The first to appear are the antennae, into which the praeoral somites are prolonged. The remainder appear from before backwards in regular order, viz. jaw, oral papillae, legs 1–17. The full number of somites and their appendages is not, however, completed until a later stage. The nervous system is formed as an annular thickening of ectoderm passing in front of the mouth and behind the anus, and lying on each side of the blastopore along the lines of the somites. The praeoral part of this thickening, which gives rise to the cerebral ganglia, becomes pitted inwards on each side (fig. 11, F, *c.g.*). These pits are eventually closed, and form the hollow ventral appendages of the suprapharyngeal ganglia of the adult (fig. 7, *d*). The lips are formed as folds of the side wall of the body, extending from the praeoral lobes to just behind the jaw (fig. 11, F, *L*). They enclose the jaws (*j*), mouth (*M*), and opening of the salivary glands (*o.s*), and so give rise to the buccal cavity. The embryo has now lost its spiral curvature, and becomes completely doubled upon itself, the hind end being in contact with the mouth (fig. 11, G). It remains in this position until birth. The just-born young are from 10 to 15 mm. in length, and have green antennae, but the rest of the body is either quite white or of a reddish colour. This red colour differs from the colour of the adult in being soluble in spirit. The mesoblastic somites are paired sacs formed from the anterior lateral portions of the primitive streak (fig. 11, C). As they are formed they become placed in pairs on each side of the blastopore. The somites of the first pair eventually obtain a position entirely in front of the blastopore (Fig. 11, D). They form the somites of the praeoral lobes. The full complement of somites is acquired at about the stage of fig. 11, E. The relations of the mesoblastic somites are shown in fig. 12, A, which represents a transverse section taken between the mouth and anus of an embryo of the stage of fig. 11, D. The history of these somites is an exceedingly interesting one, and may be described shortly as follows: They divide into two parts—a ventral part which extends into the appendage, and a dorsal part (fig. 12, B). Each of the ventral parts acquires an opening to the exterior, just outside the nerve-cord,

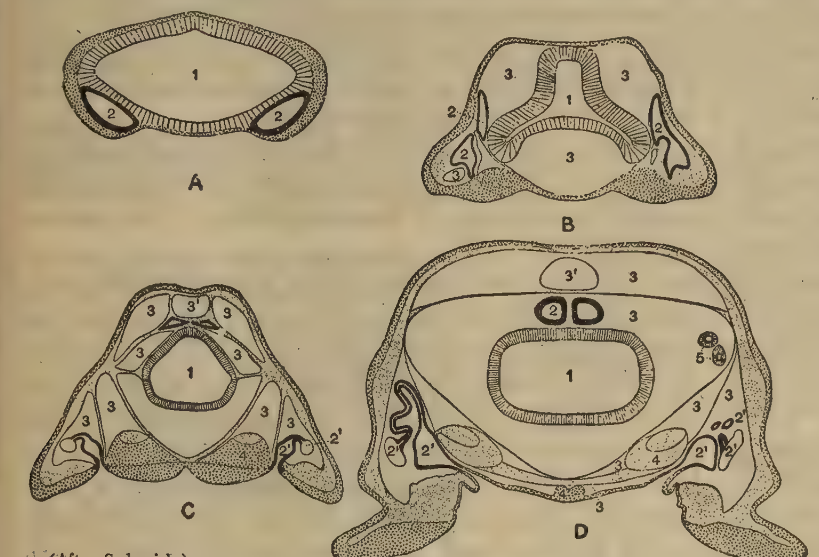


(After Sedgwick.)

FIG. 11.—A Series of Embryos of *P. capensis*. The hind end of embryos B, C, D is uppermost in the figures, the primitive streak is the white patch behind the blastopore.

A, Gastrula stage, ventral view, showing blastopore.
B, Older gastrula stage, ventral view, showing elongated blastopore and primitive streak.
C, Ventral view of embryo with three pairs of mesoblastic somites, dumb-bell shaped blastopore and primitive streak.
D, Ventral view of embryo, in which the blastopore has completely closed in its middle portion. The anterior pair of somites have moved to the front end of the body.
E, side view of later embryo. *At*, Antenna; *d*, dorsal projection; *p.s.*, praeoral somite.
F, Ventral view of head of embryo, intermediate between E and G. *At*, Antennae; *c.g*, cerebral groove; *j*, jaws; *j.s.* swelling at base of jaws; *L*, lips; *M*, mouth; *or.p*, oral papillae; *o.s*, opening of salivary gland.
G, side view of older embryo.

and becomes entirely transformed into a nephridium (fig. 12, D, 2′). The dorsal part shifts dorsalwards and diminishes relatively in size (fig. 12, C). Its fate differs in the different parts of the body. In the anterior somites it dwindles and disappears, but in the posterior part it unites with the dorsal divisions of contiguous somites of the same side, and forms a tube—the generative tube (fig. 12, D, 2). The last section of this tube retains its connexion with the ventral portion of the somite, and so acquires an external opening, which is at first lateral, but soon shifts to the middle line, and fuses with its fellow, to form the single generative opening. The praeoral somite develops the rudiment of a nephridium, but eventually entirely disappears. The jaw somite also disappears; the oral papilla somite forms ventrally the salivary glands, which are thus serially homologous with nephridia. The various divisions of the perivisceral cavity develop as a series of spaces between the ectoderm and endoderm, and later in the mesoderm. The mesoderm seems to be formed entirely from the proliferation of the cells of the mesoblastic somites. It thus appears that in *Peripatus* the coelom does not develop a perivisceral portion, but gives rise only to the renal and reproductive organs.



(After Sedgwick.)

FIG. 12.—A series of diagrams of transverse sections through *Peripatus* embryos to show the relations of the coelom at successive stages.

A, Early stage; no trace of the vascular space; endoderm and ectoderm in contact.

B, Endoderm has separated from the dorsal and ventral ectoderm. The somite is represented as having divided on the left side into a dorsal and ventral portion.

C, The haemocoele (3) has become divided up into a number of spaces, the arrangement of which is unimportant. The dorsal part of the somite has travelled dorsalwards, and now constitutes a small space (triangular in section) just dorsal to the gut. The ventral portion (2) has assumed a tubular character, and has acquired an external opening. The internal vesicle is already indicated, and is shown in the diagram by the thinner black line: 1, gut; 2, somite; 2′, nephridial part of coelom; 3, haemocoele; 3′, part of haemocoele which will form the heart—the part of the haemocoele on each side of this will form the pericardium; 4, nerve-cord; 4, slime glands.

D represents the conditions at the time of birth. The coelom is represented as surrounded by a thick black line, except in the part which forms the internal vesicle of the nephridium.

The genus *Peripatus* was established in 1826 by L. Guilding, who first obtained specimens of it from St Vincent in the Antilles. He regarded it as a mollusc, being no doubt deceived by the slug-like appearance given by the antennae. Specimens were subsequently obtained from other parts of the neotropical region, and from South Africa and Australia, and the animal was variously assigned by the zoologists of the day to the Annelida and Myriapoda. Its true place in the system, as a primitive member of the group Arthropoda, was first established in 1874 by H. N. Moseley, who discovered the tracheae. *Peripatus* is an Arthropod, as shown by (1) the presence of appendages modified as jaws; (2) the presence of paired lateral ostia perforating the wall of heart and putting its cavity in communication with the pericardium; (3) the presence of a vascular body cavity and pericardium (haemocoelic body cavity); (4) absence of a perivisceral section of the coelom. Finally, the tracheae, though not characteristic of all the classes of the Arthropoda, are found nowhere outside that group, and constitute a very important additional reason for uniting *Peripatus* with it. *Peripatus*, though indubitably an Arthropod, differs in such important respects from all the old-established Arthropod classes, that a special class, equivalent in rank to the others, and called Prototracheata or Onychophora, has had, as we have seen, to be created for its sole occupancy. This unlikeness to other Arthropoda is mainly due to the Annelidan affinities which it presents, but in part to the presence of the following peculiar features: (1) the number and diffusion of the tracheal apertures; (2) the restriction of the jaws to a single pair; (3) the disposition of the generative organs; (4) the texture of the skin; and (5) the simplicity and similarity of all the segments of the body behind the head. The Annelidan affinities are superficially indicated in so marked a manner by the thinness of the cuticle, the dermo-muscular body-wall, the hollow appendages, that, as already stated, many of the earlier zoologists who examined *Peripatus* placed it among the segmented worms; and the discovery that there is some solid morphological basis for this determination constitutes one of the most interesting points of the recent work on the genus. The Annelidan features are: (1) the paired nephridia in every segment of the body behind the first two (Saenger, Balfour); (2) the presence of cilia in the generative tracts (Gaffron). It is true that neither of these features is absolutely distinctive of the Annelida, but when taken in conjunction with the Annelidan disposition of the chief systems of organs, viz. the central nervous system, and the main vascular trunk or heart, they may be considered as indicating affinities in that direction.

SYNOPSIS OF SPECIES.

PERIPATUS (Guilding).—Soft-bodied vermiform animals, with one pair of ringed antennae, one pair of jaws, one pair of oral papillae, and a varying number of claw-bearing ambulatory legs. Dorsal surface arched and more darkly pigmented than the flat ventral surface. Skin transversely ridged and beset by wart-like spiniferous papillae. Mouth anterior, ventral; anus posterior, terminal. Generative opening single, median, ventral and posterior. One pair of simple eyes. Brain large, with two ventral hollow appendages; ventral cords widely divaricated, without distinct ganglia. Alimentary canal simple, uncoiled. Segmentally arranged paired nephridia are present. Body cavity is continuous with the vascular system, and does not communicate with the paired nephridia. Heart tubular, with paired ostia. Respiration by means of tracheae. Dioecious; males smaller and generally less numerous than females. Generative glands tubular, continuous with the ducts. Viviparous. Young born fully developed. Distribution: Africa (Cape Colony, Natal, and the Gaboon), New Zealand, Australia and Tasmania, New Britain, South and Central America and the West Indies, the Malay Peninsula [and in Sumatra ?].

The genus *Peripatus*, so far as adult conformation is concerned, is a very homogeneous one. It is true, as was pointed out by Sedgwick, that the species from the same part of the world resemble one another more closely than they do species from other regions, but recent researches have shown that the line between them cannot be so sharply drawn as was at first supposed, and it is certainly not desirable in the present state of our knowledge to divide them into generic or subgeneric groups, as has been done by some zoologists. (The following genera have been proposed: *Peripatus* for the neotropical species, *Peripatoides* for the Australasian, *Peripatopsis* and *Opisthopatus* for the African, *Paraperipatus* for the New Britain, *Eoperipatus* for the Malayan species, and *Ooperipatus* for the supposed oviparous species of Australia and New Zealand.) The colour is highly variable in species from all regions; it is perhaps more constant in the species from the neotropical region than in those from elsewhere. The number of legs tends to be variable whenever it exceeds 19 praegenital pairs; when the number is less than that it is usually, though not always, constant. More constant points of difference are the form of the jaws, the position of the generative orifice, the presence of a receptaculum seminis and a receptaculum ovorum, the arrangement of the primary papillae on the distal end of the feet, and above all the early development.

South African Species.—With three spinous pads on the legs, and feet with two primary papillae on the anterior side and one on the posterior side; outer jaw with one minor tooth at the base of the main tooth, inner jaw with no interval between the large tooth and the series of small ones; last fully developed leg of the male with enlarged crural gland opening on a large papilla placed on its ventral surface; coxal organs absent; the nephridial openings of the 4th and 5th pairs of legs are placed in the proximal spinous pad. Genital opening subterminal, behind the last pair of fully developed legs; oviduct without receptacula seminis or receptacula ovorum; the terminal unpaired portion of vas deferens short. Ova of considerable size, but with only a small quantity of yolk. The embryos in the uterus are all nearly of the same age, except for a month or two before birth, when two broods overlap.

The following species are aberrant in respect of these characters: *Peripatus* (*Opisthopatus*) *cinctipes*, Purcell (Cape Colony and Natal), presents a few Australasian features; there is a small receptaculum seminis on each oviduct, some of the legs are provided with well-developed coxal organs, the feet have one anterior, one posterior and one dorsal papilla, and the successive difference in the ages of the embryos in the uterus, though nothing like that found in the neotropical species, is slightly greater than that found in othe investigated African species. Several pairs of legs in the middle region of the body are provided with enlarged crural glands which open on a large papilla. Male with four accessory glands, opening on each side of and behind the genital aperture. *P. tholloni*, Bouvier, (Equatorial West Africa [Gaboon]), shows some neotropical features; there are 24 to 25 pairs of legs, the genital opening is between the penultimate legs, and though there are only three spinous pads the nephridial openings of the 4th and 5th legs are proximal to the 3rd pad, coxal organs are present, and the jaws are of the neotropical type; the oviducts have receptacula seminis. The following South African species may be mentioned: *P. capensis* (Grube), with 17 (rarely 18) pairs of claw-bearing legs; *P. balfouri* (Sedgw.) with 18 (rarely 19) pairs; *P. moseleyi* (Wood-M.), with 20 to 24 pairs.

Australasian Species.—With 14, 15 or 16 pairs of claw-bearing ambulatory legs, with three spinous pads on the legs, and nephridial opening of the 4th and 5th legs on the proximal pad; feet with one anterior, one posterior and one dorsal primary papilla; inner jaw without diastema, outer with or without a minor tooth. Last leg of the male with or without a large white papilla on its ventral surface for the opening of a gland, and marked papillae for the crural glands are sometimes present on other legs of the male; well-developed coxal glands absent. Genital opening between the legs of the last pair; oviducts with receptacula seminis, without receptacula ovorum; the terminal portion of the vas deferens long and complicated; the accessory male glands open between the genital aperture and the anus, near the latter. Ova large and heavily charged with yolk, and provided with a stoutish shell. The uterus appears to contain embryos of different ages. Specimens are recorded from West Australia, Queensland, New South Wales, Victoria and New Zealand. The Australasian species are in some confusion. The number of claw-bearing legs varies from 14 to 16 pairs, but the number most often found is 15. Whether the number varies in the same species is not clear. There appears to be evidence that some species are occasionally or normally oviparous, and in the supposed oviparous species the oviduct opens at the end of a papilla called from its supposed function an ovipositor, but the oviparity has not yet been certainly proved as a normal occurrence. Among the species described may be mentioned *P. leuckarti* (Saenger), *P. insignis* (Dendy), *P. oviparus* (Dendy), *P. viridimaculatus* (Dendy), *P. novae zealandiae* (Hutton), but it is by no means certain that future research will maintain these. Mr J. J. Fletcher, indeed, is of opinion that the Australian forms are all varieties of one species, *P. leuckarti.*

Neotropical Species.—With three to five spinous pads on the legs, nephridial opening of the 4th and 5th legs usually proximal to the 3rd pad, and feet either with two primary papillae on the anterior side and one on the posterior, or with two on the anterior and two on the posterior; outer jaw with small minor tooth or teeth at the base of the main tooth, inner jaw with diastema. A variable number of posterior legs of the males anterior to the genital opening with one or two large papillae carrying the openings of the crural glands; well-developed coxal organs present on most of the legs. The primary papillae usually divided into two portions. Genital opening between the legs of the penultimate pair; oviduct provided with receptacula seminis and ovorum; unpaired part of vas deferens long and complicated; accessory organs of male opening at the sides of the anus. Ova minute, with little food-yolk; embryos in the uterus at very different stages of development. The number of legs usually if not always variable in the same species; the usual number is 28 to 32 pairs, but in some species 40 to 43 pairs are found. The neotropical species appear to fall into two groups: (1) the so-called Andean species, viz. those which inhabit the high plateaus or Pacific slope of the Andes; in these there are 4 (sometimes 5) pedal papillae, and the nephridial openings of the 4th and 5th legs are on the third pad; and (2) the Caribbean species, viz. the remaining neotropical species, in which there are 3 papillae on the foot and the nephridial openings of the 4th and 5th legs are between the 3rd and 4th pads. The Andean species are *P. eisenii* (Wh.), *P. tuberculatus* (Bouv.), *P. lankesteri* (Bouv.), *P. quitensis* (Schm.), *P. corradi* (Cam.), *P. cameranoi* (Bouv.) and *P. balzani* (Cam.). Of the remaining species, which are the majority, may be mentioned *P. edwardsii* (Blanch), *P. jamaicensis* (Gr. and Cock.), *P. trinidadensis* (Sedgw.), *P. torquatus* (Ken.), *P. im thurmi* (Scl.).

New Britain Peripatus.—With 22 to 24 pairs of claw-bearing legs, with three spinous pads on the legs, and nephridial openings of legs 4 and 5 (sometimes of 6 also) on the proximal pad; feet with one primary papilla on the anterior, one on the posterior side, and one on the dorsal side (median or submedian); outer jaw with a minor tooth, inner jaw without diastema; crural glands absent; well-developed coxal organs absent. Genital opening subterminal behind the last pair of legs; oviduct with receptaculum seminis, without receptaculum ovorum; unpaired part of vas deferens very short; accessory glands two, opening medianly and dorsally. Ova small, ·1 mm. in diameter, with little yolk, and the embryos provided with large trophic vesicles (Willey). Embryos in the uterus of very different ages, and probably born all the year round. One species only known, *P. novae britanniae* (Willey).

Sumatran Peripatus.—Peripatus with 24 pairs of ambulatory legs, and four spinous pads on the legs. The primary papillae of the neotropical character with conical bases. Generative opening between the legs of the penultimate pair. Feet with only two papillae. Single species. *P. sumatranus* (Sedgw.). The existence of this species is doubtful.

Peripatus from the Malay Peninsula.—With 23 to 25 pairs of claw-bearing legs, four spinous pads on the legs, and nephridial openings of legs 4 and 5 in the middle of the proximal pad or on its proximal side; feet with two primary papillae, one anterior and one posterior; outer jaw with two, inner jaw with two or three minor teeth at the base of the main tooth, separated by a diastema from the row of small teeth; crural glands present in the male only, in the two pairs of legs preceding the generative opening; coxal glands present. Genital opening between the penultimate legs; oviduct with receptacula seminis and ovorum; unpaired part of vas deferens long; male accessory glands two, opening medianly between the legs of the last pair. Ova large, with much yolk and thick membrane, like those of Australasian species; embryos with slit-like blastopore and of very different ages in the same uterus, probably born all the year round. The species are *P. weldoni* (Evans), *P. horsti* (Evans) and *P. butleri* (Evans). It will thus be seen that the Malay species, while resembling the neotropical species in the generative organs, differ from these in many features of the legs and feet, in the important characters furnished by the size and structure of the ovum, and by their early development.

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PERIPTERAL (Gr. περί, round, and πτερόν, a wing), in architecture, the term applied to a temple or other structure where the columns of the front portico are returned along its sides as wings at the distance of one or two intercolumniations from the walls of the naos or cella. Almost all the Greek temples were peripteral, whether Doric, Ionic, or Corinthian (see TEMPLE).

PERISSODACTYLA (*i.e.* odd-toed), the name proposed by Sir R. Owen for that division of ungulate mammals in which the toe corresponding to the middle (third) digit of the human hand and foot is symmetrical in itself, and larger than those on either side (when such are present). The Perissodactyla have been brigaded with the Artiodactyla (*q.v.*) to form the typical group of the ungulates, under the name of Diplarthra, or Ungulata Vera, and the features distinguishing the combined group from the less specialized members of the order Ungulata will be found under the heading of that order.

The following are the leading characteristics by means of which the sub-order Perissodactyla is distinguished from the Artiodactyla. The cheek-teeth (premolars and molars) form a continuous series, with massive, quadrate, transversely ridged or complex crowns—the posterior premolars usually resembling the molars in structure. Crown of the last lower molar commonly bilobed. Dorso-lumbar vertebrae never fewer than twenty-two, usually twenty-three in the existing species. Nasal bones expanded posteriorly. An alisphenoid canal. Femur with a third trochanter. The middle or third digit on both fore and hind feet larger than any of the others, and symmetrical in itself, the free border of the terminal phalanx being evenly rounded (see fig. 1). This may be the only functional toe, or the second and fourth may be subequally developed on each side. In the tapirs and many extinct forms the fifth toe also remains on the fore-limb, but its presence does not interfere with the symmetrical arrangement of the remainder of the foot on each side of the median line of the third or middle digit. The astragalus has a pulley-like surface above for articulation into the tibia, but its lower surface is flattened and unites to a much greater extent with the navicular than with the cuboid, which bone is of comparatively less importance than in the Artiodactyles. In existing forms the calcaneum does not articulate with the lower end of the fibula. The stomach is simple, the caecum large and capacious, the placenta diffused, and the teats inguinal.

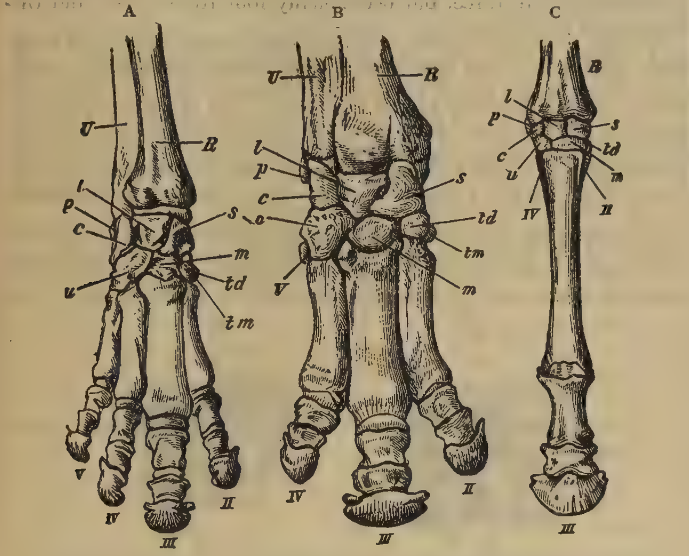

FIG. 1.—Bones of Right Fore-Foot of existing Perissodactyla.
A, Tapir (*Tapirus indicus*).
B, Rhinoceros (*Rhinoceros sumatrensis*).
C, Horse (*Equus caballus*).
U, ulna; *R*, radius; *c*, cuneiform; *l*, lunar; *s*, scaphoid; *u*, unciform; *m*, magnum; *td*, trapezoid; *tm*, trapezium.

The Perissodactyla may be divided into the four following sections, namely the extinct Titanotheroidea, the Hippoidea, represented by the horse tribe and their ancestors, the Tapiroidea, typified by the tapirs, and the Rhinocerotoidea, which includes the modern rhinoceroses and their forerunners.

1. *Titanotheres.*—In the Titanotheroidea the dentition may be expressed by the formula $i\frac{3\cdot2\text{ or }0}{3\cdot2\text{ or }0}$, $c\frac{1}{1}$, $p\frac{4}{4-3}$, $m\frac{3}{3}$. There is usually a short gap between the canine and first premolar; the upper molars are short-crowned and transitional between the bunodont (tubercular) and selenodont (crescentic) types, with two outer concave tubercles and two inner conical ones; while the lower molars are crescentic, with three lobes in the last of the series. The skull is elongated, with the orbit not separated from the temporal fossa and the nasals, which may or may not carry horns, reaching at least as far forwards as the union of the premaxillae. The post-glenoid, post-tympanic and paroccipital processes of the skull are large, and there is an alisphenoid canal. There are four functional toes in front and three behind; while the calcaneum, unlike that of the other three groups, articulates with the fibula. The group is represented by the families *Palaeosyopidae* and *Titanotheriidae* in the Tertiary deposits of North America. Both families are described under the heading TITANOTHERIIDAE.

2. *Horse Group.*—In the Hippoidea there is generally the full series of 44 teeth, but the first premolar, which is always small, is often deciduous or even absent in the lower or in both jaws. The incisors are chisel-shaped, and the canines tend to become isolated, so as in the more specialized forms to occupy a more or less midway position in a longer or shorter gap between the incisors and premolars. In the upper molars the two outer columns or tubercles of the primitive tubercular molar coalesce to form an outer wall, from which proceed two crescentic transverse crests, the connexion between the crests and the wall being slight or imperfect, and the crests themselves sometimes tubercular. Each of the lower molars carries two crescentic ridges. In the earlier forms the cheek-teeth are low-crowned, but in the higher types they become high-crowned. The number of front toes ranges from four to one, and of hind ones from three to one. The post-glenoid, post-tympanic and paroccipital processes of the skull are large; the second of these being always distinct. Nasals long, normally without traces of horns.

The section is divisible into the families *Equidae* and *Palaeotheriidae*, of which the latter is extinct.

In the *Equidae* the premolars are generally $\frac{4}{4}$ or $\frac{3}{3}$. In the earlier short-crowned forms these teeth are unlike the molars, and the first of the series is separated by a gap from the second. In the high-crowned types, as well as in some of the intermediate ones, they become molar-like, and roots are not developed in the whole cheek-series till late. Orbit in higher forms closed by bone; and ridges of lower cheek-teeth terminating in large loops. Front toes 4, 3 or 1, hind; 3 or 1. (See EQUIDAE and HORSE.)

In the *Palaeotheriidae* the premolars may be $\frac{4}{4}$ or $\frac{3}{3}$, and are generally molar-like, while the first (when present) is always close to the second; all the cheek-teeth short-crowned and rooted, with or without cement. Outer walls of upper cheek-teeth W-shaped, and transverse crests oblique. Orbit open behind; and ridges of lower cheek-teeth generally terminating in small loops. Feet always 3-toed. (See PALAEOTHERIUM.)

3. *Tapir Group.*—In the Tapiroidea the dentition may be either the full 44, or lack the first premolar in the lower or in both jaws. The incisors are chisel-shaped; and (unlike the early Hippoidea) there is no gap between the first premolar, when present, and the second. The upper cheek-teeth are short-crowned and without cement, and show distinct traces of the primitive tubercles; the two outer columns form a more or less complete external wall, connected with the inner ones by a pair of nearly straight transverse crests; and the premolars are originally simpler than the molars. Lower cheek-teeth with two straight transverse ridges. Nasals long in early, but shorter in later forms, hornless; orbit open behind. Front toes, 4; hind toes, 3.

This group is also divided into two families, the *Tapiridae* and *Lophiodontidae*, the latter extinct.

In the *Tapiridae* the dentition may be reduced below the typical 44 by the loss of the first lower premolar. Hinder premolars either simple or molar-like. Outer columns of upper molars similar, the hinder ones not flattened; ridges of lower molars oblique or directly transverse, a third ridge to the last molar in the earlier forms. The *Lophiodontidae*, which date from the Eocene, come very close to *Hyracotherium* in the horse-line; and it is solely on the authority of American palaeontologists that the division of these early forms into equoids and tapiroids is attempted. In North America the earliest representative of the group is *Systemodon* of the Lower Eocene, in which all the upper premolars are quite simple; while the molars are of a type which would readily develop into that of the modern tapirs, both outer columns being conical and of equal size. The absence of a gap between the lower canine and first premolar and between the latter and the following tooth is regarded as an essentially tapir-like feature. *Lophiodochoerus* apparently represents this stage in the European Lower Eocene; *Isectolophus*, of the American Middle Eocene, represents a distinct advance, the last upper premolar becoming molar-like, while a second species from the Upper Eocene is still more advanced; the third lobe is, however, retained in the last lower molar. In the

Oligocene of both hemispheres appears *Protapirus*, which ranges well into the Miocene, and is essentially a tapir, having lost the third lobe of the last lower molar, and being in process of acquiring molar-like upper premolars, although none of these teeth have two complete inner columns. Finally, *Tapirus* itself, in which the last three upper premolars, makes its appearance in the Upper Miocene, and continues till the present day. The characters of the genus may be expressed as follows in a more detailed manner.

The dentition is $i\,\frac{3}{3}$, $c\,\frac{1}{1}$, $p\,\frac{4}{3}$, $m\,\frac{3}{3}$, total 42. Of the upper incisors the first and second are nearly equal, with short, broad crowns, the third is large and conical, considerably larger than the canine, which is separated from it by an interval. Lower incisors diminishing in size from the first to the third; the canine, which is in contact with the third incisor, large and conical, working against (and behind) the canine-like third upper incisor. In both jaws there is a long space between the canines and the commencement of the teeth of the cheek-series, which are all in contact. First upper premolar with a triangular crown narrow in front owing to the absence of the anterior inner column. The other upper premolars and molars all formed on the same plan and of nearly the same size, with four roots and quadrate crowns, rather wider transversely than from before backwards, each having four columns, connected by a pair of transverse ridges, anterior and posterior. The first lower premolar compressed in front; the others composed of a single pair of transverse crests, with a small anterior and posterior basal ridge. Skull elevated and compressed; with the orbit and temporal fossa widely continuous, there being no true post-orbital process from the frontal bone. Nasal apertures very large, and extending high on the face between the orbits; nasal bones short, elevated, triangular and pointed in front. Vertebrae: cervical, 7; dorsal, 18; lumbar, 5; sacral, 6; caudal about 12. Limbs short and stout. Fore-feet with four toes, having distinct hoofs: the first toe being absent, the third the longest, the second and fourth nearly equal, and the fifth the shortest and scarcely reaching the ground in the ordinary standing position. Hind-feet with the typical perissodactyle arrangement of three toes—the middle one being the largest, the two others nearly equal. Nose and upper lip elongated into a flexible, mobile snout or short proboscis, near the end of which the nostrils are situated. Eyes rather small. Ears of moderate size, ovate, erect. Tail very short. Skin thick and but scantily covered with hair. Tapirs are common to the Malay countries and tropical America; two species from the latter area differ from the rest in having a vertical bony partition to the nasal septum, and are hence subgenerically or generically separated as *Tapirella* (*Elasmognathus*) (see TAPIR). Nearly related is the extinct family *Lophiodontidae* (inclusive of the American *Helaletidae*), in which both the upper and lower first premolar may be absent, while the upper molars present a more rhinoceros-like form, owing to the lateral compression and consequent lengthening of the outer columns, of which the hinder is bent somewhat inwards and is more or less concave externally, thus forming a more complete outer wall. In America the family is represented by *Heptodon*, of the Middle Eocene, which differs from the early members of the tapir-stock in having a long gap between the lower canine and first premolar; the dentition is complete, and the upper premolars are simple. The next stage is *Helaletes*, also of Middle Eocene age, in which the first lower premolar has disappeared, and the last two upper premolars have become molar-like. Finally, in the Oligocene *Colodon* the last three upper premolars are like the molars, and the first pair of lower incisors is lost. In Europe the group is represented by the long-known and typical genus *Lophiodon* with three premolars in each jaw, of which the upper are simpler than the molars. The genus is especially characteristic of the Middle and Upper Eocene, and some of the species attained the size of a rhinoceros.

4. *Rhinoceros Group.*—The last section of the Perissodactyla is that of the Rhinocerotoidea, represented by the modern rhinoceroses and their extinct allies. In this group the incisors and canines are very variable in number and form; the lower canine being separated by only a short gap from the outer incisor (when present), but by a long one from the first premolar, which is in contact with the second. The second and third premolars, which are always present, are large and molar-like; the whole of these teeth being essentially of the lophodont type of *Lophiodon*, but the last upper molars assume a more or less triangular form, with an oblique outer wall, and there are certain complications in the structure of all these teeth in the more specialized types (fig. 2). The lower cheek-teeth have, unlike those of the Tapiroidea, crescentic ridges, which have not the loops at their extremities characteristic of the advanced Hippoidea; the last lower molar has no third lobe. The facial portion of the skull is generally shorter than the cranial; the orbit is freely open behind; and the premaxillae tend to be reduced and fused with the nasals. Front toes, 3 or 4; hind toes, 3.

The most primitive group is that of the American *Hyracodontidae*, represented in the Oligocene by *Hyrachyus*, *Hyracodon* and *Triplopus*. With the exception of the first lower premolar, the dentition is complete; the incisors being normal, but the canine rudimentary, and the last upper molar distinctly triangular. The upper molars have a crista and a crochet (fig. 2). The skull is high, with the facial and cranial portions approximately equal. There are only three front toes, and the limbs are long and adapted for running.

In the *Amynodontidae*, represented by the North American Middle Eocene *Amynodon* and *Metamynodon*, the premolars may be either $\frac{4}{4}$ or $\frac{3}{3}$, making the total number of teeth either 44 or 40. The incisors tend to become lateral, the canines are enlarged, and the last upper molar is sub-quadrangular. The upper molars have a crista but no crochet (fig. 2). As in the last family, the post-glenoid process of the skull is broad; the whole skull being depressed with a shortened facial portion. The fore-foot is five-toed and spreading; indicating that the members of the family were swamp-dwelling animals.

Finally, we have the family *Rhinocerotidae*, which includes the existing representatives of the group. In this family the dentition has undergone considerable reduction, and may be represented inclusive of all the variations, by the formula $i\,\frac{2\text{ or }0}{1\text{ or }0}$ $c\,\frac{0\text{ or }1}{1\text{ or }0}$ $p\,\frac{4\text{ or }2}{4\;3\text{ or }2}$ $m\,\frac{3}{3}$. The first upper incisor, when present, has an antero-posteriorly elongated crown, but the second is small; when fully developed, the lower canine is a large forwardly directed tusk-like tooth with sharp cutting-edges, and biting against the first upper incisor. The third upper molar is triangular, and most of the teeth of the upper cheek-series may have both crochet and crista (fig. 2). The post-glenoid process is small, and the facial and cranial portions of the skull are approximately of equal length. Usually there are three, but occasionally four front toes; and the limb-bones are short.

A large number of representatives of the group are known from both the Old and the New World; specialization displaying itself in the later ones in the development of dermal horns over the nasal bones, either in laterally placed pairs as in some of the early forms, or in the median line, either single or double. In North America rhinoceroses became extinct before the close of the Pliocene period; but in the Old World, although their geographical distribution has become greatly restricted, at least five well-marked species survive. The group is unknown in South America.

As regards the dentition of the existing species, the cheek-series consists of the four premolars and three molars above and below, all in contact and closely resembling each other, except the first, which is much smaller than the rest and often deciduous; the others gradually increasing in size up to the penultimate. The upper molars present a characteristic pattern of crown, having a much-developed flat or more or less sinuous outer wall, and two transverse ridges running obliquely inwards and backwards from it, terminating internally in conical eminences or columns, and enclosing a deep valley between. The posterior valley is formed behind the posterior transverse ridge, and is bounded externally by a backward continuation of the outer wall and behind by the cingulum. The anterior valley is formed in the same manner, but is much smaller. The middle valley is often intersected by vertical "crista" and "crochet" plates projecting into it from the anterior surface of the posterior transverse ridge or from the wall, the development of which is a useful guide in discriminating species, especially those known only by teeth and bones. The depressions between the ridges are not filled up with cement. As stated above, the lower molars have the crown formed by a pair of crescents; the last having no third lobe.

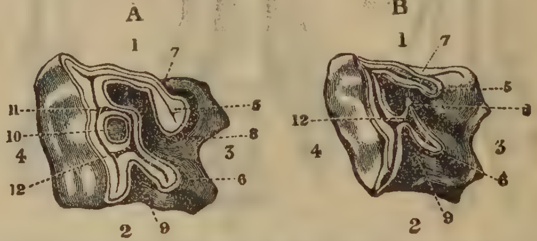

FIG. 2.—Grinding Surface of moderately worn Right Upper Second Molars of Rhinoceros.

A, *Rhinoceros unicornis.* B, *Rhinoceros sondaicus.*

1, Anterior surface.
2, Posterior surface.
3, Internal surface.
4, External surface (wall or dorsum).
5, Antero-internal pillar or column.
6, Postero-internal pillar or column.
7, Anterior valley.
8, Median valley.
9, Posterior valley.
10, Accessory valley.
11, Crista.
12, Crochet.

The head is large, and the skull elongated, and elevated posteriorly into a transverse occipital crest. No post-orbital processes or any separation between orbits and temporal fossae. Nasal bones large and stout, co-ossified, and standing out freely above the premaxillae, from which they are separated by a deep and wide fissure; the latter small, generally not meeting in the middle line in front, often rudimentary. Tympanics small, not forming a bulla. Brain-cavity small for the size of the skull. Vertebrae: cervical, 7; dorsal 19–20; lumbar, 3; sacral, 4; caudal, about 22.

Limbs stout, and of moderate length. Three completely developed toes, with distinct broad rounded hoofs on each foot. Teats two, inguinal. Eyes small. Ears of moderate size, oval, erect, prominent, placed near the occiput. Skin very thick, in many species thrown into massive folds. Hairy covering scanty. One or two median horns on the face. When one is present it is situated over the conjoined nasal bones; when two, the hinder one is over the frontals. These horns, which are of a more or less conical form and usually recurved, and often grow to a great length (three or even four feet), are composed of a solid mass of hardened epidermic cells growing from a cluster of long dermal papillae. The cells formed on each papilla constitute a distinct horny fibre, like a thick hair, and the whole is cemented together by an intermediate mass of cells which grow up from the interspaces between the papillae. It results from this that the horn has the appearance of a mass of agglutinated hairs, which, in the newly growing part at the base, readily fray out on destruction of the softer intermediate substance; but the fibres differ from true hairs in growing from a free papilla of the derm, and not within a follicular involution of the same. Considerable difference of opinion exists with regard to the best classification of the family, some authorities including most of the species in the typical genus *Rhinoceros*, while others recognize quite a number of sub-families and still more genera. Here the family is divided into two groups *Rhinocerotinae* and *Elasmotheriinae*, the latter including only *Elasmotherium*, and the former all the rest. In the Lower Oligocene of Europe we have *Ronzotherium* and in that of America *Leptaceratherium* (*Trigonias*), which were primitive species with persistent upper canines and three-toed fore-feet. Possibly they belonged to the *Amynodontidae*, but they may have been related to the Upper Oligocene *Diceratherium*, in which the nasal bones formed a transverse pair; this genus being common to Europe and North America; *Caenopus* is an allied American type. Hornless rhinoceroses, with five front-toes, ranging from the Oligocene to the Lower Pliocene in Europe, represent the genus *Aceratherium*, which may also occur in America, as it certainly does in India. With the short-skulled, short-footed, three-toed and generally horned rhinoceroses ranging in Europe and America from the Lower Miocene to the Lower Pliocene, typified by the European *R. goldfursi* and *R. brachypus*, we may consider the genus *Rhinoceros* to commence; these species constituting the subgenus *Teleoceras*. The living *R.* (*Dicerorhinus*) *sumatrensis* of south-eastern Asia indicates another subgenus, represented in the European Miocene by *R. sansaniensis* and in the Indian Pliocene by *R. platyrhinus*, in which two horns are combined with the presence of upper incisors and lower canines. Next we have the living African species, representing the subgenus *Diceros*, in which there are two horns but no front teeth. To this group belongs the extinct European and Asiatic woolly rhinoceros, *Rhinoceros* (*Diceros*) *antiquitatis*, of Pleistocene age, of which the frozen bodies are sometimes found in Siberia, and *R.* (*D.*) *pachygnathus* of the Lower Pliocene of Greece. Finally the Great Indian rhinoceros *R. unicornis*, the Javan *R. sondaicus*, and the Lower Pliocene Indian *R. sivalensis* and *R. palaeindicus*, represent *Rhinoceros* proper, in which front teeth are present, but there is only one horn. (See RHINOCEROS.)

The subfamily *Elasmotheriinae* is represented only by the huge *E. sibircum* of the Siberian Pleistocene, in which the premolars were reduced to $\frac{2}{2}$ while front-teeth were probably wanting, and the cheek teeth developed tall crowns, without roots, but with cement in the valleys, and the enamel of the central parts curiously crimped. A hump on the forehead probably indicates the existence of a large frontal horn.

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PERISTYLE (Gr. περί, round, and στῦλος, column), in architecture, a range of columns (whether rectangular or circular on plan) in one or two rows, enclosing the sanctuary of a temple; the term is also applied to the same feature when built round the court in which the temple is situated and in Roman houses to the court in the rear, round which the private rooms of the family were arranged, which were entered from the covered colonnade round the court.

PERITONITIS, inflammation of the peritoneum—the serous membrane which lines the abdominal and pelvic cavities and gives a covering to their viscera. It may exist in an acute or a chronic form, and may be either localized or diffused.

Acute peritonitis may be brought on, like other inflammations, by exposure to wet or cold, or in connexion with injury to, or disease of, some abdominal organ, or with general feebleness of health. It is an occasional result of hernia and of obstruction of the bowels, of wounds penetrating the abdomen, of the perforation of viscera, as in ulcer of the stomach, and of the intestine in typhoid fever, of the bursting of abscesses or cysts into the abdominal cavity, and also of the extensions of inflammatory action from some abdominal or pelvic organ, such as the appendix, the uterus, or bladder. At first localized, it may afterwards become general. The changes effected in the peritoneum are similar to those undergone by other serous membranes when inflamed. Thus, there are congestion; exudation of lymph in greater or less abundance, at first greyish and soft, thereafter yellow, becoming tough and causing the folds of the intestine to adhere together; effusion of fluid, either clear, turbid, bloody or purulent. The tough, plastic lymph connecting adjacent folds of intestine is sometimes drawn out like spun-glass by the movements of the intestines, forming bands and loops through or beneath which a piece of bowel may become fatally snared.

The *symptoms* of acute peritonitis usually begin by a shivering fit or rigor, together with vomiting, and with pain in the abdomen of a peculiarly severe and sickening character, accompanied with extreme tenderness, so that pressure, even of the bed-clothes, causes aggravation of suffering. The patient lies on the back with the knees drawn up so as to relax the abdominal muscles; the breathing becomes rapid and shallow, and is performed by movements of the chest only, the abdominal muscles remaining quiescent—unlike what takes place in healthy respiration. The abdomen becomes swollen by flatulent distension of the intestines, which increases the distress. There is usually constipation. The skin is hot, although there may be perspiration; the pulse is small, hard and wiry; the urine is scanty and high coloured, and is passed with pain. The face is pinched and anxious. These symptoms may pass off in a day or two; if they do not the case is apt to go on to a fatal termination. In such event the abdomen becomes more distended; hiccough, and the vomiting of brown or blood-coloured matter occur; the temperature falls, the face becomes cold and clammy; the pulse is exceedingly rapid and feeble, and death takes place from collapse, the mental faculties remaining clear till the close. When the peritonitis is due to perforation—as may happen in the case of gastric ulcer or of ulcers of typhoid fever, or in the giving way of a loop of strangulated bowel—the above-mentioned symptoms and the fatal collapse may all take place in from twelve to twenty-four hours. The puerperal form of this disease, which comes on within a day or two after childbirth, is often rapidly fatal. The actual cause of death is the absorption of the poisonous inflammatory products which have been poured out into the peritoneal cavity, as well as of the toxic fluids which have remained stagnant in the paralysed bowel.

Perhaps the commonest cause of septic peritonitis is the escape of micro-organisms (bacillus coli) from the ulcerated, mortified or inflamed appendix (see APPENDICITIS). A generation or so ago deaths from this cause were generally placed under the single heading of "peritonitis," but at the present time the primary disease is shown upon the certificate which too often runs thus: appendicitis five days, acute peritonitis two days.

Chronic peritonitis may occur as a result of the acute attack, or as a tuberculous disease. In the former case, the gravest symptoms having subsided, some abdominal pain continues, and there is considerable swelling of the abdomen, corresponding to a thickening of the peritoneum, and to the presence of fluid in the peritoneal cavity. This kind of peritonitis may also develop slowly without there having been any preceding acute attack. There is a gradual loss of strength and flesh. The disease is essentially a chronic one; it is not usually fatal.

Tuberculous peritonitis occurs either alone or in association with tuberculous disease of a joint or of the lungs. The chief symptoms are abdominal discomfort, or pain, and distension of the bowels. The patient may suffer from either constipation or diarrhoea, or each alternately. Along with these local manifestations there may exist the usual phenomena of tuberculous disease, viz. high fever, with rapid emaciation and loss of strength. But some cases of tuberculous peritonitis present symptoms which are not only obscure, but actually misleading.

There may be no abdominal distension, and no pain or tenderness. The patient may lie quietly in bed, flat on his back, with the legs down straight, and he may have no marked elevation of temperature. There may be no vomiting and no constipation or diarrhoea. In some cases, the neighbouring coils of intestine having been glued together, a collection of serous fluid takes its place in the midst of the mass, and, being walled in by the adhesions, forms a rounded tumour, dull on percussion, but not tender or painful. Such cases, especially when occurring in women, are apt to be mistaken for cystic disease of the ovary.

As regards the *treatment of acute peritonitis*, the first thing that the surgeon has to do is to assure himself that the disease is not due to some cause which itself should be dealt with, to a septic disease of appendix or Fallopian tube, for instance, or to a toxic condition of the uterus, the result, perhaps, of a criminal or innocent abortion, or to a perforated ulcer of stomach or intestine. In many obscure cases the safest treatment is likely to be afforded by an exploratory abdominal section. If the medical attendant has made up his mind that the question of exploration is not to be entertained—a decision which should be arrived at only after most deliberate consultation—the best thing will be to apply fomentations to the abdomen, and to administer small and repeated doses of morphia by the skin—$\frac{1}{8}$ or $\frac{1}{4}$ grain—repeated every hour or so until the physiological effect is produced. As regards other drugs, it may be a question as to whether calomel or Epsom salts should be given. As regards food, the only thing that can be safely recommended is a little hot water taken in sips. A bed-cradle should be placed over the patient in order to keep the weight of the bed-clothes from the abdomen. (E. O.*)

PERIZONIUS (or ACCINCTUS), the name of JAKOB VOORBROEK (1651–1715), Dutch classical scholar, who was born at Appingedam in Groningen on the 26th of October 1651. He was the son of Anton Perizonius (1626–1672), the author of a once well-known treatise, *De ratione studii theologici*. Having studied at the university of Utrecht, he was appointed in 1682 to the chair of eloquence and history at Franeker through the influence of J. G. Graevius and Nicolas Heinsius. In 1693 he was promoted to the corresponding chair at Leiden, where he died on the 6th of April 1715. The numerous works of Perizonius entitle him to a very high place among the scholars of his age. Special interest attaches to his edition of the *Minerva* of Francisco Sanchez or Sanctius of Salamanca (1st ed., 1587; ed. C. L. Bauer, 1793–1801), one of the last developments of the study of Latin grammar in its pre-scientific stage, when the phenomena of language were still regarded as for the most part disconnected, conventional or fortuitous. Mention should also be made of his *Animadversiones historicae* (1685), which may be said to have laid the foundations of historical criticism, and of his treatises on the Roman republic, alluded to by Niebuhr as marking the beginning of that new era of historical study with which his own name is so closely associated.

The article on Perizonius in Van der Aa's *Biographisch Woordenboek der Nederlanden* contains full biographical and bibliographical particulars; see also F. A. Eckstein in Ersch and Gruber's *Allgemeine Encyklopädie*.

PERJURY (through the Anglo-Fr. *perjurie*, modern *parjure*, Lat. *perjurium*, a false oath, *perjurare*, to swear falsely), an assertion upon an oath duly administered in a judicial proceeding before a competent court of the truth of some matter of fact, material to the question depending in that proceeding, which assertion the assertor does not believe to be true when he makes it, or on which he knows himself to be ignorant (Stephen, *Digest of the Criminal Law*, art. 135). In the early stages of legal history perjury seems to have been regarded rather as a sin than as a crime, and so subject only to supernatural penalties. The injury caused by a false oath was supposed to be done not so much to society as to the Divine Being in whose name the oath was taken (see OATH). In Roman law, even in the time of the empire, the perjurer fell simply under divine reprobation, and was not dealt with as a criminal, except where he had been bribed to withhold true or give false evidence, or where the oath was by the genius of the emperor. In the latter case punishment was no doubt inflicted more for the insult to the emperor than for the perjury. False testimony leading to the conviction of a person for a crime punishable with death constituted the offence of homicide rather than of perjury. In England, perjury, as being a sin, was originally a matter of ecclesiastical cognisance. At a later period, when it had become a crime, the jurisdiction of the spiritual courts became gradually confined to such perjury as was committed in ecclesiastical proceedings, and did not extend to perjury committed in a temporal court. The only perjury which was for a long time noticed at common law was the perjury of jurors. Attaint of jurors (see ATTAINT, WRIT OF) who were originally rather in the position of witnesses than of judges of fact, incidentally subjected them to punishment for perjury. Criminal jurisdiction over perjury by persons other than jurors seems to have been first assumed by the Star Chamber, acting under the powers supposed to have been conferred by an act of Henry VII. (1487). After the abolition of the Star Chamber by the Long Parliament in 1641 and the gradual diminution of the authority of the spiritual courts, perjury (whether in the strict sense of the word or the taking of a false oath in non-judicial proceedings) practically fell entirely within the jurisdiction of the ordinary criminal tribunals. At common law only a false oath in judicial proceedings is perjury. But by statute the penalties of perjury have been extended to extra-judicial matters *e.g.* false declarations made for the purpose of procuring marriage (The Marriage and Registration Act 1856), and false affidavits under the Bills of Sale Act 1878. False affirmation by a person permitted by law to affirm is perjury (The Evidence Further Amendment Act 1869; The Evidence Amendment Act 1870).

In order to support an indictment for perjury the prosecution must prove the authority to administer the oath, the occasion of administering it, the taking of the oath, the substance of the oath, the materiality of the matter sworn, the falsity of the matter sworn, and the corrupt intention of the defendant. The indictment must allege that the perjury was wilful and corrupt, and must set out the false statement or statements on which perjury is assigned, subject to the provisions of the Prosecutions for Perjury Act 1749 (which also applies to subornation of perjury). By that act it is sufficient to set out the substance of the offence, without setting forth the bill, answer, &c., or any part of the record and without setting forth the commission or authority of the court before whom the perjury was committed. The matter sworn to must be one of fact and not of mere belief or opinion. It is not homicide, as in Roman law, to procure the death of another by false evidence, but the Criminal Code, ss. 118, 164, proposed to make such an offence a substantive crime of greater gravity than ordinary perjury, and punishable by penal servitude for life. It is a rule of evidence, founded upon obvious reasons, that the testimony of a single witness is insufficient to convict on a charge of perjury. There must be corroboration of his evidence in some material particular. Perjury is a common law misdemeanour, not triable at quarter-sessions. Most persons in a judicial position have the right of directing the prosecution of any witness, if it appears to them that he has been guilty of perjury (The Criminal Procedure Act 1851). The provisions of the Vexatious Indictments Act 1859 extend to perjury and subornation of perjury. By that Act no indictment for either of such offences can be preferred unless the prosecutor or accused is bound by recognisance, or the accused is in custody, or the consent of a judge is obtained, or (in the case of perjury) a prosecution is directed under the act of 1851.

Subornation of perjury is procuring a person to commit a perjury which he actually commits in consequence of such procurement. If the person attempted to be suborned do not take the oath, the person inciting him, though not guilty of subornation, is liable to fine and corporal punishment. Perjury and subornation of perjury are punishable at common law with fine and imprisonment. By the combined operation of the Perjury Act 1728 and later statutes, the punishment at present appears to be penal servitude for any term, or imprisonment with or without hard labour for a term not exceeding seven years (see Stephen, *Digest*, art. 148). The punishment at common law was whipping, imprisonment, fine and pillory.

Perjury or prevarication committed before a committee of either House of Parliament may be dealt with as a contempt or breach of privilege as well as by prosecution. As to false oaths not perjury, it is a misdemeanor at common law, punishable by fine and imprisonment, to swear falsely before any person authorized to administer an oath upon a matter of common concern, under such circumstances that the false swearing, if committed in judicial proceedings, would have amounted to perjury. There are some cases of making false declarations which are punishable on summary conviction, *e.g.* certain declarations under the Registration of Births and Deaths Act 1874, and the Customs Consolidation Act 1876.

In Scotland the law, as a general rule, agrees with that of England. Perjury may be committed by a party on reference to oath as well as by a witness. A witness making a false affirmation is guilty of perjury (The Affirmation [Scotland] Act, 1865). The acts of 1851 and 1859 do not extend to Scotland. The trial, though usually by the court of justiciary, may be by the court of session if the perjury is committed in the course of an action before that court. The punishment is penal servitude or imprisonment at the discretion of the court. Formerly a person convicted of perjury was disabled from giving evidence in future; this disability was abolished by the Evidence (Scotland) Act 1852.

In the United States the common law has been extended by most states to embrace false affirmations and false evidence in proceedings not judicial. Perjury in a United States court is dealt with by an act of Congress of the 3rd of March 1825, by which the maximum punishment for perjury or subornation of perjury is a fine of $2000 or imprisonment for not more than five years. Jurisdiction to punish perjury committed in the state courts belongs to the states, as the Federal Constitution did not give it to the Federal government. Statutory provisions founded upon the English act of 1749, have been adopted in some states. In the states which have not adopted such provisions, the indictment must set out the offence with the particularity necessary at common law.

On the continent of Europe perjury is also regarded as an offence of gravity punishable by imprisonment for varying periods. In Germany, as in England, it was at one time a matter for the spiritual courts. In Austria it is treated as a form of fraud, and the punishment is proportioned to the estimated amount of damage done to the party aggrieved. In France the term perjury (*parjure*) is specifically applied only to the making of false oaths by parties in a civil suit.

PERKIN, SIR WILLIAM HENRY (1838–1907), English chemist, was born in London on the 12th of March 1838. From an early age he determined to adopt chemistry as his profession, although his father, who was a builder, would have preferred him to be an architect. Attending the City of London School he devoted all his spare time to chemistry, and on leaving, in 1853, entered the Royal College of Chemistry, then under the direction of A. W. Hofmann, in whose own research laboratory he was in the course of a year or two promoted to be an assistant. Devoting his evenings to private investigations in a rough laboratory fitted up at his home, Perkin was fired by some remarks of Hofmann's to undertake the artificial production of quinine. In this attempt he was unsuccessful, but the observations he made in the course of his experiments induced him, early in 1856, to try the effect of treating aniline sulphate with bichromate of potash. The result was a precipitate, aniline black, from which he obtained the colouring matter subsequently known as aniline blue or mauve. He lost no time in bringing this substance before the managers of Pullar's dye-works, Perth, and they expressed a favourable opinion of it, if only it should not prove too expensive in use. Thus encouraged, he took out a patent for his process, and leaving the College of Chemistry, a boy of eighteen, he proceeded, with the aid of his father and brother, to erect works at Greenford Green, near Harrow, for the manufacture of the newly discovered colouring matter, and by the end of 1857 the works were in operation. That date may therefore be reckoned as that of the foundation of the coal-tar colour industry, which has since attained such important dimensions—in Germany, however, rather than in England, the country where it originated. Perkin also had a large share in the introduction of artificial alizarin (*q.v.*), the red dye of the madder root. C. Graebe and C. T. Liebermann in 1868 prepared that substance synthetically from anthracene, but their process was not practicable on a large scale, and it was left to him to patent a method that was commercially valuable. This he did in 1869, thus securing for the Greenford Green works a monopoly of alizarin manufacture for several years. About the same time he also carried out a series of investigations into kindred substances, such as anthrapurpurin. About 1874 he abandoned the manufacture of coal-tar colours and devoted himself exclusively to research in pure chemistry, and among the discoveries he made in this field was that of the reaction known by his name, depending on the condensation of aldehydes with fatty acids (see CINNAMIC ACID). Later still he engaged in the study of the relations between chemical constitution and rotation of the plane of polarization in a magnetic field, and enunciated a law expressing the variation of such rotation in bodies belonging to homologous series. For this work he was in 1889 awarded a Davy medal by the Royal Society, which ten years previously had bestowed upon him a Royal medal in recognition of his investigations in the coal-tar colours. The Chemical Society, of which he became secretary in 1869 and president in 1883, presented him with its Longstaff medal in 1889, and in 1890 he received the Albert medal of the Society of Arts. In 1906 an international celebration of the fiftieth anniversary of his invention of mauve was held in London, and in the same year he was made a knight. He died near Harrow on the 14th of July 1907.

His eldest son, WILLIAM HENRY PERKIN, who was born at Sudbury, near Harrow, on the 17th of June 1860, and was educated at the City of London School, the Royal College of Science, and the universities of Würzburg and Munich, became professor of chemistry at the Heriot-Watt College, Edinburgh, in 1887, and professor of organic chemistry at Owens College, Manchester, in 1892. His chief researches deal with the polymethylene compounds, the alkaloids, in particular hydrastine and berberine, and the camphors and terpenes (*q.v.*). He received the Davy medal from the Royal Society in 1904.

PERKINS, CHARLES CALLAHAN (1823–1886), American artist and author, was born in Boston and educated at Harvard, subsequently studying art in Rome and Paris. Returning to Boston, he helped to found the Museum of Fine Arts, of which he was honorary director, and for many years he played a leading part in artistic circles as a cultured critic and writer. His chief publications were *Tuscan Sculptors* (1864) and *Italian Sculptors* (1868)—replaced in 1883 by *The Historical Handbook of Italian Sculptors—Art in Education* (1870), and *Sepulchral Monuments in Italy* (1885).

PERKINS, JACOB (1766–1849), American inventor and physicist, was born at Newburyport, Massachusetts, in 1766, and was apprenticed to a goldsmith. He soon made himself known by a variety of useful mechanical inventions, and in 1818 came over to England with a plan for engraving bank-notes on steel, which ultimately proved a signal success, and was carried out by Perkins in partnership with the English engraver Heath. His chief contribution to physics lay in the experiments by which he proved the compressibility of water and measured it by a piezometer of his own invention (see *Phil. Trans.*, 1820, 1826). He retired in 1834, and died in London on the 30th of July 1849.

His second son, ANGIER MARCH PERKINS (1799?–1881), also born at Newburyport, went to England in 1827, and was the author of a system of warming buildings by means of high-pressure steam. His grandson, LOFTUS PERKINS (1834–1891), most of whose life was spent in England, experimented with the application to steam engines of steam at very high pressures, constructing in 1880 a yacht, the "Anthracite," whose engines worked with a pressure of 500 ℔ to the sq. in.

PERLEBERG, a town of Germany, in the Prussian province of Brandenburg, on the Stepenitz, 6 m. N.E. from Wittenberge by the railway to Neustrelitz. Pop. (1905), 9502. It contains a fine Gothic Evangelical church, a Roman Catholic church, a synagogue and several schools, and has a town-hall, dating from the 15th century, and a Roland column. Its chief manufactures are machinery, soap, blacking and clogs.

See Höpfner, *Perleberger Reimchronik. Perleberg von 1200 bis 1700* (Perleberg, 1876).

PERLES, JOSEPH (1835–1894), Jewish rabbi, was born in Hungary in 1835, and died at Munich in 1894. He was one of the first rabbis trained at the new type of seminary (Breslau). Perles' most important essays were on folk-lore and custom. There is much that is striking and original in his history of marriage (*Die jüdische Hochzeit in nachbiblischer Zeit*, 1860), and of mourning customs (*Die Leichenfeierlichkeiten im nachbiblischen Judenthum*, 1861), his contributions to the sources of the Arabian Nights (*Zur rabbinischen Sprach-und Sagenkunde*, 1873), and his notes on rabbinic antiquities (*Beiträge zur rabbinischen Sprach- und Altertumskunde*, 1893). Perles' essays are rich in suggestiveness, and have been the starting-point of much fruitful research. He also wrote an essay on Nachmanides, and a biography and critical appreciation of Rashba (1863). (I. A.)

PERLITE, or PEARLSTONE, a glassy volcanic rock which, when struck with a hammer, breaks up into small rounded masses that often have a pearly lustre. The reason for this peculiarity is obvious in microscopic sections of the rock, for many small cracks may be seen traversing the glassy substance. These mostly take a circular course, and often occur in groups, one within another. The circular cracks bound the little spheres into which the rock falls when it is struck, and the concentric fissures are the cause of the pearly lustre, by the reflection of light from enclosed films of air. Longer straight cracks run across the sections separating areas in which the circular fissures preponderate. By decomposition the fissures may be occupied by deposits of limonite, which make them more obvious, or by other secondary minerals. The glass itself often undergoes change along the cracks by becoming finely crystalline or devitrified, dull in appearance and slightly opaque in section. In polarized light the perlitic glass is usually quite isotropic, but sometimes the internal part of some of the spheres has a slight double refraction which is apparently due to strain. The glass found on the waste-heaps of glass-furnaces is sometimes very coarsely perlitic.

Perlitic structure is not confined to glass, but may be seen also in that variety of opal which is called hyalite. This forms small transparent rounded masses like drops of gum, and in microscopic section exhibits concentric systems of cracks. Hyalite, like perlitic obsidian, is amorphous or non-crystalline. It is easy to imitate perlitic structure by taking a little Canada balsam and heating it on a slip of glass till most of the volatile matters are driven out; then drop it in a basin of cold water and typical perlitic structure will be produced. The reason is apparently the sudden contraction when the mass is chilled. In the glaze on tiles and china rounded or polygonal systems of cracks may often be seen which somewhat resemble perlitic structure but are less perfect and regular. Many rocks which are cryptocrystalline or felsitic, and not glassy, have perfect perlitic structure, and it seems probable that these were originally vitreous obsidians or pitchstones and have in process of time been changed to a finely crystalline state by devitrification. Occasionally in olivine and quartz rounded cracks not unlike perlitic structure may be observed.

Many perlitic rocks contain well-developed crystals of quartz, feldspar, augite or magnetite, &c., usually more or less corroded or rounded, and in the fine glassy base minute crystallites often abound. Some of the rocks have the resinous lustre and the high percentages of combined water which distinguish the pitchstones; others are bright and fresh obsidians, and nearly all the older examples are dull, cryptocrystalline felsites. According to their chemical compositions they range from very acid rhyolites to trachytes and andesites, and the dark basaltic glasses or tachylytes are sometimes highly perlitic. It is probable that most perlites are of intrusive origin, and the general absence of steam cavities in these rocks would support this conclusion, but some perlitic Hungarian rhyolites are believed to be lavas.

Very well known rocks of this kind are found in Meissen, Saxony, as dikes of greenish and brownish pitchstone. Other examples are furnished by the Tertiary igneous rocks of Hungary (Tokai, &c.), the Euganean Hills (Italy) and Ponza Island (in the Mediterranean). In mineralogical collections rounded nodules of brown glass varying from the size of a pea to that of an orange may often be seen labelled *Marekanite*. They have long been known to geologists and are found at Ockotsk, Siberia, in association with a large mass of perlitic obsidian. These globular bodies are, in fact, the more coherent portions of a perlite; the rest of the rock falls down in a fine powder, setting free the glassy spheres. They are subject to considerable internal strain, as is shown by the fact that when struck with a hammer or sliced with a lapidary's saw they often burst into fragments. Their behaviour in this respect closely resembles the balls of rapidly cooled, unannealed glass which are called Prince Rupert's drops. In their natural condition the marekanite spheres are doubly refracting, but when they have been heated and very slowly cooled they lose this property and no longer exhibit any tendency to sudden disintegration.

In Great Britain Tertiary vitreous rocks are not common, but the pitchstone which forms the Scuir of Eigg is a dark andesitic porphyry with perlitic structure in its glassy matrix. A better example, however, is provided by a perlitic dacitic pitchstone porphyry that occurs near the Tay Bridge in Fifeshire. The tachylytic basalt dikes of Mull are occasionally highly perlitic. At Sandy Braes in Antrim a perlitic obsidian has been found, and the Lea Rock, near Wellington in Shropshire, is a devitrified obsidian which shows perlitic cracks and the remains of spherulites. (J. S. F.)

PERM, a government of east Russia, bounded S. by the governments of Orenburg and Ufa, W. by Vyatka, N.W. by Vologda, and E. by Tobolsk (Siberia). It has an area of 128,173 sq. m. Though administratively it belongs entirely to Russia in Europe, its eastern part (about 57,000 sq. m.) is situated in Siberia, in the basin of the Ob. The government is traversed from north to south by the Ural Mountains, 30 to 45 m. in width, thickly clothed with forests, and deeply excavated by rivers. The highest summits do not rise above 3600 ft. in the northern section of the range (the Vogulian Ural); in the central portion, between 59° and 60° 30′ N., they once or twice exceed 5000 ft. (Denezhkin, 5360 ft.); but the chain soon sinks towards the south, where it barely attains an elevation of 3000 ft. Where the great Siberian road crosses it the highest point is 1400 ft.

The government is very well drained by rivers belonging to the Pechora, Tobol (affluent of the Ob) and Kama systems. The Pechora itself rises in the northern corner of the government, and its tributary the Volosnitsa is separated by a distance of less than 3 m. from the navigable Vogulka, a tributary of the Kama, a circumstance of some commercial importance. The chief river of Perm, is however, the Kama, whose navigable tributaries the Chusovaya, Sylva and Kolva are important channels for the export of heavy iron goods to Russia. The government is dotted with a great number of lakes of comparatively trifling size, their total area being 730 sq. m., and with marshes, which are extensive in the hilly tracts of the north. Granites, diorites, porphyries, serpentines and Laurentian gneisses and limestones, containing iron, copper and zinc ores, constitute the main axis of the Ural chain; their western slope is covered by a narrow strip of Huronian crystalline slates, which disappear in the east under the Post-Tertiary deposits of the Siberian lowlands, while on the west narrow strips of Silurian limestones, quartzites and slates, and separate islands of Devonian deposits, appear on the surface. These in their turn are overlain with Carboniferous clays and sandstones, containing Coal Measures in several isolated basins. The Permian deposits extend as a regular strip, parallel to the main ridge, over these last, and are covered with the so-called "variegated marls," which are considered as Triassic, and appear only in the western corner of the territory.

Perm is the chief mining region of Russia, owing to its wealth in iron, silver, platinum, copper, nickel, lead, chrome ore, manganese and auriferous alluvial deposits. Many rare metals, such as iridium, osmium, rhodium and ruthenium, are found along with the above, as also a great variety of precious stones, such as diamonds, sapphires, jaspers, tourmalines, beryls, phenacites, chrysoberyls, emeralds, aquamarines, topazes, amethysts, jades, malachite. Salt-springs occur in the west; and the mineral waters, though still little known, are worthy of mention. No less than 70 % of the total area is occupied with forest; but the forests are distributed very unequally, covering 95% of the area in the north and only 25% in the south-east. Firs, the pine, cedar, larch, birch, alder and lime are the most common; the oak appears only in the south-west. The flora of

Perm presents a mixture of Siberian and Russian species, several of which have their north-eastern or south-western limits within the government. The climate is severe, the average temperature at different places being as follows:—

	Lat. N.	Altitude.	Yearly Average.	January Average.	July Average.
		Ft.	F.	F.	F.
Bogoslovsk	59° 45′	630	29·3°	3·0°	62·6°
Usolye (Kama)	59° 25′	300	34·0°	4·5°	63·8°
Nizhniy-Tagilsk	57° 55′	590	33·1°	2·0°	64·9°
Ekaterinburg	56° 48′	890	32·9°	2·5°	63·5°

The estimated population in 1906 was 3,487,100, and consists chiefly of Great Russians, besides Bashkirs (including Meshcheryaks and Teptyars), Permyaks or Permians, Tatars, Cheremisses, Syryenians, Votyaks and Voguls. Agriculture is the general occupation; rye, oats, barley and hemp are raised in all parts, and wheat, millet, buckwheat, potatoes and flax in the south. Cattle-breeding is specially developed in the south-east among the Bashkirs, who have large numbers of horses. Mining is developing steadily though slowly. The ironworks employ nearly 200,000 hands (12,000 being in the Imperial ironworks), and their aggregate output reaches an estimated value of £6,000,000 annually. The annual production of gold is valued at nearly half a million sterling, and of platinum at approximately a quarter of a million, the output of platinum being equal to 95% of the world's total output. Coal and coke to the extent of 300,000 to 500,000 tons, salt to 300,000 tons, asbestos and other minerals are also obtained. The first place among the manufacturing industries is taken by flour-mills. The cutting of precious stones is extensively carried on throughout the villages on the eastern slope of the Ural Mountains, the chief market for them being at Ekaterinburg. An active trade, greatly favoured by the easy communication of the chief centres of the mining industry with the market of Nizhniy Novgorod on the one side and with the network of Siberian rivers on the other, is carried on in metals and metal wares, minerals, timber and wooden wares, tallow, skins, cattle, furs, corn and linseed. Large caravans descend the affluents of the Kama every spring, and reach the fairs of Laishev and Nizhniy Novgorod, or descend the Volga to Samara and Astrakhan; while Ekaterinburg is an important centre for the trade with Siberia. The fairs at Irbit, second in importance only to that of Nizhniy Novgorod, and Ivanov (in the district of Shadrinsk) are centres for supplying Siberia with groceries and manufactured wares, as also for the purchase of tea, of furs for Russia, and of corn and cattle for the mining districts. The chief commercial centres are Ekaterinburg, Irbit, Perm, Kamyshlov, Shadrinsk and Cherdyn.

Perm is more largely provided with educational institutions and primary schools than most of the governments of central Russia. Besides the ecclesiastical seminary at Perm there is a mining school at Ekaterinburg. The Perm *zemstvo* or provincial council is one of the most active in Russia in promoting the spread of education and agricultural knowledge among the peasants.

The government is intersected by a railway from Perm eastwards across the Urals, and thence southwards along their eastern slope to Ekaterinburg, Chelyabinsk (main Siberian trunk line) and Tyumen; also by a railway from Perm to Kotlas, at the head of the Northern Dvina.

History.—Remains of palaeolithic man, everywhere very scarce in Russia, have not yet been discovered in the upper basins of the Kama and Ob, with the exception, perhaps, of a single human skull found in a cavern on the Chanva (basin of Kama), together with a skull of *Ursus spelaeus*. Neolithic remains are met with in immense quantities on both Ural slopes. Still larger quantities of implements belonging to an early Finnish, or rather Ugrian, civilization are found everywhere in the basin of the Kama. Herodotus speaks of the richness of this country inhabited by the Ugrians, who kept up a brisk traffic with the Greek colony of Olbia near the mouth of the Dnieper, and with the Bosporus by way of the Sea of Azov and the Volga. The precise period at which the Ugrians left the district for the southern steppes of Russia (the *Lebedia* of Constantine Porphyrogenitus) is not known. In the 9th century, if not earlier, the Norsemen were acquainted with the country as Bjarmeland, and Byzantine annalists knew it as Permia. Nestor describes it as a territory of the Perm or Permians, a Finnish people.

The Russians penetrated into this region at an early date. In the 11th century Novgorod levied tribute from the Finnish inhabitants, and undertook the colonization of the country, which in the treaties of the 13th century is dealt with as a separate territory of Novgorod. In 1471 the Novgorod colonies in Perm were annexed to Moscow, which in the following year erected a fort to protect the Russian settlers and tradesmen against the Voguls, Ostiaks and Samoyedes. The mineral wealth of the country attracted the attention of the Moscow princes, and in the end of the 15th century Ivan III. sent two Germans to search for ores; these they succeeded in finding south of the upper Pechora. The Stroganovs in the 16th century founded the first salt- and ironworks, built forts, and colonized the Ural region. The rapidly-growing trade with Siberia gave a new impulse to the development of the country. This trade had its centres at Perm and Solikamsk, and later at Irbit.

(P. A. K.; J. T. Be.)

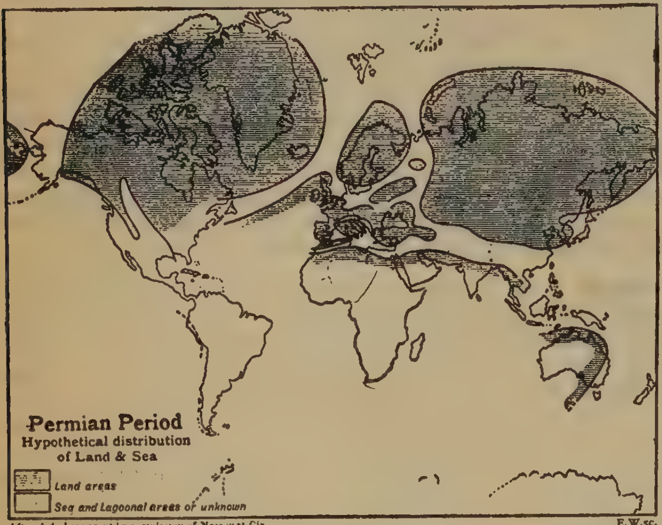
PERM, a town of Russia, capital of the government of the same name, stands on the left bank of the Kama, on the great highway to Siberia, 1130 m. by rail and river N.E. from Moscow. Pop. (1879), 32,350; (1897), 45,403. During summer it has regular steam communication with Kazan, 605 m. distant, and it is connected by rail (311 m.) with Ekaterinburg on the east side of the Urals. The town is mostly built of wood, with broad streets and wide squares, and has a somewhat poor aspect, especially when compared with Ekaterinburg. It is the seat of a bishop of the Orthodox Greek Church, and has an ecclesiastical seminary and a military school, besides several scientific institutions (the Ural society of natural sciences, archives committee, technical society), and a scientific museum. Its industries develop but slowly, the chief works being ship-building yards, tanneries, chemical works, saw-mills, brickfields, copper foundries, machinery works, soap and candle factories and rope-works. The government has a manufactory of steel guns and munitions of war in the immediate neighbourhood of the town.

The present site of Perm was occupied, as early as 1568, by a settlement named Brukhanovo, founded by one of the Stroganovs; this settlement seems to have received the name of Perm in the 17th century. A copperworks was founded in the immediate neighbourhood in 1723, and in 1781 it received officially the name of Perm, and became an administrative centre both for the country and for the mining region.

PERMEABILITY, MAGNETIC, the ratio of the magnetic induction or flux-density in any medium to the inducing magnetic force. In the C.G.S. electromagnetic system of units the permeability is regarded as a pure number, and its value in empty space is taken as unity. The permeability of a metal belonging to the ferromagnetic class—iron, nickel, cobalt and some of their alloys—is a function of the magnetic force, and also depends upon the previous magnetic history of the specimen. As the force increases from zero the permeability of a given specimen rises to a maximum, which may amount to several thousands, and then gradually falls off, tending to become unity when the force is increased without limit. Every other substance has a constant permeability, which differs from unity only by a very small fraction; if the substance is paramagnetic, its permeability is a little greater than 1; if diamagnetic, a little less. The conception of permeability (Lat. *per*, through, and *meare*, to wander), is due to Faraday, who spoke of it as "conducting power for magnetism" (*Experimental Researches*, xxvi.), and the term now in use was introduced by W. Thomson (Lord Kelvin), in 1872, having been suggested by a hydrokinetic analogy (*Reprint of Papers on Electrostatics and Magnetism*, xxxi., xlii.). It is generally of importance that the iron employed in the construction of electrical machinery should possess high permeability under the magnetic force to which it is to be subjected. (See Electromagnetism and Magnetism.)

PERMEAMETER, an instrument for rapidly measuring the permeability of a sample of iron or steel with sufficient accuracy for many commercial purposes. The name was first applied by S. P. Thompson to an apparatus devised by himself in 1890, which indicates the mechanical force required to detach one end of the sample, arranged as the core of a straight electromagnet, from an iron yoke of special form; when this force is known, the permeability can be easily calculated. (See MAGNETISM.)

PERMIAN, in geology, the youngest and uppermost system of strata of the Palaeozoic series, situated above the Carboniferous and below the Trias. The term "Permian" (derived from the Russian province of Perm, where the rocks are extensively developed) was introduced in 1841 by Sir R. I. Murchison. In England the series of red sandstones, conglomerates, breccias and marls which overlie the Coal Measures were at one time grouped together in one great formation as the "New Red Sandstone," in contradistinction to the Old Red Sandstone below the Carboniferous: they were likewise known as the *Poikilitic series* (from Gr. ποικίλος, mottled) from their mottled or variegated colour. They are now divided into two systems or groups of formations; the lower portion being included in the Palaeozoic series under the name Permian, the upper portion being relegated to the Mesozoic series and termed Trias. In Germany the name *Dyas* was proposed by J. Marcou for the rocks of this age on account of the twofold nature of the series in Thuringia, Saxony, &c. The intimate stratigraphical relationship that exists in many quarters between the Permian rocks and the Carboniferous beds, and the practical difficulties in the way of drawing a satisfactory base-line to the system, have led to the adoption of the term *Permo-carboniferous* in South Africa, southern Asia, America, Australia and Russia, for strata upon this horizon: C. W. von Gümbel used "Post-carbon" in this sense. In a similar manner *Permo-triassic* has been employed in cases where a stratigraphical passage from rocks with Permian fossils to others bearing a Triassic fauna is apparent.


Permian Period
Hypothetical distribution of Land & Sea
Land areas
Sea and Lagoonal areas or unknown

After A de Lapparent by permission of Masson et Cie E.W.sc.

The Permian system in England consists of the following subdivisions:—

		W. of England.	E. of England.
3. Upper ...	Red sandstones, clays, and gypsum	600 ft.	50–100 ft.
2. Middle ..	Magnesian limestone . . Marl slate	10–30 "	600 "
1. Lower ...	Red and variegated sandstone Reddish-brown and purple sandstones and marls, with calcareous conglomerates and breccias of volcanic rocks	3000 "	100–250 "

From the thicknesses here given it is evident that the Permian rocks have a very different development on the two sides of England. On the east side, from the coast of Northumberland southwards to the plains of the Trent, they consist chiefly of a great central mass of limestone. But on the west side of the Pennine Chain, and extending southwards into the central counties, the calcareous zone disappears, and we have a great accumulation of red, arenaceous and gravelly rocks.

The lower subdivision attains its greatest development in the vale of the Eden, where it consists of brick-red sandstones, the Penrith sandstone series, with some beds of calcareous conglomerate or breccia, locally known as "brockram," derived from the waste of the Carboniferous Limestone. These red rocks extend across the Solway into the valleys of the Nith and Annan, in the south of Scotland, where they lie unconformably on the Lower Silurian rocks. Their breccias consist of fragments of the adjacent Silurian greywackes and shales, but near Dumfries some calcareous breccias or "brockrams" occur. These brecciated masses have evidently accumulated in small lakes or narrow fiords. Much farther south, in Staffordshire, and in the districts of the Clent and Abberley Hills, the brecciated conglomerates in the Permian series attain a thickness of 400 ft. They have been shown by Sir A. C. Ramsay to consist in large measure of volcanic rocks, grits, slates and limestones, which can be identified with rocks on the borders of Wales. Some of the stones are 3 ft. in diameter and show distinct striation. The same writer pointed out that these Permian drift-beds cannot be distinguished by any essential character from modern glacial drifts; on the other hand, W. W. King and others have opposed this view.

The middle subdivision is the chief repository of fossils in the Permian system. Its strata are not red, but consist of a lower zone of hard brown shale with occasional thin limestone bands (Marl Slate) and an upper thick mass of dolomite (Magnesian Limestone). The latter is the chief feature in the Permian development of the east of England. It corresponds with the *Zechstein* of Germany, as the Marl Slate does with the *Kupfer-schiefer*. It is a very variable rock in its lithological characters, being sometimes dull, earthy, fine-grained and fossiliferous, in other places quite crystalline, and composed of globular, reniform, botryoidal, or other irregular concretions of crystalline and frequently internally radiated dolomite. Though the Magnesian Limestone runs as a thick persistent zone down the east of England, it is represented on the Lancashire and Cheshire side by bright red and variegated sandstone covered by a thin group of red marls, with numerous thin courses of limestone, containing *Schizodus*, *Bakevellia* and other characteristic fossils of the Magnesian Limestone.

Concerning the rocks classed as Permian in the central counties of England there exists some doubt, for recent work tends to show that the lower parts are clearly related to the Carboniferous rocks by their fossils; while there is little evidence to warrant the exclusion of the higher beds from the Trias. Similarly in south Devon, where red sandstones and coarse breccias are well exposed, it has been found difficult to say whether the series should be regarded as Triassic or Permian, though the prevailing tendency is to retain them in the latter system.

The "Dyas" type of the system is found in enormous masses of strata flanking the Harz Mountains, and also in the Rhine provinces, Saxony, Thuringia, Bavaria and Bohemia. In general terms it may be said that in this region there is a lower sandy and conglomeratic subdivision with an upper one more calcareous; the former is known as the *Rothliegende*, the latter as the *Zechstein* group. On the south side of the Harz Mountains the following subdivisions are recognized:—

Zechstein Group.	Upper	Anhydrite, gypsum, rock-salt, dolomite, marl, fetid shale and limestone. The amorphous gypsum is the chief member of this group; the limestone is sometimes full of bitumen.
	Middle	Dolomite (*Haupt-dolomit*), crystalline granular (*Rauchwacke*), and fine powdery (*Asche*) with gypsum at bottom.
	Lower	Zechstein-limestone, an argillaceous, thin-bedded compact limestone 15 to 90 ft. thick. Kupfer-schiefer, a black bituminous copper-bearing shale, not more than 2 ft. thick, often much less, but very constant.
		Zechstein-conglomerate and calcareous sandstone.
Rothliegende Group.	Upper	Red sandstones (*Kreuznach* beds), red shales (*Monsig* beds) with sheets of melaphyre tuff, and quartz-porphyry-conglomerate (*Wadern*, *Oberhof*, *Sötern* and *Tambach* beds).
	Lower	Sandstones and glomerates (*Tholayer* beds) on black shales with poor coal seams and clay ironstones (*Lebach* and *Goldlauter* beds). Sandstones and shales with seams of coal on red and grey sandstones and shales with impure limestones (*Cusel* beds, including Manebach beds, upper, and Gehren beds, lower).

The name *Rothliegende* or *Rothtodtliegende* (red-dead-layer) was given by the miners because their ores disappeared in the red rocks below the copper-bearing Kupfer-schiefer. The Kupfer-schiefer, although so thin, has been worked in the Mansfeld district for a long period; it contains abundant remains of fish (*Palaeoniscus*, *Platysomus*) and plants (*Ullmannia*). The beds of rock-salt in the German Zechstein are of the greatest importance; at Sperenberg near Berlin it has been penetrated to a depth of 4000 ft. Associated with the salt, gypsum and anhydrite are numerous potassium and magnesium salts, including carnallite, kieserite and polyhalite, which are exploited at Stassfurt and are the only important potassium deposits known. Permian rocks of the Rothliegende type are scattered over a wide area in France, where the lower beds are usually conformable with the Coal Measures. In the upper beds occur the bituminous or "Boghead" shale of Autun. In Russia strata of this age cover an enormous area, in the Ural region, in the governments of Perm, Kasan, Kostroma, and in Armenia. The Russian Permian shows no sharp division into two series; the two types of deposit tend to be more mixed and include in addition some deposits of the more open sea. The general sequence begins with the *Artinsk* beds, sandy and marly or conglomeratic beds in close connexion with the Carboniferous, overlain by the *Kungur* limestones and dolomites; these are followed by red fresh-water sandstones, over which comes an important series of copper-bearing sandstones and conglomerates. Above this, in Kostroma, Vyatka and Kasan there is a calcareous and dolomitic series, the so-called "Russian Zechstein" with marine fossils; the uppermost beds are red marls, with few fresh-water fossils, the *Tartarian* beds.

The character of the fossils in the Permian of the Mediterranean and south-east Europe—well exemplified in the deposits of Sicily—together with their more generally calcareous nature, indicate a more open sea and more stable marine conditions than obtained farther north. This sea is traceable across south-east Russia into the middle of Asia, through Turkestan and Persia, into the Salt Range of India, where the Productus limestone may be taken as representative of the normal marine plan of Permian times. Southwards, however, of the Nerbudda River another and quite distinct continental assemblage of deposits holds the ground, viz. the lower portion of the great fresh-water Gondwāna system. The coarse *Talchir conglomerates* at the base are succeeded by the sandstones and shales of the *Karharbari group*, with numerous coal seams, and these in turn are followed by the *Damuda series* (upwards of 10,000 ft.) of similar rocks, with ironstones and very valuable coal seams. All these strata are characterized by the presence of the Glossopteris flora. A similar succession of beds has been recorded in north-west Afghanistan. In close relationship with the lower members of the Indian Gondwāna series, both as regards fossil contents and lithological characters, are the lower *Karoo beds* of South Africa (Dwyka conglomerate, Ecca shales and mudstones, Beaufort beds and Kimberley shales), also the coal-bearing beds of the Transvaal; the Permo-carboniferous rocks of Australia (including the rich coal measures of Newcastle, the Greta coal measures and marine beds, upper and lower, of New South Wales; those of Tasmania, the Bowen River beds of Queensland, and the Bacchus Marsh glacial beds of Victoria), and similar rocks in New Zealand (Maitai formation, south island; Dun Mountain limestone and Rimutaka beds of the north island) and South America. In North America Permian rocks occur in the east in Pennsylvania, West Virginia, Maryland and Ohio ("Upper Barren Measures"), and in Prince Edward Island, New Brunswick, where they succeed the Carboniferous rocks very regularly. West of the Mississippi, in Texas (7000 ft., including the Wichita beds, Clear Fork and Double Mountain beds), Kansas and Nebraska, the Permian is more extensive and on the whole is more readily separable from the Carboniferous. Here the lower beds are marine and contain many limestones and dolomites; the higher beds are mainly red sandstones and marls with gypsum; in Texas it is of interest to note the occurrence of copper-stained strata. These upper "Red Beds" are often not clearly distinguishable from the Trias.

Life of the Permian Period.—The records of the plants and animals of this period are comparatively meagre. The plants show that a gradual change from the Carboniferous types was in progress. Two floral regions are clearly indicated, a northern and a southern. In the latter, which may be regarded as conterminous with the continent of Gondwāna, the Lepidodendrons, Sigillarias, Calamites, &c., of the Coal Measures gave place to a distinct flora, named from the prevalence of *Glossopteris*, the Glossopteris (tongue-fern) flora. Traces of this southern flora have been found in northern Russia. *Gangamopteris*, *Callipteris*, *Taeniopteris*, *Schizopteris*, *Walchia*, *Voltzia*, *Ullmannia*, *Saportea*, *Baiera* are characteristic Permian genera. Among the larger animals amphibians occupied a prominent position, their footprints being very common in the sandstones; they include numerous Labyrinthodonts, *Archegosaurus*, *Stereorachis*, *Branchiosaurus*. At this time the true reptiles began to leave their remains in the rocks; many highly interesting forms are known—*Palaeohatteria*, *Proterosaurus*, *Stereosternum*; others having certain mammalian characteristics include *Pareiosaurus*, *Cynognathus*, *Dicynodon*. Among the fishes may be mentioned *Platysomus*, *Palaeoniscus*, *Amblypterus*, *Pleuracanthus*. Turning to the invertebrates, undoubtedly the most interesting feature is gradual introduction into the Cephalopoda of the ammonite-like forms such as *Medlicottia*, *Waagenoceras*, *Popanoceras*, in place of the more simple lobed goniatites of the Carboniferous. Brachiopods (*Productus horridus*, *Bakevellia tumida*), Bryozoa and corals were by no means scarce in the more open Permian seas. *Schizodus Schlotheimii*, *Strophalosia Goldfussi*, *Myophoria*, *Leimyalind*, *Bellerophon* are characteristic Permian molluscs. The last of the trilobites appears in the Permian of North America.

The evidence so far obtained indicates that in Permian times much of the land in the northern hemisphere was near the general sea-level, and that conditions of considerable aridity prevailed which involved the repeated isolation and evaporation of marine lagoons and land-locked seas. South of this region in Europe and Asia there extended an open "Mediterranean" sea, the "Tethys" of E. Suess; while over an enormous area in the southern hemisphere a great land area was spread, "Gondwāna land," the land of the Glossopteris flora. At many points in this vast tract, as we have seen, coarse conglomeratic deposits, Talchir, Dwyka, Bacchus Marsh, &c., indicate profound glacial conditions, which some have thought were present also in Britain, Germany and elsewhere in the north. Moderate earth movements were taking place in North America, where the Appalachian and Ouachita mountains were in course of elevation, and in Europe this was a time of great volcanic activity. In the Saal region volcanic rocks in the lower Rothliegende have been penetrated for 1100 ft. without reaching the bottom, and elsewhere in central Europe great sheets of contemporaneous quartz porphyry, granite porphyry, melaphyre and porphyrite are abundant with their corresponding tuffs. Melaphyres and tuffs appear in the Vosges, which in the south of France are enormous masses of melaphyre and quartz porphyry. Basic lavas and tuffs—diabase, pierite, olivine basalt and andesite tuffs—were erupted from many small vents in Ayrshire and the Nith basin, and basic lavas occur also in Devonshire. Volcanic rocks occur also in New Zealand, Sumatra and the Transvaal.

Table of Permian Strata, showing approximate correlations.

Stages.	Britain.	Saxony, Thuringia, Bohemia.		Basin of the Saar.		Alps.		Russia.	India.		North America.			
Thuringian	Marls and gypsum. Magnesian limestone. Marl slate.	Salt beds of Stassfurt. Zechstein limestones. Kupfer-schiefer.		Zechstein.	Upper red sandstones, breccias and conglomerates.	Bellerophon limestone. Dolomites and shales of Neumarkt. Sandstones of Gröden.		Tartarian Marls. Cephalopod beds of Armenia. Copper-bearing sandstones in Ural region. Limestones and dolomites of Kostroma (Russian Zechstein). Kungur and Artinsk sandstones. Beds of Novaya Zemblya and Spitzbergen.	Talchir beds. Karharbari group. Damuda group. (?) Panchet group. Productus limestones. Dandote group of Salt Range. Productus limestones. Limestone of Chitichan.	Part of Lower Gondwāna equivalents in South Africa, Australasia and South America.	Red beds, Cimarron series.	Kansas. Kiger stage. Salt Fork stage.	Double Mountain beds of Texas.	Upper Barren Measures of Pennsylvania, Nova Scotia, New Brunswick.
Punjabian or Saxonian	Red sandstones, conglomerates, breccias and marls doubtfully assigned to this period. Volcanic rocks in Scotland and Devonshire.	Contemporaneous eruptive rocks.	Weissliegendes. Tambach beds. Oberhöf beds. Goldlauter beds.	Rothliegendes.	Red sandstones with eruptive rocks. The beds of Kreuznach, Wadern, Sötern, Tholey.	Verrucano.	Fusulina limestones.						Clear Fork beds.	
Artinskian (marine) or Autunian (continental)			Manebach beds. Brandschiefer beds of Wessig. Gehren beds. Braunau beds of Bohemia.	Rothliegendes.	Lebach beds. Cusel beds.	Verrucano.					Big Blue series.	Wellington beds. Marion beds. Chase stage.	Wichita beds.	

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PERNAMBUCO, a north-eastern state of Brazil, bounded N. by Ceará and Parahyba, E. by the Atlantic, S. by Alagôas and Bahia, and W. by Piauhy. Area, 49,573 sq. m.; pop. (1900), 1,178,150. It comprises a comparatively narrow coastal zone, a high inland plateau, and an intermediate zone formed by the terraces and slopes between the two. Its surface is much broken by the remains of the ancient plateau which has been worn down by erosion, leaving escarpments and ranges of flat-topped mountains, called *chapadas*, capped in places by horizontal layers of sandstone. Ranges of these *chapadas* form the boundary lines with three states—the Serras dos Irmãos and Vermelha with Piauhy, the Serra do Araripe with Ceará, and the Serra dos Cariris Velhos with Parahyba. The coastal zone is low, well-wooded and fertile. It has a hot, humid climate, relieved to some extent by the south-east trade winds. This region is locally known as the *mattas* (forests). The middle zone, called the *caatinga* or *agreste* region, has a drier climate and lighter vegetation. The inland region, called the *sertão*, is high, stony, and dry, and frequently devastated by prolonged droughts (*sêccas*). The climate is characterized by hot days and cool nights, and is considered healthy, though the daily change tends to provoke bronchial, catarrhal and inflammatory diseases. There are two clearly defined seasons, a rainy season from March to June, and a dry season for the remaining months. The rivers of the state include a number of small plateau streams flowing southward to the São Francisco River, and several large streams in the eastern part flowing eastward to the Atlantic. The former are the Moxotó, Ema, Pajehú, Terra Nova, Brigida, Bôa Vista and Pontal, and are dry channels the greater part of the year. The largest of the coastal rivers are the Goyanna, which is formed by the confluence of the Tracunhaem and Capibaribe-mirim, and drains a rich agricultural region in the north-east part of the state; the Capibaribe, which has its source in the Serra de Jacarará and flows eastward to the Atlantic at Recife with a course of nearly 300 m.; the Ipojuca, which rises in the Serra de Aldeia Velha and reaches the coast south of Recife; the Serinhaen and the Una. A large tributary of the last—the Rio Jacuhipe, forms part of the boundary line with Alagôas.

Pernambuco is chiefly agricultural, the lowlands being devoted to sugar and fruit, with coffee in some of the more elevated localities, the *agreste* region to cotton, tobacco, Indian corn, beans and stock, and the *sertão* to grazing and in some localities to cotton. Sugar, molasses, rum (*aguardente* or *cachaça*), tobacco and fruit are largely exported. Coco-nuts, cacao, bananas, mangoes and other tropical fruits are produced in profusion, but the production of foodstuffs (beans, Indian corn, mandioca, &c.) is not sufficient for local consumption. Mangabeira rubber is collected to a limited extent, and piassava fibre is an article of export. Orchids are also collected for export in the districts of Garanhuns and Timbaúba. Cotton-weaving and cigar-making are the principal manufacturing industries, after the large *engenhos* devoted to the manufacture of sugar and rum. The railways of the state are the Recife and São Francisco (77 m.), Central de Pernambuco (132 m.) and Sul de Pernambuco (120 m.) —all government properties leased to the Great Western of Brazil Railway Co., Ltd., since 1901. Besides these there are the line from Recife to Limoeiro and Timbaúba (112 m.), with an extension from Timbaúba to Pilar (24 m.). All these lines concentrate at the port of Recife. The capital of the state is Recife, commonly known among foreigners as Pernambuco. There are a number of large towns in the state, but the census returns include their populations in those of the *municipios* (communes) to which they belong. The most important are: Bezerros (17,484), Bom Jardim (40,160), Brejo da Madre de Deus (13,655), a town of the higher *agreste* region, Cabo (13,337), Caruarú (17,844), Escada (9331), Garanhuns (32,788, covering six towns and villages), Gloria de Goytá (24,554), Goyanna, Limoeiro (21,576), Olinda (8080), the old colonial capital and episcopal see, Rio Formosa (6080), Timbaúba (9514) and Victoria (32,422).

Pernambuco was first settled in 1526 by Christovão Jacques who founded a settlement on the Rio Iguarassú that was afterwards abandoned. The first permanent settlement was made by Duarte Coelho Pereira at Olinda in 1530, and four years later he was granted a *capitania* of 50 leagues extending from the mouth of the São Francisco northward to that of the Iguarassú. Adjacent to this grant on the north was the *capitania* of Itamaracá, granted to Pero Lopes de Souza, which covered the remainder of the present state. The *capitania* of Pernambuco was ably governed and took an active part in the expulsion of the French from the trading posts established along the coast northward to Maranhão, and in establishing Portuguese colonies in their places. In 1630 Pernambuco was occupied by the Dutch and continued under their rule until 1654. Although an active guerrilla warfare was waged against the Dutch during a large part of that period, they did much to promote the agricultural and commercial interests of the colony, especially under the wise administration of Maurice of Nassau. In 1817 Pernambuco was the scene of a revolutionary outbreak, which resulted in the separation of the present states of Alagôas and Rio Grande do Norte, Ceará and Parahyba having been detached in 1799. There was another insurrection in 1822 when the Portuguese captain-general, Luiz de Rego, and his garrison was expelled, and in 1824 dissatisfaction with the arbitrary proceedings of Dom Pedro I. at Rio de Janeiro led to a separatist revolution for the formation of a new state, to be called the Federação do Equador. There was another outbreak in 1831 and frequent disorders down to 1848, when they culminated in another unsuccessful revolution. The population of the Pernambuco *sertão* has always been noted for its turbulent, lawless character, due partly to distance from the coast where the bulk of the population is concentrated, partly to difficult means of communication, and partly to the fact that this remote region has long been the refuge of criminals from the coast towns.

PERNAU (in Russ. *Pernov* and in Esthonian *Pernolin*), a seaport and watering-place of western Russia, in the government of Livonia, 155 m. N. of Riga, on the left bank of the Pernau or Pernova, which about half a mile farther down enters the Bay of Pernau, the northern arm of the Gulf of Riga. Pop., 12,856. The harbour is usually free from ice from the end of April to the middle of December.

Founded on the right side of the river in 1255 by one of the bishops of Oesel, Pernau soon became a flourishing place. In the 16th century it was occupied in succession by the Swedes, the Poles and the Teutonic Knights. After 1599 the Poles transferred the town to the left side of the river; and in 1642 the Swedes, who had been in possession since 1617, strengthened it with regular fortifications. In 1710 it was taken by the Russians, and the fortress is now demolished.

PERNE, ANDREW (c. 1519–1589), vice-chancellor of Cambridge University and dean of Ely, born about 1591, was son of John Perne of East Bilney, Norfolk. He was educated at St John's college, Cambridge, graduating B.A. in 1539, B.D. in 1547 and D.D. in 1552. He was elected fellow of Queens' in 1540, and vice-president in 1551, and was five times vice-chancellor; but he owes his notoriety to his remarkable versatility, and, like the vicar of Bray, he was always faithful to the national religion, whatever it might be. In April 1547 he advocated Catholic doctrines, but recanted two months later, and his

Protestant faith was strengthened during Edward VI.'s reign; he was appointed a royal chaplain and canon of Windsor. Soon after Mary's accession, however, he perceived the error of his ways and was made master of Peterhouse in 1554 and dean of Ely in 1557. He preached the sermon in 1556 when the bodies of Bucer and Fagius were disinterred and burnt for heresy, and also in 1560 when these proceedings were reversed and the dead heretics were rehabilitated. In Elizabeth's reign he subscribed the Thirty-nine Articles, denounced the pope and tried to convert Abbot Feckenham to Protestantism; and in 1584 Whitgift in vain recommended him for a bishopric. He died on the 26th of April 1589. He was selected as the type of Anglican prelate by the authors of the Martin Mar-prelate tracts and other Puritans, who nicknamed him "Old Andrew Turncoat," "Andrew Ambo," "Old Father Palinode." Cambridge wits, it was said, translated "perno" by "I turn, I rat, I change often"; and a coat that had often been turned was said to have been "perned." (A. F. P.)

PÉRONNE, a town of northern France, capital of an arrondissement of the department of Somme, on the right bank of the Somme at its confluence with the Cologne, 35 m. E. by N. of Amiens by rail. Pop. (1906), 3698. The church of St Jean (1509–1525) was greatly damaged during the bombardment of 1870–71, but has since been restored. The castle of Péronne still retains four large conical-roofed towers dating from the middle ages, one of which is said to have been the prison of Louis XI. in 1468, when he was forced to agree to the "Treaty of Péronne." Péronne has a sub-prefecture, a tribunal of first instance and a communal college. Its trade and industry are of little importance.

The Frankish kings had a villa at Péronne, which Clovis II. gave to Erchinoaldus, mayor of the palace. The latter founded a monastery here, and raised in honour of St Fursy a collegiate church, which was a wealthy establishment until the Revolution; it is the burial-place of Charles the Simple, who died of starvation in a dungeon in Péronne, into which he had been thrown by the count of Vermandois (929). After the death of Philip of Alsace, Péronne, which he had inherited through his wife, escheated to the French Crown in the reign of Philip Augustus, from whom in 1209 it received a charter. By the treaty of Arras (1435) it was given to the Burgundians; bought back by Louis XI., it passed again into the hands of Charles the Bold in 1465. On the death of Charles, however, in 1477, Louis XI. resumed possession. In 1536 the emperor Charles V. besieged Péronne, but without success; in its defence a woman called Marie Fouré greatly distinguished herself. A statue of her stands in the town; and the anniversary of the raising of the siege is still celebrated annually. It was the first town after Paris at which the League was proclaimed in 1577. Péronne's greatest misfortunes occurred during the Franco-German War. It was invested on the 27th of December 1870, and bombarded from the 28th to the 9th of the following January, upon which date, on account of the sufferings of the civil population, among whom small-pox had broken out, it was compelled to capitulate.

PEROVSKITE, or PEROFSKITE, a mineral consisting of calcium titanate, $CaTiO_3$, usually with a small proportion of the calcium replaced by iron. The crystals found in schistose rocks have the form of cubes, which are sometimes modified on the edges and corners by numerous small planes; on the other hand, the crystals occurring as an accessory constituent of eruptive rocks are octahedral in form and microscopic in size. Although geometrically cubic, the crystals are always doubly refracting, and they sometimes show evidence of complex mimetic twinning; their structure as shown in polarized light is very similar to that of the mineral boracite, and they are therefore described as pseudo-cubic. There are distinct cleavages parallel to the faces of the cube. The colour varies from pale yellow to blackish-brown and the lustre is adamantine to metallic; the crystals are transparent to opaque. The index of refraction is high, the hardness 5½ and the specific gravity 4·0. The mineral was discovered at Achmatovsk near Zlatonst in the Urals by G. Rose in 1839, and named in honour of Count L. A. Perovsky; at this locality large cubes occur with calcite and magnetite in a chlorite-schist. Similar crystals are also found in talc-schist at Zermatt in Switzerland. The microscopic octahedral crystals are characteristic of melilite basalt and nepheline basalt; they have also been found in peridotite and serpentine. (L. J. S.)

PEROWNE, JOHN JAMES STEWART (1823–1904), English bishop, was born, of Huguenot ancestry, at Burdwan, Bengal, on the 13th of March 1823. He was educated at Norwich and at Corpus Christi College, Cambridge, bcoming a fellow in 1849. After holding a chair in King's College, London, he was appointed vice-principal at St David's College, Lampeter (1862–1872). In 1868 he was Hulsean lecturer, taking as his subject *Immortality.* He was elected canon of Llandaff in 1869, dean of Peterborough 1878, and in 1891 succeeded Henry Philpott as bishop of Worcester. Perowne was a good Hebrew scholar of the old type and sat on the Old Testament Revision Committee. He is best remembered as the general editor of the *Cambridge Bible for Schools and Colleges.* His chief works were a *Commentary on the Book of Psalms* (2 vols., 1864–1868) and a life of Bishop Thirlwall (1877–1878). He resigned his see in 1901, and died on the 6th of November 1904.

PĒRŌZ (*Peirozes*, Priscus, *fr.* 33; *Perozes*, Procop. *Pers.* i. 3 and Agath. iv. 27; the modern form of the name is Feroz, Firuz, cf. FIRUZABAD), Sassanid king of Persia, A.D. 457–484, son of Yazdegerd II. He rebelled against his brother Homizd III., and in 459 defeated and killed him with the help of the Ephthalites, or White Huns, who had invaded Bactria. He also killed most of his other relatives, and persecuted the Christians. But he favoured the introduction of Nestorianism, in opposition to the orthodox creed of Byzantium. With the Romans he maintained peace, but he tried to keep down the Ephthalites, who began to conquer eastern Iran. The Romans supported him with subsidies; but all his wars were disastrous. Once he was himself taken prisoner and had to give his son Kavadh as hostage till after two years he was able to pay a heavy ransom. Then he broke the treaty again and advanced with a large army. But he lost his way in the eastern desert and perished with his whole army (484). The Ephthalites invaded and plundered Persia for two years, till at last a noble Persian from the old family of Karen, Zarmihr (or Sokhra), restored some degree of order. He raised Balash, a brother of Pērōz, to the throne. (ED. M.)

PERPENDICULAR PERIOD, the term given by Thomas Rickman to the third period of Gothic architecture in England, in consequence of the great predominance of perpendicular lines. In the later examples of the Decorated period the omission of the circles in the tracery had led to the employment of curves of double curvature which developed into flamboyant tracery, and the introduction of the perpendicular lines was a reaction in the contrary direction. The mullions of the windows (which are sometimes of immense size, so as to give greater space for the stained glass) are carried up into the arch mould of the windows, and the upper portion is subdivided by additional mullions. The buttresses and wall surface are likewise divided up into vertical panels. The doorways are frequently enclosed within a square head over the arch mouldings, the spandrils being fitted with quatrefoils or tracery. Inside the church the triforium disappears, or its place is filled with panelling, and greater importance is given to the clerestory windows which constitute the finest features in the churches of this period. The mouldings are flatter and less effective than those of the earlier periods, and one of the chief characteristics is the introduction of large elliptical hollows. The finest features of this period are the magnificent timber roofs, such as those of Westminster Hall (1395), Christ Church Hall, Oxford, and Crosby Hall.

The earliest examples of the Perpendicular period, dating from 1360, are found at Gloucester, where the masons of the cathedral would seem to have been far in advance of those in other towns. Among other buildings of note are the choir and tower of York Cathedral (1389–1407); the nave and western transepts of Canterbury Cathedral (1378–1411), and the tower (towards the end of the 15th century); New College, Oxford (1380–1386); the Beauchamp Chapel, Warwick (1381–1391); the nave and aisles of Winchester Cathedral (1399–1419); the transept and tower of Merton College, Oxford (1424–1450); Manchester Cathedral (1422); the central tower of Gloucester Cathedral (1454–1457), and that of Magdalen College, Oxford (1475–1480). To those examples should be added the towers at Wrexham, Coventry, Evesham, and St Mary's at Taunton, the first being of exceptional magnificence.

PERPENT, or Parpent Stones, in architecture, bond or "through stones," the διατόνοι of the Greeks and Romans, long stones going right through walls, and tying them together from face to face. The O. Fr. *parpain*, modern *parpaing*, from which this word is derived, is obscure in origin. It may be from a supposed Lat. *perpago*, *perpaginis*, formed like *compago*, a joint, from the root of *pangere*, to fasten, and meaning "something fastened together," or from some popular corruption of Lat. *perpendiculum*, plummet or plumb-line (*pir* or *pendere*, to hang), referring to the smooth perpendicular faces of the stone.

PERPETUAL MOTION, or Perpetuum Mobile, in its usual significance, not simply a machine which will go on moving for ever, but a machine which, once set in motion, will go on doing useful work without drawing on any external source of energy, or a machine which in every complete cycle of its operation will give forth more energy than it has absorbed. Briefly, a perpetual motion usually means a machine which will create energy.

The earlier seekers after the "perpetuum mobile" did not always appreciate the exact nature of their quest; for we find among their ideals a clock that would periodically rewind itself, and thus go without human interference as long as its machinery would last. The energy created by such a machine would simply be the work done in overcoming the friction of its parts, so that its projectors might be held merely to have been ignorant of the laws of friction and of the dynamic theory of heat. Most of the perpetual motionists, however, had more practical views, and explicitly declared the object of their inventions to be the doing of useful work, such as raising water, grinding corn, and so on. Like the exact quadrature of the circle, the transmutation of metals and other famous problems of antiquity, the perpetual motion has now become a venerable paradox. Still, like these others, it retains a great historical interest. Just as some of the most interesting branches of modern pure mathematics sprang from the problem of squaring the circle, as the researches of the alchemists developed into the science of modern chemistry, so, as the result of the vain search after the perpetual motion, there grew up the greatest of all the generalizations of physical science, the principle of the conservation of energy.

There was a time when the problem of the perpetual motion was one worthy of the attention of a philosopher. Before that analysis of the action of ordinary machines which led to the laws of dynamics, and the discussion of the dynamical interdependence of natural phenomena which accompanied the establishment of the dynamical theory of heat, there was nothing plainly unreasonable in the idea that work might be done by the mere concatenation of machinery. It had not then been proved that energy is uncreatable and indestructible in the ordinary course of nature; even now that proof has only been given by induction from long observation of facts. There was a time when wise men believed that a spirit, whose maintenance would cost nothing, could by magic art be summoned from the deep to do his master's work; and it was just as reasonable to suppose that a structure of wood, brass and iron could be found to work under like conditions. The disproof is in both cases alike. No such spirit has ever existed, save in the imagination of his describer, and no such machine has ever been known to act, save in the fancy of its inventor.

The principle of the conservation of energy, which in one sense is simply denial of the possibility of a perpetual motion, rests on facts drawn from every branch of physical science; and, although its full establishment only dates from the middle of the 19th century, yet so numerous are the cases in which it has been tested, so various the deductions from it that have been proved to accord with experience, that it is now regarded as one of the best-established laws of nature. Consequently, on any one who calls it in question is thrown the burden of proving his case. If any machine were produced whose source of energy could not at once be traced, a man of science (complete freedom of investigation being supposed) would in the first place try to trace its power to some hidden source of a kind already known; or in the last resort he would seek for a source of energy of a new kind and give it a new name. Any assertion of creation of energy by means of a mere machine would have to be authenticated in many instances, and established by long investigation, before it could be received in modern science. The case is precisely as with the law of gravitation; if any apparent exception to this were observed in the case of some heavenly body, astronomers, instead of denying the law, would immediately seek to explain the occurrence by a wider application of it, say by including in their calculations the effect of some disturbing body hitherto neglected. If a man likes to indulge the notion that, after all, an exception to the law of the conservation of energy may be found, and, provided he submits his idea to the test of experiment at his own charges without annoying his neighbours, all that can be said is that he is engaged in an unpromising enterprise. The case is otherwise with the projector who comes forward with some machine which claims by the mere ingenuity of its contrivance to multiply the energy supplied to it from some of the ordinary sources of nature and sets to work to pester scientific men to examine his supposed discovery, or attempts therewith to induce the credulous to waste their money. This is by far the largest class of perpetual-motion-mongers nowadays. The interest of such cases is that attaching to the morbid anatomy of the human mind. Perhaps the most striking feature about them is the woful sameness of the symptoms of their madness. As a body perpetual-motion seekers are ambitious, lovers of the short path to wealth and fame, but wholly superficial. Their inventions are very rarely characterized even by mechanical ingenuity. Sometimes indeed the inventor has simply bewildered himself by the complexity of his device; but in most cases the machines of the perpetual motionist are of child-like simplicity, remarkable only for the extraordinary assertions of the inventor concerning them. Wealth of ideas there is none; simply assertions that such and such a machine solves the problem, although an identical contrivance has been shown to do no such thing by the brutal test of standing still in the hands of many previous inventors. Hosts of the seekers for the perpetual motion have attacked their insoluble problem with less than a schoolboy's share of the requisite knowledge; and their confidence as a rule is in proportion to their ignorance. Very often they get no further than a mere prospectus, on the strength of which they claim some imaginary reward, or offer their precious discovery for sale; sometimes they get the length of a model which wants only the last perfection (already in the inventor's brain) to solve the great problem; sometimes fraud is made to supply the motive power which their real or pretended efforts have failed to discover.

It was no doubt the barefaced fallacy of most of the plans for perpetual motion that led the majority of scientific men to conclude at a very early date that the "perpetuum mobile" was an impossibility. We find the Paris Academy of Sciences refusing, as early as 1775, to receive schemes for the perpetual motion, which they class with solutions of the duplication of the cube, the trisection of an angle and the quadrature of the circle. Stevinus and Leibnitz seem to have regarded its impossibility as axiomatic; and Newton at the beginning of his *Principia* states, so far as ordinary mechanics are concerned, a principle which virtually amounts to the same thing.

The famous proof of P. De la Hire simply refers to some of the more common gravitational perpetual motions. The truth is, as we have said already, that, if proof is to be given, or considered necessary, it must proceed by induction from all physical phenomena.

It would serve no useful purpose here to give an exhaustive historical account [1] of the vagaries of mankind in pursuit of the "perpetuum mobile." The reader may refer to Henry Dircks's *Perpetuum Mobile* (2 vols., 1861 and 1870), from which, for the most part, we select the following facts.

By far the most numerous class of perpetual motions is that which seeks to utilize the action of gravity upon rigid solids. We have not read of any actual proposal of the kind, but the most obvious thing to imagine in this way would be to procure some substance which intercepts gravitational attraction. If this could be had, then, by introducing a plate of it underneath a body while it was raised, we could elevate the body without doing work; then, removing the plate, we could allow the body to fall and do work; eccentrics or other imposing device being added to move the gravitation intercepter, behold a perpetual motion complete! The great difficulty is that no one has found the proper material for an intercepter.

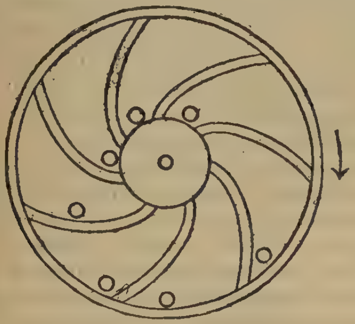
FIG. 1.

Fig. 1 represents one of the most ancient and oftenest-repeated of gravitational perpetual motions. The idea is that the balls rolling in the compartments between the felloe and the rim of the wheel will, on the whole, so comport themselves that the moment about the centre of those on the descending side exceeds the moment of those on the ascending side. Endless devices, such as curved spokes, levers with elbow-joints, eccentrics, &c., have been proposed for effecting this impossibility. The student of dynamics at once convinces himself that no machinery can effect any such result; because if we give the wheel a complete turn, so that each ball returns to its original position, the whole work done by the ball will, at the most, equal that done on it. We know that if the laws of motion be true, in each step the kinetic energy given to the whole system of wheel and balls is equal to that taken from the potential energy of the balls less what is dissipated in the form of heat by frictional forces, or vice versa, if the wheel and balls be losing kinetic energy—save that the friction in both cases leads to dissipation. So that, whatever the system may lose, it can, after it is left to itself, never gain energy during its motion.

The two most famous perpetual motions of history, viz. the wheels of the marquis of Worcester (d. 1667) and of Councillor Orffyraeus, were probably of this type. The marquis of Worcester gives the following account of his machine in his *Century of Inventions* (art. 56):—

"To provide and make that all the Weights of the descending side of a Wheel shall be perpetually further from the Centre than those of the mounting side, and yet equal in number and heft to one side as the other. A most incredible thing, if not seen but tried before the late king (of blessed memory) in the *Tower*, by my directions, two Extraordinary Embassadors accompanying His Majesty, and the Duke of *Richmond*, and Duke *Hamilton*, with most of the Court, attending him. The Wheel was 14. Foot over, and 40. Weights of 50. pounds apiece. Sir *William Balfore*, then Lieutenant of the *Tower*, can justify it, with several others. They all saw that no sooner these great Weights passed the Diameter-line of the lower side, but they hung a foot further from the Centre, nor no sooner passed the Diameter-line of the upper side but they hung a foot nearer. Be pleased to judge the consequence."

Orffyraeus (whose real name was Johann Ernst Elias Bessler) (1680–1745) also obtained distinguished patronage for his invention. His last wheel, for he appears to have constructed more than one, was 12 ft. in diameter and 1 ft. 2 in. broad; it consisted of a light framework of wood, covered in with oilcloth so that the interior was concealed, and was mounted on an axle which had no visible connexion with any external mover. It was examined and approved of by the landgrave of Hesse-Cassel, in whose castle at Weissenstein it is said to have gone for eight weeks in a sealed room. The most remarkable thing about this machine is that it evidently imposed upon the mathematician W. J. 'sGravesande, who wrote a letter to Newton giving an account of his examination of Orffyraeus's wheel undertaken at the request of the landgrave, wherein he professes himself dissatisfied with the proofs theretofore given of the impossibility of perpetual motion, and indicates his opinion that the invention of Orffyraeus is worthy of investigation. He himself, however, was not allowed to examine the interior of the wheel. The inventor seems to have destroyed it himself. One story is that he did so on account of difficulties with the landgrave's government as to a licence for it; another that he was annoyed at the examination by 'sGravesande, and wrote on the wall of the room containing the fragments of his model that he had destroyed it because of the impertinent curiosity of 'sGravesande.

The overbalancing wheel perpetual motion seems to be as old as the 13th century. Dircks quotes an account of an invention by Wilars de Honecort, an architect whose sketchbook is still preserved in the Écoles des Chartes at Paris. De Honecort says, "Many a time have skilful workmen tried to contrive a wheel that shall turn of itself; here is a way to do it by means of an uneven number of mallets, or by quicksilver." He thereupon gives a rude sketch of a wheel with mallets jointed to its circumference. It would appear from some of the manuscripts of Leonardo da Vinci that he had worked with similar notions.

Another scheme of the perpetual motionist is a water-wheel which shall feed its own mill-stream. This notion is probably as old as the first miller who experienced the difficulty of a dry season. One form is figured in the *Mathematical Magic* (1648) of Bishop Wilkins (1614–1672); the essential part of it is the water-screw of Archimedes, which appears in many of the earlier machines of this class. Some of the later ones dispense with even the subtlety of the water-screw, and boldly represent a water-wheel pumping the water upon its own buckets.

Perpetual motions founded on the hydrostatical paradox are not uncommon; Denis Papin exposes one of these in the *Philosophical Transactions* for 1685. The most naïve of these devices is that illustrated in fig. 2, the idea of which is that the larger quantity of water in the wider part of the vessel weighing more will overbalance the smaller quantity in the narrower part, so that the water will run over at C, and so on continually.

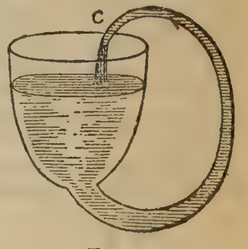

FIG. 2.

Capillary attraction has also been a favourite field for the vain quest; for, if by capillary action fluids can be made to disobey the law of never rising above their own level, what so easy as thus to produce a continual ascent and overflow, and thus perpetual motion? Various schemes of this kind, involving an endless band which should raise more water by its capillary action on one side than on the other, have been proposed. The most celebrated is that of Sir William Congreve (1772–1828). EFG (fig. 3) is an inclined plane over pulleys; at the top and bottom travels an endless band of sponge, *abcd*, and over this again an endless band of heavy weights jointed together. The whole stands over the surface of still water. The capillary action raises the water in *ab*, whereas the same thing cannot happen in the part *ad*, since the weights squeeze the water out. Hence, inch for inch, *ab* is heavier than *ad*; but we know that if *ab* were only just as heavy inch for inch as *ad* there would be equilibrium, if the heavy chain be also uniform; therefore the extra weight of *ab* will cause the chain to move round in the direction of the arrow, and this will go on continually.

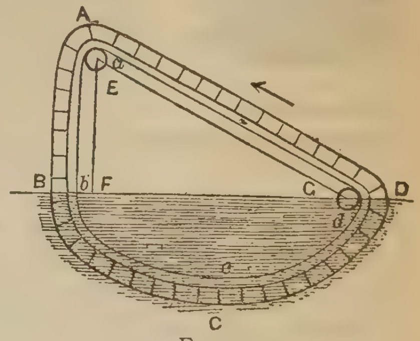

FIG. 3.

The more recondite vehicles of energy, such as electricity and magnetism, are more seldom drawn upon by perpetual-motion inventors than might perhaps be expected. William Gilbert, in his treatise *De Magnete*, alludes to some of them, and Bishop Wilkins mentions among others a machine "wherein a loadstone is so disposed that it shall draw unto it on a reclined plane a bullet of steel, which, still, as it ascends near to the loadstone, may be contrived to fall through some hole in the plane and so to return unto the place whence at first it began to move, and being there, the loadstone will again attract it upwards, till, coming to this hole, it will fall down again, and so the motion shall be perpetual." The fact that screens do exist whereby electrical and magnetic action can be cut off would seem to open a door for the perpetual-motion seeker. Unfortunately the bringing up and removing of these screens involves in all cases just that gain or loss of work which is demanded by the law of the conservation of energy. A shoemaker of Linlithgow called Spence pretended that he had found a black substance which intercepted magnetic attraction and repulsion, and he produced two machines which were moved, as he asserted, by the agency of permanent magnets, thanks to the black substance. The fraud was speedily exposed, but it is worthy of remark that Sir David Brewster thought the thing worth mentioning in a letter to the *Annales de chimie* (1818), wherein he states " that Mr Playfair and Captain Kater have inspected both of these machines and are satisfied that they resolve the problem of perpetual motion."

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[1] We may here notice, so far as more recent times are concerned, the claim of an American enthusiast, who, having worked a Hampson plant for liquefying air, stated that 3 ℔ of liquid air sufficed to liquefy ten, and of these ten seven could be employed as a source of motive power, whilst the remaining three could be utilized in the production of another 10 ℔ of the liquid gas. There was thus available an inexhaustible supply of energy! The absurdity of the proposition is obvious to any one acquainted with the laws of thermodynamics. Of more interest is the radium clock devised by the Hon. R. J. Strutt. This consists of a vacuum vessel from the top of which depends a short tube containing a fragment of a radioactive substance. At the lower end of this tube there are two gold leaves as in an electroscope. Fused into the sides of the vacuum vessel at points where the extended gold leaves touch the glass are two platinum wires, the outer ends of which are earthed. The "clock" acts as follows. The radio-active substance emits a preponderating number of positively electrified particles, so that the leaves become charged and hence extended. On contact with the wires fused into the vessel, this charge is conducted away and the leaves fall together. The process is then repeated, and will continue until all the energy of the radium has been dissipated. This period is extremely long, for 1000 years must elapse before even half the radium has disappeared.—[Ed.]

The present writer once was sent an elaborate drawing of a locomotive engine which was to be worked by the agency of permanent magnets. He forgets the details, but it was not so simple as the plan represented in fig. 4, where M and N are permanent magnets, whose attraction is "screened" by the wooden blocks A and B from the upper left and lower right quadrants of the soft iron wheel W, which consequently is attracted round in the same direction by both M and N, and thus goes on for ever.

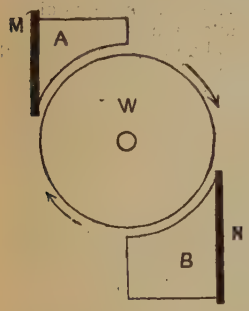

FIG. 4.

One more page from this chapter of the book of human folly; the author is the famous Jean Bernoulli the elder. We translate his Latin, as far as possible, into modern phraseology. In the first place we must premise the following (see fig. 5). (1) If there be two fluids of different densities whose densities are in the ratio of G to L, the height of equiponderating cylinders on equal bases will be in the inverse ratio of L to G. (2) Accordingly, if the height AC of one fluid, contained in the vase AD, be in this ratio to the height EF of the other liquid, which is in a tube open at both ends, the liquids so placed will remain at rest. (3) Wherefore, if AC be to EF in a greater ratio than L to G, the liquid in the tube will ascend; or if the tube be not sufficiently long the liquid will overflow at the orifice E (this follows from hydrostatic principles). (4) It is possible to have two liquids of different density that will mix. (5) It is possible to have a filter, colander, or other separator, by means of which the lighter liquid mixed with the heavier may be separated again therefrom.

Construction.—These things being presupposed (says Bernoulli), I thus construct a perpetual motion. Let there be taken in any (if you please, in equal) quantities two liquids of different densities mixed together (which may be had by hyp. 4), and let the ratio of their densities be first determined, and be the heavier to the lighter as G to L, then with the mixture let the vase AD be filled up to A. This done let the tube EF, open at both ends, be taken of such a length that $AC:EF>2L:G+L$; let the lower orifice F of this tube be stopped, or rather covered with the filter or other material separating the lighter liquid from the heavier (which may also be had by hyp. 5); now let the tube thus prepared be immersed to the bottom of the vessel CD; I say that the liquid will continually ascend through the orifice F of the tube and overflow by the orifice E upon the liquid below.

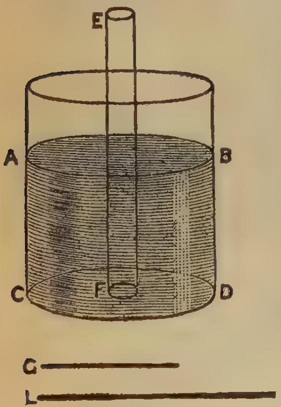

FIG. 5.

Demonstration.—Because the orifice F of the tube is covered by the filter (by constr.) which separates the lighter liquid from the heavier, it follows that, if the tube be immersed to the bottom of the vessel, the lighter liquid alone which is mixed with the heavier ought to rise through the filter into the tube, and that, too, higher than the surface of the surrounding liquid (by hyp. 2), so that $AC:EF=2L:G+L$; but since by constr. $AC:EF>2L:G+L$ it necessarily follows (by hyp. 3) that the lighter liquid will flow over by the orifice E into the vessel below, and there will meet the heavier and be again mixed with it; and it will then penetrate the filter, again ascend the tube, and be a second time driven through the upper orifice. Thus, therefore, will the flow be continued for ever.—Q.E D.

Bernoulli then proceeds to apply this theory to explain the perpetual rise of water to the mountains, and its flow in rivers to the sea, which others had falsely attributed to capillary action—his idea being that it was an effect of the different densities of salt and fresh water.

One really is at a loss with Bernoulli's wonderful theory, whether to admire most the conscientious statement of the hypothesis, the prim logic of the demonstration, so carefully cut according to the pattern of the ancients, or the weighty superstructure built on so frail a foundation. Most of our perpetual motions were clearly the result of too little learning; surely this one was the product of too much. (G. CH.)

PERPETUITY (Lat. *perpetuus*, continuous), the state of being perpetual or continuing for an indefinite time; in law the tying-up of an estate for a lengthened period, for the purpose of preventing or restricting alienation. As being opposed to the interest of the state and individual effort, the creation of perpetuities has been considerably curtailed, and the rule against perpetuities in the United Kingdom now forbids the making of an executory interest unless beginning within the period of any fixed number of existing lives and an additional period of twenty-one years (with a few months added, if necessary, for the period of gestation). The rule applies to dispositions of personal property (see ACCUMULATION) as well as of real property. There are certain exceptions to the rule, as in the case of limitations in mortmain and to charitable uses, and also in the case of a perpetuity created by act of parliament (*e.g.* the estate of Blenheim, settled on the duke of Marlborough, and Strathfieldsaye on the duke of Wellington). In the United States the English common-law rule against perpetuities obtains in many of the states; in others it has been replaced or reinforced by statutory rules (see Gray on *Alienation*, § 42). Charities may be established in perpetuity, and provision may be made for an accumulation of the funds for a reasonable time, *e.g.* for 100 years (*Woodruff* v. *Marsh*, 63 Conn. Rep. 125; 38 Amer. St. Rep. 346). The general tendency of American legislation is to favour tying up estates to a greater extent than was formerly approved.

PERPIGNAN, a town of south-western France, capital of the department of Pyrénées-Orientales, on the right bank of the Têt, 7 m. from the Mediterranean and 42 m. S. by W. of Narbonne by rail. Pop. (1906), town, 32,683; commune, 38,898. The north-west quarter of the town is traversed by the Basse, a tributary of the Têt, while to the south it is overlooked by a citadel enclosing a castle (13th century) of the kings of Majorca. The chapel is remarkable as being a mixture of the Romanesque, Pointed and Moorish styles. The ramparts surrounding the citadel are the work of Louis XI., Charles V. and Vauban. The sculptures and caryatides still to be seen on the gateway of the citadel were placed there by the duke of Alva. The cathedral of St Jean was begun in 1324 and finished in 1509. The most noteworthy feature in the building is an immense reredos of white marble (early 17th century) by Bartholomew Soler of Barcelona.

In the north of the town commanding the gateway of Notre-Dame (1481) there stands a curious machicolated stronghold known as the Castillet (14th and 15th centuries), now used as a prison. The buildings of the old university (18th century) contain the library and the museum, the latter possessing the first photographic proofs executed by Daguerre and a collection of sculptures and paintings. Statues of François Arago, the astronomer, and Hyacinthe Rigoud, the painter, stand in the squares named after them.

Perpignan is a fortified place of the first class, and seat of a prefect, a bishop and a court of assizes, and has tribunals of first instance and of commerce, a chamber of commerce, a branch of the Bank of France, a communal college for boys, a school of music and training colleges for both sexes. The higher tribunal of Andovic sits at Perpignan. Trade is in wine, iron, wool, oil, corks and leather.

Perpignan dates at least from the 10th century. In the 11th and 12th centuries it was a capital of the counts of Roussillon, from whom it passed in 1172 to the kings of Aragon. Philip the Bold, king of France, died there in 1285, as he was returning from an unsuccessful expedition into Aragon. At that time it belonged to the kingdom of Majorca, and its sovereigns resided there until, in 1344, that small state reverted to the possession of the kings of Aragon, who in 1349 founded a university at Perpignan. When Louis XI. occupied Roussillon as security for money advanced by him to the king of Aragon, Perpignan resisted the French arms for a considerable time, and only yielded through stress of famine (March 15, 1475). Roussillon was restored to Aragon by Charles VIII. and Perpignan was again besieged in 1542 under Francis I., but without success. Later on, however, the inhabitants, angered by the tyranny and cruelty of the Spanish governor, surrendered the town to Louis XIII. The citadel held out until the 9th of September 1642, and the place has ever since belonged to France, to which it was formally ceded by the treaty of the Pyrenees (1659). In 1602 the bishopric of Elne was transferred to Perpignan.

See P. Vibal, *Perpignan depuis les origines jusqu' à nos jours* (Paris, 1898).

PERQUISITE (Lat. *perquisitum*, that which has been acquired by careful search; *perquirere*, to search diligently), a term properly used of the profits which accrue to the holder of an office over and above the regular emoluments; also, in law, the casual profits, such as accrue by heriots, fines, reliefs, &c., to a lord of a manor above the yearly revenue from the copyholds. The word is used generally of the casual profits allowed by custom to servants or other employés from superfluous articles which the employer has enjoyed the use of or which are supposed not to be needed.

PERRAULT, CHARLES (1628–1703), French author, was born in Paris on the 12th of January 1628. His father, Pierre Perrault, was a barrister, all of whose four sons were men of some distinction: Claude (1613–1688), the second, was by profession a physician, but became the architect of the Louvre, and translated Vitruvius (1673). Charles was brought up at the Collège de Beauvais, until he chose to quarrel with his masters, after which he was allowed to follow his own bent in the way of study. He took his degree of *licencié en droit* at Orleans in 1651, and was almost immediately called to the Paris bar, where, however, he practised for a very short time. In 1654 his brother became receiver-general of Paris, and made Charles his clerk. After nearly ten years of this employment he was, in 1663, chosen by Colbert as his secretary to assist and advise him in matters relating to the arts and sciences, not forgetting literature. He was controller-general of the department of public works, member of the commission that afterwards developed into the *Académie des inscriptions*, and in 1671 he was admitted to the *Académie française*. Perrault justified his election in several ways. One was the orderly arrangement of the business affairs of the Academy, another was the suggestion of the custom of holding public *séances* for the reception of candidates. Colbert's death in 1683 put an end to Perrault's official career, and he then gave himself up to literature, beginning with *Saint Paulin évêque de Nole, avec une épître chrétienne sur la pénitence, et une ode aux nouveaux convertis*. The famous dispute of the ancients and moderns arose from a poem on the *Siècle de Louis le Grand* (1687), read before the Academy by Perrault, on which Boileau commented in violent terms. Perrault had ideas and a will of his own, and he published (4 vols., 1688–1696) his *Parallèle des anciens et des modernes*. The controversy that followed in its train raged hotly in France, passed thence to England, and in the days of Antoine Houdart de la Motte and Fénelon broke out again in the country of its origin. As far as Perrault is concerned he was inferior to his adversaries in learning, but decidedly superior to them in wit and politeness.

It is not known what drew Perrault to the composition of the only works of his which are still read, but the taste for fairy stories and Oriental tales at court is noticed by Mme de Sevigné in 1676, and at the end of the 17th century gave rise to the fairy stories of Mlle L'Héritier de Villaudon, whose *Bigarrures ingénieuses* appeared in 1696, of Mme d'Aulnoy and others, while Antoine Galland's translation of the *Thousand-and-One Nights* belongs to the early years of the 18th century. The first of Perrault's contes, *Grisélidis*, which is in verse, appeared in 1691, and was reprinted with *Peau d'âne* and *Les Souhaits ridicules*, also in verse, in a *Recueil de pièces curieuses*—published at the Hague in 1694. But Perrault was no poet, and the merit of these pieces is entirely obscured by that of the prose tales, *La Belle au bois dormant*, *Petit chaperon rouge*, *La Barbe bleue*, *Le Chat botté*, *Les Fées*, *Cendrillon*, *Riquet à la houppe* and *Le Petit poucet*, which appeared in a volume with 1697 on the title-page, and with the general title of *Histoires ou contes du temps passé avec des moralités*. The frontispiece contained a placard with the inscription, *Contes de ma mère l'oie*. In 1876 Paul Lacroix attributed the stories to the authorship of Perrault's son, P. Darmancour, who signed the dedication, and was then, according to Lacroix, nineteen years old. Andrew Lang has suggested that the son was a child, not a young man of nineteen, that he really wrote down the stories as he heard them, and that they were then edited by his father. This supposition would explain the mixture of naïveté and satire in the text. Perrault's other works include his *Mémoires* (in which he was assisted by his brother Claude), giving much valuable information on Colbert's ministry; an *Enéide travestie* written in collaboration with his two brothers, and *Les Hommes illustres qui ont paru en France pendant ce siècle* (2 vols., 1696–1700). He died on the 16th of May 1703, in Paris. His son, Perrault d'Arma-Court, was the author of a well-known book, *Contes des fées*, containing the story of Cinderella, &c.

Except the tales, Perrault's works have not recently been reprinted. Of these there are many modern editions, *e.g.* by Paul Lacroix (1876), and by A. Lefèbvre ("Nouvelle collection Jannet," 1875); also *Perrault's Popular Tales* (Oxford, 1888), which contains the French text edited by Andrew Lang, with an introduction, and an examination of the sources of each story. See also Hippolyte Rigault, *Hist. de la querelle des anciens et des modernes* (1856).

PERRERS (or DE WINDSOR), **ALICE** (d. 1400), mistress of the English king Edward III., belonged probably to the Hertfordshire family of Perrers, although it is also stated that she was of more humble birth. Before 1366 she had entered the service of Edward's queen, Philippa, and she appears later as the wife of Sir William de Windsor, deputy of Ireland (d. 1384). Her intimacy with the king began about 1366, and during the next few years she received from him several grants of land and gifts of jewels. Not content with the great influence which she obtained over Edward, Alice interfered in the proceedings of the courts of law to secure sentences in favour of her friends, or of those who had purchased her favour; actions which induced the parliament of 1376 to forbid all women from practising in the law courts. Alice was banished, but John of Gaunt, duke of Lancaster, allowed her to return to court after the death of Edward the Black Prince in June 1376, and the parliament of 1377 reversed the sentence against her. Again attempting to pervert the course of justice, she was tried by the peers and banished after the death of Edward III. in June 1377; but this sentence was annulled two years later, and Alice regained some influence at court. Her time, however, was mainly spent in lawsuits, one being with William of Wykeham, bishop of Winchester, and another with her dead husband's nephew and heir, John de Windsor.

PERRON, PIERRE CUILLIER (1755–1834), French military adventurer in India, whose name was originally Pierre Cuillier, was born in 1755 at Château du Loire in France, the son of a cloth merchant. In 1780 he went out to India as a sailor on a French frigate, deserted on the Malabar coast, and made his way to upper India, where he enlisted in the rana of Gohad's corps under a Scotsman named Sangster. In 1790 he took service under De Boigne, and was appointed to the command of his second brigade. In 1795 he assisted to win the battle of Kardla against the nizam of Hyderabad, and on De Boigne's retirement became commander-in-chief of Sindhia's army. At the battle of Malpura (1800) he defeated the Rajput forces. After the defeat of Ujjain (1801) he refused to send his troops to the aid of Sindhia. His treachery on this occasion shook his position, and on the outbreak of war between Sindhia and the British in 1803 Perron was superseded and fled to the British camp. In the battles of Delhi, Laswari and Assaye, Perron's battalions were completely destroyed by Lord Lake and

Sir Arthur Wellesley. He returned to France with a large fortune, and died in 1834.

See H. Compton, *European Military Adventurers of Hindustan* (1892).

PERRON (a French word meaning properly a "large stone," Ital. *petrone*, from Lat. *petra*, Fr. *pierre*, stone), in architecture, a term applied to a raised platform reached by steps in front of the entrance to a building. The grand flight of external steps entering the mansions of the medieval nobility or high officials was considered in itself a mark of jurisdiction, as it is said that sentence was there pronounced against criminals, who were afterwards executed at the foot of the steps—as at the Giant's Stairs of the Doge's palace at Venice.

PERRONE, GIOVANNI (1794–1876), Italian theologian, was born at Chieri (Piedmont) in 1794. He studied theology at Turin, and in his twenty-first year went to Rome, where he joined the Society of Jesus. In 1816 he was sent as professor of theology to Orvieto, and in 1823 was appointed to a similar post in the Collegium Romanum. From Ferrara, where he was rector of the Jesuit College after 1830, he returned to his teaching work in Rome, being made head of his old college in 1850. He took a leading part in the discussions which led up to the promulgation of the dogma of the Immaculate Conception (1854), and in 1869 was prominent on the Ultramontane side in the Vatican Council. His numerous dogmatic works are characteristic of orthodox modern Roman theology. They include *Praelectiones theologicae* (9 vols., Rome, 1835 sqq.), *Praelectiones theologicae in compendium redactae* (4 vols., Rome, 1845), *Il Hermesianismo* (Rome, 1838), *Il Protestantismo e la regola di fede* (3 vols., 1853), *De divinitate D. N. Jesu Christi* (3 vols., Turin, 1870). He died on the 26th of August 1876.

PERROT, SIR JOHN (*c.* 1527–1592), lord deputy of Ireland, was the son of Mary Berkley, who afterwards married Thomas Perrot, a Pembrokeshire gentleman. He was generally reputed to be a son of Henry VIII., and was attached to the household of William Paulet, 1st marquess of Winchester. He was in this way brought to the notice of Henry VIII., who died, however, before fulfilling his promises of advancement, but Perrot was knighted at the coronation of Edward VI. During Mary's reign he suffered a short imprisonment on the charge of harbouring his uncle, Robert Perrot, and other heretics. In spite of his Protestantism he received the castle and lordship of Carew in Pembrokeshire, and at the beginning of Elizabeth's reign he was entrusted with the naval defence of South Wales. In 1570 Perrot reluctantly accepted the newly created post of lord president of Munster. He landed at Waterford in February of the next year, and energetically set about the reduction of the province. In the course of two years he hunted down James Fitzmaurice Fitzgerald, whose submission he received in 1572. Perrot resented the reinstatement of Gerald Fitzgerald, 15th earl of Desmond, and after vainly seeking his own recall left Ireland without leave in July 1573, and presenting himself at court was allowed to resign his office, in which he was succeeded by Sir William Drury. He returned to his Welsh home, where he was fully occupied with his duties as vice-admiral of the Welsh seas and a member of the council of the marches. Although in 1578 he was accused by the deputy-admiral, Richard Vaughan, of tyranny, subversion of justice and of dealings with the pirates, he evidently retained the royal confidence, for he was made commissioner for piracy in Pembrokeshire in 1578, and in the next year was put in command of a squadron charged to intercept Spanish ships on the Irish coast.

The recall of Arthur Grey, Lord Grey de Wilton, in 1582, left vacant the office of lord deputy of Ireland, and Perrot was appointed to it early in 1584. Sir John Norris became lord president of Munster and Sir Richard Bingham went to Connaught. Perrot's chief instructions concerned the plantation of Munster, where the confiscated estates, some 600,000 acres in extent, of the earl of Desmond were to be given to English landlords at a nominal rent, provided that they brought with them English farmers and labourers. Before he had had time to embark on this enterprise he heard that the Highland clans of Maclean and MacDonnell were raiding Ulster at the invitation of Sorley Boy MacDonnell, the Scoto-Irish constable of Dunluce Castle. He marched into Ulster, but Sorley Boy escaped him, and crossed to Scotland, only to return later with reinforcements. The lord deputy was roundly abused by Elizabeth for undertaking "a rash, unadvised journey," but Sorley Boy was reduced to submission in 1586. In 1585 Perrot succeeded in completing the "composition of Connaught," a scheme for a contract between Elizabeth and the landholders of the province by which the queen should receive a small quitrent. During his career as lord deputy he had established peace, and had deserved well of Elizabeth. But a rash and violent temper, coupled with unsparing criticism, not to say abuse, of his associates, had made him numerous enemies. A hastily conceived plan for the conversion of the revenues of St Patrick's Cathedral, Dublin, to provide funds for the erection of two colleges, led to a violent quarrel with Adam Loftus, archbishop of Armagh. Perrot had interfered in Bingham's government of Connaught, and in May 1587 he actually struck Sir Nicholas Bagenal, the knight marshal, in the council chamber. Elizabeth decided to supersede him in January 1588, but it was only six months later that his successor, Sir William Fitzwilliam, arrived in Dublin. After his return to England his enemies continued to work for his ruin, and a forged letter purporting to be from him to Philip II. of Spain gave colour to an accusation of treasonable correspondence with the queen's enemies, but when he was tried before a special commission in 1592 the charge of high treason was chiefly based on his alleged contemptuous remarks about Elizabeth. He was found guilty, but died in the Tower in September 1592. Elizabeth was said to have intended his pardon.

A life of Sir John Perrot from a MS. dating from the end of Elizabeth's reign was printed in 1728. Sir James Perrot (1571–1637), writer and politician, was his illegitimate son.

PERRY, MATTHEW CALBRAITH (1794–1858), American naval officer, was born in South Kingston, Rhode Island, on the 10th of April 1794. He became a midshipman in 1809, and served successively in the schooner "Revenge" (then commanded by his brother, Oliver H. Perry) and the frigate "President." In 1813 he became a lieutenant, and during the War of 1812 served in the frigate "United States" (which, when abandoned by Perry, was blockaded in the harbour of New London, Connecticut), the "President" and the "Chippewa." Soon after the war Perry was assigned to the Brooklyn (New York) navy yard, where he served till 1819. He became a commander in 1826, and during 1826–1830 was in the recruiting service at Boston, where he took a leading part in organizing the first naval apprentice system of the United States navy. He was promoted in 1837 to the rank of captain (then the highest actual rank in the United States navy), and in 1838–1840 commanded the "Fulton II.," the first American steam war vessel. He also planned the "Missouri" and the "Mississippi," the first steam frigates of the United States navy, and was in command of the Brooklyn navy yard from June 1841 until March 1843, when he assumed command of a squadron sent to the African coast by the United States, under the Webster-Ashburton treaty, to aid in suppressing the slave trade. This command of a squadron entitled him to the honorary rank of commodore. On the 23rd of October 1846, during the Mexican War, Perry, in command of the steam vessels "Vixen" and "McLane," and four schooners, attacked and captured Frontera, at the mouth of the Tobasco river, then pushed on up the river and (on the 24th) captured the town of Tobasco, thereby cutting off Mexico from Yucatan. He relieved Commodore David Conner at Vera Cruz on the 21st of March 1847, and after a two days' bombardment by a battery landed from the ships the city wall was breached sufficiently to admit the entrance of troops.

Commodore Perry's distinctive achievement, however, was his negotiation in 1854 of the treaty between the United States and Japan, which opened Japan to the influences of western civilization. Perry sailed from Norfolk, Virginia, on the 24th of November 1852, in the "Mississippi." He reached Hong-Kong on the 7th of April and on the 8th of July dropped anchor off the city of Uraga, on the western shore of the Bay of Yedo with the "Susquehanna," his flagship, the "Mississippi," and the sloops-of-war "Saratoga" and "Plymouth." On the 14th of July, accompanied by his officers and escorted by a body of armed marines and sailors (in all about 300 men), he went ashore and presented to commissioners especially appointed by the shōgun to receive them, President Fillmore's letters to the emperor, and his own credentials. A few days later the American fleet sailed for Hong-Kong with the understanding that Perry would return in the following spring to receive the emperor's reply. On the 11th of February, accordingly, he reappeared in the Bay of Yedo with his fleet—this time composed of the "Susquehanna," "Powhatan" and "Mississippi," and the sailing vessels "Vandalia," "Lexington" and "Southampton," and despite the protests of the Japanese selected an anchorage about 12 m. farther up the bay, nearly opposite the present site of Yokohama, and within about 10 m. of Yedo (Tōkyō). Here, on the 31st of March 1854, was concluded the first treaty (ratified at Simoda, on the 21st of February 1855, and proclaimed on the 22nd of June following) between the United States and Japan. The more important articles of this treaty provided that the port of Simoda, in the principality of Idzu, and the port of Hakodate, in the principality of Matsmai, were constituted as ports for the reception of American ships, where they could buy such supplies as they needed; that Japanese vessels should assist American vessels driven ashore on the coasts of Japan, and that the crews of such vessels should be properly cared for at one of the two treaty ports; that shipwrecked and other American citizens in Japan should be as free as in other countries, within certain prescribed limits; that ships of the United States should be permitted to trade at the two treaty ports under temporary regulations prescribed by the Japanese, that American ships should use only the ports named, except under stress of weather, and that privileges granted to other nations thereafter must also be extended to the United States. Commodore Perry died in New York City on the 4th of March 1858.

A complete and readable account of this expedition, and its results, scientific as well as political, compiled from the journals and reports of Commodore Perry and his officers, was published by the United States government under the title, *Narrative of the Expedition of an American Squadron to the China Seas and Japan* (3 vols., Washington, 1856). The first volume of this work, containing Commodore Perry's narrative, was also published separately. A brief biography of Perry is included in Charles Morris's *Heroes of the Navy in America* (Philadelphia and London, 1907). See also William E. Griffis's *Matthew Calbraith Perry, a Typical American Naval Officer* (Boston, 1887).

PERRY, OLIVER HAZARD (1785–1819), American naval officer, was born at South Kingston, Rhode Island, on the 23rd of August 1785. He entered the navy as midshipman (1799) with his father, Christopher Raymond Perry (1761–1818), a captain in the navy, and saw service against the Barbary pirates. At the beginning of the War of 1812 he was in command of a flotilla at Newport, but was transferred (Feb. 1813) to the Lakes. He served with Commodore Chauncey, and then was sent from Lake Ontario to Lake Erie, where he took up the chief command at the end of March 1813. With the help of a strong detachment of officers and men from the Atlantic coast he equipped a squadron consisting of one brig, six fine schooners and one sloop. Other vessels were laid down at Presque Isle (now Erie), where he concentrated the Lake Erie fleet in July. When Captain Perry appeared off Amherstburg, where Captain Robert Heriot Barclay (d. 1837), the British commander, was lying with his squadron, he had a very marked superiority. Captain Barclay, after a hot engagement—the Battle of Lake Erie—in which Captain Perry's flagship the "Lawrence," a brig, was so severely shattered that he had to leave her, was completely defeated. Perry commanded the "Java" in the Mediterranean expedition of 1815–1816, and he died at Port of Spain in Trinidad on the 23rd of August 1819, of yellow fever contracted on the coast of Brazil.

See O. H. Lyman, *Commodore O. H. Perry and the War on the Lakes* (New York, 1905).

PERRY, a city and the county-seat of Noble county, Oklahoma, U.S.A., 30 m. N. by E. of Guthrie. Pop. (1900), 3351 (399 negroes); (1910) 3133. Perry is served by the Atchison, Topeka & Santa Fé railway and by the St Louis & San Francisco system. It is the commercial centre of a large agricultural and stock-raising region, which produces cotton and grain. Perry was settled in 1889.

PERRY (from Fr. *poiré*, from *poire*, a pear), an alcoholic beverage, obtained by the fermentation of the juice of pears. The manufacture is in all essentials identical with that of CIDER (*q.v.*).

PERRYVILLE, a town of Boyle county, Kentucky, U.S.A., about 10 m. W. of Danville. Pop. (1910), 407. Here on the 8th of October 1863 General Braxton Bragg, in command of the Confederate army of the Mississippi of about 16,000 men, with which he had invaded Kentucky, faced about in his slow retreat across the state and gave battle to the Union army of the Ohio of about 40,000 (of whom only about 22,000 were actually engaged) commanded by Major-General Don Carlos Buell. Bragg's order to attack was disregarded by Major-General Leonidas Polk, who preferred adopting the "defensive-offensive" rather than engage all of Buell's force. Bragg himself came on the field about 10 a.m. and repeated his orders for an attack, but it was 2 p.m. before there was an actual engagement. Then after much delay on Polk's part the Confederate army joined battle with McCook's corps. The Confederate lines were broken and driven back through Perryville, where caissons, ammunition wagons and 140 officers and men were captured. Darkness had now come on, and in the night Bragg withdrew. His losses were reported as 510 killed, 2635 wounded and 251 missing. The Union loss was 845 killed, 2851 wounded and 515 captured or missing. The battle was drawn tactically, but strategically it was a Union victory and it virtually closed Bragg's unsuccessful Kentucky campaign, which is sometimes called the Perryville campaign.

PERSEPOLIS, an ancient city of Persia, situated some 40 m. N.E. of Shiraz, not far from where the small river Pulwar flows into the Kur (Kyrus). The site is marked by a large terrace with its east side leaning on Kuhi Rahmet ("the Mount of Grace"). The other three sides are formed by a retaining wall, varying in height with the slope of the ground from 14 to 41 ft.; on the west side a magnificent double stair, of very easy steps, leads to the top. On this terrace are the ruins of a number of colossal buildings, all constructed of dark-grey marble from the adjacent mountain. The stones were laid without mortar, and many of them are still *in situ*. Especially striking are the huge pillars, of which a number still stand erect. Several of the buildings were never finished. F. Stolze has shown that in some cases even the mason's rubbish has not been removed.[1] These ruins, for which the name *Kizil minare* or *Chihil menare* ("the forty columns or minarets"), can be traced back to the 13th century, are now known as *Takhti Jamshid* ("the throne of Jamshid"). That they represent the Persepolis captured and partly destroyed by Alexander the Great has been beyond dispute at least since the time of Pietro della Valle.[2]

Behind Takhti Jamshid are three sepulchres hewn out of the rock in the hillside, the façades, one of which is incomplete, being richly ornamented with reliefs. About 8 m. N.N.E., on the opposite side of the Pulwar, rises a perpendicular wall of rock, in which four similar tombs are cut, at a considerable height from the bottom of the valley. The modern Persians call this place *Nakshi Rustam* ("the picture of Rustam") from the Sassanian reliefs beneath the opening, which they take to be a representation of the mythical hero Rustam. That the occupants of these seven tombs were kings might be inferred from the sculptures, and one of those at Nakshi Rustam is expressly declared in its inscription to be the tomb of Darius Hystaspis, concerning whom Ctesias relates that his grave was in the face of a rock, and could only be reached by means of an apparatus of ropes. Ctesias mentions further, with regard to a number of Persians kings, either that their remains were brought "to the Persians," or that they died there.[1] Now we know that Cyrus was buried at Pasargadae (*q.v.*) and if there is any truth in the statement that the body of Cambyses was brought home "to the Persians" his burying-place must be sought somewhere beside that of his father. In order to identify the graves of Persepolis we must bear in mind that Ctesias assumes that it was the custom for a king to prepare his own tomb during his lifetime. Hence the kings buried at Nakshi Rustam are probably, besides Darius, Xerxes I., Artaxerxes I. and Darius II. Xerxes II., who reigned for a very short time, could scarcely have obtained so splendid a monument, and still less could the usurper Sogdianus (Secydianus). The two completed graves behind Takhti Jamshid would then belong to Artaxerxes II. and Artaxerxes III. The unfinished one is perhaps that of Arses, who reigned at the longest two years, or, if not his, then that of Darius III. (Codomannus), who is one of those whose bodies are said to have been brought "to the Persians"[2] (see ARCHITECTURE, fig. 12). Another small group of ruins in the same style is found at the village of Hājjīābād, on the Pulwar, a good hour's walk above Takhti Jamshid. These formed a single building, which was still intact 900 years ago, and was used as the mosque of the then existing city of Istakhr.

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[1] Cf. J. Chardin, E. Kaempfer, C. Niebuhr and W. Ouseley. Niebuhr's drawings, though good, are, for the purposes of the architectural student, inferior to the great work of C. Texier, and still more to that of E. Flandin and P. Coste. Good sketches, chiefly after Flandin, are given by C. Kossowicz, *Inscriptiones palaeopersicae* (St Petersburg, 1872). In addition to these we have the photographic plates in F. Stolze's *Persepolis* (2 vols., Berlin, 1882).

[2] *Lettera XV*. (ed. Brighton, 1843), ii. 246 seq.

Since Cyrus was buried in Pasargadae, which moreover is mentioned in Ctesias as his own city,[3] and since, to judge from the inscriptions, the buildings of Persepolis commenced with Darius I., it was probably under this king, with whom the sceptre passed to a new branch of the royal house, that Persepolis became the capital[4] (see PERSIA: *Ancient History*, V. 2) of Persia proper. As a residence, however, for the rulers of the empire, a remote place in a difficult alpine region was far from convenient, and the real capitals were Susa, Babylon and Ecbatana. This accounts for the fact that the Greeks were not acquainted with the city until it was taken and plundered by Alexander the Great. Ctesias must certainly have known of it, and it is possible that he may have named it simply Πέρσαι, after the people, as is undoubtedly done by certain writers of a somewhat later date.[5] But whether the city really bore the name of the people and the country is another question. And it is extremely hazardous to assume, with Sir H. Rawlinson and J. Oppert, that the words *anā Pārsā*, "in this Persia," which occur in an inscription on the gateway built by Xerxes (D. l. 14), signify "in this *city* of Pārsā," and consequently prove that the name of the city is identical with the name of the country. The form Persepolis (with a play on πέρσις, destruction) appears first in Cleitarchus, one of the earliest, but unfortunately one of the most imaginative annalists of the exploits of Alexander.

It has been universally admitted that "the palaces" or "the palace" (τὰ βασίλεια) burned down by Alexander are those now in ruins at Takhti Jamshid. From Stolze's investigations it appears that at least one of these, the castle built by Xerxes, bears evident traces of having been destroyed by fire. The locality described by Diodorus after Cleitarchus corresponds in important particulars with Takhti Jamshid, for example, in being supported by the mountain on the east.[6] There is, however, one formidable difficulty. Diodorus says that the rock at the back of the palace containing the royal sepulchres is so steep that the bodies could be raised to their last resting-place only by mechanical appliances. This is not true of the graves behind Takhti Jamshid, to which, as F. Stolze expressly observes, one can easily ride up; on the other hand, it is strictly true of the graves at Nakshi Rustam. Stolze accordingly started the theory that the royal castle of Persepolis stood close by Nakshi Rustam, and has sunk in course of time to shapeless heaps of earth, under which the remains may be concealed. The vast ruins, however, of Takhti Jamshid, and the terrace constructed with so much labour, can hardly be anything else than the ruins of palaces; as for temples, the Persians had no such thing, at least in the time of Darius and Xerxes. Moreover, Persian tradition at a very remote period knew of only three architectural wonders in that region, which it attributed to the fabulous queen Humāi (Khumāi)—the grave of Cyrus at Murgab, the building at Hājjīābād, and those on the great terrace.[7] It is safest therefore to identify these last with the royal palaces destroyed by Alexander. Cleitarchus, who can scarcely have visited the place himself, with his usual recklessness of statement, confounded the tombs behind the palaces with those of Nakshi Rustam; indeed he appears to imagine that all the royal sepulchres were at the same place.

In 316 B.C. Persepolis was still the capital of Persis as a province of the great Macedonian Empire (see Diod. xix, 21 seq., 46; probably after Hieronymus of Cardia, who was living about 316). The city must have gradually declined in the course of time; but the ruins of the Achaemenidae remained as a witness to its ancient glory. It is probable that the principal town of the country, or at least of the district, was always in this neighbourhood. About A.D. 200 we find there the city Istakhr (properly *Stakhr*) as the seat of the local governors. There the foundations of the second great Persian Empire were laid, and Istakhr acquired special importance as the centre of priestly wisdom and orthodoxy. The Sassanian kings have covered the face of the rocks in this neighbourhood, and in part even the Achaemenian ruins, with their sculptures and inscriptions, and must themselves have built largely here, although never on the same scale of magnificence as their ancient predecessors. The Romans knew as little about Istakhr as the Greeks had done about Persepolis—and this in spite of the fact that for four hundred years the Sassanians maintained relations, friendly or hostile, with the empire.

At the time of the Arabian conquest Istakhr offered a desperate resistance, but the city was still a place of considerable importance in the 1st century of Islam (see CALIPHATE), although its greatness was speedily eclipsed by the new metropolis Shiraz. In the 10th century Istakhr had become an utterly insignificant place, as may be seen from the descriptions of Istakhr, a native (*c.* 950), and of Mukaddasi (*c.* 985). During the following centuries Istakhr gradually declines, until, as a *city*, it ceased to exist. This fruitful region, however, was covered with villages till the frightful devastations of the 18th century; and even now it is, comparatively speaking, well cultivated. The "castle of Istakhr" played a conspicuous part several times during the Mahommedan period as a strong fortress. It was the middlemost and the highest of the three steep crags which rise from the valley of the Kur, at some distance to the west or north-west of Nakshi Rustam. We learn from Oriental writers that one of the Buyid (Buwaihid) sultans in the 10th century of the Flight constructed the great cisterns, which may yet be seen, and have been visited, amongst others, by James Morier and E. Flandin. W. Ouseley points out that this castle was still used in the 16th century, at least as a state prison. But when Pietro della Valle was there in 1621 it was already in ruins.

[1] This statement is not made in Ctesias (or rather in the extracts of Photius) about Darius II., which is probably accidental; in the case of Sogdianus, who as a usurper was not deemed worthy of honourable burial, there is a good reason for the omission.

[2] Arrian, iii. 22, 1.

[3] Cf. also in particular Plutarch, *Artax.* iii., where Pasargadae is distinctly looked on as the sacred cradle of the dynasty.

[4] The story of Aelian (*H. A.* i. 59), who makes Cyrus build his royal palace in Persepolis, deserves no attention.

[5] So Arrian (iii. 18, 1, 10), or rather his best authority, King Ptolemy. So, again, the Babylonian Berossus, shortly after Alexander. See Clemens Alex., *Admon. ad gentes*, c. 5, where, with Georg Hoffmann (*Pers. Märtyrer*, 137), καὶ is to be inserted before Πέρσαις, and this to be understood as the name of the metropolis.

[6] The name of this mountain too, βασιλικὸν ὄρος, is identical with *Shāhkūh*, which is at least tolerably well established by W. Ouseley (ii. 417) as a synonym of *Kūhi rahmet*.

[7] See especially Hamza Isp., 38; Ṭabarī, i. 690, 816 (cf. T. Nöldeke, *Geschichte der Perser . . . aus . . . Ṭabari*, p. 8). The ruins at Takhti Jamshid are alluded to as the work of Humāi, in connexion with an event which occurred shortly after A.D. 200.

Bibliography.—E. Flandin and P. Coste, *Voyage en Perse* (1843–1847); F. Stolze, *Die Achaemenidischen und Sassanidischen Denkmäler und Inschriften von Persepolis*, &c. (1882); G. Perrot and C. Chipiez, *Histoire de l'art dans l'antiquité*, v. (1890). See also Darius; Persia: *Ancient History*; and Caliphate.

(Th. N.; A. H. S.)

PERSEUS, in Greek legend, son of Danaë and Zeus. When Perseus was grown to manhood Polydectes, king of Seriphus, cast his eye on Danaë; and, in order to rid himself of the son, exacted of him a promise that he would bring him the head of the Gorgon Medusa. The Gorgons dwelt with their sisters the Graeae (the grey women) by the great ocean, far away in the west. Guided by Hermes and Athena, Perseus came to the Graeae. They were three hags, with but one eye and one tooth between them. Perseus stole the eye and the tooth, and would not restore them till the Graeae had guided him to the Nymphs, from whom he received the winged sandals, a wallet (*κίβισις*, resembling a gamekeeper's bag) and the helmet of Hades, which rendered him invisible. Thus equipped and armed by Hermes with a sharp sword like a sickle, he came upon the Gorgons as they slept, and cut off Medusa's head, while with averted eyes he looked at her reflection which Athena showed him in the mirror of her shield. Perseus put the Gorgon's head in his wallet and fled, pursued by Medusa's sisters, to Ethiopia, where he delivered and married Andromeda (*q.v.*). With her he returned to Seriphus in time to rescue his mother and Dictys from Polydectes, whom he turned to stone with all his court by showing them the Gorgon's head. The island itself was turned to stone, and the very frogs of Seriphus (so ran the proverb) were dumb (Aelian, *Nat. anim.* iii. 37). Perseus then gave the head of Medusa to Athena, and, with Danaë and Andromeda, hastened to Argos to see his grandfather, Acrisius, once more. But before his arrival Acrisius, fearing the oracle, had fled to Larissa in Thessaly. Thither Perseus followed him, and at some funeral games held in honour of the king of that country unwittingly slew his grandfather by the throw of a quoit, which struck him on the foot. Ashamed to return to Argos, Perseus gave his kingdom to Megapenthes (Acrisius's nephew), and received from him Tiryns in exchange. There he reigned and founded Mideia and Mycenae, and became the ancestor of the Persides, amongst whom were Eurystheus and Heracles.

The legend of Perseus was localized in various places. Italy claimed that the chest containing Danaë and Perseus drifted ashore on the Italian coast (Virgil, *Aen.* vii. 372, 410). The Persian kings were said to have been descended from Perses a son of Perseus, and, according to Pausanias of Damascus,[1] he taught the Persians to worship fire, and founded the Magian priesthood. His cult was transferred to the kings of Pontus, for on coins of Amisus he is represented with the features of Mithradates Eupator. Like Andromeda, Hesione, the daughter of Laomedon, king of Troy, was rescued by Heracles from a sea-monster, and both stories have been interpreted of the sun slaying the darkness, Andromeda and Hesione being the moon, which the darkness is about to devour. In one version of the story of Hesione, Heracles is said to have spent three days, like Jonah, in the belly of the beast, and it is noteworthy that the Greek representations of Andromeda's monster were the models for Jonah's fish in early Christian art. Its bones and Andromeda's chains were shown on a rock at Joppa. Perseus appears on coins of Pontus and Cappadocia, and of Tarsus in Cilicia, which he was said to have founded. The legend of St George was influenced by the traditions current regarding Perseus in Syria and Asia Minor.

For the slaying of the Medusa, see F. H. Knatz, *Quomodo Persei fabulam artifices graeci et romani tractaverint* (1893); and, on the whole story, E. S. Hartland, *The Legend of Perseus* (1894–1896).

PERSEUS, in astronomy, a constellation of the northern hemisphere, called after the Greek legendary hero, it is mentioned by Eudoxus (4th century B.C.) and Aratus (3rd century B.C.); Ptolemy and Tycho Brahe catalogued 29 stars, Hevelius 46. The most important member of this constellation is β *Persei* or Algol (*q.v.*), a famous variable star. θ *Persei* is a triple star, composed of one 4th magnitude star and two of the 10th magnitude; ρ *Persei* is an irregular variable, with a range in magnitude of 3·4 to 4·1. *Nova Persei* is a "new" star discovered in 1887 and subsequently recognized on Harvard plates by Mrs Fleming in 1895; another new star was discovered by Anderson on the 21st of February 1901, which, after increasing in magnitude, gradually became fainter and ultimately disappeared. There is a nebula surrounding *Nova Persei* (1901) which was photographed at Yerkes observatory in September 1901; a pair of star clusters, appearing as a bright patch in the Milky Way; and the meteoric swarm named the Perseids, which appear in August and have their radiant in Perseus. (See Meteor.)

PERSEUS OF MACEDONIA (b. *c.* 212 B.C.), the last king of Macedonia, eldest son of Philip V. He had his brother Demetrius killed, and thus cleared his way to the throne in 179. War broke out with Rome in 171 B.C. when P. Licinius Crassus was sent to attack him. Perseus defeated Crassus at Callinicus in Thessaly, but in 168 he was annihilated at Pydna by L. Aemilius Paulus. He was led in triumph through Rome, and died in captivity at Alba Fucens. (See Macedonia.)

PERSHORE, a market town in the Evesham parliamentary division of Worcestershire, England, 113 m. W.N.W. of London and 7 S.E. of Worcester by the Great Western railway. Pop. (1901), 3348. The station is 1½ m. from the town. Market gardening and fruit-growing (especially plums) are carried on and agricultural implements are manufactured. The churches of the two parishes of Holy Cross and St Andrew face one another across a road. Holy Cross is a remnant of a mitred abbey of Benedictines, said to have been founded about 970 by King Edgar, on the site of a Mercian religious settlement. There remain only the fine Early English choir, with Decorated additions, the Norman south transept and the majestic Decorated tower; while slight fragments of a Norman nave are seen.

PERSIA, a kingdom of western Asia, bounded on the N. by the Caspian Sea and the Russian Transcaucasian and Transcaspian territories, on the E. by Afghanistan and Baluchistan, on the S. by the Arabian Sea and the Persian Gulf, and on the W. by Turkish territory. Long before the Christian era the satrapies of Darius comprehended roughly an immense range of territory, from the Mediterranean to the Indus and from the Caucasian chain and Jaxartes to the Persian Gulf and Arabian Ocean. In the 17th and 18th centuries A.D. the conquests of 'Abbas and Nadir kept up these boundaries more or less on the east, but failed to secure them on the west, and were limited to the Caucasus and Oxus on the north. Persia of the present day is not only, in the matter of geographical definition, far from the vast empire of Sacred Writ and remote history, but it is not even the less extensive dominion of the Safawi kings and Nadir Shah. It may be said, however, to comprise now quite as much settled and consolidated territory as at any period of its political existence of which we can speak with authority.

Western Frontier.

Boundaries.—The region of Ararat presents a good starting point for the definition of the western and northern frontiers of Persia. A line 20 m. in length from a point on the river Aras, in 39° 45′ N. and 44° 40′ E. to Mt Ararat, in the south-westerly direction, divides Persia from Russia. Southwards from Mt Ararat the Perso-Turkish frontier extends about 700 m. to the mouth of the Shatt el Arab in the Persian Gulf in 30° N. and 48° 40′ E., but is undefined with the exception of the western boundary of the little district of Kotur. A mixed commission was appointed in 1843 for the settlement of the Perso-Turkish frontier. The labours of this commission resulted in the Erzerum treaty of 1847, by which both powers abandoned some lands and agreed to appoint commissioners to define the frontier. The commissioners met in 1849, 1850 and 1851 at Bagdad and Muhamrah without arriving at any result. In 1851 Lord Palmerston proposed that the general line of frontier should be traced by the agents of Turkey and Persia at Constantinople, assisted by the commissioners, in conformity with the treaty of Erzerum, leaving doubtful localities to be settled in future. The Russian government agreed to this proposal, and the work of surveying the country from Mt Ararat to the Persian Gulf was then undertaken. When this was done the preparation of a map, embracing territory 700 m. in length by 20 to 40 m. broad, was put in hand, and this work lasted from November 1857 till March 1865, when the Porte was informed in May of that year that "in the opinion of the mediating Powers, the future line of boundary between the respective dominions of the sultan and the shah was to be found within the limits traced on the map; that the two Mahommedan governments should themselves mark out the line; and that in the event of any differences arising between them in regard to any particular locality, the points in dispute should be referred to the decision of the governments of England and Russia." This boundary has remained unsettled, and disputes have frequently arisen between the Turkish and Persian governments with regard to their respective claims to land (Hertslet, *Persian Treaties*). In the autumn of 1907 Turkish troops occupied not only "doubtful localities" but also adjoining lands which were indisputably Persian territory. The want of a determined line of demarcation between the two countries may have political advantages, but is inconvenient to the geographer and most unfavourable to the cause of order and good government.

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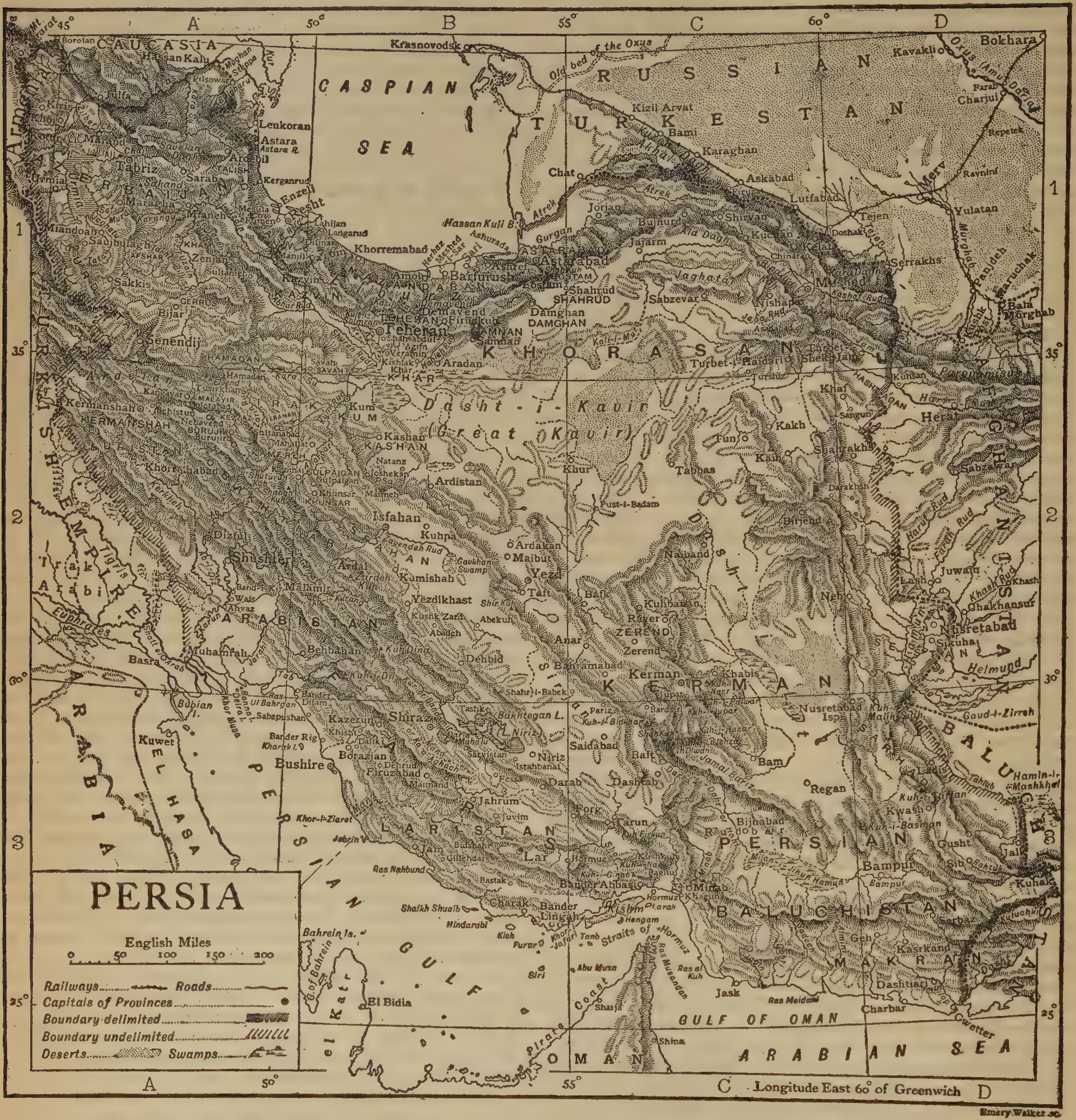
[1] Author of a history of Antioch; he is quoted by John Malalas, *Chronographia*, pp. 37–38, ed. Bonn (1831). Nothing further is known of him (see C. W. Müller, *Fragmenta historicorum graecorum*, iv. 467).


PERSIA
English Miles
0 50 100 150 200
Railways
Roads
Capitals of Provinces
Boundary delimited
Boundary undelimited
Deserts
Swamps
A
B
C
D
1
2
3
45°
50°
55°
60°
35°
30°
25°
Longitude East 60° of Greenwich
CAUCASIA
CASPIAN SEA
RUSSIAN TURKESTAN
Krasnovodsk
Old bed of the Oxus
Bokhara
Charjui
Kizil Arvat
Askabad
Merv
Lenkoran
Astara
Tabriz
Ardebil
Resht
Enzeli
Urmia
Maragha
Zenjan
Kazvin
Teheran
Demavend
Barfurush
Astarabad
Shahrud
Damghan
Semnan
Sabzevar
Meshed
Nishapur
Bujnurd
Kuchan
Serrakhs
Turbet-i-Haidari
Herat
KHORASAN
Dasht-i-Kavir (Great Kavir)
Hamadan
Kermanshah
Senendij
Sakkis
Kum
Kashan
Isfahan
Ardistan
Yezd
Tabbas
Birjend
Dizful
Shushter
Ahvaz
Basra
Kuweit
Bushire
Shiraz
Kazerun
Niriz
Darab
Lar
Bander Abbasi
Kerman
Bam
Regan
Bampur
Jask
Gwetter
Charbar
KERMAN
LARISTAN
ARABISTAN
TURKISH EMPIRE
'Irak Arabi
ARABIA
EL HASA
PERSIAN GULF
Straits of Hormuz
GULF OF OMAN
ARABIAN SEA
OMAN
BALUCHISTAN
PERSIAN BALUCHISTAN
MAKRAN
Seistan
Nasratabad
Helmund
Gaud-i-Zirreh
Bahrein Is.
El Bidia
Emery Walker sc.

Northern Frontier.

From the point on the Aras River 20 m. north-east of Mt Ararat, the river forms the northern boundary down to 48° E. The frontier line then runs about 35 m. in a south-easterly direction through the Moghan steppe to Pilsowar on the Bulgharu River and then south with a bend to the west to the Astara River and the port of Astara in 38° 27′ N. and 48° 53′ E. From Astara eastwards the boundary is formed by the shore of the Caspian until it touches the Bay of Hassan Kul north of Astarabad. East of the Caspian Sea and beginning at Hassan Kuli Bay the river Atrek serves as the frontier as far as Chat. It then extends east and south-east to Serrakhs on the Tejen River in 36° 40′ N. and 61° 20′ E. The distance from Mt Ararat to Serrakhs in a straight line is about 930 m. The frontier from Mt Ararat to Astara was defined by the treaty of Turkmanchai (Feb. 22, 1828), and a convention of the 8th of July 1893. The frontier east of the Caspian was defined by the Akhal-Khorasan Boundary Convention of the 21st of December 1881 and the frontier convention of the 8th of July 1893.

Eastern Frontier.

The eastern frontier extends from Serrakhs to near Gwetter on the Arabian Sea in 25° N. and 61° 30′ E., a distance of about 800 m. From Serrakhs to near Kuhsan the boundary is formed by the Tejen River (called Hari Rud, or river of Herat, in its upper course); it then runs almost due south to the border of Seistan in 31° N., and then through Seistan follows the line fixed by Sir Frederick Goldsmid's and Sir Henry McMahon's commissions in 1872 and 1903–1905 to Kuh i Malik Siah. From this point to the sea the frontier separates Persian territory from British Baluchistan and runs south-east to Kuhak and then south-west to Gwetter. This last section was determined by Sir Frederick Goldsmid's commission in 1871.

Southern Frontier.

The southern boundary is the coast line of the Arabian Sea and the Persian Gulf from Gwetter to the mouth of the Shatt el Arab, a distance of about 870 m., comprised between 48° 40′ E. and 61° 30′ E. The islands situated close to the northern shore of the Persian Gulf are Persian territory; they are, from east to west, Hormuz (Ormus), Larak, Kishm, Hengam, Furur, Kish (Kais), Hindarabi, Shaikh-Shu'aib, Jebrin, Kharak, Kharaku (Khorgu).

Physical Geography.—Modern Persia occupies the western and larger half of the great Iranian plateau which, rising to a height of from 4000 to 8000 ft. between the valleys of the Indus and Tigris, covers more than a million square miles. Taking the Kuren Dagh or Kopet Dagh to form the northern scarp of this plateau east of the Caspian, we find a prolongation of it in the highlands north of the political frontier on the Aras, and even in the Caucasus itself. On the north-west Persia is united by the highlands of Armenia to the mountains of Asia Minor; on the north-west the Paropamisus and Hindu Kush connect it with the Himalayas. The lines of boundary on the western and eastern faces are to be traced amid high ranges of mountains broken here and there by deserts and valleys. These ranges lie for the most part north-east and south-east, as do those in the interior, with a marked exception between Teherān and Bujnurd, and in Baluchistan, where they lie rather north-east and south-west, or, in the latter case, sometimes east and west. The real lowlands are the tracts near the sea-coast belonging to the forest-clad provinces of the Caspian in the north and the shores of the Persian Gulf below Basra and elsewhere. The Persians have no special names for the great ranges. Mountains and valleys are known only by local names which frequently cover but a few miles. Even the name Elburz, which European geographers apply to the chains and ranges that extend for a length of over 500 m. from Azerbaijan in the west to Khorasan in the east, stands with the Persians only for the 60 or 70 m. of mountains north and north-east of Teherān, including the cone of Demavend. The great central range, which extends, almost unbroken, for nearly 800 m. from Azerbaijan in the north-west to Baluchistan in the south-east, may aptly be called the *Central Range*. It has many peaks 9000 to 10,000 ft. in height, and some of its summits rise to an elevation of 11,000 ft. and near Kermān of nearly 13,000 ft. (Kuh-i-Jupar). The valleys and plains west of the Central Range, as for instance those of Mahallat, Joshekan, Isfahan, Sirjan, have an elevation of 5000 to 6500 ft.; those within the range, as Jasp, Ardahal, So, Pariz, are about 1000 ft. higher; and those east of it slope from an elevation of 5000 to 6000 ft. down to the depressions of the central plateau which, east of Kum, are not more than 2600 ft. and east of Kermān 1500 to 1700 ft. above the sea-level. Some of the ranges west of the Central Range, which form the highlands of Kurdistan, Luristan, Bakhtiari and Fars, and are parallel to it, end near the Persian Gulf; others follow the Central Range, and take a direction to the east at some point between Kermān and the sea on the western frontier of Baluchistan. Some of these western ranges rise to considerable elevations; those forming the Turko-Persian frontier west of the lake of Urmia have peaks 11,000 ft. in height, while the Sahand, east of the lake and south of Tabriz, has an elevation of 12,000 ft. Farther south, the Takht-i-Bilkis, in the Afshar district, rises to 11,200 ft., the Elvend (ancient Orontes), near Hamadan, to 11,600. The Shuturun Kuh, south of Burujird, is over 11,000 ft. in height, the Shahan Kuh, Kuh-i-Gerra, Zardeh Kuh and Kuh-i-Karan (by some writers called Kuh-i-Rang), all in the Bakhtiari country west of Isfahan, are 12,800 to 13,000 ft. in height; and the Kuh-i-Dina (by some writers wrongly called Kuh-i-Dinar) has an elevation of over 14,000 ft. Still farther south, towards Kermān, there are several peaks (Bid-Khan, Lalehzar, Shah-Kuh, Jamal Bariz, &c.) which rise to an elevation of 13,000 ft. or more, and the Kuh-i-Hazar, south of Kermān, is 14,700 ft. in height. Beginning near Ardebil in Azerbaijan, where the cone of Savelan rises to an elevation of 15,792 ft. (Russian trigonometrical survey), and ending in Khorasan, the great Elburz range presents on its southern, or inward, face a more or less abrupt scarp rising above immense gravel slopes, and reaches in some of its summits a height of nearly 13,000 ft.; and the peak of Demavend, north-west of Teherān, has a height of at least 18,000 ft. There are several important ranges in Khorasan, and one of them, the Binalud, west of Meshed and north of Nishapur, has several peaks of 11,000 to 12,000 ft. in height. In south-eastern Persia the Kuh-i-Basman, a dormant volcano, 11,000 to 12,000 ft. in height, in the Basman district, and the Kuh-i-Taftan, *i.e.* the hot or burning mountain (also called Kuh-i-Nushadar from the "sal ammoniac," *nushadar*, found on its slopes), an active triple-peaked volcano in the Sarhad district and 12,681 ft. in height (Captain Jennings), are notable features.

Rivers.

Taking the area of Persia at 628,000 sq. m. the drainage may thus be distributed: (1) into the Arabian Sea and Persian Gulf, 135,000 sq. m.; (2) into the Caspian, 100,000; (3) into the Seistan depression, 43,000; (4) into the Urmia Lake, 20,000; (5) into the interior of Persia, 330,000. The first district comprises most of the south-western provinces and the whole of the coast region as far east as Gwetter; the second relates to the tracts west, south and east of the southern part of the Caspian Sea. The tracts south of the Caspian are not more than 20 to 50 m. wide; those on the west widen out to a depth of 250 m., meeting the watershed of the Tigris on the one side and that of the Euphrates and Lake Van on the other, and embracing between the two the basin of Lake Urmia. On the east the watershed of the Caspian gradually increases in breadth, the foot of the scarp extending considerably to the north of the south-eastern angle of that sea, three degrees east of which it turns to the south-east, parallel to the axis of the Kopet Dagh. The third drainage area comprises Persian Seistan with part of the Helmund (Hilmend) basin and a considerable tract adjoining it on the west. The fourth is a comparatively small area on the western frontier containing the basin of Lake Urmia, shut off from the rest of the inland drainage, and the fifth area takes in a part of Baluchistan, most of Kermān, a part of Fars, all Yezd, Isfahan, Kashan, Kum, Irak, Khamseh, Kazvin, Teherān, Samnan, Damghan, Shahrud, Khorasan and the central desert regions.

Four rivers belonging essentially to Persia, in reference to the Caspian watershed, are the Seafid Rud or Kizil Uzain on the south-west, the Herhaz on the south and the Gurgan and Atrek at the south-eastern corner of that inland sea. The Seafid Rud rises in Persian Kurdistan in about 35° 50′ N. and 46° 45′ E., a few miles from Senendij. It has a very tortuous course of nearly 500 m., for the distance from its source to the Caspian, 57 m. east of Resht, is only 210 m. in a straight line. The Kizil Uzain takes up some important affluents and is called Seafid Rud from the point where it breaks through the Elburz to the sea, a distance of 70 m. It drains 25,000 to 30,000 sq. m. of the country. The Herhaz, though not important in length of course or drainage, also, like the Seafid Rud, breaks through the Elburz range from the inner southern scarp to the north. It rises on the slopes of the Kasil Kuh, a peak 12,000 ft. in height within the Elburz, and about 25 m. north of Teherān, flows easterly through the Lar plateau, where it is known as the Lar River, and takes up several affluents; turns to the north-east at the foot of Demavend, leaving that mountain to the left, and flows due north past Amol to the Caspian. Its length is about 120 m. The Gurgan rises on the Armutlu plateau in Khorasan east of Astarabad, and enters the Caspian in 37° 4′ N., north-west of Astarabad, after a course of about 200 m. The Atrek rises a few miles from Kuchan and enters the Caspian at the Bay of Hassan Kuli in 37° 21′ N., after a course of about 300 m. From the sea to the Russian frontier post of Chat the river forms the frontier between Persia and the Russian Transcaspian region.

The drainage of the rivers which have no outlet to the sea and form inland lakes and swamps (*kavir*) may be estimated at 350,000 sq. m., including the drainage of Lake Urmia, which is about 20,000 sq. m. Fourteen rivers flow into the lake: the Aji Chai, Safi Chai, Murdi Chai and Jaghatu from the east, the Tatau (Tatava) from the south, and nine smaller rivers from the west. During heavy rains and when the snows on the hills melt, thousands of streams flow from all directions into the innumerable depressions of inner Persia, or help to swell the perennial rivers which have no outlet to the sea. These latter are few in number, and some of them barely suffice for purposes of agricultural irrigation, and in summer dwindle down to small rills. The perennial streams which help to form the kavirs (salt swamps) east of Kum and Kashan are the Hableh-rud, rising east of Demavend, the Jajrud, rising north of Teherān, the Kend and Kerej rivers, rising north-west of Teherān, the Shureh-rud (also called Abhar-rud), rising near Sultanieh on the road between Kazvin and Tabriz, and the Kara-su, which rises near Hamadan and is joined by the Zarin-rud (also known as Do-ab), the Reza Chai (also called Mazdakan-rud), the Jehrud River and the Kum-rud. The river of Isfahan, Zendeh-rud, *i.e.* "the great river" (from Persian *zendeh* [Pehlevi, *zendek*], great), but now generally known as Zayendeh-rud, *i.e.* "the life-giving river," flows into the Gavkhani or Gavkhaneh swamp, east of Isfahan. In Fars the Kur with its affluents forms the lake of Bakhtegan (also known as Lake of Niriz), and in its lower course, is generally called Bandamir (made famous by Thomas Moore) from the band (dam) constructed by the Amir (prince) Asad-ed-dowleh in the 10th century. ("Note on the Kur River in Fars," *Proc. Royal Geog. Soc.*, London, 1891.) The rivers flowing into the Persian Gulf and Arabian Sea diminish in importance from west to east. There are first the Diyala and Kerkheh flowing into the Tigris from the hills of Kurdistan; the Ab i Diz and Karun which unite below Shushter, and reach the Shatt el Arab at Muhamrah; and the Jarahi and Tab, which with the Karun form "the delta of Persian Arabistan, the most extensive and fertile plain in Persia." There are many streams which though fordable at most seasons (some of them are often quite dry) are unfordable during the rains. Two of these may be mentioned here, viz. the Mand and the Minab, which St John (*loc. cit.* p. 9) considered as being "of far more importance than the maps would lead the observer to suppose." The former, after a run of over 300 m. from its sources in the hills west of Shiraz, debouches at Khor-i-Ziaret about 60 m. south of Bushire. It is mentioned by the old Arab and Persian geographers as the Sitakan (in some MSS. misspelt Sakkan), and is the Sitakos of Arrian and the Sitioganus of Pliny. In its upper course it is now known as the Kara-aghach (Wych-elm) River (cf. "Notes on the River Mand in Southern Persia," *Royal Geog. Soc.*, London, December 1883). The Minab has two outlets into the Persian Gulf, one the Khor-i-Minab, a salt-water creek into which the river overflows during the rains, about 30 m. east of Bander Abbasi, the other the true Minab, at Khagun, some miles south of the creek. It rises in the hills about 100 m. north of Bander Abbasi, and has a considerable drainage. Its bed near the town of Minab (15 m. from the coast) is nearly a mile in width, and during the rains the water covers the whole bed, rendering it quite unfordable. During ordinary weather, in March 1884, the water flowing past the town was 100 yds. in width and 2 ft. deep (Preece, *Proc. Royal Geog. Soc.*, January 1885). In ordinary seasons very little water of the river runs into its original bed, being diverted into canals, &c. The creek, the Anamis of Nearchus, is navigable nearly all through the year as far as Shahbander, the custom-house, about 7 m. inland, for vessels of 20 tons burden.

Desert.

"The great desert region of Persia," writes Le Strange (*Lands of the Eastern Caliphate*, 1905), "stretches right across the high plateau of Irân going from north-west to south-east, and dividing the fertile provinces of the land into two groups; for the desert is continuous from the southern base of the Elburz mountains, that to the north overlook the Caspian, to the arid ranges of Makrân, which border the Persian Gulf. Thus it measures nearly 800 m. in length, but the breadth varies considerably; for in shape this immense area of drought is somewhat that of an hour-glass with a narrow neck, measuring only some 100 m. across, dividing Kermân from Seistân, while both north and south of this the breadth expands and in places reaches to over 200 m. At the present day the desert, as a whole, is known as the Lût or Dasht-i-Lût; the saline swamps and the dry salt area being more particularly known as the Dasht-i-Kavîr, the term Kavîr being also occasionally applied to the desert as a whole."

A three-wire telegraph line on iron posts, completed in March 1907, passes through this region, and it is the unenviable lot of some Englishmen stationed at Bam and Nusretabad Ispi (Isbidh of medieval Arab geographers) on the confines of the desert regularly to inspect and test it. Of the northerly Great Kavir Dr Tietze thought that it was composed of a complex of isolated salt swamps separated by sand-dunes, low ridges of limestone and gypsum, perhaps also by volcanic rocks (*Jahrbuch k. k. geolog. Reichsanstalt*, Vienna, 1877). Dr Sven Hedin explored the northern part of the Great Desert in 1906. (A. H.-S.)

Geology.—Persia consists of a central region covered by Quaternary deposits and bordered on the north, west and south by a raised rim composed of older rocks. These older rocks also form the isolated ranges which rise through the Quaternary deposits of the central area.

In northern Persia the rocks of the elevated rim are thrown into folds which form a curve round the southern shore of the Caspian. The mountain ranges of Khorasan show the western portion of a second curve of folding which is probably continued into the Hindu Kush. In the western rim of Persia the folds run from north-west to south-east, and in the south these folds appear to curve gradually eastward, following the trend of the coast. The folds in the central Persian chains run from north-west to south-east, parallel to those of the western border. It is seldom that the old crystalline rocks, which form the floor upon which the sedimentary strata were deposited, are exposed to view. Gneiss, granite and crystalline schist, however, are found in the Elburz and in some of the central ranges; and similar rocks form a large part of the Zagros. Some of these rocks are probably Archean, but some appear to be metamorphosed sedimentary deposits of later date. The oldest beds in which fossils have yet been found belong to the Upper Devonian. They are well developed in the Elburz range, where they attain a thickness of some 9000 to 10,000 ft., and they have been found also in some of the central ranges and in the Bakhtiari Mountains. In the Elburz range the Devonian is succeeded by a series of limestones with *Productus*. The greater part of the series belongs to the Carboniferous, but the upper beds are probably of Permian age. The limestones are followed by sandstones and shales with occasional seams of coal. The plants which have been found in these beds indicate a Rhaetic or Liassic age. The Middle and Upper Jurassic form a considerable portion of the Elburz and have yielded marine fossils belonging to several different horizons. The Cretaceous system is very widely spread in Persia. It is one of the most conspicuous formations in the Zagros and in the central ranges, and probably forms a large part of the plateau, beneath the Quaternary deposits. The most prominent member of the series is a massive limestone containing *Hippurites* and belonging to the upper division of the system. The Tertiary deposits include nummulitic limestone (Eocene); a series of limestones, sandstones and conglomerates, with marine Miocene fossils; and red marls, clays and sandstones with rock-salt and gypsum, believed to belong to the Upper Miocene. In the Elburz there is a considerable deposit of palagonite tuff which appears to be of Oligocene age. The nummulitic limestone takes part in the formation of the mountain chains. The Miocene deposits generally lie at the foot of the chains, or in the valleys; but occasionally they are found at higher levels. Pliocene deposits cover a considerable area near the coast. Both in the Elburz range and near the Baluchistan frontier there are numerous recent volcanoes. Some of these seem to be extinct, but several continue to emit vapours and gases. Demavend in the Elburz and Kuh-i-Taftan on the Baluchistan frontier are among the best-known. (P. La.)

See W. K. Loftus, "On the Geology of Portions of the Turko-Persian Frontier, and of the Districts adjoining," *Quart. Journ. Geol. Soc.* vol. xi. pp. 247-344, pl. ix. (London, 1855); W. T. Blanford, *Eastern Persia*, vol. ii. (Zoology and Geology) (London, 1876); C. L. Griesbach, *Field-notes*: No. 5, to accompany a Geological Sketch Map of Afghanistan and North-Eastern Khorasan, Rec. Geol. Surv. India, xx. 93–103 (1887), with map; A. F. Stahl, "Zur Geologie von Persien," *Peterm. Mitt.*, Ergänzungsheft 122 (1897); J. de Morgan, *Mission scientifique en Perse*, vol. iii. (completed 1905, Paris). A summary by H. Douvillé of the principal geological results of de Morgan's expedition will be found in *Bull. soc. géol. France*, 4th series, vol. iv. pp. 539-553.

Climate.—For the rainfall on the watershed of the Persian Gulf there are two places of observation, Bushire and Jask; at the first it is a little in excess of that of inner Persia, while at the second it is very much less. The rainfall on the Caspian watershed greatly exceeds that of inner Persia; at Astarabad and Ashurada, in the south-eastern corner of the Caspian, it is about 50% more; and at Resht and Lenkoran, in the south-western corner, it is four and five times that of the adjoining districts across the ridges to the south. With the exception of the Caspian watershed and that of the Urmia basin, the country has probably in no part a yearly rainfall exceeding 13 or 14 in., and throughout the greater part of central and south-eastern Persia the yearly rainfall probably does not exceed 6 in. The following mean values of the rainfall at Teherān have been derived from observations taken by the writer during 1892–1907:—

	Jan.	Feb.	Mar.	April.	May.	June.	
Mean .	in. 1·76	in. 1·17	in. 1·87	in. 1·41	in. ·50	in. ·06	Total for Year. 9·86 in.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
	in. ·05	in. ·05	in. ·06	in. ·32	in. 1·35	in. 1·26	

Good harvests depend on the rainfall from October to April, and on an amount of snow sufficient to cover the crops during frosts. During normal winters in Teherān and surrounding districts the rainfall amounts to 9 or 10 in., with 3 to 4 of snow, but in the winter 1898–1899 it was only 5½ in., with only 1 in. of snow; and in 1899–1900 the harvests were in consequence exceptionally bad, and large quantities of wheat and flour had to be brought from the provinces and even from Russia at high freights, causing the price of bread at Teherān to rise 200%. The first table on p. 191 shows the mean annual rainfall in inches at fifteen stations in and near Persia.

The prevailing winds throughout Persia and the Persian Gulf are the north-west and south-east owing partly to the position of the Black Sea and Mediterranean and of the Arabian Sea, and partly to the bearing of the axes of the great mountain chains. A dry and warm wind comes down from the snowy Elburz to Gilan in December and January, and much resembles the föhn of the Alps (Dr Tholozan, "Sur les vents du Nord de la Perse et sur le foehn du Guilan," *Comptes rendus*, Acad. d. Sciences, March 1882).

Station.	Lat. N.	Long. E.	Altitude.	Period of Observations.	Year.	Authority.
			Feet.	Years.		
Lenkoran .	38° 46′	48° 51′	−60	28¼	46·82	Supan.[1]
Resht . .	37° 17′	49° 35′	−50	2	56·45	British Consul.[2]
Ashurada .	36° 54′	53° 55′	−80	19	17·17	Supan.[1]
Astarabad .	36° 51′	54° 25′	−40	7	16·28	Symons.[3]
Meshed . .	36° 17′	59° 36′	3180	9	9·33	British Consul.[4]
Quetta . .	30° 11′	67° 3′	5500	19	10·09	Supan.[1]
Kalat. . .	28° 53′	66° 28′	6500	15	8·98	,,
Maskat . .	23° 29′	58° 33′	—	3	6·13	,,
Jask . . .	25° 39′	57° 46′	—	10	3·24	English Telegraph.[5]
Bushire . .	28° 59′	50° 49′	—	19	13·36	Supan.[1]
Isfahan . .	32° 37′	51° 40′	5370	7	5·44	English Telegraph.[5]
Teherān .	35° 41′	51° 25′	3810	15	9·86	The writer.
Urmia (Sair).	37° 28′	45° 8′	6225	1	21·51	Symons.[3]
Bagdad . .	33° 19′	44° 26′	—	7	10·59	Supan.[1]
Merv . .	37° 35′	61° 50′	700	1	6·36	Symons.[3]

Observations for temperature have been taken for many years at the stations of the Indo-European Telegraph and for a few years at the British consulate in Meshed, and the monthly and annual means shown in the following table have been derived from the indications of maximum and minimum thermometers in degrees Fahrenheit.

Station.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Highest observed.	Lowest observed.	Difference between Extremes.
Meshed . . .	32	34	49	59	68	76	78	70	67	55	48	40	56·3	91	15	76
Teherān . . .	38	38	48	51	71	81	84	81	73	64	53	43	60·4	111	3	108
Tabriz[6] . . .	17	25	39	54	63	74	79	81	73	62	48	34	54·1	99	−18	117
Kashan[7] . . .	35	36	43	60	74	83	90	85	77	68	53	42	62·2	113	9	104
Isfahan . . .	—	—	—	—	—	—	—	—	—	—	—	—	58·0	106	− 3	109
Abadeh[8] . . .	41	41	47	56	68	75	79	75	71	59	55	46	59·5	96	14	82
Dehbid[9] . . .	27	30	38	45	57	65	69	65	61	52	43	36	49·0	91	−19	110
Shiraz[10] . . .	48	47	55	63	73	80	85	81	76	67	55	49	65·0	113	21	92
Kazerun[11] . .	51	50	52	67	84	93	95	94	87	79	70	56	73·2	110	36	74
Borazjuan[12] . .	55	57	66	80	94	97	100	99	92	83	72	64	80·0	117	48	69
Bushire . . .	58	60	65	74	82	86	90	90	87	80	71	62	75·4	109	41	68

Very few hygrometrical observations have been taken, and only those of the British residency at Bushire are more or less trustworthy, and have been regularly registered for a number of years. In inner Persia the air is exceptionally dry, and in many districts polished steel may be exposed in the open during a great part of the year without becoming tarnished. Along the shores of the Caspian, particularly in Gilan and Mazandaran, and of the Persian Gulf from the mouth of the Shatt el Arab down to Bander Abbasi, the air during a great part of the year contains much moisture—dry- and wet-bulb thermometers at times indicating the same temperature—and at nights there are heavy falls of dew. In Gilan and Mazandaran the air contains much moisture up to considerable elevations and as far as 30 to 40 m. away from the sea; but along the Persian Gulf, where vegetation is very scanty, stations only a few miles away from the coast and not more than 20 or 30 ft. above the sea-level have a comparatively dry climate. Frequently when the temperature in the shade at Bushire is not more than 85° or 90°, and the great humidity of the air causes much bodily discomfort, life is almost pleasant 12 or 20 m. inland with a temperature of over 100°.

Fauna.—Mr W. T. Blanford has described with great care and minuteness the zoology of Persia. In company with Major St John, R.E., he made a large collection of the vertebrate fauna in a journey from Gwetter to Teherān in 1872. Having added to this a previous collection made by the same officer with the assistance of a native from Calcutta, he had before him the principal materials for his work. Before commencing his analysis he adverted to his predecessors in the same field, *i.e.* Gmelin (whose travels were published in 1774–1784), Olivier (1807), Pallas (1811), Ménétries (1832), Belanger (1834), Eichwald (1834–1841), Aucher Éloy (1851), Loftus, Count Keyserling, Kokschy, Chesney, the Hon. C. Murray, De Filippi (1865), Hume (1873), and Professor Strauch of St Petersburg. All of these had, more or less, contributed something to the knowledge of the subject, whether as writers or as collectors, or in both capacities, and to all the due meed of credit was assigned. Blanford divided Persia into five zoological provinces: (1) the Persian plateau, or from the Kopet Dagh southwards to nearly 28° N. lat., including all Khorasan to the Perso-Afghan border, its western limit being indicated by a long line to the north-west from near Shiraz, taking in the whole upper country to the Russian frontier and the Elburz; (2) the provinces south and south-west of the Caspian; (3) a narrow strip of wooded country south-west of the Zagros range, from the Diyala River in Turkey in Asia to Shiraz; (4) the Persian side of the Shatt-el-Arab, and Aralictan, east of the Tigris; and (5) the shores of the Persian Gulf and Baluchistan. The fauna of the Persian plateau he described as "Palaearctic, with a great prevalence of desert forms; or, perhaps more correctly, as being of the desert type with Palaearctic species in the more fertile regions." In the Caspian provinces he found the fauna, on the whole, Palaearctic also, "most of the animals being identical with those of south-eastern Europe." But some were essentially indigenous, and he observed "a singular character given to the fauna by the presence of certain Eastern forms, unknown in other parts of Persia, such as the tiger, a remarkable deer of the Indo-Malayan group, allied to *Cervus axis*, and a pit viper (*Halys*)." Including the oak-forests of Shiraz with the wooded slopes of the Zagros, he found in his third division that, however little known was the tract, it appeared to contain, like the second, "a Palaearctic fauna with a few peculiar species." As to Persian Mesopotamia, he considered its fauna to belong to the same Palaearctic region as Syria, but could scarcely speak with confidence on its characteristic forms. The fifth and last division, Baluchistan and the shores of the Persian Gulf, presented, however, in the animals common to the Persian highland "for the most part desert types, whilst the characteristic Palaearctic species almost entirely disappear, their place being taken by Indian or Indo-African forms." The Persian Gulf Arab, though not equal to the pure Arabian, is a very serviceable animal, and has always a value in the Indian market. Among others the wandering Turkish tribes in Fars have the credit of possessing good steeds. The Turkoman horse of Khorasan and the Atak is a large, bony and clumsy-looking quadruped, with marvellous power and endurance. Colonel C. E. Stewart stated that the Khorasan camel is celebrated for its size and strength, that it has very long hair, and bears cold and exposure far better than the ordinary Arabian or Persian camel, and that, while the ordinary Persian camel only carries a load of some 320 lb and an Indian camel one of some 400 lb, the Khorasan camel will carry from 600 to 700 lb. The best animals, he notes, are a cross between the Bactrian or two-humped and the Arabian or one-humped camel. Sheep, goats, dogs and cats are good of their kind; but not all the last are the beautiful creatures which, bearing the name of the country, have arrived at such distinction in Europe. Nor are these to be obtained, as supposed, at Angora in Asia Minor. Van or Isfahan is a more likely habitat. The cat at the first place, called by the Turks "Van kedisi," has a certain local reputation. Among the wild animals are the lion, tiger, leopard, lynx, brown bear, hyena, hog, badger, porcupine, pole-cat, weasel, marten, wolf, jackal, fox, hare, wild ass, wild sheep, wild cat, mountain-goat, gazelle and deer. The tiger is peculiar to the Caspian provinces. Lovett says they are plentiful in Astrabad; he measured two specimens, one 10 ft. 8 in., the other 8 ft. 10 in. from the tip of the nose to the end of the tail. Lynxes and bears were to be found in the same vicinity, and the wild pig was both numerous and destructive.

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[1] Dr A. Supan, "Die Vertheilung des Niederschlag's auf der festen Erdoberfläche," *Pet. Mitt.*, Suppl. 124 (1898).

[2] Consular report (Gilan, 1897).

[3] Symons's *Monthly Meteorological Mag.* (Dec. 1893).

[4] 1899–1907.

[5] Observations taken at the telegraph stations, and kindly communicated by Mr R. C. Barker, C.I.E., director of the Indo-European Telegraph Department in Persia. Those for Isfahan are during the years 1900–1907.

[6] 38° 5′ N.; 46° 18′ E.; altitude 4423 ft.
[7] 34° ,, ; 51° 27′ ,, ; ,, 3190 ,,
[8] 31° 18′ ,, ; 52° 38′ ,, ; ,, 6200 ,,
[9] 30° 37′ ,, ; 53° 10′ ,, ; ,, 8000 ,,
[10] 29° 37′ ,, ; 52° 32′ ,, ; ,, 5000 ,,
[11] 29° 37′ ,, ; 51° 43′ ,, ; ,, 2800 ,,
[12] 29° 15′ ,, ; 51° 3′ ,, ; ,, 100 ,,

According to Blanford there are about four hundred known species of birds in Persia. The game birds have admirable representatives in the pheasant, "karkavul" (*Phasianus colchicus*, L.); snowcock or royal partridge, "kebk-i-dari" (*Tetraogallus Caspius*, Gmel.); black partridge, "durraj" (*Francolinus vulgaris*, Steph.); red-legged partridge, "kebk" (*Caccabis chukar*, Gray); sand-partridge or seesee, "tihu" (*Ammoperdix bonhami*, Gray); Indian grey partridge, "jirufti" (*Ortygornis ponticerianus*, Gmel.); quail, "belderjin" (*Coturnix communis*, Bonn.); sandgrouse, "siyah-sineh" (*Pterocles arenarius*, Pall.); bustard, "hubareh" (*Otis tetrax*, *L.* and *O. McQueenii*, Gray); woodcock, snipe, pigeon, many kinds of goose, duck, &c. The flamingo comes up from the south as far north as the neighbourhood of Teherān; the stork abounds. Poultry is good and plentiful. A large kind of fowl known as "Lari" (from the province Lar, in southern Persia) is said to be a descendant of fowls brought to Persia by the Portuguese in the 16th century.

The fish principally caught along the southern shore of the Caspian are the sturgeon, "sagmahi," dogfish (*Acipenser ruthenus* and *A. huso*); sheat-fish or silure, "simm," "summ" (*Silurus glanis*); salmon, "azad mahi" (*Salmo salar*); trout, "maseh" (*Salmo trutta*); carp, "kupur" (*Cyprinus ballerus* and *C. carpio*); bream, "subulu" (*Abramis brama*); pike-perch, "mahi safid" (*Perca lucioperca* or *Lucioperca sandra*). There is also a herring which frequents only the southern half of the Caspian, not passing over the shallow part of the sea which extends from Baku eastwards. As it was first observed near the mouth of the river Kur it has been named *Clupea Kurensis*. Fish are scarce in inner Persia; salmon trout and mud-trout are plentiful in some of the mountain streams. Many underground canals are frequented by carp and roach. The silure has also been observed in some streams which flow into the Urmia lake, and in Kurdistan.

Flora.—In the provinces of Gilan, Mazandaran and Astarabad on the Caspian, from the shore to an altitude of about 3000 ft. on the northern slopes of the great mountain range which separates those provinces from the highlands of Persia, the flora is similar to that of Grisebach's "mediterranean region." At higher altitudes many forms of a more northern flora appear. As we approach inner Persia the flora rapidly makes place to "steppe vegetation" in the plains, while the mediterranean flora predominates in the hills. The steppe vegetation extends in the south to the outer range of the hills which separate inner Persia from the Persian Gulf and the Indian Ocean. Beyond this outer range and along the shore of the sea the flora is that of the "Sahara region," which extends eastwards to Sind.

Generally speaking, everywhere, excepting in the northern lowlands and in a few favoured spots in the hilly districts, the vegetation is scanty. In inner Persia the hills and plains are bare of trees, and steppe and desert predominate. The date-palm thrives well as far north as Tabbas in latitude 33° 36′ and at an altitude of 2000 ft. and in the south extensive date-groves, producing excellent fruit, exist at altitudes of 2000 to 5000 ft. The olive is cultivated at Rudbar south of Resht in Gilan, and a few isolated olive-trees have been observed in central and southern Persia.

Of fruits the variety is great, and nearly all the fruits of Europe are well represented. The common, yet excellent melons, water-melons, grapes, apricots, cherries, plums, apples, are within the reach of the poorest. Less common and picked fruits are expensive, particularly so when cost of transport has to be considered; for instance, a good orange costs 2d. or 3d. in Teherān, while in Mazandaran (only 100 m. distant), whence the oranges are brought, it costs ½d. Some fruits are famous and vie in excellence with any that European orchards produce; such are the peaches of Tabriz and Meshed, the sugar melons of Kashan and Isfahan, the apples of Demavend, pears of Natanz, figs of Kermānshāh, &c. The strawberry was brought to Persia about 1859, and is much cultivated in the gardens of Teherān and neighbourhood; the raspberry was introduced at about the same time, but is not much appreciated. Currants and gooseberries are now also grown. The common vegetables also are plentiful and cheap, but only a few, such as the broad-bean, egg-plant (*Solanum melongena*), onion, carrot, beetroot, black turnip, are appreciated by the natives, who generally do not take kindly to newly-introduced varieties. The potato, although successfully cultivated in Persia since about 1780, has not yet found favour, and the same may be said of the tomato, asparagus, celery and others. Flowers are abundant, but it is only since the beginning of Nasr ed din Shah's reign (1848), when European gardeners were employed in Persia, that they were rationally cultivated. Nearly all the European garden flowers, even the rarer ones, can now be seen not only in the parks and gardens of the rich and well-to-do but in many unpretentious courtyards with only a few square yards of surface.

Population.—In 1881 the present writer estimated the population of Persia at 7,653,600; 1,963,800 urban, 3,780,000 rural and 1,909,800 wandering ("Bevölkerung der Erde," p. 28; *Ency. Brit.* 9th ed. p. 628); and, allowing for an increase of about 1% per annum the population for 1910 may be estimated at 10 millions. No statistics whatever being kept, nothing precise is known of the movement of the population. During the ninth decade of the 19th century many Persian subjects emigrated, and many Persian villages were deserted and fell to ruins; since then a small immigration has set in and new villages have been founded. Persians say that the females exceed the males by 10 to 20%, but wherever the present writer has been able to obtain trustworthy information he found the excess to be less than 2%. Of the deaths in any place the only check obtainable is from the public body-washers, but many corpses are buried without the aid of the *public* body-washers; and the population of the place not being accurately known, the number of deaths, however correct, is useless for statistical purposes. Medical men have stated that the number of deaths, in times when there are no epidemics, amounts to 19 or 20 per thousand, and the number of births to 25 to 40 per thousand.

The prices of the staple articles of food and all necessaries of life have risen considerably since 1880, and, particularly in the large cities, are now very high. As salaries and wages have not increased at the same rate, many of the upper classes and officials are not so well off as formerly. By dismissing their servants in order to reduce expenditure, they have thrown great numbers of men out of employment, while many labourers and workmen are living very poorly and often suffer want. Tradesmen are less affected, because they can sell the articles which they manufacture at values which are more in proportion with the increased prices of food. In 1880 a labourer earning 25 krans, or £1 sterling a month, could afford to keep a family; by 1908, in krans, he earned double what he did in 1880, but his wage, expressed in sterling, was the same, and wherever the prices of food have risen more than his wages he could not afford to keep a family. In many districts and cities the number of births is therefore reduced, while at the same time the mortality, in consequence of bad and often insufficient food, is considerably increased.

The description of the Persian character by C. J. Wills, in his *In the Land of the Lion and Sun* (1883), is still worth quoting:—

"The character of the Persian is that of an easy-going man with a wish to make things pleasant generally. He is hospitable, obliging, and specially well disposed to the foreigner. His home virtues are many: he is very kind and indulgent to his children and, as a son, his respect for both parents is excessive, developed in a greater degree to his father, in whose presence he will rarely sit, and whom he is in the habit of addressing and speaking of as 'master.' The full stream of his love and reverence is reserved for his mother; he never leaves her to starve, and her wishes are laws to him. The mother is always the most important member of the household, and the grandmother is treated with veneration. The presence of the mother-in-law is coveted by their sons-in-law, who look on them as the guardians of the virtue of their wives. The paternal uncle is a much nearer tie than with us; while men look on their first cousins on the father's side as their most natural wives.

"Black slaves and men-nurses or 'lallahs' are much respected; the 'dayah' or wet nurse is looked on as a second mother and usually provided for for life. Persians are very kind to their servants; a master will often be addressed by his servant as his father, and the servant will protect his master's property as he would his own. A servant is invariably spoken to as 'bacha' (child). The servants expect that their master will never allow them to be wronged. The slaves in Persia have a good time; well fed, well clothed, treated as spoiled children, given the lightest work, and often given in marriage to a favourite son or taken as 'segah' or concubine by the master himself, slaves have the certainty of a well-cared-for old age. They are looked on as confidential servants, are entrusted with large sums of money, and the conduct of the most important affairs; and seldom abuse their trust. The greatest punishment to an untrustworthy slave is to give him his liberty and let him earn his living. They vary in colour and value: the 'Habashi' or Abyssinian is the most valued; the Suhali or Somali, next in blackness, is next in price; the Bombassi, or coal-black negro of the interior, being of much less price, and usually only used as a cook. The prices of slaves in Shiraz are, a good Habashi girl of twelve to fourteen £40, a good Somali same age, half as much; while a Bombassi is to be got for £14, being chosen merely for physical strength. They are never sold, save on importation, though at times they are given away. . . . I have never seen a Persian unkind to his own horse or his slave, and when overtaken by poverty he will first sell his shirt, *then* his slave.

"In commercial morality, a Persian merchant will compare not unfavourably with the European generally. . . . To the poor, Persians are unostentatiously generous; most of the rich have regular pensioners, old servants, or poor relations who live on their bounty; and though there are no workhouses, there are in ordinary times no deaths from starvation; and charity, though not organized, is general. . . . Procrastination is the attribute of all Persians, 'to-morrow' being ever the answer to any proposition, and the 'to-morrow' means indefinite delay. A great dislike is shown generally to a written contract binding the parties to a fixed date; and, as a rule, on breaking it the Persian always appeals for and expects delay and indefinite days of grace. . . .

"Persians are clean in their persons, washing themselves and their garments frequently. The Persian always makes the best of his appearance; he is very neat in his dress, and is particular as to the sit of his hat and the cut of his coat. All Persians are fond of animals, and do not treat them badly when their own property.

"Cruelty is not a Persian vice; torture and punishments of an unusual and painful nature being part of their judicial system. There are no vindictive punishments, such as a solitary confinement, penal servitude for long terms of years, &c. Seldom, indeed, is a man imprisoned more than twelve months, the rule being that there is a general jail delivery at the New Year. Royal clemency is frequently shown, often, perhaps, with want of judgment."

Costume.—The costume of the Persians may be shortly described as fitted to their active habits. The men invariably wear an unstarched shirt of cotton, sewn with white silk, often, particularly in the south of Persia, elaborately embroidered about the neck. It fastens in front by a flap, having two small buttons or knots at the left shoulder, and seldom comes below the hips. It has no collar, and the sleeves are loose. The lower orders often have it dyed blue; but the servant and upper classes always prefer a white shirt. Silk shirts are now seldom seen on men. Among the very religious during the mourning month ("Muharram") the shirt is at times dyed black. The "zir-jamah," or trousers,[1] are of cloth among the higher classes, particularly those of the military order, who affect a garment of a tightness approaching that worn by Europeans. The ordinary "zir-jamah" are of white, blue or red cotton, very loose, and are exactly similar to the pyjamas worn by Europeans in India. They are held up by a thin cord of red or green silk or cotton round the waist, and the labouring classes, when engaged in heavy or dirty work, or when running, generally tuck the end of these garments under the cord, which leaves their legs bare and free to the middle of the thigh. The amplitude of this part of his attire enables the Persian to sit without discomfort on his heels; chairs are only used by the rich, great or Europeanized. Over the shirt and "zir-jamah" comes the "arkhalik," generally of quilted chintz or print, a closely-fitting garment, collarless, with tight sleeves to the elbow, whence, to the wrist, are a number of little metal buttons, fastened in winter, but not in summer. Above this is the "kamarchin," a tunic of coloured calico, cloth, Kashmir or Kermān shawl, silk, satin or velvet (gold embroidered, or otherwise), according to the time of the year and the purse and position of the wearer. This, like the "arkhalik," is open in front, and shows the shirt. It sometimes has a small standing collar, and is double-breasted. It has a pocket-hole on either side, giving access to the pockets, which are always in the "arkhalik," where also is the breast-pocket in which watch, money, jewels, and seals are kept. The length of the "kamarchin" denotes the class of the wearer. The military and official classes and the various servants wear it short, to the knee, while fops and sharpers wear it even shorter. Priests, merchants, villagers, especially about Shiraz, townsmen, shopkeepers, doctors and lawyers wear it very long, often nearly to the heels. Over the "kamarchin" is worn the "kulijah," or coat. This is, as a rule, cast off in summer, save on formal occasions, and is often borne by a servant, or carried over the shoulder by the owner. It is of cloth, shawl or camel-hair cloth, and is lined with silk or cloth, flannel or fur. It has, like the Turkish frockcoat, a very loose sleeve, with many plaits behind. It has lapels, as with us, and is trimmed with gold lace, shawl or fur, or is worn quite plain. It has a roll collar and false pockets.

Besides these garments there are others: the long "jubba," or cloth cloak, worn by "mirzas" (secretaries), government employés of high rank, as ministers, farmers of taxes, courtiers, physicians, priests; the "abba," or camel-hair cloak of the Arab, worn by travellers, priests and horsemen; the "pustin," or Afghan skin-cloak, used by travellers and the sick or aged; the "nimtan," or common sheepskin jacket, with short sleeves, used by shopkeepers and the lower class of servants, grooms, &c., in winter; the "yapanjah," or woollen Kurdish cloak, a kind of felt, having a shaggy side, of immense thickness, worn generally by shepherds, who use it as greatcoat, bed and bedding. There is also the felt coat of the villager, very warm and inexpensive, the cost being from 5 to 15 krans (a kran = 10d.). The "kamarband," or girdle, is also characteristic of class. It is made of muslin, shawl or cotton cloth among the priests, merchants, bazaar people, the secretary class and the more aged government employés. In it are carried, by literati and merchants, the pen-case and a roll of paper; its voluminous folds are used as pockets; by the bazaar people and villagers, porters and merchants' servants, a small sheath knife is struck in it; while by "farrashes," the carpet-spreader class, a large "khanjar," or curved dagger, with a heavy ivory handle, is carried. The headgear is very distinctive. The turban worn by priests is generally white, consisting of many yards of muslin. When the wearers are "saiyid" of the Prophet, a *green*[2] turban is worn, also a "kamarband" of *green* muslin, or shawl or cotton cloth. Merchants generally wear a turban of muslin embroidered in colours, or of a yellow pattern on straw-coloured muslin, or of calico, or shawl. The distinctive mark of the courtier, military, and upper servant class is the belt, generally of black varnished leather with a brass clasp; princes and courtiers often replace this clasp by a huge round ornament of cut stones. The "kulah," or hat, is of cloth or sheepskin on a frame of pasteboard. The fashions in hats change yearly. The Isfahan merchant and the Armenian at times wear the hat very tall. (The waist of the Persian is generally small, and he is very proud of his fine figure and broad shoulders.)

The hair is generally shaved at the crown, or the entire head is shaved, a "kakul," or long thin lock, being sometimes left, often 2 ft. long, from the middle of the crown. This is to enable the prophet Mahomet to draw up the believer into paradise. The lower orders generally, have the hair over the temporal bone long, and brought in two long locks turning backwards behind the ear, termed "zulf"; the beaux and youths are constantly twisting and combing these. The rest of the head is shaven. Long hair, however, is going out of fashion in Persia, and the more civilized affect the cropped hair worn by Europeans, and even have a parting in it. The chin is never shaved, save by "beauty men," or "kashangs," though often clipped, while the moustache is usually left long. At forty a man generally lets his beard grow its full length, and cherishes it much; part of a Persian's religious exercises is the combing of his beard. Socks, knitted principally at Isfahan, are worn; they are only about 2 in. long in the leg. The rich, however, wear them longer. They are of white cotton in summer and coloured worsted in winter. Villagers only wear socks on state occasions. Shoes are of many patterns. The "urussi," or Russian shoe is the most common; next, the "kafsh" or slipper of various kinds. The heel is folded down and remains so. The priests wear a peculiar heavy shoe, with an ivory or wooden lining at the heel. Green shoes of shagreen are common at Isfahan. Blacking is unknown to Persians generally. Boots are only used by horsemen, and are then worn much too large for ease. Those worn by couriers often come up the thigh. With boots are worn "shalwars," or baggy riding breeches, very loose, and tied by a string at the ankle; a sort of kilt is worn by couriers. Pocket-handkerchiefs are seldom used, save by the rich or the Teherānis. Most Persians wear a "shab kulah," or night hat, a loose baggy cap of shawl or quilted material, often embroidered by the ladies.

Arms are usually carried only by tribesmen. The natives of the south of Persia and servants carry a "kammah," or dirk. The soldiery, on or off duty, always carry one of these or their side-arms, sometimes both. They hack but never thrust with them. On the road the carrying of weapons is necessary.

The costume of the women has undergone considerable change in the last century. It is now, when carried to the extreme of fashion, highly indecent and must be very uncomfortable. The garment doing duty as a chemise is called a "pirahan"; it is, with the lower orders, of white or blue calico, and comes down to the middle of the thigh, leaving the leg nude. Among the upper classes it is frequently of silk. At Shiraz it is often of fine cotton, and elaborately ornamented with black embroidery. With the rich it is often of gauze, and much embroidered with gold thread, pearls, &c. The head is usually covered with a "char-kadd," or large square of embroidered silk or cotton, folded so as to display the corners, and fastened under the chin by a brooch. It is often of considerable value, being of Kashmir shawl, embroidered gauze, &c. A "jika," a jewelled feather-like ornament, is often worn at the side of the head, while the front hair, cut to a level with the mouth, is brought up in love-locks on either cheek. Beneath the "char-kadd" is generally a small kerchief of dark material, only the edge of which is visible. The ends of the "char-kadd" cover the shoulders, but the gauze "pirahan" is quite transparent. A profusion of jewellery is worn of the most solid description, none hollow; silver is worn only by the very poor, coral only by negresses. Necklaces and bracelets are much affected, and chains with scent-caskets attached, while the arms are covered with clanking glass bangles called "alangu," some twenty even of these being on one arm. Jewelled "bazubands," containing talismans, are often worn on the upper arm, while among the lower orders and south Persian or Arab women nose-rings are not uncommon, and bangles or anklets of beads.

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[1] *Zir jamah* are loose trousers and also drawers worn under the *shalvar*, or tight trousers.

[2] Green turbans are now rarely seen; the colour is generally dark blue, or black.

The face on important occasions is usually much painted, save by young ladies in the heyday of beauty. The colour is very freely applied, the cheeks being as much raddled as a clown's, and the neck smeared with white, while the eyelashes are marked round with "kuhl." This is supposed to be beneficial to the eyes, and almost every woman uses it. The eyebrows are widened and painted till they appear to meet, while sham moles or stars are painted on the chin and cheek; even spangles are stuck at times on the chin and forehead. Tattooing is common among the poor and in villages, and is seen among the upper classes. The hair, though generally hidden by the "char-kadd," is at times exposed and plaited into innumerable little tails of great length, while a coquettish little skull-cap of embroidery, or shawl, or coloured silk is worn. False hair is common. The Persian ladies' hair is very luxuriant and never cut; it is nearly always dyed red with henna, or with indigo to a blue-black tinge; it is naturally a glossy black. Fair hair is not esteemed. Blue eyes are not uncommon, but brown ones are the rule. A full-moon face is much admired, and a dark complexion termed "namak" (salt) is the highest native idea of beauty. Most Persian women are small, with tiny feet and hands. The figure is always lost after maternity, and no support of any kind is worn.

A very short jacket, of gay colour, quite open in front, having tight sleeves with many metal buttons, is usually worn in summer, and a lined outer coat in cold weather. In winter a pair of very short white cotton socks are used, and tiny slippers with a high heel; in summer in the house ladies go often barefoot. The rest of the costume is composed of the "tumbun" or "shalvar," short skirts of great width, held by a running string—the outer one being usually of silk, velvet, or Kashmir shawl, often trimmed with gold lace, or, among the poor, of loud-patterned chintz or print. Beneath are innumerable other garments of the same shape, varying in texture from silk and satin to print. The whole is very short, among the women of fashion extending only to the thigh. In winter an over-mantle like the "kulijah," or coat of the man, with short sleeves, lined and trimmed with furs, is worn. Leg-coverings are now being introduced. In ancient days the Persian ladies always wore them, as may be seen by the pictures in the South Kensington Museum. Then the two embroidered legs, now so fashionable as Persian embroideries ("naḳsh"), occupied a girl from childhood to marriage in making; they are *all sewing* in elaborate patterns of great beauty, worked on muslin in silk. The outdoor costume of the Persian women is quite another thing. Enveloped in a huge blue sheet, with a yard of linen as a veil perforated for two inches square with minute holes, the feet thrust into two huge bags of coloured stuff, a wife is perfectly unrecognizable, even by her husband, when out of doors. The dress of all is the same; and, save in quality or costliness, the effect is similar.

As for the children, they are always when infants swaddled; when they can walk they are dressed as little men and women, and with the dress they generally ape the manners. It is a strange custom with the Persian ladies to dress little girls as boys, and little boys as girls, till they reach the age of seven or eight years; this is often done for fun, or on account of some vow—oftener to avert the evil eye.

Towns.—The principal cities of Persia with their populations as estimated in 1908 are: Teherān (280,000); Tabriz (200,000); Isfahan (100,000); Meshed (80,000); Kermān, Resht, Shiraz (60,000); Barfurush, Kazvin, Yezd (50,000); Hamadan, Kermānshāh (40,000); Kashan, Khoi, Urmia (35,000); Birjend, Burujird, Bushire, Dizful, Kum, Senendij (Sinna), Zenjan (25,000 to 30,000); Amol, Ardebil, Ardistan, Astarabad, Abekuh, Bam, Bander, Abbasi, Bander Lingah, Damghan, Dilman, Istahbanat, Jahrum, Khunsar, Kumishah, Kuchan, Marand, Maragha, Nishapur, Sari, Sabzevar, Samnan, Shahrud, Shushter (10,000 to 20,000).

Political and Administrative Divisions.—The empire of Persia, officially known as *Mamalik i Mahruseh i Iran*, "the protected kingdoms of Persia," is divided into a number of provinces, which, when large, and containing important sub-provinces and districts, are called *mamlikat*, "kingdom," when smaller, *vilayat* and *ayalat*, and are ruled by governors-general and governors appointed by and directly responsible to the Crown. These provinces are further divided into sub-provinces, *vilayats*, districts, sub-districts and parishes, *buluk*, *nahiyeh*, *mahal*, and towns, cities, parishes and villages, *shehr*, *kassabeh*, *mahalleh*, *dih*, which are ruled by lieutenant-governors and other functionaries appointed by and responsible to the governors. All governors are called *hakim*, or *hukmran*, but those of large provinces generally have the title of *vali*, and sometimes *firmanfirma*. A governor of a small district is a *zabit*; a deputy-governor is called *naib el hukumeh*, or *naib el ayaleh*; an administrative division is a *kalamro*, or *hukumat*. Until recently the principal governorships were conferred upon the shah's sons, brothers, uncles and other near relatives, but now many of them are held by men who have little if any connexion with the royal family. Also, the governors are now, as a rule, resident in their provinces instead of being absentees at the capital. There are also some small districts or dependencies generally held in fief, *turyul*, by princes or high functionaries who take the revenues in lieu of salaries, pensions, allowances, &c., and either themselves govern or appoint others to do so.

Every town has a mayor, or chief magistrate, called *beglerbegi*, "lord of lords," *kalantar*, "the greater," and sometimes *darogha*, "overseer," or chief of police; every ward or parish, *mahalleh*, of a town and every village has a head-man called *ked khoda*, "house-lord." These officers are responsible to the governor for the collection of the taxes and the orderly state of their towns, parishes and villages. In the important provinces and sub-provinces the governors are assisted by a man of experience, to whom the accounts and details of the government are entrusted. This person, called *viziar*, or *paishkar*, is often nominated by the shah, and his functions in the provincial government are similar to those of the grand vizir in the central government, and comprise very extended administrative powers, including at times the command of the military forces in his province. Among the nomads a different system of titles prevails, the chiefs who are responsible for the taxes and the orderly conduct of their tribes and clans being known as *ilkhani*, *ilbegi* (both meaning "tribe-lord," but the latter being considered an inferior title to the former), *khan*, *rais*, *amir*, *mir*, *shaikh*, *tushmal*, &c.

The governors and chiefs, excepting those possessing hereditary rights, are frequently changed; appointments are for one year only and are sometimes renewed, but it does not often occur that an official holds the same government for longer than that period, while it happens rarely that a province is governed by the same person for two or three years. This was not so formerly, when not infrequently an official, generally a near relation of the shah, held the same governorship for five, ten or even more years. The governorship of the province of Azerbaijan was an exception until the end of 1906, being always held by the *Valiahd*, "heir apparent," or crown prince.

The political divisions of Persia, provinces, sub-provinces, districts, &c., ruled by *hakims* number over 200 (cf. the statement in Nöldeke's *Geschichte des Artachšîr Pâpakân*, "after Alexander's death there were in Iran 240 local governors"), but the administrative divisions, *hukumat*, or *kalamro*, with governors appointed by the Crown and responsible to it for the revenues, have been under fifty for sixty-five years or more. In 1840 there were twenty-nine administrative divisions, in 1868 twenty-two, in 1875 twenty-nine, in 1884 nineteen, in 1890 forty-six, and in 1908 thirty-five, as follows:—

(*a*) *Provinces*:—

1. Arabistan and Bakhtiari.
2. Astarabad and Gurgan.
3. Azerbaijan.
4. Fars.
5. Gerrus.
6. Gilan and Talish.
7. Hamadan.
8. Irak, Gulpaigan, Khunsar, Kamereh, Kezzaz, Ferakan.
9. Isfahan.
10. Kashan.
11. Kazvin.
12. Kermān and Baluchistan.
13. Kermānshāh.
14. Kamseh.
15. Khar.
16. Khorasan.
17. Kum.
18. Kurdistan.
19. Luristan and Burujird.
20. Mazandaran.
21. Nehavend, Malayir and Tusirkhan.
22. Savah.
23. Samnan and Damghan.
24. Shahrud and Bostam.
25. Teherān.
26. Zerend and Bagdadi Shahsevens.

(*b*) *Dependencies, or Fiefs*:—

1. Asadabad.
2. Demavend.
3. Firuzkuh.
4. Josehekan.
5. Kangaver.
6. Natanz.
7. Talikan.
8. Tarom Ulia.
9. Kharakan.

Roads.—With the exception of five short roads, having an aggregate length of less than 900 m., all the roads of the country are mere mule tracks, carriageable in the plains and during the dry season, but totally unfit for continuous wheeled traffic during all seasons, and in the hilly districts often so difficult as to cause much damage to goods and the animals carrying them. There are a few miles of roads in the immediate neighbourhood of Teherān leading from the city to royal palaces, but not of any commercial importance. The five exceptions are: (1) Resht–Kazvin–Teherān, 227 m.; (2) Julfa–Tabriz, 80 m.; (3) Teherān–Kum–Sultanabad, 160 m.; (4) Meshed–Kuchan–Askabad, 150 m.; 30 of which are on Russian territory; (5) Isfahan–Ahvaz, 280 m. The first of these roads consists of two sections: Resht–Kazvin, 135 m., and Kazvin–Teherān, 92 m. The first section was constructed in 1897–1899 by a Russian company, in virtue of a concession which the Persian government granted in 1893; and the second section was constructed in 1878–1879 by the Persian government at a cost of about £20,000, ceded to the concessionnaire of the first section in 1896, and repaired and partly reconstructed by the Russian company in 1898–1899. Both sections were officially opened to traffic in August 1899. The capital of the company is 3,200,000 roubles (£341,330), of which 1,700,000 is in shares taken by the public, and 1,500,000 in debentures taken by the Russian government, which also guarantees 5% on the shares. About two-thirds of the capital has been expended on construction. The company's income is derived from tolls levied on vehicles and animals using the road. These tolls were at first very high but were reduced by 15% in 1904, and by another 10% in 1909. If all the trade between Russia and Teherān were to pass over this road, the tolls would no doubt pay a fair dividend on the capital, but much of it goes by way of the Teherān–Meshed-i-Sar route, which is much shorter and has no tolls. The second road, Julfa–Tabriz, 80 m., was constructed by the same Russian company in 1903. The third road, Teherān–Kum–Sultanabad, 160 m., also consists of two sections: the first, Teherān–Kum, 92 m., the other, Kum–Sultanabad, 68 m. The first section was constructed by the Persian government in 1883 at a cost of about £12,000, purchased by the Imperial Bank of Persia in 1890 for £10,000, and reconstructed at a cost of about £45,000. The second section formed part of the "Ahvaz road concession" which was obtained by the Imperial Bank of Persia in 1890 with the object of connecting Teherān with Ahvaz on the Karun by a direct cart road via Sultanabad, Burujird, Khorremabad (Luristan), Dizful and Shushter. The concession was ceded to Messrs Lynch, of London, "The Persian Road and Transport Company," in 1903. The fourth cart-road, Meshed–Askabad, 120 m. to the Persian frontier, was constructed by the Persian government in 1889–1892 in accordance with art. v. of the Khorasan Boundary Convention between Russia and Persia of December 1881. The Persian section cost £13,000. The fifth road, Isfahan–Ahvaz, 280 m., is the old mule track provided with some bridges, and improved by freeing it of boulders and stones, &c., at a total cost of £5500. The concession for this road was obtained in 1897 by the Bakhtiari chiefs and ceded to Messrs Lynch, of London, who advanced the necessary capital at 6% interest and later formed the Persian Road and Transport Company. The road was opened for traffic in the autumn of 1900. The revenue is derived from tolls levied on animals passing with loads. The tolls collected in 1907 amounted to £3100.

Railways.—Persia possesses only 8 m. of railway and 6½ m. of tramway, both worked by a Belgian company. The railway consists of a single line, one-metre gauge, from Teherān to Shah-abdul-Azim, south of Teherān, and of two branch lines which connect the main line with some limestone quarries in the hills south-east of the city. The tramway also is a single line of one-metre gauge, and runs through some of the principal streets of Teherān. The length of the main railway line is 5½ m., that of the branches 2½. The main line was opened in 1888, the branches were constructed in 1893, and the tramway started in 1889. The capital now invested in this enterprise, and largely subscribed for by Russian capitalists, amounts to £320,000. There are also ordinary shares to the amount of £200,000 put down in the company's annual balance-sheets as of no value. The general opinion is that if Russian capitalists had not been interested in the enterprise the company would have liquidated long ago. (On railways in Persia, the many concessions granted by the Persian government, and only one having a result, ch. xviii. of Lord Curzon's *Persia* [i. 613–639], and on the Belgian enterprise, Lorini's *La Persia economica* [pp. 157–158] may be consulted.)

Posts.—Down to 1874 the postal system was in the hands of an official called *chaparchi bashi*, who was the head farmer of the post, or *chapars*, and letters and small parcels were conveyed by him and his agents at high and arbitrary rates and without any responsibility. The establishment of a regular post was one of the results of the shah Nasr-ed-din's first visit to Europe (1873). Two officials of the Austrian postal department having been engaged in 1874, an experiment of a post office upon European lines was made in the following year with a postal delivery in the capital and some of the neighbouring villages where the European legations have their summer quarters. In the beginning of 1876 a regular weekly post was established between Teherān, Tabriz and Julfa (Russo-Persian frontier) and Resht. Other lines, connecting all the principal cities with the capital, were opened shortly afterwards, and on the 1st of September 1877 Persia joined the international postal union with the rates of 2½d. per ½ oz. for letters, 1d. for post-cards, ½d. per 2 oz. for newspapers, &c., between Persia and any union country. The inland rates were a little less. There are now between Persia and foreign countries a bi-weekly service via Russia (Resht–Baku, Tabriz–Tiflis) and a weekly service via India (Bushire–Bombay). On the inland lines, with the exception of that between Teherān and Tabriz, the service is weekly. There are reported to be 140 post offices. Statistics as to the number of letters, post-cards, newspapers, &c., conveyed are kept but not published; and since 1885, when a liberal-minded director communicated those for the year 1884–1885 to the present writer, no others, although many times promised, have been obtained. In the year 1884–1885 there were conveyed 1,368,835 letters, 2050 post-cards, 7455 samples, and 173,995 parcels, having a value of £304,720; and the receipts exceeded the expenditure by £466. Since then the traffic has much increased, and the excess of receipts over expenditure in the year 1898–1899 was reported to have been £10,000, but was probably more than that, for the minister of posts farmed the department for £12,000 per annum. The farm system was abolished in 1901 and in the following year the post office was joined to the customs department worked by Belgian officials. Under the most favourable conditions letters from London via Russia are delivered at Tabriz in 9 days, at Teherān in 10, at Isfahan in 14, and at Shiraz in 18 days; and via India, at Bushire in 26 days, at Shiraz in 31, at Isfahan in 36, and at Teherān in 40 days; but during the winter letters between London and Teherān sometimes take a month. In the interior the mails are conveyed on horseback, and, being packed in badly-made soft leather bags, are frequently damaged through careless packing and wet. The first Persian postage stamps were issued in 1875 and roughly printed in Persia. Since then there have been numerous issues, many practically bogus ones for collectors. Authentic specimens of the early ones are much valued by stamp collectors. (For information on the postal system of Persia, see G. Riederer, *Aus Persien*, Vienna, 1882; Fr. Schueller, *Die persische Post und die Postwerthzeichen von Persien*, Vienna, 1893.)

Telegraphs.—The first line of telegraphs—from Teherān to Sultanieh, about 160 m. on the road to Tabriz—was constructed in 1859. In the following year it was continued to Tabriz, and in 1863 to Julfa on the Russian frontier. With the object of establishing a direct telegraphic communication between England and India, by connecting the European and Indian systems by a land line through Persia from Bagdad—then the most easterly Turkish telegraphic station—to Bushire and by a cable from Bushire eastwards, a telegraphic convention was concluded in the same year between the British and Persian governments, and a one-wire line on wooden posts from the Turkish frontier, near Bagdad, to Bushire via Kermānshāh, Hamadan, Teherān, Isfahan and Shiraz, was constructed at the cost and under the supervision of the British government. In 1865 a new convention, providing for a second wire, was concluded, and for some years messages between Europe and India were transmitted either via Constantinople, Bagdad, Teherān, Bushire, or via Russia, Tiflis, Tabriz, Teherān, Bushire. An alternative line between Bagdad and India was created by the construction of a land line to Fao, at the head of the Persian Gulf, and the laying of a cable thence to Bushire. The service was very inefficient, and messages between England and India took several days and sometimes weeks to reach their destination. In 1869 Messrs Siemens of Berlin, in virtue of concessions obtained in the year before and later disposed of to the Indo-European Telegraph Company, Ltd.—who also took over Reuter's cable from Lowestoft to Emden (274 knots)—constructed a two-wire line on iron posts through Germany and Russia, and in Persia from Julfa to Teherān. This line was opened on the 31st of January 1870. The British government then handed the Bagdad-Teherān section, which had become unnecessary for international through traffic between Europe and India, over to the Persian government, and changed its Teherān–Bushire line into one of two wires on iron posts. In 1873, according to a convention signed December 1872, a third wire was added to the line, and there was then a three-wire line on iron posts (439 m. Indo-European Telegraph Company, 675 m. Indian government) from Julfa to Bushire. In August 1901 a convention was concluded between the British and Persian governments for a three-wire line on iron posts from Kashan (a station on the Teherān-Bushire line) to Baluchistan via Yezd, Kermān and Bam (805 m.). The construction of this "Central Persia line," as it is known officially, was begun in December 1902 and completed in March 1907. The section Kashan–Isfahan of the old Teherān–Bushire was then taken up and Isafahan was connected with the Central Persia line by a two-wire line from Ardistan, 71 m. south-east from Kashan. One of the three wires between Isfahan and Bushire was also taken up, and there are now a five-wire line from Teherān to Ardistan (224½ m.), a three-wire line from Ardistan to the Baluchistan frontier (734 m.) and a two-wire line from Ardistan to Bushire (497 m.). These lines, as well as that of the Indo-European Telegraph Company from Julfa to Teherān, are worked throughout by an English staff and may be classed among the finest and most efficient in the world. The central line is continued through Baluchistan to Karachi, and from Bushire messages go by cable (laid in 1864) to Jask, and thence either by cable or by land to Karachi, Bombay, &c. The telegraphic convention between the British and Persian governments has again been renewed, and is in force until 1925; and the concessions to the company were prolonged to the same year by the Russian government in March 1900. In addition to these lines, Persia possesses 4191 m. of single-wire lines on wooden poles belonging to the Persian government and worked by a Persian staff; the

Teherān-Meshed line (555 m.), however, is looked after by an English inspector and two English clerks at Meshed, and since 1885 the Indian government has allowed a sum not exceeding 20,000 rupees per annum for its maintenance; and the Meshed-Seistan line, 523 m., is looked after by twelve Russian inspectors and clerks. The Persian lines are farmed out for 1,800,000 krans (about £36,000) per annum and no statistics are published. There are in all 131 stations. Statistics of the traffic on the Indo-European line are given in the administration reports of the Indo-European telegraph department, published by government, and from them the figures in the following table have been obtained:—

Year.	Traffic over Lines between London and Karachi.	Earnings in thousands of Pounds.		Net Profits of the Government Dept.	
	Number of Messages transmitted.	Government Department.	Indo-European Telegraph Co.	Total amount. Rupees.	Percentage on Capital Outlay.
1887–1888	83,031	74	100	198,381	1·75
1892–1893	117,500	84	116	437,668	3·80
1897–1898	146,988	106	145	758,172	6·57
1902–1903	178,250	111	155	589,571	4·50
1905–1906	211,003	113	157	774,368	5·39
1906–1907	259,355	108	149	458,559	3·09

Manufactures, &c.—The handbook on Persian art published by Colonel Murdoch Smith, R.E., in 1876, with reference to the collection purchased and sent home by him for the Victoria and Albert Museum, has an instructive account of the more common manufactures of the country. They are classified under the respective heads of "porcelain and earthenware," "tiles," "arms and armour," "textile fabrics," "needlework and embroidery," "metal-work," "wood carving and mosaic-painting," "manuscripts," "enamel," "jewelry" and "musical instruments." Specimens of the greater number are not only to be procured in England, but are almost familiar to the ordinary Londoner. It need scarcely be said that tiles have rather increased in value than deteriorated in the eyes of the connoisseur, that the ornamentation of metal-work, wood carving and inlaying, gem and seal engraving, are exquisite of their kind, and that the carpets manufactured by skilled workmen, when left to themselves and their native patterns, are to a great extent unrivalled. Of the above-mentioned articles, carpets, shawls, woollen and cotton fabrics and silk stuffs are the more important. Carpets may be divided into three categories: (1) *Kali*, with a pile, and cut like plush; (2) *gilim*, smooth; (3) *nimads*, felts. Only the two first are exported. The *Kali* and its smaller sizes, called *Kalicheh* (in Europe, rugs), are chiefly made in Ferahan, Sultanabad (Irak), Khorasan, Kurdistan, Karadagh, Yezd, Kermān, and among the nomad tribes of southern Persia. From the two first-mentioned localities, where a British firm has been established for many years, great quantities, valued in some years at £100,000, find their way to European and American markets, while rugs to the value of £30,000 per annum are exported from the Persian Gulf ports. Of the second kind, *gilim* (used in Europe for curtains, hangings, and chair-covers), considerable quantities are exported from Shushter and Kurdistan. The value of the carpets exported during the year 1906–1907 was close upon £900,000, Turkey taking £613,300, Russia £196,700, United States £40,600, Great Britain £20,700, Egypt £18,500 and India £5400. Shawls are manufactured in Kermān and Meshed, and form an article of export, principally to Turkey. Woollen fabrics are manufactured in many districts, but are not exported in any great quantity. Coarse cotton stuffs, chiefly of the kind called *Kerbaz*, used in their natural colour, or dyed blue with indigo, are manufactured in all districts but not exported; cottons, called Kalamkar, which are made in Manchester and block-printed in colours at Isfahan and Kumishah, find their way to foreign markets, principally Russian. Of silk fabrics manufactured in Persia, principally in Khorasan, Kashan and Yezd, about £100,000 worth per annum is exported to Turkey, Russia and India. In the environs of Kashan and in Fars, chiefly at Maimand, much rose-water is made, and a considerable quantity of it is exported by way of Bushire to India and Java. Many attempts have been made to start manufactures, supported by foreign capital and conducted by foreigners, but nearly all have resulted in loss. In 1879 the Persian government was induced to spend £30,000 on the erection of a gas factory in Teherān, but work was soon stopped for want of good coal. A few years later a Persian bought the factory and plant for £10,000, and made them over in 1891 to the Compagnie générale pour l'éclairage et le hauffage en Perse, which after bringing out much additional plant, and wasting much capital in trying for some years in vain to make good and cheap gas out of bad and dear coal, closed the factory. In 1891 another Belgian company, Société anonyme des verreries nationales de Perse, opened a glass factory in Teherān, but the difficulty of obtaining the raw material cheaply and in large quantities was too great to make it a paying concern, and the factory had to be closed. A third Belgian company, Société anonyme pour la fabrication du sucre en Perse, with a large capital, then came to Persia, and began making beetroot sugar in the winter of 1895. But, like the gas and glass companies, it found the cost of the raw material and the incidental expenses too great, and ceased its operations in 1899. In 1890 a Russian company started a match factory near Teherān with an initial outlay, it is said, of about £20,000, but could not successfully compete with Austrian and Swedish matches and ceased operations very soon. A Persian gentleman erected a cotton-spinning factory at Teherān in 1894 with expensive machinery; it turned out some excellent yarn but could not compete in price with imported yarns.

Agricultural Products.—Wheat, barley and rice are grown in all districts, the two former up to considerable altitudes (8000 ft.), the last wherever the water supply is abundant, and in inner Persia generally along rivers; and all three are largely exported. The most important rice-growing districts which produce more than they require for local consumption and supply other districts, or export great quantities, are Astarabad, Mazandaran, Gilan, Veramin, (near Teherān). Lenjan (near Isfahan), and some localities in Fars and Azerbaijan. Peas, beans, lentils, gram, maize, millet, are also universally cultivated, and exported from the Persian Gulf ports to India and the Arabian coast. The export of rice amounted to 52,200 tons in 1906–1907, and was valued at £472,550. The Persian fruit is excellent and abundant, and large quantities, principally dried and called khushkbar (dry fruit), as quinces, peaches, apricots, plums (of several kinds), raisins, figs, almonds, pistachios, walnuts and dates (the last only from the south), as well as oranges (only from the Caspian provinces), are exported. The fruit exported during 1906–1907 had a value of £1,019,000. Nothing is being done to improve the vine, and the Persian wines, until recently of world-wide reputation, are yearly getting thinner and poorer. The phylloxera has done much damage. The naturalist S. G. Gmelin, who explored the southern shores of the Caspian in 1771, observed that the wines of Gilan were made from the wild grape. Cotton is largely grown, principally in the central districts and Khorasan, and some qualities are excellent and command high prices in the European markets; 18,400 tons of raw cotton, valued at £838,787, were exported to Russia in 1906–1907. Good hemp grows wild in Mazandaran. Tobacco of two kinds, one the *tumbaku* (*Nicotiana persica*, Lindl.), for water pipes, the other the *tutun* (*Nicotiana rustica*, L.), for ordinary pipes and cigarettes, is much cultivated. The tumbaku for export is chiefly produced in the central districts round about Isfahan and near Kashan, while the tumbaku of Shiraz, Fessa, and Darab in Fars, considered the best in Persia, is not much appreciated abroad. Tutun is cultivated in Azerbaijan, near Urmia and other places near the Turkish frontier, in Kurdistan, and, since 1875, in the district of Resht, in Gilan. About 1885 the quantity of tobacco exported amounted to between 4000 and 5000 tons. In 1906–1907 only 1820 tons, valued at £42,000, were exported. The cultivation of poppy for opium greatly increased after 1880, and it was estimated in 1900 that the annual produce of opium amounted to over 1000 tons, of which about two-fifths was consumed and smoked in the country. The principal opium-producing districts are those of Shiraz, Isfahan, Yezd, Kermān, Khorasan, Burujird and Kermānshāh. While the quantity consumed in the country is now probably the same, the quantity exported is much less: 239 tons, valued at £237,270 in 1906–1907. The value of the silk produced in Persia in the 'sixties was £1,000,000 per annum, and decreased in consequence of silk-worm disease to £30,000, in 1890. The quantity produced has since then steadily increased and its yearly value is estimated at half a million. Cocoons and raw silk valued at £316,140 were exported in 1906–1907. Of oil-yielding plants the castor-oil plant, sesame, linseed and olive are cultivated, the last only in a small district south of and near Resht. Very little oil is exported. The potato, not yet a staple article of food, tomatoes, celery, cauliflower, artichokes and other vegetables are now much more grown than formerly, chiefly in consequence of the great influx of Europeans, who are the principal consumers.

Among the valuable vegetable products forming articles of export are various gums and dyes, the most important being gum tragacanth, which exudes from the astragalus plant in the hilly region from Kurdistan in the north-west to Kermān in the south-east. Other gums are gum-ammoniac, asafetida, galbanum, sagapanum, sarcocolla and opoponax. In 1906–1907, 3310 tons of various gums of a value of £300,000 were exported. Of dye-stuffs there are produced henna (*Lawsonia inermis*) principally grown at Khabis near Kermān, woad and madder; a small quantity of indigo is grown near Dizful and Shushter. The export of dyes in 1906–1907 was 985 tons, valued at £32,326.

Horses, mules and donkeys, formerly exported in great numbers, are at present not very abundant, and their prices have risen much since 1880. Some nomad tribes who owned many brood mares, and yearly sold hundreds of horses, now hardly possess sufficient animals for their own requirements. The scarcity of animals, as well as the dearness of fodder, is one of the causes of the dearness of transport, and freights have risen on the most frequented roads from 3d. per ton-mile in 1880 to 10d., and even 13d., per ton-mile. The prices of staple articles of food rose steadily from 1880 and reached a maximum in 1900 and 1901, as will be seen from the following table:—

	Average Price, 1880.		Price, April 1900.		Price, June 1908.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*
Wheat, per kharvar (649 ℔)	22	6	102	0	32	0
Rice ,,	56	3	64	0	64	0
Bread, ordinary, per mann (6½ ℔)		3·60		9·60		3·84
Meat, mutton (per mann)	1	2·40	2	9·60	1	5·28
Cheese ,,	1	6	2	4·80	1	0
Clarified butter ,,	2	3	4	9·60	5	4·80
Milk ,,		4·50		9·60		7·68
Eggs, per 100	1	6	3	7·20	3	2·40

Forests and Timber.—Timber from the forests of Mazandaran and Gilan has been a valuable article of export for many years, and since about 1870 large quantities of boxwood have also been exported thence; in some years the value of the timber and boxwood exported has exceeded £50,000. This value represented about 200,000 box trees and quite as many others. Much timber is also used for charcoal-burning, and occasionally large parts of forest are burned by the people in order to obtain clearings for the cultivation of rice. The destruction of the forests by timber-cutters and charcoal-burners has been allowed to go on unchecked, no plantations have been laid out, and nothing has been done for forest conservation. Indiscriminate cutting has occasionally been confined within certain bounds, but such restrictions were generally either of short duration or made for the convenience and profit of local governors. The oak forests of Kurdistan, Luristan and the Bakhtiari district are also being rapidly thinned. A small step in the right direction was made in 1900 by engaging the services of an official of the Prussian forest department, but unfortunately, beyond sending him to inspect the Mazandaran forests belonging to the Crown, and employing him to lay out a small plantation in the Jajrud valley, east of Teherān, nothing was done. The monopoly for cutting and exporting the timber of the Mazandaran forests is leased to European firms, principally for box and oak. Boxwood has become scarce. There are many kinds of good timber-yielding trees, the best known being alder (*Alnus glutinosa*, Wild., *A. barbata*, *A. cordifolia*, Ten.), ash (*Fraxinus excelsior*, L.), beech (*Fagus sylvatica*), elm (*Ulmus campestris*, *U. effusa*, *U. pedunculata*), wych-elm (*Ulmus montana*), hornbeam (*Carpinus betulus*, L.), juniper (*Juniperus excelsa*, *J. communis*, *J. sabina*), maple (*Acer insigne*, Boiss., *A. campestre*, *A. pseudo-platanus*, L.), oak (*Quercus ballota*, *Q. castaneaefolia*, *Q. sessiliflora*, *Q. pedunculata*), walnut, nettle tree (*Celtis australis*, L.), Siberian elm (*Zelkova crenata*, Spach.), and various kinds of poplar. Pipe-sticks, from the wild cherry tree, are exported to Turkey.

Fisheries.—Fish is a staple food along the shores of the Persian Gulf, but the Crown derives no revenue from fisheries there. The fisheries of the Caspian littoral are leased to a Russian firm (since 1868), and most of the fish goes to Russia (31,120 tons, value £556,125, in 1906–1907). The fish principally caught are sturgeon, giving caviare, sheat fish or silure, salmon, carp, bream and perch.

Minerals and Mining.—Persia possesses considerable mineral riches, but the absence of cheap and easy means of transport, and the scarcity of fuel and water which prevails almost everywhere, make any exploitation on a remunerative scale impossible, and the attempts which have been made to work mines with European capital and under European superintendence have been financially unsuccessful. Deposits of rich ores of copper, lead, iron, manganese, zinc, nickel, cobalt, &c., abound. A few mines are worked by natives in a primitive, systemless manner, and without any great outlay of capital. There are turquoise mines near Nishapur (for description of mines, manner of working, &c., see A. Houtum-Schindler, *Report on the Turquoise Mines in Khorasan*, F. O. Reports, 1884, and "Die Gegend zwischen Sabzwar und Meschhed," *Jahrbuch k. k. geol. R. A. Wien*, vol. xxxvi.; also E. Tielze, *Verhandl. k. k. geol. R. A.*, 1884, p. 93); several copper mines in Khorasan, Samnan, Azerbaijan and Kermān; some of lead, two considerably argentiferous, in Khorasan, Tudarvar (near Samnan), Anguran, Afshar (both west of Zenjan), and Kermān; two of iron at Mesula in Gilan and Nur in Mazandaran; two of orpiment in Afshar and near Urmia; one of cobalt at Kamsar (near Kashan); one of alum in Tarom (near Kazvin); and a number of coal in the Lar district, north-east of Teherān, and at Hiv and Abyek, north-west of Teherān. There are also many quarries of rock-salt, gypsum, lime and some of marble, alabaster, soapstone, &c. The annual revenue of the government from the leases, rents and royalties of mines does not amount to more than £15,000, and about £6000 of this amount is derived from the turquoise mines near Nishapur. As the rents and royalties, excepting those on the turquoise mines, amount to about one-fifth of the net proceeds, it may be estimated that the value of the annual output does not exceed £50,000, while the intrinsic value of the ores, particularly those of lead, iron, cobalt and nickel, which have not yet been touched can be estimated at millions. There are also some very rich coal seams in eastern Persia, far away on the fringe of the desert, and under existing conditions quite valueless. The richest deposits of nickel, cobalt and antimony ores are also situated in localities where there is little water and the nearest useful fuel some hundred miles away. Auriferous alluvial strata have been discovered in various localities, but everywhere the scarcity of water has been a bar to their being exploited with profit. A rich naphtha-bearing zone stretches from the Luristan hills near Kermānshāh down to the Persian Gulf. Competent engineers and specialists have declared that borings in the Bakhtiari hills, west of Shushter, would give excellent results, but the difficult hilly country and the total absence of roads, as well as the antipathy of the inhabitants of the district, would make the transport and establishment of the necessary plant a most difficult matter. A British syndicate has been boring at several places in the zone since 1903.

Commerce.—The principal centres of commerce are Tabriz, Teherān, Resht, Meshed and Yezd; the principal ports Bander Abbasi, Lingah, Bushire and Muhamrah on the Persian Gulf, and Astara, Enzeli, Meshed i Sar and Bander i Gez on the Caspian.

Until 1899 all the customs were farmed out (1898–1899 for £300,000), but in March of that year the farm system was abolished in the two provinces of Azerbaijan and Kermānshāh, and, the experiment there proving successful, in all other provinces in the following year. At the same time a uniform duty of 5% *ad valorem* was established. In October 1901 a treaty fixing a tariff and reserving "the most favoured nation" treatment for the countries already enjoying it was concluded between Persia and Russia. It was ratified in December 1902 and came into force on the 14th of February 1903. The commercial treaty with Great Britain, concluded in 1857, provided for the "most favoured nation" treatment, but nevertheless a new treaty under which the duties levied on British imports would be the same as on Russian imports was made with Great Britain a few days before the new tariff came into force and was ratified in May.

For the value of imports and exports previous to 1901 the only statistics available were the figures given in consular reports, which were not always correct. In 1897 it was estimated that the value of the imports from and exports to Great Britain, including India, amounted to £3,250,000. About a quarter of this trade passed over the western frontier of Persia, while three-quarters passed through the Persian Gulf ports. The value of the trade between Russia and Persia was then about £3,500,000. Since 1901 detailed statistics have been published by the customs department, and according to them the values of the imports and exports in thousands of pounds sterling for the six years 1901–1907 were as follows:—

	Imports.	Exports.	Total.
1901–1902	5429	2738	8,167
1902–1903	4970	3388	8,358
1903–1904	7000	4632	11,632
1904–1905	5832	4132	9,964
1905–1906	6441	4886	11,327
1906–1907	7982	6544	14,526

The imports and exports during the year 1906–1907 (total value £14,526,234) were distributed as follows (values in thousands sterling):—

Russia	8292	U.S. America	69
Great Britain	3128	Italy	65
Turkey	1335	Egypt	41
France	700	Netherlands	37
Austria	277	Belgium	24
Afghanistan	203	Switzerland	22
Germany	182	Sweden	8
China	142	Other countries	1
			14,526

While the value of the trade between Great Britain and Persia in 1906–1907 was almost the same as in 1897, that of the trade with Russia had increased from 3½ millions to 8¼ or 137 %. The average yearly value of the trade between Great Britain and Persia during the six years was £2,952,185 (imports £2,435,016, exports £517,169); between Russia and Persia £6,475,866 (imports £3,350,072, exports £3,125,794). The average values of the trade with other countries were: France £666,000, Austria £246,000, Germany £124,000, Italy £79,000, United States of America £52,000, Netherlands £39,000.

The principal imports into Persia in approximate order of value are cottons, sugar, tea, woollens, cotton yarn, petroleum, stuffs of wool and cotton mixed, wool, hardware, ironmongery, matches, iron and steel, dyes, rice, spices and glassware. The principal exports are fruits (dried and fresh), carpets, cotton, fish, rice, gums, wool, opium, silk cocoons, skins, live animals, silks, cottons, wheat, barley, drugs and tobacco.

Shipping and Navigation.—Shipping under the Persian flag is restricted to vessels belonging to the Persian Gulf ports. Some of the larger craft, which are called *baglah*, and vary from 50 to 300 tons, carry merchandise to and from Bombay, the Malabar coast, Zanzibar, &c.; while the smaller vessels, called *bagarah*, and mostly under 20 tons, are employed in the coasting trade and the pearl-fisheries on the Arabian coast. It is estimated that the four principal ports and the many smaller ones (as Mashur, Hindian, Zaidin, Bander, Dilam, Rig, Kongan, Taheri, Kishm, Hormuz, &c.) possess at least 100 *baglahs* and several hundred *bagarahs*, besides a large number of small boats. The following figures from the commercial statistics published by the Persian Customs Department show the total shipping at the four principal Persian Gulf ports, Bushire, Bander Lingah, Bander Abbasi and Muhamrah during the years 1904–1907.

	1904–1905.	1905–1906.	1906–1907.
	Tons.	Tons.	Tons.
British	671,386	827,539	826,594
Persian	36,797	25,069	6,425
Russian	24,121	29,182	40,616
Arabian	22,487	16,749	7,932
Turkish	3,176	3,877	5,005
French	2,901	570	—
German	—	—	52,935
Total	760,868	902,986	939,507

The British shipping amounted to 89·2% of the total shipping at the four ports during the years 1904–1907. There was no German shipping in the gulf before 1906, but in the first year of its appearance (1906–1907), its tonnage at the gulf ports was almost as much as that of all other nations with the exception of Great Britain.

The shipping of 1906–1907 was distributed among the four ports as follows:—

Bushire	354,798 tons.	Bander Abbasi	245,746 tons.
Bander Lingah	155,720 ,,	Muhamrah	183,243 ,,

Bander Lingah being the port where most of the pearls obtained on the Arabian coast of the gulf are brought to and exported from, has more native shipping (all sailing vessels) than the other ports.

All the shipping on the Caspian is under the Russian flag[1] and no returns of the arrivals and departures of vessels at the Persian ports were published before 1906. According to the statistics of the customs department the shipping of the Persian ports amounted in 1906–1907 to 650,727 tons. The shipping at the principal Persian ports on the Caspian in the year 1906–1907 was: Astara 137,935 tons; Enzeli 202,132 tons; Meshed i Sar 90,799 tons; Bander-i-Gez 56,135 tons. Two or three flat-bottomed sailing vessels navigate the lake of Urmia in north-western Persia, carrying merchandise, principally agricultural produce, from the western and south-western shores to the eastern for the supply of Tabriz. The navigation is a state monopoly, leased out for £250 per annum.

Coinage, Weights and Measures.—The monetary unit is the kran, a silver coin, formerly weighing 28 nakhods (88 grains), then reduced to 26 nakhods (77 grains), and now weighing only 24 nakhods (71 grains) or somewhat less. Before the new coinage came into use (1877) the proportion of pure silver was from 92 to 95%; subsequently the proportion was for some time 90%; now it is about $89\frac{1}{2}$%. In consequence of this depreciation of the coinage and the fall in the price of silver, partly also in consequence of exchange transactions by banks, the value of the kran has since 1895 rarely been more than 4·80d., or half what it was in 1874, and fell to less than 4d. in 1905. In 1874 the kran was worth a franc; in June 1908 the exchange for a £1 bill on London was 50 krans which gives the value of 1 kran as $4\frac{4}{5}$d. Taking this value of the kran, the values of the various nickel and silver coins in circulation work out as:—

Nickel Coins.	
Shahi = 2 pul	0·24d.
Two shahis = 4 pul	0·48d.

Silver Coins.	
Five shahis = $\frac{1}{4}$ kran	1·20d.
Ten shahis = $\frac{1}{2}$ kran	2·40d.
One kran = 20 shahis = 40 pul	4·80d.
Two krans	9·60d.

In 1899 from 80 to 83 copper shahis (weighing about $\frac{4}{5}$ lb) were being given for one silver kran. This was owing to the depreciation of the copper coinage from 1896 onwards, consequent upon there being an excess of coinage due to the excessive quantities formerly put in circulation from the mint. Accordingly the government in 1900 replaced the copper by a nickel coinage (face value of nickel coin in circulation end of 1907, 4,000,000 krans). Accounts are kept in dinars, formerly a gold piece, now an imaginary coin $\frac{1}{1000}$ of a kran. Ten thousand dinars are equal to one *toman* (a word meaning ten thousand), or 10 krans silver, and 50 dinars are one shahi.

Gold coins are: $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 5, and 10 toman pieces, but they are not in circulation as current money because of their ever-varying value in silver krans, which depends upon the exchange on London.

The unit of weight is the miskal (71 grains), subdivided into 24 nakhods (2·96 grains), a nakhod being further subdivided into 4 gandum (·74 grains). Larger weights, again, are the sir (16 miskals) and the abbasi, wakkeh, or kervankeh (5 sir). Most articles are bought and sold by a weight called batman, or man, of which there are several kinds, the principal being:—

Man-i-Tabriz = 8 abbasis = 640 miskals = 6·49 lb
Man-i-Noh abbasi = 9 abbasis = 720 ,, = 7·30 ,,
Man-i-Kohneh (the old man) = 1000 ,, = 10·14 ,,
Man-i-Shah = 2 Tabriz mans = 1280 ,, = 12·98 ,,
Man-i-Rey = 4 ,, ,, = 2560 ,, = 25·96 ,,
Man-i-Bander abbasi = 840 ,, = 8·52 ,,
Man-i-Hashemi = 16 mans of 720 ,, = 116·80 ,,

Corn, straw, coal, &c., are sold by kharvar = 100 Tabriz mans = 649 lb.

The unit of measure is the zar or gez, of which, as in the case of the man, there are several variants. 40·95 in. is the most common length for the zar, but in Azerbaijan the length is 44·09 in. Long distances are calculated in farsakhs, a farsakh being equal to 6000 zar. Probably the zar in this measure = 40·95 in., which makes the farsakh 3·87 m., but the other length of the zar is sometimes used, when the farsakh becomes 4·17 m. Areas are measured in jeribs of from 1000 to 1066 square zar of 40·95 in., the surface unit thus being from 1294 to 1379 sq. yds.

Constitution and Government.—Up to the year 1906 the government of Persia was an absolute monarchy, and resembled in its principal features that of the Ottoman Empire, with the exception, however, that the monarch was not the religious head of the community. The powers of the Shah (Shahanshah,[2] or "king of kings") over his subjects and their property were absolute, but only in so far as they were not opposed to the *shar'*, or "divine law," which consists of the doctrines of the Mahommedan religion, as laid down in the Koran, the oral commentaries and sayings of the Prophet, and the interpretations by his successors and the high priesthood. In 1905, however, the people began to demand judicial reforms, and in 1906 cried out for representative institutions and a constitution. By a rescript dated the 5th of August Muzaffar-ud-Dīn Shah gave his assent to the formation of a national council (*Majlis i shora i milli*), to be composed of the representatives of the various classes: princes, clergy, members of the Kajar family and tribe—chiefs and nobles, landowners, agriculturists, merchants and tradesmen. By an ordinance of the 10th of September the number of members was fixed at 162 (60 for Teherān, 102 for the provinces) to be raised to 200 if necessary, and elections were held soon after. Electors must be males and Persian subjects of not less than 25 years of age and of good repute. Landowners must possess land of at least 1000 tomans (£200) in value, merchants and tradesmen must have a fixed and well-known place of business or shop with an annual value of not less than the average values in the localities where they are established. Soldiers and persons convicted of any criminal offence are not entitled to vote. The qualifications for membership are knowledge of the Persian language and ability to read and write it and good repute in the constituency. No person can be elected who is an alien, is under the age of 30 years or over the age of 70 years, is in the employ of the government, is in the active service of the army or navy, has been convicted of any criminal offence, or is a bankrupt.

On the 7th of October the national council, or as many members of it as could be got together, was welcomed by the shah and elected a president. This was considered as the inauguration and formal opening of parliament. An ordinance signed by Muzaffar-ud-Dīn Shah, Mahommed Ali Mirza (his successor) and the grand vizir, on the 30th of December 1906, deals with the rescript of the 5th of August, states the powers and duties of the national council and makes provision for the regulation of its general procedure by the council itself. The members have immunity from prosecution except with the knowledge of the national council. The publicity of their proceedings except under conditions accepted by the council is secured. Ministers, or their delegates may appear and speak in the national council and are responsible to that body, which also has special control of financial affairs and internal administration. Its sanction is required for all territorial changes, for the alienation of state property, for the granting of concessions, for the contracting of loans, for the construction of roads and railways, for the ratification of treaties, &c. There was to be a senate of 60 members of whom 30 were to be appointed to represent the shah and 30 to be elected on behalf of the national council, 15 of each class being from Teherān and 15 from the provinces (the senate, however, was not immediately formed).

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[1] By article v. of the Treaty of Gulistan of 1813, confirmed by article viii. of the Treaty of Turkmanchai of 1828, it was declared that Russia alone should have the right of maintaining vessels of war on the Caspian, and that no other Power should fly the military flag on that sea; and by a decision of the council of the Russian Empire, published on the 24th of November 1869, the establishment of companies for the navigation of the Caspian, except by Russian subjects, and the purchase of shares of such companies by foreigners were prohibited. (*State Papers*, vol. lxiii. 925.)

[2] We see this title in its old Persian form, *Khshayathiya Khshayathiy*, in the cuneiform inscriptions; as Βασιλέως Βασιλεῶν on the coins of the Arsacides, and as the Pahlavi *Malkan Malka* on the coins and in the inscriptions of the Sassanians. With the Mahommedan conquest of Persia and the fall of the Sassanians the title was abolished; it was in use for a short time during the 10th century, having been granted to Shah Ismail Samani by the Caliph Motadid A.D. 900; it appeared again on coins of Nadir Shah, 1736–1747, and was assumed by the present dynasty, the Kajars, in 1799.

By a rescript dated February 2, 1907, Mahommed Ali Shah confirmed the ordinance of the 30th of December, and on the 8th of October 1907 he signed the final revised constitution, and took the oath which it prescribes on the 12th of November in the presence of the national council.

In accordance with the constitution the shah must belong to the Shiah faith, and his successor must be his eldest son, or next male in succession, whose mother was a Kajar princess. The shah's civil list amounts to 500,000 tomans (£100,000).

The executive government is carried on under a cabinet composed of seven or eight vizirs (ministers), of whom one, besides holding a portfolio, is vizir azam, prime minister. The vizirs are the ministers of the interior, foreign affairs, war, justice, finance, commerce, education, public works.

Until 1906 the shah was assisted in the task of government by the *sadr azam* (grand vizir), a number of vizirs, ministers or heads of departments somewhat on European lines, and a "grand council of state," composed of some ministers and other members nominated by the shah himself as occasion required. Many of the "ministers" would have been considered in Europe merely as chiefs of departments of a ministry, as, for instance, the minister for Crown buildings, that for Crown domains, the minister of ceremonies, those for arsenals, army accounts, &c.; also an accumulation of several offices without any connexion between their functions, in the hands of a single person, was frequently a characteristic departure from the European model. The ministers were not responsible to the Crown in a way that ministers of a European government are; they rarely took any initiative, and generally referred their affairs to the grand vizir or to the shah for final decision.

There were twenty-seven vizirs (ministers), but only some of them were consulted on affairs of state. The departments that had a vizir at their head were the following: court, ceremonies, shah's secretarial department, interior, correspondence between court and governors, revenue accounts and budget, finance, treasury, outstanding accounts, foreign affairs, war, army accounts, military stores, arsenals, justice, commerce, mines and industries, agriculture and Crown domains, Crown buildings, public works, public instruction, telegraphs, posts, mint, religious endowments and pensions, customs, press. In addition to these twenty-seven vizirs with portfolios, there were some titulary vizirs at court, like *Vizir i Huzur i Humayun* (minister of the imperial presence), *Vizir i makhsus* (extraordinary minister), &c., and a number in the provinces assisting the governors in the same way as the grand vizir assists the shah. Most of these ministers were abolished under the new constitution, and the heads of subsidiary departments are entitled *mudir* or *rais*, and are placed under the responsible ministers.

Religion.—About 9,000,000 of the population are Mahommedans of the Shiah faith, and 800,000 or 900,000, principally Kurds in north-western Persia, are said to belong to the other great branch of Islam, the Sunni, which differs from the former in religious doctrine and historical belief, and is the state religion of the Turkish Empire and other Mahommedan countries. Other religions are represented in Persia by about 80,000 to 90,000 Christians (Armenians, Nestorians, Greek Orthodox and Roman Catholics, Protestants), 36,000 Jews, and 9000 Zoroastrians.

Society in Persia, being based almost exclusively on religious law, is much as it was in Biblical times among the Jews, with this difference, however, that there exists no sacerdotal caste. In Persia any person capable of reading the Koran and interpreting its laws may act as a priest (*mullah*), and as soon as such a priest becomes known for his just interpretation of the *shar'* and his superior knowledge of the traditions and articles of faith, he becomes a *mujtahid*, literally meaning "one who strives" (to acquire knowledge), and is a chief priest. The *mullahs* are referred to in questions concerning religious law, hold religious assemblies, preach in mosques, teach in colleges, and are appointed by the government as judges, head-preachers, &c. Thus the dignitaries, whose character seems to us specially a religious one, are in reality doctors, or expounders and interpreters of the law, and officiating ministers charged with the ordinary accomplishment of certain ceremonies, which every other Mussulman, "true believer," has an equal right to fulfil. Formerly there were only four or five *mujtahids* in Persia, now there are many, sometimes several in one city—Teherān, for instance, has ten; but there are only a few whose decisions are accepted as final and without appeal. The highest authority of all is vested in the *mujtahid* who resides at Kerbela, or Nejef, near Bagdad, and is considered by many *Shi'ites* as the vicegerent of the Prophet and representative of the *imam*. The shah and the government have no voice whatever in the matter of appointing *mullahs* or *mujtahids*, but frequently appoint *sheikhs-ul-islam* and *cadis*, and occasionally chief priests of mosques that receive important subsidies out of government funds. The chief priest of the principal mosque of a city, the *masjid i jami'*, is called *imam juma'*, and he, or a representative appointed by him, reads the *khutba*, "Friday oration," and also preaches. The reader of the *khutba* is also called *khatib*. The leader of the prayers in a mosque is the *pishnamaz*, and the crier to prayers is the *mu'azzin*. Many priests are appointed guardians of shrines and tombs of members of the Prophet's family (*imams* and *imamzadehs*) and are responsible for the proper administration of the property and funds with which the establishments are endowed. The guardian of a shrine is called *mutavali*, or, if the shrine is an important one with much property and many attendants, *mutavali-bashi*, and is not necessarily an ecclesiastic, for instance, the guardianship of the great shrine of Imam Reza in Meshed is generally given to a high court functionary or minister as a reward for long services to the state. In the precincts of a great shrine a malefactor finds a safe refuge from his pursuers and is lodged and fed, and from the security of his retreat he can arrange the ransom which is to purchase his immunity when he comes out.

Formerly all cases, civil and criminal, were referred to the clergy, and until the 17th century the clergy were subordinate to a kind of chief pontiff, named *sadr-us-sodur*, who possessed a very extended jurisdiction, nominated the judges, and managed all the religious endowments of the mosques, colleges, shrines, &c. Shah Safi (1629–1642), in order to diminish the influence of the clergy, appointed two such pontiffs, one for the court and nobility the other for the people. Nadir Shah (1736–1747) abolished these offices altogether, and seized most of the endowments of the ecclesiastical establishments in order to pay his troops, and, the lands appropriated by him not having been restored, the clergy have never regained the power they once possessed. Many members of the clergy, particularly those of the higher ranks, have very liberal ideas and are in favour of progress and reforms so long as they are not against the *shar'*, or divine law; but, unfortunately, they form the minority.

The *Armenians* of Persia, in so far as regards their ecclesiastical state, are divided into the two dioceses of Azerbaijan and Isfahan, and, since the late troubles in Turkey, which caused many to take refuge in Persia, are said to number over 50,000. About three-fifths of this number belong to the diocese of Azerbaijan, with a bishop at Tabriz, and reside in the cities of Tabriz, Khoï, Selmas, Urmia and Maragha, and in about thirty villages close to the north-western frontier; the other two-fifths, under the diocese of Isfahan, with a bishop in Julfa, reside in Teherān, Hamadan, Julfa, Shiraz, Bushire, Resht, Enzeli and other towns, and in some villages in the districts of Chahar Mahal, Feridan, Barbarud, Kamareh, Kazaz, Kharakan, &c. Many Persian Armenians are engaged in trade and commerce, and some of their merchants dispose of much capital, but the bulk live on the proceeds of agriculture and are poor.

The *Nestorians* in Persia, all living in cities and villages close to the Turkish frontier, numbered about 25,000 to 30,000 but many of them, some say half, together with two or three bishops, recently went over to the Greek Orthodox (Russian) Church, in consequence of the unsatisfactory protection afforded them by their patriarch, who resides in Mosul. These latter are now cared for by an archimandrite of Russian nationality and some Russian priests.

The *Greek Orthodox Catholics* are represented by Russians, who reside in northern Persia; they have a church at the Russian legation in Teherān, and another at the Russian consulate in Tabriz.

The *Roman Catholics* in Persia, Europeans and natives (mostly Armenians), number about three or four thousand, and have churches in Teherān, Julfa and Azerbaijan, served by members of the French Lazarist Mission. They also have some orphanages, schools and medical dispensaries, under the care of sisters of charity of St Vincent de Paul.

The *Protestants*, Europeans and natives (converted Armenians and Nestorians), number about 6500. The religious missions ministering to their spiritual welfare are: (1) The board of foreign missions of the Presbyterian Church in the United States of America, which has six establishments in Persia: Urmia since 1835, Teherān since 1872, Tabriz since 1873, Hamadan since 1880, Resht since 1902 and Kazvin since 1903. The establishments of Tabriz and Urmia form the Western Persia Mission, those of Teherān, Hamadan, Resht and Kazvin the Eastern Persia Mission. The former mission has 24 churches, 118 schools, 2 hospitals and 4 dispensaries; the latter has 4 churches, 11 schools, 2 hospitals and 4 dispensaries. (2) The Church Missionary Society, established in Persia since 1869. In June 1908 it had 4 places of worship (Julfa, Yezd, Kermān, Shiraz), 5 schools (Julfa, Isfahan, Yezd, Kermān and Shiraz). There are also hospitals and dispensaries for men and women at Julfa, Isfahan, Yezd and Kermān. The hospitals at Julfa and Isfahan have accommodation for 100 patients each, and are sometimes full to overflowing; the dispensaries are generally overcrowded. The establishment of the Church Missionary Society is under the care of a bishop, who resides at Julfa and is under the bishop of London. (3) The Anglican mission, which was established by Dr Benson, archbishop of Canterbury, and has its work among the Nestorians in Azerbaijan. (4) The London Society for promoting Christianity among the Jews, which was established at Teherān in 1876, and at Isfahan and Hamadan in 1889. It has in Teherān a church and a school, at Isfahan a school and at Hamadan a small school. (5) The British and Foreign Bible Society has been represented at Isfahan since 1879.

The *Jews* in Persia number about 36,000, and are found in nearly all cities of the country, but communities with synagogues and priests exist only in the larger cities like Teherān, Isfahan, Yezd, Shiraz, Hamadan, &c.

The *Zoroastrians*, commonly called "gabrs," numbering about 9000, reside principally in the cities and villages of Yezd and Kermān, and only three or four hundred live in Teherān, Kashan, Isfahan and Shiraz, some engaged in trade and commerce, but most of them employed in agricultural work and gardening. Their interests are attended to by a delegate who is appointed by the Bombay Parsis and resides at Teherān.

The non-Mussulman Persian subjects, particularly those in the provinces, were formerly much persecuted, but since 1873, when Nasru 'd-Dīn Shah returned to Persia from his first journey to Europe they have been treated more liberally. In cities where many non-Mussulman subjects reside a special official is appointed to protect them; and the ministry of justice has a special section to look after them and see that they are protected against fanaticism and injustice.

Instruction.—Primary schools, *maktab* (where Persian and a little Arabic, sufficient for reading the Koran, and sometimes also a little arithmetic, are taught to boys between the ages of seven and twelve), are very numerous. These schools are private establishments, and are under no supervision whatever. The payment for tuition varies from fourpence or fivepence to tenpence a month for each child. Colleges, *madrasah* (where young men are instructed, fed, and frequently also lodged gratuitously), exist in nearly every town. Most of them are attached to mosques, and the teachers are members of the clergy, and receive fixed salaries out of the college funds. The students are instructed in Arabic and Persian literature, religion, interpretation of the Koran, Mussulman law, logic, rhetoric, philosophy and other subjects necessary for admittance to the clergy, for doctors of law, &c., while modern sciences are neglected. Families who have means and do not desire their children to become members of the clergy, employ private tutors, and several have latterly obtained the services of English and French professors to educate their children, while others send their boys to school in England, France, Germany and Russia. At the beginning of Nasru'd-Dīn Shah's reign, a public school on the lines of a French lycée was opened in Teherān, principally with the object of educating officers for the army, but also of introducing a knowledge of Western science and languages, and a ministry of public instruction was created at the same time. Military and civilian teachers were obtained from Europe, and the state granted a large sum of money for the support of the establishment. The tuition is gratuitous, and the pupils are clothed and partly fed at government expense. Some years later a similar school, but on a much smaller scale, was opened in Tabriz. After a time the annual grant for the support of these two schools was reduced, and during the years 1890–1908 amounted to only £5000. The average number of pupils was about 250, and until the beginning of 1899 these two schools were the only establishments under the supervision of the minister of public instruction. Soon after his accession in 1896 Muzaffar-ud-Dīn Shah expressed a desire that something more should be done for public instruction, and in the following year a number of Persian notables formed a committee and opened some schools in Teherān and other places in the beginning of 1898. A year later the new schools, until then private establishments, were placed under the minister of public instruction. The new schools at Teherān have from 1000 to 1400 pupils.

A German school with an annual grant of £2400 from Persia and of £1000 from Germany was opened at Teherān in 1907. There is also established a French school under the auspices of the Alliance Française. Much has been and is being done for education by the Armenians and the Protestant and Roman Catholic missions in Persia, and a large percentage of the pupils is composed of Mussulmans. The Alliance Israélite has opened a school in Teherān. In 1907 the American Protestant mission had 129 schools with 3423 pupils, the English Protestant missions had 5 schools with 425 pupils, the Roman Catholic mission (Lazaristes) had 3 schools with 400 pupils, and the Armenians had 4 schools and 646 pupils. All these schools are supported by voluntary subscriptions and donations, and instruct both boys and girls.

Army.—Persia had no regular army until 1807, when some regiments of regular infantry (*sarbaz*) were embodied and drilled by the first French military mission to Persia under General Gardane. Since then seven other military missions (two British, two French, two Austrian, and one Russian) have come to Persia at the request of the Persian government, and many officers and non-commissioned officers, and even civilians, of various nationalities, have been engaged as army instructors. The last serious attempt to reorganize the Persian army was made in 1879, when the second Austrian mission formed the "Austrian corps" of seven new battalions of 800 men each. These new battalions were disbanded in 1882. The Russian mission of 1879 has been the most successful, and the so-called "Cossack brigade" which it formed has always been commanded by Russian officers. The brigade has a strength of about 1800 men and costs £50,000 per annum. The total annual expenditure for the army amounts to about a third of the total revenues of the government.

According to statistics published for 1905 the Persian army has an effective force of about 91,000 men, but the number of men actually serving with the colours does not exceed 35,000:—

Artillery	5309
Irregular cavalry	14,957
Infantry, 79 battalions of 400–1000 men each	63,865
Cossack brigade, artillery, horse and foot	1800
Road and frontier guards, horse and foot	5403
Total	91,334

Navy.—The Persian government possesses nine steamers. One is the "Nasru 'd-Dīn," an old yacht of about 120 tons, presented in the 'seventies by the emperor of Russia, and stationed at Enzeli, the port of Resht. The others, all employed in the customs service in the Persian Gulf, are the following: The "Persepolis," built 1884, 600 tons, 450 h.p., with three 7½ cm. and one 8½ cm. Krupp. The "Susa," built 1884, 36 tons, with one Krupp. An old Belgian yacht "Selika," purchased 1903 and renamed "Muzafferi," with two Hotchkiss guns. Five launches built in the Royal Indian Marine Docks, Bombay, in 1905, at a cost of 60,000 rupees each, of about 80 tons.

Justice.—By the theory of a Mahommedan state there should be no other courts of justice except those established for the administration of the *shar'*, the "divine or written law," but in Persia there is another judicature, which is called *'urf* and represents the "customary" or "known and unwritten law." Justice, therefore, is administered by the shah and his representatives according to one law and by the clergy according to another, but the decisions of the former must not be opposed to the fundamental doctrines of Islam. The shah's representatives for the administration of justice are the governors and other officers already mentioned. The officials charged with the administration of justice according to the *shar'* are judges, called *sheikh-ul-islam* and *kazi* (*kadhi*, *kadi* or *cadi* of Arabs and Turks), members of the clergy appointed by the government and receiving a fixed salary, but some cities are without regular appointed judges and the title of *cadi* is almost obsolete; decisions according to the *shar'* are given by all members of the clergy, ranging from ignorant *mullahs* of little villages and cantons to learned *mujtahids* of the great cities. If the parties to the suit are dissatisfied with the judgment, they may appeal to a priest who stands higher in public estimation, or one of the parties may induce a higher authority by bribery to quash the judgment of the first. Unfortunately, many members of the clergy are corrupt, but the *mujtahids*, as a rule are honest and entirely trustworthy. The functions of the representatives of the *shar'* are now limited to civil cases, while all criminal cases are referred to the *'urf*, which, however, also takes cognizance of civil disputes, should the parties desire it.

In criminal cases the dispensation of justice is always summary, and, when the offence is small, the whole procedure, including the examination of witnesses and criminal, as well as the decision and the punishment, a bastinado, is a matter of some minutes. For commercial cases, not paying a bill in time, bankruptcies, &c., a kind of jurisdiction is exercised by the minister of commerce, or a board of merchants, but the decisions of the minister, or those of the board, are rarely final. In Teherān the board of merchants is presided over by the *malik ut tujjar*, "King of Merchants," in the provincial cities by a person called *malik amin*, and *muin* of merchants.

After his second journey to Europe in 1878 Nasru'd-Dīn Shah desired to organize a police for the whole of Persia on the European system, but only a small body of police, in the capital and its immediate neighbourhood, was created in 1879. Its strength is 60 mounted policemen and 190 foot, with 11 superior and 40 subaltern officers.

There is also a "Tribunal of the Ministry for Foreign Affairs," presided over at Teherān by an official of the foreign office, and in the provincial cities by the *karguzars*, "agents," of that department. The functions of this tribunal are to inquire into and judge differences and suits between Persian subjects and foreigners, and it is stipulated in the treaty of Turkmanchai, which is the basis of all existing treaties between Persia and other countries, that "such differences and suits shall only be examined and judgment given in the presence of the dragoman of the mission or consulate (of the foreign subject), and that, once judicially concluded, such suits shall not give cause to a second inquiry. If, however, circumstances should be of a nature to require a second inquiry, it shall not take place without previous notice given to the minister, or the chargé d'affaires, or the consul, and in this case the business shall only be proceeded with at the supreme chancery of the shah at Tabriz or Teherān, likewise in the presence of a dragoman of the mission, or of the consulate." (Article vii.)

A foreign subject implicated in a criminal suit cannot be pursued or molested in any way unless there exist full proofs of his having taken part in the crime imputed to him, and should he be duly convicted of the crime, he is handed over to his legation, which either sends him back to his own country to undergo the punishment established by law, or, according to more recent usage, punishes him in Persia by fine, imprisonment, &c. In this respect the powers of the foreign representatives in Persia, now numbering ten (Great Britain, Russia, France, Turkey, Austria-Hungary, Germany, United States of America, Italy, Belgium and the Netherlands) vary considerably, some having the power of condemning a criminal to death, while others cannot do more than fine and imprison for short periods. Suits, civil and criminal, between foreign subjects are altogether out of Persian jurisdiction, and are judged by the representatives of the foreign powers accredited to Persia.

In 1889, after Nāsru 'd-Dīn Shah's return from his third visit to Europe, the council of state was instructed to compile a code of law for the regulation of justice. A beginning was made by ordering the translation of the Code Napoléon, the Indian Mahommedan code, and the Code Napoléon as modified for Algeria; but nothing further was done.

Finance.—The fixed revenues of Persia are derived from (1) regular taxation (*maliat*) composed of taxes on lands, flocks, herds, shopkeepers, artisans and trade; (2) revenues from Crown lands; (3) customs; (4) rents and leases of state monopolies. There is also a kind of irregular revenue derived from public requisitions, presents, fines, confiscations, &c., nowadays not producing much. The land tax, which varies according to localities, is paid in money and kind, and should amount on an average to about 25% of the yield of the soil. The taxation on flocks and herds exists either as a supplementary method of land taxation, or as a contribution of a certain sum per animal, and the tax on shopkeepers, artisans and trades sometimes takes the form of a poll-tax, sometimes that of an impost on the profits of the trades. The revenue from Crown lands consists of a certain proportion of the produce, and also varies much according to localities. Until March 1899 all the customs were farmed out, but since then they have been organized on European principles, with the help of Belgian officials. By treaties with Russia and Great Britain, concluded in 1901 and 1903 respectively, the 5% duty fixed by the Turkmanchai treaty was abolished, and an equitable tariff was established. The revenues from rents and leases of state monopolies are derived from posts, telegraphs, mines, mint, forests, banks, fisheries, factories, &c., and amount to about £110,000 per annum.

The total revenue of Persia, from all sources, amounted in 1876 to 58,700,000 krans, in 1884 to 50,800,000, in 1890 to 60,000,000; and in 1907–1908 to about 80,000,000 krans. This would seem to show a steady increase, but when we consider that the value of the kran in 1876 was nearly $8\frac{8}{10}$ d., and has fallen in consequence of the great depreciation of silver to only 4⅘ d., the total revenue really decreased from £1,950,000 in 1876 to £1,600,000 in 1907–1908. Out of the actual total revenue £500,000 is represented by customs and £110,000 by rents and leases of state monopolies, leaving £990,000 for maliat and revenues of Crown lands. In 1876 the two latter items amounted to about £1,600,000, while the two former were only £350,000 instead of £610,000 in 1907–1908. While the prices in krans of agricultural produce, and hence the profits of the landowners and the wages and profits of artisans and tradesmen, were in 1907–1908 more than double what they were in 1876, the maliat, the backbone of the revenue, has hardly increased at all, being 50,000,000 krans (£1,000,000) against 43,200,000 krans (£1,600,000) in 1876, and showing a decrease of over 37% in sterling money. A new assessment of the maliat, based upon the present value of the produce of lands and actual profits of artisans and tradesmen, has frequently been spoken of, and government, aided by a strong minister of the interior and an able minister of finance, ought to have no difficulty in raising the maliat to its proper level and the total revenues of the country to about two millions sterling.

Until 1888 the yearly expenditure was less than the yearly income, but subsequently the revenues were not sufficient to cover the expenditure, and many payments fell in arrear in spite of emptying the treasury of its reserve and contracting numerous loans.

In May 1892 the Persian government concluded a contract with the Imperial Bank of Persia, established by British royal charter in 1889, for a loan of £500,000 at 6%, repayable in the course of forty years, and guaranteed by the customs of Fars and the Persian Gulf ports. The produce of this loan served for the payment of an indemnity to the Imperial Tobacco Corporation, which began in 1890 and had to cease its operations in January 1892. In January 1900 the Persian government, in order to pay the arrears and start afresh with a clear balance-sheet, contracted a loan through the Banque des Prêts de Perse, a Russian institution connected with the Russian state bank, and established in 1890. This loan was for 22½ million roubles (£2,400,000) at 5% interest, guaranteed by all the Persian customs with the exception of those of Fars and the Persian Gulf ports, and repayable in the course of seventy-five years. In the contract, which was signed at St Petersburg at the end of January 1900, the Persian government undertook to redeem all its former foreign obligations (the 1892 loan) out of the proceeds of the new loan, and not to contract any other foreign loan before the redemption of the new loan without the consent of the Russian bank. The loan was at 86⅔, less 1⅔ for commission and charges, the Persian government thus receiving 85% of the nominal capital, or £2,040,000. The bonds enjoy the full guarantee of the Russian government. The yearly charge for interest and amortization, about £124,000, is to be paid in two half-yearly instalments, and in the event of default the Russian bank will have the right to exercise effective control of the customs with a maximum number of twenty-five European employés. When the contract for the new loan was concluded, the liabilities of the Persian government for the balance of the 1892 loan (about £435,000), temporary loans from various banks, arrears of pays and salaries, and other debts, amounted to over £1,500,000, so that not much margin was left. The shah's visit to Europe in the same year cost the exchequer about £180,000. In March 1902 the Russian bank agreed to grant a further loan of 10 million roubles on the same conditions as those of the first loan, and the whole amount was paid by the end of the year, but another visit of the shah to Europe and reckless expenditure at home made the position worse than before. After November 1903 the expenditure was reduced, and the new customs tariff which came into force on the 14th of February 1903 increased the revenue by nearly £200,000 per annum; it was thought that the expenditure would not exceed the receipts, even if the shah undertook a third voyage in Europe (which he did in 1905). However, in November 1907, when the national assembly or council demanded a budget and made inquiries as to the financial position, it was found that the expenditure for some years past had been half a million sterling per annum in excess of the receipts and that considerable sums were owing to banks and commercial firms who had lent money. Most of the money borrowed is at 12 to 15% interest.

Banking.—It was only in 1888 that a European bank (the New Oriental Bank Corporation, Limited) established itself in Persia and modern ideas of banking were introduced into the country. Until then the banking was done by the native money-changers (*sarrafs*) and some merchants—foreign and native—who occasionally undertook special outside transactions. In 1889 the shah granted a concession to Baron Julius de Reuter for the formation of a state bank with the exclusive right of issuing bank-notes—not exceeding £800,000 without special assent of the Persian government—on the basis of the local currency, the silver kran. With the title of "The Imperial Bank of Persia" the bank was formed in the autumn of the same year, and incorporated by royal charter granted by Queen Victoria and dated the 2nd of September 1889. The authorized capital was four millions sterling, but the bank started with a capital of one million, and began its business in Persia in October 1889. In April 1890 it took over the Persian business of the New Oriental Bank Corporation, soon afterwards opened branches and agencies at the principal towns, and issued notes in the same year. During the first two years the bank remitted the greater part of its capital to Persia at the then prevailing exchange, and received for every pound sterling 32 to 34 krans; but in consequence of the great fall in silver in 1893 and 1894, the exchange rose to 50 krans per pound sterling and more, and the bank's capital employed in Persia being reduced in value by more than one-third—100 krans, which at the beginning represented £3, then being worth only £2 or less—the original capital of one million sterling was reduced to £650,000 in December 1894. The bank has made steady progress in spite of innumerable difficulties, and paid a fair dividend to its shareholders. In his paper on "Banking in Persia" (*Journal of the Institute of Bankers*, 1891), Mr Joseph Rabino pointed out the great difficulties which make the easy distribution of funds—that is, the providing them when and where required—a matter of impossibility in Persia, and gives this fact as the reason why the Imperial Bank of Persia has local issues of notes, payable at the issuing branches only, "for, in a country like Persia, where movements of specie are so costly, slow and difficult as to become impracticable except on a small scale, the danger of issuing notes payable at more than one place is obvious." On the 20th of September 1907 the value of the notes in circulation was £395,000, and the bank held £550,000 deposits in Persia.

In 1889 the shah also granted a concession to Jaques de Poliakov of St Petersburg for the establishment of a "loan bank," or, as the original concession said, "mont-de-piété," with exclusive rights of holding public auctions. A company was formed in the same year and started business at Teherān in 1890 as the "Banque des Prêts de Perse." After confining its operations for some years to ordinary pawnbroking, without profits, it obtained the aid of the Russian State Bank, acquired large premises in Teherān, made advances to the Persian government (since 1898), and in January 1900 and March 1902 financed the loans of £2,400,000 and £1,000,000 to Persia. It has branches at Tabriz, Resht, Meshed and other places.

Various Armenian firms, one with branches at many places in Persia and Russia, also do banking business, while various European firms at Tabriz, Teherān, Isfahan, Shiraz and Bushire, facilitate remittances between Europe and Persia.

The chief business of the native *sarrafs* (money-changers, bankers, &c.) is to discount bills at high rates, hardly ever less than 12%, and remit money from place to place in Persia for a commission amounting to from 1 to 5, or even 6% on each transaction; and in spite of the European banks giving lower rates of discount and remitting money at par, the majority of the people and mercantile classes still deal with the natives. For advances with good security a native *sarraf* charges at least 12% interest per annum; as the security diminishes in value the rate of interest increases, and transactions at 10% a month, or more than 120% per annum, are not infrequent. A Persian who obtains an advance of money at less than 12% considers that he gets money "for nothing."

(A. H.-S.)

History

A.—*Ancient, to the Fall of the Sassanid Dynasty.*

I. *The Name.*—"Persia," in the strict significance of the word, denotes the country inhabited by the people designated as Persians, *i.e.* the district known in antiquity as Persis (*q.v.*), the modern Fars. Custom, however, has extended the name to the whole Iranian plateau; and it is in this sense that the term Persia is here employed.

II. *Ancient Ethnography.*—In historical times we find the major portion of Iran occupied by peoples of Indo-European origin, terming themselves Aryans (*Arya*; Zend, *Airya*) and their language Aryan—so in the inscriptions of Darius—the same name, which is used by the consanguineous tribes of India who were their nearest relations. The whole country is designated Ariana (Zend, *Airyana*)—"the land of the Aryans"—the original of the Middle-Persian *Eran* and the modern *Iran*; the Greek geographers Eratosthenes and Strabo were in error when they limited the name to the eastern districts of Iran. Thus the name of Iranians is understood to comprehend all these people of Aryan nationality.

Descent of the Iranians.

Besides the Iranians, numerous tribes of alien origin were found in Iran. In Baluchistan, even yet, we find side by side with the eponymous Iranian inhabitants, who only penetrated thither a few centuries ago, the ethnologically and philologically distinct race of the Brahui, who are probably connected with the Dravidians of India. In them we may trace the original population of these districts; and to the same original population may be assigned the tribes here settled in antiquity: the Paricanii and Gedrosii (Gadrosii), and the Myci (Herod. iii. 93, vii. 68; the *Maka* of Darius, the modern *Mekran*), to whom the name "Aethiopians" is also occasionally applied (Herod. iii. 94, vii. 70). In Media the Greek geographers mention a people of Anariacae (Strabo xi. 508, 514; Pliny, *Nat. Hist.* vi. 48; Ptolem. vi. 25; in Polyb. v. 44. 9, Ἀνιαράκαι), *i.e.* "Non-Aryans." To these the Tapuri, Amardi, Caspii, and especially the Cadusii or Gelae—situated in Ghilan on the Caspian—probably belonged. Presumably they were also related to the tribes of Armenia and the Caucasus. In the chains of Zagros we find, in Babylonian and Assyrian times, no trace of Iranians; but partly Semitic peoples—the Gutaeans, Lulubaeans, &c.—partly tribes that we can refer to no known ethnological group, *e.g.* the Cossaei (see below), and in Elymais or Susiana the Elymaeans (Elamites).

Alien Tribes in Iran.

That the Iranians must have come from the East to their later home, is sufficiently proved by their close relationship to the Indians, in conjunction with whom they previously formed a single people, bearing the name *Arya*. Their residence must have lain chiefly in the great steppe which stretches north of the Black Sea and the Caspian, through South Russia, to Turan (Turkestan) and the Oxus and Jaxartes. For here we continually discover traces of Iranian nationality. The names and words of the Scythians (*Scoloti*) in South Russia, which Herodotus has preserved, are for the most part perfectly transparent Iranian formations, identified by Zeuss and Müllenhoff; among them are many proper names in *Aria*–(Αριο–) and *aspa* (–horse–ασπος; Zend, *aspa*). The predatory tribes of Turan (*e.g.* the Massagetae) seem to have belonged to the same stock. These tribes are distinguished by the Iranian peasants as Daha (Gr. Δάαι), "enemies," "robbers"; by the Persians as Sacae; and by the Greeks generally as Scythians.

Iranians and Aryan Indians.

From the region of the steppes the Aryans must have penetrated into the cultivable land of Eastern Iran: thence one part spread over the district of the Indus, then on again to the Ganges; another moved westward to Zagros and the borders of the Semitic world.

Period of the Iranian Migration.

The date of this migration cannot yet be determined with certainty. We know only that the Aryans of India already occupied the Punjab in the Vedic era, *c.* 1600 B.C. On the other hand, about the same period a number of names, undoubtedly Iranian, made their appearance in Western Asia, (cf. Edward Meyer, "Zur ältesten Geschichte der Iranier," in *Zeitschrift für vergleichende Sprachforschung*, 1907). In the cuneiform letters from Tell el-Amarna in Egypt (1400 B.C.), we find among the princelings of Syria and Palestine names like *Artamanya*, *Arzawiya*, *Shuwardata*, a name terminating in *-warzana*, &c.; while the kings of Mitanni on the Euphrates are *Artatama*, *Shutarna*, *Artashumara*, and *Dushratta*—names too numerous and too genuinely Iranian to allow of the hypothesis of coincidence. Later still, in the Assyrian inscriptions we occasionally meet with Iranian names borne by North-Syrian princes—*e.g.* Kundaspi and

Kustaspi (=Hystaspis). Their subjects, on the contrary, speak absolutely different tongues: for the attempts to explain the languages of the Cossaeans, Mitannians, and Arzapians as Indo-European (Iranian) have ended in failure (cf. Blomfield in the *American Journal of Philology*, xxv. p. 1 sqq.).

It appears, then, that towards the middle of the second millennium before Christ, the Iranians made a great forward movement to the West, and that certain of their princes—at first, probably in the rôle of mercenary leaders—reached Mesopotamia and Syria and there founded principalities of their own, much as did the Germans under the Roman Empire, the Normans, Turks, &c. With this we may probably connect the well-known fact that it was about this very period (1700 B.C. approximately) that the horse made its appearance in Babylonia, Egypt and Greece, where for centuries subsequently its use was confined to war and the war-chariot. Before this it was as foreign to the Babylonians, even in the time of Khammurabi, as to the Egyptians under the XIIth Dynasty. On the other hand, it had been familiar to the Aryans from time immemorial: indeed they have always been peculiarly a people of riders. Thus it is quite conceivable that they brought it with them into Western Asia: and the quarter from which it came is sufficiently indicated by the fact that the Babylonians write the word "horse" with a group of signs denoting "ass of the East."

Of the Assyrian kings, Shalmaneser (Salmanassar) II. was the first to take the field against the Medes in 836 B.C., and from that period onwards they are frequently mentioned in the Assyrian annals. Sargon penetrated farthest, receiving in 715 B.C. the tribute of numerous Median town-princes. He gives a list of their names, twenty-three of which are preserved either wholly or in part, and almost all are unmistakably Iranian; as is also the case with those preserved by Esar-haddon (Assarhaddon) and elsewhere.

The Medes, then, were an Iranian nation, already occupying in the 9th century B.C. their later home in the centre of the Median highland. On the other hand, among their neighbours in Zagros and the north—corresponding to the Anariacae (Non-Aryans) of the Greeks—Iranian names are at best isolated phenomena. With other Iranian tribes the Assyrians never came in contact: for the oft-repeated assertion, that the Parsua, so prominent in their annals, were the Persians or the Parthians, is quite untenable. The Parsua of the Assyrians are located south of Lake Urmia, and can hardly have been Iranians.

None the less, the Assyrian statements with regard to the Medes demonstrate that the Iranians must have reached the west of Iran before 900 B.C. It is probable that at this period the Persians also were domiciled in their later home, even though we have no direct evidence to adduce. If this reasoning is correct, the Iranian immigration must be assigned to the first half of the second pre-Christian millennium.

Tribes of the Iranians.

The Aryans of Iran are divided into numerous tribes; these, again, being subdivided into minor tribes and clans. The principal, according to the inscriptions of Darius —which closely agree with Herodotus—are the following, several of them being also enumerated in the *Avesta*:—

1. The Medes (*Mada*) in the north-west (see MEDIA).

2. The Persians (*Parsa*) in the south (see PERSIS). To these belong the Carmanians and the Utians (*Yutiya*), who are mentioned expressly by Darius as inhabiting a district in Persis (*Beh.* III. 40).

3. The Hyrcanians (*Varkāna* in Darius, Zend *Vehrkāna*) on the eastern corner of the Caspian, in the fertile district of Astarabad.

4. The Parthians (*Parthyaei*; Pers. *Parthava*) in Khorasan (see PARTHIA).

5. The Arians ('Αρεῖοι, Pers. *Haraiva*), in the vicinity of the river Arius (*Heri-rud*), which derived its name from them. This name, which survives in the modern Herat, has of course no connexion with that of the Aryans.

6. The Drangians (*Zaranka* in Darius, *Sarangians* in Herod. iii. 93, 117, vii. 67), situated south of the Arians, in the north-west of Afghanistan (*Arachosia*) by the western affluents of Lake Hamun, and extending to the present Seistan.

7. Arachotians (Pers. *Harauvati*), in the district of the Helmand and its tributaries, round Kandahar. They are mentioned in the lists of Darius, also by the Greeks after Alexander. In Herodotus their place is taken by the Pactyans, whose name survives to the present day in the word *Pushtu*, with which the Afghans denote their language (Herod. iii. 102, iv. 44, vii. 67, 85). Probably it was the old tribal name; Arachosia being the local designation. The Thamanaeans, who appear in Herodotus (iii. 93, 117), must be classed with them.

8. The Bactrians (Pers. *Bākhtri*), on the northern declivity of the Hindu Kush, as far as the Oxus. Their capital was Bactra, the modern *Balkh* (see BACTRIA).

9. The Sogdians (Pers. *Sugudu*), in the mountainous district between the Oxus and Jaxartes.

10. The Chorasmians (Khwarizmians, Pers. *Uvarazmiya*), in the great oasis of Khiva, which still bears the name Khwarizm. They stretched far into the midst of the nomadic tribes.

11. The Margians (Pers. *Margu*), on the river Margus (Murghab); chiefly inhabiting the oasis of Merv, which has preserved their name. Darius mentions the district of Margu but, like Herodotus, omits them from his list of peoples; so that ethnographically they are perhaps to be assigned to the Arians.

12. The Sagartians (Pers. *Asagarta*); according to Herodotus (vii. 85), a nomadic tribe of horsemen; speaking, as he expressly declares, the Persian language. Hence he describes them (i. 125) as a subordinate nomad clan of the Persians. They, with the Drangians, Utians and Myci, formed a single satrapy (Herod. iii. 93). Ptolemy (vi. 2, 6) speaks of Sagartians in the Eastern Zagros in Media.

13. We have already touched on the nomadic peoples (*Dāha*, *Dahans*) of Iranian nationality, who occupied the steppes of Turkestan as far as the Sarmatians and Scythians of South Russia. That these were conscious of their Aryan origin is proved by the names Ariantas and Ariapeithes borne by Scythian (Scolot) kings (Herod, iv. 76, 87). Still they were never counted as a portion of Iran or the Iranians. To the settled peasantry, these nomads of the steppe were always "the enemy" (*dana*, *daha*, Δάαι, Dahae). Side by side with this name we find "Tūrān" and "Turanian"; a designation applied both by the later Persians and by modern writers to this region. The origin of the word is obscure, derived perhaps from an obsolete tribal name. It has no connexion whatever with the much later "Turks," who penetrated thither in the 6th century after Christ. Though found neither in the inscriptions of Darius nor in the Greek authors, the name Turan must nevertheless be of great antiquity; for not merely is it repeatedly found in the *Avesta*, under the form *Tura*, but it occurs already in a hymn, which, without doubt, originates from Zoroaster himself, and in which "the Turanian Fryāna" and his descendants are commemorated as faithful adherents of the prophet (*Yasna*, 46, 62).

The dividing line between Iranian and Indian is drawn by the Hindu Kush and the Soliman mountains of the Indus district. The valley of the Kabul (*Cophen*) is already occupied by Indian tribes, especially the Gandarians; and the Satagydae (Pers. *Thatagu*) there resident were presumably also of Indian stock. The non-Aryan population of Iran itself has been discussed above. Of its other neighbours, we must here mention the Sacae, a warlike equestrian people in the mountains of the pamir plateau and northward; who are probably of Mongol origin. Herodotus relates that the Persians distinguished "all the Scythians"—*i.e.* all the northern nomads—as Sacae; and this statement is confirmed by the inscriptions of Darius. The Babylonians employ the name Gimiri (*i.e.* Cimmerians) in the same sense.

Aryan Religion.

III. *Civilization and Religion of the Iranians.*—In the period when the ancestors of Indian and Iranian alike still formed a single nation—that of the Aryans—they developed a very marked character, which can still be distinctly traced, not only in their language, but also in their religion and in many views common to both peoples. A great number of gods—Asura, Mithras, the Dragon-slayer Verethraghna (the Indra of the Indians), the Water-shoot Apam napat (the lightning), &c.—date from this era. So, too, fire-worship, especially of the sacrificial flame; the preparation of the intoxicating *soma*, which fills man with divine strength and uplifts him to the gods; the injunction to "good thoughts and good works," imposed on the pious by Veda and Avesta alike: the belief in an unwavering order (*rta*)—a law controlling gods and men and dominating them all; yet with this, a belief in the power of magical formulae (*mantra*), exclamations and prayers, to whose compulsion not merely demons (the evil spirits of deception—*druh*) but even the gods (*daeva*) must submit; and, lastly, the institution of a priesthood of fire-kindlers (*athravan*), who are at once the repositories of all sacral traditions and the mediators in all intercourse between earth and heaven. The transition, moreover, to settled life and agriculture belongs to the Aryan period; and to it may be traced the peculiar sanctity of the cow in India and Persia. For the cow is the animal which voluntarily yields nourishment to man and aids him in his daily labours, and on it depends the industry of the peasant as contrasted with the wild desert brigand to whom the cow is unknown.

Very numerous are the legends common to both nations. These, in part, are rooted in the primeval Indo-European days, though their ultimate form dates only from the Aryan epoch. Foremost among them is the myth relating the battle of a sun-god (Ind. *Trita*, generally replaced by *Indra*, Iran. *Thraetona*) against a fearful serpent (Ind. *Ahi*, Iran. *Azhi*; known moreover as *Vrtra*): also, the legend of Yama, the first man, son of Vivasvant, who, after a long and blessed life in the happy years of the beginning, was seized by death and now rules in the kingdom of the departed. Then come a host of other tales of old-world heroes; as the "Glorious One" (Ind. *Sushrava*, Pers. *Husrava*, *Chosrau* or *Chosroes*), or the Son who goes on a journey to seek his father, and, unknown, meets his end at his hands.

The Iranian Saga.

These legends have lived and flourished in Iran at every period of its history; and neither the religion of Zoroaster, nor yet Islam, has availed to suppress them. Zoroastrianism—at least in that form in which it became the dominant creed of the Iranians—legitimized not only the old gods, but the old heroes also; and transformed them into pious helpers and servants of Ahuramazda; while the creator of the great national epic of Persia, Firdousi (A.D. 935–1020), displayed astonishing skill in combining the ancient tradition with Islam. Through his poem, this tradition is perfectly familiar to every Persian at the present day; and the primitive features of tales, whose origin must be dated 4000 years ago, are still preserved with fidelity. This tenacity of the Saga stands in the sharpest contrast with the fact that the historical memory of the Persian is extremely defective. Even the glories of the Achaemenid Empire faded rapidly, and all but completely, from recollection; so also the conquest of Alexander, and the Hellenistic and Parthian eras. In Firdousi, the legendary princes are followed, almost without a break, by Ardashir, the founder of the Sassanid dynasty: the intervening episode of Darius and Alexander is not drawn from native tradition, but borrowed from Greek literature (the Alexander-romance of the Pseudo-Callisthenes) in precisely the same way as among the nations of the Christian East in the middle ages.[1]

Needless to say, however, this long period saw the Saga much recast and expanded. Many new characters—Siyawush, Rustam, &c.—have swelled the original list: among them is King Gushtasp (Vishtaspa), the patron of Zoroaster, who was known from the poems of the prophet and is placed at the close of the legendary age. The old gods and mythical figures reappear as heroes and kings, and their battles are fought no longer in heaven but upon earth, where they are localized for the most part in the east of Iran. In other words, the war of the gods has degenerated to the war between Iranian civilization and the Turanians. Only the evil serpent Azhi Dahaka (Azhdahak) is domiciled by the *Avesta* in Babylon (*Bawri*) and depicted on the model of Babylonian gods and demons: he is a king in human form with a serpent growing from either shoulder and feeding on the brains of men. In these traits are engrained the general conditions of history and culture, under which the Iranians lived: on the one hand, the contrast between Iranian and Turanian; on the other, the dominating position of Babylon, which influenced most strongly the civilization and religion of Iran. It is idle, however, to read definite historical events into such traits, or to attempt, with some scholars, to convert them into history itself. We cannot deduce from them a conquest of Iran from Babylon: for the Babylonians never set foot in Iran, and even the Assyrians merely conquered the western portion of Media. Nor yet can we make the favourite assumption of a great empire in Bactria. On the contrary, it is historically evident that before the Achaemenids there were in Bactria only small local principalities of which Vishtaspa's was one: and it is possible that the primeval empire of the Saga is only a reflection of the Achaemenid and Sassanid empires of reality, whose existence legend dates back to the beginning of the world, simply because legend is pervaded by the assumption that the conditions obtaining in the present are the natural conditions, and, as such, valid for all time.

Difference between the Iranian and Indian Religion.

Closely connected as are the Mythology and Religion of Indian and Iranian, no less clearly marked is the fundamental difference of intellectual and moral standpoint, which has led the two nations into opposite paths of history and culture. The tendency to religious thought and to a speculative philosophy, comprehending the world as a whole, is shared by both and is doubtless an inheritance from the Aryan period. But with the Indians this speculation leads to the complete abolition of all barriers between God and man, to a mystic pantheism, and to absorption in the universal Ego, in contrast with which the world becomes an unsubstantial phantasm and sinks into nothingness. For the Iranian, on the contrary, practical life, the real world, and with them the moral commandment, fill the foreground. The new gods created by Iran are ethical powers; those of India, abstractions of worship (*brahman*) or of philosophy (*atman*). These fundamental features of Iranian sentiment encounter us not only in the doctrine of Zoroaster and the confessions of Darius, but also in that magnificent product of the Persia of Islam—the Sufi mysticism. This is pantheistic, like the Brahman philosophy. But the pantheism of the Persian is always positive,—affirming the world and life, taking joy in them, and seeking its ideal in union with a creative god: the pantheism of the Indian is negative—denying world and life, and descrying its ideal in the cessation of existence.

This contrast in intellectual and religious life must have developed very early. Probably, in the remote past violent religious disputes and feuds broke out: for otherwise it is almost inexplicable that the old Indo-European word, which in India, also, denotes the gods—*deva*—should be applied by the Iranians to the malignant demons or devils (*daeva*; mod. *div*); while they denote the gods by the name *bhaga*. Conversely the Asuras, whose name in Iran is the title of the supreme god (*ahura*, *aura*), have in India degenerated to evil spirits. It is of great importance that among the Slavonic peoples the same word *bogu* distinguishes the deity; since this points to ancient cultural influences on which we have yet no more precise information. Otherwise, the name is only found among the Phrygians, who, according to Hesychius, called the Heaven-god (Zeus) Bagaeus; there, however, it may have been borrowed from the Persians. We possess no other evidence for these events; the only document we possess for the history of Iranian religion is the sacred writing, containing the doctrines of the prophet who gave that religion a new form. This is the *Avesta*, the Bible of the modern Parsee, which comprises the revelation of Zoroaster.

Zoroaster.

As to the home and time of Zoroaster, the Parsee tradition yields us no sort of information which could possibly be of historical service. Its contents, even if they go back to lost parts of the *Avesta*, are merely a late patchwork, based on the legendary tradition and devoid of historical foundation. The attempts of West (*Pahlavi Texts Translated*, vol. v.) to turn to historical account the statements of the *Bundahish* and other Parsee books, which date Zoroaster at 258 years before Alexander, are, in the present writer's opinion, a complete failure. Jackson (*Zoroaster, the Prophet of Ancient Iran*, 1901) sides with West. The Greek theory, which relegates Zoroaster to the mists of antiquity, or even to the period of the fabulous Ninus and Semiramis, is equally valueless. Even the statement that he came from the north-west of Media (the later Atropatene), and his mother from Rai (Rhagae) in eastern Media, must be considered as problematic in the extreme. Our only trustworthy information is to be gleaned from his own testimony and from the history of his religion. And here we may take it as certain that the scene of his activity was laid in the east of Iran, in Bactria and its neighbouring regions. The contrast there existing between peasant and nomad is of vital consequence for the whole position of his creed. Among the adherents whom he gained was numbered, as already mentioned, a Turanian, one Fryana and his household. The west of Iran is scarcely ever regarded in the *Avesta*, while the districts and rivers of the east are often named. The language, even, is markedly different from the Persian; and the fire-priests are not styled Magians as in Persia—the word indeed never occurs in the *Avesta*, except in a single late passage—but *athravan*, identical with the *atharvan* of India (*πύραιθοι*, "fire-kindlers," in Strabo xv. 733). Thus it cannot be doubted that the king Vishtaspa, who received Zoroaster's doctrine and protected him, must have ruled in eastern Iran: though strangely enough scholars can still be found to identify him with the homonymous Persian Hystaspes, the father of Darius. The possibility that Zoroaster himself was not a native of East Iran, but had immigrated thither (from Rhagae?), is of course always to be considered; and this theory has been used to explain the phenomenon that the Gathas, of his own composition, are written in a different dialect from the rest of the *Avesta*. On this hypothesis, the former would be his mother-tongue: the latter the speech of eastern Iran.

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[1] The fundamental work on the history of the Iranian Saga is Nöldeke, *Das iranische Nationalepos 1896* (reprinted from the *Grundriss der iran. Philologie*, ii.).

This district is again indicated as the starting-point of Zoroastrianism, by the fact that dead bodies are not embalmed and then interred, as was usual, for instance, in Persia, but cast out to the dogs and birds (cf. Herod. i. 140), a practice, as is well known, strictly enjoined in the *Avesta*, ruthlessly executed under the Sassanids, and followed to the present day by the Parsees. The motive of this, indeed, is to be found in the sanctity of Earth, which must not be polluted by a corpse; but its origin is evidently to be traced in a barbaric custom of nomadic or semi-nomadic tribes who leave the dead to lie on the steppe; and we know from Greek sources that this custom was widely diffused among the tribes of eastern Iran.

The next clue towards determining the period of Zoroaster is, that Darius I. and all his successors, as proved by their inscriptions and by Greek testimony, were zealous adherents of the pure word of Zoroastrianism; which consequently must already have been accepted in the west of Iran. That Cyrus too owned allegiance to the creed, cannot be doubted by an unprejudiced mind, although in the dearth of contemporary monuments we possess no proof at first hand. The Assyrian inscriptions demonstrate, however, that Zoroaster's teaching was dominant in Media two centuries before Cyrus. For in the list of Median princes, to which we have already referred, are two bearing the name of Mazdaka—evidently after the god Mazda. Now this name was the invention of Zoroaster himself; and he who names himself after Mazda thereby makes a confession of faith in the religion of Zoroaster whose followers, as we know, termed themselves Mazdayasna, "worshippers of Mazda."

Thus, if the doctrine of Zoroaster predominated in Media in 714 B.C., obviously his appearance in the rôle of prophet must have been much earlier. A more definite date cannot be deduced from the evidence at our disposal, but his era may safely be placed as far back as 1000 B.C.

The religion which Zoroaster preached was the creation of a single man, who, having pondered long and deeply the problems of existence and the world, propounded the solution he found as a divine revelation. Naturally he starts from the old views, and is indebted to them for many of his tenets and ideas; but out of this material he builds a uniform system which bears throughout the impress of his own intellect. In this world, two groups of powers confront each other in a truceless war, the powers of Good, of Light, of creative Strength, of Life and of Truth, and the powers of Evil, of Darkness, Destruction, Death and Deceit. In the van of the first stands the Holy Spirit (*spenta mainyu*) or the "Great Wisdom" Mazdao. His helpers and vassals are the six powers of Good Thought (*vohu manō*, Ὠμανός), of Right Order (*asha*, Ind. *rta*, Pers. *arta*, "lawfulness"), of the Excellent Kingdom (*khshathra vairya*), of Holy Character (*spenta ārmaiti*), of Health (*haurvatāt*), and of Immortality (*ameretat*). These are comprised under the general title of "undying holy ones" (*amesha spenta*, *amshaspand*); and a host of subordinate angels (*yazata*) are ranked with them. The powers of evil are in all points the opposite of the good; at their head being the Evil Spirit (*angra mainyu*, *Ahriman*). These evil demons are identical with the old gods of the popular faith—the devas (div)—while Mazdao bears the name *Ahura*, above discussed; whence *Ahuramazda* (Ormuzd).

From this it will be manifest that the figures of Zoroaster's religion are purely abstractions; the concrete gods of vulgar belief being set aside. All those who do not belong to the devils (*devas*), might be recognized as inferior servants of Ahuramazda: chief among them being the Sun-god Mithras (see MITHRAS); the goddess of vegetation and fertility, especially of the Oxus-stream, *Anāhita Ardvisura* (*Anaitis*); and the Dragon-slayer *Verethraghna* (Gr. *Artagnes*), with the god of the intoxicating *Haoma* (the Indian Soma). In the religion of the people, these divinities always survived; and the popularity of Mithras is evinced by the numerous Aryan proper names thence derived (Mithradates, &c.). The educated community who had embraced the pure doctrine in its completeness scarcely recognized them, and the inscriptions of Darius ignore them. Only once he speaks of "the gods of the clans," and once of "the other gods which there are." Not till the time of Artaxerxes II. were Mithra and Anaitis received into the official religion of the Persian kings. But they always played a leading part in the propaganda of the Persian cults in the West.

Only one element in the old Aryan belief was preserved by Zoroaster in all its sanctity: that of Fire—the purest manifestation of Ahuramazda and the powers of Good. Thus fire-altars were everywhere erected; and, to the prophet also, the Fire-kindlers (*āthravan*) were the ministers and priests of the true religion and the intermediaries between God and man; at last in the popular mind, Zoroastrianism was identified with Fire-worship pure and simple, —inadequate though the term in reality is, as a description of its essentials.

Midway in this opposition of the powers of Good and Evil, man is placed. He has to choose on which side he will stand: he is called to serve the powers of Good: his duty lies in speaking the truth and combating the lie. And this is fulfilled when he obeys the commands of law and the true order; when he tends his cattle and fields, in contrast with the lawless and predatory nomad (Dahae); when he wars on all harmful and evil creatures, and on the devil-worshippers; when he keeps free from pollution the pure creations of Ahuramazda—fire foremost, but also earth and water; and, above all, when he practises the Good and True in thought, word and work. And as his deeds are, so shall be his fate and his future lot on the Day of Judgment; when he must cross the Bridge *Cinvat*, which, according to his works, will either guide him to the Paradise of Ahuramazda or precipitate him to the Hell of Ahriman. Obviously, it was through this preaching of a judgment to come and a direct moral responsibility of the individual man, that, like Mahomet among the Arabs, Zoroaster and his disciples gained their adherents and exercised their greatest influence.

In this creed of Zoroastrianism three important points are especially to be emphasized: for on them depend its peculiar characteristics and historical significance:—

1. The abstractions which it preaches are not products of metaphysical speculation, as in India, but rather the ethical forces which dominate human life. They impose a duty upon man, and enjoin on him a positive line of action—a definite activity in the world. And this world he is not to eschew, like the Brahman and the Buddhist, but to work in it, enjoying existence and life to the full. Thus a man's birthday is counted the highest festival (Herod. i. 133); and thus the *joie de vivre*, rich banquets and carousals are not rejected by the Persian as godless and worldly, but are even prescribed by his religion. To create offspring and people the world with servants of Ahuramazda is the duty of every true believer.[1]

2. This religion grew up in the midst of a settled peasant population, whose mode of life and views it regards as the natural disposition of things. Consequently, it is at once a product of, and a main factor in civilization; and is thereby sharply differentiated from the Israelite religion, with whose moral precepts it otherwise coincides so frequently.

3. The preaching of Zoroaster is directed to each individual man, and requires of him that he shall choose his position with regard to the fundamental problems of life and religion. Thus, even though it arose from national views, in its essence it is not national (as, for instance, the Israelite creed), but individualistic, and at the same time universal. From the first, it aims at propaganda; and the nationality of the convert is a matter of indifference. So Zoroaster himself converted the Turanian Fryana with his kindred (see above); and the same tendency to proselytize alien peoples survived in his religion. Zoroastrianism, in fact, is the first creed to work by missions or to lay claim to universality of acceptance. It was, however, only natural that its adherents should be won, first and chiefly, among the countrymen of the prophet, and its further success in gaining over all the Iranian tribes gave it a national stamp. So the Susan translation of Darius' Behistun inscription

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[1] These ideas are strongly exposed in a polemic against the Christians contained in an official edict of the Persian creed to the Armenians by Mihr Narseh, the vizier of Yazdegerd II. (about A.D. 450), preserved by the Armenian historian, Elishe.

terms Ahuramazda "the god of the Aryans." Thus the creed became a powerful factor in the development of an united Iranian nationality.

That a religion, which lays its chief stress upon moral precepts, may readily develop into casuistry and external formalism, with an infinity of minute prescriptions, injunctions on purity and the like, is well known. In the *Avesta* all these recur *ad nauseam*, so much so that the primitive spirit of the religion is stifled beneath them, as the doctrine of the ancient prophets was stifled in Judaism and the Talmud. The Sassanid Empire, indeed, is completely dominated by this formalism and ritualism; but the earlier testimony of Darius in his inscriptions and the statements in Herodotus enable us still to recognize the original healthy life of a religion capable of awakening the enthusiastic devotion of the inner man. Its formal character naturally germinated in the priesthood (Herod. i. 140; cf. Strabo xv. 733, &c.). The priests diligently practise all the precepts of their ritual—*e.g.* the extermination of noxious animals, and the exposure of corpses to the dogs and birds, that earth may not be polluted by their presence. They have advice for every contingency in life, and can say with precision when a man has been defiled, and how he may be cleansed again; they possess an endless stock of formulae for prayer, and of sentences which serve for protection against evil spirits and may be turned to purposes of magic.

The Magians.

How the doctrine overspread the whole of Iran, we do not know. In the West, among the Medes and Persians, the guardianship and ministry of Zoroastrianism is vested in an exclusive priesthood—the Magians. Whence this name—unknown as already mentioned, to the *Avesta*—took its rise, we have no knowledge. Herodotus (i. 101) includes the Magians in his list of Median tribes; and it is probable that they and their teaching reached the Persians from Media. At all events, they play here not merely the rôle of the "Fire-kindlers" (*āthravan*) in the *Avesta*, but are become an hereditary sacerdotal caste, acting an important part in the state—advisers and spiritual guides to the king, and so forth. With them the ritualism and magical character, above mentioned, are fully developed. In the narrations of Herodotus, they interpret dreams and predict the future; and in Greece, from the time of Herodotus and Sophocles (*Oed. Tyr.* 387) onward, the word *Magian* connotes a magician-priest.

See further, ZOROASTER and works there quoted.

Assyrian Conquest of Media.

IV. *Beginnings of History.*—A connected chain of historical evidence begins with the time when under Shalmaneser (Salmanassar II.), the Assyrians in 836 B.C. began for the first time to penetrate farther into the mountains of the east; and there, in addition to several non-Iranian peoples, subdued a few Median tribes. These wars were continued under successive kings, till the Assyrian power in these regions attained its zenith under Sargon (*q.v.*), who (715 B.C.) led into exile the Median chief Dayuku (see DEIOCES), a vassal of the Minni (Mannaeans), with all his family, and subjected the princes of Media as far as the mountain of Bikni (Elburz) and the border of the great desert. At that time twenty-eight Median "town-lords" paid tribute to Nineveh; two years later, (713 B.C.) no fewer than forty-six. Sargon's successors, down to Assur-bani-pal (668–626 B.C.), maintained and even augmented their suzerainty over Media, in spite of repeated attempts to throw off the yoke in conjunction with the Mannaeans, the Saparda, the Cimmerians—who had penetrated into the Armenian mountains—and others. Not till the last years of Assur-bani-pal, on which the extant Assyrian annals are silent, can an independent Median Empire have arisen.

The Median Empire.

As to the history of this empire, we have an ancient account in Herodotus, which, with a large admixture of the legendary, still contains numerous historical elements, and a completely fanciful account from Ctesias, preserved in Diodorus (ii. 32 sqq.) and much used by later writers. In the latter Nineveh is destroyed by the Mede Arbaces and the Babylonian Belesys about 880 B.C., a period when the Assyrians were just beginning to lay the foundations of their power. Arbaces is then followed by a long list of Median kings, all of them fabulous. On the other hand, according to Herodotus the Medes revolt from Assyria about 710 B.C., that is to say, at the exact time when they were subdued by Sargon. Deioces founds the monarchy; his son Phraortes begins the work of conquest; and his son Cyaxares is first overwhelmed by the Scythians, then captures Nineveh, and raises Media to a great power. A little supplementary information may be gleaned from the inscriptions of King Nabonidus of Babylon (555–539) and from a few allusions in the Old Testament. Of the Median Empire itself we do not possess a single monument. Consequently its history still lies in complete obscurity (cf. MEDIA; DEIOCES; PHRAORTES; CYAXARES).

The beginnings of the Median monarchy can scarcely go farther back than 640 B.C. To all appearance, the insurrection against Assyria must have proceeded from the desert tribe of the Manda, mentioned by Sargon: for Nabonidus invariably describes the Median kings as "kings of the Manda." According to the account of Herodotus, the dynasty was derived from Deioces, the captive of Sargon, whose descendants may have found refuge in the desert. The first historical king would seem to have been Phraortes, who probably succeeded in subduing the small local princes of Media and in rendering himself independent of Assyria. Further development was arrested by the Scythian invasion described by Herodotus. We know from Zephaniah and Jeremiah that these northern barbarians, in 626 B.C., overran and harried Syria and Palestine (cf. CYAXARES; JEWS). With these inroads of the Cimmerians and Scythians (see SCYTHIA), we must doubtless connect the great ethnographical revolution in the north of anterior Asia; the Indo-European Armenians (*Haik*), displacing the old Alarodians (*Urartu*, *Ararat*), in the country which has since borne their name; and the entry of the Cappadocians—first mentioned in the Persian period—into the east of Asia Minor. The Scythian invasion evidently contributed largely to the enfeeblement of the Assyrian Empire: for in the same year the Chaldaean Nabopolassar founded the New-Babylonian empire; and in 606 B.C. Cyaxares captured and destroyed Nineveh and the other Assyrian cities. Syria and the south he abandoned to Nabopolassar and his son Nebuchadrezzar; while, on the other hand, Assyria proper, east of the Tigris, the north of Mesopotamia with the town of Harran (*Carrhae*) and the mountains of Armenia were annexed by the Medes. Cappadocia also fell before Cyaxares; in a war with the Lydian Empire the decisive battle was broken off by the celebrated eclipse of the sun on the 28th of May 585 B.C., foretold by Thales (Herod. i. 74). After this a peace was arranged by Nebuchadrezzar of Babylon and Syennesis of Cilicia, recognizing the Halys as the borderline. To the east, the Median Empire extended far over Iran, even the Persians owning its sway. Ecbatana (*q.v.*) became the capital.

Of the states which arose out of the shattered Assyrian Empire (Media, Babylon, Egypt, Cilicia and Lydia), Media was by far the strongest. In Babylon the kings feared, and the exiled Jews hoped, an attack from the Medes (cf. Isa. xiii., xiv., xxi.; Jer. l., li.); and Nebuchadrezzar sought by every means—great fortifications, canals and so forth—to secure his empire against the menace from the north. He succeeded in maintaining the *status quo* practically unimpaired, additional security being found in intermarriage between the two dynasties. In this state of equilibrium the great powers of Anterior Asia remained during the first half of the 6th century.

Conquests of Cyrus and Cambyses.

V. *The Persian Empire of the Achaemenids.*—The balance, however, was disturbed in 553 B.C., when the Persian Cyrus, king of Anshan in Elam (*Susiana*), revolted against his suzerain Astyages, the son of Cyaxares, and three years later defeated him at Pasargadae (*q.v.*).[1] Shortly afterwards Astyages was taken prisoner, Ecbatana reduced, and the Median Empire replaced by the Persian. The Persian tribes were welded by Cyrus into a single nation, and now became the foremost people in the world (see PERSIS and CYRUS). At first Nabonidus of Babylon hailed the fall of the Medes with delight and utilized the opportunity by occupying Harran (Carrhae). But before long he recognized the danger threatened from that quarter. Cyrus and his Persians paid little heed to the treaties which the Median king had concluded with the other powers; and the result was a great coalition against him, embracing Nabonidus of Babylon, Amasis of Egypt, Croesus of Lydia, and the Spartans, whose highly efficient army seemed to the Oriental states of great value. In the spring of 546 B.C., Croesus opened the attack. Cyrus flung himself upon him, beat him at Pteria in Cappadocia and pursued him to Lydia. A second victory followed on the banks of the Pactolus; by the autumn of 546 Sardis had already fallen and the Persian power advanced at a bound to the Mediterranean. In the course of the next few years the Greek littoral towns were reduced, as also the Carians and Lycians. The king of Cilicia (Syennesis) voluntarily acknowledged the Persian suzerainty. In 539 Nabonidus was defeated and Babylon occupied, while, with the Chaldean Empire, Syria and Palestine also became Persian (see JEWS). The east of Iran was further subdued, and, after Cyrus met his end (528 B.C.) in a war against the eastern Nomads (Dahae, Massagetae), his son Cambyses conquered Egypt (525 B.C.). Cyprus and the Greek islands on the coast of Asia Minor also submitted, Samos being taken by Darius. On the other hand, an expedition by Cambyses against the Ethiopian kingdom of Napata and Meroe came to grief in Nubia. The usurpation of Smerdis (522–521 B.C.) and his death at the hands of Darius was the signal for numerous insurrections in Babylon, Susiana, Persis, Media, Armenia and many of the Eastern provinces. But, within two years (521–519), they were all crushed by Darius and his generals.

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[1] See further, BABYLONIA AND ASSYRIA: § v. *History*.

Arms and Armour.

The causes of this astonishing success, which, in the brief space of a single generation, raised a previously obscure and secluded tribe to the mastery of the whole Orient, can only be partially discerned from the evidence at our disposal. The decisive factor was of course their military superiority. The chief weapon of the Persians, as of all Iranians, was the bow, which accordingly the king himself holds in his portraits, *e.g.* on the Behistun rock and the coins (*darics*). In addition to the bow, the Persians carried short lances and short daggers. But it was not by these weapons, nor by hand to hand fighting, that the Persian victories were won. They overwhelmed their enemy under a hail of arrows, and never allowed him to come to close quarters. While the infantry kneeled to shoot, the cavalry swarmed round the hostile squadrons, threw their lines into confusion, and completed their discomfiture by a vigorous pursuit. In a charge the infantry also might employ lance and dagger; but the essential point was that the archers should be mobile and their use of the bow unhampered.

Consequently, only a few distinguished warriors wore shirts of mail. For purposes of defence the rank and file merely carried a light hide-covered shield; which the infantry, in shooting, planted before them as a sort of barrier against the enemy's missiles. Thus the Persian army was lost, if heavy-armed hoplites succeeded in gaining their lines. In spite of all their bravery, they succumbed to the Greek phalanx, when once the generalship of a Miltiades or a Pausanias had brought matters to a hand to hand conflict; and it was with justice that the Greeks—Aeschylus, for instance—viewed their battles against the Persian as a contest between spear and bow. None the less, till Marathon the Persians were successful in discomfiting every enemy before he could close, whether that enemy consisted of similarly accoutred bowmen (as the Medes), of cavalry armed with the lance (as the Lydians), or of heavily armoured warriors (as the Babylonians, Egyptians and Greeks).

To all this should be added the superiority of their leaders; Cyrus especially must have been an exceedingly able general. Obviously, also, he must have understood the art of organizing his people and arousing the feeling of nationality and the courage of self-sacrifice. In his time the Persians were a strong manly peasantry, domiciled in a healthy climate and habituated to all hardships—a point repeatedly emphasized, in the tales preserved by Herodotus, as the cause of their successes (*e.g.* Herod. ix. 122). Herodotus, however, also records (i. 135) that the Persians were "of all mankind the readiest to adopt foreign customs, good or bad," a sentence which is equally applicable to the Romans, and which in the case of both nations goes far to explain, not merely their successes, but also the character of their empires.

Organization of Darius.

The fundamental features of the imperial organization must have been due to Cyrus himself. Darius followed in his steps and completed the vast structure. His rôle, indeed, was peculiarly that of supplementing and perfecting the work of his great predecessor. The organization of the empire is planned throughout on broad, free lines; there is nothing mean and timorous in it. The great god Ahuramazda, whom king and people alike acknowledge, has given them dominion "over this earth afar, over many peoples and tongues;" and the consciousness is strong in them that they are masters of the world. Thus their sovereign styles himself "the king of kings" and "the king of the lands"—that is to say, of the whole civilized world. For the provinces remaining unsubdued on the extreme frontiers to the west, the north and the east are in their view almost negligible quantities. And far removed as the Persians are from disavowing their proud sense of nationality ("a Persian, the son of a Persian, an Aryan of Aryan stock" says Darius of himself in the inscription on his tomb)—yet equally vivid is the feeling that they rule the whole civilized world, that their task is to reduce it to unity, and that by the will of Ahuramazda they are pledged to govern it aright.

Subject Nations.

This is most clearly seen in the treatment of the subject races. In contrast with the Assyrians and the Romans the Persians invariably conducted their wars with great humanity. The vanquished kings were honourably dealt with, the enemy's towns were spared, except when grave offences and insurrections, as at Miletus and Athens, rendered punishment imperative; and their inhabitants were treated with mildness. Like Cyrus, all his successors welcomed members of the conquered nationalities to their service, employed them as administrators or generals and made them grants of land: and this not only in the case of Medes, but also of Armenians, Lydians, Jews and Greeks. The whole population of the empire was alike bound to military service. The subject-contingents stood side by side with the native Persian troops; and the garrisons—in Egypt, for instance—were composed of the most varied nationalities.

Among the subject races the Medes particularly stood high in favour. Darius in his inscriptions always names them immediately after the Persians. They were the predecessors of the Persians in the empire and the more civilized people. Their institutions, court ceremonial and dress were all adopted by the Achaemenids. Thus the tribal distinctions began to recede, and the ground was prepared for that amalgamation of the Iranians into a single, uniform nation, which under the Sassanids was completely perfected—at least for west of Iran.

The Persians.

The lion's share, indeed, falls to the dominant race itself. The inhabitants of Persis proper—from which the eastern tribes of Carmanians, Utians, &c., were excluded and formed into a separate satrapy—pay no taxes. Instead, they bring the best of their possessions (*e.g.* a particularly fine fruit) as a gift to their king on festival days; peasants meeting him on his excursions do the same (Plut. *Artax.* 4. 5; Dinon *ap.* Aelian. *var. hist.* i. 31; Xen. *Cyr.* viii. 5, 21. 7, 1). In recompense for this, he distributes on his return rich presents to every Persian man and woman—the women of Pasargadae, who are members of Cyrus's tribe, each receiving a piece of gold (Nic. Dam. fr. 66. Plut. *Alex.* 69). In relation to his Persians, he is always the people's king. At his accession he is consecrated in the temple of a warrior-goddess (Anaitis ?) at Pasargadae, and partakes of the simple meal of the old peasant days—a mess of figs, terebinths and sour milk (Plut. *Artax.* 3). The Persians swear allegiance to him and pray to Ahuramazda for his life and the welfare of the people, while he vows to protect them against every attack, and to judge and govern them as did his fathers before him (Herod. i. 132; Xen. *Cyr.* xviii. 5, 25, 27). For helpers he has at his side the "law-bearers" (*databara* Dan. iii. 2, and in Babyl. documents; cf. Herod. iii. 31, v. 25, vii. 194; Esther i. 13, &c.). These—the Persian judges—are nominated by the king for life, and generally bequeath their office to their sons. The royal decision is based on consultation with the great ones of his people: and such is the case with his officials and governors everywhere (cf. the Book of Ezra).

Every Persian able to bear arms is bound to serve the king—the great landowners on horseback, the commonalty on foot. The noble and well-to-do, who need not till their fields in person, are pledged to appear at court as frequently as possible. Their children are brought up in company with the princes "at the gates of the king," instructed in the handling of arms, in riding and hunting, and introduced to the service of the state and the knowledge of the law, as well as the commandments of religion. Then such as prove their worth are called to high office and rewarded, generally with grants of land.

The highest rank was held by the descendants of the six great families, whose heads stood by Darius at the killing of the Magian. The Greeks class them and the king together, under the name of "the seven Persians." These enjoyed the right of entering the presence unannounced, and possessed princely estates in the provinces. Besides these, however, numbers of other Persians were despatched to the provinces, settled there, and endowed with lands. There existed, in fact, under the Achaemenids a strong colonizing movement, diffused through the whole empire; traces of this policy occur more especially in Armenia, Cappadocia and Lycia, but also in the rest of Asia Minor, and not rarely in Syria and Egypt. These colonists formed the nucleus of the provincial military levy, and were a tower of strength to the Persian dominion. They composed, moreover, the Persian council, and vice-regal household of the Satraps, exactly as the Persians of the home-country composed that of the king.

Though the world-empire of Persia was thus deeply impressed by a national character, care was nevertheless exercised that the general duties and interests of the subject races should receive due consideration. We find their representatives, side by side with the Persians, occupying every sort of position in the regal and vice-regal courts. They take their part in the councils of the satraps, precisely as they do in military service (cf. the evidence of Ezra); and they, too, are rewarded by bounties and estates. To wield a peaceful authority over all the subjects of the empire, to reward merit, and to punish transgression—such is the highest task of king and officials.

Royal Residences.

On his native soil Cyrus built himself a town, with a palace and a tomb, in the district of Pasargadae (now the ruins of Murghab). This Darius replaced by a new capital, deeper in the centre of the country, which bore the name "Persian" (*Pārsa*), the Persepolis (*q.v.*) of the later Greeks. But the district of Persis was too remote to be the administrative centre of a world-empire. The natural centre lay, rather, in the ancient fertile tract on the lower Tigris and Euphrates. The actual capital of the empire was therefore Susa, where Darius I. and Artaxerxes II. erected their magnificent palaces. The winter months the kings chiefly spent in Babylon: the hot summer, in the cooler situation of Ecbatana, where Darius and Xerxes built a residence on Mt Elvend, south of the city. From a palace of Artaxerxes II. in Ecbatana itself, the fragments of a few inscribed columns (now in the possession of Mr Lindo Myers and published by Evetts in the *Zeitschr. f. Assyr. V.*) have been preserved. To Persis and Persepolis the kings paid only occasional visits especially at their coronations.

Babylonia and Egypt.

Within the empire, the two great civilized states incorporated by Cyrus and Cambyses, Babylon and Egypt, occupied a position of their own. After his defeat of Nabonidus, Cyrus proclaimed himself "King of Babel"; and the same title was borne by Cambyses, Smerdis and Darius. So, in Egypt, Cambyses adopted in full the titles of the Pharaohs. In this we may trace a desire to conciliate the native population, with the object of maintaining the fiction that the old state still continued. Darius went still farther. He encouraged the efforts of the Egyptian priesthood in every way, built temples, and enacted new laws in continuance of the old order. In Babylon his procedure was presumably similar, though here we possess no local evidence. But he lived to see that his policy had missed its goal. In 486 B.C. Egypt revolted and was only reduced by Xerxes in 484. It was this, probably, that induced him in 484 to renounce his title of "king of Babel," and to remove from its temple the golden statue of Bel-Marduk (Merodach), whose hands the king was bound to clasp on the first day of each year. This proceeding led to two insurrections in Babylon (probably in 484 and 479 B.C.), which were speedily repressed. After that the "kingship of Babel" was definitely abolished. In Egypt the Persian kings still retained the style of the Pharaohs; but we hear no more of concessions to the priesthood or to the old institutions, and, apart from the great oasis of el-Kharga, no more temples were erected (see EGYPT: *History*).

The Vizier and other Officials.

At the head of the court and the imperial administration stands the commandant of the body-guard—the ten thousand "Immortals," often depicted in the sculptures of Persepolis with lances surmounted by golden apples. This grandee, whom the Greeks termed "Chiliarch," corresponds to the modern vizier. In addition to him, we find seven councillors (Ezra vii. 14; cf. Esther i. 14). Among the other officials, the "Eye of the King" is frequently mentioned. To him was entrusted the control of the whole empire and the superintendence of all officials.

Official Languages.

The orders of the court were issued in a very simple form of the cuneiform script, probably invented by the Medes. This comprised 36 signs, almost all of which denote single sounds. In the royal inscriptions, a translation into Susan (Elamitic) and Babylonian was always appended to the Persian text. In Egypt one in hieroglyphics was added, as in the inscriptions of the Suez canal; in the Grecian provinces, another in Greek (*e.g.* the inscription of Darius on the Bosporus, Herod. iv. 37, cf. iv. 91). The cuneiform script could only be written on stone or clay. Thus there has been discovered in Babylon a copy of the Behistun (*q.v.*) inscription preserved on a block of dolerite (Weissbach, *Babylonische Miscellen.* p. 24). For administrative purposes, however, it would seem that this inconvenient material was not employed; its place being taken by skins (*διφθέραι*, parchment), the use of which was adopted from the western peoples of the empire. On these were further written the journals and records kept at the court (cf. Diod. ii. 22, 32; Ezra iv. 15, v. 17, vi. 2; Esther vi. 1, ii. 23). With such materials the cuneiform script could not be used; instead, the Persian language was written in Aramaic characters, a method which later led to the so-called Pahlavi, *i.e.* Parthian script. This mode of writing was obviously alone employed in the state-services since Darius I.; and so may be explained the fact that, under the Achaemenids, the Persian language rapidly declined, and, in the inscriptions of Artaxerxes III., only appears in an extremely neglected guise (see CUNEIFORM INSCRIPTIONS, ALPHABET).

Side by side with the Persian, the Aramaic, which had long been widely diffused as the speech of commerce, enjoyed currency in all the western half of the empire as a second dominant language. Thus all deeds, enactments and records designed for these provinces were furnished with an official Aramaic version (Ezra iv. 7). Numerous documents in this tongue, dating from the Persian period, have been discovered in Egypt (cf. Sayce and Cowley, *Aramaic Papyri discovered at Assuan* 1906), and the coins minted by the satraps and generals usually bear an Aramaic inscription. (So, also, a lion-weight from Abydos, in the British Museum.) The Demotic in Egypt was employed in private documents alone. Only in the Hellenic provinces of the empire Greek replaced Aramaic (cf. the letter to Pausanias in Thuc. i. 129; an edict to Gadatas in Magnesia, Cousin et Deschamps, *Bulletin de corresp. hellénique* xii. 530, Dittenberger, *Sylloge* 2; so, also, on coins)—a clear proof that the Persians had already begun to recognize the independent and important position of Greek civilization.[1]

The Satrapies.

Darius I. divided the Persian Empire into twenty great provinces, satrapies, with a "guardian of the country" (*khshathrapavan*; see SATRAP) at the head of each. A list is preserved in Herodotus (iii. 89 sqq.); but the boundaries were frequently changed. Each satrapy was again subdivided into several minor governorships. The satrap is the head of the whole administration of his province. He levies the taxes, controls the legal procedure, is responsible for the security of roads and property, and superintends the subordinate districts. The heads of the great military centres of the empire and the commandants of the royal fortresses are outside his jurisdiction: yet the satraps are entitled to a body of troops of their own, a privilege which they used to the full, especially in later periods. The satrap is held in his position as a subject by the controlling machinery of the empire, especially the "Eye of the King"; by the council of Persians in his province with whom he is bound to debate all matters of importance; and by the army: while in the hands of the messengers (Pers. ἀστάνδαι or ἄγγαροι—a Babylonian word: see ANGARIA) the government despatches travel "swifter than the crane" along the great imperial highways, which are all provided with regular postal stations (cf. the description of the route from Susa to Sardis in Herod. v. 52).

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[1] For the editions of the Persian inscriptions see BEHISTUN. For the Persian documents, Ed. Meyer *Entstehung des Judentums*, p. 19 sqq. The hieroglyphic inscriptions of the Suez Canal are published in the *Recueil de trav. d'égyptol. et d'assyriol.* vols. vii. ix. xi. xiii; the private documents from Babylonia and Nippur, by Strassmaier, *Babyl. Urkunden*, and Hilprecht and Clay, *Babyl. Exped. of Univ. of Pennsylvania*, vols. ix. x. Numerous Jewish documents in Aramaic have been found at Elephantine (Sayce and Cowley, *Aramaic Papyri discovered at Assuan*, 1906), among them an official complaint of the Jewish colony settled at Elephantine, addressed to the Persian satrap of Judaea, in 408 B.C., which throws a new light on many passages in Ezra and Nehemiah, published by Sachan in *Abhandlungen der berl. Akademie*, 1907.

Subject Communities.

Within the satrapies the subject races and communities occupied a tolerably independent position; for instance, the Jews, under their elders and priests, who were even able to convene a popular assembly in Jerusalem (cf. the Books of Ezra and Nehemiah). Obviously also, they enjoyed, as a rule, the privilege of deciding law-suits among themselves; their general situation being similar to that of the Christian nationalities under the Ottomans, or to that of many tribes in the Russian Empire at the present day. The pressure of despotism was manifest, not so much in that the king and his officials consistently interfered in individual cases, but that they did so on isolated and arbitrary occasions, and then swept aside the privileges of the subject, who was impotent to resist.

For the rest, the subject population falls into a number of distinct groups. In the desert (as among the Arabian and Turanian nomads), in wild and sequestered mountains (as in Zagros in north Media, and Mysia, Pisidia, Paphlagonia and Bithynia in Asia Minor), and also in many Iranian tribes, the old tribal constitution, with the chieftain as its head, was left intact even under the imperial suzerainty. The great majority of the civilized provinces were subdivided into local administrative districts governed by officials of the king and his satraps. These the Greeks named ἔθνη, "peoples." Within these, again, there might lie large town settlements whose internal affairs were controlled by the elders or the officials of the community: as, for instance, Babylon, Jerusalem, the Egyptian cities, Tarsus, Sardis and others. On the same footing were the spiritual principalities, with their great temple-property; as Bambyce in Syria, the two Comanas in Cappadocia, and so forth. Besides these, however, vast districts were either converted into royal domains (παράδεισοι) with great parks and hunting grounds under royal supervision, or else bestowed by the king on Persians or deserving members of the subject-races (the "benefactors") as their personal property. Many of these estates formed respectable principalities: *e.g.* those of the house of Otanes in Cappadocia, of Hydarnes in Armenia, Pharnabazus in Phrygia, Demaratus in Teuthrania, Themistocles in Magnesia and Lampsacus. They were absolute private property, handed down from father to son for centuries, and in the Hellenistic period not rarely became independent kingdoms. These potentates were styled by the Greeks δυνάσται or μόναρχοι.

The City States.

The last class, quite distinct from all these organizations, was formed by the city-states (πόλεις) with an independent constitution—whether a monarchy (as in Phoenicia), an aristocracy (as in Lycia), or a republic with council and popular assembly (as in the Greek towns). The essential point was that they enjoyed a separate legalized organization (autonomy). This was only to be seen in the extreme western provinces of the empire among the Phoenicians, Greeks and Lycians, whose cities were essentially distinct from those of the east; which, indeed, to Greek eyes, were only great villages (κωμοπόλεις). It is readily intelligible that their character should have proved practically incomprehensible to the Persians, with whom they came into perpetual collision. These sought, as a rule, to cope with the difficulty by transferring the government to individual persons who enjoyed their confidence: the "tyrants" of the Greek towns. Mardonius, alone, after his suppression of the Ionic revolt—which had originated with these very tyrants—made an attempt to govern them by the assistance of the democracy (492 B.C.).

Commerce and Finance.

The provinces of the Persian Empire differed as materially in economy as in organization. In the extreme west, a money currency in its most highly developed form—that of coinage minted by the state, or an autonomous community—had developed since the 7th century among the Lydians and Greeks. In the main portion, however, of the Oriental world—Egypt, Syria, Phoenicia and Babylonia—the old mode of commerce was still in vogue, conducted by means of gold and silver bars, weighed at each transaction. Indeed, a money currency only began to make headway in these districts in the 4th century B.C. In the eastern provinces, on the other hand, the primitive method of exchange by barter still held the field. Only in the auriferous and civilized frontier districts of India (the Punjab) did a system of coinage find early acceptance. There Persian and Attic money was widely distributed, and imitations of it struck, in the fifth and fourth pre-Christian centuries.

Thus the empire was compelled to grapple with all these varied conditions and to reconcile them as best it might. At the court, "natural economy" was still the rule. The officials and Oriental troops received payment in kind. They were fed "by the table of the king," from which 15,000 men daily drew their sustenance (cf. Heraclides of Cyme in Athen. iv. 145 B, &c.) and were rewarded by gifts and assignments of land. The Greek mercenaries, on the contrary, had to be paid in currency; nor could the satraps of the west dispense with hard cash. The king, again, needed the precious metals, not merely for bounties and rewards, but for important enterprises in which money payment was imperative. Consequently, the royal revenues and taxes were paid partly in the precious metals, partly in natural produce—horses and cattle, grain, clothing and its materials, furniture and all articles of industry (cf. Theopomp. fr. 124, 125, &c.). The satraps, also, in addition to money payments, levied contributions "for their table," at which the officials ate (Nehem. v. 14).

Money and Coinage.

The precious metals brought in by the tribute were collected in the great treasure-houses at Susa, Persepolis, Pasargadae and Ecbatana, where gigantic masses of silver and, more especially, of gold, were stored in bullion or partially wrought into vessels (Herod. iii. 96; Strabo xv. 731, 735; Arrian iii. 16, &c.); exactly as is the case to-day in the shah's treasure-chamber (Curzon, *Persia*, ii. 484). It is also observable that the conjunction of payments in kind and money taxes still exists. The province of Khorasan, for instance, with some half million inhabitants, paid in 1885 £154,000 in gold, and in addition natural produce to the value of £43,000 (Curzon, *op. cit.* i. 181, ii. 380). When the king required money he minted as much as was necessary. A reform in the coinage was effected by Darius, who struck the Daric (Pers. *Zariq*, *i.e.* "piece of gold"; the word has nothing to do with the name of Darius), a gold piece of 130 grains (value about 23s.); this being equivalent to 20 silver pieces ("Median shekels," σίγλοι) of 86·5 grains (value according to the then rate of silver—13⅓ silver to 1 gold—about 1s. 2d.). The coining of gold was the exclusive prerogative of the king; silver could be coined by the satraps, generals, independent communities and dynasts.

Imperial Policy.

The extent of the Persian Empire was, in essentials, defined by the great conquests of Cyrus and Cambyses. Darius was no more a *conquistador* than Augustus. Rather, the task he set himself was to round off the empire and secure its borders: and for this purpose in Asia Minor and Armenia he subdued the mountain-tribes and advanced the frontier as far as the Caucasus; Colchis alone remaining an independent kingdom under the imperial suzerainty. So, too, he annexed the Indus valley and the auriferous hill-country of Kafiristan and Cashmir (Κάσπιοι or Κάσπειροι, Herod. iii. 93, vii. 67, 86; Steph. Byz.), as well as the Dardae in Dardistan on the Indus (Ctesias, *Ind. fr.* 12. 70, &c.). From this point he directed several campaigns against the Amyrgian Sacae, on the Pamir Plateau and northwards, whom he enumerates in his list of subject races, and whose mounted archers formed a main division of the armies despatched against the Greeks. It was obviously an attempt to take the nomads of the Turanian steppe in the rear and to reduce them to quiescence, which led to his unfortunate expedition against the Scythians of the Russian steppes (*c.* 512 B.C.; cf. DARIUS).

Side by side, however, with these wars, we can read, even in the scanty tradition at our disposal, a consistent effort to further the great civilizing mission imposed on the empire. In the district of Herat, Darius established a great water-basin, designed to facilitate the cultivation of the steppe (Herod. iii. 117). He had the course of the Indus explored by the Carian captain Scylax (*q.v.*) of Caryanda, who then navigated the Indian Ocean back to Suez (Herod. iv. 44) and wrote an account of his voyage in Greek. The desire to create a direct communication between the seclusion of Persis and the commerce of the world is evident in his foundation of several harbours, described by Nearchus, on the Persian coast. But this design is still more patent in his completion of a great canal, already begun by Necho, from the Nile to Suez, along which several monuments of Darius have been preserved. Thus it was possible, as says the remnant of an hieroglyphic inscription there discovered, "for ships to sail direct from the Nile to Persia, over Saba." In the time of Herodotus the canal was in constant use (ii. 158, iv. 39): afterwards, when Egypt regained her independence, it decayed, till restored by the second Ptolemy. Even the circumnavigation of Africa was attempted under Xerxes (Herod. iv. 43).

It has already been mentioned, that, in his efforts to conciliate the Egyptians, Darius placed his chief reliance on the priesthood: and the same tendency runs throughout the imperial policy toward the conquered races. Thus Cyrus himself gave the exiled Jews in Babylon permission to return and rebuild Jerusalem. Darius allowed the restoration of the Temple; and Artaxerxes I., by the protection accorded to Ezra and Nehemiah, made the foundation of Judaism possible (see JEWS: §§ 19 sqq.). Analogously in an edict, of which a later copy is preserved in an inscription (see above), Darius commands Gadatas, the governor of a domain (παράδεισοι) in Magnesia on the Maeander, to observe scrupulously the privileges of the Apollo-sanctuary. With all the Greek oracles—even those in the mother-country—the Persians were on the best of terms. And since these might reasonably expect an enormous extension of their influence from the establishment of a Persian dominion, we find them all zealously medizing during the expedition of Xerxes.

Religion.

For the development of the Asiatic religions, the Persian Empire was of prime importance. The definite erection of a single, vast, world-empire cost them their original connexion with the state, and compelled them in future to address themselves, not to the community at large, but to individuals, to promise, not political success nor the independence of the people, but the welfare of the man. Thus they became at once universal and capable of extension by propaganda; and, with this, of entering into keen competition one with the other. These traits are most clearly marked in Judaism; but, after the Achaemenid period, they are common to all Oriental creeds, though our information as to most is scanty in the extreme.

In this competition of religions that of Iran played a most spirited part. The Persian kings—none more so than Darius, whose religious convictions are enshrined in his inscriptions—and, with the kings, their people, were ardent professors of the pure doctrine of Zoroaster; and the Persians settled in the provinces diffused his creed throughout the whole empire. Thus a strong Persian propagandism arose especially in Armenia and Cappadocia, where the religion took deep root among the people, but also in Lydia and Lycia. In the process, however, important modifications were introduced. In contrast with Judaism, Zoroastrianism did not enter the lists against all gods save its own, but found no difficulty in recognizing them as subordinate powers—helpers and servants of Ahuramazda. Consequently, the foreign creeds often reacted upon the Persian. In Cappadocia, Aramaic inscriptions have been discovered (1900), in which the indigenous god, there termed Bel the king, recognizes the "Mazdayasnian Religion" (*Dīn Mazdayasnish*)—*i.e.* the religion of Ahuramazda personified as a woman—as his sister and wife (Lidzbarski, *Ephem. f. semit. Epigr.* i. 59 sqq.).

The gorgeous cult of the gods of civilization (especially of Babylon), with their host of temples, images and festivals, exercised a corresponding influence on the mother-country. Moreover, the unadulterated doctrine of Zoroaster could no more become a permanent popular religion than can Christianity. For the masses can make little of abstractions and an omnipotent, omnipresent deity; they need concrete divine powers, standing nearer to themselves and their lot. Thus the old figures of the Aryan folk-religion return to the foreground, there to be amalgamated with the Babylonian divinities. The goddess of springs and streams (of the Oxus in particular) and of all fertility—*Ardvisura Anahita, Anaitis*—is endowed with the form of the Babylonian Ishtar and Belit. She is now depicted as a beautiful and strong woman, with prominent breasts, a golden crown of stars and golden raiment. She is worshipped as the goddess of generation and all sexual life (cf. Herod. i. 131, where the names of Mithras and Anaitis are interchanged); and religious prostitution is transferred to her service (Strabo xi. 532, xii. 559). At her side stands the sun-god Mithras, who is represented as a young and victorious hero. Both deities occupy the very first rank in the popular creed; while to the theologian they are the most potent of the good powers—Mithras being the herald and propagator of the service of Light and the mediator betwixt man and Ahuramazda, who now fades more into the background. Thus, in the subsequent period, the Persian religion appears purely as the religion of Mithras. The festival of Mithras is the chief festival of the empire, at which the king drinks and is drunken, and dances the national dance (Ctes. *fr.* 55; Duris *fr.* 13). This development culminated under Artaxerxes II., who, according to Berossus (*fr.* 16 *ap.* Clem. Alex. *prot.* i. 5, 65), first erected statues to Anaitis in Persepolis, Ecbatana, Bactria, Susa, Babylon, Damascus and Sardis. The truth of this account is proved by the fact that Artaxerxes II. and Artaxerxes III. are the only Achaemenids who, in their inscriptions, invoke Anaitis and Mithra side by side with Ahuramazda. Other gods, who come into prominence, are the dragon-slayer Verethraghna (Artagnes) and the Good Thought (Vohumano, Omanos); and even the Sacaean festival is adopted from Babylon (Berossus *fr.* 3; Ctes. *fr.* 16; Strabo xi. 512, &c.). The chief centres of the Persian cults in the west were the district of Acilisene in Armenia (Strabo xi. 532, &c.), the town of Zela in Cappadocia (Strabo xii. 559), and several cities in Lydia.

Art.

The position of the Persian monarchy as a world-empire is characteristically emphasized in the buildings of Darius and Xerxes in Persepolis and Susa. The peculiarly national basis, still recognizable in Cyrus's architecture at Pasargadae, recedes into insignificance. The royal edifices and sculptures are dependent, mainly, on Babylonian models, but, at the same time, we can trace in them the influence of Greece, Egypt and Asia Minor; the last in the rock-sepulchres. All these elements are combined into an organic unity, which achieved the greatest creations that Oriental architecture has found possible. Nevertheless, the result is not a national art, but the art of a world-empire; and it is obvious that foreign craftsmen must have been active in the royal services—among them, the Greek sculptor Telephanes of Phocaea (Pliny xxxiv. 68). So, with the collapse of the empire, the imperial art vanishes also: and when, some 500 years later, a new art arose under the Sassanids, whose achievements stand to those of Achaemenid art in much the same relation as the achievements of the two dynasties to each other, we discover only isolated reminiscences of its predecessor.

For the organization and character of the Persian Empire, see Barnabas Brisson, *De regio Persarum principatu libri iii.* (1590); Heeren, *Ideen über Politik, Handel und Verkehr der alten Welt,* i.; G. Rawlinson, *History of Herodotus,* ii. 555 sqq.; *Five Eastern Monarchies,* iii.; Eduard Meyer, *Geschichte des Altertums,* iii. On the Satrapies, cf. Krumbholz, *De Asiae minoris satrapiis persicis* (1883). See also MITHRAS.

3. *History of the Achaemenian Empire.*—The history of the Persian Empire was often written by the Greeks. The most ancient work preserved is that of Herodotus (*q.v.*), who supplies rich and valuable materials for the period ending in 479 B.C. These materials are drawn partly from sound tradition, partly from original knowledge—as in the account of the satrapies and their distribution, the royal highway, the nations in Xerxes' army and their equipment. They also contain much that is admittedly fabulous: for instance, the stories of Cyrus and Croesus, the conquest of Babylon, &c. Forty years later (*c.* 390 B.C.), the physician Ctesias of Cnidus, who for 17 years (414–398 B.C.) remained in the service of the Great King, composed a great work on the Persian history, known to us from an extract in Photius and numerous fragments. Ctesias (*q.v.*) possesses a more precise acquaintance with Persian views and institutions than Herodotus; and, where he deals with matters that came under his own cognisance, he gives much useful information. For the early period, on the other hand, he only proves how rapidly the tradition had degenerated since Herodotus; and here his narrations can only be utilized in isolated cases, and that with the greatest caution. Of more value was the great work of Dinon of Colophon (*c.* 340), which we know from numerous excellent fragments; and on the same level may be placed a few statements from Heraclides of Cyme, which afford specially important evidence on Persian institutions. To these must be added the testimony of the other Greek historians (Thucydides, Ephorus, Theopompus, &c., with the histories of Alexander), and, before all, that of Xenophon in the *Anabasis* and *Hellenica.* The *Cyropaedia* is a didactic romance, written with a view to Greek institutions and rarely preserving genuine information on the Persian Empire. Of Oriental sources, only the contemporary books of Ezra and Nehemiah are of much importance: also, a few statements in the much later Esther romance. Berossus's history of Babylon contained much valuable and trustworthy information, but next to nothing has survived. That the native tradition almost entirely forgot the Achaemenid Empire, has been mentioned above. For a more detailed account

of these sources see separate articles on HERODOTUS, &c.; EZRA; and NEHEMIAH.

Of modern accounts see especially Th. Nöldeke, *Aufsätze zur persischen Geschichte* (1887). The works of Marquart, *Untersuchungen zur Geschichte von Eran* (2 pts., 1896–1905), abound in daring theories and must be used with caution. On the chronology, cf. Eduard Meyer, *Forschungen zur alten Geschichte*, ii.

List of the Kings.

The external history of the empire is treated under the individual kings (see also history sections of articles GREECE; EGYPT; &c.). The order is as follows:—

CYRUS (558–528); conquered the Medes in 550; king of Babylon from 538.
CAMBYSES (528–521).
SMERDIS (521).
DARIUS I. (521–485).
XERXES I. (485–465).
ARTAXERXES I. (465–425).
(XERXES II. and Secydianus or Sogdianus, 425–424.)
DARIUS II. Nothus (424–404).
ARTAXERXES II. (404–359).
ARTAXERXES III. Ochus (359–338).
ARSES (338–336).
DARIUS III. (336–330).

The chronology is exactly verified by the Ptolemaic canon, by numerous Babylonian and a few Egyptian documents, and by the evidence of the Greeks. The present article gives only a brief conspectus of the main events in the history of the empire.

The Wars against Greece.

Though, unlike Cyrus and Cambyses, Darius made no new expeditions of conquest, yet a great empire, which is not bounded by another equally great, but touches on many small tribes and independent communities, is inevitably driven to expansion. We have already seen that the attempt of Darius to control the predatory nomads in the north led to his expedition against the Scythians; this, again, led to the incorporation of Thrace and Macedonia, whose king Perdiccas submitted. And since a great portion of the Mediterranean coast-line belonged to the empire, further complications resulted automatically. In contrast with the Greeks Carthage took the part of Persia. Darius, indeed, numbers the city—under the name of Karka—among his dominions: as also the Maxyans (Maciya) on the Syrtes (Andreas, *Verhandl. d. xiii. oriental. Congresses*, Hamburg, 1902, p. 97). But, above all, the Greek cities with their endless feuds and violent internal factions, were incessant in their appeals for intervention. Nevertheless, Darius left European Greece to itself, till the support accorded to the Ionian and Carian insurgents by Athens and Eretria (499 B.C.) made war inevitable. But not only the expeditions of Mardonius (492) and Datis (490), but even the carefully prepared campaign of Xerxes, in conjunction with Carthage, completely failed (480–479). On the fields of Marathon and Plataea, the Persian archers succumbed to the Greek phalanx of hoplites; but the actual decision was effected by Themistocles, who had meanwhile created the Athenian fleet which at Salamis proved its superiority over the Perso-Phoenician armada, and thus precluded beforehand the success of the land-forces.

The wreck of Xerxes' expedition is the turning-point in the history of the Persian Empire. The superiority of the Greeks was so pronounced that the Persians never found courage to repeat their attack. On the contrary, in 466 B.C. their army and fleet were again defeated by Cimon on the Eurymedon, the sequel being that the Greek provinces on the Asiatic coast, with all the Thracian possessions, were lost. In itself, indeed, this loss was of no great significance to such a vast empire; and the attempts of Athens to annex Cyprus and conquer the Nile valley, in alliance with the revolted Egyptians, ended in failure. Athens, in fact, had not sufficient strength to undertake a serious invasion of the empire or an extensive scheme of conquest. Her struggles with the other Hellenic states constrained her, by the peace of Callias (448), definitely to renounce the Persian war; to abandon Cyprus and Egypt to the king; and to content herself with his promise—not that he would surrender the littoral towns, but that he would abstain from an armed attack upon them. The really decisive point was, rather, that the disasters of Salamis and Plataea definitely shattered the offensive power of the empire; that the centre of gravity in the world's history had shifted from Susa and Babylon to the Aegean Sea; and that the Persians were conscious that in spite of all their courage they were henceforward in the presence of an enemy, superior in arms as well as in intellect, whom they could not hope to subdue by their own strength.

Internal State of the Empire. Rebellions.

Thus the great empire was reduced to immobility and stagnation—a process which was assisted by the deteriorating influences of civilization and world-dominion upon the character of the ruling race. True, the Persians continued to produce brave and honourable men. But the influences of the harem, the eunuchs, and similar court officials, made appalling progress, and men of energy began to find the temptations of power stronger than their patriotism and devotion to the king. Thus the satraps aspired to independence, not merely owing to unjust treatment, but also to avarice or favourable conditions. As early as 465 B.C., Xerxes was assassinated by his powerful vizier (chiliarch) Artabanus, who attempted to seize the reins of empire in fact, if not in name. A similar instance may be found in Bagoas (*q.v.*), after the murder of Artaxerxes III. (338 B.C.). To these factors must be added the degeneration of the royal line—a degeneration inevitable in Oriental states. Kings like Xerxes and more especially Artaxerxes I. and Artaxerxes II., so far from being gloomy despots, were good-natured potentates, but weak, capricious and readily accessible to personal influences. The only really brutal tyrants were Darius II., who was completely dominated by his bloodthirsty wife Parysatis, and Artaxerxes III. who, though he shed rivers of blood and all but exterminated his whole family, was successful in once more uniting the empire, which under the feeble sway of his father had been threatened with dissolution.

The upshot of these conditions was, that the empire never again undertook an important enterprise, but neglected more and more its great civilizing mission. In considering, however, the subsequent disorders and wars, it must be borne in mind that they affected only individual portions of the empire, and only on isolated occasions involved more extensive areas in long and serious strife. To most of the provinces the Achaemenid dominion was synonymous with two centuries of peace and order. Naturally, however, the wild tribes of the mountains and deserts, who could be curbed only by strict imperial control, asserted their independence and harassed the neighbouring provinces. Among these tribes were the Carduchians in Zagros, the Cossaeans and Uxians in the interior of Elam, the Cadusians and other non-Aryan tribes in northern Media, the Pisidians, Isaurians and Lycaonians in the Taurus, and the Mysians in Olympus. All efforts to restore order in these districts were fruitless; and when the kings removed their court to Ecbatana, they were actually obliged to purchase a free passage from the mountain tribes (Strabo xi. 524; Arrian iii. 17, 1). The kings (*e.g.* Artaxerxes II.) repeatedly took the field in great force against the Cadusians, but unsuccessfully. When, in 400 B.C., Xenophon marched with the mercenaries of Cyrus from the Tigris to the Black Sea, the authority of the king was nonexistent north of Armenia, and the tribes of the Pontic mountains, with the Greek cities on the coast, were completely independent. In Paphlagonia, the native dynasts founded a powerful though short-lived kingdom, and the chieftains of the Bithynians were absolutely their own masters. The frontier provinces of India were also lost. Egypt, which had already revolted under Libyan princes in the years 486–484, and again with Athenian help in 460–454, finally asserted its independence in 404. Henceforward the native dynasties repelled every attack, till they succumbed once more before Artaxerxes III. and Mentor of Rhodes.

In the other civilized countries, indeed, the old passion for freedom had been completely obliterated; and after the days of Darius I.—apart from the Greek, Lycian and Phoenician towns—not a single people in all these provinces dreamed of shaking off the foreign dominion. All the more clearly, then, was the inner weakness of the empire revealed by the revolts of the satraps. These were facilitated by the custom—quite contrary to the original imperial organization—which entrusted the provincial military commands to the satraps, who began to receive great masses of Greek mercenaries into their service. Under Artaxerxes I. and Darius II., these insurrections were still rare. But when the revolt of the younger Cyrus against his brother (401 B.C.) had demonstrated the surprising ease and rapidity with which a courageous army could penetrate into the heart of the empire—when the whole force of that empire had proved powerless, not only to prevent some 12,000 Greek troops, completely surrounded, cut off from their communications, and deprived through treachery of their leaders, from escaping to the coast, but even to make a serious attack on them—then, indeed, the imperial impotence became manifest. After that, revolts of the satraps in Asia Minor and Syria were of everyday occurrence, and the task of suppressing them was complicated by the foreign wars which the empire had to sustain against Greece and Egypt.

Later Wars with the Greeks. Peace of Antalcidas.

At this very period, however, the foreign policy of the empire gained a brilliant success. The collapse of the Athenian power before Syracuse (413 B.C.) induced Darius II. to order his satraps Tissaphernes and Pharnabazus, in Asia Minor, to collect the tribute overdue from the Greek cities. In alliance with Sparta (see PELOPONNESIAN WAR), Persia intervened in the conflict against Athens, and it was Persian gold that made it possible for Lysander to complete her overthrow (404 B.C.). True, war with Sparta followed immediately, over the division of the spoils, and the campaigns of the Spartan generals in Asia Minor (399–395) were all the more dangerous as they gave occasion to numerous rebellions. But Persia joined the Greek league against Sparta, and in 394 Pharnabazus and Conon annihilated the Lacedaemonian fleet at Cnidus. Thus the Spartan power of offence was crippled; and the upshot of the long-protracted war was that Sparta ruefully returned to the Persian alliance, and by the Peace of Antalcidas (*q.v.*), concluded with the king in 387 B.C., not only renounced all claims to the Asiatic possessions, but officially proclaimed the Persian suzerainty over Greece. Ninety years after Salamis and Plataea, the goal for which Xerxes had striven was actually attained, and the king's will was law in Greece. In the following decades, no Hellenic state ventured to violate the king's peace, and all the feuds that followed centred round the efforts of the combatants—Sparta, Thebes, Athens and Argos—to draw the royal powers to their side (see GREECE: *Ancient History*).

But, for these successes, the empire had to thank the internecine strife of its Greek opponents, rather than its own strength. Its feebleness, when thrown on its own resources, is evident from the fact that, during the next years, it failed both to reconquer Egypt and to suppress completely King Evagoras of Salamis in Cyprus. The satrap revolts, moreover, assumed more and more formidable proportions, and the Greek states began once more to tamper with them. Thus the reign of Artaxerxes II. ended, in 359 B.C., with a complete dissolution of the imperial authority in the west. His successor, Artaxerxes Ochus, succeeded yet again in restoring the empire in its full extent. In 355 B.C., he spoke the fatal word, which, a second—or rather a third—time, demolished the essentially unsound power of Athens. In 343 he reduced Egypt, and his generals Mentor and Memnon, with his vizier Bagoas (*q.v.*), crushed once and for all the resistance in Asia Minor. At his death in 338, immediately before the final catastrophe, the empire to all appearances was more powerful and more firmly established than it had been since the days of Xerxes.

Progress of Greek Influence.

These successes, however, were won only by means of Greek armies and Greek generals. And simultaneously the Greek civilization—diffused by mercenaries, traders, artists, prostitutes and slaves,—advanced in ever greater force. In Asia Minor and Phoenicia we can clearly trace the progress of Hellenism (*q.v.*), especially by the coinage. The stamp is cut by Greek hands and the Greek tongue predominates more and more in the inscription. We can see that the victory of Greek civilization had long been prepared on every side. But the vital point is that the absolute superiority of the Hellene was recognized as incontestable on both hands. The Persian sought to protect himself against danger, by employing Greeks in the national service and turning Greek policy to the interests of the empire. In the Greek world itself the disgrace that a people, called to universal dominion and capable of wielding it, should be dependent on the mandate of an impotent Asiatic monarchy, was keenly felt by all who were not yet absorbed in the rivalry of city with city. The spokesman of this national sentiment was Isocrates; but numerous other writers gave expression to it, notably, the historian Callisthenes of Olynthus. Union between Greeks, voluntary or compulsory, and an offensive war against Persia, was the programme they propounded.

Rise of Macedon.

Nor was the time for its fulfilment far distant. The new power which now rose to the first rank, created by Philip of Macedon, had no engrained tendency inimical to the Persian Empire. Its immediate programme was rather Macedonian expansion, at the expense of Thrace and Illyria, and the subjection of the Balkan Peninsula. But, in its efforts to extend its power over the Greek states, it was bound to make use of the tendencies which aimed at the unification of Greece for the struggle against Persia: and this ideal demand it dared not reject.

Thus the conflict became inevitable. In 340, Artaxerxes III. and his satraps supported the Greek towns in Thrace—Perinthus and Byzantium—against Macedonian aggression; in 338 he concluded an alliance with Demosthenes. When Philip, after the victory of Chaeronea, had founded the league of Corinth (337) embracing the whole of Greece, he accepted the national programme, and in 336 despatched his army to Asia Minor. That he never entertained the thought of conquering the whole Persian Empire is certain. Presumably, his ambitions would have been satisfied with the liberation of the Greek cities, and, perhaps, the subjection of Asia Minor as far as the Taurus. With this his dominion would have attained much the same compass as later under Lysimachus; farther than this the boldest hopes of Isocrates never went.

But Philip's assassination in 336 fundamentally altered the situation. In the person of his son, the throne was occupied by a soldier and statesman of genius, saturated with Greek culture and Greek thought, and intolerant of every goal but the highest. To conquer the whole world for Hellenic civilization by the aid of Macedonian spears, and to reduce the whole earth to unity, was the task that this heir of Heracles and Achilles saw before him. This idea of universal conquest was with him a conception much stronger developed than that which had inspired the Achaemenid rulers, and he entered on the project with full consciousness in the strictest sense of the phrase. In fact, if we are to understand Alexander aright, it is fatal to forget that he was overtaken by death, not at the end of his career, but at the beginning, at the age of thirty-three.

Alexander the Great.

VI. *The Macedonian Dominion.*—How Alexander conquered Persia, and how he framed his world-empire,[1] cannot be related here. The essential fact, however, is that after the victory of Gaugamela (Oct. 1, 331 B.C.) and, still more completely, after the assassination of Darius—avenged according to the Persian laws, on the perpetrators—Alexander regarded himself as the legitimate head of the Persian Empire, and therefore adopted the dress and ceremonial of the Persian kings.

With the capture of the capitals, the Persian war was at an end, and the atonement for the expedition of Xerxes was complete—a truth symbolically expressed in the burning of the palace at Persepolis. Now began the world-conquest. For an universal empire, however, the forces of Macedonia and Greece were insufficient; the monarch of a world-empire could not be bound by the limitations imposed on the tribal king of Macedon or the general of a league of Hellenic republics. He must stand as an autocrat, above them and above the law, realizing the theoretical doctrines of Plato and Aristotle, as the true king, who is a god among men, bound no more than Zeus by a law, because "himself he is the law." Thus the divine kingship of Alexander derives in direct line, not from the Oriental polities—which (Egypt apart) know nothing of royal apotheosis—but from these Hellenic theories of the state. Henceforward it becomes the form of every absolute monarchy in a civilized land, being formally mitigated only in Christian states by the assumption that the king is not God, but king "by the grace of God." The expedition of 332 B.C. to the shrine of Ammon was a preliminary to this procedure, which, in 324, was sealed by his official elevation to divine rank in all the republics of Greece. To this corresponds the fact that, instead of acting on the doctrines of Aristotle and Callisthenes, and treating the Macedonians and Greeks as masters, the Asiatics as servants, Alexander had impartial recourse to the powers of all his subjects and strove to amalgamate them. In the Persians particularly he sought a second pillar for his world-empire. Therefore, as early as 330 B.C., he drafted 30,000 young Persians, educated them in Greek customs, and trained them to war on the Macedonian model. The Indian campaign showed that his Macedonian troops were in fact inadequate to the conquest of the world, and in the summer of 326 they compelled him to turn back from the banks of the Hyphasis. On his return to Persia, he consummated at Susa (Feb. 324 B.C.) the union of Persian and Macedonian by the great marriage-feast, at which all his superior officers, with some 10,000 more Macedonians, were wedded to Persian wives. The Macedonian veterans were then disbanded, and the Persians taken into his army. Simultaneously, at the Olympian festival of 324, the command was issued to all the cities of Greece to recognize him as god and to receive the exiles home.[1] In 323 B.C. the preparations for the circumnavigation and subjection of Arabia were complete: the next enterprise being the conquest of the West, and the battle for Hellenic culture against Carthage and the Italian tribes. At that point Alexander died in Babylon on the 13th of June 323 B.C.

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[1] See ALEXANDER THE GREAT; MACEDONIAN EMPIRE; HELLENISM (for later results).

The Kingdoms of the Diadochi.

Alexander left no heir. Consequently, his death not only ended the scheme of universal conquest, but led to an immediate Macedonian reaction. The army, which was considered as the representative of the people, took over the government under the direction of its generals. The Persian wives were practically all discarded and the Persian satraps removed—at least from all important provinces. But the attempt to maintain the empire in its unity proved impracticable; and almost immediately there began the embittered war, waged for several decades by the generals (diadochi), for the inheritance of the great king.[2] It was soon obvious that the eastern rulers, at all events, could not dispense with the native element. Peucestas, the governor of Persis, there played the rôle of Alexander and won the Persians completely to his side; for which he was dismissed by Antigonus in 315 (Diod. xix. 48). A similar position was attained by Seleucus—the only one of the diadochi, who had not divorced his Persian wife, Apama—in Babylonia, which he governed from 319 to 316 and regained in the autumn of 312. While Antigonus, who, since 315, had striven to win the kingdom of Alexander for himself—was detained by the war with his rivals in the west, Seleucus, with Babylon as his headquarters, conquered the whole of Iran as far as the Indus. In northern Media alone, which lay outside the main scene of operations and had only been partially subject to the later Achaemenids, the Persian satrap Atropates, appointed by Alexander, maintained his independence and bequeathed his province to his successors. His name is borne by north Media to the present day—Atropatene, modern Azerbaijan or Adherbeijan (see MEDIA). So, too, in Armenia the Persian dynasty of the Hydarnids held its ground; and to these must be added, in the east of Asia Minor, the kingdoms of Pontus and Cappadocia, founded *c.* 301, by the Persians Mithradates I. and Ariarathes I. These states were fragments of the Achaemenid Empire, which had safely transferred themselves to the Hellenistic state-system.

Seleucus I. Nicator, and Antiochus I.

The annexation of Iran by Seleucus Nicator led to a war for the countries on the Indian frontier; his opponent being Sandracottus or Chandragupta Maurya (*q.v.*), the founder of the great Indian Empire of Maurya (Palimbothra). The result was that Seleucus abandoned to the Indian king, not merely the Indian provinces, but even the frontier districts west of the Indus (Strabo xv. 689–724), receiving as compensation 500 elephants, with other presents (Appian, *Syr.* 55; Justin xv. 4; Plut. *Alex.* 62; Athen. i. 18 D.). His next expedition was to the west to assist Lysimachus, Ptolemy and Cassander in the overthrow of Antigonus.

The battle of Ipsus, in 301, gave him Syria and the east of Asia Minor; and from then he resided at the Syrian town of Antiochia on the Orontes. Shortly afterwards he handed over the provinces east of the Euphrates to his son Antiochus, who, in the following years, till 282, exercised in the East a very energetic and beneficial activity, which continued the work of his father and gave the new empire and the Oriental Hellenistic civilization their form. In order to protect his conquests Alexander had founded several cities in Bactria, Sogdiana and India, in which he settled his veterans. On his death, these revolted and endeavoured to return to Greece, but were attacked and cut to pieces by Pithon (Diod. xviii. 7). Of the other Greek towns in Asia scarcely any were founded by Alexander himself, though the plan adopted by his successors of securing their dominions by building Greek cities may perhaps be due to him (cf. Polyb. x. 27). Most of these new cities were based on older settlements; but the essential point is, that they were peopled by Greek and Macedonian colonists, and enjoyed civic independence with laws, officials, councils and assemblies of their own, in other words, an autonomous communal constitution, under the suzerainty of the empire. A portion, moreover, of the surrounding land was assigned to them. Thus a great number of the country districts—the ἔθνη above mentioned—were transformed into municipal corporations, and thereby withdrawn from the immediate government of the king and his officials (satraps or *strategi*), though still subject to their control, except in the cases where they received unconditional freedom and so ranked as "confederates." The native population of these villages and rural districts, at first, had no civic rights, but were governed by the foreign settlers. Soon, however, the two elements began to coalesce; in the Seleucid Empire, the process seems generally to have been both rapid and complete. Thus the cities became the main factors in the diffusion of Hellenism, the Greek language and the Greek civilization over all Asia as far as the Indus. At the same time they were the centres of commerce and industrial life: and this, in conjunction with the royal favour, and the privileges accorded them, continually drew new settlers (especially Jews), and many of them developed into great and flourishing towns (see further under HELLENISM).

Greek Towns in Iran.

Shortly after his conquest of Babylonia, Seleucus had founded a new capital, Seleucia (*q.v.*), on the Tigris: his intention being at once to displace the ancient Babylon from its former central position, and to replace it by a Greek city. This was followed by a series of other foundations in Mesopotamia, Babylonia and Susiana (Elam). "Media," says Polybius (x. 27), "was encircled by a sequence of Greek towns, designed as a barrier against the barbarians." Among those mentioned are: Rhagae (Rai), which Seleucus metamorphosed into a Hellenic city, Europus, Laodicea, Apamea and Heraclea (Strabo xi. 525 Plin. vi. 43: cf. MEDIA). To these must be added Achaea in Parthia, and, farther to the east, Alexandria Arion in Aria the modern Herat: also Antiochia Margiana (Strabo xi. 514, 516 Plin. 46, 93), now Merv, and many others. Further, Alexandria in Aradrosia, near Kandahar, and the towns founded by Alexander on the Hindu-Kush and in Sogdiana.

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[1] The discussion of these events by Hogarth "The Deification of Alexander the Great," in the *English Historical Review*, ii. (1887), is quite unsatisfactory.

[2] See PTOLEMIES; SELEUCID DYNASTY.

Thus an active Hellenic life soon arose in the East; and Greek settlers must have come in numbers and founded new cities, which afterwards formed the basis of the Graeco-Bactrian kingdom. Antiochus's general Demodamas crossed the Jaxartes and set up an altar to the Didymaean Apollo (Plin. vi. 49). Another general, Patrocles, took up the investigation of the Caspian, already begun by Alexander. In contrast with the better knowledge of an older period, he came to the conclusion that the Caspian was connected with the ocean, and that it was possible to reach India on ship-board by that route (Strabo ii. 74, xi. 518; Plin. vi. 38). A project of Seleucus to connect the Caspian with the Sea of Azov by means of a canal is mentioned by Pliny (vi. 31). To Patrocles is due the information that an active commerce in Indian wares was carried on with the shores of the Black Sea, via the Caspian (Strabo xi. 509).

The Persian Religion under Greek Rule.

While Hellenism was thus gaining a firm footing in all the East, the native population remained absolutely passive. Apart from the rude mountain tribes, no national resistance was dreamed of for centuries. The Iranians quietly accepted the foreign yoke, and the higher classes adopted the external forms of the alien civilization (cf. the dedication of a Bactrian, Hyspasines, son of Mithroaxes, in the inventory of the temple of Apollo in Delos, Dittenberger, *Sylloge*, 588, l. 109) even though they were unable to renounce their innate characteristics. Eratosthenes, for instance, speaks (*ap.* Strabo i. 66) in high terms of the Iranians (*Ariani*), ranking them (as well as the Indians, Romans and Carthaginians) on a level with the Greeks, as regards their capacity for adopting city civilization. The later Parsee tradition contends that Alexander burned the sacred books of Zoroaster, the *Avesta*, and that only a few fragments were saved and afterwards reconstructed by the Arsacids and Sassanids. This is absolutely unhistorical. The Persian religion was never attacked by the Macedonians and Greeks. Under their dominion, on the contrary, it expanded with great vigour, not only in the west (Armenia, north Syria and Asia Minor, where it was the official religion of the kings of Pontus and Cappadocia), but also in the east, in the countries of the Indian frontier. That the popular gods—Mithras, Anaitis, &c.—had come to the forefront has already been mentioned. This propagandism, however, was void of all national character, and ran on precisely the same lines as the propagandism of the Syrian, Jewish and Egyptian cults. Only in Persia itself, so far as we can judge from a few scanty traces, the national character of the religion seems to have survived among the people side by side with the memory of their old imperial position.

Independent Kingdoms in Bactria and Parthia.

In 282 B.C. Seleucus took the field against Lysimachus, and annexed his dominions in Asia Minor and Thrace. In 281 he was assassinated in crossing to Europe, and his son Antiochus I. was left supreme over the whole empire. From that time onward the Seleucid Empire was never at rest. Its gigantic extent, from the Aegean to the Indus, everywhere offered points of attack to the enemy. The Lagidae, especially, with their much more compact and effective empire, employed every means to weaken their Asiatic rivals; and auxiliaries were found in the minor states on the frontier—Atropatene, Armenia, Cappadocia, Pontus and Bithynia, the Galatians, Pergamum, Rhodes and other Greek states. Moreover, the promotion of Greek civilization and city life had created numerous local centres, with separate interests and centrifugal tendencies, struggling to attain complete independence, and perpetually forcing new concessions from the empire. Thus the Seleucid kings, courageous as many of them were, were always battling for existence (see Seleucid Dynasty).

These disturbances severely affected the borders of Iran. While the Seleucid Empire, under Antiochus II. Theos (264–247), was being harried by Ptolemy II. Philadelphus, and the king's attention was wholly engaged in the defence of the western provinces, the Greeks revolted in Bactria, under their governor Diodotus (*q.v.*). Obviously, it was principally the need of protection against the nomadic tribes which led to the foundation of an independent kingdom; and Diodotus soon attained considerable power over the provinces north of the Hindu-Kush. In other provinces, too, insurrection broke out (Strabo xi. 575, Justin xli. 4); and Arsaces, a chief of the Parni or Aparni—an Iranian nomad tribe (therefore often called Dahan Scythians), inhabiting the steppe east of the Caspian—made himself master of the district of Parthia (*q.v.*) in 248 B.C. He and his brother Tiridates (*q.v.*) were the founders of the Parthian kingdom, which, however, was confined within very modest limits during the following decades. Seleucus II. Callinicus (247–226) successfully encountered Arsaces (or Tiridates), and even expelled him (*c.* 238); but new risings recalled Seleucus to Syria, and Arsaces was enabled to return to Parthia.

Antiochus III., the Great.

Greater success attended Antiochus III., the Great (222–187). At the beginning of his reign (220) he subdued, with the help of his minister Hermias, an insurrection of the satrap Molon of Media, who had assumed the royal title and was supported by his brother Alexander, satrap of Persis (Polyb. v. 40 sqq.). He further seized the opportunity of extorting an advantageous peace from King Artabazanes of Atropatene, who had considerably extended his power (Polyb. v. 55). After waging an unsuccessful war with Ptolemy IV. for the conquest of Coele-Syria, but suppressing the revolt of Achaeus in Asia Minor, and recovering the former provinces of the empire in that quarter, Antiochus led a great expedition into the East, designing to restore the imperial authority in its full extent. He first removed (211) the Armenian king Xerxes by treachery (Polyb. viii. 25; John of Antioch, *fr.* 53), and appointed two governors, Artaxias and Zariadris, in his place (Strabo xi. 531). During the next year he reduced the affairs of Media to order (Polyb. x. 27); he then conducted a successful campaign against Arsaces of Parthia (209), and against Euthydemus (*q.v.*) of Bactria (208–206), who had overthrown the dynasty of Diodotus (Polyb. x. 28 sqq., 48 sqq., xi. 34; Justin xli. 5). In spite of his successes he concluded peace with both kingdoms, rightly considering that it would be impossible to retain these remote frontier provinces permanently. He next renewed his old friendship with the Indian king Sophagasenus (Subhagasena), and received from him 150 elephants (206 B.C.). Through Arachosia and Drangiane, in the valley of the Etymander (Helmand), he marched to Carmania and Persis (Polyb. xi. 34). Both here and in Babylonia he re-established the imperial authority, and in 205 undertook a voyage from the mouth of the Tigris, through the Arabian gulf to the flourishing mercantile town of Gerrha in Arabia (now Bahrein) (Polyb. xiii. 9).

Decay of the Seleucid Empire.

Shortly afterwards, however, his successful campaign against Ptolemy V. Epiphanes led to a war with Rome in which the power of the Seleucid Empire was shattered (190 B.C.), Asia Minor lost, and the king compelled to pay a heavy contribution to Rome for a long term of years. In order to raise money he plundered a wealthy temple of Bel in Elam, but was killed by the inhabitants, 187 B.C. (Diod. xxviii. 3, xxix. 15; Strabo xvi. 744; Justin xxxii. 2; S. Jerome (Hieronymus) on *Dan.* xi. 19; Euseb. *Chron.* i. 253). The consequence of this enfeeblement of the empire was that the governors of Armenia asserted their independence. Artaxias founded the kingdom of Great Armenia; Zariadris, that of Sophene on the Euphrates and the sources of the Tigris (Strabo xi. 531). In other districts, also, rebellions occurred; and in the east, Euthydemus and his successors (Demetrius, Eucratidas, &c.) began the conquest of the Indus region and the Iranian borderland (Arachosia, Aria). (See Bactria; Euthydemus; Eucratidas; Demetrius; Menander.)

But the energetic Seleucids fought desperately against their fate. Antiochus IV. Epiphanes (176–163) restored once more the Eastern dominion, defeated Artaxias of Armenia (Appian, *Syr.* 45; Diod. xxxi. 17a; S. Jerome on *Dan.* xi. 40), restored several towns in Babylonia and subdued the Elymaeans. His attempt, however, to plunder the sanctuary of Anaitis failed (Polyb. xxxi. 11; cf. Maccab. i. 6, ii. 1, 13; App. *Syr.* 66). Persis, also, and

Media were still subject to him. But after his death at Tabae in Persis (163 B.C.; cf. Polyb. xxxi. 11; Maccab. i. 6, ii. 9; Jos. *Ant. Jud.* xii. 9, 1), the Romans took advantage of the dynastic broils to destroy the Seleucid Empire. They reduced its army and fleet, and favoured every rebellion: among others, that of the Jews. In spite of all, Demetrius I. Soter (161–150) succeeded in suppressing (159) a revolt of Timarchus of Miletus, governor of Babylon, who had occupied Media, assumed the title of "great king," and had been recognized by the Romans (Appian, *Syr.* 45–47; Trogus, *Prol.* 34; Diod. xxxi. 27 A: cf. the coins of Timarchus).[1]

Mithradates I. and Phraates II.

VII. *The Parthian Empire of the Arsacids.*—Meanwhile, in the east, the Arsacids had begun their expansion. Phraates I. (*c.* 175–170) subdued the Mardians in Elburz. His brother Mithradates I. (*c.* 170–138) had to sustain a difficult war with Eucratides of Bactria, but eventually succeeded in wresting from him a few districts on the Turanian frontier. Indeed, he penetrated as far as, and farther than, the Indus (Diod. xxxiii. 18; Oros. v. 4, 16). In the west he conquered Media, and thence subdued Babylonia. He further reduced the Elymaeans, sacked their temple in the mountains, and captured the Greek city of Seleucia on the Hedyphon (Strabo xvi. 744; Justin xli. 6). The Seleucids, meanwhile, were harassed by aggravated disorders and insurrections. Nevertheless, in 140, Demetrius II. Nicator took the field in order to save the east, but was defeated and captured. Shortly afterwards Mithradates I. died. His son Phraates II. (*c.* 138–127) was attacked in 130 by Antiochus VII. Sidetes, the brother of Demetrius II., on which the Parthian king released the latter. Antiochus pressed successfully on, and once more recovered Babylonia, but in 129 was defeated in Media and fell in a desperate struggle. With this battle the Seleucid dominion over the countries east of the Euphrates was definitely lost. The Babylonian towns, especially Seleucia (*q.v.*), were handed over by Phraates to his favourite, the Hyrcanian Himerus, who punished them severely for their resistance.

Mithradates II. and his Successors.

During these wars great changes had taken place in eastern Iran. In 159 Mongolian tribes, whom the Chinese call Yue-chi and the Greeks Scythians, forced their way into Sogdiana, and, in 139, conquered Bactria (Strabo xi. 571; Justin xlii. 1; Trog. *Prol.* 41; see BACTRIA). From Bactria they tried to advance farther into Iran and India. Entering into an alliance with Antiochus VII., they assailed the Parthian Empire. Phraates II. marched to encounter him, but was himself defeated and slain, and his country ravaged far and wide. His successor Artabanus I. (*c.* 127–124), the uncle of Phraates, also fell in battle against the Tocharians, the principal Scythian tribe (Justin xlii. 1, 2; Jos. *Ant. fr.* 66); but his son Mithradates II., surnamed "The Great" (*c.* 124–88), defeated the Scythians and restored for a while the power of the Arsacids. He also defeated Artavasdes, the king of Great Armenia; his son Tigranes, a hostage in the hands of the Parthians, was only redeemed by the cession of 70 valleys (Strabo xi. 532). When Tigranes attempted to seize Cappadocia, and the Roman praetor P. Cornelius Sulla advanced against him, Mithradates in 92 B.C. concluded the first treaty between Parthia and Rome (Plut. *Sulla*, v.; Liv. *epit.* 70). The dynastic troubles of the Seleucids in Syria gave him an opportunity for successful intervention (Jos. *Ant. Jud.* xiii. 13, 4; 14, 3). Shortly afterwards he died; and, with his death, the Arsacid power collapsed for the second time. The possession of the western provinces and the dominant position in western Asia passed to the Armenian Tigranes (*q.v.*), who wrested from the Parthians Mesopotamia and the suzerainty of Atropatene, Gordyene, Adiabene, Osroene. Simultaneously began a new and severe conflict with the Scythians. Parthian coins, probably dating from this period (Wroth, *Catal. of the Coins of Parthia*, 1903, p. xxx. and p. 40), mention victorious campaigns of Parthian kings and a conquest of the provinces of Aria, Margiane and (?) Traxiane (cf. Strabo xi. 505). But how confused the situation was is shown by the fact that in 76 B.C. the octogenarian king Sanatruces was seated on the Parthian throne by the Scythian tribe of the Sacaraucians (cf. Strabo xi. 511; Trog. *Prol.* 42). The names of his predecessors are not known to us. Obviously this period was marked by continual dynastic feuds (cf. Trog. *Prol.* 42: "ut varia complurium regum in Parthia successione imperium accepit Orodes qui Crassum delevit"). Not till Sanatruces' successor Phraates III. (70–57) do we find the kingdom again in a settled state.

Conflicts with the Romans.

A fact of decisive significance was that the Romans now began to advance against Tigranes. In vain Mithradates of Pontus and Tigranes turned to the Parthian king, the latter even proffering restitution of the conquered frontier provinces. Phraates, though rightly distrusting Rome, nevertheless concluded a treaty with Lucullus (69 B.C.) and with Pompey, and even supported the latter in his campaign against Tigranes in 66. But after the victory it was manifest that the Roman general did not consider himself bound by the Parthian treaty. When Tigranes had submitted, Pompey received him into favour and extended the Roman supremacy over the vassal states of Gordyene and Osroene; though he had allured the Parthian king with the prospect of the recovery of his old possessions as far as the Euphrates. Phraates complained, and simultaneously attacked Tigranes, now a Roman vassal (64 B.C.). But when Pompey refused reparation Phraates recognized that he was too weak to begin the struggle with Rome, and contented himself with forming an alliance with Tigranes, in hopes that the future would bring an opportunity for his revenge (Dio Cass. xxxvi. 3, 5; xxxvii. 5 sqq.; Plut. *Luc.* 30; *Pomp.* 33, 38; cf. Sallust's letter of Mithradates to Arsaces).

Although Phraates III. had not succeeded in regaining the full power of his predecessors, he felt justified in again assuming the title "king of kings"—which Pompey declined to acknowledge—and even in proclaiming himself as "god" (Phlegon, *fr.* 12 *ap.* Phot. *cod.* 97; and on part of his coins), but in 57 B.C. the "god" was assassinated by his sons Orodes and Mithradates.

Organization.

The Parthian Empire, as founded by the conquests of Mithradates I. and restored, once by Mithradates II. and again by Phraates III., was, to all exterior appearance, a continuation of the Achaemenid dominion. Thus the Arsacids now began to assume the old title "king of kings" (the *shahanshah* of modern Persia), though previously their coins, as a rule, had borne only the legend "great king." The official version, preserved by Arrian in his *Parthica* (*ap.* Phot. *cod.* 58: see PARTHIA), derives the line of these chieftains of the Parnian nomads from Artaxerxes II. In reality, however, the Parthian Empire was totally different from its predecessor, both externally and internally. It was anything rather than a world-empire. The countries west of the Euphrates never owned its dominion, and even of Iran itself not one half was subject to the Arsacids. There were indeed vassal states on every hand, but the actual possessions of the kings—the provinces governed by their satraps—consisted of a rather narrow strip of land, stretching from the Euphrates and north Babylonia through southern Media and Parthia as far as Arachosia (north-west Afghanistan), and following the course of the great trade-route which from time immemorial had carried the traffic between the west of Asia and India. We still possess a description of this route by Isidore of Charax, probably dating from the Augustan period (in C. Müller, *Geographi graeci minores*, vol. i.), in which is contained a list of the 18 imperial provinces, known also to Pliny (vi. 112; cf. 41). Isidore, indeed, enumerates nineteen; but, of these, Sacastene formed no part of the Parthian Empire, as has been shown by von Gutschmid.

Provinces.

The lower provinces (*i.e.* the districts west of Parthia) are: (1) Mesopotamia, with northern Babylonia, from the Euphrates bridge at Zeugma to Seleucia on the Tigris; (2) Apolloniatis, the plain east of the Tigris, with Artemita; (3) Chalonitis, the hill-country of Zagros; (4) Western Media; (5) Cambadene, with Bagistana (Behistun)—the mountainous portions of Media; (6) Upper Media, with Ecbatana; (7) Rhagiane or Eastern Media. Then with the Caspian Gates—the pass between Elburz and the central desert, through which lay the route from west Iran to east Iran—the upper provinces begin; (8) Choarene and (9)

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[1] For the whole of this period see further ANTIGONUS; ANTIOCHUS I.–IV.; SELEUCID DYNASTY; HELLENISM.

Comisene, the districts on the verge of the desert; (10) Hyrcania; (11) Astabene, with the royal town Asaac on the Attruck (see PARTHIA); (12) Parthyene with Parthaunisa, where the sepulchres of the kings were laid; (13) Apavarcticene (now Abiward, with the capital Kelat); (14) Margiane (Merv); (15) Aria (Herat); (16) Anauon, the southern portion of Aria; (17) Zarangiane, the country of the Drangians, on the lake of Hamun; (18) Arachosia, on the Etymander (Helmand), called by the Parthians "White India," extending as far as Alexandropolis (Kandahar), the frontier city of the Parthian Empire.

On the lower Etymander, the Sacae had established themselves—obviously on the inroad of the Scythian tribes—and after them the country was named Sacastene (now Sejistan, Seistan). Through it lay the route to Kandahar; and for this reason the district is described by Isidore, though it formed no part of the Parthian Empire.

Vassal States.

Round these provinces lay a ring of numerous minor states, which as a rule were dependent on the Arsacids. They might, however, partially transfer their allegiance on the rise of a new power (*e.g.* Tigranes in Armenia) or a Roman invasion. Thus it is not without justice that the Arsacid period is described, in the later Persian and Arabian tradition, as the period of "the kings of the part-kingdoms"—among which the Ashkanians (*i.e.* the Arsacids, from *Ashak*, the later pronunciation of the name *Arshak*=Arsaces) had won the first place. This tradition, however, is nebulous in the extreme; the whole list of kings, which it gives, is totally unhistorical; only the names of one Balash (=Vologaeses) and of the last Ardewan (=Artabanus) having been preserved. The period, from the death of Alexander to the Sassanid Ardashir I., is put by the Persian tradition at 266 years; which was afterwards corrected, after Syro-Grecian evidence, to 523 years. The actual number is 548 years (*i.e.* 323 B.C. to A.D. 226). The statements of the Armenian historians as to this period are also absolutely worthless.

The ten most important of the vassal states were:—

1. The kingdom of Osroene (*q.v.*) in the north-east of Mesopotamia, with Edessa as capital, founded about 130 B.C. by the chieftain of an Arabian tribe, the Orrhoei, which established itself there.

2. To this must be added the numerous Arabian tribes of the Mesopotamian desert, under their chiefs, among whom one Alchaudonius comes into prominence in the period of Tigranes and Crassus. Their settlement in Mesopotamia was encouraged by Tigranes, according to Plutarch (*Luc.* 21) and Pliny (vi. 142). In later times the Arabic town Atra in an oasis on the west of the Tigris, governed by its own kings, gained special importance.

3 and 4. To the east of the Tigris lay two kingdoms: Gordyene (or Cordyene), the country of the Carduchians (now Bohtan), a wild, mountainous district south of Armenia; and Adiabene (Hadyab), the ancient Assyria, on either side of the Zab (Lycus).

5. On the farther side of Zagros, adjoining Adiabene on the east, was the kingdom of Atropatene in north Media, now often simply called Media (*q.v.*).

While the power of Armenia was at its height under Tigranes (86–69 B.C.) all these states owned his rule. After the victories of Pompey, however, the Romans claimed the suzerainty, so that, during the next decades and the expeditions of Crassus and Antony, they oscillated between Rome and Parthia, though their inclination was generally to the latter. For they were all Orientals and, consciously or unconsciously, representatives of a reaction against that Hellenism which had become the heritage of Rome. At the same time the loose organization of the Parthian Empire, afforded them a greater measure of independence than they could hope to enjoy under Roman suzerainty.

6. In the south of Babylonia, in the district of Mesene (the modern *Maisan*), after the fall of Antiochus Sidetes (129 B.C.), an Arabian prince, Hyspaosines or Spasines (in a cuneiform inscription of 127, on a clay tablet dated after this year, he is called Aspasine) founded a kingdom which existed till the rise of the Sassanian Empire. Its capital was a city (mod. Mohammerah), first founded by Alexander on an artificial hill by the junction of the Eulaeus (Karun) with the Tigris, and peopled by his veterans. The town, which was originally named Alexandria and then rebuilt by Antiochus I. as Antiochia, was now refortified with dikes by Spasines, and christened Spasinu Charax ("the wall of Spasines"), or simply Charax (Plin. vi. 138 seq.). In the following centuries it was the main mercantile centre on the Tigris estuary.

The kingdom of Mesene, also called Characene, is known to us from occasional references in various authors, especially Lucian (*Macrobii*, 16), as well as from numerous coins, dated by the Seleucian era, which allow us to frame a fairly complete list of the kings.[1] The Arabian dynasty speedily assimilated itself to the native population; and most of the kings bear Babylonian—in a few cases, Parthian—names. The official language was Greek, till, on the destruction of Seleucia (A.D. 164), it was replaced on the coinage by Aramaic. Another Babylonian dynast must have been Hadadnadinaches (*c.* 100 B.C.), who built in Tello the fortified palace which has been excavated by de Sarzec.

7. East of the Tigris lay the kingdom of Elymais (Elam), to which belonged Susa and its modern representative Ahwaz, farther down on the Eulaeus. The Elymaeans, who had already offered a repeated resistance to the Seleucids, were subdued by Mithradates I., as we have mentioned above; but they remained a separate state, which often rebelled against the Arsacids (Strabo xvi. 744; cf. Plut. *Pomp.* 36; Tac. *Ann.* vi. 50). Of the kings who apparently belonged to a Parthian dynasty, several bearing the name Cammascires are known to us from coins dated 81 and 71 B.C. One of these is designated by Lucian (*Macrobii*, 16) "king of the Parthians"; while the coinage of another, Orodes, displays Aramaic script (Allotte de la Fuye, *Rev. num.*, 4me série, t. vi. p. 92 sqq., 1902). The kingdom, which is seldom mentioned, survived till Ardashir I. In its neighbourhood Strabo mentions "the minor dynasties of the Sagapenians and Silacenians" (xvi. 745). The Uxians, moreover, with the Cossaeans and other mountain tribes, maintained their independence exactly as under the later Achaemenids (Strabo xvi. 744; Plin. vi. 133).

8. The district of Persis, also, became independent soon after the time of Antiochus IV., and was ruled by its own kings, who perpetuated the Achaemenian traditions, and on their coins—which bear the Persian language in Aramaic characters, *i.e.* the so-called Pahlavi—appear as zealous adherents of Zoroastrianism and the Fire-cult (see PERSIS). They were forced, however, to acknowledge the suzerainty of Parthia, to which they stood in the same position as the Persians of Cyrus and his forefathers to the Median Empire (cf. Strabo xv. 728, 733, 736; Lucian, *Macrob.* 15). In later times, before the foundation of the Sassanid dominion, Persis was disintegrated into numerous small local states. Even in Carmania we find independent kings, one of whom gave his name to a town Vologesocerta (*Balashkert*).

9. The east of Iran—Bactria with Sogdiana, Eastern Arachosia and Gedrosia—was never subject to the Arsacids. Here the Graeco-Bactrian and Graeco-Indian kingdoms held their own, till, in 139 B.C., they succumbed before the invading Mongolian and Scythian tribes (see BACTRIA and works quoted there). But in the Indus district the Greek kings held their ground for an appreciably longer period and, for a while, widely extended their power (see MENANDER OF INDIA). Among the kings then following, only known to us from their coins, there appears a dynasty with Iranian and sometimes peculiarly Parthian names which seems to have reigned in the Punjab and Arachosia. Its best-known representative, Gondophares or Hyndopherres, to whom legend makes the apostle Thomas write, reigned over Arachosia and the Indus district about A.D. 20. Further, about A.D. 70, the *Periplus* of the Erythraean Sea mentions that the great commercial town of Minnagar in the Indus Delta was under Parthian kings, "who spent their time in expelling one another." Here, then, it would seem there existed a Parthian dynasty, which probably went back to the conquests of Mithradates I. (cf. Vincent A. Smith, "The Indo-Parthian Dynasties from about 120 B.C. to A.D. 100," in the *Zeitschr. der deutschen morgenl. Gesellsch.* 60, 1906). Naturally, such a dynasty would not long have recognized the suzerainty of the Arsacids. It succumbed to the Indo-Scythian Empire of the Kushana, who had obtained the sovereignty of Bactria as early as about A.D. 50, and thence pressed onward into India. In the period of the *Periplus* (*c.* A.D. 70) the Scythians were already settled in the Indus valley (pp. 38, 41, 48), their dominion reaching its extent under Kanishka (*c.* A.D. 123–153).

This empire of the Kushana merits special mention here, on account of its peculiar religious attitude, which we may gather from the coins of its kings, particularly those of Kanishka and his successor Huvishka, on which an alphabet adapted from the Greek is employed (cf. Aurel Stein, "Zoroastrian Deities on Indo-Scythian Coins," in *The Babylonian and Oriental Record*, vol. i., 1887). Kanishka, as is well known, had embraced Buddhism, and many of his coins bear the image and name of Buddha. Iranian divinities, however, predominate on his currency: Mithras (*Mihro* or *Helios*); the Moon *Mah* (also Selene); *Athro*, the Fire; *Orthragno* (Verethragna); *Pharro*=Farna (hvarena), "the majesty of kingship"; Teiro=Tir (Tistrya "the archer"); *Nana* (Nanaia); and others. Here, then, we have a perfect example of syncretism; as in the Mithras cult in Armenia, Asia Minor, and still further in the Roman Empire. Buddhism and Zoroastrianism have been wedded in the state religion, and, in characteristic Indian fashion, are on the best of terms with one another, precisely as, in the Chinese Empire at the present day, we find the most varied religions, side by side, and on an equal footing.

10. Originally a part of the Turanian steppe belonged to the Arsacids; it was the starting-point of their power. Soon, however, the nomads (Dahae) gained their independence, and, as we have seen, repeatedly attacked and devastated the Parthian Empire in conjunction with the Tocharians and other tribes of Sacae and Scythians. In the subsequent period, again, we shall frequently meet them.

It may appear surprising that the Arsacids made no attempt to incorporate the minor states in the empire and

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[1] See Saint-Martin, *Recherches sur la Mésène et la Characène* (1838); Reinaud, *Mémoires sur le royaume de la Mésène* (1861); E. Babelon, "Numism. et chronol. des dynastes de la Characène," in *Journ. internat. d'archéol. numism.* vol. i. (1898).

Character of the Parthian Empire.

create a great and united dominion, such as existed under the Achaemenids and was afterwards restored by the Sassanids. This fact is the clearest symptom of the inner weakness of their empire and of the small power wielded by the "king of kings." In contrast alike with its predecessors and its successors, the Arsacid dominion was peculiarly a chance formation—a state which had come into existence through fortuitous external circumstances, and had no firm foundation within itself, or any intrinsic *raison d'être.*

Three elements, of widely different kinds, contributed to its origin and defined its character. It was sprung from a predatory nomad tribe (the Parnian Dahae, Scythians) which had established itself in Khorasan (Parthia), on the borders of civilization, and thence gradually annexed further districts as the political situation or the weakness of its neighbours allowed. Consequently, these nomads were the main pillar of the empire, and from them were obviously derived the great magnates, with their huge estates and hosts of serfs, who composed the imperial council, led the armies, governed the provinces and made and unmade the kings (Strabo xi. 515; Justin xli. 2; the former terming them συγγενεῖς, "kinsmen" of the king, the latter, *probuli*). Of these great families that of Surenas held the privilege of setting the diadem on the head of the new king (Plut. *Crass.* 21; Tac. *Ann.* vi. 42).

The military organization, moreover, was wholly nomadic in character. The nucleus of the army was formed of armoured horsemen, excellently practised for long-distance fighting with bow and javelin, but totally unable to venture on a hand-to-hand conflict, their tactics being rather to swarm round the enemy's squadrons and overwhelm them under a hail of missiles. When attacked they broke up, as it seemed, in hasty and complete flight, and having thus led the hostile army to break its formation, they themselves rapidly reformed and renewed the assault. How difficult it was for infantry to hold their own against these mounted squadrons was demonstrated by the Roman campaigns, especially in broad plains like those of Mesopotamia. In winter, however, the Parthians were powerless to wage war, as the moisture of the atmosphere relaxed their bows. The infantry, in contrast with its earlier status under the Persians, was wholly neglected. On the other hand, every magnate put into the field as many mounted warriors as possible, chiefly servants and bought slaves, who, like the Janissaries and Mamelukes, were trained exclusively for war. Thus Surenas, in 53 B.C., is said to have put at the king's disposal 1000 mailed horsemen and, in all, 10,000 men, including the train, which also comprised his attendants and harem (Plut. *Crass.* 21; description of the military organization; Dio Cass. 40, 15; Justin xli. 2). In the army of 50,000 mounted men which took the field against Mark Antony there were, says Justin, only 400 freemen.

The Iranian Population.

How vital was the nomadic element in the Parthian Empire is obvious from the fact that, in civil wars, the deposed kings consistently took refuge among the Dahae or Scythians and were restored by them. But, in Parthia, these nomads were amalgamated with the native peasantry, and, with their religion, had adopted their dress and manners. Even the kings, after the first two or three, wear their hair and beard long, in the Iranian fashion, whereas their predecessors are beardless. Although the Arsacids are strangers to any deep religious interest (in contrast to the Achaemenids and Sassanids), they acknowledge the Persian gods and the leading tenets of Zoroastrianism. They erect fire-altars, and even obey the command to abandon all corpses to the dogs and fowls (Justin xli. 3). The union, moreover, recommended by that creed, between brother and sister—and even son and mother—occurs among them. Consequently, beside the council of the nobility, there is a second council of "Magians and wise men" (Strabo xi. 515).

Again, they perpetuate the traditions of the Achaemenid Empire. The Arsacids assume the title "king of kings" and derive their line from Artaxerxes II. Further, the royal apotheosis, so common among them and recurring under the Sassanids, is probably not so much of Greek origin as a development of Iranian views. For at the side of the great god Ahuramazda there stands a host of subordinate divine beings who execute his will—among these the deified heroes of legend, to whose circle the king is now admitted, since on him Ahuramazda has bestowed victory and might.

This gradual Iranianization of the Parthian Empire is shown by the fact that the subsequent Iranian traditions, and Firdousi in particular, apply the name of the "Parthian" magnates (*Pahlavan*) to the glorious heroes of the legendary epoch. Consequently, also, the language and writing of the Parthian period, which are retained under the Sassanids, received the name *Pahlavi, i.e.* "Parthian." The script was derived from the Aramaic.

Relation towards Hellenism.

But to these Oriental elements must be added that of Hellenism, the dominant world-culture which had penetrated into Parthia and Media. It was indispensable to every state which hoped to play some part in the world and was not so utterly secluded as Persis and Atropatene; and the Arsacids entertained the less thought of opposition as they were destitute of an independent national basis. All their external institutions were borrowed from the Seleucid Empire: their coinage with its Greek inscriptions and nomenclature; their Attic standard of currency; and, doubtless, a great part of their administration also. In the towns Greek merchants were everywhere settled. Mithradates I. even followed the precedent of the Seleucids in building a new city, Arsacia, which replaced the ancient Rhagae (Rai, Europus) in Media. The further the Arsacids expanded the deeper they penetrated into the province of Hellenism; the first Mithradates himself assumed, after his great conquests, the title of *Philhellen,* "the protector of Hellenism," which was retained by almost all his successors. Then follow the surnames *Epiphanes* "the revealed god," *Dicaeus* "the just," *Euergetes* "the benefactor," all of them essentially Greek in their reference, and also regularly borne by all the kings. After the conquest of the Euphrates and Tigris provinces it was imperative that the royal residence should be fixed there. But as no one ventured to transfer the royal household and the army, with its hordes of wild horsemen, to the Greek town of Seleucia, and thus disorganize its commerce, the Arsacids set up their abode in the great village of Ctesiphon, on the left bank of the Tigris, opposite to Seleucia, which accordingly retained its free Hellenic constitution (see CTESIPHON and SELEUCIA). So, also, Orodes I. spoke good Greek, and Greek tragedies were staged at his court (Plut. *Crass.* 33).

Reaction against Hellenism.

In spite of this, however, the rise of the Arsacid Empire marks the beginning of a reaction against Hellenism—not, indeed, a conscious or official reaction, but a reaction which was all the more effective because it depended on the impetus of circumstances working with all the power of a natural force. The essential point is that the East is completely divorced from the Mediterranean and the Hellenic world, that it can derive no fresh powers from that quarter, and that, consequently, the influence of the Oriental elements must steadily increase. This process can be most clearly traced on the coins—almost the sole memorials that the Parthian Empire has left. From reign to reign the portraits grow poorer and more stereotyped, and the inscriptions more neglected, till it becomes obvious that the engraver himself no longer understood Greek but copied mechanically the signs before his eyes, as is the case with the contemporary Indo-Scythian coinage, and also in Mesene. Indeed, after Vologaeses I. (51–77), the Aramaic script is occasionally employed. The political opposition to the western empires, the Seleucids first, then the Romans, precipitated this development. Naturally enough the Greek cities beheld a liberator in every army that marched from the West, and were ever ready to cast in their lot with such—a disposition for which the subsequent penalty was not lacking. The Parthian magnates, on the other hand, with the army, would have little to do with Greek culture and Greek modes of life, which they contemptuously regarded as effeminate and unmanly. Moreover, they required of their rulers that they should live in the fashion of their country, practise arms and the chase, and appear as Oriental sultans, not as Grecian kings.

These tendencies taken together explain the radical weakness of the Parthian Empire. It was easy enough to collect a great army and achieve a great victory; it was absolutely impossible to hold the army together for any longer period, or to conduct a regular campaign. The Parthians proved incapable of creating a firm, united organization, such as the Achaemenids before them, and the Sassanids after them gave to their empire. The kings themselves were toys in the hands of the magnates and the army who, tenaciously as they clung to the anointed dynasty of the Arsacids, were utterly indifferent to the person of the individual Arsacid. Every moment they were ready to overthrow the reigning monarch and to seat another on his throne. The kings, for their part, sought protection in craft, treachery and cruelty, and only succeeded in aggravating the situation. More especially they saw an enemy in every prince, and the worst of enemies in their own sons. Sanguinary crimes were thus of everyday occurrence in the royal household; and frequently it was merely a matter of chance whether the father anticipated the son, or the son the father. The conditions were the same as obtained subsequently under the Mahommedan Caliphate (*q.v.*) and the empire of the Ottomans. The internal history of the Parthian dominion is an unbroken sequence of civil war and dynastic strife.

For the literature dealing with the Parthian Empire and numismatics, see PARTHIA, under which heading will be found a complete list of the kings, so far as we are able to reconstitute them.

Later History of the Arsacid Empire.

These conditions elucidate the fact that the Parthian Empire, though founded on annexation and perpetually menaced by hostile arms in both the East and the West, yet never took a strong offensive after the days of Mithradates II. It was bound to protect itself against Scythian aggression in the East and Roman aggression in the West. To maintain, or regain, the suzerainty over Mesopotamia and the vassal states of that region, as also over Atropatene and Armenia, was its most imperative task. Yet it always remained on the defensive and even so was lacking in energy. Whenever it made an effort to enforce its claims, it retreated so soon as it was confronted by a resolute foe.

Wars with Crassus and Antonius.

Thus the wars between Parthia and Rome proceeded, not from the Parthians—deeply injured though they were by the encroachments of Pompey—but from Rome herself. Rome had been obliged, reluctantly enough, to enter upon the inheritance of Alexander the Great; and, since the time of Pompey, had definitely subjected to her dominion the Hellenistic countries as far as the Euphrates. Thus the task now faced them of annexing the remainder of the Macedonian Empire, the whole East from the Euphrates to the Indus, and of thereby saving Greek civilization (cf. Plut. *Comp. Nic. et Crass.* 4). The aristocratic republic quailed before such an enterprise, though Lucullus, at the height of his successes, entertained the thought (Plut. *Luc.* 30). But the ambitious men, whose goal was to erect their own sovereignty on the ruins of the republic, took up the project. With this objective M. Licinius Crassus, the triumvir, in 54 B.C., took the aggressive against Parthia, the occasion being favourable owing to the dynastic troubles between Orodes I., the son of Phraates III., and his brother Mithradates III. Crassus fell on the field of Carrhae (June 9, 53 B.C.). With this Mesopotamia was regained by the Parthians, and King Artavasdes of Armenia now entered their alliance. But, apart from the ravaging of Syria (51 B.C.) by Pacorus the son of Orodes, the threatened attack on the Roman Empire was carried into effect neither then nor during the civil wars of Caesar and Pompey. At the time of his assassination Caesar was intent on resuming the expedition of Crassus. The Parthians formed a league with Brutus and Cassius, as previously with Pompey, but gave them no support, until in 40 B.C. a Parthian army, led by Pacorus and the republican general Labienus, harried Syria and Asia Minor. But it was easily repulsed by Ventidius Bassus, the lieutenant of Mark Antony. Pacorus himself fell on the 9th of June 38 B.C. at Gindarus in northern Syria. Antony then attacked the Parthians in 36 B.C., and penetrated through Armenia into Atropatene, but was defeated by Phraates IV.—who in 37 B.C. had murdered his father Orodes I.—and compelled to retreat with heavy losses. The continuation of the war was frustrated by the conflict with Octavian. Armenia alone was again subdued in 34 B.C. by Antony, who treacherously captured and executed King Artavasdes.

Policy of Augustus.

Roman opinion universally expected that Augustus would take up the work of his predecessors, annihilate the Parthian dominion, and subdue the East as far as the Indians, Scythians and Seres (cf. Horace and the other Augustan poets). But Augustus disappointed these expectations. His whole policy and the needs of the newly organized Roman Empire demanded peace. His efforts were devoted to reaching a *modus vivendi*, by which the authority of Rome and her most vital claims might be peacefully vindicated. This the weakness of Parthia enabled him to effect without much difficulty. His endeavours were seconded by the revolt of Tiridates II., before whom Phraates IV. was compelled to flee (32 B.C.), till restored by the Scythians. Augustus lent no support to Tiridates in his second march on Ctesiphon (26 B.C.), but Phraates was all the more inclined on that account to stand on good terms with him. Consequently in 20 B.C., he restored the standards captured in the victories over Crassus and Antony, and recognized the Roman suzerainty over Osroene and Armenia. In return, the Parthian dominion in Babylonia and the other vassal states was left undisputed.

Thus it was due not to the successes and strength of the Parthians but entirely to the principles of Roman policy as defined by Augustus that their empire appears as a second great independent power, side by side with Rome. The precedence of the Caesars, indeed, was always admitted by the Arsacids; and Phraates IV. soon entered into a state of dependency on Rome by sending (9 B.C.) four of his sons as hostages to Augustus—a convenient method of obviating the danger threatened in their person, without the necessity of killing them. In 4 B.C., however, Phraates was assassinated by his favourite wife Musa and her son Phraates V. In the subsequent broils a Parthian faction obtained the release of one of the princes interned in Rome as Vonones I. (A.D. 8). He failed, however, to maintain his position for long. He was a stranger to the Parthian customs, and the feeling of shame at dependency on the foreigner was too strong. So the rival faction brought out another Arsacid, resident among the Scythian nomads, Artabanus II., who easily expelled Vonones—only to create a host of enemies by his brutal cruelty, and to call forth fresh disorders.

Reign of Vologaeses I.

Similar proceedings were frequently repeated in the period following. In the intervals the Parthians made several attempts to reassert their dominion over Armenia and there install an Arsacid prince; but on each occasion they retreated without giving battle so soon as the Romans prepared for war. Only the dynasty of Atropatene was finally deposed and the country placed under an Arsacid ruler. Actual war with Rome broke out under Vologaeses I. (51–77), who made his brother Tiridates king of Armenia. After protracted hostilities, in which the Roman army was commanded by Cn. Domitius Corbulo, a peace was concluded in A.D. 63, confirming the Roman suzerainty over Armenia but recognizing Tiridates as king (see CORBULO). Tiridates himself visited Rome and was there invested with the diadem by Nero (A.D. 66). After that Armenia continued under the rule of an Arsacid dynasty.

These successes of Vologaeses were counterbalanced by serious losses in the East. He was hampered in an energetic campaign against Rome by attacks of the Dahae and Sacae. Hyrcania, also, revolted and asserted its independence under a separate line of kings. A little later, the Alans, a great Iranian tribe in the south of Russia—the ancestors of the present-day Ossets—broke for the first time through the Caucasian passes, and ravaged Media and Armenia—an incursion which they often repeated in the following centuries.

On the other side, the reign of Vologaeses I. is characterized by a great advance in the Oriental reaction against Hellenism. The line of Arsacids which came to the throne in the person of Artabanus II. (A.D. 10) stands in open opposition to the old kings with their leanings to Rome and, at least external, tinge of Hellenism. The new régime obviously laid much more stress on the Oriental character of their state, though Philostratus, in his life of Apollonius of Tyana (who visited the Parthian court), states that Vardanes I. (A.D. 40–45), the rival king to the brutal Gotarzes (A.D. 40–51), was a cultivated man (*Vit. Ap.* i. 22, 28, 31 sqq.); and Vologaeses I. is distinguished by the excellent relations which subsisted all his life between himself and his brothers Pacorus and Tiridates, the kings of Media and Armenia. But the coins of Vologaeses I. are quite barbarous, and for the first time on some of them appear the initials of the name of the king in Aramaic letters by the side of the Greek legend. The Hellenism of Seleucia was now attacked with greater determination. For seven years (A.D. 37–43) the city maintained itself in open rebellion (Tac. *Ann.* xi. 8 seq.), till at last it surrendered to Vardanes, who in consequence enlarged Ctesiphon, which was afterwards fortified by Pacorus (A.D. 78–105: v. Ammian. 23, 6, 23). In the neighbourhood of the same town Vologaeses I. founded a city Vologesocerta (Balashkert), to which he attempted to transplant the population to Seleucia (Plin. vi. 122: cf. Th. Nöldeke in *Zeitschr. d. deutsch. morgenl. Gesellschaft*, xxviii., 100). Another of his foundations was Vologesias (the Arabian *Ullaish*), situated near Hira on the Euphrates, south of Babylon, which did appreciable damage to the commerce of Seleucia and is often mentioned in inscriptions as the destination of the Palmyrene caravans.

After Vologaeses I. follows a period of great disturbances. The literary tradition, indeed, deserts us almost entirely, but the coins and isolated literary references prove that during the years A.D. 77 to 147, two kings, and sometimes three or more, were often reigning concurrently (Vologaeses II. 77–79, and 111–147; Pacorus 78–*c.* 105; Osroes 106–129; Mithradates V. 129–147: also Artabanus III. 80–81; Mithradates IV. and his

Wars with Trajan and Marcus Aurelius.

son Sanatruces II. 115; and Parthamaspates 116–117). Obviously the empire can never have been at peace during these years, a fact which materially assisted the aggressive campaigns of Trajan (113–117). Trajan resuscitated the old project of Crassus and Caesar, by which the empire of Alexander as far as India was to be won for Western civilization. In pursuance of this plan he reduced Armenia, Mesopotamia and Babylonia to the position of imperial provinces. On his death, however, Hadrian immediately reverted to the Augustan policy and restored the conquests. Simultaneously there arose in the East the powerful Indo-Scythian empire of the Kushana, which doubtless limited still further the Parthian possessions in eastern Iran.

Christianity.

An era of quiet seems to have returned with Vologaeses III. (147–191), and we hear no more of rival kings. With the Roman Empire a profound peace had reigned since Hadrian (117), which was first disturbed by the attack of Marcus Aurelius and Aelius Verus in 162. This war, which broke out on the question of Armenia and Osroene, proved of decisive significance for the future development of the East, for, in its course, Seleucia was destroyed by the Romans under Avidius Cassius (164). The downfall of the great Greek city sealed the fate of Hellenism in the countries east of the Euphrates. Henceforward Greek culture practically vanishes and gives place to Aramaic; it is significant that in future the kings of Mesene stamped their coinage with Aramaic legends. This Aramaic victory was powerfully aided by the ever-increasing progress of Christianity, which soon created, as is well known, an Aramaic literature of which the language was the dialect of Edessa, a city in which the last king of Osroene, Abgar IX. (179–214), had been converted to the faith. After that Greek culture and Greek literature were only accessible to the Orientals in an Aramaic dress. Vologaeses III. is probably also the king Valgash, who, according to a native tradition, preserved in the *Dinkart*, began a collection of the sacred writings of Zoroaster—the origin of the *Avesta* which has come down to us. This would show how the national Iranian element in the Parthian Empire was continually gathering strength.

The Roman war was closed in 165 by a peace which ceded north-west Mesopotamia to Rome. Similar conflicts took place in 195–202 between Vologaeses IV. (191–209) and Septimius Severus, and again in 216–217 between Artabanus IV. (209–226) and Caracalla. They failed, however, to affect materially the position of the two empires.

Ardashir I.

VIII. *The Sassanian Empire.*—That the Arsacid Empire should have endured some 350 years after its foundation by Mithradates I. and Phraates II., was a result, not of internal strength, but of chance working in its external development. It might equally well have so existed for centuries more. But under Artabanus IV. the catastrophe came. In his days there arose in Persis—precisely as Cyrus had arisen under Astyages the Mede—a great personality. Ardashir (Artaxerxes) I., son of Papak (Babek), the descendant of Sasan, was the sovereign of one of the small states into which Persis had gradually fallen. His father Papak had taken possession of the district of Istakhr, which had replaced the old Persepolis, long a mass of ruins. Thence Ardashir I., who reigned from about A.D. 212, subdued the neighbouring potentates—disposing of his own brothers among the rest. This proceeding quickly led to war with his suzerain Artabanus IV. The conflict was protracted through several years, and the Parthians were worsted in three battles. The last of these witnessed the fall of Artabanus (A.D. 226), though a Parthian king, Artavasdes—perhaps a son of Artabanus IV.—who is only known to us from his own coins, appears to have retained a portion of the empire for some time longer. The members of the Arsacid line who fell into the hands of the victor were put to death; a number of the princes found refuge in Armenia, where the Arsacid dynasty maintained itself till A.D. 429. The remainder of the vassal states—Carmania, Susiana, Mesene—were ended by Ardashir; and the autonomous desert fortress of Hatra in Mesopotamia was destroyed by his son Shapur (Sapor) I., according to the Persian and Arabian traditions, which, in this point, are deserving of credence. The victorious Ardashir then took possession of the palace of Ctesiphon and assumed the title "King of the kings of the Iranians" (*βασιλεὺς βασιλέων Ἀριανῶν*).

Sassanian Wars with Rome.

Shapur I.

The new empire founded by Ardashir I.—the Sassanian, or Neo-Persian Empire—is essentially different from that of his Arsacid predecessors. It is, rather, a continuation of the Achaemenid traditions which were still alive on their native soil. Consequently the national impetus—already clearly revealed in the title of the new sovereign—again becomes strikingly manifest. The Sassanian Empire, in fact, is once more a national Persian or Iranian Empire. The religious element is, of course, inseparable from the national, and Ardashir, like all the dynasts of Persis, was an ardent devotee of the Zoroastrian doctrine, and closely connected with the priesthood. In his royal style he assumed the designation "Mazdayasnian" (*Μασδάσνας*), and the fire-cult was everywhere vigorously disseminated. Simultaneously the old claims to world dominion made their reappearance. After the defeat of Artabanus, Ardashir, as heir of the Achaemenids, formulated his pretensions to the dominion of western Asia (Dio. Cass. 80, 3; Herodian vi. 2, 4; Zonar. xii. 15; similarly under Shapur II.: Ammian. Marc. xvii. 5, 5). He attacked Armenia, though without permanent success (cf. von Gutschmid in *Zeitschr. d. d. morgenl. Ges.* xxxi. 47, on the fabulous Armenian account of these wars), and despatched his armies against Roman Mesopotamia. They strayed as far as Syria and Cappadocia. The inner decay of the Roman Empire, and the widespread tendency of its troops to mutiny and usurpation, favoured his enterprise. Nevertheless, the armies of Alexander Severus, supported by the king of Armenia, succeeded in repelling the Persians, though the Romans sustained severe losses (231–233). Towards the end of his reign Ardashir resumed the attack; while his son Shapur I. (241–272) reduced Nisibis and Carrhae and penetrated into Syria, but was defeated by Gordian III. at Resaena (243). Soon afterwards, however, the Roman Empire seemed to collapse utterly. The Goths defeated Decius (251) and harried the Balkan Peninsula and Asia Minor, while insurrections broke out everywhere and the legions created one Caesar after the other. Then Shapur resumed the war, subdued Armenia and plundered Antioch. The emperor Valerian, who marched to encounter him, was overthrown at Edessa and taken prisoner (260). The Persian armies advanced into Cappadocia; but here Ballista or Balista (d. *c.* 264) beat them back, and Odenathus (Odainath), prince of Palmyra (*q.v.*), rose in their rear, defeated Shapur, captured his harem, and twice forced his way to Ctesiphon (263–265). Shapur was in no position to repair the defeat, or even to hold Armenia; so that the Sassanid power failed to pass the bounds of the Arsacid Empire. Nevertheless Shapur I., in contrast to his father, assumed the title "King of the kings of the Iranians and non-Iranians" (*βασιλεὺς βασιλέων Ἀριανῶν καὶ Ἀναριανῶν*; *shah an shah Iran we Aniran*), thus emphasizing his claim to world dominion. His successors retained the designation, little as it corresponded to the facts, for the single non-Iranian land governed by the Sassanids was, as under the Parthians, the district of the Tigris and Euphrates as far as the Mesopotamian desert; western and northern Mesopotamia remained Roman.

Organization.

The Sassanid ruler is the representative of the "Kingly Majesty," derived from Ormuzd, which appears in the *Avesta* as the angel Kavaem Hvareno, "the royal glory," and, according to legend, once beamed in the Iranian kings, unattainable to all but those of royal blood. A picture, which frequently recurs in the rock-reliefs of Ardashir I. and Shapur I., represents the king and the god Ormuzd both on horseback, the latter in the act of handing to his companion the ring of sovereignty. Thus it is explicable that all the Sassanids, as many of the Arsacids before them, include the designation of "god" in their formal style. From this developed (as already under the Arsacids) that strict principle of legitimacy which is still vigorous in Firdousi. It applies, however, to the whole royal house, precisely as in the Ottoman Empire of to-day. The person of the individual ruler is, on the other hand, a matter of indifference. He can readily be removed and replaced by another; but no usurper who was not of the legitimate blood can hope to become the genuine king. Therefore the native tradition carries the Sassanid line back to the Achaemenids and, still further, to the kings of the legendary period.

Military Achievements.

Officially the king is all-powerful, and his will, which is guided by God and bound up in His law, unfettered. Thus, externally, he is surrounded by all the splendour of sovereignty; on his head he wears a great and resplendent crown, with a high circular centrepiece; he is clothed in gold and jewels; round him is a brilliant court, composed of his submissive servants. He sits in dazzling state on his throne in Ctesiphon. All who approach fling themselves to the ground, life and death depend on his nod. Among his people he is accounted the fairest, strongest and wisest man of the empire; and from him is required the practice of all piety and virtue, as well as skill in the chase and in arms—especially the bow. Ardashir I., moreover, and his successors endeavoured to establish the validity of the royal will by absorbing the vassal states and instituting a firmer organization. Nevertheless they failed to attain the complete independence and power of the Achaemenids. Not strong enough to break up the nobility, with its great estates, they were forced to utilize its services and still further to promote its interests; while their dependence on its good-will and assistance led inevitably to incessant gifts of money, lands and men. This state of affairs had also prevailed under the later Achaemenids, and had materially contributed to the disintegration of the empire and the numerous insurrections of the satraps. But the older Achaemenids held an entirely different position; and hardly a single Sassanid enjoyed even that degree of power which was still retained by the later Achaemenids. It was of fundamental importance that the Sassanian Empire could not make good its claim to world dominion; and, in spite of the title of its kings, it always remained essentially the kingdom of Iran—or rather west Iran, together with the districts on the Tigris and Euphrates. This fact, again, is most closely connected with its military and administrative organization. The external and internal conditions of the empire are in mutual reaction upon one another. The empire, which in extent did not exceed that of the Arsacids with its vassal states, was protected on the east and west by the great deserts of central Iran and Mesopotamia. For the defence of these provinces the mounted archers, who formed the basis of the army, possessed adequate strength; and though the Scythian nomads from the east, or the Romans from the west, might occasionally penetrate deep into the country, they never succeeded in maintaining their position. But the power of the neo-Persian Empire was not great enough for further conquests, though its army was capable and animated by a far stronger national feeling than that of the Parthians. It still consisted, however, of levies from the retinue of the magnates led by their territorial lords; and, although these troops would stream in at the beginning of a war, they could not be kept permanently together. For, on the one hand, they were actuated by the most varied personal interests and antipathies, not all of which the king could satisfy; on the other hand he could not, owing to the natural character and organization of his dominions, maintain and pay a large army for any length of time. Thus the great hosts soon melted away, and a war, begun successfully, ended ingloriously, and often disastrously. Under such circumstances an elaborate tactical organization employing different species of arms, or the execution of a comprehensive plan of campaign, was out of the question. The successes of the Sassanids in the east were gained in the later period of their dominion; and the Roman armies, in spite of decay in discipline and military spirit, still remained their tactical and strategical superiors. A great victory might be won—even an emperor might be captured, like Valerian—but immediately afterwards successes, such as those gained against Shapur I. (who was certainly an able general) by Ballista and Odenathus of Palmyra, or the later victories of Carus, Julian and others, demonstrated how far the Persians were from being on an equality with the Romans. That Babylonia permanently remained a Sassanian province was due merely to the geographical conditions and to the political situation of the Roman Empire, not to the strength of the Persians.

The Nobility.

Among the magnates six great houses—seven, if we include the royal house—were still regarded as the foremost, precisely as under the Achaemenids, and from these were drawn the generals, crown officials and governors (cf. Procop. *Pers.* i. 6, 13 sqq.). In the last of these positions we frequently find princes of the blood, who then bear the royal title (shah). Some of these houses—whose origin the legends derive from King Gushtasp (*i.e.* Vishtaspa), the protector of Zoroaster (Marquart, *Zeitschr. d. d. morgenl. Ges.* xlix. 635 sqq.), already existed under the Arsacids, *e.g.* the Suren (Surenas, *vide supra*, p. 798) and Karen (Carenes, Tac. *Ann.* xii. 12 sqq.), who had obviously embraced the cause of the victorious dynasty at the correct moment and so retained their position. The name Pahlavan, moreover, which denoted the Parthian magnates, passed over into the new empire. Below these there was an inferior nobility, the *dikhans* ("village-lords") and the "knights" (*aswar*); who, as among the Parthians, took the field in heavy scale-armour. To an even greater extent than under the Arsacids the empire was subdivided into a host of small provinces, at the head of each being a *Marzban* ("boundary-lord," "lord of the marches"). These were again comprised in four great districts. With each of these local potentates the king could deal with as scant consideration as he pleased, always provided that he had the power or understood the art of making himself feared. But to break through the system or replace it by another was impossible. In fact he was compelled to proceed with great caution whenever he wished to elevate a favourite of humbler origin to an office which custom reserved for the nobility. Thus it is all the more worthy of recognition that the Sassanian Empire was a fairly orderly empire, with an excellent legal administration, and that the later sovereigns did their utmost to repress the encroachments of the nobility, to protect the commonalty, and, above all, to carry out a just system of taxation.

Religious Development.

Side by side with the nobles ranked the spiritual chiefs, now a far more powerful body than under the Arsacids. Every larger district had its upper Magian (*Magupat, mobed, i.e.* "Lord of the Magians"). At their head was the supreme Mobed, resident in Rhagae (Rai), who was regarded as the successor of Zoroaster. In the new empire, of which the king and people were alike zealous professors of the true faith, their influence was extraordinarily strong (cf. Agathias ii. 26)—comparable to the influence of the priesthood in later Egypt, and especially in Byzantium and medieval Christendom. As has already been indicated, it was in their religious attitudes that the essential difference lay between the Sassanid Empire and the older Iranian states. But, in details, the fluctuations were so manifold that it is necessary at this point to enter more fully into the history of Persian religion (cf. especially H. Gelzer, "Eznik u. d. Entwickel. des pers. Religions-systems," in the *Zeitschr. f. armen. Philol.* i. 149 sqq.).

The Persian religion, as we have seen, spread more and more widely after the Achaemenian period. In the Indo-Scythian Empire the Persian gods were zealously worshipped; in Armenia the old national religion was almost entirely banished by the Persian cults (Gelzer, "Zur armen. Götterlehre," in *Ber. d. sächs. Gesch. d. Wissensch.*, 1895); in Cappadocia, North Syria and the west of Asia Minor, the Persian gods were everywhere adored side by side with the native deities. It was in the third century that the cult of Mithras, with its mysteries and a theology evolved from Zoroastrianism, attained the widest diffusion in all Latin-speaking provinces of the Roman dominion; and it even seemed for a while as though the *Sol invictus Mithras*, highly favoured by the Caesars, would become the official deity-in-chief of the empire. But in all these cults the Persian gods are perfectly tolerant of other native or foreign divinities; vigorous as was their propagandism, it was yet equally far removed from an attack on other creeds. Thus this Parseeism always bears a syncretic character; and the supreme god of Zoroastrian theory, Ahuramazda (*i.e.* Zeus or Jupiter), in practice yields place to his attendant deities, who work in the world and are able to lead the believer, who has been initiated and keeps the commandments of purity, to salvation.

But, meanwhile, in its Iranian home and especially in Persis, the religion of Zoroaster lived a quiet life, undisturbed by the proceedings of the outside world. Here the poems of the prophet and fragments of ancient religious literature survived, understood by the Magians and rendered accessible to the faithful laity by versions in the modern dialect (Pahlavi). Here the opposition between the good spirit of light and the demons of evil—between Ormuzd and Ahriman—still remained the principal dogma of the creed; while all other gods and angels, however estimable their aid, were but subordinate servants of Ormuzd, whose highest manifestation on earth was not the sun-god Mithras, but the holy fire guarded by his priests. Here all the prescriptions of purity—partly connected with national customs, and impossible of execution abroad—were diligently observed; and even the injunction not to pollute earth with corpses, but to cast out the dead to vulture and dog, was obeyed in its full force. At the same time Ahuramazda preserved his character as a national god, who bestowed on his worshippers victory and world dominion. In the sculptures of the Sassanids, as also in Armenian traditions, he appears on horseback as a war-god. Here, again, the theology was further developed, and an attempt made to annul the old dualism by envisaging both Ormuzd and Ahriman as emanations of an original principle of infinite time (Zervan), a doctrine which long enjoyed official validity under the Sassanids till, in the reign of Chosroes I., "the sect of Zervanites" was pronounced heretical.[1] But, above all, the ritual and the doctrine of purity were elaborated and expanded, and there was evolved a complete and detailed system of casuistry, dealing with all things allowed and forbidden, the forms of pollution and the expiation for each, &c., which, in its arid and spiritless monotony vividly recalls the similar prescriptions in the Pentateuch. The consequences of this development were that orthodoxy and literal obedience to all priestly injunctions now assumed an importance far greater than previously; henceforward, the great commandment of Zoroastrianism, as of Judaism, is to combat the heresies of the heathen, a movement which had already had an energetic representative in the prophet himself. Heathenish cults and forbidden manners and customs are a pollution to the land and a deep insult to the true God. Therefore the duty of the believer is to combat and destroy the unbeliever and the heretic. In short, the tolerance of the Achaemenids and the indifference of the Arsacids are now replaced by intolerance and religious persecution.

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[1] It may be observed that this innovation was also known to the Mithras-cult of the West, where Zervan appears as αἰών.

Such were the views in which Ardashir I. grew up, and in their energetic prosecution he found a potent instrument for the building up of his empire. It has previously been mentioned that Vologaeses III. had already begun a collection of the holy writings; and the task was resumed under Ardashir. At his order the orthodox doctrines and texts were compiled by the high priest Jansar; all divergent theories were prohibited and their adherents proscribed. Thus arose the *Avesta*, the sacred book of the Parsees. Above all, the sacred book of laws, the *Vendidad*, breathes throughout the spirit of the Sassanian period, in its intolerance, its casuistry degenerating into absurdity, and its soulless monotony. Subscription to the restored orthodox doctrine was to the Iranian a matter of course. The schismatics Ardashir imprisoned for a year; if, at its expiration, they still refused to listen to reason, and remained stiff-necked, they were executed. It is even related that, in his zeal for uniformity of creed, Ardashir wished to extinguish the holy fires in the great cities of the empire and the Parthian vassal states, with the exception of that which burned in the residence of the dynasty. This plan he was unable to execute. In Armenia, also, Ardashir and Shapur, during the period of their occupation, sought to introduce the orthodox religion, destroyed the heathen images—even those of the Iranian gods which were here considered heathen,—and turned the shrines into fire-altars (Gelzer, *Ber. sachs. Ges.* p. 135, 1895). Shapur I., who appears to have had a broader outlook, added to the religious writings a collection of scientific treatises on medicine, astronomy, mathematics, philosophy, zoology, &c., partly from Indian and Greek sources.

Relation to Christianity. This religious development was most strongly influenced by the fact that, meanwhile, a powerful opponent of Zoroastrianism had arisen with an equally zealous propagandism and an equal exclusiveness and intolerance. More especially in the countries of the Tigris and Euphrates, now altogether Aramaic, Christianity had everywhere gained a firm footing.[1] But its missionary enterprise stretched over the whole of Iran, and even farther. The time was come when, in the western and eastern worlds alike, the religious question was for large masses of people the most important question in life, and the diffusion of their own creed and the suppression of all others the highest and holiest of tasks. The man who thinks thus knows no compromise, and so Zoroastrianism and Christianity confronted each other as mortal enemies. Still the old idea that every religion contained a portion of the truth, and that it was possible to borrow something from one and amalgamate it with another, had not yet lost all its power. From such a conception arose the teaching of Mani or Manes. For Manichaeism (*q.v.*) is an attempt to weld the **Manichaeism.** doctrine of the Gospel and the doctrine of Zoroaster into a uniform system, though naturally not without an admixture of other elements, principally Babylonian and Gnostic. Mani, perhaps a Persian from Babylonia, is said to have made his first appearance as a teacher on the coronation day of Shapur I. At all events he found numerous adherents, both at court and among the magnates of the empire. The king even inclined to him, till in a great disputation the Magians gained the predominance. None the less Mani found means to diffuse his creed far and wide over the whole empire. Even the heir to the throne, Hormizd I. (reigned 272–273), was favourably disposed to him; but Shapur's younger son, Bahram I. (273–276), yielded to sacerdotal pressure, and Mani was executed. After that Manichaeism was persecuted and extirpated in Iran. Yet it maintained itself not merely in the west, where its head resided at Babylon—propagating thence far into the Roman Empire—but also in the east, in Khorasan and beyond the bounds of the Sassanian dominion. There the seat of its pontiff was at Samarkand; thence it penetrated into Central Asia, where, buried in the desert sands which entomb the cities of eastern Turkestan, numerous fragments of the works of Mani and his disciples, in the Persian language (Pahlavi) and Syrian script, and in an East Iranian dialect, called Sogdian, which was used by the Manichaeans of Central Asia, have been discovered (K. Müller, "Handschriftenreste in Estrangelo-schrift aus Turfan, in Chinesisch-Turkestan," in *Abh. d. berl. Akad.*, 1904); among them translations of texts of the New Testament (K. Müller, *Berichte der Berl.*, 1907, p. 260 seq.). In these texts God the Father is identified with the Zervan of Zarathustrism, the devil with Ahriman. The further religious development of the Sassanid Empire will be touched upon later.

Architecture and Arts. Like the Arsacids the kings resided in Ctesiphon, where, out of the vast palace built by Chosroes I., a portion at least of the great hall is still erect. On the ruins of Seleucia, on the opposite bank of the Tigris, Ardashir I. built the city of Veh-Ardashir ("good is Ardashir"), to which the later kings added new towns, or rather new quarters. In Susiana Shapur I. built the great city of Gondev-Shapur, which succeeded the ancient capital of the Persian Empire. At the same time the mother-country again gained importance; especially the capital of Persis, Istakhr, which had replaced the former Persepolis (now the ruins of Hajji-abad). Farther in the south-east, Ardashir I. built Gur (now Firuzabad), under the name of Ardashir-khurre ("the glory of Ardashir"). At these places and in Sarwistan, near Shiraz and elsewhere, lie ruins of the Sassanid palaces, which in their design go back to the Achaemenid architecture, blending with it, however, Graeco-Syrian elements and serving in their turn as models for the structures of the Caliphs (see ARCHITECTURE: § *Sassanian*). After its long quiescence under the Arsacids native art underwent a general renaissance, which, though not aspiring to the Achaemenian creations, was still of no small importance. Of the Sassanian rock-sculptures some have already been mentioned; besides these, numerous engraved signet-stones have been preserved. The metal-work, carpets and fabrics of this period enjoyed a high reputation; they were widely distributed and even influenced western art.

Literature. In the intellectual life and literature of the Sassanid era the main characteristic is the complete disappearance of Hellenism and the Greek language. Ardashir I. and Shapur I. still appended Greek translations to some of their inscriptions; but all of later date are drawn up in Pahlavi alone. The coins invariably bear a Pahlavi legend—on the obverse the king's head with his name and title; on the reverse, a fire-altar (generally with the ascription "fire of Ardashir, Shapur, &c.," *i.e.* the fire of the royal palace), and the name of the place of coinage, usually abbreviated. The real missionaries of culture in the empire were the Aramaeans (Syrians), who were connected with the West by their Christianity, and in their translations diffused Greek literature through the Orient. But there also developed a rather extensive Pahlavi literature, not limited to religious subjects, but containing works in *belles lettres*, modernizations of the old Iranian sagas and native traditions, *e.g.* the surviving fabulous history of Ardashir I., ethical tales, &c., with translations of foreign literature, principally Indian,—one instance being the celebrated book of tales *Kalilah and Dimnah* (see SYRIAC LITERATURE), dating from Chosroes I., in whose reign chess also was introduced from India.

AUTHORITIES.—Side by side with the accounts of Roman and Greek authors stands the indigenous tradition which, especially for the later years of the empire, is generally trustworthy. It goes back to a native work, the *Khudai nama* ("book of lords"), compiled under Chosroes I. and continued to Yazdegerd III. Its narrations are principally preserved in Tabari, though there combined with numerous Arabian traditions; also in the poetical adaptation of Firdousi. To these may be added Syrian accounts, particularly in the martyrologies, which have been excellently treated by G. Hoffmann, *Auszüge aus syrischen Akten persischer Märtyrer* (1880); also the statements of the Armenian historians.

The fundamental work on Sassanian history is Theodor Nöldeke's *Gesch. der Perser u. Araber zur Zeit der Sassaniden, aus der arabischen Chronik des Tabari* (1879, trans. with notes and excursuses chiefly on the chronology and organization of the empire). On this is based Nöldeke's *Aufsätze zur pers. Gesch.* (1887; containing a history of the Sassanian Empire, pp. 86 sqq.). The only other works requiring mention are: G. Rawlinson, *The Seventh Great Oriental Monarchy* (1876), and F. Justi's sketch in the *Grundriss der iranischen Philologie*, vol. ii. (1904). For the geography and numerous details of administration: J. Marquart, "Eranshahr" (*Abh. d. götting. Ges. d. Wissensch.*, 1901). For the numismatology the works of A. D. Mordtmann are of prime importance, especially his articles in the *Zeitschr. d. d. morgenl. Ges.* (1879), xxxiii. 113 sqq. and xxxiv. 1 sqq. (1880), where the inscriptions of the individual kings are also enumerated. Also Nöldeke, ibid. xxxi. 147 sqq. (1877). For facsimiles of coins the principal work is J. de Bartholomaei, *Collection de monnaies sassanides* (2nd ed., St Petersburg, 1875). For the inscriptions: Edward Thomas, "Early Sassanian Inscriptions," *Journ. R. A. Soc.* vol. ii. (1868); West, "Pahlavi Literature" in the *Grundriss d. iran. Philol.* vol. ii. For the monuments: Flandin and Coste, *Voyage en Perse* (1851); Stolze, *Persepolis* (1882); Fr. Sarre, *Iran. Felsreliefs a. d. Z. der Achaemeniden und Sassaniden* (1908).

In foreign policy the problems under the Sassanid kings[2]

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[1] For the propagation and history of the Christians in the Sassanid Empire, cf. Labourt, *Le Christianisme dans l'empire perse sous la dynastie sassanide* (1904); Harnack, *Die Mission und Ausbreitung des Christenthums in den ersten drei Jahrhunderten*, 2. Aufl. (1906), Bd. II. p. 121 seq.; Chabot, *Synodicon orientale* (1902) (a collection of the acts of the Nestorian synods held under the rule of the Sassanids).

[2] List of kings (after Nöldeke, *Tabari*, p. 435).

Ardashir I., 226–241.
Shapur I., 241–272.
Hormizd I., 272–273.
Bahram I., 273–276.
Bahram II., 276–293.
Bahram III., 293.
Narseh (Narses), 293–302.
Hormizd II., 302–310.
Shapur II., 310–379.
Ardashir II., 379–383.
Shapur III., 383–388.
Bahram IV., 388–399.
Yazdegerd I., 399–420.
Bahram V., Gor. 420–438.
Yazdegerd II., 438–457.
Hormizd III., 457–459.
Peroz, 457–484.
Balash, 484–488.

History of the Sassanian Empire.

remained as of old, the defence and, when possible, the expansion of the eastern and western frontiers. In the first two centuries of the Sassanid Empire we hear practically nothing of its relations with the East. Only occasional notices show that the inroads of the Oriental nomads had not ceased, and that the extent of the empire had by no means exceeded the bounds of the Parthian dominion—Sacastene (Seistan) and western Afghanistan. Far to the east, on both sides of the Indus, the Kushana Empire was still in existence, though it was already hastening to decay, and about A.D. 320 was displaced from its position in India by the Gupta dynasty. In the west the old conflict for Osroene and northern Mesopotamia (now Roman provinces), with the fortresses of Edessa, Carrhae and Nisibis, still smouldered. Armenia the Sassanids were all the more eager to regain, since there the Arsacid dynasty still survived and turned for protection to Rome, with whom, in consequence, new wars perpetually broke out. In the reign of Bahram II. (276–293), the emperor Carus, burning to avenge the disaster of Valerian, penetrated into Mesopotamia without meeting opposition, and reduced Coche (near Seleucia) and Ctesiphon; but his sudden death, in December of 283, precluded further success, and the Roman army returned home. Bahram, however, was unable to effect anything, as his brother Hormizd was in arms, supported by the Sacae and other tribes. (Mamertin, *Panegyr. Maximin.* 7. 10; *Genethl. Maximin.* 5, 17.) He chose, consequently, to buy peace with Diocletian by means of presents. Some years later his uncle and successor, Narses, after subduing his rival Bahram III., occupied Armenia and defeated the emperor Galerius at Callinicum (296). But in the following year he sustained a severe reverse in Armenia, in which he lost his war-chest and harem. He then concluded a peace, by the terms of which Armenia remained under Roman suzerainty, and the steppes of northern Mesopotamia, with Singara and the hill-country on the left bank of the Tigris as far as Gordyene, were ceded to the victor (Ammian. Marc. xxv. 7, 9; Petr. Patr. *fr.* 13, 14; Rufus *brev.* 25). In return Narses regained his household. This peace, ratified in 297 and completely expelling the Sassanids from the disputed districts, lasted for forty years.

For the rest, practically nothing is known of the history of the first six successors of Shapur I. After the death of Hormizd II. (302–310), the son of Narses, the magnates imprisoned or put to death his adult sons, one of whom, Hormisdas, later escaped to the Romans, who used him as a pretender in their wars. Shapur II., a posthumous child of the late king, was then raised to the throne, a proof that the great magnates held the sovereignty in their own hands and attempted to order matters at their own pleasure. Shapur, however, when he came to manhood proved himself an independent and energetic ruler.

Shapur II. Persecution of the Christians.

Meanwhile the Roman Empire had become Christian, the sequel of which was that the Syro-Christian population of Mesopotamia and Babylonia—even more than the Hellenic cities in former times—gravitated to the west and looked to Rome for deliverance from the infidel yoke. On similar grounds Christianity, as opposed to the Mazdaism enforced officially by the Sassanids, became predominant in Armenia. Between these two great creeds the old Armenian religion was unable to hold its own; as early as A.D. 294 King Tiridates was converted by Gregory the Illuminator and adopted the Christian faith. For this very reason the Sassanid Empire was the more constrained to champion Zoroastrianism. It was under Shapur II. that the compilation of the *Avesta* was completed and the state orthodoxy perfected by the chief *mobed*, Aturpad. All heresy was proscribed by the state, defection from the true faith pronounced a capital crime, and the persecution of the heterodox—particularly the Christians—began (cf. Sachall, "Die rechtlichen Verhältnisse der Christen in Sassanidenreich," in *Mitteilungen des Seminars für orientalische Sprachen für Berlin*, Bd. X., Abt. 2, 1907). Thus the duel between the two great empires now becomes simultaneously a duel between the two religions.

Kavadh I., 488–531.
(Djamasp, 496–498).
Chosroes (Khosrau) I., Anushirvan, 531–579.
Hormizd IV., 579–590.
Chosroes II., *Parvez*, 590–628.
(Bahram VI., *Cobin*, Bistam 590–596.)
Kavadh II., *Sheroe*, 628.
Ardashir III., 628–630.
(Shahrbaraz, 630.)
(Boran and others, 630–632.)
Yazdegerd III., 632–651.

On most of these kings there are separate articles.

In such a position of affairs a fresh war with Rome was inevitable.[1] It was begun by Shapur in A.D. 337, the year that saw the death of Constantine the Great. The conflict centred round the Mesopotamian fortresses; Shapur thrice besieged Nisibis without success, but reduced several others, as Amida (359) and Singara (360), and transplanted great masses of inhabitants into Susiana. The emperor Constantius conducted the war feebly and was consistently beaten in the field. But, in spite of all, Shapur found it impossible to penetrate deeper into the Roman territory. He was hampered by the attack of nomadic tribes in the east, among whom the Chionites now begin to be mentioned. Year after year he took the field against them (353–358), till finally he compelled them to support him with auxiliaries (Ammian. Marc. 14, 3; 16, 9; 17, 5; 18, 4, 6). With this war is evidently connected the foundation of the great town New-Shapur (Nishapur) in Khorasan.

By the resolution of Julian (363) to begin an energetic attack on the Persian Empire, the conflict, after the lapse of a quarter of a century, assumed a new phase. Julian pressed forward to Ctesiphon but succumbed to a wound; and his successor Jovian soon found himself in such straits, that he could only extricate himself and his army by a disgraceful peace at the close of 363, which ceded the possessions on the Tigris and the great fortress of Nisibis, and pledged Rome to abandon Armenia and her Arsacid protégé, Arsaces III., to the Persian.

Conquest of Armenia.

Shapur endeavoured to occupy Armenia and introduce the Zoroastrian orthodoxy. He captured Arsaces III. by treachery and compelled him to commit suicide; but the Armenian magnates proved refractory, placed Arsaces' son Pap on the throne, and found secret support among the Romans. This all but led to a new war; but in 374 Valens sacrificed Pap and had him killed in Tarsus. The subsequent invasions of the Goths, in battle with whom Valens fell at Adrianople (375), definitely precluded Roman intervention; and the end of the Armenian troubles was that (*c.* 390) Bahram IV. and Theodosius the Great concluded a treaty which abandoned the extreme west of Armenia to the Romans and confirmed the remainder in the Persian possession. Thus peace and friendship could at last exist with Rome; and in 408 Yazdegerd I. contracted an alliance with Theodosius II. In Armenia the Persians immediately removed the last kings of the house of Arsaces (430), and thenceforward the main portion of the country remained a Persian province under the control of a marzban, though the Armenian nobles still made repeated attempts at insurrection. The introduction of Zoroastrianism was abandoned; Christianity was already far too deeply rooted. But the sequel to the Roman sacrifice of Armenian interests was that the Armenian Christians now seceded from the orthodoxy of Rome and Constantinople, and organized themselves into an independent national church. This church was due, before all, to the efforts of the Catholicos Sahak (390–439), whose colleague Mesrob, by his translation of the Bible, laid the foundations of an Armenian literature (see ARMENIAN CHURCH).

Yazdegerd I.

In the interior of the Sassanian Empire the old troubles broke out anew on the death of Shapur II. (379). At first the magnates raised his aged brother Ardashir II. to the throne, then in 383 deposed him and enthroned Shapur's son as Shapur III. In 388, however, he was assassinated, as was also his brother, Bahram IV., in 399. But the son of the latter, Yazdegerd I. (399–420), was an energetic and intelligent sovereign, who held the magnates within bounds and severely chastised their attempts at encroachment. He even sought to emancipate himself from the Magian Church, put an end to the persecutions, and allowed the Persian Christians an individual organization. In the Persian tradition he is consequently known as "the sinner." In the end he was probably assassinated. So great was the bitterness against him that the magnates would admit none of his sons to the throne. One of them, however, Bahram V., found an auxiliary in the Arab chief Mondhir, who had founded a principality in Hira, west of the lower Euphrates; and, as he pledged himself to govern otherwise than his father, he received general recognition. This pledge he redeemed, and he is, in consequence, the darling of Persian tradition, which bestows on him the title of *Gor* ("the wild ass"), and is eloquent on his adventures in the chase and in love. This reversal of policy led to a Christian persecution and a new war with Rome. Bahram, however, was worsted; and in the peace of 422 Persia agreed to allow the Christians free exercise of their religion in the empire, while the same privilege was accorded to Zoroastrianism by Rome. Under his son, Yazdegerd II. (438–457), who once more revived the persecutions of the Christians and the Jews, a short conflict with Rome again ensued (441): while at the same time war prevailed in the east against the remnants of the Kushan Empire and the tribe of Kidarites, also named Huns.

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[1] For the succeeding events see also under ROME: *Ancient History*; and articles on the Roman emperors and Persian kings.

Bahram V., Gor.

Here a new foe soon arose in the shape of the Ephthalites (*Haitab*), also known as the "White Huns," a barbaric tribe which shortly after A.D. 450 raided Bactria and terminated the Kushana dominion (Procop. *Pers.* i. 3). These Ephthalite attacks harassed and weakened the Sassanids, exactly as the Tocharians had harassed and weakened the Arsacids after Phraates II. Peroz (457–484) fell in battle against them; his treasures and family were captured and the country devastated far and near. His brother Balash (484–488), being unable to repel them, was deposed and blinded, and the crown was bestowed on Kavadh I. (488–531), the son of Peroz. As the external and internal distress still continued he was dethroned and imprisoned, but took refuge among the Ephthalites and was restored in 499 by their assistance—like so many Arsacids by the arms of the Dahae and Sacae. To these struggles obviously must be attributed mainly the fact that in the whole of this period no Roman war broke out. But, at the same time, the religious duel had lost in intensity, since, among the Persian Christians, the Nestorian doctrine was now dominant. Peroz had already favoured the diffusion of Nestorianism, and in 483 it was officially adopted by a synod, after which it remained the Christian Church of the Persian Empire, its head being the patriarch of Seleucia—Ctesiphon.

The Ephthalites or White Huns.

Kavadh I.

Kavadh proved himself a vigorous ruler. On his return he restored order in the interior. In 502 he attacked the Romans and captured and destroyed Amida (mod. Diarbekr), but was compelled to ratify a peace owing to an inroad of the Huns. Toward the close of his reign (527) he resumed the war, defeating Belisarius at Callinicum (531), with the zealous support of the wild Arab Mondhir II. of Hira. On his death his son Chosroes I. concluded a peace with Justinian (532), pledging the Romans to an annual subsidy for the maintenance of the Caucasus fortresses. In his home policy Kavadh is reminiscent of Yazdegerd I. Like him he had little inclination to the orthodox church, and favoured Mazdak, the founder of a communistic sect which had made headway among the people and might be used as a weapon against the nobles, of whom Mazdak demanded that they should cut down their luxury and distribute their superfluous wealth. Another feature of his programme was the community of wives. The crown-prince, Chosroes, was, on the other hand, wholly orthodox; and, towards the close of his father's reign, in conjunction with the chief Magian, he carried through a sacrifice of the Mazdakites, who were butchered in a great massacre (528). Chosroes I. (531–579), surnamed Anushirvan ("the blessed"), then restored the orthodox doctrine in full, publishing his decision in a religious edict. At the same time he produced the official exposition of the *Avesta*, an exegetical translation in the popular tongue (Pahlavi), and declared its contents binding. Defection from Zoroastrianism was punished with death, and therefore also the proselytizing of the Christians, though the Syrian martyrologies prove that the kings frequently ignored these proceedings so long as it was at all possible to do so.

The Mazdakite Sect.

Chosroes I., Anushirvan.

Chosroes I. was one of the most illustrious sovereigns of the Sassanian Empire. From him dates a new and equitable adjustment of the imperial taxation, which was later adopted by the Arabs. His reputation as an enlightened ruler stood so high that when Justinian, in 529, closed the school of Athens, the last Neoplatonists bent their steps to him in hopes of finding in him the true philosopher-king. Their disillusionment, indeed, was speedy and complete, and their gratitude was great, when, by the conditions of the armistice of 549, he allowed their return. From 540 onward he conducted a great war against Justinian (527–565), which, though interrupted by several armistices, lasted till the fifty years' peace of 562. The net result, indeed, was merely to restore the *status quo;* but during the campaign Chosroes sacked Antioch and transplanted the population to a new quarter of Ctesiphon (540). He also extended his power to the Black Sea and the Caucasus; on the other hand, a siege of Edessa failed (544). A second war broke out in 577, chiefly on the question of Armenia and the Caucasus territory. In this Chosroes ravaged Cappadocia in 575; but the campaign in Mesopotamia was unsuccessful. In the interval between these two struggles (570) he despatched assistance to the Arabs of Yemen, who had been assailed and subdued by the Abyssinian Christians; after which period Yemen remained nominally under Persian suzerainty till its fate was sealed by the conquests of Mahomet and Islam.

Meanwhile, about A.D. 560, a new nation had sprung up in the East, the Turks. Chosroes concluded an alliance with them against the Ephthalites and so conquered Bactria south of the Oxus, with its capital Balkh. Thus this province, which, since the insurrection of Diodotus in 250 B.C., had undergone entirely different vicissitudes from the rest of Iran, was once more united to an Iranian Empire, and the Sassanid dominions, for the first time, passed the frontiers of the Arsacids. This, however, was the limit of their expansion. Neither the territories north of the Oxus, nor eastern Afghanistan and the Indus provinces, were ever subject to them. That the alliance with the Turks should soon change to hostility and mutual attack was inevitable from the nature of the case; in the second Roman war the Turkish Khan was leagued with Rome.

First Appearance of the Turks. Sassanid Conquest of Bactria.

Chosroes bequeathed this war to his son Hormizd IV. (579–590), who, in spite of repeated negotiations, failed to re-establish peace. Hormizd had not the ability to retain the authority of his father, and he further affronted the Magian priesthood by declining to proceed against the Christians and by requiring that, in his empire, both religions should dwell together in peace. Eventually he succumbed to a conspiracy of his magnates, at whose head stood the general Bahram Cobin, who had defeated the Turks, but afterwards was beaten by the Romans. Hormizd's son, Chosroes II., was set up against his father and forced to acquiesce in his execution. But immediately new risings broke out, in which Bahram Cobin—though not of the royal line—attempted to secure the crown, while simultaneously a Prince Bistam entered the lists. Chosroes fled to the Romans and the emperor Maurice undertook his restoration at the head of a great army. The people flocked to his standard; Bahram Cobin was routed (591) and fled to the Turks, who slew him, and Chosroes once more ascended the throne of Ctesiphon; Bistam held out in Media till 596. Maurice made no attempt to turn the opportunity to Roman advantage, and in the peace then concluded he even abandoned Nisibis to the Persians.

Chosroes II.

Chosroes II. (590–628) is distinguished by the surname of *Parvez* ("the conqueror"), though, in point of fact, he was immeasurably inferior to a powerful sovereign like his grandfather, or even to a competent general. He lived, however, to witness unparalleled vicissitudes of fortune. The assassination of Maurice in 602 impelled him to a war of revenge against Rome, in the course of which his armies—in 608 and, again, in 615 and 626—penetrated as far as Chalcedon opposite Constantinople, ravaged Syria, reduced Antioch (611), Damascus (613), and Jerusalem (614), and carried off the holy cross to Ctesiphon; in 619 Egypt was occupied. Meanwhile, the Roman Empire was at the lowest ebb. The great emperor Heraclius, who assumed the crown in 610, took years to create the nucleus of a new military power. This done, however, he took the field in 623, and repaid the Persians with interest. Their armies were everywhere defeated. In 624 he penetrated into Atropatene (Azerbaijan), and there destroyed the great fire-temple; in 627 he advanced into the Tigris provinces. Chosroes attempted no resistance, but fled from his residence at Dastagerd to Ctesiphon. These proceedings, in conjunction with the avarice and licence of the king, led to revolution. Chosroes was deposed and slain by his son Kavadh II. (628); but the parricide died in a few months and absolute chaos resulted. A whole list of kings and pretenders—among them the General Shahrbaraz and Boran, a daughter of Chosroes—followed rapidly on one another; till finally the magnates united and, in 632, elevated a child to the throne, Yazdegerd III., grandson of Chosroes. In the interval—presumably during the reign of Queen Boran—peace was concluded with Heraclius, the old frontier being apparently restored. The cross had already been given back to the emperor.

The Arab Conquest.

Thus the hundred years' struggle between Rome and Persia, which had begun in 527 with the attack of the first Kavadh on Justinian, had run its fruitless course, utterly enfeebling both empires and consuming their powers. So it was that room was given to a new enemy who now arose between either state and either religion—the Arabs and Islam. In the same year that saw the coronation of Yazdegerd III.—the beginning of 633—the first Arab squadrons made their entry into Persian territory. After several encounters there ensued (637) the battle of Kadisiya (Qadisiya, Cadesia), fought on one of the Euphrates canals, where the fate of the Sassanian Empire was decided. A little previously, in the August of 636, Syria had fallen in a battle on the Yarmuk (Hieromax), and in 639 the Arabs penetrated into Egypt. The field of Kadisiya laid Ctesiphon, with all its treasures, at the mercy of the victor. The king fled to Media, where his generals attempted to organize the resistance; but the battle of Nehavend (?641) decided matters there. Yazdegerd sought refuge in one province after the other, till, at last, in 651, he was assassinated in Merv (see Caliphate: § A, § 1).

Thus ended the empire of the Sassanids, no less precipitately and ingloriously than that of the Achaemenids. By 650 the Arabs had occupied every province to Balkh and the Oxus. Only in the secluded districts of northern Media (Tabaristan), the "generals" of the house of Karen (Spahpat, Ispehbed) maintained themselves for a century as vassals of the caliphs—exactly as Atropates and his dynasty had done before them.

The fall of the empire sealed the fate of its religion. The Moslems officially tolerated the Zoroastrian creed, though occasional persecutions were not lacking. But little by little it vanished from Iran, with the exception of a few remnants (chiefly in the oasis of Yezd), the faithful finding a refuge in India at Bombay. These Parsees have preserved but a small part of the sacred writings; but to-day they still number their years by the era which begins on the 16th of June A.D. 632, with the accession of Yazdegerd III., the last king of their faith and the last lawful sovereign of Iran, on whom rested the god-given Royal Glory of Ormuzd.

Authorities.—Besides the works on special periods quoted above, the following general works should be consulted: Spiegel, *Eranische Altertumskunde* (3 vols., 1876 sqq.); W. Geiger and Ernst Kuhn, *Grundriss der iranischen Philologie herausg.*, vol. ii. (Literature, History and Civilization, 1896 sqq.); G. Rawlinson, *The Five Great Monarchies*, *The Sixth Monarchy*, *The Seventh Monarchy*. Further the mutually supplementary work of Th. Nöldeke, *Aufsätze zur persischen Geschichte* (1887, Medes, Persians and Sassanids), and A. v. Gutschmid, *Geschichte Irans von Alexander d. Gr. bis zum Untergang der Arsaciden* (1888). A valuable work of reference is F. Justi, *Iranisches Namenbuch* (1895).

The most important works on the monuments are: Flandin et Coste, *Voyage en Perse* (6 vols., 1840 sqq.); Texier, *L'Arménie, la Perse, et la Mesopotamie* (2 vols., 1842); Stolze, *Persepolis* (2 vols., 1882); Sarre, *Iranische Felsreliefs* (1908).

For works on the external history of Persia see those quoted under articles on Persian kings; also Rome; Greece; Egypt; Syria; &c. (Ed. M.)

B.—*Transition Period: from the Fall of the Sassanid Dynasty to the Death of Timur (1405).*

Alien Rulers.

With the final defeat of the Sassanids under Yazdegerd III. at the battles of Kadisiya (Kadessia) (637) and Nehavend (641), Persia ceased to exist as a single political unit. The country passed under a succession of alien rulers who cared nothing for its ancient institutions or its religion. For about 150 years it was governed, first from Medina and afterwards from Bagdad, by officers of the Mahommedan caliphs whose principal aim it was to destroy the old nationality by the suppression of its religion. The success of this policy was, however, only apparent, especially in Iran, the inhabitants of which adopted Islam only in the most superficial manner, and it was from Persia that the blow fell which destroyed the Omayyad caliphate and set up the Abbasids in its place (see Caliphate). Even before this event adventurers and dissatisfied Moslem officers had utilized the slumbering hostility of the Persian peoples to aid them in attacks on the caliphs (*e.g.* Ziyad, son of Abu Sofian, in the reign of Moawiya I.), and the policy of eastern expansion brought the Arab armies perpetually into the Persian provinces.

In the reign of Merwan I. the Persians (who were mostly Shi'ites) under a Moslem officer named Mokhtar (Mukhtar), whom they regarded as their mahdi, vainly attempted to assert their independence in Kufa, but were soon defeated. This rising was followed by many more (see Caliphate: § B) in which the caliphs were generally successful, and Abdalmalik (d. 705) considerably strengthened the Moslem power by instituting a thorough system of Moslem coins and enforcing Arabic as the official language throughout the empire. In the succeeding reign Persia was further subdued by the great conqueror Qoteiba (Qotaiba) b. Moslim, the Arabic governor of Khorasan. Omar II., however, extended to non-Arabic Moslems immunity from all taxes except the *zakat* (poor-rate), with the result that a large number of Persians, who still smarted under their defeat under Mokhtar, embraced Islam and drifted into the towns to form a nucleus of sedition under the Shi'ite preachers. In the reign of Yazid II. (720–724) serious risings took place in Khorasan, and in spite of the wise administration of his successor Hisham (d. 743), the disorder continued to spread, fanned by the Abbasids and the Shi'ite preachers. Ultimately in the reign of Merwan II. the non-Arabic Moslems found a leader in Abu Moslim, a *maula* (client) of Persian origin and a henchman of Ibrahim b. Mahommed b. Ali, the Shi'ite imam, who raised a great army, drove the caliph's general Nasr b. Sayyar into headlong flight, and finally expelled Merwan. Thus the Abbasids became masters of Persia and also of the Arab Empire. They had gained their success largely by the aid of the Persians, who began thenceforward to recover their lost sense of nationality; according to the Spanish author Ibn Hazm the Abbasids were a Persian dynasty which destroyed the old tribal system of the Arabs and ruled despotically as Chosroes had done. At the same time the Khorasanians had fought for the old Alid family, not for the Abbasids, and with the murder of Abu Moslim discontent again began to grow among the Shi'ites (*q.v.*). In the reign of Harun al-Rashid disturbances broke out in Khorasan which were temporarily appeased by a visit from Harun himself. Immediately afterwards Rafi' b. Laith, grandson of the Omayyad general Nasr b. Sayyar, revolted in Samarkand, and Harun on his way to attack him died at Tus (809). Harun's sons Amin and Mamun quarrelled over the succession; Amin became caliph, but Mamun by the aid of Tahir b. Ḥosain Dhu 'l-Yaminain ("the man with two right hands") and others succeeded in deposing and killing him. Tahir ultimately (820) received the governorship of Khorasan, where he succeeded in establishing a practically independent Moslem dynasty (the Tahirids)[1] which ruled until about 873 in nominal obedience to Bagdad. From 825 to about 898 a similar dynasty, the Dulafids[2] or Dolafids reigned nominally as governors under the caliphs till they were put down by Motadid. In the reign of the caliph Motasim a serious revolt of Persian Mazdakite sectaries (the Khorrami) in alliance with Byzantium was with difficulty suppressed, as also a rising of Tabaristan under an hereditary chief Maziyar who was secretly supported by the Turkish mercenaries (*e.g.*, Afshin) whom the caliph had invited to his court. To another Turk, Itakh, the caliph Wathiq gave a titular authority over all the eastern provinces. In the reign of the tenth caliph Motawakkil the Tahirids fell before Yakub b. Laith al-Saffar, who with the approbation of the caliph founded a dynasty, the Saffarid (*q.v.*), in Seistan.

Minor Dynasties.

It is convenient at this point to mention several other minor dynasties founded by nominal governors in various parts of Persia and its borderland. From 879 to about 930 the Sajids ruled in Azerbaijan, while in Tabaristan an Alid dynasty (the Zaidites) was independent from 864 to 928, when it fell before the Samanids. Subsequently descendants of this house ruled in Dailam and Gilan. Throughout this period the caliphate was falling completely under the power of the Turkish officers. Mohtadi, the fourteenth Abbasid caliph, endeavoured vainly to replace them by Persians (the Abna). His successor Motamid was attacked by the Saffarid Yakub who however was compelled to flee (see CALIPHATE: § C, § 15). Yakub's brother Amr (reigned 878–900) received the vacant position, but was taken prisoner by Isma‘il b. Ahmad, the Samanid, and the Saffarids were henceforward a merely nominal dynasty under the Samanids (900–1229). The Samanids (*q.v.*) were the first really important non-Arabic Persian dynasty since the fall of Yazdegerd III. They held sway over most of Persia and Transoxiana, and under their rule scholarship and the arts flourished exceedingly in spite of numerous civil wars. Ultimately they fell before the Ghaznevid dynasty of Sabuktagin.

Samanids.

In the reign of Motadid (CALIPHATE: § C, § 16) who, as we have seen, put down the Dolafids, and also checked the Sajids of Azerbaijan in their designs on Syria and Egypt, the Kharijites of Mesopotamia were put down by the aid of the Hamdanites of Mosul, who were to become an important dynasty (see below). Subsequently the caliphate, which had temporarily recovered some of its authority, resumed its downward course, and the great families of Persia once again asserted themselves. In the reign of Qahir (d. 934), a new dynasty arose in Persia, that of the Buyids (Buwayhids). This family was descended from one Abu Shaja Buya, who claimed to be of the old Sassanian house and had become a chieftain in Dailam. He had successively fought for the Samanids and the Ziyarids,[3] a dynasty of Jorjan, and his son Imad addaula (ed-dowleh, originally Abu 'l Ḥasan Ali) received from Mardawij of the latter house the governorship of Karaj; his second son Rokn addaula (Abu Ali Ḥasan) subsequently held Rai and Isfahan, while the third, Moizz addaula (Abu 'l Ḥosain Ahmad) secured Kermān, Ahvaz and even Bagdad.

Buyids.

The reign of the caliph Mottaqi (CALIPHATE: § C, §21) was a period of perpetual strife between the Dailamites, the Turks and the Hamdanid Nasir addaula of Mosul. In the next reign Moizz addaula took Bagdad (945) and was recognized by the caliph Mostakfi as sultan[4] and amir al-Omara. It was at this time that the three brothers took the titles Imad, Rukn (Rokn), and Moizz addaula. The authority of the family was absolute, though they paid outward respect to the caliphs. Moizz addaula repelled an attack of the Hamdanids of Mosul. The Buyids, and especially Adod addaula (Azud-ed-Dowleh, and similar forms), ruled Bagdad wisely and improved the city by great public works such as the great dike, still known as the Bend Amir on the Kur (Cyrus) near Persepolis. Their sway extended from the Persian Gulf to the Caspian Sea (CALIPHATE: § C, § 24). Ultimately, however, the Buyid dynasty grew weaker under the quarrels of its members and fell an easy prey to the Ghaznevids. In the meantime (999) the Samanids fell before the Ilek-Khans of Turkestan, to the great advantage of the Ghaznevid princes.

For these and other minor dynasties such as the Hasanwayhids of Kurdistan (*c.* 959–1015) and the Kakwayhids of Kurdistan (1007–1051), see Stockvis, *Manuel d'histoire*, i. 113 sqq. (Leiden, 1888).

Ghaznevids.

The centre of force in Persian politics now changes from west to east. Hitherto the ultimate power, at least nominally, had resided in the caliphate at Bagdad, and all the dynasties which have been noticed derived their authority formally from that source. With the rise of the Ghaznevids and later the Seljuks, the Abbasid caliphate ceased to count as an independent power. As we have seen, the Ghaznevid armies in a brief space destroyed most of the native dynasties of Persia. The first of the house was Alptagin, a Turkish slave of the Samanid Mansur I., who, having quarrelled with his master, took refuge in Afghanistan and founded a semi-independent authority. After his death three unimportant governors of his house held sway, but in 977 the power fell to another former slave, Sabuktagin, who was recognized by the Samanid Nuh II. His son and successor Mahmud (*q.v.*) was attacked by a brother, Isma‘il, and retired from Khorasan (of which he had been governor). The Samanids then fell under the power of the Tatar Ilkhans, but Mahmud returned, triumphed over both the Samanids and the Tatars, and assumed the independent title of sultan with authority over Khorasan, Transoxiana and parts of north-west India. Mahmud was a great conqueror, and wherever he went he replaced the existing religion by Mahommedanism. He is described as the patron (if a somewhat ungenerous one) of literature; it was under his auspices that Firdousī collected the ancient myths of Persia and produced the great epic *Shahnama* (Book of the Kings). His descendants held a nominal rule till 1187, but in 1152 they lost all their extra-Indian territories to the Ghoṛids, and during the last thirty-five years reigned in diminished splendour at Lahore. Even before this time, however, the supremacy which they enjoyed under Mahmud in Persia had fallen into the hands of the Seljuks who, in the reign of Mas‘ud I., son of Mahmud, conquered Khorasan. In 1037 Seljuk princes were recognized in Merv and Nishapur, and in the ensuing eighteen years the Seljuks conquered Balkh, Jorjan, Tabaristan, Khwarizm, Hamadan, Rai, Isfahan, and finally Bagdad (1055). The Abbasid caliphs, who still enjoyed a precarious and shadowy authority at the pleasure of Turkish viziers, gladly surrendered themselves to the protection of the Mahommedan Seljuks, who paid them all outward respect.

Seljuks.

Thus for the first time since the Arab conquest of the Sassanian realm Persia was ruled by a single authority, which extended its conquests westward into Asia Minor, where it checked the rulers of Byzantium, and eastward to India and Central Asia. The history of this period is treated at length in the articles CALIPHATE: § C, §§ 26 sqq.; and SELJUKS. A bare outline only is required here.

The first three Seljuk rulers were Toghrul Beg, Alp Arslan and Malik Shah. On the death of the last the empire was distracted by civil war between his sons Barkiyaroq, Mahommed and Sinjar, with the result that, although the Seljuks of the direct line maintained nominal supremacy till the death of Sinjar (1157), other branches of the family established themselves in various parts of the empire—Syria, Rum (Asia Minor),

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[1] Tahir died 822 or 824; Talha d. 828; Abdallah, 828–844; Tahir II., 844–862; Mahommed, 862–873.

[2] Abu Dolaf Qasim b. Idris-‘Ijli (825); ‘Abdalaziz (842); Dolaf (873); Ahmad (878); Omar 893–898).

[3] The Ziyarid dynasty was founded by Mardawij b. Ziyar (928–935). His successors were Zahir addaula (ud-daula, ed-dowleh) Abu Mansur Washmagir (935–967), Bistun (967–976), Shams al Ma‘ali Qabus (976–1012), Falak al Ma‘ali Manushahr (1012–1029), Anushirwān (1029–1042). They were Alyite in religion. They were of progressively less importance under the Samanids, and were ultimately expelled by the Ghaznevids.

[4] This is denied by S. Lane Poole, who points out that they did not use the title on their coins.

Kermān, and Irak with Kurdistan. Sinjar himself lost all his dominions except Khorasan in wars with the Karakitai. The sultans of Kermān were rarely independent in the full sense, but they enjoyed comparative peace and prosperity till the death of Toghrul Shah (1170), after which their power fell before the Ghuzz tribes; Kermān was finally captured in 1195 by the Khwarizm shahs. Meanwhile an independent dynasty was formed about 1136 in Azerbaijan by the governors (atabegs) appointed by the Seljuks; this dynasty was overthrown by the Khwarizm shahs in 1225. Similar dynasties existed in Laristan and Fars.

The empire of the Seljuks was essentially military. Their authority over their own officers was so precarious that they preferred to entrust the command to Turkish slaves. These officers, however, were far from loyal to their lords. In every part of the empire they gradually superseded the Seljuk princes, and the minor dynasties above mentioned all owed their existence to the ambition of the Turkish regents or atabegs. The last important dynasty in Persia prior to the Mongol invasion was that of the Salgharids in Fars, founded by the descendants of a Turkish general Salaghar, who had formerly been a Turkoman leader and ultimately became chamberlain to Toghrul Beg. The first ruler was Sonkor b. Modud, who made himself independent in Fars in 1148. The fourth, Sa'd, became tributary to the Khwarizm shahs in 1195, and the fifth acknowledged allegiance to the Mongol Ogotai and received the title Kutbegh Khan. His successors were vassals of the Mongols, and the last, the Princess 'Abish (d. 1287), was the wife of Hulagu's son Mangu Timur.

Khwarizm.

Before passing on to the Mongol conquerors of Persia it is necessary briefly to notice the shahs of Khwarizm, who have frequently been mentioned as overthrowing the minor dynasties which arose with the decay of the Seljuks. These rulers were descended from Anushtajin, a Turkish slave of Ghazni, who became cupbearer to the Seljuk Malik Shah, and afterwards governor of Khwarizm (Khiva) in 1077. In 1138 the third of the line, Atsiz, revolted but was defeated and expelled by Sinjar. Shortly afterwards he returned, firmly established his power, and extended the Khwarizm Empire as far as Jand on the Sihun. The brief reigns of Il-Arslan and Sultan Shah Mahmud were succeeded by that of Tukush (1172–1199) and Ala ed-din Mahommed[1] (1199–1220). The former of these subdued Khorasan, Rai and Isfahan, while the latter brought practically all Persia under his sway, conquered Bokhara, Samarkand and Otrar, capital of the Karakitai, and had even made himself master of Ghazni when his career was stopped by the hordes of the Mongol Jenghiz Khan. In 1231 the last of his house, Jelal ud-din (Jalaluddin) Mangbarti, or Mango-berti, was banished, and thus the empire of the Khwarizm shahs, which for a brief period had included practically all the lands conquered by the Seljuks, passed away.

Thus from the fall of the Samanids to the invasion of the Mongols five or at most six important dynasties held sway over Persia, while some forty small dynasties enjoyed a measure of local autonomy. During the whole of this period the Abbasid caliphs had been nominally reigning throughout the Mahommedan world with their capital at Bagdad. But with hardly any exceptions they had been the merest puppets, now in the hands of Turkish ministers, now under the protection of practically independent dynasts. The real rulers of Persia during the years 874–1231 were, as we have seen, the Samanids, the Buyids, the Ghaznevids, the Seljuks, the Salgharids and the Khwarizm shahs. We now come to a new period in Persian history, when the numerous petty dynasties which succeeded the Seljuks were all swallowed up in the great Mongol invasion.

Mongols.

In the later years of the 12th century the Mongols began their westward march and, after the conquest of the ancient kingdom of the Kajakitai, reached the borders of the territory of the Khwarizm shahs, which was at once overwhelmed. Jenghiz Khan died in 1272, and the Mongol Empire stretching from the Caspian to the Yellow Sea was divided up among his sons. Persia itself fell partly in the domain of Jagatai and partly in that of the Golden Horde. The actual governor of Persia was Tului or Tule, whose son Hulagu or Hulaku is the first who can be rightly regarded as the sovereign of Persia. His accession occurred in 1256, and henceforward Persia becomes after 600 years of spasmodic government a national unit. Hulagu at once proceeded to destroy a number of nascent dynasties which endeavoured to establish themselves on the ruins of the Khwarizm Empire; about 1255 he destroyed the dynasty of the Assassins[2] by the capture of their stronghold of Alamut (Eagle's Nest), and finally in 1258 captured Bagdad. The thirty-eighth and last Abbasid caliph, Mostasim, was brutally murdered, and thus the Mahommedan caliphate ceased to exist even as an emasculated pontificate. The Persian Empire under Hulagu and his descendants extended from the dominions of Jagatai on the north to that of the Egyptian dynasts on the south, and from the Byzantine Empire on the west to the confines of China. Its rulers paid a nominal homage to the Khakhan (Great Khan) in China, and officially recognized this dependence in their title of Ilkhan, *i.e.* provincial or dependent khan. From 1258 to 1335 the Ilkhans were not seriously challenged. Hulagu fixed his capital at Maragha (Meragha) in Azerbaijan, where he erected an observatory for Nasir ud-din Tusi, who at his request prepared the astronomical tables known as the *Zidj-i-Ilkhani*. He died in 1265 and was succeeded by his son Abagha or Abaka, who married the daughter of Michael Palaeologus, the Byzantine ruler. Abagha was a peaceful ruler and endeavoured by wise administration to give order and prosperity to a country torn asunder by a long period of intestine war and the Mongol invasion. He succeeded in repelling two attacks by other Mongolian princes of the house of Jenghiz Khan; otherwise his reign was uneventful. His brother Nikudar (originally Nicolas) Ahmad Khan succeeded him in 1281. This prince was converted to Islam, an event of great moment both to the internal peace and to the external relations of Persia. His persecution of the Christians led them into alliance with the Mongols, who detested Islam; the combined forces were too strong for Nikudar, who was murdered in 1284. The external results were of more importance. The Ilkhans, who had failed in their attempt to wrest Syria from the Mameluke rulers of Egypt, had subsequently endeavoured to effect their object by inducing the European Powers to make a new crusade. The conversion of Nikudar put an end to this policy and Egypt was for some time free from Persian attack (see EGYPT: *History*). The Mongol leaders put on the throne a son of Abagha, by name Arghun. His reign was troubled. His first minister Shams ud-din was suspected of having poisoned Abagha, and was soon put to death. His successor, the amir Bogha, conspired against Arghun and was executed. Under the third minister (1289–1291), a Jewish doctor named Sa'd addaula (ed-Dowleh), religious troubles arose owing to his persecution of the Mahommedans and his favouring the Christians. The financial administration of Sa'd was prudent and successful, if somewhat severe, and the revenue benefited considerably under his care. But he committed the tactical error of appointing a disproportionate number of Jews and Christians as revenue officials, and thus made many enemies among the Mongol nobles, who had him assassinated in 1291 when Arghun was lying fatally ill. It is possible that it was Sa'd's diplomacy which led Pope Nicholas IV. to send a mission to Arghun with a view to a new crusade. The reign of Arghun was also disturbed by a rebellion of a grandson of Hulagu, Baidu Khan. Arghun died soon after the murder of Sa'd, and was succeeded by his brother Kaikhatu, or Gaykhatu, who was taken prisoner by Baidu Khan and killed (1295). Baidu's reign was cut short in the same year by Arghun's son Ghazan Mahmud, whose reign (1295–1304) was a period of prosperity in war and administration. Ghazan was a man of great ability. He established a permanent staff to deal with legal, financial and military affairs, put on a firm basis the monetary system and the system of weights and measures, and perfected the mounted postal service. Ghazan fought with success against Egypt (which country had already from 1293 to December 1294 been ruled by a Mongol usurper Kitboga), and even held Damascus for a few months. In 1303, however, his troops were defeated at Merj al-Saffar, and Mongol claims on Syria were definitely abandoned. It was even suggested that the titular Abbasid caliphs (who retained an empty title in Cairo under Mameluke protection) should be reinstated at Bagdad, but this proposal was not carried into effect. Ghazan is historically important, however, mainly as the first Mongol ruler who definitely adopted Islam with a large number of his subjects. He died in 1304, traditionally of anger at the Syrian fiasco, and was succeeded by his brother Uljaitu (Oeljeitu). The chief events of his reign were a successful war against Tatar invaders and the substitution of the new city of Sultania as capital for Tabriz, which had been Ghazan's headquarters. Uljaitu was a Shiʽite and even stamped his coins with the names of the twelve Shiʽite imams. He died in 1316, and was succeeded by Abu Saʽid, his son. The prince, under whom a definite peace was made with Malik al-Nasir, the Mameluke ruler of Egypt, had great trouble with powerful viziers and generals which he accentuated by his passion for Bagdad-Khatun, wife of the amir Ḥosain and daughter of the amir Chupan. This lady he eventually married, with the result that Chupan headed a revolt of his tribe, the Selduz. Abu Saʽid died of fever in 1335, and with him the first Mongol or Ilkhan dynasty of Persia practically came to an end. The real power was divided between Chupan and Ḥosain the Jelair (or Jalair), or the Ilkhanian, and their sons, known respectively as the Little Ḥasan (Ḥasan Kuchuk) and the great Ḥasan (Ḥasan Buzurg). Two puppet kings, Arpa Khan, a descendant of Hulagu's brother Arikbuhga, and Musa Khan, a descendant of Baidu, nominally reigned for a few months each. Then Ḥasan Kuchuk set up one Sati-beg, Abu Saʽid's daughter, and wife successively of Chupan, Arfa Khan and one Suleiman, the last of whom was khan from 1339 to 1343; in the same time Ḥasan Buzurg set up successively Mahommed, Tugha-Timur and Jahan-Timur. A sixth nonentity, Nushirwan, was a Chupani nominee in 1344, after which time Ḥasan Buzurg definitely installed himself as the first khan of the Jelairid or Ilkhanian-Jelairid dynasty.

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[1] It was this prince who destroyed the Ghorid dynasty, which claimed descent from the legendary Persian monarch Zohak. Except for a brief period of submission to the Ghaznevids (1009–1099) they ruled at Ghor until 1215, when they were conquered after a fierce struggle.

[2] The dynasty of the Assassins or Isma'ilites was founded in 1090 and extended its rule over much of western Persia and Syria (for the rulers see Stockvis, *op. cit.* i. 131, and article ASSASSIN).

Minor Dynasties.

Practically from the reign of Abu Saʽid Persia was divided under five minor dynasties, (1) the Jelairids, (2) the Mozaffarids, (3) the Sarbadarids (Serbedarians), (4) the Beni Kurt, and (5) the Jubanians, all of which ultimately fell before the armies of Timur.

1. The Jelairid rulers were Ḥasan Buzurg (1336, strictly 1344–1356), Owais (1356–1374), Ḥosain (1374–1382), Sultan Ahmad (1382–1410), Shah Walad (1410–1411). Their capital was Bagdad, and their dominion was increased under Ḥasan. Owais added Azerbaijan, Tabriz, and even Mosul and Diarbekr. Ḥosain fought with the Mozaffarids of Shiraz and the Black Sheep Turkomans (Kara Kuyunli) of Armenia, with the latter of whom he ultimately entered into alliance. On his death Azerbaijan and Irak fell to his brother, Sultan Ahmad, while another brother Bayezid ruled for a few months in part of Kurdistan. It was about this time that Timur (*q.v.*) began his great career of conquest, under which the power of the various Persian dynasties collapsed. By 1393 he had conquered northern Persia and Armenia, Bagdad, Mesopotamia, Diarbekr and Van, and Ahmad fled to Egypt, where he was received by Barkuk (Barquq) the Mameluke sultan. Barkuk, who had already excited the enmity of Timur by slaying one of his envoys, espoused Ahmad's cause, and restored him to Bagdad after Timur's return to his normal capital Samarkand. Timur retaliated and until his death Ahmad ruled only from time to time. In 1406 Ahmad was finally restored, but almost immediately entered upon a quarrel with Kara Yusuf, leader of the Black Sheep Turkomans (Kara Kuyunli), who defeated and killed him in 1410. His nephew Shah Walad reigned for a few months only and the throne was occupied by his widow Tandu, formerly wife of Barkuk, who ruled over Basra, Wasit and Shuster till 1416, paying allegiance to Shah Rukh, the second Timurid ruler. Walad's sons Mahmud, Owais and Mahommed, and Ḥosain, grandson of Sultan Ahmad, successively occupied the throne. The last of these was killed by the Kara Kuyunli, who had established a dynasty in western Persia after Kara Yusuf's victory in 1410.

2. The Mozaffarids, who ruled roughly from 1313 to 1399 in Fars, Kermān and Kurdistan, were descended from the Amir Mozaffar, or Muzaffar, who held a post as governor under the Ilkhan ruler. His son Mobariz ud-din Mahommed, who followed him in 1313, became governor in Fars under Abu Saʽid, in Kermān in 1340, and subsequently made himself independent at Fars and Shiraz (1353) and in Isfahan (1356). In 1357 he was deposed and blinded, and though restored was exiled again and died in 1364. His descendants, except for Jelal ed-din (Jalaluddin) Shah Shujaʽ, the patron of the poet Hafiz, were unimportant, and the dynasty was wiped out by Timur about 1392.

3. The Sarbadarids (so called from their motto *Sar-ba-dar*, "Head to the Gibbet"), descendants of Abd al-Razzak, who rebelled in Khorasan about 1337, enjoyed some measure of independence under twelve rulers till they also were destroyed by Timur (*c.* 1380).

4. The Beni Kurt (or Kart), who had governed in Khorasan from 1245, became independent in the early 14th century; they were abolished by Timur (*c.* 1383).

5. The Jubanians had some power in Azerbaijan from 1337 to 1355, when they were dethroned by the Kipchaks of the house of Jenghiz Khan.

The authority of Timur, which, as we have seen, was dominant throughout Persia from at least as early as 1395 till his death in 1405, was never unchallenged. He passed from one victory to another, but the conquered districts were never really settled under his administration. Fresh risings of the defeated dynasties followed each new enterprise, and he had also to deal with the Mongol hordes whose territory marched with northern Persia. His descendants were for a brief period the overlords of Persia, but after Shah Rukh (reigned 1409–1446) and Ala addaula (1447), the so-called Timurid dynasty ceased to have any authority over Persia. There were Timurid governors of Fars under Shah Rukh, Pir Mahommed (1405–1409), Iskendar (1409–1414), Ibrahim (1415–1434) and Abdallah (1434); in other parts of Persia many of the Timurid family held governorships of greater or less importance.

Authorities.—The works relating to Persia will be found under articles on the main dynasties (Caliphate; Seljuks; Mongols), and the great rulers (Jenghiz Khan; Mahmud of Ghazni; Timur). For general information and chronology see S. Lane Poole, *Mohammedan Dynasties* (London, 1894); Stockvis, *Manuel d'histoire*, vol. i. (Leiden, 1888); Sir H. Howorth, *History of the Mongols* (1876–1888). (J. M. M.)

C.—*From the Death of Timur to the Fall of the Safawid Dynasty, 1405–1736.*

The Timurides and Turkomans, 1405-1499.

Timur died in 1405, when in the seventieth year of his age and about to invade China. Besides exercising sovereignty over Transoxiana and those vast regions more or less absorbed in Asiatic Russia of the 19th century, inclusive of the Caucasus, Astrakhan and the lower Volga, and overrunning Mesopotamia, Syria, Asia Minor, Afghanistan and India, he had at this time left his indelible mark upon the chief cities and provinces of Persia. Khorasan and Mazandaran had submitted to him in 1381, Azerbaijan had shortly after followed their example, and Isfahan was seized in 1387. From Isfahan he passed on to Shiraz, and thence returned in triumph to his own capital of Samarkand. Five years later he subdued Mazandaran, and later still he was again at Shiraz, having effected the subjugation of Luristan and other provinces in the west. It may be said that from north to south, or from Astarabad to Hormuz, the whole country had been brought within his dominion.

The third son of Timur, Miran Shah, had ruled over part of Persia in his father's lifetime; but he was said to be insane, and his incapacity for government had caused the loss of Bagdad and revolt in other provinces. His claim to succession had been put aside by Timur in favour of Pir Mahommed, the son of a deceased son, but Khalil Shah, a son of the discarded prince, won the day. His waste of time and treasure upon a fascinating mistress named Shadu 'l-Mulk, the "delight of the kingdom," soon brought about his deposition, and in 1408 he gave way to Shah Rukh, who, with the exception of Miran Shah, was the only surviving son of Timur. In fact the uncle and nephew changed places—the one quitting his government of Khorasan to take possession of the Central-Asian throne, the other consenting to become governor of the vacated Persian province and abandon the cares of the empire at Samarkand. In 1409 Khalil Shah died; and the story goes that Shadu 'l-Mulk stabbed herself and was buried with her royal lover at Rai, one of the towns which his grandfather had partly destroyed.

Shah Rukh, the fourth son of Timur, reigned for thirty-eight years, and appears to have been a brave, generous, and enlightened monarch. He removed his capital from Samarkand to Herat, of which place he rebuilt the citadel, restoring and improving the town. Merv also profited from his attention to its material interests. Sir John Malcolm speaks of the splendour of his court and of his encouragement of science and learning. He sent an embassy to China; and an English version of the travels to India of one of his emissaries, Abd ur-Razzak, is to be found in R. H. Major's *India in the Fifteenth Century* (London, Hakluyt Society, 1857). As regards his Persian possessions, he had some trouble in the north-west, where the Turkomans of Asia Minor, known as the Kara Kuyun,[1] or "Black Sheep," led by Kara Yusuf[2] and his sons Iskandar and Jahan Shah, had advanced upon Tabriz, the capital of Azerbaijan. On the death of the Shah Rukh in 1446 he was succeeded by his son Ulugh Bey, whose scientific tastes are demonstrated in the astronomical tables bearing his name, quoted by European writers when determining the latitude of places in Persia. He was, moreover, himself a poet and patron of literature, and built a college as well as an observatory at Samarkand. There is no evidence to show that he did much to consolidate his grandfather's conquests south of the Caspian. Ulugh Bey was put to death by his son Abd ul-Latif, who, six months later, was slain by his own soldiers. Babar—not the illustrious founder of the Mughal dynasty in India, but an elder member of the same house—next obtained possession of the sovereign power, and established himself in the government of Khorasan and the neighbouring countries. He died after a short rule, from habitual intemperance. After him Abu Sa'id, grandson of Miran Shah, and once governor of Fars, became a candidate for empire, and allied himself with the Uzbeg Tatars, seized Bokhara, entered Khorasan, and waged war upon the Turkoman tribe aforesaid, which, since the invasion of Azerbaijan, had, under Jahan Shah, overrun Irak, Fars and Kermān, and pillaged Herat. But he was eventually taken prisoner by Uzun Ḥasan, and killed in 1468.

Ḥosain Mirza.

It is difficult to assign dates to a few events recorded in Persian history for the eighteen years following the death of Abd ul-Latif; and, were it not for chance European missions, the same difficulty would be felt in dealing with the period after the death of Abu Sa'id up to the accession of Isma'il Sufi in 1499. Sultan Ahmad, eldest son of Abu Sa'id, reigned in Bokhara; his brother, Omar Sheikh, in Ferghana; but the son of the latter, the great Babar, was driven by the Uzbegs to Kabul and India. More to the purpose is it that Sultan Ḥosain Mirza, great-grandson of Omar Sheikh, son of Timur, reigned in Herat from 1487 to 1506. He was a patron of learned men, among others of the historians Mirkhond and Khwadamir, and the poets Jami and Ḥatifi. But at no time could his control have extended over central and western Persia. The nearest approach to a sovereignty in those parts on the death of Abu Sa'id is that of Uzun Ḥasan, the leader of the Ak Kuyun, or "White Sheep" Turkomans, and conqueror of the "Black Sheep," whose chief, Jahan Shah, he defeated and slew. Between the two tribes there had long been a deadly feud. Both were composed of settlers in Asia Minor, the "Black Sheep" having consolidated their power at Van, the "White" at Diarbekr.

Uzun Ḥasan.

Sir John Malcolm states that at the death of Abu Sa'id, Sultan Ḥosain Mirza "made himself master of the empire," and, a little later, that "Uzun Ḥasan, after he had made himself master of Persia, turned his arms in the direction of Turkey"; but the reader is left to infer for himself what the real "empire" of Ḥosain Mirza, and what the limit of the "Persia" of Uzun Ḥasan. The second could not well be included in the first, because the Turkomans were in possession of the greater part of the Persian plateau, while the "sultan" was in Herat, to which Khorasan belonged. It may be assumed that an empire like that acquired by Timur could not long be maintained by his descendants in its integrity.

The Turkish adjective *uzun*, اوزون "long," applied to Ḥasan, the Turkoman monarch of Persia (called also by the Arabs Ḥasanu 't-Tawil), is precisely the qualifying Persian word دراز used in the compound designation of Artaxerxes Longimanus; and Malcolm quotes the statement of a Venetian envoy in evidence that Uzun Ḥasan was "a tall thin man, of a very open and engaging countenance." This reference, and a further notice in Markham's history, supply the clue to a store of valuable information made available by the publications of the Hakluyt Society. The narratives of Caterino Zeno, Barbaro and Contarini, envoys from Venice to the court of Uzun Ḥasan, are in this respect especially interesting. Zeno was sent in 1471 to incite this warlike ruler against the Ottoman sultan, and succeeded in his mission. That the result was disastrous to the shah is not surprising, but the war seems to hold a comparatively unimportant place in the annals of Turkey.

Uzun Ḥasan had married Despina (Gr. Δέσποινα), daughter of the emperor of Trebizond, Calo Johannes of the house of the Comneni; and Zeno's wife was niece to this Christian princess. The relationship naturally strengthened the envoy's position at the court, and he was permitted to visit the queen in the name of the republic which he represented. Barbaro and Contarini met at Isfahan in 1474, and there paid their respects to the shah together. Kum and Tauris or Tabriz (then the capital) were also visited by the Italian envoys following in the royal suite; and the incidental notice of these cities, added to Contarini's formal statement that "the extensive country of Ussuncassan [*sic*] is bounded by the Ottoman Empire and by Caramania," and that Siras (Shiraz) is comprehended in it, proves that at least Azerbaijan, Irak, and the main part of the provinces to the south, inclusive of Fars, were within the dominions of the reigning monarch.

There is good reason to suppose that Jahan Shah, the Black Sheep Turkoman, before his defeat by Uzun Ḥasan, had set up the standard of royalty; and Zeno, at the outset of his travels, calls him "king of Persia"[3] in 1450. Chardin alludes to him in the same sense; but Ḥasan the Long is a far more prominent figure, and has hardly received justice at the hands of the historian. Indeed, his identity seems to have been lost in the various modes of spelling his name adopted by the older chroniclers, who call him indiscriminately[4] Alymbeius, Asembeius, Asembec, Assimbeo, or Ussan Cassano. He is said to have earned the character of a wise and valiant monarch, to have reigned eleven years, to have lived to the age of seventy, and, on his death in 1477 or (according to Krusinski and Zeno) 1478, to have been succeeded on the throne of Persia by his son Ya'qub. This prince, who had slain an elder brother, died by poison (1485), after a reign of seven years. The dose was offered to him by his wife, who had been unfaithful to him and sought to set her paramour on his throne.

Anarchy.

Writers differ as to the succession to Ya'qub. Zeno's account is that a son named Allamur (called also, Alamut, Alvante, El-wand and Alwung Bey) was the next king, who, besides Persia, possessed Diarbekr and part of greater Armenia near the Euphrates. On the other hand, Krusinski states that, Ya'qub dying childless, his relative Julaver, one of the grandees of the kingdom, seized the throne, and held possession of it for three years. Baisingar, it is added, succeeded him in 1488 and reigned till 1490, when a young nobleman named Rustan (Rustam?) obtained the sovereign power and exercised it for seven years. This account is confirmed by

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[1] They were commonly called Kara Kuyun-lu and the "White Sheep" Turkomans Ak Kuyun-lu, the affix "lu" signifying possession, *i.e.* possession of a standard bearing the image of a black or white sheep.

[2] According to Erskine, this chief killed Miran Shah, whose dwelling-place was Tabriz.

[3] See also Ramusio's preface.

[4] Knolles, Purchas, Zeno.

Angiolello, a traveller who followed his countrymen Barbaro and Contarini to Persia; and from the two authorities combined may be gathered the further narration of the murder of Rustam and usurpation of the throne by a certain Ahmad, whose death, under torture, six months afterwards, made way for Alamut, the young son of Ḥasan. These discrepancies can be reconciled on reference to yet another record bound up with the narratives of the four Italians aforesaid, and of much the same period. In the *Travels of a Merchant in Persia* the story of Yaʿqub's death is supplemented by the statement that "the great lords, hearing of their king's decease, had quarrels among themselves, so that for five or six years all Persia was in a state of civil war, first one and then another of the nobles becoming sultans. At last a youth named Alamut, aged fourteen years, was raised to the throne, which he held till the succession of Sheikh Ismaʿil." Who this young man was is not specified; but other writers call Alamut and his brother Murad the sons of Yaʿqub, as though the relationship were unquestionable.

Now little is known, save incidentally, of Julaver or Rustam; but Baisingar is the name of a nephew of Omar Sheikh, king of Ferghana and contemporary of Uzun Ḥasan. There was no doubt much anarchy and confusion in the interval between the death of Yaʿqub and the restoration, for two years, of the dynasty of the White Sheep. But the tender age of Alamut would, even in civilized countries, have necessitated a regency; and it may be assumed that he was the next legitimate and more generally recognized sovereign. Markham, in designating this prince the last of his house, states that he was dethroned by the renowned founder of the Safawi dynasty. This event brings us to one of the most interesting periods of Persian history, any account of which must be defective without a prefatory sketch of Ismaʿil Sufi.

Sheikh Saifu'd-Din.

The Sufi or Safawid (Safawi) Dynasty (1499–1736).—Sheikh Saifu 'd-Din Izhak[1]—lineally descended from Musa, the seventh imam—was a resident at Ardebil (Ardabil) south-west of the Caspian, some time during the 14th century. It is said that his reputation for sanctity attracted the attention of Timur, who sought him out in his abode, and was so charmed by the visit that he released, at the holy man's request, a number of captives of Turkish origin, or Georgians, taken in the wars with Bayezid. The act ensured to the Sheikh the constant devotion and gratitude of these men—a feeling which was loyally maintained by their descendants for the members of his family in successive generations.

Sheikh Haidar.

His son Sadru'd-Din and grandson Kwaja ʿAli (who visited Mecca and died at Jerusalem) retained the high reputation of their pious predecessor. Junaid, a grandson of the last, married a sister of Uzun Ḥasan, and by her had a son named Sheikh Haidar, who married his cousin Martha, daughter of Uzun Ḥasan and Queen Despina. Three sons were the issue of this marriage, Sultan ʿAli, Ibrahim Mirza, and the youngest, Ismaʿil, the date of whose birth is put down as 1480 for reasons which will appear hereafter. So great was the influence of Sheikh Haidar, and so earnestly did he carry out the principles of conduct which had characterized his family for five generations, that his name has become, as it were, inseparable from the dynasty of his son Ismaʿil; and the term "Haidari" (leonine) is applied by many persons to indicate generally the Safawids of Persia. The outcome of his teaching was a division of Mahommedanism vitally momentous to the world of Islam. The Persian mind was peculiarly adapted to receive the form of religion prepared for it by the philosophers of Ardebil. The doctrines presented were dreamy and mystic; they rejected the infallibility of human wisdom, and threw suspicion on the order and arrangement of human orthodoxy. There was free scope given for the indulgence of that political imagination which revels in revolution and chafes at prescriptive bondage. As Malcolm remarks, "the very essence of Sufi-ism is poetry."

Those authorities who maintain that Yaʿqub Shah left no son to succeed him consider valid the claim to the vacant throne of Sheikh Haidar Sufi. Purchas says that Yaʿqub himself, "jealous of the multitude of Aidar's disciples and the greatness of his fame, caused him to be secretly murthered"; but Krusinski attributes the act to Rustam a few years later. Zeno, the anonymous merchant and Angiolello affirm that the devotee was defeated and killed in battle—the first making his conqueror to be Alamut, the second a general of Alamut's, and the third an officer sent by Rustam named Suleiman Bey. Malcolm, following the *Zubdatu 't-tawarikh*, relates that Sheikh Haidar was vanquished and slain by the governor of Shirvan. The subsequent statement that his son, Sultan ʿAli, was seized, in company with two younger brothers, by Yaʿqub, "one of the descendants of their grandfather Uzun Ḥasan, who, *jealous of the numerous disciples that resorted to Ardebil*, confined them to the hill fort of Istakhr in Fars," seems to indicate a second interpretation of the passage just extracted from Purchas, and that there is confusion of persons and incident somewhere. One of the sons here alluded to was Ismaʿil, whom Malcolm makes to have been only seven years of age when he fled to Gilan in 1492. Zeno states that he was then thirteen, which is much more probable,[2] and the several data available for reference are in favour of this supposition.

Ismaʿil I.

The life of the young Sufi from this period to his assumption of royalty in 1499 was full of stirring adventure; and his career as Ismaʿil I. was a brilliant one. According to Zeno, who seems to have carefully recorded the events of the time, he left his temporary home on an island of Lake Van before he was eighteen, and, passing into Karabakh,[3] between the Aras and Kur, turned in a south-easterly direction into Gilan. Here he was enabled, through the assistance of a friend of his father, to raise a small force with which to take possession of Baku on the Caspian, and thence to march upon Shemakha in Shirvan, a town abandoned to him without a struggle. Hearing, however, that Alamut was advancing to meet him, he was compelled to seek new levies from among the Jengian Christians and others. At the head of 16,000 men, he thoroughly routed his opponents, and, having cleared the way before him, marched straight upon Tabriz, which at once surrendered. He was soon after proclaimed shah of Persia (1499), under the designation which marked the family school of thought.

Alamut had taken refuge at Diarbekr; but his brother Murad, at the head of an army strengthened by Turkish auxiliaries, was still in the field with the object of contesting the paternal crown. Ismaʿil lost no time in moving against him, and won a new victory on the plains of Tabriz. Murad fled with a small remnant of his soldiers to Diarbekr, the rallying-point of the White Sheep Turkomans. Zeno states that in the following year Ismaʿil entered upon a new campaign in Kurdistan and Asia Minor, but that he returned to Tabriz without accomplishing his object, having been harassed by the tactics of Ala ud-Daula, a beylerbey, or governor in Armenia and parts of Syria. Another writer says that he marched against Murad Khan in Irak-i-Ajami and Shiraz. This last account is extremely probable, and would show that the young Turkoman had wished to make one grand effort to save Isfahan and Shiraz (with Kazvin and the neighbouring country), these being, after the capital Tabriz, the most important cities of Uzun Ḥasan's Persia. His men, however, apparently dismayed at the growing prestige of the enemy, did not support him, and he was defeated and probably slain. There is similar evidence of the death of Alamut, who, it is alleged, was treacherously handed over to be killed by the shah's own hands.

Ismaʿil returned again to Tabriz (1501) "and caused great rejoicings to be made on account of his victory." In 1503 he had added to his conquests Bagdad, Mosul and Jezira on the Tigris. The next year he was called to the province of

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[1] According to Langlès, the annotator of Chardin, his real designation was Abu 'l-Fath Izhak, the Sheikh Saifu 'l-Hakk wu 'd-Din or "pure one of truth and religion."

[2] So thinks the editor and annotator of the Italian *Travels in Persia*, Charles Grey.

[3] Possibly Kara-dagh, as being the more direct road.

Contest with Shaibani.

Gilan to chastise a refractory ruler. Having accomplished his end, he came back to his capital and remained there in comparative quiet till 1507.[1] Malcolm's dates are somewhat at variance with the above, for he infers that Bagdad was subdued in that particular year; but the facts remain. All writers seem to agree that in 1508 the king's attention was drawn to an invasion of Khorasan by Shaibani, or Shahi Beg, the Uzbeg, a descendant of Jenghiz and the most formidable opponent of Babar, from whom he had, seven years before, wrested the city of Samarkand, and whom he had driven from Turkestan to Kabul. Since these exploits he had obtained great successes in Tashkent, Ferghana, Hissar, Kunduz, and Khwarizm (Kharezm), and, at the time referred to, had left Samarkand intent upon mischief south and west of the Oxus, had passed the Murghab, and had reached Sarakhs (Serrakhs). Isma'il encamped on this occasion at Isfahan, and there concentrated the bulk of his army—strengthening his northern (and probably north-eastern) frontier with large bodies of cavalry, but maintaining an attitude of simple watchfulness. In 1510, when Shaibani had invaded Khorasan the second time, and had ravaged the Persian province of Kermān, Shah Isma'il asked for redress, referring to the land encroached on as "hereditary"; and Shaibani replied that he did not understand on what was founded the claim "to inherit." Eventually the Persian troops were put in movement, and the Uzbegs, having been divided into small detachments scattered over the country, fell back and retreated to Herat. Their leader repaired to Merv, but Isma'il quickly followed him and enticed him out to battle by taunt and reproach. Shaibani was defeated and fled, but was overtaken in his flight, and put to the sword, together with numerous relatives and companions.

War with Selim.

The next remarkable event in Isma'il's reign is his war with Sultan Selim I. Its origin may be traced to the Ottoman emperor's hatred and persecution of all heretical Moslems in his dominions, and the shah's anger at the fanaticism which had urged him to the slaughter of 40,000 Turks suspected to have thrown off the orthodox Sunnite doctrines. The sultan's army advanced into Azerbaijan and western Persia through Tokat and Erzingan. Isma'il had at this time the greater number of his soldiers employed in his newly-conquered province of Khorasan and was driven to raise new levies in Kurdistan to obtain a sufficient force to resist the invasion. It is asserted by some that his frontier then extended westward to Sivas, a city situated in a large high plain watered by the Kizil Irmak, and that hence to Khoi, 90 m. west of Tabriz, he followed the approved and often successful tactics of ravaging and retreating, so as to deprive his advancing enemy of supplies. There is good evidence to show that the Turkish janissaries were within an ace of open revolt, and that but for extraordinary firmness in dealing with them they would have abandoned their leader in his intended march upon Tabriz. In fine, at or near Khoi, the frontier-town of Azerbaijan, the battle (1514) was fought between the two rival monarchs, ending in the defeat of the Persians and the triumphant entry of Selim into their capital.

There are stirring accounts of that action and of the gallant deeds performed by Selim and Isma'il, both personally engaged in it, as well as by their generals.[2] Others maintain that Isma'il was not present at all.[3] It is tolerably certain that the Turks won the day by better organization, superiority of numbers, and more especially the use of artillery. On the side of the Persians the force consisted of little more than cavalry.

Selim remained at Tabriz no more than eight days. Levying a contribution at that city of a large number of its skilled artisans whom he sent off to Constantinople, he marched thence towards Karabagh with intent to fix his winter quarters in those parts and newly invade Persia in the spring, but the insubordination of his troops rendered necessary his speedy return to Turkey. His expedition, if not very glorious, had not been unproductive of visible fruits. Besides humbling the power of an arrogant enemy, he had conquered and annexed to his dominions the provinces of Diarbekr and Kurdistan.[4]

From 1514 to 1524, although the hostile feeling between the two countries was very strong, there was no serious nor open warfare. Selim's attention was diverted from Persia to Egypt; Isma'il took advantage of the sultan's death in 1519 to overrun and subdue unfortunate Georgia, as Jahan Shah of the "Black Sheep" had done before him; but Suleiman, who succeeded Selim, was too strong to admit of retaliatory invasion being carried out with impunity at the cost of Turkey.

Isma'il's Character.

In 1524 Isma'il died[5] at Ardebil when on a pilgrimage to the tomb of his father. "The Persians dwell with rapture on his character," writes Sir John Malcolm, for they deem him "not only the founder of a great dynasty, but the person to whom that faith in which they glory owes its establishment as a national religion." And he quotes a note handed down by Purchas from a contemporary European traveller which reports of him thus: "His subjects deemed him a saint, and made use of his name in their prayers. Many disdained to wear armour when they fought under Isma'il; and so enthusiastic were his soldiers in their new faith that they used to bare their breasts to their enemies and court death, exclaiming 'Shiah! Shiah!' to mark the holy cause for which they fought."

Shah Tahmasp.

Shah Ṭahmasp,[6] the eldest of the four sons of Isma'il, succeeded to the throne on the death of his father.[7] The principal occurrences in his reign, placed as nearly as possible in chronological order, were a renewal of war with the Uzbegs, who had again invaded Khorasan, and the overthrow of their army (1527); the recovery of Bagdad from a Kurdish usurper (1528); the settlement of an internal feud between Kizil-bash tribes (Shamlu and Tukulu), contending for the custody of the royal person, by the slaughter of the more unruly of the disputants (1529); the rescue of Khorasan from a fresh irruption, and of Herat from a besieging army of Uzbegs (1530); a new invasion of the Ottomans, from which Persia was saved rather by the severity of her climate than by the prowess of her warriors (1533); the wresting of Bagdad from Persia by the sultan Suleiman (1534); the king's youngest brother's rebellion and the actual seizure of Herat, necessitating the recovery of that city and a march to Kandahar (1536); the temporary loss of Kandahar in the following year (1537), when the governor ceded it to Prince Kamran, son of Babar; the hospitable reception accorded to the Indian emperor Humayun (1543); the rebellion of the shah's brother next in age, Ilkhas, who, by his alliance with the sultan, brought on a war with Turkey (1548);[1] and finally a fresh expedition to Georgia, followed by a revengeful incursion which resulted in the enforced bondage of thousands of the inhabitants (1552).

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[1] Angiolello.

[2] Knolles, Malcolm, Creasy, Markham, &c.

[3] Zeno. Angiolello says that "the Sophi monarch had left for Tauris [Tabriz] in order to assemble more troops." Krusinski infers much to the same effect, for he notes that "Selim came in person and took Tauris from Ismail, but *at the noise of his approach* was obliged to retreat with precipitation." The battle must thus have been fought and the victory gained when the shah was himself absent. Yet Markham quotes a journal which thus records his feats of prowess: "It was in vain that the brave Shah, with a blow of his sabre, severed a chain with which the Turkish guns were fastened together to resist the shock of the Persian cavalry."

[4] It was about this time that Persia again entered into direct relations with one of the states of western Europe. In 1510 and 1514 Alphonso d'Albuquerque, the governor of Portuguese India, sent envoys to Isma'il, seeking an alliance. In 1515, after occupying Hormuz, he despatched a third embassy under Fernão Gomes de Lemos. His object was to utilize the Shi'ite armies in conjunction with the Portuguese fleet for an attack upon the Sunnite powers—Egypt and Turkey—which were then at war with Portugal in the East. See, for further details and authorities, K. G. Jayne, *Vasco da Gama and his Successors*, pp. 108–110 and App. A. (London, 1910).—Ed.

[5] Malcolm says 1523, Krusinski 1525; Angiolello heard of his death at Cairo in August 1524. Krusinski adds that he was forty-five years of age.

[6] Angiolello calls him "Shiacthemes." As an instance of the absurd transliterating current in France as in England the word "Ach-tacon" may be mentioned. It is explained in Chardin's text to mean "les hôpitaux à Tauris: c'est-à-dire *lieux où l'on fait profusion de vivres.*" Chardin's editor remarks, "La dernière partie de ce mot est méconnaissable, et je ne puis deviner quel mot Persan signifiant profusion a pu donner naissance à la corruption qu'on voit ici." In other words, the first syllable "ach" (Anglice *ash*) was understood in its common acceptance for "food" or "victuals"; but "tacon" was naturally a puzzler. The solution of the whole difficulty is, however, to be found in the Turco-Persian خسته خانه *khastah khanah*, pronounced by Turks *hasta hona*, or more vulgarly *asta khon* and even to a French ear *ash-tacon*, a hospital, literally a sick-house. This word is undoubtedly current at Tabriz and throughout northern Persia.

[7] The other brothers were Ilkhas, Bahram and Sam Mirza, each having had his particular appanage assigned him.

War with Turkey.

Bayezid, a son of the Turkish emperor, rebelled, and his army was beaten in 1559 by the imperial troops at Konia in Asia Minor. He fled to Persia and took refuge with Shah Ṭahmasp, who pledged himself to give him a permanent asylum. Suleiman's demand, however, for extradition or execution was too peremptory for refusal, and the prince was delivered up to the messengers sent to take him. Whatever the motive, the act itself was highly appreciated by Suleiman, and became the means of cementing a recently concluded peace between the two monarchs. Perhaps the domestic affliction of the emperor and the anarchy which in his later years had spread in his dominions had, however, more to do with the maintenance of tranquillity than any mere personal feeling. At this time not only was there religious fanaticism at work to stir up the mutual hatred ever existing between Sunni and Shiʻah, but the intrigue of European courts was probably directed towards the maintenance of an hostility which deterred the sultan from aggressive operations north and west of Constantinople. "'Tis only the Persian stands between us and ruin" is the reported saying of Busbecq, ambassador at Suleiman's court on the part of Ferdinand of Austria; "the Turk would fain be upon us, but he keeps him back."

In 1561 Anthony Jenkinson arrived in Persia with a letter from Queen Elizabeth to the shah. He was to treat with his majesty of "Trafique and Commerce for our English Marchants,"[2] but his reception was not encouraging, and led to no result of importance.

Ṭahmasp's Death.

Ṭahmasp died in 1576, after a reign of about fifty-two years. He must have been some sixty-six years of age, having come to the throne at fourteen. Writers describe him as a robust man, of middle stature, wide-lipped, and of tawny complexion. He was not wanting in soldierly qualities; but his virtues were rather negative than decided. The deceased shah had a numerous progeny, and on his death his fifth son, Haidar Mirza, proclaimed himself king, supported in his pretensions by the Kizil-bash tribe of Ustujulu. Another tribe, the Afshar, insisted on the succession of the fourth son, Ismaʻil. Had it not been that there were two candidates in the field, the contention would have resembled that which arose shortly after Ṭahmasp's accession. Finally Ismaʻil, profiting from his brother's weak character and the intrigues set on foot against him, obtained his object, and was brought from a prison to receive the crown.

Ismaʻil II.

The reign of Ismaʻil II. lasted less than two years. He was found dead in the house of a confectioner in Kazvin, having left the world either drunk, drugged or poisoned. No steps were taken to verify the circumstances, for the event itself was a cause of general relief and joy. He was succeeded by his eldest brother, Mahommed Mirza, otherwise called Mahommed Khudabanda, whose claim to sovereignty had been originally put aside on the ground of physical infirmity. He had the good sense to trust his state affairs almost wholly to an able minister; but he was cowardly enough to deliver up that minister into the hands of his enemies. His kingdom was distracted by intestine divisions and rebellion, and the foe appeared also from without. On the east his youngest son. ʻAbbas, held possession of Khorasan; on the west the sultan's troops again entered Azerbaijan and took Tabriz. His eldest son, Hamza Mirza, upheld his fortunes to the utmost of his power, reduced the rebel chieftains, and forced the Turks to make peace and retire; but he was stabbed to death by an assassin. On the news of his death reaching Khorasan, Murshid Kuli Khan, leader of the Ustujulu Kizil-bash, who had made good in fight his claims to the guardianship of ʻAbbas, at once conducted the young prince from that province to Kazvin, and occupied the royal city. The object was evident, and in accordance with the popular feeling. ʻAbbas, who had been proclaimed king by the nobles at Nishapur some two or three years before this occurrence, may be said to have now undertaken in earnest the cares of sovereignty. His ill-starred father, at no time more than a nominal ruler, was at Shiraz, apparently deserted by soldiers and people. Malcolm infers that he died a natural death, but when[3] or where is not stated.

Mahommed Khuda-banda.

ʻAbbas the Great.

Shah ʻAbbas the Great commenced his long and glorious reign (1586) by retracing his steps towards Khorasan, which had been reinvaded by the Uzbegs almost immediately after his departure thence with the Kizil-bash chief. They had besieged and taken Herat, killed the governor, plundered the town, and laid waste the surrounding country. ʻAbbas advanced to Meshed, but owing to internal troubles he was compelled to return to Kazvin without going farther east. In his absence ʻAbd-ul-Munim Khan, the Uzbeg commander, attacked the sacred city, obtained possession of it while the shah lay helplessly ill at Teherān, and allowed his savage soldiers full licence to kill and plunder. The whole kingdom was perplexed, and ʻAbbas had much work to restore confidence and tranquillity. But circumstances rendered impossible his immediate renewal of the Khorasan warfare. He was summoned to Shiraz to put down rebellion in Fars; and before he could drive out the Uzbegs, he had to secure himself against Turkish inroads threatening from the west. He had been engaged in a war with Murad III. in Georgia. Peace was concluded between the two sovereigns in 1590; but the terms were unfavourable to Persia, who lost thereby Tabriz and one or more of the Caspian ports. A stipulation was included in the treaty to the effect that Persians were not to curse any longer the first three caliphs,—a sort of privilege previously enjoyed by Shiʻites as part and parcel of their religious faith.

In 1597 ʻAbbas renewed operations against the Uzbegs, and succeeded in recovering from them Herat and Khorasan. Eastward he extended his dominions to Balkh, and in the south his generals made the conquest of Bahrain (Bahrein), on the Arabian side of the Persian Gulf, and the territory and islands of the Persian seaboard, inclusive of the mountainous province of Lar. He strengthened his position in Khorasan by planting colonies of Kurdish horsemen on the frontier, or along what is called the "atak" or skirt of the Turkoman mountains north of Persia. In 1601 the war with the Ottoman Empire, which had been partially renewed prior to the death of Sultan Murad in 1595, with little success on the Turkish side, was now entered upon by ʻAbbas with more vigour. Taking advantage of the weakness of his ancient enemy in the days of the poor voluptuary Mahommed III., he began rapidly to recover the provinces which Persia had lost in preceding reigns, and continued to reap his advantages in succeeding campaigns under Ahmed I., until under Othman II. a peace was signed restoring to Persia the boundaries which she had obtained under the first Ismaʻil. On the other side Kandahar, which Ṭahmasp's lieutenant had yielded to the Great Mogul, was recovered from that potentate in 1609.

At the age of seventy, after a reign of forty-two years, ʻAbbas died at his favourite palace of Farahabad, on the coast of Mazandaran, on the night of the 27th of January 1628. Perhaps the most distinguished of all Persian kings, his fame was not merely local but world-wide. At his court were ambassadors from England, Russia, Spain, Portugal, Holland and India.

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[1] Creasy says that "Suliman led his armies against the Persians in several campaigns (1533, 1534, 1535, 1548, 1553, 1554), during which the Turks often suffered severely through the difficult nature of the countries traversed, as well as through the bravery and activity of the enemy." All the years given were in the reign of Ṭahmasp I.

[2] Purchas.

[3] Krusinski says in 1585.

To his Christian subjects he was a kind and tolerant ruler. The establishment of internal tranquillity, the expulsion of interlopers and marauders like Turks and Uzbegs, the introduction of salutary laws and the promotion of public works of utility—these alone would render remarkable his two-score years of enlightened government. With a fine face, "of which the most remarkable features were a high nose and a keen and piercing eye,"[1] he is said to have been below the middle height, robust, active, a sportsman, and capable of much endurance. It is, however, to be regretted that this monarch's memory is tarnished by more than one dark deed. The murder of his eldest son, Ṣufi Mirza, and the cruel treatment of the two younger brothers, were stains which could not be obliterated by an after-repentance. All that can be now said or done in the matter is to repeat the testimony of historians that his grief for the loss of Ṣufi Mirza was profound, and that, on his death-bed, he nominated that prince's son (his own grandson) his successor.

Shah Ṣufi.

Sam Mirza was seventeen years of age when the nobles, in fulfilment of the charge committed to them, proclaimed him king under the title of Shah Ṣufi. He reigned fourteen years, and his reign was a succession of barbarities, which can only be attributed to an evil disposition acted upon by an education void of all civilizing influences. When left to his own devices he became a drunkard and a murderer, and is accused of the death of his mother, sister and favourite queen. Among many other sufferers Imam Kuli Khan, conqueror of Lar and Hormuz, the son of one of ‘Abbas's most famous generals, founder of a college at Shiraz, and otherwise a public benefactor, fell a victim to his savage cruelty. During his reign the Uzbegs were driven back from Khorasan, and a rebellion was suppressed in Gilan; but Kandahar was again handed over to the Moguls of Delhi, and Bagdad retaken from Persia by Sultan Murad—both serious national losses. Tavernier, without charging the shah with injustice to Christians, mentions the circumstance that "the first and only European ever publicly executed in Persia was in his reign." He was a watchmaker named Rodolph Stadler, who had slain a Persian on suspicion of intrigue with his wife. Offered his life if he became a Moslem, he resolutely declined the proposal, and was decapitated. His tomb is to be recognized at Isfahan by the words "Cy git Rodolphe" on a long wide slab. Shah Ṣufi died (1641) at Kashan and was buried at Kum.

‘Abbas II.

His son, ‘Abbas II., succeeded him. Beyond regaining Kandahar, an operation which he is said to have directed in person when barely sixteen, there is not much to mark his life to the outer world. As to foreign relations, he received embassies from Europe and a deputation from the French East India Company; he sought to conciliate the Uzbegs by treating their refugee chiefs with unusual honour and sumptuous hospitality; he kept on good terms with Turkey; he forgave the hostility of a Georgian prince when brought to him a captive; and he was tolerant to all religions—always regarding Christians with especial favour. But he was a drunkard and a debauchee, and chroniclers are divided in opinion as to whether he died from the effects of drink or licentious living. That he changed the system of blinding his relatives from passing a hot metal over the open eye to an extraction of the whole pupil is indicative of gross brutality. ‘Abbas II. died (1668) at the age of thirty-eight, after a reign of twenty-seven years, and was buried at Kum in the same mosque as his father.

Suleiman.

‘Abbas was succeeded by his son, Shah Ṣufi II., crowned a second time under the name of Shah Suleiman. Though weak, dissolute and cruel, Suleiman is not without his panegyrists. Chardin, whose testimony is all the more valuable from the fact that he was contemporary with him, relates many stories characteristic of his temper and habits. He kept up a court at Isfahan which surprised and delighted his foreign visitors, among whom were ambassadors from European states; and one learned writer, Kaempfer, credits him with wisdom and good policy. During his reign Khorasan was invaded by the ever-encroaching Uzbegs, the Kipchak Tatars plundered the shores of the Caspian, and the island of Kishm was taken by the Dutch; but the kingdom suffered otherwise no material loss. He died in 1694, in the forty-ninth year of his age and twenty-sixth of his reign.

About a year before his death, he is described by Sanson,[2] a missionary from the French king Louis XIV., as tall, strong and active, "a fine prince—a little too effeminate for a monarch," with "a Roman nose very well proportioned to other parts," very large blue eyes, and "a midling mouth, a beard painted black, shav'd round, and well turn'd, even to his ears." The same writer greatly praises him for his kindness to Christian missionaries.

Ḥosain.

Krusinski's memoir is full of particulars regarding Shah Ḥosain, the successor of Suleiman. He had an elder and a younger brother, sons of the same mother, but the eldest had been put to death by his father's orders, and the youngest secreted by maternal precaution lest a similar fate should overtake him. There was, however, a second candidate for power in the person of a half-brother, ‘Abbas. The latter prince was the worthier of the throne, but the other better suited the policy of the eunuchs and those noblemen who had the right of election. Indeed Suleiman himself is reported to have told the grandees around him, in his last days, that "if they were for a martial king that would always keep his foot in the stirrup they ought to choose Mirza ‘Abbas, but that if they wished for a peaceable reign and a pacific king they ought to fix their eyes upon Ḥosain." But he himself made no definite choice.

Ḥosain was selected, as might have been anticipated. On his accession (1694) he displayed his attachment to religious observances by prohibiting the use of wine—causing all wine-vessels to be brought out of the royal cellars and destroyed, and forbidding the Armenians to sell any more of their stock in Isfahan. The shah's grandmother, by feigning herself sick and dependent upon wine only for cure, obtained reversal of the edict. For the following account of Shah Ḥosain and his successors to the accession of Nadir Shah, Sir Clements Markham's account has been mainly utilized.

> The new king soon fell under the influence of mullahs, and was led so far to forget his own origin as to persecute the Sufis. Though good-hearted he was weak and licentious; and once out of the hands of the fanatical party he became ensnared by women and entangled in harem intrigues. For twenty years a profound peace prevailed throughout the empire, but it was the precursor of a terrible storm destined to destroy the Safawid dynasty and scatter calamity broadcast over Persia. In the mountainous districts of Kandahar and Kabul the hardy tribes of Afghans had for centuries led a wild and almost independent life. They were divided into two great branches—the Ghilzais of Ghazni and Kabul and the Saduzais of Kandahar and Herat. In 1702 a newly-appointed governor, one Shah Nawaz, called Gurji Khan from having been "wali" or ruler of Georgia, arrived at Kandahar with a tolerably large force. He was a clever and energetic man, and had been instructed to take severe measures with the Afghans, some of whom were suspected of intriguing to restore the city to the Delhi emperor. At this time Kandahar had been for sixty years uninterruptedly in the shah's possession. The governor appears to have given great offence by the harshness of his proceedings, and a Ghilzai chief named Mir Wa‘iẓ, who had complained of his tyranny, was sent a prisoner to Isfahan. This person had much ability and no little cunning. He was permitted to go on a pilgrimage to Mecca, and on his return in 1708 he so gained upon the confidence of the Persian court that he was allowed to go back to his country. At Kandahar he planned a conspiracy against the government, slew Gurji Khan and his retinue, seized the city, defeated two Persian armies sent against him, and died a natural death in 1715. His brother, Mir ‘Abdallah, succeeded him in the government of the Afghans; but after a few months, Mahmud, a son of Mir Wa‘iẓ, a very young man, murdered his uncle and assumed the title of a sovereign prince.
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> In the meanwhile the Saduzai tribe revolted at Herat, and declared itself independent in 1717; the Kurds overran the country round Hamadan; the Uzbegs desolated Khorasan; and the Arabs of Muscat seized the island of Bahrein and threatened Bander Abbasi. Thus surrounded by dangers on all sides the wretched shah was bewildered. He made one vain attempt to regain his possessions in the Persian

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[1] Malcolm.

[2] *Present State of Persia* (London, 1695).

Gulf; but the Portuguese fleet which had promised to transport his troops to Bahrein was defeated by the imam of Muscat and forced to retreat to Goa.

Afghan Invasion.

The court of Isfahan had no sooner received tidings of this disaster than Mahmud, with a large army of Afghans, invaded Persia in the year 1721, seized Kermān, and in the following year advanced to within four days' march of the city of Isfahan. The shah offered him a sum of money to return to Kandahar, but the Afghan answered by advancing to a place called Gulnabad, within 9 m. of the capital. The ill-disciplined Persian army, hastily collected, advanced to attack the rebels. Its centre was led by Sheikh 'Ali Khan, covered by twenty-four field-pieces. The wali of Arabia commanded the right, and the 'itimadu' d-daulah, or prime minister, the left wing. The whole force amounted to 50,000 men, while the Afghans could not count half that number.

Mahmud's Usurpation.

On the 8th of March 1722 the richly dressed hosts of Persia appeared before the little band of Afghans, who were scorched and disfigured by their long marches. The wali of Arabia commenced the battle by attacking the left wing of the Afghans with great fury, routing it, and plundering their camp. The prime minister immediately afterwards attacked the enemy's right wing, but was routed, and the Afghans, taking advantage of the confusion, captured the Persian guns and turned them on the Persian centre, who fled in confusion without striking a blow. The wali of Arabia escaped into Isfahan, and Mahmud the Afghan gained a complete victory. Fifteen thousand Persians remained dead on the field. A panic now seized on the surrounding inhabitants, and thousands of country people fled into the city. Isfahan was then one of the most magnificent cities in Asia, containing more than 600,000 inhabitants. Mahmud seized on the Armenian suburb of Julfa, and invested the doomed city; but Ṭahmasp, son of the shah, had previously escaped into the mountains of Mazandaran. Famine soon began to press hard upon the besieged, and in September Shah Ḥosain offered to capitulate. Having been conducted to the Afghan camp, he fixed the royal plume of feathers on the young rebel's turban with his own hand; and 4000 Afghans were ordered to occupy the palace and gates of the city.[1] Mahmud entered Isfahan in triumph, with the captive shah on his left hand, and, seating himself on the throne in the royal palace, he was saluted as sovereign of Persia by the unfortunate Ḥosain. When Ṭahmasp, the fugitive prince, received tidings of the abdication of his father, he at once assumed the title of shah at Kazvin.

Turkey and Russia were not slow to take advantage of the calamities of Persia. The Turks seized on Tiflis, Tabriz and Hamadan, while Peter the Great, whose aid had been sought by the friendless Ṭahmasp, fitted out a fleet on the Caspian.[2] The Russians occupied Shirvan, and the province of Gilan south-west of the Caspian;[3] and Peter made a treaty with Ṭahmasp II. in July 1722, by which he agreed to drive the Afghans out of Persia on condition that Darband (Derbend), Baku, Gilan, Mazandaran and Astarabad were ceded to Russia in perpetuity. These were all the richest and most important northern provinces of Persia.

Meanwhile the invader, in 1723, invited 300 of the principal Persian nobility to a banquet and massacred them. To prevent their children rising up in vengeance they were all murdered also. Then he proceeded to slaughter vast numbers of the citizens of Isfahan, until the place was nearly depopulated. Not content with this, in February 1725 he assembled all the captives of the royal family, except the shah, in the courtyard of the palace, and caused them all to be murdered, commencing the massacre with his own hand. The wretched Ḥosain was himself wounded in endeavouring vainly to save his infant son, only five years of age. All the males of the royal family, except Ḥosain himself, Ṭahmasp, and two children, are said to have perished. At length the inhuman miscreant Mahmud died, at the early age of twenty-seven, on the 22nd of April 1725. With scarcely any neck, he had round shoulders, a broad face with a flat nose, a thin beard, and squinting eyes, which were generally downcast.

Expulsion of Afghans.

Mahmud was succeeded by his first cousin, Ashraf, the son of Mir 'Abdallah. He was a brave but cruel Afghan. He gave the dethroned shah a handsome allowance, and strove, by a mild policy, to acquire popularity. In 1727, after a short war, he signed a treaty with the Turks, acknowledging the sultan as chief of the Moslems. But the fortunate star of Ṭahmasp II. was now bebinning to rise, and the days of Afghan usurpation were numbered. He had collected a small army in Mazandaran, and was supported by Fath 'Ali Khan, the powerful chief of the Kajar tribe. In 1727 the fugitive shah was joined by Nadir Kuli, a robber chief, who murdered Fath 'Ali, and, having easily appeased the shah, received the command of the royal army. In 1729 Ashraf became alarmed, and led an Afghan army into Khorasan, where he was defeated by Nadir at Damghan, and forced to retreat. The Persian general followed close in his rear and again defeated him outside Isfahan in November of the same year. The Afghans fled through the town; and Ashraf, murdering the poor old shah Ḥosain on his way, hurried with the wreck of his army towards Shiraz. On the 16th of November the victorious Nadir entered Isfahan, and was soon followed by the young shah Ṭahmasp II., who burst into tears when he beheld the ruined palace of his ancestors. His mother, who had escaped the numerous massacres by disguising herself as a slave and performing the most degrading offices, now came forth and threw herself into his arms. Nadir did not give his enemies time to recover from their defeat. He followed them up, and again utterly routed them in January 1730. Ashraf tried to escape to Kandahar almost alone, but was murdered by a party of Baluch robbers; and thus, by the genius of Nadir, his native land was delivered from the terrible Afghan invaders.

Fall of Safawids.

The ambition of Nadir, however, was far greater than his loyalty. On pretext of incapacity, he dethroned Ṭahmasp II. in 1732, and sent him a prisoner into Khorasan, where he was murdered some years afterwards by Nadir's son while the conqueror was absent on his Indian expedition. For a short time the wily usurper placed Ṭahmasp's son on the throne, a little child, with the title of 'Abbas III., while he contented himself with the office of regent. Poor little 'Abbas died at a very convenient time, in the year 1736, and Nadir then threw off the mask. He was proclaimed shah of Persia by a vast assemblage on the plain of Moghan.

By the fall of the Safawid dynasty Persia lost her race of national monarchs, considered not only in respect of origin and birthplace but in essence and in spirit. Isma'il, Ṭahmasp and 'Abbas, whatever their faults and failings, were Persian and peculiar to Persians. Regarded in a sober English spirit, the reign of the great 'Abbas is rendered mythical by crime. But something liberal in the philosophy of their progenitors threw an attractiveness over the earlier Safawid kings which was wanting in those who came after them. The fact is that, two centuries after Shah Isma'il's accession to the throne, the Safawid race of kings was effete; and it became necessary to make room for a more vigorous if not a more lasting rule. Nadir was the strong man for the hour and occasion. He had been designated a "robber chief"; but his antecedents, like those of many others who have filled the position, have redeeming points of melodramatic interest.

Persia in 1728.

A map attached to Krusinski's volumes illustrates the extent of Persian territory in 1728, or one year before Ashraf was finally defeated by Nadir, and some eight years prior to the date on which Nadir was himself proclaimed king. It shows, during the reign of the Safawids, Tiflis, Erivan, Khoi and Bagdad to have been within the limits of Persia on the west, and in like manner Balkh and Kandahar to have been included within the eastern border. There is, however, also shown, as a result of the Afghan intrusion and the impotency of the later Safawid kings, a long broad strip of country to the west, including Tabriz and Hamadan, marked "conquests of the Turks," and the whole west shore of the Caspian from Astrakan to Mazandaran marked "conquests of the czar of Muscovy"; Makran, written Mecran, is designated "a warlike independent nation." If further allowance be made for the district held by the Afghan invaders as part of their own country, it will be seen how greatly the extent of Persia proper was reduced, and what a work Nadir had before him to restore the kingdom to its former proportions.

But the former proportions had been partly reverted to, and would doubtless have been in some respects exceeded, both in Afghanistan and the Ottoman dominions and on the shores of the Caspian, by the action of this indefatigable general, had not Ṭahmasp II. been led into a premature treaty with the Turks. Nadir's anger and indignation had been great at this weak proceeding; indeed, he had made it the ostensible cause of the shah's deposition. He had addressed letters to all the military chiefs of the country, calling upon them for support; he had sent an envoy to Constantinople insisting upon the sultan's restoration of the Persian provinces still in his possession—that is,

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[1] We have an account of the Afghan invasion and sack of Isfahan from an eye-witness, Father Krusinski, procurator of the Jesuits at that place, whose interesting work was translated into English in the last century.

[2] In 1721 Sultan Ḥosain sent an embassy to the Russians, seeking aid against the Afghans. In May 1722 a flotilla descended the Volga commanded by Tsar Peter and on the 19th of July the Russian flag first waved over the Caspian. Gilan was occupied by 6000 men under General Matushkin.

[3] The Russians remained in Gilan until 1734, when they were obliged to evacuate it, owing to the unhealthiness of the climate.

Georgia and part of Azerbaijan—and he had threatened Bagdad with assault. As regent, he had failed twice in taking the city of the caliphs, but on the second occasion he had defeated and killed its gallant defender, Topal ʽOthman, and he had succeeded in regaining Tiflis, Kars and Erivan.[1]

Russia and Turkey, naturally hostile to one another, had taken occasion of the weakness of Persia to forget their mutual quarrels and unite to plunder the tottering kingdom of the Safawid kings. A partition treaty had been signed between these two powers in 1723, by which the czar was to take Astarabad, Mazandaran, Gilan, part of Shirvan and Daghistan, while the acquisitions of the Porte were to be traced out by a line drawn from the junction of the Aras and Kur rivers, and passing along by Ardebil, Tabriz and Hamadan, and thence to Kermānshāh. Ṭahmasp was to retain the rest of his paternal kingdom on condition of his recognizing the treaty. The ingenious diplomacy of Russia in this transaction was manifested in the fact that she had already acquired the greater part of the territory allotted to her, while Turkey had to obtain her share by further conquest. But the combination to despoil a feeble neighbour was outwitted by the energy of a military commander of a remarkable type.

D.—*From the Accession of Nadir Shah, in 1736, to 1884.*

Nadir's Coronation.

Nadir, it has been said, was proclaimed shah in the plains of Moghan in 1736. Mirza Mahdi relates how this event was brought about by his address to the assembled nobles and officers on the morning of the "Nau-ruz," or Persian New-Year's Day, the response to that appeal being the offer of the crown. The conditions were that the crown should be hereditary in his family, that the claim of the Safawids was to be held for ever extinct, and that measures should be taken to bring the Shiʽites to accept uniformity of worship with the Sunnites. The mulla bashi (or high priest) objecting to the last, Nadir ordered him to be strangled, a command which was carried out on the spot. On the day following, the agreement having been ratified between sovereign and people, he was proclaimed emperor of Persia. At Kazvin the ceremony of inauguration took place. The edict expressing the royal will on the religious question is dated in June, but the date of coronation is uncertain. From Kazvin Nadir moved to Isfahan, where he organized an expedition against Kandahar, then in the possession of a brother of Mahmud, the conqueror of Shah Ḥosain. But before setting out for Afghanistan he took measures to secure the internal quiet of Persia, attacking and seizing in his stronghold the chief of the marauding Bakhtiaris, whom he put to death, retaining many of his men for service as soldiers. With an army of 80,000 men he marched through Khorasan and Seistan to Kandahar, which city he blockaded ineffectually for a year; but it finally capitulated on the loss of the citadel. Balkh fell to Riẓa Kuli, the king's son, who, moreover, crossed the Oxus and defeated the Uzbegs in battle. Besides tracing out the lines of Nadirabad, a town since merged in modern Kandahar, Nadir had taken advantage of the time available and of opportunities presented to enlist a large number of men from the Abdali and Ghilzai tribes. It is said that as many as 16,000 were at his disposal. His rejection of the Shiʽite tenets as a state religion seems to have propitiated the Sunnite Afghans.

Invasion of India.

Nadir had sent an ambassador into Hindustan requesting the Mogul emperor to order the surrender of certain unruly Afghans who had taken refuge within Indian territory, but no satisfactory reply was given, and obstacles were thrown in the way of the return of the embassy. The Persian monarch, not sorry perhaps to find a plausible pretext for encroachment in a quarter so full of promise to booty-seeking soldiers, pursued some of the fugitives through Ghazni to Kabul, which city was then under the immediate control of Naṣr Khan, governor of eastern Afghanistan, for Mahommed Shah of Delhi. This functionary, alarmed at the near approach of the Persians, fled to Peshawar. Kabul had long been considered not only an integral part but also one of the main gates of the Indian Empire; notwithstanding a stout resistance on the part of its commandant, Shir or Shirzah Khan, the place was stormed and carried (1738) by Nadir, who moved on eastward. Mirza Mahdi relates that from the Kabul plain he addressed a new remonstrance to the Delhi court, but that his envoy was arrested and killed, and his escort compelled to return by the governor of Jalalabad. The same authority notes the occupation of the latter place by Persian troops and the march thither from Gandamak. It was probably through the Khaibar (Khyber) Pass that he passed into the Peshawar plain, for it was there that he first defeated the Imperial forces.

The invasion of India had now fairly commenced, and its successful progress and consummation were mere questions of time. The prestige of this Eastern Napoleon was immense. It had not only reached but had been very keenly felt at Delhi before the conquering army had arrived. There was no actual religious war; all sectarian distinction had been disavowed; the contest was between vigorous Mahommedans and effete Mahommedans. Nadir's way had been prepared by circumstances, and as he progressed from day to day his army increased. There must have been larger accessions by voluntary recruits than losses by death or desertion. The victory on the plain of Karnal, whether accomplished by sheer fighting or the intervention of treachery, was the natural outcome of the previous situation, and the submission of the emperor followed as a matter of course.

Delhi must have experienced a sense of relief at the departure of its conqueror, whose residence there had been rendered painfully memorable by carnage and riot. The marriage of his son to the granddaughter of Aurangzeb and the formal restoration of the crown to the dethroned emperor were doubtless politic, but the descendant of Babar could not easily forget how humiliating a chapter in history would remain to be written against him. The return march of Nadir to Persia is not recorded with precision. On the 5th of May 1739 he left the gardens of Shalamar, and proceeded by way of Lahore and Peshawar through the passes to Kabul. Thence he seems to have returned to Kandahar, and in May 1740—just one year after his departure from Delhi—he was in Herat displaying the imperial throne and other costly trophies to the gaze of the admiring inhabitants. Sind was certainly included in the cession to him by Mahommed Shah of "all the territories westward of the river Attok," but only that portion of it, such as Thattah (Tatta), situated on the right bank of the Indus.

Northern Conquests.

From Herat he moved upon Balkh and Bokhara, and received the submission of Abu'l-Faiz Khan, the Uzbeg ruler, whom he restored to his throne on condition that the Oxus should be the acknowledged boundary between the two empires. The khan of Khwarizm, who had made repeated depredations in Persian territory, was taken prisoner and executed. Nadir then visited the strong fortress of Kelat, to which he was greatly attached as the scene of his boyish exploits, and Meshed, which he constituted the capital of his empire. He had extended his boundary on the east to the Indus, and to the Oxus on the north.

Wars in the West.

On the south he was restricted by the Arabian Ocean and Persian Gulf; but the west remained open to his further progress. He had in the first place to revenge the death of his brother Ibrahim Khan, slain by the Lesghians; and a campaign against the Turks might follow in due course. The first movement was unsuccessful, and indirectly attended with disastrous consequences. Nadir, when hastening to the support of some Afghan levies who were doing good service, was fired at and wounded by a stray assailant; suspecting his son, Riẓa Kuli, of complicity, he commanded the unfortunate prince to be seized and deprived of sight. From that time the heroism of the monarch appeared to die out. He became morose, tyrannical and suspicious. An easy victory over the Turks gave him but little additional glory; and he readily concluded a peace with the sultan which brought but insignificant gain to Persia.[1] Another battle won from the Ottoman troops near Diarbekr by Naṣr Ullah Mirza, the young prince who had married a princess of Delhi, left matters much the same as before.

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[1] Malcolm.

The last years of Nadir's life were full of internal trouble. On the part of the sovereign, murders and executions; on that of his subjects, revolt and conspiracy. Such a state of things could not last, and certain proscribed persons plotted the destruction of the half-demented tyrant. He was despatched by Salah Bey, captain of his guards (1747). He was some sixty years of age, and had reigned eleven years. About the time of setting out on his Indian expedition he was described as a most comely man, upwards of 6 ft., tall, well-proportioned, of robust make and constitution; inclined to be fat, but prevented by the fatigue he underwent; with fine, large black eyes and eyebrows; of sanguine complexion, made more manly by the influence of sun and weather; a loud, strong voice; a moderate wine-drinker; fond of simple diet, such as pilaos and plain dishes, but often neglectful of meals altogether, and satisfied, if occasion required, with parched peas and water, always to be procured.[2]

During the reign of Nadir an attempt was made to establish a British Caspian trade with Persia. The names of Jonas Hanway and John Elton were honourably connected with this undertaking; and the former has left most valuable records of the time and country.

Period of Anarchy.

From Nadir Shah to the Kajar Dynasty.—After the death of Nadir Shah something like anarchy prevailed for thirteen years in the greater part of Persia as it existed under Shah ʽAbbas. No sooner had the crime become known than Aḥmad Khan, chief of the Abdali Afghans, took possession of Kandahar and a certain amount of treasure. By the action of Aḥmad Abdali, Afghanistan was at once lost to the Persian crown, for this leader was strong enough to found an independent kingdom. The chief of the Bakhtiaris, Rashid, also with treasure, fled to the mountains, and the conspirators invited ʽAli, a nephew of the deceased monarch, to ascend the vacant throne. The Bakhtiari encouraged his brother, ʽAli Mardan, to compete for the succession to Nadir. The prince was welcomed by his subjects; he told them that the murder of his uncle was due to his own instigation, and, in order to conciliate them, remitted the revenues of the current year and all extraordinary taxes for the two years following.

Taking the title of ʽAdil Shah, or the "just" king, he commenced his reign by putting to death the two princes Riẓa Kuli and Naṣr Ullah, as well as all relatives whom he considered his competitors, with the exception of Shah Rukh, son of Riẓa Kuli, whom he spared in case a lineal descendant of Nadir should at any time be required. But he had not removed all dangerous members of the royal house, nor had he gauged the temper of the times or people. ʽAdil Shah was soon dethroned by his own brother, Ibrahim, and he in his turn was defeated by the adherents of Shah Rukh, who made their leader king.

Shah Rukh.

This young prince had a better and more legitimate title than that of the grandson of Nadir, for he was also grandson, on the mother's side, of the Safawid Shah Ḥusain. Amiable, generous and liberal-minded, and of prepossessing exterior, he proved to be a popular prince. But he was neither of an age nor character to rule over a people led by turbulent and disaffected chiefs, ever divided by the conflicting interests of personal ambition. Saʽid Mahommed, son of Mirza Daud, a chief mullah at Meshed, whose mother was the reputed daughter of Suleiman, declared himself king, and imprisoned and blinded Shah Rukh. Yusuf ʽAli, the general commanding the royal troops, defeated and slew Suleiman, and replaced his master on the throne, reserving to himself the protectorship or regency. A new combination of chiefs, of which Jiʽafir the Kurd and Mir ʽAlam the Arabian are the principal names handed down, brought about the death of Yusuf ʽAli and the second imprisonment of Shah Rukh. These events were followed by a quarrel terminating in the supremacy of the Arab. At this juncture Aḥmad Shah Abdali reappeared in Persian Khorasan from Herat; he attacked and took possession of Meshed, slew Mir ʽAlam, and, pledging the local chiefs to support the blinded prince in retaining the kingdom of his grandfather, returned to Afghanistan. But thenceforward this unfortunate young man was a mere shadow of royalty, and his purely local power and prestige had no further influence whatever on Persia as a country.

Further Confusion.

The land was partitioned among several distinguished persons, who had of old been biding their opportunities, or were born of the occasion. Foremost among these was Mahommed Ḥasan Khan, hereditary chief of those Kajars who were established in the south-east corner of the Caspian. His father, Fatḥ ʽAli Khan, after sheltering Shah Ṭahmasp II. at his home in Astarabad, and long acting as one of his most loyal supporters, had been put to death by Nadir, who had appointed a successor to his chiefdom from the "Yukari" or "upper" Kajars, instead of from his own, the "Ashagha," or "lower."[3] Mahommed, with his brother, had fled to the Turkomans, by whose aid he had attempted the recovery of Astarabad, but had not succeeded in regaining a permanent footing there until Nadir had been removed. On the murder of the tyrant he had raised the standard of independence, successfully resisted Aḥmad Shah and his Afghans, who sought to check his progress in the interests of Shah Rukh, and eventually brought under his own sway the valuable provinces of Gilan, Mazandaran and Astarabad[4]—quite a little kingdom in itself. In the large important province of Azerbāijan, Azad Khan, one of Nadir's generals, had established a separate government; and ʽAli Mardan, brother of the Bakhtiari chief, took forcible possession of Isfahan, empowering Shah Rukh's governor, Abu'l-Fatḥ Khan, to act for the new master instead of the old.

Had ʽAli Mardan declared himself an independent ruler he would have been by far the most important of the three persons named. But such usurpation at the old Safawid capital would have been too flagrant an act for general assent; so he put forward Ismaʽil, a nephew of Shah Ḥusain, as the representative of sovereignty, and himself as one of his two ministers—the other being Karim Khan, a chief of the Zend Kurds. Shah Ismaʽil, it need scarcely be said, possessed no real authority; but the ministers were strong men in their way, and the Zend especially had many high and excellent qualities. After a time ʽAli Mardan was assassinated, and Karim Khan became the sole living power at Isfahan. The story of the period is thus told by R. G. Watson:—

Struggle of the Three Rivals.

> "The three rivals, Karīm, Azad and Muhammad Hasan, proceeded to settle, by means of the sword, the question as to which of them was to be the sole master of Persia. A three-sided war then ensued, in the course of which each of the combatants in turn seemed at one time sure to be the final conqueror. Karīm, when he had arranged matters at Ispahan, marched to the borders of Mazandarān, where the governor of that province was ready to meet him. After a closely contested battle victory remained with Muhammad Hasan; who, however, was unable to follow up the foe, as he had to return in order to encounter Azad. That leader had invaded Gilan, but, on the news reaching him of the victory which the governor of Mazandarān had gained, he thought it prudent to retrace his steps to Sultanīyah. Karīm reunited his shattered forces at Tehrān, and retired to Ispahan to prepare for a second campaign. When he again took the field it was not to measure himself once more with the Kajar chief, but to put down the pretensions of Azad. The wary Afghan, however, shut himself up in Kazvīn, a position from which he was enabled to inflict much injury on the army of Karīm, while his own troops remained unharmed, behind the walls of the town. Karīm retired a second time to

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[1] Creasy says the war broke out in 1743, but was terminated in 1746 by a treaty which made little change in the old arrangements fixed under Murad IV.

[2] Fraser's *History of Nadir Shah* (1742).

[3] There were three branches of the Kajar tribe, *i.e.* the Suldus, Tungkut and Jalaiyar. The last, according to Watson, became settled in Iran and Turan, and seem at first to have given their name to all the tribe.

[4] Watson. Malcolm says that Gilan was under one of its own chiefs, Hidaiyat Khan.

Ispahan, and in the following spring advanced again to meet Azad. A pitched battle took place between them, in which the army of Karīm was defeated. He retreated to the capital, closely pressed by the foe. Thence he continued his way to Shirāz, but Azad was still upon his traces. He then threw himself upon the mercy of the Arabs of the Garmsir or hot country, near the Persian Gulf, to whom the name of the Afghans was hateful, and who rose in a body to turn upon Azad. Karīm, by their aid, once more repaired his losses and advanced on Ispahan, while Muhammad Hasan with fifty thousand men was coming from the opposite direction, ready to encounter either the Afghan or the Zend. The Afghan did not await his coming, but retired to his government of Tabriz.

“ The Zend issued from Ispahan, and was a second time defeated in a pitched battle by the Kajar. Karim took refuge behind the walls of Shirāz, and all the efforts of the enemy to dislodge him were ineffectual. Muhammad Hasan Khan in the following year turned his attention to Adarbaijan. Azad was no longer in a position to oppose him in the field, and he in turn became master of every place of importance in the province, while Azad had to seek assistance in vain—first from the pasha of Baghdad, and then from his former enemy, the tsar of Georgia. Next year the conquering Kajar returned to Shirāz to make an end of the only rival who now stood in his way. On his side were 80,000 men, commanded by a general who had twice defeated the Zend chief on an equal field. Karīm was still obliged to take shelter in Shirāz, and to employ artifice in order to supply the place of the force in which he was deficient. Nor were his efforts in this respect unattended with success: seduced by his gold, many of the troops of the Kajar began to desert their banners. In the meantime the neighbourhood of Shirāz was laid waste, so as to destroy the source from which Muhammad Hasan drew his provisions; by degrees his army vanished, and he had finally to retreat with rapidity to Ispahan with the few men that remained to him. Finding his position there to be untenable, he retreated still farther to the country of his own tribe, while his rival advanced to Ispahan, where he received the submission of nearly all the chief cities of Persia. The ablest of Karīm's officers, Shaikh ‘Ali, was sent in pursuit of the Kajar chief. The fidelity of the commander to whom that chieftain had confided the care of the pass leading into Mazandarān, was corrupted; and, as no further retreat was open to him, he found himself under the necessity of fighting. The combat which ensued resulted in his complete defeat, although he presented to his followers an example of the most determined valour. While attempting to effect his escape he was recognized by the chief of the other branch of the Kajar tribe, who had deserted his cause, and who had a blood-feud with him, in pursuance of which he now put him to death.

Karīm Khan.

“ For nineteen years after this event Karīm Khan ruled with the title of wakil, or regent, over the whole of Persia, excepting the province of Khurāsān. He made Shirāz the seat of his government, and by means of his brothers put down every attempt which was made to subvert his authority. The rule of the great Zend chief was just and mild, and he is on the whole, considering his education and the circumstances under which he was placed, one of the most faultless characters to be met with in Persian history.”

Karim Khan died at his capital in 1779 in the twentieth year of his reign, and, it is said, in the eightieth of his age. He built the great bazaar of Shiraz, had a tomb constructed over the remains of Hafiz, and repaired the “ turbat ” at the grave of Sa‘di, outside the walls. He encouraged commerce and agriculture, gave much attention to the shores of the Persian Gulf, and carefully studied the welfare of the Armenian community settled in his dominions. In his time the British factory was removed from Bander Abbasi to Bushire.

Zeki.

On Karim's death a new period of anarchy supervened. His brother, Zaki, a cruel and vindictive chief who, when governor of Isfahan, had revolted against Karim, assumed the government. At the same time he proclaimed Abu ‘l-Fatḥ Khan, second son of the deceased monarch, and his brother Mahommed ‘Ali, joint-successors to the throne. The seizure of the citadel at Shiraz by the adherents of the former, among whom were the more influential of the Zends, may have induced him to adopt this measure as one of prudent conciliation. But the garrison held out, and, to avoid a protracted siege, he had recourse to treachery. The suspicious nobles were solemnly adjured to trust themselves to his keeping, under promise of forgiveness. They believed his professions, tendered their submission, and were cruelly butchered. Zaki did not long enjoy the fruits of his perfidious dealing. The death of Karim Khan had raised two formidable adversaries to mar his peace.

Aga Mahommed, son of Mahommed Ḥasan, the Kajar chief of Astarabad, a prisoner at large in Shiraz, was in the environs of that city awaiting intelligence of the old king's decease, and, hearing it, instantly escaped to Mazandaran, there to gather his tribesmen together and compete for the crown of Persia. Taken prisoner by Nadir and barbarously mutilated by ‘Adil Shah, he had afterwards found means to rejoin his people, but had surrendered himself to Karim Khan when his father was killed in battle. On the other hand, Sadik, brother to Zaki, who had won considerable and deserved repute by the capture of Basra from the Turkish governor, abandoned his hold of the conquered town on hearing of the death of Karim, and appeared with his army before Shiraz. To provide against the intended action of the first, Zaki detached his nephew, ‘Ali Murad, at the head of his best troops to proceed with all speed to the north; and, as to the second, the seizure of such families of Sadik's followers as were then within the walls of the town, and other violent measures, struck such dismay into the hearts of the besieging soldiers that they dispersed and abandoned their leader to his fate. From Kermān, however, where he found an asylum, the latter addressed an urgent appeal for assistance to ‘Ali Murad. This chief, encamped at Teherān when the communication reached him, submitted the matter to his men, who decided against Zaki, but put forward their own captain as the only master they would acknowledge. ‘Ali Murad, leaving the pursuit of Aga Mahcmmed, then returned to Isfahan, where he was received with satisfaction, on the declaration that his one object was to restore to his lawful inheritance the eldest son of Karim Khan, whom Zaki had set aside in favour of a younger brother. The sequel is full of dramatic interest. Zaki, enraged at his nephew's desertion, marched out of Shiraz towards Isfahan. On his way he came to the town of Yezdikhast, where he demanded a sum of money from the inhabitants, claiming it as part of secreted revenue; the demand was refused, and eighteen of the head men were thrown down the precipice beneath his window; a “ saiyid,” or holy man, was the next victim, and his wife and daughter were to be given over to the soldiery, when a suddenly-formed conspiracy took effect, and Zaki's own life was taken in retribution for his guilt (1779).

‘Ali Murad.

When intelligence of these events reached Kermān, Sadik Khan hastened to Shiraz, proclaimed himself king in place of Abu ‘l-Fatḥ Khan, whom he declared incompetent to reign, and put out the eyes of the young prince. He despatched his son Ji‘afir to assume the government of Isfahan, and watch the movements of ‘Ali Murad, who appears to have been then absent from that city; and he gave a younger son, ‘Ali Naki, command of an army in the field. The campaign ended in the capture of Shiraz and assumption of sovereignty by ‘Ali Murad, who caused Sadik Khan to be put to death.

From this period up to the accession of Aga Mahommed Khan the summarized history of Markham will supply the principal facts required.

Lutf ‘Ali Khan.

‘Ali Murad reigned over Persia until 1785, and carried on a successful war with Aga Mahommed in Mazandaran, defeating him in several engagements, and occupying Teherān and Sari. He died on his way from the former place to Isfahan, and was succeeded by Ji‘afir, son of Sadik,[1] who reigned at Shiraz, assisted in the government by an able but unprincipled “ kalantar,” or head magistrate, named Hajji Ibrahim. This ruler was poisoned by the agency of conspirators, one of whom, Saiyid Murad, succeeded to the throne. Hajji Ibrahim, however, contriving to maintain the loyalty of the citizens towards the Zend reigning family, the usurper was killed, and Lutf ‘Ali Khan, son of Ji‘afir, proclaimed king. He had hastened to Shiraz on hearing of his father's death and received a warm welcome from the inhabitants. Hajji Ibrahim became his chief adviser, and a new minister was found for him in Mirza Ḥosain Shirazi. At the time of his accession Lutf ‘Ali Khan was only in his twentieth year, very handsome, tall, graceful, and an excellent horseman. While differing widely in character, he was a worthy successor of Karīm Khan, the great founder of the Zend dynasty. Lutf ‘Ali Khan had not been many months on the throne when Aga Mahommed advanced to attack him, and invested the city of Shiraz, but retreated soon afterwards to Teherān, which he had made the capital of his dominions. The young king then enjoyed a short period of peace.

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[1] A five days' usurpation of Bakir Khan, governor of Isfahan, is not taken into account.

Afterwards, in 1790, he collected his forces and marched against the Kajars, in the direction of Isfahan. But Hajji Ibrahim had been intriguing against his sovereign, to whose family he owed everything, not only with his officers and soldiers but also with Aga Mahommed, the chief of the Kajars, and arch-enemy of the Zends. Lutf ʻAli Khan was suddenly deserted by the whole of his army, except seventy faithful followers; and when he retreated to Shiraz he found the gates closed against him by Hajji Ibrahim, who held the city for the Kajar chief. Thence falling back upon Bushire, he found that the sheikh of that town had also betrayed him. Surrounded by treason on every side, he boldly attacked and routed the chief of Bushire and blockaded Shiraz. His unconquerable valour gained him many followers, and he defeated an army sent against him by the Kajars in 1792.

Aga Mahommed then advanced in person against his rival. He encamped with an army of 30,000 men on the plain of Mardasht, near Shiraz. Lutf ʻAli Khan, in the dead of night, suddenly attacked the camp of his enemy with only a few hundred followers. The Kajars were completely routed and thrown into confusion; but Aga Mahommed, with extraordinary presence of mind, remained in his tent, and at the first appearance of dawn his "muezzin," or public crier, was ordered to call the faithful to morning prayer as usual. Astonished at this, the few Zend cavaliers, thinking that the wholy army of Kajars had returned, fled with precipitation leaving the field in possession of Aga Mahommed. The successful Kajar then entered Shiraz, and promoted the traitor Hajji Ibrahim to be his vizier. Lutf ʻAli Khan took refuge with the hospitable chief of Tabbas in the heart of Khorasan, where he succeeded in collecting a few followers; but advancing into Fars, he was again defeated, and forced to take refuge at Kandahar.

Capture of Kermān.

In 1794, however, the undaunted prince once more crossed the Persian frontier, determined to make a last effort, and either regain his throne or die in the attempt. He occupied the city of Kermān, then a flourishing commercial town, half-way between the Persian Gulf and the province of Khorasan. Aga Mahommed besieged it with a large army in 1795, and, after a stout resistance, the gates were opened through treachery. For three hours the gallant young warrior fought in the streets with determined valour, but in vain. When he saw that all hope was gone he, with only three followers, fought his way through the Kajar host and escaped to Bam-Narmashir, the most eastern district of the province of Kermān on the borders of Seistan.

Furious at the escape of his rival, the savage conqueror ordered a general massacre; 20,000 women and children were sold into slavery, and 70,000 eyes of the inhabitants of Kermān were brought to Aga Mahommed on a platter.

Lutf ʻAli Khan took refuge in the town of Bam; but the governor of Narmashir, anxious to propitiate the conqueror, basely surrounded him as he was mounting his faithful horse Kuran to seek a more secure asylum. The young prince fought bravely; but, being badly wounded and overpowered by numbers, he was secured and sent to the camp of the Kajar chief. The spot where he was seized at Bam, when mounting his horse, was marked by a pyramid, formed, by order of his revengeful enemy, of the skulls of the most faithful of his adherents. The most hideous indignities and atrocities were committed upon his person by the cruel Kajar, and finally he was sent to Teherān and murdered, when only in his twenty-sixth year. Every member of his family and every friend was ordered to be massacred by Aga Mahommed; and the successful miscreant thus founded the dynasty of the Kajars at the price of all the best and noblest blood of Iran.

The Zend is said to be a branch of the Lak tribe, dating from the time of the Kaianian kings, and claims to have been charged with the care of the *Zend-Avesta* by Zoroaster himself.[1] The tree attached to Markham's chapter on the dynasty contains the names of eight members of the family only, *i.e.* four brothers, one of whom had a son, grandson and great-grandson; and one a son. Four of the eight were murdered, one was blinded, and one cruelly mutilated. In one case a brother murdered a brother, in another an uncle blinded his nephew.

Kajar Dynasty.—Aga Mahommed was undoubtedly one of the most cruel and vindictive despots that ever disgraced a throne. But he was not without care for the honour of his empire in the eyes of Europe and the outer world, and his early career in Mazandaran gave him a deeply-rooted mistrust of Russia, with the officers of which power he was in constant contact. The following story, told by Forster,[2] and varied by a later writer, is characteristic. A party of Russians having obtained permission to build a "counting-house" at Ashraf, in the bay of that name, erected instead a fort with eighteen guns. Aga Mahommed, learning the particulars, visited the spot, expressed great pleasure at the work done, invited the officers to dine with him, imprisoned them, and only spared their lives when they had removed the whole of the cannon and razed the fort to the ground. This occurrence must have taken place about 1782.

Aga Mahommed.

Forster was travelling homeward by the southern shores of the Caspian in January 1784, and from him we gather many interesting details of the locality and period. He calls Aga Mahommed chief of Mazandaran, as also of Astarabad and "some districts situate in Khurasan," and describes his tribe the Kajar, to be, like the Indian Rajput, usually devoted to the profession of arms. Whatever hold his father may have had on Gilan, it is certain that this province was not then in the son's possession, for his brother, Jiʻafir Kuli, governor of Balfrush (Balfroosh), had made a recent incursion into it and driven Hidaiyat Khan, its ruler, from Resht to Enzeli, and Aga Mahommed was himself meditating another attack on the same quarter. The latter's palace was at Sari, then a small and partly fortified town, thickly inhabited, and with a plentifully-supplied market. As "the most powerful chief in Persia" since the death of Karim Khan, the Russians were seeking to put their yoke upon him.

Campaign against Georgia.

As Aga Mahommed's power increased, his dislike and jealousy of the Muscovite assumed a more practical shape. His victory over Lutf ʻAli was immediately followed by an expedition into Georgia. After the death of Nadir the wali of that country had looked around him for the safest means of shaking off the yoke of Persia; and in course of time an opportunity had offered of a promising kind. In 1783, when the strength of the Persian monarchy was concentrated upon Isfahan and Shiraz, the Georgian tsar Heraclius entered into an agreement with the empress Catherine by which all connexion with the shah was disavowed, and a quasi-vassalage to Russia substituted—the said empire extending her aegis of protection over her new ally. Aga Mahommed now demanded that Heraclius should return to his position of tributary and vassal to Persia, and, as his demand was rejected, prepared for war. Dividing an army of 60,000 men into three corps, he sent one of these into Daghestan, another was to attack Erivan, and with the third he himself laid siege to Shusha in the province of Karabakh. The stubborn resistance offered at the last-named place caused him to leave there a small investing force only, and to move on with the remainder of his soldiers to join the *corps d'armée* at Erivan. Here, again, the difficulties presented caused him to repeat the same process and to effect a junction with his first corps at Ganja, the modern Elisavetpol. At this place he encountered the Georgian army under Heraclius, defeated it, and marched upon Tiflis, which he pillaged, massacring and enslaving[3] the inhabitants. Then he returned triumphant to Teherān, where (or at Ardebil on the way) he was publicly crowned shah of Persia. Erivan surrendered, but Shusha continued to hold out. These proceedings caused Russia to enter the field. Derbent was taken possession of by Imhov, Baku and Shumakhy were occupied and Gilan was threatened. The death of the empress, however, caused the issue of an order to retire, and Derbent and Baku remained the only trophies of the campaign.

Operations in Korasan.

In the meantime Aga Mahommed's attention had been called away to the east. Khorasan could hardly be called an integral part of the shah's kingdom so long as it was under even the nominal rule of the blind grandson of Nadir. But the eastern division of the province and its outlying parts were actually in the hands of the Afghans, and Meshed was not Persian in 1796 in the sense that Delhi was British at the outbreak of the Indian Mutiny. Shah Rukh held his position, such as it was, rather under Aḥmad

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[1] Markham. Morier says of Karim Khan's family, "it was a low branch of an obscure tribe in Kurdistan."

[2] *Journey from Bengal to England* (1798), ii. 201; see also Markham, pp. 341, 342.

[3] Lady Sheil says (1849); "I saw a few of these unhappy captives who all had to embrace Mahommedanism, and many of whom had risen to the highest stations, just as the Circassian slaves in Constantinople."

Shah and his successors in Afghanistan than under any other sovereign power. Aga Mahommed determined to restore the whole province to Persia, and, after a brief residence in Teherān on his return from the Georgian expedition, he set out for Meshed. It is important to note that on the occasion of his coronation he had girded on the sabre consecrated at the tomb of the founder of the Safawid—thus openly pledging himself to support the Shiʿite faith.

But there had been continual dissatisfaction in the capital of Khorasan, and constant inroads upon it from without, which the royal puppet was unable to prevent. His popularity was real, but never seemed to have effect outside the limited sphere of personal sympathy and regard. Owing to the frequent revolutions in the holy city the generals of Timur Shah, king of the Afghans, had made three expeditions on Shah Rukh's behalf. Meshed had been taken and retaken as though he were not a resident in it, much less its *de jure* king. Moreover, his two sons Nadir Mirza and Wali Niʿamat had long been fighting, and the former was in 1796 the actual ruler of the place. Three years before Timur had died, and his third son, Zaman Shah, by the intrigues of an influential sirdar, Paiyanda Khan, and been proclaimed his successor at Kabul.

Aga Mahommed's entry into Meshed was effected without a struggle on the part of those in possession. The Kajar shah walked on foot to the tomb of Imam Riza, before which he knelt and kissed the ground in token of devotion, and was recognized as a Shiʿite of Shiʿites. Shah Rukh submissively followed in his train. Then began the last act of the local tragedy. The blind king's gradual revelation, under horrible torture, of the place of concealment of his several jewels and treasures, and his deportation and death (of the injuries thus received, at Damghan, en route to Mazandaran), must be classed among the darkest records of Oriental history.

From Meshed Aga Mahommed sent an envoy to Zaman Shah, asking for the cession of Balkh, and explaining his invasion of Khorasan; but the Afghan monarch was too perplexed with the troubles in his own country and his own insecure position to do more than send an unmeaning reply. It is not shown what was the understood boundary between the two countries at this particular period; but Watson states that on the shah's departure he had received the submission of the whole of Khorasān, and left in Meshed a garrison of 12,000 men.

Death and Character of Aga Mahommed.

Aga Mahommed had now fairly established his capital at Teherān. On his return thither in September 1796 he dismissed his troops for the winter, directing their reassembly in the following spring. The re-invasion by Russia of the provinces and districts he had recently wrested from her west of the Caspian had made great progress, but the circumstance does not seem to have changed his plans for the army. Although, when the spring arrived and the shah led his forces to the Aras, the Russians had, it is true, retreated, yet territory had been regained by them as far south as the Talysh. Aga Mahommed had now arrived at the close of his career. He was enabled, with some difficulty, to get his troops across the river, and take possession of Shusha, which had given them so much trouble a year or two before. There, in camp, he was murdered (1797) by his own personal attendants—men who were under sentence of death, but allowed to be at large. He was then fifty-seven years of age, and had ruled over part of Persia for more than eighteen years—over the kingdom generally for about three years, and from his coronation for about one year only.

The brutal treatment he had experienced in boyhood under the orders of ʿAdil Shah, and the opprobrious name of "eunuch" with which he was taunted by his enemies, no doubt contributed to embitter his nature. His contempt of luxury, his avoidance of hyperbole and dislike of excessive ceremony, his protection to commerce and consideration for his soldiers, the reluctance with which he assumed the crown almost at the close of his reign—all these would have been praiseworthy in another man; but on his death the memory of his atrocious tyranny alone survived. Those who have seen his portrait once will recognize the face wherever presented. "Beardless and shrivelled," writes Sir John Malcolm, "it resembled that of an aged and wrinkled woman, and the expression of his countenance, at no time pleasant, was horrible when clouded, as it very often was, with indignation. He was sensible of this, and could not bear that any one should look at him."

Fath Ali Shah.

Aga Mahommed had made up his mind that he should be succeeded by his nephew Fath ʿAli Shah, son of his full brother, Hosain Kuli Khan, governor of Fars. There was a short interval of confusion after the murder. The remains of the sovereign were exposed to insult, the army was disturbed, the recently captured fort on the left bank of the Aras was abandoned; but the wisdom and resolution of the minister, Hajji Ibrahim, and of Mirza Mahommed Khan Kajar secured order and acceptance of the duly appointed heir. The first, proclaiming his own allegiance, put himself at the head of a large body of troops and marched towards the capital. The second closed the gates of Teherān to all comers until Fath ʿAli Shah came himself from Shiraz. Though instantly proclaimed on arrival, the new monarch was not crowned until the spring of the following year (1798).

Rebellions.

The so-called rebellions which followed were many, but not of any magnitude. Such as belong to local history are three in number, *i.e.* that of Sadik Khan Shakaki, the general whose possession of the crown jewels enabled him, after the defeat of his army at Kazvin, to secure his personal safety and obtain a government; of Hosain Kuli Khan, the shah's brother, which was compromised by the mother's intervention; and of Mahommed, son of Zaki Khan, Zend, who was defeated on more than one occasion in battle, and fled into Turkish territory. Later, Sadik Khan, having again incurred the royal displeasure, was seized, confined and mercilessly bricked up in his dungeon to die of starvation.

Another adversary presented himself in the person of Nadir Mirza, son of Shah Rukh, who, when Aga Mahommed appeared before Meshed, had taken refuge with the Afghans. Fath ʿAli sent to warn him of the consequences, but without the desired effect. Finally, he advanced into Khorasan with an army which appears to have met with no opposition save at Nishapur and Turbet, both of which places were taken, and when it reached Meshed, Nadir Mirza tendered his submission, which was accepted. Peace having been further cemented by an alliance between a Kajar general and the prince's daughter, the shah returned to Teherān.

Now that the narrative of Persian kings has been brought up to the period of the consolidation of the Kajar dynasty and commencement of the 19th century, there remains but to summarize the principal events in the reigns of Fath ʿAli Shah and his immediate successors, Mahommed Shah and Naṣru 'd-Din Shah.

War with Russia.

Fath ʿAli Shah came to the throne at about thirty-two years of age, and died at sixty-eight, after a reign of thirty-six years. Persia's great aim was to recover in the north-west, as in the north-east of her empire, the geographical limits obtained for her by the Safawid kings; and this was no easy matter when she had to contend with a strong European power whose territorial limits touched her own. Fath ʿAli Shah undertook, at the outset of his reign, a contest with Russia on the western side of the Caspian, which became constant and harassing warfare. Georgia was, clearly, not to revert to a Mahommedan suzerain. In 1800 its tsar, George, son and successor of Heraclius, notwithstanding his former professions of allegiance to the shah, renounced his crown in favour of the Russian emperor. His brother Alexander indignantly repudiated the act and resisted its fulfilment, but he was defeated by General Lazerov on the banks of the Lora. Persia then re-entered the field. Among the more notable occurrences which followed were a three days' battle, fought near Echmiadzin, between the crown prince, ʿAbbas Mirza, and General Zizianov, in which the Persians suffered much from the enemy's artillery, but would not admit they were defeated; unsuccessful attempts on the part of the Russian commander to get possession of Erivan; and a surprise, in camp, of the shah's forces, which caused them to disperse, and necessitated the king's own presence with reinforcements. On the latter occasion the shah is credited with gallantly swimming his horse across the Aras, and setting an example of energy and valour. In the following year ʿAbbas Mirza advanced upon Shishah, the chief of which place and of the Karabagh had declared for Russia; much fighting ensued, and Erivan was formally taken possession of in the name of the shah. The Russians, moreover, made a futile attempt on Gilan by landing troops at Enzeli, which returned to Baku, where Zizianov fell a victim to the treachery of the Persian governor. Somewhat later Ibrahim Khalil of Shusha, repenting of his Russophilism, determined to deliver up the Muscovite garrison at that place, but his plans were betrayed, and he and his relatives put to death. Reprisals and engagements followed with varied success; and the crown prince of Persia, after a demonstration in Shirvan, returned to Tabriz. He had practically made no progress; yet Russia, in securing possession of Derbent, Baku, Shirvan, Sheki, Ganja, the Talysh and Mugan, was probably indebted to gold as well as to the force of arms. At the same time Persia would not listen to the overtures of peace made to her by the governor-general who had succeeded Zizianov.

Relations with England, India and France.

Relations had now commenced with England and British India. A certain Mahdi ‘Ali Khan had landed at Bushire, entrusted by the governor of Bombay with a letter to the shah, and he was followed shortly by an English envoy from the governor-general, Captain Malcolm of the Madras army. He had not only to talk about the Afghans but about the French, and the trade of the Persian Gulf. The results were a political and commercial treaty, and a return mission to India from Fath ‘Ali Shah. To him France next sent her message. In 1801 an Armenian merchant from Bagdad had appeared as the bearer of credentials from Napoleon, but his mission was mistrusted and came to nothing. Some five years afterwards Jaubert, after detention and imprisonment on the road, arrived at Teherān and went back to Europe with a duly accredited Persian ambassador, who concluded a treaty with the French emperor at Finkenstein. On the return of the Persian diplomatist, a mission of many officers under General Gardane to instruct and drill the local army was sent from France to Persia. Hence arose the counter-mission of Sir Harford Jones from the British government, which, on arrival at Bombay in April 1808, found that it had been anticipated by a previously sent mission from the governor-general of India, under Malcolm again, then holding the rank of brigadier-general.

The home mission, however, proceeded to Bushire, and Malcolm's return thence to India enabled Sir Harford to move on and reach the capital in February 1809. A few days before his entry General Gardane had been dismissed, as the peace of Tilsit debarred France from aiding the shah against Russia. Sir Harford concluded a treaty with Persia the month after his arrival at the capital; but the government of India were not content to leave matters in his hands: notwithstanding the anomaly of a double mission, Malcolm was in 1810 again despatched as their own particular envoy. He brought with him Captains Lindsay and Christie to assist the Persians in the war, and presented the shah with some serviceable field-pieces; but there was little occasion for the exercise of his diplomatic ability save in his non-official intercourse with the people, and here he availed himself of it to the great advantage of himself and his country.[1] He was welcomed by the shah in camp at Ujani, and took leave a month afterwards to return via Bagdad and Basra to India. The next year Sir Harford Jones was relieved as envoy by Sir Gore Ouseley.

Renewal of Russian War.

Meanwhile hostilities had been resumed with Russia, and in 1812 the British envoy used his good offices for the restoration of peace, but the endeavour failed. To add to the Persian difficulty, in July of this year a treaty was concluded between England and Russia, and this circumstance caused the envoy to direct that British officers should take no further part in Russo-Persian military operations. Christie and Lindsay, however, resolved to remain at their own risk, and advanced with the Persian army to the Aras. On the 31st of October the force was surprised by an attack of the enemy, and retreated; the next night they were again attacked and routed at Aslanduz. Christie fell bravely fighting at the head of his brigade; Lindsay saved two of his nine guns; but neither of the two Englishmen was responsible for the disaster. Lenkoran was taken by Persia, but retaken by Russia during the next three months; and on the 13th of October 1813, through Sir Gore Ouseley's intervention, the Treaty of Gulistan put an end to the war. Persia formally ceded Georgia and the seven provinces before named, with Karabakh.

On the death of the emperor Alexander in December 1825 Prince Menshikov was sent to Teherān to settle a dispute which had arisen between the two governments regarding the prescribed frontier. But, as the claim of Persia to a particular district then occupied by Russia could not be admitted, the special envoy was given his *congé*, and war was recommenced. The chief of Talysh struck the first blow, and drove the enemy from Lenkoran. The Persians then carried all before them; and the hereditary chiefs of Shirvan, Sheki and Baku returned from exile to co-operate with the shah's general in the south. In the course of three weeks the only advanced post held by the governor-general of the Caucasus was the obstinate little fortress of Shusha. But before long all was again changed. Hearing that a Russian force of some 9000 men was concentrated at Tiflis, Mahommed Mirza, son of the crown prince, advanced to meet them on the banks of the Zezam. He was defeated; and his father was routed more seriously still at Ganja. The shah made great efforts to renew the war; but divisions took place in his son's camp, not conducive to successful operations, and new proposals of peace were made. But Russia demanded Erivan and Nakhichevan as well as the cost of the war; and in 1827 the campaign was reopened. Briefly, after successive gains and losses, not only Erivan was taken from Persia but Tabriz also, and finally, through the intervention of Sir John Macdonald, the English envoy, a new treaty was concluded at Turkmanchai, laying down the boundary between Russia and Persia. Among the hard conditions for the latter country were the cession in perpetuity of the khanates of Erivan and Nakhichevan, the inability to have an armed vessel in the Caspian, and the payment of a war indemnity of some £3,000,000.

War with Turkey.

After Russia, the neighbouring state next in importance to the well-being of Persia was Turkey, with whom she was united on the west by a common line of frontier. Selim had not scrupled, in 1804 and 1805, to allow the Russians to make free use of the south-eastern coasts of the Black Sea, to facilitate operations against the shah's troops; and there had been a passage of arms between the king's eldest son, Mahommed ‘Ali Mirza, and Suleiman Pasha, son-in-law of the governor-general of Bagdad, which is locally credited as a battle won by the former. But there was no open rupture between the two sovereigns until 1821, when the frontier disputes and complaints of Persian travellers, merchants and pilgrims culminated in a declaration of war. This made ‘Abbas Mirza at once seize upon the fortified places of Toprak Kal‘ah and Ak Sarai within the limits of the Ottoman Empire, and, overcoming the insufficient force sent against him, he was further enabled to extend his inroads to Mush, Bitlis, and other known localities. The Turkish government retaliated by a counter-invasion of the Persian frontier on the south. At that time the Pasha of Bagdad was in command of the troops. He was defeated by Mahommed ‘Ali Mirza, then prince-governor of Kermanshah, who drove his adversary back towards his capital and advanced to its immediate environs. Being attacked with cholera, however, the Persian commander recrossed the frontier, but only to succumb to the disease in the pass of Kirind. In the sequel a kind of desultory warfare appears to have been prosecuted on the Persian side of Kurdistan, and the shah himself came down with an army to Hamadan. Cholera broke out in the royal camp and caused the troops to disperse.

In the north the progress of ‘Abbas Mirza was stopped at Bayazid by a like deadly visitation; and a suspension of hostilities was agreed upon for the winter season. At the expiration of four months the sirdar of Erivan took possession of a Turkish military station on the road to Erzerum, and the crown prince marched upon that city at the head of 30,000 men. The Ottoman army which met him is said to have numbered some 52,000; but victory was on the side of their opponents. Whether the result was owing to the defection of 15,000 Kurds or not the evidence adduced is insufficient to decide. In the English records of the period it is stated that the defeat of the Turks was complete.

Profiting from this victory, ‘Abbas Mirza repeated an offer of peace before made without avail to the pasha of Erzerum; and, in order to conciliate him more effectually, he retired within the old limits of the dominions of the shah, his father. But more troubles arose at Bagdad, and other reasons intervened to protract negotiations for a year and a half. At length, in July 1823, the Treaty of Erzerum closed the war between Turkey and Persia. It provided especially against a recurrence of the proved causes of war, such as extorting taxes from Persian travellers or pilgrims, disrespect to the ladies of the royal harem and other ladies of rank proceeding to Mecca or Karbala (Kerbela), irregular levies of custom-duties, non-punishment of Kurdish depredators transgressing the boundary, and the like.

The Afghan Question.

With respect to the eastern boundaries of his kingdom, Fath ‘Ali Shah was fortunate in having to deal with a less dangerous neighbour than the Muscovite of persistent policy and the Turk of precarious friendship. The Afghan, though equal to the Persian in physical force and prowess, was his inferior in worldly knowledge and experience. Moreover, the family divisions among the ruling houses of Afghanistan grew from day to day more destructive to that patriotism and sense of nationality which Ahmad Shah had held out to his countrymen as the sole specifics for becoming a strong people.

The revolt of Nadir Mirza had, as before explained, drawn the shah's attention to Khorasan in the early part of his reign; but, although quiet had for the moment been restored at Meshed by the presence of the royal camp, fresh grounds of complaint were urged against the rash but powerless prince, and recourse was had to extreme measures. Charged with the murder of a holy saiyid, his hands were cut off and his tongue was plucked out, as part of the horrible punishment inflicted on him. It does not appear that Nadir Mirza's cause was ever seriously espoused by the Afghans, nor that Fath 'Ali Shah's claim to Meshed, as belonging to the Persian crown, was actively resisted. But the large Province of Khorasan, of which Meshed was the capital, had never been other than a nominal dependency of the crown since the death of Nadir; and in the autumn of 1830 the shah, under Russian advice, assembled a large force to bring into subjection all turbulent and refractory chiefs on the east of his kingdom. Yezd and Kerman were the first points of attack; Khorasan was afterwards entered by Samnan, or the main road from Teherān. The expedition, led by 'Abbas Mirza, involved some hard fighting and much loss of life; several forts and places were captured, among them Kuchan and Serrakhs; and it may be concluded that the objects contemplated were more or less attained. An English officer, Colonel Shee, commanded what was called the "British detachment" which accompanied the prince. Thus far as regards Yezd, Kerman and Khorasan. It was otherwise with Herat.

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[1] The "wakilu 'l-mulk," governor of Kerman, told Colonel Goldsmid, when his guest in 1866, that "his father had been Sir John Malcolm's *Mihmandar*. There never was such a man as 'Malcolm Sahib.' Not only was he generous on the part of his government, but with his own money also."—(*Telegraph and Travel*, p. 585.)

Hajji Firuzu'd-Din, son of Timur Shah, reigned undisturbed in that city from 1800 to 1816. Since Fath 'Ali Shah's accession he and his brother Mahmud had been, as it were, under Persian protection. Persia claimed the principality of Herat as part of the empire of Nadir, but her pretensions had been satisfied by payments of tribute or evasive replies. Now, however, that she marched her army against the place, Firuzu 'd-Din called in the aid of his brother Mahmud Shah of Kabul, who sent to him the famous vizier, Fath Khan Barakzai. The latter, intriguing on his own account, got possession of the town and citadel; he then sallied forth, engaged the Persian forces, and forced them to retire into their own country. In 1824, on a solicitation from Mustafa Khan, who had got temporary hold of Herat, more troops were despatched thither, but, by the use of money or bribes, their departure was purchased. Some eight or nine years afterwards 'Abbas Mirza, when at the head of his army in Meshed, invited Yar Mahommed Khan of Herat to discuss a settlement of differences between the two governments. The meeting was unproductive of good. Again the Persian troops advanced to Herat itself under the command of Mahommed Mirza, son of Abbas; but the news of his father's death caused the commander to break up his camp and return to Meshed.

Sir Gore Ouseley returned to England in 1814, in which year Mr Ellis, assisted by Mr Morier—whose "Hajji Baba" is the unfailing proof of his ability and deep knowledge of Persian character—negotiated on the part of Great Britain the Treaty of Teherān. England was to provide troops or a subsidy in the event of unprovoked invasion, while Persia was to attack the Afghans should they invade India. Captain Willock succeeded Morier as chargé d'affaires in 1815, and since that period Great Britain has always been represented at the Persian court. It was in Fath 'Ali Shah's reign that Henry Martyn was in Persia, and completed his able translation of the New Testament into the language of that country. Little more remains to be here narrated of the days of Fath 'Ali Shah. Among the remarkable occurrences may be noted the murder at Teherān in 1828 of M. Grebayadov, the Russian envoy, whose conduct in forcibly retaining two women of Erivan provoked the interference of the mullas and people. To repair the evil consequences of this act a conciliatory embassy, consisting of a young son of the crown prince and some high officers of the state, was despatched to St Petersburg. Shortly afterwards the alliance with Russia was strengthened, and that with England slackened in proportion.

Fath 'Ali Shah had a numerous family. Agreeably to the Persian custom, asserted by his predecessors, of nominating the heir-apparent from the sons of the sovereign without restriction to seniority, he had passed over the eldest, Mahommed 'Ali, in favour of a junior, 'Abbas; but, as the nominee died in the lifetime of his father, the old king had proclaimed Mahommed Mirza, the son of 'Abbas, and his own grandson, to be his successor. Why a younger son had been originally selected, to the prejudice of his elder brother, is differently stated by different writers. The true reason was probably the superior rank of his mother.

Mahommed Shah.

Mahommed Shah was twenty-eight years old when he came to the throne in 1834. He died at the age of forty-two, after a reign of about thirteen and a half years. His accession was not publicly notified for some months after his grandfather's death, for it was necessary to clear the way of all competitors, and there were two on this occasion—one 'Ali Mirza, governor of Teherān, who actually assumed a royal title, and one Hasan 'Ali Mirza, governor of Shiraz. Owing to the steps taken by the British envoy, Sir John Campbell, assisted by Colonel Bethune, at the head of a considerable force, supplied with artillery, the opposition of the first was neutralized, and Mahommed Shah, entering Teherān on the 2nd of January, was proclaimed king on the 31st of the same month. It cost more time and trouble to bring the second to book. Hasan 'Ali, "farman-farma," or commander-in-chief, and his brother and abettor, had an army at their disposal in Fars. Sir Henry Lindsay Bethune marched his soldiers to Isfahan to be ready to meet them. An engagement which took place near Kumishah, on the road between Isfahan and Shiraz, having been successful, the English commander pushed on to the latter town, where the two rebel princes were seized and imprisoned. Forwarded under escort to Teherān, they were, according to Watson, ordered to be sent on thence as state prisoners to Ardebil, but the farman-farma died on the way, and his brother was blinded before incarceration. Markham, however, states that both 'Ali Mirza and Hasan 'Ali were allowed to retire with a small pension, and that no atrocities stained the beginning of the reign of Mahommed Shah. It is presumed that the fate of the prime minister or "kaim-makam," who was strangled in prison, was no more than an ordinary execution of the law. This event, and the prevalence of plague and cholera at Teherān, marked somewhat gloomily the new monarch's first year.

The selection of a premier was one of the first weighty questions for solution. A member of the royal family, the "asafu 'd-daula," governor of Khorasan, left his government to urge his candidature for the post. The king's choice, however, fell on Hajji Mirza Aghasi, a native of Erivan, who in former years, as tutor to the sons of 'Abbas Mirza, had gained a certain reputation for learning and a smattering of the occult sciences, but whose qualifications for statesmanship were craftiness and suspicion. As might have been anticipated, the hajji fell into the hands of Russia, represented by Count Simonich, who urged him to a fresh expedition into Khorasan and the siege of Herat. There was no doubt a plausible pretext for both proposals. The chiefs, reduced to temporary submission by 'Abbas Mirza, had again revolted; and Shah Kamran, supported by his vizier, Yar Mahommed, had broken those engagements and pledges on the strength of which Fath 'Ali Shah had withdrawn his troops. In addition to these causes of offence he had appropriated the province of Seistan, over which Persia had long professed to hold the rights of suzerainty. But the king's ambition was to go farther than retaliation or chastisement. He refused to acknowledge any right to separate government whatever on the part of the Afghans, and Kandahar and Ghazni were to be recovered, as belonging to the empire of the Safawid dynasty. The advice of the British envoy was dissuasive in this respect, and therefore distasteful.

Expedition against Herat.

Sir John Campbell, in less than a year after the sovereign's installation, went home, and was succeeded as British envoy by Henry Ellis. The change in personnel signified also a transfer of superintendence of the Persian legation, which passed from the government in India to the authorities in England. The expedition was to commence with a campaign against the Turcomans—Herat being its later destination. Such counter-proposals as Ellis had suggested for consideration had been politely put aside, and the case was now more than ever complicated by the action of the Barakzai chiefs of Kandahar, who had sent a mission to Teherān to offer assistance against their Saduzai rival at Herat. Fresh provocation had, moreover, been given to the shah's government by the rash and incapable Kamran.

About the close of the summer the force moved from Teherān. The royal camp was near Astarabad in November 1836. Food was scarce: barley sold for ten times the usual price, and wheat was not procurable for any money. The troops were dissatisfied, and, being kept without pay and on short rations, took to plundering. There had been operations on the banks of the Gurgan, and the Turcomans had been driven from one of their strongholds; but little or no progress had been made in the subjection of these marauders, and the Heratis had sent word that all they could do was to pay tribute, and, if that were insufficient, the shah had better march to Herat. A military council was held at Shahrud, when it was decided to return to the capital and set out again in the spring. Accordingly the troops dispersed, and the sovereign's presence at Teherān was taken advantage of by the British minister to renew his attempts in the cause of peace. Although on the present occasion Simonich ostensibly aided the British chargé d'affaires M'Neill, who had succeeded Ellis in 1836, no argument was of any avail to divert the monarch from his purpose. He again set out in the summer, and, invading the Herat territory in November 1837, began the siege on the 23rd of that month.

Not until September in the following year did the Persian army withdraw from before the walls of the city; and then the movement only took place on the action of the British government. M'Neill, who had joined the Persian camp on the 6th of April, left it again on the 7th of June. He had done all in his power to effect a reasonable agreement between the contending parties; but both in this respect and in the matter of a commercial treaty with England, then under negotiation, his efforts had been met with evasion and latent hostility. The Russian envoy, who had appeared among the tents of the besieging army almost simultaneously with his English colleague, no sooner found himself alone in his diplomacy than he resumed his aggressive counsels, and little more than a fortnight had elapsed since M'Neill's departure when a vigorous assault, planned, it is asserted, by Simonich himself, was made upon Herat. The Persians attacked at five points, at one of which they would in all likelihood have been successful had not the Afghans been aided by Eldred Pottinger, a young Englishman, who with the science of an artillery officer combined a courage and determination which inevitably influenced his subordinates. Still the garrison was disheartened; but Colonel Stoddart's arrival on the 11th of August to threaten the shah with British intervention put a stop to further action. Colonel Stoddart's refusal to allow any but British mediators to decide the pending dispute won the day; and that officer was able to report that on

Siege of Herat.

the 9th of September Mahommed Shah had "mounted his horse" and gone from before the walls of the beleaguered city.

The siege of Herat, which lasted for nearly ten months, was the great event in the reign of Mahommed Shah. The British expedition in support of Shah Shuj'a, which may be called its natural consequence, involves a question foreign to the present narrative.

The remainder of the king's reign was marked by new difficulties with the British government; the rebellion of Aga Khan Mahlati otherwise known as the chief of the Assassins; a new rupture with Turkey; the banishment of the asafu'd-daula, governor of Khorasan, followed by the insurrection and defeat of his son; and the rise of Bābīism (*q.v.*). The first of these only calls for any detailed account.

Difficulty with England.

In the demands of the British Government was included the cession by Persia of places such as Farah and Sabzewar, which had been taken during the war from the Afghans, as well as reparation for the violence offered to the courier of the British legation. M'Neill gave a certain time for decision, at the end of which, no satisfactory reply having reached him, he broke off diplomatic relations, ordered the British officers lent to the shah to proceed towards Bagdad *en route* to India, and retired to Erzerum with the members of his mission. On the Persian side, charges were made against M'Neill, and a special envoy was sent to England to support them. An endeavour was at the same time made to interest the cabinets of Europe in influencing the British government on behalf of Persia. The envoy managed to obtain an interview with the minister of foreign affairs in London, who, in July 1839, supplied him with a statement, fuller than before, of all English demands upon his country. Considerable delay ensued, but the outcome of the whole proceedings was not only acceptance but fulfilment of all the engagements contracted. In the meantime the island of Kharak had been taken possession of by an expedition from India.

On the 11th of October 1841 a new mission arrived at Teherān from London, under John (afterwards Sir John) M'Neill, to renew diplomatic relations. It was most cordially received by the shah, and as one of its immediate results, Kharak was evacuated by the British-Indian troops.

There had been a long diplomatic correspondence in Europe on the proceedings of Count Simonich and other Russian officers at Herat. Among the papers is a very important letter from Count Nesselrode to Count Pozzo di Borgo in which Russia declares herself to be the first to counsel the shah to acquiesce in the demand made upon him, because she found "justice on the side of England" and "wrong on the side of Persia." She withdrew her agent from Kandahar and would "not have with the Afghans any relations but those of commerce, and in no wise any political interests."

Aga Khan's rebellion was fostered by the defection to his cause of a large portion of the force sent against him; but he yielded at last to the local authorities of Kerman and fled the province and country. He afterwards resided many years at Bombay, where, while maintaining among natives a quasi-spiritual character, he was better known among Europeans for his doings on the turf.

The quarrel with Turkey was generally about frontier relations. Eventually the matter was referred to an Anglo-Russian commission, of which Colonel Williams (afterwards Sir Fenwick Williams of Kars) was president. A massacre of Persians at Kerbela might have seriously complicated the dispute, but, after a first burst of indignation and call for vengeance, an expression of the regret of the Ottoman government was accepted as a sufficient apology for the occurrence.

The rebellion of the asafu 'd-daula, maternal uncle of the shah, was punished by exile, while his son, after giving trouble to his opponents, and once gaining a victory over them, took shelter with the Turcomans.

Before closing the reign of Mahommed Shah note should be taken of a prohibition to import African slaves into Persia, and a commercial treaty with England—recorded by Watson as gratifying achievements of the period by British diplomatists. The French missions in which occur the names of MM. de Lavalette and de Sartiges were notable in their way, but somewhat barren of results.

In the autumn of 1848 the shah was seized with the malady, or combination of maladies, which caused his death. Gout and erysipelas had, it is said,[1] ruined his constitution, and he died at his palace in Shimran on the 4th of September. He was buried at Kum, where is situated the shrine of Fatima, daughter of Imam Riza, by the side of his grandfather, Fath 'Ali, and other kings of Persia. In person he is described as short and fat, with an aquiline nose and agreeable countenance.[2]

Nasru 'd-Din Shah.

On the occasion of his father's death, Naṣru 'd-Din Mirza, who had been proclaimed wali 'ahd, or heir apparent, some years before, was absent at Tabriz, the headquarters of his province of Azerbaijan. Colonel Farrant, then chargé d'affaires on the part of the British government, in the absence of Colonel Sheil, who had succeeded Sir John M'Neill, had, in anticipation of the shah's decease and consequent trouble, sent a messenger to summon him instantly to Teherān. The British officer, moreover, associated himself with Prince Dolgoruki, the representative of Russia, to secure the young prince's accession.

The queen-mother, as president of the council, showed much judgment and capacity in conciliating adverse parties. But the six or seven weeks which passed between the death of the one king and the coronation of the other proved a disturbed interval, and full of stirring incident. The old minister, Hajji Mirza Aghasi, shut himself up in the royal palace with 1200 followers, and had to take refuge in the sanctuary of Shah 'Abdul-'Azim near Teherān. On the other hand Mirza Aga Khan, a partisan of the asafu 'd-daula, and himself an ex-minister of war, whom the hajji had caused to be banished, was welcomed back to the capital. At Isafahan, Shiraz and Kerman serious riots took place, which were with difficulty suppressed. While revolution prevailed in the city, robbery was rife in the province of Yezd; and from Kazvin the son of 'Ali Mirza otherwise called the "zillu's-sultan," the prince-governor of Teherān, who disputed the succession of Mahommed Shah, came forth to contest the crown with his cousin, the heir-apparent. The last-named incident soon came to an inglorious termination for its hero. But a more serious revolt was in full force at Meshed when, on the 20th of October 1848, the young shah entered his capital and was crowned at midnight king of Persia.

The chief events in the long reign of Naṣru 'd-Din, fall under four heads: (1) the insurrection in Khorasan, (2) the insurrection of the Babis, (3) the fall of the amiru 'n-nizam, and (4) the war with England.

Insurrection in Khorasan.

It has been stated that the asafu 'd-daula was a competitor with Hajji Mirza Aghasi for the post of premier in the cabinet of Mahommed Shah, that he was afterwards, in the same reign, exiled for rising in rebellion, and that his son, the salar, took shelter with the Turcomans. Some four months prior to the Mahommed Shah's decease the latter chief had reappeared in arms against his authority; he had gained possession of Meshed itself, driving the prince-governor, Hamza Mirza, into the citadel; and so firm was his attitude that Yar Mahommed of Herat, who had come to help the government officials, had retired after a fruitless co-operation, drawing away the prince-governor also. The salar now defied Murad Mirza, Naṣru 'd-Din's uncle, who was besieging the city. In April 1850, after a siege of more than eighteen months, fortune turned against the bold insurgent, and negotiations were opened for the surrender of the town and citadel. Treachery may have had to do with the result, for when the shah's troops entered the holy city the salar sought refuge in the mosque of Imam Riza, and was forcibly expelled. He and his brother were seized and put to death, the instrument used being, according to Watson, "the bowstring of Eastern story." The conqueror of Meshed, Murad Mirza, became afterwards himself the prince-governor of Khorasan.

Bābīism.

In the article on BĀBĪISM, the facts as to the life of the *Bab*, Mirza Ali Mahommed of Shiraz, and the progress of the Babīist movement, are separately noticed. The Bab himself was executed in 1850, but only after serious trouble over the new religious propaganda; and his followers kept up the revolutionary propaganda.

In the summer of 1852 the shah was attacked, while riding in the vicinity of Teherān, by four Babis, one of whom fired a pistol and slightly wounded him. The man was killed, and two others were captured by the royal attendants; the fourth jumped down a well. The existence of a conspiracy was then discovered in which some forty persons were implicated; and ten of the conspirators were put to death—some under cruel torture.

Fall of Mirza Taki.

Mirza Taki, the amiru 'n-nizam (vulgarly amir nizam), or commander-in-chief, was a good specimen of the self-made man of Persia. He was the son of a cook of Bahram Mirza, Mahommed Shah's brother, and he had filled high and important offices of state and amassed much wealth when he was made by the young shah Naṣru 'd-Din, on his accession, both his brother-in-law and his prime-minister. The choice was an admirable one; he was honest, hard-working, and liberal according to his lights; and the services of a loyal and capable adviser were secured for the new régime. Unfortunately, he did not boast the confidence of the queen-mother; and this circumstance greatly strengthened the hands of those enemies whom an honest minister must ever raise around him in a corrupt Oriental state. For a time the shah closed his eyes to the accusations and insinuations against him; but at last he fell under the evil influence of designing counsellors, and acts which should have redounded to the minister's credit became the charges on which he lost his office and his life. He was credited with an intention to grasp in his own hands the royal power; his influence over the army was cited as a cause of danger; and on the night of the 13th of November 1851 he was summoned to the palace and informed that he was no longer premier. Mirza Aga Khan, the "'itimadu 'd-daulah," was named to succeed him, and had been accordingly raised to the dignity of "sadr'azim." As the hostile faction pressed the necessity of the ex-minister's removal from the capital; he was offered the choice of the government of Fars, Isfahan or Kum. He declined all; but, through the mediation of Colonel Sheil, he was afterwards offered and accepted Kashan. Forty days after his departure an order for his execution was signed, but he anticipated his fate by committing suicide.

When England was engaged in the Crimean War of 1854–55 her alliance with a Mahommedan power in no way added to her popularity or strengthened her position in Persia. The Sunnite Turk was almost a greater enemy to his neighbour the Shi'ite than the formidable Muscovite, who had curtailed him of so large a section of his territory west of the Caspian. Since Sir John M'Neill's arrival in Teherān in 1841, formally to repair the breach with Mahommed Shah, there had been little differences, demands and explanations, and these symptoms had culminated in 1856, the year of the peace with Russia. As to Afghanistan, the vizier Yar Mahommed had in 1842, when the British troops were perishing in the passes, or otherwise in the midst of dangers, caused Kamran to be suffocated in his prison. Since that event he had himself reigned supreme in Herat, and, dying in 1851, was succeeded by his son Sa'id Mahommed. This chief soon entered upon a series of intrigues in the Persian interests, and, among other acts offensive to Great Britain, suffered one 'Abbas Kuli, who had, under guise of friendship, betrayed the cause of the salar at Meshed, to occupy the citadel of Herat, and again place a detachment of the shah's troops in Ghurian. Colonel Sheil remonstrated, and obtained a new engagement of non-interference with Herat from the Persian government, as well as the recall of 'Abbas Kuli. In September 1855 Mahommed Yusuf Saduzai seized upon Herat, putting Sa'id Mahommed to death with some of his followers who were supposed accomplices in the murder of his uncle Kamran. About this time Kohan Dil Khan, one of the chiefs of Kandahar, died, and Dost Mahommed of Kabul annexed the city to his territory. Some relations of the deceased chief made their escape to Teherān, and the shah, listening to their complaint, directed the prince-governor of Meshed to march across to the eastern frontier and occupy Herat, declaring that an invasion of Persia was imminent. Negotiations were useless, and on the 1st of November 1856 war against Persia was declared.

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[1] Watson.

[2] Markham.

Rupture with England.

In less than three weeks after its issue by proclamation of the governor-general of India, the Sind division of the field force left Karachi. On the 13th of January following the Bombay government orders notified the formation of a second division under Lieut.-General Sir James Outram. Before the general arrived the island of Kharak and port of Bushire had both been occupied, and the fort of Rishir had been attacked and carried. After the general's arrival the march upon Borazjan and the engagement at Khushab—two places on the road to Shiraz—and the operations at Muhamrah and the Karun River decided the campaign in favour of England. On the 5th of April, at Muhamrah, Sir James Outram received the news that the treaty of peace had been signed in Paris, where Lord Cowley and Farrukh Khan had conducted the negotiations. The stipulations regarding Herat were much as before; but there were to be apologies made to the mission for past insolence and rudeness, and the slave trade was to be suppressed in the Persian Gulf. With the exception of a small force retained at Bushire under General John Jacob for the three months assigned for execution of the ratifications and giving effect to certain stipulations of the treaty with regard to Afghanistan, the British troops returned to India, where their presence was greatly needed, owing to the outbreak of the Mutiny.

Anglo-Indian Telegraph Line.

The question of constructing a telegraph in Persia as a link in the overland line to connect England with India was broached in Teherān by Colonel Patrick Stewart and Captain Champain, officers of engineers, in 1862, and an agreement on the subject concluded by Edward Eastwick, when chargé d'affaires, at the close of that year. Three years later a more formal convention, including a second wire, was signed by the British envoy Charles Alison and the Persian foreign minister; meantime the work had been actively carried on, and communication opened on the one side between Bushire and Karachi and the Makran coast by cable, and on the other between Bushire and Bagdad via Teherān. The untrustworthy character of the line through Asiatic Turkey caused a subsequent change of direction; and an alternative line—the Indo-European—from London to Teherān, through Russia and along the eastern shores of the Black Sea, was constructed, and has worked well since 1872, in conjunction with the Persian land telegraph system and the Bushire-Karachi line.

The Seistan mission, under Major-General (afterwards Sir Frederic) Goldsmid, left England in August 1870, and reached Teherān on the 3rd of October. Thence it proceeded to Isfahan, from which city it moved to Baluchistan, instead of seeking its original destination. Difficulties had arisen both in arranging the preliminaries to arbitration and owing to the disordered state of Afghanistan, and it was therefore deemed advisable to commence operations by settling a frontier dispute between Persia and the Kalat state. Unfortunately, the obstructions thrown in the way of this settlement by the Persian commissioner, the untoward appearance at Bampur of an unexpected body of Kalatis, and the absence of definite instructions marred the fulfilment of the programme sketched out; but a line of boundary was proposed, which was afterwards accepted by the litigants. In the following year the same mission, accompanied by the same Persian commissioner, proceeded to Seistan, where it remained for more than five weeks, prosecuting its inquiries, until joined by another mission from India, under Major-General (afterwards Sir Richard) Pollock, accompanying the Afghan commissioner. Complications then ensued by the determined refusal of the two native officials to meet in conference; and the arbitrator had no course available but to take advantage of the notes already obtained on the spot, and return with them to Teherān, there to deliver his decision. This was done on the 19th of August 1872. The contending parties appealed to the British secretary of state for foreign affairs, as provided by previous understanding; but the decision held good, and was eventually accepted on both sides.

Nasru 'd-Din Shah, unlike his predecessors, visited Europe—in 1873 and in 1879. On the first occasion only he extended his journey to England, and was then attended by his "sadr 'azim," or prime minister, Mirza Husain Khan, an able and enlightened adviser, and a Grand Cross of the Star of India. His second visit was to Russia, Germany, France and Austria, but he did not cross the Channel. (F. J. G.; X.)

E.—*Persia from 1884 to 1901.*

The Control of the Persian Gulf.

In 1865 the shah had mooted the idea of a Persian naval flotilla in the Persian Gulf, to consist of two or three steamers manned by Arabs and commanded by English naval officers; but the idea was discountenanced by the British government, to whom it was known that the project really concealed aggressive designs upon the independence of the islands and pearl fisheries of Bahrein (Curzon, *Persia*, ii. 294). Fifteen or sixteen years later it was repeatedly pointed out to the authorities that the revenues from the customs of the Persian Gulf would be much increased if control were exercised at all the ports, particularly the small ones where smuggling was being carried on on a large scale, and in 1883 the shah decided upon the acquisition of four or five steamers, one to be purchased yearly, and instructed the late 'Ali Kuli Khan, Mukhber ad-daulah, minister of telegraphs, to obtain designs and estimates from British and German firms. The tender of a well-known German firm at Bremerhaven was finally accepted, and one of the minister's sons then residing in Berlin made the necessary contracts for the first steamer. Sir Ronald Thomson, the British representative in Persia, having at the same time induced the shah to consider the advantages to Persia of opening the Karun River and connecting it with Teherān by a carriageable road, a small river steamer for controlling the shipping on the Karun was ordered as well, and the construction of the road was decided upon. Two steamers, the "Susa" and the "Persepolis," were completed in January 1885 at a cost of £32,000, and despatched with German officers and crew to the Persian Gulf. When the steamers were ready to do the work they had been intended for, the farmer, or farmers, of the Gulf customs raised difficulties and objected to pay the cost of maintaining the "Persepolis"; the governor of Muhamrah would not allow any interference with what he considered his hereditary rights of the shipping monopoly on the Karun, and the objects for which the steamers had been brought were not attained. The "Persepolis" remained idle at Bushire, and the "Susa" was tied up in the Failieh creek, near Muhamrah. The scheme of opening the Karun and of constructing a carriageable road from Ahvaz to Teherān was also abandoned.

Frequent interruptions occurred on the telegraph line between Teherān and Meshed in 1885, at the time of the "Panjdeh incident," when the Russians were advancing towards Afghanistan and Sir Peter Lumsden was on the Afghan frontier; and Sir Ronald Thomson concluded an agreement with the Persian government for the line to be kept in working order by an English inspector, the Indian government paying a share not exceeding 20,000 rupees per annum of the cost of maintenance, and an English signaller being stationed at Meshed. Shortly afterwards Sir Ronald Thomson left Persia (he died on the 15th of November 1888), and Arthur (afterwards Sir Arthur) Nicolson was appointed chargé d'affaires. During the latter's tenure of office an agreement was concluded between the Persian and British governments regarding the British telegraph settlement at Jask, and the telegraph conventions of 1868 and 1872 relative to telegraphic communication between Europe and India through Persia, in force until the 1st of January 1895, were prolonged until the 31st of January 1905 by two conventions dated the 3rd of July 1887. Since then these conventions have been prolonged to 1925.

Ayub Khan, son of Shir 'Ali (Shere Ali) of Afghanistan, who had taken refuge in Persia in October 1881, and was kept interned in Teherān under an agreement, concluded on the 17th of April 1884, between Great Britain and Persia, with a pension of £8000 per annum from the British government escaped on the 14th of August 1887. After a futile attempt to enter Afghan territory and raise a revolt against the Amir Abdur Rahman, he gave himself up to the British consul-general at Meshed in the beginning of November, and was sent under escort to the Turkish frontier and thence via Bagdad to India. Yahya Khan, Mushir-ad-daulah, the Persian minister for foreign affairs (died 1892), who was supposed to have connived at Ayub Khan's escape in order to please his Russian friends, was dismissed from office.

In December 1887 Sir Henry Drummond Wolff was appointed minister to Persia. The appointment greatly pleased the Persian court, and the shah lent a willing ear to his advocacy for the development of trade and commerce, construction of roads, abolition of various restrictions hampering Persian merchants, &c. The shah soon afterwards (May 26, 1888) issued a proclamation assuring freedom of life and property to all his subjects, and (Oct. 30) declared the Karun river open to international navigation up to Ahvaz. At about the same time he appointed Amin-es-Sultan, who had been prime-minister since 1884, Grand Vizier (Sadr 'azim). In the same year (June 25) the first railway in Persia, a small line of 5½ miles from Teherān to Shah-abdul-Azim, was opened under the auspices of a Belgian company. A few months later (Jan. 30, 1889) Baron Julius de Reuter—in consideration of giving up the rights which he held by his concession obtained in 1873—became the owner of a concession for the formation of a Persian State Bank, with exclusive rights of issuing bank-notes and working the mines of iron, copper, lead, mercury, coal, petroleum, manganese, borax, and asbestos in Persia. Russia now insisted upon what she considered a corresponding advantage; and Prince Dolgoruki, the Russian minister, obtained in February 1889 a document from the shah which gave to Russia the refusal of any railway concession in Persia for a period of five years. The Persian State Bank was established by British royal charter, dated the 2nd of September 1889, and started business in Persia (Oct. 23) as the "Imperial Bank of Persia." The railway agreement with Russia was changed in November 1890 into one interdicting all railways whatsoever in Persia.

Shah's Visit to Europe, 1889.

In April 1889 the shah set out upon his third voyage to Europe. After a visit to the principal courts, including a stay of a month in England, where he was accompanied by Sir Henry Drummond Wolff, he returned to his capital (Oct. 20). Sir Henry returned to Persia soon afterwards, and in March of the following year the Persian government granted another important concession, that of a tobacco monopoly, to British capitalists. In the autumn bad health obliged the British minister to leave Persia. It was during his stay in England that the shah, for two or three days without his grand vizier, who was mourning for the death of his brother, listened to bad advice and granted a concession for the monopoly of lotteries in Persia to a Persian subject. The latter ceded the concession to a British syndicate for £40,000. Very soon afterwards the shah was made aware of the evil results of this monopoly, and withdrew the concession, but the syndicate did not get the money paid for it returned. This unfortunate affair had the effect of greatly discrediting Persia on the London Stock Exchange for a long time. The concession for the tobacco monopoly was taken up by the Imperial Tobacco Corporation (1891). The corporation encountered opposition fostered by the clergy and after a serious riot at Teherān (Jan. 4, 1892) the Persian government withdrew the concession and agreed to pay an indemnity of £500,000 (April 5, 1892). In order to pay this amount Persia contracted the 6% loan of £500,000 through the Imperial Bank of Persia, which was redeemed in 1900 out of the proceeds of the Russian 5% loan of that year. (For details of the tobacco concession and an account of the events which led to its withdrawal, see E. Lorini, *La Persia economica*, Rome, 1900, pp. 164–169; and Dr Feuvrier, *Trois ans à la cour de Perse*, Paris, 1899, ch. v., the latter ascribing the failure of the tobacco monopoly to Russian intrigue.)

In November 1889 Malcolm Khan, Nizam-ul-Mulk, who had been Persian representative to the court of Great Britain since October 1872, was recalled, and Mirza Mahommed 'Ali Khan, consul-general at Tiflis, was appointed in his stead, arriving in London the following March. In 1890 the scheme of a carriageable road from Teherān to Ahvaz was taken up again; the Imperial Bank of Persia obtained a concession, and work of construction was begun in the same year, and continued until 1893. In this year, too, the mining rights of the Imperial Bank of Persia were ceded to the Persian Bank Mining Rights Corporation, and a number of engineers were sent out to Persia. The total absence of easy means of communication, the high rates of transport, and the scarcity of fuel and water in the mineral districts made profitable operations impossible, and the corporation liquidated in 1894, after having expended a large sum of money.

Kate Greenfield Case.

Great excitement was caused in the summer of 1891 by the report that an English girl, Kate Greenfield, had been forcibly carried away from her mother's house at Tabriz by a Kurd. The British authorities demanded the girl's restitution from the Persian government. The Kurd, a Turkish subject, refused to give up the girl, and took her to Saujbulagh. The Turkish authorities protected him, and serious complications were imminent; but finally an interview between the girl and the British agent was arranged, and the matter was promptly settled by her declaring that she had left her mother's house of her own accord, and was the wife of the Kurd. It also became known that she was the daughter of a British-protected Hungarian named Grünfeld, who had died some years since, and an American lady of Tabriz.

Sir Frank Lascelles, who had been appointed minister to Persia in July, arrived at Teherān in the late autumn of 1891. In the following year Persia had a visitation of cholera. In Teherān and surrounding villages the number of fatal cases exceeded 28,000, or about 8% of the population. In 1893 the epidemic appeared again, but in a milder form. In June 1893 Persia ceded to Russia the small but very fertile and strategically important district of Firuza and the adjacent lands between Baba Durmaz and Lutfabad on the northern frontier of Khorasan, and received in exchange the important village of Hissar and a strip of desert ground near Abbasabad on the frontier of Azerbaijan, which had become Russian territory in 1828, according to the Treaty of Turkmanchai.

French Archaeological Concession.

Sir Frank Lascelles left Persia in the early part of 1894, and was succeeded by Sir Mortimer Durand, who was appointed in July and arrived in Teherān in November. In the following year the shah, by a firman dated the 12th of May gave the exclusive right of exploring ancient sites in Persia to the French government, with the stipulation that one-half of the discovered antiquities, excepting those of gold and silver and precious stones, should belong to the French government, which also had the preferential right of acquiring by purchase the other half and any of the other antiquities which the Persian government might wish to dispose of. In 1897 M. J. de Morgan, who had been on a scientific mission in Persia some years before and later in Egypt, was appointed chief of a mission to Persia, and began work at Susa in December.

Assassination of the Shah, 1896.

On the 1st of May 1896 Nasur 'd-Din Shah was assassinated while paying his devotions at the holy shrine of Shah-abdul-Azim. Five days later he would have entered the fiftieth (lunar) year of his reign, and great preparations for duly celebrating the jubilee had been made throughout the country. The assassin was a small tradesman of Kermān named Mirza Reza, who had resided a short time in Constantinople and there acquired revolutionary and anarchist ideas from Kemalu 'd-Din, the so-called Afghan sheikh, who, after being very kindly treated by the shah, preached revolution and anarchy at Teherān, fled to Europe, visited London, and finally took up his residence in Constantinople. Kemalu 'd-Din was a native of Hamadan and a Persian subject, and as the assassin repeatedly stated that he was the sheikh's emissary and had acted by his orders, the Persian government demanded the extradition of Kemal from the Porte; but during the protracted negotiations which followed he died. Mirza Reza was hanged on the 12th of August 1896. There were few troubles in the country when the news of the shah's death became known. Serious rioting arose only in Shiraz and Fars, where some persons lost their lives and a number of caravans were looted. European firms who had lost goods during these troubles were afterwards indemnified by the Persian government. The new shah, Muzaffar-ud-Dīn (born March 25, 1853), then governor-general of Azerbaijan, residing at Tabriz, was enthroned there on the day of his father's death, and proceeded a few days later, accompanied by the British and Russian consuls, to Teherān, where he arrived on the 8th of June.

Currency Difficulties.

An excessive copper coinage during the past three or four years had caused much distress among the poorer classes since the beginning of the year, and the small trade was almost paralysed. Immediately after his accession the shah decreed that the coining of copper money should cease and the excess of the copper coinage be withdrawn from circulation. In order to reduce the price of meat, the meat tax, which had existed since ancient times was abolished. The Imperial Bank of Persia, which had already advanced a large sum of money, and thereby greatly facilitated the shah's early departure from Tabriz and enabled the grand vizier at Teherān to carry on the government, started buying up the copper coinage at all its branches and agencies. The nominal value of the copper money was 20 shahis equal to 1 kran, but in some places the copper money circulated at the rate of 80 shahis to the kran, less than its intrinsic value; at other places the rates varied between 70 and 25 shahis, and the average circulating value in all Persia was over 40. If government had been able to buy up the excess at 40 and reissue it gradually after a time at its nominal value when the people required it, the loss would have been small. But although the transport of copper money from place to place had been strictly prohibited, dishonest officials found means to traffic in copper money on their own account, and by buying it where it was cheap and forwarding it to cities where it was dear, the bank bought it at high rates, thus rendering the arrangement for a speedy withdrawal of the excess at small cost to government futile. It was only in 1899 that the distress caused by the excessive copper coinage ceased, and then only at very great loss to government. The well-intentioned abolition of the tax on meat also had not the desired result, for by a system of "cornering" the price of meat rose to more than it was before.

Ministerial Changes, 1896-1898.

In the autumn of 1896 the grand vizier (Amin-es-Sultan) encountered much hostility from some members of the shah's entourage and various high personages. Amin-ad-daulah was appointed chief administrator (vizier) of Azerbaijan and sent to Tabriz. Shortly afterwards the grand vizier found it impossible to carry on his work, resigned, and retired to Kum (Nov. 24), and the shah formed a cabinet composed for the greater part of the leading members of the opposition to the grand vizier. After three months of the new régime affairs of state fell into arrears, and the most important department, that of the interior, was completely disorganized. The shah accordingly recalled Amin-ad-daulah from Tabriz (Feb. 1897), and appointed him minister president (raïs-i-vuzara) and minister of the interior. In June Amin-ad-daulah was made prime minister (vizir ʽazim) and given more extended powers, and in August raised to the dignity of grand vizier (sadr ʽazim). Nasru ʼl-Mulk was appointed minister of finance (Feb. 1898), and made an attempt to introduce a simple system of accounts, establish a budget, reorganize the revenue department, made a new assessment of the land-tax, &c.; but resistance on the part of the officials rendered it abortive.

In the latter part of 1897 E. Graves, the inspector of the English telegraph line from Jask eastwards, was brutally murdered by Baluchis, and the agents of the Persian government sent to seize the murderers were resisted by the tribes. A considerable district breaking out into open revolt, troops under the command of the governor-general of Kermān were despatched into Baluchistan. The port of Fannoch was taken in March 1898, and order was restored. One of the murderers was hanged at Jask (May 31).

Abortive Negotiations for British Loan in 1898.

Various attempts to obtain a foreign loan had been made during the previous year, but with the sole result of discrediting the Persian government in Europe. In the beginning of 1898 the shah's medical advisers strongly recommended a cure of mineral waters in Germany or France, and as his departure from Persia without paying the arrears to the army and to thousands of functionaries, or providing a sufficient sum for carrying on the government during his absence, would have created grave discontent, serious negotiations for a loan were entered upon. It was estimated that £1,000,000 would be required to pay all debts, including the balance of the 1892 loan, and leave a surplus sufficient for carrying on the government until the shah's return. London capitalists offered to float a loan for £1,250,000 at 5% and on the guarantee of the customs of Fars and the Persian Gulf ports, and to give £1,025,000, or 82% to the Persian government. They stipulated for a kind of control over the custom-houses by placing their own agents as cashiers in them. This stipulation was agreed to in principle by the grand vizier, Amin ad-daulah, who in March, in order to meet some pressing demands on the treasury borrowed £50,000 on the customs receipts of Kermānshāh and Bushire, and agreed to the lenders, the Imperial Bank of Persia's agents, being placed as cashiers in the custom-houses of both cities. He encountered, however, much opposition from the other ministers. Further negotiations ensued, and the shah's visit to Europe was abandoned. The assistance of the British government not being forthcoming, the grand vizier's position became more and more difficult, and on the 5th of June he had to resign. Muhsin Khan, Mushir-ad-daulah, minister for foreign affairs, then became president of the cabinet, and continued the negotiations, but could not bring them to a successful issue. Moreover, the Persian government, finding that the previous estimate of the money required for paying its debts was about 50% below the mark, now asked for double the amount offered by the London capitalists, without, however, proportionately increasing the guarantee. This disorganized all previous arrangements, and the negotiations for a London loan came to an end for a time at the end of July, leaving in the minds of the Persians the unfortunate impression that the British government had done nothing to aid them.

On the 9th of July the former grand vizier, Amin-es-Sultan, was recalled from Kum, where he had resided since November 1896, arrived at Teherān three days later, and was reinstated as grand vizier on the 10th of August. His immense popularity, his friendly relations with the clergy, and some temporary advances from the banks, tided over difficulties for some time. The reform of the customs department was now (Sept. 1898) taken up seriously, and the three Belgian custom-house officials who had been engaged by Amin-ad-daulah in the beginning of the year were instructed to collect information and devise a scheme for the reorganization of the department and the abolition of the farm system. In March 1899 the custom-houses of the provinces of Azerbaijan and Kermānshāh were given over to the Belgians. The results of this step were so satisfactory that government was induced to abolish the farm system and set up the new régime in the other provinces in March 1900, and a number of other Belgian custom-houses officials were engaged.

Russian Loan of 1900.

In September, when renewed negotiations for a loan from London were not appearing to progress favourably, and the long-thought-of visit to Europe was considered to be absolutely necessary in the following year, the shah issued a firman authorizing the Russian Banque des Prêts de Perse to float a loan. Shortly after this it was said that the London capitalists were willing to lend £1,250,000 without insisting upon the objectionable control clause; but the proposal came too late, and on the 30th ~~of~~ January 1900, the Russian government had permitted the issue of a loan for 22½ million roubles (£2,400,000) at 5%, guaranteed by all the customs receipts of Persia, excepting those for Fars and the Persian Gulf ports. Only in the event of any default of paying instalments and interests was the bank to be given control of the custom-houses. Persia received 85% of the nominal capital, and the Russian government guaranteed the bondholders. Money was immediately remitted to Teherān, and nearly all the arrears were paid, while the balance of the 1892 London 6% loan was paid off by direct remittance to London.

Shah's Visits to Europe, 1900, 1902.

Sir Mortimer Durand left Teherān in the early spring, and proceeded to Europe on leave. On the 12th of April the shah, accompanied by the grand vizier and a numerous suite, started on his voyage to Europe. The affairs of State during his absence were entrusted to a council of ministers, under the presidency of his second son, Malik Mansur Mirza, Shua-es-Sultaneh, who had made a long stay on the Continent the year before.

After a residence of a month at Contrexéville, the shah proceeded (July 14) to St Petersburg, and thence to Paris (July 29), intending to go to London on the 8th of August. But on account of the mourning in which several courts were thrown through the death of the king of Italy (July 29) and the duke of Saxe-Coburg-Gotha (July 30), the visits to England, Germany and Italy were abandoned. On the 2nd of August an anarchist made an attempt upon the shah's life in Paris.

F.—*Russo-British Rivalry (1902–1907) and the Persian Revolution (1906–1909).*

In 1902 Muzaffar-ud-Dīn Shah revisited the principal European capitals, and was received by King Edward VII. at Portsmouth in August. A mission headed by Viscount Downe was afterwards despatched to Persia, to invest the shah with the order of the Garter, a ceremony which took place in Teherān on the 2nd of February 1903. A week later, a new commercial treaty was concluded between Great Britain and Persia, which instituted various reforms in the customs service, secured to both countries the "most-favoured-nation" treatment, and substituted specific import and export duties for the charge of 5% *ad valorem* provided for in the treaty of 1857. These provisions to some extent counterbalanced the losses inflicted on British trade by the Russo-Persian commercial treaty signed in 1902, which had seriously damaged the Indian tea trade, and had led to a rapid extension of Russian influence. Between 1899 and 1903 the Russian Bank had lent Persia £4,000,000, of which fully half was paid to the shah for his personal requirements. Russian concessionnaires were given the right to build roads from Tabriz to Teherān (1902) and from Tabriz to Kazvin (1903); and the Russian Bank opened new branches in Seistan—an example followed in 1903 by the Bank of Persia. It was, however, in the Persian Gulf that the rivalry between Great Britain and Russia threatened to become dangerous. Great Britain had almost a monopoly of maritime commerce in the Gulf, and was alone responsible for buoying, lighting and policing its waters. The British claim to political supremacy in this region had thus a solid economic basis; it had been emphasized by the British action at Kuwet (*q.v.*) in 1899, and by the declaration made in the House of Lords by Lord Lansdowne, as secretary of state for foreign affairs, to the effect that Great Britain would resist by all means in its power the attempt of any other nation to establish itself in force on the shores of the Gulf. On the 16th of November 1903, Lord Curzon, the viceroy of India, sailed from Karachi for the Persian Gulf. His ship, the "Hardinge," was escorted by four cruisers, and the voyage was regarded as a political demonstration, to be interpreted in connexion with Lord Lansdowne's declaration. At Bushire, on the 1st of December, the Persian governor of Fars, Ala ad-daula, committed a breach of diplomatic etiquette which induced Lord Curzon to sail away without landing. This incident was considered by some British observers to have been brought about by Russian intrigue, and the fact that Ala ad-daula was dismissed in 1904, after the Japanese had achieved several initial successes in the Russo-Japanese war, was held to confirm this opinion. But Russian financial and commercial influence in

Persia continued to increase; in December 1904 a special mission under Mirza Riza Khan was received in audience by the tsar; and in May 1905 Muzaffar-ud-Dīn Shah himself left Persia to visit the courts of Vienna and St Petersburg.

The Seistan Mission of 1902–1905.—A dispute as to the frontier between Afghanistan and Seistan arose in 1902. The boundary delimited by the Seistan mission of 1870–1872, and known as the "Goldsmid line," was drawn along the course of the river Helmund. Between 1872 and 1902 the Helmund took a more westerly direction; no boundary marks had been erected, and a wide strip of territory remained in dispute. The Persians claimed that the boundary was the old bed of the river, the Afghans that it was the new bed; and in accordance with the treaty of 1857 both parties asked the British government to arbitrate. In January 1903, Colonel Arthur Henry MacMahon, who had previously delimited the frontier between Afghanistan and British India, was despatched from Quetta. The Persian officials were at first hostile, but their opposition, which was attributed to Russian influence at Teherān, was eventually overcome, and Colonel MacMahon (who was knighted in 1906) delivered his final award, sustaining the Persian contention, in February 1905.

British Commercial Missions.—Owing to the success of the Maclean mission, which visited and reported upon the markets and trade-routes of north-western Persia in 1903, under the direction of the Board of Trade, a similar mission was sent to southern Persia in 1904, under the auspices of the Upper India Chamber of Commerce, the Bengal Chamber and the Indian Tea Cess Company. The report of this mission (by Gleadowe-Newcomen) was published in 1906. After showing that civilized government was practically non-existent in the regions visited, it suggested as the chief remedy the conclusion of a Russo-British convention, and the division of Persia into "spheres of influence."

Russo-British Convention of 1907.—The political situation created by the Russo-Japanese War and by an internal crisis in Persia itself rendered possible such an agreement between the two rival powers, and a Russo-British convention was signed on the 31st of August 1907. Its chief provisions, in regard to Persia, are as follows: (1) north of a line drawn from Kasr-i-Shirin, Isfahan, Yezd and Kakh to the junction of the Russian, Persian and Afghan frontiers Great Britain undertook to seek no political or commercial concession, and to refrain from opposing the acquisition of any such concession by Russia or Russian subjects; (2) Russia gave to Great Britain a like undertaking in respect of the territory south of a line extending from the Afghan frontier to Gazik, Birjend, Kermān and Bander Abbasi; (3) the territory between the lines above-mentioned was to be regarded as a neutral zone in which either country might obtain concessions; (4) all existing concessions in any part of Persia were to be respected; (5) should Persia fail to meet its liabilities in respect of loans contracted, before the signature of the convention, with the Persian Banque d'Escompte and de Prêts, or with the Imperial Bank of Persia, Great Britain and Russia reserved the right to assume control over the Persian revenues payable within their respective spheres of influence. With this convention was published a letter from the British secretary of state for foreign affairs (Sir E. Grey), stating (1) that the Persian Gulf lay outside the scope of the convention, (2) that Russia admitted the special interests of Great Britain in the Gulf, and (3) that these interests were to be maintained by Great Britain as before.

The Persian Constitution.—The misgovernment and disorder which were revealed to Europe by the Gleadowe-Newcomen report, and by such sporadic outbreaks as the massacre of the Babis in Yezd (1903), had caused widespread discontent in Persia. In 1905, partly owing to the example shown by the revolutionary parties in Russia, this discontent took the form of a demand for representative institutions. On the 5th of August 1906, Muzaffar-ud-Dīn Shah issued a rescript in which he undertook to form a national council (Majlis) representing the whole people (see above, *Constitution*). The Majlis was duly elected, and was opened by the shah in person on the 7th of October 1906. In January 1907 the shah died, and was succeeded by his eldest son, Mahommed 'Ali Mirza, who on the 11th of February published a message to his people, pledging himself to adhere to the new constitution.

The Revolution.—On the 12th of November the shah visited the Majlis, and repeated his pledge, but during December a riot in Teherān developed into a political crisis, in which the shah's troops were employed against the civil population. The Majlis issued a manifesto to the powers, declaring that the shah intended to overthrow the constitution, and demanding intervention. The Russian and British ministers in Teherān urged Mahommed 'Ali to maintain the constitution, and he sent a message to the Majlis, promising compliance with its demands and agreeing to place the whole army under the control of the ministry of war. These concessions allayed the prevailing unrest for a time, but the Royalist and Nationalist parties continued secretly to intrigue against one another, and in February 1908, while the shah was driving in Teherān, two bombs were exploded under his motor-car. Two persons were killed, but the shah was unhurt, and the Majlis formally congratulated him on his escape. A prolonged ministerial crisis, in April and May, was attributed by the Nationalists to the influence of reactionary courtiers, and by the Royalists to the influence of the Anjumans, or political clubs, which were alleged to control the Nationalist majority in the Majlis. Early in June the Majlis urged the shah to dismiss the courtiers under suspicion. Mahommed 'Ali consented, but withdrew from Teherān; and on his departure the royal bodyguard of so-called "Cossacks"—Persian soldiers officered by Russians in the shah's service—at once came into conflict with the Nationalists. The house of parliament was bombarded, and when the Majlis appointed commissioners to discuss terms, the shah issued a manifesto dissolving the Majlis, and entrusted the restoration of order in Teherān to military administrators. He also proposed to substitute for the elected Majlis a council of forty members, nominated by himself; but under pressure from Great Britain and Russia he promised to abandon this scheme and to order another general election. Meanwhile, civil war had broken out in the provinces; Kurdish raiders had sacked many villages near Tabriz; Persian brigands had attacked the Russian frontier-guards on the borders of Transcaucasia, and the indemnity demanded by the tsar's government was not paid until several Persian villages had been burned by Russian troops. This incident, combined with the employment of the so-called Cossacks, evoked a protest from the Nationalists, who asserted that Russia was aiding the Royalists; the accusation was true only in so far as it referred to the conduct of certain Russian officials who acted without the consent of the Russian government. Early in 1909, indeed, a Russian force of 2600 men was sent to watch events near Tabriz, and if necessary to intervene in favour of the Nationalists who held the town, and had for some months been besieged by the shah's troops. The presence of the Russians ultimately induced the Royalists to abandon the siege. In January of the same year the revolution spread to Isfahan, where the Bakhtiari chiefs made common cause with the Nationalists, deposed the Royalist governor and marched on the capital. In May and June the shah issued proclamations declaring his fidelity to the constitution, and promising an amnesty to all political offenders; but he was powerless to stay the advance of the combined Bakhtiari and Nationalist troops, who entered Teherān on the 13th of July. After severe street fighting the Cossacks deserted to the rebels, and the shah took refuge in the Russian legation (July 15). This was interpreted as an act of abdication; on the same day the national council met, and chose Mahommed 'Ali's son, Sultan Ahmad Mirza, aged thirteen, as his successor. Asad ul-Mulk, head of the Kajar tribe, was appointed regent. On the 9th of September 1909, the ex-shah departed for his place of exile in the Crimea, escorted by Russian Cossacks and Indian sowars. On the 15th of November a newly elected Majlis was formally opened by the shah.

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2. *History*: Sir J. Malcolm, *History of Persia* (2nd ed., London, 1829); R. G. Watson, *A History of Persia from the Beginning of the Nineteenth Century* (London, 1873); Sir C. R. Markham, *A General Sketch of the History of Persia* (London, 1874), and Curzon, as quoted above, are the standard authorities on modern Persian history. The *Travels of Pedro Teixeira* (London, 1902) and other publications of the Hakluyt Society relating to Persia are also of great historical value. For more recent events see the reports of the Gleadowe-Newcomen and MacMahon missions: E. G. Browne, *The Persian Revolution of 1905–09* (London, 1910); A. Hamilton, *Problems of the Middle East* (London, 1909); V. Chirol, *The Middle Eastern Question* (London, 1904); E. C. Williams, *Across Persia* (London, 1907). The commercial convention of 1903 is given in Treaty series, No. 10 (London, 1903), the Russo-British convention in Treaty series, No. 34 (London, 1907). Other official publications of historical importance are the annual British F. O. reports, and the U.S. Consular Reports.

Language and Literature

I. *Persian* (*Iranian*) *Languages.*—Under the name of Persian is included the whole of that great family of languages occupying a field nearly coincident with the modern Iran, of which true Persian is simply the western division. It is therefore common and more correct to speak of the Iranian family. The original native name of the race which spoke these tongues was Aryan. King Darius is called on an inscription "a Persian, son of a Persian, an Aryan of Aryan race"; and the followers of the Zoroastrian religion in their earliest records never give themselves any other title but *Airyavō danghavō*, that is to say, "Aryan races." The province of the Iranian language is bounded on the west by the Semitic, on the north and north-east by the Ural-altaic or Turanian, and on the south-east by the kindred language of India.

Iranian Languages.

The Iranian languages form one of the great branches of the Indo-European stem, first recognized as such by Sir William Jones and Friedrich Schlegel. The Indo-European or Indo-Germanic languages are divided by Brugmann into (1) Aryan, with sub-branches (*a*) Indian, (*b*) Iranian; (2) Armenian; (3) Greek; (4) Albanian; (5) Italic; (6) Celtic; (7) Germanic, with sub-branches (*a*) Gothic, (*b*) Scandinavian, (*c*) West Germanic; and (8) Balto-Slavonic. (See Indo-European.) The Aryan family (called by Professor Sievers the "Asiatic base-language") is subdivided into (1) Iranian (Eranian, or Erano-Aryan) languages, (2) Pisacha, or non-Sanskritic Indo-Aryan languages, (3) Indo-Aryan, or Sanskritic Indo-Aryan languages (for the last two see Indo-Aryan); Iranian being also grouped into Persian and non-Persian.

The common characteristics of all Iranian languages, which distinguish them especially from Sanskrit, are as follows:—

1. Changes of the original *s* into the spirant *h*. Thus—

Sanskrit.	*Zend.*	*Old Persian.*	*New Persian.*
sindhu (Indus)	hindu	hindu	hind
sarva (all)	haurva	haruva	har
sama (whole)	hama	hama	ham
santi (sunt)	henti	hantiy	hend.

2. Change of the original aspirates *gh*, *dh*, *bh* (= χ, θ, φ) into the corresponding medials—

Sanskrit.	*Zend.*	*Old Persian.*	*New Persian.*
bhūmi (earth)	būmi	bumi	būm
dhita (θετός)	dāta	dāta	dād
gharma (heat)	garema	garma	garm.

3. *k*, *t*, *p* before a consonant are changed into the spirants *kh*, *th*, *f*—

Sanskrit.	*Zend.*	*Old Persian.*	*New Persian.*
prathama (first)	fratema	fratama	fradum (Parsi)
kratu (insight)	khratu	. . . .	khirad.

4. The development of soft sibilants—

Sanskrit.	*Zend.*	*Old Persian.*	*New Persian.*
Asurō Medhās[1]	Ahurō Mazdāo	Auramazdā	Ormuzd
bāhu (arm)	bāzu	. . . .	bāzū
hima (hiems)	zima	. . . .	zim.

Our knowledge of the Iranian languages in older periods is too fragmentary to allow of our giving a complete account of this family and of its special historical development. It will be sufficient here to distinguish the main types of the older and the more recent periods. From antiquity we have sufficient knowledge of two dialects, the first belonging to eastern Iran, the second to western.

Zend.

1. *Zend or Old Bactrian.*—Neither of these two titles is well chosen. The name Old Bactrian suggests that the language was limited to the small district of Bactria, or at least that it was spoken there—which is, at the most, only an hypothesis. Zend, again (originally *āzaintish*), is not the name of a language, as Anquetil Duperron supposed, but means "interpretation" or "explanation," and is specially applied to the medieval Pahlavī translation of the *Avesta*. Our "Zend-Avesta" does not mean the *Avesta* in the Zend language, but is an incorrect transcription of the original expression "Avistāk va zand," *i.e.* "the holy text (*Avesta*) together with the translation." But, since we still lack sure data to fix the home of this language with any certainty, the convenient name of Zend has become generally established in Europe, and may be provisionally retained. But the home of the Zend language was certainly in eastern Iran; all attempts to seek it farther west—*e.g.* in Media[2]—must be regarded as failures.

Zend is the language of the so-called *Avesta*,[3] the holy book of the Persians, containing the oldest documents of the religion of Zoroaster. Besides this important monument, which is about twice as large as the *Iliad* and *Odyssey* put together, we only possess very scanty relics of the Zend language in medieval glosses and scattered quotations in Pahlavī books. These remains, however, suffice to give a complete insight into the structure of the language. Not only amongst Iranian languages, but amongst all the languages of the Indo-European group, Zend takes one of the very highest places in importance for the comparative philologist. In age it almost rivals Sanskrit; in primitiveness it surpasses that language in many points; it is inferior only in respect of its less extensive literature, and because it has not been made the subject of systematic grammatical treatment. The age of Zend must be examined in connexion with the age of the *Avesta*. In its present form the *Avesta* is not the work of a single author or of any one age, but embraces collections produced during a long period. The view which became current through Anquetil Duperron, that the *Avesta* is throughout the work of Zoroaster (in Zend, *Zarathushtra*), the founder of the religion, has long been abandoned as untenable. But the opposite view, that not a single word in the book can lay claim to the authorship of Zoroaster, also appears on closer study too sweeping. In the *Avesta* two stages of the language are plainly distinguishable. The older is represented in but a small part of the whole work, the so-called *Gāthās* or songs. These songs form the true kernel of the book Yasna;[4] they must have been in existence long before all the other parts of the *Avesta*, throughout the whole of which allusions to them occur. These gāthās are what they claim to be, and what they are honoured in the whole *Avesta* as being—the actual productions of the prophet himself or of his time. They bear in themselves irrefutable proofs of their authenticity, bringing us face to face not with the Zoroaster of the legends but with a real person, announcing a new doctrine and way of salvation, no supernatural Being assured of victory, but a mere man, struggling with human conflicts of every sort, in the midst of a society of fellow-believers yet in its earliest infancy. It is almost impossible that a much later period could have produced such unpretentious and almost depreciatory representations of the deeds and personality of the prophet. If, then, the gāthās reach back to the time of Zoroaster, and he himself, according to the most probable estimate, lived as early as the 14th century B.C., the oldest component parts of the *Avesta* are hardly inferior in age to the oldest Vedic hymns. The gāthās are still extremely rough in style and expression; the language is richer in forms than the more recent Zend; and the vocabulary shows important differences. The predominance of the long vowels is a marked characteristic, the constant appearance of a long final vowel contrasting with the preference for a final short in the later speech.

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[1] Name of the supreme god of the Persians.

[2] Cf. I. Darmesteter, *Études iraniennes*, i. 10 (Paris, 1883).

[3] This, and not *Zend-Avesta*, is the correct title for the original text of the Persian Bible. The origin of the word is doubtful, and we cannot point to it before the time of the Sassanians. Perhaps it means "announcement," "revelation."

[4] The *Avesta* is divided into three parts: (1) Yasna, with an appendix, Visparad, a collection of prayers and forms for divine service; (2) Vendidad, containing directions for purification and the penal code of the ancient Persians; (3) Khordah-Avesta, or the Small Avesta, containing the Yasht, the contents of which are for the most part mythological, with shorter prayers for private devotion.

Sanskrit.	*Gāthā.*	*Later Zend.*
abhi (near)	aibī	aiwi
īhā (work)	īzhā	īzha.

The clearest evidence of the extreme age of the language of the gāthās is its striking resemblance to the oldest Sanskrit, the language of the Vedic poems. The gāthā language (much more than the later Zend) and the language of the *Vedas* have a close resemblance, exceeding that of any two Romanic languages; they seem hardly more than two dialects of one tongue. Whole strophes of the gāthās can be turned into good old Sanskrit by the application of certain phonetic laws; for example—

> " mat vāo padāish yā frasrūtā īzhayāo
> pairijasāi mazdā ustānazastō
> aṭ vāo ashā aredrahyācā nemanghā
> āt vāo vangēhush mananghō hunaretātā,"

becomes in Sanskrit—

> " mana vah padāih yā praçrutā ihāyāh
> parigachāi medha uttānahastah
> āt va rtena radhrasyaca namasā
> āt vō vasor manasah sūnṛtayā."[1]

The language of the other parts of the *Avesta* is more modern, but not all of one date, so that we can follow the gradual decline of Zend in the *Avesta* itself. The later the date of a text, the simpler is the grammar, the more lax the use of the cases. We have no chronological points by which to fix the date when Zend ceased to be a living language; no part of the *Avesta* can well be put later than the 5th or 4th century B.C. Before Alexander's time it is said to have been already written out on dressed cowhides and preserved in the state archives at Persepolis.

The followers of Zoroaster soon ceased to understand Zend. For this reason all that time had spared of the *Avesta* was translated into Middle Persian or PAHLAVĪ (*q.v.*) under the Sassanians. This translation, though still regarded as canonical by the Parsees, shows a very imperfect knowledge of the original language. Its value for modern philology has been the subject of much needless controversy amongst European scholars. It is only a secondary means towards the comprehension of the ancient text, and must be used with discrimination. A logical system of comparative exegesis, aided by constant reference to Sanskrit, its nearest ally, and to the other Iranian dialects, is the best means of recovering the lost sense of the Zend texts.

The phonetic system of Zend consists of simple signs which express the different shades of sound in the language with great precision. In the vowel-system a notable feature is the presence of the short vowels *e* and *o*, which are not found in Sanskrit and Old Persian; thus the Sanskrit *santi*, Old Persian *hantiy*, becomes *henti* in Zend. The use of the vowels is complicated by a tendency to combinations of vowels and to epenthesis, *i.e.* the transposition of weak vowels into the next syllable; *e.g.* Sanskrit *bharati*, Zend *baraiti* (he carries); Old Persian *margu*, Zend *mōurva* (Merv); Sanskrit *rinaktī*, Zend *irinakhti*. Triphthongs are not uncommon, *e.g.* Sanskrit *açvebhyas* (dative plural of *açva*, a horse) is in Zend *aspaēibyō* ; Sanskrit *kṛnoti* (he does), Zend *kerenaoiti*. Zend has also a great tendency to insert irrational vowels, especially near liquids; owing to this the words seem rather inflated; *e.g.* *savya* (on the left) becomes in Zend *hāvaya* ; *bhrājati* (it glitters), Zend *barāzaiti*; *gnā* (γυνή), Zend *genā*. In the consonantal system we are struck by the abundance of sibilants (*s* and *sh*, in three forms of modification, *z* and *zh*) and nasals (five in number), and by the complete absence of *l*. A characteristic phonetic change is that of *rt* into *sh*; *e.g.* Zend *asha* for Sanskrit *ṛta*, Old Persian *arta* (in *Artaxerxes*); *fravashi* for Pahlavī *fravardīn*, New Persian *ferver* (the spirits of the dead). The verb displays a like abundance of primary forms with Sanskrit, but the conjugation by periphrasis is only slightly developed. The noun has the same eight cases as in Sanskrit. In the gāthās there is a special ablative, limited, as in Sanskrit, to the "a" stems, whilst in later Zend the ablative is extended to all the stems indifferently.

We do not know in what character Zend was written before the time of Alexander. From the Sassanian period we find an alphabetic and very legible character in use, derived from Sassanian Pahlavī, and closely resembling the younger Pahlavī found in books. The oldest known manuscripts are of the 14th century A.D.[2]

Although the existence of the Zend language was known to the Oxford scholar Thomas Hyde, the Frenchman Anquetil Duperron, who went to the East Indies in 1755 to visit the Parsee priests, was the first to draw the attention of the learned world to the subject. Scientific study of Zend texts began with E. Burnouf, and has since then made rapid strides, especially since the *Vedas* have opened to us a knowledge of the oldest Sanskrit.

Old Persian.

2. *Old Persian.*—This is the language of the ancient Persians properly so-called,[3] in all probability the mother-tongue of Middle Persian of the Pahlavī texts, and of New Persian. We know Old Persian from the rock-inscriptions of the Achaemenians, now fully deciphered. Most of them, and these the longest, date from the time of Darius, but we have specimens as late as Artaxerxes Ochus. In the latest inscriptions the language is already much degraded; but on the whole it is almost as antique as Zend, with which it has many points in common. For instance, if we take a sentence from an inscription of Darius as—

> " Auramazdā hya imām bumim adā hya avam asmānam adā hya martiyam adā hya siyātim adā martiyahyā hya Dārayavaum khshāyathiyam akunaush aivam paruvnām khshāyathiyam,"

it would be in Zend—

> " Ahurō mazdāo yō imām būmīm adāṭ yō aom asmanem adāṭ yō mashīm adāṭ yō shāitīm adāṭ mashyahē yō dārayaṭvohūm khshaētem akerenaoṭ ōyūm pourunām khshaētem."[4]

The phonetic system in Old Persian is much simpler than in Zend; we reckon twenty-four letters in all. The short vowels *e*, *o* are wanting; in their place the old "a" sound still appears as in Sanskrit, *e.g.* Zend *bagem*, Old Persian *bagam*, Sanskrit *bhagam*; Old Persian *hamarana*, Zend *hamerena*, Sanskrit *samarana*. As regards consonants, it is noticeable that the older *z* (soft *s*) still preserved in Zend passes into *d*—a rule that still holds in New Persian; compare—

Sanskrit.	*Zend.*	*Old Persian.*	*New Persian.*
hasta (hand)	zasta	dasta	dast
jrayas (sea)	zrayō	daraya	daryā
aham (I)	azem	adam	. . .

Also Old Persian has no special *l*. Final consonants are almost entirely wanting. In this respect Old Persian goes much farther than the kindred idioms, *e.g.* Old Persian *abara*, Sanskrit *abharat*, Zend *abarat*, ἔφερε: nominative *baga*, root-form *baga-s*, Sanskrit *bhagas*. The differences in declension between Old Persian and Zend are unimportant.

Old Persian inscriptions are written in the cuneiform character of the simplest form, known as the "first class." Most of the inscriptions have besides two translations into the more complicated kinds of cuneiform character of two other languages of the Persian Empire. One of these is the Assyrian; the real nature of the second is still a mystery. The interpretation of the Persian cuneiform, the character and dialect of which were equally unknown, was begun by G. F. Grotefend, who was followed by E. Burnouf, Sir Henry Rawlinson and J. Oppert. The ancient Persian inscriptions have been collected in a Latin translation with grammar and glossaries by F. Spiegel (Leipzig, 1862; new and enlarged ed., 1881). The other ancient tongues and dialects of this family are known only by name; we read of peculiar idioms in Sogdiana, Zabulistan, Herat, &c. It is doubtful whether the languages of the Scythians, the Lycians and the Lydians, of which hardly anything remains, were Iranian or not.

After the fall of the Achaemenians there is a period of five centuries, from which no document of the Persian language has come down to us.

Under the Arsacids Persian nationality rapidly declined; all that remains to us from that period—namely, the inscriptions on coins—is in the Greek tongue. Only towards the end of the Parthian dynasty and after the rise of the Sassanians, under whom the national traditions were again cultivated in Persia, do we recover the lost traces of the Persian language in the Pahlavī inscriptions and literature.

Middle Persian.

3. *Middle Persian.*—The singular phenomena presented by Pahlavī writing have been discussed in a separate article (see PAHLAVĪ). The languages which it disguises rather than expresses—Middle Persian, as we may call it—presents many changes as compared with the Old Persian of the Achaemenians. The abundant grammatical forms of the ancient language are much reduced in number; the case-ending is lost; the noun has only two inflexions, the singular and the plural; the cases are expressed by prepositions—*e.g.* *rūbān* (the soul), nom. and acc. sing., plur. *rūbānān*; dat. *val* or *avo rūbān*, abl. *min* or *az rūbān*. Even distinctive forms for gender are entirely abandoned, *e.g.* the pronoun *avo* signifies "he," "she," "it." In the verb compound forms predominate. In this respect Middle Persian is almost exactly similar to New Persian.

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[1] "With verses of my making, which are now heard, and with prayerful hands, I come before thee, Mazda, and with the sincere humility of the upright man and with the believer's song of praise."

[2] *Grammars* by F. Spiegel (Leipzig, 1867) and A. V. W. Jackson (Stuttgart, 1892); *Dictionary* by F. Justi (Leipzig, 1864); editions of the *Avesta* by N. L. Westergaard (Copenhagen, 1852) and C. F. Geldner (Stuttgart, 1886–1895; also in English); translation into German by Spiegel (Leipzig, 1852), and into English by Darmesteter (Oxford, 1880) in Max Müller's *Sacred Books of the East*.

[3] And perhaps of the Medes. Although we have no record of the Median language we cannot regard it as differing to any great extent from the Persian. The Medes and Persians were two closely-connected races. There is nothing to justify us in looking for the true Median language either in the cuneiform writings of the second class or in Zend.

[4] "Ormuzd, who created this earth and that heaven, who created man and man's dwelling-place, who made Darius king, the one and only king of many."

New Persian.

4. *New Persian.*—The last step in the development of the language is New Persian, represented in its oldest form by Firdousī. In grammatical forms it is still poorer than Middle Persian; except English, no Indo-European language has so few inflexions, but this is made up for by the subtle development of the syntax. The structure of New Persian has hardly altered at all since the *Shāhnāma*; but the original purism of Firdousī, who made every effort to keep the language free from Semitic admixture, could not long be maintained. Arabic literature and speech exercised so powerful an influence on New Persian, especially on the written language, that it could not withstand the admission of an immense number of Semitic words. There is no Arabic word which would be refused acceptance in good Persian. But, nevertheless, New Persian has remained a language of genuine Iranian stock.

Among the changes of the sound system in New Persian, as contrasted with earlier periods, especially with Old Persian, the first that claims mention is the change of the tenues *k*, *t*, *p*, *c*, into *g*, *d*, *b*, *z*. Thus we have—

Old Persian or Zend.	*Pahlavī.*	*New Persian.*
mahrka (death)	mark	marg
Thraētaona	Frītūn	Ferīdūn
āp (water)	āp	āb
hvatō (self)	khōt	khōd
raucah (day)	rōj	rūz
haca	aj	az.

A series of consonants often disappear in the spirant; thus—

Old Persian or Zend.	*Pahlavī.*	*New Persian.*
kaufa (mountain)	kof	kōh
gāthu (place), Z. gātu	gās	gāh
cathware (four)	. . . .	cihār
bañdaka (slave)	bandak	bandah
spāda (army)	. . . .	sipāh
dadāmi (I give)	. . . .	diham.

Old *d* and *dh* frequently become *y*—

Old Persian or Zend.	*Pahlavī.*	*New Persian.*
madhu (wine)	. . . .	mai
baodhō (consciousness)	bōd	bōi
pādha (foot)	. . . .	pāi
kadha (when)	. . . .	kai.

Old *y* often appears as *j*: Zend *yāma* (glass), New Persian *jām*; *yavan* (a youth), New Persian *javān*. Two consonants are not allowed to stand together at the beginning of a word; hence vowels are frequently inserted or prefixed, *e.g.* New Persian *sitādan* or *istādan* (to stand), root *stā*; *birādar* (brother), Zend and Pahlavī *brātar*.[1]

Modern Dialects.

Amongst modern languages and dialects other than Persian which must be also assigned to the Iranian family may be mentioned:—

1. *Kurdish*, a language nearly akin to New Persian, with which it has important characteristics in common. It is chiefly distinguished from it by a marked tendency to shorten words at all costs, *e.g.* Kurd. *berā* (brother) = New Persian *birādar*; Kurd. *dim* (I give) = New Persian *diham*; Kurd. *spī* (white) = New Persian *sipēd*.

2. *Baluch*, the language of Baluchistan, also very closely akin to New Persian, but especially distinguished from it in that all the old spirants are changed into explosives, *e.g.* Baluch *vāb* (sleep) = Zend *hvafna*; Baluch *kap* (slime) = Zend *kafa*, New Persian *kaf*; Baluch *hapt* (seven) = New Persian *haft*.

3. *Ossetic*, true Iranian, in spite of its resemblance in sound to the Georgian.[2]

4. *Pushtu* (less accurately Afghan), which has certainly been increasingly influenced by the neighbouring Indian languages in inflexion, syntax and vocabulary, but is still at bottom a pure Iranian language, not merely intermediate between Iranian and Indian.

The position of *Armenian* remains doubtful. Some scholars attribute it to the Iranian family; others prefer to regard it as a separate and independent member of the Indo-European group. Many words that at first sight seem to prove its Iranian origin are only adopted from the Persian.[3] (K. G.)

II. *Modern Persian Literature.*—Persian historians are greatly at variance about the origin of their national poetry. Most of them go back to the 5th Christian century and ascribe to one of the Sassanian kings, Bahrām V. (420–439), the invention of metre and rhyme; others mention as author of the first Persian poem a certain Abulhafṣ of Soghd, near Samarḳand. In point of fact, there is no doubt that the later Sassanian rulers fostered the literary spirit of their nation (see PAHLAVĪ). Pahlavī books, however, fall outside of the present subject, which is the literature of the idiom which shaped itself out of the older Persian speech by slight modifications and a steadily increasing mixture of Arabic words and phrases in the 9th and 10th centuries of our era, and which in all essential respects has remained the same for the last thousand years. The death of Hārūn al-Rashīd in the beginning of the 9th century, which marks the commencement of the decline of the caliphate, was at the same time the starting-point of movements for national independence and a national literature in the Iranian dominion, and the common cradle of the two was in the province of Khorāsān, between the Oxus and the Jaxartes. In Merv, a Khorāsānian town, a certain ‘Abbās composed in 809 A.D. (193 A.H), according to the oldest biographical writer of Persia, Mahommed ‘Aufī, the first real poem in modern Persian, in honour of the Abbāsid prince Mamūn, Hārūn al-Rashīd's son, who had himself a strong predilection for Persia, his mother's native country, and was, moreover, thoroughly imbued with the freethinking spirit of his age. Soon after this, in 820 (205 A.H.), Ṭāhir, who aided Mamūn to wrest the caliphate from his brother Amīn, succeeded in establishing the first semi-independent Persian dynasty in Khorāsān, which was overthrown in 872 (259 A.H.) by the Ṣaffārids.

Earliest Modern Persian Poet.

Forms of Eastern Poetry.

The development of Persian poetry under these first native dynasties was slow. Arabic language and literature had gained too firm a footing to be supplanted at once by a new literary idiom still in its infancy; nevertheless the few poets who arose under the Ṭāhirids and Ṣaffārids show already the germs of the characteristic tendency of all later Persian literature, which aims at amalgamating the enforced spirit of Islamism with their own Aryan feelings, and reconciling the strict deism of the Mahommedan religion with their inborn loftier and more or less pantheistic ideas; and we can easily trace in the few fragmentary verses of men like Ḥanzala, Ḥakīm Fīrūz and Abū Salīk those principal forms of poetry now used in common by all Mahommedan nations—the forms of the *qaṣīda* (the encomiastic, elegiac or satirical poem), the *ghazal* or ode (a love-ditty, wine-song or religious hymn), the *rubā‘ī* or quatrain (our epigram, for which the Persians invented a new metre in addition to those adopted from the Arabs), and the *mathnawī* or double-rhymed poem (the legitimate form for epic and didactic poetry). The first who wrote such a mathnawī was Abū Shukūr of Balkh, the oldest literary representative of the third dynasty of Khorāsān, the Sāmānids, who had been able in the course of time to dethrone the Ṣaffārids, and to secure the government of Persia, nominally still under the supremacy of the caliphs in Bagdad, but in fact with full sovereignty. The undisputed reign of this family dates from the accession of Amīr Naṣr II. (913–942; 301–331 A.H.), who, more than any of his predecessors, patronized arts and sciences in his dominions.

Minstrels of 10th Century.

The most accomplished minstrels of his time were Mahommed Farālādī (or Farālāwī); Abū 'l-‘Abbās of Bokhārā, a writer of very tender verses; Abū 'l-Mużaffar Naṣr of Nīshāpūr; Abū ‘Abdallāh Mahommed of Junaid, equally renowned for his Arabic and Persian poetry; Ma‘nawī of Bokhārā, full of original thoughts and spiritual subtleties; Khusrawānī, from whom even Firdousī condescended to borrow quotations; Abū 'l-Hasan Shahīd of Balkh, the first who made a dīwān or alphabetical collection of his lyrics; and Rūdagī (or Rūdakī), the first classic genius of Persia, who impressed upon every form of lyric and didactic poetry its peculiar stamp and individual character (see RŪDAGĪ). His graceful and captivating style was imitated by Ḥakīm Khabbaz of Nīshāpūr, a great baker, poet and quack; Abū Shu‘aib Ṣāliḥ of Herāt, who left a spirited little song in honour of a young Christian maiden; Raunaqī of Bokhārā; Abū'l-Fatḥ of Bust, who was also a good Arabic poet; the amīr Abū 'l-Ḥasan ‘Alī Alagātchī, who handled the pen as skilfully as the sword; ‘Umāra of Merv, a famous

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[1] Grammars of New Persian, by M. Lumsden (Calcutta, 1810), A. B. Chodzko (Paris, 1852; new ed., 1883), D. Forbes (1869), J. A. Vullers (Giessen, 1870), A. Wahrmund (Giessen, 1875), C. Salemann and V. Zhukovski (Leipzig, 1889); J. T. Platts (pt. i. 1984). For the New Persian dialects see Fr. Müller, in the *Sitzungsber. der wien. Akad.*, vols. lxxvii., lxxviii.

[2] Cf. Hübschmann, in Kuhn's *Zeitschrift*, xxiv. 396.

[3] Cf. P. de Lagarde, *Armenische Studien* (Göttingen, 1877); H. Hübschmann, *Armenische Studien* (Leipzig, 1883).

Ṭabarī.

astronomer; and Kisāʾī, a native of the same town, a man of stern and ascetic manners, who sang in melodious rhythm the praise of ʿAlī and the twelve imāms. All these poets flourished under the patronage of the Sāmānid princes, who also fostered the growing desire of their nation for historical and antiquarian researches, for exegetical and medical studies. Manṣūr I., the grandson of Rūdagī's patron, ordered (963; 352 A.H.) his vizier Balʿamī to translate the famous universal history of Ṭabarī (838–923 A.D.) from Arabic into Persian; and this *Taʾrīkh-i-Ṭabarī*, the oldest prose work in modern Persian, is not merely remarkable from a philological point of view, it is also the classic model of an easy and simple style (French trans. by L. Dubeux and H. Zotenberg, 1867–1874). The same prince employed the most learned among the ulemā of Transoxiana for a translation of Ṭabarī's second great work, the *Tafsīr*, or commentary on the Koran, and accepted the dedication of the first Persian book on medicine, a pharmacopoeia by the physician Abū Manṣūr Muwaffaq b. ʿAlī of Herāt (edited by Seligmann, Vienna, 1859), which forms a kind of connecting link between Greek and Indian medicine. It was soon after further developed by the great Avicenna (d. 1037; 428 A.H.), himself a Persian by birth and author of pretty wine-songs, moral maxims, psychological tracts, and a manual of philosophic science, the *Dānishnāma-i-Alāʾī*, in his native tongue.

Daḳīḳī.

Firdousī.

Imitations of the "Shāhnāma."

A still greater impulse was given, both to the patriotic feelings and the national poetry of the Persians, by Manṣūr's son and successor, Prince Nūḥ II., who ascended the throne in 976 (365 A.H.). Full of enthusiasm for the glorious past of the old Iranian kingdom, he charged his court poet Daḳīḳī (Daqiqi), who openly professed in his ghazals the Zoroastrian creed, to turn the *Khodāʾīnāma*, or "Book of Kings," into Persian verse. Shortly after commencing this work Daḳīḳī was murdered in the prime of life; his death was soon followed by the fall of the Sāmānid dynasty itself. But Daḳīḳī's great enterprise was not abandoned; a stronger hand, a higher genius, was to continue and to complete it, and this genius was found in Firdousī (940–1020; 328–411 A.H.), with whom we enter the golden age of the national epopee in Persia (see FIRDOUSĪ). In 1011, after thirty-five years of unremitting labour, he accomplished his gigantic task, and wrote the last distichs of the immortal *Shāhnāma*, that "glorious monument of Eastern genius and learning," as Sir W. Jones calls it, "which, if ever it should be generally understood in its original language, will contest the merit of invention with Homer itself." The *Shāhnāma*, from the very moment of its appearance, exercised such an irresistible fascination upon all minds that there was soon a keen competition among the younger poets as to who should produce the most successful imitation of that classic model; and this competition has gone on under different forms through all the following centuries, even to the most recent times. First of all, the old popular traditions, so far as they had not yet been exhausted by Firdousī, were ransacked for new epic themes, and a regular cycle of national epopees gathered round the *Book of Kings*, drawn almost exclusively from the archives of the princes of Sejistān, the family of Firdousī's greatest hero, Rustam. The first and most ambitious of these competitors seems to have been Asadī's own son, ʿAlī b. Aḥmad al-Asadī, the author of the oldest Persian glossary, who completed in 1066 (458 A.H.), in upwards of 9000 distichs, the *Garshāspnāma*, or marvellous story of the warlike feats and love adventures of Garshāsp, one of Rustam's ancestors. The heroic deeds of Rustam's grandfather were celebrated in the *Sāmnāma*, which almost equals the *Shāhnāma* in length; those of Rustam's two sons, in the *Jahāgaīrnāma* and the *Farāmurznāma*; those of his daughter, an amazon, in the Brunhild style of the German Nibelunge, in the *Bānū Gushāspnāma*; those of his grandson in the *Barsūnāma*; those of his great-grandson in the *Shahriyārnāma* (ascribed to Mukhtārī and dedicated to Masʿūd Shāh, who is probably identical with Masʿūd b. Ibrāhīm, Sultan Maḥmūd's great-grandson, 1099–1114; 492–508 A.H.); and the wonderful exploits of a son of Isfandiyār, another hero of the *Shāhnāma*, in the *Bahmannāma*.

When these old Iranian sources were almost exhausted, the difficulty was met in various ingenious ways. Where some slight historical records of the heroic age were still obtainable poetical imagination seized upon them at once; where no traditions at all were forthcoming fiction pure and simple asserted its right; and thus the national epopee gave way to the epic story, and—substituting prose for verse—to the novel and the fairy tale. Models of the former class are the various *Iskandarnāmas*, or "Books of Alexander the Great," the oldest and most original of which is that of Niẓāmī of Ganja, the modern Elizavetpol (completed about 1202; 599 A.H.); the latter begins with the *Kitāb-i-Samak ʿIyār*, a novel in three volumes (about 1189; 585 A.H.), and reaches its climax in the *Būstān-i-Khayāl*, or "Garden of Imagination," a prose romance of fifteen large volumes, by Mahommed Taḳī Khayāl, written between 1742 and 1756 (1155 and 1169 A.H.). Some writers, both in prose and verse, turned from the exhausted fields of the national glory of Persia, and chose their subjects from the chivalrous times of their own Bedouin conquerors, or even from the Jewish legends of the Koran. Of this description are the *Anbiyānāma*, or history of the pre-Mahommedan prophets, by Ḥasanī Shabistarī ʿAyānī (before the 8th century of the Hegira); Ibn Ḥusām's *Khāwarnāma* (1427; 830 A.H.), of the deeds of ʿAlī; Bādhil's *Ḥamla-i-Ḥaidarī*, which was completed by Najaf (1723; 1135 A.H.), or the life of Mahommed and the first four caliphs; Kāẓim's *Faraḥnāma-i-Fāṭima*, the book of joy of Fāṭima, Mahomet's daughter (1737; 1150 A.H.)—all four in the epic metre of the *Shāhnāma*; and the prose stories of *Ḥātim Ṭāʾī*, the famous model of liberality and generosity in pre-Islamitic times; of *Amīr Ḥamzah*, the uncle of Mahomet; and of the *Muʿjizāt-i-Mūsawī*, or the miraculous deeds of Moses, by Muʿīn-almiskīn (died about 1501; 907 A.H.).

Later Epics.

Quite a different turn was taken by the ambition of another class of imitators of Firdousī, especially during the last four centuries of the Hegira, who tried to create a new heroic epopee by celebrating in rhythm and rhyme stirring events of recent date. The gigantic figure of Tīmūr inspired Hātifī (d. 1521; 927 A.H.) with his *Tīmūrnāma*; the stormy epoch of the first Ṣafawid rulers, who succeeded at last in reuniting for some time the various provinces of the old Persian realm into one great monarchy, furnished Ḳāsimī (died after 1560; 967 A.H.)[1] with the materials of his *Shāhnāma*, a poetical history of Shāh Ismaʿīl and Shāh Ṭahmāsp. Another *Shāhnāma*, celebrating Shāh ʿAbbās the Great, was written by Kamālī of Sabzevār; and even the cruelties of Nādir Shāh were duly chronicled in a pompous epic style in ʿIshratī's *Shāhnāma-i-Nādirī* (1749; 1162 A.H.). But all these poems are surpassed in length by the 33,000 distichs of the *Shāhinshāhnāma* by the poet-laureate of Fatḥ ʿAlī Shāh of Persia (1797–1834), and the 40,000 distichs of the *Georgenāma*, a poetical history of India from its discovery by the Portuguese to the conquest of Poona by the English in 1817. In India this kind of epic versification has flourished since the beginning of Humāyūn's reign (1530–1556); *e.g.* the *Żafarnāma-i-Shāhjahānī* by Ḳudsī (d. 1646; 1056 A.H.); the *Shāhinshāhnāma* by Ṭālib Kalīm (d. 1651; 1061 A.H.), another panegyrist of Shāh Jahān; Ātashī's *ʿĀdilnāma*, in honour of Shāh Mahommed ʿĀdil of Bījāpūr, who ascended the throne in 1629 (1039 A.H.) or 1627; the *Tawārīkh-i-Ḳulī Ḳuṭbshāh*, a metrical history of the Ḳuṭb shāhs of Golconda; and many more, down to the *Fatḥnāma-i-Tīpū Sultān* by Ghulām Ḥasan (1784; 1198 A.H.).

Romantic Fiction.

But the national epopee was not the only bequest the great Firdousī left to his nation. This rich genius gave also the first impulse to *romantic*, *didactic* and *mystic poetry*; and even his own age produced powerful co-operators in these three most conspicuous departments of Persian literature. *Romantic fiction*, which achieved its highest triumph in Niẓāmī of Ganja's (1141–1203; 535–599 A.H.) brilliant pictures of the struggles and passions in the human heart

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[1] After 1572 (979 A.H.) according to H. E. in *Grundriss*, ii. 237.

(see Nizami), sent forth its first tender shoots in the numerous love stories of the *Shāhnāma*, the most fascinating of which is that of Zāl and Rūdabeh, and developed almost into full bloom in Firdousī's second great mathnawī *Yūsuf u Zalīkhā*, which the aged poet wrote after his flight from Ghazni, and dedicated to the reigning caliph of Bagdad, al Qadir billah. It represents the oldest poetical treatment of the Biblical story of Joseph, which has proved so attractive to the epic poets of Persia, among others to ʽAmʽak of Bokhārā (d. 1149), who was the first after Firdousī to write a *Yūsuf u Zalīkhā* to Jāmī (d. 1492); Maujī Ḳāsim Khān, Humāyūn's amīr (d. 1571), Nāżim of Herāt (d. 1670), and Shaukat, the governor of Shīrāz under Fath ʽAlī Shāh. Perhaps prior in date to Firdousī's *Yūsuf* was his patron ʽUnsurī's romance, *Wāmiḳ u Adhrā*, a popular Iranian legend of great antiquity, which had been first written in verse under the Ṭāhirid dynasty. This favourite story was treated again by Fasīhī Jurjānī (5th century of the Hegira), and by many modern poets—as Damīrī, who died under the Ṣafawī shāh Mahommed (1577–1586; 985–994 A.H.), Nāmī, the historiographer of the Zand dynasty, and Ḥosain of Shīrāz under Fatḥ ʽAlī Shah, the last two flourishing towards the beginning of the present century. Another love story of similar antiquity formed the basis of Fakr-uddīn Asʽad Jorjānī's *Wīs u Rāmīn*, which was composed in Iṣfahān about 1048 (440 A.H.)—a poem remarkable not only for its high artistic value but also for its resemblance to Gottfried von Strassburg's *Tristan und Isolt*.

Encomiasts and Satirists.

The last-named Persian poet was apparently one of the earliest eulogists of the Seljūḳs, and it was under this Turkish dynasty that lyrical romanticism rose to the highest pitch. What Firdousī and the court-poets of Sultan Maḥmūd had commenced, what Abū 'l-Faraj Rūnī of Lahore and Masʽūd b. Saʽd b. Salmān (under Sultan Ibrāhīm, 1059–1099) had successfully continued, reached its perfection in the famous group of panegyrists who gathered in the first half of the 6th century of the Hegira round the throne of Sultan Sinjar, and partly also round that of his great antagonist, Atsiz, shāh of Khwārizm. This group included Adīb Ṣābir, who was drowned by order of the prince in the Oxus about 1145 (540 A.H.), and his pupil Jauharī, the goldsmith of Bokhārā; Amīr Muʽizzī, the king of poets at Sinjar's court, killed by a stray arrow in 1147 (542 A.H.), Rashīd Waṭwāṭ (the Swallow) who died in 1182 (578 A.H.), and left, besides his ḳaṣīdas, a valuable treatise on poetry (*Hadāʼiḳ-essiḥr*) and a metrical translation of the sentences of ʽAlī, ʽAbd-alwāsiʽ Jabalī, who sang at first, like his contemporary Hasan Ghaznawī (d. 1169; 565 A.H.), the praise of the Ghaznevid shāh Bahrām, but afterwards bestowed his eulogies upon Sinjar, the conqueror of Ghazni; and Auḥad-uddīn Anwarī, the most celebrated ḳaṣīda-writer of the whole Persian literature. Anwarī (died between 1189 and 1191; 585 and 587 A.H.), who in early life had pursued scientific studies in the madrasa of Tūs, and who ranked among the foremost astronomers of his time, owes his renown as much to the inexhaustible store of poetical similes and epitheta ornantia which he showered upon Sinjar and other royal and princely personages, as to his cutting sarcasms, which he was careful to direct, not against individuals, but against whole classes of society and the cruel wrong worked by an inexorable fate—thus disregarding the example of Firdousī, whose attack upon Sultan Mahmūd for having cheated him out of the reward for his epopee is the oldest and most finished specimen of personal satire. This legitimate branch of high art, however, soon degenerated either into the lower forms of parody and travesty—for which, for instance, a whole group of Transoxanian writers, Sūzanī of Samarḳand (d. 1174; 569 A.H.) and his contemporaries, Abū ʽAlī Shatranjī of the same town, Lāmiʽ of Bokhara, and others gained a certain literary reputation—or into mere comic pieces and jocular poems like the “Pleasantries” (*Hazliyyāt*) and the humorous stories of the “Mouse and Cat” and the “Stone-cutter” (*Sangtarash*) by ʽUbaid Zākānī (d. 1370; 772 A.H.). Anwarī's greatest rival was Khāḳānī (d. 1199; 595 A.H.), the son of a carpenter in Shīrvān, and panegyrist of the shāhs of Shīrvān, usually called the Pindar of the East. To European taste only the shorter epigrams and the double-rhymed poem *Tuḥfatulʽirāḳain*, in which Khāḳānī describes his journey to Mecca and back, give full satisfaction. Among his numerous contemporaries and followers may be noticed Mujīr-uddīn Bailaḳānī (d. 1198; 594 A.H.); Żahir Fāryābī (d. 1202; 598 A.H.) and Athīr Akhsīkatī (d. 1211; 608 A.H.)—all three panegyrists of the atābegs of Azerbaijan, and especially of Sultan Ḳizil Arslan—Kamāl-uddīn Iṣfahānī, tortured to death by the Moguls in 1237 (635 A.H.), who sang, like his father Jamāl-uddīn, the praise of the governors of Iṣfahān, and gained the epithet of the “creator of fine thoughts” (Khallāḳ-ulmaʽānī); and Saif-uddīn Isfarangī (d. 1267; 666 A.H.), a favourite of the shāhs of Khwārizm.

Didactic and Mystic Poetry.

Fruitful as the 6th and 7th centuries of the Hegira were in panegyrics, they attained an equally high standard in didactic and mystic poetry. The origin of both can again be traced to Firdousī and his time. In the ethical reflections, wise maxims and moral exhortations scattered throughout the *Shāhnāma* the didactic element is plainly visible, and equally plain in it are the traces of that mystical tendency which was soon to pervade almost all the literary productions of Persian genius. But the most characteristic passage of the epopee is the mysterious disappearance of Shāh Kaikhosrau, who suddenly, when at the height of earthly fame and splendour, renounces the world in utter disgust, and, carried away by his fervent longing for an abode of everlasting tranquillity, vanishes for ever from the midst of his companions. The first Persian who employed poetry exclusively for the illustration of Ṣūfic doctrines was Firdousī's contemporary, the renowned sheikh Abū Saʽīd b. Abū 'l-Khair of Mahna in Khorāsān (968–1049; 357–440 A.H.), the founder of that specific form of the rubaʽī which gives the most concise expression to religious and philosophic aphorisms—a form which was further developed by the great freethinker ʽOmar b. Khayyām (*q.v.*), and Afḍal-uddīn Kīāsh (d. 1307; 707 A.H.). The year of Abū Saʽīd's death is most likely that of the first great didactic mathnawī, the *Rūshanaʼīnāma*, or “Book of Enlightenment,” by Nāṣir Khosrau (*q.v.*), a poem full of sound moral and ethical maxims with slightly mystical tendencies. About twenty-five years later the first theoretical handbook of Ṣūfīsm in Persian was composed by ʼAlī b. ʼUthmān al-Jullābī al-Hujwīrī in the *Kashf-ulmaḥjūb*, or, “Revelation of Hidden Things,” which treats of the various schools of Ṣūfīs, their teachings and observances. A great saint of the same period, Sheikh ʽAbdallāh Anṣārī of Herāt (1006–1089; 396–481 A.H.), assisted in spreading the pantheistic movement by his *Munājāt* or “Invocations to God,” by several prose tracts, and by an important collection of biographies of eminent Ṣūfīs, based on an older Arabic compilation, and serving in its turn as groundwork for Jāmī's excellent *Nafaḥāt-aluns* (completed in 1478; 883 A.H.). He thus paved the way for the publication of one of the earliest textbooks of the whole sect, the *Ḥadīḳat-ulḥaḳīkat*, or “Garden of Truth” (1130; 525 A.H.), by Ḥakīm Sanāʼī of Ghazni, to whom all the later Ṣūfīc poets refer as their unrivalled master in spiritual knowledge. As the most uncompromising Ṣūfīs appear the greatest pantheistic writer of all ages, Jelāl ud-dīn Rūmī (1207–1273; 604–672 A.H.; see Rūmī), and his scarcely less renowned predecessor Farīd ud-dīn ʽAṭṭar, who was slain by the Moguls at the age of 114 lunar years in 1230 (627 A.H.). This prolific writer, having performed the pilgrimage to Mecca, devoted himself to a stern ascetic life, and to the composition of Ṣūfīc works, partly in prose, as in his valuable “Biography of Eminent Mystic Divines,” but mostly in the form of mathnawīs (upwards of twenty in number), among which the *Pandnāma*, or “Book of Counsels,” and the *Mantiḳ-uttair*, or the “Speeches of Birds,” occupy the first rank. In the latter, an allegorical poem, interspersed with moral tales and pious contemplations, the final absorption of the Ṣūfī in the deity is most ingeniously illustrated.

Ṣūfic Poets.

In strong contrast to these advanced Ṣūfīs stands the greatest moral teacher of Persia, Sheikh Saʽdī of Shīrāz (died about 110 lunar years old in 1292; 691 A.H.; see Saʽdī), whose two best known works are the *Būstān*, or “Fruit-garden,” and

Sa'dī.

Further Ṣūfic Works.

the *Gulistan*, or "Rose-garden." However, both have found comparatively few imitations—the former in the *Dastūrnāma*, or "Book of Exemplars," of Nizārī of Kohistān (d. 1320; 720 A.H.), in the *Dah Bāb*, or "Ten Letters," of Kātibī (d. 1434; 838 A.H.), and in the *Gulzār*, or "Rose-bower," of Hairatī (murdered 1554; 961 A.H.); the latter in Mu'īn-uddīn Juwainī's *Nigāristān*, or "Picture-gallery" (1335; 735 A.H.) and Jāmī's *Bahāristān*, or "Spring-garden" (1487; 892 A.H.); whereas an innumerable host of purely Ṣūfic compositions followed in the wake of Sanā'ī's, 'Aṭṭar's and Jelāl ud-dīn Rumī's mathnawīs. It will suffice to name a few of the most conspicuous. The *Lama'āt*, or "Sparks," of 'Irāḳī (d. between 1287 and 1309; 686 and 709 A.H.), the *Zād-ulmusāfirīn*, or "Store of the Wayfarers," by Husainī (d. 1318; 718 A.H.), the *Gulshan-i-Rāz*, or "Rose-bed of Mystery," by Maḥmūd Shabistarī (d. 1320; 720 A.H.), the *Jām-i-Jam*, or "Cup of Jamshīd," by Auḥadī (d. 1338; 738 A.H.), the *Anīs-ul 'Arifīn*, or "Friend of the Mystics," by Ḳāsim (Qāsim)-i-Anwār (d. 1434; 837 A.H.), and others; 'Aṣṣār's *Mihr u Mushtarī*, or "Sun and Jupiter" (1376; 778 A.H.), 'Ārifī's *Gūi u Chaugān*, or "The Ball and the Bat" (1438; 842 A.H.), *Ḥusn u Dil*, or "Beauty and Heart," by Fattāhī of Nīshāpūr (d. 1448; 852 A.H.), *Sham' u Parwāna*, or "The Candle and the Moth," by Ahlī of Shīrāz (1489; 894 A.H.), *Shāh u Gadā*, or "King and Dervish," by Hilālī (put to death 1532; 939 A.H.), Bahā-ud-dīn 'Amilī's (d. 1621; 1030 A.H.) *Nān u Halwā*, or "Bread and Sweets," *Shīr u Shakar*, or "Milk and Sugar," and many more.

Lyric Poetry.

Ghazal-writers.

Jāmi and Later Poets.

During all these periods of literary activity, *lyric* poetry, pure and simple, had by no means been neglected; almost all the renowned poets since the time of Rūdagī had sung in endless strains the pleasures of love and wine, the beauties of nature, and the almighty power of the Creator; but it was left to the incomparable genius of Ḥāfiẓ (d. 1389; 791 A.H.; see ḤĀFIẒ) to give to the world the most perfect models of lyric composition; and the lines he had laid down were more or less strictly followed by all the ghazal-writers of the 9th and 10th centuries of the Hegira—by Salmān of Sāwa (d. about 1377; 779 A.H.), who excelled besides in ḳaṣīda and mathnawī; Kamāl Khujandī (d. 1400; 803 A.H.), Ḥāfiẓ's friend, and protégé of Sultan Ḥosain (1374–1382 A.D.); Mahommed Shīrīn Maghribī (d. at Tabrīz in 1406; 809 A.H.), an intimate friend of Kamāl; Ni'mat-ullāh Walī (d. 1431; 834 A.H.), the founder of a special religious order; Ḳāsim-i-Anwār (see above); Amīr Shāhī (d. 1453; 857 A.H.), of the princely family of the Sarbadārs of Sabzewār; Bannā'ī (d. 1512; 918 A.H.), who also wrote a romantic poem, *Bahrām u Bihrūz*; Bābā Fighānī of Shīrāz (d. 1519; 925 A.H.), usually called the "Little Ḥāfiẓ"; Nargisī (d. 1531; 938 A.H.); Lisānī (d. 1534; 941 A.H.), who himself was imitated by Damīrī of Iṣfahān, Muḥtasham Kāshī and Waḥshī Bāfikī (all three died in the last decade of the 10th century of the Hegira); Ahlī of Shīrāz (d. 1535; 942 A.H.), author of the *Siḥr-i-Ḥalāl*, or "Lawful Witchcraft," which, like Kātībī's (d. 1434; 838 A.H.) *Majma'-ulbaḥrain*, of the "Confluence of the Two Seas," can be read in two different metres; Nau'ī (d. 1610; 1019 A.H.), who wrote the charming romance of a Hindu princess who burned herself in Akbar's reign with her deceased husband on the funeral pile, called *Sūz u Gudāz*, or "Burning and Melting," &c. Among the immediate predecessors of Ḥāfiẓ in the 8th century of the Hegira, in which also Ibn Yamīn, the great ḳiṭ'a-writer,[1] flourished, the highest fame was gained by the two poets of Delhi, Amīr Ḥasan and Amīr Khosrau. The latter, who died in 1325 (725 A.H.), two years before his friend Ḥasan, occupies the foremost place among all the Persian poets of India by the richness of his imagination, his graphic style, and the historical interest attached to his writings. Five extensive dīwāns testify to his versatility in all branches of lyric poetry, and nine large mathnawīs to his mastership in the epic line. Four of the latter are poetical accounts of the reigns of the emperors of Delhi, 'Alā-uddīn Khiljī (1296–1316), his predecessor Feroz Shāh and his successor Ḳuṭb-uddīn Mubārek Shah—the *Miftāh-ulfutūh*, or "Key of Victories," the *Kirān-ussa'dain*, or "The Conjunction of the Two Lucky Planets," the *Nuh Sipihr*, or "Nine Spheres," and the love-story of *Khidrkhān u Duwalrānī*. His other five mathnawīs formed the first attempt ever made to imitate Niẓāmī's famous *Khamsah*, or five romantic epopees, and this attempt turned out so well that henceforth almost all epic poets wrote quintuples of a similar description. Khwājū Kirmānī (d. 1352; 753 A.H.) was the next aspirant to Niẓāmī's fame, with five mathnawīs, among which *Humāi u Humāyūn* is the most popular, but he had to yield the palm to 'Abd urraḥmān Jāmī (1414–1492; 817–898 A.H.), the last classic poet of Persia, in whose genius were summed up all the best qualities of his great predecessors. Many poets followed in Jāmī's footsteps, first of all his nephew Hātifī (see above), and either wrote whole khamsahs or imitated at least one or other of Niẓāmī's epopees; thus we have a *Lailā u Majnūn*, for instance, by Maktabī (1490), Hilālī (see above), and Rūḥ-ulamīn (d. 1637). But their efforts could not stop the growing corruption of taste, and it was only at the court of the Mogul emperors, particularly of the great Akbar (1556–1605), who revived Sultan Maḥmūd's "round table," that Persian literature still enjoyed some kind of "Indian summer" in poets like Ghazālī of Mashhad or Meshed (d. 1572); 'Urfī of Shīrāz (d. 1591), who wrote spirited ḳaṣīdas, and, like his contemporaries Waḥshī and Kautharī, a mathnawī, *Farhād u Shīrīn*; and Faiḍī (d. 1595), the author of the romantic poem, *Nal u Daman*, who also imparted new life into the rubā'ī. In Persia proper only Zulālī, whose clever romance of "Sulṭan Maḥmūd and his favourite Ayāz" (1592) is widely read in the East, Ṣā'ib (d. 1677), who is commonly called the creator of a new style in lyric poetry, and, among the most modern, Hātif of Iṣfahān, the singer of sweet and tasteful odes (died about 1785), deserve a passing notice.

The Drama.

But we cannot conclude our brief survey of the national literature of Persia without calling attention to the rise of the *drama*, which has only sprung up in the beginning of the nineteenth century. Like the Greek drama and the mysteries of the European middle ages, it is the offspring of a purely religious ceremony, which for centuries has been performed annually during the first ten days of the month Muharram—the recital of mournful lamentations in memory of the tragic fate of the house of the caliph 'Alī, the hero of the Shī'itic Persians. Most of these passion-plays deal with the slaughter of 'Alī's son Ḥosain and his family in the battle of Kerbelā. But lately this narrow range of dramatic subjects has been considerably widened, Biblical stories and even Christian legends have been brought upon the Persian stage; and there is a fair prospect of a further development of this most interesting and important movement. (See further DRAMA: *Persian.*)

Historical Works.

In the various departments of general Persian literature not touched upon in the foregoing pages the same wonderful activity has prevailed as in the realm of poetry and fiction, since the first books on history and medicine appeared under the Sāmānids (see above). The most important section is that of historical works, which, although deficient in sound criticism and often spoiled by a highly artificial style, supply us with most valuable materials for our own research. Quite unique in this respect are the numerous histories of India, from the first invasion of Sultan Maḥmūd of Ghazni to the English conquest, and even to the first decades of the present century, most of which have been described and partly translated in the eight volumes of Sir H. M. Elliot's *History of India* (1867–1878). Persian writers have given us, besides, an immense variety of universal histories of the world, with many curious and noteworthy data (see, among others, Mīrkhond's and Khwāndamīr's works under MĪRKHOND); histories of Mahomet and the first caliphs, partly translated from Arabic originals, which have been lost; detailed accounts of all the Persian dynasties, from the Ghaznevids to the still reigning Kajars, of Jenghiz Khān and the Moguls (in Juwainī's and Waṣṣāf's elaborate *Ta'rīkhs*), and of Tīmūr and his successors (see an account of the *Zafarnāma* under PETIS DE LA CROIX); histories of sects and creeds, especially the famous *Dabistān*, or "School of Manners" (translated by Shea and Troyer, Paris 1843); and many local chronicles of Iran and Tūrān. Next in importance to history rank geography, cosmography, and travels (for instance, the *Nuzhat-ulḳulūb*, by Ḥamdallah Mustaufī, who died in 1349, and the translations of Istakhrī's and Kazvīnī's Arabic works), and the various *tadhkiras* or biographies of Ṣūfīs and poets, with selections in prose and verse, from the oldest of ʿAufī (about 1220) to the last and largest of all, the *Makhzan-ulgharā'ib*, or "Treasure of Marvellous Matters" (completed 1803), which contains biographies and specimens of more than 3000 poets. We pass over the well-stocked sections of philosophy, ethics and politics, of theology, law and Ṣūfīsm, of mathematics and astronomy, of medicine (the oldest thesaurus of which is the "Treasure of the shāh of Khwārizam," 1110), of Arabic, Persian and Turkish grammar and lexicography, and only cast a parting glance at the rich collection of old Indian folk-lore and fables preserved in the Persian version of *Kalīlah u Dimnah* (see RŪDAGĪ), of the *Sindbād-nāma*, the *Ṭūtīnāma*, or "Tales of a Parrot," and others, and at the translations of standard works of Sanskrit literature, the epopees of the *Rāmāyana* and *Mahābhārata*, the *Bhagavad-Gitā*, the *Yoga-Vasishtha*, and numerous *Purānas* and *Upanishads*, for which we are mostly indebted to the emperor Akbar's indefatigable zeal.

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[1] A ḳiṭ'a or muḳaṭṭa'a is a poem containing moral reflections, and differs from the ḳaṣīda and ghazal only by the absence of a maṭla' or initial distich.

Indian Folk-lore.

AUTHORITIES.—The standard modern discussions of Persian literature are those of E. G. Browne, *Literary History of Persia* (1902, seq.), and Hermann Ethé, in vol. ii. of Geiger and Kuhn's *Grundriss der iranischen Philologie* (Strassburg, 1906); also the latter's *Höfische und romantische Poesie der Perser* (1887), and *Mystische, didaktische und lyrische Poesie und das spätere Schriftthum der Perser* (1888). See also P. Horn, *Geschichte der persischen Litteratur* (1901). Concise sketches of Persian poetry are contained in Sir G. Ouseley's *Biographical Notices of Persian Poets* (1846); in G. L. Flügel's article in Ersch and Gruber's *Allgemeine Encyklopädie* (1842); in N. Bland's papers in the *Journ. of the Roy. As. Soc.*, vii. 345 seq. and ix. 122 seq.; and in C. A. C. Barbier de Meynard's *Poésie en Perse* (Paris, 1877). Real mines of information are the catalogues of A. Sprenger (Calcutta, 1854); W. H. Morley (London, 1854); Flügel (3 vols., Vienna, 1865); and C. Rieu (3 vols., London, 1879–1883). For the first five centuries of the Hegira compare Ethé's editions and metrical translations of "Rūdagī's Vorläufer und Zeitgenossen," in *Morgenländische Forschungen* (Leipzig, 1875); of Kisā'ī's songs, Firdousī's lyrics, and Abū Saʿīd b. Abū 'l-Khair's rubāʿīs, in *Sitzungsberichte der bayr. Akademie* (1872, p. 275 seq.; 1873, p. 622 seq.; 1874, p. 133 seq.; 1875, p. 145 seq.; and 1878, p. 38 seq.); of Avicenna's Persian poems, in *Göttinger Nachrichten* (1875, p. 555 seq.); and of Asadī and his munāẓarāt, in "Persische Tenzonen," *Verhandlungen des 5ten Orientalisten-Congresses* (Berlin, 1882, pt. ii., first half, p. 48 seq.); H. Zotenberg's *Chronique de Tabarí* (Paris, 1867–1874); Jurjanī's *Wīs u Rāmīn*, ed. in the *Bibl. Indica* (1864) (trans. into German by C. H. Graf in *Zeitschrift der morgenländischen Gesellschaft*, xxiii. 375 seq.); and A. de B. Kasimirski's *Spécimen du dīwān de Menoutchehri* (Versailles, 1876). On Khāḳāni, see N. de Khanykoff's "Mémoire," in *Journal asiatique*, 6th series, vol. iv. p. 137 seq. and vol. v. p. 296 seq., and C. Salemann's edition of his rubāʿīs, with Russian trans. (Petersburg, 1875); on Farīd uddīn ʿAṭṭār, S. de Sacy's edition of the *Pandnāma* (Paris, 1819), and Garcin de Tassy's *Mantiḳ-uṭṭair* (Paris, 1857); on the *Gulshan-i-rāz*, E. H. Whinfield's edition (London, 1880); and on Amīr Khosrau's mathnawīs, the abstracts given in Elliot's *History of India*, iii. 524 seq. German translations of Ibn Yamīn were published by O. Schlechta-Wssehrd, *Bruchstücke* (Vienna, 1852); of Jāmī's minor poems, by V. von Rosenzweig (Vienna, 1840); by F. Rückert, in *Zeitschrift für die Kunde des Morgenlandes*, vols. v. and vi., and *Zeitschrift der d. morgenl. Gesellsch.*, vols. ii., iv., v., vi., xxiv., xxv. and xxix.; and by M. Wickerhauser (Leipzig, 1855, and Vienna, 1858); German translation of *Yūsuf u Zalīkhā*, by Rosenzweig (Vienna, 1824), English by R. T. H. Griffith (London, 1881); French translation of *Lailā u Majnūn*, by A. L. de Chézy (Paris, 1805), German by A. T. Hartmann (Leipzig, 1807); Hilālī's "König und Derwisch," by Ethé, in *Morgenländ. Stud.* (Leipzig, 1870, p. 197 seq.). On the Persian drama, compare J. A. de Gobineau's *Religions et philosophies dans l'Asie centrale* (Paris, 1866); A. Chodzko's *Théâtre persan* (new ed., Paris, 1878); and Ethé, "Persische Passionspiele," in *Morgenländ. Stud.*, p. 174 seq. (H. E.)

PERSIGNY, JEAN GILBERT VICTOR FIALIN, DUC DE (1808–1872), French statesman, was born at Saint-German Lespinasse (Loire) on the 11th of January 1808, the son of a receiver of taxes. He was educated at Limoges, and entered the cavalry school at Saumur in 1826, becoming *maréchal des logis* in the 4th Hussars two years later. The share taken by his regiment in supporting the revolution of 1830 was regarded as insubordination, and next year Fialin was dismissed from the army. He became a journalist, and in 1833 became a strong Bonapartist, assuming the title of comte de Persigny, said to be dormant in his family. He planned the attempt on Strassburg in 1836 and that on Boulogne in 1840. At Boulogne he was arrested and condemned to twenty years' imprisonment in a fortress, shortly afterwards commuted into mild detention at Versailles, where he wrote a book to prove that the Pyramids were built to prevent the Nile from silting up. This was published in 1845 under the title, *De la Destination et de l'utilité permanente des Pyramides*. At the revolution of 1848 he was arrested by the provisional government, and on his release took a prominent part in securing the election of Louis Napoleon to the presidency. With Morny and the marshal Saint Arnaud he plotted the restoration of the empire, and was a devoted servant of Napoleon III. He succeeded Morny as minister of the interior in January 1852, and later in the year became senator. He resigned office in 1854, being appointed next year to the London embassy, which he occupied with a short interval (1858–1859) until 1860, when he resumed the portfolio of the interior. But the growing influence of his rival Rouher provoked his resignation in 1863, when he received the title of duke. A more dangerous enemy than Rouher was the empress Eugénie, whose marriage he had opposed and whose presence in the council chamber he deprecated in a memorandum which fell into the empress's hands. He sought in vain to see Napoleon before he started to take over the command in 1870, and the breach was further widened when master and servant were in exile. Persigny returned to France in 1871, and died at Nice on the 11th of January 1872.

See *Mémoires du duc de Persigny* (2nd ed., 1896), edited by H. de Laire d'Espagny, his former secretary; an eulogistic life, *Le Duc de Persigny* (1865), by Delaroa; and Emile Ollivier's *Empire libéral* (1895, &c.).

PERSIMMON, the name given to the fruits of *Diospyros virginiana* in the United States. The tree which bears them belongs to the order Ebenaceae, is usually from 30 to 50 ft. in height, and has oval entire leaves, and unisexual flowers on short stalks. In the male flowers, which are numerous, the stamens are sixteen in number and arranged in pairs; the female flowers are solitary, with traces of stamens, and a smooth ovary with one ovule in each of the eight cells—the ovary is surmounted by four styles, which are hairy at the base. The fruit-stalk is very short, bearing a subglobose fruit an inch or rather more in diameter, of an orange-yellow colour, and with a sweetish astringent pulp. It is surrounded at the base by the persistent calyx-lobes, which increase in size as the fruit ripens. The astringency renders the fruit somewhat unpalatable, but after it has been subjected to the action of frost, or has become partially rotted or "bletted" like a medlar, its flavour is improved. The fruit is eaten in great quantities in the southern states of America, and is also fermented with hops, corn-meal or wheat-bran into a sort of beer or made into brandy. The wood is heavy, strong and very close-grained and used in turnery. The tree is very common in the South Atlantic and Gulf states, and attains its largest size in the basin of the Mississippi. It was brought to England before 1629 and is cultivated, but rarely if ever ripens its fruit. It is easily raised from seed and can also be propagated from stolons, which are often produced in great quantity. The Chinese and Japanese cultivate another species, the *Diospyros Kaki*, of which there exist numerous ill-defined varieties. The fruits are larger than those of the American kind, variable in shape, but have similar properties. An astringent fluid, known as *shibu*, rich in tannin, is expressed from the green fruit and used in various industries. The tree is hardy in the south of England and in the Channel Islands.

PERSIS (mod. Fars, *q.v.*), the south-western part of Iran (Persia), named from the inhabitants, the Iranian people of the Pārsa (Fars); their name was pronounced by the Ionians *Persai*, with change from *a* to *e*, and this form has become dominant in Greek and in the modern European languages. The natural features of Persis are described very exactly by Nearchus, the admiral of Alexander the Great (preserved by Arrian *Indic.* 40 and Strabo xv. 727). The country is divided into three parts, of very different character and climate: the coast is sandy and very hot, without much vegetation except date palms; it has no good harbours, and the climate is very unwholesome; the population is scanty. About 50 m. from the coast rise the chains of the mountains, through which some steep passes lead into the interior valleys (called *κοιλὴ Περσίς*, Strabo xv. 729), which lie about 5000 ft. above the sea. Here the climate is temperate, the country watered by many rivers and lakes, the soil fertile, the vegetation rich, the cattle numerous. These regions, which were thickly populated, form the real Persis of history. "This land Persis," says Darius, in an inscription at Persepolis, "which Ahuramazda has given to me, which is beautiful and rich in horses and men, according to the will of Ahuramazda and myself it trembles before no enemy." The third part is the north, which belongs to the central plateau, still much higher, and therefore rough and very cold in the winter. Towards the north-west it borders on the Median district of Paraetacene (about Isfahan); towards the north and north-east it soon passes into the great desert, of which only the oasis of Yezd (*Isatichai* in Ptolem. vi. 4, 2) is inhabitable. In the east, Persis proper is separated by a desert (Laristan) from the fertile province of Carmania (Kerman), a mountainous region inhabited by a Persian tribe. To Carmania belonged also the coast, with the islands and harbours of Hormuz and Bander Abbasi. In the west Persis borders on the mountains and plains of Elam or Susiana. For the ancient topography cf. Tomaschek, "Beiträge zur historischen Topographie von Persien," in *Sitzungsber. der Wiener Akademie, phil. Cl.* cii. cviii. cxxi.

The Persians are not mentioned in history before the time of Cyrus; the attempt to identify them with the Parsua, a district in the Zagros chains south of Lake Urmia, often mentioned by the Assyrians, is not tenable. The Parsua are perhaps the non-Arian tribe Πάρσιοι in northern Media, Strabo xi. 508. Herodotus i. 125, gives a list of Persian tribes: the Pasargadae (at Murghab), Maraphii, Maspii, Panthialaei (in western Carmania), Derusiaei, Germanii (*i.e.* the Carmanians) are husbandmen, the Dahae (*i.e.* the "enemies," a general name of the rapacious nomads, used also for the Turanian tribes), Mardi, Dropici, Sagartii (called by Darius *Asagarta*, in the central desert; cf. Herod. vii. 85) are nomads. The kings of the Pasargadae, from the clan of the Achaemenidae, had become kings of the Elamitic district Anshan (probably in 596, cf. CYRUS). When, in 553, Cyrus, king of Anshan, rebelled against Astyages, the Maraphians and Maspians joined with the Pasargadae; after his victory over Astyages all the Persian tribes acknowledged him, and he took the title of "king of Persia." But from then only the inhabitants of Persis proper were considered as the rulers of the empire, and remained therefore in the organization of Darius free from taxes (Herod. iii. 97). But Carmania, with the Sagartians, the Utians (called by Darius *Yautiya*), and other tribes, formed a satrapy and paid tribute (Herod. iii. 93); the later authors therefore always distinguished between Carmania and Persis. Names of other Persian tribes, partly of very doubtful authority, are given by Strabo xv. 727,[1] and Ptolem. vi. 4 and 8.

The Persians of Cyrus (see PERSIA: *Ancient History*) were a vigorous race of husbandmen, living in a healthy climate, accustomed to hardship, brave and upright; many stories in Herodotus (especially ix. 122) point the contrast between their simple life and the effeminate nations of the civilized countries of Asia. They were firmly attached to the pure creed of Zoroaster (cf. Herod. i. 131 sqq. and the inscriptions of Darius).

When Darius had killed the usurper Smerdis and gained the crown, a new usurper, Vahyazdāta, who likewise pretended to be Smerdis, the son of Cyrus, rose in *Yautiya*, but was defeated in two battles by Darius's generals and put to death (Behistun inscription). Cyrus had built his capital with his palace and tomb, in Pasargadae (*q.v.*). Darius founded a new city about 30 m. farther south on the left bank of the Pulwar, near its confluence with the Kur, with a large terrace, on which his magnificent palace and that of his son Xerxes were built. As Pasargadae was named after the tribe in whose district it lay, so the new capital is by the Persians and Greeks simply called "the Persians"; later authors call it Persepolis (*q.v.*), "the Persian city." Another Persian palace lay in Taoke, near the coast (Strabo xv. 728; Arrian *Ind.* 39; Dionys. Perieg. 1069); Gabae, which Strabo mentions besides, is Isfahan in Paraetacene and belonged already to Media.

Both in Persepolis and Pasargadae large masses of gold and silver from the tribute of the subject nations were treasured, as in Susa and Ecbatana. But Persis lies too far off from the centre of the Asiatic world to be the seat of government. Like Arabia and similar countries, it could exercise a great momentary influence in history and produce a sudden change throughout the world; but afterwards it would sink into local insignificance. So the Persian kings fixed their residence at Susa, which is always considered as the capital of the empire (therefore Aeschylus wrongly considers it as a Persian town and places the tomb of Darius here). After the reign of Xerxes, Persis and Persepolis became utterly neglected, in spite of occasional visits, and even the palaces of Persepolis remained in part unfinished. But the national feeling of the Persians remained strong. When Alexander had won the victory of Arbela, and occupied Babylon and Susa, he met (in the spring of 330) with strong resistance in Persia, where the satrap Ariobarzanes tried to stop his progress at the "Persian gates," the pass leading up to Persepolis. Here he set fire to the cedar roof of the palace of Xerxes as a symbol that the Greek war of revenge against the Persians had come to an end. Our best information tells us that he soon had the fire extinguished (Plut. *Alex.* 38); the story of Thais is a pure fiction, and we may well believe that he repented the damage he had done (Arrian vi. 30, 1).

Alexander had planned to amalgamate the former rulers of the world with his Macedonians; but his death was followed by a Macedonian reaction. Peucestas, the new satrap of Persis, followed the example of Alexander, and thus gained a strong hold on his subjects (Diod. xix. 48); nor did Seleucus, to whom the dominion of the east ultimately passed (from 311 onwards), disdain the aid of the Persians; he is the only one among the Diadochi who retained his Persian wife, Apame, daughter of Spitamenes. At the same time Seleucus and his son Antiochus I. Soter tried to introduce Hellenism into Persis. Of Greek towns which they founded here we know Alexandria in Carmania (Plin. vi. 107; Ptol. vi. 8, 14; Ammian. Marc. 23, 6, 49), Laodicea in the east of Persis (Plin. 6, 115), Stasis, "a Persian town on a great rock, which Antiochus, the son of Seleucus, possessed" (Steph. Byz. *s.v.*), Antiochia in Persis, founded apparently by Seleucus I. and peopled by Antiochus I. with immigrants called together from all Greece, as we learn from a *psephisma* passed by "boulē and demos" of this town in 206 in honour of Magnesia on the Maeander (Kern, *Inschriften von Magnesia am Maeander*, No. 61 = Dittenberger, *Orientis gr. inscr.* 233, where they are mentioned together with a great many Seleucid towns in Susiana and Babylonia, and compare Kern, No. 18 = Dittenberger, No. 231). An insurrection of the Persians against Seleucus (II.) is mentioned in two stratagems of Polyaenus (vii. 39. 40). When in 221 Molon, the satrap of Media, rebelled against Antiochus III., his brother Alexander, satrap of Persis, joined him, but they were defeated and killed by the king. Persis remained a part of the Seleucid empire down to Antiochus IV. Epiphanes, who at the end of his reign restored once more the authority of the empire in Babylonia, Susiana and Persis; perhaps a battle, in which the satrap Numenius of Mesene (southern Babylonia) defeated the Persians on the shore of Carmania on sea and land (Plin. vi. 152), belongs to this time. But after the death of Antiochus IV. (164) the

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[1] To the Pateiskhoreis belongs the lance-bearer of Darius, "Gobryas (Gaubaruva) the Pātishuvari," mentioned in his tomb-inscription; they occur also in an inscription of Esarhaddon as Patush-ara, eastwards of Media, in Choarene at the Caspian gates; the Kyrtii are the Kurds.

Seleucid Empire began to dissolve. While the central provinces, Media and northern Babylonia, were conquered by the Parthians, Mesene, Elymais and Persis made themselves independent.

Persis never became a part of the empire of the Arsacids, although her kings recognized their supremacy when they were strong (Strabo xv. 728, 736). From the periplus of the Erythraean Sea 33-37 we learn that their authority extended over the shores of Carmania and the opposite coasts of Arabia. A Persian king, Artaxerxes, who was murdered by his brother Gosithros at the age of 93 years, is mentioned in a fragment of Isidore of Charax (Lucian, *Macrobii*, 15). Other names occur on their coins, the oldest of which are imitations of Seleucid coins, and were perhaps struck by local dynasts under their supremacy; most of the others show the king's head with the Persian tiara, and on the reverse a fire-altar with the adoring king before it, a standard (perhaps the famous banner of the smith Kavi, which became the standard of Iran under the Sassanids), and occasionally the figure of Ahuramazda; they were first explained by A. D. Mordtmann in *Zeitschrift für Numismatik*, iii., iv. and vii.; cf. *Grundriss der iranischen Philol.* ii. 486 seq. The legends are in Aramaic characters and Persian (Pahlavi) language; among them occur Artaxerxes, Darius (from a dynast of this name the town Darabjird, "town of Darius," in eastern Persia seems to derive its name), Narses, Tiridates, Manocihr and others; the name Vahuburz seems to be identical with Oborzos, mentioned by Polyaenus vii. 40, who put down a rebellion of 3000 settlers (κάτοικοι) in Persis. From the traditions about Ardashir I. we know that at his time there were different petty kingdoms and usurpers in Persis; the principal dynasty is by Tabari called Bāzrangi. The coins demonstrate that Hellenism had become quite extinct in Persis, while the old historical and mythical traditions and the Zoroastrian religion were supreme. There can be no doubt that at this time the true form of Zoroastrianism and the sacred writings were preserved only in Persis, whereas everywhere else (in Parthia, in the Indo-Scythian kingdoms of the east and in the great propagandist movement in Armenia, Syria and Asia Minor, where it developed into Mithraism) it degenerated and was mixed with other cults and ideas. So the revival of Zoroastrianism came from Persis. When Ardashir I. attempted to restore the old empire of Cyrus and Darius, and in 212 A.D. rose against the Parthian king, Artabanus, his aim was religious as well as political. The new Sassanid Empire which he founded enforced the restored religion of Zoroaster (Zarathustra) on the whole of Iran.

The new capital of Persis was Istakhr on the Pulwar, about 9 m. above Persepolis, now Hajjiabād, where even the predecessors of Ardashir I. are said to have resided. It was a great city under the Sassanids, of which some ruins are extant. But it shared the fate of its predecessor; when the empire was founded the Sassanids could no longer remain in Persis but transferred their headquarters to Ctesiphon. (Ed. M.)

PERSIUS, in full Aulus Persius Flaccus (A.D. 34–62), Roman poet and satirist. According to the *Life* contained in the MSS., Persius was a native of Volaterrae, of good stock on both parents' side. When six years old he lost his father, and his step-father died in a few years. At the age of twelve Persius came to Rome, where he was taught by Remmius Palaemon and the rhetor Verginius Flavus. Four years later began a close intimacy with the Stoic Cornutus. In this philosopher's pupil Lucan, Persius found a generous admirer of all he wrote. Still in early youth he became the friend of the lyric poet Caesius Bassus, whilst with Thrasea Paetus (whose wife Arria was a relative) he had a close friendship of ten years' duration and shared some travels. Seneca he met later, and was not attracted by his genius. In his boyhood Persius wrote a tragedy dealing with an episode of Roman history, and a work, the title of which is rendered uncertain by corruption in our MSS. Pithou's generally accepted reading makes the subject that of travel; the excursions with Thrasea however must have taken place *after* boyhood. The perusal of Lucilius revealed to Persius his vocation, and he set to work upon a book of satires. But he wrote seldom and slowly; a premature death (*uitio stomachi*) prevented the completion of his task. He is described as possessed of a gentle disposition, girlish modesty and personal beauty, and living a life of exemplary devotion towards his mother Fulvia Sisenna, his sister and his aunt. To his mother and sister he left a considerable fortune. Cornutus suppressed all his work except the book of satires in which he made some slight alterations and then handed it over to Bassus for editing. It proved an immediate success.

The scholia add a few details—on what authority is, as generally with such sources, very doubtful. The *Life* itself, though not free from the suspicion of interpolation and undoubtedly corrupt and disordered in places, is probably trustworthy. The MSS. say it came from the commentary of Valerius Probus, no doubt a learned edition of Persius like those of Virgil and Horace by this same famous "grammarian" of Berytus, the poet's contemporary. The only case in which it seems to conflict with the *Satires* themselves is in its statement as to the death of Persius's father. The declaiming of a *suasoria* in his presence (*Sat.* 3. 4 sqq.) implies a more mature age than that of six in the performer. But *pater* might here mean "step-father," or Persius may have forgotten his own autobiography, may be simply reproducing one of his models. The mere fact that the *Life* and the *Satires* agree so closely does not of course prove the authenticity of the former. One of the points of harmony is, however, too subtle for us to believe that a forger evolved it from the works of Persius. It requires indeed a thoughtful reading of the *Life* before we realize how distinct is the impression it gives of a "bookish" youth, who has never strayed far, at least in spirit, from the domestic hearth and his women-folk. And of course this is notoriously the picture drawn by the *Satires*. So much better does Persius know his books than the world that he draws the names of his characters from Horace. A keen observer of what occurs within his narrow horizon, he cannot but discern the seamy side of life (cf. *e.g.* such hints as *Sat.* iii. 110); he shows, however, none of Juvenal's undue stress on unsavoury detail or Horace's easy-going acceptance of human weaknesses. The sensitive, home-bred nature of Persius shows itself perhaps also in his frequent references to ridicule, whether of great men by street *gamins* or of the cultured by Philistines.

The chief interest of Persius's work lies in its relation to Roman satire, in its interpretation of Roman Stoicism, and in its use of the Roman tongue. The influence of Horace on Persius can, in spite of the silence of the *Life*, hardly have been less than that of Lucilius. Not only characters, as noted above, but whole phrases, thoughts and situations come direct from him. The resemblance only emphasizes the difference between the caricaturist of Stoicism and its preacher. Persius strikes the highest note that Roman satire reached; in earnestness and moral purpose rising far superior to the political rancour or good natured persiflage of his predecessors and the rhetorical indignation of Juvenal, he seems a forerunner of the great Christian Apologists. From him we learn a lesson Seneca never taught, how that wonderful philosophy could work on minds that still preserved the depth and purity of the old Roman *gravitas*. When the *Life* speaks of Seneca's genius as not attracting Persius, it presumably refers to Seneca the philosopher. Some of the parallel passages in the works of the two are very close, and hardly admit of explanation by assuming the use of a common source. With Seneca, Persius censures the style of the day, and imitates it. Indeed in some of its worst failings, straining of expression, excess of detail, exaggeration, he outbids Seneca, whilst the obscurity, which makes his little book of not seven hundred lines so difficult to read and is in no way due to great depth of thought, compares very ill with the terse clearness of the *Epistolae morales*. A curious contrast to this tendency is presented by his free use of "popular" words. As of Plato, so of Persius we hear that he emulated Sophron; the authority is a late one (Lydus, *De mag.* 1. 41), but we can at least recognize in the scene that opens *Sat.* 3. kinship with such work as Theocritus' *Adoniazusae* and the *Mimes* of Herodas.

Persius's satires are composed in hexameters, except for the scazons of the short prologue above referred to, in which he half ironically asserts that he writes to earn his bread, not because he is inspired. The first satire censures the literary tastes of the day as a reflection of the decadence of the national morals. The theme of Seneca's 114th letter is similar. The description of the *recitator* and the literary twaddlers after dinner is vividly natural, but an interesting passage which cites specimens of smooth versification and the languishing style is greatly spoiled by the difficulty of appreciating the points involved and indeed of distributing the dialogue (a not uncommon crux in Persius). The remaining satires handle in order (2) the question as to what we may justly ask of the gods (cf. Plato's second *Alcibiades*), (3) the importance of having a definite aim in life, (4) the necessity of self-knowledge for public men (cf. Plato's first *Alcibiades*), (5) the Stoic doctrine of liberty (introduced by generous allusions to Cornutus' teaching), and (6) the proper use of money. The *Life* tells us that the *Satires* were not left complete; some lines were taken (presumably by Cornutus or Bassus) from the end of the work so that it might be *quasi finitus*. This perhaps means that a sentence in which Persius had left a line imperfect, or a paragraph which he had not completed, had to be omitted. The same authority says that Cornutus definitely blacked out an offensive allusion to the emperor's literary taste, and that we owe to him the reading of the MSS. in *Sat.* i. 121,—"auriculas asini *quis non* [for *Mida rex*] habet!" Traces of lack of revision are, however, still visible; cf. *e.g.* v. 176 (sudden transition from ambition to superstition) and vi. 37 (where criticism of Greek *doctores* has nothing to do with the context). The parallels to passages of Horace and Seneca are recorded in the commentaries: in view of what the *Life* says about Lucan, the verbal resemblance of *Sat.* iii. 3 to *Phars.* x. 163 is interesting. Examples of bold language or metaphor: i. 25, *rupto iecore exierit caprificus*, 60, *linguae quantum sitiat canis*; iii. 42, *intus palleat*, 81, *silentia rodunt*; v. 92, *ueteres auiae de pulmone reuello*. Passages like iii. 87, 100 sqq. show elaboration carried beyond the rules of good taste. "Popular" words: *baro, cĕdo, ebullire, gluto, lallare, mamma, muttire, obba, palpo, stloppus*. Fine lines, &c., in i. 116 sqq., ii. 6 sqq., 61 sqq., 73 sqq., iii. 39 sqq.

AUTHORITIES.—The MSS. of Persius fall into two groups, the one represented by two of the best of them, the other by that of Pithoeus, so important for the text of Juvenal. Since the publication of J. Bieger's *de Persii cod. pith. recte aestimando* (Berlin, 1890) the tendency has been to prefer the tradition of the latter.

The important editions are: (1) with explanatory notes: Casaubon (Paris, 1605, enlarged edition by Dübner, Leipzig, 1833); O. Jahn (with the scholia and valuable prolegomena, Leipzig, 1843); Conington (with translation; 3rd ed., Oxford, 1893); B. L. Gildersleeve (New York, 1875); G. Némethy (Buda-Pesth, 1903); (2) with critical notes: Jahn-Bücheler (3rd ed., Berlin, 1893); S. G. Owen (with Juvenal, Oxford, 1902). Translations into English by Dryden (1693); Conington (*loc. cit.*) and Hemphill (Dublin, 1901). Criticism, &c., in Martha, *Les Moralistes sous l'empire romain* (5th ed., Paris, 1886); Nisard, *Poètes latins de la décadence* (Paris, 1834); Hirzel, *Der Dialog* (Leipzig, 1895); Saintsbury, *History of Criticism*, i. 248; Henderson, *Life and Principate of the Emperor Nero* (London, 1903); and the histories of Roman literature (especially Schanz, §§ 382 sqq.). A *Bibliography of Persius*, by M. H. Morgan (Cambridge, U.S.A., 1893). (W. C. Su.)

PERSON, OFFENCES AGAINST THE. This expression is used in English law to classify crimes involving some form of assault or personal violence or physical injury, *i.e.* offences affecting the life, liberty or safety of an individual: but it is also extended to certain offences against morality which cannot technically be described as assaults. The bulk of the offences thus classified, so far as their definition or punishment depends upon statute law, are included in the Offences Against the Person Act 1861 (24 & 25 Vict. c. 100), and in the Criminal Law Amendment Acts of 1880 and 1885, and the Prevention of Cruelty to Children Act 1904. The classification in these statutes is not scientific: *e.g.* bigamy is within the act of 1861 (s. 57), and certain offences involving assault, *e.g.* robbery, are to be found in other statutes. The particular offences dealt with by the acts above named are discussed under their appropriate titles, *e.g.* abortion, assault, bigamy, homicide, rape, &c. In the Indian penal code most of the offences above referred to fall under the head "offences against the human body" (ch. xvi.). In his *Digest of the Criminal Law* Sir James Stephen includes most of these offences under the title "offences against the person, the conjugal and parental rights, and the reputation of individuals," a classification also to be found in the English draft code of 1880 and adopted in the Queensland code of 1899. In working out this classification offences not involving assault are relegated to another and perhaps more appropriate title, "offences against morality."

PERSONALITY (from Lat. *persona*, originally an actor's mask, from *personare*,[1] to sound through), a term applied in philosophy and also in common speech to the identity or individuality which makes a being (person) what he is, or marks him off for all that he is not. The term "person," which is technically used not only in philosophy but also in law, is applied in theology (Gr. πρόσωπον) to the three hypostases of the Trinity. It was first introduced by Tertullian, who implied by it a single individual; the Father, the Son and the Holy Ghost were three *personae* though of one and the same substance (*unitas substantiae*). The nature of this unity in difference exercised the minds of the early Christian theologians, and was the subject of many councils and official pronouncements, according as emphasis was laid on the unity or on the separateness of the persons. There was perpetual schism between the Unitarians and Trinitarians (see for example SABELLIUS). The natural sense of the word "person" is undoubtedly individuality; hence those who found a difficulty in the philosophic conception of the three-in-one naturally tended to lay emphasis on the distinctions between the members of the Trinity (see HERESY; MONARCHIANISM; LOGOS, &c.). A further theological question arises in connexion with the doctrine of immortality (*q.v.*), and it is argued that immortality is meaningless unless the soul of the dead man is self-conscious throughout.

In philosophy the term has an important ethical significance. The Greek moralists, attaching little importance to individual citizens as such, found the highest moral perfection in the subordination of the individual to the state. Man, as πολιτικὸν ζῷον, is good only when he is a good πολίτης. Subsequent ethical systems on the contrary have laid stress on the moral worth of personality, finding the *summum bonum* in the highest realization of the self. This view is specially characteristic of the Neo-hegelian school (*e.g.* T. H. Green), but it belongs also in various degrees to all intuitional and idealistic systems. Utilitarian universalistic hedonism and evolutionist ethics so far resemble the Greek theory that they tend to minimize the importance of personality, by introducing ulterior reasons (*e.g.* the perfection of the social organism, of humanity) as the ultimate sanctions of moral principles, whereas the intuitionists by making the criterion abstract and absolute limit goodness to *personal* obedience to the a priori moral law.

Still more important problems are connected with the psychological significance of personality. What is the origin and character of the consciousness of the self? The consciousness of the identity of another person is comparatively simple; but one's own individuality consists partly in being aware of that individuality; a man cannot use the word "I" unless he is conscious of the unity of his "self," and yet there is involved in the word "I" something more than this consciousness. In what does the unity of the "self" consist prior to its being recognized in consciousness; how does the consciousness arise? The answer to this problem is to be found—in so far as it can be found—in the subject-object relation, in the distinction between the external world and the subjective processes of knowing and willing which that relation involves. I will something, and afterwards perceive a corresponding change within the unity of my external world. Hence, we may suppose, arises the consciousness of a permanent self and not-self.

It should be observed that self-consciousness varies according to the intellectual development, and the term "personality" is usually connected only with the self-consciousness of an advanced type, not, for example, with that of an animal. Even among human beings there is considerable difference. The most elementary form of human self-consciousness includes in the self not only the soul but also the body, while to the developed self-consciousness the physical self is part of the external or objective world. Finally it is necessary to refer to the Kantian distinction of the pure and the empirical ego, the latter ("the Me known") being an object of thought to the former ("the I knowing").

From the use of the term "person" as distinguishing the self from the not-self arises the phrase "personal equation" for those peculiar characteristics or idiosyncrasies which have to be taken into account in estimating the value of an individual judgment or observation. This phrase, which is commonly used in any connexion, was first applied to the errors detected in the astronomical observations of a Greenwich observer named Kinnebrook in 1795. The recognized fact that the greater or less inaccuracy is habitual to individual observers has been investigated, *e.g.* by Bessel (*Abhandlungen*, iii. 300) and by Wundt (*Physiol. Psychol.*), and machines have been devised which make allowance for the error caused by the personal equation (see MICROMETER).

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[1] So Gabius Bassus in Gell. *Noct. Att.* v. 7, 1. Since, however, it is difficult to explain *persōna* from *persŏnare* (Skeat suggests by analogy from πρόσωπον the Greek equivalent!), Walde, in *Lateinisches etymologisches Wörterbuch* (1906), suggests a derivation from Greek ζώνη, a zone. In Roman law *persona* was one who had civil rights. For the ecclesiastical *persona ecclesiae*, see PARSON.

For the psychological problem, see PSYCHOLOGY. For the problems connected with sub-conscious action, &c., see SUBLIMINAL SELF; TRANCE; HYPNOTISM; TELEPATHY.

PERSONAL PROPERTY, one branch of the main division of the English law of property, the other being "real property." The division of property into real and personal represents in a great measure the division into immovable and movable incidentally recognized in Roman law and generally adopted since. "Things personal," according to Blackstone, "are goods, money, and all other movables which may attend the owner's person wherever he thinks proper to go" (*Comm.* ii. 16). This identification of things personal with movables, though logical in theory, does not, as will be seen, perfectly express the English law, owing to the somewhat anomalous position of chattels real. In England real property is supposed to be superior in dignity to personal property, which was originally of little importance from a legal point of view. This view is the result of feudal ideas, and had no place in the Roman system, in which immovables and movables were dealt with as far as possible in the same manner, and descended according to the same rules. The main differences between real and personal property which still exist in England are these. (1) In real property there can be nothing more than limited ownership; there can be no estate properly so called in personal property, and it may be held in complete ownership. There is nothing corresponding to an estate-tail in personal property; words which in real property would create an estate-tail will give an absolute interest in personalty. A life-interest may, however, be given in personalty, except in articles *quae ipso usu consumuntur.* Limitations of personal property, equally with those of real property, fall within the rule against perpetuities. (2) Personal property is not subject to various incidents of real property, such as rent, dower or escheat. (3) On the death of the owner intestate real property descends to the heir; personal property is divided according to the Statute of Distributions. (4) Real property as a general rule must be transferred by deed; personal property does not need so solemn a mode of transfer. (5) Contracts relating to real property must be in writing by the Statute of Frauds, 29 Car. II. c. 3, s. 4; contracts relating to personal property need only be in writing when it is expressly so provided by statute, as, for instance, in the cases falling under s. 17 of the Statute of Frauds. (6) A will of lands need not be proved, but a will of personalty or of personal and real property together must be proved in order to give a title to those claiming under it. (7) Devises of real estate fall as a rule within the Mortmain Acts (see CHARITY AND CHARITIES; CORPORATION); bequests of personal property, other than chattels real, are not within the act. (8) Mortgages of real property need not generally be registered; mortgages of personal property for the most part require registration under the Bills of Sale Acts (see PLEDGE, and BILL OF SALE).

Personal estate is divided in English law into *chattels real* and *chattels personal*; the latter are again divided into *choses in possession* and *choses in action* (see CHATTEL; CHOSE).

Interest in personal property may be either absolute or qualified. The latter case is illustrated by animals *ferae naturae*, in which property is only coextensive with detention. Personal property may be acquired by occupancy (including the *accessio*, *commixtio*, and *confusio* of Roman law), by invention, as patent and copyright, or by transfer, either by the act of the law (as in bankruptcy, judgment and intestacy), or by the act of the party (as in gift, contract and will).

There are several cases in which, by statute or otherwise, property is taken out of the class of real or personal to which it seems naturally to belong. By the operation of the equitable doctrine of conversion money directed to be employed in the purchase of land, or land directed to be turned into money, is in general regarded as that species of property into which it is directed to be converted. An example of property prima facie real which is treated as personal is an estate *pur autre vie*, which, since 14 Geo. II. c. 20, s. 9, 1740–1741 (now replaced by the Wills Act 1837, s. 6) is distributable as personal property in the absence of a special occupant. Examples of property prima facie personal which is treated as real are fixtures, heirlooms, such as deeds and family portraits, and shares in some of the older companies, as the New River Company, which are real estate by statute. In ordinary cases shares in companies are personal property, unless the shareholders have individually some interest in the land as land.

The terms *heritable* and *movable* of Scots law to a great extent correspond with the real and personal of English law. The main points of difference are these. (1) Leases are heritable as to the succession to the lessee, unless the destination expressly exclude heirs, but are movable as to the fisk. (2) Money due on mortgages and securities on land is personalty in England. At common law in Scotland debts secured on heritable property are themselves heritable. But by the Titles to Land Consolidation (Scotland) Act 1868, s. 117, heritable securities are movable as far as regards the succession of the creditor, unless executors are expressly excluded. They still, however, remain heritable *quoad fiscum*, as between husband and wife, in computing legitim, and as far as regards the succession of the debtor. (3) Up to 1868 the heir of heritage succeeded to certain movable goods called heirship movables, which bore a strong likeness to the heirlooms of English law. This right of the heir was abolished by the act of 1868, s. 160. (4) Annuities, as having *tractum futuri temporis*, are heritable, and an obligation to pay them falls upon the heir of the deceased (Watson, *Law Dict. s.v.* "Annuities").

The law in the United States agrees in most respects with that of England. Heirlooms are unknown, one reason being, no doubt, that the importance of title-deeds is much less than it is in England, owing to the operation of the Registration Acts. Long terms in some states have annexed to them the properties of freehold estates. In some states estates *pur autre vie* descend like real property; in others an estate *pur autre vie* is deemed a freehold only during the life of the grantee; after his death it becomes a chattel real. In yet other states the heir has a *scintilla* of interest as special occupant (Kent, *Comm.* iv. 27). In some states railway rolling-stock is considered as purely personal, in others it has been held to be a fixture, and so to partake of the nature of real property. Shares in some of the early American corporations were, like New River shares in England, made real estate by statute, as in the case of the Cape Sable Company in Maryland (Schouler, *Law of Personal Property*, i.). In Louisiana animals employed in husbandry are, and slaves were, regarded as immovables. Pews in churches are generally real property, but in some states they are made personal property by statute. The assignment of choses in action is generally permitted, and is in most states regulated by statute. (J. W.)

PERSONATION, in English law, a form of fraud consisting in a false representation by one person (by words or conduct) that he is another person living or dead. It is not an offence by the common law unless the representation is made on oath under circumstances constituting the offence of perjury, or unless the representation if not made on oath is made under circumstances amounting to a common law cheat. Personation has been made an offence by statute in the following cases: (1) where it amounts to a false pretence by words or conduct, and is done with intent to defraud, and property is by such false pretence obtained, 24 & 25 Vict. c. 96 ss. 88–90 (see FALSE PRETENCES); (2) in the case of false and deceitful personation of any person or of the heir, executor, administrator, wife, widow, next of kin or relative of any person with intent fraudulently to obtain any land, estate, chattel, money, valuable security or property (37 & 38 Vict. c. 36 s. 1); (3) in the case of personation of votes at elections (see CORRUPT PRACTICES).

The first of these offences is a misdemeanour only; the second is a felony punishable by penal servitude for life. The second offence was created in 1874 in consequence of the Tichborne case, in which under the law as it then stood it had been necessary to prosecute the claimant for perjury. Besides the enactments above referred to there are also a number of provisions for dealing with the personation of sailors, soldiers, pensioners and owners of stock in the public funds or shares in joint-stock companies, and of persons who falsely acknowledge in the name of another recognizances, deeds or instruments, before a court or person authorized to take the acknowledgment.

PERSPECTIVE (Lat. *perspicere*, to see through), in mathematics the name given to the art of representing solid objects by a plane drawing which affects the eye as does the object itself. In the article PROJECTION it is shown that if all points in a figure be projected from a fixed centre to a plane, each point on the projection will be the projection of all points on the projecting ray. A complete representation by a single projection is therefore possible only when there is but one point to be projected on each ray. This is the case by projecting from one plane to another, but it is also the case if we project the *visible* parts of objects in nature; for every ray of light meeting the eye starts from that point in which the ray, if we follow its course from the eye backward, meets for the first time any object. Thus, if we project from a fixed centre the *visible* part of objects to a plane or other surface, then the outlines of the projection would give the same impression to the eye as the outlines of the things projected, provided that one eye only be used and that this be at the centre of projection. If at the same time the light emanating from the different points in the picture could be made to be of the same kind—that is, of the same colour and intensity and of the same kind of polarization—as that coming from the objects themselves, then the projection would give sensibly the same impression as the objects themselves. The art of obtaining this result constitutes a chief part of the technique of a painter, who includes the rules which guide him under the name of perspective, distinguishing between *linear* and *aerial* perspective—the former relating to the projection, to the *drawing* of the outlines, the latter to the colouring and the shading off of the colours in order to give the appearance of distance. Here we deal only with the former, which is in fact a branch of geometry consisting in the applications of the rules of projection.

§ 1. Our problem is the following: *There is given a figure in space, the plane of a picture, and a point as centre of projection; it is required to project the figure from the point to the plane.*

From what has been stated about projection (*q.v.*) in general it follows at once that the projection of a point is a point, that of a line a line. Further, the projection of a point at infinity in a line is in general a finite point. Hence parallel lines are projected into a pencil of lines meeting at some finite point. This point is called the *vanishing point of the direction* to which it belongs. To find it, we project the point at infinity in one of the parallel lines; that is, we draw through the eye a line in the given direction. This cuts the picture plane in the point required.

Similarly all points at infinity in a plane are projected to a line (see PROJECTION: § 6) which is called the *vanishing line of the plane* and which is *common to all parallel planes*.

All lines parallel to a plane have their vanishing points in a line, viz. in the vanishing line of the plane.

All lines parallel to the picture plane have their vanishing points at infinity in the picture plane; hence *parallel lines which are parallel to the picture plane appear in the projection as parallel lines in their true direction.*

The projection of a line is determined by the projection of two points in it, these being very often its vanishing point and its trace on the picture plane. *The projection of a point is determined by the projection of two lines through it.*

These are the general rules which we now apply. We suppose the picture plane to be vertical.

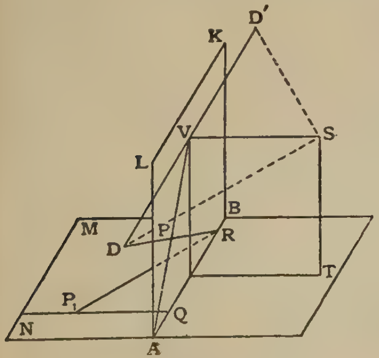

FIG. 1.

§ 2. Let (fig. 1) S be the centre of projection, where the eye is situated, and which in perspective is called the *point of sight*, ABKL the picture plane, ABMN a horizontal plane on which we suppose the objects to rest of which a perspective drawing is to be made. The lowest plane which contains points that are to appear in the picture is generally selected for this purpose, and is therefore called the ground plane, or sometimes the geometrical plane. It cuts the picture plane in a horizontal line AB called the ground line or base line or fundamental line of the picture. A horizontal line SV, drawn through the eye S perpendicular to the picture, cuts the latter at a point V called the centre of the picture or the centre of vision. The distance SV of the eye from the picture is often called the distance simply, and the height ST of the eye above the ground the height of the eye.

The vanishing line of the ground plane, and hence of every horizontal plane, is got by drawing the projecting rays from S to the points at infinity in the plane—in other words, by drawing all horizontal rays through S. These lie in a horizontal plane which cuts the picture plane in a horizontal line DD′ through the centre of vision V. This line is called the horizon in the picture. It contains the vanishing points of all horizontal lines, the centre of vision V being the vanishing point of all lines parallel to SV, that is perpendicular to the picture plane. To find the vanishing point of any other line we draw through S the ray projecting the point at infinity in the line; that is, we draw through S a ray parallel to the line, and determine the point where this ray cuts the picture plane. If the line is given by its plan on the ground plane, and its elevation on the picture plane, then its vanishing point can at once be determined; it is the vertical trace of a line parallel to it through the eye (cf. GEOMETRY: § *Descriptive*, § 6).

§ 3. To have construction in a single plane, we suppose the picture plane turned down into the ground plane; but before this is done the ground plane is pulled forward till, say, the line MN takes the place of AB, and then the picture plane is turned down. By this we keep the plan of the figure and the picture itself separate. In this new position the plane of the picture will be that of the paper (fig. 2). On it are marked the base line AB, the centre of vision V, and the horizon DD′, and also the limits ABKL of the actual picture. These, however, need not necessarily be marked. In the plan the picture plane must be supposed to pass through A_1B_1, and to be perpendicular to the ground plane. If we further suppose that the horizontal plane through the eye which cuts the picture plane in the horizon DD′ be turned down about the horizon, then the centre of sight will come to the point S, where VS equals the distance of the eye.

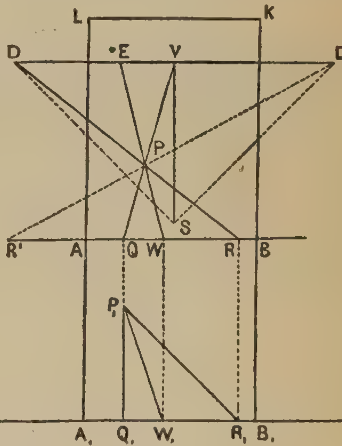

FIG. 2.

To find the vanishing point of any line in a horizontal plane, we have to draw through S a line in the given direction and see where it cuts the horizon. For instance to find the vanishing points of the two horizontal directions which make angles of 45° with the horizon, we draw through S lines SD and SD′ making each an angle of 45° with the line DD′. These points can also be found by making VD and VD′ each equal to the distance SV. The two points D, D′ are therefore called the distance points.

§ 4. Let it now be required to find the perspective P of a point P_1 (figs. 1 and 2) in the ground plane. We draw through P_1 two lines of which the projection can easily be found. The most convenient lines are the perpendicular to the base line, and a line making an angle of 45° with the picture plane. These lines in the ground plane are P_1Q_1 and P_1R_1. The first cuts the picture at Q_1 or at Q, and has the vanishing point V; hence QV is its perspective. The other cuts the picture in R_1, or rather in R, and has the vanishing point D; its perspective is RD. These two lines meet at P, which is the point required. It will be noticed that the line $QR = Q_1R_1 = Q_1P_1$ gives the distance of the point P behind the picture plane. Hence if we know the point Q where a perpendicular from a point to the picture plane cuts the latter, and also the distance of the point behind the picture plane, we can find its perspective. We join Q to V, set off QR to the right equal to the distance of the point behind the picture plane, and join R to the distance point to the left; where RD cuts QV is the point P required. Or we set off QR′ to the left equal to the distance and join R′ to the distance point D′ to the right.

If the distance of the point from the picture should be very great, the point R might fall at too great a distance from Q to be on the drawing. In this case we might set off QW equal to the *n*th part of the distance and join it to a point E, so that VE equals the *n*th part of VD. Thus if $QW = \frac{1}{3}QR$ and $VE = \frac{1}{3}VD$, then WE will again pass through P. It is thus possible to find for every point in the ground plane, or in fact in any horizontal plane, the perspective;

for the construction will not be altered if the ground plane be replaced by any other horizontal plane. We can in fact now *find the perspective of every point as soon as we know the foot of the perpendicular drawn from it to the picture plane, that is, if we know its elevation on the picture plane, and its distance behind it.* For this reason it is often convenient to draw in slight outlines the elevation of the figure on the picture plane.

Instead of drawing the elevation of the figure we may also proceed as follows. Suppose (fig. 3) A_1 to be the projection of the plan of a point A. Then the point A lies vertically above A_1 because *vertical lines appear in the perspective as vertical lines* (§ 1). If then the line VA_1 cuts the figure plane at Q, and we erect at Q a perpendicular in the picture plane to its base and set off on it QA_2 equal to the real height of the point A above the ground plane, then the point A_2 is the elevation of A and hence the line A_2V will pass through the point A. The latter thus is determined by the intersection of the vertical line through A_1 and the line A_2V.

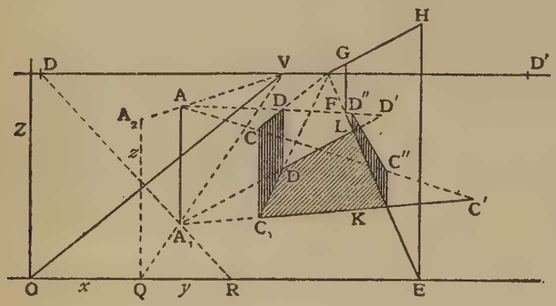

FIG. 3.

This process differs from the one mentioned before in this that the construction for finding the point is not made in the horizontal plane in which it lies, but that its plan is constructed in the ground plane. But this has a great advantage. The perspective of a horizontal plane from the picture to the line at infinity occupies in the picture the space between the line where the plane cuts the picture and the horizon, and this space is the greater the farther the plane is from the eye, that is, the farther its trace on the picture plane lies from the horizon. The horizontal plane through the eye is projected into a line, the horizon; hence no construction can be performed in it. The ground plane on the other hand is the lowest horizontal plane used. Hence it offers most space for constructions, which consequently will allow of greater accuracy.

§ 5. The process is the same if we know the co-ordinates of the point, viz. we take in the base line a point O as origin, and we take the base line, the line OV, and the perpendicular OZ as axes of co-ordinates. If we then know the co-ordinates x, y, z measured in these directions, we make $OQ = x$, set off on QV a distance QA such that its real length $QR = y$, make $QA_2 = z$, and we find A as before. This process might be simplified by setting off to begin with along OQ and OZ scales in their true dimensions and along OV a scale obtained by projecting the scale on OQ from D to the line OV.

§ 6. The methods explained give the perspective of any point in space. If lines have to be found, we may determine the perspective of two points in them and join these, and this is in many cases the most convenient process. Often, however, it will be advantageous to determine the projection of a line directly by finding its vanishing point. This is especially to be recommended when a number of parallel lines have to be drawn.

The perspective of any curve is in general a curve. The projection of a conic is a conic, or in special cases a line. The perspective of a circle may be any conic, not necessarily an ellipse. Similarly the perspective of the shadow of a circle on a plane is some conic.

§ 7. A few words must be said about the determination of shadows in perspective. The theory of their construction is very simple. We have given, say, a figure and a point L as source of light. We join the point L to any point of which we want to find the shadow and produce this line till it cuts the surface on which the shadow falls. These constructions must in many cases first be performed in plan and elevation, and then the point in the shadow has to be found in perspective. The constructions are different according as we take as the source of light a finite point (say, the flame of a lamp), or the sun, which we may suppose to be at an infinite distance.

If, for instance, in fig. 3, A is a source of light, EHGF a vertical wall, and C a point whose shadow has to be determined, then the shadow must lie on the line joining A to C. To see where this ray meets the floor we draw through the source of light and the point C a vertical plane. This will cut the floor in a line which contains the feet A_1, C_1 of the perpendiculars drawn from the points A, C to the floor, or the plans of these points. At C′, where the line A_1C_1 cuts AC, will be the shadow of C on the floor. If the wall EHGF prevents the shadow from falling on the floor, we determine the intersection K of the line A_1C_1 with the base EF of the wall and draw a vertical through it, this gives the intersection of the wall with the vertical plane through A and C. Where it cuts AC is the shadow C″ of C on the wall.

If the shadow of a screen CDD_1C_1 has to be found we find the shadow D′ of D which falls on the floor; then D_1D' is the shadow of D_1D and $D'C'$ is the shadow on the floor of the line DC. The shadow of D_1D, however, is intercepted by the wall at L. Here then the wall takes up the shadow, which must extend to D″ as the shadow of a line on a plane is a line. Thus the shadow of the screen is found in the shaded part in the figure.

§ 8. If the shadows are due to the sun, we have to find first the perspective of the sun, that is, the vanishing point of its rays. This will always be a point in the picture plane; but we have to distinguish between the cases where the sun is in the front of the picture, and so behind the spectator, or behind the picture plane, and so in front of the spectator. In the second case only does the vanishing point of the rays of the sun actually represent the sun itself. It will be a point above the horizon. In the other case the vanishing point of the rays will lie below the horizon. It is the point where a ray of the sun through the centre of sight S cuts the picture plane, or it will be the shadow of the eye on the picture. In either case the ray of the sun through any point is the line joining the perspective of that point to the vanishing point of the sun's rays. But in the one case the shadow falls away from the vanishing point, in the other it falls towards it. The direction of the sun's rays may be given by the plan and elevation of one ray.

For the construction of the shadow of points it is convenient first to draw a perpendicular from the point to the ground and to find its shadow on the ground. But the shadows of verticals from a point at infinity will be parallel; hence they have in perspective a vanishing point L_1 in the horizon. To find this point, we draw that vertical plane through the eye which contains a ray of the sun. This cuts the horizon in the required point L_1 and the picture plane in a vertical line which contains the vanishing point of the sun's rays themselves. Let then (fig. 4) L be the vanishing point of the sun's rays, L_1 be that of their projection in a horizontal plane, and let it be required to find the shadow of the vertical column AH. We draw AL_1 and EL; they meet at E′, which is the shadow of E. Similarly we find the shadows of F, G, H. Then E′F′G′H′ will be the shadow of the quadrilateral EFGH. For the shadow of the column itself we join E′ to A, &c., but only mark the outlines; F′B, the shadow of BF, does not appear as such in the figure.

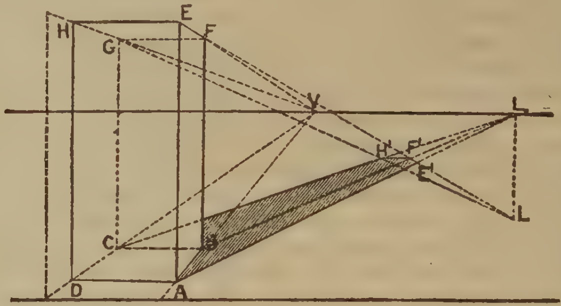

FIG. 4.

If the shadow E has to be found when falling on any other surface we use the vertical plane through E, determine its intersection with the surface, and find the point where this intersection is cut by the line EL. This will be the required shadow of E.

§ 9. If the picture is not to be drawn on a vertical but on another plane—say, the ceiling of a room—the rules given have to be slightly modified. The general principles will remain true. But if the picture is to be on a curved surface the constructions become somewhat more complicated. In the most general case conceivable it would be necessary to have a representation in plan and elevation of the figure required and of the surface on which the projection has to be made. A number of points might also be found by calculation, using co-ordinate geometry. But into this we do not enter. As an example we take the case of a panorama, where the surface is a vertical cylinder of revolution, the eye being in the axis. The ray projecting a point A cuts the cylinder in two points on opposite sides of the eye, hence geometrically speaking every point has two projections; of these only the one lying on the half ray from the eye to the point can be used in the picture. But the other has sometimes to be used in constructions, as the projection of a line has to pass through both. Parallel lines have two vanishing points which are found by drawing a line of the given direction through the eye; it cuts the cylinder in the vanishing points required. This operation may be performed by drawing on the ground the plan of the ray through the foot of the axis, and through the point where it cuts the cylinder a vertical, on which the point required must lie. Its height above is easily found by making a drawing of a vertical section on a reduced scale.

Parallel planes have in the same manner a vanishing curve. This will be for horizontal planes a horizontal circle of the height of the eye above the ground. For vertical planes it will be a pair of generators of the cylinder. For other planes the vanishing curves will be ellipses having their centre at the eye.

The projections of vertical lines will be vertical lines on the cylinder. Of all other lines they will be ellipses with the centre at the eye. If the cylinder be developed into a plane, then these ellipses will be changed into curves of sines. Parallel lines are thus represented by curves of sines which have two points in common. There is no difficulty in making all the constructions on a small scale on the drawing board and then transferring them to the cylinder.

§ 10. A variety of instruments have been proposed to facilitate perspective drawings. If the problem is to make a drawing from nature then a camera obscura or, better, Wollaston's camera lucida may be used. Other instruments are made for the construction of perspective drawings. It will often happen that the vanishing point of some direction which would be very useful in the construction falls at a great distance off the paper, and various methods have been proposed of drawing lines through such a point. For some of these see Stanley's *Descriptive Treatise on Mathematical Drawing Instruments.* (O. H.)

PERSPIRATION (Lat. *per*, through, and *spirare*, to breathe), the excretion of sweat from the sweat-glands of the skin. Sweat is a clear colourless neutral or slightly alkaline fluid containing 2% of solids. Under pathological conditions, sugar urea and other substances are found. The secretion of sweat is constantly going on, the activity of the sweat-glands being under control of the central nervous system. The only function of sweat is the regulation of the heat discharge from the body. The chief morbid conditions of the sweat-glands are excessive sweating (*Hyperidrosis*) and foetid sweating (*Bromidrosis*). Excessive sweating is a symptom observed in various diseases, such as tuberculosis and rheumatic fever, but it may exist apart from such conditions, and either be general, affecting the whole body, or confined to a part, such as the axillae, head, hands, feet, or, as in some rare instances, the one half of the body. Excessive perspiration may often be prevented by the cold bath, and by tonics, such as iron, quinine, strychnia, &c. Locally, the use of astringent lotions of vinegar or a weak solution of lead will also be of service. Foetid sweating most frequently affects the feet, specially in those who have much fatigue, and is apparently due to rapid decomposition in the perspiration which has saturated the stockings; these should be frequently changed and the feet washed several times a day, dried carefully, and dusted with some antiseptic powder.

PERTAB (or PARTAB) **SINGH,** SIR, maharaja of Idar (1844–), native Indian soldier and statesman, belonging to the Rahtor Rajputs of the Jodha class, was born in 1844, being the son of Maharaja Takht Singh, ruler of Marwar (or Jodhpur). In 1878 and again in 1879 he was chief minister of Jodhpur. In the following year he accompanied the British mission to Afghanistan, and on his return he carried out many judicious reforms and administered Jodhpur with remarkable success. He visited England to take part in the celebration of the 1887 Jubilee of Queen Victoria's reign. He served on the staffs of Sir William Lockhart and General Elles in the Tirah and Momand expeditions in 1897–98, was slightly wounded, was mentioned in despatches, and promoted to the rank of full colonel. He won the reputation of being one of the keenest sportsmen and the best riders that even Rajputana has produced. When it was decided to send a force from India to China in 1900 to relieve the foreign embassies besieged in Peking, Sir Pertab Singh at once offered the services of the Jodhpur Lancers, and himself accompanied them. His father rendered good services to the British government in the Mutiny, and Pertab Singh always cherished the memory of the protection given to Jodhpur by the East India Company in 1818. His services to the empire in India were universally recognized. From Queen Victoria he received the honour of knighthood and the Bath and the Star of India; from King Edward VII. the distinction of "aide-de-camp"; and the university of Cambridge gave him the degree of LL.D. From his own state of Jodhpur he obtained the title of Maharaja-Dhiraj. In 1901 he succeeded to the rulership of the state of Idar.

PERTH, EARLS AND DUKES OF. The Scottish title of earl of Perth was bestowed upon James, 4th Lord Drummond (d. 1611) in 1605. His ancestor Sir John Drummond (d. 1519) had been created Lord Drummond in 1488. The 1st earl's great-nephew, James, 4th earl and 1st duke of Perth (1648–1716), was a son of James, the 3rd earl (*c.* 1615–1675). When John Maitland, duke of Lauderdale, was virtually the dictator of Scotland, Perth was among his opponents, and after Lauderdale's retirement in 1680 he was one of the committee of seven which managed Scottish affairs. He was made justice-general and extraordinary lord of session in 1682, and was lord chancellor of Scotland from 1684 to 1688. As a convert to Roman Catholicism after the death of Charles II., he stood high in the favour of James II. Perth, who is credited with the introduction of the thumbscrew, was very unpopular with the Scottish people, and during the Revolution of 1688 he was imprisoned at Stirling. Released from captivity in 1693 he joined James II. at St Germains, and was made duke of Perth, a titular dignity only after the exiled king's death in 1701. His son James (*c.* 1675–1720) was with James II. in Ireland, and led the cavalry at the battle of Sheriffmuir. He was attainted in 1715, but claimed the dukedom of Perth after his father's death. His son James (1713–1746), regarded by friends and dependants as the 3rd duke of Perth, fought for the Young Pretender at Prestonpans and Culloden. His brother and heir, John, the 4th duke (*c.* 1716–1747), also joined Charles Edward, and fought at Falkirk and Culloden. The titular dukedom became extinct when the sixth holder, Edward, another son of the 1st duke, died in 1760.

The earldom was then claimed by Edward's cousin, James Lundin (1707–1781), a grandson of the 1st titular duke of Melfort, who was a brother of the 1st duke of Perth and took the name of Drummond. His son James (1744–1800) secured the Drummond estates in 1783, and was created a British peer as Lord Perth and Baron Drummond in 1797. On his death without sons in July 1800 his barony became extinct, but the claim to the earldom of Perth was inherited by his kinsman, the 4th titular duke of Melfort, and his descendants (see below). The Drummond estates, however, passed to the baron's daughter Clementina (d. 1865), afterwards the wife of Peter Robert, 20th Lord Willoughby de Eresby, and thence to her descendant the earl of Ancaster.

The 1st duke's brother, John (*c.* 1650–1715), earl of Melfort, rose to favour under Charles II. about the same time as his brother; like him, too, he became a Roman Catholic in 1686. In 1684 he was made secretary of state for Scotland; in 1686 he was created earl of Melfort by James II., and during his reign he took a leading part in Scottish affairs. After the Revolution of 1688 his great influence with James II. and with Mary of Modena drew upon him the hatred both of the French and of the Irish. He was with James II. at St Germains, but lost his former ascendancy, and died in Paris on the 25th of January 1715. In 1694 he was made duke of Melfort, and all his titles were held under the singular condition that they should descend to the children of his second wife, Euphemia (d. 1743), daughter of Sir Thomas Wallace, in preference to his children by his first wife, Sophia Lundin, who were Protestants. In 1701 Melfort was recognized as a French peer, the duc de Melfort, by Louis XIV. In 1695 he had been attainted, but his titles were claimed by John (1682–1754), his eldest son by his second wife, who shared in the rising of 1715. In 1800 John's grandson, James Louis, 4th titular duke of Melfort, claimed the earldom of Perth. This claim was unsuccessful, but in 1853 George (1807–1902), nominally 6th duke of Melfort, obtained a reversal of the various attainders, and his own recognition as earl of Perth and Melfort. The succeeding earl was his kinsman, William Huntly Drummond, Viscount Strathallan (1871–).

See Sir R. Douglas, *The Peerage of Scotland*; and *Histories of Noble British Families*, vol. ii., edited by H. Drummond (1846).

PERTH, the capital of Western Australia, situated on the Swan River, 12 m. by rail from the sea at Fremantle, and about 1700 m. W.N.W. of Melbourne. It is the seat of both Anglican and Roman Catholic bishops, and has two cathedrals. The fashionable street is St George's Terrace; in it are situated the public library, the government boys' school, the stock exchange, the town-hall, the government offices and the parliament buildings. Between it and the broad reach of the river known as Perth Water lie the governor's residence and domain. The town-hall, built entirely by convict labour, stands on an eminence in the very heart of the city; opposite to it are the government offices, housed in a four-storeyed structure in the style of the French Renaissance. The mint, opened in 1899, is a massive freestone building. There are a public library, built as a memorial of Queen Victoria's Jubilee in 1887, a Scots college, two good theatres, a mechanics' institute, a museum, and a fine Wesleyan church-house, known as Queen's Hall. The Perth Park, containing about 1200 acres, is connected by tram with the city, and in it is a well-equipped observatory. There are several smaller parks and squares in the city, while the esplanade gardens are a feature of the place, being thrown out like a pier into Perth Water. There is a good cricket ground, and three race-courses are in easy reach. South Perth, on the other side of the river, is connected by bridges and steam ferry; and adjoining the city on the north-west are the suburban municipalities of Leederville and Subiaco. Outlying suburbs are Belmont, Victoria Park, Burswood, Claremont, Cottesloe, Peppermint Grove and Bayswater. The city is lighted by electricity, and has a good service of electric trams. Perth has an agreeable climate, the mean temperature is 64·9° F., and the average rainfall 33 in. Perth was founded in 1829, received its municipal charter in 1856, and was created a city in 1880. Between 1891 and 1901 the growth of the city was remarkedly rapid; in 1891 the population was only 8447, but in 1901 it had grown to 27,471 in the city proper, and to 36,199 including the suburbs.

PERTH, a city, and royal, municipal and police burgh, and county town of Perthshire, Scotland, 32 m. N. by W. of Edinburgh direct, and 47¾ m. by the North British railway, via the Forth Bridge and Kinross Junction. Pop. (1901), 33,566. It is situated on the right bank of the Tay, between the meadows of the North Inch (98 acres) and those of the South Inch (72 acres), both laid out as public parks. The river is crossed by St John's Bridge of nine arches, completed in 1772 from the designs of John Smeaton and widened a century later; by Victoria Bridge, a modern structure connecting South Street with Dundee Road; and farther south (at the end of Tay Street) by a footway alongside of the viaduct belonging to the Caledonian railway. Of earlier bridges one, which crossed at High Street, was swept away by the flood of 1621, and another, constructed by General Wade in 1723–1733, was apparently the predecessor of Smeaton's bridge. On the left bank of the river lie the suburb of Bridgend and Kinnoull Hill (729 ft.). To the south are the wood-clad heights of Moncrieffe Hill (725 ft.), Magdalenes Hill (596 ft.), Kirkton Hill (540 ft.) and Craigie Wood (407) ft. In the river are Friarton or Moncrieffe Island and the Stanners.

Notwithstanding the importance of Perth in former times, almost the sole relic of the past is the church of St John the Baptist, a large Decorated cruciform building surmounted by a massive square central tower 155 ft. high. The original edifice is believed to have been erected in the time of Columba, but the transept and nave of the existing structure date from the early part of the 13th century, the choir from the 15th. The church was restored in 1891, and is now divided into the East, Middle and West churches. The silver-gilt communion cup used in the Middle Church is said to have been presented by Queen Mary. In May 1559 John Knox preached in St John's his famous sermon in denunciation of idolatry. The Dominican or Blackfriars' monastery, founded by Alexander II. in 1231, occupied a site near the west end of St John's Bridge; in what is now King Street stood the Carthusian monastery, founded by James I. in 1425; the Franciscan or Greyfriars' monastery, founded in 1460 by Laurance, first Lord Oliphant, stood on the present Greyfriars' cemetery; the Carmelite or Whitefriars' monastery, founded in 1260, stood west of the town. The tombstone of James I. and his queen, who were buried in the Charterhouse, was afterwards removed to St John's East Church. During the period between the beginning of the 12th century and the assassination of James I. in 1437, many of the Scottish parliaments were held in Perth. The building in which they met stood off High Street and was only cleared away in 1818, its site being occupied by the Freemasons' Hall. The earl of Gowrie's palace, built in 1520, stood in ~~spacious~~ grounds near the river and was removed in 1805 to provide room for the county buildings. The castle of Perth stood on the north of High Street, not far from St John's. It was probably built about 860 and demolished about 1400. The Spey or Spy tower, the most important fortress on the city wall, guarded the south gate close to the river, but it was taken down early in the 19th century. The market cross, erected in High Street in 1669 to replace the older cross which Cromwell destroyed, was removed in 1765 as an obstruction. The huge fortress, 466 ft. square, which Cromwell erected in 1651 on the South Inch, close to the river and the Greyfriars' burying-ground, was demolished in 1663. The house of Catherine Glover, the "Fair Maid of Perth," still stands in Curfew Row. James VI.'s Hospital, founded in 1569, occupies the site of the Carthusian monastery, the original structure having been pulled down by Cromwell's orders. The pensioners now live out and the hospital has been converted into artisans' dwellings. Among modern public buildings the principal are St Ninian's Episcopal Cathedral, in the Early Middle Pointed style, an important example (completed 1890) of the work of William Butterfield (1814–1900); the municipal buildings (1881); the city-hall; the Marshall Memorial Hall (1823), housing the public library and the museum of the Perth Literary and Antiquarian Society; the Perthshire natural history museum; the Sandeman public library (1898), founded by a bequest of Professor Sandeman of Owens College, Manchester. The general prison for Scotland, south of the South Inch, was originally erected in 1812 as a dépôt for French prisoners, but was remodelled as a convict prison in 1840 and afterwards enlarged. North-west of the city are the military barracks built in 1793-1794. Besides the regular elementary schools there are the Perth Academy (1807) with which was subsequently amalgamated the Burgh Grammar School, an institution supposed to date from the 12th century; Sharp's institute (1860); the Stewart's free school, an industrial school for girls, and the Fechney industrial school. The charitable institutions comprise the royal infirmary, in the Italian style, considerably enlarged since its foundation in 1836; the Murray royal lunatic asylum in Bridgend; the Hillside House in Kinnoull and the small-pox hospital.

From the south the city is entered by the North British railway and the Caledonian railway (which also runs west to St Fillans, east to Dundee and north-west to Aberdeen); and from the north by the Highland railway, the three systems utilizing a general station in the south-west of the town. During the season there is communication with Dundee and other river ports by steamer. The navigation of the stream is considerably obstructed by sandbanks, but vessels of 200 tons can unload at the quays, which, with the town and Friarton harbours, lie below the South Inch. The greatest tidal rise is 13 ft. The chief imports are Baltic timber, coal, salt and manure; and the exports, manufactured goods, grain, potatoes and slates. Perth has long been famous for its dyeing and bleaching, the bleach-fields being mostly situated outside of the city, in convenient proximity to the Tay and Almond. The other leading industries include manufactures of gauge-glasses, ink, muslins, India shawls, jute goods, woollens and winceys, floorcloth, and boots and shoes. There are iron foundries, breweries, distilleries, rope and sail works, coach-building yards, steam joinery works, and brick and tile works. The salmon fisheries of the Tay yield a substantial revenue. Perth is under the jurisdiction of a town council, with a lord provost and bailies, and returns one member to parliament.

History.—During the time that it was occupied by the Romans, a period estimated at 320 years, the city was called Victoria; but shortly after their withdrawal it seems to have borne the Celtic appellation of Aber-tha ("at the mouth of the Tay"). The transition to the latinized form Bertha and later to Perth (the Gaelic name being *Peart*) appears obvious. On the conversion of the original Pictish inhabitants and the dedication of the first church to St John the Baptist, the town was designated St Johnstoun, and it continued to be known indifferently by this name and that of Perth down to the 17th century. Roman remains have often been found in excavations carried out within the existing boundaries, which suggests that the Roman settlement was at least twenty feet below the present surface. The obscurity of the early annals of the town is explained by the circumstance that Edward I. caused the records to be removed. Perth is stated to have been a burgh in 1106 and was made a royal burgh by William the Lion in 1210. During the Scottish wars of the Independence its fortifications were strengthened by Edward I. (1298). Robert Bruce several times ineffectually attempted to seize it, but in 1311 he succeeded in scaling the walls during a night attack. This was the fourth and most brilliant of the seven sieges which the city has sustained. Taken by Edward III. in 1335, it was recaptured in 1339. In 1396 the combat between the Clan Chattan and the Clan Quhele, described in Scott's *Fair Maid of Perth*, took place on the North Inch in presence of Robert III. and his queen, Annabella Drummond. The Blackfriars' monastery was the scene of the murder of James I. by Walter, earl of Atholl, in 1437. In consequence Perth lost its status as capital, in which it had succeeded to Scone, and the Parliament Courts were transferred to Edinburgh in 1482. Gowrie Palace was the scene of the mysterious "Gowrie" conspiracy against James VI. in 1600. The town was taken by Montrose in 1644, by Cromwell in 1651, and was occupied by Viscount Dundee in 1689. In 1715 the Old Pretender was proclaimed king at the Mercat Cross (Sept. 16), and the chevalier himself appeared in the city in the following January, only to leave it precipitately on the approach of the earl of Argyll. Prince Charles Edward spent a few days in Perth from the 3rd of September 1745. In both rebellions the magistrates took the side of the Crown and were supported by the townsfolk generally, the Jacobites drawing their strength mainly from the county noblemen and gentry with their retainers. Since then the city has devoted itself to the pursuits of trade and commerce. Perth was visited by plague in 1512, 1585–1587, 1608 and 1645; by cholera in 1832; and the floods of 1210, 1621, 1740, 1773 and 1814 were exceptionally severe.

AUTHORITIES.—Maidment, *The Chronicle of Perth from 1210 to 1668* (1831); Penney, *Traditions of Perth* (1836); Lawson, *The Book of Perth* (1847); Peacock, *Perth, its Annals and Archives* (1849); Samuel Cowen, *The Ancient Capital of Scotland* (1904).

PERTH AMBOY, a city and port of entry of Middlesex county, New Jersey, U.S.A., at the mouth of the Raritan river, on Raritan Bay and Staten Island Sound, about 15 m. S. by W. of Newark. Pop. (1910 census) 32,121. It is served by the Pennsylvania, Lehigh Valley, Central of New Jersey and Staten Island Rapid Transit railways, and by boats to New York City. It is connected by a railway bridge (C.R.R. of N.J.) and by a foot and wagon bridge with South Amboy, on the south shore of the Raritan. Perth Amboy has a good harbour, shipyards and dry-docks. In the city still stands Franklin Palace (erected in 1764–1774), the home of William Franklin (1729–1813), a natural son of Benjamin Franklin and the last royal governor of New Jersey. In the vicinity is the Bartow House, in which William Dunlap (1766–1839), the art historian, made his first drawings. Other buildings of historic interest are the Parker Castle (*c.* 1729), a centre of Loyalist influence at the time of the War of Independence, and the Kearny Cottage, the home of "Madam Scribblerus," a half-sister of Captain James Lawrence. The city has various manufactures, the factory product in 1905 being valued at $34,800,402. Clay is obtained in the vicinity, and large shipments of coal are made. Perth Amboy was founded in 1683. It was at first called Amboy after the original Indian name; in 1684 the proprietors named it Perth in honour of James, earl of Perth (1648–1716), one of their number, and a few years later the two names were combined. From 1686 until the end of the proprietary government in 1702 Perth Amboy was the capital of the province of East Jersey, and during the period of royal government the general assembly and supreme court of New Jersey met alternately here and at Burlington. Perth Amboy was incorporated as a city in 1718, and received a new charter in 1784, and another in 1844, the last being revised in 1870. The township of Perth Amboy was incorporated in 1693 and in 1844 was included in the city.

PERTHES, FRIEDRICH CHRISTOPH (1772–1843), German publisher, nephew of Johan Georg Perthes (*q.v.*), was born at Rudolstadt on the 21st of April 1772. At the age of fifteen he became an apprentice in the service of Adam Friedrich Böhme, a bookseller in Leipzig, with whom he remained for about six years. In Hamburg, where he settled in 1793 as an assistant to the bookseller B. G. Hoffmann, he started in 1796 a bookselling business of his own, and in 1798 he entered into partnership with his brother-in-law, Johann Heinrich Besser (1775–1826). By his marriage in 1797 with a daughter of the poet, Matthias Claudius, he was brought into intimate relation with a group of Protestant writers, who exercised a powerful influence on the growth of his religious opinions. This, however, did not prevent him from being on friendly terms with a number of eminent Roman Catholic authors. Perthes was an ardent patriot; and during the period of Napoleon's supremacy he distinguished himself by his steady resistance to French pretensions. His zeal for the national cause led him, in 1810–1811, to issue *Das deutsche Museum*, to which many of the foremost publicists in Germany contributed. For some time the French made it impossible for him to live in Hamburg; and when, in 1814, he returned to that city he found that his business had greatly diminished. In 1821, his wife having died, he left Hamburg, transferring his business there to his partner, and went to Gotha, where he established what ultimately became one of the first publishing houses in Germany. It was owing to his initiation that the *Börsenverein der deutschen Buchhändler* (Union of German Booksellers) in Leipzig was founded in 1825. When the foundation-stone of the fine building of the Union was laid in 1834, Perthes was made an honorary freeman of the city of Leipzig, and in 1840 the university of Kiel conferred upon him the degree of doctor of philosophy. Perthes died at Gotha on the 18th of May 1843. His *Life* was written by his son, Klemens Theodor Perthes (1809–1867), professor of law in the university of Bonn, and author of *Das deutsche Staatsleben vor der Revolution* (Hamburg and Gotha, 1845), and *Das Herbergswesen der Handwerksgesellen* (Gotha, 1856, and again 1883), whose son Hermann Friedrich Perthes (1840–1883) was the founder of the Fridericianum at Davos Platz. The publishing business at Gotha was carried on by Perthes's younger son, Andreas, (1813–1890) and his grandson, Emil (1841–), until 1889, when it was handed over to a company.

See also O. Adler, *Friedrich and Karoline Perthes* (Leipzig, 1900).

PERTHES, JOHAN GEORG JUSTUS (1749–1816), German publisher, was born at Rudolstadt on the 11th of September 1749. In 1785 he founded at Gotha the business which bears his name (Justus Perthes). In this he was joined in 1814 by his son Wilhelm (1793–1853), who had been in the establishment of Justus' nephew, Friedrich Christoph Perthes, at Hamburg. On the death of Justus at Gotha on the 2nd of May 1816, Wilhelm took entire control of the firm. He laid the foundation of the geographical branch of the business, for which it is chiefly famous, by publishing the *Hand-atlas* (1817–1823) of Adolf Stieler (1775–1836). Wilhelm Perthes engaged the collaboration of the most eminent German geographers of the time, including Heinrich Berghaus, Christian Gottlieb Reichard (1758–1837), who was associated with Stieler in the compilation of the atlas, Karl Spruner (1803–1892) and Emil von Sydow (1812–1873). The business passed to his son Bernard Wilhelm Perthes (1821–1857), who was associated with August Petermann (under whose direction the well-known periodical *Petermanns Mitteilungen* was founded) and Bruno Hassenstein (1839–1902); and subsequently to his son Bernard (1857–). In 1863 the firm first issued the *Almanach de Gotha*, a statistical, historical and genealogical annual (in French) of the various countries of the world; and in 1866 the elaborate *Geographisches Jahrbuch* was produced under the editorship of Ernst Behm (1830–1884), on whose death it was continued under that of Professor Hermann Wagner.

PERTHSHIRE, an inland county of Scotland, bounded N. by the shires of Inverness and Aberdeen; E. by Forfarshire; S.E. by the Firth of Tay and the counties of Fife and Kinross; S. by the shires of Clackmannan and Stirling; S.W. by the counties of Stirling and Dumbarton; W. by Argyllshire and N.W. by Inverness-shire. It is the fourth largest county in Scotland, having an area of 1,595,774 acres, or 2493·4 sq. m., including the island of Mugdrum in the Firth of Tay. By far the greater part of the county is mountainous. Including the hills on the confines of Inverness-shire and Argyllshire, there are at least fifty mountains exceeding 3000 ft. in height. Of these the most familiar are Ben Lawers (3984 ft.) near Loch Tay, Ben More (3843) east of Crianlarich, Ben Lui (3708) on the Argyllshire border, Schiehallion (3547) south of Loch Rannoch, Ben Vannoch (3125) west of Loch Lyon, and Ben Chonzie (3048) near the head of Glen Almond. Of the immense number of hills of lesser altitude there may be mentioned four that have been popularized by the *Lady of the Lake*—Ben Ledi (2875) and Uam Var (2179) near Callander, and Ben Venue (2393) and Ben A'an (1750), guardians of the Trossachs. The Ochils divide Perthshire from the shires of Clackmannan, Kinross and Fife. The chief stream is the Tay, which rises on the Argyllshire frontier and discharges into the North Sea off Buddon Ness, after a course of 117 m., being thus the longest river in Scotland. Its head-waters are the Fillan and Dochart, and among its affluents are, on the right, the Bran, Almond and Earn and, on the left, the Lyon, Tummel, rising in Argyllshire and receiving the Garry on its left, and Isla. The Earn flows out of Loch Earn and enters the Firth of Tay 6½ m. below Perth. The Forth, the principal natural boundary of the shire on the south, properly belongs to Stirlingshire, in which it rises, but its leading left-hand affluents are Perthshire rivers, namely, the Teith, the Goodie, issuing from the lake of Menteith, and the Allan, rising in the Ochils near Sheriffmuir. All the lakes are narrow, scarcely one exceeding a mile in width. Loch Ericht, belonging partly to Inverness-shire, is 14½ m. long. Loch Tay (14½ m. long), situated about the centre, is the largest lake in the county. In the south are the series of lakes which the *Lady of the Lake* has rendered famous—Loch Vennachar (4½ m. long), Loch Achray (1¼ m. long), Loch Katrine (about 8 m. long); to the west of Aberfoyle is Loch Ard (3 m. long) and to the east Lake Menteith (1½ m. long). Nearly all the glens possess striking natural features, among them, from south to north, being Glens Artney, Almond, Dochart, Ogle, Lochay, Lyon, Garry, Shee, Bruar and Tilt; while the Trossachs, Killiecrankie, Birnam and Leny are the loveliest passes in the Highlands. The low-lying country is represented mainly by Strathmore, Strath Gartney, Strathallan, noted for its annual "gathering" or games, Strathearn, Strath Bran, Strath Tay and Strath Fillan, but more particularly by the fertile alluvial belts of the Carse of Gowrie, on the northern shore of the Firth of Tay, and the Carse of Stirling. The Moor of Rannoch on the borders of Argyllshire is a sterile boulder-strewn waste, and Flanders Moss, to the south-east of Lake Menteith, is a vast boggy tract, which is, however, being gradually reclaimed and brought under cultivation.

Geology.—The Highland portion of this county is built up of a great series of schists and metamorphosed rocks grouped as "Dalradian" or Eastern schists. The general direction of the strike of these rocks is W.S.W.–E.N.E. They are cut off from the Old Red Sandstone, which occupies most of the remainder of the county, by the great fault which traverses the county somewhat to the north of Aberfoyle and Crieff. But for some distance north and east of Crieff the boundary between these two formations is an unconformable one. In the neighbourhood of the fault line the Highland schists are less metamorphosed than they are farther north; about Comrie and Callander they consist of shales, greywackes and igneous rocks with radiolarian cherts and black shales that are suggestive of the rocks of Arenig age in south Scotland. At Aberfoyle, Comrie and Dunkeld roofing slates are worked and massive limestones occur in Glen Tilt, Pitlochry, Callander, Blair Atholl, Loch Rannoch and other places. A gritty series comes on above the slates and is well seen capping the summit of Ben Vorlich. A great variety of schists form the bulk of the series; but granite masses appear in their midst as at Loch Rannoch, Loch Ericht and Glen Tilt, and there are numerous acid and intermediate dikes which are themselves traversed by later basaltic dikes. The Old Red Sandstone consists in the lower portion mainly of coarse volcanic agglomerates and lava flows followed by conglomerates, sandstones and marls. The lowest beds are exposed along the crest of the Ochil Hills which like the Sidlaw Hills are anticlinal in structure, while between the Ochils and the Highland fault the rocks are folded into syncline; near the fault they become very steeply inclined and even inverted, and it is interesting also to note that the sediments become coarser as the fault is approached. The Upper Old Red Sandstone is well exposed near the Bridge of Earn and it extends beneath the marine platform of the Carse of Gowrie. The rocks are mainly red sandstones and marls, let down between two parallel east and west faults but between the Bridge of Earn and Forgandenny, west of the tract, they are seen to rest unconformably upon the lower division. Small outliers of Carboniferous rocks (lower) occur on the north of the Ochils. The marks of ice action left by the Glacial epoch are abundant and striking in Perthshire; moraines are common in the Highland glens, as those at the head of the Glengarry on borders of Loch Katrine; ice-scratched surfaces are found on the Sidlaw Hills, the Ochils, Kinnoull Hill and elsewhere; and erratic blocks of stone, such as "Samson's Putting Stone," a mass of Highland schist resting on a hill of Old Red Sandstone near Coilantogle, are widely distributed. Old high level marine beaches form terraces far up several of the larger streams, and the Carse of Gowrie, as already indicated, is formed by the beach at the 50-ft. level. The gravel cones poured out at the mouths of many of the glens which open on the south of the Ochils on to the 100-ft. or 50-ft. beaches are often the site of villages.

Climate and Agriculture.—The mountainous territory is extremely wet, the rainfall for the year varying from 93 in. in Glengyle at the head of the Loch Katrine to 37 in. at Pitlochry and 23 in. at Perth. Winter and autumn are the rainiest seasons. The temperature is remarkably constant everywhere, averaging 47° F. for the year, January being the coldest month (36·5° F.) and July the hottest (59° F.). Only a little more than one-fifth of the total area is under cultivation, and of this nearly one-third is in permanent pasture, while in addition there are about 930,000 acres of hill pasturage. The arable land is chiefly in the drier regions of the east and south-east, the soil for the most part being fertile. Light soils prevail in the lower undulating districts; clay and alluvial land occur in the Carse of Gowrie, the Carse of Stirling and the lower reach of Strathearn below and above Bridge of Earn. The best heavy carse land is very rich and productive, but requires to be thoroughly worked, limed and manured, being well adapted for wheat. A considerable area is occupied by orchards, the light quick soil of Tayside and the upper districts of Menteith being admirably fitted for apples. The number of holdings is slightly in excess of 5000 and of these the majority are under 50 acres each, chiefly in the Highland valleys and near the villages and small towns. Of grain, oats is the predominating crop, but barley and wheat are also grown. Two-thirds of the area devoted to green crops is occupied by turnips, the rest by potatoes. Most of the horses raised, chiefly Clydesdales, are used solely for agricultural purposes. Although dairy-farming is not an important industry, a large number of cows, principally Ayrshires, are kept on the lowland farms, the herds of the straths and mountain pastures being most usually West Highlands or Kyloes. Perthshire, next to Argyllshire, still carries the heaviest flocks in Scotland. Black-faced is the principal breed in the Grampians, but there is also a large number of Cheviots and South Downs, and Leicesters are common on the lower runs. Only one-seventeenth of the surface is under wood. This is well up to the proportion of the other Scottish counties, but compares unfavourably with the conditions existing in 1812, when 203,880 acres were under wood, of which 61,164 were planted and 142,716 natural. In Breadalbane and Menteith there are remains of the ancient Caledonian forest. Perthshire affords exceptional facilities for sport with rod and gun. The lochs and rivers abound with salmon and trout, while hardly any of the streams have suffered pollution from industries or manufactures. The deer forests, exceeding 100,000 acres in area, are frequented by red deer and roe deer, and on the extensive moors and in the woods are found grouse, pheasants, partridge, capercailzie, woodcock, ptarmigan and hares.

Industries.—The shire is famous for its dyeing and bleaching works, which are situated in Perth and its vicinity; but, apart from these, there are flax and jute mills at Rattray and cotton mills at Stanley, Deanston and Crieff; woollens, linen, jute and tartans are woven at Dunblane, Alyth, Blairgowrie, Coupar-Angus, Auchterarder and Crieff; tanning is carried on at Blackford, Coupar-Angus and Crieff; there are breweries and distilleries at various places, as at Auchterarder and Logierait; granite, freestone, limestone and slate are quarried at different centres; and there are sawmills and flour-mills.

Communications.—The Caledonian railway main line to Aberdeen enters the county near Dunblane and runs in a north-easterly direction via Perth. At Crieff junction it sends off a branch to Crieff and at Perth branches to Dundee and Lochearnhead. The Stirling to Oban line of the same company crosses the shire from Dunblane to Tyndrum. The Highland railway runs northwards from Perth, and has a branch at Ballinluig to Aberfeldy. Branches of the North British railway reach Perth from Mawcarse in Kinross-shire and Ladybank in Fifeshire; part of the branch from Buchlyvie on the Forth and Clyde line runs to Aberfoyle, and the West Highland railway skirts the extreme west of the shire. At several points coaches supplement the rail. In the tourist season steamers ply on Loch Tay and Loch Katrine, and there is a service on the Tay between Perth and Dundee.

Population and Administration.—In 1891 the population amounted to 122,185 and in 1901 to 123,283, or 49 persons to the sq. m. The rate of increase was the smallest of any Scottish county for the decade. In 1901 there were 78 persons speaking Gaelic only and 11,446 Gaelic and English. The chief towns are Perth (pop. 32,873), Crieff (5208), Blairgowrie (3378), Dunblane (2516), Auchterarder (2276), Coupar-Angus (2064), Rattray (2019). Among lesser centres may be mentioned Aberfeldy (1508), a favourite resort on the Tay, well known for the falls of Moness, mentioned in Robert Burns's song "The Birks of Aberfeldy"; Abernethy (623), the seat of an early bishopric, retaining one of the three ancient round towers in Scotland; Alyth (1965); Callander (1458); Comrie (1118), a holiday resort on the Earn; Pitlochry (1541); and Stanley (1035), on the Tay. Of old the county was divided into hereditary jurisdictions, which were abolished in 1748, and in 1795 the county was divided into districts for administrative purposes, a system which obtained until 1889, when county and district councils were established. The sheriffdom is divided into an eastern and western district, the seat of the one being Perth and the other Dunblane. For parliamentary purposes the county is also divided into an eastern and a western division, and the city of Perth returns a member. The shire is under school-board jurisdiction, and there are secondary schools at Perth and Crieff, and Trinity College in Glen Almond is a well-known public school on the English model.

History.—In 83 Agricola explored the lands beyond the Forth and in the following year penetrated to the Grampians, defeating the Caledonians under Galgacus with great slaughter. The site of this battle is conjectured by William Forbes Skene to have been near Meikleour, south of Blairgowrie, but other writers have referred it to Dalginross, near Comrie; to Ardoch (where there are the most perfect remains of a Roman encampment in the British Isles); and even as far north as Raedykes, near Stonehaven in Kincardineshire. The Romans did not pursue their victory, and the Picts were left undisturbed for a considerable period. At this time, according to Ptolemy, the territory now known as Perthshire was occupied by three tribes—the Damnonii, the Venicones and the Vacomagi. The Damnonii held Menteith, Strathearn and Fothrif (the western part of modern Fife and Kinross), with Alauna (Allan), just above Stirling, Lindum (Ardoch) and Victoria (believed by some authorities to be Lochore in Fifeshire, and by others to be Perth city), as their chief towns. The Venicones inhabited north-western Fife and the adjoining tract of Perthshire, with Orrea (probably Abernethy) as their chief town and a station at Ardargie. The Vacomagi dwelt in the Highland region, with stations at Inchtuthil (a peninsula in the Tay above Kinclaven) and Banatia (Buchanty on the Almond). The growing lawlessness of the southern Picts and their frequent raids in the more settled country in the south at last compelled the attention of the emperor Severus. He arrived in Britain in 208, but though he led a strong army to the shores of the Moray Firth, he was unable effectually to subdue the tribesmen. The road he constructed ran from Stirling to Ardoch (where there are notable remains) and thence by Strageath, near Muthill, where it branched north-westwards to Dalginross and Buchanty, and north-eastwards to Perth and so to the Grampians. When the Romans finally withdrew from Britain, the Picts established their capital first at Abernethy and then at Forteviot. Abernethy was the centre of the Celtic church after the conversion of the natives by Ninian, Palladius and other missionaries in the 5th and 6th centuries. On the burning of Forteviot by the Norsemen in the 8th century, the seat of Pictish government was removed to Scone. In the latter half of the 9th century Dunkeld—to which Kenneth Macalpine had brought some of the relics of Columba from Iona—became the scene of monastic activity, the abbot succeeding to the position of the abbot of Iona, and exercising great influence for nearly a hundred years. The Danes periodically harried the land, but a crushing defeat at Luncarty in 961 put an end to their inroads in this quarter. In 1054 Macbeth was defeated at Dunsinane by Siward, earl of Northumberland, who had invaded Scotland in the interest of his kinsman, Duncan's son, who, on the death of the usurper three years later, ascended the throne as Malcolm III., called Canmore. With Malcolm's accession the Celtic rule of the monarchy of Scone came to an end. Nevertheless, the Scottish sovereigns (excepting James II., James III. and Mary) continued to be crowned at Scone, which also retained the position of capital until the beginning of the 12th century, when it was displaced by Perth. From the time of Alexander I. (d. 1124), therefore, the history of the shire is merged in that of the county town, with the exception of such isolated incidents as the removal of the Coronation Stone from Scone to Westminster in 1296, the defeat of Robert Bruce at Methven in 1306, the battle of Dupplin in 1332, the victory of Dundee at Killiecrankie in 1689 and the indecisive contest at Sheriffmuir in 1715. Among archaeological remains may be mentioned the hill-fort on Dunsinane; the ship-barrow of the vikings at Rattray, weems (or earth-houses) in the parishes of Monzie, Alyth and Bendochy; the witch-stone near Cairnbeddie, one of the numerous spots where Macbeth is alleged to have met the witches, but probably a sepulchral memorial of some forgotten battle; standing stones near Pitlochry, and an extraordinary assemblage of sculptured stones at Meigle.

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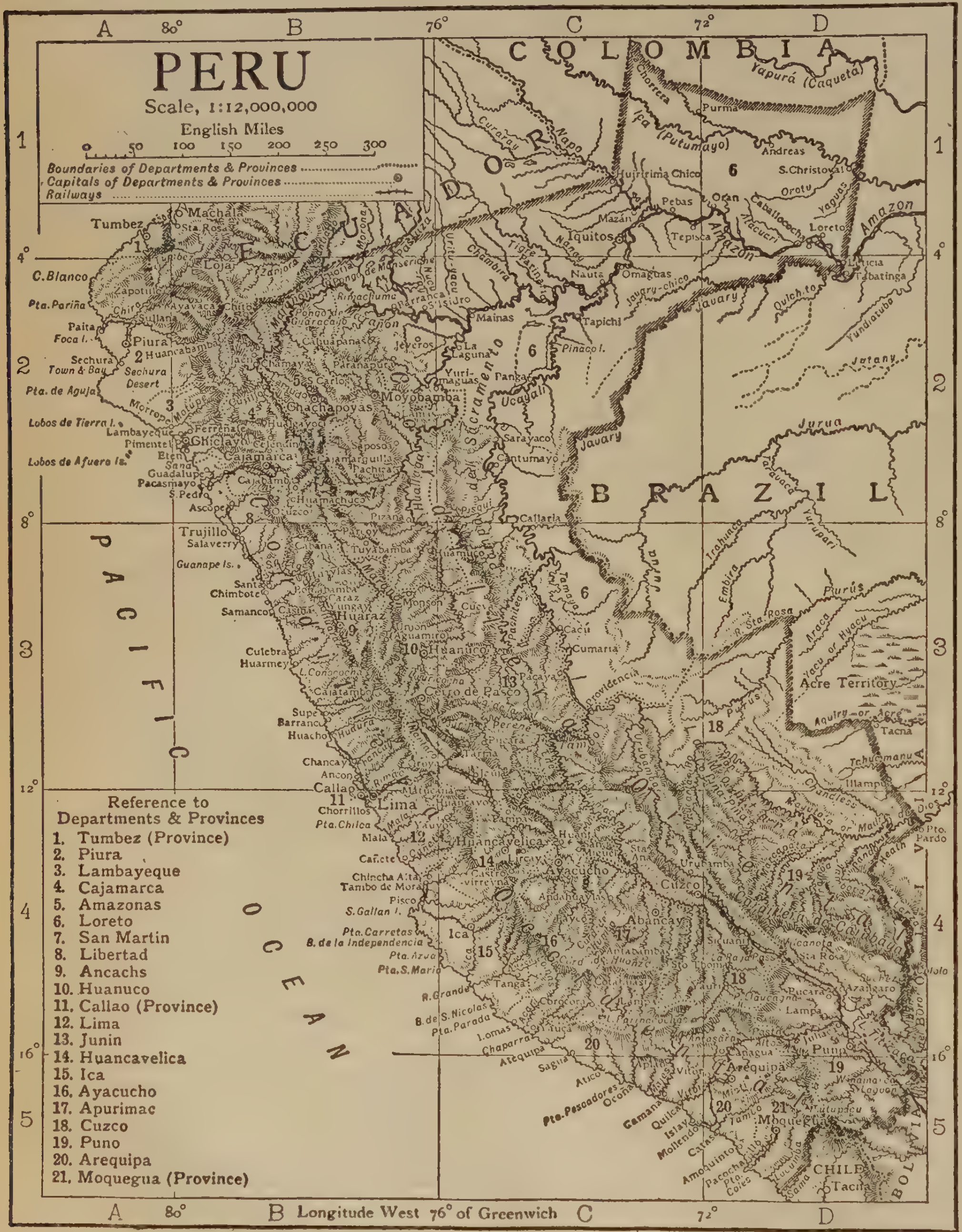
PERTINAX, PUBLIUS HELVIUS (A.D. 126–193), Roman emperor, the son of a charcoal-burner, was born at Alba Pompeia in Liguria. From being a teacher of grammar he rose through many important offices, both civil and military, to the consulate, which he held twice. Chosen, at an advanced age and against his will, on the 1st of January 193, to succeed Commodus, he was himself assassinated in a mutiny of the soldiers, on the 28th of March 193.

PERTZ, GEORG HEINRICH (1795–1876), German historian, was born at Hanover on the 28th of March 1795. From 1813 to 1818 he studied at Göttingen, chiefly under A. H. L. Heeren. His graduation thesis, published in 1819, on the history of the Merovingian mayors of the palace, attracted the attention of Baron Stein, by whom he was engaged in 1820 to edit the Carolingian chroniclers for the newly-founded Historical Society of Germany. In search of materials for this purpose, Pertz made a prolonged tour through Germany and Italy, and on his return in 1823 he received at the instance of Stein the principal charge of the publication of *Monumenta germaniae historica*, texts of all the more important historical writers on German affairs down to the year 1500, as well as of laws, imperial and regal archives, and other valuable documents, such as letters, falling within this period. Pertz made frequent journeys of exploration to the leading libraries and public record offices of Europe, publishing notes on the results of his explorations in the *Archiv. der Gesellsch. f. deutsche Geschichtskunde* (1824–1872). In 1823 he had been made secretary of the archives, and in 1827 principal keeper of the royal library at Hanover; from 1832 to 1837 he edited the *Hannoverische Zeitung*, and more than once sat as a representative in the Hanoverian second chamber. In 1842 he was called as chief librarian to Berlin, where he shortly afterwards was made a privy councillor and a member of the Academy of Sciences. He resigned all his appointments in

1874, and on the 7th of October 1876 died at Munich while attending the sittings of the historical commission.

The *Monumenta* began to appear in 1826, and at the date of his resignation 24 volumes folio (*Scriptores*, *Leges*, *Diplomata*) had appeared. This work for the first time made possible the existence of the modern school of scientific historians of medieval Germany. In connexion with the *Monumenta* Pertz also began the publication of a selection of sources in octavo form, the *Scriptores rerum germanicarum in usum scholarum*; among his other literary labours may be mentioned an edition of the *Gesammelte Werke* of Leibnitz, and a life of Stein (*Leben des Ministers Freiherrn vom Stein* (6 vols., 1849–1855); also, in an abridged form, *Aus Steins Leben* (2 vols., 1856).


PERU
Scale, 1:12,000,000
English Miles
0 50 100 150 200 250 300
Boundaries of Departments & Provinces
Capitals of Departments & Provinces
Railways
COLOMBIA
BRAZIL
PACIFIC OCEAN
CHILE
BOLIVIA
Reference to Departments & Provinces
1. Tumbez (Province)
2. Piura
3. Lambayeque
4. Cajamarca
5. Amazonas
6. Loreto
7. San Martin
8. Libertad
9. Ancachs
10. Huanuco
11. Callao (Province)
12. Lima
13. Junin
14. Huancavelica
15. Ica
16. Ayacucho
17. Apurimac
18. Cuzco
19. Puno
20. Arequipa
21. Moquegua (Province)
Longitude West 76° of Greenwich

Emery Walker sc.

PERU (apparently from *Biru*, a small river on the west coast of Colombia, where Pizarro landed), a republic of the Pacific coast of South America, extending in a general N.N.W.–S.S.E. direction from lat. 3° 21′ S. to about 18° S., with a sea-coast of 1240 m. and a width of 300 to 400 m., exclusive of territories in dispute. Its area in 1906, including Tacna and Arica, and other disputed territories occupied by neighbouring states, was officially estimated at 1,752,422 sq. kilometers, or 676,638 sq. m.; exclusive of these territories, the area of Peru is variously estimated at 439,000 to 480,000 sq. m., the Gotha measurements being 1,137,000 sq. kilometers, or 439,014 sq. m.

With the exception of parts of the Ecuador, Brazil and Bolivia frontiers, all the boundary lines have been disputed and referred to arbitration—those with Colombia and Ecuador to the king of Spain, and that with Bolivia to the president of Argentina, on which a decision was rendered on the 9th of July 1909. There have been misunderstandings with Ecuador in regard to some small areas in the Chira valley, but it may be assumed that the line is fixed between Santa Rosa (3° 21′ S.) on the Gulf of Guayaquil, and the Chinchipe river, a tributary of the Marañon. At the junction of the Cauches with that river, that Ecuadorean line descends the Chinchipe to the Marañon, and the Peruvian ascends to a point where it is intersected by a line following the eastern Cordillera northward to the head-waters of the Caquetá, or Japurá, which forms the northern boundary down to the Brazilian frontier. This claim covers all eastern Ecuador and a large part of south-eastern Colombia. In 1903 there were encounters between small bodies of Peruvian and Ecuadorean troops on the disputed frontier. After arbitration by the king of Spain had been agreed upon, the question was considered by two Spanish commissions, and modifications favouring Peru were recommended. These became known prematurely, and in May 1910 war was threatened between Peru and Ecuador in spite of an offer of mediation by the United States, Brazil and Argentina under the Hague Convention.

From the Japurá southward to the Amazon, in 4° 13′ 21″ S., 69° 35′ W., and thence up the Javary, or Yavari, to its source in 7° 8′ 4″ S., 73° 46′ 30″ W., as determined by a mixed commission, the line has been definitely settled. From near the source of the Javary, or lat. 7° 1′ 17″ S., a line running eastward to the Madeira in lat. 6° 52′ 15″ S., which is half the distance between the mouth of the Mamoré and the mouth of the Madeira, divides the Spanish and Portuguese possessions in this part of South America, according to the provisions of the treaty of San Ildefonso of 1777. This line has been twice modified by treaties between Bolivia and Brazil, but without the consent of Peru, which claimed all the territory eastward to the Madeira between the above-mentioned line and the Beni-Madidi rivers, the line of demarcation following the Pablo-bamba, a small tributary of the Madidi, to its source, and thence in a straight line to the village of Conima, on Lake Titicaca. The dispute with Brazil relates to the territory acquired by that republic from Bolivia in 1867 and 1903, and was to be settled, according to an agreement of 1908, by direct negotiation if possible, or, failing this, by arbitration. The decision of the president of Argentina of the 9th of July 1909, in regard to the remainder of this extensive territory, was a compromise, and divided it into two nearly equal parts. The line adopted starts from Lake Suches, the source of a small river of that name flowing into the north of Lake Titicaca, crosses the Cordillera by the Palomani to the Tambopata river, follows that stream to the mouth of the Lanza, thence crosses to the source of the Heath river, which forms the dividing line down to its junction with the Madre de Dios, descends that river to the mouth of the Torosmonas, thence in a straight line north-westerly to the intersection of the Tahuamanu river by the 69th meridian, and thence north on that meridian to the Brazilian frontier. This decision at first gave offence to the Bolivians, but friendly overtures from Peru led to its acceptance by both parties with the understanding that modifications would be made in locating the line wherever actual settlements had been made by either party on territory awarded to the other. With Chile the *de jure* line is that of the Camarones ravine which separated the old department of Moquegua (including the provinces of Tacna and Arica) from that of Tarapacá. The *de facto* line is that of the Sama river (usually dry), which opens on the coast a little south of Sama point, near 18° S., Chile retaining possession of the two above-mentioned provinces in violation of the treaty of Ancon, which she forced upon her defeated antagonist.

Physical Geography.—Peru is divided longitudinally into three well-defined regions, the coast, the sierra and the montaña. The coast, extending from the base of the Western or Maritime Cordillera to the Pacific Ocean, consists of a sandy desert crossed at intervals by rivers flowing through narrow, fertile valleys. The sierra is the region of the Andes, and is about 250 m. in width. It contains stupendous chains of mountains, elevated plains and table-lands, warm and fertile valleys and ravines. The montaña is the region of tropical forests within the valley of the Amazon, and skirts the eastern slopes of the Andes.

The Coast.

The coast has been upraised from the ocean at no very distant geological epoch, and is nearly as destitute of vegetation as the African Sahara. It is watered, however, by fifty streams which cross the desert at intervals. Half of these have their origin in the summits of the Andes, and run with a permanent supply of water into the ocean. The others, rising in the outer range, which does not reach the snow-line and receives less moisture, carry a volume of water to the sea during the rainy season, but for the rest of the year are nearly dry. The absence of rain here is ascribed to the action of the lofty uplands of the Andes on the trade-wind, and to the influence of the cold Humboldt current sweeping northward along the west coast of the continent. The south-east trade-wind blows obliquely across the Atlantic Ocean until it reaches Brazil. By this time it is heavily laden with vapour, which it continues to bear along across the continent, depositing it and supplying the sources of the Amazon and La Plata. When the wind rises above the snow-capped Andes, the last particle of moisture is wrung from it that a very low temperature can extract. Passing the summit of that range, it rushes down as a cool and dry wind on the Pacific slopes beyond. Meeting with no evaporating surface, and with no temperature colder than that to which it is subjected on the mountain-tops, this wind reaches the ocean before it becomes charged with fresh moisture. The constantly prevailing wind on the Peruvian coast is from the south, which is a cold wind from the Humboldt current. As it moves north it becomes gradually warmed and takes up moisture instead of depositing it as rain. From November to April there are usually constant dryness, a clear sky, and considerable, though by no means oppressive, heat. From June to September the sky is obscured for weeks together by fog, which is often accompanied by drizzling rain called *garua*. At the time when it is hottest and driest on the coast it is raining heavily in the Andes, and the rivers are full. When the rivers are at their lowest, the *garua* prevails on the coast. The climate of various parts of the coast, however, is modified by local circumstances.

The Western Cordillera, overhanging the Peruvian coast, contains a long line of volcanic mountains, most of them inactive, but their presence is probably connected with the frequent and severe earthquakes, especially in the southern section of the coast. Since 1570 seventy violently destructive earthquakes have been recorded on the west coast of South America, but the register is incomplete in its earlier part. The most terrible was that of 1746, which destroyed Callao, on the 28th of October, and there were 220 shocks in the following twenty-four hours. The town was overwhelmed by a vast wave, which rose 80 ft.; and the shocks continued until the following February. On the 13th of August 1868 an earthquake nearly destroyed Arequipa, and great waves rolled in upon the ports of Arica and Iquique. On the 9th of May 1877 nearly all the southern ports were overwhelmed.

The deserts between the river-valleys vary in extent, the largest being more than 70 m. across. On their western margin steep cliffs generally rise from the sea, above which is the *tablazo* or plateau, in some places slightly undulating, in others with ridges of considerable height rising out of it. The surface is generally hard, but in many places there are large accumulations of drifting sea-sand. The sand usually forms isolated hillocks, called *medanos*, of a half-moon shape, having their convex sides towards the trade-wind. They are from 10 to 20 ft. high, with an acute crest, the inner side perpendicular, the outer with a steep slope. Sometimes, especially at early dawn, there is a musical noise in the desert, like the sound of distant drums, which is caused by the eddying of grains of sand in the heated atmosphere, on the crests of the *medanos*.

Coast Flora.

Apparently the deserts are destitute of all vegetation; yet three kinds of herbs exist, which bury themselves deep in the earth, and survive long periods of drought. One is an amaranthaceous plant, whose stems ramify through the sandhills; the other two are a *Martynia* and an *Aniseia*, which maintain a subterranean existence during many years, and only produce leafy stems in those rare seasons when sufficient moisture penetrates to the roots. In a few hollows which are reached by moisture the trees of the desert find support, the *algarrobo* (*Prosopis horrida*), a low tree of very scraggy growth, the *vichaya* (*Capparis crotonoides*), and the *zapote del perro* (*Colicodendrum scabridum*), mere shrubs. Near the Cordillera and on its lower slopes a tall branched cactus is met with, and there are *Salicornias* and *Salsolas* near the coast. But, when the mists set in, the low hills near the coast bordering the deserts, which are called *lomas*, undergo a change as if by magic. A blooming vegetation of wild flowers for a short time covers the barren hills. Near Lima one of the low ranges is brightened by the beautiful yellow lily called *amancaes* (*Ismene Amancaes*). The other flowers of the *lomas* are the *papita de San Juan* (*Begonia geranifolia*), with red petals contrasting with the white inner sides, valerians, the beautiful *Bomarea ovata*, several species of *Oxalis*, *Solanum* and crucifers. But this carpet of flowers is very partially distributed and lasts but a short time.

The valleys form a marvellous contrast to the surrounding desert. A great mass of pale-green foliage is usually composed of the *algarrobo* trees, while the course of the river is marked by lines or groups of palms, by fine old willows (*Salix humboldtiana*), fruit-gardens, and fields of cotton, Indian corn, sugar-cane and alfalfa (lucerne). In some valleys there are expanses of sugar-cane, in others cotton, whilst in others vineyards and olive-yards predominate. The woods of *algarrobo* are used for pasture, cattle and horses enjoying the pendulous yellow pods.

Sections of the Coast.

For purposes of description the coast-region of Peru may be divided into five sections, beginning from the north: (1) the Piura region; (2) the Lambayeque and Trujillo section; (3) the Santa valleys; (4) the section from Lima to Nasca; (5) the Arequipa and Tacna section.

(1) The great desert-region of Piura extends for nearly 200 m. from the Gulf of Guayaquil to the borders of the Morrope Valley, and is traversed by three rivers—the Tumbes, Chira and Piura, the two former receiving their waters from the inner Cordillera and breaking through the outer range. It is here that the coast of South America extends farthest to the westward until it reaches Capes Blanco and Pariña, and then turns southward to the Bay of Paita. The climate of Piura is modified by the lower latitude, and also by the vicinity of the forests of Guayaquil. Fog and *garua* are much less frequent than in the coast-region farther south, while rain sometimes falls. At intervals of three or four years there are occasional heavy showers of rain from February to April. (2) The second section of the coast-region includes the valleys of the Morrope, the Chiclayo, and Lambayeque, the Saña, the Jequetepeque, the Chicama, Moche, Viru and Chao. With the intervening deserts this section extends over 200 m. All these valleys, except Morrope and Chao, are watered by rivers which have their sources far in the recesses of the mountains, and which furnish an abundant supply in the season when irrigation is needed. (3) The third section, also extending for 200 m., contains the valleys of Santa, Nepeña, Casma, Huarmey, Fortaleza, Pativilca, Supé and Huaura. The river Santa, which rises in the lake of Conococha, 12,907 ft. above the sea, and has a length of 180 m., is remarkable for its long course between the outer and central ranges of the Andes, in a trough known as the "Callejon de Huaylas," 100 m. in length. It then breaks through in a deep gorge, and reaches the sea after a course of 35 m. over the coast-belt, and after fertilizing a rich valley. The Santa and Nepeña valleys are separated by a desert 8 leagues in width, on the shores of which there is a good anchorage in the bay of Ferrol, where the port of Chimbote is the terminus of a railway. The Nepeña, Casma, Huarmey, Fortaleza and Supé rivers rise on the slope of an outer range called the Cordillera Negra, and are consequently dry during the great part of the year. Wells are dug in their beds, and the fertility of the valleys is thus maintained. The Pativilca (or Barranca) river and the Huaura break

through the outer range from their distant sources in the snowy Cordillera, and have a perennial supply of water. There are 9 leagues of desert between the Nepeña and Casma, 16 between the Casma and Huarmey, and 18 between the Huarmey and Fortaleza. The latter desert, much of which is loose sand, is called the *Pampa de Mata Cavallos*, from the number of exhausted animals which die there. Between the Supé and Pativilca is the desert called the *Pampa del Medio Mundo*. (4) The next coast-section extends for over 300 m., from Chancay to Nasca, and includes the rivers of Chancay or Lacha, of Carabayllo, Rimac, Lurin, Mala, Cañete, Chincha, Pisco or Chunchanga, Ica and Rio Grande. Here the maritime range approaches the ocean, leaving a narrower strip of coast, but the fertile valleys are closer and more numerous. Those of Carabayllo and Rimac are connected, and the view from the Bay of Callao extends over a vast expanse of fertile plain bounded by the Andes, with the white towers of Lima in a setting of verdure. Lurin and Mala are smaller valleys, but the great vale of Cañete is one green sheet of sugar-cane; and narrow strips of desert separate it from the fertile plain of Chincha, and Chincha from the famous vineyards of Pisco. The valleys of Ica, Palpa, San Xavier and Nasca are rich and fertile, though they do not extend to the sea; but between Nasca and Acari there is a desert 60 m. in width. (5) The Arequipa and Tacna section extends over 350 m. and comprises the valleys of Acari, Atequipa, Atico, Ocoña, Majes or Camana, Quilca, with the interior valley of Arequipa, Tambo, Ilo or Moquegua, Ité or Locumba, Sama, Tacna, and Azapa or Arica. Here the Western Cordillera recedes, and the important valley of Arequipa, though on its western slope, is 7000 ft. above the sea and 90 m. from the coast. Most of the rivers here have their sources in the central range, and are well supplied with water. The coast-valleys through which they flow, especially those of Majes and Locumba, are famous for their vineyards, and in the valley of Tambo there are extensive olive plantations.

Islands. The coast of Peru has few protected anchorages, and the headlands are generally abrupt and lofty. These and the few islands are frequented by sea-birds, whence come the guano-deposits, the retention of ammonia and other fertilizing properties being due to the absence of rain. The islets off the coast are all barren and rocky.

The most northern is Foca, in 5° 13′ 30″ S., near the coast to the south of Paita. The islands of Lobos de Tierra and Lobos de Afuera (2) in 6° 27′ 45″ S. and 6° 56′ 45″ S. respectively, are off the desert of Sechura, and contain deposits of guano. The two Afuera islands are 60 and 36 m. respectively from the coast at the port of San José. The islets of Macabi, in 7° 49′ 20″ S., also have guano deposits, now practically exhausted. The two islets of Guañape, surrounded by many rocks, in 8° 34′ S., contain rich deposits. Chao rises 450 ft. above the sea, off the coast, in 8° 46′ 30″ S. Corcobado is in 8° 57′ S. La Viuda is off the port of Casma, in 9° 23′ 30″ S.; and Tortuga is 2 m. distant to the north. Santa Islet lies off the bay of Cosca, in 9° 1′ 40″, and the three high rocks of Ferrol in 9° 8′ 30″ S. Farther south there is the group of islets and rocks called Huaura, in 11° 27′ S., the chief of which are El Pelado, Tambillo, Chiquitana, Bravo, Quitacalzones and Mazorque. The Hormigas are in 11° 4′ S. and 11° 58′, and the Pescadores in 11° 47′ S. The island of San Lorenzo, in 12° 4′ S., is a lofty mass, 4½ m. long by 1 broad, forming the Bay of Callao; its highest point is 1050 ft. Off its south-east end lies a small but lofty islet called Fronton, and to the south-west are the Palomitas Rocks. Horadada Islet, with a hole through it, is to the south of Callao Point. Off the valley of Lurin are the Pachacamac Islands, the most northern and largest being half a mile long. The next, called San Francisco, is like a sugar-loaf, perfectly rounded at the top. The others are mere rocks. Asia Island is farther south, 17 m. north-west of Cerro Azul, and about a mile in circuit. Pisco Bay contains San Gallan Island, high, with a bold cliff outline, 2½ m. long by 1 broad, the Ballista Islets, and farther north the three famous Chincha Islands, whose vast guano deposits are now exhausted. South of the entrance to Pisco Bay is Zarate Island, and farther south the white level islet of Santa Rosa. The Infiernillo rock is quite black, about 50 ft. high, in the form of a sugar-loaf, a mile west of the point of Santa Maria, which is near the mouth of the Ica river. Alacran is a small islet off the lofty "morro" of Arica. All these rocks and islets are barren and uninhabitable. The more common sea-birds are the *Sula variegata* or guano-bird, a large gull called the *Larus modestus*, the *Pelecanus thayus*, and the *Sterna Ynca*, a beautiful tern with curved white feathers on each side of the head. The rarest of all the gulls is also found on the Peruvian coast, namely, the *Xema furcatum*. Sea-lions (*Otaria forsteri*) are common on the rocky islands and promontories.

Sierra. The region of the Cordilleras of the Andes is divided into *puna*, or lofty uninhabited wilderness, and *sierra*, or inhabitable mountain slopes and valleys. This great mountain-system, running south-east to north-west, consists of three chains or cordilleras. The two chains, which run parallel and near each other on the western side, are of identical origin, and have been separated by the action of water during many centuries. On these chains are the volcanoes and many thermal springs. The narrow space between them is for the most part, but not always, a cold and lofty region known as the *puna* containing alpine lakes—the sources of the coast-rivers. The great eastern chain, rising from the basin of the Amazon and forming the inner wall of the system, is of distinct origin. These three chains are called the Western or Maritime Cordillera, the Central Cordillera and the Andes. Paz Soldan and other Peruvian geographers give the name of Andes, *par excellence*, to the Eastern Cordillera.

The Maritime Cordillera of Peru has no connexion with the coast ranges of Chile, but is a continuation of the Cordillera Occidental of Chile, which under various local names forms the eastern margin of the coastal desert belt from Atacama northward into Peru. It contains a regular chain of volcanic peaks overlooking the coast-region of Tarapacá. Chief among them are the snowy peak of Lirima (19,128 ft.) over the ravine of Tarapacá, the volcano of Isluga overhanging Camiña, the Bolivian peak of Sajama, and Tocora (19,741 ft.) near the Bolivian frontier. In rear of Moquegua there is a group of volcanic peaks, clustering round those of Ubinas and Huaynaputina. A great eruption of Huaynaputina began on the 15th of February 1600 and continued until the 28th. But generally these volcanoes are quiescent. Farther north the Misti volcano rises over the city of Arequipa in a perfect cone to a height of over 20,013 ft., and near its base are the hot sulphur and iron springs of Yura. The peak of Sarasara, in Parinacochas (Ayacucho) is 19,500 ft. above the sea, and in the mountains above Lima the passes attain a height of more than 15,000 ft. In latitude 10° S. the maritime chain separates into two branches, which run parallel to each other for 100 m., enclosing the remarkable ravine of Callejon de Huaylas—the eastern or main branch being known as the Cordillera Nevada and the western as the Cordillera Negra. On the Nevada the peak of Huascan reaches a height of 22,051 ft. The Huandoy peak, above Carhuaz, rises to 21,088 ft.; the Hualcan peak, overhanging the town of Yungay, is 19,945 ft. high; and most of the peaks in this part of the chain reach a height of 19,000 ft. During the rainy season, from October to May, the sky is generally clear at dawn, and the magnificent snowy peaks are clearly seen. But as the day advances the clouds collect. In most parts of the Peruvian Andes the line of perpetual snow is at 16,400 ft.; but on the Cordillera Nevada, above the Callejon de Huaylas, it sinks to 15,400 ft. This greater cold is caused by the intervention of the Cordillera Negra, which intercepts the warmth from the coast. As this lower chain does not reach the snow-line, the streams rising from it are scanty, while the Santa, Pativilca and other coast-rivers which break through it from sources in the snowy chain have a greater volume from the melted snows. At the point where the river Santa breaks through the Cordillera Negra that range begins to subside, while the Maritime Cordillera continues as one chain to and beyond the frontier of Ecuador.

The Central Cordillera is the true water-parting of the system. No river, except the Marañon, breaks through it either to the east or west, while more than twenty coast streams rise on its slopes and force their way through the maritime chain. The Central Cordillera consists mainly of crystalline and volcanic rocks, on each side of which are aqueous, in great part Jurassic, strata thrown up almost vertically. In 14° 30′ S. the central chain is connected with the Eastern Andes by the transverse mountain-knot of Vilcañota, the peak of that name being 17,651 ft. above the sea. The great inland basin of Lake Titicaca is thus formed. The central chain continues to run parallel with the Maritime Cordillera until, at Cerro Pasco, another transverse knot connects it with the Andes in 10° 30′ S. lat. It then continues northward, separating the basins of the Marañon and Huallaga; and at the northern frontier of Peru it is at length broken through by the Marañon flowing eastward.

The Eastern Andes is a magnificent range in the southern part of Peru, of Silurian formation, with talcose and clay slates, many quartz veins and eruptions of granitic rocks. Mr Forbes says that the peaks of Illampu (21,709 ft.) and Illimani (21,014 ft.) in Bolivia are Silurian and fossiliferous to their summits. The eastern range is cut through by six rivers in Peru, namely, the Marañon and Huallaga, the Perene, Mantaro, Apurimac, Vilcamayu and Paucartambo, the last five being tributaries of the Ucayali. The range of the Andes in south Peru has a high plateau to the west and the vast plains of the Amazonian basin to the east. The whole range is highly auriferous, and the thickness of the strata is not less than 10,000 ft. It is nowhere disturbed by volcanic eruptions, except at the very edge of the formation near Lake Titicaca, and in this respect it differs essentially from the Maritime Cordillera. To the eastward numerous spurs extend for varying distances into the great plain of the Amazons.

The Andes lose their majestic height to the northward; and beyond Cerro Pasco the eastern chain sinks into a lower range between the Huallaga and Ucayali. But throughout the length of Peru the three ranges are clearly defined.

Sections of Sierra. For purposes of description the sierra of Peru may be divided into four sections, each embracing portions of all three ranges. The first, from the north, comprises the upper basins of the Marañon and the Huallaga, and is 350 m. long by 100 broad. The second extends from the Knot of Cerro Pasco to Ayacucho, about 200 m., including the Lake of Chinchay-cocha and the basin of the river Xauxa. The third or Cuzco section extends 250 m. to the Knot of Vilcañota with the basins of the Pampas, Apurimac, Vilcamayu and Paucartambo. The fourth is the basin of Lake Titicaca.

Lake Junin, or Chinchay-cocha, in the second section, is 36 m. long by 7 m. broad, and 13,232 ft. above the sea. Its marshy banks are overgrown with reeds and inhabited by numerous waterfowl. From this lake the river Xauxa flows southwards through a populous valley for 150 m. before entering the forests. Lake Titicaca (see Bolivia), in the fourth or most southern section, is divided between Peru and Bolivia. It receives a number of short streams from the ranges shutting in the upper end of the valley; the largest is the Ramiz, formed by the two streams of Pucara and Azangaro, both coming from the Knot of Vilcañota to the north. The Suches, which has its source in Lake Suches, falls into Lake Titicaca on the north-west side, as well as the Yllpa and Ylave. The principal islands are Titicaca and Coati (at the south end near the peninsula of Copacabana), Campanaria (9 m. from the east shore), Soto and Esteves. There are two other lakes in the *Collao*, as the elevated region round Titicaca is called. Lake Arapa, a few miles from the northern shore of Titicaca, is 30 m. in circumference. Lake Umayo is on higher ground to the westward. The lake in Peru which is third in size is that of Parinacochas on the coast watershed, near the foot of the snowy peak of Sarasara. It is 12 m. long by 6 broad, but has never been visited and described by any modern traveller. The smaller alpine lakes, often forming the sources of rivers, are numerous.

The great rivers of the sierra are the Marañon, rising in the lake of Lauricocha and flowing northward in a deep gorge between the Maritime and Central Cordilleras for 350 m., when it forces its way through the mountains at the famous Pongo de Manseriche and enters the Amazonian plain. The Huallaga rises north of Cerro Pasco, and, passing Huanuco, flows northwards on the other side of the Central Cordillera for 300 m. It breaks through the range at the Pongo de Chasuta and falls into the Marañon. The other great rivers are tributaries of the Ucayali. The Pozuzu, flowing eastward from the Knot of Cerro Pasco, joins the Pachitea, which is the most important northern affluent of the Ucayali. The Xauxa, becoming afterwards the Mantaro, receives the drainage of Xauxa, Huancavelica and Ayacucho. The southern valleys of this part of the sierra furnish streams which form the main rivers of Pampas, Pachachaca and Apurimac. These, uniting with the Mantaro, form the Ené, and the Ené and Perené (which drains the province of Tambo) form the Tambo. The Vilcamayu rises on the Knot of Vilcañota, flows north through a lovely valley, received the Yanatilde and Paucartambo on its right bank, and, uniting with the Tambo, forms the Ucayali. Most of these main streams flow through profound gorges in a tropical climate, while the upper slopes yield products of the temperate zone, and the plateaus above are cold and bleak, affording only pasture and the hardiest cereals.

Sierran Flora and Fauna.

The great variety of elevation within the sierra produces vegetation belonging to every zone. There is a tropical flora in the deep gorges, higher up a sub-tropical, then a temperate, then a sub-arctic flora. In ascending from the coast-valleys there is first an arid range, where the great-branched cacti rear themselves up among the rocks. Farther inland, where the rains are more plentiful, is the native home of the potato. Here also are other plants with edible roots—the *oca* (*Oxalis tuberosa*), *ulluca* (*Ullucus tuberosus*), *massua* (*Tropæolum tuberosum*), and *learcó* (*Polymnia sonchifolia*). Among the first wild shrubs and trees that are met with are the *chilca* (*Baccharis Feuillei*), with a pretty yellow flower, the *Mutisia acuminata*, with beautiful red and orange flowers, several species of *Senecio*, calceolarias, the *Schinus molle*, with its graceful branches and bunches of red berries, and at higher elevations the *lambras* (*Alnus acuminata*), the *sauco* (*Sambucus peruviana*), the *queñuar* (*Buddleia incana*), and the *Polylepis racemosa*. The *Buddleia*, locally called *oliva silvestre*, flourishes at a height of 12,000 ft. round the shores of Lake Titicaca. The most numerously represented family is the *Compositae*, the grasses being next in number. The temperate valleys of the sierra yield fruits of many kinds. Those indigenous to the country are the delicious *chirimoyas*, *paltas* or alligator pears, the *paccay*, a species of *Inga*, the *lucma*, and the *granadilla* or fruit of the passion-flower. Vineyards and sugar-cane yield crops in the warmer ravines; the sub-tropical valleys are famous for splendid crops of maize; wheat and barley thrive on the mountain slopes; and at heights from 7000 to 13,000 ft. there are crops of *quinua* (*Chenopodium quinua*). In the loftiest regions the pasture chiefly consists of a coarse grass (*Stipa ychu*), of which the llamas eat the upper blades and the sheep browse on the tender shoots beneath. There are also two kinds of shrubby plants, a thorny *Composita* called "ccanlli" and another, called "tola," which is a resinous *Baccharis* and is used for fuel.

The animals which specially belong to the Peruvian Andes are the domestic llamas and alpacas and the wild vicuñas. There are deer, called *taruco* (*Cervus antisensis*); the *viscacha*, a large rodent; a species of fox called *atoc*; and the puma (*Felis concolor*) and *ucumari* or black bear with a white muzzle, when driven by hunger, wander into the loftier regions. The largest bird is the condor, and there is another bird of the vulture tribe, with a black and white wing feather formerly used by the Incas in their head-dress, called the *coraquenque* or *alcamari*. The *pito* is a brown speckled creeper which flutters about the rocks. There is a little bird, the size of a starling, with brown back striped with black, and white breast, which the Indians call *yncahualpa*; it utters a monotonous sound at each hour of the night. A partridge called *yutu* frequents the long grass. On the lakes there is a very handsome goose, with white body and dark-green wings shading into violet, called *huachua*, two kinds of ibis, a large gull (*Larus serranus*) frequenting the alpine lakes in flocks, flamingoes called *parihuana*, ducks and water-hens. Many pretty little finches fly about the maize-fields and fruit-gardens, and a little green parakeet is met with as high as 12,000 ft. above the sea.

Montaña.

The third division of Peru is the region of the tropical forests, at the base of the Andes, and within the basin of the Amazon. It is traversed by great navigable rivers. The Marañon, having burst through the defile of the Pongo de Manseriche (575 ft. above sea level), and the Huallaga through that of Chasuta, enter the forests and unite after separate courses of about 600 and 400 m., the united flood then flowing eastward to the Brazilian frontier. After 150 m. it is joined by the Ucayali, a great navigable river with a course of 600 m. The country between the Huallaga and the Ucayali, traversed by the Eastern Cordillera, is called the Pampa del Sacramento, and is characterized by extensive grassy plains. The forests drained by the Marañon, Huallaga and Ucayali form the northern portion of the Peruvian montaña. The southern half of the *montaña* is watered by streams flowing from the eastern Andes, which go to form the river Madre de Dios or Amaru-mayu, the principal branch of the river Beni, which falls into the Madeira. The region of the Peruvian montaña, which is 800 m. long from the Marañon to the Bolivian frontier, is naturally divided into two sections, the sub-tropical forests in the ravines and on the eastern slopes of the Andes, and the dense tropical forests in the Amazonian plain. The sub-tropical section is important from the value of its products and interesting from the grandeur and beauty of its scenery. Long spurs run off from the Andes, gradually decreasing in elevation, and it is sometimes a distance of 60 or 80 m. before they finally subside into the vast forest-covered plains of the Amazon basin. Numerous rivers flow through the valleys between these spurs, which are the native home of the quinine-yielding cinchona trees. The most valuable species, called *C. Calisaya*, is found in the forests of Caravaya in south Peru and in those of Bolivia. The species between Caravaya and the headwaters of the Huallaga yield very little of the febrifuge alkaloid. But the forests of Huanuco and Huamalios abound in species yielding the grey bark of commerce, which is rich in cinchonine, an alkaloid efficacious as a febrifuge, though inferior to quinine. With the cinchona trees grow many kinds of *melastomaceae*, especially the *Lasiandra*, with masses of purple flowers, tree-ferns and palms. In the warm valleys there are large plantations of coca (*Erythroxylon Coca*), the annual produce of which is stated at 15,000,000 ℔. The other products of these warm valleys are excellent coffee, cocoa, sugar, tropical fruits of all kinds, and gold in abundance. In the vast untrodden forests farther east there are timber trees of many kinds, incense trees, a great wealth of rubber trees of the *Hevea* genus, numerous varieties of beautiful palms, sarsaparilla, vanilla, ipecacuanha and copaiba. The abundant and varied fauna is the same as that of the Brazilian forests.

Geology.[1]—The Eastern Cordillera, which, however, is but little known, appears to consist, as in Bolivia, chiefly of Palaeozoic rocks; the western ranges of the Andes are formed of Mesozoic beds, together with recent volcanic lavas and ashes; and the lower hills near the coast are composed of granite, syenite and other crystalline rocks, sometimes accompanied by limestones and sandstones, which are probably of Lower Cretaceous age, and often covered by marine Tertiary deposits. Thus the orographical features of the country correspond broadly with the geological divisions.

The constitution of the Mesozoic band varies. Above Lima the western chain of the Andes is composed of porphyritic tuffs and massive limestones, while the longitudinal valley of the Oroya is hollowed in carbonaceous sandstones. From the analogy of the neighbouring countries it is possible that some of the tuffs may be Jurassic, but the other deposits probably belong for the most part to the Cretaceous system. The carbonaceous sandstone contains Gault fossils. Like the similar sandstone in Bolivia, it includes seams of coal and is frequently impregnated with cinnabar. It is in this sandstone that the rich mercury mines of Huancavelica are worked.

Farther north, in the department of Ancachs, the Mesozoic belt is composed chiefly of sandstones and shales, and the limestones which form so prominent a feature above Lima seem to have disappeared. The Cordillera Negra in this region is in many places cut by numerous dikes of diorite, and it is near these dikes that silver ores are chiefly found. In the Cordillera Nevada the Mesozoic rocks which form the chain are often covered by masses of modern volcanic rock. Similar rocks are also found in the Cordillera Negra, but the volcanic centres appear to have been in the Sierra Nevada.

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[1] See L. Crosnier, "Notice géologique sur les départements de Huancavelica et d'Ayacucho," *Ann. des mines*, 5th series, vol. ii. pp. 1–43, Pl. 1 (1852); A. Raimondi, *El Departamento de Ancachs y sus riquezas minerales* (Lima, 1873); G. Steinmann, "Ueber Tithon und Kreide in den peruanischen Anden," *Neues Jahrb.* (1882), vol. ii. pp. 130-153, Pls. 6-8; K. Gerhardt, "Beitrag zur Kenntniss der Kreideformation in Venezuela und Peru," *Neues Jahrb.*, Beil.–Bd. XI. (1897), pp. 65-117, Pls. 1, 2; J. Grzybowski, "Die Tertiärablagerungen des nördlichen Peru und ihre Molluskenfauna," *Neues Jahrb.*, Beil.-Bd. XII. (1899), pp. 610-664, Pls. 15-20.

Population.—The first trustworthy enumeration of the people of Peru was made in 1793, when there were 617,700 Indians, 241,225 mestizos (Indian and white inter-mixture), 136,311 Spaniards, 40,337 negro slaves and 41,404 mulattoes, making a total of 1,076,977, exclusive of the wild Indians of the *montaña.* Viceroy Toledo's enumeration of the Indians in 1575 gave them a total of 8,000,000, the greater part of whom had been sacrificed by Spanish cruelty. Others had withdrawn into the mountains and forests, and in the native villages under Spanish administration the birth rate had dropped to a small part of what it had been because the great bulk of the male population had been segregated in the mines and on the estates of the conquerors. This tells a story of depopulation under Spanish rule, to which the abandoned terraces (*andenes*) on the mountain sides, once highly cultivated, bear testimony. Several diverse totals have been published as the result of the census taken in 1876, which is considered imperfect. One estimate places the total at 2,660,881, comprising about 13·8% whites, 57·6% Indians, 1·9% negroes, 1·9% Asiatics, chiefly Chinese, and 24·8 % mixed races. In 1906 estimates were made under official auspices (see A. Garland, *Peru in 1906*, Lima, 1907), which gave the population as 3,547,829, including Tacna (8000). It is believed, however, that this and other larger estimates are excessive. There is no considerable immigration.

The population of Peru is mixed, including whites, Indians, Africans, Asiatics, and their mixtures and sub-mixtures. The dominant race is of Spanish origin, to a considerable extent mixed with Indian blood. The Indians are in great part descendants of the various tribes organized under the rule of the Incas at the time of the Spanish conquest. There are two distinct general types—the coast tribes occupying the fertile river valleys, who are employed on the plantations, in domestic service in the cities, or in small industries of their own, no longer numerous; and the sierra tribes, who are agriculturists, miners, stock-breeders and packers, still comparatively numerous. In addition to these are the tribes of wild Indians of the *montaña* region, or eastern forests, who were never under Inca rule and are still practically independent. Their number is estimated at 150,000 to 300,000, divided into 112 tribes, and differing widely in habits, customs and material condition. Some live in settled communities and roughly cultivate the soil. Others are hunters and fishermen and are nomadic in habit. Others are intractable forest tribes, having no relations with the whites. The sierra or upland Indians, the most numerous and strongest type, belong largely to the Quichua and Aymará families, the former inhabiting the regions northward of Cuzo, and the latter occupying the Titicaca basin and the sierras of Bolivia. These Indians are generally described as *Cholos*, a name sometimes mistakenly applied to the *mestizos*, while the tribes of the eastern forests are called *Chunchos*, *barbaros*, or simply Indians. The *Cholos* may be roughly estimated at about 1,800,000 and form by far the larger part of the sierra population. Practically all the industries and occupations of this extensive region depend upon them for labourers and servants.

The *mestizos* are of mixed Spanish and Indian blood. There are two general classes—the *costeños* or those of the coast, and the *serranos* or those of the sierras. The *mestizos* of the coast are usually traders, artisans, overseers, petty officers and clerks, and small politicians. In the sierras they have the same general occupations, but there are no social bars to their advancement, and they become lawyers, physicians, priests, merchants, officials and capitalists. The African and Asiatic elements furnish only about 2% each of the population. The Africans were introduced as slaves soon after the conquest, because the coast Indians were physically incapable of performing the work required of them on the sugar estates. All the heavy labour in the coast provinces was performed by them down to 1855, when African slavery was abolished. They have since preferred to live in the towns, although many continue on the plantations. The first Chinese coolies were introduced in 1849 to supply labourers on the sugar estates, which had begun to feel the effects of the suppression of the African slave traffic. At first the coolies were treated with cruelty. The scandals that resulted led to investigations and severe restrictions, and their employment now has become a matter of voluntary contract, usually for two years, in which fair dealing and good treatment are the rule. Many Chinese are also settled in the coast cities. Commercial relations have also been opened with Japan, and a small Japanese colony has been added to the population. The Spanish and African cross is to be seen in the mulattoes, quadroons and octoroons that inhabit the warm coast cities. Other race mixtures consist of the *zambos* (the African-Indian cross), an Asiatic graft upon these various crosses, and an extremely confusing intermixture of the various crosses, for which the Spanish races have descriptive appellations. The foreign population is chiefly concentrated in Lima and Callao, though mining and other industries have drawn small contingents to other places.

Education.—Universities and colleges were founded in Peru soon after the conquest, and Lima, Cuzco, Arequipa and Chuquisaca (now the Bolivian town of Sucre) became centres of considerable intellectual activity. Something was done for the education of the sons of the Indian " nobility," schools being created at Lima and Cuzco. The university of San Marcos at Lima is the oldest collegiate institution in the New World, originating in a grant from Charles V. in 1551 to the Dominicans for the establishment of a college in their monastery at Lima. Its present name, however, was not adopted until 1574, two years after its first secular rector had been chosen. The college of San Carlos was founded in 1770, and the school of medicine in 1792. At Cuzco the university of San Antonio Abad was founded in 1598, and the college of San Geronimo at Arequipa in 1616. The instruction given in these institutions was of the religious-scholastic character of that time, and was wholly under the supervision of the Church. Independence opened the way for a larger measure of intellectual and educational progress, especially for the lower classes. As organized under the law of the 5th of December 1905, primary instruction is free and nominally obligatory, and is under the control of the national government. The primary schools are divided into two grades: a free elementary course of two years, and a higher course of three years, in a school called the " scholastic centre," in which learning a trade is included. There were 1508 elementary schools and 862 scholastic centres in 1906. There are, besides these, a large number of private schools, which in 1906 carried about 22,000 pupils on their rolls, or three times the number in the public primary schools. To provide teachers six normal schools have been established, two of which (one for males and one for females) are in Lima. For intermediate or secondary instruction there are 23 national colleges for boys in the various departmental capitals, and three similar colleges for girls, in Ayacucho, Cuzco and Trujillo. In these the majority of pupils were under the direction of Belgian and German instructors. The private schools of this grade are still more numerous, and there are a number of special schools that belong to the same category. For higher instruction there are four universities: the Universidad Mayor de San Marcos at Lima, and three provincial institutions at Arequipa, Cuzco and Trujillo. All these have faculties of letters and law, and San Marcos has in addition faculties of theology, medicine, mathematics and science, philosophy and administrative and political economy. The professional schools include a school of civil and mining engineering at Lima (created 1876), a military school at Chorrillos under the direction of French instructors, a naval school at Callao, nine episcopal seminaries (one for each diocese), a national agricultural school in the vicinity of Lima (created 1902), and a few commercial schools. There is also a correctional school at Lima devoted to the education and training of youthful delinquents.

Science and Literature.—Towards the end of the 18th century scientific studies began to receive attention in Peru. M. Godin, a member of the French commission for measuring an arc of the meridian near Quito, became professor of mathematics at San Marcos in 1750; and the botanical expeditions sent out from Spain gave further zest to scientific research. Dr Gabriel Moreno (d. 1809), a native of Huamantanga in the Maritime Cordillera, studied under Dr Jussieu, and became an eminent botanist. Don Hipolito Unanue, born at Arica in 1755, wrote an important work on the climate of Lima and contributed to the *Mercurio peruano*. This periodical was started in 1791 at Lima, the contributors forming a society called " amantes del pais," and it was completed in eleven volumes. It contains many valuable articles on history, topography, botany, mining, commerce and statistics. An ephemeris and guide to Peru was begun by the learned geographer Dr Cosme Bueno, and continued by Dr Unanue, who brought out his guides at Lima from 1793 to 1798. In 1794 a nautical school was founded at Lima, with Andres Baleato as instructor and Pedro Alvarez as teacher of the use of instruments. Baleato also constructed a map of Peru.

A list of Peruvian authors in viceregal times occupies a long chapter in the life of St Toribio[1] by Montalvo; and the bibliographical labours of the Peruvian Leon Pinelo are still invaluable to Spanish students. The most prolific author of colonial times was Dr Pedro de Peralta y Barnuevo, who wrote more than sixty works, including an epic poem entitled *Lima fundada*.

The topographical labours of Cosme Bueno and Unanue were ably continued at Lima by Admiral Don Eduardo Carrasco, who compiled annual guides of Peru from 1826. But the most eminent Peruvian geographer is Dr Don Mariano Felipe Paz Soldan (1821–1886), whose *Geografia del Peru* appeared in 1861. His still more important work, the *Diccionario geografico estadistico del Peru* (1877), is a gazetteer on a most complete scale. In 1868 appeared his first volume of the *Historia del Peru independiente*, and two others have since been published. His *Historia de la guerra del Pacifico* is the Peruvian version of that disastrous war. The earlier history of Peru has been written in three volumes by Sebastian Lorente (d. 1884); Mariano Rivero has discussed its antiquities; and Manuel Fuentes has edited six volumes of memoirs written by Spanish viceroys. But the most valuable and important historical work by a modern Peruvian is General Mendiburu's (1805–1885) *Diccionario historico-biografico del Peru*, a monument of patient and conscientious research, combined with critical discernment of a high order. As laborious historical students, Don José Toribio Polo, the author of an ecclesiastical history of Peruvian dioceses, and Don Enrique Torres Saldamando, the historian of the Jesuits in Peru, have great merit. Among good local annalists may be mentioned Juan Gilberto Valdivia, who has written a history of Arequipa, and Pio Benigno Mesa, the author of the *Annals of Cuzco*.

The leading Peruvian authors on constitutional and legal subjects are Dr José Santistevan, who has published volumes on civil and criminal law; Luis Felipe Villaran (subsequently rector of the university at Lima), author of a work on constitutional right; Dr Francisco Garcia Calderon (once president of Peru), author of a dictionary of Peruvian legislation, in two volumes; Dr Francisco Xavier Mariategui, one of the fathers of Peruvian independence; and Dr Francisco de Paula Vigil (1792–1875), orator and statesman as well as author, whose work, *Defensa de los gobiernos*, is a noble and enlightened statement of the case for civil governments against the pretensions of the court of Rome. Manuel A. Fuentes, an able statistician and the author of the *Estadistica de Lima*, has also written a manual of parliamentary practice. Perhaps the most important work on Peru of modern times is that of the Italian savant Antonio Raimondi (1825–1890), who spent the greater part of his life in studying the topography and natural resources of the country. Only four volumes had been published at the time of his death, but he left a mass of papers and manuscripts which the government has put in the hands of the Geographical Society of Lima for publication. His great work is entitled *El Peru: estudios mineralogicos*, &c. (3 vols., Lima, 1890–1902), and one separate volume on the department of Ancachs. Peruvian literature since the independence has also attained high merit in the walks of poetry and romance. The Guayaquil author, Olmedo, who wrote the famous ode on the victory of Junin, and the Limenians Felipe Pardo and Manuel Segura are names well known wherever the Spanish language is spoken. Both died between 1860 and 1870. The comedies of Segura on the customs of Lima society, entitled *Un Paseo a Amancaes* and *La Saya y Manto*, have no equal in the dramatic literature of Spanish America and few in that of modern Spain. From 1848 date the first poetical efforts of Arnaldo Marquez, who is distinguished for his correct diction and rich imagination, as is Nicolas Corpancho for his dramas and a volume of poems entitled *Brisas*, Adolfo Garcia for a beautiful sonnet to Bolivar, which was published at Havre in 1870, in his one volume of poems, and Clemente Althaus for his productivity and style. Pedro Paz Soldan was a classical scholar who published three volumes of poems. Carlos Augusto Salaverry is known as one of Peru's best lyrical poets, and Luis Benjamin Cisneros for his two novels, *Julia* and *Edgardo*. Trinidad Fernandez and Constantino Carrasco were two poets of merit who died young, the principal work of the latter being his metrical version of the Quichua drama, *Ollantay*. José Antonio Lavalle and Narciso Arestegui are chiefly known as novelists. In his youth Ricardo Palma published three books of poems, entitled *Armonias*, *Verbos y Gerundios* and *Pasionarias*, and then, since 1870, devoted his great literary talents to writing the historical traditions of Peru, of which six volumes were published. At the outbreak of the war with Chile he was vice-director of the national library at Lima, which was wantonly pillaged by the Chilean forces. After the evacuation of Lima by the Chileans Palma devoted his life to the recovery of his scattered books and the acquisition of new collections, and he had the satisfaction before his death of re-opening the library, which had obtained about 30,000 volumes, or three-fourths of the number on its shelves before the Chilean invasion.

Of the aboriginal inhabitants of Peru much has been written. The important work of Mariano Eduardo Rivero, of Arequipa, assisted by J. J. von Tschudi, on the antiquities of Peru (*Antiguedades peruanas*, Vienna, 1841; Eng. trans., New York, 1853) has been followed by other investigators into the language, literature, customs and religion of the Incas. The best known of these are José Sebastián Barranca, the naturalist and antiquary, José Fernandez Nodal, and Gavino Pacheco Zegarra of Cuzco, who published translations of the Inca drama of *Ollantay*, and Leonardo Villar, of Cuzco.

Among Peruvian naturalists since the advent of the republic, the most distinguished have been Mariano Eduardo Rivero, the geologist, mineralogist and archaeologist, and his friend and colleague Nicolas de Pierola, authors of *Memorial de ciencias naturales*. The Lima Geographical Society (founded in 1888) is perhaps the best and most active scientific organization in the republic. Its special work covers national geographical exploration and study, archaeology, statistics and climatology, and its quarterly bulletins contain invaluable information. The society receives a government subsidy, and its rooms in the national library in Lima are the principal centre of scientific study in Peru. It had an active membership of 163 in 1906, besides 172 honorary and corresponding members. The historical institute of Peru, also at Lima, is charged by the government, from which it receives a liberal subsidy, with the work of collecting, preparing and publishing documents relating to Peruvian history, and of preserving objects of archaeological and historic character. Its museum, which is of great historical and artistic value and includes a collection of portraits of the Peruvian viceroys and presidents, is in the upper floors of the Exposition Palace. Another subsidized national society is the athenæum, which was founded in 1877 as the "literary club," and reorganized in 1887 under its present title. Its purpose is to foster learning and literary effort, and it is a popular and prominent feature in the intellectual life of the country.

Religion.—According to the constitution of 1860 "the nation professes the apostolic Roman Catholic religion; the state protects it, and does not permit the public exercise of any other." There is a certain degree of tolerance, however, and the Anglican and some of the evangelical churches are permitted to establish missions in the country, but not always without hostile demonstrations from the Catholic priesthood. There are Anglican churches in Lima and Cuzco, belonging to the diocese of the Bishop of the Falkland Islands; but their existence is illegal and is ignored rather than permitted. In its ecclesiastical organization Peru is divided into nine dioceses: Lima, which is an archbishopric, Arequipa, Puno, Cuzco, Ayacucho, Huanuco, Huaraz, Trujillo and Chachapoyas. These dioceses are subdivided into 613 curacies, presided over by *curas*, or curate-vicars. Each diocese has its seminary for the education of the priesthood, that of Arequipa being distinguished for its influence in church affairs. Arequipa, like Cordoba and Chuquisaca, is a stronghold of clericalism and exercises a decisive influence in politics as well as in church matters. There are a number of fine churches in Lima and in the sees of the various dioceses. Monasteries and nunneries are numerous, dating back to the 16th and 17th centuries, but their influence is now less potent than in those days and the monastic population is not so large. In modern times many of the convents have been devoted to educational work especially for girls, which is an obstacle to the successful development of a public school system in the country.

Political Divisions.—The empire of the Incas was divided into four main divisions, Chinchay-suyu to the north of Cuzco, Anti-suyu to the east, Colla-suyu to the south and Cunti-suyu to the west, the whole empire being called Ttahuantin-suyu, or the four governments. Each was ruled by a viceroy, under whom were the "huaranca-camayocs," or officers ruling over thousands, and inferior officers, in regular order, over 500, 100, 50 and 10 men. All disorders and irregularities were checked by the periodical visits of the *tucuyricocs* or inspectors. The Spanish conquest destroyed this complicated system. In 1569 the governor, Lope Garcia de Castro, divided Peru into *corregimientos* under officers named *corregidors*, of whom there were 77, each in direct communication with the government at Lima. An important administrative reform was made in 1784, when Peru was divided into 7 *intendencias*, each under an officer called an *intendente*. These *intendencias* included about 6 of the old *corregimientos*, which were called *partidos*, under officers named *subdelegados*. Thus the number of officers reporting direct to Lima was reduced from 77 to 7, a great improvement. The republic adopted the same system, calling the *intendencias* departments, under a prefect, and the *partidos* provinces, under a sub-prefect. Peru is divided into 18 departments, 2 littoral provinces, and what is called the constitutional province of Callao. This is exclusive of Tacna and its 3 provinces. The departments, which contain 98 provinces, with their areas, capitals and estimated populations of 1906, are as follow: the list being arranged to show the coast, sierra and *montaña* divisions:—

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[1] The city of Lima produced two saints, the archbishop St Toribio, who flourished from 1578 to 1606, and Santa Rosa, the patron saint of the city of the kings (1586–1616), whose festival is celebrated on the 26th of August.

Departments.	Area sq. m.	Estimated pop., 1906.	Capital.	Estimated pop., 1906.
Coast:—				
Piura	14,849	154,080	Piura	9,100
Lambayeque	4,615	93,070	Chiclayo	10,000
Libertad	10,209	188,200	Trujillo	6,500
Ancachs	16,567	317,050	Huaraz	13,000
Lima	13,314	250,000	Lima (1903)	140,000
Ica (or Yca)	8,721	68,220	Ica	6,000
Arequipa	21,953	171,750	Arequipa	28,000
Sierra:—				
Cajamarca	12,542	333,310	Cajamarca	9,000
Huanuco	14,028	108,980	Huanuco	6,000
Junin	23,354	305,700	Cerro de Pasco	10,000
Huancavelica	9,254	167,840	Huancavelica	6,000
Ayacucho	18,190	226,850	Ayacucho	15,000
Apurimac	8,189	133,000	Abancay	2,400
Cuzco	156,317	328,980	Cuzco	23,000
Puno	41,211	403,000	Puno	4,500
Montaña:—				
Amazonas	13,947	53,000	Chachapoyas	4,500
Loreto	238,493	120,000	Iquitos	6,000
San Martin	30,745	33,000	Moyobamba	7,500
Littoral Provinces:—				
Tumbez	1,981	8,000	Tumbez	2,300
Callao	14½	33,879	Callao (1905)	31,128
Moquegua	5,550½	31,920	Moquegua	5,000

Apart from the departmental capitals there are few towns of size and importance. The so-called coast towns are commonly at some distance from the seashore, and their shipping ports are little more than a straggling collection of wretched habitations in the vicinity of the landing-stage and its offices and warehouses. Callao (*q.v.*) is a noteworthy exception, and Paita and Pisco are something more than the average coast village. Near Lima, on the south, there are three bathing resorts, Chorrillos, Miraflores and Barranco, which have handsome residences and large populations in the bathing season. North of Lima is the port and bathing resort of Ancon, in an extremely arid locality but having a fine beach, a healthy climate and a considerable population in the season. The towns of the coast region are usually built on the same general plan, the streets crossing each other at right angles and enclosing squares, or *quadras*. In the sierra there is the same regular plan wherever the site is level enough. High-pitched red tiled roofs take the place of the flat roofs of the coast. The upper storey often recedes, leaving wide corridors under the overhanging eaves, and in the "plazas" there are frequently covered arcades. In addition to the capitals of the departments, Tarma (about 4000) and Xauxa, or Jauja (about 3000), are important towns of this region. In the *montaña* there are no towns of importance other than the capitals of the departments and the small river ports.

Communications.—The problem of easy and cheap transportation between the coast and the interior has been a vital one for Peru, for upon it depends the economic development of some of the richest parts of the republic. The arid character of the coastal zone, with an average width of about 80 m., permits cultivation of the soil only where water for irrigation is available. Only in the sierra and *montaña* regions is it possible to maintain a large population and develop the industries upon which their success as a nation depends. During colonial times and down to the middle of the 19th century pack animals were the only means of transportation across the desert and over the rough mountain trails. Railway construction in Peru began in 1848 with a short line from Callao to Lima, but the building of railway lines across the desert to the inland towns of the fertile river valleys and the Andean foot-hills did not begin until twenty years later. These roads added much to the productive resources of the country, but their extension to the sierra districts was still a vital necessity. Under the administration (1868–1872) of President José Balta the construction of two transandean and several coastal zone railways was begun, but their completion became impossible for want of funds. Balta's plans covered 1281 m. of state railways and 749 m. of private lines, the estimated cost to be about £37,500,000—a sum far beyond the resources of the republic. The two transandean lines were the famous Oroya railway, running from Callao to Oroya (1893), which crosses the Western Cordillera at an elevation of 15,645 ft., and later on to Cerro de Pasco (1904), the Goillarisquisga coal mines (1904) and Hauri (1906); and the southern line from Mollendo to Lake Titicaca, which reached Arequipa in 1869, Puno in 1871 and Checcacupe (Cuzco branch) in 1906. Surveys were completed in 1909 for an extension of the Oroya line from a point on its Cerro de Pasco branch eastward to the Ucayali, and another transandean line frequently discussed is projected from Paita across the Andes to Puerto Limon, on the Marañon—a distance of 410 m.

The most important means of communication in the republic is that of its river system, comprising, as it does, the navigable channels of the Marañon, or upper Amazon, and its tributaries. It is officially estimated that this system comprises no less than 20,000 m. of connected riverways navigable at high water for all descriptions of boats, or 10,000 m. for steamers of 20 to 2 ft. draught, which is reduced to 5800 m. at low water. The rivers forming this system are the Marañon from Puerto Limon to Tabatinga on the Brazilian frontier (484 m.), the Japurá, Putumayo, Javary, Napo, Tigre, Huallaga, Ucayali, Pachitea, Juruá, Purús, Acre, Curaray and Aguarico all navigable over parts of their courses for steamers of 4 to 8 ft. draught in periods of high water. As for the Marañon, it is claimed that steamers of 20 ft. draught can ascend to Puerto Limon at all seasons of the year. The inclusion of the upper waters of the Brazilian rivers Juruá, Purús and Acre is *pro forma* only, as they are wholly under Brazilian jurisdiction. Practically the whole of the region through which these rivers run—the *montaña* of Peru—is undeveloped, and is inhabited by Indians, with a few settlements of whites on the river courses. Its chief port is Iquitos, on the Marañon, 335 m. above the Brazilian frontier and 2653 m. from the mouth of the Amazon. It is visited by ocean-going steamers, and is the centre of the Peruvian river transportation system. The second port in importance is Yurimaguas, on the Huallaga, 143 m. from the mouth of that river and 528 m. from Iquitos, with which it is in regular communication. There are small ports, or trading posts, on all the large rivers, and occasional steamers are sent to them with supplies and to bring away rubber and other forest products. Of the rivers farther south, which discharge into the Amazon through the Madeira, the Madre de Dios alone offers an extended navigable channel, together with some of its larger tributaries, such as the Heath and Chandless. Of a widely different character is the navigation of Lake Titicaca, where steamers ply regularly between Puno and Guaqui, the latter on the south-east shore in railway connexion with La Paz, the capital of Bolivia. This is one of the most remarkable steamer routes in the world, being 12,370 ft. above sea-level. The lake is 165 m. long and from 70 to 80 m. wide and has a number of small Indian villages on its shores.

There are two submarine cable lines on the Peruvian coast—the (American) Central and South American Co. extending from Panama to Valparaiso, and the (British) West Coast Cable Co., subsidiary to the Eastern Telegraph Co., with a cable between Callao and Valparaiso. The inland telegraph service dates from 1864, when a short line from Callao to Lima was constructed, and state ownership from 1875, when the government assumed control of all lines within the republic, some of which were subsequently handed over to private administration. They connect all the important cities, towns and ports, but cover only a small part of the republic. The cost of erecting and maintaining telegraph lines in the sierra and *montaña* regions is too great to permit their extensive use, and the government is seeking to substitute wireless telegraphy. From Puerto Bermudez, on the Pachitea or Pichis river, the terminus of a government road and telegraph line, a wireless system connects with Massisea on the Ucayali, and thence with Iquitos, on the Marañon—a distance of 930 m. by steamer, which is much shortened by direct communication between the three radiographic stations. This service was opened to Iquitos on the 8th of July 1908, the first section between Puerto Bermudez and Massisea having been pronounced a success. The Peruvian telegraph system connects with those of Ecuador and Bolivia. The use of the telephone is general, 5236 m. being in operation in 1906. The postal service is unavoidably limited and defective, owing to the rugged character of the country, its sparse population, and the large percentage of illiterates. On the coast, however, in and near the large cities and towns, it compares well with other South American countries. Peru belongs to the international postal union, and had in 1906 a money order and parcels exchange with seven foreign states. A noteworthy peculiarity in the foreign mail service is that an extra charge of 2 cents for each letter and 1 cent for each post-card is collected when they are sent across the isthmus of Panama. No charge is made for the transmission of newspapers within the republic. The letter rate is 5 cents silver for 15 grams, or 10 cents to foreign countries in the postal union.

Commerce.—Owing to political disorder, difficulty in land communications, and the inheritance of vicious fiscal methods from Spanish colonial administration, the commercial development of Peru has been slow and erratic. There are many ports on the coast, but only eight of them are rated as first class, viz. Paita, Eten, Pacasmayo, Salaverry, Callao, Pisco, Mollendo and Ilo, five of which are ports of call for foreign coasting steamers. The inland port of Iquitos, on the Marañon, is also rated as first class, and enjoys special privileges because of its distance from the national capital. The second-class ports are Tumbez, Talara, Pimentel, Chimbote, Samanco, Casma, Huacho, Cerro-Azul, Tambo de Mora, Lomas and Chala, on the coast, Puno on Lake Titicaca, and Leticia on the Amazon near the western mouth of the Javary. Callao (*q.v.*) is the chief port of the republic and monopolizes the greater part of its foreign trade. Its harbour, one of the best on the west coast of South America, has been greatly improved by the port works begun under the administration of President Balta. Paita and Chimbote have good natural harbours, but the others, for the most part, are open roadsteads or unsheltered bays. Mollendo is a shipping port for Bolivian exports sent over the railway from Puno. There were 12 foreign steamship lines trading at Peruvian ports in 1908, some of them making regular trips up and down the coast at frequent intervals and carrying much of its coastwise traffic. Foreign sailing vessels since 1886 have not been permitted to engage in this traffic, but permission is given to steamships on application and under certain conditions. The imports were valued in 1907 at 55,147,870 *soles* (10 soles=£1 stg.) and the exports at 57,477,320 *soles*—the former showing a considerable increase and the latter a small decrease in comparison with 1906. The exports consist of cotton, sugar, cocaine, hides and skins, rubber and other forest products, wool, guano and mineral products. The most important export is sugar, the products of the mines ranking second. The largest share in Peru's foreign trade is taken by Great Britain, Chile ranking second and the United States third.

Products.—Although her mining industries have been the longest and most widely known, the principal source of Peru's wealth is agriculture. This seems incompatible with the arid character of the country and the peculiar conditions of its civilization, but irrigation has been successfully employed in the fertile valleys of the coast.

Agriculture.—Sugar-cane is cultivated in most of the coast valleys, and with exceptional success in those of the Canete, Rimac, Chancay, Huaura, Supe, Santa, Chicama, Pacasmayo and Chiclayo. Some of the large estates are owned and worked by British subjects. The industry was nearly ruined by the Chileans in 1880, but its recovery soon followed the termination of the war and the output has been steadily increasing. At the outbreak of the war the production was about 80,000 tons; in 1905 the production of sugar and molasses amounted to 161,851 metric tons, of which 134,344 were exported. In 1906 the total production reached 169,418 metric tons. Next in importance is cotton, which is grown along the greater part of the Peruvian coast, but chiefly in the departments of Piura, Lima and Ica. Four kinds are produced: rough cotton or "vegetable wool," sea island, brown or Mitafifi, and smooth or American. Production is steadily increasing, the export having been 8000 metric tons in 1900, 17,386 in 1905 and 20,000 in 1906. Local consumption required about 2500 tons in 1905. Rice is an important crop in the inundated lands of Lambayeque and Libertad. It is a universal article of food in Peru, and the output is consumed in the country. Maize is another important food product which is generally cultivated along the coast and in the lower valleys of the sierra. In some places two or three crops a year are obtained. It is the staple food everywhere, and little is exported. It is largely used in the manufacture of *chicha*, a fermented drink popular among the lower classes. Tobacco is grown in the department of Piura, and in the *montaña* departments of Loreto, Amazonas and Cajamarca. The local consumption is large and the export small. Another *montaña* product is coffee, whose successful development is prevented by difficult transport. A superior quality of bean is produced in the eastern valleys of the Andes, especially in the Chanchamayo valley. Cacao is another *montaña* product, although like coffee it is cultivated in the warm valleys of the sierra, but the export is small. With cheap transport to the coast the production of coffee and cacao must largely increase. Coca (*Erythroxylon coca*) is a product peculiar to the eastern Andean slopes of Bolivia and Peru, where it has long been cultivated for its leaves. These are sun-dried, packed in bales, and distributed throughout the *sierra* region, where coca is used by the natives as a stimulant. The Cholos are never without it, and with it are able to perform incredible tasks with little food. The common manner of using it is to masticate the dried leaves with a little lime. Cocaine is also derived from coca leaves, and a considerably quantity of the drug is exported. The coca shrub is most successfully cultivated at an elevation of 5000 to 6000 ft. Fruits in great variety are grown everywhere in Peru, but beyond local market demands their commercial production is limited to grapes and olives. Grapes are produced in many of the irrigated valleys of the coast, such as Chincha, Lunahuana, Ica, Vitor, Majes, Andaray, Moquegua and Locumba, and the fruit is manufactured into wines and brandies. Excellent clarets and white wines are produced, and the industry is steadily increasing. Olives were introduced early in colonial times and are cultivated in several coast valleys, especially in the provinces of Camaná (Arequipa) and Moquegua. The fruit is commonly used for the manufacture of oil, which is consumed in the country, and only a small part is exported. Were large markets available, other fruits such as oranges, lemons, limes and bananas would undoubtedly be extensively cultivated. In the *sierra* region, wheat, barley, oats, quinua (*Chenopodium quinoa*), alfalfa, Indian corn, oca (*Oxalis tuberosa*) and potatoes are the principal products. Wheat is widely grown but the output is not large. Barley and oats are grown for forage, but for this purpose alfalfa has become the staple, and without it the mountain pack-trains could not be maintained. Quinua is an indigenous plant growing at elevations of 13,500 ft. and more; its grain is an important food among the upland natives. Potatoes are grown everywhere in the sierras, and with quinua are the only crops that can be raised for human food above 13,000 ft. *Yuca* (*Manihot utilissima*), known as *cassava* in the West Indies and *mandioca* in Brazil, is also widely cultivated for food and for the manufacture of starch.

Livestock.

There are good pastures in the sierras, and cattle have been successfully reared in some of the departments since the early years of Spanish occupation, chiefly in Ancachs, Cajamarca, Junin, Ayacucho, Puno, and some parts of Cuzco. The development of alfalfa cultivation is extending the area of cattle-breeding somewhat and is improving the quality of the beef produced. The cattle are commonly small and hardy, and, like the Mexican cattle, are able to bear unfavourable conditions. Sheep are reared over a somewhat wider range, exclusively for their wool. The "natives," or descendants of the early importations, are small, long-legged animals whose wool is scanty and poor. Since the end of the 19th century efforts have been made to improve the stock through the importation of merinos, with good results. Sheep ranges under the care of Scottish shepherds have also been established in the department of Junin, the stock being imported from southern Patagonia, England and Australia. Goats are raised in Piura and Lambayeque for their skins and fat, and swine-breeding for the production of lard has become important in some of the coast valleys immediately north of Lima. Horses are reared only to a limited extent, although there is a demand for them for military purposes. The government is seeking to promote the industry through the importation of breeding mares from Argentina. Mules are bred in Piura and Apurimac, and are highly esteemed for mountain travel. The chief breeding industry is that of the llama, alpaca and vicuña—animals of the *Auchenia* family domesticated by the Indians and bred, the first as a pack animal, and the other two for their wool, hides and meat. The llama was the only beast of burden known to the South American natives before the arrival of the Spaniards and is highly serviceable on the difficult trails of the Andes. The alpaca and vicuña are smaller and weaker and have never been used for this service, but their fine, glossy fleeces were used by the Indians in the manufacture of clothing and are still an important commercial asset of the elevated table-lands of Peru and Bolivia. The export of wool in 1905 exceeded 3,300,000 ℔. The rearing of these animals requires much patience and skill, in which no one has been able to match the Indian breeders of the Andean plateaus.

Forest Products.

The natural products of Peru include rubber, cabinet woods in great variety, cinchona or Peruvian bark and other medicinal products, various fibres, and guano. There are two kinds of rubber supplied by the Peruvian *montaña* forests: *jebe* (also written *hebe*) or *seringa*, and *caucho*—the former being collected from the *Hevea guayanensis*, or *H. brasiliensis*, and the latter from the *Castilloa elastica* and some other varieties. The *Hevea* product is obtained annually by tapping the trees and coagulating the sap over a smoky fire, but the *caucho* is procured by felling the tree and collecting the sap in a hollow in the ground where it is coagulated by stirring in a mixture of soap and the juice of a plant called *vetilla*. As the species from which Ceará rubber is obtained (*Hancorina speciosa*) is found in Bolivia, it is probable that this is also a source of the Peruvian *caucho*. The *Hevea* is found along the water-courses of the lowlands, which includes the large tributaries of the Marañon, while the *caucho* species flourish on higher ground, above 900 ft. elevation. Owing to the export tax on rubber (8 cents per kilogram on *jebe* and 5 cents on *caucho*) it is probable that the official statistics do not cover the total production, which was returned as 2539 metric tons in 1905, valued at £913,989. The export of cinchona, or Peruvian bark, is not important in itself, being only 64 tons, valued at £1406 in 1905. The best bark comes from the Carabaya district in south-eastern Peru, but it is found in many localities on the eastern slopes of the Andes. The Peruvian supply is practically exhausted through the destructive methods employed in collecting the bark, and the world now depends chiefly on Bolivia and Ecuador. The forests of eastern Peru are rich in fine cabinet woods, but their inaccessibility renders them of no great value. Among the best known of them are cedar, walnut, ironwood and caoba, a kind of mahogany. Many of the forest trees of the upper Amazon valley of Brazil are likewise found in Peru. The palm family is numerous and includes the species producing vegetable ivory (*Phytelephas*), straw for plaiting Panama hats (*Carludovica palmata*), and the peach palm (*Guilielma speciosa*).

Guano.

From guano an immense revenue was derived during the third quarter of the 19th century and it is still one of the largest exports. The guano beds are found on the barren islands of the Pacific coast. They were developed commercially during the administration (1845–1851) of President Ramon Castilla, at the same time that the nitrate deposits of Tarapacá became a commercial asset of the republic. The large revenues derived from these sources undoubtedly became a cause of weakness and demoralization and eventually resulted in bankruptcy and the loss of Tarapacá. The deposits have been partially exhausted by the large shipments of over a half-century, but the export in 1905 was 73,369 tons, valued at £285,729.

Mining.—Mining was the chief industry of Peru under Spanish rule. The Inca tribes were an agricultural and pastoral people, but the abundance of gold and silver in their possession at the time of the conquest shows that mining must have received considerable attention. They used these precious metals in decorations and as ornaments, but apparently attached no great value to them. The use of bronze also shows that they must have worked, perhaps superficially, some of the great copper deposits. Immediately following the Spanish invasion the Andean region was thoroughly explored, and with the assistance of Indian slaves thousands of mines were opened, many of them failures, some of them becoming famous. There was a decline in mining enterprise after the revolt of the colonists against Spanish rule, owing to the unsettled state of the country, and this decline continued in some measure to the end of the century. The mining laws of the colonial régime and political disorder together raised a barrier to the employment of the large amount of capital needed, while the frequent outbreaks of civil war made it impossible to work any large enterprise because of its interference with labour and the free use of ports and roads. The Peruvians were impoverished, and under such conditions foreign capital could not be secured. In 1876 new mining laws were enacted which gave better titles to mining properties and better regulations for their operation, but the outbreak of the war with Chile at the end of the decade and the succeeding years of disorganization and partisan strife defeated their purpose. Another new mining code was adopted in 1901, and this, with an improvement in political and economic conditions, has led to a renewal of mining enterprise.

Practically the whole Andean region of Peru is mineral-bearing—a region 1500 m. long by 200 to 300 m. wide. Within these limits are to be found most of the minerals known—gold, silver, quicksilver, copper, lead, zinc, iron, manganese, wolfram, bismuth, thorium, vanadium, mica, coal, &c. On or near the coast are coal, salt, sulphur, borax, nitrates and petroleum. Gold is found in lodes and alluvial deposit; the former on the Pacific slope at Salpo, Otuzco, Huaylas, Yungay, Ocros, Chorrillos, Cañete, Ica, Nasca, Andaray and Arequipa, and on the table-lands and Amazon slope at Pataz, Huánuco, Chuquitambo, Huancavelica, Cuzco, Cotabambas, Aymares, Paucartambo, Santo Domingo and Sandia; the latter wholly on the Amazon slope, in the country about the Pongo de Manseriche and at Chuquibamba, both on the upper Marañon, in the districts of Pataz, Huánuco, Aymares and Antabamba (Apurimac), Paucartambo and Quippicauchi (Cuzco), and Sandia and Carabaya (Puno). The last two are most important and, it is believed, were the sources from which the Incas derived the greater part of their store. The alluvial deposits are found both in the beds of the small streams and in the soil of the small plains or *pampas*. The Aporoma deposit, in the district of Sandia, is the best known. Long ditches with stone-paved sluices for washing this mineral-bearing material have long been used by the Indians, who also construct stone bars across the beds of the streams to make riffles and hold the deposited grains of gold. Modern methods of hydraulic mining have been introduced to work the auriferous banks of Poto; elsewhere antiquated methods only are employed. The upper valley of the Marañon has undeveloped gold-bearing lodes. The number of mines worked is small and there is not much foreign capital invested in them. The gold ores of Peru are usually found in ferruginous quartz. The production in 1906 was valued at £170,355.

Peru has been known chiefly for its silver mines, some of which have been marvellously productive. The Cerro de Pasco district, with its 342 mines, is credited with a production, in value, of £40,000,000 between 1784 and 1889, and is still productive, the output for 1906 being valued at £972,958. The principal silver-producing districts, the greater part on the high table-lands and slopes of the Andes, are those of Salpo, Hualgayoc, Huari, Huallanca, Huaylas, Huaraz, Recuay, Cajatambo, Yauli, Cerro de Pasco, Morococha, Huarochiri, Huancavelica, Quespisisa, Castrovirreyna, Lucanas, Lampa, Caylloma and Puno, but there are hundreds of others outside their limits. Silver is generally found as red oxides (locally called *rosicler*), sulphides and argentiferous galena. Modern machinery is little used and many mines are practically unworkable for want of pumps. In the vicinity of some of the deposits of argentiferous galena are large coal beds, but timber is scarce on the table-lands. The dried dung of the llama (*taquia*) is generally used as fuel, as in pre-Spanish times, for roasting ores, as also a species of grass called *ichu* (*Stipa incana*), and a singular woody fungus, called *yareta* (*Azorella umbellifera*), found growing on the rocks at elevations exceeding 12,000 ft. The methods formerly employed in reducing ores were lixiviation and amalgamation with quicksilver, but modern methods are gradually coming into use. Quicksilver is found at Huancavelica, Chonta (Ancachs), and in the department of Puno. The mine first named has been worked since 1566 and its total production is estimated at 60,000 tons, the annual product being about 670 tons for a long period. The metal generally occurs as sulphide of mercury (cinnabar), but the ores vary greatly in richness—from 2½ to 20%. The annual production has fallen to a small fraction of the former output, its value in 1905 being only £340, and in 1906 £495.

The copper deposits of Peru long remained undeveloped through want of cheap transport and failure to appreciate their true value. The principal copper-bearing districts are Chimbote, Cajamarca, Huancayo, Huaraz, Huallanca, Junin, Huancavelica, Ica, Arequipa, Andahuaylas and Cuzco—chiefly situated in the high, bleak regions of the Andes. The Junin district is the best known and includes the Cerro de Pasco, Yauli, Morococha and Huallay groups of mines, all finding an outlet to the coast over the Oroya railway. These mines are of recent development, the Cerro de Pasco mines having been purchased by American capitalists. A smelting plant was erected in the vicinity of Cerro de Pasco designed to treat 1000 tons of ore daily, a railway was built to Oroya to connect with the state line terminating at that point, and a branch line 62 m. long was built to the coal-mines of Goillarisquisga. The Cerro de Pasco mines are supposed by some authorities to be the largest copper deposit in the world. In addition to the smelting works at Cerro de Pasco there are other large works at Casapalca, between Oroya and Lima, which belong to a British company, and smaller plants at Huallanca and Huinac. The production of copper is steadily increasing, the returns for 1903 being 9497 tons and for 1906 13,474 tons, valued respectively at £476,824 and £996,055. Of other metals, lead is widely distributed, its chief source being a high grade galena accompanied by silver. Iron ores are found in Piura, the Huaylas valley, Aya, and some other places, but the deposits have not been worked through lack of fuel. Sulphur deposits exist in the Sechura desert region, on the coast, and extensive borax deposits have been developed in the department of Arequipa. Coal has been found in extensive beds near Piura, Salaverry, Chimbote, Huarmey and Pisco on the coast, and at Goillarisquisga, Huarochiri and other places in the interior. Both anthracite and bituminous deposits have been found. Most of the deposits are isolated and have not been developed for want of transport. Petroleum has been found at several points on the coast in the department of Piura, and near Lake Titicaca in the department of Puno. The most productive of the Piura wells are at Talara and Zorritos, where refineries have been established. The crude oil is used on some of the Peruvian railways.

The number of mining claims (*pertenencias*) registered in 1907 was 12,858, according to official returns, each subject to a tax of 30 soles, or £3, per annum, the payment of which secures complete ownership of the property. The claims measure 100×200 metres (about 5 acres) in the case of mineral veins or lodes, and 200×200 metres (about 10 acres) for coal, alluvial gold and other deposits. The labourers are commonly obtained from the Cholos, or Indian inhabitants of the sierras, who are accustomed to high altitudes, and are generally efficient and trustworthy.

Manufactures.—The manufacturing industries of Peru are confined chiefly to the treatment of agricultural and mineral products—the manufacture of sugar and rum from sugar cane, textiles from cotton and wool, wine and spirits from grapes, cigars and cigarettes from tobacco, chocolate from cacao, kerosene and benzine from crude petroleum, cocaine from coca, and refined metals from their ores. Many of the manufacturing industries are carried on with difficulty and maintained only by protective duties on competing goods. The Incas had made much progress in weaving, and specimens of their fabrics, both plain and coloured, are to be found in many museums. The Spanish introduced their own methods, and their primitive looms are still to be found among the Indians of the interior who weave the coarse material from which their own garments are made. Modern looms for the manufacture of woollens were introduced in 1861 and of cotton goods in 1874. There are large woollen factories at Cuzco and Lima, the Santa Catalina factory at the latter place turning out cloth and cashmere for the army, blankets, counterpanes and underclothing. There are cotton factories about Lima, at Ica and at Arequipa. Besides the wine industry, an irregular though important industry is the manufacture of artificial or counterfeit spirits and liqueurs in Callao and Lima. There are breweries in Arequipa, Callao, Cuzco and Lima, and the consumption of beer is increasing. There are large cigarette factories in Lima, and others in Arequipa, Callao, Piura and Trujillo. The plaiting of Panama hats from the specially prepared fibre of the "toquilla" palm is a domestic industry among the Indians at Catacoas (Piura) and Eten (Lambayeque). Coarser straw hats are made at other places, as well as hammocks, baskets, &c.

Government.—Peru is a centralized republic, whose supreme law is the constitution of 1860. Like the other states of South America its constitution provides for popular control of legislation and the execution of the laws through free elections and comparatively short terms of office, but in practice these safeguards are often set aside and dictatorial methods supersede all others. Nominally the people are free and exercise sovereign rights in the choice of their representatives, but the ignorance of the masses, their apathy, poverty and dependence upon the great land proprietors and industrial corporations practically defeat these fundamental constitutional provisions. Citizenship is accorded to all Peruvians over the age of 21 and to all married men under that age, and the right of suffrage to all citizens who can read and write, or possess real estate or workshops, or pay taxes. In all cases the exercise of citizenship is regulated by law.

The government is divided into three independent branches, legislative, executive and judicial, of which through force of circumstances the executive has become the dominating power. The executive branch consists of a president and two vice-presidents elected for terms of four years, a cabinet of six ministers of state appointed by the president, and various subordinate officials who are under the direct orders of the president. The president is chosen by a direct popular election and cannot be re-elected to succeed himself. He must be not less than 35 years of age, a Peruvian by birth, in the enjoyment of all his civil rights, and domiciled in the republic ten years preceding the election. The immediate supervision and despatch of public administrative affairs is in the hands of the cabinet ministers—interior, foreign affairs, war and marine, finance and commerce, justice and public instruction, and public works and promotion (*fomento*). The execution of the laws in the departments and provinces, as well as the maintenance of public order, is entrusted to prefects and sub-prefects, who are appointees of the president. A vacancy in the office of president is filled by one of the two vice-presidents elected at the same time and under the same conditions. Inability of the first vice-president to assume the office opens the way for the second vice-president, who becomes acting president until a successor is chosen. The vice-presidents cannot be candidates for the presidency during their occupancy of the supreme executive office, nor can the ministers of state, nor the general-in-chief of the army, while in the exercise of their official duties.

The legislative power is exercised by a national Congress—senate and chamber of deputies—meeting annually on the 28th of July in ordinary session for a period of 90 days. Senators and deputies are inviolable in the exercise of their duties, and cannot be arrested or imprisoned during a session of Congress, including the month preceding and following the session, except *in flagrante delicto*. Members of Congress are forbidden to accept any employment or benefit from the executive. Senators and deputies are elected by direct vote—the former by departments, and the latter in proportion to the population. With both are elected an equal number of substitutes, who assume office in case of vacancy.

Departments with eight and more provinces are entitled to four senators, those of four to seven provinces three senators, those of two to three provinces two senators, and those of one province one senator. The deputies are chosen to represent 15,000 to 30,000 population each, but every province must have at least one deputy. Both senators and deputies are elected for terms of six years, and both must be native-born Peruvian citizens in the full enjoyment of their civil rights. A senator must be 35 years of age, and have a yearly income of $1000. The age limit of a deputy is 25 years, and his income must be not less than $500. In both chambers the exercise of some scientific profession is accepted in lieu of the pecuniary income. No member of the executive branch of the government (president, cabinet minister, prefect, sub-prefect, or governor) can be elected to either chamber, nor can any judge or "fiscal" of the supreme court, nor any member of the ecclesiastical hierarchy from his diocese, province or parish, nor any judge or "fiscal" of superior and first-instance courts from their judicial districts, nor any military officer from the district where he holds a military appointment at the time of election. No country is provided with more and better safeguards against electoral and official abuses than is Peru, and yet few countries suffered more from political disorder during the 19th century. The president has no veto power, but has the right to return a law to Congress with comments within a period of ten days. Should the act be again passed without amendments it becomes law; if, however, the suggested amendments are accepted the act must go over to the next session. Congress may also sit as a court of impeachment—the senate hearing and deciding the case, and the chamber acting as prosecutor. The president, ministers of state and judges of the supreme court may be brought before this court.

Justice.—The judiciary is composed of a supreme court, superior courts and courts of first instance, and justices of the peace. The supreme court is established at the national capital and consists of 11 judges and 2 "fiscals" or prosecutors. The judges are selected by Congress from lists of nominees submitted by the executive. The judges of the superior courts are chosen by the president from the list of nominees submitted by the supreme court. Questions of jurisdiction between the superior and supreme courts, as well as questions of like character between the supreme court and the executive, are decided by the senate sitting as a court. The courts of first instance are established in the capitals of provinces and their judges are chosen by the superior courts of the districts in which they are located. The independence of the Peruvian courts has not been scrupulously maintained, and there has been much criticism of their character and decisions.

The national executive appoints and removes the prefects of the departments and the sub-prefects of the provinces, and the prefects appoint the *gobiernadores* of the districts. The police officials throughout the republic are also appointees of the president and are under his orders.

Army.—After the Chilean War the disorders fomented by the rival military officers led to a desire to place the administration of public affairs under civilian control. This led to a material reduction in the army, which, as reorganized, consists of 4000 officers and men, divided into seven battalions of infantry of 300 men each, seven squadrons of cavalry of 125 men each, and one regiment of mountain artillery of 590 men, with six batteries of mountain guns. The reorganization of the army was carried out by 10 officers and 4 non-coms. of the French army, known as the French military mission, who are also charged with the direction of the military school at Chorrillos and all branches of military instruction. There are a military high school, preparatory school, and "school of application" in connexion with the training of young officers for the army. The head of the mission is chief of staff. Formerly the Indians were forcibly pressed into the service and the whites filled the positions of officers, in great part untrained. Now military service is obligatory for all Peruvians between the ages of 19 and 50, who are divided into four classes, first and second reserves (19 to 30, and 30 to 35 years), supernumeraries (those who have purchased exemption from service in the regular army), and the national guard (35 to 50 years). The regular force is maintained by annual drawings from the lists of young men 19 years of age in the first reserves, who are required to serve four years. The direction of military affairs is entrusted to a general staff, which was reorganized in 1904 on the lines adopted by the great military powers of Europe. The republic is divided into four military districts with headquarters at Piura, Lima, Arequipa and Iquitos, and these into eleven circumscriptions. The mounted police force of the republic is also organized on a military basis.

Navy.—The Peruvian navy was practically annihilated in the war with Chile, and the poverty of the country prevented for many years the adoption of any measure for its rebuilding. In 1908 it consisted of only five vessels. The naval school at Callao is under the direction of an officer of the French navy. In addition to the foregoing the government has a few small river boats on the Marañon and its tributaries, which are commanded by naval officers and used to maintain the authority of the republic and carry on geographical and hydrographical work.

Finance.—The financial record of Peru, notwithstanding her enormous natural resources, has been one of disaster and discredit. Internal strife at first prevented the development of her resources, and then when the export of guano and nitrates supplied her treasury with an abundance of funds the money was squandered on extravagant enterprises and in corrupt practices. This was followed by the loss of these resources, bankruptcy, and eventually the surrender of her principal assets to her foreign creditors. The government then had to readjust expenditures to largely diminished resources; but the obligation has been met intelligently and courageously, and since 1895 there has been an improvement in the financial state of the country. The public revenues are derived from customs, taxes, various inland and consumption taxes, state monopolies, the government wharves, posts and telegraphs, &c. The customs taxes include import and export duties, surcharges, harbour dues, warehouse charges, &c.; the inland taxes comprise consumption taxes on alcohol, tobacco, sugar and matches, stamps and stamped paper, capital and mining properties, licences, transfers of property, &c.; and the state monopolies cover opium and salt. In 1905 a loan of £600,000 was floated in Germany for additions to the navy. The growth of receipts and expenditures is shown in the following table:—

	1904.	1906.	1908.
Revenue	£1,990,568	£2,527,766	£2,997,433
Expenditure . . .	£1,884,949	£2,178,252	£3,043,032

The revenues of 1896 were only £1,128,714.

The foreign debt began with a small loan of £1,200,000 in London in 1822, and another of £1,500,000 in 1825 of which only £716,516 was placed. At the end of the war, these loans, and sums owing to Chile and Colombia, raised the foreign debt to £4,000,000. Ir

1830 the debt and accumulated interest owing in London amounted to £2,310,767, in addition to which there was a home debt of 17,183,397 dollars. In 1848 the two London loans and accumulated interest were covered by a new loan of £3,736,400, and the home debt was partially liquidated, the sale of guano giving the treasury ample resources. Lavish expenditure followed and the government was soon anticipating its revenues by obtaining advances from guano consignees, usually on unfavourable terms, and then floating loans. There was another conversion loan in 1862 in the sum of £5,500,000 and in 1864 still another loan of this character was issued, nominally for £10,000,000, of which £7,000,000 only were issued. Then followed the ambitious schemes of President Balta, which with the loans of 1870 and 1872 raised the total foreign debt to £49,000,000, on which the annual interest charge was about £2,500,000, a sum wholly beyond the resources of the treasury. In 1876 interest payments on account of this debt were suspended and in 1879–1882 the war with Chile deprived Peru of her principal sources of income—the guano deposits and the Tarapacá nitrates. In 1889 the total foreign debt, including arrears of interest, was £54,000,000, and in the following year a contract was signed with the Peruvian Corporation, a company in which the bondholders became shareholders, for the transfer to it for 66 years of the state railways, the free use of certain ports, the right of navigation on Lake Titicaca, the exploitation of the remaining guano deposits up to 3,000,000 tons, and thirty-three annual subsidies of £80,000 each, in consideration of the cancellation of the debt. Some modifications were later made in the contract, owing to the government's failure to meet the annual subsidies and the corporation's failure to extend the railways agreed upon. This contract relieved Peru of its crushing burden of foreign indebtedness, and turned an apparently heavy loss to the bondholders into a possible profit. In 1910 the foreign debt stood at £3,140,000, composed of (1) Peruvian Corporation £2,160,000; (2) wharves and docks, £80,000; (3) loan of 1905, £500,000; (4) loan of 1906, £400,000.

Currency.—The single gold standard has been in force in Peru since 1897 and 1898, silver and copper being used for subsidiary coinage. The monetary unit is the Peruvian pound (*libra*) which is uniform in weight and fineness with the British pound sterling. Half and fifth pounds are also coined. The silver coinage consists of the *sol* (100 cents), half *sol* (50 cents), and pieces of 20 (*peseta*), 10 and 5 cents; and the copper coinage of 1 and 2 cents. The single standard has worked well, and has contributed much toward the recovery of Peruvian commerce and finance. The change from the double standard was effected without any noticeable disturbance in commercial affairs, but this was in part due to the precaution of making the British pound sterling legal tender in the republic and establishing the legal equivalent between gold and silver at 10 *soles* to the pound. The coinage in 1906–1907 was about £150,000 gold and £65,000 silver, and the total circulation in that year was estimated at £1,400,000 in gold coin and £600,000 in silver coin. Previous to the adoption of the single gold standard in 1897 the monetary history of Peru had been unfortunate. The first national coinage was begun in 1822, and the decimal system was adopted in 1863. Although the double standard was in force, gold was practically demonetized by the monetary reform of 1872 because of the failure to fix a legal ratio between the two metals. Experience with paper currency has been even more disastrous. During the administration (1872–1876) of President Pardo the government borrowed heavily from the banks to avoid the suspension of work on the railways and port improvements. These banks enjoyed the privilege of issuing currency notes to the amount of three times the cash in hand without regard to their commercial liabilities. A large increase in imports, caused by fictitious prosperity and inability to obtain drafts against guano shipments, led to the exportation of coin to meet commercial obligations, and this soon reduced the currency circulation to a paper basis. The government being unable to repay its loans from the banks compelled the latter to suspend the conversion of their notes, which began to depreciate in value. In 1875 the banks were granted a *moratorium*, to enable them to obtain coin, but without result. The government in 1877 contracted a new loan with the banks and assumed responsibility for their outstanding emissions, which are said to have aggregated about 100,000,000 *soles*, and were worth barely 10% of their nominal value. At last their depreciation reached a point where their acceptance was generally refused and silver was imported for commercial needs, when the government suspended their legal tender quality and allowed them to disappear.

Weights and Measures.—The French metric system is the official standard of weights and measures and is in use in the custom-houses of the republic and in foreign trade, but the old units are still commonly used among the people. These are the ounce, 1·104 oz. avoirdupois; the *libra*, 1·014 ℔ avoirdupois; the *quintal*, 101·44 ℔ avoirdupois; the *arroba*, 25·36 ℔ avoirdupois; ditto of wine, 6·70 imperial gallons; the gallon, ·74 of an imperial gallon; the *vara*, ·927 yard; and the square *vara*, ·859 square yard. (A. J. L.)

History.—Cyclopean ruins of vast edifices, apparently never completed, exist at Tiahuanaco near the southern shore of Lake Titicaca. Remains of a similar character are found at Huaraz in the north of Peru, and at Cuzco, Ollantay-tambo and Huiñaque between Huaraz and Tiahuanaco. These works appear to have been erected by powerful sovereigns with unlimited command of labour, possibly with the object of giving employment to subjugated people, while feeding the vanity or pleasing the taste of the conqueror. Of their origin nothing is historically known. It is probable, however, that the settlement of the Cuzco valley and district by the Incas or "people of the sun" took place some 300 years before Pizarro landed in Peru. The conquering tribe or tribes had made their way to the *sierra* from the plains, and found themselves a new land sheltered from attack amidst the lofty mountains that hem in the valley of Cuzco and the vast lake basin of Titicaca, situated 12,000 ft. above the sea level. The first historical records show us these people already possessed of a considerable civilization, and speaking two allied languages, Aymara and Quichua. The expansion of the Inca rule and the formation of the Peruvian Empire was of modern growth at the time of the Spanish conquest, and dated from the victories of Pachacutic Inca who lived about a century before Huayna Capac, the Great Inca, whose death took place in 1526, the year before Pizarro first appeared on the coast. His consolidated empire extended from the river Ancasmayu north of Quito to the river Maule in the south of Chile. The Incas had an elaborate system of state-worship, with a ritual, and frequently recurring festivals. History and tradition were preserved by the bards, and dramas were enacted before the sovereign and his court. Roads with post-houses at intervals were made over the wildest mountain-ranges and the bleakest deserts for hundreds of miles. A well-considered system of land-tenure and of colonization provided for the wants of all classes of the people. The administrative details of government were minutely and carefully organized, and accurate statistics were kept by means of the "quipus" or system of knots. The edifices displayed marvellous building skill, and their workmanship is unsurpassed. The world has nothing to show, in the way of stone-cutting and fitting, to equal the skill and accuracy displayed in the Inca structures of Cuzco. As workers in metals and as potters they displayed infinite variety of design, while as cultivators and engineers they excelled their European conquerors. (For illustrations see AMERICA, Plate V.)

Conquest by Pizarro.

The story of the conquest has been told by Prescott and Helps, who give ample references to original authorities; it will be sufficient here to enumerate the dates of the leading events. On the 10th of March 1526 the contract for the conquest of Peru was signed by Francisco Pizarro, Diego de Almagro and Hernando de Luque, Gaspar de Espinosa supplying the funds. In 1527 Pizarro, after enduring fearful hardships, first reached the coast of Peru at Tumbez. In the following year he went to Spain, and on the 26th of July 1529 the capitulation with the Crown for the conquest of Peru was executed. Pizarro sailed from San Lucar with his brothers in January 1530, and landed at Tumbes in 1531. The civil war between Huascar and Atahualpa, the sons of Huayna Capac, had been fought out in the meanwhile, and the victorious Atahualpa was at Cajamarca on his way from Quito to Cuzco. On the 15th of November 1532 Pizarro with his little army, made his way to Cajamarca, where he received a friendly welcome from the Inca, whom he treacherously seized and made prisoner. He had with him only 183 men. In February 1533 his colleague Almagro arrived with reinforcements. The murder of the Inca Atahualpa was perpetrated on the 29th of August 1533, and on the 15th of November Pizarro entered Cuzco. He allowed the rightful heir to the empire, Manco, the legitimate son of Huayna Capac, to be solemnly crowned on the 24th of March 1534. Almagro then undertook an expedition to Chile, and Pizarro founded the city of Lima on the 18th of January 1535. In the following year the Incas made a brave attempt to expel the invaders, and closely besieged the Spaniards in Cuzco during February and March. But Almagro, returning from Chile, raised the siege on the 18th of April 1537. Immediately afterwards a dispute arose between the brothers, Francisco, Juan and Gonzalo Pizarro and Almagro as to the limits of their respective jurisdictions. An interview took place at Mala, on the sea-coast, on the 13th of November 1537, which led to no result, and Almagro was finally defeated in the battle of Las Salinas near Cuzco on the 26th of April 1538. His execution followed. His adherents recognized his young half-caste son, a gallant and noble youth generally known as Almagro the Lad, as his successor. Bitterly discontented, they conspired at Lima and assassinated Francisco Pizarro on the 26th of June 1541. Meanwhile Vaca de Castro had been sent out as governor of Peru by Charles V., and on hearing of the murder of Pizarro he assumed the government of the country. On the 16th of September 1542 he defeated the army of Almagro the Lad in the battle of Chupas near Guamanga, and the boy was beheaded at Cuzco.

Civil Wars.

Charles V. enacted the code known as the "New Laws" in 1542. "Encomiendas," or grants of estates on which the inhabitants were bound to pay tribute and give personal service to the grantee, were to pass to the Crown on the death of the actual holder; a fixed sum was to be assessed as tribute; and forced personal service was forbidden. Blasco Nuñez de Vela was sent out, as first viceroy of Peru, to enforce the "New Laws." Their promulgation aroused a storm among the conquerors. Gonzalo Pizarro rose in rebellion, and entered Lima on the 28th of October 1544. The viceroy fled to Quito, but was followed, defeated and killed at the battle of Anaquito on the 18th of January 1546. The "New Laws" were weakly revoked, and Pedro de la Gasca, as first president of the Audiencia (court of justice) of Peru, was sent out to restore order. He arrived in 1547, and on the 8th of April 1548 he routed the followers of Gonzalo Pizarro on the plain of Sacsahuaman near Cuzco. Gonzalo was executed on the field. La Gasca made a redistribution of "encomiendas" to the loyal conquerors, which caused great discontent, and left Peru before his scheme was made public in January 1550. On the 23rd of September 1551 Don Antonio de Mendoza arrived as second viceroy, but he died at Lima in the following July. The country was then ruled by the judges of the Audiencia, and a formidable insurrection broke out, headed by Francisco Hernandez Giron, with the object of maintaining the right of the conquerors to exact forced service from the Indians. In May 1554 Giron defeated the army of the judges at Chuquinga, but he was hopelessly routed at Fucara on the 11th of October 1554, captured, and on the 7th of December executed at Lima. Don Andres Hurtado de Mendoza, marquis of Cañete, entered Lima as third viceroy of Peru on the 6th of July 1555, and ruled with an iron hand for six years. All the leaders in former disturbances were sent to Spain. Corregidors, or governors of districts, were ordered to try summarily and execute every turbulent person within their jurisdictions. All unemployed persons were sent on distant expeditions, and moderate "encomiendes" were granted to a few deserving officers. At the same time the viceroy wisely came to an agreement with Sayri Tupac, the son and successor of the Inca Manco, and granted him a pension. He took great care to supply the natives with priests of good conduct, and promoted measures for the establishment of schools and the foundation of towns in the different provinces. The cultivation of wheat, vines and olives, and European domestic animals were introduced. The next viceroy was the Conde de Nieva (1561–1564). His successor, the licentiate Lope Garcia de Castro, who only had the title of governor, ruled from 1564 to 1569. From this time there was a succession of viceroys until 1824. The viceroys were chief magistrates, but in legal matters they had to consult the Audiencia of judges, in finance the Tribunal de Cuentas, in other branches of administration the Juntas de Gobierno and de Guerra.

Toledo's Administration.

Don Francisco de Toledo, the second son of the count of Oropesa, entered Lima as viceroy on the 26th of November 1569. Fearing that the little court of the Inca Tupac Amaru (who had succeeded his brother Sayri Tupac) might become a focus of rebellion, he seized the young prince, and unjustly beheaded the last of the Incas in the square of Cuzco in the year 1571. After a minute personal inspection of every province in Peru, he, with the experienced aid of the learned Polo de Ondegardo and the judge of Matienza, established the system under which the native population of Peru was ruled for the two succeeding centuries. His *Libro de Tasos* fixed the tribute to be paid by the Indians, exempting all men under eighteen and over fifty. He found it necessary, in order to secure efficient government, to revert in some measure to the system of the Incas. The people were to be directly governed by their native chiefs, whose duty was to collect the tribute and exercise magisterial functions. The chiefs or "curacas" had subordinate native officials under them called "pichca-pachacas" over 500 men, and "pachacas" over 100 men. The office of curaca or cacique was made hereditary, and its possessor enjoyed several privileges. Many curacas were descended from the imperial family of the Incas, or from great nobles of the Incarial court. In addition to the tribute, which was in accordance with native usage, there was the "mita," or forced labour in mines, farms and manufactories. Toledo enacted that one-seventh of the male population of a village should be subject to conscription for this service, but they were to be paid, and were not to be taken beyond a specified distance from their homes.

Vice-royalty.

The Spanish kings and viceroys desired to protect the people from tyranny, but they were unable to prevent the rapacity and lawlessness of distant officials and the country was depopulated by the illegal methods of enforcing the mita. Toledo was succeeded in 1581 by Don Martin Henriquez, who died at Lima two years afterwards. The Spanish colonies suffered from the strict system of monopoly and protection, which was only slightly relaxed by the later Bourbon kings, and from the arbitrary proceedings of the Inquisition. Between 1581 and 1776 as many as fifty-nine heretics were burned at Lima, and there were twenty-nine "autos"; but the Inquisition affected Europeans rather than natives, for the Indians, as catechumens, were exempted from its terrors. The curacas sorrowfully watched the gradual extinction of their people by the operation of the mita, protesting from time to time against the exactions and cruelty of the Spaniards. At length a descendant of the Incas, who assumed the name of Tupac Amaru, rose in rebellion in 1780. The insurrection lasted until July 1783, and cruel executions followed its suppression. This was the last effort of the Indians to throw off the Spanish yoke and the rising was by no means general. The army which overthrew Tupac Amaru consisted chiefly of loyal Indians, and the rebellion was purely anti-Spanish, and had no support from the Spanish population. The movement for independence, which slowly gained force during the opening decade of the 19th century, did not actually become serious until the conquest of Spain by the French in 1807–1808. The Creoles (Criallos) or American-born Spaniards had for long been aggrieved at being shut out from all important official positions, and at the restrictions placed upon their trade, but the bulk of the Creole population was not disloyal.

Peru Independent.

Peru was the centre of Spanish power, and the viceroy had his military strength concentrated at Lima. Consequently the insurrections in the more distant provinces, such as Chile and Buenos Aires, were the first to declare themselves independent, in 1816 and 1817. But the destruction of the viceroy's power was essential to their continued independent existence. The conquest of the Peruvian coast must always depend on the command of the sea. A fleet of armed ships was fitted out at Valparaiso in Chile, under the command of Lord Cochrane (afterwards earl of Dundonald) and officered by Englishmen. It convoyed an army of Argentine troops, with some Chileans, under the command of the Argentine general, San Martin, which landed on the coast of Peru in September 1820. San Martin was enthusiastically received, and the independence of Peru was proclaimed at Lima after the viceroy had withdrawn (July 28, 1821). On the 20th of September 1822 San Martin resigned the protectorate, with which he had been invested, and on the same day the first congress of Peru became the sovereign power of the state. After a short period of government by a committee of three, the congress elected Don José de la Riva Aguero to be first president of Peru on the 28th of February 1823. He displayed great energy in facing the difficulties of a turbulent situation, but was unsuccessful. The aid of the Colombians under Simon Bolivar was sought, and Aguero was deposed.

Bolivar arrived at Lima on the 1st of September 1823, and began to organize an army to attack the Spanish viceroy in the interior. On the 6th of August 1824 the cavalry action of Junin was fought with the Spanish forces under the command of a French adventurer, General Canterac, near the shores of the lake of Chinchay-cocha. It was won by a gallant charge of the Peruvians under Captain Suarez at the critical moment. Soon afterwards Bolivar left the army to proceed to the coast, and the final battle of Ayacucho (Dec. 9, 1824) was fought by his second in command, General Sucre. The viceroy and all his officers were taken prisoners, and the Spanish power in Peru came to an end.

General Bolivar ruled Peru with dictatorial powers for more than a year, and though there were cabals against him there can be little doubt of his popularity. He was summoned back to Colombia when he had been absent for five years and, in spite of protests left the country on the 3rd of September 1826, followed by all the Colombian troops in March 1827.

Early Presidents.

General José de Lamar, who commanded the Peruvians at Ayacucho, was elected president of Peru on the 24th of August 1827, but was deposed, after waging a brief but disastrous war with Colombia on the 7th of June 1829. General Agustin Gamarra, who had been in the Spanish service, and was chief of the staff in the patriot army at Ayacucho, was elected third president on the 31st of August 1829.

For fifteen years, from 1829 to 1844, Peru was painfully feeling her way to a right use of independence. The officers who fought at Ayacucho, and to whom the country felt natural gratitude, were all-powerful, and they had not learned to settle political differences in any other way than by the sword. Three men, during that period of probation, won a prominent place in their country's history, Generals Agustin Gamarra, Felipe Santiago Salaverry, and Andres Santa Cruz. Gamarra, born at Cuzco in 1785, never accommodated himself to constitutional usages; but he attached to himself many loyal and devoted friends, and, with all his faults he loved his country and sought its welfare according to his lights. Salaverry was a very different character. Born at Lima in 1806, of pure Basque descent, he joined the patriot army before he was fifteen and displayed his audacious valour in many a hard-fought battle. Feeling strongly the necessity that Peru had for repose, and the guilt of civil dissension, he wrote patriotic poems which became very popular. Yet he too seized the supreme power, and perished by an iniquitous sentence on the 18th of February 1836.[1] Andres Santa Cruz was an Indian statesman. His mother was a lady of high rank, of the family of the Incas, and he was very proud of his descent. Unsuccessful as a general in the field, he nevertheless possessed remarkable administrative ability and for nearly three years (1836–1839) realized his lifelong dream of a Peru-Bolivian confederation.[2] But the strong-handed intervention of Chile on the ground of assistance rendered to rebels, but really through jealousy of the confederation, ended in the defeat and overthrow of Santa Cruz, and the separation of Bolivia from Peru. But Peruvian history is not confined to the hostilities of these military rulers. Three constitutions were framed—in 1828, 1833 and 1839. Lawyers and orators are never wanting in Spanish-American states, and revolution succeeded revolution in one continuous struggle for the spoils of office. An exception must be made of the administration of General Ramon Castilla, who restored peace to Peru, and showed himself to be an honest and very capable ruler. He was elected constitutional president on the 20th of April 1845. Ten years of peace and increasing prosperity followed. In 1849 the regular payment of the interest of the public debt was commenced, steam communication was established along the Pacific coast, and a railroad was made from Lima to Callao. After a regular term of office of six years of peace and moral and material progress Castilla resigned, and General José Echenique was elected president. But the proceedings of Echenique's government in connexion with the consolidation of the internal debt were disapproved by the nation, and, after hostilities which lasted for six months, Castilla returned to power in January 1855. From December 1856 to March 1858 he had to contend with and subdue a local insurrection headed by General Agostino Vivanco, but, with these two exceptions, there was peace in Peru from 1844 to 1879, a period of thirty-five years. Castilla retired at the end of his term of office in 1862, and died in 1868. On the 2nd of August 1868 Colonel Juan Balta was elected president. With the vast sum raised from guano and nitrate deposits President Balta commenced the execution of public works, principally railroads on a gigantic scale. His period of office was signalized by the opening of an international exhibition at Lima. He was succeeded (Aug. 2, 1872) by Don Manuel Pardo (d. 1878), an honest and enlightened statesman, who did all in his power to retrieve the country from the financial difficulty into which it had been brought by the reckless policy of his predecessor, but the conditions were not capable of solution. He regulated the Chinese immigration to the coast-valleys, which from 1860 to 1872 had amounted to 58,606. He promoted education, and encouraged literature. On the 2nd of August 1876 General Mariano-Ignacio Prado was elected. (C. R. M.; X.)

War with Chile, 1879-1882.

On the 5th of April 1879 the republic of Chile declared war upon Peru, the alleged pretext being that Peru had made an offensive treaty, directed against Chile, with Bolivia, a country with which Chile had a dispute; but the publication of the text of this treaty made known the fact that it was strictly defensive and contained no just cause of war. The true object of Chile was the conquest of the rich Peruvian province of Tarapacá, the appropriation of its valuable guano and nitrate deposits, and the spoliation of the rest of the Peruvian coast. The military events of the war, calamitous for Peru, are dealt with in the article CHILE-PERUVIAN WAR. Suffice it here to note that, after the crushing defeat of the Peruvian forces at Arica (June 7, 1880) Señor Nicolas de Pierola assumed dictatorial powers, with General Andres Cáceres as commander-in-chief, but the defeats at Chorrillos (Jan. 13, 1881) and Miraflores (Jan. 15) proved the Chilean superiority, and put Lima at their mercy though desultory fighting was maintained by the remnants of the Peruvian army in the interior, under direction of General Cáceres. An attempt was made to constitute a government with Señor Calderon as president of the republic and General Cáceres as first vice-president. The negotiations between this nominal administration and the Chilean authorities for a treaty of peace proved futile, the Chilean occupation of Lima and the Peruvian seaboard continuing uninterruptedly until 1883. In that year Admiral Lynch, who had replaced General Baquedano in command of the Chilean forces after the taking of Lima, sent an expedition against the Peruvians under General Cáceres, and defeated the latter in the month of August. The Chilean authorities now began preparations for the evacuation of Lima, and to enable this measure to be effected a Peruvian administration was organized with the support of the Chileans. General Iglesias was nominated to the office of president of the republic, and in October 1883 a treaty of peace, known as the treaty of Ancon, between Peru and Chile was signed. The Chilean army of occupation was withdrawn from Lima on the 22nd of October 1883, but a strong force was maintained at Chorrillos until July 1884, when the terms of the treaty were finally approved. The principal conditions imposed by Chile were the absolute cession by Peru of the province of Tarapacá, and the occupation for a period of ten years of the territories of Tacna and Arica, the ownership of these districts to be decided by a popular vote of the inhabitants of Tacna and Arica at the expiration of the period named. A further condition was enacted that an indemnity of 10,000,000 soles was to be paid by the country finally remaining in possession—a sum equal to about £1,000,000 to-day. The Peruvians in the interior refused to recognize President Iglesias, and at once began active operations to overthrow his authority on the final departure of the Chilean troops. Affairs continued in this unsettled state until the middle of 1885, Cáceres meanwhile steadily gaining many adherents to his side of the quarrel. In the latter part of 1885 President Iglesias abdicated.

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[1] The romance of his life has been admirably written by Manuel Bilbao (1st ed., Lima, 1853; 2nd ed., Buenos Aires, 1867).

[2] The succession of presidents and supreme chiefs of Peru from 1829 to 1844 was as follows: 1829–1833, Agustin Gamarra; 1834–1835, Luis José Orbegoso; 1835–1836, Felipe Santiago Salaverry; 1836–1839, Andres Santa Cruz; 1839–1841, Agustin Gamarra; 1841–1844, Manuel Menendez.

Cáceres in Power.

Under the guidance of General Cáceres a *junta* was then formed to carry on the government until an election for the presidency should be held and the senate and chamber of deputies constituted. In the following year (1886) General Cáceres was elected president of the republic for the usual term of four years. The task assumed by the new president was no sinecure. The country had been thrown into absolute confusion from a political and administrative point of view, but gradually order was restored, and peaceful conditions were reconstituted throughout the republic. The four years of office for which General Cáceres was elected passed in uneventful fashion, and in 1890 Señor Morales Bermudez was nominated to the presidency, with Señor Solar and Señor Borgoño as first and second vice-presidents. Matters continued without alteration from the normal course until 1894, and in that year Bermudez died suddenly a few months before the expiration of the period for which he had been chosen as president. General Cáceres secured the nomination of the vice-president Borgoño as chief of the executive for the unexpired portion of the term of the late president Bermudez. This action was unconstitutional, and was bitterly resented by the vice-president Solar, who by right should have succeeded to the office. Armed resistance to the authority of Borgoño was immediately organized in the south of Peru, the movement being supported by Señores Nicolas de Pierola, Billinghurst, Durand and a number of influential Peruvians. In the month of August 1894 General Cáceres was again elected to fill the office of president, but the revolutionary movement rapidly gained ground. President Cáceres adopted energetic measures to suppress the outbreak: his efforts, however, proved unavailing, the close of 1894 finds the country districts in the power of the rebels and the authority of the legal government confined to Lima and other cities held by strong garrisons. Early in March 1895 the insurgents encamped near the outskirts of Lima, and on the 17th, 18th and 19th of March severe fighting took place, ending in the defeat of the troops under General Cáceres. A suspension of hostilities was then brought about by the efforts of H.B.M. consul. The loss on both sides to the struggle during these two days was 2800 killed and wounded. President Cáceres, finding his cause was lost, left the country, a provisional government under Señor Candamo assuming the direction of public affairs.

Pierola President.

On the 8th of September 1895 Señor Pierola was declared president of the republic for the following four years. The Peruvians were now heartily tired of revolutionary disturbances, and an insurrectionary outbreak in the district of Iquitos met with small sympathy, and was speedily crushed. In 1896 a reform of the electoral law was sanctioned. By the provisions of this act an electoral committee was constituted, composed of nine members, two of these nominated by the senate, two by the chamber of deputies, four by the supreme court, and one by the president with the consent of his ministers. To this committee was entrusted the task of the examination of all election returns, and of the proclamation of the names of successful candidates for seats in congress. Another reform brought about by Pierola was a measure introduced and sanctioned in 1897 for a modification of the marriage laws. Under the new act marriages of non-Catholics solemnized by diplomatic or consular officers or by ministers of dissenting churches, if properly registered, are valid, and those solemnized before the passing of this act were to be valid if registered before the end of 1899. Revolutionary troubles again disturbed the country in 1899, when the presidency of Señor Pierola was drawing to a close. In consequence of dissensions amongst the members of the election committee constituted by the act of 1896, the president ordered the suppression of this body. A group of malcontents under the leadership of one Durand, a man who had been prominent in the revolution against General Cáceres in 1894–95, conspired against the authorities and raised several armed bands, known locally as *montaneras*. Some skirmishes occurred between these insurgents and the government troops, the latter generally obtaining the advantage in these encounters.

Romaña President.

In September 1899 President Pierola vacated the presidency in favour of Señor Romaña, who had been elected to the office as a popular condidate and without the exercise of any undue official influence. President Romaña was educated at Stonyhurst in England, and was a civil engineer by profession. The principal political problem before the government of Peru was the ownership of the territories of Tacna and Arica. The period of ten years originally agreed upon for the Chilean occupation of these provinces expired in 1894. At that date the peace of Peru was so seriously disturbed by internal troubles that the government was quite unable to take active steps to bring about any solution of the matter. After 1894 negotiations between the two governments were attempted from time to time, but without any satisfactory results. The question hinged to a great extent on the qualification necessary for the inhabitants to vote, in the event of a plebiscite being called to decide whether Chilean ownership was to be finally established or the provinces were to revert to Peruvian sovereignty. Peru proposed that only Peruvian residents should be entitled to take part in a popular vote; Chile rejected this proposition, on the ground that all residents in the territories in question should have a voice in the final decision. The agreement between Chile and Bolivia, by which the disputed provinces were to be handed over to the latter country if Chilean possession was recognized, was also a stumbling-block, a strong feeling existed among Peruvians against this proceeding. It was not so much the value of Tacna and Arica that put difficulties in the way of a settlement as the fact that the national pride of the Peruvians ill brooked the idea of permanently losing all claim to this section of country. The money, about £1,000,000, could probably have been obtained to indemnify Chile if occasion for it arose.

The question of the delimitation of the frontier between Peru and the neighbouring republics of Ecuador, Colombia, and Brazil also cropped up at intervals. A treaty was signed with Brazil 1876, by which certain physical features were accepted by both countries as the basis for the boundary. In the case of Ecuador and Colombia a dispute arose in 1894 concerning the ownership of large tracts of uninhabited country in the vicinity of the headwaters of the Amazon and its tributaries. An agreement was proposed between Peru and Ecuador in connexion with the limits of the respective republics, but difficulties were created to prevent this proposal from becoming an accomplished fact by the pretensions put forward by Colombia. The latter state claimed sovereignty over the Napo and Marañon rivers on the grounds of the ecclesiastical jurisdiction exercised over this section of territory during the period of Spanish dominion, the government of Colombia asserting that these ecclesiastical rights to which Colombia became entitled after her separation from the Spanish crown carried also the right of absolute ownership. In a treaty signed by the three interested states in 1895 a compromise was effected by which Colombia withdrew a part of the claim advanced, and it was agreed that any further differences arising out of this frontier question should be submitted to the arbitration of the Spanish crown. The later development of the boundary question is dealt with at the outset of this article.

Señor Manuel Candamo succeeded Señor Romana as president in 1903. In the following year he died, and on the 24th of September 1904 Señor José Pardo was installed in the presidential chair. In 1908 there were some insurrectionary movements at Lima and an attempt was made to assassinate President Pardo, but they were, however, suppressed without a serious outbreak. Señor Augusto Leguiva became president on the 24th of September 1908. (C. E. A.; G. E.)

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PERU, a city of La Salle county, Illinois, U.S.A., in the north-central part of the state, on the N. bank of the Illinois River, about 100 m. S.W. of Chicago and 1 m. W. of La Salle, a terminus of the Illinois & Michigan Canal. Pop. (1900), 6863 (2095 foreign-born); (1910), 7984. It is served by the Chicago, Burlington & Quincy and the Chicago, Rock Island & Pacific railways. The city is built on the face and top of a series of river bluffs. It is the seat of St Bede College (Roman Catholic, opened in 1891), conducted by Benedictine fathers. In a large public park there is a bronze monument in memory of the soldiers of Peru who died in the Civil War. There are extensive coal-mines in the vicinity; and the city includes various manufactures. Peru was first settled about 1827, was incorporated in 1845, and re-incorporated in 1890.

PERU, a city and the county-seat of Miami county, Indiana, U.S.A., about 75 m. N. of Indianapolis, on the Wabash River. Pop. (1910 U.S. census), 10,910. Peru is served by the Chicago Cincinnati & Louisville, the Lake Erie & Western and the Wabash railways (each of which maintains shops here), and by electric lines to Indianapolis, Warsaw and other cities. The city has a Carnegie library, a railway Young Men's Christian Association, and a hospital for the employés of the Wabash railroad. There is a city park on the river, and 9 m. east of the city is Boyd park, an amusement resort. Peru is an important grain and produce market, and has various manufactures. In 1905 the value of the factory products was $1,703,417 (27·3% more than in 1900). Petroleum is found in the vicinity. Peru was settled in 1834 and was chartered as a city in 1867.

PERUGIA (anc. *Perusia*), a city and archiepiscopal see of Italy, the capital of the province of Perugia (which forms the entire *compartimento* of Umbria) situated 1444 ft. above sea-level. Pop. (1906), 22,321 (town); 65,527 (commune). The town is finely situated upon a group of hills nearly 1000 ft. above the valley of the Tiber. Its outline is very irregular; from the centre of the town, at the junction of several ridges, parts of it extend for a considerable distance along their summits, being divided from one another by deep valleys. This is the extent enclosed by the medieval walls; within them are considerable remains of the lofty terrace walls of the Eutruscan period. The so-called Arco di Augusto is a town gate with a Decorated superstructure, perhaps of the Etruscan period, bearing the inscription *Augusta Perusia*; above this again is a Renaissance loggia. The superstructure of a similar gate (Porta Marzia), which was removed in 1540 to make way for the citadel, but is depicted in a fresco by Benedetto Bonfigli (between 1461 and 1477), was re-erected in the substruction walls of the citadel itself. It bears the inscription *Colonia Vibia Augusta Perusia*, so that the town must have become a colony in the reign of the emperor C. Vibius Trebonianus Gallus (A.D. 251–253), who was a native of it. Four other gates of the Etruscan period can still be traced (F. Noack in *Römische Mitteilungen*, 1897, 166 sqq). In the garden of the church of S. Elisabeth was found in 1876 a fine mosaic in black on a white ground representing Orpheus in the midst of the beasts (*Notizie degli scavi*, 1876, 181; 1877 309).

The citadel was erected by Pope Paul III. in 1540–1546, after the plans of Antonio da Sangallo the younger, and demolished in 1860 (see Bacile di Castiglione in *L'Arte*, 1903, 347). The Piazza del Duomo is at the north of the Corso. On one side stands the cathedral of San Lorenzo, a Gothic structure of the 14th and 15th centuries, in the plan of a Latin cross, with nave and aisles of equal height; on the other the Palazzo del Municipio, presenting two fine Gothic façades, of the 14th century (though the building was not completed till 1443), with the figures of the Perugian griffin and the Guelph lion above the outside stair; and in the centre the marble fountain constructed in 1277–1280 by Arnolfo di Cambio, and adorned with statues and statuettes by Niccolo and Giovanni Pisano. The cathedral contains the burial-place of Urban IV. and Martin IV.—the remains of Innocent III. were removed to Rome in 1892 and placed in the basilica of S. Giovanni in Laterano—and the Virgin's wedding-ring; and at the north-east corner is a sitting statue of Pope Julius III. by Vincenzo Danti, erected in 1555 by the people of Perugia in gratitude for the restoration of their civic privileges. On the decoration of the Sala del Cambio, or old exchange, Perugino put forth the full force of his genius. Most of the movable paintings have since 1863 been collected in the Pinacoteca Vannucci, established in the Palazzo del Municipio; besides a considerable number of pieces by Perugino, there are specimens of Niccolò Alunno, Bonfigli, Pinturicchio, &c. A very interesting and important exhibition of Umbrian art was held here in 1907. The pictures, the needlework with some splendid pieces of embroidery from S. Francesco at Assisi, the vestments of Pope Benedict XI., and the majolica of Perugia and Deruta, a village 10 m. south, were especially noteworthy (see U. Gnoli, *L'Arte umbra alla mostra di Perugia*, Bergamo, 1908). The illuminated MSS. of the communal library, the cathedral and the church of S. Pietro, from the 7th century onwards, were also exhibited.

The formation of the Pinacoteca Vannucci has impaired the interest of several churches but in others it remains undiminished. San Domenico, a Gothic edifice originally designed by Giovanni Pisano but rebuilt in 1614, contains the monument of Pope Benedict XI. (attributed, but probably wrongly, to Giovanni Pisano by Vasari), and in its east front a Gothic window with stained glass by Fra Bartolommeo of Perugia (1441). San Pietro de' Cassinensi (outside the Porta Romana) is a basilica with nave and aisles, founded in the beginning of the 11th century by San Pietro Vincioli on the site of a building of the 6th century, and remarkable for its conspicuous spire, its ancient granite and marble columns, its walnut stall-work of 1535 by Stefano de' Zambelli da Bergamo, and its numerous pictures (by Perugino, &c.). The oratory of S. Bernardino has an early Renaissance polychrome façade, richly sculptured, of 1457–1461, by Agostino d'Antonio di Duccio of Florence. S. Severo contains Raphael's first independent fresco (1505), much damaged by restoration. The circular church of S. Angelo, with sixteen antique columns in the interior, probably dates from the middle of the 6th century. The university dates from 1307, and has faculties of law, science and medicine; it had 318 students in 1902–1903. It contains an important museum of Etruscan and Roman antiquities. Three miles to the S.S.E. the Etruscan necropolis of the ancient city was discovered in 1870. The large tomb of the Volumni (3rd century B.C.) hewn in the rock, with its carved cinerary urns, is interesting.

The ancient Perusia first appears in history as one of the twelve confederate cities of Etruria. It is first mentioned in the account of the war of 310 or 309 B.C. between the Etruscans and the Romans. It took, however, an important part in the rebellion of 295, and was reduced, with Vulsinii and Arretium, to seek for peace in the following year. In 216 and 205 it assisted Rome in the Hannibalic war, but afterwards it is not mentioned until 41–40 B.C., when L. Antonius took refuge there, and was reduced by Octavian after a long siege. A number of lead bullets used by slingers have been found in and around the city (*Corpus inscr. lat.* xi. 1212). The city was burnt, we are told, with the exception of the temples of Vulcan and Juno —the massive Etruscan terrace-walls, naturally, can hardly have suffered at all—and the town, with the territory for a mile round, was allowed to be occupied by whoever chose. It must have been rebuilt almost at once, for several bases exist, inscribed *Augusto sacr(um) Perusia restituta*; but, as we have seen, it did not become a colony until A.D. 251–253. It is hardly mentioned except by the geographers until the middle of the 6th century, when it was captured by Totila after a long siege. In the Lombard period it is spoken of as one of the principal cities of Tuscia. In the 9th century, with the consent of Charles the Great and Louis the Pious, it passed under the popes; but for many centuries the city continued to maintain an independent life, warring against many of the neighbouring lands and cities—Foligno, Assisi, Spoleto, Montepulciano, &c. It remained true for the most part to the Guelphs. On various occasions the popes found asylum within its walls, and it was the meeting-place of the conclaves which elected Honorius II. (1124), Honorius IV. (1285), Celestine V. (1294), and Clement V. (1305). But Perugia had no mind simply to subserve the papal interests. At the time of Rienzi's unfortunate enterprise it sent ten ambassadors to pay him honour; and, when papal legates sought to coerce it by foreign soldiers, or to exact contributions, they met with vigorous resistance. In the 15th century power was at last concentrated in the Baglioni family, who, though they had no legal position, defied all other authority. Gian Paolo Baglioni was lured to Rome in 1520 and beheaded by Leo X.; and in 1534 Rodolfo, who had slain a papal legate, was defeated by Pier Luigi Farnese, and the city, captured and plundered by his soldiery, was deprived of its privileges. The citadel was begun six years later "ad coercendam Perusinorum audaciam." In 1797 Perugia was occupied by the French; in 1832, 1838 and 1854 it was visited by earthquakes; in May 1849 it was seized by the Austrians; and, after a futile insurrection in 1859, it was finally united, along with the rest of Umbria, to Piedmont, in 1860.

See G. Conestabile, *I Monumenti di Perugia etrusca e romana* (Perugia, 1855); M. Symonds and L. Duff Gordon, *Perugia* ("Medieval Towns Series"), (1898); R. A. Gallenga Stuart, *Perugia* (Bergamo, 1905; W. Heywood, *Hist. of Perugia* (1910). (T. As.)

PERUGINO, PIETRO (1446–1524), whose correct family name was VANNUCCI, Italian painter, was born in 1446 at Città della Pieve in Umbria, and belongs to the Umbrian school of painting. The name of Perugino came to him from Perugia, the chief city of the neighbourhood. Pietro was one of several children born to Cristoforo Vannucci, a member of a respectable family settled at Città della Pieve. Though respectable, they seem to have been poor, or else, for some reason or other, to have left Pietro uncared for at the opening of his career. Before he had completed his ninth year the boy was articled to a master, a painter at Perugia. Who this may have been is very uncertain; the painter is spoken of as wholly mediocre, but sympathetic for the great things in his art. Benedetto Bonfigli is generally surmised; if he is rejected as being above mediocrity, either Fiorenzo di Lorenzo or Niccolò da Foligno may possibly have been the man. Pietro painted a little at Arezzo; thence he went to the headquarters of art, Florence, and frequented the famous Brancacci Chapel in the church of the Carmine. It appears to be sufficiently established that he studied in the atelier of Andrea del Verrocchio, where Leonardo de Vinci was also a pupil. He may have learned perspective, in which he particularly excelled for that period of art, from Piero de' Franceschi. The date of this first Florentine sojourn is by no means settled; some authorities incline to make it as early as 1470. while others, with perhaps better reason, postpone it till 1479. Pietro at this time was extremely poor; he had no bed, but slept on a chest for many months, and, bent upon making his way, resolutely denied himself every creature comfort.

Gradually Perugino rose into notice, and became famous not only throughout Italy but even beyond. He was one of the earliest Italian painters to practise oil-painting, in which he evinced a depth and smoothness of tint, which elicited much remark; and in perspective he applied the novel rule of two centres of vision. Some of his early works were extensive frescoes for the Ingesati fathers in their convent, which was destroyed not many years afterwards in the course of the siege of Florence; he produced for them also many cartoons, which they executed with brilliant effect in stained glass. Though greedy for gain, his integrity was proof against temptation; and an amusing anecdote has survived of how the prior of the Ingesati doled out to him the costly colour of ultramarine, and how Perugino, constantly washing his brushes, obtained a surreptitious hoard of the pigment, which he finally restored to the prior to shame his stingy suspiciousness. A good specimen of his early style in tempera is the circular picture in the Louvre of the "Virgin and Child enthroned between Saints."

Perugino returned from Florence to Perugia, and thence, towards 1483, he went to Rome. The painting of that part of the Sixtine Chapel which is now immortalized by Michelangelo's "Last Judgment" was assigned to him by the pope; he covered it with frescoes of the "Assumption," the "Nativity," and "Moses in the Bulrushes." These works were ruthlessly destroyed to make a space for his successor's more colossal genius, but other works by Perugino still remain in the Sixtine Chapel; "Moses and Zipporah" (often attributed to Signorelli), the "Baptism of Christ," and "Christ giving the Keys to Peter." Pinturicchio accompanied the greater Umbrian to Rome, and was made his partner, receiving a third of the profits; he may probably have done some of the Zipporah subject.

Pietro, now aged forty, must have left Rome after the completion of the Sixtine paintings in 1486, and in the autumn of that year he was in Florence. Here he figures by no means advantageously in a criminal court. In July 1487 he and another Perugian painter named Aulista di Angelo were convicted, on their own confession, of having in December waylaid with staves some one (the name does not appear) in the street near S. Pietro Maggiore. Perugino limited himself, in intention, to assault and battery, but Aulista had made up his mind for murder. The minor and more illustrious culprit was fined ten gold florins, and the major one exiled for life.

Between 1486 and 1499 Perugino resided chiefly in Florence, making one journey to Rome and several to Perugia. He was in many other parts of Italy from time to time. He had a regular shop in Florence, received a great number of commissions, and continued developing his practice as an oil-painter, his system of superposed layers of colour being essentially the same as that of the Van Eycks. One of his most celebrated pictures, the "Pietà" in the Pitti Gallery, belongs to the year 1495. From about 1498 he became increasingly keen after money, frequently repeating his groups from picture to picture, and leaving much of his work to journeymen. In 1499 the gild of the cambio (money-changers or bankers) of Perugia asked him to undertake the decoration of their audience-hall, and he accepted the invitation. This extensive scheme of work, which may have been finished within the year 1500, comprised the painting of the vault with the seven planets and the signs of the zodiac (Perugino doing the designs and his pupils most probably the executive work) and the representation on the walls of two sacred subjects—the "Nativity" and "Transfiguration"—the Eternal Father, the four virtues of Justice, Prudence, Temperance and Fortitude, Cato as the emblem of wisdom, and (in life size) numerous figures of classic worthies, prophets and sibyls. On the mid-pilaster of the hall Perugino placed his own portrait in bust-form. It is probable that Raphael, who in boyhood, towards 1496, had been placed by his uncles under the tuition of Perugino, bore a hand in the work of the vaulting. It may have been about this time (though some accounts date the event a few years later) that Vannucci married a young and beautiful wife, the object of his fond affection; he loved to see her handsomely dressed, and would often deck her out with his own hands. He was made one of the priors of Perugia in 1501.

While Perugino, though by no means stationary or unprogressive as an executive artist, was working contentedly upon the old lines and carrying out the ancient conceptions, a mighty wave of new art flooded Florence with its rush and Italy with its rumour. Michelangelo, twenty-five years of age in 1500, following after and distancing Leonardo da Vinci, was opening men's eyes and minds to possibilities of achievement as yet unsurmised. Vannucci in Perugia heard Buonarroti bruited abroad, and was impatient to see with his own eyes what the stir was all about. In 1504 he allowed his apprentices and assistants to disperse, and returned to Florence. Though not openly detracting, he viewed with jealousy and some grudging the advances made by Michelangelo; and Michelangelo on his part replied, with the intolerance which pertains to superiority, to the faint praise or covert dispraise of his senior and junior in the art. On one occasion, in company, he told Perugino to his face that he was "a bungler in art" (*goffo nell' arte*). Vannucci brought, with equal indiscretion and ill success, an action for defamation of character. Put on his mettle by this mortifying transaction, he determined to show what he could do, and he produced the *chef-d'œuvre* of the "Madonna and Saints" for the Certosa of Pavia. The constituent parts of this noble work have now been sundered. The only portion which remains in the Certosa is a figure of God the Father with cherubim. An "Annunciation" has disappeared from cognisance; three compartments—the Virgin adoring the infant Christ, St Michael, and St Raphael with Tobias—are among the choicer treasures of the National Gallery, London. The current story that Raphael bore a hand in the work is not likely to be true. This was succeeded in 1505 by an "Assumption," in the Cappella dei Rabatta, in the church of the Servi in Florence. The painting may have been executed chiefly by a pupil, and was at any rate a failure: it was much decried; Perugino lost his scholars; and towards 1506 he once more and finally abandoned Florence, going to Perugia, and thence in a year or two to Rome.

Pope Julius II. had summoned Perugino to paint the Stanza in the Vatican, now called that of the Incendio del Borgo; but he soon preferred a younger competitor, that very Raphael who had been trained by the aged master of Perugia; and Vannucci, after painting the ceiling with figures of God the Father in different glories, in five medallion-subjects, found his occupation gone; he retired from Rome, and was once more in Perugia from 1512. Among his latest works one of the best is the extensive altar-piece (painted between 1512 and 1517) of S. Agostino in Perugia; the component parts of it are now dispersed in various galleries.

Perugino's last frescoes were painted for the monastery of S. Agnese in Perugia, and in 1522 for the church of Castello di Fortignano hard by. Both series have disappeared from their places, the second being now in the Victoria and Albert Museum. He was still at Fontignano in 1524 when the plague broke out, and he died. He was buried in unconsecrated ground in a field, the precise spot now unknown. The reason for so obscure and unwonted a mode of burial has been discussed, and religious scepticism on the painter's own part has been assigned as the cause; the fact, however, appears to be that, on the sudden and widespread outbreak of the plague, the panic-struck local authorities ordained that all victims of the disorder should be at once interred without any waiting for religious rites. This leads us to speak of Perugino's opinions on religion. Vasari is our chief, but not our sole, authority for saying that Vannucci had very little religion, and was an open and obdurate disbeliever in the immortality of the soul. For a reader of the present day it is easier than it was for Vasari to suppose that Perugino may have been a materialist, and yet just as good and laudable a man as his orthodox Catholic neighbours or brother-artists; still there is a strong discrepancy between the quality of his art, in which all is throughout Christian, Catholic, devotional, and even pietistic, and the character of an anti-Christian contemner of the doctrine of immortality. It is difficult to reconcile this discrepancy, and certainly not a little difficult also to suppose that Vasari was totally mistaken in his assertion; he was born twenty years before Perugino's death, and must have talked with scores of people to whom the Umbrian painter had been well known. We have to remark that Perugino in 1494 painted his own portrait, now in the Uffizi Gallery of Florence, and into this he introduced a scroll lettered "Timete Deum." That an open disbeliever should inscribe himself with "Timete Deum" seems odd. The portrait in question shows a plump face, with small dark eyes, a short but well-cut nose, and sensuous lips; the neck is thick, the hair bushy and frizzled, and the general air imposing. The later portrait in the Cambio of Perugia shows the same face with traces of added years. Perugino died possessed of considerable property, leaving three sons.

Among the very numerous works of Perugino a few not already named require mention. Towards 1496 he painted the "Crucifixion," in S. Maria Maddalena dei Pazzi, Florence. The attribution to him of the picture of the marriage of Joseph and the Virgin Mary (the "Sposalizio") now in the museum of Caen, which served indisputably as the original, to a great extent, of the still more famous "Sposalizio" which was painted by Raphael in 1504, and which forms a leading attraction of the Brera Gallery in Milan, is now questioned, and it is assigned to Lo Spagna. A vastly finer work of Perugino's is the "Ascension of Christ," which, painted a littler earlier for S. Pietro of Perugia, has for years past been in the museum of Lyons; the other portions of the same altar-piece are dispersed in other galleries. In the chapel of the Disciplinati of Città della Pieve is an "Adoration of the Magi," a square of 21 ft. containing about thirty life-sized figures; this was executed, with scarcely credible celerity, from the 1st to the 25th of March (or thereabouts) in 1505, and must no doubt be in great part the work of Vannucci's pupils. In 1507, when the master's work had for years been in a course of decline and his performances were generally weak, he produced. nevertheless, one of his best pictures—the "Virgin between St Jerome and St Francis," now in the Palazzo Penna. In S. Onofrio of Florence is a much lauded and much-debated fresco of the "Last Supper," a careful and blandly correct but not inspired work; it has been ascribed to Perugino by some connoisseurs, by others to Raphael; it may more probably be by some different pupil of the Umbrian master.

AUTHORITIES.—In addition to Crowe and Cavalcaselle, see *Di Pietro Perugino e degli scolari* (1804); Mezzanotte, *Vita, &c., di Pietro Vannucci* (1836); Mariotti, *Lettere pittoriche Perugine* (1788); Claude Phillips (in *The Portfolio*) (1893); G. C. Williamson, *Perugino* (1900 and 1903).

(W. M. R.)

PERUKE, an artificial head of hair, a wig. The word is from Fr. *perruque*, an adaptation of Ital. *perruca* or *parrucca*. This is usually taken to be from Ital. *pelo*, hair; Lat. *pilus*. Span. *peluca*, wig, and Sardinian *pilucca*, lock or tuft of hair, support this view. In the 17th century the English forms which the French word took, such as *perruck* or *perug*, were corrupted into *perwyke*, and thence into *perewyk*, *perewig*, and lastly "periwig," which again was shortened into "wig," the common term for all types of artificial heads of hair. Periwig is sometimes confined to the heavy full-bottomed wigs worn from the reign of Charles II. to the introduction of the light, tailed wig of the 18th century.

PERUZZI, BALDASSARE (1481–1536), Italian architect and painter of the Roman school, was born at Ancajano, in the diocese of Volterra, and passed his early life at Siena, where his father resided. While quite young Peruzzi went to Rome, and there studied architecture and painting; in the latter he was at first a follower of Perugino. The choir frescoes in Sant' Onofrio on the Janiculan Hill, usually attributed to Pinturicchio, are by his hand. One of the first works which brought renown to the young architect was the villa on the banks of the Tiber in Rome now known as the Farnesina, originally built for the Sienese Agostino Chigi, a wealthy banker. This villa, like all Peruzzi's works, is remarkable for its graceful design and the delicacy of its detail. It is best known for the frescoes painted there by Raphael and his pupils to illustrate the stories of Psyche and Galatea. One of the loggie has frescoes by Peruzzi's own hand—the story of Medusa. On account of his success Peruzzi was appointed by Leo X. in 1520 architect to St Peter's at a salary of 250 scudi; his design for its completion was not, however, carried out. During the sack of Rome in 1527 Peruzzi barely escaped with his life, on condition of his painting the portrait of Constable de Bourbon, who had been killed during the siege (see VASARI). From Rome he escaped to Siena, where he was made city architect, and designed fortifications for its defence, a great part of which still exist. Soon afterwards he returned to Rome, where he made designs for a palace for the Orsini family, and built the palaces Massimi and Vidoni, as well as others in the south of Italy. He died in 1536, and was buried by the side of Raphael in the Pantheon.

Peruzzi was an eager student of mathematics and was also a fair classical scholar. Like many of the great artists of his time, he was remarkable for the varied extent of his knowledge and skill. A most able architect, a fair painter, and a scientific engineer, he also practised minor arts, such as stucco-work in relief, sgraffito, and the decorative painted arabesques which the influence of Raphael did so much to bring into use. His best existing works in fresco are in the Castel di Belcaro and the church of Fontegiusta in Siena. For Siena Cathedral he also designed a magnificent wooden organ-case, painted and gilt, rich with carved arabesques in friezes and pilasters; he also designed the high altar and the Cappella del Battista.

His chief pupil was the architect Serlio, who, in his work on architecture, gratefully acknowledges the great debt he owed to Peruzzi's instruction. The English National Gallery possesses an interesting drawing by his hand. The subject is the "Adoration of the Magi," and it is of special value, because the heads of the three kings are portraits of Michelangelo, Raphael, and Titian. The Uffizi and the library at Siena contain a number of Peruzzi's designs and drawings, many of which are now of priceless value, as they show ancient buildings which have been destroyed since the 16th century.

AUTHORITIES.—Vasari, *Vita di Baldassare Peruzzi* (Milanesi's ed., 1882), iv. 489; Milizia, *Memorie degli architetti* (1781, i. 210–215); Della Valle, *Lettere senesi* (1782–1786); Gaye, *Carteggio inedito d' artisti* (1839–1840); Lanzi, *Storia pittorica* (1804); and Platner, *Beschreibung der Stadt Rom* (1830–1842).

PERVIGILIUM[1] VENERIS, the Vigil of Venus, a short Latin poem. The author, date, and place of composition are unknown. The poem probably belongs to the 2nd or 3rd century A.D. An article signed L. Raquettius in the *Classical Review* (May 1905) assigns it to Sidonius Apollinaris (5th cent.) It was written professedly in early spring on the eve of a three-nights' festival of Venus (probably April 1–3). It describes in poetical language the annual awakening of the vegetable and animal world through the goddess. It consists of ninety-three verses in trochaic septenarii, and is divided into strophes of unequal length by the refrain:

"Cras amet qui nunquam amavit; quique amavit cras amet."

Editio princeps (1577); modern editions by F. Bücheler (1859), A. Riese, in *Anthologia latina* (1869), E. Bährens in *Unedierte lateinische Gedichte* (1877); S. G. Owen (with Catullus, 1893). There are translations into English verse by Thomas Stanley (1651) and Thomas Parnell, author of *The Hermit*; on the text see J. W. Mackail in *Journal of Philology* (1888), vol. xvii.

PESARO (anc. *Pisaurum*, *q.v.*), a city and seaport of the Marches, Italy, the capital of the province of Pesaro and Urbino, situated on the coast of the Adriatic 37 m. N.W. of Ancona by rail, on the right bank of the Foglia, the ancient Pisaurus. The ground on which it is built is only from 10 to 40 ft. above the sea, but it is surrounded by hills—on the E. by Monte Ardizio, on the W. by Monte Accio or San Bartolo, which derives one of its names from the tradition that the Roman dramatist L. Attius was born and buried on the spot. Upon this hill stands the Villa Imperiale, the foundation stone of which was laid by the emperor Frederick III., built by the Sforza, and decorated with fine stucco ceilings and wall paintings and pavements of majolica plaques. A new palace was begun in 1530 by the Genga for Eleonora Gonzaga, but never finished. The city walls were in 1830 transformed into a public promenade. Besides the ancient cathedral of the Annunciation (restored since 1860) with a 12th-century mosaic pavement, there are a number of smaller churches, several with Gothic portals. One of these, the church of San Francesco, now used as a cathedral, contains the "Coronation of the Virgin" by Giovanni Bellini, the largest and most important of his works outside Venice. The most conspicuous buildings are the prefecture (a palace originally erected in 1455–1465 by the Dalmatian architect Luciano da Laurana for the Sforza, and restored by Francesco Maria della Rovere in the 16th century, the Rossini theatre (opened in 1818), the fortress of Rocca Costanzia (built by Costanzo Sforza in 1474, Laurana being the architect), and the large lunatic asylum. The composer Gioacchino Rossini, who was a native of Pesaro, left all his fortune to found a musical lyceum in the city, and his statue by Marochetti (1864) stands near the railway station. The Olivieri library (established by the antiquary of that name, author of *Marmora pisaurensia*, &c.) contains about 14,000 volumes, MSS. of Tasso, &c., inscriptions and various antiquities, and a very fine collection of majolica (one of the best in Italy) from the old Urbino and other manufactories. The Museo Mosca, left by its owner to the town, contains important collections of faience, furniture, &c. Among the industries of Pesaro are the growing, spinning and weaving of silk, tanning, iron-founding, and the manufacture of glass and pottery. It is also the centre of a rich agricultural district. The harbour is of no great importance, but there is a small export trade in wine, olives, silk and glass. Pop. (1901), 14,768 (town); 24,823 (commune).

Destroyed by Vitiges the Goth, the town was restored and strengthened by Belisarius, and afterwards along with Ancona, Fano, Senigallia, and Rimini formed the Pentapolis Maritima. In the course of the 13th century Pasaro was sometimes under the government of the popes, sometimes under that of the emperors; but the Malatesta family, which first took root in the city about 1285, gradually became the real masters of the place. In 1445 they sold their rights to Francesco Sforza; and in 1512, through the influence of Julius II., the Sforza were supplanted by his nephew Francesco Maria, duke of Urbino. Leo X. took the city away from Francesco and gave it to Lorenzo de' Medici; but on Lorenzo's death Francesco was restored and Pesaro became the ordinary residence of the dukes of Urbino till the death of Francesco Maria II. in 1631, when it reverted to the States of the Church. It has formed part of the present kingdom of Italy since 1860. Terenzio Mamiani della Rovere, poet and statesman, was born at Pesaro in 1800.

PESCADORES (*i.e.* fishers,) a group of islands (called by the Japanese *Hōkō tō* or *Hōko Guntō*) lying 30 m. west of Formosa, from which they are separated by the Pescadores Channel, about the tropic of Cancer. The islands number 48 (21 inhabited), have a coast-line of 98·67 miles, a total area of 85·50 sq. m., and a population of about 55,000, principally Chinese. Flat and with unproductive soil, they are swept during one half of the year by violent N.E. winds, and also lie full in the path of the numerous typhoons that rush up the Strait of Formosa. Meteorological observations taken by the Japanese during a period of three years show that the annual average number of stormy days is 237. The anchorage is at Mako (Makyū or Makun) on the principal island of Penghu. The chief industry is fishing (whence the old Spanish name which has come into general use) and dried fish are exported.

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[1] *Pervigilium* was the term for a nocturnal festival in honour of some divinity, especially Bona Dea.

PESCARA, FERNANDO FRANCESCO DAVALOS, Marquis of (1489–1525), Italian *condottiere*, was born at Naples, his family being of Spanish origin. Rodrigo (Ruy) Lopez Davalos, his great-grandfather, a noble of Toledo, who had taken an active part in the civil wars of Castile in the reign of John II. (1407–1454), had been driven into exile, and died at Valencia. Iñigo (Ignatius), his son, entered the service of Alphonso of Aragon and Naples, followed his master to Italy, and there, making an advantageous marriage with a lady of the family of Aquino, was created marquis of Pescara. His son Alphonso, who succeeded him in the marquisate, married a lady of the Sicilian branch of the Spanish family of Cardona, and when he was treacherously killed, during a French invasion of Naples, his only son Fernando, or Ferrante, was a child in arms. At the age of six the boy was betrothed to Vittoria Colonna (*q.v.*), daughter of the general Fabrizio Colonna, and the marriage was celebrated in 1509. His position as a noble of the Aragonese party in Naples made it incumbent on him to support Ferdinand the Catholic in his Italian wars. In 1512 he commanded a body of light cavalry at the battle of Ravenna, where he was wounded and taken prisoner by the French. Thanks to the intervention of one of the foremost of the French generals, the Italian J. J. Trivulzio, who was his connexion by marriage, he was allowed to ransom himself for 6000 ducats. He commanded the Spanish infantry at the battle of La Morta, or Vicenza, on the 7th of October 1513. It was on this occasion that he called his men before the charge to take care to step on him before the enemy did if he fell. From the battle of Vicenza in 1513, down to the battle of La Bicocca on the 29th of April 1522, he continued to serve in command of the Spaniards and as the colleague rather than the subordinate of Prosper Colonna. It was only by the accident of his birth at Naples that Pescara was an Italian. He considered himself a Spaniard, spoke Spanish at all times, even to his wife, and was always surrounded by Spanish soldiers and officers. His opinion of the Italians as fighting men was unfavourable and was openly expressed. After the battle of La Bicocca Charles V. appointed Prosper Colonna commander-in-chief. Pescara, who considered himself aggrieved, made a journey to Valladolid in Spain, where the emperor then was, to state his own claims. Charles V., with whom he had long and confidential interviews, persuaded him to submit for the time to the superiority of Colonna. But in these meetings he gained the confidence of Charles V. His Spanish descent and sympathies marked him out as a safer commander of the imperial troops in Italy than an Italian could have been. When Francis I. invaded Italy in 1524 Pescara was appointed as lieutenant of the emperor to repel the invasion. The difficulties of his position were very great, for there was much discontent in the army, which was very ill paid. The tenacity, patience and tact of Pescara triumphed over all obstacles. His influence over the veteran Spanish troops and the German mercenaries kept them loyal during the long siege of Pavia. On the 24th of February 1525 he defeated and took prisoner Francis I. by a brilliant attack. Pescara's plan was remarkable for its audacity and for the skill he showed in destroying the superior French heavy cavalry by assailing them in flank with a mixed force of harquebusiers and light horse. It was believed that he was dissatisfied with the treatment he had received from the emperor; and Girolamo Morone, secretary to the duke of Milan, approached him with a scheme for expelling French, Spaniards and Germans alike from Italy, and for gaining a throne for himself. Pescara may have listened to the tempter, but in act he was loyal. He reported the offer to Charles V. and put Morone into prison. His health however had begun to give way under the strain of wounds and exposure; and he died at Milan on the 4th of November 1525. Pescara had no children; his title descended to his cousin the marquis del Vasto, also a distinguished imperial general.

Authorities.—The life of Pescara was written in Latin by Paolo Giovio, and is included in the *Vitae illustrium virorum*, printed at Basel 1578. Giovio's Latin *Life* was translated by L. Domenichi, the translator of his other works, and published at Florence, 1551. The Spanish *Historia del fortissimo y prudentissimo capitan Don Hernando de Avalos*, by El Maestro P. Vallés (Antwerp, 1553), is also a translation of Giovio. See also Mignet, *Rivalité de François Ier et de Charles Quint* (Paris, 1875), which gives references to all authorities. (D. H.)

PESCARA, a river of Italy, formed by the confluence of the Gizio and Aterno, and flowing into the Adriatic at the small town of Pescara. This town occupies the site of the ancient Aternum, the terminus of the Via Claudia Valeria, and up to 1867 a fortress of some importance. The railway from Sulmona follows the Pescara valley and joins the coast line to Brindisi at Pescara. In this valley, 22 m. from the sea, was the site of the ancient Interpromium, a town belonging probably to the Paeligni; and not far off is the very fine Cistercian abbey church of S. Clemente di Casauria, founded by the emperor Louis II. in 871. The present building belongs to the 12th century. The sculptures of the portals, the pulpit, the Paschal candelabrum, &c., and the bronze doors of this period are important. The chronicle of the abbey, of the end of the 12th century, is in the Bibliothèque nationale at Paris.

See V. Bindi, *Monumenti degli Abruzzi* (Naples, 1889), pp. 405 sqq.; P. L. Calore in *Archivio storico dell' arte* (Rome, 1891), iv. 9 sqq.

PESCHIERA SUL GARDA, a fortress of Venetia, Italy, in the province of Verona, on an island in the Mincio at its outlet from the lake of Garda, 77 m. by rail E. of Milan. It was one of the famous fortresses of the Quadrilateral, the chief bulwark of the Austrian rule in Italy until 1866 (Mantua, Legnago and Verona being the other three) and has played a prominent part in all the campaigns conducted in north Italy, more especially during the Napoleonic wars. It was taken by the Piedmontese from the Austrians, after a gallant defence by General Rath lasting six weeks, on the 30th of May 1848, and since that date has been in Italian hands.

PESCIA, a town of Tuscany, Italy, in the province of Lucca, from which it is 15 m. E.N.E. by rail, 203 ft. above sea-level. Pop. (1901), 12,400 (town); 18,000 (commune). The cathedral, restored in 1693, contains the fine chapel of the Turini family, built for Baldassare Turini (d. 1540) by Giuliano di Baccio of Florence, with his tomb by Raffaello da Montelupo. The town also has some buildings by Lazzaro Buggiano, the pupil and adoptive son of Brunelleschi. It has silk and paper manufactures.

PESETA, a silver coin and unit of value, the Spanish equivalent of the French, Belgian and Swiss *franc*, the Italian *lira* and the Greek *drachma* in the Latin monetary union. The *peso* (Lat. *pensum*, weight), of which *peseta* is a diminutive, was a Spanish coin of gold, *peso de oro*, or silver, *peso de plata*, once current in Spain and her colonies, and now the name of a silver coin of many South American states. The *peso* is also the name of the Mexican dollar.

PESHAWAR, a city of British India, the capital of the North-West Frontier Province, giving its name to a district. The city is situated near the left bank of the river Bara, 11 m. from Jamrud at the entrance of the Khyber Pass, the railway station being 1588 m. north-west of Calcutta; pop. (1901), 95,147. Two miles west of the native city are the cantonments, forming the principal military station of the North-West Frontier Province. Peshawar lies within a horseshoe ring of hills on the edge of the mountain barrier which separates India from Afghanistan, and through it have passed nearly all the invaders from the north. The native quarter is a huddle of flat-roofed houses within mud walls, crowded along narrow, crooked alleys; there is but one fairly wide street of shops. Here for many centuries the *Povindahs*, or Afghan travelling merchants, have brought their caravans from Kabul, Bokhara and Samarkand every autumn. They bring horses, wool, woollen stuffs, silks, dyes, gold-thread, fruits, precious stones, carpets and poshtins (sheepskin clothing), fighting and buying their way to the British border where, leaving their arms, they are free to wander at will to Delhi, Agra and Calcutta. The chief speciality of Peshawar consists of bright-coloured scarves called *lungis*; wax-cloth and ornamental needle-work are also local products, as well as knives and small arms.

The district of PESHAWAR has an area of 2611 sq. m.; pop. (1901), 788,707, showing an increase of 10·8% in the decade. Except on the south-east, where the Indus flows, it is encircled by mountains which are inhabited by the Mohmand, Utman Khel and Afridi tribes. The plain consists of alluvial deposits of silt and gravel. The district is naturally fertile and well watered, and is irrigated by the Swat River Canal. The principal crops are wheat, barley, maize, millets and oil-seeds, with a little cotton and sugar-cane. Peshawar also produces a fine variety of rice, known as "Bara rice," after the river which irrigates it. The North-Western railway crosses the district from Attock, and has been extended from Peshawar city to Jamrud for military purposes. The district is chiefly inhabited by Pathans; there are some Hindus engaged in trade as bankers, merchants and shop-keepers.

In early times the district of Peshawar seems to have had an essentially Indian population, for it was not till the 15th century that its present Pathan inhabitants occupied it. Under the name of Gandhara it was a centre of Buddhism, and especially Graeco-Buddhism. Rock-edicts of Asoka still exist at two places; and a *stupa* excavated in 1909 was found to contain an inscription of Kanishka, as well as relics believed to be those of Buddha himself. The last of the Indian Buddhist kings was conquered by Mahmud of Ghazni in 1009. The Mogul emperors always found difficulty in maintaining their authority over the Afghan border tribes, who finally established their independence during the reign of Aurangzeb. Peshawar was a favourite residence of the Afghan dynasty founded by Ahmed Shah Durrani, and here Mountstuart Elphinstone came as ambassador to Shah Shujah in 1809. A few years later Ranjit Singh crossed the Indus, and after much hard fighting Sikh authority was firmly established under General Avitabile in 1834. In 1848 the whole of the Punjab passed to the British. During the Mutiny, after the sepoy regiments had been disarmed, Peshawar was a source of strength rather than of danger, though Sir John Lawrence did at one time contemplate the necessity of surrendering it to the Afghans, in order to preserve the rest of Northern India.

PESHIN, or PISHIN, a district of Baluchistan. Area 2717 sq.m. Pop. (1901), 50,200. It consists of a large plain surrounded on three sides by hills, which formerly belonged to Afghanistan but was ceded to the British by the treaty of Gandamak in 1879. This plain is of considerable strategic importance, as it forms the focus of a great number of routes leading from Sind and the Punjab frontier districts to Kandahar, and is intersected by the Sind-Peshin railway. The agricultural wealth of Peshin, and consequently its revenues, have increased greatly under British administration.

PESHITTO, or PESHITO (*i.e.* "simple"), the standard version of the Bible in the Syriac language. It was long supposed to be the original Syriac version, but is now generally recognized as representing a revision made by Rabbula, bishop of Edessa, early in the 5th century, an attempt at standardizing the Syriac text such as Jerome had made for the Latin in his Vulgate. (See BIBLE.)

PESHWA (Persian for "leader," "guide"), the title of the head of the Mahratta confederacy in India. Originally the peshwa was only prime minister, but afterwards he supplanted his master and became chief of the state, founding an hereditary dynasty, with the capital at Poona. The last peshwa, Baji Rao, came into collision with the British, and was dethroned in 1818. His adopted son, Nana Sahib, took a leading part in the Mutiny of 1857, in revenge for being deprived of what he considered his rights.

PESSIMISM (from Lat. *pessimus*, worst), a word of modern coinage,[1] denoting an attitude of hopelessness towards life, a vague general opinion that pain and evil predominate in human affairs. It is the antithesis of "optimism," which denotes the view that on the whole there is a balance of good and pleasure, or at least that in the long run good will triumph. Between optimism and pessimism is the theory of "meliorism," according to which the world on the whole makes progress in goodness. The average man is pessimist or optimist not on theoretical grounds, but owing to the circumstances of his life, his material prosperity, his bodily health, his general temperament. Perhaps the most characteristic example of unsystematic pessimism is the language of Ecclesiastes, who concludes that "all is vanity."

Pessimism and optimism have, however, been expressed in systematic philosophical forms, a brief summary only of which need here be given. Such systems have been elaborated chiefly by modern thinkers, but the germs of the ideas are found widely spread in the older Oriental philosophies and in pre-Christian European thought. Generally speaking, pessimism may be found in all pantheistic and materialistic systems. It is important, however, to point out an essential distinction. The thinker who sees man confronted by the infinite non-moral forces presumed by natural pantheism inevitably predominating over the finite powers of men may appear to the modern Christian theologian or to the evolutionist as a hopeless pessimist, and yet may himself have concluded that, though the future holds out no prospect save that of annihilation, man may yet by prudence and care enjoy a considerable measure of happiness. Pessimism, therefore, depends upon the individual point of view, and the term is frequently used merely in a condemnatory sense by hostile critics. The attitude of a man who denies the doctrine of immortality and rejoices in the denial is not strictly pessimistic. A Christian again may be pessimistic about the present; he must logically be optimistic about the future—a teleological view of the universe implies optimism on the whole; the agnostic may be indifferent to, or pessimistic, regarding the future, while exceedingly satisfied with life as he finds it.

This complex view of life is exemplified by Plato, whose general theory of idealism is entirely optimistic. In analysing the world of phenomena he necessarily takes a pessimistic view because phenomena are merely imitations more or less removed from reality, *i.e.* from the good. Yet the idealistic postulate of a *summum bonum* is in result optimistic, and this view predominated among the Stoics and the Neoplatonists. The Epicureans, on the other hand, were empirical pessimists. Man is able to derive a measure of enjoyment from life in spite of the non-existence of the orthodox gods; yet this enjoyment is on the whole negative, the avoidance of pain. A similar view is that of the ancient sceptics.

Oriental pessimism, at least as understood by Europeans, is best exemplified in Buddhism, which finds in human life sorrow and pain. But all pain and sorrow are incidental to the human being in his individual capacity. He who will cast aside the "Bonds," the "Intoxications," the "Hindrances," and tread the Noble Eightfold Path (see BUDDHISM) which leads to Nirvana, will attain the ideal, the "Fruit of Arahatship," which is described in terms of glowing praise in the Pali hymns. This, the original doctrine of the Buddha, though not adopted in the full sense by all his followers, is in fact at least as optimistic as any optimism of the West. To call it "pessimism" is merely to apply to it a characteristically Western principle according to which happiness is impossible without personality. The true Buddhist on the contrary looks forward with enthusiasm to this absorption into eternal bliss.

In Europe on the whole the so-called pessimistic attitude was commoner in the Teutonic north than in the Mediterranean basin. But even here the hopefulness as regards a future life, in which the inequalities of the present would be rectified, compensated for the gloomy fatalism with which the present was regarded. The advent of Christianity, with its categorical assertion of future happiness for the good, to a large extent did away with pessimism in the true sense. In Leibnitz we find a philosophic or religious optimism, which saw in the universe the perfect work of a God who from all possibilities selected the best. Kant, though pessimistic as regards the actual man, is optimistic regarding his moral capacity. To Hegel similarly the world, though evil at any moment, progresses by conflict and suffering towards the good.

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[1] The earliest example given in the *New English Dictionary* is in S. T. Coleridge's *Letters* (1794).

Passing over the Italian Leopardi we may notice two leading modern pessimists, Schopenhauer and von Hartmann. Schopenhauer emphasizes the pessimistic side of Hegel's thought. The universe is merely blind Will, not thought; this Will is irrational, purposeless and therefore unhappy. The world being a picture of the Will is therefore similarly unhappy. Desire is a state of unhappiness, and the satisfaction of desire is therefore merely the removal of pain. Von Hartmann's doctrine of the Unconscious is in many respects similar to Schopenhauer's doctrine of the Will. The Unconscious which combines Will and Reason is, however, primarily Will. The workings of this Will are irrational primarily, but, as in its evolution it becomes more rationalized and understands the whole meaning of the Weltschmerz, it ultimately reaches the point at which the desire for existence is gone. This choice of final nothingness differs from that of Schopenhauer in being collective and not individual. The pessimism of Schopenhauer and Hartmann does not, however, exclude a certain ultimate mysticism, which bears some analogy to that of Buddhism.

Pessimism is naturally connected with materialist, optimism with idealist, views of life. The theories of the modern evolutionist school, however, have introduced into materialistic theory a new optimistic note in doctrines such as that of the survival of the fittest. Such doctrines regard the progress of humanity as on the whole tending to the greater perfection, and are markedly optimistic in contrast with earlier theories that progressive differentiation is synonymous with progressive decay. Similarly the cynical contempt which Nietzsche shows for morality and the conventional virtues is counterbalanced by the theory of the *Übermensch*, the highest type of manhood which by struggle has escaped from the ordinary weaknesses of normal humanity.

See James Sully, *Pessimism: A History and a Criticism* (1877); Caro, *Le Pessimisme au xix*^{e} *siècle* (1878); Saltus, *The Anatomy of Negation* (1886); Tulloch, *Modern Theories on Philosophy and Religion* (1884); William James, *The Will to Believe*; Dühring, *Der Werth des Lebens* (1865); Meyer, *Weltelend und Weltschmerz* (1872); E. Pfleiderer, *Der moderne Pessimismus* (1875); Agnes Taubert (Hartmann), *Der Pessimismus und seine Gegner* (1873); Gass, *Optimismus und Pessimismus* (1876); Rehmke, *Die Philos. des Weltschmerzes* (1876); Huber, *Der Pessimismus* (1876); von Golther, *Der moderne P.* (1878); Paulsen, *Schopenhauer, Hamlet, Mephistopheles* (1900); Kowalewski, *Studien zur Psychologie des P.* (1904).

PESSINUS (Πεσσινοῦς, Πεσινοῦς), an ancient city of Galatia in Asia Minor, situated on the lowest southern slope of Mt Dindymus, on the left bank of the river Sangarius, not far from its source. The ruins, discovered by Texier, lie round the village of Bala-Hissar, 8 or 9 m. S.E. of Sivri-Hissar. They include a theatre in partial preservation, but they have been mostly carried off to Sivri-Hissar, which is largely built out of them. Originally a Phrygian city, probably on the Persian "Royal Road," it became the capital of the Gallic tribe Tolistobogii and the chief commercial city of the district. It contained the most famous sanctuary of the mother of the gods (Cybele), who here went by the name of Agdistis, and was associated with the god Attis, as elsewhere with Sabazius, &c. Her priests were also princes, who bore rule not only in the city (the coinage of which, beginning about 100 B.C., was for long issued by them) but also in the country round, deriving a large revenue from the temple estates; but in the time of Strabo (A.D. 19–20) their privileges were much diminished. The high-priest always bore the god's name Attis. In the crisis of the second Punic War (205 B.C.), when the Romans lost faith in the efficacy of their own religion to save the state, the Senate, in compliance with an oracle in the Sibylline books to the effect that the foreign foe could be driven from Italy if the Idaean Mother (Cybele) were brought from Pessinus to Rome, sent ambassadors to the town, who obtained the sacred stone which was the symbol of the goddess and brought it to Rome, where the worship of Cybele was established. But the goddess continued to be worshipped in her old home; her priests, the Galli, went out to welcome Manlius on his march in 189 B.C., which shows that the town was not yet in the hands of the Tolistobogii. Soon after this a splendid new temple of the goddess was built by the Pergamenian kings. Some time before 164 B.C. Pessinus fell into the power of the Gauls, and the membership of the priestly college was then equally divided between the Gauls and the old priestly families. Like Ancyra and Tavium, Pessinus was Romanized first and Hellenized afterwards. Only about A. D. 165 did Hellenic ways and modes of thought begin to be assumed; before that we find a deep substratum of Celtic feeling and ways, on which Roman elements had been superimposed without filtering through a Hellenic medium. Christianity was introduced late; it cannot be traced before the 4th century. When Galatia was divided into two provinces (A.D. 386–395) Pessinus was made the capital of Galatia Secunda or Salutaris, and it became a metropolitan bishopric. After the 16th century it disappears from history, being supplanted, from the beginning of the period of Saracen invasion, by the impregnable fortress Justinianopolis (Sivri-Hissar), which became the capital and the residence of the bishop, thenceforward called "archbishop of Pessinus or of Justinianopolis." (J. G. C. A.)

PESTALOZZI, JOHANN HEINRICH (1746–1827), Swiss educational reformer, was born at Zürich on the 12th of January 1746. His father died when he was young, and he was brought up by his mother. At the university of Zürich he was associated with Lavater and the party of reform. His earliest years were spent in schemes for improving the condition of the people. The death of his friend Bluntschli turned him however from politics, and induced him to devote himself to education. He married at twenty-three and bought a piece of waste land at Neuhof in Aargau, where he attempted the cultivation of madder. Pestalozzi knew nothing of business, and the plan failed. Before this he had opened his farm-house as a school; but in 1780 he had to give this up also. His first book published at this time was *The Evening Hours of a Hermit* (1780), a series of aphorisms and reflections. This was followed by his masterpiece, *Leonard and Gertrude* (1781), an account of the gradual reformation, first of a household, and then of a whole village, by the efforts of a good and devoted woman. It was read with avidity in Germany, and the name of Pestalozzi was rescued from obscurity. The French invasion of Switzerland in 1798 brought into relief his truly heroic character. A number of children were left in Canton Unterwalden on the shores of the Lake of Lucerne, without parents, home, food or shelter. Pestalozzi collected a number of them into a deserted convent, and spent his energies in reclaiming them. During the winter he personally tended them with the utmost devotion, but in June 1799 the building was required by the French for a hospital, and his charges were dispersed. In 1801 Pestalozzi gave an exposition of his ideas on education in the book *How Gertrude teaches her Children*. His method is to proceed from the easier to the more difficult. To begin with observation, to pass from observation to consciousness, from consciousness to speech. Then come measuring, drawing, writing, numbers, and so reckoning. In 1799 he had been enabled to establish a school at Burgdorf, where he remained till 1804. In 1802, he went as deputy to Paris, and did his best to interest Napoleon in a scheme of national education; but the great conqueror said that he could not trouble himself about the alphabet. In 1805 he removed to Yverdun on the Lake of Neuchâtel, and for twenty years worked steadily at his task. He was visited by all who took interest in education—Talleyrand, Capo d'Istria, and Mme de Staël. He was praised by Wilhelm von Humboldt and by Fichte. His pupils included Ramsauer, Delbrück, Blochmann, Carl Ritter, Fröbel and Zeller. About 1815 dissensions broke out among the teachers of the school, and Pestalozzi's last ten years were chequered by weariness and sorrow. In 1825 he retired to Neuhof, the home of his youth; and after writing the adventures of his life, and his last work, the *Swan's Song*, he died at Brugg on the 17th of February 1827. As he said himself, the real work of his life did not lie in Burgdorf or in Yverdun. It lay in the principles of education which he practised, the development of his observation, the training of the whole man, the sympathetic application of the teacher to the taught, of which he left an example in his six months' labours at Stanz. He had the deepest effect on all branches of education, and his influence is far from being exhausted.

Pestalozzi's complete works were published at Stuttgart in 1819–1826, and an edition by Seyffarth appeared at Berlin in 1881. Volumes on his life and teaching have been written by De Guimps (1889), Barnard (1862), Krüsi (1875) and Pinloche (1901).

PETALITE, a mineral species consisting of lithium aluminium silicate, $LiAl(Si_2O_5)_2$. The monoclinic crystals approach spodumene (*q.v.*) in form, which is also a lithium aluminium silicate with the formula $LiAl(SiO_3)_2$. There is a perfect cleavage parallel to the basal plane, and the mineral usually occurs in platy cleavage masses; on this account it was named, from Gr. πέταλον (a leaf). The hardness is 6½ and the specific gravity 2·4 (that of spodumene being 3·16). The mineral is colourless or occasionally reddish, varies from transparent to translucent, and has a vitreous lustre. It was discovered in 1800 as cleavage masses in an iron mine on the island of Utö in the Stockholm archipelago, where it is associated with lepidolite, tourmaline (rubellite and indicolite) and spodumene. A variety known as "castor" is found as transparent glassy crystals associated with pollux (*q.v.*) in cavities in the granite of Elba. (L. J. S.)

PETARD (Fr. *pétard*, *péter*, to make a slight explosion), a device formerly used by military engineers for blowing in a gate or other barrier. It consisted of a small metal or wooden case, usually of sugar-loaf shape, containing a charge of powder and fired by a fuse.

PETAU, DENYS (1583–1652), Jesuit scholar, better known as DIONYSIUS PETAVIUS, was born at Orleans on the 21st of August 1583. Educated at Paris University, he came under the influence of Isaac Scaliger, who directed his attention towards the obscurer fathers of the Church. In 1603 he was appointed to a lectureship at the university of Bourges, but resigned his place two years later, in order to enter the Society of Jesus. For many years he was professor of divinity at the Collège de Clermont, the chief Jesuit establishment in Paris; there he died on the 11th of December 1652. He was one of the most brilliant scholars in a learned age. Carrying on and improving the chronological labours of Scaliger, he published in 1627 an *Opus de doctrina temporum*, which has been often reprinted. An abridgment of this work, *Rationarium temporum*, was translated into French and English, and has been brought down in a modern reprint to the year 1849. But Petau's eminence chiefly rests on his vast, but unfinished, *De theologicis dogmatibus*, the first systematic attempt ever made to treat the development of Christian doctrine from the historical point of view.

PETCHENEGS, or PATZINAKS, a barbarous people, probably of Turkish race, who at the end of the 9th century were driven into Europe from the lower Ural, and for about 300 years wandered about the northern frontier of the East Roman Empire. (See TURKS).

PETER (Lat. *Petrus* from Gr. πέτρος, a rock, Ital. *Pietro*, *Piero*, *Pier*, Fr. *Pierre*, Span. *Pedro*, Ger. *Peter*, Russ. *Petr*), a masculine name, derived from the famous surname bestowed by Christ upon his apostle Simon ("Thou art Peter and upon this rock will I build my church," Matt. xiv. 17–19). The name has consequently been very popular in Christian countries. It is noteworthy, however, that, out of deference to the "prince of the apostles" and first bishop of Rome, the name has never been assumed by a pope. The biographies which follow are arranged in the order: (1) the apostle; (2) kings; (3) other eminent men.

PETER, ST, the chief of the Twelve Apostles. He is known also by other names: (*a*) "Simon" (Σίμων) in Mark four times and Luke seven times. This use is only found in narrative before the story of the mission of the apostles: it is also found in speeches; Matthew once, Mark once and Luke twice. (*b*) "Simon who is called Peter" is found in Matthew twice and Acts four times. (*c*) "Simon Peter" is found in Matthew once, Luke once, John seventeen times (and perhaps also in 2 Peter i. 1, where the text varies between Simon and Symeon. (*d*) "Peter" is found in Matthew nineteen times, Mark eighteen times, Luke sixteen times, Acts fifty-one times, John fifteen times, Galatians twice, 1 Peter once. (*e*) "Cephas" is found in John once, Galatians four times, 1 Corinthians four times. (*f*) Symeon (Συμεών) is found in Acts once. It appears that the apostle had two names, each existing in a double form—Greek and Hebrew, Symeon (שִׁמְעוֹן) which was Graecized according to the sound into Simon, and Cephas (כֵּיפָא) which was Graecized according to the meaning into Peter (Πέτρος). Symeon and Simon are both well-known names in Aramaic and Greek respectively, but Cephas and Peter are previously unknown. Symeon was no doubt his original Aramaic name, and the earliest gospel, Mark, which has some claim specially to reproduce Petrine tradition, is careful to employ Simon until after the name Peter had been given, and not then to use it again. The Gospels agree in regarding Cephas or Peter as an additional name, which was given by Christ. But they differ as to the occasion. According to Mark iii. 13 sqq. it was given on the occasion of the mission of the Twelve. According to John i. 42 it was given at his first call. According to Matt. xvi. 13 sqq. it was given after the recognition of Jesus as Messiah at Caesarea Philippi. This last account is the only one which describes any circumstances (for a further discussion see § 3 (2) below).

According to the Gospels Peter was the son of John (Ἰωάνης, John i. 42, xxi. 15 seq.) or Jonas (Ἰωνᾶς, Matt. xxvi. 17). According to Mark i. 29 he was a fisherman of Capernaum, but John i. 44 describes him and his brother Andrew as of Bethsaida. From Mark i. 30 he is seen to have been married, and 1 Cor. ix. 5 suggests (but another interpretation is possible) that his wife went with him on his missionary journeys. In 1 Pet. v. 13 Mark is referred to as his son, but this is usually interpreted of spiritual kinship. According to legend (*Acta Nerei et Achillei*, and *Acta Philippi*) he had a daughter Petronilla, but there is no reason for thinking that this is historical.

History in the Gospels up to the Resurrection.

The Gospel narratives are unanimous in describing Peter as one of the first disciples of Christ, and from the time of his call he seems to have been present at most of the chief incidents in the narrative. He formed together with the sons of Zebedee to some extent an inner circle within the Twelve, and this favoured group is specially mentioned as present on three occasions—the raising of the daughter of Jairus (Mark v. 22–43; Matt. ix. 18–36; Luke viii. 41–56), the transfiguration (Mark ix. 2 sqq.; Matt. xvii. 1 sqq.; Luke ix. 28 sqq.) and the scene in the Garden at Gethsemane (Mark xiv. 32 sqq.; Matt. xxvi. 36 sqq.). He is also specially mentioned in connexion with his call (Mark i. 16–20; Matt. iv. 18 sqq.; Luke v. 1 sqq.; John i. 40 sqq.); the healing of his wife's mother (Mark i. 21 sqq.; Matt. viii. 14 sqq.; Luke iv. 38 sqq.); the mission of the Twelve Apostles (Mark iii. 13 sqq.; Matt. x. 1 sqq.; Luke vi. 12 sqq.); the storm on the Lake of Galilee (Mark vi. 45 sqq.; Matt. xiv. 22 sqq.; John vi. 16 sqq.); the Messianic recognition at Caesarea Philippi (Mark vii. 27 sqq.; Matt. xvi. 16 sqq.; Luke ix. 18 sqq.); the incident of the payment of tribute by the coin found in the fish caught by Peter (Matt. xvii. 25 sqq.) and with various questions leading to parables or their explanations (Mark xiii. 36 sqq.; Luke xii. 41; Matt. xviii. 21 sqq.; Mark x. 28; Matt. xix. 27; Luke xviii. 28). In the week of the Passion he appears in connexion with the incident of the withered fig-tree (Mark xi. 21; Matt. xxi. 20); as introducing the eschatological discourse (Mark xiii. 3 sqq.); and as prominent during the Last Supper (Luke xxii. 8 sqq.; John xiii. 4 sqq.; Mark xiv. 27 sqq.; Matt. xxvi. 31 sqq.). He was present in Gethsemane, and tried to offer some resistance to the arrest of Jesus (Mark xiv. 47; Matt. xxvi. 51; Luke xxii. 50; John xviii. 10). After the arrest he followed the Lord to the scene of the trial, but denied him and fled. The message of the young man at the tomb (Mark xvi. 4) was especially addressed to Peter and it is clear that the genuine conclusion of Mark must have contained an account of an appearance of the risen Lord to him.

Out of this mass of incidents the following are central and call for closer critical consideration.

1. *The Call of St Peter.*—(Mark i. 16–20; Matt. iv. 18–22; Luke v. 1–11; John i. 40–42). The account in Matthew is practically identical with that in Mark and is no doubt taken from the Marcan source, but Luke and John have different traditions. The main points are as follows: according to Mark, at the beginning of the Galilean ministry Jesus saw Peter and Andrew fishing. He called them, and they joined him. After this he went with them to Capernaum, preached in the synagogue, and healed Peter's wife's mother. Luke, who certainly used Mark, has partly rearranged this narrative and partly rejected it in favour of a different version. According to him the visit to Capernaum and the healing of the wife's mother preceded the call of Peter, and this was associated with a tradition of a miraculous draught of fishes. The advantage of the Lucan reconstruction, so far as the first part is concerned, is that it supplies a reason for Peter's ready obedience, which is somewhat difficult to understand if he had never seen Jesus before. But it seems probable that this is the motive which led to the redactorial change in Luke, and that the Marcan account, which is traditionally connected with Peter, ought to be followed. With regard to the narrative of the miraculous draught of fishes, the matter is more complicated. Luke obviously preferred this narrative to the Marcan account, but the fact that the same story comes in John xxi. suggests that there was an early tradition of some such incident of which the actual occasion and circumstances were undetermined. Luke preferred to connect it with the call of Peter, the writer of John xxi. with his restitution: probably both are of the nature of redactorial guesses, and the Marcan account must be regarded as preferable to either. The Johannine account of the call of Peter is quite different. According to this it took place immediately after the baptism of Jesus, in Judaea not in Galilee. It is connected with the giving of the name Peter, which in Mark was not given until much later.

2. *The Confession of Peter at Caesarea Philippi.*—(Mark viii. 27–33; Matt. xvi. 13–23; Luke ix. 18–22). According to Mark, Peter, in answer to the question of Jesus, recognized that He was the Messiah, but protested against the prophecy of suffering which Jesus then added. This narrative is followed, with the exception of the last part, by Luke, who as usual is inclined to omit anything which could be regarded as derogatory to the Apostles. Matthew also uses the Marcan narrative, but adds to it a new section from some other source which suggests that the name of Peter was conferred on this occasion—not, as Mark says, at the first mission of the Twelve—and confers on him the keys of the kingdom of heaven and the right of binding and loosing. This must be probably[1] interpreted as a reference to the prophecy concerning Eliakim in Isa. xxii. 22, and to technical use of the words "binding" and "loosing" by the scribes in authoritative decisions as to the obligations of the law. It thus confers on Peter a position of quite unique authority. It must, however, be noted that the power of binding and loosing is given in Matt. xviii. 18 to the whole body of disciples. This seems to be an alternative version, also found only in Matthew. The question of the historical character of the Matthaean addition to the Marcan narrative is exceedingly difficult; but it is hard to think that if it were really authentic it would have been omitted from all the other gospels, and it perhaps belongs to the little group of passages in Matthew which seem to represent early efforts towards church legislation, rather than a strictly historical narrative. Besides it is noticeable that in one other point Matthew has slightly remodelled the Marcan narrative. According to the latter Jesus asked, "Whom say men that I am?" and Peter replied "the Messiah," without qualification. But in Matthew the question is changed into "Whom say men that the Son of Man is?" and, whatever may be the original meaning of the phrase "the son of man" it cannot be doubted that in the gospels it means Messiah. Thus the simple answer of Peter in Mark would be meaningless, and it is replaced by "The Messiah, the son of the living God," which is no longer a recognition of the Messiahship of Jesus (this is treated in Matthew as an already recognized fact, cf. x. 23, xii. 40, &c.), but is a definition and an exaltation of the nature of the Messiah.

3. *The Conduct of Peter after the Betrayal.*—The consideration of this point brings one into touch with the two rival traditions as to the conduct of the disciples after the betrayal and crucifixion of the Lord—the Galilean and the Jerusalem narratives. There is one incident which must in any case be accepted as it is found in both narratives. This is the denial of Peter. It appears that Peter did not stay with the disciples and neither returned home immediately to Galilee (according to the Galilean tradition) nor sought hiding in Jerusalem (according to the Jerusalem tradition), but followed the Lord at a distance and was a witness of at least part of the trial before the Sanhedrim. He was detected and accused of being a disciple, which he denied, and so fulfilled the prophecy of Jesus that he would deny Him before the cock crowed.

But putting this incident aside, the Galilean and Jerusalem traditions do not admit of reconciliation with one another. The former is represented by Mark. According to it the disciples all fled after the betrayal (though Peter waited until after the denial), and afterwards saw the risen Lord in Galilee. The details of this narrative are unfortunately lost, as the genuine conclusion of Mark is not extant. But Mark xiv. 28 and xvi. 7 clearly imply a narrative which described how the disciples returned to Galilee, there saw the risen Lord, and perhaps even how they then returned to Jerusalem in the strength of their newly recovered faith, and so brought into existence the church of Jerusalem as we find it in the Acts. It is also clear from Mark xvi. 7 that Peter was in some special way connected with this appearance of the risen Lord, and this tradition is confirmed by 1 Cor. xv. 5, and perhaps by Luke xxiv. 34.

The Jerusalem narrative is represented especially by Luke and John (excluding John xxi. as an appendix). According to this the disciples, though they fled at the betrayal, did not return to their homes, but remained in Jerusalem, saw the risen Lord in that city, and stayed there until after the day of Pentecost. Attempts to reconcile these two narratives seem to be found in Matthew and in John xxi.

Obviously the choice which has to be made between these traditions cannot be adequately discussed here: it must suffice to say that intrinsic and traditional probability seem to favour the Galilean narrative. If so, one must say that after the denial Peter returned to Galilee—probably to resume his trade of fishing—and he there saw the risen Lord. This appearance is referred to in 1 Cor. xv. 5, and was certainly described in the lost conclusion of Mark. An account of it is preserved in John xxi., but it is here connected—probably wrongly—with a miraculous draught of fishes, just as the account of his call is in Luke.

History after the Resurrection according to the Acts and Epistles.

Immediately after the resurrection there is a missing link in the history of Peter. We know that he saw the risen Lord, and, according to the most probable view, that this was in Galilee; but the circumstances are unknown, and we have no account of his return to Jerusalem, as at the beginning of the Acts the disciples are all in Jerusalem, and the writer, in contradiction to the Marcan or Galilean narrative, assumes that they had never left it. The first part of the Acts is largely concerned with the work of Peter. He appears as the recognized leader of the Apostles in their choice of a new member of the Twelve to take the place of Judas Iscariot (Acts i. 15 sqq.); on the day of Pentecost he seems to have played a prominent part in explaining the meaning of the scene to the people (Acts ii. 14 sqq.); and soon afterwards was arrested by the Jews on the charge of being a ringleader in the disorders caused by the healing of the lame man at the "Beautiful" gate of the temple, but was released. After this he appears as the leader of the apostles in the story of Ananias and Sapphira, who perished at his rebuke for their duplicity (Acts v. 1–11). The last episode of this period is another arrest by the priests, which ended in his being scourged and released (Acts v. 17 sqq.).

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[1] See, however, A. Sulzbach's article in the *Zeitschr. f. N.T. Wiss.* (1903), p. 190. He thinks there is an allusion to a room in the Temple where the great key was kept; this room was called Kephas, because the key was placed in a recess closed by a stone. There is also a valuable article by W. Köhler in the *Archiv für Religionswiss.* treating the question of the keys from the point of view of comparative religion.

After this Peter's attention was directed to the growth of Christianity in Samaria, and he and John made a journey of inspection through that district, laying hands on those who had been baptized in order that they might receive the Holy Spirit. Here Simon Magus (*q.v.*) was encountered. He was a magician who had been converted by Philip and baptized; he desired to obtain the power of conferring the Spirit, and offered Peter money for this purpose, but was indignantly repulsed. After this Peter and John returned to Jerusalem.

During the following stay in Jerusalem, the duration of which is not defined, Peter was visited by Paul (Acts ix. 26–29; Gal. i. 18), and a comparison of the chronological date afforded by Gal. i. and ii. points to a year not earlier than 33 (Harnack) or later than 38 (C. H. Turner) for this meeting. According to Galatians, Paul saw none of the apostles on this occasion except Peter and James: it is therefore probable that none of the others were then in Jerusalem.

After this Peter made another journey, visiting especially Lydda, Joppa and Caesarea. His stay at Lydda was marked by the healing of Aeneas (Acts ix. 32–4) and at Joppa by the resuscitation of Tabitha or Dorcas. While at Joppa he stayed with Simon the tanner, and thence was summoned to Caesarea to Cornelius the centurion. He hesitated whether to go, but was persuaded by a vision and the injunction to call nothing unclean which God had cleansed. Cornelius was accordingly baptized. This is an important incident, as being the first admission of a Gentile into the church: but he was already "God-fearing," φοβούμενος τὸν θεόν (Acts x. 1), which probably denotes some sort of connexion with the Jewish synagogue, though it is difficult to say exactly what it was. After this incident Peter returned to Jerusalem. The members of the Church were somewhat shocked at the reception of a Gentile: their view apparently was that the only road to Christianity was through Judaism. They were, however, persuaded by Peter's speech (Acts xi. 4–17); but it is uncertain how far their concession went, and in the light of subsequent events it is probable that they still regarded circumcision as a necessary rite for all Christians.

After the return of Peter to Jerusalem the most important events were the famine at Jerusalem, and the persecution of the Church by Herod. During the latter Peter was put in prison (Acts xii. 3 sqq.), but was released by an angel; he first went to the house of Mary, the mother of John Mark, and afterwards went to "another place." This expression has been interpreted to mean another town, and even to be an implied reference to Rome. This last suggestion, improbable though it be, is historically important. The persecution of Herod seems to have been in his last year, which was probably A.D. 43–44. There was a marked tendency to make the duration of Peter's episcopate at Rome twenty-five years: and a combination of this tendency with the explanation that the ἕτερος τόπος was Rome probably is the origin of the traditional dating of the martyrdom of Peter in A.D. 67–68. There is, however, no justification for this view, and ἕτερος τόπος need not mean more than another house in Jerusalem.

The famine referred to in Acts xi. 27 sqq. probably began before the death of Herod, but it continued after his death, and the relief sent by the church at Antioch to Jerusalem through Paul and Barnabas probably arrived about the year 45. It is not stated in the Acts that Peter was present, and it is therefore usually assumed that he was absent, but Sir W. M. Ramsay has argued in his *St Paul the Traveller* that the visit of Paul to Jerusalem with the famine relief is the meeting between Paul and Peter referred to in Gal. ii. as the occasion of an agreement between them as to the preaching of the gospel to Jews and Gentiles. This view is not generally accepted, but it has the great advantage of avoiding the difficulty that otherwise Paul in Gal. ii. 1 sqq. must describe as his second visit to Jerusalem what was really his third. According to Ramsay, then, Peter was present during the famine, and made a private agreement with Paul that the latter should preach to the Gentiles, and so far Gentile Christianity was recognized, but the conditions of the intercourse between Gentile and Jewish Christians were not defined, and the question of circumcision was perhaps not finally settled. According to the more popular view the description in Gal. ii. applies to Acts xv. the so-called council of Jerusalem. This council met after the first missionary journey (*c.* A.D. 49) of Paul to discuss the question of the Gentiles. Peter, who was present, adopted the view that Gentile Christians were free from the obligation of the law, and this view was put into the form of the so-called Apostolic decrees by James (Acts xv. 23 sqq.).

The next information which we have about Peter is given in Gal. ii. 11 sqq. According to this he went to Antioch and at first accepted the Gentile Christians, but afterwards drew back and was rebuked by Paul. On the ordinary interpretation this must have taken place after the council, and it is exceedingly difficult to reconcile it with the attitude of Peter described in Acts xv., so that Mr C. H. Turner thinks that in this respect the account in Gal. ii. is not chronological, and places the visit of Peter to Antioch before the council. If, however, we take the theory of Sir W. M. Ramsay the matter is simpler. We thus get the compact between Paul and Peter during the famine, then a visit of Peter to Antioch, during which Peter first adopted and afterwards drew back from the position which he had agreed to privately.

History after the Council of Jerusalem.

This vacillation may then have been one of the causes which led up to the council, which may have been held before, not, as is usually thought, after the sending of the Epistle to the Galatians. For this we have no knowledge of details for which the same certainty can be claimed. There are, however, various traditions of importance. The following points are noteworthy. 1 Cor. i. 12 suggests the possibility that Peter went to Corinth, as there was a party there which used his name. It is, however, possible that this party had merely adopted the principles which, as they had been told, perhaps falsely, were supported by the leader of the Twelve. Dionysius of Corinth (*c.* 170) states that Peter was in Corinth. This may represent local tradition or may be an inference from 1 Cor. i. 12. 1 Peter suggests a ministry in the provinces of Asia Minor. There is, of course, nothing improbable in this, and even if 1 Peter be not authentic, it is early evidence for such a tradition, but it is also possible that Peter wrote to converts whom he had not personally made. This tradition is found in Origen (Eus. *H.E.* iii. 1), Epiphanius (*Haer.* xxvii., vi.), Jerome (*De Vir. ill.* 1) and other later writers; but it is possible that it is merely an inference from the epistle. Early tradition connects Peter with Antioch, of which he is said to have been the first bishop. The first writer to mention it is Origen (*Hom. vi. in Lucam*), but it is also found in the Clementine *Homilies* and *Recognitions* (*Hom.* 20, 23; *Recog.* 10, 68) and probably goes back to the lists of bishops which were drawn up in the 2nd century. Other important references to this tradition are found in Eus. *H.E.* iii. 26, 2; *Apost. Const.* vii. 46; Jerome, *De Vir. ill.* 1; *Chronicon paschale*; and *Liber pontificalis*. The tradition of work in Antioch may well be historical. Otherwise it is a rather wild elaboration of Gal. ii. 11. The most important and widespread tradition is that Peter came to Rome; and though this tradition has often been bitterly attacked, it seems to be probable that it is at least in outline quite historical. The evidence for it is earlier and better than that for any other tradition, though it is not quite convincing.

The earliest witness to a residence of Peter in Rome is probably

1 Peter, for (see PETER, EPISTLES OF) it is probable that the reference to Babylon ought to be interpreted as meaning Rome. If so, and if the epistle be genuine, this is conclusive evidence that Peter was in Rome. Even if the epistle be not genuine it is evidence of the same tradition. Nor is corroboration lacking: Clement (*c.* A.D. 97) refers to Peter and Paul as martyrs (1 *Clem.* 5–6) and says that "To these men . . . there was gathered a great company of the elect who . . . became an example to us." This points in two ways to a martyrdom of Peter in Rome, (1) because Peter and Paul are co-ordinated, and it is generally admitted that the latter suffered in Rome, (2) because they seem to be joined to the great company of martyrs who are to be an example to the Church in Rome. Similarly Ignatius (*c.* A.D. 115) says to the Romans (Rom. iv.), "I do not command you as Peter and Paul." The suggestion obviously is that the Romans had been instructed by these Apostles. By the end of the 2nd century the tradition is generally known: Irenaeus (3, 1, 1), Clement of Alexandria (comment. on 1 Peter), Origen (*Hom. vi. in Lucam*), Tertullian (*Scorp.* 15, and several passages) are explicit on the point, and from this time onwards the tradition is met with everywhere. There is also a tradition, found in Irenaeus (3, 1, 1) and in many later writers, and supported by 1 Pet. v. 13, and by the statements of Papias (Eus. *H.E.* 3, 39, 15) that Mark acted as Peter's assistant in Rome and that his gospel is based on recollections of Peter's teaching.

This evidence is probably sufficient to establish the fact that Peter, like Paul, had a wide missionary career ending in a violent death at Rome, though the details are not recoverable. The chronological question is more difficult both as regards the beginning and the end of this period of activity.

The Chronology of Peter's Wider Missionary Work.

The Acts, in describing the visits of Peter to Samaria, Joppa, Lydda and Caesarea, justify the view that his missionary activity began quite early. Gal. ii. 11 and 1 Cor. ix. 5 show that Acts minimizes rather than exaggerates this activity; the Antiochian tradition probably represents a period of missionary activity with a centre at Antioch; similarly the tradition of work in Asia is possibly correct as almost certainly is that of the visit to Rome. But we have absolutely no evidence justifying a chronological arrangement of these periods. Even the silence of Paul in the epistles of the captivity proves nothing except that Peter was not then present; the same is true of 2 Tim. even if its authenticity be undoubted.

The evidence as to the date of his death is a little fuller, but not quite satisfactory. The earliest direct witness is Tertullian, who definitely states that Peter suffered under Nero by crucifixion. Origen also relates the latter detail and adds that at his own request Peter was crucified head downwards. Probably John xxi. 18 seq. is a still earlier reference to his crucifixion. Fuller evidence is not found until Eusebius, who dates the arrival of Peter at Rome in 43 and his martyrdom twenty-five years later. But the whole question of the Eusebian chronology is very confused and difficult, and the text of the *Chronicon* is not certain. The main objection to this date is based partly on general probability, partly on the language of Clement of Rome. It is more probable on general grounds that the martyrdom of Peter took place during the persecution of Christians in 64, and it is urged that Clement's language refers to this period. It is quite possible that an error of a few years has crept into the Eusebian chronology, which is probably largely based on early episcopal lists, and therefore many scholars are inclined to think that 64 is a more probable date than 67. As a rule the discussion has mainly been between these two dates, but Sir W. M. Ramsay, in his *Church in the Roman Empire*, has adopted a different line of argument. He thinks that 1 Peter was written *c.* A.D. 80, but that it may nevertheless be Petrine; therefore he lays stress on the fact that whereas the tradition that Peter was in Rome is early and probably correct, the tradition that he was martyred under Nero is not found until much later. Thus he thinks it possible that Peter survived until *c.* 80, and was martyred under the Flavian emperors. The weak point of this theory is that Clement and Ignatius bring Peter and Paul together in a way which seems to suggest that they perished, if not together, at least at about the same time. If this view be rejected and it is necessary to fall back on the choice between 64 and 67, the problem is perhaps insoluble, but 64 has somewhat more intrinsic probability, and 67 can be explained as due to an artificial system of chronology which postulated for Peter an episcopate of Rome of twenty-five years—a number which comes so often in the early episcopal lists that it seems to mean little more than "a long time," just as "forty years" does in the Old Testament. On the whole 64 is the most probable date, but it is very far from certain: the evidence is insufficient to justify any assurance.

For further information and discussion see especially Harnack's *Chronologie*, and Bishop Chase's article in *Hastings's Dictionary of the Bible.* The latter is in many ways the most complete statement of the facts at present published.

The Grave of Peter.

Caius, who lived in the beginning of the 3rd century (see Eus. *H. E.* 2, 25), stated that the τρόπαια (*i.e.* probably the burial place, not that of execution) of Peter and Paul were on the Vatican. This is also found in the *Acta Petri*, 84 (in the *Lib. Pont.*, ed. Duchesne, p. 52 seq., 118 sqq.). From this place it appears that the relics (whether genuine or not) were moved to the catacombs in A.D. 258 (cf. the *Depositis martyrum*, and see Lightfoot's *Clement*, i. 249); hence arose the tradition of an original burial in the catacombs, found in the Hieronymian Martyrology.

For further information and investigations see Duchesne, *Liber pontificalis*; Lipsius, *Die Apokr. Apostelgesch.*; and Erbes "Die Todestage der Apostel Paulus u. Petrus," in *Texte und Untersuchungen*, N.F., iv. 1. (K. L.)

PETER I., called "the Great" (1672–1725), emperor of Russia, son of the tsar Alexius Mikhailovich and Natalia Naruishkina, was born at Moscow on the 30th of May 1672. His earliest teacher (omitting the legendary Scotchman Menzies) was the *dyak*, or clerk of the council, Nikita Zotov, subsequently the court fool, who taught his pupil to spell out the liturgical and devotional books on which the children of the tsar were generally brought up. After Zotov's departure on a diplomatic mission, in 1680, the lad had no regular tutor. From his third to his tenth year Peter shared the miseries and perils of his family. His very election (1682) was the signal for a rebellion. He saw one of his uncles dragged from the palace and butchered by a savage mob. He saw his mother's beloved mentor, and his own best friend, Artamon Matvyeev, torn, bruised and bleeding, from his retaining grasp and hacked to pieces. The haunting memories of these horrors played havoc with the nerves of a supersensitive child. The convulsions from which he suffered so much in later years must be partly attributed to this violent shock. During the regency of his half-sister Sophia (1682–1689) he occupied the subordinate position of junior tsar, and after the revolution of 1689 Peter was still left pretty much to himself. So long as he could indulge freely in his favourite pastimes—shipbuilding, ship-sailing, drilling and sham fights—he was quite content that others should rule in his name. He now found a new friend in the Swiss adventurer, François Lefort, a shrewd and jovial rascal, who not only initiated him into all the mysteries of profligacy (at the large house built at Peter's expense in the German settlement), but taught him his true business as a ruler. His mother's attempt to wean her prodigal son from his dangerous and mostly disreputable pastimes, by forcing him to marry the beautiful but stupid Eudoxia Lopukhina (Jan. 27, 1689), was a disastrous failure. The young couple were totally unsuited to each other. Peter practically deserted his unfortunate consort a little more than a year after their union.

The death of his mother (Jan. 25, 1694) left the young tsar absolutely free to follow his natural inclinations. Tiring of the great lake at Pereyaslavl, he had already seen the sea for the first time at Archangel in July 1683, and on the 1st of May 1694 returned thither to launch a ship built by himself the year before. Shortly afterwards he nearly perished during a storm in an adventurous voyage to the Solovetsky Islands in the White Sea. His natural bent was now patent. From the first the lad had taken an extraordinary interest in the technical and mechanical arts, and their application to military and naval science. He was taught the use of the astrolabe (which Prince Yakov Dolgoruki, with intent to please, had brought him from Paris) by a Dutchman, Franz Timmerman, who also instructed him in the rudiments of geometry and fortifications. He had begun to build his own boats at a very early age, and the ultimate result of these pastimes was the creation of the Russian navy. He had already surrounded himself with that characteristically Petrine institution "the jolly company," or "the company," as it was generally called, consisting of all his numerous personal friends and casual acquaintances. "The company" was graduated into a sort of mock hierarchy, political and ecclesiastical, and shared not only the orgies but also the labours of the tsar. Merit was the sole qualification for promotion, and Peter himself set the example to the other learners by gradually rising from the ranks. In 1695 he had only advanced to the post of "skipper" in his own navy and of "bombardier" in his own army. It was, however, the disreputable Lefort who, for the sake of his own interests, diverted the young tsar from mere pleasure to serious enterprises, by persuading him first to undertake the Azov expedition, and then to go abroad to complete his education.

By this time the White Sea had become too narrow for Peter, and he was looking about him for more hospitable waters. The Baltic was a closed door to Muscovy, and the key to it was held by Sweden. The Caspian remained; and it had for long been a common saying with foreign merchants that the best way of tapping the riches of the Orient was to secure possession of this vast inland lake. But so long as the Turks and Tatars made the surrounding steppes uninhabitable the Caspian was a possession of but doubtful value. The first step making for security was to build a fleet strong enough to provide against the anarchical condition of those parts; but this implied a direct attack not only upon the Crimean khan, who was mainly responsible for the conduct of the Volgan hordes, but upon the khan's suzerain, the Turkish sultan. Nevertheless Peter did not hesitate. War against Turkey was resolved upon, and Azov, the chief Turkish fortress in those regions, which could be approached by water from Moscow, became the Russian objective. From the 8th of July to the 22nd of September 1695 the Muscovites attempted in vain to capture Azov. On the 22nd of November Peter re-entered Moscow. His first military expedition had ended in unmitigated disaster, yet from this disaster is to be dated the reign of Peter the Great.

Immediately after his return he sent to Austria and Prussia for as many sappers, miners, engineers and carpenters as money could procure. He meant to build a fleet strong enough to prevent the Turkish fleet from relieving Azov. The guards and all the workmen procurable were driven, forthwith, in bands, to all the places among the forests of the Don to fell timber and work day and night, turning out scores of vessels of all kinds. Peter himself lived among his workmen, himself the most strenuous of them all, in a small two-roomed wooden hut at Voronezh. By the middle of April two warships, twenty-three galleys, four fireships and numerous smaller craft were safely launched. On the 3rd of May "the sea caravan" sailed from Voronezh, "Captain Peter Aleksyeevich" commanding the galley-flotilla from the galley "Principium," built by his own hand. The new Russian fleet did all that was required of it by preventing the Turks from relieving Azov by water; and on the 18th of July the fortress surrendered. Peter now felt able to advance along the path of progress with a quicker and a firmer step. It was resolved to consolidate the victory by establishing a new naval station at the head of the Sea of Azov, to which the name of Taganrog was given. But it was necessary to guarantee the future as well as provide for the present. Turkey was too formidable to be fought single-handed, and it was therefore determined to send a grand embassy to the principal western powers to solicit their co-operation against the Porte. On the 10th of March 1697 this embassy, under the leadership of Lefort, set out on its travels. Peter attached himself to it as a volunteer sailorman, "Peter Mikhailov," so as to have greater facility for learning ship-building and other technical sciences. As a political mission it failed utterly, the great powers being at that period far more interested in western than in eastern affairs. But personally Peter learnt nearly all that he wanted to know—gunnery at Königsberg, ship-building at Saardam and Deptford, anatomy at Leiden, engraving at Amsterdam—and was proceeding to Venice to complete his knowledge of navigation when the revolt of the *stryeltsy*, or musketeers (June 1698), recalled him to Moscow. This revolt has been greatly exaggerated. It was suppressed in an hour's time by the tsar's troops, of whom only one man was mortally wounded; and the horrible vengeance (September–October 1698) which Peter on his return to Russia wreaked upon the captive musketeers was due not to any actual fear of these antiquated warriors, but to his consciousness that behind them stood the reactionary majority of the nation who secretly sympathized with, though they durst not assist, the rebels.

Peter's foreign tour had more than ever convinced him of the inherent superiority of the foreigner. Imitation had necessarily to begin with externals, and Peter at once fell foul of the long beards and Oriental costumes which symbolized the arch-conservatism of old Russia. On the 26th of April 1698 the chief men of the tsardom were assembled round his wooden hut at Preobrazhenskoye, and Peter with his own hand deliberately clipped off the beards and moustaches of his chief boyars. The *ukaz* of the 1st of September 1698 allowed as a compromise that beards should be worn, but a graduated tax was imposed upon their wearers. The wearing of the ancient costumes was forbidden by the *ukaz* of the 4th of January 1700; thenceforth Saxon or Magyar jackets and French or German hose were prescribed. That the people themselves did not regard the reform as a trifle is plain from the numerous rebellions against it. By the *ukaz* of the 20th of December 1699 it was next commanded that henceforth the new year should not be reckoned, as heretofore, from the 1st of September, supposed to be the date of the creation, but from the first day of January, *anno domini*.

The year 1700 is memorable in Russian history as the starting-point of Peter's long and desperate struggle for the hegemony of the north. He had concluded peace with the Porte (June 13, 1700) on very advantageous terms, in order to devote himself wholly to a war with Sweden to the end that Russia might gain her proper place on the Baltic. The possession of an ice-free seaboard was essential to her natural development; the creation of a fleet would follow inevitably upon the acquisition of such a seaboard; and she could not hope to obtain her due share of the trade and commerce of the world till she possessed both. All the conjunctures seemed favourable to Peter. The Swedish government was in the hands of an untried lad of sixteen; and the fine fleets of Denmark, and the veteran soldiers of Saxony, were on the same side as the myriads of Muscovy. It seemed an easy task for such a coalition to wrest the coveted spoil from the young Charles XII.; yet Peter was the only one of the three conspirators who survived the Twenty-one Years' War in which they so confidently embarked during the summer of 1701. He was also the only one of them who got anything by it. Charles's "immersion in the Polish bog" (1702–1707), as Peter phrased it, enabled the tsar, not without considerable expense and trouble, to conquer Ingria and lay the foundations of St Petersburg. In these early days Peter would very willingly have made peace with his formidable rival if he had been allowed to retain these comparatively modest conquests. From 1707 to 1709 the war on his part was purely defensive; Charles would not hear of peace till full restitution had been made and a war indemnity paid, while Peter was fully resolved to perish rather than surrender his "paradise," Petersburg. After Pultava (June 26, 1709), Peter, hitherto commendably cautious even to cowardice, but now puffed up with pride, rashly plunged into as foolhardy an enterprise as ever his rival engaged in. The campaign of the Pruth (March to July 1711) must have been fatal to the tsar but for the incalculable behaviour of the omnipotent grand vizier, who let the Russian army go at the very instant when it lay helpless in the hollow of his hand. Even so, Peter, by the peace of the Pruth, had to sacrifice all that he had gained by the Azov expedition fifteen years previously. On receiving the tidings of the conclusion of the peace of Nystad (August 30, 1721), Peter declared, with perfect justice, that it was the most profitable peace Russia had ever concluded. The gain to Russia was, indeed, much more than territorial. In surrendering the pick of her Baltic provinces, Sweden had surrendered along with them the hegemony of the north, and all her pretensions to be considered a great power.

The Great Northern War was primarily a training school for a backward young nation, and in the second place a means of multiplying the material resources of a nation as poor as she was backward. During the whole course of it the process of internal domestic reformation had been slowly but unceasingly proceeding. Brand-new institutions on Western models were gradually growing up among the cumbrous, antiquated, worn-out machinery of old Muscovy; and new men, like Menshikov, Goloykin, Apraksin, Osterman, Kurakin, Tolstoy, Shafirov, Prokopovich, Yaguszhinsky, Yavorsky, all capable, audacious, and brimful of new ideas, were being trained under the eye of the great regenerator to help him to carry on his herculean task. At first the external form of the administration remained much the same as before. The old dignities disappeared of their own accord with the deaths of their holders, for the new men, those nearest to Peter, did not require them. "The Administrative Senate" was not introduced till 1711, and only then because the interminable war, which required Peter's prolonged absence from Russia, made it impossible for him to attend to the details of the domestic administration. Still later came the "Spiritual Department," or "Holy Synod" (January 1721), which superseded the ancient patriarchate. It was established, we are told, "because simple folks cannot distinguish the spiritual power from the sovereign power, and suppose that a supreme spiritual pastor is a second sovereign, the spiritual authority being regarded as higher and better than the temporal." From the first the regenerator in his *ukazes* was careful to make everything quite plain. He was always explaining why he did this or that, why the new was better than the old, and so on; and we must recollect that these were the first lessons of the kind the nation had ever received. The whole system of Peter was deliberately directed against the chief evils from which old Muscovy had always suffered, such as dissipation of energy, dislike of co-operation, absence of responsibility, lack of initiative, the tyranny of the family, the insignificance of the individual. The low social morality of all classes, even when morality was present at all, necessitated the regeneration of the nation against its will, and the process could therefore only be a violent one. Yet the most enlightened of Peter's contemporaries approved of and applauded his violence; some of them firmly believed that his most energetic measures were not violent enough. Thus Ivan Poroshkov, Peter's contemporary, the father of Russian political economy, writes as follows: "If any land be over-much encumbered with weeds, corn cannot be sown thereon unless the weeds first be burned with fire. In the same way, our ancient inveterate evils should also be burnt with fire." Peter himself carried this principle to its ultimate limits in dealing with his unfortunate son the Tsarevich Alexius (*q.v.*). From an ethical and religious point of view the deliberate removal of Alexius was an abominable, an inhuman crime: Peter justified it as necessary for the welfare of the new Russia which he had called into existence.

The official birthday of the Russian empire was the 22nd of October 1721, when, after a solemn thanksgiving service in the Troitsa Cathedral for the peace of Nystad, the tsar proceeded to the senate and was there acclaimed: "Father of the Fatherland, Peter the Great, and Emperor of All Russia." Some Russians would have preferred to proclaim Peter as emperor of the East; but Peter himself adopted the more patriotic title.

Towards the end of the reign the question of the succession to the throne caused the emperor some anxiety. The rightful heir, in the natural order of primogeniture, was the little grand duke Peter, son of the Tsarevich Alexius, a child of six; but Peter decided to pass him over in favour of his own beloved consort Catherine. The *ustav*, or ordinance of 1722, heralded this unheard-of innovation. Time-honoured custom had hitherto reckoned primogeniture in the male line as the best title to the Russian crown; in the *ustav* of 1722 Peter denounced primogeniture in general as a stupid, dangerous, and even unscriptural practice of dubious origin. The *ustav* was but a preliminary step to a still more sensational novelty. Peter had resolved to crown his consort empress, and on the 15th of November 1723 he issued a second manifesto explaining at some length why he was taking such an unusual step. That he should have considered any explanation necessary demonstrates that he felt himself to be treading on dangerous ground. The whole nation listened aghast to the manifesto. The coronation of a woman was in the eyes of the Russian people a scandalous innovation in any case, and the proposed coronation was doubly scandalous in view of the base and disreputable origin of Catherine herself (see CATHERINE I.). But Peter had his way, and the ceremony took place at Moscow with extraordinary pomp and splendour on the 7th of May 1724.

During the last four years of his reign Peter's policy was predominantly Oriental. He had got all he wanted in Europe, but the anarchical state of Persia at the beginning of 1722 opened up fresh vistas of conquest. The war which lasted from May 1722 to September 1723 was altogether successful, resulting in the acquisition of the towns of Baku and Derbent and the Caspian provinces of Gilan, Mazandaran and Astarabad. The Persian campaigns wore out the feeble health of Peter, who had been ailing for some time. A long and fatiguing tour of inspection over the latest of his great public works, the Ladoga Canal, during the autumn of 1724, brought back another attack of his paroxysms, and he reached Petersburg too ill to rally again, though he showed himself in public as late as the 16th of January 1725. He expired in the arms of his consort, after terrible suffering, on the 28th of January 1725.

Peter's claim to greatness rests mainly on the fact that from first to last he clearly recognized the requirements of the Russian nation and his own obligations as its ruler. It would have materially lightened his task had he placed intelligent foreigners at the head of every department of state, allowing them gradually to train up a native bureaucracy. But for the sake of the independence of the Russian nation he resisted the temptation of taking this inviting but perilous short-cut to greatness. He was determined that, at whatever cost, hardship and inconvenience, Russia should be ruled by Russians, not by foreigners; and before his death he had the satisfaction of seeing every important place in his empire in the hands of capable natives of his own training. But even in his most sweeping reforms he never lost sight of the idiosyncrasies of the people. He never destroyed anything which he was not able to replace by something better. He possessed, too, something of the heroic nature of the old Russian *bogatuirs*, or demigods, as we see them in the *skazki* and the *builinui*. His expansive nature loved width and space. No doubt this last of the *bogatuirs* possessed the violent passions as well as the wide views of his prototypes. All his qualities, indeed, were on a colossal scale. His rage was cyclonic: his hatred rarely stopped short of extermination. His banquets were orgies, his pastimes convulsions. He lived and he loved like one of the giants of old. There are deeds of his which make humanity shudder, and no man equally great has ever descended to such depths of cruelty and treachery. Yet it may generally be allowed that a strain of nobility, of which we occasionally catch illuminating glimpses, extorts from time to time an all-forgiving admiration. Strange, too, as it may sound, Peter the Great was at heart profoundly religious. Few men have ever had a more intimate persuasion that they were but instruments for good in the hands of God.

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PETER II. (1715–1730), emperor of Russia, only son of the Tsarevich Alexius, was born on the 18th of October 1715. From his childhood the orphan grand duke was kept in the strictest seclusion. His grandfather, Peter the Great, systematically ignored him. His earliest governesses were the wives of a tailor and a vintner from the Dutch settlement; a sailor called Norman taught him the rudiments of navigation; and, when he grew older, he was placed under the care of a Hungarian refugee, Janos Zeikin, who seems to have been a conscientious teacher. During the reign of Catherine I. Peter was quite ignored; but just before her death it became clear to those in power that the grandson of Peter the Great could not be kept out of his inheritance much longer. The majority of the nation and three-quarters of the nobility were on his side, while his uncle, the emperor Charles VI., through the imperial ambassador at St Petersburg, Rabutin, persistently urged his claims. The matter was arranged between Menshikov, Osterman and Rabutin; and on the 18th of May 1727 Peter II., according to the terms of the supposed last will of Catherine I., was proclaimed sovereign autocrat. The senate, the privy council and the guards took the oath of allegiance forthwith. The education of the young prince was wisely entrusted to the vice-chancellor Osterman. Menshikov, who took possession of Peter II. and lodged him in his own palace on the Vasily island, had intended to marry Peter to his daughter Maria; the scheme was frustrated by his fall (Sept. 21, 1727); but Peter only fell into the hands of the equally unscrupulous Dolgoruki, who carried him away from Petersburg to Moscow. Peter's coronation was celebrated at that city on the 25th of February 1728. He was betrothed to Catherine, second daughter of Alexis Dolgoruki, and the wedding was actually fixed for the 30th of January 1730; but on that very day the emperor died of small-pox.

PETER III. (1728–1762), emperor of Russia, only son of Charles Frederick, duke of Holstein-Gottorp, and of Anne, eldest surviving daughter of Peter the Great, was born at Kiel on the 21st of February 1728. In December 1741 he was adopted by his aunt, Elizabeth Petrovna, as soon as she was safely established on the Russian throne, and on the 18th of November 1742 was received into the Orthodox Church, exchanging his original name of Karl Peter Ulrich for that of Peter Fedorovich. On the 21st of August 1745, by the command of his aunt, he married the princess Sophia Augusta Frederica of Anhalt-Zerbst, who exchanged her name for that of Catherine Alekseyevna. The union between a prince who physically was something less than a man and mentally little more than a child, and a princess of prodigious intellect and an insatiable love of enjoyment, was bound to end in a catastrophe. But there is no foundation for the stories of Peter's neglect and brutality. It took the spouses five years to discover that their tastes were divergent and their tempers incompatible. Even when Peter III. succeeded his aunt on the 5th of January 1762, he paid off all the debts that Catherine had contracted without inquiring what they were for. On her birthday, in April, he made her a present of domains worth £10,000 per annum, though he had already readjusted her establishment on a truly imperial scale. A great deal has been made of Peter's infidelity towards his consort; but the only one who really suffered from his *liaison* with the ugly, stupid and vixenish countess Elizabeth Vorontsova was the unfortunate emperor. So far from being scandalized by the juxtaposition of "Das Fräulein" in the Winter Palace, Catherine accepted it as a matter of course, provided that her own relations with the handsome young guardsman, Gregory Orlov, were undisturbed. Nor was Peter's behaviour to his consort in public of the outrageous character we have been led to suppose. Peter, in fact, was too good-natured and inconsequent to pursue, or even premeditate, any deliberate course of ill treatment. No personal wrongs, but the deliberate determination of a strong-minded, capable woman to snatch the reins of government from the hands of a semi-imbecile, was the cause of Peter's overthrow, and his stupendous blunders supplied Catherine with her opportunity. Peter's foreign policy was the absolute reversal of the policy of his predecessor. He had not been on the throne for two months when he made pacific overtures to the wellnigh vanquished king of Prussia, whom he habitually alluded to as "the king my master." Peter's enthusiastic worship of Frederick resulted in a peace (May 5) and then (June 19) in an offensive and defensive alliance between Russia and Prussia, whereby Peter restored to Prussia all the territory won from her by Russia during the last five years at such an enormous expense of men and money, and engaged to defend Frederick against all his enemies. This was followed up by a whole series of menacing rescripts addressed by Peter to the court of Vienna, in which war was threatened unless Austria instantly complied with all the demands of the king of Prussia. Finally he picked a quarrel with Denmark for not accepting as an ultimatum the terms to be submitted by Russia to a peace conference to meet at Berlin for the purpose of adjusting the differences between the two powers. On the 6th of July the Russian army received orders to invade Denmark by way of Mecklenburg. This advance was only arrested, when the opposing forces were almost within touch of each other, by the tidings that a revolution had taken place at St Petersburg, and that Peter III. was already a prisoner in the hands of his consort. The *coup d'état* of the 9th of July 1762 properly belongs to the history of Catherine II. (*q.v.*). Here only a few words must be said as to the mysterious death of Peter at the castle of Ropsha, to which he was removed immediately after his surrender. Here he remained from the evening of the 9th to the afternoon of the 18th of July. At first Catherine and her counsellors could not make up their minds what to do with "the former emperor." Imprisonment in Schlüsselburg for life, or repatriation to Holstein, were proposed only to be rejected as dangerous. The Orlovs had even stronger motives than Catherine for suppressing the ex-emperor, for Gregory Orlov aspired to win the hand as well as the heart of his imperial mistress, and so long as Catherine's lawful husband lived, even in a prison, such a union would be impossible. The available evidence points to the irresistible conclusion that on the afternoon of the 18th of July 1762, Peter III., with his consort's connivance, was brutally murdered at Ropsha by Alexius Orlov, Theodore Baryatinski, and several other persons still unknown.

See R. N. Bain, *Peter III., Emperor of Russia* (London, 1902); V. A. Bilbasov, *History of Catherine II.* (Rus.), vol. i. (Berlin, 1900). (R. N. B.)

PETER (Pedro), the name of several Spanish kings.

Peter I., king of Aragon (d. 1104), son of Sancho Ramirez, the third in order of the historic kings of Aragon, belonged to times anterior to the authentic written history of his kingdom; and little is known of him save that he recovered Huesca from the Mahommedans in 1096.

Peter II., king of Aragon (1174–1213), son of Alphonso II. and his wife Sancia, daughter of Alphonso VIII. of Castile, was born in 1174. He had a very marked and curious personal character. As sovereign of lands on both sides of the Pyrenees, he was affected by very different influences. In his character of Spanish prince he was a crusader, and he took a distinguished part in the great victory over the Almohades at the Navas de Tolosa in 1212. But his lands to the north of the Pyrenees brought him into close relations with the Albigenses. He was a favourer of the troubadours, and in his ways of life he indulged in the laxity of Provençal morals to the fullest extent. We are told in the chronicle written by Desclot soon after his time, that Peter was only trapped into cohabiting with his wife by the device which is familiar to readers of *Measure for Measure.* In the year after the battle of the Navas de Tolosa he took up arms against the crusaders of Simon of Montfort, moved not by sympathy with the Albigenses, but by the natural political hostility of the southern princes to the conquering intervention of the north under pretence of religious zeal. His son records the way in which he spent the night before the battle of Muret with a crudity of language which defies translation, and tells us that his father was too exhausted in the morning to stand at Mass, and had to be lifted into the saddle by his squires. Peter none the less showed the greatest personal valour, and his body, recognizable by his lofty stature and personal beauty, was found on the field after the rout (Sept. 12, 1213).

See *Chronicle of James I. of Aragon*, translated by J. Forster (London, 1883); and *Life and Times of James the First the Conqueror*, by F. Darwin Swift (Oxford, 1894).

Peter III., king of Aragon (1236–1286), son of James the Conqueror, and his wife Yolande, daughter of Andrew II. of Hungary, was born in 1236. Having married Constance, daughter of Manfred of Beneventum, he came forward as the representative of the claims of the Hohenstaufen in Naples and Sicily against Charles, duke of Anjou. Peter began the long strife of the Angevine and Aragonese parties in southern Italy. His success in conquering Sicily earned him the surname of "the Great." He repelled an invasion of Catalonia undertaken by the king of France in support of Charles of Anjou, and died on the 8th of November 1286.

For the personal character of Peter III., the best witness is the *Chronicle* of Ramonde Muntanez—reprinted in the original Catalan by R. Lanz, *Literarischer Verein in Stuttgart*, vol. vii. (1844), and in French by Buchon, *Coll. des chroniques nationales* (Paris, 1824–1828). See also O. Cartellieri, *Peter von Aragon und die Sizilianische Vesper* (Heidelberg, 1904).

Peter IV., king of Aragon (d. 1387), son of Alphonso IV. and his wife Teresa d'Enteça, is known as "The Ceremonious" and also as "he of the dagger." He acquired the first title by the rigid etiquette he enforced, as one means of checking the excessive freedom of his nobles. The second name was given him because he wounded himself with his dagger in the act of cutting to pieces the so-called "charter of the Union," which authorised the rebellions of his nobles, and which he forced them to give up, after he had routed them at the battle of Epila in 1348. Of no man of the 14th century can it be more truly said that his life was a warfare on earth. He had first to subdue his nobles, and to reannex the Balearic Islands to the crown of Aragon. When he had made himself master at home, he had to carry on a long and fierce contest with his namesake Peter the Cruel of Castile, which only terminated when Henry of Trastamara succeeded, largely with Aragonese help, in making himself king of Castile in 1369. Peter succeeded in making himself master of Sicily in 1377, but ceded the actual possession of the island to his son Martin. He was three times married: to Mary, daughter of Philip of Evreux, king of Navarre; to Eleanor, daughter of Alphonso IV. of Portugal; and to Eleanor, daughter of Peter II. of Sicily, his cousin. The marriage of his daughter by his third marriage, Eleanor, with John I. of Castile, carried the crown of Aragon to the Castilian line when his male representatives became extinct on the death of his son Martin in 1410.

See Zurita, *Anales de Aragon* (Saragossa, 1610).

Peter, "the Cruel," king of Castile (1333–1369), son of Alphonso XI. and Maria, daughter of Alphonso IV. of Portugal, was born in 1333. He earned for himself the reputation of monstrous cruelty which is indicatd by the accepted title. In later ages, when the royal authority was thoroughly established, there was a reaction in Peter's favour, and an alternative name was found for him. It became a fashion to speak of him as *El Justiciero*, the executor of justice. Apologists were found to say that he had only killed men who themselves would not submit to the law or respect the rights of others. There is this amount of foundation for the plea, that the chronicler Lopez de Ayala, who fought against him, has confessed that the king's fall was regretted by the merchants and traders, who enjoyed security under his rule. Peter began to reign at the age of sixteen, and found himself subjected to the control of his mother and her favourites. He was immoral, and unfaithful to his wife, as his father had been. But Alphonso XI. did not imprison his wife, or cause her to be murdered. Peter certainly did the first, and there can be little doubt that he did the second. He had not even the excuse that he was passionately in love with his mistress, Maria de Padilla; for, at a time when he asserted that he was married to her, and when he was undoubtedly married to Blanche of Bourbon, he went through the form of marriage with a lady of the family of Castro, who bore him a son, and then deserted her. Maria de Padilla was only the one lady of his harem of whom he never became quite tired. At first he was controlled by his mother, but emancipated himself with the encouragement of the minister Albuquerque and became attached to Maria de Padilla. Maria turned him against Albuquerque. In 1354 the king was practically coerced by his mother and the nobles into marrying Blanche of Bourbon, but deserted her at once. A period of turmoil followed in which the king was for a time overpowered and in effect imprisoned. The dissensions of the party which was striving to coerce him enabled him to escape from Toro, where he was under observation, to Segovia. From 1356 to 1366 he was master, and was engaged in continual wars with Aragon, in which he showed neither ability nor daring. It was during this period that he perpetrated the series of murders which made him odious. He confided in nobody save the Jews, who were his tax-gatherers, or the Mahommedan guard he had about him. The profound hatred of the Christians for the Jews and *Mudejares*, or Mahommedans settled among them, dates from the years in which they were the agents of his unbridled tyranny. In 1366 he was assailed by his bastard brother Henry of Trastamara at the head of a host of soldiers of fortune, and fled the kingdom without daring to give battle. Almost his last act in Spain was to murder Suero, the archbishop of Santiago, and the dean, Peralvarez. Peter now took refuge with the Black Prince, by whom he was restored in the following year. But he disgusted his ally by his faithlessness and ferocity. The health of the Black Prince broke down, and he left Spain. When thrown on his own resources, Peter was soon overthrown by his brother Henry, with the aid of Bertrand du Guesclin and a body of French free companions. He was murdered by Henry in du Guesclin's tent on the 23rd of March 1369. His daughters by Maria de Padilla, Constance and Isabella, were respectively married to John of Gaunt, and Edmund, duke of York, sons of Edward III., king of England.

The great original but hostile authority for the life of Peter the Cruel is the *Chronicle* of the Chancellor Pero Lopez de Ayala (Madrid 1779–1780). A brilliantly written Life is that by Prosper Mérimée, *Hist. de Don Pèdre I., roi de Castille* (Paris, 1848). (D. H.)

PETER DES ROCHES (d. 1238), bishop of Winchester under John and Henry III., and conspicuous among the foreign favourites to whom these sovereigns owed much of their unpopularity, was a Poitevin by extraction. He received the office of chamberlain towards the close of Richard's reign, and under Richard's successor became an influential counsellor. In 1205, doubtless through John's influence, he was elected to the see of Winchester. His election was disputed but, on appeal, confirmed by Pope Innocent III., who honoured Peter by consecrating him in person. None the less, the new bishop stood by his royal patron during the whole period of the interdict. In 1213 he was made justiciar in succession to Geoffrey Fitz Peter. This promotion was justified by the fidelity with which Peter supported the king through the barons' war. At the battle of Lincoln (1217) Peter led a division of the royal army and earned some distinction by his valour; but he played a secondary part in the government so long as William Marshal held the regency. After Marshal's death (1219) Peter led the baronial opposition to Hubert de Burgh, with varying success. At first the justiciar was successful. In 1221 Peter meditated going on crusade; 1223–1224 saw his party broken up by Hubert's energetic measures; in 1227 was himself dismissed from his office and turned his back on England to join the crusade of the emperor Frederick II. He was absent from England until 1231; but in the meantime enhanced his reputation both as a soldier and diplomatist. After the fall of De Burgh he kept in the background, but offices and honours were heaped on his dependants, especially on his nephew, Peter des Rievaulx, and other Poitevins. This foreign party triumphed over the revolt which was headed by Richard Marshal in 1233. But the primate, Edmund Rich, voiced the general feeling when he denounced Peter as a mischief maker, and demanded that he should be dismissed from court. The king complied, and threatened the bishop with charges of malversation. Peter was however permitted to leave the country with a pardon (1235); he conciliated Gregory IX. by rendering efficient aid in a war with the citizens of Rome (1235); and in the next year returned without molestation to his see. He was invited to go as the king's envoy to the court of Frederick II., but refused apparently on the score of ill health. His public reconciliation with De Burgh (1236), effected through the mediation of the papal legate, provided a dramatic close to their long rivalry, but had no political significance, since both were now living in retirement. Peter died in 1238, and was buried at Winchester. He was undoubtedly a man of a winning personality, a good diplomat and financier, a statesman whose unpopularity was due in some measure to his freedom from the insularity of the Englishmen, against whom he matched himself. But his name is associated with a worthless clique of favourites, and with the first steps which were taken by Henry III. to establish a feeble and corrupt autocracy.

See C. Petit Dutaillis, *Vie et règne de Louis VIII.* (Paris, 1894); Lecointre Dupont, *Pierre des Roches* (Poitiers, 1868); Stubbs's *Constitutional History of England*, vol. ii.; H. W. C. Davis, *England under the Normans and Angevins* (1905); T. F. Tout in the *Political History of England*, vol. iii. (1905). (H. W. C. D.)

PETER LOMBARD (*c.* 1100–*c.* 1160), bishop of Paris, better known as *Magister sententiarum*, the son of obscure parents, was born about the beginning of the 12th century, at Novara (then reckoned as belonging to Lombardy). After receiving his education at Bologna, he removed to France, bearing a recommendation to Bernard of Clairvaux, who first placed him under Lotolf at Reims, and afterwards sent him to Paris with letters to Gilduin, the abbot of St Victor. He soon became known as a teacher, and obtained a theological chair in the cathedral school. His famous textbook, the *Sententiae*, was written between 1145 and 1150. On the 29th of June 1159 he became bishop of Paris. The accounts of his bishopric are satisfactory. There is a charge that he was guilty of simony, having received his office through the favour of Philip, brother of Louis VII., his former pupil. The date of his death is uncertain. According to one account he died on the 20th of July 1160, and as Maurice de Sully became bishop that year the statement seems probable. Yet there is evidence for a later date, and he may have been set aside for simony.

His famous theological handbook, *Sententiarum libri quatuor*, is, as the title implies, primarily a collection of opinions of the fathers, "sententiae patrum." These are arranged, professedly on the basis of the aphorism of Augustine, Lombard's favourite authority, that "omnis doctrina vel rerum est vel signorum," into four books, of which the first treats of God, the second of the creature, the third of the incarnation, the work of redemption, and the virtues, and the fourth of the seven sacraments and eschatology. The *Sententiae* show the influence of Abelard, both in method and arrangement, but lack entirely the daring of *Sic et Non*. Compared with that book they are tame. Gratian's *Concordia discordantium canonum*, as he called his Decretum, was another strong influence, Lombard doing in a sense for theology what Gratian did for the canon law. The influence of Hugh of St Victor is also marked. The relation to the "sentences" of a Gandulph of Bologna (still unpublished) has not been established. The most important thing in the book was its crystallization of the doctrine concerning the sacramental system, by the definite assertion of the doctrine of the seven sacraments, and the acceptance of a definition of sacrament, not merely as "a sign of a sacred thing," but as itself "capable of conveying the grace of which it is the sign." The sentences soon attained immense popularity, ultimately becoming the text-book in almost every theological school, and giving rise to endless commentaries, over 180 of these being written in England. In 1300 the theological professors of Paris agreed in the rejection of sixteen propositions taken from Lombard, but their decision was far from obtaining universal currency.

Besides the *Sententiae*, Lombard wrote numerous commentaries (*e.g.* on the Psalms, Canticles, Job, the Gospel Harmony, and the Pauline Epistles), sermons and letters, which still exist in MS. The *Glossae seu commentarius in psalmos Davidis*, were first published at Paris in 1533.

Lombard's collected works have been published in J. P. Migne's *Patrologie latine*, Tome 191 and 192. See also Denifle and Chatelain, *Chartularium universitatis parisiensis*, Tome i. (Paris, 1889); Protois, *Pierre Lombard, son époque, sa vie, ses écrits, son influence* (Paris, 1881); Kögel, *Petrus Lombard in seiner Stellung zur Philosophie des Mittelalters* (Leipzig, 1897); A. Harnack, *Dogmengeschichte*, Bd. iii. (1890; Eng. trans. 1894–1899); and the article in Herzog-Hauck's *Realencyklopädie*, Bd. xi. (Leipzig, 1902).

PETER OF AIGUEBLANCHE (d. 1268), bishop of Hereford, belonged to a noble family of Savoy and came to England in 1236 with his master, William of Savoy, bishop of Valence, being in attendance on Eleanor of Provence, the bride of Henry III. A year or two later he is found residing permanently in England as a member of the king's court; before 1239 he was archdeacon of Salop, and in 1240 he was chosen bishop of Hereford. In 1255 Peter acted as Henry's principal agent in the matter of accepting the kingdom of Sicily from Pope Alexander IV. for his son Edmund, and his rapacious and dishonest methods of raising money for this foolish enterprise added not a little to the unpopularity which surrounded the king and his foreign favourites. When civil war broke out between Henry and his barons the bishop remained loyal to his master, and whilst residing, almost for the first time, at Hereford he was taken prisoner in May 1263. He was, however, released when the king and his enemies came to terms, and after a stay in France he retired to Savoy, where he died on the 27th of November 1268.

See F. Mugnier, *Les Savoyards en Angleterre au XIII^e siècle et Pierre d' Aigueblanche* (Chambéry, 1890).

PETER OF BLOIS [PETRUS BLESENSIS] (*c.* 1135–*c.* 1205), French writer, the son of noble Breton parents, was born at Blois. He studied jurisprudence at Bologna and theology in Paris, and in 1167 he went to Sicily, where he became tutor to the young king William II., and keeper of the royal seal (*sigillarius*). But he made many enemies and soon asked permission to leave the country; his request was granted and about 1170 he returned to France. After spending some time teaching in Paris and serving Rotrou de Perche, archbishop of Rouen, as secretary, Peter entered the employ of Henry II. of England about 1173. He quickly became archdeacon of Bath and soon afterwards chancellor, or secretary, to Richard, archbishop of Canterbury, and to Richard's successor, Baldwin, being sent on two occasions to Italy to plead the cause of these prelates before the pope. After the death of Henry II. in 1189, he was for a time secretary to his widow, Eleanor, in Normandy; he obtained the posts of dean of Wolverhampton and archdeacon of London, but he appears to have been very discontented in his later years. He died some time after March 1204.

Peter's writings fall into four classes, letters, treatises, sermons and poems. His *Epistolae*, which were collected at the request of Henry II., are an important source for the history of the time; they are addressed to Henry II. and to various prelates and scholars, including Thomas Becket and John of Salisbury. His treatises include *De Ierosolymitana peregrinatione acceleranda*, an exhortation to take part in the third crusade, and *Dialogus inter regem Henricum II. et abbatem Bonaevallensem*; his extant sermons number 65 and his poems are unimportant. Peter's works have been printed in several collections, including the *Patrologia* of J. P. Migne and the *Historiae francorum scriptores* of A. Duchesne. Of separate editions the best are those by Pierre de Goussainville (Paris, 1667) and J. A. Giles (Oxford, 1846–1847).

See the *Histoire littéraire de la France*, Tome xv.; W. Stubbs, *Lectures on Medieval and Modern History* (Oxford, 1886); Sir T. D. Hardy, *Descriptive Catalogue of Materials relating to the History of Great Britain* (1862–1867), and C. L. Kingsford in vol. xlv. of the *Dictionary of National Biography* (1896).

PETER OF COURTENAY (d. 1219), emperor of Romania (or Constantinople), was a son of Peter of Courtenay (d. 1183), and a grandson of the French king, Louis VI. Having, by a first marriage, obtained the counties of Nevers and Auxerre, he took for his second wife, Yolande (d. 1219), a sister of Baldwin and Henry of Flanders, who were afterwards the first and second emperors of the Latin Empire of Constantinople. Peter accompanied his cousin, King Philip Augustus, on the crusade of 1190, fought against the Albigenses, and was present at the battle of Bouvines in 1214. When his brother-in-law, the emperor Henry, died without sons in 1216, Peter was chosen as his successor, and with a small army set out from France to take possession of his throne. Consecrated emperor at Rome, in a church outside the walls, by Pope Honorius III. on the 9th of April 1217, he borrowed some ships from the Venetians, promising in return to conquer Durazzo for them; but he failed in this enterprise, and sought to make his way to Constantinople by land. On the journey he was seized by the despot of Epirus, Theodore Angelus, and, after an imprisonment of two years, died, probably by foul means. Peter thus never governed his empire, which, however, was ruled for a time by his wife, Yolande, who had succeeded in reaching Constantinople. Two of his sons, Robert and Baldwin, became in turn emperors of Constantinople.

PETER OF DUISBURG (d. *c.* 1326), German chronicler, was born at Duisburg, and became a priest-brother of the Teutonic Order. He wrote the *Chronicon terrae Prussiae*, dedicated to the grand-master, Werner of Orseln, which is one of the chief authorities for the history of the order in Prussia. There is a rhyming translation in German by Nicholas of Jeroschin, which, together with the original, is published in Bd. I. of the *Scriptores rerum prussicarum* (Leipzig, 1861).

See M. Töppen, *Geschichte der preussischen Historiographie* (Berlin, 1853); and W. Fuchs, *Peter von Duisburg und das Chronicon olivense* (Königsberg, 1884).

PETER OF MARICOURT (13th century), a French savant, to whom his disciple, Roger Bacon, pays the highest tribute in his *opus tertium* and other works. According to Bacon he was a recluse who devoted himself to the study of nature, was able to work metals, invented armour and assisted St Louis in one of his expeditions more than his whole army. According to Émile Charles (*Roger Bacon sa vie, ses ouvrages, ses doctrines*, 1861), Peter of Maricourt is the Pierre Pérégrin (or Pèlerin) de Maricourt (Méharicourt in Picardy), known also as Petrus Peregrinus of Picardy, one of whose letters, *De magnete*, is partly reproduced in Libri's *Hist. des sciences mathématiques en Italie* (1838), ii. 70–71, 487–505.

PETER OF SAVOY (*c.* 1203–1268), earl of Richmond, younger son of Thomas I. (Tommaso), count of Savoy, was born at Susa. After spending some years as an ecclesiastic he resigned his preferments, and in 1234 married his cousin Agnes, daughter and heiress of Aymon II., lord of Faucigny. Accepting an invitation from the English king, Henry III., who had married his niece, Eleanor of Provence, Peter came to England in 1240, and was created earl of Richmond, receiving also large estates and being appointed to several important offices. During several visits to the continent of Europe Peter had largely increased his possessions in Vaud and the neighbourhood, and returning to England in 1252 he became associated with Simon de Montfort, retaining at the same time the king's friendship. Having been employed by Henry to negotiate with the pope and with Louis IX. of France, he supported Earl Simon in his efforts to impose restrictions upon the royal power; but, more moderate than many members of the baronial party, went over to Henry's side in 1260, and was consequently removed from the council. In 1263 he left England, and when his nephew, Boniface, count of Savoy, died in the same year he assumed the title of count of Savoy. This was also claimed by another nephew, Thomas; but Peter compelled the inhabitants of Turin to submit to him and secured possession of the county. He died on the 16th or 17th of May 1268, leaving an only child, Beatrice (d. 1310). Peter gave to the castle of Chillon its present form, and his name to the Savoy palace in London. He has been called *le petit Charlemagne*, and was greatly praised for his valour and his wisdom.

See L. Wurstemberger, *Peter der Zweite, Graf von Savoyen* (Zürich, 1858); F. Mugnier, *Les Savoyards en Angleterre* (Chambéry, 1890); and C. Bémont, *Simon de Montfort* (Paris, 1884).

PETER THE HERMIT, a priest of Amiens, who *may*, as Anna Comnena says, have attempted to go on a pilgrimage to Jerusalem before 1096, and have been prevented by the Turks from reaching his destination. It is uncertain whether he was present at Urban's great sermon at Clermont in 1095; but it is certain that he was one of the preachers of the crusade in France after that sermon, and his own experience may have helped to give fire to his eloquence. He soon leapt into fame as an emotional revivalist preacher: his very ass became an object of popular adoration; and thousands of peasants eagerly took the cross at his bidding. The crusade of the *pauperes*, which forms the first act in the first crusade, was his work; and he himself led one of the five sections of the *pauperes* to Constantinople, starting from Cologne in April, and arriving at Constantinople at the end of July 1096. Here he joined the only other section which had succeeded in reaching Constantinople—that of Walter the Penniless; and with the joint forces, which had made themselves a nuisance by pilfering, he crossed to the Asiatic shore in the beginning of August. In spite of his warnings, the *pauperes* began hostilities against the Turks; and Peter returned to Constantinople, either in despair at their recklessness, or in the hope of procuring supplies. In his absence the army was cut to pieces by the Turks; and he was left in Constantinople without any followers, during the winter of 1096–1097, to wait for the coming of the princes. He joined himself to their ranks in May 1097, with a little following which he seems to have collected, and marched with them through Asia Minor to Jerusalem. But he played a very subordinate part in the history of the first crusade. He appears, in the beginning of 1098, as attempting to escape from the privations of the siege of Antioch—showing himself, as Guibert of Nogent says, a "fallen star." In the middle of the year he was sent by the princes to invite Kerbogha to settle all differences by a duel; and in 1099 he appears as treasurer of the alms at the siege of Arca (March), and as leader of the supplicatory processions in Jerusalem which preceded the battle of Ascalon (August). At the end of the year he went to Laodicea, and sailed thence for the West. From this time he disappears; but Albert of Aix records that he died in 1151, as prior of a church of the Holy Sepulchre which he had founded in France.

Legend has made Peter the Hermit the author and originator of the first crusade. It has told how, in an early visit to Jerusalem, before 1096, Christ appeared to him in the Church of the Sepulchre, and bade him preach the crusade. The legend is without any basis in fact, though it appears in the pages of William of Tyre. Its origin is, however, a matter of some interest. Von Sybel, in his *Geschichte des ersten Kreuzzuges*, suggests that in the camp of the *pauperes* (which existed side by side with that of the knights, and grew increasingly large as the crusade told more and more heavily in its progress on the purses of the crusaders) some idolization of Peter the Hermit had already begun, during the first crusade, parallel to the similar glorification of Godfrey by the Lorrainers. In this idolization Peter naturally became the instigator of the crusade, just as Godfrey became the founder of the kingdom of Jerusalem and the legislator of the assizes. This version of Peter's career seems as old as the *Chanson des chétifs*, a poem which Raymond of Antioch caused to be composed in honour of the Hermit and his followers, soon after 1130. It also appears in the pages of Albert of Aix, who wrote somewhere about 1130; and from Albert it was borrowed by William of Tyre. The whole legend of Peter is an excellent instance of the legendary amplification of the first crusade—an amplification which, beginning during the crusade itself, in the "idolizations" of the different camps (*idola castrorum*, if one may pervert Bacon), soon developed into a regular saga. This saga found its most piquant beginning in the Hermit's vision at Jerusalem, and there it accordingly began—alike in Albert, followed by William of Tyre and in the *Chanson des chétifs*, followed by the later *Chanson d'Antioche*.

The original authorities for the story of Peter the Hermit are: for the authentic Peter, Anna Comnena and the *Gesta Francorum*;

for the legendary Peter, Albert of Aix. The whole career of the Hermit has been thoroughly and excellently discussed by H. Hagenmeyer, *Peter der Heremite* (Leipzig, 1879). (E. Br.)

PETER THE WILD BOY (*fl.* 1725–1785), a Hanoverian imbecile of unknown parentage, who, having been found living wild in the woods near Hanover in 1725, was brought to England by order of George I., whose interest had been aroused in the unfortunate youth. An extraordinary amount of curiosity and speculation concerning Peter was excited in London, and the craze was the subject of a biting satire by Swift, and of another entitled *The Most Wonderful Wonder that ever appeared to the Wonder of the British Nation*, which has been attributed to Swift and Arbuthnot; Defoe also wrote on the subject, and Lord Monboddo in his *Origin and Progress of Language* presents the idiot Peter as an illustration of his theory of the evolution of the human species. He lived to an advanced age, was seen by Lord Monboddo in 1782, and died in 1785.

See Henry Wilson, *The Book of Wonderful Characters* (London, 1869).

PETER, EPISTLES OF, the two books of the New Testament traditionally ascribed to the apostle Peter.

1 Peter

This epistle is addressed to "the elect who are sojourners of the Dispersion [Diaspora] in Pontus, Galatia, Cappadocia, Asia and Bithynia." The "Diaspora" was the name generally given to the Jews who were "scattered abroad." This suggests that the letter was intended for Jewish Christians in the provinces mentioned. But i. 14, 18; ii. 9, 10; iv. 3 point rather to Gentile Christians, and it is better to take this view, and interpret the "Diaspora" metaphorically as referring to the isolated position of Christians among the heathen. The general impression made by the epistle is that the central idea was to strengthen the courage of the recipients, who were likely to undergo persecution, and to enjoin on them conduct which would remove all reasonable excuse for thinking that Christianity ought to be regarded as a crime.

Ch. i. 3–12 is an introduction of praise to God that he had caused the recipients of the epistle to be born again to the living hope in a glorious salvation. The rest of the epistle may be divided into three parts: (α) i. 13–ii. 10, mainly hortatory injunctions to live holy lives in accordance with this new birth, and to grow up as God's people in communion with Christ; (β) ii. 11–iv. 6, particular directions as to the line of conduct to be pursued towards the Gentiles and towards those in authority, with special reference to the relations of slaves to masters, of wives and husbands to each other, and of Christians to one another; to the first of these a passage is appended dealing with the sufferings of Christ as an example (ii. 21–25), and the whole is completed by an exhortation to meekness and patience in suffering, in the light of the sufferings of Christ and the blessings given by them both to the living and to the dead; (γ) iv. 7–v. 11, has less cohesion. It begins with exhortations not to forget prayer and love, then the believers are warned to be careful to suffer only as Christians, not as breakers of the laws. The elders and the younger men are reminded of their duties to the community and to one another. The whole is brought to a close with an exhortation to all to fight manfully against the devil and to trust in God.

Date and Authorship.—These two questions are so closely connected that they cannot be considered separately. The external evidence of tradition is that the epistle was written by St Peter. This can be traced back to Irenaeus (iv. 9, 2) and Clement of Alexandria (*Strom.* iii. 18, 110), and it is thought by many writers that 2 Peter iii. 1, even if it be not itself Petrine, is good evidence that the writer regarded 1 Peter as apostolic. Evidence for its use, without mention of its name, may be found in Polycarp, but probably not in the other apostolic fathers (cf. *The N.T. in the Apostolic Fathers*, Oxford, 1905, p. 137). It is, however, possible that Papias made use of it. It is doubtful whether Justin Martyr used it, but probable that it was known to Theophilus of Antioch. It is not mentioned in the canon of Muratori. Thus external evidence, though unanimous in favour of the Petrine authorship, is not sufficient to settle the question. The internal evidence consists of (α) evidence bearing on the date in connexion with the persecution of Christians, (β) evidence establishing the relation of the epistle to other documents in early Christian history, and (γ) evidence concerning St Peter personally.

(α) It is clear from 1 Peter i. 6, ii. 12, iv. 12–19, v. 9, that the epistle was written during a time of persecution. The question which is doubtful is to which persecution the description best applies. The traditional opinion was that the persecution referred to was that under Nero. But it has been argued that the Neroine persecution according to Tacitus (*Ann.* xv. 44) was not a persecution of Christians as such, but was rather the result of false accusation. Moreover there is no proof that there was any persecution of Christians at this time outside Rome, and 1 Peter alludes to persecution in the provinces of Asia Minor. Therefore many critics have felt obliged to bring the epistle into connexion with the epistle of Pliny to Trajan, written *c.* 112, and asking for advice as to the procedure to be followed in trials of Christians. This is the earliest evidence which implies organized persecution in the provinces in question, and therefore Holtzmann, Weizsäcker and others regard this as fixing the date of the epistle in the beginning of the 2nd century, and excluding the Petrine authorship. Against this view it may be argued that the epistle describes the beginning of persecution. The writer still hopes that Christians will not be obliged to suffer "for the name" and is clearly aware of false accusations of crime. On the other hand Pliny's letter implies a time when Christianity was in itself a crime and was recognized as such. Thus it is urged, probably correctly, that the epistle belongs to the beginning of a period of which Pliny's letter marks a later development, and we can only say that *c.* 112 is the *terminus ad quem.* The *terminus a quo* is more difficult to find. We do not know with certainty when Christianity became a recognized offence, and scholars have supported various hypotheses. T. Mommsen, Hardy and Sanday think that even under Nero it was criminal to be a Christian; Neumann thinks that this was first the case under Domitian; Sir W. M. Ramsay believes that this attitude was one of the results of the Jewish War of 70, and ascribes it to Vespasian. If the Domitianic date be adopted the Petrine authorship is almost excluded, and it is difficult to reconcile the traditional date of St Peter's martyrdom with Ramsay's theory.

(β) The relations of 1 Peter to other books in early Christian literature is shown in the following table:—

1 Pet.	Rom.	1 Pet.	Eph.	1 Pet.	Jas.	1 Pet.	Polycarp.
i. 14 —	xii. 2	i. 1 seq.—	i. 3 seq.	i. 1 —	i. 1	i. 8—	i. 3
ii. 5 —	xii. 1	i. 14 —	ii. 3	i. 6 seq.—	i. 2 seq.	i. 13—	ii. 1
ii. 6–10—	ix. 32	ii. 18 —	vi. 5	i. 24 —	i. 10	i. 21—	ii. 1
ii. 13 —	xiii. 1	iii. 1 —	v. 22	i. 23 —	i. 18	ii. 11—	v. 3
iii. 9 —	xii. 17	iii. 22 —	i. 20	iv. 8 —	v. 20	ii. 12—	x. 2
iii. 22 —	viii. 34	v. 5 —	v. 21	v. 5 seq.—	iv. 6,10	ii. 21—	viii. 1,2
iv. 3 —	xiii. 11					iii. 9—	ii. 2
iv. 7 —	xiii. 12					iv. 7—	vii. 2
iv. 9 —	xiii. 13					iv. 16—	viii. 2
iv. 10 —	xii. 6						

From this table it is sufficiently plain that 1 Peter is closely connected with Romans, Ephesians, James and Polycarp. The majority of scholars are agreed that in the case of Romans the dependence is on the side of 1 Peter, and in the case of Polycarp on the side of Polycarp. There is less agreement as to Ephesians and James, though in the former case the general opinion favours the dependence of 1 Peter, in the latter case its priority. In England, however, the priority of James has been supported by Mayor and Hort. In the light of the established use of Romans it is possible that 1 Peter also used other Pauline epistles and some scholars have seen special traces of the influence of 1 Cor. and Gal. (for a list of these cf. Holtzmann, *Einleitung in das N.T.*, 3, p. 314). It has been argued that the use of the Pauline epistles is improbable for Peter, but this is a subjective argument which is not decisive.

(γ) According to tradition Peter was martyred in Rome, and it is probable that this was in the Neroine persecution. If this be so, the year 64 is the *terminus ad quem* of the letter, if it be authentic. Ramsay, however, thinks that Peter may have survived this persecution and suffered at the beginning of the persecutions which, he thinks, were initiated by the Flavian emperors (see Peter, St: § 5, 4 and 6).

The whole question of authorship and date is thus a complex of smaller problems, many of which do not seem to admit of any definite answer. If St Paul's epistle to the Ephesians be genuine, and it were really known to the writer of 1 Peter, and if Peter were martyred in 64, the theory of Petrine authorship demands that it was written by Peter between 59 and 64. On the Petrine hypothesis this is the most probable view. The weak point is that it assumes a great spread of Christianity in the provinces of Asia Minor outside the activity of Paul, and that the official persecution of Christians as such began throughout the Roman Empire under Nero, for neither of which is there corroborative evidence. On the non-Petrine hypothesis a date is demanded some time before the letter of Pliny; this suits the internal evidence better than any possible on the Petrine hypothesis, but it fails to explain the really considerable and early evidence for the Petrine authorship, and necessitates some purely hypothetical suggestion, such as Harnack's view that the epistle was originally anonymous, and that the opening and closing sentences (i. 1 sqq., v. 12 sqq.) were added between A.D. 150 and 175, perhaps by the writer of 2 Peter.

The Provenance of the Epistle.—This is defined in 1 Peter v. 13 as Babylon. It has sometimes been argued that this is Babylon in Mesopotamia, in which there were, until the time of the emperor Caius, many Jews; but no good tradition connects St Peter with the evangelization of Mesopotamia, and this district would have had little in common with the Graeco-Roman world of Asia Minor. Another suggestion is that the Egyptian Babylon is meant (Old Cairo); but in the 1st century this was probably merely a fortress. Thus there is an overwhelming weight of opinion in favour of the view that Rome, the Babylon of Apocalyptic literature, is intended. This also agrees with the tradition in 2 Tim. iv. 11, which (cf. 1 Pet. v. 13) suggests that St Mark was in Rome.

Reception in the Canon.—1 Peter seems to have been the earliest of the Catholic epistles to obtain recognition. By the year 200 it was accepted everywhere except in two places—the church of Edessa, which did not receive the Catholic epistles until the 5th century, and, if the canon of Muratori is to be trusted, the church of Rome. It should, however, be noted that Zahn emends the text of the Muratorianum (rather violently) so as to include the epistle (see also BIBLE: *New Testament Canon.*)

The Theology of 1 Peter.—The simplicity of the theology is marked, and affords an argument for an early date. Jesus is the Messiah of whom the prophets had spoken, and the "Spirit of Christ" is identified with the spirit which was in them. His suffering for sin had rescued the elect, and was also an example for Christians to follow. After his death he preached to the "spirits in prison." The source of Christian life is on the one hand belief in God who raised the Messiah from the dead, and on the other hand baptism which "saves . . . through the resurrection of Jesus Christ." The members of the community are "a royal priesthood, a holy nation"—*i.e.* inherit the promises made to the Jews, but this inheritance is bound up with the strongly eschatological doctrine that Christians are strangers in the world, the end of which is at hand.

The Church Organization of 1 Peter.—This also is very simple and primitive, and closely based on the Jewish model. The leaders are called presbyters or elders, and their duty is to act as shepherds to the flock. Beyond this there is no sign of a developed organization: each is to act in accordance with the gift (χάρισμα) which he has received. There is no trace of a specially set apart ministry either for the service of the community or for teaching, as to which the only limitation given is "If any man speak let him speak as the oracles of God," *i.e.* probably, in accordance with the Old Testament.

2 PETER

This epistle may be divided into five parts. (1) The writer who describes himself as "Simon (var. lect. Symeon) Peter, a servant and apostle of Jesus Christ," exhorts his readers to become perfect in knowledge and virtue, so as to enter the kingdom of Christ (i. 3–11). (2) He then explains his desire once more to testify to the power of Jesus, and bases his testimony partly on his own experience in the Holy Mount (apparently a reference to the Transfiguration), and partly on the "word of prophecy" (i. 12–21). (3) The mention of prophecy leads him to deal with the question of false prophets, who are accused of false doctrine and immoral practices. In this section is incorporated almost the whole of the epistle of Jude (ii. 1–22). (4) He then discusses a special feature of the false teaching, viz. doubts thrown on the *Parousia*, the certainty of which for the future he defends (iii. 1–13). Finally he warns his hearers that they must be found spotless at the *Parousia*, and emphasizes the agreement of his teaching with St Paul's (iii. 14–18).

The main object of the epistle is to be seen in the attack made on the false teachers, and in the defence of the certainty of the *Parousia* of the Lord.

Authorship.—The traditional view is that it was written by St Peter from Rome after 1 Peter. This view is however untenable for the following reasons. (1) The epistle is not quoted by any writer of the 2nd century, and Origen, who is the first to mention it as Petrine, admits that its authorship was disputed. (2) The style and language differ greatly from that of 1 Peter: this argument may however fairly be met by the suggestion that it is improbable that he wrote Greek with ease, and that he may have used a variety of amanuenses. (3) The growth of immorality and false teaching to which it witnesses seems irreconcilable with a very primitive period of church life. (4) It has incorporated the greater part of Jude in a wholesale manner difficult to reconcile with apostolical authorship. (5) It seems to attribute a position of scriptural authority to the Pauline epistles, and this is improbable either in the mouth of Peter, or during the 1st century.

Any one of these arguments would be weighty by itself; in combination they form an irresistible cumulative argument against the Petrine authorship of 2 Peter.

Date.—If the Petrine authorship be abandoned, the *terminus ad quem* of the epistle is its use by Origen (or, just possibly, by Clement of Alexandria), and the *terminus a quo* is fixed by the following considerations: (1) the activity of an immoral Gnosticism; (2) the attainment by the Pauline epistles of great authority, and their perversion by heretics; (3) the use made of the epistle of Jude.

It is difficult to define the exact date to which these indications point, but there is a general agreement that it must be sought in the 2nd century, and perhaps the decades immediately before and after the year A.D. 150 are the most probable.

Place of Origin.—There is hardly any evidence on this point: but the most probable place seems to be Egypt, as the letter has points of connexion with Philo, Clement of Alexandria and the Apocalypse of Peter, and seems first to have been used in the church of Alexandria. It should however be noted that Deissmann argues on lexical grounds in favour of Asia Minor (*Bibel Stud.* pp. 277–284).

Relation to other Early Christian Documents.—The documents with which 2 Peter has the greatest affinities are the epistle of Jude, and the Apocalypse of Peter, of which a fragment was found in Akhmim in 1892 by M Bouriant. In each case the affinity is very close, and is capable of more than one explanation. Roughly speaking 2 Peter ii. reproduces Jude: it is possible therefore either that Jude is an epitome of 2 Peter or that the writer of 2 Peter used Jude. The former hypothesis has a few supporters, notably T. Zahn and Spitta, but most writers are emphatic in thinking that 2 Peter has incorporated Jude, and this view is almost certainly correct (see JUDE, EPISTLE OF). The connexion with the Apocalypse of Peter is more complicated: the evidence of a comparison between the two documents (which is made in full in F. H. Chase's article in Hastings's *Dictionary of the Bible*) is to show that either one document is dependent on the other, or both were written by the same person, or both come from the same circle. Of these theories there is least to be said for the dependence of the Apocalypse on 2 Peter, and perhaps most for the dependence of 2 Peter on the Apocalypse.

Reception in the Canon.—2 Peter was the last of the Catholic epistles to be accepted as canonical. It was first regarded as such in Alexandria, perhaps originally in connexion with the Apocalypse of Peter rather than with 1 Peter. Thence it passed into the canon used by the church of Constantinople, in the 4th century made its way into the Roman canon, and in the 6th was accepted last of all by the Syria church (see also BIBLE: *New Testament Canon*).

The Theology of 2 Peter.—The theology of the epistle is specially marked by two characteristics—its high Christology and its eschatological character. Christ is referred to as "our God and Saviour," and the fatherhood of God is apparently only regarded as referring to the Divine Son. The work of Christ was the redemption of the elect, and this redemption awaits its consummation in the *Parousia.* This is the central point of the teaching of the epistle and is obviously directed against that of the false prophets. The writer looks forward to the destruction of the present world by fire, when the wicked, whether angels or men, who have been reserved for judgment will be finally condemned, and a new era of happiness for the elect will begin.

Church Organization.—There is very little in 2 Peter which throws light on church organization. From his silence it would appear that the monarchial episcopacy did not yet exist in the church to which the writer belonged, and perhaps the prophets were still the chief guides, but the argument from silence cannot be pressed. In any case the growth of false and immoral prophets, which ultimately led to the obsolescence and suppression of this order, was far advanced and was one of the reasons which led to the writing of the epistle.

AUTHORITIES.—Besides the books and articles already mentioned the following are important: F. H. Chase, "Peter" and "Epistles of Peter" in Hastings's *Dict. Bible*; P. W. Schmiedel, "Simon Peter" in the *Ency. Bib.*; Lightfoot, *S. Clement of Rome*, i, 201–315 and ii, 481–502; Harnack, *Altchr. Litt.* and *Chronologie* i (the relevant sections). The relevant sections in the Introductions of Holtzmann, T. Zahn, Jülicher, Salmon, Weiss and Moffat. The commentaries of Bigg, Mayor, F. Spitta, Kühl (in Meyer's *Commentary*), von Soden (in Holtzmann's *Commentary*), and Weiss. (K. L.)

PETERBOROUGH, a town and port of entry of Ontario, Canada, and capital of Peterborough county, situated 70 m. N.E. of Toronto, on the Otonabee river and the Grand Trunk and Canadian Pacific railways. Pop. (1901), 11,239. The five falls of the Otonabee at this point, with a total descent of 50 ft., furnish power for a large and increasing number of manufacturing establishments, whilst its canalization as part of the Trent canal gives communication with Lake Ontario and Georgian Bay. Peterborough has an electric railway, and contains important manufactories of electrical machinery and supplies, iron and steel bridges, agricultural implements and cordage, saw, flour and woollen mills.

PETERBOROUGH, a city and municipal and parliamentary borough of Northamptonshire, England, 76 m. N. from London by the Great Northern railway; served also by the London & North Western, Great Eastern and Midland railways. Pop. (1891), 25,171; (1901), 30,872. It is built chiefly along the river Nene, on the north side, and on the western border of the Fen country.

The cathedral of St Peter is the third church that has occupied the site; the first, founded under Penda, king of the Mercians, about 656, was entirely destroyed by the Danes in 870, and the second, founded in King Edgar's reign, was accidentally burnt in 1116. The present building, founded in the following year, was, inclusive of the west front, 120 years in building, being consecrated on the 4th of October 1237. It embraces in all, however, eight periods of construction, and in no other building can the transition be better studied through the various grades of Norman to Early English, while the later addition is an admirable example of Perpendicular.

The erection proceeded as usual from east to west, and, while an increase in elegance and elaboration is observable in the later parts, the character of the earlier buildings was so carefully kept in mind that no sense of incongruity is produced. A series of uniform Decorated windows were added throughout the church in the 14th century, and their effect is rather to enhance than detract from the unity of design. The choir, early Norman, terminating in an apse, was founded in 1117 or 1118 by John de Sais or Sez, and dedicated in 1140 or 1143; the aisles of both transepts and the whole of the south transept were built by Martin of Bec, 1140–1155; the remaining portions of the transepts and the central tower, of three stories, were completed by William de Waterville, 1155–1175; the nave, late Norman, was completed by Abbot Benedict, 1177–1193, who added a beautiful painted roof of wood; the western transepts, transitional Norman, were the work of Abbot Andrew, 1193–1200; the western front, actually a vast portico of three arches, the unique feature of the building, and one of the finest specimens of Early English extant, must have been built between 1200 and 1250, during which period there were several abbots; but there exists no record of its reconstruction. The lady chapel, built parallel with the choir by William Parys, prior, was consecrated in 1290; the bell-tower was erected by Abbot Richard between 1260 and 1274; the south-west spire, the pinnacles of the flanking tower of the west portal, and the enlargement of the windows of the nave and aisles were the work of Henry de Morcot in the beginning of the 14th century; the "new building" or eastern chapel in the Perpendicular style, begun in 1438, was not completed till 1528. In 1541 the church was converted into a cathedral, the abbot being made the first bishop. The extreme length of the building is 471 ft., and of the nave 211 ft., the breadth of the west front being 156; the height of the central tower, as reconstructed in the 14th century, was 150, that of the spires and tower of the west front is 156 ft. In 1643 the building was defaced by the soldiers of Cromwell, who destroyed nearly all the brasses and monuments, burnt the ancient records, levelled the altar and screen, defaced the windows, and demolished the cloisters. To obtain materials for repairs the lady chapel was taken down. In the latter part of the 18th century the church was repaved. In 1831 a throne, stalls and choir-screen were erected and other restorations completed. On account of the insecure state of the central tower in 1883 it was taken down; and its reconstruction, exactly as it stood, with the exception of the four corner turrets added early in the 19th century, was completed in 1886. The choir was reopened in 1889 after being closed, for thorough restoration, for six years.

In 1895 the restoration of the west front and other parts was begun in the face of considerable adverse criticism; but the work was carried on with the utmost care. During the carrying out of this work many interesting discoveries were made, the most important being the site of the cruciform Saxon church, enclosed within a crypt under the south transept. Catherine of Aragon was interred in the cathedral in 1536, and Mary Queen of Scots in 1587, but the body of the Scottish queen was removed to Westminster Abbey in 1612. Both interments were superintended by Robert Scarlett the sexton, commonly known as "Old Scarlett," whose portrait, a copy of the original, hangs in the west transept. He died in 1594 at the age of 98. Of the monastic buildings there are some interesting remains. The cathedral is approached by a Norman gateway, above which is the chapel of St Nicholas, built by Abbot Benedict, and now used as the music school, and on the left the chapel of St Thomas à Becket, built by Abbot Ashton in the 15th century as it stands, but originally Norman. The gateway to the bishop's palace, formerly the abbot's house, was built by Abbot Godfrey de Croyland in 1319, and the deanery gate by Abbot Kirton about 1520. One of the canonry houses is formed partly from a hall of the 13th century.

Peterborough is included for civil purposes in the parish of St John the Baptist, but for ecclesiastical purposes it is divided into four, the additional parishes being St Mary's Boongate (1857), St Mark's (1858) and St Paul's (1869). The old parish church of St John originally stood to the east of the cathedral, but was rebuilt on its present site in the centre of the city (1401–1407) in Perpendicular style. The educational establishments include the Henry VIII. grammar or chapter school, which used the chapel of St Thomas à Becket until 1885; the St Peter's training college for schoolmasters for the dioceses of Peterborough, Ely and Lincoln, erected from designs of Sir Gilbert Scott (1864); and Deacon's and Ireland's charity school, established in 1721 for the clothing and educating of twenty poor boys. The principal public building is the market house (1671), used as a town-hall. The modern prosperity and rapid growth of the town are chiefly due to the trade caused by the junction of so many railway lines. Adjoining the town are extensive works and sheds connected with the Great Northern and Midland railways. The principal manufacture is that of agricultural implements. The parliamentary borough returns one member (since 1885). The municipal borough, incorporated in 1874, is under a mayor, 6 aldermen and 18 councillors. Area, 1878 acres. The soke or liberty of Peterborough, with a population of 41,122, constitutes a separate administrative county (1888). The diocese of Peterborough includes the whole of Rutland, nearly all Leicestershire and Northamptonshire, and small portions of Derbyshire and Huntingdonshire.

Peterborough (*Burgh*, *Burgus sancti Petri*) is proved by its original name Medehamstede to have been a Saxon village before 655 when Saxulf, a monk, founded the monastery on land granted to him for that purpose by Penda, king of Mercia. Its name was altered to Burgh between 992 and 1005 after Abbot Kenulf had made a wall round the minister, but the town does not appear to have been a borough until the 12th century. The burgesses received their first charter from "Abbot Robert," probably Robert of Sutton (1262–1273). Until the 19th century the dean and chapter, who succeeded the abbot as lords of the manor, appointed a high bailiff, and the constables and other borough officers were elected at their court leet. but the borough was incorporated in 1874 under the government of a mayor, 6 aldermen and 18 councillors. Among the privileges claimed by the abbot as early as the 13th century was that of having a prison for felons taken in the soke and borough. In 1576 Bishop Scamble sold the lordship of the hundred of Nassaburgh, which is coextensive with the soke, to Queen Elizabeth, who gave it to Lord Burghley, and from that time until the 19th century he and his descendants, marquesses of Exeter, had a separate gaol in Peterborough for prisoners arrested in the soke. The trades of weaving and woolcombing were carried on in Peterborough in the 14th century. The abbot formerly held four fairs, of which two, one called St Peter's fair, granted in 1189 and now held on the second Tuesday and Wednesday in July, and the other called the Bridge fair, granted in 1439 and held on the first Tuesday, Wednesday and Thursday in October, still survive and were purchased by the corporation from the ecclesiastical commissioners in 1876. Peterborough sent two members to parliament for the first time in 1547.

PETERBOROUGH AND MONMOUTH, CHARLES MORDAUNT, Earl of (*c.* 1658–1735), English soldier and statesman, was born about 1658. His father, John Mordaunt, was created Viscount Mordaunt of Avalon and Baron Mordaunt of Reigate, Surrey, in 1659;[1] his mother was Elizabeth, the daughter and sole heiress of Thomas Carey, the second son of Robert Carey, 1st earl of Monmouth.[2] He matriculated at Christ Church, Oxford, on the 11th of April 1674. When about sixteen years of age he joined Sir John Narborough's fleet in the Mediterranean, and won his first distinction in arms in the destruction of the dey's fleet under the very guns of Tripoli. His father died on the 5th of June 1675, and Charles Mordaunt succeeded to the peerage as Viscount Mordaunt. On his return from the second expedition to Tangier he plunged into active political life as a zealous Whig and an unswerving opponent of the duke of York. But his continued hostility to James II. forced him to repair to Holland in 1686, when he proposed to William of Orange to invade England. The disposition of the cold and cautious William had little in common with the fierce and turbulent Mordaunt. His plan was rejected, though the prudent prince of Orange deemed it judicious to retain his services. When William sailed to Torbay his friend accompanied him, and when the Dutch prince was safely established on the throne of England honours without stint were showered upon Lord Mordaunt. He was sworn of the privy council on the 14th of February 1689, on the 8th of April of the same year appointed first lord of the treasury, and a day later advanced in the peerage by creation as earl of Monmouth.

In less than a year he was out of the treasury, but he still remained by the person of his monarch and was with him in his dangerous passage to Holland in January 1691. He was one of the eighteen peers who signed the protest against the rejection, on the 7th of December 1692, of the motion for the appointment of a committee to inquire into the conduct of the war, and although William had refused his consent to a bill for triennial parliaments in the previous session, Lord Monmouth did not shrink from reintroducing it in December 1693. This led to a disagreement with the court, though the final breach did not take place until January 1697, when Monmouth was accused of complicity in Sir John Fenwick's conspiracy and of the use of "undutiful words" towards the king. He was committed to the Tower, staying in confinement until the 30th of March 1697, and deprived of his employments. Some consolation for these troubles came to him on the 19th of June of the same year, when he succeeded to the earldom of Peterborough, by the death of his uncle Henry Mordaunt, 2nd earl.

The four years after his release from the Tower were mainly passed in retirement, but on the accession of Anne he plunged into political life again with avidity. His first act was to draw down on himself in February 1702 the censure of the House of Commons for the part which he took in the attempt to secure the return of his nominee for the borough of Malmesbury. Through the fear of the ministry that his restless spirit would drive him into opposition to its measures if he stayed at home, he was appointed early in 1705 to command an expedition of English and Dutch troops in Spain. He was created the sole commander of the land forces in April 1705 and joint-commander with Sir Cloudesley Shovel of the fleet on the 1st of May, after he had been reinstated a member of the privy council on the 29th of March. He arrived at Lisbon on the 20th of June 1705, sailed for Barcelona (Aug. 1705) on an expedition for the conquest of Catalonia, and began to besiege that town. For some weeks the operations were not prosecuted with vigour and Peterborough urged that the fleet should transport the troops to Italy, but the energetic counsels of the Archduke Charles at last prevailed and by the 14th of October the city fell into his hands. On the 24th of January 1706 he entered Valencia in triumph, but these movements had weakened the garrison at Barcelona, which was now besieged by a superior French force under Tessé. The garrison, commanded by the archduke, defended their positions with great bravery, but would have been obliged to surrender had not the fleet of Sir John Leake, answering the appeals of Charles but contrary to the original orders of Peterborough, come to their assistance on the 8th of May, whereupon the French raised the siege on the 11th of May. It is difficult to understand the action of Peterborough during this campaign, unless on the supposition that he was out of sympathy with the movement for placing an Austrian prince on the throne of Spain. When Charles determined upon uniting with Lord Galway's troops and marching to Madrid, the advice of Peterborough again hindered his progress. At first he urged an advance by Valencia as supplies had there been collected, then he withdrew this statement; afterwards he delayed for some weeks to join Galway, who was in need of succour, but ultimately reached the camp on the 6th of August. The leaders of the army differed in their views, and Lord Peterborough was recalled to England to explain his conduct (March 1707).

On his return to England in August he allied himself with the Tories, and received his reward in being contrasted, much to his advantage, with the Whig victor of Blenheim and Malplaquet The differences between the three peers, Peterborough, Galway and Tyrawley, who had served in Spain, formed the subject of angry debates in the Lords, when the majority declared for Peterborough; after some fiery speeches the resolution that he had performed many great and eminent services was carried, and votes of thanks were passed to him without any division (January and February 1708). His new friends were not desirous of detaining him long on English soil, and they sent him on a mission to Vienna, where he characteristically engaged the ministry in pledges of which they disapproved. His resentment at this disagreement was softened by the command of a cavalry regiment, and by his appointment as a Knight of the Garter (Aug. 3 and 4, 1713). With the accession of George I. Lord Peterborough's influence was gone. Worn out with suffering, he died at Lisbon on the 25th of October 1735. His remains were brought to England, and buried at Turvey in Bedfordshire on the 21st of November.

Lord Peterborough was short in stature and spare in habit of body. His activity knew no bounds. He was said to have seen more kings and postilions than any man in Europe, and the whole point of Swift's lines on "Mordanto" consisted in a description of the speed with which he hastened from capital to capital. He was eloquent in debate and intrepid in war, but his influence in the senate was ruined through his inconsistency, and his vigour in the field was wasted through his want of union with his colleagues. His first wife, Carey, daughter of Sir Alexander Fraser of Dores, Kincardineshire, died on the 13th of May 1709, and was buried at Turvey. Some years later (1722) he secretly married Anastasia Robinson (*c.* 1695–1755), a famous dramatic singer (from 1714) of great beauty and sweetness of disposition, daughter of Thomas Robinson (d. 1722), a portrait painter; but she was at first unrecognized as his wife, and lived apart from him (regarded merely as his mistress) with her two sisters at Parson's Green. She remained on the operatic stage, till 1724. It was only a few months before his death that (after a second marriage ceremony) she was introduced to society as the countess of Peterborough. He had a son John (1681–1710) who predeceased him, and was therefore succeeded in the title by his grandson Charles (1710–1779), whose son Charles Henry (1758–1814), 5th earl, died unmarried, the honours becoming extinct, except for the barony of Mordaunt which passed to a collateral branch and fell into abeyance in 1836.

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[1] A barony of Mordaunt by writ had existed in the family since 1529, and the viscount was the second son of the fifth of these barons, who in 1628 was created earl of Peterborough, the elder son Henry being second earl.

[2] Cr. 1626. This peerage became extinct in 1661 on the death of the 2nd earl.

Bibliography.—The best accounts of the career of Peterborough are in the life by William Stebbing (1890), and the *War of the Succession in Spain*, by Colonel the Hon. Arthur Parnell (1905). The earlier lives are founded on the memoir of Captain George Carleton (1728), which was analysed by Colonel Parnell, and dismissed as a fictitious narrative inspired by Swift, in the *Eng. Hist. Rev.* (1891), vi. 97–151). (W. P. C.)

PETERHEAD, a municipal and police burgh, and seaport of Aberdeenshire, the most easterly town in Scotland. Pop. (1901), 11,794. It is situated about 33 m. by road E.N.E. of Aberdeen and 44½ m. by rail, via Maud Junction, on the Great North of Scotland railway, from which there is a branch line. The town is built of the red granite for which it is famous, and the quarrying of which for home and foreign use constitutes an important industry. Among the principal buildings are the town-house (1788), with a spire 125 ft. high, and the Arbuthnot museum and art gallery. In front of the town-hall is a statue to Field Marshal Keith (born at Inverugie Castle, 2 m. north-west, in 1696), which was presented to the burgh in 1868 by William I. of Prussia, afterwards German emperor. Peterhead is one of the Elgin district group of parliamentary burghs, with Banff, Cullen, Elgin, Inverurie and Kintore. It formerly had an extensive trade with the ports of the Baltic, the Levant and America, and was once a sub-port to Aberdeen, but was made independent in 1832. It was also for a long period the chief seat of the Greenland trade, but the Arctic seal and whale fishery is now extinct. The north and south harbours lie between the town and Keith Inch—a suburb at the extremity of the peninsula on part of which the town is built—and the isthmus dividing them is pierced by a canal crossed by an iron swing-bridge. In the north harbour are two graving docks. A third harbour has been built, the area of the three basins amounting to 21 acres. In addition to the granite quarrying and polishing, the leading industries are ship- and boat-building, agricultural implement works and woollen manufactures. The herring fleet possesses more than 600 boats and the annual catch averages nearly £200,000. About a mile to the south is the convict prison for Scotland. Since 1886 the prisoners have been employed upon the construction of a vast harbour of refuge, for which the breakwater extends from Boddam Point northwards across the bay. This great undertaking (intended to be completed in 1921) was designed by Sir John Coode (d. 1892). Peterhead is the terminus of a cable to Norway. About 6 m. south of Peterhead are the famous Bullers, or Roarers, of Buchan, an enormous rocky cauldron into which the waves pour through a natural arch of granite, with incredible violence, in a storm.

The town and lands belonged of old to the Abbey of Deer, built in the 13th century by William Comyn, earl of Buchan; but when the abbey was erected into a temporal lordship in the family of Keith the superiority of the town passed to the earl marischal, with whom it continued till the forfeiture of the earldom in 1716. The town and lands were purchased in 1720 by a fishing company in England and, on their failure, by the Merchant Maidens' Hospital of Edinburgh for £3000, who are still the overlords. Peterhead, made a burgh of barony in 1593 by George Keith, fifth earl marischal, was the scene of the landing of the Pretender on Christmas Day 1715.

PETERHOF, a town of Russia, in the government of St Petersburg, 18 m. W. of the capital, on the south coast of the Gulf of Finland. It was founded in 1711 and has grown up round the palace built by Peter the Great in 1720; pop., 11,300. Peterhof is almost exclusively a residential town, but gem-cutting and the manufacture of agricultural implements are carried on. The palace has undergone alterations and additions, *e.g.* by Catharine II., but retains a distinct Petrine stamp. It is built on a height 50 ft. above the sea, and contains portraits of the Russian imperial family and other pictures. A statue of Peter the Great was set up near the palace in 1883, and one of Francis I. of France in 1896, a gift from the town of Havre to Nicholas II. Peterhof is connected with Oranienbaum on the west and with Stryelna on the east by series of gardens and villas.

PETERMANN, AUGUST HEINRICH (1822–1878), German cartographer, was born at Bleicherode, near Nordhausen, on the 18th of April 1822. At the age of seventeen he entered the Geographical School of Art in Potsdam, and in 1845 proceeded to Edinburgh to assist Dr Keith Johnston in the production of an English edition of the *Physical Atlas* of Berghaus. In 1847 he came to London, and published among other works, an account of Barth's expedition to Central Africa (1855). In 1854 he became director of the geographical institute of Justus Perthes in Gotha, and editor of the well-known *Petermanns Mitteilungen*. His work did much towards elucidating the geography of the interior of Africa and of the North Polar regions. Queen Victoria, at the suggestion of Bunsen, appointed him physical geographer-royal. Petermann died by his own hand at Gotha on the 25th of September 1878.

PETERS (or Peter), **HUGH** (1598–1660), English Independent divine, son of Thomas Dyckwoode, *alias* Peters, descended from a family which had quitted the Netherlands to escape religious persecution, and of Martha, daughter of John Treffry of Treffry in Cornwall, was baptized on the 29th of June 1598, and was educated at Trinity College, Cambridge. Having experienced conversion, he preached in Essex; returning to London he took Anglican orders and was appointed lecturer at St Sepulchre's. He entertained, however, unorthodox opinions, and eventually left England for Holland. He visited Gustavus Adolphus in Germany about 1632, and afterwards became the minister of the English church at Rotterdam. Here his unorthodox leanings again attracted attention, and Peters made a further move to New England. He was connected with John Winthrop through his wife, and had already formed several friendships with the American colonists. He arrived at Boston in October 1635 and was given charge of the church at Salem. He took a leading part in the affairs of the colony, and interested himself in the founding of the new colony in Connecticut. In 1641 he returned to England as agent of the colony, but soon became involved in the political troubles which now began. He became chaplain to the forces of the adventurers in Ireland, and served in 1642 in Lord Forbes's expedition, of which he wrote an account. On his return he took a violent part in the campaign against Laud, and defended the doctrines of the Independents in a preface to a tract by Richard Mather entitled "Church Government and Church Covenant discussed . . ." (1643). He gained great reputation as a preacher by his discourses and exhortations at public executions, and as army chaplain. In the latter capacity he accompanied Lord Warwick's naval expedition to Lyme in 1644 and Fairfax's campaigns of 1645 and 1646, when his eloquence is said to have had a marvellous effect in inspiring the soldiers and winning over the people. At the conclusion of the war, Peters, though greatly disliked by the Presbyterians and the Scots, had attained great influence as leader of the Independents. In his pamphlet "Last Report of the English Wars" (1646) he urged religious toleration, an alliance with foreign Protestants, and an active propagation of the gospel. In the dispute between the army and the parliament he naturally took the side of the former, and after the seizure of the king by the army in June 1647 had interviews with Charles at Newmarket and Windsor, in which he favourably impressed the latter, and gave advice upon the best course to pursue. He performed useful services in the second Civil War, procured guns for the besiegers at Pembroke, raised troops in the midlands, and arranged the surrender of the duke of Hamilton at Uttoxeter. Though at the Restoration he denied any complicity in the king's death, it is certain that in his sermons he justified and supported the trial and sentence. In August he accompanied Cromwell to Ireland, and was present at the fall of Wexford, while later he assisted the campaign by superintending from England the despatch to Cromwell of supplies and reinforcements, and was himself destined by Cromwell for a regiment of foot. In 1650 he was in South Wales, endeavouring to bring over the people to the cause, and subsequently was present at the battle of Worcester. At the conclusion of the war Peters was appointed one of the preachers at Whitehall and became a person of influence. Parliament had already voted him an annuity of £200, and Laud's library or a portion of it had been handed over to him in 1644. He was one of the committee of twenty-one appointed to suggest legal reforms, and he published his ideas on this subject, which included a register of wills and land titles and the destruction afterwards of the ancient records, in his tract, "Good Work for a Good Magistrate" (in 1651), answered by R. Vaughan and Prynne. He strongly disapproved of the war with Holland, and his interference brought upon him some sharp reprimands. In July 1658 he was sent to Dunkirk to provide apparently for the spiritual wants of the garrison. He preached the funeral sermon on Cromwell, and after the latter's death took little part in political events, though strongly disapproving of the removal of Richard. He met Monck at St Albans on the latter's march to London, but met with no favour from the new powers, being expelled from his lodgings at Whitehall in January 1660. On the 11th of May his arrest was ordered. On the 18th of June he was excepted from the Act of Indemnity and apprehended on the 2nd of September at Southwark. He sent in a defence of himself to the Lords, denying any share in the king's death. He was, however, tried on the 13th of October and found guilty of high treason. His execution took place at Charing Cross on the 16th of October, when he behaved with great fortitude, and was undismayed by the mangling of the body of John Cook, his fellow sufferer, upon which he was forced to look. Before his death he wrote "A Dying Father's Last Legacy" to his only child, Elizabeth, in which he gave a narrative of his career.

His death was viewed with greater rejoicings than perhaps attended that of any of the regicides, which is the more surprising as Peters possessed many amiable qualities, and several acts of kindness performed by him on behalf of individual Royalists are recorded. But he had incurred great unpopularity by his unrestrained speech and extreme activity in the cause. He was a man, however, of a rough, coarse nature, without tact or refinement, of strong animal spirits, undeterred by difficulties which beset men of higher mental capacity, whose energies often outran his discretion, intent upon the realities of life and the practical side of religion. His conception of religious controversy, that all differences could be avoided if ministers could only pray together and live together, is highly characteristic, and shows the largeness of his personal sympathies and at the same time the limits of his intellectual imagination. Peters married (1) Elizabeth, daughter of Thomas Cooke of Pebmarsh in Essex and widow of Edmund Read, and (2) Deliverance Sheffield, by whom he had one daughter, Elizabeth.

PETERS, KARL (1856–), German traveller in Africa, one of the founders of German East Africa, was born at Neuhaus on the Elbe on the 27th of September 1856, the son of a Lutheran clergyman. He studied at Göttingen, Tübingen and Berlin, and in 1879 was awarded a gold medal by the Berlin University for his *Frieden zu Venedig.* After visiting London to study English principles of colonization, he returned to Berlin and promoted the German Colonization Society (*Deutsche Kolonialverein*). In the autumn of 1884 he proceeded with two companions to East Africa, and concluded in the name of his society treaties with the chiefs of Useguha, Nguru, Usagara and Ukami. Returning to Europe early in 1885, he formed the German East Africa Company, which speedily obtained an imperial charter. The story of this enterprise, the first step in the formation of a German colony in East Africa, is told under AFRICA, § 5. In 1888 Peters undertook an expedition from the east coast of Africa, avowedly for the relief of Emin Pasha. This expedition was not sanctioned by the German government and was regarded by the British authorities as a filibustering exploit. One of its objects was to extend the sphere of German influence, and, reaching Uganda early in 1890, Peters concluded a treaty with the king of that country in favour of Germany. He left Uganda hastily on the approach of a representative of the British East Africa Company, and on reaching Zanzibar learned that his treaty was useless, as an agreement had been come to between Germany and Great Britain whereby Uganda was left in the British sphere. On his return to Germany Peters was received with great honours, and in 1891 published an account of his expedition entitled *Die deutsche Emin Pasha Expedition,* which was translated into English. In 1891 he went out again to East Africa as imperial high commissioner for the Kilimanjaro district, and in 1892 was one of the commissioners for delimiting the Anglo-German boundary in that region. In June 1892 accusations were brought against him of excesses in his treatment of the natives, and after three investigations had been held he was, in 1897, deprived of his commission for "misuse of official power." (He was regranted his title of imperial commissioner in 1906.) During 1893–1895 Peters was employed in the colonial office at Berlin. In 1896 he removed to London, where he occupied himself in schemes for exploiting parts of Rhodesia and Portuguese East Africa. In the interests of a company he formed, Peters explored the Fura district and Macombe's country on the Zambezi, where in 1899 he discovered ruins of ancient cities and deserted gold mines. He returned in 1901 and gave an account of his explorations in *The Eldorado of the Ancients* (1902). In 1905 he again visited the region between the Zambezi and Sabi rivers.

Besides the books already mentioned and some smaller treatises Peters published a philosophic work entitled *Willenswelt und Weltwille* (1883), and a disquisition on early gold production entitled *Das goldene Ophir Salomos* (1895), translated into English in 1898.

PETERSBURG, a city and port of entry of Virginia, U.S.A., on the Appomattox river, at the head of navigation, about 11 m. from its mouth, and 22 m. S. of Richmond. Pop. (1890), 22,680; (1900), 21,810, (10,751 negroes); (1910), 24,127. It is served by the Atlantic Coast Line, the Seaboard Air Line and the Norfolk & Western railways. The river, which is here spanned by two steel bridges and one frame bridge, is navigable to this point for vessels of 8 ft. draught at mean high water, and has been greatly improved by the Federal government, which in 1909 was engaged in deepening the whole channel to 12 ft. at mean high water and in excavating at Petersburg a new channel into which to deflect the river. In and about the city there is much of historic and scenic interest. At Blandford, a suburban hamlet, is the picturesque old Blandford church, erected about 1734. Petersburg has two public parks, and among its institutions are a home for the sick (1886), an orphanage for girls and another for negroes, the state central hospital for the insane (negroes), the southern female college (non-sectarian, 1863), the university school for boys, the Bishop Payne divinity school (Protestant Episcopal) for negroes, and the Virginia normal and industrial institute (opened in 1883), also for negroes. There are two national cemeteries near Petersburg—Poplar Grove (about 4 m. south), containing about 6200 graves, and City Point (about 9 m. east), containing about 5100 graves; and in Blandford cemetery there are about 30,000 graves of Confederate dead. In this cemetery General William Phillips is buried, and there is a monument to Captain McRae, commander of the "Petersburg Volunteers," whose bravery in 1812–1813 prompted President Madison to call Petersburg the "Cockade City." The falls above the city furnish abundant water-power, and the city has various manufactures. The factory product was valued at $5,890,574 in 1905, 11·3% more than in 1900; in both 1900 and 1905 Petersburg ranked fourth among the cities of the state in the value of factory products. From Petersburg are shipped quantities of trunks and bags, peanuts, tobacco and cotton. In 1909 the foreign trade, wholly imports, was valued at $360,774. The city was formerly in Chesterfield, Dinwiddie and Prince George counties, but is now independent of county government.

An Indian village formerly stood on or near the site of the present city, and Fort Henry was built here by the whites in 1645. Petersburg was founded in 1733 by Colonel William Byrd (1674–1744) and Peter Jones, and was named (first Peter's Point, and then Petersburg) in honour of the latter; in 1748 it was incorporated as a town. On the 25th of April 1781 a skirmish was fought in front of Petersburg between a British force of about 3000 under General William Phillips (1731?–1781) and about one-third of that number of American militia under Baron Friedrich Wilhelm von Steuben; the Americans were defeated, and the British occupied the town. In the following month the British again entered Petersburg (General Phillips dying here on the 13th), but they were soon dislodged by Lafayette who shelled the town. General Winfield Scott was born near Petersburg, and practised law here for two years before he entered the army. Petersburg was chartered as a city in 1850.

Petersburg Campaign (1864–65). The name of Petersburg is associated with operations in the American Civil War, which formed the sequel of the Wilderness Campaign (*q.v.*) and the last act in the struggle between the armies of Grant and Lee for supremacy. Petersburg (see above) and Richmond, Virginia, connected by rail and covered north, east and south by forty miles of entrenchments, formed the salients of a vast fortress, into which reinforcements and supplies could be poured from the rear by means of the James Canal, the Virginia Central, the Lynchburg, the Danville and the Weldon railroads—the latter bringing up to Petersburg from Wilmington (225 m. distant) the cargoes of blockade runners. Petersburg became a strategic point as soon as Grant determined to carry the army of the Potomac—defeated at Cold Harbor on the Chickahominy (see Wilderness Campaign)—south of Richmond, and, being joined by Butler's Army of the James (momentarily checked in the Bermuda Hundred Peninsula by a small army under Beauregard), to operate from the east, depending on the James river, as his line of supply, while the policy of the Confederate president was to employ Robert E. Lee's army to protect his capital. Petersburg was nearer than Richmond to the navigable part of the James River—City Point is only 10 m. distant—and the capture of Petersburg would involve the fall of Richmond and the capitulation or flight of Lee's army.

As early as the 9th of June 1864, while the main armies were still north of the James and Petersburg was garrisoned by a brigade under General Wise, a Federal expedition from the Army of the James approached the city. General Gillmore on the City Point road discovered strong earthworks, and General Kautz attacking on the Jerusalem Plank road experienced a repulse: the total force of the Federals was 4500, and Wise's brigade (2400) had been quickly reinforced from Beauregard's central position at Bermuda Hundred. A week later a more serious attempt was made to break through the defences, while General Lee's main army was detained north of Richmond. Grant detached the II. and XVIII. corps under Generals Smith and Hancock, who were to unite and operate along the City Point railroad and capture the outer line of works about 2 m. from Petersburg while a demonstration was made along the Norfolk railroad by cavalry under Kautz. On the 15th of June Smith attacked and captured five redans before Hancock came up, and when next day Burnside's corps (IX.) arrived and General Meade assumed control of the three corps, he attacked again at 6 p.m. On the 17th of June Warren's (V.) corps arrived, and Meade made a third assault with two corps (V., IX.). On the 18th of June the attack was renewed with three corps (II., V., IX.) late in the afternoon, and the results of the four days' fighting were so far satisfactory that ground was won which could be entrenched and held against any sortie of the Petersburg garrison. Probably on the 18th of June the town of Petersburg might have been captured by Meade, for at this crisis General Lee was in temporary eclipse. For four days Lee had refused to credit any report to the effect that Grant was crossing the James: his cavalry could not ascertain that the enemy in his front at Malvern Hill (VI. corps and Wilson's cavalry division), despite its menacing attitude towards Richmond, was only a flank guard for a movement to the south.

It was late on the 17th of June when General Beauregard, who had for three days valiantly held his main lines south of Richmond with some 14,000 infantry against three Federal corps, succeeded in convincing General Lee that the main army was again (as in 1862 on the Chickahominy) in the wrong place at the wrong time. But when at last the Confederate leader was aroused to a sense of his danger he soon filled every road with divisions marching to save Petersburg: they marched all night; they slept in the trenches on arrival, and on the 19th of June these reinforcements convinced General Meade that his main attack between the Appomattox river and the Jerusalem Plank road was delivered a day too late. At a cost of 10,000 casualties Meade had gained half a mile of ground, but the Confederates in falling back had concentrated, and now that the new plan of operations was exposed and the main bodies were again face to face the power of defensive tactics reasserted itself.

Yet June was not to close without adding some 8000 men to the Federal casualties, for in addition to daily losses by sharpshooting along the front, over 5000 men fell or were captured in operations directed against the southern railroads. Grant had resolved to deprive his enemy of these lines of supply: his plan was to prolong his line of investment westward and construct redoubts (such as Fort Davis, Fort Steadman and Fort Sedgwick) as a continual menace to the Confederate garrison and a defence against sorties, while his cavalry and portions of five corps (II., V., VI., IX. and XVIII.) engaged in enterprises which it was hoped would tempt General Lee to fight outside his works. A decisive victory in the field, a successful assault on the defences between Richmond and Petersburg, or the complete destruction of the railroads, would precipitate disaster to the South, and of these three methods the last would be the surest in its effects. But such a method was necessarily slow. General Wilson's cavalry (5500) destroyed 30 m. of the Lynchburg or South Side railroad, and 30 m. of the Danville railroad, together with Burkesville Junction and Ream's Station on the Weldon railroad; but Wilson was caught by the Confederate cavalry 100 m. from Petersburg and escaped only by destroying his wagons and limbers and abandoning twelve guns. Even the Virginia Central railroad could not be held by the Federals after Sheridan with the main body of the cavalry had been called back to White House on the Pamunkey to escort a great convoy.

By the end of June the whole of the rival forces were concentrated about the Richmond-Petersburg defences, and General A. P. Hill had already sallied out on the 21st of June to drive the II. corps from the Weldon railroad. Federal policy and Federal strategy, surmounting the crisis of Cold Harbor, were, however, at last in unison. Grant had a free hand in respect both of his dispositions and his resources in men and money, and had resolved to use unsparingly the resources placed at his disposal. Early in July Grant, however, found himself compelled to detach a corps (VI.) to strengthen the garrison at Washington, for General Early had frustrated Hunter's attempt against Lynchburg (see Shenandoah Valley), driving Hunter into West Virginia, and then, pushing down the Shenandoah and across the Potomac, had arrived within a day's march of the Federal capital. This operation checked Grant's enterprises about Petersburg and restricted the Federal front to the ground east of the Weldon railroad.

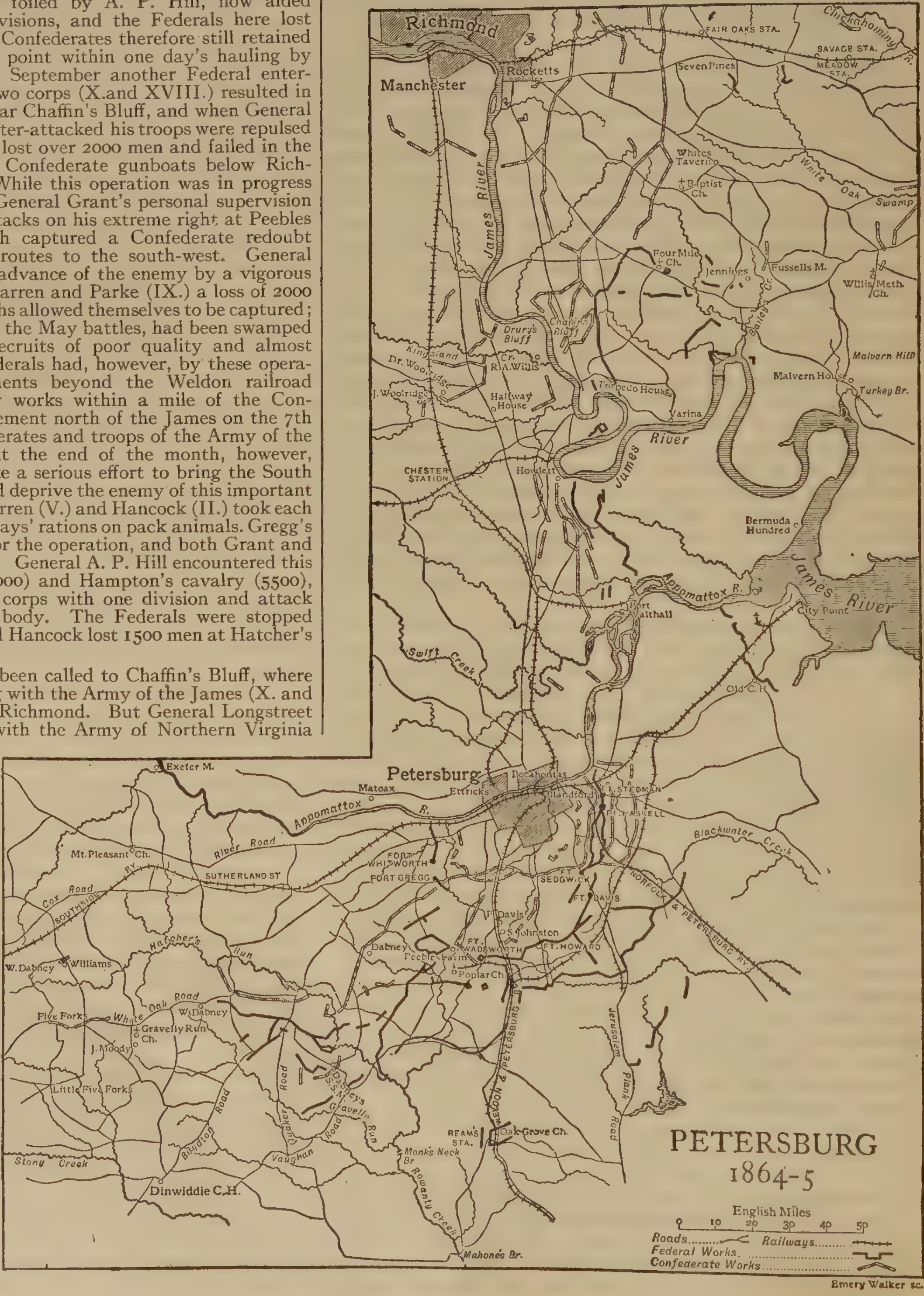
On the 25th of July Grant resolved to weaken the enemy on his front by a demonstration north of the James, and accordingly moved a corps (II.) and two cavalry divisions across the river to Malvern Hill under cover of Foster's corps (X.). But Lee possessed the inner line, and the Federal detachment found two cavalry divisions in its front, and the Richmond defences had been strengthened by three divisions of infantry. The expedition then returned to take part in a fresh enterprise, which ended disastrously to the Federals. A Confederate redan faced Burnside's IX. corps 100 yds. distant, and this strong work was to be destroyed by mining operations. The mine was fired and produced a crater 150 ft. long, 60 ft. wide and 25 ft. deep, into which the Federals poured (see FORTIFICATION and SIEGECRAFT). But the troops could be got no farther before the Confederate counter-attack was upon them, and Burnside's corps lost 4300 men.

In August Sheridan was detached to operate against General Early in the Shenandoah Valley, and in order to prevent Lee reinforcing Early another demonstration against Richmond was planned. But Lee again strengthened his left and the result of the fighting was a loss to the Federals of nearly 3000 men. Meanwhile another attack on the Weldon railroad by Warren's corps was met by General A. P. Hill on the 20th of August, and the possession of the railroad cost the Federals 3000 men. A further attempt on this railroad by Hancock's II. corps and Gregg's cavalry division at a point 3 m. south of Ream's Station was foiled by A. P. Hill, now aided by Hampton's two cavalry divisions, and the Federals here lost 2372 men and nine guns. The Confederates therefore still retained possession of the railroad to a point within one day's hauling by wagon to Petersburg. During September another Federal enterprise north of the James with two corps (X. and XVIII.) resulted in the capture of Fort Harrison near Chaffin's Bluff, and when General Lee reinforced his left and counter-attacked his troops were repulsed with heavy loss. The Federals lost over 2000 men and failed in the attempt to take Fort Gilmer, Confederate gunboats below Richmond aiding in the defence. While this operation was in progress on the Confederate left under General Grant's personal supervision General Lee was apprised of attacks on his extreme right at Peebles Farm by four divisions, which captured a Confederate redoubt covering the junction of two routes to the south-west. General A. P. Hill prevented a further advance of the enemy by a vigorous counter-attack which caused Warren and Parke (IX.) a loss of 2000 men, of whom nearly three fourths allowed themselves to be captured; for the ranks, since the losses of the May battles, had been swamped with drafted and substitute recruits of poor quality and almost insignificant training. The Federals had, however, by these operations pushed their entrenchments beyond the Weldon railroad westward and established new works within a mile of the Confederate right. A minor engagement north of the James on the 7th of October between the Confederates and troops of the Army of the James was without result. At the end of the month, however, General Grant resolved to make a serious effort to bring the South Side railroad within his lines and deprive the enemy of this important line of supply. Parke (IX.), Warren (V.) and Hancock (II.) took each some 11,000 infantry with four days' rations on pack animals. Gregg's cavalry (3000) were attached for the operation, and both Grant and Meade accompanied the troops. General A. P. Hill encountered this force with three divisions (14,000) and Hampton's cavalry (5500), and he contrived to hold two corps with one division and attack Hancock (II.) with his main body. The Federals were stopped when 6 m. from the railway, and Hancock lost 1500 men at Hatcher's Run on the 27th of October.

General Lee meanwhile had been called to Chaffin's Bluff, where again Butler was demonstrating with the Army of the James (X. and XVIII.) on the approaches to Richmond. But General Longstreet signalized his return to duty with the Army of Northern Virginia by driving Butler off with a loss of over 1000 men (action of Fair Oaks, Oct. 27). General Warren in December contrived to evade A. P. Hill and destroy the Weldon railroad at a point on the Meherrin river 40 m. from Petersburg.

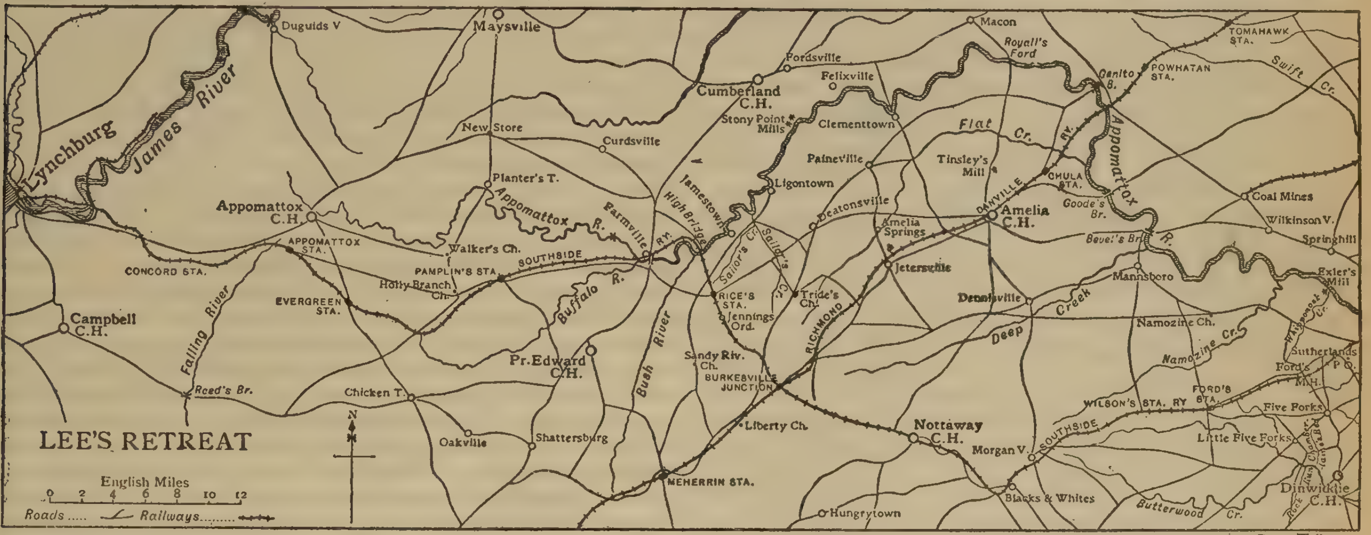
There seemed now little to tie Lee to the lines he had so painfully constructed, for his army was without coffee, tea or sugar, and though of foreign meat they had 3½ million rations and of bread 2½ million rations in reserve, the troops lived chiefly on corn-bread. A. P. Hill on the right held on from Hatcher's Run to Fort Gregg, whence Gordon and Anderson prolonged to the left as far as the Appomattox River, and Longstreet continued the line northwards along the Bermuda front across the James as far as White Oak Swamp (37 m. in all). The winter was very severe, and the continual trench-work and outpost duty overtaxed the patriotism of Lee's 50,000 infantry and stimulated desertion. ~~Supplies~~ were brought in by wagons, as the rolling stock on the railways was worn, and on the 5th of February 1865 General Gregg moved out to the Boydton Plank road to intercept the Confederate convoys. He was supported by Warren, while Humphreys's (II.) corps connected the detachment with the left of the Federal entrenchments. Gregg failed to locate the wagons, and General Lee, hearing of the expedition, sent out A. P. Hill and Gordon, who drove him back with a loss of 1500 men. Sheridan, after driving Early from the Valley in October, destroyed the railways about Staunton, Charlottesville, Gordonsville and Lynchburg, and even rendered the James Canal useless as a line of supply.

Grant recalled Sheridan to the main army in March, and at the end of the month prepared for a turning movement westward with the object of drawing Lee out of his lines. General Lee had anticipated such an attempt, and had resolved to abandon his lines and unite with Johnston in North Carolina, but the roads were not


Richmond
Manchester
Rocketts
Fair Oaks Sta.
Savage Sta.
Seven Pines
Meadow Sta.
Chickahominy R.
Whites Tavern
Baptist Ch.
White Oak Swamp
James River
Four Mile Ch.
Jennings
Fussells M.
Willis Meth. Ch.
Drury's Bluff
Chapin's Bluff
Kingsland
Dr. Woolridge
R. A. Wills
J. Woolridge
Halfway House
Torpedo House
Varina
Malvern Hill
Malvern House
Turkey Br.
Chester Station
Howlett
Bermuda Hundred
Appomattox R.
Port Walthall
City Point
Swift Creek
Old C.H.
Exeter M.
Petersburg
Matoax
Ettricks
Pocahontas
Blandford
Ft. Stedman
Ft. Haskell
Blackwater Cr.
Mt. Pleasant Ch.
River Road
Sutherland St
Fort Whitworth
Fort Gregg
Ft. Sedgwick
Ft. Davis
Norfolk & Petersburg Ry.
Cox Road
Southside Ry.
Hatcher's Run
Davis
Johnston
Dabney
Peebles Farm
Ft. Wadsworth
Ft. Howard
Poplar Ch.
W. Dabney
Williams
Five Forks
White Oak Road
W. Dabney
Gravelly Run Ch.
J. Moody
Little Five Forks
Boydton Road
Quaker Road
Dabney's Gravelly Run
Vaughan Road
Weldon & Petersburg
Jerusalem Plank Road
Ream's Sta.
Oak Grove Ch.
Monk's Neck Br.
Stony Creek
Dinwiddie C.H.
Rowanty Creek
Mahone's Br.
PETERSBURG 1864-5
English Miles
0 10 20 30 40 50
Roads
Railways
Federal Works
Confederate Works

Emery Walker sc.

yet in a state for the movement of artillery and wagons, and it was to gain time that he now ventured upon a bold offensive stroke—a night attack upon a strong point in the Federal right called Fort Stedman—the success of which might cause Grant to call in the detachments on his left and so facilitate the proposed movement of the Confederates towards Danville. General Gordon was selected to conduct the operation and his corps was strongly reinforced for the occasion. The opposing lines east of Petersburg were only 150 yds., and the sentries of each side 50 yds. apart. Gordon's men dashed across the intervening space at 4.30 a.m. on the 25th March, surprised the garrison and occupied Fort Stedman, but when daylight broke and the Federal guns could be brought to bear the fort was found to be untenable. Parke's corps (IX.) recaptured the work at a cost of 1000 men, and Gordon fell back, leaving nearly 2000 men in the hands of the Federals. The encounter would have proved a more desperate one if reinforcements on both sides had arrived in time, but Gordon had cut the telegraph which connected Fort Stedman with Grant's headquarters at City Point, and the Confederate train service broke down and delayed the arrival from Richmond of reinforcements for Gordon. Meanwhile, 6 m. westward, Humphreys' corps (II.) attacked A. P. Hill's defences and gained some local success, seizing the Confederate picket line between the Weldon railroad and the Boydton Plank road, which was at once occupied and strengthened by the Federals. The Federals lost 2000 men and the Confederates perhaps twice as many on the 25th of March.


LEE'S RETREAT
Lynchburg
James River
Duguids V
Maysville
New Store
Curdsville
Planter's T.
Appomattox R.
Appomattox C.H.
APPOMATTOX STA.
Walker's Ch.
SOUTHSIDE
PAMPLIN'S STA.
Holly Branch Ch.
CONCORD STA.
EVERGREEN STA.
Campbell C.H.
Falling River
Buffalo R.
Farmville
Ry.
Pr. Edward C.H.
Bush River
Reed's Br.
Chicken T.
Oakville
Shattersburg
MEHERRIN STA.
Jamestown
High Bridge
Cumberland C.H.
Stony Point Mills
Pordsville
Felixville
Clementtown
Macon
Royall's Ford
Genito B.
POWHATAN STA.
TOMAHAWK STA.
Swift Cr.
Flat Cr.
Painesville
Tinsley's Mill
Ligontown
Deatonsville
Amelia Springs
DANVILLE RY.
CHULA STA.
Amelia C.H.
Goode's Br.
Appomattox R.
Coal Mines
Wilkinson V.
Springhill
Bevel's Br.
Sailor's Cr.
RICE'S STA.
Jennings Ord.
Tride's Ch.
Jetersville
Dennisville
Mannsboro
Exler's Mill
Deep Creek
Namozine Ch.
Namozine Cr.
Whippomock Cr.
Sutherlands P.O.
Ford's M.H.
RICHMOND
Sandy Riv. Ch.
BURKESVILLE JUNCTION
Liberty Ch.
Nottaway C.H.
Morgan V.
SOUTHSIDE
WILSON'S STA. RY
FORD'S STA.
Five Forks
Little Five Forks
Chamberlain's Bed
Rock Run
Dinwiddie C.H.
Blacks & Whites
Butterwood Cr.
Hungrytown
N
English Miles
0 2 4 6 8 10 12
Roads
Railways

Emery Walker sc.

At this time Sherman visited Grant at City Point and proposed to move at the end of ten days on Burkesville Junction and so cut off Lee from Danville and Lynchburg; it was while Sherman was preparing for this operation that Grant finished the campaign. Secure behind his formidable entrenchments, Grant had no fear for his base on the James river, and transferred large bodies of troops to his left without Lee's knowledge. Sheridan was instructed on the 29th of March to gain the enemy's right and rear, moving by Dinwiddie Court-House and across Hatcher's Run. But the Confederates were on the alert; A. P. Hill extended his right, and Fitzhugh Lee's cavalry was brought to Sutherland Station. Sheridan had already encountered the cavalry divisions of W. H. F. Lee and Rosser on the south side of Stony Creek. Warren's corps, moving up the Quaker road, met a force under R. H. Anderson and drove it back to its works on White Oak road. Sheridan got into a flat country of dense forest, tangled undergrowth, streams and swamps, and the soil of clay and sand was impassable for wagons and guns until he had corduroyed the route. On the 29th of March General Lee perceived that the object of Grant was to seize the routes south of the Appomattox river, by which a movement south-west could be made to unite with Johnston's army, and he endeavoured to cover these roads, including the South Side railway, without losing his hold upon his works about Richmond and Petersburg, but in such a contest it was evident that numbers must prevail.

Sheridan's cavalry had reached Five Forks on the White Oak road on the 31st of March, and on his right Humphreys and Warren (II. and V.) held the Confederates to their works along Hatcher's Run astride the Boydton Plank road; yet General Lee was able to concentrate his three cavalry divisions, and supported them by Pickett's five infantry brigades. Sheridan was attacked and driven south as far as Dinwiddie Court-House; but Humphreys and Warren held their ground (action of White Oak Ridge) at a cost of 2000 men. Pickett and the cavalry fell back to Five Forks during the night and hastily entrenched, for he had been ordered by General Lee to defend this position; since the Boydton Plank road could no longer be held, the possession of White Oak road and the South Side railway became necessary for the flank movement which Lee had resolved to attempt. Grant meanwhile had ordered Warren to support Sheridan in an attack on Pickett at daybreak. Sheridan advanced on the 1st of April and at 3 p.m. issued his orders for attack, explaining verbally a diagram he had prepared for the use of divisional commanders. Pickett held a front of 2 m. with a division of cavalry on either flank and Rosser's cavalry guarding the baggage behind Hatcher's Run, and when attacked at 4 p.m. he was with Rosser 1½ m. in rear. Before Pickett was made aware of a battle being in progress his left was destroyed. General Lee seems to have made no arrangements to support Pickett in this direction. Pickett's right was defended by W. H. F. Lee against the attack of Custer's cavalry division. The position was finally carried by Sheridan's cavalry under Devin dismounting and storming the entrenchments frontally, taking three guns and 100 prisoners. Warren's corps claimed to have captured a battery and 3244 prisoners. Yet Sheridan was dissatisfied with Warren's conduct of the battle and deprived him of his command. Pickett's routed brigades were rallied at the South Side railroad and incorporated with General Anderson's command. But the Confederates had lost White Oak road, and unless General Lee was capable of a vigorous counterstroke on his extreme right it was evident he must also lose the South Side railroad. Grant, fearing such an enterprise, at once reinforced Sheridan and ordered Humphreys' corps (II.) to attack in his front if necessary to prevent Lee moving troops westward, but Lee made no effort, and so Sheridan was free to operate farther in the direction of the enemy's right and rear, while Humphreys held the enemy in his front. Sheridan remained inactive for a few days, and Lee hoped still to gain time for the roads to dry before evacuating his lines and removing his stores and ammunition by wagons towards Lynchburg.

But a crisis was approaching. Sheridan's success at Five Forks induced Grant to deliver a general assault on the 2nd of April. The Confederate lines were bombarded all night, and on the 2nd of April with Wright's corps (VI.), Grant attacked the weakest part of Lee's line and broke through, losing 1100 men in fifteen minutes. A. P. Hill was killed and his corps broke and was cut off from Petersburg. At the same time Parke's corps (IX.), on the right of the VI., attacked the eastern front near Fort Stedman but was repulsed by General Gordon; then Humphreys' corps (II.) on the left attacked a Confederate division under General Cook and forced it to retreat to the South Side railroad, where at Sutherland Station a final attack dispersed it. Wright, supported by General Ord (commanding the army of the James), afterwards won the strong redoubts called Fort Whitworth and Fort Gregg, and thus in a day the Confederate right had been destroyed from Five Forks to a point some two or three miles west of the Weldon railroad; 10 m. of works had been abandoned, and if Grant had been able to press his advantage at once the campaign must have ended. But Grant was not aware of the enemy's plight, and so resolved to wait until the morrow before completing his victory.

Meanwhile Lee perceived that the hour had come at last when Richmond must fall, and at 3 p.m. he had issued orders for the march of the remains of his army to Lynchburg via Amelia Court-House, a march which evidently must partake of the character of a forlorn hope, hastily planned, ill prepared and undertaken by troops whom the disasters and hardships of the past six months had weakened physically and morally. Yet if General Lee had negotiated a peace on the 2nd of April military history would have lost one of the finest examples of the strategic pursuit. Lee's proposed movement involved the transfer of the army and its baggage 100 m. on bad roads across the front of an enemy, and nothing but mischance could prevent the Federals intercepting Lee's columns by a shorter route and seizing the South Side railroad, on which supplies were to be forwarded from Lynchburg to meet the retreating army at Appomattox Station, Pamplin's Station or Farmville Station. The Appomattox River must be crossed two or three times at its bends. Various creeks and swamps must be bridged, and the bridges destroyed after crossing. The wagons must move on separate roads so as to be covered by the columns during marches and combats and the infantry were to follow the artillery on the roads. Longstreet, Gordon and Mahone's division from Richmond all crossed the Appomattox at Goode's Bridge. Ewell from Richmond crossed the Appomattox by the Danville railroad bridge north of Goode's Bridge. Anderson commanded the flank guard which moved south of the Appomattox with Fitzhugh Lee's cavalry. Lee gained a day's start by moving at 8 p.m., for Grant was making preparations to attack the entrenchments next day (April 3), but the start was lost in waiting for President Davis and the government to escape from Richmond. Sheridan's cavalry got in touch with Lee's flank-guard early on the 3rd of April near Namozine Creek, and at nightfall the Federal advance-guard was at Deep Creek. On the 4th of April Sheridan reached the Danville railroad at Jetersville, and on the 5th of April, when Lee had halted at Amelia Court-House on the railroad to get supplies, the Federals had three corps (II., V., VI.) in support of Sheridan 8 m. nearer than Lee to Sailor's Creek, the point where he must again cross the Appomattox.

Interception was now a *fait accompli*, though neither side suspected it. Lee was unaware of the enemy's proximity, and Grant believed that Lee would remain at Amelia Court-House, but Lee moved west, crossing Flat Creek at sunset on the 5th of April, to the Lynchburg railroad (Longstreet, marching all night, reached Rice's Station at sunrise on the 6th of April). while the Federals moved northwards on the same day to attack Lee at Amelia Court-House, and on discovering Lee's evasion the three Federal corps effected a wheel to the left and advanced on Deatonsville after bridging Flat Creek. Meanwhile the Federal cavalry under H. E. Davies had located a convoy at Painesville, dispersed its escort (Gary's cavalry) and burned the wagons, but had in turn been attacked by Fitzhugh Lee's cavalry at Amelia Springs and driven back on the main body at Flat Creek. Fitzhugh Lee had then marched to join Longstreet at Rice's Station. The rearguard of Lee's army was Gordon's command, which was at Amelia Springs after Ewell's command had passed through at 8 a.m. on the 6th of April. Lee's army stretched out for 15 m., and when its advance-guard was at Rice's Station its rearguard was still at Amelia Court-House. Rice's Station is 62 m. from Lynchburg. Here Longstreet waited all day for Anderson, Ewell and Gordon to close up, and then at night he moved 8 m. to Farmville Station (68 m. south-west of Richmond), where 80,000 rations had been railed from Lynchburg; then Longstreet crossed the Appomattox, and on the 7th of April moved forward towards Lynchburg, covered by Fitzhugh Lee's cavalry. Meanwhile the remainder of Lee's army had been practically destroyed within a few miles of the point where Longstreet had halted. Sheridan's cavalry and two corps (II., VI.) had caught the commands of Anderson, Ewell and Gordon, entangled with the trains of the army attempting the passage of Sailor's Creek; and General Ord would even have attacked Longstreet (whom he had located late at night) had his march been delayed.

Complete disorganization and demoralization seem to have taken hold of the Confederates on this fatal day, and General Lee was once more in eclipse. The Federal cavalry headed the column, the infantry attacked it, and Ewell became the victim of tactical envelopment after Anderson had been defeated and Gordon had failed to save the trains of the army. Surrender or massacre being the alternatives, Ewell surrendered, and here in fact the career of the army of Northern Virginia ended, as Grant plainly saw, for at 5.30 p.m. he addressed a demand to Lee for his capitulation. But Lee clung to his diminished forces for another 48 hours. Longstreet in crossing at Farmville had burnt the bridges and thus delayed Ord in pursuit; but Gordon and Mahone, who had crossed at High Bridge (the railroad bridge), failed to check Humphreys' corps (II.), and so were compelled to take up a position of defence on the north bank until darkness enabled them to slip away. General Lee was with this remnant of the army. Meanwhile Sheridan with the cavalry and two corps (V., XXIV.) had hastened along the South Side railroad, seizing the supplies waiting for Lee at Pamplin's Station, and then moving on another 12 m. to Appomattox Station. At nightfall he found that he was astride the enemy's line of operation, which was also his line of supply, and so General Lee would be compelled to give battle or capitulate on the morrow.

General Lee, quitting Farmville heights on the night of the 7th of April changed the order of march during the next day, so that Gordon (8000) was in the van and Longstreet (15,000) furnished the rearguard. Ewell's corps was now represented by 300 effectives. The cavalry still numbered some 1600 sabres. Lee's column was pursued along the Lynchburg Road by two Federal Corps (II., VI.), which marched 26 m. in 18½ hours, and at midnight halted within 3 m. of Longstreet, who had entrenched near Appomattox Court-House, facing east and covering the road on which Gordon's corps and the cavalry was to press forward to Lynchburg at daylight. But Gordon on the morning of the 9th of April found Sheridan's cavalry in his front, and in accordance with plans made overnight he commenced an attack, driving the Federals back until he encountered at 10 a.m. two corps of infantry (V., XXIV.) under General Ord, who had marched 29 m. in order to support Sheridan at the crisis; and when at the same moment Longstreet was threatened by Humphreys and Wright (II., VI.) the situation had arisen which General Lee considered would justify surrender, an event which had been anticipated on both sides as the result of the fighting about Farmville on the 6th and 7th of April.

The closing operations from the 29th of March to the 9th of April were all in favour of the Federals, but, nevertheless, the historian counts their losses during this period as nearly 10,000 in the five corps and cavalry which constituted General Grant's field army. On the 9th of April, at the Appomattox Court-House, the two leaders exchanged formal documents by which 2862 officers and 25,494 enlisted men were paroled, all that remained in the field of some 55,000 Confederates who were drawing rations on the 20th of February as the army of Northern Virginia. (G. W. R.)

PETERSFIELD, a market town in the Petersfield parliamentary division of Hampshire, England, 55 m. S.W. from London by the London & South Western railway. Pop. of urban district (1901), 3265. The church of St Peter retains some ornate Norman work. The picturesque market-place contains an equestrian statue of William III.

Ecclesiastically a chapelry of Buriton, Petersfield (Peterfelde) owes its origin as a borough to the charter granted by William, earl of Gloucester, in the reign of Henry II. and confirmed later by his widow, Hawise. Petersfield is not mentioned in Domesday, but it was probably then included in the manor of Mapledurham. It was a mesne borough possessing by its first charter the liberties and customs of Winchester together with a merchant gild. These grants were confirmed by John in 1198 and in 1415 Henry V. in addition freed the burgesses from all tolls. No charter of incorporation has been found. Gradually privileges and rights other than those of a mesne borough were usurped by the mayor and burgesses, but were recovered by a suit brought against them by Thomas Hanbury, owner of the borough, in 1611. A mayor continued to be elected until 1885. Petersfield was represented in parliament in 1307. No return was then made until 1552–1553, from which date two members were regularly returned. In 1832 the number was reduced to one, and in 1885 the representation was merged in that of the county. Three-day fairs at the feasts of St Peter and St Andrew were granted in 1255. In 1892 the summer fair then held on the 10th of July was abolished. The autumn fair now held on the 6th of October is for both business and pleasure. The market, which dates from before 1373, formerly held on Saturday, is now held on alternate Wednesdays. In the 16th century Petersfield had important cloth and leather manufactures.

PETER'S PENCE, Rome Scot, or Rom-feoh, a tax of a penny on every hearth, formerly paid annually to the popes; now represented by a voluntary contribution made by the devout in Roman Catholic churches. Its date of origin is doubtful. The first written evidence of it is contained in a letter of Canute (1031) sent from Rome to the English clergy. At this time it appears to have been levied on all families possessed of land worth thirty pence yearly rental, out of which they paid one penny. Matthew Paris says the tax was instituted by Offa, king of Mercia (757–796) for the upkeep of the English school and hostel at Rome. Layamon, however, declares that Ina, king of Wessex (688–725), was the originator of the idea. At the Norman Conquest it appears to have fallen into arrears for a time, for William the Conqueror promised the pope in 1076 that it should be regularly paid. By a bull of Pope Adrian IV. the tax was extended to Ireland. In 1213 Innocent III. complained that the bishops kept 1000 marks of it, only forwarding 300 to Rome. In 1306 Clement V. exacted a penny from each household instead of the £201, 9s. at which the tax appears to have been then fixed. The threat of withholding Peter's pence proved more than once a useful weapon against recalcitrant popes in the hands of English kings. Thus in 1366 and for some years after it was refused on the ground of the pope's obstinacy in withholding his consent to the statute of praemunire. During the 10th century the custom of Peter's pence was introduced into Poland, Prussia and Scandinavia, and in the 11th century Gregory VII. attempted to exact it from France and

Spain. The tax was fairly regularly paid by the English until 1534, when it was abolished by Henry VIII.

PETERWARDEIN (Hung. *Petervarad*, Serv. *Petrovaradin*), a royal free town and fortress of Hungary in the county of Syrmia, Croatia-Slavonia; situated on a promontory formed by a loop of the Danube, 62 m. N.W. of Belgrade by rail. Pop. (1900), 5019. It is connected with Neusatz on the opposite bank by a bridge of boats, a railway bridge and a steam ferry. The fortifications consist of the upper fortress, on a lofty serpentine rock rising abruptly from the plain on three sides, and of the lower fortress at the northern base of the rock. The two fortresses can accommodate a garrison of 10,000 men. In the lower fortress is the town, with a military hospital, and an arsenal containing trophies captured from the Turks. Peterwardein, the "Gibraltar of Hungary," is believed to represent the Roman *Acumincum*, and received its present name from Peter the Hermit, who here in 1096 marshalled the levies of the first crusade. It was captured by the Turks in 1526 and retained by them for 160 years. In 1716 it witnessed a signal defeat inflicted on the Turks by Prince Eugène. During the revolutionary struggles of 1848–49 the fortress was held by the insurgents for a short time.

PETHERICK, JOHN (1813–1882), Welsh traveller in East Central Africa, was born in Glamorganshire, and adopted the profession of mining engineer. In 1845 he entered the service of Mehemet Ali, and was employed in examining Upper Egypt, Nubia, the Red Sea coast and Kordofan in an unsuccessful search for coal. In 1848 Petherick left the Egyptian service and established himself at El Obeid, the capital of Kordofan, as a trader, dealing largely in gum arabic. He was at the same time made British consular agent for the Sudan. In 1853 he removed to Khartum and became an ivory trader. He travelled extensively in the Bahr-el-Ghazal region, then almost unknown, exploring the Jur, Yalo and other affluents of the Ghazal. In 1858 he penetrated to the Niam-Niam country. His additions to the knowledge of natural history were considerable, among his discoveries being the *Cobus maria* (Mrs Gray's waterbuck) and the *Balaeniceps rex* (white-headed stork). Petherick returned to England in 1859 where he made the acquaintance of J. H. Speke, then arranging for his expedition to discover the source of the Nile. While in England Petherick married, and published an account of his travels. He returned to the Sudan in 1861, accompanied by his wife and with the rank of consul. He was entrusted with a mission by the Royal Geographical Society to convey to Gondokoro relief stores for Captains Speke and Grant. Petherick got boats to Gondokoro in 1862, but Speke and Grant had not arrived. Having arranged for a native force to proceed south to get in touch with the absentees, a task successfully accomplished, Mr and Mrs Petherick undertook another journey in the Bahr-el-Ghazal, making important collections of plants and fishes. They regained Gondokoro (where one of their boats with stores was already stationed) in February 1863, four days after the arrival of Speke and Grant, who had meantime accepted the hospitality of Mr (afterwards Sir) Samuel Baker. The charge that Petherick failed to meet his engagement to those travellers is unsubstantiated. A further charge that Petherick had countenanced and even taken part in the slave trade was subsequently shown to have no foundation (Petherick in fact had endeavoured to stop the traffic), but it led Earl Russell, then secretary for foreign affairs, to abolish the British consulate at Khartum (1864). In 1865 the Pethericks returned to England, and in 1869 published *Travels in Central Africa and Explorations of the Western Nile Tributaries*, in which book are set out the details of the Speke controversy. Petherick died in London, on the 15th of July 1882.

PÉTION DE VILLENEUVE, JERÔME (1756–1794), French writer and politician, was the son of a *procureur* at Chartres. He became an avocat in 1778, and at once began to try to make a name in literature. His first printed work was an essay, *Sur les moyens de prévenir l'infanticide*, which failed to gain the prize for which it was composed, but pleased Brissot so much that he printed it in vol. vii. of his *Bibliothèque philosophique des legislateurs*. Pétion's next works, *Les Lois civiles*, and *Essai sur le mariage*, in which he advocated the marriage of priests, confirmed his position as a bold reformer, and when the elections to the States-General took place in 1789 he was elected a deputy to the Tiers État for Chartres. Both in the assembly of the Tiers État and in the Constituent Assembly Pétion showed himself a radical leader. He supported Mirabeau on the 23rd of June, attacked the queen on the 5th of October, and was elected president on the 4th of December 1790. On the 15th of June 1791 he was elected president of the criminal tribunal of Paris. On the 21st of June 1791 he was chosen one of three commissioners appointed to bring back the king from Varennes, and he has left a fatuous account of the journey. After the last meeting of the assembly on the 30th of September 1791 Robespierre and Pétion were made the popular heroes and were crowned by the populace with civic crowns. Pétion received a still further proof of the affection of the Parisians for himself on the 16th of November 1791, when he was elected second mayor of Paris in succession to Bailly. In his mayoralty he exhibited clearly his republican tendency and his hatred of the old monarchy, especially on the 20th of June 1792, when he allowed the mob to overrun the Tuileries and insult the royal family. For neglecting to protect the Tuileries he was suspended from his functions by the Directory of the department of the Seine, but the leaders of the Legislative Assembly felt that Pétion's cause was theirs, and rescinded the suspension on the 13th of July. On the 3rd of August, at the head of the municipality of Paris, Pétion demanded the dethronement of the king. He was elected to the Convention for Eure-et-Loir and became its first president. L. P. Manuel had the folly to propose that the president of the Assembly should have the same authority as the president of the United States; his proposition was at once rejected, but Pétion got the nickname of "Roi Pétion," which contributed to his fall. His jealousy of Robespierre allied him to the Girondin party, with which he voted for the king's death and for the appeal to the people. He was elected in March 1793 to the first Committee of Public Safety; and he attacked Robespierre, who had accused him of having known and having kept secret Dumouriez's project of treason. His popularity however had waned, and his name was among those of the twenty-two Girondin deputies proscribed on the 2nd of June. Pétion was one of those who escaped to Caen and raised the standard of provincial insurrection against the Convention; and, when the Norman rising failed, he fled with M. E. Guadet, F. A. Buzot, C. J. M. Barbaroux, J. B. Salle and Louvet de Couvrai to the Gironde, where they were sheltered by a wigmaker of Saint Émilion. At last, a month before Robespierre's fall in June 1794, the escaped deputies felt themselves no longer safe, and deserted their asylum; Louvet found his way to Paris, Salle and Guadet to Bordeaux, where they were soon taken; Barbaroux committed suicide; and the bodies of Pétion and Buzot, who also killed themselves, were found in a field, half-eaten by wolves.

See *Mémoires inédits de Pétion et mémoires de Buzot et de Barbaroux, accompagnés de notes inédites de Buzot et de nombreux documents inédits sur Barbaroux, Buzot, Brissot, &c., précédés d'une introduction par C. A. Dauban* (Paris, 1866); *Œuvres de Pétion* (3 vols., 1792); F. A. Aulard, *Les Orateurs de la Constituante* (Paris, 1882).

PÉTIS DE LA CROIX, FRANÇOIS (1653–1713), French Orientalist, was born in Paris in 1653. He was son of the Arabic interpreter of the French court, and inherited this office at his father's death in 1695, afterwards transmitting it to his own son, Alexandre Louis Marie, who also distinguished himself in Oriental studies. At an early age he was sent by Colbert to the East; during the ten years he spent in Syria, Persia and Turkey he mastered Arabic, Persian and Turkish, and also collected rich materials for future writings. He served a short time as secretary to the French ambassador in Morocco, and accompanied as interpreter the French forces sent against Algiers, contributing to the satisfactory settlement of the treaty of peace, which was drawn up by himself in Turkish and ratified in 1684. He conducted the negotiations with Tunis and Tripoli in 1685, and those with Morocco in 1687; and the zeal, tact and linguistic knowledge he manifested in these and other transactions with Eastern courts were at last rewarded in 1692 by his appointment to the Arabic chair in the Collège Royal de France, which he filled until his death in 1713.

He published *Contes turcs* (Paris, 1707), and *Les Mille et un jours* (5 vols., Paris, 1710–1712); an *Armenian Dictionary* and an *Account of Ethiopia*. But the lasting monument of his literary fame is his excellent French version of Sharaf-uddīn ʽAlī Yazdi's *Zafārnāma* or *History of Tīmūr* (completed 828 A.H.; A.D. 1425), which was given to the world nine years after his death (4 vols., Paris, 1722; Eng. trans. by J. Darby, London, 1723). This work, one of the rare specimens of a fairly critical history Persia can boast of, was compiled under the auspices of Mirzā Ibrāhīm Sultān, the son of Shāh Rukh and grandson of the great Tīmūr. The only error committed by Pétis de la Croix in his otherwise very correct translation is that he erroneously ascribed the important share which Ibrāhīm Sultān had in the *Zafārnāma* to Tīmūr himself.

PETIT, SIR DINSHAW MANECKJI, Bart. (1823–1901), Parsee philanthropist, was born on the 30th of June 1823. As broker to European firms he amassed a large fortune during the period of speculation in Bombay at the time of the American Civil War. In 1886 he became a member of the governor-general's legislative council. He devoted his wealth to philanthropic objects, among the public and private charities which he endowed being the Towers of Silence and fire temples of the Parsees, a hospital for animals, a college for women, and the Petit hospital. He was knighted in 1887, created a baronet in 1890, and died in February 1901.

PETIT DE JULLEVILLE, LOUIS (1841–1900), French scholar, was born in Paris on the 18th of July 1841. Educated at the École Normale Supérieure, and at the French school at Athens, he received his doctorate in literature in 1868. After holding various posts as a teacher he became professor of French medieval literature and of the history of the French language in the university of Paris in 1886. He died on the 28th of August 1900.

His most important works are: *Histoire du théâtre en France*, including *Les Mystères* (2 vols., 1880); *Les Comédiens en France au moyen âge* (1885); *La Comédie et les mœurs en France au moyen âge* (1886); *Répertoire du théâtre comique en France au moyen âge* (1886); and *Le Théâtre en France, histoire de la littérature dramatique depuis ses origines jusqu'à nos jours* (1889). Petit de Julleville was also the general editor of the *Histoire de la langue et de la littérature française* (8 vols., 1896–1900), to which he himself contributed some valuable chapters.

PETITION (Lat. for "seeking" or "praying"), a term meaning generally a prayerful request, and in its more important constitutional aspect an application for redress by a person aggrieved to an authority capable of relieving him. It may be made in the United Kingdom to the Crown or its officers, or to either house of parliament, or in certain cases to courts of justice.

Petitions to the Crown.—The right of petitioning the Crown was recognized indirectly as early as Magna Carta in the famous clause, *Nulli vendemus, nulli negabimus aut differemus, rectum vel justitiam* (25 Edw. I. c. 29), and directly at various periods later, *e.g.* in the articles of the Commons assented to by Henry IV., by which the king was to assign two days in the week for petitions (*Rot. Parl.* 8 Hen. IV., p. 585). The case of the seven bishops in 1688 confirmed the right, and finally the Bill of Rights in 1689 declared "that it is the right of the subjects to petition the king, and all commitments and prosecutions for such petitioning are illegal." Petitions to the Crown appear to have been at first for the redress of private and local grievances, or for remedies which the courts of law could not grant (May, *Parl. Pr.*, 11th ed., 522). As equity grew into a system, petitions of this kind not seeking legislative remedies tended to become superseded by bills in chancery. Statutes were originally drawn up by the judges at the close of the session of parliament from the petitions of the Commons and the answers of the Crown. Under this system of drafting it was found that the tenor of the petition and answer were not always stated correctly. To obviate this inconvenience demands for legislation came in the reign of Henry VI. to be drawn up in the form of bills which the Crown could accept or reject, but could not alter (see Anson, *Law and Custom of the Constitution*, 3rd. ed., vol. i. p. 241). In the same reign the words "by authority of parliament" were added to the words of enactment, and from the time of Henry VII. public legislation has been by bill and not by petition. A relic of the old form of statute founded upon petition still remains however in the preamble of Appropriation Acts and other statutes creating a charge upon the public revenue. It runs thus: "We, your majesty's most dutiful and loyal subjects, the Commons of the United Kingdom . . . do most humbly beseech your majesty that it may be enacted; and be it enacted," &c., from this point following the enacting words common to all statutes. The Crown may refer petitions presented to it to be adjudicated upon by a delegated authority. This course is pursued in the case of claims to peerages and offices of honour, which are referred to the House of Lords, and by that house to its committee for privileges, and in the case of petitions to the Crown in council, which are usually referred to the judicial committee. The Crown may delegate the power of receiving petitions in the first instance.

Petitions to Parliament.—Petitions to either house of the legislature seem to have been later in origin than petitions to the Crown. They are not referred to in the Bill of Rights, but the right of petition is a convention of the constitution. Petitions to the Lords or the whole parliament can be traced back to Henry III. No petition to the Commons has been found earlier than Richard II.; but from the time of Henry IV. petitions to the Commons have been freely made. The political importance of petitioning dates from about the reign of Charles I. The development of the practice of petitioning had proceeded so far in the reign of Charles II. as to lead to the passing in 1662 of an act (13 Car. II. c. 5) against "tumultuous petitioning," which is still on the statute book. It provides that no petition or address shall be presented to the king or either house of parliament by more than ten persons; nor shall any one procure above twenty persons to consent or set their hands to any petition for alteration of matters established by law in church or state, unless with the previous order of three justices of the county, or the major part of the grand jury. And in 1817 (57 Geo. III. c. 19, s. 23) meetings within a mile from Westminster Hall for the purpose of considering a petition to both houses or either house of parliament while either house is sitting were declared to be unlawful assemblies. Up to 1688 petitions to either house usually dealt only with some specific grievance. From that time dates the present practice of petitioning with regard to general measures of public policy. Petitions to the Houses of Lords or Commons must be framed in the form prescribed by the standing orders, must be properly superscribed, and must conclude with a prayer (May, *Parl. Pr.*, 11th ed., 524, 525). They may be sent free by post to members of either house if they fulfil certain conditions as to weight, &c., (*loc. cit.* p. 531).

Petitions to the Commons must be in writing, must contain none but genuine signatures, and must be free from disrespectful language or imputations upon any tribunal or constituted authority. They must be presented by a member of the house, except petitions to the House of Commons from the corporation of London, which may be presented at the bar by the sheriffs, and from the corporation of Dublin, which may be presented by the lord mayor. There is no means of compelling a member to present a petition. The rules as to petitions to the House of Lords are similar. The lord who presents a petition is required to read it to see whether in form and contents it is fit for presentation. In the Lords receivers and triers of petitions from Great Britain and Ireland and from Gascony and the lands and countries beyond the sea were appointed until 1886, though their functions had long been obsolete. Applications for leave to bring before either house bills for private or local and personal matters must under the standing orders of both houses be made by petition; and the same rule obtains as to applications for leave to be heard in opposition to such bills.

See Clifford, *History of Private Bill Legislation* (1887); May, *Parl. Pr.*, (11th ed.), c. xxv.

Petitions to Courts of Justice.—Strictly speaking, these are an indirect mode of petitioning the Crown, for in the theory of English law the Crown is the fountain of justice. But it is more convenient to treat them separately, as they now form a part of the practice of the courts. Appeals to the House of Lords and the privy council are prosecuted by petition of appeal. The original jurisdiction of the privy council to deal with petitions is confined to proceedings under certain statutes, such as the Endowed Schools Acts, the Public Schools Acts, the Universities Acts and the Patents Acts. In most cases the petitions are referred to the judicial committee of the council. Petitions may be addressed to the lord chancellor in a few instances, *e.g.* for the removal of coroners or county court judges. The House of Lords at one time claimed original jurisdiction in civil and criminal matters. As to civil matters the claim is abandoned; as to criminal matters it is now limited to impeachment for crime by the Commons on the trial for treason or felony of persons having privilege of peerage.

The most important use of petitions in England is in the High Court of Justice. In the chancery division petitions are presented either as interlocutory proceedings in the course of an action, or as original proceedings where no litigation exists—as being a more speedy form of remedy than an action. The cases in which a petition is admissible and the procedure therein, are in the main regulated by orders 52 and 55 of the rules of the supreme court. Evidence in support of petitions is usually by affidavit. Petitions in the course of an action are presented to the court in which the action is brought. Examples of original petitions are those under the Lands Clauses Acts, the Trustee Acts and the Companies Acts. For many proceedings under these acts a simpler and cheaper form of proceeding by summons has been substituted for that by petition. The matters above-mentioned are usually dealt with by the chancery division as successor of the court of chancery. Petitions are also in use in other courts having equitable jurisdiction, *e.g.* the chancery courts of the counties palatine of Lancaster and Durham and the county courts as to cases falling within § 67 of the County Courts Act 1888, and as to cases within county court jurisdiction under the Settled Land Acts or the Guardianship of Infants Act 1886 (County Court Rules, O. 38). In a few cases petitions may be brought by way of appeal, *e.g.* under the Charitable Trusts Act 1860. In the king's bench division the only use of petitions appears to be to initiate proceedings in bankruptcy. Leave to sue *in formâ pauperis* used to be given on petition but is now usually dealt with summarily. In the probate, &c., division proceedings in matrimonial causes, &c., are begun by petition, but the course of the proceedings closely resembles those of an ordinary action.

Scotland.—In Scotland petitions in the Court of Session are either original or in a pending action. Original petitions are presented to one of the divisions of the inner house, unless they relate to matters mentioned in 20 & 21 Vict. c. 56, s. 4, when they are brought before the junior lord ordinary, or unless, by special statutory provision, they may be brought before any lord ordinary, as in the case of petitions under the "Conjugal Rights (Scotland) Amendment Act 1861," or the Trusts (Scotland) Act 1867. A *petition and complaint* is a process of a quasi-criminal nature by which certain matters of summary and extraordinary jurisdiction are brought under the notice of the Court of Session. It lies against magistrates and officers of the law for breach of duty against parties guilty of contempt of court, &c. The concurrence of the lord advocate is necessary to a petition and complaint (see Mackay, *Court of Session Practice*, ii. 439).

Ireland.—The law of Ireland as to petitions is in substance the same as that of England with certain differences of detail as to the cases in which petitions may be made to courts of justice.

United States.—In the United States before the Civil War questions arose as to the right of petitioning Congress, particularly with reference to petitions for the restriction of slavery which at that time was contended to be a matter of state and not of federal concern (see Cooley, *Constitutional Limitations*, 6th ed., 1890, 426). The right of petitioning the United States government is now secured by the first amendment to the United States constitution (ratified in 1789–1791), which provides that "Congress shall make no law . . . abridging . . . the right of the people peaceably to assemble and to petition the government for a redress of grievances." In the view of the Supreme Court this amendment "assumes the existence of the right of the people to assemble for lawful purposes and protects it against encroachment by Congress. The right was not created by the amendment; neither was its continuance guaranteed except as against congressional interference. For their protection in its enjoyment, therefore, the people must look to the states. The power for that purpose was originally placed there, and has never been surrendered. The right of the people peaceably to assemble for the purpose of petitioning Congress for a redress of grievances, or for anything else connected with the powers or duties of the national government is an attribute of national citizenship, and as such under the protection of and guaranteed by the United States. The very idea of a government republican in form implies a right on the part of its citizens to meet peaceably for consultation in respect to public affairs and to petition for a redress of grievances" (*U.S.* v. *Cruikshank*, 1875; 92 U.S. 542, 552).

A Bill of Rights is incorporated in the constitutions of many states of the Union, and is made part of the supreme law of the states (see Hough, *American Constitutions*, ii. 571). Petitions can be presented to the federal or state courts of justice under much the same circumstances as in England. "It is a general rule in such cases that an affidavit should be made that the facts therein contained are true as far as known to the petitioner, and that those facts which he states as knowing from others he believes to be true" (Bouvier, *Law Dict.*).

British Possessions.—There is a right of petition to the king for the review of decisions (in matters criminal or civil) of courts of justice in the Channel Islands or Isle of Man, and in all other parts of the empire outside the British islands and of British courts in foreign countries. This right is cut down by imperial or colonial legislation in the case of Canada and Australia, see Tarring, *Law Relating to Colonies* (3rd ed., 1906) c. v.

The term *Petition of Right*, in English law, is used in two senses. (1) It denotes the statute of 1625 (3 Car. I. c. 1), a parliamentary declaration of the liberties of the people. (2) It also and more usually is employed to describe a mode of prosecuting a claim by a subject against the Crown, said to owe its origin to Edward I. Petition of right in this sense lies (*a*) to obtain restitution of real or personal property of the subject which has found its way into the hands of the Crown, or compensation if restitution cannot be made; (*b*) to recover damages for breach of a contract made on behalf of the Crown, whether the breach is due to the acts or the omissions of servants of the Crown. Where the Crown is in possession of property of the suppliant, and the title of the Crown appears by record, as by inquest of office, the remedy is somewhat different and is called *monstrans de droit.* Petition of right does not lie in respect of engagements in the naval, military or civil service of the Crown, which are as a general rule made "during pleasure," nor for breach of public duty, *e.g.* failure to perform treaty obligations, nor for trespass or negligence or other torts by Crown servants. Where such acts are wrongful the remedy is by action against the official as an individual and not in his official capacity (*Raleigh* v. *Goschen*, 1898, L.R. 1 ch. 73).

The procedure on a petition of right is either at common law or by statute. At common law the petition went through its earliest stages in the chancery. It suggests such a right as controverts the title of the Crown, and the Crown endorses upon the petition *Soit droit fait al partie.* Thereupon a commission is issued to inquire into the truth of the suggestion. After the return to the commission, the attorney-general pleads or demurs, and the merits are then determined as in actions between subject and subject. If the right be determined against the Crown, judgment of *amoveas manus* is given in favour of the suppliant. The Petition of Right Act 1860 (23 & 24 Vict. c. 34, extended to Ireland in 1873, 36 & 37 Vict. c. 69) preserves to the suppliant his right to proceed at common law, but gives an alternative remedy. The procedure is regulated by the act of 1860, and as to England also by rules made under that act on the 1st of February 1862. The petition is left with the secretary of state for the home department for the consideration of his majesty, who if he thinks fit grants his *fiat* that right be done. The *fiat* is sealed in the home office and issued to the suppliant who files it in the central office of the High Court of Justice, and a sealed copy is served upon the solicitor to the treasury, with a demand for a plea or answer on behalf of the Crown. The subsequent proceedings including those as to disclosing relevant documents are assimilated as far as possible to those in an ordinary action. A judgment in favour of the suppliant is equivalent to a judgment of *amoveas manus ouster le main.* Costs are payable to and by the Crown. A petition of right is usually tried in the chancery or king's bench divisions; but where the subject-matter of the petition arises out of the exercise of belligerent rights on behalf of the Crown, or would be cognizable in a prize court if the matter were in dispute between private persons, the suppliant may at his option intitule his petition in the admiralty division, and the lord chancellor may direct the prosecution in that division of petitions of right under the act of 1860 even when they are not so intituled (27 & 28 Vict. c. 25, s. 52).

The law as to petition of right applies to Ireland but not to Scotland, and a right to present such a petition appears to exist in colonies whose law is based on the common law of England. But in many colonies legislation has been passed with respect to suits against government which makes it unnecessary to resort to a petition of right.

PETITIO PRINCIPII, or BEGGING THE QUESTION (Gr. *τὸ ἐν ἀρχῇ λαμβάνειν, τὸ ἐξ ἀρχῆς αἰτεῖσθαι*), in logic, the fourth of Aristotle's fallacies *ἔξω τῆς λέξεως* or *extra dictionem.* Strictly this fallacy belongs to the language of disputation, when the questioner seeks (*petit*) to get his adversary to admit the very matter in question. Hence the word *principium* gives a wrong impression, for the fallacy consists not in seeking for the admission of a *principle* which will confute the particular proposition—a perfectly legitimate form of refutation—but in luring the adversary into confessing the contradictory. In the ordinary use, however, "begging the question" consists in assuming in the premises the conclusion which it is desired to prove.

PETITOT, JEAN (1608–1691), French-Swiss enamel painter, was born at Geneva, a member of a Burgundian family which had fled from France on account of religious difficulties. His father, Faulle, was a wood carver; his mother's name was Étienette Royaume. Jean was the fourth son, and was apprenticed to a jeweller goldsmith named Pierre Bordier, with whom he struck up a close friendship. The two friends, dissatisfied with the progress they made in Geneva, went into France, and after working for a while with Toutin came to England with letters of introduction to Turquet de Mayern, physician to Charles I., who presented them to the king, for whom they made a St George for the badge of the order and carried out many commissions for portraits; amongst others preparing two large ones representing Rachel de Ruvigny, countess of Southampton, now at Chatsworth, and Mary Villiers, duchess of Richmond and Lennox, dated 1643, at one time in the possession of the Crown and now in the Pierpont Morgan collection. On the execution of the king, Petitot left England for Paris with the royal household, Bordier remaining in England and carrying out certain important commissions for Cromwell and the parliament. On reaching Paris, Petitot entered into partnership with a goldsmith, Jacques Bordier, a cousin of Pierre, and it seems probable from recent research in contemporary documents that the enamel portraits attributed to Petitot were really the work of the two partners collaborating, the actual drawing being the work of Petitot, while for the enamel process Bordier was mainly responsible. The two painters were given apartments in the Louvre, received numerous commissions from Louis XIV., and painted portraits of almost every person of importance in his brilliant court. The friendship between the two lasted for thirty-five years, and was only put an end to by Bordier's death. The enamellers rendered special political services in France for the republic of Geneva, and were practically regarded as the official representatives of the republic, receiving warm thanks from the Syndics for their diplomatic work. On the revocation of the Edict of Nantes, 1685, pressure was brought to bear upon Petitot that he should change his religion. The king protected him as long as possible, and when he was arrested, with his niece, Anne Bordier, sent Bossuet, bishop of Meaux, to convince the old man of the error of his ways. Eventually, in poor health and great despair, Petitot placed his signature to an act of abjuration, and Louis XIV., unwilling to acknowledge the true reason for the imprisonment of Petitot and for his liberation, informed one of his sons, who came to thank him for the pardon given to his father, that he was willing to fall in for once with "the whim of an old man who desired to be buried with his ancestors." In 1687 therefore Petitot left Paris to return to Geneva, and, after a long and tedious inquiry, was absolved by the consistory of the church of Geneva from the crime of which they considered he had been guilty, and received back to the Huguenot communion in the church of St Gervais. In Geneva he received a very important commission from John Sobieski, king of Poland, who required portraits of himself and his queen. This was followed by numberless other commissions which the painter carried out. He died of paralysis on the 3rd of April 1691, while in the very act of painting on the enamel a portrait of his faithful wife.

Petitot married in 1651 Marguerite Cuper, and Jacques Bordier married in the same year her younger sister Anne Madeleine. He had seventeen children, and for their benefit wrote out a little octavo volume containing some genealogical information, two delightful portraits, one of himself and one of his wife, and many pages occupied with prayers, meditations and religious advice. He also prepared a second manuscript volume of prayers and meditations for the use of his family, and from these two books and the records of the Huguenot societies of France and England information has been obtained respecting the painter and his family.

Of the works of Petitot the most important collection is in the Jones Bequest at the Victoria and Albert Museum. There are many in the Louvre, sixteen at Chantilly, seventeen at Windsor, and others in the collections of Earl Beauchamp, the duke of Rutland, the duke of Richmond, the earl of Dartrey, Mr Alfred de Rothschild and the late Baroness Burdett-Coutts. Amongst Lord Dartrey's examples are portraits of Petitot and of his son, and two of the wife of Jean Petitot the younger. A second portrait of the artist belongs to the queen of Holland, and another is in the collection of the late Mr Stroehlin of Geneva. In Mr Pierpont Morgan's collection there are many exceedingly fine examples, but especially three drawings on paper, the only three which appear to have survived, and the large signed miniature of the duchess of Richmond already mentioned, the largest work Petitot ever executed save the one at Chatsworth.

See *Petitot et Bordier*, by Ernest Stroehlin (Geneva, 1905); "Some New Information respecting Jean Petitot," by G. C. Williamson, *Nineteenth Century and After* (January 1908), pp. 98–110; the privately printed *Catalogue of the Collection of Mr J. Pierpont Morgan*, vol. iii.; *The History of Portrait Miniatures*, by G. C. Williamson, vol. ii. (London, 1904). (G. C. W.)

PETITOT, JEAN LOUIS (1652–*c.* 1730), French enamel painter, was the eldest son of Jean Petitot (*q.v.*), and was instructed in enamelling by his father. Some of his works so closely resemble those of the elder Petitot that it is difficult to distinguish between them, and he was really the only serious rival his father ever had. He settled for a while in London, where he remained till 1682, and painted many enamel portraits of Charles II. In 1682 he removed to Paris, but in 1695 was back again in London, where he remained until the time of his death.

His portrait by Mignard is in the museum at Geneva, and another in enamel by himself in the collection of the earl of Dartrey, who also owns two of his wife, Madeleine Bordier, whom he married in 1683. Another portrait believed to represent him is in the collection of Mr Pierpont Morgan. (G. C. W.)

PETITS-CHEVAUX (Fr. for "little horses"), a gambling game played with a mechanical device consisting of a board perforated with a number of concentric circular slits, in which revolve, each independently on its own axis, figures of jockeys on horseback, distinguished by numbers or colours. The bystanders having staked their money according to their choice on a board marked in divisions for this purpose, the horses are started revolving rapidly together by means of mechanism attached to the board, and the horse which stops nearest a marked goal wins, every player who has staked on that horse receiving so many times his stake. Figures of railway trains and other objects sometimes take the place of horses. In recent years there has been a tendency to supplant the *petits chevaux* at French resorts by the *boule* or ball game, on the same principle of gambling; in this a ball is rolled on a basin-shaped table so that it may eventually settle in one of a number of shallow cups, each marked with a figure.

PETO, SIR SAMUEL MORTON, Bart. (1809–1889), English contractor, was born at Woking, Surrey, on the 4th of August 1809, and was at an early age apprenticed to his uncle, a London builder, who on his death in 1830 bequeathed the business to Peto and another nephew, Thomas Grissell. The partnership between Peto and Grissell lasted till 1846, amongst the many London buildings erected by the firm being the Reform Club, the Lyceum and St James's theatres, and the Nelson column. Peto afterwards entered into partnership with Edward Ladd Betts (1815–1872), and between 1846 and 1872 Messrs Peto & Betts carried out many large railway contracts at home and abroad, notably the more important portions of the South-Eastern and of the London Chatham & Dover lines, and, in conjunction with Thomas Brassey, the Grand Trunk railway of Canada, and the London Tilbury & Southend railway. In 1854–1855 Peto and Brassey constructed a railway in the Crimea between Balaclava and the British entrenchments before Sebastopol, charging the British government only the actual out-of-pocket expenses, and for his services in this matter Peto was in 1855 made a baronet. Peto entered parliament as a Liberal in 1847, and, with a few years' interval, continued there till 1868, when, his firm having been compelled to suspend payment in the financial crisis of 1866, he was forced to resign his seat, though both Mr Disraeli and Mr Gladstone publicly eulogized his personal character. He died on the 13th of November 1889.

PETŐFI, ALEXANDER (1823–1849), Hungarian lyric poet, was born at Kis-Körösö, Pest county, on New Year's Day, 1823. The family received its diploma of nobility from the emperor Leopold in 1688, but the ultra-patriotic Alexander early changed the old family name, Petrovics, which pointed to a Croatian origin, into the purely Magyar form of Petőfi. The lad's early days were spent at Félegyház and Szabadszállás, the most Hungarian parts of Hungary, where he got most of his early education, including a good grounding in Latin. German he learnt subsequently at Pesth, and French he taught himself. He began writing verses in his twelfth year, while a student at the Aszód gymnasium, where he also displayed a strong predilection for the stage, to the disgust of his rigorous father, who formally disowned his son, early in 1839, for some trifling peccadillo, and whose tyrannical temper became downright furious when a series of misfortunes ruined him utterly in 1840. For the next three years Petőfi led the wretched life of a strolling player, except for a brief interval when, to escape starvation, he enlisted as a common soldier in an infantry regiment. During the greater part of 1842 we find him a student at the Calvinist College at Pápá, where he made the acquaintance of young Jókai, and wrote the poem "Borozó," which the great critic Bajza at once inserted in the leading literary review, the *Athenaeum* (May 22, 1842). In November of the same year the restless poet quitted Pápá to join another travelling troupe, playing on one occasion the Fool in *King Lear*, and after wandering all over Hungary and suffering incredible hardships, finally settled down at Pesth (1844), where for a time he supported himself by all sorts of literary hack-work. Nevertheless, in the midst of his worst privations he had read voraciously, and was at this time profoundly influenced by the dominant Romanticism of the day; while, through Tieck, he learnt to know and value the works of Shakespeare. His first volume of original poems was published in 1844 by the Society Nemzeti Kör, through the influence of the poet Vörösmarty, when every publisher had refused his MS., and the seventy-five florins which he got for it had become a matter of life or death to him. He now became a regular contributor to the leading papers of Pesth, and was reconciled to his parents, whom he practically supported for the rest of their lives out of his literary earnings. His position, if not exactly brilliant, was now at least secure. The little volume published by the Nemzeti Kör was followed by the parody, *A Helysêg Kalapácsa* (1844); the romantic epic *János Vitéz* (1844); *Ciprislombok Etelkê Sìrjáról*, a collection of passionate elegies over his lost love, Etelké Csapó (1845); *Uti Jegyzetek*, an imitation of Heine's *Reisebilder* (1845); *Szerelem Gyöngyei* (1845); *Felhök* (1846); *Szerelme ès házassága* (1846), and many other volumes. The first edition of his collected poems appeared in 1847. Petőfi was not yet twenty-five, and, despite the protests of the classicists, who regarded him with cold dislike, the best heads in Hungary, poets like Vörösmarty and critics like Szemere, already paid him the homage due to the prince of Magyar lyrical poets. The great public was enthusiastic on the same side, and posterity, too, has placed him among the immortals. Petőfi is as simple and genuine a poet of nature as Wordsworth or Christian Winther, and his erotics, inspired throughout by a noble idealism, have all Byron's force and fervour, though it is perhaps in his martial songs that Petőfi's essentially passionate and defiant genius asserts itself most triumphantly. On the 8th of September 1847 Petőfi married Julia Szendrey, who bore him a son. When the revolutionary war broke out, he espoused the tenets of the extreme democratic faction with a heat and recklessness which estranged many of his friends. He took an active part in the Transylvanian campaigns of the heroic Bem; rose by sheer valour to the rank of major; was slain at the battle of Segesvár (July 31, 1849), and his body, which was never recovered, is supposed to have been buried in the common grave of the fallen honveds in the churchyard of Fehéregyház. The first complete edition of Petőfi's poems appeared in 1874. The best critical edition is that of Haras, 1894. There are numerous indifferent German translations.

See Ferenczi, *Petőfi Életrajza*; Fischer, *Petőfi's Leben und Werke*. (R. N. B.)

PETOSKEY, a city and the county-seat of Emmet county, Michigan, U.S.A., on Little Traverse Bay, an arm of Lake Michigan, at the mouth of Bear Creek, in the north-west part of the lower peninsula. Pop. (1890), 2872; (1900), 5285, of whom 856 were foreign-born; (1904), 5186; (1910), 4778. It is served by the Père Marquette and the Grand Rapids & Indiana railways and by steamboat lines to Chicago, Detroit, Buffalo and other lake ports. Bear Creek furnishes considerable water-power, and among the manufactures are lumber, paper, leather and foundry and machine-shop products. Petoskey was settled about 1874, was incorporated as a village in 1879, was chartered as a city in 1895, and in 1902 replaced Harbor Springs as county-seat. It was named after an Ojibwa Indian chief.

PETRA (ἡ Πέτρα = the rock), a ruined site, 30° 19′ N. and 35° 31′ E., lying in a basin among the mountains which form the eastern flank of Wadi el-ʽArāba, the great valley running from the Dead Sea to the Gulf of ʽAḳăba. The descriptions of Strabo (xvi. p. 779), Pliny (*N.H.* vi. 32) and other writers leave no doubt as to the identity of this site with the famous capital of the Nabataeans (*q.v.*) and the centre of their caravan trade. Walled in by towering rocks and watered by a perennial stream, Petra not only possessed the advantages of a fortress but controlled the main commercial routes which passed through it to Gaza in the west, to Bostra and Damascus in the north, to Elath and Leucè Comè on the Red Sea, and across the desert to the Persian Gulf.

From the ʽArāba travellers approach by a track which leads round Jebel Hārūn (Mt Hor) and enters the plain of Petra from the south; it is just possible to find a way in from the high plateau on the north; but the most impressive entrance is from the east, down a dark and narrow gorge, in places only 10 or 12 ft. wide, called the Sīḳ, *i.e.* the shaft, a split in the huge sandstone rocks which serves as the waterway of the Wadi Mūsā. Near the end of the defile stands the most elaborate of the ruins, el-Ḥazne or "the Treasury of Pharaoh," not built but hewn out of the cliff; a little farther on, at the foot of the mountain called en-Nejr, comes the theatre, so placed as to bring the greatest number of tombs within view; and at the point where the valley opens out into the plain the site of the city is revealed with striking effect. Almost enclosing it on three sides are rose-coloured mountain walls, divided into groups by deep fissures, and lined with rock-cut tombs in the form of towers. The stream of Wadi Mūsā crosses the plain and disappears among the mountains opposite; on either bank, where the ground is fairly level, the city was built, covering a space of about 1¼ sq. m. Among the ruins on the south bank stand the fragments of a temple called Ḳaṣr Firʽaun of late Roman date; just beyond this rises a rocky height which is usually regarded as the acropolis.

A position of such natural strength must have been occupied early, but we have no means of telling exactly when the history of Petra began; the evidence seems to show that the city was of relatively late foundation, though a sanctuary (see below) may have existed there from very ancient times. This part of the country was assigned by tradition to the Horites, *i.e.* probably "cave-dwellers," the predecessors of the Edomites (Gen. xiv. 6, xxxvi. 20–30; Deut. ii. 12); the habits of the original natives may have influenced the Nabataean custom of burying the dead and offering worship in half-excavated caves.[1] But that Petra itself is mentioned in the Old Testament cannot be affirmed with certainty; for though Petra is usually identified with Selaʽ[2] which also means "a rock," the reference in Judges i. 36; Isa. xvi. 1, xlii. 11; Obad. 3, is far from clear. 2 Kings xiv. 7 seems to be more explicit; in the parallel passage, however, Selaʽ is understood to mean simply "the rock" (2 Chr. xxv. 12, see LXX). Hence many authorities doubt whether any town named Selaʽ is mentioned in the Old Testament.[3] What, then, did the Semitic inhabitants call their city? Eusebius and Jerome (*Onom. sacr.* 286, 71. 145, 9; 228, 55. 287, 94), apparently on the authority of Josephus (*Ant.* iv. 7, 1; 4, 7), assert that Rekem was the native name. But in the Aramaic versions Rekem is the name of Kadesh; Josephus may have confused the two places. Sometimes the Aramaic versions give the form Rekem-Geya, which recalls the name of the village El-ji, south-east of Petra; the capital, however, would hardly be defined by the name of a neighbouring village. The Semitic name of the city, if it was not Selaʿ, must remain unknown.[1] The passage in Diodorus Siculus (xix. 94–97) which describes the expeditions which Antigonus sent against the Nabataeans in 312 B.C. is generally understood to throw some light upon the history of Petra, though it must be admitted that the *petra* referred to as a natural fortress and place of refuge cannot be a proper name, and the description at any rate implies that the town was not yet in existence. Brünnow thinks that "the rock" in question was the sacred mountain en-Nejr (above); but Buhl suggests a conspicuous height about 16 m. north of Petra, Shobak, the *Mont-royal* of the Crusaders.[2] More satisfactory evidence of the date at which the earliest Nabataean settlement began is to be obtained from an examination of the tombs. Two types may be distinguished broadly, the Nabataean and the Graeco-Roman. The Nabataean type starts from the simple pylon-tomb with a door set in a tower crowned by a parapet ornament, in imitation of the front of a dwelling-house; then, after passing through various stages, the full Nabataean type is reached, retaining all the native features and at the same time exhibiting characteristics which are partly Egyptian and partly Greek. Of this type there exist close parallels in the tomb-towers at el-Ḥejr in north Arabia, which bear long Nabataean inscriptions,[3] and so supply a date for the corresponding monuments at Petra. Then comes a series of tomb-fronts which terminate in a semicircular arch, a feature derived from north Syria, and finally the elaborate façades, from which all trace of native style has vanished, copied from the front of a Roman temple. The exact dates of the stages in this development cannot be fixed, for strangely enough few inscriptions of any length have been found at Petra,[4] perhaps because they have perished with the stucco or cement which was used upon many of the buildings. We have, then, as evidence for the earliest period, the simple pylon-tombs, which belong to the pre-Hellenic age; how far back in this stage the Nabataean settlement goes we do not know, but not farther than the 6th century B.C. A period follows in which the dominant civilization combines Greek, Egyptian and Syrian elements, clearly pointing to the age of the Ptolemies. Towards the close of the 2nd century B.C., when the Ptolemaic and Seleucid kingdoms were equally depressed, the Nabataean kingdom came to the front; under Aretas III. Philhellene, *c.* 85–60 B.C., the royal coins begin; at this time probably the theatre was excavated, and Petra must have assumed the aspect of a Hellenistic city. In the long and prosperous reign of Aretas IV. Philopatris, 9 B.C.–A.D. 40, the fine tombs of the el-Ḥejr type may be dated, perhaps also the great High-place. Then the city became more and more Romanized. In A.D. 106, when Cornelius Palma was governor of Syria, "Arabia belonging to Petra,"[5] was absorbed into the Roman Empire, and the native dynasty came to an end. But the city continued to flourish. It was visited in A.D. 131 by Hadrian, and stamped *Adrianè Petra* on its coins in gratitude for the emperor's benefactions; the superb Ḥazne, probably a temple for the worship of Isis, and the Dēr, which resembles the Ḥazne in design, belong to this period. A century later, in the time of Alexander Severus (A.D. 222–235), when the city was at the height of its splendour, the issue of coinage comes to an end, and there is no more building of sumptuous tombs, owing apparently to some sudden catastrophe, such as an invasion by the neo-Persian power under the Sassanid dynasty. Meanwhile as Palmyra (*fl.* A.D. 130–270) grew in importance and attracted the Arabian trade away from Petra, the latter declined; it seems, however, to have lingered on as a religious centre; for we are told by Epiphanius (*c.* A.D. 315–403) that in his time a feast was held there on the 25th of December in honour of the virgin Chaabou and her offspring Dusares (*Haer.* 51).

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[1] Buhl, *Gesch. der Edomiter* (1893), p. 52.

[2] *E.g.* by Driver, *Deut.* p. 38; Nöldeke, *Ency. Bibl.* col. 1185; Ed. Meyer, *Die Israeliten u. ihre Nachbarstämme*, p. 357.

[3] Buhl, p. 35 sqq., G. F. Moore, *Judges*, p. 55 seq., *Oxford Hebr. Lex. s. v.* סֶלַע; T. K. Cheyne, *Ency. Bibl. s. v.* Sela; A. Jeremias, *Das A. T. im Lichte d. alten Orients*, p. 457.

The chief god of Petra was Dhū-sharā (Δουσάρης), *i.e.* the *lord* or *owner* of *Sharā*;[6] he was worshipped under the form of a black rectangular stone, a sort of Petraean Kaʿaba (Suidas *Lex. s.v.* Θεὸς Ἄρης, and cf. Epiphan. above). Associated with Dhū-sharā was Allāt, the chief goddess of the ancient Arabs. Sanctuary chambers may be seen at various points in the site of Petra, and many places of sacrifice open to the sky are met with among the tombs, marked by remains of altars. But most eminent of all was the great High-place which has recently been discovered on en-Nejr (or Zibb ʿaṭūf). It consists of a rock-hewn altar of burnt-offering with a place for killing the victims beside it and a shallow court, perhaps intended to hold water, in front: the most complete specimen of an ancient Semitic sanctuary that is known.[7] Not far off are two obelisks cut out of the solid rock which has been removed to the level of their bases; these were either idols of Dhū-sharā and Allāt, or more probably were designed to mark the limits of the *ḥaram* of the sanctuary. West of the obelisks are three other places of sacrifice; and on the rocks below worshippers have carved their names (*CIS.* ii. 390–404). En-Nejr, with the theatre at its foot, must have been the sacred mountain, the original sanctuary of Petra, perhaps "the very high mountain of Arabia called Dusarē after the god Dusares" referred to by Steph. Byz. (*s.v.* Δουσάρη). Christianity found its way into Petra in early times; Athanasius mentions a bishop of Petra (Πετρῶν τῆς Ἀραβίας, *ad Antioch.* 10) named Asterius; at least one of the tombs (the "tomb with the urn") was used as a church; an inscription in red paint records its consecration "in the time of the most holy bishop Jason" (A.D. 447). The Christianity of Petra, as of north Arabia, was swept away by the Mahommedan conquest in A.D. 629–632. Under the Latin kingdom Petra was occupied by Baldwin I. and formed the second fief of the barony of Krak with the title Château de la Valée de Moyse or Sela; it remained in the hands of the Franks till 1189; fragments of the Crusaders' citadel are still standing near the High-place on en-Nejr.

The ruins of Petra were an object of curiosity in the middle ages and were visited by the Sultan Bibars of Egypt towards the close of the 13th century. The first European to describe them was Burckhardt (1812). All former descriptions are now superseded by the magnificent work of Brünnow and Domaszewski, *Die Provincia Arabia* (1904), who have minutely surveyed the whole site, classified the tombs, and compiled the accounts of earlier investigations; and by the independent researches of Dalman, *Petra und seine Felsheiligtümer* (1908), and of Musil, *Arabia Petraea* (1907–1908). The *Corpus Inscr. Sem.* ii. 305 sqq., should be consulted, and the descriptions in Baedeker-Socin's *Palestina* (7th edition), and *Revue biblique* for 1897, 1898, 1903. (G. A. C.*)

PETRARCH (1304–1374). Francesco Petrarca, the great Italian poet and first true reviver of learning in medieval Europe, was born at Arezzo on the 20th of July 1304. His father Petracco held a post of notary in the Florentine Rolls Court of the Riformagioni; but, having espoused the same cause as Dante during the quarrels of the Blacks and Whites, Petracco was expelled from Florence by that decree of the 27th of January 1302 which condemned Dante to lifelong exile. With his wife he took refuge in the Ghibelline township of Arezzo; and it was here, on the very night when his father, in company with other members of the White party, made an unsuccessful attempt to enter Florence by force, the Francesco first saw the light. He did not remain long in his birthplace. His mother, having obtained permission to return from banishment, settled at Incisa, a little village on the Arno above Florence, in February 1305. Here Petrarch spent seven years of boyhood, acquiring that pure Tuscan idiom which afterwards he used with such consummate mastery in ode and sonnet. Here too, in 1307, his brother Gherardo was born. In 1312 Petracco set up a house for his family at Pisa; but soon afterwards, finding no scope there for the exercise of his profession as jurist, he removed them all in 1313 to Avignon. This was a step of no small importance for the future poet-scholar. Avignon at that period still belonged to Provence, and owned King Robert of Naples as sovereign. But the popes had made it their residence after the insults offered to Boniface VIII. at Anagni in 1303. Avignon was therefore the centre of that varied society which the high pontiffs of Christendom have ever gathered round them. Nowhere else could the youth of genius who was destined to impress a cosmopolitan stamp on medieval culture and to begin the modern era have grown up under conditions more favourable to his task. At Incisa and at Pisa he had learned his mother-tongue. At Carpentras, under the direction of Convennole of Prato, he studied the humanities between the years 1315 and 1319. Avignon, at a distance from the party strife and somewhat parochial politics of the Italian commonwealths, impressed his mind with an ideal of civility raised far above provincial prejudices.

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[1] Yakut gives the name Salʿ to a fortress in Wadi Mūsā, Nöldeke, *ZDMG.* xxv. 259 seq. (1871).

[2] Brünnow, *Die Prov. Arabia*, i. 190; Buhl, *op. cit.* p. 34.

[3] *CIS.* ii. 197–226; Cooke, *North-Semitic Inscriptions*, 78–91, &c.

[4] Four important Nabat. inscrr. have been found, of which three are dated, viz. *NSI.* p. 250, *n* = *CIS.* ii. 349, 16th year of Aretas III., *i.e.* B.C. 70, so also *CIS.* ii. 442; *NSI.* 94 and 95 = *CIS.* ii. 350 and 354, the latter dated the 29th year of Aretas IV., *i.e.* A.D. 20. The other Nabat. inscrr. are mostly *graffiti*, scratched on the rocks by visitors or worshippers at the holy places; *CIS.* ii. 355–441, 444–464.

[5] This is the meaning of Arabia Petraea. Dio Cass. lxviii. 14.

[6] The whole range in which Petra lies is called Jebel esh-Sharāt, but it is doubtful whether the name of the god was derived from that of the mountain, see Ed. Meyer, *loc. cit.* p. 268 and Cooke, *NSI.* p. 218.

[7] First mentioned by E. L. Wilson (1891), rediscovered by G. L. Robinson (1900), described by S. I. Curtis, *P. E. F. Q. St.* 1900), and Savignac, *Rev. bibl.* (1903); with full plan and photographs).

Petrarch's real name according to Tuscan usage was Francesco di Petracco. But he altered this patronymic, for the sake of euphony, to Petrarca, proving by this slight change his emancipation from usages which, had he dwelt at Florence, would most probably have been imposed on him. Petracco, who was very anxious that his eldest son should become an eminent jurist, sent him at the age of fifteen to study law at Montpellier. Like Ovid and many other poets, Petrarch felt no inclination for his father's profession. His intellect, indeed, was not incapable of understanding and admiring the majestic edifice of Roman law; but he shrank with disgust from the illiberal technicalities of practice. There is an authentic story of Petracco's flinging the young student's books of poetry and rhetoric upon the fire, but saving Virgil and Cicero half-burned from the flames at his son's passionate entreaties. Notwithstanding Petrarch's firm determination to make himself a scholar and a man of letters rather than a lawyer, he so far submitted to his father's wishes as to remove about the year 1323 to Bologna, which was then the headquarters of juristic learning. There he stayed with his brother Gherardo until 1326, when his father died, and he returned to Avignon. Banishment and change of place had already diminished Petracco's fortune, which was never large; and a fraudulent administration of his estate after his death left the two heirs in almost complete destitution. The most precious remnant of Petrarch's inheritance was a MS. of Cicero. There remained no course open for him but to take orders. This he did at once on his arrival in Provence; and we have good reason to believe that he advanced in due time to the rank of priest. A great Roman noble and ecclesiastic, Giacomo Colonna, afterwards bishop of Lombez, now befriended him, and Petrarch lived for some years in partial dependence on this patron.

On the 6th of April 1327 happened the most famous event of Petrarch's history. He saw Laura for the first time in the church of St Clara at Avignon. Who Laura was remains uncertain still. That she was the daughter of Audibert de Noves and the wife of Hugh de Sade rests partly on tradition and partly on documents which the abbé de Sade professed to have copied from originals in the 18th century. Nothing is now extant to prove that, if this lady really existed, she was the Laura of the *Canzoniere*, while there are reasons for suspecting that the abbé was either the fabricator of a romance flattering to his own family, or the dupe of some previous impostor. We may, however, reject the sceptical hypothesis that Laura was a mere figment of Petrarch's fancy; and, if we accept her personal reality, the poems of her lover demonstrate that she was a married woman with whom he enjoyed a respectful and not very intimate friendship.

Petrarch's inner life after this date is mainly occupied with the passion which he celebrated in his Italian poems, and with the friendships which his Latin epistles dimly reveal to us. Besides the bishop of Lombez he was now on terms of intimacy with another member of the great Colonna family, the cardinal Giovanni. A German, Ludwig, whom he called Socrates, and a Roman, Lello, who received from him the classic name of Laellius, were among his best-loved associates. Avignon was the chief seat of his residence up to the year of 1333, when he became restless and undertook his first long journey. On this occasion he visited Paris, Ghent, Liége, Cologne, making the acquaintance of learned men and copying the manuscripts of classical authors. On his return to Avignon he engaged in public affairs, pleaded the cause of the Scaligers in their lawsuit with the Rossi for the lordship of Parma, and addressed two poetical epistles to Pope Benedict XII. upon the restoration of the papal see to Rome. His eloquence on behalf of the tyrants of Verona was successful. It won him the friendship of their ambassador, Azzo di Correggio—a fact which subsequently influenced his life in no small measure. Not very long after these events Petrarch made his first journey to Rome, a journey memorable from the account which he has left us of the impression he received from its ruins.

It was some time in the year 1337 that he established himself at Vaucluse and began that life of solitary study, heightened by communion with nature in her loneliest and wildest moods, which distinguished him in so remarkable a degree from the common herd of medieval scholars. Here he spent his time partly among books, meditating on Roman history, and preparing himself for the Latin epic of *Africa*. In his hours of recreation he climbed the hills or traced the Sorgues from its fountain under those tall limestone cliffs, while odes and sonnets to Madonna Laura were committed from his memory to paper. We may also refer many of his most important treatises in prose, as well as a large portion of his Latin correspondence, to the leisure he enjoyed in this retreat. Some woman, unknown to us by name, made him the father of a son, Giovanni, in the year 1337; and she was probably the same who brought him a daughter, Francesca, in 1343. Both children were afterwards legitimized by papal bulls. Meanwhile his fame as a poet in the Latin and the vulgar tongues steadily increased, until, when the first draughts of the *Africa* began to circulate about the year 1339, it became manifest that no one had a better right to the laurel crown than Petrarch. A desire for glory was one of the most deeply-rooted passions of his nature, and one of the points in which he most strikingly anticipated the humanistic scholars who succeeded him. It is not, therefore, surprising to find that he exerted his influence in several quarters with the view to obtaining the honours of a public coronation. The result of his intrigues was that on a single day in 1340, the 1st of September, he received two invitations, from the university of Paris and from King Robert of Naples respectively. He chose to accept the latter, journeyed in February 1341 to Naples, was honourably entertained by the king, and, after some formal disputations on matters touching the poet's art, was sent with magnificent credentials to Rome. There, in the month of April, Petrarch assumed the poet's crown upon the Capitol from the hand of the Roman senator amid the plaudits of the people and the patricians. The oration which he delivered on this occasion was composed upon these words of Virgil:—

> "Sed me Parnassi deserta per ardua dulcis
> Raptat amor."

The ancient and the modern eras met together on the Capitol at Petrarch's coronation, and a new stadium for the human spirit, that which we are wont to style Renaissance, was opened.

With the coronation in Rome a fresh chapter in the biography of Petrarch may be said to have begun. Henceforth he ranked as a rhetorician and a poet of European celebrity, the guest of princes, and the ambassador to royal courts. During the spring months of 1341 his friend Azzo di Correggio had succeeded in freeing Parma from subjugation to the Scaligers, and was laying the foundations of his own tyranny in that city. He invited Petrarch to attend him when he made his triumphal entry at the end of May; and from this time forward for a considerable period Parma and Vaucluse were the two headquarters of the poet. The one he called his Transalpine, the other his Cisalpine Parnassus. The events of the next six years of his life, from May 1341 to May 1347, may be briefly recapitulated. He lost his old friend the bishop of Lombez by death and his brother Gherardo by the entrance of the latter into a Carthusian monastery. Various small benefices were conferred upon him; and repeated offers of a papal secretaryship, which would have raised him to the highest dignities, were made and rejected. Petrarch remained true to the instinct of his own vocation, and had no intention of sacrificing his studies and his glory to ecclesiastical ambition. In January 1343 his old friend and patron Robert, king of Naples, died, and Petrarch was sent on an embassy from the papal court to his successor Joan. The notices which he has left us of Neapolitan society at this epoch are interesting, and, it was now, perhaps, that he met Boccaccio for the first time. The beginning of the year 1345 was marked by an event more interesting in the scholar's eyes than any change in dynasties. This was no less than a discovery at Verona of Cicero's *Familiar Letters*. It is much to be regretted that Petrarch found the precious MS. so late in life, when the style of his own epistles had been already modelled upon that of Seneca and St Augustine.

In the month of May 1347 Cola di Rienzi accomplished that extraordinary revolution which for a short space revived the republic in Rome, and raised this enthusiast to titular equality with kings. Petrarch, who in politics was no less visionary than Rienzi, hailed the advent of a founder and deliverer in the self-styled tribune. Without considering the impossibility of restoring the majesty of ancient Rome, or the absurdity of dignifying the medieval Roman rabble by the name of Populus Romanus, he threw himself with passion into the republican movement, and sacrificed his old friends of the Colonna family to what he judged a patriotic duty.

Petrarch built himself a house at Parma in the autumn of 1347. Here he hoped to pursue the tranquil avocations of a poet honoured by men of the world and men of letters throughout Europe, and of an idealistic politician, whose effusions on the questions of the day were read with pleasure for their style. But in the course of the next two years this agreeable prospect was overclouded by a series of calamities. Laura died of the plague on the 6th of April 1348. Francesco degli Albizzi, Mainardo Accursio, Roberto de' Bardi, Sennuccio del Bene, Luchino Visconti, the cardinal Giovanni Colonna and several other friends followed to the grave in rapid succession. All of these had been intimate acquaintances and correspondents of the poet. Friendship with him was a passion; or, what is more true perhaps, he needed friends for the maintenance of his intellectual activity at the highest point of its effectiveness. Therefore he felt the loss of these men acutely. We may say with certainty that Laura's death, accompanied by that of so many distinguished associates, was the turning-point in Petrarch's inner life. He began to think of quitting the world, and pondered a plan for establishing a kind of humanistic convent, where he might dedicate himself, in the company of kindred spirits, to still severer studies and a closer communion with God. Though nothing came of this scheme, a marked change was henceforth perceptible in Petrarch's literary compositions. The poems written *In Morte di Madonna Laura* are graver and of more religious tone. The prose works touch on retrospective topics or deal with subjects of deep meditation. At the same time his renown, continually spreading, opened to him ever fresh relations with Italian despots. The noble houses of Gonzaga at Mantua, of Carrara at Padua, of Este at Ferrara, of Malatesta at Rimini, of Visconti at Milan, vied with Azzo di Correggio in entertaining the illustrious man of letters. It was in vain that his correspondents pointed out the discrepancy between his professed zeal for Italian liberties, his recent enthusiasm for the Roman republic, and this alliance with tyrants who were destroying the freedom of the Lombard cities. Petrarch remained an incurable rhetorician; and, while he stigmatized the despots in his ode to Italy and in his epistles to the emperor he accepted their hospitality. They, on their part, seem to have understood his temperament, and to have agreed to recognize his political theories as of no practical importance. The tendency to honour men of letters and to patronize the arts which distinguished Italian princes throughout the Renaissance period first manifested itself in the attitude assumed by Visconti and Carraresi to Petrarch.

When the jubilee of 1350 was proclaimed, Petrarch made a pilgrimage to Rome, passing and returning through Florence, where he established a firm friendship with Boccaccio. It has been well remarked that, while all his other friendships are shadowy and dim, this one alone stands out with clearness. Each of the two friends had a distinguished personality. Each played a foremost part in the revival of learning. Boccaccio carried his admiration for Petrarch to the point of worship Petrarch repaid him with sympathy, counsel in literary studies, and moral support which helped to elevate and purify the younger poet's over-sensuous nature. It was Boccaccio who in the spring of 1351 brought to Petrarch, then resident with the Carrara family at Padua, an invitation from the seigniory of Florence to accept the rectorship of their recently founded university. This was accompanied by a diploma of restoration to his rights as citizen and restitution of his patrimony. But, flattering as was the offer, Petrarch declined it. He preferred his literary leisure at Vaucluse, at Parma, in the courts of princes, to a post which would have brought him into contact with jealous priors and have reduced him to the position of the servant of a commonwealth. Accordingly, we find him journeying again in 1351 to Vaucluse, again refusing the office of papal secretary, again planning visionary reforms for the Roman people, and beginning that curious fragment of an autobiography which is known as the *Epistle to Posterity*. Early in 1353 he left Avignon for the last time, and entered Lombardy by the pass of Mont Genèvre, making his way immediately to Milan. The archbishop Giovanni Visconti was at this period virtually despot of Milan. He induced Petrarch, who had long been a friend of the Visconti family, to establish himself at his court, where he found employment for him as ambassador and orator. The most memorable of his diplomatic missions was to Venice in the autumn of 1353. Towards the close of the long struggle between Genoa and the republic of St Mark the Genoese entreated Giovanni Visconti to mediate on their behalf with the Venetians. Petrarch was entrusted with the office; and on the 8th of November he delivered a studied oration before the doge Andrea Dandolo and the great council. His eloquence had no effect; but the orator entered into relations with the Venetian aristocracy which were afterwards extended and confirmed. Meanwhile, Milan continued to be his place of residence. After Giovanni's death he remained in the court of Bernabò and Galeazzo Visconti, closing his eyes to their cruelties and exactions, serving them as a diplomatist, making speeches for them on ceremonial occasions, and partaking of the splendid hospitality they offered to emperors and princes. It was in this capacity of an independent man of letters, highly placed and favoured at one of the most wealthy courts of Europe, that he addressed epistles to the emperor Charles IV. upon the distracted state of Italy, and entreated him to resume the old Ghibelline policy of Imperial interference. Charles IV. passed through Mantua in the autumn of 1354. There Petrarch made his acquaintance, and, finding him a man unfit for any noble enterprise, declined attending him to Rome. When Charles returned to Germany, after assuming the crowns in Rome and Milan, Petrarch addressed a letter of vehement invective and reproach to the emperor who was so negligent of the duties imposed on him by his high office. This did not prevent the Visconti sending him on an embassy to Charles in 1356. Petrarch found him at Prague, and, after pleading the cause of his masters, was despatched with honour and the diploma of count palatine. His student's life at Milan was again interrupted in 1360 by a mission on which Galeazzo Visconti sent him to King John of France. The tyrants of Milan were aspiring to royal alliances; Gian Galeazzo Visconti had been married to Isabella of France;

Violante Visconti, a few years later, was wedded to the English duke of Clarence. Petrarch was now commissioned to congratulate King John upon his liberation from captivity to England. This duty performed, he returned to Milan, where in 1361 he received news of the deaths of his son Giovanni and his old friend Socrates. Both had been carried off by plague.

The remaining years of Petrarch's life, important as they were for the furtherance of humanistic studies, may be briefly condensed. On the 11th of May 1362 he settled at Padua, from the neighbourhood of which he never moved again to any great distance. The same year saw him at Venice, making a donation of his library to the republic of St Mark. Here his friend Boccaccio introduced to him the Greek teacher Leontius Pilatus. Petrarch, who possessed a MS. of Homer and a portion of Plato, never acquired the Greek language, although he attempted to gain some little knowledge of it in his later years. Homer, he said, was dumb to him, while he was deaf to Homer; and he could only approach the *Iliad* in Boccaccio's rude Latin version. About this period he saw his daughter Francesca happily married, and undertook the education of a young scholar from Ravenna, whose sudden disappearance from his household caused him the deepest grief. This youth has been identified, but on insufficient grounds, with that Giovanni Malpaghini of Ravenna who was destined to form a most important link between Petrarch and the humanists of the next age of culture. Gradually his oldest friends dropped off. Azzo di Correggio died in 1362, and Laelius, Simonides, Barbato, in the following year. His own death was reported in 1365; but he survived another decade. Much of this last stage of his life was occupied at Padua in a controversy with the Averroists, whom he regarded as dangerous antagonists both to sound religion and to sound culture. A curious treatise, which grew in part out of this dispute and out of a previous duel with physicians, was the book *Upon his own Ignorance and that of many others*. At last, in 1369, tired with the bustle of a town so big as Padua, he retired to Arquà, a village in Euganean hills, where he continued his usual train of literary occupations, employing several secretaries, and studying unremittingly. All through these declining years his friendship with Boccaccio was maintained and strengthened. It rested on a solid basis of mutual affection and of common studies, the different temperaments of the two scholars securing them against the disagreements of rivalry or jealousy. One of Petrarch's last compositions was a Latin version of Boccaccio's story of Griselda. On the 18th of July 1374 his people found the old poet and scholar dead among his books in the library of that little house which looks across the hills and lowlands towards the Adriatic.

When we attempt to estimate Petrarch's position in the history of modern culture, the first thing which strikes us is that he was even less eminent as an Italian poet than as the founder of Humanism, the inaugurator of the Renaissance in Italy. What he achieved for the modern world was not merely to bequeath to his Italian imitators masterpieces of lyrical art unrivalled for perfection of workmanship, but also, and far more, to open out for Europe a new sphere of mental activity. Standing within the threshold of the middle ages, he surveyed the kingdom of the modern spirit, and, by his own inexhaustible industry in the field of scholarship and study, he determined what we call the revival of learning. By bringing the men of his own generation into sympathetic contact with antiquity, he gave a decisive impulse to that European movement which restored freedom, self-consciousness, and the faculty of progress to the human intellect. He was the first man to collect libraries, to accumulate coins, to advocate the preservation of MSS. For him the authors of the Greek and Latin world were living men—more real, in fact, than those with whom he corresponded; and the rhetorical epistles he addressed to Cicero, Seneca and Varro prove that he dwelt with them on terms of sympathetic intimacy. So far-reaching were the interests controlled by him in this capacity of humanist that his achievement as an Italian lyrist seems by comparison insignificant.

Petrarch's ideal of humanism was essentially a noble one. He regarded the orator and the poet as teachers, bound to complete themselves by education, and to exhibit to the world an image of perfected personality in prose and verse of studied beauty. Self-culture and self-effectuation seemed to him the highest aims of man. Everything which contributed to the formation of a free, impassioned, liberal individuality he regarded as praiseworthy. Everything which retarded the attainment of that end was contemptible in his eyes. The authors of antiquity, the Holy Scriptures and the fathers of the Church were valued by him as one common source of intellectual enlightenment. Eminently religious, and orthodox in his convictions, he did not seek to substitute a pagan for the Christian ideal. This was left for the scholars of the 15th and 16th centuries in Italy. At the same time, the Latin orators, historians and poets were venerated by him as depositories of a tradition only second in importance to revelation. For him there was no schism between Rome and Galilee, between classical genius and sacred inspiration. Though the latter took the first rank in relation to man's eternal welfare, the former was necessary for the perfection of his intellect and the civilization of his manners. With this double ideal in view, Petrarch poured scorn upon the French physicians and the Italian Averroists for their illiberal philistinism, no less than for their materialistic impiety. True to his conception of independent intellectual activity, he abstained from a legal career, refused important ecclesiastical office, and contented himself with paltry benefices which implied no spiritual or administrative duties, because he was resolved to follow the one purpose of his life—self-culture. Whatever in literature revealed the hearts of men was infinitely precious to him; and for this reason he professed almost a cult for St Augustine. It was to Augustine, as to a friend or a confessor, that he poured forth the secrets of his own soul in the book *De contemptu mundi*.

In this effort to realize his truest self Petrarch was eminently successful. Much as he effected by restoring to the world a sound conception of learning, and by rousing that genuine love and curiosity which led to the revival, he did even more by impressing on the age his own full-formed and striking personality. In all things he was original. Whether we regard him as a priest who published poem after poem in praise of an adored mistress, as a plebeian man of letters who conversed on equal terms with kings and princes, as a solitary dedicated to the love of nature, as an amateur diplomatist treating affairs of state with pompous eloquence in missives sent to popes and emperors, or again as a traveller eager for change of scene, ready to climb mountains for the enjoyment of broad prospects over spreading champaigns; in all these divers manifestations of his peculiar genius we trace some contrast with the manners of the 14th century, some emphatic anticipation of the 16th. The defects of Petrarch's character were no less striking than its qualities, and were indeed their complement and counterpart. That vivid conception of intellectual and moral self-culture which determined his ideal took the form in actual life of all-absorbing egotism. He was not content with knowing himself to be the leader of the age. He claimed autocracy, suffered no rival near his throne, brooked no contradiction, demanded unconditional submission to his will and judgment. Petrarch was made up of contradictions. Praising solitude, playing the hermit at Vaucluse, he only loved seclusion as a contrast to the society of courts. While he penned dissertations on the futility of fame and the burden of celebrity he was trimming his sails to catch the breeze of popular applause. No one professed a more austere morality, and few medieval writers indulged in cruder satire on the female sex; yet he passed some years in the society of a concubine, and his living masterpiece of art is the apotheosis of chivalrous passion for a woman. These discords of an undecided nature displayed themselves in his political theories and in his philosophy of conduct. In one mood he was fain to ape the antique patriot; in another he affected the monastic saint. He was clamorous for the freedom of the Roman people; yet at one time he called upon the popes to re-establish themselves in the Eternal City; at another he besought the emperor to make it his headquarters; at a third he hailed in Rienzi the founder of a new republic. He did not perceive that all these plans were incompatible. His relations to the Lombard nobles were equally at variance with his professed patriotism; and, while still a housemate of Visconti and Correggi, he kept on issuing invectives against the tyrants who divided Italy. It would not be difficult to multiply these antitheses in the character and the opinions of this singular man. But it is more to the purpose to remark that they were harmonized in a personality of potent and enduring force.

The point to notice in this complex personality is that Petrarch's ideal remained always literary. As philosopher, politician, historian, essayist, orator, he aimed at lucid and harmonious expression—not, indeed, neglecting the importance of the material he undertook to treat, but approaching his task in the spirit of an artist rather than a thinker or a man of action. This accounts for his bewildering versatility, and for his apparent want of grasp on conditions of fact. Viewed in this light Petrarch anticipated the Italian Renaissance in its weakness—that philosophical superficiality, that tendency to ornate rhetoric, that preoccupation with stylistic trifles, that want of profound conviction and stern sincerity, which stamp its minor literary products with the note of mediocrity. Had Petrarch been possessed with a passion for some commanding principle in politics, morality or science, instead of with the thirst for self-glorification and the ideal of artistic culture, it is not wholly impossible that Italian humanism might have assumed a manlier and more conscientious tone. But this is not a question which admits of discussion; for the conditions which made Petrarch what he was were already potent in Italian society. He did but express the spirit of the period he opened; and it may also be added that his own ideal was higher and severer than that of the illustrious humanists who followed him.

As an author Petrarch must be considered from two points of view—first as a writer of Latin verse and prose, secondly as an Italian lyrist. In the former capacity he was speedily outstripped by more fortunate scholars. His eclogues and epistles and the epic of *Africa*, on which he set such store, exhibit a comparatively limited command of Latin metre. His treatises, orations, and familiar letters, though remarkable for a prose style which is eminently characteristic of the man, are not distinguished by purity of diction. Much as he admired Cicero, it is clear that he had not freed himself from current medieval Latinity. Seneca and Augustine had been too much used by him as models of composition. At the same time it will be conceded that he possessed a copious vocabulary, a fine ear for cadence, and the faculty of expressing every shade of thought or feeling. What he lacked was that insight into the best classical masterpieces, that command of the best classical diction, which is the product of successive generations of scholarship. To attain to this, Giovanni da Ravenna, Colluccio Salutato, Poggio and Filelfo had to labour, before a Poliziano and a Bembo finally prepared the path for an Erasmus. Had Petrarch been born at the close of the 15th instead of at the opening of the 14th century there is no doubt that his Latinity would have been as pure, as versatile, and as pointed as that of the witty stylist of Rotterdam.

With regard to his Italian poetry Petrarch occupies a very different position. The *Rime in Vita e Morte di Madonna Laura* cannot become obsolete, for perfect metrical form has here been married to language of the choicest and the purest. It is true that even in the *Canzoniere*, as Italians prefer to call that collection of lyrics, Petrarch is not devoid of faults belonging to his age, and affectations which have imposed themselves with disastrous effect through his authority upon the literature of Europe. He appealed in his odes and sonnets to a restricted audience already educated by the chivalrous love-poetry of Provence and by Italian imitations of that style. He was not careful to exclude the commonplaces of the school, nor anxious to finish a work of art wholly free from fashionable graces and from contemporary conceits. There is therefore a certain element of artificiality in his treatment; and this, since it is easier to copy defects than excellencies, has been perpetuated with wearisome monotony by versifiers who chose him for their model. But, after making due allowance for peculiarities, the abuse of which has brought the name of Petrarchist into contempt, we can agree with Shelley that the lyrics of the *Canzoniere* "are as spells which unseal the inmost enchanted fountains of the delight which is the grief of love." Much might be written about the peculiar position held by Petrarch between the metaphysical lyrists of Tuscany and the more realistic amorists of succeeding generations. True in this respect also to his anticipation of the coming age, he was the first Italian poet of love to free himself from allegory and mysticism. Yet he was far from approaching the analysis of emotion with the directness of a Heine or De Musset. Though we believe in the reality of Laura, we derive no clear conception either of her person or her character. She is not so much a woman as woman in the abstract; and perhaps on this very account the poems written for her by her lover have been taken to the heart by countless lovers who came after him. The method of his art is so generalizing, while his feeling is so natural, that every man can see himself reflected in the singer and his mistress shadowed forth in Laura. The same criticism might be passed on Petrarch's descriptions of nature. That he felt the beauties of nature keenly is certain, and he frequently touches them with obvious appreciation. Yet he has written nothing so characteristic of Vaucluse as to be inapplicable to any solitude where there are woods and water. The *Canzoniere* is therefore one long melodious monody poured from the poet's soul, with the indefinite form of a beautiful woman seated in a lovely landscape, a perpetual object of delightful contemplation. This disengagement from local circumstance without the sacrifice of emotional sincerity is a merit in Petrarch, but it became a fault in his imitators. Lacking his intensity of passion and his admirable faculty for seizing the most evanescent shades of difference in feeling, they degenerated into colourless and lifeless insipidities made insupportable by the frigid repetition of tropes and conceits which we are fain to pardon in the master.

Petrarch did not distinguish himself by love-poetry alone in the Italian language. His odes to Giacomo Colonna, to Cola di Rienzi and to the princes of Italy display him in another light. They exhibit the oratorical fervour, the pleader's eloquence in its most perfect lustre, which Petrarch possessed in no less measure than subjective passion. Modern literature has nothing nobler, nothing more harmonious in the declamatory style than these three patriotic effusions. Their spirit itself is epoch-making in the history of Europe. Up to this point Italy had scarcely begun to exist. There were Florentines and Lombards, Guelfs and Ghibellines; but even Dante had scarcely conceived of Italy as a nation, independent of the empire, inclusive of her several component commonwealths. To the high conception of Italian nationality, to the belief in that spiritual unity which underlay her many discords and divisions, Petrarch attained partly through his disengagement from civic and local partisanship, partly through his large and liberal ideal of culture.

The materials for a life of Petrarch are afforded in abundance by his letters, collected and prepared for publication under his own eyes. These are divided into *Familiar Correspondence*, *Correspondence in Old Age*, *Divers Letters* and *Letters without a Title*; to which may be added the curious autobiographical fragment entitled the *Epistle to Posterity*. Next in importance rank the epistles and eclogues in Latin verse, the Italian poems and the rhetorical addresses to popes, emperors, Cola di Rienzi and some great men of antiquity. For the comprehension of his character the treatise *De contemptu mundi*, addressed to St Augustine and styled his Secret, is invaluable. Without attempting a complete list of Petrarch's works, it may be well to illustrate the extent of his erudition and his activity as a writer by a brief enumeration of the most important. In the section belonging to moral philosophy, we find *De remediis utriusque fortunae*, a treatise on human happiness and unhappiness; *De vita solitaria*, a panegyric of solitude; *De otio religiosorum*, a similar essay on monastic life, inspired by a visit to his brother Gherardo in his convent near Marseilles. On historical subjects the most considerable are *Rerum memorandarum libri*, a miscellany from a student's commonplace-book, and *De viris illustribus*, an epitome of the biographies of Roman worthies. Three polemical works require mention: *Contra cujusdam anonymi Galli calumnias apologia*, *Contra medicum quendam invectivarum libri*, and *De sui ipsius et multorum ignorantia*—controversial and sarcastic compositions, which grew out of Petrarch's quarrels with the physicians of Avignon and the Averroists of Padua. In this connexion it might also be well to mention the remarkable satires on the papal court, included in the *Epistolae sine titulo*. Five public orations have been preserved, the most weighty of which, in explanation of Petrarch's conception of literature, is the speech delivered on the Capitol upon the occasion of his coronation. Among his Latin poems *Africa*, an epic on Scipio Africanus, takes the first place. Twelve *Eclogues* and three books of *Epistles* in verse close the list. In Italian we possess the *Canzoniere*, which includes odes and sonnets written for Laura during her lifetime, those written for her after her death, and a miscellaneous section containing the three patriotic odes and three famous poetical invectives against the papal court. Besides these lyrical compositions are the semi-epical or allegorical *Trionfi*—Triumphs of Love, Chastity, Death, Fame, Time and Divinity, written in terza rima of smooth and limpid quality. Though these Triumphs, as a whole, are deficient in poetic inspiration, the second canto of the *Trionfo della morte*, in which Petrarch describes a vision of his dead love Laura, is justly famous for reserved passion and pathos tempered to a tranquil harmony.

The complete bibliography of Petrarch forms a considerable volume. Such a work was attempted by Domenico Rossetti (Trieste, 1828). It will be enough here to mention the Basel edition of 1581, in folio, as the basis for all subsequent editions of his collected works. Among editions of the *Canzoniere* special mention may be made of those of Marsand (Padua, 1820), Leopardi in Le Monnier's collection, Mestica (1895), and Cardnui (1899). Nor must Fracassetti's Italian version of the *Letters* (published in 5 vols. by Le Monnier) be neglected. De Sade's *Life* of the poet (Amsterdam, 1764–1767) marks an epoch in the history of his numerous biographies; but this is in many important points untrustworthy, and it has been superseded by Gustav Koerting's exhaustive volume on *Petrarcas Leben und Werke* (Leipzig, 1878). Georg Voigt's *Wiederbelebung des classischen Alterthums* (Berlin, 1859) contains a well-digested estimate of Petrarch's relation to the revival of learning. Mezière's *Petrarque* (1868) is a monograph of merit. English readers may be referred to a little book on Petrarch by Henry Reeve, and to vols. ii. and iv. of Symond's *Renaissance in Italy*. See also Maud F. Jerrold, *Francesco Petrarca, poet and humanist* (1909). (J. A. S.)

PETRE, SIR EDWARD (1631–1699), Jesuit confessor of King James II. of England, was born in Paris. He was the son of Sir Francis Petre, Bart., of Cranham, head of a junior branch of the family of the Barons Petre, and his wife Elizabeth Gage, daughter of Sir John Gage, both strong Roman Catholics. In 1649 he was sent for his education to the Jesuit College at St Omer, and he entered the order under the name of Spencer in 1652, but did not receive the full orders till 1671. In 1679 he succeeded his elder brother in the title and family estates. On the accession of James II. in 1685 he was chosen as confessor by the king, who looked upon him as "a resolute and undertaking man." During the whole of the king's reign Petre was one of his advisers who did the most to encourage him in the policy which ended by producing the revolution of 1688. The king contemplated making him archbishop of York, as the see was then vacant, but the pope, Innocent XI., who was not friendly to the order, would not grant a dispensation to hold it, and even directed Petre's superiors to rebuke him for his excessive ambition. In 1687 he was made privy councillor. When the revolution broke out Petre was compelled to flee disguised as a woman. After his flight he had no further relations with James II. After a visit to Rome, he became head of the Jesuit College at St Omer in 1693, from whence he was transferred to Walten in Flanders in 1697. He died on the 15th of May 1699. A younger brother Charles (1644–1712) was also a member of the order.

PETRE, SIR WILLIAM (*c.* 1505–1572), English politician, was a son of John Petre, a Devon man, and was educated at Exeter College, Oxford, afterwards becoming a fellow of All Souls' College. He entered the public service in early life, owing his introduction therein doubtless to the fact that at Oxford he had been tutor to Anne Boleyn's brother, George Boleyn, Viscount Rochford, and began his official career by serving the English government abroad. In 1536 he was made deputy, or proctor, for the vicar-general, Thomas Cromwell, and as such he presided over the convocation which met in June of this year. In 1543 Petre was knighted and was appointed a secretary of state; in 1545 he was sent as ambassador to the emperor Charles V. A very politic man, he retained his position under Edward VI. and also under Mary, forsaking the protector Somerset at the right moment and winning Mary's goodwill by favouring her marriage with Philip II. of Spain. He resigned his secretaryship in 1557, but took some part in public business under Elizabeth until his death at his residence, Ingatestone, Essex, on the 13th of January 1572.

His son John Petre (1549–1613) was created Baron Petre of Writtle in 1603. The 2nd baron was his son William (1575–1637), whose grandson was William, the 4th baron (*c.* 1626–1684). Denounced by Titus Oates as a papist, the last named was arrested with other Roman Catholic noblemen in 1678 and remained without trial in the Tower of London until his death. His brother John (1629–1684) was the 5th lord, and the latter's nephew, Robert (1689–1713), was the 7th lord. It was Robert's action in cutting a lock of hair from a lady's head which led Pope to write his poem "The Rape of the Lock." The Petres have been consistently attached to the Roman Catholic faith, William Joseph, the 13th baron (1847–1893), being a priest of the Roman church, and the barony is still (1911) in existence. One of the 1st baron's grandsons was William Petre (1602–1677), who translated the *Flos sanctorum* of Pedro de Ribadeneira as *Lives of the Saints* (St Omer, 1699; London, 1730).

See *Genealogical Collections illustrating the History of Roman Catholic Families of England*, vol. i., edited by J. J. Howard and H. F. Burke.

PETREL, the general name of a group of birds (of which more than 100 species are recognized), derived from the habit which some of them possess of apparently walking on the surface of the water as the apostle St Peter (of whose name the word is a diminutive form) is recorded (Matt. xiv. 29) to have done. The petrels, all of which are placed in the family *Procellariidae*, were formerly associated with the *Laridae* (see GULL), but they are now placed as the sole members of the suborder *Tubinares* (the name denoting the characteristic tubular structure of their nostrils) and of the order *Procellariiformes* (see BIRD). They are subdivided into four groups or subfamilies: (1) *Pelecanoidinae* (or *Halodrominae*), containing some three or four species known as diving-petrels, with habits very different from others of the family, and almost peculiar to high southern latitudes from Cape Horn to New Zealand; (2) *Procellariinae*, or petrels proper (and shearwaters); (3) *Diomedeinae*, or albatrosses (see MALLEMUCK); and (4) *Oceanitinae*, containing small sooty-black birds of the genera *Cymodroma*, *Pealea*, *Pelagodroma*, *Garrodia* and *Oceanites*, the distinctive nature of which was first recognized by Coues in 1864.

Petrels are archaic oceanic forms, with great powers of flight, dispersed throughout all the seas and oceans of the world, and some species apparently never resort to land except for the purpose of nidification, though nearly all are liable at times to be driven ashore, and often very far inland, by gales of wind.[1] It would also seem that during the breeding-season many of them are wholly nocturnal in their habits, passing the day in holes of the ground, or in clefts of the rocks, in which they generally nestle, the hen of each pair laying a single white egg, sparsely speckled in a few species with fine reddish dots. Of those species that frequent the North Atlantic, the common Storm-Petrel, *Procellaria pelagica*, a little bird which has to the ordinary eye rather the look of a Swift or Swallow, is the "Mother Carey's chicken" of sailors, and is widely believed to be the harbinger of bad weather; but seamen hardly discriminate between this and others nearly resembling it in appearance, such as Leach's or the Fork-tailed Petrel, *Cymochorea leucorrhoa*, a rather larger but less common bird, and Wilson's Petrel, *Oceanites oceanicus*, the type of the Family *Oceanitidae* mentioned above, which is more common on the American side. But it is in the Southern Ocean that Petrels most abound, both as species and as individuals. The Cape-Pigeon or Pintado Petrel, *Daption capensis*, is one that has long been well known to mariners and other wayfarers on the great waters, while those who voyage to or from Australia, whatever be the route they take, are certain to meet with many more species, some, as *Ossifraga gigantea*, as large as Albatrosses, and several of them called by sailors by a variety of choice names, generally having reference to the strong smell of musk emitted by the birds, among which that of "Stink-pot" is not the most opprobrious. None of the Petrels are endowed with any brilliant colouring—sooty-black, grey of various tints (one of which is often called "blue"), and white being the only hues the plumage exhibits.

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[1] Thus *Oestrelata haesitata*, the Capped Petrel, a species whose proper home seems to be Guadeloupe and some of the neighbouring West-Indian Islands, has occurred in the State of New York, near Boulogne, in Norfolk, and in Hungary (*Ibis*, 1884, p. 202).

The distribution of the several species of Petrels in the Southern Ocean has been treated by A. Milne-Edwards in the *Annales des sciences naturelles* for 1882 (6th series *Zoologie*, vol. xiii. art. 4, pp. 1–22). (A. N.)

PETRIE, GEORGE (1790–1866), Irish antiquary, was the son of James Petrie, a native of Aberdeen, who had settled in Dublin as a portrait and miniature painter. He was born in Dublin in January 1790, and was educated as an artist. Besides attaining considerable reputation as a painter of Irish landscape, he devoted much time to the illustration of the antiquities of the country. In 1828 he was appointed to conduct the antiquarian and historical section of the ordnance survey of Ireland. In 1832 he became editor of the *Dublin Penny Journal*, a periodical designed to disseminate information among the masses, to which he contributed numerous articles on the history of the fine arts in Ireland. Petrie may be regarded as the first scientific investigator of Irish archaeology, his contributions to which are also in themselves of much importance. His *Essay on Round Towers*, for which in 1830 he received the prize of the Irish Academy, still ranks as a standard work. Among his other contributions to Irish archaeology are his *Essay on the Military Architecture of Ireland* and his *History and Antiquities of Tara Hill*. He died on the 17th of January 1866.

See the *Life and Labours in Art and Archaeology of George Petrie*, by William Stokes (1868).

PETRIE, WILLIAM MATTHEW FLINDERS (1853–), English egyptologist, was born at Charlton on the 3rd of June 1853, being the son of William Petrie, C.E. His mother was the daughter of Captain Matthew Flinders, the Australian explorer. He took an early interest in archaeological research, and between 1875 and 1880 was busily engaged in studying ancient British remains at Stonehenge and elsewhere; in 1880 he published his book on Stonehenge, with an account of his theories on this subject. He was also much interested in ancient weights and measures, and in 1875 published a work on *Inductive Metrology*. In 1881 he began a long series of important surveys and excavations in Egypt, beginning with the pyramids at Giza, and following up his work there by excavations at the great temple at Tanis (1884), and discovering and exploring the long-lost Greek city of Naucratis in the Delta (1885), and the towns of Am and Daphnae (1886), where he found important remains of the time when they were inhabited by the Pharaohs. Between 1888 and 1890 he was at work in the Fayum, opening up Hawara, Kahun and Lachish; and in 1891 he discovered the ancient temple at Medum. Much of this work was done in connexion with the Palestine Exploration Fund. By this time his reputation was established. He published in 1893 his *Ten Years' Diggings in Egypt*, was given the honorary degree of D.C.L. by Oxford, and was appointed Edwards Professor of Egyptology at University College, London. In 1894 he founded the Egyptian Research Account, which in 1905 was reconstituted as the British School of Archaeology in Egypt (not to be confused with the Egypt Exploration Fund, founded 1892). Perhaps the most important work which the School has accomplished has been the investigation of the site of Memphis (*q.v.*)

The extent as well as the chronological order of Professor Petrie's excavations may best be shown by a list of his works.

WORKS.—His chief general works on Egyptian subjects are, *Ten Years' Diggings in Egypt* (1893); *History of Egypt* (1894–1905); *Egyptian Tales* (1895); *Religion and Conscience in Ancient Egypt* (1898); *Syria and Egypt* (1898); *Royal Tombs of the First Dynasty* (1900); *Royal Tombs of the Earliest Dynasties* (1901); *Hyksos and Israelite Cities* (1906); *Religion of Ancient Egypt* (1906); *Personal Religion in Egypt* (1908). On particular sites, *Pyramids and Temples of Gizeh* (1883); *Tanis I.* (1885); *Nankratis I.* (1886); *Hawara* (1889); *Kahun* (1890); *Illahun* (1891); *Medum* (1892); *Tell el Amarna* (1895); *Koptos* (1896); *Nogada* (1896); *Six Temples at Thebes* (1897); *Deshasheh* (1897); *Dendereh* (1900); *Diospolis* (1901); *Abydos I.* (1902); *Abydos II.* (1903); *Ehnasya* (1904); *Egyptians in Sinai* and *Researches in Sinai* (1906); *Gizeh and Rifeh* (1907); *Athribis* (1908); *Memphis* and *Qurneh* (1909).

PETRIOU (also called *Cha-chang-sao*), a town and port of Siam, in the division of Pachim, about 45 m. E. of Bangkok. It is the centre of that part of southern Siam which is watered by the Bang Pakong River. It is built on low-lying, swampy ground, about 10 m. from the mouth of the above river. The population is about 10,000, mixed Siamese and Chinese, the latter slightly predominating. Rice-mills give employment to a large number of indentured Chinese coolies, but the inhabitants are chiefly engaged in agriculture. A railway connecting with Bangkok was opened in the spring of 1908.

PETROLEA, a town and port of entry in Lambton county, Ontario, Canada, situated 42 m. W. of London on Bear Creek, an affluent of Sydenham River, and on the Grand Trunk and Michigan Central railways. Pop. (1901), 4135. It is in the midst of the oil region of Canada, and numerous wells in the vicinity have an aggregate output of about 30,000,000 gallons of crude oil per annum, much of which is refined in the town.

PETROLEUM (Lat. *petra*, rock, and *oleum*, oil), a term which, in its widest sense, embraces the whole of the hydrocarbons, gaseous, liquid and solid, occurring in nature (see BITUMEN). Here the application of the term is limited to the liquid which is so important an article of commerce, though references will also be made to natural gas which accompanies petroleum. Descriptions of the solid forms will be found in the articles on asphalt or asphaltum, albertite, elaterite, gilsonite, hatchettite and ozokerite. Particulars of the shales which yield oil on destructive distillation are given in the article on paraffin.

Ancient History.—Petroleum was collected for use in the most remote ages of which we have any records. Herodotus describes the oil pits near Ardericca (near Babylon), and the pitch spring of Zacynthus (Zante), whilst Strabo, Dioscorides and Pliny mention the use of the oil of Agrigentum, in Sicily, for illumination, and Plutarch refers to the petroleum found near Ecbatana (Kerkuk). The ancient records of China and Japan are said to contain many allusions to the use of natural gas for lighting and heating. Petroleum ("burning water") was known in Japan in the 7th century, whilst in Europe the gas springs of the north of Italy led to the adoption in 1226 by the municipality of Salsomaggiore of a salamander surrounded by flames as its emblem. Marco Polo refers to the oil springs of Baku towards the end of the 13th century; the medicinal properties of the oil of Tegernsee in Bavaria gave it the name of "St Quirinus's Oil" in 1436; the oil of Pechelbronn, Elsass, was discovered in 1498, and the "earthbalsam" of Galicia was known in 1506. The earliest mention of American petroleum occurs in Sir Walter Raleigh's account of the Trinidad pitch-lake in 1595; whilst thirty-seven years later, the account of a visit of a Franciscan, Joseph de la Roche d'Allion, to the oil springs of New York was published in Sagard's *Histoire du Canada*. In the 17th century, Thomas Shirley brought the natural gas of Wigan, in Shropshire, to the notice of the Royal Society. In 1724 Hermann Boernaave referred to the oleum terrae of Burma, and "Barbados tar" was then well known as a medicinal agent. A Russian traveller, Peter Kalm, in his work on America, published in 1748, showed on a map the oil springs of Pennsylvania, and about the same time Raicevich referred to the "liquid bitumen" of Rumania.

Modern Development and Industrial Progress.—The first commercial exploitation of importance appears to have been the distillation of the oil at Alfreton in Derbyshire by James Young, who patented his process for the manufacture of paraffin in 1850. In 1853 and 1854 patents for the preparation of this substance from petroleum were obtained by Warren de la Rue, and the process was applied to the "Rangoon oil" brought to Great Britain from Yenangyaung in Upper Burma. The active growth of the petroleum industry of the United States began in 1859, though in the early part of the century the petroleum of Lake Seneca, N.Y., was used as an embrocation under the name of "Seneca oil," and the "American Medicinal Oil" of Kentucky was largely sold after its discovery in 1829. The Pennsylvania Rock Oil Company was formed in 1854, but its operations were unsuccessful, and in 1858 certain of the members founded the Seneca Oil Company, under whose direction E. L. Drake started a well on Oil Creek, Pennsylvania. After drilling had been carried to a depth of 69 feet, on the 28th of August 1859, the tools suddenly dropped into a crevice, and on the following day the well was found to have "struck oil." This well yielded 25 barrels a day for some time, but at the end of the year the output was at the rate of 15 barrels. The production of crude petroleum in the United States was officially reported to have been 2000 barrels in 1859, 4,215,000 barrels in 1869, 19,914,146 barrels in 1879, 35,163,513 barrels in 1889, 57,084,428 barrels in 1899, and 126,493,936 barrels in 1906. From Oil Creek, development spread first over the eastern United States and then became general, subsequently embracing Canada (1862), recently discovered fields being those of Illinois, Alberta and California (44,854,737 barrels in 1908).

For about 10 years Pennsylvania was the one great oil producer of the world, but since 1870 the industry has spread all over the globe. From the time of the completion on the Baku field of the first flowing well (which was unmanageable and resulted in the loss of the greater part of the oil), Russia has ranked second in the list of producing countries, whilst Galicia and Rumania became prominent in 1878 and 1880 respectively. Sumatra, Java and Borneo, where active development began in 1883, 1886 and 1896, bid fair to rank before long among the chief sources of the oil supplies of the world. Similarly, Burma, where the Burmah Oil Company have, since 1890, rapidly extended their operations, is rising to a position of importance. Oil fields are being continually opened up in other parts of the world, and whilst America still maintains her position as the largest petroleum producer, the world's supplies are now being derived from a steadily increasing number of centres.

Physical and Chemical Properties.—Although our information respecting the chemical composition of petroleum has been almost entirely gained since the middle of the 18th century, a considerable amount of empirical knowledge of the substance was possessed by chemists at an earlier date, and there was much speculation as to its origin. In his *Sylva sylvarum* (1627), Francis Bacon states that "the original concretion of bitumen is a mixture of a fiery and watery substance," and observes that flame "attracts" the naphtha of Babylon "afar off." P. J. Macquer (1764), T. O. Bergman (1784) Charles Hatchett (1798) and others also expressed views with regard to the constitution and origin of bitumens. Of these early writers, Hatchett is the most explicit, the various bituminous substances being by him classified and defined. Jacob Joseph Winterl, in 1788, appears to have been the first to examine petroleum chemically, but the earliest systematic investigation was that carried out by Professor B. Silliman, Jun., in 1855, who then reported upon the results which he had obtained with the "rock oil or petroleum" of Venango county, Pennsylvania. This report has become a classic in the literature of petroleum.

The physical properties of petroleum vary greatly. The colour ranges from pale yellow through red and brown to black or greenish, while by reflected light it is, in the majority of cases, of a green hue. The specific gravity of crude petroleum appears to range from ·771 to 1·06, and the flash point from below 0° to 370°F. Viscosity increases with density, but oils of the same density often vary greatly; the coefficient of expansion, on the other hand, varies inversely with the density, but bears no simple relation to the change of fluidity of the oil under the influence of heat, this being most marked in oils of paraffin base. The calorific power of Baku oil appears to be highest, while this oil is poorest in solid hydrocarbons, of which the American petroleums contain moderate quantities, and the Upper Burma oils the largest amount. The boiling point, being determined by the character of the constituents of the oil, necessarily varies greatly in different oils, as do the amounts of distillate obtained from them at specified temperatures.

Even prior to the discovery of petroleum in commercial quantities, a number of chemists had made determinations of the chemical composition of several different varieties, and these investigations, supplemented by those of a later date, show that petroleum consists of about 84% by weight of carbon with 12% of hydrogen, and varying proportions of sulphur, nitrogen and oxygen. The principal elements are found in various combinations, the hydrocarbons of the Pennsylvania oils being mainly paraffins (*q.v.*), while those of Caucasian petroleum belong for the most part to the naphthenes, isomeric with the olefines (*q.v.*).

Paraffins are found in all crude oils, and olefines in varying proportions in the majority, while acetylene has been found in Baku oil; members of the benzene group and its derivatives, notably benzene and toluene, occur in all petroleums. Naphthenes are the chief components of some oils, as already indicated, and occur in varying quantities in many others. Certain crude oils have also been found to contain camphenes, naphthalene and other aromatic hydrocarbons. It is found that transparent oils under the influence of light absorb oxygen, becoming deeper in colour and opalescent, while strong acidity and a penetrating odour are developed, these changes being due to the formation of various acid and phenylated compounds, which are also occasionally found in fresh oils. The residues from petroleum distillation have been shown to contain very dense solids and liquids of high specific gravity, having a large proportion of carbon and possessed of remarkable fluorescent properties.

Natural gas is found to consist mainly of the lower paraffins, with varying quantities of carbon dioxide, carbon monoxide, hydrogen, nitrogen and oxygen, in some cases also sulphuretted hydrogen and possibly ammonia. This mixture dissolves in petroleum, escaping when the oil is stored, and conversely it invariably carries a certain amount of water and oil, which is deposited on compression.

Occurrence.—Bitumen is, in its various forms, one of the most widely-distributed of substances, occurring in strata of every geological age, from the lowest Archean rocks to those now in process of deposition, and in greater or less quantity throughout both hemispheres, from Spitzbergen to New Zealand, and from California to Japan. The occurrence of commercially valuable petroleum is, however, comparatively limited, hitherto exploited deposits being confined to rocks younger than the Cambrian and older than the Quaternary, while the majority of developed oil-fields have been discovered north of the equator.

The main requisites for a productive oil or gas field are a porous reservoir and an impervious cover. Thus, while the mineral may be formed in a stratum other than that in which it is found, though in many cases it is indigenous to it, for the formation of a natural reservoir of the fluid (whether liquid or gas) it is necessary that there should be a suitable porous rock to contain it. Such a rock is typically exemplified by a coarse-grained sandstone or conglomerate, while a limestone may be naturally porous, or, like the Trenton limestone of Ohio and Indiana, rendered so by its conversion into dolomite and the consequent production of cavities due to shrinkage—a change occurring only in the purer limestones. Similarly it is necessary, in view of the hydrostatical relations of water and mineral oils, and the volatile character of the latter, that the porous stratum should be protected from water and air by an overlying shale or other impervious deposit. Water, often saline or sulphurous, is also found in these porous rocks and replaces the oil as the latter is withdrawn.

In addition to these two necessary factors, structural conditions play an important part in determining the accumulation of oil and gas. The main supplies have been obtained from strata unbroken and comparatively undisturbed, but the occurrence of anticlinal or terrace structure, however slightly marked or limited in extent, exerts a powerful influence on the creation of reservoirs of petroleum. These tectonic arches often extend for long distances with great regularity, but are frequently crossed by subsidiary anticlines, which themselves play a not unimportant part in the aggregation of the oil. Owing to difference of density the oil and water in the anticlines separate into two layers, the upper consisting of oil which fills the anticlines, while the water remains in the synclines. Any gas which may be present rises to the summits of the anticlines. When the slow folding of the strata is accompanied by a gradual local descent, a modified or "arrested" anticlinal structure, known as a "terrace" is produced, the upheaving action at that part being sufficient only to arrest the descent which would otherwise occur. The terraces may thus be regarded as flat and extended anticlines. They need not be horizontal, and sometimes have a dip of a few feet per mile, as in the case of the Ohio and Indiana oil fields, where the amount varies from one to ten feet. These slight differences in level, however, are found to have a most powerful effect in the direction already mentioned.

It is evident that accurate knowledge of the character and structure of the rock-formations in petroliferous territories is of the greatest importance in enabling the expert to select favourable sites for drilling operations; hence on well-conducted petroleum-properties it is now customary to note the character and thickness of the strata perforated by the drill, so that a complete section may be prepared from the recorded data. In some cases the depths are stated with reference to sea-level, instead of being taken from the surface, thus greatly facilitating the utilization of the records.

Oil and gas are often met with in drilled wells under great pressure, which is highest as a rule in the deepest wells. The closed pressure in the Trenton limestone in Ohio and Indiana is about 200–300 lb. per sq. in., although a much higher pressure has been registered in many wells. The gas wells of Pennsylvania indicate about double the pressure of those drilled in the Trenton limestone, 600–800 lb. not being unusual, and even 1000 lb having been recorded. The extremely high pressure under which oil is met with in wells drilled in some parts of the Russian oil fields is a matter of common knowledge, and a fountain or spouting well resulting therefrom is one of the "sights" of the country. A famous fountain in the Groznyi oil field in the northern Caucasus, which began to flow in August 1895, was estimated to have thrown up during the first three days 1,200,000 poods (over 4,500,000 gallons, or about 18,500 tons) of oil a day. It flowed continuously, though in gradually diminishing quantity, for fifteen months; afterwards the flow became intermittent. In April 1897 there was still an occasional outburst of oil and gas.

Three theories have been propounded to account for this pressure:—

1. That it results from the weight of the overlying strata.

2. That it is due to water-pressure, as in artesian wells ("hydrostatic" or "artesian" theory).

3. That it is caused by the compressed condition of the gradually accumulating gas.

Of these the first has been proved untenable, and while in some instances (*e.g.* certain wells in Ohio), the second has held good, the third appears to be the most widely applicable.

The conditions of formation and accumulation of petroleum point to the fact that the principal oil fields of the world are merely reservoirs, which will become exhausted in the course of years, as in the case of the decreasing yield of certain of the American fields. But new deposits are continually being exploited, and there may be others as yet unknown, which would entirely alter any view that might be expressed at the present time in regard to the probable duration of the world's supply of oil and gas.

As already stated, every one of the great geological systems appears to have produced some form of bitumen, and in the following table an attempt has been made to classify on this basis the various localities in which petroleum or natural gas has been found in large or small quantities:—

Recent.—Lancashire (Down Holland Moss), Holland, Sweden, Sardinia, Kaluga (Russia), Red Sea, Mediterranean.

Pleistocene.—Schleswig-Holstein, Minnesota, Illinois, Louisiana.

Pliocene.—Spain, Italy, Albania, Croatia, Hungary, Hesse, Hanover, Transcaspia, Algeria, Florida, Alabama, California, Mexico, Peru, Victoria, New Zealand.

Miocene.—France, Switzerland, Spain, Italy, Sicily, Greece, Rumania, Turkey-in-Europe, Styria, Slavonia, Hungary, Transylvania, Galicia, Lower Austria, Württemberg, Brandenberg, West Prussia, Crimea, Kuban, Terek, Kutais, Tiflis, Elizabetpol, Siberia, Transcaspia, Mesopotamia, Persia, Assam, Burma, Anam, Japan, Philippine Islands, Borneo, Sumatra, Java, Algeria, Egypt, British Columbia, Alaska, Washington, California, Colorado, Texas, Louisiana, Barbados, Trinidad, Venezuela, Peru, South Australia, Victoria, New Zealand.

Oligocene.—France, Spain, Greece, Rumania, Hungary, Transylvania, Galicia, Bavaria, Elsass, Rhenish Bavaria, Hesse, Saxony, Crimea, Daghestan, Tiflis, Baku, Alaska, California, Florida.

Eocene.—Devonshire (retinasphalt), France, Spain, Italy, Asia Minor, Montenegro, Bosnia and Herzegovina, Rumania, Dalmatia, Istria, Hungary, Transylvania, Galicia, Moravia, Bavaria, Elsass, Kutais, Armenia, Persia, Baluchistan, Afghanistan, Punjab, Assam, Sumatra, Algeria, Egypt, Maryland, Colorado, Utah, Nevada, California, Louisiana, Texas, Cuba, Colombia, Brazil.

Cretaceous.—Holland, France, Switzerland, Spain, Italy, Sicily, Greece, Hungary, Silesia, Moravia, Westphalia, Brunswick, Hanover, Schleswig-Holstein, (German) Silesia, Poland, Kutais, Uralsk, Turkestan, Armenia, Syria, Arabia, Persia, Tunis, Egypt, West Africa, British Columbia, Alberta, Assiniboia, Athabasca, Manitoba, New Jersey, South Dakota, Washington, Montana, Oklahoma, Utah, Wyoming, Colorado, California, New Mexico, Arkansas, Texas, Louisiana, Mexico, Hayti, Trinidad, Colombia, Argentina [?], New Zealand.

Neocomian.—Sussex, France, Switzerland, Spain, Hungary, Transylvania, Bukowina, Galicia, Hesse, Baden, Hanover, Brunswick, California, Texas, Mexico, Bolivia, Argentina.

Jurassic.—Yorkshire, Somerset, Buckingham, France, Switzerland, Spain, Italy, Lower Austria, Baden, Elsass, Hesse, Hanover, Brunswick, Sizran, Tiflis, Siberia, Persia, Madagascar, Alaska, Wyoming, Colorado, Mexico, Argentina.

Triassic.—Yorkshire, Staffordshire, France, Portugal, Spain, Italy, Montenegro, Upper Austria, Tyrol, Bavaria, Württemberg, Baden, Elsass, Lothringen, Rhenish Bavaria, Rhenish Prussia, Hanover, Brunswick, Sweden, Spitzbergen, Punjab, China, Transvaal, Cape Colony, Connecticut, New Jersey, Virginia, North Carolina, Wyoming, Argentina, New South Wales, Queensland.

Permian.—Yorkshire, Denbigh, Moravia, Bohemia, Baden, Saxony, Vologda, Afa, Kazan, Simbirsk, Samara, Kansas, Wyoming, Oklahoma, Texas (Permo-Carboniferous).

Carboniferous.—Scotland, North of England, and Midlands, Wales, France, Belgium, Carniola, Moravia, Elsass, Saxony, Perm, Sizran, China, Cape Colony, Nova Scotia, Newfoundland, Pennsylvania, West Virginia, Ohio, Michigan, Indiana, Illinois, Iowa, Missouri, Tennessee, Kentucky, Alabama, Kansas, Arkansas, Colorado, Oklahoma, Tasmania, Victoria (Permo-Carboniferous), West Australia (Permo-Carboniferous).

Devonian.—Scotland, Devonshire, Spain, Hanover, Archangel, Vitebsk, Athabasca, Mackenzie, Ontario, Quebec, New Brunswick, Newfoundland, New York, Pennsylvania, West Virginia, Ohio, Michigan, Wisconsin, Kentucky.

Silurian.—Shropshire, Wales, Bohemia, Sweden, Esthonia, Manitoba, Ontario, Quebec, Newfoundland, New York, Pennsylvania [?], Ohio, Michigan, Indiana, Illinois, Minnesota, Tennessee, Kentucky, Georgia, Alabama, Oklahoma, New Mexico, New Caledonia.

Cambrian.—Shropshire, New York.

Archean.—France, Norway, Sweden, Ontario.

In this list, while certain occurrences in rocks of undetermined age in little-known regions have been omitted, many of those included are of merely academic interest, and a still larger number indicate fields supplying at present only local needs. All have been arranged in geographical order without reference to productive capacity or importance. It should be pointed out that the deposits which have been hitherto of chief commercial importance occur in the old rocks (Carboniferous to Silurian) on the one hand, and in the comparatively new Tertiary formations on the other, the intermediate periods yielding but little or at any rate far less abundantly.

Origin.—The question of the origin of petroleum (and natural gas), though for the first half of the 19th century of little more than academic interest, has engaged the attention of naturalists and others for over a hundred years. As early as 1804, Humboldt expressed the opinion that petroleum was produced by distillation from deep-seated strata, and Karl Reichenbach in 1834, suggested that it was derived from the action of heat on the turpentine of pine-trees, whilst Brunet, in 1838, adumbrated a similar theory of origin on the ground of certain laboratory experiments. The theories propounded may be divided into two groups, namely, those ascribing to petroleum an inorganic origin, and those which regard it as the result of the decomposition of organic matter.

M. P. E. Berthelot was the first to suggest, in 1866, after conducting a series of experiments, that mineral oil was produced by purely chemical action, similar to that employed in the manufacture of acetylene. Other theories of a like nature were brought forward by various chemists, Mendeléeff, for example, ascribing the formation of petroleum to the action of water at high temperatures on iron carbide in the interior of the earth.

On the other hand, an overwhelming and increasing majority of those who have studied the natural conditions under which petroleum occurs are of opinion that it is of organic origin. The earlier supporters of the organic theory held that it was a product of the natural distillation of coal or carbonaceous matter; but though in a few instances volcanic intrusions appear to have converted coal or allied substances into oil, it seems that terrestrial vegetation does not generally give rise to petroleum. Among those who have considered that it is derived from the decomposition of both animal and vegetable marine organisms may be mentioned J. P. Lesley, E. Orton and S. F. Peckham, but others have held that it is of exclusively animal origin, a view supported by such occurrences as those in the orthoceratities of the Trenton limestone, and by the experiments of C. Engler, who obtained a liquid like crude petroleum by the distillation of menhaden (fish) oil. Similarly there is a difference of opinion as to the conditions under which the organisms have been mineralized, some holding that the process has taken place at a high temperature and under great pressure; but the lack of practical evidence in nature in support of these views has led many to conclude that petroleum, like coal, has been formed at moderate temperatures, and under pressures varying with the depth of the containing rocks. This view is supported by the fact that petroleum is found on the Sardinian and Swedish coasts as a product of the decomposition of seaweed, heated only by the sun, and under atmospheric pressure.

Consideration of the evidence leads us to the conclusion that, at least in commercially valuable deposits, mineral oil has generally been formed by the decomposition of marine organisms, in some cases animal, in others vegetable, in others both, under practically normal conditions of temperature and pressure.

Early Methods.

Extraction (*Technically termed Production.*)—The earliest system adopted for the collection of petroleum appears to have consisted in skimming the oil from the surface of the water upon which it had accumulated, and Professor Lesley states that at Paint Creek, in Johnson county, Kentucky, a Mr George and others were in the habit of collecting oil from the sands, "by making shallow canals 100 or 200 ft. long, with an upright board and a reservoir at one end, from which they obtained as much as 200 barrels per year by stirring the sands with a pole." It is said that at Echigo in Japan, old wells, supposed to have been dug several hundred years ago, are existent, and that a Japanese history—called *Kokushiriyaku*, states that "burning water" was obtained in Echigo about A.D. 615.

The United States.

The petroleum industry in the United States may be considered to date from the year 1859, when the first well avowedly drilled for the production of oil was completed by E. L. Drake. The present method of drilling has been evolved from the artesian well system previously adopted for obtaining brine and water. The drilling of petroleum wells is carried on by individuals or companies, either on lands owned by them, or on properties whose owners grant leases, usually on condition that a certain number of wells shall be sunk within a stated period, and that a portion of the oil obtained (usually from one-tenth to one-fourth) shall be appropriated as royalty to the lessor. Such leases are often transferred at a larger royalty, especially after the territory has been proved productive. The "wild-cat" wells, sunk by speculators on untested territory or on lands which had not previously proved productive, played an important part in the earlier mapping out of the petroleum fields. To discourage the sinking of wells on land immediately adjoining productive territory, it has been usual to drill along the borders of the land as far as practicable, in order to first obtain the oil which might otherwise be raised by others; and on account of the small area often controlled by the operator, the number of wells drilled has frequently been far in excess of the number which might reasonably be sunk. Experience has proved that in some of the oil fields of the United States one well to five acres is as close as they should be drilled.

Oil Derrick.

After the selection of the site, the first operation consists in the erection of the rig. The chief portion of this rig is the derrick, which consists of four strong uprights or legs held in position by ties and braces, and resting on strong wooden sills, which are preferred, as a foundation, to masonry. For drilling the deeper wells, the derrick, on account of the length of the "string" of drilling tools, is usually at least 70 ft. high, about 20 ft. wide at the base, and 4 ft. wide at the summit. The whole derrick is set up by keys, no mortices or tenons being used, and thus the complete rig may be readily taken down and set up on a new site. The samson-post, which supports the walking beam, and the jack-posts, are dove-tailed and keyed into the sills. The samson-post is placed flush with one side of the main sill, the band-wheel jack-post being flush with the other side, so that the walking-beam, which imparts motion to the string of tools, works parallel with the main sill.

The boiler generally used is of the locomotive type and is usually stationary, though sometimes a portable form is preferred. It is either set in the first instance at some distance from the engine and well, or is subsequently removed sufficiently far away before the drill enters the oil-bearing formation, and until the oil and gas are under control, in order to minimize the risk of fire. A large boiler frequently supplies the engines of several wells. The engine, which is provided with reversing gear, is of 12 or 15 horse-power and motion is communicated through a belt to the band-wheel, which operates the walking-beam by means of a crank. The throttle-valve is opened or closed by turning a grooved vertical pulley by means of an endless cord, called the telegraph, passing round another pulley fixed upon the "headache-post," and is thus under the control of the driller working in the derrick. The headache-post is a vertical wooden beam placed on the main sill directly below the walking-beam, to receive the weight of the latter in case of breakage of connexions. The position of the reversing link is altered by means of a cord, passing over two pulleys, fixed respectively in the engine-house and on the derrick. At one end of the band-wheel shaft is the bull-rope pulley, and upon the other end is a crank having six holes to receive a movable wrist-pin, the length of stroke of the walking-beam being thus adjusted. The revolution of the bull-wheels is checked by the use of a powerful hand-brake.

The band-wheel communicates motion to the walking-beam, while drilling is in progress, through the crank and a connecting-rod known as the pitman; to the bull-wheels, while the tools are being raised, by the bull-rope; and to the sand-pump reel, by a friction pulley, while the sand-pump is being used. It is therefore necessary that the machinery should be so arranged that the connexions may be rapidly made and broken. The sand-pump reel is set in motion by pressing a lever, the reel being then brought into contact with the face of the band-wheel. The sand-pump descends by gravitation, and its fall is checked by pressing back the lever, so as to throw the reel against a post which serves as a brake.

Drilling Tools.

The drilling tools are suspended by an untarred manila rope, 2 in. in diameter, passing from the bull-wheel shaft over a grooved wheel known as the crown-pulley, at the summit of the derrick. The string of drilling tools consists of two parts separated by an appliance known as the jars. This piece of apparatus was introduced by William Morris in 1831, and consists of a long double link with closely-fitting jaws which, however, slide freely up and down. It may be compared to a couple of elongated and flattened links of chain. The links are about 30 in. long and are interposed between the heavy iron auger-stem carrying the bit and the upper rod, known as the sinker-bar. Their principal use is to give a sharp jar to the drill on the up-stroke so that the bit is dislodged if it has become jammed in the rock. In addition to the appliances mentioned the tools comprise reamers to enlarge the bore of the well, the winged-substitute which is fitted above the bit to prevent it from glancing off, and above the round reamer to keep it in place, a temper-screw with clamps and wrenches. Sand-pumps and bailers are also required to remove detritus, water and oil from the bore-hole.

The action of the jars and temper-screw has been described by John F. Carll as follows: "Suppose the tools to have been just run to the bottom of the well, the jars closed and the cable slack. The men now take hold of the bull-wheels and draw up the slack until the sinker-bar rises, the 'play' of the jars allowing it to come up 13 in. without disturbing the auger-stem. When the jars come together they slack back about 4 in., and the cable is in position to be clamped in the temper-screw. If now the vertical movement of the walking-beam be 24 in., when it starts on the up-stroke the sinker-bar rises 4 in., and the cross-heads come together with a smart blow, then the auger-stem is picked up and lifted 20 in. On the down-stroke, the auger-stem falls 20 in., while the sinker-bar goes down 24 in. to telescope the jars for the next blow coming up. A skilful driller never allows his jars to strike on the down-stroke, they are only used to jar down when the tools stick on some obstruction in the well before reaching the bottom, and in fishing operations. An unskilful workman sometimes 'loses the jar' and works for hours without accomplishing anything. The tools may be standing at the bottom while he is playing with the slack of the cable or they may be swinging all the time several feet from the bottom. As the jar works off, or grows more feeble, by reason of the downward advance of the drill, it is 'tempered' to the proper strength by letting down the temper-screw to give the jars more play. The temper-screw forms the connecting link between the walking-beam and cable, and it is 'let out' gradually to regulate the play of the jars as fast as the drill penetrates. When its whole length is run down, the rope clamps play very near the well-mouth. The tools are then withdrawn, the well is sand-pumped, and preparations are made for the next 'run.'"

The ordinary sand-pump or bailer, consists of a plain cylinder of light galvanized iron with a bail at the top and a stem-valve at the bottom. It is usually about 6 ft. in length but is sometimes as much as 15 or 20 ft., and as its valve-stem projects downwards beyond the bottom, it empties itself when rested upon the bottom of the waste-trough.

The operation of drilling is frequently interrupted by the occurrence of an accident, which necessitates the use of fishing tools. If the fishing operation is unsuccessful the well has to be abandoned, often after months of labour, unless it is found possible to drill past the tools which have been lost. In readiness for a fracture of the drilling tools or of the cable, special appliances known as fishing tools are provided. These are so numerous and varied in form that a description would be impossible within the scope of this article. The fishing tools are generally attached to the cable, and are used with portions of the ordinary string of tools, but some are fitted to pump-rods or tubing, and others to special rods.

Drilling the Well.

The drilling of a well is commonly carried out under contract, the producer erecting the derrick and providing the engine and boiler while the drilling contractor finds the tools, and is responsible for accidents or failure to complete the well. The drilling "crew" consists of two drillers and two tool-dressers, working in pairs in two "tours" (noon to midnight and midnight to noon).

The earlier wells in Pennsylvania consisted of three sections, the first formed of surface clays and gravels, the second of stratified rocks containing water, and the third of stratified rocks, including the oil-sands, usually free from water. The conductor, which was a wooden casing of somewhat greater internal diameter than the maximum bore of the well, passed through the first of these divisions, and casing was used in the second to prevent percolation of water into the oil-bearing portion. In later wells the conductor has been replaced with an 8-in. wrought-iron drive-pipe, terminating in a steel shoe, which is driven to the bed-rock, and a 7⅞-in. hole is drilled below it to the base of the lowest water-bearing stratum. The bore is then reduced to 5⅝ in., and a bevelled shoulder being made in the rock, a 5⅝-in. casing, having a collar to fit water-tight on the bevel shoulder, is inserted. The well is then completed with a 5½ in. bit. As the water is shut off before the portion of the well below the water-bearing strata is bored the remainder of the drilling is conducted with only sufficient water in the well to admit of sand-pumping. The drill is thus allowed to fall freely, instead of being partly upheld by the buoyancy of the water, as in earlier wells.

Wells in Pennsylvania now range in depth from 300 ft. to 3700 ft. Four strings of iron casing are usually employed, having the following diameters: 10 in., $8\frac{1}{4}$ in., $6\frac{1}{4}$ in. and 5 in., the lengths of tube forming the casing being screwed together. Contractors will often undertake to drill wells of moderate depth at 90 cents to $1 per foot, but the cost of a deep well may amount to as much as $7000.

Rotary System.

The rotary system of drilling which is in general use in the oil-fields of the coastal plain of Texas is a modification of that invented by Fauvelle in 1845, and used in the early years of the industry in some of the oil-producing countries of Europe. It is one of the most rapid and economical which can be employed in soft formations, but where hard rock is encountered it is almost useless. The principle of this system consists essentially in the use of rotating hollow drilling rods or casing, to which is attached the drilling-bit and through which a continuous stream of water, under a pressure of 40 to 100 lb. per sq. in., is forced.

Yield of Wells.

The yield of petroleum wells varies within very wide limits, and the relative importance of the different producing districts is also constantly changing. I. C. White, state geologist of West Virginia, estimates that in fairly good producing sand a cubic foot of rock contains from 6 to 12 pints of oil. He assumes that in what is considered a good producing district the amount of petroleum which can be obtained from a cubic foot of rock would not be more than a gallon, and that the average thickness of the oil-bearing rock would not exceed 5 ft. Taking these figures as a basis, the total yield of oil from an acre of petroliferous territory would be a little over 5000 barrels of 42 U.S. gallons.

A flow of oil may often be induced in a well which would otherwise require to be pumped, by preventing the escape of gas which issues with the oil, and causing its pressure to raise the oil. The device employed for this purpose is known as the water-packer, and consists in its simplest form of an india-rubber ring, which is applied between the tubing and the well-casing, so that upon compression it makes a tight joint. The gas thus confined in the oil-chamber forces the oil up the tubing.

For pumping a well a valved working-barrel with valved sucker is attached to the lower end of the tubing, a perforated "anchor" being placed below. The sucker carries a series of three or four leather cups, which are pressed against the inner surface of the working barrel by the weight of the column of oil. The sucker is connected by a string of sucker-rods with the walking-beam. There is usually fixed above the sucker a short iron valve-rod, with a device known as a rivet-catcher to prevent damage to the pump by the dropping of rivets from the pump-rods.

Torpedoing Wells.

On the completion of drilling, or when the production is found to decrease, it is usual to torpedo the well to increase the flow. The explosive employed is generally nitroglycerin, and the amount used has been increased from the original 4 to 6 quarts to 60, 80, 100 and even 200 quarts. It is placed in tin canisters of about $3\frac{1}{2}$ to 5 in. in diameter and about 10 ft. in length. The canisters have conical bottoms and fit one in the other. They are consecutively filled with nitroglycerin, and are lowered to the bottom of the well, one after the other, by a cord wound upon a reel, until the required number have been inserted. Formerly the upper end of the highest canister was fitted with a "firing-head," consisting of a circular plate of iron, slightly smaller than the bore of the well, and having attached to its underside a vertical rod or pin carrying a percussion cap. The cap rested on the bottom of a small iron cylinder containing nitroglycerin. To explode the charge an iron weight, known as a go-devil, was dropped into the well, and striking the disk exploded the cap and fired the torpedo. Now, however, a miniature torpedo known as a go-devil squib, holding about a quart of nitroglycerin, and having a firing-head similar to that already described, is almost invariably employed. The disk is dispensed with, and the percussion cap is exploded by the impact of a leaden weight running on a cord. The squib is lowered after the torpedo, and, when exploded by the descent of the weight, fires the charge. It must be borne in mind that although the explosion may increase the production for a time, it is by no means certain that the actual output of a well is increased in all such cases, though from some wells there would be no production without the use of the torpedo.

Drilling in Canada.

The petroleum industry in Canada is mainly concentrated in the district of Petrolea, Ontario. On account of the small depth of the wells, and the tenacious nature of the principal strata bored through, the Canadian method of drilling differs from the Pennsylvanian or American system in the following particulars:—

1. The use of slender wooden boring-rods instead of a cable.
2. The employment of a simple auger instead of a spudding-bit.
3. The adoption of a different arrangement for transmitting motion.
4. The use of a lighter set of drilling tools.

Drilling in Russia.

Although petroleum wells in Russia have not the depth of many of those in the United States, the disturbed character of the strata, with consequent liability to caving, and the occurrence of hard concretions, render drilling a lengthy and expensive operation. It is usual to begin by making an excavation 8 ft. in diameter and 24 ft. in depth, and lining the sides of this with wood or brick. The initial diameter of the well drilled from the bottom of this pit is in some instances as much as 36 in., bore-holes of the larger size being preferred, as they are less liable to become choked, and admit of the use of larger bailers for raising the oil.

The drilling of wells of large size requires the use of heavy tools and of very strong appliances generally. The system usually adopted is a modification of the Canadian system already described, the boring rods being, however, of iron instead of wood, but the cable system has also to some extent been used. For the ordinary 2-in. plain-laid manila cable a wire rope has in some cases been successfully substituted.

Rivetted iron casing, made of $\frac{3}{16}$-in. plate, is employed, and is constantly lowered so as to follow the drill closely, in order to prevent caving. Within recent years, owing to the initiative of Colonel English, a method of raising oil by the agency of compressed air has been introduced into the Baku oil-fields.

Drilling in Galicia.

In Galicia the Canadian system is nearly exclusively adopted. In some instances under-reaming is found necessary. This consists in the use of an expanding reamer by means of which the well may be drilled to a diameter admitting of the casing descending freely, which obviously could not be accomplished with an ordinary bit introduced through the casing. Of late years the under-reamer has been largely superseded by the eccentric bit.

The Calyx Drill.

The Davis calyx drill has also been employed for petroleum drilling. This apparatus may be described as a steel-pointed core-drill. The bit or cutter consists of a cylindrical metallic shell, the lower end of which is made, by a process of gulleting, into a series of sharp teeth, which are set in and out alternately. The outward set of teeth drill the hole large enough to permit the drilling apparatus to descend freely, and the teeth set inwardly pare down the core to such a diameter as will admit of the body of the cutter passing over it without seizing. The calyx is a long tube, or a series of connected tubes, situated above the core barrel, to which it is equal in diameter.

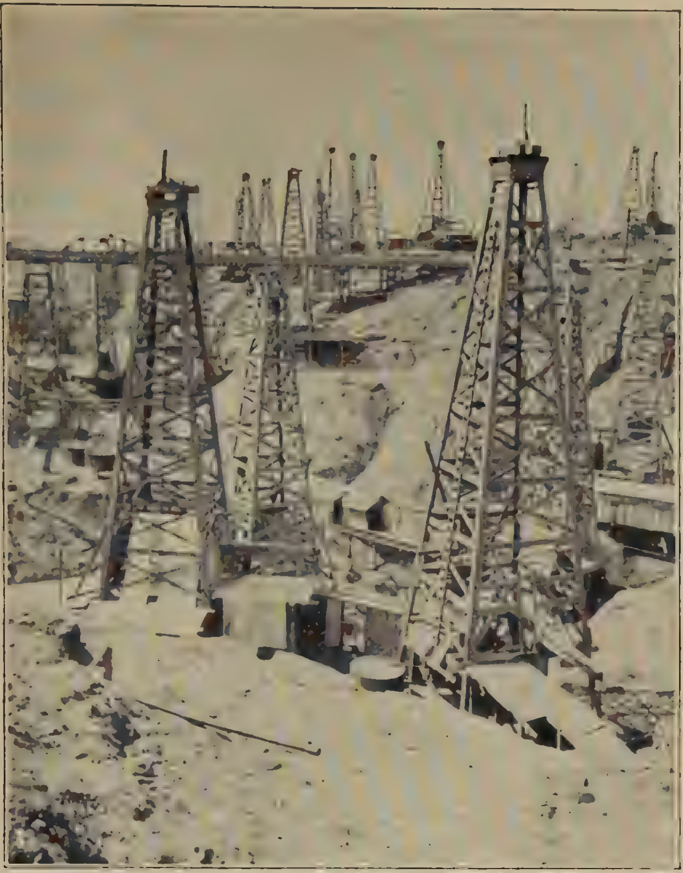
Comparison of Systems.

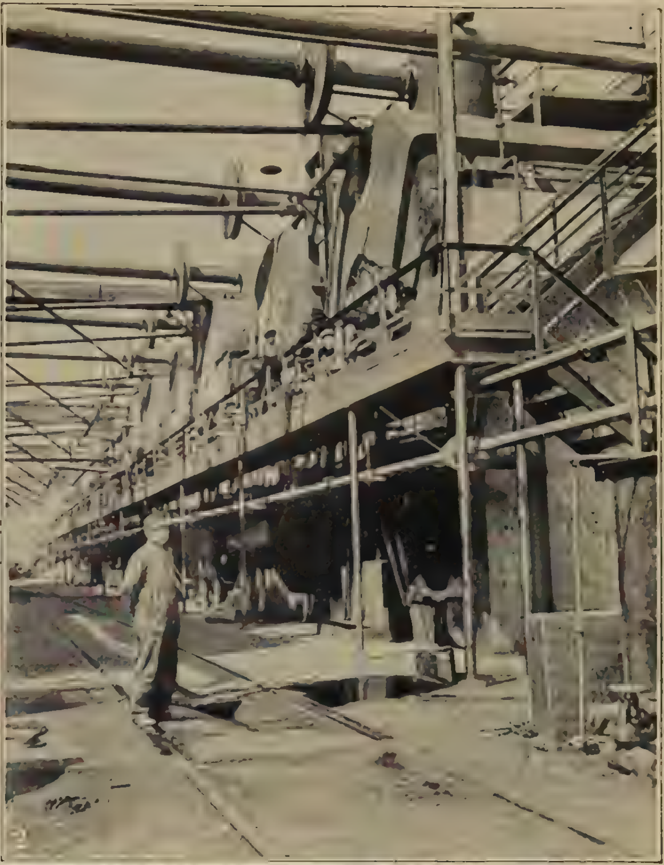
In conclusion it may be stated that the two systems of drilling for petroleum with which by far the largest amount of work has been, and is being done, are the American or rope system, and the Canadian or rod system. The former is not only employed in the United States, but is in use in Upper Burma, Java, Rumania and elsewhere. The latter was introduced by Canadians into Galicia and, with certain modifications, has hitherto been found to be the best for that country. A form of the rod system is used in the Russian oil-fields, but owing to the large diameter of the wells the appliances differ from those employed elsewhere.

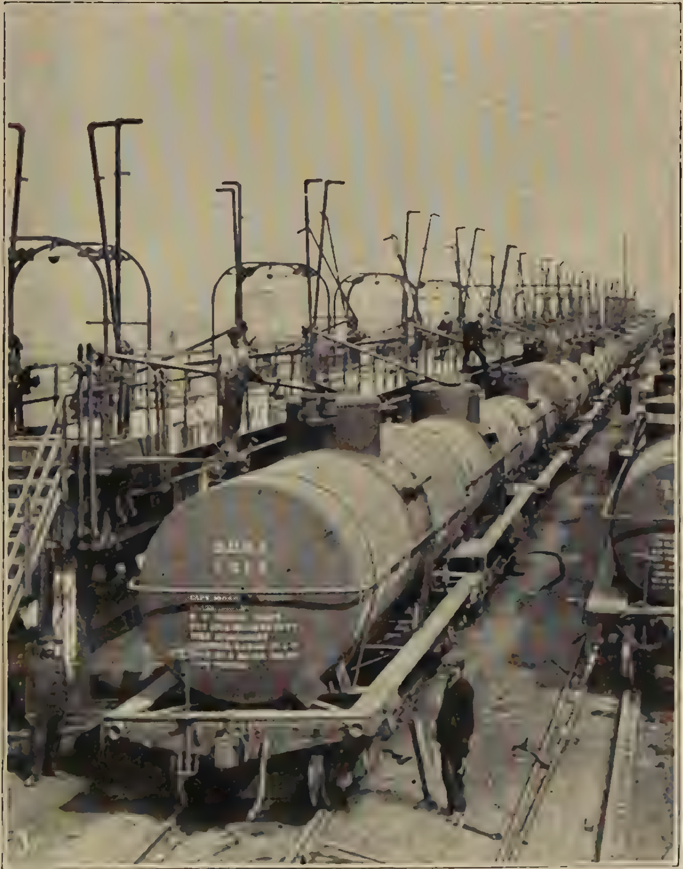
The wells from which the supplies of natural gas are obtained in the United States are drilled and cased in the same manner as the oil wells.

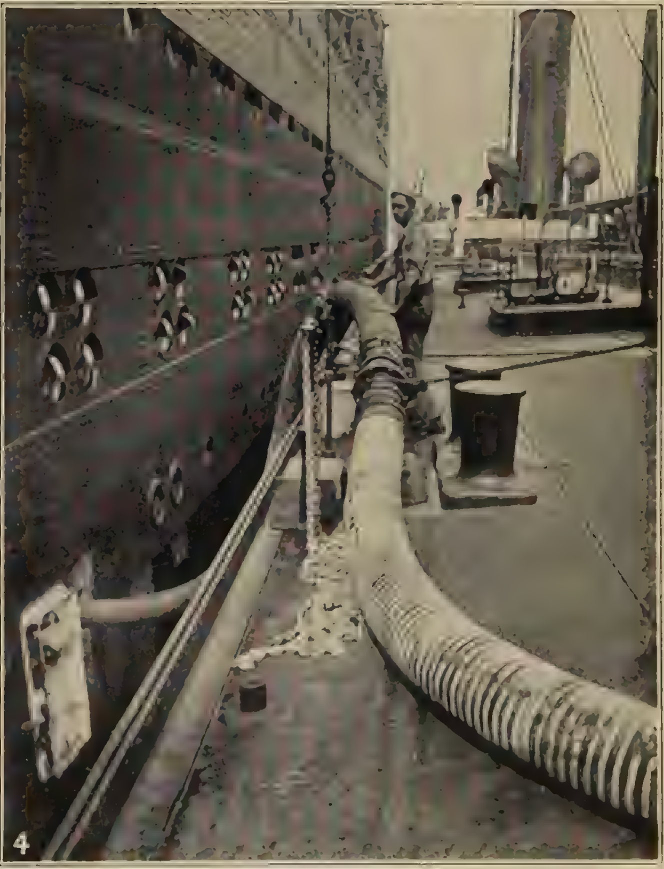
Transport and Storage.—In the early days of the petroleum industry the oil was transported in the most primitive manner. Thus, in Upper Burma, it was conveyed in earthenware vessels from the wells to the river bank, where it was poured into the holds of boats. It is interesting to find that a rude pipe-line formerly existed in this field for conveying the crude oil from the wells to the river; this was made of bamboos, but it is said that the loss by leakage was so great as to lead to its immediate abandonment on completion. In Russia, until 1875, the crude oil was carried in barrels on Persian carts known as "arbas." These have two wheels of $8\frac{1}{2}$ to 9 ft. in diameter, the body carrying one barrel, while another is slung beneath the axle. In America, crude petroleum was at first transported in iron-hooped barrels, holding from 40 to 42 American gallons, which were carried by teamsters to Oil Creek and the Allegheny River, where they were loaded on boats, these being floated down stream whenever sufficient water was present—a method leading to much loss by collision and grounding. Bulk barges were soon introduced on the larger rivers, but the use of these was partially rendered unnecessary by the introduction of railways, when the oil was at first transported in barrels on freight cars, but later in tank-cars. These at first consisted of an ordinary truck on which were placed two wooden tub-like tanks, each holding about 2000 gallons; they were replaced in 1871 by the modern type of tank-car, constructed with a horizontal cylindrical tank of boiler plate.

The means of transporting petroleum in bulk commonly used at the present day is the pipe-line system, the history of which dates from 1860. In that year S. D. Karns suggested laying a 6-in. pipe from Burning Springs to Parkersburg, West Virginia, a distance of 36 m.; but his proposal was never carried into effect. Two years later, however, L. Hutchinson of New York, laid a short line from the Tarr Farm wells to the refinery, which passed over a hill, the oil being moved on the syphon principle, and a year later constructed another three miles long to the railway. These attempts were, however, unsuccessful, on account of the excessive leakage









(*Ewing Galloway.*)

Fig. 1. Oil derricks in the Yen-ang-Yaung fields on the Irawaddy river, central Burma. Fig. 2. Stills for refining crude oil at Sinclair Refinery, East Chicago. The oil is piped from Oklahoma and Texas to this refinery, a distance of about 800 miles. Fig. 3. Rack for loading tanks with gasoline from the refinery at East Chicago. Fig. 4. Bunkering the S.S. "Majestic" at New York. Oil is an extremely important factor in industry. Full particulars regarding it are to be found in the exhaustive article Petroleum, Vol. 31. See also Raw Materials in same volume.

at the joints of the pipes. With the adoption of carefully fitted screw-joints in 1865 the pipe line gradually came into general use, until in 1891 the lines owned by the various transit companies of Pennsylvania amounted in length to 25,000 m.

The pumps employed to force the oil through the pipes were at first of the single-cylinder or "donkey" type, but these were found to cause excessive wear—a defect remedied by the use of the Worthington pump now generally adopted. The engines used on the main 6-in. lines are of 600 to 800 h.p., while those on the small-diameter local lines range from 25 to 30 h.p.

Tanks of various types are employed in storing the oil, those at the wells being circular and usually made of wood, with a content of 250 barrels and upwards. Large tanks of boiler-plate are used to receive the oil as it comes through the pipe-lines. Those adopted by the National Transit Company are 90 ft. in diameter and 30 ft. high, with slightly conical wooden roofs covered with sheet iron; their capacity is 35,000 barrels, and they are placed upon the carefully levelled ground without any foundation.

Kerosene is transported in bulk by various means; specially constructed steel tank barges are used on the waterways of the United States, tank-cars on the railroads, and tank-wagons on the roads. The barrels employed in the transport of petroleum products are made of well-seasoned white-oak staves bound by six or eight iron hoops. They are coated internally with glue, and painted in the well-known colours, blue staves and white heads. The tins largely used for kerosene are made by machinery and contain 5 American gallons. They are hermetically sealed for transport.

In Canada, means of transport similar to those already described are employed, but the reservoirs for storage often consist of excavations in the soft Erie clay of the oil district, the sides of which are supported by planks.

The primitive methods originally in use in the Russian oil-fields have already been described; but these were long ago superseded by pipe-lines, while a great deal of oil is carried by tank steamers on the Caspian to the mouth of the Volga where it is transferred to barges and thence at Tzaritzin to railway tank-cars. The American type of storage-tank is generally employed, in conjunction with clay-lined reservoirs.

Natural gas is largely used in the United States, and for some time, owing to defective methods of storage, delivery and consumption, great waste occurred. The improvements introduced in 1890 and 1891, whereby this state of affairs was put an end to, consisted in the introduction of the principle of supply by meter, and the adoption of a comprehensive system of reducing the initial pressure of the gas, so as to diminish loss by leakage. For the latter purpose, Westinghouse gas-regulators are employed, the positions of the regulators being so chosen as to equalize the pressure throughout the service. The gas is distributed to the consumer from the wells in wrought-iron pipes, ranging in diameter from 20 in. down to 2 in. Riveted wrought-iron pipes 3 ft. in diameter are also used. The initial pressure is sometimes as high as 400 ℔ to the sq. in., but usually ranges from 200 to 300 ℔. The most common method of distribution in cities and towns is by a series of pipes from 12 in. down to 2 in. in diameter, usually carrying a pressure of about 4 oz. to the sq. in. To these pipes the service-pipes leading into the houses of the consumers are connected.

Refining of Petroleum.—The distillation of petroleum, especially of such as was intended for medicinal use, was regularly carried on in the 18th century, and earlier. V. I. Ragozin states in his work on the petroleum industry that Johann Lerche, who visited the Caspian district in 1735, found that the crude Caucasian oil required to be distilled to render it satisfactorily combustible, and that, when distilled, it yielded a bright yellow oil resembling a spirit, which readily ignited. As early as 1823 the brothers Dubinin erected a refinery in the village of Mosdok, and in 1846 applied to Prince Woronzoff for a subsidy for extending the use of petroleum-distillates in the Caucasus. In their application, which was unsuccessful, they stated that they had taught the Don Cossacks to "change black naphtha into white," and showed by a drawing, preserved in the archives of the Caucasian government, how this was achieved. They used an iron still, set in brickwork, and from a working charge of forty "buckets" of crude petroleum obtained a yield of sixteen buckets of "white naphtha." The top of the still had a removable head, connected with a condenser consisting of a copper worm in a barrel of water. The "white naphtha" was sold at Nijni Novgorod without further treatment.

Some of the more viscous crude oils obtained in the United States are employed as lubricants under the name of "natural oils," either without any treatment or after clarification by subsidence and filtration through animal charcoal. Others are deprived of a part of their more volatile constituents by spontaneous evaporation, or by distillation, *in vacuo* or otherwise, at the lowest possible temperature. Such are known as "reduced oils."

In most petroleum-producing countries, however, and particularly where the product is abundant, the crude oil is fractionally distilled, so as to separate it into petroleum spirit of various grades, burning oils, gas oils, lubricating oils, and (if the crude oil yields that product) paraffin. The distillates obtained are usually purified by treatment, successively, with sulphuric acid and solution of caustic soda, followed by washing with water.

Crude petroleum was experimentally distilled in the United States in 1833 by Prof. Silliman (d. 1864), and the refining of petroleum in that country may be said to date from about the year 1855, when Samuel M. Kier fitted up a small refinery with a five-barrel still, for the treatment of the oil obtained from his father's salt-wells. At this period the supply of the raw material was insufficient to admit of any important development in the industry, and before the drilling of artesian wells for petroleum was initiated by Drake the "coal-oil" or shale-oil industry had assumed considerable proportions in the United States. Two large refineries, one on Newtown Creek, Long Island, and another in South Brooklyn, also on Long Island, were in successful operation when the abundant production of petroleum, which immediately followed the completion of the Drake well, placed at the disposal of the refiner a material which could be worked more profitably than bituminous shale. The existing refineries were accordingly altered so as to adapt them for the refining of petroleum; but in the manufacture of burning oil from petroleum the small stills which had been in use in the distillation of shale-oil were at first employed.

In the earlier refineries the stills, the capacity of which varied from 25 to 80 barrels, usually consisted of a vertical cylinder, constructed of cast- or wrought-iron, with a boiler-plate bottom and a cast-iron dome, on which the "goose-neck" was bolted. The charge was distilled almost to dryness, though the operation was not carried far enough to cause the residue to "coke." The operation was, however, completely revolutionized in the United States by the introduction of the "cracking process," and by the division of the distillation into two parts, one consisting in the removal of the more volatile constituents of the oil, and the other in the distillation (which is usually conducted in separate stills) of the residues from the first distillation, for the production of lubricating oils and paraffin.

Various arrangements have been proposed and patented for the continuous distillation of petroleum, in which crude oil is supplied to a range of stills as fast as the distillates pass off. The system is largely employed in Russia, and its use has been frequently attempted in the United States, but the results have not been satisfactory, on account, it is said, of the much greater quantity of dissolved gas contained in the American oil, the larger proportion of kerosene which such oil yields, and the less fluid character of the residue.

In the United States a horizontal cylindrical still is usually employed in the distillation of the spirit and kerosene, but what is known as the "cheese-box" still has also been largely used. American stills of the former type are constructed of wrought-iron or steel, and are about 30 ft. in length by 12 ft. 6 in. in diameter, with a dome about 3 ft. in diameter, furnished with a vapour-pipe 15 in. in diameter. The charge for such a still is about 600 barrels. The stills were formerly completely bricked in, so that the vapours should be kept fully heated until they escaped to the condenser, but since the introduction of the "cracking process," the upper part has usually been left exposed to the air. The cheese-box still has a vertical cylindrical body, which may be as much as 30 ft. in diameter and 9 ft. in depth, connected by means of three vertical pipes with a vapour-chest furnished with a large number, frequently as many as forty, of 3-in. discharge-pipes arranged in parallel lines.

The stills employed in Russia and Galicia are usually smaller than those already described.

The "cracking" process, whereby a considerable quantity of the oil which is intermediate between kerosene and lubricating oil is converted into hydrocarbons of lower specific gravity and boiling-point suitable for illuminating purposes, is one of great scientific and technical interest. It is generally understood that the products of fractional distillation, even in the laboratory, are not identical with the hydrocarbons present in the crude oil, but are in part produced by the action of heat upon them. This was plainly stated by Professor Silliman in the earliest stages of development of the American petroleum industry. An important paper bearing on the subject was published in 1871, by T. E. Thorpe and J. Young, as a preliminary note on their experiments on the action of heat under pressure on solid paraffin. They found that the paraffin was thus converted, with the evolution of but little gas, into hydrocarbons which were liquid at ordinary temperatures. In an experiment on 3500 grams of paraffin produced from shale (melting point 44·5° C.) they obtained nearly 4 litres of liquid hydrocarbons, which they subjected to fractional distillation, and on examining the fraction distilling below 100° C., they found it to consist mainly of olefines. The hydrocarbon $C_{20}H_{42}$, for example, might be resolved into $C_5H_{12}+C_{15}H_{30}$, or $C_6H_{14}+C_{14}H_{28}$, or $C_7H_{16}+C_{13}H_{26}$, &c., the general equation of the decomposition being—

$$C_nH_{2n+2} \text{ (paraffin)} = C_{n-p}H_{2(n-p)+2} \text{ (paraffin)} + C_pH_{2p} \text{ (olefine)}.$$

The product actually obtained is a mixture of several paraffins and several olefines.

The cracking process practically consists in distilling the oils at a temperature higher than the normal boiling point of the constituents which it is desired to decompose. This may be brought about by a distillation under pressure, or by allowing the condensed distillate to fall into the highly heated residue in the still. The result of this treatment is that the comparatively heavy oils undergo dissociation, as shown by the experiments of Thorpe and Young, into specifically lighter hydrocarbons of lower boiling points, and the yield of kerosene from ordinary crude petroleum may thus be greatly increased. A large number of arrangements for carrying out the cracking process have been proposed and patented, probably the earliest directly bearing on the subject being that of James Young, who in 1865 patented his "Improvements in treating hydrocarbon oils." In this patent, the distillation is described as being conducted in a vessel having a loaded valve or a partially closed stop-cock, through which the confined vapour escapes under any desired pressure. Under such conditions, distillation takes place at higher temperatures than the normal boiling-points of the constituent hydrocarbons of the oil, and a partial cracking results. The process patented by Dewar and Redwood in 1889 consists in the use of a suitable still and condenser in free communication with each other—*i.e.* without any valve between them—the space in the still and condenser not occupied by liquid being charged with air, carbon dioxide or other gas, under the required pressure, and the condenser being provided with a regulated outlet for condensed liquid. An objectionable feature of the system of allowing the vapour to escape from the still to the condenser through a loaded valve, viz: the irregularity of the distillation, is thus removed, and the benefits of regular vaporization and condensation under high pressure are obtained. In the American petroleum refineries it is found that sufficient cracking can be produced by slow distillation in stills of which the upper part is sufficiently cool to allow of the condensation of the vapours of the less volatile hydrocarbons, the condensed liquid thus falling back into the heated body of oil.

In the earlier stages of the development of the manufacture of mineral lubricating oils, the residues were distilled in cast-iron stills, and the lubricating properties of the products thus obtained were injured by overheating. The modern practice is to employ horizontal cylindrical wrought-iron or steel stills, and to introduce steam into the oil. The steam is superheated and may thus be heated to any desired temperature without increase of pressure, which would be liable to damage the still. The steam operates by carrying the vapours away to the condenser as fast as they are generated, the injury to the products resulting from their remaining in contact with the highly-heated surface of the still being thus prevented.

In order to separate the distillate into various fractions, and to remove as much of it as possible free from condensed steam, it is now usual to employ condensing appliances of special form with outlets for running off the different fractions.

The process of distillation of lubricating oils under reduced atmospheric pressure is now in very general use, especially for obtaining the heavier products. The vapours from the still pass through a condenser into a receiver, which is in communication with the exhauster.

The products obtained by the distillation of petroleum are not in a marketable condition, but require chemical treatment to remove acid and other bodies which impart a dark colour as well as an unpleasant odour to the liquid, and in the case of lamp-oils, reduce the power of rising in the wick by capillary attraction.

At the inception of the industry kerosene came into the market as a dark yellow or reddish-coloured liquid, and in the first instance, the removal of colour was attempted by treatment with soda lye and lime solution. It was, however, found that after the oil so purified had been burned in a lamp, for a short time, the wick became encrusted, and the oil failed to rise properly. Eichler, of Baku, is stated to have been the first to introduce, in Russia, the use of sulphuric acid, followed by that of soda lye, and his process is in universal use at the present time. The rationale of this treatment is not fully understood, but the action appears to consist in the separation or decomposition of the aromatic hydrocarbons, fatty and other acids, phenols, tarry bodies, &c., which lower the quality of the oil, the sulphuric acid removing some, while the caustic soda takes out the remainder, and neutralizes the acid which has been left in the oil. This treatment with acid and alkali is usually effected by agitation with compressed air. Oils which contain sulphur-compounds are subjected to a special process of refining in which cupric oxide or litharge is employed as a desulphurizing agent.

Testing.—A large number of physical and chemical tests are applied both to crude petroleum and to the products manufactured therefrom. The industry is conducted upon a basis of recognized standards of quality, and testing is necessary in the interests of both refiner and consumer, as well as compulsory in connexion with the various statutory and municipal regulations.

In the routine examination of crude petroleum it is customary to determine the *specific gravity*, and the amount of water and earthy matter in suspension; the oil is also frequently subjected to a process of fractional distillation in order to ascertain whether there has been any addition of distilled products or residue. Petroleum spirit is tested for specific gravity, range of boiling-points, and results of fractional distillation. To illuminating oil or kerosene a series of tests is applied in order that the colour, odour, specific gravity and *flash-point* or *fire-test* may be recorded. In the testing of mineral lubricating oils the *viscosity*, flash-point, "cold-test," and specific gravity are the characters of chief importance. Fuel oil is submitted to certain of the foregoing tests and in addition the *calorimetric value* is determined. Paraffin wax is tested for *melting-point* (or setting-point), and the semi-refined product is further examined to ascertain the percentage of oil, water and dirt present.

In civilized countries provision is made by law for the testing of the flash-point or fire-test of lamp-oil (illuminating oil or kerosene), the method of testing and the minimum limit of flash-point or fire-test being prescribed (see below, *Legislation*).

The earliest form of testing instrument employed for this purpose was that of Giuseppe Tagliabue of New York, which consists of a glass cup placed in a copper water bath heated by a spirit lamp. The cup is filled with the oil to be tested, a thermometer placed in it and heat applied, the temperatures being noted at which, on passing a lighted splinter of wood over the surface of the oil, a flash occurs, and after further heating, the oil ignites. The first temperature is known as the flash-point, the second as the "fire-test." Such an apparatus, in which the oil-cup is uncovered, is known as an open-test instrument. In Saybolt's Electric Tester (1879) ignition is effected by a spark from an induction-coil passing between platinum points placed at a fixed distance above the oil.

Before long, however, it was found that the open-cup tests (though they are employed in the United States and elsewhere at the present time) were often very untrustworthy. Accordingly Keates proposed the substitution of a closed cup in 1871, but his suggestions were not adopted. In 1875 Sir Frederick Abel, at the request of the British Government, began to investigate the matter, and in August 1879 the "Abel test" was legalized. This apparatus has an oil-cup consisting of a cylindrical brass or gun-metal vessel, the cover of which is provided with three rectangular holes which may be closed and opened by means of a perforated slide moving in grooves; the movement of the slide causes a small oscillating colza- or rape-oil lamp to be tilted so that the flame (of specified size) is brought just below the surface of the lid. The oil-cup is supported in a bath or heating-vessel, consisting of two flat-bottomed copper cylinders, to contain water, heated by a spirit lamp, and provided with an air-space between the water-vessel and the oil-cup. Thermometers are placed in both oil-cup and water-bath, the temperature of the latter being raised to 130° at the commencement of the test, while the oil is put in at about 60° F. Testing is begun when the temperature reaches 66° by slowly drawing the slide open and reclosing it, the speed being regulated by the swing of a pendulum supplied with the instrument. It has been found that variations in barometric pressure affect the flash-point and accordingly corrections have to be made in obtaining strictly comparative results at different pressures. The Abel-Pensky instrument, used in India and in Germany, differs only in being provided with a clockwork arrangement for moving the slide. Numerous other forms of open-test and close-test instruments have from time to time been devised, some of which are in use in the United States and in other countries.

It is still customary to determine the open flash-point and fire-test of lubricating oils, but the close flash-point is also usually ascertained, a modification of the Abel or Abel-Pensky apparatus, known as the Pensky-Martens, having been devised for the purpose. This instrument is so constructed that the higher temperature needed can be readily applied, and it is fitted with a stirrer to equalize the heating of the contents of the oil-cup.

For the testing of the viscosity of lubricating oils the Boverton Redwood standardized viscometer is generally employed in Great Britain. By means of this instrument the time occupied in the flow of a measured quantity of the oil through a small orifice at a given temperature is measured.

Uses.—Petroleum has very long been known as a source of light and heat, while the use of crude oil for the treatment of wounds and cutaneous affections, and as a lubricant, was even more general and led to the raw material being an article of commerce at a still earlier date. For pharmaceutical purposes crude petroleum is no longer generally used by civilized races, though the product *vaseline* is largely employed in this way, and emulsions of petroleum have been administered internally in various pectoral complaints; while the volatile product termed *rhigolene* has been largely used as a local anaesthetic.

For illuminating purposes, the most extensively-used product is kerosene, but both the more and the less volatile portions of petroleum are employed in suitable lamps. Petroleum products are also largely utilized in gas manufacture for, (1) the production of "*air-gas*," (2) the manufacture of *oil-gas*, and (3) the enrichment of *coal-gas*. For heating purposes, the stoves employed are practically kerosene lamps of suitable construction, though gasoline is used as a domestic fuel in the United States. The use of petroleum as liquid fuel is dealt with under FUEL, as is the employment of its products in motors, which has greatly increased the demand for petroleum spirit. Petroleum has largely superseded other oils, and is still gaining ground, as a lubricant for machinery and railway rolling-stock, either alone or in admixture with fixed oils. The more viscous descriptions of mineral oils have also been found suitable for use in the Elmore process of ore-concentration by oil.

Legislation.—Since the inception of the petroleum industry, most civilized countries have prescribed by law a test of flash-point or inflammability, designed in most cases primarily to afford a definition of oils for lighting purposes which may be safely stored without the adoption of special precautions. In the United Kingdom the limit has, for the purpose in question, been fixed by the legislature at 73° F., by the "Abel-test," which is the equivalent of the former standard of 100° F. by the "open-test." While the subject of the testing of petroleum for legislative purposes has been investigated in Great Britain by committees of both branches of the legislature, with a view to change in the law, the standard has never been raised, since such a course would tend to reduce the available supply and thus lead to increase in price or deterioration in quality. Moreover the chief object of the Petroleum Acts passed in the United Kingdom has hitherto been to regulate storage, and it has always been possible to obtain oils either of higher or lower flash-point, when such are preferred, irrespective of the legal standard, in addition to which it may be asserted that in a properly constructed lamp used with reasonable care the ordinary oil of commerce is a safe illuminant. The more recent legislation with regard to "petroleum spirit" relates mainly to the quantity which may be stored for use on "light locomotives."

The more important local authorities throughout the country have made regulations under the powers conferred upon them by the Petroleum Acts, with the object of regulating the "keeping, sale, conveyance and hawking" of petroleum products having a flash-point below 73° F., and the Port of London authority, together with other water-way and harbour authorities in the United Kingdom, have their own by-laws relating to the navigation of vessels carrying such petroleum.

In other countries the flash-point standards differ considerably, as do the storage regulations. In France, the standard is 35° C. (Granier tester, equivalent to 98° F.), and according to their flash-point, liquid hydrocarbons are divided into two classes (below and above 35° C.), considered differently in regard to quantities storable and other regulations. In Germany, the law prescribes a close-test of 21° C., equal to about 70° F., whilst in Russia the standard is 28° C., equal to 84·4° F., by the close-test; in both these countries the weights of petroleum which may be stored in specified buildings are determined by law. In the United States, various methods of testing and various minimum standards have been adopted. In Pennsylvania, the prescribed limit is a "fire-test" of 110° F., equivalent to about 70° F., close-test, while in the State of New York it is 100° F., close-test.

See Sir Boverton Redwood's *Petroleum and its Products* (2nd ed., London, 1906); A. Beeby Thompson, *Petroleum Mining* (1910); L. C. Tassart, *Exploitation du Pétrole* (1908); C. Engler and H. Höfer, *Das Erdöl*, 5 vols. (1909 seq.); A. B. Thompson, *The Oil Fields of Russia* (1908); and J. D. Henry, *Oil Fields of the Empire* (1910). (B. R.)

PETROLOGY, the science of rocks (Gr. πέτρος), the branch of geology which is concerned with the investigation of the composition, structure and history of the rock masses which make up the accessible portions of the earth's crust. Rocks have been defined as "aggregates of minerals." They are the units with which the geologist deals in investigating the structure of a district. Some varieties cover enormous areas and are among the commonest and most familiar objects of nature. Granite, sandstone, clay, limestone, slate often form whole provinces and build up lofty mountains. Such unconsolidated materials as sand, gravel, clay, soil are justly included among rocks as being mineral masses which play an important rôle in field geology. Other rock species are of rare occurrence and may be known in only one or two localities in distant parts of the earth's surface. Nearly all rocks consist of minerals, whether in a crystalline or non-crystalline state, but the insoluble and imperishable parts of the skeletons of animals and plants may constitute a considerable portion of rocks, as for example, coral limestone, lignite beds and chalk.

Treatment of the Subject.—In this paragraph the subject matter of the science of petrology is briefly surveyed; the object is to point out the headings under which particular subjects are treated (there is a separate article on the terms printed in italics). General questions as to the nature, origin and classification of rocks and the methods of examination are discussed in the present article; *mineralogy* comprises similar matter respecting the component minerals; *metamorphism*, *metasomatism*, *pneumatolysis* and the formation of *concretions* are agencies which effect rocks and modify them. Three classes of rocks are recognized: the igneous, sedimentary and metamorphic. The plutonic, or deep-seated rocks, which cooled far below the surface, and occur as *batholites*, bosses, *laccolites*, and *veins*, include the great classes *granite*, *syenite*, *diorite*, *gabbro* and *peridotite*; related to the granites are *aplite*, *greisen*, *pegmatite*, *schorl* rock and *micropegmatite*; to the syenites, *borolanite*, *monzonite*, *nepheline-syenite* and *ijolite*; to the diorites, *aphanite*, *napoleonite* and *tonalite*; to the gabbros, *pyroxenite* and *theralite*, and to peridotites, *picrite* and *serpentine*. The hypabyssal intrusive rocks, occurring as *sills*, *veins*, *dikes*, *necks*, &c., are represented by *porphyry* and *porphyrite* (including *bostonite*, *felsite* and *quartz-porphyry*), *diabase* and *lamprophyre*; some *pitchstones* belong to this group and contain *crystallites* and *spherulites*. The volcanic rocks, found typically as lava flows, include *rhyolite* and *obsidian* (with sometimes *perlite*), *trachyte* and *phonolite* (and leucitophyre which is treated under *leucite*), *andesite* and *dacite*, *basalt* (with the related *dolerite*, *variolite* and *tachylyte*), *nephelinite* and *tephrite*. Among sedimentary rocks we recognize a volcanic group (including *tuff*, *agglomerate* and some kinds of *pumice*); an arenaceous series such as *sand* (some with *glauconite*), *sandstone*, *quartzite*, *greywacke* and *gravel*; an argillaceous group including *clay*, *firebrick*, *phyllite*, *laterite*, *shale* and *slate*; a calcareous series with *chalk*, *limestone* (often forming *stalactites* and *stalagmites*), *dolomite* and *marls* or argillaceous limestones (*flint* occurs as nodules in chalk); the natural *phosphates* may be mentioned here. The metamorphic rocks are commonly *gneisses* and *schists* (including *mica-schist*); other types are *amphibolite*, *charnockite*, *eclogite*, *epidiorite*, *epidosite*, *granulite*, *itacolumite*, *hornfels*, *mylonite* and the *scapolite* rocks.

Composition.—Only the commonest minerals are of importance as rock formers. Their number is small, not exceeding a hundred in all, and much less than this if we do not reckon the subdivisions into which the commoner species are broken up. The vast majority of the rocks which we see around us every day consist of quartz, felspar, mica, chlorite, kaolin, calcite, epidote, olivine, augite, hornblende, magnetite, haematite, limonite and a few other minerals. Each of these has a recognized position in the economy of nature. A main determining factor is the chemical composition of the mass, for a certain mineral can be formed only when the necessary elements are present in the rock. Calcite is commonest in limestones, as these consist essentially of carbonate of lime; quartz in sandstones and in certain igneous rocks which contain a high percentage of silica. Other factors are of equal importance in determining the natural association or paragenesis of rock-making minerals, principally the mode of origin of the rock and the stages through which it has passed in attaining its present condition. Two rock masses may have very much the same bulk composition and yet consist of entirely different assemblages of minerals. The tendency is always for those compounds to be formed which are stable under the conditions under which the rock mass originated. A granite arises by the consolidation of a molten magma (a fused rock mass; Gr. μάγμα, from μάσσειν, to knead) at high temperatures and great pressures and its component minerals are such as are formed in such circumstances. Exposed to moisture, carbonic acid and other subaerial agents at the ordinary temperatures of the earth's surface, some of these original minerals, such as quartz and white mica are permanent and remain unaffected; others "weather" or decay and are replaced by new combinations. The felspar passes into kaolin, muscovite and quartz, and if any black mica (biotite) has been present it yields chlorite, epidote, rutile and other substances. These changes are accompanied by disintegration, and the rock falls into a loose, incoherent, earthy mass which may be regarded as a sand or soil. The materials thus formed may be washed away and deposited as a sandstone or grit. The structure of the original rock is now replaced by a new one; the mineralogical constitution is profoundly altered; but the bulk chemical composition may not be very different. The sedimentary rock may again undergo a metamorphosis. If penetrated by igneous rocks it may be recrystallized or, if subjected to enormous pressures with heat and movement, such as attend the building of folded mountain chains, it may be converted into a gneiss not very different in mineralogical composition though radically different in structure to the granite which was its original state.

Structure.—The two factors above enumerated, namely the chemical and mineral composition of rocks, are scarcely of greater importance than their structure, or the relations of the parts of which they consist to one another. Regarded from this standpoint rocks may be divided into the crystalline and the fragmental. Inorganic matter, if free to take that physical state in which it is most stable, always tends to crystallize.

Crystalline Rocks.

Crystalline rock masses have consolidated from solution or from fusion. The vast majority of igneous rocks belong to this group and the degree of perfection in which they have attained the crystalline state depends primarily on the conditions under which they solidified. Such rocks as granite, which have cooled very slowly and under great pressures, have completely crystallized, but many lavas were poured out at the surface and cooled very rapidly; in this latter group a small amount of non-crystalline or glassy matter is frequent. Other crystalline rocks such as rock-salt, gypsum and anhydrite have been deposited from solution in water, mostly owing to evaporation on exposure to the air. Still another group, which includes the marbles, mica-schists and quartzites, are recrystallized, that is to say, they were at first fragmental rocks, like limestone, clay and sandstone and have never been in a molten condition nor entirely in solution. Certain agencies however, acting on them, have effaced their primitive structures, and induced crystallization. This is a kind of metamorphism.

Fragmental Rocks.

The fragmental structure needs little explanation; wherever rocks disintegrate fragments are produced which are suitable for the formation of new rocks of this group. The original materials may be organic (shells, corals, plants) or vitreous (volcanic glasses) or crystalline (granite, marble, &c.); the pulverizing agent may be frost, rain, running water, or the steam explosions which shatter the lava within a volcanic crater and produce the fragmental rocks known as volcanic ash, tuffs and agglomerates. The materials may be loose and incoherent (sand, clay, gravel) or compacted by pressure and the deposit of cementing substances by percolating water (sandstone, shale, conglomerate). The grains of which fragmental rocks are composed may be coarse or fine, fresh or decayed, uniform or diverse in their composition; the one feature which gives unity to the class is the fact that they are all derived from pre-existing rocks or organisms. Because they are made up of broken pieces these rocks are often said to be "clastic."

Origin of Rocks.—The study of the structure of rocks evidently leads us to another method of regarding them, which is more fundamental than those enumerated above, as the structure depends on the mode of origin. Rocks are divided into three great classes, the Igneous, the Sedimentary and the Metamorphic.

Igneous Rocks.

The *igneous* (Lat. *ignis*, fire) rocks have all consolidated from a state of fusion. Some of them are crystalline or "massive"; others are fragmental. The massive igneous rocks include a few which are nearly completely vitreous, and still more which contain a small amount of amorphous matter, but the majority are completely crystallized. Among the best known examples are obsidian, pumice, basalt, trachyte, granite, diorite. The fragmental igneous rocks consist of volcanic ashes more or less firmly compacted.

Sedimentary Rocks.

The *sedimentary* rocks form a second group; they have all been laid down as deposits on the earth's surface subject to the conditions of temperature, moisture and pressure which obtain there. They include fragmental and crystalline varieties. The former consist of the débris of pre-existing rocks, accumulated in seas, lakes or dry land and more or less indurated by pressure and cementing substances. Gravel, sand and clay, conglomerate, sandstone, shale are well-known examples. Many of them are fossiliferous as they contain fragments of organisms. Some are very largely made up of remains of animals or plants, more or less altered by mineralization. These are sometimes placed into a special group as rocks of organic origin; limestone, peat and coal are typical of this class. The crystalline sediments are such as rock-salt and gypsum, deposits of saline lakes or isolated portions of the sea. They were formed under conditions unfavourable to life and hence rarely contain fossils. The *metamorphic* rocks are known to be almost entirely altered igneous or sedimentary masses.

Metamorphic Rocks.

Metamorphism consists in the destruction of the original structures and the development of new minerals. The chemical composition of the rocks however suffers little change. The rock becomes as a rule more crystalline; but all stages in the process may be found and in a metamorphosed sediment, *e.g.* a sandstone, remains of the original sand grains and primary fragmental structure may be observed, although extensive recrystallization has taken place. The agencies which produce metamorphism are high temperatures, pressure, interstitial moisture and in many cases movement. The effects of high temperatures are seen best in the rocks surrounding great outcrops of intrusive granite, for they have been baked and crystallized by the heat of the igneous rock (thermo-metamorphism). In folded mountain chains where the strata have been greatly compressed and their particles have been forced to move over one another a different type of metamorphism prevails (regional or dynamic metamorphism).

Macroscopic Characters.

Methods of Investigation.—The macroscopic (Gr. μακρός, large) characters of rocks, those visible in hand-specimens without the aid of the microscope, are very varied and difficult to describe accurately and fully. The geologist in the field depends principally on them and on a few rough chemical and physical tests; and to the practical engineer, architect and quarry-master they are all-important. Although frequently insufficient in themselves to determine the true nature of a rock, they usually serve for a preliminary classification and often give all the information which is really needed. With a small bottle of acid to test for carbonate of lime, a knife to ascertain the hardness of rocks and minerals, and a pocket lens to magnify their structure, the field geologist is rarely at a loss to what group a rock belongs. The fine grained species are often indeterminable in this way, and the minute mineral components of all rocks can usually be ascertained only by microscopic examination. But it is easy to see that a sandstone or grit consists of more or less rounded, waterworn sand-grains and if it contains dull, weathered particles of felspar, shining scales of mica or small crystals of calcite these also rarely escape observation. Shales and clay rocks generally are soft, fine grained, often laminated and not infrequently contain minute organisms or fragments of plants. Limestones are easily marked with a knife-blade, effervesce readily with weak cold acid and often contain entire or broken shells or other fossils. The crystalline nature of a granite or basalt is obvious at a glance, and while the former contains white or pink felspar, clear vitreous quartz and glancing flakes of mica, the other will show yellow-green olivine, black augite and grey striated plagioclase.

Microscopic Characters.

But when dealing with unfamiliar types or with rocks so fine grained that their component minerals cannot be determined with the aid of a lens, the geologist is obliged to have recourse to more delicate and searching methods of investigation. With the aid of the blowpipe (to test the fusibility of detached crystals), the goniometer, the magnet, the magnifying glass and the specific gravity balance, the earlier travellers attained surprisingly accurate results. Examples of these may be found in the works of von Buch, Scrope, Darwin and many others. About the end of the 18th century, Dolomieu examined crushed rock powders under the microscope and Cordier in 1815 crushed, levigated and investigated the finer ground-mass of igneous rocks. His researches are models of scrupulous accuracy, and he was able to announce that they consisted essentially of such minerals as felspar, augite, iron ores and volcanic glass, and did not differ in nature from the coarser grained rocks. Nicol, whose name is associated with the discovery of the Nicol's prism, seems to have been the first to prepare thin slices of mineral substances, and his methods were applied by Witham (1831) to the study of plant petrifactions. This method, of such far-reaching importance in petrology, was not at once made use of for the systematic investigation of rocks, and it was not till 1858 that Sorby pointed out its value. Meanwhile the optical study of sections of crystals had been advanced by Sir David Brewster and other physicists and mineralogists and it only remained to apply their methods to the minerals visible in rock sections. Very rapid progress was made and the names of Zirkel, Allport, Vogelsang, Schuster, Rosenbusch, Bertrand, Fouqué and Lévy are among those of the most active pioneers in the new field of research. To such importance have microscopical methods attained that textbooks of petrology at the present time are very largely devoted to a description of the appearances presented by the minerals of rocks as studied in transparent micro-sections.

Sections.

A good rock-section should be about one-thousandth of an inch in thickness, and is by no means very difficult to make. A thin splinter of the rock, about as large as a halfpenny may be taken; it should be as fresh as possible and free from obvious cracks. By grinding on a plate of planed steel or cast iron with a little fine carborundum it is soon rendered flat on one side and is then transferred to a sheet of plate glass and smoothed with the very finest emery till all minute pits and roughnesses are removed and the surface is a uniform plane. The rock-chip is then washed, and placed on a copper or iron plate which is heated by a spirit or gas lamp. A microscopic glass slip is also warmed on this plate with a drop of viscous natural Canada balsam on its surface. The more volatile ingredients of the balsam are dispelled by the heat, and when that is accomplished the smooth, dry, warm rock is pressed firmly into contact with the glass plate so that the film of balsam intervening may be as thin as possible and free from air-bubbles. The preparation is allowed to cool and then the rock chip is again ground down as before, first with carborundum and, when it becomes transparent, with fine emery till the desired thickness is obtained. It is then cleaned, again heated with a little more balsam, and covered with a cover glass. The labour of grinding the first surface may be avoided by cutting off a smooth slice with an iron disk armed with crushed diamond powder. A second application of the slitter after the first face is smoothed and cemented to the glass will in expert hands leave a rock-section so thin as to be already transparent. In this way the preparation of a section may require only twenty minutes.

Microscope.

Characters of Minerals.

The microscope employed is usually one which is provided with a rotating stage beneath which there is a polarizer, while above the objective or the eyepiece an analyser is mounted; alternatively the stage may be fixed and the polarizing and analysing prisms may be capable of simultaneous rotation by means of toothed wheels and a connecting-rod. If ordinary light and not polarized light is desired, both prisms may be withdrawn from the axis of the instrument; if the polarizer only is inserted the light transmitted is plane polarized; with both prisms in position the slide is viewed between "crossed nicols." A microscopic rock-section in ordinary light if a suitable magnification (say 30) be employed is seen to consist of grains or crystals varying in colour, size and shape. Some minerals are colourless and transparent (quartz, calcite, felspar, muscovite, &c.), others are yellow or brown (rutile, tourmaline, biotite), green (diopside, hornblende, chlorite), blue (glaucophane), pink (garnet), &c. The same mineral may present a variety of colours, in the same or different rocks, and these colours may be arranged in zones parallel to the surfaces of the crystals. Thus tourmaline may be brown, yellow, pink, blue, green, violet, grey or colourless, but every mineral has one or more characteristic, because most common tints. The shapes of the crystals determine in a general way the outlines of the sections of them presented on the slides. If the mineral has one or more good cleavages they will be indicated by systems of cracks (see Pl. III.). The refractive index is also clearly shown by the appearance of the sections, which are rough, with well-defined borders if they have a much stronger refraction than the medium in which they are mounted. Some minerals decompose readily and become turbid and semi-transparent (*e.g.* felspar); others remain always perfectly fresh and clear (*e.g.* quartz), others yield characteristic secondary products (such as green chlorite after biotite). The inclusions in the crystals are of great interest; one mineral may enclose another, or may contain spaces occupied by glass, by fluids or by gases.

Micro-Structure.

Lastly the *structure* of the rock, that is to say, the relation of its components to one another, is usually clearly indicated, whether it be fragmental or massive; the presence of glassy matter in contradistinction to a completely crystalline or "holo-crystalline" condition; the nature and origin of organic fragments; banding, foliation or lamination; the pumiceous or porous structure of many lavas; these and many other characters, though often not visible in the hand specimens of a rock, are rendered obvious by the examination of a microscopic section. Many refined methods of observation may be introduced, such as the measurement of the size of the elements of the rock by the help of micrometers; their relative proportions by means of a glass plate ruled in small squares; the angles between cleavages or faces seen in section by the use of the rotating graduated stage, and the estimation of the refractive index of the mineral by comparison with those of different mounting media.

Pleochroism.

Further information is obtained by inserting the polarizer and rotating the section. The light vibrates now only in one plane, and in passing through doubly refracting crystals in the slide is, speaking generally, broken up into two rays, which vibrate at right angles to one another. In many coloured minerals such as biotite, hornblende, tourmaline, chlorite, these two rays have different colours, and when a section containing any of these minerals is rotated the change of colour is often very striking. This property, known as "pleochroism" (Gr. πλείων, more; χρώς, colour), is of great value in the determination of rock-making minerals. It is often especially intense in small spots which surround minute enclosures of other minerals, such as zircon and epidote; these are known as "pleochroic halos."

Double Refraction.

Extinction.

If the analyser be now inserted in such a position that it is crossed relatively to the polarizer the field of view will be dark where there are no minerals, or where the light passes through isotropic substances such as glass, liquids and cubic crystals. All other crystalline bodies, being doubly refracting, will appear bright in some position as the stage is rotated. The only exception to this rule is provided by sections which are perpendicular to the optic axes of birefringent crystals; these remain dark or nearly dark during a whole rotation, and as will be seen later, their investigation is of special importance. The doubly refracting mineral sections, however, will in all cases appear black in certain positions as the stage is rotated. They are said to be "extinguished" when this takes place. If we note these positions we may measure the angle between them and any cleavages, faces or other structures of the crystal by means of the rotating stage. These angles are characteristic of the system to which the mineral belongs and often of the mineral species itself (see CRYSTALLOGRAPHY). To facilitate measurement of extinction angles various kinds of eyepieces have been devised, some having a stauroscopic calcite plate, others with two or four plates of quartz cemented together; these are often found to give more exact results than are obtained by observing merely the position in which the mineral section is most completely dark between crossed nicols.

The mineral sections when not extinguished are not only bright but are coloured and the colours they show depend on several factors, the most important of which is the strength of the double refraction. If all the sections are of the same thickness as is nearly true of well-made slides, the minerals with strongest double refraction yield the highest polarization colours. The order in which the colours are arranged is that known as Newton's scale, the lowest being dark grey, then grey, white, yellow, orange, red, purple, blue and so on. The difference between the refractive indexes of the ordinary and the extraordinary ray in quartz is ·009, and in a rock-section about $\frac{1}{500}$ of an inch thick this mineral gives grey and white polarization tints; nepheline with weaker double refraction gives dark grey; augite on the other hand will give red and blue, while calcite with still stronger double refraction will appear pinkish or greenish white. All sections of the same mineral, however, will not have the same colour; it was stated above that sections perpendicular to an optic axis will be nearly black, and, in general, the more nearly any section approaches this direction the lower its polarization colours will be. By taking the average, or the highest colour given by any mineral, the relative value of its double refraction can be estimated; or if the thickness of the section be precisely known the difference between the two refractive indexes can be ascertained. If the slides be thick the colours will be on the whole higher than in thin slides.

It is often important to find out whether of the two axes of elasticity (or vibration traces) in the section is that of greater elasticity (or lesser refractive index). The quartz wedge or selenite plate enables us to do this. Suppose a doubly refracting mineral section so placed that it is "extinguished"; if now it is rotated through 45° it will be brightly illuminated. If the quartz wedge be passed across it so that the long axis of the wedge is parallel to the axis of elasticity in the section the polarization colours will rise or fall. If they rise the axes of greater elasticity in the two minerals are parallel; if they sink the axis of greater elasticity in the one is parallel to that of lesser elasticity in the other. In the latter case by pushing the wedge sufficiently far complete darkness or compensation will result. Selenite wedges, selenite plates, mica wedges and mica plates are also used for this purpose. A quartz wedge also may be calibrated by determining the amount of double refraction in all parts of its length. If now it be used to produce compensation or complete extinction in any doubly refracting mineral section, we can ascertain what is the strength of the double refraction of the section because it is obviously equal and opposite to that of a known part of the quartz wedge.

A further refinement of microscopic methods consists of the use of strongly convergent polarized light (konoscopic methods). This is obtained by a wide angled achromatic condenser above the polarizer, and a high power microscopic objective. Those sections are most useful which are perpendicular to an optic axis, and consequently remain dark on rotation. If they belong to uniaxial crystals they show a dark cross or convergent light between crossed nicols, the bars of which remain parallel to the wires in the field of the eye-piece. Sections perpendicular to an optic axis of a biaxial mineral under the same conditions show a dark bar which on rotation becomes curved to a hyperbolic shape. If the section is perpendicular to a "bisectrix" (see CRYSTALLOGRAPHY) a black cross is seen which on rotation opens out to form two hyperbolas, the apices of which are turned towards one another. The optic axes emerge at the apices of the hyperbolas and may be surrounded by coloured rings, though owing to the thinness of minerals in rock sections these are only seen when the double refraction of the mineral is strong. The distance between the axes as seen in the field of the microscope depends partly on the axial angle of the crystal and partly on the numerical aperture of the objective. If it is measured by means of an eye-piece micrometer, the optic axial angle of the mineral can be found by a simple calculation. The quartz wedge, quarter mica plate or selenite plate permit the determination of the positive or negative character of the crystal by the changes in the colour or shape of the figures observed in the field. These operations are precisely similar to those employed by the mineralogist in the examination of plates cut from crystals. It is sufficient to point out that the petrological microscope in its modern development is an optical instrument of great precision, enabling us to determine physical constants of crystallized substances as well as serving to produce magnified images like the ordinary microscope. A great variety of accessory apparatus has been devised to fit it for these special uses.

Separation of Components.

The separation of the ingredients of a crushed rock powder from one to another in order to obtain pure samples suitable for analysis is also extensively practised. It may be effected by means of a powerful electro-magnet the strength of which can be regulated as desired. A weak magnetic field will attract magnetite, then haematite and other ores of iron. Silicates containing iron will follow in definite order and biotite, enstatite, augite, hornblende, garnet and similar ferro-magnesian minerals may be successively abstracted; at last only the colourless, non-magnetic compounds, such as muscovite, calcite, quartz and felspar, will remain. Chemical methods also are useful. A weak acid will dissolve calcite from a crushed limestone, leaving only dolomite, silicates or quartz. Hydrofluoric acid will attack felspar before quartz, and if employed with great caution will dissolve these and any glassy material in a rock powder before dissolving augite or hypersthene. Methods of separation by specific gravity have a still wider application. The simplest of these is levigation (Lat. *levigare*, to make smooth, *levis*) or treatment by a current of water; it is extensively employed in the mechanical analysis of soils and in the treatment of ores, but is not so successful with rocks, as their components do not as a rule differ very greatly in specific gravity.

Fluids are used which do not attack the majority of the rock-making minerals and at the same time have a high specific gravity. Solutions of potassium mercuric iodide (sp. gr. 3·196), cadmium borotungstate (sp. gr. 3·30), methlyene iodide (sp. gr. 3·32), bromoform (sp. gr. 2·86), or acetylene bromide (sp. gr. 3·00) are the principal media employed. They may be diluted (with water, benzene, &c.) to any desired extent and again concentrated by evaporation. If the rock be a granite consisting of biotite (sp. gr. 3·1), muscovite (sp. gr. 2·85), quartz (sp. gr. 2·65), oligoclase (sp. gr. 2·64) and orthoclase (sp. gr. 2·56) the crushed minerals will all float in methylene iodide; on gradual dilution with benzene they will be precipitated in the order given above. Although simple in theory these methods are tedious in practice, especially as it is common for one rock-making mineral to enclose another. But expert handling of fresh and suitable rocks yields excellent results and much purer powders may be obtained by this means than by any other.

Examination of Rock Powders.

Although rocks are now studied principally in microscopic sections the investigation of fine crushed rock powders, which was the first branch of microscopic petrology to receive attention, is by no means discontinued. The modern optical methods are perfectly applicable to transparent mineral fragments of any kind. Minerals are almost as easily determined in powder as in section, but it is otherwise with rocks, as the structure or relation of the components to one another, which is an element of great importance in the study of the history and classification of rocks, is almost completely destroyed by grinding them to powder.

Chemical Analysis.

In addition to naked-eye and microscopic investigations chemical methods of research are of the greatest practical utility to the petrographer. The crushed and separated powders, obtained by the processes described above, may be analysed and thus the chemical composition of the minerals in the rock determined qualitatively or quantitatively. The chemical testing of microscopic sections and minute grains by the help of the microscope is a very elegant and valuable means of discriminating between the mineral components of fine-grained rocks. Thus the presence of apatite in rock-sections is established by covering a bare rock-section with solution of ammonium molybdate; a turbid yellow precipitate forms over the crystals of the mineral in question (indicating the presence of phosphates). Many silicates are insoluble in acids and cannot be tested in this way, but others are partly dissolved, leaving a film of gelatinous silica which can be stained with colouring matters such as the aniline dyes (nepheline, analcite, zeolites, &c.).

Complete chemical analyses of rocks are also widely made use of and are of the first importance, especially when new species are under description. Rock analysis has of late years (largely under the influence of the chemical laboratory of the United States Geological Survey) reached a high pitch of refinement and complexity. As many as twenty or twenty-five components may be determined, but for practical purposes a knowledge of the relative proportions of silica, alumina, ferrous and ferric oxides, magnesia, lime, potash, soda and water will carry us a long way in determining the position to which a rock is to be assigned in any of the conventional classifications. A chemical analysis is in itself usually sufficient to indicate whether a rock is igneous or sedimentary and in either case to show with considerable accuracy to what subdivision of these classes it belongs. In the case of metamorphic rocks it often establishes whether the original mass was a sediment or of volcanic origin.

Specific Gravity.

The specific gravity of rocks is determined in the usual way by means of the balance and the pycnometer. It is greatest in those rocks which contain most magnesia, iron and heavy metals; least in rocks rich in alkalis, silica and water. It diminishes with weathering, and generally those rocks which are highly crystalline have higher specific gravities than those which are wholly or partly vitreous when both have the same chemical composition. The specific gravity of the commoner rocks ranges from about 2·5 to 3·2.

Rock Synthesis.

The above methods of investigation, naked eye, physical, microscopical, chemical, may be grouped together as analytical in contradistinction to the synthetic investigation of rocks, which proceeds by experimental work to reproduce different rock types and in this way to elucidate their origin and explain their structures. In many cases no experiment is necessary. Every stage in the origin of clays, sands and gravels can be seen in process around us, but where these have been converted into coherent shales, sandstones and conglomerates, and still more where they have experienced some degree of metamorphism, there are many obscure points about their history upon which experiment may yet throw light. Up to the present time these investigations have been almost entirely confined to the attempt to reproduce igneous rocks by fusion of mixtures of crushed minerals or of chemicals in specially contrived furnaces. The earliest researches of this sort are of those of Faujas St Fond and of de Saussure, but Sir James Hall really laid the foundations of this branch of petrology. He showed (1798) that the whinstones (diabases) of Edinburgh were fusible and if rapidly cooled yielded black vitreous masses closely resembling natural pitchstones and obsidians; if cooled more slowly they consolidated as crystalline rocks not unlike the whinstones themselves and containing olivine, augite and felspar (the essential minerals of these rocks). Many years later Daubrée, Delesse and others carried on similar experiments, but the first notable advance was made in 1878, when Fouqué and Lévy began their researches.

They succeeded in producing such rocks as porphyrite, leucite-tephrite, basalt and dolerite, and obtained also various structural modifications well known in igneous rocks, *e.g.* the porphyritic and the ophitic (Gr. ὄφις, serpent). Incidentally they showed that while many basic rocks (basalts, &c.) could be perfectly imitated in the laboratory, the acid rocks could not, and advanced the explanation that for the crystallization of the latter the gases never absent in natural rock magmas were indispensable mineralizing agents. It has subsequently been proved that steam, or such volatile substances as certain borates, molybdates, chlorides, fluorides, assist in the formation of orthoclase, quartz and mica (the minerals of granite). Sir James Hall also made the first contribution to the experimental study of metamorphic rocks by converting chalk

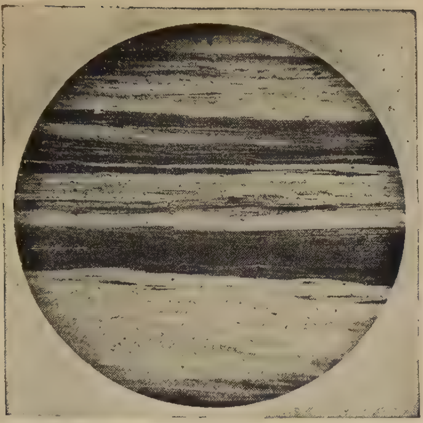


FIG. 1.—BANDED OBSIDIAN, KIRGHIZ (×25).

The rock consists of alternate bands of brown and colourless glass which have been arranged in stripes by the fluxion movement of the viscous mass before solidification. The glass is rendered granular by very minute crystals.

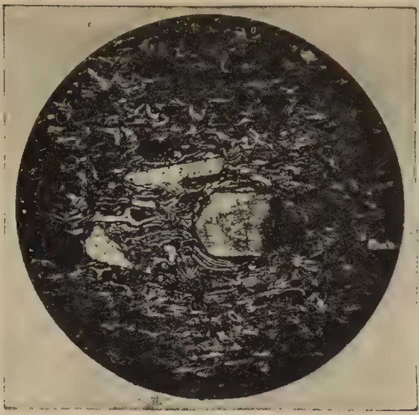


FIG. 2.—FLUIDAL RHYOLITE, HUNGARY (× 15).

In the centre are crystals of felspar, rather turbid through weathering. The matrix is partly glassy, partly felsitic, and shows the effects of streaming movements with eddies behind the felspar crystals.

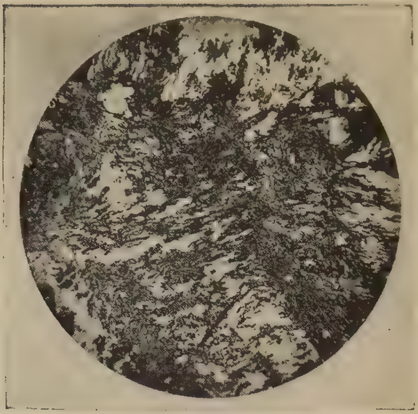


FIG. 3.—OBSIDIAN, MEXICO (× 15).

This rock has a damascened pattern owing to the irregular mingling of streams of brown and of colourless glass. It is nearly quite free from minute crystals.

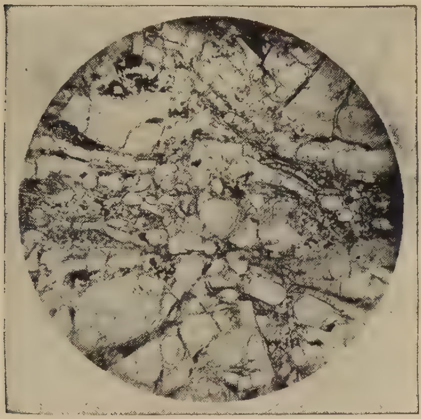


FIG. 4.—PERLITIC OBSIDIAN, TOKAI, HUNGARY (× 15).

The clear glassy rock is traversed by a large number of cracks, some long and straight, while others are nearly circular. These are rendered more distinct by the deposit of thin films of secondary limonite in them. The cracks are due to contraction on cooling.

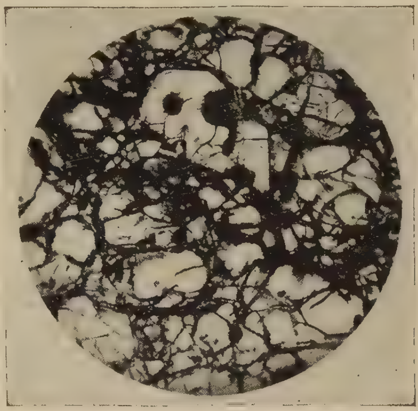


FIG. 5.—PERLITIC PITCHSTONE, MEISSEN, GERMANY (× 15).

The perlitic, rounded cracks are very clearly seen, because the rock is decomposing and becoming slightly opaque along them. At the top there is a corroded crystal of felspar, showing cleavage, with large circular enclosures of brownish glass.

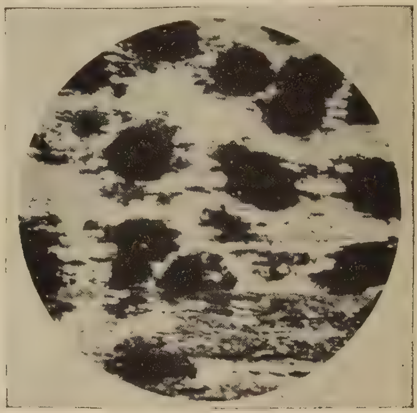


FIG. 6.—OBSIDIAN, ICELAND (× 17).

In the clear glassy base there are rounded yellow spots (spherulites) arranged in fluxion streams.

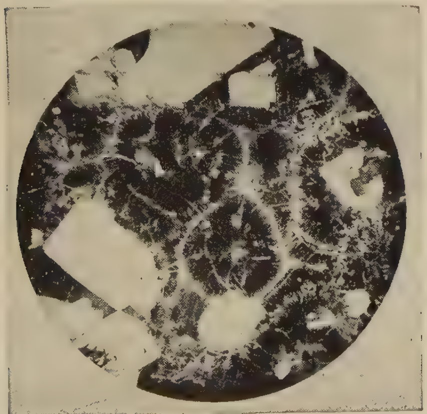


FIG. 7.—SPHERULITIC RHYOLITE, HLINIK, HUNGARY (× 10).

The white, angular patches are crystals of quartz and of sanidine felspar. Between them there is a yellowish glass showing circular areas with a well-defined radiate fibrous structure (spherulites).

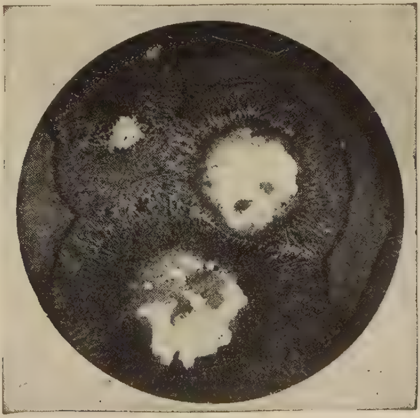


FIG. 8.—SPHERULITIC FELSITE, ARRAN, SCOTLAND (× 10).

The round spherulites of this rock are large and sometimes composite; their radiate structure is obvious. This is a devitrified pitchstone, no longer glassy but finely crystalline, and at the centres of the spherulites there are spaces occupied by a secondary deposit of quartz.

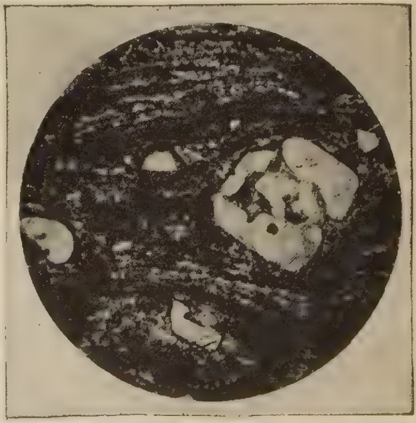


FIG. 9.—PORPHYRITIC AND FLUIDAL RHYOLITE, HUNGARY (× 12).

The ground mass is partly glassy, partly felsitic, and shows fluxion-banding. The large quartz is a double hexagonal pyramid, but its edges and corners are rounded by corrosion and large irregular areas of glass penetrate to its centre.

PLATE II.

PETROLOGY

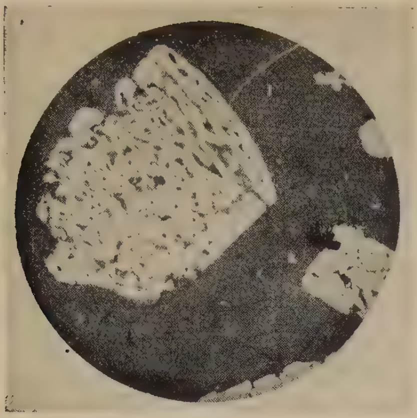


FIG. 1.—PORPHYRITIC PITCHSTONE, SCUIR OF EIGG, SCOTLAND (×10).

A large porphyritic felspar crystal is seen lying in a pale-brown glassy base and containing many glass inclusions of irregular shape. The felspar, in one margin especially, shows corroded outlines.

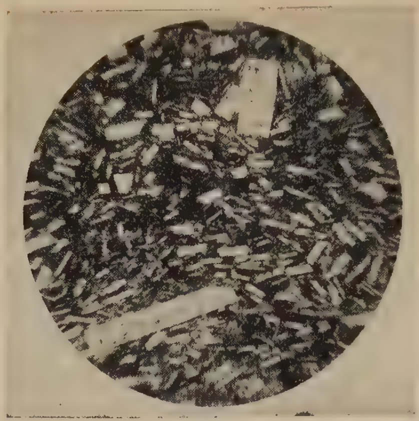


FIG. 2.—TRACHYTE, OROTAVA, TENERIFFE (× 12).

There are larger porphyritic felspars of the first generation, and smaller ones of later origin composing part of the ground-mass, which also contains a considerable amount of yellow vitreous material.

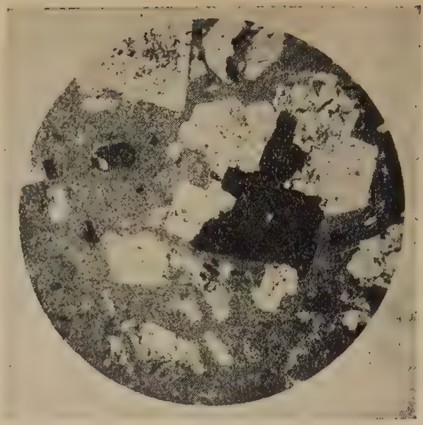


FIG. 3.—TRACHYTE, PERLENHARDT, GERMANY (× 10).

In this rock there are porphyritic crystals of felspar and of dark brown biotite (nearly black in the photograph), with a few of green augite and magnetite. The ground-mass is finely crystalline.

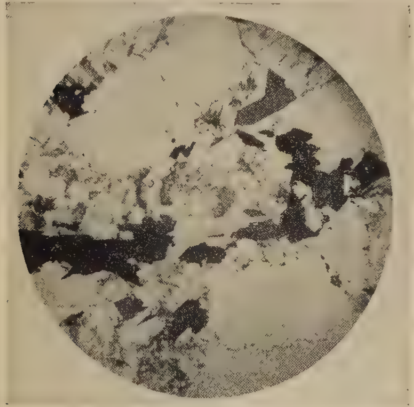


FIG. 4.—GRANITE RUBISLAW, ABERDEEN (× 10).

This is a non-porphyritic, holocrystalline rock. Among its components the crystals of dark mica are conspicuous, and with them occur also a few plates of white mica, with perfect cleavage. The slightly turbid or granular substance is felspar, a little decomposed, and the large clear spaces are crystals of quartz.

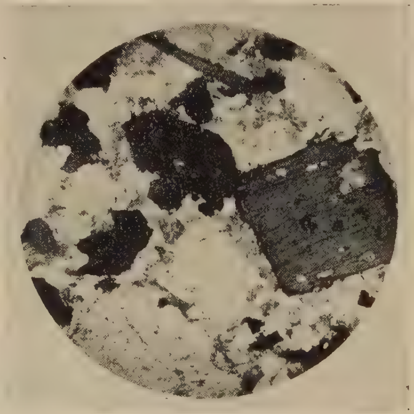


FIG. 5.—HORNBLENDE-GRANITE, DALBEATTIE, SCOTLAND (× 15).

The dark crystal with fine parallel lines of cleavage is biotite; the others, with two less perfect cleavages, are hornblende. At the top there is a long rod-shaped grain of sphene. The granular-looking substance is felspar, and the quartz, as usual, is clear and transparent.

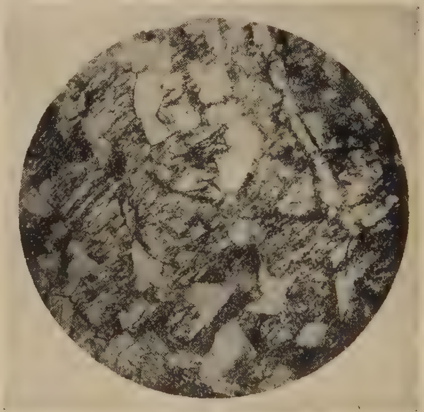


FIG. 6.—GRAPHIC GRANITE, BODENMAIS, BAVARIA (× 10).

This rock consists of angular patches of clear quartz scattered through a striated dull matrix of felspar. The different quartz areas have all the same optical orientation, as if they were parts of a single crystal.

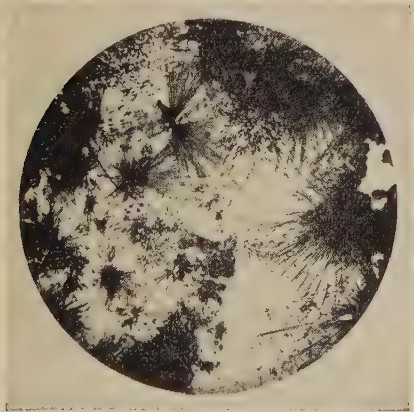


FIG. 7.—LUXULLIANITE, LUXULYAN, CORNWALL (× 15).

In this variety of tourmaline-granite there are many blue needles of tourmaline, grouped in stellate clusters which are embedded in a matrix of clear quartz. These pointed needles diverge from the surfaces of larger grains of tourmaline.

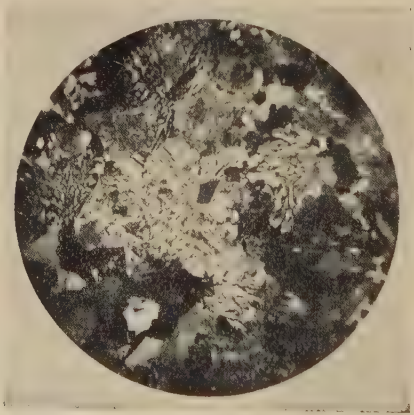


FIG. 8.—GRANOPHYRE, BRAEMAR, SCOTLAND (× 37).

This photograph is taken between crossed nicols to show the graphic structure of the ground-mass, similar to that of Fig. 6, but on a much finer scale. The quartz towards the centre of the field appears as white, angular areas, embedded in a grey matrix of felspar, and each mineral reacts in a uniform fashion to polarized light over an area of moderate extent.

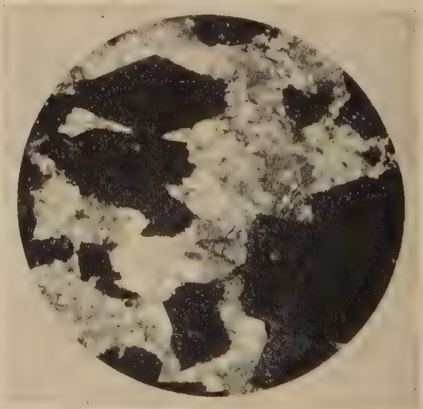


FIG. 9.—DIORITE, HODRITCH, HUNGARY (× 10).

The dark crystals are green hornblende, and show the outlines which are characteristic of that mineral. The cloudy grey substance between them is felspar in a somewhat weathered state.

into marble by heating it in a closed gun-barrel, which prevented the escape of the carbonic acid at high temperatures. Adams and Nicholson have carried this a stage farther by subjecting marble to great pressure in hydraulic presses and have shown how the foliated structures, frequent in natural marbles, may be produced artificially.

Rock Classification.—The three great classes of rocks above enumerated—the igneous, the sedimentary and the metamorphic—are subdivided into many groups which to a small extent resemble the genera and species under which the naturalist classifies the members of the animal kingdom. There are, however, no hard and fast boundaries between allied rocks. By increase or diminution in the proportions of their constituent minerals they pass by every gradation into one another; the distinctive structures also of one kind of rock may often be traced gradually merging into those of another. Hence the definitions adopted in establishing rock nomenclature merely correspond to selected points (more or less arbitrary) in a continuously graduated series. This is frequently urged as a reason for reducing rock classification to its simplest possible terms, and using only a few generalized rock designations. But it is clear that many apparently trivial differences tend regularly to recur, and have a real significance, and so long as any variation can be shown to be of this nature it deserves recognition.

Igneous Rocks.

Lavas or Effusive Types.

The *igneous rocks* (crystalline and fragmental) form a well-defined group, differing in origin from all others. The crystalline or massive varieties may occur in two different ways; the lavas have been poured out at the surface and have consolidated after ejection, under conditions which are fairly well understood, seeing that they may be examined at active volcanoes in many parts of the world; the intrusive rocks, on the other hand, have been injected from below into cracks and fissures in the strata and have cooled there beneath masses which conceal them from view till exposed by denudation at a subsequent period. The members of these two groups differ in many respects from one another, so that it is often possible to assign a rock to one or other of them on mere superficial inspection. The lavas (or effusive rocks), having cooled rapidly in contact with the air, are mostly finely crystalline or have at least fine-grained ground-mass representing that part of the viscous semi-crystalline lava flow which was still liquid at the moment of eruption. At this time they were exposed only to atmospheric pressure, and the steam and other gases, which they contained in great quantity, were free to escape; many important modifications arise from this, the most striking being the frequent presence of numerous steam cavities (vesicular structure) often drawn out to elongated shapes subsequently filled up with minerals by infiltration (amygdaloidal structure). As crystallization was going on while the mass was still creeping forward over the surface of the earth, the latest formed minerals (in the ground-mass) are commonly arranged in subparallel winding lines following the direction of movement (fluxion or fluidal structure) (see Pl. I. figs. 2 and 9, Pl. II. fig. 2), and the larger early minerals which had previously crystallized may show the same arrangement. Most lavas have fallen considerably below their original temperatures before they are emitted. In their behaviour they present a close analogy to hot solutions of salts in water, which, when they approach the saturation temperature, first deposit a crop of large, well-formed crystals (labile stage) and subsequently precipitate clouds of smaller less perfect crystalline particles (metastable stage). In igneous rocks the first generation of crystals generally forms before the lava has emerged to the surface, that is to say, during the ascent from the subterranean depths to the crater of the volcano. It has frequently been verified by observation that freshly emitted lavas contain large crystals borne along in a molten, liquid mass. The large, well-formed, early crystals are said to be porphyritic (Pl. III. figs. 1, 2, 3); the smaller crystals of the surrounding matrix or ground-mass belong to the post-effusion stage. More rarely lavas are completely fused at the moment of ejection; they may then cool to form a non-porphyritic, finely crystalline rock, or if more rapidly chilled may in large part be non-crystalline or glassy (vitreous rocks such as obsidian, tachylyte, pitchstone (Pl. I. figs. 1, 4, 5). A common feature of glassy rocks is the presence of rounded bodies (spherulites: Gr. *σφαῖρα*, ball), consisting of fine divergent fibres radiating from a centre (Pl. I. figs. 7, 8); they consist of imperfect crystals of felspar, mixed with quartz or tridymite; similar bodies are often produced artificially in glasses which are allowed to cool slowly. Rarely these spherulites are hollow or consist of concentric shells with spaces between (lithophysae: Gr. *λίθος*, stone; *φῦσα*, bellows). Perlitic structure, also common in glasses, consists in the presence of concentric rounded cracks owing to contraction on cooling (see Perlite).

The phenocrysts (Gr. *φαίνειν*, to show; *κρύσταλλον*, crystal) or porphyritic minerals are not only larger than those of the ground-mass. As the matrix was still liquid when they formed they were free to take perfect crystalline shapes, not being interfered with by the pressure of adjacent crystals. They seem to have grown rapidly, as they are often filled with enclosures of glassy or finely crystalline material like that of the ground-mass (Pl. II. fig. 1). Microscopic examination of the phenocrysts often reveals that they have had a complex history. Very frequently they show successive layers of different composition, indicated by variations in colour or other optical properties; thus augite may be green at the centre and various shades of brown outside this; or may be pale green centrally and darker green with strong pleochroism (aegirine) at the periphery. In the felspars the centre is usually more basic and richer in lime than the surrounding faces, and successive zones may often be noted, each less basic than those which lie within it. Phenocrysts of quartz (and of other minerals), instead of sharp, perfect crystalline faces, may show rounded corroded surfaces (Pl. I. fig. 9), with the points blunted and irregular tongue-like projections of the matrix into the substance of the crystal. It is clear that after the mineral had crystallized it was partly again dissolved or corroded at some period before the matrix solidified. Corroded phenocrysts of biotite and hornblende are very common in some lavas; they are surrounded by black rims of magnetite mixed with pale green augite. The hornblende or biotite substance has proved unstable at a certain stage of consolidation and has been replaced by a paramorph of augite and magnetite which may be partially or completely substituted for the original crystal but still retains its characteristic outlines.

Plutonic or Abyssal Types.

Let us now consider the characteristics of a typical deep-seated rock like granite or diorite (Pl. II. figs. 4, 5, 9). That these are igneous is proved by the manner in which they have burst through the superincumbent strata, filling the cracks with ramifying veins; that they were at a very high temperature is equally clear from the changes which they have induced in the rocks in contact with them. But as their heat could dissipate only very slowly, because of the masses which covered them, complete crystallization has taken place and no vitreous rapidly chilled matter is present. As they have had time to come to rest before crystallizing they are not fluidal. Their contained gases have not been able to escape through the thick layer of strata beneath which they were injected, and may often be observed occupying cavities in the minerals, or have occasioned many important modifications in the crystallization of the rock. Because their crystals are of approximately equal size these rocks are said to be granular; there is typically no distinction between a first generation of large well-shaped crystals and a fine-grained ground-mass. Their minerals have formed, however, in a definite order, and each has had a period of crystallization which may be very distinct or may have coincided with or overlapped the period of formation of some of the other ingredients. The earlier have originated at a time when most of the rock was still liquid and are more or less perfect; the later are less regular in shape because they were compelled to occupy the interspaces left between the already formed crystals (Pl. II. figs. 5, 9). The former are said to be idiomorphic (or automorphic), the latter are anidiomorphic (allotriomorphic, xenomorphic).[1] There are also many other characteristics which serve to distinguish the members of these two groups. Orthoclase, for example, is the typical felspar of granite, while its modification sanidine occurs in lavas of similar composition. The same distinction holds between elaeolite and nepheline. Leucite is common in lavas, very rare in plutonic rocks. Muscovite is confined to the intrusives. These differences show the influence of the physical conditions under which consolidation takes place.

Intrusive or Hypabyssal Types.

There is a certain class of intrusive rocks which have risen upwards towards the surface, but have failed to reach it, and have solidified in fissures as dikes and intrusive sills at no great depth. To this type the name *intrusive* (or *hyp-abyssal*) is often given in distinction to the *plutonic* (or *abyssal*) which formed at greater depths. As might be expected, they show structures intermediate between those of the effusive and the plutonic rocks. They are very commonly porphyritic, not rarely vitreous, and sometimes even vesicular. In fact many of them are indistinguishable petrologically from lavas of similar composition.

The attempt to form a special group of hypabyssal (intrusive and dike) rocks has met with much criticism and opposition. Such a group certainly cannot rank as equally important and equally well characterized with the plutonic and the effusive. But there are many kinds of rock which are not found to occur normally in any other manner. As examples we may cite the lamprophyres, the aplites and the porphyrites. These never occur as lava flows or as great plutonic bosses; if magmas of the same composition as these rocks occur in either of these ways they consolidate with different assemblages of minerals and different structures.

Subdivisions of Igneous Rock Class.

In subdividing the plutonic, the hypabyssal and the effusive rocks, the principle is followed of grouping those together which resemble one another in mineral constitution and in chemical composition. In a broad sense these two properties are interdependent.

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[1] Idiomorphic, having its own characteristic form, Gr. *ἴδιος*, belonging to one's self, (*αὐτός*), *μορφή* (form); allotriomorphic, from Gr. *ἀλλότριος*, belonging to another (*ἄλλος*), a stranger (*ξένος*).

Chemical Characters.

The commoner rock constituents are nearly all oxides; chlorine, sulphur and fluorine are the only important exceptions to this and their total amount in any rock is usually much less than 1 %. F. W. Clarke has calculated that a little more than 47 % of the earth's crust consists of oxygen. It occurs principally in combination as oxides, of which the chief are silica, alumina, iron oxides, lime, magnesia, potash and soda. The silica functions principally as an acid, forming silicates, and all the commonest minerals of igneous rocks are of this nature. From a computation based on 1672 analyses of all kinds of rocks Clarke arrived at the following as the average percentage composition: $SiO_2=59·71$, $Al_2O_3=15·41$, $Fe_2O_3=2·63$, $FeO=3·52$, $MgO=4·36$, $CaO=4·90$, $Na_2O=3·55$, $K_2O=2·80$, $H_2O=1·52$, $TiO_2=0·60$, $P_2O_5=0·22$, total 99·22 %. All the other constituents occur only in very small quantities, usually much less than 1 %.

These oxides do not combine in a haphazard way. The potash and soda, for example, with a sufficient amount of alumina and silica, combine to produce felspars. In some cases they may take other forms, such as nepheline, leucite and muscovite, but in the great majority of instances they are found as felspar. The phosphoric acid with lime forms apatite. The titanium dioxide with ferrous oxide gives rise to ilmenite. Part of the lime forms lime felspar. Magnesia and iron oxides with silica crystallize as olivine or enstatite, or with alumina and lime form the complex ferro-magnesian silicates of which the pyroxenes, amphiboles and biotites are the chief. Any excess of silica above what is required to neutralize the bases will separate out as quartz; excess of alumina crystallizes as corundum. These must be regarded only as general tendencies, which are modified by physical conditions in a manner not as yet understood. It is possible by inspection of a rock analysis to say approximately what minerals the rock will contain, but there are numerous exceptions to any rule which can be laid down.

Mineral Constitution.

Hence we may say that except in acid or siliceous rocks containing 66 % of silica and over, quartz will not be abundant. In basic rocks (containing 60 % silica or less) it is rare and accidental. If magnesia and iron be above the average while silica is low olivine may be expected; where silica is present in greater quantity other ferro-magnesian minerals, such as augite, hornblende, enstatite or biotite, occur rather than olivine. Unless potash is high and silica relatively low leucite will not be present, for leucite does not occur with free quartz. Nepheline, likewise, is usually found in rocks with much soda and comparatively little silica. With high alkalis soda-bearing pyroxenes and amphiboles may be present. The lower the percentage of silica and the alkalis the greater is the prevalence of lime felspar as contracted with soda or potash felspar. Clarke has calculated the relative abundance of the principal rock-forming minerals with the following results: Apatite = 0·6, titanium minerals = 1·5, quartz = 12·0, felspars = 59·5, biotite = 3·8, hornblende and pyroxene = 16·8, total = 94·2 %. This, however, can only be a rough approximation. The other determining factor, namely the physical conditions attending consolidation, plays on the whole a smaller part, yet is by no means negligible, as a few instances will prove. There are certain minerals which are practically confined to deep-seated intrusive rocks, *e.g.* microcline, muscovite, diallage. Leucite is very rare in plutonic masses; many minerals have special peculiarities in microscopic character according to whether they crystallized in depth or near the surface, *e.g.* hypersthene, orthoclase, quartz. There are some curious instances of rocks having the same chemical composition but consisting of entirely different minerals, *e.g.* the hornblendite of Gran, in Norway, containing only hornblende, has the same composition as some of the camptonites of the same locality which contain felspar and hornblende of a different variety. In this connexion we may repeat what has been said above about the corrosion of porphyritic minerals in igneous rocks. In rhyolites and trachytes early crystals of hornblende and biotite may be found in great numbers partially converted into augite and magnetite. The hornblende and biotite were stable under the pressures and other conditions which obtained below the surface, but unstable at higher levels. In the ground-mass of these rocks augite is almost universally present. But the plutonic representatives of the same magma, granite and syenite contain biotite and hornblende far more commonly than augite.

Acid, Intermediate and Basic Igneous Rocks.

Those rocks which contain most silica and on crystallizing yield free quartz are erected into a group generally designated the "acid" rocks. Those again which contain least silica and most magnesia and iron, so that quartz is absent while olivine is usually abundant, form the "basic" group. The "intermediate" rocks include those which are characterized by the general absence of both quartz and olivine. An important subdivision of these contains a very high percentage of alkalis, especially soda, and consequently has minerals such as nepheline and leucite not common in other rocks. It is often separated from the others as the "alkali" or "soda" rocks, and there is a corresponding series of basic rocks. Lastly a small sub-group rich in olivine and without felspar has been called the "ultrabasic" rocks. They have very low percentages of silica but much iron and magnesia.

Except these last practically all rocks contain felspars or felspathoid minerals. In the acid rocks the common felspars are orthoclase, with perthite, microcline, oligoclase, all having much silica and alkalis. In the basic rocks labradorite, anorthite and bytownite prevail, being rich in lime and poor in silica, potash and soda. Augite is the commonest ferro-magnesian of the basic rocks, but biotite and hornblende are on the whole more frequent in the acid.

The rocks which contain leucite or nepheline, either partly or wholly replacing felspar are not included in this table. They are essentially of intermediate or of basic character. We might in consequence regard them as varieties of syenite, diorite, gabbro, &c., in which felspathoid minerals occur, and indeed there are many transitions between syenites of ordinary type and nepheline—or leucite—syenite, and between gabbro or dolerite and theralite or essexite. But as many minerals develop in these "alkali" rocks which are uncommon elsewhere, it is convenient in a purely formal classification like that which is outlined here to treat the whole assemblage as a distinct series.

	Acid.	Intermediate.		Basic.	Ultrabasic.
		Little or no Quartz.			
Commonest Minerals.	Quartz Orthoclase (and Oligoclase), Mica, Hornblende, Augite.	Orthoclase Hornblende, Augite, Biotite.	Plagioclase Hornblende, Augite, Biotite.	No Quartz Plagioclase Augite, Olivine.	No Felspar Augite, Hornblende, Olivine.
Plutonic or Abyssal type.	Granite.	Syenite.	Diorite.	Gabbro.	Peridotite.
Intrusive or Hypabyssal type.	Quartz-porphyry.	Orthoclase-porphyry.	Porphyrite.	Dolerite.	Picrite.
Lavas or Effusive type.	Rhyolite, Obsidian.	Trachyte.	Andesite.	Basalt.	Limburgite.

Nepheline and Leucite-bearing Rocks.

Commonest Minerals.	Alkali Felspar, Nepheline or Leucite, Augite, Hornblende, Biotite.	Soda Lime Felspar Nepheline or Leucite, Augite, Hornblende (Olivine).	Nepheline or Leucite, Augite, Hornblende, Olivine.
Plutonic type.	Nepheline-syenite. Leucite-syenite.	Essexite and Theralite.	Ijolite and Missourite.
Intrusive type.	Nepheline-porphyry.		
Effusive type or Lavas.	Phonolite, Leucitophyre.	Tephrite and Basanite.	Nepheline-basalt. Leucite-basalt

This classification is based essentially on the mineralogical constitution of the igneous rocks. Any chemical distinctions between the different groups, though implied, are relegated to a subordinate position. It is admittedly artificial but it has grown up with the growth of the science and is still adopted as the basis on which more minute subdivisions are erected. The subdivisions are by no means of equal value. The syenites, for example, and the peridotites, are far less important than the granites, diorites and gabbros. Moreover, the effusive andesites do not always correspond to the plutonic diorites but partly also to the gabbros. As the different kinds of rock, regarded as aggregates of minerals, pass gradually into one another, transitional types are very common and are often so important as to receive special names. The quartz-syenites and nordmarkites may be interposed between granite and syenite, the tonalites and adamellites between granite and diorite, the monzonites between syenite and diorite, norites and hyperites between diorite and gabbro, and so on.

There is of course a large number of recognized rock species not included in the tables given. These are of two kinds, either belonging to groups which are subdivisions of those enumerated (bearing the same relation to them that species do to genera) or rare and exceptional rocks that do not fall within any of the main subdivisions proposed. The question may be asked—When is a rock entitled to be recognized as belonging to a distinct species or variety and deserving a name for itself? It must, first of all, be proved to occur in considerable quantity at some locality, or better still at a series of localities or to have been produced from different magmas at more than one period of the earth's history. In other words, it must not be a mere anomaly. Moreover, it should have a distinctive mineral constitution, differing from other rocks, or something individual in the characters of its minerals or of its structures. It is often surprising how peculiar types of rock, believed at first to be unique, turn up with identical features in widely scattered regions, *alnöite*, for example, occurs in Norway, Scotland, Montreal, British Columbia, New York and Brazil, *tinguaite* in Scotland, Norway, Brazil, Montana, Portugal, &c. This indicates that underlying all the variations in mineralogical, structural and chemical properties there are definite relationships which tend to repeat themselves, producing the same types whenever the same conditions are present.

Although in former years the view was widely current, especially in Germany, that igneous rocks belonging to different geological epochs should receive different names, it is now admitted on all sides that this cannot be upheld.

In 1902 a group of American petrographers brought forward a proposal to discard all existing classifications of igneous rocks and to substitute for them a "quantitative" classification based on chemical analysis. They showed how vague and often unscientific was much of the existing terminology and argued that as the chemical composition of an igneous rock was its most fundamental characteristic it should be elevated to prime position. Geological occurrence, structure, mineralogical constitution, the hitherto accepted criteria for the discrimination of rock species were relegated to the background. The completed rock analysis is first to be interpreted in terms of the rock-forming minerals which might be expected to be formed when the magma crystallizes, *e.g.* quartz felspars of various kinds, olivine, akermannite, felspathoids, magnetite, corundum and so on, and the rocks are divided into groups strictly according to the relative proportion of these minerals to one another. There is no need here to describe the minutia of the process adopted as the authors have stated them very clearly in their treatise (*Quantitative Classification of Igneous Rocks*, Chicago, 1902), and there is no indication that even in the United States it will ever displace the older classifications.

Consanguinity.

We can often observe in a series of eruptives belonging to one period and a restricted area certain features which distinguish them as a whole more or less completely from other similar assemblages. Such groups are often said to be consanguineous, and to characterize a definite "petrological province." Excellent examples of this are furnished by the Devonian igneous rocks of southern Norway as described by Brögger, the Tertiary rocks of the Hebrides (Harker), the Italian lavas studied by H. S. Washington. On a larger scale the volcanoes which girdle the Pacific (Andes, Cordillera, Japan, &c.), and those which occur on the volcanic islands of the Atlantic, show the same phenomena. Each of these groups has been formed presumably from a single deep-seated magma or source of supply and during a period which while necessarily prolonged was not of vast duration in a geological sense.

Differentiation.

On the other hand, each of the great suites of eruptive rocks which constitute such a petrological province embraces a great range of types. Prolonged eruptions have in a few cases a somewhat monotonous character, owing to the predominance of one kind of rock. Thus the lavas of the Hawaiian Islands are mostly basaltic, as are those of Oregon, Washington and the Deccan, all of which form geological masses of enormous magnitude. But it is more usual to find basalts, andesites, trachytes, dacites and many other rocks occurring in a single eruptive complex. The process by which a magma splits up into a variety of partial products is known as "differentiation." Its importance from the standpoint of theoretical petrology is very great, but as yet no adequate explanation of it has been offered. Differentiation may show itself in two ways. In the first type the successive emissions from a volcanic focus may differ considerably from one another. Thus in the Pentland Hills, near Edinburgh, the lavas which are of lower Devonian age, were first basaltic, then andesitic, trachytic and dacitic, and finally rhyolitic, and this succession was repeated a second time. Yet they all must have come from the same focus, or at any rate from a group of foci very closely connected with one another. Occasionally it is found that the earlier lavas are of intermediate character and that basic alternate with acid during the later stages of the volcanic history.

Not less interesting are those cases in which a single body of rock has in consolidation yielded a variety of petrographical types often widely divergent. This is best shown by great plutonic bosses which may be regarded as having once been vast subterranean spaces filled with a nearly homogeneous liquid magma. Cooling took place gradually from the outer surfaces where the igneous rock was in contact with the surrounding strata. The resultant laccolite (Gr. λάκκος, pit, crater, λίθος, stone), stock or boss, may be a few hundred yards or many miles in diameter and often contains a great diversity of crystalline rocks. Thus peridotite, gabbro, diorite, tonalite and granite, are often associated, usually in such a way that the more basic are the first-formed and lie nearest the external surfaces of the mass. The reverse sequence occurs occasionally, the edges being highly acid while the central parts consist of more basic rocks. Sometimes the later phases penetrate into and vein the earlier; evidently there has been some movement due to temporary increase of pressure when part of the laccolite was solid and part still in a liquid state. This links these phenomena with those above described where successive emissions of different character have proceeded outwards from the focus.

According to modern views two explanations of these facts are possible. Some geologists hold that the different rock facies found in association are often due to local absorption of surrounding rocks by the molten magma ("assimilation"). Effects of this kind are to be expected, and have been clearly proved in many places. There is, however, a general reluctance to admit that they are of great importance. The nature and succession of the rock species do not as a rule show any relation to the sedimentary or other materials which may be supposed to have been dissolved; and where solution is known to have gone on the products are usually of abnormal character and easily distinguishable from the common rock types.

Hence it is generally supposed that differentiation is to be ascribed to some physical or chemical processes which lead to the splitting up of a magma into dissimilar portions, each of which consolidates as a distinct kind of rock. Two factors can be selected as probably most potent. One important factor is cooling and another is crystallization. According to physico-chemical laws the least soluble substances will tend to diffuse towards the cooling surfaces (Ludwig–Sorets's principle). This is in accordance with the majority of the observed facts and is probably a *vera causa* of differentiation, though what its potency may be is uncertain. As a rock solidifies the minerals which crystallize follow one another in a more or less well-defined order, the most basic (according to Rosenbusch's law) being first to separate out. That in a general way the peripheral portions of a laccolite consist mainly of those early basic minerals suggests that the sequence of crystallization helps largely in determining the succession (and consequently the distribution of rock species in a plutonic complex). Gravity also may play a part, for it is proved that in a solution at rest the heaviest components will be concentrated towards the base. This must, however, be of secondary importance as in laccolites the top portions often consist of more basic and heavier varieties of rock than the centres. It has also been argued that the earliest minerals being heaviest and in any case denser than the fused magma around them, will tend to sink by their own weight and to be congregated near the bottom of the mass. Electric currents, magnetic attraction and convection currents have also been called in to account for the phenomena observed. Magmas have also been compared to liquids which, when they cool, split up into portions no longer completely soluble in one another (liquation hypothesis). Each of these partial magmas may dissolve a portion of the others and as the temperature falls and the conditions change a range of liquids differing in composition may be supposed to arise.

All igneous magmas contain dissolved gases (steam, carbonic acid, sulphuretted hydrogen, chlorine, fluorine, boric acid, &c.). Of these water is the principal, and was formerly believed to have percolated downwards from the earth's surface to the heated rocks below, but is now generally admitted to be an integral part of the magma. Many peculiarities of the structure of the plutonic rocks as contrasted with the lavas may reasonably be accounted for by the operation of these gases, which were unable to escape as the deep-seated masses slowly cooled, while they were promptly given up by the superficial effusions. The acid plutonic or intrusive rocks have never been reproduced by laboratory experiments, and the only successful attempts to obtain their minerals artificially have been those in which special provision was made for the retention of the "mineralizing" gases in the crucibles or sealed tubes employed. These gases often do not enter into the composition of the rock-forming minerals, for most of these are free from water, carbonic acid, &c. Hence as crystallization goes on the residual liquor must contain an ever-increasing proportion of volatile constituents. It is conceivable that in the final stages the still uncrystallized part of the magma has more resemblance to a solution of mineral matter in superheated steam than to a dry igneous fusion. Quartz, for example, is the last mineral to form in a granite. It bears much of the stamp of the quartz which we know has been deposited from aqueous solution in veins, &c. It is at the same time the most infusible of all the common minerals of rocks. Its late formation shows that in this case it arose at comparatively low temperatures and points clearly to the special importance of the gases of the magma as determining the sequence of crystallization.

When solidification is nearly complete the gases can no longer be retained in the rock and make their escape through fissures towards the surface. They are powerful agents in attacking the minerals of the rocks which they traverse, and instances of their operation are found in the kaolinization of granites, tourmalinization and formation of greisen, deposit of quartz veins, stanniferous and auriferous veins, apatite veins, and the group of changes known as propylitization.[1] These "pneumatolytic" (Gr. πνεῦμα, spirit, vapour, λύειν, to loose, dissolve) processes are of the first importance in the genesis of many ore deposits. They are a real part of the history of the magma itself and constitute the terminal phases of the volcanic sequence.

The complicated succession from basic (or ultrabasic) to acid types exemplified in the history of many magmas is reflected with

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[1] The term "propylite" (Gr. πρόπυλον, a gateway) was given by Richthofen to a volcanic rock which is supposed to have marked a new epoch in volcanic geology (see ANDESITE).

Sequence of Crystallization.

astonishing completeness in the history of individual products. In each class of rock crystallization follows a definite course. The first minerals to separate belong to a group known as the minor accessories; this includes zircon, apatite, sphene, iron oxides; then follow in order olivine, augite, hornblende, biotite, plagioclase, felspar (beginning with the varieties most rich in lime and ending with those which contain most soda), orthoclase, microcline and quartz (with micropegmatite). Many exceptions to this rule are known; the same mineral may crystallize at two different periods; two or more minerals may crystallize simultaneously or the stages in which they form may overlap. But the succession above given holds in the vast majority of cases. Expressed in this way: the more basic minerals precede the less basic; it is known as Rosenbusch's law.

Poikilitic.

Types of Structure.—In some rocks there seems to be little tendency for the minerals to envelop one another. This is true of many gabbros, aplites and granites (Pl. III, fig. 7). The grains then lie side by side, with the faces of the latter moulded on or adapted to the more perfect crystalline outlines of the earlier. More commonly some closer relationship exists between them. When the smaller idiomorphic crystals of the first-formed are scattered irregularly through the larger and less perfect crystals of later origin, the structure is said to be poikilitic (Gr. ποικίλος, many-coloured, mottled). A variety of this, known as ophitic (Pl. III, fig. 6), is very characteristic of many dolerites and diabases, in which large plates of augite enclose many small laths of plagioclase felspar. Biotite and hornblende frequently enclose felspar ophitically; less commonly iron oxides and sphene do so. In peridotites the "lustre-mottled" structure arises from pyroxene or hornblende enveloping olivine in the same manner (Pl. III, fig. 8). In these cases no crystallographic relation exists between the two minerals (enclosing and enclosed).

Parallel Growths.

But often the surrounding mineral has been laid down on the surface of the other in such a way that they have certain crystalline faces or axes parallel to one another. This is known as "parallel growth." It is best seen in zoned crystals of plagioclase felspar, which may range in composition from anorthite to oligoclase, the more acid layers being deposited regularly on the surfaces of the more basic. Biotite and muscovite, hornblende and augite, enstatite and diallage, epidote and orthite, very frequently are associated in this way.

Graphic Intergrowths.

When two minerals crystallize simultaneously they may be intergrown in "graphic" fashion. The best example is quartz and orthoclase occurring together as micropegmatite (Pl. II, figs. 6 and 8). The quartz forms angular patches in the felspar, which though separated have the same crystalline orientation and one position of extinction, while the felspar on its part behaves in the same way. Two porous crystals thus interpenetrate but the scattered parts of each mineral maintain their connexion with the others. There may be also a definite relation between the crystalline axes of the two crystals, though this is not known in all cases. Augite also occurs in graphic intergrowth with hornblende, olivine and felspar; and hornblende, cordierite, epidote and biotite in graphic intergrowth with quartz.

Physical Chemistry of Igneous Rocks.—The great advances that have been made in recent years in our knowledge of physical chemistry have very important bearings on petrological investigations. Especially in the study of the genesis of igneous rocks we anticipate that by this means much light will be thrown on problems which are now very obscure and a complete revolution in our ideas of the conditions which affect crystallization may yet be the consequence. Already many important results have been gleaned. As yet little work of an exact and quantitative nature has been done on actual rocks or on mixtures resembling them in composition, but at the Carnegie Institution in Washington, an elaborate series of experiments in the synthesis of minerals and the properties of mixtures of these is being carried on, with all the refinements which modern science can suggest. The work of Doelter and of Vogt may also be mentioned in this connexion. At the same time the mathematical theory of the physical processes involved has received much attention, and serves both to direct and to elucidate the experimental work.

Magmas as Solutions.

A fused mixture of two minerals may be regarded as a solution of one on the other. If such a solution be cooled down, crystallization will generally set in and if the two components be independent (or do not form mixed crystals) one of them may be expected to start crystallizing. On further cooling, more of this mineral will separate out till at last a residue is left which contains the two components in definite proportions. This mixture, which is known as the eutectic mixture, has the lowest melting-point of any which can be formed from these minerals. If heat be still abstracted the eutectic will consolidate as a whole; its two mineral components will crystallize simultaneously. At any given pressure the composition of the eutectic mixture in such a case is always the same.

Similarly, if there be three independent components (none of which forms mixed crystals with the others), according to their relative amounts and to the composition of the eutectic mixture one will begin to crystallize; then another will make its appearance in solid form, and when the excess of these has been removed, the ternary eutectic (that mixture of the three which has the lowest melting-point) will be produced and crystallization of all three components will go on simultaneously.

These processes have without doubt a very close analogy to the formation of igneous rocks. Thus in certain felsites or porphyries which may be considered as being essentially mixtures of quartz and felspar, a certain amount of quartz has crystallized out at an early period in the form of well-shaped porphyritic crystals, and thereafter the remainder of the rock has solidified as a very fine-grained, cryptocrystalline or sometimes micrographic groundmass which consists of quartz and felspar in intimate intermixture. The latter closely resembles a eutectic, and chemical studies have proved that within somewhat narrow limits the composition of these felsitic ground-masses is constant.

But the comparison must not be pushed too far, as there are always other components than quartz and felspar (apatite, zircon, biotite and iron oxides being the most common), and in rocks of this type the gases dissolved in the magma play a very important part. As crystallization goes on, these gases are set free and their pressure must increase to some extent. Moreover, the felspar is not one mineral but two or perhaps three, there being always soda felspar and potash felspar and usually also a small amount of lime felspar in these porphyries.

In a typical basic rock the conditions are even more complex. A dolerite, for example, usually contains, as its last products of crystallization, pyroxene and felspar. Of these the latter consists of three distinct species, the former of an unknown number; and in each case they can form mixed crystals, to a greater or less extent with one another. From these considerations it will be clear that the properties of solutions of two or three independent components, do not necessarily explain the process of crystallization in any igneous rock.

Very frequently in porphyries not only quartz but felspar also is present in large well-formed early crystals. Similarly in basalts, augite and felspar may appear both as phenocrysts and as components of the ground-mass. As an explanation of this it has been suggested that supersaturation has taken place. We may suppose that the augite which was in excess of the proportion necessary to form the felspar-augite, eutectic mixture, first separated out. When the remaining solution reached the eutectic composition the felspar did not at once start crystallizing, perhaps because nuclei are necessary to initiate crystal-growth and these were not at hand; augite went on crystallizing while felspar lagged behind. Then felspar began and as the mixture was now supersaturated with that mineral a considerable amount of it was rapidly thrown out of the solution. At the same time there would be a tendency for part of the augite, already crystallized, to be dissolved and its crystals would be corroded, losing their sharp and perfect edges, as is often observed in rocks of this group. When the necessary adjustments had been made the eutectic mixture would be established and thereafter the two minerals would consolidate simultaneously (or nearly so) till crystallization was complete.

There is a good deal of evidence to show that supersaturation is not unimportant in igneous magmas. The frequency with which they form glasses proves that under certain conditions the molten rocks are highly viscous. Much will depend also on the presence, accidental or otherwise, of nuclei on which a mineral substance can be deposited. It is known that minerals differ in their tendency to crystallize, some doing so very readily while others are slow and backward. The rate at which crystallization goes on depends on many factors, and there are remarkable differences in this respect between minerals.

On the other hand, there is plenty of evidence to show that supersaturation, though probably one of the causes, is not the principal cause of the appearance of more than one mineral in two generations of crystals. In some of the quartz-porphyries, for example, there are phenocrysts not only of quartz and felspar but also of micropegmatite. These prove that quartz and felspar were not crystallizing successively or alternately but simultaneously.

The great majority of the minerals found in igneous rocks are not of simple composition, but are mixtures of various elementary minerals in very different proportions. This enormously complicates the theoretical problems of consolidation. It has been found, for example, that in the case of three minerals—one of which is independent, while the two others can form mixed crystals—there is a large number of possible sequences; and, what is very important, one mineral may separate out entirely at an early stage, or its crystallization may be interrupted and not continuous. The ternary eutectic, which is produced by a mixture of three independent minerals, may not in such a case be the last substance to crystallize, and may not be present at all. This is very much in accordance with the observed facts of petrology; for usually in a rock there is one mineral which indubitably was the last of all to finish crystallizing and contained no appreciable quantity of the others.

As yet we know little about such important questions as the composition of the eutectic mixtures of rock-minerals, their latent heat of fusion, specific heats, mutual solubilities, inversion temperatures, &c. Until we are in possession of a large body of accurate information on such points as these the theoretical treatment of the processes involved in the formation of igneous rocks cannot be successfully handled. But every day sees an increase in the amount of data available, and encourages us to believe that sooner or later some of the simpler igneous rocks at any rate will be completely explicable on physico-chemical principles.

Post-volcanic Changes.

Rock masses of igneous origin have no sooner consolidated than they begin to change. The gases with which the magma is charged are slowly dissipated, lava-flows often remain hot and steaming for many years. These gases attack the components of the rock and deposit new minerals in cavities and fissures. The beautiful zeolites, so well known to collectors of minerals, are largely of this origin. Even before these "post-volcanic" processes have ceased atmospheric decomposition begins. Rain, frost, carbonic acid, oxygen and other agents operate continuously, and do not cease till the whole mass has crumbled down and most of its ingredients have been resolved into new products. In the classification of rocks these secondary changes are generally considered unessential; rocks are classified and described as if they were ideally fresh, though this is rarely the case in nature.

Secondary Changes.

Epigenitic change (secondary processes) may be arranged under a number of headings, each of which is typical of a group of rocks or rock-forming minerals, though usually more than one of these alterations will be found in progress in the same rock. Silicification, the replacement of the minerals by crystalline or crypto-crystalline silica, is most common in acid rocks, such as rhyolite, but is also found in serpentine, &c. Kaolinization is the decomposition of the felspars, which are the commonest minerals of igneous rocks, into kaolin (along with quartz, muscovite, &c.); it is best shown by granites and syenites. Serpentinization is the alteration of olivine to serpentine (with magnetite); it is typical of peridotites, but occurs in most of the basic rocks. In uralitization secondary hornblende replaces augite; this occurs very generally in diabases; chloritization is the alteration of augite (biotite or hornblende) to chlorite, and is seen in many diabases, diorites and greenstones. Epidotization occurs also in rocks of this group, and consists in the development of epidote from biotite, hornblende, augite or plagioclase felspar.

The *sedimentary rocks*, which constitute the second great group, have many points in common that distinguish them from the igneous and the metamorphic. They have all originated on the surface of the earth, and at the period of their formation were exposed only to the temperature of the air and to atmospheric pressure (or the pressures which exist at the bottoms of seas and lakes). Their minerals are in most cases not susceptible to change when exposed to moist air or sea, and many of them are hydrated (chlorite, micas, &c.), or oxidized (iron ores), or contain carbonic acid (calcite, dolomite). The extent, however, to which this is the case depends largely on the rapidity with which they have accumulated; coarse rocks quickly piled up often consist of materials only partly weathered. When crystalline, the sedimentary rocks are usually soluble at low temperatures. The members of this group occur in beds or strata, hence they are often known as the stratified rocks; the upper beds are always of later formation than those which underlie them, except (as may happen when great disturbance has taken place) the whole series is inverted or overturned. Many of the stratified rocks have been formed by the agency of moving water (rivers, currents, &c.) and are grouped together as "aqueous" rocks; others have been deposited by the wind in deserts, on sandy beaches, &c. (these are "aeolian"). Others are the remains of animals or of plants, modified by the action of time, pressure and percolating water. Lastly, we find beds of crystalline nature, such as rock-salt and gypsum, which have been formed by the desiccation of saline waters; other crystalline stratified rocks, such as dolomite and many bedded iron-stones, are replacement products due to the introduction of mineral matter in solution, which replaced the original rock mass partially or wholly.

When the rocks exposed at the earth's surface give way before the attack of the agencies of denudation, they crumble down and are resolved into two parts. One of these consists of solid material (sand, clay and angular débris) insoluble in carbonated waters; the other part is dissolved and washed away. The undissolved residues, when they finally come to rest, form *clastic* sedimentary rocks (sandstone, conglomerate, shale, &c.). The dissolved portions are partly transferred to the sea, where they help to increase its store of salts, and may again be precipitated as *crystalline* sedimentary rocks; but they are also made use of by plants and by animals to form their skeletal and vital tissues. From this latter portion the rocks of *organic* origin are built up. These may also contain certain ingredients derived from the atmosphere (nitrogen, carbon in coals, &c.).

We have thus three types of sediments of distinct origin, which may be named the clastic (or fragmental), the crystalline and the organic.

Clastic.

The clastic materials may accumulate *in situ*, and then differ chiefly in their disintegrated and weathered state from the parent rock masses on which they rest. The best example of these are the soils, but in elevated regions angular broken rock often covers large areas. More usually they are transported by wind or water, and become sorted out according to their size and density. The coarsest débris comes first to rest and is least worn and weathered; it includes screes, gravels, coarse sands, &c., and consolidates as conglomerates, breccias and pebbly grits. The bedding of these rocks is rudimentary and imperfect, and as each bed is traced along its outcrop it frequently changes its character with the strata on which it rests. The most finely divided sediment travels farthest, and is laid down in thin uniform sheets of wide extent. It is known as mud and clay; around the shores of our continents, at distances of a hundred miles and more from land, great sheets of mud are spread over the ocean floors. This mud contains minute particles of quartz and of felspar, but consists essentially of finely divided scaly minerals, which by their small size and flat shape tend to remain suspended in water for a very long time. Chlorite, white micas and kaolin are the best examples of this class of substances. Wind action is even more effective than water in separating and removing these fine particles. They to a very large extent escape mechanical attrition, because they are transported in suspension and are not swept along the ground or the bottom of the sea; hence they are mostly angular. Fragments of intermediate magnitudes (from $\frac{1}{100}$ of an inch to $\frac{1}{8}$ of an inch) are classed as sands. They consist largely of quartz, because it does not weather into scaly minerals like felspar, and having but a poor cleavage does not split up into flakes like mica or chlorite. These quartz grains have been rolled along and are usually rounded and worn (Pl. IV., fig. 1). More or less of garnet felspar, tourmaline, zircon, rutile, &c., are mixed with the quartz, because these are hard minerals not readily decomposed.

The mechanical sorting by the transporting agencies is usually somewhat incomplete, and mixed types of sediment result, such as gravels containing sand, or clays with coarser arenaceous particles. Moreover, successive layers of deposit may not always be entirely similar, and alternations of varying composition may follow one another in thin laminae: *e.g.* laminae of arenaceous material in beds of clay and shale. Organic matter is frequently mingled with the finer-grained sediments.

These three types have been named the psephitic (or pebbly; Gr. *ψῆφος*, pebble); psammitic (or sandy, Gr. *ψάμμος*, sand), and pelitic (or muddy: Gr. *πηλός*, mud).

Two groups of clastic sediments deserve special treatment. The pyroclastic (Gr. *πῦρ*, fire, and *κλαστός*, broken) rocks of volcanic origin, consist mostly of broken pieces of lava (bombs, ash, &c.) (Pl. IV. fig. 2), and only accidentally contain other rocks or fossils. They are stratified, and may be coarse or fine, but are usually much less perfectly sorted out, according to their fineness, than ordinary aqueous or aeolian deposits. The glacial clays (boulder clays), representing the ground moraines of ancient glaciers and ice sheets, are characterized by the very variable size of their ingredients and the striated, blunted sub-angular form of the larger rock fragments. In them stratification is exceptional and fossils are very rare.

Crystalline.

The crystalline sedimentary rocks have been deposited from solution in water. The commonest types, such as rock-salt, gypsum, anhydrite, carnallite, are known to have arisen by the evaporation of enclosed saline lakes exposed to a dry atmosphere. They occur usually in beds with layers of red clay and marl; some limestones have been formed by calcareous waters containing carbonate of lime dissolved in an excess of carbonic acid; with the escape of the volatile gas the mineral matter is precipitated (sinters, *Sprudelstein*, &c.). Heated waters on cooling may yield up part of their dissolved mineral substances; thus siliceous sinters are produced around geysers and hot springs in many parts of the world. There seems no reason to separate from these the veinstones which fill the fissures by which these waters rise to the surface. They differ from those above enumerated in being more perfectly crystallized and in having no definite stratification, but only a banding parallel to the more or less vertical walls of the fissure. Another subdivision of this class of rocks is due to recrystallization or crystalline replacement of pre-existing sediments. Thus limestones are dolomitized or converted into ironstones, flints and cherts, by percolating waters which remove the lime salts and substitute for them compounds of iron, magnesia, silicon, and so on. This may be considered a kind of metamorphism; it is generally known as metasomatism (*q.v.*).

Organic.

The rocks of organic origin may be due to animals or plants. They are of great importance, as limestones and coals belong to this group. They are the most fossiliferous of all rocks; but clastic sediments are often rich in fossils though crystalline sediments rarely are. They may be subdivided, according to their dominant components, into calcareous, carbonaceous, siliceous, ferruginous, and so on. The calcareous organic rocks may consist principally of foraminifera, crinoids, corals, brachiopoda, mollusca, polyzoa, &c. Most of them, however, contain a mixture of organisms. By crystallization and metasomatic changes they often lose their organic structures; metamorphism of any kind has the same effect. The carbonaceous rocks are essentially plant deposits; they include peat, lignite and coal. The siliceous organic rocks include radiolarian and diatom oozes; in the older formations they occur as radiolarian cherts. Flint nodules owe their silica to disseminated fossils of this nature which have been dissolved and redeposited by concretionary action. Some kinds of siliceous sinter may be produced by organisms inhabiting hot silicated waters. Calcareous oolites in the same way may have arisen through the agency of minute plants. Bog iron ores also may be of organic rather than of merely chemical origin. The phosphatic rocks so extensively sought after as sources of fertilizing agents for use in agriculture are for the most part of organic origin, since they owe their substance to the remains of certain varieties of animals which secrete a phosphatic skeleton; but most of them no longer show organic structures but have been converted into nodular or concretionary forms.

Cementation.

Coloration.

All sediments are at first in an incoherent condition (*e.g.* sands, clays and gravels, beds of shells, &c.), and in this state they may remain for an indefinite period. Millions of years have elapsed since some of the early Tertiary strata gathered on the ocean floor, yet they are quite friable (*e.g.* the London Clay) and differ little from many recent accumulations. There are few exceptions, however, to the rule that with increasing age sedimentary rocks become more indurated, and the older they are the more likely it is that they will have the firm consistency generally implied in the term "rock." The pressure of newer sediments on underlying masses is apparently one cause of this change, though not in itself a very powerful one. More efficiency is generally ascribed to the action of percolating water, which takes up certain soluble materials and redeposits them in pores and cavities. This operation is probably accelerated by the increased pressure produced by superincumbent masses, and to some extent also by the rise of temperature which inevitably takes place in rocks buried to some depth beneath the surface. The rise of temperature, however, is never very great; we know more than one instance of sedimentary deposits which have been buried beneath four or five miles of similar strata (*e.g.* parts of the Old Red Sandstone), yet no perceptible difference in condition can be made out between beds of similar composition at the top of the series and near its base. The redeposited cementing material is most commonly calcareous or siliceous. Limestones, which were originally a loose accumulation of shells, corals, &c., become compacted into firm rock in this manner; and the process often takes place with surprising ease, as for example in the deeper parts of coral reefs, or even in wind-blown masses of shelly sand exposed merely to the action of rain. The cementing substance may be regularly deposited in crystalline continuity on the original grains, where these were crystalline; and even in sandstones (such as Kentish Rag) a crystalline matrix of calcite often envelopes the sand grains. The change of aragonite to calcite and of calcite to dolomite, by forming new crystalline masses in the interior of the rock, usually also accelerates consolidation. Silica is less easily soluble in ordinary waters, but even this ingredient of rocks is dissolved and redeposited with great frequency. Many sandstones are held together by an infinitesimal amount of colloid or cryptocrystalline silica; when freshly dug from the quarry they are soft and easily trimmed, but after exposure to the air for some time they become much harder, as their siliceous cement sets and passes into a rigid condition. Others contain fine scales of kaolin or of mica. Argillaceous materials may be compacted by mere pressure, like graphite and other scaly minerals. Oxides and carbonates of iron play a large part in many sedimentary rocks and are especially important as colouring matters. The red sands and limestones, for example, which are so abundant, contain small amounts of ferric oxide (haematite), which in a finely divided state gives a red hue of all rocks in which it is present. Limonite, on the other hand, makes rocks yellow or brown; oxides of manganese, asphalt and other carbonaceous substances are the cause of the black colour of many sediments. Bluish tints result sometimes from the presence of phosphates or of fluorspar; while green is most frequently seen in rocks which contain glauconite or chlorite.

Metamorphic Rocks.—The *metamorphic rocks*, which form the third great subdivision, are even more varied than the igneous and the sedimentary. They include representatives of nearly all kinds of the other two classes, their common characteristic being that they have all undergone considerable alterations in structure or in mineral composition. The agencies of *metamorphism* (*q.v.*) are of two kinds—thermal and regional. In the former case contact with intrusive igneous masses, such as granite, laccolites or dikes, have indurated and recrystallized the original rock. In the second case the actions are more complex and less clearly understood; it is evident that pressure and interstitial movement have had a powerful influence, possibly assisted by rise of temperature. In thermal or contact alteration the rocks are baked, indurated, and often in large measure recrystallized. In regional metamorphism recrystallization also goes on, but the final products are usually schists and gneisses. It is as a rule not difficult to distinguish the two classes of metamorphic rocks at a glance, and they may conveniently be considered separately.

Thermo-metamorphism.

When a rock is contact altered by an igneous intrusion it very frequently becomes harder, more crystalline and more lustrous, owing to the development of many small crystals in its mass. Many altered rocks of this type were formerly called hornstones, and the term *hornfelses* (Ger. *Hornfels*) is often used by geologists to signify those fine grained, compact, crystalline products of thermal metamorphism. A shale becomes a dark argillaceous hornfels, full of tiny plates of brownish biotite; a marl or impure limestone changes to a grey, yellow or greenish lime-silicate-hornfels, tough and splintery, with abundance of augite, garnet, wollastonite and other minerals in which lime is an important component. A diabase or andesite becomes a diabase hornfels or andesite hornfels with a large development of new hornblende and biotite and a partial recrystallization of the original felspar. A chert or flint becomes a finely crystalline quartz rock; sandstones lose their clastic structure and are converted into a mosaic of small close-fitting grains of quartz.

If the rock was originally banded or foliated (as, for example, a laminated sandstone or a foliated calc-schist) this character may not be obliterated, and a banded hornfels is the product; fossils even may have their shapes preserved, though entirely recrystallized, and in many contact altered lavas the steam cavities are still visible, though their contents have usually entered into new combinations to form minerals which were not originally present. The minute structures, however, disappear, often completely, if the thermal alteration is very profound; thus small grains of quartz in a shale are lost or blend with the surrounding particles of clay, and the fine ground-mass of lavas is entirely reconstructed.

By recrystallization in this manner peculiar rocks of very distinct types are often produced. Thus shales may pass into cordierite rocks, or may show large crystals of andalusite (and chiastolite, Pl. IV., fig. 9), staurolite, garnet, kyanite and sillimanite. A considerable amount of mica (both muscovite and biotite) is simultaneously formed, and the resulting product has a close resemblance to many kinds of schist. Limestones, if pure, are often turned into coarsely crystalline marbles (Pl. IV., fig. 4); but if there was an admixture of clay or sand in the original rock such minerals as garnet, epidote, idocrase, wollastonite, will be present. Sandstones when greatly heated may change into coarse quartzites composed of large clear grains of quartz. These more intense stages of alteration are not so commonly seen in igneous rocks, possibly because their minerals, being formed at high temperatures, are not so easily transformed or recrystallized.

In a few cases rocks are fused and in the dark glassy product minute crystals of spinel, sillimanite and cordierite may separate out. Shales are occasionally thus altered by basalt dikes, and felspathic sandstones may be completely vitrified. Similar changes may be induced in shales by the burning of coal seams or even by an ordinary furnace.

There is also a tendency for interfusion of the igneous with the sedimentary rock. Granites may absorb fragments of shale or pieces of basalt. In that case hybrid rocks arise which have not the characters of normal igneous or sedimentary rocks. Such effects are scarce and are usually easily recognized. Sometimes an invading granite magma permeates the rocks around, filling their joints and planes of bedding, &c., with threads of quartz and felspar. This is very exceptional, but instances of it are known and it may take place on a large scale.

Regional Metamorphism.

The other type of metamorphism is often said to be regional; sometimes it is called dynamic, but these terms have not strictly the same connotation. It may be said as a rule to make the rock more crystalline and at the same time to give it a foliated, schistose or gneissic structure. This latter consists in a definite arrangement of the minerals, so that such as are platy or prismatic (*e.g.* mica and hornblende, which are very common in these rocks) have their longest axes arranged parallel to one another. For that reason many of these rocks split readily in one direction (schists). The minerals also tend to aggregate in bands; thus there are seams of quartz and of mica in a mica schist, very thin, but consisting essentially of one mineral. These seams are called folia (leaflets), and though never very pure or very persistent they give the rock a streaked or banded character when they are seen edgewise (Pl. IV. figs. 6, 7, 8). Along the folia composed of the soft or fissile minerals the rocks will sever most readily, and the freshly split specimen will appear to be faced or coated with this mineral; for example, a piece of mica schist looked at facewise might be supposed to consist entirely of shining scales of mica. On the edge of the specimen, however, the white folia of granular quartz

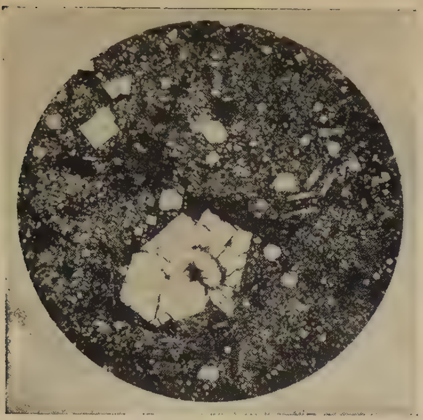

FIG. 1.—PHONOLITE, TEPLITZER SCHLOSSBERG, BOHEMIA (× 12).

The large white crystal is felspar, the smaller ones are nepheline having six-sided and four-sided sections. The dark mineral in the ground-mass is aegirine.

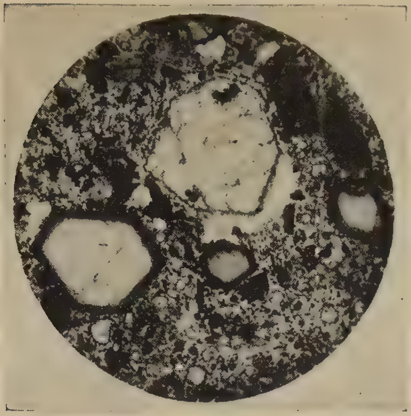

FIG. 2.—LEUCITOPHYRE, RIEDEN, EIFFEL, GERMANY (× 15)

A porphyritic clear crystal of leucite lies near the centre of the field; towards the margins are nosean crystals with clear centres and broad black edges. The black spots are aegirine and aegirine-augite, and in the ground-mass small prisms of white nepheline may be seen.

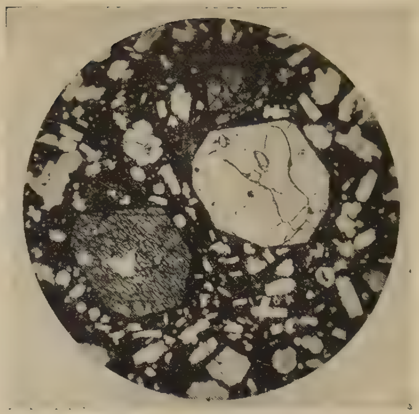

FIG. 3.—LEUCITE-BASANITE, VESUVIUS (× 8).

The rounded central crystal is leucite, showing zones of inclusions and well-marked cracks; below it is a dark-brown augite, and olivine occurs near the bottom of the field. There are numerous rectangular white sections of plagioclase felspar. The dark ground-mass is partly vitreous.

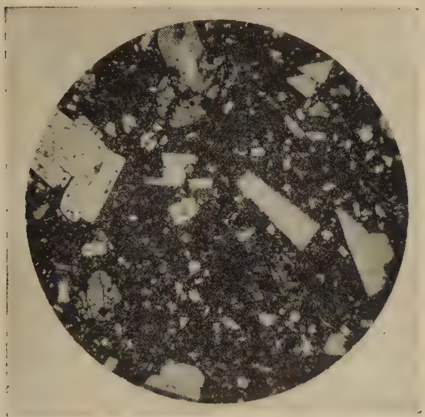

FIG. 4.—HYPERSTHENE-ANDESITE, ALWYN, CHEVIOTS, ENGLAND (× 10).

A porphyritic rock with phenocrysts of white plagioclase felspar and of pale-brown augite and hypersthene in a fine ground-mass, partly glassy.

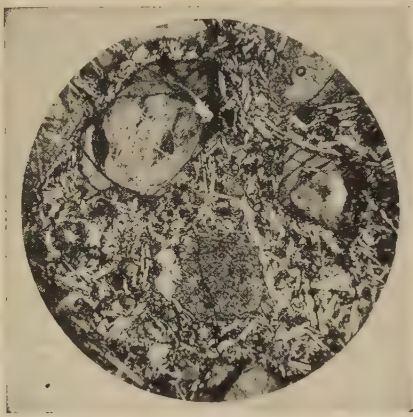

FIG. 5.—OLIVINE-BASALT, CRAIGLOCKART, EDINBURGH, SCOTLAND (× 10).

Two large crystals of augite above and below, and of olivine (right and left) lie in a crystalline ground-mass of plagioclase felspar, augite, and magnetite. The olivine has been altered to fibrous green serpentine, and the pseudomorphs show traces of the original cleavage cracks.

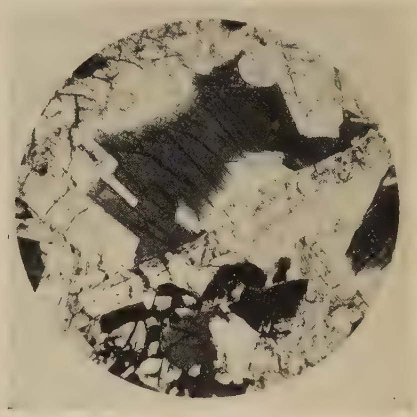

FIG. 6.—OPHITIC OLIVINE-DOLERITE DUN FION, ARRAN, SCOTLAND.

The white mineral is plagioclase felspar, which penetrates a large dark crystal of augite in ophitic manner. At the bottom of the field there are a few grains of olivine, colourless, but with strongly marked cracks.

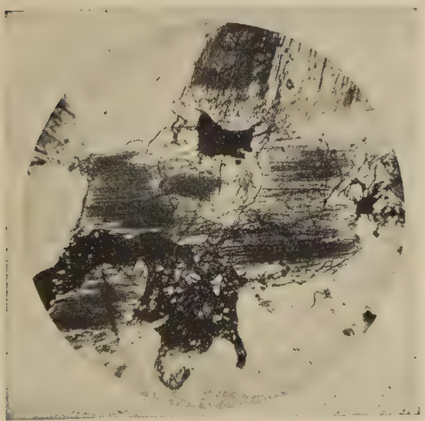

FIG. 7.—OLIVINE-GABBRO, VOLPERSDORF, SILESIA (× 10).

Felspar occurs towards the edges of the field and surrounds a cluster of diallage (with strong, dark, parallel lamination) and of olivine (covered with a black network of secondary magnetite).

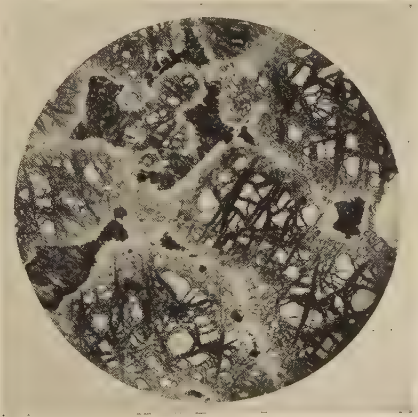

FIG. 8.—PERIDOTITE, ELBA (× 10).

The rounded crystals are olivine, weathering as usual to magnetite and serpentine along its cracks and borders. The dark interstitial substance is enstatite weathered to bastite.

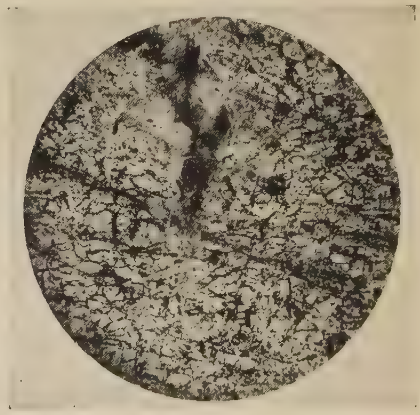

FIG. 9.—SERPENTINE, COLMONELL, AYRSHIRE, SCOTLAND (× 12).

In this rock the process of serpentinization, seen in the previous figure, is complete. No olivine remains, but a meshwork of magnetite indicates the position of the cracks in the original crystals.

Plate IV.

PETROLOGY

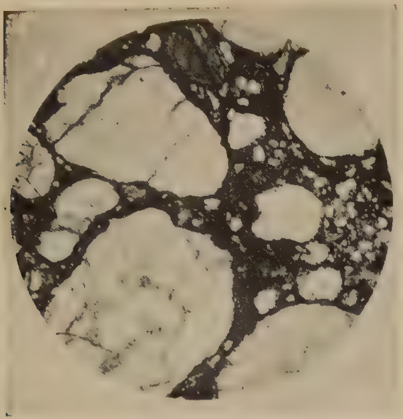

Fig. 1.—PEBBLY GRIT, BANFF, SCOTLAND (× 12).

The white pebbles are quartz with irregular cracks and streaks of fluid inclusions. The matrix is a dark, semi-opaque mixture of clay and small sand-grains.

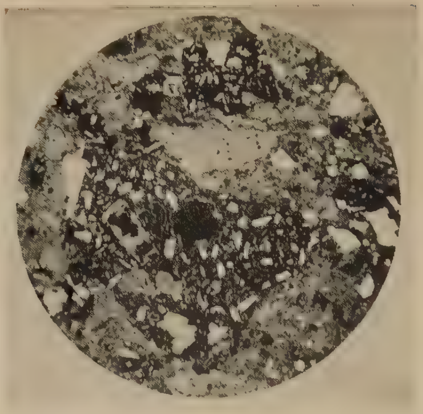

Fig. 2.—VOLCANIC TUFF, ARTHUR'S SEAT, EDINBURGH (× 8).

A fragmental volcanic rock with small lapilli of basalt; these are vesicular and contain little felspar crystals. Broken felspars also lie scattered through the rock.

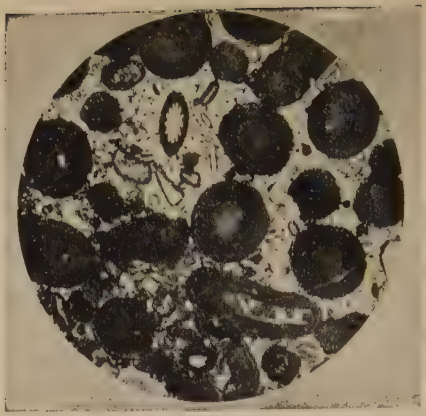

Fig. 3.—CRINOIDAL LIMESTONE, (CARBONIFEROUS), CLIFTON, NEAR BATH, ENGLAND (× 10).

The oolitic grains are round or oval, with concentric zoning; in their interior there is sometimes a shell fragment or other nucleus. The interstitial matrix is clear, granular, crystalline calcite.

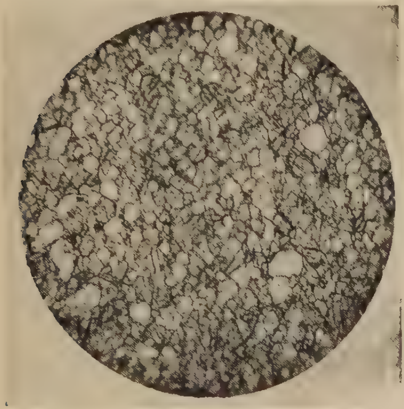

Fig. 4.—MARBLE, CARRARA, ITALY (× 8).

A section of well-known statuary marble which consists entirely of calcite in small irregular crystals closely fitted together.

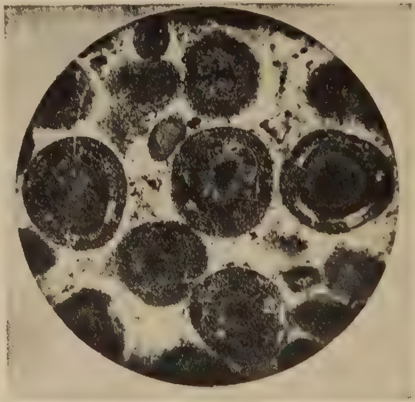

Fig. 5.—OOLITIC CHERT (CAMBRIAN), SUTHERLANDSHIRE, SCOTLAND (× 15).

This has been once an oolitic limestone, but the calcite has been entirely replaced by silica with perfect preservation of the oolitic structure.

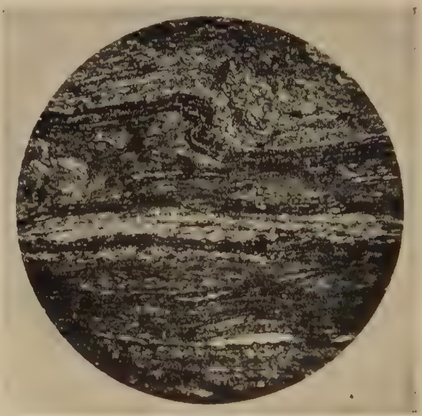

Fig. 6.—MYLONITE DURNESS, SUTHERLANDSHIRE (×18).

This well-banded rock was once a crystalline gneiss which has been greatly crushed by earth-movements, and has been ground down into a fine aggregate of quartz, felspar, and mica. The banding is due to internal flow under great pressure.

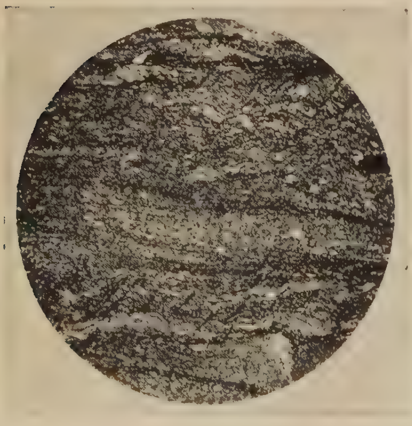

Fig. 7.—SLATE, WADEBRIDGE, CORNWALL (× 20).

A fine-grained clay rock with small clear spots of quartz and minute scales of mica, chlorite, &c. The parallel arrangement of the latter is the cause of cleavage. Obscure dark lines cut across the rock and indicate the development of a secondary cross-cleavage or slip-cleavage.

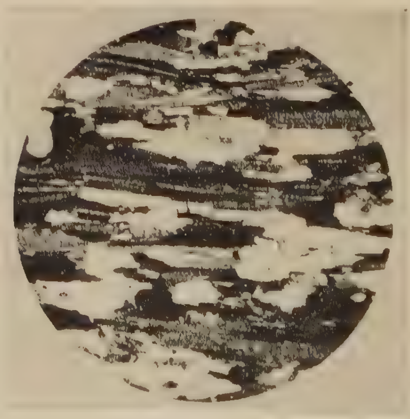

Fig. 8.—MICA-SCHIST, BLAIR-ATHOLL, PERTHSHIRE, SCOTLAND (× 32).

A clay rock like the preceding one, but more metamorphic and coarsely crystalline. The clear spots are quartz and the bladed mineral between them is brown and white mica (biotite and muscovite).

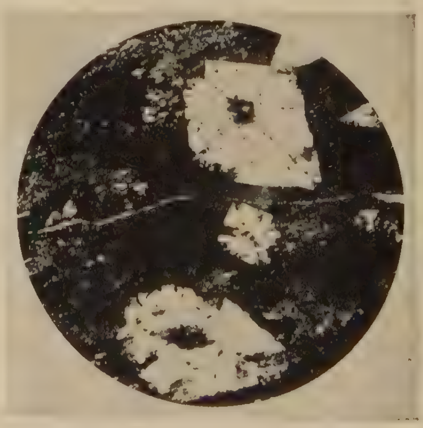

Fig. 9.—CHIASTOLITE-SLATE, SKIDDAW, CUMBERLAND (× 17).

A clay rock affected by contact metamorphism attended by the production of needles of chiastolite, which have in transverse section a diamond-shape with dark enclosures at their centres and a dark cross radiating to their corners.

will be visible. In gneisses these alternating folia are thicker and less regular than in schists; they are often lenticular, dying out rapidly. Gneisses also, as a rule, contain more felspar than schists do, and they are tougher and less fissile. Contortion or crumpling (Pl. IV. fig. 6) of the foliation is by no means uncommon, and then the splitting faces are undulose or puckered. The origin of schistosity or foliation is not perfectly understood, but it is clear that in many cases it is due to pressure, acting in a direction perpendicular to the banding, and to interstitial movement or internal flow arranging the mineral particles while they are crystallizing.

Rocks which were originally sedimentary and rocks which were undoubtedly igneous are converted into schists and gneisses, and if originally of similar composition they may be very difficult to distinguish from one another if the metamorphism has been great. A quartz-porphyry, for example, and a fine felspathic sandstone, may both be converted into a grey or pink mica-schist. Usually, however, we may distinguish between sedimentary and igneous schists and gneisses. Often the metamorphism is progressive, and if the whole district occupied by these rocks be searched traces of bedding, of clastic structure, unconformability or other evidence may be obtained showing that we are dealing with a group of altered sediments. In other cases intrusive junctions, chilled edges, contact alteration or porphyritic structure may prove that in its original condition a metamorphic gneiss was an igneous rock. The last appeal is often to the chemist, for there are certain rock types which occur only as sediments, while others are found only among igneous masses, and, however advanced the metamorphism may be, it rarely modifies the chemical composition of the mass very greatly. Such rocks, for example, as limestones, calc-schists, dolomites, quartzites and aluminous shales have very definite chemical characters which distinguish them even when completely recrystallized.

The schists and gneisses are classified according to the minerals they consist of, and this depends principally on their chemical composition. We have, for example, a group of metamorphic limestones, marbles, calc-schists and cipolins, with crystalline dolomites; many of these contain silicates such as mica, tremolite, diopside, scapolite, quartz and felspar. They are derived from calcareous sediments of different degrees of purity. Another group is rich in quartz (quartzites, quartz schists and quartzose gneisses), with variable amounts of white and black mica, garnet, felspar, zoisite and hornblende. These were once sandstones and arenaceous rocks. The graphitic schists may readily be believed to represent sediments once containing coaly matter or plant remains; there are also schistose ironstones (haematite-schists), but metamorphic beds of salt or gypsum are exceedingly uncommon. Among schists of igneous origin we may mention the silky calc-schists, the foliated serpentines (once ultrabasic masses rich in olivine), and the white mica-schists, porphyroids and banded halleflintas, which have been derived from rhyolites, quartz-porphyries and acid tuffs. The majority of mica-schists, however, are altered clays and shales, and pass into the normal sedimentary rocks through various types of phyllite and mica-slates. They are among the most common metamorphic rocks; some of them are graphitic and others calcareous. The diversity in appearance and composition is very great, but they form a well-defined group not difficult to recognize, from the abundance of black and white micas and their thin, foliated, schistose character. As a special subgroup we have the andalusite-, staurolite-, kyanite- and sillimanite-schists, together with the cordierite-gneisses, which usually make their appearance in the vicinity of gneissose granites, and have presumably been affected by contact alteration. The more coarsely foliated gneisses are almost as frequent as the mica-schists, and present a great variety of types differing in composition and in appearance. They contain quartz, one or more varieties of felspar, and usually mica hornblende or augite, often garnet, iron oxides, &c. Hence in composition they resemble granite, differing principally in their foliated structure. Many of them have "augen" or large elliptical crystals, mostly felspar but sometimes quartz, which are the crushed remains of porphyritic minerals; the foliation of the matrix winds around these augen, closing in on each side. Most of these augen gneisses are metamorphic granites, but sometimes a conglomerate bed simulates a gneiss of this kind rather closely. There are other gneisses, which were derived from felspathic sandstones, grits, arkoses and sediments of that order; they mostly contain biotite and muscovite, but the hornblende and pyroxene gneisses are usually igneous rocks allied in composition to the hornblende-granites and quartz-diorites. The metamorphic forms of dolerite, basalt and the basic igneous rocks generally have a distinctive facies as their pyroxene and olivine are replaced by dark green hornblende, with often epidote, garnet and biotite. These rocks have a well developed foliation, as the prismatic hornblendes lie side by side in parallel arrangement. The majority of amphibolites, hornblende-schists, foliated epidiorites and green schists belong to this group. Where they are least altered they pass through chloritic schists into sheared diabases, flaser gabbros and other rocks in which remains of the original igneous minerals and structures occur in greater or less profusion.

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PETRONEL, a 16th or 17th century fire-arm, defined by R. Barret (*Theorike and Practike of Modern Warres*, 1598) as a "horseman's peece." It was the fire-arm which developed on the one hand into the pistol and on the other into the carbine. The name (Fr. *petrinel* for *poitrinal*) was given to the weapon either because it was fired with the butt resting against the chest (*poitrine*, Lat. *pectus*) or because it was carried slung from a belt across the chest.

PETRONIUS (G. (?)[1] Petronius Arbiter), Roman writer of the Neronian age. His own work, the *Satirae*, tells us nothing directly of his fortunes, position, or even century. Some lines of Sidonius Apollinaris refer to him and are often taken to imply that he lived and wrote at Marseilles. If, however, we accept the identification of this author with the Petronius of Tacitus, Nero's courtier, we must suppose either that Marseilles was his birthplace or, as is more likely, that Sidonius refers to the novel itself and that its scene was partly laid at Marseilles. The chief personages of the story are evidently strangers in the towns of southern Italy where we find them. Their Greek-sounding names (Encolpius, Ascyltos, Giton, &c.) and literary training accord with the characteristics of the old Greek colony in the 1st century A.D. The high position among Latin writers ascribed by Sidonius to Petronius, and the mention of him beside Menander by Macrobius, when compared with the absolute silence of Quintilian, Juvenal and Martial, seem adverse to the opinion that the *Satirae* was a work of the age of Nero. But Quintilian was concerned with writers who could be turned to use in the education of an orator. The silence of Juvenal and Martial may be accidental or it is possible that a work so abnormal in form and substance was more highly prized by later generations than by the author's contemporaries.

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[1] The MSS. of the *Satirae* give no praenomen. Tacitus's Petronius is Gaius, though the elder Pliny and Plutarch call him Titus. The name Arbiter, given him by later writers, is not an ordinary cognomen; it may have been bestowed on him by contemporaries from the fact that his judgment was regarded as the criterion of good taste.

A comparison of the impression the book gives us of the character and genius of its author with the elaborate picture of the courtier in Tacitus certainly suggests the identity of the two. Tacitus, it is true, mentions no important work as the composition of his C. Petronius; such a work as the *Satirae* he may have regarded as beneath that dignity of history which he so proudly realized. The care he gives to Petronius's portrait perhaps shows that the man enjoyed greater notoriety than was due merely to the part he played in history. "He spent his days in sleep, his nights in attending to his official duties or in amusement, by his dissolute life he had become as famous as other men by a life of energy, and he was regarded as no ordinary profligate, but as an accomplished voluptuary. His reckless freedom of speech, being regarded as frankness, procured him popularity. Yet during his provincial governorship, and later when he held the office of consul, he had shown vigour and capacity for affairs. Afterwards returning to his life of vicious indulgence, he became one of the chosen circle of Nero's intimates, and was looked upon as an absolute authority on questions of taste (*arbiter elegantiae*) in connexion with the science of luxurious living."[1] Tacitus goes on to say that this excited the jealousy of Tigellinus, an accusation followed, and Petronius committed suicide in a way that was in keeping with his life and character. He selected the slow process of opening veins and having them bound up again, whilst he conversed on light and trifling topics with his friends. He then dined luxuriously, slept for some time, and, so far from adopting the common practice of flattering Nero or Tigellinus in his will, wrote and sent under seal to Nero a document which professed to give, with the names of his partners, a detailed account of the abominations which that emperor had practised.

A fact confirmatory of the general truth of this graphic portrait is added by the elder Pliny, who mentions that just before his death he destroyed a valuable murrhine vase to prevent its falling into the imperial hands. Do the traits of this picture agree with that impression of himself which the author of the *Satirae* has left upon his work? That we possess therein part of the document sent to Nero is an impossible theory. Our fragments profess to be extracts from the fifteenth and sixteenth books of the *Satirae*: Petronius could not have composed one-tenth even of what we have in the time in which he is said to have composed his memorial to Nero. We may be sure too that the latter was very frank in its language, and treated Nero with far greater severity than the *Banquet* treats Trimalchio. On the other hand, it is clear that the creator of Trimalchio, Encolpius and Giton had the experience, the inclinations and the literary gifts which would enable him to describe with forcible mockery the debaucheries of Nero. And the impression of his personality does in another respect correspond closely with the Petronius of the *Annals*—in the union of immoral sensualism with a rich vein of cynical humour and admirable taste.

The style of the work, where it does not purposely reproduce the solecisms and colloquialisms of the vulgar rich, is of the purest Latin of the Silver age.[2] Nor would there be any point in the verses on the capture of Troy and the Civil War at any other era than that in which Nero's *Troica* and Lucan's *Pharsalia* were fashionable poems. The reciting poet indeed is a feature of a later age also, as we learn from Martial and Juvenal. But we know from Tacitus that the luxury of the table, so conspicuous in Trimalchio's *Banquet*, fell out of fashion after Nero (*Ann.* 3. 55).

Of the work itself there have been preserved 141 sections of a narrative, in the main consecutive, although interrupted by frequent gaps. The name *Satirae*, given in the best MSS., implies that it belongs to the type to which Varro, imitating the Greek Menippus, had given the character of a medley of prose and verse composition. But the string of fictitious narrative by which the medley is held together is something quite new in Roman literature. This careless prodigal was so happily inspired in his devices for amusing himself as to introduce to Rome and thereby transmit to modern times the novel based on the ordinary experience of contemporary life[3]—the precursor of such novels as *Gil Blas* and *Roderick Random.* There is no evidence of the existence of a regular plot in the fragments, but we find one central figure, Encolpius, who professes to narrate his adventures and describe all that he saw and heard, whilst allowing various other personages to exhibit their peculiarities and express their opinions dramatically.

The fragment opens with the appearance of the hero, Encolpius, who seems to be an itinerant lecturer travelling with a companion named Ascyltos and a boy Giton, in a portico of a Greek town, in Campania. An admirable lecture on the false taste in literature, resulting from the prevailing system of education, is replied to by a rival declaimer, Agamemno, who shifts the blame from the teachers to the parents. The central personages of the story next go through a series of questionable adventures, in the course of which they are involved in a charge of robbery. A day or two after they are present at a dinner given by a freedman of enormous wealth, Trimalchio, who entertained with ostentatious and grotesque extravagance a number of men of his own rank but less prosperous. We listen to the ordinary talk of the guests about their neighbours, about the weather, about the hard times, about the public games, about the education of their children. We recognize in an extravagant form the same kind of vulgarity and pretension which the satirist of all times delights to expose in the illiterate and ostentatious millionaires of the age. Next day Encolpius separates from his companions in a fit of jealousy, and, after two or three days' sulking and brooding on his revenge, enters a picture gallery, where he meets with an old poet, who, after talking sensibly on the decay of art and the inferiority of the painters of the age to the old masters, proceeds to illustrate a picture of the capture of Troy by some verses on that theme. This ends in those who are walking in the adjoining colonnade driving him out with stones. The scene is next on board ship, where Encolpius finds he has fallen into the hands of some old enemies. They are shipwrecked, and Encolpius, Giton and the old poet get to shore in the neighbourhood of Crotona, where, as the inhabitants are notorious fortune-hunters, the adventurers set up as men of fortune. The fragment ends with a new set of questionable adventures, in which prominent parts are played by a beautiful enchantress named Circe, a priestess of Priapus, and a certain matron who leaves them her heirs, but attaches a condition to the inheritance which even Encolpius might have shrunk from fulfilling.[4] If we can suppose the author of this work to have been animated by any other motive than the desire to amuse himself, it might be that of convincing himself that the world in general was as bad as he was himself. Juvenal and Swift are justly regarded as among the very greatest of satirists, and their estimate of human nature is perhaps nearly as unfavourable as that of Petronius; but their attitude towards human degradation is not one of complacent amusement; their realism is the realism of disgust, not, like that of Petronius, a realism of sympathy. Martial does not gloat over the vices of which he writes with cynical frankness. He is perfectly aware that they are vices, and that the reproach of them is the worst that can be cast on any one. And, further, Martial, with all his faults, is, in his affections, his tastes, his relations to others, essentially human, friendly, generous, true. There is perhaps not a single sentence in Petronius which implies any knowledge of or sympathy with the existence of affection, conscience or honour, or even the most elementary goodness of heart.

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[1] *Ann.* xvi. 18.

[2] The false taste in literature and expression fostered by the *declamationes* is condemned by both Persius and Petronius on the same grounds. Cf. too Pers. i. 121, *hoc ego apertum, hoc ridere meum, tam nil, nulla tibi uendo Iliade* with *Sat.* 52, *meum intellegere nulla pecunia uendo*; Pers. ii. 9, *O si ebulliat patruus, praeclarum funus, et o si sub rastro crepet argenti mihi seria* with *Sat.* 88, *Alius donum promittit, si propinquum divitem extulerit, alius si thesaurum effoderit* and 42, *homo animam ebulliit*; Pers. iv. 26, *arat . . . quantum non milvus oberrat* with *Sat.* 37, *fundos habet qua milvi volant.* Both use the rare word *baro. Animam ebullire* occurs in Seneca's *Apocolocyntosis*, and the verbal resemblances illustrate perhaps rather the common use by both writers of the vulgar style. Cf. for resemblances to the style of the younger Seneca and the date of the work in general, Studer, *Rh. Mus.* (1843).

[3] For the whole question of possible predecessors and Petronius's relation to the extant Greek romances see W. Schmid; "Der griechische Roman" in *Jahrbücher für das klass. Altertum*, &c. (1904). One would certainly have expected the realistic tendency which appears in the New Comedy, the *Characters* of Theophrastus and the Mimes, to have borne this fruit before the first century of our era.—(W. C. Su.)

[4] Omnes qui in testamento meo legata habent praeter libertos meos, hac conditione percipient quae dedi, si corpus meum in partes conciderint et astante populo comederint (141).

The work has reached us in so fragmentary and mutilated a shape that we may of course altogether have missed the key to it; it may have been intended by its author to be a sustained satire, written in a vein of reserved and powerful irony, of the type realized in our modern *Jonathan Wild* or *Barry Lyndon*. Otherwise we must admit that, in the entire divorce of intellectual power and insight from any element of right human feeling, the work is an exceptional phenomenon in literature. For, as a work of original power, of humorous representation, of literary invention and art, the fragment deserves all the admiration which it has received. We recognize the *arbiter elegantiae* in the admirable sense of the remarks scattered through it on education, on art, on poetry and on eloquence. There is a true feeling of nature in the description of a grove of plane-trees, cypresses and pines:

> "Has inter ludebat aquis errantibus amnis
> Spumeus et querulo vexabat rore lapillos."

And some of the shorter pieces anticipate the terseness and elegance of Martial. The long fragment on the Civil War does not seem to be written so much with the view of parodying as of entering into rivalry with the poem of Lucan. In the epigram extemporized by Trimalchio late on in the banquet:

> "Quod non expectes, ex transverso fit—
> Et supra nos Fortuna negotia curat,
> Quare da nobis vina Falerna, puer,"

we have probably a more deliberate parody of the style of verses produced by the illiterate aspirants to be in the fashion of the day. We might conjecture that the chief gift to which Petronius owed his social and his literary success was that of humorous mimicry. In Trimalchio and his various guests, in the old poet, in the cultivated, depraved and moody Encolpius, in the Chrysis, Quartilla, Polyaenis, &c., we recognize in living examples the play of those various appetites, passions and tendencies which satirists deal with as abstract qualities. Another gift he possesses in a high degree, which must have availed him in society as well as in literature—the gift of story-telling; and some of the stories which first appear in the *Satirae*—*e.g.* that of the Matron of Ephesus—have enjoyed a great reputation in later times. His style, too, is that of an excellent talker, who could have discussed questions of taste and literature with the most cultivated men of any time as well as amused the most dissolute society of any time in their most reckless revels. One phrase of his is often quoted by many who have never come upon it in its original context, "Horatii curiosa felicitas."

Authorities.—Until about 1650 only part of the Banquet of Trimalchio, with the other fragments of the work, was known. The best MS. of this type is a Leiden MS., a copy by Scaliger of one which seems to have belonged to Cujacius. Marinus Statilius (see, however, Ellis, *Journal of Philology*, 12, p. 266) discovered at Trau in Dalmatia a MS. containing the whole Banquet, which was first published at Padua in 1664.

The important editions are (1) with explanatory notes: Burmann (Amsterdam, 1743, with Heinsius's notes), and, of the *Cena* only, Friedländer (Leipzig, 2nd ed., 1906) and Lowe (Cambridge, 1904); (2) with critical notes: Bücheler (Berlin, 1862, 4th ed., 1904). Translations into German in Friedländer's edition (*Cena* only), into French by de Guerle (complete, in Garnier's *Bibliothèque*), into English in Lowe's edition (*Cena* only) and Bohn's series (complete). Lexicon to Petronius by Segebade and Lommatsch (Leipzig, 1898). Criticism, &c., in Haley, "Quaestt. Petron." (*Harvard Studies*, 1891); Collignon, *Étude sur Pétrone* (Paris, 1892); Emile Thomas, *L'Envers de la société romaine d'après Pétrone* (Paris, 1892); Hirzel, *Der Dialog*, ii. (Leipzig, 1895); Tyrrell, *Latin Poetry* (London, 1895); Norden, *Antike Kunstprosa* i. (Leipzig, 1898); Henderson, *Life and Principate of the Emperor Nero* (London, 1903); Dill, *Roman Society from Nero to Marcus Aurelius* (London, 1905); and the various histories of Roman literature (especially Schanz, §§ 395 sqq.).

(W. Y. S.; W. C. Su.).

PETROPAVLOVSK, a town of West Siberia, in the government of Akmolinsk, on the right bank of the Ishim river, and on the great Siberian highway, 170 m. by rail W. of Omsk. The population, 7850 in 1865, was 21,796 in 1900, of whom one-third were Mahommedan Kirghiz. The town carries on an active trade in cattle, furs, tea, wool, skins, cottons, woollen stuffs, corn, metals, metallic wares and spirits. The small fort of Petropavlovsk was founded in 1752, and was the military centre of the Ishim line of fortifications.

Petropavlovsk is also the name of a Russian seaport in Kamchatka, on the eastern shore of the Bay of Avacha, in 53° N. and 158° 44′ E. Its harbour, one of the best on the Pacific, is little used, and the town consists merely of a few huts with some 400 inhabitants. Its naval institutions were transferred to Nikolayevsk after the attack of the Anglo French fleet in 1854.

PETROPOLIS, a city of the state of Rio de Janeiro, Brazil, in an elevated valley of the Serra de Estrella, 2634 ft. above sea-level and 27 m. N. of the city of Rio de Janeiro, with which it is connected by a combined railway and steamship line, and also by a longer railway line. Pop. of the municipality (1900), 29,331, a large percentage being summer residents, as the census was taken late in December; (1902, municipal census), 18,373. Petropolis is served by the Principe do Grão Pará railway, now a part of the Leopoldina system, which connects with Rio de Janeiro and Nictheroy on the coast, and with the station of Entre Rios on the Central of Brazil railway. Its altitude gives the city a cool invigorating climate, making it a favourite summer residence for the well-to-do classes of Rio. The rainfall is abundant, and especially so in summer (December to March) when the humidity is extreme. Vegetation is luxuriant and comprises a great variety of tropical and sub-tropical species. The city is built in a large, irregularly shaped basin formed by streams which converge to form the Piabanha river, a tributary of the Parahyba do Sul. Among the public buildings are the old imperial palace, a modern summer residence of the national executive and a municipal hall. Although Petropolis is not a commercial centre, its water-power and cool climate are making it an important manufacturing town. Among the products are cotton fabrics and garments, beer, and Camembert and Brie cheeses.

Petropolis was founded in 1845 by Julius Frederick Köler under the auspices of the emperor of Brazil, Dom Pedro II., on lands purchased by his father, Dom Pedro I., in 1822. The place was previously known as Corrego Secco, which Dr George Gardner described in 1837 as "a small, miserable village." The first emperor planned to establish there a German colony, but the plan was not realized until 1845, when about 2700 colonists from Germany were located there. Its growth was slow, but the choice of the place by the emperor as a summer residence drew thither many of the wealthy residents of the capital. The Mauá railway was opened to the foot of the *serra* (Raiz da Serra) in 1854, and the macadamized road up the *serra* to the town in 1856. The mountain section of the railway, on the Riggenbach system, was completed in 1883. Petropolis has since become the summer residence of the diplomatic corps and of the higher officials of the Federal government, and was the capital of the state of Rio de Janeiro from 1893 to 1903.

PETROVSK, a seaport of Russia in Transcaucasia, on the Caspian Sea, in the province of Daghestan, 180 m. by rail E. of Vladikavkaz, and 235 m. N.W. from Baku. Pop. 9806. The town has become the port of embarcation for Krasnovodsk, the Transcaspian territory, and the Central Asian khanates. There are naphtha wells; and the hot sulphur baths at Ak-gol and Talga, close by, attract many visitors in summer.

PETROVSK, a town of eastern Russia, in the government of Saratov, on the Medvyeditsa, a tributary of the Don, 60 m. N.W. of the town of Saratov. Pop. (1864), 10,128; (1897), 13,212. It was founded by Peter the Great in 1698 as a defence against the Kuban Tatars. Its industrial establishments include distilleries, tanneries, tallow and brickworks.

PETROZAVODSK, a town and episcopal see of Russia, capital of the government of Olonets, on the west shore of Lake Onega, 190 m. N.E. of St Petersburg. Pop. (1865), 11,027; (1897), 12,521. Two cathedrals, built towards the end of the 18th century, a mining school, an ecclesiastical seminary and a government cannon-foundry are the chief public buildings and institutions. Peter the Great founded ironworks here in 1703, but they continued in operation only twenty-four years. The cannon-foundry was instituted in 1774. Petrozavodsk became the capital of the government of Olonets in 1802.

PETRUCCI, PANDOLFO (d. 1512), tyrant of Siena, spent the greater part of his youth in exile, on account of the civil strife by which his native town of Siena was torn; but on the triumph of the party of the *Noveschi* (those who supported the Council of Nine) in 1487 he was able to return home. On the death of his brother Giacopo, one of the most powerful men in the city, Pandolfo succeeded to all the latter's offices and emoluments (1497), thus becoming in fact if not in name master of Siena. By his marriage with Aurelia, daughter of Nicola Borghese, another very influential citizen, he still further strengthened his authority. But he soon began to abuse his power by selling public offices to the highest bidders, or conferring them on his followers. A plot was made to murder him, but he discovered the conspiracy in time, and his own father-in-law, who had been leader of the movement, was put to death. In 1498 he prevented the outbreak of war with Florence over the possession of Montepulciano, which had been a bone of contention between the two cities for over a hundred years. His attitude towards Cesare Borgia was exceedingly astute; at first he assisted him, and obtained from him with the favour of the French king the cession of Piombino; but having subsequently aroused the suspicions of Borgia, the latter attempted to suppress Petrucci by inviting him to the fatal meeting of Senigallia. The Sienese tyrant, however, did not fall into the trap, and although Borgia in 1502 obliged him to quit Siena, he returned two months later, more powerful than before. Petrucci supported Pisa in the war against Florence, but eventually, through the intervention of the pope and of the king of Spain, he made peace with the latter city, to which he gave back Montepulciano in 1512. As a reward for this action Pope Julius II. created his nephew cardinal. During his last days Petrucci abdicated his authority in favour of his son Borghese. He died at San Quirico di Osenna on the 21st of May 1512.

See Pecci, *Memorie storico-critiche di Siena* (Siena, 1755); U. G. Mondolfo, *P. Petrucci signore di Siena* (Siena, 1899).

PETRUS AUREOLUS (ORIOL), scholastic philosopher and monk of the Franciscan order, lived in the latter half of the 13th century, and died in Paris in 1321 just after his appointment as archbishop of Aix. He was one of the first to attack the realist doctrines of Duns Scotus, and is interesting mainly as the precursor of William of Occam in his revival of Nominalism. His ability earned for him the titles of *Doctor Facundus* and *Doctor Abundans*.

PETTENKOFEN, AUGUST VON (1821–1889), Austrian painter, born in Vienna, was brought up on his father's estate in Galicia. Having decided to give up the military career on which he had started, he devoted himself to painting, taking for his subjects the simple scenes of the life on the dreary Puszta. His paintings are treasured for their fine qualities of colour, and for the sincerity with which the artist sets before us the uneventful melancholy life of Hungarian peasants and gipsies—without any theatrical pathos or forced humour. He was the inventor of the Pettenkofen box, an appliance for dissolving and redistributing cracked or discoloured varnish without friction or the dangerous use of chemicals. He died in Vienna in 1889.

PETTENKOFER, MAX JOSEPH VON (1818–1901), Bavarian chemist and hygienist, was born on the 3rd of December 1818 at Lichtenheim, near Neuburg. He was a nephew of Franz Xaver Pettenkofer (1783–1850), who from 1823 was surgeon and apothecary to the Bavarian court and was the author of some chemical investigations on the vegetable alkaloids. He studied pharmacy and medicine at Munich, where he graduated M.D. in 1843, and after working under Liebig at Giessen was appointed chemist to the Munich mint in 1845. Two years later he was chosen extraordinary professor of chemistry in the medical faculty, in 1853 he received the ordinary professorship, and in 1865 he became also professor of hygiene. In 1894 he retired from active work, and on the 10th of February 1901 he shot himself in a fit of depression at his home on the Starnberger See, near Munich. In his earlier years he devoted himself to chemistry, both theoretical and applied, publishing papers on the preparation of gold and platinum, numerical relations between the atomic weights of analogous elements, the formation of aventurine glass, the manufacture of illuminating gas from wood, the preservation of oil-paintings, &c. The reaction known by his name for the detection of bile acids was published in 1844. In his widely used method for the quantitative determination of carbonic acid the gaseous mixture is shaken up with baryta or lime water of known strength and the change in alkalinity ascertained by means of oxalic acid. But his name is most familiar in connexion with his work in practical hygiene, as an apostle of good water, fresh air and proper sewage disposal. His attention was drawn to this subject about 1850 by the unhealthy condition of Munich. Pettenkofer gave vigorous expression to his views on hygiene and disease in numerous books and papers; he was an editor of the *Zeitschrift für Biologie* from 1865 to 1882, and of the *Archiv für Hygiene* from 1883 to 1894.

PETTICOAT, an underskirt, as part of a woman's dress. The petticoat, *i.e.* "petty-coat" or small coat, was originally a short garment for the upper part of the body worn under an outer dress; in the *Promptorium parvulorum* the Latin equivalent is *tunicula*. It was both a man's and a woman's garment, and was in the first case worn as a small coat under the doublet, and by women apparently as a kind of chemise. It was, however, early applied to the skirt worn by women hanging from the waist, whether as the principal lower garment or as an underskirt. In the middle of the 17th century the wide breeches with heavy lace or embroidered ends worn by men were known as "petticoat breeches," a term alsc applied to the loose canvas or oilskin overalls worn by fishermen.

PETTIE, JOHN (1839–1893), Scottish painter, was born in Edinburgh on the 17th of March 1839, the son of Alexander and Alison Pettie. In 1852 the family removed to East Linton, Haddingtonshire, and a portrait by the lad of the village carrier and his donkey overcame his father's objections to art as a career for his son. When sixteen he entered the Trustees' Academy in Edinburgh, working under Robert Scott Lauder with W. Q. Orchardson, J. MacWhirter, W. M'Taggart, Peter Graham, Tom Graham and G. P. Chalmers. His first exhibits at the Royal Scottish Academy were "A Scene from the Fortunes of Nigel"—one of the many subjects for which he sought inspiration in the novels of Sir Walter Scott—and two portraits in 1858, followed in 1859 by "The Prison Pet." To the Royal Academy in 1860 he sent "The Armourers"; and the success of this work and of "What d'ye Lack, Madam?" in the following year, encouraged him to settle in London (1862), where he joined Orchardson. In 1866 he was elected an Associate of the Royal Academy, and in 1874 received full academical honours in succession to Sir Edwin Landseer. His diploma picture was "Jacobites, 1745." Pettie was a hard and rapid worker, and, in his best days, a colourist of a high order and a brilliant executant. In his early days he produced a certain amount of book illustration. His connexion with *Good Words* began in 1861, and was continued till 1864. With J. MacWhirter he illustrated *The Postman's Bag* (Strahan, 1862), and Wordsworth's *Poetry for the Young* (Strahan, 1863). His principal paintings, in addition to those already mentioned, are "Cromwell's Saints" (1862); "The Trio" (1863); "George Fox refusing to take the Oath" (1864); "A Drumhead Court-martial" (1865); "The Arrest for Witchcraft" (1866); "Treason" (1867, now in the Mappin Art Gallery, Sheffield); "Tussle with a Highland Smuggler" (1868); "The Sally" (1870); "Terms to the Besieged" (1872); "The Flag of Truce" (1873); "Ho! Ho! Old Noll" and "A State Secret" (1874); "A Sword and Dagger Fight" (1877); "The Death Warrant" (1879); "Monmouth and James II." (1882); "The Vigil" (1884, in the Chantrey Collection, National Gallery of British Art); "Challenged" (1885); "The Chieftain's Candlesticks" (1886); "Two Strings to Her Bow" (1887); "The Traitor" and "Sir Charles Wyndham as David Garrick" (1888); and "The Ultimatum" and "Bonnie Prince Charlie" (1892). Pettie died at Hastings on the 21st of February 1893. In 1894 a selection of his work was included in the Winter Exhibition of the Royal Academy. His portrait by himself is in the Tate Gallery.

John Pettie, R.A. (London, 1908), by his nephew Martin Hardie, gives the story of his life, a catalogue of his pictures, and fifty reproductions in colours.

PETTY, SIR WILLIAM (1623–1687), English statistician and political economist, born on the 26th of May 1623, was the son of a clothier at Romsey in Hampshire, and received his early education at the grammar school there. About the age of fifteen he went to Caen (Normandy), taking with him a little stock of merchandise, on which he traded, and so maintained himself whilst learning French, improving himself in Latin and Greek, and studying mathematics and other sciences. On his return to England he seems to have had for a short time a place in the royal navy. He went abroad again in 1643, and remained for three years in France and the Netherlands, pursuing his studies. In Paris he read Vesalius with Hobbes, who was then preparing his *Tractatus opticus*, and it is said that Petty drew the diagrams for him. In 1647 Petty obtained a patent for the invention of double writing, *i.e.* a copying machine. In politics he espoused the side of the parliament. His first publication was a letter to Samuel Hartlib in 1648, entitled *Advice for the Advancement of some Particular Parts of Learning*, the object of which was to recommend such a change in education as would give it a more practical character. In the same year he took up his residence at Oxford, where he was made deputy professor of anatomy, and where he gave instruction in that science and in chemistry. In 1649 he obtained the degree of doctor of physic, and was soon after elected a fellow of Brasenose College. He gained some notoriety in 1650 by restoring to life a woman who had been hanged for infanticide. In 1651 he was made professor of anatomy at Oxford, and also became professor of music at Gresham College. In 1652 he went to Ireland, having been appointed physician to the army in that country. In 1654, observing that the admeasurement and division of the lands forfeited in 1641 and granted to the soldiers had been "most inefficiently and absurdly managed," he entered into a contract to execute a fresh survey, which he completed in thirteen months.[1] By this he gained £9000, and part of the money he invested profitably in the purchase of soldiers' debentures. He thus became possessor of so large a domain in the county of Kerry that, according to John Aubrey, he could behold from Mt Mangerton 50,000 acres of his own land. He set up ironworks in that neighbourhood, opened lead-mines and marble-quarries, established a pilchard fishery, and commenced a trade in timber. Besides the office of commissioner of distribution of the lands he had surveyed, he held that of secretary to the lord-lieutenant, Henry Cromwell, and was also during two years clerk of the council. In January 1658 he was elected to Richard Cromwell's parliament as member for West Looe in Cornwall. After the Restoration he returned to England and was favourably received and knighted by Charles II., who was "much pleased with his ingenious discourses," and who, it is said, intended to create him earl of Kilmore. He obtained from the king a new patent constituting him surveyor-general of Ireland. In 1663 he attracted much notice by the success of his invention of a double-bottomed ship, which twice made the passage between Dublin and Holyhead, but was afterwards lost in a violent storm. He was one of the first members of the Royal Society, and sat on its council. He died in London on the 16th of December 1687, and was buried in the church of his native place. His will, a curious and characteristic document, is printed in Chalmers's *Biographical Dictionary*.

His widow, Elizabeth (d. 1708), daughter of Sir Hardress Waller (1604–1666), the Irish Cromwellian soldier and regicide, was created Baroness Shelburne by James II. in 1688; and her two sons were successively created earls of Shelburne, but on their death without issue the Petty estates passed to their sister, Anne, and after her marriage to the 1st earl of Kerry the Shelburne title was revived in her son's favour (see under LANSDOWNE, 1st MARQUESS).

Petty's Irish survey was based on a collection of social data which entitles him to be considered a real pioneer in the science of comparative statistics. He was also one of the first in whom we find a tendency to a view of industrial phenomena which was at variance with the then dominant mercantilist ideas, and he exhibits a statesmanlike sense of the elements in which the strength of a nation really consists. Roscher names him as having, along with Locke and Dudley North, raised the English school to the highest point it attained before the time of Hume. His *Treatise of Taxes and Contributions* contains a clear statement of the doctrine that price depends on the labour necessary for production. Petty is much concerned to discover a fixed unit of value, and he thinks he has found it in the necessary sustenance of a man for a day. He understands the cheapening effect of the division of labour. He states correctly the notion of "natural and true" rent as the remainder of the produce of land after payment of the cost of production; but he seems to have no idea of the "law of diminishing returns." He has much that is just on the subject of money: he sees that there may be an excess of it as well as a deficiency, and regards the prohibition of its exportation as contrary to sound policy. But he errs in attributing the fall of the rate of interest which takes place in the progress of industry to the increase in the quantity of money. He protested against the fetters imposed on the trade of Ireland, and advocated a union of that country with Great Britain. Whilst the general tendency in his day was to represent England as in a state of progressive decline—an opinion put forward particularly in the tract entitled *Britannia languens*—Petty declared her resources and prospects to be not inferior to those of France.

A complete list of his works is given in the *Athenae oxonienses*. The most important are: the *Treatise of Taxes and Contributions* (1662, 1667 and 1685); *Political Arithmetic*, presented in MS. to Charles II., but, because it contained matter likely to be offensive to France, kept unpublished till 1691, when it was edited by Petty's son Charles; *Quantulumcunque, or a Tract concerning Money* (1682); *Observations upon the Dublin Bills of Mortality in 1681 and the State of that City* (1683); *Essay concerning the Multiplication of Mankind* (1686); *Political Anatomy of Ireland* (1691). Several papers appeared in the *Philosophical Transactions*. See *Economic Writings of Sir William Petty*, ed. C. H. Hull (2 vols., 1899).

PETTY-OFFICER, the title in the navy of a large number of minor (Fr. *petit*, small) officers, of less than commissioned or warrant rank—such as the master-at-arms, sailmaker, caulker, armourer, cook, &c. They were originally named, and removable, by the captain.

PETUNIA, in botany, a genus of plants belonging to the natural order Solanaceae and containing about 16 species, chiefly South American (southern Brazil and Argentina). The garden forms are derived from the white-flowered P. *nyctaginiflora* and the violet- or purple-flowered P. *violacea*. The varieties of petunia, especially the double forms, make admirable specimens for pot culture.

Named or specially fine varieties are propagated by cuttings taken from stock plants kept through the winter on a dry warm shelf, and moved into a brisk moist heat in early spring; the young shoots are planted in pans or pots filled with sandy soil, and, aided by a brisk bottom heat, strike root in a few days. They are then potted singly into thumb-pots, and when once established are gradually hardened off, and afterwards repotted as required. The shoots should be topped to make bushy plants, and their tops may be utilized as cuttings. The single varieties are raised from seeds sown in light sandy soil in heat, in the early spring, and very slightly covered. The plants need to be pricked out or potted off as soon as large enough to handle. Good strains of seeds supply plants suitable for bedding; but, as they do not reproduce themselves exactly, any sorts particularly required must be propagated, like the double ones, from cuttings.

PETWORTH, a market town in the Horsham parliamentary division of Sussex, England, 55 m. S.S.W. from London by the London, Brighton & South Coast railway. Pop. (1901), 2503. The church of St Mary is Perpendicular, and contains numerous memorials of members of the Percy family and others. Petworth House, situated in a beautiful park, dates from the 18th century, and contains a magnificent collection of pictures. At Bignor in the neighbourhood are remains of an important and splendidly adorned Roman villa.

The first mention of Petworth (Peartingawyrth, Peteorde, Puetewird, Pedewurde, Putteworth, Pytteworth, Petteworth) occurs in a grant by Eardwulf, king of Northumbria, to St Peter's Church, about 791. In the time of Edward the Confessor Petworth was an allodial manor held by his queen Edith, and in 1086 Robert Fitz-Tetbald held it of Roger Montgomery, earl of Shrewsbury. It then included a church and a mill, and was rated at nine hides. Through Queen Adelisa, Petworth came first into the hands of her steward, Reginald de Wyndsor, and was afterwards given to her brother Josceline, who held it of the honour of Arundel. Josceline married Agnes de Percy and assumed the surname of Percy. The honour and manor of Petworth followed the descent of this family until 1708. In 1377 Henry Percy was created earl of Northumberland. The only daughter of the last earl married Charles, duke of Somerset, in 1682, and Petworth descended through their daughter Catherine to the earls of Egremont. The adopted son of the third earl was created Baron Leconfield in 1859.

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[1] The survey executed by Petty was, somewhat whimsically, called the "Down Survey," because the results were set *down* in maps; it is called by that name in Petty's will. He left in MS. a full account of the proceedings in connexion with it, which was edited by Sir Thomas A. Larcom for the Irish Archaeological Society in 1851. The maps, some of which were injured by a fire in 1711, are preserved in the Public Record Office, Dublin.

PEUTINGER KONRAD (1465–1547), German humanist and antiquarian, was born at Augsburg. In 1497 he was town clerk of his native place, and was on intimate terms with the emperor Maximilian. He was one of the first to publish Roman inscriptions, and his name remains associated with the famous *Tabula peutingeriana* (see MAP), a map of the military roads of the western Roman Empire, which was discovered by Konrad Celtes, who handed it over to Peutinger for publication. Peutinger also edited the *Historia Gothorum* of Jordanes, and the *Historia gentis Langobardorum* of Paulus Diaconus.

The *Tabula peutingeriana* was first published as a whole by F. de Scheyb (1753); later editions by E. Desjardins (1869–1874) and C. Miller (1888); see also E. Paulus, *Erklärung der Peutinger Tafel* (1867); and Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans., 1900).

PEVENSEY, a village in the Eastbourne parliamentary division of Sussex, England, 65 m. S.S.E. from London by the London, Brighton & South Coast railway. Pop. (1901), 468. The village is a member of the Cinque Ports, but the sea has receded a mile from it in historic times. The outer wall, with solid towers, of the celebrated castle, is of Roman construction, and originally enclosed a complete oval; it is generally considered to have enclosed the strong town of *Anderida.* Within rise the fine ruins, principally of the 13th century, but in part Norman, of the castle proper, with a keep and four massive round towers. The church of St Nicholas, close to the castle, shows beautiful Early English work. It has been supposed that Pevensey was the scene of the landing of Caesar in 55 B.C., but the question is disputed.

The name of Pevensey (Paevenisel, Pevensel, Pevenes, Pemsey) first occurs in a grant of land there by the south Saxon Duke Berthuald to the abbey of St Denis in 795. In later Saxon times, at least by the reign of Edward the Confessor, it was a royal borough and had a harbour and a market. Its early importance was due to its fencible port. It was the landing place of William the Norman on his way to conquer, and was the *caput* of the rape of Pevensey, which was granted by William to the earl of Mortain and subsequently became the Honour of the Eagle. Some time before the reign of Edward I. the town of Pevensey was made a member of Hastings and shared the liberties of the Cinque Ports, but apart from them it possesses no charter. It was governed by a bailiff and twelve jurats, elected annually, until by an act of 1883 it ceased to exist as a borough. Its seal dates apparently from the reign of Henry III. The gradual decline of Pevensey was complete in the 15th century and was caused by the recession of the sea and consequent loss of the harbour.

PEW (Mid. Eng. *puwe*, through O. Fr. *puya*, *pui*, mod. *puy*, in the sense of hill, cf. *appuyer*, to lean against; from Lat. *podium*, a high place, balcony; Gr. *πόδιον*, pedestal, *πούς*, foot), a term, in its most usual meaning, for a fixed seat in a church, usually enclosed, slightly raised from the floors, and composed of wood framing, mostly with ornamented ends. Some bench ends are certainly of Decorated character, and some have been considered to be of the Early English period. They are sometimes of plain oak board, 2½ to 3 in. thick, chamfered, and with a necking and finial generally called a *poppy head;* others are plainly panelled with bold cappings; in others the panels are ornamented with tracery or with the *linen pattern*, and sometimes with running foliages. The large pews with high enclosures, curtains, &c., known familiarly as "horse-boxes," and common in English parish churches during the 18th and early part of the 19th centuries, have nearly all been cleared away. The parish church of Whitby, in Yorkshire, is perhaps the best surviving example of an unaltered interior.

The Latin word *podium* was particularly applied to a balcony or parapet next to the arena in the Roman theatre where the emperor and other distinguished persons sat. According to Du Cange (*Glossarium, s.v. podium*), it is found in medieval Latin for a bench (*subsellium*) for the minor canons at a church in Lyons (1343), and also for a kneeling stool in a monastic church. The word "pew" in English was often used for a stall for the minister, for a reading desk, or for a pulpit. The floor space of the nave and transepts of medieval churches was usually open, mats being sometimes provided for kneeling, and if any fixed seats were provided these would be for the patrons of the church or for distinguished people. Some enclosed seats, however, seem to have been reserved for women, as is seen in *Piers Plowman*, ch. vii. 144, "Among wyves and wodewes ich am ywoned sitte yparroked in puwes." They did not come into general use till the middle of the 15th or beginning of the 16th century (see Gasquet, *Parish Life in Medieval England*, (1906, pp. 62 and 133). Over the few seats thus allotted dispute arose and attempts were made to appropriate them. Thus the constitutions for the synod of Exeter, drawn up by Bishop Peter Quivel in 1287, forbid any one "to claim any sitting in the church as his own. . . . Whoever first comes to pray, let him take what place he wishes in which to pray."

At common law all seats in a parish church are for the common use of all the parishioners, and every parishioner has a right to a seat without paying for it. The disposition of the seats is in the discretion of the churchwardens acting for the ordinary for the purpose of orderly arrangement (as to the exercise of this discretion see *Reynolds* v. *Monckton*, 1841, 2 M. & R. 384), and this can be exercised in cases where all the seats are free (*Asher* v. *Calcraft*, 1887, 18 Q.B.D. 607). The right to a seat does not belong to a non-parishioner. As against the assignment and disposition of seats by the ordinary, acting through the churchwardens, two kinds of appropriation can be set up (*a*) by the grant of a faculty by the ordinary, and (*b*) by prescription, based on the presumption of a lost faculty. Such faculties are rarely granted now; they were formerly common; the grant was to a man and his family "so long as they remain inhabitants of a certain house in the parish"; the words "of a certain house" are now usually omitted. The claim to a pew by prescription must be in respect of a house in the parish; the right is subject to the burden of repairing the pew; it is not an easement, nor does the Prescription Act 1832 apply to it (see for the whole subject of a claim by prescription *Phillips* v. *Halliday*, 1891, A.C. 228). The letting of pews in parish churches became common in the 16th century, but there are some earlier instances of the use, for example at St Ewens, Bristol, in 1455 (*Churchwardens' Accounts*, Sir J. Maclean, *Trans. Bristol and Gloucester Archaeol. Assoc.*, vol. xv., 1890–1891). The taking of pew rents in parish churches is illegal (Lord Stowell, in *Walter* v. *Gunner*, 1798, 3 *Hag. Consist.* 817); but under the various Church Building Acts seats may be let and rents charged to pay the salary of the minister, &c.

See A. Heales, *History and Law of Church Seats and Pews* (1872); Phillimore, *Eccles. Law* (1896), ii. 1424 seq.

PEWTER, a general name used to denote a number of alloys of various metals in diverse proportions, the sole common feature of which lies in the fact that tin is always the chief constituent. The etymology of the word is doubtful, but it is probably an English modification of *spelter*, which was adopted with more or less local alteration by the continental European nations, who at an early period were eager purchasers of the ware, becoming *peauter* in Dutch, *peutre*, *peautre* or *piautre* in French, *peltro* in Italian and *peltre* in Spanish. Roman pewter, the oldest known, which has been disinterred at various places in England and elsewhere, was composed of tin and lead alone, for the occasional traces of iron are believed to be accidental, in proportions which, though varying considerably, group themselves around two definite formulae, one containing 71·5 parts of tin to 27·8 of lead, the other 78·2 of tin to 21·7 of lead, or one libra of tin to 4⅓ and 3 unciae of lead respectively. On the European continent in the middle ages, some ten centuries later than the supposed date of the Roman pewter found in Britain, when we first get definite records of the composition of pewter, lead remained the chief, if not the only secondary ingredient. In 1437 the pewterers of Montpelier added 4 parts of lead to 96 of tin, when making dishes and porringers 10 parts of lead to 90 of tin for salt-cellars and ewers; those of Limoges used 4 parts of lead to 100 of tin; at Nuremberg in 1576 it was ordained that not more than 1 lb of lead should be mixed with every 10 lb of tin; in France during the 18th century a limit of 15% of lead was imposed, while at the present time 16·5% with a margin of 1·5 for errors is regarded as safe for the storage of wine and consequently legal.

In England the earliest known ordinances for the regulation of the craft were drawn up in 1348 and received the approval of the mayor and aldermen. From them we learn that for rounded vessels lead might be mixed with the tin in the proportion of 26 lb to each hundredweight, though this quantity appears to have been found excessive, since in 1351 a pewterer was punished because his alloy contained more than 16 lb to the hundredweight, unless this be a clerical error in the contemporary records of the Pewterers' Company. Articles made of this material were to be known as "vessels of tyn for ever" but the alloy soon came to be known as "ley." Another formula, however, authorized in the same document, would appear to have been at that time an exclusively English secret, to which was presumably due the universal recognition of the superiority of the island wares which is so notable a fact in the history of pewter. It was known as "fyne peauter" and used for dishes, saucers, platters, chargers, and for all "things that they make square," such as cruets, chrismatories, &c., which owing either to the rough usage they would be submitted to, or to the sharpness of their angles, called for greater toughness in the material. The recipe for this alloy as originally propounded was as much brass to the tin "as it wol receiuve of his nature," but the lack of precision in this perhaps rendered it difficult to distinguish accidental variations from deliberate adulteration, and in 1474–1475 it was resolved that 26 lb of brass must be mixed with every hundredweight of tin. The penalties for infringement of the rules were severe and frequently enforced, but in spite of them alterations and improvements crept in. The chief and perhaps the earliest of these was the addition of a certain proportion of bismuth, or as it was then called "tin glass." When this was first used is not recorded, but by 1561 it was accepted as a matter of course; in 1630 a maker "was found in fault for not sufficiently tempering his metal with tin glass"; and in 1653 it was ordered that 3 lb weight of tin glass at least must be mixed with every 1000 lb of tin. Antimony was subsequently introduced—though there is no mention of it in the records of the Pewterers' Company—sometimes alone as in tin and temper (1·6 to 150 parts) and trifle (17 parts to 83 of tin), sometimes with other metals as in hard metal (96 parts of tin, 8 of antimony and 2 of copper), a mixture very closely resembling that still used under the name of "Britannia metal," and in plate pewter (100 parts of tin, 8 of antimony, 4 of copper and 4 of bismuth). The wares were originally fashioned in two ways, by hammering or by casting, and the workers in each were strictly differentiated, the former, who worked in fine pewter, being known as Sadware men, the latter who used "ley" as Hollow-ware men. A third class, known as Triflers, from the alloy they were limited to, probably at first only manufactured such small articles of domestic use or ornament as did not definitely fall under either of the other headings, but from an authorized list of wares, drawn up by a committee of Triflers in 1612, it is clear that the barrier between them and the Hollow-ware men had been largely broken down. Another method of working pewter which seems to have been introduced later, and never followed to any great extent, was spinning, by which the vessel was shaped in a mould on a wheel by the mere pressure of a blunt tool, the softness of the metal allowing of its flowing sufficiently for this purpose.

Pewter first appears in history in 1074, when a synod at Rouen permitted its use as a substitute for gold or silver in church vessels, a concession accepted also at Winchester two years later, again withdrawn in 1175, but once more tacitly adopted some twenty years after. The records of its domestic use commence with the caldrons employed for boiling the meat at the coronation of Edward I. in 1274, though we gather that the trade was even then flourishing in Paris and Bruges, whence during the following century it extended to Augsburg, Nuremberg, Poitiers, Mons and other continental centres. Confined at first to the more wealthy classes, we can trace as time goes on its extension lower and lower in the social scale, until at the end of the 17th century its use was almost universal. Thenceforward its vogue steadily declined. The growing cheapness of glass and chinaware and the invention of more showy metals brought upon it by degrees the fatal stigma of vulgarity, until with very few exceptions its manufacture entirely ceased.

Artistically, pewter was at its best when its makers were least conscious of the art revealed in it, thinking more of the durability and appropriateness to purpose of their wares than of their decorative qualities. Though intentionally ornamental vessels may be found earlier, it was not until the 18th century that the pewterers set themselves to slavishly copying the designs and methods of the silversmiths, whether suitable to their material or not, and thereby undoubtedly hastened their own downfall.

Of recent years pewter has taken its place among the articles sought after by collectors, and its cost has so materially and rapidly increased that the manufacture of vessels, guaranteed of course genuinely antique, bids fair to become once more a paying industry. Unfortunately the various enactments compelling each maker to stamp his ware with a definite touch-mark seem at all times to have been very generally evaded or ignored, and experience alone is therefore the only safe guide to distinguishing new from old.

Bibliography.—*History of the Worshipful Company of Pewterers of the City of London*, by Charles Welch (London, 1902); *Pewter Plate*, by R. J. L. Masse (London, 1904); *Scottish Pewter Ware and Pewterers*, by L. Ingleby Wood (Morton, Edinburgh, n.d.); *Old Pewter*, by Malcolm Bell (Newnes, London, n.d.); *Les Métaux dans l'antiquité et au moyen âge. L'Etain*, by Germain Bapst (Paris, 1884); *Dictionnaire de l'ameublement et de la décoration*, by Henri Havard; *Histoire du mobilier*, by Albert Jacquemart (Paris, 1877); "Analysis of Roman Pewter," by W. Gowland, *Archaeologia*, vol. lvi. (1898); *Pewter Marks and Old Pewter Ware: Domestic and Ecclesiastical*, by Christopher A. Markham (1909). (M. Be.)

PÉZENAS, a town of southern France, in the department of Hérault 33 m. W.S.W. of Montpellier on the southern railway. Pop. (1906), 6432. The commerce in cognac, spirits and wines is so important that the prices current for these at the weekly sales are registered throughout the wine marts of France and Europe. There is a handsome monument to Molière, who lived at Pézenas several years and produced his first plays there in 1655 and 1656. A gateway (15th century) and old mansion of the 15th and 16th centuries are of interest.

Pézenas (*Piscennae*) was founded by the Gauls. In the 10th century it became the capital of a countship subsequently held by important families including those of Montmorency, Condé and Conti. In the 17th century the town was on several occasions the meeting place of the estates of Languedoc.

PFAFF, JOHANN FRIEDRICH (1765–1825), German mathematician, was born on the 22nd of December 1765 at Stuttgart. He received his early education at the Carlsschule, where he met F. Schiller, his lifelong friend. His mathematical capacity was early noticed; he pursued his studies at Göttingen under Abraham Gotthelf Kästner (1719–1800), and in 1787 he went to Berlin and studied practical astronomy under J. E. Bode. In 1788 Pfaff became professor of mathematics in Helmstedt, and so continued until that university was abolished in 1810. From that time till his death on the 21st of April 1825 he held the chair of mathematics at Halle. Pfaff's researches bore chiefly on the theory of series, to which he applied the methods of the so-called combinatorial school of German mathematicians, and on the solution of differential equations. His two principal works are *Disquisitiones analyticae maxime ad calculum integralem et doctrinam serierum pertinentes* (4to., vol. i., Helmstedt, 1797) and "Methodus generalis, aequationes differentiarum particularum, necnon aequationes differentiales vulgares, utrasque primi ordinis inter quotcumque variabiles, complete integrandi" in *Abh. d. Berl. Acad.* (1814–1815). The former work contains Pfaff's discussion of a certain differential equation which generally bears his name, but which had originally been treated in a less complete manner by L. Euler (see DIFFERENTIAL EQUATIONS). The latter work contains an important addition to the theory of partial differential equations as it had been left by J. L. Lagrange.

His brother, JOHANN WILHELM ANDREAS PFAFF (1774–1835), was professor of pure and applied mathematics successively at Dorpat, Nuremberg, Würzburg and Erlangen. Another brother, CHRISTIAN HEINRICH PFAFF (1773–1852), graduated in medicine at Stuttgart in 1793, and from 1801 till his death was professor of medicine, physics and chemistry at the university of Kiel.

PFALZBURG, a town of Germany, in the imperial province of Alsace-Lorraine, lies high on the west slopes of the Vosges, 25 m. N.W. of Strassburg by rail. Pop. (1905), 3716. It contains an Evangelical and a Roman Catholic church, a synagogue and a teachers' seminary. Its industries include the manufacture of gloves, straw hats and liqueurs, and also quarrying.

The principality of Pfalzburg, of which this town was the capital, originally a part of Luxemburg, afterwards belonged in turn to the bishop of Metz, the bishop of Strassburg and the duke of Lorraine, and passed into the possession of France in 1661. The town was of importance as commanding the passes of the Vosges, and was strongly fortified by Vauban in 1680. The works resisted the Allies in 1814 and 1815, and the Germans for four months in 1870, but they were taken on the 12th of December of that year. They have since been razed.

PFEIFFER, FRANZ (1815–1868), German scholar, was born at Bettlach near Soleure on the 27th of February 1815. After studying at the university of Munich he went to Stuttgart, where in 1846 he became librarian to the royal library. In 1856 Pfeiffer founded the *Germania*, a quarterly periodical devoted to German antiquarian research. In 1857, having established his fame as one of the foremost authorities on German medieval literature and philology, he was appointed professor of these subjects at the university of Vienna; and in 1860 was made a member of the Imperial Academy of Sciences. He died at Vienna on the 29th of May 1868.

Among the many writings edited by him may be mentioned the *Barlaam und Josaphat* of Rudolf von Ems (1843), the *Edelstein* of Ulrich Boner (1844), *Die deutschen Mystiker des 14. Jahrhunderts* (1845–1857; new ed., 1906), the *Buch der Natur* of Konrad von Megenberg, a 14th-century writer (1861), *Die Predigten des Berthold von Regensburg* (1862), and the poems of Walther von der Vogelweide (1864; 6th ed. by K. Bartsch, 1880). Of his independent writings the most important are *Zur deutschen Literaturgeschichte*, *Über Wesen und Bildung der höfischen Sprache in mittelhochdeutscher Zeit*, *Der Dichter des Nibelungenliedes*, *Forschung und Kritik auf dem Gebiete des deutschen Altertums*, and *Altdeutsches Übungsbuch*. A biographical sketch by Karl Bartsch is in *Uhlands Briefwechsel mit Freiherrn von Lassberg*, edited by Franz Pfeiffer (1870).

PFEIFFER. IDA LAURA (1797–1858), Austrian traveller, daughter of a merchant named Reyer, was born at Vienna on the 14th of October 1797. In 1820 she married Dr Pfeiffer, a lawyer of Lemberg, who subsequently incurred official persecution and was reduced to poverty. In her later life Mme Pfeiffer devoted her limited means to travel. In 1842 she visited Palestine and Egypt, and published an account of her journey in *Reise einer Wienerin in das Heilige Land* (Vienna, 1843). In 1845 she set out to Scandinavia and Iceland, describing her tour in two volumes, *Reise nach dem skandinavischen Norden und der Insel Island* (Pest, 1846). In 1846 she started on a journey round the world, visiting Brazil, Chile and other countries of South America, Tahiti, China, India, Persia, Asia Minor and Greece, and reaching home in 1848. The results were published in *Eine Frauenfahrt um die Welt* (Vienna, 1850). In 1851 she went to England and thence to South Africa, intending to penetrate into the interior; this proved impracticable, but she proceeded to the Malay Archipelago, spending eighteen months in the Sunda Islands and the Moluccas. After a visit to Australia, Madame Pfeiffer proceeded to California, Oregon, Peru, Ecuador, New Granada, the Missiones Territory, and north again to the Great Lakes, reaching home in 1854. Her narrative, *Meine zweite Weltreise*, was published at Vienna in 1856. In May of the same year she set out to explore Madagascar, where at first she was cordially received by the queen. But she unwittingly allowed herself to be involved in a plot to overthrow the government, and was expelled the country. She died at Vienna on the 27th of October 1858.

The *Reise nach Madagascar* was issued in 1861 (Vienna), with a biography by her son.

PFLEIDERER, OTTO (1839–1908), German Protestant theologian, was born at Stetten near Cannstadt in Württemberg on the 1st of September 1839. From 1857 to 1861 he studied at Tübingen under F. C. Baur; and afterwards in England and Scotland. He then entered the ministry, became *repetent* at Tübingen, and for a short time held a pastorate at Heilbronn (1868). In 1870 he became chief pastor and superintendent at Jena and soon afterwards professor ordinarius of theology, but in 1875 he was called to the chair of systematic theology at Berlin, having made his name by a series of articles on New Testament criticism and Johannine and Pauline theology, which appeared in Adolf Hilgenfeld's *Zeitschrift für wissenschaftliche Theologie*, and by his *Der Paulinismus*, published in 1873 (2nd ed., 1890; Eng. trans., *Paulinism: a Contribution to the History of Primitive Christian Theology*, 2 vols., 1873, &c.). *Das Urchristentum, seine Schriften und Lehren, in geschichtlichem Zusammenhang beschrieben* was published in 1878 and considerably enlarged for a second edition in 1902 (Eng. trans., 1906). In 1890 appeared *The Development of Theology since Kant, and its Progress in Great Britain since 1825*, which was written for publication in England. A more elaborate work was his *Religionsphilosophie auf geschichtlichen Grundlage* (1878; 2nd ed., enlarged, 1883–1884; Eng. trans., from 2nd German ed., *The Philosophy of Religion on the Basis of its History*, 4 vols., 1886–1888). "The Influence of the Apostle Paul on the Development of Christianity" was the title of a course of Hibbert Lectures given in London in 1885. In 1894 he delivered the Gifford Lectures at Edinburgh, the subject being "The Philosophy and Development of Religion." His later publications included: *The Early Christian Conception of Christ* (1905), *Die Entstehung des Christentums* (1905; Eng. trans., 1906), *Religion und Religionen* (1906; Eng. trans., 1907), and *Die Entwicklung des Christentums* (1907). He died on the 18th of July 1908, at Gross Lichterfelde, near Berlin. In New Testament criticism Pfleiderer belonged to the critical school which grew out of the impulse given by F. C. Baur. But, like other modern German theologians, he showed a greater disposition to compromise. All his work shows a judicial tone of mind, and is remarkable for the charm of its style.

Pfleiderer's younger brother EDMUND (1842–1902) distinguished himself both in philosophy and theology. He too entered the ministry (1864) and during the Franco-German War served as army chaplain, an experience described in his *Erlebnisse eines Feldgeistlichen* (1890). He was afterwards appointed professor ordinarius of philosophy at Kiel (1873), and in 1878 he was elected to the philosophical chair at Tübingen. He published works on Leibnitz, empiricism and scepticism in Hume's philosophy, modern pessimism, Kantic criticism, English philosophy, Heraclitus of Ephesus and many other subjects.

PFORTA, or SCHULPFORTA, formerly a Cistercian monastery dating from 1140, and now a celebrated German public school. It is in the Prussian province of Saxony, on the Saale, 2 m. S.W. of Naumburg. The remains of the monastery include the 13th century Gothic church, recently restored, the Romanesque chapel (12th century) and other buildings now used as dormitories, lecture rooms, &c. There is also the Fürstenhaus, built in 1573. Schulpforta was one of the three *Fürstenschulen* founded in 1543 by Maurice duke, and later elector, of Saxony, the two others being at Grimma and at Meissen. The property of the dissolved monastery provided a good revenue for the new educational foundation, which now amounts to about £15,000 a year. Free education is provided for 140 boys, the total number of pupils being 185. After being in the possession of Saxony, Pforta passed to Prussia in 1815, and since this date the school has been entirely reorganized.

PFORZHEIM, a town of Germany, in the grand duchy of Baden, at the confluence of the Nagold and the Enz, on the northern margin of the Black Forest, 19 m. S.E. of Karlsruhe by rail, and at the junction of lines to Wildbad and Ettlingen. Pop. (1895), 33,345; (1905), 59,395, most of whom are Protestants. Its most interesting buildings are the old palace of the margraves of Baden, and the Schlosskirche, the latter an edifice of the 12th–15th centuries, containing the tombs and monuments of the margraves. Pforzheim is the chief centre in Germany for the manufacture of gold and silver ornaments and jewelry, an industry which gives employment to about 22,000 hands, besides which there are iron and copper works, and manufactures of chemicals, paper, leather, machinery, &c. A brisk trade is maintained in timber, cattle and agricultural produce.

Pforzheim (Porta Hercyniae) is of Roman origin. From about 1300 to 1565 it was the seat of the margraves of Baden. It was taken by the troops of the Catholic League in 1624, and was destroyed by the French in 1689. The story of the 400 citizens of Pforzheim who sacrificed themselves for their prince after the battle of Wimpfen in May 1622 has been relegated by modern historical research to the domain of legend.

See Coste, *Die 400 Pforzheimer* (1879); Brombacher, *Der Tod der 400 Pforzheimer* (Pforzheim, 1886); Stolz, *Geschichte der Stadt Pforzheim* (Pforzheim, 1901).

PHAEDO, Greek philosopher, founder of the Elian school, was a native of Elis, born in the last years of the 5th century B.C. In the war of 401–400 between Sparta and Elis he was taken prisoner and became a slave in Athens, where his beauty brought him notoriety. He became a pupil of Socrates, who conceived a warm affection for him. It appears that he was intimate with Cebes and Plato, and he gave his name to one of Plato's dialogues. Athenaeus relates, however, that he resolutely declined responsibility for any of the views with which Plato credits him, and that the relations between him and Plato were the reverse of friendly. Aeschines also wrote a dialogue called *Phaedo*. Shortly after the death of Socrates Phaedo returned to Elis, where his disciples included Anchipylus, Moschus and Pleistanus, who succeeded him. Subsequently Menedemus and Asclepiades transferred the school to Eretria, where it was known as the Eretrian school and is frequently identified (*e.g.* by Cicero) with the Megarians. The doctrines of Phaedo are not known, nor is it possible to infer them from the Platonic dialogue. His writings, none of which are preserved, were in the form of dialogues. As to their authenticity nothing is known, in spite of an attempt at selection by Panaetius (Diog. Laërt. ii. 64), who maintains that the *Zopyrus* and the *Simon* are genuine. Seneca has preserved one of his dicta (*Epist.* 94. 41), namely that one method of acquiring virtue is to frequent the society of good men.

See Wilamowitz, *Hermes*, xiv. 189 seq.

PHAEDRA, in Greek legend, daughter of Minos and Pasiphaë. With her sister Ariadne she was carried off by Theseus to Athens, and became his wife. On the way to Eleusis she met Hippolytus, son of Theseus by a former wife (Hippolyte, queen of the Amazons, or her sister Antiope), and fell in love with him. Finding her advances rejected, she hanged herself, leaving behind a letter in which she accused Hippolytus of having made dishonourable proposals. The same story, in the main, is told of Bellerophon and Anteia. It formed the subject of tragedies by Sophocles, Euripides (two, one of which is extant), Seneca and Racine.

PHAEDRUS, Roman fabulist, was by birth a Macedonian and lived in the reigns of Augustus, Tiberius, Gaius and Claudius. According to his own statement (prologue to book iii.), not perhaps to be taken too literally, he was born on the Pierian Mountain, but he seems to have been brought at an early age to Italy, for he mentions that he read a verse of Ennius as a boy at school. According to the heading of the chief MS. he was a slave and was freed by Augustus. He incurred the wrath of Sejanus, the powerful minister of Tiberius, by some supposed allusions in his fables, and was brought to trial and punished. We learn this from the prologue to the third book, which is dedicated to Eutychus, who has been identified with the famous charioteer and favourite of Gaius. The fourth book is dedicated to Particulo, who seems to have dabbled in literature. The dates of their publication are unknown, but Seneca, writing between A.D. 41 and 43 (*Consol. ad Polyb.* 27), knows nothing of Phaedrus, and it is probable that he had published nothing then. His work shows little or no originality; he simply versified in iambic trimeters the fables current in his day under the name of "Aesop," interspersing them with anecdotes drawn from daily life, history and mythology. He tells his fable and draws the moral with businesslike directness and simplicity; his language is terse and clear, but thoroughly prosaic, though it occasionally attains a dignity bordering on eloquence. His Latin is correct, and, except for an excessive and peculiar use of abstract words, shows hardly anything that might not have been written in the Augustan age. From a literary point of view Phaedrus is inferior to Babrius, and to his own imitator, La Fontaine; he lacks the quiet picturesqueness and pathos of the former, and the exuberant vivacity and humour of the latter. Though he frequently refers to the envy and detraction which pursued him, Phaedrus seems to have attracted little attention in antiquity. He is mentioned by Martial (iii. 20, 5), who imitated some of his verses, and by Avianus. Prudentius must have read him, for he imitates one of his lines (Prud. *Cath.* vii. 115; cf. Phaedrus, iv. 6, 10).

The first edition of the five books of Phaedrus was published by Pithou at Troyes in 1596 from a manuscript now in the possession of the marquis of Rosanbo. In the beginning of the 18th century there was discovered at Parma a MS. of Perotti (1430–1480), archbishop of Siponto, containing sixty-four fables of Phaedrus, of which some thirty were new. These new fables were first published at Naples by Cassitto in 1808, and afterwards (much more correctly) by Jannelli in 1809. Both editions were superseded by the discovery of a much better preserved MS. of Perotti in the Vatican, published by Angelo Mai in 1831. For some time the authenticity of these new fables was disputed, but they are now generally accepted, and with justice, as genuine fables of Phaedrus. They do not form a sixth book, for we know from Avianus that Phaedrus wrote five books only, but it is impossible to assign them to their original places in the five books. They are usually printed as an appendix.

In the middle ages Phaedrus exercised a considerable influence through the prose versions of his fables which were current, though his own works and even his name were forgotten. Of these prose versions the oldest existing seems to be that known as the "Anonymus Nilanti," so called because first edited by Nilant at Leiden in 1709 from a MS. of the 13th century. It approaches the text of Phaedrus so closely that it was probably made directly from it. Of the sixty-seven fables which it contains thirty are derived from lost fables of Phaedrus. But the largest and most influential of the prose versions of Phaedrus is that which bears the name of *Romulus*. It contains eighty-three fables, is as old as the 10th century, and seems to have been based on a still earlier prose version, which, under the name of "Aesop," and addressed to one Rufus, may have been made in the Carolingian period or even earlier. About this *Romulus* nothing is known. The collection of fables in the Weissenburg (now Wolfenbüttel) MS. is based on the same version as *Romulus*. These three prose versions contain in all one hundred distinct fables, of which fifty-six are derived from the existing and the remaining forty-four presumably from lost fables of Phaedrus. Some scholars, as Burmann, Dressler and L. Müller, have tried to restore these lost fables by versifying the prose versions.

The collection bearing the name of *Romulus* became the source from which, during the second half of the middle ages, almost all the collections of Latin fables in prose and verse were wholly or partially drawn. A 12th-century version of the first three books of *Romulus* in elegiac verse enjoyed a wide popularity, even into the Renaissance. Its author (generally referred to since the edition of Névelet in 1610 as the "Anonymus Neveleti") was long unknown, but Hervieux has shown grounds for identifying him with Walther of England, chaplain to Henry II. and afterwards archbishop of Palermo.

Another version of *Romulus* in Latin elegiacs was made by Alexander Neckam, born at St Albans in 1157. Amongst the collections partly derived from *Romulus* the most famous is probably that in French verse by Marie de France. About 1200 a collection of fables in Latin prose, based partly on *Romulus*, was made by the Cistercian monk Odo of Sherrington; they have a strong medieval and clerical tinge. In 1370 Gerard of Minden wrote a poetical version of *Romulus* in Low German.

Since Pithou's edition in 1596 Phaedrus has been often edited and translated; among the editions may be mentioned those of Burmann (1718 and 1727), Bentley (1726), Schwabe (1806), Berger de Xivrey (1830), Orelli (1832), Eyssenhardt (1867), L. Müller (1877), Rica (1885), and above all that of L. Havet (Paris, 1895). For the medieval versions of Phaedrus and their derivatives see L. Roth, in *Philologus*, i. 523 seq.; E. Grosse, in *Jahrb. f. class. Philol.*, cv. (1872); and especially the learned work of Hervieux, *Les Fabulistes latins depuis le siècle d'Auguste jusqu'à la fin du moyen âge* (Paris, 1884), who gives the Latin texts of all the medieval imitators (direct and indirect) of Phaedrus, some of them being published for the first time. (J. P. P.)

PHAER (or Phayer), **THOMAS** (1510?–1560), English translator of Virgil, was educated at Oxford and at Lincoln's Inn. He published in 1535 *Natura brevium*, and in 1543 *Newe Boke of Presidentes*. He says on the title-page of his version of the *Aeneid* that he was "solicitor to the king and queen's majesties, attending their honourable council in the marches of Wales." He settled at Kilgarran in Pembrokeshire, and combined the study of medicine with his legal practice. He wrote several medical works, and was admitted M.D. of Oxford in 1559. He contributed to Sackville's *Mirrour for Magistrates*, "Howe Owen Glendower, being seduced by false prophecies, toke upon him to be Prince of Wales." In 1558 appeared *The Seven First Bookes of the Eneidos of Virgil converted into English Meter.* He had completed two more books in April 1560 and had begun the tenth, but he died in the autumn of that year, leaving his task incomplete. The translation was finished by Thomas Twyne in 1584. Phaer's translation, which was in rhymed fourteen-syllabled lines, was greatly admired by his contemporaries, and he deserves credit as the first to attempt a complete version, the earlier renderings of Surrey and Gawain Douglas being fragmentary although of greater poetic value.

PHAËTHON (Gr. φαέθων, shining, radiant), in Greek mythology, the son of Helios the sun-god, and the nymph Clymene. He persuaded his father to let him drive the chariot of the sun across the sky, but he lost control of the horses, and driving too near the earth scorched it. To save the world from utter destruction Zeus killed Phaëthon with a thunderbolt. He fell to earth at the mouth of the Eridanus, a river of northern Europe (identified in later times with the Po), on the banks of which his weeping sisters, the Heliades, were transformed into poplars and their tears into amber. This part of the legend points to the mouth of the Oder or Vistula, where amber abounds. Phaëthon was the subject of a drama of the same name by Euripides, of which some fragments remain, and of a lost tragedy of Aeschylus (*Heliades*); the story is most fully told in the *Metamorphoses* of Ovid (i. 750–ii. 366 and Nonnus, *Dionysiaca*, xxxviii). Phaëthon has been identified with the sun himself and with the morning star (Phosphorus). In the former case the legend is supposed to represent the sun sinking in the west in a blaze of light. His identification with the morning star is supported by Hyginus (*Astron.* ii. 42), where it is stated that the morning (and evening) star was the son of Cephalus and Eos (the father and mother of Phaëthon according to Hesiod, *Theog.* 984–986). The fall of Phaëthon is a favourite subject, especially on sarcophagus reliefs, as indicating the transitoriness of human life.

See G. Knaack, "Quaestiones Phaethonteae," in *Philologische Untersuchungen* (1885); F. Wieseler, *Phaethon* (1857); Wilamowitz-Möllendorff and C. Robert in *Hermes*, xviii. (1883); Frazer's *Pausanias*, ii. 59; S. Reinach, *Revue de l'hist. des religions*, lviii. (1908).

PHAGOCYTOSIS (Gr. φαγεῖν, to eat, devour, and κύτος, cell). Many cells of the body possess the property of engulfing particles, a character to be associated with their power of performing amoeboid movement. This property is termed *phagocytosis*. Primarily this phagocytic power was simply the means by which the cell took within its cell body food particles which were ultimately digested and assimilated. In the higher organisms, however, this property has been developed for different purposes, and in pathology at the present day a meaning wider than that above given is often included in the term. The particle having been taken into the cell, one of three things may happen. (1) The particle may consist of digestible material, in which case the cell secretes a digestive fluid, a food vacuole is formed, the particle is gradually dissolved by the secretion and the products absorbed into the cell substance. (2) The particle may be indigestible, in which case it is retained within the cell body for a time and ultimately discharged. The particle englobed may comprise almost any material, but if it is to serve as a food it must be of animal or vegetable origin. At the time of ingestion it may be dead or living. In the case in which it is living the organism is first killed and then digested, or (3) the organism may prove resistant, in which case it may multiply and finally destroy the cell, when a number of organisms are set free. This is one of the means by which, in the higher organisms, a local infection may become distributed through the organism. The digestion effected within a cell is fermentative in character. Thus a proteolytic ferment has been prepared from the bodies of amoebae—the ferment possessing fairly active properties both in acid, neutral or alkaline media, but especially in the latter.

In studying the process of phagocytosis generally much information may be gained as to its general characters by the study of the processes of intracellular digestion in the simpler Invertebrates, a study largely extended by Metchnikoff and his co-workers in the elaboration of Metchnikoff's view of the nature of immunity. Thus, to take an instance from the sponges. Food substances, in the form of minute organisms, which have penetrated the pores of the sponge are seized by the ciliated or amoeboid cells lining those spaces, and are then killed and digested. In this case also the process of digestion is proved to be fermentative. It is readily understandable that we should find such cells on the external surface of an organism or on the surface lining the alimentary tract, particularly in the latter position. But in addition there are many cells within the body in which phagocytic power is retained and markedly developed. Such cells may be fixed or wandering cells. They are employed for removing foreign material or debris which may occur within a tissue. For instance, as the result of an injury, inflammatory process, &c., cells and other structures of a tissue may be destroyed. One of the processes of repair consists in the removal of the resulting debris, which is effected by phagocytes. A similar process is seen with red blood corpuscles which may have escaped into a tissue through rupture of capillaries. Foreign particles accidentally gaining admission to a tissue are in many cases removed in a similar manner, *e.g.* soot particles which have passed through the respiratory surface are then largely removed by phagocytes and carried to the bronchial lymphatic glands. Very commonly living organisms effect an entrance through wound surfaces, the alimentary surface, &c., and one of the processes employed for their destruction and removal is that of phagocytosis.

As an illustration of the removal of foreign red blood corpuscles we may take the experiments of Metchnikoff in which a small drop of defibrinated blood of the goose was injected under the skin of a snail. The corpuscles quickly spread through the haemolymph of the snail, which by itself, however, effects no change in them. At the end of several hours examination shows that the leucocytes of the snail have englobed a large number of the red corpuscles. The following day intact corpuscles can still be found in the haemolymph, but the major number have already been devoured by the leucocytes. When taken up by a phagocyte the red corpuscle becomes round and its wall permeable. A vacuole is formed around the corpuscle, in which dissolved haemoglobin can be seen; a part of this haemoglobin also passes into the nucleus of the red corpuscle, proving that it too has been profoundly altered. Many of the nuclei are discharged. After some time the only parts of the corpuscle remaining are pieces of the nucleus and the peripheral layer of the corpuscle. Frequently the phagocytes, after having devoured one or several red corpuscles, themselves become a prey to their fellows. Analogous changes are observed in the tissues of a mammal when blood which has been extravasated is being removed, *e.g.* after a bruise. The first effect of the haemorrhage is an exudative inflammation, during which leucocytes arrive in large numbers and engulf the corpuscles. In the process of digestion which follows the haemoglobin is altered and new pigments formed from it. In mammals this pigment is dark red or brownish, in the pigeon it is green. Finally the corpuscles are completely digested. Analogous phenomena may be observed in connexion with the removal of cell débris resulting from any injury. Numbers of phagocytes may be found at work in this direction, for instance in the pus formed within an aseptic abscess. Hence we may regard the phagocytes as acting as the scavengers of the tissues.

In the instances we have been dealing with the phagocytes are chiefly of the class of wandering cells and are brought to the seat of their activity by the blood. In examining any tissue where the process is going on it is seen that the phagocytes have accumulated there in large numbers. They have been attracted to the damaged area. The mechanism which effects this attraction is a chemical one—chemiotaxis. At the seat of the change chemical substances are produced which act upon the phagocytes, causing them to migrate towards the source—positive chemiotaxis. Apparently the material dissolving from cell débris can act in this manner. Thus if a capillary tube filled with a tissue extract be inserted under the skin of an animal, within a short time it will be found to be surrounded with numbers of leucocytes, which may also have encroached into the tube itself. As in other instances of chemiotaxis the same chemical stimulus in a higher concentration may repel the cells—negative chemiotaxis. Instances of this are especially frequent in relation to micro-organisms and phagocytes, to which we may now turn.

That phagocytes can paralyse, kill and digest many micro-organisms is the main fact in Metchnikoff's theory of the nature of immunity. The reaction may be readily studied by injecting a small quantity of a fluid culture of some mildly pathogenic organism into the peritoneal cavity of an animal, and in the course of an hour or so examining a smear from the surface of the omentum, when an abundance of phagocytes enclosing the organism in different stages of digestion will be found. Or we may adopt Leishman's method, in which a few drops of human blood are diluted with saline solution and centrifuged. The layer of white corpuscles is pipetted off, suspended in serum, and a minute drop of a suspension of a pathogenic organism is added. The preparation is then incubated at 37° C. for a quarter of an hour. Upon examining a drop of this mixture a number of bacteria are found within the phagocytes. Thus this attack and destruction of bacteria by phagocytes may take place within the body or by cells removed from the body. Whether or no a phagocyte can engulf bacteria is dependent upon a number of factors—partly specific properties of the phagocyte, partly factors varying with the constitution of the body serum. Thus Wright and Douglas, employing Leishman's method, have proved that leucocytes do not take up bacteria freely unless the serum in which they are suspended contain opsonins. They found, for example, that leucocytes taken from a patient suffering from a pyococci infection if suspended in normal human serum take up the cocci abundantly, whereas if the same leucocytes are suspended under similar conditions in the patient's own serum the reaction may be almost absent. Further, leucocytes taken from a normal individual and suspended in the patient's serum are practically inactive, while the same phagocytes in normal serum are very active. Exactly how the substance in the serum acts is undecided, but it has been proved that there are in serum substances which become fixed to bacteria and which render them an easier prey to the phagocytes. This specific opsonin is used up when the bacteria are added to the serum, so that if the bacteria are subsequently removed the serum is no longer active. There is evidence too that there is a multiplicity of opsonins. As to the origin of the opsonins we have no certain evidence. It is suggested that they are a secretion from the leucocytes themselves and that it is an evidence of another and preliminary mode of attack possessed by the leucocyte, viz. the discharge of a secretion from the cell which is to damage or paralyse the bacterium and thus enable the phagocyte to engulf it.

The mechanism of destruction of a bacterium once it has been taken up by a phagocyte is probably, just as in the instance of dead cellular material, one of intracellular digestion. The bacterium before being engulfed is probably inert in most instances, though it may yet prove too strong for the phagocyte. The next stage we can trace is the formation of a vacuole around the organism, or, if the latter be large, around a part of the organism, and the part thus surrounded quickly shows signs of destruction. For instance, its staining reactions become weaker. When a part only of the organism is surrounded by a vacuole the part thus surrounded soon ceases to stain, while the remaining part stains normally, and we thus have a marked contrast evidencing the two stages.

In the next place we must ask which are the cells possessing phagocytic powers? Leaving apart the cells lining the alimentary tract (because we know practically nothing of their power in this respect) a number of free cells possess amoeboid properties as well as also a number of fixed cells. These latter are attached to certain spots of a tissue, but are capable of throwing out processes which can seize upon particles of foreign matter or even upon certain elements of the same organism. Of this category Metchnikoff distinguishes the nerve cells, the large cells of the spleen pulp and of lymph glands, certain endothelial cells, the neuroglia cells, and perhaps certain cells of connective tissues. All these elements can under certain conditions act as phagocytes, and with the exception of the nerve cells all are of mesoblastic origin. Those of greater importance on account of their greater activity in this respect are the large splenic and lymph cells, the neuroglia cells and certain endothelial cells. With regard to the wandering cells Metchnikoff considers that some are certainly non-phagocytic, for instance the lymphocytes. According to Metchnikoff it is only when these cells become older and have developed a nucleus rich in chromatin and an abundant cell body that these cells develop phagocytic properties. This is the large hyaline leucocyte. The polymorphonuclear and the eosinophil leucocyte are both phagocytes. Metchnikoff therefore divides the phagocytes into two classes—the microphages, comprising the polymorphonuclear and the eosinophil cell, and the macrophages, containing the large hyaline cell, the cell of the splenic pulp, the endothelial cell and the neuroglia cell. From further observation of these cells he concludes that the microphages are chiefly concerned in opposing the micro-organisms of acute infections, whereas the macrophages are chiefly concerned in combating chronic infections. It is the macrophage also which is concerned in removing cell débris, *e.g.* red corpuscles from a haemorrhage or the red corpuscles of another animal which may have been introduced experimentally.

Metchnikoff and his co-workers have shown that the two principal groups of leucocytes are generally spread throughout the vertebrates. Thus instances of each kind are found even in the lamprey, though here their staining properties are feebler; also cells which show but small differences from the analogous cells of mammals are found in the alligator. (T. G. Br.)

PHALANGER, a book-name applied to the more typical representatives of the group of diprotodont marsupial mammals, including the cuscuses of the Moluccas and Celebes, and the so-called opossums of Australia, and thus collectively the whole family Phalangeridae. (See MARSUPIALIA.)

Phalangers generally are small or medium-sized woolly-coated marsupials, with long, powerful, and often prehensile tails, large claws, and opposable nailless first hind toes. They seem in the day to be dull and sleepy, but are alert at night. They live mostly upon fruits, leaves and blossoms, although a few feed habitually upon insects, and all relish, in confinement, an occasional bird or other small animal. Several possess flying-membranes stretched between their fore and hind limbs, by the help of which they can make long and sustained leaps through the air, like flying-squirrels; but the possession of these flying-membranes does not seem to be any indication of special affinity, the characters of the skull and teeth sharply dividing the flying forms and uniting them with other species of the non-flying groups. The skull (see fig. 1) is, as a rule, broad and flattened, with the posterior part swollen out laterally owing to the numerous air-cells situated in the substance of the squamosal bones. The dental formula is very variable, especially as regards the premolars, of which some at least in each genus are reduced to functionless rudiments, and may even vary in number on the two sides of the jaw of the same individual. The incisors are always $\frac{3}{1}$, the lower one very large and inclined forwards, and the canines normally $\frac{1}{1}$, of which the inferior is always minute, and in one genus generally absent. The molars number either $\frac{3}{3}$ or $\frac{2}{2}$. All the species here discussed are included in the sub-family Phalangerinae, of which the distinctive features, as well as those of the family Phalangerinae, are referred to under Marsupialia.

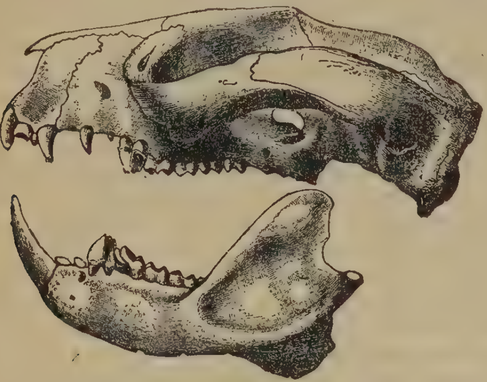


Fig. 1.—Skull of Grey Cuscus (*Phalanger orientalis*).

The most generalized representatives of the group appear to be the ring-tailed phalangers, constituting the genus *Pseudochirus*, which is common to Australia, Tasmania and New Guinea, and includes at least half a score of species. The dentition is generally *i.* $\frac{3}{2}$, *c.* $\frac{1}{0}$, *p.*+*m.* $\frac{7}{7}$, but one upper incisor and the canine may be wanting. The crowns of the molars show a crescentic structure, but they are said to retain the three primitive cusps, which are fused in the other genera. The prehensile tail has its tip naked for a short distance, and the whole of the terminal third and the under surface of the remainder short-haired, the tip being generally white. The hair is thick and woolly, and generally yellowish-olive in colour. These phalangers are the ring-tailed opossums of the Australians. From this genus is apparently derived the taguan flying-squirrel, or flying-phalanger (*Petauroides volans*), which ranges from Queensland to Victoria, and is the largest of the flying group. Its dentition is essentially similar to that of *Pseudochirus*, although there is one pair less of cheek-teeth, and the bushy tail is naked and prehensile at the tip. Reverting to the non-flying species, we have *Gymnobelideus leadbeateri*, a small animal from Victoria representing a genus by itself, with the same dental formula as *Pseudochirus*, but cheek-teeth of a different type, the ears naked (instead of hairy) behind, glands on the chest and between the ears, and the tail long and evenly bushy to the tip. From this are evidently derived the flying-phalangers—flying-squirrels—of the genus *Petaurus*, which differ merely in the possession of a parachute, and are represented by several species, ranging from Australia (exclusive of Tasmania) to the Aru Islands, New Guinea, and New Ireland. Of the yellow-bellied species, *P. australis*, the habits are described by J. Gould as follows: "This animal is common in all the brushes of New South Wales, particularly those which stretch along the coast from Port Philip to Moreton Bay. In these vast forests trees of one kind or another are perpetually flowering, and thus offer a never-failing supply of the blossoms upon which it feeds; the flowers of the various kinds of gums, some of which are of great magnitude, are the principal favourites. Like the rest of the genus, it is nocturnal in its habits, dwelling in holes and in the spouts of the larger branches during the day, and displaying the greatest activity at night while running over the small leafy branches, frequently even to their very extremities, in search of insects and the honey of the newly opened blossoms. Its structure being ill adapted for terrestrial habits, it seldom descends to the ground except for the purpose of passing to a tree too distant to be attained by springing from the one it wishes to leave. The tops of the trees are traversed by this animal with as much ease as the most level ground is by such as are destined for terra firma. If chased or forced to flight it ascends to the highest branch and performs the most enormous leaps, sweeping from tree to tree with wonderful address; a slight elevation gives its body an impetus which with the expansion of its membrane enables it to pass to a considerable distance, always ascending a little at the extremity of the leap; by this ascent the animal is prevented from receiving the shock which it would otherwise sustain."

A second species, *P. sciureus*, in some ways one of the most beautiful of all mammals, is shown in fig. 2.

A precisely similar relationship exists between the tiny feather-tailed phalanger, *Distoechurus pennatus*, of New Guinea, and the equally minute pigmy flying-phalanger or flying-mouse, *Acrobates pygmaeus*, of Queensland, New South Wales and Victoria; both being characterized by the hairs of the tail forming a vane on each side, as well as by tufts of long hairs at the base of the thinly-haired ears. There are six pairs of cheek-teeth, of which the last three are small and rounded, with blunted cusps, while the anterior teeth are sharp and of insectivorous type. The pigmy flying-phalanger feeds on honey from flowers and insects.

To some extent intermediate in structure between *Acrobates* and *Petaurus*, although without a parachute, are the beautiful little dormouse-phalangers, as typified by *Dromicia nana*, which range from Western Australia and Tasmania to New Guinea. They appear to be a generalized type, which has died out where they have come into competition with the more specialized forms. Although unable to fly they are exceedingly active, and take long leaps from bough to bough; externally they are characterized by their dormouse-like form, large, thin, and nearly naked ears, without tufts inside or at the base, sharp and rudimentary front claws and long sharp hind ones, and mouse-like tail, which is furry at the base, then scaly, and naked and prehensile at the tip. There may be either six or seven pairs of cheek-teeth, of which the hinder carry four small smooth cusps, and the first upper incisor is much longer than the other two. The striped phalangers (*Dactylopsila*) are larger animals, of the approximate size of a squirrel, easily recognized by the longitudinal yellow and black striping of the fur, and the slender and elongated fourth front toe. The typical *D. trivirgata* is common to north Australia and New Guinea, but *D. palpator*, which has the fourth toe still more elongated, is exclusively Papuan. They have seven pairs of cheek teeth, of which the four last are oblong and four-cusped; and the first lower incisor is longer than in any other phalanger. They apparently feed on both leaves and grubs, probably extracting the latter from crannies with the elongated toe. The tail is more or less bare on the under side of the tip.

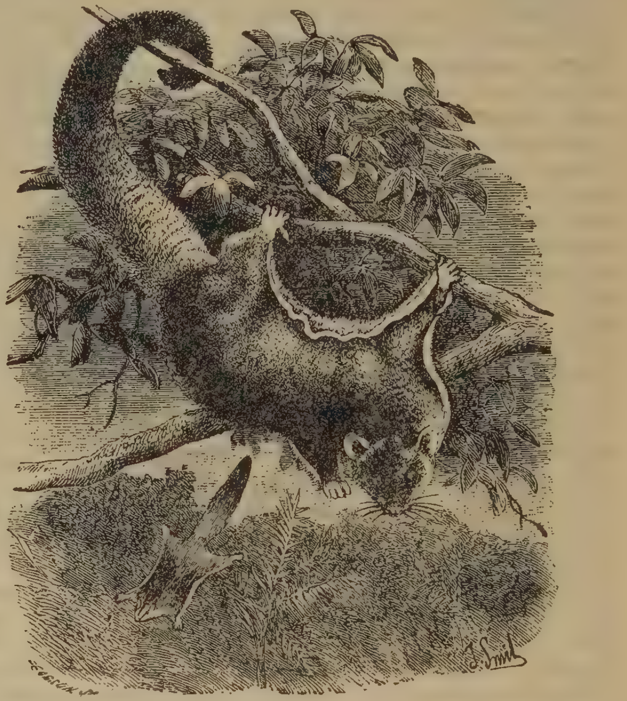


Fig. 2.—Squirrel Flying-Phalanger (*Petaurus sciureus*).

The last group of the sub-family is represented firstly by the cuscuses, or cususes (*Phalanger*), which are arboreal animals of the approximate size of cats, and range from the Solomon Islands through New Guinea and the Moluccas to Celebes, being, in fact, the only Old World marsupials found westwards of New Guinea. Externally they are characterized by their thick woolly fur, short or medium ears, which are hairy outside, and sometimes inside as well, by the naked and striated soles of the feet, and the long and markedly prehensile tail, of which the basal half is furred like the body, and the terminal half entirely naked. The number of cheek-teeth varies, owing to the frequent absence of some of the front ones, but there are generally seven pairs, of which the last four carry crescents internally and cusps externally. About ten species are known, of which the grey cuscus (*P. orientalis*) of Amboyna and Timor was discovered about 300 years ago, and was thus the first known Old World marsupial. In the spotted cuscus (*P. maculatus*) the males are marked with orange and white, while the females are uniformly greyish. Cuscuses are sleepy animals, feeding mainly on leaves, but also devouring birds and small mammals.

Nearly allied to the cuscuses are the typical Australian phalangers, or opossums, forming the genus *Trichosurus*. They differ from the cuscuses, among other features, by the thick and non-tapering tail being covered with bushy hair up to the extreme tip, which is naked, as is a narrow line along the middle of the terminal third (or rather more) of the lower surface, by the presence of a gland on the chest, and by the soles of the hind feet being hairy. In the skull the upper canine is separated from the outermost incisor, instead of close to it as in the cuscuses (fig. 1). The best-known species is the brush-tailed phalanger, or brush-tailed opossum (*T. vulpecula*), of Australia, an animal of the size of a small fox, represented in Tasmania by the brown phalanger (*T. vulpecula fuliginosus*). The short-eared phalanger (*T. canina*) represents the group in Southern Queensland and New South Wales. The dental formula in both is *i.* $\frac{3}{2}$, *c.* $\frac{1}{0}$, *p.* $\frac{3}{3}$, *m.* $\frac{3}{3}$. These animals are wholly arboreal and mainly nocturnal in their habits; and it is these which form the chief game in "opossum-shooting" among the gum-trees by moonlight.

The long-snouted phalanger is referred to under MARSUPIALIA.

(R. L.*)

PHALANX (Gr. φάλαγξ, of unknown origin), the name, in Greek history of the arrangement of heavy-armed infantry in a single close mass of spearmen (see ARMY: *History*). In anatomy, the Latin plural *phalanges* is the term applied to the bones of the finger and toe, and in botany to a group of united stamen clusters. The term "phalanx" was adopted by F. C. M. Fourier (*q.v.*) as the name of the socialistic community living in a "phalanstery."

PHALARIS, tyrant of Acragas (Agrigentum) in Sicily, *c.* 570–554 B.C. He was entrusted with the building of the temple of Zeus Atabyrius in the citadel, and took advantage of his position to make himself despot (Aristotle, *Politics*, v. 10). Under his rule Agrigentum seems to have attained considerable prosperity. He supplied the city with water, adorned it with fine buildings, and strengthened it with walls. On the northern coast of the island the people of Himera elected him general with absolute power, in spite of the warnings of the poet Stesichorus (Aristotle, *Rhetoric*, ii. 20). According to Suïdas he succeeded in making himself master of the whole of the island. He was at last overthrown in a general rising headed by Telemachus, the ancestor of Theron (tyrant *c.* 488–472), and burned in his brazen bull.

After ages have held up Phalaris to infamy for his excessive cruelty. In his brazen bull, invented, it is said, by Perillus of Athens, the tyrant's victims were shut up and, a fire being kindled beneath, were roasted alive, while their shrieks represented the bellowing of the bull. Perillus himself is said to have been the first victim. There is hardly room to doubt that we have here a tradition of human sacrifice in connexion with the worship of the Phoenician Baal (Zeus Atabyrius) such as prevailed at Rhodes; when misfortune threatened Rhodes the brazen bulls in his temple bellowed. The Rhodians brought this worship to Gela, which they founded conjointly with the Cretans, and from Gela it passed to Agrigentum. Human sacrifices to Baal were common, and, though in Phoenicia proper there is no proof that the victims were burned alive, the Carthaginians had a brazen image of Baal, from whose down-turned hands the children slid into a pit of fire; and the story that Minos had a brazen man who pressed people to his glowing breast points to similar rites in Crete, where the child-devouring Minotaur must certainly be connected with Baal and the favourite sacrifice to him of children.

The story of the bull cannot be dismissed as pure invention. Pindar (*Pythia*, i. 185), who lived less than a century afterwards, expressly associates this instrument of torture with the name of the tyrant. There was certainly a brazen bull at Agrigentum, which was carried off by the Carthaginians to Carthage, whence it was again taken by Scipio and restored to Agrigentum. In later times the tradition prevailed that Phalaris was a naturally humane man and a patron of philosophy and literature. He is so described in the declamations ascribed to Lucian, and in the letters which bear his own name. Plutarch, too, though he takes the unfavourable view, mentions that the Sicilians gave to the severity of Phalaris the name of justice and a hatred of crime. Phalaris may thus have been one of those men who combine justice and even humanity with religious fanaticism (Suïdas, *s.v.*; Diod. Sic. ix. 20, 30, xiii. 90, xxxii. 25; Polybius vii. 7, xii. 25; Cicero, *De Officiis*, ii. 7, iii. 6).

The letters bearing the name of Phalaris (148 in number) are now chiefly remembered for the crushing exposure they received at the hands of Richard Bentley in his controversy with the Hon. Charles Boyle, who had published an edition of them in 1695. The first edition of Bentley's *Dissertation on Phalaris* appeared in 1697, and the second edition, replying to the answer which Boyle published in 1698, came out in 1699. From the mention in the letters of towns (Phintia, Alaesa and Tauromenium) which did not exist in the time of Phalaris, from the imitations of authors (Herodotus, Democritus, Euripides, Callimachus) who wrote long after he was dead, from the reference to tragedies, though tragedy was not yet invented in the lifetime of Phalaris, from the dialect, which is not Dorian but Attic, nay, New or Late Attic, as well as from absurdities in the matter, and the entire absence of any reference to them by any writer before Stobaeus (*c.* A.D. 500), Bentley sufficiently proved that the letters were written by a sophist or rhetorician (possibly Adrianus of Tyre, died *c.* A.D. 192) hundreds of years after the death of Phalaris. Suïdas admired the letters, which he thought genuine, and in modern times, before their exposure by Bentley, they were thought highly of by some (*e.g.* Sir William Temple in his *Essay on Ancient and Modern Learning*), though others, as Politianus and Erasmus, perceived that they were not by Phalaris. The latest edition of the *Epistles* is by R. Hercher, in *Epistolographi graeci* (1873), and of Bentley's Dissertation by W. Wagner (with introduction and notes, 1883); see especially R. C. Jebb, *Life of Bentley* (1882).

PHALLICISM, or PHALLISM (from Gr. φαλλός), an anthropological term applied to that form of nature worship in which adoration is paid to the generative function symbolized by the phallus, the male organ. It is common among primitive peoples, especially in the East, and had been prominent also among more advanced peoples, *e.g.* the Phoenicians and the Greeks. In its most elementary form it is associated with frankly orgiastic rites. This aspect remains in more advanced forms, but gradually it tends to give place to the joyous recognition of the principle of natural reproduction. In Greece for example, where phallicism was the essence of the Dionysiac worship and a phallic revel was the origin of comedy (see also HERMES), the purely material and the symbolical aspects no doubt existed side by side; the Orphic mysteries had to the intellectual Greeks a significance wholly different from that which they had to the common people. Phallic worship is specially interesting as a form of sympathetic magic: observing the fertilizing effect of sun and rain, the savage sought to promote the growth of vegetation in the spring by means of symbolic sexual indulgence. Such were the rites which shocked Jewish writers in connexion with the worship of Baal and Astārōth (see BAAL, and cf. ATARGATIS, ISHTAR). The same principle is at the root of the widespread nature worship of Asia Minor, whose chief deity, the Great Mother of the Gods (*q.v.*), is the personification of the earth's fertility: similarly in India worship is paid to divine mothers. Generally it should be observed that phallic worship is not specially or perhaps primarily paid to male deities, though commonly the more important deity is accompanied by a companion of the other sex, or is itself androgynous, the two symbols being found together.

In the Dionysiac rites the emblem was carried at the head of the processions and was immediately followed by a body of men dressed as women (the *ithyphalli*). In Rome the phallus was the most common amulet worn by children to avert the evil eye: the Latin word was *fascinum* (cf. Pliny, *Nat. Hist.* xix. 50, *satyrica signa*; Varro, *Ling. Lat.* vii. 97, ed. Müller). Pollux says that such emblems were placed by smiths before their forges. Before the temple of Aphrodite at Hierapolis (*q.v.*) were two huge phalli (180 ft. high), and other similar objects existed in all parts of the ancient world both in statuary and in painting. Among the Hindus (see HINDUISM) the phallus is called *linga* or *lingam*, with the female counterpart called *yoni*; the *linga* symbolizes the generative power of Siva, and is a charm against sterility. The rites classed together as *Sakti puja* represent the adoration of the female principle. In Mexico, Central America, Peru and other parts of America phallic emblems are found. The tendency, however, to identify all obelisk-like stones and tree-trunks, together with rites like circumcision, as remains of phallic worship, has met with much criticism (*e.g.* Robertson Smith, *Religion of the Semites*, 2nd ed., pp. 456 sqq.).

For authorities see works quoted under RELIGION: §§ A and B *ad fin.*

PHALTAN, a native state of India, in the central division of Bombay, ranking as one of the Satara jagirs. Area, 397 sq. m.; pop. (1901), 45,739, showing a decrease of 31% in the decade. The estimated revenue is £13,000, and the tribute £640. The chief, whose title is nimbalkar, is a Mahratta, tracing his descent to a grantee from a Delhi emperor in the 14th century. The town of Phaltan is 37 m. north-east of Satara; pop. (1901), 9512.

PHANARIOTES, a name derived from Phanar, the chief Greek quarter at Stamboul, where the oecumenical patriarchate is situated, and applied to those members of families resident in the Phanar quarter who between the years 1711 and 1821 were appointed hospodars of the Danubian principalities; that period of Moldo-Wallachian history is also usually termed the Phanariote epoch. It is not to be understood as marking the introduction into the principalities of the Greek element, which had already established itself firmly in both provinces, to both of which Greek princes had been appointed before the 18th century. But whereas the Greek families of earlier introduction gradually became merged in their country of adoption, the later immigrants retained their separate nationality and grew to be powerful agents for furthering the spread of Graecism in the principalities. The person raised to the princely dignity was usually the chief dragoman of the Sublime Porte, and was consequently well versed in contemporary politics and the statecraft of the Ottoman government. The new prince, who was compelled to purchase his elevation with a heavy bribe, proceeded to the country which he was selected to govern, and of the language of which he was in nearly every case totally ignorant, accompanied by a horde of needy hangers-on; he and his acolytes counted on recouping themselves in as short a time as possible for their initial outlay and in laying by a sufficiency to live on after the termination of the prince's brief authority. It was the interest of the Porte to change the princes as often as possible, as the accession donation thus became due more frequently. When, owing to the numerous cases of treachery among the princes, the choice became limited to a few families the plan was hit upon of frequently shifting the prince from one province to the other: the prince of Wallachia, the richer of the two principalities, was always ready to pay a handsome *douceur* to avert his transfer to Yassy; the prince of Moldavia was equally ready to bribe his supporters at Constantinople to secure his appointment to Wallachia. To raise funds to satisfy the rapacity of the Porte the princes became past masters in the art of spoliation, and the inhabitants, liable to every species of tax which the ingenuity of their Greek rulers could devise, were reduced to the last stage of destitution. The active part taken by the Greek princes in the revolt of 1820–21 induced the Porte to revert to the appointment of native princes.

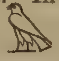
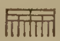
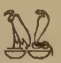
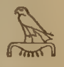
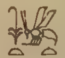
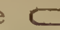
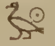
PHANIAS, of Eresus in Lesbos, Greek philosopher, important as an immediate follower of and commentator on Aristotle, came to Athens about 332 B.C., and joined his compatriot, Theophrastus, in the Peripatetic school. He wrote works entitled *Analytica, Categoriae* and *De interpretatione*, which were either paraphrases or critical commentaries, and seem to have added little to Aristotle's own writings. Alexander of Aphrodisias refers to a work πρὸς Διόδωρον, and Athenaeus quotes from another treatise, *Against the Sophists.* Outside philosophy, he and Theophrastus carried on the physical investigations of Aristotle; Athenaeus frequently quotes from a work on botany which manifests great care in definitions and accuracy of observation. From Plutarch (*Life of Themistocles*) we learn that he was regarded as an historian of importance. The chief of his historical works is the *Prytaneis Eresii*, which was either a history of his native place or a general history of Greece arranged according to the period of the Eresian magistracy. He wrote also works on the *Tyrants of Sicily* and on tyranny in general. The value of these books is attested by the frequency with which they are quoted on questions of chronology (*e.g.* by Plutarch, Suïdas, Athenaeus). To the history of Greek literature he contributed works on the poets and on the Socratics, both of which are quoted.

He must be distinguished from another Phanias, a Stoic philosopher, disciple of Posidonius. Diogenes Laërtius mentions a work of his wherein he compares Posidonius with Panaetius in arguing from physical principles.

PHANOCLES, Greek elegiac poet, probably flourished about the time of Alexander the Great. His extant fragments show resemblances in style and language to Philetas, Callimachus and Hermesianax. He was the author of a poem on paederasty. A lengthy fragment in Stobaeus (*Florilegium*, 64) describes the love of Orpheus for the youthful Calaïs, son of Boreas, and his subsequent death at the hands of the Thracian women. It is one of the best extant specimens of Greek elegiac poetry.

See N. Bach, *Philetae, Hermesianactis, et Phanoclis reliquiae* (1829); L. Preller, *Ausgewählte Aufsätze aus dem Gebiete der classischen Alterthumswissenschaft* (1864).

PHANTASMAGORIA, a name invented by a certain Philipstal in 1802 (from Gr. φάντασμα, phantasm, apparition; and ἀγορά, assembly) for a show or exhibition of optical illusions produced by means of the projecting lantern (*q.v.*). The word has since been applied to any rapidly or strikingly changing scene, and especially to a disordered or fantastic scene or picture of the imagination.

PHARAOH (Par'oh), the Hebraized title of the king of Egypt (*q.v.*), in Egyptian Per-'o; Pheron in Herodotus represents the same. Its combination with the name of the king, as in Pharaoh-Necho, Pharaoh-Hophra, is in accordance with contemporary native usage: the name of the earlier Pharaoh Shishak (Sheshonk) is rightly given without the title. In hieroglyphic a king bears several names preceded by distinctive titles. In the IVth Dynasty there might be four of the latter: (1)  identifying him with the royal god Horus; the name is commonly written in a frame  representing the façade of a building, perhaps a palace or tomb, on which the falcon stands. (2)  connecting him with the vulture and uraeus goddesses, Nekhabi and Buto of the south and north. (3)  a hawk on the symbol of gold, signifying the victorious Horus. (4)  the old titles of the rulers of the separate kingdoms of Upper and Lower Egypt, to be read *stni*, "butcher(?)" and *byti*, "beekeeper(?)" The personal name of the king followed (4), and was enclosed in a cartouche  apparently symbolizing the circuit of the sun which alone bounded the king's rule. Before the IVth Dynasty the cartouche is seldom found: the usual title is (1), and (3) does not occur. In the Vth Dynasty the custom began of giving the king at his accession a special name connecting him with the sun: this was placed in the cartouche after (4), and a fifth title was added: (5)  Si-rē, "son of the Sun-god," to precede a cartouche containing the personal name. The king was briefly spoken of by his title *stni* (see 4), or *ḥnm-f*, "his service," or *Ity*, "liege-lord." These titles were preserved in the sacred writing down to the latest age. An old term for the royal palace establishment and estate was Per-'o, "the Great House," and this gradually became the personal designation of Pharaoh (cf. the Grand Porte), displacing all others in the popular language. (F. Ll. G.)

PHARI, a town of Tibet. It is supposed to be the highest and coldest town in the world, being 15,000 ft. above the sea. As it commands the road between the Chumbi Valley and Lhasa and also one of the chief passes into Bhutan, Phari is of considerable military importance, and is defended by a large fort or Jong, which was occupied by the British expedition of 1904. Phari Jong is supposed to have been built about 1500 A.D., and was enlarged or rebuilt in 1792, under Chinese advice, as a defence against the British. It has the appearance of a medieval castle, and seems to have been built in imitation of the European style.

PHARISEES, a sect of the Jews first mentioned by Josephus, in his account (*Ant.* xiii. 5, 9) of the reign of Jonathan, the brother and successor of Judas Maccabaeus. The name, which may be translated "Separatists," indicates their devotion to the ideal, enforced by Ezra and Nehemiah upon the reluctant Jews, of a nation separate from all other nations in virtue of its peculiar relation to Yahweh (Neh. ix.). This ideal nation consisted of all who were prepared to obey the Law of Moses, irrespective of their natural descent. Consequently the Pharisees, who seem to have been an order of religious teachers, were concerned to make converts (proselytes), and some of their greatest teachers were of non-Jewish parentage. They were also concerned to insist upon the strict observance of the Law, so far as it was compatible with the exigencies of ordinary life, and to train disciples who should set a proper example to the mass of the people.

The ideal of separation descended from the Great Synagogue (Assembly) of the time of Ezra to the Synagogue of the Ḥasidaeans (Assidaeons), who allied themselves with Judas Maccabaeus when his followers decided to suspend the law of the Sabbath, in order that the true Jews might preserve themselves from annihilation and survive to keep the Law as a whole. This action of the Ḥasidaeans is clearly the practical outcome of the principle which Josephus describes in the language of philosophy as the characteristic of the Pharisees—"some things and not all are the work of Fate" (*Ant.* xiii. 5, 9). Fate is the Stoic term for God; and these forerunners of the Pharisees judged that the time had come for them to take action rather than to wait passively on God. But then and always the prime concern of the Pharisees was the extension of God's sovereignty (the Kingdom of God) throughout the world. God's will, which all men should obey, was revealed in the Law, and though He might appoint governors over them, He remained their King, and no governor who was not a prophet—God's mere mouthpiece—could command their unquestioning obedience. When Judas reconquered Jerusalem and re-dedicated the desecrated Temple, his work, from the Pharisees' point of view, was done. The Temple-worship was part and parcel of the Divine plan, and a legitimate High Priest was necessary. Alanius was, therefore, welcomed by the Ḥasidaeans, and only his treacherous murder of sixty of their number taught them that any Syrian nominee was their enemy. Later they acquiesced in the election of Simon to the high-priesthood with the condition "until there should arise a faithful prophet"; but some of them remonstrated against the combination of the sacred office with the position of political ruler in the person of John Hyrcanus as contrary to the precedent set by Moses at his death. When Alexandra came to the throne the Pharisees were the real rulers and imposed upon the people the deductions from the written Law which formed the growing body of their oral tradition. Their reign was long enough to establish this tradition in respect of ritual, and even when this golden age—as it seemed to later Scribes—was over they exercised a paramount influence upon the common people. They had learned to read God's will in the events of history, and deduced (for example) the doctrine of the resurrection of the dead from the death of the martyrs under Antiochus Epiphanes and Alcimus. And what they learned from current history and from the ancient history of the nation recorded in Scripture they taught in the synagogues, which corresponded not merely to the parish churches but also to the schools—day schools and Sunday schools—of to-day. Apart from their control of public education, their power was enhanced by their efforts to better the position of women, and by their notorious leniency in the matter of punishments. Everything—the repeated statements of Josephus and the facts of Jewish history after A.D. 70—goes to show that the Pharisees moulded the religion of the people. Attempts have been made in modern times to represent the Apocalyptists as opposed to the Pharisees and as occupying the position in popular estimation which Josephus ascribes to the Pharisees. But for such representations there is no solid ground. Superficially the language of apocalypses differs from that of rabbinic decisions, and where the seer takes a comprehensive view of the ages the rabbi legislates for particular cases. But even in the Talmud the reign of Alexandra is described in apocalyptic language such as is commonly applied to the future age, and if allowance be made for the symbolism proper to revelations it is clear that essentially the scribe and the seer have the same purpose and even the same doctrines. The Pharisees were occupied with the piecemeal realization of the dreams of their supposed opponents, which gain a vague glory from their being far off.

The gospels generally have left upon the minds of men an impression unfavourable to the Pharisees. They contain denunciations attributed to our Lord and assigned—with obvious injustice in some cases—to the scribes of this sect. It is to be remembered that the Pharisees were the only sect of the Jews who survived in Christian times and that the Pharisees were never a homogeneous body possessed of a definite policy or body of doctrine. Moreover it is clear that our Lord denounced not all the Pharisees but the hypocrites only, as did the rabbis whose sayings are reported in the Talmud and other Jewish books. Again the third gospel in particular betrays relations between the Pharisees and Jesus very different from those of the common Christian view, which conjures up an impossible picture of an absolute breach between the Prophet of Nazareth and the whole corporation of the Pharisees as a result of a quarrel with certain members of that dissident sect of independent thinkers. Gamaliel and his pupil St Paul are better representatives of the non-hypocritical Pharisee; and the Pauline Epistles or the writings of Philo are the best extant examples of the manner and matter of their teaching. As for the denunciations, apart from the charge of insincerity, it appears that the scribes in question are pilloried for the defects—or the excesses—of their qualities. Indeed they are corroborative evidence for the reverence with which the Pharisees were regarded by the people generally, and for the zeal with which they strove to fulfil God's will as contained in the Law and elucidated by the Tradition. (J. H. A. H.)

PHARMACOLOGY. Systematic writers on the subject differ considerably in the exact meaning which they attach to the term pharmacology (φάρμακον, a drug; λόγος, a discourse), some making it much more comprehensive than others. Binz, for instance, defines it as treating of the origin, nature, chemical and physical qualities, physiological actions, and therapeutical uses of drugs; in France and in Italy it is restricted to the mere description of medicines and their preparations, the action and uses of which as remedies are included in the term therapeutics. In English-speaking countries, and by the majority of German writers, the meaning is now restricted to the study of the action of chemical substances (as apart from foods) on all kinds of animals, from bacteria up to man; it is, in fact, a comparative study of the action of chemical bodies on invertebrate and vertebrate animals. One of its practical aims is to obtain a wide and accurate knowledge of remedial substances in relation to their application in the treatment of disease, while another is to discover new or improved remedies. This meaning of the word has now become fixed in the English language by use and wont. The term pharmaco-dynamics (φάρμακον, δύναμις, power), which is etymologically more correct, is often used as its equivalent, but it has never become widely adopted. The study of pharmacological actions was at first almost entirely confined to those of remedial agents, and especially to the remedies in the different national pharmacopoeias, but in many cases it has now been extended to substances which are not used for curative purposes. The introduction into practical use of many medicines, such as paraldehyde, phenazone and strophanthus, has followed the study of their actions on animals, and this tends to be more and more the case. Pharmacology is a branch of biology; it is also closely connected with pathology and bacteriology, for certain drugs produce structural as well as functional changes in the tissues, and in germ diseases the peculiar symptoms are caused by foreign substances (toxins) formed by the infective organisms present in the body. The effects of many of these toxins bear a close resemblance to the action of certain well-known drugs, as in the case of tetanus toxin and strychnine, and are studied by the same methods of observation and research. It is impossible also to dissociate pharmacology from clinical therapeutics; the former investigates the agents which are used in the treatment of disease, the latter is concerned with their remedial powers and the conditions under which they are to be used. Hence the word "pharmaco-therapy" has come into use, and most of the newer standard textbooks combine together the consideration of pharmacology and therapeutics. Pharmacology is also related to toxicology, as many remedial and other agents are more or less poisonous when given in large doses, but it does not include the detection, tests, and the other strictly medico-legal aspects of poisoning.

History.

Pharmacology proper began as the result of the application of strictly experimental methods to physiology. The discovery (early in the 19th century) that plants owe their remedial and poisonous qualities to small quantities of definite active principles, such as alkaloids and neutral bodies, which can be extracted in a chemically pure condition, had also a very important effect on its development. We meet first with experiments made by investigators who perceived that observations on man and animals might lead to a better understanding of the action of drugs. In 1676 Wepfer and Conrad Brunner demonstrated on dogs the tetanizing action of nux vomica, and similar rough experiments were repeated from time to time with other substances by later investigators. In 1755 Menghini published an elaborate study of the action of camphor on a great variety of different kinds of animals. Albert von Haller (b. 1708) sought to elucidate the action of remedies by observations on healthy men, and in 1767 William Alexander made experiments on himself with drugs, which were, however, brought to an abrupt termination by his nearly killing himself. In 1776 Daries, by observations on himself and on cats, established the mydriatic action of belladonna and other atropaceous plants. Hitherto no attempt had been made to determine what particular parts of the body were especially affected by drugs, but Fontana showed, in his great work (Florence, 1765) on the venom of the viper and on other poisons, that the general symptoms were brought about by an action on particular organs. He performed more than six thousand experiments, more than four thousand of which were on animals, and he determined the effects on the heart and other important structures. These analytical methods of research were well known to the second Monro in Edinburgh, and to his pupils, one of whom, William Alexander, wrote a thesis in 1790 entitled "De partibus corporis animalis quae viribus opii parent." His methods were doubtless known also to the French physiologist Magendie, who improved upon them, and who in 1809 published a research on the Upas Tieuté and other strychnine-containing plants, in which he showed that their effects were due to an action on the spinal cord. The researches of his pupil, Claude Bernard, on curare, were equally exact and logical, and have served as the model for many subsequent investigations. In consequence, from the time of Magendie pharmacology may be said to have been put on a more exact basis. By the middle of the 19th century there were many workers on the subject, and the actions of such drugs as digitalis, morphine, alcohol, and many others had been frequently and minutely investigated. About this time Buchheim, professor of materia medica in Dorpat from 1846 to 1879, founded the first pharmacological laboratory on modern lines in Europe, and he introduced a more rational classification of drugs than had hitherto been in use, arranging them in groups according to their pharmacological actions. In the herbals and older treatises on materia medica and therapeutics no explanation is usually offered of the action of medicines, and in such works as that of Cullen (1789) only a few of the more obvious actions are occasionally explained according to the current theories of physiology and pathology. In works such as Pareira's *Elements of Materia Medica and Therapeutics* (1842), the physiological effects of medicines are usually described, but very briefly as compared with the materia medica. At the present day most textbooks dealing with medicinal agents and treatment devote a large part of their space to pharmacology, and a corresponding change has taken place in the teaching of the subject in universities and medical schools. Since Magendie's time numerous papers dealing with pharmacological subjects have appeared in the *Journal of Anatomy and Physiology*, the *Journal of Physiology*, Virchow's *Archiv*, and the principal medical periodicals of all countries. In 1873 the *Archiv für experimentelle Pathologie und Pharmakologie* first appeared, in 1895 the *Archives Internationales de Pharmakodynamie*, and in 1909 *The Journal of Pharmacology and Therapeutics* (published at Baltimore, U.S.A.), all of which are chiefly or entirely devoted to pharmacology.

Action of Drugs.

The methods of research are essentially those employed by physiologists, the action of substances being studied in the usual way on bacteria, leucocytes, frogs, rabbits and other animals. Not only are the general symptoms investigated, but it is necessary to carry out experiments on the nerves, muscles, circulation, secretions, &c., so as to get a more exact knowledge of the reasons of the general action. It is true that many of these animals react somewhat differently to drugs, both as regards each other and as regards man, but for the most part the differences are quantitative rather than qualitative. After carrying out a series of observations on animals, the drug can be assigned to its special group, and a good idea can be obtained of its possible practical value or the reverse; hence there is a saving of time and an avoidance of the necessity of testing its effects on man. The action of a drug may be called direct when it acts on any part to which it is immediately applied, or which it may reach through the blood; and indirect when one organ is affected secondarily to another, as, for instance, in strychnine poisoning when the muscles are violently contracted as the result of the action of the alkaloid upon the spinal cord. In a few cases the action is merely physical, but most frequently it is chemical in its nature, and is exerted on the living cell, the activity of which is either stimulated or depressed. In some cases the substances actually enter into a chemical combination with the protoplasm, which may be temporary or (much less frequently) permanent; in other cases they seem simply to modify or disturb the usual chemical activity of the cells. Prolonged or excessive stimulation invariably leads to depression or paralysis, the tissues becoming fatigued, and from this condition they may recover or they may not. When we come to consider more in detail the results of these actions we find that the various secretions of the body, such as the sweat, gastric juice, bile, milk, urine, &c., may be increased or diminished; that the heart may have its muscular or nervous apparatus stimulated or depressed; that the nerve-centres in the brain, medulla and spinal cord may be rendered more sensitive or the reverse; and that the general metabolism of the body may be altered in various ways. In addition, the fluid constituents, such as the lymph and blood, may have their composition and bulk considerably altered, while the special senses, the temperature, and, in short, every function and tissue, may be more or less affected.

Some drugs given in excess are poisons to all forms of protoplasm, but when given in doses much short of the lethal they usually exhibit a distinct tendency to affect specially, and at an early period, certain organs or tissues, and hence result differences in action; others may act only on certain organs, leaving the others practically untouched. It is often possible by appropriate dosage to contrive that these special parts or organs may be affected and the rest of the body left practically intact, and it is by taking advantage of these selective actions that remedial or therapeutical effects are usually obtained. Some substances have a very wide range of action, and involve a great variety of structures, while others, such as purgatives, have a very limited sphere. The action of drugs is often modified by circumstances peculiar to the individuals or animals to whom they are administered. In man the most important of these circumstances is age, but speaking broadly this is really a question of bulk, the child being affected like the adult, but by smaller doses. There are exceptions to this, however, as children are more affected in proportion by opium and some other substances, and less by mercury and arsenic. In old age also the nervous system and the tissues generally do not react so readily as in youth. Habit, race, personal temperament, emotional conditions, disease, the time and circumstances of administration, and other accidental causes may also modify the action in man. Some species of animals are much more susceptible to the action of certain drugs than others, a condition which depends on obvious or unknown structural or metabolic differences. In the same way some individuals show a special tendency to poisoning by doses of certain drugs which are harmless to the great majority of mankind, and hence we get unexpected or unusual results, these arising from special susceptibility on the part of certain organs. These idiosyncrasies are not confined to drugs, but are seen with a few articles of food, such as eggs and shellfish. It is well known that the habitual consumption of certain drugs, such as tobacco, Indian hemp, opium, arsenic, alcohol and many others, gradually induces a condition of tolerance to their effects, so that large doses can be taken without causing symptoms of poisoning. In all cases, however, there is a limit, and after it is reached the ordinary effects of these substances are seen. Some individuals, however, never become tolerant, and show poisonous effects on each repetition of the dose. The degree of tolerance often differs in individuals at different times and in different circumstances, and may become lost by breaking off the habit for a short time. The explanation generally given is that the nerve and other cells become accustomed to the drug, so that they cease to react, or that an antitoxin is formed which antagonizes the poison, or that the poison is rapidly destroyed in the body. Recent researches on arsenic and atropine, however, point to the leucocytes as playing an important part in the production of tolerance, as these gradually become capable of ingesting large amounts of the foreign substances, and thus render them more or less harmless to the tissues, until they are gradually excreted from the body. When the amount is too large to be dealt with by the leucocytes, poisoning seems to occur even in the most habituated. Tolerance is therefore analogous to, but not identical with, the immunity which takes place with the toxins of infectious diseases and snake poison. Certain substances, notably digitalis, lead, mercury and strychnine, exhibit what is called a cumulative action—that is to say, when small quantities have been taken over a period of time, poisoning or an excessive action suddenly ensues. The explanation in these cases is that the drug is absorbed more rapidly than it is excreted, hence there is a tendency to accumulation in the body until a point is reached when the amount becomes poisonous.

Bodies which have a close resemblance in their chemical constitution exhibit a similar resemblance in their pharmacological action, and as the constitution of the substance becomes modified chemically so does its action pharmacologically. Numerous researches have demonstrated these points with regard to individual groups of substances, but hitherto it has not been possible to formulate any fixed laws regarding the relationship between chemical constitution and physiological action.

When drugs are swallowed no absorption may take place from the alimentary canal; but, as a rule, they pass from there into the blood. Absorption may also take place from the skin, from the rectum, from the respiratory passages, or from wounds, and from direct injection into the subcutaneous tissue or into a blood vessel. Very rarely, as in the case of silver salts, excretion does not take place; but usually the drug is got rid of by the ordinary channels of elimination. Just as drugs act upon the tissues, so they themselves are in many cases reacted upon, and broken up or altered. While in the alimentary canal they are subjected to the action of the digestive fluids and the varied contents of the stomach and intestines, and after absorption they come under the influence of the constituents of the blood and lymph, and of the chemical action of the tissue cells. Inorganic bodies, such as metals, may enter into albuminous combinations which may greatly modify their effects, and organic substances may be split up into simpler compounds by oxidation or reduction, or may be rendered more complex by synthesis.

The antagonism between certain drugs has been much studied in relation to their use as antidotes in poisoning, the aim being to counteract the effects rather than to obtain a direct physiological antagonistic action. Substances which directly antagonize each other by acting on the same tissue are few in number, but there are numerous instances in which the effects or symptoms may be obviated by acting on another tissue. Thus curare may stop strychnine convulsions by paralysing the terminations of motor nerves, and chloroform may exercise the same effect by abolishing the irritability of the spinal cord. If two poisons act on the same tissue, one stimulating and the other paralysing it, the paralysing substance removes the action of the stimulant substance, not by bringing the tissue back to its normal state, but by abolishing its excitability; hence, although life may be saved by such an action, yet it can only be so within certain limits of dosage, because the antagonism is never complete at every point.

Speaking in the widest sense, every substance has an action on living protoplasm, but for convenience pharmacological substances have come to be limited to those which are used as drugs, or which have a distinct action upon the animal organism. Such substances are derived from (1) the chemical elements and their compounds; (2) plants; and (3) animals. The first class includes such substances as iodine, mercury, iron, carbon, and their various compounds, and such bodies as alcohol, chloroform and chloral, all of which are found in nature or can be prepared by ordinary chemical processes of manufacture. From plants many substances are obtained which at the present time we are unable to make in the chemical laboratory, and of the constitution or composition of which we are in many cases ignorant. Some of these, such as resins, gums, essential oils and fats, are readily obtained as natural exudations or by very simple manipulations, while others, such as the alkaloids, glucosides and vegetable acids, often require to be extracted by very complex processes. Substances obtained from animals include gland secretions, pepsin and other ferments, musk, cod-liver oil, &c., and to these may be added various antitoxins. The classification of substances having pharmacological actions presents so many difficulties that no satisfactory or universally adopted method has yet been proposed. Our knowledge presents so many gaps, and the mode of action of many remedies is so obscure and imperfectly understood, that any arrangement adopted must be more or less tentative in character. The close alliance between pharmacology, therapeutics and clinical medicine has induced many authors to treat the subject from a clinical point of view, while its relationships to chemistry and physiology have been utilized to elaborate a chemical and physiological classification respectively as the basis for systematic description. Certain writers in despair have adopted an alphabetical arrangement of the subject, while others have divided it up into inorganic, vegetable and animal substances. These last-mentioned methods are far behind our present state of knowledge, and need not be discussed here. The objection to a strictly chemical classification is, that while many substances closely allied chemically have a somewhat similar action in certain respects, yet in others they differ very widely—a striking example of which is given in the case of sodium and potassium. A physiological classification according to an action on the brain, heart, kidney or other important organ becomes still more bewildering, as many substances produce the same effects by different agencies, as, for instance, the kidneys may be acted upon directly or through the circulation, while the heart may be affected either through its muscular substance or its nervous apparatus. A clinical or therapeutical classification into such divisions as anaesthetics, expectorants, bitters, and so on, according to their practical applications, also leads to difficulties, as many drugs are employed for numerous purposes. The ideal method of grouping pharmacological substances would be in reference to their chemical action on living protoplasm, but as yet our knowledge is too scanty for this. At the present time the method adopted by Buchheim, or some modification of it, is the most scientific. As the result of painstaking investigations he grouped together all those substances having similar actions, giving to each group the name of its best-known or most thoroughly investigated member. Once the groups were more or less fixed any new substance could, when

Classification.

its action was determined, be referred to its own group, and thus be placed or classified. As few substances are absolutely identical in action, but only broadly similar, it is often difficult to divide sharply one group from another. In a *résumé* it is manifestly impossible to pass in review every pharmacological substance, and we shall therefore confine ourselves to those groups which are of practical importance. Many individual drugs are described under their own headings.

GROUP I. *Acids.*—This includes sulphuric, hydrochloric, nitric, phosphoric, tartaric, citric, acetic and lactic acids, all of which owe their action to their acidity. Many of the other acids, such as carbolic and salicylic, have specific effects which have no relationship to their acid reaction. The concentrated acids have an intense local action, varying from complete destruction of the tissues to more or less irritation. When considerably diluted they are only slightly irritating; externally applied and in the stomach they have an antiseptic action; they increase the secretion of saliva, and thus assuage thirst. In the intestine they combine with ammonia and other alkalis present, and are absorbed into the blood as neutral salts, being excreted chiefly in the urine. In small doses they somewhat increase general metabolism. Boric acid only belongs partially to this group, as it and its compound borax have certain specific actions in addition.

GROUP II. *Alkalis.*—This includes caustic potash, caustic soda, solution of ammonia, their carbonates and bicarbonates, borax, soaps, lithium carbonate and citrate, quicklime, slaked lime, chalk, magnesia and magnesium carbonate. All these substances, apart from any other actions, exert a similar effect upon the body in virtue of their alkalinity. When they are taken internally in small amounts they neutralize the acids in the stomach and other parts of the alimentary canal, and at the same time they increase the normal acid secretion of the stomach. After absorption into the blood, which they make somewhat more alkaline, they are excreted chiefly in the urine, to which they impart an alkaline reaction if given in sufficient quantity. Some of them by stimulating the kidney cells act as diuretics, but others apparently lack this action. Caustic potash and caustic soda are locally very irritating, and destroy the tissues, but lose this quality when combined with acids as in the case of their carbonates, bicarbonates and borax. Quicklime is also caustic, but magnesia is bland and unirritating. Weak solutions applied locally saponify fats, soften the epidermis, and thus act as slight stimulants and cleansers of the skin. Calcium salts form insoluble soaps with fats, and combine with albumen in a manner which makes them soothing and astringent rather than irritating. Apart from alkaline effects, these metals differ considerably pharmacologically. Potassium and lithium have a depressing action upon the nervous system, ammonium salts have a stimulating action, while sodium practically speaking is indifferent. Calcium and magnesium have actions somewhat similar to that of potassium. Most of these substances are normal constituents of the body, and indispensable for healthy existence. They are contained in sufficient amount in our ordinary dietary to supply the needs of the organism.

GROUP III. *Easily absorbed Salts.*—Sodium chloride may be taken as the type of those salts which diffuse readily, and are therefore easily absorbed. Sodium nitrate, potassium nitrate, potassium chloride, ammonium chloride, the alkaline iodides and bromides, also belong partly to this group, although most of them have also specific actions. Locally they cause considerable irritation, and when swallowed in concentrated solution may cause vomiting. From the stomach and intestines they are rapidly absorbed, and rapidly excreted from the blood, increasing all secretions and the general metabolism. These effects are apparently due to their irritating action upon individual cells.

GROUP IV. *Salts absorbed with difficulty.*—This group includes the sulphates of sodium, potassium and magnesium, the acetate and tartrate of potash, citrate of magnesium, sodium phosphate, sodium tartrate and similar salts. Locally their action is slight, but when taken internally, dissolved in water, they are not absorbed from the alimentary canal except in very limited amount. They therefore remain for the most part in the intestine, and as they attract and retain large quantities of water, and at the same time slightly stimulate the mucous membrane, they come to have a purgative action and form the well-known group of saline cathartics. The small portion which is absorbed exerts a diuretic action.

GROUP V. *Heavy Metals.*—These include iron, manganese, aluminium, chromium, zinc, copper, silver, gold, platinum, lead, mercury, and probably antimony, arsenic and bismuth. Although some of these differ very greatly in their actions after absorption, still locally they have certain effects in common due chiefly to their chemical action on albumen. Their soluble salts combine with albumen and preserve it, strong solutions being extremely irritant or caustic, while weaker ones are astringent simply, or even soothing. They are all antiseptics. Their insoluble compounds are much less active locally than the soluble, and in many cases are only effective to the extent to which they are dissolved by the secretions. Some metals are only absorbed from the alimentary canal to such a very limited amount that they exert no general action, while others readily pass into the blood and give rise to more or less marked effects. All of them injected into the blood in large doses act as muscle and nerve poisons, and during their excretion by the kidney usually irritate it severely, but only a few are absorbed in sufficient amount to produce similar effects when given by the mouth. When iron is injected directly into a vein it depresses the heart's action, the blood pressure and the nervous system, and during its excretion greatly irritates the bowel and the kidneys. When taken by the mouth, however, no such actions are seen, owing to the fact that very minute quantities are absorbed and that these become stored in the liver, where they are converted into organic compounds and ultimately go to form haemoglobin. Soluble salts of manganese, aluminium, zinc, copper, gold, platinum and bismuth have, when given by the mouth, little action beyond their local astringent or irritating effects; but when injected into a blood vessel they all exert much the same depressing effect upon the heart and nervous system. Silver resembles them closely, but differs by the circumstance that it is deposited permanently in minute granules in the tissues, and, without affecting the general health, stains the skin of a bluish colour (argyria). Mercury and lead are absorbed from the bowel in considerable quantities, and are capable of inducing acute irritant poisoning as well as chronic poisoning. Lead poisons the muscular and nervous systems, and gives rise to paralysis, wasting, colic and other symptoms, while in the case of mercury, tremors, salivation, anaemia and very marked cachexia are induced. Arsenic and antimony do not form combinations with albumen, but they both greatly depress the central nervous system and circulation; and, if their action be long continued in large doses, they cause fatty degeneration of the viscera and disappearance of glycogen from the liver. Locally they are both very irritating, and antimony has a special tendency to cause vomiting.

GROUP VI. *Halogens.*—This group includes iodine, bromine and chlorine, in their free state or as compounds. Locally they are all three strongly irritant or caustic, owing to their chemical action on albumen. They are in addition powerful germicides, and by splitting up water may act as oxidizing agents. Owing to their strong affinity for the hydrogen of organic compounds they often act as bleachers and deodorizers. Iodine has a special interest, as it is a necessary constituent of food, and is present in the secretion of the thyroid gland. Apart from certain conditions of ill health, the iodides, as such, have no very marked influence on the healthy body beyond their saline action. Alkaline bromides, in addition to their saline action, have in sufficient doses a depressing effect upon the central nervous system, and less markedly upon the heart. Chlorine compounds are not known to exercise any action of a similar kind.

GROUP VII. *Sulphur.*—Sulphur itself has no action, but when brought into contact with the secretions it forms sulphides, sulphites and sulphuretted hydrogen, and thereby becomes more or less irritant and antiseptic. In the bowel its conversion into sulphides causes it to act as a mild laxative. Baths containing sulphuretted hydrogen or alkaline sulphides have a slightly irritating effect upon the skin, and stimulate the general metabolism.

GROUP VIII. *Phosphorus.*—This includes phosphides, and, according to some authorities, hypophosphites. Phosphorus is present in all cells, in considerable quantity in the nervous tissue, and in the bones as phosphates. It is therefore, in some form or other, a necessary part of dietary. When taken by the mouth phosphorus is an irritant poison in large doses; in small doses the only effects noticeable consist in an increased formation of bony and connective tissue, although it is also supposed to exert a gently stimulating effect upon the nervous system.

GROUP IX. *Oxygen.*—When pure oxygen is inhaled the only effect is a slight increase of the amount of the gas in the blood, but this has no particular physiological effect. The pharmacological action of hydrogen peroxide (H_2O_2), potassium permanganate, powdered charcoal and some other oxidizing agents depends on the readiness with which they give up oxygen.

GROUP X. *Carbonic Acid.*—Carbonic acid gas, carbonic oxide (CO) and some other irrespirable gases produce their effects practically by asphyxiation. When dissolved in water, however, carbonic acid gas is a gentle stimulant to the mouth, stomach and bowel, the mixture being absorbed more rapidly than plain water; hence its greater value in assuaging thirst. Nitrous oxide (laughing gas) was at one time believed to act simply by cutting off the supply of oxygen to the tissues, but it also has a specific effect in producing paralysis of certain parts of the central nervous system, and hence its value as an anaesthetic; when given in small amounts mixed with air it produces a condition of exhilaration.

GROUP XI. *Water.*—Water acts directly as a diluent and solvent. It therefore increases all the secretions, especially those of the skin and kidneys, while it also stimulates the general metabolism of the body and the excretion of nitrogenous products. Mineral waters act in the same way, but their effects are very much modified by, and depend largely upon, other constituents, such as alkaline salts, iron, arsenic, sulphides, carbonic acid, &c.

GROUP XII. *Tannic Acid.*—Tannic acid is present in small quantities in the great majority of plants, but in notable quantity in gall-nuts, oak bark, bearberry leaves, rhatany root, catechu, kino, red gum, bael fruit, logwood and witch hazel, all of which are largely used as medicines. In these the variety of tannic acid is not exactly the same, but although there are slight chemical differences, they all possess the power of tanning raw hides and of preserving albuminous tissues. The action of tannic acid is strictly local, and depends upon its power of precipitating albumen and of destroying germs. It thus acts as an astringent on all mucous membranes. After absorption into the blood it loses this effect, as it is partly broken up into gallic acid and partly combined with alkalis, both of which changes nullify its action upon albumen.

Group XIII. *Local Irritants.*—Although some of the drugs already considered have a local irritant action, they produce other more important effects, but the substances here ranged under this heading depend entirely for their action on their local irritant effects.

a. Those which act upon the alimentary canal: Simple bitters such as quassia wood, columbo root, taraxacum, gentian, chiretta, and many others, irritate gently the mucous membrane of the stomach and bowels, and by increasing the secretions improve the appetite and digestion. The aromatic bitters such as chamomile flowers, cascarilla bark, hops, orange peel and others contain in addition small quantities of essential oils which increase their local action. The active principles in some of these bitters have been isolated pure, and have been found to be alkaloids or neutral compounds. Substances like pepper, cayenne pepper, mustard, horse-radish and ginger irritate the stomach and bowel much in the same way, but are more pungent, and are consequently used as condiments. Some of these have a similar but less marked effect upon the skin. The large number of vegetable substances used as purgatives owe their action to an irritating effect upon the mucous membrane and the neuro-muscular apparatus of the bowel, whereby the secretions and peristalsis are more or less increased, as the result of which diarrhoea ensues. Some of them cause so much irritation that the discharge is very watery (hydragogue cathartics), while others, for example aloes, by acting gently on the lower part of the bowel and on its muscular coat, produce simply a laxative effect. A few of them, such as aloin and colocynthin, are also purgative when injected subcutaneously or into the blood, probably owing to their being excreted into the intestinal canal.

b. Those which act on the skin: The best known of these is cantharides (Spanish fly), the active principle of which is a colourless crystalline body—cantharidin—which is extremely irritating. On a mucous membrane or a delicate skin it exerts an irritant action, which occurs more quickly than on a thickened epidermis, such as the scalp, and according to the strength and period of application there may result redness, a blister, or an ulcer. Many other substances, such as chrysarobin, mustard, pepper, &c., are also capable of irritating the skin, the effect produced varying from mere dilatation of the cutaneous vessels to destruction of tissue.

Group XIV. *Male-fern.*—This includes the male-fern, santonin, cusso, pomegranate bark, pumpkin seeds and many other substances containing active principles which have a specific poisonous action on intestinal parasitic worms. Apart from this their actions vary considerably, but are of little practical importance.

Group XV. *Ethereal Oils.*—This includes a very large number of substances which owe their action to the fact that they contain ethereal or essential oils. The best known of these are cloves, pimento (allspice), myrtle, eucalyptus, caraway, fennel, dill, coriander, rosemary, lavender, peppermint, spearmint, nutmeg, cinnamon, sandal-wood, turpentine, juniper berries, valerian and sumbul. In this group may be included the oleo-resins, such as copaiba, cubebs and Canada balsam; the gum-resins, such as asafetida, myrrh, ammoniacum and galbanum; and the true balsams, such as benzoin, storax, balsam of Tolu and balsam of Peru. The resins when taken internally have much the same action as essential oils, which are closely allied chemically, while the benzoic and cinnamic acids in the balsams modify their actions very slightly. Although individual essential oils may differ somewhat in action, chemically and pharmacologically they are fundamentally similar. They all have a poisonous action on protoplasm, which makes them useful in medicine as antiseptics, disinfectants, germicides, anti-fermentatives and parasiticides; when locally applied they are more or less irritating, and, when very dilute, astringent. When swallowed in small doses they slightly irritate the mouth and gastric mucous membrane, increasing the secretions and producing a feeling of warmth. At the same time they increase the movements of the stomach, and also in this way hasten digestion, an action which extends to the upper part of the bowel. They are readily absorbed into the blood, and they are excreted chiefly by the kidneys in a more or less altered form, and probably also by the different mucous membranes, and even by the skin. After absorption their action, speaking generally, is exerted on the brain and spinal cord, and is at first slightly stimulant and afterwards depressing, even to the causing of sleepiness and stupor. Locally applied they depress the terminations of sensory nerves, and may thereby lessen pain. On the heart and circulation the effects are stimulant unless large doses are given, when the pulse becomes slow and blood-pressure much lessened. During excretion they irritate the kidneys and the sweat-glands, and thereby increase the excretion of urine and of sweat. They also increase the number of leucocytes in the blood, and the more irritating of them increase the flow of blood to the pelvic organs, and may thus stimulate the uterus, or in large doses cause abortion. The various camphors, such as laurel camphor, Borneo camphor, menthol and cumarin, are oxidized derivatives of essential oils, and differ only superficially from them in their action.

Group XVI. *Phenol.*—This includes a very large number of bodies chemically allied to benzol, such as carbolic acid, sulphocarbolates, creosote, wood tar, coal tar, oil of cade, thymol, salicylic acid, benzoic acid, naphthol, hydroquinon, cresol, guaiacol, ichthyol, saccharin and many others. These all resemble carbolic acid more or less closely, and may be described as general protoplasm poisons. Locally their destructive and irritating effects vary a good deal, but even when very dilute they all have a marked poisonous action on bacteria, white blood corpuscles, yeast and similar organisms. After absorption most of them exercise a depressing effect upon the nervous system, and are capable of reducing high temperature. They are mostly excreted in the urine.

Group XVII. *Alcohol.*—This group also includes a very large number of chemical bodies, only a few of which are mentioned here. Ethyl alcohol is taken as a type of the action of methyl alcohol, amyl alcohol, propyl alcohol, ether, acetic ether, paraldehyde, sulphonal, chloroform, methyl chloride, ethyl chloride, chloral hydrate, butylchloral hydrate, and almost any number of derivatives from these. Some of them are so volatile that they produce their effects when inhaled, others when sprayed upon the skin cause intense cold and then anaesthesia; but taken in the broadest sense the action of all of them after absorption into the blood is very similar, and is exerted upon the central nervous system, more especially the cerebrum. In all cases there is a longer or shorter period of excitement, followed by intoxication or narcosis, and with large doses this passes into paralysis and death from depression of the respiratory centre or of the heart. Small doses of any of them dilate the blood vessels from an action on the vaso-motor centre in the medulla oblongata, as a result of which the heart beats more rapidly and the blood circulates more freely; but larger doses have a general depressing effect upon the circulatory system. Under their action more heat is lost from the body, the general metabolism is diminished and the temperature falls. With some of them, such as chloral and chloroform, the stimulation period is short compared with the narcotic period, while with others, such as ether, the reverse is the case.

Group XVIII. *Nitrites.*—This group contains amyl nitrite, ethyl nitrite, methyl nitrite, nitroglycerin, sodium and potassium nitrites, erythrol-tetranitrate, and many other compounds containing nitrous or nitric acid. The latter becomes reduced to nitrous in the body, and thereby exercises its characteristic effects. These consist chiefly in an action upon non-striped muscle, vasomotor centres, blood vessels and the blood. When they are given by inhalation or by the mouth their first effect is to produce marked dilatation of the small arteries, with a fall of blood-pressure and a greatly increased rapidity of the heart's action. At the same time the non-striped muscles slightly lose their tonicity, and when very large doses are given the haemoglobin of the blood becomes converted into the chocolate-coloured methaemoglobin. The volatile members of the group act much more rapidly and more transiently than the others.

Group XIX. *Alkaloids.*—This embraces a very large number of important pharmacological substances, which differ a good deal in the details of their action, but they all act upon muscle and nerve tissue. Some of them affect only certain portions of the nervous system, others have a much wider range of action; they may act in either case as stimulants or as depressants, and hence the symptoms produced by them vary very greatly.

1. Morphine and the other opium alkaloids (codeine, narcotine, laudanine, &c.) have two prominent actions–a narcotic followed by a tetanic action. In morphine, on the higher animals at least, the narcotic action is very marked, the tetanizing action slightly so; while in thebaine there is little narcotic effect, but a tetanizing action like that of strychnine. Morphine exercises its effects chiefly upon the cerebrum and the medulla oblongata in man. It has in addition a markedly depressing action upon the respiratory centre, it lessens all the secretions except the sweat, and diminishes bowel peristalsis and the size of the pupil. Men are much more affected by it than birds, rabbits, dogs and most other animals. Cats, however, show marked symptoms of cerebral excitement and increase of the reflexes. Compared with morphine, codeine and the other alkaloids are only slightly narcotizing.

2. Strychnine and brucine very closely resemble each other in action, and under this heading curarine may also be included. These bodies stimulate the grey matter in the spinal cord and cause tetanic convulsions. In the case of curare these are masked almost at once by paralysis of the terminations of the motor nerves.

3. Caffeine is the active principle in tea, coffee, kola, maté and guarana; while theobromine, a body closely allied to it, is found in cocoa and chocolate. They both stimulate the grey nerve-cells in the brain and cord, this being the foundation of their dietetic value and their use as nervine stimulants. They also markedly increase the secretion of urine by stimulating the secreting cells of the kidneys.

4. Cocaine is the active principle of the coca leaf, which is chewed

as a stimulant-narcotic in Peru and Bolivia. Small doses excite the nervous system, while larger doses are depressing. The chief action of cocaine from a practical point of view is its power of paralysing the terminations of sensory nerves.

5. Atropine, hyoscyamine, homatropine, duboisine, daturine and some other bodies have a paralysing action upon the ends of the motor and secretory nerves. They therefore lessen all the secretions, and among other actions dilate the pupil and increase the rapidity of the heart by paralysing the vagus. In addition they have a stimulating action on the central nervous system.

6. Nicotine, piturine and lobeline are the active principles of tobacco and other substances which are smoked as stimulant narcotics. In large doses they are powerful nerve poisons, but as usually taken they exercise a gently stimulant effect upon the nervous system. Pilocarpine has an action closely allied to that of nicotine, but as it is much less poisonous (the effects produced by small doses being chiefly excessive sweating and salivation), it is capable of being utilized in medicine. Muscarine has a very close resemblance in action to pilocarpine.

7. Physostigmine, the active principle of the Calabar bean, acts chiefly as a stimulant to voluntary and involuntary muscles, and at the same time exercises a depressing effect upon the spinal cord. It contracts the pupil.

8. Conine, gelseminine and sparteine all exert a paralysing effect on the terminations of the motor nerves, to the implication of which the weakened gait and other symptoms are due.

9. Aconitine, delphinine and many of their derivatives have a very widespread depressing action on muscle and nerve.

10. Apomorphine is essentially a muscle poison, but owing to the fact that minute doses stimulate the vomiting centre and cause emesis before any other symptoms are observable, its emetic action is the most prominent effect in man.

11. Emetine acts as a gradual depressant to the nervous system in animals. In man its chief effect is its emetic action, which seems to be due entirely to local irritation of the stomach.

12. Quinine. Several of the other alkaloids found in cinchona bark act very much like quinine. They all depress the conducting power and the grey matter of the spinal cord, and to a much less extent that of the brain. They lessen the general metabolism and lower febrile temperature. The cinchona alkaloids have a specifically poisonous effect on the parasites of malaria when present in human blood, and are poisonous to all low organisms.

13. Phenacetin, acetanilide, phenazone and many similar bodies act as antipyretics in virtue of an action on the heat-regulating centres in the cerebrum.

GROUP XX. *Digitalis.*—This group-name has been given to a large number of substances which have an action similar to that of the foxglove leaves, including the active principles of strophanthus, squill, *Urechites suberecta*, *Convallaria majalis*, *Nerium Oleander*, *Helleborus niger*, *Antiaris toxicaria* (the upas tree), and several others. The active principles of these vary a good deal in chemical composition, but they are all non-nitrogenous neutral bodies. Their action is exerted upon muscle, and chiefly upon the muscle of the heart and blood vessels. The individual muscle-fibres contract and expand more perfectly, and thus the diastole and systole of the heart are rendered more complete, the pulse is slowed, and the blood-pressure is raised. The slowing of the heart is partly brought about by an action on the vagus centre.

GROUP XXI. *Picrotoxin.*—In large doses the action of picrotoxin is exerted chiefly on the medullary nerve centres, whereby irregular tonic-clonic convulsions are produced; in minute doses it stops the secretion of sweat.

GROUP XXII. *Saponin.*—Saponin and many allied bodies form an abundant soapy-looking froth when shaken up with water, and they are contained in a very large number of plants, the chief of which are the *Quillaia saponaria*, *Polygala senega*, sarsaparilla, and others, known collectively as soapworts. They all act as local irritants in the alimentary canal, and after absorption are more or less depressing to the muscular and nervous systems. They produce slight nausea and increased secretion of mucus.

GROUP XXIII. *Cyanogen.*—This includes compounds of cyanogen such as hydrocyanic (prussic) acid, cyanides of potassium, sodium, &c., cherry-laurel water, amygdalin, bitter almonds and other chemical and vegetable substances which readily yield hydrocyanic acid. Hydrocyanic acid is a general protoplasmic poison, all the lower organisms being very susceptible to its action, while in the higher animals it speedily depresses or paralyses all forms of nerve tissue. It enters into combination with haemoglobin, forming a bright scarlet compound and interfering with respiration. It kills by its paralysing effect on the motor ganglia of the heart and on the respiratory centre.

GROUP XXIV. *Ferments.*—These include such bodies as pepsin, diastase, the pancreatic ferments, papain, the pine-apple ferment, taka-diastase and others, and serve to convert starch into saccharine substances, or albumen into peptone and albumoses.

GROUP XXV. *Animal Glands and Secretions.*—Of these the thyroid gland, the suprarenal bodies, the spleen, the bile, the bone marrow, the ovaries and some others have been investigated fully. Speaking generally, when given in small doses their action on the healthy organism is slight or nil, but in disease some of them are capable of acting as substitutes for deficient secretions.

GROUP XXVI. *Antitoxins.*—These are substances which antagonize the toxins formed in the body by pathogenic organisms, the toxins of snake venom and other animal poisons, and vegetable toxins such as abrin, ricin, &c. A healthy person can be rendered insusceptible by gradually accustoming him to increasing doses of these poisons, and this immunity is due to antitoxins which are found in the blood-serum and which are products of the blood cells. The nature of these antitoxic substances is not definitely known, but they combine with and destroy the poisons. In specific germ diseases a similar antitoxin forms, and in cases which recover it counteracts the toxin, while the germs are destroyed by the tissues. Antitoxins can be prepared by immunizing a large animal, such as a horse, by injecting gradually increasing doses of specific toxins into its subcutaneous tissue. In due time the horse is bled, the serum is filtered free of blood corpuscles, and then constitutes the antitoxic serum, which can be standardized to a certain potency. Such serums are injected subcutaneously in diphtheria, tetanus, streptococcic infections, plague, snake-poisoning, cholera and other similar diseases. They do not as a rule harm healthy men even in large quantities, but when repeated they often cause serious symptoms due to the body becoming more sensitive to the action of the horse-serum in which they are contained.

GROUP XXVII. *Neutral Fats.*—This includes cod-liver oil, almond oil, olive oil, lard, &c., all of which act as foods when taken internally, and have a merely physical emollient action when applied externally. Lanolin, linseed oil, wax, spermaceti, &c., also belong to this group. The paraffins, glycerin and vaseline, although not fats, have much the same effect when applied externally, but they are not nutritive.

GROUP XXVIII. *Sugars, Starches, Gums, Gelatin, &c.*—Although these and allied bodies are used in various ways as remedies, their action is for the most part purely mechanical or dietetic.

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(R. S.*)

Terminology in Therapeutics.

It may be useful to give here a general explanation of the common names used in the therapeutic classification of drugs. It is convenient to divide drugs and other substances used in medicine into groups according to the part of the system on which they chiefly act, though, as stated above, many drugs act in more than one manner and could come under several groups.

I. Drugs acting on the blood vessels, which either dilate the vessels when taken internally or applied locally, or contract the superficial arterioles. *Irritants* (Lat. *irritare*, to excite) include: *Rubefacients* (Lat. *rubefacere*, to make red), which cause the skin to become red from dilatation of the blood vessels; *Vesicants* (Lat. *vesica*, a bladder), which irritate sufficiently to cause the blood-serum to exude and form vesicles or blisters, *e.g.* cantharides; *Pustulants* (Lat. *pustula*, a blister), still more powerful in their effects, causing the blisters to become filled with pus, *e.g.* croton oil. *Escharotics* (Gr. ἐσχάρα, hearth, brazier; hence mark of a burn, "scar") or *Caustics* (Gr. καιειν, to burn), cause the death of the part, *e.g.* silver nitrate and nitric acid. The term *counter-irritant* is used when an irritant is applied to the skin for the purpose of relieving pain or congestion by dilating the superficial vessels. Drugs which contract the vessels and diminish exudation comprise *Astringents* (Lat. *astringere*, to draw close), while *Styptics* (στύφειν, to contract) or *Haemostatics* (Gr. αἷμα, blood, στατικός, causing to stand) are substances applied either locally or internally in order to arrest bleeding; cold, adrenalin, ergot and the per-salts of iron may be taken as examples.

II. Drugs acting on the digestive tract. *Sialogogues* (Gr. σίαλον, spittle, ἀγωγός, leading) increase the flow of saliva, *e.g.* mercury; *Antisialogogues* decrease the flow, *e.g.* belladonna. *Aromatics* (Gr. ἄρωμα, spice) or *Bitters* increase the flow of the gastric juice. *Stomachics* (Gr. στόμαχος) have the same effect. The term *Carminatives* (Lat. *carminare*, to card wool), adopted from the old medical theory of humours, is generally applied to pungent substances which help to expel gas from the stomach by stimulating the movement of its contents. *Emetics* (Gr. ἔμετος, vomiting) are substances given for the purpose of causing vomiting, *e.g.* ipecacuanha or apomorphine. *Anti-emetics* or *Sedatives* (Lat. *sedare*, to compose) arrest vomiting either by their central or local action, *e.g.* opium, cocaine or cerium oxalate. *Purgatives* (Lat. *purgare*, to cleanse) aid the onward passage of the contents of the intestinal canal, either by increasing the contractions of its muscular coat as *laxatives* (Lat. *laxare*, to loosen), *e.g.* as magnesia, or by increasing the flow of fluid. Some are termed *drastics* (Gr. δραστικός, active) or *cathartics* (Gr. καθαρτικός, cleansing), which produce watery evacuations. *Cholagogues* (Gr. χολή, bile, ἀγωγός, leading) are purgatives which act by increasing the flow of bile, either by causing an increased secretion (*e.g.* podophyllum) or by sweeping it onwards by stimulating the intestinal contractions (*e.g.* calomel).

III. Drugs acting on parasites. *Anthelmintics* (Gr. ἀντί, against, ἕλμινς, ἕλμινθος, a worm) are drugs which kill parasites inhabiting the intestine. The term *vermicide* (Lat. *vermis*, worm, *caedere*, to kill) is applied to drugs which directly kill the entozoa, while *vermifuge* (Lat. *vermis*, worm, *fugare*, to put to flight) is applied to the purgative usually given after the vermicide for the purpose of expelling the worm. *Parasiticides* or *anti-parasitics* destroy parasites; the terms are usually restricted to those acting on skin-parasites as contrasted with intestinal ones.

IV. Drugs acting on the urinary system. *Diuretics* (Gr. διά, through, οὖρον, the urine) increase the flow of urine, while *lithontriptics* (Gr. λίθος, stone, τρίβειν, to rub, grind down) are drugs given to prevent the formation of urinary calculi.

V. Drugs acting on the generative system. *Aphrodisiacs* (Gr. Ἀφροδίτη, the goddess of love) increase the action of the generative centre in the spinal cord; *Anaphrodisiacs* decrease its action. *Ecbolics* (Gr. ἐκβάλλειν, to throw out) or *oxytocics* (Gr. ὀξύς, sharp, quick, τόκος, parturition) stimulate uterine action. *Emmenagogues* (Gr. ἔμμηνα, menses, ἀγωγός, leading) are substances which increase the menstrual flow. *Galactogogues* (Gr. γάλα, milk) increase the secretion of milk, while *antigalactogogues* (*e.g.* belladonna) have the opposite effect.

VI. Drugs acting on the respiratory system. *Expectorants* increase the bronchial secretions; *antispasmodics* relax the spasm of the muscular coat of the bronchial tubes, *e.g.* stramonium. This latter term is also used for drugs which act as general depressants.

VII. Drugs or substances acting on the bodily heat. *Antipyretics* (Gr. ἀντί, against, πυρετός, fever) either increase the heat loss or diminish its production; *e.g.* phenacetin, cold water, &c.

VIII. Drugs or substances acting on the skin. *Diaphoretics* (Gr. διαφορεῖν, to carry through) increase the amount of sweat, either by acting directly on the sweat centres or on the nerve terminals. The word *Sudorific* (Lat. *sudor*, sweat) is applied to them when they act very powerfully. *Anhidrotics* or *Antihidrotics* (Gr. ἱδρώς, sweat) diminish the secretion of sweat. *Emollients* (Lat. *mollis*, soft) are substances which soften and protect the parts. Demulcents (Lat. *demulcere*, soften), soothe the skin or mucous membrane.

IX. Drugs acting on metabolism. *Alteratives* are drugs which alter the course of a disease, the mode of action being unknown. *Tonics* are drugs which increase the muscular tone of the body by acting either on the stomach, heart, spinal cord, &c.

X. Drugs acting on the blood. *Antitoxins* are organic products designed to neutralize the formation of the toxins of certain diseases in the blood. *Toxins* are also injected in order to stimulate the blood plasma to form antitoxins (see BACTERIOLOGY). *Antiperiodics* inhibit a disease having periodic recurrences; *e.g.* quinine in malaria. *Haematinics* are drugs which increase the amount of haemoglobin in the blood.

XI. Drugs acting on the nervous system. *Anaesthetics* (*q.v.*) diminish sensibility, either central or peripheral; *Anodynes* (Gr. ἀν-, priv., ὀδύνη, pain) relieve pain only, but, as in *Analgesics* (Gr. ἄλγησις, sense of pain), sensibility is unaltered. *Stimulants* are those which lead to excitation of the mental faculties and in quantity may lead to delirium and incoherence. *Hypnotics* (Gr. ὕπνος, sleep) or *Soporifics* (Lat. *sopor*, a deep sleep) are drugs which produce sleep without causing cerebral excitement. *Narcotics* (Gr. νάρκη, numbness) are those which besides producing sleep may in large doses depress the functions of respiration and circulation.

XII. Drugs which arrest the progress of putrefaction. This is either by inhibiting the growth of micro-organisms (*Antiseptics*) or by destroying them when present (*Disinfectants*). (H. L. H.)

PHARMACOPOEIA (lit. the art of the φαρμακοποιός, or drug-compounder), in its modern technical sense, a book containing directions for the identification of simples and the preparation of compound medicines, and published by the authority of a government or of a medical or pharmaceutical society. The name has also been applied to similar compendiums issued by private individuals. The first work of the kind published under government authority appears to have been that of Nuremberg in 1542; a passing student named Valerius Cordus showed a collection of medical receipts, which he had selected from the writings of the most eminent medical authorities, to the physicians of the town, who urged him to print it for the benefit of the apothecaries, and obtained for his work the sanction of the senatus. An earlier work, known as the *Antidotarium florentinum*, had been published under the authority of the college of medicine of Florence. The term "pharmacopoeia" first appears as a distinct title in a work published at Basel in 1561 by Dr A. Foes, but does not appear to have come into general use until the beginning of the 17th century. Before 1542 the works principally used by apothecaries were the treatises on simples by Avicenna and Serapion; the *De synonymis* and *Quid pro quo* of Simon Januensis; the *Liber servitoris* of Bulchasim Ben Aberazerim, which described the preparations made from plants, animals and minerals, and was the type of the chemical portion of modern pharmacopoeias; and the *Antidotarium* of Nicolaus de Salerno, containing Galenical compounds arranged alphabetically. Of this last work there were two editions in use—Nicolaus magnus and Nicolaus parvus; in the latter several of the compounds described in the larger edition were omitted and the formulae given on a smaller scale.

Until 1617 such drugs and medicines as were in common use were sold in England by the apothecaries and grocers. In that year the apothecaries obtained a separate charter, and it was enacted that no grocer should keep an apothecary's shop. The preparation of physicians' prescriptions was thus confined to the apothecaries, upon whom pressure was brought to bear to make them dispense accurately, by the issue of a pharmacopoeia in May 1618 by the College of Physicians, and by the power which the wardens of the apothecaries received in common with the censors of the College of Physicians of examining the shops of apothecaries within 7 m. of London and destroying all the compounds which they found unfaithfully prepared. This, the first authorized *London Pharmacopoeia*, was selected chiefly from the works of Mezue and Nicolaus de Salerno, but it was found to be so full of errors that the whole edition was cancelled, and a fresh edition was published in the following December. At this period the compounds employed in medicine were often heterogeneous mixtures, some of which contained from 20 to 70, or more, ingredients, while a large number of simples were used in consequence of the same substance being supposed to possess different qualities according to the source from which it was derived. Thus crabs' eyes, pearls, oyster-shells and coral were supposed to have different properties. Among other ingredients entering into some of these formulae were the excrements of human beings, dogs, mice, geese and other animals, calculi, human skull and moss growing on it, blind puppies, earthworms, &c. Although other editions of the *London Pharmacopoeia* were issued in 1621, 1632, 1639 and 1677, it was not until the edition of 1721, published under the auspices of Sir Hans Sloane, that any important alterations were made. In this issue many of the ridiculous remedies previously in use were omitted, although a good number were still retained, such as dogs' excrement, earthworms, and moss from the human skull; the botanical names of herbal remedies were for the first time added to the official ones; the simple distilled waters were ordered of a uniform strength; sweetened spirits, cordials and ratifias were omitted as well as several compounds no longer used in London, although still in vogue elsewhere. A great improvement was effected in the edition published in 1746, in which only those preparations were retained which had received the approval of the majority of the pharmacopoeia committee; to these was added a list of those drugs only which were supposed to be the most efficacious. An attempt was made to simplify further the older formulae by the rejection of superfluous ingredients. In the edition published in 1788 the tendency to simplify was carried out to a much greater extent, and the extremely compound medicines which had formed the principal remedies of physicians for 2000 years were discarded, while a few powerful drugs which had been considered too dangerous to be included in the *Pharmacopoeia* of 1765 were restored to their previous position. In 1809 the French chemical nomenclature was adopted, and in 1815 a corrected impression of the same was issued. Subsequent editions were published in 1824, 1836 and 1851.

The first *Edinburgh Pharmacopoeia* was published in 1699 and the last in 1841; the first *Dublin Pharmacopoeia* in 1807 and the last in 1850.

The preparations contained in these three pharmacopoeias were not all uniform in strength, a source of much inconvenience and danger to the public, when powerful preparations such as dilute hydrocyanic acid were ordered in the one country and dispensed according to the national pharmacopoeia in another. In consequence of this inconvenience the Medical Act of 1858 ordained that the General Medical Council should cause to be published a book containing a list of medicines and compounds, to be called the *British Pharmacopoeia*, which should be a substitute throughout Great Britain and Ireland for the separate pharmacopoeias. Hitherto these had been published in Latin. The first *British Pharmacopoeia* was published in the English language in 1864, but gave such general dissatisfaction both to the medical profession and to chemists and druggists that the General Medical Council brought out a new and amended edition in 1867. This dissatisfaction was probably owing partly to the fact that the majority of the compilers of the work were not engaged in the practice of pharmacy, and therefore competent rather to decide upon the kind of preparations required than upon the method of their manufacture. The necessity for this element in the construction of a pharmacopoeia is now fully recognized in other countries, in most of which pharmaceutical chemists are represented on the committee for the preparation of the legally recognized manuals.

National pharmacopoeias now exist in the following countries: Austria, Belgium, Chile, Denmark, France, Germany, Great Britain, Greece, Holland, Hungary, India, Japan, Mexico, Norway, Portugal, Russia, Spain, Sweden, Italy, Switzerland, the United States of America and Venezuela. All the above-mentioned were issued under the authority of government, and their instructions have the force of law in their respective countries, except that of the United States, which was prepared by commissioners appointed by medical and pharmaceutical societies, and has no other authority, although generally accepted as the national textbook.

The French *Codex* has probably a more extended use than any other pharmacopoeia outside its own country, being, in connexion with Dorvault's *L'Officine*, the standard for druggists in a large portion of Central and South America; it is also official in Turkey. The sum-total of the drugs and preparations it contains is about 1250, or double the average of other modern pharmacopoeias. The progress of medical knowledge has led to a gradual but very perceptible alteration in the contents of the pharmacopoeias. The original very complex formulae have been simplified until only the most active ingredients have been retained, and in many cases the active principles have to a large extent replaced the crude drugs from which they were derived. From time to time such secret remedies of druggists or physicians as have met with popular or professional approval have been represented by simpler official preparations.

The rapid increase in medical and pharmaceutical knowledge renders necessary frequent new editions of the national pharmacopoeias, the office of which is to furnish definite formulae for preparations that have already come into extensive use in medical practice, so as to ensure uniformity of strength, and to give the characters and tests by which their purity and potency may be determined. But each new edition requires several years to carry out numerous experiments for devising suitable formulae, so that the current Pharmacopoeia can never be quite up to date. This difficulty has hitherto been met by the publication of such non-official formularies as Squire's *Companion to the Pharmacopoeia* and Martindale's *Extra Pharmacopoeia*, in which all new remedies and their preparations, uses and doses are recorded, and in the former the varying strengths of the same preparations in the different pharmacopoeias are also compared. The need of such works to supplement the Pharmacopoeia is shown by the fact that they are even more largely used than the Pharmacopoeia itself, the first having been issued in 18 and the second in 13 editions at comparatively short intervals. In England the task of elaborating a new Pharmacopoeia is entrusted to a body of a purely medical character, and legally the pharmacist has not, as in other countries, a voice in the matter, notwithstanding the fact that, although the medical practitioner is naturally the best judge of the drug or preparations that will afford the best therapeutic result, he is not so competent as the pharmacist to say how that preparation can be produced in the most effective and satisfactory manner, nor how the purity of drugs can be tested. In the preparation of the fourth edition of the *British Pharmacopoeia* in 1898 some new departures were made. A committee of the Pharmaceutical Society of Great Britain was appointed at the request of the General Medical Council to advise on pharmaceutical matters and the valuable assistance rendered by it is acknowledged in the preface of that work. A census of prescriptions was taken to ascertain the relative frequency with which different preparations and drugs were used in prescriptions, and suggestions and criticisms were sought from various medical and pharmaceutical bodies at home and in the colonies. As regards the purely pharmaceutical part of the work a committee of reference in pharmacy, nominated by the pharmaceutical societies of Great Britain and Ireland, was appointed to report to the Pharmacopoeia Committee of the Medical Council.

Some difficulty has arisen since the passing of the Adulteration of Food and Drugs Act concerning the use of the Pharmacopoeia as a legal standard for the drugs and preparations contained in it. The Pharmacopoeia is defined in the preface as only "intended to afford to the members of the medical profession and those engaged in the preparation of medicines throughout the British Empire one uniform standard and guide whereby the nature and composition of substances to be used in medicine may be ascertained and determined." It is obvious that it cannot be an encyclopaedia of substances used in medicine, and can only be used as a standard for the substances and preparations contained in it, and for no others. It has been held in the Divisional Courts (*Dickins* v. *Randerson*) that the Pharmacopoeia is a standard for official preparations asked for under their pharmacopoeial name. But there are many substances in the Pharmacopoeia which are not only employed in medicine, but have other uses, such as sulphur, benzoin, tragacanth, gum arabic, ammonium carbonate, beeswax, oil of turpentine, linseed oil, and for these a commercial standard of purity as distinct from a medicinal one is needed, since the preparations used in medicine should be of the highest possible degree of purity obtainable, and this standard would be too high and too expensive for ordinary purposes. The use of trade synonyms in the Pharmacopoeia, such as saltpetre for purified potassium nitrate, and milk of sulphur for precipitated sulphur, is partly answerable for this difficulty, and has proved to be a mistake, since it affords ground for legal prosecution if a chemist sells a drug of ordinary commercial purity for trade purposes, instead of the purified preparation which is official in the Pharmacopoeia for medicinal use. This would not be the case if the trade synonym were omitted. For many drugs and chemicals not in the Pharmacopoeia there is no standard of purity that can be used under the Adulteration of Food and Drugs Act, and for these, as well as for the commercial quality of those drugs and essential oils which are also in the Pharmacopoeia, a legal standard of commercial purity is much needed. This subject formed the basis of discussion at several meetings of the Pharmaceutical Society, and the results have been embodied in a work entitled *Suggested Standards for Foods and Drugs*, by C. G. Moor, which indicates the average degree of purity of many drugs and chemicals used in the arts, as well as the highest degree of purity obtainable in commerce of those used in medicine.

An important step has also been taken in this direction by the publication under the authority of the Council of the Pharmaceutical Society of Great Britain of the *British Pharmaceutical Codex*, in which the characters of and tests for the purity of many non-official drugs and preparations are given as well as the character of many glandular preparations and antitoxins that have come into use in medicine, but have not yet been introduced into the Pharmacopoeia. This work may also possibly serve as a standard under the Adulteration of Food and Drugs Act for the purity and strength of drugs not included in the Pharmacopoeia and as a standard for the commercial grade of purity of those in the Pharmacopoeia which are used for non-medical purposes.

Another legal difficulty connected with modern pharmacopoeias is the inclusion in some of them of synthetic chemical remedies, the processes for preparing which have been patented, whilst the substances are sold under trade-mark names such as veronal. The scientific chemical name is often long and unwieldy, and the physician prefers when writing a prescription to use the shorter name under which it is sold by the patentees. In this case the pharmacist is compelled to use the more expensive patented article and the patient complains of the price. If he uses the same article under its pharmacopoeial name when the patented article is prescribed he lays himself open to prosecution by the patentee for infringement of patent rights. The only plan, therefore, is for the physician to use the chemical name (which cannot be patented) as given in the Pharmacopoeia, or—for those synthetic remedies not included in the Pharmacopoeia—to use the scientific and chemical name given in the British Pharmaceutical Codex.

International Pharmacopoeia.—Increased facilities for travel have brought into greater prominence the importance of an approach to uniformity in the formulae of the more powerful remedies, in order to avoid danger to patients when a prescription is dispensed in a different country from that in which it was written. Attempts have been made by international pharmaceutical and medical conferences to settle a basis on which an international pharmacopoeia could be prepared, but, owing to national jealousies and the attempt to include too many preparations in such a work it has not as yet been produced. The standardization of preparations of patent medicines, as regards the amount of active principles they contain, can only conveniently and economically be done in operating on large quantities, and must naturally lead to the preparations being standardized at wholesale houses, who issue a guarantee with them; but it is not yet certain that deterioration may not take place after standardization, in such as those of ergot or digitalis, so that it is somewhat questionable whether the standardization is of permanent value in all cases. Probably more dependence is to be placed on careful selection of the drug, and skill in its preparation and preservation by the retail pharmacist, who should be personally responsible for the quality and purity of the preparations he sells. Although the attempt to form an international pharmacopoeia has failed, a project for an imperial pharmacopoeia which should be adapted to the general and local requirements of all parts of the British Empire has met with better success. With the aid of the medical and pharmaceutical authorities in each of the seventy administrative divisions of the British Empire an Indian and Colonial addendum to the *British Pharmacopoeia* of 1898 was compiled and published in 1900 in which each article receives official sanction in the countries indicated at the foot of the monographs. This was regarded as a preparatory step to the publication of a complete imperial pharmacopoeia.

Several unofficial universal pharmacopoeias have been published in England and in France, which serve to show the comparative strength of parallel preparations in different countries. The metric or decimal mode of calculation and the centigrade scale of temperature are adopted in all pharmacopoeias except those of Great Britain (in which the metric equivalents are now given) and in some instances of Greece. The majority omit chemical formulae. An alphabetical arrangement is followed in all. The maximum doses of preparations are given in several pharmacopoeias and the physician must indicate on his prescription, if he exceeds this limit, by using a note of exclamation after each article, that he purposely intends such a dose to be employed. The great increase of medical literature and international exchange of medical journals has led to the adoption in almost every country of all the really valuable remedial agents, and the more extended use of active principles has given rise to an approximation in strength of their solutions. The difficulty of nomenclature could probably be overcome by a list of synonyms being given with each article, and that of language by the use of Latin. The greatest stumbling-blocks in the way of uniformity are the tinctures and extracts—a class of preparations containing many very powerful drugs, but in which the same name does not always indicate the same thing; thus, extract of aconite signifies an extract of the root in the pharmacopoeias of the United States, Japan and Russia, extract of the leaves in the Danish and Portuguese, inspissated juice of the fresh leaves in the Greek, and alcoholic extract of the root in that of Spain and Italy, and alcoholic extract of the dried leaves in the Chilean pharmacopoeias. It appears probable, however, that the growth of pharmaceutical chemistry will indicate, in time, which of those in use form the most active and trustworthy preparations, while the general adoption of the metric system will lead to clearer approximation of strength than hitherto. The method adopted by the Portuguese Pharmacopoeia comes nearest to that uniformity which is so desirable in such preparations, as the tinctures of the fresh plants are all prepared with equal parts of the drug and alcoholic menstruum; simple tinctures in general, with unfortunately a few exceptions, with one part of the drug in five parts of alcohol of given strength; ethereal tinctures are in the proportion of one part in ten; and the tinctures of the alkaloids and their salts contain one part of the alkaloid in ninety-nine of menstruum.

Homoeopathic and eclectic practitioners as well as dentists have also their special pharmacopoeias.

See Bell and Redwood, *Progress of Pharmacy* (London, 1880); Scherer, *Literatura pharmacopoearum* (Leipzig and Sorau, 1822); Flint, *Report on the Pharmacopoeias of all Nations* (Washington, 1883). (E. M. H.)

PHARMACOSIDERITE, a mineral species consisting of hydrated basic ferric arsenate, $2FeAsO_4\cdot Fe(OH)_3\cdot 5H_2O$. Crystals have the form of small, sharply defined cubes of an olive- or grass-green colour, and occur together in considerable numbers on the matrix of the specimens. On account of its cubic form the mineral was early known as "cube ore" (Ger., *Würfelerz*); the name pharmacosiderite, given by J. F. L. Hausmann in 1813, alludes to the arsenic and iron present (*φάρμακον*, poison, and *σίδηρος*, iron). The faces of the cube are striated parallel to one diagonal, and alternate corners are sometimes replaced by faces of a tetrahedron. The crystals are feebly doubly refracting, and in polarized light exhibit a banded structure parallel to the cube faces. The hardness is 2½ and the specific gravity 2·8. Recent analyses prove the presence of a small but variable amount of potassium (K_2O, 2·68–4·13%) in the Cornish crystals, though in those from Hungary there is only a trace; this constituent appears to take the place of basic hydrogen in the above formula. A curious property is to be observed when a crystal of pharmacosiderite is placed in a solution of ammonia—in a few minutes the green colour changes throughout the whole crystal to red; on placing the red crystal in dilute hydrochloric acid the green colour is restored. Natural crystals are sometimes honey-yellow to brown in colour, but this appears to be due to alteration.

Pharmacosiderite is a mineral of secondary origin, the crystals occurring attached to gozzany quartz in the upper part of veins of copper ore. It was found in some abundance at the end of the 18th century in the copper mines of the St Day district in Cornwall, and has since been found at a few other localities, for example, at Königsberg near Schemnitz in Hungary, and in the Tintic district in Utah. (L. J. S.)

PHARMACY, a term which in the original Greek form signified the use of any kind of drug (*φάρμακον*), potion or spell, and hence also poison and witchcraft. In the modern signification it is applied to the act of preparing, preserving and compounding medicines, according to the prescriptions of physicians. It was used first in this sense in 1597.

In the earliest periods of the world's history of which we have any record, this art, like that of the perfumer, was practised by a special class of the priesthood, as in the case of Eleazar (Num. iv. 16), and that of medicine by another class (Lev. xiii.).

Egyptian inscriptions indicate that the physician-priests sent their prescriptions to be dispensed by the priests of Isis when, accompanied by the chanter of incantations and spells, they visited the sick[1]. A papyrus of Sent, 3300 B.C., gives directions as to the preparation of prescriptions. In the Ebers papyrus, 1550 B.C., mention is made of blisters, ointments, clysters, mineral and vegetable drugs. The art of the apothecary is alluded to very early in the Old Testament history (Exod. xxx. 25–35 and in xxxvii. 20) and again in the time of Solomon (Eccles. x. 9), but this word, which is translated *par fumeur* in the French version, only indicates that the preparation of fragrant unguents and incense formed, even at that early date, a part of pharmacy, since the drugs mentioned, viz. galbanum, myrrh, stacte, frankincense, calamus, cassia and cinnamon, were all of them used in perfumes, even the myrrh being probably the kind distinguished at the present time in the Bombay market as perfumed myrrh or bissabol, which still forms an ingredient of the joss sticks used as incense in the temples in China. The myrrh mentioned in Gen. xxxvii. 35 is described under another Hebrew word, and refers to ladanum, a fragrant resin produced in Cyprus, and the use of this drug, as well as that of cinnamon and cassia, indicates even at that early period a knowledge of the products of Somaliland, Arabia and the East Indies and the existence of trade between the farther East and Egypt. In China also at a very early period the art of pharmacy was practised. Ching-Hong, a contemporary of Menes I. of Egypt, was learned in the art, and made decoctions and extracts of plants. The materia medica of the Chinese at the present date affords an excellent illustration of the changes that have taken place in the use of drugs, and of the theories and superstitions that have guided the selection of these from the earliest ages, inasmuch as it still comprises articles that were formerly used in medicine, but have now been utterly discarded. Thus the doctrine of signatures is evident in the use of the celebrated Ginseng root of China, which, like that of the mandrake (Gen. xxx. 14–16), owed its employment to the fact that the root often divides into branches resembling the arms and legs of a man, and this resemblance gave rise to the belief that it conferred strength and virility. The same belief is shown in the botanical names applied to many plants, *e.g.* Pulmonaria, Hepatica, Scrophularia, and others.

The astrological belief that plants, animals and minerals are under the influence of the planets is shown in the older names of some of the metals, *e.g.* Saturn for lead, Venus for copper, and Mars for iron, and the belief that the colours of flowers indicated the particular planet they were under led to their use in diseases and for constitutions supposed to be under the same planet. Physicians to this day head their prescriptions with a sign that originally meant an invocation to Jupiter, but now represents the word *recipe*.

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[1] The Egyptians believed that the medicinal virtues of plants were due to the spirits who dwelt within them.

The belief, which is still held by the Chinese, that the excrements of animals retain the properties and peculiarities of the animals from which they are derived, led to the use in medicine of these disgusting remedies, which are still sold in drug shops in China, and were only omitted from the English Pharmacopoeia as late as 1721. At that date the science of chemistry was very imperfectly known, and the real constituents of ordinary remedies so little understood that different virtues were attributed to different products containing the same constituents. Thus, prepared oyster-shells, coral, pearls, crabs' "eyes" and burnt hart's horn were regarded as specifics in different complaints, in ignorance of the fact that they all contain, as the chief ingredients, calcium phosphate and carbonate. The celebrated Gascoigne's powder, which was sold as late as the middle of the 19th century in the form of balls like sal prunella, consisted of equal parts of crabs' "eyes," the black tips of crabs' claws, Oriental pearls, Oriental bezoar and white coral, and was administered in jelly made of hart's horn, but was prescribed by physicians chiefly for wealthy people, as it cost about forty shillings per ounce. Superstition also entered largely into the choice of remedies. Thus various parts of criminals, such as the thigh bone of a hanged man, moss grown on a human skull, &c., were used, and even the celebrated Dr Culpeper in the 17th century recommended "the ashes of the head of a coal black cat as a specific for such as have a skin growing over their sight."

In course of time the knowledge of drugs, and consequently the number in use, gradually increased, and some of the preparations made in accordance with the art attained a celebrity that lasted for centuries. Thus diachylon plaster was invented by Menecrates in A.D. 1, and was used by him for the same purposes as it is employed to-day. An electuary of opium, known as *Mithradatum*, was invented by Mithradates VI., king of Pontus, who lived in constant fear of being poisoned, and tested the effects of poisons on criminals, and is said to have taken poisons and their antidotes every day in the year. The prescription for the general antidote known as Mithradatum was found with his body, together with other medical MSS., by Pompey, after his victory over that king. The prescription was improved by Damocrates and Andromachus, body physicians to Nero. The first was subsequently known as *Mithradatum Damocratis*, and the second as *Theriaca Andromachi*, the name *Theriaca* or *Tiriaca* being derived from the snake called Tyrus, the flesh of which was added to it by Andromachus. The former contained 55, or, according to some formulae, 72 ingredients, and occurs in all the dispensatories, from that of Corvus Valerius up to the pharmacopoeias of the 19th century; and aromatic preparations of opium are still used, under the name of *Theriaka* in Persia. The *Theriaca* prepared at Venice had the highest reputation, probably because in Venice the component parts were exposed to the inspection of wise men and doctors for two months, to determine whether they were or were not fit for use. The apothecaries' ordinance at Nuremberg provided that no *Theriaca* should in future be branded with the seal of the city unless it had been previously examined and declared worthy of the same by the doctors of medicine, and that every druggist must know the age of the *Theriaca* he sold. Inasmuch as its action changed very materially with age, "the buyer should in all instances be informed, so that he may not be deceived." The last public preparation of *Theriaca* took place at Nuremberg in 1754.

In A.D. 77-78 Dioscorides of Anazarba, in Cilicia, wrote his great work on materia medica, which still remains the most important work on the plants and drugs used in ancient times (of which about 400 were enumerated) and until the 17th century was held as the most valuable guide to medicinal plants and drugs extant. Nearly 100 years afterwards Galen, the imperial physician at Rome (A.D. 131-200), who was learned in surgery, pharmacy and materia medica, added about 200 more plants to those described by Dioscorides.

Galen believed in the doctrine of humours originated by Hippocrates, which supposes the condition of the body to depend upon the proper mixture of the four elements, hot, cold, moist and dry, and that drugs possess the same elementary qualities, and that on the principle of contraries one or other was indicated, *e.g.* a cooling remedy for a feverish state. This doctrine was held for many centuries, and drugs are classed by all the old herbalists as having one or other of these qualities in a greater or less degree. Galen is said to have invented hiera-picra, which he employed as an anthelmintic; it is still used in England as a domestic remedy. In the 6th century Alexander of Tralles used colchicum for gout, iron for anaemia, and rhubarb in liver weakness and dysentery. The practice of pharmacy was extended by the Arabian physicians, and the separation of it from medicine was recognized in the 8th, and legalized in the 11th century. The practice of "polypharmacy," or the use of a large number of ingredients in prescriptions, which was common in the middle ages, was greatly due to the view enunciated by Alkekendo, and held by one of the Arabian schools of medicine: that the activity of medicine increases in a duplicate ratio when compounded with others; and it was only in the first half of the 18th century that the practice was altogether discontinued in the pharmacopoeias, although the theory was shown to be incorrect by Averroes in the 12th century.

The establishments for dispensing medicines at Cordova, Toledo and other large towns under Arab rule, were placed under severe legal restrictions. Frederick II. in A.D. 1233 passed a law, which remained in force for a long time in the two Sicilies, by which every medical man was required to give information against any pharmacist who should sell bad medicine. The pharmacists were divided into two classes, the *stationarii*, who sold simple drugs and non-magisterial preparations at a tariff determined by competent authorities, and the *confectionarii*, whose business it was to dispense scrupulously the prescriptions of medical men; all pharmaceutical establishments were placed under the surveillance of the college of medicine. In the monastic period pharmacy was to a great extent under the control of the religious orders, particularly the Benedictines, who, from coming into contact with the Arabian physicians, devoted themselves to pharmacy, pharmacology and therapeutics; but, as monks were forbidden to shed blood, surgery fell largely into the hands of barbers, so that the class of barber-surgeons came into existence, and the sign of their skill in blood-letting still appears in provincial districts in England in the form of the barber's pole, representing the application of bandages.

In England the separation between medicine and pharmacy was somewhat later than on the continent of Europe. The earliest record of an apothecary's shop in London was in 1345. The status of the apothecary, as subordinate to the physician in the time of Henry VIII., is evident from the following, out of 21 rules laid down by a prominent apothecary, who was a cousin of Anne Boleyn: "His garden must be at hand, with plenty of herbs and seeds and roots. He must read Dioscorides. He must have mortars, pots, filters, glasses and boxes clean and sweet. He must have two places in the shop, one most clean for physic, and the base place for chirurgic stuff. He is neither to increase nor to diminish the physician's prescription; he is neither to buy nor to sell rotten drugs. He is only to meddle in his own vocation; and to remember that his office is only to be the physician's cook."

The drugs used by the physicians and apothecaries were purchased from the grossarii or sellers in gross, who were subsequently called grocers, some of whom specialized as druggists and others as chymists or chemists. The apothecaries, who were the pharmacists of those days, were not represented by any corporate body, but in the reign of King James I., in 1606, were incorporated with the Company of Grocers. This arrangement was not, however, approved of by the physicians, who obtained in 1617 a separate charter for the apothecaries, to the number of 114, which was the number of physicians then practising in London. At the same time it was enacted that no grocer should keep an apothecary's shop, and that no surgeon should sell medicines, and that the physicians should have the power to search the shops of the apothecaries within 7 m. of London under a penalty of £100 in case of a refusal to permit it. Soon after the apothecaries were formed into a separate company they took into consideration means to prevent the frauds and adulterations practised by the grocers and druggists, and, to remedy the evil, established a manufactory of their own in 1626 so that they might make preparations for their own members. The frauds and adulterations were probably due in part to the apothecaries, for Dr Merrit, a collegiate physician of London, stated that "such chymists which sell preparations honestly made complain that few apothecaries will go to the price of them." The medicinal preparations which required the aid of a furnace, such as mineral earths, were undertaken by the chymists, who probably derived their name from the Alchymists, who flourished from the 14th to the 16th centuries. When the word was discovered to be derived from an Arabic prefix and a Greek word the prefix was dropped. In the 19th century the word chymist became altered to chemist, although the original spelling is still continued to a small extent. The curious signs on the coloured carboys in chemists' windows, which were commonly to be seen until the middle of the 19th century, were signs used by the alchemists to indicate various chemical substances. In 1694 the apothecaries had increased from 114 to nearly 1000, and many of them, having acquired a knowledge of the uses of medicine, began to prescribe medicines for their customers and to assume the functions of the physician, who retorted in 1697 by establishing dispensaries, where medicines could be procured at their intrinsic value, or at cost price. The assistants employed at these dispensaries after a time appear to have gone into business on their own account, and in this way the dispensing chemists, as a class, appear to have originated.

In 1748 the Apothecaries' Corporation obtained a charter empowering them to license apothecaries to sell medicines in London, or within 7 m., and intended to use it to restrain chemists and druggists from practising pharmacy, and to prohibit physicians and surgeons from selling the medicines they prescribed; but the apothecaries, by paying increased attention to medical and surgical practice, had not only alienated the physicians and surgeons, but materially strengthened the position of chemists and druggists as dispensers of prescriptions. When a further attempt was made in 1815 to bring a bill into parliament including provisions for prohibiting the practice of pharmacy by uneducated persons, and giving power to examine dispensing chemists, the latter became alarmed, and, finding that the provisions of the bill were entirely in the interests of the apothecaries, and directed against chemists and druggists, the latter took measures to oppose it in parliament, which were so far successful as to prevent apothecaries from interfering in any way with, or obtaining any control over, chemists and druggists. In 1841 another attempt was made by the apothecaries to control the trade of chemists and druggists on the ground that no adequate examination or education in pharmacy existed, and that such should be instituted, and be controlled by the apothecaries and physicians, but the latter disclaimed any desire to take an active part in the matter. The chemists and druggists, recognizing that no institution for the systematic education and examination of chemists and druggists existed in England, and that no proof could be given that each individual possessed the necessary qualifications, decided that this objection must be met, and that pharmacy must be placed upon a more scientific footing. They therefore resolved upon the foundation of a voluntary society, under the title of the Pharmaceutical Society of Great Britain, "for advancing the knowledge of chemistry and pharmacy, and promoting a uniform system of education for those who should practise the same, also for protecting the collective and individual interests and privileges of all its members, in the event of any hostile attack in parliament or elsewhere." This society was instituted in 1841, the original founders being chemists and druggists in the metropolis and provincial towns. On the 18th of February 1843 a royal charter of incorporation was granted to the society, and a permanent status was thus acquired. Chemists in business before the granting of the charter were entitled to join the society as members, but those who wished to join it subsequently could do so only on condition of passing an examination for the purpose of testing their knowledge of pharmacy. A school of pharmacy was instituted, and a museum and library were started. The chemical laboratory in connexion with the school was, when first instituted, the only one in England for teaching purposes, and the museum is now reputed to be the best pharmaceutical one in the world, the library now containing about 13,000 volumes.

The examinations are three in number. The first is of a preliminary character, qualifying for registration as a student or apprentice; in lieu of this examination, certificates of matriculation at a university, and those of certain other educational bodies, are accepted. The second examination qualifies for registration as a chemist and druggist. This is known as the minor examination, and must be passed before anyone can legally dispense, compound and sell scheduled poisons. The subjects included are systematic botany, vegetable morphology and physiology, chemistry, physics, materia medica, pharmacy, dispensing, posology, the reading of prescriptions, and a knowledge of poisons and their antidotes. The Poisons and Pharmacy Act of 1908 (section 4) has given the society power to regulate the preliminary training, arrange a curriculum, and divide the qualifying examination into two parts, so that an approximation to the standard of pharmaceutical education on the Continent is likely to take place within a short period. Degrees in science and pharmacy are granted by the universities of Manchester and Glasgow, and other universities were in 1910 considering the question of granting degrees.

The third, or major examination, which qualifies for registration as a pharmaceutical chemist, is not, like the minor, a compulsory one, but ranks as an honours examination. The education for this examination has kept pace with the rapid advances of science, all the following subjects now receiving attention: the microscopical structure of plants and drugs, so as to detect adulterations and impurities in powdered drugs; organic and quantitative analysis, including those of food and drugs, water, soils, gas and urine; optics, so as to enable them to carry out the prescriptions of oculists; spectrum analysis; the use of the polariscope and refractometer; the method of applying Röntgen rays; the preparation of glandular secretions and antitoxins; and the chemistry of remedies for the fungoid diseases and insect pests of plants.

Those who have passed this examination are competent to perform analysis of all kinds, and generally obtain the preference for various appointments, such as head dispensers in government or other large hospitals, or as analysts. The society has also established a chemical research laboratory, in which much useful work has been done in connexion with the national pharmacopoeia under the direction of the Pharmacopoeia Committee of the Medical Council.

A pharmacy act, which was passed in 1852, established a distinction between registered and examined, and unregistered and unexamined chemists and druggists, creating a register of the former under the name of pharmaceutical chemists, so that the public might discriminate between the two classes. A subsequent pharmacy act, passed in 1868, added a register of chemists and druggists, and rendered it unlawful for any unregistered person to sell or keep open shop for selling the poisons mentioned in the schedule of this act. The administration of the act was entrusted to the pharmaceutical society, and the duty of prosecuting unauthorized practitioners has been performed by the society ever since, without any pecuniary assistance from the state, although the legal expenses involved in prosecution amount to a considerable portion of its income.

The Poisons and Pharmacy Act of 1908 extended the schedule of poisons instituted by the act of 1868, and it now includes arsenic, aconite, aconitine and their preparations; all poisonous vegetable alkaloids, and their salts and poisonous derivatives; atropine and its salts and their preparations; belladonna and all preparations or admixtures (except belladonna plasters) containing 0·1 % or more of belladonna alkaloid; cantharides and its poisonous derivatives; any preparation or admixture of coca-leaves containing 0·1 % or more of coca alkaloids; corrosive sublimate; cyanide of potassium and all poisonous cyanides and their preparations; tartar emetic, nux vomica, and all preparations or admixtures containing 0·2% or more of strychnine; opium and all preparations and admixtures containing 1% or more of morphine; picro-toxine; prussic acid and all preparations and admixtures containing 0·1% or more of prussic acid; savin and its oil, and all preparations or admixtures containing savin or its oil. None of these may be sold to any person who is unknown to the seller, unless introduced by a person known to the seller, and not until after an entry is made in a book kept for the purpose, stating, in the prescribed form, the date of sale, name and address of purchaser, the name and quantity of the article sold, and the purpose for which it is stated by the purchaser to be required. The signature of the purchaser and introducer (if any) must be affixed to the entry.

The following poisons may not be sold, either retail or wholesale, unless distinctly labelled with the name of the article, and the word poison, with the name and address of the seller:—

Almonds, essential oil of (unless deprived of prussic acid). Antimonial wine. Cantharides, tincture and all vesicating liquids, preparations or admixtures of. Carbolic acid, and liquid preparations of carbolic acid and its homologues containing more than 3% of those substances, except preparations for use as sheep-wash or for any other purpose in connexion with agriculture or horticulture, contained in a closed vessel distinctly labelled with the word "poisonous," the name and address of the seller, and a notice of the special purposes for which the preparations are intended. Chloral hydrate. Chloroform, and all preparations or admixtures containing more than 20% of chloroform. Coca, any preparation or admixture of, containing more than 0·1% but less than 1% of coca alkaloids. Digitalis. Mercuric iodide. Mercuric sulphocyanide. Oxalic acid. Poppies, all preparations of, excepting red poppy petals and syrup of red poppies (*Papaver Rhoeas*). Precipitate, red, and all oxides of mercury. Precipitate, white. Strophanthus. Sulphonal. All preparations or admixtures which are not included in part 1 of the schedule, and contain a poison within the meaning of the pharmacy acts, except preparations or admixtures, the exclusion of which from this schedule is indicated by the words therein relating to carbolic acid, chloroform and coca, and except such substances as come within the provisions of section 5 of the act.

It has been erroneously represented by interested persons that the Pharmaceutical Society desires a monopoly of the sale of poisons. This is not the case. Any poisonous substance that is not included in the schedules can be sold by anyone, as, for instance, red lead, sulphate of copper, &c. The duty of the Pharmaceutical Society is a purely legal one, and relates only to the schedules of poisons framed by the government to protect the public by rendering it a difficult matter to obtain the poisons most frequently used for criminal purposes. In continental countries the laws are even more stringent.

In response to an agitation originated by certain manufacturers (one of whom was a member of parliament), who were prosecuted for omitting to label arsenical and nicotine preparations as poisons, as required by the Pharmacy Act of 1868, a new act was passed in 1908, by which persons, without any training in toxicology, and being neither pharmaceutical chemists, nor chemists and druggists, may be granted licences by local authorities to sell poisonous substances used exclusively in agriculture or horticulture, for the destruction of insects, fungi or bacteria, or as sheep dips or weed-killers, but which are poisonous by reason of containing the scheduled poisons, arsenic or nicotine, &c. One condition concerning the granting of such licences has been, it is said, deliberately ignored in many towns, viz. that the local authority, before granting a licence, "shall take into consideration whether, in the neighbourhood, the reasonable requirements of the public are satisfied with regard to the purchase of poisonous substances, and also any objections they may receive from the chief officer of police, or from any existing vendors of the substances to which the application relates." It is left to the Pharmaceutical Society to take legal action against any infringement of the law, although it is obvious that this should be carried out at the government expense, since it is for the benefit of a section of the public, and obviously to the loss of the members of the Pharmaceutical Society. Moreover, the present act nullifies the object of the previous act of 1868, which was to reduce the facilities for obtaining poisons. The fact that a voluntary society with limited funds must contest the illegal decisions of local councils, without government support, seems likely to render this portion of the act of 1908 a dead letter.

At the time of the passing of the Pharmacy Act of 1852 co-operative associations did not come under consideration, and no provision was made concerning them as regards the title of chemist, or as to any action such associations might take to evade the law. It has been decided in the law courts that a limited liability company is not a person in the eye of the law, and therefore does not come under the operation of the act of 1868. The result of this decision was that any chemist who failed to pass the qualifying examination could constitute himself with a few others, even if ignorant of pharmacy, into a limited liability company, which would then have been outside the powers of the act, and not subject to its provisions. This false position was remedied by the act of 1908, which brings companies into line with individuals.

Foreign Regulations.

On the continent of Europe the dispensing of prescriptions is confined to pharmacists (*pharmaciens* and *apothekers*). They are not allowed to prescribe, nor the medical men to dispense, except under special licence, and then only in small villages, where the pharmacist could not make a living. The principle of "one man one shop" is general; a pharmacist may not own more than one shop in the same town. In Holland he may not enter into any agreement, direct or indirect, with a medical man with regard to the supply of medicines. In Austria, Germany, Italy, Rumania and Russia the number of pharmacies is limited according to the population. In France, Switzerland, Belgium and Holland the number is not limited, and every qualified pharmacist has the right to open a shop or buy a pharmacy. Where the number of pharmacies is limited by law prescriptions may only be dispensed at these establishments. The original prescription is kept by the pharmacist for either three or ten years, according to the country, and a certified copy given to the patient, written on white paper if for internal use, or on coloured paper (usually orange yellow) if for external use. The price of the drugs and the tariff for dispensing prescriptions is fixed by government authority. In Russia a prescription containing any of the poisons indicated in the schedules A and B in the Russian pharmacopoeia may not be repeated, except by order of the doctor. The use of pharmacopoeia preparations made by manufacturers is allowed, but the seller is held responsible for their purity and strength. The prices charged for dispensing are lower in countries where the number of pharmacies is limited by law, the larger returns enabling the profit to be lessened.

The educational course adopted in different countries varies as to the details of the subjects taught. The preliminary, or classical examination, is usually that of university matriculation, or its equivalent. The period of study is eighteen months in Denmark or Norway, and two in Austria, Finland, Germany, Portugal, Russia, Sweden and Switzerland, three in Belgium, France, Greece and Italy, four to six in Holland, and five in Spain. In Great Britain the period of study is voluntary, and usually occupies only one year. Two or three years of apprenticeship is required in most countries, including Great Britain, but none in Belgium, Greece, Italy or Spain.

Patent Medicines.

The subject of patent medicines is but little understood by the general public. Any medicine, the composition of which is kept secret, but which is advertised on the label for the cure of diseases, must in Great Britain bear a patent medicine stamp equal to about one-ninth of its face value. The British Medical Association published in 1907 a work on *Secret Remedies; what they cost and what they contain*. The analyses published in this work show that nearly all the widely advertised secret remedies contain only well-known and inexpensive drugs. The Pharmaceutical Society on the other hand has also published a *Pharmaceutical Journal Formulary*, including several hundred formulae of proprietary medicines sold by pharmacists, so that it is now possible for any medical man to ascertain what they contain. The government accepts all the therein published formulae as "known, admitted and approved" remedies, and therefore not requiring a patent medicine stamp. In this way widely advertised secret remedies can be replaced by medicines of known composition and accepted value in any part of the world. Most continental countries have issued stringent laws against the sale of secret remedies, and these have been lately strengthened in Germany, France and Italy. In Switzerland secret remedies cannot be advertised without submitting the formula and a sample of the remedy to the board of health.

(E. M. H.)

PHARNABAZUS, Persian soldier and statesman, the son of Pharnaces, belonged to a family which from 478 governed the satrapy of Phrygia on the Hellespont, from its headquarters at Dascylium, and, according to a discovery by Th. Nöldeke, was descended from Otanes, one of the associates of Darius in the murder of Smerdis. Pharnabazus first appears as satrap of this province in 413, when, having received orders from Darius II. to send in the outstanding tribute of the Greek cities on the coast, he, like Tissaphernes of Caria, entered into negotiations with Sparta and began war with Athens. The conduct of the war was much hindered by the rivalry between the two satraps, of whom Pharnabazus was by far the more energetic and upright. After the war he came into conflict with Lysander (*q.v.*: see also PELOPONNESIAN WAR), who tried to keep the Greek cities under his own dominion, and became one of the causes of his overthrow, by a letter which he sent to the ephors at Sparta (Plut. *Lys.* 19; Nepos, *Lys.* 4; Polyaen. vii. 19). He received Alcibiades at his court and promised him means to go up to the king to reveal the intrigues of Cyrus, but when the Spartans insisted on his death he yielded to their demand for his assassination (Plut. *Alcib.* 37 sqq.; Diod. xiv. 11). When in 399 the war with Sparta broke out he again tried to conduct it strenuously. With the help of Conon and Evagoras of Salamis he organized the Persian fleet, and while he was hard pressed on land by Agesilaus he prepared the decisive sea-battle, which was fought in August 394 at Cnidus under his and Conon's command, and completely destroyed the Spartan fleet. He sent support to the allies in Greece, by which the walls of the Peiraeus were rebuilt. But in the war on land he struggled in vain against the lethargy and disorganization of the Persian Empire; and when at last, in 387, in consequence of the embassy of Antalcidas to Susa, the king decided to conclude peace with Sparta and to enter again into close alliance with her, Pharnabazus, the principal opponent of Sparta, was recalled from his command in high honours, to marry Apame, a daughter of the king (Plut. *Artax.* 27). In 385 he was one of the generals sent against Egypt, and in 377 he was ordered to prepare a new expedition against the valley of the Nile. The gathering of the army took years, and when in 373 all was ready, his attempt to force the passage of the Nile failed. A conflict with Iphicrates, the leader of the Greek mercenaries, increased the difficulties; at last Pharnabazus led the army back to Asia. From these campaigns date the silver coins with the name of Pharnabazus in Aramaic writing. When he died is not known.

In the time of Alexander we meet with a Persian general Pharnabazus, son of Artabazus (Arrian ii. 1 seq.), who probably was the grandson of the older Pharnabazus.

The name Pharnabazus is also borne by a king of Iberia (Georgia) on the Caucasus, where the dynasty seems to have been of Persian origin, defeated by a general of Marcus Antonius (Mark Antony) in 36 B.C. (Dio Cass. xlix. 24). In the Georgian dynasty the name occurs as late as the 19th century. (ED. M.)

PHARYNGITIS. The pharynx, or upper portion of the gullet (seen to a large extent on looking at the back of the mouth) is frequently the seat of a chronic inflammatory condition, usually associated with derangements of the digestive organs, or with syphilis or gout; sometimes it is due to much speaking or to excessive tobacco-smoking—especially of cigarettes. On inspection, the inflamed mucous membrane is seen unduly red and glazed, and dotted over with enlarged follicles. The condition produces considerable irritation and "dryness," with cough and discomfort, which may eventually become chronic. Treatment consists in removing all sources of irritation, in rectifying gastric disturbance, and in the application of the electric cautery, of astringent lotions or of mild caustic solutions. The pain may be relieved by spraying with certain anodyne solutions. In the case of adenoid growths (see ADENOIDS) there is often an associated granular appearance of the pharynx, due to enlargement of the minute glands of the mucous membrane. The inflamed pharynx of the orator (" clergyman's sore-throat ") may be put right by lessons in elocution or by complete rest for a time. The gouty throat may call for a change of diet, or for a stay at one of the watering-places where early rising, moderate food, regular exercise and the drinking of laxative waters join in restoring health. (E. O.*)

PHARYNX (Gr. φάρυγξ, throat), in anatomy, the cavity into which both the nose and mouth lead, which is prolonged into the oesophagus or gullet below, and from which the larynx or air tube comes off below and in front; it therefore serves as a passage both for food and air. It may be likened to an empty sack turned upside down and narrowing toward its mouth. The back and sides of the sack are formed by the three constrictor muscles of the pharynx, each of which overlaps the outer surface of the one above it, and these are lined internally by thick mucous membrane. The upturned bottom of the sack is attached firmly to the base of the skull and the internal pterygoid plates, so that this part cannot collapse, but below the anterior and posterior walls are in contact, and a transverse section of the pharynx is a mere slit.

From the front wall, on a level with the floor of the nose and roof of the mouth, a slanting shelf of muscular and glandular tissue covered with mucous membrane, projects downward and backward into the cavity, and divides it into an upper part or naso-pharynx and a lower or oral pharynx (see fig.). This shelf is the *soft palate*, and from the middle of its free border hangs a worm-like projection, of variable length but averaging about half an inch, the *uvula*. The whole of the front wall of the naso-pharynx is wanting, and here the cavity opens into the nose through the posterior nasal apertures (see OLFACTORY SYSTEM). On each side of the naso-pharynx, and therefore above the soft palate, is the large triangular opening of the Eustachian tube through which air passes to the tympanum (see EAR). Behind this opening, and reaching up to the roof of the naso-pharynx, is a mass of lymphoid tissue, most marked in children, known as the pharyngeal tonsil. This tissue, when it hypertrophies, causes the disease known as " adenoids."

From the mid-line of the roof of the pharynx a small pouch, the *bursa pharyngea*, best seen in childhood, projects upward, while on each side, above and behind the opening of the Eustachian tube, is a depression known as the lateral recess of the pharynx.

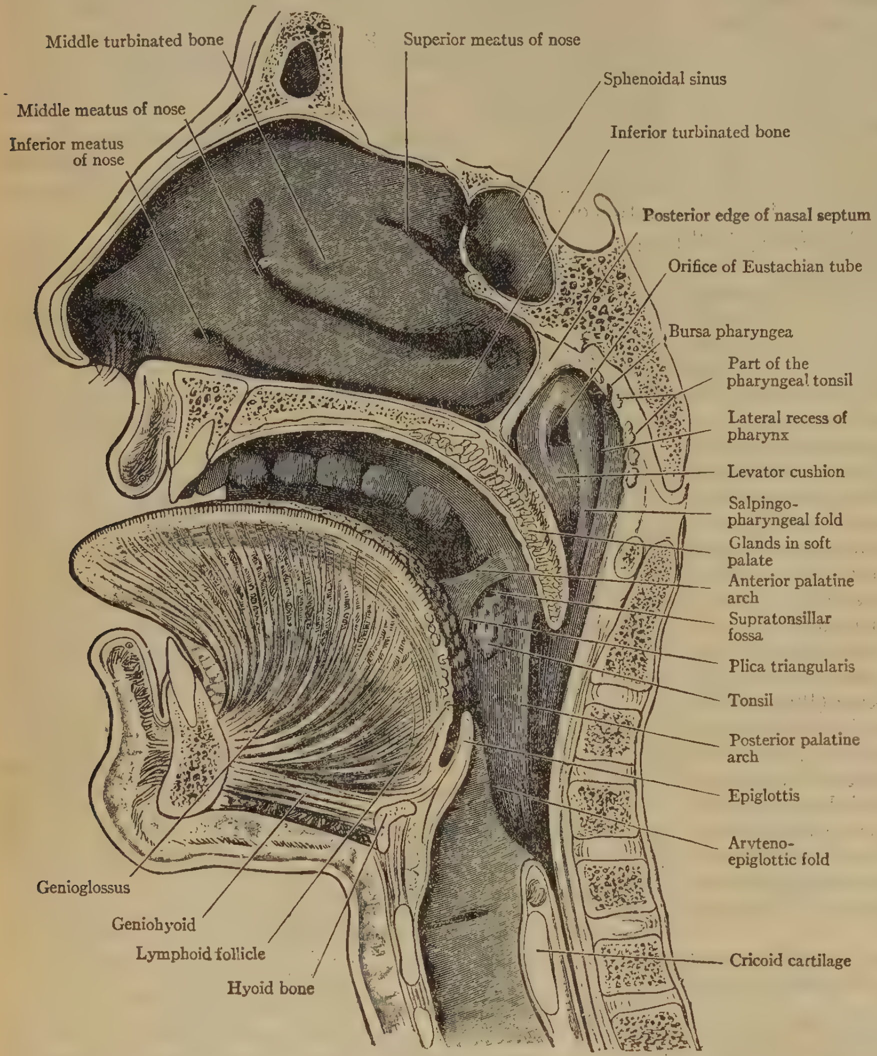
The oral pharynx communicates with the naso-pharynx by the pharyngeal isthmus behind the free edge of the soft palate. Above and in front it is continuous with the cavity of the mouth, and the demarcation between the two is a ridge of mucous membrane on each side running from the soft palate to the side of the tongue, and caused by the projection of the palato-glossus muscle. This is known as the anterior pillar of the fauces or anterior palatine arch. About half an inch behind this ridge is another, made by the palato-pharyngeus muscle, which gradually fades away in the side of the pharynx below. This is the posterior pillar of the fauces or posterior palatine arch, and between it and the anterior is the fossa (tonsilar sinus) in which the tonsil lies.

The *Tonsil* is an oval mass of lymphoid tissue covered by mucous membrane which dips in to form mucous crypts; externally its position nearly corresponds to that of the angle of the jaw. It is very vascular, deriving its blood from five neighbouring arteries. Below the level of the tonsil the anterior wall of the pharynx is formed by the posterior or pharyngeal surface of the tongue (*q.v.*), while below that is the epiglottis and upper opening of the larynx which is bounded laterally by the aryteno-epiglottic folds (see RESPIRATORY SYSTEM). On the lateral side of each of these folds is a pear-shaped fossa known as the *sinus pyriformis*. Below this the pharynx narrows rapidly until the level of the lower border of the cricoid cartilage in front and of the sixth cervical vertebra behind is reached; here it passes into the oesophagus, having reached a total length of about five inches.

The mucous membrane of the naso-pharynx, like that of the rest of the respiratory tract, is lined by ciliated columnar epithelium, but in the oral pharynx the epithelium is of the stratified squamous variety. Numerous racemose glands are present (see EPITHELIAL TISSUES), as well as patches of lymphoid tissue especially in childhood. Outside the mucous membrane and separating it from the constrictor muscles is the pharyngeal aponeurosis, which blends above with the periosteum of the base of the skull.

Embryology.—The pharynx is partly formed from the ectodermal stomatodaeal invagination (see EMBRYOLOGY and MOUTH) and partly from the fore gut, which is the cephalic part of the entodermal mesodaeum. Up to the fifteenth day (see MOUTH), the bucco-pharyngeal membrane separates these structures, and, though no vestiges of it remain, it is clear that the upper and front part of the naso-pharynx is stomatodaeal while the rest is mesodaeal. The five visceral arches with their intervening clefts or pouches surround the pharynx, and the Eustachian tube is a remnant of the first of these. The second pouch is represented in the adult by the tonsilar sinus, and until lately the lateral recess of the pharynx was looked upon as part of the same, but it has now been shown to be an independent diverticulum. The *sinus pyriformis* probably represents that part of the fourth groove from which the lateral lobes of the thyroid body are derived.

The *Bursa pharyngea* was at one time looked upon as the place whence the pituitary body had been derived from the roof of the pharynx, but this is now disproved and its meaning is unknown The tonsil is formed in the second branchial cleft or rather pouch, for the clefts are largely incomplete in man, about the fourth month; its lymphoid tissue, as well as that elsewhere in the pharynx, is formed from lymphocytes in the subjacent mesenchyme (see EMBRYOLOGY), though whether these wander in from the blood or are derived from original mesenchyme cells is still doubtful. The development of the ventral part of the pharynx is dealt with in the articles TONGUE and RESPIRATORY SYSTEM.



(From Ambrose Birmingham, Cunningham's *Text Book of Anatomy.*)

Sagittal Section through Mouth, Tongue, Larynx, Pharynx and Nasal Cavity.

The section is slightly oblique, and the posterior edge of the nasal septum has been preserved. The specimen is viewed slightly from below, hence in part the low position of the inferior turbinated bone.

For literature see Quain's *Elements of Anatomy*, vol. i. (London, 1908), and J. P. McMurrich, *Development of the Human Body* (London, 1906).

Comparative Anatomy.—In the lower, water-breathing, vertebrates the pharynx is the part in which respiration occurs. The water passes in through the mouth and out through the gill slits where it comes in contact with the gills or branchiae.

The lowest subphylum of the phylum Chordata, to which the term Adelochorda is sometimes applied, contains a worm-like creature Balanoglossus, in which numerous rows of gill slits open from the pharynx, though Cephalodiscus, another member of the same subphylum, has only one pair of these.

In the subphylum Urochorda, to which the Ascidians or sea-squirts belong, there are many rows of gill slits, as there are also in the Acrania, of which Amphioxus, the lancelet, is the type. In all these lower forms there are no true gills, as the blood-vessels lining the large number of slits provide a sufficient area for the exchange of gases.

In the Cyclostomata a reduction of the number of gill slits takes place, and an increased area for respiration is provided by the gill pouches lined by pleated folds of entodermal mucous membrane; these form the simplest type of true internal gills. In the larval lamprey (Ammocoetes) there are eight gill slits opening from the pharynx, but in the adult (Petromyzon) they are reduced to seven, and a septum grows forward separating the ventral or branchial part of the pharynx from the dorsal or digestive part. Both these tubes, however, communicate near the mouth.

In fishes there are usually five pairs of gill slits, though a rudimentary one in front of these is often present and is called the spiracle. Occasionally, as in Hexanchus and Heptanchus, there may be six or seven slits, and the evidence of comparative anatomy is that fishes formerly had a larger number of gill slits than at present.

In the Teleostomi, which include the bony fishes, there is an external gill cover or operculum.

In the Dipnoi or mud fish the work of the gills is shared by that of the lungs, and in the African form, Protopterus, external gills, developed from the ectodermal parts of the gill slits, first appear. In the tailed Amphibians (Urodela) the first and fifth gill clefts are never perforated and are therefore in the same condition as all the gill clefts of the human embryo, while in the gilled salamanders (Necturus and Proteus) only two gill clefts remain patent. The gills in all the Amphibia are external and of ectodermal origin, but in the Anura (frogs and toads) these are succeeded before the metamorphosis from the tadpole stage by internal gills, which, unlike those of fish, are said to be derived from the ectoderm.

In the embryos of the Sauropsida (reptiles and birds) five gill clefts are evident, though the posterior two are seldom at any time perforated, while in the Mammalia the rudiments of the fifth cleft are no longer found in the embryo, and in man, at all events, none of them are normally perforated except that part of the first which forms the Eustachian tube. It will thus be seen that in the process of phylogeny there is a gradual suppression of the gill clefts beginning at the more posterior ones.

The soft palate is first found in crocodiles as a membranous structure, and it becomes muscular in mammals. The bursa pharyngea and pharyngeal tonsil are found in several of the lower mammals. In the sheep the latter is particularly large.

For literature and further details, see R. Wiedersheim's *Comparative Anatomy of Vertebrates*, translated by W. N. Parker (London, 1907); also Parker and Haswell's *Zoology* (London, 1897). (F. G. P.)

PHEASANT (Mid. Eng. *fesaunt* and *fesaun*; Ger. *fasan* and anciently *fasant*; Fr. *faisan*—all from the Lat. *phasianus* or *phasiana, sc. avis*), the bird brought from the banks of the river Phasis, now the Rioni, in Colchis, where it is still abundant, and introduced, according to legend, by the Argonauts into Europe. Judging from the recognition of the remains of several species referred to the genus *Phasianus* both in Greece and in France,[1] it seems not impossible that the ordinary pheasant, the *P. colchicus* of ornithologists, may have been indigenous to this quarter of the globe. If it was introduced into England, it must almost certainly have been brought by the Romans;[2] for, setting aside several earlier records of doubtful authority,[3] Stubbs has shown that by the regulations of King Harold in 1059 *unus phasianus* is prescribed as the alternative of two partridges or other birds among the "pitantiae" (rations or commons, as we might now say) of the canons of Waltham Abbey, and, as W. B. Dawkins has remarked (*Ibis*, 1869, p. 358), neither Anglo-Saxons nor Danes were likely to have introduced it into England. It seems to have been early under legal protection, for, according to Dugdale, a licence was granted in the reign of Henry I. to the abbot of Amesbury to kill hares and pheasants, and from the price at which the latter are reckoned in various documents, we may conclude that they were not very abundant for some centuries, and also that they were occasionally artificially reared and fattened, as appears from Upton,[1] who wrote about the middle of the 15th century, while Henry VIII. seems from his privy purse expenses to have had in his household in 1532 a French priest as a regular "fesaunt breder," and in the accounts of the Kytsons of Hengrave in Suffolk for 1607 mention is made of wheat to feed pheasants, partridges and quails.

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[1] These are *P. archiaci* from Pikermi, *P. altus* and *P. medius* from the lacustrine beds of Sansan, and *P. desnoyersi* from Touraine, see A. Milne Edwards, *Ois. foss. de la France* (ii. 229, 239–243).

[2] Undoubted remains have been found in excavations at Silchester.

[3] Among these perhaps that worthy of most attention is in Probert's translation of *The Ancient Laws of Cambria* (ed. 1823, pp. 367, 368), wherein extracts are given from Welsh triads, presumably of the age of Howel the Good, who died in 948. One of them is, "There are three barking hunts: a bear, a squirrel and a pheasant." The explanation is, "A pheasant is called a barking hunt, because when the pointers come upon it and chase it, it takes to a tree, where it is hunted by baiting." The present writer has not been able to trace the manuscript containing these remarkable

The practice of bringing up pheasants by hand is now extensively followed, and the numbers so reared vastly exceed those that are bred at large. The eggs are collected from birds that are either running wild or kept in pens, and are placed under domestic hens; but, though these prove most attentive foster-mothers, much additional care on the part of their keepers is needed to ensure the arrival at maturity of the poults; for, being necessarily crowded in a comparatively small space, they are subject to several diseases which often carry off a large proportion, to say nothing of the risk they run by not being provided with proper food, or by meeting an early death from various predatory animals attracted by the assemblage of so many helpless victims. As they advance in age the young pheasants readily take to a wild life, and indeed can only be kept from wandering in every direction by being plentifully supplied with food, which has to be scattered for them in the coverts in which it is desired that they should stay. The proportion of pheasants artificially bred that "come to the gun" would seem to vary enormously, not only irregularly according to the weather, but regularly according to the district. In the eastern counties of England, and some other favourable localities, perhaps three-fourths of those that are hatched may be satisfactorily accounted for; but in many of the western counties, though they are the objects of equal or even greater care, it would seem that more than half of the number that live to grow their feathers disappear inexplicably before the coverts are beaten. For the sport of pheasant-shooting see Shooting.

Formerly pheasants were taken in snares or nets, and by hawking; but the crossbow was also used, and the better to obtain a "sitting shot,"—for with that weapon men had not learnt to "shoot flying"—dogs appear to have been employed in the way indicated by the lines under an engraving by Hollar, who died in 1677:—

> "The Feasant Cocke the woods doth most frequent,
> Where Spaniells spring and pearche him by the sent."[2]

Of the many other species of the genus *Phasianus*, two only can be dwelt upon here. These are the ring-necked pheasant of China, *P. torquatus*, easily known by the broad white collar, whence it has its name, as well as by the pale greyish-blue of its upper wing-coverts and rump and the light buff of its flanks, and the *P. versicolor* of Japan, often called the green pheasant from the beautiful tinge of that colour that in certain lights pervades almost the whole of its plumage, and, deepening into dark emerald, occupies all the breast and lower surface that in the common and Chinese birds is bay barred with glossy black scallops. Both of these species have been introduced into England, and cross freely with *P. colchicus*, while the hybrids of each with the older inhabitants of the woods are not only perfectly fertile *inter se*, but cross as freely with the other hybrids, so that birds are frequently found in which the blood of the three species is mingled. The hybrids of the first cross are generally larger than either of their parents, but the superiority of size does not seem to be maintained by their descendants. White and pied varieties of the common pheasant, as of most birds, often occur, and with a little care a race or breed of each can be perpetuated. A much rarer variety is sometimes seen; this is known as the Bohemian pheasant, not that there is the least reason to suppose it has any right to such an epithet, for it appears, as it were, accidentally among a stock of the pure *P. colchicus*, and offers an example analogous to that of the Japan peafowl (see Peacock), being, like that breed, capable of perpetuation by selection. Two other species of pheasant have been introduced to the coverts of England—*P. reevesi* from China, remarkable for its very long tail, white with black bars, and the copper pheasant, *P. soemmerringi*, from Japan. The well-known gold and silver pheasants, *P. pictus* and *P. nycthemerus*, each the type of a distinct section or subgenus, are both from China and have long been introduced into Europe, but are only fitted for the aviary. To the former is allied the still more beautiful *P. amherstiae*, and to the latter about a dozen more species, most of them known to Indian sportsmen by the general name of "kaleege." The comparatively plain pucras pheasants, *Pucrasia*, the magnificent monauls, *Lophophorus*, and the fine snow-pheasants, *Crossoptilum*—of each of which genera there are several species, may also be mentioned.

All the species known at the time are beautifully figured from drawings by J. Wolf in D. G. Elliot's *Monograph of the Phasianidae* (2 vols., fol., 1870–1872)—the last term being used in a somewhat general sense. With a more precise scope W. B. Tegetmeier's *Pheasants: their Natural History and Practical Management* (4th ed., 1904) is to be commended as a very useful work. (A. N.)

PHEIDIAS, son of Charmides, universally regarded as the greatest of Greek sculptors, was born at Athens about 500 B.C. We have varying accounts of his training. Hegias of Athens, Ageladas of Argos, and the Thasian painter Polygnotus, have all been regarded as his teachers. In favour of Ageladas it may be said that the influence of the many Dorian schools is certainly to be traced in some of his work. Of his life we know little apart from his works. Of his death we have two discrepant accounts. According to Plutarch he was made an object of attack by the political enemies of Pericles, and died in prison at Athens. According to Philochorus, as quoted by a scholiast on Aristophanes, he fled to Elis, where he made the great statue of Zeus for the Eleans, and was afterwards put to death by them. For several reasons the first of these tales is preferable.

Plutarch gives in his life of Pericles a charming account of the vast artistic activity which went on at Athens while that statesman was in power. He used for the decoration of his own city the money furnished by the Athenian allies for defence against Persia: it is very fortunate that after the time of Xerxes Persia made no deliberate attempt against Greece. "In all these works," says Plutarch, "Pheidias was the adviser and overseer of Pericles." Pheidias introduced his own portrait and that of Pericles on the shield of his Parthenos statue. And it was through Pheidias that the political enemies of Pericles struck at him. It thus abundantly appears that Pheidias was closely connected with Pericles, and a ruling spirit in the Athenian art of the period. But it is not easy to go beyond this general assertion into details.

It is important to observe that in resting the fame of Pheidias upon the sculptures of the Parthenon we proceed with little evidence. No ancient writer ascribes them to him, and he seldom, if ever, executed works in marble. What he was celebrated

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statements so as to find out the original word rendered "pheasant" by the translator; but a reference to what is probably the same passage with the same meaning is given by Ray (*Synops. meth. animalium*, pp. 213, 214) on the authority of Llwyd or Lloyd, though there is no mention of it in Wotton and Clarke's *Leges Wallicae* (1730). A charter (Kemble, *Cod. diplom.* iv. 236), professedly of Edward the Confessor, granting the wardenship of certain forests in Essex to Ralph Peperking, speaks of "fesant hen" and "fesant cocke," but is now known to be spurious.

[1] In his *De studio militari* (not printed till 1654) he states (p. 195) that the pheasant was brought from the East by "Palladius ancorista."

[2] Quoted by the writer (Broderip ?) of the article "Spaniel" in the *Penny Cyclopaedia*. The lines throw light on the asserted Welsh practice mentioned in a former note.

for in antiquity was his statues in bronze or gold and ivory. If Plutarch tells us that he superintended the great works of Pericles on the Acropolis, this phrase is very vague. On the other hand, inscriptions prove that the marble blocks intended for the pedimental statues of the Parthenon were not brought to Athens until 434 B.C., which was probably after the death of Pheidias. And there is a marked contrast in style between these statues and the certain works of Pheidias. It is therefore probable that most if not all of the sculptural decoration of the Parthenon was the work of pupils of Pheidias, such as Alcamenes and Agoracritus, rather than his own.

The earliest of the great works of Pheidias were dedications in memory of Marathon, from the spoils of the victory. At Delphi he erected a great group in bronze including the figures of Apollo and Athena, several Attic heroes, and Miltiades the general. On the Acropolis of Athens he set up a colossal bronze image of Athena, which was visible far out at sea. At Pellene in Achaea, and at Plataea he made two other statues of Athena, also a statue of Aphrodite in ivory and gold for the people of Elis. But among the Greeks themselves the two works of Pheidias which far outshone all others, and were the basis of his fame, were the colossal figures in gold and ivory of Zeus at Olympia and of Athena Parthenos at Athens, both of which belong to about the middle of the 5th century. Of the Zeus we have unfortunately lost all trace save small copies on coins of Elis, which give us but a general notion of the pose, and the character of the head. The god was seated on a throne, every part of which was used as a ground for sculptural decoration. His body was of ivory, his robe of gold. His head was of somewhat archaic type: the Otricoli mask which used to be regarded as a copy of the head of the Olympian statue is certainly more than a century later in style. Of the Athena Parthenos two small copies in marble have been found at Athens (see Greek Art, fig. 38) which have no excellence of workmanship, but have a certain evidential value as to the treatment of their original.

It will be seen how very small is our actual knowledge of the works of Pheidias. There are many stately figures in the Roman and other museums which clearly belong to the same school as the Parthenos; but they are copies of the Roman age, and not to be trusted in point of style. A. Furtwängler proposes to find in a statue of which the head is at Bologna, and the body at Dresden, a copy of the Lemnian Athena of Pheidias; but his arguments (*Masterpieces*, at the beginning) are anything but conclusive. Much more satisfactory as evidence are some 5th century torsos of Athena found at Athens. The very fine torso of Athena in the École des Beaux Arts at Paris, which has unfortunately lost its head, may perhaps best serve to help our imagination in reconstructing a Pheidian original.

As regards the decorative sculptures of the Parthenon, which the Greeks rated far below their colossus in ivory and gold, see the article Parthenon.

Ancient critics take a very high view of the merits of Pheidias. What they especially praise is the ethos or permanent moral level of his works as compared with those of the later "pathetic" school. Demetrius calls his statues sublime, and at the same time precise. That he rode on the crest of a splendid wave of art is not to be questioned: but it is to be regretted that we have no morsel of work extant for which we can definitely hold him responsible. (P. G.)

PHEIDON (8th or 7th century B.C.), king of Argos, generally, though wrongly, called "tyrant." According to tradition he flourished during the first half of the 8th century B.C. He was a vigorous and energetic ruler and greatly increased the power of Argos. He gradually regained sway over the various cities of the Argive confederacy, the members of which had become practically independent, and (in the words of Ephorus) "re-united the broken fragments of the inheritance of Temenus." His object was to secure predominance for Argos in the north of Peloponnesus. According to Plutarch, he attempted to break the power of Corinth, by requesting the Corinthians to send him 1000 of their picked youths, ostensibly to aid him in war, his real intention being to put them to death; but the plot was revealed. Pheidon assisted the Pisatans to expel the Elean superintendents of the Olympian games and presided at the festival himself. The Eleans, however, refused to recognize the Olympiad or to include it in the register, and shortly afterwards, with the aid of the Spartans, who are said to have looked upon Pheidon as having ousted them from the headship of Greece, defeated Pheidon and were reinstated in the possession of Pisatis and their former privileges. Pheidon is said to have lost his life in a faction fight at Corinth, where the monarchy had recently been overthrown. The affair of the games has an important bearing on his date. Pausanias (vi. 22, 2) definitely states that Pheidon presided at the festival in the 8th Olympiad (*i.e.* in 748 B.C.), but in the list of the suitors of Agariste, daughter of Cleisthenes of Sicyon, given by Herodotus, there occurs the name of Leocedes (Lacedas), son of Pheidon of Argos. According to this, Pheidon must have flourished during the early part of the 6th century. It has therefore been assumed that Herodotus confused two Pheidons, both kings of Argos. The suggested substitution in the text of Pausanias of the 28th for the 8th Olympiad (*i.e.* 668 instead of 748) would not bring it into agreement with Herodotus, for even then Pheidon's son could not have been a suitor in 570 for the hand of Agariste. But the story of Agariste's wooing resembles romance and has slight chronological value. On the whole, modern authorities assign Pheidon to the first half of the 7th century. Herodotus further states that Pheidon established a system of weights and measures throughout Peloponnesus, to which Ephorus and the Parian Chronicle add that he was the first to coin silver money, and that his mint was at Aegina. But according to the better authority of Herodotus (i. 94) and Xenophanes of Colophon, the Lydians were the first coiners of money at the beginning of the 7th century, and, further, the oldest known Aeginetan coins are of later date than Pheidon. Hence, unless a later Pheidon is assumed, the statement of Ephorus must be considered unhistorical. No such difficulty occurs in regard to the weights and measures; it is generally agreed that a system was already in existence in the time of Pheidon, into which he introduced certain changes. A passage in the Aristotelian *Constitution of Athens* (x. 2) states that the measures used before the Solonian period of reform were called "Pheidonian."

See Herodotus vi. 127; Ephorus in Strabo viii. 358, 376; Plutarch, *Amatoriae narrationes*, 2; Marmor parium, *ep.* 30; Pollux ix. 83; Nicolaus Damascenus, frag. 41 (in C. W. Müller's *Frag. hist. graecorum*, iii.); G. Grote, *History of Greece*, pt. ii. ch. 4; B. V. Head, *Historia Numorum* (1887); F. Hultsch, *Griechische und römische Metrologie* (1882); G. Rawlinson's *Herodotus*, appendix, bk. i., note 8. On the question of Pheidon's date, see J. B. Bury, *History of Greece*, ii. 468 (1902); J. P. Mahaffy, *Problems in Greek History*, ch. 3 (1892); J. G. Frazer's note on Pausanias vi. 22, 2; and especially G. Busolt, *Griechische Geschichte* (2nd ed., 1893), ch. iii. 12. C. Trieber, *Pheidon von Argos* (Hanover, 1880), and J. Beloch, in *Rheinisches Museum*, xlv. 595 (1890), favour a later date, about 580.

PHELPS, AUSTIN (1820–1890), American Congregational minister and educationalist, was born on the 7th of January 1820 at West Brookfield, Massachusetts, son of Eliakim Phelps,[1] a clergyman, who, during the boyhood of his son was principal of a girls' school in Pittsfield, Massachusetts, and later pastor of a Presbyterian church in Geneva, New York. The son studied at Hobart College in 1833–1835, then at Amherst for a year, and in 1837 graduated at the university of Pennsylvania. He studied theology at Union Theological Seminary, at the Yale Divinity School, and at Andover, and was licensed to preach in 1840 by the Third Presbytery of Philadelphia. He was pastor of the Pine Street (Congregational) Church in Boston in 1842–1848, and in 1848–1879 was professor of sacred rhetoric and homiletics at Andover Theological Seminary, of which he was president from 1869 to 1879, when his failing health forced him to resign. He died on the 13th of October 1890 at Bar Harbor, Maine. His *Theory of Preaching* (1881) and *English*

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[1] Eliakim Phelps afterwards lived in Stratford, Herkimer county, New York, where his house was "possessed" and was long a place of curious interest to students of "spiritualism."

Style in Public Discourse (1883) became standard textbooks; and personally he was a brilliant preacher. He married in 1842 Elizabeth Stuart (1815–1852), eldest daughter of Moses Stuart, then president of Andover; she was the author of the popular story *Sunnyside* (1851) and of other books. In 1854 he married her sister, who died only eighteen months later; and in 1858 he married Mary A. Johnson, of Boston.

With Professors E. A. Park and D. L. Furber he edited *Hymns and Choirs* (1860), and with Professor Park and Lowell Mason *The Sabbath Hymn Book* (1859). *The Still Hour* (1859), a summary of a series of sermons on prayer, is a devotional classic. His other works are: *The New Birth* (1867), portraying conversion (in some instances) as a gradual change; *Sabbath Hours* (1874); *Studies of the Old Testament* (1878); *Men and Books* (1882); *My Portfolio* (1882); *My Study* (1885); and *My Note Book* (1890).

See *Austin Phelps: A Memoir* (New York, 1891), by his daughter, Elizabeth Stuart Phelps-Ward.

PHELPS, EDWARD JOHN (1822–1900), American lawyer and diplomat, was born on the 11th of July 1822 at Middlebury, Vermont. He graduated from Middlebury College in 1840, was a schoolmaster for a year in Virginia, and was admitted to the bar in 1843. He began practice at Middlebury, but in 1845 removed to Burlington, Vermont. From 1851 to 1853 he was second comptroller of the United States Treasury, and then practised law in New York City until 1857, when he returned to Burlington. Becoming a Democrat after the Whig party had ceased to exist, he was debarred from a political career in his own state, where his party was in the minority, but he served in the state constitutional convention in 1870, and in 1880 was the Democratic candidate for governor of his state. He was one of the founders of the American Bar Association, and was its president in 1880–1881. From 1881 until his death he was Kent Professor of Law in Yale University. He was minister to Great Britain from 1885 to 1889, and in 1893 served as senior counsel for the United States before the international tribunal at Paris to adjust the Bering Sea controversy. His closing argument, requiring eleven days for its delivery, was an exhaustive review of the case. Phelps' lectured on medical jurisprudence at the university of Vermont in 1881–1883, and on constitutional law at Boston University in 1882–1883, and delivered numerous addresses, among them that on "The United States Supreme Court and the Sovereignty of the People" at the contennial celebration of the Federal Judiciary in 1890 and an oration at the dedication of the Bennington Battle Monument, unveiled in 1891 at the centennial of Vermont's admission to the Union. In politics Phelps was always Conservative, opposing the anti-slavery movement before 1860, the free-silver movement in 1896, when he supported the Republican presidential ticket, and after 1898 becoming an ardent "anti-expansionist." He died at New Haven, Connecticut, on the 9th of March 1900.

See the *Orations and Essays of Edward John Phelps*, edited by J. G. McCullough, with a *Memoir* by John W. Stewart (New York, 1901); and "Life and Public Services of the Hon. Edward J. Phelps," by Matthew H. Buckham, in *Proceedings* of the Vermont Historical Society (Burlington, Vt., 1901).

PHELPS, SAMUEL (1804–1878), English actor and manager, was born at Devonport on the 13th of February 1804. He was early thrown upon his own resources, and worked in various newspaper offices. Shortly after his marriage in 1826 to Sarah Cooper (d. 1867), he accepted a theatrical engagement in the York circuit at eighteen shillings a week, and afterwards appeared in south of England towns in prominent tragic rôles, attracting sufficient attention to be spoken of as a rival to Kean. He made his first London appearance on the 28th of August 1837 as Shylock at the Haymarket. After a short season there he was with Macready for about six years at Covent Garden, the Haymarket and Drury Lane successively. In 1844 he became co-lessee of Sadler's Wells Theatre with Thomas L. Greenwood and Mrs Mary Amelia Warner (1804–1854). Greenwood supplied the business capacity, Phelps was the theatrical manager, and Mrs Warner leading lady. In this position Phelps remained for twenty years, during which time he raised the Sadler's Wells house to an important position, and himself appeared in a very extensive and varied repertory. Thirty-four of Shakespeare's plays were presented there under his direction, with great educational effect, both on public and players. In 1861 Greenwood retired from the partnership, and Phelps, unable to cope with the business of management, retired from it in the following year. For the next fifteen years he acted under various managements, achieving considerable success in some of Halliday's dramatic versions of Scott's novels, such as *The Fortunes of Nigel* and *Ivanhoe*. His last appearance was in 1878 as Wolsey in *Henry VIII.*, and he died on the 6th of November 1878. He was a sound and capable actor, rather than one of any marked genius; and, in spite of his predilection for tragedy, was most successful in such characters of comedy as called for dry humour. Perhaps Sir Pertinax Macsycophant in Charles Macklin's *The Man of the World* was his finest impersonation. He published an annotated edition of Shakespeare's plays (2 vols., 1852–1854).

PHELYPEAUX, a French family of Blésois. Its two principal branches were those of the siegneurs of Herbault, La Vrillière and Saint Florentin, and of the counts of Pontchartrain and Maurepas. Raimond Phelypeaux, seigneur of Herbault and La Vrillière (d. 1629), was treasurer of the *Épargne* in 1599, and became secretary of state in 1621. His son Louis succeeded him in this latter office, and died in 1681. Balthazar Phelypeaux, marquis de Châteauneuf (d. 1700), and Louis, marquis de La Vrillière (d. 1725), respectively son and grandson of Louis, were also secretaries of state. Louis Phelypeaux (1705–1777), count of Saint Florentin and afterwards duke of La Vrillière (1770), succeeded his father as secretary of state; became minister of the king's household in 1749, a minister of state in 1751, and discharged the functions of minister of foreign affairs on the disgrace of Choiseul (1770). He incurred great unpopularity by his abuse of *lettres de cachet*, and had to resign in 1775. Raimond Balthazar Phelypeaux, seigneur du Verger, a member of the La Vrillière branch, was sent as ambassador to Savoy in 1700, where he discovered the intrigues of the duke of Savoy, Victor Amadeus II., against France; and when war was declared he was kept a close prisoner by the duke (1703–1704). At the time of his death (1713) he was governor-general in the West Indies. The branch of Pontchartrain-Maurepas was founded by Paul Phelypeaux (1569–1621), brother of the first-mentioned Raimond; he became secretary of state in 1610.

PHENACETIN, $C_2H_5O{\cdot}C_6H_4{\cdot}NHCOCH_3$ (para-acetaminophenetol), a drug prepared by acetylating para-phenetidin, or by heating para-acetylaminophenol and potassium ethyl sulphate with alcoholic soda to 150° C. Para-phenetidin is prepared by treating the sodium salt of para-nitrophenol with ethyl iodide, and reducing the nitrophenetol to para-phenetidin or aminophenetol. The yield may be doubled by diazotizing para-phenetidin, coupling with phenol, ethylating and reducing:

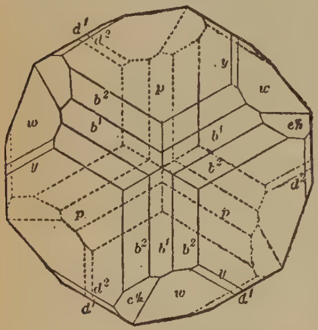
$$\mathrm{EtO{\cdot}C_6H_4{\cdot}NH_2 \rightarrow EtO{\cdot}C_6H_4{\cdot}N_2OH \rightarrow EtO{\cdot}C_6H_4{\cdot}N_2{\cdot}C_6H{\cdot}OH \rightarrow}$$
$$\mathrm{EtO{\cdot}C_6H_4{\cdot}N_2{\cdot}C_6H_4{\cdot}OEt \rightarrow 2EtO{\cdot}C_6H_4{\cdot}NH_2.}$$

It crystallizes from water in colourless plates, melting at 135° C. It is soluble in about 70 parts of hot and in about 1400 parts of cold water.

Several compounds related to phenacetin have been introduced into medicine. Triphenin is propylphenetidin; lactophenin is lactylphenetidin; pyrantin is para-ethoxyphenyl succinimide, $EtO{\cdot}C_6H_4{\cdot}N[CO{\cdot}CH_2]_2$; salophen or saliphenin is salicylphenetidin; amygdophenin is mandelylphenetidin. In addition, several other derivatives have been suggested which have a greater solubility than phenacetin, *e.g.* phesin, which is the sodium salt of phenacetin sulphonic acid, apolysin and citrophen (citrophenin), which are citric acid derivatives of para-phenetidin, &c.

Phenacetin is contained in both the British and United States pharmacopoeia, in the latter under the name of acetphenetidin. The dose is 5 to 10 grs. given in cachets or in suspension. When the drug is carelessly made it may contain impurities, producing considerable irritation of the kidneys. The physiological action of phenacetin consists in a sedative action on the sensory tracts of the spinal cord, and a depressant action on the heart, where it tends to paralyse the action of the cardiac muscle. Upon the bodily heat it exercises a marked effect, decreasing the action of the heat-producing centre as well as increasing the dissipation of heat, and thus causing a marked fall in temperature. In toxic doses the blood becomes dark and blackish from the formation of methaemoglobin, and the urine is changed in colour from the passage of altered blood. The chief therapeutic use of phenacetin is as an antineuralgic, and it is of service in migraine, rheumatism of the sub-acute type, intercostal neuralgia and locomotor ataxia.

PHENACITE, a mineral consisting of beryllium orthosilicate, Be_2SiO_4, occasionally used as a gem-stone. It occurs as isolated crystals, which are rhombohedral with parallel-faced hemihedrism, and are either lenticular or prismatic in habit: the lenticular habit is determined by the development of faces of several obtuse rhombohedra and the absence of prism faces (the accompanying figure is a plan of such a crystal viewed along the triad, or principal, axis). There is no cleavage, and the fracture is conchoidal. The hardness is high, being 7½–8; the specific gravity is 2·98. The crystals are sometimes perfectly colourless and transparent, but more often they are greyish or yellowish and only translucent; occasionally they are pale rose-red. In general appearance the mineral is not unlike quartz, for which indeed it had been mistaken; on this account it was named, by N. Nordenskiöld in 1833, from Gr. φέναξ (a deceiver).



Phenacite has long been known from the emerald and chrysoberyl mine on the Takovaya stream, near Ekaterinburg in the Urals, where large crystals occur in mica-schist. It is also found with topaz and amazon-stone in the granite of the Ilmen mountains in the southern Urals and of the Pike's Peak region in Colorado. Large crystals of prismatic habit have more recently been found in a felspar quarry at Kragerö in Norway. Framont near Schirmeck in Alsace is another well-known locality. Still larger crystals, measuring 12 in. in diameter and weighing 28 lb, have been found at Greenwood in Maine, but these are pseudomorphs of quartz after phenacite.

For gem purposes the stone is cut in the brilliant form, of which there are two fine examples, weighing 43 and 34 carats, in the British Museum. The indices of refraction ($\omega=1{\cdot}6540$, $\epsilon=1{\cdot}6527$) are higher than those of quartz, beryl or topaz; a faceted phenacite is consequently rather brilliant and may sometimes be mistaken for diamond. (L. J. S.)

PHENACODUS, one of the earliest and most primitive of the ungulate mammals, typifying the family *Phenacodontidae* and the sub-order Condylarthra. The typical *Phenacodus primaevus*, of the Lower or Wasatch Eocene of North America, was a relatively small ungulate, of slight build, with straight limbs each terminating in five complete toes, and walking in the digitigrade fashion of the modern tapir. The middle toe was the largest, and the weight of the body was mainly supported on this and the two adjoining digits, which appear to have been encased in hoofs, thus foreshadowing the tridactyle type common in perissodactyle and certain extinct groups of ungulates. The skull was small, with proportionately minute brain; and the arched back, strong lumbar vertebrae, long and powerful tail, and comparatively feeble fore-quarters all proclaim kinship with the primitive creodont Carnivora (see CREODONTA), from which *Phenacodus* and its allies, and through them the more typical Ungulata, are probably derived. All the bones of the limbs are separate, and those of the carpus and tarsus do not alternate; that is to say, each one in the upper row is placed immediately above the corresponding one in the row below. The full series of forty-four teeth was developed; and the upper molars were short-crowned, or brachyodont, with six low cones, two internal, two intermediate and two external, so that they were of the typical primitive bunodont structure. In habits the animal was cursorial and herbivorous, or possibly carnivorous.

In the Puerco, or Lowest Eocene of North America the place of the above species was taken by *Euprotogonia puercensis*, an animal only half the size of *Phenacodus primaevus*, with the terminal joints of the limbs intermediate between hoofs and claws, and the first and fifth toes taking their full share in the support of the weight of the body. These two genera may be regarded as forming the earliest stages in the evolution of the horse, coming below *Hyracotherium* (see EQUIDAE).

As ancestors of the Artiodactyle section of the Ungulata, we may look to forms more or less closely related to the North American Lower Eocene genera *Mioclaenus* and *Pantolestes*, respectively typifying the families *Mioclaenidae* and *Pantolestidae*. They were five-toed, bunodont Condylarthra, with a decided approximation to the perissodactyle type in the structure of the feet. A third type of Condylarthra from the North American Lower Eocene is represented by the family *Meniscotheriidae*, including the genera *Meniscotherium* and *Hyracops*. These, it is suggested, may have been related to the ancestral Hyracoidea. Teeth and jaws probably referable to the Condylarthra have been obtained in European early Tertiary formations. All Ungulata probably originated from Condylarthra.

See H. F. Osborn, *Skeleton of Phenacodus primaevus*; comparison with *Euprotogonia*, Bull. Amer. Mus. x. 159. (R. L.*)

PHENANTHRENE, $C_{14}H_{10}$, a hydrocarbon isomeric with anthracene, with which it occurs in the fraction of the coal tar distillate boiling between 270°–400° C. It may be separated from the anthracene oil by repeated fractional distillation, followed by fractional crystallization from alcohol (anthracene being the less soluble), and finally purified by oxidizing any residual anthracene with potassium bichromate and sulphuric acid (R. Anschutz and G. Schultz, *Ann.*, 1879, 196, p. 35); or the two hydrocarbons may be separated by carbon bisulphide, in which anthracene is insoluble. It is formed when the vapours of toluene, stilbene, dibenzyl, ortho-ditolyl, or coumarone and benzene are passed through a red-hot tube; by distilling morphine with zinc dust; and, with anthracene, by the action of sodium on ortho-brombenzyl bromide (C. L. Jackson and J. F. White, *Amer. Chem. Jour.*, 1880, 2, p. 391). It crystallizes in colourless plates or needles, which melt at 99° C. Its solutions in alcohol and ether have a faint blue fluorescence. When heated to 250° C. with red phosphorus and hydriodic acid it gives a hydride $C_{14}H_{24}$. It is nitrated by nitric acid and sulphonated by sulphuric acid. With picric acid it forms a sparingly soluble picrate, which melts at 145° C. On the condition of phenanthrene in alcoholic solution see R. Behrend, *Zeit. phys. Chem.*, 1892, 9, p. 405; 10, p. 265. Chromic acid oxidizes phenanthrene, first to phenanthrene-quinone, and then to diphenic acid, $HO_2C{\cdot}C_6H_4{\cdot}C_6H_4{\cdot}CO_2H$.

Phenanthrene-quinone, $[C_6H_4]_2[CO]_2$, crystallizes in orange needles which melt at 198° C. It possesses the characteristic properties of a diketone, forming crystalline derivatives with sodium bisulphite and a dioxime with hydroxylamine. It is non-volatile in steam, and is odourless. Sulphurous acid reduces it to the corresponding dihydroxy compound. It combines with ortho-diamines, in the presence of acetic acid, to form *phenazines*.

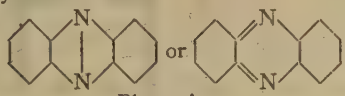
On the constitution of phenanthrene see CHEMISTRY: § *Organic*.

PHENAZINE (Azophenylene), $C_{12}H_8N_2$, in organic chemistry, the parent substance of many dyestuffs, *e.g.* the eurhodines, toluylene red, indulines and safranines. It is a dibenzoparadiazine having the formula given below. It may be obtained by distilling barium azobenzoate (A. Claus, *Ber.*, 1873, 6, p. 723); by passing aniline vapour over lead oxide, or by the oxidation of dihydrophenazine, which is prepared by heating pyrocatechin with orthophenylene diamine (C. Ris, *Ber.*, 1886, 19, p. 2206). It is also formed when ortho-aminodiphenylamine is distilled over lead peroxide (O. Fischer and E. Hepp). It crystallizes in yellow needles which melt at 171° C., and are only sparingly soluble in alcohol. Sulphuric acid dissolves it, forming a deep-red solution. The more complex phenazines, such as the naphthophenazines, naphthazines and naphthotolazines, may be prepared by condensing ortho-diamines with ortho-quinones (O. Hinsberg, *Ann.*, 1887, 237, p. 340); by the oxidation of an ortho-diamine in the presence of α-naphthol (O. Witt), and by the decomposition of ortho-anilido-(-toluidido- &c.)-azo compounds with dilute acids. If alkyl or aryl-ortho-diamines be used azonium bases are obtained. The azines are mostly yellow in colour, distil unchanged and are stable to oxidants. They add on alkyl iodides readily, forming alkyl azonium salts.

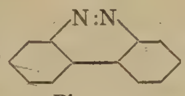
By the entrance of amino or hydroxyl groups into the molecule dyestuffs are formed. The mono-amino derivatives or *eurhodines* are obtained when the arylmonamines are condensed with ortho-amino zo compounds; by condensing quinone dichlorimide or para-nitrosodimethyl aniline with monamines containing a free para position, or by oxidizing ortho-hydroxydiaminodiphenylamines (R. Nietzki, *Ber.*, 1895, 28, p. 2976; O. Fischer, ibid., 1896, 29, p. 1874). They are yellowish-red solids, which behave as weak bases, their salts undergoing hydrolytic dissociation in aqueous solution. When heated with concentrated hydrochloric acid the amino group is replaced by the hydroxyl group and the phenolic eurhodols are produced.

The symmetrical diaminophenazine is the parent substance of the important dyestuff toluylene red or dimethyldiaminotoluphenazine. It is obtained by the oxidation of orthophenylene diamine with ferric chloride; when a mixture of para-aminodimethylaniline and meta-toluylenediamine is oxidized in the cold, toluylene blue, an indamine, being formed as an intermediate product and passing into the red when boiled; and also by the oxidation of dimethylparaphenylene diamine with metatoluylene diamine. It crystallizes in orange-red needles and its alcoholic solution fluoresces strongly. It dyes silk and mordanted cotton a fine scarlet. It is known commercially as *neutral red*. For the phenazonium salts see SAFRANINE.

Phenazone is an isomer of phenazine, to which it bears the same relation that phenanthrene bears to anthracene. It is formed by reducing diortho-dinitrodiphenyl with sodium amalgam and methyl alcohol, or by heating diphenylene-ortho-dihydrazine with hydrochloric acid to 150° C. It crystallizes in needles which melt at 156° C. Potassium permanganate oxidizes it to pyridazine tetracarboxylic acid.

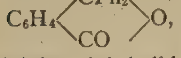


Phenazine.

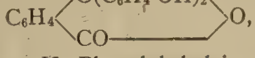


Phenazone.

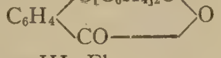
PHENOLPHTHALEIN, in organic chemistry, a compound derived from phthalophenone, or diphenyl phthalide (formula I.), the anhydride of triphenyl-carbinol-ortho-carboxylic acid, which is obtained by condensing phthalyl chloride with benzene in the presence of aluminium chloride. The phthaleins are formed from this anhydride by the entrance of hydroxyl or amino groups into the two phenyl residues, and are prepared by condensing phenols with phthalic anhydride, phenol itself giving rise to phenolphthalein (formula II.) together with a small quantity of fluorane (formula III.), whilst resorcin under similar conditions yields fluorescein (*q.v.*). The phthaleins on reduction yield phthalines, which are derivatives of triphenylmethane carboxylic acid; these reduction products are colourless and may be regarded as the leuco-compounds of the phthaleins, thus phenolphthalein itself gives phenolphthaline (formula IV.). Dehydrating agents usually convert the phenolphthalines into anthraquinone derivatives.



$$C_6H_4\left\langle\begin{matrix}CPh_2\\CO\end{matrix}\right\rangle O,$$

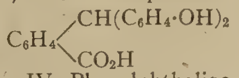


$$C_6H_4\left\langle\begin{matrix}C(C_6H_4{\cdot}OH)_2\\CO\text{———}\end{matrix}\right\rangle O,$$



$$C_6H_4\left\langle\begin{matrix}C[C_6H_4]_2O\\CO\text{———}\end{matrix}\right\rangle O$$

I. Diphenylphthalide, II. Phenolphthalein, III. Fluorane.



$$C_6H_4\left\langle\begin{matrix}CH(C_6H_4{\cdot}OH)_2\\CO_2H\end{matrix}\right.$$

IV. Phenolphthaline.

Phenolphthalein is obtained when phenol and phthalic anhydride are heated with concentrated sulphuric acid. It crystallizes in colourless crusts and is nearly insoluble in water, but dissolves in dilute solutions of the caustic alkalis with a fine red colour, being reprecipitated from these solutions by the addition of mineral acid. It dissolves in concentrated caustic alkalis to a colourless solution which probably contains salts of a non-quinonoid character. This difference in behaviour has led to considerable discussion (see H. Meyer, *Monats.*, 1899, 20, p. 337; R. Meyer, *Ber.*, 1903, 36, p. 2949; A. G. Perkin and Green, *Jour. Chem. Soc.*, 1904, p. 398). On fusion with caustic alkali, phenolphthalein yields benzoic acid and para-dihydroxybenzophenone, which shows that in the original condensation the phthalic acid residue has taken the para position to the hydroxyl groups of the phenol.

Fluorane is a product of the condensation of the phthalic acid residue in the ortho position to the hydroxyl groups of the phenol, anhydride formation also taking place between these hydroxyl groups. It dissolves in concentrated sulphuric acid with a yellowish-green fluorescence. The rhodamines, which are closely related to the phthaleins, are formed by the condensation of the alkyl meta-aminophenols with phthalic anhydride in the presence of sulphuric acid. Their salts are fine red dyes.

PHENOMENON (Gr. *φαινόμενον*, a thing seen, from *φαίνεσθαι*, to appear), in ordinary language a thing, process, event, &c., observed by the senses. Thus the rising of the sun, a thunderstorm, an earthquake are natural “phenomena.” From this springs the incorrect colloquial sense, something out of the common, an event which especially strikes the attention; hence such phrases as “phenomenal” activity. In Greek philosophy phenomena are the changing objects of the senses as opposed to essences (*τὰ ἄντα*) which are one and permanent, and are therefore regarded as being more real, the objects of reason rather than of senses which are “bad witnesses.” In modern philosophy the phenomenon is neither the “thing-in-itself,” nor the noumenon (*q.v.*) or object of pure thought, but the thing-in-itself as it appears to the mind in sensation (see especially KANT; and METAPHYSICS). In this sense the subjective character is of prime importance. Among derivative terms are “Phenomenalism” and “Phenomenology.” Phenomenalism is either (1) the doctrine that there can be no knowledge except by phenomena, *i.e.* sense-given data, or (2) the doctrine that all known things are phenomena, *i.e.* that there are no “things-in-themselves.” “Phenomenology” is the science of phenomena: every special science has a special section in which its particular phenomena are described. The term was first used in English in the 3rd edition of the *Ency. Brit.* in the article “Philosophy” by J. Robison. Kant has a special use of the term for that part of the *Metaphysic of Nature* which considers motion and rest as predicates of a judgment about things.

PHERECRATES, Greek poet of the Old Attic Comedy, was a contemporary of Cratinus, Crates and Aristophanes. At first an actor, he seems to have gained a prize for a play in 438 B.C. The only other ascertained date in his life is 420, when he produced his play *The Wild Men*. Like Crates, whom he imitated, he abandoned personal satire for more general themes, although in some of the fragments of his plays we find him attacking Alcibiades and others. He was especially famed for his inventive imagination, and the elegance and purity of his diction are attested by the epithet ἀττικώτατος (most Attic) applied to him by Athenaeus and the sophist Phrynichus. He was the inventor of a new metre, called after him Pherecratean, which frequently occurs in the choruses of Greek tragedies and in Horace.

A considerable number of fragments from his 16 (or 13) plays has been preserved, collected in T. Kock, *Comicorum Atticorum Fragmenta*, i. (1880), and A. Meineke, *Poetarum Comicorum Graecorum Fragmenta* (1855).

PHERECYDES OF LEROS, Greek mythographer, *fl. c.* 454 B.C. He is probably identical with Pherecydes of Athens, although the two are distinguished by Suïdas (also by I. Lipsius, *Quaestiones logographicae*, 1886). He seems to have been born in the island of Leros, and to have been called an Athenian because he spent the greater part of his life and wrote his great work there. Of his treatises, *On Leros*, *On Iphigeneia*, *On the Festivals of Dionysus*, nothing remains; but numerous fragments of his genealogies of the gods and heroes, variously called Ἱστορίαι, Γενεαλογίαι, Αὐτοχθόνες, in ten books, written in the Ionic dialect, have been preserved (see C. W. Müller's *Frag. hist. graec.*, vol. i. pp. xxxiv., 70). He modified the legends, not with a view to rationalizing them, but rather to adjust them to popular beliefs. He cannot, therefore, be classed with Hecataeus, whose method was far more scientific.

See C. Lütke, *Pherecydea* (diss. Göttingen, 1893); W. Christ, *Geschichte der griechischen Litteratur* (1898); and specially H. Bertsch, *Pherekydeische Studien* (1898).

PHERECYDES OF SYROS, Greek philosopher (or rather philosophical theologian), flourished during the 6th century B.C. He was sometimes reckoned one of the Seven Wise Men, and is said to have been the teacher of Pythagoras. With the possible exception of Cadmus (*q.v.*) of Miletus, he was the first Greek prose-writer. He belonged to the circle of Peisistratus at Athens, and was the founder of an Orphic community. He is characterized as "one of the earliest representatives of a half-critical, half-credulous eclecticism" (Gomperz). He was credited with having originated the doctrine of metempsychosis (*q.v.*), while Cicero and Augustine assert that he was the first to teach the immortality of the soul. Of his astronomical studies he left a proof in the "heliotropion," a cave at Syros which served to determine the annual turning-point of the sun, like the grotto of Posillipo (Posilipo, Posilippo) at Naples, and was one of the sights of the island.

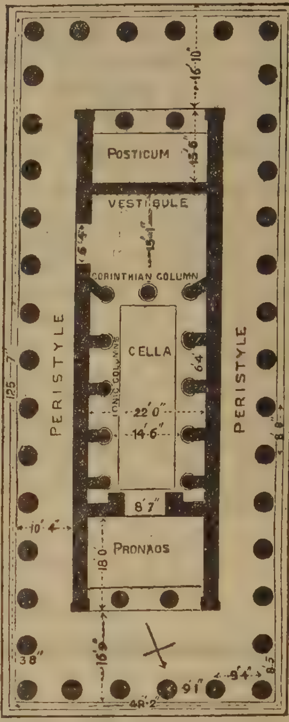
In his cosmogonic treatise on nature and the gods, called *Πεντέμυχος* (Preller's correction of Suïdas, who has *ἑπτάμυχος*) from the five elementary or original principles (aether, fire, air, water, earth; Gomperz substitutes smoke and darkness for aether and earth), he enunciated a system in which science, allegory and mythology were blended. In the beginning were Chronos, the principle of time; Zeus (Zas), the principle of life; and Chthoniē, the earth goddess. Chronos begat fire, air and water, and from these three sprang numerous other gods. Smoke and darkness appear in a later tradition. A fragment of the "sacred marriage" of Zas and Chthoniē was found on an Egyptian papyrus at the end of the 19th century.

See H. Diels, *Fragmente der Vorsokratiker* (1903); also O. Kern, *De Orphei, Epimenidis, Pherecydis theogoniis* (1888); D. Speliotopoulos, *Περὶ Φερεκύδου τοῦ Συρίου* (Athens, 1890); T. Gomperz, *Greek Thinkers* (Eng. trans.), i. 85; B. P. Grenfell, *New Classical Fragments* (1897); H. Weil, *Études sur l'antiquité grecque* (1900).

PHIGALIA, or PHIGALEIA (*Φιγάλια* or *Φιγαλεία*; mod. *Pavlitsa*), an ancient Greek city in the south-west angle of Arcadia, situated on an elevated rocky site, among some of the highest mountains in the Peloponnesus—the most conspicuous being Mt Cotylium and Mt Elasum; the identification of the latter is uncertain.

In 659 B.C. Phigalia was taken by the Lacedaemonians, but soon after recovered its independence by the help of the Orasthasians. During the struggle between Achaeans and Aetolians in 221 B.C. it was held by Dorimachus, who left it on the approach of Philip V. of Macedon. In common with the other cities of Arcadia, it appears from Strabo to have fallen into utter decay under the Roman rule. Several curious cults were preserved near Phigalia, including that of the fish-tailed goddess Eurynome and the Black Demeter with a horse's head, whose image was renewed by Onatas. Notices of it in Greek history are rare and scanty. Though its existing ruins and the description of Pausanias show it to have been a place of considerable strength and importance, no autonomous coins of Phigalia are known. Nothing remains above ground of the temples of Artemis or Dionysus and the numerous statues and other works of art which existed at the time of Pausanias's visit, about A.D. 170. A great part of the city wall, built in fine Hellenic masonry, partly polygonal and partly isodomous, and a large square central fortress with a circular projecting tower, are the only remains now traceable—at least without the aid of excavation. The walls, once nearly 2 m. in circuit, are strongly placed on rocks, which slope down to the little river Neda.

One very important monument still exists in a fairly perfect state; this is a temple dedicated to Apollo Epicurius (the Preserver), built, not at Phigalia itself, but at Bassae, 5 or 6 m. away, on the slope of Mt Cotylium; it commemorates the aid rendered by Apollo in stopping a plague which in the 5th century B.C. was devastating Phigalia. This temple is mentioned by Pausanias (viii. 41) as being (next to that of Tegea) the finest in the Peloponnesus, "from the beauty of its stone and the symmetry of its proportions." It was designed by Ictinus, who, with Callicrates, was joint architect of the Parthenon at Athens. Though visited by Chandler, Dodwell, Gell, and other English travellers, the temple was neither explored nor measured till 1811–1812, when C. R. Cockerell and some other archaeologists spent several months in making excavations there. After nearly fifty years' delay, Professor Cockerell published the results of these labours, as well as of his previous work at Aegina, in *Temples of Aegina and Bassae* (1860), one of the most careful and beautifully illustrated archaeological works produced. The labours of Cockerell and his companions were richly rewarded; not only were sufficient remains of the architectural features discovered to show clearly the whole design, but the internal sculptured frieze of the cella was found almost perfect. This and other fragments of its sculpture are now in the British Museum. The colonnade of the temple has been recently restored by the Greek authorities.



Plan of the Temple at Bassae.

The figure shows the plan of the temple, which is of the Doric order, but has an internal arrangement of its cella unlike that of any other known temple. It stands on an elevated and partly artificial plateau, which commands an extensive view of the oak-clad mountains of Arcadia, reaching away to the blue waters of the Messenian Gulf. Unlike other Doric temples, which usually stand east and west, this is placed north and south; but it has a side entrance on the east. It is hexastyle, with fifteen columns on its flanks; thirty-four out of the thirty-eight columns of the peristyle are still standing, with the greater part of their architrave, but the rest of the entablature and both pediments have fallen, together with the greater part of the internal columns of the cella. It will be seen from the plan that these are very strangely placed, apparently without symmetry, as regards the interior, though they are set regularly opposite the voids in the peristyle.

With the exception of one at the south end, which is Corinthian, the internal columns are of the Ionic order, and are engaged with the cella-wall, forming a series of recesses, which may have been designed to contain statues. Another peculiarity of this interior is that these columns reach to the top of the cella in one order, not in two ranges of columns, one over the other, as was the usual Doric fashion. These inner columns carried an Ionic entablature, of which the frieze now in the British Museum formed a part. The pediments and external metopes of the peristyle appear to have contained no sculpture, but the metopes within the peristyle on the exterior of the cella had sculptured subjects; only a few fragments of these were, however, discovered. The position occupied by the great statue of Apollo is a difficult problem. Cockerell, with much probability, places it in the southern portion of the cella, facing the eastern side door, so that it would be lighted up by the rays of the rising sun. The main entrance is at the northern end through the pronaos, once defended by a door in the end of the cella and a metal screen, of which traces were found on the two columns of the pronaos. There was no door between the posticum and the cella. The general proportions of the fronts resemble those of the Theseum at Athens, except that the entablature is less massive, the columns thicker, and the diminution less—all proportionally speaking. In plan the temple is long in proportion to its width—measuring, on the top of the stylobate, 125 ft. 7 in. by 48 ft. 2 in., while the Theseum (built probably half a century earlier) is about 104 ft. 2 in. by 45 ft. 2 in.

The material of which the temple is built is a fine grey limestone (once covered with painted stucco), except the roof-tiles, the capitals of the cella columns, the architraves, the *lacunaria* (ceilings) of the posticum and pronaos, and the sculpture, all of which are of white marble. The roof-tiles, specially noticed by Pausanias, are remarkable for their size, workmanship, and the beauty of the Parian marble of which they are made. They measure 2 ft. 1 in. by 3 ft. 6 in., and are fitted together in the most careful and ingenious manner. Unlike those of the Parthenon and the temple of Aegina, the *ἁρμοί* or "joint-tiles" are worked out of the same piece of marble as the flat ones, for the sake of more perfect fitting and greater security against wet.

Traces of painting on various architectural members were found by Cockerell, but they were too much faded for the colours to be distinguished. The designs are the usual Greek patterns—the fret, the honeysuckle, and the egg and dart.

The sculpture is of the greatest interest, as being designed to decorate one of the finest buildings in the Peloponnesus in the latter half of the 5th century B.C.; see *Brit. Mus. Catalogue of Sculpture*, vol. i

The frieze, now in the British Museum, is complete; it is nearly 101 ft. long by 2 ft. high, carved in relief on twenty-three slabs of marble $4\frac{1}{2}$ to 5 in. thick. The subjects are the battle of the Lapithae and the Centaurs, and that between the Amazons and the Greeks, the two favourite subjects in Greek plastic art of the best period. They are designed with wonderful fertility of invention, and life-like realism and spirit; the composition is arranged so as to form a series of diagonal lines or zigzags *M*; thus forming a pleasing contrast to the unbroken horizontal lines of the cornice and architrave. The various groups are skilfully united together by some dominant line or action, so that the whole subject forms one unbroken composition.

The relief is very high, more than 3½ in. in the most salient parts, and the whole treatment is quite opposite to that of the Parthenon frieze, which is a very superior work of art to that at Bassae. Many of the limbs are quite detached from the ground; the drill has been largely used to emphasize certain shadows, and in many places, for want of due calculation, the sculptor has had to cut into the flat background behind the figures. From this it would appear that no finished clay-model was prepared, but that the relief was sculptured with only the help of a drawing. The point of sight, more than 20 ft. below the bottom of the frieze, and the direction in which the light fell on it have evidently been carefully considered. Many parts, invisible from below, are left comparatively rough. The workmanship throughout is unequal, and the hands of several sculptors can be detected. On the whole, the execution is not equal to the beauty of the design, and the whole frieze is somewhat marred by an evident desire to produce the maximum of effect with the least possible amount of labour—very different from the almost gem-like finish of the Parthenon frieze. Even the design is inferior to the Athenian one; most of the figures are ungracefully short in their proportions, and there is a great want of refined beauty in many of the female hands and faces. It is in the fire of its varied action and its subtlety of expression that this sculpture most excels. The noble movements of the heroic Greeks form a striking contrast to the feminine weakness of the wounded Amazons, or the struggles with teeth and hoofs of the brutish Centaurs; the group of Apollo and Artemis in their chariot is full of grace and dignified power. The marble in which this frieze is sculptured is somewhat coarse and crystalline; the slabs appear not to have been built into their place but fixed afterwards, with the aid of two bronze bolts driven through the face of each.

Of the metopes, which were 2 ft. 8 in. square, only one exists nearly complete, with eleven fragments; the one almost perfect has a relief of a nude warrior, with floating drapery, overcoming a long-haired bearded man, who sinks vanquished at his feet. The relief of these is rather less than that of the frieze figures, and the work is nobler in character and superior in execution.

In addition to the works mentioned in the text, see Leake, *Morea* (i. 490 and ii. 319; Curtius, *Peloponnesos.* i. 319; Ross, *Reisen in Peloponnesos*; Stackelberg, *Der Apollo-Tempel zu Bassae* (1826); Lenormant, *Bas-reliefs du Parthenon et de Phigalie* (1834); and Histories of Sculpture mentioned under Greek Art.

(J. H. M.; E. Gr.)

PHILADELPHIA, the Greek name (1) of a city in Palestine in the land of Ammon (see Ammonites), and (2) of a city so-called in honour of Attalus II. of Pergamum, the modern Ala-Shehr (*q.v.*).

PHILADELPHIA, the third city in population in the United States, the chief city of Pennsylvania, and a port of entry, co-extensive with Philadelphia county, extending W. from the Delaware river beyond the Schuylkill River, and from below the confluence of the Delaware and Schuylkill rivers N.E. about 23 m. along the Delaware river and Poquessing Creek. Independence Hall, which is a few squares east by south of the city hall, is in 39° 56′ 57·5″ N. and 75° 8′ 54·75″ W. The port is about 102 m. from the Atlantic Ocean, and the city hall is 90 m. by rail S.S.W. of New York and 135 m. N.E. of Washington. The city has an area of 132·7 sq. m. At the southern extremity are lowlands protected by dikes from the tide; the business centre between the rivers is about 40 ft. higher but level; the district west of the Schuylkill is generally rolling; and in the upper district the surface rises from the Delaware toward the north-west until in the extreme north-west is a picturesque district overlooking Wissahickon Creek from hills exceeding 400 ft. in height.

Population.—When the first United States census was taken, in 1790, Philadelphia was the second largest city in the Union, and had a population of 28,522. It held this rank until 1830, when it was exceeded in size by Baltimore as well as by New York. In 1850 it was smaller also than Boston; but in 1854 the Consolidation Act extended its boundaries so as to include all Philadelphia county and in 1860 the city had risen again to second rank. This rank it held until 1890 when, although its population had grown to 1,046,964, it was 50,000 less than that of Chicago. In 1900, with a population of 1,293,679, it was still farther behind both New York and Chicago. In 1900, of the total population, 998,357, or 77·18%, were native-born, as against only 63% native-born in New York and 65·43% native-born in Chicago. Of Philadelphia's native-born white population, however, 414,093, or 44·24%, were of foreign-born parentage. The foreign-born population included 98,427 born in Ireland, 71,319 born in Germany, 36,752 born in England, 28,951 born in Russia (largely Hebrews), 17,830 born in Italy, 8479 born in Scotland and 5154 born in Austria; and the coloured consisted of 62,613 negroes, 1165 Chinese, 234 Indians and 12 Japanese. In 1910 the population was 1,549,008.

Streets.—With the exception of a limited number of diagonal thoroughfares and of streets laid out in outlying districts in conformity with the natural contour of the ground the plan of the city is regular. Market Street—which Penn called High Street—is the principal thoroughfare east and west, Broad Street the principal thoroughfare north and south, and these streets intersect at right angles at City Hall Square in the business centre. The streets parallel with Broad are numbered from First or Front Street west from the Delaware River to Sixty-Third Street, taking the prefix "North" north of Market Street and the prefix "South" south of it; the streets parallel with Market are named mostly from trees and from the governors and counties of Pennsylvania.

The wholesale district is centred at the east end of Market Street near the Delaware river. The best retail shops are farther west on the south side of Chestnut Street and on Market and Arch streets. Most of the leading banks and trust companies are on Chestnut Street and on Third Street between Chestnut and Walnut streets. Several of the larger office buildings and the stations of the Pennsylvania and the Philadelphia & Reading railways are in the vicinity of the city hall; here too, are the Baldwin Locomotive Works. The large textile mills, the great coal wharves and the Cramp Ship-Yards are to the north-east along the Delaware, and in districts west of these are the leading manufactories of iron and steel. There are large sugar refineries in the south-eastern part of the city. Rittenhouse Square, a short distance south-west of the city hall, is the centre of the old aristocratic residential district, and the south side of Walnut Street between Fourteenth and Nineteenth streets is a fashionable parade. There are fine residences on North Broad Street and on some of the streets crossing it, and many beautiful villas in the picturesque suburbs of the north-west. The most congested tenements, occupied largely by Italians, Hebrews and negroes, are along the alleys between the rivers and south of Market Street, often in the rear of some of the best of the older residences.

The principal structure is the city hall (or "Public Buildings") one of the largest buildings in the world in ground space (4½ acres). It rises 548 ft. to the top of a colossal bronze statue (37 ft. high) of William Penn (by Alexander Calder) surmounting the tower. It accommodates the state and county courts as well as the municipal and county offices. The foundation stone was laid in August 1872. On its first floor is Joseph A. Bailly's statue of Washington, which was erected in front of Independence Hall in 1869. About the Public Buildings are statues of Generals McClellan and Reynolds, President McKinley, and Joseph Leidy and St Gaudens's "Pilgrim." On all sides are great buildings: on the north the masonic temple (1868–1873); on the south the stately Betz Building; on the west the enormous Broad Street station of the Pennsylvania railway. The Pennsylvania Academy of Fine Arts and the Oddfellows' Temple are among other notable buildings in the vicinity. The post office, facing Ninth Street and extending from Market Street to Chestnut Street, was opened in 1884; in front is a seated statue of Benjamin Franklin, by John J. Boyle. The mint is at the corner of Sixteenth and Spring Garden streets. The custom-house, on Chestnut Street, was designed by William Strickland (1787–1854), in his day the leading American architect. It was modelled after the Parthenon of Athens, was built for the Second United States Bank, was completed in 1824, and was put to its present use in 1845. Other prominent buildings of which Strickland was the architect are the stock exchange, St Paul's Protestant Episcopal Church, St Stephen's Church, the almshouse and the United States Naval Asylum. The main building of Girard College (on Girard Avenue, between North 19th and North 25th streets), of which Thomas Ustick Walter (1804–1887), a pupil of Strickland's, was the architect, is one of the finest specimens of pure Greek architecture in America. Near the Schuylkill river, in West Philadelphia, are the buildings of the university of Pennsylvania. Its free museum of science and art, at South 23rd and Spruce, on the opposite side of the river, was built from the designs of Walter Cope, Frank Miles Day and Wilson Eyre, and its north-western part was first opened in 1899. Tall steel-frame structures, of which the Betz Building, completed in 1893, was the first, have become numerous. The Roman Catholic Cathedral of St Peter and St Paul, east of Logan Square, was begun in 1846 and was eighteen years in building. The Arch Street Methodist Episcopal Church is one of the most handsome churches in the city. The South Memorial Church of the Advocate (1897), on North 18th and Diamond streets, is a reproduction on a smaller scale of Amiens Cathedral.

Perhaps the most famous historical monument in the United States is Independence Hall, on Chestnut Street between Fifth and Sixth streets, designed for the state house by Andrew Hamilton (*c.* 1676–1741), speaker of the assembly, and was used for that purpose until 1799. The foundations were laid in 1731 and the main building was ready for occupancy in 1735, although the entire building was not completed until 1751. The steeple was taken down in 1774 but was restored by Strickland in 1828, and further restorations of the building to its original condition were effected later. In the east room on the first floor of this building the second Continental Congress met on the 10th of May 1775, George Washington was chosen commander-in-chief of the Continental army on the 15th of June 1775, and the Declaration of Independence was adopted on the 4th of July 1776. The room contains much of the furniture of those days, and on its walls are portraits of forty-five of the fifty-six signers of the Declaration and a portrait of Washington by Peale. At the head of the stairway is the famous Liberty bell, which bears the inscription, "Proclaim liberty through all the land unto all the inhabitants thereof" and is supposed (without adequate evidence) to have been the first bell to announce the adoption of the Declaration of Independence. It was cast in England in 1752, was cracked soon after it was brought to America, was recast with more copper in Philadelphia, and was cracked again in 1835 while being tolled in memory of Chief Justice John Marshall, and on the 22nd of February 1843 this crack was so increased as nearly to destroy its sound. On the second floor is the original of the charter which William Penn granted to the city in 1701 and the painting of Penn's treaty with the Indians by Benjamin West. The building has been set apart by the city, which purchased it from the state in 1816, as a museum of historical relics. On the north-west corner of Independence Square is old Congress hall, in which Congress sat from 1790 to 1800, and in which Washington was inaugurated in 1793 and Adams in 1797. At the north-east corner is the old city-hall, on the second floor of which the Supreme Court of the United States sat from 1791 to 1900. A short distance east of Independence Square in Carpenters' Hall, in which the first continental congress assembled on the 5th of September 1774 and in which the national convention in 1787 framed the present constitution of the United States; the building was also the headquarters of the Pennsylvania committee of correspondence, the basement was used as a magazine for ammunition during the War of Independence, and from 1791 to 1797 the whole of it was occupied by the First United States Bank. The Carpenters' Company (established in 1724) erected the building in 1770, and since 1857 has preserved it wholly for its historic associations. On Arch Street near the Delaware is preserved as a national monument the house in which Betsy Ross, in 1777, made what has been called the first United States flag, in accordance with the resolution of Congress of the 14th of June. Not far from this house is Christ Church (Protestant Episcopal), a fine colonial edifice designed mainly by Dr John Kearsley (1684–1772). The corner stone was laid in 1727, but the steeple, in part designed by Benjamin Franklin and containing a famous chime of eight bells, was not completed until 1754. The interior was restored to its ancient character in 1882, the pews of Washington and Franklin are preserved, and a set of communion plate presented to the church by Queen Anne in 1708 is used on great occasions. In the churchyard are the graves of Benjamin Franklin, Robert Morris, Brigadier-General John Forbes, John Penn, Peyton Randolph, Francis Hopkinson and Benjamin Rush. St Peter's, the second Protestant Episcopal Church in the city, has a massive tower and a simple spire; within are the original pews. In the south-east part of the city near the Delaware is the ivy-clad Old Swedes' Church, built of brick in 1698–1700. The house which William Penn built about 1683 for his daughter Letitia was removed to Fairmount Park and rebuilt in 1883. In Germantown (*q.v.*), a suburb which was annexed in 1854, are several other historic buildings.

The dominant feature of the domestic architecture is the long rows, in street after street, of plain two-storey or three-storey dwellings of red ("Philadelphia") pressed brick with white marble steps and trimmings, and with white or green shutters, each intended for one family.

Parks.—Fairmount Park extends along both banks of the Schuylkill for about 5 m. and from the confluence of the Schuylkill and Wissahickon Creek it continues up the latter stream through a romantic glen for 6 m. Its area is about 3418 acres. Five acres of an estate belonging to Robert Morris during the War of Independence and known as "Fair Mount," or "The Hills," were purchased by the municipality for "a city waterworks and for park purposes" in 1812, and from this beginning the park grew to its present dimensions by purchases and gifts. The principal buildings in the park are: the McPherson mansion, once the property of Benedict Arnold and in October 1780 confiscated by the committee of safety; the Peters (or Belmont) Mansion, built in 1745 and much frequented by the notables of the Revolutionary and early national period; the birth-place of David Rittenhouse, the astronomer, and a monastery of the German pietists, both on the banks of Wissahickon; and memorial hall and horticultural hall, both survivals of the centennial exhibition of 1876. On Lemon Hill, near the south end of the park, stands the Robert Morris mansion; in the vicinity is the cabin which was General U. S. Grant's headquarters at City Point, Virginia, during the winter of 1864–1865. Near the Columbia Avenue entrance to the park and near the East Park Reservoir are the children's playhouse and playground, endowed by the will of Mrs Sarah A. Smith (d. 1895). At the Green Street entrance is an imposing monument to Washington, designed by Rudolph Siemering and erected by the Society of the Cincinnati in 1896–1897, with a bronze equestrian statue. The Smith Memorial entrance, white granite with bronze statues, was erected in memory of the officers of the Civil War. The park also contains[1] a monument to Lincoln by Randolph Rogers; an equestrian statue of Grant by Daniel Chester French and Edward C. Potter; an equestrian statue of Major-General James Gordon Meade by Alexander Milne Calder; an equestrian statue of Joan of Arc by Emmanuel Fremiet; an heroic bust of James A. Garfield by Augustus St Gaudens; statues of Columbus, Humboldt, Schiller and Goethe; a Tam O' Shanter group of four figures in red sandstone by James Thom; John J. Boyle's "Stone Age in America"; Cyrus Edwin Dallin's "Medicine Man"; Wilhelm Wolff's "Wounded Lioness" (at the entrance to the Zoological Gardens); Albert Wolff's "Lion Fighter"; Auguste Nicolas Cain's "Lioness bringing a Wild Boar to her Cubs"; Edward Kemeys's "Hudson Bay Wolves"; Frederick Remington's "Cow Boy"; and several artistic fountains, and a Japanese temple-gate. In the down-town district, Franklin, Washington, Rittenhouse and Logan squares, equidistant from the city-hall, have been reserved for public parks from the founding of the city; in Rittenhouse Square is the bronze "Lion and Serpent" of A. L. Barye. In Clarence H. Clark Park, West Philadelphia, is Frank Edwin Elwell's group "Dickens and Little Nell." In Broad and Spring Garden streets opposite the Baldwin Locomotive Works is Herbert Adams's statue of Matthias William Baldwin (1795–1866), founder of the works. Close to the bank of the Delaware, some distance N.N.E. of the city-hall, is the small Penn Treaty Park with a monument to mark the site of the great elm tree under which Penn, according to tradition, negotiated his treaty with the Indians in 1683. In the south-west part of the city, along the Schuylkill, is Bartram's botanical garden (27 acres), which the city added to its park system in 1891; in it is the stone house, with ivy-covered walls, which the famous botanist built with his own hands.

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[1] Many of the statues and other works of art in Fairmount and other parks are the gift of the Fairmount Park Art Association (1871; reorganized in 1888 and 1906).

Through the efforts of the City Park Association, organized in 1888, a number of outlying parks, connecting parkways and small triangular or circular parks, have been placed on the city plan. Among these are League Island Park (300 acres), opposite the United States navy yard on League Island; Penny Pack Creek Park (about 1200 acres), extending 6½ m. along Penny Pack Creek, in the north-east; Cobb's Creek Park, extending about 4 m. along the western border; Fairmount Parkway, 300 ft. wide on a direct line south-east from Fairmount Park to Logan Square and somewhat narrower from Logan Square to the city-hall; and Torresdale Parkway (300 ft. wide and 10½ m. long), from Hunting Park, 4½ m. north of the city-hall, along a direct line north-east to the city limits. A plaza at the intersection of Broad and Johnson streets, radiating streets therefrom, and the widening of Broad Street to 300 ft. from this plaza to League Island Park are also on the city plan. Laurel Hill cemetery, on a high bank of the Schuylkill and contiguous to Fairmount Park, is the city's principal burying ground; in it are the tombs of Dr Elisha Kent Kane, the Arctic explorer, and Major-General Meade.

Theatres.—The first Shakespearean performance in the United States was probably at Philadelphia in 1749; another company played there in 1754 and 1759; and in 1766 was built the Old Southwark theatre, in which Major John André and Captain John Peter De Lancey acted during the British occupation of the city, and which after twenty years of illegal existence was opened "by authority" in 1789. The Walnut Street theatre (1808) is said to be the oldest play-house in the United States. Other theatres are the Garrick, the large Academy of Music, the Chestnut Street opera house, the Lyric, the Adelphi, the Park and the German.

Clubs.—Among social clubs are the Union League, the University (1881), the Philadelphia, the City, the Markham, the Manufacturers (1887), the Rittenhouse, the Lawyers, the Clover, the Pen and Pencil, the Art, the Mercantile, several country clubs and athletic clubs (notably the Racket), and the foremost cricket clubs in the United States, the Belmont, the Philadelphia, the Keystone, the Merion (at Haverford), and the Germantown (at Manheim).

Museums, Learned Societies and Libraries.—In the southern part of Fairmount Park is a zoological garden with an excellent collection. Its site is the former estate of John Penn, grandson of William Penn. The collection is an outgrowth of the museum, the first in the United States, opened by Charles Willson Peale in Independence Hall in 1802. It is now owned by the Zoological Society (incorporated in 1859) and was opened in 1874. Other museums in Fairmount Park are: the botanical collection in horticultural hall; and in memorial hall the general art collections of the Pennsylvania Museum and School of Industrial Arts and the Wilstach collection of paintings (about 500), including examples of the Italian schools from the 15th to the 17th centuries and of modern French and American painters. Bartram's botanical garden, mentioned above as a city park, was established in 1728 by John Bartram (1699–1777) and is the oldest botanical garden in America. The Philadelphia Commercial Museums, founded in 1894, is a notable institution for promoting the foreign commerce of the United States, having a collection of raw materials and manufactured products from all countries, a laboratory and a library. The institution investigates trade conditions and the requirements of markets in all parts of the world, maintains a bureau of information, issues a weekly bulletin for American exporters and a monthly publication for foreign buyers, and has published several "foreign commercial guides" and other commercial works. The museum is maintained chiefly by municipal appropriations and by fees. Its control is vested in "The Board of Trustees of the Philadelphia Museums," composed of fourteen citizens of Philadelphia chosen for life and eight *ex officio* members who are the incumbents of the leading state and municipal offices. There are home and foreign advisory boards, and the immediate management is under a director. In 1727 Franklin, then in his twenty-second year, formed most of his "ingenious acquaintance into a club," which he called the Junto, "for mutual improvement," and out of the Junto grew in 1731 the library of the Library Company of Philadelphia, which he spoke of as the "mother of all North American subscription libraries," but which was not the first subscription library in North America. The Library Company of Philadelphia absorbed in 1769 the Union Library, which had been founded some years before; and in 1792 the Loganian library, a valuable collection of classical and other works provided for under the will of James Logan, a friend of Penn, was transferred to it. Subsequently it acquired by bequest the libraries of the Rev. Samuel Preston of London and of William Mackenzie of Philadelphia. Among the rarities in the latter was a copy of Caxton's *Golden Legend* (1486). In 1869 the Library Company was made the beneficiary, under the will of Dr James Rush (1786–1869), of an estate valued at about a million dollars, and with this money the Ridgway branch was established in 1878. The library has owned its building since 1790; the building on the present site was opened in 1880 and was enlarged in 1889.

The American Philosophical Society, founded by Franklin in 1743, is the oldest and the most famous academy of science in America. Its organization was the immediate consequence of a circular by Franklin entitled, *A Proposal for Promoting Useful Knowledge among the British Plantations in America.* In 1769 it united with (and officially took the name of) "The American Society held at Philadelphia for Promoting Useful Knowledge." Among its early presidents were Franklin, Rittenhouse and Jefferson. It has a valuable library—about 50,000 vols.—containing the great mass of the correspondence of Franklin; here, too, are many interesting relics, among them the chair in which Jefferson sat while writing the Declaration of Independence and an autograph copy of the Declaration. The society has published 27 quarto vols. of *Transactions* (1771–1908); its *Proceedings* have been published regularly since 1838, and in 1884 those from 1744 to 1838, compiled from the manuscript minutes, were also published. The Academy of Natural Sciences of Philadelphia, founded in 1812, has been noted for its collection of birds since it acquired, in 1846, the collection of the duc de Rivoli numbering more than 12,000 specimens; several smaller collections have since been added. The academy has a notable collection of shells and fossils and the "types" of Leidy, Cope, Say, Conrad and other naturalists, and a library. It is composed of the following "sections": biological and microscopical (1868), entomological (1876), botanical (1876), mineralogical and geological (1877) and ornithological (1891). It has published a *Journal* since 1817 and its *Proceedings* since 1841, and periodicals on entomology, conchology and ornithology. To a few young men and women it gives training in scientific investigation without charge. The Pennsylvania Historical Society, organized in 1824, has a valuable collection of historical material, including the papers of the Penn family and the Charlemagne Tower collection of American colonial laws, and many early American printed handbills and books (especially of Bradford, Franklin and Christopher Saur), portraits and relics. With the proceeds of the society's publication fund the *Pennsylvania Magazine of History and Biography* has been published since 1877. The Numismatic and Antiquarian Society of Philadelphia, organized in 1858, is the oldest numismatic organization in the United States; it has a collection of coins, and since 1865 it has published its *Proceedings.* The College of Physicians and Surgeons has an excellent medical library. The free library of Philadelphia (established 1891) includes a main library and several branches. Other important libraries are that of the university of Pennsylvania, the Mercantile, that of Franklin Institute, that of the Law Association of Philadelphia, the Athenaeum, that of the German Society of Pennsylvania, and Apprentices'. The free museum of science and art of the university of Pennsylvania has valuable archaeological collections, notably the American and the Babylonian collections made by university expeditions.

Schools.—William Penn in his frame of government provided for a committee of manners, education and art. The assembly, in March 1683, passed an act which provided that all children should be taught to read and write by the time they were twelve years of age, that then they should be taught some useful trade, and that for every child not so taught the parent or guardian should be fined five pounds. At a meeting of the provincial council held in Philadelphia in 1683 the governor and council appointed as schoolmaster, Enoch Flower, who for twenty years had held that position in England. But schools were left almost wholly to private initiative until 1818. The first grammar school, commonly known in its early years as the Friends' free school, was established in 1689 under the care of the celebrated George Keith; although maintained by the Friends it was open to all, and for more than sixty years was the only public place for free instruction in the province. It was chartered by Penn in 1701, 1708 and 1711, in time became known as the William Penn Charter School, and is still a secondary school on Twelfth Street. In 1740 a building was erected for a "charity school" and for a "house of worship," but the school had not been opened when, in 1749, Franklin published his *Proposals relating to the Education of Youth in Pensilvania.* Under the influence of this publication a new educational association was formed which purchased the building and in January 1751 opened in it an institution that was chartered as an "academy and charitable school" in 1753, was rechartered as a college and academy in 1755, and became the university of Pennsylvania by act of the state legislature passed in 1791. The university occupied the site of the present post office from 1802 until 1872, but was then removed to grounds near the western bank of the Schuylkill.

The foundation of the present public school system was laid in 1818 by an act of the legislature which constituted the city and county of Philadelphia the first school district of Pennsylvania and provided for the establishment therein of free schools for indigent orphans and the children of indigent parents; the same act authorized the establishment of a model school for the training of teachers, which was the pioneer school for this purpose in America. In 1834 free elementary schools were authorized for all children of school age, and since then the system has developed until it embraces the Central High School for boys, which has a semi-collegiate course with a department of pedagogy and confers the degrees of B.A. and B.S.; a Normal High School for girls, into which the model school was converted in 1848, in which most of the teachers of the city are trained and which only graduates of the Girls' High School are permitted to enter; the William Penn High School for girls (opened 1909) with academic, commercial, applied arts, household science and library economy departments; a School of industrial arts; two manual training schools; about one hundred night schools (attended mainly by adults); several special schools for habitual truants or insubordinate and disorderly children; and a number of vacation schools and playgrounds for the summer season. In 1909 district high schools were planned as a part of the public school system. The city has also many private high schools and academies.

Besides the university of Pennsylvania and the Central High School for boys the collegiate institutions are La Salle College (Roman Catholic; opened in 1867) and the Temple University (non-sectarian; chartered in 1888 as Temple College after four years of teaching; in 1891 received the power to confer degrees); which is designed especially for self-supporting men and women and was founded by Russell Hermann Conwell (b. 1842), a lawyer and journalist, who entered the Baptist ministry in 1879, was pastor of the Grace Baptist Church of Philadelphia in 1881–1891, became pastor of the Grace Baptist Temple in 1891, and was a public lecturer. He was the first president of the Temple College, which was begun in connexion with the work of his church. Temple University offers instruction both day and evening, has classes from the kindergarten to the highest university grades, and courses in business, civil engineering, domestic art and domestic science, physical training, pedagogy and music; it has a theological school (1893), a law school (1894), a medical school (1901) and a school of pharmacy (1902); and in 1907 the Philadelphia Dental College, one of the best known dental schools in the country, joined the university. In 1893 a trust fund left by Hyman Gratz was used to found the Gratz College for the education of teachers in Jewish schools and for the study of the Hebrew language, and Jewish history, literature and religion; the college is under the control of the Kaal Kidosh Mikoe Israel of Philadelphia. Bryn Mawr College (*q.v.*), one of the leading institutions in America for the higher education of women, is a few miles beyond the city limits. Schools of medicine, for which Philadelphia has long been noted, include the department of medicine of the university of Pennsylvania (opened in 1765); Jefferson Medical College (1825); the Woman's Medical College (1850), the first chartered school of medicine for women to confer the degree of M.D.; the Medico-Chirurgical College (1881); Hahnemann (homoeopathic) Medical College (1888); and the department of medicine of Temple University (1901). Among other professional schools are the department of law of the university of Pennsylvania (1790), the law school of Temple University (1894); the divinity school of the Protestant Episcopal Church (1862); the Lutheran theological Seminary (1864); Saint Vincent's (Theological) Seminary (R.C., 1868); the theological school of Temple University (non-sectarian, 1893); Pennsylvania College of Dental Surgery (1856); Philadelphia Dental College (1863; since 1907 a part of Temple University); the department of dentistry of the university of Pennsylvania (1878); the department of dentistry of the Medico-Chirurgical College (1897); the Philadelphia College of Pharmacy (1821); the department of pharmacy of the Medico-Chirurgical College (1898); and the school of pharmacy of Temple University (1902). Girard College (see GIRARD, STEPHEN) is a noted institution for the education of poor white orphan boys. The Pennsylvania Academy of the Fine Arts, founded in 1805 in Independence Hall, was the first art school in America; it occupies a fine building on Broad and Cherry streets, with a gallery of about 500 paintings, including examples of early American masters (especially Gilbert Stuart, of whom it has the largest collection), of modern American artists (especially in the Temple collection), and, in the collection of Henry C. Gibson, of French landscapes. The Drexel Institute of Arts and Sciences, founded in 1891 by Anthony J. Drexel and endowed by him with $2,000,000, occupies a beautiful building (Chestnut Street and 32nd; opened in 1891) and embraces the following departments: architecture, science and technology, commerce and finance, domestic science, domestic arts, library school, English language and literature, history, civil government and economics, physical training, evening classes, department of free public lectures and concerts, library and reading room, and museum and picture gallery. The institution bestows free scholarships on a considerable number of students and charges the others very moderate fees. Its building houses a library, a collection of rare prints and autographs, and a museum with a picture gallery and exhibits of embroidery, textiles, ceramics, wood and metal work, &c. The Pennsylvania Museum and School of Industrial Art founded in 1876 and opened in 1877, has schools at Broad and Pine streets—the museum is housed in Memorial Hall in Fairmount Park. The school is a pioneer in America; it was originally a school of applied art, but in 1884 the Philadelphia textile school was established as another department. The Wagner Free Institute of Science, founded by William Wagner in 1855, has a library and a natural history museum, provides free lectures on scientific subjects, and publishes *Transactions*, containing scientific memoirs. The Franklin Institute for the promotion of mechanic arts (1824) has a technical library (with full patent records of several nations); since 1824 it has held exhibitions of manufactures; it has published since 1826 the *Journal of the Franklin Institute*; the institute provides lecture courses and has night schools of drawing, machine design and naval architecture. The Spring Garden Institute (1851), with day classes in mechanical drawing, handiwork, and applied electricity, and night classes in those subjects and in freehand and architectural drawing; the Philadelphia School of Design for Women (1836), of which Emily Sartain, a daughter of John Sartain, became principal in 1886; and a school of horology (1894) are other manual and industrial training schools within the city, and not far beyond the city limits is the Williamson Free School of Mechanical Trades (1888), endowed by Isaiah Vansant Williamson (1803–1889) with more than $5,000,000 for the free training of bricklayers, machinists, carpenters, pattern makers, stationary engineers and other mechanics. The Lincoln Institution and Educational Home until 1907 was devoted mainly to the education of Indians.

Newspapers and Periodicals.—The *American Weekly Mercury* was the first newspaper published in Philadelphia and the third in the colonies. It was first issued on the 22nd of December 1719 by Andrew Sowle Bradford, a son of William Bradford, the first printer in the Middle Colonies, and was the first newspaper in these colonies. The second newspaper in the city and in the province was the *Universal Instructor in all Arts and Sciences and Pennsylvania Gazette.* It was established in 1728 by Samuel Keimer, but less than a year afterwards it became the property of Benjamin Franklin and Hugh Meredith, who shortened its title to the *Pennsylvania Gazette.* The only one of the newspapers established during the colonial era which survived the 19th century was the *Pennsylvania Packet or General Advertiser*, which was started in 1771 by John Dunlap, and during the War of Independence was published semi-weekly, with occasional "postscripts" of important news; in 1839 it was absorbed by the *North American* (1829), with which the *United States Gazette* (1789) was united in 1847 and which is still published as the *North American.* The *Aurora and General Advertiser*, established in 1790 by Benjamin Franklin Bache (1769–1798), a grandson of Franklin, was a notorious anti-Federalist organ in its early years. A pioneer among newspapers at modern prices is the *Public Ledger*, founded in 1836, and in 1864 purchased by George William Childs. Other prominent daily papers now published are the *Inquirer* (Republican; 1829), the *Press* (Republican; 1857), the *Record* (Independent Democrat; 1870), the *Demokrat* (German; 1838), the *Evening Bulletin* (Republican; established in 1815 as the *American Sentinel*), the *Evening Item* (1847), the *Evening Telegraph* (Independent Republican; 1864), and the *Tageblatt* (Labour; German; 1877). Many of the earlier literary periodicals of America were published in Philadelphia; among them were the *American Magazine* (1757–1758 and 1769), Thomas Paine's *Pennsylvania Magazine* (1775–1776), the *Columbian Magazine* (1786–1790; called the *Universal Asylum* in 1790) which was edited by Matthew Carey and by A. J. Dallas, the excellent *American Museum* (1787–1792 and 1798), with which Carey was connected, the *Port Folio* (1801–1827; edited until 1812 by Joseph Dennie) and the *Analectic* (1802–1812) which succeeded *Select Reviews and Spirit of the Foreign Magazines* (1809), of which Washington Irving was editor in 1813–1814, and to which Paulding and Verplanck contributed, and the *American Quarterly Review* (1827–1837). Among others were: *Godey's Lady's Book* (1830–1877), for which Poe, Irving, Longfellow, Willis and others wrote; and *Graham's Lady's and Gentleman's Magazine* (1840–1859), with the contributors just named and Cooper, John G. Saxe, E. P. Whipple and others. *Lippincott's Magazine* (1868) is a monthly, best known for its fiction. The *Saturday Evening Post*, which has the largest circulation of the weekly publications, and the *Ladies' Home Journal* (1883), the semi-monthly with the largest circulation, are owned by the same company. The *Farm Journal* (1877) is a well-known agricultural monthly.

Trusts, Charities, &c.—Girard College and thirty-eight other charities are maintained out of the proceeds of as many trusts, which are administered by a board of directors composed of twelve members, appointed by the courts of common pleas, and the mayor, president of the select council, and president of the common council as *ex-officio* members. In 1907 the invested capital of the Girard Trust alone amounted to $24,467,770 and the income from it was $1,988,054. The total capital of all the minor trusts in the same year was $1,583,026 and the income from this was $56,730. Among the minor trust funds are: Wills Hospital (established in 1825); Benjamin Franklin Fund (1790) for aiding young married artificers; Thomas D. Grover Fund (1849) for providing the poor with fuel and food; Mary Shields Almshouse Fund (1880); and the John Scott Medal Fund (1816) for bestowing medals upon young inventors. To Franklin Philadelphia is largely indebted for the Pennsylvania hospital, the first hospital in the United States, which was projected in 1751 and is one of the foremost of nearly one hundred such institutions in the city. The municipal hospital for contagious diseases and hospitals for the indigent and the insane are maintained by the municipality, but most of the other institutions for the sick are maintained by medical schools and religious sects. Municipal charities are under the supervision of the department of public health and charities. Philadelphia is the seat of the state penitentiary for the eastern district, in which, in 1829, was inaugurated the "individual" system, *i.e.* the separate imprisonment and discriminating treatment of criminals with a view to effecting their reform.

Transportation and Commerce.—Nearly every street in the business centre and about one-third of the streets throughout the built-up portion of the city have a single track of electric railway (overhead trolley), and most of the wider ones, except Broad Street, which has none, have a double track. A subway line has been opened for a short distance under Market Street, and other subway lines, as well as elevated lines, have been projected. The entire system, embracing in 1909 a total of 624·21 m., is operated by the Philadelphia Rapid Transit Company. Several inter-urban electric lines afford cheap service to neighbouring towns and cities. The extensive railway system under the control of the Pennsylvania railway together with the Baltimore & Ohio railway affords transportation facilities north to New York, south to Baltimore, Washington and the south, west to the bituminous coalfields of Pennsylvania, the grain fields of the Middle West, and to Pittsburg, Cleveland, Cincinnati and Chicago. The Philadelphia & Reading railway connects the city with the great anthracite coal region, and both the Philadelphia & Reading and the Pennsylvania control a line to Atlantic City. The Schuylkill is navigable for small craft to the "Fall line," about 7¾ m. above its mouth and for vessels drawing 26 ft. to the oil refineries at Point Breeze, 3 m. from the mouth; from Point Breeze to the head of navigation the channel depth varies from 14 to 22 ft. The Delaware river is navigable to Trenton, New Jersey, about 30 m. above the upper end of the port of Philadelphia, and although in its natural condition this river was only 17 ft. deep at low water in its shallowest part below the port this depth was increased between 1836 and 1899 to 26 ft. (except in three shoal stretches), and a project of the Federal government was adopted in 1899 for increasing the depth to 30 ft. and the width to 600 ft. In 1905 the city of Philadelphia and the state of Pennsylvania appropriated $750,000 for the improvement of the river between the city and the southern boundary of the state.[1] Steamships ply regularly between Philadelphia and several European ports, ports in the West Indies, and ports of the United States.

The port extends from the Pennsylvania railway terminal at Greenwich Point up the Delaware River to the Philadelphia & Reading terminal at Port Richmond, a distance of about 8 m., and there are minor harbour facilities on the Schuylkill. The natural facilities, together with the improvements that have been made, were long offset by an inefficient port administration under an antiquated law of 1803 which permitted the wharves to pass largely under private control; but in 1907 the old board of port wardens was abolished and in its place was created a municipal department of wharves, docks and ferries.

Until the opening of the Erie Canal, in 1825, Philadelphia was the emporium of the United States; it was then displaced by New York. Some years later Philadelphia lost its lucrative China trade, and its decline in commercial importance continued until 1883, when the value of its imports amounted to only $32,811,045, the value of its exports to only $38,662,434, and the city was outranked in foreign trade by New York, Boston, San Francisco and New Orleans. By 1900, however, the value of its imports had risen to $49,191,236 and the value of its exports to $81,327,704; in 1909 the value of the imports was $78,003,464, an amount less than one-eleventh that of New York, but exceeded only by New York and Boston, and the value of the exports was $80,650,274, an amount less than one-eighth that of New York, but exceeded only by New York, Galveston and New Orleans. The principal imports are sugar, drugs and chemicals, goatskins, wool, tobacco, jute and burlap, and cotton goods, iron ore, manufactured iron, hides and bananas; the principal exports are iron (manufactured), steel, petroleum, wheat, flour, lard, cattle and meat products. The proximity of the city to New York, whence many of its products are shipped, makes the statistics of its direct imports and exports no true index of its commercial importance.

Manufactures.—Philadelphia has always been one of the foremost manufacturing centres in the United States, and in 1905 it was outranked only by New York and Chicago.[2] The total value of its factory product was $519,981,812 in 1900, and $591,388,078 in 1905. Measured by the value of the products, Philadelphia ranked first among the cities of the country in 1905 in refining sugar and molasses ($37,182,504; 13·4% of the total of the country) and in the manufacture of carpets and rugs ($25,232,510; 41% of the total of the country), leather ($23,903,239; 9·5% of the total of the country), hosiery and knit goods ($15,770,873; 11·5% of the total of the country), woollen goods ($12,239,881; 8·6% of the total of the country), and felt hats ($5,847,771; 16% of the total of the country); second in the manufacture of worsted goods ($26,964,533; 16% of the total of the country) and in dyeing and finishing textiles ($4,371,006; 8·6% of the total of the country); and third in the manufacture of clothing ($31,031,882; 5·1% of the total of the country) and silk goods ($5,079,193; 3·8% of the total of the country). Other large industries are the manufacture of foundry and machine-shop products, cotton goods, malt liquors, iron and steel, chemicals, cigars and cigarettes, soap, confectionery, furniture, paints, boots and shoes, electrical apparatus, and cordage and twine, and among notable individual establishments are the Baldwin Locomotive Works, the Cramp Ship-Yards and the Disston or Keystone Saw Works. There are petroleum refineries at Point Breeze near the mouth of the Schuylkill; petroleum is piped to them from the north-west part of the state.

Water Supply.—The first municipal waterworks, installed in 1799–1801, pumped water by steam power from the Schuylkill into an elevated tank in Centre Square, where the city-hall now stands; this was one of the earliest applications of steam to municipal water pumping. In 1812–1815 new steam works were installed on Quarry Hill, or Fairmount; in 1819–1822 pumping works operated by water power were substituted for those operated by steam; and it was in great part for the preservation of the purity of the water supply that Fairmount Park was created. The park, however, did not serve its purpose in this respect. The water was impure and inadequate: additional works were installed from time to time, mostly on the Schuylkill, whence water was pumped by steam to reservoirs from which distribution was made by gravity; and to meet the increasing demands new filtration works and accessories were installed in 1901–1908. These take the water mainly from the Delaware river.

Government and Finances.—Inasmuch as it has been proved that in 1683 there was in use in Philadelphia a seal bearing the inscription "Philadelphia .83. William. Penn. Proprietor. and. Governor" and in all respects different from the provincial seal or the county seal, it seems that there was then a distinct government for the city. In July 1684 the provincial council, presided over by William Penn, appointed a committee to draft a borough charter, but there is no record of the work of this committee, and it is uncertain what the government of Philadelphia was for the next seventeen years.[3] In 1701 Penn himself issued a charter creating a close corporation modelled after the English borough and under this the city was governed until the War of Independence. Upon the annulment of the Penn charter by the Declaration of Independence, government by commissions was established, but in 1789 a new charter was granted and, although the government has since undergone many and great changes, it is by virtue of this charter that the city remains a corporation to-day. The Consolidation Act of 1854 extended the boundaries to the county lines without destroying the county government, changed the corporate name from "Mayor, Aldermen, and Citizens of Philadelphia" to "the City of Philadelphia," created the offices of controller and receiver of taxes, and considerably modified the powers and duties of the corporation and its officers. The Bullitt Act, passed in 1885 to go into effect in 1887, and since 1885 amended and supplemented, is a new charter except in name; particularly notable is its transfer of the balance of power from the councils and various self-perpetuating commissions to the mayor.

The mayor is elected for a term of four years and is not eligible to the office for the next succeeding term. With the advice and consent of the select council he appoints the directors of the departments of public safety, public works,[4] health and charities, supplies and (since 1907) wharves, docks and ferries, and the three members of the civil service commission. He may appoint three persons to examine any department and for reasons given in writing may remove any officer whom he has appointed. His veto power extends to items in appropriation bills, but any item or ordinance may be passed over his veto within five days of such veto by an affirmative vote of three-fifths of the members elected to each council. The select council is composed of one member from each of the 47 wards, and in the common council each ward has one member for every four thousand names on the last completed assessment list (including names of those paying poll taxes as well as those paying taxes on real or personal property); in 1909 there were 80 members of the common council. The several administrative departments are: public safety, public works, receiver of taxes, city treasurer, city controller, law, education, charities and corrections, supplies, wharves, docks and ferries, civil service commission and sinking fund commission (composed of the mayor, the city controller and a commissioner elected by a majority vote of the city councils). Members of the select council are elected for three years—one-third each year; members of the common council for two years—one half each year; and the receiver of taxes, the city treasurer, the city controller, and the city solicitor, who is the head of the department of law, for a term of three years. The police constitute a bureau of the department of public safety, and at their head is a superintendent appointed by the director of the department with the approval of the select council. The department of education is administered by a central board appointed (at large) by the judges of the courts of common pleas.

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[1] The city had previously expended $1,555,000 on the improvement of the Delaware and Schuylkill rivers.

[2] The Philadelphia Museums claim that excluding slaughter-house and sweat-shop products the value of Philadelphia's manufactured products is greater than that of any other city in the country.

[3] A document purporting to be a charter, bearing the date of the 20th of May 1691, and signed by Thomas Lloyd, deputy-governor, was discovered in 1887, but the great seal is missing and there is no evidence that the charter was even in operation. The minutes of "a meeting of the Council held at Philadelphia on the third day of Sixth Month 1691" mention "Humphrey Morrey the present Mayor of the city of Philadelphia"; and this would seem to show that there was a regular municipal government in 1691. See *Philadelphia: Its Founding and Seals: Report of the Committee . . . to determine the Year of the Physical and Legal Founding of the City of Philadelphia* (Philadelphia, 1908).

[4] In 1905 the state legislature took the appointment of these officers from the mayor and vested it in the councils, but this legislation was repealed in 1906.

The assessed value of taxable property in the city increased from $153,369,048 in 1856 to $536,667,834 in 1880, to $880,935,265 in 1900, and to $1,358,675,057 in 1910. The city's yearly expenditure increased from $5,170,680 in 1856 to $14,640,479 in 1880, to $30,628,246 in 1900, and to $48,012,630 in 1909. The principal items of expenditure in 1909 were: for public schools $8,242,218; for the bureau of water, $2,827,200; for streets and highways, $4,219,260; for police, $3,810,535; and for protection against fire, $1,873,720. The receipts for the same year were $44,372,927, of which $18,851,442 were from the property tax (municipal and state), and $4,396,124 were from the water tax. The city's indebtedness increased rapidly for a period of twenty-five years following consolidation. At the beginning of 1856 the funded debt was $16,781,470, by the beginning of 1870 it had grown to $42,401,933, and by the beginning of 1880 to $70,970,041. By the new state constitution adopted in 1873 no municipality is permitted to create a debt exceeding 7% of the assessed value of its taxable property,[1] in 1879 the state legislature passed an act to prevent the city from living beyond its income, and as a consequence of these restrictions the funded debt, less loans held by the sinking fund, was reduced by the beginning of 1895 to $33,139,695. The great expense of installing the new filter plant, developing the park system, and making other improvements has, however, caused it to grow again; at the beginning of 1910 the total funded debt was $95,483,820 and the net funded debt was $84,901,620.

History.—The patent granted to William Penn for the territory embraced within the present commonwealth of Pennsylvania was signed by Charles II. on the 4th of March 1681 and Penn agreed that "a quantity of land or ground plat should be laid out for a large town or city in the most convenient place upon the river for health and navigation," and that every purchaser of 500 acres in the country shall be allowed a lot of 10 acres in the town or city, "if the place will allow it." In September Penn appointed William Crispin, Nathaniel Allen and John Bezan a commission to proceed to the new province and lay out the city, directing them to select a site on the Delaware where "it is most navigable, high, dry and healthy; that is where most ships can best ride, of deepest draught of water, if possible to load or unload at the bank or key side without boating or lightering of it." Crispin, a kinsman of the proprietor, died on the voyage out, but William Heage had been named a fourth commissioner some time after the appointment of the others and the three survivors arrived in the province toward the close of the year. They had been preceded by Penn's cousin, Captain William Markham, as deputy-governor, and were soon followed by the surveyor-general, Thomas Holme. Although the Swedes had established a settlement at the mouth of the Schuylkill not later than 1643 and the site now selected by the commissioners was held by three brothers of the Swaenson family, these brothers agreed to take in exchange land in what is now known as Northern Liberties, and as early as July 1682 Holme, according to modified instructions from Penn for making the lots smaller than originally intended, laid out the city extending from the Delaware river on the east to the Schuylkill river on the west, a distance of about 2 m., and from Vine Street on the north to Cedar (now South) Street on the south, a distance of about 1 m. Penn landed at New Castle on the Delaware on the 27th of October 1682 and two days later came up as far as Upland, now Chester, 13 m. south of Philadelphia, but when he came to his newly founded city is not known. He is known, however, to have presided at a meeting of the provincial council held here on the 10th of March 1683, and from that time Philadelphia was the capital of Pennsylvania until 1799, when Lancaster became the capital. During nearly the whole of this period it was also the most important city commercially, politically and socially in the colonies. Quaker influence remained strong in the city, especially up to the beginning of the 19th century; and it was predominant in Philadelphia long after it had given way before the Scotch-Irish in the rest of Pennsylvania. But even in Philadelphia the academy (later the university of Pennsylvania) soon came under the control of the Protestant Episcopal Church. The first Continental Congress met in Carpenters' Hall on the 5th of September 1774; the second in the old state house (Independence Hall) on the 10th of May 1775; and throughout the War of Independence, except from the 26th of September 1777 to the 18th of June 1778, when it was in possession of the British,[2] Philadelphia was the virtual capital of the colonies; it was a brilliant social city, especially during the British possession. The national convention which framed the present constitution of the United States sat in Philadelphia in 1787, and from 1790 to 1800 the city was the national capital. Here Benjamin Franklin and David Rittenhouse made their great contributions to science, and here Washington delivered his farewell address to the people of the United States. Here, in July and August 1789, the clerical and lay delegates from the Protestant Episcopal Churches in the United States met and formally organized the Protestant Episcopal Church in the United States. Here the first bank in the colonies—the Bank of North America—was opened in 1781, and here the first mint for the coinage of the money of the United States was established in 1792. The city was visited with an epidemic of yellow fever in 1793 and again in 1798; and in 1832 nearly 1000 inhabitants died of Asiatic cholera.

The original boundaries remained unchanged for 172 years, but the adjoining territory as it became populated was erected into corporated districts in the following order: Southwark (1762), Northern Liberties (1771), Moyamensing (1812), Spring Garden (1813), Kensington (1820), Penn (1844), Richmond (1847), West Philadelphia (1851) and Belmont (1853). In 1854 all these districts, together with the boroughs of Germantown, Frankford, Manayunk, White Hall, Bridesburg and Aramingo, and the townships of Passyunk, Blockley, Kingsessing, Roxborough, Germantown, Bristol, Oxford, Lower Dublin, Moreland, Byberry, Delaware and Penn was abolished and the boundaries of Philadelphia were extended to the county lines by a single act of the state legislature. The consolidation was in part the outcome of a demand for efficiency in preserving order. There had been occasional outbreaks of disorder: on the 17th of May 1838 an anti-abolition mob had burned Pennsylvania Hall, which had been dedicated three days before to the discussion of abolition, temperance and equality; in May 1844 anti-Catholic rioters had burned St Michael's and St Augustine's churches, and minor riots had occured in 1835, 1842 and 1843. Philadelphia was from the first strongly anti-slavery in sentiment, and it was here in December 1833 that the American Anti-Slavery Society was organized, and in 1856, on the anniversary of the battle of Bunker Hill, that the first national convention of the Republican party met. During the Civil War the arsenal and the Southwark navy yard were busy manufacturing material for the Federal armies, the city was crowded with wounded soldiers, and here in 1864 was held the great sanitary fair for the benefit of the United States sanitary commission, an organization for the relief and care of wounded and sick soldiers. In 1876, the centennial year of American independence, a great exhibition of the industries of all nations was held in Fairmount Park from the 10th of May to the 10th of November, and about fifty buildings were erected for the purpose. In October 1882 the city celebrated the bi-centennial of the landing of William Penn, and in October 1908 the 225th anniversary of its foundation.

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[1] If the debt of a city already exceeded the 7% limit it could be increased only by permission of the legislature.

[2] Lord Howe, who had been in command of the British, embarked for England on the 24th of May, and on the 18th of this month was held for his farewell entertainment the famous *Mischianza*, a feast of gaiety with a tournament somewhat like those common in the age of chivalry, which was in large part planned by Captain John André.

Bibliography.—J. T. Scharf and T. Westcott, *History of Philadelphia* (Philadelphia, 1884), the standard history; J. F. Watson, *Annals of Philadelphia*, revised by W. P. Hazard (Philadelphia, 1898), often the record of tradition; E. P. Allinson and B. Penrose, *Philadelphia 1681–1887; a History of Municipal Development* (Philadelphia, 1887); J. H. Young (ed.), *Memorial History of the City of Philadelphia* (New York, 1895); Lillian I. Rhoades, *The Story of Philadelphia* (New York, 1900); T. Williams, “Philadelphia,” in L. P. Powell's *Historic Towns of the Middle States* (New York, 1899); F. M. Etting, *An Historical Account of the Old State House* (Philadelphia, 1891); E. K. Price, *History of the Consolidation of Philadelphia* (Philadelphia, 1873); and Agnes Repplier, *Philadelphia, the Place and People* (New York, 1898).

PHILADELPHIANS, a sect of religious mystics, founded in London in the latter part of the 17th century. In 1652 Dr John Pordage (1607–1681), rector of Bradfield, Berkshire, gathered together a few followers of Jakob Boehme, the chief of whom was Jane Lead or Leade (*née* Ward; 1623–1704). Pordage was ejected from his living by the Triers in 1655, but was restored in 1660. Mrs Leade had been from girlhood of a mystical temperament, and experienced phantasms which she recorded in a diary entitled *A Fountain of Gardens*, beginning in 1670, in which year the Philadelphian society was definitely organized. She drew up for it “The Laws of Paradise,” which show that the enterprise was designed “to advance the Kingdom of God by improving the life, teaching the loftiest morality, and enforcing the duty of universal brotherhood, peace and love.” Its members had a strong faith in what they called the “Divine Secrets,” the wonders of God and nature, the profound spiritual experiences of regeneration and soul-resurrection, and the second Advent. In 1693 some of Mrs Leade's writings were translated into Dutch, and by this means and her acquaintance with Francis Lee (1661–1719), an Oxford scholar who studied medicine at Leiden and became her son-in-law, a connexion was opened up with Germany and Holland. In 1703 the Philadelphians drew up their confession, but they made no further progress and soon declined. The Holland branch withdrew, and the English government forbade the society to meet. For many years, however, a considerable number of people regarded Mrs Leade's visions, which were published in a long series of writings, as proofs of her divine calling. In her later years she had a severe struggle with poverty, which was relieved by a pension granted by Baron Kniphausen.

PHILAE, an islet in the Nile above the First Cataract, of great beauty and interest, but since the completion of the Assuan dam in 1902 submerged except for a few months yearly during High Nile (July to October), when the water is allowed to run freely through the sluices of the Assuan dam. Philae is the nearest island to the point where the ancient desert road from Assuan rejoins the river south of the cataract. It marks also the end of the cataract region. Below it the channel is broad and straight with rocky granite islands to the west. The name in Egyptian was Pilak, “the angle (?) island”: the Arabs call it Anas el Wagud, after the hero of a romantic tale in the *Arabian Nights*. Ancient graffiti abound in all this district, and on Bigeh, a larger island adjoining Philae, there was a temple as early as the reign of Tethmosis III. The name of Amasis II. (570–535 B.C.) is said to have been found at Philae, and it is possible that there were still older buildings which have been swallowed up in later constructions. About 350 B.C. Nekhtnebf, the last of the native kings of Egypt, built a temple to Isis, most of which was destroyed by floods. Ptolemy Philadelphus reconstructed some of this work and began a large temple which Ptolemy Euergetes I. completed, but the decoration, carried on under later Ptolemies and Caesars, was never finished. The temple of Isis was the chief sanctuary of the Dodecaschoenus, the portion of Lower Nubia generally held by the Ptolemies and Romans. The little island won great favour as a religious resort, not only for the Egyptians and the Ethiopians and others who frequented the border district and the market of Assuan, but also for Greek and Roman visitors. One temple or chapel after another sprang up upon it dedicated to various gods, including the Nubian Mandulis. Ergamenes (Arkamane), king of Ethiopia, shared with the Ptolemies in the building. Besides the temple of Isis with its birth-temple in the first court, there were smaller temples or shrines of Arsenuphis, Mandulis, Imuthes, Hathor, Harendotes (a form of Horus) and Augustus (in the Roman style), besides unnamed ones. There were also monumental gateways, and the island was protected by a stone quay all round with the necessary staircases, &c., and a Nilometer. The most beautiful of all the buildings is an unfinished kiosque inscribed by Trajan, well known under the name of “Pharaoh's Bed.” Graffiti of pilgrims to the shrine of Isis are dated as late as the end of the 5th century A.D. The decree of Theodosius (A.D. 378) which suppressed pagan worship in the empire was of little effect in the extreme south. In A.D. 453 Maximinus, the general of the emperor Marcian, after inflicting a severe defeat on the Nobatae and Blemmyes who were settled in Lower Nubia, and thence raided Upper Egypt, made peace on terms which included permission for these heathen tribes to visit the temple and even to borrow the image of Isis on certain occasions. It was not till the reign of Justinian, A.D. 527–565, that the temple of Philae was finally closed, and the idols taken to Constantinople. Remains of Christian churches were disclosed by the thorough exploration carried out in 1895–1896 in view of the Barrage scheme, under the direction of Captain Lyons. The accumulations of rubbish on the island were cleared away and the walls and foundations of the stone buildings were all repaired and strengthened before the dam was completed. The annual flooding now appears to be actually beneficial to the stonework, by removing the disintegrating salts and incrustations. The tops of most of the buildings and the whole nucleus of the temple of Isis to the floor remained all the year round above the water level until the dam was raised another 26 ft.—a work begun in 1907—when the temples were entirely submerged except during July–October. But the beauty of the island and its ruins and palm trees, the joy of travellers and artists, is almost gone.

See H. G. Lyons, *A Report on the Island and Temples of Philae* (Cairo, 1896), with numerous plans and photographs; a second report, *A Report on the Temples of Philae* (1908), deals with the condition of the ruins as affected by the immersions occasioned by the filling of the Assuan dam; Baedeker's *Egypt*; and on the effects of the submersion, &c., reports in *Annales du service des antiquités*, vols. iv. v. (F. Ll. G.)

PHILARET [Theodore Nikitich Romanov] (? 1553–1633), patriarch of Moscow, was the second son of the boyar Nikita Romanovich. During the reign of his first cousin Theodore I. (1584–1598), Theodore Romanov distinguished himself both as a soldier and a diplomatist, fighting against the Swedes in 1590, and conducting negotiations with the ambassadors of the emperor Rudolph II. in 1593–1594. On the death of the childless tsar, he was the popular candidate for the vacant throne; but he acquiesced in the election of Boris Godunov, and shared the disgrace of his too-powerful family three years later, when Boris compelled both him and his wife, Xenia Chestovaya, to take monastic vows under the names of Philaret and Martha respectively. Philaret was kept in the strictest confinement in the Antoniev monastery, where he was exposed to every conceivable indignity; but when the pseudo-Demetrius overthrew the Godunovs he released Philaret and made him metropolitan of Rostov (1605). In 1609 Philaret fell into the hands of pseudo-Demetrius II., who named him patriarch of all Russia, though his jurisdiction only extended over the very limited area which acknowledged the impostor. From 1610–1618 he was a prisoner in the hands of the Polish king, Sigismund III., whom he refused to acknowledge as tsar of Muscovy on being sent on an embassy to the Polish camp in 1610. He was released on the conclusion of the truce of Deulino (Feb. 13, 1619), and on the 2nd of June was canonically enthroned patriarch of Moscow. Henceforth, till his death, the established government of Muscovy was a diarchy. From 1619 to 1633 there were two actual sovereigns, Tsar Michael and his father, the most holy Patriarch Philaret. Theoretically they were co-regents, but Philaret frequently transacted affairs of state without consulting the tsar. He replenished the treasury by a more equable and rational system of assessing and collecting the taxes. His most important domestic measure was the chaining of the peasantry to the soil, a measure directed against the ever increasing migration of the down-trodden serfs to the steppes, where they became freebooters instead of tax-payers. The taxation of the tsar's *slyuzhnuie lyudi*, or military tenants, was a first step towards the proportional taxation of the hitherto privileged classes. Philaret's zeal for the purity of orthodoxy sometimes led him into excesses; but he encouraged the publication of theological works, formed the nucleus of the subsequently famous Patriarchal Library, and commanded that every archbishop should establish a seminary for the clergy, himself setting the example. Another great service rendered by Philaret to his country was the reorganization of the Muscovite army with the help of foreign officers. His death in October 1633 put an end to the Russo-Polish War (1632–33), withdrawing the strongest prop from an executive feeble enough even when supported by all the weight of his authority.

See R. N. Bain, *The First Romanovs* (London, 1905); S. M. Solovev, *Hist. of Russia* (Rus.), vol. ix. (St Petersb. 1895, &c.) (R. N. B.)

PHILATELY (Gr. φίλος, loving, and ἀτελής, free of tax), the study and collection of postage-stamps and other marks of prepayment issued by post-offices. The fancy for collecting postage-stamps began a short time after the issue of the first British penny and two-penny stamps in 1840 (see Post and Postal Service). Dr Gray, an official of the British Museum, began collecting them soon after their appearance, and an advertisement in an issue of *The Times* of 1841 asks for gifts of cancelled stamps for a young lady. In 1842 the new hobby was ridiculed in *Punch*. It was not until about 1860, however, that stamp collecting began to be systematically carried on with full regard to such *minutiae* as the different kinds of paper, water-marks, perforation, shade of colour and distinctive outline. About 1862 a teacher in Paris directed that foreign stamps should be collected and pasted upon the pages of his pupils' atlases and geographies according to countries, and this may have been the first form of the systematic classification of stamps in a collection. Of existing collections the oldest were begun between 1853 and 1860, by which year French collectors had assumed especial prominence. Professional dealers now made their appearance, and in 1861 philatelic literature, now of vast extent, was inaugurated by the publication in Strasburg of a catalogue of stamps issued up to that time. The Paris collectors were the first to classify stamps, measure them by the gauge, note the water-marks and separate the distinct issues of each country. Collecting with due regard to the relationship of different issues is called *plating*. The first English catalogue was issued in 1862, followed in December of the same year by *The Stamp Collector's Review and Monthly Advertiser*, published in Liverpool, the first philatelic periodical, the second, *The Stamp Collector's Magazine*, appearing in 1863. In 1863 also appeared *Le Timbre-Poste*, a Brussels journal. Up to 1910 over 800 philatelic periodicals had appeared.

Although small bodies of enthusiasts had banded together in England, France and the United States for the study and collection of postage-stamps as early as 1865, it was not until 1869 that the first great club, the *Philatelic Society of London*, still the most important in the world, was founded. Other societies in Great Britain are the *Junior Philatelic* of London, and those of Birmingham, Manchester, Edinburgh and Leith. The leading society in America is the American Philatelic Association; in France the *Société française de timbrologie*; in Germany the *Internationaler Philatelisten-Verein*. More than 400 such organizations are now in existence, the majority of them in the United States and Germany. At a philatelic congress, held in London in 1910, the formation of a universal union of philatelic societies "to discourage unnecessary or speculative issues" was considered.

Not only the stamps themselves were collected, but "entires," *i.e.* postcards, envelopes with the stamps still adhering, &c. Marks of prepayment at last became so numerous that, about 1880, specialists began to appear, who restricted their collections to the stamps of some particular country or continent, or to postcards or newspaper-wrappers alone. The most extensive and valuable stamp collection in the world, that of Baron P. von Ferrary of Paris, was begun about 1865. This collection, which cost its owner at least £250,000, contains a cancelled and an uncancelled specimen of each stamp. The next greatest collection is that bequeathed to the British nation in 1891 by T. K. Tapling, M.P., now in the British Museum. Among other important collections may be mentioned those in the German Postal Museum in Berlin, of King George V. of England, W. B. Avery, H. J. Duveen and the earl of Crawford. The largest sum realized for an entire collection was £27,500, which was paid for that of M. P. Castle, consisting of European stamps only. The value of a stamp depends partly upon its age, but much more upon its rarity, which again is dependent upon the number of the particular stamps originally issued. Most stamps have a quoted value, but some possess a conventional value only, such as those of which only one or two specimens are known to exist; for instance, the one-cent stamp of the 1856 issue of British Guiana (one known copy); the Italian 15 *centesimi* stamp of 1865 converted by an overprint into 20 *centesimi* (one copy); the Cape of Good Hope triangular, printed by mistake on paper intended for stamps of other colonies (four copies); and the 2 cent stamps of the earliest issue of British Guiana (ten copies). The best known of the very rare stamps are the 1d. and 2d. "Post-Office" Mauritius, for which higher prices have been paid than for any other stamps, although 23 copies are known to exist out of the 1000 issued. For a fine specimen of these Mauritius stamps £2000 has been offered. Two of them have been sold for £2400. Philatelic exhibitions such as those held in London in 1890 and 1897 and in Manchester in 1909 have proved popular.

"Reprints" are reimpressions, taken from the original plates, of obsolete stamps, and have a much smaller value than specimens of the original issue. Forgeries of the rarer stamps are common but are easily detected. Modern postage-stamp albums are often beautiful specimens of the printer's art, reproductions of every known stamp being given in the original colours.

See W. J. Hardy and E. D. Bacon, *The Stamp Collector* (London, 1898); Oliver Firth, *Postage Stamps and Their Collection*, (1897); F. J. Melville, *A B C of Stamp Collecting* (1903); Calman and Collin, *Catalogue for Advanced Collectors* (New York, 1902); Hastings E. Wright and A. B. Creeke, *History of the Adhesive Stamps of the British Isles* (London, 1899); J. K. Tiffany, *Stamp Collector's Library Companion* (Chicago, 1889); Luff, *The Postage Stamps of the United States* (New York, 1902); W. E. Daniells, *History of British Postmarks* (London, 1898); L. Salefranque, *Le Timbre à travers l'histoire* (Rouen, 1890); R. Senf, *Illustrierter Postwerthzeichenkatalog* (Leipzig, annually); Krötzsch, *Permanentes Handbuch der Postfreimarkenkunde* (Leipzig, annually); periodicals: *The London Philatelist* (monthly); *Illustrierte Briefmarken-Zeitung* (Leipzig).

PHILEMON (*c.* 361–263 B.C.), Greek poet of the New Comedy, was born at Soli in Cilicia, or at Syracuse. He settled at Athens early in life, and his first play was produced in 330. He was a contemporary and rival of Menander, whom he frequently vanquished in poetical contests. Posterity reversed the verdict and attributed Philemon's successes to unfair influence. He made a journey to the east, and resided at the court of Ptolemy, king of Egypt, for some time. Plutarch (*De Cohibenda Ira*, 9) relates that on his journey he was driven by a storm to Cyrene, and fell into the hands of its king Magas, whom he had formerly satirized. Magas treated him with contempt, and finally dismissed him with a present of toys. Various accounts of his death are given; a violent outburst of laughter, excess of joy at a dramatic victory, or a peaceful end while engaged in composing his last work (Apuleius, *Florida*, 16; Lucian, *Macrob.* 25; Plutarch, *An Seni*, p. 725). Of the ninety-seven plays which he is said to have composed, the titles of fifty-seven and considerable fragments have been preserved. Some of these may have been the work of his son, the younger Philemon, who is said to have composed fifty-four comedies. *The Merchant* and *The Treasure* of Philemon were the originals respectively of the *Mercator* and *Trinummus* of Plautus. The fragments preserved by Stobaeus, Athenaeus and other writers contain much wit and good sense. Quintilian (*Instit.* x. 1, 72) assigned the second place among the poets of the New Comedy to Philemon, and Apuleius, who had a high opinion of him, has drawn a comparison between him and Menander.

See A. Meineke, *Menandri et Philemonis reliquiae* (1823, including Bentley's emendations); T. Kock, *Comicorum graecorum fragmenta*, vol. iii. (1884).

PHILEMON, EPISTLE TO, a scripture of the New Testament. Onesimus, a slave, had robbed (*vv.* 11, 18–19) and run away from his master Philemon, a prosperous and influential Christian citizen of Colossae (Col. iv. 9), either offence rendering him liable to be crucified. Voluntarily or accidentally, he came across Paul, who won him over to the Christian faith. In the few tactful and charming lines of this brief note, the apostle sends him back to his master with a plea for kindly treatment. After greeting Philemon and his wife, with Archippus (possibly their son) and the Christians who met for worship at Philemon's house (*vv.* 1–2), Paul rejoices over (*vv.* 4–7) his correspondent's character; it encourages him to make an appeal on behalf of the unworthy Onesimus (8–21), now returning (Col. iv. 9) along with Tychicus to Colossae, as a penitent and sincere Christian, in order to resume his place in the household. With a line or two of personal detail (22–25) the note closes.

Rome would be a more natural rendezvous for fugitivarii (runaway slaves) than Caesarea (Hilgenfeld and others), and it is probable that Paul wrote this note, with Philippians and Colossians, from the metropolis. As Laodicea is close to Colossae it does not follow, even if Archippus be held to have belonged to the former town (as Lightfoot argues from Col. iv. 13–17), that Philemon's residence must have been there also (so A. Maier, Thiersch, Wieseler, &c.). Paul cannot have converted Philemon at Colossae (Col. ii. 1), but elsewhere, possibly at Ephesus; yet Philemon may have been on a visit to Ephesus, for, even were the Ephesian Onesimus of Ignatius (Eph. ii.) the Onesimus of this note, it would not prove that he had always lived there. No adequate reason has been shown for suspecting that the note is interpolated at any point. The association of Timotheus with Paul (*v.* 1) does not involve any official tinge, which would justify the deletion of *καὶ Τιμόθεος ὁ ἀδελφός μου* in that verse, and of *ἡμῶν* in *vv.* 1–2 (so Holtzmann), and Hausrath's suspicions of the allusion to Paul as a prisoner and of *v.* 12 are equally arbitrary. The construction in *vv.* 5–6 is difficult, but it yields to exegetical treatment (cf. especially Haupt's note) and does not involve the interpolation of matter by the later redactor of Colossians and Ephesians (Holtzmann, Hausrath[1] and Brückner, *Reihenfolge d. paul. Briefe*, 200 seq.).

The brevity of the note and its lack of doctrinal significance prevented it from gaining frequent quotation in the early Christian literature, but it appears in Marcion's canon as well as in the Muratorian, whilst Tertullian mentions, and Origen expressly quotes it. During the 19th century, the hesitation about Colossians led to the rejection of Philemon by some critics as a pseudonymous little pamphlet on the slave question—an aberration of literary criticism (reproduced in *Ency. Bib.*, 3693 seq.) which needs simply to be chronicled. It is interesting to observe that, apart from the letter of commendation for Phoebe (Rom. xvi.), this is the only letter in the New Testament addressed, even in part, to a woman, unless the second epistle of John be taken as meant for an individual.

BIBLIOGRAPHY.—In addition to most commentaries on Colossians and to Dr M. R. Vincent's edition of Philippians, compare special exegetical studies by R. Rollock (Geneva, 1602), G. C. Storr (1781), J. K. I. Demme, *Erklärung d. Philemon-Briefes* (1844); H. A. Petermann, *Ad fidem versionum ... cum earum textu orig. graece* (Berlin, 1844); M. Rothe, *Pauli ad Philem. epistolae interpretatio historico-exegetica* (Bremen, 1844); and H. J. Holtzmann, *Zeitschrift für wissen. Theologie* (1873), pp. 428 sqq., besides the essays of J. G. C. Klotzsch, *De occasione et indole epistolae ad Philem.* (1792); D. H. Wildschut, *De vi dictionis et sermonis elegantia in epistola ad Philem.* (1809); and J. P. Esser, *Der Brief an Philemon* (1875). An up-to-date survey of criticism is furnished by Dr J. H. Bernard in Hastings's *Dictionary of the Bible*, iv. 832–834, and a good exposition may be found in Z. Weber's *Der Brief an d. Philemon, ein Vorbild für die christl. Behandlung sozialer Fragen* (1896), as well as in Dr A. H. Drysdale's devotional commentary (London, 1906). (J. Mt.)

PHILEMON and **BAUCIS,** the hero and heroine of a beautiful story told by Ovid (*Metam.* viii. 610–715), the scene of which is laid in Phrygia. Zeus, accompanied by Hermes, visited earth in human form; tired and weary, they sought shelter for the night, but all shut their doors against them except an aged couple living in a humble cottage, who afforded them hospitality. Before their departure the gods revealed themselves, and bade their hosts follow them to the top of a mountain, to escape the punishment destined to fall on the rest of the inhabitants. The country was overwhelmed by a flood; the cottage, which alone remained standing, was changed into a magnificent temple. The gods appointed Philemon and Baucis priest and priestess, and granted their prayer that they might die together. After many years they were changed into trees—Philemon into an oak, Baucis into a lime. The story, which emphasizes the sacred duty of hospitality, is probably of local Phrygian origin, put together from two widely circulated legends of the visits of gods to men, and of the preservation of certain individuals from the flood as the reward of piety. It lingers in the account (Acts xiv.) of the healing of the lame man by Paul at Lystra, the inhabitants of which identified Paul and Barnabas with Zeus and Hermes, "come down in the likeness of men."

Similar stories are given in J. Grimm, *Deutsche Mythologie* (Eng. trans., 1883, ii. 580, and iii. 38).

PHILES, MANUEL (*c.* 1275–1345), of Ephesus, Byzantine poet. At an early age he removed to Constantinople, where he was the pupil of Georgius Pachymeres, in whose honour he composed a memorial poem. Philes appears to have travelled extensively, and his writings contain much information concerning the imperial court and distinguished Byzantines. Having offended one of the emperors by indiscreet remarks published in a chronography, he was thrown into prison and only released after an abject apology. Philes is the counterpart of Theodorus Prodromus in the time of the Comneni; his character, as shown in his poems, is that of a begging poet, always pleading poverty, and ready to descend to the grossest flattery to obtain the favourable notice of the great. With one unimportant exception, his productions are in verse, the greater part in dodecasyllabic iambic trimeters, the remainder in the fifteen-syllable "political" measure.

Philes was the author of poems on a great variety of subjects: on the characteristics of animals, chiefly based upon Aelian and Oppian, a didactic poem of some 2000 lines, dedicated to Michael Palaeologus; on the elephant; on plants; a necrological poem, probably written on the death of one of the sons of the imperial house; a panegyric on John Cantacuzene, in the form of a dialogue; a conversation between a man and his soul; on ecclesiastical subjects, such as church festivals, Christian beliefs, the saints and fathers of the church; on works of art, perhaps the most valuable of all his pieces for their bearing on Byzantine iconography, since the writer had before him the works he describes, and also the most successful from a literary point of view; occasional poems, many of which are simply begging letters in verse.

Editions: the natural history poems in F. Lehrs and F. Dübner, *Poetae bucolici et didactici* (Didot series, 1846); Manuelis Philae *Carmina inedita*, ed. A. Martini (1900); Manuelis Philae *Carmina* ed. E. Miller (1855–1857). See also C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897).

PHILETAS of Cos, Alexandrian poet and critic, flourished in the second half of the 4th century B.C. He was tutor to the son of Ptolemy I. of Egypt, and also taught Theocritus and the grammarian Zenodotus. His thinness made him an object of ridicule; according to the comic poets, he carried lead in his shoes to keep himself from being blown away. Over-study of Megarian dialectic subtleties is said to have shortened his life. His elegies, chiefly of an amatory nature and singing the praises of his mistress Battis (or Bittis), were much admired by the Romans. He is frequently mentioned by Ovid and Propertius, the latter of whom imitated him and preferred him to his rival Callimachus, whose superior mythological lore was more to the taste of the Alexandrian critics. Philetas was also the author of a vocabulary called Ἄτακτα, explaining the meanings of rare and obscure words, including words peculiar to certain dialects; and of notes on Homer, severely criticized by Aristarchus.

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[1] *History of the New Testament Times* (1895), iv. 122–123. See, on this, Schenkel's *Bibel-Lexikon*, iv. 531–532.

Fragments edited by N. Bach (1828), and T. Bergk, *Poetae lyrici graeci*; see also E. W. Maass, *De tribus Philetae carminibus* (1895).

PHILIDOR, FRANÇOIS ANDRÉ DANICAN (1726–1795), French composer and chess-player, was born at Dreux, on the 7th of September 1726, of a musical family. The family name was Danican, but that of Philidor, added in the middle of the 17th century, eventually supplanted the older name. François André received a musical education as a member of the corps of pages attached to the orchestra of the king; and subsequently he earned his living by giving lessons and copying music. Much of his time was, however, devoted to chess, at which he soon became an expert. He spent many years in travelling on the Continent and in England, meeting and defeating the most noted players of the time, and is regarded as the strongest player and greatest theoretician of the 18th century. Returning to France in 1754, he resolved to devote himself seriously to musical composition, and after producing several works of minor importance brought out at Paris, in the year 1759, his successful light opera, *Blaise le Savetier*, which was followed by a number of others, notably *Le Soldat magicien* (1760), *Le Jardinier et son seigneur* (1761), *Le Sorcier* (1762), and *Tom Jones* (1764). He died in London on the 31st of August 1795.

PHILIP (Gr. Φίλιππος, fond of horses, from φιλεῖν, to love, and ἵππος, horse; Lat. *Philippus*, whence *e.g.* M. H. Ger. *Philippes*, Dutch *Filips*, and, with dropping of the final s, It. *Filippo*, Fr. *Philippe*, Ger. *Philipp*, Sp. *Felipe*), a masculine proper name, popularized among the Christian nations as having been that of one of the apostles of Christ. Notices of distinguished men who have borne this name are arranged below in the following order: (1) Biblical; (2) Kings of Macedonia, France, Germany and Spain; (3) other rulers.

PHILIP, one of the twelve apostles, mentioned fifth in all the lists (Matt. x. 3; Mark iii. 18; Luke vi. 14; Acts i. 13). He is a mere name in the Synoptists, but a figure of some prominence in the Fourth Gospel. There he is said to have been "of Bethsaida, the city of Andrew and Peter," and to have received his call to follow Jesus at Bethany, having previously been, it would seem, a disciple of the Baptist (John i. 43, 44; cf. 28). Philip was at that time the means of bringing Nathanael to Jesus (John i. 45), and at a later date he, along with Andrew, carried the request of the inquiring Greeks to the Master (John xii. 22). Philip and Andrew alone are mentioned by name in connexion with the feeding of the five thousand (John vi. 5, 7), and Philip is also one of the few interlocutors in John xiv. Slight though these references are, all agree in presenting Philip as of an inquiring and calculating character, slow to take the initiative, but, when convinced of the path of duty, thoroughly loyal in following it. After the resurrection he was present at the election of Matthias as successor to Judas, but he does not again appear in the New Testament history; it is, however, implied that he still continued in Jerusalem after the outbreak of the first persecution.

Little reliance can be placed on the traditional accounts of Philip, owing to the evident confusion that had arisen between him and the evangelist of the same name, who appears in the book of Acts (see below). According to Polycrates, bishop of Ephesus, in his controversial letter written to Victor of Rome towards the end of the 2nd century (*ap.* Euseb. *H. E.*, iii. 31, v. 24), the graves of Philip "of the twelve apostles," and of his two aged virgin daughters were in (the Phrygian) Hierapolis; a third daughter, "who had lived in the Holy Ghost," was buried at Ephesus. With this may be compared the testimony of Clement of Alexandria, who incidentally (*Strom.* iii. 6) speaks of "Philip the Apostle" as having begotten children and as having given daughters in marriage. On the other hand, Proclus, one of the interlocutors in the "Dialogue of Caius," a writing of somewhat later date than the letter of Polycrates, mentions (*ap.* Euseb. *H. E.*, iii. 31) "four prophetesses, the daughters of Philip at Hierapolis in Asia, whose tomb and that of their father are to be seen there," where the mention of the daughters *prophesying* identifies the person meant with the Philip of Acts (cf. Acts xxi. 8). The reasons for setting aside this latter identification, and for holding that the Philip who lived at Hierapolis was the Apostle are clearly stated by Lightfoot, Colossians (2) note 3, p. 45 seq., and fresh confirmation of his view has recently been afforded by the discovery of an inscription at Hierapolis, showing that the church there was dedicated to the memory "of the holy and glorious apostle and theologian Philip" (Ramsay, *Cities and Bishoprics of Phrygia*, vol. i., pt. ii. p. 552).

See also Corssen, "Die Töchter des Philippus" in the *Zeitschrift für die neutestamentliche Wissenschaft* (1901), p. 289 sqq. The other view, that the Philip of Hierapolis is the Philip of Acts, is taken by Zahn, *Forschungen zur Geschichte des neutestamentlichen Kanons* (1900), vi. 158 sqq.

A later stage of the tradition regarding Philip appears in various late apocryphal writings which have been edited by Tischendorf in his *Acta apostolorum apocrypha*, and in his *Apocalypses apocryphae*. According to the *Acta Philippi*, a work belonging at the earliest to the close of the 4th century (see Zahn, *op. cit.* p. 18 sqq.), Philip, with Bartholomew and his own sister Mariamne, exercised a widespread missionary activity, preaching not only throughout Asia Minor, but also in Hellas the city of the Athenians, in Scythia, and in Gaul, &c. According to one account he died a natural death; according to another he was hanged or crucified, head downwards. An apocryphal gospel, which describes the progress of the soul through the next world, bears his name (Hennecke, *Neutestamentliche Apokryphen*, 1904, p. 40 seq.).

Since the 6th century Philip has been commemorated in the West, along with St James the Less, on the 1st of May, their relics being deposited in the same church in Rome; in the Eastern Church Philip's day is the 14th of November, and that of James the Less the 23rd of October.

PHILIP, "the evangelist," is first mentioned in the Acts (vi. 5) as one of "the seven" who were chosen to attend to certain temporal affairs of the church in Jerusalem in consequence of the murmurings of the Hellenists against the Hebrews. After the martyrdom of Stephen he went to "the city of Samaria," where he preached with much success, Simon Magus being one of his converts. He afterwards instructed and baptized the Ethiopian eunuch on the road between Jerusalem and Gaza; next he was "caught away" by the Spirit and "found at Azotus" (Ashdod), whence "passing through he preached in all the cities till he came to Caesarea" (Acts viii.). Here some years afterwards, according to Acts xxi. 8, 9, where he is described as "the evangelist" (a term found again in the New Testament only in Eph. iv. 11; 2 Tim. iv. 5), he entertained Paul and his companion on their way to Jerusalem; at that time "he had four daughters which did prophesy." At a very early period he came to be confounded with the apostle Philip (see above); the confusion was all the more easy because, as an esteemed member of the apostolic company, he may readily have been described as an apostle in the wider sense of that word (see further Salmon, *Introd. to the New Testament*, 7th ed., p. 313 sqq.). A late tradition describes him as settling at Tralles in Asia Minor, where he became the overseer or ruler of the church. "Philip the deacon" is commemorated on the 6th of June.

PHILIP I., king of Macedonia, a semi-legendary prince, son of Argaeus, was, according to Herodotus (viii. 137–139) and Thucydides (ii. 100), the third of the Macedonian kings. In the texts of Dexippus and Eusebius he ranks sixth, Caranus, Coenus and Thurimas (or Turimmas) being there regarded as the predecessors of Perdiccas I., whom Herodotus and Thucydides regard as the first king of Macedonia. Eusebius and Dexippus assign to Philip I. a reign of 38 and 35 years respectively. There is, however, no real evidence for his existence. (E. R. B.)

PHILIP II. (382–336 B.C.), king of Macedonia, the son of Amyntas II., and the Lyncestian Eurydice, reigned 359–336. At his birth the Macedonian kingdom, including the turbulent peoples of the hill-country behind, was very imperfectly consolidated. In 370 Amyntas died, and the troubled reign of

Philip's eldest brother, Alexander II., was cut short in 368 by his assassination. His murderer, Ptolemy of Alorus, ruled as regent for the young Perdiccas, Amyntas's second son. In 367 Philip was delivered as hostage to the Thebans, then the leading power of Greece (by whom does not seem clear). During the three years he spent at Thebes the boy no doubt observed and learnt much. When he returned to Macedonia (364) Perdiccas had succeeded in getting rid of Ptolemy; but he fell in 360–359 before an onset of the hill tribes instigated by the queen-mother Eurydice, leaving only an infant son. Various pretenders sprang up and the kingdom fell into confusion. Philip seized the throne and drove back his rivals. He now began the great task of his life—the creation of the Macedonian national army. The first experiment he made with this new organism was brilliantly successful. The hill tribes were broken by a single battle in 358, and Philip established his authority inland as far as Lake Ochrida. In the autumn of the same year he took the Athenian colony, Amphipolis, which commanded the gold-mines of Mt Pangaeus. Their possession was all-important for Philip, and he set there the new city, called after him, Philippi. Athens was temporarily pacified by assurances that Amphipolis would be handed over to her later on. The work of fashioning the Macedonian army occupied Philip for the next few years, whilst his diplomacy was busy securing partisans within the states of Greece. He avoided as yet a forward policy, and having taken Pydna and Potidaea soon after Amphipolis, he made them over to the Olynthian confederation (see OLYNTHUS). His marriage with the fierce witch-woman, Olympias, daughter of the Epirote king, falls in this period, and in 356 she bore him his greater son, Alexander. In 353 Philip was ready for strong action. He first attacked Abdera and Maronea, on the Thracian sea-board, and then took Methone, which belonged to Athens. An overt breach with Athens was now inevitable. In the same summer he invaded Thessaly, where the Aleuadae of Larissa ranged themselves on his side against the *tagus* Lycophron, "tyrant" of Pherae. Pherae called in the help of the Phocian mercenaries, who had profaned Delphi, and Philip met with a check. He had, however, the advantage of now being able to present himself to the Greeks as the champion of Apollo in a holy war, and in 352 the Macedonian army won a complete victory over the Pheraeans and Phocians. This battle made Philip *tagus* of Thessaly, and he claimed as his own Magnesia, with the important harbour of Pagasae. Hostilities with Athens did not yet take place, but Athens was threatened by the Macedonian party which Philip's gold created in Euboea.

From 352 to 346 Philip did not again come south. He was active in completing the subjugation of the Balkan hill-country to the west and north, and in reducing the Greek cities of the coast as far as the Hebrus (Maritza). For the chief of these, indeed, Olynthus, he continued to profess friendship till its neighbour cities were in his hands. Then, in 349, he opened war upon it. Athens, to whom Olynthus appealed, sent no adequate forces, in spite of the upbraidings of Demosthenes (see his *Olynthiacs*), and in the spring of 347 Olynthus fell. Philip razed it to the ground (see OLYNTHUS). Macedonia and the regions adjoining it having now been securely consolidated, Philip celebrated his "Olympian" games at Dium. In 347 Philip advanced to the conquest of the eastern districts about the Hebrus, and compelled the submission of the Thracian prince Cersobleptes. Meanwhile Athens had made overtures for peace (see the *De falsa legatione* of Demosthenes), and when Philip, in 346, again moved south, peace was sworn in Thessaly. The time was come for Philip to assert himself in Greece, and the Phocians, who still dominated Delphi and held Thermopylae, could furnish a pretext to the champion of Pan-Hellenism and Apollo. The Phocian mercenaries at Thermopylae were bought off and Philip crossed into central Greece. Here he made Thebes his ally and visited the Phocians with crushing vengeance. The Pythian games of 346 were celebrated at the delivered Delphi under Philip's presidency. Pan-Hellenic enthusiasts already saw Philip as the destined captain-general of a national crusade against Persia (Isocrates, *Philippus*, about 345). And such a position Philip had determined to secure: the Macedonian agents continued to work throughout the Greek states, and in the Peloponnesus Sparta soon found herself isolated. Euboea, too, submitted to Macedonian influence, and even received some garrisons. But more work had to be done in the Balkan highlands. In 344, or one of the following years, the Macedonian arms were carried across Epirus to the Adriatic. In 342 Philip led a great expedition north "comparable to nothing in antiquity since Darius' famous march to Scythia." In 341 his army was still campaigning in eastern Thrace, when Philip felt compelled to show his presence in Thessaly. During these years, although Athens had not overtly broken the peace of 346, there had been various diplomatic bickerings and hostile intrigues between the two powers (cf. the *Philippics* of Demosthenes). Athens had even sent emissaries to the Persian court to give warning of the proposed national crusade. She now egged on the cities of the Propontis (Byzantium, Perinthus, Selymbria), who felt themselves threatened by Philip's Thracian conquests, to declare against him. The sieges of Perinthus and Byzantium (340, 339) ended in Philip's meeting with a signal check, due in some measure to the help afforded the besieged cities by Athens and her allies. Philip's influence all over Greece was compromised. But before marching south he led another expedition across the Balkans into the country now called Bulgaria, and returned to Pella with much spoil but severely wounded in the thigh. In 338 he once more crossed into central Greece. The pretext was the contumacy shown by the Locrian town Amphissa to the rulings of the Amphictyonic Council. Philip's fortification of Elatea filled Athens with alarm. Thebes was induced to join Athens; so were some of the minor Peloponnesian states, and the allies took the field against Philip. This opposition was crushed by the epoch-making battle of Chaeroneia, which left Greece at Philip's feet. In the following year (337) Philip was in the Peloponnesus, and a congress of the Greek states at the Isthmus (from which, however, Sparta held sullenly aloof) recognized Philip as captain-general for the war against Persia. Philip returned to Macedonia to complete his preparations; an advanced force was sent into Asia in the spring of 336. But Philip's plans were suddenly blasted by his assassination in the same year during the marriage festival of his daughter at Aegae, the old capital of Macedonia. He left, however, in the Macedonian army a splendid instrument which enabled his son within ten years to change the face of the world.

Philip stands high among the makers of kingdoms. Restless energy, determination, a faculty for animating and organizing a strong people, went with unscrupulous duplicity and a full-blooded vehemence in the pleasures of sense. Yet Philip was not untouched by ideal considerations, as is proved by the respect, no doubt sincere, which he showed for Hellenic culture, by the forbearance and deference with which he treated Athens, the sacred city of that culture and his mortal foe. A special interest belongs to the Macedonian kingdom as it was shaped by Philip, since it forestalls a system which was not to find the time ripe for it in European history till many centuries later—the national kingdom quickened with the culture developed by the ancient city-states. The national kingdoms founded by the Northern races, after the fall of the Roman Empire, under the influence of the classical tradition, are the beginnings of the modern European system; Philip of Macedon foreshadows Theodoric, Charlemagne and William the Conqueror. But this first national kingdom within the sphere of Greek culture could not ultimately live between the surge of the Northern barbarians and the Roman power.

See the authorities under GREECE: *History*. A vivid and masterly sketch of Philip's personality and work is given in D. G. Hogarth's *Philip and Alexander* (1897). (E. R. B.)

PHILIP III. [ARRHIDAEUS], king of Macedonia, was the feeble-minded son of Philip II. of Macedonia by a Thessalian wife. He was chosen by the Macedonian army at Babylon in 323 to be nominal king conjointly with the infant Alexander, and was killed in Macedonia by order of Olympias (317). (See MACEDONIAN EMPIRE.)

PHILIP IV., king of Macedonia, was the son of Cassander, king of Macedonia: he reigned only one year (297–296).

PHILIP V., king of Macedonia, son of Demetrius II. and Chryseïs, was an infant at his father's death in 230–229. His cousin, Antigonus Doson, administered the kingdom as regent till his death in 221–220, when Philip was eighteen years old. Philip now ascended the throne and reigned till 179. His reign was occupied in the vain struggle to maintain the old Macedonian supremacy in the Balkan Peninsula, which became hopeless after the intervention of Rome and the decisive battle of Cynoscephalae (197). See Rome: *History*, § II. "The Republic" (period B, § b). (E. R. B.)

PHILIP I. (1052–1108), king of France, eldest son of Henry I. of France and Anne, daughter of Jaroslav I. (d. 1054), grand duke of Kiev, came to the throne, when a child of eight, by the death of his father on the 4th of August 1060. He had been crowned at Reims, in the presence of a number of magnates, on the 23rd of May 1059. Philip passed most of his early years in and around Paris, where the castles of lawless barons, such as that of Montlhéry, threatened even his personal safety. His minority came to an end in 1066. In the long reign that followed he showed no great ability or energy, and a looseness of morals which embroiled him with the Church. Before he was fifty years of age he became "fond of nothing but good cheer and sleep." But he increased the lands of his house around Paris, maintained order in them, and held his own against William I. and William II. of England, whose power in France far exceeded his own. This he accomplished for the most part by taking advantage of the quarrels among his vassals. When Baldwin VI. of Flanders died, in 1070, his son Arnulf was attacked by his uncle Robert the Frisian, count of Holland. Philip interfered, at the prayer of Arnulf's mother, Richildis; but the allies were defeated near Cassel on the 22nd of February 1071 and Arnulf slain. After a second war peace was sealed, apparently, by the marriage of Philip to Robert's step-daughter Bertha, daughter of Gertrude of Saxony and Florence, count of Holland. In 1074 a new rupture led to Philip seizing Corbie, part of the dower of his aunt Adèle, who had married Baldwin IV. of Flanders. By this he secured a sort of outpost in the direction of Flanders. The other main episodes of his reign were the quarrel over the Angevin inheritance and his wars with the dukes of Normandy. In the struggle between Fulk Rechin and his brother Geoffrey the Bearded for the inheritance of their uncle, Geoffrey Martel (d. 1060), count of Anjou, Philip received from Fulk in 1069, as the price of his neutrality, Château Landon and the Gatinais. This acquisition linked the county of Sens, acquired in 1055, with the rest of the domain round Paris, Melun and Orleans. War with William I. was chronic but intermittent. In 1076 Philip forced him to raise the siege of Dol in Brittany. Peace was made in 1077, and in December 1079 they together besieged Robert Curthose in the castle of Gerberoy. On the 8th of May 1080 the siege was raised and peace made. War with William began again in 1081 over the county of Vexin, which Philip had seized on the retirement of its count, Simon of Valois, to a monastery in 1076. William demanded reparation for the raid of Philip's vassals and the cession of Pontoise, Chaumont-en-Vexin and Mantes, but died after sacking Mantes in the same year. In 1098 there was war between Philip and William Rufus in both Maine and the Vexin. William came in person from Maine to lead the attack in the Vexin in September, and crossed the Seine, penetrating to within 30 m. of Paris on the west; but the campaign brought no results. In his last years Philip left the duty of repelling the attacks of his Norman and other enemies to his son Louis, associating him with himself, as "king-designate," some time between the 24th of May 1098 and the 25th of September 1100.

It was his second marriage which was the cause of Philip's greatest difficulties. On the 15th of May 1092 he carried off Bertrada, daughter of Simon, baron de Montfort, wife of Fulk Rechin, and prepared to marry her, though his wife Bertha was still living. The bishops, headed by Ivo, bishop of Chartres, refused to attend the ceremony of marriage, but one was found to perform it. Philip's open simony had long been a cause of friction with the papacy. When he added bigamy and adultery, Urban II. excommunicated him. The bishop of Chartres, in consequence, refused to bring his vassals to help Philip's ally, Robert, duke of Normandy, against his brother William in 1094. Bertha died in that year, but Fulk was still living, and the sentence was renewed at the council of Autun on the 15th of October. Philip replied by summoning the bishops to Paris to try Ivo of Chartres for treason. He gained a respite from the papal sentence by promises of submission, but the sentence was renewed by Urban at the council of Clermont in 1095, in 1096, and in 1097, and at Poitiers in 1101, despite the protest of William IX., count of Poitiers, who entered the church with his knights to prevent his suzerain from being excommunicated on his lands. Philip was reconciled with the Church in 1104, and took an oath not to have any converse or society with Bertrada except in the presence of "non-suspect" persons. But they seem to have gone on living together, and even visited Fulk Rechin (Bertrada's husband) in company on the 15th of October 1106. Philip died at the end of July 1108.

His reign is chiefly remarkable for the steady growth of the royal domain. In addition to the gains mentioned, he bought in 1101 a large slice of territory, including Bourges and Dun-le-Roi, from Eudes Arpin, viscount of Bourges, who was going on the crusade; and toward the end of his reign took Montlhéry, whose lord beset the southern approach to Paris. By his first queen he had four children: Louis VI., who succeeded him; Henry, who died young; Charles; and Constance, who married Hugh I., count of Champagne, and later Bohemund I., prince of Antioch. By Bertrada de Montfort he had three children: Philip, count of Montes; Fleury or Florus, who married the heiress of Nangis; and Cecilia, who married, first Tancred, prince of Galilee and Antioch, and secondly Pons de Saint Gilles, count of Tripoli.

The materials for the reign of Philip I. are in the *Recueil des historiens des Gaules et de la France*, vols. xi. to xvi. See especially the critical examination by Dom Brial of the historians who have spoken of Philip I. at the beginning of vol. xvi Consult also E. A. Freeman, *Norman Conquest*, iv., *passim*, and *William Rufus*, ii. 165–302; A. Luchaire, *Louis le Gros* (Paris, 1890), and "Les Premiers Capetiens" in E. Lavisse's *Histoire de France* (II. ii., pp. 168–175). More recent is the *Recueil des actes de Philippe I.*, edited by M. Pron (1908), and B. Monod's *Essai sur les rapports de Pascal II. avec Philippe I.* (Paris, 1907). For notices of the principal chronicles of the time see A. Molinier, *Les Sources de l'histoire de France* (II., esp. p. 307 et seq.).

PHILIP II. (1165–1223), known as PHILIP AUGUSTUS, king of France, son of Louis VII. and Adela, daughter of Theobald II., count of Champagne, was born on the 21st of August 1165. On the 1st of November 1179 he was associated with his father as king by being crowned at Reims, and at once his father's illness threw the responsibility of government on him, the death of Louis on the 19th of September 1180 leaving him sole king.

The boy-king found himself and his kingdom in a difficult and humiliating position. His long strip of royal domain was hemmed in by the Angevin Empire on the west and by the kingdom of Arles on the south-east. Henry II. of England was feudal lord of the greater part of France, practically all west of a line which began at Dieppe and ended at the foot of the Pyrenees more than half-way across to the Mediterranean, while at one point it nearly touched the Rhone. Philip's predecessors had consolidated the Capetian power within these narrow limits, but he himself was overshadowed by the power of his uncles, William, archbishop of Reims; Henry I., count of Champagne; and Theobald V., count of Blois and Chartres. He secured an ally against them, and an addition to the royal domain, by marrying, on the 28th of April 1180, Isabella or Elizabeth, daughter of Baldwin V., count of Hainaut, and of Marguerite, sister of Philip of Alsace, the reigning count of Flanders, who ceded Arras, St Omer, Aire and Hesdin, and their districts, as Isabella's dowry, a district afterwards called Artois. On the 28th of June 1180 Philip made a treaty with Henry II. at Gisors, and his reign thus opened auspiciously. But from 1181 to 1185 he had to struggle against a feudal league of his Champagnard uncles and other great barons, whose most active member was Stephen I., count of Sancerre (1152–1191). Though attacked from both north and south, the king's activity enabled him to compel the count of Sancerre to implore peace in 1181. On the death of Isabel of Vermandois, wife of Count Philip of Flanders, in 1182, Philip claimed Vermandois and seized Chauné and St Quentin, and forced his father-in-law, Baldwin of Hainaut, to support him by threatening to divorce Queen Isabel. The count of Flanders was obliged to sign the treaty of Boves in July 1185, which gave the king, in addition to the expectation of Artois, his wife's dower, sixty-five castles in Vermandois and the town of Amiens. By 1186 Hugh, duke of Burgundy, the only member of the coalition not yet subdued, was forced to submit. Then, secure at home, the king turned against Henry II., and by the truce of Châteauroux in June 1187, gained Issoudun and the seigniory of Fréteval in the Vendômois. Though the truce was for two years, Philip assembled an army in 1188 to invade Normandy, demanding Gisors and the conclusion of the marriage which had been arranged between his sister Alice and Richard of England, who had meanwhile deserted his father. But the news came that Saladin had taken Jerusalem and Richard took the cross. Shortly afterwards Philip took advantage of a rising against his quondam friend Richard, who was duke of Aquitaine, to seize the county of Berry. At a conference at Bonmoulins on the 18th of November Richard again abandoned his father, and after a second conference at La Ferté Bernard, Philip invaded Maine and forced Henry II. to conclude the treaty of Azay on the 4th of July 1189, by which the English king did homage and surrendered the territories of Graçy and Issoudun. Henry died two days later. Pledges of mutual good faith and fellowship were renewed between Philip and Richard of England on the 30th of December 1189, and they both prepared to go on the crusade.

Before setting out Philip arranged for the government of France during his absence by his famous testament of 1190, by which he proposed to rule France as far as possible from Palestine. The power of the regents, Adela, the queen-mother, and William, archbishop of Reims, was restricted by a council composed mostly of clerks who had the king's confidence. An annual report on the state of the kingdom was to be sent him. On the way to Palestine the two kings quarrelled. At the siege of Acre Philip fell ill, and on the 22nd of July, nine days after its fall, he announced his intention of returning home. He reached Paris at Christmas 1191, having concluded on his way an alliance with the emperor Henry VI. against Richard, despite his pledges not to molest his lands. When Leopold I., duke of Austria, took Richard prisoner and delivered him to the emperor, Philip did his utmost by offers of money to prolong his captivity, and, allied with the English king's brother John, attacked Richard's domains, but upon Richard's return the Normans rallied enthusiastically to his aid. Philip was defeated at Fréteval on the 3rd of July 1194, but he continued the war, generally with ill success, for the next five years. Again a formidable coalition was formed against him, including Baldwin IX., count of Flanders and Hainaut, Renaud of Dammartin, count of Boulogne, Louis, count of Blois, and Raymond VI., count of Toulouse. In Germany, Otto of Brunswick, afterwards the emperor Otto IV., allied himself with Richard, while Philip was supported by Otto's rival, Philip of Swabia. Richard's death, in April 1199, removed his arch-enemy, and Richard's successor, John, concluded the treaty of Le Goulet with Philip on the 22nd of May 1200, ceding to him the county of Evreux, Graçy and Issoudun, and the suzerainty of Berry and Auvergne. John renounced his suzerainty over Brittany and the guardianship of his nephew, Arthur; he engaged not to aid the count of Flanders or Otto IV. without Philip's consent, paid him a relief of 20,000 marks, and recognized himself as his vassal for his continental fiefs. Philip's son Louis, afterwards Louis VIII., married Blanche of Castile, John's niece. But in 1202 the war was renewed, John having seized some castles from the family of Lusignan, whose head was the count of La Marche, and taken for his queen a prospective bride, Isabelle Taillefer, from Hugh, son of Hugh IX., count of La Marche. At an interview at Le Goulet on the 25th of March, Philip demanded the cession of Anjou, Poitou and Normandy to his ward, Arthur. John refused; he was summoned to Paris before the royal judges, and failing to appear was sentenced at the end of April 1202 to lose all his fiefs. Brittany, Aquitaine and Anjou were conferred on Arthur. Philip invaded Normandy, took Lyons-la-Forêt and Eu, and, establishing himself in Gournay, besieged Arques. But John, joined by William des Roches and other lords of Maine and Poitou, jealous at the increase of Philip's power, defeated and took Arthur prisoner at Mirebeau. Philip abandoned the siege of Arques in a fit of fury, marched to the Loire, burning everywhere, and then returned to Paris. But John soon alienated the Poitevin barons, and William des Roches signed a treaty with Philip on the 22nd of March 1203. Then Philip continued his great task, the conquest of Normandy, capturing the towns around the fortress of Château-Gaillard which Richard had built to command the valley of the Seine. Pope Innocent III. tried to bring about peace, but Philip was obdurate, and after murdering Arthur of Brittany John took refuge in England in December 1203. The fall of Château-Gaillard, after a siege which lasted from September 1203 to April 1204, decided the fate of Normandy. Rouen, bound by ties of trade to England, resisted for forty days; but it surrendered on the 24th of June 1204. The conquest of Maine, Touraine, Anjou and Poitou in 1204 and 1205 was little more than a military promenade, though the castles of Loches and Chinon held out for a year. Philip secured his conquest by lavishing privileges on the convents and towns. He left the great lords, such as William des Roches, in full possession of their feudal power. In 1206 he marched through Brittany and divided it amongst his adherents. A truce for two years was made on the 26th of October 1206 by which John renounced all claims in Normandy, Maine, Brittany, Touraine and Anjou, but it did not last six months. Then Poitou was thoroughly subdued, and another truce was made in 1208, little more than southern Saintonge and Gascony being left in the hands of John. Philip had reduced to a mere remnant the formidable continental empire of the Angevins, which had threatened the existence of the Capetian monarchy.

Philip then undertook to invade England. In the assembly of Soissons on the 8th of April 1213 he made every preparation for carrying out the sentence of deposition pronounced by the pope against John. He had collected 1500 vessels and summoned all his barons when Innocent III., having sufficiently frightened John, sent Pandulf with the terms of submission, which John accepted on the 13th of May.

Disappointed of his hopes of England, Philip turned his arms against Ferdinand, count of Flanders. Ferdinand, son of Sancho I., king of Portugal, owed his county to Philip, who, hoping to find him a docile protégé, had married him to Jeanne, heiress of Flanders, daughter of Count Baldwin IX., who became emperor of the East, using the weak Philip of Namur, her guardian, to accomplish that end. They were married in January 1212. On the morrow of the marriage Louis, afterwards Louis VIII., seized Aire and St Omer in right of his mother, Isabella, and on this account Ferdinand refused his feudal duty in the English expedition. Moreover, the trade interests of his subjects, who got their raw wool from England, drew him to an alliance with England. Philip's attack brought this about on the 22nd of May 1213. He invaded Flanders and took the chief towns within a week; but he had part of his fleet burned by the English at Damme, and had to burn the rest to save it from falling into their hands. He returned to Paris, and Ferdinand retook most of the towns which had been taken by the king. A war of fire and pillage began, in which Philip and his son Louis burned their way through Flanders, and Ferdinand did the same through Artois.

In 1214 came the great crisis of Philip's life. All the forces against which he had been struggling united to overwhelm him. Paris was to be attacked from Flanders and Guienne at the same time. A league including his rebel vassals, Renaud of Dammartin, count of Boulogne, and Ferdinand, count of Flanders, with the emperor Otto IV. and a number of German princes of the Rhine region, had been formed in the north-east, while John of England made one more attempt to recover his heritage at the head of an army of mercenaries aided by the fickle baronage of Poitou. John landed at La Rochelle on the 16th of February 1214, and was at first successful. On the 19th of June he laid siege to La Roche-aux-Moines, the fortress which defended Angers and commanded the Loire valley; but on the approach of a royal army under Prince Louis on the 2nd of July his Poitevin barons refused to risk a pitched battle, and he fled hastily to La Rochelle. The Angevin Empire in France was lost. Meanwhile Philip himself won his greatest victory at the bridge of Bouvines, among the morasses of Flanders. At first taken by surprise, he turned the abortive attack into a complete rout. Renaud and Ferdinand were taken prisoner, and Otto IV. fled from the battlefield. The army of the allies was utterly destroyed (July 27, 1214). Nothing shows the progress of the Capetian monarchy more than the enthusiasm and joy of the people of France, as described by William the Breton, over this crowning victory. The battle of Bouvines, a decisive battle for the history of Germany as well as for France and England, sealed the work of Philip Augustus. The expedition of his son Louis to conquer England can hardly be considered as an incident of his reign, though he was careful to safeguard the rights of the French Crown. More important was the Albigensian crusade, in which he allowed Louis to take part, though he himself, preoccupied with the king of England, had refused time after time to do anything. He treated Simon de Montfort as if he were a royal *bailli*; but it was not in virtue of any deep-laid scheme of his that in the end Amaury de Montfort, Simon's son, resigned himself to leave his lands to the Crown of France, and gave the Crown a power it had never before possessed in Languedoc.

Even more than by his conquests Philip II. marks an epoch in French history by his work as an organizer and statesman. He surrounded himself with clerks and legists of more or less humble origin, who gave him counsel and acted as his agents. His *baillis*, who at first rather resembled the itinerant justices of Henry II. of England, were sent into the royal domain to supervise the conduct of the *prévôts* and hear complaints, while in the newly acquired lands in the south local feudal magnates were given similar powers with the title of *sénéchal*. Feudal service was more and more compounded for by a money payment, while additional taxes were raised, all going to pay the mercenaries with whom he fought Richard I. and John. The extension of the system of *sauvegarde*, by which abbeys, towns or lay vassals put themselves under the special protection of the king, and that of *pariage*, by which the possessor surrendered half the interest in his estate to the king in return for protection or some further grant, increased the royal power. The small barons were completely reduced to submission, whilst the greater feudatories could often appoint a castellan to their own castles only after he had taken an oath to the king. Philip supported the clergy against the feudal lords, and in many cases against the burgesses of the towns, but rigidly exacted from them the performance of their secular duties, ironically promising to aid the clergy of Reims, who had failed to do so, "with his prayers only" against the violence of the lords of Rethel and Roucy. He clung to his right of *regale*, or enjoyment of the revenues of bishoprics during their vacancy, though it was at times commuted for a fixed payment. The attempt to raise a tithe for the crusade in 1189 failed, however, before a general resistance owing to an unfair assessment.

It has been said with some justice that Philip II. was the first king of France to take the bourgeoisie into partnership. He favoured the great merchants, granting them trade privileges and monopolies. The Jews he protected and plundered by turns, after the fashion of medieval kings. Amongst the subject towns administered by *prévôts* a great extension of the "custom of Lorris" took place during his reign. But it is as the ally and protector of the communes that he takes his almost unique place in French history. Before him they were resisted and often crushed; after him they were exploited, oppressed, and finally destroyed. In the case of Senlis he extended the jurisdiction of the commune to all crimes committed in the district. It is true that he suppressed some communes in the newly conquered fiefs, such as Normandy, where John had been prodigal of privileges, but he erected new communes in his own private domain, quite contrary to the custom of other kings. He seems to have regarded them as a kind of garrison against feudal unruliness, while the rents they furnished increased his financial resources. He created no new types of commune, however, except Peronne, which received a maximum of political independence, the twenty-four electors, who named the *jurés* and other officers, being elected by the *corps de métiers*.

The newly organized powers of the Crown were in evidence everywhere, interfering in the family affairs of the great feudatories and taking advantage of minorities, such as that of Theobald IV. of Champagne. The great feudatories accepted his legislation on dower in 1214 and 1219 and the *établissement* of 1209 making co-heirs of fiefs hold direct from the king and not from one of their number. The Tournois was substituted for the Angevin money in Normandy after 1204. The army which safeguarded this active monarchy consisted chiefly of mercenaries. The old feudal *ost* was but rarely convoked. The communes, though they appear as taking part in the battle of Bouvines, compounded for their service by a money payment as early as 1194.

Philip's policy of building up a strong monarchy was pursued with a steadiness of aim which excluded both enthusiasm and scruple. But he seems to have prided himself on a certain humanity, or even generosity of temper, which led him to avoid putting his enemies to death, though he did not scruple to condemn Renaud of Dammartin to the most inhuman of imprisonments. He was impulsive and could display extraordinary activity at times, but he possessed also a certain coldness and caution. He shrank from no trickery in carrying out his ends, and had no room for pity. He could not even trust his own son with any power, and was brutal in his relations with his queen, Ingeborg. He is described by Paiën Gâtineau as "a well-knit, handsome man, bald (from his illness at Acre), of agreeable face and ruddy complexion, loving good cheer, wine and women. Generous to his friends, he was miserly to those who displeased him; very skilled in the art of the engineer, catholic in his faith, far-seeing, obstinate in his resolution. His judgment was sound and quick. He was also quick in his anger, but easily appeased." As the result of his steadiness of aim and patient sagacity, at the end of his reign the Crown was victorious over the feudal nobility and the royal domain extended to the frontiers along with royal authority. Artois, the Amienois, Valois, Vermandois, the greater part of the Beauvaisis, Normandy, Maine, Anjou, Touraine, and an important part of Poitou and Saintonge, were added to the domain during his reign. The number of *prévôtés* was increased from thirty-eight to ninety-four, and the royal revenue increased from 19,000 livres a month to 1200 livres a day.

Philip Augustus died on the 14th of July 1223. He was thrice married. His first wife, Isabella, by whom he had one son, Louis, died in 1189 or 1190. After her death he married Ingibjörg or Ingeborg (*q.v.*), daughter of Valdemar I. of Denmark. This unlucky marriage was negotiated, it is said, chiefly to acquire the old claims of Denmark over England, to be used as a weapon against Richard I. However that may be, he soon repudiated this Danish princess, for whom he seems to have conceived an unconquerable aversion on the very morrow of his marriage to her, and in 1196, in defiance of the pope, who had refused to nullify his union with Ingeborg, married Agnes, daughter of Bertold IV., duke of Meran. This led to his excommunication and brought the interdict upon France, and did more to weaken him than any other act of his. In 1200 he was forced to put away Agnes and to recognize Ingeborg as his lawful wife, but he kept her in prison until 1213. By Agnes (d. 1201) he had a son Philip, called "Hurepel," count of Clermont, and a daughter Mary, who married Philip, count of Namur (d. 1213), and then Henry II., duke of Brabant. Ingeborg lived until 1236.

See A. Luchaire in E. Lavisse's *Histoire de France*, tome iii. 83–284 (Paris, 1904), and literature there indicated; L. Deslisle, *Catalogue des actes de Philippe Auguste* (Paris, 1856 and 1901); A. Cartellieri, *Philip II. August*, Bd. I. *Bis zum Tode Ludwigs VII.*

(Leipzig, 1899), Bd. II. *Der Kreuzzug* (1906); and W. H. Hutton, *Philip Augustus* (in the Foreign Statesmen series, London, 1896). A. Molinier, *Les Sources de l'histoire de France* (tome iii. pp. 1–38), gives a complete bibliography of the sources for Philip's reign, including the history of the Third Crusade.

PHILIP III. (1245–1285), surnamed "the Bold" (*le Hardi*), king of France, son of Louis IX. and Margaret, daughter of Raymond-Bérenger IV., count of Provence, was born on the 3rd of April 1245. His funeral monument at St Denis depicts a man with beardless, square-cut features, but lacking character and animation. The authenticity of this effigy is fairly well borne out by what is known of him from other sources. He had many of the virtues of St Louis, but neither decision of character nor devotion to duty. He was pious, charitable, of unimpeachable morality, quick-tempered but placable, no great scholar, and only energetic as a hunter. The absence in him of the qualities that fit a man to rule made his court the arena of intriguing factions, which in reality ruled France during his reign of fifteen years. Matthew of Vendôme, abbot of St Denis, an old servant of Louis IX., acted as Philip's counsellor, so the chroniclers state, throughout the reign; but he is only a shadowy figure, and it is difficult to reconcile the statement that "everything was done according to his will" with the known facts. It was probably with administration, and not policy, that Matthew was chiefly concerned. In one instance at least his advice was openly flouted. Coming to the throne by the death of his father on the 25th of August 1270, Philip began his reign by falling entirely under the influence of Pierre de la Brosse, who had been surgeon and valet-de-chambre to his father, upon whom he lavished lands and honours, making him lord (sieur) of Langeais, Chatillon-sur-Indre and Damville. Even Edward I. of England and William Dampierre, count of Flanders, strove to win his favour by gifts. But his fall was assured when Philip, who in 1271 lost his first wife, Isabella, daughter of James I., king of Aragon, married in 1274 Marie, daughter of Henry III., duke of Brabant. She was young and beautiful, and supplied a centre round which those who wished the downfall of the favourite grouped themselves. In June 1278 he was charged with various crimes, including one of poisoning the king's eldest son, and hanged at Montfaucon. His death left the parties of Marie, the queen, and Margaret, the queen-mother, to struggle for the mastery. The first subject of dispute was the inheritance of the count of Provence, Raymond-Bérenger IV., father of Margaret and of Eleanor, wife of Henry III. of England. Upon his death, in 1245, his youngest daughter, Beatrice, wife of Charles of Anjou, the king's uncle, succeeded to his lands, to the exclusion of her elder sisters, who claimed some portion of them for themselves. In 1281 war nearly broke out on this question. Margaret and her friends formed the league of Mâcon against Charles of Anjou, but the king managed to keep them at peace. The settlement of the claims of the king of England in Aquitaine by the treaty of Amiens in 1279 was a victory for the party of Margaret.

Agenais and southern Saintonge, which fell to the Crown by the death of Alfonse of Poitiers in 1276, as part of his vast possessions in Aquitaine and Languedoc, were ceded to Edward I. of England in accordance with the treaty of Paris 1259. Another portion of the heritage of Alfonse, the Venaissin, was ceded to the papacy to redeem an old promise. In general the strong will of Charles of Anjou directed Philip's policy. He secretly urged his nephew's candidature for the imperial crown, left vacant by the death of Richard of Cornwall, king of the Romans, in 1272, but without success. In May 1275 the party of Marie secured for Philip, the king's second son, the hand of Jeanne, the heiress of Navarre and Champagne, along with the guardianship of the kingdom of Navarre during the minority of Jeanne. But early in 1276 Jeanne's mother, Blanche, the widow of Henry III. of Navarre and Champagne, married Edmund, first earl of Lancaster, brother of Edward I.; and she and her English husband kept Champagne until, in 1284, Jeanne came of age.

An expedition of Philip against Castile in aid of the children of his sister, Blanche, proved abortive. Regardless of this warning, he was induced in 1284 to take up the quarrel of his uncle Charles in Sicily, after the Sicilian Vespers in 1282. Two assemblies of barons and prelates were held at Bourges in November 1283 and February 1284 to deliberate on the question. This was a mere matter of form; Marie of Brabant and her party had decided the matter beforehand, and the crown of Aragon, which the French pope Martin IV. had declared forfeited by Peter, was accepted for Charles of Valois, Philip's third son. The project was strongly opposed by Matthew of Vendôme, who was in correspondence with the king of England on the subject. It was the first warlike expedition undertaken by the house of Capet outside France. It proved a disastrous failure. The French army laid siege to Gerona on the 26th of June 1285. The town surrendered on the 7th of September, but disease and the defeat of the fleet by the Aragonese navy at Las Farmiguas Islands led to a retreat, during which, on the 5th of October, the king died. In the same month the garrison placed at Gerona surrendered. It is typical of Philip's character and career that he should die thus, in an expedition undertaken against the interests of his kingdom, at the instigation of his ambitious uncle.

Philip was twice married. On the 28th of May 1262 he married Isabella, daughter of James I., king of Aragon, who died in 1271. By her he had four children: Louis, who died in 1276; Philip, born in 1268; Charles of Valois, born on the 12th of March 1270; and Robert, who died young. By his second wife, Marie (d. 1322), daughter of Henry III. of Brabant, whom he married in 1274, he had three children: Louis, count of Evreux; Margaret, who married in 1299 Edward I., king of England; and Blanche, who married Rudolph III., duke of Austria.

See Ch. V. Langlois, *Le Règne de Philippe le Hardi* (Paris, 1887); and in E. Lavisse's *Histoire de France*, tome iii., ii. 113–117 (Paris, 1901); Fr. Walter, *Die Politik der Kurie unter Gregor X.* (Berlin, 1894); Registers of Gregory X. and Nicholas III., published by the French school at Rome; R. Sternfeld, *Ludwigs des Heiligen Kreuzzug nach Tunis und die Politik Karls I. von Sizilien* (1896); P. Fournier, *Le Royaume d'Arles* (Paris, 1891). For complete bibliography of sources see A. Molinier, *Les Sources de l'histoire de France*, tome iii. 171–187 (Paris, 1903).

PHILIP IV. (1268–1314), called "*le Bel*" or "the Fair," king of France, was the son of Philip III. and his wife, Isabella of Aragon. His reign, which began in October 1285, is one of the most momentous in the history of medieval Europe, yet it belongs rather to the history of France and to that of the papacy than to the biography of the king. Little is known of the personal part played by Philip in the events associated with his name, and later historians have been divided between the view which regards him as a handsome, lethargic nonentity and that which paints him as a master of statecraft who, under a veil of phlegmatic indifference and pious sentiment, masked an inflexible purpose, of which his ministers were but the spokesmen and executors. The first view seems to be borne out by the language of contemporary chroniclers. To his enemy, Bernard Saisset, he was neither man nor beast, but a statue, "the handsomest man in the world, but unable to do anything but stare fixedly at people without saying a word." Guillaume de Nogaret, his minister, draws a far more flattering picture, enlarging on his charm, his amiability, his modesty, his charity to all men, and his piety; and the traits of this over-coloured portrait are more or less repeated by Yves, a monk of St Denis. There is, however, no word of any qualities of will or initiative. All of which suggests a personality mentally and physically phlegmatic, a suggestion strengthened by the fact that Bartholomaeus de Neocastro (quoted by Wenck) describes him as corpulent in 1290.

Yet this was the king who with equal implacability brought the papacy under his yoke, carried out the destruction of the powerful order of the Temple, and laid the foundations of the national monarchy of France. In this last achievement Professor Finke finds the solution of a problem which Langlois had declared to be insoluble. In 1302, in the midst of a hostile assembly, Philip cursed his sons should they consent to hold the Crown of any one but God[1]; and in this isolated outburst he sees the key to his character. "Philip was not a man of violent initiative, the planner of daring and fateful operations; otherwise there would have been some signs of it. His personality was that of a well-instructed, outwardly cold, because cool and calculating man, essentially receptive, afire for only one idea: the highest possible development of the French monarchy, internally and externally, as against both the secular powers and the Church. His merit was that he carried through this idea in spite of dangers to himself and to the state. A resolution once arrived at he carried out with iron obstinacy." Certainly he was no *roi fainéant*. His courage at the battle of Mons-en-Pévèle was the admiration of friend and foe alike. It was against the advice of his tutor, Aegidius Colonna, that on coming to the throne he chose as his counsellors men of the legal class, and the names of his great ministers—Guillaume de Nogaret, Enguerrand de Marigny, Pierre Flotte (d. 1302)—attest the excellent quality of his judgment. He was, too, one of the few monarchs who have left to their successors reasoned programmes of reform for the state.

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[1] Wenck, p. 49.

The new materials from the Aragonese archives, published by Finke, give the same general impression of "uncanny" reticence on Philip's part; when other contemporary kings would have spoken he keeps silence, allowing his ministers to speak for him. Isolated passages in some of the Aragonese letters included in the collection, however, throw a new light on contemporary estimate of his character, describing him as all-powerful, as "pope and king and emperor in one person." [1]

The reign of Philip IV. is of peculiar interest, because of the intrusion of economic problems into the spheres of national politics and even of religion. The increased cost of government and the growing wealth of the middle class, rather than the avarice of the king and the genius of his ministers, were responsible for the genesis and direction of the new order. The greatest event of the reign was the struggle with Pope Boniface VIII. (*q.v.*). The pope, in his opposition to the imposition of royal taxation upon the clergy, went so far in the bull *Clericis laicos* of 1296 as to forbid any lay authority to demand taxes from the clergy without his consent. When Philip retaliated by a decree forbidding the exportation of any coin from France, Boniface gave way to save the papal dues, and the bulls issued by him in 1297 were a decided victory for the French king. Peace between the two potentates followed until 1301. After the arrest, by Philip's orders, of Bernard Saisset (*q.v.*), bishop of Pamiers, in that year, the quarrel flamed up again; other causes of difference existed, and in 1302 the pope issued the bull *Unam sanctam*, one of the most extravagant of all statements of papal claims. To ensure the support of his people the king had called an assembly of the three estates of his kingdom at Paris in April 1302; then in the following year Guillaume de Nogaret seized the person of the pope at Anagni, an event immortalized by Dante. Boniface escaped from his captors only to die (October 11), and the short pontificate of his saintly successor, Benedict XI., was occupied in a vain effort to restore harmony to the Church. The conclave that met at Perugia on his death was divided between the partisans of the irreconcilable policy of Boniface VIII. and those of a policy of compromise with the new state theories represented by France. The election was ultimately determined by the diplomacy and the gold of Philip's agents, and the new pope, Clement V., was the weak-willed creature of the French king, to whom he owed the tiara. When in 1309 the pope installed himself at Avignon, the new relation of the papacy and the French monarchy was patent to the world. It was the beginning of the long "Babylonish captivity" of the popes. The most notable of its first-fruits was the hideous persecution of the Templars (*q.v.*), which began with the sudden arrest of the members of the order in France in 1307, and ended with the suppression of the order by Pope Clement at the council of Vienne in 1313.

It is now tolerably clear that Philip's motives in this sinister proceeding were lack of money, and probably the deliberate wish to destroy a body which, with its privileged position and international financial and military organization, constituted a possible menace to the state. He had already persecuted and plundered the Jews and the Lombard bankers, and repeated recourse to the debasing of the coinage had led to a series of small risings. But under his rule something was done towards systematizing the royal taxes, and, as in England, the financial needs of the king led to the association of the people in the work of government.

In 1294 Philip IV. attacked Edward I. of England, then busied with the Scottish War, and seized Guienne. Edward won over the counts of Bar and of Flanders, but they were defeated and he was obliged to make peace in 1297. Then the Flemish cities rose against the French royal officers, and utterly defeated the French army at Courtrai in 1302. The reign closed with the French position unimproved in Flanders, except for the transfer to Philip by Count Robert of Lille, Douai and Béthune, and their dependencies. Philip died on the 29th of November 1314. His wife was Jeanne, queen of Navarre (d. 1304), through whom that country passed under the rule of Philip on his marriage in 1284; three of his sons, Louis X., Philip V. and Charles IV., succeeded in turn to the throne of France, and a daughter, Isabella, married Edward II. of England.

See the *Chronique* of Geoffrey of Paris, edited by M. Bouquet, in vol. xxii. of the *Recueil des historiens des Gaules et de la France.* Of modern works see E. Boutaric, *La France sous Philippe le Bel* (1861); G. Digard, *Philippe le Bel et le Saint-Siège* (1900); C. V. Langlois in E. Lavisse's *Histoire de France*, vol. iii. (1901); K. Wenck, *Philipp der Schöne von Frankreich* (Marburg, 1905); H. Finke, *Papsttum und Untergang des Templerordens*, 2 vols. (Münster i. W. 1907), esp. I. ch. ii.

PHILIP V. (*c.* 1294–1322), "the Tall," king of France, second son of Philip the Fair and Jeanne of Navarre, received the county of Poitiers as an appanage, and was affianced when a year old to Jeanne, daughter and heiress of Otto IV., count of Burgundy. The marriage took place in 1307 when he was thirteen years of age. When his elder brother, Louis X., died, on the 5th of July 1316, leaving his second wife, Clemence of Hungary, with child, Philip was appointed regent for eighteen years by the parliament of Paris, even in the event of a male heir being born. Clemence's son, born on the 15th of November, lived only four days, and Philip immediately proclaimed himself king, though several of the great barons declared that the rights of Jeanne, daughter of Louis X. by his first wife, Margaret of Burgundy, ought to be examined before anything else was done. The coronation at Reims, on the 9th of January 1317, took place with the gates of the city closed for fear of a surprise. The states-general of the 2nd of February 1317, consisting of the nobles, prelates, and the burgesses of Paris, approved the coronation of Philip, swore to obey him, and declared that women did not succeed to the Crown of France. The university of Paris approved this declaration, but its members did not take the oath. The Salic law was not involved, and it was later that the lawyers of the 14th century tried to connect this principle to an article of the Salic law, which accords inheritance in land (*i.e.* property) to males. In the Frankish law the article refers to private property, not to public law. The death of Philip's son Louis, in 1317, disarmed the opposition of Charles, count of La Marche, who now hoped to succeed to the Crown himself. Odo or Eudes IV., duke of Burgundy, was married to Jeanne, Philip's daughter, and received the county of Burgundy as her dower. The barons all did homage except Edward II. of England, and Philip's position was secured. The war with Flanders, which had begun under Philip IV. the Fair, was brought to an end on the 2nd of June 1320. The revolt of the Pastoureaux who assembled at Paris in 1320 to go on a crusade was crushed by the seneschal of Carcassonne, whither they marched. One of the special objects of their hatred, the Jews, were also mulcted heavily by Philip, who extorted 150,000 livres from those of Paris alone. He died at Longchamp on the night of the 2nd of January 1322.

Philip was a lover of poetry, surrounded himself with Provençal poets and even wrote in Provençal himself, but he was also one of the most hard-working kings of the house of Capet. The insecurity of his position made him seek the support of national assemblies and of provincial estates. His reign in some ways resembled that of Edward I. of England. He published a series of ordinances organizing the royal household and affecting the financial administration, the "parlement" and the royal forests. He abolished all garrisons in the towns except those on the frontier and provided for public order by allowing the inhabitants of his towns to arm themselves under the command of captains. He tried hard to procure a unification of coinage and weights and measures, but failed owing to the opposition of the estates, who were afraid of the new taxation necessary to meet the loss involved in raising the standard of the coinage, and who held to their local measures and currency partly from conservatism, partly as a relic of local liberty. Philip as a reformer was in many ways before his time, but his people failed to understand him, and he died under the reproach of extortion.

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[1] Finke, ii. no. 78, p. 122. Anon. to the commanderies of Gardeyne and Ascho: "Pus el es rey et papa et emperador! Car tot lo mon sap, quel papa no es negun et que el fa tot ço ques vol del papa et de la esglea."

See P. Lehugeur, *Histoire de Philippe le Long* (Paris, 1897); E. Lavisse, *Histoire de France* (Tome III, 2); and sources indicated in A. Molinier, *Répertoire des sources de l'histoire de France* (Paris, 1903).

PHILIP VI. (1293–1350), king of France, was the son of Charles of Valois, third son of Philip III., the Bold, and of Margaret of Sicily, and was thus the nephew of Philip IV., the Fair, whose sons, Louis X., Philip V. and Charles IV., died successively without leaving male heirs. He succeeded to the throne on the death of his cousin, Charles IV., in 1328. Before his accession Philip had enjoyed considerable influence, for he was count of Valois, Anjou, Maine, Chartres and Alençon. He had married in 1313 Jeanne (d. 1348), daughter of Robert II. of Burgundy, a determined woman who was long known as the real ruler of France. An expedition to Italy in 1319–20 against Galéas Visconti brought him little glory; he was more successful in a small expedition to Guienne, undertaken against a revolted vassal who was supported by the English.

When Charles IV. died, in February 1328, his wife was enceinte, and it became necessary to appoint a regency until the birth of the child, who would, if a son, succeed to the throne. At the assembly of barons called to choose a regent, Edward III. of England, the nephew and nearest male relation of Charles IV., put in a claim. Edward III., however, descended from the royal house of France by his mother Isabel, and the barons, probably actuated by an objection to the regency of an English king, decided that neither a woman, "nor by consequence her son, could succeed to the kingdom of France," and Philip of Valois, in spite of his belonging to a junior branch of the family, was elected regent. On the birth of a girl to the queen widow the regency naturally led to the throne of France, and Philip was crowned at Reims on the 29th of May 1328. Navarre had not accepted the regency, that kingdom being claimed by her husband for Jeanne, countess of Evreux, the eldest daughter of Louis X., the count of Evreux himself being, like Philip of Valois, a grandson of Philip the Bold. The new king secured the friendship of the count by allowing Jeanne's claim to Navarre, in return for a renunciation of any right to Champagne. Edward III. of England, after more than one citation, tendered verbal homage for part of Guienne at Amiens in 1329, but he declined to place his hands between those of Philip VI., and thus formally to acknowledge him as his liege lord. Two years later, however, he forwarded the acknowledgment by letters patent. Meanwhile Philip VI. had won a victory, which he turned into a massacre, at Cassel (August 23, 1328) over Bruges and the other towns of West Flanders, which under the leadership of Jakob van Artevelde had thrown off the authority of their count, Louis of Nevers. The count of Flanders was reinstated, and maintained his authority by a reign of terror.

Much harm was done to Philip VI.'s authority by the scandal arising out of the prosecution of Robert of Artois, count of Beaumont, who was the king's brother-in-law. The count had presented to the parlement of Paris forged deeds in support of his claim to the county of Artois, held by his aunt, Mahaut, countess of Burgundy. The sudden death of Mahaut, and of her daughter and heiress, Jeanne, widow of Philip V., lent colour to other suspicions, and Robert was driven from France and his goods confiscated. He found refuge, first in Brabant and then at the English court, where he was received as a relative and a victim of false accusations.

Philip VI. enjoyed powerful alliances. In Italy he was allied with his uncle, Robert of Anjou, king of Sicily, and with his former enemy, Galéas Visconti; in the north with the duke of Brabant and the princes of the Netherlands; on the east with the reigning princes of Lorraine and Savoy; with the king of Bohemia and with Pope John XXII. at Avignon, and his successor, Benedict XII. In 1336 it seemed that the Crusade, for which Philip VI. had long been preparing, would at last start; but the relations with Edward III. of England, which had always been strained, became worse, and within a year France was embarked on the struggle of the Hundred Years' War. The causes which led to war, the conflict for commercial supremacy in Flanders, disputed rights in Guienne, the help given by France to the Scots, and the unnatural situation of an English king who was also a vassal of the French Crown are dealt with elsewhere (see FRANCE: *History*). The immediate rupture in Flanders was due chiefly to the tyranny of the count of Flanders, Louis of Nevers, whom Philip VI. had reinstated. Edward III. had won over most of Philip's German and Flemish allies, and the English naval victory at Sluys (June 24, 1340), in which the French fleet was annihilated, effectually restored English preponderance in Flanders. A truce followed, but this was disturbed after a short duration by the disputed succession to the duchy of Brittany. Edward III. supported John of Montfort; Philip IV. his own nephew, Charles of Blois. A truce made at Malestroit in 1343 at the invitation of the pope, was rudely broken by Philip's violence. Olivier de Clisson, who with fourteen other Breton gentlemen, was suspected of intrigue with Edward III., was invited to a great tournament in Paris. On their arrival they were seized by Philip's orders, and without form of trial beheaded. Then followed Edward III.'s invasion of Normandy and the campaign of Creçy (*q.v.*). Philip's army was destroyed; he himself was wounded and fled from the field. He sought in vain to divert Edward from the siege of Calais by supporting the Scots in their invasion of England; but eventually a truce was arranged, which lasted until 1351. Philip VI. died at Nogent-le-roi on the 12th of August 1350.

Philip VI. met his necessities by the imposition of the hated gabelle or salt tax, which was invented by his legal advisers. The value of the coinage fluctuated continuously, to the great hindrance of trade; and although at a meeting of the States-General it was asserted that the king could levy no extraordinary taxes without the consent of the estates, he obtained heavy subsidies from the various provinces. Towards the close of his reign he acquired from Humbert II., comte de Vienne, the province of Dauphiné, and Montpellier from the king of Majorca. These acquisitions made the ultimate annexation of Provence a certainty. Philip married a second wife, Blanche of Navarre. By his first wife he left two sons—his successor, John II., and Philip of Orleans, count of Valois.

See *Continuations de la chronique de Guillaume de Nangis* edited in 1843 by Géraud for the *Soc. de l'hist. de France*; *Grandes chroniques de Saint Denis*, vol. v. (1837), edition by Paulin Paris; E. Déprez, *Les Préliminaires de la guerre de cent ans, 1328–1342* (Paris, 1902), based on texts from the English Record Office and the Vatican; Paul Viollet, *Histoire des institutions politiques de la France* vol. ii. (Paris, 1898); and E. Lavisse, *Hist. de France*, vol. iv. pt. i. (1902), by A. Colville. Further references will be found in Nos. 3095–3112 and 3165–3240 of A. Molinier's *Sources de l'histoire de France*, vol. iv. (Paris, 1904).

PHILIP (*c.* 1177–1208), German king and duke of Swabia, the rival of the emperor Otto IV., was the fifth and youngest son of the emperor Frederick I. and Beatrix, daughter of Renaud III., count of Upper Burgundy, and consequently brother of the emperor Henry VI. He entered the church, was made provost of Aix-la-Chapelle, and in 1190 or 1191 was chosen bishop of Würzburg. Having accompanied his brother Henry to Italy in 1191, Philip forsook his ecclesiastical calling, and, travelling again to Italy, was made duke of Tuscany in 1195 and received an extensive grant of lands. In 1196 he became duke of Swabia, on the death of his brother Conrad; and in May 1197 he married Irene, daughter of the eastern emperor, Isaac Angelus, and widow of Roger II., king of Sicily, a lady who is described by Walther von der Vogelweide as "the rose without a thorn, the dove without guile." Philip enjoyed his brother's confidence to a very great extent, and appears to have been designated as guardian of the young Frederick, afterwards the emperor Frederick II., in case of his father's early death. In 1197 he had set out to fetch Frederick from Sicily for his coronation when he heard of the emperor's death and returned at once to Germany. He appears to have desired to protect the interests of his nephew and to quell the disorder which arose on Henry's death, but events were too strong for him. The hostility to the kingship of a child was growing, and after Philip had been chosen as defender of the empire during Frederick's minority he consented to his own election. He was elected German king at Mühlhausen on the 8th of March 1198, and crowned at Mainz on the 8th of September following. Meanwhile a number of princes hostile to Philip, under the leadership of Adolph, archbishop of Cologne, had elected an anti-king in the person of Otto, second son of Henry the Lion, duke of Saxony. In the war that followed, Philip, who drew his principal support from south Germany, met with considerable success. In 1199 he received further accessions to his party and carried the war into his opponent's territory, although unable to obtain the support of Pope Innocent III., and only feebly assisted by his ally Philip Augustus, king of France. The following year was less favourable to his arms; and in March 1201 Innocent took the decisive step of placing Philip and his associates under the ban, and began to work energetically in favour of Otto. The two succeeding years were still more unfavourable to Philip. Otto, aided by Ottakar I., king of Bohemia, and Hermann I., landgrave of Thuringia, drove him from north Germany, thus compelling him to seek by abject concessions, but without success, reconciliation with Innocent. The submission to Philip of Hermann of Thuringia in 1204 marks the turning-point of his fortunes, and he was soon joined by Adolph of Cologne and Henry I., duke of Brabant. On the 6th of January 1205 he was crowned again with great ceremony by Adolph at Aix-la-Chapelle, though it was not till 1207 that his entry into Cologne practically brought the war to a close. A month or two later Philip was loosed from the papal ban, and in March 1208 it seems probable that a treaty was concluded by which a nephew of the pope was to marry one of Philip's daughters and to receive the disputed dukedom of Tuscany. Philip was preparing to crush the last flicker of the rebellion in Brunswick when he was murdered at Bamberg, on the 21st of June 1208, by Otto of Wittelsbach, count palatine in Bavaria, to whom he had refused the hand of one of his daughters. He left no sons, but four daughters; one of whom, Beatrix, afterwards married his rival, the emperor Otto IV. Philip was a brave and handsome man, and contemporary writers, among whom was Walther von der Vogelweide, praise his mildness and generosity.

See W. von Giesebrecht, *Geschichte der deutschen Kaiserzeit*, Bd. V. (Leipzig, 1888); E. Winkelmann, *Philipp von Schwaben und Otto IV. von Braunschweig* (Leipzig, 1873–1878); O. Abel, *König Philipp der Hohenstaufen* (Berlin, 1852); *Regesta imperii. V.*, edited by J. Ficker (Innsbruck, 1881); R. Schwemer, *Innocenz III. und die deutsche Kirche während des Thronstreites von 1198–1208* (Strassburg, 1882); and R. Riant, *Innocent III., Philippe de Souabe, et Boniface de Montferrat* (Paris, 1875).

PHILIP I., the Handsome (1478–1506), king of Spain, son of the emperor Maximilian I., and husband of Joanna the Mad, daughter of Ferdinand and Isabella, was the founder of the Habsburg dynasty in Spain, and was born at Bruges on the 22nd of July 1478. In 1482 he succeeded to the Burgundian possessions of his mother Mary, daughter of Charles the Bold, under the guardianship of his father. In 1496 he married Joanna. The marriage was one of a set of family alliances with Austria and Portugal designed to strengthen Spain against France. The death of John, the only son of Ferdinand and Isabella, opened the succession to the Spanish Crown to Joanna. In 1502 she and her husband received the homage of the cortes of Castile and of Aragon as heirs. Philip returned to Flanders before the close of the year. His life with Joanna was rendered extremely unhappy by his infidelity and by her jealousy, which, working on a neurotic temperament, precipitated her insanity. The princess gave way to paroxysms of rage, in which she was guilty of acts of atrocious violence. Before her mother's death, in 1504, she was unquestionably quite insane, and husband and wife lived apart. When Isabella died, Ferdinand endeavoured to lay hands on the regency of Castile, but the nobles, who disliked and feared him, forced him to withdraw. Philip was summoned to Spain, where he was recognized as king. He landed, with his wife, at Corunna on the 28th of April 1506, accompanied by a body of German mercenaries. Father and son-in-law had interviews at Remesal, near Pueblo de Senabria, and at Renedo, the only result of which was an indecent family quarrel, in which Ferdinand professed to defend the interests of his daughter, who he said was imprisoned by her husband. A civil war would probably have broken out between them; but Philip, who had only been in Spain long enough to prove his incapacity, died suddenly at Burgos, apparently of typhoid fever, on the 25th of September 1506. His wife refused for long to allow his body to be buried or to part from it. Philip was the father of the emperors Charles V. and Ferdinand I.

PHILIP II. (1527–1598) king of Spain, was born at Valladolid on the 21st of May 1527. He was the son of the emperor Charles V., and of his wife Isabella of Portugal, who were first cousins. Philip received his education in Spain. His tutor, Dr Juan Martinez Pedernales, who latinized his name to Siliceo, and who was also his confessor, does not appear to have done his duty very thoroughly. The prince, though he had a good command of Latin, never equalled his father as a linguist. Don Juan de Zuñiga, who was appointed to teach him the use of arms, was more conscientious; but he had a very poor pupil. From his earliest years Philip showed himself more addicted to the desk than the saddle and to the pen than to the sword. The emperor, who spent his life moving from one part of his wide dominions to another and in the camps of his armies, watched his heir's education from afar. The trend of his letters was to impress on the boy a profound sense of the high destinies to which he was born, the necessity for keeping his nobles apart from all share in the conduct of the internal government of his kingdom, and the wisdom of distrusting counsellors, who would be sure to wish to influence him for their own ends. Philip grew up grave, self-possessed and distrustful. He was beloved by his Spanish subjects, but utterly without the power of attracting men of other races. Though accused of extreme licentiousness in his relations with women, and though he lived for years in adultery with Doña Maria de Osorio, Philip was probably less immoral than most kings of his time, including his father, and was rigidly abstemious in eating and drinking. His power of work was unbounded, and he had an absolute love of reading, annotating and drafting despatches. If he had not become sovereign of the Low Countries, as heir of Mary of Burgundy through his father, Philip would in all probability have devoted himself to warfare with the Turks in the Mediterranean, and to the conquest of northern Africa. Unhappily for Spain, Charles, after some hesitation, decided to transmit the Netherlands to his son, and not to allow them to go with the empire. Philip was summoned in 1548 to Flanders, where he went unwillingly, and was ill regarded. In 1551 he was back in Spain, and intrusted with its government. In 1543 he had been married to his cousin Mary of Portugal, who bore him a son, the unhappy Don Carlos, and who died in 1545. In 1554, when Charles was meditating his abdication, and wished to secure the position of his son, he summoned Philip to Flanders again, and arranged the marriage with Mary, queen of England, who was the daughter of his mother's sister, in order to form a union of Spain, the Netherlands and England, before which France would be powerless. The marriage proved barren. The abdication of his father on the 16th of January 1556 constituted Philip sovereign of Spain with its American possessions, of the Aragonese inheritance in Italy, Naples and Sicily, of the Burgundian inheritance—the Netherlands and Franche Comté, and of the duchy of Milan, which his father separated from the empire for his benefit. It was a legacy of immense responsibilities and perils, for France was bound in common prudence to endeavour to ruin a power which encircled her on every side save the sea and threatened her independence. France was for a time beaten at the battles of St Quentin and Gravelines, and forced to make the Peace of Cateau Cambrésis (April 2, 1559). But the death of Mary of England on the 17th of November 1558 had deprived Philip of English support. The establishment of Elizabeth on the English throne put on the flank of his scattered dominions another power, forced no less than France by unavoidable political necessities to be his enemy. The early difficulties of Elizabeth's reign secured him a deceitful peace on that side for a time. His marriage with Elizabeth of Valois on the 22nd of June 1559, and the approach of the wars of religion, gave him a temporary security from France. But the religious agitation was affecting his own Flemish possessions, and when Philip went back to Spain, in August 1559, he was committed to a lifelong struggle in which he could not prove victorious except by the conquest of France and England.

If Philip II. had deserved his name of the Prudent he would have made haste, so soon as his father, who continued to intervene in the government from his retreat at Yuste in Estremadura, was dead, to relieve himself of the ruinous inheritance of the Low Countries. It was perhaps impossible for him to renounce his rights, and his education, co-operating with his natural disposition, made it morally impossible for him to believe that he could be in the wrong. Like the rest of his generation, he was convinced that unity of religion was indispensable to the maintenance of the authority of the State and of good order. Family pride, also, was carried by him to its highest possible pitch. Thus external and internal influences alike drove him into conflict with the Netherlands, France and England; with the first because political and religious discontent combined to bring about revolt, which he felt bound in duty to crush; with the second and third because they helped the Flemings and the Hollanders. The conflict assumed the character of a struggle between Protestantism and Roman Catholicism, in which Philip appeared as the champion of the Church. It was a part he rejoiced to play. He became, and could not but become, a persecutor in and out of Spain; and his persecutions not only hardened the obstinacy of the Dutch, and helped to exasperate the English, but they provoked a revolt of the Moriscoes, which impoverished his kingdom. No experience of the failure of his policy could shake his belief in its essential excellence. That whatever he did was done for the service of God, that success or failure depended on the inscrutable will of the Almighty and not on himself, were his guiding convictions, which he transmitted to his successors. The "service of God and his majesty" was the formula which expressed the belief of the sovereign and his subjects. Philip must therefore be held primarily responsible for the insane policy which brought Spain to ruin. He had a high ideal of his duty as a king to his own people, and had no natural preference for violent courses. The strong measures he took against disorderly elements in Aragon in 1591 were provoked by extreme misconduct on the part of a faction. When he enforced his claim to the crown of Portugal (1579–1581) he preferred to placate his new subjects by paying attention to their feelings and their privileges. He even made dangerous political concessions to secure the support of the gentry. It is true that he was ready to make use of assassination for political purposes; but he had been taught by his lawyers that he was "the prince," the embodied state, and as such had a right to act for the public good, *legibus solutus*. This was but in accordance with the temper of the times. Coligny, Lord Burghley and William the Silent also entered into murder plots. In his private life he was orderly and affectionate to his family and servants. He was slow to withdraw the confidence he had once given. In the painful episode of the imprisonment and death of his firstborn son, Don Carlos, Philip behaved honourably. He bore the acute agony of the disease which killed him with manly patience, and he died piously at the Escorial on the 13th of September 1598.

As an administrator Philip had all the vices of his type, that of the laborious, self-righteous man, who thinks he can supervise everything, is capable of endless toil, and jealous of his authority, and who therefore will let none of his servants act without his instructions. He set the example of the unending discussions in committee and boundless minute writing which finally choked the Spanish administration.

The *Histoire de Philippe II.* of M. H. Forneron (Paris, 1881), contains many references to authorities and is exhaustive, but the author has some violent prejudices. *Philip II.*, by Martin Hume (London, 1897), is more just in its treatment of Philip's personal character, and gives a useful bibliography. The main sources for the political history are the *Documentos Inéditos para la historia de España* (Madrid, 1842, &c.), vols. i., iii., vi., vii., xv., xxi., xxiv., xl., xcviii., ci., ciii., cx., cxi. and others; L. P. Gachard, *Actes des états généraux des Pays Bas, 1576–1585* (Brussels, 1861–1866); and the *Calendars of State Papers, Foreign Series, Elizabeth* (London, 1863–1901). See also Martin Hume, *Two English Queens and Philip* (1908).

PHILIP III. (1578–1621), king of Spain, son of Philip II. and his fourth wife, Anne, daughter of the emperor Maximilian II., was born at Madrid on the 14th of April 1578. He inherited the beliefs of his father, but no share of his industry. The old king had sorrowfully confessed that God had not given him a son capable of governing his vast dominions, and had foreseen that Philip III. would be led by his servants. This calculation was exactly fulfilled. The new king put the direction of his government entirely into the hands of his favourite, the duke of Lerma, and when he fell under the influence of Lerma's son, the duke of Uceda, in 1518, he trusted himself and his states to the new favourite. The king's own life was passed amid court festivities, on which enormous sums of money were wasted, or in the practice of childish piety. It was said that he was so virtuous as hardly to have committed a venial sin. He cannot be justly blamed for having been born to rule a despotic monarchy, without even the capacity which would have qualified him to manage a small estate. He died at Madrid on the 31st of March 1621. The story told in the memoirs of the French ambassador Bassompierre, that he was killed by the heat of a *brasero* (a pan of hot charcoal), because the proper official to take it away was not at hand, is a humorous exaggeration of the formal etiquette of the court.

R. Watson and W. Thompson, *History of Philip III.* (1786), give the most available general account of his reign; see also the continuation of Mariana's *History of Spain* by Miñana (Madrid, 1817–1822).

PHILIP IV. (1605–1665), king of Spain, eldest son of Philip III. and his wife Margaret, sister of the emperor Ferdinand II., was born at Valladolid on the 8th of April 1605. His reign, after a few passing years of barren successes, was a long story of political and military decay and disaster. The king has been held responsible for the fall of Spain, which was, however, due in the main to internal causes beyond the control of the most despotic ruler, however capable he had been. Philip certainly possessed more energy, both mental and physical, than his father. There is still in existence a translation of Guicciardini which he wrote with his own hand in order to qualify himself for government by acquiring a knowledge of political history. He was a fine horseman and keen hunter. His artistic taste was shown by his patronage of Velasquez, and his love of letters by his favour to Lope de Vega, Calderon, and other dramatists. He is even credited, on fairly probable testimony, with a share at least in the composition of several comedies. His good intentions were of no avail to his government. Coming to the throne at the age of sixteen, he did the wisest thing he could by allowing himself to be guided by the most capable man he could find. His favourite, Olivares, was a far more honest man than the duke of Lerma, and was more fit for the place of prime minister than any Spaniard of the time. But Philip IV. had not the strength of mind to free himself from the influence of Olivares when he had grown to manhood. The amusements which the favourite had encouraged became the business of the king's life. When, in 1643, the disasters falling on the monarchy on all sides led to the dismissal of Olivares, Philip had lost the power to devote himself to hard work. After a brief struggle with the task of directing the administration of the most extensive and the worst organized monarchy in Europe, he sank back into his pleasures and was governed by other favourites. His political opinions were those he had inherited from his father and grandfather. He thought it his duty to support the German Habsburgs and the cause of the Roman Catholic Church against the Protestants, to assert his sovereignty over Holland, and to extend the dominions of his house. The utter exhaustion of his people in the course of a hopeless struggle with Holland, France and England was seen by him with sympathy, but he considered it an unavoidable misfortune and not the result of his own errors, since he could not be expected to renounce his rights or to desert the cause of God and the Church. In public he maintained a bearing of rigid solemnity, and was seen to laugh only three times in the course of his life. But in private he indulged in horseplay and very coarse immorality. His court was grossly vicious. The early death of his eldest son, Baltasar Carlos, was unquestionably due to debauchery encouraged by the gentlemen entrusted by the king with his education. The lesson shocked the king, but its effect soon wore off. Philip IV. died broken-hearted on the 17th of September 1665, expressing the hope that his surviving son, Carlos, would be more fortunate than himself.

The best accounts of Philip IV. will be found in the *Estudios del reinado de Felipe IV.*, by Don A. Cánovas del Castillo (Madrid, 1889), and in the introduction by Don F. Silvela to his edition of the *Cartas de Sor Maria de Ágreda y del rey Felipe IV.* (Madrid, 1885–1886).

PHILIP V. (1683–1746), king of Spain, founder of the present Bourbon dynasty, was the son of the Dauphin Louis and his wife, Maria Anna, daughter of Ferdinand Maria, elector of Bavaria. He was born at Versailles on the 19th of December 1683. On the extinction of the male line of the house of Habsburg in Spain he was named heir by the will of Charles II. He had shared in the careful education given to his elder brother, Louis, duke of Burgundy, by Fénelon, and was himself known as duke of Anjou. Philip was by nature dull and phlegmatic. He had learnt morality from Fénelon's teaching, and showed himself throughout his life strongly adverse to the moral laxity of his grandfather and of most of the princes of his time. But his very domestic regularity caused him to be entirely under the influence of his two wives, Maria Louisa of Savoy, whom he married in 1702, and who died in February 1714, and Elizabeth Farnese of Parma, whom he married in December of the same year, and who survived him. He showed courage on the field of battle, both in Italy and Spain, during the War of the Spanish Succession, and was flattered by his courtiers with the title of *El Animoso*, or the spirited. But he had no taste for military adventure. If he had a strong passion, it was to provide for his succession to the throne of France, if his nephew, Louis XV., should die, and he indulged in many intrigues against the house of Orleans, whose right to the succession was supposed to be secured by Philip's solemn renunciation of all claim to the French throne, when he became king of Spain. It was in pursuit of one of these intrigues that he abdicated in 1724 in favour of his son Louis. But Louis died in a few months, and Philip returned to the throne. At a later period he tried to abdicate again, and his wife had to keep him in a species of disguised confinement. Throughout his life, but particularly in the later part of it, he was subject to prolonged fits of melancholia, during which he would not even speak. He died of apoplexy on the 9th of July 1746.

The best account of Philip's character and reign is still that given by Coxe in his *Memoirs of the Kings of Spain of the House of Bourbon* (London, 1815).

PHILIP THE BOLD (1342–1404), duke of Burgundy, fourth son of John II. of France and Bonne of Luxemburg, was born on the 15th of January 1342. He earned his surname by his bravery while fighting by his father's side on the field of Poitiers. After the defeat of King John he accompanied him into captivity in England. In 1360 he received the title of duke of Touraine, and in June 1363 was entrusted with the government of Burgundy, which John had united to the crown at the death of the last duke of the Capetian family, Philip of Rouvre, in 1361. In September 1363 John bestowed on Philip the title of duke of Burgundy, together with that of first peer of France. John was anxious not to displease the Burgundians, who were accustomed to their independence; and, moreover, with Philip as duke of Burgundy he was in a better posture to resist the king of Navarre, Charles the Bad, who laid claim to the duchy. The donation, which was at first kept secret in spite of a request made in 1363 for its confirmation by the emperor Charles IV., was ratified at the accession of Charles V. of France; but in consequence of Philip's preoccupation with the Grand Companies, which had invaded France, it was not until November 1364 that he definitely took possession of the duchy. Charles continued to show favour to his brother, appointing him (in 1366) his lieutenant in Champagne and marrying him to Margaret, daughter and heiress of Louis of Mâle, count of Flanders, and widow of Philip of Rouvre. Edward III. of England was negotiating for the marriage of this princess with his son Edmund, earl of Cambridge; but Charles prevailed upon Pope Urban V. to refuse the dispensation necessary on grounds of kinship, and even consented to give up Lille, Douai and Orchies to Flanders on condition that Margaret should marry his brother. Philip eventually won the day, thanks to the support of the late count's mother, and the marriage took place with high revel at Ghent on the 19th of June 1369.

During the succeeding years Philip proved a faithful ally to Charles. He took part in the almost bloodless campaign against the duke of Lancaster, who had landed at Calais; in 1377 he took several towns in French Flanders from the English; and in 1379 relieved Troyes, which had been besieged by the English. On Charles's death Philip found himself, with his brothers, the dukes of Anjou and Berry, in charge of the government of France in the name of Charles VI., who was a minor; and in the absence of the duke of Anjou, who left France in 1382 to conquer the kingdom of Naples, Philip occupied the most powerful position in the realm. He persuaded the young king to intervene in Flanders, where the citizens of Ghent, whose rebellious spirit had necessitated Philip's intervention in 1379, had again revolted under Philip van Artevelde and had expelled Louis of Mâle. On the 27th of November 1382 the Franco-Burgundian chivalry crushed the rebels at Rosebecke, and on his return the duke of Burgundy took part in repressing the popular movements which had broken out in Paris and other French towns. In 1383 an insurrection in Flanders supported by England gave rise to another French expedition; but in January 1384 the death of Louis of Mâle made Philip master of the countships of Flanders, Artois, Rethel and Nevers; and in the following year the citizens of Ghent decided to submit. At this period Philip sought to ingratiate himself with the emperor, who was a near neighbour, and of whom he held a part of his dominions, by giving two of his daughters in marriage to two princes of the house of Bavaria; he also took an important part in bringing about the marriage of a princess of the same family, Isabel, to King Charles VI.

Hostilities, however, were renewed between France and England. A formidable expedition was prepared under the direction of the duke of Burgundy, and a fleet of 1400 sail assembled at Sluys; but the enterprise failed owing to the dilatoriness of the duke of Berry. The fatiguing and inglorious expedition in the Netherlands, into which the duke dragged Charles for the purpose of supporting his kinswoman, Joan of Brabant, against the duke of Gelderland, shook Philip's credit with his nephew, who on his return declared himself of age and confided the government to the ancient councillors of his father, the "Marmousets." The king's madness (1392) restored his uncles to power, and particularly Philip, who after assuring peace by treating with the duke of Brittany and by concluding a truce of twenty-eight years with England, made strenuous efforts to put an end to the Great Schism, visiting Pope Benedict XIII.

at Avignon in 1395 in the hope of obtaining a voluntary resignation from him. But the growing influence of the king's brother, Louis of Orleans, who was on terms of great intimacy with Queen Isabel and was accused of being her lover, was a serious obstruction. Discord broke out in the council, and but for the intervention of the dukes of Berry and Bourbon the two princes would have come to an open struggle. For a brief period Philip was dispossessed of authority, but he regained it in 1402 and kept it till his death, which took place on the 27th of April 1404. The cathedral of St Bénigne at Dijon contains his remains, and his tomb (formerly in the Chartreuse of Dijon) is now in the museum in the Hôtel-de-ville.

Although he had to curb the independent spirit of the seigneurs of Franche-Comté, and in spite of frequent collisions with his vassals in Flanders and with the citizens of Besançon (who in 1386 extracted from him a promise to respect their privileges), Philip appears to have governed his territories with sagacity and a certain moderation, and he was particularly successful in employing the resources of France in the interests of Burgundy. He granted numerous privileges to the inhabitants of Dijon, and created in 1386 two *chambres des comptes*, one at Dijon and the other at Lille. He was, in the phrase of a contemporary, "kindly and amiable to high and low and those of middle rank, liberal as an Alexander, noble and pontifical, in court and state magnificent." But his liberality and his love of display involved him in enormous expense, and he left so many debts that his widow was compelled to renounce her personal estate to avoid the responsibility of discharging them. By his wife Margaret (d. 1405) he had a numerous family: John the Fearless, who succeeded him; Charles and Louis, who both died in infancy; Anthony, count of Rethel, and Philip, count of Nevers, both killed at Agincourt; Margaret, who married William of Bavaria, count of Ostrevant; Catherine, wife of Leopold, duke of Austria; Mary, wife of Amadeus VIII. of Savoy; and Bonne, who was betrothed to John of Bourbon and died young.

(R. Po.)

PHILIP THE GOOD (1396–1467), duke of Burgundy, son of John the Fearless, duke of Burgundy, and Margaret of Bavaria, was born at Dijon on the 13th of June 1396, and succeeded his father on the 10th of September 1419. The natural outcome of the assassination of John the Fearless (*q.v.*) was to drive his successor to the English side. In 1419 Philip signed with Henry V. of England the treaty of Arras, by which he recognized Henry as regent and future heir of the kingdom of France, and in 1420 gave his adherence to the treaty of Troyes. Early in December 1420 Philip entered Paris with the king of England, and subsequently took part in the defeat of the French at Mons-en-Vimeu. By a treaty concluded by Philip at Amiens in April 1423 with the dukes of Brittany and Bedford, John, duke of Bedford, married Philip's sister Anne, and Arthur of Brittany, earl of Richmond, became the husband of Philip's sister Margaret. A few years later discord arose among the allies. When the duke of Bedford besieged Orleans the inhabitants offered to surrender, but to the duke of Burgundy; whereupon Bedford retorted that "he did not beat the bushes for others to take the birds." When this speech reached Philip's ears he withdrew his troops in dudgeon, and concluded a truce with France (1429). Bedford, however, succeeded in conciliating him by promises and presents, and in 1430 Philip took part in the campaign against Compiègne.

But another conflict arose between the duke of Burgundy and the English. Jacqueline, countess of Hainaut, the divorced wife of the duke of Brabant and the heiress of Holland and Zeeland, had married the duke of Gloucester, who attempted to take forcible possession of his wife's territories. Philip, however, himself claimed Brabant as having been bequeathed to him by his cousin Philip, the late duke, with the result that the Burgundians repulsed the troops of the duke of Gloucester, and Jacqueline was forced to recognize the duke of Burgundy as her lieutenant and heir. Moreover, the duchess of Bedford had died in 1433. Charles VII., who in spite of the efforts of the cardinal of Ste-Croix and the conferences held by him at Auxerre and Semur had hitherto refused to return to France, finally decided to take part in the conferences which were opened at St Vaast d'Arras on the 6th of August 1435, and to which the whole of Christendom attached very high importance, all the princes of Europe and the pope and the council of Basel being represented. Philip consented to a reconciliation with the king of France, and agreed to recognize him as his legitimate sovereign on condition that he should not be required to pay him homage during his lifetime. Charles, on his part, solemnly craved pardon for the murder of John the Fearless through the mouth of the dean of the church in Paris, and handed over to the duke the counties of Mâcon, Auxerre, Bar-sur-Seine and Ponthieu, and the towns on and near the Somme (Roye, Montdidier, Péronne), reserving the option of redeeming the Somme towns for 400,000 gold crowns. Philip proved a faithful ally of the king, aiding him in re-entering Paris and preparing an expedition against Calais, which, however, failed through the ill-will of his Flemish subjects (1436). In 1440 he paid the ransom of Charles of Orleans (the son of his father's old enemy), who had been a prisoner in England since the battle of Agincourt; received him with great honour at Gravelines; and married him to Mary of Cleves, upon whom he bestowed a handsome dowry. In 1442 Philip entered into a conspiracy to give the duke of Orleans a larger share in the affairs of the kingdom. To René of Anjou, the duke of Lorraine, he showed himself less generous, setting up another claimant to the duchy of Lorraine in the person of Anthony of Vaudemont, and taking René prisoner in 1431; it was not until 1436 that he consented definitively to release René on condition that he should abandon several strong places and pay an enormous ransom. In 1445, at the conferences of Châlons-sur-Marne, the duchess of Burgundy renounced these claims in her husband's name in order to assure the execution of the treaty of Arras.

Philip was frequently disturbed by the insubordination of the Flemish communes. He had to quell seditions at Liége (1430), Ghent (1432) and Antwerp (1435). In 1438 he was driven with the duchess out of Bruges by the revolted citizens, a revolt which he repressed with great severity. In 1448 the citizens of Ghent rose in rebellion, but, disappointed of French support, they were defeated at Ruppelmonde and in 1453 were overwhelmed at the battle of Gavre, where they left 20,000 dead on the field. At a banquet shortly afterwards Philip vowed that he would lead a crusade against the Turks, who had seized Constantinople, and the knights of his court swore to follow his example.[1] The expedition, however, did not take place, and was but a pretext for levying subsidies and for knightly entertainments. In 1459 Philip sent an embassy under the duke of Cleves into Italy to take part in the conferences preparatory to a fresh expedition against the Turks, but this enterprise likewise fell to the ground. In 1456 the duke of Burgundy had given an asylum to the Dauphin Louis (afterwards Louis XI.), who had quarrelled with his father and had been forced to leave France. The "fox who would rob his host's hen-roost," as the old king called Louis, repaid his protector by attempting to sow discord in the ducal family of Burgundy, and then retired to the castle of Genappe in Brabant. At Charles VII.'s death, however, Philip was one of the first to recognize the new king, and accompanied him to Paris. During the journey Louis won over the seigneurs of Croy, the principal counsellors of the duke of Burgundy, and persuaded Philip to allow him to redeem the Somme towns for the sum stipulated in the treaty of Arras. This proceeding infuriated Philip's son Charles, count of Charolais, who prevailed upon his father to break his pledge and declare war on the king of France. On the 12th of April 1465 Philip handed over to his son the entire administration of his estates. The old duke died at Bruges on the 15th of June 1467, and was buried at Dijon.

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[1] This was the singular vow known as "the vow of the pheasant," from the fact that Philip placed his hand solemnly on a pheasant, which had been brought to him by his herald, and vowed that he would fight the Turks and challenge their sultan to single combat.

Philip was a great lover of pomp and luxury and a friend of letters, being the patron of Georges Chastelain, Olivier de la Marche and Antoine de la Salle, and the founder of the collection of MSS. known as the "Bibliothèque de Bourgogne" (now at Brussels), and also of the university of Dôle (1421). He administered his estates wisely; promoted commerce and industry, particularly in Flanders; and left his son a well-lined treasury. He was thrice married: in 1409 to Michelle (d. 1422), daughter of Charles VI. of France; in 1424 to Bonne of Artois (d. 1425); and in 1429 to Isabel (d. 1472), daughter of John I., king of Portugal. On the occasion of his third marriage Philip founded the order of the Golden Fleece. He was succeeded by Charles, afterwards known as Charles the Bold, his only surviving son by Isabel. He had several illegitimate children, among them being Corneille, called the Grand Bastard, who was killed in 1452 at the battle of Ruppelmonde.

(R. Po.)

PHILIP, Landgrave of Hesse (1504–1567), son of the landgrave William II., was born at Marburg on the 13th of November 1504. He became landgrave on his father's death in 1509, and having been declared of age in 1518, was married in 1523 to Christina, daughter of George, duke of Saxony (d. 1539). In 1522 and 1523 he assisted to quell the rising of Franz von Sickingen (*q.v.*), who had raided Hesse five years previously, and in 1525 he took a leading part in crushing the rebellion of the peasants in north Germany, being mainly responsible for their defeat at Frankenhausen. About this time Philip adopted the reformed faith, of which he was afterwards the zealous and daring defender. Indifferent to theological, or even to patriotic, considerations, his plans to protect the reformers rested upon two main principles—unity among the Protestants at home and military aid from abroad. The schemes he put forward as one of the heads of the league of Schmalkalden, aimed primarily at overthrowing the house of Habsburg; to this end aid was sought from foreigner and native, from Protestant and Catholic alike. Envoys were sent repeatedly to France, England and Denmark; Turkey and Venice were looked to for assistance; the jealousy felt towards the Habsburgs by the Bavarian Wittelsbachs was skilfully fomented; and the German Protestants were assured that attack was the best, nay the only, means of defence. Before the formation of the league of Schmalkalden Philip was very intimate with Zwingli, and up to the time of the reformer's death, in 1531, he hoped that material aid would be forthcoming from his followers. In 1526 he had aided John the Constant, elector of Saxony, to form an alliance of reforming princes; and in 1529 he called together the abortive conference at Marburg, hoping thus to close the breach between Lutherans and Zwinglians. More aggressive was his action in 1528. Deceived by the forgeries of Otto von Pack (*q.v.*), he believed in the existence of a conspiracy to crush the reformers, and was only restrained from attacking his enemies by the influence of John of Saxony and Luther. He succeeded, however, in compelling the archbishop of Mainz and the bishops of Würzburg and Bamberg to contribute to the cost of his mobilization. Philip was freely accused of having employed Pack to concoct the forgery; and, although this charge is doubtless false, his eager acceptance of Pack's unproved statements aroused considerable ill-feeling among the Catholics, which he was not slow to return. In 1529 the landgrave signed the "protest" which was presented to the diet at Spires, being thus one of the original "Protestants;" in 1530 he was among the subscribers to the confession of Augsburg; and the formation of the league of Schmalkalden in the same year was largely due to his energy.

His next important undertaking, the restoration of Ulrich, duke of Würtemberg (*q.v.*) to his duchy, was attended with conspicuous success. Würtemberg had passed into the possession of the Habsburgs, but after Philip's brief and victorious campaign in 1534 the humiliation of Charles V. and his brother, the German king, Ferdinand I., was so complete that it was said the landgrave had done more for Protestantism by this enterprise than a thousand of Luther's books would do. After this victory Philip entertained the idea of coming to terms with Charles V. on the basis of extensive concessions to the Protestants; but he quickly returned to his former plans for leading a general attack on the Habsburgs. The Concord of Wittenberg, made in 1536, was favourable for these schemes, but after five years spent in assiduous preparation war was prevented by the serious illness of the landgrave and the lukewarmness of his allies. Recovering from his malady, he had returned to his intrigues when an event happened which materially affected the fortunes of the Reformation. His union with Christina was not a happy one, and having fixed his affections upon Margaret von der Saal (d. 1566), he obtained an opinion from Protestant theologians that bigamy was not forbidden by Holy Writ. Luther and Melancthon at length consented to the marriage, but stipulated that it should be kept secret, and it was celebrated in March 1540. The marriage, however, became known, and a great outcry arose against Philip, whose friends quickly deserted him. He objected to Luther's counsel to deny the existence of a second marriage; abused John Frederick, elector of Saxony, for not coming to support him; and caused bigamy to be publicly defended. Alarmed, however, by the strength of his enemies, and by their evident determination to punish him as a bigamist, he in June 1541 made a treaty with Charles V. at Regensburg. In return for a general pardon he undertook to break off relations with France and England and loyally to support the emperor.

During these years Philip had been forwarding the progress of the Reformation in Hesse. This was begun about 1526, when an important synod was held at Homburg; the university of Marburg was founded in the interests of the reformers in 1527; and after the diet of Spires in 1529 the work was conducted with renewed vigour. The Catholic worship was suppressed, and the secularized church revenues supplied an endowment of the new university.

The peace between the emperor and the landgrave was soon broken. In 1542 Philip persuaded the league of Schmalkalden to attack Henry II., duke of Brunswick-Wolfenbüttel, ostensibly in the interests of the Protestant towns of Brunswick and Goslar. The duchy was quickly overrun, and Henry—a Catholic prince—driven out; but the good understanding between the emperor and the landgrave was destroyed, and the relations between Protestants and Catholics became worse than before. Nor was the fissure in the Protestant ranks closed, and Charles took advantage of this disunion to conquer Gelderland and to mature his preparations for overthrowing the league of Schmalkalden. Unlike John Frederick of Saxony, Philip divined, or partly divined, the emperor's intentions, and urged repeatedly that the forces of the league should be put in order. This advice passed unheeded, and when Charles suddenly showed his hand, and in July 1546 issued the imperial ban against the landgrave and the elector, it was seen that the two princes were almost isolated. Fighting began along the upper Danube, and when indecision and want of funds had ruined the league's chances of success, Philip returned to Hesse and busied himself with seeking help from foreign powers; while in April 1547 John Frederick was captured at Mühlberg. After this defeat the landgrave was induced to surrender to Charles in June by his son-in-law, Maurice, now elector of Saxony, and Joachim II., elector of Brandenburg, who promised Philip that he should be pardoned, and were greatly incensed when the emperor refused to assent to this condition. There is, however, no truth in the story that the word *einiges* was altered by an imperial servant into *ewiges*, thus making the phrase "without any imprisonment" in the treaty of surrender to read "without perpetual imprisonment." Philip was sentenced to detention for fifteen years, and as he was heartily disliked by Charles his imprisonment was a rigorous one, and became still more so after he had made an attempt to escape. His acceptance of the *Interim* in 1548 did not bring him freedom; but this came in consequence of the humiliation of

Charles V. at the hands of Maurice in 1552; and after the conclusion of the peace of Passau in this year he returned to Hesse. Although less active than formerly, the landgrave did not cease to intrigue on behalf of the Protestants while continuing the work of reforming and organizing the Church in Hesse. In 1562 he aided the Huguenots with troops, and he was frequently in communication with the insurgents in the Netherlands; but his efforts to form a union of the Protestants were fruitless. Philip, who is sometimes called the *Magnanimous*, died at Cassel on the 31st of March 1567. By Christina he had four sons and five daughters, and according to his directions the landgraviate was partitioned at his death between his sons. He had also by Margaret von der Saal seven sons, who were called counts of Dietz, and one daughter.

See Ch. von Rommel, *Philipp der Grossmüthige* (Giessen, 1830); *Briefwechsel Landgraf Philipps mit Bucer*, edited by M. Lenz (Leipzig, 1881–1890); *Politisches Archiv des Landgrafen Philipp*, edited by F. Küch (Leipzig, 1904); L. G. Mogen, *Historia captivitatis Philippi Magnanimi* (Frankfort, 1766); W. Falckenheiner, *Philipp der Grossmüthige im Bauernkriege* (Marburg, 1887); H. Schwarz, *Landgraf Philipp von Hessen und die Packschen Händel* (Leipzig, 1881); J. Wille, *Philipp der Grossmüthige von Hessen und die Restitution Ulrichs von Württemberg* (Tübingen, 1882); W. W. Rockwell *Die Doppelehe des Landgrafen Philipp von Hessen* (Marburg, 1904); A. Heidenhain, *Die Unionspolitik Philipps von Hessen* (Halle, 1890); K. Varrentrapp, *Landgraf Philipp von Hessen und die Universität Marburg* (Cassel, 1904); Von Drach and Könnecke, *Die Bildnisse Philipps des Grossmütigen* (Cassel, 1905); *Festschrift zum Gedächtnis Philipps*, published by the *Verein für hessische Geschichte und Landeskunde* (Cassel, 1904); and *Philipp der Grossmütige, Beiträge zur Geschichte seines Lebens und seiner Zeit*, published by the *Historischer Verein für das Grossherzogtum Hessen* (Marburg, 1904).

PHILIP, JOHN (1775–1851), British missionary in South Africa, was born on the 14th of April 1775, at Kirkcaldy, Fife, the son of a schoolmaster in that town. After having been apprenticed to a linendraper, and for three years a clerk in a Dundee business house, he entered the Hoxton (Congregational) Theological College, and in 1804 was appointed to a Congregational chapel in Aberdeen. In 1818 he joined the Rev. John Campbell in his second journey to South Africa to inspect the stations of the London Missionary Society, and reported that the conduct of the Cape Colonists towards the natives was deserving of strong reprobation. In 1822 the London Missionary Society appointed him superintendent of their South African stations. He made his headquarters at Cape Town, where he also established and undertook the pastorate of the Union Chapel. His indignation was aroused by the barbarities inflicted upon the Hottentots and Kaffirs (by a minority of the colonists), and he set himself to remedy their grievances; but his zeal was greater than his knowledge. He misjudged the character both of the colonists and of the natives, his cardinal mistake being in regarding the African as little removed from the European in intellect and capacity. It was the period of the agitation for the abolition of slavery in England, where Philip's charges against the colonists and the colonial government found powerful support. His influence was seen in the ordinance of 1828 granting all free coloured persons at the Cape every right to which any other British subjects were entitled. During 1826–1828 he was in England, and in the last-named year he published *Researches in South Africa*, containing his views on the native question. His recommendations were adopted by the House of Commons, but his unpopularity in South Africa was great, and in 1830 he was convicted of libelling a Cape official. The British government, however, caused the Cape government to conform to the views of Philip, who for over twenty years exercised a powerful, and in many respects unfavourable, influence over the destinies of the country. One of Philip's ideals was the curbing of colonial "aggression" by the creation of a belt of native states around Cape Colony. In Sir Benjamin D'Urban Philip found a governor anxious to promote the interests of the natives. When however at the close of the Kaffir War of 1834–35 D'Urban annexed the country up to the Kei River, Philip's hostility was aroused. He came to England in 1836, in company with a Kaffir convert and a Hottentot convert, and aroused public opinion against the Cape government. His views triumphed, D'Urban was dismissed, and Philip returned to the Cape as unofficial adviser to the government on all matters affecting the natives. For a time his plan of buffer states was carried out, but in 1846 another Kaffir rising convinced him of the futility of his schemes. The Kaffir chief who had accompanied him to England joined the enemy; and many of his converts showed that his efforts on their behalf had effected no change in their character. This was a blow from which he did not recover. The annexation of the Orange River Sovereignty in 1848 followed, finally destroying his hope of maintaining independent native states. In 1849 he severed his connexion with politics and retired to the mission station at Hankey, Cape Colony, where he died on the 27th of August 1851.

See SOUTH AFRICA: *History*; G. M'C. Theal's *History of South Africa since 1795* (London, ed. 1908); *Missionary Magazine* (1836–1851); R. Wardlaw's *Funeral Sermon*, 1852.

PHILIP, KING (*c.* 1639–1676), chief sachem of the Wampanoag Indians in America, and the son of Massasoit (d. 1662)—as the English, mistaking this title (great chief) for a proper name, called Woosamequin (Yellow Feather)—who for forty years was the friend and ally of the English colonists at Plymouth. To Massasoit's two sons, Wamsutta and Metacomet, the English gave the names respectively of Alexander and Philip. Alexander succeeded his father as sachem, and in the same year, while in Marshfield, whither he had gone to explain certain alleged unfriendly acts toward the English, was taken ill; he died on his way home. Philip, who succeeded Alexander, suspected the English of poisoning his brother. The English had grown stronger and more numerous, and had begun to meddle in the internal affairs of the Indians. In 1667 one of Philip's Indians accused him to the English of attempting to betray them to the French or Dutch, but this charge was not proved. In 1671 the Plymouth authorities demanded that the Wampanoags should surrender their arms; Philip consented, but his followers failed to comply, and measures were taken to enforce the promise. Philip thereupon went before the general court, agreed to pay an annual tribute, and not to sell lands or engage in war with other Indians without the consent of the Plymouth government. In 1674, when three Wampanoags were executed at Plymouth for the alleged murder of Sassamon, an Indian convert who had played the part of informer to the English, Philip could no longer hold his followers in check. There were outbreaks in the middle of June 1675, and on the 24th of June the massacre of whites began. There was no concerted movement of the various tribes and the war had not been previously planned. The Nipmuck Indians rose in July; the tribes along the Connecticut river in August; those in the present states of Maine and New Hampshire in September and October, and the Narragansets in December, when (on the 19th) they were attacked and seriously crippled, in what is now the township of South Kingstown, Rhode Island, by the English (under Governor Josiah Winslow of Plymouth), who suspected their loyalty.

The colony of Connecticut took quick measures of defence, guarded its frontier, maintained its alliance with the Mohegans, and suffered little injury. Massachusetts and Plymouth were slower in acting and suffered great loss. Rhode Island raised no troops, and suffered severely. Early in the autumn Philip went nearly as far west as Albany in an unsuccessful attempt to get aid from the French and the Mohawks and supplies from the Dutch traders. At Deerfield on the 18th of September about 60 English were killed and the settlement was abandoned. In the spring of 1676 it became evident that the Indian power was waning. The warriors had been unable to plant their crops; they were weaker numerically and more poorly armed than the English, and the latter had also made an alliance with the friendly Naticks and the Niantics. On the 1st of August 1676 Philip's wife and nine-year old son were captured, and on the 11th of August an Indian traitor guided the English to the sachem's hiding place in a swamp at the foot of Mount Hope (in what is now the township of Bristol, Rhode Island), where early the next morning he was surprised, and while trying to escape was killed by an Indian. The head of Philip was sent to Plymouth and set on a pole in a public place, where it remained for a quarter of a century; his right hand was given to his slayer, who preserved it in rum and won many pennies by exhibiting it in the New England towns. The struggle was now over in southern New England, but it continued along the north-eastern frontier till the spring of 1678, and nearly every settlement beyond the Piscataqua was destroyed. In the colonies of Plymouth, Massachusetts, Rhode Island and Connecticut six hundred men (or about 9% of the fighting population), besides many women and children, had been killed; thirteen settlements had been completely destroyed, and about forty others were partly burned. Plymouth had incurred a debt greater than the value of the personal property of her people. The Indians suffered even worse: in addition to the large number of men, women and children slain, great numbers, among them the wife and son of Philip, were sold into slavery in the Spanish Indies and the Bermudas. Many others migrated from New England to New York; and the few remaining Indians, feeble and dispirited, were no longer a power to be reckoned with. Philip was an Indian patriot and statesman, not a warrior; he united the tribes in their resistance to the colonists, but was not a great leader in battle.

See George M. Bodges, *Soldiers in King Philip's War* (Leominster, Mass., 1896); John Gorham Palfrey, *History of New England*, vol. iii. (Boston, 1864); and especially George W. Ellis and John E. Morris, *King Philip's War* (New York, 1906). See also *Entertaining Passages Relating to King Philip's War* (Boston, 1716; new edition, edited with notes by H. M. Dexter, Boston, 1865), the account by Colonel Benjamin Church (1639–1718), one of the principal leaders of the English, of the warfare in south-eastern New England, in which he took part; it is one of the most famous and realistic accounts of early Indian warfare.

PHILIPPA OF HAINAUT (*c.* 1314–1369), queen of the English king Edward III., was the daughter of William the Good, count of Holland and Hainaut, and his wife Jeanne de Valois, granddaughter of Philip III. of France. Edward visited the court of Count William in 1326 with his mother Isabella, who immediately arranged a marriage between him and Philippa. After a dispensation had been obtained for the marriage of the cousins (they were both descendants of Philip III.) Philippa was married by proxy at Valenciennes in October 1327, and landed in England in December. She joined Edward at York, where she was married on the 30th of January 1328. Her marriage dower had been seized by the queen dowager Isabella to pay a body of Hainauters, with whose help she had compassed her husband's deposition. The alliance ensured for Edward in his French wars the support of Philippa's influential kindred; and before starting on his French campaign he secured troops from William the Good, as well as from the count of Gelderland, the count of Julick, and the emperor Louis the Bavarian. Her mother Jeanne de Valois, visited her in 1331 and further cemented the community of interests between England and Flanders. Before 1335 Philippa had established a small colony of Flemish weavers at Norwich, and she showed an active interest in the weaving trade by repeated visits to the town. She also encouraged coal-mining on her estates in Tynedale. Her eldest son, Edward the Black Prince, was born in 1330, and she subsequently bore six sons and five daughters. In November 1342 she became guardian of John of Gaunt and her younger children, with their lands. Her agents are said to have shown great harshness in collecting the feudal dues with which to supply her large household. The anecdotes of her piety and generosity which have been preserved are proof, however, of her popularity. She interceded in 1331 with the king for some carpenters whose careless work on a platform resulted in an accident to herself and her ladies, and on a more famous occasion her prayers saved the citizens of Calais from Edward's vengeance. There is a generally accepted story, based on the chronicles of Jehan le Bel and Froissart, that she summoned the English forces to meet the Scottish invasion of 1346, and harangued the troops before the battle of Neville's Cross. She certainly exercised considerable influence over her husband, whom she constantly accompanied on his campaigns; and her death on the 15th of August 1369 was a misfortune for the kingdom at large, since Edward from that time came under the domination of the rapacious Alice Perrers. Philippa was the patron and friend of Froissart, who was her secretary from 1361 to 1366. Queen's College, Oxford, was not, as is stated in Skelton's version of her epitaph, founded by her, but by her chaplain, Robert of Eglesfield. Her chief benefactions were made to the hospital of St Katharine's by the Tower, London.

See Agnes Strickland, *Lives of the Queens of England*, vol. i. In addition to the account given in his *Chroniques*, Froissart wrote a formal eulogy of her, which has been lost.

PHILIPPEVILLE, a seaport of Algeria, chief town of an arrondissement in the department of Constantine, and 54 m. N. by E. of that city, on the Bay of Stora, in 36° 53′ N. 6° 54′ E. It is connected by railway with Constantine, Batna and Biskra. The town derives its importance from being the port of Constantine. The harbour works, with every vessel in port, having been destroyed by a storm in 1878, a more commodious harbour was built, at a cost of about £1,200,000. From Cape Skikda, on the east a mole or breakwater projects 4592 ft. to the W.N.W., while from Château Vert on the west another mole runs out 1312 ft. to the north, leaving an entrance to the port about 656 ft. wide. The protected area comprises an outer and an inner basin. The depth of water at the entrance is about 33 ft., alongside the quays about 20 ft. The quays are faced with blocks of white marble brought from the quarries at Filfila, 16 m. distant. Pop. (1906), of the town 16,539, of the commune 26,050, of the arrondissement, which includes 12 communes, 147,607.

Philippeville occupies the site of successive Phoenician and Roman cities. By the Romans, under whom it attained a high state of prosperity, it was named Rusicada. In the middle ages the town ceased to be inhabited. The site was purchased from the Arabs by Marshal Valée in 1838 for £6. Some parts of the Roman theatre remain, but the stones of the amphitheatre, which stood without the walls of the modern town, and which the French found in an almost perfect state of preservation, were used by them for building purposes, and the railway was cut through the site. On a hill above the town are the Roman reservoirs, which have been restored and still supply the town with water. They are fed by a canal from the Wadi Beni Meleh. The Roman baths, in the centre of the modern town, serve as cellars for military stores.

PHILIPPI (Turk. *Filibejik*), a city of ancient Macedonia, on a steep hill near the river Gangites (mod. *Angista*), overlooking an extensive plain and at no great distance from the coast of the Aegean, on the highway between Neapolis (Kavalla) and Thessalonica. Originally called Crenides (Fountains), it took its later name from Philip II. of Macedon, who made himself master of the neighbouring gold mines of the Hill of Dionysus, and fortified the city as one of his frontier-towns. In 42 B.C., after the victory gained over the senatorial party by Octavius and Antony, it became a Roman colony, *Colonia Julia Philippensis*, which was probably increased after the battle of Actium (*Col. Aug. Julia Phil.*). The inhabitants received the Jus Italicum, and Philippi was one of the specially designated "first cities" (Acts xvi. 12; see Marquardt, *Röm. Staatsverwaltung*, i. 187). The city was twice visited by St Paul, whose Epistle to the Philippians was addressed to his converts here. The site, now uninhabited, is marked by ruins—the substructions of an amphitheatre, parts of a great temple—which have furnished interesting inscriptions. A little to the east is the huge stone monument of C. Vibius, known to the Turks as Dikelitashlar and to the Greeks as the Manger of Bucephalus.

See Heuzey and Daumet, *Mission arch. en Macédoine*, Paris (1865), and other authorities in bibliography of MACEDONIA; *Corp. Inscr. Lat.* iii. 1. (J. D. B.)

PHILIPPIANS, EPISTLE TO THE, a book of the New Testament. Communications had already passed between the Christians of Philippi and Paul, not only when he was at Thessalonica (iv. 15–16), but at some subsequent period (iv. 18), when Epaphroditus had brought him a present of money from them. It is possible that this gift was accompanied by a letter. At any rate the extant epistle is the answer to one received from the Philippian Christians, who had evidently desired information about the apostle's health and prospects (i. 12), assured him of their prayers (i. 19), and wondered whether he, their pride and glory (καύχημα), would return to them (i. 25 seq.).

After a brief greeting (i. 1, 2), Paul assures them of his loving interest in their present attainments and future progress in the faith of the gospel (i. 3–11); then, relieving their anxiety about his own prospects, he expresses the confident hope that he will be released and thus be able to return to them (i.12–26). Meantime they were to avoid any pride or factiousness which might break their unity[1] as a church (i. 27–ii. 18), and they are promised a visit from two of Paul's coadjutors,[2] who are well known to them (ii. 19–30). At this point the letter suddenly swerves[3] into a passionate warning against some errorists of Judaism (iii. 1–iv. 1), after which the appeal for unity at Philippi is reiterated (iv. 2–9),[4] and the epistle closes with some personal details (iv. 10–23).

Paul is a prisoner when he writes, and the place of composition may therefore be Caesarea or Rome (Acts xxviii. 16, 30–31). The evidence upon the whole seems to point to the latter. The phrase οἰκία Καίσαρος (iv. 22) suits Rome better than Caesarea, and, while πραιτώριον (i. 13) does not necessarily imply the capital, it is most naturally understood of Rome.[5] But the whole tone of the epistle suggests that Paul expected a speedy end to his case. Now at Caesarea this was out of the question. His appeal to Caesar involved a protracted process, and it is very difficult to put expressions like those *e.g.* of ii. 23 into such a situation. The critical outlook of Philippians does not correspond with the position of the apostle at Caesarea, nor can the latter town be said to have been a centre of vigorous Christian propaganda (i. 17). Finally, the contention that no visit of Timothy to Rome is known is an argument from silence which is of little more weight than the plea of Spitta that the cupidity of Felix (Acts xxiv. 26) was excited by the arrival of the money from Philippi (Phil. iv. 16).

A further examination of the epistle shows that it must have been written towards the close of the διετία ὅλη of Acts xxviii. 30, not in the earlier part of the Roman captivity. Paul is on the edge and eve of the great decision. Behind him (i. 12–13) lies a period during which considerable progress has been made in the local preaching and extension of the gospel, nor does the language of the apostle suggest that this fresh departure in the propaganda was stimulated by the mere novelty of his arrival. Furthermore, the relations between the Philippians and himself presuppose, on any fair estimate, an interval of time which cannot be crushed into a few months. News of his arrival must have reached them; money was collected (ii. 25, iv. 18) and then forwarded by Epaphroditus, who fell sick after he reached the capital; news of this again floated back to Philippi, and subsequently Paul heard of the Philippians' concern (ii. 26). Not till then did he compose this letter.

Philippians is thus the last extant letter we possess from Paul, unless some of the notes embedded in the pastoral epistles are to be dated subsequent to its composition. It unites the close of his career in Rome with the beginning of his mission work in Europe (iv. 15; cf. Acts xvi. 12), and illustrates not merely the situation of the apostle at Rome, but the terms of exceptional affection which existed from first to last between him and the Macedonian churches. The main argument for putting it earlier is derived from the admitted affinities between it and Romans, the Colossian and Ephesian epistles containing, it is held, a more advanced christology (so Lightfoot especially, and Hort, *Judaistic Christianity*, pp. 115–129). But such considerations are not decisive. Paul wrote from time to time, not in the execution of a literary plan, but as different objects or interests called out his powers. The Philippians did not require, and therefore did not receive, the same elaborate warnings as the Asiatic churches. Hence on the one hand it is unreal to lay stress on coincidences with Romans, as if these necessarily implied that both epistles must have been composed shortly after one another, while again the further stage of thought on Christ and the Church, which is evident in Colossians, does not prove that the latter must have followed the former. Upon the whole, the internal evidence of the epistle strongly favours its position as the last of the captivity epistles.

The attempts made during the 19th century to disprove the Pauline authorship now possess merely an historic interest, nor have the various hypotheses of more or less extensive interpolation won any serious support.[6] More significance attaches to the view that the epistle is made up of two separate notes, written to Philippi at different times. The fusion of the two is found in the abrupt hiatus of iii. 1, and evidence is led from supposed inconsistencies between the earlier and the latter parts of the epistle. But the flexibility of a letter-writer, under different moods of feeling, which would naturally lead to rapid transitions, may be adduced as some explanation of the latter phenomena. The exegesis does not absolutely necessitate a partition of the epistle, which (so Heinrichs and Paulus) would make iii. 1–iv. 20 a special letter addressed to some inner circle of the apostle's friends (in spite of iv. 10 seq.), or take iii.–iv. (Hausrath, *History of N. T. Times*, iv. 162 seq. and Bacon, *Story of St Paul*, pp. 367 seq.) as earlier than i.–ii. Besides, as Pfleiderer points out, the hypothesis is shipwrecked on the difficulty of imagining that "each of the epistles had but one essential part: the first, in particular, lacking an expression of thanks for the gift from the Philippians, which must nevertheless, according to ii. 25, have already taken place." In his letter to the Philippians (iii. 2) Polycarp indeed observes that Paul wrote ἐπιστολάς to them; but, even if the plural could not be taken as equivalent to a single despatch, it would not necessarily support the partition theory of the canonical Philippians. Polycarp may have known of more than one Pauline note to Philippi, no longer extant, or he may be referring loosely to 2 Thessalonians, which was addressed to a neighbouring Macedonian church. The exegetical arguments are, in short, the final court of appeal, and their verdict tells rather in favour of the epistle's integrity. The simplest account of iii. 1 is to suppose that Paul started afresh to complete or supplement what he had already written, possibly because some fresh tidings from Philippi had reached him in the interval. Psychologically the change from ii. 19 seq., with its note of farewell, to the impassioned outburst of iii. 2 seq., is not incredible in an informal letter from a man like Paul. The hiatus is striking, but it cannot be held to necessitate an editorial dovetailing of two separate epistles. It is doubtful, therefore, if the ingenious attempts to analyse Philippians have proved much more convincing than the similar movement of literary criticism upon the first Philippic of Demosthenes, where research has swung back in the main to a conservative position (cf. A. Baron in *Wiener Studien*, 1884, 173–205).

The first clear echoes of the epistle are heard in Polycarp, though it was probably known to Clement of Rome and Ignatius (cf. the evidence tabulated in *The New Testament in the Apostolic*

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[1] For the strong Christian consciousness of solidarity, presupposed in the Philippians, see Von Dobschutz's *Christian Life in the Primitive Church* (1904), pp. 93 seq.

[2] The touch of acerbity in ii. 21 (after i. 14) is probably to be explained by the fact that "Paul had found some of the brethren reluctant to undertake a journey to Macedonia, or to perform some other service which he desired, and the words only express the momentary disappointment of a man who was imprisoned and ready to die for the gospel" (Drummond). Cf. Renan's *Antichrist* (Eng. trans. p. 48).

[3] The so-called logion in (Justin's?) *De resurrect.* 9: εἴρηκεν ἐν οὐρανῷ τὴν κατοίκησιν ὑπάρχειν, seems a mere echo of iii. 20.

[4] On iv. 8 Von Soden notes (*History of Early Christian Literature*, p. 114) that "it is as if we heard the ripple of the waves at the meeting of the two streams which have their source in Zion and the Parthenon."

[5] If the expression meant (*a*) the *praefecti praetorio* or officials charged with the care of prisoners under trial, *i.e.* the supreme imperial court, or (*b*) the praetorian guard, or (*c*) their barracks, this would almost follow. But conceivably it might mean the palace, *i.e.* of Herod (Acts xxiii. 35). The balance of probabilities falls, however, in favour of the court hypothesis.

[6] To the details furnished in the present writer's *Historical New Testament* (2nd ed., 1901, pp. 634–635) may be added references to Völter's *Paulus u. seine Briefe* (1905), pp. 286–323, Belser's *Einleitung in der N. T.* (2nd ed., 1905), pp. 555 seq., and Schmiedel's paragraphs in *Ency. Bib.* (3147–3148). Pfleiderer (*Primitive Christianity*, i. 254 seq.) now hesitates on ii. 6 seq. alone like Brückner and Schmiedel. The objections to Paul's authorship on the score of style and grammar are finally set aside by the philologist Nägeli in *Der Wortschatz des Apostels Paulus* 1905), pp. 80–82.

Fathers, 1905, pp. 53 seq., 71 seq., 94 seq., with R. J. Knowling's *Testimony of St Paul to Christ*, pp. 111 seq. and Gregory's *Canon and Text of N. T.*, 1907, pp. 205–206).

Bibliography.—The ablest among recent editions of the Greek text are those of R. A. Lipsius (*Hand-Commentar zum N. T.*, 2nd ed., 1892), E. Haupt (in Meyer's *Kommentar*, 1902) and H. A. A. Kennedy (*Expositor's Greek Testament*, 1903), to which may be added the older commentaries of C. J. Ellicott (5th ed., 1888), J. B. Lightfoot (6th ed., 1891) and A. Klöpper (1893), which in some respects are not yet superseded. Other modern editions by M. R. Vincent (*Internat. Crit. Commentary*, 1897), H. C. G. Moule (*Cambridge Greek Testament*, 1897) and J. M. S. Baljon (1904) are worthy of notice, as well as the Roman Catholic commentaries by P. Beelen (Louvain, 1852) and A. Bisping (1866). The earlier work on the epistle is adequately summarized by B. Weiss in his *Der Philipperbrief ausgelegt u. die Geschichte seiner Auslegung kritisch dargestellt* (1859). There are brief popular commentaries in German by A. Neander (Eng. trans., 1851, Edinburgh), K. Braune (in Lange's *Bibel-Werk*, 2nd ed., 1875), Von Soden (1890), K. J. Müller (1899) and W. Lueken (in *Die Schriften des N. T.*, 1906); in English by C. J. Vaughan, M. F. Sadler (1889), J. Agar Beet, G. C. Martin (*Century Bible*) and Principal Drummond (*Internat. Handbooks* to *N. T.*, 1899). In addition to the literature cited in the course of this article, consult the general studies by M. Hasselmann (*Analyse pragmatique de l'épître aux Phil.*, 1862); A. Sabatier (*Encycl. des sciences relig.* x. 569–573); J. Gibb (Hastings's *Dict. Bible*, iii. 840–844); Sir W. M. Ramsay (*St Paul the Traveller*, ch. x., xv. § 4) and R. R. Smith (*The Epistle of St. Paul's First Trial*, Cambridge, 1899); besides the older essays of Rettig (*Quaestiones philippienses*, Giessen, 1831) and C. Müller (*Comment. de locis quibusdam epistolae ad Phil.*, 1844). The case against the Pauline authorship was stated most fully by F. C. Baur (*Paulus*, Eng. trans., ii. 45 seq. and in *Theol. Jahrb.*, 1849, pp. 501 seq., 1852, pp. 133 seq.); E. Hinsch (*Zeitschrift für wiss. Theol.*, 1873, pp. 59 seq.); S. Hoekstra (*Theol. Tijdschrift*, 1875, pp. 416 seq.); J. P. Straatman (*De Gemeente te Rome*, 1878, pp. 201 seq.); C. Holsten (*Jahrb. für protest. Theologie*, 1875, pp. 425 seq. 1876, pp. 58 seq., 282 seq.); and Van Manen (*Handeleiding voor de oudchrist. Letterkunde*, 1900, pp. 49–51, 82–84; also in *Ency. Bib.*, 3703–3713). The most thorough replies have been those of Lünemann (*Pauli ad Philipp. epistola contra Baurium defensa*, 1847); Ernesti (*Studien und Kritiken*, 1848, pp. 858–924, 1851, pp. 591–632); B. Brückner (*Epistola ad Phil. Paulo auctori vindicata contra Baurium*, 1848); A. Resch (*De l'Authent. de l'épître aux Ph.*, 1850); Grimm (*Zeitschrift für wiss. Theologie*, 1873, pp. 33 seq.); Hilgenfeld (ibid., 1884, pp. 498 seq.); C. Weizsäcker (*Apostolic Age*, i. 218 seq., 279 seq., ii. 131) and Clemen (*Paulus*, i. 130–138). The religious ideas of the epistle are best stated in English by Principal Rainy (Philippians, *Expositor's Bible*) and H. C. G. Moule (*Philippian Studies*, 1897). Of the numberless monographs on ii. 6 seq., the most full is Tholuck's *Disputatio christologica de loco Pauli, Phil. ii. 6–9*; and discussions of special excellence may be found in A. B. Bruce, *The Humiliation of Christ* (3rd ed., 1889, pp. 15 seq., 357 seq.); Weiffenbach's *Zur Auslegung d. Stelle Phil. ii. 5–11* (Karlsruhe, 1884); and E. H. Gifford, *The Incarnation* (reprinted from the *Expositor*, 1896). (J. Mt.)

PHILIPPICS, in classical literature, a series of orations delivered by Demosthenes against Philip of Macedon. The name was applied to the speeches of Cicero against Mark Antony, and "Philippic" has passed into general use in the sense of an impassioned invective or declamation.

PHILIPPICUS, East Roman emperor, 711–713, was the son of the patrician Nicephorus, and became distinguished as a soldier under Justinian II. His proper name, which indicates his Armenian origin, was Bardanes. Relying on the support of the Monothelite party, he made some pretensions to the throne on the outbreak of the first great rebellion against Justinian; these led to his relegation to Cephalonia by Tiberius Absimarus, and subsequently to his banishment, by order of Justinian, to Cherson. Here Bardanes, taking the name of Philippicus, successfully incited the inhabitants to revolt, and on the assassination of Justinian he at once assumed the purple. Among his first acts were the deposition of Cyrus, the orthodox patriarch of Constantinople, in favour of John, a member of his own sect, and the summoning of a *conciliabulum* of Eastern bishops, which abolished the canons of the sixth general council. Meanwhile Terbelis, king of the Bulgarians, plundered up to the walls of Constantinople, and shortly afterwards the Saracens made similar inroads from the Asiatic side. The reign of Philippicus was brought to a close through a conspiracy headed by two of his generals, who caused him to be blinded.

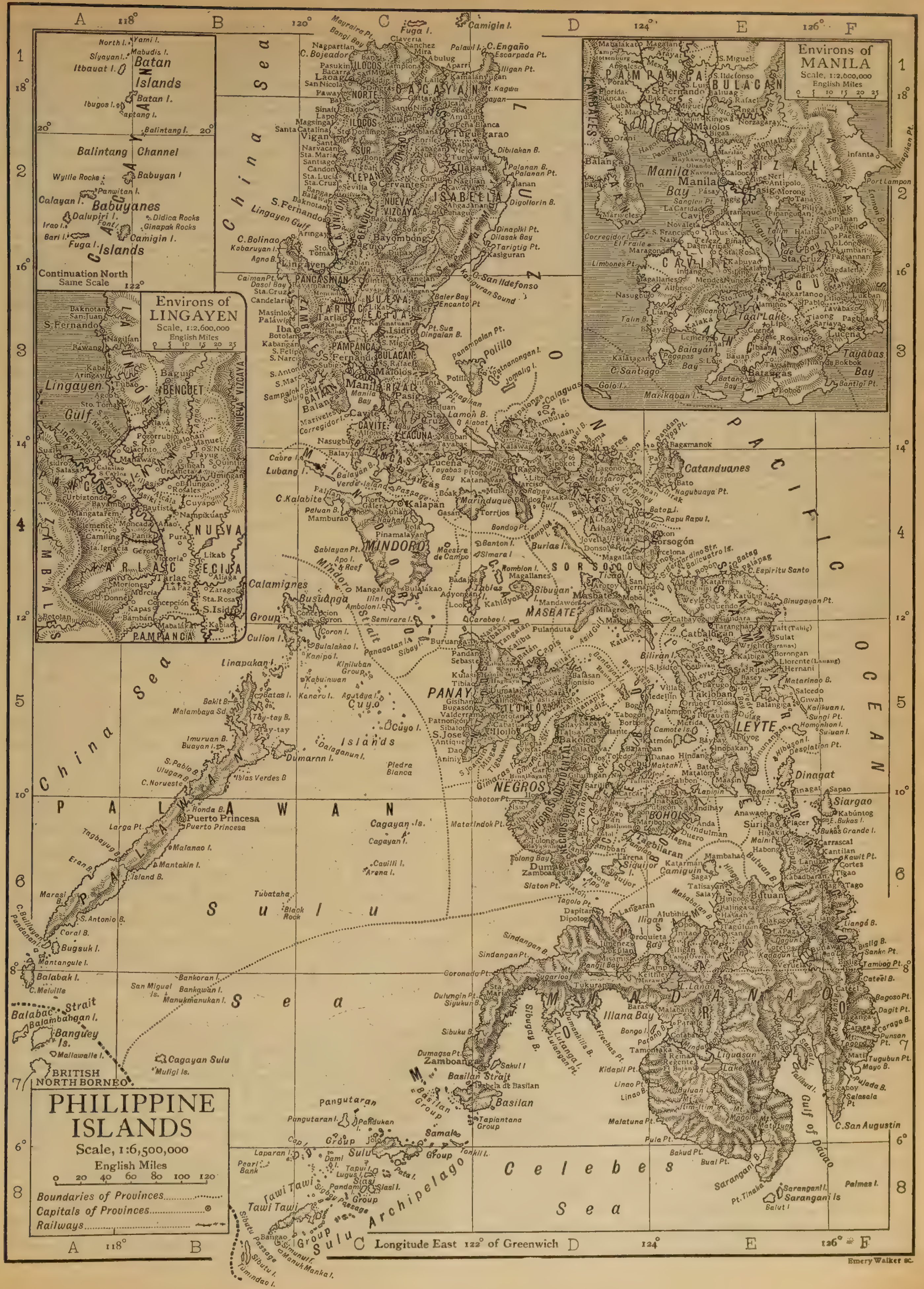
See Gibbon, *Decline and Fall of the Roman Empire* (ed. Bury, London, 1896), v. 183–184.

PHILIPPINE ISLANDS, or The Philippines, an archipelago belonging to the United States of America, situated about 500 m. off the S.E. coast of Asia between 4° 40′ and 21° 10′ N. and between 116° 40′ and 126° 34′ E. It is bounded W. and N. by the China Sea, E. by the Pacific Ocean, and S. by the Celebes Sea and the coastal waters of Borneo. Of the large islands, Luzon (40,969 sq. m.) is the most northerly, and Mindanao (36,292 sq. m.), the most southerly. Between Luzon and Mindanao are Samar (5031 sq. m.), Negros (4881 sq. m.), Panay (4611 sq. m.), Mindoro (3851 sq. m.), Leyte (2722 sq. m.), Cebú (1762 sq. m.), Bohol (1441 sq. m.) and Masbate (1236 sq. m.). Farther west and separated from the southern portion of this chain is the long narrow island of Palawan or Paragua (4027 sq. m.). The total land area of the Philippines is about 115,026 sq. m., and 92% of this is included in the eleven islands named above. There are twenty others, which have an area ranging from 106 sq. m. to 682 sq. m., and the total number of islands enumerated within the archipelago is 3141; of these 2775 contain less than 1 sq. m. each.

Physical Features.—The islands are mainly of volcanic origin, and their surface is much broken by hills, isolated volcanoes and mountain ranges, trending north and south, north-west and south-east, or north-east and south-west. Extending for 350 m. along the east coast of central and northern Luzon is the Sierra Madre range, rising in occasional peaks to more than 4500 ft. and seldom less than 3500 ft. On the west coast are the Caraballos Occidentales north from the Gulf of Lingayén and the Zambales southward from that gulf to Manila Bay. The Caraballos Occidentales range is very complex; the central ridge is in some parts a rolling plateau, but it rises in Mt Datá to 7364 ft., and numerous lofty spurs project from it. Much of the Zambales range has an average height of 4000 ft. or more, and several peaks are more than 5000 ft. high. Between the Sierra Madre and Caraballos Occidentales is the valley of the Cagayán river, about 50 m. wide, and east of the Zambales range is a lowland basin, about 150 m. long and 50 m. wide, and not more than 100 ft. above the sea except near its centre, where the extinct volcano of Aráyat rises to 3564 ft. The greater part of southern Luzon is occupied by isolated volcanoes and irregular masses of hills and mountains. Mt Mayon (7916 ft.), near the south-eastern extremity, is an active volcano with an almost perfect cone. Of less prominence are Mt Banájao (7382 ft.), Mt Isarog (6634 ft.) and Mt Masaraga (5244 ft.). The island of Mindanao is traversed north to south by mountain ranges, which rise in their summits to heights exceeding 4000 ft. That along the east coast is longest and least broken, and between it and the next range inland is the level valley of the Agusan river, from 40 to 50 m. wide. Farther west and south-west is the valley of the Rio Grande Mindanao, the largest river on the island, and between the lower course of this river and the south coast is a mountain range with a north-west and south-east trend. On the east border of the south portion of the basin of the Rio Grande Mindanao is Mt Apo (10,312 ft.), an extinct volcano and the highest elevation in the archipelago.

Each of the larger islands between Luzon and Mindanao, except Samar and Bohol, is traversed longitudinally by a single mountain range with occasional spurs. In Leyte there are several isolated volcanic cones, two of which, in the north part, exceed 4000 ft. In Mindoro the range is broad, extending from coast to coast, and it culminates in Mt Halcón (about 8800 ft.). In Negros is Mt Canlaón (8192 ft.), a volcano, and several summits exceeding 6000 ft. In Panay is Mt Madiaás (7264 ft.) and several other peaks exceeding 4000 ft. The highest peaks in Masbate are about 2500 ft. high, and in Cebú not much more than 2000 ft. In Samar there are irregular masses of hills. The southern portion of Bohol is very hilly, but the northern portion is more level. Palawan, 275 m. long and about 15 m. wide, is traversed throughout its length by a range of mountains with an average height of 4000 to 5000 ft. and a few summits about 6000 ft. high. Submarine mountain ranges connect not only the islands within the archipelago, but also the archipelago itself with Borneo and Celebes, so that only shallow channels connect the interior waters with the Pacific Ocean and the China Sea. The coast-line of the Philippines, more than 11,000 m. in length, is fringed with coral reefs and broken by numerous gulfs and bays.

The Cagayán river, in north Luzon, is the largest in the archipelago. It is about 220 m. long and drains to the northward about 10,000 sq. m., or nearly one-fourth of the island. The Rio Grande de Mindanao (known in its upper course as the Rio Pulangua) drains to the south and west a larger area in central and southern Mindanao and is second in size. It and the Agusan, which drains to the northward the mountain valley in east Mindanao, are each over 200 m. in length. The principal rivers of the lowland basin of central Luzon are the Pampanga and the Agno. The Pampanga rises in the highlands on the north-east border, flows south by west, and discharges through several channels into Manila Bay. The


PHILIPPINE ISLANDS
Scale, 1:6,500,000
English Miles
0 20 40 60 80 100 120
Boundaries of Provinces
Capitals of Provinces
Railways
Environs of LINGAYEN
Scale, 1:2,600,000
English Miles
Environs of MANILA
Scale, 1:2,600,000
English Miles
Continuation North Same Scale
Batan Islands
Babuyanes Islands
Balintang Channel
China Sea
Pacific Ocean
Sulu Sea
Celebes Sea
Luzon
Mindoro
Panay
Negros
Cebu
Bohol
Leyte
Samar
Masbate
Mindanao
Palawan
Sulu Archipelago
Manila
British North Borneo
Longitude East 122° of Greenwich
Emery Walker sc.

Agno rises in the mountains on the north border, flows south, south-west and north-west, and discharges through several channels into the Gulf of Lingayén. Each of these has a great number of small tributaries, and along the coast of this lowland basin are many small tide water streams. The Pasig is a short but commercially important stream connecting Laguna de Bay with Manila Bay. The Rio Bícol, which rises in Lake Bato and flows N.N.W. into San Miguel Bay, is the principal river of south Luzon. Samar, Panay, Negros, Leyte, Bohol and Cebú are drained by many streams, and a few of those in Samar, Panay and Negros are of considerable size.

In the lowland basin of central Luzon, 6 m. inland from Manila Bay, is Laguna de Bay, the largest body of fresh water in the Philippines. It is 32 m. long from north-west to south-east and its coast-line, broken on the north by two hilly peninsulas, is 108 m. long. Lake Taal, a few miles south-west of Laguna de Bay, occupies the crater of a great volcano. It is 17½ m. long and 12 m. wide. The country rises gently to it on all sides, and on an island near its centre is the active volcano of Taal, 1050 ft. high. In north Luzon is Lake Cagayán. In Mindanao there are lakes Lanao, Liguasan and Buluan in the west-central portion and lakes Mainit, Pinaya, Dagun, Sadocum and Linao in the valley of the Agusan. There are small lakes in some of the other islands.

Geology.—The Philippines appear to be the remnants of a somewhat complex system of mountain arcs, which from their similarity of form and direction seem to be in some way connected with the mountain ranges of Annam. The oldest rocks exposed are gneiss, talc-schist and serpentine, with intrusive masses of gabbro and diabase. These are overlaid by a limestone, upon which rests conformably a series of sandstones with coal seams. The age of these beds is unknown. In some of the islands nummulitic limestone (Eocene) occurs. Coral limestones, probably of Middle Tertiary age, are also found, sometimes 4000 ft. above the sea, and marine deposits of a very late geological period occur near the coast and in the low-lying depressions. Volcanic rocks of modern date cover extensive areas, especially in the southern part of Luzon and in Mindanao. In Luzon trachytic tuffs are sometimes interstratified with nummulitic limestone, thus showing that the eruptions had already begun in the Eocene period.

Volcanoes and Earthquakes.—There are twelve active volcanoes in the archipelago. They are Babuyán Claro, Camiguín de Babuyanes and Didicas in the Babuyanes Islands off the north coast of Luzon; Cagua or Caua in north Luzon; Taal, Mayón and Bulusan in south Luzon; Canlaon and Magasó in Negros; Camiguín de Mindanao in the island of Camiguín, off the north coast of Mindanao; and Apo and Calayo in Mindanao. Only a few eruptions have been recorded of any of these, however, except Taal and Mayón, and there has been no great eruption of Taal since 1754. But there were 26 eruptions of Mayón in the 19th century, and those of 1814 and 1897 were of great violence. That of 1897 began practically without warning on the 23rd of June, became alarming on the 24th and destructive on the 25th, and ceased on the 30th. Streams of lava completely destroyed several villages and injured others, as well as the town of San Fernando. The lava flow extended more than 7 m. eastward, and a rain of ashes extended 100 m. to the east and 75 m. to the west. There are eight other volcanoes, which although extinct or dormant have well-preserved cones. They are Aráyat, Banájao, San Cristóbal, Isarog and Malinao in south Luzon, and Macaturin and Matutum in Mindanao.

Earthquakes are frequent and occasionally violent. In the seven years 1902–1908 the microseismograph at Manila recorded 796 local earthquakes. In the 47 years ending March 1909 the various regions of the archipelago were visited by about 60 strong earthquakes; 16 of these, in ten different regions, occurred in the decade from 1890 to 1900. There were 8 in the year 1897 alone, and one of these ruined the town of Zamboanga in west Mindanao and caused considerable loss of life by falling buildings and immense sea waves. A new island appeared at this time off the coast of Borneo, near Labuan. The principal centres of disturbance are in the valley of the Agusan, in the region of Mayón volcano, in the region of Taal volcano, on Masbate Island, and along the north shore of Luzon. The islands of Cebú, Bohol, Negros and Palawan are rarely shaken.

Fauna.—The Philippines, politically speaking, and the Philippines, zoologically speaking, are not identical areas; Balabac, Palawan and the Calamianes being characterized by the occurrence of numerous Bornean forms which are conspicuously absent from the remaining islands. Although the Philippines are commonly held to form an eastern extension of the Indo-Malayan sub-region, there is a large amount of specialization in the fauna of the islands eastward of the Palawan group. Mammals are scarce. No marsupials occur. The edentates are represented by the pangolin (*Manis* sp.?) of the Palawan group. In the seas are found the dolphin, cachalot and dugong. Wild hogs of at least two species occur. The beautiful axis deer of Sulu has apparently been brought there by man. Red or brown deer occur in Basilan, Mindanao, Leyte, Samar and the Calamianes Islands. The number of species and their respective ranges have not been satisfactorily determined. In Masbate, Panay, Guimaras and Negros there is a dark-coloured species marked with buff spots. Deer are absent in Palawan, Tawi Tawi, Tablas, Romblon, Sibuyan and Siquijor. Humped cattle are raised on most of the islands. They are killed for their flesh, hides and horns, and little attention is paid to their milk-giving properties. The water-buffalo, or caraboa, occurs in a wild state in Luzon, Mindoro, the Calamianes group, Masbate, Negros and Mindanao, but the wild herds are believed to have originated from domesticated animals. The domesticated water-buffalo is sluggish in its movements, and will not work through the heat of the day; but it is a wonderful swimmer, and makes its way through the worst quagmire with ease. It is universally used as a draught animal and beast of burden. The most interesting of the ruminants is the timarau (*Bubalus mindorensis*, Heude), peculiar to Mindoro. Unlike the water-buffalo, it does not bathe in water or wallow in mud. It is extremely wild, feeding by night and sleeping by day in the densest jungle. It sometimes charges the hunter without provocation, and is very dangerous when wounded. It attacks and kills the much larger wild buffalo. All attempts to domesticate it have failed. A chevrotain is found in Balabac. The house rat, introduced by man, is a common nuisance, and mice occasionally seriously damage sugar-cane and rice. Squirrels are confined to the eastern chain of islands from Basilan to Samar and to the Palawan-Calamianes group. In the southern islands there is a tiny species, the size of a mouse. Very large flying-squirrels are found in Palawan and Mindanao. Squirrel-shrews occur in the Palawan-Calamianes group, and true shrews at various points in the archipelago. Among the Carnivores are the binturong and an otter, both found in the Palawan-Calamianes group; two civet cats, which range throughout the archipelago, and a wild cat of small size, which has been found in Palawan, Panay, Negros and Luzon. Bats are very numerous, and a number of the species are peculiar to the Philippines. *Galeopithecus* and *Tarsius* range from Basilan to Samar; the former occurs also in Bohol. In spite of all that has been said to the contrary, but one species of monkey (*Macacus philippinensis*, Geoff.) has been discovered in the Philippines. It occurs on every island of any importance. Its flesh is occasionally eaten by the natives. Albino specimens of this monkey are not uncommon, but the pure white monkeys, not albinos, said to inhabit Mindanao, are mythical. The large fruit bats (*Pteropus*) occur in immense colonies, and are sometimes eaten by the natives.

Especial importance attaches to the unexpected discovery by Whitehead of a new and peculiar mammalian fauna, inhabiting a small plateau on the top of Mt Data, in north Luzon, at an altitude of more than 7000 ft. Specimens of 15 species were obtained, embracing 5 new genera (*Calaemomys*, *Chrotomys*, *Rhynchomys*, *Batomys* and *Carpomys*). Eight of the species were new and strikingly peculiar. Their zoological relationships are probably with Celebes and with Australia. Other discoveries include a few new squirrels and bats, and the occurrence of a lemur (*Nycticebus tardigradus*) in Tawi Tawi.

The islands are as rich in birds as they are poor in mammals, the total number of species recorded up to 1906 being 693, of which about one-half are peculiar to the Philippines. A study of their geographical distribution has demonstrated that the islands may be divided into fairly well-marked groups, in each of which the birds show a degree of specialization closely correlated with diversity of environment and completeness and probable duration of separation from adjacent groups. Balabac, Palawan and the Calamianes show a very strong Bornean element. Mindoro stands by itself. Luzon and the small neighbouring islands have 51 peculiar forms. A close relationship exists between the birds of the entire eastern chain of islands. Numerous genera and some families which are absent from the central islands range from Luzon to Basilan. These genera usually have distinct representative species in Luzon, Samar and Leyte, Mindanao, and in some cases in Basilan also. The greatest differences occur between Luzon and Samar and Leyte. The latter islands have 22 peculiar species.

Sulu and Tawi Tawi belong zoologically to the Philippines, but have 12 well-marked peculiar species, and many of the characteristic Mindanao-Basilan forms are lacking. Panay, Guimaras, Negros and Masbate constitute a sharply defined area, characterized not only by the occurrence of 30 peculiar species, but by the absence of important genera, and even whole families represented in the eastern islands. Most of the mammals characteristic of the latter region are lacking. It is a curious fact that Cebú stands quite by itself, although the deep channel separating it from Negros narrows at one point to about 4 m. Cebú possesses 9 striking species of birds not known to exist elsewhere, and lacks many of the characteristic forms of the central and eastern islands. The zoological position of Bohol has not been satisfactorily determined, but all existing evidence indicates that it must be grouped with Samar and Leyte.

Among the more interesting birds may be mentioned the "mound builder" (*Megapodius cumingi*, Dillwyn), which buries its large eggs in the soft sand along the sea beach, or under great mounds of earth and dead leaves, often at a depth of three or more feet below the surface. The young are forced to dig their way out and shift for themselves. The eggs are highly prized by the natives. The jungle fowl abounds. There are 35 species of pigeons and doves, many of them most beautifully coloured and all edible. Snipe, plover, turnstones and other shore birds are abundant during the cool season, and herons, bitterns and ducks at all times. The birds of prey, 45 species, of which 22 are peculiar to the group, vary in size from a tiny falcon not larger than a sparrow (*Microhierax*), to an immense monkey-catching eagle (*Pithecophaga gefferyi*, Grant), which is strong enough to seize monkeys as they leap from tree to tree. There are 21 species of kingfishers, 15 being peculiar. Of the 12 species of hornbills not one occurs outside of the Philippines. Frog-mouths, bee-birds, night-hawks and swifts are found in considerable variety. One of the last (*Collocalia troglodytes*, Gray) constructs the edible nests so highly prized by the Chinese. The best nests are obtained on the precipitous sides of the Peñon de Coron, between Culion and Busuanga.

There may also be mentioned 21 cuckoos, 1 cockatoo, 20 parrots and parakeets, 20 woodpeckers, barbets, broadbills, starlings, orioles, weaver-finches, larks, nuthatches, 28 beautifully coloured sun-birds, and 23 flower-peckers, titmice, shrikes, swallow-shrikes, tailor-birds, thrushes, fruit-thrushes, fairy blue-birds, fire-birds, 42 fly-catchers, 4 swallows, and 5 species of most beautifully coloured ant-thrushes, as well as a large number of birds for which English names cannot be readily supplied.

Reptiles and batrachians are abundant, but have been little studied. Pythons occur throughout the group, and sometimes attain enormous size. There are numerous venomous serpents, but the mortality from snake-bite is low. Geckoes may be seen on the walls and ceilings of any house. Flying lizards abound in the forests. Large iguanas are numerous. Their eggs are prized by the natives, and the flesh of one species, known as ibit or pelubid, is highly esteemed. Crocodiles are extremely numerous in many of the streams, and are occasionally found in the sea along the coasts. Specimens have been obtained measuring 18 ft. in length. Land turtles of small size are common. Very large sea turtles are often captured by the fishermen, and their flesh is highly appreciated as an article of food. A considerable business is done in tortoise-shell. Frogs occur in great variety. One small species appears in immense numbers with the oncoming of the rainy season, and at night the noise of its outcry almost deadens other sounds.

Fishes, especially marine fishes, are numerous and varied. About 500 species of food fishes have been found, and common among them are the bangos or milkfish, the banak or mullet, mackerel, herring, anchovies, groupers, snappers, pompano, tarpon and bonito. The "dalag," which is found in the paddy-fields during the wet season, is a favourite with the natives.

The Philippines are famous for the variety, beauty and abundance of their land molluscs. Fresh-water and marine molluscs are also very numerous. While most of the species are of interest chiefly to the conchologist, there are a number of edible forms. The shells of *Placuna placenta*, L., split into thin flat plates and, cut into small squares, are almost universally used in place of window glass. The valves of the giant clam (*Tridachna*) sometimes attain a length of 5 ft. and weigh hundreds of pounds. Pearl-oysters are abundant in the southern waters of the archipelago. Pearl-fishing is an important industry in the Sulu Islands. The shells of the pearly nautilus are commonly used by the Visayans for drinking cups. From the great opercula of certain marine forms bracelets and other ornaments are carved, while the hard serrated edges of other species are sometimes employed in place of knives for harvesting rice. The land molluscs have been thoroughly classified, but much still remains to be done with the marine species.

Arthropoda are very abundant and as yet little known. Shrimps, crabs and lobsters form an important source of food supply. Mosquitoes are numerous in the wet lowlands. Bees are abundant, and wild honey and wax are gathered in considerable quantities. The number of species of ants is very large. Some of them infest dwelling-houses and swarm over the food. The termites, or so-called "white ants," inflict great damage on wooden buildings. Plagues of locusts occasionally, during a drought, ruin growing crops; in damp wet weather these insects are destroyed by a fungus growth (*Empusa gryllae*) within their bodies.

Land-leeches swarm in the damp lowland forests. The coral beds of Mindanao and the Sulu Archipelago are of unsurpassed beauty, and Guimaras, Cebú and Siquijor are completely covered with a thick cap of coral limestone.

Flora.—The rich and varied flora of the Philippines is essentially Malayan, intermixed with Chinese and Australian elements, but with sufficient individuality to constitute a sub-region, there being at least 769 species peculiar to the archipelago. More than two-thirds of the land surface is covered with forests. In the lowlands and on the lower mountain slopes the forests are composed chiefly of broad-leaved trees, common among which are the bamboo, the coco and other palms, and the banyan tree; but on the higher mountain slopes pines are most abundant. About 750 species of wood are of commercial or local value, among them are woods well suited for structural purposes, inside finishing, cabinet work and carriage making. Plants valuable for their fibre number about 300, and among them is the abacá (*Musa texilis*), from the leaves of which Manila hemp is made. There are gutta-percha, india-rubber and other trees and plants yielding gums, the banana, mango, and many other trees and plants yielding fruits; and various trees and plants yielding nuts, spices, oils and medicines.

Climate.—A uniformly high temperature, excessive humidity, heavy rainfalls and violent tropical storms, known as typhoons or bagúios, are characteristic of the Philippine climate. At Manila the mean annual temperature is about 80° F., the range of mean monthly temperature 6·48°, from 77° in January to 83·48° in May; and the range of extremes (during the period from 1881 to 1902) 39·96° from 60·08° in January 1881 to 100·04° in May 1889. In accordance with the monthly variations in temperature at Manila the year is divided into three seasons: temperate (November, December, January and February), hot (April, May and June) and intermediate (March, July, September and October). Throughout the archipelago the mean annual temperature varies much more with the altitude than with the latitude, but the range in mean monthly temperatures increases from 3·96° F. at Dávao, Mindanao, in 7° 1′ N. to 12·6° at Santo Domingo, Batan Islands, in 20° 28′ N. The equability of the temperature also decreases appreciably from the sea-coast to the interior. The maximum daily range of temperature at Manila varies from 13·8° in June to 17·7° in December. At Manila the monthly average of relative humidity ranges from 70·7° in April to 85·5° in September, and the annual average is 79·4°. The mean annual rainfall in this city is about 76 in., and nearly three-fourths of it is from the middle of June to the middle of October, when the winds blow from the south-west. During the period from 1865 to 1902 the annual rainfall varied from 35·6 in. in 1885 to 117·3 in. in 1867 when in the month of September alone there was a fall of 57·8 in. In July, August and September two-thirds of the days are rainy, but in February, March and April only one-tenth of them are rainy. On the Pacific coast of Luzon, Samar, Leyte and Mindanao the rainy season is from November to May, when the winds blow from the east or the north-east. In the year ending August 1903 the amounts of rainfall at 41 observation stations widely distributed throughout the archipelago varied from 16·2 in. at Zamboanga in west Mindanao to 152 in. at Masinloc, on the west coast of central Luzon. The Philippines are visited on the average by twenty or more typhoons annually. About one-fifth of them occur in September. During January, February, March and April they are rare; in May, June and July they become increasingly common, and in August there is a falling off in the number, which reaches its maximum in September, gradually decreasing in October, November and December. In the famous typhoon of the 20th of October 1882, the vortex of which passed over Manila, an immense amount of damage was done in the city. Two thousand persons lost their lives in Samar and Leyte during the great storm of 1897. The typhoon warnings sent out from the Manila observatory annually save heavy loss of life and property.

Soil.—The soil, usually of a reddish-brown colour, is for the most part disintegrated lava mixed with decayed vegetation; occasionally there is also a mixture of disintegrated coral limestone.

Agriculture.—Agriculture is the principal industry. In 1903 about 40 % of the working population were engaged in agricultural pursuits. The industry is, however, in a primitive condition. The native farmers are lazy and slow to appreciate the advantages of the methods recommended by the Americans. Only 9·5 % of all the land in the archipelago was included in "farms" in 1903, and less than one-half of the farm land was under cultivation. La Laguna, Luzon, was the only province in which more than 50 % of the land was included in "farms," and Cebú the only island in which more than 25 % of the land was included in farms; in the large island of Mindanao only 1·4 %, in Masbate only 1·6 %, and in Mindoro only 3·9 %. There were 815,453 "farms" or individual holdings, but more than one-fifth of these were small parcels or gardens containing less than an acre each; about one-half contained less than 2½ acres each, and the average size was 8·57 acres. More than four-fifths of them were worked by owners, and the remainder chiefly by share tenants. The principal crops are hemp (abacá), sugar, tobacco, coco-nuts and rice. Most of the hemp (538,200 acres in 1902) is grown in south Luzon and in Samar and Leyte, but smaller crops are produced in Cebú, Mindoro, Marinduque, north Mindanao and south Negros; the crop became of commercial importance about 1855, and in 1907 the yield for export amounted to 112,895 tons. About two-thirds of the sugar is produced in Negros, but it is an important crop in the provinces of Pampanga and Tarlac, within the lowland basin of Luzon, also in the province of Batangas on the south coast of Luzon, in the south and east of Panay, and in Cebú. The production increased from about 6000 tons in 1855 to 300,000 tons in 1893, and for many years prior to 1887 it was a more important crop than hemp, but since the American occupation the crop has been smaller. The total acreage in 1902 was 177,620 acres, and in 1907 the yield for export was 118,395 tons. Approximately one-half of the tobacco, 77,632 acres yielding 37,485 lb in 1902, is grown in the valley of the Cagayán river, and most of the remainder, which is of inferior quality, in the neighbouring provinces of Union, Ilocos Norte and Abra, and in Panay, Cebú, Masbate and Negros. The natives chew betel nuts instead of tobacco, and to the production of these nuts they devote more than 60,000 acres. The rich soil of the lowlands of the province of Laguna is especially well adapted to the culture of the coco-nut palm, and since the American occupation considerable land in this province that had formerly been devoted to sugar has been planted with these trees. They thrive well also in most low districts along the coasts; in 1902 about 375,000 acres were devoted to the culture of them.

Rice is the staple food of the natives. When the Philippines were discovered by the Spaniards it was the only cultivated crop of importance, and until the 19th century it was the chief article of export, but as the culture of the more profitable crops of hemp, sugar and coco-nuts was extended it became an article of import. As late as 1902, however, about one-half of the land under cultivation was sown to rice. It is grown most extensively in the lowlands of the south half of Luzon, in north Panay and in Negros, but the culture of either the lowland or the upland varieties for local consumption is very general. In some districts Indian corn is the staple food instead of rice, and the production of this cereal in small quantities for livestock is general. It is grown most extensively in the valley of the Cagayán river, in 1902 the total acreage in the archipelago was about 254,470. For several years prior to 1891, coffee, grown principally in the provinces of Cavite, Batangas and Lepanto-Bontoc, Luzon, was nearly as important a crop as tobacco, but between 1891 and 1898 most of the coffee plantations were destroyed by insects and disease. A small quantity of coffee is grown in the province of Benguet, Luzon, and is of superior quality. Cotton, the cultivation of which was discouraged by the Spanish government as a means of increasing the cultivation of tobacco, is a very small crop, except in the provinces of Ilocos Norte, and Ilocos Sur on the west coast of north Luzon; in 1902 there were in these provinces about 5525 acres of cotton. Many tropical fruits grow wild but their quality is often inferior; those cultivated most extensively are mangoes and bananas. Grapes, blackberries, figs and strawberries have been introduced from the United States and are grown successfully in the province of Benguet. The natives care little for the garden vegetables common to Europe and America, but in the vicinity of Manila and other large centres of population the Chinese grow many of these for consumption by European and American inhabitants.

With the exception of the water-buffalo, which is indispensable for agricultural purposes, the domestic animals are very inferior in quality and few in numbers. The horses, which are of Mexican, Spanish and Chinese origin, are small and poorly cared for; some American horses have been introduced for the purpose of improving the breed. The neat cattle, which are of Australian and Indian origin, are raised chiefly for beef, their hides and their horns; about nine-tenths of them were destroyed by the rinderpest and the war at the close of the 19th century. Swine are numerous but they are of a kind known in the United States as "razorbacks." There are many goats but only a few sheep. In one district near Manila duck-raising is of considerable importance, but the principal branch of the poultry industry consists in the raising of game-cocks for cock-fighting, which is the national sport.

Mineral Resources.—Numerous mineral deposits have been discovered, but little has been determined with respect to their value. Sub-bituminous coal is widely distributed. That near the surface is generally poor in quality and the difficulties of deep mining may be great because of folds and faults in the rocks. There are, however, promising fields near Danao, in Cebú; on the island of Polillo, off the east coast of Luzon; in the south part of Mindoro; on Batán Island, off the south-east coast of Luzon; on Dinagat Island, off the north coast of Mindanao; and in the north-east corner of Negros. Gold has been found in small quantities in nearly all the provinces. There is some rude gold mining by the natives. As the result of favourable indications extensive gold-mining operations have been instituted in the provinces of Benguet and Ambos Camarines in Luzon, and on the island of Masbate. Copper is scarcely less widely distributed than gold, but the production of it awaits smelters and better facilities for transportation. There are extensive deposits of iron ore (magnetite and hematite) in the province of Bulacan, Luzon. Iron ore has been found in other provinces of Luzon and in the islands of Cebú, Panay and Marinduque. There are outcrops of lead in Marinduque and Cebú, and in Marinduque considerable silver is associated with the lead. Among other minerals are sulphur, lime, gypsum and phosphate.

Manufactures.—The manufacturing industry consists mainly in preparing agricultural products for market, and in the production by the natives of wearing apparel, furniture, household utensils, and other articles required to supply their primitive wants. The most important factories are those for the manufacture of cigars and cigarettes, but most cigars and some of the cigarettes are made by hand. In the manufacture of sugar most of the mills in use extract only about three-fourths of the juice from the cane; in 1902 about 73 % of it was manufactured by 528 mills operated by steam; 17 % by 470 mills operated by hand or by a carabao; and 10 % by 77 mills operated by water-power. In the principal rice-producing districts the rice is threshed and cleaned by machines, but in other districts more primitive methods are employed. Most of the cloth which the natives wear the women weave in their own homes. There are three principal varieties: *sinamay*, which is made from selected hemp fibres and is worn by both men and women; *jusi*, which is made from a mixture of hemp and pineapple-plant fibres with or without the addition of some cotton and silk and is used for making women's dresses and men's shirts; *pina*, which is made from the fibres in the leaf of the pineapple-plant and is used for making women's garments, handkerchiefs and scarfs. *Nipa*, made from the fibre of the agave or maguey plant and worn by women, is less common. Hats are made of palm leaves, alacá leaves, banana leaves, split bamboo and various grasses. Mats, rugs and carpets are made principally of split bamboo; chairs and beds of balinag and other woods and of rattan. Alcohol is distilled from nipa, coco-nuts, buri (*Corypha umbraculifera*), cauong (*Caryota onusta*), pugahan (*Caryota urens*) and Indian corn. Other manufactures of the natives include vehicles of various kinds, harnesses, indigo, coco-nut oil, soap, salt and lime.

Communications and Commerce.—The first railway in the Philippines was the line from Manila to Dagupan (120 m.) which was built by an English corporation under a guaranty of the Spanish government and was opened in 1892. There was no further construction for ten years. But in 1902 and 1903 the Philippine government, as established in 1902 by an act of the Congress of the United States, granted franchises for the extension of the Manila-Dagupan railway to Cabanatuan (55 m.) and to Antipolo (24 m.). The first of these branches was completed in 1905, the second in 1906. In February 1905 Congress authorized the Philippine government to aid and encourage the construction of railways by guaranteeing 4 % interest on bonds; the duty on imported materials used in the construction of railways and the internal revenue on Philippine forest products used for that purpose have also been removed. With this assistance the Manila Railroad Company, organized under the laws of the state of New Jersey, agreed to construct about 600 m. of railway in Luzon; and the Philippine Railroad Company, organized under the laws of the state of Connecticut, agreed to construct about 300 m. in Panay, Cebú and Negros. In 1909 there were in operation more than 300 m. in Luzon, 60 m. in Cebú and 50 m. in Panay. At the beginning of the American occupation the roads were very bad and in many of the islands there were none; but in 1909 there were at least 400 m. of good roads. The Cagayán river, which is navigable for native boats 160 m. from its mouth, and for rafts 40 m. farther up, is an important highway of commerce in north Luzon. Many miles of inland water communication with small boats or bamboo rafts are afforded by the Pampanga, Agno, Abra, Pasig and Bicol rivers in Luzon, and by the Agusan and Rio Grande de Mindanao in Mindanao. There are few harbours which admit vessels drawing more than 15 ft. of water, but many which admit smaller vessels, and at the close of 1909 there were 151 steamboats and 424 sailboats engaged in the coasting trade. Manila is the principal port of entry, and since the American occupation Manila harbour has been made accessible to vessels drawing 30 ft. of water. Cebú in Cebú and Iloilo in Panay are ports of entry second and third in rank, although small in comparison with Manila; there are others of minor importance.

The foreign commerce of the Philippines consists chiefly in the exportation of Manila hemp, dried coco-nut meat (copra), sugar and tobacco, both in the leaf and in cigars and cigarettes; and in the importation of cotton goods, rice, wheat-flour, fresh beef, boots and shoes, iron and steel, illuminating oil, liquors, paper and paper goods. The value of the exports increased from $19,751,068 in the year ending the 30th of June 1900 to $32,816,567 in the year ending the 30th of June 1908, and the value of the imports increased during the same period from $20,601,436 to $30,918,357. A very large part of the trade is with the United States and Great Britain. The imports from Great Britain exceed those from the United States, but the exports to the United States are much greater than those to Great Britain, and the total trade with the United States is greater than that with any other country. In 1909 8·05 % of the imports were from the United States and 17·8 % of the exports were to the United States; in 1908 16·4 % of the imports were from the United States and 31·4 % of the exports were to the United States. In 1909 free trade was established between the United States and the Philippines in all goods which are the growth, product or manufacture of these countries, with the exception of rice, except that a limit to the free importation from the Philippines to the United States in any one year is fixed on cigars at 15,000,000; on wrapper tobacco and on filler tobacco, when mixed with more than 15 % of wrapper tobacco, at 300,000 lb; on filler tobacco at 1,000,000 lb and on sugar at 300,000 gross tons. In the case of manufactures the law provides that only those articles which do not contain more than 20 % in value of foreign materials shall be admitted free.

Population.—The total population of the archipelago as enumerated in the census of 1903 was 7,635,426. Of this number 6,987,868 were classed as civilized and 647,740 as wild; 7,579,288 or 99·2 % were native-born and 56,138 were foreign-born; 7,539,632 were of the Malayan or brown race, 42,097 were of the yellow race, 24,016 were of the black race, 14,271 were of the white race, and 15,419 were of mixed races. Of the black race 23,511, or 97·8 %, were Negritos, who are believed to be the aborigines of the Philippines. Nearly all of them live in a primitive state in the interior of Luzon, Panay, Mindanao and

Negros. They are very short of stature, 4 ft. 10 in. being about the average height of a full-grown man, and the women are shorter. Their colour is black, their skull decidedly round, their hair thick and frizzly, their legs thin and almost without calves, and their toes so prehensile that they can use them nearly as well as their fingers. They tattoo themselves and wear very little clothing, usually only a geestring. They have no fixed abodes but roam about in groups of a few families. They are skilful with the bow and in throwing stones, and they can easily kindle a fire, even in the wet season, by rubbing together two pieces of dry bamboo. Their food consists principally of game, roots and wild fruits. The women, who do all the work, collect wax and honey, which are their principal staples in trade. Few Negritos live to be fifty years of age. The brown race, which came from the south in successive waves of immigration beginning in prehistoric times, is composed of twenty-three distinct tribes varying widely in culture, language and appearance; their languages however belong to one common stock and there is a general resemblance in physical features and in quality of mind. The great bulk of the population, approximately 90%, is included in seven Christian tribes as follows: Visayan, 3,219,030; Tagálog, 1,460,695; Ilocano, 803,942; Bicol, 566,365; Pangasinan, 343,686; Pampangan, 280,984; and Cagayán, 159,648. The Visayans are the principal inhabitants of the islands in the central part of the archipelago (Panay, Cebú, Negros, Leyte, Bohol, Samar, Masbate and Paragua) and on the north and east coasts of Mindanao; they were perhaps the most civilized people in the archipelago when discovered by the Spaniards, by whom they were originally called Pintados because they were in the habit of painting their bodies; but since then their progress has been less rapid than that of the Tagálogs—who constitute the bulk of the population of Manila and central Luzon and the majority of the population of Mindanao—who are now the most cultured of the brown races in the Philippines. Most of the Ilocanos are in the western half of north Luzon; most of the Bicols in south Luzon; most of the Pangasinans in the province of Pangasinan, which borders on the Gulf of Lingayén; most of the Pampangans in the province of Pampanga, which borders the north shore of Manila Bay; and most of the Cagayáns in the valley of the Cagayán river. More than three-fourths of the wild population is included in the Moro, Igorot and Negrito tribes. The Igorots (197,938 wild and 13,582 civilized) are the chief representatives of the early Malay immigration to the archipelago. They are the principal inhabitants of the provinces of Lepanto-Bontoc and Benguet in north Luzon and are numerous in the mountain districts of neighbouring provinces. Among the wildest of them head-hunting is still a common practice; but the majority are industrious farmers laying out their fields on artificial terraces and constructing irrigation canals with remarkable skill. The Moros (275,224 wild and 2323 civilized) were the last of the Malays to migrate to the islands; they came after their conversion to the Mahommedan religion, and their migration continued until the Spanish conquest. More than one-half of them are in Mindanao and they are the principal inhabitants of the small islands of Jolo, Basilan, Siassi and Tawi Tawi south-west of Mindanao. Slavery is common among them. They are generally miserably poor, cruel and haughty. Nearly three-fourths of the foreign-born and 97·5% of the representatives of the yellow race come from China. The mixture of the races is principally that of the Chinese with the Malays or the Spaniards with the Malays. More than half the representatives of the white race (1903) were Americans. Most of the inhabitants live in groups of villages. In 1903 there were 13,400 villages and nearly three-fourths of them contained fewer than 600 inhabitants each. Laoag in north Luzon with a population of 19,699, Iloilo in Panay with a population of 19,054, Cebú with a population of 18,330, and Nueva Cáceres in south Luzon (10,201), were the only towns with a population exceeding 10,000; and Manila (219,928) was the only city. After the 1903 census many towns were enlarged by annexation of suburbs.

Government.—At the beginning of the American occupation, in August 1898, a purely military government was established; but in May 1899 the military authorities began the re-establishment of civil courts, and in July of the same year they began the organization of civil municipal governments. To continue the work of organizing and establishing civil government the president of the United States appointed in February 1900 a Philippine Commission of five members, with William H. Taft as chairman. On the 1st of September 1900 this body assumed the legislative functions of the central government at Manila; on the 4th of July 1901 the executive authority was, by order of the president, transferred from the military governor to Judge Taft, whom he had appointed civil governor; on the 6th of September 1901 the Philippine Commission, by authority of the president, established the four executive departments, of interior, commerce and police, finance and justice, and public instruction; and on the 29th of October 1901 the president appointed a vice-governor. The Congress of the United States, in an act approved on the 1st of July 1902, ratified and confirmed the government as thus established, but required that future appointments by the president of the governor, vice-governor, members of the commission and heads of the executive departments should be made with the consent of the Senate. The organic act contained a bill of rights, provided for the establishment of a popular assembly two years after the completion of a census of the Philippines, and more definitely provided for the organization of the judiciary. The first popular assembly, of 80 members, was opened at Manila on the 16th of October 1907, and since then the legislature has been composed of two branches, the Philippine Commission (five Americans and four, formerly three, Filipinos), and the Philippine Assembly. The members of the Assembly are elected by districts (the population of which is approximately equal) for a term of two years. A voter must be twenty-three years of age, must have been a resident of the municipality for six months, must not be a citizen or subject of any foreign country, and must possess at least one of the following qualifications: have been an office-holder under Spanish rule, own real estate worth 500 pesos, pay taxes amounting annually to 30 pesos, or be able to speak, read and write either Spanish or English. The legislature meets annually; a regular session is limited to 90 days, and a special session to 30 days.

Justice is administered principally by a supreme court, courts of first instance, and courts of justices of the peace. The supreme court consists of seven members, four Americans and three Filipinos; and the chief justice and associate justices of the supreme court are appointed by the president of the United States with the consent of the Senate. The judges of the courts of first instance are appointed by the governor with the consent of the Philippine Commission. A judgment of the supreme court of the Philippines which affects any statute, treaty, title, right or privilege of the United States may be reversed, modified or affirmed by the Supreme Court of the United States; an appeal to the Supreme Court of the United States may also be had in any cause in which the value in controversy exceeds $25,000.

The most common form of provincial government is that by a governor, who is elected biennially by the municipal councillors in convention, and a secretary, a treasurer, a supervisor, and a fiscal or prosecuting attorney, who are appointed by the Philippine Commission. Each municipality is governed by a president, a vice-president, and a municipal council, all of whom are elected biennially by the qualified electors of the municipality. The Philippine "municipality" is an administrative area, often sparsely settled, is often called a town, and may be compared to a New England township; the municipalities are the units into which the provinces are divided. Each municipality is made up of barrios or small villages (about 13,400 in the entire archipelago) and of one, or more, more thickly peopled areas, each called a *poblacion*, and resembling the township "centre" of New England.

Education.—The establishment of an efficient system of elementary schools has been an important part of the work of the American administration. Under Spanish rule the Church established colleges and seminaries for training priests, but the Spanish system of secular schools for elementary instruction, established in 1863, accomplished little; the schools were taught by unqualified native teachers and the supervision of them was very lax. The American system, established by the Philippine Commission in 1901, provides a course of instruction (in the English language) for 11 years: 4 primary, 3 intermediate and 4 secondary. In the intermediate and secondary departments there is a choice of six courses; general, teaching, farming, toolwork, housekeeping and household arts and business. The administrative head of the system is the director of education, who is appointed by the commission, and who arranges the course of study, approves the plans for school houses, determines in what towns secondary schools shall be established and in what towns American teachers shall teach, divides the archipelago into school divisions and appoints a division superintendent in each, and supervises the examination of teachers and the application of insular school funds. Associated with him is an advisory board also appointed by the commission. In each school division, of which there were 35 in 1908, the division superintendent appoints the native teachers, prepares for the municipal councils estimates of school expenses, and approves all expenditures from municipal school funds. In each municipality there is a school board consisting of the president of the municipality and from four to six other members as the division superintendent shall determine; one-half of them are elected by the municipal council and one-half are appointed by the division superintendent. In 1902 there were 928 American teachers employed in the Philippine schools; the employment of American teachers is only a temporary policy, however, and by 1908 the number has been reduced to 795. In 1910 there were more than 6000 Filipino teachers who were teaching English to more than 500,000 pupils. The total number of children of school age in the islands probably reaches 2,000,000. The insular government also makes annual appropriations for the maintenance of Filipino students at educational institutions in the United States; in 1908 the number so provided for was 130. Besides the elementary schools there are at Manila the Philippine Normal School, the Philippine School of Arts and Trades, the Philippine School of Commerce and the school for the instruction of the deaf and blind, and in 1908 the Philippine legislature passed an act for the establishment of a university of the Philippines.

Finance.—Revenue is derived largely from customs duties and internal revenue taxes. In 1909 the receipts were $22,739,000, the expenditure $23,337,000, and the total bonded indebtedness $16,000,000. (N. D. M.)

History.—The Philippine Islands were discovered by Magellan in March 1521. The first island on which he landed was Malhou, between Samar and Dinagat. Then sailing south he touched at Mindanao, from which he sailed north-west, past Bohol to Cebú. Here he found a good harbour in the bay on which the city of Cebú now stands. He made an alliance with the natives, who undertook to supply him with provisions. With his new allies he crossed to the little island of Mactan, where he was killed in a skirmish. A Portuguese by birth, he had been sailing in the employ of King Charles I. of Spain (the emperor Charles V.), with the object of proving that the Moluccas lay within that part of the world which Pope Alexander VI. and the treaty of Tordesillas (June 7, 1494) had given to Spain and not to Portugal. Magellan named his discovery the Archipelago of San Lazarus. The Spaniards, however, called the group the *Islas de Poniente* (Western Islands). The Portuguese called them the *Islas de Oriente.* The distinction was not accidental. To the Portuguese they constituted the eastern boundary of their world. From the Spanish point of view the islands were on the extreme western verge of the national domain. In 1529, by the treaty of Zaragosa, Spain relinquished to Portugal all claims to the Moluccas and agreed that no Spaniard should trade or sail west of a meridian drawn 297 leagues east of the Moluccas. This was a plain renunciation of any rights over the Philippines, which lie several degrees west of the Moluccas. This fact, however, was ignored and in 1542 an attempt to conquer the Philippines was made by Ruy Lopez de Villabos (*c.* 1500–1544). Villabos chose to honour the heir-apparent of the Spanish throne by naming some of the islands which he discovered, west and north of Magellan's discovery, the Islas Filipinas. After the accession of Philip II. (1555–1598) a much more important expedition was fitted out on the Mexican coast, under the direction of the distinguished conquistador, Miguel Lopez de Legaspi (1524–1572). In the sailing directions, issued in 1561, for the use of this expedition the phrase "las Islas Filipinas" was used as applying to the entire archipelago. Starting on the 2nd of November 1564, from Navidad, with four ships built and equipped on the spot, Legaspi began an enterprise which entitles him to a place among the greatest of colonial pioneers. He was accompanied by five Augustinian friars and four hundred men. In 1565 he founded, on the island of Cebú, San Miguel, the first permanent Spanish settlement in the islands, destined to become the Villa de Santísimo Nombre de Jesus, later the city of Cebú. In 1571 the city of Manila was founded and became the insular capital. Legaspi's conquest of the islands was facilitated by the fact that there were no established native states, but rather a congeries of small clan-like groups, the headship of which was hereditary. Legaspi was reinforced from time to time by small contingents of troops and friars. Although he encountered enormous obstacles, including famine and mutiny, the hostility and treachery of the natives and of foreigners, and the neglect of the home government, he laid a sure foundation for permanent Spanish occupation. By a combination of tact, courage and resourcefulness he won the hearts of the natives, repelled the Portuguese and, notwithstanding the great distance from Spain, established the new colony on a practical basis. Before his death in 1572 he had explored and pacified a large part of the island territory, had established trade, and had arrested the progress of Mahommedanism.

The Friars and the Officials.

The conquest of the Philippines was essentially a missionary conquest. Inspired by apostolic zeal the friars braved the terrors of life in the remote villages, raised the natives from barbarianism and taught them the forms of Christianity. As a result of their labours the Christian Filipinos stand unique as the only large mass of Asiatics converted to Christianity in modern times. The friars promoted the social and economic advancement of the islands, cultivated the native taste for music, introduced improvements in agriculture and imported Indian corn and cacao from America. Tobacco was introduced by the government.

The colonial government was patterned on that of Spanish America. The powers of the governor-general were limited only by the *audiencia* or supreme court, of which he was president, and by the *residencia* or official investigation at the expiration of his term. The islands were subdivided into provinces under *alcaldes majores* who exercised both executive and judicial functions. The favouritism and corruption that honeycombed the civil service of Spain frequently resulted in placing in responsible positions persons who were entirely unfit. Hairdressers were made into *alcaldes*, and sailors were transformed into *gobernadors* by the miraculous grace of royal decrees. The provinces were subdivided into *pueblos*, each under a native *gobernadorcillo*, elected annually. The permanent offices could be bought, sold and inherited. The mistake was made of paying very low salaries to the officials, who took this as a justification for illegal exactions. The difficulty of securing proper officials gradually resulted in the more important civil functions being handed over to the friars, who frequently exercised a benevolent despotism. In more than half of the twelve hundred villages there was no other Spaniard beside the priest. The Spanish language was practically unknown. It was far easier for the monks to learn the native dialects than to teach their parishioners Spanish. For two centuries and a half after the conquest there is little narrative history worth recording. There were border wars with rebellious savage tribes, attacks made by Chinese pirates seeking plunder or refuge, volcanic eruptions, earthquakes, tornadoes and the periodical visits of marauders from the southern islands.

British Occupation of Manila.

In 1762, however, as an incident of the war between Spain and England, a British fleet of thirteen ships, under the command of Admiral Samuel Cornish (d. 1770) and Brigadier-General William Draper (1721–1787), was sent to the Philippines. The available Spanish army consisted of about 600 men, while the attacking force numbered 6830. After a bombardment, Manila fell and on the 5th of October the British entered the city. By the terms of the capitulation the whole of the archipelago was surrendered to the British and an indemnity of 4,000,000 pesos was to be paid. As there was no governor-general at the time, the British were obliged to treat with the acting-governor, the Archbishop Manuel Antonio Rojo; but his authority was set aside by a war-party who rallied around Simon Anda y Salazer, a member of the *audiencia.* Anda proclaimed himself governor-general and practically succeeded in confining the British to Manila. At the close of the war the Philippines were returned to Spain. Manila was evacuated in March 1764.

Economic Development.

For the first quarter of a century after the Spanish conquest the islands were allowed free trade. Then came the familiar restrictions, limiting commerce to a fixed amount annually, and effectively checking economic development. In 1591 direct trade between the Philippines and South America was prohibited. In 1593 trade between the Philippines and Mexico, the only route open between the colony and Spain, was limited to two ships annually, the ships not to exceed 300 tons burden. The result was that the command of the Acapulco galleon was rarely worth less than $50,000. The passenger fare from Manila to Acapulco, at the end of the 18th century, was $1000. This monopoly lasted until the Mexican War of Independence forced the Spanish government to regard the Philippines as being in the East instead of the West. Spain's colonial policy was not based on an exaltation of the commercial ideal. However much the administrators may have fallen short in actual practice, the Spanish ideal was to preserve and civilize the native races, rather than to establish lucrative trading posts where the natives might be easily exploited. In America the laws which provided elaborate safeguards for the protection of the Indians were, to a large degree, nullified by the lust for gold and silver and the consequent demand for labourers in the mines. In the Philippines the humane policy of the home government had no such powerful obstacles to contend with. Business was not developed. The natives were allowed to live the indolent life of the tropics. Compared with the results of English or Dutch colonization the conversion and civilization of the Filipinos is a most remarkable achievement. Notwithstanding the undeniable vices, follies and absurd illiberalities of the Spanish colonial régime, the Philippines were the only group in the East Indies that improved in civilization in the three centuries following their discovery. The chief defect in the Spanish Philippine policy was that while it made converts it did not make citizens. Self-reliance, free-thought and mental growth were not encouraged. Progress in scientific knowledge was effectively blocked by the friars. Their presses confined their activities to the production of catechisms, martyrologies and handbooks in the native languages after the fashion of the presses of Mexico. Five hundred such works were printed and distributed in Manila alone before 1800. To reach the masses, unfamiliar with Spanish, manuals of devotion and outlines of Christian doctrine were translated into the various native languages. Of the Bible itself, no part was translated or published. A knowledge of reading and writing was generally diffused throughout the group.

Era of Discontent.

The era of discontent may be said to have begun in 1825 when the loss of her colonies on the mainland of America caused Spain to take a more immediate interest in the Philippines, and increased emigration to the islands. Between 1840 and 1872 thirty newspapers were founded. The introduction of secular books and papers, more or less surreptitiously, helped to spread the seeds of sedition. In 1852 the Spanish Filipino Bank was established. In 1856 foreign trade, hitherto confined to Manila, was permitted to enter the port of Iloilo, and foreign traders were allowed to open branch houses outside of the capital. The change in Spain's economic policy, including an attempt to exploit the coalfields and to encourage both agriculture and commerce, helped to awaken hitherto dormant elements. In 1601 the Jesuits had opened a college in Manila for the education of Spanish youth. In 1768 they had been expelled. In 1859 they were permitted to return on the understanding that they were to devote themselves to education.

The Spanish Revolution of 1868 caused a further influx of Spaniards and also the introduction of the pernicious "spoils system." With every change of ministry in Madrid came a new lot of hungry politicians anxious to fill even the more humble colonial offices. The opening of the Suez Canal in 1869, followed by the establishment of direct steam communication between Spain and the Philippines, sounded the death knell of the peaceful missionary era and brought about the definite entry of the islands into the world of commerce and progress.

The friars, by perpetuating medieval conditions in a country that was now being opened to contact with the civilized world, increased the feeling of discontent. The natural result was a violent conflict. The more advanced Filipinos desired the fulfilment of the decrees of the Council of Trent whereby the incumbencies in Christianized towns and villages should be held by regular clergy and not by friars. Filipinos had for generations been ordained into priesthood although not received into monastic orders. This measure was really aimed at the political and economic supremacy of the Spanish-born friars, who had by this time acquired 400,000 acres of agricultural land, more than half of it in the vicinity of Manila. The agrarian question added to the growing discontent. All the revolutions began in the province of Cavité, where the friars owned 125,000 acres. In 1872 the secret agents of the friars induced the native garrison at Cavité to mutiny and thus give the friars an excuse to press for vigorous action. The mutiny was not successful, but Father Burgos, the leader of the reform party, was publicly garrotted with three other native priests; and the native clergy were declared to be incompetent to have the cure of souls. Several of the richest and best educated Filipinos were convicted of treason and banished.

Rizal.

With the increased facilities for European travel Filipinos began to visit Europe and return with new and broader notions of life. The most distinguished of the travellers was José Rizal (1861–1896). Born in Calainha, in the province of Luzon, of pure Tagálog parentage, he attended the newly reopened Jesuit university in Manila. He was then sent to Europe to complete his studies, first in Madrid, where he became a doctor of medicine, and later in Germany, where he received the degree of Ph.D. He came into touch with advanced methods of scientific research, acquired great ability as a writer, keen perception of truth and an unflinching realization of the defects of his own people, and the unpleasant but essential fact that to have better government they must first deserve it. His propaganda, aimed at the small body of Filipinos who had sufficient education to appreciate political satire, was very effective. His most famous novel, *Noli me tangere*, was published in 1886. In this he drew a masterly picture, not only of the life and immorality of the friars but also of the insolent Filipino chiefs or *caciques*, subservient to the powers above, tyrannical to those below, superstitious, unprogressive and grasping. Caciquism or "bossism," government by local aristocrats, was the prime feature of village life in the islands during the entire period of Spanish rule and existed long before their arrival.

The Liga Filipina.

The campaign of Rizal, Marcelo del Pilar, Graciano Lopez Jaena and Apolinario Mabini, the leaders in the "Young Filipino Party," was a protest against both the domination of the friars and economic and administrative caciquism. To escape the vengeance of the friars, Rizal was obliged to flee to Europe. In 1892 he returned to the islands on the assurance of the governor, Eulogio Despujols y Dusay, that he might live there in peace. His enemies, however, succeeded in having him arrested on a charge of treason. Meanwhile he had organized a reform party under the title of *Liga Filipina*. Its object had been to procure, by pacific means, several reforms in the government of the islands, the chief of which were the expulsion of the friars, and the withdrawal of the governor-general's arbitrary power to deport Filipinos. The friars importuned Despujols for Rizal's life but he persistently refused their demand, and met the case half-way by banishing Rizal to Mindanao. Incensed by the failure of their plot, the friars obtained the recall of Despujols.

The Katipunan.

The new governor, Ramón Blanco, was like Despujols and many of his predecessors, humane at heart, but he could do little more than hold in check the tyrannical schemes of the clergy. The banishment of Rizal convinced the reform party that peaceful endeavour was futile. A secret organization, the *Katipunan*, was therefore started to secure reforms by force of arms. It was founded by Andres

Bonifacio, a schoolmaster of Cavité. In 1895–1896 the friars acting as spies for the government, obtained the banishment of many hundreds of natives.

Revolt of 1896.

On the day after the Katipunan conspiracy had been brought prematurely to light by a traitor, three hundred prominent Filipinos were lodged in prison. This precipitated the revolt. The *insurrectos* attacked the civil guard outside the city, but were unsuccessful. A week later some hundreds of insurgents attacked the powder magazine at San Juan del Monte, but were completely routed. Four of their chiefs were taken prisoners and executed in Manila. Ten days after the plot was discovered Manila and five other provinces were officially proclaimed in a state of siege. The *insurrectos* concentrated all their energies upon Cavité province. Several villages fell into their hands. The insurgent commander-in-chief was Emilio Aguinaldo. He was born in 1869 in Cavité, son of a native farmer of considerable ability, and of a half-caste mother whose father was a Chinaman. After attending the Tagálog school at Cavité he entered the Jesuit College in Manila but did not graduate. In 1893 he became municipal alcalde of Cavité, and later joined the Katipunan.

The government was in a difficult position. General Blanco had extremely few European troops at his disposal, and it was doubtful how far native troops could be trusted. Reinforcements were on the way from Spain, but the demands of Cuba had already depleted the Peninsula of the best fighting material. Blanco, blamed for not acting at once, was recalled. In December 1896 General Camilo Garcia de Polavieja (b. 1838) arrived as his successor, with General José Lachambre (b. 1846) as chief of staff. Before Blanco left he had released Rizal and allowed him to go to Spain, but the friars caused his arrest and he was sent back to Manila, where he was executed by Polavieja's orders in December 1896.

Lachambre took the field in Cavité with energy and succeeded in quelling the rebellion in that province. He was then despatched north. Numerous small battles were fought with Aguinaldo and the insurgents, who were repeatedly defeated only to reappear in other places. Polavieja's demand for more troops having been refused, he resigned, and was succeeded in the spring of 1897 by General Fernando Primo de Rivera. Hostilities continued, but the wet season set in, making operations extremely difficult. Before Primo de Rivera could make much headway against the insurgents affairs in Cuba became so serious that the Spanish government cabled him that pacification was most urgently desired. As a result he suspended operations and signed the treaty of Biacabató (Dec. 12, 1897), by which Aguinaldo and thirty-five of his chief followers were allowed to retire to Hongkong with a cash indemnity of 400,000 pesos. The Madrid government refused to confirm the terms of peace, and the peace rejoicings in Manila were followed by the persecution of all those who were known to have sympathized with the movement.

Spanish-American War.

On the 15th of February 1898 in Havana harbour, the U.S.S. "Maine" was blown up. On the 15th of March Primo de Rivera, learning that the American Commodore George Dewey was mobilizing his fleet in the harbour of Hongkong, called a council at which the Spanish Admiral Patricio Montojo (b. 1839) stated that, in the event of a conflict, his own fleet would be inevitably destroyed. Primo de Rivera was now recalled and General Basilio Augusti (b. 1840) took his place. With a new governor-general all plans had to be reconsidered. Before suitable defences could be made, word came from Hongkong that Dewey had started for Manila and Montojo hurriedly sailed from Subig Bay to Cavité, barely in time to anchor before Dewey arrived. Few among his crew understood handling a gun properly, and owing to the poor care which his vessels had received they were actually inferior to the individual vessels of the American squadron. Commodore Dewey arrived in the Bay of Manila on the 1st of May, and totally destroyed or disabled the Spanish fleet. The surrender of the city was refused. The Americans occupied Cavité. The battle of Manila Bay and the defeat of the Spanish fleet destroyed the prestige of Spain throughout the islands. Insurrections began in nearly every province. Aguinaldo and his friends were allowed to come to Cavité in an American transport. With the approval of Commodore Dewey, who allowed arms to be supplied him, Aguinaldo successfully renewed his campaign against the Spaniards until practically all Luzon, except the city of Manila and suburbs, was in his control. Reinforcements arrived, and on the 13th of August Manila was taken by the Americans, under General Wesley Merritt (b. 1836).

Revolt against the Americans.

The refusal of General Merritt to permit Aguinaldo's troops to enter Manila created resentment on the part of the Filipinos. A so-called constitutional convention was held at Malolos, and a constitution was adopted. At the same time the Visayan Republic was organized, and it professed allegiance to Aguinaldo's government. Neither Aguinaldo's government nor the Visayan government was able to maintain order, and the whole country was subject to the looting of robber bands. The treaty of peace between the United States and Spain, by which the Philippine Islands passed into the hands of the former, was signed in Paris on the 10th of December 1898, but it was not confirmed by the Senate until the 6th of February 1899. During this period the Filipino army remained under arms. On the 4th of February hostilities broke out between the Americans and the Filipinos. The latter were defeated on the 5th, at Paco, with heavy loss. The American troops, now under General E. S. Otis (b. 1838), following up the enemy, drove them out of Malolos and then withdrew to Manila to await reinforcements, which brought the total American force up to about 60,000 men. It is unnecessary to trace in detail the gradual conquest of the islands, or the hundreds of engagements, often small, between the rebels and the Americans. Owing to the nature of the country, and the hope of securing independence from a possible overthrow of the Republican party in the United States, the war was prolonged for two or three years. With the capture of Aguinaldo on the 23rd of March 1901, the resistance became little more than that of guerrillas.

The Taft Commission.

Civil government was introduced as fast as possible. During 1899 the Schurman commission, headed by Dr Jacob G. Schurman of Cornell University, was sent by President McKinley to report on the state of affairs. In February 1900 a second and more powerful commission was appointed, consisting of Judge W. H. Taft, Professor D. C. Worcester (b. 1866), General L. E. Wright (b. 1846), Mr H. C. Ide (b. 1844), and Professor Bernard Moses (b. 1846). Under the presidency of Mr Taft it began to exercise a legislative jurisdiction in September 1900. Its first act was to appropriate $1,000,000 for the construction and improvement of roads. It next provided for the improvement of Manila harbour, which involved an expenditure of $3,000,000. The fifth act extended to the islands the benefits of a civil service based on merit. In 1901 a general school law was passed under which 1000 American school teachers were introduced. They were scattered among 500 towns, to teach 2500 Filipino teachers English and modern methods of school teaching. Other legislation provided for the organization of a judiciary, a supreme court, the enactment of a code of civil procedure, the establishment of a bureau of forestry, a health department, and an agricultural bureau and a bureau of constabulary, made up of native soldiers officered by white men. Ladronism was very widely distributed under Spanish rule, and the old *guardia civil* committed outrages almost equal to those of the brigands themselves. The new constabulary has been eminently successful in maintaining law and order. Great progress has been made in the scientific mapping of the islands.

Civil Government.

On the 4th of July 1901 the office of military governor was abolished, the military forces being largely recalled, and the part remaining being made henceforth subordinate to the civil authorities. Mr Taft became governor-general. A general amnesty was granted to all rebels and political prisoners who would take the oath of allegiance to the United States. On the 1st of July 1902 President

Roosevelt signed an act establishing the civil government of the Philippines and providing for a new legislative body. A census was authorized and was taken in 1903. The act of 1902 also authorized the purchase of land belonging to the friars. Although among such an ignorant and diversified body as that of the Filipinos public opinion can hardly be said to exist, there is no doubt that the hatred of the friars was practically universal. When the revolution came the members of the four orders had to flee for their lives, although the people who killed or imprisoned those they could catch were generally good Catholics. As the insular government could not safely allow the friars to return to their parishes the friars' lands were bought for $7,000,000. Mr Taft managed the delicate task of conducting negotiations with the Vatican without arousing the hostility of either Catholics or Protestants. On the 1st of February 1904 General L. E. Wright became governor. He was succeeded in 1905 by Mr H. C. Ide, who was succeeded by General James T. Smith in 1906. The elections for the first Philippine Assembly were held on the 30th of July 1907, and 31 Nationalists, 16 Progressists, 33 Independents and others were elected. The total vote cast was about 100,000. In many districts the Nationalists' candidates promised that if they were returned immediate independence would follow. When the Assembly met it became apparent that the great majority were more anxious to act as a dignified branch of the legislature than to maintain consistency with their pre-election declarations. The legislature convened for its second session on the 1st of February 1909. During this session 72 laws were passed, of which 23 had been introduced by the Commission and 49 by the Assembly. Among the acts was one providing for the continuance of Spanish as the official language of the courts until 1913; an act providing for bankruptcy; and an act fixing the age of majority at 21 years.

Governor Smith left the islands in May 1909 and was succeeded by W. Cameron Forbes. On the 6th of August 1909 the Payne and Colton bills became law, greatly promoting trade between the Islands and the United States (see *Communications and Commerce*). On the 2nd of November 1909 delegates were elected for the second Philippine Assembly. (H. Bi.)

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PHILIPPOPOLIS (Bulgarian, *Plovdiv*; Turkish, *Felibe*), the capital of Eastern Rumelia, and of the department of Philippopolis, Bulgaria; situated in the midst of picturesque granite eminences on the right bank of the river Maritza, 96 m. E.S.E. of Sofia and 97 m. W.N.W. of Adrianople. Pop. (1906) 45,572, of whom a large majority are Bulgarians, and the remainder chiefly Turks, Greeks, Jews, Armenians or gipsies. Philippopolis is on the main railway from Vienna to Constantinople, via Belgrade and Sofia. The Maritza is navigable up to this point, and as the city has communication by rail both with the port of Dédéagatch on the Mediterranean and that of Burgas on the Black Sea, and is situated in a remarkably fertile country, it has become the chief commercial centre of southern Bulgaria, and is the seat of both Greek and Bulgarian archbishops. The residences of the richer Greeks and Bulgarians occupy the slopes of the largest eminence, the Jambaz-tépé, in the centre of the city; between it and the Nobtet-tépé, from the summit of which there is a magnificent view of the city, is the Armenian quarter; near the bridge over the Maritza is the poorer Turkish quarter; and south-west of the Jambaz-tépé there is a suburb of villas. On the Bunari-tépé a monument has been erected by the Russians in commemoration of the war of 1877, and near this is the new palace of the king of Bulgaria. The Sahub-tépé is crowned by a clock-tower. Not far from it are the beautiful Exhibition Park laid out in 1892 and the fine Journaia-Jami Mosque. Near the Maritza are the remains of the ancient konak (palace) of the Turkish pashas, the public park formed by the Russians in 1877, the gymnasium, and the new Greek cathedral. The city has a large commerce in rice, attar of roses, and cocoons; other exports being wheat, wine, tobacco, alcohol and hides.

Eumolpia, a Thracian town, was captured by Philip of Macedon and made one of his frontier posts; hence its name of *Philippopolis*, or "Philip's City." Under the Romans Philoppopolis or Trimontium became the capital of Thracia; and, even after its capture by the Goths, when 100,000 persons are said to have been slain, it continued to be a flourishing city till it was again sacked by the Bulgarians in 1205. It passed under Turkish rule in 1363; in 1818 it was destroyed by an earthquake; and in 1846 it suffered from a severe conflagration. During the war of 1877–78 the city was occupied by the Russians (see also Bulgaria: *History*).

PHILIPPSBURG, a town of Germany, in the grand duchy of Baden, situated on a sluggish arm of the Rhine, 15 m. N. of Karlsruhe, on the railway Bruchsal-Germersheim. Pop. (1905) 2625. It has manufactures of tobacco and cigars, and some trade in cattle and hops. Philippsburg, formerly an important fortress, originally belonged to the ecclesiastical principality of Spires, and was named Udenheim. In 1338 it was surrounded with walls by bishop Gerhard. A later bishop of Spires, Philipp Christoph von Sötern, made the place his residence early in the 17th century, strengthened the fortifications, and renamed it Philippsburg after himself. At the peace of Westphalia in 1648 the French remained in possession of the town, but in 1679 it was restored to Germany, and though again captured by the French in 1688 it was once more restored in 1697. In 1734 the dilapidated fortress fell an easy prey to the French under Marshal Berwick, who, however, lost his life beneath its walls. It was restored to Germany in 1735, and was again besieged by the French in 1799. The town was assigned to Baden in 1803.

See Nopp, *Geschichte der Stadt Philippsburg* (Philippsburg, 1881).

PHILIPPUS, MARCUS JULIUS, Roman emperor A.D. 244 to 249, often called "Philip the Arab," was a native of Bostra in Arabia Trachonitis. Having entered the Roman army, he rose to be praetorian praefect in the Persian campaign of Gordian III., and, inspiring the soldiers to slay the young emperor, was raised by them to the purple (244). Of his reign little is known except that he celebrated the secular games with great pomp in 248, when Rome was supposed to have reached the thousandth year of her existence. A rebellion broke out among the legions of Moesia, and Decius, who was sent to quell it, was forced by the troops to put himself at their head and march upon Italy. Philip was defeated and slain in a battle near Verona. According to Christian writers, he was a convert to Christianity.

See Aurelius Victor, *Caesares*, 28; Eutropius, ix. 3; Zonaras, xii. 19.

PHILIPS, AMBROSE (*c.* 1675–1749), English poet, was born in Shropshire of a Leicestershire family. He was educated at Shrewsbury school and St John's College, Cambridge, of which he became a fellow in 1699. He seems to have lived chiefly at Cambridge until he resigned his fellowship in 1708, and his pastorals probably belong to this period. He worked for Jacob Tonson the bookseller, and his *Pastorals* opened the 6th volume of Tonson's *Miscellanies* (1709), which also contained the pastorals of Pope. Philips was a stanch Whig, and a friend of Steele and Addison. In Nos. 22, 23, 30 and 32 (1713) of the *Guardian* he was injudiciously praised as the only worthy successor of Spenser. The writer of the papers, who is supposed to have been Thomas Tickell, pointedly ignored Pope's pastorals. In the *Spectator* Addison applauded him for his simplicity, and for having written English eclogues unencumbered by the machinery of classical mythology. Pope's jealousy was roused, and he sent an anonymous contribution to the *Guardian* (No. 40) in which he drew an ironical comparison between his own and Philip's pastorals, censuring himself and praising Philips's worst passages. Philips is said to have threatened to cane Pope with a rod he kept hung up at Button's coffee-house for the purpose. It was at Pope's request that Gay burlesqued Philips's pastorals in his *Shepherd's Week*, but the parody pleased by the very quality of simplicity which it was intended to ridicule. Samuel Johnson describes the relations between Pope and Philips as a "perpetual reciprocation of malevolence." Pope lost no opportunity of scoffing at Philips, who figured in the *Bathos* and the *Dunciad*, as Macer in the *Characters*; and in the "Instructions to a porter how to find Mr Curll's authors" he is a "Pindaric writer in red stockings." In 1718 he started a Whig paper, *The Freethinker*, in conjunction with Hugh Boulter, then vicar of St Olave's, Southwark. He had been made justice of the peace for Westminster, and in 1717 a commissioner for the lottery, and when Boulter was made archbishop of Armagh, Philips accompanied him as secretary. He sat in the Irish parliament for Co. Armagh, was secretary to the lord chancellor in 1726, and in 1733 became a judge of the prerogative court. His patron died in 1742, and six years later Philips returned to London, where he died on the 18th of June 1749.

His contemporary reputation rested on his pastorals and epistles, particularly the description of winter addressed by him from Copenhagen (1709) to the earl of Dorset. In T. H. Ward's *English Poets*, however, he is represented by two of the simple and charming pieces addressed to the infant children of Lord Carteret and of Daniel Pulteney. These were scoffed at by Swift as "little flams on Miss Carteret," and earned for Philips from Henry Carey the nickname of "Namby-Pamby."

Philips's works are an abridgment of Bishop Hacket's *Life* of John Williams (1700); *The Thousand and One Days; Persian Tales* . . . . (1722), from the French of F. Pétis de la Croix; three plays: *The Distrest Mother* (1712), an adaptation of Racine's *Andromaque*; *The Briton* (1722); *Humfrey, duke of Gloucester* (1723). Many of his poems, which included some translations from Sappho, Anacreon and Pindar, were published separately, and a collected edition appeared in 1748.

PHILIPS, JOHN (1676–1708), English poet and man of letters, son of Dr Stephen Philips, archdeacon of Shropshire, was born at his father's vicarage at Bampton, Oxfordshire, on the 30th of December 1676. He was educated at Winchester and Christ Church, Oxford. He was a careful reader of Virgil and of Milton. In 1701 his poem, *The Splendid Shilling*, was published without his consent, and a second unauthorized version in 1705 induced him to print a correct edition in that year. *The Splendid Shilling*, which Addison in *The Tatler* called "the finest burlesque poem in the British language," recites in Miltonic blank verse the miseries consequent on the want of that piece of money. Its success introduced Philips to the notice of Robert Harley and Henry St John, who commissioned him to write a Tory counterblast to Joseph Addison's *Campaign*. Philips was happier in burlesquing his favourite author than in genuine imitation of a heroic theme. His Marlborough is modelled on the warriors of Homer and Virgil; he rides precipitate over heaps of fallen horses, changing the fortune of the battle by his own right arm. *Cyder* (1708) is modelled on the *Georgics* of Virgil. *Cerealia, an Imitation of Milton* (1706), although printed without his name, may safely be ascribed to him. In all his poems except *Blenheim* he found an opportunity to insert a eulogy of tobacco. Philips died at Hereford on the 15th of February 1708/9. There is an inscription to his memory in Westminster Abbey.

See *The Whole Works of . . . John Philips . . . To which is prefixed his life*, by Mr [G.] Sewell (3rd ed., 1720); Johnson, *Lives of the Poets*; and *Biographia Britannica*.

PHILIPS, KATHARINE (1631–1664), English poet, daughter of John Fowler, a merchant of Bucklersbury, London, was born on the 1st of January 1631. Her father was a Presbyterian, and Katharine is said to have read the Bible through before she was five years old. On arriving at years of discretion she broke with Presbyterian traditions in both religion and politics, became an ardent admirer of the king and his church policy, and in 1647 married James Philips, a Welsh royalist. Her home at the Priory, Cardigan, became the centre of a "society of friendship," the members of which were known to one another by fantastic names, Mrs Philips being "Orinda," her husband "Antenor," Sir Charles Cotterel "Poliarchus." The "matchless" Orinda, as her admirers called her, posed as the apostle of female friendship. That there was much solid worth under her affectations is proved by the respect and friendship she inspired. Jeremy Taylor in 1659 dedicated to her his "Discourse on the Nature, Offices and Measures of Friendship," and Cowley, Henry Vaughan the Silurist, the earl of Roscommon and the earl of Cork and Orrery all celebrated her talent. In 1662 she went to Dublin to pursue her husband's claim to certain Irish estates, and there she completed a translation of Corneille's *Pompée*, produced with great success in 1663 in the Smock Alley Theatre, and printed in the same year both in Dublin and London. She went to London in March 1664 with a nearly completed translation of Corneille's *Horace*, but died of smallpox on the 22nd of June. The literary atmosphere of her circle is preserved in the excellent *Letters of Orinda to Poliarchus*, published by Bernard Lintot in 1705 and 1709. "Poliarchus" (Sir Charles Cotterel) was master of the ceremonies at the court of the Restoration, and afterwards translated the romances of La Calprenède. Mrs Philips had two children, one of whom, Katharine, became the wife of Lewis Wogan of Boulston, Pembrokeshire. According to Mr Gosse, this lady may have been "Joan Philips," the author of a volume of *Female Poems . . . written by Ephelia*, which are in the style of Orinda, and display genuine feeling with very little reserve.

See E. W. Gosse, *Seventeenth Century Studies* (1883). *Poems, By the Incomparable Mrs K. P.* appeared surreptitiously in 1664 and an authentic edition in 1667. *Selected Poems*, edited with an appreciation by Miss L. I. Guiney, appeared in 1904; but the best modern edition is in Saintsbury's *Minor Poets of the Caroline Period* (vol. i., 1905).

PHILISTINES,[1] the general name for the people of Philistia (Ass. *Palaštu, Pilištu*; Eg. *p-r-s-t*), a district embracing the rich lowlands on the Mediterranean coast from the neighbourhood of Jaffa (Joppa) to the Egyptian desert south of Gaza (on the subsequent extension of the name in its Greek form Palaestina, see Palestine).

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[1] "Philistine," as a term of contempt, hostility or reproach, appears first in English, in a sense equivalent to "the enemy," as early as the beginning of the 17th century, and later as a slang term for a bailiff or a sheriff's officer, or merely for drunken or vicious people generally. In German universities the townsfolk

1. *Egyptian Evidence.*—The name is derived from the Purasati, one of a great confederation from north Syria, Asia Minor and the Levant, which threatened Egypt in the XXth Dynasty. They are not among the hordes enumerated by Rameses II. or Merneptah, but in the eighth year of Rameses III. (*c.* 1200–1190) the Purasati hold a prominent place in a widespread movement on land and sea. The Syrian states were overwhelmed and the advance upon Egypt seemed irresistible. Rameses, however, collected a large fleet and an army of native troops and mercenaries and claimed decisive victories. The Egyptian monuments depict the flight of the enemy, the heavy ox-carts with their women and children, and the confusion of their ships. But the sequel of the events is not certain. Even if the increasing weakness of the Egyptian Empire did not invite a repetition of the incursion, it could have allowed the survivors to settle down, and about a century later one of the peoples formerly closely allied with the Purasati is found strongly entrenched at Dor, and together with the more northerly port of Byblos treats with scant respect the traditional suzerainty of Egypt.[1] That some definite political changes ensued in this age have been inferred on other grounds, and the identification of the Purasati with the Philistines may permit the assumption that the latter succeeded in occupying the district with which they have always been associated.

The Egyptian monuments represent the Purasati with a very distinctive feather head-dress resembling that of the Lycians and Mycenaeans. Their general physiognomy is hardly Cilician or Hittite, but European. Their arms comprise two short swords, a longer spear, a round shield, and they sometimes wear a coat of mail; a curious feature is their tactics of fighting in a circle of protecting shields. The chariots resemble the Hittite with two crossed receptacles for the weapons, but obviously these were not used by the Purasati alone. On archaeological grounds the Purasati have been connected with the people of Keftiu, *i.e.* Mycenaeans of Crete, although a wider application of this term is not to be excluded.

See further, G. Maspero, *Struggle of the Nations*, pp. 461 sqq.; W. M. Müller, *Asien u. Europa*, pp. 354 sqq.; *Mitteil. d. vorderasiat. Gesell.* pp. 1–42 (1900), pp. 113 sqq. (1904); H. R. Hall, *British School of Athens*, viii. 157 sqq., x. 154 sqq.; *Proc. Soc. Bibl. Arch.* xxxi. (1909) *passim*; R. Weill, *Rev. archéol.*, i. 52 sqq. (1904); R. Dussaud, *Rev. de l'hist. des relig.*, ii. 52 sqq. (1905). More recently, A. Wiedemann, *Orient. lit. Zeit.* (1910), cols. 49 sqq. disputes the identification of Keft with Crete.

2. *History.*—Biblical tradition, too, has recognized the Philistines as immigrants from Caphtor (Amos ix. 7). They appear in the pre-Mosaic age (Gen. xxi. 32, 34, xxvi.), at the Exodus of the Israelites (Ex. xiii. 17, xv. 14), and the invasion of Palestine. They are represented as a confederation of five cities (Ashdod, Ascalon [Ashkelon], Ekron, Gath and Gaza) which remained unconquered (Joshua xiii. 2 seq., Judges iii. 3; contrast Joshua xv. 45–47, xix. 43). The institution of the Hebrew monarchy (*c.* 1000 B.C.) follows upon periods of Philistine oppression (Judges iii. 31, x. 7, 11, xiii. 1–5; see Samson; Eli; Samuel; Saul; David). The subjugation of them is ascribed to Samuel (1 Sam. vii. 13), Saul (xiv. 47), and David (2 Sam. viii. 1; for Solomon see 1 Kings x. 20); but they evidently recovered their independence, and we find that twice within a short time the northern Israelites laid siege to the border fortress of Gibbethon (1 Kings xv. 27, xvi. 15). Although this place has not been identified, it is mentioned in a list of Danite cities with Aijalon, Ekron, Eltekeh and Timnah (Joshua xix. 44, xxi. 23), names of importance for the history. Somewhat later the evidence becomes fuller, and much valuable light is thrown upon the part which the Philistine coast played in the political history of Palestine. Gaza, the most southerly and famous of the Philistine towns, was the terminus of the great caravan-route from Edom and south Arabia, with whose Bedouin it was generally on good terms. It was "the outpost of Africa, the door of Asia" (G. A. Smith), the stepping-off point for the invasion of Egypt, and the fortress which, next in importance to Lachish, barred the maritime road to Phoenicia and Syria.[2] It is necessary to realize Gaza's position and its links with trading centres, since conditions in the comparatively small and half-desert land of Judah depended essentially upon its relations with the Edomites and Arabian tribes on the south-east and with the Philistines on the west.[3] Jehoshaphat's supremacy over Philistines and Arabians (2 Chron. xvii. 11, partly implied in 1 Kings xxii. 47) is followed by the revolt of Libnah (near Lachish) and Edom against his son Jehoram (2 Kings viii. 20, 22). The book of Chronicles mentions Philistines and Arabians, and knows of a previous warning by a prophet of Mareshah (east of Lachish; 2 Chron. xx. 37, xxi. 16). In like manner, the conquests of Uzziah over Edom and allied tribes (2 Kings xiv. 22, see 2 Chron. xxvi. 7) and over Gath, Ashdod and Jabneh (ibid. *v.* 6) find their sequel in the alliance of Samaria and Damascus against Ahaz, when Edom recovered its independence (so read for "Syria" in 2 Kings xvi. 6), and the Philistines attacked Beth-shemesh, Aijalon, Timnath, &c. (2 Chron. xxviii. 17 seq.).[4] These notices at least represent natural conditions, and the Assyrian inscriptions now are our authority. Tiglath-pileser IV. (734 B.C.) marched down and seized Gaza, removing its gods and goods. Its king Hanun had fled to Muṣri, but was pursued and captured; Ascalon, Judah and Edom appear in a list of tributaries. Muṣri was entrusted to the care of the Arabian Idibi'il (of the desert district), but continued to support anti-Assyrian leagues (see Hoshea), and again in 720 (two years after the fall of Samaria) was in alliance with Gaza and north Palestine. Assyria under Sargon defeated the southern confederation at Rapiḥi (Raphia on the border of Egypt) and captured Hanun; the significance of the victory is evident from the submission of the queen of Aribi (Arabia), the Sabaean Itamara, and Muṣri. This Muṣri appears to have been a district outside the limits of Egypt proper, and although tribes of the Delta may well have been concerned, its relations to Philistia agree with the independent biblical account of the part played previously by Edom and Arabian tribes (see Mizraim). But the disturbances continued, and although desert tribes were removed and settled in Samaria in 715, Muṣri and Philistia were soon in arms again. Ashdod (see Isa. xx.) and Gath were taken and sacked, the people removed, and fresh colonies were introduced. Judah, Edom and Moab were also involved, but submitted (711 B.C.). Scarcely ten years passed and the whole of Palestine and Syria was again torn with intrigues. Sennacherib (Sargon's successor in 705) marched to the land of the "Hittites," traversed

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were called by the students *Philister*; they were "outsiders," the enemy of the chosen people. It is supposed that this use arose in 1693 in Jena after a "town and gown" row in which a student had been killed and a sermon preached on the text "the Philistines be upon you, Samson" (see *Quarterly Review*, April 1899, 438, note, quoted in the *New English Dictionary*). "Philistine" thus became the name of contempt applied by the cultured to those whom they considered beneath them in intellect and taste, and was first so used in English by Carlyle, and Matthew Arnold (*Essays in Criticism*, "Heinrich Heine," 1865) gave the word its vogue and its final connotation, as signifying "inaccessible to and impatient of ideas."—[Ed.]

[1] So the Papyrus first published by W. Golénischeff (*Rec. de travaux*, xxi. 74 sqq.), on which see A. Erman, *Zeit. f. aegypt. Sprache*, pp. 1–14 (1900); W. M. Müller, *Mitteil. d. vorderasiat. Gesell.* pp. 14 sqq. (1900); J. H. Breasted, *Hist. of Eg.* pp. 513 sqq.; *Historical Records*, iv. 274 sqq.; H. W. Hogg, in the *Theolog. Series I.* of the publications of university of Manchester, p. 90 seq.

[2] See G. A. Smith, *Hist. Geog. of the Holy Land*, chs. ix. seq.; and M. A. Meyer, *History of the City of Gaza* (New York, 1907). For the traditions associating Gaza with Crete, see the latter, Index, *s.v.* Minos; the resemblance between the Minaeans of South Arabia and Cretan Minos has afforded grounds for all kinds of speculations, ancient (Pliny vi. 157) and modern.

[3] Between the central Judaean plateau and the latter lay the "lowlands" (Shĕphēlah), a district open equally to Judaeans and Philistines alike.

[4] Cf. Gaza and Edom against Judah in Amos i. 6, and, for the part played by Damascus, the later vicissitudes under the Nabataeans (Josephus, *Ant.* xiii. 13. 3). It is difficult to date the alliance of Syria and Philistia against Israel in Isa. ix. 11 seq. (on the text, see the commentaries).

the coast and, descending from Sidon, took Jaffa, Beth-dagon, Beneberak, Ekron and Timnah (all in the district ascribed to the southern Dan). At Eltekeh (also in Dan) the allies were defeated. Farther south came the turn of Ascalon, Lachish and Libnah; Judah under Hezekiah suffered severely, and its western cities were transferred to the faithful vassals of Ekron, Ashdod and Gaza. The immediate subsequent events are obscure (see further HEZEKIAH). In the 7th century Gaza, Ascalon, Ashdod and Ekron were Assyrian vassals, together with Judah, Moab and Edom—in all, twenty-two kings of the "Hittites"—and the discovery of Assyrian contract-tablets at Gezer (*c.* 650) may indicate the presence of Assyrian garrisons. But as the Assyrian power declined Egyptian monarchs formed plans of aggrandizement. Herodotus mentions the Scythian invasion and sack of the temple of Aphrodite Urania (Astarte) at Ascalon, also the prolonged siege of Ashdod by Psammetichus, and the occupation of Kadytis (? Gaza) by Necho (i. 105, ii. 157 sqq., iii. 5). But the Babylonian Empire followed upon traditional lines and thrust back Egypt, and Nabonidus (553 B.C.) claims his vassals as far as Gaza. The Persians took over the realm of their predecessors, and Gaza grew in importance as a seat of international commerce. Nehemiah speaks not of Philistines, but of Ashdodites (iv. 7), speaking an "Ashdodite" dialect (xiii. 24); just as Strabo regards the Jews, the Idumaeans, the Gazans and the Ashdodites as four cognate peoples having the common characteristic of combining agriculture with commerce. In southern Philistia at least, Arabian immigration became more pronounced. In the time of Cambyses Arabs were settled at Jenysos south of Gaza (Herod. iii. 5), and when Alexander marched upon Egypt, Gaza with its army of Arabs and Persians offered a strenuous resistance. Recent discoveries near Tell Sandahannah (or Mareshah) have revealed the presence of North Arabian (Edomite) names about the 2nd century B.C.[1] On the history of the district see further JEWS; MACCABEES; PALESTINE.

3. *Philistine Traditions.*—The interdependence of the south Palestinian peoples follows from geographical conditions which are unchangeable, and the fuller light thrown upon the last decades of the 8th century B.C. illuminates the more fragmentary evidence elsewhere.[2] Hence the two sieges of the Philistine Gibbethon by the Israelites (above) obviously have some significance for Judaean history, but the Judaean annals unfortunately afford no help (see ASA). Again, the Aramaean attack upon Israel by Hazael of Damascus leads to the capture of Gath (2 Kings xii. 17), and this, together with the statement that he took "the Philistine" from Jehoahaz of Israel (ibid. xiii. 22, Lucian's recension), bears upon Judah, but the statements are isolated. Somewhat later, the Assyrian king Adad-nirari IV. claimed tribute from Edom, Philistia and Beth-Omri (the Israelite kingdom); the curious omission of Judah has suggested that it was then included with the second or third of these (see JEWS, § 12). The Philistines naturally had a prominent place in popular tradition, and the story of Isaac and the Philistine Abimelech (Gen. xxvi., cf. xxi. 32) is of great interest for its unbiased representation of intercourse, enmity, alliance and covenant. But it is important to notice that a parallel story (xx.) is without this distinctively *Philistine* background, and this variation is significant. One account of the Israelite invasion conceived a conquest of earlier giant inhabitants (Anākīm) who survived in Gaza, Gath and Ashdod (Joshua xi. 21 seq., contrast xiii. 3), but were driven out from Hebron by Caleb (Joshua xv. 14, cf. Num. xiii. 22, 28). The Philistines themselves are called the remnant of the Anākīm (Jer. xlvii. 5, so the Septuagint), or as Caphtōrīm replace the earlier Avvim (Deut. ii. 23, see Joshua xiii. 3). Samuel's great defeat of the Philistines leads to "peace between Israel and the *Amorites*" (1 Sam. vii. 14); and the migration of the Danites is placed after Samson's conflicts with the Philistines (Judges xviii. seq.), or is due to the pressure of Amorites (i. 34). Even in David's fights with the Philistines in Judah, Jerusalem is Jebusite, neighbouring non-Israelite cities are Hivite or Amorite (Joshua ix. 7, 2 Sam. xxi. 2), and his strange adversaries find a close parallel in the semi-mythical sons of Anak (2 Sam. xxi. 16, 18, 20, 22). This fluctuation, due partly to the different circles in which the biblical narratives took shape, and partly to definite reshaping of the traditions of the past, seriously complicates all attempts to combine the early history of Israel with the external evidence. The history of the Philistine district goes back long before the time of the Purasati (*c.* 1200 B.C.), and if the references to Philistines in pre-Mosaic times are treated as anachronisms, those which can be applied to the 12th–11th century do not at once acquire an historical value.[3] The references of the time of the Exodus, the Invasion and the "Judges"—whatever chronological scheme be adopted—must be taken in connexion with a careful examination of all the evidence. It is inherently not improbable that a recollection has been preserved of Philistine oppressions in the 11th century, but it is extremely difficult to sketch any adequate sequence of events, and among the conflicting traditions are situations equally applicable to later periods of hostility. Biblical history has presented its own views of the Israelite and Judaean monarchies; Israel has its enemies who come pouring forth from the south (1 Sam. xiii. 17, 18), while the founder of the Judaean dynasty has intimate relations with a Philistine king Achish (or Abimelech, Ps. xxxiv.), or, from another point of view, clears the district of a prehistoric race of giants. In the stories of Samson and Samuel, the Philistines are located in the maritime plain, whereas, in the oldest traceable account of Saul's rise (apparently shortly before 1000 B.C.) they hold Israel (1 Sam. ix. 16, xiii. 3 seq., 7, xiv. 1, 11, 21). But there is no historical continuity between the two situations, and the immediate prelude to the achievements of Saul and Jonathan is lost. The biblical evidence does not favour any continued Philistine domination since the time of Rameses III., who indeed, later in his reign, made an expedition, not against the Purasati, but into North Syria, and, as appears from the Papyrus Harris, restored Egyptian supremacy over Palestine and Syria. Upon the (incomplete) external evidence and upon a careful criticism of the biblical history of this period, and not upon any promiscuous combination of the two sources, must depend the value of the plausible though broad reconstructions which have been proposed.[4]

Considerable stress is often laid upon Goliath's armour of bronze and his iron weapon, but even David himself has helmet, sword and coat-of-mail at his disposal (1 Sam. xvii.), and suits of armour had already been taken from Mesopotamia by Tethmosis III. Chariots of iron are ascribed to the Canaanites (Joshua xvii. 16, 18, Judges i. 19, iv. 3); but if early references to iron are treated as unhistorical (Gen. iv. 22, Num. xxxi. 22, xxxv. 16, Deut. iv. 20, viii. 9, xix. 5, xxvii. 5, xxviii. 48, xxxiii. 25, Joshua vi. 19, 24) Goliath's iron spear-head must be judged together with the whole narrative in the light of a consistent historical criticism.[5]

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[1] Peters and Thiersch, *Painted Tombs in the Necropolis of Marissa* (1905).

[2] Thus, the capture of Gezer by Egypt (1 Kings ix. 16) was presumably only part of some more extensive operations, but their relation to Shishak's great Palestine campaign is uncertain; see A. Alt, *Israel u. Aegypten*, pp. 19-38 (Leipzig, 1909). It would be unsafe to infer much from the Eg. reference to the "messenger (*wpty*, meaning ambiguous)" of Canaan and Philistia (*Bull. Mus. Cairo*, i. 98).

[3] The inhabitants of Ascalon besieged by Rameses II. are represented as Hittites. For an attempt to treat the pre-Mosaic references as historical, see A. Noordtzij, *De Filistijnen* (Kampen, 1905).

[4] See on these, W. M. Müller, *Mitteil. d. vorderasiat. Gesell.* p. 39 seq.; G. F. Moore, *Ency. Bib.*, art. "Philistines," col. 3720 seq., and cf. H. W. Hogg, *op. cit.* p. 91. For the suggestion that the "Philistines" have in certain cases taken the place of another ethnic, see S. A. Cook, *Crit. Notes on O. T. History*, pp. 43 seq., 127 seq., 131 seq., 136 seq., 144; cf., from another point of view, T. K. Cheyne, *Decline and Fall of Kingdom of Judah* (1908), pp. xx. sqq.

[5] The introduction of iron has been ascribed to about 1000 B.C. (Macalister, *Quart. Statem.* p. 321 [1905], as against p. 122 [1904]; H. Vincent, *Canaan d'après l'exploration récente*, p. 235 seq.). It need hardly be said that the height and might of Goliath must be regarded in the same way as Num. xiii. 32; Deut. ii. 11. The men of the heroic age are giants, as were the 'Ad and Thamud to the later Arabs.

4. *Conclusions.*—The Philistines appear in the Old Testament as a Semitic or at least a thoroughly Semitized people. Their proper names show that before and even during the Persian age their languages differed only dialectically from Hebrew. Among the exceptions must be reckoned Achish (Sept. ἀκχους), with which has been compared Ikausu, a king of Ekron (7th century) and the "Keftian" name *Akashau* of the XIXth Egyptian dynasty. Names in *-ath* (Goliath, Ahuzzath, Gen. xxvi.) are not restricted to Philistines, and Phicol (ibid.) is too obscure to serve as evidence. The religion is not novel. The male god Dagon has his partner Astarte (*qq.v.*), and Baal-zebub, a famous oracle of Ekron (2 Kings i.) finds a parallel in the local "baals" of Palestine.[1] Even when the region seems to be completely Hellenized after the Persian age, it is not so certain that Greek culture pervaded all classes (see G. F. Moore, *Ency. Bib.* col. 3726), although a certain amount of foreign influence probably made itself felt upon the coast-towns at all times. The use of the term ἀλλόφυλοι in Maccabaean and later writings (cf. the contemptuous hatred of Ben Sira, Ecclesiasticus l. 26, and the author of Jubilees xxiv. 30 sqq.) correctly expresses the conditions of the Greek age and the Maccabaean wars, and naturally any allusion to the situations of many centuries previously is quite unnecessary. Similarly, the biblical evidence represents the traditions in the form which they had reached in the writer's time, the true date of which is often uncertain. Antagonism between Philistines and Israelites was not a persisting feature, and, although the former are styled "uncircumcised" (chiefly in the stories in the book of Samuel), the term gained new force when the expulsion of uncircumcised aliens from the sanctuary of Jerusalem was proclaimed in the writings ascribed to Ezekiel (ch. xliv.).[2]

In fact the question arises whether the history of the Philistines is not that of a territorial designation, rather than that of the lineal descendants of the Purasati, who, if one of the peoples who took part in the events of the XXth Dynasty, may well have bequeathed their name. The Mediterranean coast-land was always exposed to incursions of aliens, and when Carians appear as royal and temple guards at Jerusalem (2 Kings xi. 4), it is sufficient to recall old Greek traditions of a Carian sea-power and relations between Philistia and Greek lands.[3] Even the presence of Carians and Ionians in the time of Psammetichus I. may be assumed, and when these are planted at Defneh it is noteworthy that this is also closely associated with a Jewish colony (viz. Tahpanhes, Jer. xliii. seq.). Although the Purasati appear after the 15th–14th centuries, now illuminated by the Amarna tablets, their own history is perhaps earlier.[4] But there is no reason at present to believe that their entrance caused any break in the archaeological history. The apparently "Aegean" influence which enters into the general "Amarna" period seems to begin before the age of the Amarna tablets (at Lachish), and it passes gradually into later phases contemporary with the Israelite monarchy. There is a fairly continuous intercourse with external culture (Cypriote, early and late Greek), and, if Gath be identified with Tel eṣ-Ṣāfi, Bliss and Macalister, who excavated it, found no trace of any interruption in its history. Only at Gezer—perhaps Philistine, 2 Sam. v. 25—has there been found evidence for a strange race with several distinctive features. Bricked vault tombs were discovered containing bodies outstretched (not contracted); the deposits were of an unusually fine character and comprised silver, alabaster and even iron. The culture appears to find Carian and Lydian parallels, and has been ascribed provisionally to the 13th–10th centuries. So far, however, of the cities lying within or immediately exposed to Philistine influence, the discoveries at Gezer are unique.[5]

According to the biblical traditions the Philistines are the remnant of Caphtor (Jer. xlvii. 4, Amos ix. 7), and the Caphtōrīm drove out the aboriginal Avva from Gaza and district, as the Horites and Rephaim were displaced by Edom and Ammon (Deut. ii. 23). These Caphtōrīm, together with Ludim (Lydians) and other petty peoples, apparently of the Delta, are once reckoned to Egypt (Gen. x. 14).[6] By Caphtor the Septuagint has sometimes understood Cappadocia, which indeed may be valid for its age, but the name is to be identified with the Egyptian K(a)ptar, which in later Ptolemaic times seems to mean Phoenicia, although *Keftiu* had had another connotation. The Cherethites, associated with the Philistine district (1 Sam. xxx. 14, 16, Ezek. xxv. 16, Zeph. ii. 5 seq.), are sometimes recognized by the Septuagint as Cretans, and, with the Pelethites (often taken to be a rhyming form of Philistines), they form part of the royal body-guard of Judaean kings (2 Sam. viii. 18, xv. 18. xx. 7, 1 Kings i. 38, 44; in 2 Sam. xx. 23 the Hebrew text has Carites). However adequate these identifications may seem, the persistence of an independent clan or tribe of Cherethites-Cretans to the close of the 7th century would imply an unbroken chain of nearly six hundred years, unless, as is inherently more probable, later immigrations had occurred within the interval. But upon the ethnological relations either of the south Palestinian coast or of the Delta it would be unsafe to dogmatize. So far as can be ascertained, then, the first mention of the Philistines belongs to an age of disturbance and change in connexion with movements in Asia Minor. Archaeological evidence for their influence has indeed been adduced,[7] but it is certain that some account must be taken also of the influence by land from North Syria and Asia Minor. The influences, whether from the Levant or from the north, were not confined to the age of Rameses III. alone, and the biblical evidence, especially, while possibly preserving some recollection of the invasion of the Purasati, is in every case late and may be shaped by later historical vicissitudes. It is impossible that Palestine should have remained untouched by the external movements in connexion with the Delta, the Levant and Asia Minor, and it is possible that the course of internal history in the age immediately before and after 1000 B.C. ran upon lines different from the detailed popular religious traditions which the biblical historians have employed. (See further PALESTINE: *History.*)

For older studies, see F. Hitzig, *Urgeschichte der Philister* (1845), with the theory of the Pelasgic origin of the Philistines; K. Stark, *Gaza u. d. philist. Küste* (1852), and (with special reference to earlier theories) W. Robertson Smith's art. in *Ency. Brit.*, 9th ed.

(S. A. C.)

PHILISTUS, Greek historian of Sicily, was born at Syracuse about the beginning of the Peloponnesian War (432 B.C.). He was a faithful supporter of the elder Dionysius, and commander of the citadel. In 386 he excited the jealousy of the tyrant by secretly marrying his niece, and was sent into banishment. He settled at Thurii, but afterwards removed to Adria, where he remained until the death of Dionysius (366). He was then recalled by the younger Dionysius, whom he persuaded to dismiss Plato and Dion. When Dion set sail from Zacynthus with the object of liberating Syracuse from the *tyrannis*, Philistus was entrusted with the command of the fleet, but he was defeated and put to death (356). During his stay at Adria, Philistus occupied himself with the composition of his Σικελικά, a history of Sicily in eleven books. The first part (bks. i.–vii.) comprised the history of the island from the earliest times to the capture of Agrigentum by the Carthaginians (406); the second, the history of the elder and the younger Dionysius (down to 363). From this point the work was carried on by Philistus's fellow countryman Athanas. Cicero (*ad. Q. Fr.* ii. 13), who had a high opinion of his work, calls him the miniature Thucydides" (*pusillus Thucydides*). He was admitted by the Alexandrian critics into the canon of historiographers, and his work was highly valued by Alexander the Great.

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[1] See further, F. Schwally, *Zeit. Wissens. Theol.* xxxiv. 103–108. A few Hebrew words have been regarded as Philistine loan-words, so notably *pillégesh*, "concubine" (παλλακή, παλλακίς, Lat. *pellex*), and *seren* (τύραννος) the title applied to the five lords of the Philistine confederation; *seren* otherwise means "axle," and may have been applied metaphorically like the Arab. *ḳoṭb* (W. R. Smith). On the other hand, a common origin in Asia Minor is also possible for these words.

[2] In the prophetical writings the Philistines are denounced (with Ammon, Moab and Edom) for their vengeance upon Judah (Ezek. xxv. 15–17). With Tyre and Sidon they are condemned for plundering Judah, and for kidnapping its children to sell to the Greeks (Joel iii. 4–8; cf. Amos i. 6–12; 1 Macc. iii. 41). They are threatened with a foe from the north (Jer. xxv. 20; Isa. xiv. 29–31; see ZEPHANIAH), as also is Phoenicia (Jer. xlvii. 2–7) upon whom they depend (cf. Zech. ix. 3–8). Judah is promised reprisals (Zeph. ii. 7; Obad. 19), and a remnant of the Philistines may become worshippers of Yahweh (Zech. ix. 7). The historical backgrounds of these passages are disputed.

[3] See J. L. Myres, *Journal of Hellenic Studies*, xxvi. 84 sqq. (1906); especially pp. 108, 127 sqq.

[4] This is suggested by the recent discovery at Phaestos in Crete of a disk with evidence for a native script; see A. J. Evans, *Scripta Minoa* (Oxford, 1909), pp. 22 sqq.; E. Meyer, *Sizungsberichte* of the Berlin Academy for the 21st of October 1909.

[5] See R. A. S. Macalister, *Quarterly Stat.* of the Palestine Explor. Fund, pp. 319 sqq. (1905), pp. 197 sqq. (1907), and J. L. Myres, ibid. pp. 240 sqq. (1907). On the other hand, H. Thiersch would connect the painted pottery of Tel eṣ-Ṣāfi, &c., with the Philistines (*Jahrbuch d. Arch. Inst.* col. 378 sqq., Berlin, 1908); cf. also H. R. Hall, *Proc. Soc. Bibl. Arch.* xxxi. 235.

[6] *v.* 13 seq. may be a secondary addition "written from specially intimate acquaintance with the (later ?) Egyptian geography" (J. Skinner, *Genesis*, p. 214).

[7] See D. G. Hogarth, *Ionia and the East*, pp. 28 seq. (Oxford, 1909); Evans, *Scripta Minoa*, pp. 77 sqq.

See Diod. Sic. xiii. 103, xiv. 8, xv. 7, xvi. 11, 16; Plutarch, *Dion*, 11–36; Cicero, *Brutus*, 17, *De oratore*, ii. 13; Quintilian, *Instit.* x. 1, 74; fragments and life in C. W. Müller, *Fragmenta historicorum graecorum*, vol. i. (1841); C. Wachsmuth, *Einleitung in das Studium der alten Geschichte* (1895); E. A. Freeman, *History of Sicily* (1891–1894); A. Holm, *Geschichte Siciliens im Altert.* (1870–1898).

PHILLAUR, a town of British India, in Jullundur district, Punjab, on the north bank of the river Sutlej, 8 m. N. of Ludhiana. Pop. (1901), 6986. Founded by the Mogul emperor Shah Jahan, it was long of importance as commanding the crossing of the Sutlej. At the Mutiny in 1857 the fort contained the siege train, which was sent safely to Delhi; but the sepoy regiment in the cantonment shortly afterwards mutinied and escaped. The fort is now occupied by the police training school and the central bureau of the criminal identification department.

PHILLIMORE, SIR ROBERT JOSEPH (1810–1885), English judge, third son of a well-known ecclesiastical lawyer, Dr Joseph Phillimore, was born at Whitehall on the 5th of November 1810. Educated at Westminster and Christ Church, Oxford, where a lifelong friendship with W. E. Gladstone began, his first appointment was to a clerkship in the board of control, where he remained from 1832 to 1835. Admitted as an advocate at Doctors' Commons in 1839, he was called to the bar at the Middle Temple in 1841, and rose very rapidly in his profession. He was engaged as counsel in almost every case of importance that came before the admiralty, probate or divorce courts, and became successively master of faculties, commissary of the deans and chapters of St Paul's and Westminster, official of the archdeaconries of Middlesex and London, and chancellor of the dioceses of Chichester and Salisbury. In 1853 he entered parliament as member for Tavistock. A moderate in politics, his energies were devoted to non-party measures, and in 1854 he introduced the bill for allowing viva voce evidence in the ecclesiastical courts. He sat for Tavistock until 1857, when he offered himself as a candidate for Coventry, but was defeated. He was appointed judge of the Cinque Ports in 1855, Queen's Counsel in 1858, and advocate-general in admiralty in 1862, and succeeded Dr Stephen Lushington (1782–1873) as judge of the court of arches five years later. Here his care, patience and courtesy, combined with unusual lucidity of expression, won general respect. In 1875, in accordance with the Public Worship Regulation Act, he resigned, and was succeeded by Lord Penzance. When the Judicature Act came into force the powers of the admiralty court were transferred to the High Court of Justice, and Sir Robert Phillimore was therefore the last judge of the historic court of the lord high admiral of England. He continued to sit as judge for the new admiralty, probate and divorce division until 1883, when he resigned. He wrote *Ecclesiastical Law of the Church of England*, a book which still holds its ground, *Commentaries on International Law*, and a translation of Lessing's *Laocoon*. He married, in 1844, Charlotte Anne, daughter of John Denison of Ossington Hall, Newark. He was knighted in 1862, and created a baronet in 1881. He died at Shiplake, near Henley-on-Thames, on the 4th of February 1885. His eldest son, Sir Walter G. F. Phillimore (b. 1845), also distinguished as an authority on ecclesiastical and admiralty law, became in 1897 a judge of the high court.

PHILLIP, JOHN (1817–1867), Scottish painter, was born at Aberdeen, Scotland, on the 19th of April 1817. His father, an old soldier, was in humble circumstances, and the son became an errand-boy to a tinsmith, and was then apprenticed to a painter and glazier. Having received some technical instruction from a local artist named William Mercer, he began, at the age of about fifteen, to paint portraits. In 1834 he made a very brief visit to London. About this time he became assistant to James Forbes, an Aberdeen portrait-painter. He had already gained a valuable patron. Having been sent to repair a window in the house of Major P. L. Gordon, his interest in the works of art in the house attracted the attention of their owner. Gordon brought the young artist under the notice of Lord Panmure, who in 1836 sent him to London, promising to bear the cost of his art education. At first Phillip was placed under T. M. Joy, but he soon entered the schools of the Royal Academy. In 1839 he figured for the first time in the royal academy exhibition with a portrait and a landscape, and in the following year he was represented by a more ambitious figure-picture of "Tasso in Disguise relating his Persecutions to his Sister." For the next ten years he supported himself mainly by portraiture and by painting subjects of national incident, such as "Presbyterian Catechizing," "Baptism in Scotland," and the "Spaewife." His productions at this period, as well as his earlier subject-pictures, are reminiscent of the practice and methods of Wilkie and the Scottish genre-painters of his time. In 1851 his health showed signs of delicacy, and he went to Spain in search of a warmer climate. He was brought face to face for the first time with the brilliant sunshine and the splendid colour of the south, and it was in coping with these that he first manifested his artistic individuality and finally displayed his full powers. In the "Letter-writer of Seville" (1854), commissioned by Queen Victoria at the suggestion of Sir Edwin Landseer, the artist is struggling with new difficulties in the portrayal of unwonted splendours of colour and light. In 1857 Phillip was elected an associate of the Royal Academy, and in 1859 a full member. In 1855 and in 1860 further visits to Spain were made, and in each case the painter returned with fresh materials to be embodied with increasing power and subtlety in the long series of works which won for him the title of "Spanish Phillip." His highest point of execution is probably reached in "La Gloria" (1864) and a smaller single-figure painting of the same period entitled "El Cigarillo." These Spanish subjects were varied in 1860 by a rendering of the marriage of the princess royal with the crown prince of Prussia, executed by command of the queen, and in 1863 by a picture of the House of Commons. During his last visit to Spain Phillip occupied himself in a careful study of the art of Velazquez, and the copies which he made fetched large prices after his death, examples having been secured by the royal and the royal Scottish academies. The year before his death he visited Italy and devoted attention to the works of Titian. The results of this study of the old masters are visible in such works as "La Loteria Nacional¡" left uncompleted at his death. During this period he resided much in the Highlands, and seemed to be returning to his first love for Scottish subjects, painting several national scenes, and planning others that were never completed. He died in London on the 27th of February 1867.

His works were collected in the International Exhibition of 1873, and many of them are engraved by T. Oldham Barlow. In addition to the paintings already specified the following are among the more important: "Life among the Gipsies of Seville" (1853), "El Paseo" (1855), "Collection of the Offertory in a Scotch Kirk" (1855), "A Gipsy Water-carrier in Seville" (1855), "The Prayer of Faith shall save the Sick" (1856), "The Dying Contrabandist" (1856), "The Prison Window" (1857), "A Huff" (1859), "Early Career of Murillo" (1865), "A Chat round the Brasero" (1866).

PHILLIPS, ADELAIDE (1833–1882), American contralto singer, was born at Stratford-on-Avon, England, her family emigrating to America in 1840. Her mother taught dancing, and Adelaide began a career on the Boston stage at ten years old. But in 1850 her talent for singing became evident, and through Jenny Lind and others she was sent to London and to Italy to study. In 1855 she returned to America an accomplished vocalist; and for many years she was the leading American contralto, equally successful in oratorio and on the concert platform. She died at Carlsbad on the 3rd of October 1882.

PHILLIPS, EDWARD (1630–1696), English author, son of Edward Phillips of the crown office in chancery, and his wife Anne, only sister of John Milton, the poet, was born in August 1630 in the Strand, London. His father died in 1631, and Anne Phillips eventually married her husband's successor in the crown office, Thomas Agar. Edward Phillips and his younger brother, John, were educated by Milton. Edward entered Magdalen Hall, Oxford, in November 1650, but left the university in 1651 to be a bookseller's clerk in London. Although he entirely differed from Milton in his religious and political views, and seems, to judge from the free character of his *Mysteries of Love and Eloquence* (1658), to have undergone a certain revulsion from his Puritan upbringing, he remained on affectionate terms with his uncle to the end. He was tutor to the son of John Evelyn, the diarist, from 1663 to 1672 at Sayes Court, near Deptford, and in 1677–1679 in the family of Henry Bennet, earl of Arlington. The date of his death is unknown but his last book is dated 1696.

His most important work is *Theatrum poetarum* (1675), a list of the chief poets of all ages and countries, but principally of the English poets, with short critical notes and a prefatory *Discourse of the Poets and Poetry*, which has usually been traced to Milton's hand. He also wrote *A New World in Words, or a General Dictionary* (1658), which went through many editions; a new edition of Baker's *Chronicle*, of which the section on the period from 1650 to 1658 was written by himself from the royalist standpoint; a supplement (1676) to John Speed's *Theatre of Great Britain*; and in 1684 *Enchiridion linguae latinae*, said to have been taken chiefly from notes prepared by Milton. Aubrey states that all Milton's papers came into Phillips's hands, and in 1694 he published a translation of his *Letters of State* with a valuable memoir

His brother, JOHN PHILLIPS (1631–1706), in 1652 published a Latin reply to the anonymous attack on Milton entitled *Pro Rege et populo anglicano*. He appears to have acted as unofficial secretary to Milton, but, disappointed of regular political employment, and chafing against the discipline he was under, he published in 1655 a bitter attack on Puritanism entitled a *Satyr against Hypocrites* (1655). In 1656 he was summoned before the privy council for his share in a book of licentious poems, *Sportive Wit*, which was suppressed by the authorities but almost immediately replaced by a similar collection, *Wit and Drollery*. In *Montelion* (1660) he ridiculed the astrological almanacs of William Lilly. Two other skits of this name, in 1661 and 1662, also full of course royalist wit, were probably by another hand. In 1678 he supported the agitation of Titus Oates, writing on his behalf, says Wood, "many lies and villanies." *Dr Oates's Narrative of the Popish Plot indicated* was the first of these tracts. He began a monthly historical review in 1688 entitled *Modern History or a Monthly Account of all considerable Occurrences, Civil, Ecclesiastical and Military*, followed in 1690 by *The Present State of Europe, or a Historical and Political Mercury*, which was supplemented by a preliminary volume giving a history of events from 1688. He executed many translations from the French, and a version (1687) of *Don Quixote*.

An extended, but by no means friendly, account of the brothers is given by Wood, *Athen. oxon.* (ed. Bliss, iv. 764 seq.), where a long list of their works is dealt with. This formed the basis of William Godwin's *Lives of Edward and John Phillips* (1815), with which is reprinted Edward Phillips's *Life of John Milton*.

PHILLIPS, JOHN (1800–1874), English geologist, was born on the 25th of December 1800 at Marden in Wiltshire. His father belonged to an old Welsh family, but settled in England as an officer of excise and married the sister of William Smith, the "Father of English Geology." Both parents dying when he was a child, Phillips came under the charge of his uncle; and after being educated at various schools, he accompanied Smith on his wanderings in connexion with his geological maps. In the spring of 1824 Smith went to York to deliver a course of lectures on geology, and his nephew accompanied him. Phillips accepted engagements in the principal Yorkshire towns to arrange their museums and give courses of lectures on the collections contained therein. York became his residence, where he obtained, in 1825, the situation of keeper of the Yorkshire museum and secretary of the Yorkshire Philosophical Society. From that centre he extended his operations to towns beyond the county; and in 1831 he included University College, London, in the sphere of his activity. In that year the British Association for the Advancement of Science was founded at York, and Phillips was one of the active minds who organized its machinery. He became in 1832 the first assistant secretary, a post which he held until 1859. In 1834 he accepted the professorship of geology at King's College, London, but retained his post at York. In 1834 he was elected F.R.S.; in later years he received hon. degrees of LL.D. from Dublin and Cambridge, and D.C.L. from Oxford; while in 1845 he was awarded the Wollaston Medal by the Geological Society of London. In 1840 he resigned his charge of the York museum and was appointed on the staff of the geological survey of Great Britain under De la Beche. He spent some time in studying the Palaeozoic fossils of Devon, Cornwall and West Somerset, of which he published a descriptive memoir (1841); and he made a detailed survey of the region of the Malvern Hills, of which he prepared the elaborate account that appears in vol. ii. of the *Memoirs of the Survey* (1848). In 1844 he became professor of geology in the university of Dublin. Nine years later, on the death of H. E. Strickland, who had acted as substitute for Dean Buckland in the readership of geology in the university of Oxford, Phillips succeeded to the post of deputy, and at the dean's death in 1856 became himself reader, a post which he held to the time of his death. During his residence in Oxford he took a leading part in the foundation and arrangement of the new museum erected in 1859 (see his *Notices of Rocks and Fossils in the University Museum*, 1863; and *The Oxford Museum*, by H. W. Acland and J. Ruskin, 1859; reprinted with additions 1893). Phillips was also keeper of the Ashmolean museum from 1854–1870. In 1859–1860 he was president of the Geological Society of London, and in 1865 president of the British Association. He dined at All Souls College on the 23rd of April 1874, but on leaving he slipped and fell down a flight of stone stairs, and died on the following day.

From the time he wrote his first paper "On the Direction of the Diluvial Currents in Yorkshire" (1827), down to the last days of his life, Phillips continued a constant contributor to the literature of science. The pages of the *Philosophical Magazine*, the *Journal of the Geological Society*, the *Geological Magazine* and other publications contain valuable essays by him. He was also the author of numerous separate works, which were of great benefit in extending a sound knowledge of geology. Among these may be specially mentioned: *Illustrations of the Geology of Yorkshire* (in two parts, 1829 and 1836; 2nd ed. of pt. 1 in 1835, 3rd ed., edited by R. Etheridge, in 1875); *A Treatise on Geology* (1837–1839); *Memoirs of William Smith* (1844); *The Rivers, Mountains and Sea-Coast of Yorkshire* (1853); *Manual of Geology, Practical and Theoretical* (1855); *Life on the Earth: its Origin and Succession* (1860); *Vesuvius* (1869); *Geology of Oxford and the Valley of the Thames* (1871). To these should be added his *Monograph of British Belemnitidae* (1865), for the Palaeontographical Society, and his geological map of the British Isles (1847).

See Biographical Memoir, with portrait, in *Geol. Mag.* (July 1870).

PHILLIPS, SAMUEL (1814–1854), English journalist, the son of a Jewish tradesman in London, was born on the 28th of December 1814. He was educated at University College, London, and then at Göttingen. Having renounced the Jewish faith, he returned to England and entered Sidney Sussex College, Cambridge, with the design of taking orders. His father's death, however, prevented this, and in 1841 he took to literary work. He wrote a novel, *Caleb Stukely* (1862), and other tales, and about 1845 began a connexion with *The Times* as literary critic. In the following year he purchased the *John Bull* newspaper, and edited it for a year. Two volumes of his *Essays from The Times* appeared in 1852 and 1854. Phillips took an active part in the formation of the Crystal Palace Company, and wrote their descriptive guides. In 1852 the university of Göttingen conferred upon him the honorary degree of LL.D. He died at Brighton on the 14th of October 1854.

PHILLIPS, STEPHEN (1868–), British poet and dramatist, was born on the 28th of July 1868 at Somertown near Oxford, the son of the Rev. Stephen Phillips, precentor of Peterborough Cathedral. He was educated at Stratford and Peterborough Grammar Schools, and entered Queen's College, Cambridge; but during his first term at Cambridge, when F. R. Benson's dramatic company visited the town, he joined it, and for six years played various small parts. In 1890 a slender volume of verse was published at Oxford with the title *Primavera*, which contained contributions by him and by his cousin Laurence Binyon and others. In 1894 he published *Eremus*, a long poem of loose structure in blank verse of a philosophical complexion. In 1896 appeared *Christ in Hades*, forming with a few other short pieces one of the slim paper-covered volumes of Elkin Mathews's "Shilling Garland." This poem arrested the attention of watchful critics of poetry, and when it was followed by a collection of *Poems* in 1897 the writer's position as a new poet of exceptional gifts was generally recognized. This volume contained a new edition of "Christ in Hades," together with "Marpessa," "The Woman with the Dead Soul," "The Wife" and shorter pieces, including the fine lines "To Milton, Blind." The volume won the prize of £100 offered by the *Academy* newspaper for the best new book of its year, ran through half a dozen editions in two years, and established Mr Phillips's rank as poet, which was sustained by the publication in the *Nineteenth Century* in 1898 of his poem "Endymion." George Alexander, the actor-manager, moved perhaps by a certain clamour among the critics for a literary drama, then commissioned Mr Phillips to write him a play, the result being *Paolo and Francesca* (1900), a drama founded on Dante's famous episode. Encouraged by the great success of the drama in its literary form, Mr Alexander produced the piece at the St James's Theatre in the course of 1901. In the meantime, Mr Phillips's next play, *Herod: a Tragedy*, had been produced by Beerbohm Tree on the 31st of October 1900, and was published as a book in 1901; *Ulysses*, also produced by Beerbohm Tree, was published in 1902; *The Sin of David*, a drama on the story of David and Bathsheba, translated into the times and terms of Cromwellian England, was published in 1904; and *Nero*, produced by Beerbohm Tree, was published in 1906. In these plays the poet's avowed aim was, instead of attempting to revive the method of Shakespeare and the Elizabethans, to revitalize the method of Greek drama. *Paolo and Francesca* (which admitted certainly one scene on an Elizabethan model) was the most successful, the subject being best adapted to the lyrical cast of Mr Phillips's poetical temperament; but all contained fine poetry, skilfully stage-managed by a writer who had practical experience of stage craft.

See the section on Stephen Phillips in *Poets of the Younger Generation*, by William Archer (1902); also the articles on "Tragedy and Mr Stephen Phillips," by William Watson, in the *Fortnightly Review* (March 1898); "The Poetry of Mr Stephen Phillips," in the *Edinburgh Review* (January 1900); "Mr Stephen Phillips," in the *Century* (January 1901), by Edmund Gosse; and "Mr Stephen Phillips," in the *Quarterly Review* (April 1902), by Arthur Symons.

For bibliography up to July 1903, see *English Illustrated Magazine* new series, vol. xxix. p. 442.

PHILLIPS, THOMAS (1770–1845), English portrait and subject painter, was born at Dudley in Warwickshire on the 18th of October 1770. Having acquired the art of glass-painting at Birmingham he visited London in 1790 with an introduction to Benjamin West, who found him employment on the windows in St George's Chapel at Windsor. In 1792 Phillips painted a view of Windsor Castle, and in the next two years he exhibited the "Death of Talbot, Earl of Shrewsbury, at the Battle of Castillon," "Ruth and Naomi," "Elijah restoring the Widow's Son," "Cupid disarmed by Euphrosyne," and other pictures. After 1796, however, he mainly confined himself to portrait-painting. It was not long before he became the chosen painter of men of genius and talent, notwithstanding the rivalry of Hoppner, Owen, Jackson and Lawrence; and he left behind portraits of nearly all the illustrious characters of his day. In 1804 he was elected associate and in 1808 member of the Royal Academy. In 1824 Phillips succeeded Fuseli as professor of painting to the Royal Academy, an office which he held till 1832. During this period he delivered ten *Lectures on the History and Principles of Painting*, which were published in 1833. He died on the 20th of April 1845.

PHILLIPS, WENDELL (1811–1884), American orator and reformer, was born in Boston on the 29th of November 1811. His father, John Phillips (1770–1823), a man of wealth and influence, graduated at Harvard College in 1788, and became successively "town advocate and public prosecutor," and in 1822 first mayor of Boston, then recently made into a city. Wendell Phillips himself attended the public Latin school, entered Harvard College before he was sixteen, and graduated in 1831 in the same class with the historian John Lothrop Motley. He graduated at the Harvard law school in 1834, and was admitted to the bar in Boston. He soon came under the influence of the anti-slavery movement, witnessing in 1835 the mobbing, in Boston, of William Lloyd Garrison. On the 8th of December 1837 a meeting was held at Faneuil Hall to express the sentiments of the people on the murder of Elijah P. Lovejoy, at Alton, Illinois, for defending his press from a pro-slavery mob. In the course of the meeting a speech was made in opposition to its general current by James T. Austin (1784–1870), attorney-general of the state, who said that Lovejoy had died "as the fool dieth," and compared his murderers to the men who threw the tea into Boston harbour just before the War of Independence. The speech seemed likely to divide the audience, when Wendell Phillips took the platform. "When I heard," he said, "the gentleman lay down principles which placed the murderers of Alton side by side with Otis and Hancock, with Quincy and Adams, I thought these pictured lips (pointing to their portraits) would have broken into voice to rebuke the recreant American, the slanderer of the dead." This appeal not merely determined the sentiment of the meeting, it gave Wendell Phillips his first fame and determined his career. Although loving his profession, and this especially for the opening it gave in the direction of public life, he practically stepped outside the sphere dearest to young Americans, and lived henceforth the life of an agitator, or, like his father, that of a "public prosecutor." Accepting unhesitatingly the leadership of Garrison, and becoming like him gradually a disunionist, he lived essentially a platform life, interested in a variety of subjects, but first and chiefly an abolitionist. In 1865, however, after the Civil War, he broke with Garrison over the question of discontinuing the Anti-Slavery Society, and from that date until the society was disbanded in 1870 he, instead of Garrison, was its president. He was not, moreover, like his great leader, a non-resistant, nor was he, on the other hand, like John Brown, borne on by irresistible necessity to overt action. Nor did he find, like his fellow-worker, Theodore Parker, the leisure to keep up his scholarship and lead in part the life of a student. Early study and travel had indeed furnished him with abundant material for rhetorical illustration; and he was also a great reader of newspapers, but he used to say that he knew in his whole life but one thing thoroughly, namely, the history of the English Civil War, and there were few occasions when he could not draw from it the needful illustration. His style of eloquence was direct and brilliant, but eminently self-controlled. He often surprised his hearers by the quietness of his beginnings, and these were very often the speeches which turned out most brilliant and most irresistible ere the close. He may be said to have introduced the direct and colloquial manner upon the American public platform, as distinct from the highly elaborated and often ornate style which had been established by Edward Everett; nor has there ever been a reversion since his day to the more artificial method. He was capable at times, nevertheless, of highly sonorous periods with superb climaxes; yet his favourite style was the conversational. His logic, while never obtruded, was rarely at fault; but he loved the flash of the rapier, and was never happier than when he had to face down a mob and utterly foil it by sheer superiority in fencing. The two volumes of his speeches, as edited by James Redpath, were fortunately made from verbatim reports, and they wisely enclose in parentheses those indications of favour or dissent from the audience which transformed so many of his speeches into exhibitions of gladiatorial skill. He was a tribune of the people, associated unflinchingly not merely with the unpopular but with the unpolished; always carrying about him not merely a certain Roman look, but a patrician air. After slavery had fallen Phillips associated himself freely with reformers occupied in other paths, herein separating himself from the other patrician of the movement, Edmund Quincy, who always frankly said that after slavery was abolished there was nothing else worth fighting for. Among other things, Phillips contended, during his later years, for prohibition, woman suffrage and various penal and administrative reforms. He was not always the best judge of character, and was sometimes allied in these movements with men who were little more than demagogues. But the proof he gave by his transfer of energies that the work of reform was never quite finished—this was something of peculiar value, and worth the risk of some indiscretions. The life of a reformer did not in itself make him thoroughly happy; he chafed more and more under its fatigues, and he always felt that his natural place would have been among senators or ambassadors; but he belonged essentially to the heroic type, and it may well have been of him that Emerson was thinking when he wrote those fine words: "What forests of laurel we bring and the tears of mankind to him who stands firm against the opinion of his contemporaries." His domestic life was most happy, though his wife was a confirmed invalid, seldom quitting her room. She was a woman of heroic nature and very strong convictions. Her husband used to say that she first made him an abolitionist. They had no children, but adopted an orphaned daughter of Mrs Eliza Garnaut, a friend, and this young girl (afterwards the wife of George W. Smalley), brought much light and joy into the household. Their worldly circumstances were easy, though they were always ready to impoverish themselves for the sake of others. Wendell Phillips died in Boston on the 2nd of February 1884.

See Lorenzo Sears, *Wendell Phillips, Orator and Agitator* (New York, 1909) (T. W. H.)

PHILLIPS, WILLIAM (1775–1828), British mineralogist and geologist, son of James Phillips, printer and bookseller in London, was born on the 10th of May 1775. He early became interested in mineralogy and geology, and was one of the founders of the Geological Society of London (1807). His *Outlines of Mineralogy and Geology* (1815) and *Elementary Introduction to the Knowledge of Mineralogy* (1816) became standard textbooks. His digest of English geology, *A selection of Facts from the Best Authorities, arranged so as to form an Outline of the Geology of England and Wales* (1818), formed the foundation of the larger work undertaken by Phillips in conjunction with W. D. Conybeare, of which only the first part was published, entitled *Outlines of the Geology of England and Wales* (1822). This volume made an era in geology. As a model of careful original observation, of judicious compilation, of succinct description and of luminous arrangement it has been of the utmost service in the development of geology in Britain. In this work Phillips reprinted his admirable description of the chalk cliffs of Dover and other parts of East Kent, published in 1819 in *Trans. Geol. Soc.* vol. v. Phillips was a member of the Society of Friends. He was elected a Fellow of the Royal Society in 1827. He died on the 2nd of April 1828.

His brother, RICHARD PHILLIPS (1778–1851), was distinguished as a chemist, and became F.R.S. in 1822. He was appointed chemist and curator to the Museum of Economic (afterwards Practical) Geology, then situated in Craig's Court (1839). He was the author of papers published in the *Annals of Philosophy* and *Philosophical Magazine*. In 1796 the two brothers, together with William Allen and Luke Howard, took part in forming the Askesian Society.

PHILLIPSBURG, a town of Warren county, New Jersey, U.S.A., on the Delaware river, opposite Easton, Pennsylvania, and about 51 m. N.N.W. of Trenton, N.J. Pop. (1900) 10,052, of whom 990 were foreign-born; (1910 U.S. census) 13,903. Served by the Central of New Jersey and other railways, the town is situated in the river bottom and on a bluff which commands beautiful views. The river is spanned here by several bridges. The town has railway shops and various manufactures. In 1905 the value of the factory products was $6,684,173 (45·8% more than in 1900). Phillipsburg was settled about 1750. It was only a straggling village when the Morris Banking and Canal Company was chartered in 1824, but its growth was accelerated by the canal (no longer used), by the establishment in 1848 of an iron furnace, and by the completion of the Central Railroad of New Jersey to this point in 1852; the town was incorporated in 1861.

PHILLIPSITE, a mineral of the zeolite group; a hydrated potassium, calcium and aluminium silicate, approximating to $(K_2, Ca)Al_2(SiO_3)_4 \cdot 4H_2O$. It varies somewhat in composition, and a variety ("pseudophillipsite") containing rather less silica has the formula $(K_2, Ca)_2Al_4Si_5O_{18} \cdot 9H_2O$. Crystals are monoclinic, but only complex cruciform twins are known, these being exactly like twins of harmotome (*q.v.*). Crystals of phillipsite are, however, usually smaller and more transparent and glassy than those of harmotome. Spherical groups with a radially fibrous structure and bristled with crystals on the surface are not uncommon. The hardness is 4½, and the specific gravity 2·2. The species was established by A. Lévy in 1825 and named after William Phillips. French authors use the name christianite (after Christian VIII. of Denmark), given by A. Des Cloizeaux in 1847.

Phillipsite is a mineral of secondary origin, and occurs with other zeolites in the amygdaloidal cavities of basic volcanic rocks: *e.g.* in the basalt of the Giant's Causeway in County Antrim, and near Melbourne in Victoria; and in leucitite near Rome. Small crystals of recent formation have been observed in the masonry of the hot baths at Plombières and Bourbonne-les-Bains, in France. Minute spherical aggregates embedded in red clay were dredged by the "Challenger" from the bottom of the Central Pacific, where they had been formed by the decomposition of lava. (L. J. S.)

PHILLPOTTS, HENRY (1778–1869), English bishop, was born at Bridgwater on the 6th of May 1778, and was educated at Gloucester College school and at Corpus Christi College, Oxford. He became a fellow of Magdalen College, Oxford, in 1795, took orders in 1802, and was select university preacher in 1804. In 1805 he received the living of Stainton-le-Street, Durham, and in addition was appointed to Bishop Middleham, Durham, in the succeeding year. For twenty years he was chaplain to Shute Barrington, bishop of Durham. He was appoined vicar of Gateshead in 1808, prebendary of Durham in 1809, and vicar of St Margaret, Durham, in 1810. After holding the rich living of Stanhope, Durham from 1820, and the deanery of Chester from 1828, he was consecrated bishop of Exeter in 1831, holding with the see a residentiary canonry at Durham. His published works include numerous speeches and pamphlets, including those connected with his well-known Roman Catholic controversy with Charles Butler (1750–1832). He was an energetic supporter of the Tory party, even when it acted contrary to his views in passing the Roman Catholic Emancipation Act of 1829. He died on the 18th of September 1869. "Henry of Exeter," as he was commonly called, was one of the most striking figures in the English Church of the 18th century. His intellect was strong rather than broad, his position being that of the traditional High Churchman, with little sympathy either with the Evangelicals or with the Tractarians. On the one hand the famous Gorham judgment was the outcome of his refusal to institute to the living of Brampford Speke a clergyman George Cornelius Gorham (1787–1857), who had openly disavowed his belief in baptismal regeneration; on the other he denounced the equally famous Tract XC. in his episcopal charge of 1843. As bishop he was a strict disciplinarian, and did much to restore order in a diocese of which the clergy had become extraordinarily demoralized. Though accused of avarice and pluralism, Phillpotts was generous in his gifts to the church, founding the theological college at Exeter and spending large sums on the restoration of the cathedral.

PHILO, Jewish Hellenist, and author of an epic poem in Greek hexameters on the history of Jerusalem. Alexander Polyhistor (*c.* 105–35 B.C.) quotes several passages of the poem, and is the source of the extracts in Eusebius (*Praeparatio evangelica*, ix. 20, 24, 37). This is probably the Philo who is mentioned by Clemens Alexandrinus (*Strom.* i. 21, 141) and by Josephus (*Contra Apionem*, i. 23), who calls him "the elder."

See M. Philippson's work on the Jewish poets Ezechiel and Philo (Berlin, 1830).

PHILO, often called PHILO JUDAEUS, Jewish philospher, appears to have spent his whole life at Alexandria, where he was probably born *c.* 20–10 B.C. His father Alexander was alabarch or arabarch (that is, probably, chief farmer of taxes on the Arabic side of the Nile), from which it may be concluded that the family was influential and wealthy (Jos. *Ant.* xviii. 8, 1). Jerome's statement (*De vir. ill.* 11) that he was of priestly race is confirmed by no older authority. The only event of his life which can be actually dated belongs to A.D. 40, when Philo, then a man of advanced years, went from Alexandria to Rome, at the head of a Jewish embassy, to persuade the emperor Gaius to abstain from claiming divine honour of the Jews. Of this embassy Philo has left a full and vivid account (*De legatione ad Gaium*). Various fathers and theologians of the Church state that in the time of Claudius he met St Peter in Rome;[1] but this legend has no historic value, and probably arose because the book *De vita contemplativa*, ascribed to Philo, in which Eusebius already recognized a glorification of Christian monasticism, seemed to indicate a disposition towards Christianity.

Though we know so little of Philo's own life, his numerous extant writings give the fullest information as to his views of the universe and of life, and his religious and scientific aims, and so enable us adequately to estimate his position and importance in the history of thought. He is quite the most important representative of Hellenistic Judaism, and his writings give us the clearest view of what this development of Judaism was and aimed at. The development of Judaism in the diaspora (*q.v.*) differed in important points from that in Palestine, where, since the successful opposition of the Maccabee age to the Hellenization which Antiochus Epiphanes had sought to carry through by force, the attitude of the nation to Greek culture had been essentially negative. In the diaspora, on the other hand, the Jews had been deeply influenced by the Greeks; they soon more or less forgot their Semitic mother-tongue, and with the language of Hellas they appropriated much of Hellenic culture. They were deeply impressed by that irresistible force which was blending all races and nations into one great cosmopolitan unity, and so the Jews too on their dispersion became in speech and nationality Greeks, or rather "Hellenists." Now the distinguishing character of Hellenism is not the absolute disappearance of the Oriental civilizations before that of Greece but the combination of the two with a preponderance of the Greek element. So it was with the Jews, but in their case the old religion had much more persistence than in other Hellenistic circles, though in other respects they too yielded to the superior force of Greek civilization. This we must hold to have been the case not only in Alexandria but throughout the diaspora from the commencement of the Hellenistic period down to the later Roman Empire. It was only after ancient civilization gave way before the barbarian immigrations and the rising force of Christianity that rabbinism became supreme even among the Jews of the diaspora. This Hellenistico-Judaic phase of culture is sometimes called "Alexandrian," and the expression is justifiable if it only means that in Alexandria it attained its highest development and flourished most. For here the Jews began to busy themselves with Greek literature even under their clement rulers, the first Ptolemies, and here the law and other Scriptures were first translated into Greek; here the process of fusion began earliest and proceeded with greatest rapidity; here, therefore, also the Jews first engaged in a scientific study of Greek philosophy and transplanted that philosophy to the soil of Judaism. We read of a Jewish philosopher Aristobulus in the time of Ptolemy VI. Philometor, in the middle of the 2nd century B.C., of whose philosophical commentary on the Pentateuch fragments have been preserved by Clement of Alexandria and Eusebius. So far as we can judge from these, his aim was to put upon the sacred text a sense which should appeal even to Greek readers, and in particular to get rid of all anthropomorphic utterances about God. Eusebius regards him as a Peripatetic. We may suppose that this philosophical line of thought had its representatives in Alexandria between the times of Aristobulus and Philo, but we are not acquainted with the names of any such. Philo certainly, to judge by his historical influence, was the greatest of all these Jewish philosophers, and in his case we can follow in detail the methods by which Greek culture was harmonized with Jewish faith. On one side he is quite a Greek, on the other quite a Jew. His language is formed on the best classical models, especially Plato. He knows and often cites the great Greek poets, particularly Homer and the tragedians, but his chief studies had been in Greek philosophy, and he speaks of Heraclitus, Plato, the Stoics and the Pythagoreans in terms of the highest veneration. He had appropriated their doctrines so completely that he must himself be reckoned among the Greek philosophers; his system was eclectic, but the borrowed elements are combined into a new unity with so much originality that at the same time he may fairly be regarded as representing a philosophy of his own, which has for its characteristic feature the constant prominence of a fundamental religious idea. Philo's closest affinities are with Plato, the later Pythagoreans and the Stoics.[2] Yet with all this Philo remained a Jew, and a great part of his writings is expressly directed to recommend Judaism to the respect and, if possible, the acceptance of the Greeks. He was not a stranger to the specifically Jewish culture that prevailed in Palestine; in Hebrew he was not proficient, but the numerous etymologies he gives show that he had made some study of that language.[3] His method of exegesis is in point of form identical with that of the Palestinian scribes, and in point of matter coincidences are not absolutely rare.[4] But above all his whole works prove on every page that he felt himself to be thoroughly a Jew, and desired to be nothing else. Jewish "philosophy" is to him the true and highest wisdom; the knowledge of God and of things divine and human which is contained in the Mosaic Scriptures is to him the deepest and the purest.

If now we ask wherein Philo's Judaism consisted we must answer that it lies mainly in the formal claim that the Jewish people, in virtue of the divine revelation given to Moses, possesses the true knowledge in things religious. Thoroughly Jewish is his recognition that the Mosaic Scriptures of the Pentateuch are of absolute divine authority, and that everything they contain is valuable and significant because divinely revealed. The other Jewish Scriptures are also recognized as prophetic, *i.e.* as the writings of inspired men, but he does not place them on the same lines with the law, and he quotes them so seldom that we cannot determine the compass of his canon. The decisive and normative authority is to him the "holy laws" of Moses, and this not only in the sense that everything they contain is true but that all truth is contained in them. Everything that is right and good in the doctrines of the Greek philosophers had already been quite as well, or even better, taught by Moses. Thus, since Philo had been deeply influenced by the teachings of Greek philosophy he actually finds in the Pentateuch everything which he had learned from the Greeks. From these premises he assumes as requiring no proof that the Greek philosophers must in some way have drawn from Moses, a view indeed which is already expressed by Aristobulus. To carry out these presuppositions called for an exegetical method which seems very strange to us, that, namely, of the allegorical interpretation of Scripture. The allegorical method had been practised before Philo's date in the rabbinical schools of Palestine, and he himself expressly refers to its use by his predecessors, nor does he feel that any further justification is requisite. With its aid he discovers indications of the profoundest doctrines of philosophy in the simplest stories of the Pentateuch.[1]

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[1] Euseb., *H. E.* ii. 17, 1; Jer. *ut supra*; Phot. *Bibl.* Cod. 105; Suïd., *s.v.* "Φίλων."

[2] The fathers of the Church have specially noticed his Platonism and Pythagoreanism; an old proverb even says, with some exaggeration, ἢ Πλάτων φιλωνίζει ἢ Φίλων πλατωνίζει (Jerome, Photius and Suïdas, *ut supra*). Clement of Alexandria directly calls him a Pythagorean. Eusebius (*H. E.* ii. 4, 3) observes both tendencies. Recent writers, especially Zeller, lay weight also on his Stoic affinities, and with justice, for the elements which he borrows from Stoicism are as numerous and important as those derived from the other two schools.

[3] See the list of these in Vallarsi's edition of Jerome (iii. 731–734), and compare Siegfried, "Philonische Studien," in *Merx's Archiv.* ii. 143–163 (1872).

[4] See Siegfried, *Philo*, pp. 142–159.

This merely formal principle of the absolute authority of Moses is really the one point in which Philo still holds to genuinely Jewish conceptions. In the whole substance of his philosophy the Jewish point of view is more or less completely modified—sometimes almost extinguished—by what he has learned from the Greeks. Comparatively speaking, he is most truly a Jew in his conception of God. The doctrine of monotheism, the stress laid on the absolute majesty and sovereignty of God above the world, the principle that He is to be worshipped without images, are all points in which Philo justly feels his superiority as a Jew over popular heathenism. But only over popular heathenism, for the Greek philosophers had long since arrived at least at a theoretical monotheism, and their influence on Philo is nowhere more strongly seen than in the detailed development of his doctrine of God. The specifically Jewish (*i.e.* particularistic) conception of the election of Israel, the obligation of the Mosaic law, the future glory of the chosen nation, have almost disappeared; he is really a cosmopolitan and praises the Mosaic law just because he deems it cosmopolitan. The true sage who follows the law of Moses is the citizen not of a particular state but of the world. A certain attachment which Philo still manifests to the particularistic conceptions of his race is meant only "in majorem Judaeorum gloriam." The Jewish people has received a certain preference from God, but only because it has the most virtuous ancestry and is itself distinguished for virtue. The Mosaic law is binding, but only because it is the most righteous, humane and rational of laws, and even its outward ceremonies always disclose rational ideas and aims. And lastly, outward prosperity is promised to the pious, even on earth, but the promise belongs to all who turn from idols to the true God. Thus, in the whole substance of his view of the universe, Philo occupies the standpoint of Greek philosophy rather than of national Judaism, and his philosophy of the world and of life can be completely set forth without any reference to conceptions specifically Jewish.

His doctrine of God starts from the idea that God is a Being absolutely bare of quality. All quality in finite beings has limitation, and no limitation can be predicated of God, who is eternal, unchangeable, simple substance, free, self-sufficient, better than the good and the beautiful. To predicate any quality (ποιότης) of God would be to reduce Him to the sphere of finite existence. Of Him we can say only *that* He is, not *what* He is, and such purely negative predications as to His being appear to Philo, as to the later Pythagoreans and the Neoplatonists, the only way of securing His absolute elevation above the world. At bottom, no doubt, the meaning of these negations is that God is the most perfect being; and so, conversely, we are told that God contains all perfection, that He fills and encompasses all things with His being.

A consistent application of Philo's abstract conception of God would exclude the possibility of any active relation of God to the world, and therefore of religion, for a Being absolutely without quality and movement cannot be conceived as actively concerned with the multiplicity of individual things. And so in fact Philo does teach that the absolute perfection, purity and loftiness of God would be violated by direct contact with imperfect, impure and finite things. But the possibility of a connexion between God and the world is reached through a distinction which forms the most important point in his theology and cosmology; the proper Being of God is distinguished from the infinite multiplicity of divine Ideas or Forces: God himself is without quality, but He disposes of an infinite variety of divine Forces, through whose mediation an active relation of God to the world is brought about. In the details of his teaching as to these mediating entities Philo is guided partly by Plato and partly by the Stoics, but at the same time he makes use of the concrete religious conceptions of heathenism and Judaism. Following Plato, he first calls them Ideas or ideal patterns of all things; they are thoughts of God, yet possess a real existence, and were produced before the creation of the sensible world, of which they are the types. But, in distinction from Plato, Philo's ideas are at the same time efficient causes or Forces (δυνάμεις), which bring unformed matter into order conformably to the patterns within themselves, and are in fact the media of all God's activity in the world. This modification of the Platonic Ideas is due to Stoic influence, which appears also when Philo gives to the ἰδέαι or δυνάμεις the name of λόγοι, *i.e.* operative ideas—parts, as it were, of the operative Reason. For, when Philo calls his mediating entities λόγοι, the sense designed is analogous to that of the Stoics when they call God the Logos, *i.e.* the Reason which operates in the world. But at the same time Philo maintains that the divine Forces are identical with the "daemons" of the Greeks, and the "angels" of the Jews, *i.e.* servants and messengers of God by means of which He communicates with the finite world. All this shows how uncertain was Philo's conception of the nature of these mediating Forces. On the one hand they are nothing else than Ideas of individual things conceived in the mind of God, and as such ought to have no other reality than that of immanent existence in God, and so Philo says expressly that the totality of Ideas, the κόσμος νοητός, is simply the Reason of God as Creator (θεοῦ λόγος ἤδη κοσμοποιοῦντος). Yet, on the other hand, they are represented as hypostases distinct from God, individual entities existing independently and apart from Him. This vacillation, however, as Zeller and other recent writers have justly remarked, is necessarily involved in Philo's premises, for, on the one hand, it is God who works in the world through His Ideas, and therefore they must be identical with God; but, on the other hand, God is not to come into direct contact with the world, and therefore the Forces through which He works must be distinct from Him. The same inevitable amphiboly dominates in what is taught as to the supreme Idea or Logos. Philo regards all individual Ideas as comprehended in one highest and most general Idea or Force—the unity of the individual Ideas—which he calls the Logos or Reason of God, and which is again regarded as operative Reason. The Logos, therefore, is the highest mediator between God and the world, the firstborn son of God, the archangel who is the vehicle of all revelation, and the high priest who stands before God on behalf of the world. Through him the world was created, and so he is identified with the creative Word of God in Genesis (the Greek λόγος meaning both "reason" and "word"). Here again, we see, the philosopher is unable to escape from the difficulty that the Logos is at once the immanent Reason of God, and yet also an hypostasis standing between God and the world. The whole doctrine of this mediatorial hypostasis is a strange intertwining of very dissimilar threads; on one side the way was prepared for it by the older Jewish distinction between the Wisdom of God and God Himself, of which we find the beginnings even in the Old Testament (Job xxviii. 12 seq.; Prov. viii., ix.), and the fuller development in the books of Ecclesiasticus and Wisdom, the latter of which comes very near to Philo's ideas if we substitute for the term "wisdom" that of (divine) "Reason." In Greek philosophy, again, Philo, as we have seen, chiefly follows the Platonic doctrines of Ideas and the Soul of the World, and the Stoic doctrine of God as the λόγος or Reason operative in the world. In its Stoic form the latter doctrine was pantheistic, but Philo could adapt it to his purpose simply by drawing a sharper distinction between the Logos and the world.

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[1] For details, see Gfrörer, *Philo*, i. 68 seq.; Zeller, *Phil. der Gr.* (3rd ed., vol. iii., pt. ii., pp. 346–352); Siegfried, *Philo*, pp. 160 seq.

Like his doctrine of God, Philo's doctrine of the world and creation rests on the presupposition of an absolute metaphysical contrast between God and the world. The world can be ascribed to God only in so far as it is a cosmos or orderly world; its material substratum is not even indirectly referable to God. Matter (ὕλη, or, as the Stoics said, οὐσία) is a second principle, but in itself an empty one, its essence being a mere negation of all true being. It is a lifeless, unmoved, shapeless mass, out of which God formed the actual world by means of the Logos and divine Forces. Strictly speaking, the world is only formed, not created, since matter did not originate with God.

Philo's doctrine of man is also strictly dualistic, and is mainly derived from Plato. Man is a twofold being, with a higher and a lower origin. Of the pure souls which fill airy space, those nearest the earth are attracted by the sensible and descend into sensible bodies; these souls are the Godward side of man. But on his other side man is a creature of sense, and so has in him a fountain of sin and all evil. The body, therefore, is a prison, a coffin, or a grave for the soul which seeks to rise again to God. From this anthropology the principles of Philo's ethics are derived, its highest maxim necessarily being deliverance from the world of sense and the mortification of all the impulses of sense. In carrying out this thought, as in many other details of his ethical teaching, Philo closely follows the Stoics. But he is separated from Stoical ethics by his strong religious interests, which carry him to very different views of the means and aim of ethical development. The Stoics cast man upon his own resources; Philo points him to the assistance of God, without whom man, a captive to sense, could never raise himself to walk in the ways of true wisdom and virtue. And as moral effort can bear fruit only with God's help, so too God Himself is the goal of that effort. Even in this life the truly wise and virtuous is lifted above his sensible existence, and enjoys in ecstasy the vision of God, his own consciousness sinking and disappearing in the divine light. Beyond this ecstasy there lies but one further step, viz. entire liberation from the body of sense and the return of the soul to its original condition; it came from God and must rise to Him again. But natural death brings this consummation only to those who, while they lived on earth, kept themselves free from attachment to the things of sense; all others must at death pass into another body; transmigration of souls is in fact the necessary consequence of Philo's premises, though he seldom speaks of it expressly.

Philo's literary labours have a twofold object, being directed either to expound the true sense of the Mosaic law, *i.e.* the philosophy which we have just described, to his Jewish brethren, or to convince heathen readers of the excellence, the supreme purity and truth, of the Jewish religion, whose holy records contain the deepest and most perfect philosophy, the best and most humane legislation. Thus as a literary figure Philo, in conformity with his education and views of life, stands between the Greeks and the Jews, seeking to gain the Jews for Hellenism and the Greeks for Judaism, yet always taking it for granted that his standpoint really *is* Jewish, and just on that account truly philosophical and cosmopolitan.

The titles of the numerous extant writings of Philo present at first sight a most confusing multiplicity. More than three-fourths of them, however, are really mere sections of a small number of larger works. Three such great works on the Pentateuch can be distinguished.

I. The smallest of these is the Ζητήματα καὶ λύσεις (*Quaestiones et solutiones*), a short exposition of Genesis and Exodus, in the form of question and answer. The work is cited under this title by Eusebius (*H. E.* ii. 18, 1, 5; *Praep. Ev.* vii. 13), and by later writers, but the Greek text is now almost wholly lost, and only about one-half preserved in an Armenian translation. Genesis seems to have occupied six books.[1] Eusebius tells us that Exodus filled five books. In the Armenian translation, first published by the learned Mechitarist, J. Bapt. Aucher, in 1826, are preserved four books on Genesis and two on Exodus, but with lacunae. A Latin fragment, about half of the fourth books on Genesis (*Phil. Jud. CII. quaestt. ... super Gen.*), was first printed at Paris in 1520. Of the Greek we have numerous but short fragments in various Florilegia.[2] The interpretations in this work are partly literal and partly allegorical.

II. Philo's most important work is the Νόμων ἱερῶν ἀλληγορίαι (Euseb. *H. E.* ii. 18, 1; Phot. *Bibl.* Cod. 103), a vast and copious allegorical commentary on Genesis, dealing with chaps. ii.–iv., verse by verse, and with select passages in the later chapters. The readers in view are mainly Jews, for the form is modelled on the rabbinic Midrash. The main idea is that the characters which appear in Genesis are properly allegories of states of the soul (τρόποι τῆς ψυχῆς). All persons and actions being interpreted in this sense, the work as a whole is a very extensive body of psychology and ethics. It begins with Gen. ii. 1, for the *De mundi opificio*, which treats of the creation according to Gen. i., ii., does not belong to this series of allegorical commentaries, but deals with the actual history of creation, and that under a quite different literary form. With this exception, however, the Νόμων ἀλληγορίαι includes all the treatises in the first volume of Mangey's edition, viz.—Νόμων ἱερῶν ἀλληγορίαι πρῶται τῶν μετὰ τὴν ἑξαήμερον (*Legum allegoriarum*, lib. i., M. i. 43–65), on Gen. ii. 1–17. (2) Νόμ. ἱερ. ἀλλ. δεύτεραι (*Leg. all.* lib. ii., M. i. 66–86), on Gen. ii. 18–iii. 1a. (3) Νόμ. ἱερ. ἀλλ. τρίται (*Leg. all.* lib. iii., M. i. 87–137), on Gen. iii. 8b–19. The commentaries on Gen. iii. 1b–8a, 20–23 are lost. (4) Περὶ τῶν χερουβὶμ καὶ τῆς φλογίνης ῥομφαίας καὶ τοῦ κτισθέντος πρώτου ἐξ ἀνθρώπου Κάϊν (*De cherubim et flammeo gladio*, M. i. 138–162), on Gen. iii. 24 and iv. 1. (5) Περὶ ὧν ἱερουργοῦσιν Ἄβελ τε καὶ Κάϊν (*De sacrificiis Abelis et Caini*, M. i. 163–190), on Gen. iv. 2–4. The commentaries on Gen. iv. 5–7 are lost. (6) Περὶ τοῦ τὸ χεῖρον τῷ κρείττονι φιλεῖν ἐπιτίθεσθαι (*Quod deterius potiori insidiari soleat*, M. i. 191–225), on Gen. iv. 8–15. (7) Περὶ τῶν τοῦ δοκησισόφου Κάϊν ἐγγόνων καὶ ὡς μετανάστης γίνεται (*De posteritate Caini*, &c., M. i. 226–261), on Gen. iv. 16–25; this book, which is wanting in editions prior to Mangey's, is incorrectly given by him, but much more correctly by Tischendorf, *Philonea*, pp. 84–143. None of the preceding is mentioned by its special title by Euseb. *H.E.* ii. 18, while he cites all that follow by their titles. The reason must be that all up to this point, and no further, are included by him in the Νόμων ἱερῶν ἀλληγορίαι; agreeing with this we find that these, and these only, are cited under that general title in the Florilegia, especially the so-called *Johannes Monachus ineditus* (see Mangey's notes before each book). We may therefore conclude with confidence that Philo published the continuous commentaries on Gen. ii.–iv. under the title *Allegories of the Sacred Laws*, and the following commentaries on select passages under special titles, though the identity of literary character entitles us to regard the latter as part of the same great literary plan with the former. (8) Περὶ γιγάντων (*De gigantibus*, M. i. 262–272), on Gen. vi. 1–4. (9) Ὅτι ἄτρεπτον τὸ θεῖον (*Quod Deus sit immutabilis*, M. i. 272–299), on Gen. vi. 4–12. (10) Περὶ γεωργίας (*De agricultura*, M. i. 300–328), on Gen. ix. 20a. (11) Περὶ φυτουργίας Νῶε τὸ δεύτερον (*De plantatione Noe*, M. i. 329–356), on Gen. ix. 20b. (12) Περὶ μέθης (*De ebrietate*, M. i. 357–391), on Gen. ix. 21; the introduction shows that this book was preceded by another which put together the views of the philosophers about drunkenness. (13) Περὶ τοῦ ἐξένηψε Νῶε (*De sobrietate*, M. i. 392–403), on Gen. ix. 24. (14) Περὶ συγχύσεως διαλέκτων (*De confusione linguarum*, M. i. 404–435), on Gen. xi. 1–9. (15) Περὶ ἀποικίας (*De migratione Abrahami*, M. i. 436–472), on Gen. xii. 1–6. (16) Περὶ τοῦ τίς ὁ τῶν θείων πραγμάτων κληρονόμος (*Quis rerum divinarum haeres sit*, M. i. 473–518), on Gen. xv. 1–18. (17) Περὶ τῆς εἰς τὰ προπαιδεύματα συνόδου (*De congressu quaerendae eruditionis causa*, M. i. 519–545), on Gen. xvi. 1–6. (18) Περὶ φυγάδων (*De profugis*, M. i. 546–577), on Gen. xvi. 6–14. (19) Περὶ τῶν μετονομαζομένων καὶ ὧν ἕνεκα μετονομάζονται (*De mutatione nominum*, M. i. 578–619), on Gen. xvii. 1–22; in this work Philo mentions that he had written two books, now wholly lost, Περὶ διαθηκῶν (M. i. 586). (20) Περὶ τοῦ θεοπέμπτους εἶναι τοὺς ὀνείρους (*De somniis*, lib. i., M. i. 620–658), on the two dreams of Jacob, Gen. xxviii. and xxxi. (21) Book ii. of the same (M. i. 659–699), on the dreams of Joseph, the chief butler, the chief baker, and Pharaoh, Gen. xxxvii. and xl., xli. Eusebius makes Philo the author of five books on dreams; three, therefore, are lost.

III. A work of a very different kind is the group of writings which we may call "An Exposition of the Mosaic law for Gentiles," which, in spite of their very various contents, present on nearer examination indubitable marks of close connexion. In them Philo seeks to give an orderly view of the chief points of the Mosaic legislation in the Pentateuch, and to recommend it as valuable to Gentile readers. The method of exposition is somewhat more popular than in the allegorical commentaries, for, though that method of interpretation is not wholly excluded, the main object is to give such a view of the legislation as Philo accepted as historical. This work has three main divisions: (*a*) an Account of the creation (κοσμοποιΐα) which Moses put first to show that his legislation was conformed to the will of nature, and that therefore those who followed it were true cosmopolitans; (*b*) the Biographies of the Virtuous—being, so to speak, the living unwritten laws which, unlike written laws, present the general types of moral conduct; (*c*) Legislation Proper, in two subdivisions—(*a*) the ten principal chapters of the law, (*β*) the special laws belonging to each of these ten. An appendix adds a view of such laws as do not fall under the rubrics of the decalogue, arranged under the headings of certain cardinal virtues.

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[1] See, especially Mai, *Scriptt. vett. nov. coll.* vol. vii. pt. i. pp. 100, 106, 108.

[2] See *Opp.*, ed. Mangey, ii. 648–680; Mai, *op. cit.*, vol. vii. pt. i. 96 seq.; Euseb. *Praep. Ev.* vii. 13. A fragment on the cherubim, Exod. xxv. 18, has been published by Mai, *Class. Auctt.* iv. 430 seq., by Grossmann (1856) and by Tischendorf (p. 144 seq.).

The treatises which belong to this work are the following: (1) Περὶ τῆς Μωϋσέως κοσμοποιΐας (*De mundi opificio*, M. i. 1–42). This work does not fall within the number of the allegorical commentaries. On the other hand, the introduction to the treatise *De Abrahamo* makes clear its immediate connexion with the *De mundi opificio*. The position of the *De mundi opificio* at the head of the allegorical commentaries, which is at present usual in the editions, seems indeed to go back to a very early date, for even Eusebius cites a passage from it with the formula ἀπὸ τοῦ πρώτου τῶν εἰς τὸν νόμον (*Praep. Ev.* viii. 12 fin., ed. Gaisford). The group of the Βίοι σοφῶν is headed by (2) Βίος σοφοῦ τοῦ κατὰ διδασκαλίαν τελειωθέντος ἢ περὶ νόμων ἀγράφων [ά], ὅ ἐστι περὶ Ἀβραάμ (*De Abrahamo*, M. ii. 1–40). Abraham is here set forth as the type of διδασκαλικὴ ἀρετή, *i.e.* of virtue as a thing learned. This biography of Abraham was followed by that of Isaac as a type of φυσικὴ ἀρετή, *i.e.* of innate or natural virtue, which in turn was succeeded by that of Jacob as representing ἀσκητικὴ ἀρετή, *i.e.* virtue acquired by practice; but both these are now lost. Hence in the editions the next treatise is (3) Βίος πολιτικὸς ὅπερ ἐστὶ περὶ Ἰωσήφ (*De Josepho*, M. ii. 41–79), where Joseph is taken as the pattern of the wise man in his civil relations. The Biographies of the Virtuous are followed by (4) Περὶ τῶν δέκα λογίων ἃ κεφάλαια νόμων εἰσί (*De decalogo*, M. ii. 180–209) and (5) Περὶ τῶν ἀναφερομένων ἐν εἴδει νόμων εἰς τὰ συντείνοντα κεφάλαια τῶν δέκα λόγων (*De specialibus legibus*; the unabridged title is given by Eusebius, *H.E.* ii. 18, 5). Here under the rubrics of the ten commandments a systematic review of the special laws of the Mosaic economy is given; for example, under the first and second commandments (divine worship) a survey is taken of the entire legislation relating to priesthood and sacrifice; under the fourth (*i.e.* the Sabbath law, according to Philo's reckoning) there is a survey of all the laws about feasts; under the sixth (adultery) an account of matrimonial law; and so on. According to Eusebius the work embraced four books, which seem to have reached us entire, but in the editions have been perversely broken up into a considerable number of separate tractates. (*a*) The first book (on the first and second commandments) includes the following: *De circumcisione* (M. ii. 210–212); *De monarchia*, lib. i. (ii. 213–222); *De monarchia*, lib. ii. (ii. 222–232); *De praemiis sacerdotum* (ii. 232–237); *De victimis* (ii. 237–250); *De sacrificantibus*, or *De victimas offerentibus* (ii. 251–264); *De mercede meretricis non accipienda in sacrarium* (ii. 264–269). (*b*) The second book (on the third, fourth and fifth commandments, *i.e.* on perjury, Sabbath observance, and filial piety) is incomplete in Mangey (ii. 270–298), the section *De septenario* (on the Sabbath and feasts in general) being imperfect, and that *De colendis parentibus* being entirely wanting. Mai to a large extent made good the defect (*De cophini festo et de colendis parentibus*, Milan, 1818), but Tischendorf was the first to edit the full text (*Philonea*, pp. 1–83). (*c*) The third book relates to the sixth and seventh commandments (adultery and murder; M. ii. 299–334). (*d*) To the fourth book (relating to the last three commandments) belongs all that is found in Mangey, ii. 335–374, that is to say, not merely the tractates *De judice* (ii. 344–348) and *De concupiscentia* (ii. 348–358), but also those *De justitia* (ii. 358–361) and *De creatione principum* (ii. 361–374). The last-named is, properly speaking, only a portion of the *De justitia*, which, however, certainly belongs to the fourth book, of which the superscription expressly bears that it treats also περὶ δικαιοσύνης. With this tractate begins the appendix to the work *De specialibus legibus*, into which, under the rubric of certain cardinal virtues, such Mosaic laws are brought together as could not be dealt with under any of the decalogue rubrics. The continuation of this appendix forms a book by itself. (6) Περὶ τριῶν ἀρετῶν ἤτοι περὶ ἀνδρείας καὶ φιλανθρωπίας καὶ μετανοίας (*De fortitudine*, M. ii. 375–383; *De caritate*, ii. 383–405; *De poenitentia*, ii. 405–407). Finally, in less intimate connexion with this entire work is another treatise still to be mentioned, (7) Περὶ ἄθλων καὶ ἐπιτιμίων (*De praemiis et poenis*, M. ii. 408–428) and Περὶ ἀρῶν (*De execrationibus*, M. ii. 429–457), two parts which constitute a single whole and deal with the promises and threatenings of the law.

IV. Besides the above-named three great works on the Pentateuch, Philo was the author of a number of isolated writings, of which the following have reached us either in their entirety or in fragments. (1) Περὶ βίου Μωσέως (*Vita Mosis*, lib. i.–iii., M. ii. 80–179). It is usual to group this, as being biographical in its character, with the Βίοι σοφῶν, and thus to incorporate it immediately after the *De Josepho* with the large work on the Mosaic legislation. But, as has been seen, the Βίοι σοφῶν are intended to represent the general types of morality, while Moses is by no means so dealt with, but as a unique individual. All that can be said is that the literary character of the *Vita Mosis* is the same as that of the larger work. As in the latter the Mosaic legislation, so in the former the activity of the legislator himself, is delineated for the benefit of Gentile readers. (2) Περὶ τοῦ πάντα σπουδαῖον εἶναι ἐλεύθερον (*Quod omnis probus liber*, M. ii. 445–470). In the introduction to this treatise reference is made to an earlier book which had for its theme the converse proposition. The complete work was still extant in the time of Eusebius (*H. E.* ii. 18, 6): Περὶ τοῦ δοῦλον εἶναι πάντα φαῦλον, ᾧ ἑξῆς ἐστιν ὁ περὶ τοῦ πάντα σπουδαῖον ἐλεύθερον εἶναι. The genuineness of the writing now possessed by us is not undisputed: but see Lucius, *Der Essenismus* (1881), pp. 13–23. (3) Εἰς Φλάκκον (*Adversus Flaccum*, M. ii. 517–544) and (4) Περὶ ἀρετῶν καὶ πρεσβείας πρὸς Γάϊον (*De legatione ad Gaium*, M. ii. 545–600). These two works have a very intimate connexion. In the first Philo relates how the Roman governor Flaccus in Alexandria, towards the beginning of the reign of Caligula, allowed the Alexandrian mob, without interference, to insult the Jews of that city in the grossest manner, and even to persecute them to the shedding of blood. In the second he tells how the Jews had been subjected to still greater sufferings through the command of Caligula that divine honours should be everywhere accorded to him, and how the Jews of Alexandria in vain sought relief by a mission to Rome which was headed by Philo. But both together were only parts of a larger work, in five books, of which the first two and the last have perished. For it is clear from the introduction to the *Adversus Flaccum* that it had been preceded by another book in which the Jewish persecutions by Sejanus, under the reign of Tiberius, were spoken of, and the *Chronicon* of Eusebius (ed. Schoene, ii. 150, 151) informs us that these persecutions of Sejanus were related in the second book of the work now under discussion. But from the conclusion of the *Legatio ad Gaium*, which we still possess, we learn that it was also followed by another book which exhibited the παλινῳδία, or change of Jewish fortunes for the better. Thus we make out five books in all—the number actually given by Eusebius (*H.E.* ii. 5, 1). (5) Περὶ προνοίας (*De providentia*). This work has reached us only in an Armenian translation, which has been edited, with a Latin translation, by Aucher (see below), 1822. It is mentioned by its Greek title in Eusebius (*H.E.* ii. 18, 6; *Praep. Ev.* vii. 20 fin., viii. 13 fin., ed. Gaisford). The Armenian text gives two books, but of these the first, if genuine at all, at any rate appears only in an abridged and somewhat revised state.[1] Eusebius (*Praep. Ev.* viii. 14) quotes from the second book to an extent that amounts to a series of excerpts from the whole. The short passage in *Praep. Ev.* vii. 21, is also taken from this book; and it appears that Eusebius knew nothing at all about the first. (6) Ἀλέξανδρος ἢ περὶ τοῦ λόγον ἔχειν τὰ ἄλογα ζῷα (*De Alexandro et quod propriam rationem muta animalia habeant*; so Jerome, *De Vir. Ill.* c. 11); the Greek title is given in Euseb. *H.E.* ii. 18, 6. This also now exists only in an Armenian translation, which has been edited by Aucher. Two small Greek fragments occur in the *Florilegium* of Leontius and Johannes (Mai, *Scr. vet. nov. coll.* vii. 1, pp. 99, 100a). (7) Ὑποθετικά, a writing now known to us only through fragments preserved in Euseb. *Praep. Ev.* viii. 6, 7. The title, as Bernays[2] has shown, means "Counsels," "Recommendations," the reference being to such laws of the Jews as can be recommended also to non-Jewish readers. (8) Περὶ Ἰουδαίων, a title met with in Euseb. *H.E.* ii. 18, 6. The writing is no doubt the same as Ἡ ὑπὲρ Ἰουδαίων ἀπολογία, from which a quotation is given in Euseb. *Praep. Ev.* viii. 11. To this place also, perhaps, belongs the *De nobilitate* (M. ii. 437–444), which treats of that true noblesse of wisdom in which the Jewish people also is not wanting.[3]

V. *The doubtful treatises:* (1) Περὶ βίου θεωρητικοῦ ἢ ἱκετῶν ἀρετῶν (*De vita contemplativa*). This contains the sole original account of an ascetic community known as the Therapeutae (*q.v.*) having their home on the shores of Lake Mareotis. These were held by Eusebius and many other Christian writers to be the earliest Christian monks, which of course could not be the case if it was a genuine work of Philo. On this account, amongst others, it was held to be spurious by Graetz and P. E. Lucius; and this view gradually received the assent of most modern scholars. Latterly, however, L. Massebieau has shown with great thoroughness that in language and thought alike it is essentially Philonic, and the genuineness of the book has also been affirmed by P. Wendland, and especially by F. C. Conybeare. (2) Περὶ ἀφθαρσίας κόσμου (*De incorruptibilitate mundi*), declared unauthentic by Z. Frankel and J. Bernays, has been successfully defended by F. Cumont. (3) Περὶ κόσμου (*De mundo*). It is generally agreed that, in L. Cohn's words, this is "nothing but a compilation from various portions of the περὶ ἀφθαρσίας κόσμου and other Philonic works." (4) Two discourses, *De Sampsone* and *De Iona*, extant only in Armenian, and certain other writings of the same kind. These appear only to have been imputed to Philo by chance, and certainly cannot claim to be his work. (5) Περὶ τοῦ πάντα σπουδαῖον εἶναι ἐλεύθερον (*Quod omnis probus liber sit*) has been questioned by Z. Frankel and R. Ansfeld; but their arguments would rather point to its being an early work of Philo, which P. Wendland believes to be the case. (6) Περὶ προνοίας (*De providentia*), which we possess as a whole only in an Armenian version, consists of two books, the first of which appears to be in a Christian recension, but there is no reason for denying its Philonic origin.

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[1] See Diels, *Doxographi Graeci*, 1879, pp. 1-4; Zeller, *Phil. d. Gr.* iii. 2, p. 340 (3rd ed).

[2] *Monatsb. d. Berl. Akad.* (1876), pp. 589–609.

[3] This conjecture is Dähne's, *Theol. Stud. u. Krit.* (1833), pp. 990, 1037.

Editions.—Till recent days the best edition was that of Mangey (2 vols., London, 1742); the handiest the Holtze duodecimo (Leipzig, 1851). Both are still very useful, but for scholars they will be superseded by the enlarged and critical edition of Leopold Cohn and Paul Wendland (Berlin, 1896–1902). See also papers by Cohn in *Hermes*, xxxviii. (1903) and xliii. (1908). There is an English translation of the old text by C. D. Yonge (4 vols., London, 1854).

Literature.—The best special studies of Philo will be found in Siegfried, *Philo von Alex.* (Jena, 1875); Drummond, *Philo-Judaeus* (London, 1888). For his place in philosophy, see Zeller, *Phil. der Griechen* (1881). For his relation to Palestinian speculation, B. Ritter, *Philo und die Halacha* (Leipzig, 1879). An excellent general account will be found in Schürer, *The Jewish People in the time of Jesus Christ* (Eng. trans., 1891), or in Dr Edersheim's article on Philo in the *Dictionary of Christian Biography.* For the question of the genuineness and historical value of the *De vita contemplativa*, see L. Massebieau, in *Revue de l'histoire des religions*, vol. xvi. (Paris, 1887); F. C. Conybeare, *Philo: About the Contemplative Life* (Oxford, 1895); G. Fayot, *Études sur les thérapeutes* (Genève, 1880); P. E. Lucius, *Die Therapeuten* (Strassburg, 1880); P. Wendland, *Die Therapeuten* (Leipzig, 1896). Also F. Cumont, *Philo, de aet. mundi* (1891); J. Bernays in the *Abhand. der k. Akad. der Wiss.* (1876).
(E. S.*; C. Bi.)

PHILO OF BYZANTIUM, Greek writer on mechanics, flourished during the latter half of the 2nd century B.C. (according to some, a century earlier). He was the author of a large work Μηχανικὴ σύνταξις), of which the fourth and (in epitome) fifth books are extant, treating of missiles, the construction of fortresses, provisioning, attack and defence (ed. R. Schöne, 1893, with German translation in H. Köchly's *Griechische Kriegsschriftsteller*, vol. i. 1853; E. A. Rochas d'Aiglun, *Poliorcétique des Grecs*, 1872). Another portion of the work, on pneumatic engines, has been preserved in the form of a Latin translation (*De ingeniis spiritualibus*) made from an Arabic version (ed. W. Schmidt, with German translation, in the works of Heron of Alexandria, vol. i., in "Teubner Series," 1899; with French translation by Rochas, *La Science des philosophes . . . dans l'antiquité*, 1882).

A little treatise *On the Seven Wonders of the World*, wrongly attributed to Philo, probably belongs to the 6th century A.D. It is printed in R. Hercher's Aelian (1858).

PHILO OF LARISSA, Greek philosopher of the first half of the 1st century B.C. During the Mithradatic wars he left Athens and took up his residence in Rome. He was a pupil of Clitomachus, whom he succeeded as head of the Third or New Academy. According to Sextus Empiricus, he was the founder of the Fourth Academy, but other writers refuse to admit the separate existence of more than three academies (see Academy, Greek). In Rome he lectured on rhetoric and philosophy, and collected around him many eminent pupils, amongst whom Cicero was the most famous and the most enthusiastic. None of his works is extant; our knowledge of his views is derived from Numenius, Sextus Empiricus and Cicero. In general, his philosophy was a reaction against the sceptic or agnostic position of the Middle and New Academy in favour of the dogmatism of Plato.

See Grysar, *Die Akademiker Philo und Antiochus* (1849); Hermann, *De Philone Larissaeo* (Göttingen, 1851 and 1855).

PHILO, HERENNIUS, of Byblus, Greek grammarian, was born, according to Suïdas, in A.D. 42. He lived into the reign of Hadrian, of which he wrote a history, now lost. He was the author of various works: *On the Acquisition and Choice of Books*; *On Cities and their Famous Men*, epitomized by the grammarian Aelius Serenus, and one of the chief authorities used by Hesychius and Stephanus of Byzantium; *On Synonyms*, of which there is extant an epitome by Ammonius Grammaticus. But he is chiefly known for his translation of the Phoenician history of Sanchuniathon, who was said to have lived before the Trojan war. Of this work considerable fragments have been preserved, chiefly by Eusebius in the *Praeparatio evangelica* (i. 9, 10; iv. 16). They present a euhemeristic *réchauffé* of Phoenician theology and mythology, which is represented as translated from the original Phoenician. Sanchuniathon is probably an imaginary personage, whose name is formed from that of the Phoenician god Sanchon.

Editions of the fragments by J. C. Orelli (1826) and C. Müller, *Frag. hist. graec.* vol. iii. In 1836 F. Wagenfeld brought out what claimed to be a complete translation by Philo (from a MS. discovered in a convent in Portugal, now considered spurious). There are English translations by I. P. Cory (1828) and Bishop R. Cumberland (1720).

PHILOCHORUS, of Athens, Greek historian during the 3rd century B.C., was a member of a priestly family. He was a seer and interpreter of signs, and a man of considerable influence. He was strongly anti-Macedonian in politics, and a bitter opponent of Demetrius Poliorcetes. When Antigonus Gonatas, the son of the latter, besieged and captured Athens (261), Philochorus was put to death for having supported Ptolemy Philadelphus, who had encouraged the Athenians in their resistance to Macedonia. His investigations into the usages and customs of his native Attica were embodied in an *Atthis*, in seventeen books, a history of Athens from the earliest times to 262 B.C. Considerable fragments are preserved in the lexicographers, scholiasts, Athenaeus, and elsewhere. The work was epitomized by the author himself, and later by Asinius Pollio of Tralles (perhaps a freedman of the famous Gaius Asinius Pollio). Philochorus also wrote on oracles, divination and sacrifices; the mythology and religious observances of the tetrapolis of Attica; the myths of Sophocles; the lives of Euripides and Pythagoras; the foundation of Salamis. He compiled chronological lists of the archons and Olympiads, and made a collection of Attic inscriptions, the first of its kind in Greece.

Fragments and life in C. W. Müller, *Fragmenta historicorum graecorum*, vol. i. (1841); A. Böckh, *Gesammelte kleine Schriften*, vol. v. (1871), on the plan of the work; J. Strenge, *Quaestiones philochoreae* (Göttingen, 1868); C. Wachsmuth, *Einleitung in das Studium der alten Geschichte* (1895).

PHILOCTETES, in Greek legend, son of Poeas king of the Malians of Mt Oeta, one of the suitors of Helen and a celebrated hero of the Trojan War. Homer merely states that he was distinguished for his prowess with the bow; that he was bitten by a snake on the journey to Troy and left behind in the island of Lemnos; and that he subsequently returned home in safety. These brief allusions were elaborated by the "cyclic" poets, and the adventures of Philoctetes formed the subject of tragedies by Aeschylus, Sophocles and Euripides. In the later form of the story Philoctetes was the friend and armour-bearer of Heracles, who presented him with his bow and poisoned arrows as a reward for kindling the fire on Mt Oeta, on which the hero immolated himself. Philoctetes remained at Lemnos till the tenth year of the war. An oracle having declared that Troy could not be taken without the arrows of Heracles, Odysseus and Diomedes (or Neoptolemus) were sent to fetch Philoctetes. On his arrival before Troy he was healed of his wound by Machaon, and slew Paris; shortly afterwards the city was taken. On his return to his own country, finding that a revolt had broken out against him, he again took ship and sailed for Italy, where he founded Petilia and Cremissa. He fell fighting on the side of a band of Rhodian colonists against some later immigrants from Pallene in Achaea. His tomb and sanctuary were shown at Macalla, on the coast of Bruttium.

Of the Aeschylean and Euripidean tragedies only a few fragments remain; of the two by Sophocles, one is extant, the other, dealing with the fortunes of Philoctetes before Troy, is lost. Some light is thrown upon the lost plays by Dio Chrysostom, who in one of his discourses (52) describes his reading of the three tragedies, and in another (59) gives a prose version of the opening of the *Philoctetes* of Euripides. Philoctetes was also the subject of tragedies by Achaeus of Eretria, Euphorion of Chalcis and the Roman tragedian Accius. According to F. Marx (*Neue Jahrbücher für das klassische Altertum*, 1904, p. 673–685), Philoctetes did not appear in the original legend of Troy. He is a form of the Lemnian Hephaestus, who alighted on the island when flung out of Olympus by Zeus. Like him, he is lame and an outcast for nine years; like him, he is brought back in time of need. His connexion with the fall of Troy indicates that the fire-god himself set fire to the city; in like manner no other than the fire-god was thought worthy to kindle the pyre of Heracles.

See Homer, *Iliad*, ii. 718, *Odyssey*, iii. 190, viii. 219; Sophocles, *Philoctetes*, and Jebb's *Introduction*; Diod. Sic. iv. 38; Philostratus, *Heroica*, 6; Strabo vi. 254; Hyginus, *Fab.* 36, 102.

PHILODEMUS, Epicurean philosopher and poet, was born at Gadara in Coele-Syria early in the 1st century B.C., and settled in Rome in the time of Cicero. He was a friend of Calpurnius Piso, and was implicated in his profligacy by Cicero (*in Pisonem*, 29), who, however, praises him warmly for his philosophic views and for the *elegans lascivia* of his poems (cf. Horace, *Satires*, I. 2. 120). The Greek anthology contains thirty-four of his epigrams. From the excavations of the villa at Herculaneum (*q.v.*) there have been recovered thirty-six treatises attributed to Philodemus, and it has been suggested that the villa was actually owned by him; but this is generally denied. These works deal with music, rhetoric, ethics, signs, virtues and vices, and defend the Epicurean standpoint against the Stoics and the Peripatetics.

The *Rhetoric* has been edited by Sudhaus (1892–1895); the *De Ira* and the *De Pietate* by Gomperz (1864 to 1865); the *De Musica* by Kempke (1884); *De Vitiis* by Ussing (1868); *De Morte* by Mekler (1886). See *Hercul. Volum.* (Oxford, 1824 and 1861); Mayor on Cicero's *De Natura deorum* (1871).

PHILOLAUS (b. *c.* 480), Greek philosopher of the Pythagorean school, was born at Tarentum or at Crotona[1] (so Diog. Laërt. viii. 84). He was said to have been intimate with Democritus, and was probably one of his teachers. After the death of Pythagoras great dissensions prevailed in the cities of lower Italy. According to some accounts, Philolaus, obliged to flee, took refuge first in Lucania and then at Thebes, where he had as pupils Simmias and Cebes, who subsequently, being still young men (νεανίσκοι), were present at the death of Socrates. Before this Philolaus had returned to Italy, where he was the teacher of Archytas. He entered deeply into the distinctively Pythagorean number theory, particularly dwelling on the properties inherent in the decad—the sum of the first four numbers, consequently the fourth triangular number, the *tetractys* (see *Vit. Pythag.* ap. *Phot. Bibl.* p. 712)—which he called great, all-powerful, and all-producing. The great Pythagorean oath was taken by the sacred *tetractys*. The discovery of the regular solids is attributed to Pythagoras by Eudemus, and Empedocles is stated to have been the first who maintained that there are four elements. Philolaus, connecting these ideas, held that the elementary nature of bodies depends on their form, and assigned the tetrahedron to fire, the octahedron to air, the icosahedron to water, and the cube to earth; the dodecahedron he assigned to a fifth element, aether, or, as some think, to the universe (see Plut. *de Pl. Ph.* ii. 6, ἐκ δὲ τοῦ δωδεκαέδρου τὴν τοῦ παντὸς σφαῖραν and Stob. *Ecl. Phys.* i. 10, ὁ τᾶς σφαίρας ὁλκός). This theory, however superficial from the standpoint of observation, indicates considerable knowledge of geometry and gave a great impulse to the study of the science. Following Parmenides, Philolaus regarded the soul as a "mixture and harmony" of the bodily parts; he also assumed a substantial soul, whose existence in the body is an exile on account of sin.

Philolaus was the first to propound the doctrine of the motion of the earth; some attribute this doctrine to Pythagoras, but there is no evidence in support of their view. Philolaus supposed that the sphere of the fixed stars, the five planets, the sun, moon and earth, all moved round the central fire, which he called the hearth of the universe, the house of Zeus, and the mother of the gods (see Stob. *Ecl. Phys.* i. 488); but as these made up only nine revolving bodies he conceived, in accordance with his number theory, a tenth, which he called counter-earth, ἀντίχθων. He supposed the sun to be a disk of glass which reflects the light of the universe. He made the lunar month consist of $29\frac{1}{2}$ days, the lunar year of 354, and the solar year of $365\frac{1}{2}$ days. He was the first who published a book on the Pythagorean doctrines, a treatise of which Plato made use in the composition of his Timaeus. This work of the Pythagorean, to which the mystical name Βάκχαι is sometimes given, seems to have consisted of three books: (1) Περὶ κόσμου, containing a general account of the origin and arrangement of the universe; (2) Περὶ φύσεως, an exposition of the nature of numbers; (3) Περὶ ψυχῆς, on the nature of the soul.

See Boeckh, *Philolaus des Pythagoreers Lehren nebst den Bruchstücken seines Werkes* (Berlin, 1819); Schaarschmidt, *Die angebliche Schriftstellerei des Philolaus* (1864); also Fabricius, *Bibliotheca graeca*; Zeller, *History of Greek Philosophy*; Chaignet, *Pythagore et la philosophie pythagoricienne, contenant les fragments de Philolaus et d'Architas* (1873); Th. Gomperz, *Greek Thinkers* (Eng. trans. (1901), i. 123 sqq., 543 sqq. and authorities there quoted; also art. PYTHAGORAS. For fragments see Ritter and Preller, *Hist. Philosoph.* ch. ii.

PHILOLOGY, the generally accepted comprehensive name for the study of the word (Gr. λόγος), or languages; it designates that branch of knowledge which deals with human speech, and with all that speech discloses as to the nature and history of man. Philology has two principal divisions, corresponding to the two uses of "word" or "speech," as signifying either what is said or the language in which it is said, as either the thought expressed—which, when recorded, takes the form of literature—or the instrumentality of its expression: these divisions are the literary and the linguistic. Not all study of literature, indeed, is philological: as when, for example, the records of the ancient Chinese are ransacked for notices of astronomical or meteorological phenomena, or the principles of geometry are learned from the textbook of a Greek sage; while, on the other hand, to study Ptolemy and Euclid for the history of the sciences represented by them is philological more than scientific. Again, the study of language itself has its literary side: as when the vocabulary of a community (say of the ancient Indo-Europeans or Aryans) is taken as a document from which to infer the range and grade of knowledge of its speakers, their circumstances and their institutions. The two divisions thus do not admit of absolute distinction and separation, though for some time past tending toward greater independence. The literary is the older of the two; it even occupied until recently the whole field, since the scientific study of language itself has arisen only within the 19th century. Till then, literary philology included linguistic, as a merely subordinate and auxiliary part, the knowledge of a language being the necessary key to a knowledge of the literature written in that language. When, therefore, instead of studying each language by itself for the sake of its own literature men began to compare one language with another, in order to bring to light their relationships, their structures, their histories, the name "comparative philology" naturally enough suggested itself and came into use for the new method; and this name, awkward and trivial though it may be, has become so firmly fixed in English usage that it can be only slowly, if at all, displaced. European usage (especially German) tends more strongly than English to restrict the name philology to its older office, and to employ for the recent branch of knowledge a specific term, like those that have gained more or less currency with us also; as glottic, glossology, linguistics, linguistic science, science of language, and the like. It is not a question of absolute propriety or correctness, since the word philology is in its nature wide enough to imply all language-study of whatever kind; it is one, rather, of the convenient distinction of methods that have grown too independent and important to be any longer well included under a common name.

I.—*The Science of Language in general.*

Nature of the Science.

Philology, in all its departments, began and grew up as classical; the history of our civilization made the study of Greek and Latin long the exclusive, still longer the predominant and regulating, occupation of secular scholarship. The Hebrew and its literature were held apart, as something of a different order, as sacred. It was not imagined that any tongue to which culture and literature did not lend importance was worthy of serious attention from scholars. The first essays in comparison, likewise, were made upon the classical tongues, and were as erroneous in method and fertile in false conclusions as was to be expected, considering the narrowness of view and the controlling prejudices of those who made them; and the admission of Hebrew to the comparison only added to the confusion. The change which the past century has seen has been a part of the general scientific movement of the age, which has brought about the establishment of so many new branches of knowledge, both historical and physical, by the abandonment of shackling prejudices, the freedom of inquiry, the recognition of the dignity of all knowledge, the wide-reaching assemblage of facts and their objective comparison, and the resulting constant improvement of method. Literary philology has had its full share of advantage from this movement; but linguistic philology has been actually created by it out of the crude observations and wild deductions of earlier times, as truly as chemistry out of alchemy, or geology out of diluvianism. It is unnecessary here to follow out the details of the development; but we may well refer to the decisive influence of one discovery, the decisive action of one scholar. It was the discovery of the special relationship of the Aryan or Indo-European languages, depending in great measure upon the introduction of the Sanskrit as a term in their comparison, and demonstrated and worked out by the German scholar Bopp, that founded the science of linguistic philology. While there is abundant room for further improvement, it yet appears that the grand features of philologic study, in all its departments, are now so distinctly drawn that no revolution of its methods, but only their modification in minor respects, is henceforth probable. How and for what purposes to investigate the literature of any people (philology in the more proper sense), combining the knowledge thus obtained with that derived from other sources; how to study and set forth the material and structure and combinations of a language (grammar), or of a body of related languages (comparative grammar); how to co-ordinate and interpret the general phenomena of language, as variously illustrated in the infinitely varying facts of different tongues, so as to exhibit its nature as a factor in human history and its methods of life and growth (linguistic science)—these are what philology teaches.

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[1] Boeckh places his life between the 70th and 95th Olympiads (496–396 B.C.). He was a contemporary of Socrates and Democritus, but senior to them, and was probably somewhat junior to Empedocles, so that his birth may be placed at about 480.

Relation to Anthropology.

The study of language is a division of the general science of anthropology (*q.v.*), and is akin to all the rest in respect to its objects and its methods. Man as we now see him is a twofold being: in part the child of nature, as to his capacities and desires, his endowments of mind and body; in part the creature of education, by training in the knowledge, the arts, the social conduct, of which his predecessors have gained possession. And the problem of anthropology is this: how natural man has become cultivated man; how a being thus endowed by nature should have begun and carried on the processes of acquisition which have brought him to his present state. The results of his predecessors' labours are not transmuted for his benefit into natural instincts, in language or in anything else. The child of the most civilized race, if isolated and left wholly to his own resources, aided by neither the example nor the instruction of his fellows, would no more speak the speech of his ancestors than he would build their houses, fashion their clothes, practise any of their arts, inherit their knowledge or wealth. In fact, he would possess no language, no arts, no wealth, but would have to go to work to acquire them, by the same processes which began to win them for the first human beings. One advantage he would doubtless enjoy: the descendant of a cultivated race has an enhanced aptitude for the reception of cultivation; he is more cultivable; and this is an element that has to be allowed for in comparing present conditions with past, as influencing the rate of progress, but nothing more. In all other respects it is man with the endowments which we now find him possessed of, but destitute of the gradually accumulated results of the exercise of his faculties, whose progress we have to explain. And it is, as a matter of necessity, by studying recent observable modes of acquisition, and transferring them, with due allowance for different circumstances, to the more primitive periods, that the question of first acquisition or origin is to be solved, for language as for tools, for arts, for family and social organization, and the rest. There is just as much and just as little reason for assuming miraculous interference and aid in one of these departments as in another. If men have been left to themselves to make and improve instruments, to form and perfect modes of social organization, by implanted powers directed by natural desires, and under the pressure of circumstances, then also to make and change the signs that constitute their speech. All expressions, as all instruments, are at present, and have been through the known past, made and changed by the men who use them; the same will have been the case in the unknown or prehistoric past. And we command now enough of the history of language, with the processes of its life and growth, to determine with confidence its mode of origin—within certain limits, as will appear below.

Cause of Language-making.

It is beyond all question, in the first place, that the desire of communication was the only force directly impelling men to the production of language. Man's sociality, his disposition to band together with his fellows, for lower and for higher purposes, for mutual help and for sympathy, is one of his most fundamental characteristics. To understand those about one and to be understood by them is now, and must have been from the very beginning, a prime necessity of human existence; we cannot conceive of man, even in his most undeveloped state, as without the recognition of it. Communication is still the universally recognized office of speech, and to the immense majority of speakers the only one; the common man knows no other, and can only with difficulty and imperfectly be brought to see that there is any other; of the added distinctness and reach of mental action which the possession of such an instrumentality gives him he is wholly unconscious: and it is obvious that what the comparatively cultivated being of to-day can hardly be made to realize can never have acted upon the first men as a motive to action. It may perhaps be made a question which of the two uses of speech, communication or the facilitation of thought is the higher; there can be no question, at any rate, that the former is the broader and the more fundamental. That the kind and degree of thinking which we do nowadays would be impossible without language-signs is true enough; but so also it would be impossible without written signs. That there was a time when men had to do what mental work they could without the help of writing, as an art not yet devised, we have no difficulty in realizing, because the art is of comparatively recent device, and there are still communities enough that are working without it; it is much harder to realize that there was a time when speaking also was an art not yet attained, and that men had to carry on their rude and rudimentary thinking without it. Writing too was devised for conscious purposes of communication only; its esoteric uses, like those of speech, were at first unsuspected, and incapable of acting as an inducement; they were not noticed until made experience of, and then only by those who look beneath the surface of things. There is no analogy closer and more instructive than this between speech and writing. But analogies are abundant elsewhere in the history of human development. Everywhere it is the lower and more obvious inducements that are first effective, and that lead gradually to the possession of what serves and stimulates higher wants. All the arts and industries have grown out of men's effort to get enough to eat and protection against cold and heat—just as language, with all its uses, out of men's effort to communicate with their fellows. As a solitary man now would never form even the beginnings of speech, as one separated from society unlearns his speech by disuse and becomes virtually dumb, so early man, with all his powers, would never have acquired speech, save as to those powers was added sociality with the needs it brought. We might conceive of a solitary man as housing and dressing himself, devising rude tools, and thus lifting himself a step from wildness toward cultivation; but we cannot conceive of him as ever learning to talk. Recognition of the impulse to communication as the efficient cause of language-making is an element of primary importance in the theory of the origin of language. No one who either leaves it out of account or denies it will, however ingenious and entertaining his speculations, cast any real light on the earliest history of speech. To inquire under what peculiar circumstances, in connexion with what mode of individual or combined action, a first outburst of oral expression may have taken place, is, on the other hand, quite futile. The needed circumstances were always present when human beings were in one another's society; there was an incessant drawing-on to attempts at mutual understanding which met with occasional, and then ever more frequent and complete success. There inheres in most reasoning upon this subject the rooted assumption, governing opinion even when not openly upheld or consciously made, that conceptions have real natural names, and that in a state of nature these will somehow break forth and reveal themselves under favouring circumstances. The falsity of such a view is shown by our whole further discussion.

Beginnings of Speech and Writing.

The character of the motive force to speech determined the character of the beginnings of speech. That was first signified which was most capable of intelligible signification, not that which was first in order of importance, as judged by any standard which we can apply to it, or first in order of conceptional development. All attempts to determine the first spoken signs by asking what should have most impressed the mind of primitive man are and must be failures. It was the exigencies and possibilities of practical life, in conditions quite out of reach of our distinct conception, that prescribed the earliest signs of communication. So, by a true and instructive analogy, the beginnings of writing are rude depictions of visible objects; it is now thoroughly recognized that no alphabet, of whatever present character, can have originated in any other way; everything else is gradually arrived at from that—as, indeed, in the ingeniously shaping hands of man, from any central body of signs, though but of small extent, all else is attainable by processes of analogy and adaptation and transfer. Now what is it that is directly signifiable in the world about us? Evidently the separate acts and qualities of sensible objects, and nothing else. In writing, or signification to the eye, the first element is the rude depiction of the outline of an object, or of that one of the sum of its characteristic qualities which the eye takes note of and the hand is capable of intelligibly reproducing; from that the mind understands the whole complex object itself, and then whatever further may in the circumstances of its use be suggested by it. So, for example, the picture of a tree signifies primarily a tree, then perhaps wood, something made of wood, and so on; that of a pair of outstretched wings signifies secondarily flight, then soaring, height, and whatever else these may lead to. No concrete thing is signifiable in its totality or otherwise than by a facile analysis of its constituent qualities and a selection of the one which is both sufficiently characteristic in itself and capable of being called up by a sign before the mind addressed.

Instrumentalities of Expression.

The Voice.

And what quality shall be selected depends in great measure upon the instrumentality used for its signification. Of such instrumentalities men possess a considerable variety. We must leave out of account that of depiction, as just instanced, because its employment belongs to a much more advanced state of cultivation, and leads the way to the invention not of speech but of the analogous and auxiliary art of writing. There remain gesture, or changes of position of the various parts of the body, especially of the most mobile parts, the arms and hands; grimace, or the changes of expression of the features of the countenance (in strictness, a variety of the preceding); and utterance, or the production of audible sound. It cannot be doubted that, in the first stages of communicative expression, all these three were used together, each for the particular purposes which it was best calculated to serve. The nearest approach to such action that is now possible is when two persons, wholly ignorant of one another's speech, meet and need to communicate—an imperfect correspondence, because each is trained to habits of expression and works consciously, and with the advantage of long experience, towards making himself understood; yet it is good for its main purpose. What they do, to reach mutual comprehension, is like what the first speechless men, unconsciously and infinitely more slowly, learned to do: face, hands, body, voice, are all put to use. It is altogether probable that gesture at first performed the principal part, even to such extent that the earliest human language may be said to have been a language of gesture signs; indeed, there exist at ~~the~~ present day such gesture-languages as those in use between roving tribes of different speech that from time to time meet one another (the most noted example is that of the gesture-language, of a very considerable degree of development, of the prairie tribes of American Indians); or such signs as are the natural resort of those who by deafness are cut off from ordinary spoken intercourse with their fellows. Yet there never can have been a stage or period in which all the three instrumentalities were not put to use together. In fact, they are still all used together; that is even now an ineffective speaking to which grimace and gesture ("action," as Demosthenes called them) are not added as enforcers; and the lower the grade of development and culture of a language, the more important, even for intelligibility, is their addition. But voice has won to itself the chief and almost exclusive part in communication, insomuch that we call all communication "language" (*i.e.* "tonguiness") just as a race of mutes might call it "handiness" and talk (by gesture) of a handiness of grimace. This is not in the least because of any closer connexion of the thinking apparatus with the muscles that act to produce audible sounds than with those that act to produce visible motions; not because there are natural uttered names for conceptions any more than natural gestured names. It is simply a case of "survival of the fittest," or analogous to the process by which iron has become the exclusive material of swords, and gold and silver of money; because, namely, experience has shown this to be the material best adapted to this special use. The advantages of voice are numerous and obvious. There is first its economy, as employing a mechanism that is available for little else, and leaving free for other purposes those indispensable instruments the hands. Then there is its superior perceptibleness: its nice differences impress themselves upon the sense at a distance at which visible motions become indistinct; they are not hidden by intervening objects; they allow the eyes of the listener as well as the hands of the speaker to be employed in other useful work; they are as plain in the dark as in the light; and they are able to catch and command the attention of one who is not to be reached in any other way. We might add as the third advantage a superior capability of variation and combination on the part of spoken sounds; but this is not to be insisted on, inasmuch as we hardly know what a gesture-language might have become if men's ingenuity in expression had been expended through all time upon its elaboration; and the superiority, however real, can hardly have been obvious enough to serve as a motive: certainly, there are spoken languages now existing whose abundance of resources falls short of what is attainable by gesture. Oral utterance is the form which expression has inevitably taken, the sum of man's endowments being what it is; but it would be a mistake to suppose that a necessity of any other kind is involved in their relation. The fundamental conditions of speech are man's grade of intellectual power and his social instinct; these being given, his expression follows, availing itself of what means it finds best suited to its purpose; if voice had been wanting it would have taken the next best. So, in certain well-known cases, a marked artistic gift on the part of individuals deprived of the use of hands has found means of exercise in the feet instead. But men in general have hands, instruments of exquisite tact and power, to serve the needs of their intellect; and so voice also, to provide and use the tools of thought; there is no error in maintaining that the voice is given us for speech, if only we do not proceed to draw from such a dictum false conclusions as to the relation between thought and utterance. Man is created with bodily instruments suited to do the work prescribed by his mental capacities; therein lies the harmony of his endowment.

Imitation.

It is through imitation that all signification becomes directly suggestive. The first written signs are (as already noticed) the depictions of visible objects, and could be nothing else; and, by the same necessity, the first uttered signs were the imitations of audible sounds. To reproduce any sound of which the originating cause or the circumstances of production are known, brings up of course before the conception that sound, along with the originator, or circumstances of origination, or whatever else may be naturally associated with it. There are two special directions in which this mode of sign-making is fruitful: imitation of the sounds of external nature (as the cries of animals and the noises of inanimate objects when in motion or acted on by other objects) and imitation of human sounds. The two are essentially one in principle, although by some held apart, or even opposed to each other, as respectively the imitative or onomatopoetic and the exclamatory or interjectional beginnings of speech; they differ only in their spheres of significance, the one being especially suggestive of external objects, the other of inward feelings. There are natural human tones, indicative of feeling, as there are natural gestures, poses, modes of facial expression, which either are immediately intelligible to us (as is the warning cry of the hen to the day-old chicken), or have their value taught us by our earliest experiences. If we hear a cry of joy or a shriek of pain, a laugh or a groan, we need no explanation in words to tell us what it signifies any more than when we see a sad face or a drooping attitude. So also the characteristic cry or act of anything outside ourselves, if even rudely imitated, is to us an effective reminder and awakener of conception. We have no reason to question that such were the suggestions of the beginnings of uttered expression. The same means have made their contributions to language even down to our own day; we call words so produced "onomatopoetic" (*i.e.* "name-making"), after the example of the Greeks, who could not conceive that actually new additions to language should be made in any other way. What and how wide the range of the imitative principle, and what amount of language-signs it was capable of yielding, is a subject for special investigation—or rather, of speculation, since anything like exact knowledge in regard to it will never be attained; and the matter is one of altogether secondary consequence; it is sufficient for our purpose that enough could certainly be won in this way to serve as the effective germs of speech.

Language.

All the natural means of expression are still at our command, and are put to more or less use by us, and their products are as intelligible to us as they have been to any generation of our ancestors, back to the very first. They are analogous also to the means of communication of the lower animals; this, so far as we know, consists in observing and interpreting one another's movements and natural sounds (where there are such). But language is a step beyond this, and different from it. To make language, the intent to signify must be present. A cry wrung out by pain, or a laugh of amusement, though intelligible, is not language; either of them, if consciously reproduced in order to signify to another pain or pleasure, is language. So a cough within hearing of any one attracts his attention; but to cough, or to produce any other sound, articulate or inarticulate, for the purpose of attracting another's attention, is to commit an act of language-making, such as in human history preceded in abundance the establishment of definite traditional signs for conceptions. Here begins to appear the division between human language and all brute expression; since we do not know that any animal but man ever definitely took this step. It would be highly interesting to find out just how near any come to it; and to this point ought to be especially directed the attention of those who are investigating the communication of the lower animals in its relation to human communication. Among the animals of highest intelligence that associate with man and learn something of his ways, a certain amount of sign-making expressly for communication is not to be denied; the dog that barks at a door because he knows that somebody will come and let him in is an instance of it; perhaps, in wild life, the throwing out of sentinel birds from a flock, whose warning cry shall advertise their fellows of the threat of danger, is as near an approach to it as is anywhere made.

Language Conventional.

But the actual permanent beginnings of speech are only reached when the natural basis is still further abandoned, and signs begin to be used, not because their natural suggestiveness is seen in them, but by imitation, from the example of others who have been observed to use the same sign for the same purpose. Then for the first time the means of communication becomes something to be handed down, rather than made anew by each individual; it takes on that traditional character which is the essential character of all human institutions, which appears not less in the forms of social organization, the details of religious ceremonial, the methods of art and the arts, than in language. That all existing speech, and all known recorded speech, is purely traditional, cannot at all be questioned. It is proved even by the single fact that for any given conception there are as many different spoken signs as there are languages—say a thousand (this number is rather far within than beyond the truth), each of them intelligible to him who has learned to use it and to associate it with the conception to which it belongs, but unintelligible to the users of the nine hundred and ninety-nine other signs, as these are all unintelligible to him; unless, indeed, he learn a few of them also, even as at the beginning he learned the one that he calls his own. What single sign, and what set of signs any individual shall use, depends upon the community into the midst of which he is cast, by birth or other circumstances, during his first years. That it does not depend upon his race is demonstrated by facts the most numerous and various; the African whose purity of descent is attested by every feature is found all over the world speaking just that language, or jargon, into the midst of which the fates of present or former slavery have brought his parents; every civilized community contains elements of various lineage, combined into one by unity of speech; and instances are frequent enough where whole nations speak a tongue of which their ancestors knew nothing; for example, the Celtic Gauls and the Germanic Normans of France speak the dialect of a geographically insignificant district in central Italy, while we ourselves can hardly utter a sentence or write a line without bringing in more or less of that same dialect. There is not an item of any tongue of which we know anything that *is* "natural" expression, or to the possession of which its speaker is brought by birth instead of by education; there is even very little that is traceably founded on such natural expression; everywhere θέσις or human attribution reigns supreme, and the original φύσις or natural significance has disappeared and is only to be found by theoretic induction (as we have found it above). It seems to some as if a name like *cuckoo* (one of the most striking available cases of onomatopoeia) were a "natural" one; but there is just as much θέσις in it as in any other name; it implies the observation of an aggregate of qualities in a certain bird, and the selection of one among them as the convenient basis of a mutual understanding when the bird is in question; every animal conspicuous to us must have its designation, won in one way or another; and in this case to imitate the characteristic cry is the most available way. If anything but convenience and availability were involved, all our names for animals would have to be and to remain imitations of the sounds they make. That the name of *cuckoo* is applied also to the female and young, and at other than the singing season, and then to related species which do not make the same sound—all helps to show the essentially conventional character of even this name. An analogous process of elimination of original meaning, and reduction to the value of conventional designation merely, is to be seen in every part of language throughout its whole history. Since men ceased to derive their names from signs having a natural suggestiveness, and began to make them from other names already in use with an understood value, every new name has had its etymology and its historical occasion—as, for example, the name *quarantine* from the two-score (*quarantaine*) of days of precautionary confinement, or *volume* from its being rolled up, or *book* from a beech-wood staff, or *copper* from Cyprus, or *lunacy* from a fancied influence of the moon, or *priest* from being an older (πρεσβύτερος) person, or *butterfly* from the butter-yellow colour of a certain common species: every part of our language, as of every other, is full of such examples—but, when once the name is applied, it belongs to that to which it is applied, and no longer to its relatives by etymology; its origin is neglected, and its form may be gradually changed beyond recognition, or its meaning so far altered that comparison with the original shall seem a joke or an absurdity. This is a regular and essential part of the process of name-making in all human speech, and from the very beginning of the history of speech: in fact (as pointed out above), the latter can only be said to have begun when this process was successfully initiated, when uttered signs began to be, what they have ever since continued to be, conventional, or dependent only on a mutual understanding. Thus alone did language gain the capacity of unlimited growth and development. The sphere and scope of natural expression are narrowly bounded; but there is no end to the resources of conventional sign-making.

Brute Speech and Human Speech.

It is well to point out here that this change of the basis of men's communication from natural suggestiveness to mutual understanding, and the consequent purely conventional character of all human language, in its every part and particle, puts an absolute line of demarcation between the latter and the means of communication of all the lower animals. The two are not of the same kind, any more than human society in its variety of organization is of the same kind with the instinctive herding of wild cattle or swarming of insects, any more than human architecture with the instinctive burrowing of the fox and nest-building of the bird, any more than human industry and accumulation of capital with the instinctive hoarding of bees and beavers. In all these cases alike the action of men is a result of the adaptation of means at hand to the satisfaction of felt needs, or of purposes dimly perceived at first, but growing clearer with gradually acquired experience. Man is the only being that has established institutions—gradually accumulated and perfected results of the exercise of powers analogous in kind to, but greatly differing in degree from, those of the lower animals. The difference in degree of endowment does not constitute the difference in language, it only leads to it. There was a time when all existing human beings were as destitute of language as the dog; and that time would come again for any number of human beings who should be cut off (if that were practicable) from all instruction by their fellows: only they would at once proceed to recreate language, society and arts by the same steps by which their own remote ancestors created those which we now possess; while the dog would remain what he and his ancestors have always been, a creature of very superior intelligence, indeed, as compared with most, of infinite intelligence as compared with many, yet incapable of rising by the acquisition of culture through the formation and development of traditional institutions. There is just the same *saltus* existent in the difference between man's conventional speech and the natural communication of the lower races as in that between men's forms of society and the instinctive associations of the lower races; but it is no greater and no other; it is neither more absolute and characteristic nor more difficult to explain. Hence those who put forward language as *the* distinction between man and the lower animals, and those who look upon our language as the same in kind with the means of communication of the lower animals, only much more complete and perfect, fail alike to comprehend the true nature of language, and are alike wrong in their arguments and conclusions. No addition to or multiplication of brute speech would make anything like human speech; the two are separated by a step which no animal below man has ever taken; and, on the other hand, language is only the most conspicuous among those institutions the development of which has constituted human progress, while their possession constitutes human culture.

Language and Culture.

With the question of the origin of man, whether or not developed out of lower animal forms, intermediate to the anthropoid apes, language has nothing to do, nor can its study ever be made to contribute anything to the solution of that question. If there once existed creatures above the apes and below man, who were extirpated by primitive man as his especial rivals in the struggle for existence, or became extinct in any other way, there is no difficulty in supposing them to have possessed forms of speech, more rudimentary and imperfect than ours. At any rate, all existing human speech is one in the essential characteristics which we have thus far noted or shall hereafter have to consider, even as humanity is one in its distinction from the lower animals; the differences are in non-essentials. All speech is one in the sense that every human being, of whatever race he may be, is capable of acquiring any existing tongue, and of using it for the same purposes for which its present possessors use it, with such power and effect as his individual capacity allows, and without any essential change in the mental operations carried on by means of speech—even as he may acquire any other of the items of culture belonging to a race not his own. The difference between employing one language and another is like that between employing one instrument and another in mechanical arts; one instrument may be better than another, and may enable its user to turn out better work, but the human ingenuity behind both is the same, and works in the same way. Nor has the making of language anything whatever to do with making man what he is, as an animal species having a certain physical form and intellectual endowment. Being what he is by nature, man has by the development of language and other institutions become what he is by culture. His acquired culture is the necessary result of his native endowment, not the contrary. The acquisition of the first stumbling beginnings of a superior means of communication had no more influence to raise him from a simian to a human being than the present high culture and perfected speech of certain races has to lift them up to something more than human and specifically different from the races of inferior culture. It cannot be too absolutely laid down that differences of language, down to the possession of language at all, are differences only in respect to education and culture.

Development of Language-signs.

How long man, after he came into such being as he now is, physically and intellectually, continued to communicate with imitative signs of direct significance, when the production of traditional signs began, how rapidly they were accumulated, and how long any traces of their imitative origin clave to them—these and the like questions it is at present idle to try to answer even conjecturally: just as it is to seek to determine when the first instruments were used, how soon they were shaped instead of being left crude, at what epoch fire was reduced to service, and so on. The stages of development and their succession are clear enough; to fix their chronology will doubtless never be found practicable. There is much reason for holding, as some do, that the very first items of culture were hardest to win and cost most time, the rate of accumulation (as in the case of capital) increasing with the amount accumulated. Beyond all reasonable question, however, there was a positively long period of purely imitative signs, and a longer one of mixed imitative and traditional ones, the latter gradually gaining upon the former, before the present condition of things was reached, when the production of new signs by imitation is only sporadic and of the utmost rarity, and all language-signs besides are traditional, their increase in any community being solely by variation and combination, and by borrowing from other communities.

The Root-stage.

Of what nature, in various respects, this earliest language-material was is sufficiently clear. The signs, in the first place, were of the sort that we call "roots." By this is only meant that they were integral signs, significant in their entirety, not divisible into parts, of which one signified one thing and another another thing, or of which one gave the main significance, while another was an added sign of kind or relation. In a language of developed structure like our own, we arrive at such "roots" mainly by an artificial stripping-off of the signs of relation which almost every word still has, or can be shown to have once had. In *un-cost-li-ness*, for example, *cost* is the centrally significant element; so far as English is concerned it is a root, about which cluster a whole body of forms and derivatives; if we could follow its history no farther it would be to us an ultimate root, as much so as *bind* or *sing* or *mean*. But we can follow it up, to the Latin compound *con-sta*, a root *sta* with a prefixed formative element *con*. Then *sta*, which in slightly varied forms we find in a whole body of related tongues called "Indo-European," having in them all the same significance "stand," is an Indo-European root, and to us an ultimate one, because we can follow its history no farther; but there always remains the possibility that it is as far from being actually original as is the English root *cost*: that is to say, it is not within our power ever to get back to the really primitive elements of speech and to demonstrate their character by positive evidence. The reason for accepting a primitive root-stage of language is in great part theoretical: because nothing else is reconcilable with any acceptable view of the origin of language. The law of the simplicity of beginnings is an absolute one for everything of the nature of an institution, for every gradually developed product of the exercise of human faculties. That an original speech-sign should be of double character, one part of it meaning this and another part that, or one part radical and the other formative, is as inconceivable as that the first instruments should have had handles, or the first shelters a front room and a back one. But this theoretical reason finds all the historical support which it needs in the fact that, through all the observable periods of language-history we see formative elements coming from words originally independent, and not from anything else. Thus, in the example just taken, the *-li-* of *costliness* is a suffix of so recent growth that its whole history is distinctly traceable; it is simply our adjective *like*, worn down in both form and meaning to a subordinate value in combination with certain words to which it was appended, and then added freely as a suffix to any word from which it was desired to make a derivative adjective—or, later but more often, a derivative adverb. The *ness* is much older (though only Germanic), and its history obscurer; it contains, in fact, two parts, neither of them of demonstrable origin; but there are equivalent later suffixes, as *ship* in *hardship* and *dom* in *wisdom*, whose derivation from independent words (*shape*, *doom*) is beyond question. The *un-* of *uncostliness* is still more ancient (being Indo-European), and its probably pronominal origin hardly available as an illustration; but the comparatively modern prefix *be-*, of *become*, *belie*, &c., comes from the independent preposition *by*, by the same process as *-ly* or *-li-* from *like*. And the *con* which has contributed its part to the making of the quasi-root *cost* is also in origin identical with the Latin preposition *cum*, "with." By all the known facts of later language-growth we are driven to the opinion that every formative element goes back to some previously existing independent word; and hence that in analysing our present words we are retracing the steps of an earlier synthesis, or following up the history of our formed words toward the unformed roots out of which they have grown. The doctrine of the historical growth of language-structure leads by a logical necessity to that of a root-stage in the history of all language; the only means of avoiding the latter is the assumption of a miraculous element in the former.

Earliest Phonetic Forms.

Of what phonetic form were the earliest traditional speech-signs is, so far as essentials are concerned, to be inferred with reasonable certainty. They were doubtless articulate: that is to say, composed of alternating consonant and vowel sounds, like our present speech; and they probably contained a part of the same sounds which we now use. All human language is of this character; there are no sounds in any tongue which are not learned and reproduced as easily by children of one race as of another; all dialects admit a like phonetic analysis, and are representable by alphabetic signs; and the leading sounds, consonant and vowel, are even practically the same in all; though every dialect has its own (for the most part, readily definable and imitable) niceties of their pronunciation, while certain sounds are rare, or even met with only in a single group of languages or in a single language. Articulate sounds are such as are capable of being combined with others into that succession of distinct yet connectable syllables which is the characteristic of human speech-utterance. The name "articulate" belongs to this utterance, as distinguished from inarticulate human sounds and cries and from the sounds made by the lower animals. The word itself is Latin, by translation from the Greek, and, though very widely misunderstood, and even deliberately misapplied in some languages to designate all sound, of whatever kind, uttered by any living creature, is a most happily chosen and truly descriptive term. It signifies "jointed," or broken up into successive parts, like a limb or stem; the joints are the syllables; and the syllabic structure is mainly effected by the alternation of closer or consonant sounds with opener or vowel sounds. The simplest syllabic combination (as the facts of language show) is that of a single consonant with a following vowel; and there are languages even now existing which reject any other. Hence there is much plausibility in the view that the first speech-signs will have had this phonetic form and been monosyllabic, or dissyllabic only by repetition (reduplication) of one syllable, such as the speech of very young children shows to have a peculiar ease and naturalness. The point, however, is one of only secondary importance, and may be left to the further progress of phonetic study to settle, if it can; the root-theory, at any rate, is not bound to any definite form or extent of root, but only denies that there can have been any grammatical structure in language except by development in connexion with experience in the use of language. What particular sounds, and how many, made up the first spoken alphabet is also a matter of conjecture merely; they are likely to have been the closest consonants and the openest vowels, medial utterances being of later development.

Character of Early Speech.

As regards their significant value, the first language-signs must have denoted those physical acts and qualities which are directly apprehensible by the senses; both because these alone are directly signifiable, and because it was only they that untrained human beings had the power to deal with or the occasion to use. Such signs would then be applied to more intellectual uses as fast as there was occasion for it. The whole history of language, down to our own day, is full of examples of the reduction of physical terms and phrases to the expression of non-physical conceptions and relations; we can hardly write a line without giving illustrations of this kind of linguistic growth. So pervading is it, that we never regard ourselves as having read the history of any intellectual or moral term till we have traced it back to a physical origin. And we are still all the time drawing figurative comparisons between material and moral things and processes, and calling the latter by the names of the former. There has never been any difficulty in providing for new knowledge and more refined thought by putting to new uses the earlier and grosser materials of speech.

As a matter of course, whatever we now signify by our simple expressions for simple acts, wants, and the like, was intended to be signified through the first speech-signs by the users of them. But to us, with our elaborated apparatus of speech, the sentence, composed of subject and predicate, with a verb or special predicative word to signify the predication, is established as the norm of expression, and we regard everything else as an abbreviated sentence, or as involving a virtual sentence. With a view to this we must have "parts of speech": that is, words held apart in office from one another, each usable for such and such a purpose and no other, and answering a due variety of purposes, so that when they are combined they fit together, as parts composing a whole, and the desired meaning is made clear. Inflexions, too, lend their aid; or else auxiliary words of various kinds answering the same purpose—namely, of determining the relations of the members of the sentence. But all our success in understanding the earliest stages of language depends upon our power to conceive a state of things where none of these distinctions were established, where one speech-sign was like another, calling up a conception in its indefinite entirety, and leaving the circumstances of the case to limit its application.

Such a language is far below ours in explicitness; but it would suffice for a great deal of successful communication; indeed (as will be shown farther on) there are many languages even now in existence which are little better off. So a look of approval or disgust, a gesture of beckoning or repulsion, a grunt of assent or inquiry, is as significant as a sentence, means a sentence, is translatable into a sentence, and hence may even in a certain way be called a sentence; and in the same way, but only so, the original roots of language may be said to have been sentences. In point of fact, between the holophrastic gesture or uttered sign and the sentence which we can now substitute for it—for example between the sign of beckoning and the equivalent sentence, "I want you to come here"—lies the whole history of development of inflective speech.

Development of Language

What has been this history of development, how the first scanty and formless signs have been changed into the immense variety and fullness of existing speech, it is of course impossible to point out in detail, or by demonstration of facts, because nearly the whole process is hidden in the darkness of an impenetrable past. The only way to cast any light upon it is by careful induction from the change and growth which are seen to have been going on in the recent periods for which we have recorded evidence, or which are going on at the present time. Of some groups of related languages we can read the life for three or four thousand years back, and by comparison can infer it much farther; and the knowledge thus won is what we have to apply to the explanation of periods and languages otherwise unknown. Nothing has a right to be admitted as a factor in language-growth of which the action is not demonstrable in recorded language. Our own family of languages is the one of whose development most is known, by observation and well-warranted inference; and it may be well here to sketch the most important features of its history, by way of general illustration.

in Indo-European Speech.

Apparently the earliest class-distinction traceable in Indo-European speech is that of pronominal roots, or signs of position, from the more general mass of roots. It is not a formal distinction, marked by a structural difference, but, so far as can be seen, is founded only on the assignment by usage of certain elements to certain offices. Formal distinction began with combination, the addition of one element to another, their fusion into a single word, and the reduction of the one part to a subordinate value, as sign of a certain modification of meaning of the other. Thus, doubtless by endings of pronominal origin, were made the first verb-forms, or words used only when predication was intended (since that is all that makes a verb), conveying at first a distinction of persons only, then of persons and numbers, while the further distinctions of tense and mode were by degrees added. To the nouns, which became nouns by the setting up of the separate and special class of verbs, were added in like manner distinctions of case, of number, and of gender. With the separation of noun and verb, and the establishment of their respective inflexion, the creative work of language-making is virtually done; the rest is a matter of differentiation of uses. For the noun (noun substantive) and the adjective (noun adjective) become two parts of speech only by a gradually deepened separation of use; there is no original or formal distinction between them; the pronouns as a rule merely add the noun-inflexion to a special set of stems; adverbs are a part of the same formation as noun-cases; prepositions are adverbs with a specialized construction, of secondary growth; conjunctions are the products of a like specialization; articles, where found at all, are merely weakened demonstratives and numerals.

To the process of form-making, as exhibited in this history, belong two parts: the one external, consisting in the addition of one existing element of speech to another and their combination into a single word; the other internal, consisting in the adaptation of the compound to its special use and involving the subordination of one element to the other. Both parts appear also abundantly in other departments of language-change, and throughout the whole history of our languages; nothing has to be assumed for the earliest formations which is not plainly illustrated in the latest. For example, the last important addition to the formative apparatus of English is the common adverb-making suffix *-ly*, coming, as already pointed out, from the independent adjective *like*. There was nothing at first to distinguish a compound like *godly* (*godlike*) from one like *storm-tossed*, save that the former was more adaptable than the other to wider uses; resemblance is an idea easily generalized into appurtenance and the like, and the conversion of *godlike* to *godly* is a simple result of the processes of phonetic change described farther on. The extension of the same element to combination with adjectives instead of nouns, and its conversion to adverb-making value, is a much more striking case of adaptation, and is nearly limited to English among the Germanic languages that have turned *like* into a suffix. A similar striking case of combination and adaptation is seen in the Romanic adverb-making suffix *mente* or *ment*, coming from the Latin ablative *mente*, "with mind." So, to make a Romanic future like *donnerai*, "I shall give," there was needed in the first place the pre-existing elements, *donner*, "to give," and *ai*, "I have," and their combination; but this is only a part; the other indispensable part is the gradual adaptation of a phrase meaning "I have [something before me] for giving" to the expression of simple futurity, *donabo*. So far as the adaptation is concerned the case is quite parallel to that of *j'ai donné*, "I have given," &c. (equivalent phrases or combinations are found in many languages), where the expression of possession of something that is acted on has been in like manner modified into the expression of past action. Parallel in both combination and adaptation is the past tense *loved*, according to a widely accepted theory, from *love-did*, while we have again the same adaptation without combination in the equivalent phrase *did love*.

That these are examples of the process by which the whole inflective structure of Ind.-European language was built up admits of no reasonable question. Our belief that it is so rests upon the solid foundation that we can demonstrate no other process, and that this one is sufficient. It is true that we can prove such an origin for our formative elements in only a small minority of instances; but this is just what was to be expected, considering what we know of the disguising processes of language-growth. No one would guess in the mere *y* of *ably* (for *able-ly*) the presence of the adjective *like*, any more than in the altered final of *sent* and the shortened vowel of *led* the effect of a *did* once added to *send* and *lead*. The true history of these forms can be shown, because there happen to be other facts left in existence to show it; where such facts are not within reach we are left to infer by analogy from the known to the unknown. The validity of our inference can only be shaken by showing that there are forms incapable of having been made in this way, or that there are and have been other ways of making forms. Of the former there is evidently but small chance; if a noun-form meaning, "with mind" can become the means of conversion of all the adjectives of a language into adverbs, and a verb meaning "have" (and, yet earlier, "seize") of signifying both future and past time, there is obviously nothing that is impossible of attainment by such means. As regards the latter, no one appears to have even attempted to demonstrate the genesis of formative elements in any other way during the historical periods of language; it is simply assumed that the early methods of language-making will have been something different from and superior in spontaneity and fruitfulness to the later ones; that certain forms, or forms at certain periods, were made out-and-out, as forms; that signs of formal distinction somehow exuded from roots and stems; that original words were many-membered, and that a formative value settled in some member of them—and the like. Such doctrines are purely fanciful, and so opposed to the teachings both of observation and of sound theory that the epithet absurd is hardly too strong to apply to them. If the later races, of developed intelligence, and trained in the methods of a fuller expression, can only win a new form by a long and gradual process of combination and adaptation, why should the earlier and comparatively untrained generations have been able to do any

All formal Elements once Material.

better? The advantage ought to be, if anywhere, on our side. The progress of language in every department, accompanying and representing the advance of the race, on the whole, in the art of speaking as in other arts, is from the grosser to the more refined, from the physical to the moral and intellectual, from the material to the formal. The conversion of compounds into forms, by the reduction of one of their elements to formative value, is simply a part of the general process which also creates auxiliaries and form-words and connectives, all the vocabulary of mind, and all the figurative phraseology that gives life and vigour to our speech. If a copula, expressive of the grammatical relation of predication, could be won only by attenuation of the meaning of verbs signifying "grow," "breathe," "stand," and the like; if our auxiliaries of tense and mode all go traceably back to words of physical meaning (as *have* to "seize," *may* to "be great or strong," *shall* to "be under penalty," and so on); if *of* comes from the comparatively physical *off*, and *for* from "before, forward"; if relative pronouns are specialized demonstratives and interrogatives; if *right* means etymologically "straight," and *wrong* means "twisted"; if *spirit* is "blowing," and *intellect* a "picking out among," and *understanding* a "getting beneath," and *development* an "unfolding"; if an event *takes place* or *comes to pass*, and then *drops out* of mind and is *forgotten* (opposite of *gotten*)—then it is of no avail to object to the grossness of any of the processes by which, in earlier language or in later, the expression of formal relations is won. The mental sense of the relation expressed is entirely superior to and independent of the means of its expression. He who, to express the plural of *man*, says what is equivalent to *man-man* or *heap-man* (devices which are met with in not a few languages) has just as good a sense of plurality as he who says *men* or *homines*; that sense is no more degraded in him by the coarseness of the phrase he uses to signify it than is our own sense of eventuality and of pastness by the undisguised coarseness of *take place* and *have been*. In short, it is to be laid down with the utmost distinctness and confidence, as a law of language-growth, that there is nothing formal anywhere in language which was not once material; that the formal is made out of the material, by processes which began in the earliest history of language and are still in action.

Laws of Change and Growth.

We have dropped here the restriction to our own or Indo-European language with which we began, because it is evident that what is true of this family of speech, one of the most highly organized that exist, may also be true of the rest—must be true of them, unless some valid evidence be found to the contrary. The unity of human nature makes human speech alike in the character of its beginnings and in the general features of its after-history. Everywhere among men a certain store of expression, body of traditional signs of thought, being given, as used by a certain community, it is capable of increase on certain accordant lines, and only on them. In some languages, and under peculiar circumstances, borrowing is a great means of increase; but it is the most external and least organically important of all. Out-and-out invention (which, so far as we can see, must be of the kind called by us onomatopoetic) is found to play only a very insignificant part in the historical periods of language—clearly because there are other and easier modes of gaining new expression for what needs to be expressed. In the course of phonetic change a word sometimes varies into two (or more) forms, and makes so many words, which are differently turned to account. Everything beyond this must be the product of combination; there is no other way, so far as concerns the externals of speech. Then, partly as accompanying and aiding this external growth, partly as separate from and supplementing it, there is in all language an internal growth, making no appearance in the audible part of speech, consisting in multiplication of meanings, their modification in the way of precision or comprehension or correctness, the restriction of words to certain uses, and so on. Along with these, too, a constant change of phonetic form constitutes an inseparable part of the life of language. Speech is no more stable with respect to the sounds of which it is composed than with respect to its grammatical forms, its vocabulary, or the body of conceptions signified by it. Even nearly related languages differ as much in their spoken alphabets and the combinations of sounds they admit, and in their uttered forms of words historically the same, as in any other part; and the same is true of local dialects and of class dialects within the same community. Phonetic change has nothing whatever to do with change of meaning; the two are the product of wholly independent tendencies. Sometimes, indeed, they chance to coincide, as in the distinction of *minúte* "small," and *mínute* "moment"; but it is only by chance, as the spoken accordance of *second* in its two meanings ("next" and "sixtieth of a minute") shows; words that maintain their identity of value most obstinately, like the numerals, are liable to vary indefinitely in form (so *four*, *fidvor*, *quatuor*, *τέσσαρ-ες*, &c., from an original *kwetwor-*; *five*, *quinque*, *πέντε*, *coic*, &c., from *penkwe*—while, on the other hand, *two* and *three* show as striking an accordance of form as of meaning through all the same languages); what is far the most common is that the word becomes very unlike its former self in both respects, like *priest* from the Greek *πρεσβύτερος* (*presbyter*), literally "older man." Human convenience is, to be sure, the governing motive in both changes; but it is convenience of two different kinds: the one mental, depending on the fact (pointed out above) that a name when once applied belongs to the thing to which it is applied, to the disregard of its etymological connexions, does not need to be changed when the thing changes, and is ready for new application to anything that can be brought into one class with the latter; and the other physical, depending on the organs of speech and their successive movements, by which the sounds that make up the word are produced. Phonetic convenience is economy of effort on the part of those organs; and to no other law than that of economy of utterance have any of the phenomena of phonetic change been found traceable (though it is also to be noted that some phenomena have not hitherto been successfully brought under it, and that the way of effecting this is still unclear): "Euphony," which used to be appealed to as explanation, is a false principle, except so far as the term may be made an idealized synonym of economy. The ear finds that agreeable which the organs of utterance find facile. Economy in utterance is no isolated tendency; it is the same that plays its part in all other kinds of human action, and in language appears equally in the abbreviation of the sentence by leaving out parts that can be spared without loss of intelligibility. It is an insidious tendency, always lying in wait, like gravitation, to pull down what is not sufficiently held up—the holding-up force in language being the faithfulness of tradition, or accurate reproduction by the learner and user of the signs which he has acquired. No generation of men has any intention to speak otherwise than as its predecessor has spoken, or any consciousness that it is doing so; and yet, from generation to generation, words are shortened, sounds are assimilated to one another, and one element passes out of use while a new one is introduced. Abbreviation and assimilation are the most conspicuous departments of phonetic change, and those in which the nature of the governing tendency is most plainly seen. Taken by itself, one sound is as easy as another to the person who has accustomed himself to it from childhood; and those which the young child most easily acquires are not those which in the history of speech are least liable to alteration; it is especially in the combinations and transitions of rapid speaking that the tongue, as it were, finds out for itself easier ways of performing its task, by dropping and slurring and adapting. To trace out the infinitely varied items of this change, to co-ordinate and compare them and discover their reasons, constitutes a special department of language-study, which is treated under the head of PHONETICS. It only needs to be pointed out here that phonetic change plays a necessary part in the structural development of language, by integrating compound words through fusion and loss of identity of their component parts, and, what is of yet more importance, by converting them into forms, through disguise of identity of one of the parts and its phonetic subordination to the other part. It is this that turns, for example, the compound *god-like* into the derivative *godly*, the compound *love-did* into the verbal form *loved*. And yet one further result sometimes follows: an internal change is wrought by phonetic influence in the body of a word, which change then may in the further history of the word be left as the sole means of distinction between one form and another. It is thus that, in the most recent period, the distinction of *led* from *lead* and *met* from *meet* and so on has been made; the added auxiliary which originally made these preterites induced a shortening of the root-vowel, and this was left behind when the auxiliary disappeared by the usual process of abbreviation. It is in the same way that the distinctions of *men* from *man*, of *were* from *was*, of *set* from *sit*, with all their analogues, were brought about: by a modification of vowel-sound (Ger. *Umlaut*) occasioned by the presence in the following syllable of an *i*-vowel, which in the older stages of the language is still to be seen there. And the distinctions of *sing*, *sang*, *sung* and *song*, of *bind*, *bound*, *band* and *bond*, are certainly of the same kind, though they go back so far in the history of our family of languages that their beginnings are not yet clearly demonstrable; they were in their origin phonetic accidents, inorganic, mere accompaniments and results of external combinations which bore the office of distinction of meaning and were sufficient to it; in some of our languages they have been disregarded and effaced, in others they have risen to prominent importance. To regard these internal changes as primary and organic is parallel with assuming the primariness of the formative apparatus of language in general; like this, it ignores the positive evidence we have of the secondary production of such differences; they are, like everything else in linguistic structure, the outcome of combination and adaptation.

Borrowing or Mixing.

Borrowing, or the taking-in of material out of another language, has been more than once referred to above as sometimes an important element in language-history, though less deep-reaching and organic than the rest. There is nothing anomalous about borrowing; it is rather in essential accordance with the whole process of language-acquisition. All our names were adopted by us because they were already in use by others; and a community is in the same way capable of taking a new name from a community with which it comes in contact as an individual from individuals. Not that it seeks or admits in this way new names for old things; but it accepts new things along with the names that seem to belong to them. Hence any degree of intercourse between one community and another, leading to exchange of products or of knowledge, is sure to lead also to some borrowing of names; and there is hardly a language in the world, except of races occupying peculiarly isolated positions, that does not contain a certain amount of foreign material thus won, even as our English has elements in its vocabulary from half the other tongues in the world. The scale of borrowing is greatly increased when one people becomes the pupil of another in respect of its civilization: hence the abundant classical elements in all the European tongues, even the non-Romanic; hence the Arabic material in Persian and Turkish and Malay; hence the Chinese in Japanese and Corean; and, as a further result, even dead languages, like the Greek and Latin and the Sanskrit, become stores to be drawn upon in that learned and conscious quest of new expression which in the school-stage of culture supplements or even in a measure replaces the unconscious growth of natural speech. So, in mixture of communities, which is a highly-intensified form of contact and intercourse, there follows such mixture of speech as the conditions of the case determine; yet not a mixture on equal terms, through all the departments of vocabulary and grammar; the resulting speech (just as when two individuals learn to speak alike) is essentially that of the one constituent of the new community, with more or less material borrowed from that of the other. What is most easily taken in out of another language is the names of concrete things; every degree of removal from this involves additional difficulty—names of abstract things, epithets, verbs, connectives, forms. Indeed, the borrowing of forms in the highest sense, or forms of inflexion, is well-nigh or quite impossible; no example of it has been demonstrated in any of the historical periods of language, though it is sometimes adventurously assumed as a part of prehistoric growth. How nearly it may be approached is instanced by the presence in English of such learned plurals as *phenomena* and *strata*. This extreme resistance to mixture in the department of inflexion is the ground on which some deny the possibility of mixture in language, and hence the existence of such a thing as a mixed language. The difference is mainly a verbal one; but it would seem about as reasonable to deny that a region is inundated so long as the tops of its highest mountains are above water. According to the simple and natural meaning of the term, nearly all languages are mixed, in varying degree and within varying limits, which the circumstances of each case must explain.

Isolating Languages.

These are the leading processes of change seen at work in all present speech and in all known past speech, and hence to be regarded as having worked through the whole history of speech. By their operation every existing tongue has been developed out of its rudimentary radical condition to that in which we now see it. The variety of existing languages is well-nigh infinite, not only in their material but in their degree of development and the kind of resulting structure. Just as the earlier stages in the history of the use of tools are exemplified even at the present day by races which have never advanced beyond them, so is it in regard to language also—and, of course, in the latter case as in the former, this state of things strengthens and establishes the theory of a gradual development. There is not an element of linguistic structure possessed by some languages which is not wanting in others; and there are even tongues which have no formal structure, and which cannot be shown ever to have advanced out of the radical stage. The most noted example of such a rudimentary tongue is the Chinese, which in its present condition lacks all formal distinction of the parts of speech, all inflexion, all derivation; each of its words (all of them monosyllables) is an integral sign, not divisible into parts of separate significance; and each in general is usable wherever the radical idea is wanted, with the value of one part of speech or another, as determined by the connexion in which it stands; a condition parallel with that in which Indo-European speech may be regarded as existing prior to the beginnings of its career of formal development briefly sketched above. And there are other tongues, related and unrelated to Chinese, of which the same description, or one nearly like it, might be given. To call such languages radical is by no means to maintain that they exhibit the primal roots of human speech, unchanged or only phonetically changed, or that they have known nothing of the combination of element with element. Of some of them the roots are in greater or less part dissyllabic; and we do not yet know that all dissyllabism, and even that all complexity of syllable beyond a single consonant with following vowel, is not the result of combination or reduplication. But all combination is not form-making; it needs a whole class of combinations, with a recognized common element in them producing a recognized common modification of meaning, to make a form. The same elements which (in Latin, and even to some extent in English also) are of formal value in *con-stant* and *pre-dict* lack that character in *cost* and *preach*; the same *like* which makes adverbs in *tru-ly* and *right-ly* is present without any such value in *such* and *which* (from *so-like* and *who-like*); *cost* and *preach*, and *such* and *which*, are as purely radical in English as other words of which we do not happen to be able to demonstrate the composite character. And so a Chinese monosyllable or an Egyptian or Polynesian dissyllable is radical, unless there can be demonstrated in some part of it a formative value; and a language wholly composed of such words is a root-language. Recent investigation goes to show that Chinese had at some period of its history a formal development, since extinguished by the same processes of phonetic decay which in English have wiped out so many signs of a formal character and brought back so considerable a part of the vocabulary to monosyllabism. In languages thus constituted the only possible external alteration is that phonetic change to which all human speech, from the very beginning of its traditional life, is liable; the only growth is internal, by that multiplication and adaptation and improvement of meanings which is equally an inseparable part of all language-history. This may include the reduction of certain elements to the value of auxiliaries, particles, form-words, such as play an important part in analytical tongues like English, and are perhaps also instanced in prehistoric Indo-European speech by the class of pronominal roots. Phrases take the place of compounds and of inflexions, and the same element may have an auxiliary value in certain connexions while retaining its full force in others, like, for instance, our own *have.* It is not easy to define the distinction between such phrase-collocations and the beginnings of agglutination; yet the distinction itself is in general clearly enough to be drawn (like that in French between *donnerai* and *ai donné*) when the whole habit of the language is well understood.

Agglutinative Languages.

Inflective.

Such languages, constituting the small minority of human tongues, are wont to be called "isolating," *i.e.* using each element by itself, in its integral form. All besides are "agglutinative," or more or less compounded into words containing a formal part, an indicator of class-value. Here the differences, in kind and degree, are very great; the variety ranges from a scantiness hardly superior to Chinese isolation up to an intricacy compared with which Indo-European structure is hardly fuller than Chinese. Some brief characterization of the various families of language in this respect will be given farther on, in connexion with their classification. The attempt is also made to classify the great mass of agglutinating tongues under different heads: those are ranked as simply "agglutinative" in which there is a general conservation of the separate identity of root or stem on the one hand, and of formative element, suffix or prefix, on the other; while the name "inflective," used in a higher and pregnant sense, is given to those that admit a superior fusion and integration of the two parts, to the disguise and loss of separate identity, and, yet more, with the development of an internal change as auxiliary to or as substitute for the original agglutination. But there is no term in linguistic science so uncertain of meaning, so arbitrary of application, so dependent on the idiosyncrasy of its user, as the term "inflective." Any language ought to have the right to be called inflective that has inflexion: that is, that not merely distinguishes parts of speech and roots and stems formally from one another, but also conjugates its verbs and declines its nouns; and the name is sometimes so used. If, again, it be strictly limited to signify the possession of *inner flexion* of roots and stems (as if simply agglutinated forms could be called "exflective"), it marks only a difference of degree of agglutination, and should be carefully used as so doing. As describing the fundamental and predominant character of language-structure, it belongs to only one family of languages, the Semitic, where most of the work of grammatical distinction is done by internal changes of vowel, the origin of which thus far eludes all attempts at explanation. By perhaps the majority of students of language it is, as a generally descriptive title, restricted to that family and one other, the Indo-European or Indo-Germanic; but such a classification is not to be approved, for, in respect to this characteristic, Indo-European speech ranks not with Semitic but with the great body of agglutinative tongues. To few of these can the name be altogether denied, since there is hardly a body of related dialects in existence that does not exhibit some items of "inflective" structure; the Aryan is only the one among them that has most to show. Outside the Semitic, at any rate, one should not speak of inflective and non-inflective languages, but only of languages more inflective and less inflective.

Value of Structure.

To account for the great and striking differences of structure among human languages is beyond the power of the linguistic student, and will doubtless always continue so. We are not likely to be able even to demonstrate a correlation of capacities, saying that a race which has done this and that in other departments of human activity might have been expected to form such and such a language. Every tongue represents the general outcome of the capacity of a race as exerted in this particular direction, under the influence of historical circumstances which we can have no hope of tracing. There are striking apparent anomalies to be noted. The Chinese and the Egyptians have shown themselves to be among the most gifted races the earth has known; but the Chinese tongue is of unsurpassed jejuneness, and the Egyptian, in point of structure, little better, while among the wild tribes of Africa and America we find tongues of every grade, up to a high one, or to the highest. This shows clearly enough that mental power is not measured by language-structure. But any other linguistic test would prove equally insufficient. On the whole, the value and rank of a language are determined by what its users have made it do. The reflex action of its speech on the mind and culture of a people is a theme of high interest, but of extreme difficulty, and apt to lead its investigators away into empty declamation; taking everything together, its amount, as is shown by the instances already referred to, is but small. The question is simply one of the facilitation of work by the use of one set of tools rather than another; and a poor tool in skilful hands can do vastly better work than the best tool in unskilful hands—even as the ancient Egyptians, without steel or steam, turned out products which, both for colossal grandeur and for exquisite finish, are the despair of modern engineers and artists. In such a history of development as that of human speech a fortunate turn may lead to results of unforeseen value; the earlier steps determine the later in a degree quite beyond their own intrinsic importance. Everything in language depends upon habit and analogy; and the formation of habit is a slow process, while the habit once formed exercises a constraining as well as a guiding influence. Hence the persistency of language-structure: when a certain sum and kind of expression is produced, and made to answer the purposes of expression, it remains the same by inertia; a shift of direction becomes of extreme difficulty. No other reason can at present be given why in historical time there has been no marked development out of one grade of structure into another; but the fact no more shakes the linguistic scholar's belief in the growth of structure than the absence of new animal species worked out under his eyes shakes the confidence of the believer in animal development. The modifying causes and their modes of action are clearly seen, and there is no limit to the results of their action except what is imposed by circumstances.

Unity of Origin of Speech.

It is in vain to attempt to use dates in language-history, to say when this or that step in development was taken, and how long a period it cost, especially now that the changed views as to the antiquity of man are making it probable that only a small part of the whole history is brought within the reach even of our deductions from the most ancient recorded dialects. At any rate, for aught that we know or have reason to believe, all existing dialects are equally old; every one alike has the whole immeasurable past of language-life behind it, has reached its present condition by advance along its own line of growth and change from the first beginnings of human expression. Many of these separate lines we clearly see to converge and unite, as we follow them back into the past; but whether they all ultimately converge to one point is a question quite beyond our power to answer. If in this immensity of time many languages have won so little, if everywhere language-growth has been so slow, then we can only differ as to whether it is reasonably certain, or probable, or only possible, that there should have been a considerable first period of human existence without traditional speech, and a yet more considerable one before the fixation of so much as should leave abiding traces in its descendants, and that meanwhile the race should have multiplied and scattered into independent communities. And the mere possibility is enough to exclude all dogmatic assertion of the unity of origin of human speech, even assuming unity of origin of the human race. For to prove that identity by the still existing facts of language is utterly out of the question;

the metamorphosing effect of constant change has been too great to allow it. In point of fact, taking languages as they now exist, only those have been shown related which possess a common structure, or have together grown out of the more primitive radical stage, since structure proves itself a more constant and reliable evidence than material. And this is likely ever to be the case; at any rate, to trace all the world's languages so far back toward their beginnings as to find in them evidences of identity is beyond the wildest hope. We must be content with demonstrating for those beginnings a unity of kind as alike a body of formless roots. But, on the other hand, since this unity is really demonstrated, since all structure is the result of growth, and no degree of difference of structure, any more than of difference of material, refuses explanation as the result of discordant growth from identical beginnings, it is equally inadmissible to claim that the diversities of language prove it to have had different beginnings. That is to say, the question of the unity of speech, and yet more that of the unity of the race, is beyond the reach of the student of language; the best view he can attain is the hypothetical one, that, if the race is one, the beginnings of speech were perhaps one—but probably not, even then. This negative conclusion is so clearly established as to leave no excuse for the still oft-repeated attempts to press language into service on either side of the controversy respecting human unity of race.

Unconscious Growth through Individuals.

That all making and changing of language is by the act of its speakers is too obvious to call for discussion. No other force capable of acting and of producing effects is either demonstrable or conceivable as concerned in the work. The doctrine that language is an organism, growing by its own inherent powers, exempt from the interference of those who use it, is simply an indefensible paradox. Every word that is uttered is so by an act of human will, at first in imitation of others, then more and more by a formed and controlling habit; it is accessible to no change except by influences working in the speaker's mind and leading him to make it otherwise. Not that he is aware of this, or directs his action knowingly to that end. The whole process is unconscious. If any implication of reflective or intended action can be shown to inhere in any doctrine of linguistic science, it vitiates that doctrine. The attitude of the ordinary speaker towards his language is that of unreasoning acceptance; it seems to him that his names for things are their real names, and all others unintelligent nicknames; he thinks himself to possess his speech by the same tenure as his sight or hearing; it is "natural" to him (or, if he reasons about it, he attributes it to a divine origin, as races beginning to philosophize are wont to ascribe their various social institutions to their gods); he knows nothing of its structure and relations; it never occurs to him to find fault with it, or to deem it insufficient and add to or change it; he is wholly unaware that it does change. He simply satisfies his social needs of communication by means of it; and if he has anything to express that is different from what has been expressed before, he takes the shortest way to a provision for the need; while any relaxation of the energy of utterance tends to a variation in the uttered combinations; and thus changes come by his act, though without his knowledge. His sole object is, on the basis of what language he has, to make known his thought in the most convenient way to his fellow; everything else follows with and from that. Human nature and circumstances being what they are, what follows actually is, as already shown, incessant growth and change. For it we have not to seek special disturbing causes in the history of the speakers, although such may come in to heighten and quicken the change; we know that even in a small community, on a narrow islet, cut off from all intercourse with other communities, the speech would grow different—as certainly, if not as rapidly, as anywhere in the world—and only by the action of its speakers: not that the speakers of a language act in unison and simultaneously to produce a given change. This must begin in an individual, or more or less accordantly in a limited number of individuals and spread from such example through the community. Initiation by one or a few, acceptance and adoption by the rest—such is the necessary method of all linguistic change, and to be read as plainly in the facts of change now going on among ourselves as in those of former language. The doctrine of the inaccessibility of language to other action than that of its speakers does not imply a power in the individual speaker to create or alter anything in the common speech, any more than it implies his desire to do so. What he suggests by his example must be approved by the imitation of his fellows, in order to become language. The common speech is the common property, and no one person has any more power over it than another. If there are, for example, a thousand speakers of a certain dialect, each one wields in general a thousandth part of the force required to change it—with just so much more as may belong to his excess of influence over his fellows, due to recognized superiority of any kind on his part. His action is limited only by their assent; but this is in effect a very narrow limitation, ensuring the adoption of nothing that is not in near accordance with the already existing; though it is also to be noted that he is as little apt to strike off into startling change as they to allow it; since the governing power of already formed habits of speech is as strong in him as in them. That change to which the existing habits naturally lead is easy to bring about; any other is practically impossible. It is this tendency on the part of the collective speakers of a language to approve or reject a proposed change according to its conformity with their already subsisting usages that we are accustomed to call by the fanciful name "the genius of a language."

Dialectic Variation.

On the relation of the part played in language-change by the individual to that by the community, in combination with the inevitableness of change, rests the explanation of the dialectic variation of language. If language were stable there would of course be no divarication; but since it is always varying, and by items of difference that proceed from individuals and become general by diffusion, there can be uniformity of change only so far as diffusion goes or as the influences of communication extend. Within the limits of a single community, small or large, whatever change arises spreads gradually to all, and so becomes part of the general speech; but let that community become divided into two (or more) parts, and then the changes arising in either part do not spread to the other, and there begins to appear a difference in linguistic usage between them. It is at first slight, even to insignificance; not greater than exists between the dialects of different localities or ranks or occupations in the same community, without detriment to the general unity of speech. This unity, namely, rests solely on mutual intelligibility, and is compatible with no small amount of individual and class difference, in vocabulary, in grammar and in pronunciation; indeed, in the strictest sense, each individual has a dialect of his own, different from that of every other, even as he has a handwriting, a countenance, a character of his own. And every item of change, as it takes place, must have its season of existence as a local or class or trade peculiarity, before it gains universal currency; some of them linger long in that condition, or never emerge from it. All these differences in the speech of different sub-communities within the same community are essentially dialectic; they differ not in kind, but only in degree, from those which separate the best-marked dialects; they are kept down by general communication within the limit of general mutual intelligibility. Where that restraining influence ceases the limit is gradually but surely overpassed, and real dialects are the result. From what we know of the life of language we can say positively that continued uniformity of speech without continued community is not practicable. If it were possible to divide artificially, by an impassable chasm or wall, a people one for ages, and continuing to occupy the same seats, the language of the divided parts would at once begin to be dialectically different; and after sufficient time had elapsed each would have become unintelligible to the other. That is to say, whenever a community of uniform speech breaks up, its speech breaks up also; nor do we know of any other cause of dialectic diversity.

In applying this explanation of dialectic growth we have to allow for modifying circumstances of various nature, which alter not indeed the fact but the rate and kind of divarication. Some languages grow and change much more rapidly than others, with a corresponding effect upon divarication, since this is but a result of discordant growth. Usually, when there is division of a community, the parts get into different external circumstances, come in contact or mingle with different neighbouring communities, and the like; and this quickens and increases their divergence of speech. But the modifying factor of by far the highest importance here, as elsewhere in the history of language, is civilization. Civilization in its higher forms so multiplies the forces of communication as to render it possible that the widely-divided parts of one people, living in circumstances and under institutions of very different character, should yet maintain a substantial oneness of speech; of this there is no more striking example than the two great divisions of the English-speaking people on opposite sides of the Atlantic. On the other hand, a savage people cannot spread even a little without dialectic disunity; there are abundant examples to be met with now of mutually unintelligible speech between the smallest subdivisions of a race of obviously kindred tongue—as the different clusters of huts on the same coral islet. It is with linguistic unity precisely as it is with political unity, and for the same reasons. Before the attainment of civilization the human race, whether proceeding from one centre of dispersion or from several, was spread over the earth in a state of utter disintegration; but every centre of civilization becomes also a centre of integration; its influences make for unity of speech as of all other social institutions. Since culture has become incontestably the dominant power in human history, the unifying forces in language have also been stronger than the diversifying; and with culture at its full height, and spread equally to every land and race, one universal language, like one universal community, is not an absurdity or theoretic impossibility, but only a Utopian or millennial dream.

Dialectic variation is thus simply a consequence of the movements of population. As the original human race or races, so the divisions or communities of later formation, from point to point through the whole life of man on the earth, have spread and separated, but jostled and interfered, have conquered and exterminated or mingled and absorbed; and their speech has been affected accordingly. Hence something of these movements can be read in the present condition of languages, as in a faithful though obscure record—more, doubtless, than can be read in any other way, however little it may be when viewed absolutely. Dialectic resemblances point inevitably back to an earlier unity of speech, and hence of community; from what we know of the history of speech, they are not to be accounted for in any other way. The longer the separation that has produced the diversity, the greater its degree. With every generation the amount of accordance decreases and that of discordance increases the common origin of the dialects is at first palpable, then evident on examination, then to be made out by skilled research, then perhaps no longer demonstrable at all; for there is plainly no limit to the possible divergence.

Families of Speech.

So long, now, as any evidence of original unity is discoverable we call the languages "related dialects," and combine them into a "family." The term "family" simply signifies a group of languages which the evidence thus far at command, as estimated by us, leads us to regard as descended by the ordinary processes of dialectic divarication from one original tongue. That it does not imply a denial of the possibility of wider relationship is obvious from what has been said above. That there is abundant room for error in the classification represented by it is also clear, since we may take purely accidental resemblances, or the results of borrowing, for evidence of common descent, or may overlook or wrongly estimate real evidences, which more study and improved method will bring to light. Grouping into families is nothing more than the best classification attainable at a given stage in the progress of linguistic science; it is in no small part provisional only, and is always held liable to modification, even sweeping, by the results of further research. Of some families we can follow the history by external evidences a great way back into the past; their structure is so highly developed as to be traced with confidence everywhere; and their territory is well within our reach: such we regard with the highest degree of confidence, hardly allowing for more than the possibility that some other dialect, or group, or now-accepted family even, may sometime prove its right to be added on. But these are the rare exceptions; in the great majority of cases we have only the languages as they now exist, and in more or less scanty collections, of every degree of trustworthiness; and even their first grouping is tentative and incomplete, and involves an adjournment of deeper questions to the day of more light. To complete and perfect the work of classification by relationship, or the establishment of families and their subdivisions, is the first object of the comparative study of languages. No other classification has a value in the least comparable with it; that by grade of structure is a mere recreation, leading to nothing; that by absolute worth is of no account whatever, at any rate in the present state of our knowledge. On genetic relationship, in the first place, is founded all investigation of the historical development of languages; since it is in the main the comparison of related dialects, even in the case of families having a long recorded history, and elsewhere only that, that gives us knowledge of their earlier condition and enables us to trace the lines of change. In the second place, and yet more obviously, with this classification is connected all that language has to teach as to the affinities of human races; whatever aid linguistic science renders to ethnology rests upon the proved relationships of human tongues.

Recapitulation.

That a classification of languages, to which we have now to proceed, is not equivalent to a classification of races, and why this is so, is evident enough from the principles which have been brought out by our whole discussion of languages, and which, in their bearing upon this particular point, may well be recapitulated here. No language is a race-characteristic, determined by the special endowments of a race; all languages are of the nature of institutions, parallel products of powers common to all mankind—the powers, namely, involved in the application of the fittest available means to securing the common end of communication. Hence they are indefinitely transferable, like other institutions—like religions, arts, forms of social organization, and so on—under the constraining force of circumstances. As an individual can learn any language, foreign as well as ancestral, if it be put in his way, so also a community, which in respect to such a matter is only an aggregate of individuals. Accordingly, as individuals of very various race are often found in one community, speaking together one tongue, and utterly ignorant of any other, so there are found great communities of various descent, speaking the dialects of one common tongue, which at some period historical circumstances have imposed upon them. The conspicuous example, which comes into every one's mind when this subject is discussed, is that of the Romanic countries of southern Europe, all using dialects of a language which, 2500 years ago, was itself the insignificant dialect of a small district in central Italy; but this is only the most important and striking of a whole class of similar facts. Such are the results of the contact and mixture of races and languages. If language-history were limited to growth and divarication, and race-history to spread and dispersion, it would be a comparatively easy task to trace both backward toward their origin; as the case is, the confusion is inextricable and hopeless. Mixture of race and mixture of speech are coincident and connected processes; the latter never takes place without something of the former; but the one is not at all a measure of the other, because circumstances may give to the speech of the one element of population a greatly disproportionate preponderance. Thus, there is left in French only an insignificant trace of the Celtic dialects of the predominant race-constituent of the French people; French is the speech of the Latin conquerors of Gaul, mixed perceptibly with that of its later Frankish conquerors; it was adopted in its integrity by the Norse conquerors of a part of the land, then brought into Britain by the same Norsemen in the course of their further conquests, this time only as an element of mixture, and thence carried with English speech to America, to be the language of a still further mixed community. Almost every possible phase of language-mixture is traceable in the history of the abundant words of Latin origin used by American negroes. What events of this character took place in prehistoric time we shall never be able to tell. If any one chooses to assert the possibility that even the completely isolated dialect of the little Basque community may have been derived by the Iberian race from an intrusive minority as small as that which made the Celts of Gaul speakers of Latin, we should have to admit it as a possibility—yet without detriment to the value of the dialect as indicating the isolated race-position of its speakers. In strictness, language is never a proof of race, either in an individual or in a community; it is only a probable indication of race, in the absence of more authoritative opposing indications; it is one evidence, to be combined with others, in the approach towards a solution of the confessedly insoluble problems of human history. But we must notice, as a most important circumstance, that its degree of probability is greatest where its aid is most needed, in prehistoric periods and among uncultivated races; since it is mainly civilization that gives to language a propagative force disproportionate to the number of its speakers. On the whole, the contributions of language to ethnology are practically far greater in amount and more distinct than those derived from any other source.

Classification.

The genetical classification of languages, then, is to be taken for just what it attempts to be, and no more: primarily as a classification of languages only; but secondarily as casting light, in varying manner and degree, on movements of community, which in their turn depend more or less upon movements of races. It is what the fates of men have left to represent the tongues of men—a record imperfect even to fragmentariness. Many a family once as important as some of those here set down has perhaps been wiped out of existence, or is left only in an inconspicuous fragment; one and another has perhaps been extended far beyond the limits of the race that shaped it—which, we can never tell to our satisfaction.

1. *Indo-European* (*Indo-Germanic*) *Family.*—To this family belongs incontestably the first place, and for many reasons: the historical position of the peoples speaking its dialects, who have now long been the leaders in the world's history; the abundance and variety and merit of its literatures, ancient and modern, which, especially the modern, are wholly unapproached by those of any other division of mankind; the period covered by its records; and, most of all, the great variety and richness of its development. These advantages make of it an illustration of the history of human speech with which no other family can bear a moment's comparison as to value, however important various other families may be in their bearing on one and another point or department of history, and however necessary the combination of the testimony of all to a solution of the problems involved in speech. These advantages have made Indo-European language the training-ground of comparative philology, and its study will always remain the leading branch of that science. Many matters of importance in its history have been brought up and used as illustrations in the preceding discussion; but as its constitution and ascertained development call for a fuller and more systematic exposition than they have found here, a special section is devoted to the subject (see Part II. below; also INDO-EUROPEAN LANGUAGE).

2. *Semitic Family.*—This family also is beyond all question the second in importance, on account of the part which its peoples (Hebrews, Phoenicians, Assyrians, Syrians, Arabs, Abyssinians, &c.) have played in history, and of the rank of its literatures. For a special treatment of it see SEMITIC LANGUAGES. Some of the peculiarities of the language have been alluded to above; in the monotony and rigidity of its triliteral roots, and in the extended use which it makes of internal vowel-change ("inflexion" in the special sense of that term) for the purposes of grammatical distinction, it is more peculiar and unlike all the other known families of language than these are unlike one another. There are, and perhaps will always be, those to whom the peculiarities just mentioned will seem original; but if the views of language and its history taken above are in the main true, then that opinion is untenable; Semitic language must have grown into its present forms out of beginnings accordant in kind, if not identical in substance, with those of other families; and the only question remaining to be solved is, through what processes and under what governing tendencies Semitic speech should have arrived at its present state. And with this solution is most obviously and incontestably bound up that of the other interesting and much discussed question, whether the Semitic family can be shown to be related with other families, especially with the Indo-European. To some the possession in common of grammatical gender, or of the classification of objects in general as masculine and feminine, is of itself enough to prove such relationship; but, though the fact is a striking one, and of no small importance as an indication, this degree of value can by no means be attributed to it in the present state of our knowledge—any more than to any other single item of structure among the infinite variety of such, distributed among the multitude of human tongues. Many others compare the Semitic and Indo-European "roots" with one another, and believe themselves to find there numerous indications of identity of material and signification; but these also must pass for insufficient, until it shall prove possible by their aid to work out an acceptable theory of how Semitic structure should have grown out of such radical elements as underlie Indo-European structure, or out of the accordant initial products of a structural growth that afterwards diverged into two so discordant forms. To show that, both the material and the method have been hitherto wanting, and any confident decision is at least premature; but present probabilities are strongly against the solubility of the question. While many general considerations favour the ultimate unity of these two great civilized and civilizing white races of neighbouring homes, and no discordance of speech (as was shown above) can ever be made to prove their diversity of origin, it seems in a high degree unlikely that the evidence of speech will ever be made to prove them one.

3. *Hamitic Family.*—The prominent importance of this family (see HAMITIC LANGUAGES) is due to a single one of its members, the Egyptian. It occupies the north-eastern corner of Africa, with the border-lands of that continent stretching westward along the whole shore of the Mediterranean, and southward to beyond the equator. It falls into three principal divisions: (1) the ancient Egyptian, with its descendant, the more modern Coptic (itself now for some centuries extinct; see EGYPT, COPTS); (2) the Libyan or Berber languages of northern Africa; (3) the Ethiopic languages of eastern Africa. Its situation thus plainly suggests the theory of its intrusion from Asia, across the isthmus of Suez, and its gradual spread from that point; and the theory is strongly favoured by the physical character of the Hamites, and the historical position, especially of the Egyptians, so strikingly different from that of the African races in general. Linguistic evidences of the relationship of Hamite with Semite have also been sought, and by many believed to be found; but the maintenance of the two families in their separateness is an indication that those evidences have not yet been accepted as satisfactory; and such is indeed the case. The Egyptian is a language of extreme simplicity of structure, almost of no structure at all. Its radical words are partly monosyllabic, partly of more than one syllable, but not in the latter case any more than in the former showing traceable signs of extension by formative processes from simpler

elements. It has no derivative apparatus by which noun-stems are made from roots; the root is the stem likewise; there is nothing that can be properly called either declension or conjugation; and the same pronominal particles or suffixes have now a subjective value, indicating use as a verb, and now a possessive, indicating use as a noun. There is no method known to linguistic science by which the relationship of such a tongue as this with the highly and peculiarly inflective Semitic can be shown, short of a thorough working out of the history of development of each family taken by itself, and a retracing in some measure of the steps by which each should have arrived at its present position from a common starting-point; and this has by no means been done. In short, the problem of the relation of Semitic with Hamitic, not less than with Indo-European, depends upon that of Semitic growth, and the two must be solved together. There are striking correspondences between the pronouns of the two families, such as, if supported by evidences from other parts of their material, would be taken as signs of relationship; but, in the absence of such support, they are not to be relied upon, not till it can be shown to be possible that two languages could grow to be so different in all other respects as are Egyptian and Hebrew, and yet retain by inheritance corresponding pronouns. And the possession of grammatical gender by Indo-European, Semitic and Hamitic speech, and by them almost alone, among all human languages, though an extremely noteworthy fact, is (as was pointed out above) in the present condition of linguistic science quite too weak a basis for a belief in the original identity of the three families.

Egyptian is limited to the delta and valley of the Nile, and is the only Hamitic language which has ancient records; of the others the existing forms alone are known.

The Libyan or Berber division of the family occupies the inhabitable part of northern Africa, so far as it has not been displaced by intrusive tongues of other connexion—in later times the Arabic, which since the Mahommedan conquest has been the cultivated tongue of the Mediterranean coast, while the earlier Vandal, Latin and Punic have disappeared, except in the traces they may have left in Berber dialectic speech. The principal dialects are the Kabyle, the Shilha and the Tuarek or Tamashek, corresponding nearly to the ancient Numidian, Mauretanian and Gaetulian respectively.

The third or Ethiopic division includes as its chief members the Beja or Bíshárín, the Saho, the Dankali, the Somali, and the more inland Galla; the first two lying along the Red Sea north of Semitic Abyssinia, the others south of it, to the equator. By some authorities (Lepsius, Bleek) there is added to the Hamitic family as a fourth division a group from extreme southern Africa, the Hottentot and Bushman languages. The ground of this classification is the possession by the Hottentot of the distinction of grammatical gender, and even its designation by signs closely corresponding to those used in the Ethiopic division. Others deny the sufficiency of this evidence, and rank the Hottentot as a separate group of African dialects, adding to it provisionally the Bushman, until better knowledge of the latter shall show whether it is or is not a group by itself. If the Hottentot be Hamitic, we shall have to suppose it cut off at a very remote period from the rest of the family, and forced gradually southward, while all the time suffering mixture both of speech and of blood with the negro races, until the physical constitution of its speakers has become completely metamorphosed, and of its original speech no signs are left save those referred to above; and while such exceptional phonetic peculiarities have been worked out as the use of the clicks or clucking sounds: and this must be regarded as at least extremely difficult.

4. *Monosyllabic or South-eastern Asiatic Family.*—This body of languages may well enough be the next taken up; and here again (as was the case with the preceding family) on account of the prominent importance of one of its dialects and of the people speaking it—the Chinese people and language. The territory of the family includes the whole south-eastern corner of Asia: China on the north-east, Farther India in the south, and the high plateau of Tibet, with the neighbouring Himalayan regions, to the westward. The ultimate unity of all these languages rests chiefly upon the evidence of their form, as being all alike essentially monosyllabic and isolating, or destitute of formal structure; the material correspondences among them, of accordant words, are not sufficient to prove them related. The Chinese itself can be followed up, in contemporary records, to a period probably not far from 2000 B.C., and the language, the people, and their institutions, are then already in the main what they have ever since continued to be (see CHINA); the other leading tongues come into view much later, as they receive culture and religion from China on the one hand (the Annamites), or from India on the other (the Tibetans, Burmese, Siamese); and the territory includes great numbers of wild tribes unknown until our own times, whose race-relations and language-relations are as yet very obscure. Current opinion tends to regard the Annamites, Peguans and Cambodians (the Mon-Khmer group) as forming a more nearly related group or division, and as having been the earlier population of Farther India, in part dispossessed and driven forward by the later intrusion from the north of Siamese and Burmese, of whom the former are more nearly related to the Chinese and the latter to the Tibetans. The Mon-Khmer group is itself more nearly related to the Kolarian and Malay-Polynesian.

The character of the languages of this family, especially as instanced by its most important member, the Chinese, has been pretty fully set forth in the general discussions above. They are languages of roots: that is to say, there is not demonstrable in any of their words a formative part, limiting the word, along with others similarly characterized, to a certain office or set of offices in the formation of the sentence. That the words are ultimate roots, come down from the first period of language-making, we have no reason whatever to believe; and they may possibly have passed through processes of growth which equipped them with some scanty supply of forms; but no evidence to that effect has yet been produced. The indications relied on to show an earlier polysyllabism in the family (though already in Chinese reduced to monosyllabism before the earliest historical appearance of the language, some 4000 years ago) are the comparatively recent loss of certain final mutes in Chinese words, and the presence on a considerable scale in Tibetan spelling of added initial and final consonants, now silent in the literary dialect, but claimed to be still uttered in some parts of the country. If the theory connecting these phenomena be established, the Tibetan will approve itself to be by far the most primitive of the dialects of the family, furnishing the key to the history of the rest.

For further details respecting the various tongues of the monosyllabic family, the articles on the different divisions of its territory (BURMA; CHINA; SIAM; TIBET, &c.) may be consulted. The languages all alike show an addition to the resources of distinction possessed by languages in general, in the use of tones: that is to say, words of which the alphabetic elements are the same differ in meaning according as they are uttered in a higher or a lower tone, with the rising or the falling inflexion, and so on. By this means, for example, the monosyllabic elements of the literary Chinese, numbering but 500 as we should write them, are raised to the number of about 1500 words.

5. *Ural-Altaic* (*Scythian, Turanian*) *Family.*—China and Tibet are bordered on the north and west by the eastern branches of another immense family, which stretches through central and northern Asia into Europe, overlapping the European border in Turkey, and reaching across it in Russia and Scandinavia to the very shore of the Atlantic. Usage has not so definitely determined as in the case of most other families by what name it shall be called; Turanian is perhaps the commonest appellation, but also the most objectionable. Five principal branches are generally reckoned as composing the family. The two easternmost are the Tungusian, with the Manchu for its principal division, and the Mongol (see MONGOLS)

Of these two the language is exceedingly simple in structure, being raised but little above the formlessness of the Chinese. The Tungusian, however, some authorities would couple with Japanese as a separate branch. The three others are: the Turkish or Tatar, the dialects of which reach from the mouth of the Lena (Yakut) to Turkey in Europe; the Samoyed, from the Altai down to the arctic shore of Asia, and along this to the White Sea—an unimportant congeries of barbarous tribes; and the Finno-Hungarian, including the tongues of the two cultivated peoples from which it takes its name, and also those of a great part of the population of northern and central Russia, to beyond the Ural Mountains, and finally the Lappish, of northern Scandinavia. The nearer relation of the Samoyed is with the Finno-Hungarian. The Turkish is a type of a well-developed language of purely agglutinative structure: that is, lacking that higher degree of integration which issues in internal change. Whether this degree is wholly wanting in Finnish and Hungarian is made a question; at any rate, the languages named have no reason to envy the tongues technically called "inflective." Of a value not inferior to that of inflective characteristics is one that belongs to all the Ural-Altaic tongues, in varying measure and form, and helps to bind them together into a single family—the harmonic sequence of vowels, namely, as between root and endings, or a modification of the vowels of the endings to agree with that of the root or its final syllable.

While the physical race-characteristics known as Mongolian are wanting in the speakers of the western dialects of this family, they are conspicuously present in the people of Japan and Korea; and hence the tendency of scholars to endeavour to connect the languages of the two latter countries, since they also are of agglutinative structure (see JAPAN and KOREA) with the family now under treatment, as also with one another.

Other languages of north-eastern Asia, too little known to group, and too unimportant to treat as separate families, may be mentioned here by way of appendix to their neighbours of the most diversified and widespread Asiatic family. They are the Aino, of Yezo and the Kurile Islands with part of the neighbouring coast; the Kamchatkan; and the Yukagir and Tchuktchi of the extreme north-east. These are sometimes combined with the Eskimo under the title of the Arctic or Hyperborean languages.

The opinion has been held by many scholars that the agglutinative dialects—Sumerain, Accadian, &c.—of the presumed founders of Mesopotamian culture and teachers of the Assyrian Semites (see BABYLONIA) belonged to the Ural-Altaic family, and specifically to its Finno-Ugrian branch; but the data for this view are still very uncertain. The mere possession of an agglutinative structure cannot be taken as proving anything in the way of relationship.

6. *Dravidian or South Indian Family.*—This is an important body of nearly and clearly related tongues, spoken by about 50,000,000 people, doubtless representing the main population of all India at the time when the intrusive Indo-European tribes broke in from the north-west, and still filling most of the southern peninsula, the Deccan, together with part of Ceylon. They are languages of a high grade of structure, and of great power and euphony; and the principal ones have enjoyed a long cultivation, founded on that of the Sanskrit. As they obviously have no Indo-European affinities, the attempt has been made to connect them also with the Ural-Altaic or Turanian family, but altogether without success, although there is nothing in their style of structure that should make such connexion impossible.

7. *Malay-Polynesian Family.*—Not all the tribes that make up the non-Indo-European population of India speak Dravidian dialects. The Santals and certain other wild tribes appear to be of another lineage. These are now generally known as Kolarian, and are connected with the Malay-Polynesian family.

The islands, greater and smaller, lying off the south-eastern coast of Asia and those scattered over the Pacific, all the way from Madagascar to Easter Island, are filled with their own peculiar families of languages, standing in a more or less distant relationship to the languages of the Mon-Khmer group, and the Kolarians on the mainland and the Nicobar islanders. The principal one among them is the great Malay-Polynesian family. It falls into two principal divisions, Malayan and Polynesian. The Malayan includes, besides the Malay proper (see MALAYS), which occupies the Malaccan peninsula (yet doubtless not as original home of the division, but by immigration from the islands), the languages also of Sumatra, Java, Borneo, &c., of the Philippine Islands, of part of Formosa, and of Madagascar, together with the coasts of Celebes and other islands occupied in the interior by Papuans. The Polynesian division includes most of the tongues of the remaining scattered groups of islands, and that of New Zealand. Probably to these are to be added, as a third division, the Melanesian dialects of the Melanesian Archipelago, of which both the physical and the linguistic peculiarities would in that case be ascribed to mixture with the black Papuan races. All these languages are extremely simple in phonetic form, and of a low grade of structure, the Polynesian branch being in both respects the lowest, and some of the Malayan dialects having reached a development considerably more advanced. The radical elements are much oftener of two syllables than of one, and reduplication plays an important part in their extension and variation. Malay literature goes back as far as to the 13th century, and there are Javan records even from the early centuries of our era, the result of religion and culture introduced into that island from Brahmanic India. In recent years more active investigation has been carried on with a view to tracing out the special laws of historical development prevailing in the family.

8. *Other Oceanic Families.*—At least two other families, unconnected with the preceding and with one another, are found among the Pacific Islands, and only there. The continental island of Australia, with its dependency Tasmania (where, however, the native tongue has now become extinct), has its own body of probably related dialects, as its own physical type. They have been but imperfectly investigated, their importance, except to the professed student of language, being nothing; but they are not destitute of a rude agglutinative structure of their own. Still less known are the Papuan or Negrito languages, belonging to the black race with frizzled hair inhabiting most of New Guinea, and found also in the interior of some of the other islands, having been driven from the coasts by superior intruders of the Malay race.

9. *Caucasian Languages.*—Of the existing languages of Asia there remain to be mentioned only those of the Caucasian mountains and highlands, between the Black and Caspian Seas, pressed upon the north by Slavonians and Turks, upon the south by Armenians and Kurds and Turks. Its situation makes of the Caucasus a natural eddy in all movements of emigration between Asia and Europe; and its linguistic condition is as if remnants of many families otherwise extinct had been stranded and preserved there. The dialects north of the principal range—Circassian, Mitsjeghian, Lesghian, &c.—have not been proved to be related either to one another or to those of the south. Among the latter, the Georgian is much the most widespread and important (see GEORGIA) and, alone among them all, possesses a literature. The Caucasian dialects present many exceptional and difficult features, and are in great part of so high a grade of structure as to have been allowed the epithet inflective by those who attach special importance to the distinction thus expressed.

10. *Remnants of Families in Europe.*—The Basque people of the western Pyrenees, at the angle of the Bay of Biscay, are shown by their speech to be an isolated remnant of some race which was doubtless once much more widely spread, but has now everywhere else lost its separate identity; as such it is of extreme interest to the ethnologist (see BASQUES). The Basque language appears to be unrelated to any other on earth. It is of a very highly agglutinative structure, being equalled in intricacy of combination only by a part of the American dialects. Limited as it is in territory, it falls into a number of well-marked dialects, so that it also may not be refused the name of a "family."

The only other case of the kind worth noting is that of the

Etruscan language of northern central Italy, which long ago became extinct, in consequence of the conquest and absorption of Etruria by Rome, but which still exists in numerous brief inscriptions (see ETRURIA). Many attempts have been made to connect the language with other families, and it has even quite recently been pronounced Aryan or Indo-European, of the Italican branch, by scholars of high rank. But its supposed Indo-European relationship was at once shown to be erroneous when, in 1892, a small book which had been used to pack a mummy was discovered in the museum at Agram, and published. The probability of relationship with the ancient Lydian, as was the opinion held in ancient times, has been increased by recent research, and is likely soon to be verified or disproved by the discovery of Lydian records.

In order to complete this review of the languages of the Old World it only remains to notice those of Africa which have not been already mentioned. They are grouped under two heads: the languages of the south and those of the centre of the continent.

11. *South African or Bantu Family.*—This is a very extensive and distinctly marked family (see BANTU LANGUAGES), occupying (except the Hottentot and Bushman territory) the whole southern peninsula of the continent from some degrees north of the equator. It is held apart from all other known families of language by a single prominent characteristic—the extent to which it makes use of prefixes instead of suffixes as the apparatus of grammatical distinction; its inflexion, both declensional and conjugational, is by appended elements which precede the stem or root. The most conspicuous part of this is the variety of prefixes, different in singular and plural, by which the various classes or genders (not founded on sex; the ground of classification is generally obscure) of nouns are distinguished; these then reappear in the other members of the sentence, as adjectives and verbs and pronouns, which are determined by the noun, thus producing an alliterative concord that runs through the sentence. The pronominal determinants of the verb, both subject and object, also come before it; but the determinants of mode of action, as causative, &c., are mostly suffixed. The language in general is rich in the means of formal distinction. Those dialects which border on the Hottentots have, apparently by derivation from the latter, the clicks or clucking-sounds which form a conspicuous part of the Hottentot spoken alphabet.

12. *Central African Languages.*—The remaining languages of Africa form a broad band across the centre of the continent, between the Bantu on the south and the Hamitic on the east and north. The Bantu group, extending from north of the equator to the Cape of Good Hope, with a vast variety of dialects, is the most important of all African languages. To it belongs Swahili, the language of Zanzibar, only less valuable as a means of communication and trade than the Haussa of the Sudan, the most important of the dialects under the influence of the Hamitic languages. The African languages are by no means to be called a family, but rather a great mass of dialects, numbering by hundreds, of varying structure, as to the relations of which there is great discordance of opinion even among the most recent and competent authorities. It is no place here to enter into the vexed questions of African linguistics, or even to report the varying views upon the subject; that would require a space wholly disproportioned to the importance of African speech in the general sum of human language. There is no small variety of physical type as well as of speech in the central belt; and, partly upon the evidence of lighter tint and apparently higher endowment, certain races are set off and made a separate division of; such is the Nuba-Fulah division of F. Müller, rejected by Lepsius. The latter regarded all the varieties of physical and linguistic character in the central belt as due to mixture between pure Africans of the south and Hamites of the north and east; but this is at present an hypothesis only, and a very improbable one, since it implies modes and results of mixture to which no analogies are quotable from languages whose history is known; nor does it appear at all probable that the collision of two races and types of speech should produce such an immense and diverse body of transitional types. It is far from impossible that the present prominence of the South African or Bantu family may be secondary, due to the great expansion under favouring circumstances of a race once having no more importance than belongs now to many of the Central African races, and speaking a tongue which differed from theirs only as theirs differed from one another. None of the Central African languages is a prefix-language in the same degree as the Bantu, and in many of them prefixes play no greater part than in the world's languages in general; others show special forms or traces of the prefix structure; and some have features of an extraordinary character, hardly to be paralleled elsewhere. One group in the east (Oigob, &c.) has a gender distinction, involving that of sex, but really founded on relative power and dignity: things disparaged, including women, are put in one class; things extolled, including men, are put in the other. This is perhaps the most significant hint anywhere to be found of how a gender-distinction like that in our own Indo-European languages, which we usually regard as being essentially a distinction of sex, while in fact it only includes such, may have arisen. Common among the African languages, as among many other families, especially the American, is a generic distinction between animate beings and inanimate things.

13. *American Languages.*—With these the case is closely the same as with the Central African languages: there is an immense number of dialects, of greatly varied structure (see INDIANS, NORTH AMERICAN). Even among neighbouring families like the Algonquin, Iroquois and Dakota, whose agreement in style of structure (polysynthetic), taken in connexion with the accordant race-type of their speakers, forbids us to regard them as ultimately different, no material correspondence, agreement in words and meanings, is to be traced; and there are in America all the degrees of polysynthetism, down to the lowest, and even to its entire absence. Such being the case, it ought to be evident to every one accustomed to deal with this class of subjects that all attempts to connect American languages as a body with languages of the Old World are and must be fruitless.

Literature.—Many of the theoretic points discussed above are treated by the writer with more fulness in his *Language and the Study of Language* (1867) and *Life and Growth of Language* (1875). Other English works to consult are M. Müller's *Lectures on the Science of Language*; Farrar's *Chapters on Language*; Wedgwood's *Origin of Language* (all more or less antiquated); Sayce's *Principles of Philology* and *Introduction to the Science of Language*, &c.; Sweet, *The History of Language* (1900). In German, see Paul's *Principien der Sprachgeschichte* (Halle, 1880); Delbrück's *Einleitung in das Sprachstudium* (Leipzig, 1880; 4th ed., 1909; 5th ed., 1910; there is also an English version); Brugmann and Delbrück's *Grundriss der vergleichenden Grammatik der indogermanischen Sprachen* (1886–1900; a second edition of the first volume was published in 1897, two parts of vol. ii., including the stem-formation and declension of the noun and pronoun appeared in 1906 and 1909); also the works of W. von Humboldt and of H. Steinthal, the most important of whose linguistic works, *Charakteristik der hauptsächlichsten Typen des Sprachbaues* (1861), was recast and brought up to date under the same title by F. Misteli (1893). See also handy summaries covering the same ground, but without bibliography, in F. N. Finck's *Die Sprachstämme des Erdkreises* (1909) and *Die Haupttypen des Sprachbaus* (1910). Many of the languages of India and Farther India have been treated in the *Linguistic Survey of India*, edited by Dr G. E. Grierson (a government publication still in progress). A short popular account of the subject is given in Porzczinski's *Einleitung in die Sprachwissenschaft* (1910), a German translation of a Russian original. The Bantu languages have been treated by Black, Torrand, and most recently by Meinhof, whose *Lautlehre der Bantu Sprachen* (1910) is the most complete handling of the subject. As to the classification and relationships of languages, see Hovelacque's *La Linguistique* (Paris, 1876) and F. Müller's *Grundriss der Sprachwissenschaft* (Vienna, 3 vols.; a fourth was left incomplete at the author's death). Both works are already somewhat antiquated. As to the history of the study, see Lersch's *Sprachphilosophie der Alten* (1840); Steinthal's *Geschichte der Sprachwissenschaft bei den Griechen und Römern* (1863); Benfey's *Geschichte der Sprachwissenschaft und Orientalischen Philologie in Deutschland* (1869); Sandys's *History of Classical Scholarship* (3 vols., 1906–1908); Vilh. Thomsen's *Sprogardenskatens Historien Kortpattit franckling* (1902). (W. D. W.)

II.—*Comparative Philology of the Indo-European Languages.*

Historical Sketch.

Bopp and J. Grimm.

The study of Indo-European comparative philology has from its outset necessarily been in close connexion with the study of Sanskrit, a language unparalleled amongst its cognates in antiquity and distinctness of structure and consequently the natural basis of comparison in this field. It is therefore not to be wondered at that we find no clear views of the mutual relationship of the individual members of the Indo-European family or their position with regard to other languages until Sanskrit began to attract the attention of European philologists, or that the introduction of Sanskrit as an object of study was closely followed by the discovery of the original community of a vast range of languages and dialects hitherto not brought into connexion at all, or only made the objects of baseless speculations. We meet with the first clear conception of this idea of an Indo-European community of languages in the distinguished English scholar Sir William Jones, who, as early as 1786, expressed himself as follows: "The Sanskrit language, whatever may be its antiquity, is of wonderful structure; more perfect than the Greek, more copious than the Latin, and more exquisitely refined than either, yet bearing to both of them a stronger affinity, both in the roots of verbs and in the forms of grammar, than could have been produced by accident; so strong that no philologer could examine all the three without believing them to have sprung from some common source which, perhaps, no longer exists. There is a similar reason, though not quite so forcible, for supposing that both the Gothic and the Celtic, though blended with a different idiom, had the same origin with the Sanskrit."[1] But neither Sir William Jones nor any of his older contemporaries who had arrived at similar conclusions ever raised this important discovery from a brilliant *aperçu* into a valid scientific theory through a detailed and systematic comparison of the languages in question. To have achieved this is the undoubted merit of the German, Franz Bopp (*q.v.*), the founder of scientific philology of the Indo-European languages, and subsequently through this example also the founder of comparative philology in general. Next to him Jacob Grimm (*q.v.*) must be mentioned here as the father of historical grammar. The first part of his famous *Deutsche Grammatik* appeared in 1819, three years after Bopp had published his first epoch-making book, *Ueber das Conjugationssystem der Sanskritsprache.* Bopp's results were here at once utilized, yet Grimm's whole system was entirely independent of that of Bopp, and had no doubt been worked out before Grimm knew of his illustrious predecessor. In fact, their scientific aims and methods were totally different. Bopp's interest was not concentrated in comparison as such, but chiefly inclined towards the explanation of the origin of grammatical forms, and comparison to him was only a means of approaching that end.

In this more or less speculative turn of his interest Bopp showed himself the true son of a philosophical period when general linguistics received its characteristic stamp from the labours and endeavours of men like the two Schlegels and Wilhelm von Humboldt. Jacob Grimm's aims were of a less lofty character than those of Bopp, whose work, to his own mind, was crowned by his theory of the origin of inflexion through agglutination. In confining his task to a more limited range than the vast field of Indo-European languages embraced in Bopp's researches, and thus fixing his attention on a group of idioms exhibiting a striking regularity in their mutual relationship, both where they coincide and where they differ, he made it his foremost object to investigate and illustrate the continuous progress, subject to definite laws, by which these languages had been developed from their common source. He thus raised the hitherto neglected study of the development of sounds to an equal level with the study of grammatical forms, which had so far almost exclusively absorbed all the interest of linguistic research. Grimm's discovery of the so-called "Lautverschiebung," or Law of the Permutation of Consonants in the Teutonic languages (which, however, had been partly found and proclaimed before Grimm by the Danish scholar Rask), became especially important as a stimulus for further investigation in this line. Grimm's influence on comparative philology (which is secondary only to that of Bopp, although he was never a comparative philologist in the sense that Bopp was, and did not always derive the benefit from Bopp's works which they might have afforded him) is clearly traceable in the work of Bopp's successors, amongst whom Friedrich August Pott (1802–1887) is universally judged to hold the foremost rank. In his great work, *Etymologische Forschungen auf dem Gebiete der indogermanischen Sprachen, mit besonderem Bezug auf die Lautumwandlung im Sanskrit, Griechischen, Lateinischen, Littauischen, und Gothischen* (Lemgo, 1833–1836), we find Indo-European etymology for the first time based on a scientific investigation of general Indo-European phonology. Amongst Pott's contemporaries Theodor Benfey deserves mention on account of his *Griechisches Wurzellexicon* (Berlin, 1839), a work equally remarkable for copiousness of contents and power of combination, yet showing no advance on Bopp's standpoint in its conception of phonetic changes.

Benfey.

Schleicher.

A third period in the history of Indo-European philology is marked by the name of August Schleicher, whose *Compendium der vergleichenden Grammatik der indogermanischen Sprachen* first appeared in 1861. In the period subsequent to the appearance of Pott's *Etymologische Forschungen*, a number of distinguished scholars, too large to be recorded here individually,[2] had devoted their labours to the different branches of Indo-European philology, especially assisted and promoted in their work by the rapidly progressing Vedic (and Avestic) studies that had been inaugurated by Rosen, Roth, Benfey, Westergaard, Müller, Kuhn, Aufrecht and others. Moreover, new foundations had been laid for the study of the Slavonic languages by Miklosich and Schleicher, of Lithuanian by Kurschat and Schleicher, of Celtic by Zeuss. Of the classical languages Greek had found a most distinguished representative in Curtius, while Corssen, Mommsen, Aufrecht, Kirchhoff, &c., had collected most valuable materials towards the elucidation of Latin and the cognate Italic idioms. In his *Compendium* Schleicher undertook and solved the difficult task of sifting down the countless details amassed since the days of Bopp and Grimm, and thus making the individual languages stand out clearly on their common background, while Bopp's attention had been especially occupied with what was common to all Indo-European tongues. There are two prominent features which characterize this part of Schleicher's work—his assumption and partial reconstruction of a prehistoric parent speech, from which the separate Indo-European languages were supposed to have sprung, and the establishment of a long series of phonetic laws, regulating the changes by which that development of the individual idioms had taken place. On Schleicher's views of and contributions towards general comparative philology (which he erroneously proposed to consider as a branch of natural science) we need not enter here. (See *Evolution and the Science of Language in Darwin and Modern Science*, 1909, pp. 526 sqq.)

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[1] For this quotation and the following historical sketch in general see Th. Benfey, *Geschichte der Sprachwissenschaft*, p. 438 (Munich, 1869); and especially B. Delbrück, *Introduction to the Study of Language*, p. 1 (Leipzig, 1882; a fifth German edition appeared in 1909).

[2] The extensive progress made in this period is best illustrated by the foundation of two periodicals especially devoted to Indo-European comparative philology, Kuhn's *Zeitschrift für vergleichende Sprachforschung* (now 27 vols., Berlin, from 1851), and Kuhn's *Beitrage zur vergleichenden Sprachforschung* (8 vols., Berlin, from 1858). Benfey's school is more especially represented by the contributors to Benfey's *Orient und Occident* (3 vols., Göttingen, from 1862), and subsequently through Bezzenberger's *Beiträge zur Kunde der indogermanischen Sprachen* (30 vols., Göttingen, from 1877); this journal has now been amalgamated with Kuhn's *Zeitschrift.* The views of the "New Grammarians"—Leskien, Brugmann, Osthoff and their schools—are represented in *Indogermanische Forschungen* (27 vols., since 1890). The Göttingen school has a further representative in *Glotta*, now (1910) in its third volume. The history of the meaning of words has a special periodical for itself, *Wörter und Sachen*, now in its second volume. Besides those mentioned there are many journals, publications of academies, &c., in Belgium, Sweden, Denmark, Italy, &c., which no serious student of comparative philology can ignore. France possesses two periodicals of the same kind, the *Revue de Linguistique* (Paris, from 1868) and the *Mémoires de la Société de Linguistique de Paris* (also from 1868), while England is represented by the *Proceedings* and *Transactions* of the Philological Societies of London and Cambridge, the *Classical Review* (23 vols., since 1887), and the *Classical Quarterly* (4 vols., since 1907), and America by the *Transactions of the American Philological Association* (from 1868), the *American Journal of Philology* (30 vols., from 1880), *Classical Philology* (5 vols., from 1906), and other more specialist organs.

New Linguistic School.

Phonetic Change.

For some time after Schleicher's premature death (in 1868) Indo-European philology continued in paths indicated by him and Curtius, with the exception, perhaps, of the school founded by Benfey, who had always stood on independent ground. The difference between the two schools, however, was less strikingly marked in their writings, because it chiefly concerns general views of language and the Indo-European languages in particular, although the characteristic task of the period alluded to was that of working out the more minute details of comparison; but behind all this the general interest still clung to Bopp's old glottogonic problems. In 1876, however, a new movement, inspired in the first instance by the works of W. D. Whitney, began, and a younger school of linguists has sprung up who are united in their opposition to many theories of the older generation, yet often differ materially both with regard to method and the solution of individual problems. In its present state this younger school (often branded with the name of Neo-Grammarians, "Junggrammatiker," by its opponents real and imaginary) is marked by certain distinct tendencies. In the first place, they are inclined more or less, and the older members of the school perhaps more than the younger, to abandon glottogonic problems as insoluble, if not for ever, yet for the present and with the scanty means that Indo-European philology alone can furnish for this purpose. In this they are in opposition to the whole of the older school. In the second place, they object to the use of all misleading metaphorical comparisons of processes in the history of language with processes of organic development—comparisons used at all times, but especially cherished by Schleicher. In the third place—and this has been of the greatest practical importance—they hold that our general views of language and our methods of comparison should be formed after a careful study of the living languages, because these alone are fully controllable in every minute detail, and can therefore alone give us a clear insight into the working of the different motive forces which shape and modify language, and that the history of earlier periods of language, consequently, can only be duly illustrated by tracing out the share which each of these forces has had in every individual case of change. Of these forces two are found to be especially prominent—phonetic variation and formation by analogy. They generally work in turns and often in opposition to one another, the former frequently tending to differentiation of earlier unities, the latter to abolition of earlier differences, especially to restoration of conformity disturbed by phonetic change. There are, however, other important differences in the action of the two forces. Phonetic change affects exclusively the pronunciation of a language by substituting one sound or sound-group for another. From this simple fact it is self-evident that phonetic changes as such admit of no exceptions. Pronunciation—that is, the use of certain sounds in certain combinations—is perfectly unconscious in natural unstudied speech, and every speaker or generation of speakers has only one way of utterance for individual sounds or their combinations. If, therefore, a given sound was once changed into another under given circumstances, the new sound must necessarily and unconsciously replace its predecessor in every word that falls under the same rules, because the older sound ceases to be practised and therefore disappears from the language. Thus, for instance, the sound of the short so-called Italian *a* in English has become exchanged for the peculiarly English sound in *man, hat*, &c., which is so exclusively used and practised now by English speakers that they feel great difficulty in pronouncing the Italian sound, which at an earlier period was almost as frequent in English as in any other language that has preserved the Italian sound up to the present day. Again, the sound of the so-called long English *a* in *make, paper*, &c., although once a monophthong, is now pronounced as a diphthong, combining the sounds of the English short *e* and *i*, and no trace of the old monophthong is left, except where it was followed by *r*, as in *hare, mare* (also *air, their, where*, &c.), where the *a* has a broader sound somewhat approaching that of the short *a* in *hat*. This last instance may at the same time serve to illustrate the restrictions made above as to sounds changing their pronunciation in certain groups or combinations, or under given circumstances only. We may learn from it that phonetic change need not always affect the same original sound in the same way in all its combinations, but that neighbouring sounds often influence the special direction in which the sound is modified. The different sounds of the English *a* in *make* and *hare* are both equivalents of the same Old English sound *ă* (=the Italian short *a*) in *macian, hara*. The latter sound has been split in two, but this process again has taken place with perfect regularity, the one sound appearing before *r*, the other before all other consonants. It is easy to see that the common practice of comprising the history of the Old English *a* in the one rule—that it was changed into the sound of the *ă* in *make* except when followed by an *r*—can only be defended on the practical ground that this rule is convenient to remember, because the words exhibiting the former change are more numerous than the instances of the latter; apart from this there is nothing to justify the assumption that one of these changes is the rule and the other the exception. The fact is, that we have two independent cases of change, which ought to be stated in two distinct and independent rules according to the different positions in which the original *ă* stood before the splitting began. It is also easy to observe that the variety of modifying influences may be much more manifold than in the present instance of *make* and *hare*, and that the number of special phonetic rules in such cases must be increased in proportion to the progress made in the investigation of the said modifying powers.

In truth, however, the study of phonetic laws falls into several different stages, and the meaning attached to the phrase *phonetic law* has varied at each of these stages. Moreover, the sweeping nature of the original generalizations has become so hedged in and contracted by limitations that a recent writer has been compelled once more to formulate the question whether phonetic laws actually exist. It must be admitted in the first place that the word *law* has been ill chosen for use in this connexion. In phonetic laws there is no element which can be identified as coming under the definition of a law as propounded by a jurist like John Austin. There is no authority which enunciates the law, there is no penalty for the breach of it. But the philologists who first used the term were not thinking of law in its strict signification, but of its use in such metaphorical expressions as scientific laws, for, as already mentioned, Schleicher and his followers in the middle of the 19th century had taken a keen interest in the development of the natural sciences, and had to some extent assimilated their terminology to that employed in those sciences. It was, however, soon recognized that the laws of language and those of natural science were not really alike or akin. A scientific "law" is only a brief method of expressing the fact that universal experience shows that certain causes universally produce certain effects. In chemistry two atoms of hydrogen and one of oxygen will make water, and they will make nothing else at any time or at any place the world over. Phonetic laws, however, do not hold true universally. They are often curiously limited in the area to which they apply. In ancient Greek, for example, the sound *-s-* between two vowels, which had been handed down from the original language whence Greek and the sister languages are derived, regularly disappears; in Latin, on the other hand, it changes into *-r-*; thus an original genitive of a neuter substantive we find represented in Greek by *γένε-ος*, a form which comparison with other languages shows to be traceable to an earlier **genes-os*, preceding the separation of the languages, while the same original stem with a different vowel in the ending appears in Latin as *gener-is*. Similarly an early **euso* appears in Greek as *εὕω*, in Latin as *uro*. This disappearance of original intervocalic *s* pervades all Greek dialects—the apparent exceptions come under the heading of analogical change; with a very few exceptions similarly explicable Latin intervocalic *s* has become *r*. But Latin was originally limited to a very small part even of Italy, and the next neighbours of the Latins on the east and south—the Sabines, Campanians and Samnites—retained this intervocalic *s* without changing it into *r*. On the other hand, the neighbours to the north-east—the Umbrians in and beyond the Apennines—shared in this rhotacism. Yet the Celts, who bordered on the Umbrians along the Po, and who spoke a language in many respects very closely akin to the dialects of Italy, in this regard agree rather with Greek than the Italic languages. In Latin, again, the period of action of the law which changed intervocalic *s* into *r* did not in all probability exceed the century from 450 B.C. to 350 B.C. So unlike, indeed, are phonetic laws to the laws of natural science in universality that an opponent of the dogma which declares that phonetic laws have no exceptions has compared them with the laws of fashion. The comparison is not so outrageous as it may seem at first sight. For in language there are two kinds of sound change, that which is unconscious, universal at a given time and within a given area, and, on the other hand, that which belongs only to a particular class or clique, deviates consciously from the pronunciation of the majority, is therefore not universal, and exercises no permanent influence on the language. The second kind of sound change corresponds exactly to the laws of fashion; it is in fact one of them. Such sound changes are the pronunciation of the English ending *-ing* as *-in'*, which was fashionable in the middle of the 19th century. This had, though probably without the knowledge of those who used it, an historical justification in the earlier forms from which most of the English words now ending in *-ing* are descended, and which survive in numerous local dialects. A similar conventional mispronunciation was the lisp affected by some would-be artistic persons at a somewhat later period. Belonging to an entirely different social stratum, and now equally obsolete, was the London pronunciation of the first half of the 19th century typified in Tony and Sam Weller's treatment of *v* and *w* in the *Pickwick Papers*. This, however, made a much nearer approach to being a genuine dialect peculiarity. It undoubtedly pervaded the pronunciation of the lower classes in London at one time; had it survived it might conceivably have spread over a wider and wider area until it embraced the whole population of England. A later change, that of the diphthong *ai* into *ei* (so that *day*, *daily* are pronounced *dy*, *dyly*), has spread from Essex and the East End of London over a large part of London and of the adjacent counties, and is still widening its range both geographically and socially. The history of these sound changes has not yet been investigated in detail with the thoroughness which it deserves.

There is, then, a part of sound change which is a matter of fashion and which is conscious. This sound change appears frequently in the pronunciation of individuals who have migrated from one part of a country to another. In many parts of Scotland, for example, the prepositions *with* and *of* appear in dialect only in the forms *wi'* and *o'*, which were originally the unaccented forms. In the conscious attempts to pronounce them as they appear in literary English, the educated Scotsman, if he remains in his native place, as a rule pronounces them as *with* (with the final sound unvoiced as it appears in the Scottish legal preposition *outwith*) and as *off*, the final sound here also being unvoiced. If he migrates to England or to Australia he will probably in course of time adopt the pronunciation with a voiced final sound. In the course of years habit will become second nature, and in this respect the speaker's pronunciation will become identical with that of his neighbours. It is clear, however, that changes of this nature cannot take place on a large scale. If a large number of persons migrate in a body and continue to live in close intercourse with one another and but little in contact with the outside world, changes such as take place in the pronunciation of the individual emigrant do not occur. There can be no imitation of alien sounds, for there are none; no greater effort to be intelligible is required, for the audience has not changed. Hence it has been often remarked that a population which history shows to have remained undisturbed for very long periods in the same geographical situation manifests but little change in its language. Thus in Arabia and Lithuania the population has remained practically unmixed in the same habitat for thousands of years, with the result that the languages spoken there remain at the present day the most archaic members of the linguistic families to which they respectively belong.

From what has been said it will be obvious that a phonetic law is only an observed uniformity in the treatment of a sound or a combination of sounds within a linguistic area at a given time. In the definition the term *linguistic area* is a very variable quantity. Thus it is a phonetic law that a sound of the original Indo-European language, the precise pronunciation of which cannot be determined, but which was at any rate a palatal sound (*ǩ*), appears in the Indo-European group (Sanskrit, Zend, Old Persian, with their descendants), in Armenian, in Balto-Slavonic and Albanian, in the form of a sibilant, while in Greek, the Italic dialects; Germanic and Celtic, it appears as a *k*-sound (see INDO-EUROPEAN LANGUAGES). Here the linguistic area is extremely wide, and it is clear that the difference between the two groups of languages must be dated back to a very early period. Again, it is a phonetic law of Greek that the original combination *st-* at the beginning of words is retained in Greek. How then are we to explain the existence side by side of *στέγος* and *τέγος*? The former apparently complies with the law, the latter does not. The former has by its side the verb *στέγω*, while *τέγος* is supported only by the rare *τέγη*. Yet the forms of the verb and substantive found in the Germanic languages leave no doubt that the forms without *s-* represent an extremely old form, for the English *thatch* could not have changed its original *t-* into *th-* if it had been preceded by *s-*, the law being as strict for English as for Greek that initial *st-* remains unchanged. On the other hand, a phonetic law may be limited to a very small area. Thus in the dialect of Eretria, and nowhere else within the area of the Ionic dialect of ancient Greek, do we find the change of the sound which appears elsewhere in Greek as *-σ-* between vowels into *-ρ-*: *σίτηριν* for *σίτησιν* (acc. sing.), *παραβαίνωριν* for *παραβαίνωσιν* (3rd pl. subjunctive). Why this change should take place here and nowhere else we do not know, although it may be conjectured that the cause was a mixture with immigrants speaking a different dialect, a mixture which ancient tradition supported. Undoubtedly such mixtures are the chief conditions of phonetic change, the effect of which is universal. The manner in which the change takes place is that the basis of articulation, the method in which the sound is produced, becomes changed. Thus along the "Highland line" in Scotland, where the English and Gaelic-speaking populations had their linguistic frontier for centuries, the *wh-* of English, the Anglo-Saxon *hw-*, becomes universally *f-*, *wha?* becoming *fa?* *white*, *fite*, &c., *f* being the sound which it was most easy to substitute for the difficult *hw-*. The history of Spanish in the different communities of South America excellently illustrates this point. After the discovery of America there was a large influx of Spaniards into Chile, who ultimately, and chiefly by intermarriage, incorporated amongst them a considerable element from amongst the native Araucanian Indians. The result has been that the language of Chile is Spanish, pronounced not with the genuine sounds of Spanish, but with the sounds of the Araucanian language substituted for them. Elsewhere in Spanish America the language of the conquerors remained comparatively pure, because the Spaniards were much fewer in number, and had therefore to maintain themselves as a caste apart. For the same reason Latin has split up into the numerous branches which we know as the Romance languages. The particular line of development which, *e.g.* French followed as compared with Spanish or with the language of the Rhaetian Alps was conditioned by the nature of the sounds in the language which preceded it in the same area, and which was spoken by the ancient Gauls who adopted Latin. The difficulty found in all of these cases is precisely of the same kind as that which an adult at the present day speaking one language finds in attempting to learn the pronunciation of another language. On the one hand, it is only with the greatest difficulty that muscles for many years accustomed to perform one set of movements can be forced into performing another set which are very similar but yet not identical; on the other hand, to an untrained ear the difference between the two sounds may remain unappreciated. The result is that the new language is pronounced with the sounds of the speaker's original language. If the new language is adopted by a whole people to whom it was originally foreign, the children naturally learn it from their parents with the sounds of the old language which has now become obsolete. Thus the basis of articulation is changed, and if, as was the case with Latin, this process be frequently repeated among peoples speaking languages with articulation widely differing one from another, it is clear that a series of different dialects of the adopted language has been created. This kind of change is immediate and universal throughout the whole area where linguistic change has taken place.

Analogical change, on the other hand, does not affect the pronunciation of a language as a whole in the way that phonetic change does, but is confined to the formation, inflexion, syntax and meaning of single words or groups of words, and therefore is very apt to bear an entirely arbitrary and irregular character. A few instances will be sufficient to illustrate this and also to show how the apparently irregular phenomena of analogy may be classified. (*a*) In Old English a certain number of substantives formed their plurals by mutation of the root vowels, as *fōt*, *fēt*, or *bōc*, *bēc*. In Modern English this system of inflexion has been preserved in some cases, as in *foot*, *feet*, and altered in others, as *book*, *books*. Now, while *foot*, *feet* and *book* are the regular modern phonetic equivalents of the old *fōt*, *fēt*, *bōc*, the plural *books* can in no way be phonetically traced back to the old *bēc*, the phonetical equivalent of which in Modern English would be **beech*. The only possible explanation of a form like *books* is that the older *bēc* was at some date given up and replaced by an entirely new formation, shaped after the analogy of the numerous words with a plural in *-s* without modification of the root-vowel. Such changes, which are very numerous, exemplify the first kind of analogy, which is generally termed *formal* analogy. Other examples are the almost entire disappearance from the language of the forms in *er* and *en*, which were earlier used as plurals in English. That they were originally stem and not case suffixes does not affect the point. In Middle English, as in Modern English, *oxen* was spelt as a plural; *oxen* survives, but *eyen*, except in such dialect forms as the Scotch *e'en*, has been replaced by the form in *-s*: *eyes*. Similarly in Middle English the suffix *-er* existed in many words which had been originally of the neuter gender. Thus the plural of *child* was *childer*, of *calf* was *calver*, traces of which, besides the survival in dialect of *childer* and of *calver* (become by the 16th century in northern Scotch *cār*—pronounced as *cahr*—which is still in common use), are to be found in the place, and hence personal, names Childer-ley and Calver-ley. The old plural of *brother* was *brēther*, where the suffix, however, contained an original *-r*, not *-s* changed into *-r*, as did *childer* and *calver*. In Old English, alongside the form for *child* making a plural *childer*, there had been a masculine form making its plural in *-s*. It would not have been surprising therefore if in Modern English the plural of *child* had been *childs*. But in spite of the common tendency to make the plural of all noun-stems in *-s*, *child* has gone in the opposite direction and has not only maintained its *-r*, but has added to it the *-en* of stems like *oxen* and *eyen*. In Wiclif we find a similar plural to calf, *calveren*, but here *calves* has long replaced in the literary language both the earlier forms.

(*b*) Let us now take another instance from the English verb. In Old English the different persons of the preterite indicative in the so-called strong (irregular) verbs were generally distinguished by different root-vowels; *rīdan*, "to ride," and *bindan*, "to bind," for instance, form their preterities thus; *ic rād*, *ðū ride*, *hē rād*, *wē*, *gē*, *hīe ridon*, and *ic band*, *ðū bunde*, *hē band*, *wē*, *gē*, *hīe bundon*. In modern English this difference in the root-vowels has been abandoned, and *rode*, *bound* now stand for all persons, *rode* being the modern phonetic equivalent of the 1st and 3rd sing. *rād*, while *bound* represents the *u-* form of *bindan*. When one form or set of forms ousts other varying forms from the same paradigm, the change is described variously as *material* or *logical* analogy. Inasmuch as a similar process of levelling to that seen in *rode* has been carried through in all preterites of Modern English, regularity prevails even here, though a few traces of the old conflict are still visible in such poetic forms as *sung* for the preterite side by side with *sang*. But when we look to its results in the individual verbs we soon find that the choice amongst the different forms which might have served as starting-points has been entirely arbitrary. It is indeed impossible to say why the old singular form should have been chosen as a model in one case, as in *rode*, and the old plural form in another, as in *bound*. From these and numerous similar instances we must draw the conclusion that it is beyond our power to ascertain whence analogical changes start, and to what extent they may be carried through when once begun. All we can do is to classify carefully the single cases that come under our observation, and in this way to investigate where such changes are especially apt to take place and what is their general direction. As to the latter points, it has been observed before that levelling of existing differences is one of the chief features in analogical change (as in the case of *rode* and *bound*). As to the former, it must be borne in mind that, before any analogical change can take place, some mental connexion must exist between the words or forms serving as models and those which are remodelled after the types suggested to the minds of the speakers through the former. Of such natural mental combinations two classes deserve special notice: the mutual relationship in which the different, say inflexional, forms of the same word stand to each other, and the more abstract analogies between the inflexional system of word-groups bearing a similar character, as, for instance, the different declensions of nouns and pronouns, or the different conjugations of verbs. The instance of *rode*, *bound* may serve to illustrate the former category, that of *books* the latter. In the first case a levelling has taken place between the different forms of the root-vowels once exhibited in the different preterite forms of *rīdan* or *bindan*, which clearly constitute a natural group or mental unity in consequence of their meaning. The form of *rode* as a plural has simply been taken from the old singular *rād*, the long *a* of which has become in *Modern* English *ō*, that of *bound* as a singular from the old plural *bundon*, the *u-* sound of which has in Modern English come to be pronounced as a diphthong. In the case of *book*, *books* for *bōc*, *bēc*, this explanation would fall short. Although we might say that the vowel of the singular here was carried into the plural, yet this would not explain the plural *-s*. So it becomes evident that the old declension of *bōc*, *bēc* was remodelled after the declension of words like *arm*, *arms*, which had always formed their plurals in *-s*. The changes indicated may generally be shown by a proportion, the new analogical formation being the unknown quantity to be ascertained. Thus in the case cited above, *arm*: arms = book: x; and clearly the form to be ascertained is *books*. Isolated words or forms which are no part of natural groups or systems, inflexional, formative or syntactical must be regarded as commonly safe from alterations through analogy, and are therefore of especial value with regard to establishing rules of purely phonetic development.

(*c*) In syntactical analogy the mental connexion between the two series of constructions between which the change takes place is generally still more conspicuous. The connexion may be one of similar or of contrasted meaning. In Latin, adjectives of fullness, like other adjectives, no doubt originally were followed by the genitive case; participles, on the other hand, were followed by the instrumental ablative. Thus Plautus in the *Aulularia* 813 and elsewhere could say *aulam auri plenam*, "a pot full *of* gold," or 802 *aulam onustam auro*, "a pot laden *with* gold." From these the transition was easy to the construction *aulam onustam auri*, as if in English one should say (as was possible in Earlier English), "a pot laden *of* gold." In English, contrasted words often tend to assimilate their syntactical constructions. Thus, the adjectives *like* and *similar* are followed by the preposition *to* (though in Modern English *like* need have no preposition), and upon the analogy of such words, *different* and *averse*, with which correct speakers and writers couple *from*, are by no means rarely followed by *to*. Nor is it uncommon to hear or to see *differ with* instead of *differ from*, upon the analogy of *agree with*. Curiously enough, Latin, from which *differ* is descended, is found to follow the same analogy even in good writers. Thus Cicero (*Academica Pr.* ii. 143) combines *dissidere* with *cum*, as later does Seneca (*Epistulae*, 18. 1).

(*d*) In the development of analogy in meaning, similarity of sound is often the effective cause. Thus *impertinent* is properly *irrelevant, not to the point*, and is still so used in legal language; its more common signification of "saucy" arises from its accidental resemblance in sound to *pert*, a word which curiously enough has reversed its meaning, being now used in the sense of *mal-apert*, while the Old French *apert*, *aspert* (a confusion of Lat. *apertus*, "open," with *expertus*, "skilled"), meant both "open" and "skilful." Thus from very early times the verbs *fly* and *flee* have been confused, though they are of entirely different origins. When Middle English began to lose its verb endings in *-en*, it was very easy for the verb *leren*, "teach," and *lernen*, "learn," to be confused. Hence frequently in Elizabethan English *learn* stands side by side with *teache* in the same signification. Cf. Tottell's Miscellany, p. 129 (Arber):

> "I would not have it thought hereby
> The dolphin swimme I meane to *teache*:
> Nor yet to *learn* the Fawcon flie:
> I rowe not so farre past my reache."

The New School.

It is true that the distinction between phonetic and analogical change has always been acknowledged in comparative philology. At the same time it cannot be denied that analogical changes were for a long time treated with a certain disdain and contempt, as deviations from the only course of development then allowed to be truly "organic" and natural, namely, that of gradual phonetic change (hence the epithet "false" so constantly attached to analogy in former times). Amongst those who have recently contributed most towards a more correct evaluation of analogy as a motive power in language, Professor Whitney must be mentioned in the first place. In Germany Professor Scherer (*Zur Geschichte der deutschen Sprache*, 1868) was the first to apply analogy as a principle of explanation on a larger scale, but in a wilful and unsystematic way. Hence he failed to produce an immediate and lasting impression, and the merit of having introduced into the practice of modern comparative philology a strictly systematic consideration of both phonetic and analogic changes as co-ordinate factors in the development of language rests with Professor Leskien of Leipzig, and a number of younger scholars who had more or less experienced his personal influence. Amongst these Brugmann, Osthoff and Paul rank foremost as the most vigorous and successful defenders of the new method, the correctness of which has since been practically acknowledged by most of the leading philologists of all shades of opinion.

Historical Syntax.

While the syntax of individual languages was one of the first features which attracted the grammarians' attention, at any rate in so far as particular authors differed from a given standard, it is only in very recent times that syntax has received methodical treatment from the comparative point of view. It may indeed be said that almost the whole fabric of the comparative syntax of the Indo-European languages as it exists to-day has been reared by one man—Professor Berthold Delbrück of Jena. In a series of brilliant studies beginning with a pamphlet on the Locative, Ablative, and Instrumental, published in 1867, and continued in his *Syntactical Researches* (*Syntaktische Forschungen*) in five volumes, comprising a treatment of the conjunctive and optative moods in Sanskrit and Greek (1871), the theory of the Sanskrit tenses (1877), the order of words in early Sanskrit prose (Çatapatha Brahmana; 1878), the foundations of Greek syntax (1879), and the syntax of the oldest Sanskrit (*Altindische Syntax*), dealing exclusively with the literature of the Vedas and Brahmaṇas (1888), Professor Delbrück laid the foundations for his treatment of comparative syntax in three volumes (1893, 1897, 1900), which has formed the completion of Brugmann's *Grundriss der vergleichenden Grammatik der indogermanischen Sprachen.* The only work by another hand (on a large department of the subject) which deserves to be mentioned by the side of Delbrück's studies is the small treatise by Hübschmann on the theory of the cases (*Zur Casuslehre*, 1875). For the comparative neglect of this field of investigation there are several reasons. The earlier philologists had so much to do in determining the languages which should be included within the Indo-European group, and in organizing the field of research as a whole, that it is not to be wondered at if they were unable to devote much attention to syntax. In the 'seventies, when attention began to be more directed towards comparative syntax, the remarkable discoveries made by Verner with regard to accentuation, and by Brugmann, Collitz and others with regard to the phonology of the Indo-European languages, again distracted attention from the subject. Moreover, the research in itself is infinitely more difficult than that into sounds and forms; for the latter may be carried on by the help of grammars and dictionaries with a comparatively small knowledge of the literature of any individual language, while on the other hand the study of syntax is impossible without a thorough and intimate knowledge of the literature and modes of expression in each separate language. It is not, therefore, matter for wonder that Delbrück has confined himself in the investigation of syntax to a part only of the languages whose sounds and forms are discussed by Brugmann in the earlier volumes of the *Grundriss*. To cover the whole ground is beyond the powers of a single man, and there is a great lack of preliminary studies on the syntax of many of the languages.

One of the most difficult problems connected with syntax, but primarily, as it appears, a question of morphology, is the origin of grammatical gender. It cannot be said to be an advantage to the languages which possess it, while languages which, like English, have dropped it except for an occasional metaphor, suffer no loss. Nor is the problem confined to the history of gender in the substantive. Even more perplexing is the introduction of gender into the adjective. The pronouns of the first and second persons, which are certainly very old, show no trace of gender; the pronouns of the third person, which are more of the nature of deictic adjectives, generally possess it. To the question how grammatical gender arose in the substantive, the answer was till comparatively recently supposed to be that primitive man was given greatly to personification, endowing inanimate things with life and attributing to them influences benign or the reverse upon his own existence. The answer is not quite sufficient, for though this tendency to personification, which philologists have perhaps unduly decried or altogether denied, might account for life being attributed to inanimate objects, it hardly explains why some should be treated as masculine and others as feminine. Nor is it true, as has also been suggested, that in the case of the lower animals the generic name for the larger and stronger animals is masculine and that for the smaller or weaker feminine. In both Greek and Latin the wolf is masculine and the fox feminine, but the lamb or the chicken which the fox robs from the fold or the henroost is rarely feminine, generally masculine. Nor does this explanation account for the mouse in those languages being of the masculine gender, while the ferret or cat which caught them is feminine (γαλῆ, *feles*). An explanation which completes the theory of personification, if it does not altogether drive it from the field, has been put forward by Brugmann.[1] In its briefest form this explanation is that gender was attached to certain suffixes because they chanced to occur frequently in words which markedly implied sex. In the Indo-European languages the commonest suffix indicating feminine gender is *ā*. According to this theory it had originally nothing to do with gender, but as some early words for woman or wife ended with this sound it came to be identified with feminine gender. Similarly the ending *os* in *o*-stems occurred often in names connected with males and so became identified with the masculine gender. But many stems indicate either gender indifferently, and even the very old sex words *father* and *mother* have the same ending. But when masculine and feminine endings have been attached to certain suffixes in this way, how comes it that in one series of stems the neuter should be marked not by an absence of all suffix but by a separate suffix in *-m*? These are the *o*-stems, other forms of which have been markedly identified with the masculine gender. As this characteristic, like the others mentioned, goes back apparently to a time before the separation of the Indo-European languages, explanation can hardly pass beyond speculation. It is, however, to be noted that the neuter form of the nominative is phonetically identical with the accusative form of the masculine, and it has been ingeniously argued[2] that such forms were used originally in the accusative, such neuters not forming the subject to a verb. To the same writer the most plausible explanation of the presence of gender in the adjective is due, viz. that gender began with the deictic pronoun **so* "that man," **sā* "that woman," and that hence it passed to the adjective with which the pronoun was so frequently accompanied. If this explanation be right, analogy has brought into the Indo-European languages the useless multiplication of gender marks in such sentences as the Latin *hae pulcrae feminae caesae sunt*, where the feminine gender is indicated no less than four times without any obvious gain over the English *These fair women were slain*, where grammatical gender is no longer obviously indicated at all.

Closely related to this question is that of the history of the neuter plural, which was first fully worked out by Professor Johannes Schmidt of Berlin.[3] The curious construction, most common in ancient Greek, whereby a neuter plural is combined with a singular verb, is now demonstrated to be an archaic survival from the time when the neuter plural was a collective singular. Thus a word like the Latin *iugum* was a single yoke, the plural *iuga*, however, which was earlier *iugā*, was a collection of yokes, with the same final *ā* as is found generally in feminine substantives. The declension ought therefore to have been originally: nominative *iugā*, genitive *iugās*, &c., like *mensa*, &c., of the first declension. But as *iuguum* was used in the neuter singular for both nominative and accusative, *iugā* when it was felt as the corresponding plural was used for the accusative as well as the nominative, while the other cases of the plural were taken over from the masculine *o*-stems, with which the singular neuter in *-o-m* was so closely connected. That collective words should be used for the plural is not surprising; the English *youth*, first an abstract, next a collective, and finally an individual, is a case in point.

For the early history of the syntax of the verb Greek and Sanskrit are important above all other languages, because in them the original forms and the original usages are better preserved than they are elsewhere. And it is in the verb that the great difficulties of comparative syntax present themselves. The noun system is so well preserved in several languages that, when the number of the original cases had once been determined, the sifting of the pro-ethnic usages attaching to each case was tolerably easy, for besides Sanskrit and (to a less extent) Latin, Lithuanian and Slavonic have kept the pro-ethnic case system almost complete. The ideas also which had to be expressed by the cases were on the whole of a very concrete character, so that here the problem was much simplified. On the other hand, the ideas expressed by the forms of the verb are of a much more subtle nature, while the verb system in all languages except Greek and Sanskrit has broken down earlier and more completely than the noun. It is clear that the verb of the original Indo-European language possessed two voices, and forms corresponding to what we call the Indicative, Subjunctive, and Optative moods, and to the Present, Imperfect, Future, Aorist, and Perfect tenses. The imperative mood seems primitively to have been confined to the second person singular, just as the vocative, which, like the imperative is a stem form without suffix, was confined to the singular. The infinitive, as is well known, is in all languages of this system not originally a verbal but a substantival form. The pluperfect, where it has developed, seems to be a mixed form arising from the application of aorist endings to a perfect stem. Thus far the history of the verb system is tolerably clear. But when we attempt to define the original meaning of the moods and of the tenses we pass into a region where, in spite of assiduous investigation in many quarters during recent years, the scanty amount of light thrown on the problem has only served to make the darkness visible. As regards the tenses, at least, it has been shown that without doubt there is no difference in formation between present, future and aorist stems, while the earliest meaning of the perfect was that of a special kind of present expressing either repeated or intensive action or a state. It has also been proved that the original meaning of the aorist is not past in time, and that in fact the only element whereby these languages could express remoteness in time was the augment. The augment seems to have been originally a pronominal deictic particle. Thus, as there was no original pluperfect, as neither perfect nor aorist originally referred to past time, and as the future, except in Lithuanian (with slight traces in Slavonic) and the Indo-Iranian group, cannot be clearly distinguished from the aorist, the system as a method of expressing time absolutely breaks down. The tenses in fact did not originally express the times when the action took place, but the type of action which took place. Thus the present system in the main expressed continued or durative action, the aorist only the fact that the action had taken place. The action indicated by the aorist might have been of considerable duration, or it might have been begun and ended in a moment; its characteristics in this respect are not in any way indicated by the aorist form, which intimates only that the action is viewed as a completed whole and not as a continuous process. The present system, however, is built up in a great variety of ways (thirty-two according to Brugmann's enumeration). It is a priori unlikely that such a multiplicity of formations had not originally some reason for its existence, and Delbrück thinks that he has discovered a difference in syntactical value between various forms. The reduplicated present forms of the type seen in Sanskrit *jígāti*, Greek *δίδωμι*, &c., he regards as expressing originally an action which consisted of repeated acts of the same nature (iterative), though this iterative meaning frequently passed into an intensive meaning. Presents of the type seen in Sanskrit *tṛ́ṣyati*, "is thirsty," and Greek *χαίρω*, "am glad" (for **χαρι̯ω*), where the *ι̯* (*y*) of the suffix has modified the first syllable and disappeared, he regards as *cursive—i.e.* they express continuous action without reference to its beginning or end. Verbs which have regard to the beginning or end of the action he calls terminative, and finds them represented (*a*) in verbs with *-n-* suffixes, Sanskrit *ṛṇóti*, *ὄρνυσι*, "sets in motion," *ἄγνυμι*, "break to pieces"; (*b*) in verbs with the suffix *-sko-*, Sanskrit *gáchati*, "goes" (to a definite destination), Greek *βάσκω*, &c. The roots he classifies as momentary (punktuell) or non-momentary, according as they do or do not express an action which is begun and ended at once.

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[1] Techmer's *Internationale Zeitschrift für Sprachwissenschaft*, iv. 100.

[2] B. I. Wheeler, *Journal of Germanic Philology*, ii. 528 sqq.

[3] *Pluralbildungen der indogermanischen Neutra* (1889).

This method of classification was no doubt suggested in the first instance by the characteristics of the Slavonic verb system. In this system a clear distinction is drawn in nearly all verbs between those which express a process (durative verbs) and those which express a completed action (perfective verbs). When perfective and durative verbs are formed from the same root, the perfective are distinguished from the durative forms (*a*) by having a preposition prefixed, or (*b*) by having a different stem formation. Thus in the Old Bulgarian (Old Ecclesiastical Slavonic) *to strike* (hit) and *to strike dead* are expressed by the same verb, but in the latter meaning a preposition is found which does not appear in the former, *biti* (infinitive), "to strike"; *u-biti*, "to strike dead." *To strike* is *durative*; *to strike dead* is *perfective*. As an example of difference of stem formation expressing this difference of meaning, we may quote *sěsti*, "to sit down" (perfective), *sědtěi*, "to sit" (durative). Verbs with a suffix in *-n-* have often a perfective meaning: cf. the Sanskrit and Greek verbs quoted above. The *perfective* verbs correspond in meaning to the Greek aorist, and are to be carefully distinguished from *perfect* forms. The same distinction of meaning is often achieved in other languages also by means of prepositions, *e.g.* in Latin (Seneca, *Epp.* xciii. 10), *Quid autem ad rem pertinet, quamdiu* vites, *quod* evitare *non possis?* "What does it matter how long you go on avoiding [durative] what you cannot escape [perfective]." From this example, however, it is clear that, though the means employed to make the distinction are different, there is no difference in meaning between such perfective verbs and those classified by Delbrück as terminative. Here, as in many other parts of this study, the ideas are new, and grammatical terminology has not yet sufficiently crystallized, and still leaves something to be desired both in clearness and in precision.

As regards the moods, the difficulty has been to find any criterion whereby the functions of one mood should be differentiated from those of the others. It has long been recognized that the difference between indicative and subjunctive is one of meaning and not one of formation; that, *e.g.*, in Sanskrit *bharati* (3rd sing. pres. indic.), "bears," is morphologically identical with *hanati*, "may slay" (3rd sing. pres. subj.), and that the latter is described as a subjunctive only because of the meaning, and because there exists a dissyllabic form, *hanti*, which makes the indicative "slays." Similarly in Greek it is impossible to distinguish morphologically between *παύσω*, "I shall check" (fut. indic.) and *παύσω*, "let me check" (1st aor. subj.). Moreover, in the earliest forms of the languages which preserve the moods best (Greek and Sanskrit), the connexion syntactically between the indicative and the subjunctive forms is closest. Not only does the future express futurity, but also the determination of the subject to carry out the action expressed, which, in Delbrück's discussion of the moods, is precisely the point chosen as characteristic of the subjunctive. On the other hand, the present optative differs from the present (and future) indicative and present subjunctive in having a special mood suffix, and in having secondary while they have primary personal endings. Nevertheless its meaning overlaps that of the other forms, and some excellent authorities, like Professor W. W. Goodwin, see in future indicative, subjunctive and optative only different degrees of remoteness in the future, the remoteness being least in the future and greatest in the optative. Delbrück, however, abides, with slight modifications, by the distinction which he propounded in 1871 that the subjunctive expresses Will and the optative Wish. Here again the problem has not been solved, and it is doubtful how far any definite solution is likely to be arrived at, since there are so many gaps in our knowledge of mood forms. These gaps, owing to the break-up of the system at so early a period, it is hardly probable we shall ever be able to fill. It is possible, however, to do a great deal more than has yet been done even in the most familiar languages. In Latin, for instance, even now, the facts for the uses of the moods within the two centuries of the classical period are very imperfectly known, and it is no exaggeration to say that more has been done in the last hundred years for Sanskrit than has been done in two thousand years of continuous study for Latin or Greek.

A still later addition to the domain of Philology—the study of meaning—presents fewer difficulties, but until recent years has been equally neglected. The study is so recent that the literature of the subject is still extremely small. The only attempts to deal with it on a large scale are M. Bréal's *Essai de Sémantique* (1897), now translated into English under the title of *Semantics* (1900), with a valuable introduction and appendix by Dr Postgate, and M. de la Grasserie's *Essai d'une Sémantique integrale* (1908), a work which deserves mention for its attempt to make a thorough classification and a corresponding terminology for semantic phenomena, but the value of which is much diminished by hasty compilation and imperfect knowledge of many of the languages quoted. From the practical point of view many of the phenomena have been classified in works on rhetoric under the headings of Metaphor, Synecdoche and Metonymy. The psychological principle behind this superficial classification is that of association of ideas. Here, as elsewhere, changes proceed not by accident, but according to definite principles. Here, as elsewhere in language, in history, and the other moral sciences, the particular principle in operation can be ascertained only by beginning with the result and working back to the cause. In the development of meaning much more than in phonetics is this necessarily the case. In phonetics all speakers of the same dialect start with approximately the same sound. But the same combination of sounds which we call a word does not recall the same idea to all persons who use that word. The idea that the phrase *railway station* calls up in the mind of a Londoner is very different from that which occurs to the mind of a child acquainted only with a wayside station serving the wants of a country village of a few hundred inhabitants. The word *herring* suggests one idea or train of ideas to the fisherman who catches the fish, another to the merchant who purchases it from the fisherman, a third to the domestic who cooks it, and so on. To members of the same family the same word may often have widely different associations, and, if so, the metaphors for which the word will be employed will differ in each case.

For the history of meaning it is necessary to have regard to all the forms of association of ideas which psychology recognizes. These are contiguity in place or in time, resemblance and contrast. Contrast, however, as J. S. Mill and Bain have shown, is not a simple form of association, but is evolved partly from contiguity, partly from resemblance. An artificial hollow generally implies also an artificial height made of the materials excavated from the hollow. Hence in most languages some words occur with the two contrasted meanings. Thus in English we find *dyke* in use both for a ditch and for a mound fronted by a ditch, the word *ditch* being, in fact, but a dialectal form of *dyke*. In Scotland, on the other hand, where earthen mounds and stone walls form more frequent boundaries between fields than in England, the word *dyke* is now practically limited to elevated boundaries, while *ditch* is limited to excavated boundaries. Thus the proverb, "February fill dyke," which in England implies that the February rains will fill the ditches, is often understood in Scotland to mean that in February the snow will be level with the tops of the stone or turf walls. Similarly in Latin Tacitus can say *fossas proruere*, which can only apply to levelling raised mounds; while in Greek Xenophon also talks of the ditch (trench) thrown up (*τάφρος ἀναβεβλημένη*). It is only natural, therefore, that other words with several meanings should be used similarly: *moat*, originally a mound of earth or peat, has come to mean a big ditch; while, conversely, soldiers in trenches are not so much in ditches, as the word ought to signify, as behind breastworks. Sometimes, when two actions opposed to one another are contiguous, a word seems to change to the exact opposite of its original meaning. Thus the English verb *wean*, which meant originally to accustom (to cooked food), has been transferred to the necessary preliminary, to disaccustom to the breast.

Resemblances may be (i.) genuine, and (*a*) of external appearance, or (*b*) of other characteristics; or (ii.) fanciful or analogical. From resemblance in the external appearance of the object, the word *gem*, which in Latin (*gemma*) usually means a bud, has come to mean first a pearl and then by extension of the meaning any precious stone. From the concentric coats which appear in both, the Latin word for a pearl (*unio*, acc. *unionem*) appears in English as *onien*. Examples where the characteristics are not of external appearance are such as the German *kaiser* and the Russian *tsar*, which are descended from Julius Caesar, while the Lithuanian word for king—*karālius*—is *Carolus*, *i.e.* Charlemagne. So in modern Persian, *Xusrev*, "Lord," comes from the Zend proper name Husravah (Chosroes). As already pointed out, the resemblances which have established a connexion between *pert* and *impertinent* (properly irrelevant) are in sound only. The same is true of the supposed relation of the verb *cut* to *cutlass*, *cutler* and *cutlet*. While *train oil* really means oil in drops like tears (cf. German *Thräne*), most people connect it with railway trains. The resemblance in some cases is merely in function. Thus, though the fir and the oak have no resemblance one to the other, the word *fir* is now generally identified with the Latin *quercus* in etymology (cf. *four* and *quattuor*), in the same way as the Latin *fagus*, "beech," is with the Greek φηγός, "oak," the users of the word having, in the course of their migrations, passed from a land with oaks to a land with firs in the one case, and from a land of beeches to a land of oaks in the other. Resemblance as the basis of metaphor has a very widely extended influence on language.

The most numerous and most varied forms of change in meaning depend, however, upon the law of contiguity. Perhaps the commonest of all forms of contiguity is that where the word indicating some accompanying feature or condition replaces the word for the object referred to. In the countries that border the Mediterranean the heat of midday is accompanied and intensified by the dying away of the wind, a characteristic remarked upon by Aeschylus (*Agam.* 565): "What time upon his noonday couch, windless and waveless sank the sea to rest." From the Greek word καῦμα, "burning heat," arises through Late Latin the English *calm*, where the absence of wind is the only idea present, that of heat having altogether disappeared. Again, in *bugle*, which is abbreviated for *buglehorn*, the word which survives properly means *wild ox*, and the originally more important element is lost. In a combination like *silver bugle* the word has gone a stage further; the original meaning of horn has also disappeared. There is no longer any thought of an animal's horn; the only idea that survives is that of a musical instrument. From the cope or cloak (*capella*) of St Martin, which was preserved as a sacred relic by the Frankish kings, comes the word *chapel*. The word was first transferred from the cloak to the holy place wherein it was kept, and thence to similar shrines, and ultimately to any place, not being a church, where prayers were said. A *jig* was originally not the dance, but the fiddle which supplied the music for the dance. The names of liquors are often replaced by some accompaniment as of the place, *port*, *sherry*, *champagne*, or by a qualifying adjective as in *brandy*, properly "burnt," from the Dutch *brandewijn*; or, again, only the less important element of the word is retained as in *whisky*, literally "water," for the older *usquebaugh*, a corruption of Gaelic words meaning the "water of life" (*aqua vitae*). Replacement of substantives by their accompanying adjectives is common in most languages. One of the most common methods of coining a name for a new article is to give it the name of the place or people whence it comes. Thus we have arras, lawn (from Laon), cravat (Croat), coach from Kocs in Hungary, bilboes (both fetters and swords) from the iron mines of Bilboa in Spain. Equally common are the names of inventors—pinchbeck, tontine, silhouette, guillotine, derrick. In the word *cash*, which comes indirectly from Latin *capsa*, "a box," the thing contained has taken its name from the container. Similarly *mortar*, "cement," derives its name from the mortar in which it was mixed, while in *box* the material (boxwood, Lat. *buxus*, Greek, πύξος) has usurped the place of the article made. In *leper* the disease (Lat. *lepra*, the rough disease, from Greek, λεπρὰ νόσος) has been made into the name of the sufferer, who was earlier called a leprous man. As a consequence, a new substantive *leprosy* has to be taken from the adjective to indicate the disease. The various changes in meaning, which are classed together as synecdoche, have their origin in contiguity. Thus we have the species for the genus; the butcher, who properly kills goats only (Old French *boc*), has ousted the flesher. But we have also the genus for the species; corn, as a rule, means in England wheat; in Scotland oats; in America, maize. The individual becomes collective as in corps, navy, body (of men); the collective becomes individual when Latin *racemus*, "bunch of grapes," passes into English "raisin." Here would come the so-called meliorative and pejorative developments in word-meaning, whereby, *e.g.* *steward*, "the sty-ward," becomes the title of a great officer of the realm and the name of a line of kings; or, on the other side, *sou* (Latin *solidus*) passes from the name of a gold coin to that of one of proverbially insignificant value. Here, too, would come many euphemistic uses which are, for the most part, applications of more general terms to avoid the mention of some specific act or object which is unpleasant, as death, murder, bankruptcy, debt, &c., while metaphorical terms for the same things come under resemblance. These examples do not exhaust the forms of contiguity which appear in language, but they are enough to show how far-reaching the effect of this type of association of ideas is upon language, and how extensive the field is which still calls for investigation before the study of meaning attains the same development as the investigation of the other branches of the history of language.

Authorities (since 1885).—For methods of Linguistic Study: Paul, *Principien der Sprachgeschichte* (3rd ed., 1898); Von der Gabelentz, *Die Sprachwissenschaft* (2nd ed., 1901); Strong, Logeman & Wheeler, *The History of Language* (1891), an adaptation of the ideas of Paul's *Principien*, with many excellent examples; van Ginneken, *Principes de Linguistique psychologique* (1907). For the Controversy regarding Phonetic Laws: Curtius, *Zur Kritik der neuesten Sprachforschung*; Brugmann, *Zum heutigen Stand der Sprachwissenschaft*; Schuchardt, *Über die Lautgesetze: gegen die Junggrammatiker* (all in 1885); Tarbell, "Phonetic Law," in *Transactions of American Philological Association* for 1886, pp. 1 sqq.; Wechssler, "Giebt es Lautgesetze?" (1900), Sonderabzug aus *Forschungen zur romanischen Philologie*: Festgabe für Hermann Suchier; Wundt, *Die Völkerpsychologie* (1900), vol. i.; Oertel, *Lectures on the Study of Language* (1901), lecture iv. For Analogy: Wheeler, "Analogy and the Scope of its Application in Language" (1887), *Cornell University Studies in Classical Philology*. For the Classification of Languages: Misteli, *Characteristik der hauptsächlichsten Typen des Sprachbaues* (1893). For the Phonology, Morphology and Syntax of the Indo-European Languages: Brugmann and Delbrück, *Grundriss der vergleichenden Grammatik der indogermanischen Sprachen* (1886–1900); a new edition of the *Phonology* by Brugmann in 1897, of the stem-formations and inflexion of Nouns, Adjectives, Pronouns and Numerals in two parts (1906, 1909); the first edition of the *Phonology and Morphology*, translated into English in four volumes by Wright, Conway and Rouse. For Discussion of Contested Points: Bechtel, *Die Hauptprobleme der indo-germanischen Lautlehre* (1892). For Syntax: Delbrück, in the works mentioned, in the text. For Semantics: besides Bréal and Postgate, see Wundt, *Die Völkerpsychologie*, vol. i. pt. 2, and articles by John Grote in the *Journal of Philology*, vols. iv. and v. A bibliography of the works which have appeared since 1890 will be found in the *Anzeiger für indogermanische Sprach- und Altertumskunde: Beiblatt zu den indogermanischen Forschungen redigiert*, by W. Streitberg. (P. Gi.; E. Si.)

Summary of Philological Articles

In addition to the genetic classification of languages given above (on pp. 426–429), some further guidance as to the actual headings under which the philological section is arranged may be of service to the student.

The pivot of the whole section is the article Alphabet, which traces the history of language and writing to the earliest stages, embodying the results of archaeological studies in all countries, together with the general conclusions based thereon. In this article (with further details under Crete) will be found an account of the controversy regarding the Cretan discoveries of Dr A. J. Evans. Supplementary to this comparative survey are the articles Palaeography, Inscriptions, Writing and Phonetics. The first two deal with ancient documents of all kinds: Palaeography with those specimens of ancient writing, literary, economic or legal, which were committed to codices, tablets or rolls by the use of the stilus, the reed or the pen; Inscriptions with documents engraved on stone or metal.

Writing deals, chiefly from the anthropological standpoint, with primitive attempts to record ideas in an intelligible form, *e.g.* with "knot-signs," "message-sticks," picture-writing and the like. Phonetics covers the whole subject of speech sounds and pronunciation, the organs of speech and national sound systems.

Supplementary, from another point of view, to the article Alphabet is a complete series of articles on the letters of the English alphabet. In these articles the history of the individual letters is traced from the Phoenician through Aramaic, Greek and Roman to modern times. All these articles may be read in connexion with a comparative table in the article Alphabet (*ad fin.*), which shows in parallel columns the earliest equivalents of the modern English letters, *i.e.* Brahmi, Kharoṣṭhi, oldest Æthiopic, Sabæan, Nashki, Tema, Sindjirli, the Moabite stone, Phoenician, Greek, Latin, Cyrillic and Glagolitic. Another important comparative table of written signs is contained in the article Slavs, showing the various Cyrillic, Glagolitic and Latin letters used by the Slav peoples.

Passing from articles dealing with the method and general subject-matter of philology, the student will find articles on the great families of languages, each with its subordinate articles on special languages and dialects.

1. *Indo-European Languages.*—Of articles on language-families, the most important is that under the heading Indo-European Languages. This great division, which is dealt with from the comparative standpoint in the second part of the article Philology, is under its own heading treated in detail. The article begins with a sub-classification into two main groups—the so-called (A) *centum* and (B) *satem* groups—each of which is further divided into four sections. In accordance with this classification there are separate articles on the individual ancient and modern languages and dialects.

A. (1) Greek Language (supplemented by sections under Homer, Dorians, &c.); (2) Latin Language (with Osca Lingua, Iguvium, &c., and articles on the Italic tribes and places, *e.g.* Veneti, Caere); (3) Celtic, *s.v.* Celt (with subsidiary articles); and (4) Teutonic, *s.v.* Teutonic Languages, Scandinavian Languages, and the like.

The modern descendants of these languages are all further treated separately. Thus following Latin Language is the article Romance Languages, which traces the development of the Latin tongue during its gradual differentiation into Italian, French, Spanish, Rumanian, &c.; while a more detailed account of these will be found under Italian Language; French Language; Spain: *Language*; Rumania: *Language*. There is also a special article Provençal Language, dealing with the Romanic speech of southern France. The Teutonic languages are similarly dealt with in detail under English Language (including Anglo-Saxon); Dutch Language; German Language. Scandinavian Language itself includes Icelandic, Norwegian, Swedish, Danish.

B. In the *satem* group of the Indo-European family the four divisions are as follows:—

(1) Indo-Iranian or Aryan. This division may be subdivided into (*a*) Indo-Iranian, treated mainly in the article Persia: *Language and Literature* (including Zend, Old, Middle and New Persian, and the modern dialects), and (*b*) Indian. The Indian languages are discussed primarily under Indo-Aryan Languages, which describes the relations of *Pisaca, Sanskrit, Prakrit,* and gives a paradigm of the various languages of the three great divisions of India. This central article refers to the separate articles Pisaca, Sanskrit and Prakrit, which in turn are supplemented by a number of articles on particular languages. Of these reference may be made to Bengali; Bihari; Gujarati and Rajasthani; Hindostani; Kashmiri; Marathi; Pali. The gipsy languages, which may probably be assigned to the Indo-Iranian division, are described under Gipsies.

(2) The account of Armenian will be found under Armenian Language and Literature.

(3) The Balto-Slavonic Languages. Of these the three comprised in the Baltic group, viz. Lithuanian, Lettic and Old Prussian, are described under the heading Lithuanians and Letts. For the Slavonic group, the chief article is Slavs: *Language*, which deals with the elements common to all the Slavonic tongues, with their early history and differentiation. It contains a comparative table of alphabets. It is supplemented by an article Old Slavonic, and by further information under the headings Russia, Bulgaria, Servia, Poland, Bohemia, Croatia-Slavonia, Slovaks, Slovenes, Sorbs, Kashubes, Polabs.

(4) The Albanian dialects are treated under Albania.

2. *Semitic Languages.*—At the heading of this section stands the article Semitic Languages, supplemented by Hebrew Language, Aramaic Languages, and linguistic sections under Phoenicia, Ethiopia, and the like.

3. *Hamitic Languages.*—The central article in this family is Hamitic Languages, which is supplemented, so far as the Cushitic or Ethiopian group is concerned, by further information in the articles Egypt; Ethiopia; Abyssinia; Somaliland; and, so far as the Libyan group is concerned, by the articles Berbers and Kabyles.

4. The chief feature of the *Monosyllabic* family is the section *Language* under China, supplemented again by similar sections in articles on other countries of south-eastern Asia, and by the article Tibeto-Burman Languages. There is also a language section under Japan which discusses the affinities between Chinese, Korean and Japanese.

5. The *Ural-Altaic* family is described in outline in the article Ural-Altaic, which gives the general relationships of Turkish, Finno-Ugrian, Mongol and Manchu, and of minor subdivisions such as Syryenian, Mordvinian and Votyak. Turkish is discussed in the article Turks: *Language*, which deals with Osmanli proper and the Tatar-Turkish languages generally. The article Finno-Ugrian is a comparative survey dealing with the language of the Finns, Lapps, Samoyedes, &c.; while Magyar is treated separately in Hungary: *Language*. Under Mongols there is a special section *Language*, discussing the three groups of East Mongol, West Mongol (including Kalmuck) and Buriat.

6. The principal languages of southern India, *e.g.* Tamil, Malayālam, Kanarese, Telugu, &c., are dealt with generally under the heading Dravidian; while there is a separate article Tamils, containing a section on their language; and brief notes under the headings Brahui, Telugu, Malayālam, &c.

7 and 8. The scattered languages of the Malay-Polynesian family and other Oceanic peoples are treated principally in the article Malays, which further information is given under the headings Polynesia; Samoa; Java; Negritos, Battas, &c.

9. The Caucasian family is described chiefly in the article Georgia: *Ethnology*. Further information will be found in Caucasia: *Ethnology*.

10. Of the remaining European languages only two need special mention: Basque, which is treated in a special section under the heading Basques; and the lost Etruscan, which is treated under Etruria and Latin Language.

11. The principal languages of southern and central Africa are treated fully under Bantu Languages. There is a brief account of the Bushman language under Bushmen, and of the Hottentot languages under Hottentots.

12. *Intermediate African Languages.*—Among the numerous languages spoken by the people of the great central belt of the African continent, the most important is the Hausa, described under that heading.

13. *America.*—The whole question of the languages of the North American Indians is dealt with in the article Indians, North American, which contains an elaborate linguistic paradigm.

Bibliographical information will be found in practically all the above headings. In addition to the most modern authorities there quoted, there will be found in the article Dictionary a very full list of older lexicographical works.

The above summary does not purport to present dogmatically a rigid philological classification. It disregards many problems, and is intended solely to enable the student readily to find the material of which he may be in search.

PHILOMEL (Fr. *Philomèle*; Ger. *Philomele* or *Stahlgeige*), a musical instrument similar to the violin, but having four steel, wire strings. The philomel has a body with incurvations similar to those of the guitar; therefore, without corner blocks, the outline of the upper lobe forms a wavy shoulder reminiscent of the viols but more ornate and fanciful. The peg-box sometimes terminates in a fancy head instead of a scroll. The philomel, never used in the orchestra, is the instrument of the dilettanti, frequently played in Germany with the bowed zither. The accordance of the philomel is the same as for the violin; the timbre is shrill and crystal-like. There is also an alto philomel corresponding to the viola. The bowed melodion is similar to the philomel, and has four steel strings of the same accordance as the violin, but arranged in inverse order; instead of being held like the violin and philomel, under the chin, it is placed on the knees of the performer, so that a hook under the fingerboard rests against the table. (K. S.)

PHILON, Athenian architect of the 4th century B.C., is known as the planner of two important works—the portico of the great Hall of the Mysteries at Eleusis and an arsenal at Athens. Of the last we have exact knowledge from an inscription. E. A. Gardner (*Ancient Athens*, p. 557) observes that it "is perhaps known to us more in detail than any other lost monument of antiquity." It was to hold the rigging of the galleys; and was so contrived that all its contents were visible from a central hall, and so liable to the inspection of the Athenian democracy. (See Athens.)

PHILOPATRIS, the title of a dialogue formerly attributed to Lucian, but now generally admitted to be spurious. Its date and purport have long formed the subject of discussion. The scene is laid at Constantinople. A certain Triephon, who has been converted to Christianity by a bald, long-nosed Galilaean, who was carried up through the air into the third heaven (an evident allusion to St Paul), meets a friend, Critias, who is in a state of great excitement. Triephon inquires the reason, and the invocation of Zeus by Critias leads to a discussion on paganism and Christianity, in which all the gods proposed by Critias are rejected by Triephon, who finally suggests that Critias should swear by the Trinity. (The sub-title, ἢ διδασκόμενος, refers to this "instruction" of Critias in matters relating to Christianity.) Critias goes on to relate how he had been introduced to a gathering of pessimists, who predicted all kinds of disturbances in the empire and defeat at the hands of its enemies. In the meantime a third person appears on the scene, with the news that the imperial armies have obtained a glorious victory. The hope is expressed that Babel (Bagdad, the chief city of the caliphs) may soon be destroyed, Egypt subdued (that is, reconquered from the Arabs), and the attacks of the Scythians (Russians or Bulgarians) repulsed. The whole concludes with thanks to the unknown god of Athens that they have been permitted to be the subjects of such an emperor and the inhabitants of such an empire. The *Philopatris* was for a long time regarded as an attack upon Christianity, and assigned to the time of Julian the Apostate (emperor 361–363). Chronological indications (*e.g.* the allusion to a massacre of women in Crete) led Niebuhr to ascribe it to the reign of Nicephorus Phocas (963–969), and this view is now generally supported. There being at that time no pagans in Constantinople, the "pessimists" referred to must be Christians—either monks, especially the intimate friends of the patriarch of Constantinople, who, aggrieved at the measures taken by Phocas in regard to the property of the Church, were ready to welcome the defeat of the imperial arms and the ruin of the empire; or harmless visionaries, who claimed to predict the future by fasting, prayer and vigil. In any case, the author, whether he was a sophist commissioned by Phocas to attack the monks, or some professor who hoped to profit by singing the imperial praises, represents the views of the "patriotic" (as the title shows) as opposed to the "unpatriotic" party. According to another view, which assigns the dialogue to the time of Heraclius (610–641), the author was a Christian fanatic, whose object was to make known the existence of a conventicle of belated pagans, the enemies alike of the Christian faith and the empire; it is doubtful, however, whether such a pagan community, sufficiently numerous to be of importance, actually existed at that date. The object of the first and longer portion of the dialogue was to combat the humanism of the period, which threatened a revival of polytheism as a rival of Christianity.

Bibliography.—Editions by J. M. Gesner (1715) and C. B. Hase in the Bonn *Corpus scriptorum hist. byz.* (1828), vol. xi.; also included in Jacobitz's edition of Lucian (1839). See R. Crampe, *Philopatris. Ein heidnisches Konventikel des siebenten Jahrhunderts zu Constantinopel* (1894); R. Garnett, "Alms for Oblivion" in *Cornhill Magazine* (May, 1901); C. Stach, *De Philopatride* (Cracow, 1894), who shows its late origin by linguistic tests; S. Reinach in *Revue archéologique* (1902), vol. i.; B. G. Niebuhr, "Ueber das Alter des Dialogs Philopatris" in his *Kleine historische Schriften* (1843), vol. ii. and, for further authorities, article by Von Dobschütz in Herzog-Hauck's *Realencyklopädie für protestantische Theologie* (1904).

PHILOPOEMEN (253–184 B.C.), Greek general, was born at Megalopolis, and educated by the academic philosophers Ecdemus and Demophanes or Megalophanes, who had distinguished themselves as champions of freedom. Avoiding the fashionable and luxurious gymnasia, he devoted himself to military studies, hunting and border forays. In 233–2 Philopoemen skilfully evacuated Megalopolis before the attack of Cleomenes III., and distinguished himself at Sellasia (222). The next eleven years he spent as a condottiere in Crete. Elected commander of the League's cavalry on his return, he reorganized that force and defeated the Aetolians on the Elean frontier (210). Appointed to the chief command two years later, he introduced heavy armour and close formation for the infantry, and with a well-trained army beat Machanidas of Sparta, near Mantinea. The new "liberator" was now so famous that Philip V. of Macedon attempted to poison him. In 202–1 Philopoemen drove Nabis, the Spartan tyrant, from Messene and routed him off Tegea. After another long sojourn in Crete he again received the command against Nabis. Though unsuccessful at sea, he almost annihilated Nabis's land force near Gythium, but was prevented by the Roman Flamininus from taking Sparta. In 190 Philopoemen protected Sparta, which meanwhile had joined the League and thereupon seceded, but punished a renewed defection so cruelly as to draw the censure of Rome upon his country. At Messene he likewise checked a revolt (189), but when that city again rebelled, in 184, he was captured in a skirmish and promptly executed. His body was recovered by the Achaeans and buried with great solemnity.

Philopoemen's great merit lies in his having restored to his compatriots that military efficiency without which the Achaean League for all its skilful diplomacy could never stand. Towards Rome he advocated a courteous but independent attitude. In politics he was a democrat, and introduced reforms of a popular character (see Achaean League).

Polybius' *Histories* (x.–xxiii.) are our chief authority. These and a special treatise on Philopoemen (now lost) were used by Plutarch (*Philopoemen*), Pausanias (viii. 49–51), Livy (xxxi.–xxxviii.), and indirectly by Justin (xxx.–xxxiv.).

PHILOPONUS, JOANNES (John the Grammarian), Greek philosopher of Alexandria, lived in the later part of the 5th and the beginning of the 6th century of our era. The surname *Grammaticus* he assumed in virtue of his lectures on language and literature; that of *Philoponus* owing to the large number of treatises he composed. He was a pupil of Ammonius Hermiae, and is supposed to have written the life of Aristotle sometimes attributed to his master. To Philoponus are attributed a large number of works on theology and philosophy. It is said that, though he was a pupil of Ammonius, he was at first a Christian, and he has been credited with the authorship of a commentary on the Mosaic Cosmogony in eight books, dedicated to Sergius, patriarch of Constantinople, and edited by Balthasar Corderius in 1630. Other authorities maintain that this, as well as the *Disputatio de paschale*, was the work of another author, John the Tritheist. It was perhaps this Philoponus who tried to save the Alexandrian library from the caliph Omar after Amu's victory in 639.

The more certain writings of Philoponus consist of commentaries on Aristotle. These include works on the *Physica*, the *Prior* and the *Posterior Analytics*, the *Meteorologica*, the *De anima*, the *De generatione animalium*, the *De generatione et interitu* and the *Metaphysica*. These have been frequently edited and are interesting in connexion with the adoption of Aristotelianism by the Christian Church. They seem to have embodied the lectures of Ammonius with additions by Philoponus, and are remarkable rather for elaborate care than for originality and insight. He wrote also an attack on Proclus (*De aeternitate mundi*). Two treatises on mathematics are ascribed to him: *A Commentary on the Mathematics of Nicomachus*, edited by Hoche (1864 and 1867), and a *Treatise on the Use of the Astrolabe*, published by Hase. The latter is the most ancient work on this instrument, and its authenticity is rendered almost certain by its reference to Ammonius as the master of the author.

PHILOSOPHY (Gr. φίλος, fond of, and σοφία, wisdom), a general term whose meaning and scope have varied very considerably according to the usage of different authors and different ages. It can best be explained by a survey of the steps by which philosophy differentiated itself, in the history of Greek thought, from the idea of knowledge and culture in general. These steps may be traced in the gradual specification of the term. The tradition which assigns the first employment of the Greek word φιλοσοφία to Pythagoras has hardly any claim to be regarded as authentic; and the somewhat self-conscious modesty to which Diogenes Laërtius attributes the choice of the designation is, in all probability, a piece of etymology crystallized into narrative. It is true that, as a matter of fact, the earliest uses of the word (the verb φιλοσοφεῖν occurs in Herodotus and Thucydides) imply the idea of the *pursuit* of knowledge; but the distinction between the σοφός, or wise man, and the φιλόσοφος, or lover of wisdom, appears first in the Platonic writings, and lends itself naturally to the so-called Socratic irony. The same thought is to be found in Xenophon, and is doubtless to be attributed to the historical Socrates. But the word soon lost this special implication. What is of real interest to us is to trace the progress from the idea of the philosopher as occupied with any and every department of knowledge to that which assigns him a special kind of knowledge as his province.

A specific sense of the word first meets us in Plato, who defines the philosopher as one who apprehends the essence or reality of things in opposition to the man who dwells in appearances and the shows of sense. The philosophers, he says, " are those who are able to grasp the eternal and immutable"; they are "those who set their affections on that which in each case really exists" (*Rep.* 480). In Plato, however, this distinction is applied chiefly in an ethical and religious direction; and, while it defines philosophy, so far correctly, as the endeavour to express what things are in their ultimate constitution, it is not yet accompanied by a sufficient differentiation of the subsidiary inquiries by which this ultimate question may be approached. Logic, ethics and physics, psychology, theory of knowledge and metaphysics are all fused together by Plato in a semi-religious synthesis. It is not till we come to Aristotle—the encyclopaedist of the ancient world—that we find a demarcation of the different philosophic disciplines corresponding, in the main, to that still current. The earliest philosophers, or " physiologers," had occupied themselves chiefly with what we may call cosmology; the one question which covers everything for them is that of the underlying substance of the world around them, and they essay to answer this question, so to speak, by simple inspection. In Socrates and Plato, on the other hand, the start is made from a consideration of man's moral and intellectual activity; but knowledge and action are confused with one another, as in the Socratic doctrine that virtue is knowledge. To this correspond the Platonic confusion of logic and ethics and the attempt to substitute a theory of concepts for a metaphysic of reality. Aristotle's methodic intellect led him to separate the different aspects of reality here confounded. He became the founder of logic, psychology, ethics and aesthetics as separate sciences; while he prefixed to all such (comparatively) special inquiries the investigation of the ultimate nature of existence as such, or of those first principles which are common to, and presupposed in, every narrower field of knowledge. For this investigation Aristotle's most usual name is "first philosophy" or, as a modern might say, "first principles"; but there has since been appropriated to it, apparently by accident, the title " metaphysics." " Philosophy," as a term of general application, was not, indeed restricted by Aristotle or his successors to the disciplines just enumerated. Aristotle himself includes under the title, besides mathematics, all his physical inquiries. It was only in the Alexandrian period, as Zeller points out, that the special sciences attained to independent cultivation Nevertheless, as the mass of knowledge accumulated, it naturally came about that the name " philosophy " ceased to be applied to inquiries concerned with the particulars as such. The details of physics, for example, were abandoned to the scientific specialist, and philosophy restricted itself in this department to the question of the relation of the physical universe to the ultimate ground or author of things. This inquiry which was long called " rational cosmology," may be said to form part of the general subject of metaphysics, or at all events a pendant to it. By the gradual sifting out of the special sciences philosophy thus came to embrace primarily the inquiries grouped as " metaphysics " or " first philosophy." These would embrace, according to the Wolffian scheme long current in philosophical textbooks, ontology proper, or the science of being as such, with its three-branch sciences of (rational) psychology, cosmology and (rational or natural) theology, dealing with the three chief forms of being—the soul, the world and God. Subsidiary to metaphysics, as the central inquiry, stand the sciences of logic and ethics, to which may be added aesthetics, constituting three normative sciences—sciences, that is, which do not, primarily, describe facts, but rather prescribe ends or set forth ideals. It is evident, however, that if logic deals with conceptions which may be considered constitutive of knowledge as such, and if ethics deals with the harmonious realization of human life, which is the highest known form of existence, both sciences must have a great deal of weight in the settling of the general question of metaphysics.

In sum, then, we may say that " philosophy " has come to be understood at least in modern times as a general term covering the various disciplines just enumerated. It has frequently tended, however, and still tends, to be used as specially convertible with the narrower term " metaphysics." This is not unnatural, seeing that it is only so far as they bear on the one central question of the nature of existence that philosophy spreads its mantle over psychology, logic or ethics. The particular organic conditions of perception and the associative laws to which the mind, as a part of nature, is subjected, are facts in themselves indifferent to the philosopher; and therefore the development of psychology into an independent science, which took place during the latter half of the 19th century and may now be said to be complete, represents an entirely natural evolution. Similarly, logic, so far as it is an art of thought or a doctrine of fallacies, and ethics, so far as it is occupied with a natural history of impulses and moral sentiments, do neither of them belong, except by courtesy, to the philosophic province. But, although this is so, it is perhaps hardly desirable to deprive ourselves of the use of two terms instead of one. It will not be easy to infuse into so abstract and bloodless a term as " metaphysics " the fuller life (and especially the inclusion of ethical considerations) suggested by the more concrete term "philosophy."

We shall first of all, then, attempt to differentiate philosophy from the special sciences, and afterwards proceed to take up one by one what have been called the philosophical sciences, with the view of showing how far the usual subject-matter of each is really philosophical in its bearing, and how far it belongs rather to the domain of " science " strictly so called. The order in which, for clearness of exposition, it will be most convenient to consider these disciplines will be psychology, epistemology or theory of knowledge, and metaphysics, then logic, aesthetics and ethics. Finally, the connexion of the last-mentioned with politics (or, to speak more modernly, with jurisprudence and sociology), with the philosophy of history and the philosophy of religion, will call for a few words on the relation of these sciences to general philosophy.

Philosophy and Natural Science.—In distinguishing philosophy from the sciences, it may not be amiss at the outset to guard against the possible misunderstanding that philosophy is concerned with a subject-matter different from, and in some obscure way transcending, the subject-matter of the sciences. Now that psychology, or the observational and experimental study of mind, may be said to have been definitively included among the positive sciences, there is not even the apparent ground which once existed for such an idea. Philosophy, even under its most discredited name of metaphysics, has no other subject-matter than the nature of the real world, as that world lies around us in everyday life, and lies open to observers on every side. But if this is so, it may be asked what function can remain for philosophy when every portion of the field is already lotted out and enclosed by specialists? Philosophy claims to be the science of the whole; but, if we get the knowledge of the parts from the different sciences, what is there left for philosophy to tell us? To this it is sufficient to answer generally that the synthesis of the parts is something more than that detailed knowledge of the parts in separation which is gained by the man of science. It is with the ultimate synthesis that philosophy concerns itself; it has to show that the subject-matter which we are all dealing with in detail really *is* a whole, consisting of articulated members. Evidently, therefore, the relation existing between philosophy and the sciences will be, to some extent, one of reciprocal influence. The sciences may be said to furnish philosophy with its matter, but philosophical criticism reacts upon the matter thus furnished, and transforms it. Such transformation is inevitable, for the parts only exist and can only be fully, *i.e.* truly, known in their relation to the whole. A pure specialist, if such a being were possible, would be merely an instrument whose results had to be co-ordinated and used by others. Now, though a pure specialist may be an abstraction of the mind, the tendency of specialists in any department naturally is to lose sight of the whole in attention to the particular categories or modes of nature's working which happen to be exemplified, and fruitfully applied, in their own sphere of investigation; and in proportion as this is the case it becomes necessary for their theories to be co-ordinated with the results of other inquirers, and set, as it were, in the light of the whole. This task of co-ordination, in the broadest sense, is undertaken by philosophy; for the philosopher is essentially what Plato, in a happy moment, styled him, συνοπτικός, the man who takes a "synoptic" or comprehensive view of the universe as a whole. The aim of philosophy (whether fully attainable or not) is to exhibit the universe as a rational system in the harmony of all its parts; and accordingly the philosopher refuses to consider the parts out of their relation to the whole whose parts they are. Philosophy corrects in this way the abstractions which are inevitably made by the scientific specialist, and may claim, therefore, to be the only "concrete" science, that is to say, the only science which takes account of all the elements in the problem, and the only science whose results can claim to be true in more than a provisional sense.

For it is evident from what has been said that the way in which we commonly speak of "facts" is calculated to convey a false impression. The world is not a collection of individual facts existing side by side and capable of being known separately. A fact is nothing except in its relations to other facts; and as these relations are multiplied in the progress of knowledge the nature of the so-called fact is indefinitely modified. Moreover, every statement of fact involves certain general notions and theories, so that the "facts" of the separate sciences cannot be stated except in terms of the conceptions or hypotheses which are assumed by the particular science. Thus mathematics assumes space as an existent infinite, without investigating in what sense the existence or the infinity of this *Unding*, as Kant called it, can be asserted. In the same way, physics may be said to assume the notion of material atoms and forces. These and similar assumptions are ultimate presuppositions or working hypotheses for the sciences themselves. But it is the office of philosophy, as a theory of knowledge, to submit such conceptions to a critical analysis, with a view to discover how far they can be *thought out*, or how far, when this is done, they refute themselves, and call for a different form of statement, if they are to be taken as a statement of the ultimate nature of the real.[1] The first statement may frequently turn out to have been merely provisionally or relatively true; it is then superseded by, or rather inevitably merges itself in, a less abstract account. In this the same "facts" appear differently, because no longer separated from other aspects that belong to the full reality of the known world. There is no such thing, we have said, as an individual fact; and the nature of any fact is not fully known unless we know it in all its relations to the system of the universe, or, in Spinoza's phrase, *sub specie aeternitatis*. In strictness, there is but one *res completa* or concrete fact, and it is the business of philosophy, as science of the whole, to expound the chief relations that constitute its complex nature.

The last abstraction which it becomes the duty of philosophy to remove is the abstraction from the knowing subject which is made by all the sciences, including, as we shall see, the science of psychology. The sciences, one and all, deal with a world of objects, but the ultimate fact as we know it is the existence of an object for a subject. Subject-object, knowledge, or, more widely, self-consciousness with its implicates—this unity in duality is the ultimate aspect which reality presents. It has generally been considered, therefore, as constituting in a special sense the problem of philosophy. Philosophy may be said to be the explication of what is involved in this relation, or, in Kantian phraseology, a theory of its possibility. Any would-be theory of the universe which makes its central fact impossible stands self-condemned. On the other hand, a sufficient analysis here may be expected to yield us a statement of the reality of things *in its last terms*, and thus to shed a light backwards upon the true nature of our subordinate conceptions.

Psychology, Epistemology and Metaphysics.—This leads to the consideration of the main divisions of philosophy—PSYCHOLOGY (*q.v.*), epistemology (theory of knowledge, *Erkenntnisstheorie*), and metaphysics (ontology; see METAPHYSIC). A special relation has always existed between psychology and systematic philosophy, but the closeness of the connexion has been characteristic of modern and more particularly of English thought. The connexion is not difficult to explain, seeing that in psychology, or the science of mind, we study the fact of intelligence (and moral action), and have, so far, in our hands the fact to which all other facts are relative. From this point of view we may even see a truth in Jacobi's dictum as quoted by Sir W. Hamilton: "Nature conceals God; man reveals God." Nature by itself, that is to say, is insufficient. The ultimate explanation of things cannot be given by any theory which excludes from its survey the intelligence in which nature, as it were, gathers herself up. But knowledge, or the mind as knowing, willing, &c., may be looked at in two different ways. It may be regarded simply as a fact; in which case the evolutions of mind may be traced and reduced to laws in the same way as the phenomena treated by the other sciences. This study gives us the science of empirical psychology, or, as it is now termed, psychology *sans phrase*. In order to give an adequate account of its subject-matter, psychology may require higher or more complex categories than are employed in the other sciences, just as biology, for example, cannot work with mechanical categories alone, but introduces the conception of development or growth. But the affinities of such a study are manifestly with the sciences as such rather than with philosophy; and the definitive establishment of psychology as an independent science has already been alluded to. Since it has been taken up by specialists, psychology is being established on a broader basis of induction, and with the advantage, in some departments, of the employment of experimental methods of measurement. But it is not of mind in this aspect that such assertions can be made as those quoted above. Mind, as studied by the psychologist—mind as a mere fact or phenomenon—grounds no inference to anything beyond itself. The distinction between mind viewed as a succession of "states of consciousness" and the further aspect of mind which philosophy considers was very clearly put by Croom Robertson, who also made a happy suggestion of two terms to designate the double point of view:

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[1] The revisional office which philosophy here assumes constitutes her the critic of the sciences. It is in this connexion that the meaning of the definition of philosophy as "the science of principles" can best be seen. This is perhaps the most usual definition, and, though vague, one of the least misleading.

> "We may view knowledge as mere subjective function, but it has its full meaning only as it is taken to represent what we may call objective fact, or is such as is named (in different circumstances) real, valid, true. As mere subjective function, which it is to the psychologist, it is best spoken of by an unambiguous name, and for this there seems none better than Intellection. We may then say that psychology is occupied with the natural function of *Intellection*, seeking to discover its laws and distinguishing its various modes (perception, representative imagination, conception, &c.) according to the various circumstances in which the laws are found at work. Philosophy, on the other hand, is theory of *Knowledge* (as that which is known)."—"Psychology and Philosophy," *Mind* (1883), pp. 15, 16.

The confusion of these two points of view has led, and still leads, to serious philosophical misconception. It is hardly an exaggeration to say that, in the English school since Hume, psychology superseded properly philosophical inquiry. And we find even a thinker with a wider horizon like Sir W. Hamilton encouraging the confusion by speaking of "psychology *or* metaphysics,"[1] while his lectures on metaphysics are mainly taken up with what belongs in the strictest sense to psychology proper, with an occasional excursus (as in the theory of perception) into epistemology. The distinction between psychology and theory of knowledge was first clearly made by Kant, who repeatedly insisted that the *Critique of Pure Reason* was not to be taken as a psychological inquiry. He defined his problem as the *quid juris* or the question of the validity of knowledge, not its *quid facti* or the laws of the empirical genesis and evolution of intellection (to use Croom Robertson's phraseology). Since Kant philosophy has chiefly taken the form of theory of knowledge or of a criticism of experience. Not, indeed, a preliminary criticism of our faculties or conceptions such as Kant himself proposed to institute, in order to determine the limits of their application; such a criticism *ab extra* of the nature of our experience is essentially a thing impossible. The only criticism which can be applied in such a case is the immanent criticism which the conceptions or categories exercise upon one another. The organized criticism of these conceptions is really nothing more than the full explication of what they mean and of what experience in its full nature or notion is. This constitutes the theory of knowledge in the only tenable sense of the term, and it lays down, in Kantian language, the conditions of the possibility of experience. These conditions are the conditions of knowledge as such, or, as it may be put, of objective consciousness—of a self-consciousness of a world of objects and through them conscious of itself. The inquiry is, therefore, logical or transcendental in its nature, and does not entangle us in any decision as to the conditions of the genesis of such consciousness in the individual. When we inquire into subjective conditions we are thinking of facts causing other facts. But the logical or transcendental conditions are not causes or even factors of knowledge; they are the statement of its idea. Hence the dispute between evolutionist and transcendentalist rests, in general, on an *ignoratio elenchi*; for the history of the genesis of an idea (the historical or genetic method) does not contain an answer to—though it may throw light on—the philosophical question of its truth or validity. Speaking of this transcendental consciousness, Kant goes so far as to say that it is not of the slightest consequence "whether the idea of it be clear or obscure (in empirical consciousness), no, not even whether it really exists or not. But the possibility of the logical form of all knowledge rests on its relation to this apperception as a faculty or potentiality" (*Werke*, ed. Hartenstein, iii. 578 note). Or, if we return to the distinction between epistemology and psychology, by way of illustrating the nature of the former, we may take the following summing up by Professor James Ward in a valuable article on "Psychological Principles" in *Mind* (April 1883, pp. 166, 167): "Comparing psychology and epistemology, then, we may say that the former is essentially genetic in its method, and might, if we had the power to revise our existing terminology, be called biology; the latter, on the other hand, is essentially devoid of everything historical, and treats, *sub specie aeternitatis*, as Spinoza might have said, of human knowledge, conceived as the possession of mind in general."

Kant's problem is not, in its wording, very different from that which Locke set before him when he resolved to "inquire into the original, certainty and extent of human knowledge together with the grounds and degrees of belief, opinion and assent." Locke's *Essay* is undoubtedly, in its intention, a contribution to the theory of knowledge. But, because time had not yet made the matter clear, Locke suffered himself to digress in his second book into the psychological question of the origin of our ideas; and his theory of knowledge is ruined by the failure to distinguish between the epistemological sense of "idea" as significant content and the psychological sense in which it is applied to a fact or process in the individual mind. The same confusion runs through Berkeley's arguments and vitiates his conclusions as well as those of Hume. But appearing with these thinkers as the problem of perception, epistemology widens its scope and becomes, in Kant's hands, the question of the possibility of experience in general. With Hegel it passes into a completely articulated "logic," which apparently claims to be at the same time a metaphysic, or an ultimate expression of the nature of the real.

This introduces us to the second part of the question we are seeking to determine, namely the relation of epistemology to metaphysics. It is evident that philosophy as theory of knowledge must have for its complement philosophy as metaphysics (ontology) or theory of being. The question of the truth of our knowledge, and the question of the ultimate nature of what we know, are in reality two sides of the same inquiry; and therefore our epistemological results have to be ontologically expressed. But it is not every thinker that can see his way with Hegel to assert in set terms the identity of thought and being. Hence the theory of knowledge becomes with some a theory of human ignorance. This is the case with Herbert Spencer's doctrine of the Unknowable, which he advances as the result of epistemological considerations in the philosophical prolegomena to his system. Very similar positions were maintained by Kant and Comte; and, under the name of "agnosticism" (*q.v.*), the theory has popularized itself in the outer courts of philosophy, and on the shifting borderland of philosophy and literature. The truth is that the habit of thinking exclusively from the standpoint of the theory of knowledge tends to beget an undue subjectivity of temper. And the fact that it has become usual for men to think from this standpoint is very plainly seen in the almost universal description of philosophy as an analysis of "experience," instead of its more old-fashioned designation as an inquiry into "the nature of things." As it is matter of universal agreement that the problem of being must be attacked indirectly through the problem of knowledge, this substitution may be regarded as an advance, more especially as it implies that the fact of experience, or of self-conscious existence, is the chief fact to be dealt with. But if so, then self-consciousness must be treated as itself real, and as organically related to the rest of existence. If self-consciousness be treated in this objective fashion, then we pass naturally from epistemology to metaphysics or ontology. (For, although the term "ontology" has been as good as disused, it still remains true that the aim of philosophy must be to furnish us with an ontology or a coherent and adequate theory of the nature of reality.) But if, on the other hand, knowledge and reality be *ab initio* opposed to one another—if consciousness be set on one side as over against reality, and merely holding up a mirror to it—then it follows with equal naturalness that the truly real must be something which lurks unrevealed behind the subject's representation of it. Hence come the different varieties of a so-called phenomenalism. The upholders of such a theory would, in general, deride the term "metaphysics" or "ontology"; but it is evident, none the less, that their position itself implies a certain theory of the universe and of our own place in it, and the establishment of this theory constitutes their metaphysics.

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[1] It is true that he afterwards modifies this misleading identification by introducing the distinction between empirical psychology or the phenomenology of mind and inferential psychology or ontology, *i.e.* metaphysics proper. But he continues to use the terms "philosophy," "metaphysics," and "mental science" as synonymous.

Without prejudice, then, to the claim of epistemology to constitute the central philosophic discipline, we may simply note its liability to be pressed too far. The exclusive preoccupation of men's minds with the question of knowledge during the neo-Kantian revival in the 'seventies of the last century drew from Lotze the caustic criticism that "the continual sharpening of the knife becomes tiresome, if, after all, we have nothing to cut with it." Stillingfleet's complaint against Locke was that he was "one of the gentlemen of this new way of reasoning that have almost discarded substance out of the reasonable part of the world." The same may be said with greater truth of the devotees of the theory of knowledge; they seem to have no need of so old-fashioned a commodity as reality. Yet, after all, Fichte's dictum holds good that knowledge *as* knowledge—*i.e.* so long as it is looked at as knowledge—is, *ipso facto*, *not* reality. The result of the foregoing, however, is to show that, as soon as epistemology draws its conclusion, it becomes metaphysics; the theory of knowledge passes into a theory of being. The ontological conclusion, moreover, is not to be regarded as something added by an external process; it is an immediate implication. The metaphysic is the epistemology from another point of view—regarded as completing itself, and explaining in the course of its exposition that relative or practical separation of the individual knower from the knowable world, which it is a sheer assumption to take as absolute. This, not the so-called assumption of the implicit unity of being and thought, is the really unwarrantable postulate; for it is an assumption which we are obliged to retract bit by bit, while the other offers the whole doctrine of knowledge as its voucher.

Logic, Aesthetics and Ethics.—If the theory of knowledge thus passes insensibly into metaphysics it becomes somewhat difficult to assign a distinct sphere to logic (*q.v.*). Ueberweg's definition of it as "the science of the regulative laws of thought" (or "the normative science of thought") comes near enough to the traditional sense to enable us to compare profitably the usual subject-matter of the science with the definition and end of philosophy. The introduction of the term "regulative" or "normative" is intended to differentiate the science from psychology as the science of mental processes or events. In this reference logic does not tell us how our intellections connect themselves as mental phenomena, but how we ought to connect our thoughts if they are to realize truth (either as consistency with what we thought before or as agreement with observed facts). Logic, therefore, agrees with epistemology (and differs from psychology) in treating thought not as mental fact but as knowledge, as idea, as having meaning in relation to an objective world. To this extent it must inevitably form a part of the theory of knowledge. But, if we desire to keep by older landmarks and maintain a distinction between the two disciplines, a ground for doing so may be found in the fact that all the main definitions of logic point to the investigation of the laws of thought in a subjective reference—with a view, that is, by an analysis of the operation, to ensure its more correct performance. According to the old phrase, logic is the art of correct thinking. Moreover we commonly find the logician assuming that the process of thought has advanced a certain length before his examination of it begins; he takes his material full-formed from perception, without, as a rule, inquiring into the nature of the conceptions which are involved in our perceptive experience. Occupying a position, therefore, within the wider sphere of the general theory of knowledge, ordinary logic consists in an analysis of the nature of general statement, and of the conditions under which we pass validly from one general statement to another. But the logic of the schools is eked out by contributions from a variety of sources (*e.g.* from grammar on one side and from psychology on another), and cannot claim the unity of an independent science.

Aesthetics (*q.v.*) may be treated as a department of psychology or physiology, and in England this is the mode of treatment that has been most general. To what peculiar excitation of our bodily or mental organism, it is asked, are the emotions due which make us declare an object beautiful or sublime? And, the question being put in this form, the attempt has been made in some cases to explain away any peculiarity in the emotions by analysing them into simpler elements, such as primitive organic pleasures and prolonged associations of usefulness or fitness. But, just as psychology in general cannot do duty for a theory of knowledge, so it holds true of this particular application of psychology that a mere reference of these emotions to the mechanism and interactive play of our faculties cannot be regarded as an account of the nature of the beautiful. Perhaps by talking of "emotions" we tend to give an unduly subjective colour to the investigation; it would be better to speak of the *perception* of the beautiful. Pleasure in itself is unqualified, and affords no differentia. In the case of a beautiful object the resultant pleasure borrows its specific quality from the presence of determinations essentially objective in their nature, though not reducible to the categories of science. Unless, indeed, we conceive our faculties to be constructed on some arbitrary plan which puts them out of relation to the facts with which they have to deal, we have a prima facie right to treat beauty as an objective determination of things. The question of aesthetics would then be formulated—What is it in things that makes them beautiful, and what is the relation of this aspect of the universe to its ultimate nature, as that is expounded in metaphysics? The answer constitutes the substance of aesthetics, considered as a branch of philosophy. But it is not given simply in abstract terms: the philosophical treatment of aesthetics includes also an exposition of the concrete phases of art, as these have appeared in the history of the world, relating themselves to different phases of human culture.

Of ethics (*q.v.*) it may also be said that many of the topics commonly embraced under that title are not strictly philosophical in their nature. They are subjects for a scientific psychology employing the historical method with the conceptions of heredity and development, and calling to its aid, as such a psychology will do, the investigations of all the sociological sciences. To such a psychology must be relegated all questions as to the origin and development of moral ideas. Similarly, the question debated at such length by English moralists as to the nature of the moral faculty (moral sense, conscience, &c.) and the controversy concerning the freedom of the will belong entirely to psychology. If we exclude such questions in the interest of systematic correctness, and seek to determine for ethics a definite subject-matter, the science may be said to fall into two departments. The first of these deals with the notion of duty, and endeavours to define the good or the ultimate end of action; the second lays out the scheme of concrete duties which are deducible from, or which, at least, are covered by, this abstractly stated principle. The second of these departments is really the proper subject-matter of ethics considered as a separate science; but it is often conspicuous by its absence from ethical treatises. However moralists may differ on first principles, there seems to be remarkably little practical divergence when they come to lay down the particular laws of morality. It may be added that, where a systematic account of duties is actually given, the connexion of the particular duties with the universal formula is in general more formal than real. It is only under the head of casuistry (*q.v.*) that ethics has been much cultivated as a separate science. The first department of ethics, on the other hand, is the branch of the subject in virtue of which ethics forms part of philosophy. As described above, it ought rather to be called, in Kant's phrase, the metaphysic of ethics. A theory of obligation is ultimately found to be inseparable from a metaphysic of personality. The connexion of ethics with metaphysics will be patent as a matter of fact, if it be remembered how Plato's philosophy is summed up in the idea of the good, and how

Aristotle also employs the essentially ethical notion of end as the ultimate category by which the universe may be explained or reduced to unity. But the necessity of the connexion is also apparent, unless we are to suppose that, as regards the course of universal nature, man is altogether an *imperium in imperio*, or rather (to adopt the forcible phrase of Marcus Aurelius) an abscess or excrescence on the nature of things. If, on the contrary, we must hold that man is essentially related to what the same writer calls "a common nature," then it is a legitimate corollary that in man as intelligence we ought to find the key of the whole fabric. At all events, this method of approach must be truer than any which, by restricting itself to the external aspect of phenomena as presented in space, leaves no scope for inwardness and life and all that, in Lotze's language, gives "value" to the world. The argument *ex analogia hominis* has often been carried too far; but if a "chief end of man" be discoverable—*ἀνθρώπινον ἀγαθόν*, as Aristotle wisely insisted that the ethical end must be determined—then it may be assumed that this end cannot be irrelevant to that ultimate "meaning" of the universe which, according to Lotze, is the quest of philosophy. If "the idea of humanity," as Kant called it, has ethical perfection at its core, then a universe which is really an organic whole must be ultimately representable as a moral order or a spiritual kingdom such as Leibnitz named, in words borrowed from St Augustine, a city of God.

Philosophy of the State (*Political Philosophy*), *Philosophy of History, Philosophy of Religion.*—In Plato and Aristotle ethics and politics are indissolubly connected. In other words, seeing that the highest human good is realizable only in a community, the theory of the state as the organ of morality, and itself in its structure and institutions the expression of ethical ideas or qualities, becomes an integral part of philosophy. The difficulty already hinted at, which individualistic systems of ethics experience in connecting particular duties with the abstract principle of duty is a proof of the failure of their method. For the content of morality we are necessarily referred, in great part, to the experience crystallized in laws and institutions and to the unwritten law of custom, honour and good breeding, which has become organic in the society of which we are members. Plato's *Republic* and Hegel's *Philosophie des Rechts* are the most typical examples of a fully developed philosophy of the state, but in the earlier modern period the prolonged discussion of natural rights and the social contract must be regarded as a contribution to such a theory. Moreover, if philosophy is to complete its constructive work, it must bring the course of human history within its survey, and exhibit the sequence of events as an evolution in which the purposive action of reason is traceable. This is the task of the philosophy of history, a peculiarly modern study, due to the growth of a humanistic and historical point of view. Lessing's conception of history as an "education of the human race" is a typical example of this interpretation of the facts, and was indeed the precursor which stimulated many more elaborate German theories. The philosophy of history differs, it will be observed, from the purely scientific or descriptive studies covered by the general title of sociology. Sociology conceives itself as a natural science elucidating a factual sequence. The philosophy of history is essentially teleological; that is to say, it seeks to interpret the process as the realization of an immanent end. It may be said, therefore, to involve a complete metaphysical theory. Social institutions and customs and the different forms of state-organization are judged according to the degree in which they promote the realization of the human ideal. History is thus represented by Hegel, for example, as the realization of the idea of freedom, or rather as the reconciliation of individual freedom and the play of cultured interests with the stable objectivity of law and an abiding consciousness of the greater whole in which we move. So far as the course of universal history can be truly represented as an approximation to this reconciliation by a widening and deepening of both the elements, we may claim to possess a philosophy of history. But although the possibility of such a philosophy seems implied in the postulated nationality of the universe, many would hold that it remains as yet an unachieved ideal.

There only remains to be briefly noticed the relation of philosophy to theology and the nature of what is called Philosophy of Religion. By theology is commonly understood the systematic presentation of the teaching of some positive or historical religion as to the existence and attributes of a Supreme Being, including his relation to the world and especially to man. But these topics have also been treated by philosophers and religious thinkers, without dependence on any historical data or special divine revelation, under the title of Natural Theology. Natural Theology is specially associated with the Stoic theories of providence in ancient times and with elaborations of the argument from design in the 18th century. But there is no warrant for restricting the term to any special mode of approaching the problems indicated; and as these form the central subject of metaphysical inquiry, no valid distinction can be drawn between natural theology and general metaphysics. The philosophy of religion, on the other hand, investigates the nature of the religious consciousness and the value of its pronouncements on human life and man's relation to the ground of things. Unity, reconciliation, peace, joy, "the victory that overcometh the world"—such, in slightly varying phrases, is the content of religious faith. Does this consciousness represent an authentic insight into ultimate fact, or is it a pitiful illusion of the nerves, born of man's hopes and fears and of his fundamental ignorance? The philosophy of religion assumes the first alternative. The function of philosophy in general is the reflective analysis of experience, and the religious experience of mankind is prima facie entitled to the same consideration as any other form of conscious activity. The certainties of religious faith are matter of feeling or immediate assurance, and are expressed in the pictorial language of imagination. It becomes the function of philosophy, dealing with these utterances, to relate them to the results of other spheres of experience, and to determine their real meaning in the more exact terms of thought. The philosophy of religion also traces in the different historical forms of religious belief and practice the gradual evolution of what it takes to be the truth of the matter. Such an account may be distinguished from what is usually called the science of religion by the teleological or metaphysical presuppositions it involves. The science of religion gives a purely historical and comparative account of the various manifestations of the religious instinct without pronouncing on their relative truth or value and without, therefore, professing to apply the idea of evolution in the philosophical sense. That idea is fundamental in the philosophy of religion, which therefore can be written only from the standpoint of a constructive metaphysical theory.

It is, indeed, only from the standpoint of such a theory that the definitions and divisions of the different philosophical disciplines adopted in this article can be said to hold good. But those who, like the positivists, agnostics and sceptics, deny the possibility of metaphysics as a theory of the ultimate nature of things, are still obliged to retain philosophy as a theory of knowledge, in order to justify the asserted limitation or impotence of human reason.

BIBLIOGRAPHY—The best general histories of philosophy are by J. E. Erdmann, Friedrich Ueberweg and W. Windelband, Windelband's being probably the freshest in its treatment and point of view. Ed. Zeller's *History of Greek Philosophy* still holds the field as the best continuous exposition of the subject, but more recent work in the early period is represented by H. Diels and J. Burnet, while Zeller's view of Plato may be said to have been superseded by the later researches of Lewis Campbell, H. Jackson and others. T. Gomperz's *Greek Thinkers* is an able, if somewhat diffuse, survey of the philosophical development in connexion with the general movement of Greek life and culture. It does not go beyond Plato. B. Hauréau, A. Stöckl and Karl Werner give the fullest and most trustworthy histories of the medieval period, but the subject is very carefully treated by Erdmann and Ueberweg, and a useful compendium, written from a Roman Catholic standpoint, is De Wulf's *History of Medieval Philosophy* (1900; Eng. trans., 1907). For modern times, in addition to the general histories already named, the works of Kuno Fischer, R. Falckenberg and H. Höffding, and R. Adamson's *Lectures on the Development of Modern Philosophy*,

may be specially mentioned. Writers on the history of philosophy generally prefix to their work a discussion of the scope of philosophy, its divisions and its relations to other departments of knowledge, and the account given by Windelband and Ueberweg will be found specially good. The Introductions to Philosophy published by F. Paulsen, O. Külpe, W. Wundt and G. T. Ladd, deal largely with this subject, which is also treated by Henry Sidgwick in his *Philosophy, its Scope and Relations* (1902), by Ernest Naville, *La Définition de la philosophie* (1894) and by Wundt in the introduction to his *System der Philosophie* (1889). A useful work of general reference is J. M. Baldwin's *Dictionary of Philosophy and Psychology* (3 vols., 1902–1905). (A. S. P.-P.)

PHILOSTRATUS, the name of several, three (or four), Greek sophists of the Roman imperial period—(1) Philostratus "the Athenian" (*c.* 170–245), (2) his nephew (?) Philostratus "of Lemnos" (born *c.* 190); (3) a grandson (?) of (2). Of these the most famous is Philostratus "the Athenian," author of the *Life of Apollonius Tyana*, which he dedicated to Julia Domna, wife of Alexander Severus and mother of Caracalla (see Apollonius of Tyana).[1] He wrote also Βίοι Σοφιστῶν (*Lives of the Sophists*), *Gymnasticus* and *Epistolae* (mainly of an erotic character). Very little is known of his career. Even his name is doubtful. The *Lives of the Sophists* gives the praenomen Flavius, which, however, is found elsewhere only in Tzetzes. Eunapius and Synesius call him a Lemnian; Photius a Tyrian; his letters refer to him as an Athenian. It is probable that he was born in Lemnos, studied and taught at Athens, and then settled in Rome (where he would naturally be called *atheniensis*) as a member of the learned circle with which Julia Domna surrounded herself. He was born probably in 172, and is said by Suïdas to have been living in the reign of Philip (244–249). The fact that the author of *Apollonius* is also the author of the *Lives of the Sophists* is confirmed by internal evidence. The latter is dedicated to a consul Antonius Gordianus, perhaps one of the two Gordians who were killed in 238. The work is divided into two parts: the first dealing with the ancient Sophists, *e.g.* Gorgias, the second with the later school, *e.g.* Herodes Atticus.

The *Lives* are not in the true sense biographical, but rather picturesque impressions of leading representatives of an attitude of mind full of curiosity, alert and versatile, but lacking scientific method, preferring the external excellence of style and manner to the solid achievements of serious writing. The philosopher, as he says, investigates truth; the sophist embellishes it, and takes it for granted. The *Gymnasticus* contains interesting matter concerning the Olympic games and athletic contests generally. The *Letters* breathe the spirit of the New Comedy and the Alexandrine poets; portions of *Letter 33* are almost literally translated in Ben Jonson's *Song to Celia*, "Drink to me only with thine eyes." The Ἡρωικός, formerly attributed to Philostratus the Athenian, is probably the work of Philostratus the Lemnian. It is a popular disquisition on the heroes of the Trojan War in the form of a conversation between a Thracian vine-dresser on the shore of the Hellespont and a Phoenician merchant who derives his knowledge from the hero Protesilaus, Palamedes is exalted at the expense of Odysseus, and Homer's unfairness to him is attacked. It has been suggested that Philostratus is here describing a series of heroic paintings in the palace of Julia Domna. His other work is the Εἰκόνες (*Imagines*), ostensibly a description of 64 pictures in a Neapolitan gallery. Goethe, Welcker, Brunn, E. Bertrand and Helbig, among others, have held that the descriptions are of actually existing works of art, while Heyne and Friederichs deny this. In any case they are interesting as showing the way in which ancient artists treated mythological and other subjects, and are written with artistic knowledge and in attractive language. This work is imitated by the third Philostratus (or by some later sophist) of whose descriptions of pictures 17 remain.

There is great difficulty, due to a confused statement of Suïdas, in disentangling the works and even the personalities of these Philostrati. Reference is there made to Philostratus as the son of Verus, a rhetorician in Nero's time, who wrote tragedies, comedies and treatises. Suïdas thus appears to give to Philostratus the Athenian a life of 200 years! We must be content to assume two Lemnian Philostrati, both sophists, living in Rome. See further a full discussion by K. Münscher, in *Philologus* (1907), suppl. x., pp. 469-557.

Of works bearing the name Philostratus there is a collected edition by C. F. Kayser (Zurich, 1844; Leipzig, 1870–1871), and another by Westermann (Paris, 1849), with Latin translation; these supersede those by F. Morel (Paris, 1608) and Olearius (Leipzig, 1709). There are separate editions of the *Eikones* by Schenkl and Reisch (Leipzig, 1902); of the *Gymnasticus* by Mynas (1858), who discovered the MS., Daremberg (Paris, 1858), Volckmar (Aurich, 1862), and especially Julius Jüthner (1909), with introd., comments and Ger. trans.; of 73 epistles by Boissonade (Paris, 1842). The *Life of Apollonius* was first published by Aldus (1502); a French translation by Blaise de Vigenere appeared in 1596; an English translation of the first two books was published in London (1680) by Charles Blount, with some notes by Lord Herbert of Cherbury (prohibited in England in 1693, it was reprinted on the Continent); a full translation appeared in 1903. Critical works on the *Eikones* are numerous: K. Friederichs, *Die Philostratischen Bilder* (1860); Goethe, "Philostrats Gemälde" in *Complete Works* (ed. Stuttgart, 1879); Brunn, *Die Philostratischen Bilder* (1860); A. Bougot, *Une Galerie antique* (1881); E. Bertrand, *Un Critique d'art dans l'antiquité: Philostrate et son école* (1882); Bergk, "Die Philostrate" in *Fünf Abhandlungen zur Geschichte der griechischen Philosophie und Astronomie* (1883); Schmid, *Atticismus* iv. 7, on the attribution of the works.

PHILOXENUS, of Cythera (435–380 B.C.), Greek dithyrambic poet. On the conquest of the island by the Athenians he was taken as a prisoner of war to Athens, where he came into the possession of the dithyrambic poet Melanippides, who educated him and set him free. Philoxenus afterwards resided in Sicily, at the court of Dionysius, tyrant of Syracuse, whose bad verses he declined to praise, and was in consequence sent to work in the quarries. After leaving Sicily he travelled in Greece, Italy and Asia, reciting his poems, and died at Ephesus. According to Suïdas, Philoxenus composed twenty-four dithyrambs and a lyric poem on the genealogy of the Aeacidae. In his hands the dithyramb seems to have been a sort of comic opera, and the music, composed by himself, of a debased character. His masterpiece was the *Cyclops*, a pastoral burlesque on the love of the Cyclops for the fair Galatea, written to avenge himself upon Dionysius, who was wholly or partially blind of one eye. It was parodied by Aristophanes in the *Plutus* (290). Another work of Philoxenus (sometimes attributed to Philoxenus of Leucas, a notorious parasite and glutton) is the Δεῖπνον (Dinner), of which considerable fragments have been preserved by Athenaeus. This is an elaborate bill of fare in verse, probably intended as a satire on the luxury of the Sicilian court. The great popularity of Philoxenus is attested by a complimentary resolution passed by the Athenian senate in 393. The comic poet Antiphanes spoke of him as a god among men; Alexander the Great had his poems sent to him in Asia; the Alexandrian grammarians received him into the canon; and down to the time of Polybius his works were regularly learned and annually acted by the Arcadian youth.

Fragments, with life, by G. Bippart (1843); T. Bergk, *Poetae lyrici graeci.*

PHILOXENUS (Syriac, Aksēnāyā), of Mabbōg, one of the best of Syriac prose writers, and a vehement champion of Monophysite doctrine in the end of the 5th and beginning of the 6th centuries. He was born, probably in the third quarter of the 5th century, at Taḥal, a village in the district of Bēth Garmai east of the Tigris. He was thus by birth a subject of Persia, but all his active life of which we have any record was passed in the territory of the Greek Empire. The statements that he had been a slave and was never baptized appear to be malicious inventions of his theological opponents. He was educated at Edessa, perhaps in the famous "school of the Persians," which was afterwards (in 489) expelled from Edessa[2] on account of its connexion with the Nestorian heresy. The years which followed the Council of Chalcedon (451) were a stormy period in the Syrian Church. Philoxenus soon attracted notice by his strenuous advocacy of Monophysite doctrine, and on the expulsion of Calandio (the orthodox patriarch of Antioch) in 485 was ordained bishop of Mabbōg[3] by his Monophysite successor Peter the Fuller (Barhebraeus, *Chron. eccl.* i. 183). It was probably during the earlier years of his episcopate that Philoxenus composed his thirteen homilies on the Christian life. Later he devoted himself to the revision of the Syriac version of the Bible, and with the help of his chorepiscopus Polycarp produced in 508 the so-called Philoxenian version, which was in some sense the received Bible of the Monophysites during the 6th century. Meantime he continued his ecclesiastical activity, working as a bitter opponent of

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[1] As Lemnos was an Athenian island, any Lemnian could be called an Athenian.

[2] According to Barhebraeus (*Chron. eccl.* ii. 55) through the efforts of Philoxenus himself.

[3] Hierapolis of the Greeks, Manbij of the Arabs, a few miles west of the Euphrates about latitude 36½°.

Flavian II., who had accepted the decrees of the Council of Chalcedon and was patriarch of Antioch from 498 to 512. The Monophysites had the sympathy of the emperor Anastasius, and were finally successful in ousting Flavian in 512 and replacing him by their partisan Severus. Of Philoxenus's part in the struggle we possess not too trustworthy accounts by hostile writers, such as Theophanes and Theodorus Lector. We know that in 498 he was staying at Edessa[1]; in or about 507, according to Theophanes, he was summoned by the emperor to Constantinople; and he finally presided at a synod at Sidon which was the means of procuring the replacement of Flavian by Severus. But the triumph was short-lived. Justin I., who succeeded Anastasius in 518, was less favourable to the party of Severus and Philoxenus, and in 519 they were both sentenced to banishment. Philoxenus was sent to Philippopolis in Thrace, and afterwards to Gangra in Paphlagonia, where he met his death by foul play in 523.

Apart from his redoubtable powers as a controversialist, Philoxenus deserves commemoration as a scholar, an elegant writer, and an exponent of practical Christianity. Of the chief monument of his scholarship—the Philoxenian version of the Bible—only the Gospels and certain portions of Isaiah are known to survive (see Wright, *Syr. Lit.* 14). It was an attempt to provide a more accurate rendering of the Greek Bible than had hitherto existed in Syriac, and obtained recognition among the Monophysites until superseded by the still more literal renderings of the Old Testament by Paul of Tella and of the New Testament by Thomas of Harkel (both in 616–617), of which the latter at least was based on the work of Philoxenus. There are also extant portions of commentaries on the Gospels from his pen. Of the excellence of his style and of his practical religious zeal we are able to judge from the thirteen homilies on the Christian life and character which have been edited and translated by Budge (London, 1894). In these he holds aloof for the most part from theological controversy, and treats in an admirable tone and spirit the themes of faith, simplicity, the fear of God, poverty, greed, abstinence and unchastity. His affinity with his earlier countryman Aphraates is manifest both in his choice of subjects and his manner of treatment. As his quotations from Scripture appear to be made from the Pēshīṭtā, he probably wrote the homilies before he embarked upon the Philoxenian version.[2] Philoxenus wrote also many controversial works and some liturgical pieces. Many of his letters survive, and at least two have been edited.[3] Several of his writings were translated into Arabic and Ethiopic. (N. M.)

PHILTRE (Lat. *philtrum*, from Gr. φίλτρον, φιλεῖν, to love), a drug or other medicinal drink supposed to have the magical property of exciting love.

PHINEUS, in Greek legend, son of Agenor, the blind king of Salmydessus on the coast of Thrace. He was skilled in the art of navigation, and Apollo had bestowed upon him the gift of prophecy. His blindness was a punishment from the gods for his having revealed the counsels of Zeus to mortals, or for his treatment of his sons by his first wife Cleopatra. His second wife having accused her stepsons of dishonourable proposals, Phineus put out their eyes, or exposed them to the wild beasts, or buried them in the ground up to their waists and ordered them to be scourged. Zeus offered him the choice of death or blindness. Phineus chose the latter, whereupon Helios (the sun-god), offended at the slight thus put upon him, sent the Harpies to torment him. In another story, the Argonauts (amongst whom were Calaïs and Zetes, the brothers of Cleopatra), on their arrival in Thrace found the sons of Phineus half-buried in the earth and demanded their liberation. Phineus refused, and a fight took place in which he was slain by Heracles, who freed Cleopatra (who had been thrown into prison) and her sons, and reinstated them as rulers of the kingdom. Tragedies on the subject of Phineus were written by Aeschylus and Sophocles. These would directly appeal to an Athenian audience, Phineus's first wife having been the daughter of Orithyia (daughter of Erechtheus, king of Athens), who had been carried off by Boreas to his home in Thrace. The punishment of Phineus would naturally be regarded as a just retribution for the insult put upon a princess of the royal house of Athens.

Apollodorus i. 9, 21, iii. 15, 3; Sophocles, *Antigone*, 966, with Jebb's notes; Diod. Sic. iv. 43, 44; Servius on *Aeneid* iii. 209; Schol. on Apollonius Rhodius ii. 178.

PHIPS (or Phipps), **SIR WILLIAM** (1651–1695), colonial governor of Massachusetts, was born on the 2nd of February 1651, at Woolwich, Maine, near the mouth of the Kennebec river. He was a shepherd until he was eighteen, and then a ship carpenter's apprentice for four years; worked at his trade in Boston for a year, at this time learning to read and write; and with his wife's property established a ship-yard on the Sheepscot river in Maine, but soon abandoned it because of Indian disorders. In 1684–1686, with a commission from the British Crown, he searched vainly for a wrecked Spanish treasure ship of which he had heard while on a voyage to the Bahamas; he found this vessel in 1687, and from it recovered £300,000. Of this amount much went to the duke of Albemarle, who had fitted out the second expedition. Phips received £16,000 as his share, was knighted by James II., and was appointed sheriff of New England under Sir Edmund Andros. Poorly educated and ignorant of law, Phips could accomplish little, and returned to England. In 1689 he returned to Massachusetts, found a revolutionary government in control, and at once entered into the life of the colony. He joined the North Church (Cotton Mather's) at Boston, and was soon appointed by the General Court commander of an expedition against the French in Canada, which sailed in April 1690 and easily captured Port Royal. A much larger expedition led by Phips in July against Quebec and Montreal ended disastrously. Phips generously bought at their par value, in order to give them credit in the colony, many of the colony's bills issued to pay for the expedition. In the winter of 1690 he returned to England, vainly sought aid for another expedition against Canada, and urged, with Increase Mather, the colonial agent, a restoration of the colony's charter, annulled during the reign of Charles II. The Crown, at the suggestion of Mather, appointed him the first royal governor under the new charter. On reaching Boston in May 1692, Phips found the colony in a very disordered condition, and though honest, persevering and indisposed to exalt his prerogative at the expense of the people, he was unfitted for the difficult position. He appointed a special commission to try the witchcraft cases, but did nothing to stop the witchcraft mania, and suspended the sittings of the court only after great atrocities had been committed. In defending the frontier he displayed great energy, but his policy of building forts was expensive and therefore unpopular. Having the manners of a 17th-century sea captain, he became involved in many quarrels, and engaged in a bitter controversy with Governor Benjamin Fletcher of New York. Numerous complaints to the home government resulted in his being summoned to England to answer charges. While in London awaiting trial, he died on the 18th of February 1695.

See Cotton Mather's *Life of His Excellency Sir William Phips* (London, 1697; republished in his *Magnalia* in 1702); Francis Bowen's "Life of Sir William Phips," in Jared Sparks's *American Biography*, 1st series, vol. vii. (New York, 1856); William Goold's "Sir William Phips," in *Collections of the Maine Historical Society*, series 1, vol. ix. (Portland, 1887); Ernest Myrand's *Sir William Phipps devant Quebec* (Quebec, 1893); Thomas Hutchinson's *History of Massachusetts* (2 vols., Boston; 3rd ed., 1795); and J. G. Palfrey's *History of New England* (5 vols., Boston, 1858–1890).

PHLEBITIS (from Gr. φλέψ, a vein), inflammation of a vein. When a vein is inflamed the blood in it is apt to form a clot, or thrombus, which, if loosened and displaced from its original position, may be carried as an embolus towards the heart and there be arrested; or it may pass through the cavities of the heart into the lungs, there to lodge and to give rise to alarming symptoms. If the thrombus is formed in the inflamed vein of a pile it may pass as an embolus (see Haemorrhoids) into the liver. If an embolus is carried through the left side of the heart it may enter the large vessels at the root of the neck and reach the brain, giving rise to serious cerebral disturbance or to a fatal paralysis. The thrombus may be formed in gout and rheumatism, or in consequence of stagnation of the blood-current due to slowing of the circulation in various wasting diseases. When a thrombus forms, absolute rest in the recumbent posture is to be strictly enjoined; the great danger is the displacement of the clot. An inflamed and clotted vein, if near the surface, causes an elongated, dusky elevation beneath the skin, where the vein may be felt as a hard cord, the size, perhaps, of a cedar pencil, or a pen-holder. Its course is marked by great tenderness, and the tissue which was drained by the branches of that vein are livid from congestion, and perhaps boggy and pitting with oedema. If, as often happens, the inflamed vein is one of those running conspicuously upwards from the foot—a saphenous vein (σαφής, distinct)—the patient should be placed in bed with the limb secured on a splint in order to protect it from any rough movement. Should the clot become detached, it might give rise to sudden and alarming faintness possibly even to a fatal syncope. Thus, there is always grave risk with an inflamed and clotted vein, and modern surgery shows that the safest course is, when practicable, to place a ligature on the vein upon the heart-side of the clotted piece and to remove the latter by dissection. When, as sometimes happens, the clot is invaded by septic organisms it is particularly liable to become disintegrated, and if parts of it are carried to various regions of the body they may there give rise to the formation of secondary abscesses. In the ordinary treatment of phlebitis, in addition to the insistence on perfect rest and quiet, fomentations may be applied locally, the limb being kept raised. Massage must not be employed so long as there is any risk of a clot being detached. (E. O.*)

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[1] *Chronicle* of Joshua Stylites, ch. 30.

[2] On these and other points see Budge's introduction to his second volume, which contains also a list of the other works of Philoxenus and a number of illustrative extracts.

[3] One by Martin (in *Grammatica chrestomathia et glossarium linguae syriacae*) and one by Guidi (*La Lettera di Filosseno ai monaci di Tell ʿAddā*).

PHLEGON, of Tralles in Asia Minor, Greek writer and freedman of the emperor Hadrian, flourished in the 2nd century A.D. His chief work was the *Olympiads*, an historical compendium in sixteen books, from the 1st down to the 229th Olympiad (776 B.C. to A.D. 137), of which several chapters are preserved in Photius and Syncellus. Two small works by him are extant: *On Marvels*, containing some ridiculous stories about ghosts, prophecies and monstrous births, but instructive as regards ancient superstitions; *On Long-lived Persons*, a list of Italians who had passed the age of 100, taken from the Roman censuses. Other works ascribed to Phlegon by Suïdas are a description of Sicily, a work on the Roman festivals in three books, and a topography of Rome.

Fragments in C. Müller, *Frag. hist. graec.* iii.; of the *Marvels* and *Long-lived* in O. Keller, *Rerum naturalium scriptores*, i. (1877); see also H. Diels, "Phlegons Androgynenorakel" in *Sibyllinische Blätter* (1890).

PHLOGOPITE, a mineral belonging to the group of micas (*q.v.*). It is a magnesium mica, differing from biotite in containing only a little iron; the chemical formula is $[H,K,(MgF)]_3Mg_3Al(SiO_4)_3$. It crystallizes in the monoclinic system, but the crystals are roughly developed. There is a perfect cleavage parallel to the basal plane; the cleavage flakes are not quite so elastic as those of muscovite. Sometimes it is quite colourless and transparent, but usually of a characteristic yellowish-brown colour, and often with a silvery lustre on the cleavage surfaces, hence the trade name "silver amber mica" for some varieties. The name phlogopite is from Gr. φλογωπός (fiery-looking), the mineral being sometimes brownish-red and coppery in appearance. The hardness is 2½–3, and the specific gravity 2·78–2·85. The optic axial plane is parallel to the plane of symmetry and the axial angle 0°–10°. Phlogopite occurs chiefly as scales and plates embedded in crystalline limestones of the Archean formation. The mica mined in Canada and Ceylon is mainly phlogopite, and is largely used as an insulator for electrical purposes. In Canada it occurs with apatite in pyroxene rocks which are intrusive in Laurentian gneisses and crystalline limestones, the principal mining district being in Ottawa county in Quebec and near Burgess in Lanark county, Ontario. In Ceylon, the mineral forms irregular veins, rarely exceeding one or two feet in width, traversing granulite, especially near the contact of this rock with crystalline limestone. (L. J. S.)

PHLOX (Nat. Ord. Polemoniaceae), a genus of about 30 species, mostly perennial hardy plants of great beauty, natives of North America (one occurs in Siberia), with entire, usually opposite, leaves and showy flowers generally in termina clusters. Each flower has a tubular calyx with five lobes, and a salver shaped corolla with a long slender tube and a flat limb. The five stamens are given off from the tube of the corolla at different heights and do not protrude beyond it. The ovary is three-celled with one to two ovules in each cell; it ripens into a three-valved capsule. Many of the species and varieties are tall herbs yielding a wealth of bloom throughout the summer and early autumn. These require a deep, rich, and rather heavy loam, and a cool, moist position to flourish.

The dwarf perennial species and varieties, the "moss pinks" of gardens, are charming plants for the rockery and as edging to beds and borders. They are trailing and tufted in habit, the branches rooting at the nodes. They succeed in poorer soil, and drier situations than the tall kinds. Seed is seldom produced. Propagation is effected by cuttings in July and early August, placed in a cold frame, and by division of the plants, which should be lifted carefully, and cut into rooted portions as required. The tufted kinds decay in patches in winter if the situation is moist and the weather mild and wet.

Phlox Drummondii and its numerous varieties are half-hardy annuals in Britain. It is a small-growing hairy plant, flowering profusely during the summer months. For early flowering it should be sown in heat in March and April and transferred out of doors in June. It succeeds if sown out of doors in April, but the flowering season is later and shorter.

The tall-growing border phloxes are divided into early and late flowering kinds respectively, the former derived mainly from *P. glaberrima* and *P. suffruticosa*, and the latter from *P. maculata* and *P. paniculata*. The salver-shaped flowers with cylindrical tubes range from pure white to almost bright scarlet in colour, passing through shades of pink, purple, magenta lilac, mauve and salmon. New varieties are obtained by the selection of seedlings. Owing to the frequent introduction of new kinds, the reader is referred to the current lists published by growers and nurserymen. The "moss pinks," *P. subulata* and its varieties, are all worthy of a place in the alpine garden.

The varieties are relatively few. The following list includes nearly all the best kinds:—

P. subulata, pink with dark centre; *Aldboroughensis*, rose; *annulata*, bluish white, ringed with purple; *atrolilacina*, deep lilac; *atropurpurea* purple-rose and crimson; Brightness, bright rose with scarlet eye; *compacta*, clear rose; Fairy, lilac; G. F. Wilson, mauve; *grandiflora*, pink, crimson blotch; Little Dot, white, blue centre; *Nelsoni*, pure white; Vivid, rose, carmine centre; all these are about 4 in. high. *P. divaricata*, lavender, height 1 ft.; *P. ovata*, rose, 1 ft.; *P. reptans*, rose, 6 in.; and *P. amoena*, rose, 9 in., are also charming alpines.

P. Drummondii varieties come true from seed, but are usually sown in mixture.

PHOCAEA (mod. *Fokia* or *Fokha*) an ancient city on the western coast of Asia Minor, famous as the mother city of Marseilles. It was the most northern of the Ionian cities, and was situated on the coast of the peninsula which separates the gulf of Cyme, occupied by Aeolian settlers, from the Hermaean Gulf, on which stood Smyrna and Clazomenae.[1] Its position between two good harbours, Naustathmus and Lampter (Livy xxxvii. 31), led the inhabitants to devote themselves to maritime pursuits. According to Herodotus the Phocaeans were the first of all the Greeks to undertake distant voyages, and made known the coasts of the Adriatic, Tyrrhenia and Spain. Arganthonius, king of Tartessus in Spain, invited them to emigrate in a body to his dominions, and, on their declining, presented them with a large sum of money. This they employed in constructing a strong wall around their city, a defence which stood them in good stead when Ionia was attacked by Cyrus in 546. Eventually they determined to seek a new home in the west, where they already had flourishing colonies, *e.g.*

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[1] It was said to have been founded by a band of emigrants from Phocis, under the guidance of two Athenian leaders, named Philogenes and Damon, but it joined the Ionian confederacy by accepting the government of Athenian rulers of the house of Codrus.

Alalia in Corsica and Massilia (mod. Marseilles). A large part of the emigrants proceeded only as far as Chios, returned to Phocaea, and submitted to the Persian yoke.

Phocaea continued to exist under the Persian government, but greatly reduced in population and commerce. Though it joined in the Ionian revolt against Persia in 500 it was able to send only three ships to the combined fleet which fought at Lade. But a Phocaean took the supreme command. It never again played a prominent part in Ionian history, and is rarely mentioned. In the time of Timur Fujah was a fortress of Sarukhan, but had been previously in Genoese hands. The ruins still visible on the site bear the name of Palaea Fokia, but they are of little interest. The modern town in the immediate neighbourhood, still known as Fokia, was founded by the Genoese in 1421 on account of the rich alum mines in the neighbourhood. It has a fair natural harbour, which is the nearest outlet of the rich district of Menemen. About 1880, while the Gediz Chai was throwing its silt unchecked into the Gulf of Smyrna and gradually filling the navigable channel, there was talk of reviving Fokia as a new port for Smyrna, and connecting it with the Cassaba railway. But, in deference to Smyrniote protests, a new estuary was cut for the Gediz. Fokia has acquired local importance however as a port of call for coasting steamers, and it is used to some degree as a summer residence by Smyrniotes.

(D. G. H.)

PHOCAS, East Roman emperor (602–610), was a Cappadocian of humble origin. He was still but a centurion when chosen by the army of the Danube to lead it against Constantinople. A revolt within the city soon afterwards resulted in the abdication of the reigning emperor Maurice, and in the elevation of Phocas to the throne, which seems to have been accomplished by one of the circus factions against the wish of the troops. Phocas proved entirely incapable of governing the empire. He consented to pay an increased tribute to the Avars and allowed the Persians, who had declared war in 604 under Chosroes II., to overrun the Asiatic provinces and to penetrate to the Bosporus. When the African governor Heraclius declared against him, Phocas was deserted by the starving populace of Constantinople, and deposed with scarcely a struggle (610). He died in the same year on the scaffold.

See J. B. Bury, *The Later Roman Empire* (London, 1889), ii. 197–206.

PHOCION, Athenian statesman and general, was born about 402 B.C.,[1] the son of a small manufacturer. He became a pupil of Plato and in later life was a close friend of Xenocrates. This academic training left its mark upon him, but it was as a soldier rather than as a philosopher that he first came into notice. Under Chabrias he distinguished himself in the great sea-fight of Naxos (376), and in the subsequent campaigns loyally supported his chief. He won the confidence of the allies by his justice and integrity. In 351–349[2] he entered the Persian service and helped to subdue a rebellion in Cyprus. Henceforward he always held a prominent position in Athens, and although he never canvassed he was elected general forty-five times in all. In politics he is known chiefly as the consistent opponent of the anti-Macedonian firebrands, headed by Demosthenes, Lycurgus and Hypereides, whose fervent eloquence he endeavoured to damp by recounting the plain facts of Athens's military and financial weakness and her need of peace, even when the arms of Athens seemed to prosper most. But although he won the respect of his audience, his advice was frequently discarded. Yet his influence was felt at the trial of Aeschines in 343, whom he helped to defend, and after the disaster of Chaeroneia (338), when he secured very lenient terms from Philip. He also rendered good service in the field: in 348 he saved the force operating against the philo-Macedonian tyrants in Euboea by the brilliant victory of Tamynae. Under the Macedonian predominance his reputation steadily increased. Though by no means inclined to truckle to the Macedonians, as is shown by his protection of the refugee Harpalus and his spirited campaign in defence of Attica in 322, he won the confidence of the conquerors, and in the restricted democracy which Antipater enforced he became the virtual ruler of Athens. Old age, however, was telling on him; when Polyperchon by his proclamation of "freedom" raised a new crisis in 318, Phocion's dilatoriness was interpreted as active treason on Cassander's behalf, and the people, incited by the restored democrats, deposed him from office. Phocion fled to Polyperchon, but was sent back by the latter to be tried at Athens. The assembly, containing numerous slaves and all the city mob, shouted Phocion down and condemned him to death unheard. Not long after, the Athenians decreed a public burial and a statue in his honour.

Phocion's character and policy were throughout inspired by his philosophic training, which best explains his remarkable purity of character and his prudent councils. To the same influence we may ascribe his reserve and his reluctance to co-operate heartily either with the people or with the Macedonian conquerors who put their trust in him: a greater spirit of energy and enterprise might have made him the saviour of his country. Phocion remained famous in antiquity for the pithy sayings with which he used to parry the eloquence of his opponents. Demosthenes called him "the chopper of my periods."

Plutarch (*Life of Phocion*) draws much good information from Philochorus and Duris (who reproduces Hieronymus of Cardia); his numerous anecdotes are repeated in other works of his and in Aelian (*Var. hist.*). Diodorus (xvi.–xviii.) is likewise based on Duris. See Holm. *Gk. Hist.* vol. iii. (Eng. trans., London, 1896).

(M. O. B. C.)

PHOCIS, an ancient district of central Greece (now a department, pop. 62,246), about 625 sq. m. in area, bounded on the W. by Ozolian Locris and Doris, on the N. by Opuntian Locris, on the E. by Boeotia, and on the S. by the Corinthian Gulf. The massive ridge of Parnassus (8068 ft.), which traverses the heart of the country, divides it into two distinct portions. Between this central barrier and the northern frontier range of Cnemis (3000 ft.) is the narrow but fertile valley of the Cephissus, along which most of the Phocian townships were scattered. Under the southern slope of Parnassus were situated the two small plains of Crisa and Anticyra, separated by Mt Cirphis, an offshoot from the main range. Being neither rich in material resources nor well placed for commercial enterprise, Phocis was mainly pastoral. No large cities grew up within its territory, and its chief places were mainly of strategic importance.

The early history of Phocis remains quite obscure. From the scanty notices of Greek legend it may be gathered that an influx of tribes from the north contributed largely to its population, which was reckoned as Aeolic. It is probable that the country was originally of greater extent, for there was a tradition that the Phocians once owned a strip of land round Daphnus on the sea opposite Euboea, and carried their frontier to Thermopylae; in addition, in early days they controlled the great sanctuary of Delphi. The restriction of their territory was due to the hostility of their neighbours of Boeotia and Thessaly, the latter of whom in the 6th century even carried their raids into the Cephissus valley. Moreover the Dorian population of Delphi constantly strove to establish its independence and about 590 B.C. induced a coalition of Greek states to proclaim a "Sacred War" and free the oracle from Phocian supervision. Thus their influence at Delphi was restricted to the possession of two votes in the Amphictyonic Council.

During the Persian invasion of 480 the Phocians at first joined in the national defence, but by their irresolute conduct at Thermopylae lost that position for the Greeks; in the campaign of Plataea they were enrolled on the Persian side. In 457 an attempt to extend their influence to the head waters of the Cephissus in the territory of Doris brought a Spartan army into Phocis in defence of the "metropolis of the Dorians." A similar enterprise against Delphi in 448 was again frustrated by Sparta, but not long afterwards the Phocians recaptured the sanctuary with the help of the Athenians, with whom they had entered into alliance in 454. The subsequent decline of Athenian land-power had the effect of weakening this new connexion; at the time of the Peloponnesian War Phocis was nominally an ally and dependent of Sparta, and had lost control of Delphi.

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[1] Diodorus' statement that Phocion was 75 at his death (*i.e.* that he became general at 30 and was elected 45 years in succession) would give 394–393 as the date of birth; but he must have been quite 25 as second-in-command at Naxos (376).

[2] The chronology is uncertain: the dates given for this period are Beloch's (*Griechische Geschichte*,

In the 4th century Phocis was constantly endangered by its Boeotian neighbours. After helping the Spartans to invade Boeotia during the Corinthian War (395–94), the Phocians were placed on the defensive. They received assistance from Sparta in 380, but were afterwards compelled to submit to the growing power of Thebes. The Phocian levy took part in Epaminondas' inroads into Peloponnesus, except in the final campaign of Mantinea (370–62), from which their contingent was withheld. In return for this negligence the Thebans fastened a religious quarrel upon their neighbours, and secured a penal decree against them from the Amphictyonic synod (356). The Phocians, led by two capable generals, Philomelus and Onomarchus, replied by seizing Delphi and using its riches to hire a mercenary army. With the help of these troops the Phocian League at first carried the war into Boeotia and Thessaly, and though driven out of the latter country by Philip of Macedon, maintained itself for ten years, until the exhaustion of the temple treasures and the treachery of its leaders placed it at Philip's mercy. The conditions which he imposed—the obligation to restore the temple funds, and the dispersion of the population into open villages—were soon disregarded. In 339 the Phocians began to rebuild their cities; in the following year they fought against Philip at Chaeronea. Again in 323 they took part in the Lamian War against Antipater, and in 279 helped to defend Thermopylae against the Gauls.

Henceforth little more is heard of Phocis. During the 3rd century it passed into the power of Macedonia and of the Aetolian League, to which in 196 it was definitely annexed. Under the dominion of the Roman republic its national league was dissolved, but was revived by Augustus, who also restored to Phocis the votes in the Delphic Amphictyony which it had lost in 346 and enrolled it in the new Achaean synod. The Phocian League is last heard of under Trajan.

See Strabo, pp. 401, 418, 424–425; Pausanias x. 1–4; E. Freeman, *History of Federal Government* (ed. 1893, London), pp. 113–114; G. Kazarow, *De foederis Phocensium institutis* (Leipzig, 1899); B. Head, *Historia numorum* (Oxford, 1887), pp. 287–288.

(M. O. B. C.)

PHOCYLIDES, Greek gnomic poet of Miletus, contemporary of Theognis, was born about 560 B.C. A few fragments of his "maxims" have been preserved (chiefly in the *Florilegium* of Stobaeus), in which he expresses his contempt for the pomps and vanities of rank and wealth, and sets forth in simple language his ideas of honour, justice and wisdom. A complete didactic poem (230 hexameters) called Ποίημα νουθετικόν or γνῶμαι, bearing the name of Phocylides, is now considered to be the work of an Alexandrian Christian of Jewish origin who lived between 170 B.C. and A.D. 50. The Jewish element is shown in verbal agreement with passages of the Old Testament (especially the book of Sirach); the Christian by the doctrine of the immortality of the soul and the resurrection of the body. Some Jewish authorities, however, maintain that there are in reality no traces of Christan doctrine to be found in the poem, and that the author was a Jew. The poem was first printed at Venice in 1495, and was a favourite school textbook during the Reformation period.

See fragments and the spurious poem in T. Bergk, *Poetae lyrici graeci*, ii. (4th ed., 1882); J. Bernays *Über das Phokylideische Gedicht* (1858); *Phocylides, Poem of Admonition*, with introduction and commentaries by J. B. Fenling, and translation by H. D. Goodwin (Andover, Mass., 1879); F. Susemihl, *Geschichte der griechischen Litteratur in der Alexandrinerzeit*, (1892), ii. 642; S. Krauss (*s.v.* "Pseudo-Phocylides") in *The Jewish Encyclopedia* and E. Schürer, *Hist. of the Jewish People*, div. ii., vol. iii., 313–316 (Eng. trans., 1886), where full bibliographies are given. There is an English verse translation by W. Hewett (Watford, 1840), *The Perceptive Poem of Phocylides*.

PHOEBE, in astronomy, the ninth satellite of Saturn in order of discovery, or the tenth and outermost now known in the order of distance. It was discovered by W. H. Pickering in 1899 by photographs of the stars surrounding Saturn. It is remarkable in that its motion around the planet is retrograde. (See SATURN.)

PHOEBUS (Gr. for "bright," "pure,"), a common epithet of Apollo (*q.v.*). Artemis in like manner is called Phoebe, and in the Latin poets and their modern followers Phoebus and Phoebe are often used simply for the sun and moon respectively.

PHOENICIA, in ancient geography, the name given to that part of the seaboard of Syria which extends from the Eleutherus (Nahr el-Kebīr) in the north to Mt Carmel in the south, a distance of rather more than two degrees of latitude. These limits, however, were exceeded at various times; thus, north of the Eleutherus lay Aradus and Marathus, and south of Carmel the border sometimes included Dor and even Joppa. Formed partly by alluvium carried down by perennial streams from the mountains of Lebanon and Galilee, and fringed by great sand-dunes which the sea throws up, Phoenicia is covered with a rich and fertile soil. It is only at the mouth of the Eleutherus and at Acre (ʽAkkā) that the strip of coast-land widens out into plains of any size; there is a certain amount of open country behind Beirūt; but for the most part the mountains, pierced by deep river-valleys, approach to within a few miles of the coast, or even right down to the sea, as at Rās en-Nāḳūra (Scala Tyriorum, Jos. *Bell. jud.* ii. 10, 2) and Ras el-Abiaḍ (Pliny's Promunturium Album), where a passage had to be cut in the rock for the caravan road which from time immemorial traversed this narrow belt of lowland. From the flanks of Lebanon, especially from the heights which lie to the north of the Qāsimīyeh or Ḳasimiya (Līṭāny) River, the traveller looks down upon some of the finest landscape in the world; in general features the scenery is not unlike that of the Italian Riviera, but surpasses it in grandeur and a peculiar depth of colouring.

With regard to natural products the country has few worth mentioning; minerals are found in the Lebanon, but not in any quantity; traces of amber-digging have been discovered on the coast; and the purple shell (*murex trunculus* and *brandaris*) is still plentiful. The harbours which played so important a part in antiquity are nearly all silted up, and, with the exception of Beirūt, afford no safe anchorage for the large vessels of modern times. A few bays, facing towards the north, break the coast-line, and small rocky islands are dotted here and there just off the shore. Sidon, Tyre and Aradus, though now connected with the mainland, were built originally upon islands; the Phoenicians preferred such sites, because they were convenient for shipping and easily defended against attack.

The chief towns of ancient Phoenicia, as we know of them from the Amarna tablets (15th century B.C.) and from Egyptian, Assyrian and the Old Testament documents, were the following: Acco (now Acre or ʽAkkā, Judg. i. 31), Achzib (now ez-Zīb, ibid.), Ahlab (in Assyrian Mahalliba, ibid.)—three towns on the coast south of Tyre, Ḳānāh (Josh. xix. 28), Tyre (Phoen. Ṣōr, now Ṣūr), Zarephath or Sarepta (1 Kings xvii. 9 now Sarafand), Sidon (now Ṣaidā), Berytus (Biruta in Egyptian, Biruna in the Amarna tablets, now Beirūt), Byblus (in Phoen. and Hebr. Gebal, now Jebeil), Arka, 80 m. north of Sidon (Gen. x. 17, now ʽArḳā), Sin (Assyr. Siannu, ibid.) Simyra (Gen. x. 18, now Ṣumrā), Marathus (now Amrīt) not important till the Macedonian period, Arvad or Aradus (in Phoen. Arwād, now Ruād, Gen. x. 18; Ezek. xxvii. 8, 11), the most northerly of the great Phoenician towns, and always famous as a maritime state.

Race and Language.—The Phoenicians were an early offshoot from the Semitic stock, and belonged to the Canaanite branch of it. Curiously enough in Gen. x. Sidon, the "first-born" of Canaan, is classed among the descendants of Ham; but the table of nations in Gen. x. is not arranged upon strict ethnographic principles; perhaps religious antagonism induced the Hebrews to assign to the Canaanites an ancestry different from their own; at any rate the close connexion which existed from an early date between the Phoenicians and the Egyptians may have suggested the idea that both peoples belonged to the same race. The Phoenicians themselves retained some memory of having migrated from older seats on an eastern sea; Herodotus (i. 1; vii. 89) calls it the "red sea," meaning probably the

Persian Gulf; the tradition, therefore, seems to show that the Phoenicians believed that their ancestors came originally from Babylonia. By settling along the Syrian coast they developed a strangely un-Semitic love for the sea, and advanced on different lines from the other Canaanites who occupied the interior. They called themselves Canaanites and their land Canaan; such is their name in the Amarna tablets, *Kinaḫḫi* and *Kinaḫni*; and with this agrees the statement assigned to Hecataeus (*Fr. hist. gr.* i. 17) that Phoenicia was formerly called Χνᾶ, a name which Philo of Byblus adopts into his mythology by making "Chna who was afterwards called Phoinix" the eponym of the Phoenicians (*Fr. hist. gr.* iii. 569). In the reign of Antiochus IV. and his successors the coins of Laodicea of Libanus bear the legend "Of Laodicea which is in Canaan";[1] the Old Testament also sometimes denotes Phoenicia and Phoenicians by "Canaan" and "Canaanites" (Isa. xxiii. 11; Obad. 20; Zeph. i. 11), though the latter names generally have a more extended sense. But "Sidonians" is the usual designation both in the Old Testament and in the Assyrian monuments (*Sidunnu*); and even at the time of Tyre's greatest ascendancy we read of Sidonians and not Tyrians in the Old Testament and in Homer; thus Ethbaal king of Tyre (Jos. *Ant.* viii. 13, 2) is called king of the Sidonians in 1 Kings xvi. 31. In the Homeric poems we meet with *Σιδόνιοι*, *Σιδονίη* (*Od.* iv. 618; *Il.* vi. 290; *Od.* xiii. 285; *Il.* vi. 291) and *Φοίνικες*, *Φοινίκη* (*Od.* xiii. 272, xiv. 288 seq., &c.), and both terms together (*Od.* iv. 83 seq., *Il.* xxiii. 743 seq.)[2] And the Phoenicians themselves used Sidonians as a general name; thus in the oldest Phoenician inscription known (*CIS.* i. 5=*NSI.*, No. 11), Hiram II. king of Tyre in the 8th century is styled "king of the Sidonians." But among the Greeks "Phoenicians" was the name most in use, *Φοίνικες* (plur. of *Φοῖνιξ*) for the people and *Φοινίκη* for the land (cf. PHOENIX). The former was probably the older word, and may be traced to *φοινός*="blood-red"; the Canaanite sailors were spoken of as the "red men" on account of their sunburnt skin; then the land from which they came was called after them; and then probably the original connexion between *Φοῖνιξ* and *φοινός* was forgotten, and new forms and meanings were invented. Thus *φοῖνιξ* came to mean a "date-palm"; but the date-palm is not in the least characteristic of Phoenicia, and can hardly grow there; *φοῖνιξ* in this sense has no connexion with the original meaning of Phoenician. A derivation has been sought elsewhere, and the Egyptian *Fenḫ* proposed as the origin of the name; but the word *Fenḫ* was apparently used of Asiatic barbarians in general, without any special reference to the Phoenicians (W. M. Müller, *Asien u. Europa*, p. 208 seq.). The Lat. *Poenus* is of course merely an adaptation of the Greek form.[3]

Language.—Inscriptions, coins, topographical names preserved by Greek and Latin writers, names of persons and the Punic passages in the *Poenulus* of Plautus, all show conclusively that the Phoenician language belonged to the North-Semitic group, and to that subdivision of it which is called the Canaanite and includes Hebrew and the dialect of Moab. A comparison between Phoenician and Hebrew reveals close resemblances both in grammatical forms and in vocabulary; in some respects older features have been preserved in Phoenician, others are later, others again are peculiar to the dialect; many words poetic or rare or late in Hebrew are common in Phoenician. Hence we may conclude that the two languages developed independently from a common ancestor, which can be no other than the ancient Canaanite, of which a few words have survived in the Canaanite glosses to the Amarna tablets (written in Babylonian).[4] But in forming an estimate of the Phoenician language it must be remembered that our material is scanty and limited in range; the Phoenicians were in no sense a literary people; moreover, with one exception (*CIS.* i. 5), almost all the inscriptions are subsequent to the 6th century B.C.; the majority belong to the 4th century and later, by which time the language must have undergone a certain amount of decay.[5] Indirectly, however, the Phoenicians rendered one great service to literature; they took a large share in the development and diffusion of the alphabet which forms the foundation of Greek (Herod. v. 58) and of all European writing. The Phoenician letters in their earlier types are practically identical with those used by the Hebrews (*e.g.* the Siloam inscr. *NSI.* No. 2), the Moabites (*e.g.* the Mesha stone, ibid. No. 1), and the Aramaeans of north Syria (*e.g.* the Zenjirli inscrr. ibid. Nos. 61–63). They passed through various modifications in the course of time; after leaving the mother country the script acquires a more cursive flowing style on the stones from Cyprus and Attica; the tendency becomes more strongly marked at the Punic stage; until in the neo-Punic, from the destruction of Carthage (146 B.C.) to the 1st century A.D., both the writing and the language reached their most degenerate form. As a rustic dialect the language lasted on in North Africa till the 5th century A.D. In his sermons St Augustine frequently quotes Punic words.

Early Period.

History.—The Phoenicians, in imitation of the Egyptians, claimed that their oldest cities had been founded by the gods themselves, and that their race could boast an antiquity of 30,000 years (Africanus in Syncellus, p. 31). Herodotus quotes (ii. 44) a more moderate tradition which placed the foundation of Tyre 2300 years before his time, *i.e.*, *c.* 2756 B.C. According to Justin (xviii. 3) the Phoenicians, who had long been settled on the coast and occupied Sidon, founded Tyre in the year before the fall of Troy; possibly the date 1198 B.C., given by Menander of Ephesus (in Jos. *Ant.* viii. 3, 1 and *c. Ap.* i. 18) as that from which the era of Tyre begins, may refer to the epoch which Justin mentions. Little certainty, however, can be allowed to these traditional chronologies. It is probable that in remote ages Babylonia exercised a considerable influence upon Syria and its coast towns; but Mr L. W. King has shown that the tradition, which was supposed to connect Sargon I. (*c.* 3800 B.C.) with the western land and sea, has been misunderstood; it was the sea in the east, *i.e.* the Persian Gulf, which Sargon crossed (*Chronicles concerning Early Bab. Kings*, vol. i. ch. 2, 1907).

Egyptian Rule c. 1600–1100 B.C.

The extension of the Egyptian empire in the direction of Asia began about 1600 B.C. under Aḥmosi (Aahmes, Amasis) I., the founder of the XVIIIth Dynasty, who carried his arms into Syria, and conquered at least Palestine and Phoenicia, the latter being the country called *Ḍa-hi* on the Egyptian monuments (Müller, *As. u. Eur.* p. 181). Whether the campaign of Thothmes (Tethmosis) I. to the Euphrates produced any lasting results is doubtful; it was Thothmes III. (1503–1449) who repeated and consolidated the earlier conquest, and established Egyptian suzerainty over all the petty states of Syria and Phoenicia (see EGYPT: *History*, I.). For the geography and civilization of Canaan about 1400 B.C. we have valuable evidence in the Egyptian papyrus Anastasi I., which mentions Kepuna (Gubna, Gebal-Byblus) the holy city, and continues: "Come then to Berytus, to Sidon, to Sarepta. Where is the ford of Nat-'ana (? Nahr el-Ḳāsimīyeh, or a town)? Where is 'Eutu (? Usu, Palaetyrus)? Another city on the sea is called a haven, D'ar (Tyre) is its name, water is carried to it in boats; it is richer in fish than in sands."[6] But the fullest information about the state of Phoenicia in the 15th and 14th centuries B.C. comes from the Amarna tablets, among which are many letters from the subject princes and the Egyptian governors of Phoenicia to the Pharaoh.[7] It was a time of much political disturbance. The Hittites (*q.v.*) were invading Syria; nomads from the desert supported the invasion; and many of the local chiefs were ready to seize the opportunity to throw off the yoke of Egypt. The towns of Phoenicia were divided; Aradus, Simyra, Sidon supported the rebellion; Rib-habad, the vassal of Byblus, and Abi-melech, king of Tyre, held out for Egypt; but while all the towns made professions of fidelity, they were scheming for their own interests, and in the end Egypt lost them all except Byblus. The tablets which reveal this state of affairs are written in the language and script of Babylonia, and thus show indirectly the extent to which Babylonian culture had penetrated Palestine and Phoenicia; at the same time they illustrate the closeness of the relations between the Canaanite towns and the dominant power of Egypt. After the reign of Amenophis IV. (1376–1366) that power collapsed altogether; but his successors attempted to recover it, and Ramses (Rameses) II. reconquered Phoenicia as far as Beirūt, and carved three tablets on the rock beside the Nahr el-Kelb to commemorate his victories; under the XIXth and XXth Dynasties this seems to have remained the northern limit of the Egyptian Empire. But in the reign of Ramses III. (c. 1200) great changes began to occur owing to the invasion of Syria by peoples from Asia Minor and Europe, which ended in the establishment of the Philistines on the coast near Ashkelon. The successors of Ramses III. lost their hold over Canaan; the XXIst Dynasty no longer intervened in the affairs of Syria; but Sheshonk (Shishak), the founder of the XXIInd Dynasty, about 928 B.C. endeavoured to assert the ancient supremacy of Egypt (cf. 1 Kings xiv. 25 sqq.), but his successes were not lasting, and, as we learn from the Old Testament, the power of Egypt became henceforward practically ineffective. Not until 608 did a Pharaoh (Necho) lead an Egyptian army so far north, and he was defeated by Nebuchadrezzar. During the period which elapsed before the rise of the Assyrian power in Syria the Phoenicians were left to themselves. This was the period of their development, and Tyre became the leading city of Phoenicia.

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[1] Cooke, *North-Semitic Inscriptions* (elsewhere abbreviated *NSI.*), No. 149 B. 8.

[2] In this passage "Phoenicians" is a general name for carriers of commerce, not the inhabitants of a particular country. Similarly "Sidonian" in *Il.* vi. 209, is taken to mean Semites in general. Elsewhere "Phoenicians" are merchants, kidnappers, &c., "Sidonians" are artists; to indicate nationality both names seem to be used indifferently, *e.g. Od.* xiii. 272, xiv. 288, xv. 414.

[3] See especially Pietschmann, *Gesch. d. Phönizier*, 13 sqq., and Winckler, *Keilinschr. u. d. A. T.*, 3rd ed., 127.

[4] A vocabulary is given in *KAT.*³, 652 seq.; see further Böhl, *Die Sprache d. Amarnabriefe* (1909).

[5] For the Phoen. inscrr. see *Corpus inscriptionum semiticarum*, pt. i., brought up to date provisionally by *Répertoire d'épigr. sém.* A selection is published by Lidzbarski, *Handbuch d. nordsem. Epigraphik* (1898); Cooke, *Textbook of North-Semitic Inscriptions* (1903), with translations and notes; Landau, *Beiträge z. Altertumsk. d. Orients* (1899–1906); Lidzbarski, *Altsem. Texte* (1907), pt. i.

[6] See W. M. Muller, *loc. cit.* pp. 57, 172 sqq., 184 sqq.; Jeremias, *Das A. T. im Lichte d. alt. Orients*, p. 302 seq.; *Records of the Past*, ii. 109 seq.

[7] Winckler, *Tell-el-Am. Letters* Nos. 37 sqq.; Petrie, *Syria and Egypt in the Tell el Am. Letters.*

Independence of Phoenicia.

Between the withdrawal of the Egyptian rule in Syria and the western advance of Assyria there comes an interval during which the city-states of Phoenicia owned no suzerain. The history of this period is mainly a history of Tyre, which not only rose to a sort of hegemony among the Phoenician states, but founded colonies beyond the seas (below). From 970 to 772 B.C. the bare outline of events is supplied by extracts from two Hellenistic historians, Menander of Ephesus and Dius (largely dependent upon Menander), which have been preserved by Josephus, *Ant.* viii. 5, 3 and *c. Ap.* i. 17, 18. From the data given in these passages we learn that Hiram I., son of Abi-baal, reigned in Tyre from 970 to 936 B.C. He enlarged the island-town to the east, restored and enriched the temples, built new ones to Heracles (*i.e.* Melkarth or Melqarth) and Astarte, founded the feast of the awakening of Heracles in the month Peritius, and reduced the inhabitants of Utica to their allegiance. The Tyrian annals, moreover, alluded to the connexion between Hiram and Solomon. Before this time, indeed, the Phoenicians had no doubt lived on friendly terms with the Israelites[1] (cf. Judges v. 17; Gen. xlix. 13); but the two nations seem to have drawn closer in the time of Solomon. 2 Sam. v. 11, which brings David and Hiram together, probably antedates what happened in the following reign. For Solomon's palace and temple Hiram contributed cedar and fir trees as well as workmen, receiving in exchange large annual payments of oil and wine, supplies which Phoenicia must have drawn regularly from Israelite districts (1 Kings v. 9, 11; cf. Ezek. xxvii. 17; Ezr. iii. 7; Acts xii. 20; Jos. *Ant.* xiv. 10, 6); finally, in return for the gold which he furnished for the temple, Hiram received the grant of a territory in Galilee (Cabul, 1 Kings ix. 10–14).[2] This alliance between the two monarchs led to a joint expedition from Eziongeber on the Gulf of Akaba (strictly Aqāba) to Ophir (? on the east coast of Arabia, see OPHIR) for purposes of trade. The list of Hiram's successors given by Josephus indicates frequent changes of dynasty until the time of Ithobal I. priest of Astarte, whose reign (887–855) marks a return to more settled rule. In contrast to Hiram I., king of Tyre, Ithobal or Ethbaal is styled in 1 Kings xvi. 31 "king of the Sidonians," *i.e.* of the Phoenicians, showing that in the interval the kings of Tyre had extended their rule over the other Phoenician cities. Under Ethbaal further expansion is recorded; Botrys north of Byblus and Aoza in North Africa are said to have been founded by him; the more famous Carthage owed its origin to the civil discords which followed the death of Metten I. (820), his next successor but one. According to tradition, Metten's son Pygmalion (820–773) slew the husband of his sister Elissa or Dido; whereupon she fled and founded Carthage (*q.v.*) in Libya (813; Justin xviii. 4–6). At this point Josephus's extracts from Menander come to an end.

Assyrian Rule, 876-605 B.C.

From the time of Ethbaal onwards the independence of Phoenicia was threatened by the advance of Assyria. So far back as 1100 B.C. Tiglath-pileser I. had invaded North Phoenicia, and in order to secure a harbour on the coast he occupied Arvad (Aradus); but no permanent occupation followed. In the 9th century, however, the systematic conquest of the west began. In 876 B.C. Assur-nazir-pal III. "washed his weapons in the great sea," and exacted tribute from the kings of Tyre, Sidon, Byblus and other cities, including Arvad (*Keilinschr. Bibliothek*, i. 109). The inscriptions of his son Shalmaneser II. mention the taking of tribute from the Tyrians and Sidonians in 846 and again in 849; the Byblians are included at the latter date, and among the kings defeated at Karkar in 854 or 853 was Metten-baal, king of the Arvadites (ibid. pp. 141, 143, 173). Thus Shalmaneser completed the conquests of his predecessor on the Phoenician coast, and established a supremacy which lasted for over a hundred years and was acknowledged by occasional payments of tribute. In 741 Tiglath-pileser III. mentions on his tribute-lists "Ḥirûm of Tyre"; and here for the first time a piece of native evidence becomes available. The earliest Phoenician inscription at present known (*CIS.* i. 5=*NSI.* No. 11) is engraved upon the fragments of a bronze bowl dedicated by a certain governor of Qarth-ḥadasht (or Karti-Hadasti, "New City," *i.e.* Citium), "servant of Ḥiram king of the Sidonians to Baal of Lebanon." It is to be noted that this Hiram II. was not only king of Tyre, as the Assyrian inscription calls him, but of Sidon too; and further, that by this time Tyre had established a colony in Cyprus (*q.v.*). In Tiglath-pileser's Philistine campaign of 734 Byblus and Aradus paid tribute, and an Assyrian chief officer (the Rab-shakeh) was sent to Tyre and extorted from the king, now Metten or Mattūn, the large sum of 150 talents of gold (*KB.* ii. 23). For the period which follows a certain amount of information is furnished by Menander (in Jos. *Ant.* ix. 14, 2). Elulaeus IX., in Assyrian Lulī, who ruled under the name of Pylas, was king of Tyre, Sidon, and other cities at this time (*c.* 725–690), and at the beginning of his reign suffered from an invasion by Shalmaneser IV. or Salampsas (Jos.); this was probably the expedition against Hoshea of Samaria in 725; "the king of Assyria . . . overran all Phoenicia, but soon made peace with them all and returned back." In the reign of Sargon Phoenicia itself seems to have been left alone; but the inhabitants of Citium revolted, showing that the authority of Tyre in Cyprus had grown weak; and Sargon received the submission of seven Cyprian princes, and set up in Larnaca (probably in 709) the triumphal stele now in the Berlin Museum (Schrader, *Cuneif. Inscr. and O. T.*, 2nd ed., vol. ii. p. 87). But Elulaeus, according to Menander, suppressed the revolt of Citium, and early in the reign of Sennacherib joined the league of Philistia and Judah, in alliance with Egypt and Ethiopia, which aimed at throwing off the oppressive tyranny of Assyria; as usual, however, the city-states of Phoenicia could not combine even against a common foe, and several broke away from Tyre, so Menander tells us, and sided with Assyria. In the great campaign of 701 Sennacherib came down upon the revolting provinces; he forced Lulī, king of Sidon, to fly for refuge to Cyprus, took his chief cities, and set up Tuba'lu (Ethbaal) as king, imposing a yearly tribute (*KB.* ii. 91). The blockade of Tyre by sea, significantly passed over in Sennacherib's inscription, is described by Menander. The island-city proved to be impregnable, but it was the only possession left of what had been the extensive kingdom of Elulaeus. Sennacherib, however, so far accomplished his object as to break up the combination of Tyre and Sidon, which had grown into a powerful state.[1] At Sidon the successor of Ethbaal was Abd-milkath; in alliance with a Cilician chief he rebelled against Esarhaddon about the year 678, with disastrous consequences. Sidon was annihilated; Abd-milkath fell into the hands of Esarhaddon, who founded a new Sidon on the mainland, peopled it with foreigners, and called it after his own name. The old name, however, survived in popular usage; but the character of the city was changed, and till the time of Cyrus the kingdom of Sidon ceased to exist (*KB.* ii. 125 seq., 145; *KAT.*^{3} 88). Tyre also came in for its share of hardship. Elulaeus was followed by Baal, who in 672 consented to join Tirhaka, the Ethiopian king of Egypt, in a rebellion against Assyria. Esarhaddon, on his way to Egypt for the second time, determined to deal out punishment; he blockaded Tyre, and raised earthworks on the shore and cut off the water-supply; but he did not capture the city itself. His monument found at Zenjirli represents the great king holding Baal of Tyre and Tirhaka of Egypt by cords fastened in their lips;[2] there is no evidence, however, that he actually took either of them prisoner. Early in the reign of Assur-bani-pal Tyre was besieged again (668), but Assur-bani-pal succeeded no better than his predecessors. Nevertheless Baal submitted in the end, along with the princes of Gebal and Arvad, Manasseh of Judah, and the other Canaanite chiefs; in the island of Cyprus the Assyrians carried all before them (*KB.* ii. 149 seq., 169, 173). On his return from the Arabian campaign Assur-bani-pal severely punished the rebellious inhabitants of Ushu (Palaetyrus) and Akko, and transported the survivors to Assyria (ibid. 229). In Phoenicia, as elsewhere, Assyrian rule created nothing and left nothing behind it but a record of barbarous conquest and extortion. An interesting sidelight is thrown upon this period by the list of the Thalassocracies in the *Chronicon* of Eusebius (p. 226, ed. Schoene), which places the 45 years of the sea-power of Phoenicia at a date which, with much probability, may be conjectured to lie between 709, when Cyprus submitted to Sargon, and 664, when Egypt threw off the rule of Assyria. If this dating is correct, and the Phoenician sea-power was at its height during these years, we can understand why Tyre gave so much trouble to the Assyrian kings.[3]

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[1] In Judges x. 12 (cf. *v.* 6, iii. 3) the Sidonians are mentioned among the oppressors of Israel; but there is no record of any invasion of Israel by the Phoenicians, and the statement is due to the post-exilic editor who introduced generalizations of ancient history into the book of Judges.

[2] Jos. *Ant.* viii. 3, 1, dates the building of Solomon's temple in the 11th year of Hiram, and 420 years after the foundation of Tyre. This gives a Tyrian era which began in 1198–1197 B.C., *i.e.* at the time when the Philistines settled on the coast of Canaan, an event which had considerable effect upon the cities of Phoenicia (above, Justin xviii. 3). In the Tyrian annals (Jos. *c. Ap.* i. 18) the reference was probably to the felling of timber in Lebanon for *Hiram's* temples; Josephus then misinterpreted this by 1 Kings v. 6.

The Neo-Babylonian Period, 605-538 B.C.

In the last crisis of the dying power of Assyria the Egyptians for a short time laid hands on Phoenicia; but after their defeat at the battle of Carchemish (605), the Chaldaeans became the masters of western Asia. Jeremiah's allusion (xxv. 22) in 604 to the approaching downfall of the kings of Tyre and Sidon and the coast-land beyond the sea, *i.e.* the Phoenician settlements on the Mediterranean, seems to imply that the Phoenician states recovered some measure of independence; if they did it cannot have lasted long. In 588 Apries (Pharaoh Hophra) made an attempt to displace the Chaldaean supremacy; he defeated Tyre and Sidon, and terrorized the other cities into submission (Herod. ii. 161; Diod. Sic. i. 68). Some of the Phoenician chiefs, among them Ithobal II., the new king of Tyre, while forced to yield to a change of masters, were bold enough to declare their hostility to the Babylonians. This state of affairs did not escape the vigilance of Nebuchadrezzar. After the fall of Jerusalem he marched upon Phoenicia; Apries withdrew his army, and the siege of Tyre began. For thirteen years the great merchant city held out (585–573; Jos. *c. Ap.* i. 21; cf. Ezek. xxvi. 1 seq.). Ezekiel says that Nebuchadrezzar and his host had no reward for their heavy service against Tyre, and the presumption is that the city capitulated on favourable terms; for Ithobal's reign ends with the close of the siege, and the royal family is subsequently found in Babylon. The king appointed by Nebuchadrezzar was Baal II. (574–564), after whose death a republic was formed under a single suffete or "judge" (*shōfēt*). Josephus (*loc. cit.*) is again our authority for the changes of government which followed until the monarchy was revived. At length under Hiram III. Phoenicia passed from the Chaldaeans to the Persians (538), and at the same time Amasis (Aḥmosi) II. of Egypt occupied Cyprus (Herod. ii. 182). There seems to have been no struggle; the great siege and the subsequent civil disorders had exhausted Tyre, and Sidon took its place as the leading state. About this time, too, Carthage made an effort for independence under Hanno the Great (538–521), the real founder of its fortunes; the old dependence upon Tyre was changed for a mere relation of piety observed by the annual sending of delegates (θεωροί) to the festival of Melkarth (Arrian ii. 24; Polyb. xxxi. 20, 12). The disasters and humiliations which befell Tyre during this and the foregoing period might suggest that its prosperity had been seriously damaged. But Tyre always counted for more in commerce than in politics; and in the year 586, just before the great siege, Ezekiel draws a vivid picture (ch. xxvii.) of the extent and splendour of its commercial relations. Even when cut off from its possessions on the mainland the city itself was not captured; its seafaring trade went on; and though by degrees the colonies were lost, yet the ties of race and sentiment remained strong enough to bind the Phoenicians of the mother-country to their kindred beyond the seas.

Constitution.—At this point it is convenient to mention what little is known about the constitution of the Phoenician states. All Canaanite analogy speaks for kingship as the oldest form of Phoenician government. In the native inscriptions the chief of the city in Phoenicia itself and in Cyprus is always called king. The royal houses claimed divine descent,[4] and the king could not be chosen outside their members. His power, however, was limited by the wealthy merchant families, who possessed great influence in public affairs; thus it was possible for war or peace to be decided at Tyre in the king's absence, or at Sidon against his will (Arrian ii. 15 and 16; Curtius iv. 1, 15). The priest of Melkarth at Tyre was the second man in the kingdom. Associated with the prince was a council of elders; such was the case at Gebal (Byblus) from the earliest times to the latest (Ezek. xxvii. 9); at Sidon this council consisted of 100 members (Diod. xvi. 45), perhaps also at Tyre.[5] Inscriptions of the 3rd and 2nd centuries B.C. mention a *Rab* (chief) in Sidon, Cyprus and Gaulus (Gozo); what his position was it is difficult to say; in the colonies he may have been a district governor. During Nebuchadrezzar's time, as we have seen, a republic took the place of the monarchy at Tyre, and the government was administered by a succession of suffetes (judges); they held office for short terms, and in one instance two ruled together for six years. Much later, in the 3rd century B.C., an inscription from Tyre mentions a suffete (*NSI.* No. 8) without adding more to our knowledge. Carthage, of course, was governed by two suffetes, and these officers are frequently named in connexion with the Carthaginian colonies (*NSI.* p. 115 seq.); but we must be careful not to draw the inference that Phoenicia itself had any such magistrates. Under the Persians a federal bond was formed comprising Sidon, Tyre and Aradus, whose duty it was to contribute 300 triremes to the Persian fleet (Herod. vii. 89), the lesser towns being under the command of the great cities. Aradus presided over three subordinate townships (Arrian ii. 13); Berytus, which had no king of its own, probably formed with Byblus a single kingdom; while Tripolis consisted of a federation of three cities separated by a stadium from each other, and provided a meeting-place for the federal council, which was chiefly occupied in dealings with the Persian government (Diod. xvi. 41). But federation on a larger scale was never possible in Phoenicia, for the reason that no sense of political unity existed to bind the different states together. Commercial interests dominated everything else, and while these stimulated a municipal life not without vigour, civil discipline and loyalty were but feebly felt. On occasion the towns could defend their independence with strenuous courage; the higher qualities which make for a progressive national life the Phoenicians did not possess.

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[1] The above interpretation of Menander and the Assyrian evidence is based upon Ed. Meyer, *Ency. Bib.* col. 3755. For a different explanation see Landau, *Beitr. z. Altertumsk. d. Or.* vol. i., followed by Winckler, *Altor. Forsch.* ii. 65 sqq.; these scholars take Menander to refer to the later war of Esarhaddon and Assur-bani-pal against Baal of Tyre.

[2] See the facsimile in *Ausgrabungen in Sendschirli* (Berlin, 1893), and p. 17 for the above interpretation of it.

[3] John L. Myres, *Journ. Hell. Studies* (1906), xxvi. 84 seq., criticizing Winckler, *Der Alte Orient* (1905), vol. vii. pt. 2.

[4] So the Babylonians, Canaanites (*e.g.* in the case of the Nephilim, Gen. vi. 2), Arabs, Greeks, traced the descent of heroic families to the gods. W. R. Smith, *Kinship and Marriage*, p. 206; S. I. Curtis's *Primitive Sem. Rel. To-day* (London, 1902), p. 112 seq.

[5] An inscr. from Tyre may be read, "'Abd ba'al chief of the Hundred," *NSI.* p. 129; Clermont-Ganneau, *Recueil d'arch. or.* ii. 294 seq.

The Persian Period, 538-333 B.C.

Phoenicia now became part of the fifth satrapy of the Persian Empire, and entered upon a spell of comparative peace and growing prosperity. Favoured for the sake of their fleet, and having common interests against Greece,[1] the Phoenicians were among the most loyal subjects of the empire. At this period Sidon occupied the position of leading state; in the fleet her king ranked next to Xerxes and before the king of Tyre (Herod. viii. 67); her situation afforded advantages for expansion which Tyre on its small and densely populated island could not rival. The city was distinguished by its cosmopolitan character; the satrap resided there when he came to Phoenicia, and the Persian monarch had his paradise outside the walls. In the first half of the 4th century Straton I. (in Phoen. *ʽAbd-ʽashtart* or *Bod-ʽashtart*) was king, *c.* 374–362. He cultivated friendly relations with Athens, indicated in a decree of *proxenia* (Michel, *Rec. d'inscr. gr.* No. 93 = *CIG.* No. 87); his court was famed for its luxury; and the extent to which phil-Hellenic tendencies prevailed at this time in Sidon is shown by the royal sarcophagi, noble specimens of Greek art, which have been excavated in the necropolis of the city. It was in the reign of Straton that Tyre fell into the hands of Evagoras, king of Salamis, who had already supplanted Phoenician with Greek civilization in Cyprus (Isocr. *Evag.* 62, *Paneg.* 161; Diod. xv. 2). Straton made friends with Nicocles, son of Evagoras, and with him came to an untimely end through their implication in the great revolt of the satraps, 362 B.C. (see the story of Straton's death in Jerome, *adv. Jovin.* i. 45). A new revolt of Sidon against the Persians took place under King Tennes owing to the insults offered to the Sidonians at the federal diet in Tripolis. With the aid of Nectanebus of Egypt, who had grievances of his own to avenge, the Sidonians carried the rest of Phoenicia with them and drove the satraps of Syria and Cilicia out of the country. Tennes, however, betrayed his people and opened the city to Artaxerxes III.; the inhabitants to the number of 40,000 are said to have set fire to their houses and perished; Tennes himself was executed after he had served the ends of the great king (346 B.C.; Diod. xvi. 41–45). The last king of Sidon was Straton II. (ʽAbd-ʽashtart, 346–332) before the Persian Empire came to an end.[2]

Towards the close of the 5th century the Phoenician coins begin to supplement our historical sources (see NUMISMATICS). From the time of Darius the Persian monarchs issued a gold coinage, and reserved to themselves the right of doing so; but they allowed their satraps and vassal states to coin silver and copper money at discretion. Hence Aradus, Byblus, Sidon and Tyre issued a coinage of their own, of which many specimens exist: the coins are stamped as a rule with emblem or name of the city, sometimes with the name of the ruler.[3] Thus from the coins of Byblus we learn the names of four kings, ʽEl-paʽal, ʽAz-baʽal (between 360 and 340 B.C.), Adar-melek, ʽAin-el; from the coins of the other cities it is difficult to obtain much information. The native inscriptions, however, now become available, though most of them belong to the period which follows, and only a few have been discovered in Phoenicia itself. One of the earliest of these is the inscription of Byblus (*CIS.* i. 1 = *NSI.* No. 3), dating from the Persian period; it records a dedication made by Yeḥaw-milk, king of Gebal, and mentions the name of the king's grandfather, Uri-milk, but the exact dates of their reign are not given.

The Macedonian Period, 333-69 B.C.

When Alexander the Great entered Phoenicia after the battle of Issus (333 B.C.), the kings were absent with the Persian fleet in the Aegean; but the cities of Aradus, Byblus and Sidon welcomed him readily, the last-named showing special zeal against Persia. The Tyrians also offered submission, but refused to allow the conqueror to enter the city and sacrifice to the Tyrian Heracles. Alexander was determined to make an example of the first who should offer opposition, and at once began the siege. It lasted seven months. With enormous toil the king drove out a mole from the mainland to the island and thus brought up his engines; ships from the other Phoenician towns and from Cyprus lent him their aid, and the town at length was forced in July 332; 8000 Tyrians were slain, 30,000 sold as slaves, and only a few notables, the king Azemilkos, and the festal envoys from Carthage who had taken refuge in the sanctuary of Melkarth, were spared (Diod. xvii. 40–46). It is not unlikely that Zech. ix. 2–4 refers to this famous siege. For the time Tyre lost its political existence, while the foundation of Alexandria presently changed the lines of trade, and dealt a blow even more fatal to the Phoenician cities.

During the wars of Alexander's successors Phoenicia changed hands several times between the Egyptian and the Syrian kings. Thus in 312 Tyre was captured from Antigonus by Ptolemy I., the ally of Seleucus; in 287 it passed into the dominion of Seleucus; in 275 again it was captured by Ptolemy II. Philadelphus, and began to recover itself as an autonomous municipality. From the year 275 "the people of Tyre" reckoned their era (*CIS.* i. 7 = *NSI.* No. 9, cf. 10). The Tyrian coins of the period, stamped with native, Greek and Egyptian symbols, illustrate the traditional relations of the city and the range of her ambitions. A special interest attaches to these silver tetradrachms and didrachms (staters and half-staters), because they were used by the Jews for the payment of the temple tax as "shekels of the sanctuary" (*NSI.* pp. 351, 44).

Among the Phoenician states we know most about Sidon during this period. The kingship was continued for a long time. The story goes that Alexander raised to the throne a member of the royal family, Abdalonymus, who was living in obscure poverty and working as a gardener (Justin xi. 10; Curt. iv. 1; Diod. xvii. 47 wrongly connecting the story with Tyre). In 312 Ptolemy, then master of Phoenicia, appointed his general Philocles king of the Sidonians, and a decree in honour of this king has been found at Athens (Michel, No. 387, cf. 1261); but he cannot have reigned long. For at the end of the 4th and the beginning of the 3rd century we have evidence of a native dynasty in the important inscriptions of Tabnith, Eshmun-ʽazar and Bod-ʽashtart, and in the series of inscriptions (repeating the same text) discovered at Bostan esh-Shēkh near Sidon (*NSI.* Nos. 4, 5, 6 and App. i.).[4] The last-named texts imply that the first king of this dynasty was Eshmun-ʽazar; his son Tabnith succeeded him; then came Eshmun-ʽazar II., who died young, then Bod-ʽashtart, both of them grandsons of Eshmun-ʽazar I. With Bod-ʽashtart, so far as we know, the dynasty came to an end, say about 250 B.C.; and it is not unlikely that the Sidonians reckoned an era of independence from this event (*NSI.* p. 95 *n.*).

Of the other Phoenician cities something is known of the history of Aradus. Its era began in 259 B.C., when it probably became a republic or free city. While the rest of Phoenicia passed under the rule of Ptolemy II. and his successors between 281 and 197, Aradus remained in the kingdom of the Seleucids, who greatly favoured the city and increased its privileges (Strabo xvi. 2, 14; Polyb. v. 68). But its subject-towns availed themselves of the political changes of the period to throw off their allegiance; Marathus from 278 begins to issue a coinage bearing the heads of the Ptolemies, and later on Karne asserted its independence in the same way; but in the end the Aradians recovered their supremacy. Diodorus records a barbarous attempt made by the Aradians, about 148 B.C. to destroy Marathus, which was frustrated by the pity and courage of an Aradian fisherman (xxxiii. 5). At last in the time of Tigranes, the Armenian holder of the kingdom of the Seleucids, or soon afterwards, the coins of Marathus cease; the city was levelled to the ground, and its land, with that of Simyra, was parcelled out among the Aradians (Strabo xvi. 2, 12). Akko issued coins of its own down to 267 B.C., if the reckoning was from the Seleucid era (312 B.C.); in 267 it was converted into a Greek city by Ptolemy, and called Ptolemais (Polyb. iv. 37; Strabo xvi. 2, 25; cf. Acts xxi. 7). Laodicea of Libanus was founded by Seleucus Nicator on the plain south-east of Hemesa (Ḥomṣ) in the region of the upper Orontes, and became an important city; its coins of the 2nd century B.C. bear the interesting legend in Phoenician, "Of Laodicea which is in Canaan" (*NSI.* p. 349 seq.). Another Laodicea "by the sea" (*ad mare*), also of Seleucid foundation, is probably to be identified with the ruined site called Umm el-ʻAwāmīd, near the coast between Tyre and Akko; several Phoenician inscriptions have been found there (*e.g. CIS.*, i. 7 = *NSI.* No. 9; Clermont Ganneau, *Recueil*, t. v.).

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[1] The naval expeditions against Greece in 480–449 and Sparta in 396–387 were mainly fitted out by Phoenicia. See PERSIA: *Ancient History*, for the whole of this section.

[2] Justin xviii. 3 tells a story about Tyre during this period: the city, after being worn out though not defeated in long wars with the Persians, was so enfeebled that it was seized by the slaves, who rose and massacred their masters; one Straton alone escaped and was afterwards made king. The reference to the Persians is obviously incorrect; the story, if it can be taken seriously at all, must refer to one of the sieges by the Assyrians or Chaldaeans, and, as Meyer suggests (*Ency. Bib.* col. 3760), may be derived from the story of Abdalonymus of Sidon mentioned below.

[3] See especially E. Babelon, *Les Perses Achéménides*, and cf. *NSI.* No. 149.

[4] The date of this dynasty has been much disputed; but the reference to "the lord of kings" in the great inscr. of Eshmun-ʽazar (line 18) points to the Ptolemaic period, for the Persian monarch is always styled "king of kings." The interpretation of many details of the inscr. from Bostan esh-Shēkh is still uncertain.

After the death of Antiochus IV. Epiphanes in 164 B.C., revolts and adventurers made their appearance in many parts of Syria, heralding the collapse of the kingdom of the Seleucids. Berytus was destroyed by the usurper Trypho in 140 B.C. Tyre in 120 and Sidon in 111 received complete independence, and inaugurated new eras from these dates. Byblus and Tripolis fell into the hands of "tyrants" (Strabo xvi. 2, 18; Jos. *Ant.* xiv. 3, 2), and Arab robbers plundered their territories from strongholds in the Lebanon. From 83–69 B.C. the entire kingdom was held by the Armenian Tigranes.

Roman rule.

At last in 64 B.C. Pompey arrived upon the scene and established order out of chaos. Phoenicia was incorporated into the Roman province of Syria; Aradus, Sidon, Tyre and Tripolis were confirmed in their rights of self-government and in the possession of their territories. In 14 B.C. Augustus rebuilt Berytus as a Roman colony and stationed two legions there; later on Ptolemais, Tyre and Sidon received colonial status. Under the beneficent government of Rome the chief towns prospered and extended their trade; but the whole character of the country underwent a change. During the Macedonian period Greek influences had been steadily gaining ground in Phoenicia; relations with the Greek world grew closer; the native language fell into disuse, and from the beginning of the Roman occupation Greek appears regularly in inscriptions and on coins, though on the latter Phoenician legends do not entirely vanish till the 2nd century A.D.; while the extent to which Hellenic ideas penetrated the native traditions and mythologies is seen in the writings of Philo of Byblus. For the purposes of everyday life, however, the people spoke not Greek, but Aramaic. As elsewhere, the Roman rule tended to obliterate characteristic features of national life, and under it the native language and institutions of Phoenicia became extinct.

Navigation, Trade, Colonies.—The Phoenicians were essentially a seafaring nation. Fearless and patient navigators, they ventured into regions where no one else dared to go, and, always with an eye to their monopoly, they carefully guarded the secrets of their trade routes and discoveries, and their knowledge of winds and currents. At the beginning of the 7th century B.C. a Phoenician fleet is said to have circumnavigated Africa (Herod. iv. 42). To the great powers Phoenician ships and sailors were indispensable; Sennacherib, Psammetichus and Necho, Xerxes, Alexander, all in turn employed them for their transports and sea-fights. Even when Athens had developed a rival navy Greek observers noted with admiration the discipline kept on board the Phoenician ships and the skill with which they were handled (Xen. *Oec.* viii.); all the Phoenician vessels from the round merchant-boat (γαῦλος—after which the island of Gaulus, now Gozo, near Malta was called) to the great Tarshish-ships, the "East-Indiamen" of the ancient world, excelled those of the Greeks in speed and equipment. As E. Meyer points out, the war between the Greeks and the Persians was mainly a contest between the sea-powers of Greece and Phoenicia. At what period did Phoenicia first rise to be a power in the Mediterranean? We are gradually approaching a solution of this obscure problem. Recent discoveries in Crete (*q.v.*) have brought to light the existence of a Cretan or "Minoan" sea-power of remote antiquity, and it is clear that a great deal of what used to be described as Phoenician must receive quite a different designation. The Minoan sea-power was at last broken up by invaders from the north, and a Carian rule became dominant in the Aegean (Herod. i. 171; Thucyd. i. 4, 8). It was a time of disorder and conflict due to the immigration of new races into the ancient seats of civilization, and it synchronized with the weakening of the power of Egypt in the countries which bordered on the eastern Mediterranean. This was in the 12th century B.C. The Tyrian trader saw that his opportunity was come, and the Aegean lay open to his merchant vessels. Where much is still obscure, all that seems certain is that the antiquity of Phoenicia as a sea and trading power has been greatly exaggerated both in ancient and in modern times; the Minoan power of Cnossus preceded it by many centuries; the influence of Phoenicia in the Aegean cannot be carried back much earlier than the 12th century B.C., and, comparatively speaking, it was "foreign, late, sporadic."[1]

A vivid description of the Phoenicians' trade at the time of Tyre's prosperity is given by Ezekiel (xxvii. 12–25), and it shows how extensive were their commercial relations not only by sea, but by land as well. It was they who distributed to the rest of the world the wares of Egypt and Babylonia (Herod. i. 1). From the lands of the Euphrates and Tigris regular trade-routes led to the Mediterranean with trading-stations on the way, several of which are mentioned by Ezekiel (xxvii. 23). In Egypt the Phoenician merchants soon gained a foothold; they alone were able to maintain a profitable trade in the anarchic times of the XXIInd and XXIIIrd Dynasties (825–650 B.C.), when all other foreign merchants were frightened away. Though there were never any regular colonies of Phoenicians in Egypt, the Tyrians had a quarter of their own in Memphis (Herod. ii. 112). The Arabian caravan-trade in perfume, spices and incense passed through Phoenician hands on its way to Greece and the West (Herod. iii. 107); these articles of commerce were mainly produced not in Arabia, but in East Africa and India, and the trade had its centre in the wealthy state of Sheba in Yemen. Between Israel and Phoenicia the relations naturally were close; the former provided certain necessaries of life, and received in exchange articles of luxury and splendour (Ezek. xxvii. 16–18).[2] Israelite housewives sold their homespun to Phoenician pedlars (Prov. xxxi. 24 R.V.M.); in Jerusalem Phoenician merchants and money-lenders had their quarter (Zeph. i. 11), and after the Return we hear of Tyrians selling fish and all manner of ware in the city (Neh. xiii. 16), and introducing other less desirable imports, such as foreign cults (Isa. lxv. 11). The Phoenician words which made their way into Greek at an early period indicate the kind of goods in which the Phoenicians traded with the West, or made familiar through their commerce; the following are some of them—*χρυσός, χιτών, βύσσος, ὀθόνη, μύῤῥα, νάβλα, κύπρος, φῦκος, μνᾶ, παλλακίς, βαιτύλος*. Another valuable article of commerce which the Phoenicians brought into the market was amber. They can hardly have fetched it themselves from the Baltic or the North Sea; it came to them by two well-marked routes, one from the Baltic to the Adriatic, the other up the Rhine and down the Rhone. A deposit of amber has also been found in the Lebanon, and perhaps the Phoenicians worked this and concealed its origin.

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[1] Burrows, *Discoveries in Crete* (1907), 140 sqq. It may be noted that the traditional or conjectural dates based upon the list of the Thalassocracies preserved by Eusebius carry us back to the 12th century B.C. See Professor John L. Myres's essay referred to above, § iii. (4).

[2] See Eupolemus (140–100 B.C.) quoted by Alexander Polyhistor, who, in a supposed letter from Solomon to the king of Tyre, mentions the food-supplies required by the Tyrians and promised from Palestine (*Fr. Hist. Gr.* iii. 226).

The Phoenician colonies were all supposed to have been founded from Tyre: with regard to the colonies in Cyprus and north Africa this was undoubtedly true. Cyprus possessed resources of timber and copper which could not fail to tempt the keen-eyed traders across the water, who made Citium (from Kittim, the name of the original non-Semitic inhabitants) their chief settlement, and thence established themselves in Idalium, Tamassus, Lapethus, Larnaka, Qarth-ḥadasht (Karti-hadasti) and other towns. In the inscriptions of the 4th to 3rd centuries, the Phoenician potentates in the island call themselves "kings of Kition and Idalion" (*NSI.* pp. 55-89). But the Phoenician rule was not so ancient as used to be supposed. At an early period Greeks from the south coast of Asia Minor had settled in Cyprus before the Phoenicians founded any colonies there; and it is noticeable that in the Assyrian tribute-lists of the latter half of the 7th century (*KB.* ii. pp. 149, 241) not one of the ten Cyprian kings mentioned appears to be Phoenician by name. Menander states (Jos. *Ant.* ix. 14, 2) that the kings of Tyre ruled over Cyprus at the close of the 8th century; but a clear proof that the Phoenician rule was neither ancient nor uninterrupted is given by the fact that the Cyprian Greeks took the trouble to invent a Greek cuneiform character (*Cypriote*) modelled on the Assyrian.

Homer represents the Phoenicians as present in Greek waters for purposes of traffic, but not as settlers (*Il.* xxiii. 744). They occupied trading-stations on some of the Aegean islands and on the Isthmus of Corinth. One of their objects was the collection of murex, of which an enormous supply was needed for the dyeing industry; specially famous was the purple of the Laconian waters, the isles of Elishah of Ezek. xxvii. 7. But a great deal of what was formerly assigned to Phoenician influence in the Aegean at an early period—pottery, ornaments and local myths—must be accounted for by the vigorous civilization of ancient Crete. In the Greek world the Phoenicians made themselves heartily detested; their characteristic passion for gain (τὸ φιλοχρήματον, Plato, *Rep.* iv. 435 E.) was not likely to ingratiate them with those who were compelled to make use of their services while they suffered from their greed.

Farther west in the Mediterranean Phoenician settlements were planted first in Sicily, on the south coast, at Heraclea or Ras Melqarth; the islands between Sicily and Africa, Melita (Malta) on account of its valuable harbour, Gaulus and Cossura were also occupied (Diod. v. 12); and a beginning was made with the colonization of Sardinia and Corsica; but farther west still, and on the Atlantic coasts to the right and left of the straits, more permanent colonies were established. It was the trade with Tarshish, *i.e.* the region of Tartessus in south-west Spain, which contributed most to the Phoenicians' wealth; for in this region they owned not only profitable fisheries, but rich mines of silver and other metals. The profits of the trade were enormous; it was said that even the anchors of ships returning from Spain were made of silver (Diod. v. 35). From Gadeira (Punic *Gādēr*, Lat. *Gades*, now Cadiz), the town which they built on an island near the mouth of the Guadalquiver, the Sidonian ships ventured farther on the ocean and drew tin from the mines of north-west Spain or from the richer deposits in the Cassiterides, *i.e.* the Tin Islands. These were discovered to be, not a part of Britain as was imagined at first, but a separate group by themselves, now known as the Scillies; hence it is improbable that the Phoenicians ever worked the tin-mines in Cornwall.

The rich trade with Spain led to the colonization of the West. Strabo dates the settlements beyond the Pillars of Hercules soon after the Trojan War (i. 3, 2), in the period of Tyre's first expansion. Lixus in Mauretania, Gades and Utica, are said to have been founded, one after the other, as far back as the 12th century B.C. Most of the African colonies were no doubt younger; we have traditional dates for Aoza (887–855) and Carthage (813). A large part of North-west Africa was colonized from Phoenicia; owing to these first settlers, and after them to the Carthaginians, the Phoenician language became the prevailing one, just as Latin and Arabic did in later times, and the country assumed quite a Phoenician character.

In the days of Tyre's greatness her power rested directly on the colonies, which, unlike those of Greece, remained subject to the mother-city, and paid tithes of their revenues to its chief god, Melqarth, and sent envoys annually to his feast. Then at the beginning of the 8th century B.C. the colonial power of Tyre began to decline; on the mainland and in Cyprus the Assyrians gained the upper hand; in the Greek islands the Phoenicians had already been displaced to a great extent by the advancing tide of Dorian colonization. But as Tyre decayed in power the colonies turned more and more to Carthage as their natural parent and protector. For effective control over a colonial empire Carthage had the advantage of situation over far-away Tyre; the traditional bonds grew lax and the ancient dues ceased to be paid, though as late as the middle of the 6th century Carthage rendered tithes to the Tyrian Melqarth. And the mother-country cherished its claims long after they had lost reality; in the 2nd century B.C., for example, Sidon stamped her coins with the legend, "Mother of Kambē (*i.e.* Carthage), Hippo, Kition, Tyre" (*NSI.* p. 352).

Manufactures, Inventions, Art.—From an early date the towns of the Phoenician coast were occupied, not only with distributing the merchandise of other countries but with working at industries of their own; especially purple-dyeing and textile fabrics (*Il.* vi. 289 sqq.), metal work in silver, gold and electrum (*Il.* xxiii. 741 sqq.; *Od.* iv. 615 sqq., xv. 458 sqq.), and glass-work, which had its seat at Sidon. The iron and copper mines of Cyprus (not Sidon, as Homer implies, *Od.* xv. 424) furnished the ore which was manufactured into articles of commerce.[1] Egyptian monuments frequently mention the vessels of gold and silver, iron and copper, made by the Dahi, *i.e.* the Phoenicians (W. M. Müller, *As. u. Eur.* 306); and in Cyprus and at Nimrud bronze and silver paterae have been found, engraved with Egyptian designs, the work of Phoenician artists (see table-cases C and D in the Nimrud gallery of the Brit. Mus.). The invention of these various arts and industries was popularly ascribed to the Phoenicians, no doubt merely because Phoenician traders brought the products into the market. But dyeing and embroidery probably came from Babylon in the first instance; glass-making seems to have been borrowed from Egypt; the invention of arithmetic and of weights and measures must be laid to the credit of the Babylonians. The ancients believed that the Phoenicians invented the use of the alphabet (*e.g.* Pliny, *N.H.* v. 13, cf. vii. 57; Lucan, *Bell. Civ.* iii. 220 seq.); but it is unlikely that any genuine tradition on the subject existed, and though the Phoenician theory has found favour in modern times it is open to much question. The Phoenicians cannot be said to have invented any of the arts or industries, as the ancient world imagined; but what they did was something hardly less meritorious: they developed them with singular skill, and disseminated the knowledge and use of them.

The art of Phoenicia is characterized generally by its dependence upon the art of the neighbouring races. It struck out no original line of its own, and borrowed freely from foreign, especially Egyptian, models. Remains of sculpture, engraved bronzes and gems, show clearly the source to which the Phoenician artists went for inspiration; for example, the uraeus-frieze and the winged disk, the *ankh* or symbol of life, are Egyptian designs frequently imitated. It was in the times of the Persian monarchy that Phoenician art reached its highest development, and to this period belong the oldest sculptures and coins that have come down to us. A characteristic specimen of the former is the stele of Yeḥaw-milk, king of Gebal (*CIS.* i. 1), in which the king is represented in Persian dress, and the goddess to whom he is offering a bowl looks exactly like an Egyptian Isis-Hathor; the inscription mentions the various objects of bronze and gold, engraved work and temple furniture, which the king dedicated. The whole artistic movement in Phoenicia may be divided into two great periods: in the first, from the earliest times to the 4th century B.C., Egyptian influence and then Babylonian or Asiatic influence is predominant, but the national element is strongly marked; while in the second, Greek influence has obtained the mastery, and the native element, though making itself felt, is much less obtrusive. Throughout these periods works of art, such as statues of the gods and sarcophagi, were imported direct at first from Egypt and afterwards mainly from Rhodes. The oldest example of native sarcophagi are copied from Egyptian mummy-cases, painted with colours and ornamented with carvings in low relief; towards and during the Greek period the contours of the body begin to be marked more clearly on the cover. The finest sarcophagi that have been found in the necropolis of Sidon (now in the Imperial Museum, Constantinople) are not Phoenician at all, but exquisite specimens of Greek art. The Phoenicians spent much care on their burial-places, which have furnished the most important monuments left to us. The tombs are subterranean chambers of varied and often irregular form, sometimes arranged in two storeys, sometimes in several rows one behind the other. While in early times a mere perpendicular shaft led to these excavations, at a later date stairs were constructed down to the chambers. The dead were buried either in the floor (often in a sarcophagus), or, according to later custom, in niches. The mouths of the tombs were walled up and covered with slabs, and occasionally cippi (Phoen. *maṣṣēbōth*) were set up to mark the spot. The great sepulchral monuments, popularly called *maghāzil*, *i.e.* “spindles,” above the tombs near Amrīt, have peculiarities of their own; some of them are adorned with lions at the base and with roofs of pyramidal shape. Besides busts and figurines, which belong as a rule to the Greek period, the smaller objects usually found are earthen pitchers and lamps, glass-wares, tesserae and gems. Of buildings which can be called architectural few specimens now exist on Phoenician soil, for the reason that for ages the inhabitants have used the ruins as convenient quarries. Not a vestige remains of the great sanctuary of Melqarth at Tyre; a few traces of the temple of Adonis near Byblus were discovered by Renan, and a peculiar mausoleum, Burj al-Bezzāq, is still to be seen near Amrīt; recent excavations at Bostan esh-Shēkh near Sidon have unearthed parts of the enclosure or foundations of the temple of Eshmun (*NSI.* p. 401); the conduits of Ras el-‘Ain, south of Tyre, are considered to be of ancient date. With regard to the plan and design of a Phoenician temple, it is probable that they were in many respects similar to those of the temple at Jerusalem, and the probability is confirmed by the remains of a sanctuary near Amrīt, in which there is a cella standing in the midst of a large court hewn out of the rock, together with other buildings in an Egyptian style. The two pillars before the porch of Solomon's temple (1 Kings vii. 21) remind us of the two pillars which Herodotus saw in the temple of Melqarth at Tyre (Herod. ii. 44), and of those which stood before the temples of Paphos and Hierapolis (see W. R. Smith, *Rel. of Sem.* p. 468 seq.).

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[1] Traces of ancient mining for iron have been found in the Lebanon; cf. LXX. 1 Kings ii. 46c (ed. Swete), which has been taken to refer to this quarrying in search of iron; Jer. xv. 12. See Benzinger on 1 Kings ix. 19.

The Phoenician Gods.

Religion.—Like the Canaanites of whom they formed a branch, the Phoenicians connected their religion with the great powers and processes of nature.[1] The gods whom they worshipped belonged essentially to the earth; the fertile field, trees and mountains, headlands and rivers and springs, were believed to be inhabited by different divinities, who were therefore primarily local, many in number, with no one in particular supreme over the rest. It seems, however, that as time went on some of them acquired a more extended character; thus Ba‘al and Astarte assumed celestial attributes in addition to their earthly ones, and the Tyrian Melqarth combined a celestial with a marine aspect.[2] The gods in general were called *’elōnīm*, *’elīm*; Plautus uses *alonium valonuth* for “gods and goddesses” (*Poen.* v. 1, 1). These plurals go back to the singular form ’El, the common Semitic name for God; but neither the singular nor the plural is at all common in the inscriptions (*NSI.* pp. 24, 41, 51); ’El by itself has been found only once;[3] the fem. ’Elath is also rare (ibid. pp. 135, 158). The god or goddess was generally called the Ba‘al or Ba‘alath of such and such a place, a title which was used not only by the Canaanites, but by the Aramaeans (Be‘el) and Babylonians (Bel) as well. There was no one particular god called Baal; the word is not a proper name but an appellative, a description of the deity as *owner* or *mistress*; and the same is the case with Milk or Melek, ’Adon, ’Amma, which mean *king*, *lord*, *mother*. The god himself was unnamed or had no name. Occasionally we know what the name was; the Baal of Tyre was Melqarth (Melkarth), which again means merely “king of the city”; similarly among the Aramaeans the Ba‘al of Harran was the moon-god Sin. As each city or district had its own Ba‘al, the author of its fertility, the “husband” (a common meaning of *ba‘al*) of the land which he fertilized, so there were many Ba‘als, and the Old Testament writers could allude to the Ba‘ālim of the neighbouring Canaanites. Sometimes the god received a distinguishing attribute which indicates an association not with any particular place, but with some special characteristic; the most common forms are Ba‘al-ḥammān, the chief deity of Punic north Africa, perhaps “the glowing Ba‘al,” the god of fertilizing warmth, and Ba‘al-shamēm, “Ba‘al of the heavens.”[4] The latter deity was widely venerated throughout the North-Semitic world; his name, which does not appear in the Phoenician inscriptions before the 3rd century B.C., implies perhaps a more universal conception of deity than existed in the earlier days.[5] The worship of the female along with the male principle was a strongly marked feature of Phoenician religion. To judge from the earliest evidence on the subject, the Ba‘alath of Gebal or Byblus, referred to again and again in the Amarna letters (*Bilit ša Gubla*, Nos. 55–110), must have been the most popular of the Phoenician deities, as her sanctuary was the oldest and most renowned. The *mistress of Gebal* was no doubt ‘Ashtart (Astartē in Greek, ‘Ashtōreth in the Old Testament, pronounced with the vowels of *bōsheth*, “shame”), a name which is obviously connected with the Babylonian Ishtar, and, as used in Phoenician, is practically the equivalent of “goddess.” She represented the principle of fertility and generation; references to her cult at Gebal, Sidon, Ashkelon, in Cyprus at Kition and Paphos, in Sicily at Eryx, in Gaulus, at Carthage, are frequent in the inscriptions and elsewhere. The common epithets *Κύπρις* and *Κυθέρεια* (of Kuthera in Cyprus), Cypria and Paphia, show that she was identified with Aphrodite and Venus. Though not primarily a moon-goddess, she sometimes appears in this character (Lucian, *Dea syr.* § 4; Herodian v. 6, 10), and Herodotus describes her temple at Ashkelon as that of the heavenly Aphrodite (i. 105). We find her associated with Ba‘al and called “the name of Ba‘al,” *i.e.* his manifestation, though this rendering is disputed, and some scholars prefer “‘Ashtart of the heaven of Ba‘al” (*NSI.* p. 37). Another goddess, specially honoured at Carthage, is Tanith (pronunciation uncertain); nothing is known of her characteristics; she is regularly connected with Ba‘al on the Carthaginian votive tablets, and called “the face of Ba‘al,” *i.e.* his representative or revelation, though again some question this rendering as too metaphysical, and take “face of Ba‘al” to be the name of a place, like Peni’el (“face of ’El”). Two or three other deities may be mentioned here: Eshmun, the god of vital force and healing, worshipped at Sidon especially, but also at Carthage and in the colonies, identified by the Greeks with Asclepius; Melqarth, the patron deity of Tyre, identified with Heracles; Reshef or Reshūf, the “flame” or “lightning” god, especially popular in Cyprus and derived originally from Syria, whom the Greeks called Apollo. A tendency to form a distinct deity by combining the attributes of two produced such curious fusions as Milk-‘ashtart, Milk-ba‘al, Milk-’osir, Eshmun-melqarth, Melqarth-reṣef, &c. As in the case of art and industries, so in religion the Phoenicians readily assimilated foreign ideas. The influence of Egypt was specially strong (*NSI.* pp. 62, 69, 148, 154); thus the Astarte represented on the stele of Yeḥaw-milk, mentioned above, has all the appearance of Isis, who, according to the legend preserved by Plutarch (*de Is. et Os.* 15), journeyed to Byblus, where she was called Astarte. The Phoenician settlers at the Peiraeus worshipped the Assyrian Nergal, and their proper names are compounded with the names of Babylonian and Arabian deities (*NSI.* p. 101). Closer intimacy with the Greek world naturally brought about modifications in the character of the native gods, which became apparent when Ba‘al of Sidon or Ba‘al-shamēm was identified with Zeus, Tanith with Demeter or Artemis, ‘Anath with Athena, &c.; the notion of a supreme Ba‘al, which finds expression in the Greek *βῆλος* and *βααλτίς* or *βήλθης* (the goddess of Byblus), was no doubt encouraged by foreign influences. On the other hand, the Phoenicians produced a considerable effect upon Greek and Roman religion, especially from the religious centres in Cyprus and Sicily. A great number of divinities are known only as elements in proper names, *e.g.* *Sakun*-yathon (Sanchuniathon), ‘Abd-*sasom*, *Ṣed*-yathon, and fresh ones are continually being discovered. It was the custom among the Phoenicians, as among other Semitic nations, to use the names of the gods in forming proper names and thus to express devotion or invoke favour; thus Ḥanni-ba‘al, ‘Abd-melqarth, Ḥanni-‘ashtart, Eshmun-‘azar. The proper names further illustrate the way in which the relation of man to God was regarded; the commonest forms are *servant* (‘abd, *e.g.* ‘Abd-‘ashtart), *member* or *limb* bod, *e.g.* Bod-melqarth), client or *guest* (ger, *e.g.* Ger-eshmun); the religious idea of the *guest* of a deity had its origin in the social custom of extending hospitality to a stranger and in the old Semitic right of sanctuary. The interpretation of such names as ’Abi-ba‘al (father of Ba‘al), Ḥimilkath (brother of Milkath), Ḥiram (brother of the exalted one) is not altogether certain, and can hardly be discussed here.[6]

Sacred Objects and Worship.

Probably like other Canaanites the Phoenicians offered worship “on every high hill and under every green tree”; but to judge from the allusions to sanctuaries in the inscriptions and elsewhere, the Ba‘al or ‘Ashtart of a place was usually worshipped at a temple, which consisted of a court or enclosure and a roofed shrine with a portico or pillared hall at the entrance. In the court sometimes stood a conical stone, probably the symbol of Astarte, as on the Roman coins of Byblus (illustrated in Rawlinson, *Phoenicia*, 146, Perrot et Chipiez, *Hist. de l'art*, iii. 60; see also Ohnefalsch-Richter, *Cyprus*, pl. lvi., the temenos at Idalion). Stone or bronze images of the gods were set up in the sanctuaries (*NSI.* Nos. 13 seq., 23–27, 30, &c.); and besides these the *baetylia* (meteoric stones) which were regarded as symbols of the gods. Pillars, again, had a prominent place in the court or before the shrine (*naṣab*, ibid. pp. 102 seq.); but it is not known whether the sacred pole (*’ashērah*), an invariable feature of a Canaanite sanctuary, was usual in a Phoenician temple (ibid. pp. 50 seq.). The inscriptions mention altars of stone and bronze, and from the sacrificial tariffs which have survived we learn that the chief types of sacrifice among the Phoenicians were analogous to those which we find in the Old Testament (ibid. p. 117). The ghastly practice of sacrificing human victims was resorted to in times of great distress (*e.g.* at Carthage, Diod. xx. 14), or to avert national disaster (Porphyry, *de Abstin*, ii. 56); Philo gives the legend that Cronus or El sacrificed his only son when his country was threatened with war (*Fr. hist. gr.* iii. 570); it was regarded as a patriotic act when Hamilcar threw himself upon the pyre after the disastrous battle of Himera (Herod. vii. 167). The god who demanded these victims, and especially the burning of children, seems to have been Milk, the Molech or Moloch of the Old Testament. In this connexion may be mentioned the custom of burning the chief god of the city in effigy, or in the person of a human representative, at Tyre and in the Tyrian colonies, such as Carthage and Gades; the custom lasted down to a late time (see Frazer, *loc. cit.* ch. v.). Another horrible sacrifice was regularly demanded by Phoenician religion: women sacrificed their virginity at the shrines of Astarte in the belief that they thus propitiated the goddess and won her favour (Frazer, ibid. ch. iii.); licentious rites were the natural accompaniment of the worship of the reproductive powers of nature. These temple prostitutes are called *qedēshīm qedēshōth*, *i.e.* sacred men, women, in the Old Testament (Deut. xxiii. 18; 1 Kings xiv. 24, &c.). Other persons attached to a temple were priests, augurs, sacrificers, barbers, officials in charge of the curtains, masons, &c. (*NSI.* No. 20); we hear also of religious gilds and corporations, perhaps administrative councils, associated with the sanctuaries (ibid. pp. 94, 121, 130, 144 seq.).

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[1] Cf. Hannibal's oath to Philip of Macedon; beside the named deities he invokes the gods of “sun and moon and earth, of rivers and meadows and waters” (Polyb. vii. 9).

[2] This is well brought out by G. F. Hill, *Church Quarterly Rev.* (April 1908), pp. 118–141, who specially emphasizes the evidence of the Phoenician coins.

[3] “To the lord ’El, which Ba‘al-shillem . . . vowed,” &c.; Clermont-Ganneau, *Recueil*, v. 376.

[4] Probably “the detested thing that causes horror” (שקוץ שמם) of Dan. xii. 11, xi. 31, &c., is an intentional disfigurement of בעל שמם.

[5] The name has been found on an important Aramaic inscr. from North Syria, dating *c.* 800 B.C., in which Zakir, king of Hamath and La‘ash frequently speaks of his god Be‘el-shamin (Pognon, *Inscr. sém. de la Syrie*, 1908).

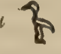
[6] See Frazer, *Adonis, Attis, Osiris*, 44 seq.

Mythology and Religious Ideas.

No doubt the Phoenicians had their legends and myths to account for the origin of man and the universe; to some extent these would have resembled the ideas embodied in the book of Genesis. Two cosmogonies have come down to us which, though they differ in details, are fundamentally in agreement. The one, of Sidonian origin, is preserved by Damascius (*de prim. principiis*, 125) and received at his hands a Neoplatonic interpretation; this cosmogony was probably the writing which Strabo ascribes to a Sidonian philosopher, Mochus, who lived before the Trojan times (xvi. 2, 24). The other and more elaborate work was composed by Philo of Byblus (temp. Hadrian); he professed that he had used as his authority the writings of Sanchuniathon (*q.v.*), an ancient Phoenician sage, who again derived his information from the mysterious inscribed stones (ἀμμουνεῖς = המנים, *i.e.* images or pillars of Ba'al-ḥammān) in the Phoenician temples. Philo's cosmogony has been preserved, at least in fragments, by Eusebius in *Praep. evang.* vol. i. (*Fr. hist. gr.* iii. 563 sqq.). It cannot, however, be taken seriously as an account of genuine Phoenician beliefs. For Sanchuniathon is a mere literary fiction; and Philo's treatment is vitiated by an obvious attempt to explain the whole system of religion on the principles of Euhemerus, an agnostic who taught the traditional mythology as primitive history, and turned all the gods and goddesses into men and women; and further by a patriotic desire to prove that Phoenicia could outdo Greece in the venerable character of its traditions, that in fact Greek mythology was simply a feeble and distorted version of the Phoenician.[1] At the same time Philo did not invent all the nonsense which he has handed down; he drew upon various sources, Greek and Egyptian, some of them ultimately of Babylonian origin, and incidentally he mentions matters of interest which, when tested by other evidence, are fairly well supported. He shows at any rate that some sort of a theology existed in his day; particularly interesting is his description of the symbolic figure of Cronus with eyes before and behind and six wings open and folded (*Fr. hist. gr.* iii. 569), a figure which is represented on the coins of Gebal-Byblus (2nd century B.C.) as the mythical founder of the city. It is evident that the gods were regarded as being intimately concerned with the lives and fortunes of their worshippers. The vast number of small votive tablets found at Carthage prove this: they were all inscribed by grateful devotees "to the lady Tanith, Face of Ba'al, and the lord Ba'al-ḥammān, because he heard their voice." The care which the Phoenicians bestowed upon the burial of the dead has been alluded to above; pillars (*maṣṣēbōth*) were set up to commemorate the dead among the living (*e.g. NSI.* Nos. 18, 19, 21, 32); if there were no children to fulfil the pious duty, a monument would be set up by a man during his lifetime (ibid. No. 16; cf. 2 Sam. xviii. 18). Any violation of the tomb was regarded with the greatest horror (ibid. Nos. 4, 5). The grave was called a resting-place (ibid. Nos. 4, 5, 16, 21), and the departed lay at rest in the underworld with the *Refāim*, the weak ones (the same word and idea in the Old Testament, Isa. xiv. 9, xxvi. 14, 19; Job xxvi. 5; Ps. lxxxviii. 11, &c.). The curious notion prevailed, as it did also among the Greeks and Romans, that it was possible to communicate with the gods of the underworld by dropping into a grave a small roll of lead (*tabella devotionis, NSI.* No. 50), inscribed with the message, generally a curse, which it was desired to convey to them.

BIBLIOGRAPHY.—The principal works bearing on the subject have been mentioned in the text and notes of this article. The following may be added: Movers, *Die Phönizier* (1842–1856), to be used with caution; Renan, *Mission de Phénicie* (1864); Schröder, *Die phönizische Sprache* (1869); Stade in *Morgenländische Forschungen* (1875); W. Baudissin, *Studien zur semitischen Religionsgeschichte* (1876, 1878); Baethgen, *Beiträge zur semitischen Religionsgeschichte* (1888); Levy, *Siegel und Gemmen* (1869); J. L. Myres and Richter, *Catalogue of the Cyprus Museum* (1899); G. F. Hill, *Catalogue of the Greek Coins of Cyprus* (1904); V. Bérard, *Les Phéniciens et l'Odyssée* (1902–1903); Lidzbarski, *Ephemeris für semitische Epigraphik* (1902–1906); H. Winckler, *Altorientalische Forschungen* (1893–1906); Freiherr von Landau, "Die Bedeutung der Phönizier im Völkerleben" in *Ex oriente lux* (Leipzig, 1905), vol. i.; Bruston, *Études Phén.* (1903); the articles by Thatcher in Hastings's *Dict. Bible* (1900) and by E. Meyer in the *Ency. Bib.* (1902). The articles by A. von Gutschmid and Albrecht Socin in the *Ency. Brit.* (9th ed.) have been to some extent incorporated in the present article. (G. A. C.*)

PHOENIX (Gr. φοῖνιξ), a fabulous sacred bird of the Egyptians. The Greek word is also used for a date-palm, a musical instrument like a guitar, and the colour purple-red or crimson. According to the story told to Herodotus (ii. 73), the bird came from Arabia every 500 years, bearing his father embalmed in a ball of myrrh, and buried him in the temple of the sun. Herodotus, who had never seen the phoenix himself, did not believe this story, but he tells us that the pictures of it represented a bird with golden and red plumage, closely resembling an eagle in size and shape. According to Pliny (*Nat. hist.* x. 2), there is only one phoenix at a time, and he, at the close of his long life, builds himself a nest with twigs of cassia and frankincense, on which he dies; from his corpse is generated a worm which grows into the young phoenix. Tacitus (*Ann.* vi. 28) says that the young bird lays his father on the altar in the city of the sun, or burns him there; but the most familiar form of the legend is that in the *Physiologus* (*q.v.*), where the phoenix is described as an Indian bird which subsists on air for 500 years, after which, lading his wings with spices, he flies to Heliopolis, enters the temple there, and is burned to ashes on the altar. Next day the young phoenix is already feathered; on the third day his pinions are full grown, he salutes the priest and flies away. The period at which the phoenix reappears is very variously stated, some authors giving as much as 1461 or even 7006 years, but 500 years is the period usually named; and Tacitus tells us that the bird was said to have appeared first under Sesostris (Senwosri), then under Amasis (Ahmosi) II., under Ptolemy III., and once again in A.D. 34, after an interval so short that the genuineness of the last phoenix was suspected. The phoenix that was shown at Rome in the year of the secular games (A.D. 47) was universally admitted to be an imposture.[2]

The form and variations of these stories characterize them as popular tales rather than official theology; but they evidently must have had points of attachment in the mystic religion of Egypt, and indeed both Horapollon and Tacitus speak of the phoenix as a symbol of the sun. Now we know from the *Book of the Dead*, and other Egyptian texts, that a stork, heron or egret called the *benu*  was one of the sacred symbols of the worship of Heliopolis, and A. Wiedemann ("Die Phönix-Sage im alten Aegypten" in *Zeitschrift für ægyptische Sprache*, xvi. 89) has made it tolerably clear that the *benu* was a symbol of the rising sun, whence it is represented as "self-generating" and called "the soul of Ra (the sun)," "the heart of the renewed Sun." All the mystic symbolism of the morning sun, especially in connexion with the doctrine of the future life, could thus be transferred to the *benu*, and the language of the hymns in which the Egyptians praised the luminary of dawn as he drew near from Arabia, delighting the gods with his fragrance and rising from the sinking flames of the morning glow, was enough to suggest most of the traits materialized in the classical pictures of the phoenix. That the *benu* is the prototype of the phoenix is further confirmed by the fact that the former word in Egyptian means also "palm-tree," just as the latter does in Greek. The very various periods named make it probable that the periodical return of the phoenix belongs only to vulgar legend, materializing what the priests knew to be symbolic. Of the birds of the heron family the gorgeous colours and plumed head spoken of by Pliny and others would be least inappropriate to the purple heron (*Ardea purpurea*), with which, or with the allied *Ardea cinerea*, it has been identified by Lepsius and Peters (*Alteste Texte des Todtenbuchs*, 1867, p. 51). But the golden and purple hues described by Herodotus may be the colours of sunrise rather than the actual hues of the purple heron. How Herodotus came to think that the bird was like an eagle is quite unexplained; perhaps this is merely a slip of memory.

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[1] An excellent and critical account of Philo's work is given by Lagrange, *Études sur les rel. sém* (2nd ed., 1905), ch. xi.

[2] Some other ancient accounts may be here referred to. That ascribed to Hecataeus is, in the judgment of C. G. Gobet (*Mnemosyne*, 1883), stolen from Herodotus by a late forger. The poem of the Jew Ezechiel quoted by Eusebius (*Praep. ev.* ix. 29, 30) appears to refer to the phoenix. Here the sweet song is first mentioned—a song which, according to the poem on the phoenix ascribed to Lactantius, accompanies the rising sun. The bird is often spoken of in Latin poetry, and is the subject of an idyll by Claudian. See also Solinus, *Collectanea*, ch. xxxiii. 11, with Salmasius's *Exercitationes*; Tertullian, *De resur. carnis*, c. 13; Clemens Rom. *Epp. ad Corinthios*, i. 25 and the (? Clementine) *Apostolical Constitutions*, v. 7

Many commentators still understand the word חוֹל, *chōl*, in Job xxix. 18 (A.V. "sand") of the phoenix. This interpretation is perhaps as old as the (original) Septuagint, and is current with the later Jews. Among the Arabs the story of the phoenix was confused with that of the salamander; and the samand or samandal (Damiri, ii. 36 seq.) is represented sometimes as a quadruped, sometimes as a bird. It was firmly believed in, for the incombustible cloths woven of flexible asbestos were popularly thought to be made of its hair or plumage, and were themselves called by the same name (cf. Yaqut i. 529, and Dozy, *s.v.*). The *'ankā* (Pers. *sīmurgh*), a stupendous bird like the roc (rukh) of Marco Polo and the *Arabian Nights*, also borrows some features of the phoenix. According to Kazwīnī (i. 420) it lives 1700 years, and when a young bird is hatched the parent of opposite sex burns itself alive. In the book of *Kalila and Dimna* the *sīmūr* or *'ankā* is the king of birds, the Indian *garūda*, on whom Vishnu rides.

PHOENIX, the capital of Arizona, U.S.A., and the county-seat of Maricopa county, situated on the Salt river, in the south central part of the state. Pop. (1890), 3152; (1900), 5544 (935 being foreign-born and 148 negroes); (1910) 11,134. It is served by the Arizona Eastern and the Santa Fé, Prescott & Phoenix railways, the former connecting at Maricopa (35 m. distant) with the Southern Pacific and the latter connecting at Ash Fork, near Prescott (194 m. distant), with the Atchison, Topeka & Santa Fé. The city is a popular winter and health resort, with a fine dry climate. The city is the see of a Protestant Episcopal bishopric. About 3 m. north of the city is the Phoenix (non-reservation) boarding-school for Indians, supported by the United States government, with an average attendance of about 700 pupils. The city lies in a great plain, in the centre of a region of pastures, gardens and orchards, the largest and most beautiful farming district of Arizona, irrigated with water stored by the great Roosevelt dam (about 70 m. north-east of Phoenix). Local interests are almost entirely in agriculture, stock-raising and fruit-growing. In the surrounding region are several large ostrich farms and a small exhibition ranch. Phoenix was settled in 1870, became the county-seat on the organization of Maricopa county in 1871, was incorporated in 1881, and became the capital of Arizona in 1889.

PHOENIX ISLANDS, a group of eight small islands in the Pacific Ocean, about 3° S., and 172° W., belonging to Great Britain. They have a land area about 16 sq. m. and a population of 60. Their names are Phoenix, Gardner (Kemin), Hull, Sydney, Birnie, Enderbury, Canton (Mary) and McKean. To the north-west of the group (between the equator and 1° N.) lie two more islets—Baker and Howland. The islands were annexed by Great Britain in 1889–1892.

PHOENIXVILLE, a borough of Chester county, Pennsylvania, U.S.A., on the Schuylkill river at the mouth of French Creek, about 28 m. north-west of Philadelphia. Pop. (1890), 8514; (1900), 9196, of whom 2221 were foreign-born and 278 were negroes; (1910 census), 10,743. It is served by the Pennsylvania (Schuylkill division) and the Philadelphia & Reading railways, and by electric railway to Spring City (pop. in 1910, 2880), 5 m. north-west of Phoenixville on the Schuylkill. Phoenixville is chiefly a manufacturing borough. Its blast-furnaces and iron mills were long among the largest in the country, and the manufacture of steel is still the borough's predominant industry. Phoenixville was settled in 1732, and was incorporated in 1849.

PHONETICS (Gr. φωνή, voice), the science of speech-sounds and the art of pronunciation. In its widest sense it is the "science of voice," dealing not only with articulate, but also with the inarticulate sounds of animals as well as men. The originally synonymous term, "phonology," is now restricted to the history and theory of sound-changes. The most obvious of the practical applications of phonetics is to the acquisition of a correct pronunciation of foreign languages. But its applications to the study of the native language are not less important: it is only by the help of phonetics that it is possible to deal effectively with vulgarisms and provincialisms of pronunciation and secure uniformity of speech; and it is only on a phonetic basis that the deaf and dumb can be taught articulate speech. From a more theoretical point of view phonetics is, in the first place, the science of linguistic observation. Without phonetic training the dialectologist, and the missionary who is confronted with a hitherto unwritten language, can neither observe fully nor record accurately the phenomena with which they have to deal. These investigations have greatly widened the scope of the science of language. The modern philologist no longer despises colloquial and illiterate forms of speech. On the contrary, he considers that in them the life and growth of language is seen more clearly than in dead literary languages, on whose study the science of comparative philology was at first exclusively built up. It was not till philologists began to ask what were the real facts underlying the comparisons of the written words in Sanskrit, Greek, Latin, and the other Indo-European languages, embodied in such generalizations as Grimm's Law, that "letter-science" developed into "sound-science" (phonology). The rise and decay of inflexions, and the development of grammatical forms generally, are, from the formal point of view, mainly phonetic problems; and phonetics enters more or less into every department of historical and comparative grammar.

Methods of Study and Investigation.—Phonetics is the science of speech-sounds. But sounds may be considered from two opposite points of view—the *organic* and the *acoustic*. From the organic point of view a sound is the result of certain actions and positions of the organs of speech, as when we define *f* as a lip-teeth (dento-labial) consonant. This is the point of view of the speaker of a language. To the hearer, on the other hand, *f* is not a lip-teeth, but a hiss consonant similar to that denoted by *th*. This is the acoustic point of view. Theoretically, the organic study of phonetics is a branch of anatomy and physiology: that part of these sciences which deals with the organs of speech (see Mouth) and their functions (see Voice); while, from the opposite point of view, the study of phonetics is based on that branch of physical science known as acoustics (see Sound), together with the anatomy and physiology of the organs of Hearing (*q.v.*).

Unfortunately, this basis is still imperfect. The principles of acoustics are well established, and we know much about the anatomy of the ear. But how the ear transmits to the brain the impression of sound is still a mystery. Again, although the mechanism of the vowel is clear enough, there is still no generally received acoustic theory of its formation. In fact, from the physical science point of view there is as yet no science of phonetics.

The real function of phonetics is philological and literary. The only sound basis of a theoretical knowledge of phonetics is the practical mastery of a limited number of sounds—that is to say, of the sounds which are already familiar to the learner in his own language. It is evident that the more familiar a sound is, the easier it is to gain insight into its mechanism and to recognize it when heard. It is indispensable to cultivate both the organic and the acoustic sense. These processes we are continually carrying out in ordinary conversation. All, therefore, that we have to do in dealing with native sounds is to develop this unconscious organic and acoustic sense into a conscious and analytic one. The first step is to learn to isolate each sound: to pronounce it, as far as possible, apart from its context; and to preserve it unchanged through every variation of length and force, and in every combination of sounds. The next step is to analyse its formation. Let the student, for instance, compare the two consonants in such a word as *five* by isolating and lengthening them till he can both hear and feel the voice-vibration in the second one. In the same way let him learn to feel the changes in the position of the tongue and lips in passing from one vowel to another. When the native sounds have been thoroughly studied in this way, the learner will proceed to foreign sounds, deducing each new sound from those which are already familiar to him.

The natural method of learning sounds is mainly a subjective one. We listen patiently till our ears are steeped, as it were, in the sound; and then, after repeated trials, we hit on the exact position of the organs of speech by which we can reproduce the sound to the speaker's satisfaction. But the natural method admits also of objective control and criticism of the movements of the lips and jaws by direct observation. The movements and positions of the tongue and soft palate, and other modifications of the mouth and throat passages are also more or less accessible to observation—in the case of self-observation with the help of a small mirror held in the hand. If the mirror is small enough to go into the mouth, and is fixed obliquely to a handle, so that it can be held against the back of the mouth at such an angle as to reflect a ray of light down the throat, we have the *laryngoscope.* Laryngoscopy has confirmed earlier results, and has also added to our knowledge of the throat sounds. But, on the other hand, it has been a fruitful source of error. There has been great discrepancy between the results obtained by different observers; and many results which were at first received with implicit confidence for their supposed rigorously scientific and objective character have been found to be worthless. It seemed at first as if Röntgen's discovery of the so-called X-rays would meet the want of a means of direct observation of the positions of the tongue, not lengthways, but from the side, as also of the interior of the throat. But although the cheeks are to a certain extent transparent to these rays, the shadow of the tongue projected on the screen is too indistinct to be of any use.

But there are other methods besides those of direct observation by which the positions of the tongue may be objectively determined and measured with more or less accuracy. The interior of the mouth may be explored by the fingers. If the little finger is held against the gums during the articulation of the vowels in *it, ate, at,* the difference in the height of the tongue will at once become apparent: in the formation of the first vowel the tongue is pressed strongly against the artificial palate, while in that of the second it only just touches it, and in that of the third it does not touch at all.

Several forms of apparatus have been devised for a more accurate determination of the positions of the tongue and the other movable organs of speech. The best results hitherto as regards the vowel-positions have been obtained by Grandgent, who uses disks of cardboard of various sizes fixed to silver wires. A full description of this and other methods will be found in Scripture's *Elements of Experimental Phonetics.*

There are other methods whose results are obtained only indirectly. The simplest of these are the *palatographic,* by which are obtained "palatograms" recording the contact of the tongue with the palate. The apparatus most generally used consists of a thin, shell-like artificial palate, which is covered with chalk and placed in the mouth; when the sound is made, the articulation of the tongue is inferred from the contact-marks on the plate. This method is evidently limited in its application. It, too, has the drawback of not being applicable to the sounds formed in the back of the mouth. The outlines of palatograms are much vaguer than they appear in the published drawings of them; and it is a question whether the thickness even of the thinnest plate does not modify the record.

The methods hitherto considered are all comparatively simple. They require no special knowledge or training, and are accessible to all. But there are more elaborate methods—with which the name "experimental phonetics" is more specially connected—involving special training in practical and theoretical physics and mathematics, and requiring the help of often complicated and costly, and not easily accessible, apparatus. The investigation of the speech curves of phonograph and gramophone records is a typical example. Good examples of these methods are afforded by E. A. Meyer's investigations of vowel-quantity in English (Englische Lautdauer, Uppsala, 1903). Their characteristic feature is their delicacy, and the minuteness of their distinctions, which often go beyond the range of the human ear. Although their results are often of value, they must always be received with caution: the sources of error are so numerous

The claims of instrumental phonetics have been so prominently brought forward of late years that they can no longer be ignored, even by the most conservative of the older generation of phoneticians. But it is possible to go too far the other way. Some of the younger generation seem to think that the instrumental methods have superseded the natural ones in the same way as the Arabic superseded the Roman numerals. This assumption has had disastrous results. It cannot be too often repeated that instrumental phonetics is, strictly speaking, not phonetics at all. It is only a help: it only supplies materials which are useless till they have been tested and accepted from the linguistic phonetician's point of view. The final arbiter in all phonetic questions is the trained ear of a practical phonetician: differences which cannot be perceived must—or at least may be—ignored; what contradicts the trained ear cannot be accepted.

Sound-Notation; Spelling Reform.—Next to the analysis of the sounds themselves, the most important problem of phonetics is their representation by means of written and printed symbols. The traditional or "nomic" orthographies of most languages are only imperfectly phonetic. And, unfortunately, of the languages in most general use, two are exceptionally unphonetic in their orthographies, French showing the greatest divergence between sound and symbol, while English shows the maximum of irregularity and arbitrariness. The German orthography is comparatively phonetic: it has hardly any silent letters, and it generally has one symbol for each sound, each symbol having only one value, the exceptions falling under a few simple rules, which are easily remembered. There are other languages which have still more phonetic orthographies, such as Spanish, Welsh and Finnish. But even the best of them are not perfect: even when they are not actually misleading, they are always inadequate. On the other hand, no system of writing is wholly unphonetic. Even in French and English there are many words whose spelling not even the most radical reformer would think of altering. In fact, all writing which has once emerged from the hieroglyphic stage is at first purely phonetic, as far as its defective means will allow. The divergence between sound and symbol which makes spelling unphonetic is the result of the retention of phonetic spellings after they have become unphonetic through changes in the pronunciation of the words themselves. Thus, such English spelling as *knight* and *wright* were still phonetic in the time of Chaucer; for at that time the initial consonants of these words were still pronounced, and the *gh* still had the sound of *ch* in German *ich.* So also *see* and *sea* are written differently, not by way of arbitrary distinction, but because they were pronounced differently till within the last few centuries—as they still are in Irish-English.

Where there is no traditional orthography, as when Old English (Anglo-Saxon) was first written down in Latin letters, spelling was necessarily phonetic; but where there is a large literature and a class of professional scribes, the influence of the traditional orthography becomes stronger, till at last the invention of printing and the diffusion of one standard dialect over a large area occupied originally by a variety of other dialects make changes of spelling as inconvenient as they were once easy and natural. The ideal orthography for printers is one which is absolutely uniform over the whole territory of the language, and absolutely unchangeable. In such orthographies as those of the present English and French there is no longer any living correspondence between sound and symbol: they are, in intention at least, wholly unphonetic; they are preserved by graphic, not by oral, tradition.

But unphoneticness has its practical limits. A purely unphonetic degradation of an originally phonetic system of writing—one in which there is absolutely no correspondence between sounds and letters—could not be mastered even by the most retentive memory: it would be even more difficult than the Chinese writing. Hence a phonetic reaction is inevitable. In the middle ages the spelling was periodically readjusted in accordance with the changes of pronunciation—as far, of course, as the imperfections of the existing orthography would allow. This adjustment went on even after the introduction of printing In fact, it is only within the last hundred years or so that the orthographies of English and French have become fixed.

One result of this fixity is that any attempt to continue the process of adjustment assumes a revolutionary character. When, in 1849, the pioneers of the modern spelling-reform movement—A. J. Ellis and I. Pitman—brought out the *Fonetic Nuz*, few of those who joined in the chorus of ridicule excited by the new alphabet stopped to consider that this uncouthness was purely the result of habit, and that the Authorized Version of the Bible in the spelling of its first edition would seem to us not less strange and uncouth than in the new-fangled phonotypy of Messrs Ellis and Pitman. Nor did they stop to consider that phonetics and phonetic spelling, so far from being innovations, are as old as civilization itself. The Alexandrian grammarians were not only phoneticians—they were spelling-reformers; they invented the Greek accents for the purpose of making the pronunciation of Greek easier to foreigners. The Romans, too, were phoneticians: they learnt Greek by phonetic methods, and paid great attention to niceties of pronunciation. The Sanskrit grammarians were still better phoneticians.

As a matter of fact, English spelling was still phonetic as late as the time of Shakespeare—in intention, at least. But although people still tried to write as they spoke, the inherited imperfections of their orthography made it more and more difficult for them to do so. Hence already in the 16th century a number of spelling-reformers made their appearance, including classical scholars such as Sir John Cheke, and A. Gill, who was head-master of St Paul's School in London. Gill has left us extracts from Spenser's *Faerie Queene* in phonetic spelling; but, strange to say, nothing of Shakespeare's, although he and Shakespeare were exact contemporaries. But Gill's and the other alphabets proposed were too intricate and cumbrous for popular use.

Nevertheless, some important phonetic reforms were successfully carried through, such as getting rid of most of the superfluous final *e*'s, utilizing the originally superfluous distinctions in form between *i* and *j*, *u* and *v*, by using *i*, *u* only as vowels, *j*, *v* only as consonants, instead of at random—a reform which seems to have begun in Italy. Another important reform was the introduction of *ea* and *oa*, as in *sea* and *boat*, which had hitherto been written with *ee* and *oo*, being thus confused with *see* and *boot*.

All these were as much phonetic reforms as it would be to utilize long *s* and tailed *z* (ʃ, ʒ) to denote the final consonants in *fish* and *rouge* respectively; a reform first suggested by A. J. Ellis, who was himself the first to call attention to the works of these early phoneticians and to utilize them in the investigations enshrined in his great work on *Early English Pronunciation*.

With all its defects, the present English spelling is still mainly phonetic; we can still approximately guess the pronunciation of the vast majority of words from their spelling. So when we say that English spelling is unphonetic we merely mean that it is a bad phonetic spelling; and all that spelling-reformers aim at is to make this bad into a good phonetic spelling, that is, an efficient and easy one. But the difficulties are great; and the more we know of phonetics, and the more we experiment with different systems of spelling, the more formidable do they appear. One of the difficulties, however, that is commonly supposed to stand in the way of spelling-reform is quite imaginary: namely, that it would destroy the historical and etymological value of the present system. Thus E. A. Freeman used to protest against it as "a reckless wiping out of the whole history of the language." Such critics fail to see that historical spelling, if carried out consistently, would destroy the materials on which alone history can be based; that these materials are nothing else but a series of phonetic spellings of different periods of the language, and that if a consistent historical and etymological spelling could have been kept up from the beginning, there would have been no Grimm's Law, no etymology; in short, no comparative or historical philology possible.

The advantages of beginning a foreign language in a phonetic notation are many and obvious. In the first place, the learner who has once mastered the notation and learnt to pronounce the sounds the letters stand for, is able to read off at once any text that is presented to him without doubt or hesitation, and without having to burden his memory with rules of pronunciation and spelling. Another advantage of phonetic spelling is that when the learner sees the words written in a representation of their actual spoken form he is able to recognize them at once when he hears them. And if the learner begins with the phonetic notation, and uses it exclusively till he has thoroughly mastered the spoken language, he will then be able to learn the ordinary spelling without fear of confusion, and quicker than he would otherwise have done.

Spelling-reform may be carried out with various degrees of thoroughness. After the failure of many schemes of radical reform, an attempt was made to begin with those numerous spellings which are both unphonetic and unhistorical, or are against the analogy of other traditional spellings. Accordingly, in 1881 the Philological Society of London "aproovd (*sic*) of certain partial corections (*sic*) of English spellings," which were also approved of by the American Spelling-reform Association; and a list of them was issued jointly by the two bodies, and recommended for general adoption. A similar movement has been started in France. But the general feeling appears to be that it is better to keep the ordinary spelling unchanged, and wait till it is possible to supersede it by one on a more or less independent basis.

If the existing Roman alphabet is made the basis of the new phonetic notation of any one language, the most obvious course is to select one of the various traditional representations of each sound, and use that one symbol exclusively, omitting, of course, at the same time all silent letters. A. J. Ellis's *English Glossic* is an example of such a phonetic spelling on a national basis. The following is a specimen:—

> Ingglish Glosik iz veri eezi too reed. Widh proper training a cheild foar yeerz oald kan bee redili taut too reed Glosik buoks.

But a system which, like this, writes short and long vowels with totally different symbols (i, ee) is only half phonetic: it is phonetic on an unphonetic basis.

A fully phonetic system, in which, for instance, long vowels and diphthongs are expressed by consistent modifications or combinations of the symbols of the short vowels, and in which simple sounds are, as far as is reasonable and convenient, expressed by single letters instead of digraphs such as *sh*, must necessarily discard any national basis. The best basis on the whole is obtained by giving the letters their original common European sounds, *i.e.* by returning to the Late Latin pronunciation, with such modifications and additions as may be advisable. As regards the vowels at least, this Latin basis is very well preserved in German and Italian. In French, on the other hand, the Latin tradition was greatly corrupted already in the earliest period through the rapid changes which the language underwent. Thus when the Latin *u* in *luna* assumed the sound it now has in French *lune*, the symbol *u* was still kept; and when the sound *u* afterwards developed again out of the diphthong *ou*, this digraph was used to denote the sound. So when the French system of spelling came into use in England after the Norman Conquest these unphonetic symbols were introduced into English spelling, so that such a word as Old English and Early Middle English *hūs*, "house," was written *hous* in the Late Middle English of Chaucer, although the sound was still that of Scotch *hoos*, *ou* (ow) being also used to denote a true diphthong (ou) in such words as *knou*, *know*, from Old English *cnāwan*.

By returning, then, to the original values of the letters we get the "Romic" or international (Continental) basis as opposed to the Glossic or national basis. Thus the passage quoted above appears as follows in Sweet's "Broad Romic" notation:—

> iŋgliʃ glosik iz veri iizi tu riid. wið prope treiniŋ ə tʃaild fɔə jiəz ould kən bii redili tɔt to riid glosik buks.

Another important general distinction is that between "broad" and "narrow" systems of notation. A broad notation is one which makes only the practically necessary distinctions in each language, and makes them in the simplest manner possible, omitting all that is superfluous. From a practical point of view the necessary distinctions are those on which differences of meaning depend. A distinction of sound which is significant in one language may be unsignificant in another. Thus the distinction between close é and open é, ê is significant in French, as in *pécher*, *pêcher*; so if in French phonetic writing the former is denoted by (e), it is necessary to find a new symbol (ϵ) for the open sound. But in languages such as English and German, where the short *e* is always open, there is no practical objection to using the unmodified (e) to denote the open sound, even if we regard (e) as the proper symbol of the close sound. And in those languages in which the short *e* is always open and the long *e* always close it is enough to mark the distinction of quantity, and leave the distinction of quality to be inferred from it (e, ee). In such a case as this it is, of course, possible to apply the principle of ignoring superfluous distinctions in the opposite way: by writing the long and short vowels in such a language (*e*, ϵ), leaving the quantity to be inferred from the quality. But the former method is the more convenient, as it does not require any new letter. The "broad" principle is especially convenient in writing diphthongs. Thus in English Broad Romic we write the diphthongs in *high* and *how* with the same vowel as *ask* (hai, hau, aask), although all these (a)'s represent different sounds in ordinary southern English pronunciation. But the pronunciation of these diphthongs varies so much in different parts of the English-speaking territory, and the distinctions are so minute that it would be inconvenient to express them in writing; and as these distinctions are non-significant, it would be useless to do so. (ai) and (au) are symbols, not of special diphthongs, but of two classes of diphthongs: they can stand for any diphthongs which begin with a vowel resembling the Italian *a*, and end with approximations to *i* and *u* respectively. Theoretically it would be just as correct in English and German to write these diphthongs (ae, ao). But these notations are misleading, because they suggest simple sounds.

In comparing the sounds of a variety of languages, or of dialects of a language, and still more in dealing with sounds in general, we require a "narrow," that is a minutely accurate, notation covering the whole field of possible sounds. It is evident from what has been said above that such a universal scientific alphabet is not suited for practical work in any one language. But the symbols of such a notation as Sweet's "Narrow Romic" are of the greatest use as keys to the exact pronunciation of the vaguer symbols of the Broad Romic notations of each language.

To prevent confusion between these two systems of notations Broad Romic symbols are enclosed in ( ), Narrow Romic in [ ], which at the same time serve to distinguish between phonetic and nomic spellings. This in English *i* (i) = [*i*] means that the English vowel in *finny* is the "wide" sound, not the "narrow" one in French *fini*, although in the Broad Romic notations of both languages (fini) is written for *finny* and *fini* alike.

Narrow Romic was originally based on A. J. Ellis's "Palaeotype," in which, as the name implies, no new letters are employed. The symbols of Palaeotype are made up, as far as possible, of the letters generally accessible in printing-offices, the ordinary Roman lower-case letters being supplemented by italics and small capitals (i, *i*, ɪ) and turned letters (ə,ɔ), many digraphs (th, sh) being also used. This notation was a reaction from Ellis's earlier phonotopy, in which a large number of new letters were used. Some of these, however, such as ʃ=(sh), ʒ=(zh), were afterwards adopted into Broad and Narrow Romic. In his Palaeotype Ellis also discarded diacritical letters, which, as he rightly says, are from a typographical point of view equivalent to new letters. In Narrow Romic a certain number of diacritical letters are used, such as (ñ, ä), most of which are already accessible. Palaeotype is a Roman-value notation, the main difference as regards the values of the symbols between it and the later systems being that it is more complex and arbitrary. Ellis afterwards had the unhappy idea of constructing a "Universal Glossic" on an English-values basis, which is even more cumbrous and difficult to remember than Palaeotype.

Sweet's Romic systems were made the basis of the "International" alphabet used in *Le Maître Phonétique*, which is the organ of the *International phonetic Association*, directed by P. Passy. Although this system is at the present time more widely known and used than any other, and although it is constructed on the international Romic principle, it is not really an international system. It is rather an attempt to make a special adaptation of the Romic basis to the needs of the French language into a general notation for all languages. But the phonetic structure of French is so abnormal, so different from that of other languages, that the attempt to force a Broad Romic French notation on such a language as English is even more hopeless than it would be to reverse the process. Although well suited for French, this alphabet must from a wider point of view be regarded as a failure: it is too minute and rigid for practical, and yet not precise enough for scientific purposes. In short, although it has done excellent service, and has helped to clear the way for a notation which shall command general acceptance, it cannot be regarded as a final solution of the problem.

Of the numerous other notations now in use, some still adhere to the diacritic principle of Lepsius's *Standard Alphabet* (1855), intended for missionary use, but found quite unfit for that purpose because of the enormous number of new types required. Most of them prefer to use new letters formed by more or less consistent modifications of the existing italic letters. A. J. Lundell's Swedish dialect alphabet and O. Jespersen's Danish dialect alphabet are good specimens of this tendency. In the latter Roman letters are used for special distinctions, just as italic letters are used in the Romic systems.

But in spite of all diversity, there is much agreement. As regards the vowels, the following approximate values are now pretty generally accepted:—

a	*as in*	father.	i	*as in*	it.
ai	,,	time.	o	,,	beau (Fr.).
au	,,	house.	œ	,,	peur (Fr.).
æ	,,	man.	ɔ	,,	fall.
e	,,	été (Fr.).	oi	,,	oil.
ei	,,	veil.	ou	,,	soul.
ϵ	,,	there.	u	,,	full.
ə	,,	further.	y	,,	une (Fr.).

Vowel-length is in some systems denoted by doubling (aa), in others by special marks (a: &c.), the diacritic in *ā* being used only in the nomic orthographies of dead and oriental languages.

The only consonant-symbols that require special notice are the following:—

c	*as in*	tyúk (Hung.).	n	*as in*	sing.
ç	,,	ich (German).	ʃ	,,	fish.
ð	,,	then.	þ	,,	thin.
j	,,	you.	w	,,	we.
ɟ	,,	nagy (Hung.).	x	,,	loch.
ñ	,,	ogni (Ital.).	ʒ	,,	rouge.

All the systems of phonetic notation hitherto considered are based on the Roman alphabet. But although the Roman alphabet has many advantages from a practical point of view, it is evidently impossible to build up a consistent and systematic notation on such an inadequate foundation of arbitrary signs. What is wanted, for scientific purposes especially, is a notation independent of the Roman alphabet, built up systematically—an alphabet in which there is a definite relation between sound and symbol.

This relation may be regarded either from the organic or the acoustic point of view. The tendency of the earlier attempts at an a priori universal alphabet was to symbolize the consonants organically, the vowels acoustically, as in E. Brücke's *Phonetische Transscription* (1863). It is now generally acknowledged that the vowels as well as the consonants must be represented on a strictly organic basis. This was first done in A. M. Bell's *Visible Speech* (1867), which appeared again (1882) in a shorter form and with some modifications under the title of *Sounds and their Relations*. Bell's pupil, H. Sweet, gave a detailed criticism of Visible Speech in a paper on *Sound-notation* (Trans. of Philological Society, 1880–1881), in which he described a revised form of it called the *Organic Alphabet*, which he afterwards employed in his *Primer of Phonetics* and other works. Sweet's Narrow Romic notation already mentioned is practically a transcription of the Organic Alphabet into Roman letters.

Such notations are alphabetic: they go on the general principle of providing separate symbols for each simple sound. But as the number of possible shades of sounds is almost infinite, even the most minutely accurate of them can do so only within certain limits. The Organic Alphabet especially makes a large use of "modifiers"—characters which are added to the other symbols to indicate nasal, palatal, &c., modifications of the sounds represented by the latter, these modifiers being generally represented by italic letters in the Narrow Romic transcription; thus (l*n*) = nazalized (l).

In the Roman alphabet such symbols as *f*, *v* are arbitrary, showing no connection in form either with one another or with the organic actions by which they are formed; but in the Organic symbol of *v*, for instance, we can see the graphic representation of its components "lips, teeth, voice-murmur." By omitting superfluous marks and utilizing various typographical devices the notation is so simplified that the symbols, in spite of their minute accuracy, are often simpler than in the corresponding Roman notation. The simplicity of the system is shown by the fact that it requires only about 110 types, as compared with the 280 of Lepsius's very imperfect Standard Alphabet.

All the systems hitherto considered are also alphabetic in a wider sense: they are intended for continuous writing, the more cumbrous "narrow" notations being, however, generally employed only in writing single words or short groups. An "analphabetic" basis was first definitely advocated by Jespersen, who represents each sound by a group of symbols resembling a chemical formula, each symbol representing not a sound, but an element of a sound: the part of the palate, tongue, &c., where the sound is formed, the degree of separation (openness) of the organs of speech, and so on. The two great advantages of such a system are that it allows perfect freedom in selecting and combining the elements and that it can be built up on the foundation of a small number of generally accessible signs.

As regards Jespersen's scheme, it is to be regretted that he has not worked it out in a more practical manner: that in his choice of the thirty odd symbols that he requires he should have gone out of his way to mix up Greek with Roman letters, together with other characters which would be avoided by any one constructing even a scientific alphabetic notation. And his use of these symbols is open to much criticism. In fact, it cannot be said that the analphabetic principle has yet had a fair trial.

The Organs of Speech.—Most speech-sounds are formed with air expelled from the lungs (voice-bellows), which passes through the two contractible bronchi or bronchial tubes into the also contractible wind-pipe or trachea, on the top of which is fixed the larynx (voice-box). Across the interior of the larynx are stretched two elastic ledges or cushions called "the vocal chords." They are inserted in front of the larynx at one end, and at the other they are fixed to two movable cartilaginous bodies "the aretynoids," so that the passage between them—the glottis—can be narrowed or closed at pleasure. The glottis is, as we see, twofold, consisting of the chord glottis and the cartilage glottis. The two can be narrowed or closed independently. The chords can also be tightened or relaxed, lengthened and shortened in various degrees.

When the whole glottis is wide open, no sound is produced by the outgoing breath except that caused by the friction of the air. Sounds in whose formation the glottis is in this passive state are called "breath" sounds. Thus (f) is the breath consonant corresponding to the "voice" or "voiced" consonant (v). In the production of voice, the chords are brought close enough together to be set in vibration by the air passing between them. In the "thick" register of the voice (chest voice) the chords vibrate in their whole length, in the "thin" register or falsetto only in part of their length. If the glottis is narrowed without vibration, "whisper" is the result. In the "weak whisper" there is narrowing the whole glottis; in the "strong whisper," which is the ordinary form, the chord glottis is entirely closed, so that the breath passes only through the cartilage glottis. In what is popularly called "whisper"—that is, speaking without voice—the breath sounds remain unchanged, while voiced sounds substitute whisper (in the phonetic sense) for voice. Thus in whispering such a word as *feel* the (f) remains unchanged, while the following vowel and consonant are formed with the glottis only half closed. Whispered sounds—both vowels and consonants—occur in ordinary loud speech in many languages. Thus the final consonants in such English words as *leaves*, *oblige* are whispered, except when followed without a pause by a voiced sound, as in *obliging*, where the (ʒ) is fully voiced.

Above the glottis—still within the larynx—comes the "upper" or "false" glottis, by which the passage can be narrowed. On the top of the larynx is fixed a leaf-like body, the "epiglottis," which in swallowing, and sometimes in speech, is pressed down over the opening of the larynx. The contractible cavity between the larynx and the mouth is called the "pharynx." The roof of the mouth consists of two parts, the "soft" and the "hard palate." The lower pendulous extremity of the soft palate, the "uvula," in its passive state leaves the passage into the nose open. In the formation of non-nasal sounds, such as (b), the uvula is pressed up so as to close the passage from the pharynx into the nose. If (b) is formed with the passage open, it becomes the corresponding nasal consonant (m). The other extremity of the (hard) palate is bounded by the teeth, behind which are the gums, extending from the teeth-rim to the arch-rim—the projection of the teeth-roots or alveolars.

There is great diversity among phoneticians as regards the mapping out—the divisions—of the palate and tongue, and their names. Foreign phoneticians generally adopt very minute distinctions, to which they give Latin names. Bell in his *Visible Speech* makes a few broad fundamental divisions. In the arrangement adopted here (mainly based on his) sounds formed on the soft palate are called "back," and are subdivided into "inner" = nearer the throat, and "outer" = nearer the teeth, further subdivisions being made by the terms "innermost," "outermost," the position exactly half way between these two last being defined as "intermediate back." Sounds formed on the hard palate or teeth may be included under the common term "forward," more accurately distinguished as "teeth" (dental), "gum," "front" (palatal, afterwards called "top" by Bell), which last is really equivalent to "mid-palatal," including the whole of the hard palate behind the gums. All of these divisions are further subdivided into "inner," &c., as with the back positions.

Of the tongue we distinguish the "back" (root), "front" or middle, "point" (tip), and "blade," which includes the point and the surface of the tongue immediately behind it. The tongue can also articulate against the lips, which, again, can articulate against the teeth. The lip passage can be closed, or narrowed in various degrees. Sounds modified by lip-narrowing are called "lip-modified" (labialized) or "round" (rounded), the last being specially used in speaking of vowels.

Speech-sounds.—The most general test of a simple as opposed to a compound sound (sound-group) is that it can be lengthened without change. As regards place of articulation, no sound is really simple: every sound is the result of the shape of the whole configurative passage from the lungs to the lips; and the ultimate sound-elements, such as voice, are never heard isolated. The most indistinct voice-murmur is as much the result of the shape of the superglottal passages as the clearest and most distinct of the other vowels; and its organic formation is as definite as theirs is, the only difference being that while in what we regard as unmodified voice all the organs except the vocal chords are in their passive, neutral positions, the other vowels are formed by actively modifying the shape of the super-glottal passages—by raising the tongue towards the palate, narrowing the lips, &c.

The most important elements of speech-sounds are those which are dependent on the shape of the glottis and of the mouth passage respectively. It is on the relation between these two factors that one of the oldest distinctions between sounds is based: that of *vowel* and *consonant*. In vowels the element of voice is the predominant one: a vowel is voice modified by the different shapes of the superglottal passages. In consonants, on the other hand, the state of the glottis is only secondary.

Consonants are generally the result of audible friction, as in (f), or of complete stoppage, as in (p). If the glottis is at the same time left open, as in (f, p), the consonant is "breath" or "voiceless"—if it is narrowed enough to make the chords vibrate, as in (v, b), the consonant is "voice" or "voiced"; intermediate positions producing the corresponding "whispered" consonants. Vowels are characterized negatively by the absence of audible friction or stoppage: if an (i) is formed with the tongue so close to the palate as to cause buzzing, it becomes a variety of the front consonant (j). There is, of course, no difficulty in forming a vowel with the glottis in the position for breath and whisper. Thus breath (i) may often be heard in French in such words as *ainsi* at the end of a sentence, the result being practically a weak form of the front-breath consonant (ç). The division between vowel and consonant is not an absolutely definite one. As we see, the closer a vowel is—that is, the narrower its configurative passage is—the more like it is to a consonant, and the more natural it is to devocalize it. Some voice consonants, on the other hand, have so little buzz that acoustically they constitute a class between consonants and vowels—a class of "vowel-like" or "liquid" consonants, such as n, m, l).

The changes in sounds which result from active narrowing of the passages admit of an important distinction as "sound-modifying" and "sound-colouring," although the distinction is not always definite. Nasality and rounding are examples of sound-modifying processes. Thus we hear a certain resemblance between (b) and (m), (i) and (y), but we regard all these four as distinct and practically independent sounds. Contraction of the pharynx, on the other hand, as also of the false glottis and windpipe, have only a sound-colouring effect: if a vowel is formed with such contractions its quality (timbre) is altered, but it still remains the same vowel. It follows from the definition of speech-sounds that they admit of a twofold classification: (1) organic and (2) acoustic. As already remarked, the older phoneticians used to classify the consonants organically, the vowels mainly from the acoustic point of view. The first to give an adequate organic classification of the vowels was the author of *Visible Speech*. Bell gave at the same time an independent acoustic classification of the consonants as well as the vowels. His acoustic classification consists simply in arranging the sounds in the order of their "pitches" (tone-heights). The pitches of the breath consonants are absolutely fixed in each individual pronunciation, while those of spoken vowels can be varied indefinitely within the compass of each voice by tightening the vocal chords in various ways and shortening their vibrating portions: the tighter and shorter the vibrating body, the quicker its vibrations, and the higher the tone. But when a vowel is whispered or breathed nothing is heard but the resonance of the configurative passages, especially in the mouth, and the pitches of these resonant cavities are as fixed as those of the breath consonants; in other words, a whispered (or breathed) vowel cannot be sung. Although the absolute pitches of voiceless sounds may vary from individual to individual the *relations* of the pitches are constant: thus in all pronunciations (ç) and whispered (i) are the highest, breath (w) in *what* and whispered (u) nearly the lowest in pitch among consonants and vowels respectively.

If phonetics were an ideally perfect science there would be no occasion to discuss whether the acoustic or the organic study of the vowels and the other speech-sounds is the more important: a full description of each sound would necessarily imply (1) an exact determination of its organic formation, (2) an acoustic analysis of the sound itself, both from the objective physical point of view and from the subjective one of the impression received by the ear, and (3) an explanation of how (2) is the necessary result of (1). Even this last question has already been solved to some extent. In fact, the connection between the organic formation and the acoustic effect is often self-evident. It is evident, for instance, that (i) and (ç) owe their clear sound and high pitch to their being formed by short, narrow passages in the front of the mouth, while (u) owes its low pitch to being formed in exactly the opposite way, the sound being farther muffled and the pitch consequently still more lowered by the rounding.

One reason why it is impossible to classify the vowels exclusively on acoustic principles is that two vowels formed in quite different ways may have the same pitch. Thus the "high-front-round" (y) and the "high-mixed" (ï) have the same pitch, the tongue-retraction of the mixed position of the latter having the same effect as the rounding of the former. It is evident, therefore, that the fundamental classification of the vowels must, like that of the consonants, be purely organic. And although for practical purposes it is often convenient to classify sounds partly from the acoustic point of view, a full scientific treatment must keep the two points of view strictly apart, and make a special chapter of the relations between them.

Vowels.—The most obvious distinction between vowels is that which depends on the share of the lips in their articulation. In such non-round vowels as (i) and (a) the lips are passive, or even separated and spread out at their corners, by which the vowels assume a clearer resonance. If, on the other hand, the lips are actively approximated, they become the round vowels (y) and "open" (o) respectively.

Vowels are formed with different degrees of rounding. As a general rule, the narrowness of the lip-passage corresponds to the narrowness of the mouth-passage. Thus, in passing from the vowel of *too* to those of *no* and *saw* the back of the tongue is progressively lowered, and the rounding is diminished in the same proportion.

But there is also abnormal rounding. Thus, if we pronounce (o) with the lips in the position they have in forming (u), the resulting "over-rounded" vowel sounds half-way between (o) and (u); the second element of the diphthong (ou) in *go* is formed in this way. Conversely, the (u) in *put* is "under-rounded" in the North of England: the tongue position is kept, but the lips are only brought together a little at the corners, as in (ɔ).

The mouth positions of the vowels are the result of two factors: (1) the height of the tongue—its nearness to the palate—and (2) the degree of its retraction. Bell distinguishes three degrees of height: in his system (u) is "high," the (o) of *boy* is "mid," and the (ɔ̣) of *saw* is "low." He also has three degrees of retraction: in "back" vowels, such as (u), the root of the tongue is drawn to the back of the mouth, and the whole tongue slopes down from back to front. In "front" vowels, such as (i), the front of the tongue is raised towards the hard palate, so that the tongue slopes down from front to back.

Most of these slope-positions yield vowels of a distinct and clear resonance. There is also a class of "flat" vowels, such as (ə), in which the tongue is in a more or less neutral position. If the tongue is raised from the low-flat position of (əə) in *bird* to the high position, we get the (ï) of North Welsh *dyn* "man," which, as already observed, is acoustically similar to (y).

The flat vowels were called "mixed" by Bell, in accordance with his view that they are the result of combining back and front articulation. And although this view is now generally abandoned, the term "mixed" is still retained by the English school of phoneticians.

In this way Bell mapped out the whole mouth by the following cardinal points:—

high-back	high-mixed	high-front
mid-back	mid-mixed	mid-front
low-back	low-mixed	low-front

In this arrangement "high-back," &c., are fixed points like those of latitude and longitude. Thus normal "high" means that the tongue is raised as close to the palate as is possible without causing consonantal friction, and "back" implies retraction of the same kind. Intermediate positions are defined as "raised," "lowered," "inner," "outer."

The most original and at the same time the most disputed part of Bell's vowel-scheme is his distinction of "primary" and "wide." All vowels fall under one of these categories. Thus, the primary French (i) and the corresponding English wide (*i*) are both high-front-vowels, and yet they are distinct in sound: the English vowel is a semitone lower in pitch. Bell explained the greater openness of the wide vowels as the result of greater expansion of the pharynx; and he considered the other class to be most nearly allied to the consonants—whence their name "primary"—the voice-passages in the formation of primary vowels being expanded only so far as to remove all fricative quality. But alterations in the shape of the pharynx have only a sound-colouring, not a sound-modifying, effect; and Sweet showed that the distinction depends on the shape of the tongue, and accordingly substituted "narrow" for Bell's "primary." He also showed that the distinction applies to consonants as well as vowels: thus the narrow French (w) in *oui* is a consonantization of the narrow French (u) in *sou*, while the English (w) preserves the wide quality of the (*u*) in *put*.

In forming narrow sounds there is a feeling of tension in that part of the tongue where the sound is formed, the tongue being clenched or bunched up lengthwise, so as to be more convex than in its relaxed or " wide " condition.

The distinction between narrow and wide can often be ignored in practical phonetic writing, for it generally depends on quantity; length and narrowness, shortness and wideness going together. When the distinction is marked, wide vowels may be expressed by italics, as in German (biinə, b*i*n).

Bell's category of " mixed-round " vowels had from the beginning been a source of difficulty to students of *Visible Speech.* But it was not till 1901 that Sweet showed that they are only mixed as regards position: they are really the corresponding back-round vowels moved forward into the middle of the mouth while preserving the slope of back vowels, instead of having the tongue flat as in the (unround) mixed vowels. They are " out-back " vowels: there is an exaggeration of the outer back position of such a back-round vowel as the English (*u*) compared with the full back (*u*) in German *muttre.*

In the same way by moving the tongue backwards while forming a front vowel another series of " in-front " vowels is obtained.

The " in-mixed " vowels are obtained by shifting the neutral mixed positions into the full back position, keeping the tongue flat, so that these vowels might also be called " back-flat."

The out-back, in-front and in-mixed vowels are included under the common designation of " shifted," as opposed to " normal " vowels.

There is a large number of other vowel-schemes, of which a survey will be found in W. Vietor's *Elemente der Phonetik.* Many of the older ones are in the form of triangles, with the three chief vowels *a, i, u* at the three corners, the other vowels being inserted between these extremes according to their acoustic relations. Since the appearance of *Visible Speech* many attempts have been made to fit his new vowels into these older schemes.

Of all the vowel-schemes the one now most generally known is perhaps that of the International Phonetic Association already mentioned. In this scheme the distinction of narrow and wide, though admitted and occasionally marked, is not an integral part of the system, the vowels being classified first as " velar " (back) and " palatal " (front), and then according to openness as " close," " half-close," " medium," " half-open " and " open."

Consonants.—These are the result of audible friction or stoppage, which may be accompanied either with breath, voice or whisper.

Consonants admit of a two-fold division (1) by form, and (2) by place. Thus (p, b) are by place lip-consonants, while by form they are stopped consonants or " stops."

If the mouth-stoppage is kept, and the nose-passage is opened, the stop becomes the corresponding " nasal "; thus (b) with the soft palate lowered becomes the nasal (m).

In " open " consonants the sound is formed by simply narrowing the passage, as in the back-open-breath (x) in Scotch and German *loch.* In some open consonants, such as the lip-teeth (f), there is slight contact of the organs, but without impeding the flow of breath.

In " divided " consonants there is central stoppage with openings at the sides, as in the familiar point-divided (l). These consonants are sometimes " unilateral "—with the opening on the side only—the character of the sound not being sensibly modified thereby.

When open and divided consonants are formed with the nose-passage open they are said to be " nazalized." Thus (m) with incomplete lip-closure becomes the nasalized lip-open-voice consonant.

" Trills " (or rolled) consonants are a special variety of un-stopped consonants resulting from the vibration of flexible parts against one another, as when the lips are trilled, or against some firm surface, as when the point of the tongue trills against the gums in the Scotch (r), or the uvula against the back of the tongue, as in the Northumbrian burred (r), and the French and German (r), where—especially in German—the trill is often reduced to a minimum or suppressed altogether.

As regards the place of consonants, there is, as already remarked, great diversity among phoneticians, both in mapping out the palate and tongue and in the names given to these divisions. The classification and nomenclature given here is, in the main, that of Bell.

By place, then, we distinguish seven main classes of consonants: back, front, point, blade, fan, lip, and lip-teeth.

" Back " (guttural) consonants are formed between the root of the tongue and the soft palate. In most languages the positions of these consonants vary according to those of the accompanying vowels: thus the back-stop and back-nasal in *king* are more forward than in *conquer.*

" Front " (palatal) consonants are formed between the middle of the tongue and the hard palate, the point of the tongue lying passively behind the lower teeth. It is easy to make the front-open-voice (j) in *you* into the corresponding stop (ɟ) by narrowing the passage till there is complete closure, as in Hungarian *nagy* (nɔɟ) " world." In the same way the open breath (ç) in German *ich* may be made into the stop (c) = Hungarian *ty.* (ɟ) nasalized becomes (ñ)—Italian *gn*, Spanish ñ, French *gn* in *vigne.* The front-divided-voice consonant is the Italian *gl* and Spanish *ll.* These are all simple sounds, distinct from the (lj), (nj) in French and English *million* and English *onion.*

" Point " consonants when formed against the teeth are called " point-teeth " (dental). English (þ) in *thin* is the point-teeth-open-breath consonant, (ð) in *then* the corresponding voice consonant. If (ð) is modified by turning the tip of the tongue back into the inner position—about on the arch-rim—it becomes the untrilled (r) in English *rearing,* in which position the tongue is easily trilled, the trilling becoming more and more difficult the more the tongue is approximated to the point-teeth position. In French and many other languages all the point consonants (t, d, n, l), &c., are formed on the teeth, except (r), which is always more retracted than the other point consonants. If the tip of the tongue is turned so far back as to articulate with its lower edge against the arch of the palate—that is, farther back than for the " inner " position—it is said to be " inverted." Inverted (r) is frequent in the dialects of the south-west of England. The opposite of inversion is " protrusion," in which the tip of the tongue articulates against the upper lip.

" Blade " consonants are formed by the blade or flattened tip of the tongue against the gums, as in English (s, z), or against the teeth, as in the corresponding French sounds. If these consonants are modified by turning the tongue a little back, so as to bring the point more into play, they become the " blade-point " consonants (ʃ, ʒ), as in *fish, measure.* (ʃ) is acoustically a dull (s). In some languages, such as German, sounds similar to (ʃ) and (z) are formed partly by rounding, which lowers the pitch of the hiss in the same way as retraction does, so that the tongue-articulation is only imperfectly carried out. When the rounding is very marked there is only a slight raising of the front of the tongue, as in some Swedish dialects; and if the tongue-articulation is progressively shifted back, and the rounding diminished in the same proportion, (ʃ) can at last develop into the pure back-open consonant (x), as in the present pronunciation of Spanish *x* and *j.*

The English point consonants (t, d, n, l) are formed on the gums just behind the teeth, the point of the tongue being flattened, so that they are almost blade consonants.

" Fan " (spread) consonants—the " emphatic " consonants of Arabic—are modifications of point and blade consonants, in which the sides of the tongue are spread out, so that the hiss of such a consonant as (s) is formed partly between the sides of the tongue and the back teeth, which gives a peculiar deep, dull quality to these sounds.

" Lip " consonants, such as (p, m), and " lip-teeth " consonants, such as (f, v), offer no difficulty. The simple lip-open-breath consonant does not occur in English; it is the sound produced in blowing out a candle. The corresponding voice sound is frequent in German—especially in Middle Germany—in such words as *quelle.*

If the lip-open consonants are modified by raising the back of the tongue, they become the " lip-back " consonants (wh, w) in English *what, we,* which may also be regarded as consonantized (*u*). In them the lip articulation predominates. In the " back-lip " consonants, as in German *auch,* the reverse is the case.

This last is one of a large number of " lip-modified " consonants, of which the already-mentioned German *sch* is a further example.

In a similar way consonants may be " front-modified." (r) is peculiarly susceptible to such modifications. In French and other languages it is formed with the tongue more convex than in English, and consequently with a tendency to front-modification. Front-modified (s) and point (r) may be heard in Russian in such words as *gusĭ* " goose," *tsarĭ* " emperor," where the final vowels are silent.

Some consonants are formed below the mouth.

When the glottis is sharply opened or closed on a passage of breath or voice an effect is produced similar to that of a stop in the mouth, such as (k). This " glottal stop " is the sound produced in hiccuping; and is an independent sound in some languages, such as Arabic, where it is called " hamza." In German all words beginning with a stressed (accented) vowel have a more or less distinct glottal stop before the vowel.

Of the passages below the glottis, the bronchials and the windpipe are both susceptible of contraction.

Spasmodic contraction of the bronchial passages is the main factor in producing what is known as " the asthmatic wheeze." If this contraction is regulated and made voluntary it results in the deep hiss of the Arabic *ḥā.* If this sound is voiced, it causes a peculiar intermittent vibration of voice, which is habitual with some speakers, especially in Germany. If this effect is softened by slightly expanding the bronchial passages, an (r)-like sound is produced, which is that of the Arabic *'ain.*

Contraction of the windpipe produces a sound similar to the Arabic *ḥā,* but weaker, which when followed by a vowel has the effect of a strong aspirate. When voiced it becomes a mere colourer of the accompanying voice-murmur, or vowel, to which it imparts a deep timbre.

Non-expiratory Sounds.—All the sounds hitherto described imply out-breathing or expiration. Many of them can also be formed with in-breathing or inspiration. In English it is a not uncommon trick of speech to pronounce *no* in this manner, to express emphatic denial.

Some consonants are formed without either in- or out-breathing, but solely with the air in the throat or mouth. In forming "suction-stops" or "clicks" the tongue or lips are put in the position for a stop, and the air is sucked out from between the organs in contact, so that when the stop is loosened, a smacking sound is produced by the air rushing in to fill the vacuum. Thus the point-click is the interjection of impatience commonly written *tut!* In many savage languages clicks are a part of ordinary speech.

Synthesis.—Besides analysing each sound separately, phonetics has to deal with the phenomena which accompany synthesis or the combination of sounds. Although a sentence may consist of a single word, and that word of a single vowel, sounds mostly occur only in combination with one another. The ordinary division into sentences and words is logical, not phonetic: we cannot mark off sentences and cut them up into words until we know what they mean and are able to analyse them grammatically. But the logical division into sentences corresponds to some extent with the phonetic division into "breath-groups," marked off by our inability to utter more than a certain number of syllables in succession without pausing to take breath. Within each of these breath-groups there is no necessary pause between the words, except when we pause for emphasis. The only necessary phonetic divisions within the breath-group are those into syllables, sounds and intervening "glides." But before considering these last it will be necessary to say something about the general factors of synthesis: quantity, stress and intonation.

As regards *quantity*, it is enough for ordinary purposes to distinguish three degrees: long, half-long or medium and short. In English what are called long vowels keep their full length when stressed and before final voice consonants, as in *see*, *broad*; and become half-long before voiceless consonants, as in *cease*, *brought*. In most other languages full length is preserved alike before all classes of consonants. The Romance languages have short final stressed vowels, as in French *si*. Unstressed vowels tend to become short in most languages. The distinctions of quantity apply to consonants as well as vowels. Thus English tends to lengthen final consonants after short stressed vowels, as in *man* compared with German *mann*, where the final consonant is quite short. Consonants, like vowels, tend to become short when unstressed. But in some languages, such as Finnish and Hungarian, stress has no effect on quantity, so that in these languages long vowels and double consonants occur as frequently in unstressed as in stressed syllables. Even in English we often lengthen final unstressed vowels in exclamations, as in *what a pity!* Some languages, such as the Romance languages and Russian, tend to level the distinctions of vowel-quantity: most of their vowels are half-long.

Stress is, organically the result of the force with which the breath is expelled from the lungs; while acoustically it produces the effect of loudness, which is dependent on the size of the sound-vibrations: the bigger the waves, the louder the sound, and the greater the stress, of which we may distinguish infinite degrees. If we distinguish only three, they are called *weak*, *medium* and *strong*. The use of stress in different languages shows the same variety as quantity. Some languages, such as French, make comparatively little use of its distinctions, uttering all the syllables of words and sentences with a more or less even degree of force. English, on the other hand, makes great use of minute distinctions of stress both to distinguish the meanings of words and to mark their relations in sentences.

With stress is closely connected the question of *syllable-division*. A syllable is a group of sounds containing a "syllabic" or syllable-former, which is, of course, able to constitute a syllable by itself. The distinction between syllabics and non-syllabics depends on sonority, the more sonorous sounds being the voiced ones, while of these again, the most open are the most sonorous, the most sonorous of all being the vowels, among which, again, the openest are the most sonorous. But these differences are only relative. When a vowel and a consonant come together the sonorousness of the vowel always overpowers that of the consonant, so that the two together only constitute one syllable. But in such a word as *little* the second (l) is so much more sonorous than the accompanying voiceless stop that it assumes syllabic function, and the whole group becomes dissyllabic to the ear. The beginning of a syllable corresponds with the beginning of the stress-impulse with which it is uttered. Thus in *atone* the strong stress and the second syllable begin on the (t), and in *bookcase* on the second (k), the first (k) belonging to the first syllable, so that the (kk) is here double, not merely long, as in *book* (bukk) by itself.

Intonation or variation of tone (pitch) depends on the rapidity of the sound-vibrations: the more rapid the vibrations, the higher the pitch. Intonation is heard only in voiced sounds, as being the only ones capable of variations of pitch.

In singing the voice generally dwells on each note without change of pitch, and then leaps up or down to the next note as quickly as possible, so that the intervening "glide" is not noticed—except in what is called portamento. In speaking, on the other hand, the voice hardly ever dwells on any one note, but is constantly gliding upwards or downwards, so that an absolutely level tone hardly ever occurs in speech. But in the rising and falling inflections of speech we can distinguish between "voice-glides" (portamentos or slurs) and "voice-leaps," although the distinction is not so definite as in singing.

Of the three primary forms of intonation the level tone ( ) can be approximately heard in *well* as an expression of musing—although it really ends with a slight rise; the rising (′) in the question *well?*; the falling (‵) in the answer *yes*. There are besides compound tones formed by uniting the two last in one syllable. The compound rising tone (ˇ) may be heard in *take care!* the compound falling tone (ˆ) in the sarcastic *oh!* All these tones may be varied according to the intervals through which they pass. The greater the interval, the more emphatic the tone. Thus a high rise, which begins high, and consequently can only rise a little higher, expresses simple question, while the same word, if uttered with a low rise extending over an interval of between a fifth and an octave—or even more—expresses various degrees of surprise or indignation, as in the emphatic *what!* compared with the simply interrogative *what?*

In English and most European languages, intonation serves to modify the general meaning and character of sentences. This is *sentence-intonation*. But some languages, such as Swedish and Norwegian, and Chinese, have *word-intonation*, by which words which would otherwise be identical in sound are distinguished. The distinction between Gr. *oíkoi* and *oîkoi* was no doubt one of intonation.

Glides.—Such a word as *cat* consists not only of the vowel and the two consonants of which it is made up, but also of "glides" or transitions between these sounds. The glide from the initial consonant to the vowel consists of all the intermediate positions through which the tongue passes on its way from the (k)-position to the (ae)-position. The number of these positions is infinite, but they are all implied by the mere juxtaposition of the symbols, for it is assumed that in all transitions from one position to another the shortest way is taken. Although the direction of a glide is dependent on the positions of the two fixed points between which it lies, its character may be varied both by the shape of the configurative passages—especially the glottis—and by stress and quantity.

In the word given above the "off-glides" from the consonants are both breath-glides, the glottis being kept open during the transition from the voiceless consonant to the following vowel, or, as in the case of the final consonant, to silence. The "on-glide" from the vowel to the (t) is, on the other hand, a voice-glide, the closure of the glottis being maintained till the stop is made.

In French and most of the languages of the south of Europe voiceless consonants are followed by voice-glides. Thus in French *qui* there is no escape of breath after the (k), as there is in English *Key*. Other languages again have breath on-glides before voiceless stops.

If an independent strong stress is put on the breath-glide of English *key*, it is heard almost as a full independent consonant, and becomes an "aspirate." Aspirated steps may be heard in the Irish-English pronunciation of such words as *tell*, and also in Danish, and in Sanskrit as pronounced in India. If the voice-glide after a voice stop is emphasized in a similar way the "sonant aspirates" of Sanskrit and its modern descendants are produced, as in Sanskrit *dhanu*.

Glides are especially important from an acoustic point of view. Acoustically speaking, indeed, voiceless stops are pure glide-sounds, the stop itself being inaudible. In voice-stops, on the other hand, the stop itself can be made audible as well as the intervening glides. In English these latter are fully voiced when they come between voice sounds, as in *ago*; but when preceded by voiceless sounds or by a pause, as in *go!* they are formed with imperfect vocality, full voice being heard only just before the stop is loosened. So also initial English (z) as in zeal is formed with imperfect vocality under the same conditions, so that it sounds like (sz). In French and other languages which have voice-glides after voiceless consonants initial (g, z) &c. are fully voiced.

Consonant-glides may be further modified in various ways. In the formation of "implosive" stops, such as occur in Saxon German, Armenian and other languages, voiceless stops followed by voice-glides are modified by simultaneous closure of the glottis, the larynx being raised by means of its muscles, so that it acts like a plug, compressing the air between the closed glottis and the mouth-stop, so that when the latter is released a peculiar choky effect is given to the off-glide.

Rounded glides may be heard in Russian in such words as *komnata*, where the rounding of the (o) is anticipated in the preceding consonant, being heard, of course, only in the off-glide of the consonant. The acoustic effect is between that of (kwó) and ordinary (ko).

Glideless consonant-combinations remain to be considered. The general articulative principle of taking the shortest way between sounds in juxtaposition necessarily results in certain transitions being effected without any glide at all. This is regularly the case when the consonants have the same place, and differ only in form, as in (nd, dlt), where the point of the tongue remains unmoved through the whole sound-group. In such combinations as (mf) the very slight glide is often got rid of entirely by assimilating the place of the first consonant to that of the second, so that the (m) becomes a lip teeth consonant, as in English *nymph*.

Even when consonants are formed in different parts of the mouth it is often possible to join them without any glide. In English such combinations as (kt, pt) are glideless, the point of the tongue being brought into position before the preceding stop is loosened. In French and most other languages such consonants are separated by a breath-glide.

Combinations of stops and vowel-like consonants (tr, gl, kw) are glideless in English and most other languages. In English the breath-glide after a voiceless stop unvoices the beginning of the following vowel-like consonant; thus *try* is almost (trh-rai).

Vowel-glides.—Vowels are begun and ended in various ways. In the "gradual beginning," which is the usual one in English and French, the glottis is gradually narrowed while breath is being emitted. In the "clear" beginning the breath is kept back till the glottis is closed for voice, which begins without any "breathiness." German favours the clear beginning, generally exaggerating it into a glottal stop.

In the gradual as well as the clear beginning the stress begins on the vowel. If in the former it is thrown back on the breath-glide, the latter is felt as an independent element and becomes the "aspirate" or (h), which in English and most other languages is a glide not only in the throat but in the mouth as well, the tongue and lips gradually moving up into the position for the following vowel while the glottis is being closed.

There is also a "strong" aspirate, which occurs in Finnish and other languages, in the formation of which the full vowel position is assumed from the beginning of the aspiration, which is therefore a voiceless vowel.

In most languages, when an aspirate comes between voiced sounds it is formed with imperfect vocality, the contrast of which with the full vocality of the other sounds is enough to produce the effect of breath. Thus in English *behold* the voice runs on without any actual break, the glottal closure being simply relaxed, not fully opened for breath, as in the emphatic *aha!* In some languages, such as Bohemian, this "voice-aspirate" is used everywhere, initially as well as medially.

Vowels are finished analogously, either by a gradual opening of the glottis, or by a cessation of aspiration while the glottis is still closed for voice. If stress is put on the gradual ending it becomes a distinct aspirate, as in the Sanskrit "visarga" in such a word as *manaḥ*.

Organic Basis.—Every language has certain general tendencies which control the formation of its sounds, constituting its "organic basis" or basis of articulation. The tendency of the present English is to flatten and lower the tongue and draw it back from the teeth, while the lips are kept as much as possible in a neutral position. The flattening of the tongue makes our vowels wide and favours the development of mixed vowels, and gives the dull quality which is especially noticeable in our (l); and its retraction is unfavourable to the development of teeth sounds; while the neutrality of the lips eliminates front-round vowels. In such a language as French everything is reversed. The tongue is arched, and raised, and advanced, and the lips articulate with energy. Hence French sounds tend to narrowness, dentality and distinct rounding.

National Sound-systems.—Each language uses only a part of the general phonetic material. Each one has only a limited number of sounds; and each one makes only a limited use of the synthetic distinctions of quantity, stress and intonation. As we have seen, many of these differences between individual languages are the result of, or may be referred to, differences in their organic basis.

Just as cognate languages differ from each other in phonetic structure, so also dialects of the same languages differ from each other more or less. Thus the sound-system of Lowland Scotch—which is, historically, a dialect of Northern English—differs considerably from that of standard English. Standard English itself was originally that mixture of the Midland and the Southern dialect which was spoken in London in the middle ages, just as standard French is, historically, the dialect of that district of which Paris is the centre. Standard English, like standard French, is now more a class-dialect than a local dialect: it is the language of the educated all over Great Britain. But it is not yet perfectly uniform. It is still liable to be influenced by the local dialects in grammar and vocabulary, and still more in pronunciation.

Again, English, like all other living languages, changes from generation to generation. Pronunciations which are vulgar in one century may become fashionable in the next. Sounds which are distinct in one generation may be confounded in another, and new distinctions may be made, new sounds may arise. A spoken language is, therefore, necessarily a vague and floating entity, and English is no exception to the rule. The very fixity of its written form gives all the freer play to the influences which cause change.

A standard spoken language is, strictly speaking, an abstraction. No two speakers of standard English pronounce exactly alike. And yet they all have something in common in every sound they utter. There are some divergencies, some peculiarities of pronunciation, which pass unnoticed, while others, less considerable perhaps in themselves, are at once felt as archaisms, vulgarisms or provincialisms, as the case may be, by the majority of educated speakers.

Sounds of English.—The following is a convenient classification of the vowels of standard English:—

a	ə	i	e	æ	u	o
aa	əə	ii	ei	uu	ou,	ɔ
ai, au					oi	
		iə	eə	uə		

Here the vowels are in four rows: (1) normally short, or, more correctly, monophthongic, (2) long, or half-diphthongic, (3) full diphthongs, (4) murmur-diphthongs.

Those under (1) are often lengthened in monosyllables such as *ten*, *good*, but they always remain absolutely monophthongic. The only one in the next row that is always strictly monophthongic is (əə): all the others, as we shall see, tend to become more or less diphthongic, especially in the south of England, being often exaggerated into full diphthongs of the (ai) and (au)-type in vulgar speech.

(a), as in *come up*, is the short vowel corresponding to the (aa) in *calm*. (aa) is the mid-back-wide vowel, and (a) differs from it only in being narrow. Acoustically, (a) is a muffled or obscure (aa): and the same effect may be produced by advancing the tongue from the mid-back to the corresponding out-back position, preserving the wide articulation: this pronunciation of *u* is common in the south of England. Historically, these sounds are the result of unrounding and older (u).

(ə), as in *sofa*, is a mixed vowel, tending to wideness and mid position, which occurs only unstressed. (əə) in *turn*, *earth*, is low-mixed-narrow. It is the result of absorption of an older (r), weakened into (ə).

(æ), as in *man*, is low-front-wide, from older mid-back-wide.

(i) in *it* is high-front-wide. The long (ii) in *eat* is narrow in the north of England, while in the south it is wide (i) followed by (j).

(e) in *men* is generally mid-front-wide. (ei) in *mane* is the same vowel either narrow or wide, raised in its latter half towards (*i*).

(u) in *good* is high-back-wide-round. Narrow (uu) in *too* becomes (*u*w) in southern English.

(o) in *not* is low-back-wide-round. In (ou), as in *no*, the mid-back-round vowel, either narrow or wide, is over-rounded in its latter half. (ɔ), as in *all*, is low-back-narrow-round.

The full diphthongs (ai, au, oi), as in *eye*, *now*, *oil*, all end in lowered high vowels. Their first elements are only roughly indicated by the transcription, and vary in the mouths of different speakers. That of (ai) is generally the out-mid-back-wide, that of (au) the broader low-mixed-wide, that of (oi) the mid-back-wide-round.

The murmur-diphthongs (iə) as in *here*, (eə) as in *air*, (uə) as in *poor*, all tend to broaden their first elements. That of (eə) is the low-front-narrow vowel. The other two begin with lowered forms of the wide (*i*) and (*u*) respectively. In (uə) the lowering is often carried so far as to make *poor* almost, or completely, into pore (pɔə).

The following arrangement of the English consonants will show their organic relations to one another:

j r; þ, ð s, z; ʃ, ʒ wh, w; f, v
l
k, g t, d p, b
ŋ n m

The "aspirate" (h) may be regarded either as a throat-consonant or as a breath-glide.

Characteristic features of the English consonant-system are the large number of hisses and buzzes, the sharp distinction of breath and voice, and, negatively, the absence of the open-back consonants, and of the voiceless forms of the vowel-like consonants (l, r) and the nasals, most of which still existed in Old English.

Bibliography.—The most important general works are: H. Sweet, *A Primer of Phonetics* (3rd ed., Oxford, 1906); E. Sievers, *Grundzüge der Lautphysiologie* (5th ed., Leipzig, 1901); W. Vietor, *Elemente der Phonetik des Deutschen, Englischen und Französischen* (5th ed., Leipzig, 1904); O. Jesperson, *Lehrbuch der Phonetik* (Leipzig, 1904); M. Trautmann, *Die Sprachlaute* (Leipzig, 1884–1886); *Le Maître Phonétique, organe de l'association phonétique internationale* (apply to Dr P. Passy, Bourg-la-Reine, France). For the laws of sound-change, see the above-mentioned work of Sievers; H. Sweet, *A History of English Sounds* (Oxford, 1888); P. Passy, *Les Changements phonétiques* (Paris, 1890). For phonetics in language-teaching see H. Sweet, *The Practical Study of Languages* (London, 1899); O. Jesperson, *How to Learn a Foreign Language* (London, 1904). For phonetic shorthand, H. Sweet, *A Manual of Current Shorthand* (Oxford, 1892). For the application of phonetics and phonetic notation to the practical study of special languages, H. Sweet, *A Primer of Spoken English* (2nd ed., Oxford, 1895); F. Beyer and P. Passy, *Elementarbuch des gesprochenen Französisch* (2nd ed., Cöthen, 1905); W. Vietor, *Deutsches Lesebuch in Lautschrift* (Leipzig, 1899). (H. Sw.)

PHONOGRAPH (Gr. φωνή, sound, γράφειν, to write), an instrument for imprinting the vibrations of sound on a moving surface of tinfoil or wax in such a form that the original sounds can be faithfully reproduced by suitable mechanism. Many attempts had been made by earlier experimenters to obtain tracings of the vibrations of bodies emitting sound, such as tuning-forks, membranes, and glass or metallic disks. In 1807 Thomas Young (*Lectures*, i. 191) described a method of recording the vibrations of a tuning-fork on the surface of a drum; his method was fully carried out by Wilhelm Wertheim in 1842 (*Recherches sur l'élasticité, 1er. mém.*). Recording the vibrations of a membrane was first accomplished by Leon Scott in 1857 by the invention of the "phonautograph," which may be regarded as the precursor of the phonograph (*Comptes rendus*, 53, p. 108). This instrument consisted of a thin membrane to which a delicate lever was attached. The membrane was stretched over the narrow end of an irregularly-shaped funnel or drum, while the end of the lever or marker was brought against the surface of a cylinder covered with paper on which soot had been deposited from a flame of turpentine or camphor. The cylinder was fixed on a fine screw moving horizontally when the cylinder was rotated. The marker thus described a spiral line on the blackened surface. When sounds were transmitted to the membrane and the cylinder was rotated the oscillations of the marker were recorded. Thus tracings of vibrations were obtained. This instrument was much improved by Karl Rudolph König, of Paris, who also made with it many valuable observations. (See *Nature*, Dec. 26, 1901, p. 184). The mechanism of the recording lever or marker was improved by William Henry Barlow, in 1874, in an instrument called by him the "logograph" (*Trans. Roy. Soc.*, 1874). The next step was König's invention of manometric flames by which the oscillations of a thin membrane under sound-pressures acted on a small reservoir of gas connected with a flame, and the oscillations were viewed in a rotating rectangular mirror, according to a method devised by Charles Wheatstone. Thus flame-pictures of the vibrations of sound were obtained (*Pogg. Ann.*, 1864, cxxii. 242, 660; see also *Quelques expériences d'acoustique*, Paris, 1882). Clarence Blake in 1876 employed the drum-head of the human ear as a logograph, and thus obtained tracings similar to those made by artificial membranes and disks (*Archiv. für Öphthalmol.*, 1876, v. 1.). In the same year Sigmund Theodor Stein photographed the vibrations of tuning-forks, violin strings, &c. (*Pogg. Ann.*, 1876, p. 142). Thus from Thomas Young downwards successful efforts had been made to record graphically on moving surfaces the vibrations of sounds, but the sounds so recorded could not be reproduced. This was accomplished by T. A. Edison in 1876, the first patent being dated January 1877.

In the first phonograph a spiral groove was cut on a brass drum fixed on a horizontal screw, so that when the drum was rotated it moved from right to left, as in the phonautograph. The recorder consisted of a membrane of parchment or gold-beater's skin stretched over the end of a short brass cylinder about 2 in. in diameter. In the centre of the membrane there was a stout steel needle having a chisel-shaped edge, and a stiff bit of steel spring was soldered to the needle near its point, while the other end of the spring was clamped to the edge of the brass cylinder over which the membrane was stretched. The recorder was then so placed beside the large cylinder that the sharp edge of the needle ran in the middle of the spiral groove when the cylinder was rotated. The cylinder was covered with a sheet of soft tinfoil. During rotation of the cylinder, and while the membrane was not vibrating, the sharp edge of the marker indented the tinfoil into the spiral groove; and when the membrane was caused to vibrate by sounds being thrown into the short cylinder by a funnel-shaped opening, the variations of pressure corresponding to each vibration caused the marker to make indentations on the tinfoil in the bottom of the groove. These indentations corresponded to the sound-waves. To reproduce the sounds the recorder was drawn away from the cylinder, and the cylinder was rotated backwards until the recorder was brought to the point at which it started. The cylinder was then rotated forwards so that the point of the recorder ran over the elevations and depressions in the bottom of the groove. These elevations and depressions, corresponding to the variations of pressure of each sound-wave, acted backwards on the membrane through the medium of the marker. The membrane was thus caused to move in the same way as it did when it was made to vibrate by the sound-waves falling upon it, and consequently movements of the same general character but of smaller amplitude were produced, and these reproduced sound-waves. Consequently the sound first given to the phonograph was reproduced with considerable accuracy. In 1878 Fleeming Jenkin and J. A. Ewing amplified the tracings made on this instrument by the sounds of vowels, and submitted the curves so obtained to harmonic analysis. (*Trans. Roy. Soc. Edin.* xxviii. 745). The marks on the tinfoil were also examined by P. F. F. Grützner, Mayer, Graham Bell, A. M. Preece, and Lahr (see *The Telephone, the Microphone, and the Phonograph*, by count du Moncel, London, 1884; also *The Speaking Telephone and Talking Phonograph*, by G. B. Prescott, New York, 1878).

The tinfoil phonograph, however, was an imperfect instrument, both as regards the medium on which the imprints were taken (tinfoil) and the general mechanism of the instrument. Many improvements were attempted. From 1877 to 1888 Edison was engaged in working out the details of the wax-cylinder phonograph. In 1885 A. G. Bell and S. Tainter patented the "graphophone," and in 1887, Emile Berliner, a German domiciled in America, patented the "gramophone," wherein the cylinder was coated with lampblack, and the friction between it and the stylus was made uniform for all vibrations. Incidentally it may be mentioned that Charles Cross deposited in 1877 a sealed packet with the Académie des Sciences, Paris, containing a suggestion for reproducing sound from a Scott phonautograph record. The improvements made by Edison consisted chiefly (1) in substituting for tinfoil cylinders or disks made of a waxy substance on which permanent records are taken; (2) in substituting a thin glass plate for the parchment membrane; (3) in improving the mechanical action of the marker; and (4) in driving the drum carrying the wax cylinder at a uniform and rapid speed by an electric motor placed below the instrument.

In the first place, permanent records can be taken on the wax, which is composed of stearin and paraffin. This material is brittle, but it readily takes the imprints made by the marker, which is now a tiny bit of sapphire. The marker, when used for recording, is shod with a chisel-shaped edge of sapphire; but the sapphire is rounded when the marker is used for reproducing the sound. The marker also, instead of being a stiff needle coming from the centre of the membrane or glass plate, is now a lever, weighted so as to keep it in contact with the surface of the wax. A single vibration of a pure tone consists of an increase of pressure followed by a diminution of pressure. When the disk of glass is submitted to an increase of pressure the action of the lever is such that, while the wax cylinder is rotating, the point of the marker is angled downwards, and this cuts deeply into the wax; and when there is diminution of pressure the point is angled upwards, so as to act less deeply. In reproducing the sound, the blunt end of the marker runs over all the elevations and depressions in the bottom of the groove cut on the wax cylinder. There is thus increased pressure transmitted upwards to the glass disk when the point runs over an elevation, and less pressure when the point runs over a depression on the wax cylinder. The glass disk is thus, as it were, pulled inwards and thrust outwards with each vibration, but these pulls and thrusts follow each other so rapidly that the ear takes no cognizance of the difference of phase of the vibrations of the glass plate in imprinting and in reproducing. The variations of pressure are communicated to the glass plate, and these, by the medium of the air, are transmitted to the drum-head of the ear, and the sound is reproduced with remarkable fidelity. It is necessary for accurate reproduction that the point of the marker be in the centre of the groove. In the older phonographs this required accurate adjustment by a fine screw, but in newer forms a certain amount of lateral oscillation is allowed to the marker, by which it slips automatically into the groove. Two other improvements have been effected in the construction of the instrument. A powerful triple-spring motor has been substituted for the electric motor, and the circumference of the wax cylinder has been increased from $6\frac{7}{8}$ in. to 15 in., whilst the disk is 12 in. in diameter. The cylinders make about two revolutions per second, so that with the smaller cylinder the point of the marker runs over nearly 14 in. in one second, while with the larger it runs over about 30 in. The marks corresponding to the individual vibrations of tones of high pitch are therefore less likely to be crowded together with the larger cylinder, and these higher tones in particular are more accurately reproduced. In a form of instrument called the 200-thread machine motion of the drum bearing the cylinder was taken off a screw the thread of which was 50 to the inch, and by a system of gearing the grooves on the cylinder were 200 to the inch, or $\frac{1}{200}$ of an inch apart. It was somewhat difficult to keep the marker in the grooves when they were so close together; and the movement is now taken directly off a screw the thread of which is 100 to the inch, so that the grooves on the cylinder are $\frac{1}{100}$ of an inch apart. Thus with the large cylinder a spiral groove of over 300 yds. may be described by the recorder, and with a speed of about two revolutions per second this distance is covered by the marker in about six minutes. By diminishing the speed of revolution, which can be easily done, the time may be considerably lengthened.

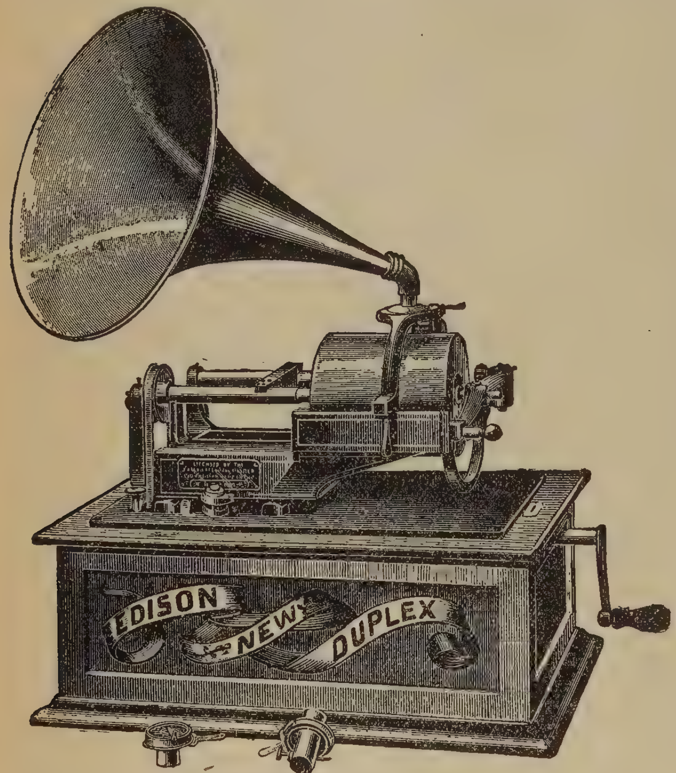


FIG. 1*a*.—Exterior of Edison Phonograph.

In the plate machine the disk is fixed to a table which is rotated at a fixed speed of about 76 revolutions a minute. The speed of the lateral movement of the table is also uniform, and by a regular progression brings the wax blank under the sound-box to the sapphire cutting point, which detaches a fine unbroken thread of wax as it cuts into the surface of the blank to a depth of $3\frac{1}{2}$- to 4-thousandths of an inch, beginning at about half an inch from the circumference and continuing the spiral groove to within a couple of inches of the centre, according to the length of the music to be recorded. The essential difference between the disk and cylinder machine is that in the former the waves are recorded by horizontal motion over the disk, while in the latter the waves are recorded as indentations.

The following is the *modus operandi* of making a record. The person making the record sings or plays in front of a horn or funnel used for the purpose of focusing the sound-waves upon the diaphragm. The artist and the funnel are on one side of a screen and the recording apparatus in charge of an operator on the other. The arrangement of the various instruments in the recording room at proper relative distances from the horn is of the utmost importance in order to preserve the balance of tone. At about 4 ft. from the horn are grouped the violins and the wood wind (flutes, oboes and clarinets); behind the brass wind (horns, trumpets, trombones and tubers), and right at the back the violoncellos and double basses and the kettle-drums and other instruments of percussion which may be required. On the other side of the screen is the sound-box and the recording cylinder or disk.

Cylinder records are duplicated by taking a plaster cast, electroplating, and then using it as a matrix. The disk record admits of similar treatment. After dusting with graphite it is electroplated to about ·9 mm. thick. This forms the permanent or master record, from which the working negatives are made by taking wax impresses of it and obtaining copper electros in turn from them. The matrix is then nickel-plated and polished and is ready for use in pressing out the commercial records by means of an hydraulic press, the material used being a tough and elastic substance containing shellac and other compounds such as wood charcoal, barium sulphate, earthy colouring matters and cotton flock.

There is still a defect to be overcome in the gramophone, and that is the hissing of the needle produced by friction both during recording and intensified in reproduction. In one device for remedying this the stylus acts like a stylographic pen, depositing on a polished surface a fine stream of some liquid which solidifies and hardens very rapidly, forming a sinuous ridge instead of a groove in a wax blank. A negative is taken of the record and the matrix is made from it in the usual way.

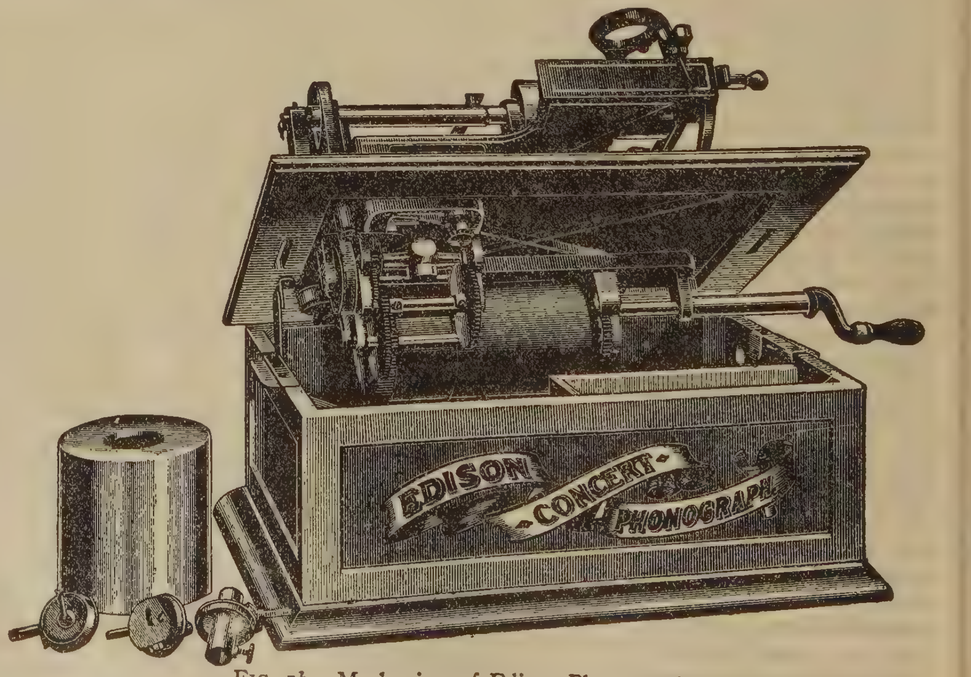


FIG. 1*b*.—Mechanism of Edison Phonograph.

The auxeto-gramophone or auxetophone, patented by Short in 1898 and improved by the Hon. C. A. Parsons, is similar in scope to the gramophone but attains its results in a different manner. In the Parsons-Short sound-box there is no diaphragm, but a column of compressed air is controlled by a delicately adjusted grid-valve consisting of a metal comb rigidly connected to the stylus bar, so that as the needle moves the metal comb moves with it, following the lines of vibration fixed on the record and opening or closing the slots in the valve seat. The column of compressed air to which the valve gives access thus receives series of minute pulsations identical with those which originally produced the sounds recorded. In connexion with the sound-box is the apparatus for supplying compressed air, consisting of a sixth-horse power electric motor driving the compressor, an oil filter, a reservoir and a dust collector to keep the air absolutely free from foreign substances likely to interfere with the action of the valve.

The practical possibilities of the gramophone are being realized in many countries. Matrices of the records of well-known artists have been deposited at the British Museum and at the Grand Opéra in Paris. Austria established a public phonogram record office in 1903, in which are collected folk-songs and records of all kinds for enriching the department of ethnography. The same idea is being carried out in Germany by private societies and by royal museums. In Hungary records of the various dialects have been secured. The possibilities of the gramophone as a teacher are far-reaching, not only in the domain of music but in learning languages, &c.

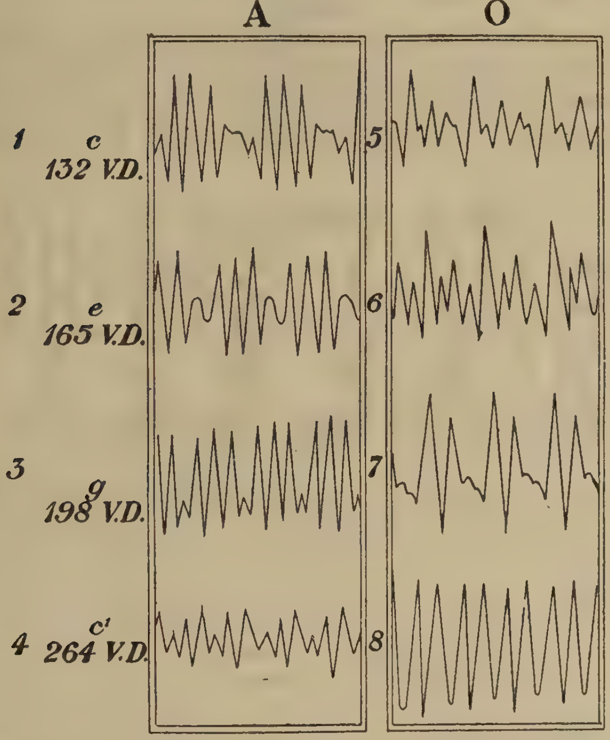


FIG. 2.

To understand how the phonograph records and reproduces musical tones, it is necessary to remember (1) that *pitch* or *frequency* depends on the number of vibrations executed by the vibrating body in a given period of time, or on the duration of each vibration; (2) that *intensity* or *loudness* depends on the amplitude of the movement of the vibrating body; and (3) that *quality, timbre* or *clang*, first, depends on the form of the individual vibrations, or rather on the power the ear possesses of appreciating a simple pendular vibration producing a pure tone, or of decomposing more or less completely a compound vibration into the simple pendular vibrations of which it is composed. If we apply this to the record of the phonograph, we find that, given a constant and sufficiently rapid velocity of the record, a note or tone of a certain pitch will be heard when the marker runs over a number of elevations and depressions corresponding to the frequency of that note. Thus if the note was produced by 200 vibrations per second, and suppose that it lasted in the music for $\frac{1}{10}$ of a second, 20 marks, each made in $\frac{1}{200}$ of a second, would be imprinted on the wax. Consequently, in reproduction, the marker would run over the 20 marks in $\frac{1}{10}$ of a second, and a tone of that frequency would be reproduced. The loudness would correspond to the depth of each individual mark on the cylinder or the width on the disk. The greater the depth of a series of successive marks produced by a loud tone, the greater, in reproduction, would be the amplitude of the excursions of the glass disk and the louder would be the tone reproduced. Lastly, the form of the marks corresponding to individual vibrations would determine the quality of the tone or note reproduced, by which we can distinguish the tone of one instrument from another, or the sensation produced by a tone of pure and simple quality, like that from a well-bowed tuning-fork or an open organ pipe, and that given by a trumpet or an orchestra, in which the sounds of many instruments are blended together. When the phonograph records the sound of an orchestra it does not record the tones of each instrument, but it imprints the form of impression corresponding to the very complex sound-wave formed by all the instruments combined. This particular form, infinitely varied, will reproduce backwards, as has been explained, by acting on the glass plate, the particular form of sound-wave corresponding to the sound of the orchestra. Numerous instruments blend their tones to make one wave-form, and when one instrument predominates, or if a human voice is singing to the accompaniment of the orchestra, another form of sound-wave, or rather a complex series of sound waves, is imprinted. When reproduced, the wave-forms again exist in the air as very complex variations of pressure; these act on the drum-head of the human ear, there is transmission to the brain, and there an analysis of the complex sensation takes place, and we distinguish the trombone from the oboe, or the human voice from the violin obbligato.

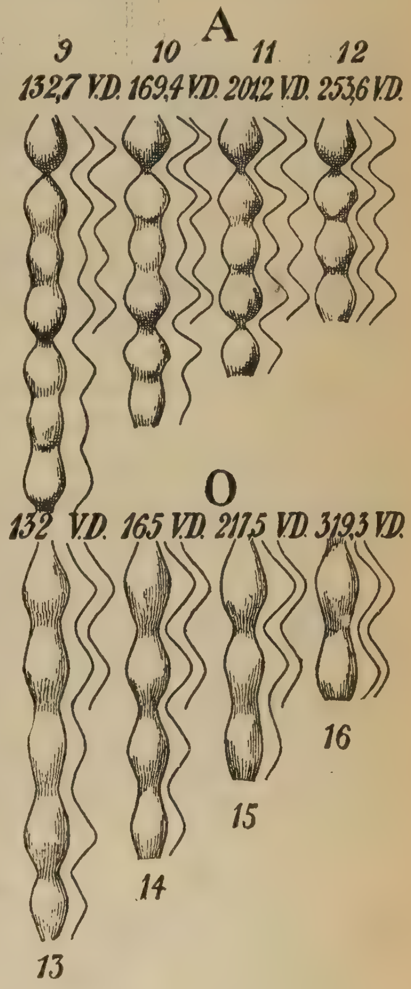


FIG. 3.

Many efforts have been made to obtain graphic tracings of wave-forms imprinted on the wax phonograph records. Thus J. G. M'Kendrick took (1) celloidin casts of the surface, and (2) microphotographs of a small portion of the cylinder (*Journ. of Anat. and Phys.*, July 1895). He also devised a phonograph recorder by which the curves were much amplified (*Trans. Roy. Soc. Edin.*, vol. xxxviii.; *Proc. Roy. Soc. Edin.*, 1896–1897, Opening Address; *Sound and Speech Waves as revealed by the Phonograph*, London, 1897; and *Schäfer's Physiol.*, vol. ii., "Vocal Sounds," p. 1229). As already mentioned, so long ago as 1878 Fleeming Jenkin and Ewing had examined the marks on the tinfoil phonograph. Professor Ludimar Hermann, of Königsberg, took up the subject about 1890, using the wax-cylinder phonograph. He obtained photographs of the curves on the wax cylinder, a beam of light reflected from a small mirror attached to the vibrating disk of the phonograph being allowed to fall on a sensitive plate while the phonograph was slowly travelling. (For references to Hermann's important papers, see *Schäfer's Physiology*, ii. 1222.) Boeke, of Alkmaar, has devised an ingenious and accurate method of obtaining curves from the wax cylinder. He measured by means of a microscope the transverse diameter of the impressions on the surface of the cylinder, on different (generally equidistant) parts of the period, and he infers from these measurements the depth of the impressions on the same spot, or, in other words, he derives from these measurements the curve of the vibrations of the tone which produced the impression (*Archiv. f. d. ges. Physiol.* Bonn, Bd. 1, S. 297; also *Proc. Roy. Soc. Edin.*, 1898).

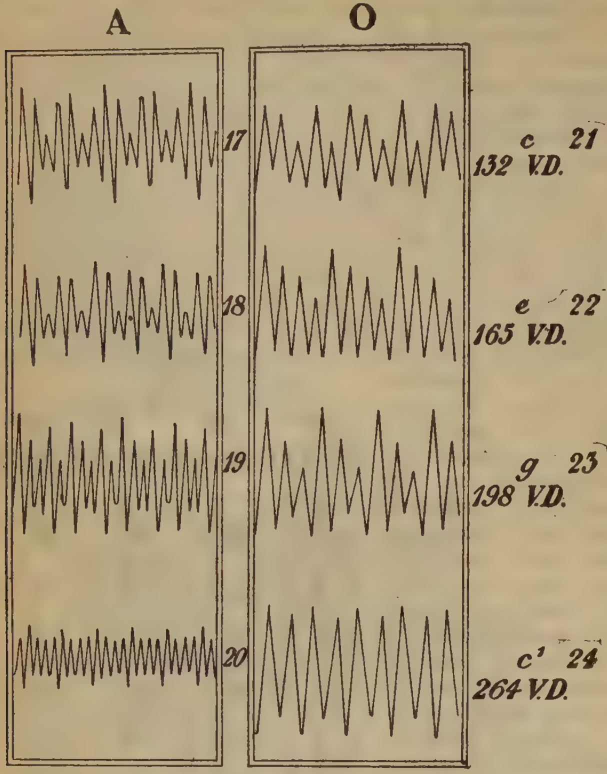


FIG. 4.

From a communication to the Dutch Otorhinolaryngological Society Dr Boeke has permitted the author to select the accompanying illustrations, which will give the reader a fair conception of the nature of the marks on the wax cylinder produced by various tones. Fig. 2 shows portions of the curves obtained by Hermann, and enlarged by Boeke one and a half times. The numbers 1 to 4 refer to periods of the vowel A (as in "hard"), sung by Hermann on the notes *c e g c′*. Numbers 5 to 8 show the curves of the vowel *o* (as in "go") sung to the same notes. The number of vibrations is also noted. Boeke measured the marks for the same vowels by his method, from the same cylinder, and constructing the curves, found the relative lengths to be the same. In fig. 3 we see the indentations produced by the same vowels, sung by Hermann on the notes *c e g c′*, on the same phonograph cylinder, but delineated by Boeke after his method. The curves are also shown in linear fashion beside each group of indentations. From these measurements the curves were calculated and reproduced, as in fig. 4. Thus the curves of the same vowel sounds on the same cylinder are shown by two methods, that of Hermann and that of Boeke.

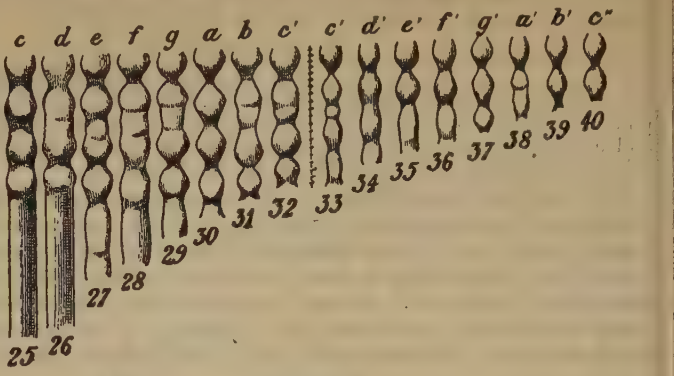


FIG. 5.

In fig. 5 we see the indentations on the vowel *a*, sung by Dr Boeke, aged 55, on the notes *c d e f g a b c′*, and near the frequencies of 128, 144, 160, 170·6, 192, 213·3, 240 and 256. The numbers 33 to 40 show the marks produced by the same vowel, sung by his son, aged 13. It will be seen that the boy sang the notes exactly an octave higher. Fig. 6 shows the marks produced by some musical sounds. Each shows on the right-hand side the curve deduced from the marks, and under it a graphical representation of the results of its harmonic analysis after the theorem of Fourier, in which the ordinates represent the amplitude of the subsequent harmonic constituents. No. 41 is the period of the sound of a pitch-pipe giving *a′* (425 double vibrations per second), No. 42 the period of a Dutch pitch-pipe, also sounding *a′* (424·64 double vibrations per second). No. 43 is a record of the period of a sound produced by blowing between two strips of indiarubber to imitate the vocal cords, with a frequency of 453 double vibrations per second. No. 44 is that of a telephone pipe used by Hermann (503 double vibrations per second). Nos. 45 and 46 show the marks of a cornet sounding the notes *a* of ± 400 double vibrations per second, and *e* of 300 double vibrations per second. In fig. 7 are shown a number of vowel curves for the vowels O, OE, A, E and I. Each curve has on the right-hand side a graphical representation of its harmonic analysis. The curves are in five vertical columns, having on the

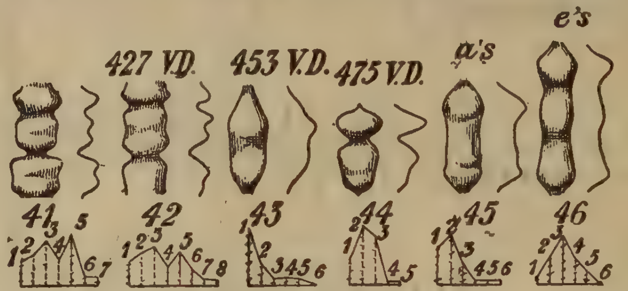


FIG. 6.

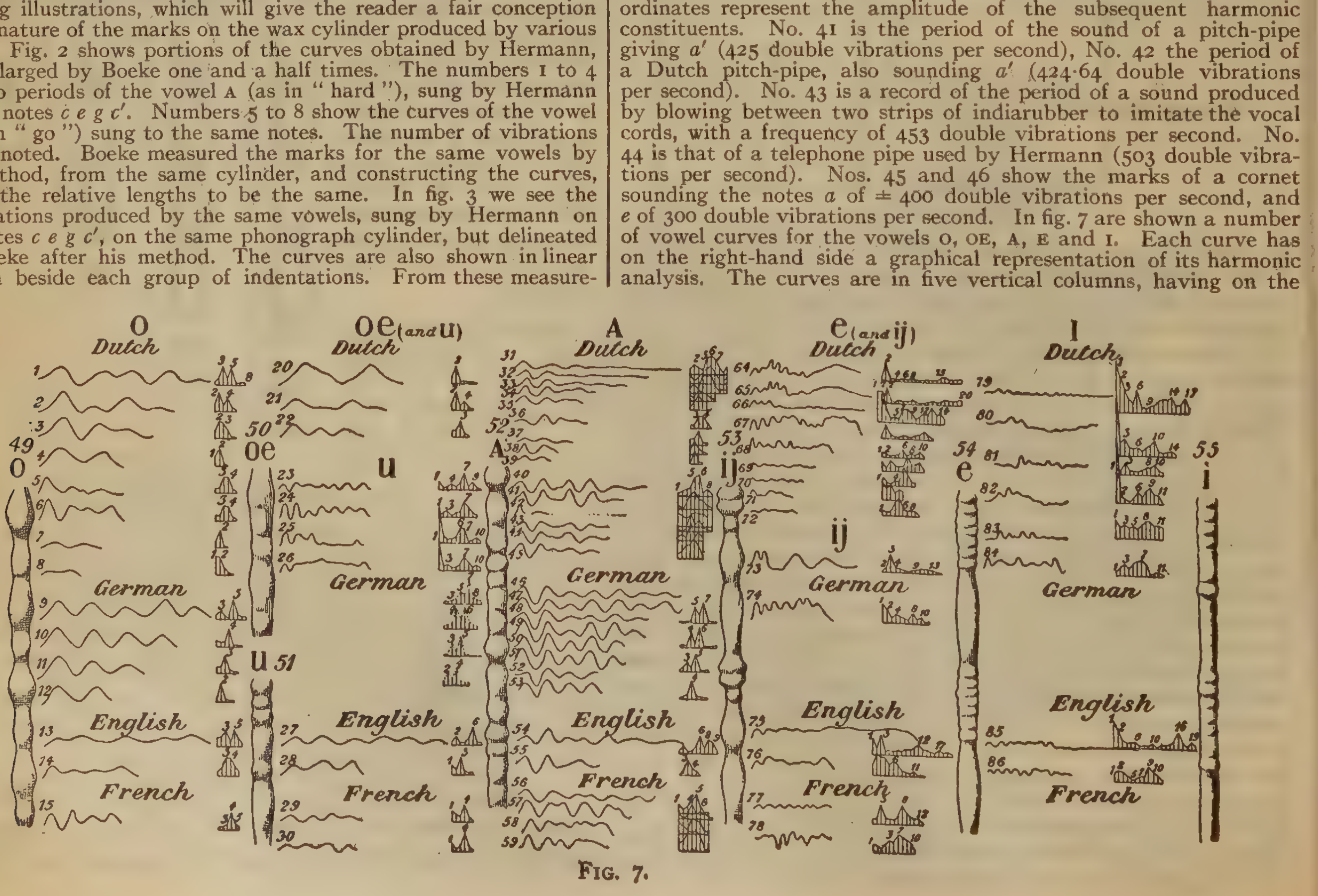


FIG. 7.

left-hand side of each drawings, by Boeke's method, of two periods of the marks of the vowel. The marks are shown for the Dutch, German, English and French languages. The sounds of the vowels are *o*, like *o* in "go"; *oe*, like *oo* in "too"; *u*, like the German *ü* in "Führer"; *a*, like *a* in "hard"; *e*, like *a* in "take"; *ij*, not in English words, but somewhat like *ē* in "bell"; and *i*, like *ee* in "beer." The first section contains only Dutch vowel sounds, either sung or spoken by Boeke or members of his family. The second section contains curves from the voice of Professor Hermann, the third from the voice of the author from a cylinder sent by him to Dr Boeke, and the fourth from the voice of Mons. H. Marichelle, professeur de l'Institut des Sourds-Muets, also forwarded by him to Dr Boeke. Thus curves and marks of the same vowel are shown from the voices of men of four nationalities.

On the construction of the gramophone, see L. N. Reddie, *Journ. Soc. Arts* (1908).

PHONOLITE (Gr. *φωνή*, sound, and *λίθος*, stone), in petrology, a group of volcanic lavas containing much nepheline and sanidine felspar. The term "clinkstone" was formerly given by geologists to many fine grained compact lavas, which split into thin tough plates, and gave out a ringing sound when struck with the hammer. Some of these clinkstones were phonolites in the modern sense, but as the name clinkstone was used for a large variety of rocks, many of which have no close affinities with one another, it has been discarded and "phonolite" is substituted for it. The group includes rocks which are rich in alkalis with only a moderate percentage of silica; hence they contain no free quartz but much alkali felspar (sanidine and anorthoclase) and nepheline. Large plates of sanidine are often visible in the rocks; the nepheline is usually not obvious to the unaided eye. Most phonolites show fluxion structure, both in the orientation of their phenocrysts and in the smaller crystals which make up the ground-mass; and this determines to a large extent the platy jointing. Although vitreous and pumiceous forms are known they are rare, and in the great majority of cases these rocks are finely crystalline with a dull or shimmering lustre in the ground-mass. Marked characteristics are the readiness with which they decompose, and the frequency of veins and cavities occupied by natrolite, analcite, scolecite and other zeolites. Small black grains of augite or hornblende and sometimes blue specks of haüyne may be seen in the rocks when they are fresh.

The dominant minerals are sanidine, nepheline, pyroxene, amphibole, various felspathoids and iron oxides. The sanidine is usually in two generations, the first consisting of large crystals of flattened and tabular shape, while the second generation is represented by small rectangular prisms arranged in parallel streams in the ground-mass; these felspars are nearly always simply twinned on the Carlsbad plan. They contain often as much soda as potash. The nepheline takes the form of hexagonal prisms with flat ends, and may be completely replaced by fibrous zeolites, so that it can only be recognized by the outlines of its pseudomorphs. In some phonolites it is exceedingly abundant in the ground-mass, and these rocks form transitions to the nephelinites (nephelinitoid phonolites) (see PETROLOGY, Plate III. fig. 1); in others it is scarce and the rocks resemble trachytes containing a little nepheline (trachytoid phonolites). The felspathoid minerals, sodalite, haüyne and nosean, which crystallize in isometric dodecahedra, are very frequent components of the phonolites; their crystals are often corroded or partly dissolved and their outlines may then be very irregular. Small rounded enclosures of glass are often numerous in them. The pyroxenes may be pale green diopside, dark green aegirine-augite, or blackish green aegirine (soda iron pyroxene), and in many cases are complex, the outer portions being aegirine while the centre is diopside. Fine needles of aegirine are often found in the ground-mass. The commonest hornblende is dark brown barkevicite. Biotite and olivine are not really frequent in these rocks, and usually have been affected by resorption. The ordinary accessory minerals of igneous rocks, apatite, magnetite and zircon occur in the phonolites, and sphene is often rather common. Another mineral which is more frequent in phonolites than in many other rocks is brown melanite garnet.

The majority of the rocks of this group are of Tertiary or Recent age, but in Scotland Carboniferous phonolites occur in several localities, *e.g.* Traprain in Haddingtonshire, also in the Eildon Hills and in Renfrewshire. In Brazil phonolites belonging to the same epoch are also known. There are several districts in Europe where Tertiary or Recent phonolites occur in considerable numbers, as in Auvergne (Mont Dore), the Eifel, and Bohemia. The Wolf Rock which lies off the south coast of Cornwall, and is the site of a well-known lighthouse, is the only mass of phonolite in England; it is supposed to be the remains of a Tertiary lava or intrusion. The Canary Islands, Cape Verde Islands, Sardinia, Aden, British East Africa and New Zealand contain many types of phonolites; they are known also in New South Wales, while in the United States phonolites occur in Colorado (at Cripple Creek) and in the Black Hills of South Dakota.

Leucite occurs in place of nepheline in a small group of phonolites (the leucite-phonolites), known principally from Rocca Monfina and other places near Naples. Blue haüyne is rather a conspicuous mineral in some of these rocks, and they also contain a good deal of sphene. When sanidine, nepheline and leucite all occur together in a volcanic rock it is classed among the leucitophyres (see PETROLOGY, Plate III. fig. 2).

The chemical analyses of phonolites given below show that these rocks are very rich in alkalis and alumina with only a moderate amount of silica, while lime, magnesia and iron oxides are present only in small quantity. They have a close resemblance in these respects to the nepheline-syenites of which they provide the effusive types. (J. S. F.)

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O
I. Phonolite, Wolf Rock, Cornwall	56·46	22·29	2·70	0·97	tr	1·47	11·13	2·81	2·05
II. Phonolite, Teplitzer Schlossberg, Bohemia	58·16	21·57	2·77	—	1·26	2·01	5·97	6·57	2·03
III. Leucite-phonolite, Rocca Monfina, Italy	58·48	19·56	—	4·99	0·53	2·60	3·14	10·47	0·24

PHORCYS (PHORCUS, PHORCYN), in Greek mythology, son of Pontus (Sea) and Gaea (Earth), father of the Graeae, the Gorgons, Scylla, and Ladon (the dragon that guarded the golden apples of the Hesperides). In Homer (*Odyssey*, xiii. 96) he is an aged sea-deity, after whom a harbour in Ithaca was named. According to Varro (quoted by Servius in *Aeneid*, v. 824) Phorcys was a king of Corsica and Sardinia, who, having been defeated by King Atlas in a naval engagement in the course of which he was drowned, was subsequently worshipped as a marine divinity.

PHORMIUM, or NEW ZEALAND FLAX (also called "New Zealand hemp"), a fibre obtained from the leaves of *Phormium tenax* (nat. ord. Liliaceae), a native of New Zealand, the Chatham Islands and Norfolk Island. This useful plant is one of the many which were discovered by Sir Joseph Banks and Dr Solander who accompanied Captain Cook on his first voyage of discovery. The seeds brought home by Banks in 1771 did not succeed, but the plant was introduced by him to the Royal Gardens at Kew in 1789, and was thence liberally distributed in Great Britain and the continent of Europe. It grows luxuriantly in the south of Ireland, where it was introduced in 1798, and also flourishes on the west coast of Scotland, and is generally cultivated as an ornamental garden plant in Europe. It has been introduced for economic purposes into the Azores and California. The name Phormium is from Gr. *φορμός*, a basket, in allusion to one of the uses made of its leaves by the New Zealanders.

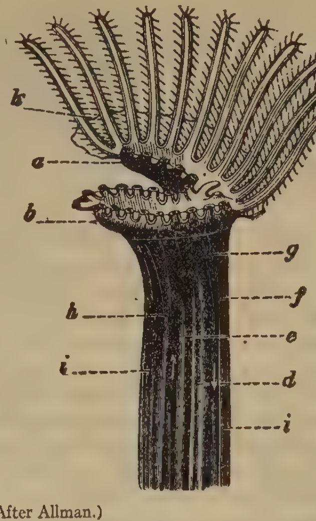
In its native country the plant is generally found near the coast. It has a fleshy rootstock, creeping beneath the surface of the soil and sending up luxuriant tufts of narrow, sword-shaped leaves, from 4 to 8 ft. long and from 2 to 4 in. in diameter. The leaves are vertical, and arranged in two rows as in the garden flag; they are very thick, stiff and leathery, dark green above, paler below, with the margin and nerve reddish-orange. From the centre of the tuft ultimately arises a tall flower-bearing stem, 5 to 15 ft. high, bearing on its numerous branches a very large number of lurid red or yellow, somewhat tubular flowers, recalling those of an aloe, and from 1 to 2 in. long. After flowering the plant dies down, but increases by new lateral growths from the rootstock. The plant will grow in almost any soil, but best on light rich soil, by the side of rivers and brooks, where sheltered from the wind.

Phormium has been treated as a cultivated plant in New Zealand, though only to a limited extent; for the supplies of the raw material dependence has been principally placed on the abundance of the wild stocks and on sets planted as hedges and boundaries by the Maoris. Among these people the fibre has always been an article of considerable importance, yielding cloaks, mats, cordage, fishing-lines, &c., its valuable properties having attracted the attention of traders even before colonists settled in the islands. The leaves, for fibre-yielding purposes, come to maturity in about six months, and the habit of the Maoris is to cut them down twice a year, rejecting the outer and leaving the central immature leaves. Phormium is prepared with great care by native methods, only the mature fibres from the under-side of the leaves being taken. These are collected in water, scraped over the edge of a shell to free them from adhering cellular tissue and epidermis, and more than once washed in a running stream, followed by renewed scraping till the desired purity of fibre is attained. This native process is exceedingly wasteful, not more than one-fourth of the leaf-fibre being thereby utilized. But up till 1860 it was only native-prepared phormium that was known in the market, and it was on the material so carefully, but wastefully, selected that the reputation of the fibre was built up. The troubles with the Maoris at that period led the colonists to engage in the industry, and the sudden demand for all available fibres caused soon afterwards by the Civil War in America greatly stimulated their endeavours. Machinery was invented for disintegrating the leaves and freeing the fibre, and at the same time experiments were made with the view of obtaining it by water-retting, and by means of alkaline solutions and other chemical agencies. But the fibre produced by these rapid and economical means was very inferior in quality to the product of Maori handiwork, mainly because weak and undeveloped strands are, by machine preparation, unavoidably intermixed with the perfect fibres, which alone the Maoris select, and so the uniform quality and strength of the material are destroyed. The New Zealand government in 1893 offered a premium of £1750 for a machine which would treat the fibre satisfactorily, and a further £250 for a process of treating the tow; and with a view to creating further interest in the matter a member of a commission of inquiry visited England during 1897. The premium was again issued in 1899. In 1903 it was stated that a German chemist had discovered a method of working and spinning the New Zealand fibre. An idea of the extent of the growth of the fibre may be gathered from the fact that the exports for 1905 amounted to 28,877 bales at a value of nearly £700,000.

Phormium is a cream-coloured fibre with a fine silky gloss, capable of being spun and woven into many of the heavier textures for which flax is used, either alone or in combination with flax. It is, however, principally a cordage fibre, and in tensile strength it is second only to manila hemp; but it does not bear well the alternations of wet and dry to which ship-ropes are subject. The fibre has come into use as a suitable material for binder-twine as used in self-binding reaping machines.

PHORONIDEA, a zoological order, containing a single genus *Phoronis*, which is known to be of practically world-wide distribution, while there are many records of its larva, *Actinotrocha*, from localities where the adult has not been found. *Phoronis* is often gregarious, the tubes which it secretes being sometimes intertwined in an inextricable mass. These associations of individuals can hardly be the result of the metamorphosis of a corresponding number of larvae, but are probably due to a spontaneous fragmentation of the adult animals, each such fragment developing into a complete *Phoronis* (De Selys-Longchamps). The animal is from a quarter of an inch to six inches (*P. australis*) in length. The free end of the long vermiform body ends in a horseshoe-shaped "lophophore," or tentacle-bearing region (fig. 1, *a*), which strikingly resembles that of the Phylactolaematous Polyzoa (see POLYZOA).

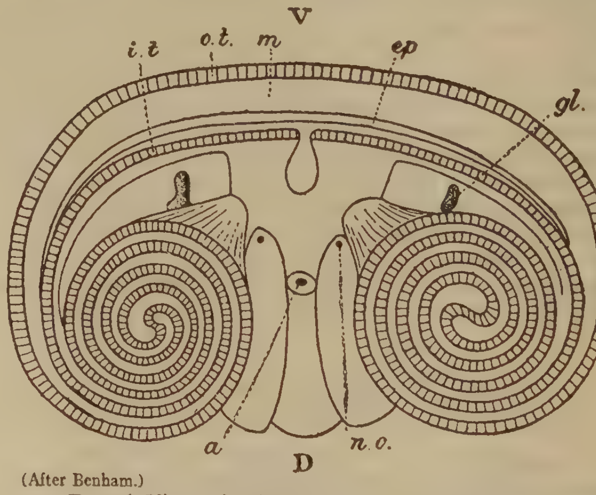
In some species (figs. 2, 3) the two ends of the lophophore are rolled into spirals. An oral view of this region (fig. 2) shows: the mouth (*m*), continuous on either side with the groove between the two series of tentacles; the anus (*a*), in the middle line, at no great distance from the mouth; a transversely elongated epistome (*ep*), between the mouth and the anus; and, in the concavity of the lophophore, the apertures of the nephridia (*n.o.*) which, according to De Selys-Longchamps, open into the two large sensory or glandular "lophophoral organs" the orifices of which are seen at *gl*. The mouth leads into the oesophagus, which extends straight down the body nearly to the aboral end or "ampulla," where it dilates into a stomach, from which the ascending limb of the U-shaped alimentary canal passes directly to the anus. The coelomic body-cavity is divided by a transverse septum (fig. 3, *s*) which lies near the bases of the tentacles. The praeseptal or lophophoral coelom is continued into each of the tentacles and into the epistome. The postseptal coelom is partially divided by a ventral mesentery which is attached along the entire length of the convex side of the loop of the alimentary canal (*a*, *a″*) and by two lateral mesenteries (*a′*) which further connect the oesophagus with the body-wall. Each nephridium is provided with either one or two funnels which open into the postseptal division of the coelom (*ne.f*). The nervous system lies in the epidermis, externally to the basement-membrane. A general nerve-plexus probably exists over considerable parts of the skin, and there are special nervous concentrations in the region of the epistome and along a double crescent (*N*) which follows the parietal attachment of the coelomic septum. The part which lies at the base of the epistome is morphologically dorsal in position. It is said by Schultz (11) to develop, in specimens which are regenerating the lophophoral end, from an invagination of the ectoderm; and in this condition is compared by him with



(After Allman.)

FIG. 1.—The Tentacular End of *Phoronis*, with most of the tentacles removed.

a, The horseshoe-shaped lophophore.
b, Mouth.
c, Optical section of the epistome (seen immediately below the end of the reference-line).
d, Oesophagus.
e, Intestine.
f, Efferent vessel.
g, One of the two efferent lophophoral vessels, uniting to form *f*.
h, Dorsal or afferent vessel.
i, Body-wall.
k, Fused bases of the tentacles.

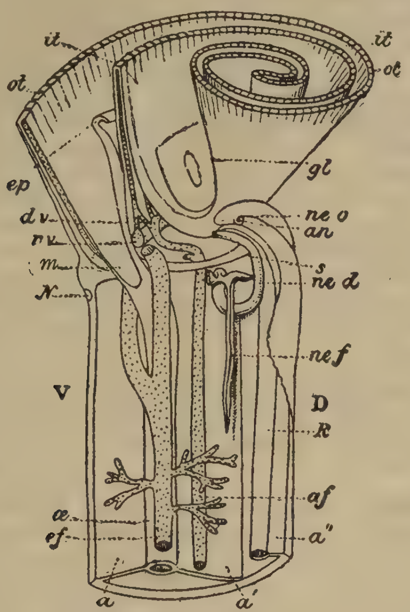


(After Benham.)

FIG. 2.—Dorsal View of *Phoronis australis*, showing the spirally coiled ends of the lophophore.

a, Anus.
D, Posterior surface.
ep, Epistome.
gl, Lophophoral organ.
i.t., Bases of inner tentacles.
m, Position of the mouth.
n.o., Nephridial surface.
n.o., Nephridial opening.
o.t., Bases of outer tentacles.
V, Anterior surface.

the hollow central nervous system of some Enteropneusta and of Vertebrates. This comparison is not admitted by De Selys-Longchamps. The vascular system contains numerous red blood-corpuscles. The principal blood-channels are two longitudinal vessels which run down the entire length of the body, and are known as the "afferent" vessel (*af*) and the "efferent" vessel (*ef*) respectively, from their relation to the tentacles. According to researches in 1907 by De Selys-Longchamps, the blood is driven by the afferent vessel (*af*) to a crescentic lophophoral vessel (*d.v.*) which supplies the tentacles. Each of these contains a single blindly ending vessel which bifurcates at its base (see fig. 3). One of these branches communicates with the afferent lophophoral vessel, while the other one opens into the crescentic efferent lophophoral vessel (*r.v.*). From this the blood passes into two lateral vessels which pierce the coelomic septum (*s.*), the right vessel proceeding on the anterior side of the oesophagus, as shown in fig. 3, to effect a union with the left one, and thus to constitute the main efferent vessel, which gives off numerous caecal branches as it passes down the body. Hence the blood returns once more to the afferent vessel through a splanchnic sinus which surrounds the stomach. The circulation is maintained by the rhythmical contraction of the afferent vessel and by less regular contractions of some of the other vessels. The reproductive organs lie on the left side, near the aboral end, both ovary and testis being present in the same individual in some of the species. They are said to be developed from the coelomic epithelium which covers the efferent vessel or its caeca. The reproductive cells pass to the exterior by means of the nephridia. Reproduction by budding does not occur, although spontaneous fragmentation of the body, followed by complete regeneration of each of the pieces, is known to take place. Regeneration of the tentacular end of the animal is of frequent occurrence.



(From Fowler, after Benham.)

FIG. 3.—Diagram of oral end of *Phoronis australis*, seen from the left side.

a,	Oesophageal (ventral) mesentery.	*N*,	Post-oral nerve-tract at base of lophophore.
a′,	Right lateral mesentery.	*ne.d.*,	Duct of nephridium.
a″,	Intestinal mesentery.	*ne.f.*,	Larger nephridial funnel.
af,	Afferent vessel.	*ne.o.*,	External opening of nephridium.
an,	Anus.		
D,	Posterior surface.	*œ*,	Oesophagus.
d.v.,	Afferent lophophoral vessel.	*ot.*,	Bases of outer tentacles.
ef,	Efferent vessel.	*R*,	Intestine.
ep,	Epistome.	*r.v.*,	Right efferent lophophoral vessel.
gl,	Lophophoral organ.		
it,	Bases of inner tentacles.	*s*,	Coelomic septum.
m,	Mouth.	V,	Anterior side.

Development and Affinities.—The eggs of *Phoronis* are small and usually undergo their early development attached to the tentacles of the adult. The attachment is probably effected (Masterman) by the secretion of the lophophoral organs (fig. 2, *gl.*). After the formation of an invaginate gastrula the larval form is rapidly acquired. On quitting the shelter of the parent tentacles the embryo becomes a pelagic larva, known as *Actinotrocha* (fig. 4) characterized by the possession of a line of tentacles running obliquely round the body. Locomotion is effected principally by means of a posterior ring of cilia surrounding the anus. The mouth (*o*) is in front of the tentacles, on the ventral side, and is overhung by a mobile praeoral hood, in which is the principal part of the nervous system. An oblique septum which follows the bases of the tentacles and corresponds with that of the adult animal divides the body-cavity into two portions. The postseptal division is a coelomic space, partially subdivided by a ventral mesentery. The praeseptal cavity is a vascular space, since it is in free communication with the dorsal vessel of the larva, and it persists in part as the two lophophoral vascular crescents of the adult. It contains two tufts of peculiar excretory cells, described by Goodrich (5) as "solenocytes," which surround the blind ends of a pair of nephridia. These pass backwards through the septum and open to the exterior ventrally. After the *Actinotrocha* has led a pelagic life for some time it develops a large ventral invagination of its body-wall (fig. 4, 2, iv.). At the metamorphosis, this sac is everted and the alimentary canal is drawn into it in the form of a loop (fig. 4, 3, 4). Most of the praetentacular region and the larval tentacles separate off, being then taken into the alimentary canal, where they are digested. The relations of the surfaces after the metamorphosis are clearly very different from those which obtained in the larva. The dorsal surface of the adult is the one between the mouth and the anus, while the median ventral line is the one which corresponds with the convexity of the alimentary canal. This view of the surfaces is, however, disputed by De Selys-Longchamps, who regards the aboral extremity of the adult as the posterior end.

The development of *Phoronis* was supposed by Caldwell (2) to furnish the explanation of the relations of the surfaces in Brachiopoda, Polyzoa and perhaps the Sipunculoid Gephyrea, in which the ontogenetic evidence is less clear. Caldwell's views were accepted by Lankester (8) in the 9th edition of this work, the Phylum Podaxonia being there instituted to include the groups just mentioned, together with the Pterobranchia. The peduncle of the Brachiopoda was supposed to correspond with the everted ventral sac of *Actinotrocha*, but the question is complicated by the want of any complete investigation of the development of the Brachiopoda, and by the absence of the anus in the majority of the genera. There is, however, a considerable amount of resemblance between the lophophore of *Phoronis australis*, with its spirally twisted ends, and that of a typical Brachiopod; nor do the structural details of the adult Brachiopods forbid the view that they may be related to *Phoronis*. The comparative study of the development does not support the hypothesis that the Polyzoa (*q.v.*) are comparable with *Phoronis*. In *Pedicellina*, the only Polyzoon in which the alimentary canal of the larva is known to become that of the first adult individual, the line between the mouth and anus is ventral in the larva; and since there is no reversal of the curvature of the digestive loop during the metamorphosis it must be regarded as ventral in the adult. There are, indeed remarkable similarities between the external characters of the Phylactolaematous Polyzoa and the Phoronidea, and notably between their lophophores. The supposed occurrence of a pair of nephridia in certain Phylactolaemata, in a position corresponding with that of the nephridia of *Phoronis*, must also be mentioned, although it has been maintained that the "nephridia" of Phylactolaemata are merely ciliated portions of the body-cavity and not indeed nephridia at all. But a serious objection to the comparison is that the development of Phylactolaemata can be explained by supposing it to be a modification of what occurs in other Polyzoa, while it appears to have no relation whatever to that of *Phoronis*.

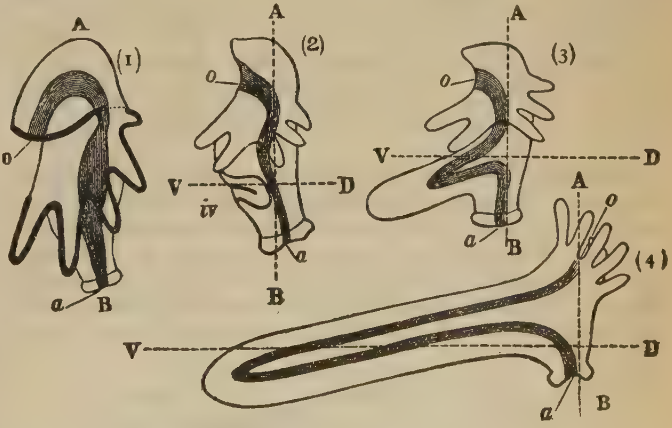


FIG. 4.—Diagrams illustrating the Metamorphosis of *Actinotrocha*.

AB, Anteroposterior axis.
DV, Dorsoventral axis.
1, 2, Actinotrocha.
3, Commencement of the metamorphosis.
4, Later stage in the metamorphosis: *a*, anus; *iv*, ventral invagination; *o*, mouth.

Most observers consider that *Actinotrocha* is a highly modified Trochosphere, and this would give it some claim to be regarded as distantly related to the Entoproct Polyzoa and to other groups which have a Trochosphere larva.

Phoronis has long been regarded as a possible ally of *Rhabdopleura* (see PTEROBRANCHIA); and Masterman (10) has attempted to demonstrate the existence in *Actinotrocha* of most of the structures which occur in the Pterobranchia. According to his view the praeoral hood of *Actinotrocha* (cf. fig. 4) corresponds with the "proboscis" of Pterobranchia; the succeeding region, as far as the bases of the tentacles, with the collar; and the post-tentacular region with the metasome. Masterman's more detailed comparisons have for the most part been rejected by other morphologists. One of the most formidable difficulties in the way of the attempt to reduce *Actinotrocha* to the Pterobranchiate type of structure is the condition of the coelom in the former. There is indeed a perfectly definite transverse septum which divides the body-cavity in the region of the tentacle-bases. Even if it be admitted that the post-septal space may be the metasomatic cavity, the praeseptal space can hardly be regarded as coelomic in nature, since it is in continuity with the vascular system; while Masterman's conclusion that the cavity of the praeoral hood (the supposed proboscis-cavity) is separated from that of the supposed collar has received no confirmation. In spite of these difficulties it must be conceded that the dorsal flexure of the alimentary canal of the Pterobranchia is very *Phoronis*-like. It has, moreover, been shown (see especially Goodrich, 5) that shortly before its metamorphosis, *Actinotrocha* develops a coelomic space which lies immediately in front of the oblique septum, and gives rise later to the cavity of the lophophore and tentacles. Regarding this as a collar-cavity, it becomes possible to agree with Masterman that the region shown in fig. 4, I. between the tentacles and the praeoral hood, is really a collar the coelom of which develops relatively late. It will be noticed that the lophophore of *Phoronis* is, on this assumption, a derivative of the collar just as it is in the Pterobranchia. The epistome of the adult *Phoronis* cannot well be the proboscis since its cavity is continuous with the lophophoral coelom, and because the praeoral hood of *Actinotrocha* is entirely lost at the metamorphosis. It is possible that this consideration will account for the want of an anterior body-cavity in *Phoronis*. Since the proboscis is a purely larval organ in this genus, it may be supposed that the coelomic space which properly belongs to it fails to develop, but that the praeoral hood itself is none the less the morphological representative of the proboscis. In spite of the criticisms which have been made on the conclusion that *Phoronis* is allied to the Pterobranchia, it is thus possible that the view is a sound one, and that the Phoronidea should take their place, with the Enteropneusta and the Pterobranchia, as an order of the Hemichordata.

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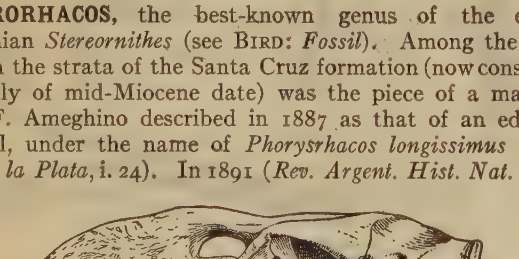
(S. F. H.)

PHORORHACOS, the best-known genus of the extinct Patagonian *Stereornithes* (see BIRD: *Fossil*). Among the bones found in the strata of the Santa Cruz formation (now considered as mainly of mid-Miocene date) was the piece of a mandible which F. Ameghino described in 1887 as that of an edentate mammal, under the name of *Phorysrhacos longissimus* (*Bolet. Mus. de la Plata*, i. 24). In 1891 (*Rev. Argent. Hist. Nat.* i. 225) he amended the name and recognized the bone as that of a bird, *Phororhacos*, which with *Brontornis* and others constituted the family *Phororhacidae*. About six species of the type genus are now known, the most complete being *Ph. inflatus*, with skull, mandible, pelvis, limbs and some of the vertebrae. These birds were at first considered as either belonging to the Ratitae, or at least related to them, until C. W. Andrews, after much of the interesting material had been acquired by the British Museum, showed the gruiform affinities of *Phororhacos* (*Ibis*, 1896, pp. 1–12), a conclusion which he was able to further corroborate after the clearing of the adherent stony matrix from the skulls (*Tr. Z. S.* 1901, xv. pp. 55–86, pls. 14–17). The skull of *Ph. longissimus* is about 2 ft. long and 10 in. high; that of *Ph. inflatus* is 13 in. long, and this creature is supposed to have stood only 3 ft. high at the middle of the back. The under jaw is slightly curved upwards and it contains a large foramen as for instance in *Psophia* and in *Mycteria*. The strongly hooked upper beak is very high, and very much compressed laterally. The palate is imperfectly desmognathous, as in *Dicholophus*, with an inconspicuous vomer. The quadrate has a double knob for its articulation with the skull, and basipterygoid processes are absent. What little is known of the shoulder-girdle (breastbone still unknown) points to a flightless bird, and so do the short wing bones, although these are stout. The pelvis has an ischiadic foramen. The hind limbs are distinctly slender, the tibia of *Ph. inflatus* being between 15 and 16 in. in length.


(From life-size model in Brit. Mus. Nat. Hist.)
Skull of Phororhacos, *longissimus*.

For further detail see F. Ameghino, "Sur les oiseaux fossiles de la Patagonie," *Bolet. inst. geogr. argentino*, xv., chs. 11 and 12 (1895); F. P. Moreno and A. Mercerat, *Catálogo de los pájaros fósiles de la República Argentina*, *An. Mus. La Plata* (1891; with 21 plates). (H. F. G.)

PHOSGENITE, a rare mineral consisting of lead chlorocarbonate, $(PbCl)_2CO_3$. The tetragonal (holosymmetric) crystals are prismatic or tabular in habit, and are bounded by smooth, bright faces: they are usually colourless and transparent, and have a brilliant adamantine lustre. Sometimes the crystals have a curious helical twist about the tetrad or principal axis. The hardness is 3 and the specific gravity 6·3. The mineral is rather sectile, and consequently was early known as "corneous lead" (Ger. *Hornblei*). The fanciful name phosgenite was given by A. Breithaupt in 1820, from phosgene, the old name of carbon oxychloride, because the mineral contains the elements carbon, oxygen and chlorine. At Cromford, near Matlock, it was long ago found in an old lead mine, being associated with anglesite and matlockite (Pb_2OCl_2) in cavities in decomposed galena: hence its common name cronfortite. Fine crystals are also found in galena at Monteponi near Iglesias in Sardinia, but the largest are those recently found near Dundas in Tasmania. Crystals of phosgenite, and also of the corresponding bromine compound $[PbBr]_2CO_3$, have been prepared artificially.

(L. J. S.)

PHOSPHATES, in chemistry, the name given to salts of phosphoric acid. As stated under PHOSPHORUS, phosphoric oxide, P_2O_5, combines with water in three proportions to form $H_2O \cdot P_2O_5$ or HPO_3, metaphosphoric acid; $2H_2O \cdot P_2O_5$ or $H_4P_2O_7$, pyrophosphoric acid; and $3H_2O \cdot P_2O_5$ or H_3PO_4, orthophosphoric or ordinary phosphoric acid. These acids each give origin to several series of salts, those of ordinary phosphoric acid being the most important, and, in addition, are widely distributed in the mineral kingdom (see below under *Mineral Phosphates*).

Orthophosphoric acid, H_3PO_4, a tribasic acid, is obtained by boiling a solution of the pentoxide in water; by oxidizing red phosphorus with nitric acid, or yellow phosphorus under the surface of water by bromine or iodine; and also by decomposing a mineral phosphate with sulphuric acid. It usually forms a thin syrup which on concentration in a vacuum over sulphuric acid deposits hard, transparent, rhombic prisms which melt at 41·7°. On long heating the syrup is partially converted into pyrophosphoric and metaphosphoric acids, but on adding water and boiling the ortho-acid is re-formed. It gives origin to three classes of salts: $M'H_2PO_4$ or $M''H_4P_2O_8$; M'_2HPO_4 or $M''HPO_4$, M'_3PO_4, $M''_3P_2O_8$ or $M'''PO_4$, wherein M', M'', M''' denote a mono-, di-, and tri-valent metal. The first set may be called monometallic, the second dimetallic, and the third trimetallic salts. Per-acid salts of the alkalis, *e.g.* $(K,Na,NH_4)H_5(PO_4)_2$, are also known; these may be regarded as composed of a monometallic phosphate with phosphoric acid, thus $M'H_2PO_4\ H_3PO_4$. The three principal groups differ remarkably in their behaviour towards indicators. The monometallic salts are strongly acid, the dimetallic are neutral or faintly alkaline, whilst the soluble trimetallic salts are strongly alkaline. The monometallic salts of the alkalis and alkaline earths may be obtained in crystal form, but those of the heavy metals are only stable when in solution. The soluble trimetallic salts are decomposed by carbonic acid into a dimetallic salt and an acid carbonate. All soluble orthophosphates give with silver nitrate a characteristic yellow precipitate of silver phosphate, Ag_3PO_4, soluble in ammonia and in nitric acid. Since the reaction with the acid salts is attended by liberation of nitric acid: $NaH_2PO_4+3AgNO_3=Ag_3PO_4+NaNO_3+2HNO_3$, $Na_2HPO_4+3AgNO_3=Ag_3PO_4+2NaNO_3+HNO_3$, it is necessary to neutralize the nitric acid if the complete precipitation of the phosphoric acid be desired. The three series also differ when heated: the trimetallic salts, containing fixed bases are unaltered, whilst the mono- and dimetallic salts yield meta- and pyrophosphates respectively. If the heating be with charcoal, the trimetallic salts of the alkalis and alkaline earths are unaltered, whilst the mono- and di-salts give free phosphorus and a trimetallic salt. Other precipitants of phosphoric acid or its salts in solution are: ammonium molybdate in nitric acid, which gives on heating a canary-yellow precipitate of ammonium phosphomolybdate, $12[MoO_3]\ (NH_4)_3PO_4$, insoluble in acids but readily soluble in ammonia; magnesium chloride, ammonium chloride and ammonia, which give on standing in a warm place a white crystalline precipitate of magnesium ammonium phosphate, $Mg(NH_4)PO_4{\cdot}6H_2O$, which is soluble in acids but highly insoluble in ammonia solutions, and on heating to redness gives magnesium pyrophosphate, $Mg_2P_2O_7$; uranic nitrate and ferric chloride, which give a yellowish-white precipitate, soluble in hydrochloric acid and ammonia, but insoluble in acetic acid; mercurous nitrate which gives a white precipitate, soluble in nitric acid, and bismuth nitrate which gives a white precipitate, insoluble in nitric acid.

Pyrophosphoric acid, $H_4P_2O_7$, is a tetrabasic acid which may be regarded as derived by eliminating a molecule of water between two molecules of ordinary phosphoric acid; its constitution may therefore be written $(HO)_2OP{\cdot}O{\cdot}PO(OH)_2$. It may be obtained as a glassy mass, indistinguishable from metaphosphoric acid, by heating phosphoric acid to 215°. When boiled with water it forms the ortho-acid, and when heated to redness the meta-acid. After neutralization, it gives a white precipitate with silver nitrate. Being a tetrabasic acid it can form four classes of salts; for example, the four solium salts $Na_4P_2O_7$, $Na_3HP_2O_7$, $Na_2H_2P_2O_7$, $NaH_3P_2O_7$ are known. The most important is the normal salt, $Na_4P_2O_7$, which is readily obtained by heating disodium orthophosphate, Na_2HPO_4. It forms monoclinic prisms (with $10H_2O$) which are permanent in air. All soluble pyrophosphates when boiled with water for a long time are converted into orthophosphates.

Metaphosphoric acid, HPO_3, is a monobasic acid which may be regarded as derived from orthophosphoric acid by the abstraction of one molecule of water, thus $H_3PO_4-H_2O=HPO_3$; its constitution is therefore $(HO)PO_2$. The acid is formed by dissolving phosphorus pentoxide in cold water, or by strongly heating orthophosphoric acid. It forms a colourless vitreous mass, hence its name "glacial phosphoric acid." It is readily soluble in water, the solution being gradually transformed into the ortho-acid, a reaction which proceeds much more rapidly on boiling. Although the acid is monobasic, salts of polymeric forms exist of the types $(MPO_3)_n$, where n may be 1, 2, 3, 4, 6. They may be obtained by heating a monometallic orthophosphate of a fixed base, or a dimetallic orthophosphate of one fixed and one volatile base, *e.g.* microcosmic salt: $MH_2PO_4=MPO_3+H_2O$, $(NH_4)\ NaHPO_4=NaPO_3+NH_3+H_2O$; they may also be obtained by acting with phosphorus pentoxide on trimetallic orthophosphates: $Na_3PO_4+P_2O_5=3NaPO_3$. The salts are usually non-crystalline and fusible. On boiling their solutions they yield orthophosphates, whilst those of the heavy metals on boiling with water give a trimetallic orthophosphate and orthophosphoric acid: $3AgPO_3+3H_2O=Ag_3PO_4+2H_3PO_4$. On heating with an oxide or carbonate they yield a trimetallic orthophosphate, carbon dioxide being evolved in the latter case. Metaphosphoric acid can be distinguished from the other two acids by its power of coagulating albumen, and by not being precipitated by magnesium and ammonium chlorides in the presence of ammonia.

(C. E.*)

Mineral Phosphates.—Those varieties of native calcium phosphate which are not distinctly crystallized, like apatite (*q.v.*), but occur in fibrous, compact or earthy masses, often nodular, and more or less impure, are included under the general term phosphorite. The name seems to have been given originally to the Spanish phosphorite, probably because it phosphoresced when heated. This mineral, known as Estremadura phosphate, occurs at Logrossan and Cáceres, where it forms an important deposit in clay-slate. It may contain from 55 to 62% of calcium phosphate, with about 7% of magnesium phosphate. A somewhat similar mineral, forming a fibrous incrustation, with a mammillary surface, and containing about 9% of calcium carbonate, is known as staffelite, a name given by A. Stein in 1866 from the locality Staffel, in the valley of the Lower Lahn, where (as also in the valley of its tributary the Dill) large deposits of phosphorite occur. Dahllite is a Norwegian phosphorite, containing calcium carbonate, named in 1888 by W. C. Brögger and H. Bäckström after the Norwegian geologists T. and J. Dahll. Osteolite is a white earthy phosphorite occurring in the clefts of basaltic rocks, named in 1851 by J. C. Bromeis from the Greek ὀστέον, bone.

Phosphorite, when occurring in large deposits, is a mineral of much economic value for conversion into the superphosphate largely used as a fertilizing agent. Many of the impure substances thus utilized are not strictly phosphorite, but pass under such names as "rock-phosphate," or, when nodular, as "coprolite" (*q.v.*), even if not of true coprolitic origin. The ultimate source of these mineral phosphates may be referred in most cases to the apatite widely distributed in crystalline rocks. Being soluble in water containing carbonic acid or organic acids it may be readily removed in solution, and may thus furnish plants and animals with the phosphates required in their structures. On the decay of these structures the phosphates are returned to the inorganic world, thus completing the cycle.

There are three sources of phosphates which are of importance geologically. They occur (*a*) in crystalline igneous and metamorphic rocks as an original constituent, (*b*) in veins associated with igneous rocks, and (*c*) in sedimentary rocks either as organic fragments or in secondary concretionary forms.

The first mode of occurrence is of little significance practically, for the crystalline rocks generally contain too little phosphate to be valuable, though occasionally an igneous rock may contain enough apatite to form an inferior fertilizing agent, *e.g.* the trachyte of Cabo de Gata in south-east Spain, which contains 12–15% of phosphoric acid. In many deposits of iron ores found in connexion with igneous or metamorphic rocks small quantities of phosphate occur. The Swedish, Norwegian, Ontario and Michigan mines yield ores of this kind; and though none of them can be profitably worked as a source of phosphate, yet on reducing the ore it may be retained in the slags, and thus rendered available for agriculture.

Another group of phosphatic deposits connected with igneous rocks comprises the apatite veins of south Norway, Ottawa and other districts in Canada. These are of pneumatolytic origin (see PNEUMATOLYSIS), and have been formed by the action of vapours emanating from cooling bodies of basic eruptive rock. Veins of this type occur at Oedegarden in Norway and Dundret in Lapland. From 1500 to 3500 tons of apatite are obtained yearly in Norway from these veins. In Ontario apatite has been worked for a long time in deposits of similar nature. The total output of Canada in 1907 was only 680 tons.

The phosphatic rocks which occur among the sedimentary strata are the principal sources of phosphates for commerce and agriculture. They are found in formations of all ages from the Cambrian to those which are accumulating at the present day. Of the latter the best known is guano (see MANURES and MANURING).

Where guano-beds are exposed to rain their soluble constituents are removed and the insoluble matters left behind. The soluble phosphates washed out of the guano may become fixed by entering into combination with the elements of the rock beneath. Many of the oceanic islets are composed of coral limestone, which in this way becomes phosphatized; others are igneous, consisting of trachyte or basalt, and these rocks are also phosphatized on their surfaces but are not so valuable, inasmuch as the presence of iron or alumina in any quantity renders them unsuited for the preparation of artificial manures.

The leached guanos and phosphatized rocks, which are grouped with them for commercial purposes, have been obtained in great quantities in many islands of the Pacific Ocean (such as Baker, Howland, Jarvis and McKean Islands) between long. 150° to 180° W. and lat. 10° N. to 10° S. In the West Indies from Venezuela to the Bahamas and in the Caribbean Sea many islands yield supplies of leached guanos; the following are important in this respect: Sombrero, Navassa, Aves, Aruba, Curaçoa. Christmas Island has been a great source of phosphates of this type; also Jaluit Island in the Maldive Archipelago, Banaba or Ocean Island, and Nauru or Pleasant Island. On Christmas Island the phosphate has been quarried to depths of 100 ft. To these leached guanos and phosphatized limestones the name sombrerite has been given. It has been estimated that 500,000 tons of phosphate were obtained in Aruba, 1,000,000 tons from Curaçoa since the deposits were discovered in 1870, and Christmas Island in 1907 yielded 290,000 tons.

In the older formations the phosphates tend to become more and more mineralized by chemical processes. In whatever form they were originally deposited they often suffer complete or partial solution and are redeposited as concretionary lumps and nodules, often called coprolites. The "Challenger" and other oceanographic expeditions have shown that on the bottom of the deep sea concretions of phosphate are now gathering around the dead bodies of fishes lying in the oozes; consequently the formation of the concretions may have been carried on simultaneously with the deposition of the strata in which they occur.

Important deposits of mineral phosphates are now worked on a large scale in the United States, the annual yield far surpassing that of any other part of the world. The most active operations are carried on in Florida, where the phosphate was first worked in 1887 in the form of pebbles in the gravels of Peace river. Then followed the discovery of "hard rock-phosphate," a massive mineral, often having cavities lined with nearly pure phosphorite. Other kinds not distinctly hard and consisting of less rich phosphatic limestone, are known as "soft phosphate": those found as smooth pebbles of variable colour are called "land pebble-phosphate," whilst the pebbles of the river-beds and old river-valleys, usually of dark colour, are distinguished as "river pebble-phosphate." The land pebble is worked in central South Florida; the hard rock chiefly between Albion and Bay City. In South Carolina, where there are important deposits of phosphate, formerly more productive than at present, the "land rock" is worked near Charleston, and the "river rock" in the Coosaw river and other streams near Beaufort. The phosphate beds contain Eocene fossils derived from the underlying strata and many fragments of Pleistocene vertebrata such as mastodon, elephant, stag, horse, pig, &c. The phosphate occurs as lumps varying greatly in size, scattered through a sand or clay; they often contain phosphatized Eocene fossils (Mollusca, &c.). Sometimes the phosphate is found at the surface, but generally it is covered by alluvial sands and clays. Phosphate mining began in South Carolina in 1868, and for twenty years that state was the principal producer. Then the Florida deposits began to be worked. In 1892 the phosphates of Tennessee, derived from Ordovician limestones, came into the market. From North Carolina, Alabama and Pennsylvania, also, phosphates have been obtained but only in comparatively small quantities. In 1900 mining for phosphates was commenced in Arkansas. In 1908 Florida produced 1,673,651 tons of phosphate valued at 11 million dollars. All the other states together produce less phosphate than Florida, and among them Tennessee takes the first place with an output of 403,180 tons.

Algeria contains important deposits of phosphorite, especially near Tebessa and at Tocqueville in the province of Constantine. Near Jebel Kouif, on the frontier between Algeria and Tunis, there are phosphate workings, as also in Tunis, at Gafsa. The deposits belong to the Lower Eocene, where it rests unconformably upon the Cretaceous. The joint production of Tunis and Algeria in 1907 was not less than a million tons. Phosphates occur also in Egypt, in the desert east of Keneh and in the Dakla oasis in the Libyan desert.

France is rich in mineral phosphates, the chief deposits being the departments of the Pas-de-Calais, Somme, Aisne, Oise in and Meuse, in the north-east, and another group in the departments of Lot, Tarn-et-Garonne and Aveyron, in the south-west: phosphates occur also in the Pyrenees. The deposits near Caylus and in Quercy occupy fissures and pockets in Jurassic limestone, and have yielded a remarkable assemblage of the relics of Tertiary mammals and other fossils. Phosphates occur in Belgium, especially near Mons, and these, like those of north-east France, are principally in the Upper Chalk. Two varieties of phosphate rock are recognized in these districts, viz. the phosphatic chalk and the phosphate sand, the latter resulting from the decomposition of the former. Large and valuable deposits of the sand have been obtained in sinks and depressions on the surface of the chalk. The production is on the whole diminishing in Belgium (180,000 tons in 1907), but in France it is still large (375,000 tons in 1907).

In the Lahn district of Nassau (Germany) there are phosphate beds in Devonian rocks. The deposits were rich but irregular and local, and were much worked from 1866 to 1884, but are no longer of economic importance. In northern Estremadura in Spain and Alemtezo in Portugal there are vein deposits of phosphate of lime. As much as 200,000 tons of phosphate have been raised in these provinces, but in 1906 the total production of Spain was only 1300 tons. Large deposits of phosphate occur in Russia, and those in the neighbourhood of Kertch have attracted some attention; it is said that the Cretaceous rocks between the rivers Dniester and Volga contain very large supplies of phosphate, though probably of low grade.

Phosphatic nodules and concretions, with phosphatized fossils and their casts, occur at various geological horizons in Great Britain. Bands of black nodules, highly phosphatic, are found at the top of the Bala limestone in North Wales; beds of concretions occur in the Jurassic series; and important deposits are known in the Cretaceous strata, especially in the Lower Greensand and at the base of the Gault. The Lower Greensand phosphates have been worked, under the name of "coprolites," at Potton in Bedfordshire and at Upware and Wicken in Cambridgeshire. The Cambridge Greensand, rich in phosphatic nodules, occurs at the base of the Chalk Marl. The chalk occasionally becomes phosphatized, as at Taplow (Bucks) and Lewes (Sussex). At the base of the Red Crag in East Anglia, and occasionally at the base of the other Pliocene Crags, there is a "nodule bed," consisting of phosphatic nodules, with rolled teeth and bones, which were formerly worked as "coprolites" for the preparation of artificial manure. Professor R. J. Strutt has found that phosphatized nodules and bones are rich in radioactive constituents, and has brought this into relation with their geological age.

Bibliography.—For American phosphates see *The Phosphates of America*, by Francis Wyatt (5th ed., New York and London, 1894); the Annual Reports on *Mineral Resources of the U.S.* (U.S. Geol. Survey), including some valuable reports by C. W. Hayes, also those in Rothwell's *Mineral Industry*; "Nature and Origin of Deposits of Phosphate of Lime," by R. A. F. Penrose, Jun., *Bull. U.S. Geol. Survey*, No. 46 (1888); *Florida, South Carolina and Canadian Phosphates*, by C. C. Hoyer Miller (London, 1892); and *The Non-metallic Minerals*, by G. P. Merrill (1904). Many of the above include descriptions of mineral phosphates in other parts of the world. For a general discussion of the origin of the phosphates, see "The Natural History of Phosphate Deposits," by J. J. H. Teall, *Proc. Geol. Assoc.* xvi. 369 (1900). Consult also *Étude complète sur les phosphates*, by A. Deckers (Liége, 1894).

(J. S. F.; F. W. R.*)

PHOSPHORESCENCE, a name given to a variety of physical phenomena due to different causes, but all consisting in the emission of a pale, more or less ill-defined light, not obviously due to combustion. The word was first used by physicists to describe the property possessed by many substances of themselves becoming luminous after exposure to light. This property has been noticed from early times. Pliny speaks of various gems which shine with a light of their own, and Albertus Magnus knew that the diamond becomes phosphorescent when moderately heated. But the first discovery of this property which apparently attracted scientific attention seems to have been that of the Bologna stone (barium sulphide), which was discovered by Vincenzo Cascariolo, a cobbler of Bologna, in about 1602. This was followed by the discovery of a number of other substances which become luminous either after exposure to light or on heating, or by attrition, and to which the general name of "phosphori" (from φῶς and φόρος, bringing light) was given. Among these may be mentioned Homberg's phosphorus (calcium chloride), John Canton's phosphorus (calcium sulphide) and Balduin's phosphorus (calcium nitrate). Of late years it has been found convenient to limit the strict meaning of the word "phosphorescence" to the case of bodies which, after exposure to light, become self-luminous (even if only for a fraction of a second). The general term "luminescence" has been proposed by E. Wiedemann to include all cases in which bodies give off light not due to ignition. This general term embraces several subdivisions. Thus, fluorescence (*q.v.*) and phosphorescence are included under the same heading, "photoluminescence," being distinguished from each other only by the fact that fluorescent bodies emit their characteristic light only while under the influence of the exciting illumination, while phosphorescent bodies are luminous for an appreciable time after the exciting light is cut off.

Phosphorescence, in its restricted meaning as above explained, is most strikingly exhibited by the artificial sulphides of calcium, strontium and barium. If any of these substances is exposed for some time to daylight, or, better, to direct sunlight, or to the light of the electric arc, it will shine for hours in the dark with a soft coloured light. The colour depends not only on the nature of the substance, but also on its physical condition, and on its temperature during insolation, that is, exposure to the sun's rays. Thus the phosphorescent light emitted by calcium sulphide may be orange-yellow, yellow, green or violet, according to the method of preparation and the materials used. Balmain's luminous paint, a preparation of calcium sulphide, shines with a white light. The colour also depends on the temperature during exposure to light. Thus A. E. Becquerel found that the light given by a specimen of strontium sulphide changed from violet to blue, green, yellow and orange, as the temperature during the corresponding previous insolation was 20°, 40°, 70°, 100° or 200° C. The duration of phosphorescence varies greatly with different substances. It may last for days or for only a fraction of a second.

As in the case of fluorescent bodies, the light produced by phosphorescent substances consists commonly of rays less refrangible than those of the exciting light. Thus the ultra-violet portion of the spectrum is usually the most efficient in exciting rays belonging to the visible part of the spectrum. V. Klatt and Ph. Lenard (*Wied. Ann.*, 1889, xxxviii. 90), have shown that the phosphorescence of calcium sulphide and other phosphori depends on the presence of minute quantities of other substances, such as copper, bismuth and manganese. The maximum intensity of phosphorescent light is obtained when a certain definite proportion of the impurity is present, and the intensity is diminished if this proportion is increased.

It appears likely that when a phosphorescent body is exposed to light, the energy of the light is stored up in some kind of strain energy, and that the phosphorescent light is given out during a more or less slow recovery from this state of strain. Klatt and Lenard have shown that the sulphides of the alkaline earths lose the property of phosphorescing when subjected to heavy pressure. Many fluorescent solutions become briefly phosphorescent when rendered solid by gelatin.

When the duration of phosphorescence is brief, some mechanical device becomes necessary to detect it. The earliest and best-known instrument for this purpose is Becquerel's phosphoroscope. It consists essentially of a shallow drum, in whose ends two eccentric holes, exactly opposite one another, are cut. Inside it are fixed two equal metal disks, attached perpendicularly to an axis, and divided into the same number of sectors, the alternate sectors of each being cut out. One of these disks is close to one end of the drum, the other to the opposite end, and the sectors are so arranged that, when the disks are made to rotate, the hole in one end is open while that in the other is closed, and vice versa. If the eye be placed near one hole, and a ray of sunlight be admitted by the other, it is obvious that while the sun shines on an object inside the drum the aperture next the eye is closed, and vice versa. If the disks be made to revolve with great velocity by means of a train of toothed wheels the object will be presented to the eye almost instantly after it has been exposed to sunlight, and these presentations succeed one another so rapidly as to produce a sense of continuous vision. By means of this apparatus we can test with considerable accuracy the duration of the phenomenon after the light has been cut off. For this purpose we require to know merely the number of sectors in the disks and the rate at which they are turned.

Thermoluminescence.—Some bodies which do not emit light at ordinary temperatures in a dark room begin to do so if they are heated to a temperature below a visible red heat. In the case of chlorophane, a variety of fluor-spar, the heat of the hand is sufficient. Many yellow diamonds exhibit this form of luminescence. It has been shown, however, that a previous exposure to light is always necessary. Sir James Dewar found that if ammonium platinocyanide, Balmain's paint and some other substances are cooled to the temperature of liquid air and exposed to light, they do not phosphoresce, but as soon as they are allowed to warm up to the ordinary temperature they emit a brilliant light. On the other hand, some bodies, such as gelatin, celluloid, paraffin and ivory, are phosphorescent at very low temperatures, but lose the property at ordinary temperatures.

Triboluminescence (from τρίβειν, to rub) is luminescence excited by friction, percussion, cleavage or such mechanical means. Calcium chloride, prepared at a red heat, exhibits this property. If sugar is broken in the dark, or two crystals of quartz rubbed together, or a piece of mica cleft, a flash of light is seen, but this is probably of electrical origin. Closely allied to this form of luminescence is *crystalloluminescence*, a phosphorescent light seen when some substances crystallize from solution or after fusion. This property is exhibited by arsenious acid when crystallizing from solution in hydrochloric acid.

Chemiluminescence is the name given to those cases in which chemical action produces light without any great rise of temperature. Phosphorus exposed to moist air in a dark room shines with a soft light due to slow oxidation. Decaying wood and other vegetable substances often exhibit the same property.

Electroluminescence is luminescence due to electrical causes. Many gases are phosphorescent for a short time after an electric discharge has been passed through them, and some solid substances, especially diamonds and rubies, are strongly phosphorescent when exposed to kathode rays in a vacuum tube.

See generally, Winkelmann, *Handbuch der Physik*, Bd. vi. (1906); E. Becquerel, *La Lumière* (1867). (J. R. C.)

Phosphorescence in Zoology.

The emission of light by living substance is a widespread occurrence, and is part of the general metabolism by which the potential energy introduced as food is transformed into kinetic energy and appears in the form of movement, heat, electricity and light. In many cases it is probably an accidental by-product, and like the heat radiated by living tissues, is not necessarily of use to the organism. But in other cases the capacity to produce light is awakened on stimulation, as when the wind ripples the surface of the sea, or when the water is disturbed by the blade of an oar. It has been suggested that the response to the stimulus may be protective, and that enemies are frightened by the flash of light. In luminous insects and deep-sea fish the power of emitting light appears to have a special significance, and very elaborate mechanisms have been developed. The pale glow of phosphorescence has a certain resemblance to the light emitted by phosphorus, and it was an early suggestion that the phenomenon in living organisms was due to that substance. Phosphorus, however, and its luminous compounds are deadly poisons to all living tissues, and never occur in them in the course of natural metabolism, and the phosphorescence of life cannot therefore be assigned to the oxidation of phosphorus. On the other hand, it is certainly the result of a process of oxidation, as the emission of light continues only in the presence of oxygen. J. H. Fabre showed in 1855 that the luminous fungus, *Agaricus*, discharges more carbonic acid when it is emitting light, and Max Schultze in 1865 showed that in insects the luminous cells are closely associated with the tracheae, and that during phosphorescence they withdraw oxygen from them. In 1880 B. Radziszewski showed that many fats, ethereal oils and alcohols emit light when slowly combined with oxygen in alkaline fluids at appropriate temperatures. Probably the phosphorescence of organisms is due to a similar process acting on the many fats, oils and similar substances found in living cells. The colour varies much in different organisms; green has been observed in the glow-sworm, fire-flies, brittle-stars, centipedes and annelids; blue in the Italian fire-fly (*Luciola italica*); blue and light green are the predominant colours in the phosphorescence of marine organisms, but red and lilac have also been observed. The Lantern-Fly (*Fulgora pyrorhynchus*) is said to have a purple light, and E. H. Giglioli has recorded that an individual *Appendicularia* appeared first red, and then blue, and then green. P. Panceri, chiefly in the case of *Salps*, and S. P. Langley and F. W. Very in the case of *Pyrophorus*, have investigated the light spectroscopically, and found that it consisted of a continuous band without separate bright lines. The solar spectrum extends farther both towards the violet and the red ends, but is less intense in the green when equal luminosities are compared.

Many of the bacteria of putrefaction are phosphorescent, and the light emitted by dead fish or molluscs or flesh is probably due in every case to the presence of these. Under the miscroscope, the individual bacteria appear as shining points of light. The phosphorescence of decaying wood is due to the presence of the mycelium of *Agaricus melleus*, and various other species of *Agaricus* have been found to be luminous. The great displays of phosphorescence in sea-water are usually due to the presence of very large numbers of small luminous organisms, either protozoa or protophyta. Of these *Noctiluca miliaris* and species of *Peridinium* and *Pyrocystis* are the most frequent, the two former near land and the latter in mid-ocean.

In higher animals the phosphorescence tends to be limited to special parts of the body which may form elaborate and highly specialized luminous organs. Many coelenterates show the beginning of such localization; in medusae the whole surface may be luminous, but the light is brighter along the radial canals, in the ovaries, or in the marginal sense-organs. In Pennatulids each polyp has eight luminous bands on the outer surface of the digestive cavity. Some Chaetopods (*Chaetopterus* and *Tomopteris*) have luminous organs at the bases of the lateral processes of the body. *Pyrosoma*, a colonial pelagic ascidian, is responsible for some of the most striking displays of phosphorescence in tropical seas; it has two small patches of cells at the base of each inhalent tube which on stimulation discharge light, and the luminosity has been observed to spread through the colony from the point of irritation.

Amongst the Crustacea, many pelagic Copepods are phosphorescent. W. Giesbrecht has shown that the light is produced by a fluid secreted by certain dermal glands. A similar fluid in other Copepods hardens to form a protective case, and it may be that the display of light is in such cases an accidental by-product. Glands in the labrum of the Ostracod *Pyrocypris* and on the maxillae of the Mysid *Gnathophausia* similarly produce a luminous secretion. In the Euphausiacea, on the other hand, phosphorescence is produced by elaborate luminous organs which are situated on the thoracic appendages and the abdomen, and which were at first believed to be ocular organs. The deep-sea Decapod Crustaceans belonging to many families are luminous. A. Alcock observed that in some of the deep-sea prawns a luminous secretion was discharged at the bases of the antennae, but in most cases the luminous organs are numerous eye-like structures on the limbs and body.

The rock-boring mollusc, *Pholas*, which Pliny knew to be phosphorescent, has luminous organs along the anterior border of the mantle, two small triangular patches at the entrance of the anterior siphon, and two long parallel cords within the siphon. The cells of these organs have peculiar, granulated contents. W. E. Hoyle, in his presidential address to the Zoological Section of the British Association in 1907, brought together observations on the occurrence of luminous organs in no less than thirty-three species of Cephalopods. In *Heteroteuthis*, *Sepiola* and *Rossia* the light is produced by the secretion of a glandular organ on the ventral side of the body behind the funnel. The secretion glows through the transparent wall with a greenish colour, but, at least in the case of *Heteroteuthis*, continues to glow after being ejected into the water. In most cases the luminous organs are nonglandular and may be simple, or possess not only a generator but a reflector, lens and diaphragm. The different organs shine with different coloured lights, and as the Cephalopods are for the most part inhabitants of the depths of the sea, it has been suggested that they serve as recognition marks.

Some centipedes (*e.g. Geophilus electricus* and *G. phosphoreus*) are luminous, and, if allowed to crawl over the hand, are stated to leave a luminous trail. Amongst insects, elaborate luminous organs are developed in several cases. The abdomen of a Ceylonese May-fly (*Teleganodes*) is luminous. The so-called New Zealand "glow-worm" is the larva of the fly *Boletophila luminosa*, and some gnats have been observed to be luminous, although the suggestion is that in their case disease is present and the light emanates from phosphorescent bacteria. An ant (*Orya*) and a poduran (*Anurophorus*) are occasionally luminous. The so-called lantern flies are Homoptera allied to the Cicadas, and the supposed luminous organ is a huge projection of the front of the head, regarding the luminosity of which there is some doubt. The glow-worms and true fire-flies are beetles. Eggs, larvae and adults are in some cases luminous. The organs consist of a pale transparent superficial layer which gives the light, and a deeper layer which may act as a reflector. They are in close connexion with the tracheae and the light is produced by the oxidation of a substance formed under the influence of the nervous system, and probably some kind of organic fat. In the females the phosphorescence is probably a sexual lure; in the males its function is unknown.

Phosphorescent organs known as *photophores* are characteristic structures in many of the deep-sea Teleostome fishes, and have been developed in widely different families (*Stomiatidae*, *Scopelidae*, *Halosauridae* and *Anomalopidae*), whilst numerous simple luminous organs have been detected in many species of Selachii. The number, distribution and complexity of the organs vary much in different fish. They are most frequent on the sides and ventral surface of the anterior part of the body and the head, and may extend to the tail. The simpler forms are generally arranged in rows, sometimes metamerically distributed; the more complex organs are larger and less numerous. In *Opostomias micrionus* there is a large organ on a median barbel hanging down from the chin, others below the eyes, and one on the elongated first ray of the pectoral fin. In *Sternoptyx diaphana* there is one on the lower jaw, and in many species one or two below the eyes. The luminous organs appear to be specialized skin glands which secrete a fluid that becomes luminous on slow oxidation. The essential part of the organ remains a collection of gland cells, but in the more complex types there are blood vessels and nerves, a protecting membrane, an iris-like diaphragm, a reflector and lens. As the distribution and probably the colour of the light varies with the species, these organs may serve as recognition marks. They may also attract prey, and from their association with the eyes in such a position as to send light downwards and forwards it is probable that in the higher types they are used by the fish actually as lanterns in the dark abysses of the sea. (P. C. M.)

PHOSPHORITE, in mineralogy, the name given to impure massive apatite (*q.v.*; see also PHOSPHATES).

PHOSPHORUS (Gr. φῶς, light, φέρειν, to bear), the name originally given to any substance which possessed the property of phosphorescence (*q.v.*), *i.e.* the power of shining in the dark, but now generally restricted to a non-metallic element, which was first known as *Phosphorus mirabilis* or *igneus*. This element is very widely distributed in nature in combination, but is never found free. In the mineral kingdom it is exceptionally abundant, forming large deposits of phosphates (*q.v.*). It is also necessary to animal and vegetable life (see MANURE). It occurs in the urine, blood, tissues, and bones of animals, calcium phosphate forming about 58% of bones, which owe their rigidity to its presence.

The element appears to have been first obtained in 1669 by Brand of Hamburg; Krafft bought his secret and in 1677 exhibited specimens in England, where it created an immense sensation. Its preparation was assiduously sought for, and Kunckel in 1678 and Boyle in 1680 succeeded in obtaining it by the same process as was discovered by Brand, *i.e.* by evaporating urine to dryness and distilling the residue with sand. This method was generally adopted until 1775, when Scheele prepared it from bones, which had been shown by Gahn in 1769 to contain calcium phosphate. Scheele treated bone ash with nitric acid, precipitated the calcium as sulphate, filtered, evaporated and distilled the residue with charcoal. Nicolas and Pelletier improved the process by decomposing the bone-ash directly with sulphuric acid; whilst Fourcroy and Vauquelin introduced further economies. In modern practice degreased bones (see GELATIN), or bone-ash which has lost its virtue as a filtering medium, &c., or a mineral phosphate is treated with sufficient sulphuric acid to precipitate all the calcium, the calcium sulphate filtered off, and the filtrate concentrated, mixed with charcoal, coke or sawdust and dried in a muffle furnace. The product is then distilled from Stourbridge clay retorts, arranged in a galley furnace, previously heated to a red heat. The temperature is now raised to a white heat, and the product led by malleable iron pipes into condensing troughs containing water, when it condenses. The chemical reactions are as follows: the treatment of the calcium phosphate with the acid gives phosphoric acid, H_3PO_4, which at a red heat loses water to give metaphosphoric acid, HPO_3; this at a white heat reacts with carbon to give hydrogen, carbon monoxide and phosphorus, thus: $2HPO_3 + 6C = H_2 + 6CO + P_2$.

Electrothermal processes are also employed. Calcium phosphate, mixed with sand and carbon, is fed into an electric furnace, provided with a closely fitting cover with an outlet leading to a condenser. At the temperature of the furnace the silica (sand) attacks the calcium phosphate, forming silicate, and setting free phosphorus pentoxide, which is attacked by the carbon, forming phosphorus and carbon monoxide. As phosphorus boils at 290° C. (554° F.), it is produced in the form of vapour, which, mingled with carbon monoxide, passes to the condenser, where it is condensed. It is then cast under water. The calcium silicate remains in the furnace in the form of a liquid slag, which may be run off, so that the action is practically continuous. Kaolin may with advantage be used in addition to or in part substitution for sand, because the double silicate thus formed is more fusible than the single silicate of lime. The alternating current is generally used, the action not being electrolytic. One of the special advantages of the electrical over the older process is that the distilling vessels have a longer life, owing to the fact that they are not externally heated, and so subjected to a relatively high temperature when in contact with the corrosive slag formed in the process. The Readman-Parker process (see *Jour. Soc. Chem. Ind.*, 1891, x. 445) appears to be very generally adopted. Readman, experimenting with a Cowles furnace in Staffordshire in 1888, patented his process, and in the same year Parker and Robinson, working independently, patented a similar one. The two inventors then co-operated, an experimental plant was run successfully, and the patents were taken over by the leading manufacturers. With the object of obtaining a valuable by-product in place of the slag produced in this furnace, several patentees (*e.g.* Hilbert and Frank, Billaudot, Bradley and Jacobs, and others) have sought to combine the manufacture of calcium carbide and phosphorus by using only calcium phosphate and carbon, effecting direct reduction by carbon at a high temperature.

The crude phosphorus is purified by melting under water and then filtering through animal black and afterwards through chamois leather, or by treating it, when molten, with chromic acid or a mixture of potassium bichromate and sulphuric acid; this causes the impurities to rise to the surface as a scum which can be skimmed off. It is usually sent on the market in the form of sticks, which were at one time prepared by sucking the molten material up glass tubes; but the dangers to the workmen and other disadvantages of this method have led to its replacement by a continuous process, in which the phosphorus leaves the melting-pot for a pipe surrounded by water, in which it solidifies and can be removed as a continuous rod.

Properties.—When perfectly pure phosphorus is a white, transparent, waxy solid, but as usually prepared it is yellowish owing to the presence of the allotropic "red phosphorus," J. Böeseken (*Abs. Jour. Chem. Soc.*, 1907, ii. 343, 760) prepares perfectly pure phosphorus by heating the crude product with chromic acid solution, washing and drying in a vacuum, first at 40°, then at 80°. It remains colourless in vacuum tubes in the dark, but on exposure it rapidly turns yellow. At 25° to 30° C. it is soft and flexible, but it hardens when strongly cooled, and can then only be cut with difficulty. The fracture is distinctly crystalline; large crystals, either regular dodecahedra or octahedra, may be obtained by crystallization from carbon bisulphide, sulphur chloride, &c., or by sublimation. It is a non-conductor of electricity. Its density at 0° is 1·836; this regularly diminishes up to the melting-point, 44·3°, when a sudden drop occurs. Molten phosphorus is a viscid, oily, highly refractive liquid, which may be supercooled to 32° before solidification. It boils at 290°, forming a colourless vapour which just about the boiling-point corresponds in density to tetratomic molecules, P_4; at 1500° to 1700°, however, Biltz and Meyer detected dissociation into P_2 molecules. Beckmann obtained P_4 molecules from the boiling-point of carbon bisulphide solutions, and Hertz arrived at the same conclusion from the lowering of the freezing-point in benzene solution; E. Paternò and Nasini, however, detected dissociation. Phosphorus is nearly insoluble in water, but dissolves in carbon bisulphide, sulphur chloride, benzene and oil of turpentine.

The element is highly inflammable, taking fire in air at 34° and burning with a bright white flame and forming dense white clouds of the pentoxide; in perfectly dry air or oxygen, however, it may be distilled unchanged, H. B. Baker showing that a trace of water vapour was necessary for combination to occur. When exposed to the air a stick of phosphorus undergoes slow combustion, which is revealed by a greenish-white phosphorescence when the stick is viewed in the dark. This phenomenon was minutely studied by Boyle, who found that solutions in some essential oils (oil of cloves) showed the same character, whilst in others (oils of mace and aniseed) there was no phosphorescence. He also noticed a strong garlic-like odour, which we now know to be due to ozone. Frederick Slare noticed that the luminosity increased when the air was rarefied, an observation confirmed by Hawksbee and Homberg, and which was possibly the basis of Berzelius's theory that the luminosity depended on the volatility of the element and not on the presence of oxygen. Lampadius, however, showed that there was no phosphorescence in a Torricellian vacuum; and other experimenters proved that oxygen was essential to the process. It depends on the partial pressure of the oxygen and also on temperature. In compressed air at ordinary temperature there is no glowing, but it may be brought about by heating. Again, in oxygen under ordinary conditions there is no phosphorescence, but if the gas be heated to 25° glowing occurs, as is also the case if the pressure be diminished or the gas diluted. It is also remarkable that many gases and vapours, *e.g.* Cl, Br, I,NH_3, N_2O, NO_2, H_2S, SO_2, CS_2, CH_4, C_2H_4, inhibit the phosphorescence.

The theory of this action is not settled. It is certain that the formation of hydrogen peroxide and ozone accompany the glowing, and in 1848 Schonbein tried to demonstrate that it depended on the ozone. E. Jungfleisch (*Comptes rendus*, 1905, 140, p. 444) suggested that it is due to the combustion of an oxide more volatile than phosphorus, a view which appears to be supported by the observations of Scharff (*Zeit. physik. Chem.*, 1908, 62, p. 178) and of L. and E. Bloch (*Comptes rendus*, 1908, 147, p. 842).

The element combines directly with the halogens, sulphur and selenium, and most of the metals burn in its vapour forming phosphides. When finely divided it decomposes water giving hydrogen phosphide; it also reduces sulphurous and sulphuric acids, and when boiled with water gives phosphine and hypophosphorous acid; when slowly oxidized under water it yields hypophosphoric acid.

Allotropic Phosphorus.—Several allotropic forms of phosphorus have been described, and in recent years much work has been done towards settling their identities. When the ordinary form immersed in water is exposed to light, it gradually loses its transparency and becomes coated with a thin film. This substance was regarded as an allotrope, but since it is not produced in non-aerated water it is probably an oxide. More important is the so-called "red phosphorus," which is produced by heating yellow phosphorus to about 230° for 24 hours in an inert atmosphere, or in closed vessels to 300°, when the change is effected in a few minutes. E. Kopp in 1844 and B. C. Brodie in 1853 showed that a trace of iodine also expedited the change. The same form is also produced by submitting ordinary phosphorus to the silent electric discharge, to sunlight or the ultra-violet light. Since this form does not inflame until heated to above 350°, it is manufactured in large quantities for consumption in the match industry. The process consists in heating yellow phosphorus in iron pots provided with air-tight lids, which, however, bear a long pipe open to the air. A small quantity of the phosphorus combines with the oxygen in the vessel, and after this the operation is practically conducted in an atmosphere of nitrogen with the additional safety from any risk of explosion. The product is ground under water, and any unchanged yellow form is eliminated by boiling with caustic soda, the product being then washed and dried and finally packed in tin boxes. The red variety is remarkably different from the yellow. It is a dark red microcrystalline powder, insoluble in carbon bisulphide, oil of turpentine, &c., and having a density of 2·2. It is stable to air and light, and does not combine with oxygen until heated to above 350° in air or 260° in oxygen, forming the pentoxide. It is also non-poisonous. When heated in a vacuum to 530° it sublimes, and on condensation forms microscopic needles.

Hittorf's phosphorus is another crystalline allotrope formed by heating phosphorus with lead in a sealed tube to redness, and removing the lead by boiling the product with nitric and hydrochloric acid. It is also obtained by heating red phosphorus under pressure to 580°. It forms a lustrous, nearly black crystalline mass, composed of minute rhombohedra. G. E. Linck and P. Möller (*Ber.*, 1908, 41, p. 1404) have affirmed that the product of the first process always contains lead. E. Cohen and J. Olie, Jun. (*Abs. Jour. Chem. Soc.*, 1909, ii. 998) regard red phosphorus as a solid solution of the white in Hittorf's, but this is contradicted by A. Stock (*Ber.*, 1909, 42, p. 4510), who points out that ordinary red phosphorus melts at 605°–610°, whilst Hittorf's melts at 620°; moreover, the latter is less reactive than the former at high temperatures.

Another form was obtained by R. Schenck (*Zeit. Elektrochem*, 1905, ii. 117) as a scarlet amorphous powder by deposition of solutions of phosphorus in the tri-iodide, tribromide or sulphide (P_4S_3). It phosphoresces in ozone, but not in air, and is non-poisonous; from its solution in alcoholic potash acids precipitate the hydride $P_{12}H_6$, and when heated it is transformed into the red modification. It has been used in combination with potassium chlorate as a composition for matches to strike on any surface. Finally a black phosphorus was described by Thénard as formed by rapidly-cooling melted phosphorus.

Phosphine (phosphoretted hydrogen), PH_3, a gas formed in the putrefaction of organic matter containing phosphorus, was obtained by Gengembre (*Crell's Ann.*, 1789, i. 450) by the action of potash upon phosphorus, the gas so prepared being spontaneously inflammable. Some time later Davy, by heating phosphorous acid, obtained a phosphoretted hydrogen which was not spontaneously inflammable. These gases were considered to be distinct until Le Verrier (*Ann. chim. phys.*, 1835 [2], 60, p. 174) showed that the inflammability of Gengembre's phosphine was due to small quantities of liquid phosphoretted hydrogen, P_2H_4. Phosphine may be prepared by the decomposition of calcium phosphide with water (P_2H_4 being formed simultaneously); by the decomposition of phosphorous and hypophosphorous acids when strongly heated; and by the action of solutions of the caustic alkalis on phosphorus: $P_4+3NaOH+3H_2O=PH_3+3NaH_2PO_2$; hydrogen and P_2H_4 are produced at the same time, and the gas may be freed from the latter substance by passing into a hydrochloric acid solution of cuprous chloride, and heating the solution, when pure phosphine is liberated (Riban, *Comptes rendus*, 58, p. 581). The pure gas may also be obtained by heating phosphonium iodide with caustic potash (A. W. Hofmann, *Ber.*, 1871, 4, p. 200); by the decomposition of crystalline calcium phosphide or of aluminium phosphide with water (H. Moissan, *Bull. soc. chim.*, 1899 (3), 21, p. 926; Matignon, *Comptes rendus*, 1900, 130, p. 1391); and by the reduction of phosphorous acid with nascent hydrogen.

It is a colourless, extremely poisonous gas, possessing a characteristic offensive smell, resembling that of rotting fish. It becomes liquid at -90° C., and solid at -133° C. (K. Olszewski, *Monats.*, 1866, 7, p. 371). It is only slightly soluble in water, but is readily soluble in solutions of copper sulphate, hypochlorous acid, and acid solutions of cuprous chloride. It burns with a brightly luminous flame, and is spontaneously inflammable at about 100° C. When mixed with oxygen it combines explosively if the mixture be under diminished pressure, and is violently decomposed by the halogens. It is also decomposed when heated with sulphur or with most metals, in the latter case with the liberation of hydrogen and formation of phosphide of the metal. It combines with the halide derivatives of boron and silicon to form, *e.g.* $PH_3{\cdot}2BF_3$, $2PH_3{\cdot}SiCl_4$ (Besson, *Comptes rendus*, 1890, 110, 80, pp. 240, 516; 1891, 113, p. 78), with the halogen acids to form phosphonium salts, PH_4X ($X=Cl,Br,I$), and with sodammonium and potassammonium to form PH_2Na, PH_2K (Joannis, *Comptes rendus*, 1894, 119, p. 557). It oxidizes slowly in air, and is a reducing agent. It decomposes when heated, hydrogen and red phosphorus being formed.

Liquid Phosphoretted Hydrogen, P_2H_4, first obtained by P. Thénard (*Comptes rendus*, 1844, 18, p. 652) by decomposing calcium phosphide with warm water, the products of reaction being then passed through a U tube surrounded by a freezing mixture (see also L. Gattermann, *Ber.*, 1890, 23, p. 1174). It is a colourless liquid which boils at 57°–58° C. It is insoluble in water, but soluble in alcohol and ether. It is very unstable, being readily decomposed by heat or light. By passing the products of the decomposition of calcium phosphide with water over granular calcium chloride, the P_2H_4 gives a new hydride, $P_{12}H_6$ and phosphine, the former being an odourless, canary-yellow, amorphous powder. When heated in a vacuum it evolves phosphine, and leaves an orange-red residue of a second new hydride, P_9H_2 (A. Stock, W. Böttcher, and W. Lenger, *Ber.*, 1909, 42, pp. 2839, 2847, 2853).

Solid Phosphoretted Hydrogen, P_4H_2, first obtained by Le Verrier (*loc. cit.*), is formed by the action of phosphorus trichloride on gaseous phosphine (Besson, *Comptes rendus*, 111, p. 972); by the action of water on phosphorus di-iodide and by the decomposition of calcium phosphide with hot concentrated hydrochloric acid. It is a yellow solid, which is insoluble in water. It burns when heated to about 200° C. Oxidizing agents decompose it with great violence. When warmed with alcoholic potash it yields gaseous phosphine, hydrogen and a hypophosphite. It reduces silver salts.

Phosphonium Salts.—The *chloride*, PH_4Cl, was obtained as a crystalline solid by Ogier (*Comptes rendus*, 1879, 89, p. 705) by combining phosphine and hydrochloric acid gas under a pressure of from 14–20 atmospheres; it can also be obtained at -30° to -35° C. under ordinary atmospheric pressure. It crystallizes in large transparent cubes, but rapidly dissociates into its constituents on exposure. The *bromide*, PH_4Br, was first obtained by H. Rose (*Pogg. Ann.*, 1832, 24, p. 151) from phosphine and hydrobromic acid; it also results when phosphorus is heated with hydrobromic acid to 100–120° C. in sealed tubes (Damoiseau, *Bull. soc. chim.*, 1881, 35, p. 49). It crystallizes in colourless cubes, is deliquescent, and often inflames spontaneously on exposure to air. It is readily decomposed by water and also by carbonyl chloride (Besson, *Comptes rendus*, 1896, 122, p. 140): $6PH_4Br + 5COCl_2 = 10HCl + 5CO + 6HBr + 2PH_3 + P_4H_2$. The *iodide*, PH_4I, first prepared by J. Gay-Lussac (*Ann. chim. phys.*, 1814, 91, p. 14), is usually obtained by the action of water on a mixture of phosphorus and iodine (A. W. Hofmann, *Ber.*, 1873, 6, p. 286). It is also prepared by the action of iodine on gaseous phosphine, or by heating amorphous phosphorus with concentrated hydriodic acid solution to 160° C. It crystallizes in large cubes and sublimes readily. It is a strong reducing agent. Water and the caustic alkalis readily decompose it with liberation of phosphine and the formation of iodides or hydriodic acid. It is also decomposed by carbonyl chloride (Besson, *loc. cit.*).

$$4PH_4I+8COCl_2=16HCl+8CO+P_2I_4+2P.$$

Just as the amines are derived from ammonia, so from phosphine are derived the primary, secondary and tertiary organic phosphines by the exchange of hydrogen for alkyl groups, and corresponding to the phosphonium salts there exists a series of organic phosphonium bases. The primary and secondary phosphines are produced when the alkyl iodides are heated with phosphonium iodide and zinc oxide to 150° C. (A. W. Hofmann, *Ber.*, 1871, 4, pp. 430, 605), thus: $2RI+2PH_4I+ZnO=2R{\cdot}PH_2{\cdot}HI+ZnI_2+H_2O$, $2RI+PH_4I+ZnO=R_2{\cdot}PH{\cdot}HI+ZnI_2+H_2O$. The reaction mixture on treatment with water yields the primary phosphine, the secondary phosphine being then liberated from its hydriodide by caustic soda. The tertiary phosphines, discovered by L. Thénard (*Comptes rendus*, 1845, 21, p. 144; 1847, 25, p. 892), are formed (together with the quaternary phosphonium salts) by heating alkyl iodides with phosphonium iodide to 150–180° C.: $PH_4I+3CH_3I=P(CH_3)_3HI+3HI$; $P(CH_3)_3HI+CH_3I=P(CH_3)_4I+HI$ (see also Fireman, *Ber.*, 1897, 30, p. 1088). They are also formed by the interaction of phosphorus trichloride and zinc alkyls (Cahours and Hofmann, *Ann.*, 1857, 104, p. 1): $2PCl_3+3Zn(C_2H_5)_2=3ZnCl_2+2P(C_2H_5)_3$.

The primary and secondary phosphines are colourless compounds, and with the exception of methyl phosphine are liquid at ordinary temperature. They possess an unpleasant odour, fume on exposure to air, show a neutral reaction, but combine with acids to form salts. They oxidize very rapidly on exposure, in many cases being spontaneously inflammable. On oxidation with nitric acid the primary compounds give monoalkyl phosphinic acids, $R{\cdot}PO(OH)_2$, the secondary yielding dialkyl phosphinic acids, $R_2PO(OH)$. The primary phosphines are very weak bases, their salts with acids being readily decomposed by water. The tertiary phosphines are characterized by their readiness to pass into derivatives containing pentavalent phosphorus, and consequently they form addition compounds with sulphur, carbon bisulphide, chlorine, bromine, the halogen acids and the alkyl halides with great readiness. On oxidation they yield phosphine oxides, $R_3P{\cdot}O$. The quaternary phosphonium salts resemble the corresponding nitrogen compounds. They are stable towards aqueous alkalis, but on digestion with moist silver oxide yield the phosphonium hydroxides, which are stronger bases than the caustic alkalis. They differ from the organic ammonium hydroxides in their behaviour when heated, yielding phosphine oxides and paraffin hydrocarbons: $R_4P{\cdot}OH=R_3PO+RH$. The boiling-points of some members of the series are shown in the table:—

	Primary.	Secondary.	Tertiary.
Methyl . . .	— 14° C.	25° C.	40–42° C.
Ethyl . . .	+ 25° C.	85° C.	128° C.
Isopropyl . . .	41° C.	118° C.	—
Isobutyl . . .	62° C.	153° C.	215° C.
Isoamyl . . .	107° C.	210–215° C.	300° C.(?)

The alkyl phosphinic acids are colourless crystalline compounds which are easily soluble in water and alcohol. They yield two series of salts, viz. $RHM{\cdot}PO_3$ and RM_2PO_3 ($M=$metal). The dialkyl phosphinic acids are also colourless compounds, the majority of which are insoluble in water. They yield only one series of salts.

Oxides.—Phosphorus forms three well-defined oxides, P_4O_6, P_2O_4 and P_2O_5; two others, P_4O and P_2O, have been described.

Phosphorus suboxide, P_4O, is said to be formed, mixed with the other oxides, when the element is burnt in a limited supply of air or in pure oxygen under reduced pressure (E. Jungfleisch, *Abs. Jour. Chem. Soc.*, 1907, ii. 761), and also when a solution of phosphorus in the trichloride or tribromide is exposed to light. It is a yellow or red powder which becomes dark red on heating; it is stable in air, and can be heated to 300° without decomposition. Its existence, however, has been denied by A. Stock (*Abs. Jour. Chem. Soc.*, 1910, ii. 121). The oxide P_2O was obtained by Besson (*Comptes rendus*, 1897, 124, p. 763; 1901, pp. 132, 1556) by heating a mixture of phosphonium bromide and phosphorus oxychloride in sealed tubes to 50°.

Phosphorus oxide, P_4O_6, discovered by Sage in 1777, is a product of the limited combustion of phosphorus in air. It may be conveniently prepared by passing a rapid current of air over burning phosphorus contained in a combustion tube, and condensing the product in a metal condenser, from which it may be removed by heating the condenser to 50°–60° (Thorpe and Tutton, *Jour. Chem. Soc.*, 1890, pp. 545, 632; 1891, p. 1019). Jungfleisch has obtained it by carrying out the combustion with oxygen under reduced pressure, or diluted with an inert gas. It forms crystals, apparently monoclinic, which melt at 22·5° to a clear, colourless, mobile liquid of boiling-point 173·1°. Its specific gravity is 2·135 at 21°. Vapour density and cryoscopic determinations point to the double formula, P_4O_6. It is comparatively stable up to 200°, but when heated in a sealed tube to 440° it gives phosphorus and the tetroxide P_2O_4. It is unaffected by light when pure, but if phosphorus be present, even in minute quantity, it turns yellow and ultimately dark red. It oxidizes on exposure to air to the pentoxide, and with a brilliant inflammation when thrown into oxygen at 50°–60°. It slowly reacts with cold water to form phosphorous acid; but with hot water it is energetically decomposed, giving much red phosphorus or the suboxide being formed with an explosive evolution of spontaneously inflammable phosphoretted hydrogen; phosphoric acid is also formed. With dilute alkalis phosphites are slowly formed, but with concentrated solutions the decomposition follows the same course as with hot water. With chlorine it gives phosphoryl and "metaphosphoryl" chlorides, the action being accompanied with a greenish flame; bromine gives phosphorus pentabromide and pentoxide which interact to give phosphoryl and "metaphosphoryl" bromides; iodine gives phosphorus di-iodide, P_2I_4, and pentoxide, P_2O_5; whilst hydrochloric acid gives phosphorus trichloride and phosphorous acid, which interact to form free phosphorus, phosphoric acid and hydrochloric acid. It combines violently with sulphur at 160° to form *phosphorus sulphoxide*, $P_4O_6S_4$, which forms highly lustrous tetragonal plates (after sublimation), melting at 102° and boiling at 295°; it is decomposed by water into sulphuretted hydrogen and metaphosphoric acid, the latter changing on standing into orthophosphoric acid. Sulphur trioxide and sulphuric acid oxidize phosphorus oxide, giving the pentoxide and sulphur dioxide, whilst sulphur chloride, S_2Cl_2, gives phosphoryl and thiophosphoryl chlorides, free sulphur and sulphur dioxide. Ammonia also reacts immediately, giving phosphorus diamide, $P(OH)(NH_2)_2$, and the corresponding ammonium salt. Phosphorous oxide is very poisonous, and is responsible for the caries set up in the jaws of those employed in the phosphorus industries (see below). It is probable, however, that pure phosphorous oxide vapour is odourless, and the odour of phosphorus as ordinarily perceived is that of a mixture of the oxide with ozone.

Phosphorus tetroxide, P_2O_4, was obtained by Thorpe and Tutton by heating the product of the limited combustion of phosphorus *in vacuo* as a sublimate of transparent, highly lustrous, orthorhombic crystals. They are highly deliquescent, and form with water a mixture of phosphorous and phosphoric acids: $P_2O_4+3H_2O=H_3PO_3+H_3PO_4$. The vapour density at about 1400° is 230, *i.e.* slightly less than that required by P_8O_{16} (West, *Jour. Chem. Soc.*, 1902, p. 923).

Phosphoric oxide, or *phosphorus pentoxide*, P_4O_{10}, formed when phosphorus is burned in an excess of air or oxygen, or from dry phosphorus and oxygen at atmospheric pressure (Jungfleisch, *loc. cit.*), was examined by Boyle and named "flowers of phosphorus" by Marggraf in 1740. It is a soft, flocculent powder, which on sublimation forms transparent, monoclinic crystals. It is extremely deliquescent, hissing when thrown into water, with which it combines to form phosphoric acid. It is reduced when heated with carbon to phosphorus, carbon monoxide being formed simultaneously. Its vapour density at 1400° points to the double formula (West, *Jour. Chem. Soc.*, 1896, p. 154).

Oxyacids.—Phosphorus forms several oxyacids: hypophosphorous acid, H_3PO_2, and hypophosphoric acid, $H_4P_2O_6$ or H_2PO_3, of which the anhydrides are unknown; phosphorous acid, H_3PO_3, derived from P_4O_6; monoperphosphoric acid, H_3PO_5; perphosphoric acid, $H_4P_2O_8$; and meta-, pyro-, and ortho-phosphoric acids, derived from P_4O_{10}, for which see PHOSPHATES.

Hypophosphorous acid, $HP(OH)_2$, discovered by Dulong in 1816, and obtained crystalline by Thomson in 1874 (*Ber.*, 7, p. 994), is prepared in the form of its barium salt by warming phosphorus with baryta water, removing the excess of baryta by carbon dioxide, and crystallizing the filtrate. The acid may be prepared by evaporating in a vacuum the solution obtained by decomposing the barium salt with the equivalent amount of sulphuric acid. The acid forms a white crystalline mass, melting at 17·4° and having a strong acid reaction. Exposure to air gives phosphorous and phosphoric acids, and on heating it gives phosphine and phosphoric acid. A characteristic reaction is the formation of a red precipitate of cuprous hydride, Cu_2H_2, when heated with copper sulphate solution to 60°. It is a monobasic acid forming salts which are permanent in air, but which are gradually oxidized in aqueous solution. On heating they yield phosphine and leave a residue of pyrophosphate, or a mixture of meta- and pyrophosphates, with a little phosphorus. They react as reducing agents. On boiling with caustic potash they evolve hydrogen, yielding a phosphate.

Phosphorous acid, $P(OH)_3$, discovered by Davy in 1812, may be obtained by dissolving its anhydride, P_4O_6, in cold water; by immersing sticks of phosphorus in a solution of copper sulphate contained in a well-closed flask, filtering from the copper sulphide and precipitating the sulphuric acid simultaneously formed by baryta water, and concentrating the solution *in vacuo*; or by passing chlorine into melted phosphorus covered with water, the first formed phosphorus trichloride being decomposed by the water into phosphorous and hydrochloric acids. It may also be prepared by leading a current of dry air into phosphorus trichloride at 60° and passing the vapours into water at 0°, the crystals thus formed being drained, washed with ice-cold water and dried in a vacuum. The crystals melt at 70°. The acid is very deliquescent, and oxidizes on exposure to air to phosphoric acid. It decomposes on heating into phosphine and phosphoric acid. It is an energetic reducing agent; for example, when boiled with copper sulphate metallic copper is precipitated and hydrogen evolved. Although nominally tribasic the commonest metallic salts are dibasic. Organic ethers, however, are known in which one, two and three of the hydrogen atoms are substituted (Michaelis and Becker, *Ber.*, 1897, 30, p. 1003). The metallic phosphites are stable both dry and in solution; when strongly heated they evolve hydrogen and yield a pyrophosphate, or, especially with the heavy metals, they give hydrogen and a mixture of phosphide and pyrophosphate.

Hypophosphoric acid, $H_4P_2O_6$ or H_2PO_3, discovered by Salzer in 1877 among the oxidation products of phosphorus by moist air, may be prepared by oxidizing phosphorus in an aqueous solution of copper nitrate, or by oxidizing sticks of phosphorus under water, neutralizing with sodium carbonate, forming the lead salt and decomposing this with sulphuretted hydrogen (J. Cavalier and E. Cornee, *Abs. Jour. Chem. Soc.*, 1910, ii. 31). The aqueous solution may be boiled without decomposition, but on concentration it yields phosphorous and phosphoric acids. Deliquescent, rectangular tablets of $H_4P_2O_6 2H_2O$ separate out on concentrating a solution in a vacuum, which on drying further give the acid, which melts at 55°, and decomposes suddenly when heated to 70° into phosphorous and metaphosphoric acids with a certain amount of hydrogen phosphide. The solution is stable to oxidizing agents such as dilute hydrogen peroxide and chlorine, but is oxidized by potassium permanganate to phosphoric acid; it does not reduce salts of the heavy metals. With silver nitrate it gives a white precipitate, $Ag_4P_2O_6$. The sodium salt, $Na_4P_2O_6{\cdot}10H_2O$, forms monoclinic prisms and in solution is strongly alkaline; the acid salt, $Na_3HP_2O_6{\cdot}9H_2O$, forms monoclinic tablets. The formula of the acid is not quite definite. Cryoscopic measurements on the sodium salt points to the double formula, but the organic esters appear to be derived from H_2PO_3 (see A. Rosenheim and M. Pritze, *Ber.*, 1908, 41, 2708; E. Cornee, *Abs. Jour. Chem. Soc.*, 1910, ii. 121).

Monoperphosphoric and *perphosphoric acids*, H_3PO_5 and $H_4P_2O_8$, were obtained by J. Schmidlin and P. Massini (*Ber.*, 1910, 43, 1162). The first is formed when 30% hydrogen peroxide reacts with phosphorus pentoxide or meta- or pyrophosphoric acids at low temperatures and the mixture diluted with ice-cold water. The solution is strongly oxidizing, even converting manganous salts to permanganates in the cold, a property not possessed by monopersulphuric acid. Perphosphoric acid is formed when pyrophosphoric acid is treated with a large excess of hydrogen peroxide.

Halogen Compounds.—*Phosphorus trifluoride*, PF_3, discovered by Davy, may be obtained mixed with the pentafluoride; by direct combination of its elements; from the tribromide and arsenic trifluoride (MacIvor); from the tribromide and zinc fluoride, and from dried copper phosphide and lead fluoride (H. Moissan). It is a colourless, non-fuming gas, which gives a colourless, mobile liquid at −10° and 20 atmospheres; the liquid boils at −95° and solidifies at −160° (Moissan, *Comptes rendus*, 1904, 138, p. 789). It does not burn in air, but explodes, under the action of a flame or the electric spark, when mixed with half its volume of oxygen, giving the oxyfluoride, POF_3. It is slowly decomposed by water giving hydrofluoric and phosphorous acids, or, in addition, fluorphosphorous acid, HPF_4. It has no action on glass in the cold, but when heated it gives phosphorus and silicon tetrafluoride. *Phosphorus pentafluoride*, PF_5, discovered by Thorpe (*Proc. Roy. Soc.*, 1877, 25, p. 122), may be obtained by burning the trifluoride in fluorine, from the pentachloride and arsenic trifluoride and from the trifluoride and bromine, the first formed fluorobromide, PF_3Br_2, decomposing into the pentabromide and pentafluoride: $5PF_3Br_2=3PF_5+2PBr_5$. It is a colourless gas $4\frac{1}{2}$ times heavier than air, and liquefies at 15° under 40 atmospheres, solidifying when the pressure is diminished. It is incombustible and extinguishes flame. It fumes in moist air and is quickly decomposed by water giving hydrofluoric and phosphoric acids. It does not dissociate on heating as do the pentachloride and pentabromide, thus indicating the existence of pentavalent phosphorus in a gaseous compound; dissociation, however, into the trifluoride and free fluorine may be brought about by induction sparks of 150 to 200 mm. in length. It combines directly with ammonia in the proportion $2PF_5:5NH_3$, and with nitrogen peroxide at −10° in the proportion $PF_5:NO_2$. *Phosphorus trifluorodichloride*, PF_3Cl_2, prepared from chlorine and the trifluoride, is a pungent-smelling gas, which at 250° gives the pentachloride and fluoride. The *trifluorodibromide* (see above) is an amber-coloured mobile liquid. *Phosphoryl trifluoride*, POF_3, may be obtained by exploding 2 volumes of phosphorus trifluoride with 1 volume of oxygen (Moissan, 1886); by heating 2 parts of finely-divided cryolite and 3 parts of phosphorus pentoxide (Thorpe and Hambly, *Jour. Chem. Soc.*, 1889, p. 759); or from phosphoryl chloride and zinc fluoride at 40° to 50°. It is a colourless fuming gas, which liquefies under ordinary pressure at −50°, and under a pressure of 15 atmospheres at 16°; it may be solidified to a snow-like mass. Water gives hydrofluoric and phosphoric acids. The corresponding sulphur compound, thiophosphoryl fluoride, PSF_3, obtained by heating lead fluoride and phosphorus pentasulphide to 200°, is a colourless gas, which may be condensed to a clear transparent liquid. It spontaneously inflames in air or oxygen; and when the gas is issuing from a jet into air the flame is greyish green, with a faintly luminous and yellow tip; the flame is probably one of the coldest known. The combustion probably follows the equation $PSF_3+O_2=PF_3+SO_2$, the trifluoride at a higher temperature decomposing according to the equations: $10PF_3+5O_2=6PF_5+2P_2O_5$, $2PF_3+O_2=2POF_3$, the complete reaction tending to the equation: $10PSF_3+15O_2=6PF_5+2P_2O_5+10SO_2$. The gas dissolves in water on shaking; $PSF_3+4H_2O=H_2S+H_3PO_4+3HF$, but is more readily taken up by alkaline solutions with the formation of fluoride and thiophosphate: $PSF_3+6NaOH=Na_3PSO_3+3NaF$. Heated in a glass tube it gives silicon fluoride, phosphorus and sulphur, $PSF_3=PF_3+S$; $4PF_3+3SiO_2=3SiF_4+P_4+3O_2$. Electric sparks give at first free sulphur and the trifluoride, the latter at a higher temperature splitting into the pentafluoride and phosphorus. With dry ammonia it gives ammonium fluoride and a compound $P(NH_2)_2SF$.

Phosphorus trichloride or *phosphorous chloride*, PCl_3, discovered by Gay-Lussac and Thénard in 1808, is obtained by passing a slow current of chlorine over heated red phosphorus or through a solution of ordinary phosphorus in carbon disulphide (purifying in the latter case by fractional distillation). It is a colourless, mobile liquid of specific gravity 1·6128 at 0° and boiling-point 76°. With chlorine it gives the pentachloride, PCl_5, and with oxygen when heated phosphoryl chloride, $POCl_3$. Water gives hydrochloric and phosphorous acids, with separation of red phosphorus if the water be hot. When led with hydrogen into liquid ammonia it gives $NH:PNH_2$, which on elevation of temperature gives $P_2(NH)_3$ (Joannis, *Comptes rendus*, 1904, 139, p. 364). By submitting a mixture of phosphorous chloride and hydrogen to an electric discharge A. Besson and A. Fournier (*Comptes rendus*, 1901, 150, p. 102) obtained phosphorus dichloride, P_2Cl_4, as a colourless, oily, strongly fuming liquid, freezing at −28° and boiling at 180° with decomposition. With water it gave phosphorous acid and a yellow indefinite solid. It decomposes slowly at ordinary temperatures. *Phosphorus pentachloride*, PCl_5, discovered by Davy in 1810 and analysed by Dulong in 1816, is formed from chlorine and the trichloride. It is a straw-coloured solid, which by fusion under pressure gives prismatic crystals. It sublimes when heated, but under pressure it melts at 148°, giving a normal vapour density, but on further heating it dissociates into the trichloride and chlorine; this dissociation may be retarded by vapourizing in an atmosphere of chlorine. It fumes strongly in moist air, giving hydrochloric acid and phosphoryl chloride, $POCl_3$; with water it gives phosphoric and hydrochloric acids.

Phosphoryl trichloride or *phosphorus oxychloride*, $POCl_3$, corresponding to phosphoric acid, $(HO)_3PO$, discovered in 1847 by Wurtz, may be produced by the action of many substances containing hydroxy groups on the pentachloride; from the trichloride and potassium chlorate; by leaving phosphorus pentoxide in contact with hydrochloric acid: $2P_2O_5+3HCl=POCl_3+3HPO_3$; or by heating the pentachloride and pentoxide under pressure: $3PCl_5+P_2O_5=5POCl_3$. It is a colourless liquid, boiling at 107·2°, and when solidified it melts at 0·8°. Water gives hydrochloric and phosphoric acids; dilute alcohol gives monoethyl phosphoric acid, $C_2H_5{\cdot}H_2PO_4$, whilst absolute alcohol gives triethyl phosphate, $(C_2H_5)_3PO_4$. *Pyrophosphoryl chloride*, $P_2O_3Cl_4$, corresponding to pyrophosphoric acid, was obtained by Geuther and Michaelis (*Ber.*, 1871, 4, p. 766) in the oxidation of phosphorus trichloride with nitrogen peroxide at low temperature; it is a colourless fuming liquid which boils at about 212° with some decomposition. With water it gives phosphoric and hydrochloric acids. *Thiophosphoryl chloride*, $PSCl_3$, may be obtained by the direct combination of sulphur with the trichloride; from sulphuretted hydrogen and the pentachloride; from antimony trisulphide and the pentachloride; by heating the pentasulphide with the pentachloride; and by dissolving phosphorus in sulphur chloride and distilling the solution: $2P+3S_2Cl_2=4S+2PSCl_3$. It is a colourless mobile liquid, boiling at 125·1° and having a pungent, slightly aromatic odour. It is slowly decomposed by water giving phosphoric and hydrochloric acids, with sulphuretted hydrogen; alkalis form a thiophosphate, *e.g.* $PS(OK)_3$, and a chloride.

Phosphorus tribromide, PBr_3, prepared by mixing solutions of its elements in carbon disulphide and distilling, is a transparent, mobile liquid, boiling at 173° and resembling the trichloride chemically. The *pentabromide*, PBr_5, which results from phosphorus and an excess of bromine, is a yellow solid, and closely resembles the pentachloride. The *bromochloride*, PCl_3Br_2, is an orange-coloured solid formed from bromine and the trichloride, into which components it decomposes at 35°. *Phosphoryl tribromide*, $POBr_3$, is a solid, melting at 45° and boiling at 195°. *Thiophosphoryl bromide*, $PSBr_3$, obtained after the manner of the corresponding chloride, forms yellow octahedra which melt at 38°, and have a penetrating, aromatic odour. With water it gives sulphur, sulphuretted hydrogen, hydrobromic, phosphorous and phosphoric acids, the sulphur and phosphorous acid being produced by the interaction of the previously formed sulphuretted hydrogen and phosphoric acid. *Pyrophosphoryl thiobromide*, $(PBr_2S)_2S$, and *metaphosphoryl thiobromide*, PS_2Br, are also known.

Phosphorus forms three iodides. The subiodide, P_4I, was obtained by R. Boulough (*Comptes rendus*, 1905, 141, p. 256), who acted with dry iodine on phosphorus dissolved in carbon disulphide; with alkalis it gives $P_4(OH)$. The di-iodide and tri-iodide are formed similarly; the first is deposited as orange-coloured prisms which melt at 110° to a red liquid (see Doughty, *Jour. Amer. Chem. Soc.*, 1905, 27, p. 1444), whilst the second forms dark-red hexagonal plates which melt at 55°.

Sulphides and Thio-acids.—Phosphorus and sulphur combine energetically with considerable rise of temperature to form sulphides. The researches of A. Stock (*Ber.*, 1908, 41, pp. 558, 657; 1909, 42, p. 2062; 1910, 43, pp. 150, 414) show that three exist, P_4S_3, P_4S_7, P_2S_5. The first is prepared by heating red phosphorus with finely powdered sulphur in a tube sealed at one end and filled with carbon dioxide. The product is extracted with carbon disulphide and the residue distilled in carbon dioxide. It forms light yellow crystals from benzene, which melt at 1725° and boil at 407°–408° with slight decomposition. Alkalis give hydrogen and phosphine. The second, P_4S_7, is obtained by heating a mixture of red phosphorus and sulphur in the proportions given by $P_4S_7+5\%\ P_4S_3$, and crystallizing from carbon disulphide in which P_4S_3 is readily soluble. It forms small, slightly yellow prisms, which melt at 310° and boil at 523°. The third, or pentasulphide, P_2S_5, was obtained as a substance resembling flowers of sulphur by A. Stock and K. Thiel (*Ber.*, 1905, 38, p. 2719; 1910, 43, p. 1223), who heated sulphur with phosphorus in carbon disulphide solution with a trace of iodine to 120°–130°. It exists in two forms, one having the formula P_4S_{10}, and the other a lower molecular weight. With liquid ammonia it gives $P_2S_5{\cdot}7NH_3$, which is a mixture of ammonium iminotrithiophosphate, $P(SNH_4)_3:NH$, and ammonium nitrilodithiophosphate, $P(SNH_4)_2⋮N$. Water converts the former into ammonium thiophosphate, $PO(SNH_4)_3.H_2O$, whilst the latter heated to 300° in a vacuum gives thiophosphoric nitrile, $N⋮P:S$ (Stock, ibid., 1906, 39, p. 1967).

Thiophosphates result on dissolving the pentasulphide in alkalis. Sodium monothiophosphate, $Na_3PSO_3{\cdot}12H_2O$, is obtained by adding one P_2S_5 to six NaOH, adding alcohol, dissolving the precipitate in water and heating to 90°. On cooling the salt separates as white six-sided tablets. Sodium dithiophosphate, $Na_3PS_2O_2{\cdot}11H_2O$, is obtained by heating the above solution only to 50°–55°, cooling and adding alcohol, which precipitates the dithio salt. On heating it gives the monothio salt. Sodium trithiophosphate appears to be formed when the pentasulphide acts with sodium hydrosulphide at 20°. All thiophosphates are decomposed by acids giving sulphuretted hydrogen and sometimes free sulphur. They also act in many cases as reducing agents.

Nitrogen Compounds.—Phosphorus pentachloride combines directly with ammonia, and the compound when heated to redness loses ammonium chloride and hydrochloric acid and gives phospham, PN_2H_4, a substance first described by Davy in 1811. It is a white, infusible, very stable solid, which decomposes water on heating, giving ammonia and metaphosphoric acid, whilst alkalis give an analogous reaction. With methyl and ethyl alcohols it forms secondary amines (Vidal, *Comptes rendus*, 1891, 112, p. 950; 1892, 115, p. 123). The diamide, PN_2H_4, was obtained by Hugot (ibid., 1905, 141, p. 1235) by acting with ammonia gas on phosphorus tribromide or tri-iodide at −70°; it is very unstable, and decomposes at −25°. Phosphorus combines with nitrogen and chlorine to form several polymeric substances of the general formula $(PNCl_2)\,x$, where x may be 1, 3, 4, 5, 6, 7, or 11; they may be obtained by heating the pentachloride with ammonium chloride in a sealed tube and separating the mixture by fractional distillation (H. N. Stokes, *Amer. Chem. Jour.*, 1898, 20, p. 740; also see Besson and Rosset, *Comptes rendus*, 1906, 37, p. 143). The commonest form is $P_3N_3Cl_6$, a crystalline solid, insoluble in water, but soluble in alcohol and ether. Several phosphoamides have been described. The diamide, $PO\,(NH_2)(NH)$, results when the pentachloride is saturated with ammonia gas and the first formed chlorophosphamide, $PCl_3(NH_2)_2$, is decomposed by water. The triamide, $PO(NH_2)_3$, results from ammonia and phosphorus oxychloride. Both these compounds on heating give phosphomonamide, PON, of which a polymer $(PON)_2$ had been described by Oddo (*Gazz. chim. Ital.*, 1899, 29 (ii.), p. 330). Stokes (*Amer. Chem. Jour.*, 1893, 15, p. 198; 1894, 16, pp. 123, 154) has described $PO(OH)_2NH_2$ and $PO(OH)(NH_2)_2$, whilst the compound $PO(OH)NH$ was obtained by Schiff (*Ann.*, 1857, 103, p. 168) by acting with ammonia on the pentoxide. Numerous other nitrogen compounds have been obtained.

The atomic weight of phosphorus was determined by Berzelius, Pélouze, Jacquelin, Dumas, Schrötter, Brodie and van der Plaats. More recent are the investigations of G. Ter Gazarian (*Compt. rend.*, 1909, 148, p. 1397) on hydrogen phosphide, which gave the value 30·906, and of G. P. Baxter and G. Jones (*Journ. Amer. Chem. Soc.*, 1910, 32, p. 298) on silver phosphate, which gave the value 31·04.

Therapeutics.—The phosphorus used in the British pharmacopoeia is obtained from calcium phosphate, and is a waxlike non-metallic substance soluble in oils and luminous in the dark. There are various medicinal preparations. In young animals phosphorus has a remarkable influence on the growth of bone, causing a proliferation of the jelly-like masses and finally a deposit in them of true bony material. Owing to this influence it has been used in rickets and osteomalacia. Its most effective use, however, is as a nerve tonic in paralysis agitans, locomotor ataxia, impotence and nervous exhaustion. In some skin diseases such as psoriasis, chronic eczema and acne indurata, phosphorus is very useful, and cases of diabetes mellitus and lymphadenoma have improved under some of its compounds. The hypophosphites have been recommended in pulmonary affections, being said to act as free phosphorus without being irritant, and the glycero-phosphates are certainly useful to stimulate metabolism. Dilute phosphoric acid is used as a gastric stimulant. It does not resemble phosphorus in its physiological action and cannot be used to replace it.

Toxicology.—Poisonous amounts of phosphorus are frequently taken or administered, criminally or accidentally, it being easily accessible to the public in the form of matches or of vermin pastes. They may have been swallowed several hours before symptoms of acute poisoning show themselves, with nausea and vomiting, and a burning in the oesophagus, stomach and abdomen. The important thing is to prevent the absorption of the poison, so emetics and purgatives should be given at once. Sulphate of copper, in doses of 3 to 5 gr., freely diluted and repeated every few minutes forms the harmless, black phosphide of copper, which is rapidly eliminated by the kidneys. The stomach may be washed out with warm water and then with a 2% solution of permanganate of potash, an enema of the same solution being given. The old French oil of turpentine is the best antidote to use in phosphorus poisoning, delaying the toxic effects; but ordinary oils are not only useless but harmful. When some time has elapsed before treatment and the phosphorus has become absorbed, the organic degenerative changes cannot be easily controlled. For the chronic form of industrial poisoning in the manufacture of lucifer matches—a form of necrosis, known in England as "phossy jaw" and in France as "*mal chimique*," a localized inflammatory infection of the periosteum, ending with the death and exfoliation of part of the bone—see MATCH.

PHOTIUS (*c.* 820–891), patriarch of Constantinople (858–867 and 878–886). From his early years he displayed an extraordinary talent and appetite for knowledge, and as soon as he had completed his own education he began to teach with distinguished success grammar, rhetoric, divinity and philosophy. The way to public life was probably opened for him by the marriage of his brother Sergius to the princess Irene, sister of Theodora, who, upon the death of her husband Theophilus in 842, had assumed the regency of the empire. Photius became captain of the guard and subsequently first imperial secretary. The dissensions between the patriarch Ignatius and Bardas, the uncle of the youthful Emperor Michael III., brought promotion to Photius. Ignatius was arrested and imprisoned (Nov. 858), and upon refusing to resign his office was illegally deposed, while Photius, although a layman, received all the necessary sacerdotal orders within six days, and was installed as patriarch in his place. Ignatius, continuing to refuse the abdication which could alone have given Photius's elevation a semblance of legality, was treated with extreme severity. His cause was subsequently espoused by Pope Nicholas in a manner highly offensive to the independent feeling of the Eastern Church. Photius felt himself the champion of Eastern Christianity against Latin pretensions; and when in 863 Nicholas finally anathematized and deposed him, he replied by a counter-excommunication. Meanwhile, the situation was suddenly changed by the murder of Photius's patron, Bardas, by order of the emperor Michael, who was himself assassinated by his colleague Basil in the following year (867). The fall of Photius immediately ensued; he was removed from his office and banished about the end of September 867, a few days after the accession of Basil, and Ignatius was reinstated on the 23rd of November. About 876 Photius was suddenly recalled to Constantinople and entrusted with the education of Basil's children. On the death of Ignatius, probably in October 878, Photius, after a decent show of reluctance, again filled the patriarchal throne. He then proceeded to obtain the formal recognition of the Christian world. In November 879 a synod was convened at Constantinople. The legates of Pope John VIII. attended, prepared to acknowledge Photius as legitimate patriarch, a concession for which John was much censured by Latin opinion. He stood firm, however, on the other two points which had long been contested between the Eastern and Western Churches, the ecclesiastical jurisdiction over Bulgaria and the introduction of the "filioque" clause into the creed. He disowned his legates, who had shown a tendency to yield, again excommunicated Photius, and thus aroused the open hostility which has never been appeased to this day. Strong in the support of the council, Photius simply ignored him. At the height of glory and success he was suddenly precipitated from his dignity by another palace revolution. After the death of Basil (886), his son and successor Leo, who had formerly been devoted to Photius, but in recent years displayed great hatred towards him, deprived him of his office and banished him to the monastery of Bordi in Armenia. From this time Photius disappears from history. No letters of this period of his life are extant, which leads to the inference that his imprisonment was severe. The precise date of his death is not known, but it is said to have occurred on the 6th of February 891.

For long after Photius's death his memory was held in no special honour by his countrymen. But when, in the crusading age, the Greek Church and state were alike in danger from Latin encroachments, Photius became a national hero, and is at present regarded as little short of a saint. To this character he has not the least pretension. Few men, it is probable, have been more atrociously calumniated; but, when every specific statement to his prejudice has been rejected, he still appears on a general review of his actions worldly, crafty and unscrupulous. Yet he shows to no little advantage as an ecclesiastical statesman. His firmness was heroic, his sagacity profound and far-seeing; he supported good and evil fortune with equal dignity; and his fall was on both occasions due to revolutions beyond his control. In erudition, literary power, and force and versatility of intellect he far surpassed every contemporary.

The most important of the works of Photius is his renowned *Bibliotheca* or *Myriobiblon* (ed. I. Bekker, 1824–1825), a collection of extracts from and abridgments of 280 volumes of classical authors (usually cited as *Codices*), the originals of which are now to a great extent lost. The work is specially rich in extracts from historical writers. To Photius we are indebted for almost all we possess of Ctesias, Memnon, Conon, the lost books of Diodorus Siculus, and the lost writings of Arrian. Theology and ecclesiastical history are also very fully represented, but poetry and ancient philosophy are almost entirely ignored. It seems that he did not think it necessary to deal with those authors with whom every well-educated man would naturally be familiar. The literary criticisms, generally distinguished by keen and independent judgment, and the excerpts, vary considerably in length. The numerous biographical notices are probably taken from the work of Hesychius of Miletus. The *Lexicon* (Λέξεων Συναγωγή), published later than the *Bibliotheca*, was probably in the main the work of some of his pupils. It was intended as a book of reference to facilitate the reading of old classical and sacred authors, whose language and vocabulary were out of date. The only MS. of the *Lexicon* is the Codex Galeanus, formerly in the possession of Thomas Gale (*q.v.*), and now in the library of Trinity College, Cambridge (ed. S. A. Naber, 1864, with introduction on the authorities, critical commentary, and valuable indexes). His most important theological work is the *Amphilochia*, a collection of some 300 questions and answers on difficult points in Scripture, addressed to Amphilochius, archbishop of Cyzicus (ed. Sophocles Oeconomus, Athens, 1858). Other similar works are his treatise in four books against the Manichaeans and Paulicians, and his controversy with the Latins on the Procession of the Holy Spirit. His *Epistles*, political and private, addressed to high church and state dignitaries, are valuable for the light they throw upon the character and versatility of the writer (ed. J. Valettas, London, 1864). A large number of his speeches and homilies have been edited by S. Aristarches (1900). The only complete edition is Bishop Malou's in Migne's *Patrologia graeca*, ci.–cv. R. Reifzenstein (*Der Anfang des Lexikons des Photius*, 1907) has published a hitherto unedited MS. containing numerous fragments from various verse and prose authors.

After the allusions in his own writings the chief contemporary authority for the life of Photius is his bitter enemy, Nicetas the Paphlagonian, the biographer of his rival Ignatius. The standard modern work is that of Cardinal Hergenröther, *Photius, Patriarch von Constantinopel* (1867–1869). As a dignitary of the Roman Catholic Church, Cardinal Hergenröther is inevitably biased against Photius as an ecclesiastic, but his natural candour and sympathy with intellectual eminence have made him just to the man.

See also article by F. Kattenbusch in Herzog-Hauck's *Realencyklopädie für protestantische Theologie* (1904), containing full bibliographical details; J. A. Fabricius, *Bibliotheca graeca*, x. 670–776, xi. 1–37; C. Krumbacher, *Geschichte der byzantinischen Litteratur*, pp. 73–79, 515–524 (2nd ed., 1897); J. E. Sandys, *History of Classical Scholarship* (2nd ed., 1906).

PHOTOCHEMISTRY (Gr. φῶs, light, and "chemistry"), in the widest sense, the branch of chemical science which deals with the optical properties of substances and their relations to chemical constitution and reactions; in the narrower sense it is concerned with the action of light on chemical change. The first definition includes such subjects as refractive and dispersive power, colour, fluorescence, phosphorescence, optical isomerism, spectroscopy, &c.—subjects which are treated under other headings; here we only discuss the subject matter of the narrower definition.

Probably the earliest photochemical investigations were associated with the darkening of certain silver salts under the action of light, processes which were subsequently utilized in photography (*q.v.*). At the same time, however, it had been observed that other chemical changes were regulated by the access of light; and the first complete study of such a problem was made by J. W. Draper in 1843, who investigated the combination of hydrogen and chlorine to form hydrochloric acid, a reaction which had been previously studied by Gay-Lussac and Thénard. Draper concluded that the first action of sunlight consisted in producing an allotrope of chlorine, which subsequently combined with the hydrogen. This was denied by Bunsen and Roscoe in 1857; and in 1887 Pringsheim suggested that the reaction proceeded in two stages: $H_2O + Cl_2 = Cl_2O + H_2$, $2H_2 + Cl_2O = H_2O + 2HCl$. This view demands the presence of water vapour (H. B. Baker showed that the perfectly dry gases would not combine), and also explains the period which elapses before the reaction commenced (the "photochemical induction" of Bunsen and Roscoe) as taken up by the formation of the chlorine monoxide necessary to the second part of the reaction. The decomposition of hydriodic acid into hydrogen and iodine was studied by Lemoine in 1877, who found that 80% decomposed after a month's exposure; he also observed that the reaction proceeded quicker in blue vessels than in red. A broader investigation was published by P. L. Chastaing in 1878, who found that the red rays generally oxidized inorganic compounds, whilst the violet reduces them, and that with organic compounds the action was entirely oxidizing. These and other reactions suggested the making of actinometers, or instruments for measuring the actinic effect of light waves. The most important employ silver salts; Eder developed a form based on the reaction between mercuric chloride and ammonium oxalate: $2HgCl_2 + (NH_4)_2C_2O_4 = 2HgCl + 2NH_4Cl + 2CO_2$, the extent of the decomposition being determined by the amount of mercurous chloride or carbon dioxide liberated.

The article PHOTOGRAPHY (*q.v.*) deals with early investigations on the chemical action of light, and we may proceed here to modern work on organic compounds. That sunlight accelerates the action of the halogens, chlorine and bromine, on such compounds, is well known. John Davy obtained phosgene, $COCl_2$, by the direct combination of chlorine and carbon monoxide in sunlight (see Weigert, *Ann. d. Phys.*, 1907 (iv.), 24, p. 55); chlorine combines with half its volume of methane explosively in sunlight, whilst in diffused light it substitutes; with toluene it gives benzyl chloride, $C_6H_5CH_2Cl$, in sunlight, and chlortoluene, $C_6H_4(CH)_3Cl$, in the dark; with benzene it gives an addition product, $C_6H_6Cl_6$, in sunlight, and substitutes in the dark. Bromine deports itself similarly, substituting and forming addition products with unsaturated compounds more readily in sunlight. Sometimes isomerization may occur; for instance, Wislicenus found that angelic acid gave dibromangelic acid in the dark, and dibromtiglic acid in sunlight. Many substances decompose when exposed to sunlight; for example, alkyl iodides darken, owing to the liberation of iodine; aliphatic acids (especially dibasic) in the presence of uranic oxide lose carbon dioxide; polyhydric alcohols give products identical with those produced by fermentation; whilst aliphatic ketones give a hydrocarbon and an acid.

Among aromatic compounds, benzaldehyde gives a trimeric and tetrameric benzaldehyde, benzoic acid and hydrobenzoin (G. L. Ciamician and P. Silber, *Atti. R. Accad. Lincei*, 1909); in alcoholic solution it gives hydrobenzoin; whilst with nitrobenzene it is oxidized to benzoic acid, the nitrobenzene suffering reduction to nitrosobenzene and phenyl-β-hydroxylamine; the latter isomerizes to ortho- and para-aminophenol, which, in turn, combine with the previously formed benzoic acid. Similarly acetophenone and benzophenone in alcoholic solution give dimethylhydrobenzoin and benzopinacone. With nitro compounds Sach and Hilbert concluded that those containing a ·CH· side group in the ortho position to the $\cdot NO_2$ group were decomposed by light. For example, ortho-nitrobenzaldehyde in alcoholic solution gives nitrosobenzoic ester and 22′ azoxybenzoic acid, with the intermediate formation of nitrobenzaldehydediethylacetal, $NO_2 \cdot C_6H_4 \cdot CH(OC_2H_5)_2$ (E. Bamberger and F. Elgar, *Ann.* 1910, 371, p. 319). Bamberger also investigated nitrosobenzene, obtaining azoxybenzene as chief product, together with various azo compounds, nitrobenzene, aniline, hydroquinone and a resin.

For the photochemistry of diazo derivatives see Ruff and Stein, *Ber.*, 1901, 34, p. 1668, and of the terpenes see G. L. Ciamician and P. Silber, *Ber.*, 1907 and 1908.

Light is also powerful in producing isomerization and polymerization. Isomerization chiefly appears in the formation of stable stereo-isomers from the labile forms, and more rarely in inducing real isomerization or phototropy (Marckwald, 1899). As examples we may notice the observation of Chattaway (*Journ. Chem. Soc.* 1906, 89, p. 462) that many phenylhydrazones (yellow) change into azo compounds (red), of M. Padoa and F. Graziani (*Atti. R. Accad. Lincei*, 1909) on the β-naphthylhydrazones (the α-compounds are not phototropic), and of A. Senier and F. G. Shepheard (*Journ. Chem. Soc.*, 1909, 95, p. 1943) on the arylidene- and naphthylidene-amines, which change from yellow to orange on exposure to sunlight. Light need not act in the same direction as heat (changes due to heat may be termed *thermotropic*). For example, heat changes the α form of benzyl-β-aminocrotonic ester into the β form, whereas light reverses this; similarly heat and light have reverse actions with *as*-diphenyl ethylene, $CH_2 : C(C_6H_5)_2$ (R. Stoermer, *Ber.*, 1909, 42, p. 4865); the change, however, is in the same direction with Senier and Shepheard's compounds. With regard to polymerization we may notice the production of benzene derivatives from acetylene and its homologues, and of tetramethylenes from the olefines.

Theory of Photochemical Action.—Although much work has been done in the qualitative and quantitative study of photochemical reactions relatively little attention has been given to the theoretical explanation of these phenomena. That the solution was to be found in an analogy to electrolysis was suggested by Grotthuss in 1818, who laid down: (1) only those rays which are absorbed can produce chemical change, (2) the action of the light is analogous to that of a voltaic cell; and he regarded light as made up of positive and negative electricity. The first principle received early acceptance; but the development of the second is due to W. D. Bancroft who, in a series of papers in the *Journal of Physical Chemistry* for 1908 and 1909, has applied it generally to the reactions under consideration. Any electrolytic action demands a certain minimum electromotive force; this, however, can be diminished by suitable depolarizers, which generally act by combining with a product of the decomposition. Similarly, in some photochemical reactions the low electromotive force of the light is sufficient to induce decomposition, but in other cases a depolarizer must be present. For example, ferric chloride in aqueous solution is unchanged by light, but in alcoholic solution reduction to ferrous chloride occurs, the liberated chlorine combining with the alcohol. In the same way Bancroft showed that the solvent media employed in photographic plates act as depolarizers. The same theory explains the action of sensitizers, which may act optically or chemically. In the first case they are substances having selective absorption, and hence alter the sensitivity of the system to certain rays. In the second case there are no strong absorption bands, and the substances act by combining with the decomposition products. Bancroft applied his theory to the explanation of photochemical oxidation, and also to the chlorination and bromination of hydrocarbons. In the latter case it is supposed that the halogen produces ions; if the positive ions are in excess side chains are substituted, if the negative the nucleus.

Standard treatises are: J. M. Eder, *Handbuch der Photographie*, vol. i. pt. 2 (1906); H. W. Vogel, *Photochemie* (1906). An account of the action of light on organic compounds is given in A. W. Stewart, *Recent Advances in Organic Chemistry* (1908).

PHOTOGRAPHY (Gr. φῶς, light, and γράφειν, to write), the science and art of producing pictures by the action of light on chemically prepared (sensitized) plates or films.

History.

It would be somewhat difficult to fix a date when what we now know as "photographic action" was first recorded. No doubt the tanning of the skin by the sun's rays was what was first noticed, and this is as truly the effect of solar radiation as is the darkening of the sensitive paper which is now in use in photographic printing operations. We may take it that K. W. Scheele was the first to investigate the darkening action of sunlight on silver chloride. He found that when silver chloride was exposed to the action of light beneath water there was dissolved in the fluid a substance which, on the addition of lunar caustic (silver nitrate), caused the precipitation of new silver chloride, and that on applying a solution of ammonia to the blackened chloride an insoluble residue of metallic silver was left behind. He also noticed that of the rays of the spectrum the violet most readily blackened the silver chloride. In Scheele, then, we have the first who applied combined chemical and spectrum analysis to the science of photography. In 1782 J. Senebier repeated Scheele's experiments, and found that in fifteen seconds the violet rays blackened silver chloride as much as the red rays did in twenty minutes.[1] In 1798 Count Rumford contributed a paper to the *Philosophical Transactions* entitled "An inquiry concerning the chemical properties that have been attributed to light," in which he tried to demonstrate that all effects produced on metallic solution could be brought about by a temperature somewhat less than that of boiling water. Robert Harrup in 1802, however, conclusively showed in *Nicholson's Journal* that, at all events, salts of mercury were reduced by visible radiation and not by change of temperature.

In 1801 we come to the next decided step in the study of photographic action, when Johann Wilhelm Ritter (1776–1810) proved the existence of rays lying beyond the violet, and found that they had the power of blackening silver chloride. Such a discovery naturally gave a direction to the investigations of others, and Thomas Johann Seebeck (1770–1831) (between 1802 and 1808) and, in 1812, Jacques Étienne Bérard (1789–1869) turned their attention to this particular subject, eliciting valuable information. We need only mention two or three other cases where the influence of light was noticed at the beginning of the 19th century. William Hyde Wollaston observed the conversion of yellow gum guaiacum into a green tint by the violet rays, and the restoration of the colour by the red rays—both of which are the effect of absorption of light, the original yellow colour of the gum absorbing the violet rays, whilst the green colour to which it is changed absorbs the red rays. Sir Humphry Davy found that puce-coloured lead oxide, when damp, became red in the red rays, whilst it blackened in the violet rays, and that the green mercury oxide became red in the red rays—again an example of the necessity of absorption to effect a molecular or chemical change in a substance. U. R. T. Le Bouvier Desmorties in 1801 observed the change effected in Prussian blue, and Carl Wilhelm Böckman noted the action of the two ends of the spectrum on phosphorus, a research which John William Draper extended farther in America at a later date.

To England belongs the honour of first producing a photograph by utilizing Scheele's observations on silver chloride. In June 1802 Thomas Wedgwood (1771–1805) published in the *Journal* of the Royal Institution the paper—"An account of a method of copying paintings upon glass and of making profiles by the agency of light upon nitrate of silver, with observations by H. Davy." He remarks that white paper or white leather moistened with a solution of silver nitrate undergoes no change when kept in a dark place, but on being exposed to the daylight it speedily changes colour, and, after passing through various shades of grey and brown, becomes at length nearly black. The alteration of colour takes place more speedily in proportion as the light is more intense.

> "In the direct beam of the sun two or three minutes are sufficient to produce the full effect, in the shade several hours are required, and light transmitted through different-coloured glasses acts upon it with different degrees of intensity. Thus it is found that red rays, or the common sunbeams passed through red glass, have very little action upon it; yellow and green are more efficacious, but blue and violet light produce the most decided and powerful effects."

Wedgwood goes on to describe the method of using this prepared paper by throwing shadows on it, and inferentially by what we now call "contact printing." He states that he has been unable to fix his prints, no washing being sufficient to eliminate the traces of the silver salt which occupied the unexposed or shaded portions. Davy in a note states that he has found that, though the images formed by an ordinary camera obscura were too faint to print out in the solar microscope, the images of small objects could easily be copied on such paper.

> "In comparing the effects produced by light upon muriate of silver (silver chloride) with those upon the nitrate it seemed evident that the muriate was the more susceptible, and both were more readily acted upon when moist than when dry—a fact long ago known. Even in the twilight the colour of the moist muriate of silver, spread upon paper, slowly changed from white to faint violet; though under similar circumstances no intermediate alteration was produced upon the nitrate. . . . Nothing but a method of preventing the unshaded parts of the delineations from being coloured by exposure to the day is wanting to render this process as useful as it is elegant."

In this method of preparing the paper lies the germ of the silver-printing processes of modern times, and it was only by the spread of chemical knowledge that the hiatus which was to render the "process as useful as it is elegant" was filled up—when sodium thiosulphate (hyposulphite of soda), discovered by François Chaussier in 1799, or three years before Wedgwood published his paper, was used for making the print permanent. Here we must call attention to an important observation by Seebeck of Jena in 1810. In the *Farbenlehre* of Goethe he says:—

> "When a spectrum produced by a properly constructed prism is thrown upon moist chloride of silver paper, if the printing be continued for from fifteen to twenty minutes, whilst a constant position for the spectrum is maintained by any means, I observe the following. In the violet the chloride is a reddish brown (sometimes more violet, sometimes more blue), and this coloration extends well beyond the limit of the violet; in the blue the chloride takes a clear blue tint, which fades away, becoming lighter in the green. In the yellow I usually found the chloride unaltered; sometimes, however, it had a light yellow tint; in the red and beyond the red it took a rose or lilac tint. This image of the spectrum shows beyond the red and the violet a region more or less light and uncoloured. This is how the decomposition of the silver chloride is seen in this region. Beyond

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[1] It may here be remarked that had he used a pure spectrum he would have found that the red rays did not blacken the material in the slightest degree.

the brown band, . . . which was produced in the violet, the silver chloride was coloured a grey-violet for a distance of several inches. In proportion as the distance from the violet increased, the tint became lighter. Beyond the red, on the contrary, the chloride took a feeble red tint for a considerable distance. When moist chloride of silver, having received the action of light for a time, is exposed to the spectrum, the blue and violet behave as above. In the yellow and red regions, on the other hand, it is found that the silver chloride becomes paler; . . . the parts acted upon by the red rays and by those beyond take a light coloration."

This has been brought forward by J. M. Eder as being the first record we have of photographic action lending itself to production of natural colours. This observation of Seebeck was allowed to lie fallow for many years, until it was again taken up and published as a novelty.

The first to found a process of photography which gave pictures that were subsequently unaffected by light was Nicéphore de Niepce. His process, which he called provisionally "héliographie, dessins, et gravures," consists in coating the surface of a metallic plate with a solution of asphaltum in oil of lavender and exposing it to a camera image. He recommends that the asphaltum be powdered and the oil of lavender dropped upon it in a wine-glass, and that it be then gently heated. A polished plate is covered with this varnish, and, when dried, is ready for employment in the camera. After requisite exposure, which is very long indeed, a very faint image, requiring development, is seen. Development is effected by diluting oil of lavender with ten parts by volume of white petroleum. After this mixture has been allowed to stand two or three days it becomes clear and is ready to be used. The plate is placed in a dish and covered with the solvent. By degrees the parts unaffected by light dissolve away, and the picture, formed of modified asphaltum, is developed. The plate is then lifted from the dish, allowed to drain, and finally freed from the remaining solvents by washing in water. Subsequently, instead of using oil of lavender as the asphaltum solvent, Niepce employed an animal oil, which gave a deeper colour and more tenacity to the surface-film.

Later, Louis Jacques Mandé Daguerre (1789–1851) and Niepce used as a solvent the brittle residue obtained from evaporating the oil of lavender dissolved in ether or alcohol—a transparent solution of a lemon-yellow colour being formed. This solution was used for covering glass or silver plates, which, when dried, could be used in the camera. The time of exposure varied somewhat in length. Daguerre remarked that "the time required to procure a photographic copy of a landscape is from seven to eight hours, but single monuments, when strongly lighted by the sun, or which are themselves very bright, can be taken in about three hours." Perhaps there is no sentence that illustrates more forcibly the advance made in photography from the days when this process was described. The ratio of three hours to $\frac{1}{250}$th of a second is a fair estimate of the progress made since Niepce. The development was conducted by means of petroleum-vapour, which dissolved the parts not acted upon by light. As a rule silver plates seem to have been used, and occasionally glass; but it does not appear whether the latter material was chosen because an image would be projected through it or whether simply for the sake of effect. Viewed in the light of present knowledge, a more perfectly developable image in half-tone would be obtained by exposing the film through the *back* of the glass. The action of light on most organic matter is apparently one of oxidation. In the case of asphaltum or bitumen of Judaea the oxidation causes a hardening of the material and an insolubility in the usual solvents. Hence that surface of the film is generally hardened first which first feels the influence of light. Where half-tones exist, as in a landscape picture, the film remote from the surface first receiving the image is not acted upon at all, and remains soluble in the solvent. It is thus readily seen that, in the case of half-tone pictures, or even in copying engravings, if the action were not continued sufficiently long when the surface of the film farthest from the glass was first acted upon, the layer next the glass would in some places remain soluble, and on development would be dissolved away, carrying the top layer of hardened resinous matter with it, and thus give rise to imperfect pictures. In carbon-printing development from the back of the exposed film is absolutely essential, since it depends on the same principles as does heliography, and in this the same mode of procedure is advisable.

It would appear that Niepce began his researches as early as 1814, but it was not till 1827 that he had any success worth recounting. At that date he communicated a paper to Dr Bauer of Kew, the secretary of the Royal Society of London, with a view to its presentation to that society. Its publication, however, was prevented because the process, of which examples were shown, was a secret one. In an authentic MS. copy of Niepce's "Mémoire," dated "Kew, le 8 Décembre 1827," he says that "in his framed drawings made on tin the tone is too feeble, but that by the use of chemical agents the tone may be darkened." This shows that Niepce was familiar with the idea of using some darkening medium even with his photographs taken on tin plates.

Daguerreotype.—We have noticed in the joint process of Daguerre and Niepce that polished silver plates were used, and we know from the latter that amongst the chemical agents tried iodine suggested itself. Iodine vapour or solution applied to a silvered plate would cause the formation of silver iodide on those parts not acted upon by light. The removal of the resinous picture would leave an image formed of metallic silver, whilst the black parts of the original would be represented by the darker silver iodide. This was probably the origin of the daguerreotype process. Such observers as Niepce and Daguerre, who had formed a partnership for prosecuting their researches, would not have thus formed silver iodide without noticing that it changed in colour when exposed to the light. What parts respectively Daguerre and Niepce played in the development of the daguerreotype will probably never be known with absolute accuracy, but in a letter from Dr Bauer to Dr J. J. Bennett, F.R.S., dated the 7th of May 1839, the former says:—

> "I received a very interesting letter from Mons. Isidore Niepce, dated 12th March [about a month after the publication of the daguerreotype process], and that letter fully confirms what I suspected of Daguerre's manœuvres with poor Nicéphore, but Mr Isidore observes that for the present that letter might be considered confidential."

Dr Bauer evidently knew more of "poor Nicéphore's" work than most people, and at that early period he clearly thought that an injustice had been done to Niepce at the hands of Daguerre. It should be remarked that Nicéphore de Niepce died in 1833, and a new agreement was entered into between his son Isidore de Niepce and Daguerre to continue the prosecution of their researches. It appears further that Niepce communicated his process to Daguerre on the 5th of December 1829. At his death some letters from Daguerre and others were left by him in which iodine, sulphur, phosphorus, &c., are mentioned as having been used on the metal plates, and their sensitiveness to light, when thus treated, commented upon. We are thus led to believe that a great part of the success in producing the daguerreotype is due to the elder Niepce; and indeed it must have been thought so at the time, since, on the publication of the process, life-pensions of 6000 francs and 4000 francs were given to Daguerre and to Isidore Niepce respectively. In point of chronology the publication of the discovery of the daguerreotype process was made subsequently to the Talbot-type process. It will, however, be convenient to continue the history of the daguerreotype, premising that it was published on the 6th of February 1839, whilst Talbot's process was given to the world on the 25th of January of the same year.

Daguerreotype pictures were originally taken on silver-plated copper, and even now the silvered surface thus prepared serves better than electro-deposited silver of any thickness. An outline of the operations is as follows. A brightly-polished silver plate is cleaned by finely-powdered pumice and olive oil, and then by dilute nitric acid, and a soft buff is employed to give it a brilliant polish, the slightest trace of foreign matter or stain being fatal to the production of a perfect picture. The plate, thus prepared, is ready for the iodizing operation. Small fragments of iodine are scattered over a saucer, covered with gauze. Over this the plate is placed, face downwards, resting on supports, and the vapour from the iodine is allowed to form upon it a surface of silver iodide. It is essential to note the colour of the surface-formed iodide at its several stages, the varying colours being due to interference colours caused by the different thicknesses of the minutely thin film of iodide. The stage of maximum sensitiveness is obtained when it is of a golden orange colour. In this state the plate is withdrawn and removed to the dark slide of the camera, ready for exposure. A plan frequently adopted to give an even film of iodide was to saturate a card with iodine and hold the plate a short distance above the card. Long exposures were required, varying in Paris from three to thirty minutes. The length of the exposure was evidently a matter of judgment, more particularly as over-exposure introduced an evil which was called "solarization," but which was in reality due to the oxidation of the iodide by prolonged exposure to light.

As a matter of history it may be remarked that the development of the image by mercury vapour is said to be due to a chance discovery of Daguerre. It appears that for some time previous to the publication of the daguerreotype method he had been experimenting with iodized silver plates, producing images by what would now be called the "printing out" process. This operation involved so long an exposure that he sought some means of reducing it by the application of different reagents. Having on one occasion exposed such a plate to a camera-image, he accidentally placed it in the dark in a cupboard containing various chemicals, and found after the lapse of a night that he had a perfect image developed. By the process of exhaustion he arrived at the fact that it was the mercury vapour, which even at ordinary temperatures volatilizes, that had caused this intensification of the almost invisible camera-image. It was this discovery that enabled the exposures to be very considerably shortened from those which it was found necessary to give in mere camera-*printing*.

The development of the image was effected by placing the exposed plate over a slightly heated (about 75° C.) cup of mercury. The vapour of mercury condensed on those places where the light had acted in an almost exact ratio to the intensity of its action. This produced a picture in an amalgam, the vapour of which attached itself to the altered silver iodide. Proof that such was the case was subsequently afforded by the fact that the mercurial image could be removed by heat. The developing box was so constructed that it was possible to examine the picture through a yellow glass window whilst the image was being brought out. The next operation was to fix the picture by dipping it in a solution of hyposulphite of soda. The image produced by this method is so delicate that it will not bear the slightest handling, and has to be protected from accidental touching.

The first great improvement in the daguerreotype process was the resensitizing of the iodized film by bromine vapour. John Frederick Goddard published his account of the use of bromine in conjunction with iodine in 1840, and A. F. J. Claudet (1797–1867) employed a combination of iodine and chlorine vapour in 1841. In 1844 Daguerre published his improved method of preparing the plates, which is in reality based on the use of bromine with iodine. That this addition points to additional sensitiveness will be readily understood when we remark that so-called instantaneous pictures of yachts in full sail, and of large size, have been taken on plates so prepared—a feat which is utterly impossible with the original process as described by Daguerre. The next improvement in the process was toning or gilding the image by a solution of gold, a practice introduced by H. L. Fizeau. Gold chloride is mixed with hyposulphite of soda, and the levelled plate, bearing a sufficient quantity of the fluid, is warmed by a spirit-lamp until the required vigour is given to the image, as a consequence of which it is better seen in most lights. Nearly all the daguerreotypes extant have been treated in this manner, and no doubt their permanence is in a great measure due to this operation. Images of this class can be copied by taking electrotypes from them, as shown by Sir W. R. Grove and others. These reproductions are admirable in every way, and furnish a proof that the daguerrean image is a relief.

Fox-Talbot Process.—In January 1839 Fox Talbot described the first of his processes, photogenic drawing, in a paper to the Royal Society. He states that he began experimenting in 1834, and that in the solar microscope he obtained an outline of the object to be depicted in full sunshine in half a second. He published in the *Philosophical Magazine* full details of his method, which consisted essentially in soaking paper in common salt, brushing one side only of it with about a 12% solution of silver nitrate in water, and drying at the fire. Fox Talbot stated that by repeating the alternate washes of the silver and salt—always ending, however, with the former—greater sensitiveness was attained. This is the same in every respect as the method practised by Wedgwood in 1802; but, when we come to the next process, which he called "calotype" or "beautiful picture," we have a distinct advance. This process Talbot protected by a patent in 1841.

It may be briefly described as the application of silver iodide to a paper support. Carefully selected paper was brushed over with a solution of silver nitrate (100 grains to the ounce of distilled water), and dried by the fire. It was then dipped into a solution of potassium iodide (500 grains being dissolved in a pint of water), where it was allowed to stay two or three minutes until silver iodide was formed. In this state the iodide is scarcely sensitive to light, but is sensitized by brushing "gallo-nitrate of silver" over the surface to which the silver nitrate had been first applied. This "gallo-nitrate" is merely a mixture, consisting of 100 grains of silver nitrate dissolved in 2 oz. of water, to which is added one-sixth of its volume of acetic acid, and immediately before applying to the paper an equal bulk of a saturated solution of gallic acid in water. The prepared surface is then ready for exposure in the camera, and, after a short insolation, develops itself in the dark, or the development may be hastened by a fresh application of the "gallo-nitrate of silver." The picture is then fixed by washing it in clean water and drying slightly in blotting paper, after which it is treated with a solution of potassium bromide, and again washed and dried. Here there is no mention made of hyposulphite of soda as a fixing agent, that having been first used by Sir J. Herschel in February 1840.

In a strictly historical notice it ought to be mentioned that development by means of gallic acid and silver nitrate was first known to Rev. J. B. Reade. When impressing images in the solar microscope he employed gallic acid and silver in order to render more sensitive the silver chloride paper that he was using, and he accidentally found that the image could be developed without the aid of light. The priority of the discovery was claimed by Fox Talbot; and his claim was sustained after a lawsuit, apparently on the ground that Reade's method had never been legally published. Talbot afterwards made many slight improvements in the process. In one of his patents he recognizes the value of the proper fixing of his photogenic drawings by hyposulphite of soda, and also the production of positive prints from the calotype negatives. We pass over his application of albumen to porcelain and its subsequent treatment with iodine vapour, as also his application of albumen in which silver iodide was held in suspension to a glass plate, since in this he was preceded by Niepce de St Victor in 1848.

Albumen Process on Glass.—It was a decided advance when Niepce de St Victor, a nephew of Nicéphore de Niepce, employed a glass plate and coated it with iodized albumen. The originator of this method did not meet with much success. In the hands of Blanquart Évrard it became more practicable; but it was carried out in its greatest perfection by G. Le Gray.

The outline of the operations is as follows: The whites of five fresh eggs are mixed with about one hundred grains of potassium iodide, about twenty grains of potassium bromide and ten grains of common salt. The mixture is beaten up into a froth and allowed to settle for twenty-four hours, when the clear liquid is decanted off. A circular pool of albumen is poured on a glass plate, and a straight ruler (its ends being wrapped with waxed paper to prevent its edge from touching the plate anywhere except at the margins) is drawn over the plate, sweeping off the excess of albumen, and so leaving an even film. The plate is first allowed to dry spontaneously, a final heating being given to it in an oven or before the fire. The heat hardens the albumen, and it becomes insoluble and ready for the silver nitrate bath. One of the difficulties is to prevent crystallization of the salts held in solution, and this can only be effected by keeping them in defect rather than in excess. The plate is sensitized for five minutes in a bath of silver nitrate, acidified with acetic acid, and exposed whilst still wet, or it may be slightly washed and again dried and exposed whilst in its desiccated state. The image is developed by gallic acid in the usual way.

After the application of albumen many modifications were introduced in the shape of starch, serum of milk, gelatin, all of which were intended to hold iodide *in situ* on the plate; and the development in every case seems to have been by gallic acid. At one time the waxed-paper process subsequently introduced by Le Gray was a great favourite. Paper that had been made translucent by white wax was immersed in a solution of potassium iodide until impregnated with it, after which it was sensitized in the usual way, development being by gallic acid. In images obtained by this process the high lights are represented by metallic silver, whilst the shadows are translucent. Such a print is called a "negative." When silver chloride paper is darkened by the passage of light through a negative, we get the highest lights represented by white paper and the shadows by darkened chloride. A print of this kind is called a "positive."

Collodion Process.—A great impetus was given to photography in 1850, on the introduction of collodion (*q.v.*), a very convenient vehicle on account of the facility with which the plates are prepared, and also because it is a substance as a rule totally unaffected by silver nitrate, which is not the case with other organic substances. Thus albumen forms a definite silver compound, as do gelatin, starch and gum. The employment of collodion was first suggested by Le Gray, but it remained for Frederick Scott Archer of London, closely followed by P. W. Fry, to make a really practical use of the discovery. When collodion is poured on a glass plate it leaves on drying a hard transparent film which under the microscope is slightly reticulated. Before drying, the film is gelatinous and perfectly adapted for holding *in situ* salts soluble in ether and alcohol. Where such salts are present they crystallize out when the film is dried, hence such a film is only suitable where the plates are ready to be immersed in the silver bath. As a rule, about five grains of the soluble gun-cotton are dissolved in an ounce of a mixture of equal parts of ether and alcohol, both of which must be of low specific gravity, ·725 and ·805 respectively. If the alcohol or ether be much diluted with water the gun-cotton (pyroxylin) precipitates, but, even if less diluted, it forms a film which is "crapey" and uneven. Such was the material which Le Gray proposed and which Archer brought into practical use. The opaque silver plate with its one impression was abandoned; and the paper support of Talbot, with its inequalities of grain and thickness, followed suit, though not immediately. When once a negative had been obtained with collodion on a glass plate—the image showing high lights by almost complete opacity and the shadows by transparency (as was the case, too, in the calotype process)—any number of impressions could be obtained by means of the silver-printing process introduced by Fox Talbot, and they were found to possess a delicacy and refinement of detail that certainly eclipsed the finest print obtained from a calotype negative. To any one who had practised the somewhat tedious calotype process, or the waxed-paper process of Le Gray with its still longer preparation and development, the advent of the collodion method must have been extremely welcome, since it effected a saving in time, money and uncertainty. The rapidity of photographic action was much increased, and the production of a different character of pictures thus became possible.

We give an outline of the procedure. A glass plate is carefully cleaned by a detergent such as a cream of tripoli powder and spirits of wine (to which a little ammonia is often added), then wiped with a soft rag, and finally polished with a silk handkerchief or chamois leather. A collodion containing soluble iodides and bromides is made to flow over the plate, all excess being drained off when it is covered. A good standard formula for the collodion is—55 grains of pyroxylin, 5 oz. of alcohol, 5 oz. of ether; and in this liquid are dissolved 2½ grains of ammonium iodide, 2 grains of cadmium iodide and 2 grains of cadmium bromide. When the collodion is set the plate is immersed in a bath of silver nitrate—a vertical form being that mostly used in England, whilst a horizontal dish is used on the continent of Europe—a good formula for which is 350 grains of silver nitrate with 10 oz. of water. The plate is steadily lowered into this solution, and moved in it until all the repellent action between the aqueous solution of the silver and the solvents of the collodion is removed, when it is allowed to rest for a couple of minutes, after which period it is taken out and placed in the dark slide ready for exposure in the camera. After undergoing proper exposure the plate is withdrawn, and in a room lighted with yellow light the developing solution is applied, which originally was a solution of pyrogallic acid in water restrained in its action by the addition of acetic acid. One of the old formulae employed by P. H. Delamotte was 9 grains of pyrogallic acid, 2 drachms of glacial acetic acid and 3 oz. of water. The image gradually appears after the application of this solution, building itself up from the silver nitrate clinging to the film, which is reduced to the metallic state by degrees. Should the density be insufficient a few drops of silver nitrate are added to the pryogallic acid solution and the developing action continued.

In 1844 Robert Hunt introduced another reducing agent, which is still the favourite, viz. ferrous sulphate. By its use the time of necessary exposure of the plate is reduced and the image develops with great rapidity. A sample of this developing solution is 20 grains of ferrous sulphate, 20 minims of acetic acid, with 1 oz. of water. This often leaves the image thinner than is requisite for the formation of a good print, and it is intensified with pyrogallic acid and silver. Other intensifiers are used to increase the deposit on a plate by means of mercury or uranium, followed by other solutions to still further darken the double salts formed on the film. Such intensifying agents have to be applied to the image after the plate is fixed, which is done by a concentrated solution of hyposulphite of soda or by potassium cyanide, the latter salt having been first introduced by Martin and Marc Antoine Augustin Gaudin in 1853 (*La Lumière*, April 23, 1853). Twenty-five grains of potassium cyanide to one ounce of water is the strength of the solution usually employed. The reaction of both these fixing agents is to form with the sensitive salts of silver double hyposulphites or cyanides, which are soluble in water and salt. The utility of bromides in the collodion process seems to have been recognized in its earliest days, Scott Archer (1852) and R. J. Bingham (1850) both mentioning it. We notice this, since as late as 1866 a patent-right in its use was sought to be enforced in America, the patent being taken out by James Cutting in July 1854.

Positive Pictures by the Collodion Process.—In the infancy of the collodion process it was shown by Horne that a negative image could be made to assume the appearance of a positive by whitening the metallic silver deposit. This he effected by using with the pyrogallic acid developer a small quantity of nitric acid. A better result was obtained by P. W. Fry with ferrous sulphate and ferrous nitrate, whilst Hugh Diamond gave effect to the matter in a practical way. F. Scott Archer used mercuric chloride to whiten the image. To Robert Hunt, however, must be rewarded the credit of noticing the action of this salt on the image (*Phil. Trans.*, 1843). The whitened picture may be made to stand out against black velvet, or black varnish may be poured over the film to give the necessary black background, or, more recently, the positive pictures may be produced on japanned iron plates (ferrotype plates) or on japanned leather. This process is still occasionally practised by itinerant photographers.

Moist Collodion Process.—It is seen that for the successful working of the collodion process it was necessary that the plate should be exposed very shortly after its preparation; this was a drawback, inasmuch as it necessitated taking a heavy equipment into the field. In 1856, Sir William Crookes and J. Spiller published in the *Philosophical Magazine* a process whereby they were enabled to keep a film moist (so as to prevent crystallization of the silver nitrate) several days, enabling plates to be prepared at home, exposed in the field, and then developed in the dark room. The plate was prepared in the usual way and a solution of zinc nitrate and silver nitrate in water was made to flow over it. The hygroscopic nature of the zinc salt kept sufficient moisture on the plate to attain the desired end. Various modifications in procedure have been made.

Dry Plates.—It would appear that the first experiments with collodion dry plates were due to Marc Antoine Augustin Gaudin. In *La Lumière* of the 22nd of April and the 27th of May 1854 he describes his researches on the question; whilst in England G. R. Muirhead, on the 4th of August 1854, stated that light acts almost as energetically on a dry surface as on a wet after all the silver has been washed away from the former previous to desiccation. J. M. Taupenot, however, seems to have been the first to use a dry-plate process that was really workable. His original plan was to coat a plate with collodion, sensitize it in the ordinary manner, wash it, cause a solution of albumen to flow over the surface, dry it, dip it in a bath of silver nitrate acidified with acetic acid, and wash and dry it again. The plate was then in a condition to be exposed, and was to be developed with pyrogallic acid and silver. In this method we have a double manipulation, which is long in execution, though perfectly effective.

A great advance was made in all dry-plate processes by the introduction of what is known as the "alkaline developer," which is, however, inapplicable to all plates on which silver nitrate is present in the free state. The developers previously described, either for collodion or paper processes, were dependent on the reduction of metallic silver by some such agent as ferrous sulphate, the reduction taking place gradually and the reduced particles aggregating on those portions of the film which had been acted upon by light. The action of light being to reduce the silver iodide, bromide or chloride, these reduced particles really acted as nuclei for the crystallized metal. It will be evident that in such a method of development the molecular attraction acts at distances relatively great compared with the diameters of the molecules themselves. If it were possible to reduce the altered particles of silver salt it was plain that development would be more rapid, and also that the number of molecules reduced by light would be smaller if the metallic silver could be derived from silver compounds within shorter distances of the centres of molecular attraction. Alkaline development accomplished this to a very remarkable extent; but the method is only really practicable when applied to films containing silver bromide and chloride, as silver iodide is only slightly amenable to the alkaline development. The introduction of this developer is believed to be of American origin; and it is known that in the year 1862 Major C. Russell used it with the dry plates he introduced.

An alkaline developer consists of an alkali, a reducing agent and a restraining agent. These bodies, when combined and applied to the solid silver bromide or chloride, after being acted upon by light, were able to reduce the sub-bromide or sub-chloride, and to build up an image upon it, leaving the unaltered bromide intact, except so far as it was used in the building up. In 1877 Sir W. Abney investigated this action. A dry plate was prepared by the bath process in the usual manner (to be described below), and exposed in the camera. The exposed film was covered with another film of collodiobromide emulsion, which of course had not seen the light. An image was obtained from the double film by means of the alkaline developer, which penetrated through the upper unexposed film. The development was prolonged until an image appeared through the unexposed film, when the plate was fixed, washed and dried. A piece of gelatinous paper was cemented on the upper film, and a similar piece on the lower after both had been stripped off the glass. When quite dry the two papers were forcibly separated, a film adhering to each. The upper film, *although never exposed to light*, showed an image in some cases more intense than the under film. The action of the alkaline developer was here manifest: the silver bromide in close contiguity to the exposed particles was reduced to the metallic state. Hence, from this and similar experiments, Abney concluded that silver bromide could not exist in the presence of a freshly precipitated or reduced metallic silver, and that a sub-bromide was immediately formed. From this it will be seen that the deposited silver is well within the sphere of molecular attraction, and that consequently a less exposure (*i.e.* the reduction of fewer molecules of the sensitive salt) would give a developable image.

The alkalis used embraced the alkalis themselves and the mono-carbonates. The sole reducing agent up till recent times was pyrogallic acid. In the year 1880 Abney found that hydroquinone was even more effective than pyrogallic acid, its reducing power being stronger. Various other experimentalists tried other kindred substances, but without adding to the list of really useful agents until recently.

The following are some of the most effective:—

Eikonogen Developer.

Eikonogen	25 parts.
Sodium sulphite	50 ,,
Sodium carbonate	50 ,,
Potassium bromide	½ ,,
Water	1000 ,,

This is a one-solution developer, and acts energetically.

Metol Developer.

Solution A.

Metol	2 parts.
Sodium sulphite	18 ,,
Water	100 ,,

Solution B.

Sodium carbonate	6 parts.
Potassium bromide	1 ,,
Water	100 ,,

For use, take one part of A to from 1 to 3 parts of B.

Amidol Developer.

Amidol	3 parts.
Sodium sulphite	100 ,,
Potassium bromide	1 to 3 ,,
Water	1000 ,,

This developer requires no addition of alkali.

Ortol Developer.

Solution A.

Ortol	15 parts.
Sodium metabisulphite	7 ,,
Water	1000 ,,

Solution B.

Sodium carbonate	100 parts.
Sodium sulphite	125 ,,
Potassium bromide	3 ,,
Water	1000 ,,

A and B solutions are mixed together in equal proportions.

Besides these, there are several more, such as adurol, glycin, pyrocatechin, which have been used with more or less success. They all give a black in lieu of that dark olive-green deposit of silver which is so often found with pyrogallol developers. All are alkaline developers, and the image is built up from the sensitive salt within the film. They are applicable to gelatin or collodion plates, but for the latter rather more bromide of an alkali is added, to retard fogging.

Another set of developers for dry plates dependent on the reduction of the silver bromide and the metallic state is founded on the fact that certain organic salts of iron can be utilized. In 1877 M. Carey Lea of Philadelphia and William Willis announced almost simultaneously that a solution of ferrous oxalate in neutral potassium oxalate was effective as a developer, and from that time its use has been acknowledged. In 1882 J. M. Eder demonstrated that gelatino-silver chloride plates could be developed with ferrous citrate, which could not be so readily accomplished with ferrous oxalate. The exposure for chloride plates when developed by the latter was extremely prolonged. In the same year Abney showed that if ferrous oxalate were dissolved in potassium citrate a much more powerful agent was formed, which allowed not only gelatino-chloride plates to be readily developed but also collodio-chloride plates. These plates were undevelopable except by the precipitation method until the advent of the agents last-mentioned owing to the fact that the chloride was as readily reduced as the sub-chloride.

Amongst the components of an alkaline developer we mentioned a restrainer. This factor, generally a bromide or chloride of an alkali, serves probably to form a compound with the silver salt which has not been acted upon by light, and which is less easily reduced than is the silver salt alone—the altered particles being left intact. The action of the restrainer is regarded by some as due to its combination with the alkali. But whichever theory is correct the fact remains that the restrainer does make the primitive salt less amenable to reduction. Such restrainers as the bromides of the alkalis act through chemical means; but there are others which act through physical means, an example of which we have in the preparation of a gelatin plate. In this case the gelatin wraps up the particles of the silver compound in a colloidal sheath, as it were, and the developing solution only gets at them in a very gradual manner, for the natural tendency of all such reducing agents is to attack the particles on which least work has to be expended. In the case of silver sub-bromide the developer has only to remove one atom of bromine, whereas it has to remove two in the case of silver bromide. The sub-bromide formed by light and that subsequently produced in the act of development are therefore reduced. A large proportion of gelatin compared with the silver salt in a film enables an alkaline developer to be used without any chemical restrainer; but when the gelatin bears a small proportion to the silver such a restrainer has to be used. With collodion films the particles of bromide are more or less unenveloped, and hence in this case some kind of chemical restrainer is absolutely necessary. We may say that the organic iron developers require less restraining in their action than do the alkaline developers.

In Major Russell's process the plate was prepared by immersion in a strong solution of silver nitrate and then washed and a preservative applied. The last-named agent executes two functions, one being to absorb the halogen liberated by the action of light and the other to preserve the film from atmospheric action. Tannin, which Major Russell employed, if we mistake not, is a good absorbent of the halogens, and acts as a varnish to the film. Other collodion dry-plate processes carried out by means of the silver-nitrate bath were very numerous at one time, many different organic bodies being also employed. In most cases ordinary iodized collodion was made use of, a small percentage of soluble bromide being as a rule added to it. When plates were developed by the alkaline method this extra bromide induced density, since it was the silver bromide alone which was amenable to it, the iodide being almost entirely unaffected by the weak developer which was at that time in general use.

Dry-Plate Bath Process.—One of the most successful bath dry-plate processes was introduced by R. Manners Gordon. The plate was given an edging of albumen and then coated with ordinary iodized collodion to which one grain per ounce of cadmium bromide had been added. It was kept in the silver-nitrate bath for ten minutes, after which it was washed thoroughly. The following preservative was then applied:—

1.	Gum arabic	20 grs.
	Sugar candy	5 ,,
	Water	6 dr.
2.	Gallic acid	3 grs.
	Water	2 dr.

These ingredients were mixed just before use and, after filtering, applied for one minute to the plate, which was allowed to drain and set up to dry naturally. Great latitude is admissible in the exposure; it should rarely be less than four times or more than twenty times that which would be required for a wet plate under ordinary circumstances. The image may be developed with ferrous sulphate restrained by a solution of gelatin and glacial acetic acid, to which a solution of silver nitrate is added just before application, or by an alkaline developer.

In photographic processes not only has the chemical condition of the film to be taken into account but also the optical. When light falls on a semi-opaque or translucent film it is scattered by the particles in it and passes through the glass plate to the back. Here the rays are partly transmitted and partly reflected, a very small quantity of them being absorbed by the material of the glass. Theory points out that the strongest reflection from the back of the glass should take place at the "critical" angle. In 1875 Abney investigated the subject and proved that practice agreed with theory in every respect, and that the image of a point of light in development on a plate was surrounded by a ring of reduced silver caused by the reflection of the scattered light from the back surface of the glass, and that this ring was shaded inwards and outwards in such a manner that the shading varied with the intensity of the light reflected at different angles. To avoid "halation," as this phenomenon is called, it was usual to cover the back of dry plates with some material which should be in optical contact with it, and as nearly as possible of the same density as glass, and which at the same time should absorb all the photographically active rays. This was called "backing a plate."

Collodion Emulsion Processes.—In 1864 W. B. Bolton and B. J. Sayce published the germ of a process which revolutionized photographic manipulations. In the ordinary collodion process a sensitive film is procured by coating a glass plate with collodion containing the iodide and bromide of some soluble salt, and then, when set, immersing it in a solution of silver nitrate in order to form silver iodide and bromide in the film. The question that presented itself to Bolton and Sayce was whether it might not be possible to get the sensitive salts of silver formed *in* the collodion whilst liquid, and a sensitive film given to a plate by merely letting this collodion, containing the salts in suspension, flow over the glass plate. Gaudin had attempted to do this with silver chloride, and later G. W. Simpson had succeeded in perfecting a printing process with collodion containing silver chloride, citric acid and silver nitrate; but the chloride until recently has been considered a slow working salt, and nearly incapable of development. Up to the time of W. B. Bolton and B. J. Sayce's experiments silver iodide had been considered the staple of a sensitive film on which to take negatives; and though bromide had been used by Major Russell and others, it had not met with so much favour as to lead to the omission of the iodide. At the date mentioned the suspension of silver iodide in collodion was not thought practicable, and the inventors of the process turned their attention to silver bromide, which they found could be secured in such a fine state of division that it remained suspended for a considerable time in collodion, and even when precipitated could be resuspended by simple agitation. The outline of the method was to dissolve a soluble bromide in plain collodion, and add to it drop by drop an alcoholic solution of silver nitrate, the latter being in excess or defect according to the will of the operator. To prepare a sensitive surface the collodion containing the emulsified sensitive salt was poured over a glass plate, allowed to set, and washed till all the soluble salts resulting from the double decomposition of the soluble bromide and the silver nitrate, together with the unaltered soluble bromide or silver nitrate, were removed, when the film was exposed wet, or allowed to dry and then exposed. The rapidity of these plates was not in any way remarkable, but the process had the great advantage of doing away with the sensitizing nitrate of silver bath, and thus avoiding a tiresome operation. The plates were developed by the alkaline method, and gave images which, if not primarily dense enough, could be intensified by the application of pyrogallic acid and silver nitrate as in the wet collodion process. Such was the crude germ of a method which was destined to effect a complete change in the aspect of photographic negative taking[1]; but for some time it lay dormant. In fact there was at first much to discourage trial of it, since the plates often became veiled on development.

M. Carey Lea of Philadelphia, and W. Cooper, jun., of Reading, may be said to have given the real impetus to the method. Carey Lea, by introducing an acid into the emulsion, established a practicable collodion emulsion process, which was rapid and at the same time gave negative pictures free from veil. To secure the rapidity Carey Lea employed a fair excess of silver nitrate, and Colonel H. Stuart Wortley gained further rapidity by a still greater increase of it; the free use of acid was the only means by which this could be effected without hopelessly spoiling the emulsion. The addition of the mineral acids such as Carey Lea employed is to prevent the formation of (or to destroy when formed) any silver sub-bromide or oxide, either of which acts as a nucleus on which development can take place. Abney first showed the theoretical effect of acids on the sub-bromide, as also the effect of oxidizing agents on both the above compounds (see below). A more valuable modification was introduced in 1874 by W. B. Bolton, one of the originators of the process, who allowed the ether and the alcohol of the collodion to evaporate, and then washed away all the soluble salts from the gelatinous mass formed of pyroxylin and sensitive salt. After washing for a considerable time, the pellicle was dried naturally or washed with alcohol, and then the pyroxylin redissolved in ether and alcohol, leaving an emulsion of silver bromide, silver chloride or silver iodide, or mixtures of all suspended in collodion. In this state the plate could be coated and dried at once for exposure. Sometimes, in fact generally, preservatives were used, as in the case of dry plates with the bath, in order to prevent the atmosphere from rendering the surface of the film spotty or insensitive on development. This modification had the great advantage of allowing a large quantity of sensitive salt to be prepared of precisely the same value as to rapidity of action and quality of film.

A great advance in the use of the collodion bromide process was made by Colonel Stuart Wortley, who in June 1873 made known the powerful nature of a *strongly* alkaline developer as opposed to the weak one which up to that time had usually been employed for a collodion emulsion plate, or indeed for any dry plate.

An example of the preparation of a collodion emulsion and the developer is the following: 2½ oz. of alcohol, 5 oz. of ether, 75 grains of pyroxylin. In 1 oz. of alcohol are dissolved 200 grains of zinc bromide[2]; it is then acidulated with 4 or 5 drops of nitric acid, and added to half the above collodion. In 2 drachms of water are dissolved 330 grains of silver nitrate, 1 oz. of alcohol being added. The silvered alcohol is next poured into the other half of the collodion and the brominized collodion dropped in, care being taken to shake between the operations. An emulsion of silver bromide is formed in suspension; and it is in every case left for 10 to 20 hours to what is technically called "ripen," or, in other words, to become creamy when poured out upon a glass plate. When the emulsion has ripened it may be used at once or be poured out into a flat dish and the solvents allowed to evaporate till the pyroxylin becomes gelatinous. In this state it is washed in water till all the soluble salts are carried away. After this it may be either spread out on a cloth and dried or treated with two or three doses of alcohol, and then redissolved in equal parts of alcohol (specific gravity, ·805) and ether (specific gravity, ·720). In this condition it is a washed emulsion, and a glass plate can be coated with it and the film dried, or it may be washed and some of the many preservatives, such as albumen, beer, coffee, gum, &c., applied.

The type of a useful alkaline developer for collodion plates is as follows:—

1.	Pyrogallic acid	96 grs.
	Alcohol	1 oz.
2.	Potassium bromide	12 grs.
	Water distilled	1 oz.
3.	Ammonium carbonate	80 grs.
	Water	1 oz.

To develop the plate 6 minims of No. 1, ½ drachm of No. 2, and 3 drachms of No. 3 are mixed together and made to flow over the plate after washing the preservative off under the tap. Sometimes the

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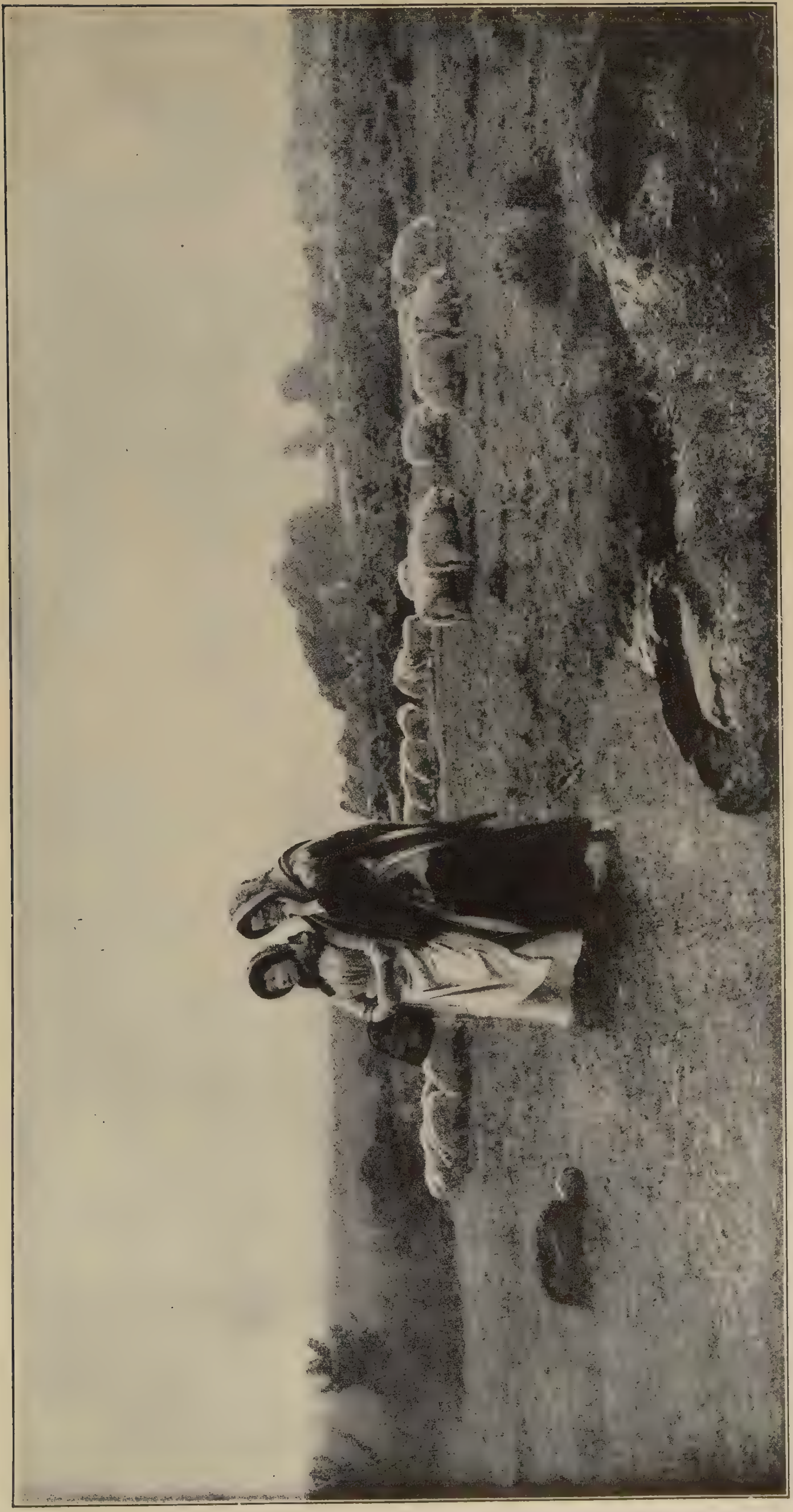
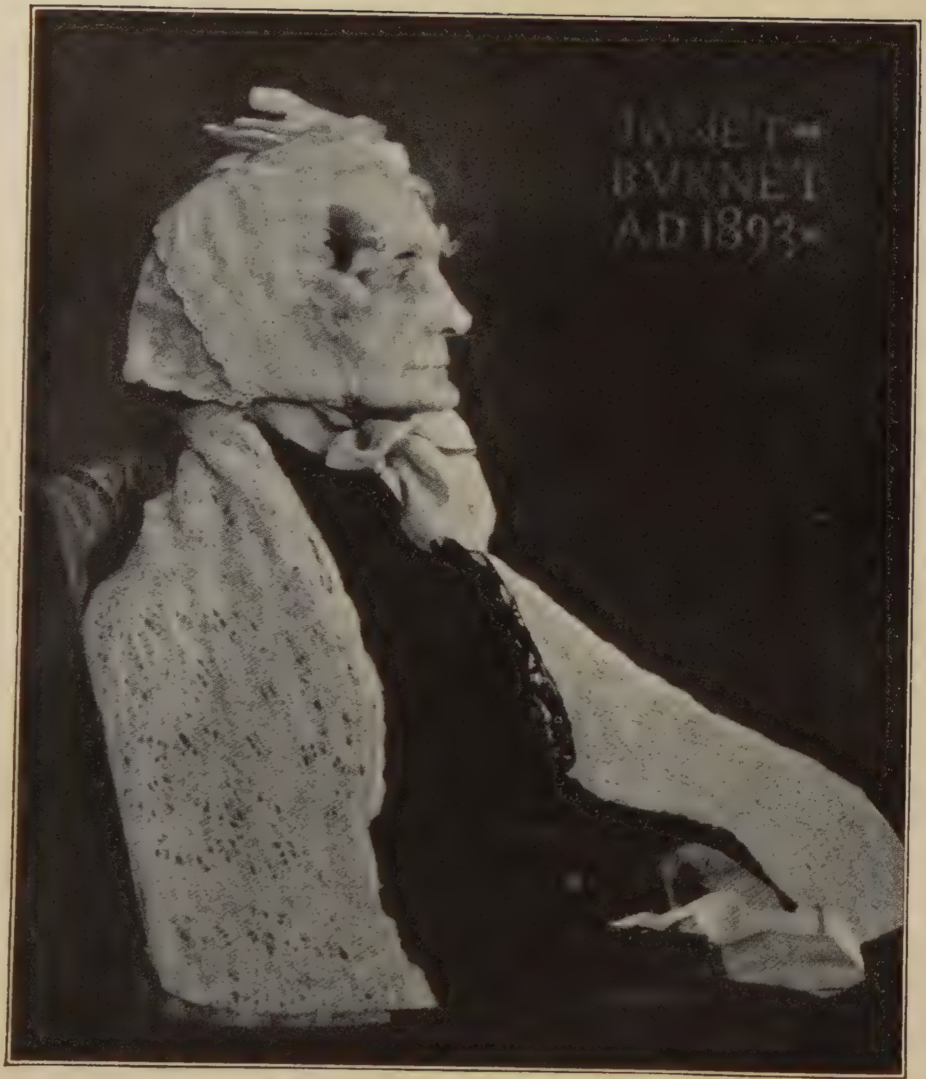
[1] An account of Sayce's process is to be found in the *Photographic News* of October 1865, or the *Photographic Journal* of the same date.

[2] The advantages of this salt were pointed out by Leon Warnerke in 1875.



"CARROLLING." By H. P. Robinson.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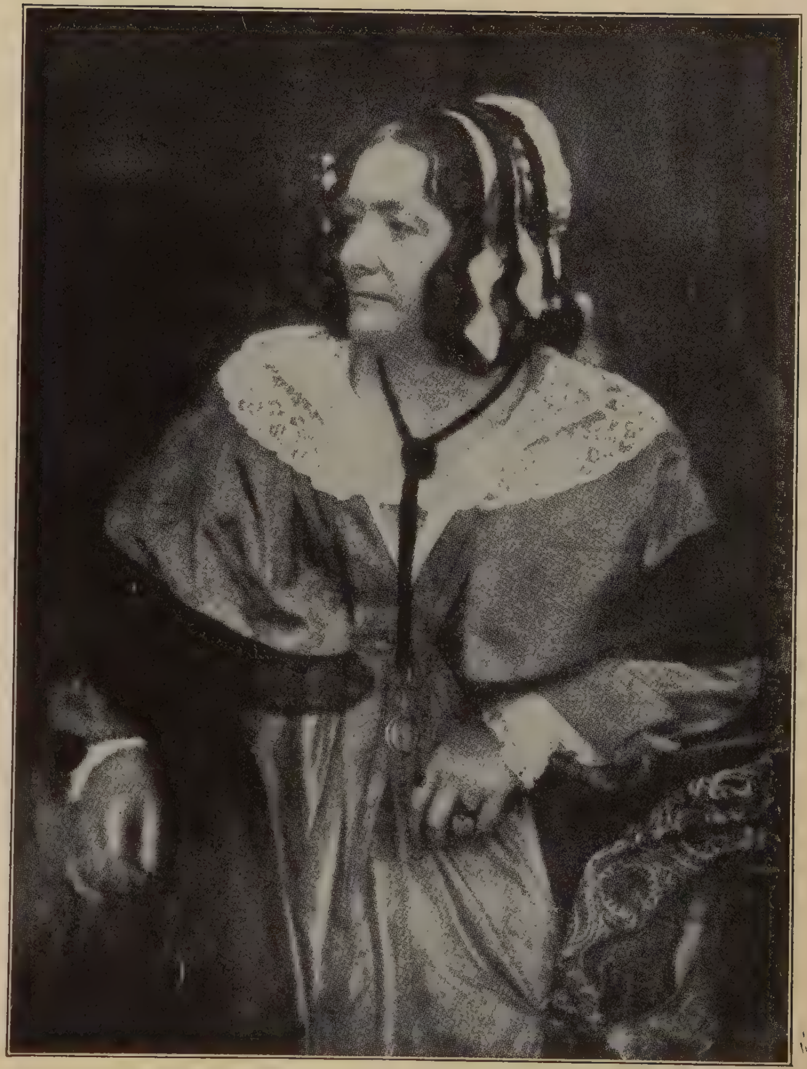
PORTRAIT STUDY. By JAMES CRAIG ANNAN.



PORTRAIT. By DAVID OCTAVIUS HILL, R.S.A.

development is conducted in a flat dish, sometimes the solution is poured on the plate.[1] The unreduced salts are eliminated by either cyanide of potassium or sodium hyposulphite. Intensity may be given to the image, if requisite, either before or after the "fixing" operation. Where resort is had to ferrous oxalate development, the developer is made in one of two ways—(1) by saturating a saturated solution of neutral potassium oxalate with ferrous oxalate, and adding an equal volume of a solution (10 grains to 1 oz. of water) of potassium bromide to restrain the action, or (2) by mixing, according to Eder's plan, 3 volumes by measure of a saturated solution of the potassium oxalate with 1 volume by measure of a saturated solution of ferrous sulphate, and adding to the ferrous oxalate solution thus obtained an equal bulk of the above solution of potassium bromide. The development is conducted in precisely the same manner as indicated above, and the image is fixed by one of the same agents.

Gelatin Emulsion Process.—The facility with which silver bromide emulsion could be prepared in collodion had turned investigation into substitutes for it. As early as September 1871 Dr R. L. Maddox had tried emulsifying the silver salt in gelatin, and had produced negatives of rare excellence. In November 1873 J. King described a similar process, getting rid of the soluble salts by washing. Efforts had also been made in this direction by J. Burgess in July 1873. R. Kennett in 1874 may be said to have been the first to put forward the gelatin emulsion process in a practical and workable form, as he then published a formula which gave good and quick results. It was not till 1878, however, that the great capabilities of silver bromide when held in suspension by gelatin were fairly known; in March of that year C. Bennett showed that by keeping the gelatin solution liquid at a low temperature for as long as seven days extraordinary rapidity was conferred on the sensitive salt. The molecular condition of the silver bromide seemed to be altered, and to be amenable to a far more powerful developer than had hitherto been dreamt of. In 1874 J. S. Stas had shown that various modifications of silver bromide and chloride were possible, and it seemed that the green molecular condition (one of those noted by Stas) of the bromide was attained by prolonged warming. It may be said that the advent of rapid plates was 1878, and that the full credit of this discovery should be allotted to C. Bennett. Both Kennett and Bennett got rid of the soluble salts from the emulsion by washing; and in order to attain success it was requisite that the bromide should be in excess of that necessary to combine with the silver nitrate used to form the emulsion. In June 1879 Abney showed that a good emulsion might be formed by precipitating a silver bromide by dropping a solution of a soluble bromide into a dilute solution of silver nitrate. The supernatant liquid was decanted, and after two or three washings with water the precipitate was mixed with the proper amount of gelatin. D. B. van Monckhoven of Ghent, in experimenting with this process, hit upon the plan of obtaining the emulsion by acting on silver carbonate with hydrobromic acid, which left no soluble salts to be extracted. He further, in August 1879, announced that he had obtained great rapidity by adding to the bromide emulsion a certain quantity of ammonia. This addition rapidly altered the silver bromide from its ordinary state to the green molecular condition referred to above. At this point we have the branching off of the gelatin emulsion process into two great divisions, viz. that in which rapidity was gained by long-continued heating, and the other in which it was gained by the use of ammonia—a subdivision which is maintained to the present day. Opinions as to the merits of the two methods are much divided, some maintaining that the quality of the heated emulsion is better than that produced by alkalinity, and vice versa. We may mention that in 1881 Dr A. Herschel introduced a plan for making an alcoholic gelatin emulsion with the idea of inducing rapid drying of the plates, and in the same year H. W. Vogel of Berlin introduced a method of combining gelatin and pyroxylin together by means of a solvent which acted on the gelatin and allowed the addition of alcohol in order to dissolve the pyroxylin. This "collodio-gelatin emulsion" was only a shortlived process, which is not surprising, since its preparation involved the inhalation of the fumes of acetic acid.

The warming process introduced by Bennett was soon superseded. Colonel Stuart Wortley in 1879 announced that, by raising the temperature of the vessel in which the emulsion was stewed to 150° F., instead of days being required to give the desired sensibility only a few hours were necessary. A further advance was made by boiling the emulsion, first practised, we believe, by G. Mansfield in 1879. Another improvement was effected by W. B. Bolton by emulsifying the silver salt in a small quantity of gelatin and then raising the emulsion to boiling point, boiling it for from half an hour to an hour, when extreme rapidity was attained. Many minor improvements in this process have been made from time to time. It may be useful to give an idea of the relative rapidities of the various processes we have described.

Daguerreotype, originally	half an hour's exposure.
Calotype	2 or 3 minutes' ,,
Collodion	10 seconds' ,,
Collodion emulsion	15 seconds' ,,
Rapid gelatin emulsion	$\frac{1}{15}$th second ,,

TECHNIQUE OF PHOTOGRAPHY

Gelatin Emulsions.

The following is an outline of two representative processes. All operations should be conducted in light which can act but very slightly on the sensitive salts employed, and this is more necessary with this process than with others on account of the extreme ease with which the equilibrium of the molecules is upset in giving rise to the molecule which is developable. The light to work with is gaslight or candlelight passing through a sheet of Chance's stained red glass backed by orange paper. Stained red glass allows but few chemically effective rays to pass through it, whilst the orange paper diffuses the light. If daylight be employed, it is as well to have a double thickness of orange paper. The following should be weighed out:—

1.	Potassium iodide	5 grs.
2.	Potassium bromide	135 ,,
3.	Nelson's No. 1 photographic gelatin	30 ,,
4.	Silver nitrate	175 ,,
5.	Autotype or other hard gelatin	100 ,,
	Nelson's No. 1 gelatin	100 ,,

Nos. 3 and 5 are rapidly covered with water or washed for a few seconds under the tap to get rid of any dust. No. 2 is dissolved in 1½ oz. of water, and a little tincture of iodine added till it assumes a light sherry colour. No. 1 is dissolved in 60 minims of water. No. 4 is dissolved in ½ oz. of water, and No. 3 is allowed to swell up in 1 oz. of water, and is then dissolved by heat. All the flasks containing these solutions are placed in water at 150° F. and carried into the "dark room," as the orange-lighted chamber is ordinarily called; Nos. 3 and 4 are then mixed together in a jar or flask, and No. 2 added drop by drop till half its bulk is gone, when No. 1 is added to the remainder, and the double solution is dropped in as before. When all is added there ought to be formed an emulsion which is very ruddy when examined by gaslight, or orange by daylight. The flask containing the emulsion is next placed in boiling water, which is kept in a state of ebullition for about three-quarters of an hour. It is then ready, when the contents of the flask have cooled down to about 100° F., for the addition of No. 5, which should in the interval be placed in 2 oz. of water to swell and finally be dissolved. The gelatin emulsion thus formed is placed in a cool place to set, after which it is turned into a piece of coarse canvas or mosquito netting made into a bag. By squeezing, threads of gelatin containing the sensitive salt can be made to fall into cold water; by this means the soluble salts are extracted. This is readily done in two or three hours by frequently changing the water, or by allowing running water to flow over the emulsion-threads. The gelatin is next drained by straining canvas over a jar and turning out the threads on to it, after which it is placed in a flask, and warmed till it dissolves, half an ounce of alcohol being added. Finally it is filtered through chamois leather or swansdown calico. In this state it is ready for the plates.

The other method of forming the emulsion is with ammonia. The same quantities as before are weighed out, but the solutions of Nos. 2 and 3 are first mixed together and No. 4 is dissolved in 1 oz. of water, and strong ammonia of specific gravity ·880 added to it till the oxide first precipitated is just redissolved. This solution is then dropped into Nos. 2 and 3 as previously described, and finally No. 1 is added. In this case no boiling is required; but to secure rapidity it is as well that the emulsion should be kept an hour at a temperature of about 90° F., after which half the total quantity of No. 5 is added. When set the emulsion is washed, drained, and redissolved as before; but in order to give tenacity to the gelatin the remainder of No. 5 is added *before* the addition of the alcohol, and *before* filtering.

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[1] For further details the reader is referred to *Instruction in Photography*, 11th ed., p. 362.

Coating the Plates.—Glass plates are best cleaned with nitric acid, rinsed, and then treated with potash solution, rinsed again, and dried with a clean cloth. They are then ready for receiving the emulsion, which, after being warmed to about 120° F., is poured on them to cover well the surface. This being done, the plates are placed on a level shelf and allowed to stay there till the gelatin is thoroughly set; they are then put in a drying cupboard, through which a current of warm air is made to pass. It should be remarked that the warmth is only necessary to enable the air to take up the moisture from the plates. They ought to dry in about twelve hours, and they are ready for use.

Exposure.—With a good emulsion and on a bright day the exposure of a plate to a landscape, with a lens whose aperture is one-sixteenth that of the focal distance, should not be more than one-half to one-fifth of a second. This time depends, of course, on the nature of the view; if there be foliage in the immediate foreground it will be longer. In the portrait-studio, under the same circumstances, an exposure with a portrait lens may be from half a second to four or five seconds.

Development of the Plate.—To develop the image either a ferrous oxalate solution or alkaline pyrogallic acid may be used. No chemical restrainer such as potassium bromide is necessary, since the gelatin itself acts as a physical restrainer. If the alkaline developer be used, the following may be taken as a good standard:—

1.	Pyrogallol	50 grs.
	Citric acid	10 ,,
	Water	1 oz.
2.	Potassium bromide	10 grs.
	Water	1 oz.
3.	Ammonia, ·880	1 dr.
	Water	9 ,,

One dram of each of these is taken and the mixture made up to 2 oz. with water. The plate is placed in a dish and the above poured over it without stoppage, whereupon the image gradually appears and, if the exposure has been properly timed, gains sufficient density for printing purposes. It is fixed in a solution of hyposulphite of soda, as in the other processes already described, and then thoroughly washed for two or three hours to eliminate all the soluble salt. This long washing is necessary on account of the nature of the gelatin.

Intensifying the Negative.—Sometimes it is necessary to intensify the negative, which can be done in a variety of ways with mercury salts. An excellent plan, introduced by Chapman Jones, is to use a saturated solution of mercuric chloride in water. After thorough washing the negative is treated with ferrous oxalate. This process can be repeated till sufficient density is attained. With most other methods with mercury the image is apt to become yellow and to fade; with this apparently it is not.

Varnishing the Negative.—The negative is often protected by receiving first a film of plain collodion and then a coat of shellac or other photographic varnish. This protects the gelatin from moisture and also from becoming stained with the silver nitrate owing to contact with the sensitive paper used in silver printing. Another varnish is a solution of celloidin in amyl acetate. This is an excellent protection against damp.

Printing Processes.

The first printing process may be said to be that of Fox Talbot (see above), which has continued to be generally employed (with the addition of albumen to give a surface to the print—an addition first made, we believe, by Fox Talbot).

Paper for printing is prepared by mixing 150 parts of ammonium chloride with 240 parts of spirits of wine and 2000 parts of water, though the proportions may vary. These ingredients are dissolved, and the whites of fifteen fairly-sized eggs are added and the whole beaten up to a froth. In hot weather it is advisable to add a drop of carbolic acid to prevent decomposition. The albumen is allowed two or three days to settle, when it is filtered through a sponge placed in a funnel, or through two or three thicknesses of fine muslin, and transferred to a flat dish. The paper is cut of convenient size and allowed to float on the solution for about a minute, when it is taken off and dried in a warm room. For dead prints, on which colouring is to take place, plain salted paper is useful. It can be made of the following proportions—90 parts of ammonium chloride, 100 parts of sodium citrate, 10 parts of gelatin, 5000 parts of distilled water. The gelatin is first dissolved in hot water and the remaining components are added. It is next filtered, and the paper allowed to float on it for three minutes, then withdrawn and dried.

Sensitizing Bath.—To sensitize the paper it is floated on a 10% solution of silver nitrate for three minutes. It is then hung up and allowed to dry, after which it is ready for use. To print the image the paper is placed in a printing frame over a negative and exposed to light. It is allowed to print till such time as the image appears rather darker than it should finally appear.

Toning and Fixing the Print.—The next operation is to tone and fix the print. In the earlier days this was accomplished by means of a bath of *sel d'or*—a mixture of hyposulphite of soda and gold chloride. This gilded the darkened parts of the print which light had reduced to the semi-metallic state: and on the removal of the chloride by means of hyposulphite an image composed of metallic silver, an organic salt of silver and gold was left behind. There was a suspicion, however, that part of the coloration was due to a combination of sulphur with the silver, not that pure silver sulphide is in any degree fugitive, but the sulphuretted organic salt of silver seems to be liable to change. This gave place to a method of alkaline toning, or rather, we should say, of neutral toning, by employing gold chloride with a salt, such as the carbonate or acetate of soda, chloride of lime, borax, &c. By this means there was no danger of sulphurization during the toning, to which the method by *sel d'or* was prone owing to the decomposition of the hyposulphite. The substances which can be employed in toning seem to be those in which an alkaline base is combined with a weak acid, the latter being readily displaced by a stronger acid, such as nitric acid, which must exist in the paper after printing. This branch of photography owes much to the Rev. T. F. Hardwich, he having carried on extensive researches in connexion with it during 1854 and subsequent years. A. Davanne and A. Girard, a little later, also investigated the matter with fruitful results.

The following may be taken as two typical toning-baths:—

	Gold chloride	1 part.
	Sodium carbonate	10 parts.
	Water	5000 ,,
(α)	Borax	100 ,,
	Water	4000 ,,
(β)	Gold chloride	1 part.
	Water	4000 parts

In the latter (α) and (β) are mixed in equal parts immediately before use. Each of these is better used only once. A third bath is:—

Gold chloride	2 parts.
Chloride of lime	2 ,,
Chalk	40 ,,
Water	8000 ,,

These are mixed together, the water being warmed. When cool the solution is ready for use. In toning prints there is a distinct difference in the *modus operandi* according to the toning-bath employed. Thus in the first two baths the print must be thoroughly washed in water to remove all free silver nitrate, that salt forming no part in the chemical reactions. On the other hand, where free chlorine is used, the presence of free silver nitrate or some active chlorine absorbent is a necessity. In 1872 Abney showed that with such a toning-bath free silver nitrate might be eliminated, and if the print were immersed in a solution of a salt such as lead nitrate the toning action proceeded rapidly and without causing any fading of the image whilst toning, which was not the case when the free silver nitrate was totally removed and no other chlorine absorbent substituted. This was an important factor, and one which had been overlooked. In the third bath the free silver nitrate should only be partially removed by washing. The print, having been partially washed or thoroughly washed, as the case may be, is immersed in the toning-bath till the image attains a purple or bluish tone, after which it is ready for fixing. The solution used for this purpose is a 20% solution of hyposulphite of soda, to which it is best to add a dew drops of ammonia in order to render it alkaline. About ten minutes suffice to effect the conversion of the chloride into hyposulphite of silver, which is soluble in hyposulphite of soda and can be removed by washing. The organic salts of silver seem, however, to form a different salt, which is partially insoluble, but which the ammonia helps to remove. If it is not removed there is a sulphur compound left behind, according to J. Spiller, which by time and exposure becomes yellow.

The use of potassium cyanide for fixing prints is to be avoided, as this reagent attacks the organic coloured oxide which, if removed, would render the print a ghost. The washing of silver prints should be very complete, since it is said that the least trace of hyposulphite left behind renders the fading of the image a mere matter of time. The stability of a print has been supposed to be increased by immersing it, after washing, in a solution of alum. The alum, like any acid body, decomposes the hyposulphite into sulphur and sulphurous acid. If this be the case, it seems probable that the destruction of the hyposulphite by time is not the occasion of fading, but that its hygroscopic character is. This, however, is a moot point. It is usual to wash the prints some hours in running water. We have found that half a dozen changes of water, and between successive changes the application of a sponge to the back of each print separately, are equally or more efficacious. On drying the print assumes a darker tone than it has after leaving the fixing bath.

Different tones can thus be given to a print by different toning-baths; and the gold itself may be deposited in a ruddy form or in a blue form. The former molecular condition gives the red and sepia tones, and the latter the blue and black tones. The degree of minute subdivision of the gold may be conceived when it is stated that, on a couple of sheets of albuminized paper fully printed, the gold necessary to give a decided tone does not exceed half a grain.

Collodio-chloride Silver Printing Process.—In the history of the emulsion processes we stated that Gaudin attempted to use silver chloride suspended in collodion, but it was not till the year 1864 that any practical use was made of the suggestion so far as silver printing is concerned. In the autumn of that year George Wharton Simpson worked out a method which has been more or less successfully employed. The formula appended is Simpson's:—

1.	Silver nitrate	60 parts.
	Distilled water	60 ,,
2.	Strontium chloride	64 ,,
	Alcohol	1000 ,,
3.	Citric acid	64 ,,
	Alcohol	1000 ,,

To every 1000 parts of plain collodion 30 parts of No. 1, previously mixed with 60 parts of alcohol, are added; 60 parts of No. 2 are next mixed with the collodion, and finally 30 parts of No. 3. This forms an emulsion of silver chloride and also contains citric acid and silver nitrate. The defect of this emulsion is that it contains a large proportion of soluble salts, which are apt to crystallize out on drying, more particularly if it be applied to glass plates. The addition of the citric acid and the excess of silver nitrate is the key to the whole process; for, unless some body were present which on exposure to light was capable of forming a highly-coloured organic oxide of silver, no vigour would be obtained in printing. If pure chloride be used, though an apparently strong image would be obtained, yet on fixing only a feeble trace of it would be left, and the print would be worthless. The collodio-chloride emulsion may be applied to glass, or to paper, and the printing carried on in the usual manner. The toning takes place by means of the chloride of lime or by ammonium sulphocyanide and gold, which is practically a return to the *sel d'or* bath. The organic salt formed in this procedure does not seem so prone to be decomposed by keeping as does that formed by albumen, and the washing can be more completely carried out. There are in the market several papers which are collodio-chloride.

Gelatino-citro-chloride Emulsion.—A modified emulsion printing process was introduced by Abney in 1881, which consisted in suspending silver chloride and silver citrate in gelatin, there being no excess of silver present. The formula of producing it is as follows:—

1.	Sodium chloride	40 parts.
	Potassium citrate	40 ,,
	Water	500 ,,
2.	Silver nitrate	150 ,,
	Water	500 ,,
3.	Gelatin	300 ,,
	Water	1700 ,,

Nos. 2 and 3 are mixed together whilst warm, and No. 1 is then gently added, the gelatin solution being kept in brisk agitation. This produces the emulsion of citrate and chloride of silver. The gelatin containing the suspended salts is heated for five minutes at boiling point, when it is allowed to cool and subsequently slightly washed, as in the gelatino-bromide emulsion. It is then ready for application to paper or glass. The prints are of a beautiful colour, and seem to be fairly permanent. They may be readily toned by the borax or by the chloride of lime toning-bath, and are fixed with the hyposulphite solution of the strength before given. Most, if not all, of the gelatin papers now extant are made somewhat after this manner.

Printing with Salts of Uranium.—The sensitiveness of the salts of uranium to light seems to have been discovered by Niepce, and was subsequently applied to photography by J. E. Burnett in England. One of the original formulae consisted of 20 parts of uranic nitrate with 600 parts of water. Paper, which is better if slightly sized previously with gelatin, is floated on this solution. When dry it is exposed beneath a negative, and a very faint image is produced; but it can be developed into a strong one by 6 to 10% solution of silver nitrate to which a trace of acetic acid has been added, or by a 2% solution of gold chloride. In both these cases the silver and gold are deposited in the metallic state. Another developer is a 2% solution of potassium ferrocyanide to which a trace of nitric acid has been added, sufficient to give a red coloration. The development takes place most readily by letting the paper float on these solutions.

Self-toning Papers.—There are several self-toning papers based on the chloride emulsion process. These contain the necessary amount of gold to tone the print. The print is produced in the ordinary way and then immersed in salt and water or in some cases potassium sulphocyanide. The print is finished by immersing in weak hyposulphite of soda.

Printing with Chromates: Carbon Prints.—The first mention of the use of potassium bichromate for printing purposes seems to have been made by Mungo Ponton in May 1839, when he stated that paper, if saturated with this salt and dried, and then exposed to the sun's rays through a drawing, would produce a yellow picture on an orange ground, nothing more being required to fix it than washing it in water, when a white picture on an orange ground was obtained. In 1840 Edmond Becquerel announced that paper sized with iodide of starch and soaked in potassium bichromate was, on drying, more sensitive than unsized paper. Joseph Dixon of Massachusetts, in the following year, produced copies of bank-notes by using gum arabic with potassium bichromate spread upon a lithographic stone, and, after exposure of the sensitive surface through a bank-note, by washing away the unaltered gum and inking the stone as in ordinary lithography. The same process, with slight modifications, has been used by Simonau and Toovey of Brussels, and produces excellent results. Dixon's method, however, was published in the *Scientific American* for 1854, and consequently, as regards priority, it ranks after Fox Talbot's photo-engraving process (see below), published in 1852. On the 13th of December 1855 Alphonse Poitevin took out a patent in England, in which he vaguely described a method of taking a direct carbon-print by rendering gelatin insoluble through the action of light on potassium bichromate. This idea was taken up by John Pouncey of Dorchester, who perhaps was the first to produce veritable carbon-prints, notwithstanding that Testud de Beauregard took out a somewhat similar patent to Poitevin's at the end of 1857.

Pouncey published his process on the 1st of January 1859; but, as described by him, it was by no means in a perfect state, half-tones being wanting. The cause of this was first pointed out by Abbé Laborde in 1858, whilst describing a kindred process in a note to the French Photographic Society. He says, "In the sensitive film, however thin it may be, two distinct surfaces must be recognized—an outer, and an inner which is in contact with the paper. The action of light commences on the outer surface; in the washing, therefore, the half-tones lose their hold on the paper and are washed away." J. C. Burnett in 1858 was the first to endeavour to get rid of this defect in carbon printing. In a paper to the Photographic Society of London he says, "There are two essential requisites . . . (2) that in printing the paper should have its *un*prepared side (and not its prepared side, as in ordinary printing) placed in contact with the negative in the pressure-frame, as it is only by printing in this way that we can expect to be able afterwards to remove by washing the unacted-upon portions of the mixture. In a positive of this sort printed from the front or prepared side the attainment of half-tones by washing away more or less depth of the mixture, according to the depth to which it has been hardened, is prevented by the insoluble parts being on the surface and in consequence protecting the soluble part from the action of the water used in washing; so that either nothing is removed, or by steeping very long till the inner soluble part is sufficiently softened the whole depth comes bodily away, leaving the paper white." This method of exposing through the back of the paper was crude and unsatisfactory, and in 1860 Fargier patented a process in which, after exposure to light of the gelatin film which contained pigment, the surface was coated with collodion, and the print placed in warm water, where it separated from the paper support and could be transferred to glass. Poitevin successfully opposed this patent, for he had used this means of detaching the films in his powder-carbon process, in which ferric chloride and tartaric acid were used. Fargier at any rate gave an impetus to carbon-printing, and J. W. Swan took up the matter, and in 1864 secured a patent. One of the great features in Swan's innovations was the production of what is now known as "carbon-tissue," made by coating paper with a mixture of gelatin, sugar and colouring matter, and rendered sensitive to light by means of potassium or ammonium bichromate. After exposure to light Swan placed the printed carbon-tissue on an india-rubber surface, to which it was made to adhere by pressure. The print was immersed in hot water, the paper backing stripped off, and the soluble gelatin containing colouring matter washed away. The picture could then be retransferred to its final support of paper. In 1869 J. R. Johnson of London took out a patent in which he claimed that carbon-tissue which had been soaked in water for a short period, by its tendency to swell further, would adhere to any waterproof surface such as glass, metal, waxed paper, &c., without any adhesive material being applied. This was a most important improvement. Johnson also applied soap to the gelatin to prevent its excessive brittleness on drying, and made its final support of gelatinized paper, rendered insoluble by chrome alum. In 1874 J. R. Sawyer patented a flexible support for developing on; this was a sized paper coated with gelatin and treated with an ammoniacal solution of shellac in borax, on which wax or resin was rubbed. The advantage of this flexible support is that the dark parts of the picture have no tendency to contract from the lighter parts, which they were apt to do when a metal plate was used, as was the case in Johnson's original process. With this patent, and minor improvements made since, carbon-printing has arrived at its present state of perfection.

According to P. E. Liesegang, the carbon-tissue when prepared on a large scale consists of from 120 to 150 grains of gelatin (a soft kind), 15 grains of soap, 21 grains of sugar and from 4 to 8 grains of dry colouring matter. The last-named may be of various kinds, from lamp-black pigment to soluble colours such as alizarin. The gelatin, sugar and soap are put in water and allowed to stand for an hour, and then melted, the liquid afterwards receiving the colours, which have been ground on a slab. The mixture is filtered through fine muslin. In making the tissue in large quantities the two ends of a piece of roll-paper are pasted together and the paper hung on two rollers; one of wood about 5 in. in diameter is fixed near the top of the room and the other over a trough containing the gelatin solution, the paper being brought into contact with the surface of the gelatin by being made to revolve on the rollers. The thickness of the coating is proportional to the rate at which the paper is drawn over the gelatin: the slower the movement, the thicker the coating. The paper is taken off the rollers, cut through, and hung up to dry on wooden laths. If it be required to make the tissue sensitive at once, 120 grains of potassium bichromate should be mixed with the ingredients in the above formula. The carbon-tissue when prepared should be floated on a sensitizing bath consisting of one part of potassium bichromate in 40 parts of water. This is effected by turning up about 1 in. from the end of the sheet of tissue (cut to the proper size), making a roll of it, and letting it unroll along the surface of the sensitizing solution, where it is allowed to remain till the gelatin film feels soft. It is then taken off and hung up to dry in a dark room through which a current of dry warm air is passing. Tissue dried quickly, though not so sensitive, is more manageable to work than if more slowly dried. As the tissue is coloured, it is not possible to ascertain by inspection whether the printing operation is sufficiently carried out, and in order to ascertain this it is usual to place a piece of ordinary silvered paper in an actinometer, or photometer, alongside the carbon-tissue to ascertain the amount of light that has acted on it. There are several devices for ascertaining this amount, the simplest being an arrangement of a varying number of thicknesses of gold-beater's skin. The value of 1, 2, 3, &c., thicknesses of the skin as a screen to the light is ascertained by experiment. Supposing it is judged that a sheet of tissue under some one negative ought to be exposed to light corresponding to a given number of thicknesses, chloride of silver paper is placed alongside the negative beneath the actinometer and allowed to remain there until it takes a visible tint beneath a number of thicknesses equivalent to the strength of the negative. After the tissue is removed from the printing-frame—supposing a double transfer is to be made—it is placed in a dish of cold water, face downwards, along with a piece of Sawyer's flexible support. When the edges of the tissue begin to curl up, its surface and that of the flexible support are brought together and placed flat. The water is pressed out with an india-rubber squeezer or "squeegee" and the two surfaces adhere. About a couple of minutes later they are placed in warm water of about 90° to 100° F., and the paper of the tissue, loosened by the gelatin solution next it becoming soluble, can be stripped off, leaving the image (reversed as regards right and left) on the flexible support. An application of warm water removes the rest of the soluble gelatin and pigment. When dried the image is transferred to its permanent support. This usually consists of white paper coated with gelatin and made insoluble with chrome alum, though it may be mixed with barium sulphate or other similar pigments. This transfer-paper is made to receive the image by being soaked in hot water till it becomes slimy to the touch; and the surface of the damped print is brought into contact with the surface of the retransfer-paper, in the same manner as was done with the flexible support and the carbon-tissue. When dry the retransfer-paper bearing the gelatin image can be stripped off the flexible support, which may be used again as a temporary support for other pictures. If a *reversed* negative be used the image may be transferred at once to its *final* support instead of to the temporary flexible support, which is a point of practical value, since single-transfer are better than double-transfer prints.

Printing with Salts of Iron.—Sir John Herschel and Robert Hunt entered into various methods of printing with salts of iron. At the present time two or three are practised, being used in draughtsmen's offices for copying tracings (see SUN-COPYING).

Photo-mechanical Printing Processes.—Poitevin claimed to have discovered that a film of gelatin impregnated with potassium bichromate, after being acted upon by light and damping, would receive greasy ink on those parts which had been affected by light. But Paul Oreloth seems to have made the discovery previous to 1854, for in his patent of that year he states that his designs were inked with printing ink before being transferred to stone or zinc. C. M. Tessie de Motay (in 1865) and C. R. Marechal of Metz, however, seem to have been the first to produce half-tones from gelatin films by means of greasy ink. Their general procedure consisted in coating metallic plates with gelatin impregnated with potassium or ammonium bichromate or tri-chromate and mercuric chloride, then treating with silver oleate, exposing to light through a negative, washing, inking with a lithographic roller, and printing from the plates as for an ordinary lithograph. The half-tints by this process were very good, and illustrations executed by it are to be found in several existing works. The method of producing the plates, however, was most laborious, and it was simplified by A. Albert of Munich. He had been experimenting for many years, endeavouring to make the gelatin films more durable than those of Tessie de Motay. He added gum-resins, alum, tannin and other such matters, which had the property of hardening gelatin; but the difficulty of adding sufficient to the mass in its liquid state before the whole became coagulated rendered these unmanageable. It at last occurred to him that if the hardening action of light were utilized by exposing the surface next the plate to light after or before exposing the front surface to the film and the image, the necessary hardness might be given to the gelatin without adding any chemical hardeners to it. In Tessie de Motay's process the hardening was almost absent, and the plates were consequently not durable. It is evident that to effect this one of two things had to be done: either the metallic plate used by Tessie de Motay must be abandoned, or else the film must be stripped off the plate and exposed in that manner. Albert adopted the transparent plate, and his success was assured, since instead of less than a hundred impressions being pulled from one plate he was able to take over a thousand. This occurred about 1867, but the formula was not published for two or three years afterwards, when it was divulged by Ohm and Grossman, one of whom had been employed by Albert of Munich, and had endeavoured to introduce a process which resembled Albert's earlier efforts. The name of "Lichtdruck" was given about this time to these surface-printing processes, and Albert may be considered, if not the inventor, at all events the perfecter of the method. Another modification of "Lichtdruck" was patented in England by Ernest Edwards under the name of "heliotype."

Woodbury Type.—This process was invented by W. Woodbury about the year 1864, though we believe that J. W. Swan had been working independently in the same direction about the same time. In October 1864 a description of the invention was given in the *Photographic News.* Marc Antoine A. Gaudin claimed the principle of the process, insisting that it was old, and basing his pretensions on the fact that he had printed with translucent ink from intaglio blocks engraved by hand; but at the same time he remarked that the application of the principle might lead to important results. It was just these results which Woodbury obtained, and for which he was entitled to the fullest credit. Woodbury subsequently introduced certain modifications, the outcome being what is known as the "stannotype process," of which in 1880 he read a description before the French Photographic Society (see PROCESS).

Photo-lithography.—Reference has been made to the effect of light on gelatin impregnated with potassium bichromate, whereby the gelatin becomes insoluble, and also incapable of absorbing water where the action of the light has had full play. It is this last phenomenon which occupies such an important place in photo-lithography. In the spring of 1859 E. J. Asser of Amsterdam produced photographs on a paper basis in printer's ink. Being anxious to produce copies of such prints mechanically, he conceived the idea of transferring the greasy ink impression to stone, and multiplying the impressions by mechanical lithography. Following very closely upon Asser, J. W. Osborne of Melbourne made a similar application; his process is described by himself in the *Photographic Journal* for April 1860 as follows: "A negative is produced in the usual way, bearing to the original the desired ratio. . . . A positive is printed from this negative upon a sheet of (gelatinized) paper, so prepared that the image can be transferred to stone, it having been previously covered with greasy printer's ink. The impression is developed by washing away the soluble matter with hot water, which leaves the ink on the lines of print of the map or engraving." The process of transferring is accomplished in the ordinary way. Early in 1860 Colonel Sir H. James, R.E., F.R.S., brought forward the Southampton method of photo-lithography, which had been carefully worked out by Captain de Courcy Scott, R.E. The "papyrotype process" was published by Abney in 1870 (see LITHOGRAPHY and PROCESS).

Photographs in Natural Colours.

The first notice on record of coloured light impressing its own colours on a sensitive surface is in the passage already quoted from the *Farbenlehre* of Goethe, where T. J. Seebeck of Jena (1810) describes the impression he obtained on paper impregnated with moist silver chloride. In 1839 Sir J. Herschel (*Athenaeum*, No. 621) gave a somewhat similar description. In 1848 Edmond Becquerel succeeded in reproducing upon a daguerreotype plate not only the colours of the spectrum but also, up to a certain point, the colours of drawings and objects. His method of proceeding was to give the silver plate a thin coating of silver chloride by immersing it in ferric or cupric chlorides. It may also be immersed in chlorine water till it takes a feeble rose tint. Becquerel preferred to chlorinize the plate by immersion in a solution of hydrochloric acid in water, attaching it to the positive pole of a voltaic couple, whilst the other pole he attached to a platinum plate also immersed in the acid solution. After a minute's subjection to the current the plate took successively a grey, a yellow, a violet and a blue tint, which order was again repeated. When the violet tint appeared for the second time the plate was withdrawn and washed and dried over a spirit-lamp. In this state it produced the spectrum colours, but it was found better to heat the plate till it assumed a rose tint. At a later date Niepce de St Victor chlorinized by chloride of lime, and made the surface more sensitive by applying a solution of lead chloride in dextrin. G. W. Simpson also obtained coloured images on silver chloride emulsion in collodion, but they were less vivid and satisfactory than those obtained on daguerreotype plates. Poitevin obtained coloured images on ordinary silver chloride paper by preparing it in the usual manner and washing it and exposing it to light. It was afterwards treated with a solution of potassium bichromate and cupric sulphate, and dried in darkness. Sheets so prepared gave coloured images from coloured pictures, which he stated could be fixed by sulphuric acid (*Comptes rendus*, 1868, 61, p. 11). In the *Bulletin de la Société Française* (1874) Colonel St Florent described experiments which he made with the same object. He immersed ordinary or albuminized paper in silver nitrate and afterwards plunged it into a solution of uranium nitrate and zinc chloride acidulated with hydrochloric acid; it was then exposed to light till it took a violet, blue or lavender tint. Before exposure the paper was floated on a solution of mercuric nitrate, its surface dried, and exposed to a coloured image.

It is supposed—though it is very doubtful if it be so—that the nature of the chloride used to obtain the silver chloride has a great effect on the colours impressed; and Niepce in 1857 made some observations on the relationship which seemed to exist between the coloured flames produced by the metal and the colour impressed on a plate prepared with a chloride of such a metal. In 1880 Abney showed that the production of colour really resulted from the oxidation of the chloride that was coloured by light. Plates immersed in a solution of hydrogen peroxide took the colours of the spectrum much more rapidly than when not immersed, and the size of the molecules seemed to regulate the colour. He further stated that the whole of the spectrum colours might be derived from a mixture of two or at most three sizes of molecules.

In 1841, Robert Hunt published some results of colour-photography by means of silver fluoride. A paper was washed with silver nitrate and with sodium fluoride, and afterwards exposed to the spectrum. The action of the spectrum commenced at the centre of the yellow ray and rapidly proceeded upwards, arriving at its maximum in the blue ray. As far as the indigo the action was uniform, whilst in the violet the paper took a brown tint. When it was previously exposed, however, a yellow space was occupied where the yellow rays had acted, a green band where the green had acted, whilst in the blue and indigo it took an intense blue, and over the violet there was a ruddy brown. In reference to these coloured images on paper it must not be forgotten that pure salts of silver are not being dealt with as a rule. An organic salt of silver is usually mixed with silver chloride paper, the organic salt being due to the sizing of the paper, which towards the red end of the spectrum is usually more sensitive than the chloride. If a piece of ordinary silver chloride paper is exposed to the spectrum till an impression is made, it will usually be found that the blue colour of the darkened chloride is mixed with that due to the coloration of the darkened organic compound of silver in the violet region, whereas in the blue and green this organic compound is alone affected, and is of a different colour from that of the darkened mixed chloride and organic compound. This naturally gives an impression that the different rays yield different tints, whereas this result is simply owing to the different range of sensitiveness of the bodies. In the case of the silver chlorinized plate and of true collodio-chloride, in which no organic salt has been dissolved, we have a true coloration by the spectrum. At present there is no means of permanently fixing the coloured images which have been obtained, the effect of light being to destroy them. If protected from oxygen they last longer than if they have free access to it, as is the case when the surface is exposed to the air.

A method devised by Gabrielle Lippmann, of Paris, by which the natural colours of objects are reproduced by means of interference, may be briefly described as follows: A sensitive plate is placed in contact with a film of mercury, and the exposure to the spectrum, or to the image of coloured objects to be photographed, is made through the back of the plate. On development, the image appears coloured when viewed at one particular angle, the colours being approximately those of the object. The necessary exposure to produce this result was very prolonged in the first experiments in which the spectrum was photographed, and a longer exposure had to be given to the red than was required for the blue. Lippmann at first employed collodion dry plates, prepared, it is believed, with albumen, and it required considerable manipulation to bring out the colours correctly. A. Lumière used gelatin plates dyed with appropriate dyes (orthochromatic plates); the exposure was much diminished, and very excellent representations were produced of all natural colours. The main point to aim at in the preparation of the plate seems to be to obtain a very sensitive film without any, or, at all events, with the least possible, "grain" in the sensitive salt. A formula published by Lumière seems to attain this object. Viewed directly, the developed images appear like ordinary negatives, but when held at an angle to the light the colours are vivid. They are not pure monochromatic colours, but have very much the quality of colours obtained by polarized light. It appears that they are produced by what may be termed "nodes" of different-coloured lights acting within the film. Thus in photographing the spectrum, rays penetrate to the reflecting mercury and are reflected back from it, and these, with the incident waves of light, form nodes where no motion exists, in a somewhat similar way to those obtained in a cord stretched between two points when plucked. In the negative these nodal points are found in the thickness of the silver deposit. When white light is sent through the film after the image has been developed, theoretically only rays of the wave-lengths which formed these nodes are reflected to the eye, and thus we get an impression of colour.

Action of Light on Chemical Compounds.

Reference has been made above to early investigations on the chemical action of light. In 1777 Karl Wilhelm Scheele (Hunt's *Researches in Light*) made the following experiments on silver salts:—

> "I precipitated a solution of silver by sal-ammoniac; then I edulcorated it and dried the precipitate and exposed it to the beams of the sun for two weeks; after which I stirred the powder, and repeated the same several times. Hereupon I poured some caustic spirit of sal-ammoniac (strong ammonia) on this, in all appearance, black powder, and set it by for digestion. This menstruum dissolved a quantity of *luna cornua* (horn silver), though some black powder remained undissolved. The powder having been washed was, for the greater part, dissolved by a pure acid of nitre (nitric acid), which, by the operation, acquired volatility. This solution I precipitated again by means of sal-ammoniac into horn silver. Hence it follows that the blackness which the luna cornua acquires from the sun's light, and likewise the solution of silver poured on chalk, is *silver by reduction*. . . . I mixed so much of distilled water with well-edulcorated horn silver as would just cover this powder. The half of this mixture I poured into a white crystal phial, exposed it to the beams of the sun, and shook it several times each day; the other half I set in a dark place. After having exposed the one mixture during the space of two weeks, I filtrated the water standing over the horn silver, grown already black; I let some of this water fall by drops in a solution of silver, which was immediately precipitated into horn silver."

This, as far as we know, is the first intimation of the reducing action of light. From this it is evident that Scheele had found that the silver chloride was decomposed by the action of light liberating some form of chlorine. Others have repeated these experiments and found that chlorine is really liberated from the chloride; but it is necessary that some body should be present which would absorb the chlorine, or, at all events, that the chlorine should be free to escape. A tube of dried silver chloride, sealed up *in vacuo*, will not discolour in the light, but keeps its ordinary white colour. A pretty experiment is to seal up *in vacuo*, at one end of a bent tube, perfectly dry chloride, and at the other a drop of mercury. The mercury vapour volatilizes to a certain extent and fills the tube. When exposed to light chlorine is liberated from the chloride, and calomel forms on the sides of the tube. In this case the chloride darkens. Again, dried chloride sealed up in dry hydrogen discolours, owing to the combination of the chlorine with the hydrogen. Poitevin and H. W. Vogel first enunciated the law that for the reduction by light of the haloid salts of silver halogen absorbents were necessary, and it was by following out this law that the present rapidity in obtaining camera images has been rendered possible. To put it briefly, then, the *visible* action of light is a reducing action, which is aided by or entirely due to the fact that other bodies are present which will absorb the halogens.

In the above we have alluded to the *visible* results on silver salts. It by no means follows that the exposure of a silver salt to light for such a brief period as to leave no visible effect must be due to the same effect, that is, that any of the molecules are absolutely reduced or split up by the light. That this or some other action takes place is shown by the fact that the silver salt is capable of alkaline development, that is, the particles which have suffered a change in their molecules can be reduced to metallic silver, whilst those which have not been acted upon remain unaltered by the same chemical agency. Two theories have been offered to explain the invisible change which takes place in the salts of silver. One is based on the supposition that the molecules of the salt can rearrange their atoms under the vibrations caused by the ether waves placing them in more unstable positions than they were in before the impact of light took place. This, it is presumed, would allow the developer to separate the atoms of such shaken molecules when it came in contact with them. The other theory is that, as in the case of the visible effects of light, some of the molecules are at once reduced and that the developer finishes the disintegration which the light has begun. In the case of the alkaline development the unaltered molecules next those primarily reduced combine with the reduced silver atom and again form an unstable compound and are in their turn reduced.

The first theory would require some such action as that just mentioned to take place and cause the invisible image formed by the shaking apart of the light-stricken molecules to become visible. It is hard to see why other unacted upon molecules close to those which were made unstable and which have been shaken apart by the developer should themselves be placed in unstable equilibrium and amenable to reduction. In the second theory, called the "chemical theory," the reduction is perfectly easy to understand. Abney adopts the chemical theory as the balance of unsubstantiated evidence is in its favour. There is another action which seems to occur almost simultaneously when exposure takes place in the absence of an active halogen absorbent, as is the case when the exposure is given in the air, that is, an oxidizing action occurs. The molecules of the altered haloid salts take up oxygen and form oxides. If a sensitive salt be briefly exposed to light and then treated with an oxidizing substance, such as potassium bichromate, potassium permanganate, hydrogen peroxide, ozone, an image is not developed, but remains unaltered, showing that a change has been effected in the compound which under ordinary circumstances is developable. If such an oxidized salt be treated very cautiously with nascent hydrogen, the oxygen is withdrawn and the image is again capable of development.[1]

Spectrum Effects on Silver Compounds.—The next inquiry is as to the effect of the spectrum on the different silver compounds. We have already described Seebeck's (1810) experiments on silver chloride with the spectrum whereby he obtained coloured photographs, but Scheele in 1777 allowed a spectrum to fall on the same material, and found that it blackened much more readily in the violet rays than in any other. Senebier's experiments have been already quoted. We merely mention these two for their historical interest, and pass on to the study of the action of the spectrum on different compounds by Sir J. Herschel (*Phil. Trans.*, 1840). He describes many experiments, which have become the foundation of nearly all subsequent researches of the same kind. The effects of the spectrum have been studied by various experimenters since that time, amongst whom we may mention Edmond Becquerel, John William Draper, Alphonse Louis Poitevin, H. W. Vogel, Victor Schumann and W. de W. Abney. Fig. 1 is compiled from a cut which appeared in the *Proc. Roy. Soc.* for 1882, and shows the researches made by Abney as regards the action of the spectrum on the three principal haloid salts of silver. No. 7 shows the effect of the spectrum on a peculiar modification of silver bromide made by Abney, which is seen to be sensitive to the infra-red rays.

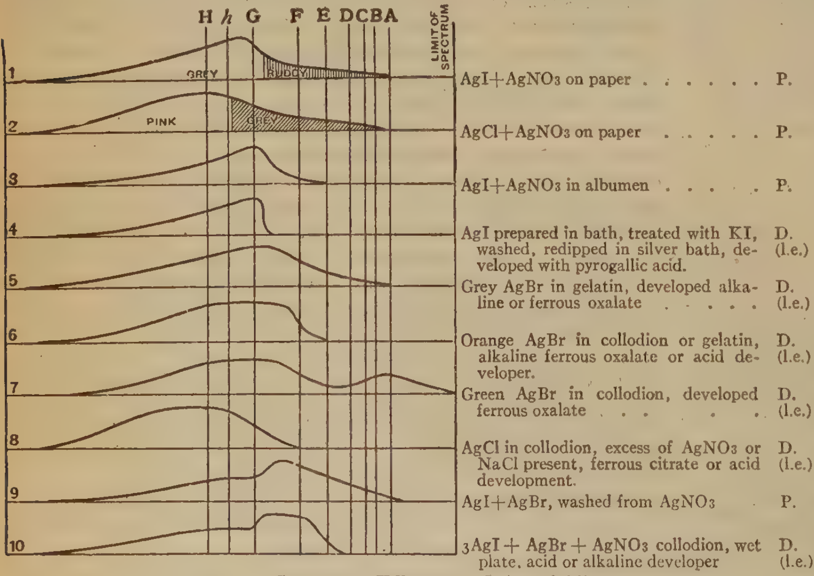

FIG. 1.—Spectrum Effects on Salts of Silver.
[P. = print; D. = developed; l.e. = long exposure].

Effect of Dyes on Sensitive Films.—In 1874 Dr H. W. Vogel of Berlin found that when films were stained with certain dyes and exposed to the spectrum an increased action on development was shown in those parts of the spectrum which the dye absorbed. The dyes which produced this action he called "optical sensitizers," whilst preservatives which absorbed the halogen liberated by light he called "chemical sensitizers." A dye might, according to him, be an optical and a chemical sensitizer. He further claimed that, if a film were prepared in which the haloid soluble salt was in excess and then dyed, no action took place unless some "chemical sensitizer" were present. The term "optical sensitizer" seems a misnomer, since it is meant to imply that it renders the salts of silver sensitive to those regions of the spectrum to which they were previously insensitive, merely by the addition of the dye. The idea of the action of dyes was at first combated, but it was soon recognized that such an action did really exist. Abney showed in 1875 that certain dyes combined with silver and formed true coloured organic salts of silver which were sensitive to light; and Dr Robert Amory went so far as to take a spectrum on a combination of silver with eosin, which was one of the dyes experimented upon by J. Waterhouse, who had closely followed Dr Vogel, and proved that the spectrum acted simply on those parts which were absorbed by the compound. Abney further demonstrated that, in many cases at all events, the dyes were themselves reduced by light, thus acting as nuclei on which the silver could be deposited. He further showed that even when the haloid soluble salt was in excess the same character of spectrum was produced as when the silver nitrate was in excess, though the exposure had to be prolonged. This action he concluded was due to the dye.

Correct Rendering of Colours in Monochrome.—In Plate IV., fig. 14 the sensitiveness of a plate stained with homocol is shown, and it is evident that as it is sensitive throughout the visible spectrum there must be some means of cutting off by a transparent screen so much of the spectrum luminosity at different parts that every colour having the same luminosity to the eye shall be shown on a negative of equal density. When this is done the relative luminosities of all colours will be shown by the same relative densities or in a print by different depths of greys. Abney devised a sensitometer which should be used to ascertain the colour of the screen that should be employed. By proper means the luminosity of the light of day coming through a red, a green, a blue and an orange glass can be very accurately measured; if $\frac{1}{2}$-in. squares of these coloured glasses, together with a white glass of the same area, be placed in a row and cemented on white glass, we have a colour-screen which we can make available for finding the kind of light-filter to be employed. This is readily done by reducing the luminosity of the light coming through all the glasses to that of the luminosity of the light coming through the blue glass. If the luminosity of the blue be 5 and that of the white light 100, then the luminosity of the former must be reduced to $\frac{1}{20}$ of its original value, and so with the other glasses. The luminosity of the light coming through each small glass square can be made equal by rotating in front of them a disk in which apertures are cut corresponding to the reduction required. The

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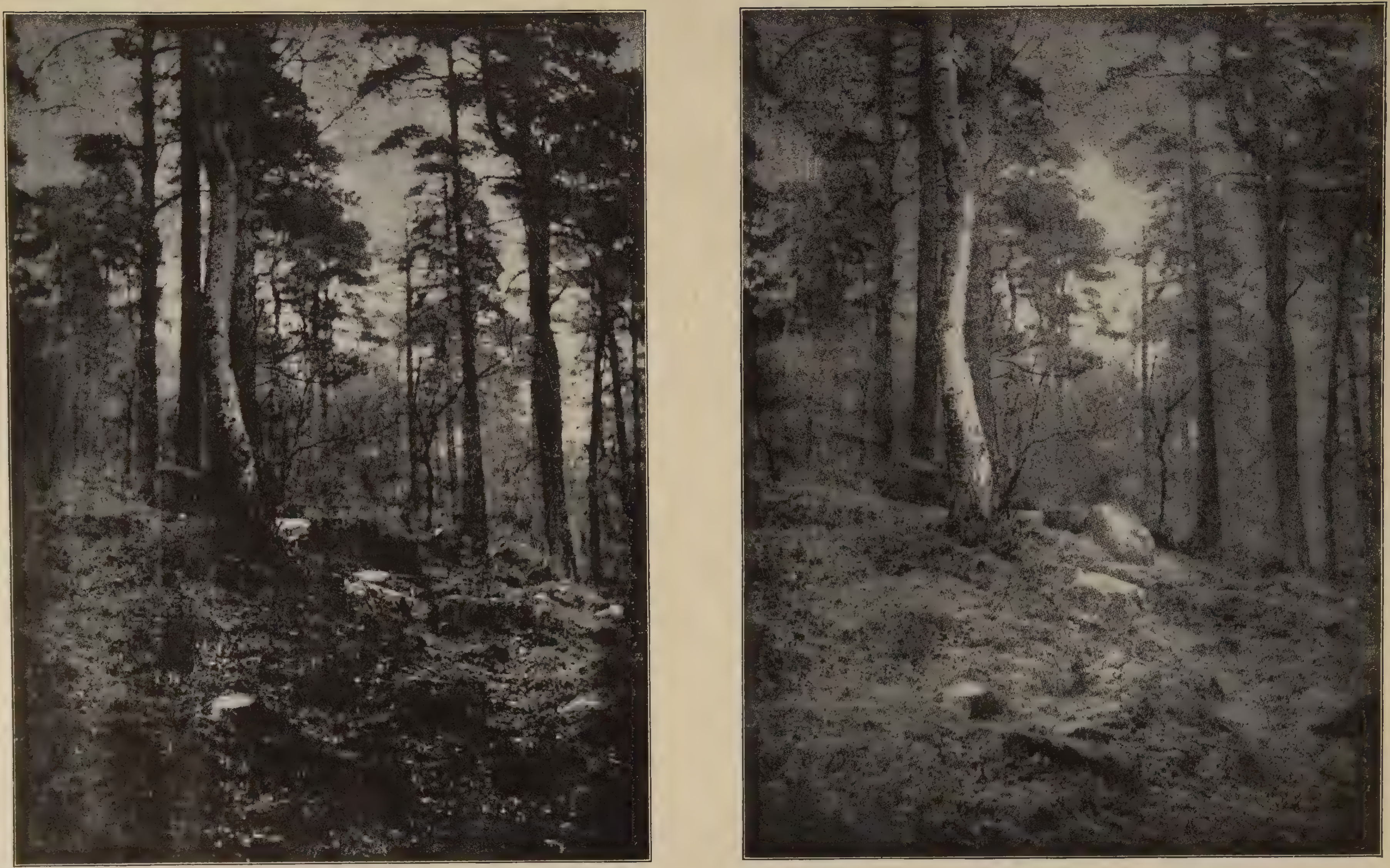
[1] See Abney, "Destruction of the Photographic Image," *Phil. Mag.* (1878), vol. v.; also *Proc. Roy. Soc.* (1878), vol. xxvii.

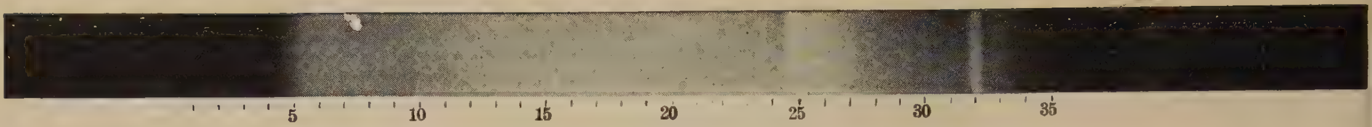


LANDSCAPE. By A. Horsley Hinton.

(The right-hand printing is from the same negative, but with the action of the light controlled.)

Plate IV.

PHOTOGRAPHY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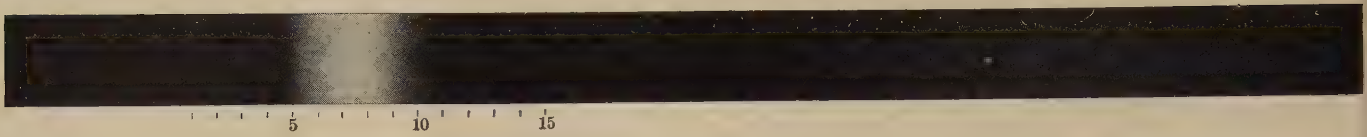
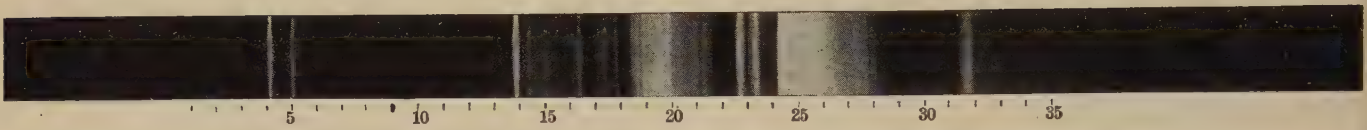
CONTINUOUS SPECTRUM TAKEN WITH THE ELECTRIC ARC.



FLUORESCENT SPECTRUM OF EOSIN.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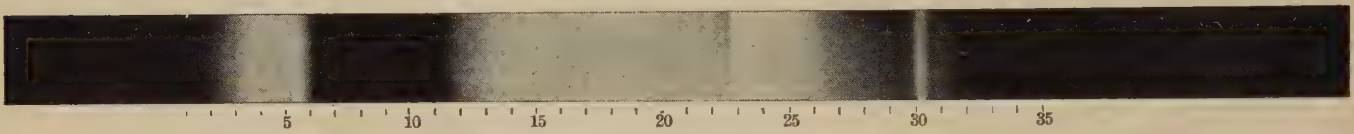
SPECTRUM OF VOLATILIZED LITHIUM AND SODIUM.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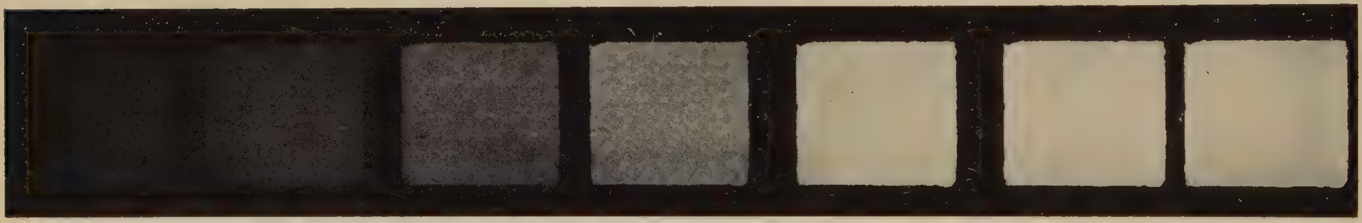
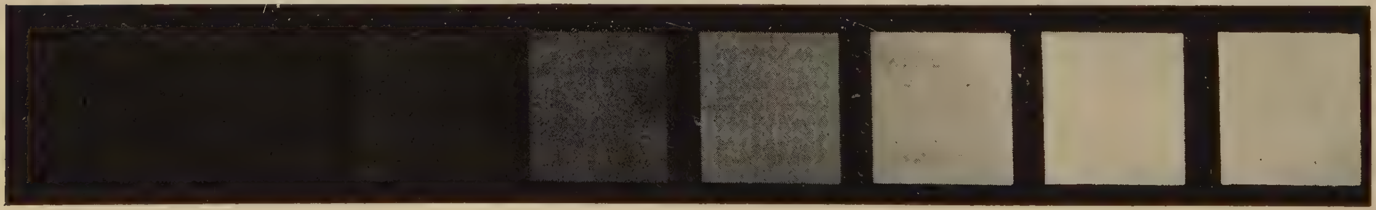
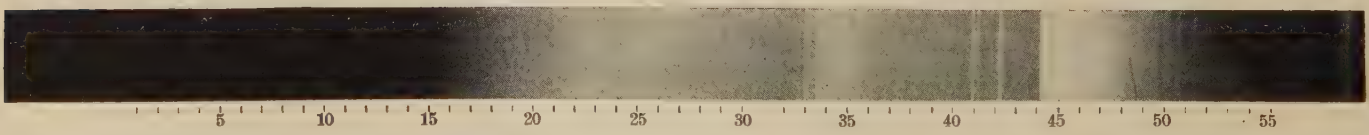
ABSORPTION SPECTRUM OF EOSIN.



GRADUATION SCALE ON HOMOCOL STAINED "SEED" PLATE.



GRADUATION SCALE ON UNSTAINED PLATE.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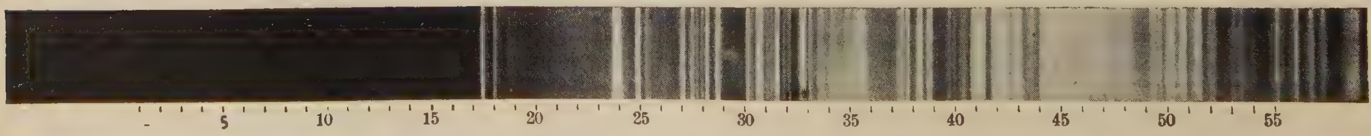
IMPRESSED CONTINUOUS SPECTRUM.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SPECTRUM OF BRIGHT LINES OF METALS.

blue glass, for instance, would not be covered by the disk at all, while opposite the white square the disk would have an aperture of an angle of 18°. When a plate is exposed behind the row of glass squares, with the light passing through the rotating disk, having the appropriate apertures for each glass, the negative obtained would under ordinary conditions, show square patches of very different opacity. A light-filter of some transparent colour, if placed in the path of the light, will alter the opacities, and eventually one can be found which will only allow such coloured light to be transmitted as will cause all the opacities in the negative to be the same. As the luminosities of the white light passing through the glasses are made equal, and as the photographic deposits are also rendered equal, this light-filter, if used in front of the camera lens, will render all coloured objects in correct monochrome luminosity. Another plan, based on the same principles, is to place segments of annuluses of vermilion, chrome yellow, emerald green, French blue and white on a disk, and to complete the annuluses with black segments, the amount of black depending on the luminosity of the pigments, which can be readily measured. When the disk is rotated, rings of colour, modified in brightness by black, are seen, and each ring will be of the same luminosity. As before, a screen (light-filter) to be used in front of the lens must be found which will cause the developed images of all the rings to appear of equal opacity. It must be remembered that the light in which the object is to be photographed must be the same as that in which the luminosity of the glasses or pigments is measured.

Action of the Spectrum on Chromic Salts.—The salts most usually employed in photography are the bichromates of the alkalis. The result of spectrum action is confined to its own most refrangible end, commencing in the ultra-violet and reaching as far as in the solar spectrum. Fig. 2 shows the relative action of the various parts of the spectrum on potassium bichromate. If other bichromates are employed, the action will be found to be tolerably well represented by the figures. No. 1 is the effect of a long exposure, No. 2 of a shorter one. It should be noticed that the solution of potassium bichromate absorbs those rays alone which are effective in altering the bichromate. This change is only possible in the presence of organic matter of some kind, such as gelatin or albumen.

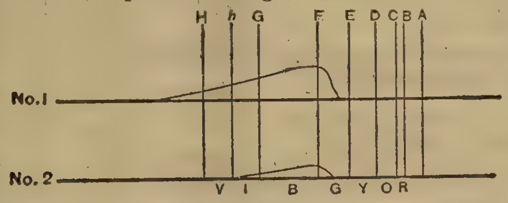

FIG. 2.—The top letters have reference to the Fraunhofer lines; the bottom letters are the initials of the colours. The relative sensitiveness is shown by the height of the curve above the base-line.

Action of the Spectrum on Asphaltum.—This seems to be continued into and below the red, the blue rays, however, are the most effective. The action of light on this body is to render it less soluble in its usual solvents.

Action of the Spectrum on Salts of Iron.—The commonest ferric salt in use is the oxalate, by which the beautiful platinotype prints are produced. We give this as a representation (fig. 3) of the spectra obtained on ferric salts in general. Here, again, we have an example of the law that exists as to the correlation between absorption and chemical action. One of the most remarkable compounds of iron is that experimented upon by Sir J. Herschel and later by Lord Rayleigh, viz. ferrocyanide of potassium and ferric chloride. If these two be brushed over paper, and the paper be then exposed to a bright solar spectrum, action is exhibited into the infra-red region. This is one of the few instances in which these light-waves of low refrangibility are capable of producing any effect. The colour of this solution is a muddy green, and analysis shows that it cuts off these rays as well as generally absorbs those of higher refrangibility.

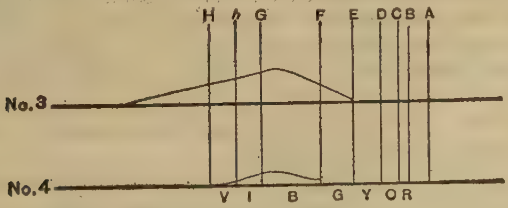

FIG. 3.—Same description as for fig. 2.

Action of Light on Uranium.—The salts of uranium are affected by light in the presence of organic matter, and they too are only acted upon by those rays which they absorb. Thus nitrate of uranium, which shows, too, absorption-bands in the green blue, is affected more where these occur than in any other portion of the spectrum.

Some salts of mercury, gold, copper, lead, manganese, molybdenum, platinum, vanadium, are affected by light, but in a less degree than those which we have discussed. In the organic world there are very few substances which do not change by the continuous action of light, and it will be found that as a rule they are affected by the blue end of the spectrum rather than by the red end (see PHOTOCHEMISTRY).

The following table gives the names of the observers of the action of light on different substances, with the date of publication of the several observations. It is nearly identical with one given by Dr Eder in his *Geschichte der Photo-Chemie.*

Substance.	Observer.	Date.
Silver.		
Nitrate solution mixed with chalk, gives in sunshine copies of writing	J. H. Schulze	1727
Nitrate solution on paper	Hellot	1737
Nitrate photographically used	Wedgwood and Davy.	1802
Nitrate on silk	Fulhame	1797
	Rumford	1798
Nitrate with white of egg	B. Fischer	1812
Nitrate with lead salts	Herschel	1839
Chloride	J. B. Beccarius	1757
Chloride in the spectrum	Scheele	1777
Chloride photographically used	Wedgwood	1802
Chloride blackened	Lassaigne	1839
Iodide	Davy	1814
Iodide by action of iodine (on metallic silver).	Daguerre	1839
Iodide photographically used	Herschel	1840
Iodide with gallic acid	Talbot	1841
Iodide with ferrous sulphate	Hunt	1844
Chloride and iodide by chlorine and iodine (on metallic silver).	Claudet	1840
Bromide	Balard	1826
Bromide by action of bromine (on metallic silver).	Goddard	1840
Sulpho-cyanide	Grotthus	1818
Nitrite	Hess	1828
Oxide with ammonia	Mitscherlich	1827
Sulphate	Bergmann	1779
Chromate	Vauquelin	1798
Carbonate	Buchholz	1800
Oxalate	Bergmann	1779
Benzoate	Trommsdorf	1793
Citrate	Vauquelin	1798
Kinate	Henry and Plisson	1829
Borate	Rose	1830
Pyrophosphate	Stromeyer	1830
Lactate	Pelouze and Gay-Lussac.	1833
Formiates	Hunt	1844
Fulminates	Hunt	1844
Sulphide by vapour of sulphur (on metallic silver).	Niepce	1820
Phosphide by vapour of phosphorus (on metallic silver).	Niepce	1820
Gold.		
Oxide	Scheele	1777
Chloride on paper	Hellot	1737
Chloride on silk	Fulhame	1794
Chloride in ethereal solution	Rumford	1793
Chloride with ferrocyanide and ferricyanide of potassium.	Hunt	1844
Chloride and oxalic acid	Döbereiner	1831
Chromate	Hunt	1844
Plate of gold and iodine vapour	Goddard	1842

Substance.	Observer.	Date.
Platinum.		
Chloride in ether	Gehlen	1804
Chloride with lime	Herschel	1840
Iodide	Herschel	1840
Bromide	Hunt	1844
Cyanide		
Double chloride of platinum and potassium.	Döbereiner	1828
Mercury.		
Oxide (mercurous)	Gay-Lussac and Thénard.	1811
Oxide	Davy	1812
Oxide (mercuric)	Davy	1797
Oxide (more accurate observations)	Abildgaard Harup not till	1797 1801
Chloride (mercurous)	K. Neumann previously to	1739
Chloride (mercuric)	Boullay	1803
Chloride with oxalic acid	Bergmann	1776
Sulphate	Meyer	1764
Oxalate (mercuric)	Bergmann	1776
Oxalate (mercurous)	Harff	1836
Sulphate and ammonia (mercurous).	Fourcroy	1791
Acetate (mercurous)	Garot	1826
Bromide (mercuric)	Löwig	1828
Iodide (mercurous)	Torosewicz Artus	1836 1836
Iodide (mercuric)	Field	1836
Citrate (mercuric)	Harff	1836
Tartrate and potassium (mercurous).	Carbonell and Bravo	1831
Carbonate (mercuric)	Davy	1812
Nitrate	Herschel	1840
Sulphide (mercuric)	Vitruvius	I B.C.
Iron.		
Sulphate (ferrous)	Chastaing	1877
Chloride (ferric) and alcohol	Bestuscheff	1725
Chloride and ether	Klaproth	1782
Oxalate (ferric)	Döbereiner	1831
Ferrocyanide of potassium	Heinrich	1808
Sulphocyanide	Grotthus	1818
Prussian blue	Scopoli	1783
Ferric citrate with ammonium	Herschel	1840
Ferric tartrate	Herschel	1840
Chromate	Hunt	1844
Copper.		
Chloride (cupric dissolved in ether).	Gehlen	1804
Oxalate with sodium	A. Vogel	1813
Chromate	Hunt	1844
Chromate with ammonium		
Carbonate		
Iodide		
Sulphate		
Chloride (cuprous)	A. Vogel	1859
Copper plates (iodized)	Kratoch Talbot	1841 1841
Manganese.		
Sulphate	Brandenburg	1815
Oxalate	Suckow	1832
Potassium permanganate	Frommberg	1824
Peroxide and cyanide of potassium	Hunt	1844
Chloride	Hunt	1844
Lead.		
Oxide	Davy	1802
Iodide	Schönbein	1850
Sulphite		
Peroxide	Gay-Lussac	1811
Red lead and cyanide of potassium	Hunt	1844
Acetate	Hunt	1844
Nickel.		
Nitrate	Hunt	1844
Nitrate with ferro-prussiates		
Iodide		
Tin.		
Purple of cassius	Uncertain	
Various Substances.		
Cobalt salts	Hunt	1844
Arsenic sulphide (realgar)	Sage	1803
Antimony sulphide	Suckow	1832
Bismuth salts	Hunt	1844
Cadmium salts		
Rhodium salts		
Vanadic salts	Roscoe	1874
Iridium ammonium chloride	Döbereiner	1831
Potassium bichromate	Mungo Ponton	1838
Potassium with iodide of starch	Becquerel	1840
Metallic chromates	Hunt	1843
Chlorine and hydrogen	Gay-Lussac and Thénard.	1809
Chlorine (tithonized)	Draper	1842
Chlorine and ether	Cahours	1810
Chlorine in water	Berthollet	1785
Chlorine and ethylene	Gay-Lussac and Thénard	1809
Chlorine and carbon-monoxide	Davy	1812
Chlorine and marsh gas	Henry	1821
Chlorine and hydrocyanic acid	Serullas	1827
Bromide and hydrogen	Balard	1832
Iodine and ethylene	Faraday	1821
Cyanogen, solution of	Pelouze and Richardson.	1837
Various other methyl compounds	Cahours	1846
Hydrocyanic acid	Torosewicz	1836
Hypochlorites (calcium and potassium)	Döbereiner	1813
Uranium chloride and ether	Gehlen	1804
Molybdenate of potassium and tin salts.	Jager	1800
Crystallization of salts under influence of light.	Petit Chaptal Dize	1722 1788 1789
Phosphorus (in hydrogen, nitrogen, &c.)	Bockmann	1800
Phosphuretted hydrogen	A. Vogel	1812
Nitric acid	Scheele	1777
Hog's fat	Vogel	1806
Palm oil	Fier	1832
Asphalt	Niepce	1814
Resins (mastic, sandarac, gamboge, ammoniacum, &c.).	Senebier	1782
Guaiacum	Hagemann	1782
Bitumens all decomposed, all residues of essential oils.	Daguerre	1839
Coloured extracts from flowers	Senebier	1782
Similar colouring matters spread upon paper.	Herschel	1842
Yellow wax bleached	Pliny	1st cent. A.D.
Eudoxia macrembolitissa (purple dye).		10th cent.
Other purple dyes	Cole Réaumur	1684 1711
Oils generally	Senebier	1782
Nitric ether	Senebier	1782
Nicotine	Henry & Boutron-Charlard.	1836
Santonine	Merk	1883

Effect of Hydrogen Peroxide on Sensitive Plates.—Dr W. J. Russell made a series of experiments on the effect of exposure of sensitive plates to the action of vapours and gases for long periods. It has long been known that contact of plates with such substances as wood caused a sensitive surface to show "fog" on development. By a somewhat exhaustive series of experiments, Russell showed that the probable cause of this fog is hydrogen peroxide, since substances which favoured its formation produced the same effect. This is somewhat remarkable, as this same substance will completely destroy the effect that light has had on a sensitive plate; indeed, it affords one way of destroying a light image on a sensitive collodion plate. The experiments of Russell give a warning to store exposed plates for brief periods. It appears that negatives wrapped in paraffin paper are secure from this danger.

The Application of Photography to Quantitative Measures.—In order to employ photography for the measurement of light it was necessary that some means should be devised by which the opacity of the deposit produced on the development of a plate could be determined. It is believed that in 1874 the first attempt was made by Sir W. Abney to do this. In the *Phil. Mag.* he showed how density could be measured by means of an instrument, the diaphanometer, he had devised, in which transparent black wedges were used to make matches between the naked light and the same light after passing through the photographic opacity that had to be measured. In 1887, owing to the perfecting of the rotating sectors, which could be made to increase or diminish the apertures at pleasure during its rotation, the measurement of opacities became easy. The Rumford method of comparing the light through the deposit with the naked beam, using the sectors to equalize the illumination, was adopted, the deposit being placed between the light and the screen, the comparison light being a beam reflected from the same light on to the screen.

Owing to the fact that photographic deposit scatters light more or less, the opacities measured by this plan were slightly greater than was shown when such opacities were to be used for contact printing. The final plan adopted by Abney was to place the part of the plate carrying the deposit to be measured behind a screen constructed as above. C D (fig. 4) is a dull black card with an aperture cut in it which may be of any desired shape. This aperture was covered with transparent paper, as was also a portion B, the same size as A, but pasted on the black card itself. Light thrown from behind A would be matched with light thrown on to B from the front when a rod in the path of this last beam was made to prevent this light falling on A. When a portion of a plate bearing a deposit was placed behind and close to A, the light thrown on B had to be diminished by the sector till the two squares appeared equally bright and the aperture of the sector was noted and compared with that required when the deposit was removed.

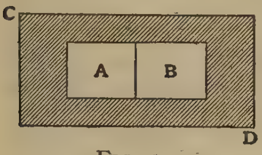

FIG. 4.

With this screen accurate measures of printing densities can be made, and it can also be used in the determination of the comparative photographic brightness of the light issuing from different objects. For instance, the relative brightness of the different parts of the corona as seen in a total eclipse can be readily determined if a "time scale" of gradation is impressed on the plate on which it is taken. Both scale and streamer can then be enlarged optically and thrown on the part of the screen A. The measures of the streamer densities can then be directly compared with the densities of the scale and the relative "photographic" brightness of the different parts of the streamer be ascertained by comparison with this scale also.

The same method of measurement was adopted in ascertaining quantitatively the sensitiveness of the spectrum of ordinary plates and of plates in which dyes are present. The figures on Pl. IV show reproductions of plates which were exposed to the spectrum. No. 1 is a continuous spectrum taken with the electric light; no. 7 is an impressed continuous spectrum; no. 8 shows the bright lines of metals; no. 3 the line spectrum of volatilized lithium and sodium to indicate the position of the spectrum colours. Nos. 4 and 2 are the absorption and fluorescent spectra of eosin. No. 5 is the graduation scale formed by a bromogelatin "Seed" plate stained with homocol, a cyanine derivative sensitive to the red; no. 6 is a similar scale formed by an unstained plate. The small numbers placed below the different bands show an empiric scale which is made to apply to each of them. The first step is to measure

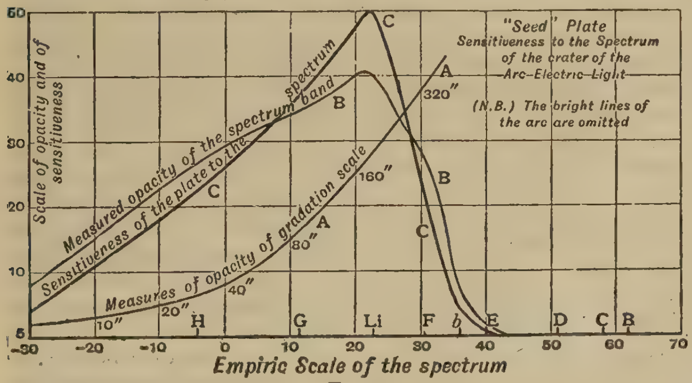

FIG. 5.

the opacity of the gradation scale, next the opacity of the continuous spectrum at the various numbers of the empiric scale, and also the opacity of the other bands at the same scale numbers. The continuous spectrum will give the sensitiveness of the plate to the different parts of the spectrum when the measures of its different opacities are compared with those of the scale of gradation, and a curve of sensitiveness can be plotted from these comparisons. It is evident that the measures of the other two bands will give us information as to the fluorescence and the absorption of the eosin. Fig. 5 shows the curve of opacity of the image of the spectrum at its different parts, and also the curve of sensitiveness of the plate to the different parts of the spectrum. This last is derived from a comparison of the measured densities with those of the gradation scale.

Measurement of the Rapidity of a Plate.—The first attempt that was made to ascertain the rapidity of a plate was by Abney (*Phil. Mag.* 1874), who demonstrated that within limits the transparency of deposit varied as the logarithm of the exposure.

The last formula has been accepted for general use, though it is believed that it is not absolutely correct, though very approximately true and sufficiently near to be of practical value. This belief is based on the further researches described below.[1]

In 1888 Sir W. Abney pointed out that the speed of a plate could be determined by the formula $T=E-\mu(\log E+C)^2$, where T is the transparency, E is the exposure (or time of exposure × intensity of light acting), and C a constant. If the abscissae (exposures) are plotted as logarithms, the curve takes the same form as that of the law of error, which has a singular point, a tangent through which lies closely along the curve and cuts the axis of Y at a point which has a value of $2/\sqrt{E}$. If the total transparency be unity, this ordinate has a value of 1·212, the singular point having a value of 0·606. The ordinate of the zero point of the curve will be where the tangent to the singular point cuts the line drawn at 1·212. The difference between the measurements of this zero point for two kinds of plates (*i.e.* C in the formula) from the points in the abscissae marking the same exposure, will give the relative sensitiveness of the two plates in terms of log x^2. In 1890 Hurter and Driffield (*Journ. Soc. Chem. Ind.* Jan. 19, 1891) worked out a less empirical formula connecting the exposure E with the density of deposit, which in an approximate shape had the form $D=\gamma\log(E/i)$, where D is the density of deposit (or log 1/T), i the "inertia" of the plate, T the transparency of the deposit. In the customary way a small portion of a plate was exposed to a constant light at a fixed distance and for a fixed time, and another small portion to the same light for double the time, and so on. By measuring the densities of the various deposits and constructing a curve, a large part of which was approximately a straight line, it was found possible, by the production of the straight portion to meet the axis of X, to give the relative sensitiveness of different plates by the distance of the intersection from the zero point L. (See also *Exposure Meters*, below, under § 1, APPARATUS.)

Effect of Temperature on Sensitiveness.—In 1876 Abney showed that heat apparently increased, while cold diminished, the sensitiveness of a plate, but the experiments were rather of the qualitative than the quantitative order. In 1893, from fresh experiments,[2] he found that the effect of a difference in temperature of some 40° C. invariably caused a diminution in sensitiveness of the sensitive salt at the lower temperature, a plate often requiring more than double the exposure at a temperature of about −18° C. than it did when the temperature was increased to +33° C. The general deduction from the experiments was that increase in temperature involved increase in sensitiveness so long as the constituents of the plate (gelatin, &c.) were unaltered. Sir James Dewar stated at the Royal Institution in 1896 that at a temperature of −180° C. certain sensitive films were reduced in sensitiveness to less than a quarter of that which they possess at ordinary temperatures. It appears also, from his subsequent inquiry, that when the same films were subjected to the temperature of liquid hydrogen (−252° C.) the loss in sensitiveness becomes asymptotic as the absolute zero is approached. Presumably, therefore, some degree of sensitiveness would still be preserved even at the absolute zero.

Effect of Small Intensities of Light on a Sensitive Salt.[3]—When a plate is exposed for a certain time to a light of given intensity, it is commonly said to have received so much exposure (E). If the time be altered, and the intensity of the light also, so that the exposure (time × intensity) is the same, it was usually accepted that the energy expended in doing chemical work in the film was the same. A series of experiments conducted under differing conditions has shown that such is not the case, and that the more intense the light (within certain limits) the greater is the chemical action, as shown on the development of a plate. Fig. 6 illustrates the results obtained in three cases. The exposure E is the same in all cases. The curves are so drawn that the scale of abscissae is the intensity of the light in powers of −2, and the ordinates show the percentages of chemical action produced. If the chemical action remained the same when the intensity of light was reduced, E remaining the same, each of the curves would be shown as a straight line at the height of 100, which is the transparency of deposit with the unit of light. As it is, they show diminishing percentages as the light intensity is diminished.

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[1] Those *applicable to the correction* of star magnitudes as determined by photography have been verified and confirmed by Schwarzchild, Michalke and others.

[2] Abney, *Proc. Roy. Soc.* 1893.

[3] Abney, *Proc. Roy. Soc.* 1893, and *Journ. Camera Club*, 1893.

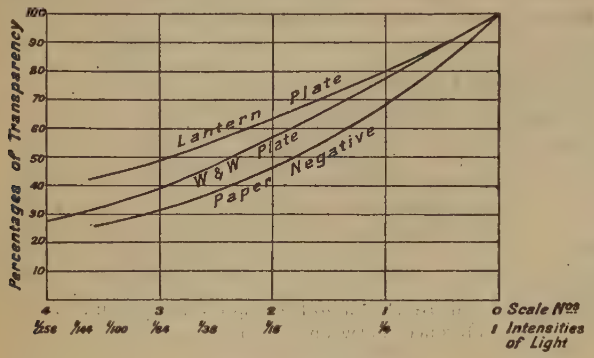

FIG. 6.

Thus, when the intensity of the light is reduced to $\frac{1}{64}$ of the original, and the time of exposure is prolonged 64 times, the useful energy expended on a lantern plate is only 50 % of that expended when the light and time of exposure are each unity. In the cases to which the diagram refers, the light used was a standard amyl acetate lamp, and the unit of intensity taken was this light at a distance of 2 ft. from the plate, and the unit of time was 10 seconds. The lamp being moved to 16 ft. from the plate, gave an intensity of $\frac{1}{64}$ the unit, and the time of exposure had to be increased to 640 seconds, so that E was the same in both cases. Further, it was found that when the *times* of exposure on different parts of the plate were successively doubled, light at a fixed distance being used for one series, and altered for a second series, the slopes of the curves of transparency (*i.e.* the gradation) were parallel to one another. This investigation is of use when camera images are in question, as the picture is formed by different intensities of light, not very different from those of the amyl acetate lamp, the *time of exposure* being the same for all intensities. The deductions made from the investigation are that with a slow plate the energy expended in chemical action is smaller as the intensity is diminished, while with a quick plate the variation is much less. As a practical deduction, we may say that to obtain proper contrast in a badly lighted picture it is advisable to use a slow plate.

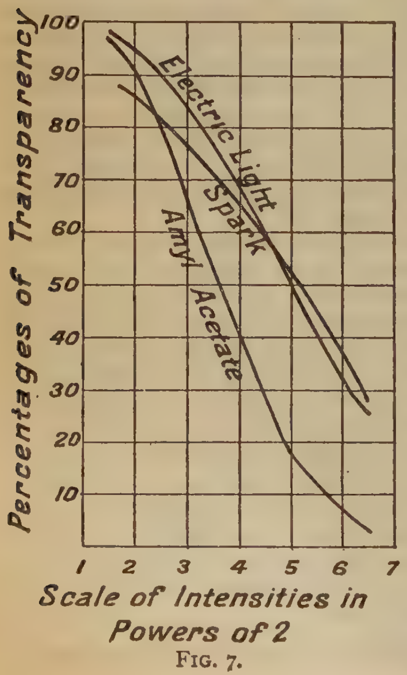

FIG. 7.

Effect of very Intense Light on a Sensitive Salt.—Another investigation was made as to the effect of very intense light on sensitive surfaces. In this case a screen of step-by-step graduated opacities was made use of, and plates exposed through it to the action of lights markedly differing in intensity, one being that of the amyl acetate lamp, another that of the arc light, and a third the light emitted from the spark of a Wimshurst machine. The exposures were so made that one of the opacities produced on the plate from exposure to each source of light was approximately the same. The unit of intensity of light is, of course, in each case widely different. The slope of the curve due to the spark light is less steep than that due to the arc light, and the latter, again, is much less steep than that due to the amyl acetate lamp. A further investigation was made of the effect of increasing the time of exposure when the intense light was diminished, and it was found that with all plates the useful chemical energy acting on a plate was least with the most intense light, but increased as the intensity diminished, though the time was correspondingly increased. This is the reverse of what we have recorded as taking place when a comparatively feeble light was employed. Further, it was proved that the variation was greatest in those plates which are ordinarily considered to be the most rapid. It follows, therefore, that there is some intensity of light when the useful chemical energy is at a maximum, and that this intensity varies for each kind of plate.

Intermittent Exposure of a Sensitive Salt.—The same investigator has shown that, if a total exposure is made up of intermittent exposures, the chemical action on a sensitive salt is less than it is when the same exposure is not intermittent. It was also proved that the longer the time of rest between the intermittent exposures (within limits) the less was the chemical action. We may quote one case. Exposures were first made to a naked light, and afterwards to the same light for six times longer, as a rotating disk intervened which had 12 apertures of 5° cut in it at equal intervals apart, and 720 intermittent exposures per second were given. The plate was moved to different distances from the light, so that the intensity was altered. The apparent loss of exposure by the intervention of the disk increases as the intensity diminishes, the ratios of the chemical energy usefully employed of the naked light exposure to that of the intermitting exposures being:—

For intensity 1	1 to ·815
„ „ $\frac{1}{4}$	1 „ ·500
„ „ $\frac{1}{16}$	1 „ ·423
„ „ $\frac{1}{64}$	1 „ ·370

These results appear to be explicable by the theoretical considerations regarding molecular motion.

Effect of Monochromatic Light of Varying Wave-lengths on a Sensitive Salt.—It has been a subject of investigation as to whether the gradation on a plate is altered when exposures are made to lights of different colours; that is to say, whether the shades of tone in a negative of a white object illuminated by, say, a red light, would be the same as those in the negative if illuminated by a blue light. Abney[1] announced that the gradation was different; and, quite independently, Chapman Jones made a general deduction for isochromatic plates that, except with a certain developer, the gradation was steeper (that is, the curve shown graphically would be steeper) the greater the wave-lengths of the light to which the sensitive salt was subjected. For plates made with the ordinary haloid salts of silver Chapman Jones's deduction requires modification. When monochromatic light from the spectrum is employed, it is found that the gradation increases with wave-lengths of light which are less, and also with those which are greater, than the light whose wave-lengths has a maximum effect on the sensitive salt experimented with. Thus with bromo-iodide of silver the maximum effect produced by the spectrum is close to the blue lithium line, and the gradation of the plate illuminated with that light is less steep than when the light is spectrum violet, green, yellow or red. From the red to the yellow the gradation is much the steepest. Whether these results have any practical bearing on ordinary photographic exposures is not settled, but that they must have some decided effect on the accuracy of three-colour work for the production of pictures in approximately natural colours is undoubted, and they may have a direct influence on the determination of star magnitudes by means of photography.

Reproduction of Coloured Objects by means of Three Photographic Positives.—Ives's Process.—A practical plan of producing images in approximately the true colours of nature has been devised by preparing three positives of the same object, one illuminated by a red, the other by a green, and the third by a blue light; the images from these three transparencies, when visually combined, will show the colours of the object. This plan was scientifically and practically worked out by F. E. Ives of Philadelphia, though in France and elsewhere it had been formulated, especially by Hauron Du Cros.

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[1] *Proc. Roy. Soc.*, 1900.

The following description may be taken as that of Ives's process: by the trichromatic theory of colour-vision every colour in nature can be accounted for by the mixture of two or three of the three-colour sensations, red, green and blue, to which the eye is supposed to respond. Thus a mixture of a red and green sensation produces the sensation of yellow; of a green and blue, that of a blue-green; of red and blue, that of purple; and of all three, that of white. For the sensations we may substitute those colours which most nearly respond to the theoretical sensations without any material loss of purity in the resulting sensation. We must take the spectrum of white light as the only perfect scale of pure colours. It has been proved that the red sensation in the eye is excited by a large part of the visible spectrum, but with varying intensities. If, then, we can on a photographic plate produce a developed image of the spectrum which exactly corresponds in opacity and position to the amount of red stimulation excited in those regions, we shall, on illuminating a transparent positive taken from such a negative with a pure red light, have a representation of the spectrum such as would be seen by an eye which was only endowed with the sensation of red. Similarly, if negatives could be taken to fulfil the like conditions for the green and for the blue sensations, we should obtain positives from them which, when illuminated by pure green and blue light respectively, would show the spectrum as seen by an eye which was only endowed with a green or a blue sensation. Evidently if by some artifice we can throw the coloured images of these three positives on a screen, superposing them one over the other in their proper relative positions, the spectrum will be reproduced, for the overlapping colours, by their variation in intensity, will form the colours intermediate between those used for the illumination of the positives. For the purpose of producing the three suitable negatives of the spectrum, three light-filters, through which the image has to pass before reaching the photographic plate, have to be found. With all present plates these are compromises. Roughly speaking, the screens used for taking the three negatives are an orange, a bluish-green and a blue. These transmit those parts of the spectrum which answer to the three sensations. When these are obtained an image of a coloured object can be reproduced in its true colours.

Abney devised sensitometers for determining the colours of the screens to be placed before the lens in order to secure the three-colour negatives which should answer these requirements. Their production depends upon the same principles indicated as necessary for the correct rendering in monochrome of a coloured object. When the sensitometer takes the form of glasses through which light is transmitted to the plate, the luminosities of the coloured lights transmitted are determined, and also their percentage composition in terms of the red, green, and blue lights, and thence are deduced the luminosities in terms of red, green and blue. For ascertaining what screen should be used to produce the red negative the luminosity transmitted through each glass is so adjusted that the luminosity of the red components in each is made equal by rotating a disk with correct apertures cut out close to the row of glasses. This gives a sensitometer of equal red values. A coloured screen has to be found which, when placed in front of the lens, will cause the opacities of the deposit on the plate, corresponding to each square of glass, to be the same throughout. This is done by trial, the colour being altered till the proper result is obtained. In a similar way the "green" and "blue" screens are determined. Coloured pigments rotating on a disk can also be employed, as indicated in the paragraph on the correct rendering of colour in monochrome.

As to the camera for the amateur, whose plates are not as a rule large, all of the three negatives should be obtained on one plate, since only in this way can they be developed and the densities increased together. (For commercial work the negatives often cannot be taken on the same plate, as it would make the plate too large to manipulate.) The camera may be of an ordinary type, with a repeating back, bringing successively three different portions of the plate opposite the lens. It is convenient to have a slide, in front of which a holder containing the three screens can be fixed, which will then be close to the plate; such a one has been devised by E. Sanger-Shepherd. The light passes through them one by one as the plate is moved into the three positions. The three exposures are given separately, after which the plate is ready for development. The three separate exposures are, however, a source of trouble at times, particularly in the case of landscapes, for the lighting may vary and the sky may have moving clouds, in which case the pictures would show variations which should not exist. Sanger-Shepherd has a "one-exposure" camera by which the three images are thrown side by side on the plate. Thus any movement in the picture affects all three negatives alike. Abney has also introduced a "one-exposure" camera which takes in a larger angle than that of Sanger-Shepherd. The next point is the exposures which should be given through each screen. This can be done by placing in front of the plate and extending its whole length a scale of gradation through which the light coming from a sun-illuminated white card passes, as well as through the screens. In the case of the three-exposure camera the *times* of exposure are varied till the densities of the image of the gradation appear the same in each of the three images. In the case of the one-exposure camera, the light reaching the plate through the screens is altered by cutting off with a shutter more or less of the lens used. As the plates employed for the purpose of the three-colour negatives must be sensitive to every colour, the ordinary dark-room light should be most cautiously used. If used at all, it should be very feeble and development must be carried out in a dish with a cover to it. The plate is manipulated in the usual way.

Joly's Process.—Professor J. Joly, of Dublin, in 1897 introduced a colour process by which an image in approximately natural colours could be thrown upon a screen by an optical lantern, only one transparency being employed, instead of three, as in the Ives process. A "taking" screen was ruled with alternating orange, blue-green and blue lines $\frac{1}{200}$ to $\frac{1}{300}$ in. apart, touching one another and following one another in the above order. When such a screen was placed in front of a sensitive plate in the camera, and exposure made to the image of a coloured object, there were practically three negatives on the same plate, each being confined to the area occupied by lines of the same colour. The shades of colour and the depth of the colours used in ruling depended on the brand of plate. When a perfect triune negative was obtained, a transparency was made from it, and in contact with this was placed a screen ruled with lines the same distance apart, but of the colours corresponding to the three colour sensations, namely red, green and blue. The red lines were made to fall on the image taken through the orange lines, the green on that of the blue-green, and the blue or violet on that of the blue. On the screen there are practically three differently coloured images shown by one transparency. The eye blends the different colours together and a picture is seen in approximately the correct colours of the original.

Autochrome.—A very remarkable process, founded on J. Joly's process, was introduced in 1907 by A. Lumière et ses Fils of Lyons. Starch grains of very minute size, some of which were dyed with a red stain, a second portion with a green, and a third portion with a blue, are mixed together in such proportions that a fine layer of them appears grey when viewed by transmitted light. Under a magnifying glass the grains are coloured, but owing to the want of focus in the eye the colours blend one with the other. Such a layer is embedded on the surface of a glass plate in a waterproof vehicle, and a film of sensitive emulsion held *in situ* in some material, the composition of which has not been published, covers this layer. When such a plate is placed in the camera, with *the back of the plate* next the lens, the light passes through the coloured granules, and again we have three negatives on one plate, but instead of each negative being represented by lines as in the Joly process they are represented by dots of silver deposit. Owing to the way in which the three-coloured film is prepared, it is evident that a positive taken from such a negative could not be backed with granules of the right colour, as the granules are placed at random in the layer. Lumière, to overcome this difficulty, converted the negative into a positive in a very ingenious way. The plate was developed with pyrogallic and ammonia in the usual way, but instead of fixing it it was plunged into a solution of potassium permanganate and sulphuric acid. This dissolved all the silver that had been deposited during development and left a film of unaltered silver salt. On looking through the plate the colours of the coloured layer coming through the different dots where the silver was at first deposited appeared in view, and the image was the image in colour of the object photographed. The plate after being washed was taken into the light and redeveloped with an alkaline developer, which converted the sensitive salt of silver to the metallic state. The image now consisted of black particles of silver and the coloured image. The plate was next fixed in hyposulphite of soda to remove any unreduced silver salt that might be left, and the picture after washing was complete. The coloured image so obtained is a very close representation of the true colours, but as the "taking" screen is the same as the "viewing" screen some little variation must result.

Positives in Three Colours.—Ives was the first to show that a transparency displaying approximately all the colours in nature could be produced on the same principles that underlie the three-colour printing. This he effected by printing each of the three negatives, produced for his triple projection process as already described, on gelatine films sensitized by bichromate of potash. Each of the three transparent films was dyed with a colour complementary to the colour of the light which he transmitted through the positives when used for projection. Thus the "red" positive he dyed with a blue-green dye, the "green" positive with a purple dye, and the "blue" positive with a yellow dye. These three films, when superposed, gave the colours of the original object. Sanger-Shepherd has made the process a commercial success (see PROCESS) and produces lantern slides of great beauty, in which all colours are correctly rendered. Instead of using a dye for the "red" transparency, he converts the silver image of a positive image into an iron salt resembling Prussian blue in colour. (W. DE W. A.)

II.—PHOTOGRAPHIC APPARATUS

Photographic apparatus consists essentially of the camera with lens and stand, lens shutters, exposure meters, prepared plates for the production of negatives or transparencies, sensitive papers and apparatus for producing positive prints, direct or by enlargement. Besides these there are many subsidiary accessories.

Since the introduction of highly sensitive dry plates and their extended use in hand cameras, the art and practice of photography have been revolutionized. Numerous special forms of apparatus have been created suitable for the requirements of the new photography, and their manufacture and sale have become important industries. The value of the exports of photographic materials from the United Kingdom in 1906 was £22,716. The most important improvement has been in the construction of anastigmatic lenses, which, having great covering power, flatness of field, and freedom from astigmatism, can be worked with very much larger apertures than was possible with the earlier forms of rectilinear or aplanatic lenses. The increased rapidity of working thus gained has rendered it easy to photograph objects in very rapid motion with great perfection. This has encouraged the construction of the very light and compact hand cameras now so universally in use, while, again, their use has been greatly simplified by improvements in the manufacture of sensitive plates and films and the introduction of light, flexible, sensitive films which can be changed freely in daylight. The introduction in 1907 of Messrs Lumiere's "Autochrome" process of colour photography has also been a great advance, tending to popularize photographic work by the facility it offers for reproducing objects in the colours of nature.

The Camera.

Historical.—The camera obscura (*q.v.*) was first applied to photographic use by Thomas Wedgwood between 1792 and 1802. No description of his camera is available, but it was probably one of the sketching cameras then in use. In 1812 W. H. Wollaston found that by using a meniscus lens with a concave surface towards the object and the convex towards the screen, a diaphragm being placed in front, the projected image of the camera obscura was greatly improved in sharpness over a larger field. The first photographic lenses made by V. and Ch. L. Chevalier in Paris (1830–1840) were on this principle. The photographic camera in its simplest form is a rectangular box, one end of which is fitted to carry a lens and the opposite one with a recess for holding the focusing screen and plate holders, these ends being connected by a rigid or expanding base-board and body, constructed to keep out all light from the sensitive plate except that passing through the lens. In 1816 Joseph Nicéphore Niepce, of Chalon-sur-Saône, for his photographic experiments made a little camera, or artificial eye, with a box six inches square fitted with an elongated tube carrying a lenticular glass. There are now in the Chalon Museum cameras of his with an iris diaphragm for admitting more or less light to the lens; some with an accordion bellows, others with a double expanding rigid body for adjusting the focus. The iris diaphragm was adopted later by Chevalier for his photographic lenses. In 1835 W. H. Fox Talbot constructed simple box cameras for taking views of his house on sensitive paper, and claimed them as the first photographs of a building (*Phil. Mag.* 1839, 14, p. 206). Fr. von Kobell and C. A. Steinheil, early in 1839, made a camera with an opera glass lens for taking landscapes on paper. Later in 1839 J. W. Draper successfully used a camera for his daguerreotype experiments made of a spectacle lens, 14 in. focus, fitted into a cigar box. He also used a camera fitted with a concave mirror instead of a lens. Similar cameras were constructed by A. T. Wolcott (1840) and R. Beard (1841) for reversing the image in daguerreotype portraits. They have also been recommended by V. Zenger (1875) and D. Mach (1890) for scientific work.

L. J. M. Daguerre's camera, as made by Chevalier in 1839 for daguerreotype, was of Niepce's rigid double body type, fitted with an achromatic meniscus lens with diaphragm in front on Wollaston's principle, the back part with the plate moving away from the lens for focusing, and fixed in its place with a thumbscrew. This expanding arrangement enabled lenses of different focal lengths to be used. With modifications cameras of this type were in use for many years afterwards for portrait and studio purposes. For work in the field they were found inconvenient, and many more portable forms were brought out, among them G. Knight's and T. Ottewill's single and double folding cameras (1853), made collapsible with hinges, so as to fold on to the base-board. Cameras with light bodies made of waterproof cloth, &c., also came into use, but these were superseded by cameras with collapsible bellows-body of leather, which, invented by Niepce, were used in France, in 1839, by Baron A. P. de Séguier and others for daguerreotype. The first record of them in England is, apparently, J. Atkinson's portable stereoscopic camera of parallel-side bellows form (*Ph. Journ.* 1857, 3, p. 261), which was soon followed by C. T. H. Kinnear's lighter conical form, made by Bell of Edinburgh (*Ph. Journ.* 1858, 4, p. 166). They have since been made in various patterns, conical, oblong and square, by P. Meagher, G. Hare and others, and are still, in modified forms, in general use as studio, field or hand cameras. When wet collodion plates were used many cameras were fitted with arrangements for developing in the field.

Information on these and other early cameras will be found in the photographic journals, in C. Fabre's *Traité encyclopédique de photographie*, vol. i., and in J. M. Eder's *Ausführliches Handbuch der Photographie*, 2nd ed., vol. i., pt. ii.

The distinctive feature of present day photography is the world-wide use of the hand camera. Its convenience, the ease with which it can be carried and worked, and the remarkably low prices at which good, useful cameras of the kind can be supplied, concurrently with improvements in rapid sensitive plates and lenses, have conduced to this result. It has also had a valuable educational influence in quickening artistic perception and scientific inquiry, besides its use in depicting scenes and passing events for historical record. Small portable cameras had been made by B. G. Edwards (1855), T. Scaife (Pistolgraph, 1858), A. Bertsch (1860), T. Ottewill (1861), and others, but it was not until rapid gelatin dry plates were available in 1881 that T. Bolas brought out his "detective" camera (*Ph. Journ.* 1881, p. 59). It consisted of a double camera (one as finder, the other for taking the picture) enclosed in another box, suitably covered, which also contained the double-plate carriers and had apertures in front of the viewing and taking lenses. In another form the finder was omitted. A month later A. Loisseau and J. B. Germeuil-Bonnaud patented an opera glass camera. Various forms of portable magazine cameras followed, among them A. Pumphrey's "Repeating Camera" (1881), W. Rouch's "Eureka" (1887), R. Krugener's camera (book form, 1888), and others in collapsible or box forms disguised as books, watches, &c., but they did not come into general use before 1888, when the Eastman Company of Rochester, U.S.A., brought out their very portable roll-film cameras, now known under the trade name of "Kodak." The manufacture of these and other light hand cameras has since become a very important and flourishing industry in Great Britain, Germany, France and the United States. It is noteworthy that the most modern form of hand camera, the reflex, goes back to an early type of portable camera obscura, figured by Johann Zahn in 1686, in which a mirror was used for reflecting the image on to a horizontal focusing screen, at the same time reversing it. The first photographic camera on this principle was T. Sutton's (1860), which has served as a basis for many subsequent developments. A. D. Loman's (1889) and R. Krugener's (1891) were early examples of the hand camera type, but great improvements have since been made.

Modern cameras differ so much in details of improved construction that only a few of the more important requirements can be noticed. A camera should be well and strongly made of seasoned wood or of metal, perfectly rigid when set up, to avoid any shifting of the axis of the lens in respect to the sensitive plate. The front and back of the camera should normally be vertical and parallel, and the axis of the lens perpendicular to the centre of the plate, but arrangements are usually made by vertical and lateral adjustments on the camera front for raising the lens to take in less foreground or vice versa, or for moving it right or left, the latter becoming a vertical movement when the camera has to be turned on its side. In the Adams "Idento" camera the lens and finder can be rotated together on the rising front according as the camera is used horizontally or vertically, the finder showing in either case the identical view projected on the plate. The best modern field cameras are fitted with a swing-back or swing-front and sometimes with both. A swing-back is necessary for bringing back the plate to the vertical position, so as to prevent convergence of vertical lines, when the camera has to be tilted. A rising swing-front, in which the lens is tilted, answers the same purpose, provided the camera is kept level. If further tilting is necessary, when taking high buildings &c., the swing-back and front may both be required, but must be kept vertical and parallel and the effect is that of an abnormal rising front. Many modern cameras are fitted with a double rising front. The vertical and side swings are also useful for equalizing the definition of objects at different distances from the camera, but they alter the perspective. These swing-movements should preferably be round the central horizontal or vertical axis of the back or front, but are frequently effected by simple inclination of the back or lens front on a hinge. When the rising front is used a lens of extended covering power is desirable, and it may be necessary to stop it down to obtain good definition over the extended area of the picture. A slight inclination of the lens may also be useful in readjusting the focus. The camera and plate carriers must be perfectly light-tight and all inner bright surfaces made dead black to prevent reflections from bright spots being thrown on the plate. The black varnish used, preferably of shellac and lampblack in spirit, must have no deleterious effect on the plates. Although the weight and bulk are increased it is convenient to have the camera square and fitted with a reversible back, so that the greatest length of the plate may be horizontal or vertical, as desired. Many cameras are fitted with revolving backs to be used in either position. In some French cameras the back part of the camera with the bellows is reversible, to be used upright or horizontal.

Focusing.—The earlier cameras were focused by drawing out the back and clamping it with a thumb-screw working in a slot in the base-board. When bellows cameras were introduced they were focused by an endless screw, and these are still used for large copying cameras. Most modern cameras are fitted with rack and pinion movements working either in front or at the back of the camera or both. Many hand cameras, requiring to be brought to focus at once, are fitted with studs (infinity catches) which fix the front in focus for distant objects, nearer distances being noted on an engraved scale attached to the base-board. Such scales should be verified by measurement. In hand cameras with fixed infinity focus, the necessary adjustments for distance of near objects are made on the lens mount. The focusing screen may be ruled with parallel cross lines for purposes of measurement, and as a check on the verticality of the camera when photographing buildings or other objects with vertical lines. The distance of the lens from the focusing screen and from the sensitive plate in the dark slide must coincide exactly. This can be tested by measurement or by focusing a bright, well-defined object on the screen and then on a ground-glass plate placed in each of the slides to be examined. A level or other means of showing that the camera is level and the plate vertical should be attached to the camera, also a view meter or finder, showing the exact extent of the picture on the focusing glass. In the view meter the picture is viewed directly through a pin-hole mounted at the back of the camera as it appears in a frame with cross wires on the rising front, adjusted to the size of the plate and the focus of the lens. Finders are practically small reflex cameras, and a reduced image is seen reflected from a mirror or prism. A rectangular concave glass mounted on the camera is also a convenient form, it can be combined with a mirror for vertical observation, and in Watson's new form is also arranged as a level and telemeter (*B. J. A.* p. 724, 1908). The image seen in the finders should correspond exactly with that on the plate. When the rising front is used special arrangements have to be made to ensure the correspondence of the images in the finder and on the ground-glass. This is done in the "Adams Identoscope" (1908), which is fitted to the swing front and adjusted by a lever to follow the movement of the lens.

Plate-holders or Dark-slides.—The dark-slides or backs, holding sensitive plates, are made either single or double, the former usually for wet plates, the latter for dry plates. The ordinary book-form double dark-slide has been in use since the early days of calotype paper negatives, and contains two plates separated by a blackened metal plate; three of them usually form a set, the shutters being numbered 1 to 6, the odd numbers on the opening side. Inner frames can be used for smaller plates if desired. The slides should fit easily into the camera and the shutters run smoothly out and in. They must be perfectly light-tight, the corner joints, the hinges in the shutters, and the openings in the sides and top of the book-form slides are all weak points requiring occasional careful examination or protection by metal plates. The shutters of dark-slides are either jointed or solid and removable; the former is perhaps the more convenient, but both forms may become liable to let in light. Various forms of solid slides, single and double, are now made in wood or metal, or of wood for the frame and metal for the shutters; they are lighter, more compact and less liable to admit light to the plates. In some cases one slide can suffice for the exposure of several plates or stiff films, enclosed in separate envelopes, as in the "Wishart-Mackenzie" slide, the "Victrix" and other similar ones, or contained in a single packet, as in the "Premo Filmpack," and similar arrangements which enable twelve thin celluloid films to be placed in the camera, exposed one after the other, and removed again safely in daylight, the pack being replaced, if necessary, by another. The packets of films are made of light cardboard, and effect a great saving of bulk and weight (fig. 1). Roll-holders are also a convenient way of carrying sensitive celluloid films in lengths of six or twelve exposures, rolled on spools, which can be changed in daylight. Changing boxes for holding a reserve of plates or celluloid films in sheaths, are used with some magazine and other cameras. They are arranged to fit on the camera in place of the dark-slide and the plates are changed automatically so that exposed plates are placed in order successively at the back, a fresh plate going forward for exposure and the number of the exposure being recorded at the same time.

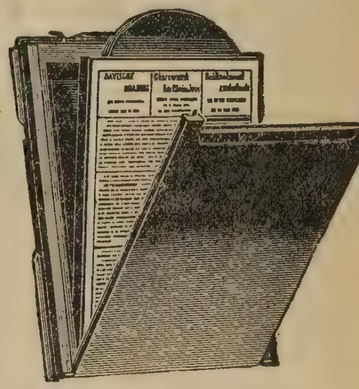

FIG. 1.—Premo Film-pack.

Studio cameras, for portraiture, are usually of the square bellows type, of solid construction, to take large and heavy lenses; adjustable from front and back with rack and pinion movements, to enable long or short focus lenses to be used, with extra extension for copying or enlarging. They are generally fitted with repeating backs, allowing two or more exposures to be made on one plate. The backs are square or reversible, so that the plates can be used upright or lengthways, and are fitted with double swing movements at the back. When single dark slides are used they are best fitted with a flexible shutter to avoid jerking and movement of the camera. For portraiture they are mounted on solid pillar stands, being raised or lowered with an endless screw or rack-work, and the table-top usually has vertical and horizontal angular movements. Large cameras with long extension for copying purposes are made in many forms with special arrangements for the various photo-mechanical processes, and are mounted on substantial table-stands with screw adjustments for obtaining the various motions above noted, and also a rectilinear traversing motion right or left. All these stands should be absolutely rigid and free from tremor. Process cameras are, however, sometimes mounted, together with the copying board, on swinging stands, to avoid the effects of vibration.

Portable and *field* cameras include cameras of the Hare and Meagher types for outdoor work and general purposes on plates 15 in. × 12 in. to 8½ in. × 6½ in., and in lighter forms from 6½ in. × 4¾ in. to 4¼ in. × 3¼ in. For general purposes they are usually made with square bellows and folding tail-board, rather more substantially than those with conical bellows intended for outdoor work. There are many patterns, the principal modern improvements in field cameras being swinging fronts, tripod head and turntable in the base-board, double and sometimes triple extension movements from the back and front for long or short focus lenses, and the use of aluminium for some of the metal-work. They are fitted with a focusing screen and are intended for use on a tripod stand, though some of the smaller sizes of the modern light hand or stand cameras can be used as hand cameras with finders. The plates are carried in the usual dark-slides, but the smaller sizes, from half-plate downwards, can be fitted with roll-holders for flexible films, or with film packs or other daylight changing arrangements.

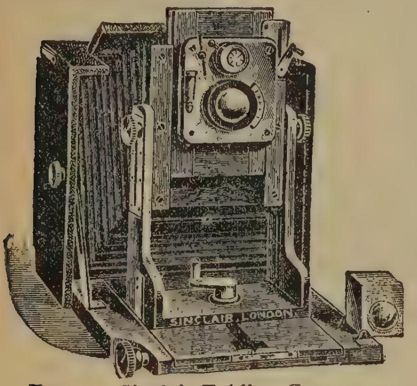

FIG. 2.—Sinclair Folding Camera.

Folding and Hand Cameras.—Folding cameras form a class of modern portable cameras which have many conveniences for hand or stand work from quarter-plate to 7 in. × 5 in. They may have all the fittings of a stand camera and be made to take glass plates, flat or roll films, but have the advantage of forming when closed a convenient package enclosing camera, lens and shutter, all in position for immediate use when opened out (fig. 2). Most of them are fitted with focusing glass and finders, and may focus by scale in the same way as hand cameras. With an apparatus of this kind on a light stand any class of ordinary indoor or outdoor work can be undertaken within the size of the plate, and the extension of the bellows, which should be quite double the focus of the lens.

The multiplicity of forms and arrangements of hand cameras makes it difficult to classify them into distinct types; but they may be mainly divided into *box* and *folding* cameras, and further into (*a*) cameras with enclosed changing magazines for plates or flat films; (*b*) with enclosed roll film on spools; (*c*) with separate changing magazines, changing boxes or roll-holders; (*d*) with single, double or multiple plate carriers or film-packs. Most cameras that will take glass plates in the ordinary plate-holders will take cut films in suitable sheaths or can be fitted with envelope slides, film-packs or roll-holders. The normal size for hand cameras is the quarter-plate (4¼ in. × 3¼ in.), or the continental size 9 × 12 cm.; 5 in. × 4 in. is also a popular size, and cameras for the post-card size, 5½ in. × 3½ in. or 15 × 10 cm. have been largely adopted. Smaller sizes are also made for lantern plates and for the lighter pocket cameras, some in the form of stereoscopes, field-glasses or watches, as in the "Ticka," but the pictures are small and require enlarging. Hand cameras are constructed on the same principles as stand cameras, but, being specially intended for instantaneous work, they are simplified and adapted for rapid focusing and exposing. The focusing screen is superseded or supplemented by finders arranged to show the limits of the subject on the plate, the focus being adjusted by the infinity catches and focusing scales above noticed. Swing-backs and fronts are often dispensed with, but are desirable adjuncts, and a rising and falling front particularly so. Lenses of fairly large aperture, *f*/6 to *f*/8, and good covering power, preferably of the anastigmatic type, or a rapid aplanat, should be used, but for very rapid work anastigmats working from *f*/4 to *f*/6 will be more useful. Hand cameras can also be fitted with telephoto objectives of large aperture. Some cheap hand cameras are fitted with single landscape lenses or aplanats working about *f*/11 or lower, but the want of intensity limits their use to well-illuminated subjects. Shutters of the between-lens type are now generally used in hand cameras, and for ordinary purposes should give fairly accurate exposures from $\frac{1}{5}$ to $\frac{1}{50}$ of a second or less and also time exposures. Some central shutters are speeded for shorter exposures to $\frac{1}{800}$ of a second, but for these focal plane shutters are preferable, and for the more rapid exposures to $\frac{1}{1000}$ of a second and less are necessary. The shutter should be efficient, regular in action, and readily released by gentle pressure, pneumatic or otherwise. Mechanism for automatically changing plates or films in hand cameras of the box magazine type must be certain in action, simple and not readily put out of order, special care being taken to avoid rubbing or abrasion of the plates in changing or transport. In changing plates or films the number of plates exposed should be recorded automatically, and duplicate exposures prevented as far as practicable. A circular level placed ~~near~~ the finder is useful.

The choice of a hand camera depends upon the circumstances in which it is to be used, and the purpose for which it is principally required. For general work and with the modern facilities for carrying and changing plates and films in daylight, the numerous folding hand or stand cameras for plates, flat or roll films, with full adjustments, will be found most useful. Box or magazine cameras in which a supply of cut films or plates can be carried, changed mechanically, and exposed rapidly in succession, are convenient, but their use is limited and they are liable to get out of order. A third class are the reflex and other hand cameras with focal plane shutters for specially rapid instantaneous work as noticed below. There are two types of light folding hand or stand cameras, specially adapted for hand camera work—those made for taking glass plates and cut films, and the folding pocket Kodak or other roll-film cameras. The former are now made of very light construction with mahogany or metal bodies, wooden or aluminium base-boards, thin metal dark-slides (fig. 3). The cameras of the pocket Kodak type are of similar construction, but made to take roll films on spools, or with an attachment for focusing glass and dark-slides for taking plates and cut films. Attached to a sling-strap the quarter-plate size can be quite conveniently carried in a side-pocket. Watson's "Deft" folding camera is fitted with a focal plane shutter (fig. 4). The "Selfix carbine" camera has a *self-erecting* front bringing the lens at once into position for use on opening out. Those fitted with lenses of fairly large aperture, double extension, and rising and falling fronts are to be preferred. Of box or magazine cameras there is an immense variety. In some the lens is fixed in focus for all objects within a certain distance, in others it is adjusted by a focusing scale on the lens or by an extending front. Some have a single magazine, others two or more. Some take only glass plates, others plates or cut films. All of them are, however, self-contained and ready for immediate exposure. One of the earliest forms of single magazine cameras, still in use, as in the "Eureka" and "Yale," is the "bag," in which a supply of plates or films in sheaths, is kept in a magazine behind the camera, ready for exposure, the plates as exposed being lifted with the fingers into a bag or expanding chamber above the magazine and placed behind the rest of the plates at the back, a fresh plate taking its place in front. In some forms the magazines are removable and replaceable by others. The arrangement is simple and effective, but the bag, usually made of soft leather or cloth, is liable to wear and puncture, and may make dust. The cameras with double magazines in which unexposed plates are kept in one recess and transferred successively after exposure to a second recess are more complicated, and many

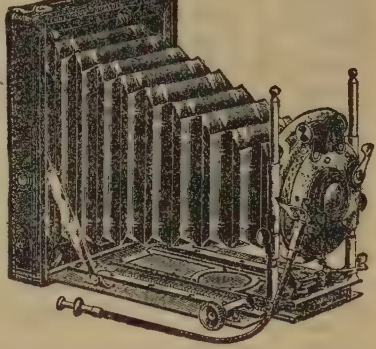

FIG. 3.—Ernemann's Pocket Camera.

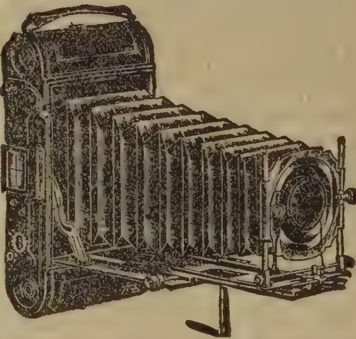

FIG. 4.—The "Deft" Folding Focal-plane Camera.

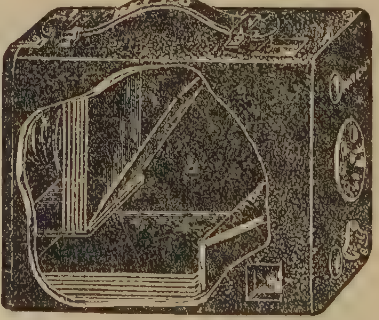

FIG. 5.—Double-magazine Box Camera.

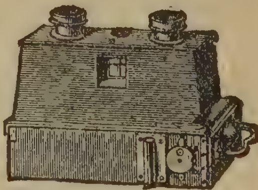

FIG. 6.—The Verascope, Richard.

ingenious devices have been invented for effecting the change (fig. 5). Some forms are effective and popular on account of their compactness and readiness for immediate exposure, but there is always a risk of the mechanism failing, and care has to be taken in charging them to lay the plates truly in their places. The very handy binocular cameras, or *photo-jumelles*, of which the "Verascope" (fig. 6) is a type, are of this class, and have additional magazines. So also are hand cameras of R. and J. Beck's "Frena" type, specially constructed for using stiff celluloid films. The films are notched on two sides and packed in bundles alternately with cards similarly notched. The pack of films and cards is placed in a magazine at the back of the camera, and by the movement of a lever, after exposure, the exposed film and its following card are released, and by turning the camera down are dropped into a second receptacle. A "folding Frena" is now made as a folding camera with attached magazine for films, without which it can be used separately for plates. R. and J. Beck's new "Dai-Cornex" is a great improvement in this form of camera, being a daylight-loading box magazine camera for plates, the plates being packed in a bundle of ridged sheaths, so that they are quite protected from light and can be put into or taken out of the camera in full daylight. In other respects it resembles other magazine cameras (fig. 7). Another useful magazine camera is the "Zambex," carrying either plates or films, held in skeleton frames in envelopes which can be loaded or unloaded in daylight, and are kept ready for use in the back of the camera and exposed consecutively. For work in which speed is of primary importance hand cameras fitted with very rapid lenses and focal plane shutters are necessary, and several forms of portable collapsible cameras of this kind are now available, such as the Goerz-Anschütz, Zeiss's "Palmos," Watson's "Vril" (fig. 8), Adams, "Idento," &c., and are lighter and more portable than the reflex cameras. Hand cameras are generally fitted with screw-bushes for mounting on a tripod stand when time exposures are wanted. The light folding wooden or aluminium stands noted below are specially suitable.

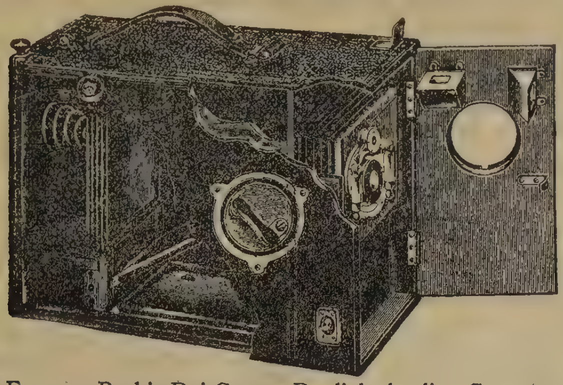

FIG. 7.—Beck's Dai-Cornex Daylight-loading Camera.

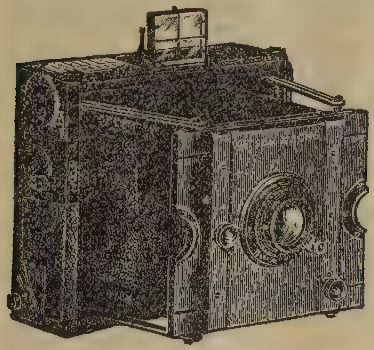

FIG. 8.—Watson's "Vril" Camera.

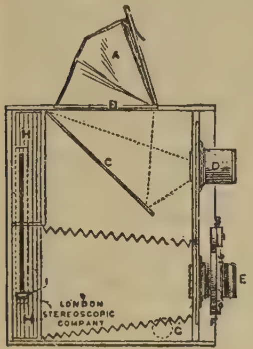

FIG. 9.—Camera fitted with Twin Lenses, section to show working.
A, Hood of finder.
B, Ground glass screen.
C, Mirror.
D, Viewing lens.
E, Working lens.
F, Shutter.
G, Focusing pinion.
H, Plate carrier.
I, Plate.

Twin-lens and Reflex Cameras.—For photographing animals, objects in motion, public functions, &c., it is important to have the means of watching the movement till the critical moment of exposure arrives. For this it is convenient to have a camera fitted with twin lenses working in two separate compartments (fig. 9) or more simply with a mirror throwing a full-sized unreversed image of the object from the lens on to the focusing screen (fig. 10). With the former, which has the advantage that the image is seen before, during, and after exposure, the lenses must be of exactly equal focus and focused together by the same motion of the rack-work, the object being viewed on the focusing screen of the upper compartment, and the plate kept ready in the lower to be exposed when desired. Binocular hand cameras are also made on this principle, one compartment serving for focusing, the other holding lens and plates. Stereoscopic cameras are another form of twin-lens cameras, and are usually made for also taking single panoramic pictures.

In *reflex* cameras only one lens is necessary, though two are convenient, and can be used somewhat as in fig. 9. They generally consist of a cubical box camera containing a movable mirror facing the lens at an angle of 45° and throwing up the image projected from it on to a horizontal focusing screen, on which it is viewed through a flexible hood which folds down in the upper part of the camera when not in use (fig. 10). In order to get the greatest rapidity of exposure a focal-plane shutter is generally fitted, and by a single movement of the release the mirror is smoothly lifted and the plate exposed simultaneously. They should be fitted with anastigmatic lenses working at large apertures for very rapid work. In some forms the lens is fixed, but usually there is a front bellows extension for long-focus lenses, with rising and falling front, to which swing motion may be given, a swing-back not being generally used with the focal plane shutter. In the "Ernex" camera E. Human has made an arrangement by which the camera back, horizontal viewing screen and reflector are made to swing simultaneously, by a rack and pinion movement. They may also have reversing or revolving backs for quickly changing the position of the plate. 5 in. × 4 in. and $3\frac{1}{4}$ in. × $4\frac{1}{4}$ in. are the usual sizes of the plates, but larger and smaller sizes are also available. These cameras require the best workmanship and perfect mechanism for successful working and freedom from any jarring movement in releasing the shutter or mirror. The focusing screen must also be in accurate register with the focus of the lens on the plate. Those forms in which the image can also be viewed at the height of the eye, as in the Graflex (fig. 10), are preferable. Although reflex cameras are rather heavy and bulky as hand cameras, they have many advantages over the ordinary hand camera with finder and focusing scales for the purpose of the press photographer, the naturalist and others, in observing and recording very rapid movements, and have come into very general use for such purposes. They permit the accurate focusing of a full-sized image on the ground-glass up to the moment of exposure, especially useful when lenses of long or short focus are required and when the rising or swing front is in use. The aspect of this image on the ground-glass is also a great aid in the selection and placing of the subject and in judging the exposure required for it. They practically have all the advantages of a stand camera and can be used as such on a stand for subjects requiring prolonged exposure. They are also coming into increasing use in studio work for portraits of children, &c. Their use and adjustments are discussed by G. E. Brown in the *British Journal Almanac* for 1909.

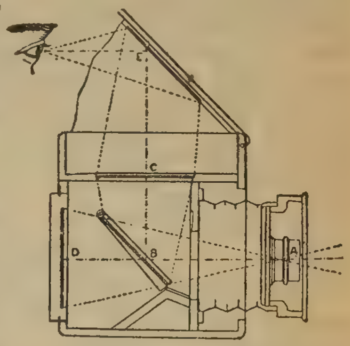

FIG. 10.—Reflex Camera.
A, Lens.
B, Mirror.
C, Ground-glass.
D, Plate.
E, Supplementary mirror.

Panoramic Cameras.—Many so-called "panoramic" cameras have been introduced from time to time, among them T. Sutton's (1861), and J. R. Johnson's "Pantascopic" (1864), but did not come into general use till the use of curved surfaces of celluloid film enabled such cameras of convenient size and weight to be put on the market. They are on the same principle as one made by F. von Martens in 1845 for curved daguerreotype plates, and covering an angle of 150°. P. Moëssard's "Cylindrographe" of 1889 was the first of the modern type. It consists of a semi-circular

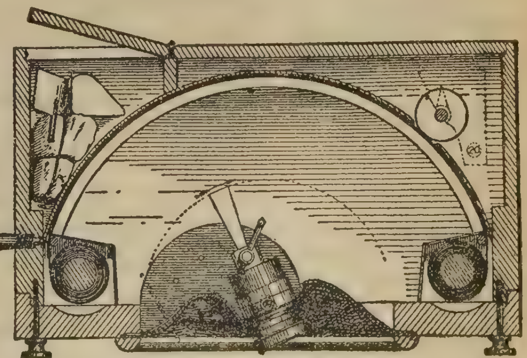

FIG. 11.—Section of "Al-Vista" Panoramic Camera.

camera, the front of it formed of light-proof cloth and the back by the curved flexible carriers. The lens is fitted on a vertical axis, so that the nodal point of emergence remains motionless, and is revolved round it by means of a handle worked by hand and carrying a view meter. The illumination of the image is regulated by an adjustable vertical slit in a tube attached to the lens inside the box, and by altering the rate at which the lens is revolved. The pictures taken embrace less than 180°. The apparatus folds together and is quite portable; it is fully described in Moëssard's *Le Cylindrographe* (Paris, 1889). The "Al-Vista" (1901) and the "Panoram Kodak" (1900) are on the same principle, but arranged as roll-holder hand cameras, in two sizes, carrying film for several exposures, 7 in. × 2¼ in. or 4 in. × 12 in. They work instantaneously, and by means of a clock-spring the lens rotates rapidly over a half-circle when released. The angle of view is about 120° (figs. 11 and 12). The views taken with this kind of camera are sometimes disappointing, on account of the development of cylindrical perspective on a plane surface causing apparent distortion. This distortion is avoided in Carl Zeiss's "Palmos Panoram" camera for plates 6¾ in. × 3¼ in., fitted with "Tessar" lens and focal plane shutter, and other similar cameras which can be used for stereoscopic or single pictures. Other more elaborate instruments driven by clockwork have been made for making a complete tour of the horizon. Among them C. Damoizeau's "Cyclographe," which can be used with lenses of different foci and takes the pictures on a roll-film, which is unrolled as the instrument revolves on its axis, the lens also rotating on its nodal point of emergence; and thus the image always remains sharp (*Bull. Soc. Franc. d. Phot.*, 1891, p. 183). Commandant A. Daubresse has improved on Moëssard's apparatus, by placing the lens vertically between two right-angled prisms, the upper of which receives the image and projects it through the lens on to the lower prism, from which, by rotation of the system on the vertical axis, it is projected on to a cylindrical film through an angle of 360° (Ibid. 1906, p. 430; *E. Jb.*, 1907, p. 91). The "Periphote" and Ernemann's "Rundblick" camera are improved forms (*E. Jb.*, 1908, p. 322).

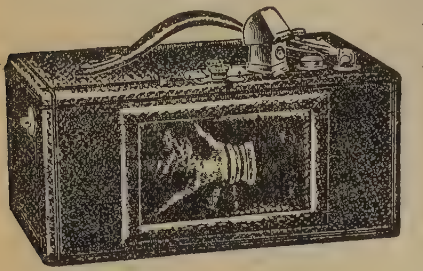

FIG. 12.—"Al-Vista" Panoramic Camera, closed.

Many early forms of panoramic cameras are described in *B. J. A.* 1892, p. 517. Colonel R. W. Stewart's "Panoram" (1893), A. Chevalier's "Photographic Plane Table," J. Bridges Lee's "Photo-Theodolite" (1894), and similar cameras fitted with telescopes, levels and divided circles, are instruments of precision suitable for photographic surveying. Improved instruments for topographical surveying with stereo-photographic apparatus, on the principle worked out by Dr C. Pulfrich, of Messrs Zeiss & Co., in his stereo-comparator (1903), are being practically developed, and much information regarding them will be found in papers by E. Dolezal and others in J. M. Eder's *Jahrbücher*, 1903 to 1908; also a paper by Lieut. F. V. Thompson in *Geographical Journal*, 1908, xxxi. 534.

Cameras for Three-Colour Photography.—Many forms of camera have been constructed for making the three negatives required for trichromatic photography. They fall into two types: (1) those with a repeating back fitted with three colour-screens or filters—red, green and violet—through which the colour impressions are made successively with one lens upon a single colour-sensitive plate, as in the Sanger-Shepherd system. The colour-screens are placed immediately in front of the sensitive plate in the repeating back, which is moved on for each exposure. In a more recent form, by the same maker, the three images are taken on the sensitive plate with one exposure. The camera is divided into three compartments, and fitted with a special diaphragm which can be regulated for the varying sensitiveness of different batches of plates. The central image is impressed directly on the plate; the other two by reflection from prisms arranged so as to equalize the sizes of the three images on the sensitive plates, the light rays passing in each case through a suitable colour-filter—red, green and blue-violet—somewhat on the principle of F. E. Ives's camera of 1900 (fig. 13). It is convenient and successful in working. (2) Cameras made on the reflecting principle of L. Ducos du Hauron (1876), elaborated by F. E. Ives (1894) in his photochromoscope, in which three images are taken through three colour-screens on separate plates with one lens, the respective exposures being regulated by reflection of the light coming from the lens by plane mirrors on to the sensitive plates, and its filtration through the colour-screens in front of them. Many variations of this method have been proposed, in which reflecting prisms replace the mirrors. The different systems have been discussed by W. Gamble (*Ph. Jour.* 1905, xlv. 150), the latter also by E. T. Butler (Ibid. p. 199). Sir W. de W. Abney has described three-colour cameras for landscape work in *Ph. Jour.* 1904, xliv. 81, and 1908, xlviii. 331.

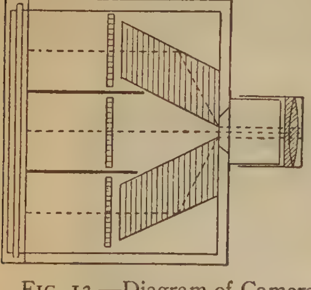

FIG. 13.—Diagram of Camera for Three-colour Photography.

Enlarging Cameras.—These cameras vary in form, according to the nature of the illumination, but ordinarily consist of a double or triple extension bellows camera, with a holder for the negative or transparency at one end, and for the sensitive plate or paper at the other, the lens being placed on a fixed partition between the two. Some recent forms of "daylight enlargers" can be used as an ordinary camera. Other cheaper ones are on the fixed focus principle. Enlargers for use with artificial light are made like a magic lantern, with a condenser, projecting an enlarged image on to a sensitive plate or paper fixed on an easel or screen. A simple arrangement for daylight enlarging is to fix a suitable camera on to a larger one by a sliding front, and mount the two on a studio stand tilted so that the image may be illuminated by the open sky.

Cinematographs.—Many special cameras and lenses have been introduced for taking on a long flexible sensitive film an extended series of small photographs of the successive phases of movements, and again projecting them on a screen so as to reproduce the scene, with an illusion of motion, in what are known as "living pictures," biographs, &c. As each photograph requires a certain minimum time for exposure and must be kept in true position in sequence with the rest, some means of regulating the intermittent exposures and keeping the film in position have to be adopted; and there are many different ways of doing it, either by a continuous or intermittent motion and exposure of the film while it is being unwound from one roller on to another. The films used are similar to the ordinary celluloid films, but in narrow bands from 1⅜ in. to 2⅜ in. in width, the length varying with the number of exposures required, at the rate of 16 to 20 per second. They are perforated on both sides, so that they may run true and have the necessary intermittent motion, the perforations fitting on to studs on a sprocket wheel in connexion with the driving wheel and crank handle. Special lenses of short focus, from 1 in. to 3 in., with good covering power and large apertures *f*/4 to *f*/2, are required both for photographing and projecting; several such are noted below. Absolute rigidity in the camera is essential. Special stands are made for the purpose, but if a tripod stand is used it should be well braced. Special apparatus is required for developing and fixing the exposed films. They are wound on large rollers supported over troughs containing the necessary solutions (see CINEMATOGRAPH). The mechanical arrangements are treated in H. V. Hopwood, *Living Pictures* (1899); F. P. Liesegang, *Handbuch der praktischen Kinematographie* (1907); K. W. Wolf-Czapek, *Die Kinematographie* (1908); G. Lindsay Johnson, *Photographic Optics* (1909); Eder's *Jahrbücher.*

A method of cinematography in colour was introduced by G. A. Smith and C. Urban in 1908, the main features of it being the use of a film sensitive to *all* colour waves to the furthest red; superimposing the colour records by persistence of vision; the use of two-colour records instead of three, in order to reduce the interval between the successive presentations; adaptation to existing cinematograph machinery and films. These conditions are fulfilled by the use, in place of the ordinary revolving sector shutter in front of the lens passing intermittent white light, of a special, more rapidly revolving shutter divided into four sectors, one fitted with orange-red glass, another with bluish-green glass and two intermediate opaque sectors, so that at every revolution of the shutter an exposure is made through the red and green glasses alternately. The former passes white and yellow, and then orange, scarlet to deepest red; whilst the latter also passes white and yellow, green, blue-green, blue, all in proportion according to the red and green sensitiveness of the specially sensitized panchromatic emulsion on the film. The same shutter and colour screens are used for projection, some supplementary blue rays being added. The results are satisfactory and the method promises to be of great practical value (see *Jour. Roy. Soc. Arts*, 1908, 57, No. 2926).

Special cameras are made for various branches of scientific research in photo-micrography, photo-spectroscopy, astronomical photography, &c.

Tripod Stands.—Field cameras are usually supported on wooden tripod stands, folding in two or more sections, the head being separate or fixed in the base-board of the camera. The legs should be capable of extension to about 5 ft. and adjustable in length for use on uneven ground. A tripod stand may be light, but must be firm and rigid when set up. To prevent slipping, shoes of india-rubber or cork may be fitted to the points of the legs, and in some cases it may be desirable to strengthen the tripod by a folding adjustable brace. W. Butler's "Swincam" camera stand is made to enable the camera to be securely fixed in awkward positions, and has many valuable special features, great extension, swivel points to the feet, &c. For hand cameras the very light, portable metal folding and walking-stick stands are convenient.

Photographic Objectives or Lenses.

The objective is the most important item of photographic apparatus, because upon it depends the perfection with which a correct and well-defined picture is projected upon the *plane* surface of the sensitive plate of objects in the different planes forming the field of view, which naturally would come to a focus on a series of *curved* surfaces. This flattened picture must be equally illuminated and sharply defined, within a limit of confusion from $\frac{1}{100}$ to $\frac{1}{250}$ of an inch, over a sufficiently wide angle. A good objective must also pass sufficient light to produce the required effect on the photographic plate with short exposures; the chemical and visual foci must coincide exactly, and it must not distort straight or parallel lines. The fulfilment of these conditions is complicated by the presence of sundry focal displacements or aberrations. (1) *Spherical aberration*, or non-coincidence of the foci of the central and marginal pencils of rays passing through the lens. It is corrected by varying the curves of the component lenses and by the use of a diaphragm. (2) *Coma*, or blur, due to lateral spherical aberration of oblique rays, and mostly found in unsymmetrical combinations and single view lenses. It is partly eliminated by the diaphragm. (3) *Astigmatism*, which accompanies coma in single lenses, and is usually present in symmetrical aplanats, manifests itself by forming two sets of images of points off the axis, lying in two separate curved surfaces, one set focusing tangentially as more or less horizontal lines, the other radially as more or less vertical lines. It increases with the obliquity of the rays and causes want of definition and difference of focus between horizontal and vertical lines away from the centre. (4) *Curvature of field*, also increasing with the obliquity of the rays. (5) *Distortion*, outward or inward, according to the nature and construction of the objective. With the single meniscus view lens, used with its concave surface towards the object and a diaphragm in front, a square will appear barrel shaped from inward contraction of the lines towards the centre; but with the convex surface towards the object and the diaphragm behind, it will appear with concave sides from outward expansion from the centre. It can be corrected by using two such lenses with the convex sides outwards and a central diaphragm, as in periscopic or rectilinear lenses. Lenses of the orthoscopic and telephoto types generally show the latter form of distortion. (6) *Chromatic aberration*, produced by the dispersion of the white light passing through the lens, and the different coloured rays composing it coming to a focus at different distances from the visual focus in the order of their wave-lengths. It thus affects both the *positions* and *sizes* of the image for the different colours. For ordinary photographic work it suffices for the blue-violet and yellow rays to be coincident, but for the new processes of photography in three colours, apochromatic lenses, in which perfect coincidence of the coloured rays is secured, are required to obtain the accurate register of the three images. The corrections are effected by compensating lenses of different refractive powers (see ABERRATION).

In constructing photographic objectives these aberrations and distortions have to be neutralized, by regulating the curves of the different positive and negative component lenses, the refractive and dispersive indices of the glasses from which they are made, and the distances of the refracting surfaces, so as to make the objective as far as possible *stigmatic* or focusing to a *point*, giving an image well defined and undistorted. This perfect correction could never be effected in objectives made before 1887, and very few could be effectively used at their full apertures, because although linear distortion could be overcome there were always residual aberrations affecting the oblique rays and necessitating the use of a diaphragm, which by lengthening out the rays caused them to define clearly over a larger surface, at the expense of luminous intensity and rapidity of working. The introduction of rapid gelatin dry plates enabled photographs to be taken with much greater rapidity than before, and led to a demand for greater intensity of illumination and better definition in lenses to meet the requirements of the necessarily very rapid exposures in hand cameras. For studio and copying work quick-acting lenses are also valuable in dull weather or in winter.

The rapidity of a lens with a light of given intensity depends upon the diameter of its aperture, or that of the diaphragm used, relatively to the focal length. In order, therefore, to obtain increased rapidity combined with perfect definition, some means had to be found of constructing photographic objectives with larger effective apertures. This necessity had long been recognized and met by many of the best makers for objectives of the single meniscus and aplanatic types, but with only partial success, because such objectives are dependent upon the diaphragm for the further correction necessary to obtain good definition over an extended field. The difficulty was in the removal of astigmatism and curvature of the field, which, as J. Petzval had shown, was impossible with the old optical flint and crown glasses. In 1886 Messrs E. Abbe and O. Schott, of Jena, introduced several new varieties of optical glasses, among them new crown glasses which, with a lower dispersion than flint glass, have a *higher* instead of a *lower* refractive power. It was thus rendered possible to overcome the old difficulties and to revolutionize photographic optics by enabling objectives to be made free from astigmatism, working at their full apertures with great flatness of field independently of the diaphragm, which is now chiefly used to extend the area of definition or angle of view, and the so-called "depth of focus" for objects in different planes.

Photographic objectives may be classed as follows:—

1. Single achromatic combinations.	Old types.
2. Unsymmetrical doublets.	
3. Symmetrical doublets.	
4. Triple combinations.	
5. Anastigmatic combinations—symmetrical and unsymmetrical.	New types.
6. Telephotographic objectives.	
7. Anachromatic combinations.	

They are also sometimes classified according to their rapidity, as expressed by their effective apertures, into "extra rapid," with apertures larger than *f*/6; "rapid," with apertures from *f*/6 to *f*/8; "slow," with apertures less than *f*/11. Another classification is according to the angle of view, "narrow angle" up to 35°; "medium angle" up to 60°; "wide angle" up to 90°, 100°, or more. Many lenses are made in series, differing in rapidity and angle of view as well as in length of focus.

1. *Single Achromatic Combination or Landscape Lens.*—This is the earliest form of photographic objective, evolved from W. H. Wollaston's improved single periscopic meniscus camera obscura lens (1812). It was made achromatic by Ch. Chevalier, and so used by L. J. M. Daguerre, though it required correction for chemical focus, as did the object glasses of telescopes or opera glasses first used for photography. The single landscape lens usually consists of an achromatic compound meniscus, formed of a biconvex positive crown cemented to a biconcave negative flint to secure achromatism and partially correct the spherical aberration, and may be taken as the type of the "old photographic achromat" (fig. 14).[1] It is used with its concave side towards the object and a diaphragm in front, thus producing inward or barrel-shaped distortion, inherent in this type of objective, and rendering it unsuitable for copying or architecture, though not very noticeable in landscape work. The full aperture has to be largely reduced by a diaphragm to improve definition; so it is slow, though many improved forms have been brought out. It has always been popular for pure landscape work on account of the equality of illumination over the plate, depth of focus, and the softness and brilliancy of the image owing to its thinness and freedom from reflecting surfaces. In some of its improved and "long focus" forms it is preferred by portraitists for large heads, on account of the general softness it gives when used with large apertures.

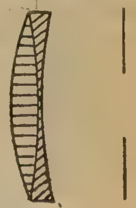
FIG. 14.—Single Landscape Lens.

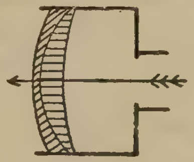
FIG. 15.—Grubb's "Aplanatic" Lens.

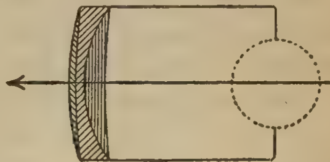
FIG. 16.—Rapid Landscape Lens. Long Focus.

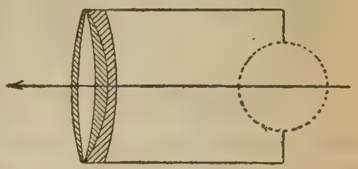
FIG. 17.—Rectilinear Landscape Lens.

The following are some of the best-known improved objectives of this type: T. Grubb's "Aplanatic" (1857), *f*/15 to *f*/30 (fig. 15); J. H. Dallmeyer's "Wide Angle Landscape Lens" (1865), *f*/15, angle 75°. In it distortion was reduced and marginal definition improved. The "Rapid (long focus) Landscape Lens" (1884), *f*/12, angle 40° (fig. 16), was a modification of it, and at *f*/8 is useful for heads in portraiture. W. Wray's "Landscape Lens" (1886), *f*/11, is also useful for portraiture in the larger sizes at *f*/8. Fr. Voigtländer's "Wide-Angle Landscape Lens" (1888)

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[1] In the diagrams of lenses which follow, a uniform system of indicating the nature of the glass employed by means of the shading has been adopted.

Flint glass is indicated thus:— ▨

Crown glass of low refractive power thus:— ▧

Crown glass of high refractive power thus:— ▤

(These two are used indiscriminately in lenses made before the introduction of the new Jena glass.)

Extra light flint glass thus:— ▥

In most cases the front of the lens is on the right.

f/15, angle 90°, with great covering power and depth of focus. T. R. Dallmeyer's "Rectilinear Landscape Lens" (1888), *f*/14, angle 60° (fig. 17), was of novel construction, free from distortion, brilliant in working and useful for copying. Messrs Ross's "Wide-Angle Landscape Lens" (1890), *f*/16, angle 70°, triple cemented and made of Jena glass. Many other excellent objectives of this type have been made by British and foreign makers and are still used, though somewhat superseded by the fully corrected anastigmats specially made to work singly, or as single elements of anastigmatic doublets, as noticed in § 5.

2. *Unsymmetrical Doublets: Old Types.*—This class includes objectives with comparatively large apertures formed of two dissimilar combinations, in most cases correcting each other, with a diaphragm between them. In some the single elements may be used independently. All the older "portrait" lenses, some of the aplanatic doublets and Fr. von Voigtländer's "Orthoscopic" Lens (1857), now disused, are of this type. Even with the present improved conditions, the portraitist working in a studio requires a quick-acting objective of large effective aperture and comparatively short focus, giving a brilliant well-defined image of near objects in different planes over a restricted field of view. The early single lenses were found to be too slow for portraiture by the daguerreotype and talbotype processes, and the efforts of opticians were directed to the problem of obtaining the maximum amount of light, together with good definition and flatness of field, and about 1840 compound lenses were brought out by Andrew Ross and C. Chevalier, consisting of two achromatic compounds, one at each end of a tube. Ross's lens, made for H. Collen, is interesting as the first lens corrected photographically, so that the visual and chemical foci were coincident (fig. 18). Ch. Chevalier also combined lenses of different foci, as is now done for "convertible" objectives, used singly or combined. He also fitted them with iris diaphragms. These forms were soon superseded by the compound portrait lens, calculated by J. Petzval and brought out by Fr. von Voigtländer in 1841. It consists of two dissimilar achromatic combinations widely separated. At first the diaphragms were in front, but now they are central. The front element is a plano-convex composed of a biconvex crown cemented to a plano-concave flint, while the back element is a double convex, composed of a biconvex crown separated by an air-space from a concavo-convex flint (fig. 19). This form of objective quickly supplanted all other for portraitures, and is still largely used, though it has defects which prevent its use for general purposes and is being superseded for portraiture by some of the rapid anastigmats. In his "Quick Acting Portrait Lens" (1860), *f*/4, angle 45°, J. H. Dallmeyer improved the correction for spherical aberration, and in his "Extra Quick Acting Portrait Lens" (1860), *f*/2·2, used for cinematograph work, attained greater rapidity. In the "Patent Portrait Lens" (1866), *f*/3, *f*/4 and *f*/6, angles 50° to 55° (fig. 20), he made great changes in the form and relative positions of the back elements, giving a flatter field and freedom from flare spot. By separating the two components of the back element more or less spherical aberration could be introduced to give softer definition and greater depth of focus. In 1875 Dr. A. Steinheil made an unsymmetrical aplanatic portrait combination of peculiar construction, working at *f*/3·2. It was an improvement on his similar symmetrical "Portrait-Aplanat," Form I. of 1874, but was superseded in 1881 by the "Portrait Antiplanet," *f*/4 and free from astigmatism over an angle of 14°. It had six reflecting surfaces and nearly approached a triplet (fig. 21). Steinheil's "Group Aplanats" (1879), *f*/6·4, angle 70°, were an improvement on the ordinary "Aplanats," but were superseded in 1881 by the "Group Antiplanets," *f*/5, angle 70°, lenses of a distinct type (fig. 22). They were a further advance on the "Aplanats," working at larger apertures and giving better definition. This lens is interesting as the first in which astigmatism was eliminated by combining a "crown-shaped" lens of high refractivity, with a "flint-shaped" of lower refractivity, though made of the old glasses. In his "Rapid Antiplanet" (1893), *f*/6·5, angle 30°, Dr R. Steinheil improved the "Group Antiplanet" as regards astigmatism and covering power by replacing the thick back combination by a triple long-focus negative element consisting of a crown between two flints, with a heavy barium crown in the front element instead of a flint (fig. 23). Voigtländer, who originally constructed the Petzval portrait lens, improved it in 1878 and 1885, and now makes two lenses on the same principle, series I. *f*/3·2, angle 28°, for ordinary portraiture and projection, and series Iα., *f*/2·3, angle 22° (1900) for astrophotography, cinematography, &c., when intense illumination is required over a small field. Both are quite free from coma.

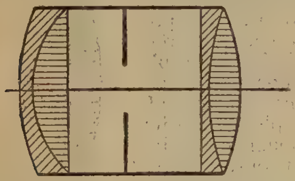


FIG. 18.—First English Portrait Lens.

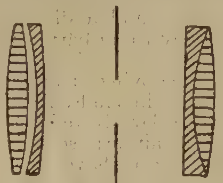


FIG. 19.—Portrait Lens.

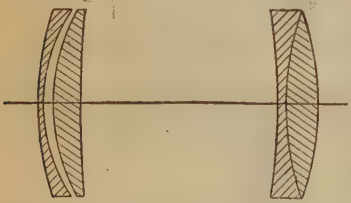


FIG. 20.—Dallmeyer's Patent Portrait Lens.

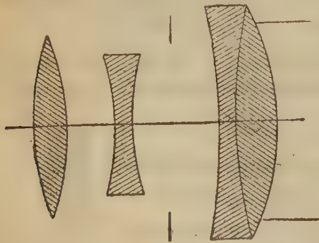


FIG. 21.—Portrait Antiplanet.

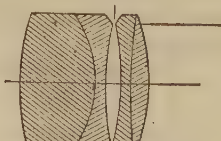


FIG. 22.—Group Antiplanet.

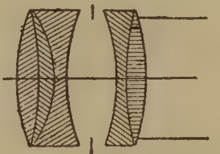


FIG. 23.—R. Steinheil's Improved Group Antiplanet.

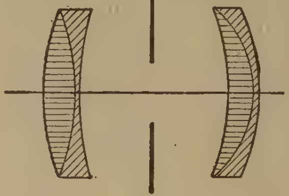


FIG. 24.—Ordinary Angle Actinic Doublet.

Most of the above are portrait objectives of large aperture, but unsymmetrical doublets have also been made for landscape work. J. T. Goddard's "Combination Landscape Lens" (1859) was one of the first, and was free from distortion, gave a flat field, and could be used as a convertible lens. In 1864 T. Ross issued his "Actinic Doublets," modified from the Collen lens, in three series —"small angle," *f*/8, angle 40° to 50°; "ordinary angle," *f*/14, angle 60° to 75° (fig. 24); "large angle," *f*/16, angle 80° to 95°. These lenses were similar to the "Globe," but unsymmetrical and more rapid. The separate elements could be used alone. Some of them were fitted with a shutter near the diaphragm. They were superseded by the "Symmetrical" lenses.

3. *Symmetrical Doublets.*—This class includes objectives formed of two similar combinations of lenses, usually of the convergent meniscus form, with their concave surfaces inwards and a diaphragm between them; consequently they are rectilinear and practically free from marginal distortion. Until the introduction of anastigmatic doublets they were in general use for all purposes under the names "Aplanat," "Rectilinear," "Symmetrical," "Euryscope," &c. They are still largely used and have been improved by the use of Jena glasses in their construction.

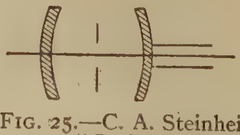


FIG. 25.—C. A. Steinheil's "Periskop."

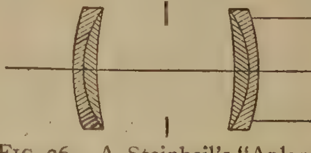


FIG. 26.—A. Steinheil's "Aplanat."

The first recorded lens of this type was Dr J. W. Draper's combination used in 1839 for daguerreotype portraits, consisting of two double-convex lenses 4 in. diameter, with a united focus of 8 in., mounted in a tube with a diaphragm 3½ in. in front. In 1841 T. Davidson made a combination of two single landscape lenses very similar to the later rectilinear doublets. Being slower than the Petzval portrait lens its value as a non-distorting lens for general purposes was not recognized. G. S. Cundell (1844) combined two uncorrected meniscus lenses with a diaphragm between them. In 1860 T. Sutton brought out his "Panoramic Lens," which worked on curved plates covering about 100°. It was followed by C. C. Harrison's "Globe Lens" (1862), angle 75°, composed of a symmetrical pair of deep compound menisci, the exterior surfaces forming part of a sphere. Though defective and slow it was popular for a time. C. A. Steinheil's "Periskop" (1865, *f*/13·5, angle 90°, was a symmetrical doublet formed of two plain crown menisci with central diaphragm (fig. 25). It gave a larger field than the "Globe," the lenses being closer together. Being nonachromatic it had to be adjusted for chemical focus. It was quite free from distortion, with a very flat field, and both nodal points together. It is considered the best possible combination of two plain lenses, and is still used in some of the cheaper hand cameras with fixed focus, the difference of the chemical and visual foci being allowed for in the camera or by adjustable lens mounts. G. Rodenstock's "Bistigmats" are of this class. J. Zentmayer made a similar unsymmetrical lens. In A. Steinheil's "Aplanat" (1866) the same principle was carried out with achromatized lenses, and a great improvement was effected in the construction of non-distorting objectives of fairly large aperture. It consisted of two positive cemented flint menisci, each composed of a dense flint with negative focus outside and a light flint with positive focus inside, its concave surfaces facing the centre (fig. 26). This use of flint glasses alone was peculiar, former achromatic lenses having been made of flint and crown. These lenses were made in three rapidities: "Ordinary," *f*/6 or *f*/7, angle 60°; "Landscape," *f*/12 to *f*/15, angle 90°, also used in convertible sets; "Wide Angle Landscape," *f*/20 to *f*/25, angle 104°; "Wide Angle Reproduction," similar to the last, but with sharper definition. The "Aplanat" had many advantages over previous doublets and the triplet, being more rapid, perfectly symmetrical, so that there was no necessity for turning them when enlarging, and free from distortion or flare. There was no chemical focus. Each component could be used alone for landscape work with double focus, subject to the ordinary defects of single lenses. By the use of Jena glasses in the "Universal Aplanat" (1886) the components of this lens were brought closer together, its intensity increased, and it was made more portable. J. H. Dallmeyer had been working in the same direction simultaneously with Steinheil, and in 1866 brought out his "Wide Angle Rectilinear," *f*/15, angle 100°, made of flint and crown, the front element being larger than the back (fig. 27). It was slow for ordinary purposes and was succeeded in 1867 by the well-known "Rapid Rectilinear," *f*/8, on the same principle as Steinheil's "Aplanat," but made of flint and crown (fig. 28). Ross's "Rapid" and "Portable Symmetrical" lenses, Voigtländer's "Euryscopes," and other similar lenses of British and foreign manufacture are of the same type, and still in use. They are excellent for general purposes and copying, but astigmatism is always present, and although they can be used with larger apertures than the triplets they displaced, they require stopping down to secure good marginal definition over the size of plate they are said to cover. By the use of Jena glasses they have been improved to work at larger apertures, and some are made with triple cemented elements.

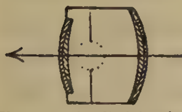


Fig. 27.—Wide-Angle Rectilinear Lens.

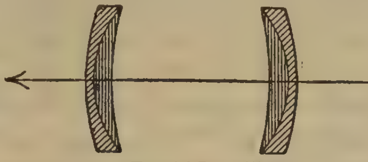


Fig. 28.—Rapid Rectilinear Lens.

4. *Triple Combinations: Old Types.*—This class comprises objectives composed of three separate combinations of glasses widely separated from each other. An early form of this type was made by Andrew Ross (1841) for W. H. Fox Talbot, others by F. S. Archer, J. T. Goddard (1859), T. Sutton (1860), but they never came into general use. J. H. Dallmeyer's "Triple Achromatic Lens" (1861), *f*/10, angle 60°, now out of date, was an excellent non-distorting lens, very useful for general work and copying (fig. 29). As made by Dallmeyer, the inner surfaces of the front and back components were slightly concave, but in T. Ross's "Actinic Triplets" (1861), *f*/16, they were flat. The centre lens was an achromatic negative serving to flatten the field.

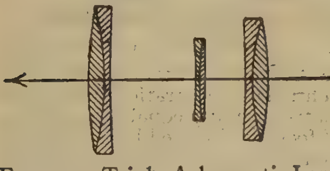


Fig. 29.—Triple Achromatic Lens.

5. *Anastigmatic Combinations, Symmetrical and Unsymmetrical.*—As already stated, it was found practically impossible to obtain flatness of field, together with freedom from astigmatism, in objectives constructed with the old optical glasses. A. Steinheil attempted it in the "Antiplanets," but with only partial success. The Abbe and Schott Jena glasses, issued in 1886, put a new power into the hands of opticians by largely increasing their choice of glasses with different refractive and dispersive powers. Whereas the old glasses had high refractivity with higher dispersion, in the new ones high refractivity with lower dispersion could be set against lower refractivity with higher dispersion.

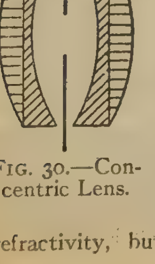


Fig. 30.—Concentric Lens.

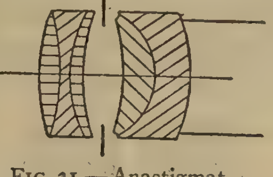


Fig. 31.—Anastigmat. Series II. *f*/6·3.

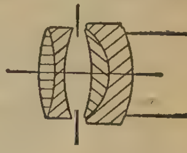


Fig. 32.—Anastigmat. Series IIIa. *f*/9.

Between 1887 and 1889 the first attempts to make anastigmatic objectives with the new glasses were made by M. Mittenzwei of Zwickau, R. D. Gray of New Jersey, E. Hartnach and A. Miethe of Berlin ("Pantoscope"), K. Fritsch of Vienna ("Apochromat") and Fr. von Voigtländer of Brunswick, with more or less success, but progress was hindered by the instability of some of the early glasses, which was afterwards overcome by sandwiching the soft glasses between two hard ones. In 1888 Dr H. L. H. Schroeder worked out for Messrs Ross the "Concentric Lens" (fig. 30) issued in 1892 (*Ph. Jour.*, 16, p. 276). It was a symmetrical doublet of novel construction, each element consisting of a plano-convex crown of high refractivity cemented to a plano-concave flint of lower refractivity, but about equal or higher dispersion. Both the uncemented surfaces were spherical and concentric. At *f*/16 it gave sharp definition and flatness of field with freedom from astigmatism, distortion or flare over an angle of 75°. It was an excellent lens, though slow, and has been superseded by the "Homocentric" and other more rapid anastigmats. Dr Paul Rudolph, of Messrs Carl Zeiss & Co., Jena, worked out in 1889 a new and successful method of constructing a photographic objective by which astigmatism of the oblique rays and the want of marginal definition due to it could be eliminated without loss of rapidity, so that a comparatively extended field could be covered with a large aperture. This he did on the principle of the opposite or opposed gradation of the refractive indices in the front and back lenses, by a combination of two dissimilar systems of single lenses cemented together, the positive element of each having in one case a *higher* and in the other a *lower* refractive index than that of the negative element with which it was associated. The front system, relied upon for the correction of spherical aberration, was made of the old glasses, a crown positive of low and a flint negative of high refractivity, whilst the back system, relied upon for the anastigmatic flattening of the field, was made of the new glasses, a crown positive of high and a flint negative of low refractivity. Both systems being spherically and chromatically corrected for a large aperture, the field was flattened, the astigmatism of the one being corrected by the opposite astigmatism of the other, without destroying the flatness of the field over a large angle (see *E. Jb.*, 1891 and 1893; M. von Rohr's *Geschichte*, and O. Lummer, *Photographic Optics*, for further details). They were issued by Messrs Zeiss and their licencees (in England, Messrs Ross), in 1890, in two different types. The more rapid had five lenses (fig. 31), two of ordinary glasses in the front normal achromat, and three in the back abnormal achromat, two crowns of very high refractive power, with a negative flint of very low refractive power between them.

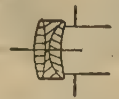


Fig. 33.—Anastigmat. Series VI.

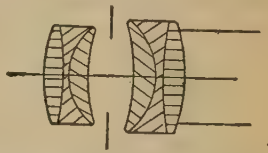


Fig. 34.—Satz Anastigmat. Series VIa.

The fifth lens assisted in removing spherical aberrations of higher orders with large apertures. The second type, series IIIa., *f*/9, 1899 (fig. 32), had only two lenses, the functions of which were as above. These combinations could not be used separately as single lenses. They are now issued as "Protars," series IIa., *f*/8; IIIa., *f*/9; V., *f*/18. In 1891 Dr Rudolph devoted himself to perfecting the single landscape lens, and constructed on the same principle a single combination of three lenses, the central one having a refractive index between the indices of the two others, and one of its cemented surfaces diverging, while the other was converging. At *f*/14·5 this lens gave an anastigmatically flat image with freedom from spherical aberration on or off the axis. It was, however, not brought out till 1893, as a convertible lens or "Satz-Anastigmat," series VI., *f*/14·5, and VIa., *f*/7·7 (figs. 33 and 34). In the meantime Dr E. von Höegh (C. B. Goerz) and Dr A. Steinheil had also been working at the problem and had independently calculated lenses similar to Rudolph's, but, whereas he had devoted himself to perfecting the single lens, they sought more perfect correction by combining two single anastigmatic lenses to form a doublet. Dr Rudolph had had the same idea, but Messrs Goerz secured the priority of patent in 1892, and in 1893 brought out their "Double Anastigmat," now known as "Dagor." It was the first symmetrical anastigmat which combined freedom from astigmatism with flatness of field and great covering power at the large aperture of *f*/7·7 (fig. 35). Both these types of Zeiss's "Protars" and Goerz's "Dagor" anastigmats have since

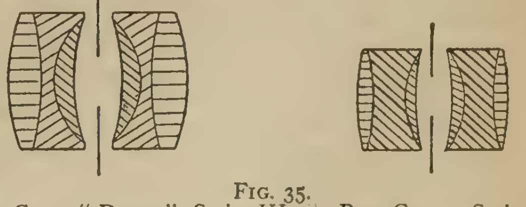


Fig. 35.
Ross-Goerz "Dagor." Series III. Ross-Goerz. Series IV.

been made by Messrs Ross in England. Messrs Steinheil brought out their first "Orthostigmats" in 1893, but, owing to patent difficulties, were unable to manufacture them in Germany, and they were issued later in France and England. They were followed by a second type, which has since been issued in several series by Messrs Steinheil and by Messrs Beck in England (fig. 36). According to Dr R. Steinheil (*E. Jb.*, 1897, p. 172) this lens was an application of two principles recognized by Dr A. Steinheil as necessary for the spherical and anastigmatic correction of a lens. He attempted to carry them out in the "Antiplanet," but was prevented by the want of suitable glass. He found that for *anastigmatic* correction an objective should have the separating surface between two media *concave* towards the medium of higher refraction (new achromat), and for *spherical* correction the separating surface should be *convex* towards the higher refracting medium. A fully corrected cemented lens cannot, therefore, be made with less than three glasses, but with uncemented lenses an air-space may form one of the media. In 1895 Dr D. Kaempfer worked out the "Collinear" for Messrs Voigtländer, constructed on the same principles as the "Orthostigmat," type II., and similar to it (fig. 37). It is made in three series: II., *f*/5·4 and *f*/6·3; III., *f*/6·8 and *f*/7·7 (convertible); IV., *f*/12·5, and the apochromatic collinear *f*/8, calculated by Dr H. Harting for three-colour reproduction, &c. (*Ph. Jour.*, 1901, 25, p. 323.)

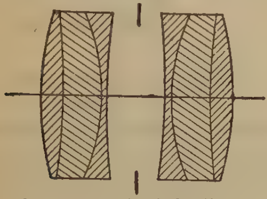


FIG. 36.—Steinheil's "Orthostigmat."

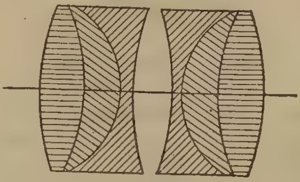
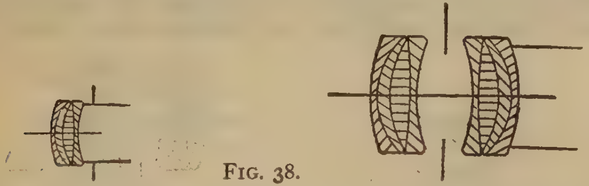


FIG. 37.—"Collinear." Series II.

In 1894 Dr Rudolph extended the application of his principle by combining the old achromat and the new achromat into a single quadruple cemented lens (fig. 38), which, according to T. R. Dallmeyer, was the most perfectly corrected single lens that had been evolved up to 1900, Dr Rudolph having succeeded in obtaining freedom from spherical aberration and astigmatism, and also in eliminating coma (*Ph. Jour.* 1901, 25, p. 68). These lenses were issued in 1895 as series VII. singly and VII*a*., in combinations now known as "Convertible Protars," and the earlier series VI. and VI*a*. were withdrawn. The single lenses of series VII., *f*/12·5, angle 85°, have great anastigmatic flatness of field and only very slight marginal distortion, a condition not realized before in a single lens. The relative rapidities of the double combinations of series VII*a*. vary from *f*/6·3 to *f*/8, according to the lenses used. They are excellent lenses for all general purposes.


Series VII. *f*/12·5. FIG. 38. Series VII*a*. *f*/6·3.

In their "Convertible Protars," series IV. (1908), *f*/12·5, angle 60°, Messrs Zeiss have simplified and cheapened the construction of these lenses by the use of new Jena glasses, so that they consist of three instead of four lens elements cemented together, while possessing the same high efficiency as series VII. They are issued as "single" or "double" Protars, *f*/12·5 and *f*/6·3 or *f*/7, also in sets of three or four objectives of different foci, which are combined to give pictures of different angles of view from the same standpoint. With both series when using the "Protar" lens singly, it should be screwed behind the iris diaphragm of the mount, to avoid curvature of the field, and when two such lenses are combined the one with the greater focal length should be placed in front.

In 1895 Messrs Goerz patented a double anastigmat, *f*/5·6, with quintuple single lens components as a convertible lens, for which greater sharpness of definition and intensity, with perfect freedom from astigmatism and distortion in the single lens, were claimed. It was issued in 1898, but, like an earlier analogous quintuplet of Messrs Turner & Reich (1895), it has not come into use on account of the cost and difficulty of construction. The latter firm, however, brought out in 1906 a new symmetrical quintuplet at *f*/6·8.

A triple anastigmatic combination containing remarkable new features, constructed and patented by H. D. Taylor, was issued in 1895 by Messrs Taylor, Taylor & Hobson under the name of the "Cooke Lens," and later by Messrs Voigtländer as the "Triple Anastigmat." It consists of three single lenses, two of them positive crossed lenses of crown glass with high refraction and low dispersion, with their most convex sides outwards, and between them, in front of the diaphragm, a single biconcave of light flint (fig. 39). All these lenses are designed to be free from diaphragm corrections, while the focal power of the negative lens is made as closely equal to the combined focal powers of the two positive lenses as may be necessary for the flattening of the field and correcting marginal astigmatism. They are not convertible, but arrangements are made for replacing the back lens by a low-power extension lens (*Ph. Jour.* 1895, 19, p. 64). Series III., *f*/6·5 (fig. 40), and series IV., *f*/5·6, are portrait lenses. In the larger objectives of series II. the back lenses are adjustable for uniform sharp definition or a soft diffusion of focus. In a later series VI. (1907), *f*/5·6, this adjustment for diffusion is given to the front lens and is so arranged for portraiture that the diffusing adjustment and iris diaphragm can be operated from the back of the camera while viewing the focusing screen. A special fully corrected "Process" lens on the same general principle has recently been brought out for three-colour work and fine-line reproduction. Another distinctly new type of anastigmatic objective involving several new principles of construction was patented by H. L. Aldis in 1895, and brought out by Messrs Dallmeyer in three series, under the name of "Stigmatic" (*Ph. Jour.*, 1896, 20, p. 117). It also approaches the triplet construction and depends on the introduction of air-spaces between the component lenses. According to Aldis, three conditions must be observed to obtain a flat field free from marginal astigmatism: (1) The converging lenses must be of high, the diverging of low, refractive index; (2) the converging and diverging components must be separated by a considerable interval; (3) thick meniscus glasses should be used. The first "Stigmatic" was a portrait lens, series I., 1896, *f*/4. It has been made in two forms, first with a triple front lens, and a back negative system formed of a single thick crown lens of high refractivity with a negative cemented meniscus. In the second form (fig. 41) the front component consists of a cemented positive and negative, and both parts of the back component are cemented lenses. All the converging lenses are of dense baryta crown, while both the diverging lenses in the back component are a light silicate crown. It is fully corrected for spherical and chromatic aberration, free from distortion and nearly so for astigmatism, giving equal illumination over a flat field of 60°. Diffusion of focus is obtained by unscrewing the back cell. Series II. (1897) is on the same principle but differs in construction, working at *f*/6 over an angle of 85° as a universal and convertible lens (fig. 42). The front or back component can be used alone, giving the choice of two focal lengths, 1⅝ and twice the focal length of the complete lens. The principles of its construction were described by T. R. Dallmeyer in *Ph. Jour.* 1897, 21, p. 167. Series III., *f*/7·5, will at *f*/16 give sharp definition over a plate two sizes larger. The single components are not convertible.

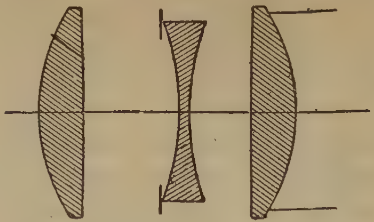


FIG. 39.—"Cooke" Portrait Lens. Aperture *f*/4·5.

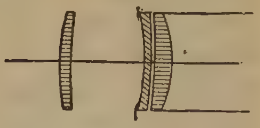


FIG. 40.—"Cooke" Lens. Series III.

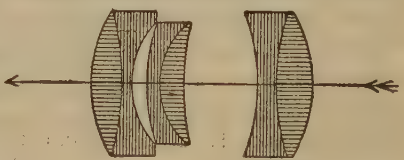


FIG. 41.—Stigmatic Portrait Lens. Series I.

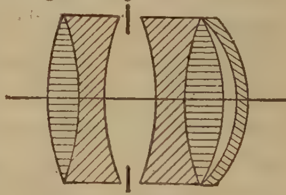


FIG. 42.—Stigmatic Lens. Series II.

In 1897 Messrs Zeiss issued the "Planar," an objective of large aperture based on the principle of the Gauss telescope objective. It is a symmetrical doublet, each element consisting of three lenses, the two inner ones being a double convex and a double concave, of equal refractive but different dispersive power, cemented together and separated by an air-space from the outer convex meniscus (fig. 43). Its special points are its good colour correction, large relative aperture and intensity, varying from *f*/3·6 to *f*/6, with perfectly sharp definition and anastigmatic flatness of field over an angle of view from 62° to 72°. It is a very rapid wide-angle lens useful for instantaneous work with the cinematograph and hand cameras, also for portraits and groups, photo-micrography and enlargements or reductions (see *E. Jb.*, 1898, p. 79, Von Rohr, p. 390, and Lummer, p. 81). Apochromatic planars with reduced secondary spectrum were brought out in 1903 for three-colour photography, and are also useful for astrophotography, the circle of diffusion being very small. The "Unar" (1900), *f*/4·5 in the smaller and *f*/6·5 in the larger sizes, angle 65° and 68°, was a further improvement by Dr Rudolph. It consists of two unsymmetrical combinations, each formed of two single lenses of very transparent glass, dense baryta crown and light flint, separated by positive and negative air-spaces (fig. 44). The separate halves cannot be used as single lenses, neither being fully corrected for colour. It is well adapted for portraiture, groups or landscapes, especially for rapid hand camera work, on account of its covering power, with freedom from astigmatism and sharp definition with large relative aperture.

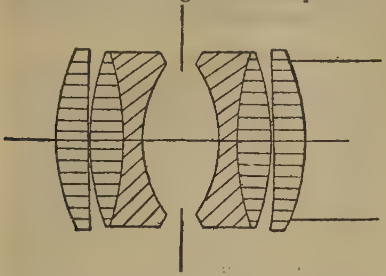


FIG. 43.—Planar. Series I*a*. *f*/4.

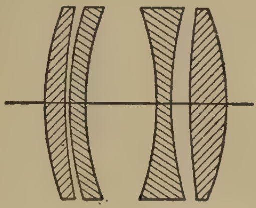


FIG. 44.—Zeiss's "Unar."

In 1898 Messrs Goerz patented their "Double Anastigmat Celor," series I*b*., *f*/4·5 to *f*/5·5. It is a symmetrical doublet, each element consisting of two thin single lenses: a positive of high and a negative of low refractive index, separated by an air-space (fig. 45). It is derived from the triple anastigmats by decreasing the refractive power of the central convex meniscus to the refractive power of air, so that it becomes a convex air-space between a double convex and a double concave lens. Less deeply curved surfaces can be given to the lenses, and the doublet gives anastigmatic flatness of field over an angle of 62° to 66°, equal to the best anastigmats with a still larger aperture. Series I*c*., *f*/6·3, is similar and recommended for hand cameras, the aperture being smaller. Goerz's "Hypergon," (1900) *f*/22, angle 135°, is a symmetrical doublet of remarkable construction, consisting of only two single semi-globular, very thin lenses, with diaphragm at the centre of curvature between them. Astigmatism and curvature have been eliminated, and definition is good over the above wide angle with no distortion. Chromatic aberration is uncorrected, but compensated for by using a small stop. A star mask is fitted in front of the lens to allow for falling off of illumination towards the margin (*E. Jb.*, 1901, p. 103). The "Syntor" (1903), Series I*d*., *f*/6·8, angle 64° to 70°, is on the same principle as the "Celor," but cheaper, for use in hand cameras or telephoto combinations. The "Alethar," series V. (1903), *f*/11, is a lens with diminished secondary spectrum, for three-colour reproductions, half-tone process work, and general purposes. It is a symmetrical doublet, each element consisting of a negative and positive separated by an air-space (fig. 46). The negative is composed of three cemented lenses, which correct the spherical and chromatic aberrations more fully than hitherto possible, so that all the colours of the spectrum are focused in the same invariable plane. It gives great crispness of definition at full aperture (W. Zschokke, *E. Jb.*, 1904, p. 165). Goerz's "Pantar," *f*/6·3 (1904), is a convertible 4-lens anastigmat, and an improvement on the "Dagor," in that the single elements are completely corrected for coma, and thus form efficient long-focus lenses for landscape, &c., at an aperture of *f*/12·5, while the doublets formed by various combinations of the single elements are universal objectives working from *f*/6·3 to *f*/7·7. The single elements are similar to those of the "Dagor," but have an additional negative lens at the back, so that the outer two of the three cemented surfaces have a collective and the inner one a dispersive action, by which coma is eliminated (*E. Jb.*, 1905, p. 55).

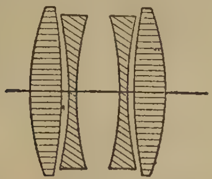


FIG. 45.—Goerz's "Celor."

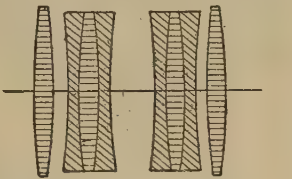


FIG. 46.—Goerz's "Alethar."

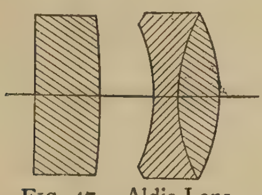


FIG. 47.—Aldis Lens. Series II.

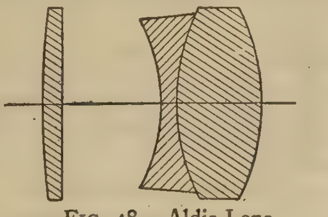


FIG. 48.—Aldis Lens. Series III.

In 1902 H. L. Aldis issued the "Aldis Lens," *f*/6, a doublet composed of a cemented meniscus in front and a single double-convex back lens. It is a long-focus objective with short back focus, and is made in two forms, series II., *f*/6 (fig. 47), and series III. (1903), *f*/7·7 (fig. 48). In the latter the back element is very thin, and the front combination of infinite focal length. By discarding the symmetrical form simplicity is secured, while open or reflecting surfaces are avoided. Special attention has been paid to perfect correction of spherical aberration in the centre of the field. It is lighter, smaller and cheaper than series II. The "Duo" lens of the same maker (1907) is intended to replace the front lens and double the focus, but with less rapidity and without any loss of quality. The "Trio" (1908) is similar, but only increases the focus one and a half times and is thus more suitable for cameras of short extension. The Aldis "Oxys" anastigmat, series II. (1908), *f*/5·65, angle 85°, is an improved form. Being an unsymmetrical cemented doublet it is free from the defects incidental to air-spaces and is constructed to give more perfect correction for flatness of field with large aperture and wide angle.

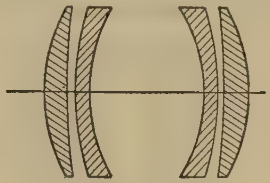


FIG. 49.—"Omnar," Series III.

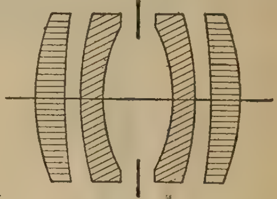


FIG. 50.—Ross's "Homocentric."

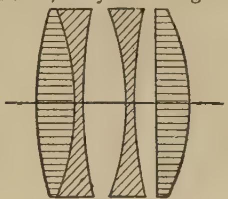


FIG. 51.—Zeiss's "Tessar."

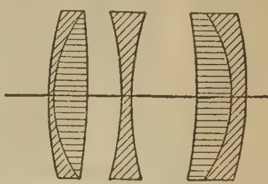


FIG. 52.—Voigtländer's "Heliar."

It is generally stated that it is impossible to make a spherically, chromatically and anastigmatically corrected photographic objective with the old optical glasses. K. Martin, of Messrs Busch of Rathenow, has, however, shown (*E. Jb.*, 1902, p. 68) that it is quite possible to do so with a system of separated lenses, and that it is immaterial whether the index of the flint or the crown is the higher. An anastigmat on this principle was issued by Messrs Busch in 1902, as the "Omnar," series III., *f*/7·7 (fig. 49). Series II., *f*/5·5, angle 75°, and I., *f*/4·5, have since been issued. It is a symmetrical doublet, each element consisting of a negative flint meniscus of higher refraction, and a positive crown of lower refraction with an air-space between them in the form of a negative lens. The back element can be used alone. The "Lumar" series, by G. Rodenstock, is similar. In 1902 Messrs Ross brought out the "Homocentric," a symmetrical doublet, each element consisting of a negative and positive meniscus separated by an air-space (fig. 50). It is constructed so that all rays of light emanating from any one point of the object are converged again into one point in the image. It is also quite free from spherical zones, is not altered in focus with different diaphragms, and thus has exquisite defining power. The colour correction is so perfect that the different coloured images are identical in size and position, thus rendering it specially suitable for three-colour and process work. The back lens can be used alone, with diaphragms, as a single lens of about double the focus of the doublet. It is made in several series: II., *f*/5·6, and III., *f*/6·3, for rapid and instantaneous work; V., *f*/8, for ordinary purposes; VI., *f*/8, for process work and three-colour reproduction. A later series, IV. (1907), "Compound Homocentric," *f*/6·8, differs from the others in being a symmetrical doublet composed of two triple cemented elements, very close together and separated by a diaphragm. It is specially suitable for outdoor work, also for copying and enlarging, having good covering power. Zeiss's "Tessar" (1902) is a rapid unsymmetrical doublet, formed of two separated uncemented positive and negative lenses in the front element and a cemented meniscus at the back (fig. 51). The two halves cannot be used separately. The glasses used are very transparent, permanent and lessen the secondary spectrum. Three series are made by Messrs Ross, I*c*., *f*/3·5 for cinematographic work and portraiture, and *f*/4·5 for hand-camera work and portraiture; II*b*., *f*/6·3 for general purposes, and VIII., the "Apochromatic Tessar," specially corrected for three-colour work and reproduction. They all give fine definition over a large flat field, free from any zonal aberration. The *f*/3·5 portrait lenses, with double the field and covering power of the Petzval lens, are anastigmatic and free from distortion. Messrs Voigtländer's "Heliar" (1902), *f*/4·5, angle 50°, calculated by Dr H. Harting, is an objective of large aperture, suitable for portraits and very rapid instantaneous work, being well corrected for astigmatism, coma and curvature of field, with freedom from flare. It is a triplet consisting of a central negative lens, with cemented double front and back lenses (fig. 52). The negative lenses are of light silicate flint, the two positive of the heaviest baryta crown. Besides being a rapid universal lens, it is specially suitable for half-tone process work, with a large diaphragm (*E. Jb.*, 1903, p. 117). The "Dynar" (1903), *f*/6, angle 60°, is of somewhat similar construction, but differs from the "Heliar" in the positive lenses of the cemented pairs being outside instead of towards the central lens. It can only be used as a whole. It is made of hard colourless Jena glasses, giving great brilliancy and uniformity of illumination over a large angle, and is specially adapted for very rapid hand-camera work.

Dr R. Steinheil's "Unofocal" (1903), *f*/4·5 is a symmetrical doublet, each element consisting of two single separated lenses of equal refractive power and of equal focus of opposite signs, hence its name. Each half can be used as a single lens with small stops. In its construction a quite new principle was followed, the separation of the lenses fulfilling an important part in the colour correction, as explained by Conrad Beck in *Ph. Journ.* (1904), 44, p. 177. This plan satisfies the Petzval condition and removes its restrictions, so that a lens of *f*/4·5 can be produced with telescopic central definition, perfect freedom from distortion and flare over a flat field of 60°, with great equality of illumination (fig. 53). They are made by Messrs Beck in two series: II., *f*/4·5, for portraiture, rapid hand-camera work, telephotography and projection; and I., *f*/6, in which the lenses are closer together, for hand-camera work and general purposes. E. Arbeit's "Euryplan" anastigmats (1903), made by Schulze Bros., Potsdam, are apochromatic objectives of quite new construction, giving perfect definition with large apertures over a wide angle, made in four series: I., *f*/4·5, angle 80°; II., *f*/5·6, angle 90°; III., *f*/6·8 to 7·5, angle 82°; IV., *f*/6·5. They are symmetrical doublets, each element consisting of three lenses, a new achromat formed of a biconvex of heavy baryta crown of high refractivity and low dispersion, separated by an air-space from a positive meniscus of the same baryta crown, with its concave side towards the diaphragm. In series I., *f*/4·5, the two positives are placed outside (fig. 54), in series II. and III. they are inside. The single elements are fully corrected astigmatically and chromatically, and can be used singly at double the focus (*E. Jb.* 1904, p. 35).

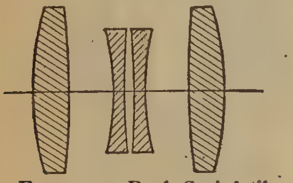


FIG. 53.—Beck-Steinheil "Unofocal."

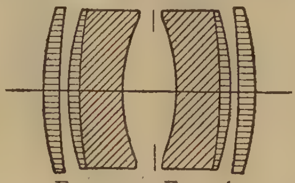


FIG. 54.—Euryplan, *f*/4·5.

Beck's "Isostigmar" (1907) is a new anastigmat showing a distinct departure from the ordinary principles of construction, in that it does not fulfil the Petzval condition that the sum of the focal powers of its individual lenses multiplied by the reciprocals of their respective refractive indices should be equal to zero, or $\Sigma(1/\mu f) = 0$. It is a 5-lens combination, two separated thin single lenses in the front element and three in the back (fig. 55). In departing from the Petzval condition very low power lenses can be used, thus reducing the initial errors to be corrected; no individual component having a shorter focal length than one-half that of a complete objective. A special feature is the excellent correction of the oblique spherical aberrations and central aberrations, giving a practically flat field without astigmatism over angles from 60° to 90°. The half combinations can also be used alone with diaphragms as long focus lenses of different foci (*Ph. Journ.* 1907, 47, p. 191). It is issued in six series: I. (1908), *f*/4·5, large aperture, series, for reflex press work and portraiture; I*a*., *f*/6·5, angle 60°–65°, long focus, for portraiture, &c.; II., *f*/5·8, angle 70°, for general use, III. *f*/7·7, angle 65°, similar to II. but less rapid; IV. *f*/6·3, angle 90°; wide angle, giving satisfactory definition at full aperture over an angle from 80° to 85°. Having such a large reserve of covering power the latter is very useful when an extended use of the rising front is required, either at a wide or ordinary angle. V. (1908), *f*/11, "Process" lenses specially corrected to give a flat field for copying. They can be fitted with suitable reversing prisms. VI. (1908), *f*/5·6, variable portrait lenses, adjustable for sharp or soft definition from the back of the camera while focusing.

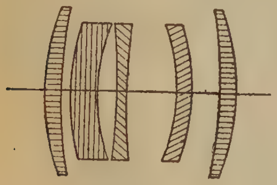


FIG. 55.—Beck's "Isostigmar."

The above represent the principal types of anastigmats, but many more objectives of the kind, triple or quadruple, cemented or uncemented, with air-spaces, in many modifications, have been issued by English and foreign makers.

6. *Telephotographic Objectives.*—For some years past special objectives, or attachments, have been constructed for photographing near or distant objects on an enlarged scale with an ordinary camera, the extension required being very much less than would be needed to obtain an image of the same size with an ordinary long-focus lens without enlargement. They consist of a combination of a positive converging with a negative dispersing lens, by which the image is picked up and enlarged to varying degrees, according to the system of lenses used and the extension given to the camera, thus producing the same effect as a positive lens of very much longer focus. Enlarged images of this kind can also be made by a combination of two converging lenses, one of them forming an image of the object, which is received on the other of shorter focus and projected on the sensitive plate, being enlarged more or less according to the optical conditions and relative positions of the lenses and sensitive plate. The photoheliographs at Greenwich and other solar observatories, designed by Warren de la Rue, are on this principle. Portable apparatus of the kind was made in 1869 by MM. Borie and de Tournemire, and later by Jarret, but this system requires much greater extension of the camera, entailing more loss of intensity of the image, and has never come into use.

The modern telephotographic combination is generally looked upon as an application of the principle of the "Barlow" lens, but it really goes back to the Galilean telescope (*c.* 1610). J. B. Porta mentions the combination of concave and convex lenses for giving enlarged and clearer images of near and distant objects (*Magia Naturalis*, lib. 17, cap. 10, 1589). J. Kepler showed that by a combination of a convex with a concave lens images of objects could be depicted on paper of a larger size than by the convex lens alone, but reversed (*Dioptrice*, *Prob.* cv. 1611). Christopher Scheiner made use of the same principle in his "Helioscope" for solar observations (*Rosa Ursina*, cap. vii. 1630). F. M. Deschales and P. Z. Traber also dealt with the question, and in J. Zahn's *Oculus artificialis Teledioptricus* (1686) we find figured a reflecting camera fitted with a compound enlarging lens on this principle. In his *Nova Dioptrica* (1692), W. Molyneux has given some interesting problems for calculating the position of the compound focus of a convex with a concave lens, also the angles subtended by an object on the focal plane. If for the simple uncorrected glasses then used we substitute a system of photographically corrected positive and negative lenses, suitably mounted, and put a sensitive plate in place of the paper, we have the modern telephotographic arrangement. I. Porro seems to have been the first to use a combination of this kind for photographing an eclipse in 1857, and later for terrestrial objects. It consisted of a small achromatic single lens combined with a concave lens. Many attempts were afterwards made in France, and also in England, to utilize the principle, but special lenses for the purpose were not available. Ad. Steinheil constructed one in 1889 for the Brussels Observatory, and another in 1890 for the Marine Department in Berlin. In 1891, curiously enough, three such combinations were worked out quite independently and patented, by T. R Dallmeyer in London, A. Miethe in Berlin and A. Duboscq in Paris. Since that time these combinations have been greatly improved by increase in the working apertures and reduction in size and weight, so that they can be used in hand cameras. They are exceedingly valuable for obtaining details of inaccessible objects at a distance, whether architectural or topographical, and for photographing animals without approaching them too closely. Large portraits can also be taken with much better perspective effects and more conveniently than by using long-focus lenses much nearer to the sitter. With the very perfect telephotographic objectives now available the loss of intensity of illumination, which no doubt was the bar to early progress in this direction, has been overcome, and definition has also been improved, so that snapshots can readily be made with combinations of high intensity, while

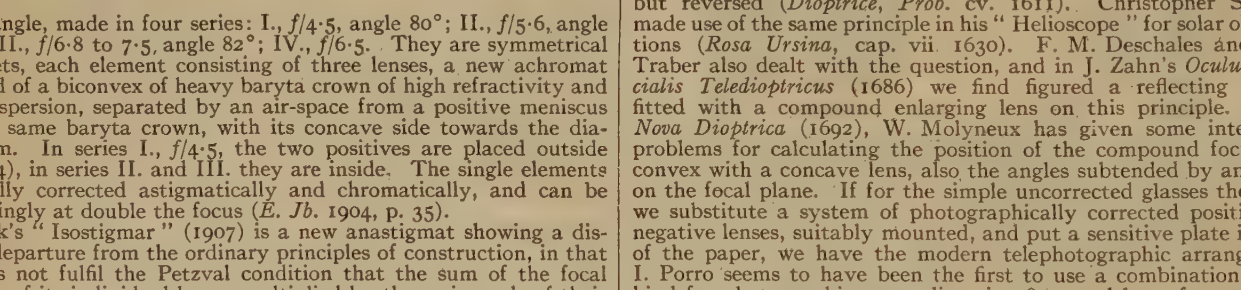


FIG. 56.

with those of ordinary intensity the exposures are not unduly prolonged, and good definition can be obtained over an extended field.

The optical principle on which these combinations are based is very simple, and will be understood from fig. 56. It depends mainly on the fact that in order that a *real* image may be thrown on the screen of an object AB, the rays proceeding from it, which pass through the positive system L_1, must come to a focus at a point f within the secondary focus f'' of the negative system L_2. Falling within this limit, they will be intercepted by L_2 and made less convergent, so that instead of coming to a focus at f, they will continue to converge till they reach the screen at f'', and will there form a proportionally larger image $a'b'$ of AB than the image ab given by the positive lens alone at f; just as stated in Kepler's problem. Moreover, this image $a'b'$ will be of the same size as if it had been produced directly by a positive lens L_3 with a focal length equal to lf'', and this distance is the equivalent focal length of the entire system. It can be found from the formula $F = f_1 f_2/d$, where f_1 and f_2 are the focal lengths of L_1 and L_2 respectively, and $d = f_1 + f_2 - s$, s being the distance between the lenses. In many instruments of the kind a scale showing the value of d is engraved on the mount. If the rays from AB come to a focus in front of L_2, on it, or beyond f'', no real image can be projected on the screen. There is therefore a certain limit, which is greater in proportion to the length of focus of the negative system, within which the focus of the positive system L_1 may fall and produce a series of well-defined images on the screen, which can be varied in size by altering the amount of separation of the two systems of lenses within the above limit, and the distance of the screen from L_2. Every change in the position of the screen will involve a corresponding adjustment of the lenses. The greater the extension of the camera and the closer the lenses, the greater the size of the image, and vice versa. The camera extension for a given magnification can be found by multiplying the focal length of the negative system by the number of magnifications, less one. The magnification produced by a given camera extension is found by dividing the latter by the focal length of the negative system, and adding one.

In its usual form (fig. 57) the telephotographic combination consists of a quick-acting portrait lens, or an anastigmatic doublet of large aperture and relative intensity of suitable focal length, fitted at one end of a tube, in which slides a smaller tube carrying a properly corrected negative system, which may vary in focus, but must be of shorter focus than the positive (usually about half); the shorter the focus the greater the magnifying power for a given extension of camera. The amount of separation of the lenses is limited on the one hand by the position of the focus of the positive system, and on the other by the focus of the negative system, as explained above, and can be adjusted within these limits by a rack and pinion. The tubes are adjusted so that when closed up the two foci may coincide, or nearly so, and $d = 0$, or its minimum value; and when opened to their fullest extent the focus of the positive may fall upon the negative system, or so that d may not exceed the focal length of the negative system. Within these limits the focal length of the combination will be positive, and a real image formed on the screen. Several forms of them have been brought out by various makes, some, as Zeiss's, with a special positive lens, others for use with anastigmats and other lenses of large apertures. The negative lenses are also made of various powers.

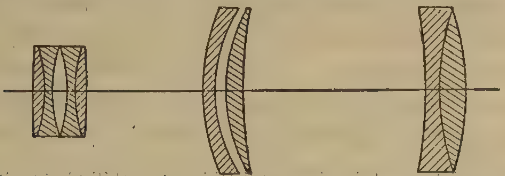


FIG. 57.—T. R. Dallmeyer's Compound Telephotographic Lens.

Messrs Dallmeyer's "Adon" (1902) is a telephotographic lens, for use with hand cameras, composed of two achromatic combinations adjusted for parallel rays, a front positive lens $4\frac{1}{2}$ in. focal length, and a back negative lens of $2\frac{1}{4}$ in. focus. These are mounted to permit of great variation in the separation, so that when the "Adon" is fixed on the *front* of a suitable lens, near or distant objects may be taken on an enlarged scale without altering the focus of the camera, or the enlargement can be varied with further extension of the camera. Used alone it is a complete telephoto lens of moderate magnifying power, and will cover plates 15 in. × 12 in. In 1903 a special form, the "Junior Adon," was made in three kinds for use with kodaks and similar folding hand cameras, single and double extension, giving a fixed degree of magnification without loss of rapidity, while focusing can be effected by scale. It is intended to replace the front lens of an R.R. or anastigmatic lens and cannot be used independently. Messrs Busch's "Bis-Telar," $f/9$ (1905), is another compact fixed focus telephoto lens, specially for use with hand cameras. It is a complete lens in itself, requiring no attachments and can be fitted to a central shutter. It is made in three sizes magnifying from two to three times. An improved form of this lens (1908), working at the large aperture of $f/7$, is similar to an old form of "Dialytic" lens worked out by J. Petzval, having a positive front and negative back meniscus, with their concave surfaces facing inwards (fig. 58). As in the old "Orthoscopic" and lenses of that type there is some outward distortion, but it is very slight. These lenses are made in five sizes with foci from 8 to 22 in., requiring camera extensions from $4\frac{1}{8}$ in. to $11\frac{1}{2}$ in. They magnify about twice. According to K. Martin, a telephoto-combination of the Bis-Telar type can be used in a reversed position as a projecting lens for the lantern, with the advantage of increasing the illumination from a given source of light (*E. Jb.* 1908, p. 46).

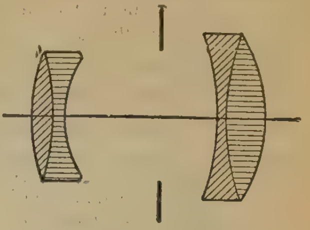


FIG. 58.—"Bis-Telar."

Captain Owen Wheeler proposed in 1907 a high-power telephoto arrangement, made by Messrs Staley, in which the negative attachment consists of three negative lenses, any single one of which can be used separately, giving magnifications of about 6, 9, and 13 diameters with a camera extension of 14 in. By combining the three a magnification of 30 diameters is attainable with the same short extension, which is a great advantage in many ways. In 1908 Messrs Zeiss issued their "Special Tele-objectives" in two sizes working at $f/10$, the larger with an aperture of 3·14 in. and 32 in. focal length fitted in a special "tele-camera" for plates 9 × 12 cm. with a monocular field glass magnifying four times as finder. The smaller one, with 18 in. focus, is adapted for hand cameras with 6 in. bellows extension. They consist of specially corrected positive and negative combination with a definite focal length and requiring a definite camera extension, and are specially suitable for balloon photography, instantaneous portraiture, &c. The theory, construction and use of telephoto lenses has been fully described by T. R. Dallmeyer in his *Telephotography*.

7. *Anachromatic Lenses.*—For large portraiture a certain amount of softness and diffusion of the image has long been recognized by artists as desirable, and in 1895 the "Dallmeyer-Bergheim Lens" was constructed with this special object. It is composed of a single uncorrected positive meniscus front lens, with a diaphragm in front of it, and an uncorrected negative meniscus back lens, and in the larger sizes it has great range of focal length on the telephotographic principle. The spherical and chromatic aberration produced by the uncorrected single lenses gives the diffusion of focus which produces the peculiarly soft and delicate effect aimed at. It is most useful for large heads and life-size studies, the great depth of focus conducing to uniformity of definition. There is no distortion, and by stopping down to about one-third perfect definition can be obtained. It works with great brilliancy, both elements being single glasses. It was the first of the anachromatic portrait lenses. Since 1903 Messrs C. Puyo and L. de Pulligny have been experimenting with various combinations of uncorrected lenses for producing the same effect in portrait and landscape photography by the diffusion of focus produced by chromatic aberration, and suitable lenses of this kind have recently been brought out in Paris as *Les Objectifs d'artiste.* In their construction the principal points to be considered are *spherical aberration*, to be minimized in the form and arrangement of the lenses selected; *distortion*, corrected by using a symmetrical system; *astigmatism*, avoided by using combinations of low power. The lenses used by Puyo have been: (1) a plano-convex crown with convex side in front at $f/8$ or $f/9$, or even $f/5$ for heads; (2) a simple thin concavo-convex meniscus, with concave side in front, is better and suitable for full lengths at $f/10$; (3) a symmetrical system formed of two similar crown menisci, concave sides inwards, is generally useful when worked at $f/10$, or even $f/5$. Arrangements are made in mounting these lenses for automatically making the necessary correction for colour. Another form is the "Adjustable Landscape Lens," formed of an anterior plano-convex crown, 3 cm. diameter, and a posterior plano-concave crown, each of 10 cm. focus, and the same radii of curvature. In contact they have an infinite focus, but when slightly separated any focus can be obtained up to about 10 cm. In such a telephotographic system, properly stopped down, anastigmatism, flatness of field, and rectilinearity are secured over a fairly large field. These lenses are fully described in *Les Objectifs d'artiste*, by L. de Pulligny and C. Puyo (Paris, 1906), and various forms, portrait and landscape, have been made by Messrs Hermagis, Turillon & Morin (see Fabre, *T. E. P. Suppl. D.* 101).

Diaphragm Apertures.—In order to regulate the intensity of the illumination by the lens, to enlarge its field, and, in the case of the older forms of objectives, to extend the area of good marginal definition, diaphragms are used, usually with circular apertures. They are made in different ways: (1) as single metal plates, fitting into a slot in the lens tube (Waterhouse diaphragms); (2) Rotatory: a single plate revolving on a central axis and pierced with apertures cut to fit centrically in the opening of the lens; (3) Iris: a form of diaphragm now very generally used, and very convenient, because it can be easily adjusted as required for intermediate apertures. As a rule they are placed at the optical centre between the elements of a compound lens or in front of a single one.

In order to provide a uniform system of diaphragm apertures, the Royal Photographic Society in 1881 drew up some rules, which were revised in 1891 and again in 1901. The former standard unit *f*/4, and the numerical notation used with it, have been abolished in favour of the unit *f*/1 established at the International Congress in Paris 1900. Intensity ratio is defined as dependent upon the effective aperture of a lens, and not upon the diameter of the diaphragm in relation to the focal length of a lens. The effective aperture of the lens is determined as follows: The lens must be focused for parallel rays. An opaque screen is then placed in the principal focal plane, and a pinhole is made in the centre of the plate (in the axis of the lens); an illuminant is placed immediately behind the pinhole itself, when the diameter of the beam emerging from the front surface of the lens may be measured. (It will be found that except in the case of the diaphragm being placed in front of the lens, the diameter of the diaphragm itself is seldom that of the effective aperture.) Every diaphragm is to be marked with its true intensity ratio as above defined, but the present intensity ratios are retained in their order of sequence: *f*/1, *f*/1·4, *f*/2, *f*/2·8, *f*/4, *f*/5·6, *f*/8, *f*/11·3, *f*/16, *f*/22·6, *f*/32, *f*/45·2, *f*/64, &c., each diaphragm requiring double the exposure required by the preceding one. In other cases apertures are to be made in uniformity with the scale, with the exception of the highest intensity, *e.g.* a lens of *f*/6·3 would be marked for *f*/6·3, *f*/8, &c. The corresponding numbers are known as *f* numbers, but are only applicable for a lens focused for distance. Other systems of notation are in use, but the above is generally adopted (see Fabre, *T.E.P. Suppl.* C. 38). Special diaphragms are in use for process work with ruled screens (see N.S. Amstutz, *Handbook of Photo-engraving*, 1907). Standards for the screws of photographic lens-flange fittings, and for the screws fitted to cameras for attachment to the stand or for fixing movable parts, have also been laid down (*Ph. Journ.* 1901, 25, p. 322).

Instantaneous Shutters.

The general use of rapid dry plates and hand cameras has rendered it necessary to have some mechanical means of regulating exposures in small fractions of a second, especially for objects in rapid motion, and this instantaneous shutter has become an essential part of modern photographic equipment in many forms and patterns, but practically three types are preferred—the between-lens shutter, the roller-blind shutters, used before or behind the lens, and the focal plane shutter, in front of and close to the plate and forming part of the back of the camera. The usual limit of rapidity of the two former is nominally about $\frac{1}{100}$ of a second, and for ordinary purposes higher speeds are seldom required, while with the latter speeds of $\frac{1}{1000}$ to $\frac{1}{2000}$ of a second may be attained.

Two important factors in the use of lens shutters are the *rapidity* or *speed*, measured by the total duration of exposure from opening to closing, and the *efficiency*, measured by the ratio of the time during which the shutter is fully open and the time occupied in opening and closing. Both factors are more or less variable, either with differences of construction, of diaphragm opening or of position of the shutter with regard to the plate and lens. In any case the *efficient* exposure is always less than the *actual*, and may be considerably so.

The rapidity required of a shutter in photographing moving objects is regulated by the minimum time necessary to produce a well-exposed image upon the plate, with a loss of definition, or blurring, by displacement not exceeding $\frac{1}{100}$, or preferably $\frac{1}{200}$ to $\frac{1}{250}$ of an inch, if enlargement is extended. This will depend on the state of the light and the illumination of the object, the relative intensity of the lens as measured by its effective aperture and focal length, the sensitiveness of the plate, and the amount of effective light passing through the shutter during the exposure. The amount of displacement to be guarded against depends upon the rate of movement of the object, the direction in which it is moving with reference to the axis of the lens, its distance from the camera, and the focal length of the lens. It will be proportionately less as the distance of the object increases, and as the rate of its motion and the focal length of the lens for a given distance decrease, and vice versa. It will be greatest when the object is moving at right angles to the axis of the lens, and least when the motion is directly towards it; but in that case there will be some increase in the apparent size of the object as it approaches the camera. For example: An object moving 1 m. an hour advances 17·6 in. per second. With a lens of 5-in. focus this would represent a displacement on the ground glass, for an object 50 ft. away, amounting to ·146 in. per second, and it would require exposures between $\frac{1}{15}$ and $\frac{1}{37}$ of a second to give maximum or minimum displacements of the image between $\frac{1}{100}$ and $\frac{1}{250}$ of an inch. An object at the same distance moving ten times as fast would require 1-10 of the above exposures. If, however, the distance be increased, the possible exposure may also be increased in the same proportion, so that the object moving 10 m. an hour at 500 ft. distance would only require the original exposures of $\frac{1}{15}$ to $\frac{1}{37}$ of a second. On the other hand, the limits of exposure for an object moving 1 m. an hour within 10 ft. of the lens would be between $\frac{1}{75}$ and $\frac{1}{185}$ of a second. This is entirely independent of the sensitiveness of the plate, and only represents the maximum duration of exposure permissible in order to reduce the blurring of the image between certain limits. The sensitiveness of the plate, and the intensity and amount of light acting upon it through the lens and shutter, ~~must~~ be adjusted so as to produce the desired photographic effect within that time. With a lens of 8 in. focal length the displacement would have increased in the first instance to ·23 in. per second, and the maximum exposure permissible would be from $\frac{1}{25}$ to $\frac{1}{57}$ of a second. This shows that there is an advantage in using short-focus lenses for very rapid exposures. In practice, most work of this kind is done upon quarter-plates ($4\frac{1}{4} \times 3\frac{1}{4}$ in.) with lenses of $4\frac{1}{2}$ to 5 in. focus. As the displacement will be greatest for an object moving at a right angle across the axis of the lens, an exposure sufficient for this case will be sufficient for any other. Sir William Abney has discussed this question practically in his *Instantaneous Photography*, and it is treated mathematically by W. B. Coventry in his *Technics of the Hand Camera*, in which will be found formulae and tables for ascertaining the distances and limiting exposures for moving objects, allowing for a blur of $\frac{1}{100}$ of an inch. In foreign treatises the limit is usually calculated for a displacement of $\frac{1}{10}$ of a millimetre, or about $\frac{1}{250}$ of an inch.

An efficient shutter should fulfil the following conditions: It should be light and compact, simple in construction and action, strongly made, and not liable to get out of order; capable of being set without admitting light into the camera; easily released with a slight pressure of the finger, if a pneumatic release is not fitted, and free from any tendency to shake the camera on release. It should open and close quickly, allowing the largest possible proportion of the exposure to be made with the full aperture, and it must not cut off any of the effective light passing through the lens, but should distribute it evenly all over the plate: though in landscape work it is an advantage to give the foreground more exposure than the sky. It should be adjustable for variable instantaneous and for prolonged or "time" exposures. With a good shutter there is less risk of shaking the camera in short "time" exposures, from $\frac{1}{4}$ to 1 second, than there is in taking off a cap. Shutters working between the lenses must permit of the use of diaphragms in the lenses, and of alterations of speed while set. Above all, a shutter must be constant in its action, giving short and variable exposures always correctly or relatively so, an important condition which cannot always be fulfilled, and the exposures marked on the indicator should be capable of being repeated with tolerable certainty. Shutters should also be adaptable for use with different lenses. Three methods of varying the speed of a shutter are in use: (1) by altering the length of the slot; (2) by the retarding action of a pneumatic brake; (3) by varying the tension of a spring. The latter is considered by W. B. Coventry as far the best. They are usually released by the pressure of the finger on the end of a lever holding the moving part in a state of tension; or better, by J. Cadett's system of pneumatic pressure, applied by means of a compressible rubber bulb and tube, which may drive a piston acting on the lever holding the shutter, or inflate a collapsible bulb at the other end of the tube and thus exert the necessary pressure on the lever. With W. Watson's "Antinous" release a flexible wire acts directly on the piston or trigger release of a cylinder shutter. It is also adapted for roller-blind, focal plane, flap, and various forms of between-lens shutters. It is durable, effective and convenient (see fig. 3). In many cases both methods can be used as desired, the mechanical release being preferable on account of its convenience and freedom from liability to shake the camera.

The following are the principal types of instantaneous shutter: (1) Flap, (2) drop, (3) combined drop and flap, (4) rotary, (5) roller blind, (6) focal plane, (7) moving blade central, (8) iris. They can be applied in four different positions: (*a*) in front of the lens; (*b*) centrally, near the diaphragm; (*c*) behind the lens (*d*) immediately in front of the sensitive plate. They all, however, come under two main classes: *Lateral*, including those in which the exposure commences and ends at the circumference of the lens aperture; and *Central*, those in which the exposure begins and ends at the centre of the aperture. Some of them are "lateral" in their single form and "central" when double. The form and position of the effective aperture of a shutter, relatively to the lens and plate, have a strong influence, either favourable or unfavourable, on the amount of effective light passing through the lens, and its even distribution over the plate. This is especially the case during the incomplete phases of opening and closing the aperture. It seems to be agreed that the best position for lens shutters of the lateral type is behind the objective, and for those of the central type, between the component lenses. In this latter position the whole of the plate is illuminated during the full period of exposure, with a gradually increasing intensity, until the full opening is reached, and then the illumination gradually falls off until the shutter is closed. The most effective shutter is one in which the first and third phases of incomplete illumination, during the opening and closing, are the shortest compared with the second phase of full opening.

With the focal plane shutters, however, different portions of the plate are exposed in succession, the lens working at its full aperture and efficiency throughout the exposure.

To secure successful results in using instantaneous shutters, the operator should make himself acquainted with the working of his shutter and its efficiency in various circumstances of exposure with the lenses, plates and developer he proposes to use; ascertaining the actual value of the various exposures marked on the indicator, and, what is more important, how far they can be depended on for regularity. There are many simple ways in which the actual time of exposure from opening to closing can be ascertained sufficiently closely for practical purposes. They depend upon the measurement of the trace left on a sensitive plate by the passage of a brightly illuminated object revolving at a known speed or falling vertically through a known distance, when photographed with different speeds of the shutter against a dark background. These, and the more elaborate methods for obtaining more accurate determinations of the shutter-exposure periods and of the corresponding effective exposures —*i.e.* showing the actual effect of the shutter through its different phases from opening to closing—have been described by Sir William Abney in the work already mentioned, by A. Londe in *La Photographie moderne* and *La Photographie instantanée*. An apparatus for testing shutters at the National Physical Laboratory was described by J. de Graaf Hunter in the *Optician*, 1906.

1. *Flap Shutters.*—The simple flap shutters consisting of a hinged flap opening upwards in front of the lens, though favourites in early days for landscape work, and still useful for intermittent exposures or as sky-shades for securing cloud effects or increasing foreground exposures, have been almost superseded by quicker and more compact forms. They are used with single and double flaps for portraiture and studio work, for which purpose they are made to act noiselessly and not attract the attention of the sitters. Guerry's (figs. 59 and 60) is a good example of the type. W. Watson's "Silent" shutter is hemispherical in form and collapsible, the two wings opening out and folding together, when actuated by a special "Antinous" release, and R. & J. Beck's is another form, a single lifting flap with pneumatic release.

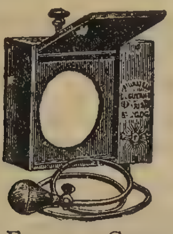


Fig. 59.—Guerry's Single-flap Shutter.

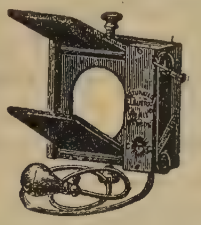


Fig. 60.—Guerry's Double-flap Shutter.

2. *Drop Shutters.*—The old simple drop shutter, in which a plate having an opening in it falls in front of the lens aperture, has been superseded by the more compact and quicker-working roller-blind shutters, which act on much the same principle. It had a theoretical interest in connexion with the effect of different forms of aperture—circular, square, or elongated—used with shutters of the lateral type, but it is now generally recognized that a more or less extended rectangular opening, of at least the full width of the lens aperture, is best for securing the even admission of light from all parts of the image with shutters of the rectilinear lateral type, to which this and similar shutters, in which a single opening passes across the lens aperture, belong. In Busch's "sky shade" shutter (1907), fitting on the front of the lens a single leaf moves vertically upwards and descends again, giving less exposure to the sky.

3. *Combined Drop and Flap Shutters.*—In early dry-plate days several forms of this kind of shutter were brought out, under the names of Phoenix, Phantom, &c., but are now little used. In these shutters, in addition to the drop slide, there was also a lifting flap, which on release opened from below, and, having fully uncovered the aperture, released the drop slide, which fell and closed the shutter. They were useful and effective in the smaller sizes, but heavy and cumbrous in the larger. Speed could only be estimated very roughly by the use of india-rubber bands for giving tension.

4. *Rotary Shutters.*—These are of the lateral type, and consist of a circular metal disk revolving on an axis eccentric to the axis of the lens, and furnished with a radial sector-shaped opening, which passes laterally in front of the lens aperture when the tension of a spring is released (fig. 61). They are used in various patterns in cheap hand cameras, usually in front of the objective, though they may be placed behind it or between the component lenses. So long as the opening is at least equal to the size of the lens aperture, the illumination is sufficiently even, but the openings are usually elongated so as to give a longer period of full opening. Working by a spring they are more portable and convenient than drop shutters. Beck's "Celverex" between-lens shutter (1906) is of this type, the disk being revolved by a spring and the variations of exposure obtained by altering the size of the opening passing over the lens aperture, and not the tension of the spring. It is speeded for exposures of $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$, $\frac{1}{80}$ sec.; also "bulb" and "time." It is fairly accurate and consistent in action, but loses efficiency at the highest speeds by the diminution of the opening.

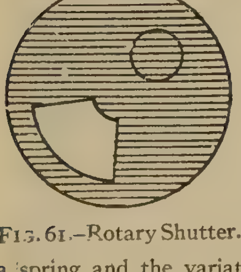


Fig. 61.—Rotary Shutter.

5. *Roller-Blind Shutters.*—For general use the well-known roller-blind shutter of the single lateral type, as made by Thornton-Pickard and others, is undoubtedly one of the most popular and efficient. It possesses most of the qualities laid down as essential to a good shutter, gives good illumination, appears to be fairly regular in its action and can be used for time or instantaneous exposures. It consists of a light mahogany or aluminium box, arranged so that it can be fitted in front of or behind the objective. It is made in different sizes, and each size can be adjusted to smaller objectives (fig. 62). It is also made with a disappearing cord, and in an improved pattern, the "Royal," all the fittings are inside the box. By pulling the cord an opaque black curtain with an elongated rectangular aperture is unrolled from the lower roller on to the upper one, and held by a coiled spring on the lower roller (fig. 63). Pressure on a pneumatic bulb inflates a second smaller bulb, raising a lever which releases the spring, and thus brings the blind down with a rapidity which can be adjusted by turning a handle actuating the spring, the corresponding speed being shown on an indicator. For time exposures, pressure on the bulb opens the shutter, and another pressure closes it, but an arrangement is now made by which time exposures of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 3 seconds can be given automatically, the pressure of the bulb opening the shutter, which closes of itself at the expiration of the exposure required. The theory of shutters of this type has been very fully discussed by Coventry (*op. cit.* p. 50), who shows that for any given tension of the spring the actual exposure decreases as the size of the lens aperture diminishes, while the effective exposure remains constant for all apertures. This is peculiar to the lateral shutter. He also shows that with plates of very different rapidities, though the exposure may be the same, the actual exposure effective is less with the rapid plate and a small stop than with the slow plate and a large stop; consequently the blur due to the movement of the object would be proportionately less on the rapid plate than on the slow one. Also that for any given lens the smaller the shutter the more rapid the exposure can be made, though with the same lens a larger shutter is capable of giving a more efficient though less rapid exposure. It is better, therefore, for moderate exposures, to have a larger shutter than the size of the lens requires. Sir William Abney had given diagrams of the action of a shutter of this kind in his book referred to; they show clearly that the centre of the plate gets more exposure than the margins; but practically this is not very noticeable, and the action is very regular.

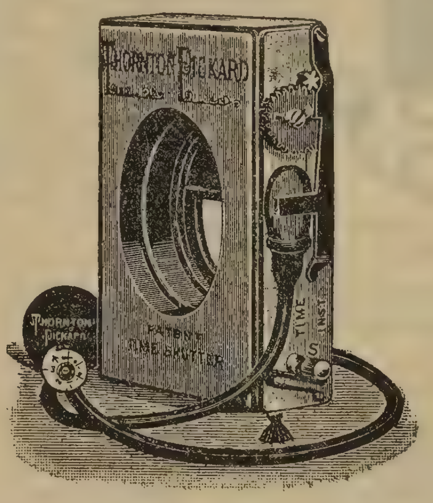


Fig. 62.—Thornton-Pickard Roller-Blind Shutter with automatic exposure appliance.

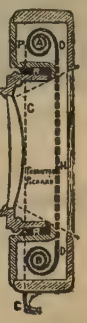


Fig. 63.—Mechanism of the Thornton-Pickard Roller-Blind Shutter.
A, Upper roller.
B, Lower roller.
C, Cord.
D, Black curtain.
H, Aperture in curtain.
R, Rubber ring adapter.

6. *Focal Plane Shutters.*—These are also roller-blind shutters with mechanism similar to the foregoing, but arranged so that the slit in the curtain may move rapidly close in front of the sensitive plate, exposing different portions of it in turn, the intensity of the exposure being regulated by the width of the slit, whether adjustable or not, and the rapidity with which it is moved by the unwinding of a spring. The advantages of these shutters are now being fully appreciated, the principal being that they are quite independent of the lens, so that one shutter will serve for different lenses, and any suitable lens may be used at its full intensity, without the loss of efficiency inherent in the ordinary forms of lens-shutters. They thus add effectively, if not actually, to the speed of a slow lens, or if a lens be stopped down there is less loss of efficiency, with a gain in increased depth and definition. They are particularly well adapted for the very short exposures required in photographing near and quickly moving objects, racing horses, divers, &c., and many reflex and other hand cameras are fitted with them. They are constructed in different forms, either for short exposures with high speeds alone, or for short and prolonged exposures; with a single slit of fixed or variable width moved at regulated speeds, or with a series of slits or openings varying in width, their speeds being adjusted by the

tensions of the springs. Thus the new Goerz-Anschütz shutter has ten tensions and nine curtain apertures, providing for ninety different speeds or exposures, ranging from $\frac{1}{10}$ to $\frac{1}{1200}$ of a second, besides autobulb exposures from $\frac{1}{2}$ to 5 seconds and time exposures (fig. 64). Most of these shutters are now provided with a self-capping device for protecting the sensitive plate during the setting of the shutter. As the slit moves progressively over the plate, if it is too narrow or moving too slowly, it may cause distortion of the images of quickly-moving objects, especially if near the camera, but with due care in regulating the width of the slit and the duration of exposure this is practically not often perceptible, especially if the slit is arranged to move in the same direction as the object.

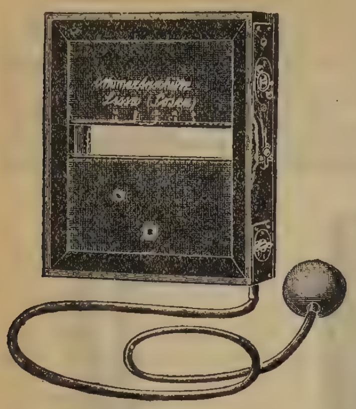


FIG. 64.—Goerz-Anschütz Focal Plane Shutter.

The theory of these shutters is discussed by Coventry (*op. cit.* p. 69), more fully by Fabre (*T. E. P. Suppl., C.* p. 128), and their practical use in *Focal Plane Photography* ("Photo-Miniature Series," No. 77, 1907).

7. *Moving Blade Central Shutters.*—These shutters, in which two thin metal or ebonite plates or opaque curtains with round or rectangular apertures, or in other cases two curved blades, pass very quickly over each other in opposite directions, are largely used in many patterns fitted between the lenses of a combination or attached to them in front or behind. Formed of two single lateral shutters opening and closing in the centre of the lens aperture, they become central, the exposure taking place during the short period in which the openings are passing each other or the curved blades opening out and closing again. To obtain the greatest efficiency the size of the openings should correspond with the full aperture of the lens. If each plate moves as fast as a drop shutter the combination gives double the speed, corresponding to half the exposure. The sensitive plate will be most evenly and strongly illuminated when the leaves of the shutter work inside the lens near the diaphragm, as in Bausch and Lomb's "Unicum" and other similar between-lens shutters, in general use (fig. 65). This necessitates the fitting of the lens to the shutter, but with adapters it is possible to fit other lenses. Some forms are, however, suitable for use in front of the lens, such as the "Constant" and Lancaster's "See-Saw" (fig. 66), while those of the double roller-blind type can be used either in front of or behind the lens, though this position is not a favourable one. In these the rectangular form of aperture is the best, circular apertures cutting off a good deal of light, as in the case of drop shutters. W. B. Coventry (*op. cit.* p. 60) has discussed the action of the double roller-blind shutter as typical of the central class of shutters, and shows that while, under similar conditions, with the lateral shutter the effective exposure is constant and the actual exposure variable at all apertures, it is the reverse with the central shutters, and it will not be so easy to calculate exposures with different sized stops. A central shutter, acting as a diaphragm of variable aperture, gives a more efficient exposure than a lateral shutter of the same dimensions, as long as the opening is greater than the lens aperture, the coefficient of illumination of the lens varying as long as the shutter opening is smaller than that of the diaphragm used. It is desirable, therefore, to increase the speed and use as large an aperture as possible, so that the diaphragm used may be entirely uncovered during the greater part of the exposure.

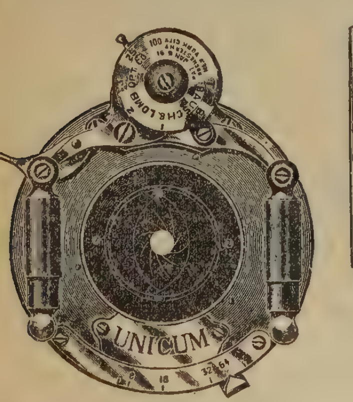


FIG. 65.—Bausch and Lomb's "Unicum" Shutter.

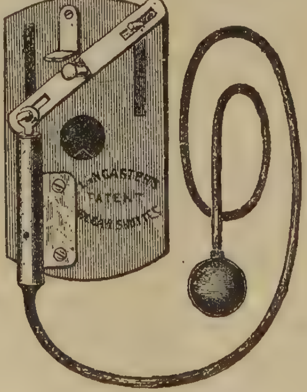


FIG. 66.—Lancaster's "See-Saw" Shutter.

8. *Iris Shutters.*—These are a further development of the double curved blade central shutters, and constructed on the principle of the "Iris" diaphragm, with several leaves opening out from the centre of the lens and closing again. They are usually fitted between the lenses of double objectives, and can be made very light and compact. Theoretically this central position of the shutter is the best, and the "Iris" is the best form for ensuring the most equal distribution of light over the plate, provided, as before, that the opening is equal to the full aperture of the lens. They are made so that the periods of opening and closing may be as short as possible compared with that of full opening. They require great care in construction and fitting to the lens, and so are expensive. They can, however, be used with convertible sets of lenses of different foci fitting the same mount. Several forms are made by British and foreign makers, with three, four or more leaves. Goerz's "Sector" shutter (fig. 67) may be taken as a type. Georgen's "Central" shutter is very light and smooth in working, and can be used in front of a lens for telephoto work. Further details regarding the different forms of shutters, theoretical and practical, will be found in the works by Abney, Coventry, Eder, Fabre and Londe.

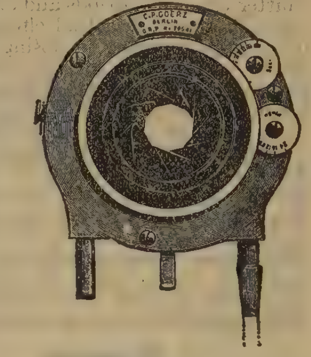


FIG. 67.—Goerz's "Sector" Shutter.

Exposure Meters.

When gelatin dry plates came into general use, and were made of many different degrees of sensitiveness, the want of a guide to the proper exposure for the various makes of plates under different conditions of lighting began to be felt, and several methods were devised for meeting it. Some of them depend solely upon data derived from observations of the action of the principal factors affecting the result, namely: (1) the speed of the plate; (2) the actinic power of the sun's light for the time of year in a given latitude and its position at the particular time of day; (3) the effective diaphragm aperture of the lens; (4) the nature of the subject and its illumination as affected by local and atmospheric conditions. With others these data are supplemented by, and practically based upon, actinometric observations of the action of the light upon sensitive paper exposed near the camera or the subject at the time. Both methods are in many cases of undoubted use, but the information given by instruments of this kind can only be considered as approximate, and much is left to the judgment of the operator, whose surest guide will be an intelligent study of the principles on which these instruments are based, together with carefully-recorded observations of the combined working of his lenses, shutters, plates and methods of development under the varying conditions of practical work. Before using any of these instruments it is necessary to know approximately the relative sensitiveness or "speed" of the plate in use. In the early days of gelatin dry plates their rapidities were stated as so many times those of wet plates, or (as they are still) "ordinary," "instantaneous," "rapid" or "extra-rapid," terms which, though suitable for one make of plate, may not be so for others. This was improved upon by the adoption, in 1878, of Leon Warnerke's "Sensitometer," which was in use as a standard for some years. It consisted of a transparent scale of 25 squares of different intensities, marked with opaque numbers and arranged so that each third number indicated a doubled rapidity. This was placed in a frame in front of the sensitive plate, and exposed for thirty seconds to the constant light emitted by a phosphorescent tablet, supplied with the instrument, which was previously excited by burning one inch of magnesium ribbon in front of it. The exposed plate was then developed and fixed, and the highest number visible indicated the rapidity of the plate. In 1890 F. Hurter and V. C. Driffield introduced an entirely new system of calculating the sensitiveness of plates of different rapidities. They make a series of exposures in seconds on different parts of the plate in geometrical progression with a standard candle at one metre distance. After development for a certain fixed period with a standard developer, fixing, washing and drying, the "densities" or logarithms of the opacities of the different parts are measured by a special photometer and plotted on a skeleton diagram, producing a curve, one portion of which will practically be a straight line. The position of this line with reference to a scale of exposures given on the diagram decides the rapidity of the plate, while its length indicates the "capacity" of the plate for the truthful rendering of tone. The elaborate investigations by which these results were obtained are of great interest, and were published in the *Journal of the Society for Chemical Industry* (1890, 1891), and later ones in the *Photographic Journal* (1898). A complete account of the system by V. C. Driffield was published in 1903, as No. 56 of the "Photo Miniature Series." The sensitiveness shown on the H. & D. scale is directly proportional to the speed number given. The method has been adopted by several dry-plate makers in denoting the sensitiveness of their different brands, and is more or less the basis on which the plate-speeds for the modern English dry-plate actinometers and exposure meters are calculated. Several systems of photometry and measurement of the speeds of dry plates have been discussed at the meetings of the *Congrès International de Photographie*, in 1889, 1891, 1900 and 1905, but no definite standard has been finally adopted. In Germany the use of J. Scheiner's sensitometer has been adopted, and appears to be extending. It is based on a system of photographing the graduated tints given by rotating sectors. A full account of the instrument, and of a system of sensitometry based on its use, is given by J. M. Eder in the *Photographische Correspondenz* (1898) p. 469, and (1900) p. 244. In 1901 Chapman Jones brought out a convenient plate-tester on the same principle as the Warnerke sensitometer, but extended by the addition of a colour sensitometer, which is useful for the comparison of orthochromatic dry plates, colour screens, light filters, &c. It consists of a screen plate, $4\frac{1}{4}\times3\frac{1}{4}$ in., containing a series of twenty-five tints of graduated densities; a series of coloured squares, blue, green, yellow and red, and a strip of neutral grey, all five being of approximately equal luminosity; a series of four squares of special pure colours, each representing a definite portion of the spectrum; also a space of line design, over which is superposed a half-tone negative. To use the instrument, a quarter-plate of the brand to be tested is exposed behind the screen for a few seconds to the light of a standard candle placed at the distance of a foot, developed, fixed and washed. An examination of the plate will show the sensitiveness, range of gradation, possible range of exposure, sensitiveness to colour, size of grain, amount of halation, and the most suitable light for development. It can be used for many other tests, and enables any brand of plates to be readily tested by the user and compared with any standard he may find convenient. In making these and similar tests, a standard developer should be allowed to act for a fixed period and at a uniform temperature (*Ph. Journ.*, 1901, 25, p. 246).

The next important factor is the actinic power of the light. It depends normally on the height of the sun for the latitude of the place at the time when the photograph is taken, and exposures in bright sunlight are found to vary approximately as the cosecant of the sun's altitude above the horizon. The light of the sun itself is practically the same at any given time and place year after year, but is liable to more or less local and temporary diminution by the amount of cloud, haze, dust, &c., present in the atmosphere at the time. It is also affected by the time of day, increasing from sunrise to noon, and then decreasing to sunset. The remaining factor is the effective diaphragm aperture of the lens in relation to its focal length. In most cases of ordinary outdoor exposures this can be taken at its normal value, but becomes smaller and increases exposure if the focal length is much increased for photographing near objects. Besides these principal factors, the nature and colour of the objects, their distance, and the amount of light received and reflected by them under various atmospheric conditions, have a great influence on the exposure required. W. B. Coventry has shown (*op. cit.* p. 75) how the "light coefficient L," for full sunlight, can be found, and has given a table of values of L for the latitude of London for every hour of the day in periods of ten days throughout the year, also the relative coefficients for "diffused light," "cloudy," "dull" and "very dull." Tables of exposures for different subjects under varying conditions of light have been published by W. K. Burton, A. S. Platts, F. W. Mills, Sir D. Salomons and others, and in preparing them Dr J. A. Scott's tables, showing monthly and daily variations of light for countries about N. lat. 53°, are generally used. The more modern tables, such as are published in the printed "exposure notebooks," also take into account the plate speeds, but unfortunately there is no uniform standard of plate speeds, owing to the difficulty of fixing a definite standard of light. The subject is fully treated in the *British Journal Almanac* (1901), p. 675, the *Watkins Manual*, H. Boursault's *Calcul du temps de pose en photographie*, and similar works by A. de la Baume Pluvinel, G. de C. d'Espinassoux and others.

Based on the same principle as these exposure tables, various portable exposure meters have been brought out, in which scales representing the coefficients for plate-speed, light and diaphragm are arranged as in a slide rule, so that, when properly set, the normal exposure required can be found by inspection, and increased or diminished according to circumstances. In Hurter and Driffield's "Actinograph" the light coefficient is given by a printed card showing the curves for every day in the year and for every hour of the day, the unit being the $\frac{1}{100}$ part of the brightest possible diffused daylight when the altitude of the sun is 90°. The "lens" scale shows the ratios of aperture to focal length in general use, and is calculated for single, double and triple systems of lenses. The "speed" scale is based on the exposure in seconds which with one actinograph degree of light will produce a perfect negative of an ordinary landscape. An additional scale is given for five different degrees of illumination—"very bright," "bright," "mean," "dull," "very dull." A table of factors for "views," "portraiture," "interiors," "copying," is also given, and these regulate the figure to be taken for the exposure. The scales are engraved on boxwood, and there are two sliding pieces (fig. 68). It is specially adapted for use with plates of speed numbers agreeing with the H. & D. scale, but can be used with any plate of which the relative speed number is known. Convenient exposure meters have been made since 1890 by A. Watkins, of Hereford, in different forms based upon an actinometrical test of the light at the time of exposure. In the complete "Standard Meter" (1890) scales corresponding to "speed of plate," "diaphragm *f* numbers," "light," "subject" and "enlarging," marked P. D. A. S. and E., are arranged on rings adjustable round a cylinder. The plate-speeds are taken from a table and the "light coefficient," or "actinometer number," is ascertained at the time by exposing a piece of sensitive paper in the actinometer at the end of the instrument for the number of seconds required to match a fixed tint as shown by an attached pendulum. Many improvements have been made in it and the latest pattern (1908) is made in magnalium (fig. 69). The "Dial" meter (1901) is a simpler form in a circular metal case with four apertures marked "plate," "stop," "act" and "exp." above the corresponding scales, and an actinometer for testing the light. The numbers showing the speed of the plate in use, the *f* value of the diaphragm, and the actinometer exposure in seconds are brought into the respective apertures and the exposure required is read off in the "exposure" aperture. An "indoor meter" is also made, and a "hand camera calculator" for use with the "Standard" or "Bee" meters. The "Queen Bee" and "Bee" meters (1903) are later, smaller and more convenient patterns which have superseded the "Dial" meter and have the plate numbers and exposures marked round the case, and the scales of "*f* numbers" and "light" on a revolving glass plate. This is revolved till the *f* number on the right is opposite the speed number of the plate; opposite the "actinometer number" on the left, found as above, will be found the exposure in seconds (fig. 70). The "Queen Bee" meter is similar to the "Bee," but of better construction and fitted with a pendulum.

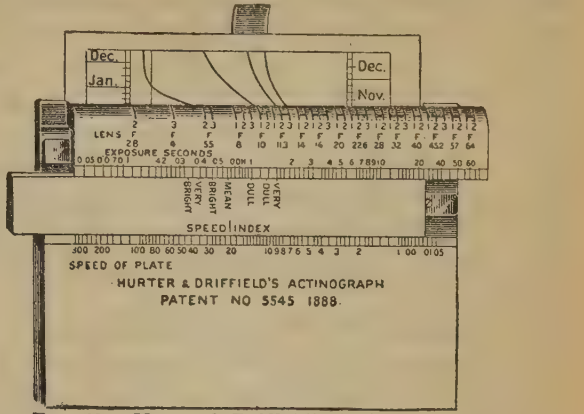


FIG. 68.—Hurter & Driffield's Actinograph.

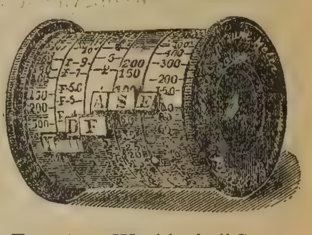


FIG. 69.—Watkins's "Standard" Meter.

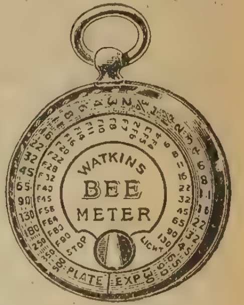


FIG. 70.—The Watkins's "Bee" Meter.

G. F. Wynne's "Infallible" exposure meter (1893) is also in dial form, but the sensitive paper is exposed directly, no pendulum is used, and the scales are open on the dial. In use, the glass carrying the movable scale is turned until the actinometer time in seconds upon the exposure scale is opposite the diaphragm number of the plate, as given in the list of plate speeds; the correct exposure will then be found against each stop given on the scale. There are practically only two scales: the scale of diaphragms representing the diaphragm apertures or *f* numbers, the speed of plate and the variation of exposure due to subject; and the time scale, representing the actinometer time and the exposure (fig. 71). The actinometer is protected by a yellow glass screen when not in use. In a smaller form the scales are on the

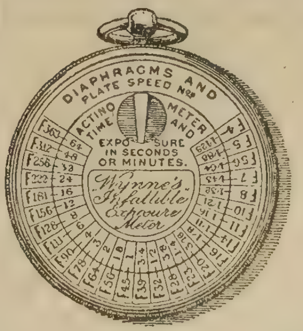

DIAPHRAGMS AND PLATE SPEED NOS
ACTINO TIME
METER TIME
EXPOSURE IN SECONDS OR MINUTES.
Wynne's Infallible Exposure Meter

FIG. 71.—Wynne's "Infallible" Exposure Meter.

circumference of a locket, and the actinometer at the back. An "Infallible" Printmeter is also made for showing exposures in contact printing on sensitive papers, but can also be used for testing speeds of plates and papers. Beck's "Zambex" Exposure Meter gives the exposure and stop to be used, also the depth of focus to be obtained with different diaphragm apertures. The required exposure is set to the "speed" number on the next scale of the meter. The third scale corresponds to the times of darkening the sensitive paper in the actinometer attached to the meter, and shows the diaphragm aperture suitable for the given exposure. Other scales show the distances that will be in focus with the different stops used, arranged so that the focal depth of four different lenses can be found. Several other exposure meters are made on the principle of the slide rule, with scale corresponding to the factors of "plate speed," "diaphragm number," "light," "subject," "exposure," and the exposure is found by simple inspection without an actinometer. They are designed for use with particular brands of plates, but can be used for others of similar speeds.

Another class of exposure meters comprises those in which the intensity of the light is estimated visually by extinction through a semi-transparent medium of increasing intensity, such as J. Découdun's (1888), in which the exposure is judged by the disappearance of a series of small clear openings on a graduated scale of densities when laid on the most important part of the image as seen on the ground-glass. Its indications are not very definite, and the paper scale changes in density after a time. A better form is "E. Degen's Normal Photometer" (1903), consisting of two sliding violet glass prisms, one adjusted for the diaphragm apertures, the other for the actinic illumination of the object. They are mounted with their outer faces parallel. In use the upper slide with prism is drawn out so that the pointer coincides with the division indicating the diaphragm aperture to be used; the object to be photographed is then viewed directly through openings at one end of the instrument, and the lower slide is drawn out and pushed back slowly till the object viewed is almost obscured. The attached pointer will then indicate the exposure required, or, reversing the order, the diaphragm aperture for a given exposure can be found. Auxiliary scales are attached for very short or very long exposures. The principle of construction is that the logarithms of the times of exposure are proportional to the thickness of the coloured prisms. "G. Heyde's Actino-Photometer" (1906) is on a somewhat similar principle, and consists of a circular metal box with dark violet glass viewing screens in the centre of both sides, with an obscuring iris inside the case worked by revolving the back of the box. On the front of the instrument exposure tables are given for plates of every rapidity, and for diaphragm apertures from *f*/3 to *f*/45. Exposure meters of this type are specially applicable for open-air work where there is sufficient light for ready measurement. Other simple actinometers are in use for carbon and process printing, consisting generally of translucent graduated scales in different densities of paper, coloured gelatin, &c., or of a photographed scale graduated by increasing exposures. The "Burton actinometer," for pigment printing, made on this principle, contains several small negatives of different densities, one of which is selected of equal depth to the one to be printed, and the progress of the printing is estimated by exposing a piece of sensitive paper under it and examining it from time to time.

SENSITIVE PLATES, FILMS AND PAPERS

Sensitive Dry Plates.—A special feature of modern photography is the use of trustworthy ready-prepared sensitive dry plates and films in different grades of sensitiveness, so that there is no necessity for the photographer to prepare his own plates, nor, indeed, could he do so with any advantage. The practice of outdoor and studio photography has thus been very greatly simplified; and although with wet collodion there was the advantage of seeing the results at once and retaking a picture if necessary, the uncertainties connected with the use of the silver bath and collodion, and the amount of cumbrous apparatus necessary for preparing and developing the plates, far outweighed it. There is also an enormous saving of time, in using dry plates as compared with wet, by deferring development. In tropical climates, also, dry plates can be used when work with wet plates would be impossible. On the other hand, the uncertainty of more or less random exposures on ready-prepared plates must not be overlooked. Besides their use in taking negatives, gelatin dry plates are also largely used for printing transparencies, lantern slides, enlargements, &c. For negative work they are prepared with an emulsion in gelatin of silver bromide, alone or with the addition of silver iodide or chloride, and are to be obtained in five or six degrees of rapidity: "slow," for photomechanical or "process" work; "ordinary," for general purposes when quick exposures are not required; "rapid," for landscape and portraits; "extra rapid," for instantaneous exposures; and "double extra rapid," for very quick snapshot work in dull weather or for special subjects. These latter kinds are exceedingly sensitive, and require great care in use to avoid fog. In order to prevent halation, or irregular action by reflection from the back surface of the glass, dry plates are coated with a non-actinic "backing," which can easily be removed before development.

Self-developing dry plates were introduced in 1906, in which the developing agent is mixed in the film itself, as in the Ilford "Amauto" plate, which only requires immersion in a solution of washing soda for development, or, as in the Wellington "Watalu" plates, applied on the back of the plate, plain water only being required for development, this application also preventing halation. The slow plates used for printing lantern slides and transparencies are usually prepared with an emulsion of silver chloride with or without free silver nitrate and other haloids.

The rendering of photographic plates isochromatic or sensitive to all colours by dyeing them with eosin, or other suitable dyes, has been greatly improved by the use of new dyes, especially those of the isocyanin group, prepared by Dr E. König of the Hoechst factory, and known as "orthochrom T," "dicyanin," "pinaverdol," "pinachrom" and "pinacyanol," the latter of which can confer on a silver bromide plate as high a degree of sensitiveness for red as erythrosin does for yellow; also F. Bayer's "Homocol," Dr A. Miethe's "ethyl red," and other similar dyes (see *E. Jb.*, 1905, pp. 183, 336). Panchromatic plates are now largely manufactured and used for all photographic work in which a true rendering of the relative colour luminosities is essential, and more particularly for the various methods of colour reproduction in which plates are required to be sensitive to red, green and blue-violet. They are made in different degrees of general and colour sensitiveness, according to the purpose for which they are required, the ordinary "isochromatic" being most sensitive for yellow and green, and the "panchromatic" for red, orange and yellow, as well as for green, blue and violet. To obtain the best results from all these plates it is necessary to screen off the blue and violet rays with yellow or orange transparent screens, or colour filters, made of coloured glass, or glass coated with coloured gelatin, collodion, &c., or with glass cells containing solutions of suitable dyes or salts. For the various processes of three-colour reproduction panchromatic plates and special red, green and blue-violet filters have to be used for taking the three negatives, their intensities and absorptions being carefully adjusted to the particular plates in use; the same applies, but less strictly, to the yellow screens used with ordinary isochromatic plates. Dyes specially suitable for these colour-filters have been prepared by Dr E. König. Various kinds of colour screens for ordinary, microscopic and trichromatic work are made commercially, and Messrs Schott of Jena make a special yellow glass in three tints for the purpose.

Plates for Colour Photography.—In 1868 Louis Ducos du Hauron, among various trichromatic methods patented for photographically reproducing coloured objects in the colours of nature, described one in which the trichromatic principle, instead of being carried out on three separate plates, was to be combined in one plate by means of a transparent medium covered by a trichromatic screen divided into narrow juxtaposed lines or minute spaces, corresponding to the three primary colours, red, green and blue-violet, the transparent colour of each of these lines or spaces acting as a colour filter. A sensitive panchromatic plate was to be exposed in contact with this screen to produce a negative with lines or spots corresponding to the relative strength of the three coloured lights passing through it, so that a diapositive print on glass properly registered with the tricolour screen would show the object in its proper colours. This method could not be carried out successfully for want of efficient panchromatic plates and other difficulties.

Between 1892 and 1898 several patents were taken out by J. W. McDonough and J. Joly for various methods of preparing trichromatic ruled screens (*Ph. Journ.*, 1900, p. 191). The Joly method was fairly successful in action, but had several disadvantages owing to the coarseness of the lines, the necessity for having two screens, one for taking and another for viewing, and the cost of making them (*B. J. A.*, 1899, p. 671). The "Florence" chromatic plate (1905), worked out in America by J. H. Powrie and Florence M. Warner, was an improvement on the Joly method, the colour screen being photographically printed on a glass plate, coated with panchromatic emulsion and exposed to the coloured object through the screen (*Penrose Pictorial Annual*, 1905–1906, p. 111). Some good results were produced, but it has not come into use.

After several years of laborious research, Messrs Lumière, of Lyons, adopting Ducos du Hauron's coloured grain method, succeeded where he had failed, and in 1907 brought out their "Autochrome" plates, in a very complete and practical form, making it possible to produce photographs in the colour of natural objects by one exposure instead of three, as in the ordinary three-colour processes. Glass plates are coated with an adhesive medium over which is spread a mixture of potato starch grains, of microscopic fineness, stained violet, green and orange, the interstices being filled in with fine carbon powder to form a tricolour screen, dark by reflected and of a pinkish, pearly appearance by transmitted light. This is varnished and coated with a thin sensitive panchromatic emulsion of gelatino-silver bromide. The plates are exposed in the camera from the back, through the tricolour films, using also a special compensating orange-yellow screen, before or behind the lens, then developed as usual, producing a negative coloured image in the complementary colours, which is then treated and reversed so as to produce a positive coloured image by transmission, showing the picture in its proper colours. The results thus obtained are remarkably good and practically solve the problem of direct colour photography in a simple and fairly inexpensive manner (see *Agenda Lumière*, 1909).

In C. L. Finlay's "Thames" colour plate (1908) the tricolour screen is formed by rows of circular dots coloured alternately orange-red and green and the intermediate spaces blue. It is used alone, the coated surface being placed in contact with a panchromatic plate, the uncoated side towards the lens. It carries register marks for adjusting it to the finished picture after development and reversal of the image. These screens, being more transparent than the "Autochrome," require less exposure, but the colour rendering is not so perfect. In the Jougla "Omnicolore" plate (1909) the tricolour screen and sensitive surface are combined on one plate as in the "Autochrome," but the screen is made up of a series of blue-violet parallel lines, with intermediate alternate broken lines of orange-red and yellowish-green at right angles to them, the red narrower than the green. The relative sizes of the coloured dots in the three plates are approximately:—

"Autochrome" starch grains .	$\frac{1}{2800}$ to $\frac{1}{3750}$ in.
"Thames" plate, dots, diameter . .	$\frac{1}{840}$ "
"Omnicolore" plates, blue line . .	$\frac{1}{400}$ "
" " red square . .	$\frac{1}{800}$ "

E. Fenske's "Aurora" plate (1909) is a tricolour screen formed by coating a glass plate with a mixture of finely divided particles of gelatin, dyed orange-red, green and blue-violet, without any intervening spaces. The grain generally is coarser and more irregular than in the "Autochrome" plates, but optically corresponds more closely to them than the "Thames" or "Omnicolore" screens do. These plates are issued uncoated for use with any suitable panchromatic plate. A later process is due to Dufay. With the exception of the "Autochrome," these processes are still more or less in the experimental stage.

Celluloid Films.—In order to avoid the weight of glass plates, which may become burdensome on a tour, and also the risk of breakage of valuable records, thin films or sheets of celluloid coated with sensitive emulsions can be used, with great saving of bulk and weight and no loss of efficiency, though such films are sometimes liable to deterioration by long keeping before or after exposure. They are made in two thicknesses, stiff or flexible, the stiff being used exactly as plates, but held in a carrier or simply backed with a card or glass plate, while the flexible are made up in separate sheaths with cardboard backing, as in the "Kodoid" films, or in convenient packages of twelve or more in "film packs" of various patterns. Flexible films of this kind on celluloid have for many years past also been prepared in long strips of different widths suitable for use in hand cameras of the Kodak types and in roll-holders. In the early forms of roll-holders the films were used alone, and being unprotected had to be changed in the dark room, but, as already stated, they are now supplied on spools in cartridges which can be changed in daylight. C. Silvy seems to have been the first to employ this method in 1870. In these cartridges the film is attached to a much longer strip of black paper, and rolled up with it, so that several turns of the paper have to be unrolled before the film is ready for exposure, this point being marked on the outside paper for the successive exposures, with numbers visible through a red screen at the back of the holder. When all have been exposed, the black paper is rolled on for several turns, and when taken out of the holder the loose end is fastened up till the film is developed. As these films are principally used for landscape work, it is now usual to make them isochromatic, and they may be used with or without a yellow screen. They are also made "non-curling" by being coated with gelatin on both sides. Negatives taken on these thin films have the advantage that they can be printed from either side without perceptible loss of definition, which is useful in printing by the single transfer carbon process, and in some of the photo-mechanical printing methods. Flexible transparent films in sheets and rolls have also been prepared upon hardened gelatin, but it is difficult to retain the original dimensions of the film owing to expansion of the gelatin. Paper coated with sensitive emulsions has been successfully used for making negatives in the same way as the celluloid films, and is cheaper, but much more liable to deterioration from atmospheric action before and after exposure, and unless developed soon after exposure the impressed images may fade and become undevelopable. Such papers are, however, still used in meteorological and other self-recording instruments. Stripping films of thin celluloid upon a paper support were introduced by Messrs Wellington and Ward, and had advantages for printing from either side, but are not now made.

Photographic Printing Papers.—*Pari passu* with the supply of ready-prepared plates, all kinds of photographic printing papers can now be obtained ready for use, so that the photographer has nothing to do with the preparation of his sensitive plates or papers. The old albuminized papers have been generally superseded by ready-prepared sensitive papers coated by machinery with emulsions of silver haloids in gelatin, with or without citrate or other organic silver salts, the chloride being used for most of the "P.O.P." or "printing out papers," which contain more or less free silver nitrate, and in the "self-toning" papers some salt of gold. Some of these printing out papers are also made with emulsions of silver chloride in collodion, and known as "C.C." or "collodiochloride." The basis of most of the developable bromide papers used for enlargements and direct copying, containing no free silver nitrate, and with which an invisible image is brought out by development, much in the same way as with dry plates, is silver bromide. These papers are made in great variety of tints and surfaces, "smooth" and "rough," "glossy" and "matt," for producing different effects. They are largely used for direct printing by artificial light or daylight, for enlargements, and for printing photographic post-cards, &c., in large numbers by machinery, the prints being made on a long band with an almost instantaneous exposure, and developed and fixed by being passed through the proper solutions on large rollers or otherwise. Papers for the platinotype processes, sensitized with salts of platinum and iron, are also manufactured for printing out entirely or for development with potassic oxalate. Prints on these papers have the advantage of being permanent.

Messrs York Schwartz and J. Mallabar's process of developing and toning prints made on a special sensitive paper prepared with an emulsion of silver phosphate was introduced by Messrs Houghton in 1908 under the name of "Ensyna." Very short exposures to day or artificial light are required, and with a special developer ("Ensynoid") permanent prints are obtained with a varied scale of tones similar to those given by toning with gold, the colour of the print being determined by the exposure, short exposures giving purple and long exposures brown or reddish tones. The process is a rapid one, the operations of printing, developing, fixing and washing being completed within about ten minutes or even less.

For the various methods of printing in permanent pigments ("Autotype," &c.) tissues are prepared coated with pigmented gelatin in various colours, and very successful results in colour photography have been obtained by printing from suitable negatives in three colours with specially prepared yellow, blue and pink tissues. Similar papers, prepared with pigmented gum instead of gelatin, are used in the "gum bichromate" process, and "single transfer" papers, coated with plain gelatin, are used in the pigment printing processes to receive the developed print, and are also useful for photo-lithography, the new "oil-printing" methods, and in trichromatic printing on paper by the Sanger-Shepherd method and Dr König's "Pinatype." For Manly's "Ozotype" and "Ozobrome" processes special gelatinized and pigmented papers are made. "Cyanotype" and "Ferrogallic" papers are prepared for the use of architects, engineers, &c., in rolls of considerable width, for the direct reproduction of tracings and drawings as blue or black prints by these and similar methods.

Apparatus for Development.—The recognition of the fact that the two principal factors in the development of modern photographic dry plates with a suitable developer are time and temperature, and also that a prolonged immersion in dilute solutions is in many cases a more convenient and equally efficient method of development, has led to the construction of apparatus for enabling the operation to be carried out almost automatically and for timing its duration.

In 1894 A. Watkins brought out his factorial system of development based on the principle "that with a correct exposure on a given plate with a given developing agent, the time of development required for a given printing opacity has a fixed arithmetical ratio to the time of appearance of the high lights of the image, provided the developing power of the solution remains constant during development; and this rule holds good for all variations of strength, amount of alkali or bromide, and temperature within those limits which have been found safe in practice" (*Photo. News*, 1894, 38, pp. 115, 729; and further, *Ph. Journ.*, 1900, 24, p. 221). By a series of observations he ascertained the multiplying factors of most of the developers in ordinary use, and in 1905 brought out his "factorial calculator" and a "dark-room clock" for facilitating the working of the method. The former is made of aluminium, and consists of two circular disks, the upper smaller one rotating and carrying a pointer. The outer disk is marked with a scale of Watkins' factors for the different developers, as given in the "instructions" accompanying the instrument, and is used to denote the "time of development" in minutes. The scale on the inner disk shows the "time of appearance" in seconds or minutes. In use the pointer is set to the factor for the developer in use, and against the "time of appearance" on the inner scale will be found the total number of minutes required for complete development (fig. 72).

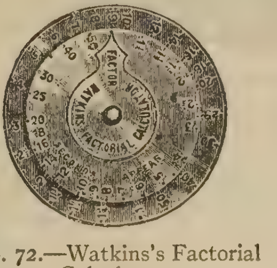


FIG. 72.—Watkins's Factorial Calculator.

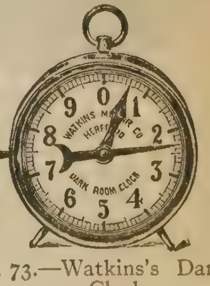


FIG. 73.—Watkins's Dark-room Clock.

The "calculator" can be used with any ordinary clock or watch, but the "dark-room clock" (fig. 73) has been specially constructed for the factorial system. It is an improvement on the earlier forms of Watkins' "Eikronometer," and has a 4 in. dial with 10 minute and 100 seconds divisions, very plain for dark rooms, centre seconds hand, stop action and outside indicator to mark the completed time. The seconds hand completes the revolution in 100 seconds, while the minute hand does so in 10 minutes, or sufficient for the longest ordinary development, though it runs on, if necessary, very much longer, both hands starting together always at O.

In 1908 Watkins brought out another system of "thermo-development" by time dependent on the use of a *standard* "time developer," the duration of the development, at a given temperature, being modified according to the make and speed of the particular plate in use. The temperature variations are indicated by a movable scale, or "thermo-calculator," on the bottle of developer, the variations for development speed of various plates being given approximately on the "Watkins' Plate Speed List," which thus shows the "speed of plate" and "speed of development" with the standard developer at 60°. This method is well adapted for plates, films and stand development in tanks or machines, no observation of the plate being required, and the times are most conveniently observed with the "dark-room clock." Full details of these two distinct methods of development will be found in the 4th edition of the *Watkins' Manual of Exposure and Development.*

C. W. Piper's "photographer's stop clock" (1906) is a more elaborate clock, intended for use not only in "time development" but for all photographic operations in which accurate control in regard to time is of importance. It is fitted with a gong and arranged to work by "time" or "bulb." Once started, by pressure on a lever or on the bulb, it will continue to go until stopped, striking the gong at the completion of every minute, when the seconds hand reaches the zero point. A second pressure on the bulb stops the clock, so long as the pressure is continued, while pressure on a lever stops it permanently. It is thus useful for timing any intermittent operations, whilst the clock adds up the separate times and prevents the occurrence of errors difficult to avoid when timing with an ordinary watch. By an additional attachment a prolonged time exposure with the camera may be terminated, or an "instantaneous" or short "time" exposure given at any prearranged time. Messrs Houghton's "Ensign" clock for time development has a dial with 60 divisions, a single hand, and is fitted with a gong. It can be set to ring an alarm bell at the expiration of any period from one minute to one hour, can be started or stopped immediately and is easily read in the dark-room. It requires no winding up, the action of setting providing the tension for the recording movements. It can be stopped and started at will and the bell arranged to give a short or prolonged ring. S. Stanley's is another convenient form, with a 4½ in. dial, divided into 60 seconds and 60 minutes, the thick hand recording the seconds and the thin hand the minutes.

Several forms of developing tanks and machines have been constructed for developing a number of exposed plates, together with ordinary or dilute developers, with the aid of the factorial system or independently of it. The Kodak "Automatic Developing Tank" (1905) is a useful arrangement by which bands of exposed roll films can be developed in daylight, without any need of a dark-room (fig. 74). The exposed film is wound from the spool into a red celluloid apron contained in a box A, then placed in the tank B, where it is left in a dilute developer for about twenty minutes, and requires no attention. It gives very good results. For the "Brownie" films a special daylight developing box is made. With the Kodak "Eastman Plate-developing Tank" (1908) the exposed plates are removed, in the dark-room, from the plate holders and placed, in pairs back to back, in a special framework holding six pairs, which is lowered into a metal tank containing the developer, and is fitted with a watertight lid so that it can be inverted during development. A clock face, with pointer, by which the period of development may be noted is fitted outside the tank. Another apparatus of the kind is made for developing celluloid films exposed in the "Premo Film Packs" (fig. 75). Other forms are made, and in some the fixing and washing can also be effected. These tanks undoubtedly save much time and trouble in developing a large number of exposed plates or films, and have been found to work with efficiency and regularity. Eastman Kodak Co. brought out in 1907 a machine for developing paper prints on bromide or gaslight papers.

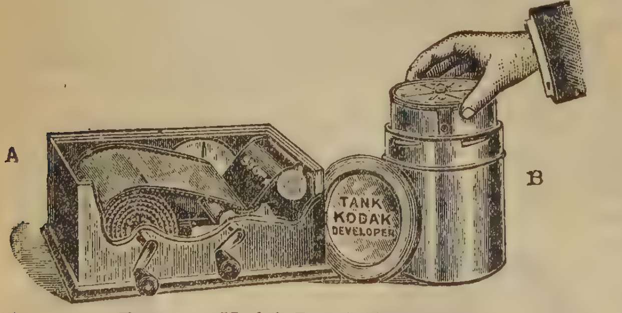


FIG. 74.—Kodak Developing Tank.

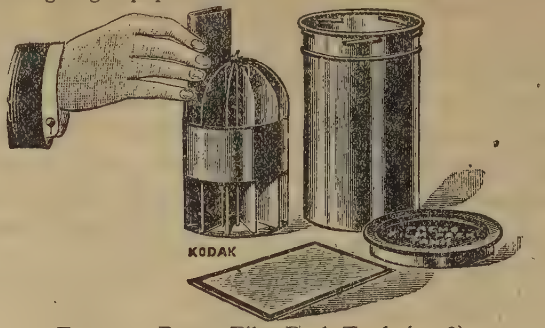


FIG. 75.—Premo Film Pack Tank (1908).

PHOTOGRAPHIC PRINTING APPARATUS

For ordinary printing purposes pressure frames, with or without glass fronts, are used for holding the negative and sensitive paper in close contact during exposure to light. They are fitted with hinged backs enabling the progress of the printing to be seen. The pressure is usually given with springs or with screws or wedges acting on the back. They are made in different kinds shown in the dealers' catalogues. For copying large tracings and engineers' drawings by the cyanotype and similar processes large glazed frames are used, mounted on a stand with axle, so that they may be easily turned over for refilling or fixed at a suitable angle to the light. The pressure is given by an elastic cushion or vacuum arrangement, by which air is pumped out from under an india-rubber sheet covering the back of the frame, thus securing a perfectly uniform pressure of about 14 ℔ to the square inch without strain on the front glass. Such frames are also useful for various photo-mechanical printing processes with large negatives or metal plates.

For rapid printing of post-card and other negatives up to 8½ × 6½ in. a handy and simple apparatus the "Rapide" has been brought out, consisting of a lantern fitted for oil, gas or electric light, with a sloping front, in which a special printing frame is fixed and arranged so that the prints can be rapidly exposed one after another (*B. J. A.* 1909), p. 691. In another form arrangements are made for exposing a large number of printing frames on a suitable stand, in one or two tiers round a central arc lamp, which may be provided, as in the "Westminster" revolving printing frame, with a shade to protect the eyes of the operator when examining the prints or changing the frames.

For printing tracings, &c., in long rolls, cylinder and rotatory machines of various types are used, so that the tracing and sensitive paper may be drawn together at a regulated speed in close contact round a glass cylindrical surface within which electric arc or mercury vapour lamps supply the source of light. Several machines of this kind are described in Eder's *Jahrbuch* for 1908, also in the patent records and photographic journals.

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III.—Pictorial Photography

Pictorial photography differs from other branches of photographic practice in the motive by which it is prompted. Employing the same methods and tools, it seeks to use photographic processes as a means of personal artistic expression. Thus in the early days of Fox Talbot's calotype, about 1846, David Octavius Hill, a successful Scottish painter, took up this method of portrayal, and, guided by an artist's knowledge and taste, and unfettered by photographic convention, which indeed had then scarcely begun to grow, produced portraits which for genuine pictorial quality have perhaps never been surpassed, especially if some allowance be made for the necessary imperfections of the "Talbotype" (see Plate II). Whether they were in their day typical examples of Talbotype with all the latest improvements, Hill probably never cared. When, again, a few years later, Sir William J. Newton, the eminent miniature painter, read a paper before the newly formed Photographic Society of Great Britain (now the Royal Photographic Society), his recommendation to depart from the custom of defining everything with excessive sharpness caused his address to be almost epoch-making. "I do not conceive it to be necessary or desirable," he said, "for an artist to represent, or aim at, the attainment of every minute detail, but to endeavour at producing a broad and general effect. . . . I do not consider that the whole of the subject should be what is called 'in focus'; on the contrary, I have found in many instances that the object is better obtained by the whole subject being a little out of focus." The doctrine has been persistently repeated ever since, but only within the last decade of the 19th century was the suppression or diffusion of focus received by photographers generally with anything better than ridicule or contempt, because it was unorthodox. O. G. Rejlander, Mrs Julia Margaret Cameron, H. P. Robinson, and others, by precept or practice, strove against such photographic conventions as had arisen out of those technical exigencies to which pictorial qualities were so often sacrificed. As late as 1868, in the *Manual of Photographic Manipulation*, by Lake Price, the old advice to arrange a group of persons in crescent form, so as to adapt the subject to the curve of the field of the lens, was repeated with the additional recommendation of plotting out on the ground beforehand the "curve of the focus" as a guide. As a defiance of this dictum, Rejlander, in 1869, produced a group of the members of the Solar Club in which some of the chief figures were set widely out of the "curve of the focus." The mere technical difficulties of this performance with wet collodion plates, and in an ordinary upper room, need not be touched upon here, but it is to be noted as one of those triumphant departures from convention which have marked the progressive stages of pictorial photography. At about the same period, Mrs Cameron, carrying the recommendation of "a little out of focus" rather further, regardless of how her lens was intended to be used by its maker, secured the rendering dictated by her own taste and judgment, with the result that many of her portraits, such as those of Tennyson, Carlyle, &c., are still in their way unsurpassed. Contemporaneously, Adam Salomon, a talented sculptor, "sunned" down the too garish lights of his photographic prints, and strengthened the high lights by working on the back of the negative.

But, during the concluding quarter of the 19th century, probably the most powerful influence in pictorial photography was that of H. P. Robinson, who died in February 1901, and, but for a brief period about the year 1875, was one of the most prolific "picture makers." Inspired by Rejlander, of whom he was a contemporary, Robinson will perhaps be best remembered by his earlier advocacy of combination printing. As early as 1855 Berwick and Annan exhibited a photograph which was the result of printing from more than one negative, a figure from one plate being cunningly introduced into a landscape print from another. Then came from Rejlander "The Two Ways of Life," in which, with wonderful ingenuity, thirty different negatives were combined. Robinson followed, and between 1858 and 1887 exhibited numerous examples of combination-printing, one of the most popular and fairly typical examples being "Carolling" (see Plate II), which received a medal in the exhibition of the Royal Photographic Society in 1887.

Though in this combination-printing one may perhaps perceive the germ of incentive towards the production of special effects not seen in the original, yet the practice was not destined to become very popular, for even in the most capable hands there remains the difficulty, if not impossibility, of fitting a portion of one negative into a print from another and still preserving true relative tonality, and even true proportion. Skilfully produced, eminently popular in character though "Carolling" may be, such errors are not absent. Of this combination-printing Dr P. H. Emerson has said: "Cloud printing is the simplest form of combination-printing, and the only one admissible when we are considering artistic work. Rejlander, however, in the early days of photography, tried to make pictures by combination-printing. This process is really what many of us practised in the nursery, that is, cutting out figures and pasting them into white spaces left for that purpose in the picture-book. With all the care in the world the very best artist living could not do this satisfactorily. Nature is so subtle that it is impossible to do this sort of patchwork and represent her. Even if the greater truths be registered, the lesser truths, still important, cannot be obtained, and the softness of outline is easily lost. The relation of the figure to the landscape can never be truly represented in this manner, for all subtle modelling of the contour of the figure is lost."

Pictorial photography received a large accession of votaries in consequence of the greater facilities offered by the introduction of the gelatino-bromide, or dry-plate, process, which, although dating from 1880, did not notably affect photographic communities until some years afterwards; and although improvement in appliances and instruments had little to do with the advance of the pictorial side of photography, yet, indirectly at least, the dry-plate and the platinotype printing process have had an undoubted effect. The former gave enormously increased facility, and dispensed with tedious manipulations and chemical knowledge, while its increased light-sensitiveness decreased the limitations as to subjects and effects. The platinotype process was discovered in 1874–1880 by W. Willis, who employed his chemical skill and knowledge to give the world a printing process more likely than the hitherto prevalent silver papers to satisfy artistic requirements.

Up to 1882 but few outdoor photographers had ventured to run counter to the general dictum that photographs should only be taken during sunshine or good bright light, and unquestioning consent would have been given everywhere to the proposition that it would be absurd to work when anything like fog or atmospheric haze was present. Isochromatic plates, introduced for the purpose of equalizing the actinic power of various colour luminosities, and so rendering colours in correct relative value, were recommended by one writer, who applauded their supposed advantage of enabling the photographer to photograph distance without any suggestion of atmosphere. That evening or morning haze might enhance the beauty of a landscape, or that the mystery of half-concealment might itself be beautiful, does not seem to have occurred to the photographer, who had become infatuated by the exquisite clearness and sharpness which, with a minimum of labour, he was able to achieve. It is therefore interesting to note one of the first photographic successes which broke away from this convention, just as Rejlander's Solar Club group defied the formula of arranging human figures like the tiers of an amphitheatre. William M'Leish, of Darlington, a Scottish gardener who had taken to photography, and who seems to have been less under the influence, or it may have been that he was ignorant, of the old *dicta*, sent to the Royal Photographic Society's Exhibition in 1882 a photograph entitled " Misty Morning on the Wear," a very beautiful view of Durham Cathedral as seen through the mist from across the river. The judges, although they that year awarded eleven medals, passed this by; but appreciation came from outside, for newspaper critics, and practically all those who were not blinded by prejudice and conventionality, declared it to be *the* photograph of the year. The exhibitions immediately succeeding revealed numerous imitators of M'Leish, and both figure and landscape work began to be shown in which there was evidence of greater freedom and originality.

Meanwhile the Photographic Society of Great Britain had drifted away from its artistic starting-point, and had become chiefly absorbed in purely scientific and technical subjects. But the general apathy which existed in respect of the artistic aspirations of some workers was the forerunner of a period of renaissance which was to end in lifting the pictorial side of photography into a greatly improved position. In 1886 Dr P. H. Emerson read before the Camera Club a paper on " Naturalistic Photography," which served as an introduction to the publication (1887) of his book under that title. Unquestionably this book struck a powerful blow at the many conventionalities which had grown up in the practice of photography; the chief doctrines set forth being the differentiation of focus in different planes, a more complete recognition and truer rendering of " tone," a kind of truthful impressionism derived from a close study and general acquaintance of nature, and a generally higher and more intellectual standard. After the publication of a second edition in 1889 Dr Emerson publicly renounced the views he had published, by issuing in January of 1891 a bitterly worded, black-bordered pamphlet, entitled *The Death of Naturalistic Photography*. But the thoughts which the book had stirred were not to be stilled by its withdrawal. Towards the end of the same year the conflict which within the Photographic Society had become apparent as between the pictorial enthusiasts and the older school, culminated in connexion with some matters respecting the hanging of certain photographs at the exhibition of that year; and a number of prominent members resigned their membership as a protest against the lack of sympathy and the insufficient manner in which pictorial work was represented and encouraged. This secession was to prove the most important event in the history of that branch of photography. The secessionists being among the most popular contributors to the annual exhibition gathered round them numerous sympathizers. In the following year they formed themselves into a brotherhood called " The Linked Ring," and in 1893 held their first " Photographic Salon," at the Dudley Gallery, Piccadilly. The most noteworthy of the early adherents attracted to the new body was James Craig Annan, whose work was practically unknown until he exhibited it at the first Salon; and almost at once he, by general consent, took a position amongst pictorial photographers second to none (see Plate II).

Aroused into greater activity by these events, the Royal Photographic Society began to pay more attention to what had now become the more popular phase. At subsequent exhibitions the technical and scientific work was hung separately from the " Art Section," and a separate set of judges was elected for each section. It became the custom to allot by far the greater amount of space to the " artistic "; and later, artists were elected as judges, by way of encouraging those who were devoted to the pictorial side to send in for exhibition. In the autumn of 1900 the New Gallery was secured, and a comprehensive exhibition of all phases of photography was held.

It is interesting to note that as a distinct movement pictorial photography is essentially of British origin, and this is shown by the manner in which organized photographic bodies in Vienna, Brussels, Paris, St Petersburg, Florence and other European cities, as well as in Philadelphia, Chicago, &c., following the example of London, held exhibitions on exactly similar lines to those of the London Photographic Salon, and invited known British exhibitors to contribute. The international character of the " Linked Ring " encouraged an interchange of works between British and foreign exhibitors, with the result that the productions of certain French, Austrian and American photographers are perfectly familiar in Great Britain. This, in the year 1900, led to a very remarkable cult calling itself " The New American School," which had a powerful influence on contemporaries in Great Britain.

It may be well to glance at such improvements of process or apparatus as have not been direct and essential means to pictorial advance, but rather modifications and improvements made in response to the requirements of the artistic aspirant. Such improvements are of two orders—those which are devised with the aim of securing greater accuracy of delineation, the correction of distortion and of apparent exaggeration of perspective, and the more truthful rendering of relative values and tones; and those which seek to give the operator greater personal control over the finished result. While great advances have been made in photographic optics, it cannot be said that pictorial work has been thereby materially assisted, some of the most successful exponents preferring to use the simplest form of uncorrected objective, or even to dispense with the lens altogether, choosing rather to employ a minute aperture, technically called a " pinhole." This is but one example of many which might be quoted to bear out the statement that in photography the advance of anything in the nature of artistic qualities has not been correlative with mechanical improvements. The hand camera can only be said to have had an indirect influence: it has increased the photographer's facilities, and by removing the encumbrance of heavy tools has widened his sphere of operations; but it is perhaps in connexion with the plates and printing processes that more direct advantages have been gained. The fact that the actinic power of colours is not proportional to their luminosity was long regretted as an obstacle to correct representation; but by the introduction of orthochromatic or isochromatic plates in 1886 (when B. J. Edwards bought the Tailfer and Clayton patent, under which he shortly brought out his orthochromatic plates) this original disability was removed; while with increased rapidity in the isochromatic plate colour values may still further be corrected by the use of coloured screens or light filters, without interfering with the practicability of making sufficiently rapid exposures for most subjects. Again, by a better knowledge of what is required in artistic representation, certain modifications in the formulated treatment of ordinary and uncorrected plates are found to do much towards removing the evil; hence, with an ordinary plate " backed " so as to counteract over-exposure of the higher lights, an exposure may, except in extreme cases, be given of length sufficient to secure the feeble rays of the less actinic colours, and by subsequent suitable development a result hardly distinguishable from that of a colour corrected plate may be secured. Chemical experiment has placed in the photographer's hands improved and easier means of entire, unequal and local intensification and reduction, but utility of these is restricted. By the artistic worker it is claimed that the lens and camera are but the tools, and the negative the preliminary sketch or study, the final print standing to him in the same relation as the finished painting does to the artist. In the production of the print various means of personally controlling the formation of the image have been resorted to. Thus the local development of platinotype by means of glycerine has its champions, but it seems to have been little used, its resuscitation being chiefly due to two or three prominent workers in New York. Here should also be mentioned the revival in 1898 of rough-surface printing papers, chiefly those sensitized with silver, the roughest texture drawing papers being employed to break up the excessive sharpness of the photographic image, and by the superficial inequalities introducing the effect of luminousness to over-dark shadows and variety to blank whites. The almost forgotten process of Pouncy, and of Poitevin, now known as the gum bichromate process, was rehabilitated in 1894 by M. Rouille Ladeveze expressly to meet the needs of the pictorial worker. Perhaps the best results that have been achieved by it are those of M. Robert Demachy of Paris, though many English workers have used it with remarkable success. In it paper of any kind may be selected as the support. The power of the operator to modify the printed image to almost any extent, even to introducing and eliminating lights and shadows, and in other ways to depart widely from the image given by the negative, depends upon the fact that the coating of gum and pigment (which, being bichromatized, becomes insoluble in proportion as it is acted upon by light) holds the pigment but imperfectly, and yields it up upon a vigorous application of water. According, therefore, to its application or retention, the operator can lighten or deepen in tone any portion. Numberless variations of other methods, such as brush development and local toning or stopping, have been suggested with the same object. Other workers have shown that by dexterously shutting off and admitting the light to various parts of the negative whilst printing, the disposition of the lights and shades in the print can be modified to so great an extent as to alter the general contour of the scene. Examples of an original unaltered print, and one which has been thus modified, are shown in the accompanying plate. Portions are shaded in by allowing the light to have access to the print, either through the negative—in which case the image with all its details, prints more deeply—or by removing the negative, when the action of the light is to flatten and suppress both detail and contrast. Latterly some few have resorted to extensive working on the negative, both on the back and on the film; drawing by hand is practised on the film to render too prominent features less obtrusive, and objects in the background are merged by an intricacy of lines and cross-hatching. Many of the results are very pleasing, although one hesitates to justify the means, however good the end. On the other hand, to exclaim for purity of method and the exclusion of extraneous aids is very like setting up an arbitrary standard no less unreasonable than those conventions against which pictorial photography has so long striven.

AUTHORITIES.—P. H. Emerson, *Naturalistic Photography*; H. P. Robinson, *Picture-making by Photography*; *Art Photography*; *Pictorial Effect in Photography*; *Elements of a Pictorial Photograph*; A. H. Wall, *Artistic Landscape Photography* (1896); A. Horsley Hinton, *Practical Pictorial Photography* (1898), and subsequent editions; C. Puyo, *Notes sur la photographie artistique* (Paris).

(A. H. H.)

PHOTOGRAPHY, CELESTIAL. The requisites for celestial photography are best explained by a comparison with ordinary photography in several essential points.

a. Illumination.—In taking a portrait artificial light is used, being thrown on to the face of the sitter either directly or by reflection. If the day is dull a longer exposure is required, and artificial light may be used when the daylight fails. In photographing the stars there is no question of illuminating them by artificial light; for the strongest searchlight which we could throw in the direction of the heavenly bodies would have no sensible effect. The light used is their own, and its feebleness renders it necessary to make long exposures, the length increasing as we attempt to get images of fainter objects. The invention of the dry plate, by making it possible to give very long exposures, caused a revolution in celestial photography. With the wet plate, exposures were limited to the few minutes during which the film would remain wet; but the dry plate can remain in the telescope for days, weeks or even years if necessary. On the approach of daylight, the cap is put on the camera, or the plate removed into the dark room; but when night returns the plate is put back in the telescope, which is accurately pointed to the same stars, the cap is removed, and the exposure is resumed without any loss from the interruption.

b. Magnification.—In taking a portrait we can obtain a large or small size by placing the camera near the sitter or far away. But this method is not available for the heavenly bodies, since we cannot sensibly approach them. To magnify an image we must lengthen the focus of the camera, either directly or indirectly. The *direct* method is to construct a lens or mirror of long focus; the camera becomes similar in length to a telescope; and indeed resembles a telescope in other respects, except that we take away the eye-piece and put in a photographic plate instead. If, however, we already have a lens of short focus which we wish to use, we may lengthen the focus *indirectly* by using a secondary magnifier, that is by putting in another lens near the focus of the first. In either case the profitable magnification is limited, not only by the imperfections of the optical apparatus but by disturbances in the atmosphere. Air currents, either outside or inside the telescope, act as irregular lenses of varying shape, and produce such defects in the image that we gain nothing by enlarging it beyond a certain point. Such air disturbances do not trouble the ordinary photographer at all, or scarcely at all: he is only concerned with a few feet of air, whereas the celestial photographer cannot escape from the necessity of looking through many miles of it.

c. Steadiness.—In taking a portrait the photographer is only concerned to fix his camera firmly and to induce his sitter to remain still. The heavenly bodies are in constant motion, though their real and apparent movements are fortunately smooth, except for air disturbances above mentioned. If, therefore, it were possible to devise perfectly smooth clockwork, we could keep the camera or telescope continually pointed to the required star or stars. But human workmanship has not yet made clockwork of sufficient strength and accuracy to keep a large telescope satisfactorily pointed. The clockwork which had been found good enough for use with visual telescopes was soon found to be quite inadequate for photography. The first method adopted was to bind two telescopes, one visual and the other photographic, firmly together; and by looking through the visual one to keep some object steadily on the crosswires by using the slow motion screws; meanwhile the other telescope was kept properly pointed for taking a photograph. As it was sometimes found that extremely fine movements were required, electrical arrangements were devised, whereby the observer, on simply pressing a button, could accelerate or retard the rate of the clockwork by a minute amount, instead of actually turning the screws by hand. And about the same time the idea arose of making these corrections automatically. This automatic correction is based on the principle that a freely swinging pendulum, which has no work to do, will naturally keep much better time than the clockwork which has to drive a heavy telescope; and if such a pendulum is therefore arranged to send a current every second through certain electro-magnets, apparatus can be devised to detect whether the clockwork is going properly; and to correct it in the right direction, if it is not. One or more of these three methods, which may be called hand-guiding, electrical control, and automatic electric control, are used in taking all celestial photographs.

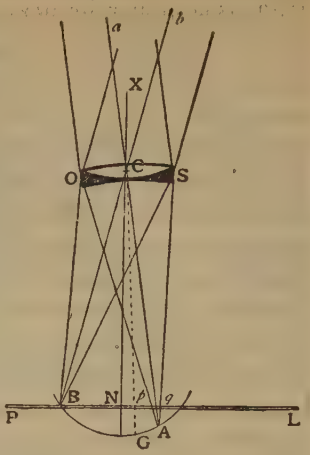
The Photographic Image.—The image of a star on the plate should be, theoretically, merely a point; but in practice it is a small patch on the plate which grows in size as the exposure is lengthened, while at the same time it becomes darker in the middle. One reason for this is that light is many-coloured, and when we attempt to focus it by a lens, we can only get a very few colours into even approximate focus; the other colours are not brought to focus at all, and form concentric patches of fainter light on the plate, which increase in size with the error of focus. Thus at best our focusing is only a compromise. When the exposure is short, those colours which have most nearly been brought to focus have an effect, while the faint light of the others may produce no sensible impression. It is natural to select for the colours to be brought most sharply to focus those which are most important photographically, viz. those at the violet end of the spectrum. As the exposure proceeds the faint light of the other colours affects the plate by accumulation, and hence the image spreads, while at the same time the central part naturally becomes blacker.

A reflecting telescope brings all colours to the same focus; and it might appear, therefore, that images formed with it will not spread in this way. There is, however, another cause of spreading besides that due to colour; neither the reflecting telescope nor the lens can focus all the light received by them for more than one particular star. It is just theoretically possible to construct a mirror which would focus all the light from a star seen in the direction of its axis; but the light from another star seen in a slightly different direction would not be truly focused, since directly we leave the axis, some parts of the mirror have a focus slightly different from other parts; and if the image produced is magnified, it is seen to have a shape like that of a kite. As the exposure is prolonged the small kite-shaped figure gradually increases in size from the point towards the head, and this defect is the more pronounced the farther we depart from the centre of the plate. The result is, speaking generally, that the images near the centre of a plate may be fairly small and circular, but at a certain distance from the centre they become distorted and large. It is a practical problem of great importance to have this distance as great as possible, so that the field of good definition may be large. Estimating in terms of angular distance from the centre of the field, the reflecting telescope has a good field of not more than 40′; a telescope with one compound lens (the ordinary refractor) a field of about 1°, while if two compound lenses are used (as is the case in portrait photography) the field may be very greatly extended, 10° or 15° having been successfully covered. This is naturally a very great advantage of the "doublet" over other forms of telescope, an advantage which has only recently been fully realized. But there is a compensating drawback; to get a large field we must either use a large plate, which is liable to bend or to have a permanent curvature; or if we use a small plate the picture will be on a small scale, so that we lose accuracy in another way.

Star Charts may thus be made by photography with any desired combination of these advantages. The Cape Photographic *Durchmusterung* is a photographic survey of the southern hemisphere by means of 250 plates each covering 5° × 5° taken at the Royal Observatory, Cape of Good Hope; the plates being afterwards measured at Groningen in Holland by Professor J. C. Kapteyn who recorded the places to $0^{s}\cdot1$ and $0'\cdot1$. A much higher degree of accuracy is aimed at in the international scheme for a map of the whole sky undertaken jointly by eighteen observatories in 1887. The plates are only 2° × 2°, and each of the eighteen observatories must take about 600 to cover its zone of the sky once, 1200 to cover it twice. Exposures of 6 min., 3 min., and 20 sec. are given, the telescope being pointed in a slightly different direction for each exposure; so that each star to about the 9th magnitude shows 3 images, and stars to the 11th or 12th magnitude show 2; which has the incidental advantage of distinguishing stars from dust-specks. A *réseau* of lines accurately ruled at distances of 5 mm. apart in two directions at right angles is impressed on the plate by artificial light and developed along with the star images; and by use of these reference lines the places of all stars shown with 3 min. exposure are measured with a probable error which, by a resolution of the executive committee, is not to exceed $\pm 0{\cdot}20''$. An additional scheme for a series of charts enlarged from similar plates with much longer exposure has proved too costly, and only a few observatories have attempted it. Meanwhile Professor E. C. Pickering of Harvard, by using doublet lenses which cover a much larger field at once, has photographed the whole sky many times over. The plates have not been measured, and would not in any case yield results of quite the same accuracy as those of the international scheme; but being systematically stored at the Harvard Observatory they form an invaluable reference library, from which the history of remarkable objects can be read backwards when once attention is drawn to them. Thus the history of the asteroid Eros, discovered in 1898, was traced back to 1894 from these plates; new stars have been found on plates taken previous to the time of discovery, and the epoch of their blazing up recovered within narrow limits; and the history of many variable stars greatly extended. The value of this collection of photographs will steadily increase with time and growth.

Spectroscopic Star Charts.—By placing a glass prism in front of the object glass of a telescope the light from each star can be extended into a spectrum: and a chart can thus be obtained showing not only the relative positions, but the character of the light of the stars. This method has been used with great effect at Harvard: and from inspection of the plates many discoveries have been made, notably those of several novae.

The Geometry of the Star Chart.—Let OS in the figure be the object glass with which the photograph is taken, and let its optical centre be C. Let PL be the plate, and draw CN perpendicular to the surface of the plate. The point N is of fundamental importance in the geometry of the star chart and it is natural to call it the plate centre; but it must be carefully distinguished from two other points which should theoretically, but may not in practice, coincide with it. The first is the centre of the material plate, as placed in position in the telescope. In the figure NL is purposely drawn larger than PN, and this material centre would be to the right of N. The second point is that where the optical axis of the object glass (CG in the figure) cuts the plate. The object glass is drawn with an exaggerated tilt so that CG falls to the right of CN. To secure adjustment, the object glass should be "squared on" to the tube by a familiar operation, so that the tube is parallel to CG: and then the plate should be set normal to the tube and therefore to CG. This is done by observing reflected images, combined with rotation of the plate in its plane.



The field of the object glass will in general be curved: so that the points of best focus for different stars lie on a surface such as AGB (purposely exaggerated). The best practical results for focus will thus be obtained by compromise, placing the plate so that some stars, as A, are focused beyond the plate, and others, as B, nearer the object glass: exact focus only being possible for a particular ring on the plate. The star A will thus be represented by a small patch of light, *pq* on the plate, which will grow in size as above explained. When we measure the position of its image we select the centre as best we can: and in practice it is important that the point selected should be that where the line C*a* drawn from the star to the optical centre cuts the plate. If this can be done, then the chart represents the geometrical projection of the heavens from the point C on to the plane PL. The stars are usually conceived as lying on the celestial sphere, with an arbitrary radius and centre at the observer, which is in this case the object glass: describing such a sphere with C as centre and CN as radius, the lines *b*CB and *a*CA project the spherical surface on to a tangent plane at the point N, which we call the plate centre. If we point the telescope to a different part of the sky, we select a different tangent plane on which to project. It is a fundamental property of projections that a straight line projects into a straight line; and in the present instance we may add that every straight line corresponds to a great circle on the celestial sphere. Hence if we measure any rectilinear co-ordinates (x, y) of a series of stars on one plate, and co-ordinates (X, Y) of the same stars on another plate, and (x, y) are connected by a linear relation, so must (X, Y) be. This property leads at once to the equations

$$X=(ax+by+c)/(1-kx-ly),\quad Y=(dx+ey+f)/(1-kx-ly),\qquad (1)$$

the numerators being any linear functions of (x, y) but the denominators being the same linear function. When $x=0$, $y=0$, then $X=c$ and $Y=f$, which are thus the co-ordinates of the origin of (xy) on plate (XY). The co-ordinate of the origin of (XY) on plate (xy) can be shown to be (k, l) if proper units of length be chosen.

As a particular case the co-ordinates

$$x=\cot\delta\cos\alpha,\quad y=\tan\delta\sin\alpha\qquad (2)$$

represent the rectangular co-ordinates of a star of RA and declination α and δ, projected on the tangent plane at the north pole. If the same star be projected on the tangent plane at the point (A, D), then its rectangular co-ordinates (ξ, η) will be

$$\left.\begin{array}{l}\xi=\tan(\alpha-A)\sin q\sec(q-D),\quad \eta=\tan(q-D),\\ \text{where }\tan q=\tan\delta\sec(\alpha-A),\end{array}\right\}\qquad (3)$$

the axis of η being directed towards the pole. It can readily be verified that (ξ, η) can be expressed in terms of (x, y) by relations of the form (1). The co-ordinates (ξ, η) have been named "standard co-ordinates" and represent star positions on an ideal plate free from the effects of refraction and aberration. For plates of not too large a field, differential refraction and aberration are so small that their product by squares of the co-ordinates may be neglected, and the actual star positions (x, y) are connected with (ξ, η) by linear relations. The linearity of these relations is obviously not disturbed by the choice of origin of axes and of orientation; in which the effects of procession and mutation for any epoch may be included. Hence to obtain the standard co-ordinates (ξ, η) of any object on a plate it is only necessary to know the position of the plate centre (the point N in fig. 1) and the six constants in the relations

$$\xi=Ax+By+C,\quad \eta=Dx+Ey+F,\qquad (4)$$

where (x, y) are rectilinear co-ordinates referred to any axes. The constants can theoretically be determined when there are three stars on the plate for which ξ, η are known: but in practice it is better to use as many "known" stars as possible. These equations are well adapted to solution by least squares or any equivalent device.

Photography of Nebulae and Clusters.—Some of the earliest and most striking successes in celestial photography were the pictures of nebulae. Dr A. A. Common (1841–1903), F.R.S., of Ealing, led the way in 1883 with a successful picture of the great nebula in Orion, taken with a 3 ft. concave mirror by Calver. Dr Isaac Roberts (1829–1904) was the first to show the real structure of the great nebula in Andromeda, by a photograph also taken with a reflector. In the clear atmosphere of the Lick Observatory in California, small nebulae were photographed in great numbers by Professor J. E. Keeler (1857–1900): and it was shown what a large percentage were spiral in form. Prof. G. W. Ritchey, at the Yerkes Observatory, has followed up these successes with a 2-ft. reflector, and is constructing a 5-ft., to be erected on Mt Wilson (Cal.); but he has also shown that pictures of clusters are best taken with a telescope of long focus, such as the great Yerkes refractor; and incidentally that this telescope, although intended for visual work, can be adapted to photography by using a "colour screen" just in front of the plate, which sifts out the rays not brought to focus.

Photography of the Moon.—G. W. Ritchey has used the same device of a colour screen for the moon, and obtained even better pictures than those obtained at Paris, which were previously the best. The positions of a large number of craters and other points have been measured by Dr J. H. G. Franz and S. A. Saunder on photographs, and a new epoch in lunar topography has thereby been created.

Photography of the Planets.—Some striking successes have been obtained at the Lowell Observatory, Flagstaff, Arizona: by cutting down the aperture of the object-glass some of the delicate markings, called canals, on the planet Mars have been photographed; but even these do not approach what can be seen by the eye.

Photography of Comets.—Some wonderful pictures have been obtained of comets by Professor E. E. Barnard and others. Here, as in the case of nebulae, the photograph is superior to the eye in detecting faint luminosity, and delicate details of the tail structure have been photographed which could never be seen. In several pictures the tails have an appearance of violent shattering, and if successive pictures can be obtained at such times we may learn something of the nature of such disturbances.

Solar Photography.—The light of the sun is so intense that the chief difficulty is to obtain a short enough exposure. When successfully taken, photographs of the surface show the well-known spots and the mottling of the surface. The image sensibly falls off in intensity towards the limb, owing to the absorption of light by the solar atmosphere; and the bright faculae (which are thus inferred to lie above the main absorbing layer) are seen near the limb. But an immense advance in solar photography was made about a dozen years ago by the invention of the spectroheliograph, which is an instrument for photographing in the light of one very definite colour—say a single hydrogen line. The faculous appearances can be photographed with this instrument all over the sun's disk, instead of merely near the limb. The appearance presented varies enormously with the line selected, or (in the case of the wide "lines" in the spectrum, such as the H and K lines) with the particular part of the same line selected. But for a full account of such matters reference must be made to the articles SUN and SPECTROHELIOGRAPH.

AUTHORITIES.—Various papers in the *Monthly Notices of the Royal Astronomical Society* and in the *Astrophysical Journal.* Also the bulletins and circulars of the Harvard, Lick and Yerkes Observatories; and of the Executive Committee for the *Astrographic Catalogue* (published by Gauthier Villars for the Paris Académie des Sciences). See also more especially a paper by G. W. Ritchey in the *Decennial Papers* of the University of Chicago, reprinted in vol. ii. (1903) of the *Yerkes Observatory Publications.* (H. H. T.)

PHOTOMETRY (from Gr. φῶς, φωτός, light, μέτρον, a measure), the art and science of comparing the intensities or illuminating powers of two or more sources of light. As in all scientific measurements, its methods are attempts to give quantitative accuracy to the crude comparisons made by the eye itself. The necessity for this accuracy in practical affairs of life has arisen because of the great development of artificial lighting in recent times. The eye soon learns to associate with any particular source of light a quality of brightness or power of illumination which diminishes with increase of distance of the source from the eye or from the surface illuminated. This quality depends upon an intrinsic property of the source of light itself, generally known as its "candle power." The aim of photometry is to measure this candle power; and whatever be the experimental means adopted the eye must in all cases be the final judge.

In the photometric comparison of artificial lights, which frequently vary both in size and colour, direct observation of the sources themselves does not yield satisfactory results. It is found to be much better to compare the illuminations produced on dead white surfaces from which no regular reflection takes place, or through colourless translucent material uniformly illuminated by the light placed on the further side. By such processes there is always loss of light, and we must be certain that the various coloured constituents of the light are reduced in the same proportion. This necessary condition is practically satisfied by the use of white diffusing screens.

Inverse Square Distance Law.

Two principles of radiation underlie many photometric applications, namely, the inverse square distance law, and J. H. Lambert's "cosine law." Both can be established on theoretical grounds, certain conditions being fulfilled. But as these conditions are never absolutely satisfied, the applicability of the two laws must in the end be tested by experiment. Since we find that within the errors of observation four candles, placed together at a distance of 2 ft. from a diffusing screen, produce the same illumination as one candle at a distance of 1 ft., we may regard the inverse square distance law as satisfied. Thus if two lights of intensities A and B produce equal illuminations on a screen when their distances from the screen are respectively a and b, we at once write down the relation between the two intensities in the form $A : B = a^2 : b^2$. The theoretical basis of the law follows at once from the universally accepted view that light is energy radiating outwards in all directions from the source. If we assume that there is no loss of energy in the transmitting medium, then the whole amount of radiant energy passing in one second across any closed surface completely surrounding the source of light must be the same whatever the size or form of the surface. Imagine for simplicity a point source of light, or its equivalent, a uniformly radiating spherical surface with the point at its centre, and draw round this point a spherical surface of unit radius. Across this surface there will pass a definite amount of radiant energy, in other words a definite total luminous flux, E, which will be the same for all concentric spherical surfaces. Since the area of a spherical surface of radius r is $4\pi r^2$, the flux which crosses unit area is $E/4\pi r^2$. This quantity is the "illumination." It is measured in terms of the unit called the *lux*, which is defined as the illumination produced by a light of unit intensity on a perfectly white surface at a distance of 1 ft. In the great majority of photometers the illuminations are compared, and the intensities are deduced by applying the law of the squared distances.

Lambert's Cosine Law.

Lambert's cosine law has to do with the way in which a luminous surface sends off its radiations in various directions. It is a matter of common observation that the disk of the sun appears equally bright all over the surface. Careful measurements show that this is not strictly true; but it is sufficiently near the truth to suggest that under certain definable conditions the law would hold accurately. Again, when a glowing surface is viewed through a small hole in an opaque plate, the brightness is very approximately independent of the angular position of the incandescent surface. This is the same phenomenon as the first mentioned, and shows that the more oblique, and therefore larger, element of surface sends the same amount of radiation through the hole. Hence the amount per unit surface sent off at a given angle with the normal must be less than that sent off in the direction of the normal in the inverse ratio of the areas of the corresponding normal and oblique elements; that is, as the cosine of the given angle to unity. For most practical purposes, and so long as the obliquity is not great, Lambert's law may be assumed to hold.

Talbot's Law.

In almost all accurate methods of photometry the aim is to bring the illuminating powers of the two sources to equality. This may be effected by altering the distance of either light from the illuminated surface. Or we may use polarized light and diminish the intensity of the stronger beam by suitable rotation of a Nicol prism, a method particularly useful in spectrophotometers. The same result may also be effected by interposing absorbent disks, the precise absorbing powers of which must, however, be known with great accuracy. Another useful method is that first described by H. Fox Talbot in 1834, and used with effect by Professor William Swan (1849), and more recently by Sir W. de W. Abney. Talbot's law is thus enunciated by H. von Helmholtz: "When any part of the retina is excited by regularly periodic intermittent light, and when the period is sufficiently short, the resulting impression will be continuous, and will be the same as that which would be produced if the whole light were distributed uniformly throughout the whole period." Talbot deduced the principle from the well-known experiment in which a continuous luminous line is produced by rapid rotation of a luminous point. If the principle be granted, it is obvious that any mechanism by which a ray of light is obstructed in a regularly rhythmic manner during definite intervals t', separated by intervals t, during which the light is allowed to pass, will have the effect of reducing the apparent brightness of the ray in the ratio $t/(t + t')$. This is frequently accomplished by placing in the ray a rotating disk perforated by radial sectors, the so-called Talbot disk.

Standards of Light.

Vernon-Harcourt Pentane Standard.

If photometric results are to be of general value it is essential to have a unit in which to express all other intensities. For example, electric lights are classified according to their "candle-power." The candle, in terms of whose brightness the brightness of other sources of light is to be expressed, must, of course, fulfil the conditions demanded of all standards. It must give under definite and easily realizable conditions a definite and constant luminous effect, and it must be easily reproducible. The earlier attempts to get a candle of constant brightness were not very satisfactory. The British standard is a sperm candle which weighs $\frac{1}{6}$ lb, and loses in burning 120 grains per hour. It is found that these conditions are not sufficient to determine the luminous power of the candle, since the length and shape of the wick, the height of the flame, and the composition, temperature and humidity of the atmosphere all have an effect upon its brightness. The same is true of other similar sources of light—for example, the German standard candle, which is made of paraffin, has a diameter of 2 cm., and has its wick cut until the flame is 5 cm. high, but which with all precautions suffers continual alterations in brightness. For ordinary practical purposes, however, these candles are steady enough. Other kinds of flame have also been used as a standard source of light. The oldest of these is the French Carcel lamp, which is provided with a cylindrical Argand burner, and gives the standard brightness when 42 grammes of colza oil are consumed per hour. The supply and draught are regulated by clockwork. A. G. Vernon-Harcourt's pentane standard, in which a mixture of gaseous pentane and air is burnt so as to maintain a flame 2·5 in. high at ordinary barometric pressure, gives good results, and is readily adjustable to suit varied conditions. Several forms of this standard have been constructed, one of the most important being the 10 candle-power pentane lamp, in which air saturated with pentane vapour is burnt in a specially-designed burner resembling an Argand burner. For photometric purposes a definite length of the lower part of the flame is used, the upper part being hidden within an opaque tube.

Hefner Lamp.

The amyl-acetate lamp designed by H. von Hefner-Alteneck has been elaborately studied by the German authorities, and at present is probably more used than any other flame for photometry. It is of simple construction, and gives the standard brightness when it burns with a flame 4 cms. in height in still air of humidity 0·88% and free of carbon dioxide. The presence of carbon dioxide and increase in the humidity have a marked effect in diminishing the brilliancy of the flame. If the vapour pressure is e and the barometric pressure p, the strength of the flame, when all other conditions are fulfilled, is given by the formula

$$1{\cdot}049 - 5{\cdot}5e/(p-e)$$

One disadvantage for photometric purposes is the reddish colour of the flame as compared with the whiter artificial lights in general use.

For an interesting account of the various experimental investigations into the properties of the Hefner flame see E. L. Nichols, "Standards of Light," *Transactions of the International Electrical Congress*, vol. ii. (St Louis, 1904). Ångstrom's determination of the radiation of the flame in absolute energy units is also of special interest.

Attempts have been made, but hitherto with limited success, to construct a convenient standard with acetylene flame. Could a satisfactory burner be devised, so that a steady brilliancy could be easily maintained, acetylene would, because of its intense white light, soon displace all other flames as standards.

Violle's Platinum Standard.

J. Violle has proposed to use as standard the light emitted by a square centimetre of surface of platinum at its melting-point, but there are obvious practical difficulties in the way of realizing this suggested standard. J. E. Petavel, who carefully examined the necessary conditions for producing it (*Proc. Roy. Soc.* 1899), finds that the platinum must be chemically pure, that the crucible must be made of pure lime, that the fusion must be by means of the oxy-hydrogen blow-pipe, that the gases must be thoroughly mixed in the proportion of 4 volumes of hydrogen to 3 of oxygen, and that the hydrogen must contain no hydro-carbons. Under these conditions the variation in the light emitted by the molten platinum would probably not exceed 1%. O. Lummer and F. Kurlbaum have proposed as a standard a strip of platinum foil 25 mm. wide and ·015 mm. thick brought to incandescence by an electric current of about 80 amperes. The temperature is gradually increased until $\frac{1}{10}$th of the total radiation is transmitted through a water trough 2 cm. in width. This ratio is determined by means of a bolometer, and so long as it is adjusted to $\frac{1}{10}$th the light is practically constant.

Fleming's Incandescent Lamp Standard.

For comparative photometric work the incandescent electric light is very convenient, having the one great advantage over candles and flames that it is not affected by atmospheric changes. But it does not satisfy the requirements of a primary standard. It ages with use, and when run at constant voltage gradually loses in brilliancy, partly because of changes in the filament itself, partly because of the deposit of carbon on the interior of the bulb. Professor J. A. Fleming has shown that very good results can be obtained if carbon filaments carefully selected and run in ordinary bulbs for a definite time at a little above their normal voltage are remounted in large clear glass bulbs 6 or 8 in. in diameter. If used sparingly, and never above their marked voltage, these large incandescent bulbs have been found to remain constant for years, and therefore to be eminently suitable as secondary standards. In his *Handbook for the Electrical Laboratory and Testing Room* (vol. ii.) Fleming concludes that the best primary standards are the Violle incandescent platinum and the Vernon-Harcourt pentane one-candle flame; and that the most convenient practical standards are the Hefner lamp, the ten-candle pentane lamp, and the Fleming large bulb incandescent electric lamp. Comparisons of the intensities of these various standards do not give quite concordant results. Thus three different authorities have estimated the 10-candle pentane lamp as being equal to 10·75, 11·0, 11·4 Hefner lamps.

A specially constructed instrument or piece of apparatus for comparing light intensities or illuminations is called a photometer. The earlier forms of photometers were very simple and not capable of giving very precise results.

Photometers.

The principles of construction are, however, the same in all the recognized forms down to the most elaborate of recent inventions. Two of the earliest forms were described by P. Bouguer and W. Ritchie. The Ritchie wedge constitutes the basis of many varieties of type.

Ritchie's Wedge.

The two lights to be compared illuminate the sides of the wedge, which is placed between them, so that the eye set in front of the wedge sees the two sides illuminated each by one of the lights. The edge should be as sharp as possible so that the two illuminated surfaces are in close contact. The illuminations are made equal either by shifting the wedge along the line joining the lights or by moving one of the lights nearer to or farther from the wedge as may be required. The lights given out by the sources are then as the squares of the distances from the matched parts of the surfaces.

Rumford's Photometer.

Count Rumford suggested the comparison of the intensity of the shadows of the same object thrown side by side on a screen by the two lights to be compared. In this case the shadow due to one source is lit up by the other alone; and here again the amounts of light given out by the sources are as the squares of their distances from the screen when the shadows are equally intense. The shadow-casting object should be near the screen, so as to avoid penumbra as much as possible; yet not too near, so that the shadows may not overlap.

Bunsen's Photometer.

R. Bunsen suggested the very simple expedient of making a grease-spot on white paper for photometric purposes. When the paper is equally illuminated from both sides the grease-spot cannot be seen except by very close inspection. In using this photometer, the sources are placed in one line with the grease-spot, which lies between them and can be moved towards one or other. To make the most accurate determinations with this arrangement the adjustment should first be made from the side on which one source lies, then the screen turned round and the adjustment made from the side of the other source—in both cases, therefore, from the same side of the paper screen. Take the mean of these positions (which are usually very close together), and the amounts of light are as the squares of the distances of the sources from this point. The efficiency of the Bunsen photometer has been improved by using two inclined mirrors so that the eye views both sides of the paper simultaneously.

Wheatstone's Photometer.

Sir Charles Wheatstone suggested a hollow glass bead, silvered internally, and made to describe very rapidly a closed path, for use as a photometer. When it is placed between two sources we see two *parallel* curves of reflected light, one due to each source. Make these, by trial, equally bright; and the amounts of light from the sources are, again, as the squares of the distances.

Swan's Double Prism.

William Swan's prism photometer, invented in 1859, is a beautiful application of the principle embodied in Bunsen's grease-spot photometer (see *Trans. Roy. Soc. Ed.* vol. xxi.). The essential part of the instrument is fundamentally the same as that described by O. Lummer and E. Brodhun in 1889. It consists of two equal right-angled isosceles glass prisms placed with their diagonal faces together so as to form a cube (fig. 1), and cemented together by a small patch of Canada balsam, which spreads out into a circle when the prisms are pressed together. In the figure, which represents a central section of the bi-prism, the Canada balsam is represented by the letter N. The light from two illuminated surfaces, PQ, RS, is allowed to fall perpendicularly on the faces AB, AD. In each case that part of the light falling internally on the portion of the diagonal face which is not backed with the Canada balsam is totally reflected. On the other hand, the light which falls on the portion backed by the Canada balsam is almost wholly transmitted. Thus an eye placed in the position *qtp* receives light from both sources, the surface RS supplying nearly all the light that seems to come from the patch N, and the surface PQ supplying all the light which seems to come from the region immediately surrounding N. The patch N will in general be visible; but it will quite disappear when the luminosity of the ray *Tt*, which traverses the Canada balsam, is exactly equal to the luminosity of the rays *Pp*, *Qq*, which have come after total reflection from the surface PQ. This condition of invisibility of N is arrived at by adjusting the positions of the sources of light which illuminate the surfaces PQ, RS. The brightnesses of the two sources will then be as the squares of their distances from their respective screens.

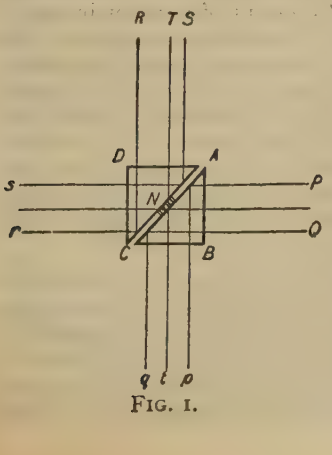


FIG. 1.

Lummer and Brodhun's Photometer.

The essential part of Lummer and Brodhun's photometer is a combination of prisms very similar to Swan's. In its most improved form the bi-prism or "optical cube" has one of its component prisms cut in a peculiar manner. The diagonal face is partly cut away, so that the central part only of this face can be brought into contact with the diagonal face of the other prism. The Canada balsam is dispensed with, the surfaces being pressed closely together so that no layer of air is left between them. In order to make the instrument convenient for use with an optical bench, Lummer and Brodhun make the illuminated surfaces which are to be compared the opposite sides of an opaque screen set in the continuation of the diagonal (CA) of the bi-prism, the rays being brought by reflection from symmetrically situated mirrors so as to enter the sides AB and AD perpendicularly. An important modification, due also to Lummer and Brodhun, is the following: By means of a sand-blast a portion, which may be called *r*, is removed from one half of the diagonal face of the one prism, and from the other half of the same prism there is removed in like manner all but a part *l* corresponding to the part *r*. The portions which have not been removed are pressed close to the diagonal face of the other prism, and become the parts through which light is freely transmitted. On the other hand, the light which enters the second prism and falls on the portions of surface backed by the layers of air filling the cut-out parts is totally reflected. The general result is the production of two similar luminous patches *l* and *r*, each of which is surrounded by a field of the same intensity as the other patch. When the photometric match is made the whole region will be uniformly bright. But, by insertion of strips of glass so as to weaken equally the intensity in the surrounding fields, the match will be obtained when these fields are made of equal intensity and when at the same time the two patches differ equally in intensity from them. Under these conditions the eye is able to judge more certainly as to the equality of intensity of the two patches, and an untrained observer is able to effect a comparison with an accuracy which is impossible with most forms of photometer.

Joly's Photometer.

J. Joly's diffusion photometer consists of two equal rectangular parallelepipeds of a translucent substance like paraffin separated by a thin opaque disk. It is set between the sources of light to be compared in such a way that each paraffin block is illuminated by one only of the sources, and is adjusted until the two blocks appear to be of the same brightness. The method is made more sensitive by mounting the photometer on an elastic vibrator so as to render it capable of a slight to-and-fro oscillation about a mean position.

Weber's Photometer.

A form of photometer which is well adapted for measuring the illumination in a region is that due to L. Weber. It consists of a horizontal tube across one end of which is fitted another tube at right angles. This second tube can be rotated into any position perpendicular to the horizontal tube. Where the axes of the two tubes meet is placed in the later forms of the instrument one of Lummer and Brodhun's modified Swan cubes. At the other end of the horizontal tube a standard flame is set illuminating a piece of ground glass which may be moved to any convenient position in the tube. The eye looks along the cross tube, at the farther end of which is placed another piece of ground glass illuminated from the outside. The illuminations of the two pieces of ground glass as viewed through the photometer double prism are brought to equality, either by shift of the ground glass to or from the standard light, or by means of two Nicol prisms placed in the cross tube. One advantage of the instrument is its portability.

Incandescent Electric Lamp.

The photometry of incandescent electric lamps has led to several special modifications and devices. The candle power varies distinctly in different horizontal directions, and one measurement in any particular direction is not sufficient. Sometimes the lamp is rotated about three times a second about a vertical axis and an average value thus obtained. But there is always a risk of the filament breaking; and in all cases the effect of centrifugal force must alter the form of the filament and therefore the distances of the different parts from the screen. Accuracy demands either the measurement of the radiation intensity in a number of directions all round the lamp, or one combined measurement of as many rays as can be conveniently combined. One of the best methods of effecting this is by means of C. P. Matthews's integrating photometer. By the use of twelve mirrors arranged in a semicircle whose diameter coincides with the axis of the lamp, twelve rays are caught and reflected outward to a second set of twelve mirrors which throw the rays on to the surface of a photometric screen. This combined effect is balanced by the illumination produced by a standard lamp on the other side of the screen (see *Trans. Amer. Inst. Elect. Eng.*, 1902, vol. xix.).

Matthews's Integrating Photometer.

Hetero-chromatic Photometry.

So long as the lights to be compared are of the same or nearly the same tint, the photometric match obtained by different observers is practically the same. If, however, they are of distinctly different colours, not only do different observers obtain different results but those obtained by the same observer at different times are not always in agreement. Helmholtz was of opinion that photometric comparison of the intensities of different coloured lights possessed no real intrinsic value. There can be little doubt that in a rigorous sense this is true. Nevertheless it is possible under certain conditions to effect a comparison which has some practical value. For example, when the intensities of two differently coloured lights differ considerably there is no difficulty in judging which is the stronger. By making the one light pass through a fairly large range of brightness we may easily assign limits outside which the intensities are undoubtedly different. After some experience these limits get close; and many experimenters find it possible, by taking proper precautions, not only to effect a match, but to effect practically the same match time after time. According to Abney, whose memoirs on colour photometry (*Phil. Trans.*, 1886, 1892) form a most important contribution to the subject, the observer in making his judgment as to the equality of luminosity of two patches of colour placed side by side must not begin to think about it, but must let the eye act as unconsciously as possible. His method was to compare the coloured patch with white light given by a particular standard and cut down to the proper intensity by use of a Talbot's rotating sector, which could be adjusted by means of a suitable mechanism while it was rotating.

Abney's Experiments.

At the same time, although the eye may be able to effect a definite matching of two patches of colour of a particular luminosity, it has been long known that a change in the luminosity will destroy the apparent equality. This depends upon a physiological property of the retina discovered by J. E. Purkinje in 1825 (see below, *Celestial Photometry*). In virtue of this property the blue and violet end of the spectrum is more stimulating to the eye than the red end when the general luminosity is low, whereas at high luminosities the red gains relatively in brightness until it becomes more stimulating than the blue. Unless therefore account is taken in some definite measurable manner of the absolute brightness, there must always be some uncertainty in the photometric comparison of the intensities of differently coloured sources of light.

Instead, however, of trying to effect a photometric match in any of the ways which have been found sufficient when the sources are of the same or nearly the same tint, we may effect important practical comparisons in what is called heterochromatic photometry by an appeal to other physiological properties of the eye. For example, the power of clearly discriminating patterns in differently coloured lights of various intensities is obviously of great practical importance; and this power of detailed discrimination may be made the basis of a method of photometry. According to this method two lights are arranged so as to illuminate two exactly similar patterns of lines drawn, for example, on the sides of a Ritchie wedge, and their distances are adjusted until the patterns are seen equally distinct on the two sides. Application of the usual distance law will then give the relation between the two lights. A discrimination photometer constructed on this principle has been designed by J. A. Fleming. Its results do not agree with the indications of an ordinary luminosity photometer; for it is found that the eye can discriminate detail better with yellow than with blue light of the same apparent luminous intensity.

Discrimination Photometer.

Flicker Photometry.

Another and very promising method of photometry depends upon the duration of luminous impressions on the retina. J. A. F. Plateau observed in 1829 that the blending into a homogeneous impression of a pattern of alternate sectors of black and some other colour marked on a disk when that disk was rotated occurred for rates of rotation which depended on the colour used. A form of experiment suggested in Professor O. N. Rood's *Modern Chromatics* seems to have been first carried out by E. L. Nichols (*Amer. Journ. of Science*, 1881). A black disk with four narrow open sectors was rotated in front of the slit of a spectroscope. When the rotation was not too quick the yellow part of the spectrum appeared as a succession of flashes of light separated by intervals of darkness of appreciable length, whereas towards both the red and violet ends no apparent interruption in the steady luminosity could be observed. As the rate of rotation increased the part of the spectrum in which flickering appeared contracted to a smaller length extending on each side of the yellow, and finally with sufficiently rapid alternation the yellow itself became steady. This seems to show that the retinal image persists for a shorter time with yellow light than with light of any other colour; for with it the intervals of darkness must be shorter before a continuous impression can be obtained. Now yellow is the most luminous part of the spectrum as it affects the normal human eye; and E. S. Ferry (*Amer. Journ. of Science*, 1892) has shown that the duration of luminous impression is mostly, if not entirely, determined by the luminosity of the ray. Hence the determination of the minimum rate of intermittence at which a particular colour of light becomes continuous may be regarded as a measure of the luminosity, the slower rate corresponding to the lower luminosity. Although in the experiment just described the red part of the ordinary solar spectrum becomes continuous for a slower rate of intermittence than the yellow part, yet we have simply to make a red ray as luminous as the yellow ray to find that they become continuous for the same rate of intermittence. It is, however, highly improbable that the duration of impression depends *only* on the luminosity of the light and not to some extent upon the wave-length. There are indeed phenomena which require for their explanation the assumption that the duration of luminous impression does depend on the colour as well as on the brightness.

Rood's Experiments.

Nevertheless the luminosity is by far the more important factor, as shown by Ogden N. Rood's experiments. He found (*Amer. Journ. of Science*, 1893) that, when a disk whose halves differ in tint but not in luminosity is rotated rather slowly, the eye of the observer sees no flickering such as is at once apparent when the halves differ slightly in luminosity. Rood himself suggested various forms of photometer based on this principle. In his latest form (*Amer. Journ. of Science*, Sept. 1899) the differently coloured beams of light which are to be compared photometrically are made to illuminate the two surfaces of a Ritchie wedge set facing the eye. Between the wedge and the eye is placed a cylindrical concave lens, which can be set in oscillation by means of a motor in such a way that first the one illuminated surface of the wedge and then the other is presented to the eye in sufficiently rapid alternation. The one source of light is kept fixed, while the other is moved about until the sensation of flicker disappears. From work with this form of instrument Rood concluded that "the accuracy attainable with the flicker photometer, as at present constructed, and using light of different colours almost spectral in hue, is about the same as with ordinary photometers using plain white light, or light of exactly the same colour."

Simmance and Abady's Photometer.

Various modifications of Rood's forms have been constructed from time to time by different experimenters. The Simmance and Abady flicker photometer is an ingenious and yet mechanically simple method by which (as it were) the wedge itself is made to oscillate so as to throw on the eye in rapid succession, first the one side and then the other. The rim of a wheel of white material is bevelled in a peculiar manner. The sharp edge, which passes slightly obliquely across the rim from one side of the wheel to the other and back again, is the meeting of two exactly similar conical surfaces facing different ways and having their axes parallel to, but on opposite sides of, the axis of rotation of the wheel. As the wheel rotates with its rim facing the eye, the intersection of the two surfaces crosses and recrosses the line of vision during each revolution. Hence first the one illuminated side and then the other are presented to the eye in rapid alternation. The inventors of this instrument claim that their instrument can gauge accurately and easily the relative intensities of two lights, whether of the same or of different colour (*Phil. Mag.*, 1904). There is no doubt that results obtained by different observers with a flicker photometer are in better agreement than with any other form of photometer. The comparative ease with which the balance is obtained even when the tints are markedly different shows that its action depends upon a visual distinction which the eye can readily appreciate, and this distinction is mainly one of brightness.

Spectro-photometry.

The spectrophotometer is an instrument which enables us to make photometric comparisons between the similarly coloured portions of the spectra of two different sources of light, or of two parts of the same original source after they have passed through different absorbing media. When it is desired to compare the intensities of the spectra from two different sources a convenient form is the one described by E. L. Nichols. A direct vision spectroscope mounted upon a carriage travels along a track between the two sources. In front of the slit two right-angled triangular prisms are set so that the light from each source enters the one side of one prism perpendicularly and is totally reflected into the spectroscope. The two spectra are then seen side by side. Attention being fixed on some chosen narrow portion, say, in the green, the instrument is moved along the track between the sources until the two portions appear of the same intensity. The process is then repeated until the whole spectrum has been explored.

Brace's Spectro-photometer.

In Lummer and Brodhun's form of spectrophotometer the rays to be compared pass in perpendicular lines through the modified Swan double prism, and then together side by side through a spectroscope. By means of a simple modification in the form of the two prisms, Professor D. B. Brace (*Phil. Mag.*, 1899) made the combined prism serve to produce the spectra as well as to effect the desired comparison. In this arrangement the compound prism ABC (fig. 2) is made up of two equal right-angled prisms ADB and ADC placed with their longer sides in contact, so that the whole forms an equilateral prism with three polished faces. Part of the interface AD is silvered, the silvering forming a narrow central strip running parallel to AD. Along the rest of the interface the two prisms are cemented together with Canada balsam or other material having as nearly as possible the same refractive index as the glass. When two rays R S enter symmetrically from opposite sides of the base of the compound prism as shown in the diagram, the ray R will pass through the prism except where the silver strip intercepts it, and will form a part of a spectrum visible to the eye placed at R′, while to the same eye there will be visible the similarly dispersed ray SS′ reflected from the silvered surface. Thus two systems of incident parallel rays of white light will form on emergence two spectra with corresponding rays exactly parallel. With these and other forms of instrument the aim of the experimenter is to make the two spectra of equal intensity by a method which enables him to compare the original intensities of the sources. In most cases the relative intensities of the portions of the spectra being compared cannot conveniently be altered by varying the distances of the sources. Recourse is therefore generally had to one of the other methods already mentioned, such as the use of polarizing prisms or of rotating sectors. Under certain conditions K. Vierordt's method of allowing the two rays to pass through slits of different width leads to good results, but too great confidence cannot be placed upon it.

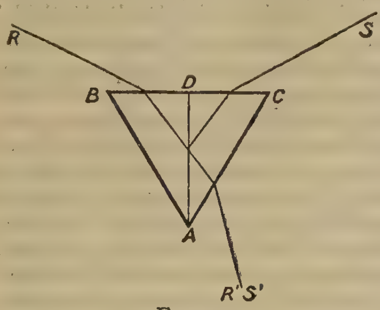


FIG. 2.

In other types of spectrophotometer, such as those associated with the names of H. Trannin, A. Crova, H. Wild, G. Hüfner, J. Königsberger, A. König, F. F. Martens and others, the equalization in brightness of two rays is effected by using polarized light, which can be cut down at pleasure by rotation of a Nicol prism. For example, in the König-Martens instrument the two rays which are to be compared enter the upper and lower halves of a divided slit. After passing through a lens they pass in succession through (1) a dispersing prism, (2) a Wollaston prism, (3) a biprism, and are finally focused where the eight spectra so produced can be viewed by the eye. Of these only two are made use of, the others being cut out. These two are polarized in perpendicular planes, so that if between the spectrum images and the eye a Nicol prism is introduced the intensities of any two narrow corresponding portions of the two spectra can be readily equalized. In terms of the angle of rotation of the Nicol the relative intensities of the original rays can be calculated. An important application of the spectrophotometer is to measure the absorptive powers and extinction coefficients of transparent substances for the differently coloured rays of light. By appropriate means the intensities of chosen corresponding parts of the two contiguous spectra are made equal—in other words, a match is established. Into the path of the rays of one of the spectra the absorbent substance is then introduced, and a match is again established. A measure of the loss of luminosity due to the interposition of the absorbent substance is thus obtained.

Konig-Martens's Spectro-photometer.

Milne's Spectro-photometer.

To facilitate experiments of this nature Dr J. R. Milne has devised a spectrophotometer which presents some novelties of construction (see *Proceedings of the Optical Convention*, 1905, vol. i.). The light from a bright flame is suitably projected by a lens so as to illuminate a small hole in the end of the collimator. The rays from this point-source are made parallel by the collimator, and then pass, partly through the absorbing medium, partly through the space above it. These two parts of the original beam are transmitted through a dispersing prism and then fall upon a screen with two similar rectangular openings, the upper one allowing the unabsorbed part of the beam to pass, the lower that part which has been transmitted through the absorbing medium. The objective of the observing telescope converges the rays suitably upon a Wollaston prism, so that two spectra are seen side by side, having their light polarized in perpendicular planes. A Nicol prism is placed between the Wollaston prism and the eye-piece of the telescope, and by its rotation in the manner already described the intensities of any two corresponding portions of the two spectra can be brought to equality. By careful attention to all necessary details Milne shows that his instrument satisfies the requirements of a good spectrophotometer; for (1) the rays through the absorbing medium can be made strictly parallel; (2) the two spectra can be brought with ease accurately edge to edge without any diffraction effects; (3) the plane of the delimiting screen can be made conjugate to the retina of the observer's eye; (4) not only do the two spectra touch accurately along their common edge, but the two fans of rays which proceed from every point of the common edge lie in one and the same plane; (5) the eye is called upon to judge the relative intensities not of two narrow slits but of two broad uniformly illuminated areas. Milne also points out that this instrument can be used as a spectropolarimeter.

E. L. Nichols considers that spectrophotometers which depend for their action upon the properties of polarized light are necessarily open to serious objections, such as: selective absorption in the calcspar, altering the relative intensities of the constituents in the original rays; selective losses by reflection of polarized rays at the various optical surfaces; and the necessarily imperfect performance of all forms of polarizing media. To eliminate these defects as far as possible great care in construction and arrangement is needed, otherwise corrections must be applied.

It is evident that if the successive parts of two spectra are compared photometrically we may by a process of summation obtain a comparison of the total luminosities of the lights which form the spectra. This process is far too tedious to be of any practical value, but sufficiently accurate results may in certain cases be obtained by comparison of two or more particular parts of the spectra, for example, strips in the red, green and blue. Similar in principle is the method suggested by J. Macé de Lepinay, who matches his lights by looking first through a red glass of a particular tint and then through a chosen green. If R and G represent the corresponding ratios of the intensities, the required comparison is calculated from the formula $I = \frac{R}{1 + 0{\cdot}208\,(1 - GR)}$. A. Crova, one of the earliest workers in this subject, effects the photometric comparison of differently coloured lights by matching those monochromatic rays from the two sources which have the same ratio of intensities as the whole collected rays that make up the lights. Careful experiment alone can determine this particular ray, but were it once ascertained for the various sources of light in use the method would have the merits of rapidity and accuracy sufficient for practical needs. Spectrophotometric observations are necessary to determine the position in the spectrum of the particular monochromatic ray, but when it has been determined a coloured glass may be made which allows light in the neighbourhood of this ray to pass, and the photometric comparison may then be effected by looking through this glass.

This article has been confined strictly to the methods of visual photometry, with very little reference to the results. Comparison of intensities of radiation by photographic means or by methods depending on the effects of heat introduces considerations quite distinct from those which lie at the basis of photometry in its usual signification. (C. G. K.)

CELESTIAL, OR STELLAR, PHOTOMETRY

The earliest records that have come down to us regarding the relative positions of the stars in the heavens have always been accompanied with estimations of their relative brightness. With this brightness was naturally associated the thought of the relative magnitudes of the luminous bodies from whence the light was assumed to proceed. Hence in the grand catalogue of stars published by Ptolemy (*c.* 150 A.D.), but which had probably been formed three hundred years before his day by Hipparchus, the 1200 stars readily visible to the naked eye at Alexandria were divided into six classes according to their lustre, though instead of that term he uses the word *μέγεθος* or "magnitude"; the brightest he designates as being of the first magnitude, and so downwards till he comes to the *minimum visible*, to which he assigns the sixth. These magnitudes he still further divides each into three. To those stars which, though not ranged in any particular order of brightness, nevertheless exceed the average of that order in lustre he attaches the letter μ, the initial letter in *μείζων* (greater), and to those in the same order which exhibit a lustre inferior to that of the average he affixes the letter ε, the initial letter of ἐλάσσων. With this sort of subdivision he passes through all the six orders of magnitude. He does not, indeed, tell us the precise process by which these divisions were estimated, but the principle involved is obvious. It is one of the many remarkable instances of the acuteness and precision of the Greek mind that for upwards of 1500 years no real improvement was made in these estimations of lustre. J. Flamsteed extended the estimation of magnitude of stars visible only by the telescope, and he improved Ptolemy's notation by writing 4·3 instead of δ, μ—indicating thereby an order of magnitude brighter than the average of a fourth, but inferior to that of a third—and 3·4 for δ, ε, and so on; but it was not till the year 1796 that any real advance was made in stellar photometry. Sir W. Herschel, instead of assigning a particular magnitude to stars, arranged them in small groups of three or four or five, indicating the order in which they differed from each other in lustre at the time of observation. This method was admirably adapted to the discovery of any variations in brightness which might occur in the lapse of time among the members of the group. Sir William observed in this way some 1400 stars, published in four catalogues in the *Philosophical Transactions* from 1796 to 1799; and two additional catalogues were discovered among his papers in 1883 by Professor E. C. Pickering of Harvard (see *Harvard Annals*, xiv. 345), and have recently been published by Colonel J. Herschel (*Phil. Trans.*, 1906). These researches of the elder Herschel were in due time followed by those of his son, Sir John, about the year 1836 at the Cape of Good Hope. He both extended and improved the methods adopted by his father at Slough, and by a method of estimated sequences of magnitude he hoped to arrange all the stars visible to the naked eye at the Cape or in England in the order of their relative lustre, and then to reduce his results into the equivalent magnitudes adopted by the universal consent of astronomers. Sir John, however, like his father, left this important labour incomplete. Not only is the work one of great and continuous effort, but the effects of ever-varying meteorological conditions greatly impede it. Moreover, there is an unsatisfactory indefiniteness attending all estimations made by the unaided eye; numerical or quantitative comparisons are out of the question, and hence we find Sir John, in the very midst of establishing his "sequences," adopting also an instrumental method which might lead him to more definite results.

In the year when Sir John Herschel concluded his photometric work at the Cape (1838) Dr F. W. A. Argelander commenced, and in 1843 completed, his *Uranometria nova*, in which the magnitudes of all stars visible to the unaided eye in central Europe are catalogued with a precision and completeness previously unknown. It contains 3256 stars, and although it will probably be superseded by instrumental photometry it must ever remain a monument of intelligent patience. Argelander's labours were not confined to stars visible to the naked eye; by the aid of his assistants, Dr E. Schönfeld and Dr A. Krüger, three catalogues of magnitudes and celestial co-ordinates were ultimately published (1859–1862) as the *Bonn Durchmusterung*, including the enormous number of 324,188 stars, and an additional volume containing 133,659 stars south of the equator was published in 1886.

Dr B. A. Gould (1824–1896), in his *Uranometria argentina* (1879), has done similar work for 7756 stars visible only in the southern hemisphere, and his successor at Córdoba, J. M. Thome, has published (1904) three volumes of the Argentine (Córdoba) *Durchmusterung* containing 489,662 stars between declination −22° to −52°. There have been other worthy labourers in the same field, each of whom has rendered efficient service, such as Dr E. Heis and M. J. C. Houzeau.

It is to Sir John Herschel that we are indebted for the first successful attempt at stellar photometry by what may be termed "artificial" means. He deflected the light of the moon (by means of the internal reflection of a rectangular prism) through a small lens 0·12 in. in diameter and of very short focus (0·23 in.) so as to form a sort of artificial star in its focus. With strings and a wooden pole he could move this artificial star of comparison so as to be in the same line of sight with any actual star whose light he proposed to measure. Other strings enabled him to remove it to such a distance from the eye that its light was adjudged to be sensibly the same as that of the star compared; and the distance was measured by a graduated tape. While he was thus busy at the Cape of Good Hope, K. A. Steinheil at Munich had completed for Dr P. L. Seidel an instrument nearly the same in principle but more manageable in form. He divided the small object-glass of a telescope into two halves, one of which was movable in the direction of its axis. The images of two stars whose light he desired to compare were formed by prismatic reflection, nearly in the same line of sight, and one of the lenses was then moved until the light of the two images seemed equal. The distance through which it was necessary to bring the movable lens furnished the data for comparing the relative lustre of the two stars in question. More recently other photometers have been devised, and descriptions of three of them, with which considerable researches have been conducted will now be given. With the first mentioned below Professor Pickering of Harvard has made more than a million measures with his own eyes. The results of his observations, and of those of his assistants, will be found in the *Harvard Annals* especially in vol. xlv. published in 1901, which contains a general catalogue of about 24,000 stars brighter than magnitude 7·5, north of declination −40°. With the Zöllner photometer Drs Gustav Müller and P. Kempf of Potsdam have recently completed a similar piece of work, their catalogue of stars north of the equator brighter than 7·5 containing 14,199 stars (*Potsdam Publications*, 1907, vol. xvii.). The catalogue of Professor C. Pritchard was smaller, containing 2784 stars brighter than magnitude about 6·5 and north of declination −10°; but it was published in 1886, when very little had yet been done towards the systematic measurement of the brightness of the stars (*Uranometria nova oxoniensis*, vol. ii. of the Oxford University Observatory publications).

Pickering's meridian photometer (*Ann. Astron. Obs. Harv.* vols. xiv. and xxiii.) consists of two telescopes placed side by side pointing due east, the light from the stars on the meridian being reflected into them by two mirrors inclined at an angle of 45° to this direction. If there were a star exactly at the Pole, one of these mirrors

Pickering's Meridian Photometer.

would be absolutely fixed and would constantly reflect the light of this star down the axis of its telescope; in practice a slight motion can be given to the mirror so as to keep in view the polar star selected, whether Polaris, with which the brighter stars were compared, or λ Ursae Minoris, which was used for fainter stars. The second mirror (which projects a little beyond the first so as to get an unobstructed view of the meridian) can be rotated round the axis of the telescope by means of a toothed-wheel gearing, and can thus be made to reflect any star on the meridian down the second telescope; it is also provided with a small motion in the perpendicular direction, so as to command a degree or two on each side of the meridian. Near the common eyepiece of the telescopes there is a double image prism which separates the light received from each into two pencils; the pencil of ordinary rays from one object-glass is made to coincide with that of extraordinary rays from the other, and the two remaining pencils are excluded by a stop. The two coincident pencils then pass through a Nicol prism to the eye of the observer, who by rotating the prism round its axis can equalize them at a definite reading depending on their relative intensities. This reading gives in fact the difference of magnitude between the two stars selected for comparison. It may be remarked that the position of the double image prism is important. It should be just *within*, not *at*, the common focus: this position prevents any noticeable colour in the images, and gives the ordinary and extraordinary pencils a sufficient separation at the eye-stop to permit the entire exclusion of one without the loss of any part of the other. If the prism were exactly at the focus, and any part of the superfluous images were admitted, the resulting secondary images would coincide with the others and thus lead to errors in observing. But in the actual construction of the instrument the secondary images would appear, if at all, only as additional stars near those under observation, and too faint to produce any inconvenience. It is worthy of note that Professor Pickering has extended his survey into the southern hemisphere, so that the Harvard photometry is the most complete of all. Each observation consists of four comparisons; after the first two the observer reverses the position of the star images in the field, and also reverses the double-image prism. The former precaution is necessary in order to eliminate a curious error depending on the relative position of the images, which may amount to several tenths of a magnitude. Errors of this kind affect *all* estimations of the relative brightness of two stars in the same field, as has been repeatedly shown; a striking instance is given by A. W. Roberts, of Lovedale, South Africa (*Mon. Not. R.A.S.* April 1897), who found that his eye-estimations of the brightness of variable stars required a correction depending on the position-angle of the comparison star ranging over nearly two magnitudes.

Zöllner's Photometer.

In Zöllner's instrument an artificial star is taken as the standard of comparison. There is only one telescope, and inside the tube near the eye end is a plate of glass placed at an angle of 45° with the axis, so that the rays from a lamp which enter the tube from the side are reflected down the tube to the eyepiece, while the light from the star passes through the plate unobstructed. The lamplight passes through a Nicol prism and a plate of rock crystal, which give control over the colour; through two Nicols which can be rotated round the axis of the beam to definite positions read off on a graduated circle; and then through a convex lens which forms an image reflected by the glass plate to focus alongside the star. The whole of this apparatus is carried in a compact form on the eye end of the telescope, it being arranged that the lamp shall always stand upright. The measures are made by rotating the Nicols until the brightness of the artificial star is equal to that of the star viewed through the object glass, and reading the graduated circle.

The Wedge Photometer.

Professor Pritchard's (1808–1893) wedge photometer is constructed on the principle that the absorption of light in passing through a uniform medium depends, *caeteris paribus*, upon the thickness. On this principle a thin wedge is constructed of homogeneous and nearly neutral-tinted glass, through which the images of stars formed in the focus of a telescope are viewed. Simple means are contrived for measuring with great exactness the several thicknesses at which the light of these telescopic star-images is extinguished. In this way the light of any star can be readily compared with that of Polaris (or any other selected star) at the moment of observation, and thus a catalogue of star-magnitudes can be formed. Two material improvements suggested by Dr E. J. Spitta are worthy of notice. The first (*Proc. Roy. Soc.*, 1889, 47, 15) corrects a slight defect in the form of the instrument. If a pencil of rays passes through a thin wedge of tinted glass, the rays do not all pass through the same thickness of glass. Dr Spitta proposes to substitute a pair of wedges with their thicknesses increasing in opposite directions. By sliding one over the other we obtain a parallel plate of glass of varying thickness, and a uniform beam of light of sensible dimensions can then be extinguished satisfactorily. He has also pointed out a source of error in the method of "evaluating" the wedge and shown how to correct it. The scale value was determined by Professor Pritchard by the use of a doubly refracting prism of quartz and a Nicol prism. Using this method subsequently, Dr Spitta found that internal reflections within the Nicol prism interfered with the accuracy of the result, but that this error could be eliminated by using a suitable diaphragm (*Mon. Not. R.A.S.* March 1890; Abney, ibid., June 1890).

The Purkinje Phenomenon.

Since 1885 systematic catalogues of stellar brightness have been constructed with all these instruments, and it has been of great interest to compare the results. The comparison has in general shown a satisfactory agreement, but there are small differences which are almost certainly systematic, due to the difference of method and instrument. One cause of such differences, the reality of which is undoubted, but the effects of which have as yet not been perhaps fully worked out, is the "Purkinje phenomenon" (*Pflügers Archiv.* lxx. 297). If a blue source of light and a red source appear equally bright to the eye, and if the intensity of each be diminished in the same ratio, they will no longer appear equally bright, the blue now appearing the brighter; in more general terms, the equalizing of two differently coloured lights by the eye depends upon their intensity. It is clear that this phenomenon must affect all photometric work unless the stars are all exactly of the same colour, which we know they are not. For let us suppose that both the comparison star of the meridian photometer and the artificial star of the Zöllner photometer were equalized with a bright star A, and that they could be also compared *inter se* and found equally bright. Then when a faint star B comes under observation and the intensities of the comparison stars are both reduced to equality with B, they will no longer appear equal to one another unless they are exactly the same in colour. In other words, the observed ratio of intensities of A and B will vary with the colour of the comparison star, and similarly it will also vary with the aperture of the telescope employed. Now it is one of the merits of the Potsdam catalogue above mentioned that it gives estimates of the colours of the stars as well as of their magnitudes—so that we now for the first time have this systematic information. In a most interesting section of their introduction it is shown that two of the Harvard photometric catalogues show systematic differences, due to colour, and amounting to nearly half a magnitude: and that the Purkinje phenomenon is a satisfactory explanation of these differences. This is the first instance in which the effect of this phenomenon has been measured in the case of the stars, though it was known to be sensible. But there is a set of numerical results obtained in the laboratory which is of importance for all such works, viz. those obtained by Sir W. Abney (*Proc. Roy. Soc.* May 1891; and *Mon. Not. R.A.S.* April 1892), giving the limiting intensity at which each pure colour vanishes. If we start with lights C D E F G of the colours usually denoted by these letters in the spectrum, and each so bright that it appears *to the eye* as bright as an amyl-acetate lamp at 1 ft., and if then the intensity of each be gradually diminished, the C light will disappear when the original intensity has been reduced to 22,000 ten-millionths of the original value. The other colours will disappear at the following intensities, all expressed in ten-millionths of the original: D at 350, E at 35, F at 17, and G at 15. If then we had a mixture of two lights, one of C colour as bright as before, and the other of G colour 1000 times fainter (a combination in which the eye would be unable to distinguish the G light at all), and if we continually reduced the combined intensity, the luminosity of the C light would diminish so much more rapidly than that of the G that the latter would begin to assert itself, and when the combined intensities were reduced to 22,000 ten-millionths of the original value, the C light would have all disappeared, while the G light would not. Hence the colour of the light would appear pure violet, though it was originally deep red. This extreme case shows that the "last ray to disappear" when a light is gradually extinguished may be very different in colour from that of the original light, and when more usual light-mixtures are considered, such as those of sunlight and starlight, which appear nearly white to the eye, the "last ray to disappear" is found to be in the green, very near E in the spectrum. This result has two important bearings on the use of the wedge photometer. In the first place, either the wedge itself should be of a greenish hue, or green light should be used in finding the scale-value (the constant B in the formula $m = A + Bw$). In the second, star magnitudes obtained by extinction with the wedge will agree better with those obtained by photography than those obtained with other visual photometers, since photographic action is chiefly produced by rays from E to G in the spectrum, and the E light of ultimate importance with the wedge photometer is nearer this light in character than the D light with which other photometers are chiefly concerned. It would also appear that results obtained with the wedge photometer are independent of the aperture of telescope employed, which is not the case with other photometers.

Photographic Photometry.

Passing now to the consideration of photographic methods, it is found that when a plate is exposed to the stars, the images of the brighter stars are larger and blacker than those of the fainter ones, and as the exposure is prolonged the increase in size and blackness continues. Much of the light is brought to an accurate focus, but, owing to the impossibility of perfect achromatism in the case of refractors, and to uncorrected aberration, diffraction, and possibly a slight diffusion in both refractors and reflectors, there are rays which do not come to accurate focus, grouped in rings of intensity gradually diminishing outwards from the focus. As the brightness of the star increases, or as the time of exposure is prolonged, outer and fainter rings make their impression on the plate, while the impression on the inner rings becomes deeper. Hence the increase in both diameter and blackness of the star disks. As these increase concurrently, we can estimate the magnitude of the star by noting either the increase in diameter or in blackness, or in both. There is consequently a variety in the methods proposed for determining star magnitudes by photography. But before considering these different methods, there is one point affecting them all which is of fundamental importance. In photography a new variable comes in which does not affect eye-observations, viz., the time of exposure, and it is necessary to consider how to make due allowance for it. There is a simple law which is true in the case of bright lights and rapid plates, that by doubling the exposure the same photographic effect is produced as by increasing the intensity of a source of light twofold, and so far as this law holds it gives us a simple method of comparing magnitudes. Unfortunately this law breaks down for faint lights. Sir W. Abney, who had been a vigorous advocate for the complete accuracy of this law up till 1893, in that year read a paper to the Royal Society on the failure of the law, finding that it fails when exposures to an amyl-acetate lamp at 1 ft. are reduced to $0^{s}{\cdot}001$, and "signally fails" for feeble intensities of light; indeed, it seems possible that there is a limiting intensity beyond which *no* length of exposure would produce any sensible effect. This was bad news for astronomers who have to deal with faint lights, for a simple law of this kind would have been of great value in the complex department of photometry. But it seems possible that a certain modification or equivalent of the law may be used in practice. Professor H. H. Turner found that for plates taken at Greenwich, when the time of exposure is prolonged in the ratio of five star magnitudes the photographic gain is four magnitudes (*Mon. Not. R.A.S.* lxv. 775), and a closely similar result has been obtained by Dr Schwarzschild using the method presently to be mentioned.

Diameter as Test of Magnitude.

Stars of different magnitudes impress on the plate images differing both in size and blackness. To determine the magnitude from the character of the image, the easiest quantity to measure is the diameter of the image, and when measurements of position are being made with a micrometer, it is a simple matter to record the diameter as well, in spite of the indefiniteness of the border. Accordingly we find that various laws have been proposed for representing the magnitude of a star by the diameter of its image, though these have usually been expressed, as a preliminary, as relations between the diameter and time of exposure. Thus G. P. Bond found the diameter to increase as the square of the exposure, Turner as the cube, Pritchard as the fourth power, while W. H. M. Christie has found the law that the diameter varies as the square of the logarithm of the exposure within certain limits. There is clearly no universal law—it varies with the instrument and the plate—but for a given instrument and plate an empirical law may be deduced. Or, without deducing any law at all, a series of images may be produced of stars of known brightness and known exposures, and, using this as a scale of reference, the magnitudes of other images may be inferred by interpolation. A most important piece of systematic work has been carried out by the measurement of diameters in the Cape Photographic *Durchmusterung* (*Ann. Cape Obser.* vols. iii., iv. and v.) of stars to the tenth magnitude in the southern hemisphere. The measurements were made by Professor J. C. Kapteyn of Groningen, on photographs taken at the Cape of Good Hope Observatory; he adopts as his purely empirical formula

$$\text{magnitude} = B/(\text{diameter} + C),$$

where B and C are obtained independently for every plate, from comparison with visual magnitudes. C varies from 10 to 28, and B from 90 to 260. The part of the sky photographed was found to have an important bearing on the value of these constants, and it was in the course of this work that Kapteyn found a systematic difference between stars near the Milky Way and those far from it, which may be briefly expressed in the law, *the stars of the Milky Way are in general bluer than the stars in other regions of the sky*. It is intended, however, in the present article to discuss methods rather than results, and we cannot here further notice this most interesting discovery.

Images out of Focus.

Of methods which choose the blackness of the image rather than the diameter for measurement, the most interesting is that initiated independently by Pickering at Harvard and C. Schwarzschild at Vienna, which consists in taking star images considerably out of focus. The result is that these images no longer vary appreciably in size, but only in blackness or density; and that this gradation of density is recognizable through a wide range of magnitudes. On a plate taken in good focus in the ordinary way there is a gradation of the same kind for the faintest stars; the smallest images are all of approximately the same size, but vary in tone from grey to black. But once the image becomes black it increases in size, and the change in density is not easy to follow. The images-out-of-focus method seems very promising, to judge by the published results of Dr Schwarzschild, who used a prepared comparison scale of densities, and interpolated for any given star from it. The most satisfactory photographic method would certainly be to take account of both size and blackness, *i.e.* to measure the total deposit in the film; as, for instance, by interposing the whole image in a given beam of light, and measuring the diminution of the beam caused by the obstruction. But no considerable piece of work has as yet been attempted on these lines.

Light of the Sun, Moon and Planets.

Even in a rapid sketch of so extensive a subject some notice must be taken of the application of photometry to the determination of the relative amount of light received on the earth from the sun, the moon and the planets. The methods by which these ratios have been obtained are as simple as they are ingenious; and for them we are mainly indebted to the labours of P. Bouguer and W. C. Bond (1789–1859). The former compared the light received from the sun with that from the moon in the following fashion in 1725. A hole one-twelfth of a Paris inch was made in the shutter of a darkened room; close to it was placed a concave lens, and in this way an image of the sun 9 in. in diameter was received on a screen. Bouguer found that this light was equal to that of a candle viewed at 16 in. from his eye. A similar experiment was repeated with the light of the full moon. The image now formed was only two-thirds of an inch in diameter, and he found that the light of this image was comparable with that of the same candle viewed at a distance of 50 ft. From these data and a very simple calculation it followed that the light of the sun was about 256,289 times that of the moon. Other experiments followed, and the average of all the results was that the light of the sun was about 300,000 times the average light of a full moon, both being viewed in the heavens at the same altitudes. The details will be found in Bouguer's *Traité d'optique*. W. H. Wollaston in 1829 tried a series of experiments in which the ratio 801,072 was obtained; but the omission of certain necessary precautions vitiates the result (*Phil. Trans.* 1829). Bond (*Mem. Amer. Acad.* 1861, p. 295) adopted a different process. He formed the image of the sun on a silvered globe of some 10 in. diameter; the light of this image was reflected on to a small mercurial thermometer bulb; and then this second image was compared with a Bengal light so moved that the lights appeared to be equal. The same process was adopted with the full moon instead of with the sun. The result was that the sun's light was 470,980 times that of the moon. Seidel long before this date had compared the light of the mean full moon with that of Jupiter in mean opposition; his result is 6430. So also this light of Jupiter was found to be ·4864 times that of Venus at her brightest; and Jupiter was found to give 8·2 times the light of *a* Lyrae. If, then, these numbers could be accepted with confidence, we should have the means of comparing the light received from the sun with that received from any of the stars. Adopting these precarious numbers on the authorities of Bond and Seidel we have the following results:—

Sun's light = 470,980 that of the full moon.
,, = 622,600,000 ,, Venus at her brightest.
,, = 302,835,000 ,, Jupiter at mean opposition.
,, = 5,970,500,000 ,, Sirius.

Very little Heat from the Stars.

Lastly, Bouguer, by comparing the light of the full moon viewed at different altitudes with an artificial light, found that the atmosphere absorbs ·1877 of the light incident on it at the zenith of any place. Professor Pritchard, from photometric measures taken at Cairo, found this number to be ·157. At Oxford it was ·209. Thus Bouguer's determination indicates an absorptive capacity in the atmosphere of Brittany just midway between those of Oxford and Cairo. Seidel at Munich expresses "surprise" at finding his own results so nearly accordant with Bouguer's. Although rather outside the domain of photometry in the strict sense, a word or two may be said here about recent attempts to measure the heat received from the stars, the first being made with the "radio-micrometer" of C. V. Boys (*Proc. Roy. Soc.* 1890). This is an extremely delicate instrument for measuring radiant heat, and consists of a very light thermo-electric circuit (two tiny bars of antimony and bismuth soldered together at one edge, the outer edges being connected by a hoop of copper wire) suspended by a quartz fibre (a torsion fibre of the very greatest sensitiveness) in a strong magnetic field. A minute quantity of radiant heat falling on one of the junctions of the circuit sets up a current in the circuit, which thus rotates in the magnetic field until brought to rest by the torsion of the fibre. For use on the heavenly bodies the radiant heat is collected to focus by a reflecting telescope (an object-glass would absorb it), and when the telescope is pointed to the moon the varying radiation from different parts of the disk is beautifully shown. No heat comes from the unlit portion, and of the illuminated portion the maximum is obtained from near the limb. But when pointed to the brightest stars no indications were obtained, although the instrument is sensitive enough to detect the heat from a candle more than a mile off. It seems certain that indications of heat from the stars obtained by previous observers must be spurious. It is also manifest that to obtain satisfactory results even more sensitive apparatus must be devised, and by using a radiometer and the powerful resources of the Yerkes Observatory E. F. Nichols succeeded in 1808 and 1900 in obtaining indications of heat from Arcturus and Vega, as well as from Jupiter and Saturn (*Astrophysical Journ.* xiii., 101), the heat received being comparable with that from a candle 6 m. away. We may place alongside this result that obtained by W. J. Dibdin (*Proc. Roy. Soc.* April 1892), who compared candle-light with twenty-one stars ranging to the sixth magnitude, and found the light of a second magnitude star equal to that of a candle at 1260 ft. (H. H. T.)

PHRAATES (PHRAHATES; Pers. *Frahāt*, modern *Ferhāt*), the name of five Parthian kings.

1. PHRAATES I., son of Priapatius, reigned *c.* 175–170 B.C. He subdued the Mardi, a mountainous tribe in the Elburz (Justin xli. 5; Isid. Charac. 7). He died young, and appointed as his successor not one of his sons, but his brother Mithradates I. (Justin xli. 5).

2. PHRAATES II., son of Mithradates I., the conqueror of Babylonia, reigned 138–127. He was attacked in 130 by Antiochus VII. Sidetes, who, however, in 129 was defeated and killed in a great battle in Media, which ended the Seleucid rule east of the Euphrates (see SELEUCID DYNASTY). Meanwhile the kingdom was invaded by the Scythians (the Tochari of Bactria), who had helped Antiochus. Phraates marched against them, but was defeated and killed (Justin xlii. 1; Johannes Antioch, *fr.* 66).

3. PHRAATES III., "the God" (Phlegon, *fr.* 12 *ap.* Photius *cod.* 97 and on some of his coins), succeeded his father, Sanatruces, in 70 B.C., at the time when Lucullus was preparing to attack Tigranes of Armenia, who was supreme in western Asia and had wrested Mesopotamia and several vassal states from the Parthian kingdom. Naturally, Phraates declined to assist Mithradates of Pontus and Tigranes against the Romans (see TIGRANES). He supported his son-in-law, the younger Tigranes, when he rebelled against his father, and invaded Armenia (65 B.C.) in alliance with Pompey, who abandoned Mesopotamia to the Parthians (Dio. Cass. xxxvi. 45, 51; Appian, *Mithr.* 104; Liv. *Epit.* 100). But Pompey soon overrode the treaty; he acknowledged the elder Tigranes, took his son prisoner, occupied the vassal states Gordyene and Osroëne for the Romans, and denied the title of "king of kings," which Phraates had adopted again, to the Parthian king (Plut. *Pomp.* 33, 38; Dio. Cass. xxxvii. 5 seq.). About 57 Phraates was murdered by his two sons, Orodes I. and Mithradates III.

4. PHRAATES IV., son of Orodes I., by whom he was appointed successor in 37 B.C., after the death of Pacorus. He soon murdered his father and all his thirty brothers (Justin xlii. 5; Plut. *Crass.* 33; Dio Cass. xlix. 23). He was attacked in 36 by Antonius (Mark Antony), who marched through Armenia into Media Atropatene, and was defeated and lost the greater part of his army. Believing himself betrayed by Artavasdes, king of Armenia, he invaded his kingdom in 34, took him prisoner, and concluded a treaty with another Artavasdes, king of Atropatene. But when the war with Octavianus Augustus broke out, he could not maintain his conquests; Phraates recovered Atropatene and drove Artaxes, the son of Artavasdes, back into Armenia (Dio. Cass. xlix. 24 sqq., 39 seq., 44; cf. li. 16; Plut. *Antonius*, 37 seq.). But by his many cruelties Phraates had roused the indignation of his subjects, who raised Tiridates II. to the throne in 32. Phraates was restored by the Scythians, and Tiridates fled into Syria. The Romans hoped that Augustus would avenge the defeat of Crassus on the Parthians, but he contented himself with a treaty, by which Phraates gave back the prisoners and the conquered eagles (20 B.C., *Mon. Anc.* 5, 40 sqq.; Justin xlii. 5); the kingdom of Armenia also was recognized as a Roman dependency. Soon afterwards Phraates, whose greatest enemies were his own family, sent five of his sons as hostages to Augustus, thus acknowledging his dependence on Rome. This plan he adopted on the advice of an Italian concubine whom he made his legitimate wife under the name of "the goddess Musa"; her son Phraates, commonly called Phraataces (a diminutive form), he appointed successor. About 4 B.C. he was murdered by Musa and her son (Joseph. *Ant.* xviii. 2, 4).

5. PHRAATES V., or PHRAATACES, the younger son of Phraates IV. and the "goddess Musa," with whom he is associated on his coins. Under him a war threatened to break out with Rome about the supremacy in Armenia and Media. But when Augustus sent his adopted son Gaius Caesar into the east in order to invade Parthia, the Parthians preferred to conclude a

treaty (A.D. 1), by which once again Armenia was recognized as in the Roman sphere (Dio. Cass. lv. 10; Velleius ii. 101). Soon after Phraataces and his mother were slain by the Parthians, about A.D. 5 (Joseph. *Ant.* xviii. 2, 4). (Ed. M.)

PHRANTZA, GEORGE [Georgios Phrantzes] (1401–*c.* 1477), the last Byzantine historian, was born in Constantinople. At an early age he became secretary to Manuel II. Palaeologus, in 1432 protovestiarius (great chamberlain), in 1446 praefect of Sparta, and subsequently great logothete (chancellor). At the capture of Constantinople by the Turks (1453) he fell into their hands, but managed to escape to Peloponnesus, where he obtained protection at the court of Thomas Palaeologus, despot of Achaea. After the downfall of the Peloponnesian princes (1460) Phrantza retired to the monastery of Tarchaniotes in Corfu. Here he wrote his *Chronicle*, containing the history of the house of the Palaeologi from 1258–1476. It is a most valuable authority for the events of his own times.

Editions by I. Bekker (1838) in the *Corpus scriptorum hist. byz.*, and in J. P. Migne, *Patrologia graeca*, clvi; see also C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897).

PHRAORTES, the Greek form of *Fravartish*, king of Media. According to Herodotus (i. 102) he was the son of Deioces, and began the Median conquests. He first subjugated the Persians, and then a great many other peoples of Asia, till at last he attacked the Assyrians, but was defeated and killed in a battle, after a reign of twenty-two years (about 646–625 B.C.; but perhaps, as G. Rawlinson supposes, the fifty-three years of Deioces ought in reality to be transferred to him). From other sources we obtain no information whatever about Phraortes; but the data of the Assyrian inscriptions prove that Assur-banipal (see Babylonia and Assyria), at least during the greater part of his reign, maintained the Assyrian supremacy in Western Asia, and that in 645 he conquered Susa. The Medians too were subject to him as far as the Elburz and the central Iranian desert.

When after the assassination of Smerdis all the Iranian tribes, the Babylonians and the Armenians rebelled against Darius and the Persian rule, "a man of the name of Fravartish (*i.e.* Phraortes), a Mede, rebelled in Media and spoke to the people thus: I am Khshathrita, of the family of Uvakhshatra (Cyaxares)." He reigned for a short time, but was defeated by Hydarnes, and afterwards by Darius himself, taken prisoner in Rhagae (Rai), and executed in Ecbatana (520 B.C.; see inscription of Darius at Behistun). (Ed. M.)

PHRENOLOGY, (from Gr. φρήν, mind, and λόγος, discourse), the name given by Thomas Ignatius Forster to the empirical system of psychology formulated by F. J. Gall, and developed by his followers, especially by J. K. Spurzheim and G. Combe, by whom it was named "cranioscopy," "craniology," "physiognomy" or "zoonomy." The principles upon which it is based are five: (1) the brain is the organ of the mind; (2) the mental powers of man can be analysed into a definite number of independent faculties; (3) these faculties are innate, and each has its seat in a definite region of the surface of the brain; (4) the size of each such region is the measure of the degree to which the faculty seated in it forms a constituent element in the character of the individual; (5) the correspondence between the outer surface of the skull and the contour of the brain-surface beneath is sufficiently close to enable the observer to recognize the relative sizes of these several organs by the examination of the outer surface of the head. It professes primarily to be a system of psychology, but its second and more popular claim is that it affords a method whereby the disposition and character of the subject may be ascertained.

History.—That the phenomena of mind are in some measure connected with the action of the brain has been recognized from a very early age of philosophy. It is true that Aristotle[1] describes the brain as the coldest and most bloodless of bodily organs, of the nature of water and earth, whose chief purpose is to temper the excessive heat of the heart, as the cooler regions of the firmament condense the vapours rising from the earth. In his view, as in that of most of the earlier writers of other nations of antiquity, the heart is the seat of life; to it, not to the brain, the Hebrew writers refer thoughts and affections, while they considered judgment as seated sometimes in the head, sometimes in the kidneys.[2] This was likewise the teaching of the ancient Egyptian philosophy; and hence, while many rites were practised and prayers offered for the preservation of the heart of the deceased, there were none for the conservation of the brain.[3] We learn from Diogenes Laertius[4] that Pythagoras held more accurate physiological views, as he taught that the mind and the intellect have their seat in the brain. The theory of Hippocrates was Pythagorean rather than Aristotelian, for, although in one passage in his work *De corde* he expresses himself doubtfully, yet elsewhere he clearly states that he considers the brain to be the index and messenger of the intellect.[5] The cerebral seat of sense-perception is also taught by Plato,[6] who puts into the mouth of Socrates the theory that the brain is the organ affected by the senses, whereby memory and opinion arise, and from whence knowledge springs. The classic poets also notice this dependence of mind on brain; for example, in the *Clouds* (v. 1276) Strepsiades accuses Amynias of not being in his right mind, and, on being asked why, responds, "You seem to me as if you had had a concussion of the brain."

The two founders of anatomical science, Erasistratus and Herophilus, who lived in the days of Ptolemy Soter, taught not only that the brain was the seat of sensation and of intellect, but also that there was therein a certain degree of localization of function. Erasistratus believed that the sensory nerves arose from the brain-membranes, the motor from the cerebral substance. Herophilus was apparently the first who held that the vital forces resided in and circulated from the ventricles of the brain, at least so we gather from Celsus and the other authors who have preserved his views. By the influence of the writings of Galen,[7] which directly teach that the brain is the seat of soul and intellect the Pythagorean doctrine prevailed among the later philosophers. According to the Galenical theory the animal spirits have their origin in the ventricles of the brain, and pass into the heart from which they are conveyed by the arteries through the body. Galen in one place (viii. 159) refers their origin to the brain-substance, but the ventricular theory was that adopted by his followers, some of whom suggested that there was some relation between the shape of the head and the character and disposition of the mind.[8] The Arabian physicians Averroes[9] and Rhazes[10] adopted the Galenical doctrine and developed the hypothesis of a fourfold ventricular localization of faculties, which the Greeks had originated. Avicenna[11] added to these a fifth region. Such of the early Christian authors as referred in their writings to the relation of soul to body naturally adopted the teaching of Galen which they accommodated to their theology, thereby conferring on it an importance which rendered correction difficult. Tertullian[1] in a sense expresses his belief in a theory of localization as also at a later period does Thomas Aquinas.[2]

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[1] *De partibus animalium*, ii. c. 7 (Paris, 1629, p. 986).

[2] In the Chaldee portion of Daniel (ii. 28, iv. 5, vii. 1) visions and thoughts are referred to the head. For other particulars as to early views see Nasse on the psychical relations of the heart in *Zeitschr. f. psychische Aerzte* (1818), vol. i. A few of the later medical writers express similar views; see Santa Cruz, *Opuscula medica*, Madrid (1624).

[3] *Book of the Dead*, ch. xxvi.–xxx.

[4] viii. 30; ed. Cobet, Paris (1850), p. 211,—Φρένας δὲ καὶ νοῦν, τὰ ἐν τῷ ἐγκεφάλῳ.

[5] *De morbo sacro*, on *Opp.* ed. Kühn, i. 612 seq.; also *Epist.* iii. 824. Among later writers Licetus of Genoa taught the co-extension of soul and body, upon which subject he wrote two books (Padua, 1616). In this connexion may be noted a curious work by Schegkius, *Dialogus de animae principatu, Aristotelis et Galeni rationes praeferens quibus ille cordi, hic cerebro, principatum attribuit* (Tübingen, 1542).

[6] *Phaedo*, Valpy's ed. 1833, ch. xlv., p. 128. See also Haller's *Bibl. anat.*, i. 30.

[7] *De usu partium*, ed. Kühn, iii. 700.—τὰς μὲν οὖν ἀποδείξεις τοῦ τὴν λογιστικὴν ψυχὴν οἰκεῖν ἐν ἐγκεφάλῳ, καὶ πνεῦμα ψυχικὸν ἐν αὐτῷ περιέχεσθαι πάμπολυ. See also v. 288, viii. 159, xv. 360. In his *Definitiones medicae* (467, xix. 459) he says that the brain has a ψυχικὴ δύναμις, but does not specify in what part the power inheres.

[8] See Paulus Aegineta, Stephen's ed. 1567, cap. 62, col. 363, also Actuarius, *De actionibus et affectibus spiritus animalis* (Paris, 1556), p. 22, c. 7.

[9] *Comment. in Arist.*, Latin tr. (Venice, 1550), vi. 73.

[10] "Imaginatio quidem in doubus ventriculis anterioribus perficitur. Cogitatio vero in medio expletur. Memoria autem posteriorem possidet ventriculam." *De re medica*, Gérard's trans. (Basel, 1554), i. 9.

[11] *Lib. canonis* (1507), p. 19, and *De naturalibus*, c. 6.

Early in the 13th century Albertus Magnus[3] gave a detailed description of the distribution of mental and psychical faculties in the head. The anterior region he assigned to judgment, the middle to imagination, and the posterior to memory. A somewhat similar allocation was made by Gordon, professor of medicine in Montpellier (1296),[4] who assigned common sensation and the reception of impressions to the anterior cornua of the lateral ventricles, *phantasia* to the posterior, this power being two-fold (*imaginativa* and *cogitativa*), judgment or *aestimativa* to the third ventricle, and memory to the fourth.[5] Figures of a similar division were given by Petrus Montagnana[6] and Lodovico Dolce[7] still later by Ghiradelli of Bologna[8] and by Theodore Gall of Antwerp.[9] That the "vital spirits" resided in the ventricles was doubted by many, and denied by a few of the anatomists of the 17th century. G. Bauhin in 1621[10] attacked the old view, and Hoffmann of Altorf showed that, as the ventricles were closed cavities, they could not transmit any material fluid. That these spirits existed at all was doubted by Alexander Benedictus,[11] Plater,[12] and a few others; but they were believed in by the great majority of 17th and even of 18th century medical writers, many of whom conceived that the ventricles were *semper pleni spiritibus animalibus flammulis similibus, quorum beneficiis intelligimus, sentimus, et movemus*,[13] and the opponents of this view were strongly assailed by J. Riolan and others as revolutionary. Columbus[14] ridiculed the idea that the convoluted surface can have anything to do with intellect, as the ass, a proverbially stupid animal, has a convoluted cerebrum. According to his view, the convolutions are for the purpose of lightening the brain and facilitating its movements. The grey matter of the surface of the cerebrum was recognized as the true dynamic element by M. Malpighi[15] and T. Willis.[16] The latter regarded the convoluted surface of the cerebrum as the seat of the memory and the will, the convolutions being intended to retain the animal spirits for the various acts of imagination and memory. Imagination he described as seated in the corpus callosum, sense-perception in the corpus striatum, and *impetus et perturbatio* in the basal parts of the cerebrum above the crura. The thalami he regarded as the centres of sight and the cerebellum of involuntary acts. Succeeding anatomists simply varied these localizations according to their respective fancies. G. M. Lancisi placed sense-perception in the corpus callosum, R. Vieussens in the centrum ovale majus. R. Descartes supposed the soul to be seated in the pineal gland, others in the brain-commissures especially the pons Varolii.[17] Meyer considered abstract ideas to arise in the cerebellum, and memory to have its seat at the roots of the nerves.[18]

Of later writers three deserve special notice, as having largely prepared the way for the more modern school of phrenology. J. A. Unzer, of Halle, in his work on physiology extended the pre-existing theories of localization. Metzger,[19] twenty years before the publication of Prochaska's work, had proposed to make a series of observations on the anatomical characters of the brains of persons of marked intellectual peculiarity; but apparently he did not carry this into effect. In a more special manner Prochaska of Vienna may be looked upon as the father of phrenology, as in his work on the nervous system, published in Vienna in 1784, are to be found the germs of the later views which were propounded in that city twelve years later.[20]

The system formulated by Gall (*q.v.*) is thus a modern expansion of an old empirical philosophy, and its immediate parentage is easily traced, although, according to Gall's account, it was with him the result of independent observations. These, he tells us, he began to make at an early age, by learning to correlate the outward appearances and mental qualities of his schoolfellows. Gall's first published paper was a letter in the *Deutscher Merkur* of December 1798, but his principal expositions were oral, and attracted much popular attention, which increased when, in 1802, he was commanded by the Austrian government, at the instance of the ecclesiastical authorities, to discontinue his public lectures. In 1804 he obtained the co-operation of Spurzheim (1776–1832), a native of Longwich, near Treves, who became his pupil in 1800, and proved a powerful ally in promulgating the system. Master and pupil at first taught in harmony, but they found it advisable to separate in 1813; and we find Spurzheim, several years after their parting, declaring that Gall had not introduced any improvements into his system since their separation (notes to Chenevix, p. 99). "My philosophical views," he also says, "widely differ from those of Gall."

In Paris, where he settled in 1807, Gall made many influential converts to his system. F. J. V. Broussais, H. M. D. de Blainville, H. Cloquet, G. Andral, E. Geoffroy St-Hilaire, Vimont and others adopted it and countenanced its progress. Gall visited Great Britain, but the diffusion of phrenology here was chiefly due to Spurzheim, who lectured through the country and through America, and with the aid of his pupil, George Combe, attracted a large popular following. His most influential disciples were J. Elliotson, Andrew Combe, Sir G. S. Mackenzie, R. Macnish, T. Laycock and Archbishop R. Whately, and in America Caldwell and J. Godman. On the opposite side many influential men took up a strongly antagonistic position, prominent among whom were J. Barclay the anatomist, P. M. Roget, Sir Charles Bell, Sir W. Hamilton, F. Jeffrey, H. P. Brougham, T. Brown and Sir B. Brodie. The nature of the system rendered it eminently fitted to catch public attention, and it rapidly attained to so great a degree of popularity that in 1832 there were twenty-nine phrenological societies in Great Britain, and several journals devoted to phrenology in Britain and America; of these the *Phrenological Journal*, a quarterly, edited chiefly by George Combe with aid from others of the Edinburgh confraternity, notably Sir George Mackenzie and Macnish, "the modern Pythagorean," lived from 1823 to 1847, through twenty volumes. The controversy in many places was heated and often personal, and this largely increased the popular interest. In the *Edinburgh Review* the theory was severely criticized by Thomas Brown, and afterwards in a still more trenchant manner by Jeffrey. In *Blackwood* it was ridiculed by Professor John Wilson. Being a subject which lent itself easily to burlesque, it was parodied cleverly in a long rhyme by two authors, "The Craniad," 87 pages long, published in 1817, while, on the other hand, verse was pressed into its service in the rhyme "Phrenology in Edinburgh" in 1824.[1] The best defence of the system was that by Chenevix in the third number of the *Foreign Quarterly*, afterwards reprinted with notes by Spurzheim.

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[1] *De anima*, cxiv. (ed. Franeker, 1597), p. 268.

[2] *Summa theologiae*, ed. Migne, i. 1094, 1106–7. Prochaska and his translator, Laycock (*Mind and Brain*, ii. 163), charge Duns Scotus with holding this view; probably he did, but he does not express it, as he simply specifies the cerebrum and its root, the spinal cord, as the source of the nerves along which sensory impulses travel. *Comment. de anima*, i. 515 (Leiden, 1637).

[3] *Opera*, iii. 124, vi. 20 (Leiden, 1651).

[4] *Lilium medicinae*, 101 (Venice, 1494).

[5] Avicenna's fifth region is interposed between *imaginativa* and *aestimativa* (*De naturalibus*, c. vi.). Thomas Aquinas combines the last two, which he says are possessed by the same eminence. On the other hand, he says of *ratio particularis*, "medici assignant determinatum organum, scilicet mediam partem capitis" (i. 1106).

[6] *Physiognomia* (Padua, 1491).

[7] *Dialogo nel quale si ragione del modo di accrescere e conservar la memoria*, 27 (Venice, 1562).

[8] *Physiognomia*, 1670.

[9] *Tabulae element. scientiae* (Rome, 1632).

[10] *Theatr. anat.* (Basel, 1621, iii. 314); Caspar Hoffmann, *De usu cerebri* (Leipzig, 1619). See also Spigelius, *De corp. humani fabrica*, 296 (Amsterdam, 1645); Varolius (1591), p. 6; Wepfer, *Historiarum apoplecticarum potissimum anatomiae subjectorum auctarium* (Amsterdam, 1681). See also many of the anatomical works of this age, such as those of Fernel, Cabrol, Argenterius, Rolfinck, &c.

[11] Alexander Benedictus, *Anatomica*, vol. iii. (Basel, 1527). Quercetanus is said by Laycock (following Prochaska)to have assailed this doctrine of spirits; on what ground is not apparent, as he certainly expresses himself as a believer in the old view; see *Tetras graviss. totius capitis affect.* x. 89 (Marburg, 1606). Possibly Prochaska may allude to an obscure passage in the work of the other Quercetanus (Eustachius), *Acroamaton in librum Hippocratis*, p. 14 (Basel, 1549), not to the better-known Josephus Armeniacus; but he gives no reference.

[12] *Opera*, col. 22, 89 (Basel, 1625).

[13] *Joelis opera medica*, 22 (Amsterdam, 1663).

[14] *De re anatomica*, p. 350 (Frankfort, 1593).

[15] "Epist. de cerebro et cort. cereb. ad Fracassatum," in *Opp.*, vol. ii. (Geneva, 1685).

[16] *De anima brutorum*, p. 71 (Oxford, 1677), "hae particulae subtilissimae, spiritus animales dictae, partium istarum substantias corticales primo subeuntes, exinde in utriusque meditullia," &c.; also p. 76 seq.

[17] Fechner, *Elemente der Psychophysik*, ii. 396.

[18] Some of the medieval views were very fanciful, thus Shabbethai b. Abraham, the earliest Jewish writer on medicine (d. A.D. 959), thought that the spirit of life has its seat in the brain-membrane, expanded over the brain and subarachnoid fluid, as the Shekinah in the heavens arched over the earth and waters. See *Der Mensch als Gottes Ebenbild*, ed. Jellinek (Leipzig, 1854), and Castelli, *Commento* (Florence, 1880).

[19] *Vermischte medicinische Schriften* (1764), i. 58.

[20] See Laycock's trans.. in *Sydenh. Society's Pub.* (1851).

The Faculties and their Localities.—The system of Gall was constructed by a method of pure empiricism, and his so-called organs were for the most part identified on slender grounds. Having selected the place of a faculty, he examined the heads of his friends and casts of persons with that peculiarity in common, and in them he sought for the distinctive feature of their characteristic trait. Some of his earlier studies were made among low associates, in gaols and in lunatic asylums, and some of the qualities located by him were such as tend to become perverted to crime. These he named after their excessive manifestations, mapping out organs of murder, theft, &c.; but as this cast some discredit on the system the names were changed by Spurzheim, who claimed as his the moral and religious considerations associated with it. Gall marked out on his model of the head the places of twenty-six organs as round enclosures with vacant interspaces. Spurzheim and Combe divided the whole scalp into oblong and conterminous patches (see the accompanying figures). Other methods of division and other names have been suggested by succeeding authors, especially by Cox, Sidney Smith (not Sydney), Toulmin Smith, K. G. Carus of Dresden, Don Mariano Cubi i Solar, W. B. Powell of Kentucky, J. R. Buchanan of Cincinnati, Hittel of New York. Some, like the brothers Fowler, raise the number of organs to forty-three; but the system of Spurzheim and Combe is that which has always been most popular in Britain.

Spurzheim separated the component faculties of the human mind into two great groups and subdivided these as follows:—

- I. Feelings, divided into—
  - 1. Propensities, internal impulses inviting only to certain actions.
  - 2. Sentiments, impulses which prompt to emotion as well as to action.
    - A. Lower—those common to man and the lower animals.
    - B. Higher—those proper to man.
- II. Intellectual faculties.
  - 1. Perceptive faculties.
  - 2. Reflective faculties.

In the following list the locality and the circumstances of the first recognition of the organ are appended to the names, which are mostly the inventions of Spurzheim. Gall's names are placed in brackets.[2]

Propensities.

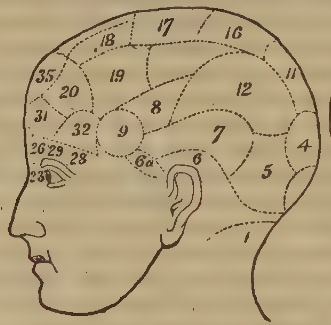
1. Amativeness (*Instinct de la génération*), median, below the inion; first determined by Gall from its heat in an hysterical widow, supposed to be confirmed by many observations, and referred to the cerebellum.[3]

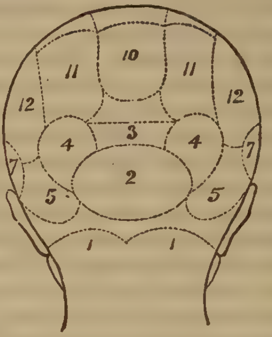
2. Philoprogenitiveness (*Amour de la progéniture*), median, on the squama occipitis, and selected as the organ for the love of children because this part of the skull is usually more prominent in apes and in women, in whom the love of children is supposed to be stronger than in men.

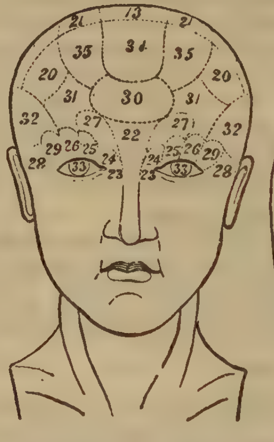
3. Concentrativeness, below the obelion and over the lambda. This is a region of uncertain function, unnoticed by Gall, but described as Inhabitiveness by Spurzheim, because he found it large in cats and in a clergyman fond of his home. It has since been considered by Combe to be the seat of the power of concentration, whereof he believed Inhabitiveness to be a special case.

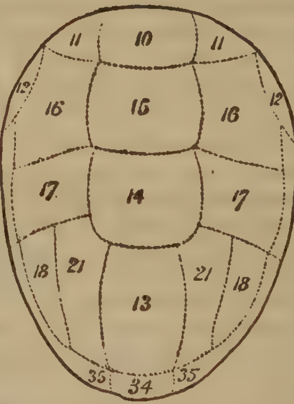
4. Adhesiveness (*Amitié*), over the lateral area of the lambdoidal suture. This region was prominent in a lady introduced to Gall as a model of friendship, and is said by him to be the region where persons who are closely attached put their heads together.

5. Combativeness (*Instinct de la défense*), above the asterion; it was found by Gall by examining the heads of the most quarrelsome of his low companions whom he had beforehand stimulated by alcohol. It was verified by comparing this region with the same part of the head of a quarrelsome young lady.









6. Destructiveness (*Instinct carnassier*), above the ear meatus. This is the widest part of the skulls of carnivorous animals, and was found large in the head of a student so fond of torturing animals that he became a surgeon, also large in the head of an apothecary who became an executioner.

6*a*. Alimentiveness, over the temporal muscle and above the ear. Hoppe describes it as being large in a gourmand acquaintance, and he therefore supposes it to be the origin of selecting food.

7. Secretiveness (*Ruse, Finesse*), the posterior part of the squamous suture.

8. Acquisitiveness (*Sentiment de la propriété*), on the upper edge of the front half of the squamous suture. This part of the head Gall noticed to be prominent in the pickpockets of his acquaintance.

9. Constructiveness (*Sens de méchanique*), on the stephanion; detected by its prominence on the heads of persons of mechanical genius. It was found large on the head of a milliner of uncommon taste and on a skull reputed to be that of Raphael.

The organ of Vitativeness, or love of life, is supposed by Combe to be seated at the base of the skull. To this locality Herophilus referred most of the intellectual powers.

Lower Sentiments.

10. Self-esteem (*Orgueil, fierté*), at and immediately over the obelion; found by Gall in a beggar who excused his poverty on account of his pride. This was confirmed by the observation that proud persons held their heads backwards in the line of the organ.

11. Love of Approbation (*Vanité*), outside the obelion; the region in which Gall saw a protuberance on the head of a lunatic who fancied herself queen of France.

12. Cautiousness (*Circonspection*), on the parietal eminence; placed here because an ecclesiastic of hesitating disposition and a vacillating councillor of state had both large parietal eminences.

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[1] Other burlesque and satirical writings were published at this time, notably *The Phrenologists*, a farce by Wade (1830); *The Head-piece, or Phrenology opposed to Divine Revelation*, by James the Less; and *A Helmet for the Headpiece, or Phrenology incompatible with Reason*, by Daniel the Seer.

[2] For topographical purposes Broca's names are adopted as the most convenient for localities on the head.

[3] Apollonius Rhodius speaking of the love of Medea for Jason (*Argonautica*, iii. 760–765) says, δάκρυ δ' ἀπ' ὀφθαληῶν ῥέεν· ἔνδοθι δ' αἰεὶ τεῖρ' ὀδύνη σμύχουσα διὰ χροός, ἀμφὶ ἀραῖας ἶνος καὶ κεφαλῆς, ὑπὸ νείατον ἰνίον ἄχρις, . . .

Superior Sentiments.

13. Benevolence (*Bonté*), on the middle of the frontal bone in front of the coronal suture; here Gall noticed a rising on the head of the highly commended servant of a friend, as well as on a benevolent schoolmate who nursed his brothers and sisters when they were ill. To this spot Xenocrates referred the intellectual powers.

14. Veneration (*Sentiment réligieux*), median at the bregma. Gall noted when visiting churches that those who prayed with the greatest fervour were prominent in this region, and it was also prominent in a pious brother.

15. Conscientiousness, Believingness (Forster) unknown to Gall; recognized by Spurzheim usually from its deficiency, and placed between the last and the parietal eminence.

16. Firmness (*Fermeté*), median, on the sagittal suture from behind the bregma to the front of the obelion. Lavater first pointed out that persons of determination had lofty heads.

17. Hope, not regarded as primary by Gall, who believed hope to be akin to desire and a function of every faculty which desires and left this territory unallocated.

18. Wonder, said to be large in vision-seers and many psychic researchers. A second similar organ placed between this and the next is called Mysterizingness by Forster, and is said to be the seat of belief in ghosts and in the supernatural.

19. Ideality (*Poésie*), noted by Gall from its prominence in the busts of poets; said to be the part touched by the hand when composing poetry.

20. Wit (*Esprit caustique*), the frontal eminence, the organ of the sense of the ludicrous, prominent in F. Rabelais and J. Swift.

21. Imitation (*Faculté d'imiter*), disposition to mimicry, placed between Benevolence and Wonder.

Perceptive Faculties.

22. Individuality, over the frontal sinus in the middle line; the capacity of recognizing external objects and forming ideas therefrom; said to have been large in Michelangelo, and small in the Scots.

23. Form (*Mémoire des personnes*), capacity of recognizing faces; gives a wide interval between the eyes; found by Gall in a squinting girl with a good memory for faces.

24. Size, over the trochlea at the orbital edge; described by Spurzheim and Vimont as the capacity of estimating space and distance.

25. Weight, outside the last on the orbital edge and, like it, over the frontal sinus. The prominence of ridge here is due to large sinus or a projecting bone. Certain old writers, such as Strato Physicus, located the whole intellect in this ridge.

26. Colour, also on the orbital edge external to the last.

27. Locality (*Sens de localité*), placed above Individuality on each side, and corresponding to the upper part of the frontal sinus and to the region immediately above it.

28. Number, on the external angular process of the frontal bone, large in a calculating boy in Vienna.

29. Order, internal to the last, first noted by Spurzheim in an orderly idiot.

30. Eventuality (*Mémoire des choses*), the median projection above the glabella, supposed to be the seat of the memory of events.

31. Time, below the frontal eminence and a little in front of the temporal crest.

32. Tune (*Sens des rapports des tons*), on the foremost part of the temporal muscle, where Gall noticed a bulge on the head of a musical prodigy of five.

33. Language (*Sens des mots*), behind the eye. This was the first organ noticed by Gall, as a clever schoolfellow, quick at languages, had prominent eyes. Old authors had noted the connexion between prominent eyeballs and mental development; thus Gazzali and Syenensis Medicus Cyprius place the intellect and soul behind the eyeballs.

Reflective Faculties.

34. Comparison (*Sagacité comparative*), median, at the top of the bare region of the forehead, where a savant friend of Gall's, fond of analogies, had a prominent boss.

35. Causality (*Esprit métaphysique*), the eminence on each side of Comparison, noticed on the head of Fichte and on a bust of Kant; the seat of the faculty of correlating causes and effects.

The first identification of each organ was made by an induction from very limited data, but the founders and exponents of the system have collected all available instances wherein enlargements of each of these regions coexisted with increased powers of the faculty supposed to reside therein, and in some cases they have discovered coincidences of a surprising nature. When, however, such do not exist, a convenient excuse is found by reference to the indefinite article of temperament, or by a supposed explanation of the faculty in question as not simple but produced by the co-operation of other influences. Thus, as Sheridan's bump of wit was small, he is said not to have been truly witty; but to have had comparison and memory strongly developed. The girl Labrosse (described in Férussac's *Bulletin* for October 1831), who exhibited strong amativeness but had a rudimentary cerebellum, is said to have obliterated it by over-use. Thurtell, a cold-blooded murderer, whose organ of benevolence was large, is said to have been generous, as he once gave half-a-guinea to a friend, &c.

The method whereby the sizes of organs are estimated is arbitrary and the boundaries of the regions indefinite. The attempts of Nicol, Straton and Wight to devise mechanical and accurate modes of measurement have not been very successful and have not found favour with the professional phrenologist.

Anatomical Aspect of Phrenology.—The phrenological controversy served the useful purpose of stimulating research into the anatomy of the brain; but we owe very little of solid progress to the advocates of the system. Gall is the only writer of his creed in whose works original observations of value are to be found, and Dr B. Holländer has cited many interesting and carefully recorded anatomical and clinical facts in his writings. Although the study of the surface of the cerebrum is of the essence of phrenology, yet nowhere in the circle of phrenological literature are the convolutions of the brain accurately described; our knowledge of their order and disposition comes from the morphologist, not from the phrenologist. The first real step towards their systematic description was made by L. Rolando,[1] who in 1830 described the fissure to which his name is attached, and very little advance was made until the publication in 1856 of L. P. Gratiolet's[2] and Huschke's[3] memoirs. These works for the first time placed the description of the surface of the brain, imperfectly attempted by L. A. Desmoulins in 1825,[4] on a satisfactory basis.

A description of the anatomy of the brain is given under the heading BRAIN, so it is necessary here only to refer to points not included in that account.

1. Any psychological theory which correlates brain-action and mental phenomena requires a correspondence between brain-size and mental power; and, speaking generally, the brains of those whose capacities are above the average are larger than those of the general run of their fellow-men.

2. Direct measurements of the relative developments of different portions of brains are difficult and troublesome to make; but their importance to phrenologists is so great that it is remarkable that no attempts to obtain any such were made by them. The series given by R. Wagner of the relative sizes of the cerebral lobes of four brains is almost the only record of importance in this direction, and is appended.

Brain of	Square Inches. Surface of Frontal Lobe.	Surface of Parietal Lobe.	Surface of Occipital Lobe.	Surface of Temporo-Sphenoidal.	Relation of Frontal Lobe (Perceptive and Reflective Organs) to whole Surface = 1.	Relation of Parietal Lobe (Sentiments) to Surface = 1.	Relation of Remaining Surface (Propensities) to Surface = 1.	Extent of Free Surface.	Extent of Surface of Involutions.	Total Extent of Surface.	Weight in Grammes.
Fuchs, clinical teacher . .	143·4	69·5	59	67·5	·419	·203	·340	110·7	231·3	342	1499
Gauss, mathematician . .	139	70·6	59·4	68·4	·407	·207	·374	112·8	228·2	341	1492
Workman . .	113·2	62·3	50·3	62	·385	·214	·385	97·4	193·6	291	1273
Woman . .	130	65	51	66·8	·409	·204	·370	107·5	209.9	317·4	1185

From this it appears that the woman exceeded Gauss in perceptive and reflective organs, exceeded Fuchs in sentiment, and fell below the workman in propensities. It must be said, however, that the phrenological divisions do not accurately coincide with the anatomical. It would furnish important physiological data if the brains of men distinguished for special qualities were examined in this or some comparable way.

3. It is important in relation to phrenology to ascertain the constancy of the convolutions. Many varieties in the detail of the surface-patterns have been recorded by Tenchini, Poggi, Giacomini, N. Rüdinger, Cunningham and Sernow,[5] but the general plan is fairly uniform. A still more important question has been recently raised by J. N. Langley, viz. how far identical spots on

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[1] *Della Struttura degli emisferi cerebrali* (Turin, 1830).

[2] *Mémoire sur les plis cérébraux de l'homme et des primates* (Paris, 1856).

[3] *Schädel, Hirn, und Seele* (Jena, 1856).

[4] Magendie and Desmoulins, *Anat. du syst. nerveux* (Paris, 1825).

[5] *Rivista sperimentale di freniatria* (1883), ii. 193; ibid. iv. 403; *Archiv für Anthropologie* (1879), xi. 289.

identical convolutions in different brains consist of nerve-cells with precisely the same connexions. The convoluted arrangement results from growth of brain-surface under constraint, hence as the different tracts of surface undergo proportional overgrowth they may fold along different lines. The occurrence of small differences in the rate of overgrowth, testified to by the varieties of the resulting pattern, can hardly fail to cause considerable alteration in the place of definite territories of grey cells. Some method for the determination of the limits of these shiftings of place is required before comparisons can be of value as phrenological data.

4. The comparison of the rate of growth of brain with the development of mental faculties is important not only to the phrenologist but to the psychologist. No observations on this point were made by phrenological writers, who only refer to the first and rather crude observations of the earlier anatomists. We have, however, recently learned from the researches of T. L. W. von Bischoff, Tuczec, Cunningham, and S. Exner[1] many particulars as to the rate and progress of brain-growth. At birth the brain weighs one-tenth of the weight of the body, and averages about 11 oz. For the first year brain-growth and consequently expansion of the skull proceed with great rapidity, the growth during a large part of this period averaging one cubic centimetre daily. This enormous increase is chiefly due to the rapid development of medullated nerve-fibres, which are deficient in the foetal brain. During the second and third years growth takes place more slowly, the occipital and parietal lobes increasing more than the frontal or temporo-sphenoidal. During these and the four succeeding years the base elongates commensurately with the increasing depth of the face. In the sixth and seventh years the frontal lobes grow faster than the parietals, and at seven the average brain has attained the weight of 1340 grammes, being the weight of the body as 1 : 20. In the period between seven years and puberty growth is slight, but at puberty the whole brain grows actively, especially the frontal lobes. This activity lasts until about eighteen years of age, then diminishes; but the average brain does not reach its maximum size until about thirty, from a little after which period the brain tends to diminish towards senility.[2]

5. The estimation of the relative development of grey and white matter in the several lobes is important to any theory of cerebral dynamics which allocates functions specifically diverse to each separate part of the brain-surface; but no attempt has been made by the phrenologist to obtain precise results in this direction, nor even to determine the physical constants of the two forms of brain-matter. The recently introduced method of Bourgoin and B. Danilewski, based upon the differing specific gravities of grey and white matter, promises to give definite information as to the relative amounts of these forms of brain-matter; but further experiments are needed to perfect the method.[3]

6. The relations, if any, between the alterations which take place in the shape and position of the head and alterations in brain-surface have been speculated on by the phrenologist. Broussais is reported to have said that his organ of causality had enlarged with increasing use, and a list of cases of similar alterations of head-shape is given by Deville (*Phrén. Journ.* xiv. 32), most of which are simply age-changes, of the kind described by Professor J. Cleland (*Phil. Trans.*, 1870). There are no exact measurements recorded which indicate the occurrence of topical increases of a normal brain in special directions coincident with the cultivation of definite faculties. All the so-called cases are given vaguely, with no measurements, and the careful measurements of George Combe in such cases as were available to him showed no appreciable alterations in adult heads even at long intervals of time (see also Andrew Combe, *Phren. Journ.* x. 414).

7. The phrenological want of knowledge of the topography of the brain-surface was necessarily correlated with ignorance of the exact relations of the convolutions to the interior of the cranial bones; these have been carefully worked out by E. Huschke, Heffler, W. A. Turner, Cunningham and Reid. Some latitude, however, must be allowed in topography, as the exact relation of convolution of skull varies with the shape of the skull. Giacomini showed that the fissure of Rolando is perceptibly farther back from the coronal suture in dolichocephalic than in brachycephalic skulls, and it is still farther back in the extreme boat-shaped form of long-headedness. Passet shows that there is a slight topographical difference in the two sexes (*Arch. f. Anthrop.*, 1882, xiv. 89), and in the heads of those with a symmetrically-shaped skull there is often a want of lateral symmetry of convolution. Artificial deformations likewise alter the topographical relations of convolutions, and have served not a little to puzzle the phrenologist. Thus, the artificial dolichocephaly of the Caribs having bulged the squama occipitis, they decided that these people must be amiable lovers of children,[4] &c.

8. The existence of structural differences between different areas of cerebral surface is important to any theory of cerebral localization, but no phrenologist has given us any original information on this point. Since the investigation of J. G. F. Baillarger[5] and Bevan-Lewis it has been shown that some local differentiations of structure do really exist. Thus in the convolutions around the fissure of Rolando the ganglion-cells of the fourth layer are of large size (giant-cells of Betz), and in the convolutions of the temporo-sphenoidal lobe a layer of small angular cells (granule-cells) is interposed between the larger pyramidal and the ganglion-cells, so that, while in the parts of the brain above the fissure of Sylvius the gray cortex is for the most part five-layered, below and behind that fissure it is six-layered. There is no abrupt passage from the one to the other, the only sudden transition of structure of the grey cortex being at the hippocampal sulcus; and giant-cells, although of smaller size, and less like those of the anterior cornu of the spinal cord, are scattered over other parts of the cerebral grey matter.[6]

Other local variations in structure have been described by Elliot Smith and other histologists.

The teaching of anatomy with regard to phrenology may be summarized thus: (1) the rate of growth of brain is concurrent with the rate of development of mental faculty; (2) there is some degree of structural differentiation as there are varying rates of development of different parts of the cerebral surface; (3) there is no accordance between the regions of Gall and Spurzheim and definite areas of cerebral surface.

Physiological Aspect.—The theory of some of the older metaphysicians, that the mind, in feeling and reflection, makes use of no material instrument is not now accepted by psychologists. It was advanced by Brougham and Jeffrey as against the theory of phrenology; but the doctrine that the brain is the organ of the mind is now universally received. While it is probable that certain molecular changes in the grey matter are antecedents or concomitants of mental phenomena, the precise nature of these processes, to what extent they take place, or how they vary among themselves have not as yet been determined experimentally; the occurrence of the change can only be demonstrated by some such coarse method as the altered pulsation of the carotid arteries,[7] the increase of the temperature of the head,[8] the abstraction, during brain-action, of blood from other organs as shown by the plethysmograph, or the formation of lecithin and other products of metabolism in brain-substance. As yet no light has been shed on the connexion between the molecular changes in the nerve-cell and the phenomena of thought and feeling. While our knowledge of the anatomy of the brain, especially of the grey nuclei and of the white bands uniting them, has in recent years become much more accurate (see articles BRAIN and MUSCLE AND NERVE), our knowledge of the physiology of the nerve centres is still indefinite and fragmentary, even when the utmost allowance is made for the experimental work of C. S. Sherrington, A.S.F. Grünbaum, F. Goltz and others; and the hypotheses relating to the division of labour in the nerve-centres is chiefly based on anatomical structure. Certain masses of grey nerve-matter situated in the spinal cord and medulla oblongata are so linked by nerve-cords to organs outside the nervous system which are set apart for the discharge of separate functions that they obviously form parts of the mechanism for the fulfilment of such functions. In cases where these can be subjected to experiment we learn that they are nervous centres presiding over the discharge of such functions; and it has been determined by experiment, or else deduced from anatomical structure, that in those lower parts of the nervous centres which are more directly connected with the segmental elements of the body there is a certain localization of function; hence the centres of pelvic actions, of respiration, cardiac action, and inhibition of vaso-motor influence, deglutition, secretions, &c., can be mapped out in ascending series. As certain of these centres are united by bands of fibres to the larger and higher-lying grey portions of the nervous centres there is an a priori presumption in favour of the extension of this principle of localization. This has been premised on metaphysical as well as on anatomical grounds. A. B. Bonnet long ago believed each portion of the brain to have a specifically separate function, and Herbert Spencer has said that "no physiologist can long resist the conviction that different parts of the cerebrum subserve different kinds of mental action. Localization of function is the law of all organization; separateness of duty is universally accompanied with separateness of structure, and it would be marvellous were an exception to exist in the cerebral hemispheres. Let it be granted that the cerebral hemispheres are the seats of the higher psychical activities; let it be granted that among these higher psychical activities there are distinctions of kind which, though not definite, are yet practically recognizable, and it cannot be denied, without going in direct opposition to established physiological principles, that these more or less distinct kinds of psychical activity must be carried on in more or less distinct parts of the cerebral hemisphere."

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[1] *Neurologisches Centralblatt* (1883), p. 457.

[2] Weisbach, *Med. Jahrbuch. der k. Gesellsch, der Aerzte*, xvii. 133 (Vienna, 1869); Merkel, *Beiträge z. post-embryonalen Entwickelung des menschl. Schädel* (Bonn, 1882); Calori, *Mem. de l'accad. di Bologna* (1871), x. 35. Cunningham, *Cunningham Memoir*, Royal Irish Academy.

[3] *Centralblatt* (1880), No. 14; *Beiträge zur Biologie* (Stuttgart 1882).

[4] Martius tells us that the Caribs castrate their own children, fatten and eat them, an abuse of the organ of philoprogenitiveness; see also Garcilaso de la Vega, *Hist. des Incas*, i. 12.

[5] *Mém. de l'acad. de médecine* (1840), viii. 149.

[6] For further particulars of structure, in addition to the authors quoted at i. 878, see Bevan-Lewis and Clark, *P.R.S.*, (1878), and *Phil. Trans.* (1880 and 1882).

[7] See Eugène Gley, "Sur les conditions physiologiques de la pensée," in *Archives de physiologie* (1881), p. 742.

[8] J. S. Lombard, *N. Y. Med. Journal* (June 1867), and *Experimental Researches on the Regional Temperature of the Head* (London, 1872).

For a masterly review of the old and the new association and localization theories, see W. Wundt's *Grundzüge der physiologischen Psychologie*, i. 289 sqq.; also the same author's *Essays*, Leipzig (1888), pp. 109 sqq.

There is a large weight of evidence in favour of the existence of some form of localization of function. So little is known of the physical changes which underlie psychical phenomena, or indeed of the succession of the psychical processes themselves, that we cannot as yet judge as to the nature of the mechanism of these centres. So much of the psychic work of the individual life consists in the interpretation of sensations and the translation of these into motions that there are strong a priori grounds for expecting to find that much of the material of the nerve-centres is occupied with this kind of work, but in the present conflict of experimental evidence it is safer to suspend judgment. That these local areas are not centres in the sense of being indispensable parts of their respective motor apparatuses is clear, as the function abolished by ablation of a part returns, though tardily, so that whatever superintendence the removed region exercised apparently becomes assumed by another part of the brain.[1] Experimental physiology and pathology, by suggesting other functions for parts of the brain-surface, are thus directly subversive of many details of the phrenology of Gall and Spurzheim.

Psychological Aspect.—The fundamental hypothesis which underlies phrenology as a system of mental science is that mental phenomena are resolvable into the manifestations of a group of separate faculties. A faculty is defined as "a convenient expression for the particular states into which the mind enters when influenced by particular organs; it is applied to the feelings as well as to the intellect, thus the faculty of benevolence means every mode of benevolence induced by the organ of benevolence" (Combe). In another work the same author says it is "used to denote a particular power of feeling, thinking, perceiving, connected with a particular part of the brain." The assumption is contained in the definition that the exercise of a faculty is the physical outcome of the activity of the organ, and in several of the standard works this is illustrated by misleading analogies between these and other organs; thus the organs of benevolence and of firmness are said to be as distinct as the liver and pancreas. The mind, according to another author, consists of the sum of all the faculties. In this view the unity of consciousness is somewhat difficult to explain, and consequently there is assumed by others a single unifying substratum, and on this the organs are supposed to act; thus thoughts are defined as "relations of the simple substance, mind, to certain portions of the encephalon" (Welsh, *Phren. Journ.* i. 206). Gall himself believed that there was but a single principle which saw, felt, tasted, heard, touched, thought and willed (*Fonctions du cerveau*, i. 243); and the American exponent of phrenology, Caldwell, says "the mind is as single in its power as it is in its substance; it is a quickening and operating principle, essential to all the mental faculties, but does not, by any means, possess them itself" (*Elements*, p. 16). It is not easy to understand the supposed relation of this hypothetical substratum to the separate faculties acting on it. It must be both immaterial and unconnected with the brain, as the whole two thousand million cells supposed to exist in the cerebral hemispheres are all parcelled out among the faculties, and none are left for the unifying *nous*.

Each organ is considered as engaged, either independently in bringing forth its own product, or collectively with others in elaborating compound mental states, and according to their several degrees of development and activity they are considered capable of perceiving, conceiving, recollecting, judging or imagining each its own subject. This mechanical conception of the division of labour in the production of the phenomena of mind has the charm of simplicity, but is attended with the difficulty that arises in discriminating the operations of the different organs one from the other. Phrenologists are apt to be vague respecting the limits of the several faculties, as about the boundaries of the separate organs. It was pointed out by Jeffrey that the lines of demarcation between benevolence, adhesiveness and philoprogenitiveness were indeterminate, although the organs are not very close, and the same applies to other organs.

It is unfortunate for the clearness of the definition that, although historically the faculties were the first phenomena noted, independent of and previous to their localization, yet in the definition the faculties are defined in terms of their localities.

The following arguments are adduced in favour of the fundamental separateness of the faculties: (1) analogy—elsewhere in the animal economy division of labour is the rule; (2) the variety of mental endowment observed among children before they are influenced by education, and the inequalities in the mental endowments of individuals; (3) the phenomena of insanity, especially of monomania; (4) the varying periods at which individual faculties attain their maximum development; (5) the phenomena of dreams, and the awakening of a limited number of faculties during them; (6) pain being felt in an organ when it is overtaxed.[2]

Such faculties are supposed to be primary—(1) as exist in some animals and not in others, (2) as vary in their development in the sexes, (3) as are developed in varying proportions with regard to other faculties, (4) as may act separately from other faculties, (5) as are not necessarily simultaneous with other faculties in action, (6) as are hereditary, and (7) as may be singly diseased.

According to the development of their powers mankind may be divided into six classes: (1) those in whom the highest qualities are largely developed and the animal qualities feeble; (2) those with the reversed conditions developed, with large animal and feeble intellectual and moral faculties; (3) those in whom good and evil are in constant war, with active animal and strong intellectual faculties and sentiments; (4) those partial geniuses in whom a few qualities are unusually developed, while the rest are at or below the mediocre standard; (5) those men of moderate endowment in whom some faculties are nearly or quite deficient; (6) those with an unvarying standard of undistinguished mediocrity in all their faculties.

It is perhaps unfortunate that the word "faculty" has been used in this sense of original power by phrenologists. It would have been better to employ, as Mr Lewes suggests, the term

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[1] For cases, see Rochefontaine, *Archives de Physiologie* (1883), 28; Bianchi, *La Psichiatria*, i. 97.

[2] It is interesting in this connexion to note that in a case published by Professor Hamilton in *Brain* (April 1884), where a tumour existed on the occipital lobe, the pain was persistently referred to the forehead. Many similar cases are to be noticed among the records of localized brain-lesions. Bearing on this point also it is worth noting, once for all, that in nothing is the purely hypothetical nature of phrenological description better realized than in the accounts of what these authors call the "natural language of the faculties,"—that poets are supposed to touch ideality when composing, musicians to press on tone and time, and painters on form and colour, when in the exercise of their arts! Yet we are gravely taught this in the standard works on the subject.

"function" for the native activity of an organ, and to leave "faculty" for the expression of an acquired activity. "Faculty is properly limited to active power, and therefore is abusively applied to the mere passive affections of the mind" (Hamilton, *Lectures*, i. 177).

An attempt has been recently made by Dr Bernard Holländer to correlate the doctrines of phrenology with the modern physiological and pathological observations which bear upon the localization of function. In his works *The Mental Functions of the Brain*, under the sub-title "The Revival of Phrenology" (1901), and in *Scientific Phrenology* (1902), the author endeavours to bring Gall's clinical and pathological instances into line with more modern observations. He deprecates the craniology of Gall, as far as it deals with mere "bumps," and honours him, with justice, as the recorder of many facts worth saving out of the wreck of his system; and he endeavours, though with doubtful success, to establish an unbroken connexion between phrenology, in the Greek sense, and our present knowledge of cerebral localization.

The substance of Holländer's first work is of two kinds. The one kind is a tabulated statement of many hundred cases of different forms of mania, with injury or disease limited to one portion of the brain; the other kind is a tabulated statement of cases of injury or disease of the brain, followed by perversion, or exaltation, or loss of some definite instinct or faculty of consciousness.

He divides the tabulated cases of mania into three groups: (i) Melancholia; (ii) Irascible Insanity, "Mania furiosa"; (iii) Mania with suspicion and delusions of persecution. For these three groups of cases he lays down the following rules: (i) Melancholia is especially associated with injury or disease of the parietal lobe of the brain, more particularly with injury or disease of the convolutions underlying the parietal eminences of the skull, *i.e.* the supramarginal and angular convolutions. (ii) Mania furiosa is especially associated with injury or disease of the central portion of the temporal lobe. (iii) Mania with suspicion and delusions of persecution is especially associated with injury or disease of the posterior portion of the temporal lobe.

The second kind of cases, where injury or disease of the brain, strictly localized to one part or another of its grey matter, was followed by perversion, exaltation or loss of some one instinct, habit or faculty, includes cases of kleptomania, cases of voracious hunger and thirst, cases of sexual desire exalted or lost, and cases of loss of certain special memories, as of words, tunes, numbers and the like.

These two collections of recorded cases, taken from a vast mass of clinical and pathological literature accumulated during the past century, have been arranged by Dr Holländer with great industry; so as to extend the limits of the study of cerebral localization, and to advance it from the observation of the motor areas and the special sense centres to the observation of the higher acts and states of consciousness. Modern physiology, from its objective point of view, is engaged over finer and finer issues of microscopic and experimental work; and, from its subjective point of view, is becoming more and more psychological, seeking a higher level of interpretation, and a statement of the departmental life of the brain in terms of ever-increasing complexity. The motor centres, governing the voluntary purposeful movements of the body, are considered to be not simply motor, but "psycho-motor"; the speech-centres are not homogeneous, but are on experimental grounds differentiated into sub-centres for the utterance of words, the recognition of words and the understanding of words; the visual centres are in like manner subdivided according to the consciousness involved in the complete act of vision. There is room, therefore, for a "higher phrenology," if it can show clear evidence in favour of the localization, in determinate regions of the brain, of the physical changes accompanying certain states of consciousness.

Of the two kinds of cases that Dr Holländer has tabulated, it cannot be said that the cases of mania are convincing. Some of them are altogether beside the mark; *e.g.* he quotes two cases of melancholia, after an injury over the left parietal bone, which were cured by an operation limited to the scalp (excision of a painful scar, removal of a small nerve-tumour of the scalp); in neither case was anything done to the skull or to the brain, but both patients were cured of their melancholy. Again, the acceptance of these rules as to the localization of these insane thoughts involves the localization of sane thoughts in the same areas of the brain, and this in turn involves assumptions that are wholly unwarranted by our present knowledge. Moreover, cases of mania are so common that it might be possible to find an equal number of cases to controvert his rules: we want *consecutive*, not *picked* cases. If 5000 consecutive fatal cases of these different kinds of mania, with the post mortem record of each case, were tabulated, we should then begin to stand on surer ground. Again, though Dr Holländer seems to argue well, where he says that the facial and other movements, induced by direct electrical stimulation of certain convolutions are such as express the mental states which he attributes to those convolutions, yet this argument is insecure, partly because Sherrington's recent work, on the motor area of the anthropoid apes, has rendered it necessary to reconsider the present localization of the motor area in man, and partly because the interpretation of facial and muscular movements as representing this or that state of the emotions is always precarious.

The second kind of cases, where injury or disease limited to one portion of the brain is followed by perversion, exaltation or loss of some special instinct or habit, is more valuable and more convincing; especially the cases of voracious hunger and thirst, those of true kleptomania, and those of the loss of certain special memories. It is not so easy to believe that the cerebellum is in any primary way associated with sexual desire: its position, its structure and its proved association with the co-ordination of muscular movements seem clearly to indicate that its work is wholly subordinate and complementary to the work of the cerebral hemispheres; and the evidence adduced in favour of its being the "seat" of the sexual impulses hardly amounts to more than a probability that it may transmit or co-ordinate the performance of the sexual act.

Practical Application.—"Die Schädellehre ist allerdings nicht so sehr Irrthum in der Idee als Charlatanerie in der Ausführung," says one of its most acute critics. Even though no fault could be found with the physiology and psychology of phrenology, it would not necessarily follow that the theory could be utilized as a practical method of reading character; for, although the inner surface of the skull is moulded on the brain, and the outer surface approximates to parallelism thereto, yet the correspondence is sufficiently variable to render conclusions therefrom uncertain. The spongy layer or diploe which separates the two compact tables may vary conspicuously in amount in different parts of the same skull, as in the cases described by Professor Humphry (*Journ. of Anat.* viii. 137). The frontal sinus, that *opprobrium phrenologicum*, is a reality, not unfrequently of large size, and may wholly occupy the regions of five organs. The centres of ossification of the frontal and parietal bones, the muscular crests of these and of the occipital bones also, differ in their prominence in different skulls. Premature synostoses of sutures mould the brain without doing much injury to its parts. In such cases there are compensatory dilatations in other directions modifying sometimes to an extreme degree the relation of brain-surface to skull-surface. The writer has found such displacements in extremely scaphocephalic skulls; the same is true of accidental deformations due to pressure on the infantile skull before it consolidates. Artificial malformations alter the apparent skull shape considerably while they affect the relative development of the parts of the brain cortex but little. All these and other cogent reasons of a like kind, whose force can be estimated by those accustomed to deal with the component soft parts of the head, should lead phrenologists to be careful in predicating relative brain-development from skull-shape. Psychology, physiology and experience alike contribute to discredit the practical working of the system and to show how worthless the so-called diagnoses of character really are. Its application by those who are its votaries is seldom worse than amusing, but it is capable of doing positive social harm, as in its proposed application to the discrimination or selection of servants and other subordinate officials. It has even been proposed to use it for the purposes of the guarantee society and for the selection of parliamentary representatives. The sarcastic suggestion which originated with Christopher North of moulding children's heads so as to suppress the evil and foster the good was actually repeated in good faith by a writer on phrenology, but experience of the effects of malformation leads one to be sceptical as to the feasibility of this mode of producing a social Utopia.

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PHRYGIA, the name of a large country in Asia Minor, inhabited by a race which the Greeks called Φρύγες, *freemen.*[1] Roughly speaking, Phrygia comprised the western part of the great central plateau of Anatolia, extending as far east as the river Halys; but its boundaries were vague,[2] and varied so much at different periods that a sketch of its history must precede any account of the geography. According to unvarying Greek tradition the Phrygians were most closely akin to certain tribes of Macedonia and Thrace; and their near relationship to the Hellenic stock is proved by all that is known of their language and art, and is accepted by almost every modern authority. The country named Phrygia in the better known period of history lies inland, separated from the sea by Paphlagonia, Bithynia, Mysia and Lydia. Yet we hear of a Phrygian "thalassocracy" at the beginning of the 9th century B.C. The Troad and the district round Mt Sipylus are frequently called Phrygian, as also is the seaport Sinope; and a district on the coast between Sestus and the river Cius was regularly named Little Phrygia; names like Mygdones, Doliones and Phryges or Briges, &c., were widely current both in Asia Minor and in Europe. The inference has been generally drawn that the Phrygians belonged to a stock widespread in the countries which lie round the Aegean Sea. There is, however, no conclusive evidence whether this stock came from the east over Armenia, or was European in origin and crossed the Hellespont into Asia Minor; but modern opinion inclines decidedly to the latter view.

According to Greek tradition there existed in early time a Phrygian kingdom in the Sangarius valley, ruled by kings among whom the names Gordius and Midas were common. It was known to the ancient Greeks of Ionia and the Troad as something great and half-divine. When the goddess appeared to her favourite Anchises she represented herself as daughter of the king of Phrygia; the Phrygians were said to be the oldest people, and their language the original speech of mankind; the Phrygian kings were familiar associates of the gods, and the heroes of the land tried their skill against the gods themselves; we hear of the well-walled cities of Phrygia and of the riches of its kings. Tradition is completely corroborated by archaeological evidence. In the mountainous region on the upper waters of the Sangarius, between Kutaiah Eski Shehr and Afium (Afiom) Kara Hissar, there exist numerous monuments of great antiquity, showing a style of marked individuality, and implying a high degree of artistic skill among the people who produced them. On two of these monuments are engraved the names of "Midas the King" and of the goddess "Kybile the Mother." Even the title "king" (ἄναξ)[3] appears to have been borrowed by Greek from Phrygian.

It is impossible to fix a date for the beginning of the Phrygian kingdom. It appears to have arisen on the ruins of an older civilization, whose existence is revealed to us only by the few monuments which it has left. These monuments, which are found in Lydia, Phrygia, Cappadocia and Lycaonia, as well as in north and central Syria, point to the existence of a homogeneous civilization over those countries; they show a singularly marked style of art, and are frequently inscribed with a peculiar kind of hieroglyphics, engraved *boustrophedon*; and they originated probably from a great Hittite kingdom, whose kings ruled the countries from Lydia to the borders of Egypt. There can be traced in Asia Minor an ancient road-system, to which belongs the "royal road" from Sardis to the Persian capital, Susa (Herod. v. 55). The royal road followed a route so difficult and circuitous that it is quite unintelligible as the direct path from any centre in Persia, Assyria or Syria to the west of Asia Minor. It can be understood only by reference to an imperial centre far in the north. The old trade-route from Cappadocia to Sinope, which had passed out of use centuries before the time of Strabo (pp. 540, 546), fixes this centre with precision. It must be far enough west to explain why trade tended to the distant Sinope,[4] hardly accessible behind lofty and rugged mountains, and not to Amisus by the short and easy route which was used in the Graeco-Roman period. This road-system, then, points distinctly to a centre in northern Cappadocia near the Halys. Here must have stood the capital of some great empire connected with its extremities, Sardis or Ephesus on the west, Sinope on the north, the Euphrates on the east, the Cilician Gates on the south, by roads so well made as to continue in use for a long time after the centre of power had changed to Assyria, and the old road-system had become circuitous and unsuitable.[5] The precise spot on which the city stood is marked by the great ruins of Boghaz Keui, probably the ancient Pteria, of which the wide circuit, powerful walls and wonderful rock-sculptures make the site indisputably the most remarkable in Asia Minor. On this site Winckler found in 1907 the records of the Hittite kings who fought against Egypt and Assyria.

The ancient road from Pteria to Sardis crossed the upper Sangarius valley, and its course may be traced by the monuments of this early period. Close to its track, on a lofty plateau which overhangs the Phrygian monument inscribed with the name of "Midas the King," is a great city, inferior indeed to Pteria in extent, but surrounded by rock-sculptures quite as remarkable as those of the Cappadocian city. The plateau is 2 m. in circumference, and presents on all sides a perpendicular face of rock 50 to 200 ft. in height. This natural defence was crowned by a wall partly Cyclopean, partly built of large squared stones.[6] This city was evidently the centre of the old Phrygian kingdom of the Sangarius valley, but at least one of the monuments in it seems to belong to the older period of Cappadocian supremacy, and to prove that the city already existed in that earlier time. The Phrygian kingdom and art therefore took the place of an older civilization. It is probable that the tradition of battles between the Phrygians and the Amazons on the banks of the Sangarius preserves the memory of a struggle between the two races and the victory of the Phryges.

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[1] The meaning is given in Hesych, *s.v.* "Βρίγες."

[2] The difficulty of specifying the limits gave rise to a proverb—χωρὶς τὰ Φρυγῶν.

[3] ϝανακτει on the Midas tomb. It is expressly recorded that τυραννος is a Lydian word. Βασιλεύς resists all attempts to explain it as a purely Greek formation, and the termination assimilates it to certain Phrygian words.

[4] Sinope was made a Greek colony in 751 B.C., but it is said to have existed long before that time.

[5] When the Persians conquered Lydia they retained, at least for a time, this route, which they found in existence.

[6] The stones have all fallen, but the line where they were fitted on the rocks can be traced by any careful explorer. The small fortress Pishmish Kalessi is a miniature of the great city beside it. (See Perrot, *Explor. Archéol.* p. 169 and pl. viii.)

Of the monuments that exist around this city two classes may be confidently referred to the period of Phrygian greatness. That which is inscribed with the name of "Midas the King" is the most remarkable example of one class, in which a large perpendicular surface of rock is covered with a geometrical pattern of squares, crosses and maeanders, surmounted by a pediment supported in the centre by a pilaster in low relief. In some cases a floral pattern occupies part of the surface, and in one case the two sides of the pediment are filled by two sphinxes of archaic type.[1] In some of these monuments a doorway is carved in the lower part; the door is usually closed, but in one case, viz. the sphinx monument just alluded to, the valves of the door are thrown wide open and give access to a little chamber, on the back of which is sculptured in relief a rude image of the Mother-goddess Cybele, having on each side of her a lion which rests its forepaws on her shoulder and places its head against hers. Sometimes a grave has been found hidden behind the carved front; in other cases no grave can be detected, but it is probable that they are all sepulchral.[2] The imitation of woodwork is obvious on several monuments of this kind. The second class is marked by the heraldic type of two animals, usually lions rampant, facing one another, but divided by a pillar or some other device. This type is occasionally found conjoined with the preceding; and various details common to both classes show that there was no great difference in time between them. The heraldic type is used on the monuments which appear to be the older, and the geometrical pattern is often employed on the inscribed monuments, which are obviously later than the earliest uninscribed. Monuments of this class are carved on the front of a sepulchral chamber, the entrance to which is a small doorway placed high and inaccessible in the rocks. There are also many rock monuments of the Roman time.

Early Phrygian art stands in close relationship with the art of Cappadocia. The monuments of the type of the Midas tomb are obviously imitated from patterns which were employed in cloth and carpets and probably also in the tilework on the inside of chambers varying slightly according to the material. Such patterns were used in Cappadocia, and the priest in the rock-sculpture at Ibriz wears an embroidered robe strikingly similar in style to the pattern on the Midas tomb; but the idea of using the pattern as the Phrygians did seems peculiar to themselves. The heraldic type of the second class is found also in the art of Assyria, and was undoubtedly adopted by the Phrygians from earlier art; but it is used so frequently in Phrygia as to be specially characteristic of that country.[3] While Phrygian art is distinctly non-Oriental in spirit, its resemblance to archaic Greek art is a fact of the greatest importance. It is not merely that certain types are employed both in Phrygia and in Greece, but several favourite types in early Greek art can be traced in Phrygia, employed in similar spirit and for similar purposes. The heraldic type of the two lions is the device over the principal gateway of Mycenae, and stamps this, the oldest great monument on Greek soil, with a distinctly Phrygian character. Mycenae was the city of the Pelopidae, whom Greek tradition unhesitatingly declares to be Phrygian immigrants. A study of the topography of the Argive plain suggests the conclusion that Mycenae, Midea and Tiryns form a group of cities founded by an immigrant people in opposition to Argos, the natural capital of the plain and the stronghold of the native race. Midea appears to be the city of Midas, and the name is one more link in the chain that binds Mycenae to Phrygia. This connexion, whatever may have been its character, belongs to the remote period when the Phrygians inhabited the Aegean coasts. In the 8th and probably in the 9th century B.C. communication with Phrygia seems to have been maintained especially by the Greeks of Cyme, Phocaea and Smyrna. About the end of the 8th century Midas, king of Phrygia, married Damodice, daughter of Agamemnon, the last king of Cyme. Gyges, the first Mermnad king of Lydia (687–653), had a Phrygian mother. The worship of Cybele spread over Phocaea to the west as far as Massilia: rock monuments in the Phrygian style and votive reliefs of an Anatolian type are found near Phocaea. Smyrna was devoted to the Phrygian Meter Sipylene. It is then natural that the Homeric poems refer to Phrygia in the terms above described, and make Priam's wife a Phrygian woman. After the foundation of the Greek colony at Sinope in 751 there can be no doubt that it formed the link of connexion between Greece and Phrygia. Phrygian and Cappadocian traders brought their goods, no doubt on camels, to Sinope, and the Greek sailors, the ἀειναῦται of Miletus, carried home the works of Oriental and Phrygian artisans. The Greek alphabet was carried to Phrygia and Pteria, either from Sinope or more probably direct east from Cyme, in the latter part of the 8th century. The immense importance of Sinope in early times is abundantly attested, and we need not doubt that very intimate relations existed at this port between the Ionic colonists and the natives. The effects of this commerce on the development of Greece were very great. It affected Ionia in the first place, and the mainland of Greece indirectly; the art of Ionia at this period is almost unknown, but it was probably closely allied to that of Phrygia.[4] A striking fact in this connexion is the use of a very simple kind of Ionic capital in one early Phrygian monument, suggesting that the "proto-Ionic" column came to Greece over Phrygia. It is obvious that the revolution which took place in the relations between Phrygians and Greeks must be due to some great movement of races which disturbed the old paths of communication. Abel is probably correct in placing the inroads of the barbarous European tribes, Bithynians, Thyni, Mariandyni, &c., into Asia Minor about the beginning of the 9th century B.C. The Phrygian element on the coast was weakened and in many places annihilated; that in the interior was strengthened; and we may suppose that the kingdom of the Sangarius valley now sprang into greatness. The kingdom of Lydia appears to have become important about the end of the 8th century, and to have completely barred the path between Phrygia and Cyme or Smyrna. Ionian maritime enterprise opened a new way over Sinope.[5]

The downfall of the Phrygian monarchy can be dated with comparative accuracy. Between 680 and 670 the Cimmerians in their destructive progress over Asia Minor overran Phrygia; the king Midas in despair put an end to his own life; and from henceforth the history of Phrygia is a story of slavery, degradation and decay, which contrasts strangely with the earlier legends. The catastrophe seems to have deeply impressed the Greek mind, and the memory of it was preserved. The date of the Cimmerian invasion is fixed by the concurrent testimony of the contemporary poets Archilochus and Callinus, of the late chronologists Eusebius, &c., and of the inscriptions of the Assyrian king Esar-haddon. The Cimmerians were finally expelled from Asia Minor by Alyattes before his war with the Medes under Cyaxares (590–585 B.C.). The Cimmerians, therefore, were ravaging Asia Minor, and presumably held possession of Phrygia, the only country where they achieved complete success, till some time between 610 and 590. Phrygia then fell under the Lydian power, and by the treaty of 585 the Halys was definitely fixed as the boundary between Lydia and Media (see Lydia and Persia). The period from 675 to 585 must therefore be considered as one of great disturbance and probably of complete paralysis in Phrygia. After 585 the country was ruled again by its own princes under subjection to Lydian supremacy. To judge from the monuments, it appears to have recovered some of its old prosperity; but the art of this later period has to a great extent lost the strongly marked individuality of its earlier bloom. The later sepulchral monuments belong to a class which is widely spread over Asia Minor from Lycia to Pontus. The graves are made inside a chamber excavated in the rock, and the front of the chamber imitates a house or temple. No attempt is made to conceal the entrance or to render it inaccessible. The architectural details are in some cases unmistakably copied, without intentional modification, from the architecture of Greek temples; others point perhaps to Persian influence, while several—which are perhaps among the early works of this period—show the old freedom and power of employing in new and original ways details partly learned from abroad. This style continued in use under the Persians, under whose rule the Phrygians passed when Cyrus defeated Croesus in 546, and lasted till the Roman period. One monument appears to presuppose a development of Greek plastic art later than the time of Alexander[1] and is almost certainly of the Roman time. It would, however, be wrong to suppose that the influence of truly Hellenic art on Phrygia began with the conquest of Alexander. Under the later Mermnad kings the Lydian empire was penetrated with Greek influence, and Xanthus, the early Lydian historian, wrote his history in Greek. Under the Persian rule perhaps it was more difficult for Greek manners to spread far east; but we need not think that European influence was absolutely unfelt even in Phrygia. The probability is that Alexander found in all the large cities a party favourable to Greek manners and trade. Very little is to be learned from the ancient writers with regard to the state of Phrygia from 585 to 300. The slave-trade flourished: Phrygian slaves were common in the Greek market, and the Phrygian names Midas and Manes were stock-names for slaves. Herodotus (i. 14) records that a king Midas of Phrygia dedicated his own chair at Delphi; the chair stood in the treasury of Cypselus, and cannot have been deposited there before 680 to 660 B.C. It is not improbable that the event belongs to the time of Alyattes or Croesus, when Greek influence was favoured throughout the Lydian empire; and it is easy to understand how the offering of a king Midas should be considered, in the time of Herodotus, as the earliest made by a foreign prince to a Greek god. The Phrygian troops in the army of Xerxes were armed like the Armenians and led by the same commander.

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[1] Published in *Journ. Hell. Stud.* (1884).

[2] The monuments of Phrygia fall into two groups, which probably mark the sites of two cities about 16 m. distant from each other, Metropolis and Conni. One group lies round the villages of Yazili-Kaya, Kumbet, Yapuldak and Bakshish; the other beside Liyen, Bei Keui, Demirli and Ayazin.

[3] The heraldic type continues on gravestones down to the latest period of paganism. Carpets with geometrical patterns of the Midas-tomb style are occasionally found at the present time in the houses of the peasantry of the district.

[4] See Furtwängler, *Goldfund von Vettersfelde*, Winckelm. Progr. (1884); Hogarth, &c., *The Archaic Artemisia* (British Museum, 1908). The closest analogies of old Phrygian art are to be found in the earliest Greek bronze work in Olympia, Italy and the northern lands.

[5] Hipponax, *fr.* 36 [49], proves that a trade-route from Phrygia down the Maeander to Miletus was used in the 6th century.

It is to be presumed that the cities of the Sangarius valley gradually lost importance in the Persian period. The final castastrophe was the invasion of the Gauls about 270 to 250; and, though the circumstances of this invasion are almost unknown, yet we may safely reckon among them the complete devastation of northern Phrygia. At last Attalus I. settled the Gauls permanently in eastern Phrygia, and a large part of the country was henceforth known as Galatia. Strabo mentions that the great cities of ancient Phrygia were in his time either deserted or marked by mere villages. The great city over the tomb of Midas has remained uninhabited down to the present day. About 5 m. west of it, near the modern Kumbet, stood Metropolis, a bishopric in the Byzantine time, but never mentioned under the Roman empire.

Alexander the Great placed Phrygia under the command of Antigonus, who retained it when the empire was broken up. When Antigonus was defeated and slain, at the decisive battle of Ipsus, Phrygia came under the sway of Seleucus. As the Pergamenian kings grew powerful, and at last confined the Gauls in eastern Phrygia, the western half of the country was incorporated in the kingdom of Pergamum. Under the Roman empire Phrygia had no political existence under a separate government, but formed part of the vast province of Asia. In autumn 85 B.C. the pacification of the province was completed by Sulla, and throughout the imperial time it was common for the Phrygians to date from this era. The imperial rule was highly favourable to the spread of Hellenistic civilization, which under the Greek kings had affected only a few of the great cities, leaving the mass of the country purely Phrygian. A good deal of local self-government was permitted; the cities struck their own bronze coins, inscribed on them the names of their own magistrates,[2] and probably administered their own laws in matters purely local. The western part of the country was pervaded by Graeco-Roman civilization very much sooner than the central, and in the country districts the Phrygian language[3] continued in common use at least as late as the third century after Christ.

When the Roman empire was reorganized by Diocletian at the end of the 3rd century Phrygia was divided into two provinces, distinguished at first as Prima and Secunda, or Great and Little, for which the names Pacatiana and Salutaris soon came into general use. Pacatiana comprised the western half, which had long been completely pervaded by Graeco-Roman manners, and Salutaris the eastern, in which the native manners and language were still not extinct. Each province was governed by a *praeses* or ἡγεμών about A.D. 412, but shortly after this date an officer of consular rank was sent to each province (Hierocles, *Synecd.*). About 535 Justinian made some changes in the provincial administration: the governor of Pacatiana was henceforth a *comes*, while Salutaris was still ruled by a *consularis*. When the provinces of the Eastern empire were reorganized and divided into *themata* the two Phrygias were broken up between the Anatolic, Opsician and Thracesian themes, and the name Phrygia finally disappeared. Almost the whole of Byzantine Phrygia is now included in the vilayet of Brusa, with the exception of a small part of Parorius and the district about Themisonium (Karayuk Bazar) and Ceretapa (Kayadibi), which belong to the vilayet of Konia, and the district of Laodicea and Hierapolis, which belongs to Aidin. The principal modern cities are Kutaiah (Cotyaeum), Eski Shehir (Dorylaeum), Afiom Kara Hissar (near Prymnessus), and Ushak (Trajanopolis).

It is impossible to say anything definite about the boundaries of Phrygia before the 5th century. Under the Persians Great Phrygia extended on the east to the Halys and the Salt Desert; Xenophon (*Anab.* i. 2, 19) includes Iconium on the south-east within the province, whereas Strabo makes Tyriaeum the boundary in this direction. The southern frontier is unknown: the language of Livy (xxxviii. 15) implies that the southern Metropolis (in the Tchul Ova) belonged to Pisidia; but Strabo (p. 629) includes it in Phrygia. Celaenae, beside the later city of Apamea (Dineir), and the entire valley of the Lycus, were Phrygian. The Maeander above its junction with the Lycus formed for a little way the boundary between Phrygia and Lydia. The great plateau now called the Banaz Ova was entirely or in great part Phrygian. Mt Dindymus (Murad Dagh) marked the frontier of Mysia, and the entire valley of the Tembrogius or Tembris (Porsuk Su) was certainly included in Phrygia. The boundaries of the two Byzantine Phrygias were not always the same.

Taking Hierocles as authority, the extent of the two provinces at the beginning of the 6th century will be readily gathered from the accompanying list, in which those towns which coined money under the Roman empire are italicized and the name of the nearest modern village is appended.

I. Pacatina.—(1) *Laodicea* (Eski Hissar); (2) *Hierapolis* (Pambuk Kalessi); (3) Mosyna (Geveze); [(4) Motellopolis, only in *Notitiae*

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[1] A gorgoneum of Roman period, on a tomb engraved in *Journ. Hell. Stud.* (Pl. xxvi.).

[2] This liberty was not granted to the cities of any other province in Anatolia.

[3] A number of inscriptions in a language presumably Phrygian have been discovered in the centre and east of the country; they belong generally to the end of the 2nd and to the 3rd century.

Episcop. (Medele)]; (5) *Attudda* (Assar); (6) *Trapezopolis* (Bolo S. from Serai Keui); (7) *Colossae* (near Chonas); (8) *Ceretapa Diocaesarea* (Kayadibi); (9) *Themisonium* (Karayuk Bazar); (10) Tacina (Yarishli); (11) Sanaus (Sari Kavak, in Daz Kiri); (12) *Dionysopolis* (Orta Keui); (13) Anastasiopolis, originally a village of the Hyrgaleis (Utch Kuyular); (14) Attanassus (Eski Aidan); (15) Lunda (Eski Seid); (16) *Peltae* (Karayashlar); (17) *Eumenea* (Ishekli); (18) *Siblia* (Homa); (19) Pepuza (Duman or Suretli); (20) *Bria* (Bourgas); (21) *Sebaste* (Sivasli); (22) Eluza or Aludda (Hadjimlar); (23) *Acmonia* (Ahat Keui); (24) *Alia* (Kirka); (25) *Siocharax* (Otourak), (26) *Dioclea* (Dola); (27) *Aristium* (Karaj Euren, in Sitchanli Ova); (28) *Cidyessus* (Geukche Eyuk); (29) *Apia* (Abia); (30) *Cotyaeum* (Kutaiah); (31) *Aezani* (Tchavdir Hissar); (32) *Tiberiopolis* (Amed); (33) *Cadoi* (Gediz); (34) *Ancyra* (Kilisse Keui); (35) *Synaus* (Simav); (36) *Flaviopolis Temenothyrae* (Ushak); (37) *Trajanopolis Grimenothyrae* (Giaour Euren, near Orta Keui); (38) *Blaundus* (Suleimanli)

II. SALUTARIS.—(1) *Eucarpia* (Emir Assar); (2) *Hieropolis* (Kotch Hissar); (3) *Otrous* (Tchor Hissar); (4) *Stectorium* (Mentesh); (5) *Bruzus* (Kara Sandykly)[1]; (6) *Beudus* (Aghzi Kara); (7) Augustopolis, formerly Anabura (Surmeneh); (8) *Sibidunda* (Baljik Hissar); (9) *Lysias* (Oinan); (10) *Synnada* (Tchifut Cassaba); (11) *Prymnessus* (Seulun); (12) Ipsus, afterwards *Julia* (near Sakly); (13) Polybotus (Bolawadun); (14) *Docimium* (Istcha Kara Hissar); (15) Metropolis (Kumbet), including Conni (B. Tchorgia) and Ambasus (Ambanaz); (16) Merus (Doghan Arslan); (17) *Nacolea* (Seidi Ghazi); (18) *Dorylaeum* (Eski Sheher); (19) *Midaeum* (Kara Euuk); (20) Lycaones (Kalejik); (21) Aulocra (in Dombai Ova); (22) Amadassus (unknown, perhaps corrupt: it should include Kinnaborion near Geneli); (23) Praepenissus (Altyntash). In later times the important fortress (and bishopric) of Acroenus was founded on the site of the present Afiom Kara Hissar.

Besides these, certain cities beyond the bounds of the Byzantine Phrygias belonged under the Roman empire to the province of Asia and are usually considered Phrygian: (1) in Byzantine Pisidia, *Philomelium* (Ak Shehr), *Hadrianopolis;* (2) in Byzantine Galatia, *Amorium* (Assar near Hamza Hadji), Orcistus (Alikel or Alekian), Tricomia or Trocmada or Trocnada (Kaimaz); (3) in Byzantine Lycia, *Cibyra* (Horzum).

Phrygia contains several well-marked geographical districts. (1) PARORIUS, the long, level, elevated valley stretching north-west to south-east between the Sultan Dagh and the Emir Dagh from Holmi (about Tchai) to Tyriaeum (Ilghin); its waters collect within the valley, in three lakes, which probably supply the great fountains in the Axylon and through them the Sangarius. (2) AXYLON, the vast treeless plains on the upper Sangarius; there burst forth at various points great perennial springs, the Sakaria fountains (Strabo p. 543), Ilije Bashi, Bunar Bashi, Geuk Bunar, Uzuk Bashi, &c., which feed the Sangarius. Great part of the Axylon was assigned to Galatia. (3) The rest of Phrygia is mountainous (except the great plateau, Banaz Ova), consisting of hill-country intersected by rivers, each of which flows through a fertile valley of varying breadth. The northern half is drained by rivers which run to the Black Sea; of these the eastern ones, Porsuk Su (Tembris or Tembrogius), Seidi Su (Parthenius), Bardakchi Tchai (Xerabates), and Bayat Tchai (Alandrus), join the Sangarius, while the western,[2] Taushanly Tchai (Rhyndacus) and Simav Tchai (Macestus), meet and flow into the Propontis. The Hermus drains a small district included in the Byzantine Phrygia, but in earlier times assigned to Lydia and Mysia. Great part of southern and western Phrygia is drained by the Maeander with its tributaries, Sandykly Tchai (Glaucus), Banaz Tchai, Kopli Su (Hippurius), and Tchuruk Su (Lycus); moreover, some upland plains on the south, especially the Dombai Ova (Aulocra), communicate by underground channels with the Maeander. Finally, the Karayuk Ova in the extreme south-west drains through the Kazanes, a tributary of the Indus, to the Lycian Sea. Phrygia Parorius and all the river-valleys are exceedingly fertile, and agriculture was the chief occupation of the ancient inhabitants; according to the myth, Gordius was called from the plough to the throne. The high-lying plains and parts of the vast Axylon furnish good pasturage, which formerly nourished countless flocks of sheep. The Romans also obtained fine horses from Phrygia. Grapes, which still grow abundantly in various parts, were much cultivated in ancient times. Other fruits are rare, except in a few small districts. Figs cannot be grown in the country, and the ancient references to Phrygian figs are either erroneous or due to a loose use of the term Phrygia.[3] Trees are exceedingly scarce in the country; and the pine-woods on the western tributaries of the Sangarius and the valonia oaks in parts of the Banaz Ova and a few other districts form exceptions. The underground wealth is not known to be great. Iron was worked in the district of Cibyra, and the marble of Synnada, or more correctly of Docimium, was largely used by the Romans. Copper and quicksilver were mined in the Zizima district, north of Iconium. The scenery is generally monotonous; even the mountainous districts rarely show striking features or boldness of character; where the landscape has beauty it is of a subdued melancholy character. The water-supply is rarely abundant, and agriculture is more or less dependent on an uncertain rainfall. The circumstances of the country are well calculated to impress the inhabitants with a sense of the overwhelming power of nature and of their complete dependence on it. Their mythology so far as we know it, has a melancholy and mystic tone, and their religion partakes of the same character. The two chief deities were Cybele, the Mother, the reproductive and nourishing power of Earth, and Sabazius, the Son, the life of nature, dying and reviving every year (see GREAT MOTHER OF THE GODS). The annual vicissitudes of the life of Sabazius, the Greek Dionysus, were accompanied by the mimic rites of his worshippers, who mourned with his sufferings and rejoiced with his joy. They enacted the story of his birth and life and death; the Earth, the Mother, is fertilized only by an act of violence by her own child; the representative of the god was probably slain each year by a cruel death, just as the god himself died. The rites were characterized by a frenzy of devotion, unrestrained enthusiasm, wild orgiastic dances and wanderings in the forests, and were accompanied by the music of the flute, cymbal, and tambourine.[4] At an early time this worship was affected by Oriental influence, coming over Syria from Babylonia. Sabazius was identified with Adonis or Attis (Atys), Cybele with the Syrian goddess; and many of the coarsest rites of the Phrygian worship, the mutilation of the priests, the prostitution at the shrine,[5] came from the countries of the south-east. But one point of Semitic religion never penetrated west of the Halys: the pig was always unclean and abhorred among the Semites, whereas it was the animal regularly used in purification by the Phrygians, Lydians, Lycians and Greeks. The Phrygian religion exercised a very strong influence on Greece. In the archaic period the Dionysiac rites and orgies spread from Thrace into Greece, in spite of opposition which has left many traces in tradition, and the worship of Demeter at Eleusis was modified by Cretan influence ultimately traceable to Asia Minor. Pindar erected a shrine of the Mother of the gods beside his house, and the Athenians were directed by the Delphic oracle to atone for the execution of a priest of Cybele during the Peloponnesian War by building the Metroon. In these and other cases the Phrygian character was more or less Hellenized; but wave after wave of religious influence from Asia Minor introduced into Greece the unmodified "barbarian" ritual of Phrygia. The rites spread first among the common people and those engaged in foreign trade. The comic poets satirized them, and Plato and Demosthenes inveighed against them; but they continued to spread, with all their fervid enthusiasm, their superstition and their obscene practices, wide among the people, whose religious cravings were not satisfied with the purely external religions of Hellenism. The orgies or mysteries were open to all, freemen or slaves, who had duly performed the preliminary purifications, and secured to the participants salvation and remission of sins. Under MYSTERIES (*q.v.*) a distinction of character has been pointed out between the true Hellenic mysteries, such as the Eleusinian and the Phrygian; but there certainly existed much similarity between the two rituals. In the first centuries after Christ only the Phrygian and the Egyptian rites retained much real hold on the Graeco-Roman world. Phrygia itself, however, was very early converted to Christianity. Christian inscriptions in the country begin in the 2nd and are abundant in the 3rd century. There is every appearance that the great mass of the people were Christians before 300, and Eusebius (*H.E.* v. 16) is probably correct in his statement that in the time of Diocletian there was a Phrygian city in which every living soul was Christian. The great Phrygian saint of the 2nd century was named Avircius Marcellus (Abercius); the mass of legends and miracles in the late biography of him long brought his very existence into dispute, but a fragment of his gravestone, discovered in 1883, and now preserved in the Lateran Museum in Rome, has proved that he was a real person, and makes it probable that the wide-reaching conversion of the people attributed to him did actually take place. The strange enthusiastic character of the old Phrygian religion was not wholly lost when the country became Christian, but is clearly traced in the various heresies that arose in central Anatolia. Especially the wild ecstatic character and the prophecies of the Montanists recall the old type of religion. Montanus (see MONTANISM) was born on the borders of Phrygia and Mysia (probably south-east from Philadelphia), and was vehemently opposed by Abercius.

Of the old Phrygian language very little is known; a few words are preserved in Hesychius and other writers. Plato mentions that the Phrygian words for "dog," "fire," &c., were the same as the Greek; and to these we may add from inscriptions the words for "mother," "king," &c. A few inscriptions of the ancient period are known, and a larger number of the Roman period have been published in the *Oesterreichische Jahreshefte* (1905).

Owing to the scantiness of published material about Phrygia frequent reference has been made in this article to unpublished monuments. Besides the works already quoted of Abel and Perrot, see Ritter's "Kleinasien," in his *Erdkunde von Asien*; Leake, *Asia Minor* (1824); Kiepert appendix to Franz, *Fünf Inschr. u. fünf Städte Kleinasiens* (1840); Haase, in Ersch and Gruber's *Encyklop.* art. "Phrygien"; Hamilton, *Travels in Asia Minor* (1842); Hirschfeld, "Reisebericht," in the *Berl. Monatsber* (1879); Texier, *Asie mineure* (1862); Steuart, *Ancient Monuments of Lydia and Phrygia*, besides the special chapters in the geographical treatises of Cramer, Vivien St Martin, Forbiger, &c.; numerous articles by recent travellers; J. G. C. Anderson in *Journal of Hellenic Studies* (1898, &c); D. G. Hogarth, ibid.; Körte in *Mittheil. Inst. Athen.*, &c., and his book *Gordium* (1904); Humann and Judeich, *Hierapolis* (1898); Radet in his work *En Phrygie*; Ramsay [in addition to articles in *Mittheil. Instit. Athen.* (1882 sqq.), *Bulletin de corresp. hellén* (1883 sqq.), *Journal of Hellenic Studies* (1882, sqq.), *American Journal of Archaeology, Revue des études anciennes*], *Cities and Bishoprics of Phrygia*, vols. i. ii. (1895 sqq.); *Studies in the History and Art of the Eastern Provinces* (1906); *Pauline and other Studies* (1906); *Historical Commentary on Galatians*, &c. (1899); *Cities of St Paul* (1907); see also T. Eisele, "Die Phrygischen Kulte" in *Neue Jahrb. f. das klass. Altertum* (Sept. 1909). (W. M. Ra.)

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[1] Nos. 1–5 were called the Phrygian "Pentapolis."

[2] This district was according to the Greek view part of Mysia.

[3] In Strabo, p. 577, *ἐλαιόφυτον* must be wrong; *ἀμπελόφυτον* is true to fact, and is probably the right reading. Olives cannot now grow on these uplands, which are over 3000 ft. above sea-level.

[4] The influence which was exerted on Greek music and lyric poetry by the Phrygian music was great; see MARSYAS; OLYMPUS.

[5] There is no direct evidence that this was practised in the worship of Cybele, but analogy and indirect arguments make it pretty certain.

PHRYNE, Greek courtesan, lived in the 4th century B.C. Her real name was Mnesarete, but owing to her complexion she was called Phryne (toad), a name given to other courtesans. She was born at Thespiae in Boeotia, but seems to have lived at Athens. She acquired so much wealth by her extraordinary beauty that she offered to rebuild the walls of Thebes, which had been destroyed by Alexander the Great (336), on condition that the words "Destroyed by Alexander, restored by Phryne the courtesan," were inscribed upon them. On the occasion of a festival of Poseidon at Eleusis she laid aside her garments, let down her hair, and stepped into the sea in the sight of the people, thus suggesting to the painter Apelles his great picture of Aphrodite Anadyomene, for which Phryne sat as model. She was also (according to some) the model for the statue of the Cnidian Aphrodite by Praxiteles. When accused of profaning the Eleusinian mysteries, she was defended by the orator Hypereides, one of her lovers. When it seemed as if the verdict would be unfavourable, he rent her robe and displayed her lovely bosom, which so moved her judges that they acquitted her. According to others, she herself thus displayed her charms. She is said to have made an attempt on the virtue of the philosopher Xenocrates. A statue of Phryne, the work of Praxiteles, was placed in a temple at Thespiae by the side of a statue of Aphrodite by the same artist.

See Athenaeus, pp. 558, 567, 583, 585, 590, 591; Aelian, *Var. Hist.* ix. 32; Pliny, *Nat. Hist.* xxxiv. 71.

PHRYNICHUS—1. Son of Polyphradmon and pupil of Thespis, one of the earliest of the Greek tragedians. Some of the ancients, indeed, regarded him as the real founder of tragedy. He gained his first poetical victory in 511 B.C. His famous play, the *Capture of Miletus*, was probably composed shortly after the conquest of that city by the Persians. The audience was moved to tears, the poet was fined for reminding the Athenians of their misfortunes, and it was decreed that no play on the subject should be produced again. In 476 Phrynichus was successful with the *Phoenissae*, so called from the Phoenician women who formed the chorus, which celebrated the defeat of Xerxes at Salamis (480). Themistocles acted as choragus, and one of the objects of the play was to remind the Athenians of his great deeds. The *Persians* of Aeschylus (472) was an imitation of the *Phoenissae*. Phrynichus is said to have died in Sicily. Some of the titles of his plays, *Danaïdes, Actaeon, Alcestis, Tantalus*, show that he treated mythological as well as contemporary subjects. He introduced a separate actor as distinct from the leader of the chorus, and thus laid the foundation of dialogue. But in his plays, as in the early tragedies generally, the dramatic element was subordinate to the lyric element as represented by the chorus and the dance. According to Suidas, Phrynichus first introduced female characters on the stage (played by men in masks), and made special use of the trochaic tetrameter.

Fragments in A. Nauck, *Tragicorum graecorum fragmenta* (1887).

2. A poet of the Old Attic comedy and a contemporary of Aristophanes. His first comedy was exhibited in 429 B.C. He composed ten plays, of which the *Solitary* (Μονότροπος) was exhibited in 414 along with the *Birds* of Aristophanes and gained the third prize. The *Muses* carried off the second prize in 405, Aristophanes being first with the *Frogs*, in which he accuses Phrynichus of employing vulgar tricks to raise a laugh, of plagiarism and bad versification.

Fragments in T. Kock, *Comicorum atticorum fragmenta* (1880).

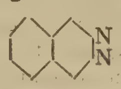
3. PHRYNICHUS ARABIUS, a grammarian of Bithynia, lived in the 2nd century A.D. According to Suïdas he was the author of (1) an *Atticist*, or *On Attic Words*, in two books; (2) *Τιθεμένων συναγωγή*, a collection of subjects for discussion; (3) *Σοφιστικὴ παρασκευή*, or Sophistical Equipment, in forty-seven (or seventy-four) books. As models of Attic style Phrynichus assigned the highest place to Plato, Demosthenes and Aeschines the Socratic. The work was learned, but prolix and garrulous. A fragment contained in a Paris MS. was published by B. de Montfaucon, and by I. Bekker in his *Anecdota graeca* (1814). Another work of Phrynichus, not mentioned by Photius, but perhaps identical with the *Atticist* mentioned by Suïdas, the *Selection* (Ἐκλογή) *of Attic Words and Phrases*, is extant. It is dedicated to Cornelianus, a man of literary tastes, and one of the imperial secretaries, who had invited the author to undertake the work. It is a collection of current words and forms which deviated from the Old Attic standard, the true Attic equivalents being given side by side. The work is thus a lexicon antibarbarum, and is interesting as illustrating the changes through which the Greek language had passed between the 4th century B.C. and the 2nd century A.D.

Editions of the Ἐκλογή, with valuable notes, have been published by C. A. Lobeck (1820) and W. G. Rutherford (1881); Lobeck devotes his attention chiefly to the later, Rutherford to the earlier usages noticed by Phrynichus. See also J. Brenous, *De Phrynicho Atticista* (1895).

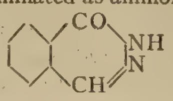
4. An Athenian general in the Peloponnesian War. He took a leading part in establishing the oligarchy of the Four Hundred at Athens in 411 B.C., and was assassinated in the same year (Thucydides viii.).

PHTHALAZINES (benzo-orthodiazines or benzopyridazines), in organic chemistry a group of heterocyclic compounds containing the ring complex shown in formula I. They are isomeric with the cinnolines (*q.v.*). The parent substance of the group, phthalazine, $C_8H_6N_2$, is best obtained from the condensation of ω-tetrabromorthoxylene with hydrazine (D. Gabriel, *Ber.*, 1893, 26, p. 2210), or by the reduction of chlorphthalazine with phosphorus and hydriodic acid (*Ber.*, 1897, p. 3024). It possesses basic properties and forms addition products with alkyl iodides. On oxidation with alkaline potassium permanganate it yields pyridazine dicarboxylic acid. Zinc and hydrochloric acid decompose it with formation of orthoxylylene diamine.

The keto-hydro derivative *phthalazone*, $C_8H_6ON_2$, (formula II.), is obtained by condensing hydrazine with orthophthalaldehydo-acid. On treatment with phosphorus oxychloride it yields a chlorphthalazine which with zinc and hydrochloric acid gives isoindole, C_8H_7N, and with tin and hydrochloric acid phthalimidine, C_8H_7ON, the second nitrogen atom being eliminated as ammonia.



I. Phthalazine.



II. Phthalazone.

PHTHALIC ACIDS, or BENZENE DICARBOXYLIC ACIDS, $C_6H_4(CO_2H)_2$. There are three isomers: (1) ortho, or phthalic acid; (2) meta, or isophthalic acid; (3) para, or terephthalic acid.

Phthalic acid was obtained by Laurent in 1836 by oxidizing naphthalene tetrachloride, and, believing it to be a naphthalene derivative, he named it naphthalenic acid; Marignac determined its formula and showed Laurent's supposition to be incorrect, upon which Laurent gave it its present name. It is manufactured by oxidizing naphthalene tetrachloride (prepared from naphthalene, potassium chlorate and hydrochloric acid) with nitric acid, or, better, by oxidizing the hydrocarbon with fuming sulphuric acid, using mercury or mercuric sulphate as a catalyst (German pat. 91, 202). It also results on the oxidation of orthodiderivatives of benzene. It forms white crystals, melting at 213° with decomposition into water and phthalic anhydride; the latter forms long white needles, melting at 128° and boiling at 284°. Heated with an excess of lime it gives benzene; calcium benzoate results when calcium phthalate is heated with one molecule of lime to 330°–350°. The acid (and anhydride) are largely used in the colour industry (see FLUORESCEIN; PHENOLPHTHALEIN).

Phthalyl chloride, $C_6H_4(COCl)_2$ or $C_6H_4(CCl_2)(CO)O$, formed by heating the anhydride with phosphorus chloride, is an oil which solidifies at 0° and boils at 275°. In some reactions it behaves as having the first formula, in others as having the second. Phthalyl chloride with phosphorus pentachloride gives two phthalylene tetrachlorides, one melting at 88° and the other at 47°. They cannot be changed into one another, and have been given the formulae $C_6H_4(CCl_3)(COCl)$ and $C_6H_4(CCl_2)_2O$. Phthalimide, $C_6H_4(CO)_2NH$, is formed by heating phthalic anhydride or chloride in ammonia gas or by molecular rearrangement of ortho-cyanbenzoic acid. It forms N-metallic and alkyl salts. Bromine and potash give anthranilic acid, $C_6H_4(NH_2)(CO_2H)$. (See INDIGO.)

Isophthalic acid is obtained by oxidizing meta-xylene with chromic acid, or by fusing potassium meta-sulphobenzoate, or meta-brombenzoate with potassium formate (terephthalic acid is also formed in the last case). It melts above 300°, and dissolves in 7800 parts of cold water and in 460 of boiling. The barium salt ($+6H_2O$) is very soluble (a distinction between phthalic and terephthalic acids). *Uvitic acid*, 5-methyl isophthalic acid, is obtained by oxidizing mesitylene or by condensing pyroracemic acid with baryta water.

Terephthalic acid, formed by oxidizing para-diderivatives of benzene, or best by oxidizing caraway oil, a mixture of cymene and cuminol, with chromic acid, as almost insoluble in water, alcohol and ether; it sublimes without melting when heated.

For the reduced phthalic acids see POLYMETHYLENES.

PHTHISIS (Gr. φθίσις "wasting"), a term formerly applied (like "Consumption") to the disease of the lung now known as Tuberculosis (*q.v.*).

PHYLACTERY (φυλακτήριον), a Greek word meaning "guard" (*sc.* against misfortune), *i.e.* an amulet. It is applied in the New Testament to the *tefillin* or "prayer-thongs" worn by orthodox Jews daily at morning-prayer (whether at home or in the synagogue). The title employed in Hebrew, *tefillin*, seems really to be derived from an Aramaic term meaning "attachments," "ornaments"; it corresponds to the Biblical Hebrew word rendered "frontlets" (*totafôth*). The *tefillin* or phylacteries are worn, one on the left arm (the "hand-tefilla"), and the other on the head (the "head-tefilla"). In each case the leather thongs support a small satchel which is fastened to the arm and the forehead respectively, and contains certain passages of the Law written (in Hebrew) on parchment, viz. Exod. xiii. 1-10 amd 11-16; Deut. vi. 4-9 and xi. 13-21. The custom of wearing phylacteries seems to have been derived in the first instance from the Pharisees. By the Sadducees and the generality of the people in the time of Christ it seems not to have been practised. Later it became—not without protest—one of the badges of orthodox Judaism. It is significant that the custom is entirely unknown to the Samaritan community.

The phylacteries, together with the "fringe" (*tsitsîth*) and door-post symbol (*mezuza*)—which latter consists of a piece of parchment, containing the Hebrew text of Deut. vi. 4-9 and xi. 13-21 enclosed in a glass or metal tube, and fixed upon the right hand post of the door of each dwelling-room in a house—form the three sets of visible signs by which the Israelite is constantly reminded of his duty to God (cf. Num. xv. 39-40; Deut. vi. 9; xi. 20). The "fringe" (or "tassels") was originally attached to the common outer garment—a large square wrap—the loose end of which hung over the left shoulder. This garment with tassels is mentioned in the New Testament (cf. Matt. ix. 20; xiv. 36; xxiii. 5 and parallels). Among modern Jews it has survived in two forms: (1) the fringed praying shawl called *talith* worn by every male orthodox Jew at the synagogue morning service; and (2) an under-garment, shaped like a chest-protector, one part covering the chest, the other the back, which is worn continuously by male orthodox Jews. It is called *Arba Kanfoth* (*i.e.* "Four Corners," Deut. xxii. 12) or "little Talith," and is, of course, "fringed." Both phylactery and mezuza were supposed to keep off hurtful demons (Targ. on Cant. viii. 3).

See Surenhusius, *Mischna*, i. 9 seq.; and Bodenschatz, *Kirch. Verf. d. heutigen Juden*, iv. 9 seq. (W. R. S.; G. H. Bo.)

PHYLARCHUS, a Greek historian, who flourished during the time of Aratus, the strategus of the Achaean League, in the 3rd century B.C. His birthplace is variously given as Athens, Naucratis, or Sicyon. He was probably a native of Naucratis, and subsequently migrated to Athens. He was the author of a history in 28 books, covering the period from the expedition of Pyrrhus king of Epirus to Peloponnesus (272) to the death of the Spartan king Cleomenes (220) after his defeat by Antigonus Doson. Polybius (ii. 56-63) charges him with undue partiality for Cleomenes and unfairness towards Aratus; Plutarch (*Aratus*, 38), who is of the same opinion, did not hesitate to use him freely in his own biographies of Agis and Cleomenes.

Fragments and life in C. W. Müller, *Fragmenta historicorum graecorum*, vol. i. (1841); monographs by J. F. Lucht (1836) and C. A. F. Brückner (1839); C. Wachsmuth, *Einleitung in das Studium der alten Geschichte* (1895).

PHYLE, a mountain fortress, on a pass leading from Athens to Boeotia and Thebes, and commanding a fine view of the Attic plain. It is situated on the south-west end of Mt Parnes. It is chiefly famous for its occupation by Thrasybulus at the head of the Athenian exiles during the rule of the Thirty Tyrants in 404 B.C. After defending himself from attack, with the help of a snowstorm, he succeeded by a venturesome night march in seizing Munychia. Close to Phyle is the cliff called Harma, over which the Pythian lightnings were watched for from Athens.

PHYLLITE (Gr. φύλλον, a leaf, probably because they yield leaf-like plates, owing to their fissility), in petrology, a group of rocks which are in practically all cases metamorphosed argillaceous sediments, consisting essentially of quartz, chlorite and muscovite, and possessing a well-marked parallel arrangement or schistosity. They form an intermediate term in the series of altered clays or shaly deposits between clay-slates and mica-schists. The clay-slates have a very similar mineral constitution to the phyllites, but are finer grained and are distinguished also by a very much better cleavage. In the phyllites also white mica (muscovite or sericite) is more abundant as a rule than in slate, and its crystalline plates are larger; the abundance of mica gives these rocks a glossy sheen on the smooth planes of fissility. Many of the best Welsh slates are rich in small scales of white mica, which polarize brightly between crossed nicols. The Cornish slates are still more micaceous and rather coarser grained, so that they might be called mica-slates or even phyllites.

A microscopical section of a typical phyllite shows green chlorite and colourless mica both in irregular plates disposed in parallel order, with a greater or smaller amount of quartz which forms small lenticular grains elongated parallel to the foliation. Grains of iron oxide (magnetite and haematite) and black graphitic dust are very commonly present. Feldspar is absent or scarce, but some phyllites are characterized by the development of small rounded grains of albite, often in considerable numbers. The minute needles of rutile, so often seen in clay-slates, are not often met with in phyllites, but this mineral forms small prisms which may be intergrown with black magnetite; at other times it occurs as networks of sagenite. Other phyllites contain carbonates (usually calcite but sometimes dolomite) in flat or spindle-shaped crystals, which often give evidence of crushing. Very tiny blue needles of tourmaline are by no means rare in phyllites, though readily overlooked. Garnet occurs sometimes, a good example of garnetiferous phyllite being furnished by the whetstones of the Ardennes, in which there are many small isotropic crystals of magnesian garnet. Hornblende, often in branching feathery crystals, is a less frequent accessory. In some phyllites a mineral of the chloritoid group makes its appearance; this may be ottrelite, sismondine or other varieties of chloritoid, and occurs in large sub-hexagonal plates showing complex twinning, and lying across the foliation planes of the rock, so that they seem to have developed after the movements and pressures which gave rise to the foliation had ceased.

The structural variations presented by the phyllites are comparatively few. The most finely crystalline specimens have generally the most perfect parallel arrangement of their constituents. The foliation is generally flat or linear, but in some rocks is undulose or crumpled. From the imperfection of their cleavage phyllites are rarely suitable for roofing materials; their softness renders them valueless as road stones, but they are not uncommonly employed as inferior building materials. They are exceedingly common in all parts of the world where metamorphic rocks occur; as in the Scottish Highlands, Cornwall, Anglesey, north-west Ireland, the Ardennes, the Harz Mountains, Saxony, the Alps, Norway, the Appalachians, the Great Lakes district in America, &c. (J. S. F.)

PHYLLOXERA (Gr. *φύλλον*, leaf, and *ξηρός*, dry), a genus of insects belonging to the family of Aphidae, or Plant-lice, in the Homopterous section of the order Hemiptera. It is chiefly known from the causal relation of one of its species to the most serious of vine-diseases. The name was first given in 1834 to a plant-louse which was observed to "dry up the leaves" of oaks in Provence. About twenty-seven species are now known, all characterized by length not exceeding ·06 of an inch, flat wings, three articulations in the antennae, one or two articulations in the tarses, with digitules, but without cornicles on the abdomen.

The following full description of the only species which attacks the vine, the *Phylloxera vastatrix*, or grape-louse, is reprinted from the article VINE in the 9th edition of this encyclopaedia.

"The symptoms of the disease, by means of which an infected spot may be readily recognized, are as follows: The vines are stunted and bear few leaves, and those small ones. When the disease reaches an advanced stage the leaves are discoloured, yellow or reddish, with their edges turned back, and withered. The grapes are arrested in their growth and their skin is wrinkled. If the roots are examined numerous fusiform swellings are found upon the smaller rootlets. These are at first yellowish in colour and fleshy; but as they grow older they become rotten and assume a brown or black colour. If the roots on which these swellings occur be examined with a lens, a number of minute insects of a yellowish-brown colour are observed; these are the root-forms (radicola) of *Phylloxera* (fig. 1); they are about ·8 mm. long, of an oval outline and with a swollen body. No distinction between head, thorax and abdomen can be observed. The head bears small red eyes and a pair of three-jointed antennæ, the first two joints being short and thick, the third more elongated, with the end cut off obliquely and slightly hollowed out. Underneath, between the legs, lies the rostrum, which reaches back to the abdomen. The insect is fixed by this rostrum, which is inserted into the root of the vine for the purpose of sucking the sap. The abdomen consists of seven segments, and these as well as the anterior segments bear four rows of small tubercles on their dorsal surface. These root-dwelling insects are females, which lay parthenogenetic eggs. The insect is fixed by its proboscis, but moves its abdomen about and lays thirty to forty yellow eggs in small clusters. After the lapse of six, eight or twelve days, according to the temperature, the larvae hatch out of the eggs. These are light yellow in colour and in appearance resemble their mother, but with relatively larger appendages. They move actively about for a few days and then, having selected a convenient place on the young roots, insert their proboscis and become stationary. They moult five times, becoming with each change of skin darker in colour; in about three weeks they become adult and capable of laying parthenogenetic eggs. In this way the insect increases with appalling rapidity: it has been calculated that a single mother which dies after laying her eggs in March would have over 25,000,000 descendants by October. If, however, the insect were content with this method of reproduction the disease could be isolated by surrounding the infected patches with a deep ditch full of some such substance as coal-tar, which would prevent the insects spreading on to the roots of healthy vines. The fertility of the parthenogenetically produced insects would also diminish after a certain number of generations had been produced.

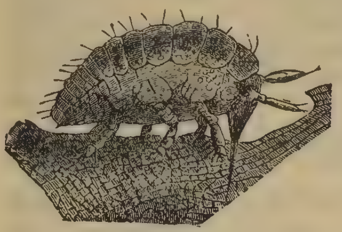


FIG. 1.—Root-inhabiting Form (Radicola) of *Phylloxera*, with proboscis inserted into tissue of root of vine.

As the summer wears on a second form of insect appears amongst the root-dwellers, though hatched from the same eggs as the form described above. These are the nymphs, destined to acquire wings; their body is more slender in outline, and at first they bear well-marked tubercles. After several moults the rudiments of two pairs of wings appear, and then the insect creeps up to the surface of the earth, and on to the vine. Here it undergoes its fifth and last moult, and appears as a winged female, capable of reproducing parthenogenetically. The winged form has a slender body with distinct head (fig. 2). The eyes are well developed, with numerous facets; the antennae have three joints, the terminal one shaped like that of the root-dwellers. The wings are transparent, with few nervures, and are well adapted for flight. The anterior pair reach far beyond the end of the abdomen; the posterior are narrower and not so long. These winged forms are about 1 mm. long. They fly about from July till October, living upon the sap of the vine, which is sucked up by the rostrum from the leaves or buds. They lay their parthenogenetically produced eggs in the angles of the veins of the leaves, in the buds, or, if the season is already far advanced, in the bark. In very damp or cold weather the insect remains in the ground near the surface, and deposits its eggs there. The eggs are very few in number and of two sizes, small and large (fig. 3, *b* and *c*). From the larger a female (fig. 4) is hatched in eight or ten days, and simultaneously, for the first time in the life-history of the *Phylloxera*, a male (fig. 3) appears from the smaller egg. Neither male nor female has wings; the rostrum is replaced by a functionless tubercle; and there is no alimentary canal. The female is larger than the male and differs from it and the other forms in the last joint of the antennae. The life of these sexual forms lasts but a few days, and is entirely taken up with reproduction. The female is fertilized by the male and three or four days later lays a single egg—the winter egg—and then dies. This egg is laid in the crevices of the bark of the vine, and as it is protectively coloured it is almost impossible to find it. Here the winter eggs remain undeveloped during the cold months; but in the following spring, as a rule in the month of April, they give birth to a female insect without wings, which resembles the root-dwelling forms, but has pointed antennae. These forms are termed the stock-mothers; they creep into the buds of the vine, and, as these develop into the young leaves, insert their proboscis into the upper side. By this means a gall is produced on the under side of the leaf.

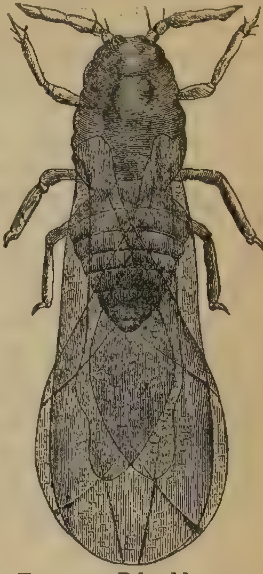


FIG. 2.—*Phylloxera.* Winged Female which lives on leaves and buds of vine, and lays parthenogenetically eggs of two kinds, one developing into a wingless female, the other into a male.

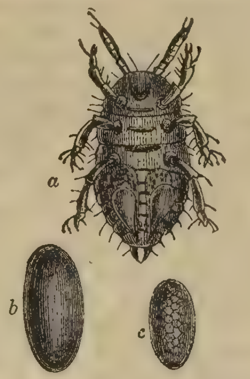


FIG. 3.—*a*, Male produced from small egg *c*, laid by winged female (fig. 2); *b*, large egg; *c*, small egg.

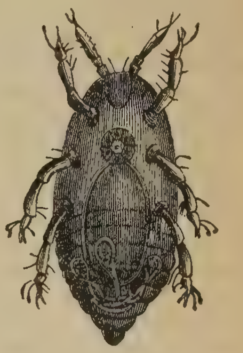
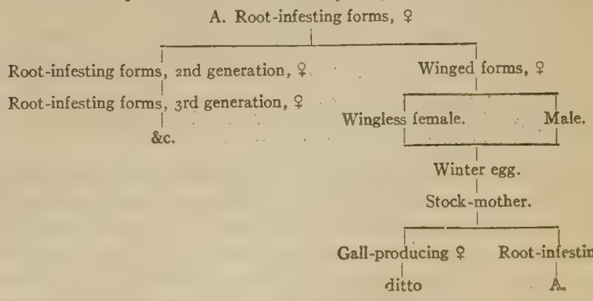


FIG. 4.—Wingless Female produced from large egg (fig. 3, *b*), laid by winged female (fig. 2).

Scheme of the Various Forms of Phylloxera vastatrix.


A. Root-infesting forms, ♀
Root-infesting forms, 2nd generation, ♀
Winged forms, ♀
Root-infesting forms, 3rd generation, ♀
Wingless female.
Male.
&c.
Winter egg.
Stock-mother.
Gall-producing ♀
Root-infesting ♀
ditto
A.

The gall is cup-shaped, and its outer surface is crumpled and covered with small warts and hairs. The opening upon the upper surface of the leaf is protected by similar structures. Within this gall the stock-mother lives and surrounds herself with numerous parthenogenetically produced eggs—sometimes as many as two hundred in a single gall; these eggs give birth after six or eight days to a numerous progeny (gallicola); some of which form new galls and multiply in the leaves, whilst others descend to the roots and become the root-dwelling forms already described. The galls and the gall-producing form are much commoner in America than in the Old World.

The particular species of phylloxera which attacks the vine is a native of the United States, probably originating among the wild vines of the Colorado district. It was first observed in 1856 by Asa Fitch (1809–1878), who did not suspect its mischief, and called it *Pemphigus vitifoliae.* In 1863 it was independently discovered by Westwood in an English vinery at Hammersmith; he was ignorant of Fitch's observation, and called it *Peritymbia vitisana.* From 1858 to 1863 there were many importations of American vines for grafting purposes to Bordeaux, Roquemaure and other parts of France, England, Ireland, Germany, Portugal, &c. It is practically certain that the deadly phylloxera was imported on these plants. A year or two later certain vine-growers in the South of France began to complain of the new vine-disease. M. Delorme, of Arles, in 1865, appears to have been the first who recognized its novelty and had a presentiment of disaster. The disease steadily spread outwards in concentric circles from its first place of lodgment near Roquemaure. Within two or three years whole departments were infested. In 1866 a second centre of infection made its appearance near Bordeaux. The vine-growers were at their wits' end to account for this new plague, which threatened to be even more costly than the oïdium. The completeness of the ruin which threatened them may be illustrated by the statistics for a single commune, that of Graveson, whose average annual production of wine in the years 1865–1867 was about 220,000 gallons. In 1868 this fell to 121,000 gallons, in 1869 to 48,400 gallons, in 1870 to 8800 gallons, and by 1873 to 1100 gallons.

In 1868 Planchon proved that the disease was due to a new species of phylloxera, which was invariably found on the roots of the affected vines, and to which he accordingly gave the prophetic name of *Phylloxera vastatrix.* During the next ten years a series of students, of whom only Riley and Balbiani need be mentioned here, worked out the natural history of *Phylloxera vastatrix,* and proved its identity with the American grape-louse. Its devastations rapidly assumed gigantic proportions. In France, where the disease was by far the most prevalent—owing in great part to the obstinacy with which the vine-growers at first refused to take any reasonable precautions against its spread—M. Lalande, president of the chamber of commerce at Bordeaux, in 1888 calculated the direct loss to the country by the phylloxera at 10 milliards (£400,000,000), or double the indemnity which had been paid to Germany in 1871!

The phylloxera has made its appearance in almost every vine-growing country in the world. Thus it appeared in Austria-Hungary in 1868; in Italy, in spite of the frantic efforts made—as in other countries—to keep it out by strict legislation against the import of vines, in 1879; in Russia in 1880; in Germany, on the Rhine and Moselle, and in Switzerland in 1872; in Madeira, Spain and Portugal, about 1876. The pest even crossed the oceans, and appeared in Australia, at Geelong, about 1880; it has since twice broken out in Victoria, and has ravaged the vineyards of South Australia and New South Wales. At the Cape, in spite of a long endeavour to prohibit the import of the phylloxera, it appeared about 1884. In 1885 it crossed the Mediterranean to Algeria. There was only one country where its ravages were long unimportant; that was its home in the United States, where the native vines had become, by the operation of natural selection, immune to its attacks. Yet no imported vine has ever lived there more than five years, and in 1890 the phylloxera crossed the Rocky Mountains, and seriously damaged the vineyards of California, where it had previously been unknown.

Three different methods of fighting the pest have been successfully adopted. One is to kill the phylloxera itself; another, to destroy it along with the infected vines, and plant fresh and healthy plants; the third, to adapt the secular therapeutics of nature, and to introduce American vines which a long acquaintance with the phylloxera has made immune to its ravages. Insecticides, of which the bisulphide of carbon (CS_2) and the sulpho-carbonate of potassium (KCS_3) remain in use, were injected into the earth to kill the phylloxera on the roots of the vine. These methods were chiefly advocated in vineyards of the first class, where it was worth while to spend a good deal of money and labour to preserve the old and famous vines: the Château Leoville Poyferré and Clos Vougeot are instances. Some good judges attribute the peculiar and not unpleasing flavour of certain clarets of 1888 to means thus adopted to kill the phylloxera. The second plan was largely adopted in Switzerland and on the Rhine, where measures resembling those taken with cattle suspected of anthrax were applied to all diseased vineyards. The third plan, which consists in replanting the affected vineyard with American vines—such as the *Vitis labrusca, V. riparia, V. rupestris* or *V. monticola*—has proved the most generally successful.

A very good bibliography will be found in *Les Insectes de la vigne,* by Professor Majet of Montpellier (1890), which is the best book on the subject. Reference may also be made to the classic memoirs of Planchon, culminating in *Les Mœurs de la phylloxera de la vigne* (1877); Dreyfus, *Über Phylloxerinen* (1889); Lichtenstein, *Histoire du phylloxera*; the *Rapports annuels à la commission supérieure du phylloxera*; and the excellent *Report on Phylloxera* drawn up by the Hon. J. W. Taverner (Victoria, 1899, No. 68).
(W. E. G. F.)

PHYSHARMONICA, a keyboard instrument fitted with free-reeds, a kind of harmonium much used in Germany. The physharmonica resembles a small harmonium, but is differentiated from it by having no stops; being without percussion action, it does not speak readily or clearly. As in the harmonium, the bellows are worked by the feet by an alternate movement, which also affords a means of varying the dynamic force of the tone according as more or less energetic pedalling increases or decreases the pressure of the wind supply. The physharmonica was invented in 1818 by Anton Häckel, of Vienna; in the original instrument the bellows were placed right and left immediately under the shallow wind-chest, and were worked by means of pedals connected by stout wire. A specimen, having a compass of four octaves and a very sweet tone, is preserved in the collection of Paul de Wit, formerly in Leipzig, now transferred to Cologne. (K. S.)

PHYSICAL PHENOMENA, in the terminology of spiritualism and psychical research, molar or molecular phenomena in the physical world not traceable to ordinary causes and referred to the action of spirits or of mediums in abnormal psychical states. Among the phenomena or alleged phenomena are: materialization, levitation or elongation of the medium; passage of matter through matter, alteration of weight in a balance, tying of knots in an endless cord, apports (objects brought from a distance) and movements of objects (telekinesis); the production of writing, imprints of plaster or other objects; raps, voices and other sounds, including music; spirit photographs; lights and perfumes. To these may be added immunity against the effects of fire and the untying of ropes.

Analogous phenomena are found in many parts of the world (see POLTERGEIST; FIREWALKING); spectral lights are associated with the tombs of Mahommedan saints, with Buddhist shrines, with religious revivals, with Red Indian and other magicians, &c., and as sporadic phenomena in the Highlands and Norway. Levitation is asserted of Australian wizards, the rope-trick of Eskimo angekoks; glyphs and direct writing are found in Mexican and Tibetan cults.

See F. Podmore, *Modern Spiritualism*; F. W. H. Myers, *Human Personality*, ii. 506; *Journal S. P. R.*, vi. 309 sq. (N. W. T.)

PHYSIOCRATIC SCHOOL, the name given to a group of French economists and philosophers. The heads of the school were François Quesnay (*q.v.*) and Jean Claude Marie Vincent, sieur de Gournay (1712–1759). The principles of the school had been put forward in 1755 by R. Cantillon, a French merchant of Irish extraction (*Essai sur la nature du commerce en général*), whose biography W. S. Jevons has elucidated, and whom he regards as the true founder of political economy; but it was in the hands of Quesnay and Gournay that they acquired a systematic form, and became the creed of a united group of thinkers and practical men, bent on carrying them into action. The members of the group called themselves *les économistes*, but it is more convenient, because unambiguous, to designate them by the name *physiocrates* (Gr. φύσις, nature, and κρατεῖν, to rule), invented by P. S. Dupont de Nemours (1739–1817), who was one of their number. In this name, intended to express the fundamental idea of the school, much more is implied than the subjection of the phenomena of the social, and in particular the economic, world to fixed relations of coexistence and succession. This is the positive doctrine which lies at the bottom of all true science. But the law of nature referred to in the title of the sect was something quite different. The theological dogma which represented all the movements of the universe as directed by divine wisdom and benevolence to the production of the greatest possible sum of happiness had been transformed in the hands of the metaphysicians into the conception of a *jus naturae*, a harmonious and beneficial code established by the favourite entity of these thinkers, nature, antecedent to human institutions, and furnishing the model to which they should be made to conform.

The general political doctrine is as follows: Society is composed of a number of individuals, all having the same natural rights. If all do not possess (as some members of the negative school maintained) equal capacities, each can at least best understand his own interest, and is led by nature to follow it. The social union is really a contract between these individuals, the object of which is the limitation of the natural freedom of each just so far as it is inconsistent with the rights of the others. Government, though necessary, is a necessary evil; and the governing power appointed by consent should be limited to the amount of interference absolutely required to secure the fulfilment of the contract. In the economic sphere this implies the right of the individual to such natural enjoyments as he can acquire by his labour. That labour, therefore, should be undisturbed and unfettered, and its fruits should be guaranteed to the possessor; in other words, property should be sacred. Each citizen must be allowed to make the most of his labour; and therefore freedom of exchange should be ensured, and competition in the market should be unrestricted, no monopolies or privileges being permitted to exist.

The physiocrats then proceed with the economic analysis as follows: Only those labours are truly "productive" which add to the quantity of raw materials available for the purposes of man; and the real annual addition to the wealth of the community consists of the excess of the mass of agricultural products (including, of course, metals) over their cost of production. On the amount of this *produit net* depends the well-being of the community and the possibility of its advance in civilization. The manufacturer merely gives a new form to the materials extracted from the earth; the higher value of the object, after it has passed through his hands, only represents the quantity of provisions and other materials used and consumed in its elaboration. Commerce does nothing more than transfer the wealth already existing from one hand to another; what the trading classes gain thereby is acquired at the cost of the nation, and it is desirable that its amount should be as small as possible. The occupations of the manufacturer and merchant, as well as the liberal professions, and every kind of personal service, are "useful" indeed, but they are "sterile," drawing their income, not from any fund which they themselves create, but from the superfluous earnings of the agriculturist. The revenue of the state, which must be derived altogether from this net product, ought to be raised in the most direct and simplest way—namely, by a single impost of the nature of a land tax.

The special doctrine relating to the exclusive productiveness of agriculture arose out of a confusion between "value" on the one hand and "matter and energy" on the other. A. Smith and others have shown that the attempt to fix the character of "sterility" on manufactures and commerce was founded in error. And the proposal of a single *impôt territorial* falls to the ground with the doctrine on which it was based. But such influence as the school exerted depended little, if at all, on these peculiar tenets, which indeed some of its members did not hold. The effective result of its teaching was mainly destructive. It continued in a more systematic form the efforts in favour of the freedom of industry already begun in England and France. It was to be expected that the reformers should, in the spirit of the negative philosophy, exaggerate the vices of established systems; and there can be no doubt that they condemned too absolutely the economic action of the state, both in principle and in its historic manifestations, and pushed the *laissez-faire* doctrine beyond its just limits. But this was a necessary incident of their connexion with the revolutionary movement, of which they really formed one wing. In the course of that movement, the primitive social contract, the sovereignty of the people and other dogmas now seen to be untenable, were habitually invoked in the region of politics proper, and had a transitory utility as ready and effective instruments of warfare. And so also in the economic sphere the doctrines of natural rights of buying and selling, of the sufficiency of enlightened selfishness as a guide in mutual dealings, of the certainty that each member of the society will understand and follow his true interests, and of the coincidence of those interests with the public welfare, though they will not bear a dispassionate examination, were temporarily useful as convenient and serviceable weapons for the overthrow of the established order.

These conclusions as to the revolutionary tendencies of the school are not at all affected by the fact that the form of government preferred by Quesnay and some of his chief followers was what they called a legal despotism, which should embrace within itself both the legislative and the executive function. The reason for this preference was that an enlightened central power could more promptly and efficaciously introduce the policy they advocated than an assembly representing divergent opinions and fettered by constitutional checks and limitations. Turgot used the absolute power of the Crown to carry into effect some of his measures for the liberation of industry, though he ultimately failed because unsustained by the requisite force of character in Louis XVI. But what the physiocratic idea with respect to the normal method of government was appears from Quesnay's advice to the dauphin, that when he became king he should "do nothing, but let the laws rule," the laws having been, of course, first brought into conformity with the *jus naturae*. The partiality of the school for agriculture was in harmony with the sentiment in favour of "nature" and primitive simplicity which then showed itself in so many forms in France, especially in combination with the revolutionary spirit, and of which Rousseau was the most eloquent exponent. The members of the physiocratic group were undoubtedly men of thorough uprightness, and inspired with a sincere desire for the public good, especially for the material and moral elevation of the working classes. Quesnay was physician to Louis XV., and resided in the palace at Versailles; but in the midst of that corrupt court he maintained his integrity, and spoke with manly frankness what he believed to be the truth. And never did any statesman devote himself with greater singleness of purpose or more earnest endeavour to the service of his country than Turgot, who was the principal practical representative of the school.

The physiocratic school never obtained much direct popular influence, even in its native country, though it strongly attracted many of the more gifted and earnest minds. Its members, writing on dry subjects in an austere and often heavy style, did not find acceptance with a public which demanded before all things charm of manner in those who addressed it. The physiocratic tenets, which were in fact partly erroneous, were regarded by many as chimerical, and were ridiculed in the contemporary literature; as, for example, the *impôt unique* by Voltaire in his *L'Homme aux quarante écus*, which was directed in particular against P. P. Mercier-Larivière (1720–1794). It was justly objected to the group that they were too absolute in their view of things; they supposed, as Smith remarks in speaking of Quesnay, that the body politic could thrive only under one precise régime—that, namely, which they recommended—and thought their doctrines universally and immediately applicable in practice. They did not, as theorists, sufficiently take into account national diversities or different stages in social development; nor did they, as politicians, adequately estimate the impediments which ignorance, prejudice and interested opposition present to enlightened statesmanship.

The physiocratic system, after guiding in some degree the policy of the Constituent Assembly, and awakening a few echoes here and there in foreign countries, soon ceased to exist as a living power; but the good elements it comprised were not lost to mankind, being incorporated into the more complete construction of Adam Smith.

See the article on QUESNAY, with bibliography appended thereto, also the articles on MIRABEAU and TURGOT. Most French histories contain an account of the school; see especially Tocqueville, *L'Ancien régime et la révolution*, ch. iii.; Taine, *Les Origines de la France contemporaine*, vol. i.; R. Stourm, *Les Finances de l'ancien régime et de la révolution* (1885); Droz, *Histoire du règne de Louis XVI.*; also L. de Lavergne, *Économistes français du XVIII^e siècle*; H. Higgs, *The Physiocrats* (London, 1897, with authorities).

PHYSIOGNOMY, the English form of the middle Greek *φυσιογνωμία*, a contraction of the classical *φυσιογνωμονία* (from *φύσις*, nature, and *γνώμων*, an interpreter), (1) a term which denotes a supposed science for the "discovery of the disposition of the mind by the lineaments of the body" (Bacon); (2) is also used colloquially as a synonym for the face or outward appearance, being variously spelled by the old writers: *fysenamy* by Lydgate, *phisnomi* in Udall's translation of Erasmus on Mark iv., *physnomie* in Bale's *English Votaries* (i. 2. p. 44), and *fisnomie* in *All's well that ends well*, iv. 5 (first folio).

Physiognomy was regarded by those who cultivated it as a twofold science: (1) a mode of discriminating character by the outward appearance, and (2) a method of divination from form and feature. On account of the abuses of the latter aspect of the subject its practice was forbidden by the English law. By the act of parliament 17 George II. c. 5 (1743) all persons pretending to have skill in physiognomy were deemed rogues and vagabonds, and were liable to be publicly whipped, or sent to the house of correction until next sessions.[1] The pursuit thus stigmatized as unlawful is one of great antiquity, and one which in ancient and medieval times had an extensive though now almost forgotten literature. It was very early noticed that the good and evil passions by their continual exercise stamp their impress on the face, and that each particular passion has its own expression. Thus far physiognomy is a branch of physiology. But in its second aspect it touched divination and astrology, of which Galen[2] says that the physiognomical part is the greater, and this aspect of the subject bulked largely in the fanciful literature of the middle ages. There is evidence in the earliest classical literature that physiognomy formed part of the most ancient practical philosophy. Homer was a close observer of expression and of appearance as correlated with character, as is shown by his description of Thersites[3] and elsewhere. Hippocrates, writing about 450 B.C., expresses his belief in the influence of environment in determining disposition, and in the reaction of these upon feature,[4] a view in which he is supported later by Trogus. Galen, in his work Περὶ τῶν τῆς ψυχῆς ἠθῶν, having discussed the nature and immortality of the soul, proceeds in ch. vii. to a brief study of physiognomy (ed. Kuhn iv. 795). In this passage he deprecates current physiognomical speculations, saying that he might criticize them but feared to waste time and become tedious over them. In chapter viii. he quotes with approbation the Hippocratic doctrine referred to above; and in a later work, Περὶ κατακλίσεως προγνωστικά, he speaks of the advantage of a knowledge of physiognomy to the physician.[5] We learn both from Iamblichus[6] and Porphyry[7] that Pythagoras practised the diagnosis of the characters of candidates for pupilage before admitting them, although he seems to have discredited the current physiognomy of the schools, as he rejected Cylo, the Crotonian, on account of his professing these doctrines, and thereby was brought into some trouble.[8] Plato also tells us that Socrates predicted the promotion of Alcibiades from his appearance; and Apuleius[9] speaks of Socrates recognizing the abilities of Plato at first view. On the other hand, it has been recorded by Cicero[10] that a certain physiognomist, Zopyrus, who professed to know the habits and manners of men from their bodies, eyes, face and forehead, characterized Socrates as stupid, sensual and dull (*bardus*), "in quo Alcibiades cachinnum dicitur sustulisse." Alexander Aphrodisiensis adds that, when his disciples laughed at the judgment, Socrates said it was true, for such had been his nature before the study of philosophy had modified it. Zopyrus is also referred to by Maximus Tyrius[11] as making his recognitions "intuitu solo."

That one's occupation stamps its impress on the outward appearance was also noticed at an early period. In the curious poem in the Sallier papyrus (II.), written about 1800 B.C., Duan, son of Khertu, expatiates on the effects of divers handicrafts on the workmen as compared with the elevating influences of a literary life.[12] Josephus tells us that Caesar detected the pretence of the spurious Alexander by his rough hands and surface.[13]

The first systematic treatise which has come down to us is that attributed to Aristotle,[14] in which he devotes six chapters to the consideration of the method of study, the general signs of character, the particular appearances characteristic of the dispositions, of strength and weakness, of genius and stupidity, of timidity, impudence, anger, and their opposites, &c. Then he studies the physiognomy of the sexes, and the characters derived from the different features, and from colour, hair, body, limbs, gait and voice. He compares the varieties of mankind to animals, the male to the lion, the female to the leopard. The general character of the work may be gathered from the following specimen. While discussing noses, he says that those with thick bulbous ends belong to persons who are insensitive, swinish; sharp-tipped belong to the irascible, those easily provoked, like dogs; rounded, large, obtuse noses to the magnanimous, the lion-like; slender hooked noses to the eagle-like, the noble but grasping; round-tipped retroussé noses to the luxurious, like barndoor fowl; noses with a very slight notch at the root belong to the impudent, the crow-like; while snub noses belong to persons of luxurious habits, whom he compares to deer; open nostrils are signs of passion, &c.

The practice of physiognomy is alluded to in many of the Greek classics.[15] Apion speaks of the metoposcopists, who judge by the appearance of the face, and Cleanthes the Stoic says it is possible to tell habits from the aspect (cf. Ecclus. xix. 29, 30). Polemon (*c.* A.D. 150) compiled a treatise (published 1534, in Latin) on the subject, similar in character to that of Aristotle; but he excels in graphic descriptions of different dispositions, and differs only from Aristotle in some of his animal comparisons. A more important work was written by a converted Jew, Adamantius, about A.D. 415. This is in two books, the first on the expression of the eye, the second on physiognomy in general, mostly Aristotelian in character.

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[1] The Act 39 Elizabeth c. 4 (1597–1598) declared "all persons fayning to have knowledge of Phisiognomie or like Fantasticall Ymaginacious" liable to "be stripped naked from the middle upwards and openly whipped until his body be bloudye." This was modified by 13 Anne c. 26 (1713), still further by 17 George II. c. 5, which was re-enacted by the Vagrancy Act 1824. This last act only specifies palmistry.

[2] Galen. Περὶ κατακλίσεως προγνωστικά (ed. Kühn xix. 530).

[3] *Iliad*, ii. 214. See also Blackwell's *Inquiry*, (2nd ed. 1736), p. 330. A physiognomical study of the Homeric heroes is given by Malalas, *Chronogr.* ed. Dindorf, v. 105.

[4] Περὶ ἀέρων, ὑδάτων, τόπων (ed. Kühn, i. 547).

[5] *Op. cit.*, xix. 530.

[6] Περὶ βίου Πυθαγορικοῦ λόγος, i. 17, 59 (Amsterdam, 1707).

[7] *De vita Pythagorae*, p. 16 (Amsterdam, 1707). This author tells us that he applied the same rule to his friends. See also Aulus Gellius, i. ix.

[8] *Iamblichus*, p. 49.

[9] *De dogmate Platonis*, i. 567, p. 34 (Leiden, 1714).

[10] *Tuscul. quaestionum*, iv. 37. *De fato*, v.

[11] *Diss.*, xv. 157 (Cambridge, 1703).

[12] *Select Papyri*, Pl. xv., xix., and (Anastasi) ibid., cxxviii., cxxxiii.

[13] *Ant.*, xvii. 12, 2.

[14] Authors differ in their views as to its authenticity, but Diogenes Laërtius (v. 22) and Stobaeus (*Serm.* clxxxix.) both believe it to be genuine. The chief difficulty is the reference to a certain sophist, Dionysius, but this is probably an interpolation. There are physiognomic references in other writings of Aristotle (cf. *Anal. pr.*, ii. c. 30; *Hist. anim.*, i. 8, &c.) sufficient to justify the attribution of the treatise to him. On this, see Franz, Preface, p. vi. seq., of his *Scriptores physiognomiae veteres* (Leipzig, 1780).

[15] See an interesting paper on "Stretching and Yawning as Signs of Madness," by Professor Ridgeway (*Trans. Camb. Phil. Soc.*, i. 201), which refers to Aristoph. *Wasps*, 642, with which he compares Plautus, *Menaechmi*, 279. Other references exist to physiognomy in Cassiodorus, Isidorus, Meletius and Nemesius, but none of any great importance.

Among the Latin classical authors Juvenal, Suetonius and Pliny in well-known passages refer to the practice of physiognomy, and numerous allusions occur in the works of the Christian Fathers, especially Clement of Alexandria and Origen (for example, the familiar passage in his work against Celsus, i. 33).[1]

While the earlier classical physiognomy was chiefly descriptive, the later medieval authors particularly developed the predictive and astrological side, their treatises often digressing into chiromancy, onychomancy, clidomancy, podoscopy, spasmatomancy, and other branches of prophetic folk-lore and magic.

Along with the medical science of the period the Arabians contributed to the literature of physiognomy; ʽAli b. Ragel wrote a book on naevi; Rhazes (1040) devoted several chapters to it; and Averroes (1165) made many references to it in his *De sanitate*, p. 82 (Leiden, 1537). Avicenna also makes some acute physiognomical remarks in his *De animalibus*, which was translated by Michael Scot about 1270. Among medieval writers Albertus Magnus (born 1205) devotes much of the second section of his *De animalibus* to physiognomy; but this chiefly consists of extracts from Aristotle, Polemon and Loxus. He does not enter into the animal comparisons of his predecessors, but occupies himself chiefly with simple descriptive physiognomy as indicative of character; and the same is true of the scattered references in the writings of Duns Scotus and Thomas Aquinas. The famous sage of Balwearie, Michael Scot, while court astrologer to the emperor Frederick II., wrote his treatise *De hominis phisiognomia*, much of which is physiological and of curious interest. It was probably composed about 1272, but not printed until 1477. This was the first printed work on the subject. Physiognomy also forms the third part of his work *De secretis naturae*. In 1335 Pietro d'Abano of Padua delivered in Paris a course of lectures on this subject (afterwards edited by Blondus, 1544), a few years before he was burned for heresy.

The 16th century was rich in publications on physiognomy. The works of the classical authors before mentioned were printed, and other treatises were published by John de Indagine, Cocles, Andreas Corvus, Michael Blondus, Janus Cornaro, Anselm Douxciel, Pompeius Ronnseus, Gratarolus, Lucas Gauricus, Tricassus, Cardanus, Taisnierus, Magnus Hund, Rothman, Johannes Padovanus, and, greatest of all, Giambattista della Porta. The earliest English works were anonymous: *On the Art of Foretelling Future Events by Inspection of the Hand* (1504), and *A Pleasant Introduction to the Art of Chiromancie and Physiognomie* (1588). Dr Thomas Hill's work, *The Contemplation of Mankynde, contayning a singular Discourse after the Art of Physiognomie*, published in 1571, is a quaintly written adaptation from the Italian authors of the day. The undated book on moles and naevi by "Merlin Britannicus," after the model of ʽAli ibn Ragel, is of about the same date.

The development of a more accurate anatomy in the 17th century seems to have diminished the interest in physiognomy, by substituting fact for fiction; and consequently the literature, though as great in quantity, became less valuable in quality. The principal writers of this age were T. Campanella, R. Coclenius, Clement, Timpler, J. E. Gallimard, Moldenarius, Septalius, Saunders, C. Lebrun (a precursor of Charles Bell), Elsholz, de la Bellière, J. Evelyn (in the appendix to *Numismata*), Baldus, Bulwer (in his *Pathomyotomia*), Fuchs, Spontoni, Ghiradelli, Chiaramonti, A. Ingegneri, Finella, De la Chambre, Zanardus, R. Fludd, and others of less importance.

The 18th century shows a still greater decline of interest in physiognomy. Historians of philosophy, like J. Meursius and Franz, re-edited some of the classical works, and G. G. Fülleborn reviewed the relation of physiognomy to philosophy. Indeed, the only name worthy of note is that of J. K. Lavater (*q.v.*). The other authors of this century are Peuschel, Spon, Schutz, Wegelin, J. Pernetti, Girtanner, Grohmann, and several anonymous writers, and from the anatomical side G. M. Lancisi, J. Parsons and Peter Camper. The popular style, good illustrations and pious spirit pervading the writings of Lavater have given to them a popularity they little deserved, as there is no system in his work, which chiefly consists of rhapsodical comments upon the several portraits. Having a happy knack of estimating character, especially when acquainted with the histories of the persons in question, the good pastor contrived to write a graphic and readable book, but one much inferior to Porta's or Aristotle's as a systematic treatise. The treatises of Nicolai and of Lichtenberg were written to refute his theory. With Lavater the descriptive school of physiognomists may be said to have ended, as the astrological physiognomy expired with de la Bellière. The few works which have since appeared, before the rise of the physiological school of Sir Charles Bell and Charles Darwin, are undeserving of notice, the development of phrenology having given to pure physiognomy the *coup de grâce* by taking into itself whatever was likely to live of the older science. The writers of the 19th century are Hörstig, Maas, Rainer, Thoné, A. Stöhr, Sehler, Dr Rubels, Polli, Cardona, Mastriani, Diez, Carus, Piderit, Burgess and P. Gratiolet.

The physiological school of physiognomy was foreshadowed by Parsons and founded by Sir Charles Bell, whose *Essay on the Anatomy of the Expression*, published in 1806, was the first scientific study of the physical manifestation of emotions in the terms of the muscles which produce these manifestations. In the later editions of this essay the thesis is elaborated with greater detail. Moreau's edition of Lavater, in 1807, was somewhat along the same lines. In 1817 Dr Cross of Glasgow wrote his defence of a scientific physiognomy based on general physiological principles. The experiments of G. B. A. Duchenne (*Mécanisme de la physiognomie humaine*, Paris, 1862) showed that by the use of electricity the action of the separate muscles could be studied and by the aid of photography accurately represented. These observations confirmed by experimental demonstration the hypothetical conclusions of Bell. The machinery of expression having thus been indicated, the connexion of the physical actions and the psychical state was made the subject of speculation by Herbert Spencer (*Psychology*, 1855). These speculations were reduced to a system by Darwin (*Expression of Emotions*, 1872), who formulated and illustrated the following as fundamental physiognomical principles:—

(1) Certain complex acts are of direct or indirect service, under certain conditions of the mind, in order to relieve or gratify certain sensations or desires; and whenever the same states of mind are induced the same sets of actions tend to be performed, even when they have ceased to be of use. (2) When a directly opposite state of mind is induced to one with which a definite action is correlated, there is a strong and involuntary tendency to perform a reverse action. (3) When the sensorium is strongly excited nerve-force is generated in excess, and is transmitted in definite directions, depending on the connexions of nerve-cells and on habit.

The last of these propositions is adversely criticized by P. Mantegazza as a truism, but it may be allowed to stand with the qualification that we are ignorant concerning the nature of the influence called "nerve-force." It follows from these propositions that the expression of emotion is, for the most part, not under control of the will, and that those striped muscles are the most expressive which are the least voluntary. To the foregoing may be added the following three additional propositions, so as to form a more complete expression of a physiognomical philosophy:—

(4) Certain muscles concerned in producing these skin-folds become strengthened by habitual action, and when the skin diminishes

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[1] For Scriptural allusions to physiognomy see Vecchius, *Observationes in div. script.* (Naples, 1641). Other classical references are contained in the *Prooemium* to the 1593 edition of the works of Baptista Portae.

in elasticity and fulness with advancing age, the wrinkles at right angles to the course of the muscular fibres become permanent. (5) To some extent habitual muscular action of this kind may, by affecting local nutrition, alter the contour of such bones and cartilages as are related to the muscles of expression. (6) If the mental disposition and proneness to action are inherited by children from their parents, it may be that the facility in, and disposition towards, certain forms of expression are in like manner matters of heredity.

Illustrations of these theoretic propositions are to be found in the works of Bell, Duchenne and Darwin, and in the later publications of Theodor Piderit, *Mimike und Physiognomik* (1886) and Mantegazza, *Physiognomy and Expression* (1890), to which the student may be referred for further information.

For information on artistic anatomy as applied to physiognomy see the catalogue of sixty-two authors by Ludwig Choulant, *Geschichte und Bibliographie der anatomischen Abbildung*, &c. (Leipzig, 1852), and the works of the authors enumerated above, especially those of Aristotle, Franz, Porta, Cardan, Corvus and Bulwer. For physiognomy of disease, besides the usual medical handbooks, see Cabuchet, *Essai sur l'expression de la face dans les maladies* (Paris, 1801); Mantegazza, *Physiology of Pain* (1893), and Polli, *Saggio di fisiognomonia e potognomonia* (1837). For ethnological physiognomy, see amongst older authors Gratarolus, and amongst moderns the writers cited in the various textbooks on anthropology, especially Schadow, *Physionomies nationales* (1835) and Park Harrison, *Journ. Anthrop. Inst.* (1883). The study of the physical characteristics of criminals is discussed at great length by Lombroso, *L'Uomo delinquente* (1897); Ferri, *L'Omicidio* (1895); von Baer, *Der Verbrecher* (1893); Laurent, *Les Habitués des prisons* (1890); and Havelock Ellis, *The Criminal* (1901). (A. Ma.)

PHYSIOLOGUS, the title usually given to a collection of some fifty Christian allegories much read in the middle ages, and still existing in several forms and in about a dozen Eastern and Western languages. As nearly all its imagery is taken from the animal world, it is also known as the *Bestiary*. There can be hardly a doubt about the time and general circumstances of its origin. Christian teachers, especially those who had a leaning towards Gnostic speculations, took an interest in natural history, partly because of certain passages of Scripture that they wanted to explain, and partly on account of the divine revelation in the book of nature, of which also it was man's sacred duty to take proper advantage. Both lines of study were readily combined by applying to the interpretation of descriptions of natural objects the allegorical method adopted for the interpretation of Biblical texts. Now the early Christian centuries were anything but a period of scientific research. Rhetorical accomplishments were considered to be the chief object of a liberal education, and to this end every kind of learning was made subservient. Instead of reading Aristotle and other naturalists, people went for information to commonplace books like those of Aelian, in which scraps of folk-lore, travellers' tales and fragments of misapprehended science were set forth in an elegant style. Theological writers were not in the least prepared to question the worth of the marvellous descriptions of creatures that were current in the schools on the faith of authorities vaguely known as "the history of animals," "the naturalists," and "the naturalist" in the singular number (φυσιολόγος).[1] So they took their notions of strange beasts and other marvels of the visible world on trust and did their best to make them available for religious instruction. In some measure we find this practice adopted by more than one of the Fathers, but it was the Alexandrian school, with its pronounced taste for symbolism, that made the most of it. Clement himself had declared that natural lore, as taught in the course of higher Christian education according to the canon of truth, ought to proceed from "cosmogony" to "the theological idea,"[2] and even in the little that is left of the works of Origen we have two instances of the proceeding in question. And yet the fact that these reappear in the *Physiologus* would not suffice to stamp the work as a series of extracts from Alexandrian writings, as parallels of the same kind can be adduced from Epiphanius (*loc. cit.*) and Ephraem Syrus (*Opp. Syr.* ii. 17, 130). Father Cahier would even trace the book to Tatian, and it is true that that heresiarch mentions a writing of his own upon animals. Still, the context in which the quotation occurs makes it evident that the subject-matter was not the nature of particular species nor the spiritual lessons to be drawn therefrom, but rather the place occupied by animal beings in the system of creation. On the other hand, the opinion of Cardinal Pitra, who referred the *Physiologus* to the more orthodox though somewhat peculiar teaching of the Alexandrians, is fully borne out by a close examination of the irregularities of doctrine pointed out in the *Physiologus* by Cahier, all of which are to be met with in Origen. The technical words by which the process of allegorizing is designated in the *Physiologus*, like ἑρμηνεία, θεωρία, ἀναγωγή, ἀλληγορία, are familiar to the students of Alexandrian exegesis. It has, moreover, been remarked that almost all the animals mentioned were at home in the Egypt of those days, or at least, like the elephant, were to be seen there occasionally, whereas the structure of the hedgehog, for instance, is explained by a reference to the sea-porcupine, better known to fish-buyers on the Mediterranean. The fables of the phoenix and of the conduct of the wild ass and the ape at the time of the equinox owe their origin to astronomical symbols belonging to the Nile country.[3] In both chapters an Egyptian month is named, and elsewhere the antelope bears its Coptic name of "antholops."

That the substance of the *Physiologus* was borrowed from commentaries on Scripture[4] is confirmed by many of the sections opening with a text, followed up by some such formula as "but the Physiologus says." When zoological records failed, Egypto-Hellenic ingenuity was never at a loss for a fanciful invention distilled from the text itself, but which to succeeding copyists appeared as part of the teaching of the original *Physiologus*. As a typical instance we may take the chapter on the ant-lion—not the insect, but an imaginary creature suggested by Job. iv. 11. The exceptional Hebrew for a lion (*layish*) appeared to the Septuagint translators to call for a special rendering, and as there was said to exist on the Arabian coast a lion-like animal called "myrmex" (see Strabo xvi. 774; Aelian, *N.A.*, vii. 47) they ventured to give the compound noun "myrmekoleon." After so many years the commentators had lost the key to this unusual term, and only knew that in common Greek "myrmex" meant an ant. So the text "the myrmekoleon hath perished for that he had no nourishment" set them pondering, and others reproduced their meditations, with the following result: "The *Physiologus* relates about the ant-lion: his father hath the shape of a lion, his mother that of an ant; the father liveth upon flesh, and the mother upon herbs. And these bring forth the ant-lion, a compound of both, and in part like to either, for his fore part is that of a lion, and his hind part like that of an ant. Being thus composed, he is neither able to eat flesh like his father, nor herbs like his mother; therefore he perisheth from inanition"; the moral follows.

At a later period, when the Church had learnt to look with suspicion upon devotional books likely to provoke the scoffing of some and lead others into heresy, a work of this kind could hardly meet with her approval. A synod of Pope Gelasius, held in 496, passed censure, among others, on the "Liber Physiologus, qui ab haereticis conscriptus est et B. Ambrosii nomine signatus, apocryphus," and evidence has even been offered that a similar sentence was pronounced a century before. Still, in spite of such measures, the *Physiologus*, like the *Church History* of Eusebius or the *Pastor of Hermas*, continued to be read with general interest, and even Gregory the Great did not disdain to allude to it on occasion. Yet the Oriental versions, which had certainly nothing to do with the Church of Rome, show that there was no systematic revision made according to the catholic standard of doctrine. The book remained essentially the same, albeit great liberties were taken with its details and outward form. There must have been many imperfect copies in circulation, from which people transcribed such sections as they found or chose, and afterwards completed their MS. as occasion served. Some even rearranged the contents according to the alphabet or to zoological affinity. So little was the collection considered as a literary work with a definite text that every one assumed a right to abridge or enlarge, to insert ideas of his own, or fresh scriptural quotations; nor were the scribes and translators by any means scrupulous about the names of natural objects, and even the passages from Holy Writ. *Physiologus* had been abandoned by scholars, and left to take its chance among the tales and traditions of the uneducated mass. Nevertheless, or rather for this very reason, its symbols found their way into the rising literature of the vulgar tongues, and helped to quicken the fancy of the artists employed upon church buildings and furniture.

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[1] Origen, *Sel. in Jerem.* xvii. 11, ἐν τῇ περὶ ζῴων ἱστορίᾳ; Epiphan. *Adv. haer.* i. 3, p. 274 (ed. D. Petav.), ὥς φασιν οἱ φυσιολόγοι; Origen, *Hom.* xvii., in Gen. xliv. 9, "nam physiologus de catulo leonis scribit."

[2] *Strom.*, iv. p. 564 (ed. Potter), ἡ γοῦν κατὰ τὸν τῆς ἀληθείας κανόνα γνωστικῆς παραδόσεως φυσιολογία, μᾶλλον δὲ ἐποπτεία, ἐκ τοῦ περὶ κοσμογονίας ἤρτηται λόγου, ἐνθένδε ἀναβαίνουσα ἐπὶ τὸ θεολογικὸν εἶδος.

[3] Cp. Leemans on Horapollo i. 16, 34.

[4] Including the Apocrypha. See the Icelandic account of the elephant, also a decidedly Alexandrian fragment upon the μάργος, founded upon 4 Macc. i. 3, which has got into the scholia upon the *Odyssey* xviii. 2 (ii. 533, ed. Dindorf, Oxford, 1855).

The history of the *Physiologus* has become entwined from the beginning with that of the commentaries on the account of creation in Genesis. The principal production of this kind in our possession is the *Hexaemeron* of Basil, which contains several passages very like those of the *Physiologus*. For instance, in the seventh homily the fable of the nuptials of the viper and the conger-eel, known already to Aelian and Oppian, and proceeding from a curious misreading of Aristotle (*Hist. An.* v. 4, 540 b, Bekk.), serves to point more than one moral. Notwithstanding the difference in theology, passages of this kind could not but be welcome to the admirers of the Alexandrian allegories. In fact a medley from both Basil and the *Physiologus* exists under the title of the *Hexaemeron* of Eustathius; some copies of the first bear as a title Περὶ φυσιολογίας, and in a Milan MS. the "morals" of the *Physiologus* are ascribed to Basil. The Leyden Syriac is supplemented with literal extracts from the latter, and the whole is presented as his work. Other copies give the names of Gregory Theologus, Epiphanius, Chrysostom and Isidore.

As far as can be judged, the emblems of the original *Physiologus* were the following: (1) the lion (footprints rubbed out with tail; sleeps with eyes open; cubs receive life only three days after birth by their father's breath); (2) the sun-lizard (restores its sight by looking at the sun); (3) the charadrius (Deut. xiv. 16; presages recovery or death of patients); (4) the pelican (recalls its young to life by its own blood); (5) the owl (or nyktikorax; loves darkness and solitude); (6) the eagle (renews its youth by sunlight and bathing in a fountain); (7) the phoenix (revives from fire); (8) the hoopoe (redeems its parents from the ills of old age); (9) the wild ass (suffers no male besides itself); (10) the viper (born at the cost of both its parents' death); (11) the serpent (sheds its skin; puts aside its venom before drinking; is afraid of man in a state of nudity; hides its head and abandons the rest of its body); (12) the ant (orderly and laborious; prevents stored grain from germinating; distinguishes wheat from barley on the stalk); (13) the sirens and onocentaurs (Isa. xiii. 21, 22; compound creatures); (14) the hedgehog (pricks grapes upon its quills); (15) the fox (catches birds by simulating death); (16) the panther (spotted skin; enmity to the dragon; sleeps for three days after meals; allures its prey by sweet odour); (17) the sea-tortoise (or aspidochelone; mistaken by sailors for an island); (18) the partridge (hatches eggs of other birds); (19) the vulture (assisted in birth by a stone with loose kernel); (20) the ant-lion (able neither to take the one food nor to digest the other); (21) the weasel (conceives by the mouth and brings forth by the ear); (22) the unicorn (caught only by a virgin); (23) the beaver (gives up its testes when pursued); (24) the hyaena (a hermaphrodite); (25) the otter (enhydris; enters the crocodile's mouth to kill it); (26) the ichneumon (covers itself with mud to kill the dragon; another version of No. 25); (27) the crow (takes but one consort in its life); (28) the turtle-dove(same nature as No. 27); (29) the frog (either living on land and killed by rain, or in the water without ever seeing the sun); (30) the stag (destroys its enemy the serpent); (31) the salamander (quenches fire); (32) the diamond (powerful against all danger); (33) the swallow (brings forth but once; misreading of Aristotle, *Hist. An.* v. 13); (34) the tree called peridexion (protects pigeons from the serpent by its shadow); (35) the pigeons (of several colours; led by one of them, which is of a purple or golden colour); (36) the antelope (or hydrippus; caught by its horns in the thicket); (37) the fire-flints (of two sexes; combine to produce fire); (38) the magnet (adheres to iron); (39) the saw-fish (sails in company with ships); (40) the ibis (fishes only along the shore); (41) the ibex (descries a hunter from afar); (42) the diamond again (read "carbuncle"; found only by night); (43) the elephant (conceives after partaking of mandrake; brings forth in the water; the young protected from the serpent by the father; when fallen is lifted up only by a certain small individual of its own kind); (44) the agate (employed in pearl-fishing); (45) the wild ass and ape (mark the equinox); (46) the Indian stone (relieves patients of the dropsy); (47) the heron (touches no dead body, and keeps to one dwelling-place); (48) the sycamore (or wild fig; grubs living inside the fruit and coming out); (49) the ostrich (devours all sorts of things; forgetful of its own eggs). Besides these, or part of them, certain copies contain sections of unknown origin about the bee, the stork, the tiger, the woodpecker, the spider and the wild boar.

The Greek text of the *Physiologus* exists only in late MSS., and has to be corrected from the translations. In Syriac we have a full copy in a 12th-century Leyden MS., published in J. P. N. Land's *Anecdota syriaca*; thirty-two chapters with the "morals" left out in a very late Vatican copy, published by Tychsen; and about the same number in a late MS. of the British Museum (Add. 25878). In Armenian Pitra gave some thirty-two chapters from a Paris MS. (13th century). The Aethiopic exists both in London and Paris, and was printed at Leipzig by Dr Hommel in 1877. In Arabic we have fragments at Paris, of which Renan translated a specimen for the *Spicilegium solesmense*, and another version of thirty-seven chapters at Leiden, probably the work of a monk at Jerusalem, which Land translated and printed with the Syriac. The Latin MSS. of Bern are, after the Vatican glossary of Ansileubus, the oldest of which we know; there are others in several libraries, and printed editions by Mai, Heider and Cahier. Besides these, a few fragments of an old abridgment occur in Vallarsi's edition of Jerome's works (vol. xi. col. 218). A metrical *Physiologus* of but twelve chapters is the work of Theobaldus, probably abbot of Monte Cassino (A.D. 1022–1035). From this was imitated the Old-English fragment printed by Th. Wright, and afterwards by Maetzner; also the Old-French *Sensuyl le bestiaire d'amours*. The prose *Physiologus* was done into Old High German before 1000, and afterwards into rhyme in the same idiom; since Von der Hagen (1824) its various forms have found careful editors among the leading Germanists. The Icelandic, in a Copenhagen MS. of the 13th century, was printed by Professor Th. Möbius in his *Analecta norroena* (2nd ed., 1877); at the same time he gave it in German in Dr Hommel's Aethiopic publication. Some Anglo-Saxon metrical fragments are to be found in Grein's *Bibliothek*, vol. i. The Provençal (*c.* 1250), published in Bartsch's *Chrestomathie provençale*, omits the "morals," but is remarkable for its peculiarities of form. Before this there had been translations into French dialects, as by Philippe de Thaun (1121), by Guillaume, "clerc de Normandie," also, about the same period, by Pierre, a clergyman of Picardy. All the Old-French materials have not yet been thoroughly examined, and it is far from improbable that some versions of the book either remain to be detected or are now lost past recovery. A full account of the history of the *Physiologus* should also embrace the subjects taken from it in the productions of Christian art, the parodies suggested by the original work, *e.g.* the *Bestiaire d'amour* by Richard de Fournival, and finally the traces left by it upon the encyclopaedical and literary work of the later middle ages.

Nearly all the information now obtainable is to be found in the following works and such as are there quoted: *S. Epiphanius ad physiologum*, ed. Ponce de Leon (with woodcuts) (Rome, 1587); another edition, with copper-plates (Antwerp, 1588); *S. Eustathii in hexahemeron commentarius*, ed. Leo Allatius (Lyons, 1629; cf. H. van Herwerden, *Exercitt. Critt.*, pp. 180–182, Hague, 1862); *Physiologus syrus*, ed. O. G. Tychsen (Rostock, 1795); *Classici auctores*, ed. Mai, vii. 585–596 (Rome, 1835); G. Heider, in *Archiv für Kunde österreich. Geschichtsquellen* ii. 545 seq. (Vienna, 1850); Cahier and Martin, *Mélanges d'archéologie*, &c. ii. 85 seq. (Paris, 1851), iii. 203 seq. (1853), iv. 55 seq. (1856); Cahier, *Nouveaux mélanges* (1874), p. 106 seq.; J. B. Pitra, *Spicilegium solesmense* iii. xlvii. seq., 338 seq., 416, 535 (Paris, 1855); Maetzner, *Altengl. Sprachproben* (Berlin, 1867), vol. i. pt. i. p. 55 seq.; J. Victor Carus, *Gesch. der Zoologie* (Munich, 1872), p. 109 seq.; J. P. N. Land, *Anecdota syriaca* (Leiden, 1874), iv. 31 seq., 115 seq., and in *Verslagen en Mededeelingen der kon. Akad. van Wetenschappen*, 2nd series, vol. iv. (Amsterdam, 1874); Möbius and Hommel in their publications quoted above. See also Lauchert, *Geschichte des Physiologus* (Strassburg, 1889) and E. Peters, *Der griechische Physiologus und seine orientalischen Übersetzungen* (Berlin, 1898).

PHYSIOLOGY (from Gr. φύσις, nature, and λόγος, discourse), the science or theory of the properties, processes and functions of living organisms. Physiology is distinguished from anatomy as dealing specifically with the functions of an organism, rather than its structure. The two main branches of the science are animal and plant (vegetable) physiology, and in animal physiology that of man stands out as primarily associated with the word.

History of Theory.

Ever since men began to take a scientific interest in the problems of life two distinct rival explanatory principles of vital phenomena have claimed attention: a natural and a mystical principle. The first outcome of the scientific attempt to explain vital phenomena after the natural method and by a unitary principle was the doctrine of the *Pneuma*, held by the followers of Hippocrates, which found its clearest expression in Galen's system. According to this doctrine, the origin of all vital phenomena was a very fine substance, the Pneuma, which was supposed to exist in atmospheric air, to be inhaled into the lungs of man, and thus through the blood to reach all the parts of the body, where it produced vital phenomena. This doctrine—an attempt to explain the phenomena of life which was not altogether natural, but even materialistic—was accepted by the middle ages together with Galen's system. With its translation into the Latin *spiritus*, however, the conception of the Pneuma lost its original force. The *spiritus animales* of the middle ages developed ere long into mystical powers, the result being the explanation of vital phenomena by a supernatural theory. Not until the scientific renaissance of the 16th and 17th centuries did views again undergo a change. After the establishment of a scientific method in physiology by William Harvey, and the development of Descartes' mechanical system of regarding living bodies, the natural explanation of vital phenomena once more universally found favour. Two schools arose, which endeavoured by dissimilar methods to find a mechanical explanation of vital phenomena: the *iatrophysical*, originating with the gifted and versatile Borelli, and the *iatrochemical*, founded by the Dutchman, F. de la Boë (Sylvius). But when both chemical and physical methods of explanation failed at such problems as, for instance, irritability and evolution, another change in opinion took place. By degrees there emerged once more the tendency to explain vital phenomena by mystical means, finding expression in the *Animism* of Stahl, to quote an example; and in the second half of the 18th century *Vitalism*, originating in France, began its victorious march throughout the whole scientific world. Again the opinion came to be entertained that the cause of vital phenomena was a mystical power (*force hypermécanique*)—that "vital force" which, neither physical nor chemical in its nature, was held to be active in living organisms only. Vitalism continued to be the ruling idea in physiology until about the middle of the 19th century, and its supremacy was only gradually overthrown by the great discoveries in natural science of that century. The chemical discoveries resulting from Wöhler's synthesis of urea first showed that typical products of the animal body, the production of which had hitherto been supposed to be solely the result of the operation of vital force, could be obtained artificially by purely chemical methods. Then above all came the discovery of the law of the Conservation of Energy by Robert Mayer (1814–1878) and Hermann von Helmholtz (1821–1894), and its application to the living organism by Mayer, Helmholtz, Pierre Louis Dulong (1785–1838), Edward Frankland, Max Rubner and others, to prove that the manifestations of energy by the organism are simply the result of the quantity of potential energy received into the body by means of food. Finally, the stupendous results arrived at by Darwin and the establishment of the fundamental law of "biogenesis" by Ernst Haeckel, prepared the way for a natural explanation of the enigma of evolution and structure of organisms. Thus by the second half of the 19th century the doctrine of vital force was definitely and finally overthrown to make way for the triumph of the natural method of explaining vital phenomena, which down to the present time has continued to spread and flourish with an unparalleled fertility. It would, it is true, appear as if in our day, after the lapse of half a century, mystical tendencies were again disposed to crop up in the investigation of life. Here and there is heard once more the watchword of Vitalism. But all the so-called *neo-vitalistic* efforts—such as those of Alexander von Bunge (1803–1890), Georg Evon Rindfleisch (b. 1835), Johannes Reinke (b. 1849) and others—have nothing to do with the old vitalism. They originate solely in a widespread confusion with regard to the boundaries of natural science, their principal tendency being to amalgamate psychological and speculative questions with problems of purely natural science. In the face of all these efforts, which by their unfortunate designations of Vitalism and Neo-vitalism give rise to entirely false conceptions, and which by their intermingling of psychological questions and questions of natural science have led to mere confusion in research, it is essential that natural philosophy should be called upon to realize its own limits, and above all clearly to understand that the sole concern of physical science is the investigation of the phenomena of the material world. Physiology, as the doctrine of life, must therefore confine itself to the material vital phenomena of organisms. It is self-evident, however, that only such laws as govern the material world will be found governing material vital phenomena—the laws, that is, which have hitherto been brought to their most exact and most logical development by physics and chemistry, or, more generally speaking, by mechanics. The explanatory principles of vital phenomena must therefore be identical with those of inorganic nature—that is, with the principles of mechanics.

Ultimate Elements of Life.

The investigation of vital phenomena in this sense requires, in the first place, an exact knowledge of the substratum in which these phenomena are manifested, just as in chemistry and physics a thorough knowledge of the composition of the material world is a necessary premise to the investigation of the phenomena of inorganic nature. The knowledge of the composition and structure of organisms has in the course of the scientific development of anatomy attained to an ever-increasing minuteness of detail, without having as yet reached a definite limit. The last important step in this direction was the discovery by Matthias Jakob Schleiden (1804–1881) and Theodor Schwann (1810–1882) that all organisms are built up of elementary living structural components, namely of cells (see Cytology). The details of the anatomical construction of organisms are described under various appropriate headings, and a general guide to these will be found under Anatomy and Zoology. We would here merely point out that a cell is the simplest particle of living substance which appears to be permanently capable of life. Different elements are essential, however, to the existence of the cell—two, at least, so far as has hitherto been discovered—the protoplasm and the nucleus. It must at present be regarded as at least very doubtful whether the *centrosome*, which in recent times it has been possible to demonstrate as existing in very many cells, and which appears sometimes in the protoplasm, sometimes in the nucleus, is a general and third independent cell-constituent. On the other hand, the number of special constituent parts which appear in various cell-forms is very large. A question which has long been discussed, and which has received special and animated attention, is that with regard to the finer structure of the cells—with regard, that is, to the protoplasm and the nucleus lying in it. Views on this subject have diverged very widely, and several totally diverse theories have been opposed to one another. One theory maintains that the living cell-substance has a reticular structure; another, that it is fibrillous. According to a third theory, the essence of the construction of the cell-substance lies in the granules which it contains; and according to a fourth, it lies in the ground-substance in which these granules are embedded. One view holds this ground substance to be homogeneous, another regards it as possessing a fine foam-structure. It may at present be regarded as incontrovertible that living substance is more or less fluid, and that there does not exist any *general* structure for all cell-forms. But in some special cases all the theories which have been quoted are to a certain extent correct. In different cells there are reticular, fibrillous and granular differentiations respectively, and differentiations in foam-structure; in many cells, however, the protoplasm appears to be beyond doubt homogeneous and without a distinct structure, and only under certain conditions to assume changing structures. But the fact which is of most importance for the right understanding of vital phenomena is that the cell-substance is always more or less fluid, for only in a fluid substratum can such intense chemical processes be enacted as are to be found in every living cell.

Where the analytical powers of the microscope in anatomy can go no farther, chemical analysis of the composition of the cell steps in. By its means the discovery is made that there is no *elementary* difference between organic and inorganic nature, for only such chemical elements as are known to exist in the inorganic world are found in the organic. On the other hand, however, the living cell-substance possesses chemical *compounds* which find analogues nowhere in inorganic nature. The characteristic organic substances which are present in every cell are proteids and proteid-compounds. Besides these there occur, widely disseminated, carbohydrates, fats and other organic substances, which partly originate in the decomposition of proteids and their compounds, and are partly used for their construction. Lastly, there are in addition great quantities of water and some inorganic salts.

General Phenomena of Life.

Such are the structure and composition of the substratum in which vital phenomena play their part. When we consider vital phenomena themselves in the various living organisms—in protista, plants, animals, man—there appears an incalculable diversity of phenomena. Here, however, as in the case of the structure of organisms, we have to analyse and to penetrate ever farther and deeper till we reach the fundamental phenomena. We then find that the great variety of vital manifestations may be traced back to a few fundamental general groups, which are precisely the same groups of phenomena as those to be observed in inorganic nature. All the processes that take place in the organic world may be regarded from the three different standpoints of their changes in substance, in energy and in form; for substance, energy and form are all necessary to our conception of matter. Accordingly, the general elementary vital phenomena likewise fall into three groups—metabolism, the mechanism of energy, and the assumption of form. Every cell, so long as it is living, takes in certain substances from its environment, submits them to chemical transformation in its interior, and gives out other substances. This *metabolism* is manifested in several special functions—in nutrition and digestion, respiration and circulation, secretion and excretion. The essence of the whole process is the fact that while out of these ingested stuffs living substance is always again being formed by the living substance which already exists, it is itself continually undergoing decomposition, and the products of this decomposition are what the cell gives off again to the outside. With metabolism, however, there is inseparably associated a *transformation of energy*. These substances taken in by the cell contain a large quantity of potential energy, which is transformed into kinetic energy. This has for its result the manifold activities of the organism, more especially motion, heat, electricity and light. Finally, the chemical transformations in living substance may also manifest themselves outwardly in *changes of form*, as is the case generally in the matter of growth, reproduction and development. The three general elementary groups of vital phenomena are therefore in reality merely the expression of the various aspects of one and the same process—of the actual vital process itself. The ultimate object of all physiology is to discover what this vital process is—that is to say, what is the exact cause of these manifold vital phenomena—a goal from which it is at the present day still very remote.

Conditions of Life.

As every physical and chemical phenomenon of inorganic nature occurs only under distinct conditions, so vital phenomena are also dependent upon certain conditions of life. Every living body, every living cell, requires food, water, oxygen, and, further, a certain temperature and a certain pressure in its environment. These are the *general* conditions of life. But the *special* conditions on which depends the continued existence of the individual forms of organism are as numerous as the forms of organisms themselves. Now, just as the physicist or chemist varies those conditions under which a phenomenon occurs in order to get at its causes, so does the physiologist try to experiment with vital phenomena, altering the vital conditions: and testing the changes which are thereby produced. The great importance of this method consists in the power it gives the experimenter of analysing vital phenomena systematically from definite points of view. Every change in its normal vital conditions which produces any effect whatsoever upon an organism is termed a *stimulus*. This is the only general definition we have for a conception which is of such vast importance to physiology. According to it, experimental physiology is entirely a physiology of stimuli. It further follows from this conception of stimulation that there must be an enormous multiplicity of stimuli, since each particular vital condition may be subjected to some change capable of acting upon it as a stimulus. But, besides this, other factors may be brought to bear upon organisms which have absolutely no place among their vital conditions: for instance, many chemical reagents and electric currents. These influences come under the general definition of stimulus, because they likewise imply a change in the conditions under which the organism lives. From their qualitative nature stimuli are distinguished as chemical, thermal, photic, mechanical and electrical. Each of these several varieties may, however, be applied quantitatively in various degrees of intensity, and may in consequence produce quite different results. This opens up to experimental physiology a vast field of research. But the physiology of stimulation is not only of the greatest value as a *means* of research: its importance is much increased by the fact that in nature itself stimuli are everywhere and constantly acting upon the organism and its parts. Hence the investigation of their action comes to be not merely a *means*, but a direct *end* of research.

Actions of Stimuli.

Although it is not at present possible to define all the laws that govern stimulation, on the one hand because the number of stimulating effects known to us in the whole organic world is as yet too limited, and on the other because those already known have not yet been thoroughly analysed, yet it is within our power to classify stimulating effects according to their various characteristics, and to ascertain a few facts concerning their general and fundamental conformity to law. The first fact, apparent from a glance at a great many of the various forms of stimulation, is that all their effects are manifested in either a *quantitative* or a *qualitative* alteration of the characteristic vital phenomena of each living object. The quantitative is the usual mode of action of stimuli. It is generally found that a stimulus either increases or diminishes the intensity of vital phenomena. In the first case the effect is one of excitation; in the second of depression. It is the more important to bear in mind this twofold operation of stimuli, owing to the fact that in former times physiologists were very apt to conceive of excitation and stimulation as identical. It is now, however, an undisputed fact that depression may also occur as a typical effect of stimulation. This is most apparent in cases where the same stimulus that produces excitation may on being applied for a longer period and with greater intensity, produce depression. Thus narcotics (alcohol, ether, chloroform, morphia, &c.) on certain forms of living substance produce the phenomena of excitation when their action is weak, whereas when it is stronger they produce complete depression. Thus, likewise, temperature stimuli act differently upon vital phenomena according to the degree of temperature: very low temperatures depressing, medium temperatures exciting with increasing intensity, and higher temperatures from a certain height upwards again depressing. The effects of stimulation are not, however, always manifested in merely quantitative changes of the normal vital phenomena. Sometimes, especially in the case of long uninterrupted and chronic stimuli, stimulation is found gradually to produce phenomena which are apparently quite foreign to the normal vital phenomena of the cell in question. Such *qualitative* alterations of normal vital phenomena are perceptible chiefly in chronic maladies in the cells of different organs (the heart, liver, kidneys, spleen, &c.), in which the vital conditions become gradually more and more modified by the cause of the malady. To this category pertain all the so-called chronic processes of degeneration which in pathology are known as fatty degeneration, mucous degeneration, amyloid degeneration, and so forth. The characteristic element in all these processes is that the normal metabolism is diverted into a wrong channel by the altered vital conditions of the cells of the organ affected, so that substances are formed and accumulated in the cell which are entirely foreign to its normal life. But this class of stimulation is still very obscure as regards causes and inner processes, and it is within the range of possibility that the ultimate cause of the qualitative changes in the normal metabolism is to be found simply in the processes of excitation and depression which chronic stimulation produces in separate parts of the metabolism. Thus, at least with regard to fat-metamorphosis (fatty degeneration), it is highly probable that fat is deposited in the protoplasm simply because, owing to an inadequate supply of oxygen, it cannot, when it originates, be oxidized in the same proportion as it is formed, whereas in the normal cell all fat which originates in metabolism is consumed as soon as it is produced. According to this conception, therefore, fatty degeneration is attributable primarily to a depression of the processes of oxidation in the cell. If we may accept this view as correct with regard to the other metamorphic processes also, the qualitative changes in vital phenomena under the influence of stimuli would after all depend simply upon the excitation or depression of the constituent parts of the vital process, and, according to such a view, all stimuli would act primarily only as exciting or as depressing agents upon the normal process of life.

In accordance with the three groups into which general vital phenomena are divided, it follows as a matter of course that the excitation or depression produced by a stimulus can manifest itself in the cell's metabolism, assumption of form, and manifestation of energy. The effects of excitation upon the production of energy are the most striking, and were therefore in former times frequently thought to have a claim *par excellence* to rank as stimulating effects. These reactions attract most attention in cases where the production of energy is proportionately very great—as with muscle, for instance, which is made to twitch and perform work by a feeble stimulus. Processes of discharge (Auslösungsvorgänge), however, lie at the bottom of cases like these. Potential chemical energy, which is stored up in a considerable quantity in living substance, is converted by the impulse of the stimulus into kinetic energy. Therefore the amount of the effect of stimulation—that is to say, the quantity of work performed—bears no proportion whatever to the amount of energy acting as a stimulus upon the muscle. The amount of energy thus acting may be very small as contrasted with an enormous production of energy on the part of the living substance. It will not do to make generalizations, however, with regard to this proportion, as was frequently done in former times. All processes of stimulation are not processes of discharge. The influence of many stimuli, as has been observed, consists far more in depression than in excitation, so that in certain circumstances a stimulus actually diminishes the normal liberation of energy. There is therefore no general law as to the proportion which the amount of energy acting as a stimulus upon living substance bears to the amount of energy liberated.

Directive Stimulation.

Among special varieties of stimulation there is one class of stimuli which has attracted particular attention—namely, those which act unilaterally upon free-moving organisms. It is principally with the lowest forms of life that we have here to do—unicellular protista and free-living cells in the bodies of higher organisms (sperm-cells, leucocytes, &c.). When from one direction a stimulus—be it chemical, thermal, photic, electrical, or of any other kind—acts upon these organisms in their medium, they are impelled to move in a course bearing a definite relation to the source of the stimulus—either directly towards that source or directly away from it, more rarely in a course transverse to it. This directive action of stimulation is under such a fixed conformity to law, that it vividly recalls such purely physical processes as, for instance, the attraction and repulsion of iron particles by the poles of a magnet. For example, if light falls from one side upon a vessel full of water containing unicellular green algae, according to the intensity of the light these organisms swim either towards the illuminated side, where they form a compact mass on the edge of the vessel, or away from it, to cluster on the opposite edge. In the same way infusoria in water are observed to hasten towards or to flee from certain chemical substances, and leucocytes in our bodies act in the same manner towards the metabolic products of pus-forming bacteria which have penetrated into an open wound. The suppuration of wounds is always accompanied by an amazing conglomeration of leucocytes at the seat of the lesion. Perhaps the most striking effects are those of the constant electric current upon unicellular organisms, since in this case the motion follows the cause with absolutely automatic regularity, certainty and rapidity. Thus, for example, after the establishment of the current many Infusoria (Paramaecium) accumulate at the negative pole with great celerity and without deviation, and turn round again with equal celerity as soon as the direction of the current is altered. As such cases of directive stimulation may occur among all varieties of stimuli whenever stimuli act unilaterally, they have been designated, according to the direction in which they occur in relation to the source of the stimulus, as positive or negative chemotaxis, phototaxis, thermotaxis, galvanotaxis, and so forth. The strange and perplexing element in these phenomena becomes clear to us as soon as we know the characteristic method of locomotion for each form of organism, and whether the stimulus in question in the given intensity exercises an effect of excitation or of depression upon the special form. The direction of motion is the essential mechanical result of unilateral stimulation of the organs of locomotion. Seeing that these reactions are exceedingly widely distributed throughout the whole organic world, and possess a deep biological significance for the existence and continuance of life, the interest they have awakened is thoroughly justified.

"Specific Energy."

One of the most important physiological discoveries of the 19th century was that of the "Specific Energy of Sense-substances." Johannes Müller was the first to establish the fact that very different varieties of stimuli applied to one and the same organ of sense always produce one and the same variety of sensation, and that, conversely, the same stimulus applied to the different organs of sense produces a different sensation in each organ—the one, in fact, which is its specific attribute. Thus, for example, mechanical, electrical and photic stimuli applied to the optic nerve produce no other sensation than that of light; and, conversely, any one variety of stimulus—take the electrical, for example—produces sensations of light, hearing, taste or smell, according as it affects the optic, auditory, gustatory or olfactory nerves. This law of the "Specific Energy of Sense-substances," as Johannes Müller (1809–1875) called it, has come to have a highly important bearing upon scientific criticism, since it proves experimentally that the things of the outer world are in themselves in no way discernible by us, but that from one and the same outward object—the electric current, or a mechanical pressure, for instance—we receive altogether different sensations and form altogether different conceptions according to the sense-organ affected. But this law does not possess significance for psychology alone; as regards physiology also it has a much more general and more comprehensive force than Müller ever anticipated. It holds good, as demonstrated by Ewald Hering (b. 1834) and others, not of sense-substances only, but of living substance generally. Each cell has its specific energy in Johannes Müller's sense, and in its extended form there is no more general law for all the operations of stimuli than this law of specific energy. To take examples, whether a muscle be stimulated by a chemical, mechanical, thermal or electrical stimulus the result is in each case the same—namely, a twitching of the muscle. Let a salivary gland be stimulated chemically, mechanically, electrically or in any other way, there always follows the same specific action—a secretion of saliva; no matter what be the kind of stimulus acting upon it, the liver-cell always reacts by producing bile, and so on. On the other hand, one and the same stimulus—the electric current, for example—gives in each form of living substance a specific result: twitching in the muscle, secretion of saliva in the salivary gland, production of bile in the liver-cell, &c. That is, of course, with the proviso that the effect of the stimulus be exciting and not depressing. The following general formulation, however, of the law of specific energy brings the depressing stimuli also within its scope: "Different stimuli produce in each form of living substance an increase or a diminution of its specific activity." As already observed, it will probably be found that those weak chronic forms of stimulation which produce qualitative changes may also be comprised under this general law.

Mechanism of Life.

The knowledge thus far acquired from analysis of vital phenomena and their changes under the influence of stimuli affords but a very indefinite temporary basis for the theory of the actual vital process itself, of which vital phenomena are the outward manifestation. The conceptions to which physiological research has hitherto attained in this matter are of a more or less doubtful nature. The facts contained in them still require to be linked together by hypotheses if we are to obtain even a vague outline of what lies hidden behind the great riddle of life. Such hypotheses, serving as they do to link facts consistently together, are absolutely essential, however, to the further progress of research, and without their aid any systematic investigation would be impracticable. But at the same time it must never be forgotten that these hypotheses are merely provisional, and that whenever they are found to be no longer in harmony with the widening range of new experiences and ideas they must either be proved to be facts or be subjected to modification. This is the point of view from which we must deal with modern ideas concerning the nature of the actual vital process—the mechanism of life.

Metabolism.

The fundamental fact of life is the metabolism of living substance which is continually and spontaneously undergoing decomposition, and building itself up anew with the help of the food-substances it takes in. These processes of decomposition and of reconstruction may be briefly designated as *dissimilation* (catabolism) and *assimilation* (anabolism) respectively. Now the question arises: How are we to understand this process of dissimilation and assimilation from a mechanical standpoint? It is quite evident that we have to do with some chemical occurrence; but *how* are the chemical transformations brought about? There are obviously two possibilities. It is conceivable that the decomposition of food-stuffs and the formation of excretion-products in the cell-body are caused by the repeated casual encounter of a great series of chemical combinations and by their repeatedly reacting upon one another in the same manner, bringing about transformations and forming waste products which are excreted, while at the same time certain chemical affinities are always taking in from without new chemical combinations (food-stuffs) and uniting them. This theory was in fact occasionally advanced in former times, particularly in its chemical aspect, and the belief was especially entertained that the enzymes in living substance might play an important part in these transformations. This assumption, however, leads to no clear and lucid image of what takes place, and, moreover, draws too largely upon auxiliary hypotheses. It has therefore met with but little acceptance. The other possible explanation of metabolism is that its whole process is confined to one single class of chemical combinations whose tendency it is to be constantly undergoing spontaneous decomposition and regeneration. This latter theory was founded by Ludimar Hermann (b. 1838), Eduard Friedrich Pflüger (b. 1829) and others, and has met with universal recognition because of its naturalness, simplicity and clearness.

Proteids.

Starting with this hypothesis, the path of further research lies clear and well defined before us. In the first place, we are obviously met by the question: What conception are we to form of these combinations on which hinges the whole vital process? Among the organic matters which compose living substance, proteids perform the most important part. Proteids and proteid-compounds form the only organic matter which is never absent from any cell. They form also the greater part of all the organic compounds of the cell, unless reserve-stuffs are accumulated to a considerable extent, and they are by far the most complicated of the compounds of living substance. While animal life is impossible without proteid food, there are, on the other hand, animals which can continue to subsist on proteid alone. This series of facts proves very conclusively that proteids and their compounds play by far the most important part of all organic matter in the processes of life. The idea thus naturally presents itself that the required hypothetical compound forming the central point of metabolism will be found to bear a very close relation to proteids. But another point must be here considered. The proteids and their compounds known to us are, comparatively speaking, stable compounds, which never undergo spontaneous decomposition so long as they are protected from outward injury, whereas the hypothetical combination which lies at the centre of organic metabolism is extraordinarily liable and continually undergoing spontaneous decomposition. Therefore we have to think not of ordinary proteids in this case, but of still more complicated combinations, the atoms in the molecule of which have a strong tendency to group themselves in new arrangements. Owing to their fundamental importance, these combinations have been termed "biogens." When we come to inquire how such labile biogen molecules are built up out of the proteids of food, we find our knowledge very much restricted. Doubtless the intramolecular addition of inspired oxygen has much to do with it; for living substance when deprived of oxygen loses its irritability—that is to say, its tendency to decomposition. The fact that the decomposition of living substance is always associated with the formation of carbonic acid—a circumstance obviously necessitating the aid of oxygen—also points to the absolute indispensableness of oxygen in the matter. Pflüger has further suggested that the molecule of living substance owes its lability and its tendency to form carbonic acid when joined by oxygen atoms principally to cyanogen groups which are contained in it. According to this view, the following is supposed to be the process of the formation of biogen molecules: It is assumed that the biogen molecules already present in living substance take out of the proteids of food certain groups of atoms, and dispose them so as to produce cyanogen-like compounds. The addition of oxygen atoms then brings the biogen molecule to the maximum of its power of decomposition, so that—partly spontaneously, but more especially when impelled by a stimulus—it breaks down somewhat explosively, causing the formation of carbonic acid. In this proceeding, according to the hypothesis which is the most widely accepted and the most fruitful in results, would lie the very germ of the vital process.

Mechanism of Cell-life.

If we accept these views as far as their general principle is concerned, assimilation is the re-formation of biogen molecules by those already existing, aided by food-stuffs; dissimilation, the decomposition of biogen molecules. To this primary process, however, is attached a whole series of secondary chemical processes, which serve partly to work upon the food so as to fit it for the building up of biogen molecules, and partly to form out of the direct decomposition-products of the biogen molecules the characteristic secretion-products of living substance (excretions and secretions). The various workings of matter in the cell are rendered very much more complex by the circumstance that the living cell exhibits various morphological differentiations—above all, the differentiation in protoplasm and nucleus. Again, a transformation of energy is inseparably connected with metabolism. Along with food and oxygen potential chemical energy is continually being introduced into the cell, to be accumulated in the biogen molecules, and at their decomposition transformed into kinetic energy, which finds an outlet in the various manifestations of energy in the cell—motion, heat, and so forth. In the light of this hypothesis the operations of stimuli also become comprehensible. Seeing that there is an initial tendency to the occurrence of certain definite chemical processes, which are associated with the reconstruction and decomposition of biogen molecules, various stimuli will either further or hinder the course of this metabolic series. A cell which is exposed to no outward disturbance, and which continues always in the unvarying medium provided by an exact sufficiency of food, will be in "metabolic equilibrium"—that is to say, its assimilation and its dissimilation will be equal (A = D). When, however, the influence of external stimuli is brought to bear upon them—that is to say, any change in their environing vital conditions—A and D will either be altered in similar proportion, or their mutual equilibrium will be disturbed. In the former case the vital processes will merely be intensified in their course; in the latter and usual case the result will be determined according to the part of metabolism excited or depressed. When the effect of a stimulus is to excite D continuously in a high degree without correspondingly increasing A, the result is a dying off—an atrophy. In the contrary case, when A remains continuously greater than D, the result is growth, increase and reproduction of the cell. Experience proves, however, that A and D stand in a certain relation of mutual dependence to each other, with the result that when D has been increased by a stimulus, for example, A correspondingly increases during the stimulation, and continues to do so after its cessation, till the loss in living substance produced by the stimulation of D is eventually made good, and metabolic equilibrium is restored. The muscle may be taken as an example of this self-regulation of metabolism common to all living substance (Hering's *Selbststeuerung des Stoffwechsels*). When a muscle has been fatigued by some stimulation causing an enormous increase of D, there is a corresponding spontaneous increase in A. After some time the muscle is observed to have recovered. It has once more become capable of performing work; its metabolism is again in equilibrium.

Metabolic Equilibrium.

The vital phenomena of the cell may be derived mechanically from metabolism and the changes it undergoes under the influence of stimuli. Our ability to do this will increase more rapidly as we become better acquainted with the details of the metabolism of the cell itself. The foregoing outline must be regarded, of course, as embodying only a fragmentary hypothesis, which can serve as a guide for further research only so long as it does not clash with facts, and which must be amplified, specialized and developed with the widening of specific knowledge regarding the cell's metabolism. The relations already known are so exceedingly complex that only by slow degrees can we pursue the investigation of separate fragments of the entire metabolic series. The differentiation of nucleus and protoplasm in the living substance of the cell alone gives rise to an extraordinary complication in the metabolic process, for these two parts of the cell stand in the most complicated correlation with one another as well as with the environing medium—a fact of which the experiments made by vivisection in various free-living cell-forms have furnished abundant evidence. The farther such knowledge advances, the more rounded, clear and free from hypotheses will become our conception of the cell's metabolism. But the cell is the elementary component part of all organisms, and from the life of individual cells is constructed the life of the separate tissues and various organs, and thus of the entire organism. Hence the cell is the only vital element which the organism possesses, and therefore the investigation of the vital processes in its separate cells leads ultimately to a knowledge regarding the mechanism of life in the whole.

Cell-Processes the Secret of Life.

Vegetable physiology is dealt with in the article PLANTS: *Physiology*. For details of different parts of the animal body, see ANIMAL HEAT; RESPIRATORY SYSTEM; VASCULAR SYSTEM; TOUCH; SMELL; TASTE; VISION; HEARING; VOICE; MUSCLE AND NERVE; SLEEP; HYPNOTISM; BRAIN; SPINAL CORD; SYMPATHETIC SYSTEM; BLOOD; LYMPH; PHAGOCYTOSIS; DIGESTIVE ORGANS; NUTRITION, &c.

The principal modern English textbooks of animal physiology are those of Sir Michael Foster (1885), A. E. Schäfer (1898), Noël Paton (1908), Halliburton (1909), and Starling (1909). See, however, the bibliographical notes to the separate articles. (M. V.)

PIACENZA (Lat. *Placentia*), a town and episcopal see of Emilia, Italy, the capital of the province of Piacenza, 42½ m. S.E. of Milan and 91 m. N.W. of Bologna by rail. Pop. (1906), 39,786. It lies on the Lombard plain, 217 ft. above sea-level, near the right bank of the Po, which here is crossed by road and railway bridges, just below the confluence of the Trebia. It is still surrounded by walls with bastions and fosse in a circuit of 4 m. The cathedral was erected between 1122 and 1233, in the Lombard Romanesque style, under the direction of Santo da Sambuceto, on the site of a church of the 9th century which had been destroyed by earthquake. The west front has three doors with curious pillared porches. The campanile is a massive square brick tower 223 ft. high; the iron cage attached to one of its windows was put up in 1495 by Ludovico il Moro for the confinement of persons guilty of treason or sacrilege. The crypt is a large church supported by one hundred columns. The entire edifice has been restored since 1898, and the frescoes by Guercino and Caracci, which decorate parts of its roof, though good in themselves, are inappropriate to its severe style. Sant' Antonino, which was the cathedral church till 877, is supposed to have been founded by St Victor, the first bishop of Piacenza, in the 4th century, and restored in 903; it was rebuilt in 1104, and altered in 1857. It was within its walls that the deputies of the Lombard League swore to the conditions of peace ratified in 1183 at Constance. The Gothic brick vestibule (Il Paradiso) on the north side is one of the older parts of the building. San Francesco, a spacious Gothic edifice begun by the Franciscans in 1278, was erected on the site of the palace of Ubertino Landi, a leader of the Ghibelline party. S. Savino, a fine Romanesque building of A.D. 903 (well restored in 1903), contains a mosaic pavement of this period with curious representations, including one of a game of chess. S. Sisto, which dates from 1499, and takes the place of the church founded in 874 by Angilberga (consort of the emperor Louis II.), lost its chief attraction when Raphael's Sistine Madonna (now in Dresden) was sold by the monks in 1754 to Frederick Augustus III. Its place, however, is occupied by a copy by Avanzini, and there are also several good intarsias by Bartolomeo da Busseto. S. Sepolcro and S. Maria della Campagna are both good early Renaissance churches; the latter is rich in frescoes by Pordenone. S. Anna, dating from 1334, was the church of the barefooted Carmelites. Of the secular buildings the most interesting is the Palazzo Communale, begun in 1281, one of the finest buildings of its kind in Italy. The square in front is known as the Piazza dei Cavalli, from the two bronze equestrian statues of Ranuccio (1620) and his father Alexander, prince of Parma, governor of the Netherlands (1625). Both were designed by Francesco Mocchi. The Palazzo dei Tribunali and the Palazzo degli Scoti are fine early Renaissance brick buildings with terra-cotta decorations. The huge Farnese palace was begun after Vignola's designs by Margaret of Austria in 1558, but it was never completed, and since 1800 it has been used as barracks. Other buildings or institutions of note are the old and the new bishop's palace, the fine theatre designed by Lotario Tomba in 1803, the great hospital dating from 1471, the library presented to the commune in 1846 by the marquis Ferdinando Landi, and the Passerini library founded in 1685. The Museo Civico, formed in 1903, contains collections of antiquities (though many of the Roman antiquities of Piacenza have passed to the museum of Parma), some good Flemish tapestries and a few pictures. The castle erected by Antonio da Sangallo the younger has been demolished. Piacenza is the junction of the Milan and Bologna line with that from Voghera and Turin. From Codogno, 7 m.

to the north, a branch line runs to Cremona. By road Piacenza is 88 m. north-east of Genoa. The town has an arsenal, a technical and arts school, and various industries—iron and brass works, foundries, silk-throwing, printing works and flour-mills.

Piacenza was made a Roman colony in 218 B.C. While its walls were yet unfinished it had to repulse an attack by the Gauls, and in the latter part of 218 it afforded protection to the remains of the Roman army under Scipio which had been defeated in the great battle on the Trebia. In 205 it withstood a protracted siege by Hasdrubal. Five years later the Gauls burned the city; and in 190 it had to be recruited with three thousand families. In 187 it was connected with Ariminum and the south by the construction of the Via Aemilia. Later on it became a very important road centre; the continuation northwards of the Via Aemilia towards Milan, with a branch to Ticinum, crossed the Po there, and the Via Postumia from Cremona to Dertona and Genoa passed through it. Later still Augustus reconstructed the road from Dertona to Vade, and into Gallia Narbonensis, and gave it the name of Julia Augusta from Placentia onwards. The rectangular arrangement of the streets in the centre of the town, through which passes the Via Aemilia, is no doubt a survival from Roman times. Placentia is mentioned in connexion with its capture by Cinna and a defeat of the forces of Carbo in the neighbourhood (82 B.C.), a mutiny of Julius Caesar's garrison (50 B.C.), another mutiny under Augustus (40 B.C.), the defence of the city by Spurinna, Otho's general, against Caecina, Vitellius's general (A.D. 69), and the defeat of Aurelian by the Marcomanni outside the walls (A.D. 271). In 546 Totila reduced Piacenza by famine. Between 997 and 1035 the city was governed by its bishops, who had received the title of count from Otho III. At Roncaglia, 5 m. to the east, the emperor Conrad II. held the diet which passed the Salic law. In the latter part of the 12th century it was one of the leading members of the Lombard League. For the most part it remained Guelph, though at times, as when it called in Galeazzo Visconti, it was glad to appeal to a powerful Ghibelline for aid against its domestic tyrants. In 1447 the city was captured and sacked by Francesco Sforza. Having been occupied by the papal forces in 1512, it was in 1545 united with Parma (*q.v.*) to form an hereditary duchy for Pierluigi Farnese, son of Paul III. In 1746 a battle between the Franco-Spanish forces and the Austrians was fought under the city walls, and in 1796 it was occupied by the French. In 1848 Piacenza was the first of the towns of Lombardy to join Piedmont; but it was reoccupied by the Austrians till 1859.

PIANOFORTE (Ital. *piano*, soft, and *forte*, loud). The group of keyed stringed musical instruments, among which the pianoforte is latest in order of time, has been invented and step by step developed with the modern art of music, which is based upon the simultaneous employment of different musical sounds. In the 10th century the "organum" arose, an elementary system of accompaniment to the voice, consisting of fourths and octaves below the melody and moving with it; and the organ (*q.v.*), the earliest keyed instrument, was, in the first instance, the rude embodiment of this idea and convenient means for its expression. There was as yet no keyboard of balanced key levers; sliders were drawn out like modern draw-stops, to admit the compressed air necessary to make the pipes sound. About the same time arose a large stringed instrument, the organistrum,[1] the parent of the now obsolete hurdy-gurdy; as the organ needed a blower as well as an organist, so the player of the organistrum required a handle-turner, by whose aid the three strings of the instrument were made to sound simultaneously upon a wheel, and, according to the well-known sculptured relief of St George de Boscherville, one string was manipulated by means of a row of stoppers or tangents pressed inwards to produce the notes. The other strings were drones, analogous to the drones of the bagpipes, but originally the three strings followed the changing organum.

History of Evolution.

In the 11th century, the epoch of Guido d'Arezzo, to whom the beginning of musical notation is attributed, the Pythagorean monochord, with its shifting bridge, was used in the singing schools to teach the intervals of the plain-song of the church. The practical necessity, not merely of demonstrating the proportionate relations of the intervals, but also of initiating pupils into the different gradations of the church tones, had soon after Guido's time brought into use quadruplex-fashioned monochords, which were constructed with scales, analogous to the modern practice with thermometers which are made to show both Réaumur and Centigrade, so that four lines indicated as many authentic and as many plagal tones. This arrangement found great acceptance, for Aribo,[2] writing about fifty years after Guido, says that few monochords were to be found without it. Had the clavichord then been known, this makeshift contrivance would not have been used. Aribo strenuously endeavoured to improve it, and "by the grace of God" invented a monochord measure which, on account of the rapidity of the leaps he could make with it, he named a wild-goat (*caprea*). Jean de Muris (*Musica speculativa*, 1323) teaches how true relations may be found by a single-string monochord, but recommends a four-stringed one, properly a tetrachord, to gain a knowledge of unfamiliar intervals. He describes the musical instruments known in his time, but does not mention the clavichord or monochord with keys, which could not have been then invented. Perhaps one of the earliest forms of such an instrument, in which stoppers or tangents had been adopted from the organistrum, is shown in fig. 1, from a wood carving of a vicar choral or organist, preserved in St Mary's church, Shrewsbury. The latest date to which this interesting figure may be attributed is 1460, but the conventional representation shows that the instrument was then already of a past fashion, although perhaps still retained in use and familiar to the carver.

Monochord; Clavichord.

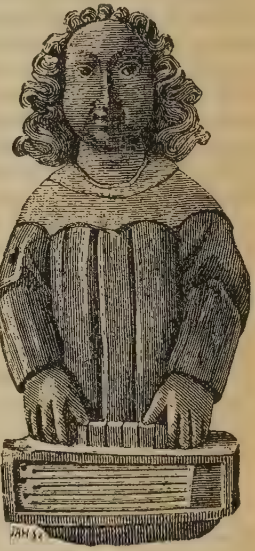

FIG. 1.—Earliest existing representation of a Keyed Stringed Instrument, from St Mary's, Shrewsbury (primitive Clavichord). Before 1460.

In the Weimar *Wunderbuch*,[3] a MS. dated 1440, with pen and ink miniatures, is given a "clavichordium" having 8 short and apparently 16 long keys, the artist has drawn 12 strings in a rectangular case, but no tangents are visible. A keyboard of balanced keys existed in the little portable organ known as the regal, so often represented in old carvings, paintings and stained windows. Vitruvius, *De architectura*, lib. x. cap. xi., translated by Newton, describes a balanced keyboard; but the key apparatus is more particularly shown in *The Pneumatics of Hero of Alexandria*, translated by Bennet Woodcroft (London, 1851). In confirmation of this has been the remarkable recovery at Carthage[4] of a terra-cotta model of a Hydraulikon or water organ, dating from the 2nd century A.D., in which a balanced keyboard of 18 or 19 keys is shown. It seems likely the balanced keyboard was lost, and afterwards reinvented. The name of regal was derived from the rule (*regula*) or graduated scale of keys, and its use was to give the singers in religious processions the note or pitch. The only instrument of this kind known to exist in the United Kingdom is at Blair Atholl, and it bears the very late date of 1630. The Brussels regal[1] may be as modern. These are instances of how long a some-time admired musical instrument may remain in use after its first intention is forgotten. We attribute the adaptation of the narrow regal keyboard to what was still called the monochord, but was now a complex of monochords over one resonance board, to the latter half of the 14th century; it was accomplished by the substitution of tangents fixed in the future ends of the balanced keys for the movable bridges of the monochord or such stoppers as are shown in the Shrewsbury carving. Thus the monochordium or "payre of monochordis" became the clavichordium or "payre of clavichordis"—pair being applied, in the old sense of a "pair of steps," to a series of degrees. This use of the word to imply gradation was common in England to all keyed instruments; thus we read, in the Tudor period and later, of a pair of regals, organs, or virginals. Ed. van der Straeten[2] reproduces a so-called clavichord of the 15th century from a MS. in the public library at Ghent. The treatise is anonymous, but other treatises in the same MS. bear dates 1503 and 1504. Van der Straeten is of opinion that the drawing may be assigned to the middle of the 15th century. The scribe calls the instrument a clavicimbalum, and this is undoubtedly correct; the 8 strings in the drawing are stretched from back to front over a long soundboard, the longest strings to the left; 8 keys, 4 long and 4 short with levers to which are attached the jacks, are seen in a horizontal line behind the keyboard, and behind them again are given the names of the notes a, b, c, d, e, f, g, h. In the Weimar *Wunderbuch* is a pen-and-ink sketch of the "clavicimbalum"[3] placed upon a table, in which we recognize the familiar outline of the harpsichord, but on a smaller scale. The keyboard shows white and black notes—the latter short keys, one between each group of two white keys, precisely as in the instrument reproduced by Van der Straeten—but no mechanism is visible under the strings.

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[1] An organistrum is shown in the lower right hand corner of the full page miniature of a fine 12th century psalter of English workmanship, forming part of the Hunterian collection in University Court Library, Glasgow. No. 31 in *Catalogue of the Exhibition of Illuminated MSS. at the Burlington Fine Arts Club* (1908).

[2] See "Musica aribonis scholastici," printed by Martin Gerbert in *Scriptores ecclesiastici de musica sacra* (1784), ii. 197; and in J. P. Migne, *Patrologiae cursus completus*, vol. 150, col. 1307.

[3] *Grossherzogliche Bibliothek*. See also Dr Alwin Schulz, *Deutsches Leben im xiv. and xv. Jahrhund.* (Vienna, 1892), p. 58, fig. 522.

[4] For an illustration of this important piece of evidence, see under ORGAN: *Ancient History*; and for description and illustration of balanced keys, see KEYBOARD.

The earliest known record of the clavichord occurs in some rules of the minnesingers,[4] dated 1404, preserved at Vienna. The monochord is named with it, showing a differentiation of these instruments, and of them from the clavicymbalum, the keyed cymbal, cembalo (Italian), or psaltery. From this we learn that a keyboard had been thus early adapted to that favourite medieval stringed instrument, the "cembalo" of Boccaccio, the "sautrie" of Chaucer. There were two forms of the psaltery: (1) the trapeze, one of the oldest representations of which is to be found in Orcagna's famous Trionfo della Morte in the Campo Santo at Pisa, and another by the same painter in the National Gallery, London; and (2) the contemporary "testa di porco," the pig's head, which was of triangular shape as the name suggests. The trapeze psaltery was strung horizontally, the "istromento di porco" either horizontally or vertically—the notes, as in the common dulcimer, being in groups of three or four unisons. In these differences of form and stringing we see the cause of the ultimate differentiation of the spinet and harpsichord. The compass of the psalteries was nearly that of Guido's scale; but according to Mersenne,[5] the lowest interval was a fourth, G to C, which is worthy of notice as anticipating the later "short measure"[6] of the spinet and organ.

The simplicity of the clavichord inclines us to place it, in order of time, before the clavicymbalum or clavicembalo; but we do not know how the sounds of the latter were at first excited. There is an indication as to its early form to be seen in the church of the Certosa near Pavia, which compares in probable date with the Shrewsbury example. We quote the reference to it from Dr Ambros.[1] He says a carving represents King David as holding an "istromento di porco" which has eight strings and as many keys lying parallel to them; inside the body of the instrument, which is open at the side nearest the right hand of King David, he touches the keys with the right hand and damps the strings with the left. The attribution of archaism applies with equal force to this carving as to the Shrewsbury one, for when the monastery of Certosa near Pavia was built by Ambrogio Fossana in 1472, chromatic keyboards, which imply a considerable advance, were already in use. There is an authentic representation of a chromatic keyboard, painted not later than 1426, in the St Cecilia panel (now at Berlin) of the famous Adoration of the Lamb by the Van Eycks. The instrument depicted is a positive organ, and it is interesting to notice in this realistic painting that the keys are evidently boxwood, as in the Italian spinets of later date, and that the angel plays a common chord—A with the right hand, F and C with the left. But diatonic organs with eight steps or keys in the octave, which included the B flat and the B natural, as in Guido's scale, were long preserved, for Praetorius speaks of them as still existing nearly two hundred years later. This diatonic keyboard, we learn from Sebastian Virdung (*Musica getutscht und auszgezogen*, Basel, 1511), was the keyboard of the early clavichord. We reproduce his diagram as the only authority we have for the disposition of the one short key.

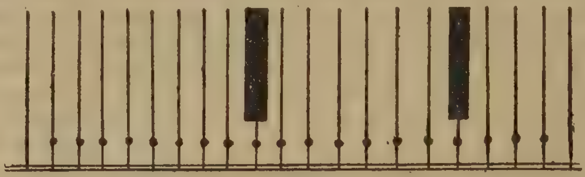

FIG. 2.—Diatonic Clavichord Keyboard (Guido's Scale) from Virdung. Before 1511.

The extent of this scale is exactly Guido's. Virdung's diagram of the chromatic is the same as our own familiar keyboard, and comprises three octaves and a note, from F below the bass stave to G above the treble. But Virdung tells us that even then clavichords were made longer than four octaves by repetition of the same order of keys. The introduction of the chromatic order he attributes to the study of Boetius, and the consequent endeavour to restore the three musical *genera* of the Greeks—the diatonic, chromatic and enharmonic. But the last-named had not been attained. Virdung gives woodcuts of the clavichordium, the virginal, the clavicymbalum and the clavicytherium. We reproduce three of them (figs. 3, 6 and 12), omitting the virginal as obviously incorrect. Writers on musical instruments have continually repeated these drawings without discerning that in the printing they are reversed, which puts the keyboards entirely wrong, and that in Luscinius's Latin translation of Virdung (*Musurgia, sive praxis musicae*, Strasburg, 1536), which has been hitherto chiefly followed, two of the engravings, the clavicimbalum and the clavicytherium, are transposed, another cause of error. Martin Agricola (*Musica instrumentalis*, Wittenberg, 1529) has copied Virdung's illustrations with some differences of perspective, and the addition, here and there, of errors of his own.

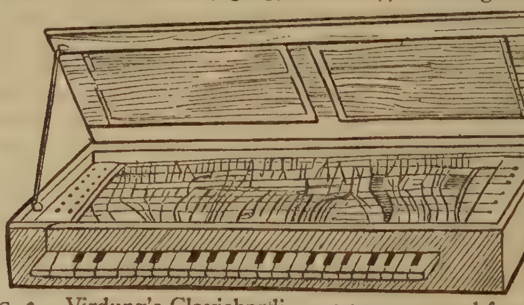

FIG. 3.—Virdung's Clavichordium, 1511; reversed facsimile.

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[1] See Victor C. Mahillon, *Catalogue descriptif* (1880), I. p. 320, No. 454: regal with two bellows, end of XVI. C. Compass E to a^2.

[2] *La Musique aux Pays Bas*, i. 278.

[3] See Dr Alwin Schulz, *op. cit.*, fig. 524.

[4] V. 410 and 414. See Ambros, *Geschichte der Musik* (1892), ii. 226.

[5] *L'Harmonie universelle* (Paris, 1636), livre III. p. 107.

[6] A. J. Hipkins, *History of Pianoforte* (London, 1896), p. 51.

[7] *Geschichte der Musik*, ii. 544–555.

Still vulgarly known as monochord, Virdung's clavichord was really a box of monochords, all the strings being of the same length. He derives the clavichord from Guido's monochord as he does the virginal from the psaltery, but, at the same time, confesses he does not know when, or by whom, either instrument was invented. We observe in this drawing the short sound-board, which always remained a peculiarity of the clavichord, and the straight sound-board bridge—necessarily so when all the strings were of one length. To gain an angle of incidence for the tangents against the strings the keys were made crooked, an expedient further rendered necessary by the "fretting"—three tangents, according to Virdung, being directed to stop as many notes from each single group of three strings tuned in unison; each tangent thus made a different vibrating length of string. In the drawing the strings are merely indicated. The German for fret is *Bund*, and such a clavichord, in that language, is known as a "gebundenes Clavichord" both fret (to rub) and *Bund* (from *binden*, to bind) having been taken over from the lute or viol. The French and Italians employ "touche" and "tasto," touch. Praetorius who wrote a hundred years later than Virdung, says two, three and four tangents were thus employed in stopping. There are extant small clavichords having three keys and tangents to one pair of strings and others have no more than two tangents to a note formed by a pair of strings, instead of three. Thus seven pairs of strings suffice for an octave of twelve keys, the open notes being F, G, A, B flat, C, D, E flat, and by an unexplained peculiarity, perhaps derived from some special estimation of the notes which was connected with the church modes, A and D are left throughout free from a second tangent. A corresponding value of these notes is shown by their independence of chromatic alteration in tuning the double Irish harp, as explained by Vincentio Galilei in his treatise on music (*Dialogo della musica*, Florence, 1581). Adlung, who died in 1762, speaks of another fretting, but it must have been an adaptation to the modern major scale, the "free" notes being E and B. Clavichords were made with double fretting up to about the year 1700—that is to say, to the epoch of J. S. Bach, who, taking advantage of its abolition and the consequent use of independent pairs of strings for each note, was enabled to tune in all keys equally, which had been impossible so long as the fretting was maintained. The modern scales having become established, Bach was now able to produce, in 1722, *Das wohltemperirte Clavier*, the first collection of preludes and fugues in all the twenty-four major and minor scales for a clavichord which was tuned, as to concordance and dissonance, fairly equal.

The oldest clavichord, here called manicordo (as French *manicorde*, from monochord), known to exist is that shown in fig. 4. It will be observed that the lowest octave is here already "bundfrei" or fret-free. The strings are no longer of equal length, and there are three bridges, divisions of the one bridge, in different positions on the sound-board. Mersenne's "manicorde" (*Harmonie universelle*, Paris 1636, p. 115), shown in an engraving in that work, has the strings still nearly of equal length, but the sound-board bridge is divided into five. The fretted clavichords made in Germany in the last years of the 17th century have the curved sound-board bridge, like a spinet. In the clavichord the tangents always form the second bridge, indispensable for the vibration, besides acting as the sound exciters (fig. 5). The common damper to all the strings is a list of cloth, interwoven behind the tangents. As the tangents quitted the strings the cloth immediately stopped all vibration. Too much cloth would diminish the tone of this already feeble instrument, which gained the name of "dumb spinet" from its use. In the clavichord in Rubens's St Cecilia (Dresden Gallery)—interesting as perhaps representing that painter's own instrument—the damping cloth is accurately painted. The number of keys there shown is three octaves and a third, F to A—the same extent as in Handel's clavichord now in the museum at Maidstone (an Italian instrument dated 1726, and not fretted), but with the peculiarity of a combined chromatic and short octave in the lowest notes, to which we shall have to refer when we arrive at the spinet; we pass it by as the only instance we have come across in the clavichord.

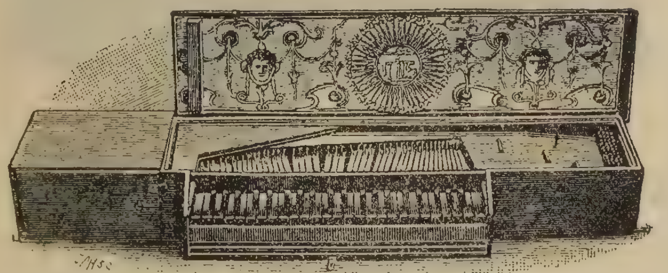

FIG. 4.—Manicordo (Clavichord) d'Eleonora di Montalvo, 1659; Kraus Museum, Florence.

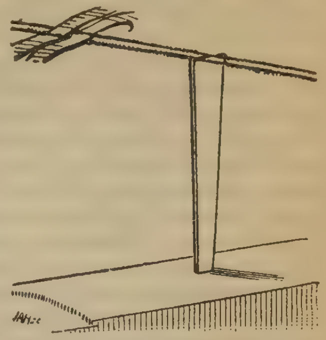

FIG. 5.—Clavichord Tangent.

The clavichord must have gone out of favour in Great Britain and the Netherlands early in the 16th century, before its expressive power, which is of the most tender and intimate quality, could have been, from the nature of the music played, observed,—the more brilliant and elegant spinet being preferred to it. Like the other keyboard instruments it had no German name, and can hardly have been of German origin. Holbein, in his drawing of the family of Sir Thomas More, 1528, now at Basel, indicates the place for "Klavikordi und ander Seytinspill." But it remained longest in use in Germany—until even the beginning of the 19th century. It was the favourite "Klavier" of the Bachs. Besides that of Handel already noticed there are in existence clavichords the former possession of which is attributed to Mozart and Beethoven. The clavichord was obedient to a peculiarity of touch possible on no other keyboard instrument. This is described by C. P. Emmanuel Bach in his famous essay on playing and accompaniment, entitled *Versuch über die wahre Art das Klavier zu spielen* ("An Essay on the True Way to play Keyboard Instruments.") It is the *Bebung* (trembling), a vibration in a melody note of the same nature as the tremolo frequently employed by violin players to heighten the expressive effect; it was gained by a repeated movement of the fleshy end of the finger while the key was still held down. The *Bebung* was indicated in the notation by dots over the note to be affected by it, perhaps showing how many times the note should be repeated. According to the practice of the Bachs, as handed down to us in the above mentioned essay, great smoothness of touch was required to play the clavichord in tune. As with the monochord, the means taken to produce the sound disturbed the accuracy of the string measurement by increasing tension, so that a key touched too firmly in the clavichord, by unduly raising the string, sharpened the pitch, an error in playing deprecated by C. P. Emmanuel Bach. This answers the assertion which has been made that J. S. Bach could not have been nice about tuning when he played from preference on an instrument of uncertain intonation.

Virginal.

Clavicimbalum.

The next instrument described by Virdung is the virginal (*virginalis*, proper for a girl), a parallelogram in shape, having the same projecting keyboard and compass of keys the same as the clavichordium. Here we can trace derivation from the psaltery in the sound-board covering the entire inner surface of the instrument and in the triangular disposition of the strings. The virginal in Virdung's drawing has an impossible position with reference to the keyboard, which renders its reproduction as an illustration useless. But in the next drawing, the clavicimbalum, this is rectified, and the drawing, reversed on account of the keyboard, can be accepted as roughly representing the instrument so called (fig. 6). There would be no difference between it and the virginal were it not for a peculiarity of keyboard compass, which emphatically refers itself to the Italian "spinetta," a name unnoticed by Virdung or by his countryman Arnold Schlick, who, in the same year 1511, published his *Spiegel der Orgelmacher* (Organ-builders' Mirror), and named the clavichordium and clavicimbalum as familiar instruments. In the first place, the keyboard, beginning apparently with B natural, instead of F, makes the clavicimbalum smaller than the virginal, the strings in this arrangement being shorter; in the next place it is almost certain that the Italian spinet compass, beginning apparently upon a semitone, is identical with a "short measure" or "short octave" organ compass, a very old keyboard arrangement, by which the lowest note, representing B, really sounded G and C sharp in like manner A. The origin of this may be deduced from the psaltery and many representations of the regal, and its object appears to have been to obtain dominant basses for cadences, harmonious closes having early been sought for as giving pleasure to the ear. Authority for this practice is to be found in Mersenne, who, in 1636, expressly describes it as occurring in his own spinet (*espinette*). He says the keyboards of the spinet and organ are the same. Now, in his Latin edition of the same work he renders espinette by clavicimbalum. We read (*Harmonie Universelle*, Paris, 1636, liv. 3, p. 107—"Its longest string [his spinet's] is little more than a foot in length between the two bridges. It has only thirty-one keys [*marches*] in its keyboard, and as many strings over its sound-board [he now refers to the illustration], so that there are five keys hidden on account of the perspective—that is to say, three diatonic and two chromatic [*feintes*, same as the Latin *ficti*], of which the first is cut into two [a divided sharp forming two keys]; but these sharps serve to go down to the third and fourth below the first step, C *sol* [tenor clef C], in order to go as far as the third octave, for the eighteen principal steps make but an eighteenth, that is to say, a fourth more than two octaves." The note we call F, he, on his engraving, letters as C, indicating the pitch of a spinet of the second size, which the one described is not. The third and fourth, reached by his divided sharp, are consequently the lower A and G; or, to complete, as he says, the third octave, the lowest note might be F, but for that he would want the diatonic semitone B, which his spinet, according to his description, did not possess.[1] Mersenne's statement sufficiently proves, first, the use in spinets as well as in organs of what we now call "short measure," and, secondly, the object of divided sharps at the lower end of the keyboard to gain lower notes. He speaks of one string only to each note; unlike the double and triple strung clavichord, those instruments, clavicimbalum, spinet, or virginal, derived from the psaltery, could only present one string to the mechanical plectrum which twanged it. As regards the kind of plectra earliest used we have no evidence. The little crow-quill points project from centred tongues in uprights of wood known as "jacks" (fig. 7), which also carry the dampers, and rising by the depression of the keys in front, the quills set the strings vibrating as they pluck them in passing, springs at first of steel, later of bristle, giving energy to the twang and governing their return. J. C. Scaliger in *Poetices libri septem* (1561, p. 51, c. 1.) states that the Clavicimbalum and Harpichordum of his boyhood are now called Spinets on account of those quill points (*ab illis mucronibus*), and attributes the introduction of the name "spinetta" to them (from *spina*, a thorn). We will leave harpichordum for the present, but the early identity of clavicimbalum and spinetta is certainly proved.

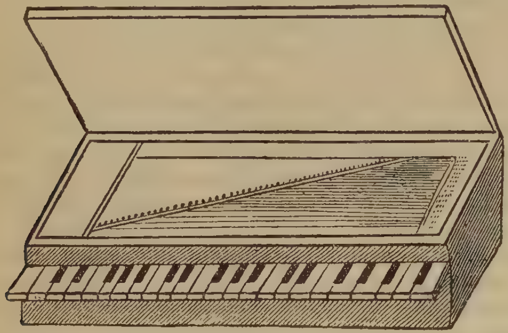

FIG. 6.—Virdung's Clavicimbalum (Spinet), 1511; reversed facsimile.

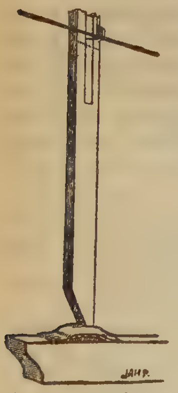

FIG. 7.—Spinet "Jack."

Spinet.

Scaliger's etymology remained unquestioned until Signor Ponsicchi of Florence discovered another derivation. He found in a rare book entitled *Conclusione nel suono dell' organo, di D. Adriano Banchieri* (Bologna, 1608), the following passage, which translated reads: "Spinetta was thus named from the inventor of that oblong form, who was one Maestro Giovanni Spinetti, a Venetian; and I have seen one of those instruments, in the possession of Francesco Stivori, organist of the magnificent community of Montagnana, within which was this inscription—*Joannes Spinetvs Venetvs fecit*, A.D. 1503." Scaliger's and Banchieri's statements may be combined, as there is no discrepancy of dates, or we may rely upon whichever seems to us to have the greater authority, always bearing in mind that neither invalidates the other. The introduction of crow-quill points, and adaptation to an oblong case of an instrument previously in a trapeze form, are synchronous; but we must accept 1503 as a late date for one of Spinetti's instruments, seeing that the altered form had already become common, as shown by Virdung, in another country as early as 1511. After this date there are frequent references to spinets in public records and other documents, and we have fortunately the instruments themselves to put in evidence, preserved in public museums and in private collections. A spinet dated 1490 was shown at Bologna in 1888; another old spinet in the Conservatoire, Paris, is a pentagonal instrument made by Francesco di Portalupis at Verona, 1523. The Milanese Rossi were famous spinet-makers, and have been accredited (*La Nobilità di Milano*, 1595) with an improvement in the form which we believe was the recessing of the keyboard, a feature which had previously entirely projected; by the recessing a greater width was obtained for the sound-board. The spinets by Annibale Rosso at South Kensington, dated respectively 1555 (fig. 8) and 1577, show this alteration, and may be compared with the older and purer form of one, dated 1568, by Marco Jadra (also known as Marco "dalle spinette," or "dai cembali"). Besides the pentagonal spinet, there was an heptagonal variety; they had neither covers nor stands, and were often withdrawn from decorated cases when required for performance. In other instances, as in the 1577 Rosso spinet, the case of the instrument itself was richly adorned. The apparent compass of the keyboard in Italy generally exceeded four octaves by a semitone, E to F; but we may regard the lowest natural key as usually C, and the lowest sharp key as usually D, in these instruments, according to "short measure."

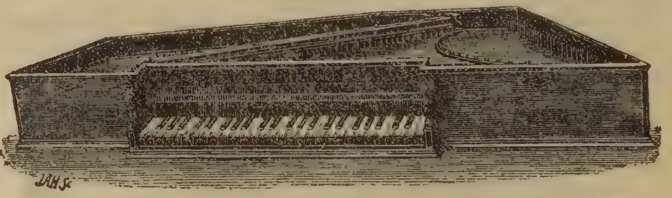

FIG. 8.—Milanese Spinetta, by Annibale Rosso, 1555; South Kensington Museum.

Clavecin.

The rectangular spinet, Virdung's "virginal," early assumed in Italy the fashion of the large "cassoni" or wedding chests. The oldest we know of in this style, and dated, is the fine specimen belonging to M. Terme which figures in *L'Art decoratif* (fig. 9). Virginal is not an Italian name;

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[1] A. J. Ellis (*History of Musical Pitch*, p. 318) sees the B in Mersenne's outline diagram.

the rectangular instrument in Italy is "spinetta tavola." In England, from Henry VII. to Charles II., all quilled instruments (*stromenti di penna*), without distinction as to form, were known as virginals. It was a common name, equivalent to the contemporary Italian *clavicordo* and Flemish *clavisingel*. From the latter, by apocope, we arrive at the French *clavecin*—the French *clavier* (*clavis*, a key), a keyboard, being in its turn adopted by the Germans to denote any keyboard stringed instrument.

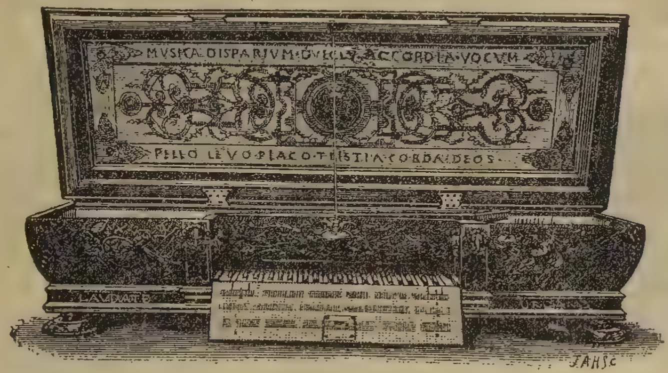
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FIG. 9.—Spinetta Tavola (Virginal), 1568; Vict. and Albert Museum.

Mersenne (*op. cit.*, liv. iii., p. 158) gives three sizes for spinets—one 2½ ft. wide, tuned to the octave of the "ton de chapelle" (in his day a half tone above the present English medium pitch), one of 3½ ft. tuned to the fourth below, and one of 5 ft. tuned to the octave below the first, the last being therefore tuned in unison to the chapel pitch. He says his own spinet was one of the smallest it was customary to make, but from the lettering of the keys in his drawing it would have been of the second size, or the spinet tuned to the fourth. The octave spinet, of trapeze form, was known in Italy as "ottavina" or "spinetta di serenata." It had a less compass of keys than the larger instrument, being apparently three and two-third octaves, E to C—which by the "short measure" would be four octaves, C to C. We learn from Praetorius that these little spinets were placed upon the larger ones in performance; their use was to heighten the brilliant effect. In the double rectangular clavisingel of the Netherlands, in which there was a movable octave instrument, we recognize a similar intention. There is a fine spinet of this kind at Nuremberg. Praetorius illustrates the Italian spinet by a form known as the "spinetta traversa," an approach towards the long clavicembalo or harpsichord, the tuning pins being immediately over the keyboard. This transposed spinet, more powerful than the old trapeze one, became fashionable in England after the Restoration, Haward, Keene, Slade, Player, Baudin, the Hitchcocks, Mahoon, Haxby, the Harrir family, and others having made such "spinets" during a period for which we have dates from 1664 to 1784. Pepys bought his "Espinette" from Charles Haward for £5, July 13, 1664.

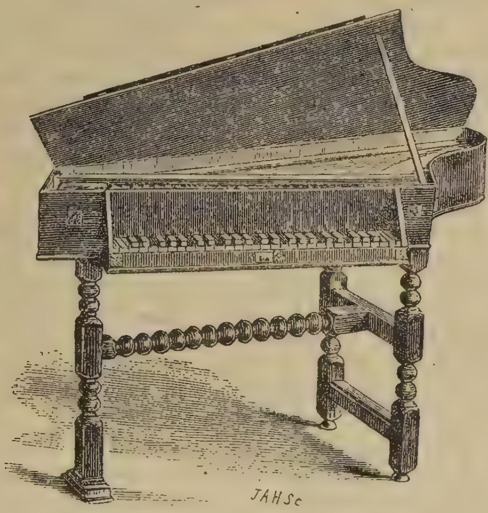

FIG. 10.—English Spinet (Spinetta Traversa), by Carolus Haward. About 1668.

The spinets of Keene and Player, made about 1700, have frequently two divided sharps at the bass end of the keyboard, as in the description by Mersenne, quoted above, of a spinet with short measure. Such divided sharps have been assumed to be quarter tones, but enharmonic intervals in the extreme bass can have no justification. From the tuning of Handel's Italian clavichord already mentioned, which has this peculiarity, and from Praetorius we find the further halves of the two divided sharps were the chromatic semitones, and the nearer halves the major thirds below *i.e.* the dominant fourths to the next natural keys. Thomas Hitchcock (for whom there are dates 1664 and 1703 written on keys and jacks of spinets bearing Edward Blunt's name and having divided bass sharps) made a great advance in constructing spinets, giving them the wide compass of five octaves, from G to G, with very fine keyboards in which the sharps were inlaid with a slip of the ivory or ebony, as the case might be, of the naturals. Their instruments, always numbered, and not dated as has been sometimes supposed, became models for contemporary and subsequent English makers.

Harpsichord: Clavicymbal.

We have now to ask what was the difference beween Scaliger's harpichordum and his clavicymbal. Galilei, the father of the astronomer of that name (*Dialogo della musica antica e moderna*, Florence, 1581), says that the harpichord was so named from having resembled an "arpa giacente," a prostrate or "couched" harp, proving that the clavicymbal was at first the trapeze-shaped spinet; and we should therefore differentiate harpichord and clavicymbal as, in form, suggested by or derived from the harp and psaltery, or from a "testa di porco" and an ordinary trapeze psaltery. We are inclined to prefer the latter. The Latin name "clavicymbalum," having early been replaced by spinet and virginal, was in Italy and France bestowed upon the long harpichord, and was continued as clavicembalo (gravecembalo, or familiarly cembalo only) and clavecin. Much later, after the restoration of the Stuarts, the first name was accepted and naturalized in England as harpsichord, which we will define as the long instrument with quills, shaped like a modern grand piano, and resembling a wing, from which it has gained the German appellation "Flügel." We can point out no long instrument of this kind so old as the Roman cembalo at South Kensington (fig. 11). It was made by Geronimo of Bologna in 1521, two years before the Paris Portalupis spinet. The outer case is of finely tooled leather. It has a spinet keyboard with a compass of nearly four octaves, E to D. The natural keys are of boxwood, gracefully arcaded in front. The keyboard of the Italian cembalo was afterwards carried out to the normal four octaves. There is an existing example, dated 1626, with the bass keys carried out without sharps in long measure (unfortunately altered by a restorer). It is surprising to see with what steady persistence the Italians adhered to their original model in making the instrument. As late as the epoch of Cristofori,[1] and in his 1722 cembalo at Florence,[2] we still find the independent outer case, the single keyboard, the two unisons, without power to reduce to one by using stops. The Italians have been as conservative with their forms of spinet, and are to this day with their organs. The startling "piano e forte" of 1598, brought to light from the records of the house of D'Este by Count Valdrighi of Modena,[3] after much consideration and a desire to find in it an anticipation of Cristofori's subsequent invention of the pianoforte, we are disposed to regard as an ordinary cembalo with power to shift, by a stop, from two unisons (forte) to one string (piano), at that time a Flemish practice, and most likely brought to Italy by one of the Flemish musicians who founded the Italian school of composition. About the year 1600, when accompaniment was invented for monody, large cembalos were made for the orchestras to bring out the bass part, the performer standing to play. Such an instrument was called "archicembalo,"[1] a name also applied to a large cembalo, made by Vito Trasuntino, a Venetian, in 1606, intended by thirty-one keys in each of its four octaves—one hundred and twenty-five in all—to restore the three genera of the ancient Greeks. How many attempts have been made before and since Trasuntino to purify intonation in keyboard instruments by multiplying keys in the octave? Simultaneously with Father Smith's well-known experiment in the Temple organ, London, there were divided keys in an Italian harpsichord to gain a separate G sharp and A flat, and a separate D sharp and E flat.

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[1] In the harpsichord Cristofori made for Prince Ferdinand dei Medici in 1702, recently acquired by Mr Stearns, of Detroit, and presented by him to the University of Michigan, U.S.A., there are three keyboards, thus arranged: 1st, highest keyboard, octave string only; 2nd, middle, octave and first unison; 3rd, lowest, both unisons. A harpsichord similarly designed with three keyboards, inscribed "Vincentius Sodi Florentinus Fecit, Anno Domini 1779," was presented by Mrs J. Crosby Brown to the Metropolitan Museum, New York.

[2] In the Kraus Museum Catalogue (1901), No. 559.

[3] See Van der Straeten, vi. 122.

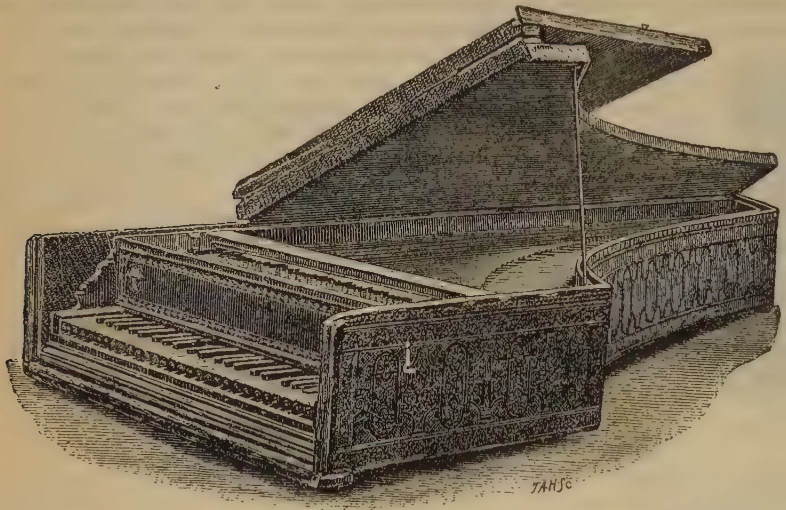

FIG. 11.—Roman Clavicembalo by Geronimo of Bologna, 1521; Vict. and Albert Museum.

Double keyboards and stops in the long cembalo or harpsichord came into use in the Netherlands early in the 16th century. We find them imported into England. The following citations, quoted by Rimbault in his *History of the Pianoforte*, but imperfectly understood by him, are from the privy purse expenses of King Henry VIII., as extracted by Sir Harris Nicolas in 1827.

> "1530 (April). Item the vj daye paied to William Lewes for ii payer of virginalls in one coffer with iiii stoppes brought to Grenewiche iii li. And for ii payer of virginalls in one coffer brought to the More other iii li."

Now the second instrument may be explained, virginals meaning any quilled instrument, as a double spinet, like that at Nuremberg by Martin van der Beest, the octave division being movable. But the first cannot be so explained; the four stops can only belong to a harpsichord, and the two pair instrument to a double-keyed one, one keyboard being over, and not by the side of the other. Again from the inventory after the king's death (see Brit. Mus. Harl. MS. 1419) fol. 247—

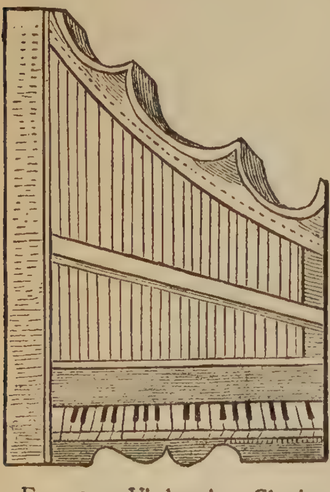

FIG. 12.—Virdung's Clavicytherium (upright Harpsichord), 1511; (reversed facsimile).

> "Two fair pair of new long Virginalls made harp-fashion of Cipres, with keys of ivory, having the King's Arms crowned and supported by his Grace's beastes within a garter gilt, standing over the keys."

We are disposed to believe that we have here another double keyboard harpsichord. Rimbault saw in this an upright instrument, such as Virdung's clavicytherium (fig. 12). Having since seen the one in the Kraus Museum, Florence, it seems that Virdung's drawing should not have been reversed; but he has mistaken the wires acting upon the jacks for strings, and omitted the latter stretched horizontally across the soundboard (see CLAVICYTHERIUM). We read in an inventory of the furniture of Warwick Castle, 1584, "a faire paire of double virginalls," and in the Hengrave inventory, 1603, "one great payre of double virginalls." Hans Ruckers, the great clavisingel maker of Antwerp, lived too late to have invented the double keyboard and stops, evident adaptions from the organ, and the octave string (the invention of which was so long attributed to him), which incorporated the octave spinet with the large instrument, to be henceforth playable without the co-operation of another performer, was already in use when he began his work. Until the last harpsichord was made by Joseph Kirkman, in 1798, scarcely an instrument of the kind was constructed, except in Italy, without the octaves. The harpsichord as known throughout the 18th century, with piano upper and forte lower keyboard, was the invention of Hans Ruckers's grandson, Jean Ruckers's nephew, Jan Couchet, about 1640. Before that time the double keyboards in Flemish harpsichords were merely a transposing expedient, to change the pitch a fourth, from plagal to authentic and vice versa, while using the same groups of keys. Fortunately there is a harpsichord existing with double keyboards unaltered, date 1638, belonging to Sir Bernard Samuelson, formerly in the possession of Mr Spence, of Florence, made by Jean Ruckers, the keyboards being in their original position. It was not so much invention as beauty of tone which made the Ruckers' harpsichords famous. The Ruckers harpsichords in the 18th century were fetching such prices as Bologna lutes did in the 17th or Cremona violins do now. There are still many specimens existing in Belgium, France and England. Handel had a Ruckers harpsichord, now in Buckingham Palace; it completes the number of sixty-three existing Ruckers instruments catalogued in Grove's *Dictionary of Music and Musicians*.

After the Antwerp make declined, London became pre-eminent for harpsichords—the representative makers being Jacob Kirckmann and Burckhard Tschudi, pupils of a Flemish master, one Tabel, who had settled in London, and whose business Kirckmann continued through marriage with Tabel's widow. Tschudi was of a noble Swiss family belonging to the canton of Glarus. According to the custom with foreign names obtaining at that time, by which Haendel became Handel, and Schmidt Smith, Kirckmann dropped his final *n* and Tschudi became Shudi, but he resumed the full spelling in the facies of the splendid harpsichords he made in 1766 for Frederick the Great, which are still preserved in the New Palace, Potsdam. By these great makers the harpsichord became a larger, heavier-strung and more powerful instrument, and fancy stops were added to vary the tone effects. To the three shifting registers of jacks of the octave and first and second unisons were added the "lute," the charm of which was due to the favouring of high harmonics by plucking the strings close to the bridge, and the "harp," a surding or muting effect produced by impeding the vibration of the strings by contact of small pieces of buff leather. Two pedals were also used, the left-hand one a combination of a unison and lute. This pedal, with the "machine" stop, reduced the upper keyboard to the lute register, the plectra of which acted upon the strings near the wrest-plank bridge only; the lower keyboard to the second unison. Releasing the machine stop and quitting the pedal restores the first unison on both keyboards and the octave on the lower. The right-hand pedal was to raise a hinged portion of the top or cover and thus gain some power of "swell" or crescendo, an invention of Roger Plenius,[1] to whom also the harp stop may be rightly attributed. This ingenious harpsichord maker had been stimulated to gain these effects by the nascent pianoforte which, as we shall find, he was the first to make in England. The first idea of pedals for the harpsichord to act as stops appears to have been John Hayward's (?Haward) as early as 1676, as we learn from Mace's *Musick's Monument*, p. 235. The French makers preferred a kind of knee-pedal arrangement, known as the "genouillère," and sometimes a more complete muting by one long strip of buff leather, the "sourdine." As an improvement upon Plenius's clumsy swell, Shudi in 1769 patented the Venetian swell, a framing of louvres, like a Venetian blind, which opened by the movement of the pedal, and becoming in England a favourite addition to harpsichords, was early transferred to the organ, in which it replaced the rude "nag's-head" swell. A French harpsichord maker, Marius, whose name is remembered from a futile attempt to design a pianoforte action, invented a folding harpsichord, the "clavecin brisé," by which the instrument could be disposed of in a smaller space. One, which is preserved at Berlin, probably formed part of the camp baggage of Frederick the Great.

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[1] Invented by Nicola Vicentino; see *L'Antica musica ridotto alla moderna prattica* (Rome, 1555).

Cristofori's Invention of the Pianoforte.

It was formerly a custom with kings, princes and nobles to keep large collections of musical instruments for actual playing purposes, in the domestic and festive music of their courts. There are records of their inventories, and it was to keep such a collection in playing order that Prince Ferdinand dei Medici engaged a Paduan harpsichord maker, Bartolommeo Cristofori, the man of genius who invented and produced the pianoforte.[2] We fortunately possess the record of this invention in a literary form from a well-known writer, the Marchese Scipione Maffei; his description appeared in the *Giornale dei letterati d'Italia*, a publication conducted by Apostolo Zeno. The date of Maffei's paper was 1711. Rimbault reproduced it, with a technically imperfect translation, in his *History of the Pianoforte*. We learn from it that in 1709 Cristofori had completed four "gravecembali col piano e forte"—keyed-psalteries with soft and loud—three of them being of the long or usual harpsichord form. A synonym in Italian for the original cembalo (or psaltery) is "salterio," and if it were struck with hammers it became a "salterio tedesco" (the German *hackbrett*, or chopping board), the latter being the common dulcimer. Now the first notion of a pianoforte is a dulcimer with keys, and we may perhaps not be wrong in supposing that there had been many attempts and failures to put a keyboard to a dulcimer or hammers to a harpsichord before Cristofori successfully solved the problem. The sketch of his action in Maffei's essay shows an incomplete stage in the invention, although the kernel of it—the principle of escapement or the controlled rebound of the hammer—is already there. He obtains it by a centred lever (*linguetta mobile*) or hopper, working, when the key is depressed by the touch, in a small projection from the centred hammer-butt. The return, governed by a spring, must have been uncertain and incapable of further regulating than could be obtained by modifying the strength of the spring. Moreover, the hammer had each time to be raised the entire distance of its fall. There are, however, two pianofortes by Cristofori, dated repectively 1720 and 1726, which show a much improved, we may even say a perfected, construction, for the whole of an essential piano movement is there. The earlier instrument (now in the Metropolitan Museum, New York) has undergone considerable restoration, the original hollow hammer-head having been replaced by a modern one, and the hammer-butt, instead of being centred by means of the holes provided by Cristofori himself for the purpose, having been lengthened by a leather hinge screwed to the block;[3] but the 1726 one, which is in the Kraus Museum at Florence, retains the original leather hammer-heads. Both instruments possess alike a contrivance for determining the radius of the hopper, and both have been unexpectedly found to have the "check" (Ital. *paramartello*), which regulates the fall of the hammer according to the strength of the blow which has impelled it to the strings. After this discovery of the actual instruments of Cristofori there can be no longer doubt as to the attribution of the invention to him in its initiation and its practical completion with escapement and check. To Cristofori we are indebted, not only for the power of playing *piano* and *forte*, but for the infinite variations of tone, or *nuances*, which render the instrument so delightful.

But his problem was not solved by the devising of a working action; there was much more to be done to instal the pianoforte as a new musical instrument. The resonance, that most subtle and yet all-embracing factor, had been experimentally developed to a certain perfection by many generations of spinet and harpsichord makers, but the resistance structure had to be thought out again. Thicker stringing, rendered indispensable to withstand even Cristofori's light hammers, demanded in its turn a stronger framing than the harpsichord had needed. To make his structure firm he considerably increased the strength of the block which holds the tuning-pins, and as he could not do so without materially adding to its thickness, he adopted the bold expedient of inverting it; driving his wrest-pins, harp-fashion, through it, so that tuning was effected at their upper, while the wires were attached to their lower, ends. Then, to guarantee the security of the case, he ran an independent string-block round it of stouter wood than had been used in harpsichords, in which block the hitch-pins were driven to hold the farther ends of the strings, which were spaced at

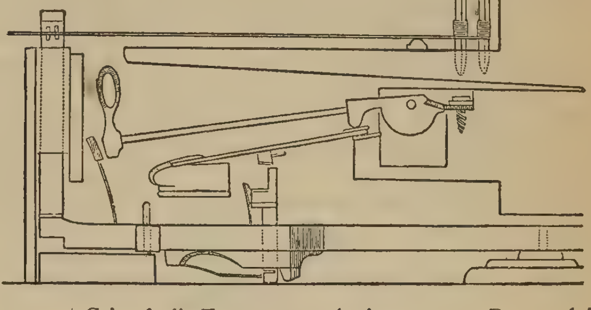

FIG. 13.—Cristofori's Escapement Action, 1720. Restored in 1875 by Cesare Ponsicchi.

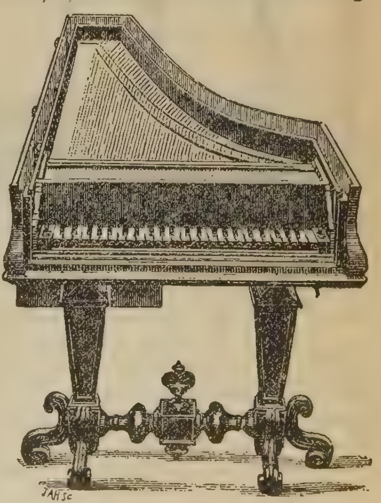

FIG. 14.—Cristofori's Piano e Forte, 1726; Kraus Museum, Florence.

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[1] Mace describes a primitive swell contrivance for an organ 65 years before Plenius took out his patent (1741).

[2] The invention of the piano by Cristofori, and him alone, is now past discussion. What is still required to satisfy curiosity would be the discovery of a Fort Bien or Frederici square piano, said to antedate by a year or two Zumpe's invention of the instrument in London. The name Fort Bien was derived, consciously or unconsciously, from the Saxon German peculiarity of interchanging B and P. Among Mozart's effects at the time of his death was a *Forte-Biano mit Pedal* (see *Vierzehnter jährlicher Bericht des Mozarteum*, "Salzburg," Dec. 19, 1791). Also wanted is the "old movement" for the long or grand pianos, sometimes quoted in the Broadwood day-books of the last quarter of the 18th century with reference to the displacement by the Backers English action.

[3] Communicated by Baron Alexander Kraus (May 1908).

equal distances (unlike the harpsichord), the dampers lying between the pairs of unisons.

Silbermann.

Cristofori died in 1731. He had pupils,[1] but did not found a school of Italian pianoforte-making, perhaps from the peculiar Italian conservatism in musical instruments we have already remarked upon. The essay of Scipione Maffei was translated into German, in 1725, by König, the court poet at Dresden, and friend of Gottfried Silbermann, the renowned organ builder and harpsichord and clavichord maker.[2] Incited by this publication, and perhaps by having seen in Dresden one of Cristofori's pianofortes, Silbermann appears to have taken up the new instrument, and in 1726 to have manufactured two, which J. S. Bach, according to his pupil Agricola, pronounced failures. The trebles were too weak; the touch was too heavy. There has long been another version to this story, viz. that Silbermann borrowed the idea of his action from a very simple model contrived by a young musician named Schroeter, who had left it at the electoral court in 1721, and, quitting Saxony to travel, had not afterwards claimed it. It may be so; but Schroeter's letter, printed in Mitzler's *Bibliothek*, dated 1738, is not supported by any other evidence than the recent discovery of an altered German harpsichord, the hammer action of which, in its simplicity, may have been taken from Schroeter's diagram, and would sufficiently account for the condemnation of Silbermann's earliest pianofortes if he had made use of it. In either case it is easy to distinguish between the lines of Schroeter's interesting communications (to Mitzler, and later to Marpurg) the bitter disappointment he felt in being left out of the practical development of so important an instrument.

But, whatever Silbermann's first experiments were based upon, it was ascertained, by the investigations of A. J. Hipkins, that he, when successful, adopted Cristofori's pianoforte without further alteration than the compass and colour of the keys and the style of joinery of the case. In the Silbermann grand pianofortes, in the three palaces at Potsdam, known to have been Frederick the Great's, and to have been acquired by that monarch prior to J. S. Bach's visit to him in 1747, we find the Cristofori framing, stringing, inverted wrest-plank and action complete. Fig. 15 represents the instrument on which J. S. Bach played in the Town Palace, Potsdam.

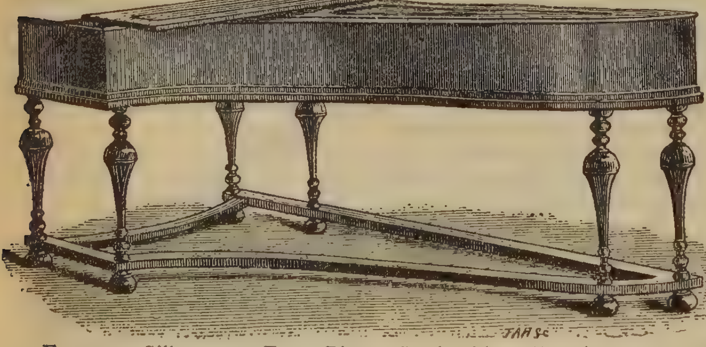

Fig. 15.—Silbermann Forte Piano; Stadtschloss, Potsdam, 1746.

Frederici.

It has been repeatedly stated in Germany that Frederici, of Gera in Saxony, an organ builder and musical instrument maker, invented the square or table-shaped piano, the "fort bien," as he is said to have called it, about 1758–1760. No square piano by this maker is forthcoming, though an "upright grand" piano, made by Domenico del Mela in 1739, with an action adapted from Cristofori's has been discovered by Signor Ponsicchi of Florence. Victor Mahillon of Brussels, however, acquired a Frederici "upright grand" piano, dated 1745 (fig. 16). In Frederici's upright grand action we have not to do with the ideas of either Cristofori or Schroeter; the movement is practically identical with the hammer action of a German clock, and has its counterpart in a piano at Nuremberg; a fact which needs further elucidation. We note here the earliest example of the leather hinge, afterwards so common in piano actions and only now going out of use. Where are we to look for Schroeter's copyist if not found in Silbermann, Frederici, or, as we shall presently see, perhaps J. G. Wagner? It might be in the harpsichord we have mentioned, which, made in 1712 by one Brock for the elector of Hanover (afterwards George I. of England), was by him presented to the Protestant pastor of Schulenberg, near Hanover, and has since been rudely altered into a pianoforte (fig. 17). There is an altered harpsichord in the museum at Basel which appears to have been no more successful. But an attempted combination of harpsichord and pianoforte appears as a very early intention. The English poet Mason, the friend of Gray, bought such an instrument at Hamburg in 1755, with "the cleverest mechanism imaginable."

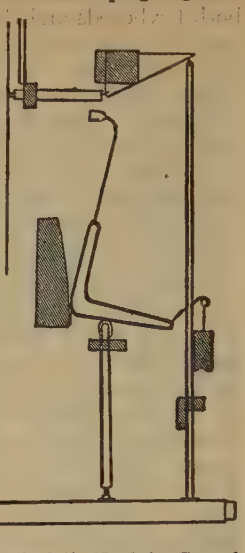

Fig. 16.—Frederici's Upright Grand Piano Action, 1745. In the museum of the Brussels Conservatoire.

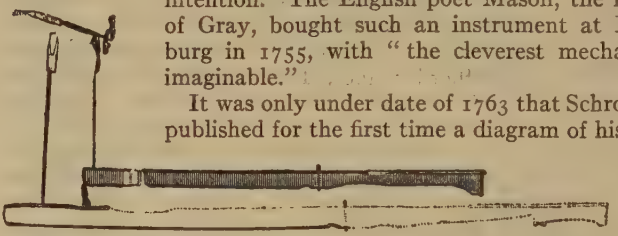

Fig. 17.—Hammer and Lifter of altered Harpsichord by Brock. Instrument in the collection of Mr Kendrick Pyne, Manchester.

Schroeter; Zumpe.

It was only under date of 1763 that Schroeter[3] published for the first time a diagram of his proposed invention, designed more than forty years before. It appeared in Marpurg's *Kritische Briefe* (Berlin, 1764). Now, immediately after, Johann Zumpe, a German in London, who had been one of Shudi's workmen, invented or introduced (for there is some tradition that Mason had to do with the invention of it)[4] a square piano, which was to become the most popular domestic instrument. It would seem that Zumpe was in fact not the inventor of the square piano, which appears to have been well known in Germany before his date, a discovery made by Mr George Rose. In Paul de Wit's Musical Instrument Museum—formerly in Leipzig, now transferred to Cologne—there is a small square piano, 27 in. long, 10 in. wide and 4½ in. high, having a contracted keyboard of 3 octaves and 2 notes. The action of this small instrument is practically identical in every detail with that of the square pianofortes made much later by Zumpe (Paul de Wit, *Katalog des musikhistorischen Museums*, Leipzig, 1903. No. 55, illustration, p. 38). Inside is inscribed: "Friedrich Hildebrandt, Instrumentenmacher in Leipzig, Quergasse," with four figures almost illegible. Paul de Wit refers the instrument to the middle of the 18th century. It has all the appearance of being a reduced copy of a well-established type, differing very little from the later models, except that it has no dampers. It seems probable that this small instrument is a converted clavichord, and that the action may have been suggested by Schroeter's model, left in 1721 at the Electoral Court of Saxony. Burney tells us all about Zumpe; and his instruments still existing would fix the date of the first at about 1765. Fetis narrates, however, that he began the study of the piano on a square piano made by Zumpe in 1762. In his simple "old man's head" action we have the nearest approach to a realization of Schroeter's simple idea. It will be observed that Schroeter's damper would stop all vibration at once. This defect is overcome by Zumpe's "mopstick" damper.

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[1] See Cesare Ponsicchi, *Il Pianoforte, sua origine e sviluppo* (Florence, 1876), p. 37.

[2] This translation, published at Hamburg and reproduced *in extenso*, may be read in Dr Oscar Paul's *Geschichte des Claviers* (Leipzig, 1868).

[3] For arguments in favour of Schroeter's claim to the invention of the pianoforte see Dr Oscar Paul, *op. cit.* pp. 85–104, who was answered by A. J. Hipkins in Grove's *Dict. of Music and Musicians*.

[4] Mason really invented the "celestina" (known as Adam Walker's patent No. 1020), as we know from the correspondence of Mary Granville. Under date of the 11th of January 1775 she describes this invention as a short harpsichord 2 ft. long, but played with the right hand only. The left hand controlled a kind of violin bow, which produced a charming *sostinente*, in character of tone between the violin tone and that of musical glasses.

Stein.

Another piano action had, however, come into use about that time or even earlier in Germany. The discovery of it in the simplest form is to be attributed to V. C. Mahillon, who found it in a square piano belonging to Henri Gosselin, painter, of Brussels. The principle of this action is that which was later perfected by the addition of a good escapement by Stein of Augsburg, and was again later experimented upon by Sebastian Erard. Its origin is perhaps due to the contrivance of a piano action that should suit the shallow clavichord and permit of its transformation into a square piano; a transformation, Schroeter tells us, had been going on when he wrote his complaint. It will be observed that the hammer is, as compared with other actions, reversed, and the axis rises with the key, necessitating a fixed means for raising the hammer, in this action effected by a rail against which the hammer is jerked up. It was Stein's merit to graft the hopper principle upon this simple action; and Mozart's approbation of the invention, when he met with it at Augsburg in 1777, is expressed in a well-known letter addressed to his mother. No more "blocking" of the hammer, destroying all vibration, was henceforth to vex his mind. He had found the instrument that for the rest of his short life replaced the harpsichord. V. C. Mahillon secured for his museum the only Johann Andreas Stein piano which is known to remain. It is from Augsburg, dated 1780, and has Stein's escapement action, two unisons, and the knee pedal, then and later common in Germany.

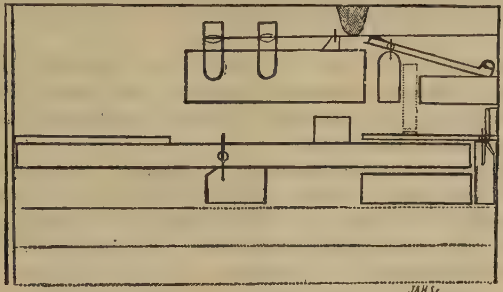

FIG. 18.—Schroeter's Model for an Action, 1721.

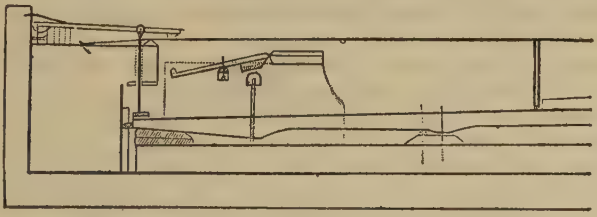

FIG. 19.—Zumpe's Square Piano Action, 1766.

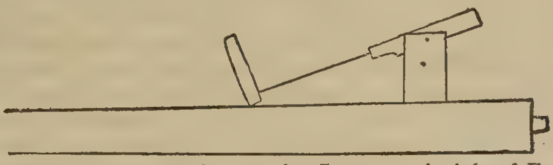

FIG. 20.—Old Piano Action on the German principle of Escapement. Square Piano belonging to M. Gosselin, Brussels.

Mozart's own grand piano, preserved at Salzburg, and the two grand pianos (the latest dated 1790) by Huhn of Berlin, preserved at Berlin and Charlottenburg, because they had belonged to Queen Luise of Prussia, follow Stein in all particulars. These instruments have three unisons upwards, and the muting movement known as *celeste*, which no doubt Stein had also. The wrest-plank is not inverted; nor is there any imitation of Cristofori. We may regard Stein, coming after the Seven Years' War which had devastated Saxony, as the German reinventor of the grand piano. Stein's instrument was accepted as a model, as we have seen, in Berlin as well as Vienna, to which city his business was transferred in 1794 by his daughter Nanette, known as an accomplished pianist and friend of Beethoven, who at that time used Stein's pianos. She had her brother in the business with her, and had already, in 1793, married J. A. Streicher, a pianist from Stuttgart, and distinguished as a personal friend of Schiller. In 1802, the brother and sister dissolving partnership, Streicher began himself to take his full share of the work, and on Stein's lines improved the Viennese instrument, so popular for many years and famous for its lightness of touch, which contributed to the special character of the Viennese school of pianoforte playing. Since 1862, when Steinway's example caused a complete revolution in German and Austrian piano-making, the old wooden cheap grand piano has died out. We will quit the early German piano with an illustration (fig. 22) of an early square piano action in an instrument made by Johann Gottlob Wagner of Dresden in 1783. This interesting discovery of Mahillon's introduces us to a rude imitation (in the principle) of Cristofori, and it appears to have no relation whatever to the clock-hammer motion seen in Frederici's.

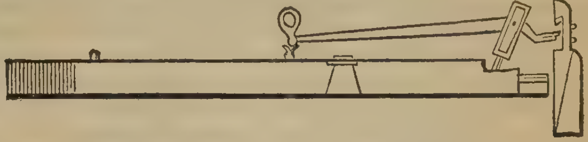

FIG. 21.—Stein's Action (the earliest so-called Viennese), 1780.

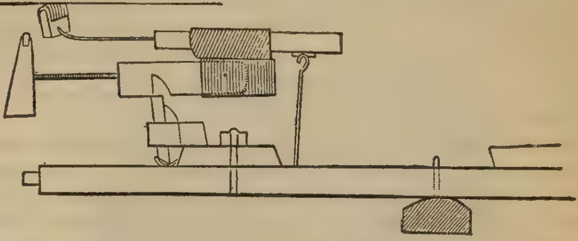

FIG. 22.—German Square Action, 1783. Piano by Wagner, Dresden.

The Pianoforte in England.

Burney, who lived through the period of the displacement of the harpsichord by the pianoforte, is the only authority to whom we can refer as to the introduction of the latter instrument into England. He tells us,[1] in his gossiping way, that the first hammer harpsichord that came to England was made by an English monk at Rome, a Father Wood, for an English gentleman, Samuel Crisp of Chesington; the tone of this instrument was superior to that produced by quills, with the added power of the shades of *piano* and *forte*, so that, although the touch and mechanism were so imperfect that nothing quick could be executed upon it, yet in a slow movement like the "Dead March" in *Saul* it excited wonder and delight. Fulke Greville afterwards bought this instrument for 100 guineas, and it remained unique in England for several years, until Plenius, the inventor of the lyrichord, made a pianoforte in imitation of it. In this instrument the touch was better, but the tone was inferior. We have no date for Father Wood. Plenius produced his lyrichord, a *sostenente* harpsichord, in 1745. When Mason imported a pianoforte in 1755, Fulke Greville's could have been no longer unique. The Italian origin of Father Wood's piano points to a copy of Cristofori, but the description of its capabilities in no way confirms this supposition, unless we adopt the very possible theory that the instrument had arrived out of order and there was on one in London who could put it right, or would perhaps divine that it was wrong. Burney further tells us that the arrival in London of J. C. Bach in 1759 was the motive for several of the second-rate harpsichord makers trying to make pianofortes, but with no particular success. Of these Americus Backers (d. 1776), said to be a Dutchman, appears to have gained the first place. He was afterwards the inventor of the so-called English action, and as this action is based upon Cristofori's we may suppose he at first followed Silbermann in copying the original inventor.

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[1] Rees's *New Cyclopaedia*, art. "Harpsichord."

Backers.

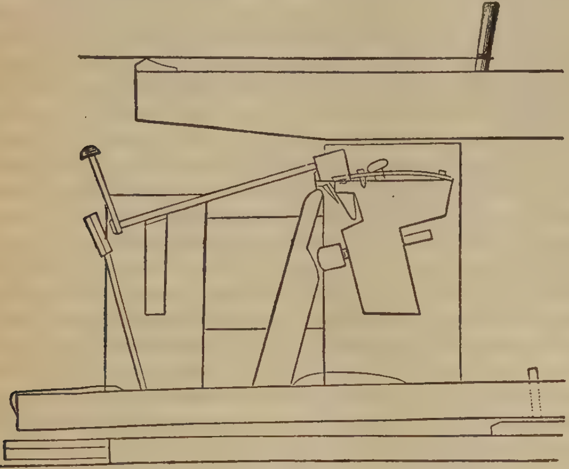

Fig. 23.—Grand Piano Action, 1776. The "English" action of Americus Backers.

There is an old play-bill of Covent Garden in Messrs Broadwood's possession dated the 16th of May 1767, which has the following announcement:—

"End of Act 1. Miss Brickler will sing a favourite song from *Judith*, accompanied by Mr Dibdin on a new instrument call'd Piano Forte."

The mind at once reverts to Backers as the probable maker of this novelty. Backers's "Original Forte Piano" was played at the Thatched House in St James's Street, London, in 1773. Ponsicchi has found a Backers grand piano at Pistoria, dated that year. It was Backers who produced the action continued in the direct principle by the firm of Broadwood, or with the reversed lever and hammer-butt introduced by the firm of Collard in 1835.

Broadwood; Stodart.

The escapement lever is suggested by Cristofori's first action, to which Backers has added a contrivance for regulating it by means of a button and screw. The check is from Cristofori's second action. No more durable action has been constructed, and it has always been found equal, whether made in England or abroad, to the demands of the most advanced virtuosi. John Broadwood and Robert Stodart were friends, Stodart having been Broadwood's pupil; and they were the assistants of Backers in the installation of his invention. On his deathbed he commended it to Broadwood's care, but Stodart appears to have been the first to advance it—Broadwood being probably held back by his partnership with his brother-in-law, the son of Shudi, in the harpsichord business. (The elder Shudi had died in 1773.) Stodart soon made a considerable reputation with his "grand" pianofortes, a designation he was the first to give them. In Stodart's grand piano we first find an adaptation from the lyrichord of Plenius, of steel arches between the wrest-plank and belly-rail, bridging the gap up which the hammers rise, in itself an important cause of weakness. These are not found in any contemporary German instruments, but may have been part of Backers's.

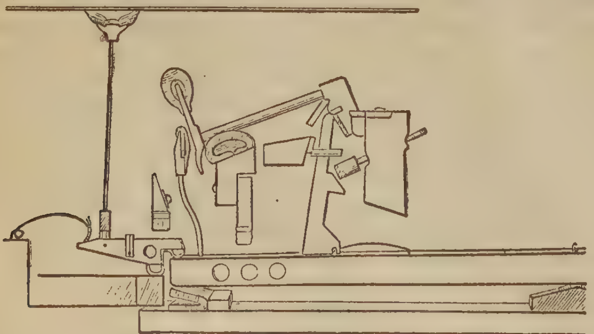

Fig. 24.—Broadwood's Grand Piano Action, 1884. English direct mechanism.

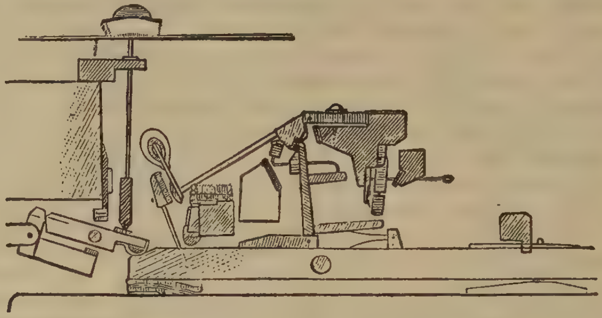

Fig. 25.—Collard's Grand Piano Action, 1884. English action, with reversed hopper and contrivance for repetition added.

Imitation of the harpsichord by "octaving" was at this time an object with piano makers. Zumpe's small square piano had met with great succcess; he was soon enabled to retire, and his imitators, who were legion, continued his model with its hand stops for the dampers and sourdine, with little change but that which straightened the keys from the divergences inherited from the clavichord. John Broadwood took this domestic instrument first in hand to improve it, and in the year 1780 succeeded in entirely reconstructing it. He transferred the wrest-plank and pins from the right-hand side, as in the clavichord, to the back of the case, an improvement universally adopted after his patent, No. 1379 of 1783, expired. In this patent we first find the damper and piano pedals, since universally accepted, but at first in the grand pianofortes only. Zumpe's action remaining with an altered damper, another inventor, John Geib, patented (No. 1571 of 1786) the hopper with two separate escapements, one of which soon became adopted in the grasshopper of the square piano, it is believed by Geib himself; and Petzold, a Paris maker, appears to have taken later to the escapement effected upon the key. We may mention here that the square piano was developed and continued in England until about the year 1860, when it went out of fashion.

To return to John Broadwood—having launched his reconstructed square piano, he next turned his attention to the grand piano to continue the improvement of it from the point where Backers had left it. The grand piano was in framing and resonance entirely on the harpsichord principle, the sound-board bridge being still continued in one undivided length. The strings, which were of brass wire in the bass, descended in notes of three unisons to the lowest note of the scale. Tension was left to chance, and a reasonable striking line or place for the hammers was not thought of. Theory requires that the notes of octaves should be multiples in the ratio of 1 to 2, by which, taking the treble clef C at one foot, the lowest F of the five-octave scale would require a vibrating length between the bridges of 12 ft. As only half this length could be conveniently afforded, we see at once a reason for the above-mentioned deficiencies. Only the three octaves of the treble, which had lengths practically ideal, could be tolerably adjusted. Then the striking-line, which should be at an eighth or not less than a ninth or tenth of the vibrating length, and had never been cared for in the harpsichord, was in the lowest two octaves out of all proportion, with corresponding disadvantage to the tone. John Broadwood did not venture alone upon the path towards rectifying these faults. He called in the aid of professed men of science—Tiberius Cavallo, who in 1788 published his calculations of the tension, and Dr Gray, of the British Museum. The problem was solved by dividing the sound-board bridge, the lower half of which was advanced to carry the bass strings, which were still of brass. The first attempts to equalize the tension and improve the striking-place were here set forth, to the great advantage of the instrument, which in its wooden construction might now be considered complete. The greatest pianists of that epoch, except Mozart and Beethoven, were assembled in London—Clementi, who first gave the pianoforte its own character, raising it from being a mere variety of the harpsichord, his pupils Cramer and for a time Hummel, later on John Field, and also the brilliant virtuosi Dussek and Steibelt. To please Dussek, Broadwood in 1791 carried his five-octave, F to F, keyboard, by adding keys upwards, to five and a half octaves, F to C. In 1794 the additional bass half octave to C, which Shudi had first introduced in his double harpsichords, was given to the piano. Steibelt, while in England, instituted the familiar signs for the employment of the pedals, which owes its charm to excitement of the imagination instigated by power over an acoustical phenomenon, the sympathetic vibration of the strings. In 1799 Clementi founded a pianoforte manufactory, to be subsequently developed and carried on by Messrs Collard.

Erard.

The first square piano made in France is said to have been constructed in 1776 by Sebastian Erard, a young Alsatian. In 1786 he came to England and founded the London manufactory of harps and pianofortes bearing his name. That eminent mechanician and inventor is said to have at first adopted for his pianos the English models. However, in 1794 and 1801, as is shown by his patents, he was certainly engaged upon the elementary action described as appertaining to Gosselin's piano, of probably German origin. In his long-continued labour of inventing and constructing a double escapement action, Erard appears to have sought to combine the English power of gradation of tone with the German lightness of touch. He took out his first patent for a "repetition" action in 1808, claiming for it "the power of giving repeated strokes without missing or failure, by very small angular motions of the key itself." He did not, however, succeed in producing his famous repetition or double escapement action until 1821; it was then patented by his nephew Pierre Erard, who, when the patent expired in England in 1835, proved a loss from the difficulties of carrying out the invention, which induced the House of Lords to grant an extension of the patent.

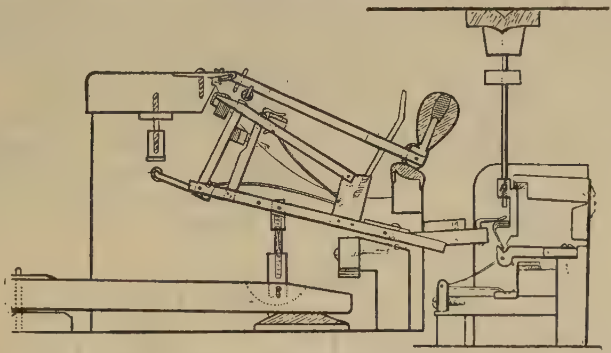

FIG. 26.—Erard's Double Escapement Action, 1884. The double escapement or repetition is effected by a spring in the balance pressing the hinged lever upwards, to allow the hopper which delivers the blow to return to its position under the nose of the hammer, before the key has risen again.

Erard invented in 1808 an upward bearing to the wrest-plank bridge, by means of agraffes or studs of metal through holes in which the strings are made to pass, bearing against the upper side. The wooden bridge with down-bearing strings is clearly not in relation with upward-striking hammers, the tendency of which must be to raise the strings from the bridge, to the detriment of the tone. A long brass bridge on this principle was introduced by William Stodart in 1822. A pressure-bar bearing of later introduction is claimed for the French maker, Bord. The first to see the importance of iron sharing with wood (ultimately almost supplanting it) in pianoforte framing was a native of England and a civil engineer by profession, John Isaac Hawkins, known as the inventor of the ever-pointed pencil. He was living at Philadelphia, U.S.A., when he invented and first produced the familiar cottage pianoforte—"portable grand" as he then called it. He patented it in America, his father, Isaac Hawkins, taking out the patent for him in England in the same year, 1800. It will be observed that the illustration here given (fig. 28) represents a wreck; but a draughtsman's restoration might be open to question.

Hawkins.

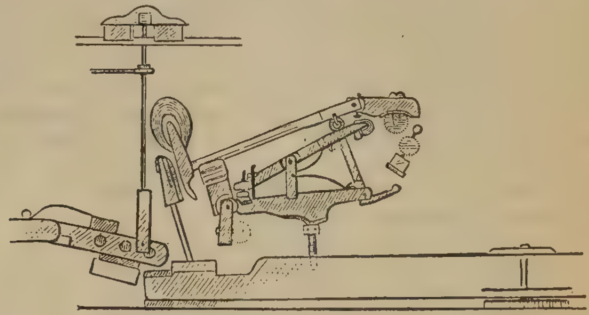

FIG. 27.—Steinway's Grand Piano Action, 1884. The double escapement as in Erard's, but with shortened balance and usual check.

There had been upright grand pianos as well as upright harpsichords, the horizontal instrument being turned up upon its wider end and a keyboard and action adapted to it. William Southwell, an Irish piano-maker, had in 1798 tried a similar experiment with a square piano, to be repeated in later years by W. F. Collard of London; but Hawkins was the first to make a piano, or pianino, with the strings descending to the floor, the keyboard being raised, and this, although at the moment the chief, was not his only merit. He anticipated nearly every discovery that has since been introduced as novel. His instrument (fig. 28) is in a complete iron frame, independent of the case; and in this frame, strengthened by a system of iron resistance rods combined with an iron upper bridge, his sound-board is entirely suspended. An apparatus for tuning by mechanical screws regulates the tension of the strings, which are of equal length throughout. The action, in metal supports, anticipates Wornum's in the checking, and still later ideas in a contrivance for repetition. This remarkable bundle of inventions was brought to London and exhibited by Hawkins himself;

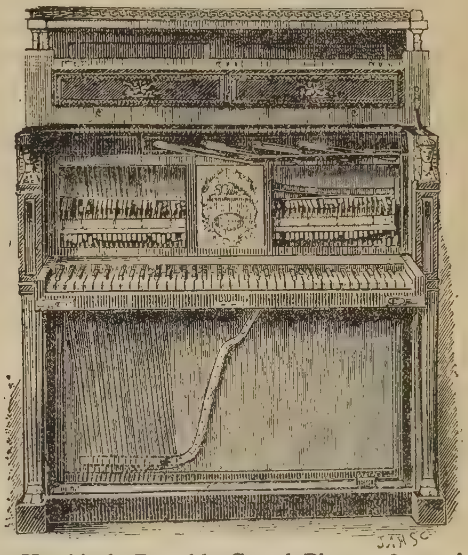

FIG. 28.—Hawkins's Portable Grand Piano, 1800. An upright instrument, the original of the modern cottage piano or pianino. In Messrs Broadwood's museum and unrestored.

but the instrument being poor in the tone failed to bring him pecuniary reward or the credit he deserved. Southwell appears to have been one of the first to profit by Hawkins's ideas by bringing out the high cabinet pianoforte, with hinged sticker action, in 1807. All that he could, however, patent in it was the simple damper action, turning on a pivot to relieve the dampers from the strings, which is still frequently used with such actions. The next steps for producing the lower or cottage upright piano were taken by Robert Wornum, who in 1811 produced a diagonally, and in 1813 a vertically, strung one. Wornum's perfected crank action (fig. 29) was not complete until 1826, when it was patented for a cabinet piano; but it was not really introduced until three years later, when Wornum applied it to his little "piccolo." The principle of this centred lever check action was introduced into Paris by Pleyel[1] and Pape, and thence into Germany and America.

Allen.

It was not, however, from Hawkins's invention that iron became introduced as essential to the structure of a pianoforte. This was due to William Allen, a young Scotsman in the employ of the Stodarts. He devised a metal system of framing intended primarily for compensation, but soon to become, in other hands, a framing for resistance. His idea was to meet the divergence in tuning caused in brass and iron strings by atmospheric changes by compensating tubes and plates of the same metals, guaranteeing their stability by a cross batoning of stout wooden bars and a metal bar across the wrest-plank. Allen, being simply a tuner, had not the full practical knowledge for carrying out the idea. He had to ally himself with Stodart's foreman, Thom; and Allen and Thom patented the invention in January 1820. The firm of Stodart at once acquired the patent.

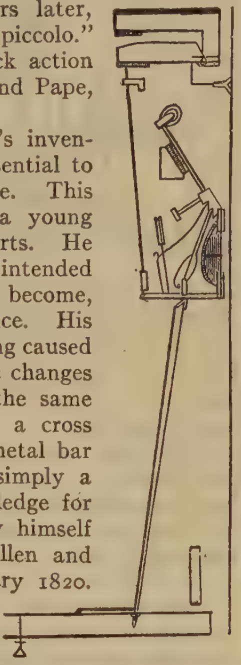

FIG. 29.—Wornum's Upright Action, 1826. The original of the now universal crank action in upright pianos.

We have now arrived at an important epoch in pianoforte construction—the abolition, at least in England and France, of the wooden construction in favour of a combined construction of iron and wood, the former material gradually asserting pre-eminence. Allen's design is shown in fig. 30. The long bars shown in the diagram are really tubes fixed at one end only; those of iron lie over the iron or steel wire, while those of brass lie over the brass wire, the metal plates to which they are attached being in the same correspondence. At once a great advance was made in the possibility of using heavier strings than could be stretched before, without danger to the durability of the case and frame. The next step was in 1821, to a fixed iron string-plate, the invention of one of Broadwood's workmen, Samuel Hervé, which was in the first instance applied to one of the square pianos of that firm. The great advantage in the fixed plate was a more even solid counterpoise to the drawing or tension of the strings and the abolition of their undue length behind the bridge, a reduction which Isaac Carter[2] had tried some years before, but unsuccessfully, to accomplish with a plate of wood. So generally was attention now given to improved methods of resistance that it has not been found possible to determine who first practically introduced those long iron or steel resistance bars which are so familiar a feature in modern grand pianos. They were experimented on as substitutes for the wooden bracing by Joseph Smith in 1798; but to James Broadwood belongs the credit of trying them first above the sound-board in the treble part of the scale as long ago as 1808, and again in 1818; he did not succeed, however, in fixing them properly. The introduction of fixed resistance bars is really due to observation of Allen's compensating tubes, which were, at the same time, resisting. Sebastian and Pierre Erard seem to have been first in the field in 1823 with a complete system of nine resistance bars from treble to bass, with a simple mode of fastening them through the sound-board to the wooden beams beneath, but, although these bars appear in their patent of 1824, which chiefly concerned their repetition action, the Erards did not either in France or England claim them as of original invention, nor is there any string-plate combined with them in their patent. James Broadwood, by his patent of 1827, claimed the combination of string-plate and resistance bars, which was clearly the completion of the wood and metal instrument, differing from Allen's in the nature of the resistance being fixed. Broadwood, however, left the brass bars out, but added a fourth bar in the middle to the three in the treble he had previously used. It must be borne in mind that it was the trebles that gave way in the old wooden construction before the tenor and bass of the instrument. But the weight of the stringing was always increasing, and a heavy close overspinning of the bass strings had become general. The resistance bars were increased to five, six, seven, eight and, as we have seen, even nine, according to the ideas of the different English and French makers who used them in their pursuit of stability.

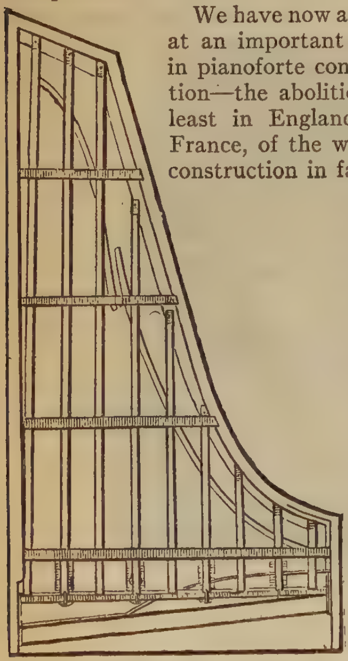

FIG. 30.—Allen's Compensating Grand Piano, 1820. The first complete metal framing system applied over the strings.

The next important addition to the grand piano in order of time was the harmonic bar of Pierre Erard, introduced in 1838. This was a gun-metal bar of alternate pressing and drawing power by means of screws which were tapped into the wrest-plank immediately above the treble bearings, making that part of the instrument nearly immovable; this favoured the production of higher harmonics to the treble notes, recognized in what we commonly call "ring." A similar bar, subsequently extended by Broadwood across the entire wrest-plank, was to prevent any tendency in the wrest-plank to rise, from the combined upward drawing of the strings. A method of fastening the strings on the string-plate depending upon friction, and thus dispensing with "eyes," was a contribution of the Collards, who had retained James Stewart, a man of considerable inventive power, who had been in America with Chickering. This invention was introduced in 1827. Between 1847 and 1849

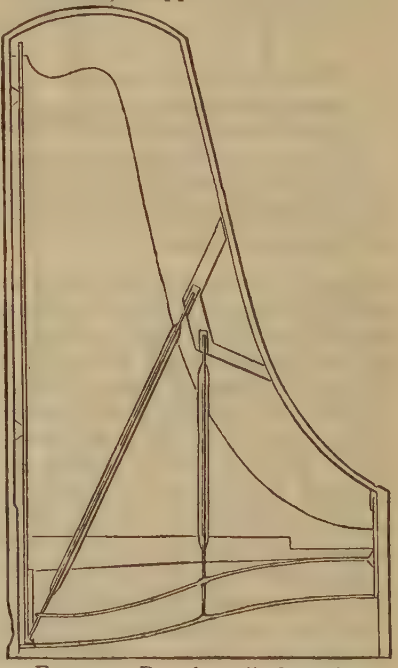

FIG. 31.—Broadwood's Iron Grand Piano, 1884. Complete iron frame with diagonal resistance bar.

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[1] Pleyel exhibited a small upright piano in Paris in 1827. Pierre Erard did not turn his attention to upright pianos until 1831.

[2] Sometime foreman to the pianoforte maker Mott, who attracted much attention by a piano with *sostenente* effect, produced by a roller and silk attachments in 1817. But a *sostenente* piano, however perfect, is no longer a true piano such as Beethoven and Chopin wrote for.

Mr Henry Fowler Broadwood, son of James, and grandson of John Broadwood, and also great-grandson of Shudi (Tschudi), invented a grand pianoforte to depend practically upon iron, in which, to avoid the conspicuous inequalities caused by the breaking of the scale with resistance bars, there should be no bar parallel to the strings except a bass bar, while another flanged resistance bar, as an entirely novel feature, crossed over the strings from the bass corner of the wrest-plank to a point upon the string-plate where the greatest accumulation of tension strain was found. Broadwood did not continue, without some compromise, this extreme renunciation of ordinary resistance means. After the Great Exhibition of 1851 he employed an ordinary straight bar in the middle of his concert grand scale, his smaller grands having frequently two such as well as the long bass bar. After 1862 he covered his wrest-plank with a thick plate of iron into which the tuning pins screw as well as into the wood beneath, thus avoiding the crushing of the wood by the constant pressure of the pin across the pull of the string, an ultimate source of danger to durability.

The introduction of iron into pianoforte structure was differently and independently effected in America, the fundamental idea there being to use a single casting for the metal plate and bars, instead of forging or casting them in separate pieces. Alphaeus Babcock was the pioneer to this kind of metal construction. He also was bitten with the compensation notion, and had cast an iron ring for a square piano in 1825, which, although not a success, gave the clue to a single casting resistance framing, successfully accomplished by Conrad Meyer, in Philadelphia, in 1833, in a square piano which still exists, and was shown in the Paris Exhibition of 1878. Meyer's idea was improved upon by Jonas Chickering (1797–1853) of Boston, who applied it to the grand piano as well as to the square, and brought the principle up to a high degree of perfection —establishing by it the independent construction of the American pianoforte.

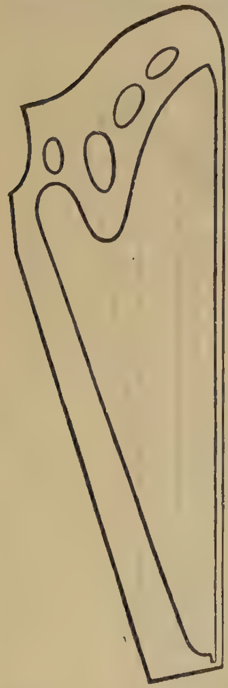

FIG. 32.—Meyer's Metal Frame for a Square Piano, 1833. In a single casting.

Over-stringing.

Steinway.

We have now to do with over- or cross-stringing, by which the bass division of the strings is made to cross over the tenor part of the scale in a single, double or treble disposition at diverging angles—the object being in the first instance to get longer bass strings than are attainable in a parallel scale, and in the next to open out the scale and extend the area of bridge pressure on the sound-board. In the 18th century clavichords were sometimes overstrung in the lowest octave to get a clearer tone in that very indistinct part of the instrument (strings tuned an octave higher being employed). The first suggestion for the overstringing in the piano was made by the celebrated flute-player and inventor Theobald Boehm, who carried it beyond theory in London, in 1831, by employing a small firm located in Cheapside, Gerock & Wolf, to make some overstrung pianos for him. Boehm expected to gain in tone; Pape, an ingenious mechanician in Paris, tried a like experiment to gain economy in dimensions, his notion being to supply the best piano possible with the least outlay of means. Tomkinson in London continued Pape's model, but neither Boehm's nor Pape's took permanent root. The Great Exhibition of 1851 contained a grand piano, made by Lichtenthal of St Petersburg, overstrung in order to gain symmetry by two angle sides to the case. It was regarded as a curiosity only. Later, in 1855, Henry Engelhard Steinway (originally Steinweg; 1797–1871), who had emigrated from Brunswick to New York in 1849, and had established the firm of Steinway & Sons in 1853 in that city, effected the combination of an overstrung scale with the American iron frame, which exhibited in grand and square instruments shown in London in the International Exhibition of 1862, excited the attention of European pianoforte makers, leading ultimately to important results. The Chickering firm claim to have anticipated the Steinways in this invention. They assert that Jonas Chickering had begun a square piano on this combined system in 1853, but, he died before it was completed, and it was brought out later. It is often difficult to adjudicate upon the claims of inventors, so rarely is an invention the product of one man's mind alone. However, the principle was taken up and generally adopted in America and Germany, and found followers elsewhere, not only in grand but in upright pianos, to the manufacture of which it gave, and particularly in Germany, a powerful impetus.

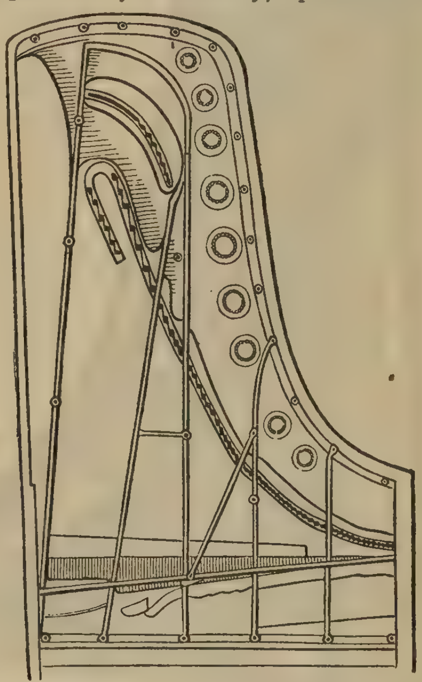

FIG. 33.—Steinway's Grand Piano, 1884. Metal framing in a single casting and overstrung.

Recent Structural Changes.

Since 1885 the American system of a metal plate in one casting, and cross- or over-stringing by which the spun bass strings cross the longer steel diagonally, has become general in Europe with the exception of France, where musical taste has remained constant to the older wooden structure and parallel stringing throughout. The greater tenacity of the modern cast-steel wire favours a very much higher tension, and consequent easier production of the higher partials of the notes, permitting a *sostenuto* unknown to Beethoven, Schumann or Chopin. While in 1862 the highest tension of a concert grand piano worked out at sixteen tons, since 1885 thirty tons has been recorded. Generally speaking, the rise in tension may be expressed musically by the interval of a minor third, to the great advantage of the standing in tune. First shown by Henry Steinway in the London Exhibition of 1862, this altered construction attracted extraordinary attention at Paris in 1867, and determined the German direction of manufacture and a few years later the English. What is now particularly noticeable wherever pianos are made is the higher average of excellence attained in making, as well as in piano-playing. Naturally the artistic quality, the personal note, characterizes all first-class instruments, and permits that liberty of choice which appertains to a true conception of art.

Much attention has been given of late years to the touch of pianos, to make it less tiring for the modern performer, especially since, in 1885–1886, Anton Rubinstein went through the herculean feat of seven consecutive historical recitals, repeated in the capital cities and principal musical centres of Europe. For even this stupendous player a light touch was indispensable. In the competition for power piano makers had been gradually increasing the weight of touch to be overcome by the finger, until, to obtain the faintest pianissimo from middle C, at the front edge of the key, from three to four ounces was a not uncommon weight. The Broadwood grand piano which Chopin used for his recitals in London and Manchester in 1848, an instrument that has never been repaired or altered, shows the resistance he required: the middle C sounds at two ounces and a half, and to that weight piano-makers have returned, regarding two ounces and three-quarters as a possible maximum. Owing to the greater substance of the hammers in the bass, the touch will always be heavier in that department, and lighter in the treble from the lesser weight. In balancing the keys, allowance has to be made for the shorter leverage of the black keys. When the player touches the keys farther back the leverage is proportionately shortened and the weight increased, and there is also an ascending scale in the weight of the player's blow or pressure from pianissimo to fortissimo. The sum of the aggregate force expended by a pianist in a recital of an hour and a half's duration, if calculated, would be astonishing.

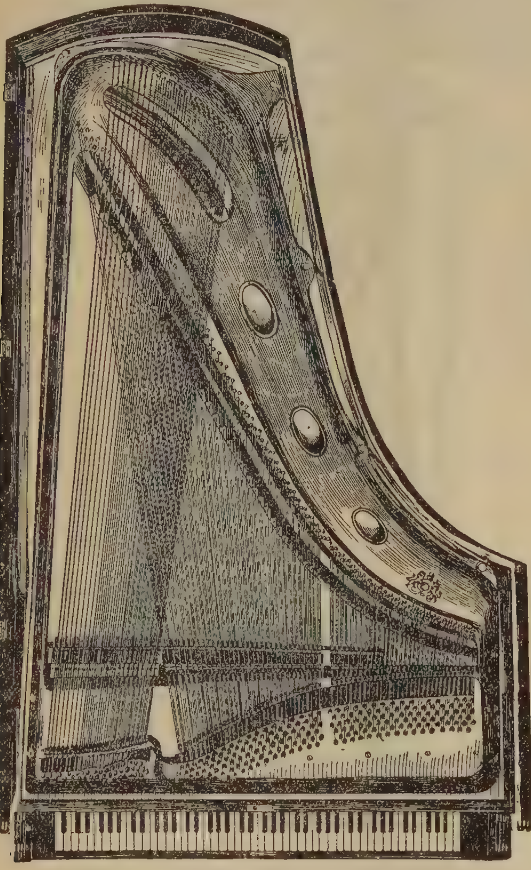

Fig. 34.—Broadwood Barless Grand.

The most important structural change in pianos in recent years has been the rejection of support given by metal bars or struts between the metal plate to which the strings are hitched and the wrest-plank wherein the tuning-pins are inserted. These bars formed part of William Allen's invention, brought forward by Stodart in 1820, and were first employed for rigidity in place of compensation by the Paris Erards two years later, Broadwood in London introducing about that time the fixed metal plate. The patent No. 1231, for the barless or open-scale piano, taken out in London in 1888 by H. J. Tschudi Broadwood, is remarkable for simplification of design as well as other qualities. Ten years elapsed after the taking out of the patent before the first *barless grand* was heard in public (January 1898 at St James's Hall). The metal frame, bolted in the usual manner to the bottom framing, is of fine cast steel entirely free from any transverse bars or struts, being instead turned up round the edges to form a continuous flange, which enables the frame to bear the increased modern tension while providing additional elasticity and equality of vibration power throughout the scaling. The absence of barring and bracing tends to subdue the metallic quality of tone so often observable in pianofortes constructed with heavy iron frames, and the barless steel frame being so much more elastic than the latter, no loss in resonance is perceptible. The tone of the barless grand is of singular beauty and sonority and is even throughout the compass.

The Increase of Resonance.

The problem of resonance—with stringed keyboard instruments, the reinforcement or amplification of sound—has, from the days of the lute- and spinet-makers, been empirical. With lute, guitar, and viol or violin the sound-box comes in, combining in the instrument the distinct properties of string and enclosed air or wind. With the spinet, harpsichord and piano we have to do chiefly with the plate of elastic wood, to amplify the initial sound of the strings; and the old plan of a thin plate of spruce, put in slightly convex and with an under-barring of wood for tension, has absorbed the attention of piano-makers. The violin belly, with its bass bar and sound post, has relation to it; but the recent invention of the Stroh violin has shown that the initial string vibrations may be passed through a bridge, be concentrated, and adequately transferred to an aluminium disk not much larger than half a crown. The piano, with its numerous strings, cannot be so reduced, but the reinforcement problem is open to another solution, tentative it is true, but a possible rival. The "Gladiator" soundboard is the invention of Albert Schulz, late director of the piano manufactory of Ritmüller and Söhne of Göttingen. Dr Moser's name has been associated with the inventor's in the English patent. In the "Gladiator" two slabs of wood, with grain of opposed direction to give the necessary tension, are glued together, and the whole system of belly bars is done away with. There is a thinning round the edge, to facilitate promptness of speech. As we are still feeling our way towards an accurate and comprehensive statement of resonance, this invention is one claiming scientific interest, as well as being of possible practical importance.

Repetition.

To return to the touch. The desirability of what is called repetition—that the jack or sticker, which from the depression of the key delivers the blow that raises the hammer to the strings, should never be far away from the notch or nose which receives the impulse—is as much an object of consideration with piano-makers now as it has been since Sebastian Erard began those experiments in 1808 which ended

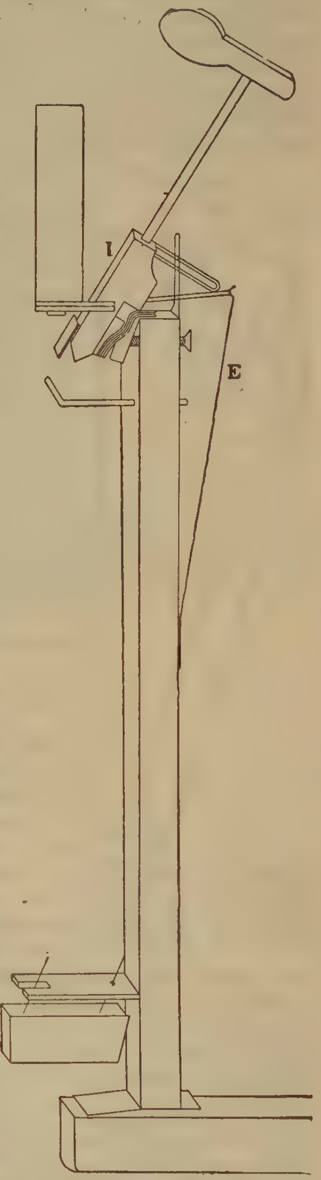

Fig. 35.—Cary's Repeating Action. I, the butt in which the hammer is glued. E, a spring attached to the butt by a link of silk cord passed through a wire guide. The object is that though the key may be still pressed down, the hammer returns but a short distance to ensure a quick response to the blow if repeated.

in his famous "double escapement" action. The principle of this grand action, like that of Wornum patented for upright pianos in 1826, has become general. But Joseph Henry Cary in 1853 (patent No. 2283) invented a simple contrivance for repetition in all pianos, neglected at the time, and subsequently repatented and disputed over by others, which has only been preserved in the records of the patent office, while the inventor has left no other mark. But the utility of the invention has come to light. It is increasingly used in the actions of upright pianos, and, in combination with the old English grand action, is successfully competing with the Erard action proper and the simplified Herz-Erard, of late years so very generally employed.

Technique.

There has been a great change in the freer technique of piano-playing, partly favoured by the development of piano-making, but reacting and obliging the piano-makers to keep their attention incessantly alive to the aim and requirements of the players. It is true that the genius of Beethoven dominates a technique that has become obsolete, and so completely that the adequate performance of his piano works still gives to the sense as well as the intellect the highest pleasure, but his annotations to Cramer's *Studies*, as preserved by Schindler, betray the close touch of the clavichord-player and the student of C. P. E. Bach's *Essay on Clavichord-Playing*, as well as the weakness as a musical instrument of the early piano. The inventor of a technique so original, and at the time (*c.* 1830) so extraordinary, as Chopin's, sat at the piano with his elbows immovable, using, for flexibility, neither wrist nor arm. With Chopin, to play loudly was anathema. The modern free style of playing comes from Czerny—whom Beethoven despised as having no legato (*Bindung*)—through Liszt to the Rubinsteins and to the splendidly equipped performers of our time, to whom the pedal has become indispensable for cantabile and effect.

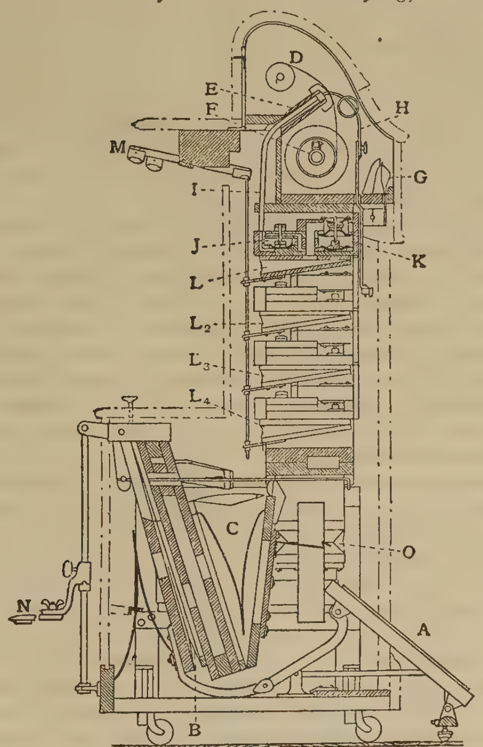

Fig. 36.—Modern Pianola.

A, Blowing pedals operated by feet of player connected by metal crank to feeder B, which exhausts air from bellows C, which in turn exhausts air from all working valves and bellows in Pianola.

D, is perforated roll passing over tracker bar E winding on to spool F operated by a pneumatic motor and controlled by lever G, which is connected to metrostyle pointer H. This is used in conjunction with a specially marked roll, giving correct interpretation of tempo.

I, is channel leading to primary pneumatic J operating secondary pneumatic K, which exhausts striking motor L, connected to key lever M to depress piano key.

The themodist device consists of two small holes, one at each end of tracker bar E, connecting with pneumatic valve, which increases power of suction instantaneously when melody notes are being played, by means of an extra perforation at each outside edge of music roll D; one hole for bass melody at left, and one at right edge for treble melody.

N, is metal arm or bracket connected to lever in front for purpose of depressing sustaining pedal of piano.

O, is the governing bellows of motor for operating music-roll and prevents pace of roll being accelerated or retarded by hard or soft pedalling, thus allowing great change of expression to be made without interfering with speed of roll.

Mechanical Playing.

The most expert performers are now rivalled technically by the recent extraordinary invasion of the American automatic piano-players—the Angelus, Pianola, Apollo, Cecilian, and other varieties of the same idea. The use of the perforated roll acts by means of the ingenious and indeed faultless application of pneumatic leverage to the ordinary piano, doing duty for the pianist's fingers; and it is made possible to play louder or softer, faster or slower, by mechanical arrangement. Such an instrument lacks the player's touch, which is as personal and indispensable for sympathy as the singer's voice or violinist's bow. Still, to a violinist, it is a benefit to have a correct coadjutor in a Beethoven or Brahms sonata with one of these handy companions, just as it is to a singer to have always at command the accompaniments to his or her repertory. The Apollo has the addition of a useful transposing apparatus—an aid, however, that, though often tried, has never yet been adopted; it is possibly too disturbing to the musician's ear. The mechanical tuning-pin is an analogous experiment which comes regularly under notice as the years go by, to be as persistently rejected. The most practical of these tuning inventions was the Alibert, shown in the Inventions Exhibition, 1885. Here, pressure upon the strings above the wrest-plank bridge modified their tension after a first rough adjustment to pitch had been effected.

The perforated music-sheet, a mechanism common to piano-playing attachments as well as self-playing pianos, first appears in a French patent, 1842. A United States patent for a keyboard piano-player was issued to E. D. Bootman (Dec. 18, 1860), and the first pneumatic keyboard piano-player was patented in France in 1863 by M. Fourneaux. Between 1879 and 1902 a total of 55 patents had been issued in the States. The first complete automatic piano-player ready for performance was the Angelus (No. 24799, 1897). The specification is from a communication to the British patent office by Edward Hollingworth White, of Meriden, New Haven county, Conn., U.S.A. There is a pneumatic chest, fulcrum bar, finger levers, bellows and pedals. The whole apparatus is contained in a portable cabinet mounted upon castors, so as to be conveniently moved about a room. The finger levers or key strikers correspond with a considerable portion of the manual keys or clavier of a piano. Thus the automatic piano-player comprises a portable cabinet provided with bellows and operating pedals, a pneumatic actuating mechanism, a tracker adjusted for the use of a perforated music-sheet, a pneumatic motor and winding-roll mechanism to propel the music-sheet, and a series of finger levers operated by the pneumatic mechanism, so projecting as to overhang the piano keyboard and play upon it, with rockers or levers for depressing the piano pedals. Subsequently the apparatus was made capable of accelerating or retarding the tempo at the will of the operator. A roll of music, 12 in. wide and varying in length according to the composition, can be placed in position promptly, and when exhausted can be returned upon its original roll by a simple stop, altogether a triumph of mechanical adjustment. The Pianola followed in 1898, the Apollo 1900. The difference of all these clever contrivances is not conspicuous to the amateur.

While these allied inventions have had to do with a substitute for touch and the necessity for the persevering acquirement of a difficult technique, another, the Virgil Practice Clavier, so called after the inventor, Mr Almon Kincaid Virgil, an American music teacher, is intended to shorten the period of study by doing away with tone, so that the finger technique is acquired mechanically and unmusically, while value of tone, reading, expression, whatever we understand by musical production exciting our receptivity through the ear, is delayed until the player's hand is formed and considerably developed. The opinion of some of the very greatest pianists is brought forward as approving of the system; in the work, for instance, of Vladimir de Pachmann, whose technique was formed long before the Virgil Clavier came to Europe. Bearing in mind that the minimum weight of the touch of a concert piano is not likely to exceed three and a half ounces it is hardly likely that these skilled performers use this dumb keyboard with the graduated weight advised for advancing pupils, namely, from five to eight ounces. It is allowed that the lightest possible touch may be used at first. One high recommendation certainly remains after all that may be said regarding Mr Virgil's invention: that it is practically silent, almost noiseless, the up and down clicks that mark the duration of finger attachment being alone audible, a boon to the unwilling hearers of ordinary piano practice, scales and five-finger exercises. Mr Virgil's invention was produced in its elementary form in 1872, the more satisfactory Practice Clavier dates from the completion of the invention, about 1890. It was brought to England in 1895 by Mr Virgil.

The Dumb Keyboard.

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PIANOSA (anc. *Planasia*), an island of Italy, belonging to the province of Leghorn, and forming part of the commune of Marciana (Elba), from which it is 7½ m. S.W. Pop. (1881), 774. As its name indicates, it is quite flat, and the highest point is only 95 ft. above sea-level. Its area is 6 sq. m. Augustus banished to it his grandson, Agrippa Postumus, and some ruins of baths near the harbour still bear his name. It changed hands more than once in the wars between Pisa and Genoa in the 12th and 13th centuries; from 1390 it belonged to the prince of Piombino, but was depopulated in 1553 by the Turkish fleet, and only resettled at the beginning of the 19th century. In 1857 a penal colony was established here.

PIARISTS, the popular name of a Catholic educational order, the "clerici regulares scholarum *piarum*," the Pauline Congregation of the Mother of God, founded by Joseph Calasanza (Josephus a Matre Dei) at Rome in the beginning of the 17th century. Calasanza, a native of Calasanz in the province of Huesca in Aragon, was born on September 11, 1556, studied at Lerida and Alcalá, and after his ordination to the priesthood removed to Rome (1592). Here he organized, in 1607, a brotherhood which ultimately, in 1617, became an independent Congregation, numbering at that time fifteen priests, under Calasanza as their head. To the three usual vows they added a fourth, that of devotion to the gratuitous instruction of youth. In 1622 the Congregation received a new constitution from Gregory XV., and had all the privileges of the mendicant orders conferred upon it, Calasanza being recognized as general. In 1643 the jealousy of the Jesuits led to his removal from office; owing to the same cause the Congregation was deprived of its privileges by Innocent X. in 1646. Calasanza, who died on August 22, 1648, was beatified in 1748, and canonized in 1767. The privileges of the Congregation were successively restored in 1660, 1669 and 1698. The Piarists, who are not numerous, are found chiefly in Italy, Spain, the West Indies, Germany, and especially in Austria-Hungary. Before the course of study was regulated by the state, a Piarist establishment contained nine classes: reading, writing, elementary mathematics, schola parva or Rudimentorum, schola Principiorum, Grammatica, Syntaxis, Humanitas or Poesis, Rhetorica. The general provost of the order is chosen by the general chapter, and with a general procurator and four assistants resides at Rome. The members are divided into professors, novices, and lay brethren. Their dress is very similar to that of the Jesuits; their motto "Ad majus pietatis incrementum!"

For Calasanza, see Timon-David, *Vie de St Joseph Calasance* (Marseilles, 1884); on the Piarists, P. Helyot, *Hist. des ordres religieuses* (1715), iv. 281; J. A Seyffert, *Ordensregeln der Piaristen* (Halle, 1783); J. Schaller, *Gedanken über die Ordensfassung der Piaristen* (Prague, 1805); A. Heimbucher, *Orden und Kongregationen* (1897) ii. 271; articles by O. Zöckler in Herzog-Hauck's *Realencyklopädie für protestantische Theologie* (1904), vol. xv. and by C. Kniel in Wetzer and Welte's *Kirchen-lexikon* (1895), vol. ix.

PIATRA (Peatra), the capital of the department of Neamtzu, Rumania, situated on the left bank of the river Bistritza, where it cuts a way through the Carpathian foothills. Pop. (1900), 17,391. A branch railway passes through the town, and at Bacau meets the main line from Czernowitz in Bukowina to Galatz. The church of St John's (or the Prince's) monastery was founded in 1497 by Stephen the Great. There are saw-mills and textile factories in Piatra, which has a considerable trade in wine and timber. Neamtzu is one of the most densely forested regions in Moldavia. Lumber rafts are floated down the Bistritza to the Sereth, and so on to Galatz. There are several monasteries in the neighbourhood.

PIATTI, CARLO ALFREDO (1822–1901), Italian violoncellist, was born at Bergamo on the 8th of January 1822. He was the son of a violinist, and became a pupil at the conservatorio of Milan. From 1838 onwards he journeyed over Europe, playing with extraordinary success in all the important cities of the continent. In 1844 he appeared before the London public at a Philharmonic Concert; and in 1859, on the foundation of the Popular Concerts, he took up the work with which he was most intimately connected for thirty-nine seasons, retaining until 1897 the post of first violoncello at these famous chamber concerts, during the latter half of each series. His purely classical style, his wide musical sympathies, and his general culture and charm, would have ensured him a high position even without his marvellously finished technical skill. In 1894 the fiftieth anniversary of his first appearance in London was celebrated by a reception given in honour of him and his lifelong friend Joachim. He retired from public life, owing to a severe illness, in 1897, and until his death at Bergamo on the 19th of July 1901 divided his time between his native town and Cadenabbia. As a composer he attained a wide popularity with some graceful and popular songs; he did excellent work as an editor; and he was an enthusiastic collector and musical antiquary.

PIAUHY, or Piauhi, a north-eastern state of Brazil, bounded N. and W. by Maranhão, E. by Ceará, Pernambuco and Bahia, and S. by Bahia. It has a few miles of Atlantic coast-line on the N., and the Rio Parnahyba forms the boundary line with Maranhão throughout its entire length. Area, 116,523 sq. m.; pop. (1900), 334,328. Part of the state on the Atlantic coast and along the lower Parnahyba is low, swampy and malarial. South of this the country rises gradually to a high plateau with open campos. This plateau region is watered by numerous tributaries of the Parnahyba, chief of which are the Urussuhy, the Canindé and its tributary the Piauhy, the Gurgueia and its tributary the Parahim, which drains the large inland lake of Parnaguá, the Longa, and the Poty, which has its source in the state of Ceará. The Parnahyba is navigable for boats of 3 ft. draught up to Nova York, a few miles above the mouth of the Gurgueia, and could be made navigable up to the mouth of the Balsas. The climate is hot and humid in the lowlands and along the lower Parnahyba, but in the uplands it is dry with high sun temperatures and cool nights. The principal industry is stock-raising, which dates from the first settlement in 1674 by Domingos Affonso Mafrense, who established here a large number of cattle ranges. A secondary industry is the raising of goats, which are able to stand neglect and a scanty food supply. Sheep have likewise been raised in Piauhy, but there is no market for mutton and their wool is not utilized. The agricultural products are cotton, sugar and tobacco. Of food-stuffs the people do not produce enough for their own consumption. Forest products include rubber, carnauba wax and dyewoods. The exports include hides, skins, rubber, wax, tobacco and cotton. The capital is Therezina, on the right bank of the Parnahyba, 250 m. above Parnahyba (town), with which it is connected by a line of light-draught river boats. The town dates from 1852, is attractively situated, and is regularly laid out with broad, straight streets crossing each other at right angles. The population of the *municipio* in 1890 was 31,523, which includes a large rural district. Other towns, with their populations in 1890, are Oeiras (19,858), founded in 1718 under the name of Moxa; Amarante (15,525); Valença (17,693); and Campo Maior (12,425), the figures given of population being those of the large districts (*municipios*) in which the towns are situated.

PIAZZA, properly an open square or place in an Italian town (Ital. *piazza*, from Lat. *platea*, broad space, Gr. πλάτυς, broad). These squares were usually surrounded with a colonnade or arcade, and thus the word has been loosely applied to a covered walk or arcade along the front of a building, and in America, to the veranda of a house.

PIAZZA ARMERINA, a city of Sicily, in the province of Caltanisetta, 39 m. by road E.S.E. from that town, and the same distance S. of the railway station of Assoro-Valguarnera, 43 m. W. of Catania, situated 2360 ft. above sea-level. Pop. (1901), 24,119. It has a 15th-century cathedral, with a fine campanile, and some of the houses show Norman or Gothic architecture. The foundation of the town dates from the 11th century, and the dialect is Lombard.

See Mauceri in *L'Arte* (1906), 14.

PIAZZI, GIUSEPPE (1746–1826), Italian astronomer, was born at Ponte, in the Valtellina, on the 16th of July 1746. He entered the Theatine Order in 1764, accepted the chair of mathematics in the academy of Palermo in 1780, and persuaded the viceroy, Prince Caramanico, to build an observatory there. During a visit to England in 1788 he procured from Jesse Ramsden a five-foot altazimuth, with which he collected at Palermo, 1792–1813, the materials for two admirable star-catalogues, published in 1803 and 1814 respectively. While engaged on this work he discovered, on the 1st of January 1801, the first asteroid or minor planet, to which he gave the name of Ceres, the tutelary deity of Sicily. He died at Naples on the 22nd of July 1826.

See B. E. Maineri, *L'Astronomo Giuseppe Piazzi* (Milan, 1871); R. Wolf, *Biographien*, Bd. iv. p. 275; *Monatliche Correspondenz* (1810; portrait), xxi. 46; *Astr. Jahrbuch*, liv. 218; *Bulletin des sciences* (1826), vi. 339; *Edin. Journal of Science* (1827), vi. 193; *Memoirs Roy. Astr. Soc.* iii. 119; R. Grant, *Hist. Phys. Astronomy*, pp. 238, 510, 549.

PIBRAC, GUY DU FAUR, Seigneur de (1529–1584), French jurist and poet, was born at Toulouse, of an old family of the magistracy. He studied law there with Jacques Cujas, and afterwards at Padua. In 1548 he was admitted to the bar at Toulouse, at once took high rank, and rose to be *juge-mage*, an office in Languedocian cities about equal to that of *prévôt*. He was selected in 1562 as one of the three representatives of the king of France at the council of Trent. In 1565 he became general advocate to the parlement of Paris, and extended the renaissance in jurisprudence which was transforming French justice. In 1573 he was sent by Charles IX. to accompany as chancellor his brother Henry (afterwards Henry III.) to Poland, of which country Henry had been elected king. Pibrac's fluent Latin won much applause from the Poles, but his second visit to Poland in 1575, when sent back by Henry III. to try to save the Crown he had deserted, was not so successful. Then he was employed in negotiations with the so-called *politiques*, and he managed to keep them quiet for a while. In 1578 he became the chancellor of Marguerite of France, queen of Navarre. Although he was fifty, her beauty and intellectual gifts led him to aspire to win her affection; but he was rejected with disdain. He died in 1584. His oratorical style was too pedantic, but quotations from the classics had a fresher meaning in his day. He was the friend of Ronsard, de Thou and L'Hôpital, and left, among other literary remains, elegant and sententious *quatraines*.

PIBROCH, a form of music as played by the bagpipe. The word is derived from the Gaelic *piobaireachd*, the art of the bagpiper. This special form of bagpipe music, consisting of a series of variations founded on a theme, was called the *urlar*. These variations are generally of a martial or warlike character and include dirges and marches (see Bagpipe).

PICA, the name of the European representative of a group of diminutive rodent mammals, also known as tailless hares, mouse-hares, or piping hares, constituting the family *Ochotonidae* with the single genus *Ochotona*. From the more typical hares and rabbits they differ by the short and rounded ears, the absence of a tail, and the relatively shorter hind-limbs, as well as by complete collar-bones. The soles of the feet are hairy, and the fur is usually soft and thick; while in some cases the last upper molar is absent. Picas are inhabitants of cold and desert regions. They dwell either in the chinks between rocks, or in burrows, although one Himalayan species frequents pine-forests. They are very active, and most of the species utter a piping or whistling cry. They store up a supply of grass for winter use; in Siberia it is stacked in small heaps. The Himalayan *Ochotona roylei* may be seen in the daytime, but most kinds are nocturnal. The Siberian species, *O. alpina*, ranges into eastern Europe, but Central Asia is the headquarters, although a few species range into Arctic America and the Rocky Mountains. In size picas may be compared to guinea-pigs. Till of late years the group has been generally known by the name of *Lagomys*. There are several extinct genera.

See Rodentia; also J. L. Bouhote, "The Mouse-hares of the genus *Ochotona*," *Proc. Zool. Soc.* (London, 1905). (R. L.*)

PICA, the Latin name of a genus of oscine passerine birds, the magpies. The Latin word, by interchange of initial *p* and *k*, is possibly the Gr. κισσα (see Magpie), and probably the same word as *picus*, the woodpecker (*q.v.*). Another derivation would connect both *pica* and *picus* with the root *pic-* of *pingere*, to paint, from the parti-coloured appearance of the bird. It is this "pied" or black and white look of the page that probably gave the name of *pica*, "pie" or "pye," to the ordinal printed in black-letter (see PIE), and thence to a size of type in printing coming next to "English" (see TYPOGRAPHY). The Gr. κίσσα and Lat. *pica* were used of a perverted craving for unnatural foods; and the word has been adopted in this sense in modern medical terminology.

PICARD, LOUIS JOSEPH ERNEST (1821–1877), French politician, was born in Paris on the 24th of December 1821. After taking his doctorate in law in 1846 he joined the Parisian bar. Elected to the corps législatif in 1858, he joined the group of Émile Ollivier. But as Ollivier approximated to the government standpoint, Picard, one of the members of the group known as *Les Cinq*, veered more to the left. He founded in 1868 a weekly democratic journal, *L'Électeur libre*, and in 1869 was elected both for Hérault and Paris, electing to sit for the former. From the 4th of September 1870 he held the portfolio of finance in the government of National Defence. In January 1871 he accompanied Jules Favre to Versailles to arrange the capitulation of Paris, and in the next month he became minister of the interior in Thiers's cabinet. Attacked both by the Monarchist and the Republican press, he resigned in May. Later in the year he was sent as ambassador to Brussels, where he remained for two years. On his return to Paris he resumed his seat in the Left centre, and in 1875 became life senator. He died in Paris on the 13th of May 1877.

PICARDY (*La Picardie*), one of the old provinces of France, bounded on the N. by Hainaut and Artois, on the E. by Champagne, on the S. by the Île de France, and on the W. by Normandy and the English Channel. Its maritime frontier ran from the mouth of the Aa to the cliffs of Caux, and it included the whole of the basin of the Somme and part of that of the Oise. The chief towns of Picardy were Amiens, Boulogne, Abbeville, Laon, Soissons, Montreuil, Péronne, Beauvais, Montdidier, St Quentin and Noyon. Its principal rivers were the Somme and the Oise. Picardy formed part of the archdiocese of Reims, and its bishoprics were Amiens, Beauvais, Senlis, Soissons, Noyon and Laon. In 1789 the province of Picardy was covered by the three bishoprics of Amiens, Noyon and Boulogne. It was one of the provinces of the five great fermes, districts subject to the tariff of 1664, and in judicial matters was under the authority of the parlement of Paris. Its area now forms the department of the Somme and parts of the departments of Pas de Calais, Aisne and Oise.

The name of Picardy does not appear until the 13th century, but was employed by Matthew Paris and was in general use in the 14th century. In the 13th century the province was divided into the two bailliages of Amiens and Vermandois, but its regular organization as part of the kingdom of France only dates from the beginning of the 16th century. At this time it was divided into north and south Picardy. North Picardy, or Picardy proper, formed one of the great military governorships of the kingdom, while south Picardy was included in the Île de France. North Picardy was divided into upper and lower Picardy, the former being the interior part of the province and the latter the district along the coast. Upper Picardy comprised the districts of Amiénois, Santerre, Vermandois and Thiérache, and lower Picardy those of Ponthieu, Vimeu, Boulonnais and Calaisis, or the Pays reconquis; south Picardy included the districts of Beauvaisis, Laonnais and Soissonais.

Under the Romans Picardy was part of Belgica secunda; it was inhabited by the Morini, the Ambiani, the Veromandui, the Bellovaci and the Suessiones, whose names still appear in Amiens, Vermandois, Beauvais and Soissons. The Romans intersected the district with roads and built several castra to defend the valley of the Somme. In the 3rd century Christianity was preached here, and St Quentin and others were martyred. A little later abbeys were founded, among them Corbie, St Valéry and St Riquier. Early in the 5th century Picardy became the centre of Merovingian France, for, as the historian Michelet says, "l'histoire de l'antique France semble entassée en Picardie." Clovis had his first capital at Soissons, Charlemagne had his at Noyon, and Laon was the capital and the refuge of the later and feebler Carolingian sovereigns.

During the later feudal period Picardy was the home of the counts of Vermandois, of Clermont and of Ponthieu, the sire of Coucy and others. The neighbouring dukes of Burgundy cast covetous eyes upon the province; in 1435, by the famous treaty of Arras, the royal towns and lands in the valley of the Somme were ceded by King Charles VII. to Burgundy. However, after the death of Charles the Bold in 1477 Picardy was finally united with the crown of France. The province was early an industrial district. Flemish immigrants brought with them the lucrative trade of weaving cloth, and the Somme towns were soon competing with those of Flanders. The Picard towns were noted for their love of independence, which often brought them into collision with the kings of France during the 13th century. At a later time the province received a number of Spanish immigrants. In the middle ages the Picards formed one of the four "nations" at the university of Paris. Picardy has a high place as a home of Gothic art, this being testified to by the superb cathedrals at Amiens and Noyon, while within its borders is the famous château of Coucy.

Picardy has a literature of its own, which was rich and popular in the 12th century. It suffered greatly from the ravages of the Normans, and later during the Hundred Years' War and the wars between France and Spain. Within it are the famous fields of Creçy, Agincourt and St Quentin, while it also includes places of conference like Guînes, Amiens and Picquigny. The Picard had a high reputation as a soldier, being sometimes called the "Gascon of the North," and in 1558 Henry II. created the *régiment de Picardie*. Many anthropological remains have been found in the Somme valley.

See Labourt, *Essai sur l'origine des villes de Picardie* (Amiens, 1840); Grenier, *Introduction à l'histoire générale de la province de Picardie* (Amiens, 1856); and H. Carnoy, *Littérature orale de la Picardie* (1883).

PICARESQUE NOVEL, THE. This special form of the *roman d'aventures* may be defined as the prose autobiography of a real or fictitious personage who describes his experiences as a social parasite, and who satirizes the society which he has exploited. The picaroon, or rogue type, is represented by Encolpos, Ascyltos and Giton in the *Satyricon* which tradition ascribes to Petronius; it persists in Lucian, in the *Roman de Renart*, in the *fableaux*, and in other works popular during the middle ages; and it is incarnated in real life by such men of genius as the Archpriest of Hita and François Villon. But in its final form the picaresque novel may be regarded as a Spanish invention. The word *pícaro* is first used, apparently, in a letter written by Eugenio de Salazar at Toledo on the 15th of April 1560; the etymology which derives *pícaro* from *picar* (to pick up) is unsatisfactory to philologists, but it suggests the picaroon's chief business in life. In the *Tesoro de la lengua castellana* (Madrid, 1611) Sebastian Covarrubias y Orozco, the best of Spanish lexicographers, describes a pícaro as a man of loose character engaged in menial work and—by extension—a rascal who attains his ends by skilful dissimulation; and the earliest application of the expression *pícaro* to a character in fiction occurs in Mateo Alemán's *Guzmán de Alfarache*, the first part of which was published in 1599. But a genuine *novela picaresca* existed in Spain before the word *pícaro* became generally current.

The earliest specimen of the kind is *La Vida de Lazarillo de Tormes y de sus fortunas y adversidades*, an anonymous tale long attributed, on insufficient grounds, to Diego Hurtado de Mendoza (*q.v.*). The authorship of this brilliant book and the circumstances of its publication are obscure; however, it was certainly issued not later than 1554, and was thrice reprinted before 1559, when it was placed on the Index. Imitations of so successful a story were inevitable, and so early as 1555 there appeared at Antwerp *La Segunda parte de Lazarillo de Tormes*, an anonymous sequel which completely misinterpreted the irreverent wit of the original. The first part had been prohibited because of its attacks on the clergy; in the second part the hero is presented as a devout youth transformed into a tunny at the intercession of the Virgin Mary, who thus saved him from death; after many extravagant experiences in this form he is restored to human shape, and proposes to teach the submarine language at the university of Salamanca. This dull performance naturally failed to please and, meanwhile, many surreptitious copies of the first part were introduced into Spain; the Inquisition finally gave up the attempt to suppress it, and in 1573 an expurgated edition was authorized. With this mutilated version the Spanish public was forced to be content during the remaining fifteen years of Philip II.'s reign. Upon the death of this sombre monarch society relaxed its hypocritical pose of austerity, and in 1599 Mateo Alemán (*q.v.*) published the *Primera parte de Guzmán de Alfarache*. It is modelled upon *Lazarillo de Tormes*, being the autobiography of the son of a ruined Genoese money-lender; but the writer indulges in a tedious series of moralizings. This contrasts sharply with the laconic cynicism of *Lazarillo de Tormes*; but *Guzmán de Alfarache* is richer in invention, in variety of episode and in the presentation of character. Its extraordinary popularity tempted a Valencian lawyer named Juan José Martí to publish a *Segunda parte de la vida del pícaro Guzmán de Alfarache* (1602) under the pseudonym of Mateo Luján de Sayavedra. Though partly plagiarized from the manuscript of the genuine second part to which Martí had somehow obtained access, the continuation was coldly received; in 1604 Alemán brought out the true continuation, and revenged himself by introducing into the narrative a brother of Martí—a crazy picaroon of the lowest morality who ultimately commits suicide in disgust at his own turpitude. In *Lazarillo de Tormes*, and still more in *Guzmán de Alfarache*, it is difficult to distinguish between the invented episodes and the personal reminiscences of the authors. The *Viage entretenido* (1603) of Agustín de Rojas is a realistic account of the writer's experiences as a strolling actor and playwright, and, apart from its considerable literary merits, it is an invaluable contribution to the history of the Spanish stage as well as a graphic record of contemporary low life; the chief character in the book is called the *caballero del milagro*, an expression which recurs in Spanish literature as the equivalent of a *chevalier d'industrie*.

The next in chronological order of the Spanish picaresque tales is *La Pícara Justina* (1605), the history of a woman picaroon, which it has long been customary to ascribe to Andrés Pérez, a Dominican monk; there is, however, no good reason to suppose that the name of Francisco López de Úbeda on the title-page is a pseudonym. The *Pícara Justina* has wrongly acquired a reputation for indecency; its real defects are an affected diction and a want of originality. The writer frankly admits that he has taken material from the *Celestina*, from *Lazarillo de Tormes*, from Guevara, Timoneda and Alemán, and he boastfully asserts that "there is nothing good in ballad, play or Spanish poet, but that its quintessence is given here." Unluckily he has not the talent to utilize these stolen goods. The *Pícara Justina* was thrice reprinted during the seventeenth century; this is the only basis for the untenable theory that it is the source of the *culteranismo* which reaches its climax in Gracian's treatises. The *Pícara Justina* is now read solely by philologists in quest of verbal eccentricities. Ginés de Pasamonte, one of the secondary figures in *Don Quixote* (1605–1615), is a singularly vivid sketch of the Spanish rogue, and in the comedy entitled *Pedro de Urdemalas* Cervantes again presents a brilliant panorama of picaresque existence. He returns to the subject in *Rinconete y Cortadillo* and in the *Coloquio de los perros*, two of the best stories in the *Novelas ejemplares* (1613). The attraction of picaresque life was felt by pious and learned critics, and expounded in print. In the *Viage del mundo* (1614) the zealous missionary Pedro de Cevallos interpolates amusing tales of what befell him in the slums of Andalusia before he fled from justice to America, where he lived as a sinful soldier till his spiritual conversion was accomplished. Cristóbal Suárez de Figueroa, a caustic critic of his contemporaries and an arbiter of taste, did not think it beneath his dignity to show a disconcerting acquaintance with the ways of professional rogues, and in *El Pasagero* (1617) he fills in the sketch of the knavish inn-keeper already outlined by Cervantes in *Don Quixote*. Evidence of the widely diffused taste for picaresque literature is found in *Enriquez de Castro* (1617), an interminable story written in Spanish by a Frenchman named François Loubayssin de Lamarca, who brought out his book at Paris; two years previously Loubayssin had introduced some clever but risky picaresque episodes in his *Engaños deste siglo y historia sucedida en nuestros tiempos*. But his attempt to fill a larger canvas is a complete failure.

The roving instinct of Vicente Martínez Espinel (*q.v.*) had led him into strange and dangerous company before and after his ordination as a priest, and a great part of his *Relaciones de la vida del escudero Marcos de Obregón* (1618) is manifestly the confession of one who has regretfully outlived his pleasant vices. The baffling compound of fact with fiction and the lucid style of which Espinel was a master would suffice to win for *Marcos de Obregón* a permanent place in the history of Spanish literature; the fact that it was largely utilized by Le Sage in *Gil Blas* has won for it a place in the history of comparative literature. Within five months of its publication at Madrid a fragmentary French version by the Sieur d'Audiguier was issued at Paris, and at Paris also there appeared a Spanish picaresque story entitled *La Desordenada codicia de los bienes ajenos* (1619), ascribed conjecturally to a certain Dr Carlos García, who reports his conversation with a garrulous gaol-bird, and appends a glossary of slang terms used by the confraternity of thieves; he was not, however, the first worker in this field, for a key to their gross jargon had been given ten years previously by Juan Hidalgo in his *Romances de germania* (1609), a series of gipsy ballads. Every kind of picaroon is portrayed with intelligent sympathy by Alonso Jerónimo de Salas Barbadillo, who is always described as a picaresque novelist; yet he so constantly neglects the recognized conventions of the Spanish school that his right to the title is disputable. Thus in *La Hija de Celestina* (1612) he abandons the autobiographical form, in *El Subtil cordobés Pedro de Urdemalas* (1620) he alternates between dialogue and verse, and in *El Necio bien afortunado* (1621) the chief character is rather a cunning dolt than a successful scoundrel. The pretence of warning newcomers against the innumerable occasions of sin in the capital is solemnly kept up by Antonio Liñan y Verdugo in his *Guia y avisos de forasteros que vienen á la corte* (1620), but in most of his tales there is more entertainment than decorum.

The profession of a serious moral purpose on the part of many picaresque writers is often a transparent excuse for the introduction of unsavoury incident. There is, however, no ground for doubting the sincerity of the physician Jerónimo de Alcalá Yañez y Ribera, who at one time thought of taking holy orders, and studied theology under St John of the Cross. An unusual gravity of intention is visible in *Alonso, mozo de muchos amos* (1624–1626), in which the repentant *pícaro* Alonso, now a lay-brother, tells the story of his past life to the superior of the monastery in which he has taken refuge. It abounds with pointed anecdotes and with curious information concerning the Spanish gipsies, and this last characteristic explains George Borrow's hyperbolical praise of the work as competing with *Don Quixote* in grave humour, and as unequalled "for knowledge of the human mind and acute observation."

At about this time there lived in Spain an ex-nun named Catalina de Erauso, who fled from her convent, dressed herself in men's clothes, enlisted, was promoted ensign, and saw more of life than any other nun in history. Broadsides relating the story of this picaresque amazon were circulated during her lifetime, and the details of her adventures arrested the attention of De Quincey, who would seem to have read them in a Spanish original which has been admirably translated since then by the French poet José Maria de Heredia. The Spanish original, in its existing form, was issued no earlier than 1829 by Joaquín María de Ferrer, whose character is not a satisfactory guarantee of the work's authenticity; but its interest is unquestionable. No such suspicion attaches to the *Vida* of Alonso de Contreras, first published in 1899; this out-at-elbows soldier faithfully records how he became a knight of the Order of Santiago, how he broke all the Commandments, how he found himself stranded in Madrid, how his fine air captivated Lope de Vega, who housed him for eight months and dedicated to him a play entitled *Rey sin reino*, and how the ex-captain ended by "resolving to retire to a lonely spot and there serve God as a hermit." Every convention of the picaresque novel is faithfully observed, and the incidents are no doubt substantially true, though Contreras, like most converts, judges his own past with unnecessary harshness. This subtle form of vanity also pervades the *Comentarios de el desengañado de sí mismo* of Diego duque de Estrada, a rakish soldier and inferior dramatist whose autobiography (begun in 1614 and continued at intervals during many years) was not printed till 1860. A far higher order of talent distinguishes the *Capitulaciones de la vida de la corte y oficios entretenidos in ella*, a bitterly unsparing review of picaresque life written by the great satirist Francisco Gomez de Quevedo y Villegas (*q.v.*). These thumbnail sketches were the preparatory studies worked up into the more elaborate *Vida del buscón Don Pablos* (1626), the cleverest and most revolting book of its class. There is no attempt to scare the wicked by means of awful examples; the moral lesson is contemptuously thrown aside; the veil of romance is rent in twain, and the *pícaro*—the nephew of the public executioner—is revealed as he is, gloating in cruelty and revelling in the conscious enjoyment of crime. But though Quevedo detests mankind, his morose vision of existence rarely degenerates into caricature. In his repugnant, misanthropic masterpiece the sordid genius of the Spanish picaroon finds absolute expression. Nothing further remained to be done in the matter of realism; henceforth the taste for picaresque novels grew less keen, and later writers unconsciously began to humanize their personages.

The *Varia fortuna del soldado Píndaro* (1626) added nothing to the established reputation of Gonzalo Císpedes y Meneses. A clever anonymous story, *Don Raimundo el entretenido* (1627), missed fire, even though it was attributed to Quevedo; yet the author, Diego Tovar y Valderrama, compiled a sprightly diary of the events which make up a picaroon's crowded day, and failed solely because the interest in rogues was waning. Other writers of undoubted gifts were slow to see that the fashion had changed. Alonso de Castillo Solórzano (*q.v.*) tempted the public with three picaresque stories published in quick succession: *La Niña de los embustes*, *Teresa de Manzanares* (1634), the *Aventuras del Bachiller Trapaza* (1637) and a sequel to the latter entitled *La Garduña de Sevilla* (1642). Clever as Castillo Solórzano's stories are, their tricky heroes and heroines were no longer welcomed with the old enthusiasm in Spain; the *Bachiller Trapaza* was destined to be continued by Mateo da Silva Cabral in Portugal and to be exploited by Le Sage in France, and to these two accidents it owes its survival. Le Sage likewise utilized in *Gil Blas* episodes taken from *El Siglo pitagórico* (1644), the work of Antonio Enríquez Gómez (*q.v.*); but most of *El Siglo pitagórico* is in verse, and as it was published at Paris by an exiled Portuguese Jew, its circulation in Spain must have been limited. The normal primitive rogue returns to the scene in *La Vida y hechos de Estebanillo González* (1646), which is no doubt the genuine autobiography that it purports to be. If he is still occasionally read by students he owes it to the fact that Le Sage drew upon him in the *Histoire d'Estevanille Gonzáles*. By the general public he is completely forgotten, and the same may be said of many subsequent Spanish writers who adopted the picaresque formula. The *Buscón* is the last great book of its kind.

Meanwhile, the rogue had forced his way into other European literatures. The Antwerp continuation (1555) of *Lazarillo de Tormes* brought the original to the notice of northern readers, and this first part was translated into French by Jean Saugrain in 1561. A Dutch version was issued anonymously in 1579, and it seems extremely likely that the book had been translated into English before this date. This follows from a manuscript note written by Gabriel Harvey in a copy of the *Howleglass* given him by Edmund Spenser; Harvey here mentions that he had received the *Howleglass*, Skoggin, Skelton and *Lazarillo* from Spenser on the 20th of December 1578. The earliest known edition of David Rowland's version of *Lazarillo de Tormes* is dated 1586, but as a licence to print a translation of this tale was granted on the 22nd of July 1568/1569, it is probable that a 1576 edition which appears in the Harleian Catalogue really existed. Numerous reprints (1599, 1639, 1669–1670, 1672, 1677) go to prove that *Lazarillo de Tormes* was very popular, and that Shakespeare had read it seems to follow from an allusion in *Much Ado about Nothing* (Act. II., sc. i.): "Now you strike like the blind man; 't was the boy that stole your meat, and you will beat the post." To Thomas Nash belongs the credit, such as it is, of being the first to write a picaresque novel in English: *The Unfortunate Traveller; or the Life of Jack Wilton* (1594). Nash carefully points out that his work is a new experiment, "being a cleane different veine from other my former courses of writing"; the only possible Spanish model that he can have had was *Lazarillo de Tormes*, but he has nothing of his predecessor's sardonic brevity, and he anticipates later Spanish writers by his emphatic insistence on the pleasures of eating and drinking to repletion. Nash led the way, and a reference to "Spanish pickaroes" in Middleton's *Spanish Gipsie* indicates that the picaroon type had speedily become familiar enough for London playgoers to understand the reference. Interest in picaresque literature was kept alive in England by a translation (1622) of a sequel to *Lazarillo de Tormes* published at Paris two years earlier by Juan de Luna, who came to London to supervise the English rendering; by James Mabbe's admirable version (1622) of *Guzmán de Alfarache*; by *The Son of the Rogue or the Politic Thief* (1638), an anonymous translation, done through the French, of *La desordenada codicia*; and by another anonymous translation (1657), likewise done through the French, of Quevedo's *Buscón*. The result of this campaign was *The English Rogue described in the Life of Meriton Latroon, a witty Extravagant* (1665), by Richard Head and Francis Kirkman. The authors of this farrago insist on the English nationality of their chief character, and repudiate the idea that they are in any way indebted to Alemán and Quevedo. It is no exaggeration, however, to say that almost all the material in the text is taken from Spanish sources, and even the thieves' vocabulary is stolen from John Awdeley's *Fraternitye of Vacabondes* or Thomas Harman's *Caveat, or Warning for Common Cursetors*. It is not till Defoe's time that the English picaresque novel acquires any real importance, and the picaresque intention informs much of his work that contravenes the accepted rules of composition. There is a female picaroon in *Moll Flanders*, and, as Defoe read Spanish, it is conceivable that Moll Flanders was suggested by the *Pícara Justina*; but this resemblance does not make a picaresque novel of *Moll Flanders*. The satirical spirit which is lacking in *Moll Flanders* is abundantly present in *Colonel Jack*, which bravely aims at exhibiting "vice and all kinds of wickedness attended with misery." Henceforward the picaroon is naturalized in English literature, and is gloriously reincarnated in Fielding's *Jonathan Wild* and in Smollett's *Ferdinand, Count Fathom*. The classification of Sterne's *Tristram Shandy* and Morier's *Hajji Baba* as picaresque novels is not strictly accurate; like *Pickwick* and *Oliver Twist* and *Barry Lyndon*, they are rather varieties of the peripatetic novel, but many incidents in all five recall the pleasing wiles of the Spanish picaroons.

The Dutch translation of *Lazarillo de Tormes* (1579) did not enable the picaresque novel to strike root in Holland, yet from it is derived one of the best Dutch comedies, *De Spaensche Brabander Jorolimo* (1616) of Gerbrand Bredero. A German translation of *Guzmán de Alfarache* was published by Aegidius Alberitnus in 1615; both *Lazarillo* and *Rinconete y Cortadillo* were translated by Niclas Ulenhart in 1716, and in 1627 there appeared an anonymous version of the *Pícara Justina*. The Spanish tradition was followed by Martin Frewden in a continuation (1626) of *Guzmán de Alfarache*, but the only original picaresque novel of real value in German is Grimmelhausen's *Simplicissimus*. The attempt to acclimatize the picaresque novel in Italy failed completely. Barezzo Barezzi translated *Guzmán de Alfarache*, *Lazarillo de Tormes* and the *Pícara Justina* in 1606, 1622 and 1624 respectively, and Giovanni Pietro Franco did the *Buscón* into Italian in 1634; but there was no important native development. The same may be said of Portugal; for though Silva Cabral's continuation of the *Bachiller Trapaza* is called the most remarkable of Portuguese picaresque romances, it is significant that *O peralvilho de Cordova* remains in manuscript.

The case was very different in France, where pictures of low life had always found admirers. The first translation of *Lazarillo de Tormes* appeared, as already noted, at Paris in 1561; the first translation of the first part of *Guzmán de Alfarache* was issued there by Gabriel Chappuis in 1600, and the dictator Chapelain deigned to translate both parts in 1619–1620; the first translation of the *Novelas ejemplares* was published at Paris in 1618 by Rosset and d'Audiguier; and French translations of *Marcos de Obregón*, of *La Desordenada codicia*, of the *Buscón* and of the *Picara Justina* were printed in 1618, 1621, 1633 and 1635 respectively. Before this series of translations was completed Charles Sorel recounted in *Francion* (1622) "the comic mishaps which befall evil-doers," invoking the common excuse that it is "lawful to find pleasure at their expense." Many of the episodes in *Francion* are picaresque in tone, but unfortunately Sorel wanders from his subject, and devotes no small part of his book to satirizing literary men who, though fribbles or paupers, are in no sense picaroons. The legitimate Spanish tradition is followed more closely and with much more ability by Paul Scarron in the *Roman comique* (1651), in which horseplay is predominant. The framework may have been suggested by Agustín de Rojas or Quevedo, both of whom introduce a strolling company. and such characters as Líandre, Angélique de l'Etoile and Ragotin might be found in any average *novela picaresca.* Scarron frankly mentions Castillo Solórzano's *Garduña de Sevilla* in his text, and his *Précaution inutile* and *Les Hypocrites* are convincing proofs of close study of Spanish picaresque stories: the *Précaution inutile* is taken from *Guzmán de Alfarache*, and *Les Hypocrites* is merely a translation of Salas Barbadillo's *Hija de Celestina.* The *Roman bourgeois* (1666) of Antoine Furetière is generally described as a picaresque novel, but this involves a new definition of the adjective; the *Roman bourgeois* includes some portraits and more satire which seem suggested by picaresque reading, but it is concerned with the foibles of the middle class rather than with the sly devices of common vagabonds.

The Spanish picaroon lives again in *Gil Blas*, where, with a dexterity almost rarer than original genius, a master of literary manipulation fuses materials unearthed from forgotten and seemingly worthless Spanish quarries. Gil Blas is a creation of the gentler, sunnier French spirit; like Beaumarchais' Figaro he is a Spaniard born, reared and humanized in Paris, and these two are the only picaroons whose relative refinement has not been gained at the cost of verisimilitude. But the old original scoundrel was not yet extinct: in the interval between the appearance of the *Barbier de Séville* and the *Mariage de Figaro* Restif de la Bretonne produced a sequel (1776) to the *Buscón*—a sequel so dull as to be wellnigh unreadable. The untamed Spanish rogue had become impossible towards the end of the 18th century: in the 19th he was deliberately rejected when Théophile Gautier wrote his *Capitaine Fracasse.* Yet Gautier conscientiously provides a Spanish atmosphere; the personages have Spanish names; the knife has a Spanish inscription; the host speaks French with a Spanish accent; Vallombreuse parts from the marquis with a Spanish formula: "beso á vuestra merced la mano, caballero." *Capitaine Fracasse* is the last important book which continues the picaresque tradition. The possibilities of picaresque fiction can never be exhausted while human nature is unchanged. Pereda (*q.v.*) in *Pedro Sánchez* (1884) touches the old theme with the accent of modernity. It may be that instead of one continuous tale, interrupted by episodical digressions, the picaresque fiction of the future will take the form of short stories independent of one another; but this would be nothing more than a convenient mechanical device, a readjustment of means to ends.

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PICAYUNE, the name in Florida and Louisiana of the Spanish half-real, $= \frac{1}{16}$ of a dollar, $6\frac{1}{4}$ cents. and hence used of the United States 5 cent piece. The French *picaillon*, from which the word was adapted in America, was an old copper coin of Piedmont. Its origin is doubtful, but is possibly related to the Italian *piccolo*, little, small. In America the word is used of anything trifling, petty, mean or contemptible.

PICCANINNY, or Pickaninny, a word applied originally by the negroes of the West Indies to their babies. It is adapted either from Span. *pequeño*, small, or Port. *pequenino*, very small. The word spread with the slave trade to America, and has since been adopted in Australia and in South Africa.

PICCININO, NICCOLÒ (1386–1444), Italian *condottiere*, born at Perugia, was the son of a butcher. He began his military career in the service of Braccio da Montone, who at that time was waging war against Perugia on his own account, and at the death of his chief, shortly followed by that of the latter's son Oddo, Piccinino became leader of Braccio's *condotta.* After serving for a short period under the Florentine Republic, he went over to Filippo Maria Visconti, duke of Milan (1425), in whose service together with Niccolò Fortebraccio he fought in the wars against the league of Pope Eugenius IV., Venice and Florence. He defeated the papal forces at Castel Bolognese (1434), but another papal army under Francesco Sforza having defeated and killed Fortebraccio at Fiordimonte, Piccinino was left in sole command, and in a series of campaigns against Sforza he seized a number of cities in Romagna by treachery. In 1439 he again fought in Lombardy with varying success against Sforza, who had now entered the Venetian service. Piccinino then induced the duke of Milan to send him to Umbria, where he hoped, like so many other *condottieri*, to carve out a dominion for himself. He was defeated by Sforza at Anghiari (1440), but although a number of his men were taken prisoners they were at once liberated, as was usually done in wars waged by soldiers of fortune. Again the war shifted to Lombardy, and Piccinino, having defeated and surrounded Sforza at Martinengo, demanded of the visconti the lordship of Piacenza as the price of Sforza's capture. The duke by way of reply concluded a truce with Sforza; but the latter, who, while professing to defend the Papal States, had established his own power in the Marche, aroused the fears of the pope and the king of Naples, as well as of the visconti, who gave the command of their joint forces to Piccinino. Sforza was driven from the Marche, but defeated Piccinino at Montelauro, and while the latter was preparing for a desperate effort against Sforza he was suddenly recalled to Milan, his army was beaten in his absence, and he died of grief and of his wounds in 1444. Short of stature, lame and in weak health, he was brave to the point of foolhardiness, wonderfully resourceful, and never overwhelmed by defeat. He was cruel and treacherous, and had no aim beyond his own aggrandizement. Piccinino left two sons, Jacopo and Francesco, both distinguished *condottieri.*

A good account of Piccinino is contained in vol. iii. of E. Ricotti's *Storia della compagnie di ventura* (Turin, 1845); G. B. Poggio, *Vita di N. Piccinino* (Venice, 1572); see also the general histories of the period.

PICCINNI, NICCOLA (1728–1800), Italian musical composer, was born at Bari on the 16th of January 1728. He was educated under Leo and Durante, at the Conservatorio di Sant' Onofrio in Naples. For this Piccinni had to thank the intervention of the bishop of Bari, his father, although himself a musician, being opposed to his son's following a musical career. His first opera, *Le Donne dispettose*, was produced in 1755, and in 1760 he composed, at Rome, the *chef d'œuvre* of his early life, *La Cecchina, ossia la buona*

Figliuola, an *opera buffa* which attained a European success. Six years after this Piccinni was invited by Queen Marie Antoinette to Paris. He had married in 1756 his pupil Vincenza Sibilla, a singer, whom he never allowed after her marriage to appear on the stage. All his next works were successful; but, unhappily, the directors of the Grand Opéra conceived the mad idea of deliberately opposing him to Gluck, by persuading the two composers to treat the same subject—*Iphigénie en Tauride*—simultaneously. The Parisian public now divided itself into two rival parties, which, under the names of Gluckists and Piccinnists, carried on an unworthy and disgraceful war. Gluck's masterly *Iphigénie* was first produced on the 18th of May 1779. Piccinni's *Iphigénie* followed on the 23rd of January 1781, and, though performed seventeen times, was afterwards consigned to oblivion. The fury of the rival parties continued unabated, even after Gluck's departure from Paris in 1780; and an attempt was afterwards made to inaugurate a new rivalry with Sacchini. Still, Piccinni held a good position, and on the death of Gluck, in 1787, proposed that a public monument should be erected to his memory—a suggestion which the Gluckists themselves declined to support. In 1784 Piccinni was professor at the Royal School of Music, one of the institutions from which the Conservatoire was formed in 1794. On the breaking out of the Revolution in 1789 Piccinni returned to Naples, where he was at first well received by King Ferdinand IV.; but the marriage of his daughter to a French democrat brought him into irretrievable disgrace. For nine years after this he maintained a precarious existence in Venice, Naples and Rome; but he returned in 1798 to Paris, where the fickle public received him with enthusiasm, but left him to starve. He died at Passy, near Paris, on the 7th of May 1800. After his death a memorial tablet was set up in the house in which he was born at Bari.

The most complete list of his works is that given in the *Rivista musicale italiana*, viii. 75. He produced over eighty operas, but although his later work shows the influence of the French and German stage, he belongs to the conventional Italian school of the 18th century.

See also P. L. Ginguené, *Notice sur la vie et les ouvrages de Niccolo Piccinni* (Paris, 1801); E. Demoiresterres, *La Musique française au 18ᵉ siècle Gluck et Piccinni 1774–1800* (Paris, 1872).

PICCOLO (Fr. *petite flûte octave*; Ger. *Pickelflöte*; Ital. *flauto piccolo* or *ottavino*), a small flute of less than half the dimensions of the large concert flute and pitched an octave higher. The principles of construction and the acoustic properties are the same for the piccolo as for the flute, with the exception that the piccolo does not contain the additional tail-piece with the extra low keys, which give the flute its extended compass. As the pitch of the piccolo is so high, the highest of all orchestral instruments with the exception of a few harmonics on the violin, the music for it is written an octave lower than the real sounds in order to avoid the ledger lines. The piccolo has been used with good effect in imitating the whistling of the wind in storms, as in Beethoven's *Pastoral Symphony*, Wagner's *Flying Dutchman*, and in conjunction with the violins in *tremolo* to depict the rustling of the leaves in the breeze, as in the "Waldweben" in *Siegfried*. Verdi employed it to advantage in *Falstaff* as a comic agent in humorous situations. The piccolo is generally in D, sometimes in E♭ or F. (K. S.)

PICCOLOMINI, the name of an Italian noble family, which was prominent in Siena (*q.v.*) from the beginning of the 13th century onwards. In 1220 Enghelberto d'Ugo Piccolomini received the fief of Montertari in Val d'Orcia from the emperor Frederick II. as a reward for services rendered. The family acquired houses and towers in Siena and castles in the republic's territory, including Montone and Castiglione; the latter they sold to the commune in 1321. They obtained great wealth through trade, and established counting-houses in Genoa, Venice, Aquileia, Trieste, and in various cities of France and Germany. Supporters of the Guelph cause in the civil broils by which Siena was torn, they were driven from the city in the time of Manfred and their houses demolished; they returned in triumph after the Angevin victories, were expelled once more during the brief reign of Conradin, and again returned to Siena with the help of Charles of Anjou. But through their riotous political activity the Piccolomini lost their commercial influence, which passed into the hands of the Florentines, although they retained their palaces, castles and about twenty fiefs, some of which were in the territory of Amalfi and of great extent. Many members of the house were distinguished ecclesiastics, generals and statesmen in Siena and elsewhere; two of them were popes, viz. Aeneas Silvius Piccolomini (Pius II., *q.v.*) and Francesco Piccolomini (Pius III., *q.v.*).

See Richter, *Die Piccolomini* (Berlin, 1874); A. Lisini and A. Liberati, *Albero della famiglia Piccolomini* (Siena, 1899); and articles by A. Lisini in the *Miscellanea storica senese*, 3rd series 12, and 4th series, 17 and 189.

PICCOLOMINI, OCTAVIO, Prince (1599–1656), duke of Amalfi, Austrian general, was born on the 11th of November 1599 in Florence, and carried a pike in the Spanish service at the age of sixteen. Two years later, on the outbreak of the Thirty Years' War in Bohemia, he was appointed a captain in a cavalry regiment sent by the grand duke of Tuscany to the emperor's army, and he fought with some distinction under Bucquoy at the Weisser Berg and in Hungary. In 1624 he served for a short time in the Spanish army and then as lieutenant-colonel of Pappenheim's cuirassier regiment in the war in the Milanese. In 1627 he re-entered the Imperial service as colonel and captain of the lifeguard of Wallenstein, duke of Friedland. In this capacity he soon fell into disgrace for practising extortion at Stargard in Pomerania, but his adroitness secured him, after no long interval, the rank of "colonel of horse and foot." About this time the appointment of his younger brother to the archbishopric of Siena secured him a position of influence in the diplomatic world. Diplomatic talent was indeed almost the birthright of a member of an Italian family, that had seen two of its members occupying the papal chair, and Wallenstein freely made use of his subordinate's capacity for negotiation and intrigue. In the events of the Mantuan War Piccolomini took a prominent part in the dual rôle of the subtle diplomatist and the plundering soldier of fortune. At this moment came the invasion of Germany by Gustavus Adolphus. Piccolomini was interned at Ferrara as a hostage for the ratification of a treaty, but he added his voice to the general call for Wallenstein's reappointment as commander-in-chief. He was not, however, included in the list of promotions that followed the duke's reappearance, and he served under General Holk, an officer brought in from the Danish service, in the preliminary operations and in the battle of Lützen. His ambition was gratified when, on reading the official report of the battle, the emperor made him a *generalfeldwachtmeister*. At the same time, however, Holk was created a field marshal at Wallenstein's instance, much to his rival's chagrin. In the campaign of 1633 Piccolomini held the command of an important detachment posted at Königgrätz to bar the enemy's advance from Silesia into Bohemia. History repeated itself on the same ground in 1756, 1778 and 1866; in the first of these cases it was a Piccolomini, grand-nephew of Octavio, who commanded the Austrians; in the last the victorious Prussians passed over the estate of Nachod, which after 1635 was a hereditary possession of the family. In May Wallenstein entered Silesia with the main army with the unavowed object of compelling or persuading the electors of Brandenburg and Saxony to make common cause with the emperor against the Swedes. Piccolomini was with him, and, disapproving of the duke's policy, joined in a military conspiracy, out of which grew the drama that ended with the murder of Wallenstein on the 25th of February 1634. Piccolomini's own part in the tragedy has been set forth for all time in the pages of Schiller's *Wallenstein*. His reward was his marshal's bâton, 100,000 gulden and the beautiful estate of Nachod in the Riesengebirge.

He was Wallenstein's pupil as well as his slayer, and had learned the art of war from that master. On the 5th–6th of September in the same year he distinguished himself amongst the foremost in the great victory of Nördlingen. He soon saw the necessity for following out the lines of military policy laid down by the duke, but neither he nor Gallas, the new lieutenant-general of the emperor, possessed the capacity for carrying it out, and the war dragged on year after year. Piccolomini was in 1635 allied with a Spanish army, and bitterly complained that their sloth and caution marred every scheme that he formed. In 1638 he was made a count of the empire, and in 1639, having been fortunate enough to win a great victory over the French (relief of Thionville, July 7, 1639), he was rewarded with the office of privy councillor from the emperor and with the dukedom of Amalfi from the king of Spain. But instead of being appointed, as he hoped, Gallas's successor, he was called in to act as *ad latus* to the Archduke Leopold Wilhelm, with whom he was defeated in the second battle of Breitenfeld in 1642. After this he spent some years in the Spanish service and received as his reward the title of grandee and the order of the Golden Fleece. Some years later, having re-entered the Imperial army, he was again disappointed of the chief command by the selection of the brave veteran Peter Melander, Count Holzapfel. But when in 1648 Melander fell in battle at Zusmarshausen, Piccolomini was at last appointed lieutenant-general of the emperor, and thus conducted as generalissimo the final campaign of the weary and desultory Thirty Years' War. Three days after the commission for executing the peace had finished its labours, the emperor addressed a letter of thanks "to the Prince Piccolomini," and awarded him a gift of 114,566 gulden. Piccolomini died on the 11th of August 1656. He left no children (his only son Josef Silvio, the "Max" of Schiller's *Wallenstein*, was murdered by the Swedes after the battle of Jankau in 1645), and his titles and estates passed to his brother's son. With the death of the latter's nephew Octavio Aeneas Josef in 1757, the line became extinct.

PICENE, $C_{22}H_{14}$, a hydrocarbon found in the pitchy residue obtained in the distillation of peat-tar and of petroleum. This is distilled to dryness and the distillate repeatedly recrystallized from cymene. It may be synthetically prepared by the action of anhydrous aluminium chloride on a mixture of naphthalene and ethylene dibromide (R. Lespieau, *Bull. soc. chim.*, 1891, (3), 6, p. 238), or by distilling α-dinaphthostilbene (T. Hirn, *Ber.*, 1899, 32, p. 3341). It crystallizes in large colourless plates which possess a blue fluorescence. It is soluble in concentrated sulphuric acid with a green colour. Chromic acid in glacial acetic acid solution oxidizes it to picene-quinone, picene-quinone carboxylic acid, and finally to phthalic acid. When heated with hydriodic acid and phosphorus it forms hydrides of composition $C_{22}H_{34}$ and $C_{22}H_{36}$ (see E. Bamberger and F. D. Chattaway, *Ann.*, 1895, 284, p. 61).

PICENUM, a district of ancient Italy, situated between the Apennines and the Adriatic, bounded N. by the Senones and S. by the Vestini. The inhabitants were, according to tradition, an offshoot of the Sabines. Strabo (v. 4, 1) gives the story of their migration, led by a woodpecker (*picus*), a bird sacred to Mars, from which they derived their name Picentini (cf. Dion. Hal. i. 14, 5), just as the Hirpini derived theirs from *hirpus*, a wolf. The district was conquered by the Romans early in the 3rd century B.C. and the whole territory was divided up among Latin-speaking settlers by the Lex Flaminia in 232 B.C. Hence we have very scanty records of any non-Latin Language that may have been spoken in the district before the 3rd century. Besides the problematic inscriptions from Belmonte, Nereto and Cupra Maritima (see SABELLIC), we have one or two Latin inscriptions (probably of the 2nd or even the 1st century B.C.) which contain certain forms showing a distinct affinity with the dialect of Iguvium (cf. the name *Paśdi*=Latin *Pacidii*). Hence there seems some ground for believing that the population which the Romans dispossessed, or held in subjection, really spoke a dialect very much like that of their neighbours in Umbria.

For inscriptions, see R. S. Conway, *The Italic Dialects*, p. 449, where the place-names and personal names of the district will also be found; see further, Livy, *Epit.* xv.; B. V. Head, *Historia numorum*, p. 19. (R. S. C.)

It was in Picenum, at Asculum, that the Social War broke out in 90 B.C. At the end of the war the district became connected with Pompeius Strabo, and his son Pompey the Great threw into the scale on the side of Sulla, in 83 B.C., all the influence he possessed there, and hoped to make it a base against Caesar's legions in 49 B.C. Under Augustus it formed the fifth region of Italy, and included twenty-three independent communities, of which five, Ancona, Firmum, Asculum, Hadria and Interamnia, were *coloniae*. It was reached from Rome by the Via Salaria, and its branch the Via Caecilia. It was also on a branch leading from the Via Flaminia at Nuceria Camellaria to Septempeda. There were also communications from north to south; a road led from Asculum to Urbs Salvia and Ancona, another from Asculum and Firmum and the coast, another from Urbs Salvia to Potentia, while finally along the whole line of the coast there ran a prolongation of the Via Flaminia, the name of which is not known to us.

At the end of the 2nd century A.D. the north-eastern portion of Umbria was divided from the rest and acquired the name Flaminia, from the high road. For the time it remained united with Umbria for administrative purposes, but passed to Picenum at latest in the time of Constantine, and acquired the name of *Flaminia et Picenum Annonarium*, the main portion of Picenum being distinguished as *Suburbicarium*. In an inscription of A.D. 399 Ravenna is actually spoken of as the chief town of Picenum. When the exarchate of Ravenna was founded the part of Picenum Annonarium near the sea became the Pentapolis Maritima, which included the five cities of Ariminum, Pisaurum, Fanum Fortunae, Sena Gallica and Ancona. The exarchate was seized by Luitprand in 727, and Ravenna itself was taken by Aistulf in 752. In the next year, however, the Emperor Pippin took it from him and handed it over to the pope, a grant confirmed by his son Charlemagne. (T. As.)

PICHEGRU, CHARLES (1761–1804), French general, was born at Arbois, or, according to Charles Nodier, at Les Planches, near Lons-le-Saulnier, on the 16th of February 1761. His father was a labourer, but the friars of Arbois gave the boy a good education, and one of his masters, the Père Partault, took him to the military school of Brienne. In 1783 he entered the first regiment of artillery, where he rapidly rose to the rank of adjutant-sub-lieutenant. When the Revolution began he became leader of the Jacobin party in Besançon, and when a regiment of volunteers of the department of the Gard marched through the city he was elected lieutenant-colonel. The fine condition of his regiment was soon remarked in the army of the Rhine, and his organizing ability was made use of by an appointment on the staff, and finally by his promotion to the rank of general of brigade. In 1793 Carnot and Saint Just were sent to find *roturier* generals who could be successful; Carnot discovered Jourdan, and Saint Just discovered Hoche and Pichegru. In co-operation with Hoche and the army of the Moselle, Pichegru, now general of division and in command of the army of the Rhine, had to reconquer Alsace and to reorganize the disheartened troops of the republic. They succeeded; Pichegru made use of the *élan* of his soldiers to win innumerable small engagements, and with Hoche forced the lines of Haguenau and relieved Landau. In December 1793 Hoche was arrested, it is said owing in part to his colleague's machinations, and Pichegru became commander-in-chief of the army of the Rhine-and-Moselle, whence he was summoned to succeed Jourdan in the army of the North in February 1794. It was now that he fought his three great campaigns of one year. The English and Austrians held a strong position along the Sambre to the sea. After vainly attempting to break the Austrian centre, Pichegru suddenly turned their left, and defeated Clerfayt at Cassel, Menin and Courtrai, while Moreau, his second in command, defeated Coburg at Tourcoing in May 1794; then after a pause, during which Pichegru feigned to besiege Ypres, he again dashed at Clerfayt and defeated him at Rousselaer and Hooglede, while Jourdan came up with the new army of the Sambre-and-Meuse, and utterly routed the Austrians at Fleurus on the 27th of June 1794. Pichegru began his second campaign by crossing the Meuse on the 18th of October, and after taking Nijmwegen drove the Austrians beyond the Rhine. Then, instead of going into winter-quarters, he prepared his army for a winter campaign. On the 28th of December he crossed the Meuse on the ice, and stormed the island of Bommel, then crossed the Waal in the same manner, and, driving the English before him, entered Utrecht on the 19th of January, and Amsterdam on the 20th of January, and soon occupied the whole of Holland. This grand feat of arms was marked by many points of interest, such as the capture of the Dutch ships, which were frozen in the Helder, by the French hussars, and the splendid discipline of the ragged battalions in Amsterdam, who, with the richest city of the continent to sack, yet behaved with a self-restraint which few revolutionary and Napoleonic armies attained. The former friend of Saint Just now offered his services to the Thermidorians, and after receiving from the Convention the title of "Sauveur de la Patrie," subdued the *sans-culottes* of Paris, when they rose in insurrection against the Convention on 12 Germinal (April 1). Pichegru then took command of the armies of the North, the Sambre-and-Meuse, and the Rhine, and crossing the Rhine in force took Mannheim in May 1795. When his fame was at its height he allowed his colleague Jourdan to be beaten, betrayed all his plans to the enemy, and took part in organizing a conspiracy for the return of Louis XVIII., in which he was to play, for his own aggrandizement, the part that Monk played from higher motives in the English revolution. His intrigues were suspected, and when he offered his resignation to the Directory in October 1795 it was to his surprise promptly accepted. He retired in disgrace, but hoped to serve the royalist cause by securing his election to the Council of Five Hundred in May 1797. He was there the royalist leader, and planned a *coup d'état*, but on the 18th Fructidor he was arrested, and with fourteen others deported to Cayenne in 1797. Escaping, he reached London in 1798, and served on General Korsakov's staff in the campaign of 1799. He went to Paris in August 1803 with Georges Cadoudal to head a royalist rising against Napoleon; but, betrayed by a friend, he was arrested on the 28th of February 1804, and on the 15th of April was found strangled in prison. It has often been asserted that he was murdered by the orders of Napoleon, but there is no foundation for the story.

Pichegru's campaigns of 1794 are marked by traits of an audacious genius which would not have disgraced Napoleon. His tremendous physical strength, the personal ascendancy he gained by this and by his powers of command made him a peculiarly formidable opponent, and thus enabled him to maintain a discipline which guaranteed the punctual execution of his orders. He had also, strangely enough, the power of captivating honest men like Moreau. He flattered in turn Saint Just and the Terrorists, the Thermidorians and the Directors, and played always for his own hand—a strange egoist who rose to fame as the leader of an idealist and sentimental crusade.

There is no really good life of Pichegru; perhaps the best is J. M. Gassier's *Vie du général Pichegru* (Paris, 1815). For his treason, trial and death, consult Montgaillard's *Mémoires concernant la trahison de Pichegru* (1804); Fauche-Borel's *Mémoires*; Savary, *Mémoires sur la mort de Pichegru* (Paris, 1825); and G. Pierret, *Pichegru, son procés et sa mort* (1826).

PICHLER, KAROLINE (1769–1843), Austrian novelist, was born at Vienna on the 7th of September 1769, the daughter of Hofrat Franz von Greiner, and married, in 1796, Andreas Pichler, a government official. For many years her salon was the centre of the literary life in the Austrian capital, where she died on the 9th of July 1843. Her early works, *Olivier*, first published anonymously (1802), *Idyllen* (1803) and *Ruth* (1805), though displaying considerable talent, were immature. She made her mark in historical romance, and the first of her novels of this class, *Agathocles* (1808), an answer to Gibbon's attack on that hero in the *Decline and Fall of the Roman Empire*, attained great popularity. Among her other novels may be mentioned *Die Belagerung Wiens* (1824); *Die Schweden in Prag* (1827); *Die Wiedereroberung Ofens* (1829) and *Henriette von England* (1832). Her last work was *Zeitbilder* (1840).

The edition of Karoline Pichler's *Sämtliche Werke* (1820–1845) comprises no less than 60 volumes. Her *Denkwürdigkeiten aus meinem Leben* (4 vols.) was published posthumously in 1844. A selection of her narratives, *Ausgewählte Erzählungen*, appeared in 4 vols. in 1894.

PICKENS, ANDREW (1739–1817), American soldier in the War of Independence, was born in Paxton, Bucks county, Pennsylvania, on the 19th of September 1739. His family settled at the Waxhaws (in what is now Lancaster county), South Carolina, in 1752. He fought against the Cherokees in 1761 as a lieutenant. In the War of Independence he rose to brigadier-general (after Cowpens) in the South Carolina militia. He was a captain among the American troops which surrendered at Ninety Six in November 1775. On the 14th of February 1779, with 300–400 men, he surprised and defeated about 700 Loyalists under Colonel Boyd on Kettle Creek, Wilkes county, Georgia; on the 20th of June he fought at Stono Ferry; and later in the same year at Tomassee defeated the Cherokees, who were allied with the British. Upon the surrender of Charleston (May 1780) he became a prisoner on parole, which he observed rigidly until, contrary to the promises made to him, Major James Dunlap plundered his plantation; he then returned to active service. His command (about 150 men) joined General Daniel Morgan immediately before the battle of Cowpens, in which Pickens commanded an advance guard (270–350 men from Georgia and North Carolina) and twice rallied the broken American militia; for his services Congress gave him a sword. With Colonel Henry Lee he harassed Lieut.-Colonel Banastre Tarleton, who was attempting to gather a Loyalist force just before the battle of Guilford Court House; and with Lee and others, he captured Augusta (June 5, 1781) after a siege. At Eutaw Springs (Sept. 8, 1781) he commanded the left wing and was wounded. In 1782 he defeated the Cherokees again and forced them to surrender all lands south of the Savannah and east of the Chattahoochee. After the war he was a member of the South Carolina House of Representatives for a number of years, of the state Constitutional Convention in 1790, and of the National House of Representatives in 1793–1795. He died in Pendleton district, South Carolina, on the 17th of August 1817. He had married in 1765 Rebecca Calhoun, an aunt of John C. Calhoun. Their son, ANDREW PICKENS (1779–1838), served as a lieutenant-colonel in the War of 1812, and was governor of South Carolina in 1816–1818.

PICKENS, FRANCIS WILKINSON (1805–1869), American politician, was born in Togadoo, St Paul's parish, South Carolina, on the 7th of April 1805, son of Andrew Pickens (1779–1838) and grandson of General Andrew Pickens (1739–1817). He was educated at Franklin College, Athens, Georgia, and at South Carolina College, Columbia, and was admitted to the bar in 1829. In 1832 he was elected to the state House of Representatives, where, as chairman of a sub-committee, he submitted a report denying the right of Congress to exercise any control over the states. He was a Democratic member of the National House of Representatives in 1834–1843, served in the South Carolina Senate in 1844–1845, was a delegate to the Nashville Southern Convention (see NASHVILLE, TENNESSEE) in 1850, was United States minister to Russia in 1858–1860, and in 1860–1862 was governor of South Carolina. He strongly advocated the secession of the Southern states; signed the South Carolina ordinance of secession; protested against Major Robert Anderson's removal from Fort Moultrie to Fort Sumter; sanctioned the firing upon the "Star of the West" (Jan. 9, 1861), which was bringing supplies to Anderson, and the bombardment of Fort Sumter; and was a zealous supporter of the Confederate cause. At the close of his term he retired to his home at Edgefield, South Carolina, where he died on the 25th of January 1869.

PICKERING, EDWARD CHARLES (1846–   ), American physicist and astronomer, was born in Boston on the 19th of July 1846. He graduated in 1865 at the Lawrence Scientific School of Harvard, where for the next two years he was a teacher of mathematics. Subsequently he became professor of physics at the Massachusetts Institute of Technology, and in 1876 he was appointed professor of astronomy and director of the Harvard College observatory. In 1877 he decided to devote one of the telescopes of the observatory to stellar photometry, and after an exhaustive trial of various forms of photometers, he devised the meridian photometer (see Photometry, Stellar), which seemed to be free from most of the sources of error. With the first instrument of this kind, having objectives of 1·5 inch aperture, he measured the brightness of 4260 stars, including all stars down to the 6th magnitude between the North Pole and −30° declination. With the object of reaching fainter stars, Professor Pickering constructed another instrument of larger dimensions, and with this more than a million observations have been made. The first important work undertaken with it was a revision of the magnitudes given in the Bonn *Durchmusterung*. On the completion of this, Professor Pickering decided to undertake the survey of the southern hemisphere. An expedition, under the direction of Prof. S. I. Bailey, was accordingly despatched (1889), and the meridian photometer erected successively in three different positions on the slopes of the Andes. The third of these was Arequipa, at which a permanent branch of the Harvard Observatory is now located. The magnitudes of nearly 8000 southern stars were determined, including 1428 stars of the 6th magnitude and brighter. The instrument was then returned to Cambridge (U.S.A.), where the survey extended so as to include all stars of magnitude 7·5 down to −40° declination, after which it was once more sent back to Arequipa. In 1886 the widow of Henry Draper, one of the pioneers of stellar spectroscopy, made a liberal provision for carrying on spectroscopic investigations at Harvard College in memory of her husband. With Professor Pickering's usual comprehensiveness, the inquiry was so arranged as to cover the whole sky; and with four telescopes—two at Cambridge for the northern hemisphere, and two at Arequipa in Peru for the southern—to which a fine 24-in. photographic telescope was afterwards added, no fewer than 75,000 photographs had been obtained up to the beginning of 1901. These investigations have yielded many important discoveries, not only of new stars, and of large numbers of variable stars, but also of a wholly new class of double stars whose binary character is only revealed by peculiarities in their spectra. The important conclusion has been already derived that the majority of the stars in the Milky Way belong to one special type.

PICKERING, TIMOTHY (1745–1829), American politician, was born at Salem, Massachusetts, on the 17th of July 1745. He graduated from Harvard College in 1763 and was admitted to the bar in 1768. In the pre-revolutionary controversies he identified himself with the American Whigs; in 1773 he prepared for Salem a paper entitled *State of the Rights of the Colonists*; in 1775 he drafted a memorial protesting against the Boston Port Bill; and in 1776 he was a representative from Salem in the General Court of Massachusetts. In 1766 he had been commissioned lieutenant and in 1769 captain in the Essex county militia; early in 1775 he published *An Easy Plan of Discipline for a Militia*, adopted in May 1776 by the General Court for use by the militia of Massachusetts, and he was elected colonel of his regiment. In the same year he became judge of the court of common pleas for Essex county, and sole judge of the maritime court for the counties of Suffolk, Essex and Middlesex. In the winter of 1776–1777 he led an Essex regiment of volunteers to New York, and he subsequently served as adjutant-general (June 1777–Jan. 1778) and later as quartermaster-general (1780–1785); he was also a member of the board of war from the 7th of November 1777 until its abolition. With the aid of some officers he drew up, in April 1783, a plan for the settlement of the North-West territory, which provided for the exclusion of slavery. In 1785 he became a commission merchant in Philadelphia; but in October 1786, soon after the legislature of Pennsylvania had passed a bill for erecting Wyoming district into the county of Luzerne, he was appointed prothonotary and a judge of the court of common pleas and clerk of the court of sessions and orphans' court for the new county, and was commissioned to organize the county. He offered to purchase for himself the Connecticut title to a farm, and in the following year he was appointed a member of a commission to settle claims according to the terms of an act, of which he was the author, confirming the Connecticut titles (see Wyoming Valley and Wilkes-Barré). Pickering was a member of the Pennsylvania convention of 1787 which ratified the Federal constitution, and of the Pennsylvania constitutional convention of 1789–1790. In November 1790 he negotiated a peace with the Seneca Indians, and he concluded treaties with the Six Nations in July 1791, in March 1792 and in November 1794. Under Washington he was postmaster-general (1791–1795), secretary of war (1795), and after December 1795 secretary of state, to which position he was reappointed (1797) by Adams. In 1783, while he was quartermaster-general, he had presented a plan for a military academy at West Point, and now, as secretary of war, he supervised the West Point military post with a view to its conversion into a military academy. As head of the state department he soon came into conflict with Adams. His hatred of France made it impossible for him to sympathize with the president's efforts to settle the differences with that country on a peaceable basis. He used all his influence to hamper the president and to advance the political interests of Alexander Hamilton, until he was dismissed, after refusing to resign, in May 1800. Returning to Massachusetts, he served as chief justice of the court of common pleas of Essex county in 1802–1803. He was a United States senator in 1803–1811 and a member of the Federal House of Representatives in 1813–1817. As an ultra Federalist—he was a prominent member of the group known as the Essex Junto—he strongly opposed the purchase of Louisiana and the War of 1812. He died at Salem, Massachusetts, on the 29th of January 1829.

The standard biography is that by his son, Octavius Pickering (1791–1868), and C. W. Upham, *The Life of Timothy Pickering* (4 vols., Boston, 1867–1873). In the library of the Massachusetts Historical Society at Boston, there are sixty-two manuscript volumes of the Pickering papers, an index to which was published in the *Collections* of the society, 6th series, vol. viii. (Boston, 1896).

His son, John Pickering (1777–1846), graduated at Harvard in 1796, studied law and was private secretary to William Smith, United States minister to Portugal, in 1797–1799, and to Rufus King, minister to Great Britain, in 1799–1801. He practised law in Salem and (after 1827) in Boston, where he was city solicitor in 1827–1846, and wrote much on law and especially on the languages of the North-American Indians. He was a founder of the American Oriental Society and published an excellent *Comprehensive Dictionary of the Greek Language* (1826).

See Mary O. Pickering (his daughter), *Life of John Pickering* (Boston, 1887).

Timothy Pickering's grandson, Charles Pickering (1805–1878), graduated at Harvard College in 1823 and at the Harvard Medical School in 1826, practised medicine in Philadelphia, was naturalist to the Wilkes exploring expedition of 1838–1842, and in 1843–1845 travelled in East Africa and India. He wrote *The Races of Man and their Geographical Distribution* (1848), *Geographical Distribution of Animals and Man* (1854), *Geographical Distribution of Plants* (1861) and *Chronological History of Plants* (1879).

PICKERING, a market town in the Whitby parliamentary division of the North Riding of Yorkshire, England, 32 m. N.E. by N. from York by the North Eastern railway, the junction of several branch lines. Pop. of urban district (1901), 3491. The church of St Peter is Norman and transitional Norman, with later additions including a Decorated spire. It contains a remarkable series of mural paintings of the 15th century. The castle, on a hill to the north, is a picturesque ruin, the fragmentary keep and several towers remaining. The work is in part Norman, but the principal portions are of the 14th century. One of the towers is connected in name and story with Fair Rosamond. The castle was held by Earl Morcar shortly before the Conquest; it then came into the hands of the Crown, and subsequently passed to the duchy of Lancaster. It was the prison of Richard II. before his confinement at Pontefract. During the civil wars of the 17th century the castle was held by the Royalists, and suffered greatly in siege. The district surrounding Pickering is agricultural, and the town is a centre of the trade. Agricultural implements are manufactured, and limestone and freestone are quarried in the vicinity.

PICKET, Piquet or Picquet (Fr. *piquet*, a pointed stake or peg, from *piquer*, to point or pierce), a military term, signifying an outpost or guard, supposed to have originated in the French army about 1690, from the circumstance that an infantry company on outpost duty dispersed its musketeers to watch, the small group of pikemen called *piquet* remaining in reserve. Thus at the present day the word "picquet" is, in Great Britain at any rate, restricted to an infantry post on the outpost line, from which the sentries or "groups" of watchers are sent out. In the United States a "picket" is synonymous with a sentry, and the "picket-line" is the extreme advanced line of observation of an army. In the French army picquets are called "grand' gardes," and the phrase "grand guard" is often met with in English military works of the 17th and 18th centuries. A body of soldiers held in readiness for military or police duties within the limits of a camp or barracks is also called a picquet or "inlying picquet." These special uses of the word in English are apparently quite modern (after about 1750). "Picket" in its ordinary meaning of a peg or stake, has always been in common military use, being applied variously to the picketing pegs in horse-lines, to long pointed stakes employed in palisades or stockades, to straight thin rods used for marking out the line of fire for guns, &c. Of the various spellings "picquet" is officially adopted in Great Britain and "picket" in the United States, but the latter is now invariably used when a peg or stake is meant.

Two obsolete meanings of the word should also be mentioned. The "picket" was a form of military punishment in vogue in the 16th and 17th centuries, which consisted in the offender being forced to stand on the narrow flat top of a peg for a period of time. The punishment died out in the 18th century and was so far unfamiliar by 1800 that Sir Thomas Picton, who ordered a mulatto woman to be so punished, was accused by public opinion in England of inflicting a torture akin to impalement. It was thought, in fact, that the prisoner was forced to stand on the head of a pointed stake, and this error is repeated in the *New English Dictionary*. In the middle of the 19th century, when elongated rifle bullets were a novelty, they were often, and especially in America, called pickets. The ordinary military use of the word gives rise to compound forms such as "picket boat" or "picket launch," large steam launch or pinnace fitted with guns and torpedoes, and employed for watching the waters of harbours, &c. For picketing in strikes, &c., see below.

PICKETING, a term used to describe a practice resorted to by workmen engaged in trade disputes, of placing one or more men near the works of the employer with whom the dispute is pending, with the object of drawing off his hands or acquiring information useful for the purposes of the dispute. In England, under the Conspiracy and Protection of Property Act 1875, it is an offence wrongfully and without legal authority to watch or beset the house or place where another resides or works, or carries on business or happens to be, or the approach to such house or place, if the object of the watching, &c., is to compel the person watched, &c., to abstain from doing or to do an act which he is legally entitled to do or to abstain from doing (§ 7). The definition of the offence was qualified by a proviso excluding from punishment those who attend at or near a house or place merely to obtain or communicate information, in other words what is termed peaceful picketing, without intimidation, molestation or direct efforts to influence the course of a trade dispute. This enactment led to a great deal of litigation between trade unions and employers; and trade unions were in some instances restrained by injunction from picketing the works of employers, The decisions of the courts upon this subject met with severe criticism from the leaders of trade unions, and by the Trades Disputes Act 1906 the proviso above quoted was repealed, and it was declared lawful for one or more persons acting for themselves or for a trade union or for an individual employer to attend at or near a house, &c., "if the attendance is merely for the purpose of peacefully obtaining or communicating information or of peacefully persuading any person to work or abstain from working." The exact effect of this change in the law has not yet been determined by the courts, but during the Belfast carters' strike of 1907 serious riots ensued upon the efforts of the authorities to counteract the interference with lawful business caused by free use of picketing. The change in the law is supplemented by provisions forbidding actions against trade unions in respect of any tortious acts alleged to have been committed by or on behalf of the union.

PICKLE. In the wider sense the term "pickle" is applied to any saline or acid preservative solution; in the narrower to vegetables preserved in vinegar. The word appears to be an adaptation of Dutch *pekel*, brine, pickle; cf. Ger. Pökel. The ultimate origin is unknown; connexions with a supposed inventor's name, such as *Beukeler* or *Böckel* are mere inventions. A solution of copper or zinc sulphate is used as a "pickle" for railway-sleepers or other wood, a brine containing salt and saltpetre as a preservative for meat, lime-water as "pickle" for eggs. Domestic pickles are made from small cucumbers, onions, cauliflowers, cabbages, mangoes and unripe walnuts, by either steeping or boiling them in salt-brine and vinegar. On account of the large proportion of water natural to these vegetables, only the strongest vinegar, containing from 5 to 6% of acetic acid, can be used. For the better kinds vinegar made from malted or unmalted barley is as a rule employed, for cheaper varieties simply dilute acetic acid obtained from acetate of lime. Sauces such as Worcestershire sauce, or Yorkshire relish, consist of fluid pickles, that is of salted and variously spiced vinegar solutions or emulsions containing tissue of vegetables (tomatoes, mushrooms, &c.), or of fish (sardines or anchovies).

PICKNELL, WILLIAM LAMB (1854–1897), American landscape-painter, was born at Hinesburg, Vermont, on the 23rd of October 1854. He was a pupil of George Inness in Rome for two years, and of J. L. Gérôme in the École des Beaux Arts, Paris. With Robert Wylie he worked for several years in Brittany, at Pont Aven and Concarneau, where he painted his "Route de Concarneau" (Corcoran Art Gallery, Washington, D.C.). His "Morning on the Loing" received a gold medal at the Paris Salon of 1895. In 1880 he became a member of the Society of American Artists, and in 1891 an associate of the National Academy of Design. He died at Marblehead, Massachusetts, on the 8th of August 1897.

PICNIC, a form of entertainment in which the guests are invited to join an excursion to some place where a meal can be taken in the open air. During the first half of the 19th century the essential of a picnic was that the guests should each bring with them a contribution of provisions. At the beginning of the 19th century a society was formed in London called the "Picnic Society," the members of which supped at the Pantheon in Oxford Street, and drew lots as to what part of the meal each should supply (see L. Melville, *The Beaux of the Regency*, 1908, i. 222). The French form *pique-nique* is said to be of recent introduction in 1692 (Ménage, *Dict. etym.*). It is doubtful whether picnic is merely a rhyming word, or can be referred to *pique*, pick, and *nique*, small coin.

PICO, an island in the Atlantic Ocean, belonging to Portugal, and forming part of the Azores archipelago. Pop. (1900), 24,028; area 175 sq. m. Pico is a conical mountain, rising to the height of 7612 ft. The soil consists entirely of pulverized lava. The so-called Fayal wine, though named after an adjacent island, was formerly produced here, and largely exported to Europe. But in 1852 the vines were attacked by the *Oidium* fungus and completely destroyed, while the orange-trees suffered almost as much from the *Coccus hesperidum*. The people were consequently forced to emigrate in great numbers, till the planting of fig-trees and apricots alleviated the evil. Pico also produces a species of wood resembling mahogany, and equal in quality to it. Its chief town is Lagens do Pico. Pop. (2975).

PICO DELLA MIRANDOLA, GIOVANNI, Count (1463–1494), Italian philosopher and writer, the youngest son of Giovanni

Francesco Pico, prince of Mirandola, a small territory about 30 Italian miles west of Ferrara, afterwards absorbed in the duchy of Modena, was born on the 24th of February 1463. The family was illustrious and wealthy, and claimed descent from Constantine. In his fourteenth year Pico went to Bologna, where he studied for two years, and was much occupied with the Decretals. The traditional studies of the place, however, disgusted him; and he spent seven years wandering through all the schools of Italy and France and collecting a precious library. Besides Greek and Latin he knew Hebrew, Chaldee and Arabic; and his Hebrew teachers (Eliah del Medigo, Leo Abarbanel and Jochanan Aleman—see L. Geiger *Johann Reuchlin* (1871), p. 167) introduced him to the Kabbalah, which had great fascinations for one who loved all mystic and theosophic speculation. His learned wanderings ended (1486) at Rome, where he set forth for public disputation a list of nine hundred questions and conclusions in all branches of philosophy and theology. He remained a year in Rome, but the disputation he proposed was never held. The pope prohibited the little book in which they were contained, and Pico had to defend the impugned theses (*De omni re scibili*) in an elaborate *Apologia*. His personal orthodoxy was, however, subsequently vindicated by a brief of Alexander VI., dated 18th June 1493. The suspected theses included such points as the following: that Christ descended *ad inferos* not in His real presence but *quoad effectum*; that no image or cross should receive *latreia* even in the sense allowed by Thomas; that it is more reasonable to regard Origen as saved than as damned; that it is not in a man's free will to believe or disbelieve an article of faith as he pleases. But perhaps the most startling thesis was that no science gives surer conviction of the divinity of Christ than "magia" (*i.e.* the knowledge of the secrets of the heavenly bodies) and Kabbalah. Pico was the first to seek in the Kabbalah a proof of the Christian mysteries and it was by him that Reuchlin was led into the same delusive path.

Pico had been up to this time a gay Italian nobleman; he was tall, handsome, fair-complexioned, with keen grey eyes and yellow hair, and a great favourite with women. But his troubles led him to more serious thoughts; and he published, in his 28th year, the *Heptaplus*, a mystical exposition of the creation. Next he planned a great seven-fold work against the enemies of the Church, of which only the section directed against astrology was completed. After leaving Rome he again lived a wandering life, often visiting Florence, to which he was drawn by his friends Politian and Marsilius Ficinus, and where also he came under the influence of Savonarola. It was at Florence that he died on the 17th of November 1494. Three years before his death he parted with his share of the ancestral principality, and designed, when certain literary plans were completed, to give away all he had and wander barefoot through the world preaching Christ. But these plans were cut short by a fever which carried him off just at the time when Charles VIII. was at Florence.

Pico's works cannot now be read with much interest, but the man himself is still interesting, partly from his influence on Reuchlin and partly from the spectacle of a truly devout mind in the brilliant circle of half-pagan scholars of the Florentine renaissance.

His works were published at Bologna in 1496 by his nephew, Giov. Fran. Pico, with a biography, which was translated by Sir Thomas More as *Life of John Picus, Earl of Mirandola*, in 1510. See the essay in Walter Pater's *Renaissance* (1878); and the study by J. Rigg, prefixed to the reprint of More's *Life* in the "Tudor Library" (London, 1890).

PICRIC ACID, or TRINITROPHENOL, $C_6H_2\cdot OH\cdot (NO_2)_3$ [1·2·4·6], an explosive and dyestuff formed by the action of concentrated nitric acid on indigo, aniline, resins, silk, wool, leather, &c. It is the final product of the direct nitration of phenol, and is usually prepared by the nitration of the mixture of phenol sulphonic acids obtained by heating phenol with concentrated sulphuric acid (E. Eisenmann and A. Arche, Eng. pat., 4539 (1889). It may also be obtained by oxidizing the symmetrical trinitrobenzene with potassium ferricyanide in alkaline solution (P. Hepp, *Ann.* 1882, 215, p. 352). It crystallizes from water in yellow plates melting at 122·5° C., which sublime on careful heating, but explode when rapidly heated. It is poisonous and possesses a bitter taste, hence its name from the Greek πικρός, bitter. It has a strongly acid reaction, being almost comparable with the carboxylic acids. By the action of bleaching powder it is converted into chlorpicrin, $CCl_3\cdot NO_2$. Phosphorus pentachloride converts it into picryl chloride, $C_6H_2Cl(NO_2)_3$, which is a true acid chloride, being decomposed by water with the regeneration of picric acid and the formation of hydrochloric acid; with ammonia it yields *picramide*, $C_6H_2NH_2(NO_2)_3$. Silver picrate and methyl iodide yield the methyl ester, which gives with ammonia picramide. Picric acid forms many well-defined salts, of a yellow or red-brown colour. It also yields crystalline compounds with many aromatic hydrocarbons and bases. It imparts a yellow colour to wool and silk. The chief application of picric acid and its salts is in the manufacture of explosives. When ignited, picric acid burns quietly with a smoky flame, and it is very difficult to detonate by percussion; its salts, however, are more readily detonated. The more important picric powders are *melinite*, believed to be a mixture of fused picric acid and gun-cotton; *lyddite*, the British service explosive, and *shimose*, the Japanese powder, both supposed to be identical with the original melinite; *Brugère's powder*, a mixture of 54 parts of ammonium picrate and 45 parts of saltpetre; *Designolle's powder*, composed of potassium picrate, saltpetre and charcoal; and *emmensite*, invented by Stephen Emmens, of the United States.

It may be detected by the addition of an aqueous solution of potassium cyanide, with which it gives a violet-red coloration, due to the formation of isopurpuric acid. R. Anschutz (*Ber.*, 1884, 17, p. 439) estimates picric acid by precipitation with acridine.

PICRITE (from Gr. πικρός, bitter, because these rocks are rich in magnesia, a base which forms bitter salts), a rock belonging to the ultrabasic group, and consisting mainly of olivine and augite often with hornblende and biotite and a greater or less amount of plagioclase felspar. The picrites are of "hypabyssal" origin and in their natural occurrence are connected with dolerites (diabases and teschenites). The distinction between them and the peridotites, which have an essentially similar composition, is not easy to define, but the peridotites accompany the true plutonic rocks, such as gabbro, norite and pyroxenite, are often very coarsely crystalline, and form large bosses and laccolites, while the picrites usually are found in sills or intrusive sheets.

In hand specimens the picrites are dark green to black; the absence or scarcity of lath-shaped plagioclase felspars distinguishes them from diabases and they rarely have the lustre-mottling which is a characteristic of the peridotites. Since they contain much olivine they readily decompose, passing into deep green and brown incoherent masses in which are embedded rounded lumps of harder consistency. They have a high specific gravity (about 3·0) and may be distinctly magnetic, because they are rich in iron ores. Porphyritic structure is rare though occurring sometimes in the rocks known as picrite-porphyrites; the phenocrysts are olivine and augite. There is seldom any fine-grained or glassy groundmass, and the typical microstructure is holocrystalline, moderately fine grained and somewhat poikilitic. Olivine is abundant in rounded pale green crystals. It may form one half of the rock but rarely more than this. The augite is generally brown or reddish-brown, sometimes violet, and tends to enclose the olivine, yielding poecilitic aggregates. Brown hornblende often occurs as marginal growths around the pyroxene, and may be so abundant as to replace augite to a large extent; rocks of this class are known as hornblende-picrites. Bright green or pale-green hornblende are less frequently present, and in many cases are really of secondary origin. Deep brown biotite is a frequent accessory mineral and both biotite and hornblende sometimes enclose olivine. A small amount of basic plagioclase occurs in many picrites; apatite, iron oxides, chromite and spinels are minor ingredients seldom altogether absent.

The minerals of picrites are very frequently decomposed. Serpentine partly or wholly replaces olivine, forming radiate fibrous masses which are green, yellow or red in microscopic sections. Sometimes hornblende (pilite), talc, chlorite and mica appear as secondary products after olivine. The augite passes into chlorite or into green fibrous or platy amphibole. Hornblende and biotite are often fresh when the other components are much altered. The felspar is rarely in good preservation but yields epidote, prehnite, sericite, kaolin; calcite and analcite are abundant in some weathered picrites.

Rocks of this type are well represented in Great Britain. In the central valley of Scotland several masses of picrite have been discovered, always in close association with olivine-diabase and teschenite. One of these forms the island of Inchcolm in the Firth of Forth, another lies near Bathgate (in Linlithgowshire), and there are others at Aberdour (Fife), Ardrossan and Barnton (Midlothian). They belong to the great series of Carboniferous eruptive rocks of the Scottish midland valley. These picrites are not known to be represented in England, but, on the other hand, there are Devonian picrites in Devon and Cornwall as basic members of the diabase and proterobase series of these counties. Some of them contain much augite like the picrite (often called palaeopicrite as being of palaeozoic age) at Menheniot Station in Cornwall and the picrite of Highweek near Newton Abbot in Devonshire. Others are hornblende-picrites like that of Cartuther near St Germans, Cornwall. Hornblende-picrite occurs also in the island of Sark and several beautiful examples have been described from Anglesey and from Penarfynnydd in North Wales and from Wicklow in Ireland. Picrites occur in several parts of Germany, notably in the Devonian rocks of the Fichtelgebirge and Nassau, where they accompany diabases and proterobases like those of Cornwall and Devonshire. In Silesia and Moravia picrites are found with teschenites like those of Central Scotland. In some of the continental picrites enstatite is present but is rare. In North America picrites occur among the igneous rocks on the Hudson river and in Alabama and Montana. (J. S. F.)

PICROTOXIN, a neutral principle obtained from the *Cocculus indicus*, which is the fruit of the *Anamirta paniculata.* It is used in medicine externally as an antiparasitic. Internally it has been successfully used to check the night-sweats of phthisis. In large doses it is a powerful poison, causing unconsciousness, delirium, convulsions, gastro-enteritis and stimulation of the respiratory centre followed by paralysis, from which death sometimes results. Formerly low class publicans sometimes added *Cocculus indicus* berries to beer to increase the intoxicating effects. Its chemical formula is $C_{15}H_{16}O_6 \cdot H_2O$.

PICTET DE LA RIVE, FRANÇOIS JULES (1809–1872), Swiss zoologist and palaeontologist, was born in Geneva on the 27th of September 1809. He graduated B. ès Sc. at Geneva in 1829, and pursued his studies for a short time at Paris, where under the influence of Cuvier, de Blainville and others, he worked at natural history and comparative anatomy. On his return to Geneva in 1830 he assisted A. P. de Candolle by giving demonstrations in comparative anatomy. Five years later, when de Candolle retired, Pictet was appointed professor of zoology and comparative anatomy. In 1846 his duties were restricted to certain branches of zoology, including geology and palaeontology, and these he continued to teach until 1859, when he retired to devote his energies to the museum of natural history and to special palaeontological work. He was rector of the academy from 1847 to 1850, and again from 1866 to 1868. He was for many years a member of the Representative Council of Geneva, and in 1862 President of the Constituent Assembly. His earlier published work related chiefly to entomology, and included *Recherches pour servir à l'histoire et à l'anatomie des Phryganides* (1834) and two parts of *Histoire naturelle, générale et particulière des insectes Neuroptères* (1842–1845). Feeling the want of a hand-book, he prepared his *Traité élémentaire de paléontologie* (4 vols. 1844–1846). In the first edition Pictet, while adopting the hypothesis of successive creations of species, admitted that some may have originated through the modification of pre-existing forms. In his second edition (1853–1857) he enters further into the probable transformation of some species, and discusses the independence of certain faunas, which did not appear to have originated from the types which locally preceded them. He now directed his attention to the fossils of his native country, more especially to those of the Cretaceous and Jurassic strata, and in 1854 he commenced the publication of his great work, *Matériaux pour la paléontologie suisse,* a series of quarto memoirs, of which six were published (1854–1873). In this work Pictet was aided by E Renevier, G. Campiche, P. de Loriol and others. Pictet also brought out *Mélanges paléontologiques* (1863–1868). He died at Geneva on the 15th of March 1872.

Obituary by W. S. Dallas, *Quart. Journ. Geol. Soc.* (1873), vol. xxix.

PICTON, SIR THOMAS (1758–1815), British general, was the younger son of Thomas Picton, of Poyston, Pembrokeshire, where he was born in August 1758. In 1771 he obtained an ensign's commission in the 12th regiment of foot, but he did not join until two years afterwards. The regiment was then stationed at Gibraltar, where he remained until he was made captain in the 75th in January 1778, when he returned to England. The regiment was disbanded five years later. On the occasion of its disbandment Picton quelled a mutiny amongst the men by his prompt personal action and courage, and was promised a majority in reward for his conduct. This, however, he did not receive, and after living in retirement on his father's estate for nearly twelve years, he went out to the West Indies in 1794 on the strength of a slight acquaintance with Sir John Vaughan, the commander-in-chief, who made him his aide-de-camp and gave him a captaincy in the 17th foot. Shortly afterwards he was promoted major. Under Sir Ralph Abercromby, who succeeded Vaughan in 1795, he took part in the capture of St Lucia (for which he was promoted lieutenant-colonel) and in that of St Vincent. After the reduction of Trinidad Abercromby made him governor of the island. He administered the island with such success that the inhabitants petitioned against the retrocession of the island to Spain, and their protest, with Picton's and Abercromby's representations, ensured the retention of Trinidad as a British possession. In October 1801 he was gazetted brigadier-general. But by this time the rigour of his government, as reported by his enemies, had led to a demand by humanitarians at home for his removal. Colonel William Fullarton (1754–1808) procured the appointment of a commission to govern the island, of which he himself was the senior member, Captain (afterwards Admiral Sir Samuel) Hood the second, and Picton himself the junior. Picton thereupon tendered his resignation, and Hood, as soon as the nature of Fullarton's proceedings became obvious, followed his example (1803). On his way home Picton took part with great credit in military operations in St Lucia and Tobago. Realizing, however, that the attacks upon him were increasing in virulence, he quickly returned to England, and in December 1803 he was arrested by order of the privy council. He was tried in the court of king's bench before Lord Ellenborough in 1806 on a charge of unlawfully applying torture to extort a confession from Luise Calderon, a mulatto woman of loose character who was charged, along with a man, with robbery. The torture consisted in compelling the woman to stand on one leg on a flat-headed peg for one hour. The punishment was ordered under Spanish law (which in default of a fresh code Picton had been appointed to administer in 1801) by the local alcalde, and approved by Picton. On these grounds the court returned a merely technical verdict of guilty, which was superseded in 1808 by a special verdict on retrial. It should be mentioned that the inhabitants of the island, who had already given him a sword of honour, and had petitioned the king not to accept his resignation, subscribed £4000 towards his legal expenses, which sum Picton contributed in return to the relief of the suffering caused by a widespread fire in Port of Spain. He had meanwhile been promoted major-general, and in 1809 he had been governor of Flushing during the Walcheren expedition. In 1810, at Wellington's request, he was appointed to command a division in Spain. For the remaining years of the Peninsular War, Picton was one of Wellington's principal subordinates. The commander-in-chief, it is true, never reposed in him the confidence that he gave to Beresford Hill and Craufurd. But in the resolute, thorough and punctual execution of a well-defined task Picton had no superior in the army. His début, owing partly to his naturally stern and now embittered temper, and partly to the difficult position in which he was placed, was unfortunate. On the Coa in July 1810 Craufurd's division became involved in an action, and Picton, his nearest neighbour, refused to support him, as Wellington's direct orders were to avoid an engagement. Details of the incident will be found in Oman, *Peninsular War*, vol. iii. Shortly after this, however, at Busaco, Picton found and used his first great opportunity for distinction. Here he had a plain duty, that of repulsing the French attack, and he performed that duty with a skill and resolution which indicated his great powers as a troop-leader. After the winter in the lines of Torres Vedras, he added to his reputation and to that of his division, the 3rd, at Fuentes d'Onor. In September he was given the local rank of lieutenant-general, and in the same month the division won great glory by its rapid and orderly retirement under severe pressure from the French cavalry at El Bodon. In October Picton was appointed to the colonelcy of the 77th regiment. In the first operations of 1812 Picton and Craufurd, side by side for the last time, stormed the two breaches of Ciudad Rodrigo, Craufurd and Picton's second in command, Major-General Mackinnon, being mortally wounded. At Badajoz, a month later, the successful storming of the fortress was due to his daring self-reliance and penetration in converting the secondary attack on the castle, delivered by the 3rd division, into a real one. He was himself wounded in this terrible engagement, but would not leave the ramparts, and the day after, having recently inherited a fortune, he gave every survivor of his command a guinea. His wound, and an attack of fever, compelled him to return to England to recruit his health, but he reappeared at the front in April 1813. While in England he was invested with the collar and badge of a K.B. by the prince regent, and in June he was made a lieutenant-general in the army. The conduct of the 3rd division under his leadership at the battle of Vittoria and in the engagements in the Pyrenees raised his reputation as a resolute and skilful fighting general to a still higher point. Early in 1814 he was offered, but after consulting Wellington declined, the command of the British forces operating on the side of Catalonia. He thus bore his share in the Orthez campaign and in the final victory before Toulouse.

On the break-up of the division the officers presented Picton with a valuable service of plate, and on the 24th of June 1814 he received for the seventh time the thanks of the House of Commons for his great services. Somewhat to his disappointment he was not included amongst the generals who were raised to the peerage, but early in 1815 he was made a G.C.B. When Napoleon returned from Elba, Picton, at Wellington's request, accepted a high command in the Anglo-Dutch army. He was severely wounded at Quatre Bras on the 16th of June, but concealed his wound and retained command of his troops, and at Waterloo on the 18th, while repulsing with impetuous valour "one of the most serious attacks made by the enemy on our position," he was shot through the head by a musket ball. His body was brought home to London, and buried in the family vault at St George's, Hanover Square. A public monument was erected to his memory in St Paul's Cathedral, by order of parliament, and in 1823 another was erected at Carmarthen by subscription, the king contributing a hundred guineas thereto.

See Robinson's *Life of Sir Thomas Picton* (London, 1836), with which, however, compare Napier's and Oman's histories of the Peninsular War as to controversial points.

PICTOU, a seaport, port of entry, and capital of Pictou county, Nova Scotia, 90 m. N.E. by N. of Halifax, on a branch of the Intercolonial railway. Pop. (1901), 3235. It has several valuable industries, and is the shipping port for the adjacent coal-mines. The Academy, founded in 1818, played an important part in the early educational history of the province, and still enjoys a high reputation.

PICUS, in Roman mythology, originally the woodpecker, the favourite bird and symbol of Mars as the god of both nature and war. He appears later as a spirit of the forests, endowed with the gift of prophecy, haunting springs and streams, with a special sanctuary in a grove on the Aventine. As a god of agriculture, especially connected with manuring the soil, he is called the son of Stercutus (from *stercus*, dung, a name of Saturn). Again, Picus is the first king of Latium, son of Saturn and father of Faunus. Virgil (*Aen.* vii. 170) describes the reception of the ambassadors of Aeneas by Latinus in an ancient temple or palace, containing figures of his divine ancestors, amongst them Picus, famous as an augur and soothsayer. According to Ovid (*Metam.* xiv., 320), Circe, while gathering herbs in the forest, saw the youthful hero out hunting, and immediately fell in love with him. Picus rejected her advances, and the goddess in her anger changed him into a woodpecker, which pecks impotently at the branches of trees, but still retains prophetic powers. The purple cloak which Picus wore fastened by a golden clasp is preserved in the plumage of the bird. In the simplest form of art, he was represented by a wooden pillar surmounted by a woodpecker; later, as a young man with the bird upon his head.

Picumnus is merely another form of Picus, and with him is associated his brother and double Pilumnus. Picumnus, a rustic deity (like Picus) and husband of Pomona, is specially concerned with the manuring of the soil and hence called *Sterquilinus*, while Pilumnus is the inventor of the pounding of grain, so named from the pestle (*pilum*) used by bakers. Under a different aspect, the pair were regarded as the guardians of women in childbed and of new-born children. Before the child was taken up and formally recognized by the father, a couch was set out for them in the atrium, where their presence guarded it from all evil. Augustine (*De civitate dei*, vi. 9) mentions a curious custom: to protect a woman in childbed from possible violence on the part of Silvanus, the assistance of three deities was invoked—Intercidona (the hewer), Pilumnus (the pounder) and Deverra (the sweeper). These deities were symbolically represented by three men who went round the house by night. One smote the threshold with an axe, another with a pestle, the third swept it with a broom—three symbols of culture (for trees were hewn down with the axe, grain pounded with the pestle, and the fruits of the field swept up with the broom) which Silvanus could not endure.

PIDGIN [or Pigeon] **ENGLISH**, the *lingua-franca* of the seaports of China, the Straits Settlements in the Far East, consisting in a jargon of corrupted English words with some intermixture of Portuguese and Malay, following Chinese idiomatic usage. It is employed as a means of communication between foreigners and the native Chinese. The word "pidgin" is the Chinese corruption of "business."

PIE. (1) The name of the bird more generally known as the magpie (*q.v.*). The word comes through the French from Lat. *pica* (*q.v.*). It is probably from the black and white or spotted appearance of the bird that the name "pie" or "pye" (Lat. *pica*) was given to the ordinal, a table or calendar which supplemented that which gave the services for the fixed festivals, &c., and pointed out the effect on them of the festivals rendered movable by the changing date of Easter. An English act of 1549 (3 & 4 Edw. VI. c. 10) abolished "pies" with manuals, legends, primers and other service books. The parti-coloured appearance of the magpie also gives rise to the term "piebald," applied to an animal, more particularly a horse, which is marked with large irregular patches of white and black; where the colour is white and some colour other than black, the more appropriate word is "skew-bald," *i.e.* marked with "skew" or irregular patches. (2) A dish made of meat, fish or other ingredients, also of vegetables or fruit, baked in a covering of pastry; in English usage, where "fruit" is the ingredient, the dish is generally called a "tart," except in the case of "apple-pie." The word appears early in the 14th century of meat or fish pies.

The expression "to eat humble-pie," *i.e.* to make an apology, to retract or recant, is a facetious adaptation of "umbles" (O. Fr. *nombles*, connected with Lat. *lumbus*, loin or *umbilicus*, navel), the inner parts of a deer, to "humble" (Lat. *humilis*, lowly). An "umble-pie," made of the inner parts of a deer or other animal, was once a favourite dish. "Printers' pie," *i.e.* a mass of confused type, is a transferred sense of "pie," the dish, or of "pie," the ordinal, from the difficulty of decipherment.

PIEDMONT (Ital. *Piemonte*; Low Lat. *Pedemons* and *Pedemontium*), a territorial division (*compartimento*) of northern

Italy, bounded N. by Switzerland, W. by France, S. by Liguria and E. by Lombardy. Physically it may be briefly described as the upper gathering-ground and valley of the river Po, enclosed on all sides except towards the Lombard plain by the vast semicircle of the Pennine, Graian, Cottian, Maritime and Ligurian Alps. In 1859 it was divided into the four provinces of Alessandria, Cuneo, Novara and Torino (Turin). It has an area of 11,340 sq. m. The people are chiefly engaged in agriculture—growing wheat, maize and rice, chestnuts, wine and hemp; in the reeling and throwing of silk and in the manufacture of cotton, woollens and clothing; there are also considerable manufactures at Turin, Savigliano, &c. The Piedmontese dialect has been rather strongly influenced by French. The chief towns in the several provinces are as follows, with their communal populations in 1901: Alessandria (72,109), Asti (39,251), Casale Monferrato (31,370), Novi Ligure (17,868), Tortona (17,419), Acqui (13,940), Valenza (10,956), Ovada (10,284); total of province 825,745, number of communes 343; Cuneo (26,879), Mondovì (18,982), Fossano (18,175), Savigliano (17,340), Saluzzo (16,028), Brà (15,821), Alba (13,637), Boves (10,137); total of province 670,504, number of communes 263; Novara (44,249), Vercelli (30,470), Biella (19,267) Trino (12,138), Borgomanero (10,131); total of province 763,830; number of communes, 437; Turin (329,691), Pinerolo (18,039), Carmagnola (11,721), Ivrea (11,696), Moncalieri (11,467); total of province 1,147,414; number of communes, 442. The total population of Piedmont was 2,738,814 in 1859, and in 1901 3,407,493. The large number of communes is noticeable, as in Lombardy, and points to a village life which, owing to greater insecurity and the character of the country, is not to be found in central and southern Italy as a whole. There are numerous summer resorts in the Alpine valleys. The chief railway centres are Turin, communicating with the Mont Cenis line, and with the Riviera by the railway over the Col di Tenda (in process of construction), Novara, Vercelli, Asti, Alessandria, Novi. The communications with Liguria are difficult owing to the approach of the mountains to the coast, and the existing lines from Genoa to Turin and Milan are hardly sufficient to cope with the traffic.

Piedmont in Roman times until 49 B.C. formed a part of Gallia Transpadana, and in Augustus' division of Italy formed with what was later known as Lombardy the 11th region. It formed part of the Lombard kingdom, and it was not till about A.D. 1000 that the house of Savoy (*q.v.*) arose. The subsequent history of Piedmont is that of its dynasty.

PIENZA, a town of Tuscany, Italy, in the province of Siena, 9 m. west of the town of Montepulciano by road, 1611 ft. above sea-level. Pop. (1901), 2730 (town); 3836 (commune). The place was originally called Corsignano and owes its present name to Aeneas Silvius Piccolomini, Pope Pius II. (*q.v.*) who was born here in 1405. The buildings which he caused to be erected by Bernardo Rossellino in 1460–1463 form a noble group of early Renaissance architecture round the Piazza del Duomo. The latter retains Gothic details in the interior, but the façade is simple Renaissance work. The other three sides are occupied by the episcopal and municipal palaces, and the Palazzo Piccolomini; the last, resembling the Palazzo Rucellai at Florence, is the finest, and in front of it is a beautiful fountain. The episcopal palace contains a museum with some fine ecclesiastical vestments, enamels and other works of art.

PIER (older forms *per* or *pere*, from Med. Lat. *pera*; the word is of obscure origin, and the connexion with Fr. *pierre*, Lat. *petra*, stone, is doubtful; equivalents are Fr. *piedroit*, *pilier*, *trumeau*; Ital. *pila*; Ger. *Pfeiler*), the term given in architecture to a vertical support in masonry or brickwork, usually rectangular on plan, which carries an arch or superstructure. The term is also sometimes given to the great circular columns which in some English cathedrals and churches carry the nave arches. In early Christian churches, when antique columns, such as abounded in Rome, were not procurable, square piers took the place of columns and sometimes alternated with them. The introduction of vaulting, however, in the 11th century, necessitated a support of much greater dimensions than those which had been deemed sufficient when the roof was of timber only, and led to the development of the compound or clustered pier. To give extra support to the subordinate arches of the nave arcade, semicircular shafts or pilasters were added, carried up to the transverse and diagonal ribs of the main vault. In Romanesque work the pier was generally square on plan with semicircular shafts attached, the angles of the pier being worked with smaller shafts. As the rings or orders of the nave arches increased in number, additional shafts were added to carry them, and the pilaster facing the nave had central and side shafts rising to carry the transverse and diagonal ribs of the vault; this development of the compound pier obtains throughout Europe in all vaulted structures. In the Early English period the piers become loftier and lighter, and in most important buildings a series of clustered columns, frequently of marble, are placed side by side, sometimes set at intervals round a circular centre, and sometimes almost touching each other. These shafts are often wholly detached from the central pier, though grouped round it, in which case they are almost always of Purbeck or Bethersden marbles. In Decorated work the shafts on plan are very often placed round a square set angle-wise, or a lozenge, the long way down the nave; the centre or core itself is often worked into hollows or other mouldings, to show between the shafts, and to form part of the composition. In this and the latter part of the previous style there is generally a fillet on the outer part of the shaft, forming what has been called a "keel moulding" (*q.v.*). They are also often tied together by bands, formed of rings of stone and sometimes of metal. About this period, too, these intermediate mouldings run up into and form part of the arch moulds, there being no impost. This arrangement became much more frequent in the Perpendicular period; in fact it was almost universal, the commonest section being a lozenge set with the long side from the nave to the aisle, and not towards the other arches, as in the Decorated period, with four shafts at the angles, between which were shallow mouldings, one of which was in general a wide hollow, sometimes with wave moulds. The small columns at the jambs of doors and windows, and in arcades, and also those attached to piers or standing detached, are generally called "shafts" (*q.v.*).

The term pier is sometimes applied to the solid parts of a wall between windows or voids, and also to the isolated masses of brickwork or masonry to which gates are hung. (R. P. S.)

Piers of Bridges.—The piers of bridges and viaducts on land are constructed of masonry or brickwork and occasionally, in the case of high piers, of open braced ironwork, as exemplified by the old Crumlin viaduct in Wales and the Pecos viaduct in Texas. These piers, besides being proportioned in cross-section to the weight they have to support, are widened out at their base, so as to distribute the load over a sufficient area for it to be borne by the stratum on which it rests without risk of settlement. Special provisions have to be made for the foundations of piers where the ground is soft for some depth, or loose water-bearing strata are encountered, and especially where the piers of large bridges crossing rivers have to be constructed under water. In soft ground, bearing piles driven down to a firm stratum, and surmounted by a planked floor or a layer of concrete, provide a convenient foundation for a pier; and in places where timber is abundant, wooden cribs filled with rubble stone or concrete have been used in the United States for raising the foundations for piers out of water. For river piers, where a firm, watertight stratum is found at a moderate depth below the river-bed, the site is often enclosed within a coffer-dam or a plate iron caisson carried down into the stratum and raised out of water; and then, after the water has been pumped out and the surface layers removed, the pier is readily built within the enclosure in the open air. When, however, a river-bed consists of silt, sand or other soft materials extending down to a considerable depth, brickwork wells are gradually sunk to a firm stratum by removing the material within them with grabs, and on them the piers are built out of water; or bottomless caissons are carried down by excavating their interiors under compressed air, and the piers are built on top of them within a plate-iron enclosure, a system adopted for the piers of the Brooklyn, St Louis, Forth and other large bridges, and essential for forming foundations on sloping rock, such as was encountered in places under the Firth of Forth.

The methods indicated above as employed for the foundations of the piers of bridges under favourable conditions belong equally to the foundations of other structures (see FOUNDATIONS); but there are some methods which, by combining bridge piers and their foundations in a single structure, appertain entirely to piers. Thus iron screw piles, sunk by turning into the soft bed of a river till they reach a firm stratum or one sufficiently consolidated by the superincumbent layers to enable it to support the wide blades of the screws with the weight imposed on them, were formerly often arranged in converging clusters joined together at the top, so as to serve as the piers of bridges having several comparatively small spans, and intended for carrying lightly constructed railways across rivers in India and elsewhere. Hollow, cast-iron, cylindrical piles also, with a broad circular disk at the bottom to increase their bearing surface, have been used for piers founded in sandy or silty strata of considerable thickness; they are sunk to the requisite depth by lowering a pipe down the inside of the pile to the bottom and emitting a powerful jet of water which, stirring up the soft material and scouring it away from under the disk, causes the pile to descend. This system was first adopted for the piers of a railway viaduct crossing the wide, sandy Kent and Leven estuaries opening into Morecambe Bay (fig. 1). Cast-iron cylinders, consisting of a series of rings formed of segments all bolted together with a specially strong bottom ring, sometimes made of wrought iron and having a cutting edge, have been often employed for the construction of the river piers of bridges, being gradually carried down to a watertight stratum by excavating inside, and subsequently filled up solid with concrete and brickwork; the piers of the Charing Cross and Cannon Street bridges across the Thames are notable instances of the adoption of this method, which is well illustrated by the piers of the bridges across the River Chittravati in India (fig. 2). Sometimes, instead of two or more independent cylinders being sunk, the whole site of a pier is enclosed within a wrought-iron caisson, usually divided into sections by vertical partitions, which is sunk and filled up solid in the same way as cylinders, a system adopted, for instance, for the piers of the bridge across the Hawkesbury River in New South Wales.

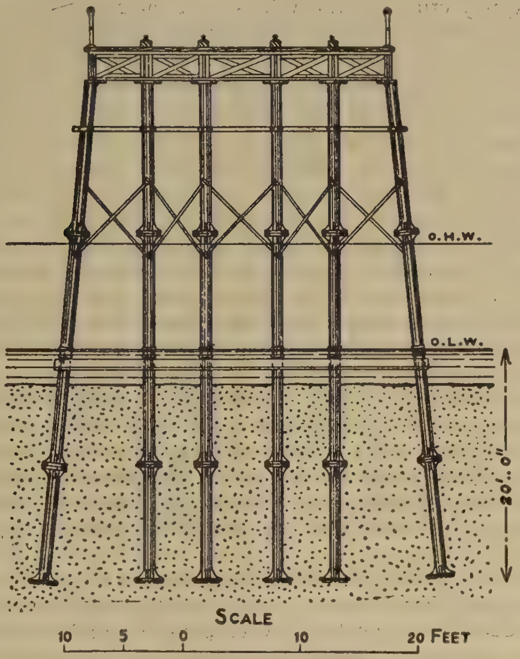

FIG. 1.—Pier with Disk Piles.

Promenade Piers.—The term pier is often applied to works sheltering harbours, such as the Tynemouth piers, which are strictly breakwaters. Landing stages also, whether solid or open, have for a long time been called piers, as the Admiralty Pier and the Prince of Wales's Pier at Dover; but the open promenade piers which form a common feature at seaside resorts are the type of pier best known to the general public. These piers are supported upon open pilework of timber or iron, and consequently expose little surface to waves in storms and do not interfere with the drift of shingle or sand along the coast (fig. 3).[1] Timber piles are best suited for withstanding the shocks of vessels at landing stages, at which places they are generally used; but since they are subject to the attacks of the teredo, and expose a considerable surface to the waves, iron piles are generally adopted for the main portion of these piers.

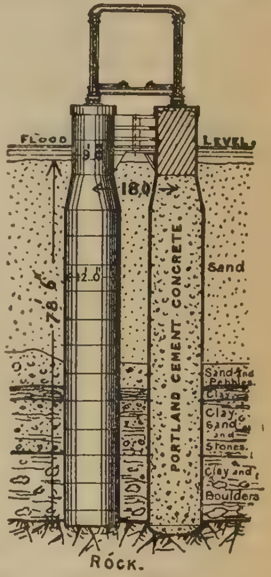

FIG. 2.—Cylindrical Piers for River Bridges.

The pioneer of these piers was the old chain pier at Brighton, which was erected in 1822–1823. It was founded upon oak piles, was 1136 ft. long, and had a timber landing-stage at the end. It consisted of four spans suspended from chains on the model of the Menai Suspension Bridge, then in course of construction, and was destroyed by a gale in December 1896. A wider and more modern type of pier was erected at the west end of Brighton in 1865–1866, and subsequently extended; whilst a new pier was completed in 1900 near the site of the old chain pier, 1700 ft. long. The Southport pier, erected in 1859–1860 and afterwards prolonged, furnishes an example of an iron pier supported on disk piles sunk in sand as described above (fig. 1); whilst the much more commonly used iron screw piles, adopted as early as 1847 for an open landing-pier on the Irish coast at Courtown, which was exposed to a great littoral drift of sand, are shown as the mode of support for the pier

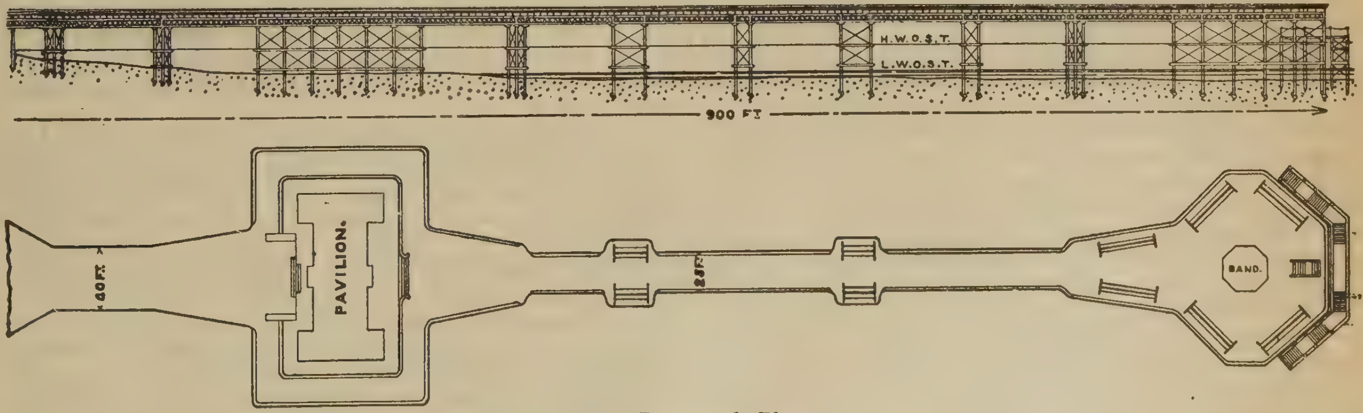

FIG. 3.—Promenade Pier.

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[1] *The Engineer* (1888), i. 380, 381 and 384.

at St Leonards (fig. 3). The length given to these promenade piers depends mainly on the slope of the foreshore, which determines the distance from the shore at which a sufficient depth is reached for steamers of moderate draught to come alongside the end of the pier. Thus, whereas a length of 900 ft. has sufficed for the St Leonards pier on a somewhat steep, shingly beach, the pier at Ryde, constituting the principal landing-place for the Isle of Wight passengers, has had to be carried out about half a mile across a flat alluvial foreshore to reach water deep enough for the access of the steamboats crossing the Solent. The vast sands, moreover, at the outlet of the Ribble estuary, stretching two or three miles in front of Southport at low water of spring tides, have necessitated the construction of a pier 4395 ft. long merely to get out to an old flood-tide channel, which is now completely severed by the sands at low water from all connexion with the river.

(L. F. V.-H.)

PIERCE, FRANKLIN (1804–1869), fourteenth president of the United States, was born at Hillsborough, New Hampshire, on the 23rd of November 1804. His father, Benjamin Pierce (1757–1839), served in the American army throughout the War of Independence, was a Democratic member of the New Hampshire House of Representatives from 1789 to 1803, and was governor of the state in 1827–1829. The son graduated in 1824 at Bowdoin College, at Brunswick, Maine, where he formed a friendship with Nathaniel Hawthorne. Pierce then studied law, and in 1827 was admitted to the bar and began to practise at Hillsborough. He at once took a lively interest in politics, and from 1829 to 1833 served in the state House of Representatives, for the last two years as Speaker. In 1833 he entered the national House of Representatives, and although he achieved no distinction in debate he was a hard worker, and a loyal supporter of the policies of President Jackson. After four years in the House he entered the Senate, being its youngest member. In 1842, before the expiration of his term, he resigned his seat, and at Concord, New Hampshire, began his career at the bar in earnest, though still retaining an interest in politics. In 1845 he declined the Democratic nomination for governor, and also an appointment to the seat in the United States Senate made vacant by the resignation of Judge Levi Woodbury. He accepted, however, an appointment as Federal District Attorney for New Hampshire, as the duties of this office, which he held in 1845–1847, were closely related to those of his profession. In 1846 he again declined public honours, when President Polk invited him to enter the cabinet as attorney-general. Soon after the outbreak of the war with Mexico, in 1846, Pierce enlisted as a private at Concord, but soon (in February 1847) became colonel of the Ninth Regiment (which joined General Winfield Scott at Pueblo on the 6th of August 1847), and later (March, 1847) became a brigadier-general of volunteers. At the battle of Contreras, on the 19th of August 1847, he was thrown from his horse and received severe injuries. At the end of the war he resigned his commission and returned to Concord. In 1850 Pierce became president of a convention assembled at Concord to revise the constitution of his state, and used his influence to secure the removal of those provisions of the constitution of 1792 which declared that only Protestants should be eligible for higher state offices. This amendment passed the convention in April 1852, but was rejected by the electorate of the state; a similar amendment was adopted by popular vote in 1877. In January 1852 the legislature of New Hampshire proposed him as a candidate for the presidency, and when the Democratic national convention met at Baltimore in the following June the Virginia delegation brought forward his name on the thirty-fifth ballot. Although both parties had declared the Compromise of 1850 a finality, the Democrats alone were thoroughly united in support of this declaration, and therefore seemed to offer the greater prospect of peace. This fact, combined with the colourless record of their candidate, enabled them to sweep the country at the November election. Pierce received 254 electoral votes, and General Winfield Scott, his Whig opponent, only 42. The Democrats carried every state except Massachusetts, Vermont, Kentucky and Tennessee. No president since James Monroe had received such a vote.

Pierce was the youngest man who had as yet been elevated to the presidency. For his cabinet he chose William L. Marcy of New York, secretary of state; Jefferson Davis of Mississippi, secretary of war; James Guthrie (1792–1869) of Kentucky, secretary of the treasury; James C. Dobbin (1814–1857) of North Carolina, secretary of the navy; Robert McClelland (1807–1880) of Michigan, secretary of the interior; James Campbell (1813–1893) of Pennsylvania, postmaster-general; and Caleb Cushing of Massachusetts, attorney-general. This was an able body of men, and is the only cabinet in American history that has continued unbroken throughout an entire administration. Although Pierce during his term in the Senate had severely criticized the Whigs for their removals of Democrats from office, he himself now adopted the policy of replacing Whigs by Democrats, and the country acquiesced. Pierce had no scruples against slavery, and opposed anti-slavery agitation as tending to disrupt the Union. The conduct of foreign relations was on the whole the most creditable part of his administration. The Koszta Affair (1853) gave the government an opportunity vigorously to assert the protection it would afford those in the process of becoming its naturalized citizens. When the British government refused to prevent recruiting for the Crimean War by their representatives in America, their minister, John F. Crampton, received his passports, and the exequaturs of the British consuls at New York, Philadelphia and Cincinnati were revoked. A commercial treaty was negotiated with Japan in 1854 after Perry's expedition in the previous year. As an avowed expansionist, Pierce sympathized with the filibuster government set up in Nicaragua by William Walker, and finally accorded it recognition. It was during this term also that the Gadsden Purchase was consummated, by which 45,535 sq. m. of territory were acquired from Mexico, and that three routes were surveyed for railways from the Mississippi river to the Pacific coast.

When the Democratic national convention met at Cincinnati in June 1856, Pierce was an avowed candidate for renomination, but as his attitude on the slavery question, and especially his subserviency to the South in supporting the pro-slavery party in the Territory of Kansas, had lost him the support of the Northern wing of his party, the nomination went to James Buchanan. After retiring from the presidency Pierce returned to Concord, and soon afterwards went abroad for a three years' tour in Europe. Many Southern leaders desired his renomination by the Democratic party in 1860, but he received such suggestions with disfavour. After his return to America he remained in retirement at Concord until the day of his death, the 8th of October 1869.

Pierce was not a great statesman, and his fame has been overshadowed by that of Benton, Calhoun, Clay and Webster. But he was an able lawyer, an orator of no mean reputation, and a brave soldier. He was a man of fine appearance and courtly manners, and he possessed personal magnetism and the ability to make friends, two qualities that contributed in great measure to his success.

A portion of Pierce's correspondence has been published in the *American Historical Review*, x. 110–127, 350–370. D. W. Bartlett's *Franklin Pierce* (Auburn, New York, 1852), and Nathaniel Hawthorne's *Franklin Pierce* (Boston, 1852), are two "campaign" biographies, and are very eulogistic. J. R. Irelan's *History of the Life, Administration and Times of Franklin Pierce* (Chicago, 1888), being vol. xiv. of his *Republic*, is a more critical work, but inaccurate as to details. J. E. Cooley's *Review of the Administration of General Pierce* (New York, 1854) and Anna E. Carroll's *Review of Pierce's Administration* (Boston, 1856) are hostile anti-administration tracts. The best accounts of Pierce's administration are to be found in James Schouler's *History of the United States*, vol. v. (new ed., New York, 1894); J. F. Rhodes's *History of the United States*, vols. i. and ii. (New York, 1893–1894); and J. W. Burgess's *Middle Period* (New York, 1900).

PIERO DI COSIMO (1462–1521), the name by which the Florentine painter Pietro di Lorenzo is generally known. He was born in Florence about 1462, and worked in the *bottega* of Cosimo Rosselli (from whom he derived his popular name). Other influences that can be traced in his work are those of Filippino Lippi, Luca Signorelli, and Leonardo da Vinci, and, as has been recently suggested by Professor R. Muther, that of Hugo van der Goes, whose Portinari altar-piece (now at the

Spedale of S. Maria Novella in Florence) helped to lead the whole of Florentine painting into new channels. From him, most probably, he acquired the love of landscape and the intimate knowledge of the growth of flowers and of animal life. The influence of Hugo van der Goes is especially apparent in the "Adoration of the Shepherds," at the Berlin Museum. He had the gift of a fertile fantastic imagination, which, as a result of a journey to Rome in 1482 with his master, Rosselli, became directed towards the myths of classic antiquity. He proves himself a true child of the Renaissance in such pictures as the "Death of Procris," at the National Gallery, the "Mars and Venus," at the Berlin Gallery, the "Perseus and Andromeda" series, at the Uffizi in Florence, and the "Hylas and the Nymphs" belonging to Mr Benson. If, as we are told by Vasari, he spent the last years of his life in gloomy retirement, the change was probably due to Savonarola, under whose influence he turned his attention once more to religious art. The "Immaculate Conception," at the Uffizi, and the "Holy Family," at Dresden, best illustrate the religious fervour to which he was stimulated by the stern preacher.

With the exception of the landscape background in Rosselli's fresco of the "Sermon on the Mount," in the Sistine Chapel, we have no record of any fresco work from his brush. On the other hand, he enjoyed a great reputation as a portrait painter, though the only known examples that can be definitely ascribed to him are the portrait of a warrior, at the National Gallery, (No. 895), the so-called "Bella Simonetta," at Chantilly, the portraits of Giuliano di San Gallo and his father, at the Hague, and a head of a youth, at Dulwich. Vasari relates that Piero excelled in designing pageants and triumphal processions for the pleasure-loving youths of Florence, and gives a vivid description of one such procession at the end of the carnival of 1507, which illustrated the triumph of death. Piero di Cosimo exercised considerable influence upon his fellow pupils Albertinelli and Bartolommeo della Porta and was the master of Andrea del Sarto. Examples of his work are also to be found at the Louvre in Paris, the Harrach and Liechtenstein collections in Vienna, the Borghese Gallery in Rome, the Spedale degli Innocenti in Florence, and in the collections of Mr John Burke and Colonel Cornwallis West in London. A "Magdalen" from his brush was added to the National Gallery of Rome in 1907.

See *Piero di Cosimo*, by F. Knapp (Halle, 1899); *Piero di Cosimo*, by H. Haberfeld (Breslau, 1901).

PIERRE, the capital of South Dakota, U.S.A., and the county-seat of Hughes county, situated on the east bank of the Missouri river, opposite the mouth of the Bad river, about 185 m. N.W. of Yankton. Pop. (1905) 2794; (1910) 3656. Pierre is served by the Chicago & North-Western railway; the Missouri is navigable here, but river traffic has been practically abandoned. Among the principal buildings are the state capitol (1909) and the post office building. Pierre has a public library, and is the seat of the Pierre Industrial School (co-educational, opened in 1890), a government boarding school (non-reservation) for Indian children. The city has a large trade in livestock, and is a centre for the mining districts of the Black Hills and for a grain-growing country. Natural gas is used for lighting, heating and power. A fur-trading post, Fort La Framboise, was built in 1817 by a French fur-trader (from whom it took its name) at the mouth of the Teton or Little Missouri river (now called the Bad River), on or near the site of the present village of Fort Pierre (pop. in 1910, 792). In 1822 Fort Tecumseh was built about 2 m. up-stream by the Columbia Fur Company, which turned it over in 1827 to the American Fur Company. The washing away of the river bank caused the abandonment of this post and the erection about a mile farther up-stream, and a short distance west of the river, of Fort Pierre Chouteau (later called Fort Pierre), occupied in 1832, and named in honour of Pierre Chouteau, jun. (1789–1865).[1] For twenty years thereafter Fort Pierre was the chief fur-trading depot of the Upper Missouri country. In 1855 the United States government bought the post building and other property for $45,000, and laid out around them a military reservation of about 270 sq. m. The fort was the headquarters of General William S. Harney (1800–1889) in his expedition against the Sioux in 1856, and in March of that year an important council between General Harney and the chiefs of all the Sioux bands, except the Blackfeet, was held here. The fort was abandoned in 1857. Pierre was laid out in 1880, was incorporated as a village in 1883, and was chartered as a city in 1900.

See Major Frederick T. Wilson, "Fort Pierre and Its Neighbors," in *South Dakota Historical Collections*, vol. i. (Aberdeen, S.D., 1902); and Hiram M. Chittenden, *The American Fur Trade of the Far West* (3 vols., New York, 1902).

PIERRE DE CASTELNAU (d. 1208), French ecclesiastic, was born in the diocese of Montpellier. In 1199 he was archdeacon of Maguelonne, and was appointed by Pope Innocent III. as one of the legates for the suppression of heresy in Languedoc. In 1202, when a monk in the Cistercian abbey of Fontfroide, Narbonne, he was designated to similar work, first in Toulouse, and afterwards at Viviers and Montpellier. In 1207 he was in the Rhone valley and in Provence, where he became involved in the strife between the count of Baux and Raymond, count of Toulouse, by one of whose agents he was assassinated on the 15th of January 1208. He was beatified in the year of his death by Pope Innocent III.

See De la Bouillerie, *Le Bienheureux Pierre de Castelnau et les Albigeois au XIII. siècle* (Paris, 1866).

PIERREFONDS, a town of northern France, in the department of Oise, 9 m. S.E. of Compiègne by road. Pop. (1906), 1482. It is celebrated for its feudal stronghold, a masterpiece of modern restoration. The building is rectangular in shape, with a tower at each corner and at the centre of each of the walls, which are strengthened by crenelation and machicolation. A lofty keep defends the principal entrances on the south-west. The interior buildings are chiefly modern, but the exterior reproduces faithfully that of the medieval fortress. Pierrefonds has a church dating from various periods from the 11th to the 16th century, and its mineral springs are in some repute. The château was begun in the last decade of the 14th century by Louis d'Orléans, to whom the domain was given by Charles VI., and finished early in the 15th century. It was subsequently held by the Burgundians, the English and the adherents of the League, from whom it passed to Henry IV. It was dismantled in 1622. The ruins, bought by Napoleon I., were restored, by order of Napoleon III., from 1858 to 1895, under the direction, first of Viollet-le-Duc and afterwards of E. Boeswillwald.

PIERREPONT, WILLIAM (*c.* 1607–1678), English politician, was the second son of Robert Pierrepont, 1st earl of Kingston. Returned to the Long Parliament in 1640 as member for Great Wenlock, he threw his influence on the side of peace and took part for the parliament in the negotiations with Charles I. at Oxford in 1643. Pierrepont was a member of the committee of both kingdoms, and represented the parliamentary party during the deliberations at Uxbridge in 1645; but from that time, according to Clarendon, he forsook his moderate attitude, and "contracted more bitterness and sourness than formerly." This statement, however, is perhaps somewhat exaggerated, as Pierrepont favoured the resumption of negotiations with the king in 1647, and in the following year his efforts on behalf of peace at Newport, where again he represented the parliamentarians, brought upon him some slight censure from Cromwell. For his services at Newport he was thanked by parliament; but he retired from active political life soon afterwards, as he disliked the "purging" of the House of Commons by Colonel Pride and the proceedings against the king. In spite of his moderate views Pierrepont enjoyed the personal friendship of Cromwell; but, although elected, he would not sit in the parliament of 1656, nor would he take the place offered to him in the Protector's House of Lords. When Richard Cromwell succeeded his father, Pierrepont was an unobtrusive but powerful influence in directing the policy of the government, and after a short period of retirement on Richard's fall he was chosen, early in 1660, a member of the council of state. He represented Nottinghamshire in the Convention Parliament of 1660, and probably was instrumental in saving the lives of some of the parliamentary leaders. At the general election of 1661 he was defeated, and, spending the remainder of his life in retirement, he died in 1678. Pierrepont married Elizabeth, daughter of Sir Thomas Harris, Bart., of Tong Castle, Shropshire, by whom he had five sons and five daughters. His eldest son, Robert (d. 1666), was the father of Robert, 3rd earl, William, 4th earl, and Evelyn, 1st duke of Kingston; and his third son, Gervase (1649–1715), was created in 1714 baron Pierrepont of Hanslope, a title which became extinct on his death.

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[1] Pierre Chouteau in 1804 succeeded his father, one of the founders of St Louis, in the Missouri Fur Company; and about 1834 Pratt, Chouteau & Company, of which he was the leading member, bought the entire western department of the American Fur Company, and in 1838 reorganized under the name of Pierre Chouteau, jun., & Company. Chouteau built (in 1830–1831) the "Yellowstone," which went up the river to the present site of Pierre in 1831, and was the first steamboat to navigate the upper waters of the Missouri. Chouteau lived for some years in New York City, and while living in St Louis was a member of the convention (1820) which drafted the first constitution of Missouri.

PIERROT (Ital. *Pedrolino*), the name given to the leading character in the French pantomime plays since the 18th century; transferred from the Italian stage, and revived especially in recent times. He is always in white, both face and costume, with a loose and daintily clownish garb, and is represented as of a freakish disposition. Modern pierrot plays have converted the pierrot into a romantic and even pathetic figure.

PIERSON, HENRY HUGO [properly HENRY HUGH PEARSON], (1815–1873), English composer, was the son of the Rev. Dr Pearson of St John's College, Oxford, where he was born in 1815; his father afterwards became dean of Salisbury. Pierson was educated at Harrow and Trinity College, Cambridge, and was at first intended for the career of medicine. His musical powers were too strong to be repressed, and after receiving instruction from Attwood and A. T. Corfe he went in 1839 to Germany to study under C. H. Rink, Tomaschek and Reissiger. He was elected Reid Professor of Music in Edinburgh in 1844, but, owing to a disagreement with the authorities, he resigned in the following year, and definitely adopted Germany as his country about the same time, making the change in his names noted above. His two operas, *Leila* (Hamburg, 1848) and *Contarini* (Hamburg, 1872), have not retained their hold upon the German public as his music to *Faust* has done, a work which until quite recently was frequently associated with Goethe's drama. He was never recognized in England as he was in Germany, for most of his career fell in the period of the Mendelssohn fashion. His most important work was the oratorio *Jerusalem*, produced at the Norwich Festival of 1852, and subsequently given in London (Sacred Harmonic Society, 1853) and Würzburg (1862). For the Norwich Festival (at one of the meetings a selection from his *Faust* music was given with success) he began an oratorio, *Hezekiah*, in 1869; it was not finished, but was given in a fragmentary condition at the festival of that year. These two large works and a number of Pierson's songs, as well as the three overtures played at the Crystal Palace, reveal undeniable originality and a wealth of melodic ideas. He was weak in contrapuntal skill, and his music was wanting in outline and coherence; but in more fortunate conditions his great gifts might have been turned to better account. He died at Leipzig on the 28th of January 1873, and was buried at Sonning, Berks., of which parish his brother, Canon Pearson, was rector.

PIETAS, in Roman mythology, the personification of the sense of duty towards God and man and the fatherland. According to a well-known story, a young woman in humble circumstances, whose father (or mother) was lying in prison under sentence of death, without food, managed to gain admittance, and fed her parent with milk from her breast. To commemorate her filial affection a temple was dedicated (181 B.C.) by Manius Acilius Glabrio to Pietas in the Forum Holitorium at Rome, on the spot where the young woman had formerly lived. The temple was probably originally vowed by the elder Glabrio out of gratitude for the *pietas* shown during the engagement by his son, who may have saved his life, as the elder Africanus that of his father at the battle of Ticinus (Livy xxi. 46); the legend of the young woman (borrowed from the Greek story of Mycon and Pero, Val. Max. v. 4, ext. 1) was then connected with the temple by the identification of its site with that of the prison. There was another temple of Pietas near the Circus Flaminius, which is connected by Amatucci (*Rivista di storia antica*, 1903) with the story of the *pietas* of C. Flaminius (Val. Max. v. 4, 5), and regarded by him as the real seat of the cult of the goddess, the Pietas of the sanctuary dedicated by Glabrio being a Greek goddess. Pietas is represented on coins as a matron throwing incense on an altar, her attribute being a stork. Typical examples of "piety" are Aeneas and Antoninus Pius, who founded games called Eusebeia at Puteoli in honour of Hadrian.

See Val. Max. v. 4, 7; Pliny, *Nat. hist.* vii. 121; Livy xl. 34; Festus, *s.v.*; G. Wissowa, *Religion und Kultus der Römer* (1902); F. Kuntze, "Die Legende von der guten Tochter," in *Jahrbücher für das klassische Altertum* (1904), xiii. 280.

PIETERMARITZBURG, the capital of Natal, situated in 29° 46′ S., 30° 13′ E., 45 m. in a direct line (71 by rail) W.N.W. of Durban. It lies, 2200 ft. above the sea, north of the river Umsunduzi, and is surrounded by wooded hills. Of these the Town Hill, flat-topped, rises 1600 ft. above the town. Pop. (1904), 31,119, of whom 15,087 were whites, 10,752 Kaffirs, and 5280 Indians. The town is laid out on the usual Dutch South African plan—in rectangular blocks with a central market square. The public buildings include the legislative council chambers and the legislative assembly buildings, government house, the government offices, college, post office and market buildings. The town-hall, a fine building in a modified Renaissance style (characteristic of the majority of the other public buildings), has a lofty tower. It was completed in 1901, and replaces a building destroyed by fire in 1898. St Saviour's is the cathedral church of the Anglican community. The headquarters of the Dutch Reformed Church are also in the town. There are monuments of Queen Victoria and Sir Theophilus Shepstone, and various war memorials—one commemorating those who fell in Zululand in 1879, and another those who lost their lives in the Boer War 1899–1902. A large park and botanical gardens add to the attractions of the town. A favourite mode of conveyance is by rickshaw. The climate is healthy and agreeable, the mean annual temperature being 65° F. (55° in June, 71° in February). The rainfall is about 38 in. a year, chiefly in the summer months (Oct.–Mar.), when the heat is tempered by violent thunderstorms.

Pietermaritzburg was founded early in 1839 by the newly-arrived Dutch settlers in Natal, and its name commemorates two of their leaders—Piet Retief and Gerrit Maritz. From the time of its establishment it was the seat of the Volksraad of the Natal Boers, and on the submission of the Boers to the British in 1842 Maritzburg (as it is usually called) became the capital of the country. It was given a municipal board in 1848, and in 1854 was incorporated as a borough. Railway connexion with Durban was made in 1880, and in 1895 the line was extended to Johannesburg. The borough covers 44 sq. m. and includes numerous attractive suburbs. The rateable value is about £4,000,000. Various industries are carried on, including brick-making, tanning, brewing, and cart and wagon building.

See J. F. Ingram, *The Story of an African City* (Maritzburg, 1898).

PIETERSBURG, a town of the Transvaal, capital of the Zoutpansberg district, and 177 m. N.N.E. of Pretoria by rail. Pop. (1904), 3276, of whom 1620 were whites. The town is pleasantly situated, at an elevation of 4200 ft., on a small tributary of the Zand river affluent of the Limpopo, and is the place of most importance in the province north of Pretoria. From it roads run to Klein Lelaba and other gold-mining centres in the neighbourhood, and through it passes the old route to Mashonaland, which crosses the Limpopo at Rhodes Drift. The Zoutpansberg district contains a comparatively dense Kaffir population, and a native newspaper is published at Pietersburg.

PIETISM, a movement in the Lutheran Church, which arose towards the end of the 17th and continued during the first half of the following century. The name of Pietists was given to the adherents of the movement by its enemies as a term of ridicule, like that of "Methodists" somewhat later in England. The Lutheran Church had, in continuing Melanchthon's attempt to construct the evangelical faith as a doctrinal system, by the 17th century become a creed-bound theological and sacramentarian institution, which orthodox theologians like Johann Gerhard of Jena (d. 1637) ruled with almost the absolutism of the papacy. Christian faith had been dismissed from its seat in the heart, where Luther had placed it, to the cold regions of the intellect. The dogmatic formularies of the Lutheran Church had usurped the position which Luther himself had assigned to the Bible alone, and as a consequence only they were studied and preached, while the Bible was neglected in the family, the study, the pulpit and the university. Instead of advocating the priesthood of all believers, the Lutheran pastors had made themselves a despotic hierarchy, while they neglected their practical pastoral work. In the Reformed Church, on the other hand, the influence of Calvin had made less for doctrine than the practical formation of Christian life. The presbyterian constitution gave the people a share in church life which the Lutherans lacked, but it involved a dogmatic legalism which imperilled Christian freedom and fostered self-righteousness.

As forerunners of the Pietists in the strict sense, not a few earnest and powerful voices had been heard bewailing the shortcomings of the Church and advocating a revival of practical and devout Christianity. Amongst them were Jakob Boehme (Behmen), the theosophic mystic; Johann Arndt, whose work on *True Christianity* became widely known and appreciated; Heinrich Müller, who described the font, the pulpit, the confessional and the altar as the four dumb idols of the Lutheran Church; the theologian, Johann Valentin Andrea, the court chaplain of the landgrave of Hesse; Schuppius, who sought to restore to the Bible its place in the pulpit; and Theophilus Grossgebauer (d. 1661) of Rostock, who from his pulpit and by his writings raised "the alarm cry of a watchman in Sion." The direct originator of the movement was Philip Jacob Spener, who combined the Lutheran emphasis on Biblical doctrine with the Reformed tendency to vigorous Christian life. Born at Rappoltsweiler, in Alsace on the 13th of, January 1635, trained by a devout godmother, who used books of devotion like Arndt's *True Christianity*, accustomed to hear the sermons of a pastor who preached the Bible more than the Lutheran creeds, Spener was early convinced of the necessity of a moral and religious reformation of the German Church. He studied theology, with a view to the Christian ministry, at Strassburg, where the professors at the time (and especially Sebastian Schmidt) were more inclined to practical Christianity than to theological disputation. He afterwards spent a year in Geneva, and was powerfully influenced by the strict moral life and rigid ecclesiastical discipline prevalent there, and also by the preaching and the piety of the Waldensian professor, Antoine Leger, and the converted Jesuit preacher, Jean de Labadie.[1] During a stay in Tübingen he read Grossgebauer's *Alarm Cry*, and in 1666 he entered upon his first pastoral charge at Frankfort-on-the-Main, profoundly impressed with a sense of the danger of the Christian life being sacrificed to zeal for rigid orthodoxy. Pietism, as a distinct movement in the German Church, was then originated by Spener by religious meetings at his house (*collegia pietatis*), at which he repeated his sermons, expounded passages of the New Testament, and induced those present to join in conversation on religious questions that arose. They gave rise to the name "Pietists." In 1675 Spener published his *Pia desideria*, or *Earnest Desires for a Reform of the True Evangelical Church.* In this publication he made six proposals as the best means of restoring the life of the Church: (1) the earnest and thorough study of the Bible in private meetings, *ecclesiolae in ecclesia*; (2) the Christian priesthood being universal, the laity should share in the spiritual government of the Church; (3) a knowledge of Christianity must be attended by the practice of it as its indispensable sign and supplement; (4) instead of merely didactic, and often bitter, attacks on the heterodox and unbelievers, a sympathetic and kindly treatment of them; (5) a reorganization of the theological training of the universities, giving more prominence to the devotional life; and (6) a different style of preaching, namely, in the place of pleasing rhetoric, the implanting of Christianity in the inner or new man, the soul of which is faith, and its effects the fruits of life. This work produced a great impression throughout Germany, and although large numbers of the orthodox Lutheran theologians and pastors were deeply offended by Spener's book, its complaints and its demands were both too well justified to admit of their being point-blank denied. A large number of pastors at once practically adopted Spener's proposals. In Paul Gerhardt the movement found a singer whose hymns are genuine folk poetry. In 1686 Spener accepted an appointment to the court-chaplaincy at Dresden, which opened to him a wider though more difficult sphere of labour. In Leipzig a society of young theologians was formed under his influence for the learned study and devout application of the Bible. Three *magistri* belonging to that society, one of whom was August Hermann Francke, subsequently the founder of the famous orphanage at Halle (1695), commenced courses of expository lectures on the Scriptures of a practical and devotional character, and in the German language, which were zealously frequented by both students and townsmen. The lectures aroused, however, the ill-will of the other theologians and pastors of Leipzig, and Francke and his friends left the city, and with the aid of Christian Thomasius and Spener founded the new university of Halle. The theological chairs in the new university were filled in complete conformity with Spener's proposals. The main difference between the new Pietistic school and the orthodox Lutherans arose from the conception of Christianity as chiefly consisting in a change of heart and consequent holiness of life, while the orthodox Lutherans of the time made it to consist mainly in correctness of doctrine.

Spener died in 1705; but the movement, guided by Francke, fertilized from Halle the whole of Middle and North Germany. Among its greatest achievements, apart from the philanthropic institutions founded at Halle, were the organization of the Moravian Church in 1727 by Count von Zinzendorf, Spener's godson and a pupil in the Halle Orphanage, and the establishment of the great Protestant missions, Ziegenbalg and others being the pioneers of an enterprise which until this time Protestantism had strangely neglected.

Pietism, of course, had its weaknesses. The very earnestness with which Spener had insisted on the necessity of a new birth, and on a separation of Christians from the world, led to exaggeration and fanaticism among followers less distinguished than himself for wisdom and moderation. Many Pietists soon maintained that the new birth must always be preceded by agonies of repentance, and that only a regenerated theologian could teach theology, while the whole school shunned all common worldly amusements, such as dancing, the theatre, and public games. There thus arose a new form of justification by works. Its *ecclesiolae in ecclesia* also weakened the power and meaning of church organization. Through these extravagances a reactionary movement arose at the beginning of the 18th century, one of the most distinguished leaders of which was Loescher, superintendent at Dresden.

As a distinct movement Pietism had run its course before the middle of the 18th century; by its very individualism it had helped to prepare the way for another great movement, the Illumination (*Aufklärung*), which was now to lead the world into new paths. Yet Pietism could claim to have contributed largely to the revival of Biblical studies in Germany, and to have made religion once more an affair of the heart and the life, and not merely of the intellect. It likewise vindicated afresh the rights of the Christian laity in regard to their own beliefs and the work of the Church, against the assumptions and despotism of an arrogant clergy. "It was," says Rudolf Sohm, "the last great surge of the waves of the ecclesiastical movement begun by the Reformation; it was the completion and the final form of the Protestantism created by the Reformation. Then came a time when another intellectual power took possession of the minds of men."

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[1] Labadie had formed the ascetic and mystic sect of "The Regenerati" in the Church of Holland (*c.* 1660), and then in other parts of the Reformed Church.

Some writers on the history of Pietism—*e.g.* Heppe and Ritschl—have included under it nearly all religious tendencies amongst Protestants of the last three centuries in the direction of a more serious cultivation of personal piety than that prevalent in the various established churches. Ritschl, too, treats Pietism as a retrograde movement of Christian life towards Catholicism. Some historians also speak of a later or modern Pietism, characterizing thereby a party in the German Church which was probably at first influenced by some remains of Spener's Pietism in Westphalia, on the Rhine, in Wurttemberg, and at Halle and Berlin. The party was chiefly distinguished by its opposition to an independent scientific study of theology, its principal theological leader being Hengstenberg, and its chief literary organ the *Evangelische Kirchenzeitung*. The party originated at the close of the wars with Napoleon I.

Amongst older works on Pietism are J. G. Walch, *Historische und theologische Einleitung in die Religionsstreitigkeiten der evangelisch-Lutherischen Kirche* (1730); A. Tholuck, *Geschichte des Pietismus und des ersten Stadiums der Aufklärung* (1865); H. Schmid, *Die Geschichte des Pietismus* (1863); M. Goebel, *Geschichte des christlichen Lebens in der Rheinisch-Westfälischen Kirche* (3 vols., 1849–1860); and the subject is dealt with at length in J. A. Dorner's and W. Gass's *Histories* of Protestant theology. More recent are Heppe's *Geschichte des Pietismus und der Mystik in der reformirten Kirche* (1879), which is sympathetic; A. Ritschl's *Geschichte des Pietismus* (3 vols., 1880–1886), which is hostile; and C. Sachsse, *Ursprung und Wesen des Pietismus* (1884). See also Fr. Nippold's article in *Theol. Stud. und Kritiken* (1882), pp. 347–392; H. von Schubert, *Outlines of Church History*, ch. xv. (Eng. trans., 1907); and Carl Mirbt's article, "Pietismus," in Herzog-Hauck's *Realencyklopädie für prot. Theologie u. Kirche*, end of vol. xv.

PIETRO DELLA VIGNA, or PIER DELLE VIGNE [PETRUS DE VINEAS or DE VINEIS] (*c.* 1190–1249), chancellor and secretary to the emperor Frederick II., was born at Capua in humble circumstances. He studied law at Padua, and through his classical education, his ability to speak Latin and his poetic gifts, he gained the favour of Frederick II., who made him his secretary, and afterwards *judex magnae curiae*, councillor, governor of Apulia, prothonotary and chancellor. The emperor, "of whose heart he held the keys," as Dante says, sent him to Rome in 1232 and 1237 to negotiate with the pope, to Padua in 1239 to induce the citizens to accept imperial protection, to England in 1234–1235 to arrange a marriage between Frederick and Isabella, sister of King Henry III. He proved a skilful and trustworthy diplomat, and he persistently defended the emperor against his traducers and against the pope's menaces. But at the Council of Lyons, which had been summoned by Pope Innocent IV., Pietro della Vigna entrusted the defence of his master to the celebrated jurist Taddeo of Suessa, who failed to prevent his condemnation. Frederick, whose suspicions had been awakened by the slanders of the envious, had him imprisoned and blinded without giving him a chance to rebut his accusers. Unable to bear his disgrace, he committed suicide in his prison at Pisa in 1249. The exact date, place and manner of his death are, however, subject to controversy, and Flaminio del Borgo states that it occurred in the church of S. Andrea, at Pisa, in 1256. The tragic fate of this man gave rise to many legends. The Guelphic tradition accuses Pietro della Vigna, as well as the emperor and the court, of heresy; it was even stated, probably without any foundation, that they were the authors of the famous work, *De tribus impostoribus*, wherein Moses, Christ and Mahomet are blasphemed.

Pietro della Vigna was a man of great culture; he encouraged science and the fine arts, and contributed much to the welfare of Italy by wise legislative reforms. He was the author of some delicate verse in the vernacular tongue, of which two *canzoni* and a sonnet are still extant. His letters, mostly written in the name of the emperor and published by Iselin (*Epistolarum libri vi.*, 2 vols., Basel, 1740), contain much valuable information on the history and culture of the 13th century. A collection of the laws of Sicily, a *Tractatus de potestate imperiali*, and another treatise, "On Consolation," in the style of Boëthius, are also attributed to him.

See Huillard-Bréholles, *Vie et correspondance de Pierre de la Vigne* (Paris, 1864); Presta, *Pier delle Vigne* (Milan, 1880); Capasso and Ianelli, *Pier delle Vigne* (Caserta, 1882); also FREDERICK II.

PIG (a word of obscure origin, connected with the Low Ger. and Dut. word of the same meaning, *bigge*), a common name given to the domesticated swine of agricultural use. (For the zoology, see SWINE.)

British breeds of pigs are classified as black, white and red. In some places, notably Wales and Gloucester, a remnant of a spotted breed lingers; and a large proportion of common pigs, often parti-coloured, are mongrels. The white breeds are liable to sun-scald, and black pigs (like black men) are much better adapted than white to exposure in strong sunlight, conforming to the rule that animals in the tropics have black skins.

The *Large Whites* may have in the skin a few blue spots which grow white hair. The head is long, light in the jowl, and wide between the eyes, with long thin ears inclined slightly forward and fringed with long fine hair. The neck is long, but not coarse, the ribs are deep, the loin wide and level, the tail set high, and the legs straight and set well outside the carcase. The whole body, including the back of the neck, is covered with straight silky hair, which denotes quality and lean meat. Pigs of this breed are very prolific, and they may be grown to enormous weights—over 11 cwt. alive.

The *Middle Whites* are built on a smaller scale than the Large Whites. They are shorter in the heads and legs, and fuller at the jowl, thicker and more compact in the body. The sows are quite as prolific as those of the Large White breed, and, as their produce matures earlier, they are much in demand for breeding porkers.

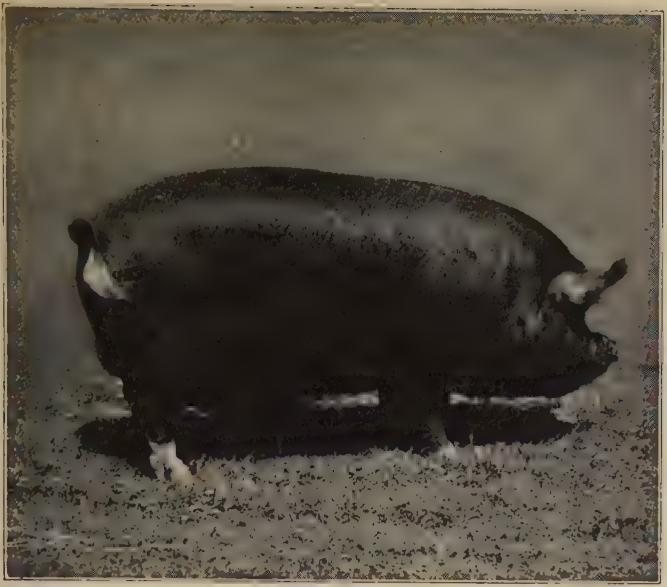
The *Small White* pigs are beautifully proportioned. The head and legs are very short, and the body short, thick and wide; the jowl is heavy, the ears pricked, and the thin skin laden with long silky, wavy, but not curly, hair, whilst the tail is very fine. A deficiency of lean meat is a common characteristic of the breed, which is almost extinct.

The above three breeds were designated Yorkshire Whites, and are still so named at times. The Middle White, formed by crossing the large and the small breeds, is not so symmetrical as the parent stocks, and the type is not uniform.

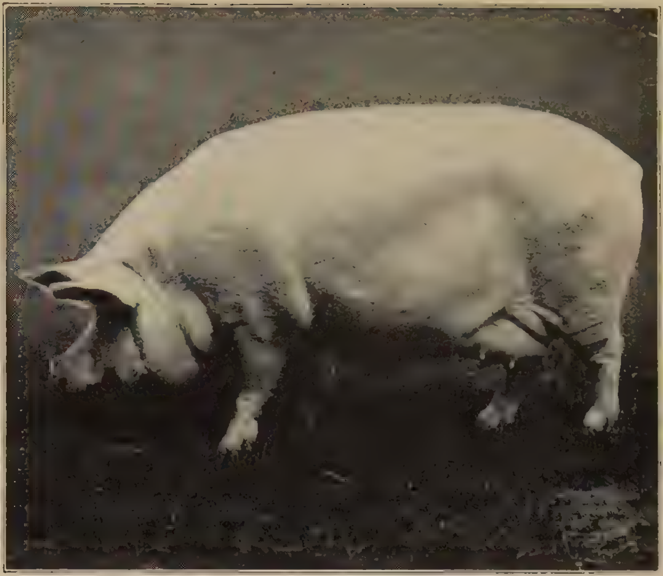
The *Lincolnshire Curly Coated* or *Boston* pig is a local breed of great size and capacity for producing pork. It is very hardy and prolific, but somewhat coarse in the bone. It has an abundance of long curly hair, a short face and a straight nose, and the ears, not too long and heavy, fall over the face. It crosses well with the Large White, the Large Black and the Berkshire.

The *Large Black* breed, which vies with the Large White breed for size, and is probably its superior as a bacon pig, has only since 1900 received national show-yard recognition; but there is ample evidence that, with its characteristic whole black colour with a mealy hue, length, fine hair and lop ear, the Large Black existed in the south of England for generations. It has been continuously and carefully bred in Cornwall, Devon, Essex and Suffolk, and from these centres it has rapidly spread all over the country. Large Blacks are exceedingly docile, and the ears, hanging well forward over the eyes, contribute materially to a quietness of habit which renders them peculiarly adapted to field grazing. On account of their hardiness and disposition to early maturity they have proved valuable for crossing purposes. The Large Black Pig Society was incorporated in 1899.

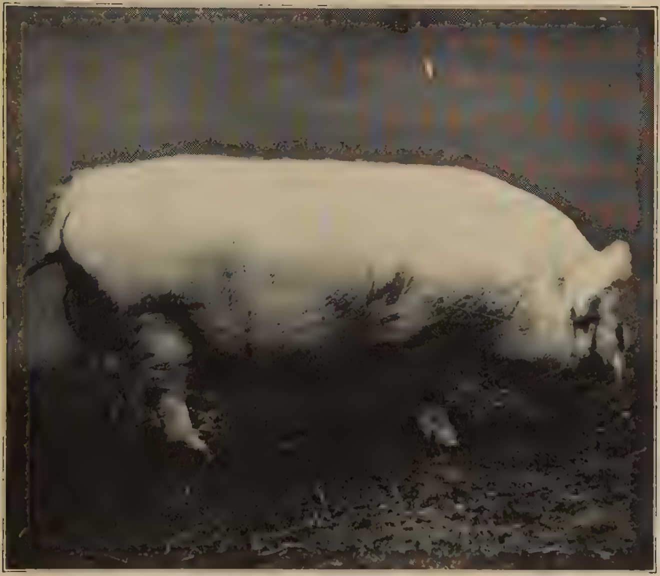
The *Berkshire* is a black pig with a pinkish skin, and a little white on the nose, forehead, pasterns, and tip to the tail. It has a moderately short head with heavy jowl, a deep, compact carcase, and wide, low and well-developed hind-quarters, with heavy hams. The skin carries an abundance of fine hair. The Berkshire is an early-maturity breed which has been somewhat



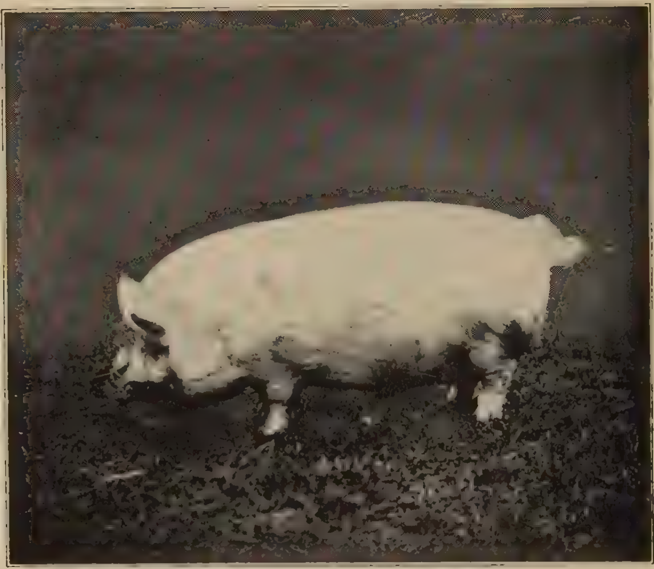
BERKSHIRE BOAR.



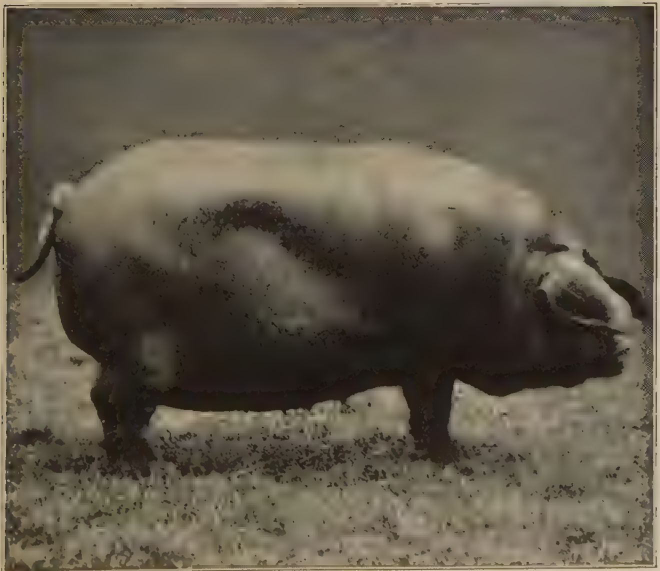
LARGE WHITE SOW.



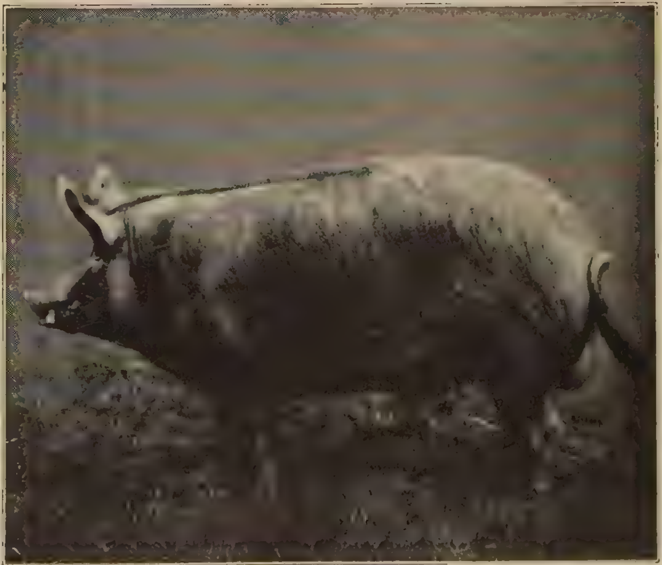
MIDDLE WHITE BOAR.



SMALL WHITE BOAR.



LARGE BLACK SOW.



TAMWORTH BOAR.

ENGLISH BREEDS OF PIG, from photographs of F. Babbage. The comparative sizes of the animals are indicated by the scale of reproduction of the photographs.

inbred, and is not so hardy and prolific as most breeds. The boars cross well with common stock. It merits the most credit in raising the quality of Irish pigs. In America it is in the front rank for numbers and quality as a lard-hog. There it often grows to be a larger and finer animal than it is in England.

The *Small Black* or *Black Suffolk* was produced from the old Essex pig by crossing with the Neapolitan. It resembles the Small White, except that the skin is coal-black in colour, and the coat of hair is not usually profuse. The Small Black, moreover, is rather longer, and stands somewhat higher, whilst it yields more lean meat than the Small White. It matures early and is quick to fatten.

The *Tamworth* is one of the oldest breeds of pigs. It is hardy, active and prolific, and nearly related to the wild boar. The colour is red or chestnut, with at times darkish spots on the skin. The head, body and legs are long, and the ribs deep and flat. Originally a local breed in the districts around the Staffordshire town from which it takes its name, it is now extensively bred, and highly valued as a bacon pig. (W. Fr.; R. W.)

In America nearly all the breeds may be classified as lard-hogs. Bacon-pigs fed on Indian corn degenerate into lard-hogs, run down in size and become too small in the bone and less prolific by inbreeding.

The *Poland-China*, the most popular breed in the United States, is thus degenerating. It is a black pig like the Berkshire, but has short lop-ears, a more pointed, straight nose, a more compact body, and more white markings. It is a breed of mixed blood, and is believed to have originated from the "Big China" pig—a large white hog with sandy spots, taken to Ohio in 1816, and blended with Irish graziers in 1839, and with a breed known as Bayfields, as well as with Berkshires. In Iowa the Berkshire is a combined lard and bacon pig in high favour.

The *Duroc Jersey* or *Duroc*, of a red or cherry-red colour—not sandy or dark—is the most popular pig in Nebraska and equal to any other in Iowa. It is a large prolific lard-hog, easily making 300 ℔ in eight months. It has gained rapidly in popularity since the beginning of this century, and is spreading to other centres.

The *Chester White*, named from Chester county, Pennsylvania, is one of the four leading breeds of lard-hogs in America. It is of mixed origin and bears a strong family resemblance to the Lincolnshire curly-coated pig. The early English ancestors, the breed of which is not on record in America, were most probably of Lincoln origin. The sow is a prolific breeder and good mother, weighing, when mature but not fat, 450 ℔—the boar averaging 600 ℔, and barrows at six to eight months 350 ℔. At Vermont Station, in a 127 days' test, Chester Whites made an average gain of 1·36 ℔ and dressed 84·5% carcase, and they can gain fully 1 ℔ of live weight for 3 ℔ of grain consumed.

Management.—The brood sow should be lengthy and of a prolific strain, known to milk well. She is moderately fed and put to a boar of her own age when large enough, *i.e.* seven to eight months old. She remains in a state of oestrum for about three days, and if not pregnant comes in heat again in three weeks. Breeding swine, male and female, run most of their time at pasture and receive a liberal allowance of green food or raw roots. The period of gestation is sixteen weeks. Six to eight pigs are reared of the first litter, and ten to twelve afterwards. Many brood sows are fattened to greatest profit after the second or third litter. Two litters are produced in one year, as pigs are usually weaned at two months old, and the sow will take the boar at from three days to a week after the pigs are removed, according to condition. A convenient sty to hold five or six pigs has a southern aspect, and consists of a covered compartment and outer court, each 10 ft. square. When the animals are fed outside the inner court is kept clean and dry, and there the pigs lie. The labouring man's pig is his bank, and is fed on scraps, small potatoes and waste products. In connexion with cheese dairies pigs are largely fed on sour whey thickened with mixed meal produced from any or all of the grains or pulses, the choice depending upon the market price. Food may with advantage be cooked for very young pigs; but, with the exception of potatoes, which should never be given raw, roots and meals are best given uncooked. Meal mixed with pulped roots for a few hours improves in digestibility, and a sprinkling of salt is an improvement. Meal derived from leguminous seeds makes the flesh firm and improves the quality. Fattening pigs are fed three times a day and supplied with coal-ashes or a few handfuls of earth. Of the fatted live weight of a pig 83 % is butcher's carcase, and 91 % of the increase from 100 to 200 ℔ is carcase. From 3 to 5 ℔ of meal consumed results in an increase of 1 ℔ of live weight in a pig, which is the most economical meat producer on a farm. Concentrated and digestible foods give best results, a pig has a small stomach. Fjord's Danish experiments show that for fattening pigs 1 ℔ of rye- or barley-meal is equivalent to 6 ℔ of skim-milk or 12 ℔ of whey, and 1 ℔ of meal equivalent to 8 ℔ of mangolds or 4 ℔ of potatoes.

Literature.—J. Coleman, *Pigs of Great Britain* (1877); Sanders Spencer, *Pigs: Breeds and Management* (1905); G. M. Rommel, *The Hog Industry* (1904; Bull. No. 47, U.S.A. Bureau of Animal Industry); J. Long, *The Book of the Pig* (1906); F. D. Coburn, *Swine Husbandry* (1904); R. Wallace, *Farm Live Stock of Great Britain* (4th ed., 1907); *Douglas Encyclopaedia* (1906); C. S. Plumb, *Types and Breeds of Farm Animals* (1906) the *Herd Books* of the Breed Societies, and *Reports* of the Agricultural Departments of Great Britain, Canada and the United States. (R. W.)

PIGALLE, JEAN BAPTISTE (1714–1785), French sculptor, was born in Paris on the 26th of January 1714. He was the seventh child of a carpenter. Although he failed to obtain the *grand prix*, after a severe struggle he entered the Academy and became one of the most popular sculptors of his day. His earlier work, such as "Child with Cage" (model at Sèvres) and "Mercury Fastening his Sandals" (Berlin, and lead cast in Louvre), is less commonplace than that of his maturer years, but his nude statue of Voltaire, dated 1776 (Institut), and his tombs of Comte d'Harcourt (*c.* 1764) (Notre Dame) and of Marshal Saxe, completed in 1777 (Lutheran church, Strassburg), are good specimens of French sculpture in the 18th century. He died on the 28th of August 1785.

See P. Tarbé, *Vie et œuv. de Pigalle* (1859); Suard, *Éloge de Pigalle*; *Mélanges de littérature.*

PIGAULT-LEBRUN (Pigault de l'Epinoy), **CHARLES ANTOINE GUILLAUME** (1753–1835), French novelist, was born at Calais (he is said to have traced his pedigree on the mother's side to Eustache de St Pierre) on the 8th of April 1753. His youth was stormy. He twice carried off young ladies of some position, and was in consequence twice imprisoned by *lettre de cachet.* The first, a Miss Crawford, the daughter of an English merchant whose office Pigault had entered, died almost immediately after her elopement; the second, Mlle de Salens, he married. He became a soldier in the Queen's Guards, then a very unsuccessful actor, and a teacher of French. At the breaking out of the great war he re-enlisted and fought at Valmy. He wrote more than twenty plays, and a large number of novels, the first of which appeared in 1787. In his old age he took to graver work, and executed an abridgement of French history in eight volumes, besides some other work. His *Œuvres complètes* were published in twenty volumes between 1822 and 1824, but much of his work is subsequent to this collection. He died on the 24th of July 1835. The style of Pigault's novels is insignificant, and their morality very far from severe. As almost the father of a kind of literature which later developed enormously, Pigault-Lebrun deserves a certain place in literary history. Among the most celebrated of his novels may be mentioned *L'Enfant du Carnaval* (1792) and *Angélique et Jeanneton de la place Maubert* (1799). His *Citateur* (2 vols., 1803), a collection of quotations against Christianity, was forbidden and yet several times reprinted.

PIGEON (Fr. *pigeon*, Ital. *piccione* and *pipione*, Lat. *pipio*, literally a nestling-bird that pipes or cries out, a "piper"—the very name now in use among some pigeon-fanciers, though "squeaker" in the more usual term). The name pigeon, doubtless of Norman introduction as a polite term, seems to bear much the same relation to dove, the word of Anglo-Saxon origin, that mutton has to sheep, beef to ox, veal to calf, and pork to bacon; no sharp zoological distinction can be drawn (see Dove) between dove and pigeon, and the collective members of the group *Columbae* are by ornithologists ordinarily called pigeons. Perhaps the best-known species to which the latter name is exclusively given in common speech[1] is the wild pigeon or passenger pigeon of North America, *Ectopistes migrarius*, which is still found in many parts of Canada and the United States, though now almost extinct and never appearing in the countless numbers that it did of old, when a flock seen by A. Wilson was estimated to consist of more than 2230 millions. The often-quoted descriptions given by him and J. J. Audubon of pigeon-haunts in the then "backwoods" of Kentucky, Ohio and Indiana need not here be reproduced. That of the latter was declared by C. Waterton to be a gross exaggeration; but the critic would certainly have changed his tone had he known that, some hundred and fifty years earlier, passenger-pigeons so swarmed and ravaged the colonists' crops near Montreal that a bishop of his own church was constrained to exorcise them with holy water, as if they had been demons.[1] The passenger-pigeon is about the size of a common turtle-dove, but with a long, wedge-shaped tail. The male is of a dark slate-colour above, and purplish-bay beneath, the sides of the neck being enlivened by violet, green and gold. The female is drab-coloured above and dull white beneath, with only a slight trace of the brilliant neck-markings.[2] (See plate illustration under Dove.)

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[1] It may be observed that the "rock-pigeons" of Anglo-Indians are Sand-grouse (*q.v.*), and the "Cape pigeon" of sailors is a petrel (*q.v.*).

Among the multitudinous forms of pigeons very few can here be noticed. A species which might possibly repay the trouble of domestication is the wonga-wonga or white-fleshed pigeon of Australia, *Leucosarcia picata*; a bird larger than the ring-dove, of a slaty-blue colour above and white beneath, streaked on the flanks with black. It is known to breed, though not very freely, in captivity, and is said to be excellent for the table. As regards flavour, the fruit-pigeons of the genus *Treron* (or *Vinago* of some authors) and its allies surpass all birds. These inhabit tropical Africa, India, and especially the Malay Archipelago; but the probability of domesticating any of them is very remote. Hardly less esteemed are the pigeons of the genus *Ptilopus* and its kindred forms, which have their headquarters in the Pacific Islands, though some occur far to the westward and also in Australia. There may be mentioned the strange Nicobar pigeon, *Caloenas* (see plate illustration under Dove), an inhabitant of the Indian Archipelago, not less remarkable for the long lustrous hackles with which its neck is clothed than for the structure of its gizzard, which has been described by Sir W. H. Flower (*Proc. Zool. Soc.*, 1860, p. 330), though this peculiarity is matched or even surpassed by that of the same organ in the *Phaenorrhina goliath* of New Caledonia (*Rev. de zoologie*, 1862, p. 138) and in the *Carpophaga latrans* of Fiji. In this last the surface of the epithelial lining is beset by horny conical processes, adapted, it is believed, for crushing the very hard fruits of *Onocarpus vitiensis* on which the bird feeds (*Proc. Zool. Soc.*, 1878, p. 102). The modern giants of the group, consisting of about half a dozen species of the genus *Goura* and known as crowned pigeons (see plate illustration under Dove), belong to New Guinea and the neighbouring islands, and are conspicuous by their large size, beautiful filmy fan-shaped crest, and the reticulated instead of scutellated covering of their "tarsi."

A very distinct type of pigeon is that represented by *Didunculus strigirostris*, the "Manu-mea" of Samoa, still believed by some to be the next of kin to the Dodo (*q.v.*), but really presenting only a superficial resemblance in the shape of its bill to that extinct form, from which it differs osteologically quite as much as do other pigeons (*Phil. Trans.*, 1869, p. 349). It remains to be seen whether the Papuan genus *Otidiphaps*, of which several species are now known, may not belong rather to the Didunculidae than to the true Columbidae.

Pigeons are now regarded as belonging to the Charadriiform or plover-like birds (see Birds) and are placed in the sub-order Columbae, near the sand-grouse (*q.v.*). They are divided into three families, Dididae, which includes the Dodo (*q.v.*) and *Solitaire*, the Columbidae, which includes the doves and pigeons, and the Didunculidae, of which the curious tooth-billed pigeon, of Samoa is the only example. The body is always compact, and the bill has a soft skin or cere covering the nostrils. The pigeons are chiefly vegetable feeders and have a hard gizzard, and all drink much water; they perch, and have a note of the nature of a "coo." The nest is a rough platform or is in holes on the ground or in rocks. The eggs are two or three and white, and the young, which are helpless when hatched, are fed by a secretion from the crop of the parents. (A. N.)

PIGEON-FLYING, the sport of racing homing-pigeons bred and trained for the purpose. It is of very recent date, although the use of birds as a means of carrying messages (see Pigeon Post) is of great antiquity. Belgium may be considered as *par excellence* the home of the sport, the first birds flown there probably coming from Holland. Long-distance flying began in 1818, with a match of 100 m., while in 1820 there was a race from Paris to Liége, and three years later the first race from London to Belgium. The sport is now a favourite one in Great Britain, the United States, France, and, to a less degree, in some other countries, although nowhere attaining the general popularity which it enjoys in Belgium, where nearly every village has its *Société colombophile*, millions of pigeons being sent over the French border to be raced back. The annual Belgian *concours national*, a race of about 500 m. from Toulouse to Brussels, was inaugurated in 1881, in which year the first regular races in Great Britain, from Exeter, Plymouth and Penzance to London, took place. The velocity attained at that time was about 1250 yds. per minute, but this was soon surpassed in the races of the London Columbarian Society, one of the winners in which attained a speed of 1836 yds. per minute.

The sport was introduced into the United States about the year 1875, although regular racing did not begin until 1878. Since then it has gained widespread popularity, the American record for old birds at 300 m. being 1848 yds. per minute and for young birds (yearlings) 1665 yds., while the distance record is 1004 m. The American "blue ribbon" championships are held at 100, 200, 300, 400, 500 and 600 m. The speed of homing-pigeons depends very greatly upon the state of the atmosphere. In the race from Montargis to Brussels in 1876 in bright and clear weather, all the prize-winners made the distance of 270 m. within three and one-quarter hours, while in the same race in 1877, on a thick and stormy day, thirty hours passed before the first bird arrived.

Training.—The loft should be on a commanding site. It is best made in the shape of a large room, suitably subdivided, protected from vermin, and provided with drinking troughs, rock salt and crushed mortar for the birds' use. It should be fitted with a sufficient number of nests about 2 ft. long, 20 in. in breadth and height. Arrangements should be made for allowing the pigeons to fly out daily for exercise; and they should be trained to re-enter the loft through bolting wires, which open inwards only, into a small chamber, to which an electric arrangement may be fitted so as to sound a bell and warn the owner of the arrival of a bird. The food of birds in training consists of vetch, beans, maize, peas, broken rice and millet, in various proportions, according to the country, climate and season of the year, the daily allowance for each bird being about 40 grammes weight. Young birds may be fed on rice in the husk and bread. They are called "squealers" for a week or two after birth, and then "squeakers" until about three months old. Each brood consists of two eggs, on which both parents sit in turn, the cock only for a few hours in the middle of the day. When the young are being brought up, only one of the parent birds is taken out at a time. One meal per day, given before the birds are let out in the morning, is sufficient. Training should commence in warm weather, when the bird is about four months old, and it consists in taking it out in a closed wicker basket and liberating or "tossing" it at gradually increasing distances from its loft, with several days interval of rest between the flights. The usual preliminary distances are 1, 2, 5, 10 and 15 or 20 m. These tosses should all be made on the same line between the loft and, say, some neighbouring city, in order that a bird may always have to fly in the same general direction during the season. About 100 m. may be expected of birds the first season; they reach their full distances only about the fifth year. It is considered better to train the young homers alone, so that they may become independent of the older birds. When thoroughly trained they may be flown over long distances about once a week. The Belgian fanciers generally divide their birds into two classes, one for breeding and the other for racing, though the latter are allowed to breed within certain limits. Some fanciers always choose birds with chicks in the nest for long journeys, claiming that they return faster with this incentive. A seamless metal ring marked with the owner's name is slipped over the foot of the pigeon when only a few days old, and during its racing career the longer wing-feathers are stamped with the bird's records. At the start of a race the competing birds are tossed together by a starter who takes the time. Upon being released the homer ascends rapidly in spirals until, apparently descrying some familiar landmark on the horizon, it will fly straight and swiftly towards it. As the birds enter their home-lofts the time is taken by the owner. A bird is not considered to have got "home" until it has actually passed through the door of its loft.

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[1] *Voyages du Baron de la Hontan dans l'Amérique septentrionale*, i. 93, 94 (2nd ed., Amsterdam, 1705). In the first edition, published at the Hague in 1703, the passage, less explicit in details but to the same effect, is at p. 80. The author's letter, describing the circumstance, is dated May 1687.

[2] There are several records of the occurrence in Britain of this pigeon, but in most cases the birds noticed cannot be supposed to have found their own way hither. One, which was shot in Fife in 1825, may, however, have crossed the Atlantic unassisted by man.

PIGEON POST. The use of homing pigeons to carry messages is as old as Solomon, and the ancient Greeks, to whom the art of training the birds came probably from the Persians, conveyed the names of Olympic victors to their various cities by this means. Before the electric telegraph this method of communication had a considerable vogue amongst stockbrokers and financiers. The Dutch government established a civil and military pigeon system in Java and Sumatra early in the 19th century, the birds being obtained from Bagdad. Details of the employment of pigeons during the siege of Paris in 1870–71 will be found in the article Post and Postal Service: *France.* This led to a revival in the training of pigeons for military purposes. Numerous private societies were established for keeping pigeons of this class in all important European countries; and, in time, various governments established systems of communication for military purposes by pigeon post. When the possibility of using the birds between military fortresses had been thoroughly tested attention was turned to their use for naval purposes, to send messages between coast stations and ships at sea. They are also found of great use by news agencies and private individuals. Governments have in several countries established lofts of their own. Laws have been passed making the destruction of such pigeons a serious offence; premiums to stimulate efficiency have been offered to private societies, and rewards given for destruction of birds of prey. Pigeons have been used by newspapers to report yacht races, and some yachts have actually been fitted with lofts. It has also been found of great importance to establish registration of all birds. In order to hinder the efficiency of the systems of foreign countries, difficulties have been placed in the way of the importation of their birds for training, and in a few cases falcons have been specially trained to interrupt the service in war-time, the Germans having set the example by employing hawks against the Paris pigeons in 1870–71. No satisfactory method of protecting the weaker birds seems to have been evolved, though the Chinese formerly provided their pigeons with whistles and bells to scare away birds of prey.

In view of the development of wireless telegraphy the modern tendency is to consider fortress warfare as the only sphere in which homing pigeons can be expected to render really valuable services. Consequently, the British Admiralty has discontinued its pigeon service, which had attained a high standard of efficiency, and other powers will no doubt follow the example. Nevertheless, large numbers of birds are, and will presumably continue to be, kept at the great inland fortresses of France, Germany and Russia.

See L. du Puy de Podio, *Die Brieftaube in der Kriegskunst* (Leipzig, 1872); Brinckmeier, *Anzucht, Pflege, und Dressur der Brieftauben* (Ilmenau, 1891).

PIGEON-SHOOTING, a form of sport consisting of shooting at live pigeons released from traps. The number of traps, which are six-sided boxes, falling flat open at the release of a spring, is usually five; these are arranged 5 yds. apart on the arc of a circle of which the shooter forms the centre. The distance (maximum) is 31 yds., handicapping being determined by shortening the distance. The five traps are each connected by wires with a case ("the puller"); a single string pulled by a man stationed at the side of the shooter works an arrangement of springs and cog-wheels in the "puller," and lets fall one of the traps; it is impossible to know beforehand which trap will be released. At a fixed distance from the centre of the traps is a boundary within which the birds hit must fall if they are to count to the shooter. This line varies in distance in the various clubs; the National Gun Club boundary being 65 yds., that of the Monaco Club being only 20 yds. The charge of shot allowed must not exceed $1\frac{1}{4}$ oz. The best type of pigeon is the blue rock. From the start of the Hurlingham Club at Fulham in 1867 pigeon-shooting was a favourite sport there; it was, however, stopped in 1906. The principal pigeon-shooting centre in England is now at the National Gun Club grounds at Hendon. The great international competitions and sweepstakes take place at Monaco. An artificial bird of clay, now more usually of a composition of pitch, is often substituted for the live pigeon. These clay birds are also sprung from traps. This sport originated in the United States, where, under the name of "trap-shooting," or inanimate bird shooting, it is extremely popular. At first the traps invented threw the birds with too great regularity of curve; now the traps throw the birds at different and unknown angles, and the skill required is great. In clay-bird shooting the traps usually number fifteen, and are out of sight of the shooter. The Inanimate Bird Shooting Association in England was started in 1893.

PIGMENTS (Lat. *pigmentum*, from *pingere*, to paint). It is convenient to distinguish between pigments and paints, the latter being prepared from the former by the addition of a vehicle or medium. Nor are pigments and dyes identical, although there are cases in which the same colouring matter which yields a dye or stain may give rise to a pigment. A pigment is, in fact, a substance which is insoluble in the vehicle with which it is mixed to make a paint, while a dye is soluble. Pigments exhibit various degrees of transparency and opacity, and ought to possess such qualities as these: ease in working, chemical indifference to each other and, generally, to the vehicles employed, also stability under exposure to light and air. As a rule, it is desirable that pigments should not be seriously affected in hue by the vehicle; at all events, whatever change does occur ought to admit of calculation. In the case of oil colours it should be remembered that a thorough drying of the paint is preferable to the formation of a surface-skin, and that a few pigments, notably white lead, possess properties conducing to this desirable result. It is scarcely necessary to add to these general observations concerning pigments that their artistic value depends primarily upon the nature and amount of the optical sensation which they are competent to produce.

Sources.

Although the number of available pigments is great, the number of chemical elements which enter into their composition is not large. Very many richly-coloured compounds cannot be employed because they lack the properties of insolubility, inertness and stability. Pigments are drawn from various sources. Some are natural, some artificial; some are inorganic, some organic, some are elements, some mixtures, some compounds. It is not unusual to arrange them into two groups, *substantive* and *adjective.* Amongst the members of the former group such a pigment as vermilion, where each particle is homogeneous, may be cited as an example. Amongst the adjective pigments rose-madder may be named, for each particle consists of a colourless base on which a colouring matter (alizarin) has been thrown. Most of the inorganic pigments, whether natural or artificial, belong to the substantive group; while there are many organic pigments, notably those of artificial origin, which are of adjective character. The following table presents a summary classification of pigments according to their source or origin:—

Mineral pigments .	Natural; as terre verte. Artificial; as aureolin.
Organic pigments .	Animal; as carmine. Vegetable; as madder-lake. Artificial; as alizarin-orange.

A variety of processes are in use in order to fit natural coloured substances for employment as pigments. The first step is, *Preparation.*

in many cases, to select, or "pick over," the raw material, rejecting whatever impurities may weaken or injure the characteristic hue of the product. It is occasionally necessary to treat the finely-ground substance with water by the method of elutriation or washing-over; the wash-waters will then deposit, on standing, various grades of the coloured body required. With rare exceptions native pigments need careful grinding, either by means of a muller on a slab or by edge rollers, or horizontal mill-stones, or special machines. The substance is usually ground in spirits of turpentine, or alcohol, or water; oil-paints are of course finally ground in a drying-oil, such as linseed oil or poppy oil; water-colours require gum-water, or gum-water and glycerin if they are to be "moist" paints. In the case of all pigments, whether mineral or organic, whether natural or artificial, it is of the highest importance to make sure that they are free from saline matters soluble in water. Such salts are removed by thorough washing with distilled water. A treatment of this kind is essential in the case of a large number of pigments formed by chemical reactions in the "wet way." Characteristic examples are furnished by Prussian blue, viridian and lakes. Sometimes it is necessary to remove dangerous impurities by solvents other than water, such as carbon bisulphide, which is used to extract free sulphur from cadmium yellow. Mention may here be made of another kind of preparative treatment which is adopted with some pigments: they are subjected to the action of heat—moderate in some cases, strong in others. Thus, a few substances, such as ivory black and yellow ochre, which in ordinary circumstances contain much non-essential moisture, before they are ground in oil may with advantage be gently dried at a temperature not above that of boiling water. Again, there are pigments, such as Prussian brown, light red and burnt sienna, which owe their hues to a process of actual calcination, the first of these being thus made from Prussian blue, the second from yellow ochre, and the third from raw sienna. The pigments known as burnt carmine and burnt madder are prepared at a much lower temperature, and ought to be described as roasted rather than as burnt.

Adulteration.

The substitution of one pigment for another is rarely practised, but it is not so unusual to find that a costly substance has received an admixture of something cheaper, and that an inferior grade of a genuine pigment has had its hue exalted or enhanced by some unlawful or dangerous addition. In fact, these two kinds of sophistication are often associated. Thus vermilion is adulterated with red lead, with red antimony sulphide, or with baryta white and lead sulphate, and then the hue of the mixture is restored to the proper pitch by the introduction of the powerful but fugitive colouring matter eosin. Amongst other adulterations which may be named here are the addition of chrome-yellow (lead chromate) to yellow ochre, of green ultramarine to terre verte, and of indigo to ivory black; this last mixture being a substitute for vine-black, the natural blue-black. The detection of the above-named sophistications is by no means difficult even in the hands of persons unacquainted with chemical manipulation, but it needs a trained analyst when quantitative results are required. If we are dealing with an oil-colour, the first step is to remove the oil by means of a solvent, such, for example, as ether. The residual pigment is then allowed to dry, and the dry powder submitted to the appropriate physical and chemical tests. Thus a suspected vermilion, having been freed from oil, is heated in a small hard glass bulb-tube: it should prove practically volatile, leaving a mere trace of residue. In this particular case the presence of a red hue in the ether-extract affords evidence of adulteration with an organic colouring matter, such as eosin. Then, again, we may detect the presence in yellow ochre of lead chromate by pouring a little sulphuretted hydrogen water and dilute hydrochloric acid upon one portion of the dry pigment, and boiling another portion with dilute sulphuric acid and some alcohol: in the former experiment blackening will occur, in the latter the liquid part of the mixture will acquire a greenish tint. So also green ultramarine may be recognized in adulterated terre verte by the addition of dilute hydrochloric acid, which destroys the colour of the adulterant and causes an abundant evolution of the evil-smelling sulphuretted hydrogen. Moreover, nothing is easier than the recognition of indigo in vine or charcoal-black, for the dry powder, heated in a glass tube, gives off purple vapours of indigo, which condense in the cooler part of the tube into a blackish sublimate.

A word must be said here as to the adulteration of white lead, and the examination of this most important pigment. The best variety of white lead or flake white contains two molecules of lead carbonate to one of lead hydrate, and is wholly soluble in dilute nitric acid, while barium sulphate, its most frequent adulterant, is wholly insoluble. China-clay and lead sulphate will also remain undissolved; but whitening or chalk cannot be detected in this way—indeed, the thorough examination of white lead, not only for sophistications but also for correspondence with the best type in composition, cannot be carried out save by a skilled chemist.

Classification.

Pigments may be classified on two systems: (1) based on the chemical composition; (2) based on the colour. On the first system pigments fall into nine groups, seven of which are fairly well defined, but the eighth and ninth have a somewhat miscellaneous character. The groups of elements, oxides, sulphides, hydrates, carbonates and silicates present this characteristic, namely, that each member of any one group is without action upon the other members of the group; any two or more may therefore be mixed together without fear of mutual injury. The same statement may be made with reference to the various inorganic salts of Group VIII. and to the organic compounds of Group IX., although in this large final group there are two pigments containing copper (verdigris and emerald green) which must be regarded with suspicion. The inertness of the members of the same group towards each other may be explained in the majority of cases by the following consideration. An oxide does not act upon an oxide, nor does a sulphide affect a sulphide, because all the pigment oxides have taken up their full complement of oxygen, and can neither give nor lose this element to similar oxides; so also with sulphur in the sulphides. A few details regarding the several members of the nine groups are now offered:—

Group I. *Elements.*—All the black pigments in ordinary use—ivory black, lamp black, charcoal black, Indian ink, and graphite, less correctly termed black-lead and plumbago—consist of or contain carbon, an element not liable to change. The metallic pigments, gold, silver, aluminium and platinum, belong here; of these, silver alone is easily susceptible of change, tarnishing by combination with sulphur.

Group II. *Oxides.*—The oxides have generally been formed at a high temperature and are not easily amenable to physical or chemical change; they are, moreover, not liable to affect other pigments, being practically inert, red lead only being an exception. The oxides include zinc white, green chromium oxide, burnt umber (a mixture of iron and manganese oxide), cobalt green ($\mathrm{CoO},n\mathrm{ZnO}$), cobalt blue ($\mathrm{CoO},n\mathrm{Al_2O_3}$), coeruleum ($\mathrm{CoO},n\mathrm{SnO_2}$), Venetian red, light red, Indian red and burnt sienna (all chiefly composed of ferric oxide), and red lead (Pb_3O_4).

Group III. *Sulphides.*—Some of the members of this group are liable to contain free sulphur, and some may give up this element to the metallic bases of other pigments. Thus cadmium yellow blackens emerald green, producing copper sulphide. Another pigment of this group, vermilion, is prone to a molecular change whereby the red form passes into the black variety. This change, frequent in water-colour drawings, is scarcely observable in works painted in oil. The sulphides comprise cadmium yellow (CdS), king's yellow (As_2S_2), realgar (As_2S_3), antimony red (Sb_2S_3) and vermilion (HgS). It is convenient to give places in the same group to the various kinds of ultramarine, blue, green, red, violet and native, for in all of them a part of the sulphur present occurs in the form of a sulphide. It may be stated that the sulphides of arsenic and antimony just named are dangerous and changeable pigments not suited for artistic painting.

Group IV. *Hydrates or Hydroxides.*—Several native earths belong here, notably yellow ochre, raw umber, raw sienna and Cappagh brown. These substances owe their colours mainly to hydrates and oxides of iron and of manganese, but the presence of a colourless body such as white clay or barium sulphate is usual with the paler pigments. A false yellow ochre from Cyprus is really a basic ferric sulphate, and does not properly belong to this group. Besides the yellow and brown pigments, there is a magnificent deep green pigment in this group, known as emerald oxide of chromium or viridian. The blue copper preparation which goes under the name of *bleu lumière* and mountain blue, a very unstable pigment, is also essentially a hydrate, though by no means pure. It should be stated that all the earthy or native hydrates belonging to this group contain water in two states, namely, hygroscopic or loosely-attached and constitutional. Before grinding them in oil, the reduction in the amount of the hygroscopic moisture by means of a current of dry air or a gentle warmth often improves the hue and working quality of these pigments.

Group V. *Carbonates.*—There is but one really important member of this group, namely, the old and typical variety of white lead ($2PbCO_3$, PbH_2O_2). Like green verditer ($2CuCO_3$. CuH_2O_2), and blue verditer ($CuCO_3$. CuH_2O_2), it is a basic carbonate. Purified chalk or whitening ($CaCO_3$) belongs here also.

Group VI. *Silicates.*—Terre verte, which is a natural green ochre containing a silicate of iron, potassium and magnesium, and one other silicate, smalt, an artificial glass containing a silicate of cobalt and potassium, constitute this small group. However, some of the ochreous earths contain silicates of iron, manganese and aluminium, as well as hydrates of the two former metals, and so have some claim to be ranked with the silicates.

Group VII. *Chromates.*—These salts are rich in oxygen. When in contact with some of the more alterable organic pigments belonging to Group IX. the chromates may lose oxygen, acquiring a somewhat greenish or greyish hue, owing to the formation of the lower or green oxide of chromium. The chromates cannot be trusted as pigments. The yellow chromates, those of barium, strontium, zinc and lead, are represented by the general formula $M''CrO_4$; chrome red is basic, and is Pb_2CrO_5.

Group VIII. *Various Inorganic Salts.*—This group is intended to receive a number of pigments which are solitary, or almost solitary, examples of various classes of salts. There is one cobaltinitrite, aureolin ($K_3Co(NO_2)_6$, associated with one or more molecules of water), called sometimes cobalt yellow; one antimonate, that of lead, the true Naples yellow; one tungstate, that of chromium, known as tungsten green; a metaphosphate of manganese, which goes under the name of Nürnberg or manganese violet; and several mixed cobalt compounds containing arsenates and phosphates of that metal, and represented by cobalt violet and Thénard's blue. Two sulphates also belong here, namely, baryta white ($BaSO_4$) and lead sulphate ($PbSO_4$); also Schweinfurt green, a basic copper arsenite. It is obvious that of the members of so miscellaneous a group of pigments no general characteristics can be predicated. But it may be stated that the two sulphates, the tungstate and the cobalt compounds are practically inert and unalterable, while the copper arsenite and the lead antimonate are sensitive to the action of sulphur and of sulphides. The cobaltinitrite, aureolin, cannot be safely mixed with some of the organic pigments belonging to the next and last group.

Group IX. *Organic Compounds.*—Most of the members of this large and unwieldy group of pigments possess this character in common, proneness to oxidation and consequent deterioration in the presence of light, moisture and air. Such oxidation is accelerated by the action of some highly oxidized pigments belonging to other groups, such as the chromates of Group VII. and aureolin of Group VIII., this action being particularly marked in the case of the yellow lakes, the cochineal lakes and indigo. There are two pigments consisting of copper salts in this group. They are verdigris—both the blue-green and the green varieties being basic copper acetates—and the pigment known in England as emerald-green, which is a basic cupric aceto-arsenite. These copper pigments present the usual sensitiveness to the attack of sulphur which distinguishes compounds of this metal, and cannot therefore be safely mixed with the members of Group III., and more particularly with the cadmium colours. About nine members of Group IX. may be regarded as substantive pigments. These include Indian yellow (mainly magnesium and calcium euxanthates), gamboge, sap green, indigo, Prussian blue, bitumen or asphalt, bistre, sepia, and the bituminous variety of Vandyck brown. The adjective pigments include a great variety of lakes where different kinds of colouring matters of more or less acid character have been thrown upon a base, generally of colourless aluminium hydrate, aluminium phosphate, stannous hydrate, stannic oxide, bartya or lime; sometimes coloured bases containing such metals as copper, chromium, manganese or iron are introduced in small quantities. The colouring matters used are both natural and artificial. Amongst the former may be named Indian lake, from the resinous exudation produced in certain trees by the attacks of *Coccus lacca*; carmine, crimson and purple lake, from the colouring matter obtained from the cochineal insect, *Coccus cacti*; rose-madder and the madder-lakes, from the alizarin and allied bodies derived from the root of the ordinary madder plant *Rubia tinctorum*; and yellow lakes, from quercitron bark (*Quercus tinctoria*), and from Persian and Avignon berries (species of *Rhamnus* or Buckthorn). The lakes derived from alkanet root, archil, Brazil wood, and red sanders wood are of very small interest and value. The same judgment may be pronounced upon the large number of artificial lakes which owe their colours to coal-tar derivatives, with the single exception of the important class of pigments obtained from artificial alizarin, and from its congeners and derivatives. Of these, alizarin (*q.v.*) itself, in its purest state and associated with alumina and a little lime, yields those pigments which possess a pink or rosy hue. When purpurin and its isomers, anthrapurpurin and flavopurpurin, are present, the red hue is more pronounced, and may even tend towards a golden colour, or, when some copper or iron or manganese is introduced, may become decidedly brown. Many of the alizarin crimsons sold as paints are not made from alizarin itself, but from the sulphonic acids of alizarin. These lakes present a wide range of hues. Another derivative of alizarin, known as β-nitro-alizarin, yields a rich orange lake, to which such names as pure orange, orange madder and marigold have been applied.

Stability.—Some notion of the relative stability of pigments will have been derived from the remarks already made under "Classification." But as permanence is of no less importance than chromatic quality in the case of pigments used in the fine art of painting, to which the present article is mainly devoted, further particulars concerning certain selected pigments may profitably be given here. Beginning with white pigments, these three may be named as useful: white lead, Freeman's white, zinc white. As an oil-colour, white lead of the old type is generally the best to use, but among water-colours its place must be taken by zinc white in the condensed form known as Chinese white. Zinc white, in spite of the qualities which recommend its use in oil, namely, the fact of its being not only unaffected by sulphur, but odourless and non-poisonous, lacks toughness as an oil-paint, and has a tendency to scale. Freeman's white, which consists essentially of lead sulphite, is the best substitute for white lead yet devised. The small percentages of zinc white and baryta white which it contains are not to be regarded as adulterations, for they greatly increase its *body*, and though of less specific gravity than lead sulphate, actually raise the weight per cubic foot of the dry pigment. Out of a dozen or more familiar yellow paints, a selection may be made of these six: yellow ochre, raw sienna, mars orange, cadmium yellow, aureolin and baryta yellow. Concerning two of these, cadmium yellow and aureolin, the following observations may be set down. Cadmium sulphide, CdS, exists in two forms, which in some measure correspond to the two modifications of mercuric and antimonious sulphides. One of these forms is yellow and the other reddish orange. When sulphuretted hydrogen is sent into a weak, cold, and neutral solution of cadmium salt, the sulphide which separates is pale and yellow—the orange variety is obtained from a strong, hot, and acid solution. The pale variety is more prone to change than the darker one; but as oil colours both forms are sufficiently stable for use, provided they are pure. The value of aureolin as a pigment depends much upon its mode of preparation. A new variety of bright yellow hue was described by Adie and Wood in 1900, and is represented by the formula $K_2NaCo(NO_2)_6$, H_2O. Of red pigments, six claim special mention. These are vermilion, light red, Venetian red, Indian red, red ochre, and the red lakes derived from madder or alizarin. Vermilion is stable in oils, but as water-colour paint is prone to change, under exposure to strong light, into the black modification of mercuric sulphide. The iron-reds named above, whether natural or artificial, are quite permanent, but so much cannot be said of the various madder-paints. They are of far greater stability under exposure to light than any other red organic pigments, and are absolutely necessary to the artist. It must be noted that those madder and alizarin lakes which contain an element of yellow and brown are less stable than those of a crimson hue. Five green pigments may be recommended, namely, viridian, or the emerald oxide of chromium, the ordinary green oxide, cobalt green, green ultramarine, and terre verte. Except for minor decorative work, where permanence is of secondary moment, one is obliged to exclude from the palette emerald green, green verditer, verdigris, sap-green, and the numerous preparations which owe their colour to mixtures of Prussian blue and chrome yellow, and are sold under the names of green vermilion, chrome green, Brunswick green, and so on. All these pigments usually contain much barium sulphate. Similarly, amongst blue pigments, ultramarine, cobalt blue and coeruleum may be retained, while smalt, indigo and all copper blues should be rejected. Prussian blue, or the mixture of this pigment with a white base which is usually called Antwerp blue, can scarcely be spared, but care should be taken to choose a sample containing no potassium compounds. Coeruleum, which may be described as cobalt stannate presents the peculiarity of appearing a greenish blue in artificial light, not a purplish blue like that of ordinary cobalt blue. Cobalt violet is a sound pigment, while manganese metaphosphate or Nürnberg violet is said not to be safe in oil. Mars violet, an artificially prepared ferric oxide, is dull in hue but permanent. Passing on to brown pigments, it is matter for regret that there are no permanent colours possessing the artistic capacities of asphalt, madder brown, and the old bituminous Vandyke brown. Cappagh brown, burnt sienna, and raw and burnt umber may be employed safely. Little need be said as to the selection of black pigments, for all are permanent. The soot from burning acetylene, which has recently been introduced, forms a black pigment of remarkable intensity.

Uses.—Hitherto pigments have been considered chiefly in relation to the requirements of the painter of pictures. In many merely decorative arts, such as the manufacture of wall-papers and the painting of woodwork and of iron, the pigments available are in one direction, that of cost, more restricted, but, on the other hand, many alterable or weak pigments are commonly employed. In paints intended for the protection of iron-work, the nature of the pigment introduced is a matter of great moment, for red lead, zinc white and white lead are found to exert a strong protective influence, which is not observed in the case of the vast majority of pigments. There are a number of other uses besides those just named for which special pigments, or, more precisely, special paints, are employed. Amongst such preparations may be named luminous paints, anti-fouling paints, metallic paints, damp-proof paints, and asbestos and other fire-proof paints.

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PIGOT, GEORGE, BARON (1719–1777), English governor of Madras, was born on the 4th of March 1719 and entered the service of the East India Company in 1736; after nineteen years he became governor and commander-in-chief of Madras in 1755. Having defended this place against the French in 1758–59 and occupied Pondicherry on behalf of the company, he resigned his office in November 1763 and returned to England, being made a baronet in 1764. In the following year he obtained a seat in parliament, and this he retained until his death; in 1766 he was created an Irish peer as Baron Pigot. Returning to India in 1775 to occupy his former position at Madras, Pigot was at once involved in a fierce quarrel with the majority of his council, which arose out of the proposed restoration of the rajah of Tanjore. The governor was arrested by order of his opponents, and was still a prisoner when he died on the 11th of May 1777. Meanwhile the conduct of Pigot was censured by the court of directors in England and the order for his restoration was followed immediately by another for his recall. This happened about a month after his death, but before the news had reached England. In 1779 the matter was discussed in parliament, and four of those who were responsible for his arrest were tried and were fined £1000 each. Pigot, who left several illegitimate children, was never married, and his barony became extinct.

Two of the governor's brothers were men of repute. SIR ROBERT PIGOT (1720–1796), who succeeded to the baronetcy, commanded his regiment (the 38th) at the battles of Lexington and Bunker Hill during the War of American Independence. He became a lieutenant-general in 1782. The other brother, HUGH PIGOT (*c.* 1721–1792), was a sailor. After some years of service he became an admiral and commander-in-chief in the West Indies in 1782. One of his sons was General SIR HENRY PIGOT (1750–1840), and another was HUGH PIGOT (1769–1797), a captain in the navy, who was murdered during a mutiny in September 1797 while in command of the "Hermione."

PIG-STICKING, or HOG-HUNTING, the chase of the wild boar, as a sport, on horseback with the spear. The chase on foot was common among ancient peoples, and in central Europe has lasted to the present day, although, on account of the introduction of fire-arms, the spear has gradually become an auxiliary weapon, used to give the *coup de grâce* to a wounded animal. The modern sport is the direct descendant of bear-spearing which was popular in Bengal until the beginning of the 19th century, when the bears had become so scarce that wild pigs were substituted as the quarry. The weapon used by the Bengalese was a short, heavy, broad-bladed javelin. British officers introduced the spear or lance and this has become the recognized method of hunting wild pigs in India. The season for hunting in northern India, the present headquarters of the sport, is from February to July. The best horses should be quick and not too big. Two kinds of weapon are used. The long, or underhand, spear, weighing from two to three pounds, has a light, tough bamboo shaft, from seven to eight feet long, armed with a small steel head of varying shape. This spear is held in the hand about two-thirds the distance from the point, with the knuckles turned down and the thumb along the shaft. The short, or jobbing, spear is from six to six and a half feet long, and somewhat heavier than the longer weapon. It is grasped near the butt, with the thumb up. Although easier to handle in the jungle, it permits the nearer approach of the boar and is therefore more dangerous to man and mount.

Having arrived at the bush-grown or marshland haunt of the pigs, the quarry is "reared," *i.e.* chased out of its cover, by a long line of beaters, usually under the command of a mounted *shikari*. Sometimes dogs and guns loaded with small shot are used to induce an animal to break cover. The mounted sportsmen, placed on the edge of the cover, attack the pig as soon as it appears, the honour of "first spear," or "spear of honour," *i.e.* the thrust that first draws blood, being much coveted. As a startled or angry wild boar is a fast runner and a desperate fighter the pig-sticker must possess a good eye, a steady hand, a firm seat, a cool head and a courageous heart. For these reasons the military authorities encourage the sport, which is for the most part carried on by the tent clubs of the larger Indian stations.

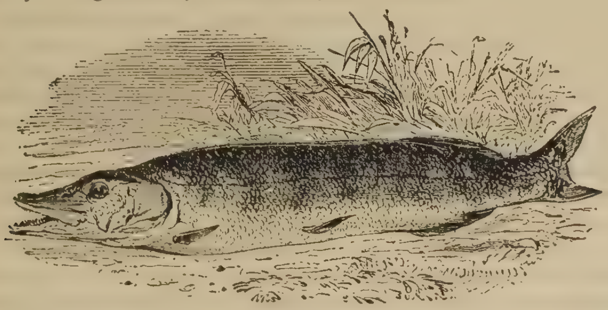
The following technical terms are used. "Frank," a boar enclosure. "Jhow," the tamarisk, a common cover for boars. "Jink" (of the boar), to turn sharply to one side. "Nullah," a dry water-course. "To pig," to hunt the boar. "Pug," the boar's footprint. "Pugging," tracking the boar. "Ride to hog," to hunt the boar. "Rootings," marks of the pig's snout in the ground. "Sanglier" (or "singular"), a boar that has separated from the "sounder." "Sounder," a family of wild swine. "Squeaker," a pig under three years. "Tusker," a full-grown boar.

See *Pig-Sticking or Hog-Hunting*, by R. S. S. Baden-Powell (London, 1889).

PIKE, ZEBULON MONTGOMERY (1779–1813), American explorer and soldier, was born in Lamberton (now a part of Trenton), New Jersey, on the 5th of January 1779, son of Zebulon Pike (1751–1834), an officer in the American army. He entered his father's company as a cadet about 1794, and became an ensign (or second lieutenant) in 1799 and first lieutenant in the same year. On the 9th of August 1805 he started with twenty men from St Louis to explore the head-waters of the Mississippi. At Prairie du Chien he met some Chippewa chiefs and induced them to expel the whisky-traders among them and to make peace with the Sioux; at the Falls of St Anthony (Sept. 23) he bought a tract 9 m. square at the mouth of the St Croix for a fort; and at Little Falls (in the middle of October) he built a stockade, where he left seven men. He reached Leech Lake ("Lake La Sang Sue"), which he called "the main source of the Mississippi," on the 1st of February 1806; went 30 m. farther to Cass Lake ("Red Cedar"); and, after working against British influences among the Indians, turned back, and went down the Mississippi from Dean Creek to St Louis, arriving on the 30th of April. In 1806 he was ordered to restore to their homes 50 Osages, redeemed by the United States government from Potawatami, and to explore the country. He started on the 15th of July; and went north along the Missouri and the Osage into the present state of Kansas and probably to the Republican river in the south of the present Nebraska, where on the 29th of September he held a grand council of the Pawnees. Then (early in October), turning nearly south, he marched to the Arkansas river, which he reached on the 14th of October, and up which (after the 28th with only 16 men) he went to the Royal Gorge (Dec. 7), having first seen the mountain called in his honour Pike's Peak on the 23rd of November; and then went north-west, probably up Oil Creek from Cañon City. In searching for the Red river he came to the South Platte, marched through South Park, left it by Trout Creek pass, struck over to the Arkansas, which he thought was the Red River for which he was searching, and, going south and south-west, came to the Rio Grande del Norte (about where Alamosa, Conejos county, Colorado, is now) on the 30th of January 1807. There on the 26th of February he and a small number of his men were taken prisoners by Spanish authorities, who sent him first to Santa Fé, then to Chihuahua to General Salcedo, and by a roundabout way to the American frontier, where he was released on the 1st of July 1807. He was promoted captain (August 1806), major (May 1808), lieutenant-colonel (Dec. 1809) and colonel (July 1812). In 1808 he tried in vain to get an appropriation from Congress for himself and his men. He was military agent in New Orleans in 1809–1810, was deputy quartermaster-general in April–July 1812, and was in active service in the War of 1812 as adjutant and inspector-general in the campaign against York (now Toronto), Canada, and in the attack on York on the 27th of April 1813 was in immediate command of the troops in action and was killed by a piece of rock which fell on him when the British garrison in its retreat set fire to the magazine.

His *Account of an Expedition to the Sources of the Mississippi and through the Western Parts of Louisiana . . . and a Tour through the Interior Parts of New Spain* was published at Philadelphia in 1810; was reprinted and rearranged in London in 1811; and was published in a French version in Paris in 1812, and a Dutch version at Amsterdam in 1812–1813. The standard edition with memoir and notes by Elliott Coues was published in three volumes in New York in 1895. Some of Pike's papers taken from him in Mexico are now in the Mexican archives (Seccion de Asuntos Internacionales caxa 1817–1824), and the more important were published by H. E. Bolton in the *American Historical Review*, (1907–1908), xiii. 798–827. See the sketch by Henry Whiting in vol. v., series 2, of Jared Sparks's *Library of American Biography*.

PIKE, fresh-water fishes generally distributed over the rivers and lakes of Europe, northern Asia, and North America, and forming a small family (*Esocidae*) of soft-rayed fishes. They are readily recognized by their elongate compressed body covered with small scales, a long head, long and spatulate snout, and very large mouth armed with strong and long teeth in the jaws and broad bands of smaller teeth on the palate and tongue. The teeth point backwards or can be depressed so as to offer no obstruction to any object entering the gape, but prevent its withdrawal in the opposite direction. The dorsal and anal fins are placed far back on the tail, thus greatly increasing the propelling power of the fish, and, although pike are bad swimmers and lead rather a sedentary than a roving life, they are excelled by no other fresh-water fish in rapidity of motion when, by a single stroke of the tail, they dash upon their prey or dart out of reach of danger. In the Old World one species only is known (*Esox lucius*), which prefers lakes and sluggish reaches of rivers to strong currents or agitated waters. Its eastward range in northern Asia is not known; it extends into Lapland in the north and into central Italy and the vicinity of Constantinople in the south, but is absent in the Iberian Peninsula. The European species occurs also in North America, and is common in the eastern United States southwards to northern Ohio. But North America is tenanted by other species of pike besides, of which the largest is the muskelunge or maskinonge of the Great Lakes (*Esox nobilior*); it commonly attains to the large size which is exceptionally recorded of *Esox lucius*. The other American pike are of smaller size, and generally named "pickerel"; but opinions as to the distinction of the species differ widely among American ichthyologists. The European pike, like its brethren, is the most voracious of fresh-water fishes; it probably exceeds the shark, to which it has been compared by many writers, in the relative quantity of food it consumes. Large specimens will seize rats or water-voles, and are said to attack even foxes and small dogs. Individuals of from 40 ℔ to 50 ℔ are not scarce, but captures of much larger ones are on record. Pike are wholesome food, and much esteemed in inland countries—the smaller (of 20 to 24 in. in length) being preferred to the larger individuals. They are prolific, and not easily exterminated in a water in which they have been once allowed to spawn. According to season and climate they spawn in April or May, and sometimes as early as February.



European Pike (*Esox lucius*).

PIKE, a word which, with its collateral forms "pick" and "peak," has as its basic meaning that of anything pointed or tapering to a point. The ultimate etymology is much disputed, and the interrelation of the collaterals is very confused. In Old English there are two forms (*pic*), one with a long and the other with a short vowel, which give "pike" and "pick" respectively. The first form gave in the 15th century the variant "peak," first with reference to the peaked shoes then fashionable, *pekyd schone*. In Romanic languages are found Fr. *pic.*, Span. *pico*, Ital. *piccare*, to pierce, &c. There are also similar words in Welsh, Cornish and Breton. The Scandinavian forms, *e.g.* Swed. and Nor. *pīk*, are probably taken from English. While some authorities take the Celtic as the original, others look to Latin for the source. Here the woodpecker, *picus*, is referred to, or more probably the root seen in *spica*, ear of corn, and *spina*, prickle (English spike, spine). The current differentiation in meanings attached to pike, pick and peak are more or less clearly marked, though in dialects they may vary. (1) *Pike*: Apart from the use as the name of the fish (see above), probably a shortened form of pike-fish, from its sharp, pointed beak, the common uses of the word are for a long hafted weapon with sharply pointed head of iron or steel, the common weapon of the foot-soldier till the introduction of the bayonet (see SPEAR and BAYONET), and for a hill with a pointed summit, appearing chiefly in the names of such hills in Cumberland, Westmorland and North West Lancashire. It may be noticed that the proverbial expression "plain as a pike-staff" appears originally as "plain as a pack-staff," the flat plain sided staff on which a pedlar carried and rested his pack. The use of "pike" for a highway, a toll-gate, &c., is merely short for "turnpike." (2) *Pick*: As a substantive this form is chiefly used of the common tool of the navvy and the miner, consisting of a curved double-ended head set at right angles to the handle, one end being squared with a chisel edge, the other pointed, and used for loosening and breaking hard masses of earth, coal, &c. (see TOOLS). The other name for this tool, "pickaxe," is a corruption of the earlier *pikoys*, Fr. *picois*, M. Lat. *picosium*, formed from Fr. *pic*, the termination being adapted to the familiar English "axe." The sense-development of the verb "to pick" is not very clear, but the following meanings give the probable line: to dig into anything like a bird with its beak, in order to extract or remove something, to gather, pluck, hence to select, choose. (3) *Peak*: The chief uses are for the front of a cap or hat projecting sharply over the eyes, for the part of a ship's hold where it narrows towards the bows, the fore-peak, or towards the stern, the after-peak, for the top corner of a sail extended by a gaff, or for the projecting end of the gaff itself, and for a pointed or conical top of a hill or mountain. The name of the high table-land district in Derbyshire is not to be connected with this word, but probably retains the name of an old English demon, *Peac* (see Peak, The).

PIKE-PERCH (*Lucioperca*), fresh-water fishes closely allied to the perch, but with strong canine teeth standing between the smaller teeth of the jaws and palate. They resemble the pike in their elongate body and head, and they are also most dangerous enemies to other fresh-water fishes, though they compensate for their destructiveness by the excellent flavour of their flesh. In Europe two species occur, the more celebrated being the "Zander" of North Germany or "Schiel" of the Danube (*Lucioperca sandra*); strange to say, it is absent in the system of the Rhine. It prefers the quiet waters of large rivers and clear deep lakes, in which it reaches a weight of 25 ℔ or 30 ℔. The second (*Lucioperca wolgensis*) is limited to rivers in southern Russia and Hungary. In North America several pike-perches have been described, but in the most recent works only two are distinguished, viz. *Lucioperca americana*, which grows to a weight of 20 ℔, and the much smaller *Lucioperca canadensis*; both are abundant in the Canadian lakes and upper Mississippi, and the latter also in the Ohio.

PIKE'S PEAK, a famous peak of the Rampart range of the Rocky Mountains in El Paso county, Colorado, U.S.A., about 6 m. W. of Colorado Springs. Though surpassed in altitude (14,108 ft.) by many summits in the state, no other is so well known. The commanding appearance of the peak is very fine. To the south are Cameron Cone (10,685 ft.), Mt Sachett, Mt Bald (13,974), Mt Rosa (11,427), and Mt Cheyenne (9407). From the summit the magnificent Sangre de Cristo range is in the foreground, while on a clear day not only its southernmost summit, Blanca Peak (14,390 ft.) is visible, but also the Spanish Peaks (12,708 and 13,623 ft.) 100 m. to the south, and Long's Peak 100 m. to the north, and between them Mt Lincoln, Gray's Peak and other giants. At the base of the mountain are Manitou and Colorado Springs, whence tourists can make the ascent of the peak (in summer safe and relatively simple) on horseback or by a cog-railway, 8·75 m. long (opened in 1891), which makes a total ascent of 8100 ft. (maximum gradient 1 in 4) to the summit. In 1905 a powerful searchlight was erected on the summit.

Pike's Peak was discovered in November 1806 by Lieut. Zebulon M. Pike. He attempted to scale it, but took the wrong path and found himself at the summit of Cheyenne Mountain. He pronounced the mountain unclimbable. In 1819 it was successfully climbed by the exploring party of Major S. H. Long.

PILASTER (Fr. *pilastre*, med. Lat. *pilastrum*, from *pila*, a pillar), in architecture, an engaged pier projecting slightly from the wall, and employed to divide up and decorate a wall surface or to serve as respond to a column. One of the earliest examples (*c.* 100 B.C.) exists in the propylaea at Priene in Asia Minor, where it tapers towards the top. Pilasters have bases and capitals and are frequently fluted like columns. The Romans would seem to have preferred semi-detached columns, but for their amphitheatres sometimes pilasters are employed, as in the upper story of the Colosseum. In the revival of Classic architecture, and especially in Italy, architects seem to have considered that no building was complete without a network of pilasters on every storey, and France and England followed their example; and not only externally but inside the great cathedrals and churches the pilaster is adopted as the simplest and best way of dividing the bays.

PILATE, PONTIUS, the Roman governor of Judaea under whom Jesus Christ suffered crucifixion. Of equestrian rank, his name Pontius suggests a Samnite origin, and his cognomen in the gospels, *pileatus* (if derived from the *pileus* or cap of liberty), descent from a freedman. In any case he came in A.D. 26 from the household of Tiberius, through the influence of Sejanus, to be procurator over part of the imperial province of Syria, viz. Judaea, Samaria and Idumea. He ruled ten years, quarrelled almost continuously with the Jews—whom Sejanus, diverging from the Caesar tradition, is said to have disliked—and in A.D. 36 was recalled. Before he arrived Tiberius died, and Pilate disappears from history. Eusebius relates (*Hist. eccl.* ii. 7)—but three centuries later and on the authority of earlier writers unnamed—that he was exiled to Gaul and committed suicide at Vienne.

Pilate kept the Roman peace in Palestine but with little understanding of the people. Sometimes he had to yield; as when he had sent the standards, by night, into the Holy City, and was besieged for five days by suppliants who had rushed to Caesarea (Jos. *Ant.* 31; *B. J.* ii. ix. 2, 3); and again when he hung up inscribed shields in Jerusalem, and was ordered by Tiberius to remove them to the other city (*Philo ad Gaium* 38). Sometimes he struck more promptly; as when the mob protested against his using the temple treasure to build an aqueduct for Jerusalem, and he disguised his soldiers to disperse them with clubs (Jos. *Ant.* xviii. 3, 2); or when he "mingled the blood" of some unknown Galileans "with their sacrifices" (Luke xiii. 1); or slew the Samaritans who came to Mt Gerizim to dig up sacred vessels hidden by Moses there (Jos. *Ant.* xviii. 4, 1)—an incident which led to his recall. Philo, who tells how any suggestion of appeal by the Jews to Tiberius enraged him, sums up their view of Pilate in Agrippa's words, as a man "inflexible, merciless, obstinate."

A more discriminating light is thrown upon him by the New Testament narratives of the trial of Jesus. They illustrate the right of review or *recognitio* which the Romans retained, at least in capital causes; the charge brought in this case of acting *adversus majestatem populi romani*; the claim made by Jesus to be a king; and the result that his judge became convinced that the claimant was opposed neither to the public peace nor to the civil supremacy of Rome. The result is explained only by the dialogue, recorded exclusively in John, which shows the accused and the Roman meeting on the highest levels of the thought and conscience of the time. "I am come to bear witness unto the truth . . . . Pilate answered, What is truth?" Estimates of Pilate's attitude at this point have varied infinitely, from Tertullian's, that he was "already in conviction a Christian"—*jam pro sua conscientia Christianus*—to Bacon's "jesting Pilate," who would not stay for a reply. We know only that to his persistent attempts thereafter to get his proposed verdict accepted by the people, came their fatal answer, "Thou art not Caesar's friend," and that at last he unwillingly ascended the *bema* (in this case a portable judgment-seat, brought for the day outside the Praetorium), and in such words as *Ibis ad crucem* "delivered Him to be crucified."

Pilate's place in the Christian tragedy, and perhaps also in the Creed, stimulated legend about him in two directions, equally unhistorical. The *Gospel of Nicodemus*, written by a Christian (possibly as early, Tischendorf thought, as the middle of the 2nd century), repeats the trial in a dull and diluted way; but adds not only alleged evidence of the Resurrection, but the splendid vision of the *descensus ad inferos*—the whole professing to be recorded in the *Acta Pilati* or official records of the governor. The *Epistola Pilati* gives Pilate's supposed account to Tiberius of the Resurrection; and the *Paradosis Pilati* relates how Tiberius condemned him and his wife Procla or Procula, both Christian converts. All this culminates in Pilate being canonized in the Abyssinian Church (June 25), and his wife in the Greek (Oct. 27). On the other hand the *Mors Pilati* tells how when condemned by the emperor he committed suicide; and his body, thrown first into the Tiber and then the Rhone, disturbed both waters, and was driven north into "Losania," where it was plunged in the gulf near Lucerne and below Mt Pilatus (originally no doubt *Pileatus* or cloud-capped), from whence it is raised every Good Friday to sit and wash unavailing hands.

Bibliography.—For legends see Tischendorf's *Evangelia apocrypha* (1863) and *Apocryphal Gospels*, Ante-Nicene Lib. (1880).

The earlier Pilate literature, to the extent of 110 treatises, chiefly of the 17th and 18th centuries, is enumerated in G. A. Müller's *Pontius Pilatus der fünfte Prokurator von Judäa* (Stuttgart, 1888). See *in loco* in the following English or translated histories of the life or time of Jesus, Theodor Keim, E. Schürer, A. Edersheim, J. P. Lange, Bernhard Weiss and F. W. Farrar; *Expositor* (1884) p. 107 and (1900) p. 59; also H Peter," Pontius Pilatus, der römische Landpfleger in Judäa," in *Neue Jahrb. f. d. kl Altertum* (1907). Sir James Fitzjames Stephen, in his *Liberty, Equality and Fraternity* (1873), p. 87, starts the question, "Was Pilate right in crucifying Christ:" his somewhat paradoxical answer is criticised in *The Trial of Jesus Christ, a legal monograph*, by A. Taylor Innes (1899).
(A. T. I.)

PILATUS, LEO, or LEONTIUS [LEONZIO PILATO] (d. 1366), one of the earliest promoters of Greek studies in western Europe, was a native of Thessalonica. According to Petrarch, he was a Calabrian, who posed as a Greek in Italy and as an Italian abroad. In 1360 he went to Florence at the invitation of Boccaccio, by whose influence he was appointed to a lectureship in Greek at the Studio, the first appointment of the kind in the west. After three years he accompanied Boccaccio to Venice on a visit to Petrarch, whom he had already met at Padua. Petrarch, disgusted with his manners and habits, despatched him to Constantinople to purchase MSS. of classical authors. Pilatus soon tired of his mission and, although Petrarch refused to receive him again, set sail for Venice. Just outside the Adriatic Gulf he was struck dead by lightning. His chief importance lies in his connexion with Petrarch and Boccaccio. He made a bald and almost word for word translation of Homer into Latin prose for Boccaccio, subsequently sent to Petrarch, who owed his introduction to the poet to Pilatus and was anxious to obtain a complete translation. Pilatus also furnished Boccaccio with the material for his genealogy of the gods, in which he made an ostentatious display of Greek learning.

See Gibbon, *Decline and Fall*, ch. 66; G. Voigt, *Die Wiederbelebung des classischen Alterthums* (1893); H. Hody, *De Graecis illustribus* (1742); G. Tiraboschi, *Storia della letteratura italiana*, v. 691.

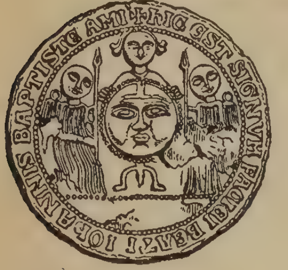
PILAU, a favourite Eastern dish, consisting essentially of rice, boiled with mutton or other meat, fowl or fish, and flavoured with spices, raisins, &c. The word appears in Persian, Turkish and Urdu, and has been adopted in European languages. The form *pilaff*, showing the Turkish pronunciation, is also common.

PILCHARD (in earlier 16th century forms *pylcher*, *pilchar*; of unknown origin; the Fr. *pilseir* is adapted from Eng.), *Clupea pilchardus*, a fish of the herring family (*Clupeidae*), abundant in the Mediterranean and on the Atlantic coasts of Europe, north to the English Channel. Sardine is another name for the same fish, which on the coast of Britanny and Normandy is also called *célan* or *céléren*. It is readily distinguished from the other European species of *Clupea*. The operculum is sculptured with ridges radiating and descending towards the suboperculum; the scales are large, about thirty along the lateral line, deciduous; the ventral fins are inserted below, or nearly below, the middle of the base of the dorsal fin; the dorsal fin has seventeen or eighteen, the anal from nineteen to twenty-one rays. A small blackish spot in the scapulary region is very constant, and sometimes succeeded by other similar marks. There are no teeth on the palate; pyloric appendages exist in great numbers; the vertebrae number fifty-three. The pilchard is one of the most important fishes of the English Channel. It spawns at a distance from the shore, and its eggs are buoyant, like those of many other marine fishes and unlike those of the herring, which are adhesive and demersal, *i.e.* develop under water. The egg of the pilchard is very easily distinguished from other pelagic eggs by the unusually large space separating the vitelline membrane from the contained ovum. Spawning takes place in summer, the season extending from June to October. When commencing their migrations towards the land the shoals consist of countless numbers, but they break up into smaller companies near the shore. Pilchards feed on minute crustaceans and other pelagic animals and require two or three years before they attain their full size, which is about 10 in. in length. The sardines of the west coast of France, which are tinned in oil for export, are immature fish of the same stock as those taken on the coasts of Cornwall; they are 5 to 7½ in. in length, and though such fish occur also on the Cornish coast it is only in small numbers and for brief periods. In the Mediterranean the sardine does not exceed 7½ in. in length when mature. On the Pacific coast of America, in New Zealand and in Japan a pilchard occurs (*Clupea sagax*) which in its characters and habits is so similar to the European pilchard that its general utilization is deserving of attention. Immense shoals are reported to visit the east coast of Otago every year in February and March. *Clupea scombrina* is the "oil sardine" of the east coast of India.
(J. T. C.)

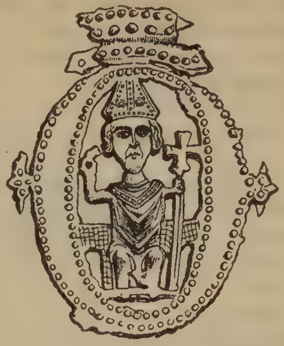
PILE, an homonymous word, of which the main branches are (1) a heap, through Fr. from *pīla*, pillar; (2) a heavy beam used in making foundations, literally a pointed stake, an adaptation of Lat. *pīlum*, javelin; (3) the nap on cloth, Lat. *pilus*, hair. In the first branch the Lat. *pīla* (for *pigla*, from root of *pangere*, to fasten) meant also a pier or mole of stone, hence any mass of masonry, as in Fr. *pile*. In English usage the word chiefly means a "heap" or "mass" of objects laid one on the top of the other, such as the heap of faggots or other combustible material on which a dead body is cremated, "funeral pile," or on which a living person is burnt as a punishment. It also is applied to a large and lofty building, and specifically, to a stand of arms, "piled" in military fashion, and to the series of plates, "galvanic" or "voltaic piles," in an electric battery. The modern "head and tail" of a coin was formerly "cross and pile," Fr. *croix et pile*, in modern Fr. *face et pile*. In the older apparatus for minting the die for the reverse was placed on a small upright pillar, *pile*, the other on a puncheon known as a "trussell" (Fr. *trousseau*). The common name of the disease of haemorrhoids (*q.v.*) or "piles" is probably an extension of this word, in the sense of mass, swelling, but may be referred to the Lat. *pila*, ball. The name of the *pilum*, or heavy javelin (lit. pounder, pestle, from *pinsere*, *pisere*, to beat), the chief weapon of the ancient Roman infantry, was adopted into many Teutonic languages in the sense of dart or arrow, cf. Germ. *Pfeil*; in English it was chiefly used of a heavy stake with one end sharpened, and driven into swampy ground or in the bed of a river to form the first foundations for a building; the primitive lake-dwellings built on "piles" are also known as "pile-dwellings." For the use of piles in building see FOUNDATIONS and BRIDGES. In heraldry a charge represented by two lines meeting in the form of an arrow head is known as a "pile," a direct adaptation probably of the Lat. *pilum*. The division of this intricate word, followed here, is that adopted by the *New English Dictionary*; other etymologists (*e.g.* Skeat, *Etym. Dict.*, 1898) arrange the words and their Latin originals somewhat differently.

PILGRIM, a wanderer, traveller, particularly to a holy place (see PILGRIMAGE). The earliest English forms are *pilegrim* or *pelegrim*, through Fr. *pèlerin* (the original O. Fr. *pelegrin* is not found), from Lat. *peregrinus*, a stranger, foreigner, particularly a resident alien in Rome (see PRAETOR, and ROMAN LAW). The Lat. *pereger*, from which *peregrinus* is formed, meant "from abroad," "travelled through many lands" (*per*, through, and *ager*, country).

It was customary for pilgrims to bring back as proof of their pilgrimage to a particular shrine or holy place a badge, usually made of lead or pewter, bearing some figure or device identifying it with the name or place. These "pilgrim signs" are frequently alluded to in literature—notably in the *Canterbury Tales* and in *Piers Plowman*. The British Museum and the Musée Cluny in Paris have fine collections of them, mainly dredged from the Thames and the Seine. The badges were generally worn fastened to the pilgrim's hat or cape. Among the best known are those of the cockle or scallop shell of St. James of Compostella in Spain; the "vernicle," a representation of the miraculous head of Christ; the *vera icon*, true image, on St Veronica's handkerchief, at Rome, or of the Abgar portrait at Genoa, of "a vernicle hadde he sowed on his cappe" (*Cant. Tales*, "Prol." 685); the Amiens badge of the head of John the Baptist on the charger, the cathedral claiming the custody of the relic from 1206 (fig. 1); and the palm branches or cross of palm leaf, the badge of the “ Palmers ” pilgrimage to the Holy Land. The most common of the English pilgrims' signs are those of the shrine of Thomas Becket at Canterbury, the greatest centre of pilgrimage in England. These take a variety of forms, sometimes a simple T, sometimes a bell marked *campana Thome*, the Canterbury bell, most often a figure of the saint, sometimes seated, sometimes riding on a horse, and carrying his episcopal cross, and with hand uplifted in benediction (fig. 2). Sometimes the badges took the shape of small *ampullae*, or vases, as in the case of the badges of the shrine of Our Lady of Walsingham, which were marked with a W and crown.



(From Andrews' *Church Treasury.*)
FIG. 1 —Pilgrim's Sign, from the cathedral at Amiens.



(From Andrews' *Church Treasury.*)
FIG. 2.—Pilgrim's Sign, from Canterbury.

See W. Andrews, *Church Treasury* (1898), article “ Pilgrims' Signs,” by Rev. G. S. Tyack; and *Guide to Medieval Room, British Museum*, p. 69.

The English “ Pilgrims' Way.”—From Winchester, in Hampshire, to Canterbury, in Kent, runs a road or way which can still be traced, now on the present made roads, now as a lane, bridle path, or cart track, now only by a line of ancient yews, hollies or oaks which once bordered it. To this old track the name of “ pilgrims' way ” has been given, for along it passed the stream of pilgrims coming through Winchester from the south and west of England and from the continent of Europe by way of Southampton to Canterbury Cathedral to view the place of the martyrdom of Thomas Becket, in the north transept, to the relics in the crypt where he was first buried after his murder, in 1170, and the shrine in the Trinity Chapel which rose above his tomb after the translation of the body in 1220. There were two festivals for the pilgrimage, on the 29th of December, the day of the martyrdom, and on the 7th of July, the day of the translation. The summer pilgrimage naturally became the most popular. In 1538 the shrine was destroyed and the relics of the saint scattered, but the great days of the pilgrimage had then passed. Erasmus gives a vivid picture of the glories of the shrine and of all that was shown to the pilgrims on his visit with Colet to Canterbury in 1514.

The principal villages, towns and places near or through which the way passed are as follow: Winchester, Alresvord, Ropley, Alton, Farnham (here the way follows the present main road), Seale, Puttenham, by the ruined chapel of St Catherine, outside Guildford, near where the road crosses the Wey above Shalford,[1] and by the chapel of St Martha, properly of “ the martyr,” now restored and used as a church, Albury, Shere, Gomshall, Dorking (near here the Mole is crossed), along the southern slope of Boxhill to Reigate, then through Gatton Park, Merstham, Otford, Wrotham, after which the Medway was crossed, Burham, past the megalithic monument Kit's Coty House, and the site of Boxley Abbey, the oldest after Waverley Abbey of Cistercian houses in England, and famous for its miraculous image of the infant saint Rumbold, and the still more famous winking rood or crucifix. The road passes next by Hollingbourne, Lenham and Charing. At Otford, Wrotham and Charing were manor-houses or rather palaces of the archbishops of Canterbury; at Hollingbourne was a manor of the priors of Christchurch. After Hollingbourne come Westwell, Eastwell, Boughton Aluph, Godmersham, Chilham Castle, and then at Harbledown, where are the remains of the Hospice of St Nicholas, the road joins Watling Street, by which came the main stream of pilgrims from London, the North and the Midlands.

This road, although its name of the Pilgrims' Way has for long confined it to the road by which the pilgrims came to Canterbury from Winchester, follows a far older track. Right back into British and even older times the main direction which commerce and travellers followed across southern and western England to the Straits of Dover and the Continent lay from Canterbury along the southern chalk slope of the North Downs to near Guildford, then by the Hog's Back to Farnham. At this point the oldest track went across Salisbury Plain towards Stonehenge and so on to Cornwall. From Farnham westward the only portion of this the oldest track that can now be traced is a small portion that still bears the name of the Harrow (*i.e.* hoary, old) road. It was in early times abandoned for the road from Winchester to which the stream of travel and commerce from the Continent and the south and south-west of England was diverted.

The “ pilgrims' way ” has been traced fully in Mrs Ady's book *The Pilgrims' Way* (1893), and the older track in the fullest detail in Hilaire Belloc's *The Old Road* (1904).

The American “ Pilgrim Fathers.”—In American history the name “ Pilgrims ” is applied to the earliest settlers of the colony of Plymouth, Massachusetts, and more specifically to the first company of emigrants, who sailed in the “ Mayflower ” in 1620. They were from the beginning Separatists from the Church of England; they had established Independent (Congregational) churches at Scrooby and Gainsborough early in the 17th century, and some of them had fled to Amsterdam in 1608 to avoid persecution, and had removed to Leiden in the following year. They sailed from Delftshaven late in July 1620, from Southampton on the 5th of August, from Plymouth on the 6th of September, and late in December 1620 founded the colony of Plymouth, Massachusetts. See MASSACHUSETTS; PLYMOUTH, and MAYFLOWER.

PILGRIMAGE (Fr. *pèlerinage*, Lat. *peregrinatio*), a journey undertaken, from religious motives, to some place reputed as sacred. These journeys play an important rôle in most pre-Christian and extra-Christian religions: in the Catholic Church their acceptance dates from the 3rd and 4th centuries.

I. *The Pilgrimage in pre-Christian and non-Christian Religions.*—To the Germanic religions the pilgrimage is unknown. On the other hand, it is an indigenous element, not only in the creeds of Asia, but in those of the ancient seats of civilization on the Mediterranean. The fundamental conception is always that the Deity resides—or exercises a peculiarly powerful influence—in some definite locality; and to this locality the devout repair, either in reverence of their god, or in quest of his assistance and bounty. Thus, as the cult of a particular divinity spreads farther and farther, so the circle expands from which are drawn those who visit his sanctuary.

One of the oldest homes of the pilgrimage is India. There the army of devotees tends more especially to the Ganges—the hallowed river of Hindu belief. On the Ganges lies Benares, the holy city of Brahminism: and to look on Benares, to visit its temples, and to be washed clean in the purifying river, is the yearning of every pious Indian. Even Buddhism—originally destitute of ceremonial—has adopted the pilgrimage; and the secondary tradition makes Buddha himself determine its goals: the place where he was born, where he first preached, where the highest insight dawned on him, and where he sank into Nirvana. The four ancient sacred resorts are Kapilavastu, Gaya, Benares and Kusinagara.

In Syria, the temple of Atargatis in Hierapolis was an immemorial resort of pilgrims. In Phoenicia, a similar significance was enjoyed by the shrine of Astarte, on the richly-watered source of the river Adonis, till, as late as the 4th century after Christ, it was destroyed by Constantine the Great. In Egypt, the great annual and monthly festivals of the indigenous gods gave rise to all manner of religious expeditions. Even among the Israelites, the visitation of certain cult-centres prevailed from remote antiquity; but, when the restriction of Yahweh-worship to Jerusalem had doomed the old shrines, the Jewish pilgrimages were directed solely to the sanctuary on Mt Moria. Among the Greeks the habit was no less deeply rooted. Just as the inhabitants of each town honoured their tutelar deity by solemn processions to his temple, so, at the period of the Olympic games, the temple of Zeus at Olympia formed the goal of multitudes from every Hellenic country. No less powerful was the attraction exercised by the shrines of the oracular divinities, though the influx of pilgrims was not limited to certain days, but, year in and year out, a stream of private persons, or embassies from the city-states, came flowing to the temple of Zeus in Dodona or the shrine of Apollo at Delphi.

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[1] Shalford Fair, the chapels on the two hills and the Surrey hills are probably the scene of Bunyan's *Pilgrim's Progress*, see E. Rénouard James, *Notes on the Pilgrim's Way in West Surrey* (1871).

The unification of the peoples of antiquity in the Roman Empire, and the resultant amalgam of religions, gave a powerful impetus to the custom. For, as East and West still met at the old sanctuaries of Greece, so—and yet more—Greece and Rome repaired to the temples of the southern and eastern deities. In the shrine of Isis at Philae, Europeans set up votive inscriptions on behalf of their kindred far away at home, and it may be surmised that even among the festival crowds at Jerusalem a few Greeks found place (John xii. 20).

The pilgrimage, however, attained its zenith under Islam. For Mahomet proclaimed it the duty of every Mussulman, once at least in his life, to visit Mecca; the result being that the birthplace of the Prophet is now the religious centre of the whole Mahommedan world (see MAHOMMEDAN RELIGION; CARAVAN; MECCA).

II. *The Pilgrimage under Christianity.*—The pilgrimages of Christianity presuppose the existence of those of paganism; but it would be an error to maintain that the former were a direct development of the latter. For primitive Christianity was devoid of any point by which these journeys of devotion might naturally have been suggested. It was a religion without temples, without sanctuaries, and without ceremonial. The saying of the Johannine Gospel—that God is to be adored neither in Jerusalem nor on Gerizim, but that His true worshipper must worship Him in spirit and in truth— is in complete harmony with the old Christian piety. And, accordingly, in the ancient Christian literature, we find no trace of a conception that the believer should visit a definite place in order to pay homage to his Master. The evolution of the Christian pilgrimage moved on other lines.

Origin.

Cicero finely observes that, in Athens, the glorious architecture caused him less pleasure than did the thought of the great men whose work was done in its midst—" how here one had lived, and there fallen asleep; how here another had disputed, and there lay buried " (*De Legg.* ii. 2). This feeling was not weakened by the advent of Christianity, in fact, we may say that it was appreciably strengthened. Cicero had already compared the sites consecrated by the memory of some illustrious name with those hallowed by recollections of a loved one. But with the Christian, when his Redeemer was in question, both motives coincided: for there the greatest was also the dearest.

In this devotion to the memory of Jesus, we find the key to the origin of the Christian pilgrimage: the faithful repaired to those places which were invested with memories of their Lord's earthly life. And these journeys must certainly date from the 2nd century. For Origen (d. 254) mentions that in Bethlehem the cave was shown where Christ was born, and in it the manger in which Mary made the bed of her child. The site must have been much visited long before this, since Origen remarks that it was common knowledge, even among the infidels, that there was the birthplace of that Jesus whom the Christians worshipped (*Contr. Cels.* i. 51). But those who visited Bethlehem must certainly have visited Jerusalem and the places there, so rich in memorials of their Master. And the sympathy of Christendom soon led them beyond this immediate circle. The anonymous author of the *Cohortatio ad Graecos*, a work of the 2nd century, visited the remnants of those cells, in which—so legend related—the seventy interpreters laboured on their version of the Old Testament: nor, when he came to Cumae in Campania, did he fail to have shown him the old shrine of the Sibyl (*Coh. ad Gr.* 13 and 37). Soon we begin to hear the names of the pilgrims. In the course of the 3rd century, as Jerome relates, Firmilian, bishop of Caesarea in Cappadocia, travelled to Palestine to view the sacred places (*De Vir. ill.* 54); while, according to Eusebius, a second bishop from Cappadocia, Alexander by name, visited Jerusalem in order to pray and acquaint himself with the holy sites, and was there invited by the community to remain with them and assume the episcopate of the aged Narcissus (*Hist. eccl.* vi. 11). With regard to his own times—the early years of the 4th century—the same authority recounts that believers kept streaming to Palestine from all regions, there to offer their prayers at a cavern shown on the Mount of Olives (*Demonstr. evang.* vi. 18).

This statement, that the Christians of the 3rd and 4th centuries were in the habit of visiting Jerusalem for prayer, proves that the non-Christian conception of the religious pilgrimage had already entered the sphere of Christian thought. That men travelled for purposes of prayer implies acceptance of the heathen theory of sanctuaries which it is an act of piety to visit. We may regret the fact, for it sullied the purity of primitive Christian thought. Nevertheless, it is clear that the development was inevitable. As soon as the non-Christian ideas of priests, sacrifices, houses of the god, and so forth, were naturalized in the Christianity of the 3rd century, it was but a short step to the belief in holy places.

III. *The Pilgrimage in the Ancient Church.*—In the passages cited above, Bethlehem and the Mount of Olives figure as the main goal of the pilgrim: and on the Mount of Olives the mind must naturally turn to the Garden of Gethsemane and the scene of the Ascension. It may seem surprising that there is no mention of Golgotha and the Sepulchre. But the visitation of these sites was rendered impossible to the Christians by the destruction of Jerusalem and the erection of the town of Aelia Capitolina. They had not forgotten them; but the grave was concealed under a mound of earth and stones —a profanation probably dating from the siege of the city and Titus's attack on the second wall. On the summit of this mound there stood, in the days of Eusebius, a sanctuary of Venus (Eus. *Vit. Const.* iii. 26, 30). The Sepulchre and the Hill of the Crucifixion were lost to the Christian pilgrim; and, consequently, before the era of Constantine, the one holy site in the town of Jerusalem was the so-called *Coenaculum*, which received its name in later years. It lay south of the city, near the outer wall, and, if Epiphanius is to be believed, was already in existence when Hadrian (130–131) visited Jerusalem (*De mens.* 14). It was regarded as the house, in which —according to the Acts of the Apostles (xii. 12 sqq.)—Mary, the mother of John Mark, lived; and the belief was that there the Lord held the Last Supper, and that there the eleven assembled after the Ascension. It was there, also, that the scene of the Pentecostal effusion of the Spirit was laid (cf. Cyrill. *Hierus. Cat.* xvi. 4).

The East.

The pilgrimage to Palestine received a powerful impetus from the erection of the memorial churches on the holy sites, under Constantine the Great, as described by Eusebius in his biography of the emperor (iii. 25 sqq.). At the order of Constantine, the shrine of Venus above mentioned was destroyed, and the accumulated rubbish removed, till the ancient rock-foundation was reached. There the cave was discovered in which Joseph of Arimathea had laid the body of Jesus; and above this cave and the Hill of the Crucifixion the imposing church of the Holy Sepulchre was built (A.D. 326–336). The churches in Bethlehem and on the Mount of Olives were erected by Helena, the mother of Constantine, who herself undertook the pilgrimage to the Holy Land. These churches were then endowed with new sanctuaries of miraculous powers; and relics of Christ were found in the shape of the Cross and the nails. Eusebius, the contemporary of Constantine, is silent on this point. To his continuators, on the other hand, it is an established fact that Helena brought all three crosses to light, and ascertained the genuine Cross by the instrumentality of a miracle, in addition to discovering the nails of the Crucifixion (Rufin. i. 7; Socr. i. 17; Sozomen. ii. 1; Theod. i. 17). It is impossible to fix the date at which the supposititious relics were introduced into the church of the Sepulchre: it is certain, however, that in the 5th century the Cross was there preserved with scrupulous reverence, and accounted the highest treasure of the sanctuary.

After the 4th century, monks and nuns begin to form no inconsiderable part of the pilgrimages—a fact which is especially manifest from the numerous notices to be found in Jerome, and the narratives of Theodoret in the *Historia religiosa*. In fact, many were inclined to regard a journey to Jerusalem as the bounden duty of every monk—an exaggerated view which led to energetic protests, especially from Gregory of Nyssa, who composed a monograph on the pilgrimages (*De iis qui adeunt Hierosol.*). Jerome, like Gregory, insists on the point that residence in Jerusalem has in itself no religious value: it is not locality, but character, that avails, and the gates of Heaven are as open in Britain as in Jerusalem (*Ep.* 58, 3). These utterances, however, must not be misinterpreted. They are not directed against the pilgrimage in itself, nor even against the belief that prayer possesses special efficacy on sacred ground, but solely against the exaggerated developments of the system.

The theologians of the 4th and 5th centuries were at one with the masses in recognizing the religious uses of the pilgrimages. Jerome in particular considered it an act of faith for a man to offer his prayers where the feet of the Lord had stood, and the traces of the Birth, of the Cross, and of the Passion were still to be seen (*Ep.* 47, 2).

We may gain some impression of the mood in which the pilgrims completed their journey, when we read how Paula, the friend of Jerome, expresses herself on her visit to the church of the Sepulchre: "As oft as we enter its precincts we see the Saviour laid in the shroud, and the angel seated at the feet of the dead!" (Hieron. *Ep.* 46, 2). She assured Jerome that, in the church of the Nativity at Bethlehem, she beheld, with the eye of faith, the Christ-child wrapped in swaddling clothes (*Ep.* 108, 10). But with these thoughts, others of an entirely different stamp were frequently blended. Pilgrimages were conceived as means to ensure an answer to particular prayers. So, for example, Eudocia, the wife of Theodosius II., vowed to undertake a pilgrimage to Jerusalem, if she should see her daughter married. (Socr. *Hist. eccl.* vii. 47). And, closely as this approaches to pagan ideas, the distinction between paganism and Christianity is completely obliterated when we find the hermit Julian and his companions travelling to Sinai in order to worship the Deity there resident (Theod. *Hist. rel.* 2).

With the number of the pilgrims the number of pilgrim-resorts also increased. Of Jerusalem alone Jerome relates that the places of prayer were so numerous that it was impossible to visit them all in one day (*Ep.* 46, 9). In the Holy Land the list was still longer: the natives were ready to show everything for which the foreigners inquired, and the pilgrim was eager to credit everything. In her expedition to the East, the Paula mentioned above visited, among other places, Sarepta and Caesarea. In the first-named place she was shown the tower of Elijah; in the second, the house of Cornelius, that of Philip, and finally the grave of the four virgins. At Bethlehem she saw, in addition to the church of the Nativity, the grave of Rachel; at Hebron the hut of Sarah, in which the swaddling clothes of Isaac and the remains of Abraham's oak were on view (Hieron. *Ep.* 108). A similar picture is given in the *Travels* of the so-called Silvia Aquitana, who seems, in reality, to have been a Spanish nun, named Etheria or Eucheria. She went as a pilgrim to Jerusalem (*c.* 380), and from there traversed the whole of Palestine, in order to visit every site which was consecrated by memories of the Lord's earthly life. Nor did she neglect the scenes of patriarchal history. Of greater antiquity is the concise account of his travels by an anonymous pilgrim, who, in A.D. 333, undertook the journey from Bordeaux to Palestine. The *Itinerary* of the African Theodosius who visited the East between A.D. 520 and A.D. 530 is of later date (P. Geyer, *Itin. hierosol. saec.* iv–viii.).

In the West.

While pilgrim-resorts were thus filling the East, their counterparts began to emerge in the West. And here the starting-point is to be found in the veneration of martyrs. Care for the tombs of martyrs was sanctioned by immemorial custom of the Church; but, in this case also, a later age failed to preserve the primitive conception in its purity; and Augustine himself was obliged to defend the usage of the Church from the imputation that it implied a transference of heathen ceremonial to the sphere of Christianity (*Contr. Faust.* xx. 21). The martyrs were the local heroes of particular communities; but there were men whose life and death were of significance for the whole of Christendom—the apostles. Of these Peter and Paul had suffered martyrdom in Rome, and it was inevitable, from the nature of the case, that their graves should soon become a resort, not only of Romans born, but of strangers also. True, the presbyter Caius (*c.* 200) who first mentions the situation of the apostolic tombs on the Vatican and the road to Ostia, and refers to the memorials there erected, has nothing to say of foreign Christians journeying to Rome in order to visit them. And though Origen travelled to Rome, it was not to view the graves of dead men, but to establish relations with the living flock (Euseb. *Hist. eccl.* ii. 25, 7; vi. 14, 10); still, it is certain that the Roman cemeteries were visited by numerous pilgrims even in the 3rd century: for the earliest *graffiti* in the papal crypt of the Coemeterium Callisti must date from this period (De Rossi, *Roma sotter.* i. 253 sqq.; Kraus, *Rom. Sott.* 148 sqq.). And if the tombs of the popes were thus visited, so much more must this hold of the tombs of the apostles. After these, the most frequented resort at Rome in the 4th century was the grave of Hippolytus. The poet Prudentius describes how, on the day of the martyr's death, an innumerable multitude of pilgrims flocked round the site. Even on ordinary days arrivals and departures were almost incessant—foreigners being everywhere seen mingled with the native Latins. They poured balsam on the sepulchre of the saint, washed it with their tears, and covered it with their kisses, in the belief that they were thus assuring themselves of his intercession or testifying their gratitude for his assistance. Prudentius says of himself, that whenever he was sick in soul or body, and prayed there, he found help and returned in cheerfulness: for God had vouchsafed His saint the power to answer all entreaties (*Perist.* xi. 175 sqq.). Paulinus of Nola (d. 431) concurs—his custom being to visit Ostia each year, and Rome on the apostolic anniversaries (*Ep.* 20, 2; 45, 1). Next to Rome the most popular religious resort was the tomb of Felix of Nola (August. *Ep.* 78, 3); while in Gaul the grave of St Martin at Tours drew pilgrims from all quarters (Paul. Nol. *Ep.* 17, 4). Africa possessed no sanctuary to compete with these; but we learn from Sulpicius Severus (*c.* 400) that the tomb of Cyprian seems to have been visited even by a Gaul (*Dial.* i. 3).

The motive that drew the pilgrims to the graves of the saints is to be found in the conviction, expressed by Prudentius, that there divine succour was certain; and hence came the belief in a never-ending series of miracles there performed (cf., *e.g.* Ennod. Ticin. *Lib. pro syn.* p. 315). Doubt was unknown. St Augustine observes that, though Africa was full of martyrs' tombs, no miracle had been wrought at them so far as his knowledge extended. This, however, did not lead him to doubt the truth of those reported by others—a fact that is somewhat surprising when we reflect that the phenomenon caused him much disquiet and perplexity. Who, he asks, can fathom the design of God in ordaining that this should happen at one place and not at another? And eventually he acquiesces in the conclusion that God, who gives every man his individual gift at pleasure, has not willed that the same powers should have efficacy at every sepulchre of the saints (*Ep.* 78, 3).

IV. *The Pilgrimage in the Middle Ages.*—The medieval Church

New Motives.

adopted the custom of the pilgrimage from the ancient Church. The young Germanic and Romance nations did precisely as the Greek and Romans had done before them, and the motives of these devotional journeys—now much more difficult of execution in the general decay of the great world-system of commerce—remained much the same. They were undertaken to the honour of God (*Pipp. Cap.* 754–755, c. 4), for purposes of prayer (*Ann. Hild.* 992), or in quest of assistance, especially health (*Vita Galli*, ii. 37; *Vita Liudg.* iii. 10). But the old causes were reinforced by others of at least equal potency. The medieval Church was even more profoundly convinced than its predecessor that the miraculous power of Deity attached to the bodies of saints and their relics. But the younger nations—French, English and German—were scantily endowed with saints; while, on the other hand, the belief obtained that the home-countries of Christianity, especially Rome and Jerusalem, possessed an inexhaustible supply of these sanctified bodies. Pilgrimages were consequently undertaken with the intention of securing relics. At first it was enough to acquire some object which had enjoyed at least a mediate connexion with the hallowed corpse. Gregory of Tours (d. 594) mentions one of his deacons who made a pilgrimage into the East, in order to collect relics of the Oriental saints; and, on his return, visited the grave of the bishop Nicetius (St Nizier, d. 573) in Lyons, where he still further increased his store. His testimony showed how relics came to be distributed among the populace: one enthusiast took a little wax dropped from the taper; another, a portion of the dust which lay on the grave; a third, a thread from the cloth covering the sarcophagus; and he himself plucked the flowers which visitors had planted above the tomb. Such were the memorials with which he returned; but the universal belief was that something of the miraculous virtue of the saint had passed into these objects (*Vit. patr.* 8, 6). Before long, however, these humble trophies failed to content the pilgrims, and they began to devote their efforts to acquiring the actual bodies, or portions of them —frequently by honest means, still oftener by trickery. One of the most attractive works of early medievalism—Einhard's little book, *Translatio Marcellini et Petri*—gives a vivid description of the methods by which the bodies of the two saints were acquired and transported from Rome to Seligenstadt on the Main.

Far more important consequences, however, resulted from the fact that the medieval mind associated the pilgrimage with the forgiveness of sins. This conception of the pilgrimage, as a means of expiation or a source of pardon for wrong, was foreign to the ancient Church. It is quite in accordance with the keener consciousness of sin, which prevailed in the middle ages, that the expiatory pilgrimage took its place side by side with the pilgrimage to the glory of God. The pilgrimage became an act of obedience; and, in the books of penance (*Poenitentialia*) which date from the early middle ages, it is enjoined—whether for a definite period (*e.g. Poen. Valicell.* i. c. 19; *Theod. Cant.* i. 2, 16) or for life (*Poen. Cummeani*, vii. 12, *Casin.* 24)—as an expiation for many of the more serious sins, especially murder or the less venial forms of unchastity. The place to be visited was not specified; but the pilgrim, who was bound by an open letter of his bishop to disclose himself as a pentitent, lay under the obligation, wherever he went, to repair to the churches and—more especially—the tombs of the saints, and there offer his prayers. On occasion, a chain or ring was fastened about his body, that his condition might be obvious to all; and soon all manner of fables gained currency: how, here or there, the iron had sprung apart by a miracle, in token that the sinner was thereby absolved by God. For instance, the *Vita Liudgeri* recounts the history of a fratricide who was condemned to this form of pilgrimage by Jonas, bishop of Orleans (d. 843); he wore three iron rings round his body and arms, and travelled bare-footed, fasting, and devoid of linen, from church to church till he found pardon, the first ring breaking by the tomb of St Gertrude at Nivelles, the second in the crypt of St Peter, and the third by the grave of Liudger. The pilgrimage with a predetermined goal was not recognized by the books of penance; but, in 1059, Peter Damiani imposed a pilgrimage to Rome or Tours on the clerics of Milan, whom he had absolved (*Acta mediol. patrol. lat.* 145, p. 98).

As the system of indulgences developed, a new motive came to the fore which rapidly overshadowed all others: pilgrimages were now undertaken to some sacred spot, simply in order to obtain the indulgence which was vested in the respective church or chapel. In the 11th century the indulgence consisted in a remission of part of the penance imposed in the confessional, in return for the discharge of some obligation voluntarily assumed by the penitent. Among these obligations, a visit to a particular church, and the bestowal of pious gifts upon it, held a prominent place. The earliest instance of the indulgential privilege conferred on a church is that granted in 1016 by Pontius, archbishop of Arles, to the Benedictine abbey of Montmajour (Mons Major) in Provence (d'Achery, *Spicil.* iii. 383 seq.) But these dispensations, which at first lay chiefly in the gift of the bishops, then almost exclusively in that of the popes, soon increased in an incessant stream, till at the close of the middle ages there were thousands of churches in every western country, by visiting which it was possible to obtain an almost indefinite number of indulgences. But, at the same time, the character of the indulgence was modified. From a remission of penance it was extended, in the 13th century, to a release from the temporal punishment exacted by God, whether in this life or in purgatory, from the repentant sinner. And, from an absolution from the consequences of guilt, it became, in the 14th and 15th centuries, a negation or the guilt itself; while simultaneously the opportunity was offered of acquiring an indulgence for the souls of those already in purgatory. Consequently, during the whole period of medievalism, the number of pilgrims was perpetually on the increase.

The Pilgrim Resorts.

So long as the number of pilgrims remained comparatively small, and the difficulties in their path proportionately great, they obtained open letters of recommendation from their bishops to the clergy and laity, which ensured them lodging in convents and charitable foundations, in addition to the protection of public officials. An instance is preserved in Markulf's formulary (ii. 49). To receive the pilgrim and supply him with alms was always considered the duty of every Christian: Charlemagne, indeed, made it a legal obligation to withhold neither roof, hearth, nor fire from them (*Admon. gent.* 789, c. 75; *Cap. Miss.* 802, c. 27).

The most important places of resort both for voluntary and involuntary pilgrimages, were still Palestine and Rome. On the analogy of the old *Itineraria*, the abbot Adamnan of Iona (d. 704) now composed his monograph *De locis sanctis*, which served as the basis of a similar book by the Venerable Bede (d. 735)—both works being edited in the *Itin. hierosol.* His authority was a Frankish bishop named Arculf, who resided for nine months as a pilgrim in Jerusalem, and visited the remaining holy sites of Palestine in addition to Alexandria and Constantinople. Of the later itineraries the *Descriptio terrae sanctae*, by the Dominican Burchardus de Monte Sion, enjoyed the widest vogue. This was written between the years 1285 and 1295; but books of travel in the modern tongues had already begun to make their appearance. The initiative was taken by the French in the 12th and 13th centuries, and the Germans followed in the 14th and 15th ; while the *Book of Wayes to Jerusalem* of John de Maundeville (*c.* 1336) attained extreme popularity, and was translated into almost all the vernacular languages. Most pilgrims, probably, contented themselves with the brief guide-books which seem to have originated in the catalogues of indulgences. In later periods, that of Romberch a Kyrspe, printed at Venice (1519), stood high in favour.

A long list might be compiled of men of distinction who performed the pilgrimage to Palestine. In the 8th century one of the most famous is the Anglo-Saxon Willibald, who died in 781 as bishop of the Frankish diocese of Eichstätt. He left his home in the spring of 720, accompanied by his father and brother. The pilgrims traversed France and Italy, visiting every religious resort; in Lucca the father died, and the brother remained behind in Rome. Early in 722 Willibald began his expedition to the Holy Land alone, except for the presence of two companions. He travelled past Naples to Syracuse, then on shipboard by Cos and Samos to Ephesus, and thence through Asia Minor to Damascus and Jerusalem. On St Martin's day, in 724, he arrived in the Holy City. After a prolonged stay in the town and its environs, Willibald proceeded (727) to Constantinople, and in 729 returned to Italy. Such is the account given by the nun of Heidenheim in her biography of Willibald; and her version is probably based on notes by the pilgrim himself (*Mon. Germ. hist. scr.* xv. 80 sqq.). In the 9th century the French monk Bernard visited Palestine with two companions, and afterwards wrote a simple and trustworthy account of his journey (*Patrol. lat.* 121, 569 sqq.). In the 10th century Conrad, bishop of Constance (934–976), performed the pilgrimage to Jerusalem three times (*Vita Chuonr.* 7); and to the same period belong the first women-pilgrims to Jerusalem of whom we have any cognisance—Hidda, mother of Gero, archbishop of Cologne (Thietm. *Chron.* ii. 16), and the countess Hademod of Ebersberg (*Chron. ebersb.*). The leaders, moreover, of the monkish reform movement in the 10th and 11th centuries, Richard of St Vanne in Verdun and Poppo, abbot of Stavelot (978–1048), had seen the Holy Land with their own eyes (*Vita Rich.* 17; *Vita Popp.* 3). In the year 1028 Archbishop Poppo of Trier (d. 1047) undertook a pilgrimage which led him past Jerusalem to the banks of the Euphrates, his return taking place in 1030 (*Gesta Trevir. Cont.* i. 4 seq.). But the most celebrated devotional expedition before the Crusades was that of the four bishops—Sigfrid of Mainz, Gunther of Bamberg, William of Utrecht, and Otto of Regensburg. They set out in 1064, with a company whose numbers exceeded seven thousand. The major portion, however, fell in battle against the Mahommedans, or succumbed to the privations of the journey, and only some two thousand saw their homes again(*Annal. Altah.*, *Lamb.*, *Disib.*, *Marian. Scot.* &c.). Among the followers of the bishops were two clerics of Bamberg, Ezzo and Wille, who composed on the way the beautiful song on the miracles of Christ—one of the oldest hymns in the German language. The text was due to Ezzo, the tune to Wille (Müllenhoff and Scherer, *Denkmäler*, i. p. 78, No. 31). A few years later Count Dietrich of Trier began a pilgrimage to Jerusalem with 113 companions, in atonement for the murder of Archbishop Kuno. The ship, however, which conveyed them went down with all hands in a storm (Berth. *Ann.* 1073).

As a result of this steady increase in the number of pilgrims, the old arrangements for their accommodation were found deficient. Consequently hospices arose which were designed exclusively for the pilgrim. Those on the Alpine passes are common knowledge. The oldest, that on the Septimer pass, dates from the Carolingian period, though it was restored in 1120 by the bishop Wido of Chur: that on the Great St Bernard was founded in the 10th century, and reorganized in the 13th. To this century may also be assigned the hospice on the Simplon; to the 14th those on the St Gothard and the Lukmanier. Similarly, the Mediterranean towns, and Jerusalem in particular, had their pilgrim-refuges. Service in the hospices was regularly performed by the hospital-fraternities—that is to say, by lay associations working under the authorization of the Church. The most important of these was the fraternity of the *Hospitale hierosolymitanum*, founded between 1065 and 1075; for hence arose the order of St John, the earliest of the orders of knighthood. In addition to the hospital of Jerusalem, numerous others were under its charge in Acre, Cyprus, Rhodes, Malta, &c. Associations were formed to assist pilgrims bound for the East; one being the *Confrérie des pèlerins de Terre-Sainte* in Paris, founded in 1325 by Louis de Bourbon, count of Clermont (afterwards first duke of Bourbon). Its church was in the rue des Cordeliers. Similar institutions existed also in Amsterdam, Utrecht, Antwerp and elsewhere in the Netherlands.

But since, in the middle ages, the Holy Land was no longer held by a Christian Power, the protection of the pilgrims was no less necessary than their sustenance. This fact, after the close of the 11th century, led to the Crusades (*q.v.*), which in many respects are to be regarded as armed pilgrimages. For the old dream of the pilgrim, to view the country where God had walked as man, lived on in the Crusades—a fact which is demonstrated by the letters of Bernard of Clairvaux, with the songs of Walther von der Vogelweide and other Crusaders. And, since the strongest motive in the pilgrimage was the acquisition of indulgences, unnumbered thousands were moved to assume the Cross, when, in 1095, Urban II. promised them plenary indulgence (*Conc. Claram.* c. 2). The conquest of Jerusalem, and the erection of a Christian empire in Palestine, naturally welled the influx of pilgrims. And though in 1187 the Holy City again fell into the hands of the infidel, while in 1291 the loss of Acre eliminated the last Christian possession in Palestine, the pilgrimages still proceeded. True, after the fall of the city and the loss of Acre, they were forbidden by the Church; but the veto was impracticable. In the 12th century these religious expeditions were still so common that, every Sunday, prayers were offered in church for the pilgrims (Honor. Aug. *Spec. eccl.* p. 828). In the 13th century the annual number of those who visited Palestine amounted to many thousands: in the 14th and 15th it had hardly shrunk. In fact, between the years 1300 and 1600, no fewer than 1400 men of distinction can be enumerated from Germany alone who travelled to the Holy Land (Röhricht and Meissner, *Deutsche Pilgerreisen*, pp. 465–546). It was not till the Reformation, the wars of the 16th century, and the loss of Rhodes, Candia and Cyprus to the Turks, that any appreciable alteration was effected. When Ignatius de Loyola (*q.v.*) set sail in 1523 from Venice to Palestine, only some thirteen souls could be mustered on the pilgrim-ship, while eight or nine others sailed with the Venetian state-vessel as far as Cyprus. A considerable number had abandoned their pilgrimage and returned home on the news of the fall of Rhodes (Dec. 25, 1522: see *Acta sanct.* Jul. vii. 642 seq.).

For pilgrimage overseas, as it was styled, the permission of the Church was still requisite. The pilgrims made their journey in grey cowls fastened by a broad belt. On the cowl they wore a red cross; and a broad-brimmed hat, a staff, sack and gourd completed their equipment. During their travels the beard was allowed to grow, and they prepared for departure by confession and communion. Of their hymns many are yet extant ("Jerusalem mirabilis," "In gottes namen faren wir," &c.). The embarcation took place either in France or Italy. In France, Marseilles was the main harbour for the pilgrims. From there ships belonging to the knights of St John and the knights templars conducted the commerce with Palestine, and carried annually some 6000 passengers. In the Italian ports the number of shipments was still greater—especially in Venice, whence the regular *passagium* started twice a year. The Venetian pilgrim ships, moreover, carried as many as 1500 souls. The pilgrims formed themselves into unions, elected a "master" and concluded their agreements, as to the outward voyage and return, in common. After Venice, Genoa and Pisa occupied the most prominent position. The voyage lasted from six to eight weeks, the stay in Jerusalem averaging ten days. The visitation of the holy places was conducted in processions headed by the Franciscans of the Convent of Zion.

The expenses of the journey to Palestine were no light matter. In the 12th century they may be estimated at 100 marks of silver (£200) for the ordinary pilgrim. This was the amount raised in 1147 by one Goswin von Randerath to defray the expenses of his pilgrimage (*Niederrhein. Urk. Buch.* i. No. 361). Later the cost was put at 280–300 ducats (£140–£150). In the 13th century a knight with two squires, one groom, and the requisite horses, had to disburse 8½ marks of silver for his passage, while for a single pilgrim the rate was rather less than 1 mark. In the 16th century Ignatius de Loyola calculated the cost of the voyage from Venice to Jaffa at some 6 or 7 gold florins (£3). The expenses of the princes and lords were, of course, much heavier. Duke William of Saxony, who was in Jerusalem in 1461, spent no less than £10,000 on his journey (see Prutz, *Kulturgeschichte der Kreuzzüge*, pp. 106 sqq.; Röhricht, *Deutsche Pilgerreisen*, p. 42).

Great as was the number of pilgrims oversea, it was yet far exceeded by that of the visitants to the "threshold of the apostles," *i.e.* Rome. As was the case with Jerusalem, guide-books to the city of the apostles were now composed. The oldest is the *Notitia ecclesiarum urbis Romae*, which was probably compiled under Honorius I. (625–638). The monograph *De locis s. martyrum* is of somewhat later date. Both are to be found in De Rossi, *Roma sotterranea*, i. 138 sqq.). The *Itinerarium einsidlense* (ed. G. Hänel, *Archiv. f. Philologie*, v. 119) belongs to the second half of the 8th century. Its composer would seem to have been a disciple of Walahfrid; for his interests are not confined to the churches, their reliquaries, and the ecclesiastical ceremonial of saint-days, but he takes a pleasure in transcribing ancient inscriptions. William of Malmesbury, again, when relating the crusade of Count Robert of Normandy (1096), transfers into his *Gesta regum anglorum* (iv. § 351) an old description of Rome, originally intended for the use of pilgrims. This may have dated from the 7th century.

The pilgrimages to Rome received their greatest impetus through the inauguration of the so-called Year of Jubilee (*q.v.*). On the 22nd of February 1300 the bull of Boniface VIII., *Antiquorum habet fidem*, promised plenary indulgence to every Roman who should visit the churches of the apostles Peter and Paul on thirty days during the year, and to every foreigner who should perform the same act on fifteen days. At the close of the Jubilee this dispensation was extended to all who had expired on the way to Rome. This placed the pilgrimage to Rome on a level with the crusades—the only mode of obtaining a plenary indulgence. The success of the papal bull was indescribable. It is computed that, in the Year of Jubilee, on an average, 200,000 strangers were present in the city during the day. The greatest number of the pilgrims came from southern France, England sending comparatively few on that occasion (see Gregorovius, *Gesch. d. Stadt Rom.* v. 546 sqq.). The Jubilee dispensation according to the edict of Boniface VIII. was to be repeated each century; but this period was greatly abridged by succeeding popes (see JUBILEE, YEAR OF), so that in the years 1350, 1390, 1423, 1450, 1475, 1500, the troops of pilgrims again came streaming into Rome to obtain the cherished dispensation.

Of the other pilgrim-resorts, we shall only emphasize the most important. Priority of mention is due to St James of Compostella (Santiago, in the Spanish province of Galicia). Here the attraction for the pilgrim was the supposed possession of the body of James the son of Zebedee. The apostle was executed (A.D. 44) by command of Herod Agrippa (Acts xii. 1); and at the beginning of the medieval period it was believed that his corpse was laid in Palestine (*Venant. Fortun. carm.* v. 144, viii. 3). The first connexion of the apostle with Spain is to be traced in the *Poema de aris b. Mar. et xii. apost. dedic.*, which is ascribed to Aldhelm (d. 709) and contains a story of his preaching in that country. The earliest account of the transference of his relics to the Peninsula is found in Notker Balbulus (d. 912, *Martyrol. in Jul. xxv.*). But in Spain belief in this cherished possession was universal; and, step by step, the theory won credence throughout the West. In 1059, Archbishop Wido of Milan journeyed to St James (Damiani, *Acta mediol.* p. 98); and a little later we hear of bands of pilgrims from Germany and France. In England, indeed, the shrine of St James of Compostella became practically the most favoured devotional resort; and in the 12th century its visitation had attained such popularity that a pilgrimage thither was ranked on a level with one to Rome or Jerusalem (Honor. August. *Spec. eccl.* p. 828). In Paris, after 1419, there existed a special hospice for the "fraternity of St James," in which from 60 to 80 pilgrims were received each day, fed, and presented with a quarter of a denarius (Dulaure, *Hist. de Paris* (1842), i. 531). Even in the period of the Reformation the "Song of St James" was sung in Germany (Wackernagel, *Kirchenlied*, ii. No. 1246); and in 1478 pilgrimages to that shrine were placed by Sixtus IV. on official equality with those to Rome and Jerusalem (*Extrav. comm. c.* 5; *De poenit.* v. 9).

In France St Martin remained the chief goal of the pilgrim; while Notre Dame de Sous-Terre in Chartres (with a portrait of the "black Virgin"), Le Puy-en-Velay (dep. Haute Loire), and others, also enjoyed considerable celebrity. In England pilgrimages were made to the tomb of the murdered archbishop, Thomas Becket, in Canterbury Cathedral. The setting of Chaucer's *Canterbury Tales* gives a vivid idea of the motley company of pilgrims; but it seems probable that Germany also sent a contingent (Gervas. *Cantuar. chr.* ann. 1184; Ralph de Diceto, *Ymag. hist.* ann. 1184). In addition, Walsingham, Peterborough, St Davids, Holywell, and St Andrews in Scotland were much frequented. In lower Germany, Cologne and Aix-la-Chapelle, in Switzerland Einsiedeln, were the principal resorts.

In Italy the church of the Archangel on Mt Gargano was one of the most ancient centres of the pilgrimage, being visited even by the monk Bernard (*vide supra*). Later the Portiuncula church at Assisi displaced all other religious resorts, with the exception of Rome; but in the 15th century it was overshadowed in turn by the "Holy House" at Loretto on the Adriatic. According to an extravagant legend, the house of Joseph and Mary in Nazareth was transported by angels, on the night of the 9th–10th of May 1291 to Dalmatia, then brought to the Italian coast opposite (Dec. 10, 1294), till, on the 7th of September 1295 it found rest on its present site. The pilgrimage thither must have attained great importance as early as the 15th century; for the popes of the Renaissance found themselves constrained to erect an imposing pilgrim church above the "Holy House."

The significance of the pilgrimage for the religious life of later medievalism cannot be adequately estimated. The possession of an extraordinary relic, a bloody Host, or the like, was everywhere considered a sufficient claim for the privileges of indulgences; and wherever this privilege existed, there the pilgrims were gathered together. All these pilgrimages, great and small, were approved and encouraged by the Church. And yet, during the whole of the middle ages, the voice of suspicion in their regard was never entirely stilled. Earnest men could not disguise from themselves the moral dangers almost inevitably consequent upon them; they recognized, moreover, that many pilgrims were actuated by extremely dubious motives; and they distrusted the exaggerated value set on outward works. The Roman papacy had no more zealous adherent than Boniface; yet he absolutely rejected the idea that Englishwomen should make the journey to Rome, and would willingly have seen the princes and bishops veto these pilgrimages altogether (*Ep.* 78). The theologians who surrounded Charlemagne held similar views. When the abbess Ethelburga of Fladbury (Worcestershire) found her projected pilgrimage impracticable, Alcuin wrote to her, saying that it was no great loss, and that God had better designs for her: "Expend the sum thou hast gathered for the journey on the support of the poor; and if thou givest as thou canst, thou shalt reap as thou wilt" (*Ep.* 300). Bishop Theodulf of Orleans (d. 821) made an energetic protest against the delusion that to go to Rome availed more than to live an upright life (*Carm.* 67). To the same effect, the synod of Chalon-sur-Saône (813) reprobated the superstition which was wedded to the pilgrimage (*c.* 13); and it would be easy to collect similar judgments, delivered in every centre of medievalism. But, fundamentally, pilgrimages in themselves were rejected by a mere handful: the protest was not against the thing, but against its excrescences. Thus Fridank, for instance, in spite of his emphatic declaration that most pilgrims returned worse than they went, himself participated in the crusade of Frederick II.

V. *The Modern Pilgrimage.*—The Reformation eradicated the belief in the religious value of visits to a particular locality. It is only pious memory that draws the Protestant to the sites consecrated by ecclesiastical history. On the other hand, while in the Eastern Church things have undergone little change, —the pilgrims, in addition to the Holy Land, visiting Mt Athos and Kiev—the developments in the Roman Church show important divergences. The Year of Jubilee, in 1525, was unprecedented in its scant attendance, but the jubilees of 1575 and 1600 again saw great armies of pilgrims marching to Rome.

Fresh pilgrim resorts now began to spring up, and medieval shrines, which had fallen on evil days, to emerge from their obscurity. In the 16th century we must mention the pilgrimages to the "Holy Mount" at Görz on the Austrian coast, and to Montserrat in the Spanish province of Barcelona: in the 17th century, those to Luxemburg, Kevelaer (Gelderland), Notre Dame de Fourvière in Lyons, Heiligenberg in Bohemia, Roermond in the Netherlands, &c. The 18th century, which witnessed the religious *Aufklärung*, was not favourable to the pilgrimage. Enlightened bishops and princes prohibited it altogether: so, for instance, Joseph II. of Austria. Archbishop Clement Wenceslaus of Trier forbade, in 1777, the much-frequented, medieval "leaping-procession" of Echternach (duchy of Luxemburg). The progressive theologians and clergy, moreover, assumed a hostile attitude, and, in 1800, even the Curia omitted the Year of Jubilee. The 19th century, on the other hand, led to an extraordinary revival of the pilgrimage. Not only did new resorts spring into existence—*e.g.* La Salette in Dauphiné (1846), and more particularly Lourdes (1858) in the department of Hautes Pyrénées—but the numbers once more attained a height which enables them to compete with the medieval figures. It is computed that 60,000 pilgrims were present in La Salette on the 29th of September 1847, the first anniversary of the appearance of Mary which gave rise to the shrine. The dedication of the church of Lourdes, in 1876, took place in the presence of 30 bishops, 3000 priests and 100,000 pilgrims. In 1877 the number rose to 250,000; and similar statistics are given of the German and Austrian devotional resorts. The sanctuaries of Aix-la-Chapelle are said to have been visited by 65,000 pilgrims on the 15th of July 1860; and on the following Sunday by 52,000. From 25,000 to 30,000 persons take part each year in the resuscitated "leaping-procession" at Echternach; and the annual visitants to the "Holy Mount" at Görz are estimated at 50,000. No new motives for the pilgrimage emerged in the 19th century, unless the ever-increasing cultus of the Virgin Mary may be classed as such, all of the new devotional sites being dedicated to the Virgin. For the rest, the desire of acquiring indulgences maintains its influence: but doubting voices are no more heard within the pale of the Roman Catholic Church.

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(A. H.*)

PILIBHIT, a town and district of British India, in the Bareilly division of the United Provinces. The town—pop. (1901), 33,490—contains the mosque of Hafiz Rahmat Khan, the Rohilla chieftain, built in the second half of the 18th century. Trade is mainly in agricultural produce, and in the products of the neighbouring Himalayan territory and Nepal.

The DISTRICT OF PILIBHIT has an area of 1350 sq. m.; pop. (1901), 470,339, showing a decrease of 3% in the decade. Though so near the Himalayas it is entirely a plain. In its midst is the Mala swamp. The east is forest-clad, poor and unhealthy; on the other side of the Mala the land becomes more fertile. The chief river is the Sarda, and the Gumti rises in the east. The principal crops are rice, pulses, wheat and sugar-cane. Sugar-refining is carried on, and sugar, wheat, rice and hemp are exported. The Lucknow-Bareilly section of the Oudh & Rohilkhand railway runs through the district, a portion of which is watered by the Rohilkhand canals.

PILLAR (O. Fr. *piler*, Mod. *pilier*, Late Lat. *pilare*, from *pila*, column), an isolated upright structure, of narrow width in relation to its height, which is either employed as a support for a superincumbent load of some sort or is set up for commemorative or ornamental purposes. In the first sense the word has many common applications, as to columns supporting the girders of a warehouse floor or the deckbeams of a ship, to the single central support or pedestal of a table, machine-tool, &c., and to the masses of coal which the miner leaves in certain methods of working as supports to the roof (see COAL); it is also used figuratively of persons in such phrases as a "pillar of the state." In architecture it has strictly the second sense. The column erected in honour of Diocletian at Alexandria is known as Pompey's pillar, and the so-called columns of Trajan and Antoninus are in reality pillars, performing no structural function beyond that of carrying a statue. In India the only example is the iron pillar at Delhi, which is an extraordinary specimen of the iron-worker's art considering the remote date at which it was made. Up to the middle of the 19th century the term "pillar" was employed to designate the masses of masonry in a church, which carry the arcades, but now the term "pier" is invariably adopted in preference.

PILLAU, a seaport and watering-place of Germany, in the Prussian province of East Prussia, on the spit of sand (*Nehrung*) which separates the Frische Haff from the Baltic, on the north of the entrance channel, and 29 m. by rail from Königsberg. Pop. (1905), 7374. It is fortified and has a harbour, which serves as the outer port of Königsberg, and to some extent also of Elbing and Braunsberg. A new navigable channel was in 1900–1901 constructed across the Frische Haff from Pillau to Königsberg. Pillau has a school of navigation, and is a well-known pilot station. Ship-building, sail-making, fishing and the working of amber are carried on.

Pillau is memorable as the place where Gustavus Adolphus of Sweden landed in 1626. It did not obtain civic privileges until 1725, but was fortified shortly after that date. In 1807 it offered a stout resistance to the French. By a treaty of the 24th of February 1812 it was ceded to Napoleon, but on the 6th of February in the following year it was restored to Prussia.

PILLION, a light saddle without pommel or bow, especially a pad fastened to the back of an ordinary saddle, as a seat for another person, generally a woman. Pillions were also used to support baggage. They were in common use from the 16th to the 18th centuries. The word appears to have been adapted into English from the Irish *pillin*, cushion, formed from Lat. *pellis*, skin. In the sense of a hat worn by a priest or doctor of divinity, "pillon" or "pylion" occurs in the 15th and 16th centuries. This is probably from Lat. *pileus*, a conical felt hat or cap, Gr. πῖλος.

PILLNITZ, a village in the kingdom of Saxony, situated on the right bank of the Elbe, 5 m. above Dresden. Pop. (1905), 770. The new palace of the king of Saxony was built in 1818 on the site of a building which was destroyed by fire. The place became a residence of the electors of Saxony about 1700, and the different parts of the palace were erected at various times during the 18th century. By the convention of Pillnitz in August 1791 the emperor Leopold II. and Frederick William II., king of Prussia, agreed to take common action against any attack on the part of France; this compact may be regarded as the basis of the first coalition against that country.

See A. von Minchwitz, *Geschichte von Pillnitz* (Dresden, 1893).

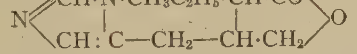
PILLORY (O. Fr. *pilori*, Prov. *espitlori*, from Lat. *speculatorium*, a place of observation or "peep-hole"), an instrument of punishment which consisted of a wooden post and frame fixed on a platform raised several feet from the ground, behind which the culprit stood, his head and his hands being thrust through holes in the frame (as are the feet in the stocks) so as to be held fast, exposed in front of it. This frame in the more complicated forms of the instrument consisted of a perforated iron circle, which secured the heads and hands of several persons at the same time, but it was commonly capable of holding only one.

In the statutes of Edward I. it is enacted that every pillory or "stretch-neck" should be made of convenient strength so that execution might be done on offenders without peril of their bodies. It was customary to shave the heads wholly or partially, and the beards of men, and to cut off the hair and even in extreme cases to shave the heads of female culprits. Some of the offences punished in England by the pillory will be found enumerated in a statute of Henry III. (1266). By this "Statute of the Pillory" it was ordered as the penalty for "forestallers and regrators, users of deceitful weights, perjurers and forgers." Stow, describing Cornhill pillory, says: "On the top of the cage (a strong prison of timber) was placed a pillory for the punishment of bakers offending in the assize of bread, for millers stealing corn at the mill, for bawds, scolds and other offenders." Until 1637 the pillory was reserved for such offenders. In that year an attack was made on the Press, and the pillory became the recognized punishment of those who published books without a licence or libelled the government. Alexander Leighton, John Lilburn, Prynne and Daniel Defoe were among those who suffered. These were popular favourites, and their exposures in the pillory were converted into public triumphs. Titus Oates, however, was put in the pillory in 1685 and nearly killed. In 1816 the pillory was abolished except for perjury and subornation, and the perjurer Peter James Bossy was the last to stand in the pillory at the Old Bailey for one hour on the 22nd of June 1830. It was finally abolished in 1837 at the end of William IV.'s reign. In France the pillory, called *carcan*, was employed till 1832. In Germany it was known as *pranger*. The pillory was used in the American colonies, and provisions as to its infliction existed in the United States statute books until 1839; it survived in the state of Delaware until 1905.

Finger-pillories were at one time in common use as instruments of domestic punishment. Two stout pieces of oak, the top being hinged to the bottom or fixed piece, formed when closed a number of holes sufficiently deep to admit the finger to the second joint, holding the hand imprisoned. A finger-pillory is preserved in the parish church of Ashby-de-la-Zouch, Leicestershire, and there is one, still in its original situation against the wall, at Littlecote Hall, Wilts.

PILLOW (O. Eng. *pylu*; Lat. *pulvinus*, a cushion), a support for the head during sleep or rest. The pillow of Western nations is a cushion of linen or other material, stuffed with feathers, down, hair or wool. In the East it is a framework made of bamboo or rattan with a depression in the top to receive the neck; similarly blocks of wood with a concave-shaped top are used by the natives of other countries. The word is found in various technical uses for a block or support, as for a brass bearing for the journal of a shaft, and the like. In architecture the term "pillowed," or "pulvinated," is given to the frieze of an order which bulges out in the centre and is convex in section. It is found in friezes of some of the later works of the Roman school and is common in Italian practice.

PILOCARPINE, $C_{11}H_{16}N_2O_2$, an alkaloid found, together with isopilocarpine and other related compounds, in the leaves of jaborandi (*Pilocarpus pennatifolius*). It was first isolated by E. Hardy in 1875 (*Ber.*, 8, p. 1594), and is a crystalline, very hygroscopic solid. It is a strong poison. It has the properties of a monacid base and contains the methylamino group, $\cdot NCH_3$. When heated with hydrochloric acid it gives isopilocarpine. Isopilocarpine was isolated in 1900 by H. A. D. Jowett (*Journ. Chem. Soc.* 77, p. 473), and is a colourless oil which boils at 261° C. (10 mm.). It is a monacid base which is readily soluble in solutions of the caustic alkalis. Jowett is of the opinion that pilocarpine and isopilocarpine are stereo-isomers of the structure:—



$$N\begin{matrix}\diagup\!\!\diagup CH\cdot N\cdot CH_3C_2H_5\cdot CH\cdot CO\diagdown \\ \qquad\qquad | \qquad\qquad\qquad\quad | \qquad\qquad\quad O \\ \diagdown CH:C{-}CH_2{-}CH\cdot CH_2\diagup\end{matrix}$$

PILOÑA, a town of northern Spain, in the province of Oviedo; between the right bank of the river Piloña, a left-hand tributary of the Sella, and the Sierra de Abes (3268 ft.). Pop. (1900), 18,228. Though officially classed as a town, Piloña is rather a densely populated mining and agricultural district. It is served by the railway from Infiesto, on the river Piloña, to Oviedo and Gijón.

PILOT, the name applied either to a particular officer serving on board a ship during the course of a voyage and having the charge of the helm and the ship's route, or to a person taken on board at a particular place for the purpose of conducting a ship through a river, road or channel, or from or into a port. The latter kind is the only one to which the term is now applied either in British or foreign countries. The word "pilot" is not the early name for the man who guides or steers a ship. In Old English the name is *lâdman*, *i.e.* the man who leads the way. "Pilot" does not appear in English till the 16th century. The origin of the word has been much debated. Many etymologists find it in the Dutch *pijloot* (Hexham's *Dictionary*, 1658). This has been identified with *peillood*, *peil-loth*, sounding lead, cf. German *peilen*, to sound; the last part of these words is the same as English "lead," the metal; the first part, *peilen*, is for *pegelen*, to mark with pegs or points for measuring, cf. *pegel*, gauge. The *New English Dictionary*, on the other hand, finds that the Dutch *piloot*, the earlier form, is taken from the French. The source is, therefore, to be looked for in Romance languages. Du Cange (*Gloss. Med. et Inf. Lat.*) gives *Pedottae*, defined as *quorum est scire intrare et exire portus*, a gloss on *pedotte e timonieri* in F. Ubaldini's edition, 1640, of *I documenti d'amore* by Francesco da Barberino (1264–1348). It is therefore conjectured that the Italian *pilota* is a popular conception of *pedotta*, and a possible source may be found in the Greek πῆδον, oar.

Authorities.

In England, formerly, pilots were subject to the jurisdiction of the lord high admiral; and in the 16th century there are many instances of the admiralty court dealing with pilots disciplinarily as well as civilly, holding them liable in damages to owners of ships lost or damaged by their negligence. For some considerable time throughout the United Kingdom the appointment and control of pilots have been in the hands of numerous societies or corporations established at the various ports by charter or act of Parliament, such as the Trinity Houses of Deptford Strond (London), Kingston-upon-Hull, Newcastle-on-Tyne, and Leith, and the Society of Cinque Ports Pilots and Court of Lodemanage (now extinct). These societies had jurisdiction over the pilots exercising their employment within the limits of such ports, and in many cases made it compulsory for ships resorting thither to employ them. By degrees the London Trinity House acquired a leading position, which was confirmed and extended by the general Pilotage Acts passed in the 18th and 19th centuries, with the object of introducing a uniform system throughout the realm. At the present day the United Kingdom is divided into districts for the purpose of pilotage jurisdiction. The (London) Trinity House has jurisdiction over the London district, which extends from Orfordness to Dungeness, and comprises the Thames and Medway up to London and Rochester bridges; the English Channel district, comprising the sea between Dungeness and the Isle of Wight; and the Trinity outport districts, which include any pilotage districts for the appointment of pilots within which no particular provision is made by act of Parliament or charter, and the number of which is 40, all English and Welsh. There are 66 other districts, within which other pilotage authorities have jurisdiction.

Law.

The present general pilotage law is contained in the Merchant Shipping Acts 1894 to 1906. Pilotage authorities are defined as bodies or persons authorized to appoint or license pilots, or to fix and alter rates of pilotage or to exercise any jurisdiction in respect of pilotage. They are subject to the control of the Board of Trade as the supreme mercantile marine authority. Those bodies, however, which existed at the time of the passing of the act retain their powers and jurisdiction, so far as is consistent with it. The board has power to appoint a new pilotage authority in any area where there is none, and to include a new area where there is none within an already existing one (but in either case pilotage cannot be made compulsory), or to transfer pilotage jurisdiction over a port other than that where the pilotage authority for that port resides, from that pilotage authority to the harbour or other local authority for that port, or to the Trinity House, or to a new authority; and the board has all powers necessary to effectuate such transfer and constitute the new authority. The board may also, by provisional order (which requires parliamentary confirmation), provide for the representation of pilots or shipowners on the pilotage authority of any district, and the exemption of ships from compulsory pilotage in any district. Where pilotage is not compulsory, and the power of obtaining pilotage licences unrestricted, the board can in the same way give the pilotage authority powers with respect to licences, amount of pilotage rates, and the like. Pilotage authorities may, by by-laws under the act (which require confirmation by order in council), exempt wholly or partly any ships or classes of ships from compulsory pilotage, and regulate the means of obtaining licences, and the amount of pilotage rates, subject to a maximum limit. They must make yearly returns to the Board of Trade of their by-laws, the names, ages and services of their licensed pilots, the rates of pilotage, the amounts received for pilotage and their receipts and expenditure; and if they fail to do so, the board may suspend their authority, which is then exercised by the Trinity House.

Qualifications.

The statutes also provide generally for the qualifications of pilots. A "qualified" pilot is one duly licensed by a pilotage authority to conduct ships to which he does not belong. On his appointment he receives a licence, which is registered with the chief officer of customs at the nearest place to the pilot's residence, and must be delivered up by the pilot whenever required by the licensing pilotage authority. On his death this licence must be returned to that authority. By an act of 1906 no pilotage certificate shall be granted to the master or mate of a British ship unless he is a British subject; this does not, however, refer to the renewal of a certificate granted before 1906 to one not a British subject. Pilotage dues are recoverable summarily from the owner, master, or consignees of the ship, after a written demand for them has been made. A pilot may not be taken beyond the limits of his district without his consent, and if so taken he is entitled to a fixed daily sum in addition to the dues; if he cannot board the ship, and leads her from his boat, he is entitled to the same dues as if he were on board; and he must be truly informed of the ship's draught of water. An unqualified pilot may in any pilotage district take charge of a ship without subjecting himself or his employer to any penalty, where no qualified pilot has offered himself, or where a ship is in distress, or in circumstances where the master must take the best assistance he can, or for the purpose of changing the moorings of any ship in port on docking or undocking her; but after a qualified pilot has offered himself any unqualified pilot continuing in charge, or any master continuing him in charge of the ship, is liable to a penalty. A qualified pilot may not be directly or indirectly interested in licensed premises or in the selling of dutiable goods, or in the unnecessary supply of gear or stores to a ship for his personal gain or for the gain of any other person. He can be punished for quitting a ship before the completion of his duty without the consent of the master, refusing or delaying to perform his duty without reasonable cause when required by lawful authority, lending his licence, acting as pilot when suspended or when intoxicated, and any pilot who through wilful breach of or neglect of duty, or by reason of his drunkenness, endangers ship, life or limb, is guilty of a misdemeanour and liable to suspension or dismissal; but the pilot has an appeal in cases of fines over £2, of suspension or dismissal, suspension or revocation of his licence, or the application of a pilotage fund to which he has contributed. This appeal lies in England to a county court judge having jurisdiction over the port where he is licensed, or a metropolitan police magistrate or stipendiary magistrate with the like power; in Scotland, to a sheriff; in Ireland, to a county court judge, chairman of quarter sessions, recorder, or magistrate. Pilotage certificates may also be granted by pilotage authorities, available within their districts, to masters and mates of ships; and the holder of such a certificate may pilot any ship in respect of which it is available without incurring any penalty for not employing a qualified pilot.

The statute further makes special regulation for Trinity House pilots. Every such pilot, on his appointment, must execute a bond for £100 conditioned for due observance of the Trinity House regulations and by-laws, and thereupon he is not liable for neglect or want of skill to anybody beyond the penalty of the bond and the amount payable to him for pilotage on the voyage on which he was engaged at the time of his so becoming liable. The licence may be revoked or suspended by the Trinity House when it thinks fit; it only continues in force for a year, and the Trinity House has absolute discretion whether it shall be renewed or not.

Pilot Boats and Signals.

A pilot boat is approved and licensed by the district pilotage authority who appoints or removes the master thereof. In order to be easily recognized, she has printed on her stern in legible white letters the name of her owner and her port, and on her bows the number of her licence; the remainder of the boat is usually black. The pilot flag is a red and white horizontal flag of a comparatively large size, and is flown from a conspicuous position. When the flag is flown from a merchant vessel, it indicates that a licensed pilot is on board or that the master or mate holds a certificate entitling him to pilot the ship. By order in council of 1900, on and after the 1st day of January 1901 the signals for a pilot displayed together or separately are: In daytime, there is (1) hoisted at the fore the pilot jack (Union Jack having round it a white border, one-fifth of the breadth of the flag); (2) the international code pilotage signal indicated by P.T.; (3) the international code flag S. (white with small blue square centre), with or without the code pennant; (4) the distant signal consisting of a cone point upwards, having above it two balls or shapes resembling balls. By night, (1) the pyrotechnic light commonly known as a blue light, every fifteen seconds; (2) a bright white light, flashed or shown at short or frequent intervals just above the bulwarks, for about a minute at a time.

Compulsory Pilotage.

Pilotage in British waters may be either compulsory or free for all or certain classes of ships. From parliamentary pilotage returns, it appears that it is compulsory in about 64 districts of the United Kingdom (of which two-thirds are the Trinity House districts), free in 32, free and compulsory in 8, while in 3 cases (Berwick, Dingwall and Coleraine) no particulars are given. British war-ships in British waters are not compelled to employ a pilot, the navigating officer becoming the pilot under the direction of the captain. If a pilot be employed, the captain and navigating officer are not relieved from responsibility. They supervise the pilot, and should, if necessary, remove him from the ship. In the majority of foreign ports British war-ships are exempted from employing pilots, but the Suez Canal and the ports of France are exceptions. The Merchant Shipping Act 1894 continues the compulsory employment of pilots in all districts where it was already compulsory, and also the already existing exemptions; and there is no power in any pilotage authority or the Board of Trade to increase the area of compulsory pilotage, though there is to diminish it. Compulsion is enforced by a provision in the act, that within a district where compulsory pilotage exists, the master of an unexempted ship who pilots her himself without holding the necessary certificate, after a qualified pilot has offered or signalled to take charge of the ship, shall be liable for each offence to a fine of double the amount of the pilotage dues demandable for the conduct of the ship. The exemptions from compulsory pilotage still existing in British territorial waters are as follows: Ships or vessels with British registers trading to Norway or the Cattegat or the Baltic (except vessels on voyages between any port in Sweden or Norway and the port o London), or round the North Cape, or into the White Sea on their inward or outward voyages, whether coming up by North o South Channels; any constant British traders inwards from ports between Boulogne inclusive and the Baltic coming up by North Channel, and any British ships or vessels trading to port between the same limits on their outward passages and when coming up by the South Channels; Irish traders using the navigation of the Thames and Medway; ships engaged in the regular coasting trade of the kingdom; ships or vessels wholly laden with stone produced in the Channel Islands and Isle of Man and brough thence; ships or vessels not exceeding 60 tons, whether British or belonging to a foreign country specified by order in council ships within the limits of the port or place to which they belong, this is not a place particularly provided for by act of Parliament or charter as regards the appointment of pilots; ships passing through the limits of any pilotage district in their voyages from one port to another port, and not being bound to any port or place within such limits or anchoring therein, but not including ships loading or discharging at any place situate within the district, or at any place situate above the district on the same river or its tributaries. Ships whose masters or mates are owners or part-owners of them, and living at Dover, Deal, or the Isle of Thanet, may be piloted by them from any of these places up and down the Thames or Medway, or into or out of any place or port within the jurisdiction of the Cinque Ports. The following ships in the London district and Trinity outport districts are also exempt when not carrying passengers, namely: Ships employed in the coasting trade of the United Kingdom; ships of not more than 60 tons burden; ships trading to or from any port in Great Britain within the above districts to or from the port of Brest in France, and any port in Europe (which does not include the United Kingdom) north and east of Brest, or to the Channel Islands or Isle of Man; and ships navigating within the limits of the port to which they belong. The port to or from which the ship must be "trading" in this provision has been interpreted by the decisions to mean the port where the cargo is substantially discharged or loaded respectively; and the word "coaster" similarly has been held to apply only to a vessel carrying to one port of the United Kingdom a cargo which has been taken in at another. Every ship carrying passengers between any place in the British Islands and any other place so situate must carry a compulsory pilot, unless her master or mate have a pilotage certificate. The effect in law of the ship (British or foreign) being in charge of a compulsory pilot under the act is that her owner and master are not answerable to any person whatever for any loss or damage occasioned by the fault or incapacity of any qualified pilot acting in charge of such ship within any district where the employment of such pilot is compulsory by law. In order to take advantage of this privilege, the shipowner must show (1) that a properly qualified pilot was acting in charge of the ship; there are, however, various kinds of qualified pilots—the qualified pilot who is always capable of acting, and the qualified pilot who is liable to be superseded if a better can be obtained; (2) that that charge was compulsory; the pilot, however, need not be compulsorily employed at the place where the accident happened, so long as he is compulsorily employed within the district where it happens; (3) that it was solely the pilot's fault or incapacity which caused the damage. Similarly, under the Harbours, Piers and Docks Clauses Act, the owner of a vessel is not liable for damage done thereby to docks or piers when she is in charge of a duly licensed pilot.

This statutory exemption of a ship in charge of a compulsory pilot from any liability for her negligent navigation by that pilot, is only declaratory of the common law of England, and is based on the principle that the pilot is a state official put in charge of a ship, and is not the servant of the shipowner so as to make him liable for his negligence; and a British court gives the same effect to any foreign or colonial law which makes it compulsory on shipowners to put a pilot in charge of their ship when within their jurisdiction. Most foreign codes, however, while agreeing with English law in making the presence of a pilot on board compulsory, differ from it in not putting him in charge of the ship; and in this case the defence of compulsory pilotage cannot be pleaded successfully in British courts. Judicial decisions have established that French, Suez Canal, Danube and Dutch pilots are not compulsory pilots in the British sense of the word, being only advisers of the master, or "living charts." But if the pilot is put in charge by the foreign or colonial law, although that law expressly provides that in spite of the owner surrendering the charge of the ship to him the owner shall still remain liable, a British court will hold the owner free from liability, on the ground that to make any person liable for a tort committed abroad, the act complained of must be wrongful not only according to the foreign law, but also by English law. This consequence which English law attaches to the employment of a compulsory pilot has been much criticized in recent times, and it would seem that the foreign view is much more satisfactory in regarding the pilot merely as the adviser and not the superior of the master. Moreover, the adoption of the foreign law on this point would restore the old general maritime law. The policy of the law was at one time inclined to extend this principle of compulsory pilotage, on the ground that it was for the benefit of commerce and the safety of seamen's lives, but it now restricts it within as narrow limits as possible, *e.g.* the presence of a compulsory pilot on board a tow who is directing the navigation of a tug does not protect the tug-owner from liability for negligent navigation. As already pointed out, pilotage authorities have no power to extend its scope.

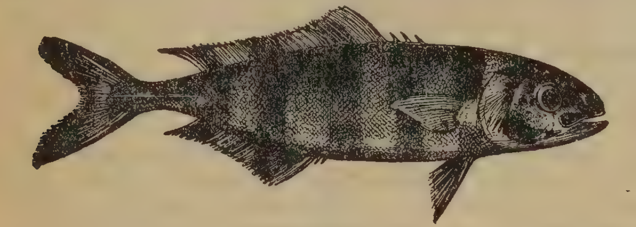
A pilot who is compulsorily in charge of a ship under English law has supreme control over her navigation, superseding the master for the time being; and if she is a tow he has also control of the navigation of her tug. The judicial decisions establish that it is within his province to decide whether the ship shall get under way, the proper time and place for her to anchor, the way of carrying her anchor, the proper orders for the helm, her rate of speed, and whether the statutory rules of navigation shall be complied with; and the master and crew must not interfere with his control, and only remain liable for the proper execution of the pilot's orders and the trim and general efficiency as to look-out, &c., of the ship. The master, however, is bound to supersede the pilot in case of his intoxication or manifest incapacity, and to interfere if there is a clear and plain prospect of danger to the ship in following the pilot's directions, *e.g.* getting under way in a thick fog. The pilot is entitled to receive from the master assistance in having his attention called to anything which a competent mariner would see that he ought to know. A pilot taken voluntarily, and not by compulsion of law, is considered as the servant of the shipowner, and as such renders him liable for his acts of negligence towards third parties. He does not, it seems, supersede the master in the control of the ship, but only advises him. The Admiralty and the Board of Trade and the Trinity House all take the view that the captain or master is bound to keep a vigilant eye on the navigation of the vessel by the pilot, and insist on all proper precautions being taken. For the purposes of a policy of marine insurance a ship is not seaworthy without a pilot in compulsory pilotage waters; and where there is no legal compulsion to have one, but the locality requires navigation by a person having local knowledge, it has been said that a ship must take a pilot, certainly when leaving a port, and probably on entering a port if a pilot is available.

A pilot can sue for his pilotage fee at common law or in Admiralty (*q.v.*), in the latter case provided that the contract was made and the work done not within the body of a county; but he has a summary remedy by statute which is of easier application. He cannot be sued in Admiralty for damage done by a collision caused by his negligence (*e.g.* on the Admiralty side of a county court having Admiralty jurisdiction); but he can be made liable at common law or in the Admiralty Division of the High Court, although in the case of a Trinity House pilot his liability is limited to the amount of his bond and pilotage fee then being earned (see above); but the court has refused to join him as a defendant to an action *in rem* brought against the ship of which he had the charge. A pilotage authority cannot be made liable for the negligent navigation of a ship by a pilot which it has licensed, for he is not its servant, though it has been held liable for the negligence of a person not licensed by it as a pilot, but employed by it for wages to pilot ships into a harbour under its jurisdiction, itself taking the pilotage dues and applying them for harbour purposes. A pilot is not in common employment with the master and crew of a ship, and can recover for any injury done him by their negligence. He may be entitled to claim salvage from a ship of which he has charge, if the services he renders are beyond the scope of his pilotage contract, either from the outset or owing to supervening circumstances, but not otherwise, whether he is on board her or leading her from his boat. (See SALVAGE.)

In the *United States* pilotage laws are regulated by the respective states. If the waters are the boundary between two states a duly licensed pilot of either state may be employed, but no discrimination can be made in the rates of pilotage between vessels of different states. In the *German Empire* the pilotage laws are very complicated. In the majority of the maritime states each one has its own regulations and laws. In *Prussia* there are government pilots who enter the service as apprentices, and are placed under a department of state. In *France* the general organization of pilots is regulated by the Statute on Pilots of the 12th of December 1806, and the pilotage regulations for each port are made by the minister of marine at the request of his local representative and the Chamber of Commerce. French pilots are exempt from military service.

See Abbott, *Shipping* (London, 1901); Maude and Pollock, *Shipping* (London, 1881); Marsden, *Collisions at Sea* (London, 1910); *Select Pleas of the Admiralty* (Selden Society, London, 1892 and 1897); Temperley, *Merchant Shipping Acts* (1907); Twiss, *Black Book of Admiralty* (London, 1871). (G. G. P.*; J. W. D.)

PILOT-FISH (*Naucrates ductor*), a pelagic fish of the family of horse-mackerels or *Carangidae*, well known to sailors from its peculiar habit of keeping company with ships and large fishes, especially sharks. It occurs in all tropical and sub-tropical seas, and is common in the Mediterranean, but becomes scarcer in higher latitudes. In summer pilots will accompany ships as far north as the south coast of England into port. This habit was known to the ancients, who describe the *Pompilus* as a fish which points out the way to dubious or embarrassed sailors, and by its sudden disappearance indicates to them the vicinity of land; the ancient seamen of the Mediterranean regarded it, therefore, as a sacred fish. That the pilot accompanies sharks is an observation which first appears in works of travel of the 17th century, the writers asserting that it is of great use to its big companion in conducting it and showing it the way to its food. It is, however, extremely doubtful whether the pilot's connexion with a shark serves a more special purpose than its temporary attachment to a ship. It accompanies both on account of the supply of food which it derives from them. The pilot, therefore, stands to both in the relation of a so-called "commensal," like the *Echeneis* or sucking-fish. All observers, however, agree that neither the pilot nor the sucker is ever attacked by the shark. The pilot attains to a length of about 12 in. In the shape of its body it resembles a mackerel, but is rather shorter, especially in the head, and covered with small scales. A sharp keel runs along the middle of each side of the tail. The first dorsal fin consists of a few short spines not connected by a membrane; the second dorsal and the anal are composed of numerous rays. The teeth, which occupy the jaws, vomer and palatine bones, are all small, in villiform bands. The coloration of the pilot renders it conspicuous at a distance; on a bluish ground-colour from five to seven dark-blue or violet cross-bands traverse the body from the back to the belly. The pilot-fish spawns in the open sea, and its fry is constantly caught in the tow-net. But young pilot-fish differ considerably from the adult, having the spines of the first dorsal connected by a membrane, and some bones of the head armed with projecting spines. These little fishes were therefore long considered to be a distinct genus, *Nauclerus*.


Pilot-fish.

PILOTY, KARL VON (1826–1886), German painter, was born at Munich, on the 1st of October 1826. His father, Ferdinand Piloty (d. 1844), enjoyed a great reputation as a lithographer. In 1840 he was admitted as a student of the Munich Academy, under the artists Schorn and Schnorr. After a journey to Belgium, France and England, he commenced work as a painter of *genre* pictures, and in 1853 produced a work, *Die Amme* ("The Wet Nurse"), which, on account of its originality of style, caused a considerable sensation in Germany at the time. But he soon forsook this branch of painting in favour of historical subjects, and produced in 1854 for King Maximilian II. "The Adhesion of Maximilian I. to the Catholic League in 1609." It was succeeded by "Seni at the Dead Body of Wallenstein" (1855), which gained for the young painter the membership of the Munich Academy, where he succeeded Schorn (his brother-in-law) as professor. Among other well-known works by Piloty are the "Battle of the White Mountain near Prague," "Nero Dancing upon the Ruins of Rome" (1861), "Godfrey of Bouillon on a Pilgrimage to the Holy Land" (1861), "Galileo in Prison" (1864), and "The Death of Alexander the Great" (unfinished), his last great work. He also executed a number of mural paintings for the royal palace in Munich. For Baron von Schach he painted the justly celebrated "Discovery of America." In 1874 he was appointed keeper of the Munich Academy, being afterwards ennobled by the king of Bavaria. Piloty was the foremost representative of the realistic school in Germany. He was a most successful teacher, and among his more famous pupils may be mentioned Makart, Lenbach, Defregger, Max and Grützner. He died at Munich on the 21st of July 1886.

PILSEN (Czech, *Plzeň*), a town of Bohemia, Austria, 68 m. W.S.W. of Prague by rail. Pop. (1900), 68,292, of which 94% are Czech. It is the second town of Bohemia, and lies at the confluence of the Radbusa and the Mies. It consists of the town proper, which is regularly built and surrounded with promenades on the site of the old ramparts, and of three suburbs. The most prominent buildings are the Gothic church of St Bartholomew, said to date from 1292, whose tower (325 ft.) is the highest in Bohemia, and the fine Renaissance town hall dating from the 16th century. The staple article of manufacture and commerce is beer, which is exported to all parts of the world. Other industrial products are machinery, enamelled tinware, leather, alum, paper, earthenware, stoves and spirits, while a tolerably brisk trade is carried on in wool, feathers, cattle and horses. In the neighbourhood are several coal-pits, iron-works and glass-works, as well as large deposits of kaolin.

Pilsen first appears in history in 976, as the scene of a battle in the war between Prince Boleslaus and the emperor Otto II., and it became a town in 1272. During the Hussite wars it was the centre of Catholic resistance to the Hussites; it was three times unsuccessfully besieged by Prokop the Great, and it took part in the league of the Romanist lords against King George of Podebrad. During the Thirty Years' War the town was taken by Mansfield in 1618 and not recaptured by the Imperialists till 1621. Wallenstein made it his winter-quarters in 1633, and it was in the great hall of the *Rathaus* that his generals took the oath of fidelity to him (January 1634). The town was unsuccessfully besieged by the Swedes in 1637 and 1648. The first Bohemian printing press was established here in 1468.

PIMA, a tribe and stock of North American Indians. Their range was southern Arizona and northern Mexico. The ruined Pima village, known to the Spanish as Casa Grande on the south bank of the Gila, is an example of their early civilization and skill in building. Driven out of their homes by neighbouring tribes, they lived a more or less nomadic life. They were always good farmers, showing much skill in irrigation. At first submitting to the Spaniards, they revolted in 1751, destroying all the missions. The war lasted two years, but since then the Pima Indians have been friendly with the settlers. As a race they are brave, honest and hard working. They number some 5000 on two reservations in Arizona. The Piman stock includes such tribes as the Papago, Huichol, Opata, Tarumari, and numbers upwards of a hundred thousand.

PIMENTO, also called ALLSPICE (from a supposed combination of various flavours) and JAMAICA PEPPER, the dried immature fruit of *Eugenia pimenta* or *Pimenta officinalis*, an evergreen tree about 30 ft. high, belonging to the natural order *Myrtaceae*. It is indigenous in the West India Islands, growing on limestone hills near the sea, and is especially grown in Jamaica. The spice derives its name from the Portuguese *pimenta*, Spanish *pimienta*, pepper, which was given to it from its resemblance to pepper-corns. The berries are gathered in July and August, when of full size, but still unripe—the small branches bearing fruit being broken off and dried in the sun and air for some days, when the stalks are removed and the berries are ready for packing. These owe their aromatic properties to an essential oil present to the extent of 3 to 4½% and consisting largely of eugenol or allyl guaiacol, $HO(CH_3O)C_6H_3\cdot C_3H_5$. The chief use of pimento is as a spice. The oil, the action of which resembles that of cloves, is occasionally used in medicine, and is also employed in perfuming soaps. The "bay rum" used as a toilet article is a tincture scented with the oil of the leaves of an allied species, *Pimenta acris*, commonly known as the bayberry tree.

PIN (a doublet with "pen" from Lat. *pinna*, feather, pinnacle, which is said to contain the same root as *πίτυς*, pine tree, and properly to mean a sharp point or end), a small peg or bolt of metal or wood, not necessarily pointed, employed as a fastening to connect together different parts of an article, as a stop to limit the motion of some moving piece in a machine, as a support on which a small wheel may turn, &c., but most commonly a small metal spike, used for fastening portions of fabrics together, having one end pointed and at the other a bulbed head, or some other arrangement for preventing the spike from passing entirely through the cloth or other material with which it is employed. In one form or another pins of this last kind are of the highest antiquity, the earliest form doubtless being a natural thorn. Pins of bronze, and bronze brooches in which the pin is the essential feature, are of common occurrence among the remains of the bronze age. The ordinary domestic pin had become in the 15th century an article of sufficient importance in England to warrant legislative notice, as in 1483 the importation of pins was prohibited by statute. In 1540 Queen Catherine received pins from France, and again in 1543 an act was passed providing that "no person shall put to sale any pinnes but only such as shall be double headed, and have the heads soldered fast to the shank of the pinnes, well smoothed, the shank well shapen, the points well and round filed, canted and sharpened." At that time pins of good quality were made of brass; but a large proportion of those against which the legislative enactment was directed were made of iron wire blanched and passed as brass pins. To a large extent the supply of pins in England was received from France till about 1626, in which year the manufacture was introduced into Gloucestershire by John Tilsby. His business flourished so well that he soon gave employment to 1500 persons, and Stroud pins attained a high reputation. In 1636 the pinmakers of London formed a corporation, and the manufacture was subsequently established at Bristol and Birmingham, the latter town ultimately becoming the principal centre of the industry. So early as 1775 the attention of the enterprising colonists in Carolina was drawn to the manufacture by the offer of prizes for the first native-made pins and needles. At a later date several pin-making machines were invented in the United States. During the war of 1812, when the price of pins rose enormously, the manufacture was actually started, but the industry was not fairly successful till about the year 1836 when the Howe Manufacturing Company was formed at Birmingham, Connecticut. Previous to this an American, Lemuel W. Wright, had in 1824 secured in England a patent for a machine to make solid-headed pins, which established the industry on its present basis.

The old form of pin consisted of a shank with a separate head of fine wire twisted round and secured to it. Fine wire for heads was first wound on a lathe round a spit the exact circumference of the pin shanks to be headed. In this way a long elastic spiral was produced which had next to be cut into heads, each consisting of two complete turns of the spiral. These heads were softened by annealing and made into a heap for the heading boy, whose duty was to thrust a number of shanks into the heap and let as many as might be fit themselves with heads. Such shanks as came out thus headed were passed to the header, who with a falling block and die arrangement compressed together shank and head of such a number as his die-block was fitted for. All the other operations of straightening the wire, cutting, pointing, &c., were separately performed, and these numerous details connected with the production of a common pin were seized on by Adam Smith as one of the most remarkable illustrations of the advantages of the division of labour.

The beautiful automatic machinery by which pins are now made of single pieces of wire is an invention of the 19th century. In 1817 a communication was made at the Patent Office by Seth Hunt, describing a machine for making pins with "head, shaft and point in one entire piece." By this machine a suitable length of wire was cut off and held in a die till a globular head was formed on one end by compression, and the other end was pointed by the revolution around it of a roughened steel wheel. This machine does not appear to have come into use; but in 1824 Wright patented the pin-making apparatus above referred to as the parent form of the machinery now employed. A factory equipped with his machines was established in London, but the company which owned it was not successful. The plant passed into the hands of Daniel Foote-Tayler of Birmingham, who obtained an extension of Wright's patent for five years from 1838, and his firm was the first to carry on the production of machine-made solid-headed pins on a commercial basis. In a modern pin-making machine wire of suitable gauge running off a reel is drawn in and straightened by passing between straightening pins or studs set in a table. When a pin length has entered it is caught by lateral jaws, beyond which enough of the end projects to form a pin-head. Against this end a steel punch advances and compresses the metal by a die arrangement into the form of a head. The pin length is immediately cut off and the headed piece drops into a slit sufficiently wide to pass the wire through but retain the head. The pins are consequently suspended by the head while their projecting extremities are held against a revolving cutter, by which they are pointed. They are next cleaned by being boiled in weak beer, and then arranged in a copper pan in layers alternating with layers of grained tin. The contents of the pan are covered with water over which a quantity of argol (bitartrate of potash) is sprinkled, and after boiling for several hours the brass pins are coated with a thin deposit of tin, which gives them their silvery appearance. They are then washed in clean water, and dried and polished by being revolved in a barrel, mixed with dry bran or fine sawdust, from which they are winnowed finished pins. A large proportion of the pins sold are stuck into paper by an automatic machine not less ingenious than the pin-making machine itself. Mourning pins are made of iron wire, finished by immersing in black japan and drying in a stove. A considerable variety of pins, including the ingeniously coiled, bent and twisted nursery safety pin, ladies' hairpins, &c., are also made by automatic machinery. The sizes of ordinary pins range from the 3½-in. stout blanket pin down to the finest slender gilt pin used by entomologists, 4500 of which weigh about an ounce.

PINA, RUY DE (1440–1521), Portuguese chronicler, was a native of Guarda. He acted as secretary of the embassy sent by King John II. to Castile in the spring of 1482, and in the following September returned there as sole envoy. He was present at the execution of the duke of Braganza at Evora in 1483, and in 1484 went to Rome as secretary of an embassy to Pope Innocent VII. On his return, the king charged him to write a history of his reign and gave him a pension for his support. Following the arrival of Columbus from his first voyage in 1493, Pina was one of the commissaries despatched to Barcelona by John II. to negotiate with the Catholic sovereigns respecting the limits of their respective jurisdictions. In September 1495 he attested the will of John II. in his capacity as a notary public, and on the 25th of October of the same year he was present at his master's death at Alvor and opened and read his testament. King Manoel confirmed his pension and appointed him in 1497 chronicler of the kingdom, keeper of the archives and royal librarian, with a suitable salary. By 1504 Pina had completed his chronicles of Alphonso V. and John II. King John III. charged him with a history of his father, Manoel, and at his death Pina had carried it down to the capture of Azamor, as we know from Damião de Goes, who used it in preparing his own chronicle of that monarch.

It is probable that the chronicles of the early kings of Portugal from Sancho I. to Alphonso IV. which were published under Pina's name in the 18th century were written by Fernão Lopes and edited by Pina, while that of King Duarte seems to have been the joint production of Lopes and Azurara, with Pina again as the editor only. Pina was a favourite of fortune during his life, for, apart from royal benefactions, he received presents from public men who wished to figure well in his books, and after his death he obtained the credit for work that was not his. His authority as an historian is considerable, and his frankness is said to have provoked remark from contemporaries.

Pina's chronicle of King Alphonso IV. was first published in Lisbon in 1853; those of King Duarte and King Alphonso V. in vol. i. of the *Collecão de livros ineditos da historia portugueza*

(Lisbon, 1790), and his chronicle of John II. in vol. ii. of the same collection (Lisbon, 1792). The introduction to the chronicle of King Duarte contains the fullest account of Pina's life. (E. Pr.)

PINACOTHECA, a picture-gallery (Gr. πινακοθήκη, from πίναξ, a tablet or picture). The name is especially given to the building containing pictures which formed the left wing of the Propylaea on the Acropolis at Athens. Though Pausanias (Bk. II., xxii. 6) speaks of the pictures "which time had not effaced," which seems to point to fresco painting, the fact that there is no trace of any preparation for stucco on the walls rather shows that the paintings were easel pictures (J. G. Frazer, *Pausanias's Description of Greece*, 1898, ii. 252). The Romans adopted the term for the room in a private house containing pictures, statues, and other works of art. It is used for a public gallery on the continent of Europe, as at Bologna and Turin. At Munich there are two galleries known as the Old and New Pinakothek.

PINAR DEL RIO, capital of Pinar del Rio Province, Cuba, about 107 m. S.W. by railway from Havana. Pop. (1907), 10,634. The city is in the fertile valley of the Guama. It is the centre of the tobacco industry of the Vuelta Abajo region. Its port is La Coloma, on the southern coast. The pueblo was created after 1773; but the history of the settlement goes back to 1571, and the parochial church dates from 1710.

PINCKNEY, CHARLES (1757–1824), American statesman, was born on the 26th of October 1757 at Charleston, South Carolina; he was the son of Charles Pinckney (1731–1784), first president of the first South Carolina Provincial Congress (Jan. to June 1775), and a cousin of Charles Cotesworth Pinckney and Thomas Pinckney. He was studying law at the outbreak of the War of Independence, served in the early campaigns in the South, and in 1779 was elected to the South Carolina House of Representatives. He was captured by the British at the fall of Charleston (1780), and remained a prisoner until the close of hostilities. He was elected a delegate to the Congress of the Confederation in 1784, 1785 and 1786, and in 1786 he moved the appointment of a committee "to take into consideration the affairs of the nation," advocating in this connexion an enlargement of the powers of Congress. The committee having been appointed, Pinckney was made chairman of a sub-committee which prepared a plan for amending the articles of confederation. In 1787 he was a delegate to the Federal constitutional convention, and on the same day (May 29) on which Edmund Randolph (*q.v.*) presented what is known as the Virginia plan, Pinckney presented a draft of a constitution which is known as the Pinckney plan. Although the Randolph resolutions were made the basis on which the new constitution was framed, Pinckney's plan seems to have been much drawn upon. Furthermore, Pinckney appears to have made valuable suggestions regarding phrasing and matters of detail. On the 18th of August he introduced a series of resolutions, and to him should probably be accredited the authorship of the substance of some thirty-one or thirty-two provisions of the constitution.[1] Pinckney was president of the State Convention of 1790 that framed a new constitution for South Carolina, was governor of the state from 1789 to 1792, a member of the state House of Representatives in 1792–1796, and again governor from 1796 to 1798. From 1799 to 1801 he was a member of the United States Senate. He entered public life as a Federalist, but later became the leader in organizing the Democratic-Republican party in his state, and contributed largely to the success of Thomas Jefferson in the presidential election of 1800. By Jefferson's appointment he was American minister to Spain from 1801 to 1805. In general his mission was a distinct failure, his arrogance and indiscretions finally causing the Spanish government to request his recall. He was elected to the state House of Representatives in 1805, was again governor of South Carolina from 1806 to 1808, in 1810–1814 was once more a member of the state House of Representatives, in which he defended President Madison's war policy, and from 1819 to 1821 was a member of the National House of Representatives, in which he opposed the Missouri Compromise in a brilliant speech. He died at Charleston, South Carolina, on the 29th of October 1824.

His son, Henry Laurens Pinckney (1794–1863), was a member of the state House of Representatives in 1816–1832, founded in 1819 and edited for fifteen years the Charleston *Mercury*, the great exponent of state's rights principles, and was a member of the National House of Representatives in 1833–1837.

PINCKNEY, CHARLES COTESWORTH (1746–1825), American statesman, was born in Charleston, South Carolina, on the 25th of February 1746, the son of Charles Pinckney (d. 1758),[2] by his second wife, the celebrated girl planter, Eliza Lucas. When a child he was sent to England, like his brother Thomas after him, to be educated. Both of them were at Westminster and Oxford and were called to the bar, and for a time they studied in France at the Royal Military College at Caen. Returning to America in 1769, C. C. Pinckney began the practice of law at Charleston, and soon became deputy attorney-general of the province. He was a member of the first South Carolina provincial congress in 1775, served as colonel in the South Carolina militia in 1776–1777, was chosen president of the South Carolina Senate in 1779, took part in the Georgia expedition and the attack on Savannah in the same year, was captured at the fall of Charleston in 1780 and was kept in close confinement until 1782, when he was exchanged. In 1783 he was commissioned a brevet brigadier-general in the continental army. He was an influential member of the constitutional convention of 1787, advocating the counting of all slaves as a basis of representation and opposing the abolition of the slave-trade. He opposed as "impracticable" the election of representatives by popular vote, and also opposed the payment of senators, who, he thought, should be men of wealth. Subsequently Pinckney bore a prominent part in securing the ratification of the Federal constitution in the South Carolina convention called for that purpose in 1788 and in framing the South Carolina State Constitution in the convention of 1790. After the organization of the Federal government, President Washington offered him at different times appointments as associate justice of the Supreme Court (1791), secretary of war (1795) and secretary of state (1795), each of which he declined; but in 1796 he succeeded James Monroe as minister to France. The Directory refused to receive him, and he retired to Holland, but in the next year, Elbridge Gerry and John Marshall having been appointed to act with him, he again repaired to Paris, where he is said to have made the famous reply to a veiled demand for a "loan" (in reality for a gift), "Millions for defence, but not one cent for tribute," —another version is, "No, not a sixpence." The mission accomplished nothing, and Pinckney and Marshall left France in disgust, Gerry (*q.v.*) remaining. When the correspondence of the commissioners was sent to the United States Congress the letters "X," "Y" and "Z," were inserted in place of the names of the French agents with whom the commission treated—hence the "X Y Z Correspondence," famous in American history. In 1800 he was the Federalist candidate for vice-president, and in 1804 and again in 1808 for president, receiving 14 electoral votes in the former and 47 in the latter year. From 1805 until his death, on the 16th of August 1825, he was president-general of the Society of the Cincinnati.

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[1] The "Pinckney Plan" has been the subject of considerable discussion. When, in 1818, John Quincy Adams was preparing the journal of the convention for publication and discovered that the Pinckney plan was missing, he wrote to Pinckney for a copy, and Pinckney sent him what he asserted was either a copy of his original draft or a copy of a draft which differed from the original in no essentials. But as this was found to bear a close resemblance to the draft reported by the committee of detail, Madison and others, who had been members of the convention, as well as historians, treated it as spurious, and for years Pinckney received little credit for his work in the convention. Later historians, however, notably J. Franklin Jameson and Andrew C. McLaughlin, have accredited to him the suggestion of a number of provisions of the constitution as a result of their efforts to reconstruct his original plan chiefly from his speeches, or alleged speeches, and from certain papers of James Wilson, a member of the committee of detail, one of which papers is believed to be an outline of the Pinckney plan. See J. F. Jameson, "Studies in the History of the Federal Convention of 1787," in the *Annual Report* of the American Historical Association for 1902, vol. i.; A. C. McLaughlin, "Outline of Pinckney's Plan for a Constitution," in *The Nation*, April 28, 1904; an article entitled "Sketch of Pinckney's Plan for a Constitution," in the *American Historical Review* for July 1904; and C. C. Nott, *The Mystery of the Pinckney Draught* (New York, 1908), an attempt by a former chief-justice of the U.S. Court of Claims to prove that the document sent by Pinckney to Adams in 1818 is a genuine copy of his original plan.

[2] Charles Pinckney, the father, was long prominent in colonial affairs; he was attorney-general of the province in 1733, speaker of the assembly in 1736–1738 and in 1740, chief justice of the province in 1752–1753, and agent for South Carolina in England in 1753–1758. He was the uncle of Charles Pinckney (1731–1784), and the great-uncle of Charles Pinckney (1757–1824). Eliza Lucas Pinckney (*c.* 1722–1793) was the daughter of Lieut.-Colonel George Lucas of the British army, who about 1738 removed from Antigua to South Carolina, where he acquired several plantations. He was almost immediately recalled to Antigua, and his daughter undertook the management of the plantations with conspicuous success. She is said to have been the first to introduce into South Carolina (and into continental North America) the cultivation and manufacture of indigo, and she also imported silkworms—in 1753 she presented to the princess of Wales a dress made of silk from her plantations. She was married to Charles Pinckney in 1744. See Harriott H. Ravenel, *Eliza Pinckney* (New York, 1896), in the "Women of Colonial and Revolutionary Times" series.

PINCKNEY, THOMAS (1750–1828), American statesman and diplomat, was born in Charleston, South Carolina, on the 23rd of October 1750, a younger brother of Charles Cotesworth Pinckney (*q.v.*). Educated in England, he returned to Charleston in 1773, and was admitted to the bar in 1774. During the War of Independence his early training at the French military college at Caen enabled him to render effective service to General Benjamin Lincoln in 1778–1779, to Count d'Estaing (1779), to General Lincoln in the defence of Charleston and afterwards to General Horatio Gates. In the battle of Camden he was badly wounded and captured, remaining a prisoner for more than a year. Subsequently he was governor of South Carolina in 1787–1789; presided over the state convention which ratified the Federal constitution in 1788; was a member of the state legislature in 1791; and was United States minister to Great Britain in 1792–1796. During part of this time (1794–1795) he was also envoy extraordinary to Spain, and in this capacity negotiated (1795) the important Treaty of San Lorenzo el Real; by that treaty the boundary between the United States and East and West Florida and between the United States and "Louisiana" was settled (Spain relinquishing all claims east of the Mississippi above 31° N. lat.), and the United States secured the freedom of navigation of the Mississippi to its mouth with the right of deposit at New Orleans for three years, after which the United States was to have the same right either at New Orleans or at some other place on the Mississippi to be designated by Spain. In 1796 Pinckney was the Federalist candidate for vice-president, and in 1797–1801 he was a Federalist representative in Congress. During the War of 1812 he was a major-general. In 1825 he succeeded his brother as president-general of the Society of the Cincinnati. He died in Charleston on the 2nd of November 1828. Pinckney, like many other South Carolina revolutionary leaders, was of aristocratic birth and politics, closely connected with England by ties of blood, education and business relations. This renders the more remarkable their attitude in the War of Independence, for which they made great sacrifices. Men of Pinckney's type were not in sympathy with the progressive democratic spirit of America, and they began to withdraw from politics after about 1800.

See C. C. Pinckney, *Life of General Thomas Pinckney* (Boston, 1895).

PINDAR (Gr. Πίνδαρος, *c.* 522–443 B.C.), the great lyric poet of ancient Greece, was born at Cynoscephalae, in Boeotia, at the time of the Pythian games (*fr.* 175, Bergk^4, 193),[1] which is taken by Böckh to be 522 B.C. He would thus be some thirty-four years younger than Simonides of Ceos. He was the son of Daiphantus and Cleodice (or Cleidice). The traditions of his family have left their impress on his poetry, and are not without importance for a correct estimate of his relation to his contemporaries. The clan of the Aegidae—tracing their line from the hero Aegeus—belonged to the "Cadmean" element of Thebes, *i.e.* to the elder nobility whose supposed date went back to the days of the founder Cadmus. A branch of the Theban Aegidae had been settled in Achaean times at Amyclae in the valley of the Eurotas (Pind. *Isthm.* vi. 14), and after the Dorian conquest of the Peloponnesus had apparently been adopted by the Spartans into one of the three Dorian tribes. The Spartan Aegidae helped to colonize the island of Thera (*Pyth.* v. 68–70). Another branch of the race was settled at Cyrene in Africa; and Pindar tells how his Aegid clansmen at Thebes "showed honour" to Cyrene as often as they kept the festival of the Carnea (*Pyth.* v. 75). Pindar is to be conceived, then, as standing within the circle of those families for whom the heroic myths were domestic records. He had a personal link with the memories which everywhere were most cherished by Dorians, no less than with those which appealed to men of "Cadmean" or of Achaean stock. And the wide ramifications of the Aegidae throughout Hellas rendered it peculiarly fitting that a member of that illustrious clan should celebrate the glories of many cities in verse which was truly Panhellenic.

Pindar is said to have received lessons in flute-playing from one Scopelinus at Thebes, and afterwards to have studied at Athens under the musicians Apollodorus (or Agathocles) and Lasus of Hermione. In his youth, as the story went, he was defeated in a poetical contest by the Theban Corinna—who, in reference to his profuse employment of Theban mythology, is said to have advised him "to sow with the hand, not with the sack." There is an extant fragment in which Corinna reproves another Theban poetess, Myrtis, "for that she, a woman, contended with Pindar" (ὅτι βανὰ φοῦσ' ἔβα Πινδάροιο ποτ' ἔριν) —a sentiment which hardly fits the story of Corinna's own victory. The facts that stand out from these meagre traditions are that Pindar was precocious and laborious. Preparatory labour of a somewhat severe and complex kind was, indeed, indispensable for the Greek lyric poet of that age. Lyric composition demanded studies not only in metre but in music, and in the adaptation of both to the intricate movements of the choral dance (ὀρχηστική). Several passages in Pindar's extant odes glance at the long technical development of Greek lyric poetry before his time, and at the various elements of art which the lyrist was required to temper into a harmonious whole (see, *e.g. Ol.* iii. 8, vi. 91, xiii. 18, xiv. 15; *Pyth.* xii. 23, &c.). The earliest ode which can be dated (*Pyth.* x.) belongs to the twentieth year of Pindar's age (502 B.C.); the latest (*Olymp.* v.) to the seventieth (452 B.C.).[2] He visited the court of Hiero at Syracuse; Theron, the despot of Acragas, also entertained him; and his travels perhaps included Cyrene. Tradition notices the special closeness of his relations with Delphi: "He was greatly honoured by all the Greeks, because he was so beloved of Apollo that he even received a share of the offerings; and at the sacrifices the priest would cry aloud that Pindar come in to the feast of the god."[3] His wife's name was Megacleia (another account says Timoxena, but this may have been a second wife), and he had a son named Daiphantus and two daughters, Eumetis and Protomache. He is said to have died at Argos, at the age of seventy-nine, in 443 B.C.

Among the Greeks of his own and later times Pindar was pre-eminently distinguished for his piety towards the gods. He tells us that, "near to the vestibule" of his house (*Pyth.* iii. 78), choruses of maidens used to dance and sing by night in praise of the Mother of the Gods (Cybele) and Pan—deities peculiarly associated with the Phrygian music of the flute, in which other members of Pindar's family besides the poet himself are said to have excelled. A statue and shrine of Cybele, which he dedicated at Thebes, were the work of the Theban artists, Aristomedes and Socrates. He also dedicated at Thebes a statue to Hermes Agoraios, and another, by Calamis, to Zeus Ammon. The latter god claimed his especial veneration because Cyrene, one of the homes of his Aegid ancestry, stood "where Zeus Ammon hath his seat," *i.e.* near the oasis and temple

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[1] The references are to the edition of Pindar by C. A. M. Fennell (1893–1899), and the fourth edition of Bergk's *Poetae lyrici graeci.*

[2] According to others, his latest poem is the eighth Pythian ode, 450 or 446.

[3] Πινδάρου γένος, in ed. Ald.

(*Pyth.* iv. 16). The author of one of the Greek lives of Pindar says that, "when Pausanias the king of the Lacedaemonians was burning Thebes, some one wrote on Pindar's house, 'Burn not the house of Pindar the poet'; and thus it alone escaped destruction." This incident, of which the occasion is not further defined, has been regarded as a later invention.[1] Better attested, at least, is the similar clemency of Alexander the Great, when he sacked Thebes one hundred and eight years after the traditional date of Pindar's death (335 B.C.). He spared only (1) the Cadmeia, or citadel, of Thebes (thenceforth to be occupied by a Macedonian garrison); (2) the temples and holy places; and (3) Pindar's house. While the inhabitants were sold into slavery, exception was made only of (1) priests and priestesses; (2) persons who had been connected by private ξενία with Philip or Alexander, or by public ξενία with the Macedonians; (3) Pindar's descendants. It is probable enough, as Dio Chrysostom suggests (ii. 33), that Alexander was partly moved by personal gratitude to a poet who had celebrated his ancestor Alexander I. of Macedon. But he must have been also, or chiefly, influenced by the sacredness which in the eyes of all Hellenes surrounded Pindar's memory, not only as that of a great national poet, but also as that of a man who had stood in a specially close relation to the gods, and, above all, to the Delphian Apollo.[2] Upwards of six hundred years after Pindar's death the traveller Pausanias saw an iron chair which was preserved among the most precious treasures of the temple in the sanctuary at Delphi. It was the chair, he was told, "in which Pindar used to sit, whenever he came to Delphi, and to chant those of his songs which pertain to Apollo" (x. 24, 5).

During the second half of Pindar's life, Athens was rising to that supremacy in literature and art which was to prove more lasting than her political primacy. Pindar did not live to see the Parthenon, or to witness the mature triumphs of Sophocles; but he knew the sculpture of Calamis, and he may have known the masterpieces of Aeschylus. It is interesting to note the feeling of this great Theban poet, who stands midway between Homeric epos and Athenian drama, towards the Athens of which Thebes was so often the bitterest foe, but with which he himself had so large a measure of spiritual kinship. A few words remain from a dithyramb in which he paid a glowing tribute to those "sons of Athens" who "laid the shining foundations of freedom" (*παῖδες Ἀθαναίων ἐβάλοντο φαεννὰν κρηπῖδ' ἐλευθερίας*, *fr.* 55, Bergk⁴, 77), while Athens itself is thus invoked: *ὦ ταὶ λιπαραὶ καὶ ἰοστέφανοι καὶ ἀοίδιμοι, Ἑλλάδος ἔρεισμα, κλειταὶ Ἀθᾶναι, δαιμόνιον πτολίεθρον* (*fr.* 54, Bergk⁴, 76). Isocrates, writing in 353 B.C., states that the phrase Ἑλλάδος ἔρεισμα, "stay of Hellas," so greatly gratified the Athenians that they conferred on Pindar the high distinction of προξενία (*i.e.* appointed him honorary consul, as it were—for Athens at Thebes), besides presenting him with a large sum of money (*Antidosis*, 166). One of the letters of the pseudo-Aeschines (*Ep.* iv.) gives an improbable turn to the story by saying that the Thebans had fined Pindar for his praise of Athens, and that the Athenians repaid him twice the sum.[3] The notice preserved by Isocrates—less than one hundred years after Pindar's death—is good warrant for the belief that Pindar had received some exceptional honours from Athens. Pausanias saw a statue of Pindar at Athens, near the temple of Ares (i. 8, 4). Besides the fragment just mentioned, several passages in Pindar's extant odes bespeak his love for Athens. Its name is almost always joined by him with some epithet of praise or reverence. In alluding to the great battles of the Persian wars, while he gives the glory of Plataea to the Spartans, he assigns that of Salamis to the Athenians (*Pyth.* i. 76). In celebrating (*Pyth.* vii.) the Pythian victory of the Athenian Megacles, he begins thus: "Fairest of preludes is the renown of Athens for the mighty race of the Alcmaeonidae. What home, or what house, could I call mine by a name that should sound more glorious for Hellas to hear?" Referring to the fact that an Aeginetan victor in the games had been trained by an Athenian, he says (*Nem.* v. 49) "meet it is that a shaper of athletes should come from Athens"—and recollecting how often Pindar compares the poet's efforts to the athlete's, we may well believe that he was thinking of his own early training at Athens.

Works.

Pindar's versatility as a lyric poet is one of the characteristics remarked by Horace (*Odes*, iv. 2), and is proved by the fragments, though the poems which have come down entire represent only one class of compositions—the *Epinicia*, or odes of victory, commemorating successes in the great games. The lyric types to which the fragments belong, though it cannot be assumed that the list is complete, are at least numerous and varied.

Fragments.

(1) Ὕμνοι, *Hymns* to deities—as to Zeus Ammon, to Persephone, to Fortune. The fragmentary ὕμνος entitled Θηβαίοις seems to have celebrated the deities of Thebes. (2) Παιᾶνες, *paeans*, expressing prayer or praise for the help of a protecting god, especially Apollo, Artemis or Zeus. (3) Διθύραμβοι, *Dithyrambs*, odes of a lofty and impassioned strain, sung by choruses in honour of Dionysus (cf. Pind. *Ol.* xiii. 18, *ταὶ Διωνύσου πόθεν ἐξέφανεν σὺν βοηλάτᾳ Χάριτες διθυράμβῳ*—where Pindar alludes to the choral form given to the dithyramb, *c.* 600 B.C., by Arion—βοηλάτης, "ox-driving," perhaps meaning "winning an ox as prize"). (4) Προσόδια, *Processional Songs*, choral chants for worshippers approaching a shrine. One was written by Pindar for the Delians, another for the Aeginetans. (5) Παρθένια, *Choral Songs for Maidens*. The reference in *Pyth.* iii. 78 to maidens worshipping Cybele and Pan near the poet's house is illustrated by the fact that one of these Παρθένια invoked "Pan, lord of Arcadia, attendant of the Great Mother, watcher of her awful shrine" (*fr.* 72, Bergk⁴, 95). (6) Ὑπορχήματα, *Choral Dance-Songs*, adapted to a lively movement, used from an early date in the cult of Apollo, and afterwards in that of other gods, especially Dionysus. To this class belongs one of the finest fragments (84, Bergk⁴, 107), written for the Thebans in connexion with propitiatory rites after an eclipse of the sun, probably that of the 30th of April 463 B.C. (7) Ἐγκώμια, *Songs of Praise* (for men, while ὕμνοι were for gods), to be sung by a κῶμος or festal company. In strictness ἐγκώμιον was the genus of which ἐπινίκιον was a species; but the latter is more conveniently treated as a distinct kind. Pindar wrote encomia for Theron, despot of Acragas, and for Alexander I. (son of Amyntas), king of Macedon. (8) Σκόλια, *Festal Songs*. The usual sense of σκόλιον is a drinking-song, taken up by one guest after another at a banquet. But Pindar's σκόλια were choral and antistrophic. One was to be sung at Corinth by a chorus of the ἱερόδουλοι attached to the temple of Aphrodite Ourania, when a certain Xenophon offered sacrifice before going to compete at Olympia. Another brilliant fragment, for Theoxenus of Tenedos, has an erotic character. (9) Θρῆνοι, *Dirges*, to be sung with choral dance and the music of the flute, either at the burial of the dead or in commemorative rituals. Some of the most beautiful fragments belong to this class (106–110, Bergk⁴, 129–133). One of the smaller fragments (114, Bergk⁴, 137)—in memory of an Athenian who had been initiated into the Eleusinian mysteries (ἰδὼν κεῖνα)—has been conjecturally referred to the Θρῆνος which Pindar is said to have written (*schol. Pyth.* vii. 18) for Hippocrates, the grandfather of Pericles. A number of small fragments, which cannot be certainly classified, are usually given as ἐξ ἀδήλων εἰδῶν, "of uncertain class." On comparing the above list with Horace, *Odes*, iv. 2, it will be seen that he alludes to No. 3 (*dithyrambos*); to Nos. 1, 2, and 7 (*seu deos regesve canit*); and to No. 9 (*flebili sponsae juvenemve raptum Plorat*)—as well as to the extant *Epinicia* (*sive quos Elea domum reducit Palma caelestes*).

The Epinicia.—The ἐπινίκια (*sc.* μέλη), or ἐπινίκιοι (*sc.* ὕμνοι), "Odes of Victory," form a collection of forty-four odes, traditionally divided into four books, answering to the four great festivals: (1) Ὀλυμπιονῖκαι (*sc.* ὕμνοι): fourteen odes for winners of the wild olive-wreath in the Olympian games, held at Olympia in honour of Zeus once in four years; (2) Πυθιονῖκαι: twelve odes for winners of the laurel-wreath in the Pythian games held at Delphi in honour of Apollo, once in four years, the third of each Olympiad; (3) Νεμεονῖκαι: eleven odes for winners of the pine-wreath in the Nemean games, held at Nemea, in honour of Zeus, once in two years, the second and fourth of each Olympiad; and (4) Ἰσθμιονῖκαι: seven odes for winners of the parsley wreath in the Isthmian games, held at the Isthmus of Corinth, in honour of Poseidon, once in two years, the first and third of each Olympiad. The Greek way of citing an ode is by the nomin. *plur.* followed by the numeral, *e.g.* "the ninth Olympian" is Ὀλυμπισνῖκαι θʹ. The chronological range of the collection (so far as ascertainable) is from 502 B.C. (*Pyth.* x.) to 452 B.C. (*Ol.* v.). With respect to the native places of the victors, the geographical distribution is as follows: for the mainland of Greece proper, 13 odes; for Aegina, 11, for Sicily, 15; for the Epizephyrian Locrians (southern Italy), 2; for Cyrene (Africa), 3.

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[1] A. Schäfer, *Demosthenes und seine Zeit.* iii. 119.

[2] It will be remarked that history requires us to modify the statement in Milton's famous lines:—

> "The great Emathian conqueror bade spare
> The house of Pindarus, when *temple* and tower
> Went to the ground."

Indeed, the point of the incident depends much on the fact that the temples and Pindar's house were classed together for exemption.

[3] Compare Jebb, *Attic Orators*, ii. 143.

The general characteristics of the odes may be briefly considered under the following heads: (1) language; (2) treatment of theme; (3) sentiment—religious, moral and political; (4) relation to contemporary art.

1. The diction of Pindar is distinct in character from that of every other Greek poet, being almost everywhere marked by the greatest imaginative boldness. Thus (*a*) metaphor is used even for the expression of common ideas, or the translation of familiar phrases, as when a cloak is called (*Ol.* ix. 97) "a warm remedy for winds." (*b*) Images for the highest excellence are drawn from the farthest limits of travel or navigation, or from the fairest of natural objects; as when the superlative hospitality of a man who kept open house all the year round is described by saying, "far as to Phasis was his voyage in summer days, and in winter to the shores of Nile" (*Isthm.* ii. 41); or when Olympia, the "crown" or "flower" of festivals, is said to be excellent as water, bright as gold, brilliant as the noonday sun (*Ol.* i. *ad init.*). This trait might be called *the Pindaric imagery of the superlative.* (*c*) Poetical inversion of ordinary phrase is frequent; as, instead of, "he struck fear into the beasts," "he gave the beasts to fear" (*Pyth.* v. 56). (*d*) The efforts of the poet's genius are represented under an extraordinary number of similitudes, borrowed from javelin-throwing, chariot-driving, leaping, rowing, sailing, ploughing, building, shooting with the bow, sharpening a knife on a whetstone, mixing wine in a bowl, and many more. (*e*) Homely images, from common life, are not rare; as from account-keeping, usury, sending merchandise over sea, the σκυτάλη or secret dispatch, &c. And we have such homely proverbs as, "he hath his foot in this shoe," *i.e.* stands in this case (*Ol.* vi. 8). (*f*) The natural order of words in a sentence is often boldly deranged, while, on the other hand, the syntax is seldom difficult. (*g*) Words not found except in Pindar are numerous, many of these being compounds which (like ἐναρίμβροτος, καταφυλλοροεῖν, &c.) suited the dactylic metres in their Pindaric combinations. Horace was right in speaking of Pindar's "nova verba," though they were not confined to the "audaces dithyrambi."

2. The actual victory which gave occasion for the ode is seldom treated at length or in detail—which, indeed, only exceptional incidents could justify. Pindar's method is to take some heroic myth, or group of myths, connected with the victor's city or family, and, after a brief prelude, to enter on this, returning at the close, as a rule, to the subject of the victor's merit or good fortune, and interspersing the whole with moral comment. Thus the fourth Pythian is for Arcesilaus, king of Cyrene, which was said to have been founded by men of Thera, descendants of one of Jason's comrades. Using this link, Pindar introduces his splendid narrative of the Argonauts. Many odes, again, contain shorter mythical episodes—as the birth of Iamus (*Ol.* vi.), or the vision of Bellerophon (*Ol.* xiii.)—which form small pictures of masterly finish and beauty. Particular notice is due to the skill with which Pindar often manages the return from a mythical digression to his immediate theme. It is bold and swift, yet is not felt as harshly abrupt—justifying his own phrase at one such turn—*καί τινα οἶμον ἴσαμι βραχύν* (*Pyth.* iv. 247). It has been thought that, in the parenthesis about the Amazons' shields (*quibus Mos unde deductus . . . quaerere distuli*, *Odes*, iv. 4, 18), Horace was imitating a Pindaric transition; if so, he has illustrated his own observation as to the peril of imitating the Theban poet.

3. *a.* The religious feeling of Pindar is strongly marked in the odes. "From the gods are all means of human excellence." He will not believe that the gods, when they dined with Tantalus, ate his son Pelops; rather Poseidon carried off the youth to Olympus. That is, his reason for rejecting a scandalous story about the gods is purely religious, as distinct from moral; it shocks his conception of the divine dignity. With regard to oracles, he inculcates precisely such a view as would have been most acceptable to the Delphic priesthood, viz. that the gods do illumine their prophets, but that human wit can foresee nothing which the gods do not choose to reveal. A mystical doctrine of the soul's destiny after death appears in some passages (as *Ol.* ii. 66 sq.). Pindar was familiar with the idea of metempsychosis (cf. ibid. 68), but the attempt to trace Pythagoreanism in some phrases (*Pyth.* ii. 34, iii. 74) appears unsafe. The belief in a fully conscious existence for the soul in a future state, determined by the character of the earthly life, entered into the teaching of the Eleusinian and other mysteries. Comparing the fragment of the Θρῆνος (114, Bergk^4, 137), we may probably regard the mystic or esoteric element in Pindar's theology as due to such a source.

b. The moral sentiment pervading Pindar's odes rests on a constant recognition of the limits imposed by the divine will on human effort, combined with strenuous exhortation that each man should strive to reach the limit allowed in his own case. Native temperament (φυή) is the grand source of all human excellence (ἀρετή), while such excellences as can be acquired by study (διδακταὶ ἀρεταί, *Ol.* ix. 100) are of relatively small scope—the sentiment, we may remark, of one whose thoughts were habitually conversant with the native qualities of a poet on the one hand and of an athlete on the other. The elements of ὑγίεις ὄλβος—"sane happiness," such as has least reason to dread the jealousy of the gods—are substance sufficing for daily wants and good repute (εὐλογία). He who has these should not "seek to be a god." "Wealth set with virtues" (πλοῦτος ἀρεταῖς δεδαιδαλμένος), as gold with precious gems, is the most fortunate lot, *because* it affords the amplest opportunities for honourable activity. Pindar does not rise above the ethical standard of an age which said, "love thy friend and hate thy foe" (cf. *Pyth.* ii. 83; *Isthm.* iii. 65). But in one sense he has a moral elevation which is distinctively his own; he is the glowing prophet of generous emulation and of reverent self-control.

c. The political sentiments of the Theban poet are suggested by *Pyth.* xi. 52; "In polities I find the middle state crowned with more enduring good; therefore praise I not the despot's portion; those virtues move my zeal which serve the folk." If in *Pyth.* ii. 87, a democracy is described as ὁ λάβρος στρατός, "the raging crowd," it is to be noted that the ode is for Hiero of Syracuse, and that the phrase clearly refers to the violence of those democratic revolutions which, in the early part of the 5th century B.C., more than once convulsed Sicilian cities. At Thebes, after the Persian wars, a "constitutional oligarchy" (ὀλιγαρχία ἰσόνομος, Thuc. iii. 62) had replaced the narrower and less temperate oligarchy of former days (δυναστεία οὐ μετὰ νόμων); and in this we may probably recognize the phase of Greek political life most congenial to Pindar. He speaks of a king's lot as unique in its opportunities (*Ol.* i. 113); he sketches the character of an ideal king (*Pyth.* iii. 71); but nothing in his poetry implies liking for the τυραννίς as a form of government. Towards the Greek princes of Sicily and Cyrene his tone is ever one of manly independence; he speaks as a Greek citizen whose lineage places him on a level with the proudest of the Dorian race, and whose office invests him with an almost sacred dignity. In regard to the politics of Hellas at large, Pindar makes us feel the new sense of leisure for quiet pursuits and civilizing arts which came after the Persian wars. He honours "Tranquillity, the friend of cities" (Ἁσυχία φιλόπολις, *Ol.* iv. 16). The epic poet sang of wars; Pindar celebrates the "rivalries of peace."

4. Pindar's genius was boldly original; at the same time he was an exquisite artist. "Mine be it to invent new strains, mine the skill to hold my course in the chariot of the Muses; and may courage go with me, and power of ample grasp" (*Ol.*

ix. 80). Here we see the exulting sense of inborn strength; in many other places we perceive the feeling of conscious art—as in the phrase δαιδάλλειν, so apt for his method of inlaying an ode with mythical subjects, or when he compares the opening of a song to the front of a stately building (*Ol.* vi. 3). Pindar's sympathy with external nature was deeper and keener than is often discernible in the poetry of his age. It appears, for example, in his welcome of the season when "the chamber of the hours is opened, and delicate plants perceive the fragrant spring" (*fr.* 53, Bergk^4, 75); in the passage where Jason invokes "the rushing strength of waves and winds, and the nights, and the paths of the deep" (*Pyth.* iv. 195); in the lines on the eclipse of the sun (*fr.* 84, Bergk,^{4} 107); and in the picture of the eruption, when Etna, "pillar of the sky, nurse of keen snow all the year," sends forth "pure springs of fire unapproachable" (*Pyth.* i. 20). The poet's feeling for colour is often noticeable—as in the beautiful story of the birth of Iamus—when Evadne lays aside her silver pitcher and her girdle of scarlet web; the babe is found, "its delicate body steeped in the golden and deep purple rays of pansies" (*Ol.* vi. 55).

Sculpture.

The spirit of art, in every form, is represented for Pindar by χάρις—"the source of all delights to mortals" (*Ol.* i. 30)—or by the personified Charites (Graces). The Charites were often represented as young maidens, decking themselves with early flowers—the rose, in particular, being sacred to them as well as to Aphrodite. In Pindar's mind, as in the old Greek conception from which the worship of the Charites sprang, the instinct of beautiful art was inseparable from the sense of natural beauty. The period from 500 to 460 B.C., to which most of Pindar's extant odes belong, marked a stage in the development of Greek sculpture. The schools of Argos, Sicyon and Aegina were effecting a transition from archaic types to the art which was afterwards matured in the age of Pheidias. Olympia forms the central link between Pindar's poetry and Greek sculpture. From about 560 B.C. onwards sculpture had been applied to the commemoration of athletes, chiefly at Olympia. In a striking passage (*Nem.* v. *ad. init.*) Pindar recognizes sculpture and poetry as sister arts employed in the commemoration of the athlete, and contrasts the merely local effect of the statue with the wide diffusion of the poem. "No sculptor I, to fashion images that shall stand idly on one pedestal for aye; no, go thou forth from Aegina, sweet song of mine, on every freighted ship, on each light bark." Many particular subjects were common to Pindar and contemporary sculpture. Thus (1) the sculptures on the east pediment of the temple at Aegina represented Heracles coming to seek the aid of Telamon against Troy—a theme brilliantly treated by Pindar in the fifth Isthmian; (2) Hiero's victory in the chariot-race was commemorated at Olympia by the joint work of the sculptors Onatas and Calamis; (3) the Gigantomachia, (4) the wedding of Heracles and Hebe, (5) the war of the Centaurs with the Lapithae, and (6) a contest between Heracles and Apollo, are instances of mythical material treated alike by the poet and by sculptors of his day. The contemporary improvements in town architecture, introducing spacious and well-paved streets, such as the σκυρωτὴ ὁδός at Cyrene (*Pyth.* v. 87), suggests his frequent comparison of the paths of song to broad and stately causeways (πλατεῖαι πρόσοδοι—ἑκατόμπεδοι κέλευθοι, *Nem.* vi. 47; *Isthm.* vi. 22). A song is likened to cunning work which blends gold, ivory and coral (*Nem.* vii. 78). Pindar's feeling that poetry, though essentially a divine gift, has a technical side (σοφία), and that on this side it has had an historical development like that of other arts, is forcibly illustrated by his reference to the inventions (σοφίσματα) for which Corinth had early been famous. He instances (1) the development of the dithyramb, (2) certain improvements in the harnessing and driving of horses, and (3) the addition of the pediment to temples (*Ol.* xiii. 21).

In the development of Greek lyric poetry two periods are broadly distinguished. During the first, from about 600 to 500 B.C., lyric poetry is local or tribal—as Alcaeus and Sappho write for Lesbians, Alcman and Stesichorus for Dorians. During the second period, which takes its rise in the sense of Hellenic unity created by the Persian wars, the lyric poet addresses all Greece. Pindar and Simonides are the great representatives of this second period, to which Bacchylides, the nephew of Simonides, also belongs. These, with a few minor poets, are classed by German writers as *die universalen Meliker*. The Greeks usually spoke, not of "lyric," but of "melic" poetry (*i.e.* meant to be sung, and not, like the epic, recited); and "universal melic" is lyric poetry addressed to all Greece. But Pindar is more than the chief extant lyrist. Epic, lyric and dramatic poetry succeeded each other in Greek literature by a natural development. Each of them was the spontaneous utterance of the age which brought it forth. In Pindar we can see that phase of the Greek mind which produced Homeric epos passing over into the phase which produced Athenian drama. His spirit is often thoroughly dramatic—witness such scenes as the interview between Jason and Pelias (*Pyth.* iv.), the meeting of Apollo and Chiron (*Pyth.* ix.), the episode of Castor and Polydeuces (*Nem.* x.), the entertainment of Heracles by Telamon (*Isthm.* v.). Epic narrative alone was no longer enough for the men who had known that great trilogy of national life, the Persian invasions; they longed to see the heroes moving and to hear them speaking. The poet of Olympia, accustomed to see beautiful forms in vivid action or vivid art, was well fitted to be the lyric interpreter of the new dramatic impulse. Pindar has more of the Homeric spirit than any Greek lyric poet known to us. On the other side, he has a genuine, if less evident, kinship with Aeschylus and Sophocles. Pindar's work, like Olympia itself, illustrates the spiritual unity of Greek art.

The fact that certain glosses and lacunae are common to all our MSS. of Pindar make it probable that these MSS. are derived from a common archetype. Now the older scholia on Pindar, which appear to have been compiled mainly from the commentaries of Didymus (*c.* 15 B.C.), sometimes presuppose a purer text than ours. But the compiler of these older scholia lived after Herodian (A.D. 160). The archetype of our MSS., then, cannot have been older than the end of the 2nd century. Our MSS. fall into two general classes: (1) the older, representing a text which, though often corrupt, is comparatively free from interpolations; (2) the later, which exhibit the traces of a Byzantine recension, in other words, of lawless conjecture, down to the 14th or 15th century. To the first class belong Parisinus 7, breaking off in *Pyth.* v.; Ambrosianus 1, which has only *Ol.* i.–xii.; Mediceus 2; and Vaticanus 2—the two last-named being of the highest value. The editio princeps is the Aldine (Venice, 1513). A modern study of Pindar may be almost said to have begun with C. G. Heyne's edition (1773). Hermann did much to advance Pindaric criticism. But August Böckh (1811–1821), who was assisted in his commentary by L. Dissen, is justly regarded as the founder of a scientific treatment of the poet. The edition of Theodor Bergk (*Poetae lyrici graeci*, new ed. by O. Schröder, 1900) is marked by considerable boldness of conjecture, as that of Tycho Mommsen (1864) by a sometimes excessive adherence to MSS. A recension by W. Christ has been published in Teubner's series (2nd ed., 1896), also with Prolegomena and commentary (1896); and by O. Schröder (1908). The complete edition of J. W. Donaldson (1841) has many merits; but that of C. A. M. Fennell (1879–1883; new ed., 1893–1899) is better adapted to the needs of English students. The *Olympia* and *Pythia* have been edited by B. L. Gildersleeve (1885), the *Nemea* and *Isthmia* by J. B. Bury (1890–1892); the *Scholia* by E. Abel (1890, unfinished) and A. B. Brachmann (1903). There is a special lexicon by J. Rumpel (1883). The translation into English prose by Ernest Myers (2nd ed., 1883) is excellent; verse translation by T. C. Baring (1875), and of the *Olympian Odes* by Cyril Mayne (1906). Pindar's metres have been analysed by J. H. H. Schmidt, in *Die Kunstformen der griechischen Poesie* (Leipzig, 1868–1872). On Pindar generally, see monographs by A. F. Villemain (1859), L. Schmidt (1862), G. Lübbert (1882), A. Croiset (1880), W. Christ, *Geschichte der griechischen Litteratur* (1898); and the little volume by F. D. Morice in Blackwood's *Ancient Classics for English Readers*. Exhaustive bibliographical information on the earlier literature will be found in Engelmann, *Scriptores graeci* (1881); see also L. Bornemann, in Bursian's *Jahresbericht*, (cxvi. 1904), with special reference to chronological questions and *Pythia*, i., ii., iii. Some considerable fragments of the paeans were discovered in 1906 by B. P. Grenfell and A. S. Hunt (see *Oxyrhynchus papyri*, pt. v. pp. 24–81); some critical notes will be found in *Classical Review*, Feb. 1908 (A. E. Housman).

(R. C. J.; X.)

PINDARICS, the name by which was known a class of loose and irregular odes greatly in fashion in England during the close of the 17th and the beginning of the 18th century. The invention is due to Abraham Cowley, who, probably in Paris—"a place where he had no other books to direct him"—and perhaps in 1650, found a text of Pindar and determined to imitate the Greek poetry in English, without having comprehended the system upon which Pindar's prosody was built up. Cowley published, however, in 1656, fifteen *Pindarique Odes*, which became the model on which countless imitators founded their pindarics. The erroneous form of these poems, which were absolutely without discipline of structure, was first exposed by Congreve, exactly half a century later, he very justly describing them as "bundles of rambling incoherent thoughts, expressed in a like parcel of irregular stanzas, which also consist of such another complication of disproportioned, uncertain and perplexed verses and rhymes." This is harsh, but it describes a pindaric with absolute justice. Cowley had not been aware that "there is nothing more regular than the *Odes* of Pindar," and that his poems were constructed in harmony with rigid prosodical laws in strophe, antistrophe and epode; "the liberty which Pindar took in his numbers, which has been so much misunderstood and misapplied by his pretended imitators, was only in varying the stanzas in different odes; but in each particular ode they are ever correspondent one to another in their turns, and according to the order of the ode." These excellent critical remarks were made by Congreve in his *Discourse on the Pindarique Ode* of 1706, and from that date forward the use of pindarics ceased to be so lax and frantic as it had been during the previous fifty years. The time had now passed in which such a critic as Sprat could praise "this loose and unconfined measure" as having "all the grace and harmony of the most confined." It began to be felt that the English pindaric was a blunder founded upon a misconception. If we examine Cowley's "Resurrection," which was considered in the 17th century to be a model of the style, and "truly pindarical," we find it to be a shapeless poem of 64 lines, arbitrarily divided, not into strophes, but into four stanzas of unequal volume and structure; the lines which form these stanzas are of lengths varying from three feet to seven feet, with rhymes repeated in wilful disorder, the whole forming a mere vague caricature of Pindar's brilliant odes. The very laxity of these pindarics attracted the poets of the unlyrical close of the 17th century, and they served the purpose not only of Dryden and Pope, but of a score of lesser poets, among whom Oldham, Mrs Behn, Otway, Sprat, Flatman and many others were prominent. The pindaric became the almost necessary form in which to indite a poem of compliment on a birth, a wedding or a funeral. Although the vogue of these forms hardly survived the age of Anne, something of the vicious tradition of them still remained, and even in the odes of Wordsworth, Shelley and Coleridge the broken versification of Cowley's pindarics occasionally survives. Tennyson's *Ode on the Death of the Duke of Wellington* (1852) is the latest important specimen of a pindaric in English literature. (E. G.)

PINDARIS, a word of uncertain origin, applied to the irregular horsemen who accompanied the Mahratta armies in India during the 18th century when the Mughal Empire was breaking up; loosely organized under self-chosen leaders, each band was usually attached to one or other of the great Mahratta chieftains. Their special characteristic was that they received no pay, but rather purchased the privilege of plundering on their own account. The majority of them seem to have been Mahommedans: when the regular forces of the Mahrattas had been broken up in the campaigns conducted by Sir Arthur Wellesley and Lord Lake in 1802–04, the Pindaris made their headquarters in Malwa, under the tacit protection of Sindhia and Holkar. They were accustomed to assemble every year at the beginning of November, and sally forth into British territory in search of plunder. In one such raid upon the Masulipatam coast they plundered 339 villages, killing or wounding 682 persons, torturing 3600 and carrying off property worth a quarter of a million. In 1808–09 they plundered Gujarat, and in 1812 Mirzapur. In 1814 they were reckoned at 25,000 to 30,000 horsemen, half of them well armed. At last the evil became intolerable, and in 1817 the marquess of Hastings obtained the consent of the East India Company to the organized campaign, known as the Pindari War. The Pindaris were surrounded on all sides by a great army, consisting of 120,000 men and 300 guns, which converged upon them from Bengal, the Deccan and Gujarat under the supreme command of Lord Hastings in person. Sindhia was overawed and forced to sign the treaty of Gwalior, consenting to aid in the extirpation of the Pindaris, whom he had hitherto protected. The Peshwa at Poona, the Bhonsla raja at Nagpur and the army of the infant Holkar each took up arms, but were separately defeated. The Pindaris themselves offered little opposition. Amir Khan, by far their most powerful leader, accepted the conditions offered to him; and his descendant is now Nawab of the state of Tonk in Rajputana. The rest surrendered or were hunted down, the fate of Chitu, one of the most notorious, being to perish in a tiger's den. These military operations were followed by the pacification of Central India under the administration of Sir John Malcolm.

See J. Grant Duff, *History of the Mahrattas* (1826); and Major Ross of Bladensburg, *Marquess of Hastings* (Rulers of India Series) (1893).

PIND DADAN KHAN, a town of British India, in the Jhelum district of the Punjab, situated near the right bank of the river Jhelum, on the Sind-Sagar branch of the North-Western railway. Pop. (1901), 13,770. It is an important centre of trade, and its manufactures include boats, brass-ware, pottery, embroidered scarves and riding-whips.

PINDUS, the ancient name of the rugged group of mountains which separates Thessaly from Epirus, and branches south in various directions. The geographical name is sometimes extended over all these branches, and so reaches from Aetolia to the Gulf of Lamia. The northern part of the ridge was known as Lacmon. There is no modern name covering the whole range, but its different parts have separate names. Several of them attain a height of 7000 ft. or more.

PINE (Lat. *Pinus*, Gr. πίτυς), a name given by the ancients to some of the resinous cone-bearing trees to which it is now applied, and, as limited by modern botanists, the designation of a large genus of true conifers, differing from the firs in their hard woody cone-scales being thickened at the apex, and in their slender needle-shaped leaves growing from a membranous sheath, either in pairs or from three to five together—each tuft representing an abortive branch, springing from the axil of a partially deciduous scale-leaf, the base of which remains closely adherent to the stem. The numerous male catkins are generally arranged in dense whorls around the bases of the young shoots; the anther-scales, surmounted by a crest-like appendage, shed their abundant pollen by longitudinal slits; the two ovules at the base of the inner side of each fertile cone-scale develop into a pair of winged seeds, which drop from the opening scales when mature—as in the allied genera.

The pines are widely distributed over the north temperate zone, in the southern portions chiefly confined to the mountains, along which, in Central America, a few are found within the tropic; in more northern regions they frequently form extensive forests, sometimes hardly mingled with other trees. Their soft, straight-grained, resinous and often durable wood gives to many kinds a high economic value, and some are among the most esteemed of timber trees.

Of the two-leaved species, *P. sylvestris*, the pine of northern Europe, may be taken as a type. When growing in perfection it is one of the finest of the group, and perhaps the most picturesque of forest trees; attaining a height of from 70 to 120 ft., it is of conical growth when young, but in maturity acquires a spreading cedar or mushroom-like top, with a straight trunk of from 2 to 4 ft. in diameter at the base, and gnarled twisted boughs, densely clothed at the extremities with glaucous green foliage, which contrasts strongly with the fiery red-brown bark. The leaves are rather short, curved, and often twisted; the male catkins, in dense cylindrical whorls, fill the air of the forest with their sulphur-like pollen in May or June, and fecundate the purple female flowers, which, at first sessile and erect, then become recurved on a lengthening stalk; the ovate cones, about the length of the leaves, do not reach maturity until the autumn of the following year, and the seeds are seldom scattered until the third spring; the cone-scales terminate in a pyramidal recurved point, well marked in the green state and in some varieties in the mature cone, but in others scarcely projecting. *P. sylvestris* is found, in greater or less abundance, from the hills of Finmark and the plains of Bothnia to the mountains of Spain and even the higher forest-slopes of Etna, while in longitude its range extends from the shores of the North Sea to Kamchatka. Nowhere more abundant than in the Scandinavian peninsula, this tree is the true fir (*fur, fura*) of the old Norsemen, and still retains the name among their descendants in Britain, though botanically now classed as a pine. It grows vigorously in Lapland on the lower ground, and is found even at an elevation of 700 ft., while in south Norway it occurs up to 3000 ft., though the great forests from which "Norway pine" timber is chiefly derived are on the comparatively lower slopes of the south-eastern dales: in the highest situations it dwindles to a mere bush. It furnishes the yellow deal of the Baltic and Norway. In Germany, both on the mountains and the sandy plains, woods of "kiefer" are frequent and widely spread, while vast forests in Russia and Poland are chiefly composed of this species; in many northern habitats it is associated with the spruce and birch. In Asia it abounds in Siberia and on the mountains of the Amur region; on the European Alps it occurs at a height of 5600 ft., and on the Pyrenees it is found at still higher elevations; on the northern side of Etna it is said to grow at above 7000 ft. In Britain natural forests of Scotch fir of any extent are only now found in the Highlands, chiefly on the declivities of the Grampians. In former ages the tree covered a large portion of the more northern part of the island, as well as of Ireland; the numerous trunks found everywhere in the mosses and peat-bogs of the northern counties of England attest its abundance there in prehistoric times; and in the remoter post-Glacial epoch its range was probably vastly more extended. The tree is not at present indigenous in southern Britain, but when planted in suitable ground multiplies rapidly by the wind-sown seeds; on many of the sandy moors and commons natural pine woods of large extent have been thus formed during the last fifty years. The Scotch fir is a very variable tree, and certain varieties have acquired a higher reputation for the qualities of their timber than others; among those most prized by foresters is the one called the Braemar pine, the remaining fragments of the great wood in the Braemar district being chiefly composed of this kind; it is mainly distinguished by its shorter and more glaucous leaves and ovoid cones with blunt recurved spines, and especially by the early horizontal growth of its ultimately drooping boughs; of all varieties this is the most picturesque. On the European continent the Hagenau pine of Westphalia is esteemed for the straightness and good quality of its timber. The heart-wood of the finer kinds of Scotch fir is of a deep brownish-red colour, abounding in the resin to which its durability is probably due. For all indoor and most outdoor purposes it is as lasting as oak, and for ship planking is perhaps little inferior; from its lightness and elasticity it is well adapted for the construction of yachts and other small fast-sailing craft, and is said to be the best of all wood for masts and large spars; its weight varies from 30 to 40 lb the cubic foot. The sap-wood is more perishable, but it is useful for fences, casks and a variety of other purposes; soaking in lime-water renders it more lasting; great numbers of young pines are annually cut for railway sleepers, mining timber and numerous agricultural applications; large quantities are consumed for wood-pavement. The quality of the timber depends greatly on the soil and position in which the trees are grown: the dry slopes of granitic or gneissic mountains, or the deep well-drained sandy gravels of the lower country seem to answer equally well; but on clay or wet peat the tree rarely

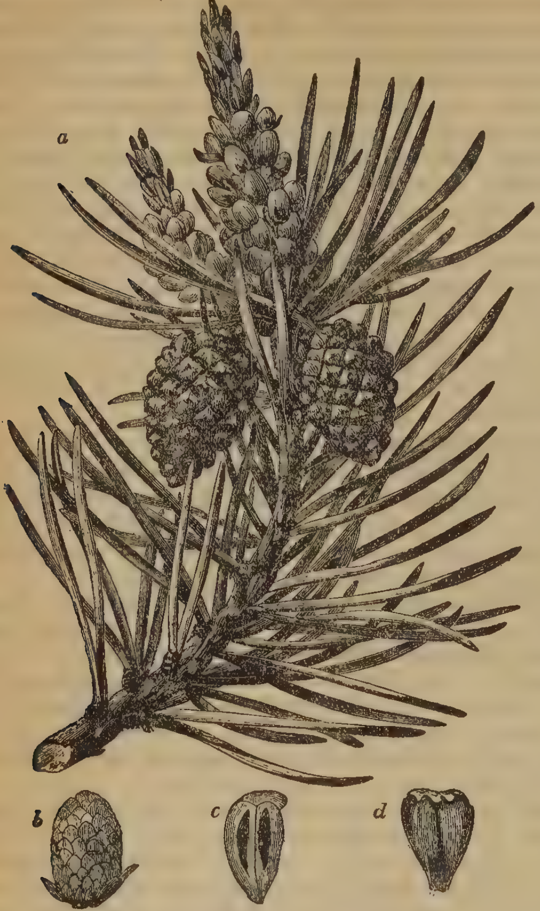


Fig. 1.—Scotch Fir (*Pinus sylvestris*).
a, Male flower and young cones; *b*, male catkin; *c*, *d*, outer and inner side of anther-scale.

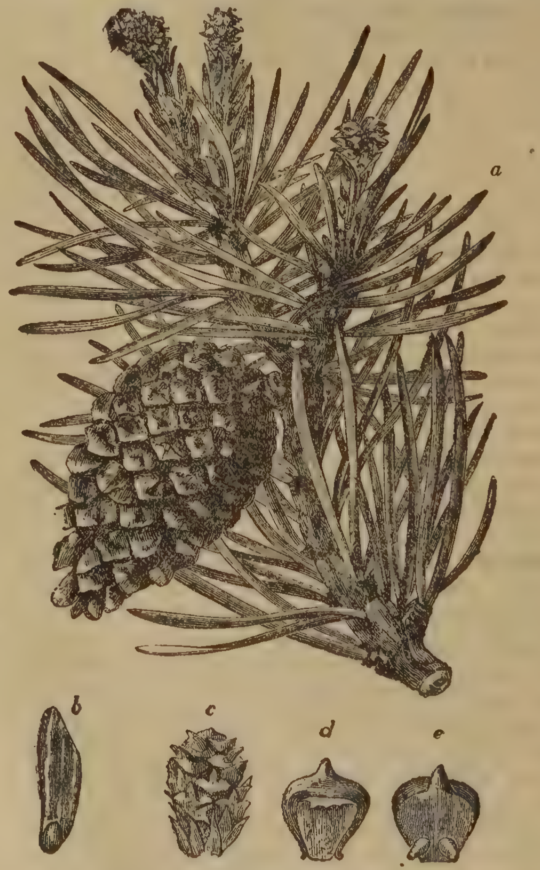
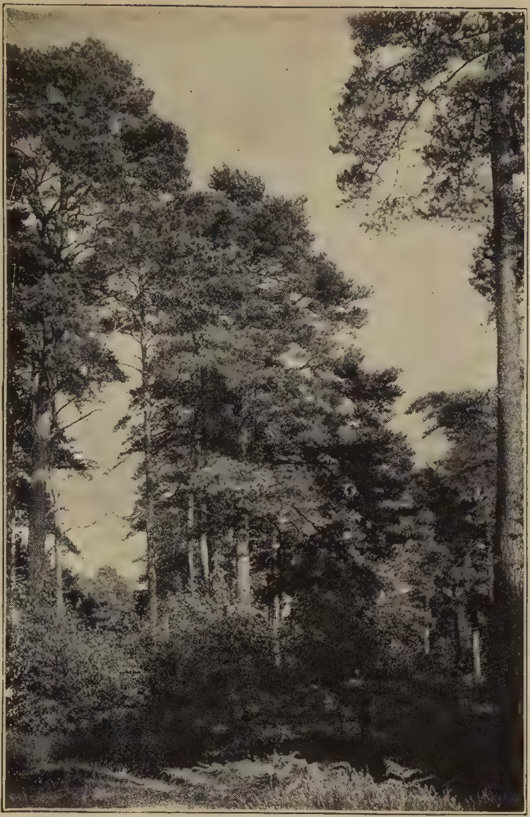


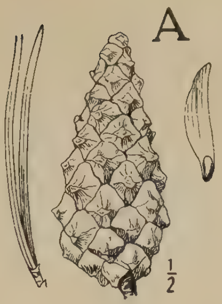
Fig. 2.—Scotch Fir (*Pinus sylvestris*).
a, Fertile flower of mature cone; *b*, winged seed; *c*, fertile catkin (or cone); *d*, scale and bract; *e*, inner side of scale.

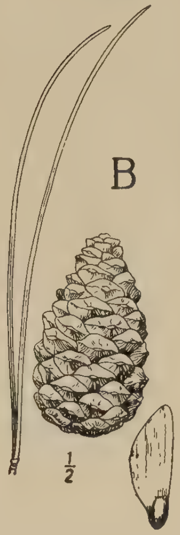
PINE

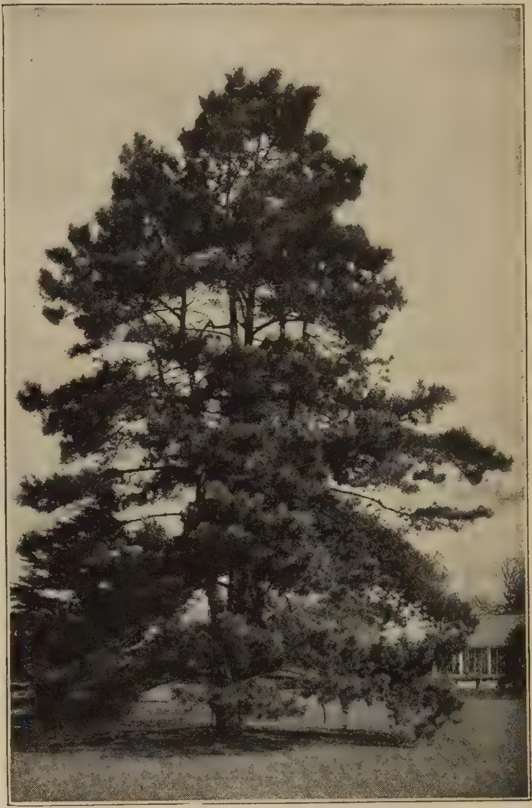
PLATE I.



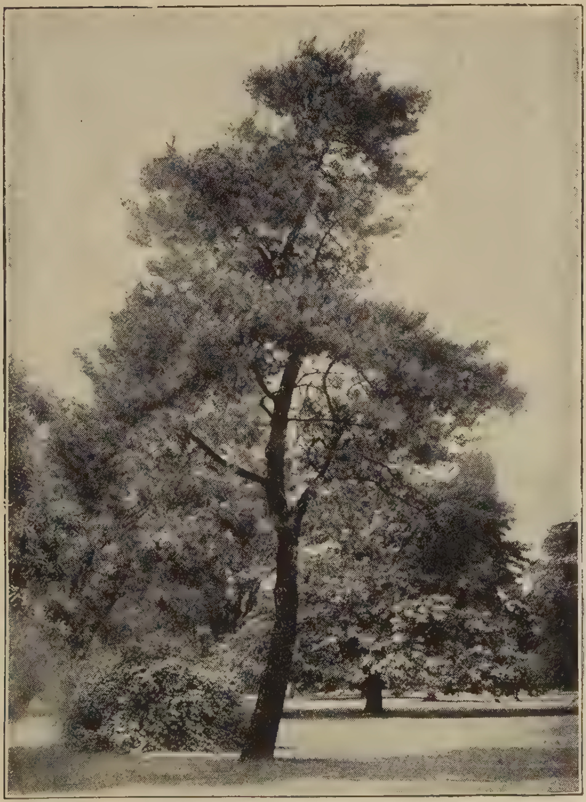
SCOTCH FIR (*Pinus sylvestris*).
A, Cone, seed and needles.



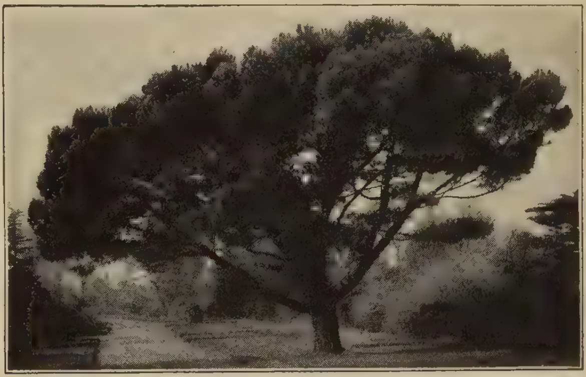




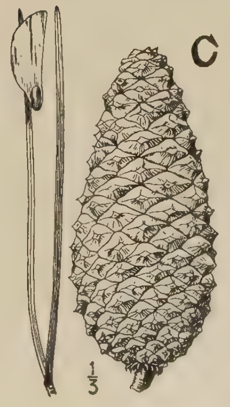
CORSICAN PINE (*Pinus Laricio*).
B, Cone, seed and needles.



CLUSTER PINE (*Pinus Pinaster*).
C, Cone, needle and seed.



STONE PINE (*Pinus Pinea*).
D, Cone and seed.



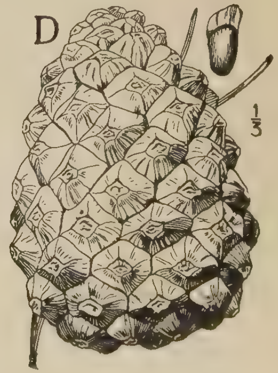
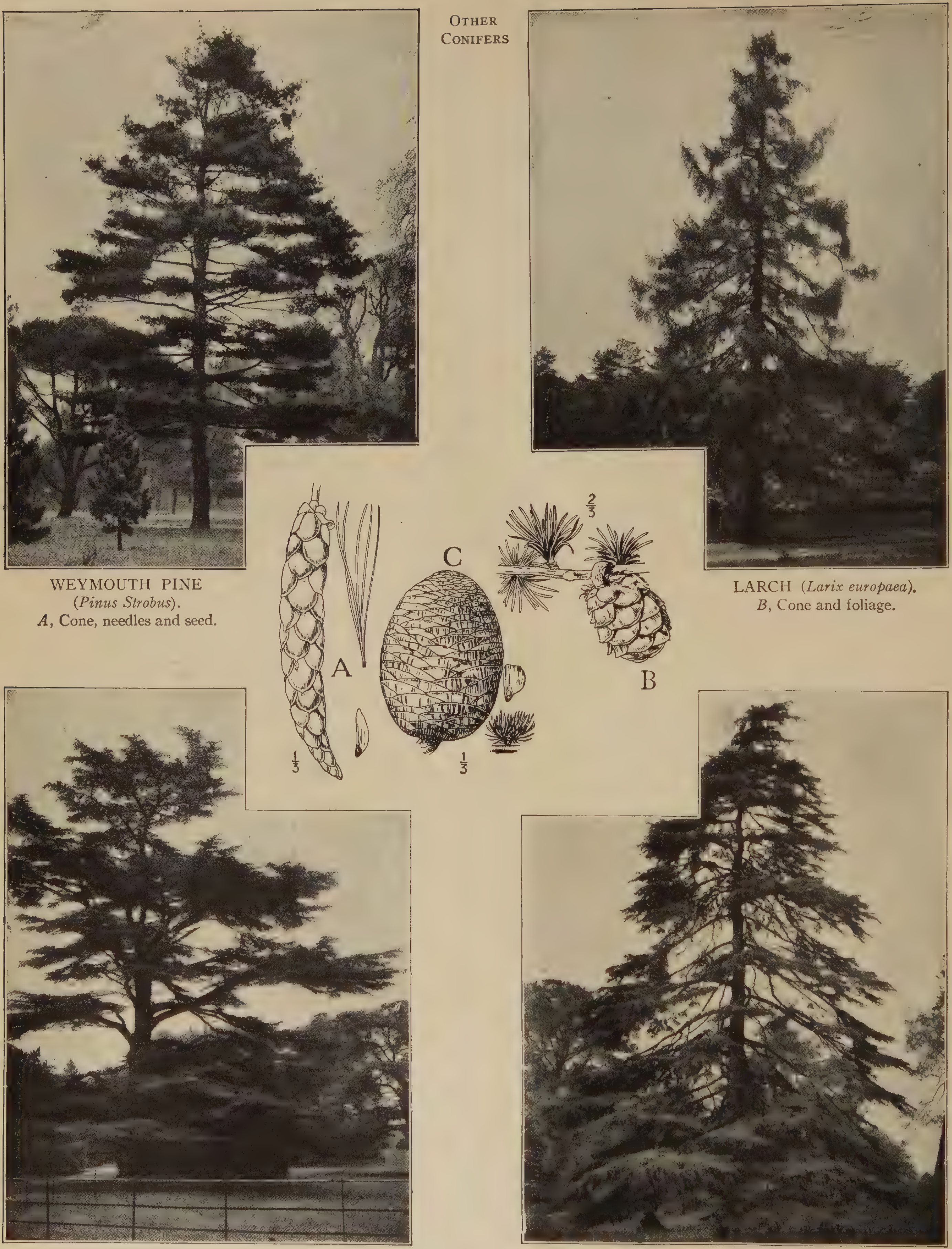


Photo. by Henry Irving.

PLATE II.

PINE

OTHER CONIFERS


A
C
B
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WEYMOUTH PINE
(*Pinus Strobus*).
A, Cone, needles and seed.

LARCH (*Larix europaea*).
B, Cone and foliage.

CEDAR OF LEBANON (*Cedrus Libani*).
C, Cone, foliage and seed.

DEODAR (*Cedrus Deodara*).

Photos by Henry Irving.

flourishes, and the timber is always indifferent; it is usually said that the wood is best in the cold climate of its more northern habitats, but a trunk (4 ft. in diameter) grown on the sands of Surrey had heart-wood quite equal to any produced in Glenmore or Rothiemurchus. The rapidity of growth is still more variable: in Britain full maturity is attained in from seventy to one hundred and twenty years, but in Norway the trunk increases much more slowly; Schübeler states that a tree felled in the Alten district (about 70° lat.), measuring 2 ft. 10 in. in diameter without the bark, showed four hundred circles of annual growth. In Norway the tree, growing in dense forests, is generally of but moderate girth, and probably this pine nowhere reaches a greater size than in the Scottish woods; a plank from Glenmore forest measured nearly 5½ ft. across, and from 3 to 4½ ft. is not an unusual diameter for a British pine tree.

Vast numbers of Scotch firs are raised in nurseries for artificial planting; the seed is sown in the spring, being just covered with earth, and the seedlings transplanted in the second year into rows for further culture, or taken direct from the seed-bed for final planting; sometimes the seed is sown where the trees are intended to grow. A plantation of Scotch fir requires frequent and careful thinning as the young trees increase in size; but pruning should be avoided as much as possible, excepting for the removal of dead wood. Plantations in England are generally ready for final cutting in from sixty to seventy years, and many are cleared at a much earlier stage of growth. *P. sylvestris* in Britain is liable to many insect depredations: the pine-chafer, *Hylurgus piniperda*, is destructive in some places, the larva of this beetle feeding on the young succulent shoots, especially in young plantations; *Hylobius abietis*, the fir-weevil, eats away the bark, and numerous lepidopterous larvae devour the leaves; the pine-sawfly is also injurious in some seasons; the removal of all dead branches from the trees and from the ground beneath them is recommended, as most of these insects lay their eggs among the decaying bark and dead leaves. In common with other pines, *P. sylvestris* is subject to the attacks of various fungi. *Trametes radiciperda* attacks the roots and penetrates to the stem, causing rotting of the wood; the disease is difficult to eradicate, as the mycelium of the fungus travels from root to root in the soil. Rotting of the wood at the base of the trunk is also caused by *Agaricus melleus*, which spreads from root to root in the soil by means of its long purple-black, cord-like mycelial strands known as *Rhizomorpha*. Much damage is often caused by species of *Peridermium*, which often invade the cortex and cambium to such an extent as to "ring" the stem or branch, or to cause an abnormal formation of turpentine which soaks into the wood and stops the upward passage of water; this causes the parts above the diseased area to perish. In England the pine is largely employed as a "nurse" for oak trees, its conical growth when young admirably adapting it for this purpose; its dense foliage renders it valuable as a shelter tree for protecting land from the wind; it stands the sea gales better than most conifers, but will not flourish on the shore like some other species.

The pine is an important tree in the economy of the northern nations of Europe. In Scandinavia and Russia houses are chiefly constructed of its timber; and log-huts are made of the smaller trunks and lined and roofed with the bark. The inner bark is twisted into ropes, and, like that of the spruce, is kiln dried, ground up, and mixed with meal in times of scarcity; in Kamchatka it is macerated in water, then pounded, and made into a kind of substitute for bread without any admixture of flour. In recent days the fibre of the leaves has been extracted in some quantity and applied to textile purposes under the name of *waldwolle*, both in Germany and Sweden. It is prepared by boiling the needles in a solution of soda to remove the resin, which process loosens the fibre and renders its separation easy; it has some resemblance to coarse wool, and is spun and woven into blankets and garments that are said to be warm and durable; it is also used for stuffing cushions; an essential oil, obtained by a previous distillation of the leaves, has medicinal virtues attributed to it by some German practitioners.

Large quantities of turpentine are extracted from this pine in Sweden and Russia by removing a strip of bark, terminating below in a deep notch cut in the wood, into which the turpentine runs, and from which it is scooped as it accumulates; but the product is not equal to that of the silver fir and other species. Tar is prepared largely from *P. sylvestris*; it is chiefly obtained from the roots, which, mingled with a few logs, are arranged in a conical or funnel-shaped hollow made on the steep side of a hill or bank; after filling up, the whole is covered with turf and fired at the top, when the tar exudes slowly and runs into an iron vessel placed below, from the spout of which it is conveyed into barrels. Most of the so-called Stockholm tar is thus prepared, chiefly in the province of Bothnia.

Closely allied to the Scotch pine, and perhaps to be regarded as a mere alpine form of that species, is the dwarf *P. montana* (or *P. Pumilio*), the "krummholz" or "knieholz" of the Germans—a recumbent bush, generally only a few feet high, but with long zigzag stems, that root occasionally at the knee-like bends where they rest upon the ground. The foliage much resembles that of the Scotch fir, but is shorter, denser and more rigid; the cones are smaller but similar in form. Abounding on the higher slopes of the Bavarian and Tirolese Alps, it is a favourite shelter for the chamois; the hunters call it the "latschen," from its recumbent straggling habit. Krummholz oil, valued in Germany as an outward application in rheumatism and for bruises and sprains, is distilled from the young branches, and a fragrant white resin that exudes in some quantity from the buds is used for similar purposes and as a perfume, under the name of Hungarian balsam it is sold in the towns of Germany, being probably obtained from the Carpathians. The red pine of Canada and New England (so called from the colour of its bark), *P. resinosa*, is a tree of considerable size, sometimes attaining the dimensions of *P. sylvestris*. The somewhat glaucous leaves form dense tufts at the ends of the branches, and are 4 or 5 in. long; the ovate blunt cones are about half that length. The tree is of quick growth and the wood strong and resinous, but it is less durable than Scotch fir, though much employed in ship-building; according to Emerson, trunks exist in Maine 4 ft. in diameter. A sandy soil seems to suit it best, and the quality of the wood probably much depends on its place of growth. Red pines abound in Nova Scotia and Newfoundland, and the tree is rather widely distributed over the northern parts of the continent; it rarely forms extensive woods, but grows chiefly in clumps among other trees, at least in its more southern habitats. Nearly allied is *P. Banksiana*, the grey or Labrador pine, sometimes called the scrub pine from its dwarfish habit; it is the most northerly representative of the genus in America, and is chiefly remarkable for its much recurved and twisted cones, about 2 in. long. The trunks are too small to be of great economic value, but the light wood is used by the natives for their canoes.

P. Laricio, the Corsican pine, is one of the noblest trees of this group, growing to a height of 100 or even 150 ft., with a straight trunk and branches in regular whorls, forming in large trees a pyramidal head; the slender leaves, of a dark green tint, are from 4 to 7 in. long; the cones, either in pairs or several together, project horizontally, and are of a light brown colour. This pine abounds in Corsica, and is found in more or less abundance in Spain, southern France, Greece, and many Mediterranean countries; it occurs on the higher mountains of Cyprus. The tree is of very rapid growth, but produces good timber, much used in southern dockyards, and very durable, though less strong than that of *P. sylvestris*; the heart-wood is of a brownish-tint. In southern France it has been planted with success on the drift-sands of the Bay of Biscay, though it does not bear the full force of the sea-blast as well as the pinaster. In England it grows well in sheltered situations and well-drained soils.

The black pine, *P. austriaca*, generally now regarded as a variety of *P. Laricio*, derives its name from the extreme depth of its foliage tints—the sharp, rigid, rather long leaves of a dark green hue giving a sombre aspect to the tree. The light-coloured, glossy, horizontal cones are generally in pairs, but sometimes three or four together. The tree is conical when young, but when old forms a spreading head; it often attains a large size. Southern Austria and the adjacent countries are the natural habitats of this pine; it seems to flourish best on rocky mountain sides, but in England grows well on sandy soils. The timber is valued in its native country, and is said to be durable and to stand exposure to the weather well; various resinous products are extracted from it. *P. pyrenaica* is a handsome species of pyramidal form, attaining a large size on the mountains of northern Spain, whence it extends through the Mediterranean region to Asia Minor, northern Persia and Afghanistan. The leaves are long and of a light bright green; the cones are solitary, oblong, conical and of a yellow tint. The timber is used in Spanish dockyards, but opinions vary as to its quality. In plantations its bright foliage, with the orange cones and young shoots, render it an ornamental tree, hardy in southern Britain. *P. brutia*, the Calabrian pine, is regarded as the same species. *P. halepensis*, another Mediterranean form, is valued for its timber, which is white with a fine grain, and resinous products.

P. pinaster, the cluster pine or pinaster, is an important species from its vigorous growth in the sand-drifts of the coast, for the purpose of binding which it has been grown more extensively and successfully than any other tree, especially on the dunes of the Bay of Biscay. Growing to a height of from 40 to 80 ft., the deeply-furrowed trunk occasionally reaches a diameter of 3 ft. or more at the base, where, like most sand trees, it usually curves upward gradually, a form that enables the long tap-roots to withstand better the strain of the sea gale; when once established, the tree is rarely overthrown even on the loosest sand. The branches curve upwards like the stem, with their thick covering of long dark green leaves, giving a massive rounded outline to the tree; the ovate cones are from 4 to 6 in. long, of a light shining brown hue, with thick scales terminating in a pyramidal apex; they are arranged around the branches in the radiating clusters that give name to the tree. The pinaster grows naturally on sandy soils around the Mediterranean from Spain to the Levant. On the drift-sands of France, especially in the Gironde, forests have been formed mainly of this pine; the seeds, sown at first under proper shelter and protected by a thick growth of broom sown simultaneously, vegetate rapidly in the sea-sand, and the trees thus raised have, by their wind-drifted seed, covered much of the former desert of the Landes with an evergreen wood. These forests of pinaster, apart from the production of timber in a once treeless district, have a great economic value as a source of turpentine, which is largely obtained from the trees by a process analogous to that employed in its collection from *P. sylvestris*; the resin is yielded from May to the end of September, the cuts being renewed as the supply fails, until the tree is exhausted; the trunks are then felled and used in the manufacture of charcoal and lamp black; much tar and pitch is also obtained from these pinaster forests. In England the cluster-pine has been largely planted on sandy districts near the sea, and has become naturalized in Purbeck and other wild tracts in the southern counties, but the summer heat is too small to permit of its resinous products acquiring any value; the soft coarse wood, though perishable in the natural state, has been used for railway sleepers after saturation with creosote or preservative solutions.

P. Pinea is the stone pine of Italy; its spreading rounded canopy of light green foliage, supported on a tall and often branchless trunk, forms a striking feature of the landscape in that country, as well as in some other Mediterranean lands. The beautiful reddish-brown shining cones, roundly ovate in shape, with pyramidal scale apices, have been prized from the ancient days of Rome for their edible nut-like seeds, which are still used as an article of food or dessert. They do not ripen until the fourth year, and are kept in the cone until required, as their abundant oil soon turns rancid. The tree has been naturalized in many warm countries, even in China; in England it seldom attains any large size, as the deficient summer heat prevents the wood from maturing; but trees occur occasionally in plantations 20 or 30 ft. in height; the wood, though soft and deficient in the resin that gives durability to the timber of some species, is valued by the southern carpenter and cabinetmaker for its lightness, its fineness of grain, and the ease with which it is worked.

P. mitis, the yellow pine of the northern and middle states of America, is rather allied to the three-leaved section, but the leaves are mostly in pairs. It is a tree of large size, often attaining a height of 70 ft. and upwards, though rarely more than 2 ft. in diameter at the root; the lower branches spread horizontally, the upper, converging towards the trunk, give the tree somewhat the aspect of a spruce, hence it is called in some districts the "spruce-pine." The leaves are long, slender, and of a bluish-green hue; the pendant cones are about 1½ in. long, with a slender point to each scale. The yellow pine is one of the most important timber trees of the genus; the heart-wood being very durable is largely employed in ship-building and for house timber, being nearly equal to that of *P. sylvestris*; large quantities are exported to Britain under the name of "New York yellow pine"; the sapwood is perishable.

The three-leaved group includes several of the most valuable trees of America; among them is *P. rigida*, the pitch pine of the northern states, a tree of from 40 to 50 ft. in height with rugged trunk, occasionally 3 ft. in diameter; the short dark-green leaves are in thick tufts, contrasting with the pale yellowish, usually clustered cones, the scales of which are furnished with small curved spines. The wood is very hard and abounds with resin, but on swampy land is of inferior quality and of little value except for fuel, for which the pitch-pine is highly prized; on drier ground the grain is fine from the numerous knots. Large quantities of tar and pitch are obtained from this species. The tree is one of the few that will flourish in salt-marshes.

P. palustris (or *P. australis*) is the "Georgia pitch pine," or yellow pine of the southern states; it abounds on the sandy soils that cover so much of Georgia, the Carolinas, and Florida, and on those dry lands attains its highest perfection, though occasionally abundant on moist ground, whence its name. The most marked feature of the tree is its long tufted foliage—the leaves, of a bright green tint, springing from long white sheaths, being often a foot in length. The tall columnar trunk furnishes the most valued pine timber of the states; close-grained and resinous, it is very durable and polishes well; it is largely employed in American shipyards, and immense quantities are exported, especially to Britain and the West Indies. This tree yields an abundant supply of tar and turpentine of good quality, which products are collected and manufactured in the "pine-barrens" on a large scale.

P. Taeda, the "loblolly pine" of the backwoodsman, a tall tree with straight trunk and spreading top, covers great tracts of the "pine-barrens" of the southern states, but also frequently spreads over deserted arable lands that have been impoverished by long and bad farming; hence the woodsmen call it the "old-field" pine, while, from the fragrance of its abundant resin, it is also known as the frankincense pine. It is a fine species 80 or 90 ft. high, having sometimes a girth of 6 or 8 ft., with a broad spreading head; the leaves are rather long and of a light green tint, the cones generally in pairs, the scales terminating in a sharp incurved prickle. The timber of this pine is indifferent, but the forests of it are of importance from the quantity of turpentine they yield; the trees also furnish much firewood of good quality.

P. ponderosa, the yellow pine of the Pacific coast of America, belongs to this section; it is a fine timber tree deserving of notice from the extreme density of its wood, which barely floats in water; it abounds in some parts of the western range of the Rocky Mountains, and is the most widely distributed pine tree of the mountain forests of western North America. The leaves are very long and twisted, the small oval cones armed with recurved prickles; the tree is said to be of rapid growth. In Oregon and California several large pines of this group are found. *P. Coulteri* or *macrocarpa*, is remarkable for its enormous cones (sometimes a foot long, 6 in. in diameter, and weighing more than 4 lb); the scales end in long hooked points curving upwards; the leaves are long, rigid, and glaucous in hue. Nearly related to this is *P. Sabiniana*, the nut-pine of California, the cones of which are 7 to 9 in. long and 5 to 6 in. in diameter, also with hooked scales; the large nut-like seeds are eaten by the Indians; the tree is one of the largest of the section, sometimes attaining a height of 120 ft. and upwards, while trunks have been found, it is said, 10 or 12 ft. in diameter. *P. longifolia*, a Himalayan species, is remarkable for the great length of its lax slender leaves, of a grass-green tint; the cones have the points of the scales recurved. It is known in India as the "cheer pine"; the wood is good, resinous, and moderately durable; the tree is common on the foot-hills of the Himalayas. *P. Gerardiana*, a north-west Himalayan species, is a medium-sized tree with a conical head, growing on the more elevated parts of the mountain range; it furnishes edible seeds. The leaves, short and glaucous, like those of the Scotch fir, have deciduous sheaths; the cones have recurved scale-points like those of the cheer pine. *P. canariensis*, which forms forests on the mountains of Grand Canary and Teneriffe, growing at an elevation of 6000 ft., also belongs to this group. The leaves are long, lax, and of a bright green tint; the cone-scales are without spines; the trunk attains a large size, and yields good and durable timber. The beautiful Monterey pine, *P. insignis*, distinguished by the brilliant colour of its foliage, has the leaves in tufts of three or four; the lower cone-scales have recurved points. This fine pine has been planted in the south-west of England, but is scarcely hardy.

The pines with five leaves in each tuft have generally deciduous sheaths. The most important economic species is the well-known white pine, *P. Strobus*, from its large growth and abundance, as well as the soft even grain of its white wood, one of the most valuable of North American timber trees. The tree abounds from Canada to Georgia, but in the eastern states has been so long sought for by the lumberer that most of the old trees have long disappeared, and large white pine timber is now only found in quantity in the Canadian Dominion. Formerly Maine and Vermont were celebrated for the size of their pines, but few of these great trees now exist in New England. On a deep rich soil *P. Strobus* attains a height of 150 ft., and trunks without a branch are sometimes found 80 or 90 ft. long; in the earlier stages of growth it has a pyramidal form, in open glades the lower boughs often touching the ground, but in old age it acquires a wide almost cedar-like top. The light bluish-green foliage is somewhat lax, very dense in young trees; the cones are long and rather curved, with thin smooth scales a little thickened at the apex, and generally more or less covered with exuding white resin; they are about 5 or 6 in. in length and 1½ to 2 in. broad; the male catkins are of a bluish tint; the cones ripen in the autumn of the second year. The wood of the white pine is durable for indoor use, especially when protected by paint, but when exposed to moist air it rapidly decays, and it is very liable to dry rot; it is said to be best when grown on sandy soils. Immense quantities are still exported, especially from Canada, its smooth easily-worked grain rendering it a favourite wood for the house-carpenter and joiner; it weighs about 28 lb per cubic foot. In England where it is generally known as the "Weymouth pine," it succeeds well on deep light soils when well-drained; trees have attained occasionally a height of 100 ft. and upwards in British plantations; but it is apt to be infested with American blight (*Eriosoma*). In northern Germany it also grows well. The climate of Scotland appears less suitable for it, probably from the want of summer heat, and it can hardly be recommended for British planting otherwise than for ornamental purposes.

Nearly approaching this is *P. excelsa*, the Bhotan pine, which differs chiefly in its longer cones and drooping glaucous foliage. It is found in Kumaon and Bhotan and on some of the Nepal ranges, but does not grow in the moist climate of the Sikkim Himalayas; it is found at a height of 7000 to 12,000 ft., and attains large dimensions; the wood is highly resinous, and is said to be durable; great quantities of a white clear turpentine exude from the branches when injured. The Bhotan pine is quite hardy in southern England, and has been largely planted of late as an ornamental tree.

P. Lambertiana, the giant pine or sugar pine of California, is the largest of the genus, rising to the height of 200 ft., with a trunk 20 to 30 ft. in girth, and, it is said, occasionally attaining much larger dimensions. The head is of a pyramidal form, the lower branches drooping like those of a Norway spruce; its foliage is of a light bright green colour. The pendent cones are very large, sometimes 18 in. long and 4 in. in diameter, with large nut-like seeds, which, pounded and baked, are eaten by the Indians. The tree abounds in some sandy districts, but more generally occurs singly or in small groups dispersed through the woods, attaining its greatest dimensions in light soils. The wood is soft and nearly white, but contains much resin, which when fire has run through the forest exudes, and, having in this half-burnt condition a sweetish taste, has given the common name to the tree; the wood seems to be formed slowly; from its smooth grain it is valued for indoor carpentry; the saccharine burnt resin is used as a laxative in California.

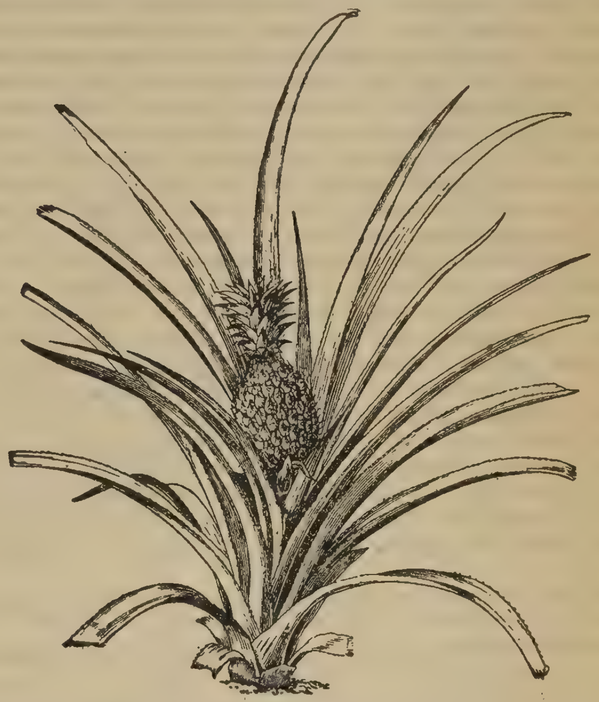
P. Cembra is the stone pine of Siberia and central Europe. It abounds on the Alps, the Carpathians and the Siberian ranges, in Switzerland being found at an altitude of 4000 to 6000 ft. It is a straight-growing tree, with grey bark and whorls of horizontal branches giving a cylindro-conical outline; the leaves are short, rigid and glaucous; the cones, oblong and rather pointing upwards, grow only near the top of the tree, and ripen in the second autumn; the seeds are oily like those of *P. Pinea*, and are eaten both on the Alps and by the inhabitants of Siberia; a fine oil is expressed from them which is used both for food and in lamps, but, like that of the Italian pine, it soon turns rancid. The growth of *P. Cembra* is slow, but the wood is of remarkably even grain, and is employed by the Swiss wood-carvers in preference to any other. The *Cembra* is the "zirbel" or "zirbel-kiefer" of the Germans, and is known locally in Switzerland as the "aroile," "aloies," and "arve."

P. occidentalis, a five-leaved pine with pale-green foliage and small ovate cones, is found on the high mountains of Santo Domingo and Cuba. Many members of the group occur on the Mexican isthmus, one of which, *P. cembroides*, produces edible seeds; another, *P. Montezumae*, is a valuable timber tree. *P. Ayacahuite*, the common white pine of Mexico, spreads southwards on to the mountains of Guatemala, it is a large tree with glaucous foliage like *P. Strobus*, and yields a valuable resin. *P. filifolia* and *P. macrophylla*, likewise natives of Central America, are remarkable for the extreme length of their leaves; the former is said to attain a large size. (C. P. J.)

PINE-APPLE. The pine-apple so called consists in reality of the inflorescence of the plant, the originally separate flowers of which, together with the bracts supporting them, become fleshy and consolidated into one mass. The swelling and fusion of the tissues take place after the process of fertilization, and it may be that the richly perfumed succulent mass is an aid in the distribution of seed by affording food to certain animals. In the highly developed cultivated pines, however, it frequently happens that the seeds do not ripen properly. The pine, *Ananas sativus*, is a member of the natural order Bromeliaceae, of tropical American origin, where it is widely spread; and it is now naturalized in the tropical regions of the Old World.

Evelyn in his *Diary* mentions tasting a pine-apple from Barbados at the table of Charles II., and this is we believe the first mention of the fruit in English literature. A picture, of which a copy may be seen at the rooms of the Royal Horticultural Society of London, represents the royal gardener, Mr Rose, presenting on bended knee the first pine-apple grown in Britain, and it is surmised that this may have been grown from the "suckers" of the fruit above alluded to by Evelyn, though it is generally considered that the pine was not cultivated in England till 1712. For many years pine-apples were cultivated in large private gardens, but owing to the great developments in culture in the West Indies, the Azores, Canary Islands, &c., they are no longer cultivated in Britain or Europe.

PINE BLUFF, a city and the county-seat of Jefferson county, Arkansas, U.S.A., situated at an altitude of about 200 ft. in the alluvial bottoms of the Arkansas river, about 107 m. from its mouth, and about 42 m. S. by E. of Little Rock. Pop. (1910), 15,102. It has an active river trade with St Louis, Memphis and New Orleans, and five railway outlets—the Missouri Pacific and its branch, the Pine Bluff & Western, and the St Louis South-Western and its two branches, the Pine Bluff & Arkansas River and the Altheimer. The city has many schools, and a business college, the state normal school for negroes, and Merrill institute, endowed by Joseph Merrill of Pine Bluff with $100,000. Large quantities of cotton and lumber are shipped from the city. Among the manufactures are cotton-seed oil, lumber and staves, and furniture. Pine Bluff has shops of the St Louis South-Western railway. The city's factory products were valued at $2,989,242 in 1905, an increase of 94% over their value in 1900. Pine Bluff was laid out in 1832 and chartered as a city in 1885.



Pine-apple (*Ananas sativus*) much reduced.

PINEL, PHILIPPE (1745–1826), French physician, was born at the château of Rascas, Saint-André, in the department of Tarn, France, on the 20th of April 1745. He studied at Lavaur and afterwards at the university of Toulouse, where he took his doctor's degree in 1773. From Montpellier he removed in 1778 to Paris, engaging there chiefly in literary work connected with his profession. His first publication was a French translation of William Cullen's *Nosology* (1785); it was followed by an edition of the works of G. Baglivi (1788), and in 1791 he published a *Traité medico-philosophique de l'aliênation mentale*. In 1792 he became head physician of the Bicêtre, and two years afterwards he received the corresponding appointment at the Salpêtrière, where he began to deliver a course of clinical lectures; these formed the basis of his *Nosographie philosophique* (1798; 6th ed., 1818), which was further developed in *La Médecine clinique* (1802). Pinel was made a member of the Institute in 1803, and soon afterwards was appointed professor of pathology in the École de Médecine. His fame rests entirely upon the fact that he was among the first to introduce the humane treatment of the insane. He died at Paris on the 26th of October 1826.

PINERO, SIR ARTHUR WING (1855–), English dramatist, was born in London on the 24th of May 1855, the son of John Daniel Pinero, a Jewish solicitor, whose family was of Portuguese origin, long established in London. A. W. Pinero was engaged in 1874 as an actor at the Theatre Royal, Edinburgh, and came to London in 1876, to play at the Globe Theatre. Later in the year he joined the Lyceum company, of which he remained a member for five years. The first piece of his to see the footlights was *£200 a year*, played in October 1877 at the Globe Theatre for the benefit of Mr F. H. Macklin. The first play to make a hit was *The Money Spinner* (Theatre Royal, Manchester, Nov. 1880); but in *The Squire* (St James's Theatre, Dec. 1881) he attempted serious drama, and gave promise of the qualities of his later work. In 1883 and 1884 Pinero produced seven pieces, but the most important of his works at this period were the successful farces produced at the Court Theatre: *The Magistrate* (March 1885), which ran for more than a year; *The Schoolmistress* (March 1886); *Dandy Dick* (Jan. 1887), revived in February 1900; *The Cabinet Minister* (April 1890), and *The Amazons* (March 1893). Two comedies of sentiment, *Sweet Lavender* (Terry's, March 1888) and *The Weaker Sex* (Theatre Royal, Manchester, Sept. 1888), met with success, and *Sweet Lavender* has enjoyed numerous revivals. With *The Profligate* (Garrick, April 1889) he returned to the serious drama which he had already touched on in *The Squire*. Out of deference to the wishes of John Hare the play was fitted with the conventional "happy ending," but the original dénouement was restored, with great advantage to the unity of the play, in the printed version. *The Second Mrs Tanqueray* (St James's, May 27, 1893) dealt with the converse of the question propounded in *The Profligate*, but with more art and more courage. The piece aroused great discussion, and placed Pinero in the front rank of living dramatists (see Drama: *Recent English*). It was translated into French, German and Italian, and the part of Paula Tanqueray, created in the first place by Mrs Patrick Campbell, attracted many actresses, among others Eleonora Duse. His later plays were *The Notorious Mrs Ebbsmith* (Garrick, March 13, 1895), *The Benefit of the Doubt* (Comedy, Oct. 1895), *The Princess and the Butterfly* (St James's, April 7, 1897), *Trelawney of the Wells* (Court, Jan. 30, 1898), *The Gay Lord Quex* (Globe, April 8, 1899), *Iris* (Garrick, Sept. 21, 1901), *Letty* (Duke of York's, Oct. 8, 1903), *A Wife Without a Smile* (Wyndham's, Oct. 9, 1904), *His House in Order* (St James's, Feb. 1, 1906), *The Thunderbolt* (St James's, May 9, 1908) and *Mid-Channel* (St James's, Sept. 2, 1909). Pinero was knighted in 1909.

His *Plays* (11 vols. 1891–1895) have prefaces by M. C. Salaman. See also H. Hamilton Fyfe, *A. W. Pinero* (1902).

PINEROLO [Pignerol], a city and episcopal see of Piedmont, Italy, in the province of Turin. Pop. (1901), 12,608 (town); 18,039 (commune). It is built on a hill-side just above the valleys of the Chisone and the Lemina, at a height of 1234 ft. above the sea, 24 m. by rail S.W. of Turin. The railway goes on to Torre Pellice; and steam tramways run from Pinerolo to Perosa, and to Cavour and Saluzzo. Till 1696 it was strongly fortified with a citadel on Santa Brigida, a castle on S. Maurizio, and city walls constructed by Thomas I. of Savoy. It has a cathedral (St Donatus), the palace of the princes of Acaia and other buildings of some interest. Cotton, silk, wool and hemp are among the local manufactures.

Pinerolo was bestowed on the bishops of Turin by Otto III. in 996; but in 1078 the countess Adelaide made it over to the Benedictine abbey of Santa Maria, in whose possession it remained till 1159. Thomas I. of Savoy captured the castle in 1188, and in 1246 the commune formally recognized the supremacy of Savoy. Passing in 1295 into the hands of Philip, son of Thomas III., Pinerolo became his residence and capital, a distinction which it retained under Amadeus VIII. of Savoy. Francis I. of France obtained possession of the town in his descent into Italy, but Emmanuel Philibert received it back from Henry III. in 1574. A second occupation by the French occurred under Cardinal Richelieu; the French language was imposed on the people, great fortifications were constructed, and the fortress (Pignerol) was used as a state prison for such men as Fouquet, De Caumont and the Man with the Iron Mask (see Iron Mask). Victor Amadeus bombarded the place in 1693, and ultimately compelled Louis XIV. to relinquish his hold on it; but before the withdrawal of the French troops the defences were demolished. In 1748 the town was made a bishop's see.

PIN-EYED, a botanical term for flowers which occur in two forms, one of which shows the stigma at the mouth of the corolla, as in the primrose; the term is contrasted with thrum-eyed.

PING-PONG, or Table-Tennis, a miniature variety of lawn-tennis played on a table, which may be of any size not less than 5½ ft. long by 3 ft. broad. Various attempts were made to adapt lawn-tennis to the house, but the real popularity of the game began when, near the close of the 19th century, celluloid balls were introduced, and the game was called ping-pong from the sound of the balls as they were struck by the racket or rebounded from the table. In 1900 the ball was improved and made heavier, and for the next two years ping-pong enjoyed a popularity never before attained by a game in so short a time, not only in Great Britain but in France, the British Colonies and America. Two leagues were formed, the "Table-Tennis Association" and the "Ping-Pong Association," whose laws were practically identical. The regular tournament table is 9 ft. long by 5 ft. broad, and the net is a little less than 7 in. high. The balls, which are of hollow celluloid, are about ¾ in. in diameter. The racket has a blade, shaped like a lawn-tennis racket, about 6 in. long and a handle long enough to grasp comfortably, all in one piece. Rackets are made either wholly of wood covered with vellum, cork, sand-paper or rubber, or of light frames covered with vellum or some other material. The table was at first marked out in courts, but is now plain. It should be unpolished and stained. In serving, a player must stand directly behind his end of the table and use an underhand motion only. The ball must clear the net and strike the table anywhere on the other side. The game is then continued until the ball misses the table or fails to pass over the net. Only one service is allowed, except in case of a *let*. The scoring is the same as in lawn-tennis.

See *Ping-Pong*, by Arnold Parker (London, 1902); *Table Tennis*, by A. Sinclair (London, 1902).

PINK, in botany, the common name corresponding to a genus of *Caryophyllacae*, the *Dianthus* of botanists. It is characterized by the presence of simple leaves borne in pairs at the thickened nodes, flowers terminating the axis and having a tubular calyx surrounded by a number of overlapping bracts, a showy corolla of five free long-stalked petals, ten stamens proceeding, together with the petals, from a short stalk supporting the ovary, which latter has two styles and ripens into a cylindric or oblong pod-like one-chambered many-seeded capsule which opens at the apex by four cults or valves. The species are herbaceous perennials of low stature, often with very showy flowers. They are natives chiefly of southern Europe and the Mediterranean region, a few being found in temperate Asia and South Africa. Four species are wild in Britain. Of these, *D. armeria*, Deptford pink and *D. deltoides*, maiden pink, are generally distributed, *D. caesius*, Cheddar pink, occurs only on the limestone rocks at Cheddar. Two others, *D. plumarius* and *D. caryophyllus*, are more or less naturalized, and are interesting as being the originals of the pinks and of the carnations and picotees of English gardens. Garden pinks are derivatives from *Dianthus plumarius*, a native of central Europe, with leaves rough at the edges, and with rose-coloured or purplish flowers. The use of "pink" for a colour is taken from the name of the plant.[1]

The pink is a favourite garden flower of hardy constitution. It has been in cultivation in England since 1629, and is a great favourite with florists, those varieties being preferred which have the margin of the petals entire, and which are well marked in the centre with bright crimson or dark purple. Its grassy but glaucous foliage is much like that of the carnation, but the whole plant is smaller and more tufted. Pinks require a free loamy soil deeply trenched, and well enriched with cow-dung. They are readily increased by cuttings (pipings), by layers and by seed. Cuttings and layers should be taken as early in July as practicable. The former should be rooted in a cold frame or in a shady spot out of doors. When rooted, which will be about August, they should be planted 4 in. apart in a nursery bed, where they may remain till the latter part of September or the early part of October. The chief attention required during winter is to press them down firmly should they become lifted by frosts, and in spring the ground should be frequently stirred and kept free from weeds. The pink is raised from seeds, not only to obtain new varieties, but to keep up a race of vigorous-growing sorts. The seeds may be sown in March or April in pots in a warm frame, and the young plants may be pricked off into boxes and sheltered in a cold frame. They should be planted out in the early part of the summer in nursery beds, in which, if they have space, they may remain to flower, or the alternate ones may be transplanted to a blooming bed in September or the early part of October; in either case they will bloom the following summer. These will grow in any good garden soil, but the richer it is the better.

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[1] The etymology of "pink" is disputed; it may be connected with "to pink" (apparently a naturalized form of "pick"), properly to prick or punch holes in material for the purpose of ornament, hence, later, to scallop or cut a pattern in the edge of the material. The flower has jagged edges to the petals, but the name occurs in the 16th century, and the later meaning, "to scallop," not till the 19th. Others connect with "pink," half-shut blinking of the eyes, as in "plumpie Bacchus, with pinke eyne" (Shakspeare *Ant. and Cl.* II. vii. 121); this word is seen in Dutch *pinken*, to blink, shut the eyes, and may be connected with "pinch." The French name for the flower, *oeillet*, little eye, may point to this derivation. The disease of horses, known as "pink-eye," a contagious influenza, is so-called from the colour of the inflamed conjunctiva, a symptom of the affection

The border varieties are useful for forcing during the early spring months. These are propagated from early pipings and grown in nursery beds, being taken up in October, potted in a rich loamy compost, and wintered in a cold pit till required for the forcing house.

The following varieties are among the best. For borders and forcing: Ascot, Carnea, Delicata, Derby Day, Her Majesty, Hercules, Anne Boleyn, Lady Blanche, Mrs Sinkins, Mrs James Welsh, Pilrig Park, Rubens, Snowdon, Tom Welsh. Florists' show and laced varieties: Attraction, Beauty of Bath, Clara, Criterion, Ensign, Galopin, Harry Hooper, John Ball, Malcolm Dunn, Mrs D. Gray, Reliance, William Paul.

The Carnation (*q.v.*) and Picotee are modifications of *Dianthus Caryophyllus*, the Clove Pink. This is a native of Europe, growing on rocks in the south, but in the north usually found on old walls. Its occurrence in England on some of the old Norman castles, as at Rochester, is supposed by Canon Ellacombe to indicate its introduction by the Normans; in any case the plant grows in similar situations in Normandy. The carnation includes those flowers which are streaked or striped lengthwise—the picotees are those in which the petals have a narrow band of colour along the edge, the remainder of the petal being free from stripes or blotches. These by the old writers were called "gillyflowers." The Sweet William of gardens is a product from *Dianthus barbatus*.

The Sea-Pink, or Thrift, *Statice Armeria* (*Armeria vulgaris*), is a member of the natural order *Plumbagineae*; it is a widely distributed plant found on rocky and stony sea-shores and on lofty mountains. There are many improved varieties of it now in cultivation, one with almost pure white flowers.

PINKERTON, ALLAN (1819–1884), American detective, was born in Glasgow, Scotland, on the 25th of August 1819. His father, a sergeant of the Glasgow municipal police, died in 1828 of injuries received from a prisoner in his custody. In 1842 Allan emigrated to Chicago, Illinois. In 1843 he removed to Dundee, Kane county, Illinois, where he established a cooperage business. Here he ran down a gang of counterfeiters, and he was appointed a deputy-sheriff of Kane county in 1846 and immediately afterwards of Cook county, with headquarters in Chicago. There he organized a force of detectives to capture thieves who were stealing railway property, and this organization developed in 1852 into Pinkerton's National Detective Agency, of which he took sole charge in 1853. He was especially successful in capturing thieves who stole large amounts from express companies. In 1866 his agency captured the principals in the theft of $700,000 from Adams Express Company safes on a train of the New York, New Haven & Hartford railway, and recovered all but about $12,000 of the stolen money. In February 1861 Pinkerton found evidence of a plot to assassinate President-elect Lincoln upon his arrival in Baltimore on his way to Washington; as a result, Lincoln passed through Baltimore at an early hour in the morning without stopping. In April 1861 Pinkerton, on the suggestion of General George B. McClellan, organized a system of obtaining military information in the Southern states. From this system he developed the Federal secret service, of which he was in charge throughout the war, under the assumed name of Major E. J. Allen. One of his detectives, James McParlan, in 1873–1876 lived among the Molly Maguires (*q.v.*) in Pennsylvania and secured evidence which led to the breaking up of the organization. In 1869 Pinkerton suffered a partial stroke of paralysis, and thereafter the management of the detective agency devolved chiefly upon his sons, William Allan (b. 1846) and Robert (1848–1907). He died in Chicago on the 1st of July 1884. He published *The Molly Maguires and the Detectives* (1877); *The Spy of the Rebellion* (1883), in which he gave his version of President-elect Lincoln's journey to Washington; and *Thirty Years a Detective* (1884).

PINKERTON, JOHN (1758–1826), Scottish archaeologist, numismatist and author, was born at Edinburgh on the 17th of February 1758. He was articled as a law clerk in Edinburgh, and his *Elegy on Craigmillar Castle* (1776) was printed during his clerkship. In 1781 he removed to London to devote himself to literary work, publishing in the same year a volume of *Rimes* of no great merit, and *Scottish Tragic Ballads*. These were followed in 1782 by *Two Dithyrambic Odes on Enthusiasm and Laughter*, and by a series of *Tales in Verse*. Under the title of *Select Scottish Ballads* he reprinted in 1783 his tragic ballads, with a supplement comprising *Ballads of the Comic Kind*. Ritson pointed out in 1784 that the so-called ancient ballads were some of them of modern date, and Pinkerton confessed that he was the author of the second part of *Hardy Knute* and part-author of some others. He published an *Essay on Medals* in 1784, and in 1785, under the pseudonym of "Robert Heron," his bold but eccentric *Letters of Literature* depreciating the classical authors of Greece and Rome. In 1786 he edited *Ancient Scottish Poems* from the MS. collections of Sir Richard Maitland of Lethington—a genuine reproduction. It was succeeded in 1787 by a compilation, under the new pseudonym of "H. Bennet," entitled *The Treasury of Wit*, and by his first important historical work, the *Dissertation on the Origin and Progress of the Scythians or Goths*, to which Gibbon acknowledged himself indebted. Pinkerton next collected and printed in 1789 certain *Vitae sanctorum scotiae*, and, a little later, published his *Enquiry into the History of Scotland preceding the Reign of Malcolm III.* His assertion that the Celtic race was incapable of assimilating the highest forms of civilization excited "violent disgust," but the *Enquiry* was twice reprinted, in 1794 and 1814, and is still of value for the documents embodied in it. His edition of Barbour's *Bruce* and a *Medallic History of England to the Revolution* appeared in 1790; a collection of *Scottish Poems reprinted from scarce Editions* in 1792; and a series of biographical sketches, the *Iconographia scotica*, in the years 1795–1797. In 1797 he published a *History of Scotland from the Accession of the House of Stuart to that of Mary*, containing much valuable material. A new biographical collection, the *Gallery of Eminent Persons of Scotland* (1799), was succeeded after a short interval by a *Modern Geography digested on a New Plan* (1802; enlarged, 1807). About this time he left London for Paris, where he made his headquarters until his death on the 10th of March 1826. His remaining publications were the *Recollections of Paris in the years 1802–3–4–5* (1806); a very useful *General Collection of Voyages and Travels* (1808–1814); a *New Modern Atlas* (1808–1819); and his *Petralogy* (1811).

PINKNEY, WILLIAM (1764–1822), American lawyer and statesman, was born in Annapolis, Maryland, on the 17th of March 1764. He was admitted to the bar in 1786, and in 1788–1792 practised in Harford county. In 1788 he was a member of the state convention which ratified the Federal constitution for Maryland, in 1788–1792 and in 1795 of the House of Delegates (where in 1788 and 1789 he defended the right of slave-owners to manumit their slaves), and in 1792–1795 of the state executive council. In 1796–1804 he was a commissioner under article 7 of Jay's Treaty of 1794 to determine the claims of American merchants for damage through "irregular or illegal captures or condemnations," and during this time adjusted on behalf of Maryland a claim of the state to stock in the Bank of England. In May 1806, with James Monroe, then minister at London, he was commissioned to treat with the British government concerning the capture of neutral ships in time of war; in 1807–1811, after Monroe's return to America, he was resident minister in London. He was elected to the Maryland senate in September 1811, and from December 1811 to January 1814 was attorney-general of the United States. In August 1814 he was wounded at Bladensburg. He served in the National House of Representatives in January–April 1816, and in 1816–1818 was minister plenipotentiary to Russia and special minister to Naples, where he attempted to secure indemnity for the losses to American merchants by seizure and confiscation during the rule of Murat in 1809. From 1820 until his death, at Washington, on the 25th of February 1822, he was a member of the United States Senate. He was a member of the conference committee on the bill for the admission of Maine and Missouri, which in its final form embodied what is known as the Missouri Compromise. Pinkney was a remarkably able lawyer and an orator of the old school.

See *The Life of William Pinkney* (New York, 1853) by his nephew, William Pinkney (1810–1883), who was Protestant Episcopal bishop of Virginia in 1879–1883; and Henry Wheaton, *Some Account of the Life, Writings, and Speeches of William Pinkney* (New York, 1828).

PINNACE, the name of two types of vessel or boat, one a light sailing vessel with two schooner-rigged masts, the other a heavy eight-oared man-of-war's boat. The word is usually referred to Lat. *pinus*, pine, but this derivation is at variance with the earlier form "spinace."

PINNACLE (from Lat. *pinnaculum*, a little feather, *pinna*; the Gr. πτερύγιον, diminutive of πτέρυξ, wing, is also used in this sense), an architectural ornament originally forming the cap or crown of a buttress or small turret, but afterwards used on parapets at the corners of towers and in many other situations. Some writers have stated that there were no pinnacles in the Romanesque styles, but conical caps to circular buttresses, with finial terminations, are not uncommon in France at very early periods. Viollet-le-Duc gives examples from St Germer and St Remi, and there is one of similar form at the west front of Rochester Cathedral. In the 12th-century Romanesque two examples have been cited, one from Bredon in Worcestershire, and the other from Cleeve in Gloucestershire. In these the buttresses run up, forming a sort of square turret, and crowned with a pyramidal cap, very much like those of the next period, the Early English. In this and the following styles the pinnacle seems generally to have had its appropriate uses. It was a weight to counteract the thrust of the vaults, particularly where there were flying buttresses; it stopped the tendency to slip of the stone copings of the gables, and counterpoised the thrust of spires; it formed a pier to steady the elegant perforated parapets of later periods; and in France especially served to counterbalance the weight of overhanging corbel tables, huge gargoyles, &c. In the Early English period the small buttresses frequently finished with gablets, and the more important with pinnacles supported with clustered shafts. At this period the pinnacles were often supported on these shafts alone, and were open below; and in larger work in this and the subsequent periods they frequently form niches and contain statues. About the Transition and during the Decorated period, the different faces above the angle shafts often finish with gablets. Those of the last-named period are much richer, and are generally decorated with crockets and finials, and sometimes with ball-flowers. Very fine groups are found at Beverley Minster and at the rise of the spire of St Mary's, Oxford. Perpendicular pinnacles differ but little from Decorated, except that the crockets and finials are of later character. They are also often set angle-ways, particularly on parapets, and the shafts are panelled. In France pinnacles, like spires, seem to have been in use earlier than in England. There are small pinnacles at the angles of the tower in the abbey of Saintes. At Roullet there are pinnacles in a similar position, each composed of four small shafts, with caps and bases surmounted with small pyramidal spires. In all these examples the towers have semicircular-headed windows.

PINNOCK, WILLIAM (1782–1843), English publisher and educational writer, was born at Alton, Hampshire, on the 3rd of February 1782, and was at first a schoolmaster, then a bookseller. In 1817 he went to London and, in partnership with Samuel Mander, began to publish cheap educational works. The firm's first productions were a series of *Catechisms*, planned by Pinnock, consisting of short popular manuals, arranged in the form of question and answer, of the different departments of knowledge. They were followed by abridged editions of Goldsmith's histories of England, Greece and Rome, and a series of county histories which were no less profitable. Pinnock lost nearly all his money in outside speculation, and died in London on the 21st of October 1843. His son, William Henry Pinnock (1813–1885), a clergyman, was the editor and author of several elementary textbooks and scriptural manuals, and of various works on ecclesiastical law and usage.

PINOCHLE, or PENUCHLE (Ger. *Pinochel* or *Binochel*, of uncertain etymology), a game of cards probably invented by Germans in the United States about the middle of the 19th century. It bears a general resemblance to Bézique (*q.v.*), and has almost entirely usurped the place of the older game in America. Pinochle may be played by two, three or four persons. Two packs, from which all cards below the nines have been deleted, are shuffled together, forming one pack of 48 cards. The object of the game is to make 1000 points. The cards rank as follows: ace 11, ten 10, king 4, queen 3, knave 2. The nine counts nothing unless it be turned for trumps, when it scores 10. The last trick scores 10. The term "to meld" (Ger. *melden*, to announce), as used in pinochle, means "to declare." "Melds" are combinations which are declared during the play of the hands. They are of three classes: (1) "marriages" and "sequences," (2) "pinochles," and (3) "fours." The "melds" of the first class score as follows: "marriage" (king and queen of any plain suit), 20; "royal marriage" (king and queen of trumps), 40; "sequence" (the five highest trumps), 150. In the second class the "melds" are "pinochle" (queen of spades and knave of diamonds), 40; "double pinochle" (both queens of spades and knaves of diamonds), 300; "grand pinochle" (king and queen of spades and knave of diamonds), 80; this "meld" is not often played in America. Of the third class the "melds" are: four aces of different suits, 100; four kings of different suits, 80; four queens of different suits, 60; four knaves of different suits, 40; eight aces, 1000; eight kings, 800; eight queens, 600; eight knaves, 400.

In single pinochle (two players) each player receives twelve cards, four at a time, the twenty-fifth being turned up beside the stock for trumps. The non-dealer leads a card, to which the dealer plays. There is no obligation either to take, follow suit or trump. The winner of the trick leads again, before which, however, he may "meld" any one combination he holds. After he has "melded," or refused to do so, he draws a card from the top of the stock and adds it to his hand without showing it, his adversary doing the same, so that each player continues to hold twelve cards. Playing, announcing, and drawing then go on until the stock is exhausted. All combinations "melded" must be laid face upward on the table but still belong to the player's hand, though they may not be taken up until the stock has given out. When this happens all announcements cease, and all cards exposed are replaced in the hands. The last twelve tricks are then played, but now both players must follow suit and must win the trick if possible, either with a superior card or a trump. A failure to do this is a "revoke" and is penalized by the loss of all points made by "cards," *i.e.* for the five highest cards in each suit, which after all the tricks have been played, are counted for the player holding them. Ace counts 11 points, ten 10, king 4, queen 3, and knave 2, whatever the suit, so that 240 points for "cards" are divided between the two players. Though points are not counted during the play, a mental count is kept, and whenever a player sees that, by adding the value of his "melds" to what he thinks his cards will count, he has enough to win the game, namely 1000 points, he "calls out" or knocks on the table, and proceeds to expose his cards. If he fails to show enough to win, he loses the game. If neither player knocks, the game continues until one of them scores 1250; if still a tie, 1500. If a player fails to make good a "meld" he is set back that number of points. The game is scored by counters or on a cribbage-board.

In three-handed pinochle the "melds" are exposed before a card is played, and no player may "meld" after he has played to the first trick. A rule is sometimes made that an overlooked combination may be scored by the other players. Four-handed pinochle is played either with partners or each player for himself.

PINSK, a town of Russia, in the government of Minsk, at the confluence of the Strumen and Pina rivers, 196 m. S.W. by rail of Minsk. Pop., 27,938, two-thirds being Jews. The town carries on considerable trade, due to the navigable river Pina, which connects it with the fertile regions in the basin of the Dnieper, and, by means of the Dnieper-and-Bug canal, with Poland and Prussia, while the Oginsky canal connects it with the basin of the Niemen. Pottery, leather, oil, soap and beer are the chief products of the local industries. The draining of the marshes around Pinsk was begun by the government in 1872, and by 1897 8,000,000 acres had been drained at an average cost of 3s. per acre. Pinsk (Pinesk) is first mentioned in 1097 as a town belonging to Sviatopolk, prince of Kiev. In 1132 it formed part of the Minsk principality. After the Mongol invasion of 1239–42 it became the chief town of a separate principality, and continued to be so until the end of the 13th century. In 1320 it was annexed to Lithuania; and in 1569, after the union of Lithuania with Poland, it was chief town of the province of Brest. During the rebellion of the Cossack chief, Bogdan Chmielnicki (1640), the Poles took it by assault, killing 14,000 persons and burning 5000 houses. Eight years later the town was burned by the Russians. Charles XII. took it in 1706, and burned the town with its suburbs. Pinsk was annexed to Russia in 1795.

PINSUTI, CIRO (1829–1888), Anglo-Italian composer, was born at Siena, and was educated in music, for a career as a pianist, partly in London and partly at Bologna, where he was a pupil of Rossini. From 1848 he made his home in England, where he became a teacher of singing, and in 1856 he was made a professor at the Academy of Music in London. He became well known as a composer of numerous favourite songs and part-songs, as well as of three operas brought out in Italy, and it is by the former that he is still remembered.

PINT (derived probably through Spanish, from Lat. *pincta*, *picta*, a painted or marked vessel), a liquid measure of capacity, equivalent to ⅛ of a gallon. The imperial British pint = ·57 of a litre, 34·66 cub. in. The United States standard pint = ·47 of a litre, 28⅞ cub. in. The word appears in French as *pinte* for a liquid measure as early as the 13th century.

PINTO, ANÍBAL (1825–1884), Chilean president, was born at Santiago, Chile. After a diplomatic training in the legation at Rome he learned the practice of administration as *intendente* of Concepcion, and from 1871 to 1876 was minister of war and marine under Errázuriz. During his term of office as president (1876 to 1881) Pinto had to deal first with a severe financial crisis, and then to conduct the struggle with Peru and Bolivia, in which he displayed great coolness of judgment and devotion to duty.

PINTO, FERNÃO MENDES (1509–1583), Portuguese adventurer, was born at Montemôr-o-Velho, of poor and humble parents, and entered the service of a noble lady in Lisbon, being afterwards for two years page to the duke of Aveiro in Setubal. Desiring to try his fortune in the East, he embarked for India in 1537 in a fleet commanded by the son of Vasco da Gama, and for twenty-one years travelled, fought and traded in China, Tartary, Pegu and the neighbouring countries, sailing in every sea, while in 1542–1543 he was one of the first Europeans to visit Japan, where he introduced the musket. Though he was thirteen times a captive and seventeen times sold into slavery, his gay and dauntless spirit brought him through every misfortune. He was soldier and sailor, merchant and doctor, missionary and ambassador; moreover, as the friend and travelling companion of St Francis Xavier, he lent the apostle of the Indies the money with which to build the first Jesuit establishment in Japan. In January 1554 Mendes Pinto was in Goa, waiting for a ship to take him to Portugal, when he took a sudden resolution to enter the company of Jesus and devote a large part of the capital he had accumulated to the evangelization of Japan. The viceroy appointed him ambassador to the king of Bungo in order to give the mission an official standing, and on the 18th of April he set sail with the provincial, Father Belchior Nunes. Owing to bad weather and contrary winds, however, the missioners did not reach Japan until July 1556, but the success of the mission represented a notable service to the cause of Christianity and civilization. On the 14th of November 1556 Father Belchior and Mendes Pinto began their return voyage and reached Goa on the 17th of February 1557. During his stay of a twelvemonth there, the latter left the company, being dispensed from his vows for want of vocation at his own request, though a modern authority states that he was expelled because he was found to be a *marrano*, *i.e.* to possess Jewish blood. He finally returned to Portugal on the 22nd of September 1558, and settled at Pragal near Almada, where he married and wrote his famous book, the *Peregrination*; the MS., in fulfilment of his wishes, was presented by his daughter to the Casa Pia for penitent women in Lisbon, and it was published by the administrators in 1614. When Philip II. of Spain came to Portugal as its king, he listened with pleasure to the account of Mendes Pinto's travels, and by letter of the 15th of January 1583 gave him a pension for his services in the Indies. But the reward came too late, for the great traveller died on the 8th of July.

In the light of our present-day knowledge of the East, Pinto is regarded as having been on the whole a careful observer and truthful narrator, but this was not always the case. Some witty countryman of his own parodied his name into *Fernão, mentes? Minto!* ("Ferdinand, do you lie? I do!"); and the English dramatist Congreve only expressed the general opinion of the unlearned when he wrote in *Love for Love* "Mendez Pinto was but a type of thee, thou liar of the first magnitude." It must be remembered that Pinto wrote the *Peregrination* long subsequent to the events he records, and this fact and a certain fertility of imagination sufficiently account for inexactitudes. Furthermore, as the book was only published posthumously, he never had the opportunity of correcting the proofs. Some of his most marvellous stories are expressly given on the authority of writers belonging to the countries he describes; others he tells from hearsay, and Oriental informants are prone to exaggeration. But if he somewhat adorned the truth, he did not wilfully misrepresent it. The book itself gives the impression of sincerity, and the editors of the first edition bear witness to the probity, good faith and truthfulness of Mendes Pinto as a man. Herrera Maldonado prefaced his Spanish translation of the *Peregrination* (1620) by a lengthy and erudite apology to demonstrate its authenticity, and Castilho has reinforced his arguments by modern testimonies. In the narrative portions of his work Pinto's style is simple, clear and natural, his diction rich, particularly in sea terms, and appropriate to his varying subjects. There is an entire absence of artifice about the book, which must always rank as a classic, and it might fairly be argued that Mendes Pinto did for the prose of Portugal what Camoens did for its poetry; this is the more remarkable, because it does not appear that he ever received any education in the ordinary sense. He wrote the book for his children to learn to read by, and modestly excused its literary defects by alleging his rudeness and lack of talent. Tradition has it that the MS. was entrusted to the chronicler Francisco de Andrade for the purpose of being polished in style and made ready for press, but that all he did was to divide it into chapters.

The *Peregrination* has gone through many editions subsequent to that of 1614, and in 1865 Castilho published excerpts in his *Livraria classica portugueza* with an interesting notice of Mendes Pinto's life and writings. Versions exist in German (3 editions), French (3 editions), Spanish (4 editions), and in English by Henry Cogan, London (1663, 1692 and—abridged and illustrated, with introduction by Arminius Vambéry—1891). Cogan omits the chapters relating to Mendes Pinto's intercourse with, and the last days of, St Francis Xavier, presumably as a concession to anti-Catholic prejudice.

See Christovão Ayres, *Fernão Mendes Pinto* (Lisbon, 1904). *Fernão Mendes Pinto e o Japão* (Lisbon, 1906); also *Subsidios . . . para a biographia de Fernão Mendes Pinto* by Jordão de Freitas (Coimbra, 1905). (E. Pr.)

PINTO. The remarkable brown, black and blue spots of discoloration of the whole body met with endemically in Mexico, Panama, Colombia and Venezuela, and known under the name of "pinto" or "mal de los pintos," were first claimed by Gastambide (*Presse méd. Belge*, 1881, Nos. 33–41) as due to the presence of a vegetable parasite, whose spores and even mycelial filaments may be detected among the deeper rows of cells of the rete mucosum. The disease appears to be one of the many forms of *morbus miseriae*; but it is contagious, and is sometimes seen in the well-to-do. In some villages of the western districts of Tabasco (Mexico) it has been estimated that 9% of the inhabitants suffer from the pinto; M'Clellan says that in 1826 in the City of Mexico he saw a whole regiment of "pintados."

PINTURICCHIO (1454–1513), Italian painter, whose full name was BERNARDINO DI BETTI, the son of a citizen of Perugia, Benedetto or Betto di Biagio, was one of a very important group who inherited the artistic traditions and developed the style of the older Perugian painters, such as Bonfigli and Fiorenzo di Lorenzo. According to Vasari he was a pupil of Perugino; and so in one sense no doubt he was, but rather as a paid assistant than as an apprentice. The strong similarity both in design and methods of execution which runs through the works of this later Perugian school is very striking; paintings by Perugino, Pinturicchio, Lo Spagna and Raphael (in his first manner) may often be mistaken one for the other. In most cases, especially in the execution of large frescoes, pupils and assistants had a large share in the work, either in enlarging the master's sketch to the full-sized cartoon, in transferring the cartoon to the wall, or in painting backgrounds, drapery and other accessories. After assisting Perugino in the execution of his frescoes in the Sistine Chapel, Pinturicchio was employed by various members of the Della Rovere family and others to decorate a whole series of chapels in the church of S. Maria del Popolo in Rome, where he appears to have worked from 1484, or earlier, to 1492 with little interruption. The earliest of these is an altarpiece of the "Adoration of the Shepherds," in the first chapel (from the west) on the south, built by Cardinal Domenico della Rovere; a portrait of the cardinal is introduced as the foremost of the kneeling shepherds. In the lunettes under the vault Pinturicchio painted small scenes from the life of St Jerome. The frescoes which he painted in the next chapel, that built by Cardinal Innocenzo Cibo, were destroyed in 1700, when the chapel was rebuilt by Cardinal Alderano Cibo. The third chapel on the south is that of Giov. della Rovere, duke of Sora, nephew of Sixtus IV., and brother of Giuliano, who was afterwards Pope Julius II. This contains a fine altarpiece of the "Madonna enthroned between Four Saints," and on the east side a very nobly composed fresco of the "Assumption of the Virgin." The vault and its lunettes are richly decorated with small pictures of the life of the Virgin, surrounded by graceful arabesques; and the dado is covered with monochrome paintings of scenes from the lives of saints, medallions with prophets, and very graceful and powerfully drawn female figures in full length in which the influence of Signorelli may be traced. In the fourth chapel Pinturicchio painted the Four Latin Doctors in the lunettes of the vault. Most of these frescoes are considerably injured by damp, but happily have suffered little from restoration; the heads are painted with much minuteness of finish, and the whole of the pictures depend very largely for their effect on the final touchings *a secco*. The last paintings completed by Pinturicchio in this church were the frescoes on the vault over the retro-choir, a very rich and well-designed piece of decorative work, with main lines arranged to suit their surroundings in a very skilful way. In the centre is an octagonal panel of the coronation of the Virgin, and round it medallions of the Four Evangelists—the spaces between them being filled up by reclining figures of the Four Sibyls. On each pendentive is a figure of one of the Four Doctors enthroned under a niched canopy. The bands which separate these pictures have elaborate arabesques on a gold ground, and the whole is painted with broad and effective touches, very telling when seen (as is necessarily the case) from a considerable distance below. No finer specimen of the decoration of a simple quadripartite vault can anywhere be seen.

In 1492 Pinturicchio was summoned to Orvieto, where he painted two Prophets and two of the Doctors in the duomo. In the following year he returned to Rome, and was employed by Pope Alexander VI. (Borgia) to decorate a suite of six rooms in the Vatican, which Alexander had just built. These rooms, called after their founder the *Appartamenti Borgia*, now form part of the Vatican library, and five of them still retain the fine series of frescoes with which they were so skilfully decorated by Pinturicchio. The upper part of the walls and vaults, not only covered with painting, but further enriched with delicate stucco work in relief, are a masterpiece of decorative design applied according to the truest principles of mural ornament—a much better model for imitation in that respect than the more celebrated Stanze of Raphael immediately over the Borgia rooms. The main subjects are: (1) the Annunciation, the Nativity, the Magi, and the Resurrection; (2) Scenes from the lives of St Catherine, St Antony and other saints; (3) allegorical figures of music, arithmetic and the like; (4) four figures in half length, with rich arabesques; (5) figures of the planets, the occupations of the various months, and other subjects. The sixth room was repainted by Perino del Vaga.[1]

Though not without interruption, Pinturicchio, assisted by his pupils, worked in these rooms from 1492 till 1498, when they were completed. His other chief frescoes in Rome, still existing in a very genuine state, are those in the Cappella Bufalini at the south-west of S Maria in Ara Coeli, probably executed from 1497 to 1500. These are well-designed compositions, noble in conception, and finished with much care and refinement. On the altar wall is a grand painting of St Bernardino of Siena between two other saints, crowned by angels; in the upper part is a figure of Christ in a vesica-glory, surrounded by angel musicians; on the left wall is a large fresco of the miracles done by the corpse of St Bernardino, very rich in colour, and full of very carefully painted heads, some being portraits of members of the Bufalini family, for whom these frescoes were executed. One group of three females, the central figure with a child at her breast, is of especial beauty, recalling the grace of Raphael's second manner. The composition of the main group round the saint's corpse appears to have been suggested by Giotto's painting of St Francis on his bier in S. Croce at Florence. On the vault are four noble figures of the Evangelists, usually attributed to Luca Signorelli, but certainly, like the rest of the frescoes in this chapel, by the hand of Pinturicchio. On the vault of the sacristy of S. Cecilia in Trastevere, Pinturicchio painted the Almighty surrounded by the Evangelists. During a visit to Orvieto in 1496 Pinturicchio painted two more figures of the Latin Doctors in the choir of the duomo—now, like the rest of his work at Orvieto, almost destroyed. For these he received fifty gold ducats.

Among his panel pictures the following are the most important. An altarpiece for S Maria de' Fossi at Perugia, painted in 1496–1498, now moved to the picture gallery, is a Madonna enthroned among Saints, graceful and sweet in expression, and very minutely painted; the wings of the retable have standing figures of St Augustine and St Jerome; and the *predella* has paintings in miniature of the Annunciation and the Evangelists. Another fine altarpiece, similar in delicacy of detail, and probably painted about the same time, is that in the cathedral of San Severino—the Madonna enthroned looks down towards the kneeling donor. The angels at the sides in beauty of face and expression recall the manner of Lorenzo di Credi or Da Vinci. The Vatican picture gallery has the largest of Pinturicchio's panels—the Coronation of the Virgin, with the apostles and other saints below. Several well-executed portraits occur among the kneeling saints. The Virgin, who kneels at Christ's feet to receive her crown, is a figure of great tenderness and beauty, and the lower group is composed with great skill and grace in arrangement. Other important panel paintings by Pinturicchio exist in the cathedral of Spello, in the Siena gallery, at Florence, at Perugia, and in other collections.

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[1] See Guattani, *Quadri nell' appart. Borgia* (Rome, 1820).

In 1501 Pinturicchio painted several fine frescoes in S. Maria Maggiore at Spello—all very decorative and full of elaborate architectural accessories. One of them, the Annunciation, is signed "Bernardinvs Pintvrichivs Pervsinvs." The most striking of all Pinturicchio's frescoes, both for brilliance of colour and their wonderful state of preservation, are those in the cathedral library at Siena, a large room built in 1495 by Cardinal Francesco Piccolomini, afterwards Pius III. In 1502 the cardinal contracted with Pinturicchio to decorate the whole room with arabesques on the vault, and on the walls ten scenes from the life of Aeneas Sylvius Piccolomini, Pius II., the uncle of Cardinal Francesco.

The contract specially provided that the cartoons, their transference on to the walls, and all the heads, were to be by Pinturicchio's own hand, thus contradicting Vasari's assertion that the cartoons were the work of Raphael. The document provides for the price of these frescoes, namely one thousand gold ducats, to be paid in various instalments. The work was begun early in 1503, but was interrupted for a while by the death of Pius III. His will, however, provided for the completion of the work by his executors, and the whole series were finished in 1507. The subjects are (1) the journey of the young Sylvius Piccolomini to the Council of Basel, in the suite of Cardinal Capranica; (2) his reception by James I. of Scotland as envoy from the Council of Basel; (3) his being crowned with the poet's laurel by Frederick III.; (4) his reception by Pope Eugenius IV. as ambassador from Frederick III.; (5) outside the wall of Siena he presents to Frederick III. his bride Leonora, infanta of Portugal; (6) he receives the cardinal's hat from Pope Calixtus III.; (7) he is borne in procession after his election as Pope Pius II.; (8) he presides at a council at Mantua; (9) he canonizes St Catherine of Siena; (10) he arrives in Ancona to promote the crusade against the Turks. In addition to these there is, outside the library, over the door, the coronation of Pius III. In the lower part of the scene of St Catherine's canonization he has introduced his own portrait, and standing by him is a youth who bears some resemblance to Raphael.

In 1508 Pinturicchio painted another panel of the Madonna enthroned among saints for the church of the Minori Conventuali at Spello. It is now over the altar in the sacristy. On his return to Siena he painted a whole series of frescoes on the walls of the Palazzo Petrucci, now all destroyed except one scene of the return of Ulysses to Penelope (or possibly Collatinus and Lucretia), which is now in the National Gallery of London, transferred to canvas. One of his last works, painted in 1513, the year of his death, is a very beautiful and highly finished panel with Christ bearing His Cross, now in the Palazzo Borromeo in Milan. Pinturicchio married Grania di Niccolò, and had by her two sons and four daughters; there is probably no truth in the story of his being starved by his wife during his last illness.

Pinturicchio's worth as a painter has been for the most part undervalued, partly owing to the very strong prejudice and dislike which tinges Vasari's biography of him. Even Crowe and Cavalcaselle hardly did him justice. A fairer estimate of his position in the history of art is given by Vermiglioli, *Memorie di Pinturicchio* (Perugia, 1837); and in the valuable notes and appendix of Milanesi's edition of Vasari, iii. 493–531 (Florence, 1878). See also Schmarsow, *Raphael und Pinturicchio in Siena* (Stuttgart, 1880), and *Pinturicchio in Rom* (Stuttgart, 1882), both well illustrated by photo-lithography. (J. H. M.)

PINWELL, GEORGE JOHN (1842–1875), British water-colour painter, was born at Wycombe, and educated at Heatherley's Academy. He is one of the most interesting personalities in the little group of water-colour painters which included Frederick Walker and A. B. Houghton, a group whose style was directly derived from the practice of drawing upon wood for book illustration. He was one of the most delightful book illustrators of his day, poetic in imagination, with considerable inventive power and an admirable sense of colour. As he died young his works are few, but their promise was so great that had he lived he would probably have attained a very high position. His early life was one of considerable privation. In 1862 he entered at Heatherley's studio and there obtained his art education. His earliest drawings appeared in *Lilliput Levée*. He did a little work for *Fun* and executed several designs for the silversmiths, Elkingtons. In 1863 his first drawing appeared in *Once a Week*, and from that time his work was in constant demand. There are many of his compositions in *Good Words*, *The Sunday Magazine*, *The Quiver* and *London Society*, but his most important productions made for the Dalziel brothers were illustrations of Goldsmith, of Jean Ingelow's poems, Robert Buchanan's *Ballads of the Affections*, and the *Arabian Nights*.

Of Pinwell's pictures in colour, which are distinguished by a remarkable, jewel-like quality and marked by his strong love of pure, bright colour and opalescent effect, the chief are the two scenes from the *Pied Piper of Hamelin*, *Gilbert à Becket's Troth*, *Out of Tune* or *The Old Cross*, *A Seat in St James's Park*, and *The Elixir of Life*.

In 1874 Pinwell fell seriously ill and went to Africa for the winter. He painted several remarkable pictures at Tangier, but his strength gradually broke down and he returned to die in his wife's arms on the 8th of September 1875. Pinwell was an exhibitor at the Dudley gallery, and in 1869 was elected associate of the Royal Water-Colour Society and full member in 1870; to this gallery he contributed fifty-nine works. A posthumous exhibition of his works was held in 1876 in Bond Street.

See *Life of George J. Pinwell*, by George C. Williamson, quarto, 1900. (G. C. W.)

PINZON, a family of wealthy Spanish navigators, of Palos in Andalusia, three members of which—Martin Alonzo, Francisco and Vicente Yañez, brothers—were associated with Columbus in the discovery of America.

Martin Alonzo Pinzon, born about the middle of the 15th century, gave material assistance to Columbus in carrying out his project. "If Colon was the head, Pinzon was the right arm" (Asensio). In the expedition of 1492 he commanded the "Pinta," on which his brother Francisco was pilot; another brother, Vicente Yañez, commanded the "Nina." On the 6th of October Martin Alonzo suggested to Columbus (when already in the longitude of the Bermudas) to change the course of the expedition from due west to south-west; on the 7th of October this suggestion—strengthened by the observation of a flight of birds to the south-west—was adopted, bringing the fleet, four days later, to the landfall at Guanahani (San Salvador, Watling Island) in the Bahamas (Oct. 12, 1492). On the 21st of November 1492, near the east end of the north coast of Cuba, Martin Alonzo left Columbus, making eastward in search of the gold-land of which they had heard the natives speak. On the 6th of January 1493 he rejoined the admiral, who accepted his excuses. But on the return journey he again left his leader, and when Columbus arrived at Palos on the 15th of March 1493 he learned that Alonzo had already landed at Bayona in Galicia. If his object was to forestall Columbus and pose as discoverer of the New World, he was foiled; audience was refused him by Ferdinand and Isabella; and soon after he died, perhaps of chagrin.

Vicente Yañez Pinzon, who commanded the "Nina" in 1492–1493, also gave Columbus material help, and remained loyal to his leader throughout. In after years he made important discoveries on his own account. Late in December 1499 he sailed with four caravels across the Atlantic to the south-west, and on the 7th of February 1500 he struck the South American continent at Cape S. Agostinho, near its most easterly projection (called by him Cape Santa Maria de la Consolacion) almost three months before the Portuguese navigator Cabral reached Brazil, the discovery of which is generally attributed to him. Proceeding southwards a short distance, he then turned north, followed the coast to the north-west, discovered the Amazon estuary, and went at least as far as what is now Costa Rica. After touching at Haiti, and losing two of his vessels among the Bahamas, Vicente returned to Palos in the end of September 1500. Although concessions were made to him, and he was created governor of the newly discovered lands by Ferdinand and Isabella, he does not seem to have ever taken possession. In 1507 we find Vicente sailing with Juan Diaz de Solis along the east coast of Central America. In 1509, again with De Solis, he coasted the Atlantic side of South America as far as the La Plata estuary, hoping to find an opening westwards leading to the Spice Islands. According to Herrera, he even reached 40° S., passing the La Plata without recognizing it, and turning back about the mouth of the Rio Negro, but this is probably an exaggeration. After 1523 all traces of Vicente are lost.

See Navarrete, *Coleccion de viajes*; Washington Irving's *Columbus*, Bk. XIV., ch. ii.; bibliography in Joaquim Caetano da Silva's *L'Oyapoc et l'Amazone* (Paris, 1861); Herrera, *Indias Occid.*, Dec. I., lib. vi. cap. 17; lib. vii., caps. 1 and 9 (Madrid, 1730); Oviedo, *Hist. general de las Indias*, lib. xxiii. cap. 1 (Madrid, 1852); O. Peschel, *Geschichte der Erdkunde*, pp. 230, 233, 249 (Munich, 1865); *Zeitalter der Entdeckungen*, pp. 305, &c., 426; Jose Maria Asensio, *Cristoval Colon, su vida, sus viajes, sus descobrimientos* (Barcelona, 1891); Cesareo Fernandez Duro, *Colon e Pinzon.*

PIO DI SAVOIA, an ancient noble Italian family, first mentioned by good authorities in the 14th century. From the house of Este (*q.v.*) they received the lordship of Carpi, and later they acquired the fiefs of Meldola, Sassuolo, &c. Many members of the family were distinguished as *condottieri*, diplomats and ecclesiastics. Alberto Pio obtained from the house of Savoy in 1450 the privilege of adding "di Savoia" to his name as a reward for his military services. Another Alberto Pio (1475–1531), who was French ambassador in Rome, won fame as a man of learning, and Cardinal Rodolfo Pio (1516–1564) was a trusted adviser to Pius III. and helped to establish the Inquisition at Milan. Ascanio Pio (d. 1649) was a dramatic poet of some merit. Spain conferred the title of prince on the family, and one branch of it is to this day established in Spain.

See P. Litta, *Le Famiglie celebri italiane* (Milan); G. Campori *Memorie storiche di Marco Pio di Savoia* (Modena, 1876); A. Ceriani and G. Porro, "Il Rotolo epistografo dei principi Pio di Savoia," in the *Archivio storico lombardo*, ser. II. an. XI. fasc. 1, ser. III. an. VIII. 96, and ser. III. an. XIX. 453.

PIOMBINO, a seaport of Tuscany, Italy, in the province of Pisa, 8 m. by rail W.S.W. of Campiglia Marittima (which is 53 m. S.S.E. of Pisa), 62 ft. above sea-level, at the southern extremity of the peninsula of the Monte Massoncello. Pop. (1901), 5979 (town); 7703 (commune). It is surrounded by old walls, and contains some interesting Renaissance works by a master of about 1458 under the influence of Alberti. It is the port of embarcation for Elba, the nearest point of which is about 6 m. to the south-west, and originally belonged to Pisa. It gives the title of prince to the Buoncompagni Ludovisi family, who, however, no longer own it.

PIONEER, properly a foot-soldier (Med. Lat. *pedo*, *pedonis*, through O. Fr. *peonnier*, *pionnier*, cf. "pawn") who with spade, axe and other implements, precedes an army or smaller military body, and clears or makes a road, digs intrenchments, prepares a camping ground, &c. The word is thus applied to all who, actually or figuratively, are first in exploring or working an undiscovered or undeveloped country or field of inquiry.

PIOTRKOW (Ger. *Petrikau*), a government of Russian Poland, bounded by the government of Warsaw on the N., Radom and Kielce on the E., Kalisz on the W. and Prussian Silesia on the S. Area, 4729 sq. m.; pop. (1906, estimate), 1,675,200. Geologically it represents a continuation of Upper Silesia, and is built up of Upper Carboniferous deposits, containing near Bendzin a bed of coal 265 sq. m. in extent. Permian and Jurassic deposits, containing zinc ores, as also lignite and limonite iron ores, overlie the Carboniferous. The surface consists of a series of heights, 1000 to 1600 ft. above sea-level, intersected by ravines, and stretching from south-west to north-east. The government is drained by the Warta and the Pilica, and was formerly covered with thick forests. It was colonized by Mazurs and Poles (Veliko-Polyans and Malo-Polyans). The government, which is the most densely peopled in the Russian Empire, is divided into eight districts, of which the chief towns are Piotrkow, Bendzin, Brzeziny, Czenstochowa, Lask, Lodz, Nowo-Radom and Rawa. Agriculture and cattle-breeding are extensively carried on; and coal and iron are mined. Textile industries developed with extraordinary rapidity during the closing years of the 19th and the opening years of the 20th centuries, the towns of Lodz, Pabianice, Zgerz and Bendzin all being important centres. Other branches of productive industry are distilleries, breweries, flour-mills, brickyards, sugar, cement, glass and candle factories. Granica and Sosnowice, in this government, are two of the most important custom-houses in Russia, and the annual trade is estimated at £12,000,000.

PIOTRKOW, a town of Russian Poland, capital of the government of the same name, and formerly the seat of the high court of Poland, on the railway from Warsaw to Vienna, 90 m. south-west of the former and 5 m. west of the river Pilica. Pop. (1900), 32,173. It is a well-kept town, with numerous gardens, and has flour-mills, saw-mills, tanneries, agricultural machinery works, and breweries. One of the oldest towns in Poland, Piotrkow was in the 15th and 16th centuries the place of meeting of the diets, and here the kings were elected. In the 14th century Casimir the Great built here a castle (now a military church) and surrounded the town with walls. Here in 1769 the Russians defeated the (Polish) forces of the Bar Confederation.

PIOZZI, HESTER LYNCH (1741–1821), English writer, well known as the friend (Mrs Thrale) of Samuel Johnson (*q.v.*), was born on the 16th of January 1741, her father being John Salusbury of Bobbel, Carnarvonshire. Her maternal uncle, Sir Robert Salusbury Cotton, contemplated providing for his niece, but he died without having carried out his intention. She and her mother lived in London, and amongst her childish recollections were meetings with James Quin and David Garrick. She received a solid education, for she was acquainted with Latin as well as with French, Italian and Spanish. In 1763 she was married to Henry Thrale, a rich Southwark brewer, whose house was at Streatham on the south-east corner of Tooting Bec Common. There was very little sympathy between the lively girl and Thrale, who was thirteen years her senior, but gradually she drew round her a distinguished circle of friends. She was introduced to Samuel Johnson in 1765 by Arthur Murphy, who was an old friend of her husband's. In 1766 Johnson paid a long visit to Streatham, and from that time was more or less domesticated with the Thrales. In time it became his custom to spend the middle of the week at Streatham, devoting the remaining days to his own heterogeneous "family." He was genuinely attached to his hostess, and thoroughly appreciated the luxury in which the Thrales lived. They were able to soften some of his eccentricities, and they certainly made him happy. He travelled with them in Wales in 1774, and in France in 1775. Dr Burney gave lessons to one of the Miss Thrales, and in 1778 he brought his daughter Fanny to Streatham. She became a warm friend of Mrs Thrale, and has left an account of the Streatham household in her diary. This friendship was by no means always unclouded. Fanny Burney was very sensitive, and sometimes thought that Mrs Thrale gave herself airs of patronage. Meanwhile, in 1772, Thrale's business was seriously injured, and he was threatened with bankruptcy. The situation was saved by his wife's efforts, and in the next year Thrale travelled, leaving her in charge of his affairs. He was twice returned for the borough of Southwark, chiefly through her efforts. In 1781 Mr Thrale died, and Dr Johnson helped the widow with her business arrangements, advising her to keep on the brewery, until she "cured his honest heart of its incipient passion for trade, by letting him into some, and only some, of its mysteries." The brewery was finally sold for £135,000. Mrs Thrale had met Gabriele Piozzi, an Italian musician, in 1780. Johnson was now in failing health, and soon began to feel himself slighted. His suspicions were definitely aroused when she laid aside her mourning for Thrale in 1782, and the Streatham house was sold. In 1783 her engagement to Piozzi was announced. The objections of her daughters and her friends induced her to break it off for a time, but it was soon resumed, and in 1784 they were married. Johnson told Miss Burney that he drove the memory of Mrs Thrale from his mind, burning every letter of hers on which he could lay his hand. The Piozzis presently left England to travel in Italy. At Florence they fell in with Robert Merry and the other "Della Cruscan" writers ridiculed by William Gifford in his *Maeviad* and *Baviad*, and she contributed some verses to their *Florence Miscellany* in 1785. In 1786 she published *Anecdotes of the late Samuel Johnson, during the last twenty years of his life*, which was severely criticized by Boswell. She was ridiculed by "Peter Pindar" in *Bozzy and*

Piozzi; or the British Biographers, A Town Eclogue (1786). But though Miss Burney and some others held aloof, the Piozzis found plenty of friends when they returned to London in 1787. Piozzi died at Brynbella, a villa he had built on his wife's Carnarvonshire estate in 1809, and Mrs Piozzi gave up her Welsh property to her husband's son, and spent most of the rest of her life at Bath and Clifton. When long past seventy she took a fancy to William Augustus Conway, the actor. She retained her vivacity to the last, celebrating her 80th birthday by a ball to six or seven hundred people at Bath. She died at Clifton on the 2nd of May 1821.

From 1776 to 1809 she kept a note-book which she called "Thraliana." Her well-known poem of the "Three Warnings" is to be found in many popular collections. *Letters to and from the late Samuel Johnson* appeared in 1788; *Observations and Reflections made in the course of a Journey, through France, Italy and Germany*, in 1789; and in 1801 she published *Retrospection; or a review of the most striking and important events, characters, and situations . . . which the last eighteen hundred years have presented to the view of mankind* (1801).

See *Letters and Literary Remains of Mrs Piozzi* (*Thrale*), *edited with notes and an Introductory Account of her Life and Writings by A. Hayward* (1861); *Piozziana; or Recollections of the late Mrs Piozzi by a Friend* (1833), the anonymous friend being Edward Mangin (1772–1852); L. B. Seeley, *Mrs Thrale, afterwards Mrs Piozzi* . . . (1891), and G. Birkbeck Hill, *Johnsonian Miscellanies* (1897). Also works noted in bibliography to JOHNSON, SAMUEL

PIPE, a term used of a musical wind-instrument of tubular form, and hence of any cylindrical hollow tube. The original application of the term is to the musical instrument (see PIPE AND TABOR below), and the source is to be found in Lat. *pipare*, to chirp, of a bird. The general meaning of "pipe," in the sense of a tube for such purposes as carrying water, gas, sewage, &c., is treated under TUBE. Among specific uses of the word are those for the hollow stem of clay, wood or other material with a bowl at one end in which tobacco is smoked (see below); for the metal or wooden sound tubes in an organ (*q.v.*); and for various forms of cylindrical veins, hollows, channels, &c., in mining and geology. The Great Roll of the Exchequer was known as the "Pipe Roll"; this contained the various "pipes" or enrolled accounts of the sheriffs, &c., which were so called either from being sent in a cylindrical case or as resembling a pipe in shape when rolled (see RECORDS).

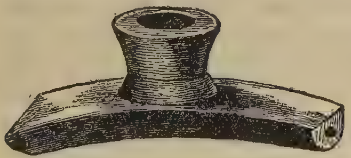


FIG. 1.—"Monitor" Pipe.

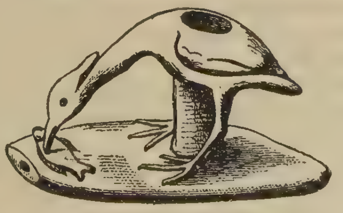


FIG. 2.—Heron Pipe.

Tobacco Pipe.—The smoking of tobacco in pipes is a custom which prevailed in America for a period of unknown duration previous to the discovery of that continent by Columbus. The most ancient pipes of which remains exist have been found in mounds or tumuli called pipe mounds, principally in Ohio, Indiana, Illinois and Iowa. These mound pipes, which are carved in porphyry and other hard stones, are very uniform in type. The pipe, cut out of a single piece of stone, consists of a slightly convex platform or base, generally from 3 to 4 in. in length, and about an inch broad, with the bowl on the centre. A fine hole is pierced from one end of the platform to the bottom of the bowl, the opposite end being obviously for holding in the hand while the pipe is being smoked. In the commonest forms the bowl is a simple cylinder or urn (fig. 1), but in many cases remarkable artistic skill has been displayed in carving the bowls into miniature figures of birds, mammals, reptiles and human heads, often grotesque and fantastic, but always vigorously expressed (fig. 2). These mound or platform pipes with carved human and animal forms are objects of the highest ethnographic interest and importance, being among the most characteristic remains of the ancient inhabitants of the Mississippi valley. The wide area over which they, as well as remains of baked clay pipes, are found throughout the American continent testifies to the universal prevalence of smoking in the pre-Columbian era. Many of the ancient clay pipes found in Mexico, &c., are elaborately moulded and ornamented, while others show considerable similarity to the early clay pipes of Europe. Among the North-American Indian tribes the tobacco pipe occupies a position of peculiar symbolic significance in connexion with the superstitious rites and usages of the race. The calumet, peace pipe or medicine pipe, is an object of the most profound veneration, entrusted to the care of a highly honoured official, and produced and smoked with much ceremony only on occasions of great importance and solemnity. It is remarkable that, whilst the most ancient American pipes had no separate stem, it is the stem only of the medicine pipe which is the object of veneration among the Indians, the bowl used being a matter of indifference. The favourite material for Indian pipe bowls is the famous red pipe stone (catlinite), a fine-grained easily-worked stone of a rich red colour of the Côteau des Prairies, west of the Big Stone Lake in S. Dakota. The quarries were formerly neutral ground among the warring Indian tribes, many sacred traditions being associated with the locality and its product.

It is disputed whether pipes for smoking were at all known in Europe previous to the discovery of America. That tobacco-smoking was unknown is certain; but pipes of iron, bronze and clay have been so frequently found associated with Roman remains and other antiquities as to lead many authorities to maintain that such pipes must have been anciently used for burning incense or for smoking aromatic herbs or hemp. Throughout Great Britain and Ireland small clay pipes are frequently dug up, in some instances associated with Roman relics. These are known amongst the people as elfin, fairy or Celtic pipes, and in some districts supernatural agencies have been called in to account for their existence. The elfin pipes have commonly flat broad heels in place of the sharp spur now found on clay pipes, and on that flat space the mark or initials of the maker is occasionally found. There is no reason to believe that these pipes are older than the 17th century. The introduction of the tobacco pipe into Europe is generally ascribed to Ralph Lane, first governor of Virginia, who in 1586 brought an Indian pipe to Sir Walter Raleigh, and taught that courtier how to use the implement. The pipe-makers of London became an incorporated body in 1619, and from England the other nations of Europe learned the art of making clay pipes.

The habit of smoking with pipes spread with incredible rapidity; and among the various peoples the pipe assumed special characteristics, and its modifications became the medium of conveying social, political and personal allusions, in many cases with no little artistic skill and humour. The pipe also became the object of much inventive ingenuity, and it varied as greatly in material as in form—wood, horn, bone, ivory, stone, precious and other metals, amber, glass, porcelain and, above all, clay being the materials employed in various forms. By degrees pipes of special form and material came to be associated with particular people, *e.g.* the elongated painted porcelain bowls and pendulous stem of the German peasantry, the red clay bowl and long cherry wood stem of the Turk, and the very small metallic bowl and cane stem of the Japanese, &c. Among other kinds of pipe which have been popular at various times are the "corn-cob," where the bowl is made of the cob of maize or Indian corn, and the "calabash" with the bowl of a small gourd. The "churchwarden" is a clay pipe with a slender stem, some 16 or 20 in. long. The most luxurious and elaborate form of pipe is the Persian *kalyún*, hookah or water tobacco pipe. This consists of three pieces, the head or bowl, the water bottle or base, and the snake or long flexible tube ending in the mouthpiece. The tobacco, which must be previously prepared by steeping in water, is placed in the head and lighted with live charcoal, a wooden stem passes from its bottom down into the water which fills the base, and the tube is fitted to a stem which ends in the bottle above the water. Thus the smoke is cooled and washed before it reaches the smoker by passing through the water in the bottle, and by being drawn through the coil of tube frequently some yards in length. The bottles are in many cases made of carved and otherwise ornamented coco-nut shells, whence the apparatus is called *nārgīla*, from *nārgīl*, a coconut. Silver, gold, damascened steel and precious stones are freely used in the making and decoration of these pipes for wealthy smokers.

Pipe Manufacture.—The regular pipe-making industries divide into many branches, of which the more important are the clay pipe, meerschaum (real and artificial), and wooden bowl trades. Clay pipes are made in prodigious numbers by hand labour with an iron mould and a steel wire for forming the tube of the stem. Pipe-moulding is a very simple operation in pottery, and the work is performed with astonishing celerity. A number of machines have been devised for automatic pipe-moulding; but the manual operations are so rapid and inexpensive that there is little margin for saving by the substitution of machinery. The pipes are very slightly fired so as to keep them soft and porous; and so cheaply made are they that the commoner kinds can be retailed at a profit for a farthing each. The principal early centres of the clay-pipe industry were at Broseley in Staffordshire, where the trade has been established since the early part of the 17th century, and at Amesbury in Wiltshire. The manufacture is still carried on at Broseley. Meerschaum pipes (see MEERSCHAUM) are the luxury of the European smoker. The favourite wooden pipe generally known as a briarwood or briar-root pipe is really made from the roots of the tree heath, *Erica arborea* (Fr. *bruyère*), principally obtained on the hills of the Maremma and taken thence to Leghorn. There the roots are shaped into blocks each suitable for a pipe, the cutting of the wood so as to avoid waste requiring considerable skill. These blocks are simmered in a vat for twelve hours, which gives them the much-appreciated yellowish-brown hue of a good "briar-root." So prepared the blocks are exported for boring and finishing. Many devices have been invented for the purpose of preventing the nicotine liquor from reaching the smoker's mouth or collecting in and fouling the pipe.

PIPE AND TABOR (Fr. *galoubet*; Ger. *Schwegel* or *Stamentienpfeiff*), a popular medieval combination of a small pipe or flageolet, and a small drum. The pipe consists of a cylindrical tube of narrow bore, pierced with three holes, two in front and one at the back, all very near the end of the pipe; and of a mouthpiece of the kind known as whistle, fipple or beak common to the *flûtes à bec* or *recorder* family. The compass of this instrument, with no more than three holes, exceeds two octaves in the hands of a good player, and is chromatic throughout. The fundamental notes of the open pipe and of the three holes cannot be produced; the scale consists, therefore, entirely of harmonics, the 2nd, 3rd and 4th of the series being easily obtained, and, by half stopping the holes, also the semitones which are required to complete the chromatic scale. The tabor being fastened to the performer's left elbow, the hands remained free, the right beating the little drum with a stick to mark the rhythm, while the left held and fingered the pipe with thumb and first two fingers.

Mersenne mentions a wonderful virtuoso, John Price, who could rise to the twenty-second on the galoubet. Praetorius mentions and figures three sizes of the Stamentienpfeiff, the treble 20 in. long, the tenor 26 in. and the bass 30, the last being played by means of a crook about 23 in. long. A specimen of the bass in the museum of the Brussels Conservatoire has for its lowest note middle C. The pipe and tabor are said to be of Provençal origin; it is certain that they were most popular in France, England and the Netherlands, and they figure largely among the musical and social scenes in the illuminated MSS. of those countries. (K. S.)

PIPE-FISHES (*Syngnathina*), small fishes, which with the Sea-horses form a distinct family, *Syngnathidae*, of Lophobranchiate Thoracostei. The name is derived from the peculiar form of their snout, which is produced into a more or less long tube, ending in a narrow and small mouth which opens upwards and is toothless. The body and tail are long and thin, snake-like, encased in hard integuments which are divided into regularly arranged segments. This dermal skeleton shows several longitudinal ridges, so that a vertical section through the body represents an angular figure, not round or oval as in the majority of other fishes. A dorsal fin is always present, and is the principal (in some species, the only) organ of locomotion. The ventral fins are as constantly absent, and the other fins may or may not be developed. The gill-openings are extremely small and placed near the upper posterior angle of the gill-cover. Most of the pipe-fishes are marine, only a few being fluviatile. Pipe-fishes are abundant on such coasts of the tropical and temperate zones as offer by their vegetation shelter to these defenceless creatures. They are very bad swimmers, slowly moving through the water by means of the rapid undulatory movement of the dorsal fin. Their tail, even when provided with a caudal fin, is of no use in swimming, and not prehensile as in sea-horses. Specimens, therefore, are not rarely found at a great distance from land, having been resistlessly carried by currents into the open ocean; one species, *Syngnathus pelagicus*, has an extraordinarily wide range over the tropical seas, and is one of the common fishes inhabiting the vegetation of the Sargasso Sea. The colour of these fishes often changes with the sea-weeds among which they may be found, passing from brown to green or even brick-red. In pipe-fishes the male is provided with a pouch—in some species on the abdomen, in others on the lower side of the tail—in which the ova are lodged during their development. This marsupial pouch is formed by a fold of the skin developed from each side of the trunk or tail, the free margins of the fold being firmly united in the median line throughout the period during which the eggs are being hatched. When the young are hatched the folds separate, leaving a wide slit, by which the young gradually escape when quite able to take care of themselves. Nearly a hundred different species of pipe-fishes are known, of which *Siphonostoma typhle*, *Syngnathus acus* (the Great Pipe-fish up to 18 in. in length), *Nerophis aequoreus* (Ocean Pipe-fish), *Nerophis ophidion* (Straightnosed Pipe-fish), and *Nerophis lumbriciformis* (Little Pipe-fish) are British species. The last three are destitute of a caudal fin.

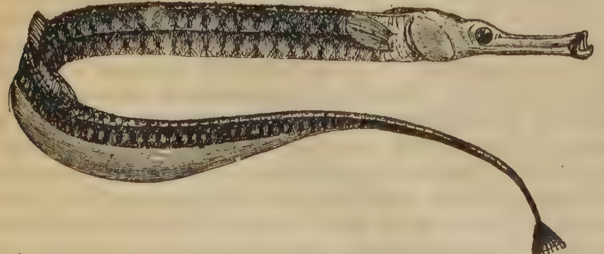


FIG. 1.—*Syngnathus acus*, Male, with sub-caudal pouch.

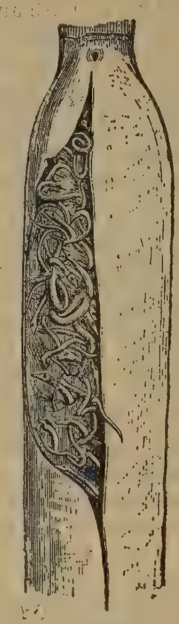


FIG. 2.—Sub-caudal pouch of *Syngnathus acus*, with the young ready to leave the pouch. One side of the membrane of the pouch is pushed aside to admit of a view of its interior. (Nat. size.)

A review of the extensive literature on the breeding habits of the *Syngnathidae* is given by E. W. Gudger, "The Breeding habits and the Segmentation of the Egg of the Pipefish," *Proc. U.S. Nat. Mus.* (1905), xxix. 447.

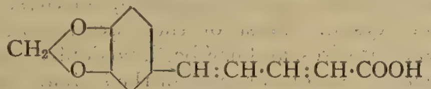
PIPER, CARL, COUNT (1647–1716), Swedish statesman, was born at Stockholm on the 29th of July 1647. He entered the foreign office after completing his academical course at Upsala, accompanied Benedict Oxenstjerna on his embassage to Russia in 1673, and attracted the attention of Charles XI. during the Scanian War by his extraordinary energy and ability. In 1679 he was appointed secretary to the board of trade and ennobled. In 1689 he was made one of the secretaries of state, and Charles XI. recommended him on his deathbed to his son and successor, Charles XII. Piper became the most confidential of the new sovereign's ministers. In 1697 he was made a senator and set over domestic affairs while still retaining his state-secretaryship. In 1698 he was created a count, in 1702 appointed chancellor of Upsala University, and during the first half of the Great Northern War, as the chief of Charles's perambulating chancellery, he was practically prime minister. It was his misfortune, however, to be obliged to support a system which was not his own. He belonged to the school of Benedict Oxenstjerna and was therefore an avowed advocate of a pacific policy. He protested in vain against nearly all the military ventures of Charles XII., *e.g.* the War of Deposition against Augustus of Saxony and Poland, the invasion of Saxony, the raid into the Ukraine. Again and again he insisted that the pacific overtures of Peter the Great should at least be fairly considered, but his master was always immovable. Piper's career came to an end at Poltava (1709), where he was among the prisoners. The last years of his life were spent in exile in Russia. He died at Schlüsselburg on the 29th of May 1716.

See W. L. Svedelius, *Count Carl Piper* (Stockholm, 1869).

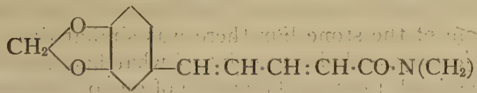
(R. N. B.)

PIPERAZIN, a substance formed by the action of sodium glycol on ethylene-diamine hydrochloride, consisting of small alkaline deliquescent crystals with a saline taste and soluble in water. It was originally introduced into medicine as a solvent for uric acid. When taken into the body the drug is partly oxidized and partly eliminated unchanged. Outside the body piperazin has a remarkable power of dissolving uric acid and producing a soluble urate, but in clinical experience it has not proved equally successful. Lycetol, lysidine and sidonal are bodies having similar action.

PIPERINE, $C_{17}H_{19}NO_3$, an alkaloid found in the fruits of *Piper nigrum* and *P. longum.* It forms white prisms, which melt at 128°–219°. It is almost insoluble in water, but readily soluble in alcohol and ether. It is a very weak base, salts being only formed with mineral acids, and these are dissociated by water. Alcoholic potash decomposes it into piperidine, $C_5H_{11}N$, and piperic acid, $C_{12}H_{10}O_4$. The constitution of piperic acid was elucidated by R. Fittig and his pupils (*Ann.*, vols. 152, 159, 168, 216, 227) and shown to be (1). Piperine consequently is (2).



(1)



(2)

Oxidation with potassium permanganate converts piperic acid into piperonal, $C_8H_6O_3$, and piperonylic acid, $C_8H_6O_4$. The latter when heated with hydrochloric acid to 170°, or water to 200°, separates carbon with the formation of protocatechuic acid, 1·2-dioxy-3-benzoic acid, $C_6H_3(OH)_2COOH$. Conversely, by heating protocatechuic acid with potash and methylene iodide, piperonylic acid was regained. These results show that piperonylic acid is the methylene ether of protocatechuic acid. Piperonal (*q.v.*) is the corresponding aldehyde. Piperic acid differs from piperonylic acid by the group C_4H_4, and it was apparent that these carbon atoms must be attached to the carbon atom which appears in the carboxyl group of piperonylic acid, for if they were directly attached to the benzene ring polycarboxylic acids would result in oxidation. The above formula for piperic acid was confirmed by its synthesis by A. Ladenburg and M. Scholtz (*Ber.*, 1894, 27, p. 2958) from piperonyl acrolein (the condensation product of piperonal and acetaldehyde) and acetic acid. The synthesis of piperine follows from the interaction of piperyl chloride (formed from piperic acid and phosphorus pentachloride) and piperidine (L. Rügheimer, *Ber.*, 1882, 15, p. 1390.)

PIPERNO (anc. *Privernum*), a town of the province of Rome, Italy, 61 m. S.E. of Rome by rail. Pop. (1901), 6736. The medieval town was founded in the 10th century (?) on a hill 490 ft. above sea-level, by refugees from the Roman town of Privernum, lower down (118 ft. above sea-level) on the highroad, 1¼ m. to the north, at the mouth of a low pass leading through the Volscian mountains to the valley of the Sacco. Here are remains of an arch crossing the road and other ruins (mostly buried) of the Roman period; but the remains above ground are largely medieval. It is improbable, however, that the ancient Volscian town should have occupied so easily accessible a site; it is not unlikely that it stood on the site occupied by the medieval and modern town, but there is no proof of this. Privernum was a Volscian town, and took up arms against Rome after the foundation of a Latin colony at Setia in 382 B.C. It was finally captured in 329 B.C., and eleven years later the tribus Oufentina was founded, taking its name from the river Oufens (mod. Uffente) in the territory of Privernum. Little is known of it subsequently. The medieval town has a picturesque piazza, with a Gothic cathedral (1283), which preserves a fine porch, though the interior was modernized in 1782; a Gothic palazzo pubblico; and other Gothic churches exist in the town. Polygonal terrace walls of the Roman or pre-Roman period exist at various places in the vicinity (G. B. Giovenale and L. Mariani in *Notizie degli Scavi*, 1899, 88).

(T. As.)

PIPERONAL (heliotropine, protocatechuic aldehyde methylene ether), $C_8H_6O_3$, an aromatic aldehyde. It is prepared by oxidizing piperic acid with potassium permanganate (R. Fittig, *Ann.*, 1869, 152, p. 35); by condensing methylene iodide with protocatechuic aldehyde (R. Wegscheider, *Monats.*, 1893, 14, p. 388); or by oxidizing isosafrol with chromic acid. It forms long colourless crystals which melt at 37° C. and boil at 263° C. It has an agreeable smell, resembling that of heliotrope, and is much used in perfumery. It is only slightly soluble in cold water, but is readily soluble in alcohol and in ether. When heated with dilute hydrochloric acid to 200° C. it yields protocatechuic aldehyde, $C_7H_6O_3$, and carbon. It readily combines with sodium bisulphite and with various bases (ammonia, aniline, methylamine, &c.).

PIPIT (cognate with the Lat. *Pipio*; see PIGEON), the name applied by ornithologists to a group of birds having a great resemblance both in habits and appearance to the larks (*q.v.*). They differ however from larks in several important characters, and, having been first separated to form the genus *Anthus*, which has since been much broken up, are now generally associated with the wagtails (*q.v.*) in the Passerine family *Motacillidae*. Pipits, of which over fifty species have been described, occur in almost all parts of the world, but in North America are represented by only two species—*Neocorys spraguii*, the prairie-lark of the north-western plains, and *Anthus ludovicianus*, the American titlark, which last is very nearly allied to the so-called water-pipit of Europe, *A. spipoletta*. To most English readers the best known species of pipit is the titlark or meadow-pipit, *A. pratensis*, a bird too common to need description, and abundant on pastures, moors, and uncultivated districts generally; but in some localities the tree-pipit, *A. trivialis*, or *A. arboreus* of some authors, takes its place, and where it does so it usually attracts attention by its loud song, which is not unlike that of a canary, but delivered (as appears to be the habit of all the pipits) on the wing and during a short circuitous flight. Another species, the rock-lark, *A. obscurus*, scarcely ever leaves the seacoast and is found almost all round the British Islands. The South-African genus *Macronyx*, remarkable for the extreme length of its hind claw, is generally placed among the pipits, but differs from all the rest in its brighter coloration, which has a curious resemblance to the American genus *Sturnella* (see ICTERUS), though the bird is certainly not allied thereto.

(A. N.)

PIPPIN, or PEPIN, the name of three members of the Carolingian family.

PIPPIN I. (d. 640), incorrectly called Pippin of Landen, was mayor of the palace to the youthful Dagobert I., whom Clotaire II. had placed over the kingdom of Austrasia. He was disgraced when Dagobert became sole king in 629, and had to seek refuge in Aquitaine. Returning at Dagobert's death (639), he governed Austrasia in Sigebert's name, but died in the following year.

PIPPIN II. (d. 714), incorrectly called Pippin of Herstal, was son of Adalgiselus (son of Arnulf, bishop of Metz) by a daughter of Pippin I., called in later documents Begga. Towards 678 he placed himself at the head of the great nobles in Austrasia to combat Ebroïn, the mayor of the palace, and Neustria. After some reverses he gained a great victory after Ebroïn's death at the battle of Tertry, not far from St Quentin. This victory made Pippin almost entire master of Gaul. He appointed one of his sons mayor of the palace of Neustria, reserving for another of his sons the mayoralty of Austrasia. He made war on the Frisians and defeated their duke Radbod; and part of this people became converts to Christianity. He also defeated Willari, the duke of the Alamanni, and subdued his country. The Bavarians, too, recognized the Frankish suzerainty. The plans he had formed for reforming the church and convoking councils were interrupted by his death, which took place on the 16th of December 714.

Pippin III. (d. 768), the Short,[1] was son of Charles Martel. Before his death in 741 Charles Martel had divided the Frankish kingdom between his two sons, Carloman and Pippin, giving Carloman the eastern part and Pippin the western. Since 737 there had been no king in the Frankish realm; in the diplomas the two brothers bear the title of *majores palatii*, while the chroniclers call them simply *principes*. In 743, however, the mayors decided to appoint a king in the person of Childeric III., who was apparently connected with the Merovingian family. But Childeric was a mere figure-head, and had no power. The two brothers presided over the tribunals, convoked the councils at which the Frankish Church was reformed, assembled the host and made war, jointly defeating and subduing Duke Hunald of Aquitaine. In 747 Carloman unexpectedly abdicated, became a monk, and retired to a monastery near Rome, subsequently founding on Mt Soracte the monastery of St Silvester. From the time of the abdication Pippin was sole master; and in 751, after consulting Pope Zacharias, he took the title of king and removed the feeble Childeric to a monastery. He then got himself crowned by St Boniface, a ceremony which was new to France and which gave the sovereign immense prestige; henceforth the king of the Franks called himself *Gratia Dei rex Francorum*. Pippin's reign is marked by many important events. He received in France a personal visit from Pope Stephen II., who conferred on him the title of Patrician of the Romans and recrowned him. In return for these honours Pippin, at the appeal of the pope, made two expeditions into Italy, in 754 and 756; and he became the veritable creator of the papal state by conferring on the pope the exarchate of Ravenna, which he had wrested from Aistulf, the king of the Lombards. Pippin took Septimania from the Arabs, and after a stubborn war of nearly eight years' duration (760–68) succeeded in taking Aquitaine from its duke, Waifer. He also intervened in Germany, where he forced the duke of Bavaria, Tassilo, to become his vassal. In 763, however, Tassilo abandoned Pippin during an expedition against Aquitaine. Pippin made several expeditions against the Saxons, but failed to subdue them. He entered into relations with the Eastern Empire, exchanging ambassadors with the emperor Constantine Copronymus. During Pippin's reign Frankish institutions underwent some modification. The Frankish assemblies, previously held in the month of March (*champs de mars*), but under Pippin deferred to May (*champs de mai*), came to be more numerous, and served the king of the Franks as a means of receiving the gifts of his subjects and of promulgating his capitularies. At the head of the administration was placed the archchaplain, and an ecclesiastical chancellor was substituted for the ancient *referendarius*. Ecclesiastical reform was continued under Pippin, Bishop Chrodegans of Metz uniting the clergy of Metz in a common life and creating canons (see CANON). Pippin died on the 24th of September 768 at St Denis, leaving two sons, Charles (Charlemagne) and Carloman.

See H. Bonnell, *Die Anfänge des karolingischen Hauses* (Berlin, 1866); H. Hahn, *Jahrbücher des frankischen Reiches 741–752* (Berlin, 1863); L. Oelsner, *Jahrbücher des frankischen Reiches unter König Pippin* (Leipzig, 1871); J. F. Böhmer and E. Mühlbacher, *Regesten des Kaiserreichs unter den Karolingern* (2nd ed., 1899); and E. Mühlbacher, *Deutsche Geschichte unter den Karolingern* (Stuttgart, 1896). (C. Pf.)

PIPRĀWA, a village on the Birdpur estate in the Basti district, United Provinces, India. It lies on the Uska-Nepal road at mile 19·75; and about half a mile south of the boundary pillar numbered 44 on the frontier line between British and Nepalese territory. The village is celebrated as the site of the following discovery:—

In 1896 interest having been aroused by the discovery, only twelve miles away, of the Buddha's birthplace (see LUMBINI), William Peppé, then resident manager of the Birdpur estate, opened a ruined tope or burial mound situate at Piprāwa, but nothing of importance was found. In January 1897 he carried the work of excavation farther. A well, 10 ft. sq., was dug down the centre of the mound. After digging through 18 ft. of solid brickwork set in clay a massive stone coffer was found lying due magnetic north and south. Its dimensions were, 4 ft. 4 in. by 2 ft. 8¼ in. and 2 ft. 2¼ in. high. The stone lid of the coffer was split into four pieces; but the coffer remained perfectly closed, so accurately was the lid fitted into flanges on the sides of the box. The pieces were thus firmly held in their place, and the contents of the coffer were found intact. These consisted of five vessels, two vases, a bowl and a casket being made of steatite, and the fifth, also a bowl, of crystal. All these vessels are beautifully worked, the crystal bowl especially, with its fish-shaped cover handle, being as a work of art of high merit.[2] The coffer is of fine hard sandstone of superior quality, and has been hollowed out, at the cost of vast labour and expense, from a solid block of rock. Peppé calculates its weight, lid included, at 1537 ℔. It is only the great solidity of this coffer which has preserved the contents. A cover of one of the vases was found dislodged and lying on the bottom of the stone coffer. As this cover fits very well it must have required a quite violent shock to remove it. This was almost certainly the shock of an earthquake, and the same shock probably caused the split in the stone lid of the coffer itself.

The vessels contained a dark dust, apparently disintegrated ashes, small pieces of bone, and a number of small pieces of jewelry in gold, silver, white and red cornelian, amethyst, topaz, garnet, coral and crystal. Most of these are perforated for mounting on threads or wires, and had been, no doubt, originally connected together to form one or more of the elaborate girdles, necklaces and breast ornaments then worn by the women.[3] On the bottom of the stone box there was similar dust, pieces of bone and jewelry, and also remains of what had been vessels of wood. The knob forming the handle of one of these wooden receptacles was still distinguishable. The total quantity of scraps of bone may have amounted to a wineglassful.

An inscription ran round one of the steatite vases just below the lid.[4] The words mean: *This shrine for ashes of the Buddha, the Exalted One, is the pious work of the Sakiyas, his brethren, associated with their sisters, and their children, and their wives.* The thirteen words, in a local dialect of Pali, are written in very ancient characters, and are the oldest inscription as yet discovered in India. Twelve out of the thirteen are well-known words, the interpretation of which is not open to doubt. One word, rendered above by "pious work," has not been found elsewhere, and its derivation is open to discussion. The explanation here adopted as most probable was put forward by Professor Pischel of Berlin.[5] The phrase "pious work" probably had a precise technical connotation like the English "benefaction."

The monument must have been of imposing appearance. The diameter (on the ground level) of the dome is 116 ft. For 8 ft. from the summit of the ruin it was not possible to trace the outline. At that point the outer wall, if one may so call it, of the solid dome could be traced, and had a diameter of 68 ft. The dome, therefore, sloped inwards 1 ft. for every 3 ft. in height, in other words, it was, like all the most ancient of these artificial burial domes in India, a shallow dome, and cannot have been more than about 35 ft. high exclusive of the ornament or "tee" on the summit. We have in bas-reliefs of the 3rd century representations of what these ornaments were like—small square erections, like a shrine or small temple, surmounted by a canopy called from its shape a T. They were then more than a third of the height of the dome itself. The total height of this Sākiya tope will therefore have been approximately a little under 50 ft. It was probably surrounded by a carved wooden railing, but this has long since disappeared.

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[1] A surname given to Pippin III. on the strength of a legendary anecdote related by the monk of St Gall.

[2] An illustration from a photograph is given in Rhys Davids' *Buddhist India*, p. 131.

[3] For figures of the jewelry found see the plate in Mr Peppé's article, reproduced in Rhys Davids' *Buddhist India*, p. 89. For the jewelry of the time, ibid., pp. 90, 91.

[4] See illustration ibid., p. 129.

[5] *Zeitschrift der deutschen morgenländischen Gesellschaft*, lvi. 157.

All such monuments hitherto discovered in India were put up in honour of some religious teacher, not in memory of royal persons, generous benefactors, politicans, or soldiers or private persons, however distinguished. And we need have no hesitation in accepting this as a monument put up over a portion of the ashes from the funeral pyre of Gotama the Buddha. The account of the death and cremation of the Buddha, preserved in the Buddhist canon, states that one-eighth portion of the ashes was presented to the Sākiya clan, and that they built a *thūpa*, or memorial mound, over it.[1]

Mr Peppé presented the coffer and vases with specimens of the jewelry to the museum at Calcutta where they still are. He also gave specimens of the trinkets to the Asiatic Society in London.

Peppé's original article is in the *Journal of the Royal Asiatic Society* for 1898, pp. 573 sqq. Comments upon it, one or two of them sceptical, are in the same journal 1898, pp. 579, 588, 387, 868; 1899, p. 425; 1901, p. 398; 1905, p. 679; 1906, pp. 149 sqq. See also A. Barth, *Comptes rendues de l'academie des inscriptions* (1898), xxvi., 147, 233; Sylvain Levy, *Journal des savants* (1905) pp. 540 sqq.; and R. Pischel and Rhys Davids as quoted above. (T. W. R. D.)

PIQUA, a city of Miami county, Ohio, U.S.A., on the Miami River and the Miami & Erie Canal, 73 m. W. by N. of Columbus. Pop. (1890), 9090; (1900), 12,172, of whom 901 were foreign-born and 487 were negroes; (1910 census), 13,388. It is served by the Pittsburg, Cincinnati, Chicago & St Louis, and the Cincinnati, Hamilton & Dayton railways, and by inter-urban electric lines to Lima, Dayton and Covington. It has a park, a public library and a public hospital. There are quarries of blue limestone in the vicinity. The city has various manufactures, the factory products being valued in 1905 at $4,035,706. The municipality owns and operates its waterworks. On or near the site of Piqua was one of the principal villages of the Chillicothe division of the Shawnee tribe; the village also was called Chillicothe. It was destroyed by George Rogers Clark in 1782. A town was laid out here in 1809 under the name of Washington, and the present name, that of another division of the Shawnee tribe, was substituted in 1823. Piqua was chartered as a city in 1846. During the French and Indian War, in 1763, a battle was fought in this vicinity chiefly between the Miamis, Wyandots, Ottawas and other Indian allies of the French, and the Delawares, Shawnees, Cherokees, Catawbas and other Indian allies of the English, the English allies making an unsuccessful attempt to drive the French allies from their fortified position, Fort Piqua.

See Henry Howe, *Historical Collections of Ohio* (Columbus, 1891).

PIQUET, a game at cards, probably a development of *ronfa*, a game mentioned by Berni in 1526; *la ronfle* (included in Rabelais's list, *c.* 1530) may be regarded as the same game. The point at piquet was anciently called *ronfle*. The Spanish name of the game was *cientos* (*centum*, a hundred). Piquet was played in England under the name of *cent*, or *sant*, probably as early as 1550 (contemporaneously with the marriage of Mary to Philip of Spain). About the middle of the 17th century (shortly after the marriage of Charles I. to Henrietta Maria of France) the name cent was dropped in England, and the French equivalent, piquet, adopted. It is played by two persons, with a pack of thirty-two cards—the sixes, fives, fours, threes and twos being thrown out from a complete pack. At one time the *partie* was the best of five games of a hundred up (a player not obtaining fifty losing a double game). But now the *partie* is generally determined in six hands, the player making the largest aggregate score being the winner. The number of points won is the difference between the two scores, with a hundred added for the game. If, however, the loser fails to make a hundred in six hands, the number of points won is the sum of the two scores, with a hundred for the game. Piquet played in this way is called *Rubicon Piquet.*

The dealer deals twelve cards to his adversary, and twelve to himself, two at a time, or three at a time. He then places the eight undealt cards, called the "stock," face downwards on the table, the top five being for the elder hand (non-dealer) to take from first in exchange for his own. The players now look at their hands, and *carte blanche* (see later) having been declared, if there is one, put out (without showing them) such cards as they deem advisable in order to improve their hands, and take in an equivalent number from the stock. Each player must discard at least one card. If the elder hand discards less than the five he is entitled to, he must state how many he leaves. He is entitled to look at the cards he leaves, replacing them face downwards on the top of the stock. The younger hand then makes the exchange from the remainder of the stock. If the elder hand leaves any of the top five, the younger may exchange as many as remain in the stock, discarding an equal number. If the younger hand leaves any cards, he announces the number left. He may look at the cards he leaves. If he looks at them he must show them to the elder hand, after the elder has named the suit he will lead first, or has led a card.

If the younger hand elects not to look at the cards left the elder cannot see them. The younger hand must make his election before he plays to the card first led, or, if so required, after the dealer has named the suit he will first lead. Each player may examine his own discard at any time during the hand; but he must keep it separate from his other cards.

The elder hand next makes a declaration of what he has in his hand.

The "point" must be called first or the right to call it is lost. It is scored by the player who announces the suit of greatest strength, valued thus: ace 11; court cards, 10 each; other cards, the number of pips on each. Thus if the elder hand's best suit is ace, king, knave, nine, eight, he calls "five cards." If the younger hand has no suit of five cards, he says "good." The elder hand then says "in spades," or whatever the suit may be, or shows his point face upwards. If the younger hand has a suit of more than five cards, he says "not good." If the younger hand has also five cards, he says "equal" or "what do they make?" when the elder calls "forty-eight" (or "making eight," short for forty-eight). The younger must not inquire what the point makes unless he has an equal number of cards. If the younger hand's five cards make less than forty-eight he says "good"; if exactly forty-eight, he says "equal"; if more than forty-eight he says "not good." The player whose point is good reckons one for each card of it; if the points are equal neither player scores for point.

"Sequences" are usually called next, the elder hand stating what his best sequence is, and the younger saying, "good," "equal," or "not good," as in the case of the point. Any three or more consecutive cards of the same suit held in hand constitute a sequence. The order of the cards is as follows: ace (highest), king, queen, knave, ten, nine, eight, seven (lowest). A sequence of three cards is called a "tierce"; of four, a "quart"; of five, a "quint"; of six, a "sixième"; of seven, a "septième"; of eight, a "huitième." A tierce of ace, king, queen is called a "tierce major"; a tierce of king, queen, knave is called a "tierce to a king" (and so on for other intermediate sequences according to the card which heads them); a tierce of nine, eight, seven is called a "tierce minor." Sequences of four or more cards follow the same nomenclature; *e.g.* ace, king, queen, knave is a quart major; knave, ten, nine, eight, is a quart to a knave; and so on A sequence of a greater number of cards is good against a sequence of a smaller number; thus, a quart minor is good against a tierce major. As between sequences containing the same number of cards, the one headed by the highest card is good; thus, a quart to a queen is good against a quart to a knave. Only identical sequences can be equal. The player whose sequence is good reckons one for each card of it, and ten in addition for quints or higher sequences. Thus a tierce counts three; a quart, four; a quint, fifteen; a sixième, sixteen; and so on. If the elder hand's sequence is good, he names the suit, or shows it face upwards. If the highest sequence (or the sequence first called) is good, all lower sequences can be reckoned, notwithstanding that the adversary has a sequence of intermediate value. For example, A has a quart to a queen (good,) and a tierce minor. He calls and reckons seven, notwithstanding that B has a quart to a knave. B's quart counts nothing. If the highest sequence is equal, neither player scores anything for sequence, even though one player may hold a second sequence of equal or inferior value.

"Quatorzes" and "trios" are the next calls. "Quatorzes" are composed of four aces, four kings, four queens, four knaves, or four tens, in order of value; "trios" of three of any of these A quatorze, if good, reckons fourteen; a trio, if good, reckons three; one that is good establishes any smaller quatorzes or trios in his hand.

When the elder hand has done calling he leads a card. Before playing to this card, the younger hand reckons all that he has good, stating of what cards his claims are composed, or showing the cards claimed for. The elder hand leads any card he pleases; the younger plays to it. The younger hand must follow suit if able; otherwise he may play any card he thinks fit. It is not compulsory to win the trick. The leader counts one for each card led, whether it wins the trick or not. If the second player wins the trick he also counts one. The winner of the last trick counts an additional one for the last card. The tricks are left face upwards in front of the player who wins them. They may be examined by either player.

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[1] Translated in Rhys Davids' *Buddhist Suttas* (Oxford, 1881).

If each player wins six tricks the cards are "divided," and there is no further score. If one player wins more than six tricks he wins "the cards," and adds ten to his score. If one player wins every trick, he wins a *capot*, and scores forty for the cards, instead of ten.

During the play of the hand, a player is entitled to be informed as to any cards his adversary holds which he has reckoned as good, or has declared to be equal. A player may require his adversary to exhibit any such cards. But if a player, having played three cards of a sixième, declared as a quint, is asked how many he has left, he need only reply "Two."

During the progress of the hand each player repeats aloud the amount of his score for the time being. At the end of the hand the points scored are recorded by each player. If there is any difference in the written scores, a player's score of his own hand is deemed to be the correct one.

Example.—A (elder hand) has dealt him ace, king, knave of spades; ace, queen, knave, eight of hearts; knave, eight, seven of clubs; and nine, eight of diamonds. He discards king of spades; eight, seven of clubs; and nine, eight of diamonds. He takes in nine, eight of spades; king of hearts; nine of clubs; and king of diamonds.

B (younger hand) has ten, seven of spades; ten, nine, seven of hearts; king, queen, ten of clubs; and ace, queen, knave, ten of diamonds. He discards seven of spades; and nine, seven of hearts. He takes in queen of spades; ace of clubs; and seven of diamonds.

The hand then proceeds thus. A (calling his point) "five cards." B says "equal," or "what do they make?"

A "forty-nine," or "making nine." B "good."

A (counting his point) "five" and, counting his sequence, which is good) "a quart major, nine. Three knaves?" B "not good."

A (leads ace of hearts and says) "ten." B "four tens, fourteen, and three queens, seventeen" (plays the ten of hearts).

A (leads the remaining hearts and says) "eleven, twelve, thirteen, fourteen." B (plays seven, ten, knave, queen of diamonds, and repeating his score says) "seventeen."

A has now five tricks, and in order to win the cards should lead any card but a high spade. He leads king of diamonds, and says "fifteen." B (wins with ace and says) "eighteen" (and then leads the winning clubs, saying) "nineteen, twenty, twenty-one, twenty-two."

A (keeps ace, knave of clubs, and repeating his score says) "fifteen." B (leads queen of spades and says) "twenty-three."

A (wins with ace and says) "sixteen" (and leads knave, saying) "eighteen" (and adding ten for the cards) "twenty-eight."

A then writes on his scoring card 28; 23. B writes on his 23; 28. The pack is collected, and the next hand commences. Three scores (omitted in order to simplify the description of the game) have yet to be mentioned.

Carte Blanche.—If either player has no king, queen or knave in the hand dealt him, he holds *carte blanche*, for which he scores ten. As soon as a player discovers he has a *carte blanche*, he must tell his adversary; this he usually does by saying "discard for *carte blanche*." The adverse discard is then made (as explained under discarding), after which the *carte blanche* is shown by dealing the cards, face upwards on the table; they are then taken back into the hand.

Pique.—If the elder hand scores, in hand and play, thirty or more, before the younger hand counts anything in that deal, he gains a *pique*, for which he scores thirty.

Repique.—If a player scores in hand alone thirty or more before his adversary reckons anything, he gains a *repique*, for which he adds sixty to his score. Equalities do not prevent piques or repiques. A player who has an equal point or sequence scores nothing for it. Therefore if, notwithstanding the equality, a player makes thirty, in hand and play, or in hand, by scores which reckon in order before anything his adversary can count, he gains a pique or a repique.

The order in which the scores accrue is of importance. For the sake of convenience, the elder hand finishes his reckoning before the younger begins. The scores, however, whether made by the elder or younger hand are recordable in the following order: (1) *carte blanche*; (2) point; (3) sequences; (4) quatorzes and trios; (5) points made in play; (6) the cards. This will often affect a pique or repique. Thus, a pique can only be made by the elder hand, as the one he reckons in play when he leads his first card counts before points subsequently made in play by the younger hand. The younger, therefore, cannot make thirty in hand and play before the elder scores one. But the one reckoned by the elder hand when he leads his first card does not prevent his being repiqued, because scores made in hand have precedence of points made in play. The elder leads his first card and counts for it before the younger reckons, simply as a convenient way of stating that he has nothing in hand which is good. Again, say A has a quint (good), a tierce, and a quatorze (good). He scores thirty-two in hand alone; but, if his point is not good, he does not gain a repique, because the younger hand's point is recordable in order before the sequences and quatorze. *Carte blanche*, taking precedence of all other scores, saves piques and repiques. It also counts towards piques and repiques. A *capot* does not count towards a pique, as the *capot* is not made in play. It is added after the play of the hand is over. A player who reckons nothing that hand as a penalty is not piqued or repiqued if he holds any cards which, but for the penalty, would have reckoned before his adversary reached thirty.

See "Cavendish," *The Laws of Piquet and of Rubicon Piquet, adopted by the Portland Club, with a Treatise on the Game* (1882); "Cavendish," *Guide to Piquet* (1898).

PIRAM, or PERIM, an island in the Gulf of Cambay, forming part of Ahmadabad district, Bombay. Formerly notorious as the stronghold of a pirate chieftain, it has attained fame among palaeontologists for the large quantity of fossil remains discovered here in 1836, similar to the better-known Siwalik fauna.

PIRANESI, GIOVANNI BATTISTA, Italian engraver of ancient architectural subjects, was born in the earlier half of the 18th century, and studied his art at Rome. The great remains of that city kindled his enthusiasm and demanded portrayal. His hand faithfully imitated the actual remains of a fabric; his invention, catching the design of the original architect, supplied the parts that were wanting; his skill introduced groups of vases, altars, tombs; and his broad and scientific distribution of light and shade completed the picture, and threw a striking effect over the whole. One engraving after another was executed with much brilliancy; and, as the work went on, the zeal of the artist only waxed stronger. In course of time it was found necessary to call in the aid of all his children and of several pupils. He did not, in fact, slacken in his exertions till his death in 1778.

The plates of Piranesi, in which the severity of burin work is largely supplemented by the freer lines of the etching-needle, were collected and preserved by his son and coadjutor Francesco. They were published, to the number of about 2000, in 29 vols. fol. (Paris, 1835–1837).

PIRANO, a seaport of Austria, in Istria, 22 m. S.W. of Trieste by rail. Pop. (1900), 13,339, mostly Italians. In addition to viticulture and the cultivation of the olive, its principal resources are ship-building and fishing. In the neighbourhood are the most extensive works in Istria for the extraction of salt from the sea-water, which produce about 50,000 tons of salt annually. Pirano is celebrated for the victory of the Venetians over the fleet of the emperor Frederick Barbarossa in 1177. It passed under the domination of Venice in 1283 and became definitely incorporated with Austria, together with the other possessions of Venice in the Istrian Peninsula, in 1813.

PIRATE AND **PIRACY.** Sir Edward Coke (*Instit.* iii. 113) describes a pirate (Lat. *pirata*, from Gr. *πειρατής*, *πειρᾶν*, to attempt or attack), as *hostis humani generis*, and as a robber upon the sea. Sir J. Fitzjames Stephen in his *Digest of Criminal Law* defined piracy as follows: "Taking a ship on the High Seas or within the jurisdiction of the Lord High Admiral from the possession or control of those who are lawfully entitled to it and carrying away the ship itself or any of its goods, tackle, apparel or furniture under circumstances which would have amounted to robbery if the act had been done within the body of an English county" (cf. *A. G. for Hong-Kong* v. *Kwok-a-Sing*, 1873, L.R. 5 P.C. 179). Piracy, being a crime not against any particular state but against all mankind, may be punished in the competent court of any country where the offender may be found or into which he may be carried. But, whilst the practice of nations gives to every one the right to pursue and exterminate pirates without any previous declaration of war (pirates holding no commission or delegated authority from any sovereign or state), it is not allowed to kill them without trial except in battle. Those who surrender or are taken prisoners must be brought before the proper tribunal and dealt with according to law.

Piracy has been dealt with in a large number of English statutes, from 1536 down to the Territorial Waters Jurisdiction Act 1878 (41 & 42 Vict. c. 73), which provided for the maintenance of the existing jurisdiction for the trial of "any act of piracy as defined by the law of nations."

During the Spanish-American War the Spanish government issued (1898) a decree declaring that "captains, masters and officers of vessels, which, as well as two-thirds of their crew, are not American, captured while committing acts of war against Spain, even if they are provided with letters of marque issued by the United States" would be regarded and judged as pirates. This was not in accordance with the international practice on the subject. A public ship or one which is entitled to fly the flag of a belligerent and navigates under the cover of state papers, by the very sense of the term, is not a pirate. Again, during the Russo-Japanese War, the word "piracy" was freely applied in British newspapers to the seizure of the "Malacca" and other vessels held up by the "Peterburg" and "Smolensk," two cruisers belonging to the Russian Black Sea volunteer fleet, which in July 1904 passed as merchantmen through the Bosporus and Dardanelles and were transformed to their real character on the open sea. The application of the term in this case was equally inaccurate.

The conversion of merchant into war ships was one of the subjects dealt with by the second Hague Conference (1907), but it was agreed that "the question of the place where such conversion is effected remains outside the scope" of the agreement."

Piracy is essentially a crime under international law, and although any state may apply its penalties to its own subjects by analogy, as was done by Great Britain and the United States in connexion with the repression of the slave trade, they cannot be lawfully applied to subjects of other states. (T. Ba.)

Historical Sketch.—It has at all times been more difficult to enforce good order on the sea than on the land; or perhaps we ought to say that the establishment of law and order on the sea has in all ages of the world's history followed, but has not accompanied, and has still less preceded, the creation of a good police on the land. The sea robber, or pirate, cannot make a profit from any part of his booty except the food which he consumes, or the vessels which he may use, unless he can find a market. But so long as he is sure that he will somewhere meet a purchaser for the goods he has taken by violence, he has every encouragement to pursue his trade. Therefore from the times described in the *Odyssey*, down to the days when Sir Henry Keppel sailed in H.M.S. "Dido" to suppress the pirates of Borneo, and when Rajah Brooke of Sarawak co-operated with him on land, we find that the prevalence of piracy and the suppression of it have been closely dependent on the efforts made to rout it out from its lurking-places on the coast, and the degree of success achieved.

Very different types of men have been named pirates. They have in fact been so unlike that to class them all together would be in the last degree unjust. The Greek in the youth of the world, and the Malay of Borneo in the 19th century, knew of no rule of morals which should restrain them from treating all who lay outside the limits of their city or their tribe as enemies, to be traded with when strong and plundered when weak. They might be patriotic, and law-abiding men towards the only authority they recognized. Their piracy was a form of war, not without close moral analogies to the seizure of Silesia by Frederick the Great, the attempted seizure of Spain by Napoleon. Indeed the story of this latter venture, with its deceitful preliminary success and its final disaster, may fairly be compared with the fall of Ulysses and his companions on the Cicones, as told in the ninth book of the *Odyssey*. Yet it would be highly uncritical to class Ulysses or Napoleon with Captain Avery, or Captain Kidd, or Bartholomew Roberts. We are not here concerned with the legal aspects of piracy, but with the true character of the persons to whom the name pirate has been applied at various times. The term was applied by the Romans to the adventurers against whom Pompey was commissioned to act by the Gabinian Law, by the English of the 9th and 10th centuries to the Vikings, and by the Spaniards to the English, French and Dutch who were found sailing beyond the line. Sufferers by naval commerce-destroyers call it "a piratical form of warfare." But the pirates of the Roman Republic were no mere "gang of robbers." They were the victims of a time of conquest and "general overture"—"the ruined men of all nations, the hunted refugees of all vanquished parties, everyone that was wretched and daring—and where was there not misery and violence in this unhappy age? It was no longer a gang of robbers who had flocked together, but a compact soldier state, in which the freemasonry of exile and of crime took the place of nationality, and within which crime redeemed itself, as it so often does in its own eyes, by displaying the most generous public spirit." Such men are akin to the *fuorusciti* of Italian history or the Dutch Beggars of the Sea, the victims of party strife in the cities, who took to the sword because they had no other resource. *Mutatis mutandis* we may say as much for the intruders beyond the line, whom history calls the "Buccaneers" (*q.v.*). The "Vikings" (*q.v.*) were a portion of the Barbarian invasions. The "Barbary Pirates" (*q.v.*) stand apart. As for the piratical character of the commerce-destroyer, or privateer—why are we to brand Captain Fortunatus Wright, the Englishman who captures a French merchant ship, or Captain Robert Surcouf, the Frenchman who captures a British East Indiaman, as piratical, and not make the same reproach against Admiral Lord Howe, or Admiral Don Luis de Córdoba, who with a fleet captures whole convoys?

The pirate pure and simple is that member of an orderly community who elects to live on the sea, by violence and robbery, making no distinction between his own city or tribe and any other. The old adage that "war makes thieves and peace hangs them" has ever been peculiarly true of the sea. War has always been conducted there by the capture of an enemy's property, and by division of the spoil. A portion of the naval forces of all nations has been composed of privateers, letters of marque or corsairs, who plundered with a licence. They have ever found a difficulty in drawing the line between enemy and neutral; when peace returned some of them found it hard to be content with honest wages earned by dull industry. Nelson declared that all privateers were no better than pirates. He was borne out by the experience of Great Britain, which at the beginning of the Seven Years' War had to take strong measures to repress the excesses of its privateers, and to hang a good few of them as mere pirates. The pirates suppressed by Pompey did not all submit to remain in the settlements he made. Some continued to rob at sea. If we can trust the *Pastoral* of Longus, and the other Greek romances, the pirate was a known type even under the Roman peace, but it is highly probable that he was more of a stock literary figure than a reality. Before the Roman peace, and during long centuries after it had been shattered, piracy was common. It grew out of a state of war. In modern times—even down to 1815—a recrudescence of piracy has followed regular hostilities. But there are other conditions which have a material influence, such as the need for a lurking-place and for a receiver of the plundered goods. An archipelago provides the best lurking-places, and next to it a coast of many inlets. Therefore the Greek Islands, the British Isles, the Antilles, the Indian Ocean, the coast of Cilicia in Asia Minor, of Dalmatia, of Malabar and of Norway, have all at one time or other, and some of them for centuries, been haunts of pirates. The convenience of the place had to be completed by the convenience of the market. In the ancient world, and the middle ages, the market never failed. One city or tribe had little care for the sufferings of another. The men of the Cinque Ports who plundered the men of Yarmouth knew that their own townsmen would never call them to account, and therefore they had a safe refuge. Even when the medieval anarchy had come to an end on land, the sea was lawless. When peace was made with Spain after the death of Queen Elizabeth there were many who could not settle down to a life of industry. Some took the plain course of betaking themselves to Algiers or Salee. But there were many who prowled nearer home. Sir William Monson, in his *Naval Tracts*, tells how he was sent in 1605 to hunt pirates out of the Shetlands and the Hebrides. He found none at sea near Scotland, but some unemployed, whom he shipped and used as guides and informers, on the coast of Ireland. At Broad Haven he discovered an Irish gentleman of the name of Cormat (presumably Cormac) living in some dignity. His house was "the well-head of all pirates," and their captains were the lovers of his daughters. Monson found agents of merchants of London and of Galway, who came to buy the goods which the pirates had to sell at a bargain. He put that interesting family under the gallows, and frightened them into turning king's evidence. It was his boast that he had cleared the Irish coast of pirates, but we know that they were common late in the reign of Charles I., and that under the name of "sea Tories" they abounded during the Civil War both in Ireland and in the Scilly Isles. Their existence was prolonged by the weakness of the government, which when piracy became very rampant took the disastrous course of offering pardon to all who would come in by a certain date. As a matter of course many did, and when their booty was spent returned to their piratical trade. Monson says that the pirates he caused to be executed had already tasted of the king's mercy. While there were friendly harbours to anchor in, purchasers to be met and a very fair prospect of a free pardon, piracy was not likely to cease.

As the 17th century drew on the law and the police became too strong for such persons as Mr Cormat at Broad Haven, and his pirate friends. But the pirate class did not cease. It was only driven to a wider field of operations—to a field which in fact stretched from the Red Sea to New England. On this wide portion of the earth's surface everything combined to favour the pirate. In the West Indies there was a "well-head" of immense capacity. Spain was forced late and reluctantly to recognize the legitimacy of any foreign settlement. She would rather put up with the lawless adventurers known as the "Brothers of the Coast" and the "Buccaneers" than co-operate with foreign governments to suppress them. Even when she renounced her full pretensions, several of the islands remained unoccupied except by the lingering remnants of the native races. Swine and cattle had been let loose on many of them, and had multiplied. The turtle was abundant and succulent. There was no want of food. A population with predatory instincts had been formed in the early days of hostile settlement and buccaneering. Jamaica was full of the so-called "private men-of-war" whose doings are prominent in the correspondence of the early governors, who were not uncommonly their associates. Add to this that the commercial policy of Spain denied to her colonists the right of trading with foreigners, and yet that she could not supply their needs herself. Hence arose a smuggling trade which had affinities with piracy. The lawless trader was not liable to be asked awkward questions, as to the origin of his cargo, by the Spanish American who purchased it on the sly for money or by barter. Nor were any questions asked him when he brought his cargo to Jamaica, San Domingo, the Carolinas, New England or even Europe. In the decay of Spain her navy was not to be feared. But it was not the commercial policy of Spain alone which helped the pirate. Great Britain, and France also, insisted that their colonists should trade exclusively with or through them. The colonists were always ready to buy "good cheap" from the smuggler, and never ask him whether the East Indian produce —tea, silk, spices and so forth—he offered for sale were purchased or plundered in the Red Sea or on the coast of Malabar or of Coromandel. Add to all this that the police and patrol work of regular navies was but superficially done even in peace, and hardly at all in war, and that in the British colonies there was no judicial machinery for trying pirates till the 11th and 12th years of William III. (1700, 1701), and it will be seen that all the conditions favoured the pirate. In the East the decadence of the Mogul Empire was plunging India into anarchy, and it had no navy. Yet a large native trade existed, conducted by "Moors," as they were called, and Madagascar, a great "no-man's-land," afforded ample anchorage and food. To get possession of a ship, to sail to the East, to plunder the "Moors," to sell the booty in New England or the Carolinas, to spend the produce in riotous living, and go to sea on the same errand again, was the round of life of the large class of known pirates, who formed a recognized element of the population of Massachusetts and New York at the end of the 17th century. These are the men we know best, for they were encouraged by the tolerance shown them to come into the light. Others are buried in, or only dimly visible in, obscurity. Some trace of these latter may be found in the *Letter Books* of the Old Providence Company, a puritan society formed in the reign of Charles I., of which Pym and the earl of Warwick, afterwards the Parliamentary admiral of the Civil War, were governors. It was founded to colonize Old Providence on the coast of Honduras, a place not to be confused with another pirate haunt, New Providence in the Bahamas. It took to plain piracy and was suppressed by the Spaniards in 1638. Warwick made a regular business and large profits by fitting out "privateers," which were in fact pirates on the "Spanish main," not the seas of America, as some have thought, but the coast of the mainland.

The lives of the later and better known pirates may be illustrated by the career of Captain Avery, or Every (alias Bridgman), whose renown was great at the end of the 17th century, and who has the credit of having inspired Defoe's *Life, Adventures and Piracies of Captain Singleton.* Avery was mate of a Bristol ship hired by the Spaniards in 1694 to serve as a coastguard vessel in South America. She was called the "Charles II.," commanded by one Captain Gibson, and mounted 40 guns. While the "Charles II." was lying at Corunna, in company with another vessel also hired by the Spaniards, waiting for the payment of wages which was delayed, Avery persuaded part of the two crews to seize her and sail with her on a piratical voyage to the East. The enterprise was carried out without bloodshed or, apparently, coercion of those who were unwilling to go. Avery and his crew sailed to Madagascar, a regular haunt of the pirates. Many of them ended by remaining for life among the natives. The adventurers in the "Charles II.," who had already made some small prizes, English and Danish, were joined at the island by others of the same character who had come from the West Indies. From Madagascar they went to the Straits of Bab-el-Mandeb, to lie in wait for the trade from India. Several prizes were taken, and finally a large and valuable ship, belonging "to the Great Mogul and his subjects," was captured about ten miles from Surat. Avery and his crew now hastened to New England to sell their booty. The "Charles II." was disposed of as a privateer at Providence, and the pirates bought a sloop in which they sailed along the coast of the English colonies, selling their spoil, with the consent of the colonists and the connivance of the officials, who were bribed. In an evil hour for themselves they decided to come to England. The Indian governments, exasperated by the piracy practised at the expense of their subjects, were threatening reprisals on the East India Company. The Company made complaints to the government at home, and energetic measures of repression were taken. Avery himself escaped capture, but several of his men were brought to trial, condemned and executed. It is to be noted that when first tried, on the 19th of October 1696, they were acquitted. They were, however, re-tried on other counts, on the 31st of October. The charge of Lord Chief Justice Holt to the jury, and the address of Sir Charles Hedges, the admiralty judge, shows that they felt both the importance and the uncertainty of securing a verdict.

The cruise of Avery is not only a typical example of a piratical venture, but it is an important date in the history of the policing of the sea. The English government was roused to a sense of the necessity for strong measures to repress piracy. All the steps taken were not according to knowledge. The extraordinary private venture of Lord Bellamont and his associates who sent out Captain Kidd (*q.v.*), a man of piratical antecedents, to suppress pirates in the Eastern seas, brought deserved discredit upon them. The decision taken on the advice of Burchett, the secretary of the admiralty, to offer a pardon to all who would surrender by a given date—for all piracies committed before the 30th of April to the east of the Cape of Good Hope, and the 30th of June 1699 to the west—was an error. It induced many to come in, but it also gave all pirates the hope that they would in the future be provided with similar means of escape. The establishment of admiralty courts in the East Indies and America and the despatch of warships were more effectual methods. Yet it was long before piracy was thoroughly checked; indeed the signing of the Peace of Utrecht was followed by a recrudescence of this form of crime. The privateers who swarmed in the West Indies and, as long as the war lasted, used, in the phrase of the time, to join the squadrons of war-ships "on the plundering account," could not settle down to dull industry. They leagued themselves into a species of pirate republic, with its capital at Providence in the Bahamas. In 1718 a special force had to be sent against them under Woodes Rogers, who is best remembered now for having taken Alexander Selkirk from the island of Juan Fernandez, in the course of a privateering voyage into the Pacific with the "duke" and "duchess" of Bristol. Rogers broke up the Providence settlement, and did a similar piece of service on the coast of Madagascar. Piracy did not, however, die. The Asiento (*q.v.*) Treaty having given Great Britain a monopoly of the slave trade with Spanish America, the monopolists, *i.e.* the South Sea Company and Royal African Company, were of course subject to the competition of interlopers. The interlopers were the natural friends of the pirates, who divided their activity between the Antilles and the west coast of Africa, plundering in the second, selling and re-fitting, not without further plunder, in the first. The most notorious of these freebooters was Bartholomew Roberts, who was introduced to piracy by Howel Davis. Roberts was the nearest known approach to the pirate of romance, ostentatious, brave, not without touches of generosity. He was killed in action with Captain Chaloner Ogle, of H.M.S. "Swallow," on the coast of Africa, in 1722.

As the American colonies grew more settled piracy became intolerable to them. Yet it lingered on the coast of North Carolina, where the pirates could either terrorize the scattered inhabitants, or were encouraged by dishonest officials. Here flourished the grotesque brute known as Blackbeard, Edward Teach, till he was run down and slain by Lieut. Milvain in 1718. It was noted that several of those who helped to suppress him afterwards "went a-pirating" themselves. So strong was the piratical tradition of the New World that even men of some standing fell into it. "Major" or Captain Stede Bonnet, who was condemned and executed at Charleston, South Carolina, as a pirate, in 1718, was a gentleman of some property in Barbadoes, who first ventured to sea in a ship of his own. Stede Bonnet had taken advantage of an act of grace, had come in on a proclamation, and had returned to a pirate's life. The last great explosion of piracy in the West Indies followed the peace of 1815. Here again we find the old conditions—privateers and other unsettled men, the safe lurking-place and the receiver. The refuge and the market were supplied by the Spanish colonies, which were plunged into anarchy by their revolt against Spain. The pirates were able to masquerade as "patriot" navies. The sloth and corruption of Spanish captains-general of Cuba were no less favourable to the pirates. The south coast of the island became a haunt of these villains till the British and American governments were driven to combine for their suppression. When they had been followed into their hiding-places and their vessels sunk, they took to brigandage on land, and were garrotted by the Spanish authorities in self-defence. The piracy of the Greek islands went on to later years, and the Malays were not tamed till nearly 1850. On the coast and the rivers of China piracy was and is endemic, but the sailing junk has no chance with the modern steamer. When cases of piracy have occurred in the Straits of Malacca or in the China seas, by which Europeans have been the sufferers, the crime has generally been perpetrated by men who shipped as passengers or as crew, and who surprised the vessel. The pirate has been as useful to the author of modern tales and poems as to the writers of the Greek romances. When he is seen in authentic evidence he is found to have been for the most part a pitiful rogue. His gains were but small. A share of £200 was wealth to a mere sailor, and one of £1000 wealth beyond the dreams of avarice. He rarely fought a warship if he could help it, and indeed nothing is more surprising than his readiness to surrender when the fate before him was the gallows.

AUTHORITIES.—The pirates of the ancient world are admirably dealt with in Mommsen's *History of Rome*. For the modern pirate, see Monson's "Naval Tracts" in *Churchill's Voyages*, v. 5 (London, 1744–1746), and in the edition of the Navy Record Society (1902). But the best accounts are to be found in the *State Trials*, vols. xiii., xiv., xv. (London, 1812). Captain Charles Johnson's *General History of the Pyrates* (London, 1724) must be used with caution. He no doubt learnt much from pirates who, having come in on a proclamation, were free to talk, but he cannot always be reconciled with authentic records. The *Documents relative to the Colonial History of the State of New York* (Albany, 1856–1858) contain many curious details. For the eastern seas, the *Compendious History of the Indian Wars; with an account of the Rise, Progress, Strength and Forces of Angria, the Pyrate*, &c., by Clement Downing (London, 1737) is useful. (D. H.)

PIRKE ABOTH. The penultimate tract of the fourth part of the Mishnah is the booklet of proverbs in five chapters called *Massecheth Aboth* (*tractatus patrum*), better known with a sixth chapter as *Pirke Aboth* (*capitula patrum*). For *Pirke Aboth* in English see *The Authorized Daily Prayer Book of the united Hebrew congregations of the British Empire*, with a new translation by the Rev. S. Singer. The six chapters are there appointed to be read one on each Sabbath afternoon between Passover and New Year. Formerly they were read, in places at least, on the six Sabbaths between Passover and Pentecost only. The subsections of the chapters are hereinafter numbered as in the Authorized Prayer Book.

Chapters i., ii.—The Mosaic succession has first to be established. Moses (i., 1–3) having received the Torah from Sinai, it was handed down to Joshua, the Elders (Josh. xxiv. 31), the Prophets and the men of the Great Synagogue, from one of the last of whom, Simon Justus, it was received by Antigonus of Socho. Next are named (i. 4–15), without any title, as links in the chain of tradition, five pairs of teachers, the last Hillel and Shammai, elsewhere in the Mishnah called *mundi patres* (Surenh. iv. 324). Rabban Jochanan ben Zacchai (ii. 9) "received from Hillel and Shammai." Sayings of Jochanan and his five disciples follow, and chap. ii. ends with words of their somewhat younger contemporary, Rabbi Tarphon (Τρύφων), to the effect *Ars longa vita brevis*. These sections (i. 1–15, ii. 9–21) contain the "Kern der Sammlung" (Strack). After the sayings of Shammai (i. 15) come interpolated sayings (i. 16–ii. 8) of Rabban Gamaliel I., Rabban Simeon, "Rabbi," *i.e.* R. Jehudah ha-Nasi (cent. A.D. 1–2), the traditional redactor of the Mishnah, Rabban Gamaliel II. and Hillel, which break the sequence.

Chapters iii., iv.—Maxims of numerous authorities, mostly Mishnah teachers and called Rabbis (Matt. xxii. 7 seq.; *J. F.* p. 27), not in exact chronological order.

Chapters v., vi.—Chap. v. which is *sui generis*, is presumably of later date than what precedes. Naming no teacher until the end, it combines historical, legendary and didactic elements. It touches upon the miraculous and its place in nature (v. 9). In form it is a series of numbered groups of things, from the ten creative Sayings to the triads of qualities which differentiate the disciples of Balaam and Abraham. R. Jacob ben Shimshon's commentary makes Aboth end with the saying of Jehudah ben Tema (v. 23), "Be bold as a leopard, and swift as an eagle, and fleet as a hart, and strong as a lion, to do the will of thy Father who is in heaven." Chapter vi., on *acquisitio legis*, is thought to have been added for use on the last of the six sabbaths above-mentioned (Strack, *J. F.* Ap. p. 61). In some manuscripts there are seven chapters.

Pirke Aboth serves as a primer to the student of rabbinic Judaism. For the most part in simple Hebrew, it has a few sayings in Aramaic (i. 13–ii., 7, v. 25, 26) and some adopted Greek words, as *paraclete* (iv. 13; Philo). He who would be pious should fulfil the dicta of Aboth (Baba Kam. 30a). It gives favourite aphorisms of leading Jewish teachers who flourished in or before the earliest Christian centuries, and supplies material for some interesting illustrations of the New Testament. Too heterogeneous to be represented by a few extracts, the collection must be read through to be appreciated. Among the sayings of Hillel we miss the best known one, *What is hateful to thee do not*, &c. (*J. F.* p. 142), with which we may now compare Ecclus. xxxi. 15 Heb., "Know (?) thy neighbour is as thyself, and consider what thou hatest." Of the precept, "Make a fence to the Torah" (i.1; cf. iii. 17) it may be said that "everything is therein." As a doctrine of development and as an ethical principle it is reflected in Clement of Alexandria's view of philosophy as a φραγμός of the vineyard (Strom. i. 20), and Polycarp's saying, "He that has love is far from all sin." The use of Aboth in the synagogue stamps it as authoritative, and, with its intrinsic excellence, has led to its being "the most popular of all rabbinical writings." For midrashic comments upon it see the Aboth of Rabbi Nathan (ed. S. Schechter, Vienna, 1887), or the rendering of it (new ed., New York, 1900) in M. L. Rodkinson's translation of the Babylonian Talmud into English. (See also APOCRYPHAL LITERATURE, § *Old Testament*, II. *d*.)

BIBLIOGRAPHY.—Aboth is included in editions of the Mishnah and the Talmud Babli, and in many prayer-books. For separate editions from about 1484–1485, see Moritz Steinschneider's Bodleian *Catalogus*, col. 228–239, 2785, and other works cited in Herm. L. Strack's very useful פרקי אבות, *Die Sprüche der Väter* (ed. 3, 1901). See also C. Taylor's *Sayings of the Jewish Fathers* (ed. 2, 1897, referred to above as *J. F.*) a separate *Appendix* (1900) describes or enumerates manuscripts of Aboth—and *Jewish Encyclopedia*, art. "Abot." (C. T.*)

PIRMASENS, a town of Germany, in the Bavarian Palatinate, 40 m. W. by S. of Spires, on the railway from Biebermühle. Pop. (1905), 34,002. The only noteworthy buildings are the town-hall and the principal Evangelical church, which contains a fine monument to Louis IX. (d. 1790), landgrave of Hesse-Darmstadt, who made the town his residence. The staple industry is the production of boots and shoes; but musical instruments, leather and machines are also manufactured. Pirmasens owes its name to a St Pirmin, who is said to have preached Christianity here in the 8th century. It originally belonged to the count of Hanau-Lichtenberg, but passed to Hesse-Darmstadt in 1736. In September 1793 the Prussians gained a victory here over a body of French troops.

See T. Weiss, *Pirmasens in der Franzosenzeit* (Pirmasens, 1905).

PIRMEZ, OCTAVE (1832–1883), Belgian author, was born at Châtelineau in 1832. He belonged to a well-known Belgian family, and his cousin, Édouard Pirmez, was distinguished for his works on literary and political subjects. He lived an uneventful life at his château of Acoz, in Hainaut, where he died in May 1883. Pirmez was an ardent admirer of the French romanticists. His works include *Les Feuillées: pensées et maximes* (1862); *Victor Hugo* (1863); *Jours de solitude* (1869); *Rémo; Souvenirs d'un frère* (1880); *Heures de philosophie* (1881); and the posthumous *Lettres à José* (1884). These books form a history of his emotional life, and reveal an extreme melancholy.

See *Vie et correspondance d'Octave Pirmez* (1888), by Adolphe Siret and José de Coppin.

PIRNA, a town in the kingdom of Saxony, on the left bank of the Elbe, 11 m. above Dresden, and on the railway to Bodenbach and Prague. Pop. (1905), 19,220. The town is regularly built, with promenades covering the site of the old fortifications; the most notable edifices are the fine Gothic parish church, built in the 16th century and restored in 1890, and the old town-hall. Excellent sandstone is found on both banks of the Elbe. There are manufactures of glass, machinery, cigars, pottery and enamelled goods; and there is a trade in grain, fruit and timber, mainly carried on by river, and a little shipbuilding. Pirna, originally a Slavonic settlement, was for many years in the alternate possession of Bohemia and Meissen, but it became permanently united with the latter, and thus with Saxony, in 1405. The Sonnenstein, a fortress on a commanding eminence above the town, was erected in the 16th century on the site of an older castle by the elector of Saxony, Augustus I. It was once considered the most important fortress on the Elbe, and successfully withstood the Swedes in 1639, but it was captured and dismantled by the Prussians in 1758, and in 1813 was occupied by the French.

See R. Hofmann, *Zur Geschichte der Stadt Pirna* (Pirna, 1891); E. Küngel, *Führer durch Pirna* (Pirna, 1889); the *Urkundenbuch der Städte Dresden und Pirna*, edited by C. F. von Posern-Klett (Leipzig, 1875); and the publications of the *Verein für Geschichte der Stadt Pirna* (Pirna, 1897 seq.).

PIROGUE, or PIRAGUA (the French and Spanish forms respectively of a Caribbean word for this type of vessel; it has at various times taken many corrupt forms, *e.g. periagua, pettiaugua, pettyoagar*), originally the native name of a vessel made by hollowing out the trunk of a tree, a "dug-out"; hence applied to many different developments of this type of vessel used in the West Indies and along the American coast. An early improvement was to split the "dug-out" into two sections and insert a flat bottom of planking to widen it; another form had a leeboard, was decked in at either end, and had two masts.

PIRON, ALEXIS (1689–1773), French epigrammatist and dramatist, was born at Dijon on the 9th of July 1689. His father, Aimé Piron, was an apothecary, who wrote verse in the Burgundian patois. Alexis began life as clerk and secretary to a banker, and then studied law. In 1719, when nearly thirty years old, he went to seek his fortune at Paris. An accident brought him money and notoriety. The jealousy of the regular actors produced an edict restricting the Théâtre de la Foire, or licensed booths at fair times, to a single character on the stage. None of the ordinary writers for this theatre would attempt a monologue-drama for the purpose, and Piron made a great success with a piece called *Arlequin Deucalion*, representing Deucalion immediately after the Deluge, amusing himself with recreating in succession the different types of man. In 1728 he produced *Les Fils ingrats* (known later as *L'École des pères*) at the *Comédie Française*. He attempted tragedy in *Callisthène* (1730), *Gustave Vasa* (1733) and *Fernand Cortès* (1744), but none of these succeeded, and Piron returned to comedy with *La Métromanie* (1738), in which the hero, Damis, suffers from the verse mania. His most intimate associates at this time were Mlle Quinault, the actress, and her friend Marie Thérèse Quenaudon, known as Mlle de Bar. This lady was slightly older than Piron and not beautiful, but after twenty years' acquaintance he married her in 1741. He died on the 21st of January 1773, in his eighty-fourth year. He was elected in 1753 to the Academy, but his enemies raked up a certain *Ode à Priape*, dating from his early days, and induced Louis XV. to interpose his veto. Piron however was pensioned, and during the last half-century of his life was never in any want. His best title to remembrance lies in his epigrams. The burlesque epitaph on himself, in which he ridicules the Academy—

"Ci-gît Piron, qui ne fut rien,
Pas même académicien"—

is well-known, while many others are as brilliant. Grimm called him a "machine à saillies."

Piron published his own theatrical works in 1758, and after his death his friend and literary executor, Rigoley de Juvigny, published his *Œuvres complètes*. M. Bonhomme produced a critical edition in 1859, completed by *Poésies choisies et pièces inédites* in 1879.

PIROT (Turkish *Shehr-Koey*), a Servian town, 12½m. from the Bulgarian frontier at Tsaribrod, on the railway line between Nish and Sofia. Pop. (1900), 10,428. Pirot is the seat of the prefecture for the department of the same name, with a tribunal, several schools and a custom-house. It is the only proper industrial town in Servia, having numerous small factories for the manufacture of thin cloth (*shayak*), woollen braid (*gaytan*), and especially carpets. Its carpets have a great reputation in the Balkan Peninsula for their quaint designs, durability and freshness of colour. Pirot has a medieval fortress, believed to have been built on the site of the Roman fortress *Quimedava*, on the military road leading from Old Naissus to Philippopolis. The town is of great strategical importance, for which reason the Russian plenipotentiaries at the Berlin congress (1878) stubbornly tried to include it within the Bulgarian frontier, while Austria and some other Powers insisted that it should be given to Servia. In the war between Servia and Bulgaria in 1885 the Bulgarians occupied and held it until the conclusion of peace.

PISA, a town, archiepiscopal see and capital of a province of the same name, Tuscany, Italy, on the Arno, 7 m. from the sea[1] and 49 m. west of Florence by rail. Pop. (1881), 42,779; (1900), 61,279. It still retains its ancient walls, 6¼ m. in circuit, and is defended by a citadel on the south-west. The principal streets run alongside the river, and are lined with fine buildings. Besides the cathedral, the baptistery and the famous leaning tower, the city possesses several notable churches, as the Renaissance church of the Tuscan order of St Stephen, built in 1562 from plans by Vasari; San Niccolo, with a four-storeyed tower (1230), built by Niccola Pisano, and the tomb of John of Swabia, the parricide; Santa Caterina (1262); Santa Maria della Spina, in the Italo-Gothic style, built in 1230 and restored in 1872; San Sepolchro, erected in 1150 by Diotisalvi; San Francesco, with frescoes by Taddeo Gaddi; and the basilica of San Michele (1018). Amongst the secular buildings may be mentioned the royal palace; the archiepiscopal palace; the palace of the order of St Stephen, built by Niccola Pisano and reconstructed by Vasari; the Upezzinghi (formerly Lanfreducci) palace, built of Carrara marble in 1590; the Lanfranchi, Agostini and other palaces; the university (1472); a large hospital (1258); and fine market halls. There are statues to Cosimo I. (by Francavilla), Archduke Leopold, and Ferdinand I. The city possesses also an academy of the fine arts, with a gallery of paintings; and the university a library of 120,000 volumes, a natural history museum, botanical garden and agricultural schools. The university, founded in 1338, has faculties of law, medicine, mathematics and philosophy and literature, and is to this day one of the most famous in Italy.

The architects of the cathedral were Boschetto and Rinaldo, both Italians, probably Pisans. It is in plan a Latin cross, with an internal length of 311½ ft. and a breadth of 252 ft. The nave, 109 ft. high, has double vaulted aisles and the transepts single aisles; and at the intersection of nave and transepts there is a cupola. The basilica is still the predominent type, but the influence of the domed churches of Constantinople and the mosques of Palermo is also apparent. The pillars which support the nave are of marble from Elba and Giglio; those of the side aisles are the spoils of ancient Greek and Roman buildings brought by the Pisan galleys. Externally the finest part of the building is the west front, in which the note struck by the range of arches running round the base is repeated by four open arcades. Of the four doors three are by John of Bologna, who was greatly helped by Francavilla, Tacca and others; that of the south side, of much older date, is generally supposed to be the work of Bonanno. Of the interior decorations it is enough to mention the altars of the nave, said to be after designs by Michelangelo, and the mosaics in the dome and the apse, which were among the latest designs of Cimabue. The baptistery was completed only in 1278, and marred in the 14th century by the introduction of Gothic details. The building is a circle 100 ft. in diameter, and is covered with a cone-surmounted dome 190 ft. high on which stands a statue of St Raniero. The lowest range of semicircular arches consists of twenty columns and the second of sixty; and above this is a row of eighteen windows in the same style separated by as many pilasters. In the interior, which is supported by four pilasters and eight columns, the most striking features are the octagonal font and the hexagonal pulpit, erected in 1260 by Niccola Pisano. The campanile or "leaning tower of Pisa" is a round tower, the noblest, according to Freeman, of the southern Romanesque. Though the walls at the base are 13 ft. thick, and at the top about half as much, they are constructed throughout of marble. The basement is surrounded by a range of semicircular arches supported by fifteen columns, and above this rise six arcades with thirty columns each. The eighth storey, which contains the bells, is of much smaller diameter than the rest of the tower, and has only twelve columns. The height of the tower is 179 ft., but the ascent is easy by a stair in the wall, and the visitor hardly perceives the inclination till he reaches the top and from the lower edge of the gallery looks "down" along the shaft receding to its base. The tower leans or deviates from the perpendicular, to a striking extent, which has gradually increased: it was 15½ ft. out of the perpendicular when measured in 1829, and 16½ ft. in 1910. There is no reason to suppose that the architects, Bonanno and William of Innsbruck, intended that the campanile should be built in an oblique position; it would appear to have assumed it while the work was still in progress. The foundations are not more than 10 ft. deep, and their circumference only that of the tower. The Campo Santo, lying to the north of the cathedral, owes its origin to Archbishop Ubaldo (1188–1200), who made the spot peculiarly sacred by bringing fifty-three shiploads of earth from Mount Calvary. The building, erected in the Italian Gothic style between 1278 and 1283, by Giovanni Pisano, is of special interest chiefly for its famous frescoes.

There are numerous industries, the most important being the manufacture of cottons. In the vicinity are the royal stud-farm (horses and dromedaries) of Cascine di San Rossore, and the mineral baths of San Giuliano, alkaline-ferruginous, with temperature 91·4° to 105·8° Fahr. At the mouth of the Arno, joined to the city by a steam tramway, is the seaside resort of Marina di Pisa, also known as Bocca d'Arno, a well-known centre for landscape painters.

The old town occupied the site of the ancient Pisae on the right bank of the Arno. The foundation of Pisae is by tradition ascribed to a very remote period, and it was often (possibly only owing to the similarity of name) believed to have been founded from Pisae in Elis. It is first mentioned in history as the place at which a Roman army from Sardinia landed in 225 B.C., its harbour being at the mouth of the south branch of the Arno, north of Livorno. Being situated on the coast road (Via Aemilia) it was important as a frontier fortress against Liguria, to which, and not to Etruria, it really belonged, perhaps, up to the time of Sulla, the actual boundary lying between it and Vada Volaterrana (mod. Vada). It became a colony in 180 B.C., and was important for the fertility of its territory, for its quarries, and for the timber it yielded for ship-building. Augustus gave it the name of Colonia Julia Pisana; his grandsons Gaius and Lucius were patrons of the colony, and after their death monuments were erected in their honour, as is recorded in two long inscriptions still extant. Greek vases have been found within the city itself, seeming to point to the presence of Etruscan tombs (G. Ghirardini in *Notizie degli Scavi*, 1892, 147); but no remains now exist except of the Roman period—some scanty ruins of baths and of a temple, while the Piazza dei Cavalieri follows the outline of the ancient theatre.

See E. Bormann, *Corp. inscr. lat.* xi. 272 (1888).

Little is known of the history of Pisa during the barbarian invasions, but it is an ascertained fact that it was one of the first towns to regain its independence. Under the Byzantine dominion Pisa, like many other of the maritime cities of Italy, profited by the weakness of the government at Constantinople to reassert its strength. And even during the first years of the harsh Lombard rule the need recognized by these oppressors of defending the Italian coast from the attacks of the Byzantines was favourable to the development of the Pisan navy. Few particulars are extant concerning the real condition of the town; but we occasionally find Pisa mentioned, almost as though it were an independent city, at moments when Italy was overwhelmed by the greatest calamities. According to Amari's happy expression, "it was already independent by sea, while still enslaved on land." Its prosperity notably declined after the establishment of the Lombard rule and under the Franks. It again began to flourish under the marquises of Tuscany, who governed it in the name of the emperor.

In 1003 we find records of a war between Pisa and Lucca, which, according to Muratori, was the first waged between Italian cities in the middle ages. But the military development and real importance of Pisa in the 11th century must be attributed to the continuous and desperate struggle it maintained against the tide of Saracenic invasion from Sicily. And, although the numerous legends and fables of the old chroniclers disguise the true history of this struggle, they serve to attest the importance of Pisa in those days. In 1004 the Saracens forced the gates and sacked a quarter of the town; and in 1011 they renewed the attack. But the Pisans repulsed them and assumed the offensive in Calabria, Sicily, and even in Africa. Still more memorable was the expedition afterwards undertaken by the united forces of Pisa and Genoa against Mogahid, better known in the Italian chronicles as Mugeto. This Moslem chief had made himself master of Sardinia, and was driven thence by the allied fleets in 1015. Again invading the island, he was again attacked and defeated by the same adversaries, leaving a brother and son, or, as some authorities aver, a wife and son, prisoners in their hands. Sardinia continued to be governed by native "judges" who were like petty sovereigns, but were now subject to the sway of Pisa. This was the primary cause of the jealousy of the Genoese, and of the wars afterwards made by them upon Pisa and carried on until its power was crushed. Meanwhile the Pisans flourished more and more, and continued hostilities against the Saracens. In 1062 their ships returned from Palermo laden with spoil. Thus it is not surprising that Pisa should already have had its own code of laws (*Consuetudini di mare*), which in 1075 were approved by Gregory VII., and in 1081 confirmed by a patent from the emperor Henry IV., a document which mentions for the first time the existence of a magistrate analogous to the consuls of the republic, although the latter, according to some writers, already existed in Pisa as early as the year 1080; the point, however, is doubtful, and other writers place the first authentic mention of the consuls in the year 1094.[1] The oldest of Pisan statutes still extant is the *Breve dei consoli di mare* of 1162.

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[1] In Strabo's time it was only 2 m. away, but the increase of the delta at the mouth of the river has since then pushed forward the coast-line.

In 1099 the Pisans joined in the second crusade, proved their valour at the capture of Jerusalem, and derived many commercial advantages from it; for within a short time they had banks, consuls, warehouses and privileges of all kinds in every Eastern port. Thus, while the commune of Pisa was still under the rule of the marquises of Tuscany, all negotiations with it were carried on as with an independent state officially represented by the archbishop and consuls. The aristocrats were the dominant party, and filled the highest offices of the republic, which, in the 12th century, rose to great power, both on sea and land, by its wars with the Lucchese, Genoese and Moslems. In 1110 Pisa made peace with Lucca after six years of continuous hostilities. And in the years 1113 and 1115 it achieved a still greater enterprise. The Pisan fleet of three hundred sail, commanded by the archbishop Pietro Moriconi, attacked the Balearic Isles, where as many as 20,000 Christians were said to be held captive by the Moslems, and returned loaded with spoil and with a multitude of Christian and Moslem prisoners. The former were set at liberty or ransomed, and among the latter was the last descendant of the reigning dynasty. The chief eunuch who had governed Majorca perished in the siege. Immediately afterwards the fourteen years' war with Genoa broke out. The two republics contested the dominion of the sea, and both claimed supreme power over the islands of Corsica and Sardinia. A papal edict awarding the supremacy of Corsica to the Pisan church proved sufficient cause for the war, which went on from 1118 to 1132. Then Innocent II. transferred the supremacy over part of Corsica to the Genoese church, and compensated Pisa by grants in Sardinia and elsewhere. Accordingly, to gratify the pope and the emperor Lothair II., the Pisans entered the Neapolitan territory to combat the Normans. They aided in the vigorous defence of the city of Naples, and twice attacked and pillaged Amalfi, in 1135 and 1137, with such effect that the town never regained its prosperity. It has been said that the copy of the Pandects then taken by the Pisans from Amalfi was the first known to them, but in fact they were already acquainted with those laws. The war with Genoa never came to a real end. Even after the retaking of Jerusalem by the Moslems (1187) the Pisans and Genoese again met in conflict in the East, and performed many deeds of valour. They were always ready to come to blows, and gave still more signal proofs of their enmity during the Sicilian War in behalf of the emperor Henry VI. From that moment it was plain that there could be no lasting peace between these rival powers until the one or the other should be crushed. The greatness and wealth of the Pisans at this period of their history is proved by the erection of the noble buildings by which their city is adorned. The foundations of the cathedral were laid in 1063, and its consecration took place in 1118; the baptistery was begun in 1152, and the campanile (the famous leaning tower) in 1174. And all three magnificent structures were mainly the work of Pisan artists, who gave new life to Italian architecture, as they afterwards renewed the art of sculpture.

It is asserted by some writers, especially by Tronci, that in the 12th century Pisa adopted a more democratic form of government. But in fact the chief authority was still vested in the nobles, who, both in Pisa and in Sardinia, exercised almost sovereign power. They formed the real strength of the republic, and kept it faithful to the empire and the Ghibelline party. The Guelph and popular element which constituted the force and prosperity of Florence was hostile to Pisa, and led to its downfall. The independence of the former city was of much later origin, only dating from the death of Countess Matilda (1115), but it rapidly rose to an ever-increasing power, and to inevitable rivalry with Pisa. Owing to the political and commercial interests binding Florence to the Roman court, the Guelph element naturally prevailed there, while the growth of its trade and commerce necessarily compelled that state to encroach on waters subject to Pisan rule. And, although Pisa had hitherto been able to oppose a glorious resistance to Genoa and Lucca, it was not so easy to continue the struggle when its enemies were backed by the arms and political wisdom of the Florentines, who were skilled in obtaining powerful allies. The chroniclers ascribe the first war with Florence, which broke out in 1222, to a most ridiculous motive. The ambassadors of the rival states in Rome are said to have quarrelled about a lapdog. This merely shows that there were already so many general and permanent reasons for war that no special cause was needed to provoke it. In 1228 the Pisans met and defeated the united forces of Florence and Lucca near Barga in the Garfagnana, and at the same time they despatched fifty-two galleys to assist Frederick II. in his expedition to the East. Shortly after this they renewed hostilities with the Genoese on account of Sardinia. The judges who governed the island were always at strife, and, as some of them applied to Pisa and some to Genoa for assistance against one another, the Italian seas were once more stained with blood, and the war burst out again and again, down to 1259, when it terminated in the decisive victory of the Pisans and the consolidation of their supremacy in Sardinia. But meanwhile Florence had made alliance with Genoa, Lucca and all the Guelph cities of Tuscany against its Ghibelline rival. The pope had excommunicated Frederick II. and all his adherents. And, as a crowning disaster, the death of Frederick in 1250 proved a mortal blow to the Italian Ghibelline cause. Nevertheless, the Pisans were undaunted. Summoning Siena, Pistoia and the Florentine exiles to their aid, they boldly faced their foe, but were defeated in 1254. Soon after this date we find the old aristocratic government of Pisa replaced by a more popular form. Instead of the consuls there were now twelve elders (*anziani*); besides the podestà, there was a captain of the people; and there was a general council as well as a senate of forty members. The rout of the Tuscan Guelphs on the field of Montaperto (1260) restored the fortunes of Pisa. But the battle of Benevento (1266), where Manfred fell, and the rout of Tagliacozzo (1268), sealing the ruin of the house of Hohenstaufen in Italy and the triumph of that of Anjou, were fatal to Pisa. For the republic had always sided with the empire and favoured Conradin, whose cruel end struck terror into the Ghibelline faction. The pope hurled an edict against the Pisans and tried to deprive them of Sardinia, while their merchants were driven from Sicily by the Angevins. The internal condition of the city was affected by these events. Owing to the increasing influence of the Guelph and popular side, to which the more ambitious nobles began to adhere for the furtherance of personal aims, the aristocratic Ghibelline party was rapidly losing ground. The first man to step to the front at this moment was Count Ugolino della Gherardesca of the powerful house of that name. He had become the virtual head of the republic, and, in order to preserve its independence and his own sway, inclined to the

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[1] It must be remembered that the Pisans and Florentines dated the beginning of the year *ab incarnatione, i.e.* from the 25th of March. But the Florentines dated it from the 25th following and the Pisans from the 25th of March preceding the commencement of the common year. The new or common style was adopted throughout Tuscany in the year 1750.

Guelphs and the popular party, in spite of the Ghibelline traditions of his race. He was supported by his kinsman Giovanni Visconti, judge of Gallura; but almost all the other great families vowed eternal hatred against him, and proclaimed him a traitor to his party, his country and his kin. So in 1274 he and Visconti were driven into exile. Both then joined the Florentines, took part in the war against their native city, and laid waste its surrounding territories. In 1276 the Pisans were compelled to agree to very grievous terms—to exempt Florentine merchandise from all harbour dues, to yield certain strongholds to Lucca, and to permit the return of Count Ugolino, whose houses they had burnt, and whose lands they had confiscated. Thus the count again became a powerful leader in Pisa. Visconti, however, was dead.

This was the moment chosen by Genoa for a desperate and decisive struggle with her perpetual rival. For some years the hostile fleets continued to harass each other and engage in petty skirmishes, as if to measure their strength and prepare for a final effort. On the 6th of August 1284 the great battle of Meloria took place. Here seventy-two Pisan galleys engaged eighty-eight Genoese, and half the Pisan fleet was destroyed. The chroniclers speak of 5000 killed and 11,000 prisoners; and, although these figures must be exaggerated, so great was the number of captives taken by the Genoese as to give rise to the saying—"To see Pisa, you must now go to Genoa." This defeat crushed the power of Pisa. She had lost her dominion over the sea, and the Tuscan Guelphs again joined in attacking her by land. Count Ugolino had taken part in the battle of Meloria and was accused of treachery. At the height of his country's disasters he sought to confirm his own power by making terms with the Florentines, by yielding certain castles to Lucca, and by neglecting to conclude negotiations with the Genoese for the release of the prisoners, lest these should all prove more or less hostile to himself. This excited a storm of opposition against him. The archbishop Ruggieri, having put himself at the head of the nobles, was elected podestà by the Lanfranchi, Sismondi and Gualandi, and a section of the popular party. The city was plunged into civil war. The great bell of the commune called together the adherents of the archbishop; the bell of the people summoned the partisans of the count. After a day's fighting (July 1, 1288) the count, his two sons and his two grandsons were captured in the palazzo del popolo (or town hall), and cast into a tower belonging to the Gualandi and known as the "Tower of the Seven Streets." Here they were all left to die of hunger. Their tragic end was afterwards immortalized in the *Divina commedia*. The sympathies of Dante Alighieri, the Florentine patriot and foe of Rome, were naturally in favour of the victims of an aristocratic prelate, opposed to all reconciliation with Florence.

The Florentines were now allied with Lucca and Genoa, and a few of their vessels succeeded in forcing an entry into the Pisan port, blocked it with sunken boats, and seized its towers. Their own internal dissensions of 1293 put a stop to the campaign, but not before they had concluded an advantageous peace. They and all the members of the Guelph league were freed from all imposts in Pisa and its port. In addition to these privileges the Genoese also held Corsica and part of Sardinia; and throughout the island of Elba they were exempted from every tax. They likewise received a ransom of 160,000 lire for their Pisan prisoners. These were no longer numerous, many having succumbed to the hardships and sufferings of all kinds to which they had been exposed.

In 1312 the arrival of the emperor Henry VII. gladdened the hearts of the Pisans, but his sudden death in 1313 again overthrew their hopes. He was interred at Pisa, and Uguccione della Faggiuola remained as imperial lieutenant, was elected podestà and captain of the people, and thus became virtual lord of the city. As a Ghibelline chief of valour and renown he was able to restore the military prestige of the Pisans, who under his command captured Lucca and defeated the Florentines at Montecatini on the 29th of August 1315. So tyrannical, however, was his rule that in 1316 he was expelled by the popular fury. But Pisa's freedom was for ever lost. He was succeeded by other lords or tyrants, of whom the most renowned was Castruccio Castracane, a political and military adventurer of much the same stamp as Uguccione himself. With the help of Louis the Bavarian, Castruccio became lord of Lucca and Pisa, and was victorious over the Florentines; but his premature death in 1328 again left the city a prey to the conflicts of opposing factions. New lords, or petty tyrants, rose to power in turn during this period of civil discord, but the military valour of the Pisans was not yet extinguished. By sea they were almost impotent—Corsica and Sardinia were lost to them for ever; but they were still formidable by land. In 1341 they besieged Lucca in order to prevent the entry of the Florentines, to whom the city had been sold for 250,000 florins by the powerful Mastino della Scala. Aided by their Milanese, Mantuan and Paduan allies, they gave battle to their rivals, put them to rout at Altopascio (Oct. 2), and then again excluded them from their port. Thereupon the Florentines obtained Porto Talamone from Siena and established a navy of their own. By this means they were enabled to capture the island of Giglio, and, attacking the Pisan harbour, carried off its chains, bore them in triumph to Florence, and suspended them in front of the baptistery, where they remained until 1848. Then, in pledge of the brotherhood of all Italian cities, they were given back to Pisa, and placed in the Campo Santo.

The war was now carried on by the free companies with varying fortune, but always more or less to the hurt of the Pisans. In 1369 Lucca was taken from them by the emperor Charles IV.; and afterwards Giovan Galeazzo Visconti, known as the count of Virtù, determined to forward his ambitious designs upon the whole of Italy by wresting Pisa from the Gambacorti. For at this time the conflicts of the Raspanti faction, headed by the Gherardesca, with the Bergolini led by the Gambacorti, had left the latter family masters of the city. At Visconti's instigation Piero Gambacorti, the ruler of the moment, was treacherously assassinated by Jacopo d'Appiano, who succeeded him as tyrant of Pisa, and bequeathed the state to his son Gherardo. The latter, a man of inferior ability and daring, sold Pisa to the count of Virtù, receiving in exchange 200,000 florins, Piombino, and the islands of Elba, Pianosa and Monte Cristo. Thus in 1399 Visconti took possession of Pisa, and left it to his natural son Gabriele Maria Visconti, who was afterwards expelled from its gates. But even during this century of disaster the Pisans continued to cherish not only commerce, but also the fine arts. In the year 1278 they had entrusted the erection of their fine Campo Santo to Niccola and Giovanni Pisano, by whom the architectural part of it was completed towards the end of the century. In the following year the first artists of Italy were engaged in its decoration, and the celebrated frescoes attributed to Orcagna (*q.v.*) were painted on its walls. Others were afterwards supplied by Benozzo Gozzoli and men of lesser note, and the labour of ornamentation was only discontinued in 1464.

Meanwhile, in 1406, the Florentines made another attack upon Pisa, besieging it simultaneously by sea and land. Owing to the starving condition of its defenders, and aided by the treachery of Giovanni Gambacorti, they entered the city in triumph on the 9th of October, and sought to "crush every germ of rebellion and drive out its citizens by measures of the utmost harshness and cruelty." Such were the orders sent by the Ten of War to the representatives of the Florentine government in Pisa, and such was then the established policy of every Italian state. Consequently for a long time there was a continual stream of emigration from Pisa. The Medici pursued a humaner course. In 1472 Lorenzo the Magnificent tried to restore the ancient renown of the Pisan university. To that end he filled it with celebrated scholars, and, leaving only a few chairs of letters and philosophy in Florence, compelled the Florentines to resort to Pisa for the prosecution of their studies. But nothing could now allay the inextinguishable hatred of the conquered people. When Charles VIII. made his descent into Italy in 1494, and came to Sarzana on his way to Tuscany, he was welcomed by the Pisans with the greatest demonstrations of joy. And, although that monarch was ostensibly the friend of Florence, they did not hesitate, even in his presence, to assert their own independence, and, casting the Florentine ensign, the Marzocco, into the Arno, made instant preparations for war. Between 1499 and 1505 they heroically withstood three sieges and repulsed three attacking armies. But their adversaries always returned to the assault, and, what was worse, yearly laid waste their territories and destroyed all their crops. Soderini, who was perpetual gonfalonier of Florence, and Machiavelli, the secretary of the Ten, urged on the war. In 1509 Florence encamped her forces on three sides of the distressed city, which at last, reduced to extremity by famine, was compelled to surrender on the 8th of June 1509. Thenceforth the Florentines remained lords of Pisa. But now, mainly owing to the efforts of Soderini and Machiavelli, the conquerors showed great magnanimity. They brought with them large stores of provisions, which were freely distributed to all; they tried to succour the suffering populace in every way, and gave other assistance to the wealthier classes. Nevertheless, emigration continued even on a larger scale than in 1406, and the real history of Pisa may be said to have ended. In Naples, in Palermo, in all parts of Italy, Switzerland and the south of France, we still find the names of Pisan families who quitted their beloved home at that time. The Florentines immediately built a new citadel, and this was a great bitterness to the Pisans. The Medici, however, remained well disposed towards the city. Leo X. was an active patron of the university, but it again declined after his death. The grand duke Cosmo I., a genuine statesman, not only restored the university, but instituted the "uffizio dei fossi," or drainage office for the reclamation of marsh lands, and founded the knighthood of St Stephen. This order played a noble part in the protection of Tuscan commerce, by fighting the Barbary pirates and establishing the prestige of the grand-ducal navy (see Medici). Under the succeeding Medici, Pisa's fortunes steadily declined. Ferdinand I. initiated a few public works there, and above all restored the cathedral, which had been partly destroyed by fire in 1595. These dreary times, however, are brightened by one glorious name—that of Galileo Galilei.

The population of Pisa within the walls had been reduced in 1551 to 8574 souls, and by 1745 it had only risen to the number of 12,406. Under the house of Lorraine, or more correctly during the reign of that enlightened reformer the grand duke Peter Leopold (1765–1790), Pisa shared in the general prosperity of Tuscany, and its population constantly increased. By 1840 it contained 21,670 souls, exclusive of the suburbs and outlying districts.

Authorities.—Paolo Tronci, *Annali di Pisa*, edited by E. V. Montazio (2 vols., Lucca, 1842–1843), which comes down to 1840; Ranieri Grassi, *Pisa e le sue adiacenze* (Pisa, 1851), which is a useful historical guide; Roncioni, "Istorie Pisane," in the *Archivio storico italiano*, vol. vi., pt. 1; "Cronache Pisane," in the same *Archivio*, vol. vi., pt. 2; for the early constitution of the city, see G. Volpe's *Studii sulle istituzioni, comunali di Pisa* (Pisa, 1902), and for the laws, F. Bonaini's *Statuti inediti della città di Pisa* (3 vols., Florence, 1851, &c.). The maritime and commercial history of the republic is dealt with in A. Schaube's *Das Konsulat des Meeres in Pisa* (Leipzig, 1888) and in Pawinski's *Zur Entstehungsgeschichte des Konsulats in den Communen Nord- und Mittel-Italiens* (Berlin, 1867); for the monuments and inscriptions see A. Da Morrona, *Pisa illustrata* (Leghorn, 1812) and G. R. de Fleury's *Les Monuments de Pise au moyen âge* (Paris, 1866); also Repetti's *Dizionario geografico della Toscana, s.v.* "Pisa." For Dante's connexion with Pisa, see *Dante e i Pisani*, by Giovanni Sforza (Pisa, 1873). Among the more recent historical guides to Pisa of a popular character is *The Story of Pisa and Lucca*, by Janet Ross and Nellie Erichsen, in Dent's "Medieval Towns" (London, 1907), and T. B. Supino's *Pisa*, in the "*Italia artistica* Series."

(P. V.)

PISA, COUNCIL OF (1409). The great schism of the west had already lasted thirty years, and the efforts which had been made to restore unity within the Church by the simultaneous resignation of the two rival pontiffs had been in vain, when in the spring of 1408, the state of affairs being desperate, the idea arose of assembling a council to effect a union without the co-operation of the popes. The initiative came from those cardinals who had one after the other seceded either from Gregory XII. or Benedict XIII. They were forestalled by the popes, who each summoned a council, the former to Cividale (in Friuli), the latter to Perpignan, so the dissident cardinals sent out antedated letters inviting Christendom to assemble at Pisa on the 25th of March 1409. Their appeal met with a response in a great part of Italy, France, Navarre, Portugal and England, and in Germany in the states subject to Wenceslas king of the Romans, the electors of Cologne and Mainz, the margrave of Brandenburg, &c. For a time the number of the fathers exceeded five hundred.

The day after the opening of the council, proceedings were started against the two popes, who, it was agreed, were to be eliminated. An act of accusation, containing in 37 articles the chief complaints against them, was read out to the people; not only their policy, but their orthodoxy was attacked, and there was even an insinuation of sorcery. The reason is, that in order to depose them with some show of legality, it was necessary, as a preliminary, to convict them of heresy, and it began to be seen that their tenacity of power, and the ruses by which they evaded the necessity of abdicating, however harmful might be their consequences, did not in themselves constitute a clearly-defined heresy. On the 5th of June 1409 was read the definitive sentence: that as heretics, and therefore separated from the Church, Pedro de Luna (Benedict XIII.) and Angelo Corrario (Gregory XII.) were *ipso facto* deposed from any office; they must not be obeyed, nor assisted, nor harboured. In the course of the rejoicings which followed this sentence among the populace of Pisa, occurred the somewhat scandalous event of the burning of two images crowned with parchment mitres, representing Gregory XII. and Benedict XIII. It was in vain that the ambassadors of Benedict XIII. presented themselves at Pisa. The crowd greeted their arrival with mockery and derision, and being treated as the envoys of heretics they escaped without having obtained a hearing.

In order to complete their task the cardinals present at Pisa, authorized by delegation of the council, shut themselves up in conclave, and elected one of their number, Peter Philarges, cardinal of Milan, as the new pope, who assumed the name of Alexander V. They had hoped to save the Church, but unfortunately the result of their efforts, generous as they were, was that the schism increased in bitterness, and that instead of the unity for which the Church craved, three popes continued to flourish. Both the deposed pontiffs protested against the legality of the council of Pisa; each had numerous partisans, and the thesis, constructed rather to meet the exigencies of the case, which attributed to a synod assembled by the cardinals the right of constituting itself judge of a sovereign pontiff, was far from being established.

Originally the council of Pisa was to have occupied itself not only with effecting the union, but also with the reform of the Church. As a matter of fact, it confined itself to expressing certain *desiderata* in a "libellus supplicatorius" which it submitted to the new pope. Alexander V. only partially acceded to these demands, many of which constituted serious encroachments on the prerogative of the Holy See; he then declared the work of reform suspended, and dissolved the council (August 7, 1409).

See Jacques Lenfant, *Histoire du concile de Pise* (Utrecht, 1731); Mansi, *Concil.*, xxvii.; F. Stuhr, *Die Organisation und Geschäftsordnung des Pisaner und Konstanzer Konzils* (Schwerin, 1891); N. Valois, *La France et le grand schisme d'occident*, iv. 3–107, 175 seq. (Paris, 1902).

(N. V.)

PIŚĀCA LANGUAGES, the name which has been given to a family of languages spoken immediately to the south of the Hindu Kush, and north of the frontier of British India. The family includes the group of Kāfir languages spoken in Kafiristān, Khowar, spoken in the Chitral country, and the group of Shīnā languages, which includes the Shīnā of Gilgit, Kōhistānī, spoken in the Kohistans of the Indus and Swat rivers, and Kashmiri. Of all these Kashmiri is the only one which has received any literary cultivation, and of which the number of speakers is known. The Piśāca languages are Aryan by origin, but are neither Iranian nor Indo-Aryan. (See Indo-Aryan Languages and Kashmiri.)

(G. A. Gr.)

PISACANE, CARLO, duke of San Giovanni (1818–1857), Italian revolutionary, was born at Naples, and entered the Neapolitan army in 1839; but having become imbued with Mazzinian ideas he emigrated in 1847, and after a short stay in England and France served in the French army in Algeria. The revolution of 1848 recalled him to Italy; he played a part in the brief but glorious history of the Roman Republic, and was the life and soul of the war commission in the defence of the city. After its capture by the French he again went into exile, first to London and then to Genoa, maintaining himself by teaching. He regarded the rule of the house of Savoy as no better than that of Austria. When Mazzini, undeterred by the failure of the abortive Milan rising on the 6th of February 1853, determined to organize an expedition to provoke a rising in the Neapolitan kingdom, Pisacane offered himself for the task, and sailed from Genoa with a few followers (including Giovanni Nicotera) on board the "Cagliari" on the 25th of June 1857. They landed on the island of Ponza, where the guards were overpowered and some hundreds of prisoners liberated, and on the 28th arrived at Sapri in Calabria and attempted to reach the Cilento. But hardly any assistance from the inhabitants was forthcoming, and the invaders were quickly overpowered, Pisacane himself being killed.

See P. M. Bilotti, *La Spedizione di Sapri* (Salerno, 1907).

PISAN, CHRISTINE DE (1364–*c.* 1430), French poet, of Italian birth, was born at Venice in 1364. When she was four years old she was brought to her father, a councillor of the Venetian Republic, in Paris, where he held office as astrologer to Charles V. At fifteen Christine married Étienne du Castel, who became Charles's notary and secretary. After the king's death in 1380 her father lost his appointment, and died soon after; and when Christine's husband died in 1389 she found herself without a protector, and with three children depending on her. This determined her to have recourse to letters as a means of livelihood. Her first ballads were written to the memory of her husband, and as love poems were the fashion she continued to write others—*lais*, *virelais*, *rondeaux* and *jeux à vendre*—though she took the precaution to assure her readers (*Cent balades*, No. 50) that they were merely exercises. In 1399 she began to study the Latin poets, and between that time and 1405, as she herself declares, she composed some fifteen important works, chiefly in prose, besides minor pieces. The earl of Salisbury, who was in Paris on the occasion of the marriage of Richard II. with Isabella of France (1396), took her elder son, Jean du Castel (b. 1384), and reared him as his own; the boy, after Salisbury's death (1400), being received by Philip of Burgundy, at whose desire Christine wrote *Le Livre des faitz et bonnes mœurs du sayge roy Charles*[1] (1405), valuable as a first-hand picture of Charles V. and his court. Her *Mutation de fortune*, in which she finds room for a great deal of history and philosophy, was presented to the same patron on New Year's Day, 1404. It possesses an introduction of great autobiographical interest. In *La Vision* (1405) she tells her own history, by way of defence against those who objected to her pretensions as a moralist. Henry IV. of England desired her to make his court her home, and she received a like invitation from Galeazzo Visconti, tyrant of Milan. She preferred, however, to remain in France, where she enjoyed the favour of Charles VI., the dukes of Berry and Burgundy, the duchess of Bourbon and others.

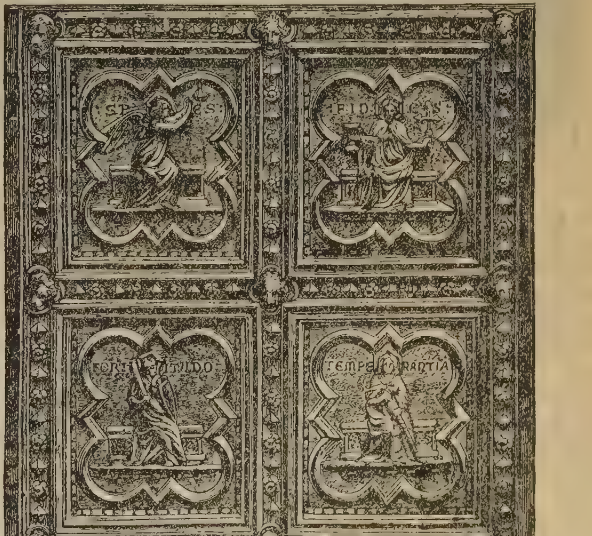
Christine was a champion of her own sex. In her *Dit de la rose* (1402) she describes an order of the rose, the members of which bind themselves by vow to defend the honour of women. Her *Épître au dieu d'amour* (1399) is a defence of women against the satire of Jean de Meun, and initiated a prolonged dispute with two great scholars of her time, Jean de Montreuil (d. 1415) and Gonthier Col, who undertook the defence of the *Roman de la rose*. Christine wrote about 1407 two books for women, *La Cité des dames* and *Le Livre des trois vertus*, or *Le Trésor de la cité des dames*. She was devoted to her adopted country. During the civil wars she wrote a *Lamentation* (1410) and a *Livre de la paix* (1412–1413), but after the disasters of the campaign of Agincourt she retired to a convent. We have no more of her work until 1429, when she broke her silence to write a song in honour of Joan of Arc. Of the circumstances of her death nothing is known but it probably took place about this time. Her *Cité des dames* contains many interesting contemporary portraits, and her *Livre des trois vertus* contains details of domestic life in the France of the early 15th century not supplied by more formal historians.

Her poems were edited by Maurice Roy for the Société des anciens Textes français (1886, &c.), and her *Livre du chemin du long éstude*, by Puschel (Berlin, 1887). There are monographs by Raimond Thomassy (Paris, 1838); E. M. D. Robineau (Saint-Omer, 1882); and Friedrich Koch (Goslar, 1885). It is possible that Jean Castel, who was chronicler of France under Louis XI., was Christine's grandson. Hoccleve imitated her *Épître au dieu d'amour*, in his "Letter of Cupid" (*Chaucerian and other Pieces*, ed. W. W. Skeat, 1897). A translation of her *Épître d'Othéa* was made (*c.* 1440) by Stephen Scrope for his stepfather, Sir John Fastolf, and is preserved in a MS. at Longleat. This was edited (1904) for the Roxburghe Club by W. G. F. Warner as *The Epistle of Othea to Hector, or the Boke of Knyghthode. The Moral Proverbs of Christyne de Pise*, translated by Earl Rivers, was printed in 1478 by Caxton, who himself translated, by order of Henry VII., her *Livre des faitz d'armes, et de chevalerie*, a treatise on the art of war, based chiefly on Vegetius. Her *Cité des dames* was translated by Brian Anslay (London, 1521).

PISANI, VETTOR (d. 1380), Venetian admiral, was in command of the Venetian fleet in 1378 during the war against the Genoese, whom he defeated off Capo d'Anzio; subsequently he recaptured Cattaro, Sebenico and Arbe, which had been seized by the Hungarians, the allies of the Genoese. But the Genoese fleet completely defeated Pisani at Pola in May 1379, and on his return to Venice he was thrown into prison. The enemy now pressed home their victory, and besieged and captured Chioggia, whereby Venice itself was in danger. The people thereupon demanded the liberation of Pisani, in whose skill they had the fullest confidence. The government gave way and appointed the aged commander admiral of the fleet once more. Through his able strategy and daring he recaptured Chioggia, defeated the Genoese and threatened Genoa itself until that republic agreed to peace terms. Pisani died in 1380 while on his way to Manfredonia with a squadron to ship provisions.

See Vittorio Lazzarini, "La morte e il monumento di Vettor Pisani," in the *Nuovo archivio veneto*, vol. xi., pt. ii. (1896).

PISANO, ANDREA, also known as ANDREA DA PONTADERA (*c.* 1270–1348), Italian sculptor, was born about 1270, and first learned the trade of a goldsmith. He became a pupil of Giovanni Pisano about 1300, and worked with him on the sculpture for S. Maria della Spina at Pisa and elsewhere. But it is at Florence



Part of the first Bronze Door of the Baptistery at Florence, by Andrea Pisano.

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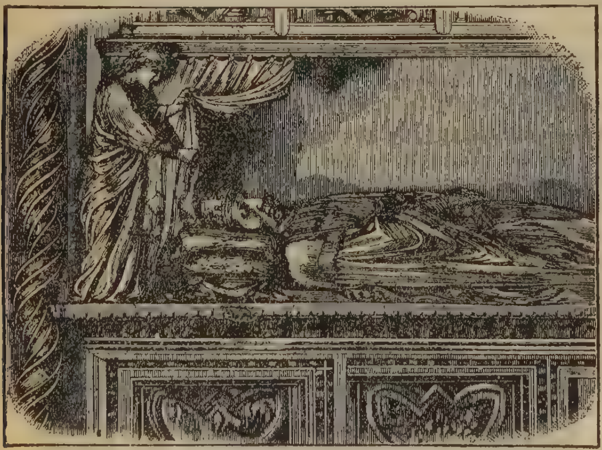
[1] See C. B. Petitot, *Collection complète des mémoires relatifs à l'histoire de France* (1st series, vols. v. and vi., 1819, &c.).

that his chief works were executed, and the formation of his mature style was due rather to Giotto than to his earlier master. Of the three world-famed bronze doors of the Florentine baptistery, the earliest one—that on the south side—was the work of Andrea; he spent many years on it; and it was finally set up in 1336.[1] It consists of a number of small quatrefoil panels—the lower eight containing single figures of the Virtues, and the rest scenes from the life of the Baptist. Andrea Pisano, while living in Florence, also produced many important works of marble sculpture, all of which show strongly Giotto's influence. In some cases probably they were actually designed by that artist, as, for instance, the double band of beautiful panel-reliefs which Andrea executed for the great campanile. The subjects of these are the Four Great Prophets, the Seven Virtues, the Seven Sacraments, the Seven Works of Mercy and the Seven Planets. The duomo contains the chief of Andrea's other Florentine works in marble. In 1347 he was appointed architect to the duomo of Orvieto, which had already been designed and begun by Lorenzo Maitani. The exact date of his death is not known, but it must have been shortly before the year 1349.

Andrea Pisano had two sons, Nino and Tommaso—both, especially the former, sculptors of considerable ability. Nino was very successful in his statues of the Madonna and Child, which are full of human feeling and soft loveliness—a perfect embodiment of the Catholic ideal of the Divine Mother. Andrea's chief pupil was Andrea di Cione, better known as Orcagna (*q.v.*). Balduccio di Pisa, another, and in one branch (that of sculpture) equally gifted pupil, executed the wonderful shrine of S. Eustorgio at Milan—a most magnificent mass of sculptured figures and reliefs.

PISANO, GIOVANNI (*c.* 1250–1330), Italian architect and sculptor, was the son of Niccola Pisano. Together with Arnolfo del Cambio and other pupils, he developed and extended into other parts of Italy the renaissance of sculpture which in the main was due to his father's talent. After he had spent the first part of his life at home as a pupil and fellow worker of Niccola, the younger Pisano was summoned between 1270 and 1274 to Naples, where he worked for Charles of Anjou on the Castel Nuovo. One of his earliest independent performances was the Campo Santo at Pisa, finished about 1283; along with this he executed various pieces of sculpture over the main door and inside the cloister. The richest in design of all his works (finished about 1286) is in the cathedral of Arezzo—a magnificent marble high altar and reredos, adorned both in front and at the back with countless figures and reliefs—mostly illustrative of the lives of St Gregory and St Donato, whose bones are enshrined there. The actual execution of this was probably wholly the work of his pupils. In 1290 Giovanni was appointed architect or "capo maestro" of the new cathedral at Siena, in which office he succeeded Lorenzo Maitani, who went to Orvieto to build the less ambitious but equally magnificent duomo which had just been founded there. The design of the gorgeous façade of that duomo has been attributed to him, but it is more probable that he only carried out Maitani's design. At Perugia, Giovanni built the church of S. Domenico in 1304, but little of the original structure remains. The north transept, however, still contains his beautiful tomb of Benedict XI., with a sleeping figure of the pope, guarded by angels who draw aside the curtain. One of Giovanni's most beautiful architectural works was the little chapel of S. Maria della Spina (now rebuilt, "restored"), on the banks of the Arno in Pisa; the actual execution of this chapel, and the sculpture with which it is adorned, was mostly the work of his pupils.[2] The influence of his father Niccola is seen strongly in all Giovanni's works, but especially in the pulpit of S. Andrea at Pistoia, executed about 1300. Another pulpit, designed on the same lines, was made by him for the nave of Pisa Cathedral between 1310 and 1311. The last part of Giovanni's life was spent at Prato, near Florence, where with many pupils he worked at the cathedral till his death about 1330.



Part of the Tomb of Benedict XI., by Giovanni Pisano.

See M. Sauerlandt, *Über die Bildwerke des Giovanni Pisano*, &c. (1904); A. Brach, *Nicola und Giovanni Pisano und die Plastik des XIV. Jahrhunderts in Siena* (1904).

PISANO, NICCOLA (*c.* 1206–1278), Italian sculptor and architect. Though he called himself *Pisanus*, from Pisa, where most of his life was spent, he was not a Pisan by birth. There are two distinct accounts of his parentage, both derived mainly from existing documents. According to one of these he is said to have been the son of "Petrus, a notary of Siena;" but this statement is very doubtful, especially as the word "Siena" or "de Senis" appears to be a conjectural addition. Another document among the archives of the Sienese Cathedral calls him son of "Petrus de Apulia." Most modern writers accept the latter statement, and believe that he not only was a native of the province of Apulia in southern Italy, but also that he gained there his early instruction in the arts of sculpture and architecture. Those, on the other hand, who, with most of the older writers, prefer to accept the theory of Niccola's origin being Tuscan, suppose that he was a native of a small town called Apulia near Lucca.

Except through his works, but little is known of the history of Niccola's life. As early as 1221 he is said to have been summoned to Naples by Frederick II., to do work in the new Castel del l'Uovo. This fact supports the theory of his southern origin, though not perhaps very strongly, as, some years before, the Pisan Bonannus had been chosen by the Norman king as the sculptor to cast one of the bronze doors for Monreale Cathedral, where it still exists. The earliest existing piece of sculpture which can be attributed to Niccola is a beautiful relief of the Deposition from the Cross in the tympanum of the arch of a side door at San Martino at Lucca; it is remarkable for its graceful composition and delicate finish of execution. The date is about 1237. In 1260, as an incised inscription records, he finished the marble pulpit for the Pisan baptistery; this is on the whole the finest of his works.

It is a high octagon, on semicircular arches, with trefoil cusps, supported by nine marble columns, three of which rest on white marble lions. In design it presents that curious combination of Gothic forms with classical details which is one of the characteristics of the medieval architecture of northern Italy; though much enriched with sculpture both in relief and in the round, the general lines of the design are not sacrificed to this, but the sculpture is kept subordinate to the whole. In this respect it is superior to the more magnificent pulpit at Siena, one of Niccola's later works, which suffers greatly from want of repose and purity of outline, owing to its being overloaded with reliefs and statuettes. Five of the sides of the main octagon have panels with subjects—the Nativity, the Adoration of the Magi, the Presentation in the Temple, the Crucifixion and the Doom. These are all, especially the first three, works of the highest beauty, and a wonderful advance on anything of the sort that had been produced by Niccola's predecessors. The drapery is gracefully arranged in broad simple folds; the heads are full of the most noble dignity; and the sweet yet stately beauty of the Madonna could hardly be surpassed. The panel with the Adoration of the Magi is perhaps the one in which Niccola's study of the antique is most apparent (see figure). The veiled and diademed figure of the Virgin Mother, seated on a throne, recalls the Roman Juno; the head of Joseph behind her might be that of Vulcan; while the youthful beauty of an Apollo and the mature dignity of a Jupiter are suggested by the standing and kneeling figures of the Magi. Certain figures in others of the panels are no less deeply imbued with classical feeling.

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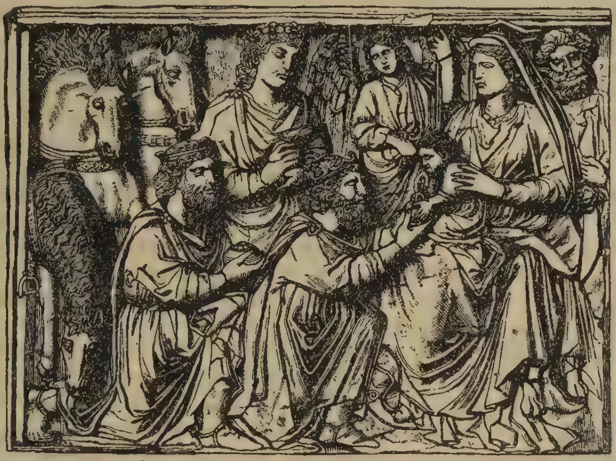
[1] The date on the door, 1330, refers to the original wax model.

[2] See Schultz, *Denkmäler der Kunst in Unter-Italien*. vii. 5.

The next important work of Niccola in date is the Arca di San Domenico, in the church at Bologna consecrated to that saint, who died in 1221. Only the main part, the actual sarcophagus covered with sculptured reliefs of St Dominic's life, is the work of Niccola and his pupils. The sculptured base and curved roof with its fanciful ornaments are later additions. This "Arca" was made when St Dominic was canonized, and his bones translated; it was finished in 1267, not by Niccola himself, but by his pupils. The most magnificent, though not the most beautiful, of Niccola's works is the great pulpit in Siena cathedral (1268). It is much larger than that at Pisa, though somewhat similar in general design, being an octagon on cusped arches and columns. Its stairs, and a large landing at the top, with carved balusters and panels, rich with semi-classical foliage, are an addition of about 1500. The pulpit itself is much overloaded with sculpture, and each relief is far too crowded with figures. An attempt to gain magnificence of effect has destroyed the dignified simplicity for which the earlier pulpit is so remarkable.



The Adoration of the Magi, one of the panels in the pulpit of the Pisan Baptistery, by Niccola Pisano.

Niccola's last great work of sculpture was the fountain in the piazza opposite the west end of the cathedral at Perugia. This is a series of basins rising one above another, each with sculptured bas-reliefs; it was begun in 1274, and completed, except the topmost basin, which is of bronze, by Niccola's son and pupil Giovanni.

Niccola Pisano was not only pre-eminent as a sculptor, but was also the greatest Italian architect of his century; he designed a number of very important buildings, though not all which are attributed to him by Vasari. Among those now existing the chief are the main part of the cathedral at Pistoia, the church and convent of Sta Margherita at Cortona, and Sta Trinità at Florence. The church of Sant' Antonio at Padua has also been attributed to him, but without reason. Unfortunately his architectural works have in most cases been much altered and modernized. Niccola was also a skilled engineer, and was compelled by the Florentines to destroy the great tower, called the *Guardamorto*, which overshadowed the baptistery at Florence, and had for long been the scene of violent conflicts between the Guelphs and Ghibellines. He managed skilfully so that it should fall without injuring the baptistery. Niccola Pisano died at Pisa in the year 1278, leaving his son Giovanni a worthy successor to his great talents both as an architect and sculptor.

Though his importance as a reviver of the old traditions of beauty in art has been to some extent exaggerated by Vasari, yet it is probable that Niccola, more than any other one man, was the means of starting that "new birth" of the plastic arts which, in the years following his death, was so fertile in countless works of the most unrivalled beauty. Both Niccola and his son had many pupils of great artistic power, and these carried the influence of the Pisani throughout Tuscany and northern Italy, so that the whole art of the succeeding generations may be said to have owed the greater part of its rapid development to this one family.

See SCULPTURE, and general histories of Italian art; Symonds, *Renaissance in Italy*; A. Brach, *Nicola und Giovanni Pisano und die Plastik des XIV. Jahrhunderts in Siena* (Strassburg, 1904).

PISANO, VITTORE (*c.* 1380–1456), commonly called PISANELLO, Italian medallist, was a native of San Vigilio sul Lago in the territory of Verona. Specimens of his work as a painter are still extant in Rome, Venice, Verona and Pistoia, and entitle him to a place of some distinction in the history of that art. The National Gallery in London possesses a very fine specimen of Pisanello's work—a panel painted with miniature-like delicacy. During the latter portion of his life he lived in Rome, where he enjoyed great repute.

PISAURUM (mod. Pesaro, *q.v.*), an ancient town of Umbria on the Via Flaminia, 26 m. from Ariminum and 8 from Fanum Fortunae. A Roman colony was founded here in the territory of the Galli Senones in 184 B.C., at the mouth of the river Pisaurus (mod. Foglia; the sea has since then receded about half a mile). Whether it took the place of an earlier town or not, is not known: an important Gaulish cemetery has been discovered near the village of Novilara between Pisaurum and Fanum, but to which of these centres (if either) it belonged is uncertain (E. Brizio in *Monumenti dei Lincei* [1895], v. 85 sqq.). In 174 B.C. we hear that the censors built a temple of Jupiter here and paved a road. T. Accius, the counsel who opposed Cicero in the case when he defended Cluentius in a still extant speech, was a native of Pisaurum. Catullus refers to the town as decadent or unhealthy, but this may be merely malicious, and does not seem to be borne out by facts: for it is not infrequently mentioned by classical authors. It was occupied by Caesar in 49 B.C., and was made a colony under the second triumvirate. Hence it bears the name Colonia Julia Felix. We hear little of it under the empire. It was destroyed by the Goths in 539, and restored by Belisarius in 545. From the inscriptions, nearly 200 in number, an idea of the importance of the town may be gained. Among them are a group of *cippi* found on the site of a sacred grove of the matrons of Pisaurum, bearing dedications to various deities, and belonging probably to the date of the foundation of the colony. There are some remains of the town walls, and an ancient bridge over the Foglia. It was, like Ariminum, a considerable place for the manufacture of bricks and pottery, though the factories cannot always be precisely localized.

PISCES (the fishes), in astronomy, the twelfth sign of the zodiac (*q.v.*), represented by two fishes tied together by their tails and denoted by the symbol ♓. It is also a constellation, mentioned by Eudoxus (4th century B.C.) and Aratus (3rd century B.C.); and catalogued by Ptolemy (38 stars), Tycho Brahe (36) and Hevelius (39). In Greek legend Aphrodite and Eros, while on the banks of the Euphrates, were surprised by Typhon, and sought safety by jumping into the water, where they were changed into two fishes. This fable, however, as in many other similar cases, is probably nothing more than an adaptation of an older Egyptian tale. *α Piscium*, is a fine double star of magnitude 3 and 4; 35 *Piscium*, is another double star, the components being a white star of the 6th magnitude and a purplish star of the 8th magnitude.

Piscis australis, the southern fish, is a constellation of the southern hemisphere, mentioned by Eudoxus and Aratus, and catalogued by Ptolemy, who described 18 stars. The most important star is *α Piscis australis* or Fomalhaut, a star of the first magnitude. *Piscis volans*, the flying fish, is a new constellation introduced by John Bayer in 1603.

PISCICULTURE (from Lat. *piscis*, fish). The species of fish which can be kept successfully in captivity throughout their lives from egg to adult is exceedingly limited in number. The various breeds of goldfish are familiar examples, but the carp is almost the only food-fish capable of similar domestication. Various other food-fishes, both marine and fresh-water, can be kept in ponds for longer or shorter periods, but refuse to breed, while in other cases the fry obtained from captive breeders will not develop. Consequently there are two main types of pisciculture to be distinguished: (1) the rearing in confinement of young fishes to an edible stage, and (2) the stocking of natural waters with eggs or fry from captured breeders.

Fish-rearing.—Of the first type of pisciculture there are few examples of commercial importance. The pond-culture of carp is an important industry in China and Germany, and has been introduced with some success in the United States, but in England it has long fallen out of use, and is not likely to be revived so long as fresh fish can be obtained and distributed so readily as is now the case. Other examples are to be found in the cultivation of the lagoons of the Adriatic, and of the salt-marshes of various parts of France. Here, as in ancient Greece and Rome, it is the practice to admit young fish from the sea by sluices, into artificial enclosures or "viviers," and to keep them there until they are large enough to be used. An interesting modification of this method of cultivation has been introduced into Denmark. The entrances to the inner lagoons of the Limfjord are naturally blocked against the immigration of flatfish by dense growths of sea-grass (*Zostera*), although the outer lagoons are annually invaded by large numbers of small plaice from the North Sea. The fishermen of the district consequently combined to defray the expenses of transplanting large numbers of small plaice from the outer waters to the inner lagoons, where they were found to thrive far better than in their natural habitat. The explanation has been shown by Dr Petersen to be due to the abundance of food, coupled with the lack of overcrowding of the small fish. This transplantation of plaice in Denmark has been annually repeated for several years with the most successful results, and a suitable subvention to the cost is now an annual charge upon the government funds.

As a result of the international North Sea fishery investigations, it has been proposed to extend the same principle for the development of the deep sea fishery in the neighbourhood of the Dogger Bank. Experiments with labelled plaice, carried out in 1904 by the Marine Biological Association, showed that small plaice transplanted to the Dogger Bank in spring grew three times as rapidly as those on the inshore grounds, and the same result, with insignificant variations, has been obtained by similar experiments in each succeeding year. In this case the deep water round the Dogger Bank acts as a barrier to the emigration of the small plaice from the shores. It has consequently been proposed that the small plaice should be transplanted in millions to the Bank by well vessels every spring. It is claimed, as a further result of the experiments, that from May to October the young fish would be practically free on the shallow part of the Bank from the risk of premature capture by trawlers, and that the increased value of the fish, consequent upon their phenomenal growth-rate, would greatly exceed the cost of transplantation.

The methods of oyster- and mussel-culture are similar in principle to those just described. A breeding stock is maintained to supply the ground, or the "collectors," with spat, and the latter, when sufficiently grown, is then transplanted to the most favourable feeding-grounds, care being taken to avoid the local over-crowding which is so commonly observed among shell-fish under natural conditions.

Fish-hatching.—The second, and more familiar, type of pisciculture is that known as fish-hatching, with which must be associated the various methods of artificial propagation.

The fertilization of the spawn is very easily effected. The eggs are collected either by "stripping" them from the mature adult immediately after capture, or by keeping the adults alive until they are ready to spawn, and then stripping them or by keeping them in reservoirs of sea-water and allowing them to spawn of their own accord. In the two former cases a little milt is allowed to fall from a male fish into a vessel containing a small quantity of water—fresh or salt as required—and the eggs are pressed from the female fish into the same vessel. In fresh-water culture the eggs thus fertilized may be at once distributed to the waters to be stocked, or they may be kept in special receptacles provided with a suitable stream of water until the fry are hatched, and then distributed, or again they may be reared in the hatchery for several months until the fry are active and hardy.

The hatching of eggs, whether of fresh-water or salt-water fishes, presents no serious difficulties, if suitable apparatus is employed; but the rearing of fry to an advanced stage, without serious losses, is less easy, and in the case of sea-fishes with pelagic eggs, the larvae of which are exceedingly small and tender, is still an unsolved problem, although recent work, carried out at the Plymouth laboratory of the Marine Biological Association, is at least promising. It has been found possible to grow pure cultures of various diatoms, and by feeding these to delicate larvae kept in sterilized sea-water, great successes have been attained. In fresh-water culture little advantage, if any, has been found to result from artificial hatching, unless this is followed by a successful period of rearing. Thus the Howietown Fishery Company recommend their customers to stock their streams *either* with unhatched ova *or* with three-month-old fry. Their experience is "that there is no half-way house between ova sown in redds and three-month-old fry. Younger fry *may* do, but only where ova would do as well, and at half the cost." In marine hatcheries, on the other hand, it is the invariable practice to hatch the eggs, although the fry have to be put into the sea at the most critical period of their lives. If it is a risky matter to plant out the robust young fry of trout under an age of three months, it would seem to be an infinitely more speculative proceeding to plant out the delicate week-old larvae of sea-fishes in an environment which teems with predaceous enemies.

Objects and Utility of Fish-hatcheries.—The earlier advocates of artificial propagation and fish-hatching seem to have been under the impression that the thousands of fry resulting from a single act of artificial propagation meant a corresponding increase in the numbers of edible fish when once they had been deposited in suitable waters; and also that artificial fertilization ensured a greater proportion of fertilized eggs than the natural process. For the second of these propositions there is no evidence, while the first proposition is now everywhere discredited. It is recognized that the great fertility of fishes is nature's provision to meet a high mortality—greater in sea-fishes with minute pelagic eggs than in fresh-water fishes with larger-yolked eggs, partly because of the greater risks of marine pelagic life, and partly because of the greater delicacy of marine larvae at the time of hatching. Artificially propagated eggs and fry after planting must submit to the same mortality as the other eggs and fry around them. Consequently it is useless to plant out eggs or fry unless in numbers sufficiently great to appreciably increase the stock of eggs and fry already existing.

It is this, combined always with the suitability of the external conditions, which accounts for the success of the best known experiments of American pisciculturists. The artificially propagated eggs of the shad from the eastern rivers of the United States were planted in those of California and the Mississippi, where the species did not naturally occur. The conditions were suitable, and the species became at once acclimatized. Similarly reservoirs and streams can be stocked with various kinds of fish not previously present. But in the case of indigenous species the breeding stock must be very seriously reduced before the addition of the eggs or fry of a few score or hundreds of fish can appreciably increase the local stock.

In the case of sea-fishes it is becoming increasingly recognized that the millions of cod fry which are annually turned out of the American, Newfoundland and Norwegian hatcheries are but an insignificant fraction of the billions of fry which are naturally produced. A single female cod liberates, according to its size, from one to five million eggs in a single season. Yet the annual output of fry from each of these hatcheries rarely exceeds 200 millions, *i.e.* the natural product of a few hundred cod at most. In Britain marine hatcheries have been established by the Fishery Board for Scotland in the bay of Nigg, near Aberdeen, by the Lancashire Sea Fisheries Committee at Peel, and by the government of the Isle of Man at Port Erin. These establishments have been principally devoted to the hatching of the eggs of plaice. But again the maximum output of fry from any one of these establishments has not exceeded 40 millions in any single year. As a single female plaice produces about 200,000 eggs per annum, this output does not exceed the natural produce of a few hundred fish. Under these circumstances the probable utility of the operations could be admitted only if the fry were sedentary and could be planted in suitable localities where young fish were naturally scarce. But the fry drift with the currents as helplessly as the eggs, and the a priori objections to the utility of the operations have in no case been met by evidence of tangible results. The plaice fry hatched in the Scottish establishment have been distributed for many years in the waters of Loch Fyne. Yet in this area, according to the investigations of Mr Williamson (*Report* of the Scottish Fishery Board for 1898), nearly 500 millions of plaice eggs are naturally produced in one spawning season. Evidence is still lacking as to whether the 20 to 30 million fry annually added from the hatchery have appreciably increased the quantities of young plaice on the surrounding shores. Supposing this could be established, the question would still remain whether the same result could not be obtained at far less expense by dispensing with the hatching operations and distributing the eggs directly after fertilization.

In the United States the utility of the cod-hatching operations has been constantly asserted by representatives of the Bureau of Fisheries, but practically the only evidence adduced is the occasional appearance of unusual numbers of cod in the neighbourhood. It has not been established that the fluctuations in the local cod fisheries bear any fixed relation to the extent of the hatching operations, while the earlier reports of the Commissioners of Fisheries contain evidence that similar fluctuations occurred before the hatching of "fish commission cod" had begun.

The situation may be summed up in the words of Mr Fryer, H.M. Superintending Inspector of Fisheries, who critically examined the evidence bearing upon the operations of the Newfoundland Hatchery at Dildo (Reports x.–xii. of the Inspectors of Sea Fisheries, E. & W.): "Where the establishment of a hatchery, even on the smallest scale, is followed by an increased take of fish, there is a tendency to connect the two as cause and effect on insufficient evidence, and without any regard to the many conditions which have always led to fluctuations in the case of any particular kind of fish."

The most exact investigations bearing upon this problem are those which have been recently undertaken in Norway in connexion with the cod-hatching operations at Arendal under Captain Dannevig. Four fjords were selected in the south coast of Norway in proximity to the hatchery, and the usual number of fry (10–30 millions) were planted in the spring in alternate fjords, leaving the intermediate fjords unsupplied. The relative number of young cod in the various fjords was then carefully investigated throughout the succeeding summer and autumn months. It was found that there was no relation between the abundance of young fish and the presence or absence of "artificial" fry. In 1904, 33 million fry were planted in Sondelefjord and young fish were exceptionally abundant in the following autumn (three times as abundant as in 1903 when no fry were planted). But their abundance was equally striking in other fjords in which no fry had been planted, while in 1905 all the fjords were deficient in young cod whether they had been planted with fry from the hatchery or not.

For a summary of these investigations see papers on "Artificial Fish-hatching in Norway," by Captain Dannevig and Mr Dahl, in the *Report* of the Lancashire Sea Fisheries Laboratory for 1906 (Liverpool, 1907).

It would thus seem clear that the attempts hitherto made to increase the supply of sea-fish by artificial hatching have been unsuccessful. The experience gained has doubtless not been wasted, but the direction to be taken by future work is plain. The energy and money devoted to hatching operations should be diverted to the serious attempt to discover a means of rearing on a large scale the just-hatched fry of the more sedentary species to a sturdy adolescence. When that has been done (it has been achieved by the present writer in the case of the sea fish *Cottus* with demersal eggs,) it would be possible to deposit the young fish in suitable localities on a large scale, with a reasonable prospect of influencing the local abundance of the species of fish in question.

For further details, see J. T. Cunningham, *Natural History of the Marketable Marine Fishes of the British Islands* (London, 1896); *A Manual of Fish-Culture* (Washington, 1897); Roché, *La Culture des mers* (Paris, 1898); W. Garstang, *Experiments on the Transplantation of Marked Plaice* (First Report of the North Sea Fisheries Investigation Committee, 1905). (W. Ga.)

PISCINA, a Latin word first applied to a fish-pond, and later used for any pool of water for bathing, &c., either natural or artificial, and also for a tank or reservoir. In ecclesiastical usage the term was given to a shallow stone basin (the French *cuvette*) placed near the altar in a church, with drains to take away the water used in the ablutions at the mass. "Piscinae" seem at first to have been mere cups or small basins, supported on perforated stems, placed close to the wall, and afterwards to have been recessed therein and covered with niche heads, which often contained shelves to serve as aumbries. They are rare in England till the 13th century, after which there is scarcely an altar without one. They frequently take the form of a double niche, with a shaft between the arched heads, which are often filled with elaborate tracing.

PISEK, a town of Bohemia, 55 m. S. of Prague by rail. Pop. (1900), 13,608, mostly Czech. It lies on the right bank of the Wottawa, which is here crossed by an interesting stone bridge of great antiquity. The most prominent buildings are the church of the Nativity, the town-hall, and a castle dating from the 15th century. The industries are iron and brass founding, brewing, and the manufacture of shoes, paper, cement and Turkish fezes. Feldspar, quartz and granite are quarried in the environs. The name of Pisek, which is the Czech for sand, is said to be derived from the gold-washing formerly carried on in the bed of the Wottawa (1571–1621).

In 1619 it was captured by the imperialist general, Karl Bonaventura de Longueval, Graf von Buquoy, and suffered so severely that the citizens opened their gates to his opponent, Ernst von Mansfeld. This was punished in October of the following year, when Duke Maximilian of Bavaria sacked the town and put nearly all the inhabitants to the sword. Pisek was one of the chief centres of the Hussites. It was occupied by the French in 1741.

PISIDIA, in ancient geography, the name given to a country in the south of Asia Minor, immediately north of Pamphylia by which it was separated from the Mediterranean, while it was bounded on the N. by Phrygia, on the E. by Lycaonia, Isauria and Cilicia, and on the W. and S.W. by Lycia and a part of Phrygia. It was a rugged and mountainous district, comprising some of the loftiest portions of the great range of Mt Taurus, together with the offshoots of the same chain towards the central table-land of Phrygia. Such a region was naturally occupied from a very early period by wild and lawless races of mountaineers, who were very imperfectly reduced to subjection by the powers that successively established their dominion in Asia Minor. The Pisidians are not mentioned by Herodotus, either among the nations that were subdued by Croesus, or among those that furnished contingents to the army of Xerxes, and the first mention of them in history occurs in the *Anabasis* of Xenophon, when they furnished a pretext to the younger Cyrus for levying the army with which he designed to subvert his brother's throne, while he pretended only to put down the Pisidians who were continually harassing the neighbouring nations by their lawless forays (*Anab.* i. 1, 11; ii. 1, 4, &c.). They are afterwards mentioned frequently by later writers among the inland nations of Asia Minor, and assume a more prominent part in the history of Alexander the Great, to whose march through their country they opposed a determined resistance. In Strabo's time they had passed under the Roman dominion, though still governed by their own petty chiefs and retaining to a considerable extent their predatory habits (giving rise to such wars as that carried on by Quirinius, about 8–6 B.C.).

The boundaries of Pisidia, like those of most of the inland provinces or regions of Asia Minor, were not clearly defined, and appear to have fluctuated at different times. This was especially the case on the side of Lycia, where the upland district of Milyas was sometimes included in Pisidia, at other times assigned to Lycia. Some writers, indeed, considered the Pisidians as the same people with the Milyans, while others regarded them as descendants of the Solymi, but Strabo speaks of the language of the Pisidians as distinct from that of the Solymi, as well as from that of the Lydians. The whole of Pisidia is an elevated region of table-lands or upland valleys in the midst of the ranges of Mt Taurus which descends abruptly on the side of Pamphylia. It contains several small lakes, and two of large size, Bey-Sheher Lake, the ancient Karalis, and the double lake now called the Egerdir Geul, of which the ancient name was Limnai. The latter is a fresh-water lake of about 30 m. in length, situated in the north of Pisidia on the frontier of Phrygia, at an elevation of 3007 ft. Karalis is a larger body, also of fresh water, and at a distinctly higher level above the sea. The only rivers of importance are the Cestrus and the Eurymedon, both of which take their rise in the highest ranges of Mt Taurus, and flow down through deep and narrow valleys to the plain of Pamphylia, which they traverse on their way to the sea.

Notwithstanding its rugged and mountainous character, Pisidia contained in ancient times several considerable towns, the ruins of which have been brought to light by the researches of recent travellers (Arundell, Hamilton, Daniell, G. Hirschfeld, Radet, Sterrett, Lanckoronski, Ramsay, &c.), and show them to have attained under the Roman Empire to a degree of opulence and prosperity far beyond what we should have looked for in a country of predatory mountaineers. The most important of them are Termessus, near the frontier of Lycia, a strong fortress in a position of great natural strength and commanding one of the principal passes into Pamphylia; Cremna, another mountain fortress, north of the preceding, impending over the valley of the Cestrus; Sagalassus, a little farther north, a large town in a strong position, the ruins of which are among the most remarkable in Asia Minor; Selge, on the right bank of the Eurymedon, surrounded by rugged mountains, notwithstanding which it was in Strabo's time a large and opulent city; and Antioch, known for distinction's sake as Antioch of Pisidia, and celebrated for the visit of St Paul. This was situated in the extreme north-east of the district immediately on the frontier of Phrygia, between Lake Egerdir and the range of the Sultan Dagh and was reckoned in the Greek and earlier Roman period, *e.g.* by Strabo, as a city of Phrygia.

Besides these there were situated in the rugged mountain tract west of the Cestrus Cretopolis, Olbasa, Pogla, Isinda, Etenna and Comama. Pednelissus was in the upper valley of the Eurymedon above Selge. The only place in the district at the present day deserving to be called a town is Isbarta, the residence of a pasha; it stands at the northern foot of the main mass of Mt Taurus, looking over a wide and fertile plain which extends up to the northern chain of Taurus. North of this and immediately on the borders of Phrygia stood Apollonia, called also Mordiaeum. Large estates in Pisidia and the adjoining parts of Phrygia belonged to the Roman emperors; and their administration has been investigated by Ramsay and others.

We have no clue to the ethnic character and relations of the Pisidians, except that we learn from Strabo that they were distinct from the neighbouring Solymi, who were probably a Semitic race, but we find mention at an early period in these mountain districts of various other tribes, as the Cabali, Milyans, &c., of all which, as well as the neighbouring Isaurians and Lycaonians, the origin is wholly unknown, and the absence of monuments of their languages must remain so. A few short Pisidian inscriptions have been published by Ramsay in *Revue des études anciennes* (1895, pp. 353–362). No inscriptions in these other languages are known. (W. M. Ra.)

PISO, the name of a distinguished Roman plebeian family of the Calpurnian gens which continued in existence till the end of the 2nd century A.D. Nearly fifty of its members were prominent in Roman history, but the following deserve particular mention.

1. Lucius Calpurnius Piso Caesoninus, Roman statesman, was the father-in-law of Julius Caesar. In 58 B.C., when consul, he and his colleague Aulus Gabinius entered into a compact with P. Clodius, with the object of getting Cicero out of the way. Psio's reward was the province of Macedonia, which he administered from 57 to the beginning of 55, when he was recalled, perhaps in consequence of the violent attack made upon him by Cicero in the senate in his speech *De provinciis consularibus.* On his return Piso addressed the senate in his defence, and Cicero replied with the coarse and exaggerated invective known as *In Pisonem.* Piso issued a pamphlet by way of rejoinder, and there the matter dropped, Cicero being afraid to bring the father-in-law of Caesar to trial. At the outbreak of the civil war Piso offered his services as mediator, but when Caesar marched upon Rome he left the city by way of protest. He did not, however, definitely declare for Pompey, but remained neutral, without forfeiting the respect of Caesar. After the murder of the dictator he insisted on the provisions of his will being strictly carried out, and for a time opposed Antony. Subsequently, however, he became one of his supporters, and is mentioned as taking part in an embassy to Antony's camp at Mutina with the object of bringing about a reconciliation.

2. Lucius Calpurnius Piso, surnamed *Frugi* (the worthy), Roman statesman and historian, was tribune in 149 B.C. He is known chiefly for his *lex Calpurnia repetundarum*, which brought about the system of *quaestiones perpetuae* and a new phase of criminal procedure. As praetor (136) and consul (133) Piso fought against the slaves in Sicily. He energetically opposed Gaius Gracchus, especially in connexion with his corn law.

See Annalists; C. Cichorius in Pauly-Wissowa's *Real encyclopädie* (1897), vol. iii., pt. 1; H. Peter, *Historicorum romanorum reliquiae* (1870), vol. i.; Teuffel-Schwabe, *Hist. of Roman Lit.* (Eng. trans.), § 132, 4. On the lex Calpurnia, *Corpus inscr. latinarum*, i., No. 198, with Mommsen's commentary; A. H. J. Greenidge, *Hist. of Rome, 133–104 B.C.* (1904).

3. Gnaeus Calpurnius Piso, Roman statesman, was consul in 7 B.C., and subsequently governor of Spain and proconsul of Africa. In A.D. 17 Tiberius appointed him governor of Syria, with secret instructions to thwart Germanicus, to whom the eastern provinces had been assigned. The indignation of the people at the death of Germanicus, and the suspicion that Piso had poisoned him, forced Tiberius to order an investigation. Piso committed suicide, though it was rumoured that Tiberius, fearing incriminating disclosures, had put him to death.

See H. Schiller, *Geschichte der römischen Kaiserzeit* (1883), vol. i.

4. Gaius Calpurnius Piso, Roman statesman, orator and patron of literature in the 1st century A.D., is known chiefly for his share in the conspiracy of A.D. 65 against Nero (*q.v.*). He was one of the most popular men in Rome, partly for his skill in poetry and music, partly for his love of luxury and generosity.

It is probably the last-named who is referred to by Calpurnius Siculus under the name of Meliboeus, and he is the subject of the panegyric *De laude Pisonis.*

PISSARRO, CAMILLE (1831–1903), French painter, was born at St Thomas in the Danish Antilles, of Jewish parents of Spanish extraction. He went to Paris at the age of twenty, and, as a pupil of Corot, came into close touch with the Barbizon masters. Though at first he devoted himself to subjects of the kind which will ever be associated with the name of Millet, his interest was entirely absorbed by the landscape, and not by the figures. He subsequently fell under the spell of the rising impressionist movement and threw in his lot with Monet and his friends, who were at that time the butt of public ridicule. Like Monet, he made sunlight, and the effect of sunlight on the objects of nature, the chief subjects of his paintings, whether in the country or on the Paris boulevards. About 1885 he took up the laboriously scientific method of the pointillists, but after a few years of these experiments he returned to a broader and more attractive manner. Indeed, in the closing years of his life he produced some of his finest paintings, in which he set down with admirable truth the peculiar atmosphere and colour and teeming life of the boulevards, streets and bridges of Paris and Rouen. He died in Paris in 1903.

Pissarro is represented in the Caillebotte room at the Luxembourg, and in almost every collection of impressionist paintings. A number of his finest works are in the collection of M. Durand-Ruel in Paris.

PISTACHIO NUT, the fruit of *Pistacia vera* (natural order Anacardiaceae), a small tree which is a native of Syria and generally cultivated in the Mediterranean region. Although a delicious nut and much prized by the Greeks and other Eastern nations, it is not well known in Britain. It is not so large as a hazel nut, but is rather longer and much thinner, and the shell is covered with a somewhat wrinkled skin. The pistachio nut is the species named in Gen. xliii. 11 (Heb. בֹּטֶן, Ar. *boṭm*) as forming part of the present which Joseph's brethren took with them from Canaan, and in Egypt it is still often placed along with sweetmeats and the like in presents of courtesy. The small nut of *Pistacia Lentiscus*, not larger than a cherry stone, also comes from Smyrna, Constantinople and Greece. *P. Lentiscus* is the mastic tree, a native of the Mediterranean region, forming a shrub or small tree with evergreen pinnately-compound leaves with a winged stalk. "Mastic" (from *masticare*, to chew) is an aromatic resinous exudation obtained by making incisions in the bark. It is chiefly produced in Asia Minor and is used by the Turks as a chewing gum. It is also used as a varnish for pictures. *P. Terebinthus*, the Cyprus turpentine tree, a native of southern Europe, Asia Minor and North Africa, yields turpentine from incisions in the trunk. A gall is produced on this tree, which is used in dyeing and tanning.

PISTIL, a term in botany for the female or seed-bearing organ of a flower (*q.v.*). The Lat. *pistillum* (diminutive from *pinsere*, *pistum*, to pound), a pestle, a club-headed instrument used for crushing or braying substances in a mortar (*q.v.*), was taken as the name for this organ from its similarity in shape, and thence adapted in Fr. *pistil* about the middle of the 18th century. In its complete form a pistil consists of three parts—ovary, at the base, containing the bodies which become seeds, style (Gr. *στῦλος*, pillar), and stigma (Gr. *στίγμα*, mark, *στίζειν*, to brand), the part which in impregnation receives the pollen.

PISTOIA, or PISTOJA (anc. *Pistoriae*), a town and episcopal see of Tuscany, Italy, in the province of Florence, from which it is 21 m. N.W. by rail. Pop. (1906), 27,127 (town); 68,131 (commune). It is situated on a slight eminence (210 ft.) near the Ombrone, one of the tributaries of the Arno. It is on the site of the Roman *Pistoriae*, which is hardly mentioned in ancient times, except for the destruction of Catiline's forces and the slaughter of their leader near it in 62 B.C., and as a station on the road between Florentia and Luca; and earlier still by Plautus, but only with jesting allusion to the similarity of the name to the word *pistor* (baker). Hardly any inscriptions of the ancient town have been found; but excavations in 1902 (see G. Pellegrini in *Notizie degli Scavi*, 1904, p. 241) in the Piazzo del Duomo led to the discovery of a large private house, which belonged to the end of the 1st century B.C. Some mosaic pavements were found, belonging perhaps to the 3rd century A.D., while the house appears to have fallen into ruin at the beginning of the 5th. Remains of four subsequent periods were discovered above it. It was found that the tradition that the cathedral occupied the site of a temple of Mars was groundless; for the house appears to have extended under it. Ammianus Marcellinus (5th century) mentions Pistoriae as a city of Tuscia Annonaria. During the middle ages Pistoia was at times a dangerous enemy to Florence, and the scene of constant conflicts between the Guelphs and Ghibellines; it was there that the great party struggle took place which resulted in the creation of the Bianchi and Neri factions (see Dante, *Inferno*, xxiv. 121 to end). In 1302–06 it was besieged and eventually taken by the armies of Florence and Lucca, and in 1325 it became subject to Castruccio of Lucca. In 1351 it was obliged to surrender to Florence, and thenceforth shared its fate.

The city is still surrounded by walls, dating from shortly after the siege of 1302–06; while two inner lines of streets represent two earlier and inner lines of wall. In the early development of architecture and sculpture Pistoia played a very important part; these arts, as they existed in Tuscany before the time of Niccola Pisano, can perhaps be better studied in Pistoia than anywhere else; nor is the city less rich in the later works produced by the school of sculptors founded by Niccola. In the 14th century Pistoia possessed a number of the most skilful artists in silver-work, a wonderful specimen of whose powers exists now in the cathedral—the great silver altar and frontal of St James, originally made for the high altar, but now placed in a chapel on the south side. The cathedral is partly of the 12th century, with a porch and façade with small arcades—in black and white marble, as is the case with several other churches of Pistoia—but was remodelled in the 13th century, and modernized inside in the worst taste. Besides the silver altar it contains many fine works of sculpture; the chief are the monument of Cino da Pistoia, lawyer and poet, Dante's contemporary (1337), by Cellino di Nese, surrounded by his scholars, and Verrocchio's finest work in marble, the monument to Cardinal Forteguerra (1474), with a large figure of Christ, surrounded by angels, in high relief. The clay model for it is in the South Kensington Museum. The monument has unfortunately been altered. The octagonal baptistery is by Cellino di Nese (1339). Among the earlier churches the principal is Sant' Andrea, enriched with sculpture, and probably designed by Gruamons and his brother Adeodatus in 1136; in the nave is Giovanni Pisano's magnificent pulpit, imitated from his father's pulpit at Pisa. Other churches of almost equal interest are S. Giovanni Fuorcivitus (so called, because it was outside the line of the earliest, pentagonal, enceinte of the middle ages), with one of the long sides elaborately adorned with small arcades in the Pisan style, in black and white marble, also with sculpture by Gruamons (1162) on the façade. Within is a beautiful group of the Visitation by Luca della Robbia. There is also a fine pulpit by Fra Guglielmo dell' Agnello of Pisa (1270). S. Bartolomeo in Pantano is an interesting basilica of 1167. San Francesco al Prato is a fine church of the end of the 13th century with interesting frescoes of the school of Giotto. San Domenico, a noble church, begun in 1294, contains the beautiful tomb of Filippo Lazari by Bernardo and Antonio Rossellino (1462–1468). In addition to its fine churches, Pistoia contains many noble palaces and public buildings. The Palazzo del Commune and the Palazzo Pretorio, once the residence of the podestà, are both fine specimens of 14th-century domestic architecture, in good preservation. The quadrangle of the latter contains many well-painted armorial bearings of the podestàs. The Ospedale del Ceppo, built originally in the 13th century, but remodelled in the 15th, is remarkable for the reliefs in enamelled and coloured terra-cotta with which its exterior is richly decorated. Besides various medallions, there is a frieze of figures in high relief extending along the whole front, over its open arcade. The reliefs consist of a series of groups representing the Seven Works of Mercy and other figures; these were executed by Giovanni Della Robbia between 1514 and 1525, and, though not equal to the best work of Luca and Andrea, are yet very fine in conception and modelling, and extremely rich in their general decorative effect. The last on the right was added in 1585 by Paladini.

The industries of Pistoia include iron and steel works, especially manufactures of glass, silk, macaroni, woollens, olive oil, ropes, paper, vehicles and fire-arms. The word "pistol" is derived (apparently through *pistolese*, a dagger—dagger and pistol being both small arms) from Pistoia, where that weapon was largely manufactured in the middle ages.

PISTOIA, SYNOD OF, a diocesan synod held in 1786 under the presidency of Scipione de' Ricci (1741–1810), bishop of Pistoia, and the patronage of Leopold, grand-duke of Tuscany, with a view to preparing the ground for a national council and a reform of the Tuscan Church. On the 26th of January the grand-duke issued a circular letter to the Tuscan bishops suggesting certain reforms, especially in the matter of the restoration of the authority of diocesan synods, the purging of the missals and breviaries of legends, the assertion of episcopal as against papal authority, the curtailing of the privileges of the monastic orders, and the better education of the clergy.

In spite of the hostile attitude of the great majority of the bishops, Bishop de' Ricci issued on the 31st of July a summons to a diocesan synod, which was solemnly opened on the 18th of September. It was attended by 233 beneficed secular and 13 regular priests, and decided with practical unanimity on a series of decrees which, had it been possible to carry them into effect, would have involved a drastic reform of the Church on the lines advocated by "Febronius" (see FEBRONIANISM).

The first decree (*Decretum de fide et ecclesia*) declared that the Catholic Church has no right to introduce new dogmas, but only to preserve in its original purity the faith once delivered by Christ to His apostles, and is infallible only so far as it conforms to Holy Scripture and true tradition; the Church, moreover is a purely spiritual body and has no authority in things secular. Other decrees denounced the abuse of indulgences, of festivals of saints, and of processions and suggested reforms; others again enjoined the closing of shops on Sunday during divine service, the issue of service-books with parallel translations in the vernacular, and recommended the abolition of all monastic orders except that of St Benedict, the rules of which were to be brought into harmony with modern ideas; nuns were to be forbidden to take the vows before the age of 40. The last decree proposed the convocation of a national council.

These decrees were issued together with a pastoral letter of Bishop de' Ricci, and were warmly approved by the grand-duke, at whose instance a national synod of the Tuscan bishops met at Florence on the 23rd of April 1787. The temper of this assembly was, however, wholly different. The bishops refused to allow a voice to any not of their own order, and in the end the decrees of Pistoia were supported by a minority of only three. They were finally condemned at Rome by the bull *Auctorem fidei* of the 28th of August 1794. De' Ricci, deprived of the personal support of the grand-duke (now the emperor Leopold I.), exposed to pressure from Rome, and threatened with mob violence as a suspected destroyer of holy relics, resigned his see in 1791, and lived in Florence as a private gentleman until his death in 1810. In May 1805, on the return of Pope Pius VII. from Paris, he had signed an act of submission to the papal decision of 1794.

De' Ricci's own memoirs, *Memorie di Scipione de' Ricci, vescovo di Prato e Pistoia*, edited by Antonio Galli, were published at Florence in 2 vols. in 1865. Besides this his letters to Antonio Marini were published by Cesare Guasti at Prato in 1857; these were promptly put on the Index. See also De Potter, *Vie de Scipion de' Ricci* (3 vols., Brussels, 1825), based on a MS. life and a MS. account of the synod placed on the Index in 1823. There are many documents in Zobi, *Storia civile della Toscana*, vols. ii. and iii. (Florence, 1856). The acts of the synod of Pistoia were published in Italian and Latin at Pavia in 1788.

PISTOL, a small fire-arm designed for quick work and personal protection at close quarters, and for use in one hand. It was originally made as a single and also double-barrelled smooth bore muzzle-loader, involving no departure in principle from the ordinary fire-arms of the day. With the introduction of revolvers and breech-loading pistols and the application of "rifling" to musket barrels, came also, in the early half of the 19th century, the rifling of pistol-barrels.

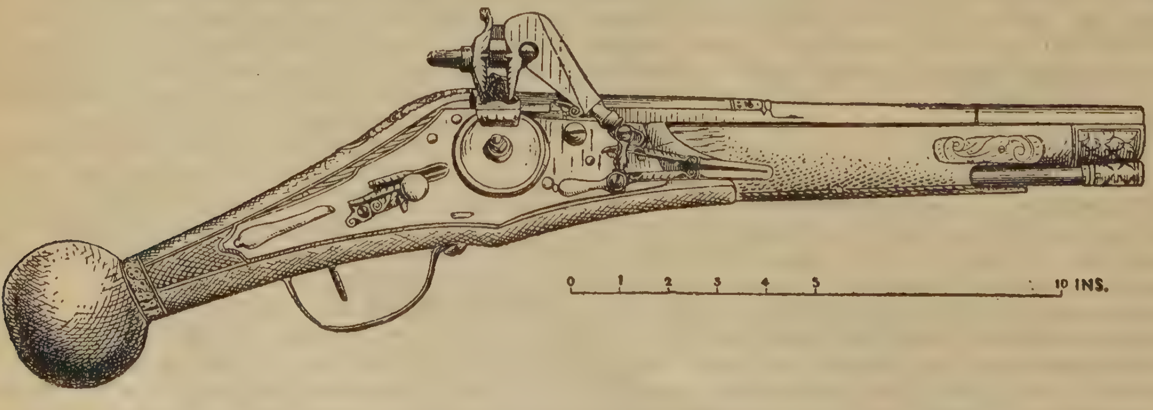


FIG. 1.—Dagg (Royal United Service Institution).

History.—Pistols are understood to have been made for the first time at Pistoia in Italy, whence they receive their name. Caminelleo Vitelli, who flourished in 1540, is the accredited inventor. The first pistols, in the 16th century, had short single barrels and heavy butts, nearly at right angles to the barrel. Shortly afterwards the pattern changed, the butts being lengthened out almost in a line with the barrels. These early pistols[1] were usually fitted with the wheel-lock (see GUN). Short, heavy pistols, called "daggs," were in common use about the middle of the 17th century, with butts of ivory, bone, hard wood or metal. A chiselled Italian dagg of 1650, for example, had a slightly bell-nosed barrel of about 8 in. in length and 14 bore. The German wheel-lock military pistols used by the Reiters, and those made for nobles and gentlemen, were profusely and beautifully ornamented. Pistols with metal hafts were common in the 16th and 17th centuries, many beautiful specimens of which, silver-mounted, were made in Edinburgh and used by Highlanders. Duelling, when in vogue, caused the production of specially accurate and well-made single-barrelled pistols, reliable at twenty paces. The pattern of this pistol seldom varied, its accuracy at short range equalling that of more modern ones, the principle of a heavy bullet and light charge of powder being employed. The first double-barrelled pistols were very bulky weapons made with the barrels laid alongside one another, necessitating two locks and two hammers. There was also the "over and under" pistol, one barrel being laid over the other. This was a more portable weapon, only requiring one lock and hammer, the second barrel being turned round by hand, after the first had been fired, or, as an alternative, the flash-hole being adjusted to the second barrel by a key. These pistols were first made with flint and steel locks and subsequently for percussion caps. Double "over and under" pistols were also made with a trigger mechanism that served to discharge both barrels in turn.

Revolvers.—A revolver is a single-barrelled pistol with a revolving breech containing several chambers for the cartridges, thus enabling successive shots to be rapidly fired from the same weapon without reloading. The ordinary pistol is now, and has been for many years past, superseded by the revolver. The first revolver, fired with the percussion cap, was made with the whole of the barrels, six, seven or eight, revolving in one piece, and was known as the "pepper-box." It was "single action," *i.e.* the hammer was raised and the barrels revolved by the pull of the trigger. This weapon was cumbrous and no accurate aim could be taken with it owing chiefly to the strength and resistance of the main-spring and the consequent strong pull required on the trigger. The principle of a revolving breech to one barrel, which superseded the "pepper-box," is an old one in the history of fire-arms, dating from the 16th century. At first the breech cylinder was revolved by hand, as in the revolving arquebus or matchlock, a specimen of which is now in the

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[1] For the use of long heavy pistols by cavalry in the 16th and 17th centuries, see ARMY: *History*; and CAVALRY.

Tower of London, but this was subsequently improved by introducing geared mechanism, by which the pull of the trigger or the cocking of the hammer, or both, do the work. There exists a pistol of the time of Charles I. which is rotated automatically as the hammer is raised.

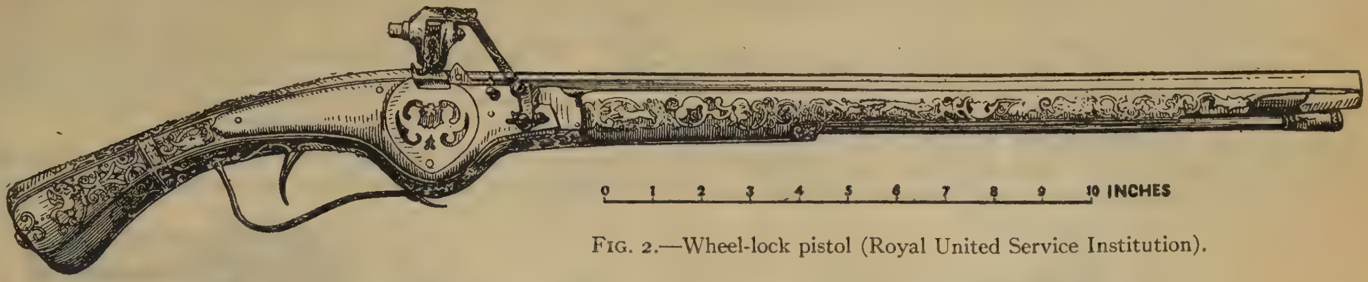


Fig. 2.—Wheel-lock pistol (Royal United Service Institution).

In 1814 a self-acting revolver mechanism of a crude pattern was produced in England. Four years later Collier used a separate spring to rotate the chamber. In 1835, an American, Samuel Colt, produced and patented the first practical revolving pistol, the idea of which was obtained by him, it is stated, from an ancient "revolving" weapon in the Tower of London. The chambers of the first Colt revolver were loaded with powder and bullets from the muzzle end, and each chamber had a nipple that required to be capped. It was the invention of the copper cap that made the Colt revolver possible. Under the old priming system with exposed powder in a pan the difficulty of separate and effective ignition with the revolving cylinder was almost insuperable.

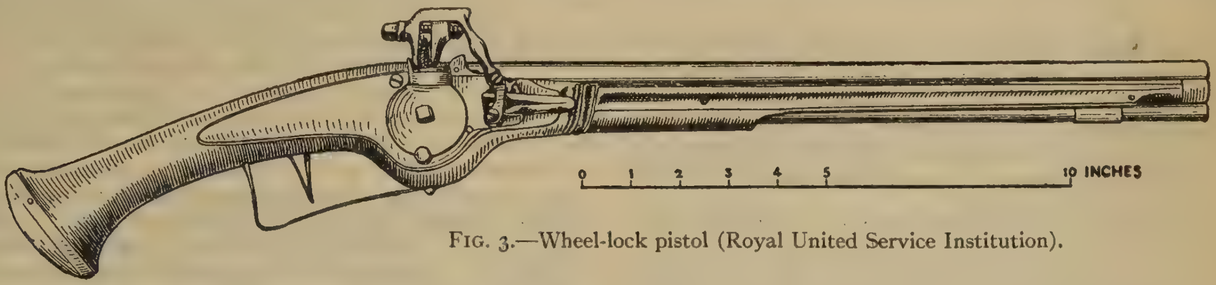


Fig. 3.—Wheel-lock pistol (Royal United Service Institution).

The first American revolver makers caused the cocking of the hammer to revolve the cylinder, while the English makers effected this by the pull of the trigger. In 1855, Adams of London, and also Tranter of Birmingham, brought out the double-action revolver, in which the revolution of the cylinder could be effected by both these methods. When the revolver is cocked and fired by pressing the trigger, greater rapidity of fire is obtained than when the hammer is cocked with the thumb, but accuracy is impaired, as the trigger requires a long pull and considerable force in order to compress the mainspring and revolve the cylinder. The double action revolver was, therefore, a great advance on the single action, enabling the first and also following shots, if desired, to be accurately fired by a moderate pressure of the trigger after the hammer had been cocked by the thumb; or, alternatively, the revolver could be rapidly fired, if necessary, by the trigger action alone. Many revolvers on the Colt principle were in use during the Crimean War and the Indian Mutiny, and proved of valuable service to British officers.

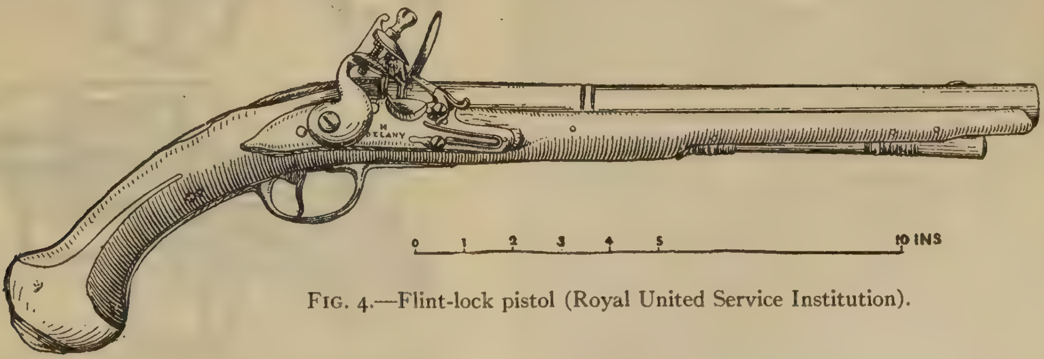


Fig. 4.—Flint-lock pistol (Royal United Service Institution).

As rim-fire, pin-fire and central-fire cartridges were successively introduced, breech-loading revolvers were constructed to use them. Messrs Smith & Wesson, of Springfield, U.S.A., produced the first metal cartridges for revolvers. Pin-fire cartridges, paper and metallic, were used on the continent of Europe for Lefaucheux and other revolvers, and these and rim-fire cartridges are still used for revolvers of small calibre. But since the central-fire cartridge has proved its superiority for guns, its principle has been generally applied to pistol cartridges, at first to the larger bores.

The alteration of the muzzle-loading to the breech-loading chamber in the revolver involved no decided change of type. The original Colt, as a breech-loader, remained practically the same weapon as before, with a changed chamber. A hinged flap uncovered the breech-chamber on the right, and as each chamber reached that point the empty cartridge case was ejected by means of an ejecting-rod carried in a tube attached to the under side of the barrel and kept in place by a spiral spring, and the chamber reloaded. The next improvement was greater ease and rapidity of extraction, obtained first by Thomas's invention of making the barrel and chamber slide forward on the frame of the pistol. The extractor, being fast to the pivot, retained the cartridges until the chamber was pushed clear of them. Then the chamber was made to swing on one side, as in the Colt pistol illustrated, enabling all the cartridges to be simultaneously extracted. Finally, self-extracting revolvers with jointed frames were introduced, in which the dropping of the barrel forces out the extractor as in an ordinary double gun, the extractor acting simultaneously in all the chambers of the pistol. A spring returns the extractor to its place when the empty cartridge cases have been ejected, and brings the barrel to an angle of about 45°, for convenience in loading. The soundness and rigidity of the weapon depend upon the efficiency of the connexion between the barrels and the standing breech, and a top snap bolt has proved the strongest and handiest with the pistol, as with the shot-gun.

This type of revolver originated with Messrs Smith & Wesson, but they and other gunmakers have greatly improved upon the original model. Between the American pattern and the English, as made by Messrs F. Webley & Son, the chief difference is that in the Smith & Wesson the holding-down bolt or catch is upon the barrel, and it engages with the top of the standing breech; whereas in the Webley the bolt is upon the standing breech and grips the extremity of the hinged barrel. Neither mechanism is as strong as could be wished if heavy charges of smokeless nitro-compounds are to be used. This hinged type of revolver is most convenient for use on horseback, as the pistol can be opened, the cartridges extracted and the weapon reloaded with one hand.

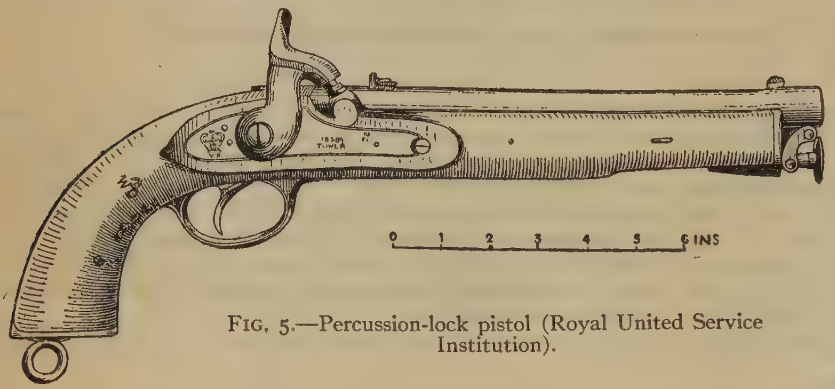


Fig. 5.—Percussion-lock pistol (Royal United Service Institution).

The *Colt's Double-action Revolver, calibre* ·38, *model* 1896, used in the United States army, consists (figs. 7 and 8) of the barrel (B), the cylinder (C) with six chambers, the frame (F), and the firing mechanism, all of steel. The muzzle velocity, with a charge of 16 grains of black powder and a bullet of 150 grains of lead, is about 708 ft. per second, giving at 25 yards a penetration of about 5 in. in pine.

The lock mechanism consists of the hammer (*h*), with its stirrup (*r*), stirrup pin (*p*), strut (*s*), strut pin (*i*), strut spring (*g*); the trigger (*t*); the rebound lever (*l*); the hand (*a*), with the spring (*z*); the cylinder bolt (*b*), with its spring (*x*); the locking lever (*v*); the main spring (*m*), and rebound lever spring (*n*). The hammer (*h*), trigger (*t*), and rebound lever (*l*) are pivoted on their respective pins, which are fastened in the left side of the frame. The lower end of the rebound lever spring (*n*) is secured to the frame and the free end bears under the rear end of the rebound lever so that the latter, when the trigger is released, cams the hammer back to its safety position, and forces the trigger forward. Pressure upon the trigger causes its upper edge to engage the strut, and thereby raises the hammer until nearly in the full-cock position, when the strut will escape from the trigger, and the hammer, under the action of the main-spring, will fall and strike the cartridge. A projection on the upper part of the trigger, working in a slot in the frame, prevents the cylinder from making more than one-sixth of a revolution at a time by entering one of the grooves nearest the rear end of the surface of the cylinder. When the cylinder is swung out of the frame, the parts are arranged to prevent the cocking of the hammer. The cylinder bolt is pivoted on the trigger pin, and its spring, bearing on the rebound lever arm, causes the nose of the bolt to project through a slot in the frame ready to enter one of the rectangular cuts in the cylinder surface. During the first movement of the trigger in cocking the revolver, the nose of the bolt is withdrawn, allowing free rotation of the cylinder. The object of the bolt is to prevent rotation of the cylinder in transportation. The hand is attached by its pivot to the trigger, and, as the latter swings on its pin when the hammer is being cocked, the hand is raised and revolves the cylinder, and also serves to lock the cylinder in position at the time of firing. An abutment on the side plate supports the hand spring in rear. The spring ensures the engagement of the hand with the ratchet (*y*). The revolver is cocked by hand by withdrawing the hammer by the pressure of the thumb until its full-cock notch engages in the rear sharp corner of the trigger. Pulling the trigger then releases the hammer, allowing its firing pin (*f*) to move forward and strike the cartridge.

The locking lever is pivoted by its screw in a recess in the left side of the frame, and so connected with the latch that it locks the hammer and trigger when the latch is pushed to the rear for opening the cylinder, and does not unlock them until the cylinder is positively closed and is locked by the latch. The cylinder revolves and is supported on a central arbour of the crane (E). The crane fits in a recess in the frame below the barrel and turns on its pivot arm (A). The ejector rod with its spring passes through the centre of the cylinder arbour and is terminated in rear by the ejector with a ratchet (*y*). Pushing against the front end of the ejector rod will empty the chambers, the cylinder being swung out for loading. The thumb-piece of the latch (*j*) slides to the rear in the left side of the frame, unlocking the cylinder for opening, but upon closing the cylinder, the body of the latch firmly enters a recess in the ejector, locking the cylinder in position for firing.

One great disadvantage of revolvers is the escape of gas at the opening between the breech of the barrel and the cylinder. This escape corrodes the surrounding parts and also materially diminishes the pressure in the barrel and the consequent velocity of the bullet. In the Nagant revolver, adopted by Russia, this disadvantage has been overcome by employing a long cartridge case which extends beyond the nose of the bullet and bridges the gap between barrel and cylinder as the cylinder is moved forward. A "mitrailleuse" pistol has also been constructed by the Braendlin Armoury Co., Ltd., on the "pepper-box" principle, with fixed barrels, either four or six, arranged in pairs, and a special striking mechanism, in which there is no revolving chamber and no escape of gas at the breech. It gives stronger shooting than a revolver, but is more cumbrous, and has the serious defect that the shock of the discharge of one barrel sometimes prematurely fires a second barrel.

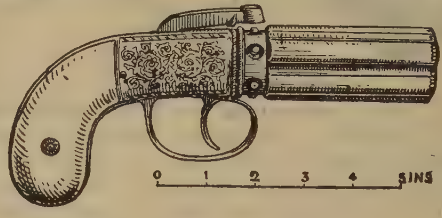
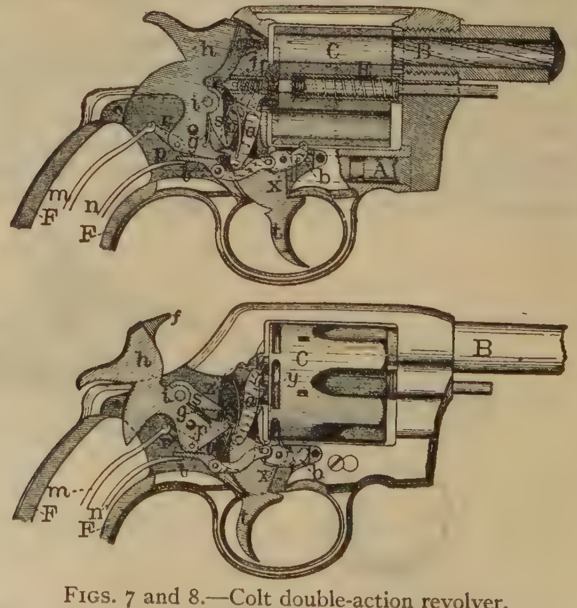


Fig. 6.—Pepper-box revolver.

In 1865, Sharp, an American, patented an invention to remedy the escape of gas, in which the four barrels of the pistol were drilled the full length out of one block of metal. The barrels were slid forward by an under lever to load, and the firing was effected by a revolving head to the hammer, set by the action of cocking the pistol.



Figs. 7 and 8.—Colt double-action revolver.

About 1878 Messrs Lancaster introduced both two- and four-barrelled hammerless pistols, in which an internal hammer was worked by the pull of the trigger. In all the three weapons above mentioned, extraction and reloading were slow processes, which made them unsuited for use on horseback.

Hammerless Revolver.—The Smith & Wesson pocket pistol is one of the safest weapons of the size made. There is no hammer or equivalent protuberance to catch as the pistol is drawn from the pocket; or to entangle if the weapon falls. An automatic safety bolt, whose length lies half across the palm of the hand, and ensures certainty of freedom at the time of shooting, blocks the action until the pistol is firmly gripped for use.

Maker's Name.	Description of Revolver.	No. of Shots.	Calibre.	Length of Barrel.	Length over all.	Weight.		Cartridge.	
								Powder Weight.	Bullet Weight.
				In.	In.	℔	oz.	gr.	gr.
Colt	New Service	6	·45	5½	10¾	2	8	40	250
	New Army	6	·38	4½	9¾	2	0	21	158
	New Police	6	·32	4	8¼	1	2	13	98
	New Pocket or Pocket Positive	6	·32	2½	6½	1	0	12	82
	Police Positive	6	·38	4	8¼	1	5½	14	150
Smith & Wesson	Double Action	5	·32	3	7½	0	12½	10	88
	Safety Hammerless	5	·32	3	7½	0	14¼	10	88
	Single Action Target	6	·38/·44	6	12½	1	3¾	20	146
	Single Action Bisley model	6	·45	8	13½	2	9	13	226
	Military and Police	6	·38	6½	12	1	15¼	21½	158
	Hand Ejector	7	·22	3	6½	0	9⅝	5	40
Webley	British Govt. Mark IV	6	·455	4	9⅛	2	3	18	265
	"W.G." Army model	6	·455	6	11¼	2	8	18	265
	"W.G." Target	6	·455	7½	13⅛	2	10	18	265
	Mark III	6	·380	3	7⅛	1	4	3 Cor	145
	"W.P." Pocket model	6	·320	3	7⅛	1	1	6	80
	R.I.C. No. 1	6	·450/·455	4½	9½	1	14	18	265

Breech-loading Pistols.—Although the revolver has for many years practically superseded the pistol, some breech-loading varieties of pistols are still made—the small pocket pistol, for example, and occasionally the heavy double-barrelled horse pistol. At one time these latter were much used, of ·577 bore, as well as the well-known short, large-bore pistol known as the Derringer, usually of ·41 calibre. The double horse pistol is now usually made for a 20-bore cartridge and spherical bullet, and weighs about 3½ ℔. It is a clumsy, but effective weapon, and fires a charge of 1¾ drams of powder without unpleasant recoil. The duelling pistol, as made by Gartinne Renette of Paris, is capable of wonderfully accurate shooting, firing a 9 millimetre spherical bullet and about 12 grs. of powder. This weapon is far superior in accuracy to a revolver. Single-barrelled pistols, chambered for the ·22 or 297/230 calibre cartridges, with a barrel of from 6 to 10 in. in length, are also made, and when fitted with a detachable metal stock form excellent little weapons for target practice.

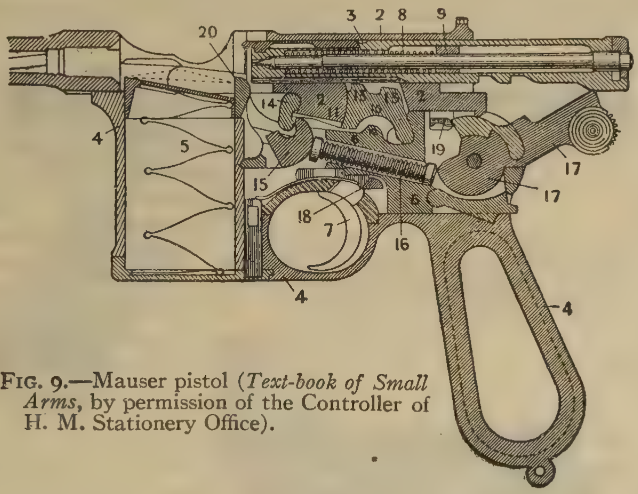
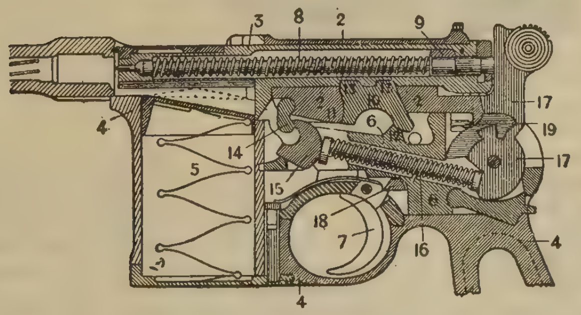


Fig. 9.—Mauser pistol (*Text-book of Small Arms*, by permission of the Controller of H. M. Stationery Office).



Automatic Revolver.—The Webley-Fosbery automatic revolver is a weapon of a distinctly new design, in which for the first time the principle of utilizing the recoil of each shot to operate the mechanism is applied to the revolver. In appearance the weapon is very similar to the Webley service model. The simple pressure of the forefinger on the trigger, the pressure being released between each shot, is all that is required to fire the six successive shots of the revolver. It is supplied with a safety bolt worked by a thumb-piece, and Messrs Webley have introduced a clip loader which enables the six chambers to be reloaded at the same time. This weapon has met with considerable success, and is made in two calibres, the ·455, 6 shot, 2 ℔ 5½ oz. in weight; and the ·38 model, 8 shot, 2 ℔ 3 oz. in weight.

Automatic Pistols.—These weapons are the latest and most advanced type of pistol, and it is anticipated by experts that they will ultimately supersede the revolver. They are made with one barrel and a magazine, on the principle of the repeating rifle, thus doing away with the escape of gas that takes place in revolvers between the chamber and the barrel.

Automatic pistols are so constructed that the force of the recoil is utilized to open the breech, extract the empty case, cock the pistol, reload the chamber with the top cartridge from the magazine, and close the breech, leaving the pistol ready to fire on again pressing the trigger.

The Mauser "self-loading" pistol (fig. 9) is one of the earliest of the successful automatic weapons. It is usually ·300 calibre, 10 shot, with a metal clip loader from which the cartridges are "stripped" into the magazine, weight 2½ ℔, length of barrel 5½ in.; bullet 85 grains, initial velocity about 1394 f.s.

The barrel (1) and body (2) are in one piece; the latter contains the bolt (3). The barrel and body slide on the frame (4); the 10-shot magazine (5) and the stock are in one piece with the frame, and the lock frame (6) and lock-work are contained in the rear part of it. The bolt (3), which is square, slides in the body, and is kept pressed up to the chamber by the bolt spring (8); the rear end of this bolt spring bears against the block (9). The striker and extractor are contained in the bolt. The bolt is locked by the bolt-lock (10). This is slotted through the centre and fits on to the projection (11) under the body; it is supported at the moment of firing by a projection on the lock frame (12); the top of the bolt-lock has two teeth (13), which in the loaded and cocked position fit into two recesses in the bolt, and the bottom of its front end [in front of the body attachment (11)] has another tooth (14) which bears on the rocker (15). This rocker is pivoted at its bottom corner. The main-spring (16) bears in front against the rocker, and in rear against the hammer mechanism. The action of the mechanism is as follows: on pressing the trigger, the trigger nose lifts the lever (18) which is attached to the sear (19), the lifting of the sear allows the main-spring to act backwards on the hammer, which impinges on the striker and fires the cartridge. At this moment the bolt is locked by the two upper teeth (13) of the bolt-lock, which is itself held up by the lock frame projection (13). But, the barrel body and bolt recoiling together $\frac{3}{16}$ of an in., the rear end of the bolt-lock (10) is no longer supported, the rocker (15) acting on the forward tooth (14) pulls down the bolt-lock and its upper teeth, the nose of the bolt-lock falling into the recess just behind the projection (12). Thus the barrel and body come to a standstill and the remaining recoil energy is used in driving back the bolt (now free) and extracting the cartridge case. When this energy is used up the bolt spring (8) reasserts itself, drives the bolt forward and pushes another cartridge into the chamber as in the magazine rifle, and the main-spring, acting on the rocker, pulls up the bolt-lock again and engages the teeth (13) in the bolt, locking it for the next shot. The releasing of the trigger brings the sear (19) to its former position, cocking the pistol.

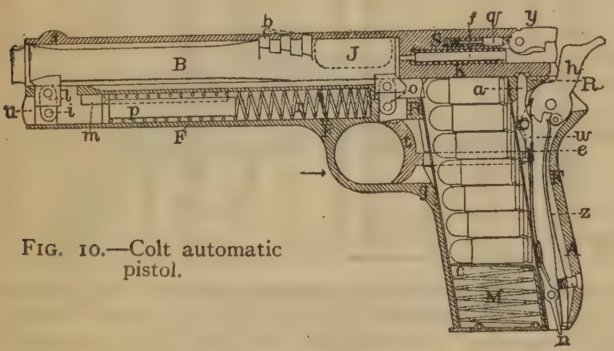


Fig. 10.—Colt automatic pistol.

This pistol is usually supplied with a wooden holster which can also be attached to the grip of the pistol and so form a shoulder-stock for long-range shooting. It is sighted from 50 to 1000 yards.

The *Colt Automatic Pistol, calibre* ·38 (fig. 10) consists of four main parts, namely the frame (F), the barrel (B), the slide (S), and the magazine (M). The frame forms, at its rear and lower part, the handle (A), which is hollow, and contains the seat for the magazine. After being charged with seven cartridges, the magazine is seated from below and held in place by the magazine catch (*n*) which slightly projects from the bottom of the handle. This projection serves to release the magazine from the catch, when it can be readily drawn from the handle for re-charging. In front of the handle is the trigger guard (*g*), in which the trigger (*t*) is found, and in the rear and above the grip the firing mechanism is placed in the part of the frame called the receiver (R). The firing mechanism consists of the hammer (*h*), the sear (*w*), the trigger (*t*), a safety device (*a*), the main-spring (*z*) and sear spring (*e*), the lower part of the latter serving to operate the magazine catch. The top of the receiver extends forward from the handle, and to it the barrel is attached by two short links, one (*l*) near the front end of the barrel, and the other (*o*) at its rear end; these links are pivoted to the receiver and also to the barrel, and allow the barrel to swing rearwards thereon. As both links are of the same length, the rearward movement of the barrel in swinging on these links carries the barrel slightly downwards, but keeps its longitudinal axis in parallel positions during all its movements. Below the barrel the receiver forms a tubular seat for the retractor spring (*r*), which in front is closed by a plug (*u*) fastened in the receiver by the lower pivot-pin (*i*) of the front barrel-link. The upper surface of the receiver and two longitudinal grooves on its sides form the seat for the slide, which is guided thereon in its rearward and forward movements. The rear part of the slide forms the bolt or breech block (K), and the front part forms a partly tubular cover (*s*) which encloses the barrel. In the forward part of the receiver is a transverse mortice extending through the retractor spring seat, and transverse recesses in the forward part of the slide serve to admit a key (*m*) which, passing through the sides of the slide and through the mortice, serves to lock the slide to the frame. The retractor spring (*r*), in its seat in the frame, consists of a spiral spring, the rear end of which rests against the receiver, and the front end of which carries a piston (*p*). The rear face of the key (*m*) has a slight recess, and when the key is in its place the front end of the retractor spring rests in this recess, thereby confining the key laterally. The tension of the retractor spring is exerted to force the key and the slide to their forward position. Upon the barrel are provided three transverse ribs (*b*), and in the interior of the slide are three corresponding recesses. These serve to lock the barrel and the slide firmly together when in their forward position. Between the locking recesses and the bolt, the slide has an opening on its right side for the ejection of the cartridge cases (J), and the bolt is provided with an extractor, a firing pin (*f*), a firing pin retraction spring (*q*), and a firing pin lock (*y*). This latter is pivoted at the rear end in the top of the slide, and when depressed, locks the firing pin in its retracted position, thus preventing its point from coming in contact with the cartridge primer. When raised, the firing pin lock releases the firing pin, and in this position also serves as the rear sight, being provided on the top with a sighting notch.

The *operation* of the pistol is as follows: When a charged magazine (M) is inserted, the slide (S) is drawn once to the rear by hand, thereby cocking the hammer (*h*). In this position of the slide, the carrier (*c*) and carrier spring in the magazine raise the topmost cartridge so as to bring it into the path of the bolt (K). On releasing the slide, it, with the bolt, is carried forward by the retractor spring (*r*), and during this movement the bolt forces the topmost cartridge into the barrel (B). As the slide approaches its forward position the front of the bolt encounters the rear end of the barrel and forces the latter to its forward position. During this forward movement the barrel swings forward and upward on the links (*l*, *o*), and thus the locking ribs (*b*) on the barrel are carried into the corresponding locking recesses in the slide. The barrel and slide are thereby interlocked, and the pistol ready for firing.

A slight pull on the trigger (*t*) now serves to move the sear (*w*) so as to release the hammer (*h*) and fire a shot. The force of the powder gases driving the bullet from the barrel is exerted rearwardly against the bolt, and, overcoming the inertia of the slide and the tension of the retractor spring, causes the slide and the barrel to recoil together. After moving rearwards together, for a distance, enough to ensure the bullet having passed from the barrel, the downward swinging movement of the barrel releases the latter from the slide and stops the barrel in its rearmost position. The momentum of the slide causes the latter to continue its rearward movement, thereby again cocking the hammer and compressing the retractor spring, until, as the slide arrives at its rearmost position, the empty shell is ejected from the side of the pistol and another cartridge raised in front of the bolt. During the return or forward movement of the slide, caused by the retractor spring, the cartridge is driven into the barrel, and the slide and barrel are interlocked, thus making the pistol ready for another shot. These operations may be continued so long as there are cartridges in the magazine, each discharge requiring only the slight pull on the trigger. The pistol is provided with a safety device (*a*) which makes it impossible to release the hammer unless the slide and barrel are in their first forward position and interlocked.

In the Borchardt-Leuger pistol (fig. 11) the bolt is solidly supported at the moment of firing by a toggle joint. The barrel (1 A) and body (1 B) slide in the frame (1 C), the bolt (2) slides in the body and is held up to the breech by the toggle joint 3 and 4 and the pins 5 and 7, which secure the links of the toggle to the body. The centre of pin (6) is below those of the other pins so that the joint cannot bend at the moment of firing. On the rear link (4) there is a swivel (9) which is connected to the recoil spring (10) in the grip. This pistol is fired by a spring striker, like a rifle, instead of by a hammer. The striker is within the bolt; it is cocked in the recoil position by a claw on the end of the front link (3 A) and held thus when ready to fire by the nose of the trigger sear, these engaging with a projection (8 A) on the side of the striker. The magazine (8 shot) is in the grip. The action is as follows: the first cartridge is loaded from the magazine by pulling back the toggle joint. As soon as the toggle joint is released the recoil spring acts and forces the bolt home, with the cartridge in front of it. On pressing the trigger the barrel and body recoil a little. Then the toggle joint comes

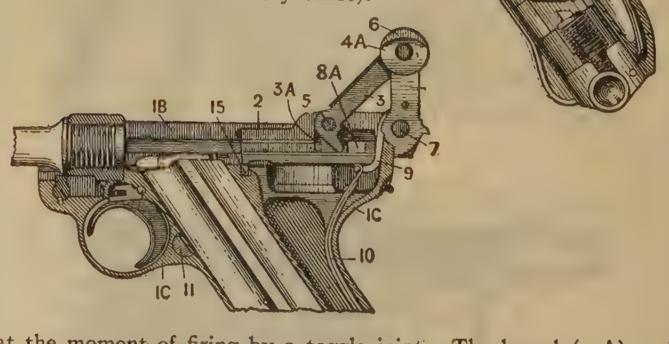


Fig. 11.—Borchardt-Leuger (*Text-book of Small Arms*, by permission of the Controller of H. M. Stationery Office).

against curved ramps on the sides of the non-recoiling frame and is forced up, so that thereafter the bolt alone recoils (the ejector is similar in principle to that of a rifle). The recoil spring then acts as before on reloading.

Other varieties of the automatic pistol are the "Mannlicher," the "Mars," the "Bergmann" and the "Webley." The last, being simple in construction, small and light, weight 18 oz. and length over all only 6½ in., may be classed as a pocket pistol.

Qualities of Automatic Pistols.—In reference to the general qualities of automatic pistols, while these weapons have the advantage over revolvers of longer range and greater rapidity of fire and recharging, on the other hand they are necessarily more complicated in their mechanism, which has to do the work of extraction, reloading and cocking that in the revolver is done by hand. A stoppage may occur through a cartridge missing fire, or continuous uncontrolled fire may take place through the trigger spring breaking until the magazine is exhausted. Their action is also to some extent uncertain, as it depends on the recoil of the discharge, which may be affected by variables in the cartridge; also the effective automatic working of the moving parts depends upon their cleanliness and lubrication. As automatic pistols, like revolvers, are intended for personal defence at short range and for sudden use in emergencies, simplicity of mechanism and certainty of action are in their case of paramount importance. There is usually no time to rectify a stoppage or jam, however slight. From a military point of view, therefore, before the revolver is altogether superseded by the automatic pistol, it is most desirable that the latter should be as certain in its action under service conditions as the former. Some automatic pistols, as already stated, are sighted up to 1000 yards, and provided with attachable butts. The practical value of these improvements is open to question, as the sighting of a pistol differs materially when used with and without a butt, and under no circumstances can the accuracy of shooting of a pistol, even with a butt, equal that of a carbine.

The tendency in automatic pistols has been to reduce the bore to ·3 in., and increase the muzzle velocity, on the lines of modern small-bore rifles. These, again, would appear to be advantages of minor importance in a weapon intended for use at short range in the field, where a heavy bullet of fairly large diameter, with a moderate muzzle velocity, has a more immediate and paralysing effect, and is therefore, from this point of view, and particularly in savage warfare, preferable to a small projectile of high muzzle velocity. (H. S.-K.)

PISTOLE, the French name given to a Spanish gold coin in use from 1537; it was a double *escudo*, the gold unit, and was worth 16s. 11¼d. sterling. The name was also given to the *louis d'or* of Louis XIII. of France, and to other European gold coins of about the value of the Spanish coin.

PISTON (through Fr. from Ital. *pistone* or *pestone*, a great pestle, from Late Lat. *pistare*, to pound, a frequentative form of classical Lat. *pinsere*), in the steam engine, a disk or partition placed inside the cylinder, from end to end of which it moves alternately under the pressure of the steam. By means of the "piston-rod" attached to it this forward and backward motion is communicated to the machinery which the engine is employed to drive, and is in most cases converted into rotary motion by a "connecting-rod," one end of which is jointed to the "cross-head" carried at the end of the piston-rod, while the other turns the crank on the crank-shaft. The piston in gas, oil and air engines has a similar function, but in a pump, instead of imparting motion, it has motion imparted to it by some prime-mover. In every case the piston must fit the cylinder so accurately that as little as possible of the working fluid, whether it be steam, gas or water, can escape past it, packing of various forms being commonly placed round its periphery in order to secure this fit. In music, the valves which in certain wind instruments, such as the cornet, enable the player to increase the length of the air-column and thus lower the note produced, are known as pistons. (See VALVES.)

PIT (O. E. *pytt*, cognate with Du. *put*, Ger. *Pfütze*, &c., all ultimately adaptations of Lat. *puteus*, well, formed from root *pu-*, to cleanse, whence *purus*, clean, pure), a term of wide application for a hole, cavity or excavation in the earth or other surface; thus it is applied to the excavations made in the ground for the purpose of extracting minerals, *e.g.* chalk, gravel or sand, or for carrying on some industry, *e.g.* tan-pit, saw-pit, or to the group of shafts which form a coal-mine. Roots and other vegetables can be stored in the winter in a pit, and the term is thus transformed to a heap of such vegetables covered with earth or straw. The word is also used of any hollow or depression in a surface, as in the body, the arm-pit, the pit of the stomach, or on the skin, as the scars left by small-pox or chicken-pox. As applied to a portion of a building or construction, the word first appears for an enclosure, often sunk in the ground, in which cock-fighting was carried on, a "cock-pit." It would seem a transference of this usage that gave the common name to that part of the auditorium of a theatre which is on the floor, the French *parterre*. In the United States a special usage is that of its application to that part of the floor space in an exchange where a particular branch of business is transacted; thus in the Chicago Board of Trade, transactions in the grain trade are carried on in what is known as the "Wheat Pit."

In Scottish legal history there was a baronial privilege which in Latin is termed *furca et fossa*, "fork (*i.e.* gallows) and pit"; here the term has usually been taken to refer to the drowning-pit, in which women criminals were put to death; others take it to refer to an ordeal pit. There is a parallel phrase in M. Dutch, *putte ends galghen*; here *putte* is the pit in which women were buried alive as a penalty.

PITCAIRN, an island in the mid-eastern Pacific Ocean, in 25° 3′ S., 130° 6′ W., belonging to Great Britain. It lies south of the Paumotu archipelago, 100 m. from the nearest member of this group. Unlike the majority of the islands in this region, it is without coral reefs, but rises abruptly with steep and rugged cliffs of dark basaltic lava. The extreme elevation is over 2000 ft., and the area 2 sq. m. The soil in the valleys is volcanic and fertile, but the gradual utilization of natural timber increases the liability to drought, as there are no streams. The climate is variable and rainy. Stone axes, remains of carved stone pillars similar to those of Easter Island, and skeletons with a pearl-mussel beneath the head have been found in the island, though it was uninhabited when discovered by Philip Carteret in 1767. Pitcairn was the name of the midshipman who first observed it.

The island was destined to become the scene of a curious social experiment. On the 28th of April 1789 a mutiny broke out on board the "Bounty," then employed by the British government in conveying young bread-fruit trees from Tahiti to the West Indies. The commander, Lieutenant William Bligh, was set adrift in the launch with part of the crew, but managed to make his way to Timor in the Malay Archipelago. The twenty-five mutineers at first all returned to Tahiti. Some remained, and six of these were ultimately court-martialled in England, three being executed in 1792. Meanwhile in 1790 a party consisting of Fletcher Christian, the leader of the mutiny, eight Englishmen, six Polynesian men and twelve Polynesian women had taken possession of Pitcairn Island and burned the "Bounty." Treachery and debauchery filled the first years of the annals of the beautiful island. By 1800 all the men were dead except Alexander Smith, afterwards known as John Adams, who rose to a sense of his responsibility and successfully trained up the youthful generation left in his charge. An American vessel, the "Topaze," discovered the strange colony in 1808; again, by accident, it was visited by the "Briton," Captain Sir F. Staines, and the "Tagus," Captain Pipon, in 1817; and by the exploring ship "Blossom" in 1825. On the death of John Adams on the 29th of March 1829 George Hunn Nobbs, who had settled at Pitcairn in 1828, was appointed pastor and chief magistrate. Through fear of drought the islanders removed to Tahiti in 1830, but disapproved of both the climate and the morals of this island, and returned to Pitcairn in 1831. Shortly after this an adventurer named Joshua Hill appeared, and, claiming government authority, tyrannized over the islanders till his removal by a British man-of-war in 1838. In 1856 the whole of the islanders—60 married persons and 134 young men, women and children—were landed on

Norfolk Island, but in 1858 two families chose to return, and their example was afterwards followed by a few others. Visited in 1873 and 1878 the colony was found in excellent order, but by the end of the century it was stated that intermarriage was bringing a deterioration of intellect, morals and energy, and that the islanders would probably drift into imbecility. Later accounts made it appear that this was an exaggeration, although the standard of morality was unquestionably low on the whole.

In religion the islanders are Seventh Day Adventists. "They have adopted an extraordinary patois, derived from the language of the Tahitian women who accompanied the mutineers of the "Bounty" to Pitcairn Island, although most of the adults can speak the English language fairly well" (R. T. Simons, *Report*, 1905). The island is a British colony by settlement, and is within the jurisdiction of the High Commissioner for the Western Pacific (since 1898). There is a governing body chosen from among the islanders, the constitution of which has been altered more than once owing to internal jealousies, &c. The island produces sweet potatoes, yams, melons, bananas and other fruits, arrowroot and coffee. Goats and chickens run wild. Some trade is carried on with Mangareva in a vessel owned by the islanders. The population is about 170.

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PITCAIRNE, ARCHIBALD (1652–1713), Scottish physician, was born at Edinburgh on the 25th of December 1652. After obtaining some classical education at the school of Dalkeith, Pitcairne entered Edinburgh University in 1668, and took his degree of M.A. in 1671. Having been sent to France for the benefit of his health, he was induced at Paris to begin the study of medicine, and after courses at Edinburgh and Paris he obtained in 1680 the degree of M.D. at Rheims. He began practice at Edinburgh, and in a short time acquired so great a reputation that in 1692 he was appointed professor of medicine at Leiden. Among his pupils were Richard Mead and H. Boerhaave, and both of them attributed much of their skill to what they had learned from Pitcairne. In 1693 Pitcairne returned to Scotland to marry a daughter of Sir Archibald Stevenson, an eminent physician in Edinburgh. The family objected to her going abroad, so he did not return to Leiden, but settled once more in Edinburgh. He rose to be the first physician in Scotland, and was frequently called into consultation both in England and Holland. Soon after his return to Edinburgh, feeling the great want of the means of anatomical study, he importuned the town council to permit himself and certain of his medical friends to treat without fee the sick paupers in "Paul's Work," on condition of being allowed to dissect such of the bodies as were unclaimed by their relatives, and therefore had to be buried at the town's expense. Strangely enough this proposal was strongly opposed by the chief surgeons of the place, but ultimately the town council had the good sense to comply with Pitcairne's request, and in this way he may be said to have the credit of laying the foundation of the great Edinburgh school of medicine.

Pitcairne's medical opinions are chiefly contained in a volume of *Dissertationes medicae* which he published in 1701 (2nd ed. 1713). In these he discusses the application of geometry to physic, the circulation of the blood in the smaller vessels, the difference in the quantity of the blood contained in the lungs of animals in the womb and of the same animals after birth, the motions by which food becomes fit to supply the blood, the question as to inventors in medicine (in which he repels the idea of certain medical discoveries of modern times having been known to the ancients, especially vindicating for Harvey the discovery of the circulation of the blood, and refuting the view that it was known to Hippocrates), the cure of fevers by evacuating medicines, and the effects of acids and alkalis in medicine. Pitcairne was a good classical scholar, and wrote Latin verses, occasionally with something more than mere imitative cleverness and skill. He was supposed to be the author of a comedy, *The Assembly*, or *Scotch Reformation*, and of a satirical poem *Babel*, containing witty sketches of prominent Presbyterian divines of the time, whom, as a loudly avowed Jacobite, he strongly disliked. He was prone to irreverent and ribald jests, and thus gained the reputation of being an unbeliever and an atheist, though he was a professed deist. The stories about his over-indulgence in drink are probably exaggerated. He was repeatedly involved in violent quarrels with his medical brethren and others, and once or twice got into scrapes with the government on account of his indiscreet political utterances. Among his friends, however, he was evidently well liked, and he is known to have acted with great kindness and generosity to deserving men who needed his help. Thomas Ruddiman, the Scottish scholar, for example, was rescued from a life of obscurity by his encouragement and assistance, and by no one was his memory more gratefully cherished. Mead, too, appears never to have forgotten what he owed to his old teacher at Leiden. A son of Pitcairne's had gone out in the rebellion of 1715, and, having been condemned to death, was saved by the earnest interposition of Mead with Sir Robert Walpole. He pleaded, very artfully, that if Walpole's health had been bettered by his skill, or if members of the royal family were preserved by his care, it was owing to the instruction he had received from Dr Pitcairne. Pitcairne died in Edinburgh on the 20th of October 1713. He had been a great collector of books, and his library, which is said to have been of considerable value, was, through the influence of Ruddiman, disposed of to Peter the Great of Russia.

PITCH. (1) (O. Eng. *pic*, an adaptation of Lat. *pix*, *picis*, Gr. πίσσα, πίττα, allied with Gr. πίτυς, pine-tree, Lat. *pinus*), the name of various substances of dark colour and of extremely viscid and tenacious consistency when subjected to heat. Strictly the term is applied to the resinous substance obtained as a solid residuum by the distillation of wood-tar (see Tar), or the non-resinous substance similarly produced from Coal-tar (*q.v.*). The name is also applied to the natural mineral substances, *i.e.* asphalt or bitumen (*qq.v.*). (2) A noun of various meanings which are somewhat difficult to connect with the verb from which they apparently must be derived. "To pitch" means primarily to thrust in or fix a stake or other pointed object into the ground, hence to place in a fixed position, set in order, cast or throw, hence to incline or slope. The etymology is obscure, but it appears in Northern dialects as "pick," of which it may be a variant; there is some difficulty in connecting this form with "pick," variant of "pike" (*q.v.*).

PITCH, MUSICAL. The pitch of a musical sound is aurally defined by its absolute position in the scale and by its relative position with regard to other musical sounds. It is precisely defined by a vibration number recording the frequency of the pulsations of a tense string, a column of air, or other vibrator, in a second of time. In Great Britain and America the complete vibration to and fro (swing both ways of a pendulum) is taken as the unit; elsewhere the vibration in one direction only (swing one way of the pendulum). The only official standard is the French, dating from 1859, preserved by a tuning-fork vibrating 870·9 (double vib. 435·45) at a temperature of 15° Centigrade (59° Fahr.) in a second. The vibration number stated in the edict establishing the Diapason Normal is 870 (435), which for comparison will be here adhered to. The natural basis for a standard musical pitch is the voice, particularly the male voice, which has been of greater importance historically. There is no reason to suppose the human voice has varied, during the period of which we have evidence, more than other physical attributes. The only difference to be reckoned with may be in recent tendencies of solo vocalists to sing for effect, and so to extend the compass of the voice upwards. Otherwise we may assume no disturbing alteration has taken place for more than 2000 years in its position and extent. Vibrations increase in rapidity as a note rises and decrease as it falls. Any note may be a pitch note; for orchestras custom has settled upon a^1 in the treble clef, for organs and pianos in Great Britain c^2, and for modern brass instruments b flat^1.

We are not without a clue to the pitch usual in the classic Greek and Alexandrian ages: the vocal octave to which the lyre was adapted was noted as from e to e^1. As in choruses baritone and low tenor singers always prevail, d–d^1, at French or at medium pitch, would really be the Greek singing octave; we may therefore regard it as a tone lower than that to which we are accustomed. But to sing the lower Greek modes in or near the vocal octave it was necessary to transpose (μεταβολή) a fourth upwards, which is effected in modern notation by a flat placed upon the b line of the staff; thus modulating from our major key of C to that of F. This transposition has had, as we shall see, much to do with the history of our subject, ultimately influencing the ecclesiastical chant and lasting until the 17th century of our era. It does not appear from any evidence that the keyboards—when there were more than one—of the early organs were arranged for transposition, but it is certain that the Flemish harpsichords to 1650 were made with double keyboards to accommodate it (see Hipkins' *History of the Pianoforte*, 1897). But a positive identity of pitch cannot be claimed for any period of time, and certainly not for the early organs; the foot-rule of the organ-builder, which had to do with the lengths of the pipes, and which varied in every country and province, could easily cause a difference of a semitone. Scale and wind-pressure are also important factors. But with all these often opposed conditions, we find less variation than might be expected, the main and really important divergence being due to the necessity of transposition, which added a very high pitch to the primarily convenient low one.

The first to attempt to define pitch would seem to have been Arnold Schlick (*Musica ausgeteutscht und ausgezogen*, Heidelberg, 1511), who gives a measure, a line of $4\frac{7}{8}$ Rhenish inches, which, he says, multiplied sixteen times, should be the lowest F of a small organ. He gives no diameter or wind-pressure. Dr A. J. Ellis used this indication to have an organ pipe made which with one-sixteenth diameter and a wind-pressure of $3\frac{1}{4}$ in., at one-fourth Schlick's length, gave f^1 301·6, from which he derived a just major third of a^1 377, which would compare very well with an old Greek a^1. Schlick goes on to say the organ is to be suited to the choir and properly tuned for singing, that the singer may not be forced to sing too high or too low and the organist have to play chromatics, which is not handy for every one. Further, he says pitch cannot be exactly defined, because voices vary; he nevertheless gives the measure above mentioned for the low F, but if a larger organ is built to include the still lower C, then this C must be *of the same measurement*, the reason being that a greater part of church music ends in "grambus," a word understood by Schlick's editor to mean the transposition of a fourth. The larger high-pitch organ will therefore be at a^1 502·6. The Halberstadt organ, about which so much has been written, was, according to Praetorius (*Syntagma musicum*, Wölffenbüttel, 1618), built in 1361, and repaired or rebuilt 1495. He gives the longest pipe of this organ, B natural, as 31 Brunswick feet, and the circumference $3\frac{1}{2}$ ft. He further tells us this pitch was a tone, nearly a tone and a half, higher than a suitable church pitch (*Chorton*), for which he gives a diagram. Dr Ellis had pipes (now preserved in the Royal Institution, London) made to reproduce both these pitches at $3\frac{1}{4}$ in. wind-pressure. The Halberstadt pitch was found to be a^1 505·8; the *Chorton*, 424·2. Ellis used mean-tone temperament in calculating this lower pitch; but as he used just intonation for the Halberstadt, it seems preferable to substitute it for the *Chorton*, thus reducing it to a^1 422·8. Praetorius's *Cammerton*, or chamber pitch, formulated in his diagrams for voices and instruments, is, he says, a whole tone higher; equivalent, therefore, to a^1 475·65. Nearly all the German organs in his time were tuned to this higher pitch. Ellis offered the suggestion of a much higher pitch for this *Cammerton* in his lecture "On the History of Musical Pitch," read before the Society of Arts, London (*Journ. Soc. Arts*, March 5, 1880), but the present writer is unable to accept it. The lower vibration number is justified by due consideration of the three divisions of the male voice, bass, tenor and alto, as given by Praetorius, whose *Cammerton* very closely corresponds with Bernhardt Schmidt's Durham organ, 1663–1668, the original pitch of which has been proved by Professor Armes to have been a^1 474·1. The Halberstadt pitch is nearly a semitone higher, which again agrees with the statement of Praetorius, and also Schlick's high C organ. Yet it would seem there had been a still higher pitch used in the old ecclesiastical music. Upon this interesting question Praetorius is confused and difficult to understand, but he never wavers about the transposition of a fourth. In one passage he distinctly says the old organ high pitch had been a whole tone above his *Cammerton*, with which we shall find his *tertia minore* combines to make the required interval. The term *tertia minore*, or *inferiore*, is used by Praetorius to describe a low pitch, often preferred in England and the Netherlands, in Italy and in some parts of Germany. An organist, instead of transposing a whole tone down from the *Cammerton*, would for the *tertia minore* have to transpose a minor third. A corroboration of this pitch is found in A. Silbermann's great organ in Strasburg minster (1713–1716), the pitch of which, taken in 1880 and reduced to 59° Fahr. (as are all pitches in this article), is a^1 393·2. An old organ at Versailles (1789) was very near this example, a^1 395·8. Sir Frederick Gore Ouseley (*vide* Ellis's lecture) regarded the French *ton de chapelle* as being about a minor third below the Diapason Normal, a^1 435, and said that most of the untouched organs in the French cathedrals were at this low pitch. Strasburg was French territory in 1713, but Silbermann's organ is not quite a whole tone below. Ellis quotes an organ at Lille, a^1 374·2, but no other instance of the very low Schlick pitch is recorded, although trial of the French cathedral organs might perhaps result in the finding of examples. Ellis gives Dom Bédos (*L'Art du facture d'orgues*, Paris, 1766) as authority for a mean tone a^1 376·6. To return to the *tertia minore*. Dr R. Smith, of Cambridge, in 1759, had the organ of Trinity College, built by Bernhardt Schmidt, lowered a whole tone, to reduce it to certain Roman pitch pipes made about 1720. His determinations of pitch by a weighted wire are not trustworthy; Ellis thinks they are not safe within four or five vibrations per second, but gives a mean pitch for this organ, when altered, of a^1 395·2. St Michael's church at Hamburg, built as late as 1762 and unaltered in 1880, had a 17th-century pitch, a^1 407·9. This is about a semitone below the Diapason Normal, and a just minor third lower than the St Jacobi organ in the same city (1688), measured by Herr Schmahl, a^1 489·2. What was remarkable in this organ was that it had one stop which was an equal minor third lower, a^1 411·4^1. The difference of a minor third, or, as we shall see later, a whole tone, had replaced the earlier fourth. Sir Frederick Gore Ouseley's comparison of the church and chamber pitches of Orlando Gibbons (*vide* Ellis's lecture) clearly shows the minor third in Great Britain in the first half of the 17th century. But the narrowing continued. Bernhardt Schmidt, better known in England as Father Smith, was invited about 1660 to build the organ for the Chapel Royal, Whitehall; two years later he built the organ in Durham Cathedral a^1 474·1, difference a whole tone, and practically agreeing with the *Cammerton* of Praetorius. The Hampton Court organ of 1690 shows that Schmidt had further lowered his pitch a semitone, to a^1 441·7. What happened at Durham was that at some subsequent date the pipes were shifted up a semitone to bring the organ into conformity with this lower pitch, with which it is probable Schmidt's organs in St Paul's and the Temple, and also Trinity College, Cambridge, agreed. This lowering tendency towards the low church pitch, and the final adoption of the latter as a general mean pitch throughout the 18th century, was no doubt influenced by the introduction of the violin, which would not bear the high tension to which the lutes and viols had been strained. Harpsichords had long been preferred at the *tertia minore*. The *Chorton* of Praetorius, a^1 422·8, is practically the same pitch as that of the fork the possession of which has been attributed to Handel, a^1 422·5. It is a very fair mean between G. Silbermann's 18th-century Dresden pitch, a^1 415, and the organs of Renatus Harris, a^1 428·7. Stein tuned Mozart's piano to a fork a^1 421·6, and the Broadwood pianos used at the London Philharmonic Society in its first concerts (1813) were tuned to a fork c^2 506·8, which gives a mean tone a^1 423·7.

According to Schindler (*Niederrheinische Musik-Zeitung*, 1855, Nos. 8 and 9) and the report of the French Commission, 1859, the rise in pitch began at the Congress of Vienna in 1816, the military bands being the cause. With the improvements in wind instruments this continued, as a more brilliant effect was gained. In 1823 Weber's *Euryanthe* is recorded as having been played in Vienna at a^1 437·5, and in 1834 Kreutzer's *Nachtlager* at a^1 440. The measurements are doubtful, but the upward tendency is clear. Scheibler, by his simple and accurate tonometer, has recorded pitches in Vienna about 1834 from a^1 433·9 to 440·2. About that time, or it may be a few years earlier, Sir George Smart established a fork for the Philharmonic Society, a^1 433·2. Forks intended for this vibration number, stamped "Philharmonic," were sold as late as 1846. But about that year the performing pitch of the Society had reached 452·5. Sir Michael Costa was the conductor 1846–1854, and from his acceptance of that high pitch the fork became known as Costa's, and its inception was attributed to him, though on insufficient grounds. In 1874 a further rise in the fork to a^1 454 was instigated by Sir Charles Hallé. The British army is bound by His Majesty's Rules and Regulations to play at the Philharmonic pitch, and a fork tuned to a^1 452·5 in 1890 is preserved as the standard for the Military Training School at Kneller Hall. But the Philharmonic Society adopted the Diapason Normal in 1896, and the military bands have not gone with it. In point of fact, they are gradually going higher, and the brass bands, which are so important in the North of England and in Wales, are not behind them.

It was the irrepressible upward tendency that caused the French government in 1859, acting with the advice of Halévy, Meyerbeer, Auber, Ambroise Thomas and Rossini, to establish by law the *Diapason Normal*. Other countries have gradually followed, and, with few exceptions, the low pitch derived from the Diapason Normal may be said to prevail throughout the musical world. Great Britain has been the last to fall in, but the predominance of the low pitch, introduced at Covent Garden Opera since 1880, is assured. The proprietors of Queen's Hall, London, did much for it when they undertook the alteration, at great expense, of their large concert organ, which had only just been erected. In 1896 the Philharmonic Society decided upon a performing pitch, ostensibly at 68° Fahr., of a^1 439; and in 1899 Messrs Broadwood made a successful effort to get this vibration number accepted by their competitors in Great Britain. The high pitch remains only where there are large concert organs not yet lowered, and with the military and brass bands.

The consideration of temperature as affecting the use of a standard pitch was not attended to when the French government issued its ordonnance. The 15° Centigrade attached to the description of the standard fork in Paris was intended for the definition and verification of the fork only. The alteration of the fork due to heat is scarcely perceptible, but wind instruments, and particularly the organ, rise almost proportionately to the increase in temperature of the surrounding air, because sound travels at an enhanced rate as the temperature rises. The coefficient of this rise is equivalent to half a vibration (0·5) per degree Fahr. per second. D. J. Blaikley (*Essay on Musical Pitch*, Catalogue of the Royal Military Exhibition, Chelsea, 1890), and Victor Mahillon (*Catalogue descriptif et analytique du Musée*, Bruxelles, troisième volume, appendice, 1900) have recorded their experience of wind instruments under changes of temperature. The French Commission, in establishing the Diapason Normal, should have chosen a temperature of 20° C. There would then have been less disturbance owing to the breath of the players and heat of the theatres or concert-rooms. It would be a great advantage to get this higher grade generally adopted. It was proposed in the Stimm-Conferenz at Vienna in 1885, but not carried. Table III., showing orchestral pitches obtained in 1899, for the measurements of which the writer is responsible, prove how chimerical it is to hope for greater accuracy than is found between 435 and 440 vibrations a second for a^1, inasmuch as temperature must always be reckoned with.

Table I.

1495 to 1690. Pitch descending.		Authority.	V. at 59° F.
Halberstadt organ	1495	Ellis	a^1 505·8
Arnold Schlick, Heidelberg	1511	Ellis	502·6
St Jacobi, Hamburg	1688–1693	Schmahl	489·2
St Catharinen, Hamburg	1543	Degenhardt	480·8
Praetorius. *Cammerton*	1618	Hipkins	475·65
Durham organ	1683	Armes and Ellis	474·1
Great Franciscan organ, Vienna	*c.* 1640	Ullmann	457·6
Hampton Court organ	1690	Ellis	441·7

Table II.

1511 to 1900. Pitch ascending.		Authority.	V. at 59° F.
Arnold Schlick, Heidelberg	1511	Ellis	a^1 377·0
Strasburg Minster. A. Silbermann	1713–1716	Stockhausen	393·2
Trinity College, Cambridge	1759	Smith and Ellis	395·2
Versailles organ	1789	M'Leod and Ellis	395·8
Praetorius "Tertia minore"	1618	Hipkins	396·4
St Michael's, Hamburg	1762	Schmahl	407·9
Pascal Taskin's tuning-fork, Paris	1783	Lissajous	409·0
St Jacobi, Hamburg, "Tertia minore" stop	1688–1693	Schmahl	411·4
Hofcapelle, Dresden	1754	Näke	415·0
St Sophie, Dresden, G. Silbermann	1722	Näke	415·5
Freiberg. G. Silbermann	1714	Näke	419·5
Seville Cathedral	1785–1790	Ellis	419·6
Old English tuning-fork	*c.* 1715	Ellis	419·9
Imperial Russian Court Church Band	1860	Näke and Ellis.	421·2
Stein's tuning-fork, Vienna	1780	Näke and Ellis.	421·6
Handel's tuning-fork	1751	Ellis	422·5
Praetorius. *Chorton*	1618	Ellis and Hipkins	422·8
Peppercorn's tuning-fork (Broadwood)	1813	Ellis	423·5
Renatus Harris, St Andrew's, Undershaft	1696	Ellis	427·7
Renatus Harris, Newcastle-on-Tyne	1670	Ions and Ellis	428·7
C. Meerens, proposed standard derived from c^2 512, and favoured by Boïto and other Italian musicians	1876	Meerens	432·0
Sir George Smart, Philharmonic	1826–1834	Ellis	433·2
Scheibler No. I., Vienna orchestra	1834	Scheibler	433·9
Montal's tuning-fork, Paris opera	1829	Cagnard de la Tour	434·0
Scheibler No. II., Paris opera	1834	Scheibler	434·0
Reissiger's tuning-fork, Dresden	1826	Näke	435·0
Paris Diapason Normal. Ordonnance	1859	Fr. Comm.	435·0
Scheibler No. III., Paris Conservatoire	1834	Scheibler	435·2
Paris Diapason Normal. Standard fork	1859	Koenig	435·45
Paris opera	1836	Cagnard de la Tour	437·0
Scheibler, Stuttgart, proposed standard (440 at 69° F.)	1834	Scheibler	440·2
Scheibler No. IV., Vienna opera	1834	Scheibler	440·3
Hullah's tuning-fork	1842	Ellis	441·3
Naples opera. San Carlo	1857	Lissajous	444·9
Society of Arts intended for 444. (Since 1886 the Society of Arts has advocated the Diapason Normal)	1860	Ellis	445·7

1511 to 1900. Pitch ascending.	Authority.	V. at 59° F.
Broadwood's medium 1850	Ellis	445·9
Paris grand opera 1858	Lissajous	448·0
Lazarus's clarinet 1843	Ellis and Hipkins	448·0
Gewandhaus, Leipzig 1869	Ellis	448·2
Berlin opera 1857	Lissajous	448·4
Milan opera, La Scala 1856	Lissajous	450·3
Philharmonic, London 1846–1854	Ellis and Hipkins	452·5
Kneller Hall 1890	Hipkins	452·5
Philharmonic, London 1874	Hipkins	454·0
Streicher's tuning-fork, Vienna 1859	Ellis	456·1
Strauss's Band, Imperial Institute, London, open air 1897	Hipkins	457·5

Table III.

Orchestral Pitch. 1899.	Authority.	V. at 68° F.
Leipzig	Blüthner	$a^1$435·0
Berlin	Bechstein	438·0
New York	Steinway	438·6
Boston	Chickering	438·8
London	Broadwood	439·0
St Petersburg	Becker	439·4
Meiningen (and Bayreuth)	Mühlfeld's clarinet	439·5
Stuttgart	A. Schiedmayer	440·0
Vienna	Bösendorfer	440·0
London. Covent Garden opera	Hipkins	440·0
Paris	Erard	442·4

Verified by A. J. Hipkins. But for Leipzig a comparison with the Gewandhaus Band may be sought. (A. J. H.)

PITCHBLENDE, or URANINITE, a mineral species consisting essentially of uranium oxide, of importance as a source of uranium and radium. It is a very heavy (specific gravity 9·0–9·7), compact mineral with a conchoidal to uneven fracture, and a brownish to velvet-black colour and pitchy lustre. Crystals are rare; they have the form of regular octahedra or less often of cubes. The hardness is 5½, and the streak is brown with a greenish tinge. The mineral has been known to occur at Joachimsthal in Bohemia since 1727, and it was early called pitchblende, because of its appearance; but its true nature was not recognized until 1789, when M. H. Klaproth's analysis of it resulted in the discovery of the element uranium. Analyses of material from different localities exhibit wide variations in chemical composition. In addition to uranium oxides, there are thorium, cerium (and lanthanum), yttrium and lead oxides, each varying in amount from a trace up to 10%. Calcium, iron, magnesium, manganese, silica, water, &c., are also present in small amounts. The amounts of uranous and uranic oxides (UO_2, 21–72; UO_3, 13–59%) also vary considerably. The mineral is often described as a uranate of uranyl, lead, thorium and cerium; but in the least altered material from Branchville in Connecticut the uranous oxide predominates, whilst in altered specimens uranic oxide is in excess. In the closely allied mineral, thorianite, thorium predominates (ThO_2, 76; UO_2, 12%). Since the dioxides of uranium, thorium and cerium may be obtained artificially as cubic crystals, it seems probable that pitchblende consists of isomorphous mixtures of these dioxides, the uranic oxide being due to oxidation.

The radio-active properties of pitchblende are of special interest. The fact that this mineral is more strongly radio-active than metallic uranium led to the discovery in it of the elements radium, polonium and actinium. When pitchblende is ignited or dissolved in dilute sulphuric acid, a gas is evolved which consists largely of helium and argon: terrestrial helium was first recognized in this mineral.

The mineral occurs either as a primary constituent of granitic rocks or as one of secondary origin in metalliferous veins. Octahedral crystals ("cleveite" and "bröggerite") occur in the pegmatite veins of southern Norway, being occasionally found in the felspar quarries at Moss, Arendal and other places. Crystals are found under similar conditions at Middletown and Branchville in Connecticut, Llano county in Texas ("nivenite"), Mitchell county in North Carolina, Villenveuve in Quebec, and other American localities. Thorianite, found as water-worn cubes in the gem-gravels near Balangoda in Sabaragamuwa province, Ceylon, has also no doubt been derived from crystalline rocks. On the other hand, the mineral found in metalliferous veins, and to which the name pitchblende is more properly restricted, never occurs as crystals, but as compact masses rendered more or less impure by admixture of other minerals, the specific gravity being sometimes as low as 6·5; thorium, cerium, &c., are absent, and radium and helium are present in smaller amounts. This variety occurs with ores of silver, lead, copper, nickel, cobalt, bismuth, &c., at Johanngeorgenstadt, Marienberg and Schneeberg in Saxony, Joachimsthal and Przibram in Bohemia, Rezbánya in Bihar Mountains in Hungary, Gilpin county in Colorado, St Just, in Penwith, Redruth, Grampound Road and elsewhere in Cornwall.

Often associated with pitchblende, and resulting from its alteration, is an orange-yellow, amorphous, gum-like mineral called gummite, which is a hydrous uranic oxide with small amounts of lead, calcium, iron, &c. (L. J. S.)

PITCHER. (1) A large vessel for holding liquids, derived through Fr. from Med. Lat. *picarium*; the Lat. variant *bicarium*, Gr. βῖκος, has given the Ger *Becher*, Eng. beaker (*q.v.*). (2) One who "pitches," *i.e.* throws, casts, fixes; the name of the player in the game of base-ball who pitches or delivers the ball to the striker.

PITCHER PLANTS, in botany, the name given to plants in which the leaves bear pitcher-like structures or are pitcher-like in form. The plant generally understood by this name is *Nepenthes*, a genus containing nearly sixty species, natives of tropical Asia, north Australia and (one only) of Madagascar. North Borneo is especially rich in species. They are shrubby plants climbing over surrounding vegetation by means of tendril-like prolongations of the midrib of the leaf beyond the leaf-tip. The pitcher is a development at the end of the tendril. It is generally tubular in form, but in some species two forms are produced on the same plant, lower or terrestrial goblet-shaped pitchers and upper suspended pitchers retaining the more primitive more or less tubular form; in a few species a third form—funnel- or cornucopia-shaped pitchers—occurs in the upper part. In the terrestrial type a pair of well-developed wings traverse the length of the pitcher; in the tubular or funnel-shaped form the wings are narrow or ridge-like. The mouth of the pitcher has a corrugated rim (peristome) formed by incurving of the margin, the convex surface of which is firm and shining. It is traversed by more or less prominent parallel

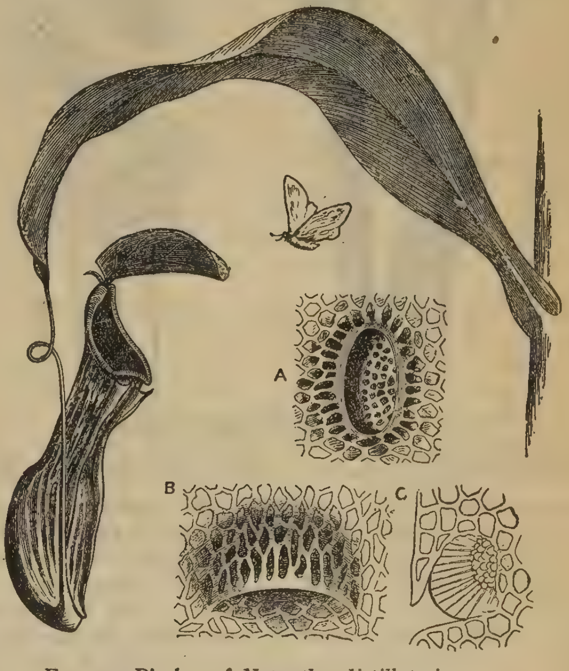

FIG. 1.—Pitcher of *Nepenthes distillatoria*.

A, Honey-gland from attractive surface of lid.

B, Digestive gland from interior of pitcher, in pocket-like depression of epidermis, opening downwards.

C, Transverse section of the same.

ridges, which are usually prolonged as teeth beyond the infolded margin. Above the mouth is the lid (operculum), which varies in size from a small narrow process to a large heart-shaped expansion. A study of the development of the pitcher, especially in the young pitchers of seedling plants, shows that the inflated portion is a development of the midrib of the leaf, while the wings, which are especially well represented in the terrestrial type of pitcher, represent the upper portion of the leaf-blade which has become separated from the lower portion by the tendril; the lid is regarded as representing two leaflets which have become fused. The short straight or curved process from the back of the pitcher behind the lid represents the organic apex of the leaf (A in fig. 1).

The size of the pitcher varies widely in the different species, from an inch to a foot or more in depth. The colour also varies considerably, even in different pitchers of the same individual, according to age, light exposure or soil conditions. It is uniformly green or more or less spotted, blotched or suffused with red or crimson, or sometimes, as in *N. sanguinea* or *N. Edwardsiana*, largely or wholly of a rich scarlet or crimson colour. Insects are attracted to the mouth of the pitcher by a series of glands, yielding a sweet excretion, which occurs on the stem and also on the leaf from the base of the leaf-stalk to the lid and peristome. Embedded in the incurved margin of the rim which affords a very insecure foothold to insects, are a number of large glands excreting a sweet juice. The cavity of the pitcher is in some species lined throughout with a smooth glistening surface over which glands are uniformly distributed; these glands secrete a liquid which is found in the pitcher even in the young state while it is still hermetically closed by the lid. In other species the glands are confined to the lower portion of the cavity surface, while the upper part bear a smooth waxy secretion on which it is impossible, or at any rate extremely difficult, for insects to secure a foothold. This area is termed the "conducting" area, as distinguished from the lower or "detentive" gland-bearing area. It has been proved that the secretion contains a digestive ferment capable of rendering proteid matter soluble. Insects, especially running insects, which have followed the track of honey glands upwards from the stem along the leaf, reach the mouth of the pitcher, and in their efforts to sip the attractive marginal glands fall over into the liquid. The smooth walls above the liquid afford no foothold, and they are drowned; their bodies ~~are~~ digested and the products of digestion are ultimately absorbed by the glands in the pitcher-wall. Thus *Nepenthes* secures a supply of nitrogenous food from the animal world in a manner somewhat similar to that adopted by the British sundew, butterwort, and other insectivorous plants.

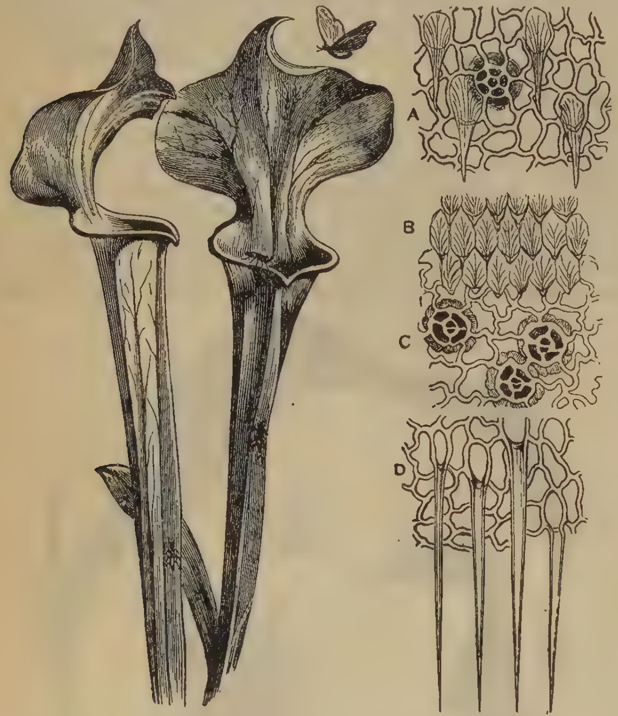

FIG. 2.—Leaves of *Sarracenia purpurec.*
A, Attractive surface of lid; B, conducting; C, glandular; and D, detentive surface; magnified. A and D are taken from *S. flava.*

The side-saddle plant, *Sarracenia*, native of the eastern United States, is also known as a pitcher-plant. There are about seven species, herbs with clusters of radical leaves some or all of which are more or less trumpet- or pitcher-shaped. The leaf has a broadly sheathing base succeeded by a short stalk bearing the pitcher, which represents a much enlarged midrib with a wing-like lamina. Above the rim of the pitcher is a broad flattened lid, which is also a laminar development. The surface of the leaf, especially the laminar wing, bears glands which in spring exude large glistening drops of nectar. The lid and mouth of the pitcher are brighter coloured than the rest of the leaf, which varies from yellow-green to deep crimson in different species and in individuals according to exposure to sunlight and other conditions. This forms the attractive area, and the inner surface of the lid also bears numerous glands, as well as downward-pointing hairs, each with a delicately striated surface (fig. 2, A). Below it is the conducting surface (B) of glassy epidermal cells, with short downward-directed points, which facilitate the descent, but impede the ascent of an insect. Then come the glandular surface (C), which is formed of smooth polished epidermis with numerous glands that secrete the fluid contents of the pitcher, and finally the detentive surface (D), of which the cells are produced into long and strong bristles which point downwards and meet in the centre of the diminishing cavity so as to render escape impossible. The secretion wets an insect very rapidly, but, so far as is known, seems to be completely destitute of digestive power—indeed, rather to accelerate decomposition. The pitchers accumulate vast quantities of insects in the course of a season, and must thus abundantly manure the surrounding soil when they die. Moreover, the

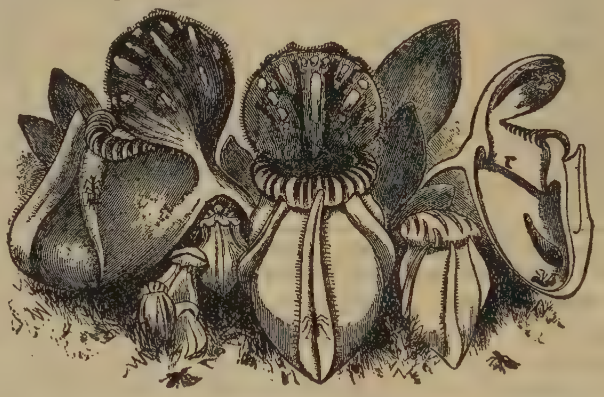

FIG. 3.—*Cephalotus follicularis*, showing ordinary leaves and pitchers, the right hand one cut open to show internal structure.

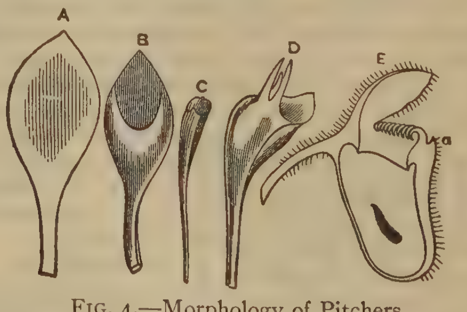

FIG. 4.—Morphology of Pitchers.
A, Ordinary leaf of *Cephalotus.*
B, Monstrous leaf with spoon-shaped depression.
C and D, Other abnormal forms more deeply pouched, showing formation of pitcher.
E, Ordinary pitcher of Cephalotus.
a, Apex of leaf.

feast is largely shared by unbidden guests. Not to speak of insects which feed upon the pitcher itself, some drop their eggs into the putrescent mass, where their larvae find abundant nourishment, while birds often slit open the pitchers with their beaks and devour the maggots in their turn.

Cephalotus follicularis, a native of south-west Australia, a small herbaceous plant, bears ordinary leaves close to the ground as well as pitchers. The latter somewhat resemble in general form those of *Nepenthes*. The lid is especially attractive to insects from its bright colour and honey secretion; three wings lead up to the mouth of the pitcher, on the inside of which a row of sharp spines points downwards, and below this a circular ridge (*r*, fig. 3) armed with papillae serves as a conducting area. A number of glands on the interior of the pitcher secrete a plentiful fluid which has digestive properties. Comparison with monstrous forms shows that the pitcher of *Cephalotus* arises by a calceolate pouching from the upper surface of the ordinary spathulate leaves, the lid here arising from the proximal side of the pitcher-orifice.

PITCHSTONE (German *Pechstein*, from its resemblance to pitch), in petrology, a glassy igneous rock having a resinous lustre and breaking with a hollow or conchoidal fracture. It differs from obsidian principally in its rather dull lustre, for obsidian is bright and vitreous in appearance; all pitchstones also contain a considerable quantity of water in combination amounting to from 5 to 10% of their weight or 10 to 20% of their volume. The majority of the rocks of this class occur as intrusive dikes or veins; they are glassy forms of quartz porphyry and other dike rocks. Their dull lustre may be connected with the great abundance of minute crystallites and microlites they nearly always contain. These are visible only in microscopic sections, and their varied shapes make pitchstones very interesting to the microscopist. Although pitchstones are known which are of Devonian age (*e.g.* the glassy dacite of the Tay Bridge in Fife, Scotland, and the andesite-pitchstones of the Cheviot Hills), most of them are Tertiary or recent, as like all natural glasses they tend to crystallize or become devitrified in course of time. In some of the older pitchstones the greater part of the mass is changed to a dull felsitic substance, while only nodules or kernels of unaltered glass remain.

Some pitchstones are very acid rocks, containing 70 to 75% of silica, and have close chemical affinities to granites and rhyolites. Others contain more alkalis and less silica, being apparently vitreous types of trachyte or keratophyre; others have the composition of dacite and andesite, but the black basaltic glasses are not usually classified among the pitchstones. Very well known rocks of this group occur at Chemnitz and Meissen in Saxony. They are brown or dark green, very often perlitic (see PETROLOGY, Plate I., fig. 5), and show progressive devitrification starting from cracks and joints and spreading inwards through the mass. For a long time the pitchstone dikes of Arran in Scotland have been famous among geologists for the great beauty and variety of skeleton crystals they contain. These pitchstones are dull green in hand specimens. Some of them contain phenocrysts of felspar, augite, &c.; others do not, but in all there is great abundance of branching feathery crystalline growths in the ground mass: they resemble the branches of fir trees or the fronds or ferns, minute crystalline rods being built together in aggregates which often recall the frost patterns on a window-pane. It is supposed that the mineral they consist of is hornblende. In addition to these larger growths there are many small microlites scattered through the glass, also hair-like trichites, and fine rounded globulites. When phenocrysts are present the small crystals are planted on their surfaces like grass growing from a turf-covered wall. These pitchstones are believed to proceed from the great eruptive centres which were active in western Scotland in early Tertiary times. Another pitchstone of the same period forms a great craggy ridge or scuir in the island of Eigg (Scotland). At one time regarded as a lava flow occupying an old stream channel it has recently been described as an intrusive sheet. It is from 200 to 300 ft. thick. The rock is a dark, nearly black, pitchstone-porphyry, with glancing idiomorphic crystals of felspar in a vitreous base. It contains no quartz; the felspars are anorthoclase, and with them there are numerous crystals of green augite. The ground mass contains small crystallites of felspar, and is of a rich brown colour in thin section with well developed perlitic structure (see PETROLOGY, Plate II., fig. 1). In chemical composition this rock resembles the trachytes rather than the rhyolites. In Eigg and Skye there are many dikes of pitchstone, mostly of intermediate rather than of acid character, all connected with the great eruptive activity which characterized that region in early Tertiary times.

The following analyses give the chemical composition of a few well-known pitchstones:—

	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	H_2O
I. Meissen, Saxony	72·42	11·26	0·75	0·28	1·35	2·86	3·80	7·64
II. Corriegills, Arran	72·07	11·26	3·24	tr.	1·53	0·61	5·61	5·45
III. Scuir of Eigg, Scotland	65·81	14·01	4·43	0·89	2·01	4·15	6·08	2·70

The first two of these contain much water for rocks the ingredients of which are but little decomposed. They are of acid or rhyolitic character, while the third is richer in alkalis and contains less silica; it belongs more naturally to the intermediate rocks (or trachytes.) (J. S. F.)

PITESCI (*Pitesti*), also written PITESTI and PITEST, the capital of the department of Argesh, Rumania; situated among the outlying hills of the Carpathians, on the river Argesh, which is here joined by several smaller streams. Pop. (1900), 15,570. The surrounding uplands produce good wine, fruit and grain, besides being rich in petroleum and salt; and, as the main Walachian railway is met at Pitesci by lines from Câmpulung and Hermannstadt in Transylvania, the town has a considerable trade. It has manufactures of lacquer and varnish.

PITH (O.E. *pitha*, cognate with Du. *pit*, kernel of a nut), properly the medulla, the central column of spongy cellular tissue, in the stems of dicotyledonous plants (see PLANTS: *Anatomy*). The word is thence applied to the spinal cord or marrow in animals, to the medullary end of a hair, and to that which forms the central part or core of any object or substance; hence, figuratively, vigour, energy, concentrated force. Very light hats or helmets are made of the dried pith of the Indian spongewood or hat plant (*Aeschynomene aspera*, the native name being *Solah*). These pith hats are worn by Europeans in India and the East. The Chinese Ricepaper-tree (*Aralia* or *Fatsia papyrifera*), from the pith of which the delicate white film known as "rice-paper" is made, is also known as the pith-plant.

PITHECANTHROPUS ERECTUS (Erect Ape-Man), the name given by Dr Eugene Dubois, of the Dutch army medical service, to the imaginary creature which he constructed from fossilized remains found by him in Java. These fragments consisted of a thigh-bone, two teeth, and the upper part of a skull, and were unearthed in 1891–1892 on the left bank of the Bengawan River near Trinil. The skull appears to have been low and depressed with strong supraciliary ridges; the teeth are very large, and the femur is quite human. The teeth and skull were found together, the femur a few yards away a year afterwards. The discoverer, however, stated it as his belief that the fragments were portions of the same skeleton and belonged to a creature half-way between man and the higher apes and of the Pleistocene age. Much discussion followed the "find," and many authorities have given an opinion adverse to Dr Dubois's theory. The prevailing opinion is that the bones are human. They are not held to represent what has been called "the missing link," bridging over the gulf between man and the apes; but almost all authorities are agreed that they constitute a further link in the chain, bringing man nearer his Simian prototype. L. Manouvrier concludes that *Homo javanensis* walked erect, was of about medium height, and was a true precursor, possibly a direct ancestor, of man. He calls attention to the fact that the cranial capacity decreases in proportion to the antiquity of the human skulls found, and that the pithecanthropus skull has a capacity of from 900 to 1000 cc.—that is, "stands at the level of the smallest which have been occasionally found amongst the reputedly lowest savage peoples."

See Dubois, *Pithecanthropus erectus* (Batavia, 1894); a later paper read by Dr Dubois before the Berlin Anthropological Society was translated in the *Smithsonian Report* for 1898. Also a paper read by Dr D. J. Cunningham before the Royal Dublin Society, January 23, 1895 (reported in *Nature*, February 28, 1895); O. C. Marsh, *American Journ. of Science* (June 1896); "Le Pithecanthropus et l'origine de l'homme," in *Bull. de la soc. d'anthrop. de Paris* (1896), pp. 460–67; L. Manouvrier, "Discussion du pithecanthropus erectus comme précurseur de l'homme," in *Bull. soc. d'anthrop. de Paris* (1895), pp. 13–47 and 216–220; L. Manouvrier, *Bull. soc. d'anthrop.* (1896), p. 419 sqq.; "The Trinil Femur contrasted with the Femora of various savage and civilized races," in *Journal of Anat. and Physiol.* (1896), xxxi. 1 seq.; Virchow, "Über den Pithecanthropus erectus Dubois" in *Zeitschrift f. Ethnologie* (1895), pp. 336, 435, 648.

PITHIVIERS, a town of north central France, capital of an arrondissement in the department of Loiret, 28 m. N.N.E. of Orleans, on the railway to Malesherbes. Pop. (1906), 5676. The church of St Solomon, chiefly in the Renaissance style, and remains of the ancient ramparts are of interest. Statues have been erected of the mathematician Denis Poisson (d. 1840), and of the physician and agriculturist Duhamel de Monceau (d. 1782), natives of Pithiviers. The town is an agricultural market, and an important centre for the saffron of the region of Gâtinaris the cultivation of which, originally introduced by the Jews of Avignon in the 12th century was fostered by Louis XIV. The shrine of St Solomon in the 9th century and that of St Gregory, an Armenian bishop, in the 10th, formed the nuclei of the town; and the donjon built at the end of the 10th century for Héloïse, lady of Pithiviers, was one of the finest of the period.

PITHOM, one of the "treasure cities" stated to have been built for Pharaoh by the Hebrews in Goshen during the Oppression (Exod. i. 11). We have here the Hebraized form of the Egyptian Petōm "House of (the sun-god) Etōm," in Greek, Patūmos, capital of the 8th nome of Lower Egypt and situated in the Wadi Tumilat on the canal from the Nile to the Red Sea. Succoth (Egyptian Thuket) was identical with it or was in its immediate neighbourhood. The site, now Tell el Maskhuta, has yielded several important monuments, including the best preserved of the trilingual stelae of Darius which commemorated his work on the canal. The earliest name yet found is that of Rameses II. of the XIXth Dynasty, but in one case he has usurped earlier work, apparently of the XIIth Dynasty (a sphinx), and the city was evidently very ancient. Several of the monuments from Pithom have been removed to Ismailia on the Suez Canal.

See Ed. Naville, *The Store City of Pithom and the route of the Exodus* (London, 1885); W. M. F. Petrie, *Tanis*, pt. i. (London, 1885); W. Golénischeff, "Stèle de Darius" in *Recueil de travaux relatifs à la philologie et l'archéologie égyptiennes et assyriennes*, xiii. 99, and the article RAMESES. (F. LL. G.)

PITHOU, PIERRE (1539–1596), French lawyer and scholar, was born at Troyes on the 1st of November 1539. His taste for literature was early seen, and his father Pierre (1496–1556) cultivated it to the utmost. He was called to the Paris bar in 1560. On the outbreak of the second war of religion in 1567, Pithou, who was a Calvinist, withdrew to Sedan and afterwards to Basel, whence he returned to France on the publication of the edict of pacification. Soon afterwards he accompanied the duc de Montmorency on his embassy to England, returning shortly before the massacre of St Bartholomew, in which he narrowly escaped with his life. Next year he followed the example of Henry of Navarre by abjuring the Protestant faith. Henry, shortly after his own accession to the throne of France, recognized Pithou's talents and services by bestowing upon him various legal appointments. The most important work of his life was his co-operation in the production of the *Satire Ménippée* (1593), which did so much to damage the cause of the League; the harangue of the Sieur d'Aubray is usually attributed to his pen. He died at Nogent-sur-Seine on the 1st of November 1596. His valuable library, specially rich in MSS., was for the most part transferred to what is now the Bibliothèque Nationale in Paris.

Pithou wrote a great number of legal and historical books, besides preparing editions of several ancient authors. His earliest publication was *Adversariorum subsecivorum lib. II.* (1565). Perhaps his edition of the *Leges Visigothorum* (1579) was his most valuable contribution to historical science; in the same line he edited the *Capitula* of Charlemagne, Louis the Pious, and Charles the Bald in 1588, and he also assisted his brother François in preparing an edition of the *Corpus juris canonici* (1687). His *Libertés de l'église gallicane* (1594) is reprinted in his *Opera sacra juridica historica miscellanea collecta* (1609). In classical literature he was the first who made the world acquainted with the *Fables* of Phaedrus (1596); he also edited the *Pervigilium Veneris* (1587), and Juvenal and Persius (1585).

Three of Pithou's brothers acquired distinction as jurists: JEAN (1524–1602), author of *Traité de police et du gouvernement des républiques*, and, in collaboration with his twin brother NICOLAS (1524–1598), of *Institution du mariage chrétien*; and FRANÇOIS (1543–1621), author of *Glossarium ad libros capitularium* (1588), *Traité de l'excommunication et de l'interdit, &c.* (1587).

PITIGLIANO, a town in Italy, province of Grosseto. Pop. (1901), 4416. It is the cathedral city of the bishopric named after the neighbouring town of Sovana, and possesses a 16th-century cathedral and a church of the 11th–15th centuries, Pitigliano was originally a fief of the countship of Sovana, which in 1293 came by marriage into the possession of the Orsini. In 1410 Sovana was taken by the Siennese, but by the terms of a peace concluded in 1417 the Orsini retained Pitigliano, Gentile Orsini (assassinated 1434) assuming the title of count of Pitigliano. The most famous of the line of counts was Niccolo III. (1442–1510), a celebrated *condottiere*. Under his successors Pitigliano became the scene of ceaseless family feuds culminating in assassinations. In 1562 the Medici of Florence seized part of their territories, and acquired the rest by exchange in 1580. The Orsini stronghold still stands in the town.

PITLOCHRY, a village of Perthshire, Scotland, 28½ m. N.W. of Perth by the Highland railway. Pop. (1901), 1541. It lies on the left bank of the Tummel, a little below the confluence of that river and the Garry, 350 ft. above the sea. It is a favourite health resort and tourist centre. Among the immediate attractions are the pass of Killiecrankie, the falls of Tummel, the exquisite prospect called "Queen's View" (named after Queen Victoria) and Loch Tummel, 8 m. to the west. One m. S.E. of the village is the Black Spout, a waterfall of 80 ft. formed by the Edradour.

PITMAN, SIR ISAAC (1813–1897), English phonographer, was born at Trowbridge, Wiltshire, on the 4th of January 1813, and was educated at the local grammar school. He started in life as a clerk in a cloth factory, but in 1831 he was sent to the Normal College of the British and Foreign School Society in London. Between 1832 and 1839 he held masterships at Barton-on-Humber and Wotton-under-Edge, but he was dismissed by the authorities when he became a Swedenborgian, and from 1839 to 1843 he conducted a private school of his own at Bath. In 1829 he took up Samuel Taylor's system of shorthand, and from that time he became an enthusiast in developing the art of phonography. In 1837 he drew up a manual of Taylor's system and offered it to Samuel Bagster (1771–1852). The publisher did not accept the work, but suggested that Pitman should invent a new system (see SHORTHAND) of his own. The result was his *Stenographic Soundhand* (1837). Bagster's friendship and active help had been secured by Pitman's undertaking to verify the half-million references in the *Comprehensive Bible*, and he published the inventor's books at a cheap rate, thus helping to bring the system within the reach of all. Pitman devoted himself to perfecting phonography and propagating its use, and established at Bath a Phonetic Institute and a *Phonetic Journal* for this purpose; he printed in shorthand a number of standard works, and his book with the title *Phonography* (1840) went through many editions. He was an enthusiastic spelling reformer, and adopted a phonetic system which he tried to bring into general use. Pitman was twice married, his first wife dying in 1857, and his second, whom he married in 1861, surviving him. In 1894 he was knighted, and on the 22nd of January 1897 he died at Bath. Sir Isaac Pitman popularized shorthand at a time when the advance of the newspaper press and modern business methods were making it a matter of great commercial importance. His system adapted itself readily to the needs of journalism, and its use revolutionized the work of reporting. He was a non-smoker, a vegetarian, and advocated temperance principles.

His Life was written by Alfred Baker (1908) and (1902) by his brother, Benn Pitman (1822–1911).

PITONI, GIUSEPPE OTTAVIO (1657–1743), Italian musical composer, was born at Rieti on the 18th of March 1657. He came to Rome as a boy and sang in the choir of SS Apostoli. Foggia gave him instructions in counterpoint, and he became maestro di Cappella, first at Terra di Rotondo and later (1673) at Assisi. In 1676 he went to Rieti, and in 1677 to Rome, where he held various appointments, dying on the 1st of February 1743 as maestro di Cappella at St Marco, where he was buried. Pitoni appears to have devoted himself exclusively to church music, and although he did not disdain the modern style with instrumental accompaniment, he is best known by his Masses and other works in the manner of Palestrina.

Several volumes of his autograph composition are in the Santini Library at Münster.

PITT, THOMAS (1653–1726), British East India merchant and politician, usually called "Diamond Pitt," was born at Blandford, Dorset, on the 5th of July 1653. In early life he went to India, and from his headquarters at Balasore he made trading journeys into Persia and soon became prominent among those who were carrying on business in opposition to the East India Company. Twice he was arrested by order of the company, the second time being when he reached London in 1683, but after litigation had detained him for some years in England he returned to India and to his former career. Unable to check him the East India Company took him into its service in 1695, and in 1697 he became president of Fort St George, or Madras. Pitt was now very zealous in defending the interests of his employers against the new East India Company, and in protecting their settlements from the attacks of the natives; in directing the commercial undertakings of the company he also appears to have been very successful. Soon, however, he had a serious quarrel with William Fraser, a member of his council, and consequently he was relieved of his office in 1709, although he was afterwards consulted by the company on matters of importance. During his residence in India Pitt bought for about £20,000 the fine diamond which was named after him; in 1717 he sold this to the regent of France, Philip duke of Orleans, for £80,000 or, according to another account, for £135,000. It is now the property of the French government. During his former stay in England Pitt had bought a good deal of property, including the manor of Old Sarum, and for a short time he had represented this borough in parliament. After his final return from India in 1710 he added to his properties and again became member of parliament for Old Sarum. He died at Swallowfield near Reading on the 28th of April 1726. His eldest son, Robert, was the father of William Pitt, earl of Chatham (*q.v.*); and of Thomas Pitt (d. 1761), whose son became the first Lord Camelford; his second son, Thomas Pitt (*c.* 1688–1729), having married Frances (d. 1772), daughter of Robert Ridgeway, 4th earl of Londonderry (d. 1714), was himself created earl of Londonderry in 1726.

PITT, WILLIAM (1759–1806), English statesman, the second son of William Pitt, earl of Chatham, and of Lady Hester Grenville, daughter of Hester, Countess Temple, was born at Hayes, near Bromley, Kent, on the 28th of May 1759. The child inherited a name which, at the time of his birth, was the most illustrious in the civilized world, and was pronounced by every Englishman with pride, and by every enemy of England with mingled admiration and terror. During the first year of his life every month had its illuminations and bonfires, and every wind brought some messenger charged with joyful tidings and hostile standards. In Westphalia the English infantry won a great battle which arrested the armies of Louis XV. in the midst of a career of conquest; Boscawen defeated one French fleet on the coast of Portugal; Hawke put to flight another in the Bay of Biscay; Johnson took Niagara; Amherst took Ticonderoga; Wolfe died by the most enviable of deaths under the walls of Quebec; Clive destroyed a Dutch armament in the Hugli, and established the English supremacy in Bengal; Coote routed Lally at Wandewash, and established the English supremacy in the Carnatic. The nation, while loudly applauding the successful warriors, considered them all, on sea and on land, in Europe, in America, and in Asia, merely as instruments which received their direction from one superior mind. It was the great William Pitt who had vanquished the French marshals in Germany and French admirals on the Atlantic—who had conquered for his country one great empire on the frozen shores of Ontario and another under the tropical sun near the mouths of the Ganges. It was not in the nature of things that popularity such as he at this time enjoyed should be permanent. That popularity had lost its gloss before his children were old enough to understand that the earl of Chatham was a great man. The energy and decision which had eminently fitted him for the direction of war were not needed in time of peace. The lofty and spirit-stirring eloquence which had made him supreme in the House of Commons often fell dead on the House of Lords. Chatham was only the ruin of Pitt, but an awful and majestic ruin, not to be contemplated by any man of sense and feeling without emotions resembling those which are excited by the remains of the Parthenon and of the Colosseum. In one respect the old statesman was eminently happy. Whatever might be the vicissitudes of his public life, he never failed to find peace and love by his own hearth. He loved all his children, and was loved by them; and of all his children the one of whom he was fondest and proudest was his second son.

Early Life.

The child's genius and ambition displayed themselves with a rare and almost unnatural precocity. At seven the interest which he took in grave subjects, the ardour with which he pursued his studies, and the sense and vivacity of his remarks on books and on events amazed his parents and instructors. One of his sayings of this date was reported to his mother by his tutor. In August 1766, when the world was agitated by the news that Mr Pitt had become earl of Chatham, little William exclaimed, "I am glad that I am not the eldest son. I want to speak in the House of Commons like papa." At fourteen the lad was in intellect a man. Hayley, who met him at Lyme in the summer of 1773, was astonished, delighted, and somewhat overawed, by hearing wit and wisdom from so young a mouth. The boy himself had already written a tragedy, bad, of course, but not worse than the tragedies of his friend. This piece (still preserved) is in some respects highly curious. There is no love. The whole plot is political; and it is remarkable that the interest, such as it is, turns on a contest about a regency. On one side is a faithful servant of the Crown, on the other an ambitious and unprincipled conspirator. At length the king, who had been missing, reappears, resumes his power, and rewards the fathful defender of his rights. A reader who should judge only by internal evidence would have no hesitation in pronouncing that the play was written by some Pittite poetaster at the time of the rejoicings for the recovery of George III. in 1789.

The pleasure with which William's parents observed the rapid development of his intellectual powers was alloyed by apprehensions about his health. He shot up alarmingly fast; he was often ill, and always weak; and it was feared that it would be impossible to rear a stripling so tall, so slender, and so feeble. Port wine was prescribed by his medical advisers; and it is said that he was, at fourteen, accustomed to take this agreeable physic in quantities which would, in our more abstemious age, be thought much more than sufficient for any full-grown man. It was probably on account of the delicacy of his frame that he was not educated like other boys of the same rank. Almost all the eminent English statesmen and orators to whom he was afterwards opposed or allied—North, Fox, Shelburne, Windham, Grey, Wellesley, Grenville, Sheridan, Canning—went through the training of great public schools. Lord Chatham had himself been a distinguished Etonian; and it is seldom that a distinguished Etonian forgets his obligations to Eton. But William's infirmities required a vigilance and tenderness such as could be found only at home He was therefore bred under the paternal roof. His studies were superintended by a clergyman named Wilson; and those studies, though often interrupted by illness, were prosecuted with extraordinary success. He was sent, towards the close of the year 1773, to Pembroke Hall, in the university of Cambridge. The governor to whom the direction of William's academical life was confided was a bachelor of arts named Pretyman,[1] who had been senior wrangler in the preceding year, and, who though not a man of prepossessing appearance or brilliant parts, was eminently acute and laborious, a sound scholar, and an excellent geometrician. A close and lasting friendship sprang up between the pair. The disciple was able, before he completed his twenty-eighth year, to make his preceptor bishop of Lincoln and dean of St Paul's; and the preceptor showed his gratitude by writing a life of the disciple, which enjoys the distinction of being the worst biographical work of its size in the world. Pitt, till he graduated, had scarcely one acquaintance, attended chapel regularly morning and evening, dined every day in hall, and never went to a single evening party. At seventeen he was admitted, after the fashion of those times, by right of birth, without any examination, to the degree of master of arts. But he continued during some years to reside at college, and to apply himself vigorously, under Pretyman's direction, to the studies of the place, while mixing freely in the best academic society.

The stock of learning which Pitt laid in during this part of his life was certainly very extraordinary. The work in which he took the greatest delight was Newton's *Principia*. His liking for mathematics, indeed, amounted to a passion, which, in the opinion of his instructors, themselves distinguished mathematicians, required to be checked rather than encouraged. Nor was the youth's proficiency in classical learning less remarkable. In one respect, indeed, he appeared to disadvantage when compared with even second-rate and third-rate men from public schools. He had never, while under Wilson's care, been in the habit of composing in the ancient languages; and he therefore never acquired the knack of versification. It would have been utterly out of his power to produce such charming elegiac lines as those in which Wellesley bade farewell to Eton, or such Virgilian hexameters as those in which Canning described the pilgrimage to Mecca. But it may be doubted whether any scholar has ever, at twenty, had a more solid and profound knowledge of the two great tongues of the old civilized world. He had set his heart on being intimately acquainted with all the extant poetry of Greece, and was not satisfied till he had mastered Lycophron's *Cassandra*.

To modern literature Pitt paid comparatively little attention. He knew no living language except French; and French he knew very imperfectly. With a few of the best English writers he was intimate, particularly with Shakespeare and Milton. The debate in Pandemonium was, as it well deserved to be, one of his favourite passages; and his early friends used to talk, long after his death, of the just emphasis and the melodious cadence with which they had heard him recite the incomparable speech of Belial. He had indeed been carefully trained from infancy in the art of managing his voice, a voice naturally clear and deep-toned. At a later period the wits of Brookes's, irritated by observing, night after night, how powerfully Pitt's sonorous elocution fascinated the rows of country gentlemen, reproached him with having been " taught by his dad on a stool ".

His education, indeed, was well adapted to form a great parliamentary speaker. The classical studies of Pitt had the effect of enriching his English vocabulary, and of making him wonderfully expert in the art of constructing correct English sentences. His practice was to look over a page or two of a Greek or Latin author, to make himself master of the meaning, and then to read the passage straight forward into his own language. This practice, begun under his first teacher Wilson, was continued under Pretyman. Of all the remains of antiquity, the orations were those on which he bestowed the most minute examination. His favourite employment was to compare harangues on opposite sides of the same question, to analyse them, and to observe which of the arguments of the first speaker were refuted by the second, which were evaded, and which were left untouched. Nor was it only in books that he at this time studied the art of parliamentary fencing. When he was at home he had frequent opportunities of hearing important debates at Westminster; and he heard them, not only with interest and enjoyment, but with close scientific attention. On one of these occasions Pitt, a youth whose abilities were as yet known only to his own family and to a small knot of college friends, was introduced on the steps of the throne in the House of Lords to Fox, his senior by eleven years, who was already the greatest debater, and one of the greatest orators, that had appeared in England. Fox used afterwards to relate that, as the discussion proceeded, Pitt repeatedly turned to him, and said, " But surely, Mr Fox, that might be met thus," or " Yes; but he lays himself open to this retort." What the particular criticisms were Fox had forgotten; but he said that he was much struck at the time by the precocity of a lad who, through the whole sitting, seemed to be thinking only how all the speeches on both sides could be answered.

He had not quite completed his nineteenth year when, on the 7th of April 1778, he attended his father to Westminster. A great debate was expected. It was known that France had recognized the independence of the United States. The duke of Richmond was about to declare his opinion that all thought of subjugating those states ought to be relinquished. Chatham had always maintained that the resistance of the colonies to the mother country was justifiable. But he conceived, very erroneously, that on the day on which their independence should be acknowledged the greatness of England would be at an end. Though sinking under the weight of years and infirmities, he determined, in spite of the entreaties of his family, to be in his place. His son supported him to a seat. The excitement and exertion were too much for the old man. In the very act of addressing the peers, he fell back in convulsions. A few weeks later his corpse was borne, with gloomy pomp, from the Painted Chamber to the Abbey. The favourite child and namesake of the deceased statesman followed the coffin as chief mourner, and saw it deposited in the transept where his own was destined to lie. His elder brother, now earl of Chatham, had means sufficient, and barely sufficient, to support the dignity of the peerage. The other members of the family were poorly provided for. William had little more than £300 a year. It was necessary for him to follow a profession. He had already begun to " eat his terms." In the spring of 1780 he came of age. He then quitted Cambridge, was called to the bar, took chambers in Lincoln's Inn, and joined the western circuit. In the autumn of that year a general election took place; and he offered himself as a candidate for the university; but he was at the bottom of the poll. He was, however, at the request of an hereditary friend, the duke of Rutland, brought into parliament by Sir James Lowther for the borough of Appleby.

Parliament, 1780.

The dangers of the country were at that time such as might well have disturbed even a constant mind. Army after army had been sent in vain against the rebellious colonists of North America. Meanwhile the house of Bourbon, humbled to the dust a few years before by the genius and vigour of Chatham, had seized the opportunity of revenge. France and Spain had united against England, and had recently been joined by Holland. The command of the Mediterranean had been for a time lost. The British flag had been scarcely able to maintain itself in the British Channel. The northern powers professed neutrality; but their neutrality had a menacing aspect. In the East, Hyder Ali had descended on the Carnatic, had destroyed the little army of Baillie, and had spread terror even to the ramparts of Fort St George. The discontents of Ireland threatened nothing less than civil war. In England the authority of Lord North's government had sunk to the

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[[1] George Pretyman (1750–1827) was senior wrangler in 1772. In 1803, on falling heir to a large estate, he assumed the name of Tomline. From Lincoln, to which see he had been elevated in 1787, he was translated to Winchester in 1820. Tomline, to whom Pitt when dying had bequeathed his papers, published his *Memoirs of the Life of William Pitt* (down to the close of 1792) in 1821 (3 vols. 8vo).]

lowest point. The king and the House of Commons were alike unpopular. The cry for parliamentary reform was scarcely less loud and vehement than afterwards in 1830.

The Opposition consisted of two parties which had once been hostile to each other, but at this conjuncture seemed to act together with cordiality. The larger of these parties consisted of the great body of the Whig aristocracy, headed by Charles, marquess of Rockingham. In the House of Commons the adherents of Rockingham were led by Fox, whose dissipated habits and ruined fortunes were the talk of the whole town, but whose commanding genius, and whose sweet, generous and affectionate disposition, extorted the admiration and love of those who most lamented the errors of his private life. Burke, superior to Fox in largeness of comprehension, in extent of knowledge, and in splendour of imagination, but less skilled in that kind of logic and in that kind of rhetoric which convince and persuade great assemblies, was willing to be the lieutenant of a young chief who might have been his son. A smaller section of the Opposition was composed of the old followers of Chatham. At their head was William, earl of Shelburne, distinguished both as a statesman and as a lover of science and letters. With him were leagued Lord Camden, who had formerly held the Great Seal, and whose integrity, ability and constitutional knowledge commanded the public respect; Barré, an eloquent and acrimonious declaimer; and Dunning, who had long held the first place at the English bar. It was to this party that Pitt was naturally attracted.

On the 26th of February 1781 he made his first speech in favour of Burke's plan of economical reform. Fox stood up at the same moment, but instantly gave way. The lofty yet animated deportment of the young member, his perfect self-possession, the readiness with which he replied to the orators who had preceded him, the silver tones of his voice, the perfect structure of his unpremeditated sentences, astonished and delighted his hearers. Burke, moved even to tears, exclaimed, "It is not a chip of the old block; it is the old block itself." "Pitt will be one of the first men in parliament," said a member of the Opposition to Fox. "He is so already," answered Fox, in whose nature envy had no place. Soon after this debate Pitt's name was put up by Fox at Brookes's Club. On two subsequent occasions during that session Pitt addressed the house, and on both fully sustained the reputation which he had acquired on his first appearance. In the summer, after the prorogation, he again went the western circuit, held several briefs, and acquitted himself in such a manner that he was highly complimented by Buller from the bench, and by Dunning at the bar.

On the 27th of November the parliament reassembled. Only forty-eight hours before had arrived tidings of the surrender of Cornwallis and his army. In the debate on the report of the address Pitt spoke with even more energy and brilliancy than on any former occasion. He was warmly applauded by his allies; but it was remarked that no person on his own side of the house was so loud in eulogy as Henry Dundas, the lord advocate of Scotland, who spoke from the ministerial ranks. From that night dates his connexion with Pitt, a connexion which soon became a close intimacy, and which lasted till it was dissolved by death. About a fortnight later Pitt spoke in the committee of supply on the army estimates. Symptoms of dissension had begun to appear on the treasury bench. Lord George Germaine, the secretary of state who was especially charged with the direction of the war in America, had held language not easily to be reconciled with declarations made by the first lord of the treasury. Pitt noticed the discrepancy with much force and keenness. Lord George and Lord North began to whisper together; and Welbore Ellis, an ancient placeman who had been drawing salary almost every quarter since the days of Henry Pelham, bent down between them to put in a word. Such interruptions sometimes discompose veteran speakers. Pitt stopped, and, looking at the group, said with admirable readiness, "I shall wait till Nestor has composed the dispute between Agamemnon and Achilles." After several defeats, or victories hardly to be distinguished from defeats, the ministry resigned. The king, reluctantly and ungraciously, consented to accept Rockingham as first minister. Fox and Shelburne became secretaries of state. Lord John Cavendish, one of the most upright and honourable of men, was made chancellor of the exchequer. Thurlow, whose abilities and force of character had made him the dictator of the House of Lords, continued to hold the Great Seal. To Pitt was offered, through Shelburne, the vice-treasurership of Ireland, one of the easiest and most highly paid places in the gift of the Crown; but the offer was without hesitation declined. The young statesman had resolved to accept no post which did not entitle him to a seat in the cabinet; and a few days later (March 1782) he announced that resolution in the House of Commons.

Pitt gave a general support to the administration of Rockingham, but omitted, in the meantime, no opportunity of courting that ultra-Whig party which the persecution of Wilkes and the Middlesex election had called into existence, and which the disastrous events of the war, and the triumph of republican principles in America, had made formidable both in numbers and in temper. He supported a motion for shortening the duration of parliaments. He made a motion for a committee to examine into the state of the representation, and, in the speech (May 7, 1782) by which that motion was introduced, avowed himself the enemy of the close boroughs, the strongholds of that corruption to which he attributed all the calamities of the nation, and which, as he phrased it in one of those exact and sonorous sentences of which he had a boundless command, had grown with the growth of England and strengthened with her strength, but had not diminished with her diminution or decayed with her decay. On this occasion he was supported by Fox. The motion was lost by only twenty votes in a house of more than three hundred members. The Reformers never again had so good a divison till the year 1831.

Office, 1782.

The new administration was strong in abilities, and was more popular than any administration which had held office since the first year of George III., but was hated by the king, hesitatingly supported by the parliament, and torn by internal dissensions. It was all that Rockingham could do to keep the peace in his cabinet; and before the cabinet had existed three months Rockingham died. In an instant all was confusion. The adherents of the deceased statesman looked on the duke of Portland as their chief. The king placed Shelburne at the head of the treasury. Fox, Lord John Cavendish, and Burke immediately resigned their offices; and the new prime minister was left to constitute a government out of very defective materials. It was necessary to find some member of the House of Commons who could confront the great orators of the Opposition; and Pitt alone had the eloquence and the courage which were required. He was offered the great place of chancellor of the exchequer and he accepted it (July 1782). He had scarcely completed his twenty-third year.

The parliament was speedily prorogued. During the recess a negotiation for peace which had been commenced under Rockingham was brought to a successful termination. England acknowledged the independence of her revolted colonies; and she ceded to her European enemies some places in the Mediterranean and in the Gulf of Mexico. But the terms which she obtained were quite as advantageous and honourable as the events of the war entitled her to expect, or as she was likely to obtain by persevering in a contest against immense odds. There is not the slightest reason to believe that Fox, if he had remained in office, would have hesitated one moment about concluding a treaty on such conditions. Unhappily Fox was, at this crisis, hurried by his passions into an error which made his genius and his virtues, during a long course of years, almost useless to his country. He saw that the great body of the House of Commons was divided into three parties—his own, that of North, and that of Shelburne; that none of those three parties was large enough to stand alone; that, therefore, unless two of them united there must be a miserably feeble administration, or, more probably, a rapid succession of miserably feeble administrations, and this at a time when a strong government was essential to the prosperity and respectability of the nation. It was then necessary and right that there should be a coalition. To every possible coalition there were objections. But of all possible coalitions that to which there were the fewest objections was undoubtedly a coalition between Shelburne and Fox. It would have been generally applauded by the followers of both. It might have been made without any sacrifice of public principle on the part of either. Unhappily, recent bickerings had left in the mind of Fox a profound dislike and distrust of Shelburne. Pitt attempted to mediate, and was authorized to invite Fox to return to the service of the Crown. "Is Lord Shelburne," said Fox, "to remain prime minister?" Pitt answered in the affirmative. "It is impossible that I can act under him," said Fox. "Then negotiation is at an end," said Pitt; "for I cannot betray him." Thus the two statesmen parted. They were never again in a private room together. As Fox and his friends would not treat with Shelburne, nothing remained to them but to treat with North. That fatal coalition which is emphatically called "The Coalition" was formed. Not three-quarters of a year had elapsed since Fox and Burke had threatened North with impeachment, and had described him night after night as the most arbitrary, the most corrupt, and the most incapable of ministers. They now allied themselves with him for the purpose of driving from office a statesman with whom they cannot be said to have differed as to any important question. Nor had they even the prudence and the patience to wait for some occasion on which they might, without inconsistency, have combined with their old enemies in opposition to the government. That nothing might be wanting to the scandal, the great orators who had, during seven years, thundered against the war determined to join with the authors of that war in passing a vote of censure on the peace.

The parliament met before Christmas 1782. But it was not till January 1783 that the preliminary treaties were signed. On the 17th of February they were taken into consideration by the House of Commons. There had been, during some days, floating rumours that Fox and North had coalesced; and the debate indicated but too clearly that those rumours were not unfounded. Pitt was suffering from indisposition—he did not rise till his own strength and that of his hearers were exhausted; and he was consequently less successful than on any former occasion. His admirers owned that his speech was feeble and petulant. He so far forgot himself as to advise Sheridan to confine himself to amusing theatrical audiences. This ignoble sarcasm gave Sheridan an opportunity of retorting with great felicity. "After what I have seen and heard to-night," he said, "I really feel strongly tempted to venture on a competition with so great an artist as Ben Jonson, and to bring on the stage a second Angry Boy." On a division, the address proposed by the supporters of the government was rejected by a majority of sixteen. But Pitt was not a man to be disheartened by a single failure, or to be put down by the most lively repartee. When, a few days later, the Opposition proposed a resolution directly censuring the treaties, he spoke with an eloquence, energy and dignity which raised his fame and popularity higher than ever. To the coalition of Fox and North he alluded in language which drew forth tumultuous applause from his followers. "If," he said, "this ill-omened and unnatural marriage be not yet consummated, I know of a just and lawful impediment; and, in the name of the public weal, I forbid the banns." The ministers were again left in a minority, and Shelburne consequently tendered his resignation (March 31, 1783). It was accepted; but the king struggled long and hard before he submitted to the terms dictated by Fox, whose faults he detested, and whose high spirit and powerful intellect he detested still more. The first place at the board of treasury was repeatedly offered to Pitt; but the offer, though tempting, was steadfastly declined. The king, bitterly complaining of Pitt's faintheartedness, tried to break the coalition. Every art of seduction was practised on North, but in vain. During several weeks the country remained without a government. It was not till all devices had failed, and till the aspect of the House of Commons became threatening, that the king gave way. The duke of Portland was declared first lord of the treasury. Thurlow was dismissed. Fox and North became secretaries of state, with power ostensibly equal. But Fox was the real prime minister. The year was far advanced before the new arrangements were completed; and nothing very important was done during the remainder of the session. Pitt, now seated on the Opposition Bench, brought the question of parliamentary reform a second time (May 7, 1783) under the consideration of the Commons. He proposed to add to the house at once a hundred county members and several members for metropolitan districts, and to enact that every borough of which an election committee should report that the majority of voters appeared to be corrupt should lose the franchise. The motion was rejected by 293 votes to 149.

After the prorogation Pitt visited the Continent for the first and last time. His travelling companion was one of his most intimate friends, William Wilberforce. That was the time of Anglomania in France; and at Paris the son of the great Chatham was absolutely hunted by men of letters and women of fashion, and forced, much against his will, into political disputation. One remarkable saying which dropped from him during this tour has been preserved. A French gentleman expressed some surprise at the immense influence which Fox, a man of pleasure, ruined by the dice-box and the turf, exercised over the English nation. "You have not," said Pitt, "been under the wand of the magician."

In November 1783 the parliament met again. The government had irresistible strength in the House of Commons, and seemed to be scarcely less strong in the House of Lords, but was, in truth, surrounded on every side by dangers. The king was impatiently waiting for the moment at which he could emancipate himself from a yoke which galled him so severely that he had more than once seriously thought of retiring to Hanover; and the king was scarcely more eager for a change than the nation. Fox and North had committed a fatal error. They ought to have known that coalitions between parties which have long been hostile can succeed only when the wish for coalition pervades the lower ranks of both. At the beginning of 1783 North had been the recognized head of the old Tory party, which, though for a moment prostrated by the disastrous issue of the American war, was still a great power in the state. Fox had, on the other hand, been the idol of the Whigs, and of the whole body of Protestant dissenters. The coalition at once alienated the most zealous Tories from North and the most zealous Whigs from Fox. Two great multitudes were at once left without any head, and both at once turned their eyes on Pitt. One party saw in him the only man who could rescue the king; the other saw in him the only man who could purify the parliament. He was supported on one side by Archbishop Markham, the preacher of divine right, and by Jenkinson, the captain of the praetorian band of the king's friends; on the other side by Jebb and Priestley, Sawbridge and Cartwright, Jack Wilkes and Horne Tooke. On the benches of the House of Commons, however, the ranks of the ministerial majority were unbroken; and that any statesman would venture to brave such a majority was thought impossible. No prince of the Hanoverian line had ever, under any provocation, ventured to appeal from the representative body to the constituent body. The ministers, therefore, notwithstanding the sullen looks and muttered words of displeasure with which their suggestions were received in the closet, notwithstanding the roar of obloquy which was rising louder and louder every day from every corner of the island, thought themselves secure. Such was their confidence in their strength that, as soon as the parliament had met, they brought forward a singularly bold and original plan for the government of the British territories in India. What was proposed in Fox's India bill was that the whole authority which till that time had been exercised over those territories by the East India Company should be transferred to seven commissioners, who were to be named by parliament, and were not to be removable at the pleasure of the Crown. Earl Fitzwilliam, the most intimate personal friend of Fox, was to be chairman of this board, and the eldest son of North was to be one of the members.

Fox's India Bill.

As soon as the outlines of the scheme were known all the hatred which the coalition had excited burst forth with an astounding explosion. Burke, who, whether right or wrong in the conclusions to which he came, had at least the merit of looking at the subject in the right point of view, vainly reminded his hearers of that mighty population whose daily rice might depend on a vote of the British parliament. He spoke with even more than his wonted power of thought and language, about the desolation of Rohilcund, about the spoliation of Benares, about the evil policy which had suffered the tanks of the Carnatic to go to ruin; but he could scarcely obtain a hearing. The contending parties, to their shame it must be said, would listen to none but English topics. Out of doors the cry against the ministry was almost universal. Town and country were united. Corporations exclaimed against the violation of the charter of the greatest corporation in the realm. Tories and democrats joined in pronouncing the proposed board an unconstitutional body. It was to consist of Fox's nominees. The effect of his bill was to give, not to the Crown, but to him personally, whether in office or in opposition, an enormous power, a patronage sufficient to counterbalance the patronage of the treasury and of the admiralty, and to decide the elections for fifty boroughs. He knew, it was said, that he was hateful alike to king and people; and he had devised a plan which would make him independent of both. Some nicknamed him Cromwell, and some Carlo Khan. Wilberforce, with his usual felicity of expression, and with very unusual bitterness of feeling, described the scheme as the genuine offspring of the coalition, as marked with the features of both its parents, the corruption of one and the violence of the other. In spite of all opposition, however, the bill was supported in every stage by great majorities, was rapidly passed, and was sent up to the Lords. To the general astonishment, when the second reading was moved in the upper house, the Opposition proposed an adjournment, and carried it by eighty-seven votes to seventy-nine. The cause of this strange turn of fortune was soon known. Pitt's cousin Earl Temple, had been in the royal closet, and had there been authorized to let it be known that his majesty would consider all who voted for the bill as his enemies. The ignominious commission was performed, and instantly a troop of lords of the bedchamber, of bishops who wished to be translated, and of Scotch peers who wished to be re-elected, made haste to change sides. On a later day the Lords rejected the bill. Fox and North were immediately directed to send their seals to the palace by their under-secretaries; and Pitt was appointed first lord of the treasury and chancellor of the exchequer (December 1783).

Prime Minister, 1783.

The general opinion was that there would be an immediate dissolution. But Pitt wisely determined to give the public feeling time to gather strength. On this point he differed from his kinsman Temple. The consequence was that Temple, who had been appointed one of the secretaries of state, resigned his office forty-eight hours after he had accepted it, and thus relieved the new government from a great load of unpopularity; for all men of sense and honour, however strong might be their dislike of the India Bill, disapproved of the manner in which that bill had been thrown out. The fame of the young prime minister preserved its whiteness. He could declare with perfect truth that, if unconstitutional machinations had been employed, he had been no party to them.

He was, however, surrounded by difficulties and dangers. In the House of Lords, indeed, he had a majority; nor could any orator of the Opposition in that assembly be considered as a match for Thurlow, who was now again chancellor, or for Camden, who cordially supported the son of his old friend Chatham. But in the other house there was not a single eminent speaker among the official men who sat round Pitt. His most useful assistant was Dundas, who, though he had not eloquence, had sense, knowledge, readiness and boldness. On the opposite benches was a powerful majority, led by Fox, who was supported by Burke, North and Sheridan. The heart of the young minister, stout as it was, almost died within him. But, whatever his internal emotions might be, his language and deportment indicated nothing but unconquerable firmness and haughty confidence in his own powers. His contest against the House of Commons lasted from the 17th of December 1783 to the 8th of March 1784. In sixteen divisions the Opposition triumphed. Again and again the king was requested to dismiss his ministers; but he was determined to go to Germany rather than yield. Pitt's resolution never wavered. The cry of the nation in his favour became vehement and almost furious. Addresses assuring him of public support came up daily from every part of the kingdom. The freedom of the city of London was presented to him in a gold box. He was sumptuously feasted in Grocers' Hall; and the shopkeepers of the Strand and Fleet Street illuminated their houses in his honour. These things could not but produce an effect within the walls of parliament. The ranks of the majority began to waver; a few passed over to the enemy; some skulked away; many were for capitulating while it was still possible to capitulate with the honours of war. Negotiations were opened with the view of forming an administration on a wide basis, but they had scarcely been opened when they were closed. The Opposition demanded, as a preliminary article of the treaty, that Pitt should resign the treasury; and with this demand Pitt steadfastly refused to comply. While the contest was raging, the clerkship of the Pells, a sinecure place for life, worth three thousand a year, and tenable with a seat in the House of Commons, became vacant. The appointment was with the chancellor of the exchequer; nobody doubted that he would appoint himself, and nobody could have blamed him if he had done so; for such sinecure offices had always been defended on the ground that they enabled a few men of eminent abilities and small incomes to live without any profession, and to devote themselves to the service of the state. Pitt, in spite of the remonstrances of his friends, gave the Pells to his father's old adherent, Colonel Barré, a man distinguished by talent and eloquence, but poor and afflicted with blindness. By this arrangement a pension which the Rockingham administration had granted to Barré was saved to the public. Pitt had his reward. No minister was ever more rancorously libelled; but even when he was known to be overwhelmed with debt, when millions were passing through his hands, when the wealthiest magnates of the realm were soliciting him for marquisates and garters, his bitterest enemies did not dare to accuse him of touching unlawful gain.

At length the hard-fought fight ended. A final remonstrance, drawn up by Burke with admirable skill, was carried on the 8th of March by a single vote in a full house. The supplies had been voted; the Mutiny Bill had been passed; and the parliament was dissolved. The popular constituent bodies all over the country were in general enthusiastic on the side of the new government. A hundred and sixty of the supporters of the coalition lost their seats. The first lord of the treasury himself came in at the head of the poll for the university of Cambridge. Wilberforce was elected knight of the great shire of York, in opposition to the whole influence of the Fitzwilliams, Cavendishes, Dundases and Saviles. In the midst of such triumphs Pitt completed his twenty-fifth year. He was now the greatest subject that England had seen during many generations. He domineered absolutely over the cabinet, and was the favourite at once of the sovereign, of the parliament and of the nation. His father had never been so powerful, nor Walpole, nor Marlborough.

Pitt's First Administration.

Pitt's first administration (1784–1801) lasted seventeen years. That long period is divided by a strongly marked line into two almost exactly equal parts. The first part ended and the second began in the autumn of 1792. Throughout both parts Pitt displayed in the highest degree the talents of a parliamentary leader. During the first part he was fortunate and in many respects a skilful administrator. With the difficulties which he had to encounter during the second part he was altogether incapable of contending; but his eloquence and his perfect mastery of the tactics of the House of Commons concealed his incapacity from the multitude.

The eight years which followed the general election of 1784 were as tranquil and prosperous as any eight years in the whole history of England. Her trade increased. Her manufactures flourished. Her exchequer was full to overflowing. Very idle apprehensions were generally entertained that the public debt, though much less than a third of the debt which we now bear with ease, would be found too heavy for the strength of the nation. But Pitt succeeded in persuading first himself and then the whole nation, his opponents included, that a new sinking fund, which, so far as it differed from former sinking funds, differed for the worse, would, by virtue of some mysterious power of propagation belonging to money, put into the pocket of the public creditor great sums not taken out of the pocket of the tax-payer. The minister was almost universally extolled as the greatest of financiers. Meanwhile both the branches of the house of Bourbon found that England was as formidable an antagonist as she had ever been. France had formed a plan for reducing Holland to vassalage. But England interposed, and France receded. Spain interrupted by violence the trade of the English merchants with the regions near the Oregon. But England armed, and Spain receded. Within the island there was profound tranquillity. The king was, for the first time, popular. From the day on which Pitt was placed at the head of affairs there was an end of secret influence. Any attempt to undermine him at court, any mutinous movement among his followers in the House of Commons, was certain to be at once put down. He had only to tender his resignation and he could dictate his own terms. For he, and he alone, stood between the king and the coalition. The nation loudly applauded the king for having the wisdom to repose entire confidence in so excellent a minister. His people heartily prayed that he might long reign over them; and they prayed the more heartily because his virtues were set off to the best advantage by the vices and follies of the prince of Wales, who lived in close intimacy with the chiefs of the Opposition.

The Regency, 1788.

How strong this feeling was in the public mind appeared signally on one great occasion. In the autumn of 1788 the king became insane. The Opposition, eager for office, committed the great indiscretion of asserting that the heir apparent had, by the fundamental laws of England, a right to be regent with the full powers of royalty. Pitt, on the other hand, maintained it to be the constitutional doctrine that when a sovereign is, by reason of infancy, disease or absence, incapable of exercising the regal funcions, it belongs to the estates of the realm to determine who shall be the vicegerent, and with what portion of the executive authority such vicegerent shall be entrusted. A long and violent contest followed, in which Pitt was supported by the great body of the people with as much enthusiasm as during the first months of his administration. Tories with one voice applauded him for defending the sick-bed of a virtuous and unhappy sovereign against a disloyal faction and an undutiful son. Not a few Whigs applauded him for asserting the authority of parliaments and the principles of the Revolution, in opposition to a doctrine which seemed to have too much affinity with the servile theory of indefeasible hereditary right. The middle class, always zealous on the side of decency and the domestic virtues, looked forward with dismay to a reign resembling that of Charles II. That the prince of Wales must be regent nobody ventured to deny. But he and his friends were so unpopular that Pitt could, with general approbation, propose to limit the powers of the regent by restrictions to which it would have been impossible to subject a prince beloved and trusted by the country. Some interested men, fully expecting a change of administration, went over to the Opposition. But the majority, purified by these desertions, closed its ranks, and presented a more firm array than ever to the enemy. In every division Pitt was victorious. When at length, after a stormy interregnum of three months, it was announced, on the very eve of the inauguration of the regent, that the king was himself again, the nation was wild with delight. Pitt with difficulty escaped from the tumultuous kindness of an innumerable multitude which insisted on drawing his coach from St Paul's Churchyard to Downing Street. This was the moment at which his fame and fortune may be said to have reached the zenith. His influence in the closet was as great as that of Carr or Villiers had been. His dominion over the parliament was more absolute than that of Walpole or Pelham had been. He was at the same time as high in the favour of the populace as ever Wilkes or Sacheverell had been. But now the tide was on the turn. Only ten days after the triumphant procession to St Paul's, the states-general of France, after an interval of a hundred and seventy-four years, met at Versailles.

French Revolution.

The nature of the great Revolution which followed was long very imperfectly understood in England. Burke saw much further than any of his contemporaries; but whatever his sagacity descried was refracted and discoloured by his passions and his imagination. More than three years elapsed before the principles of the English administration underwent any material change. Nothing could as yet be milder or more strictly constitutional than the minister's domestic policy. Not a single act indicating an arbitrary temper or a jealousy of the people could be imputed to him. In office, Pitt had redeemed the pledges which he had, at his entrance into public life, given to the supporters of parliamentary reform. He had, in 1785, brought forward a judicious plan for the representative system, and had prevailed on the king, not only to refrain from talking against that plan, but to recommend it to the houses in a speech from the throne.[1] This attempt failed; but there can be little doubt that, if the French Revolution had not produced a violent reaction of public feeling, Pitt would have performed, with little difficulty and no danger, that great work which, at a later period, Lord Grey could accomplish only by means which for a time loosened the very foundations of the commonwealth. When the atrocities of the slave trade were first brought under the consideration of parliament no abolitionist was more zealous than Pitt. A humane bill, which mitigated the horrors of the middle passage, was, in 1788, carried by the eloquence and determined spirit of Pitt, in spite of the opposition of some of his own colleagues. In 1791 he cordially concurred with Fox in maintaining the sound constitutional doctrine that an impeachment is not terminated by a dissolution. In the course of the same year the two great rivals contended side by side in a far more important cause. They are fairly entitled to divide the high honour of having added to the statute-book the inestimable law which places the liberty of the press under the protection of juries. On one occasion, and one alone, Pitt, during the first half of his long administration, acted in a manner unworthy of an enlightened Whig. In the debate on the Test Act he stooped to gratify the master whom he served, the university which he represented, and the great body of clergymen and country gentlemen on whose support he rested, by talking, with little heartiness indeed, and with no asperity, the language of a Tory. With this single exception, his conduct from the end of 1783 to the middle of 1792 was that of an honest friend of civil and religious liberty.

Nor did anything, during that period, indicate that he loved war, or harboured any malevolent feeling against any neighbouring nation. Those French writers who have represented him as a Hannibal sworn in childhood by his father to bear eternal hatred to France, as having, by mysterious intrigues and lavish bribes, instigated the leading Jacobins to commit those excesses which dishonoured the Revolution, as having been the real author of the first coalition, know nothing of his character or of his history. So far was he from being a deadly enemy to France that his laudable attempts to bring about a closer connexion with that country by means of a wise and liberal treaty of commerce brought on him the severe censure of the Opposition. He was told in the House of Commons that he was a degenerate son, and that his partiality for the hereditary foes of our island was enough to make his great father's bones stir under the pavement of the Abbey.

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[1] The speech with which the king opened the session of 1785 concluded with an assurance that his majesty would heartily concur in every measure which could tend to secure the true principles of the constitution. These words were at the time understood to refer to Pitt's Reform Bill.

And this man, whose name, if he had been so fortunate as to die in 1792, would have been associated with peace, with freedom, with philanthropy, with temperate reform, with mild and constitutional administration, lived to associate his name with arbitrary government, with harsh laws harshly executed, with alien bills, with gagging bills, with suspensions of the Habeas Corpus Act, with cruel punishments inflicted on some political agitators, with unjustifiable prosecutions instigated against others and with the most costly and most sanguinary wars of modern times. He lived to be held up to obloquy as the stern oppressor of England and the indefatigable disturber of Europe. Poets, contrasting his earlier with his later years, likened him sometimes to the apostle who kissed in order to betray, and sometimes to the evil angels who kept not their first estate. By the French press and the French tribune every crime that disgraced and every calamity that afflicted France was ascribed to the monster Pitt and his guineas. While the Jacobins were dominant it was he who had corrupted the Gironde, who had raised Lyons and Bordeaux against the Convention, who had suborned Paris to assassinate Lepelletier, and Cecilia Regnault to assassinate Robespierre. When the Thermidorian reaction came, all the atrocities of the Reign of Terror were imputed to him. Collot D'Herbois and Fouquier Tinville had been his pensioners. It was he who had hired the murderers of September, who had dictated the pamphlets of Marat and the carmagnoles of Barère, who had paid Lebon to deluge Arras with blood and Carrier to choke the Loire with corpses. The truth is that he liked neither war nor arbitrary government. He was a lover of peace and freedom, driven, by a stress against which it was hardly possible for any will or any intellect to struggle, out of the course to which his inclinations pointed, and for which his abilities and acquirements fitted him, and forced into a policy repugnant to his feelings and unsuited to his talents.

Between the spring of 1789 and the close of 1792 the public mind of England underwent a great change. If the change of Pitt's sentiments attracted peculiar notice, it was not because he changed more than his neighbours, for in fact he changed less than most of them, but because his position was far more conspicuous than theirs, because he was, till Bonaparte appeared, the individual who filled the greatest space in the eyes of the inhabitants of the civilized world. During a short time the nation, and Pitt as one of the nation, looked with interest and approbation on the French Revolution. But soon vast confiscations, the violent sweeping away of ancient institutions, the domination of clubs, the barbarities of mobs maddened by famine and hatred, produced a reaction. The court, the nobility, the gentry, the clergy, the manufacturers, the merchants, in short nineteen-twentieths of those who had good roofs over their heads and good coats on their backs, became eager intolerant Antijacobins. This feeling was at least as strong among the minister's adversaries as among his supporters. Fox in vain attempted to restrain his followers. All his genius, all his vast personal influence, could not prevent them from rising up against him in general mutiny. Burke set the example of revolt; and Burke was in no long time joined by Portland, Spencer, Fitzwilliam, Loughborough, Carlisle, Malmesbury, Windham, Elliot. In the House of Commons the followers of the great Whig statesman and orator diminished from about a hundred and sixty to fifty. In the House of Lords he had but ten or twelve adherents left. There can be no doubt that there would have been a similar mutiny on the ministerial benches if Pitt had obstinately resisted the general wish. Pressed at once by his master and by his colleagues, by old friends and by old opponents, he abandoned, slowly and reluctantly, the policy which was dear to his heart. He laboured hard to avert the European war. When the European war broke out he still flattered himself that it would not be necessary for this country to take either side. In the spring of 1792 he congratulated the parliament on the prospect of long and profound peace, and proved his sincerity by proposing large remissions of taxation. Down to the end of that year he continued to cherish the hope that England might be able to preserve neutrality. But the passions which raged on both sides of the Channel were not to be restrained. The republicans who ruled France were inflamed by a fanaticism resembling that of the Mussulmans, who, with the Koran in one hand and the sword in the other, went forth conquering and converting, eastward to the Bay of Bengal, and westward to the Pillars of Hercules. The higher and middle classes of England were animated by zeal not less fiery than that of the crusaders who raised the cry of *Deus vult* at Clermont. The impulse which drove the two nations to a collision was not to be arrested by the abilities or by the authority of any single man. As Pitt was in front of his fellows, and towered high above them, he seemed to lead them. But in fact he was violently pushed on by them, and, had he held back but a little more than he did, would have been thrust out of their way or trampled under their feet.

Pitt's War Policy.

He yielded to the current; and from that day his misfortunes began. The truth is that there were only two consistent courses before him. Since he did not choose to oppose himself, side by side with Fox, to the public feeling, he should have taken the advice of Burke, and should have availed himself of that feeling to the full extent. If it was impossible to preserve peace, he should have adopted the only policy which should lead to victory. He should have proclaimed a holy war for religion, morality, property, order, public law, and should have thus opposed to the Jacobins an energy equal to their own. Unhappily he tried to find a middle path; and he found one which united all that was worst in both extremes. He went to war; but he could not understand the peculiar character of that war. He was obstinately blind to the plain fact that he was contending against a state which was also a sect, and that a new quarrel between England and France was of quite a different kind from the old quarrels about colonies in America and fortresses in the Netherlands. It was pitiable to hear him, year after year, proving to an admiring audience that the wicked republic was exhausted, that she could not hold out, that her credit was gone, that her assignats were not worth more than the paper of which they were made—as if credit was necessary to a government of which the principle was rapine, as if Alboin could not turn Italy into a desert till he had negotiated a loan at 5%, as if the exchequer bills of Attila had been at par. It was impossible that a man who so completely mistook the nature of a contest could carry on that contest successfully. Great as Pitt's abilities were, his military administration was that of a driveller. In such an emergency, and with such means, such a statesman as Richelieu, as Louvois, as Chatham, as Wellesley, would have created in a few months one of the finest armies in the world, and would soon have discovered and brought forward generals worthy to command such an army. Germany might have been saved by another Blenheim; Flanders recovered by another Ramillies; another Poitiers might have delivered the Royalist and Catholic provinces of France from a yoke which they abhorred, and might have spread terror even to the barriers of Paris. But the fact is that, after eight years of war, after a vast destruction of life, after an expenditure of wealth far exceeding the expenditure of the American War, of the Seven Years' War, of the War of the Austrian Succession and of the War of the Spanish Succession united, the English army under Pitt was the laughing-stock of all Europe. It could not boast of one single brilliant exploit. It had never shown itself on the Continent but to be beaten, chased, forced to re-embark or forced to capitulate. To take some sugar island in the West Indies, to scatter some mob of half-naked Irish peasants—such were the most splendid victories won by the British troops under Pitt's auspices. The English navy no mismanagement could ruin. But during a long period whatever mismanagement could do was done. The earl of Chatham, without a single qualification for high public trust, was made, by fraternal partiality, first lord of the admiralty, and was kept in that great post during two years of a war in which the very existence of the state depended on the efficiency of the fleet. Fortunately he was succeeded by George, Earl Spencer, one of those chiefs of the Whig party who, in the great schism caused by the French Revolution, had followed Burke. Lord Spencer, though inferior to many of his colleagues as an orator, was decidedly the best administrator among them. To him it was owing that a long and gloomy succession of days of fasting, and most emphatically of humiliation, was interrupted, twice in the short space of eleven months, by days of thanksgiving for great victories.

It may seem paradoxical to say that the incapacity which Pitt showed in all that related to the conduct of the war is, in some sense, the most decisive proof that he was a man of very extraordinary abilities. Yet this is the simple truth. While his schemes were confounded, while his predictions were falsified, while the coalitions which he had laboured to form were falling to pieces, while the expeditions which he had sent forth at enormous cost were ending in rout and disgrace, while the enemy against whom he was feebly contending was subjugating Flanders and Brabant, the electorate of Mainz and the electorate of Trèves, Holland, Piedmont, Liguria, Lombardy, his authority over the House of Commons was constantly becoming more and more absolute. There was his empire. There were his victories—his Lodi and his Arcola, his Rivoli and his Marengo. Of the great party which had contended against him during the first eight years of his administration more than one-half now marched under his standard, with his old competitor the duke of Portland at their head; and the rest had, after many vain struggles, quitted the field in despair. Session followed session with scarcely a single division. In the eventful year 1799 the largest minority that could be mustered against the government was twenty-five.

Domestic Policy.

In Pitt's domestic policy there was at this time assuredly no want of vigour. While he offered to French Jacobinism a resistance so feeble that it only encouraged the evil which he wished to suppress, he put down English Jacobinism with a strong hand. The Habeas Corpus Act was repeatedly suspended. Public meetings were placed under severe restraints. The government obtained from parliament power to send out of the country aliens who were suspected of evil designs; and that power was not suffered to be idle. Writers who propounded doctrines adverse to monarchy and aristocracy were proscribed and punished without mercy. The old laws of Scotland against sedition, laws which were considered by Englishmen as barbarous, and which a succession of governments had suffered to rust, were now furbished up and sharpened anew. Men of cultivated minds and polished manners were, for offences which at Westminster would have been treated as mere misdemeanours, sent to herd with felons at Botany Bay. Some reformers, whose opinions were extravagant, and whose language was intemperate, but who had never dreamed of subverting the government by physical force, were indicted for high treason, and were saved from the gallows only by the righteous verdicts of juries.

Irish Policy.

One part only of Pitt's conduct during the last eight years of the 18th century deserves high praise. He was the first English minister who formed great designs for the benefit of Ireland. Had he been able to do all that he wished, it is probable that a wise and liberal policy would have averted the rebellion of 1798. But the difficulties which he encountered were great, perhaps insurmountable; and the Roman Catholics were, rather by his misfortune than by his fault, thrown into the hands of Jacobins. There was a third great rising of the Irishry against the Englishry, a rising not less formidable than the risings of 1641 and 1689. The Englishry remained victorious; and it was necessary for Pitt, as it had been necessary for Oliver Cromwell and William of Orange before him, to consider how the victory should be used. He determined to make Ireland one kingdom with England, and, at the same time, to relieve the Roman Catholic laity from civil disabilities, and to grant a public maintenance to the Roman Catholic clergy. Had he been able to carry these noble designs into effect the union would have been a union indeed. But Pitt could execute only one-half of what he had projected. He succeeded in obtaining the consent of the parliaments of both kingdoms to the union; but that reconciliation of races and sects without which the union could exist only in name was not accomplished. The king imagined that his coronation oath bound him to refuse his assent to any bill for relieving Roman Catholics from civil disabilities. Dundas tried to explain the matter, but was told to keep his Scotch metaphysics to himself. Pitt and Pitt's ablest colleagues resigned their offices (March 14, 1801).

Addington Ministry, 1801–1804.

It was necessary that the king should make a new arrangement. But by this time his anger and distress had brought back the malady which had, many years before, incapacitated him for the discharge of his functions. He actually assembled his family, read the coronation oath to them, and told them that, if he broke it, the crown would immediately pass to the house of Savoy. It was not until after an interregnum of several weeks that he regained the full use of his small faculties, and that a ministry after his own heart was at length formed. In an age pre-eminently fruitful of parliamentary talents, a cabinet was formed containing hardly a single man who in parliamentary talents could be considered as even of the second rate. Henry Addington was at the head of the treasury. He had been an early, indeed an hereditary friend of Pitt, and had by Pitt's influence been placed, while still a young man, in the chair of the House of Commons. He was universally admitted to have been the best Speaker that had sat in that chair since the retirement of Onslow. But nature had not bestowed on him very vigorous faculties; and the highly respectable situation which he long occupied with honour had rather unfitted than fitted him for the discharge of his new duties. Nevertheless, during many months, his power seemed to stand firm. The nation was put into high good humour by a peace with France. The enthusiasm with which the upper and middle classes had rushed into the war had spent itself. Jacobinism was no longer formidable. Everywhere there was a strong reaction against what was called the atheistical and anarchical philosophy of the 18th century. Bonaparte, now first consul, was busied in constructing out of the ruins of old institutions a new ecclesiastical establishment and a new order of knighthood. The treaty of Amiens was therefore hailed by the great body of the English people with extravagant joy. The popularity of the minister was for the moment immense. His want of parliamentary ability was, as yet, of little consequence; for he had scarcely any adversary to encounter. The old Opposition, delighted by the peace, regarded him with favour. A new Opposition had indeed been formed by some of the late ministers, and was led by Grenville in the House of Lords and by Windham in the House of Commons. But the new Opposition could scarcely muster ten votes, and was regarded with no favour by the country.

On Pitt the ministers relied as on their firmest support. He had not, like some of his colleagues, retired in anger. He had expressed the greatest respect for the conscientious scruple which had taken possession of the royal mind; and he had promised his successors all the help in his power. But it was hardly possible that this union should be durable. Pitt, conscious of superior powers, imagined that the place which he had quitted was now occupied by a mere puppet which he had set up, which he was to govern while he suffered it to remain, and which he was to fling aside as soon as he wished to resume his old position. Nor was it long before he began to pine for the power which he had relinquished. Addington, on the other hand, was by no means inclined to descend from his high position. He took his elevation quite seriously, attributed it to his own merit, and considered himself as one of the great triumvirate of English statesmen, as worthy to make a third with Pitt and Fox. Meanwhile Pitt's most intimate friends exerted themselves to effect a change of ministry. His favourite disciple, George Canning, was indefatigable. He spoke; he wrote; he intrigued; he tried to induce a large number of the supporters of the government to sign a round robin desiring a change; he made game of Addington and of Addington's relations in a succession of lively pasquinades. The minister's partisans retorted with equal acrimony, if not with equal vivacity. Pitt could keep out of the affray only by keeping out of politics altogether; and this it soon became impossible for him to do. The treaty of Amiens had scarcely been signed when the restless ambition and the insupportable insolence of the First Consul convinced the great body of the English people that the peace so eagerly welcomed was only a precarious armistice. As it became clearer and clearer that a war for the dignity, the independence, the very existence of the nation was at hand, men looked with increasing uneasiness on the weak and languid cabinet which would have to contend against an enemy who united more than the power of Louis the Great to more than the genius of Frederick the Great. They imagined that Pitt was the only statesman who could cope with Bonaparte. This feeling was nowhere stronger than among Addington's own colleagues. The pressure put on him was so strong that he could not help yielding to it. His first proposition was that some insignificant nobleman should be first lord of the treasury and nominal head of the administration, and that the real power should be divided between Pitt and himself, who were to be secretaries of state. Pitt, as might have been expected, refused even to discuss such a scheme, and talked of it with bitter mirth. "Which secretaryship was offered to you?" his friend Wilberforce asked. "Really," said Pitt, "I had not the curiosity to inquire." Addington was frightened into bidding higher. He offered to resign the treasury to Pitt on condition that there should be no extensive change in the government. But Pitt would listen to no such terms. Then came a dispute such as often arises after negotiations orally conducted, even when the negotiators are men of strict honour. Pitt gave one account of what had passed; Addington gave another; and, though the discrepancies were not such as necessarily implied any intentional violation of truth on either side, both were greatly exasperated.

Meanwhile the quarrel with the First Consul had to come to a crisis. On the 16th of May 1803 the king sent a message calling on the House of Commons to support him in withstanding the ambitious and encroaching policy of France; and on the 22nd the house took the message into consideration.

Pitt had now been living many months in retirement. There had been a general election since he had spoken in parliament, and there were two hundred members who had never heard him. It was known that on this occasion he would be in his place, and curiosity was wound up to the highest point. Unfortunately, the shorthand writers were, in consequence of some mistake, shut out on that day from the gallery, so that the newspapers contained only a very meagre report of the proceedings. But several accounts of what passed are extant; and of those accounts the most interesting is contained in an unpublished letter written by a very young member, John William Ward, afterwards earl of Dudley. When Pitt rose he was received with loud cheering. At every pause in his speech there was a burst of applause. The peroration is said to have been one of the most animated and magnificent ever heard in parliament. "Pitt's speech," Fox wrote a few days later, "was admired very much, and very justly. I think it was the best he ever made in that style." The debate was adjourned; and on the second night Fox replied to it in an oration which, as the most zealous Pittites were forced to acknowledge, left the palm of eloquence doubtful. Addington made a pitiable appearance between the two great rivals; and it was observed that Pitt, while exhorting the Commons to stand resolutely by the executive government against France, said not a word indicating esteem or friendship for the prime minister.

War was speedily declared. The First Consul threatened to invade England at the head of the conquerors of Belgium and Italy, and formed a great camp near the Straits of Dover. On the other side of those straits the whole British population was ready to rise up as one man in defence of the soil. In the spring of 1804 it became evident that the weakest of ministries would have to defend itself against the strongest of Oppositions, an Opposition made up of three Oppositions, each of which would, separately, have been formidable from ability, and which, when united, were also formidable from number. It was necessary to give way; the ministry was dissolved, and the task of performing a government was entrusted (May 1804) to Pitt. Pitt was of opinion that there was now an opportunity, such as had never before offered itself, and such as might never offer itself again, of uniting in the public service, on honourable terms, all the eminent talents of the kingdom. The treasury he reserved for himself; and to Fox he proposed to assign a share of power little inferior to his own. The plan was excellent; but the king would not hear of it. Dull, obstinate, unforgiving, and at that time half mad, he positively refused to admit Fox into his service. In an evil hour Pitt yielded. All that was left was to construct a government out of the wreck of Addington's feeble administration. The small circle of Pitt's personal retainers furnished him with a very few useful assistants, particularly Dundas (who had been created Viscount Melville), Lord Harrowby and Canning.

Pitt's Second Administration.

Such was the inauspicious manner in which Pitt entered on his second administration (May 12, 1804). The whole history of that administration was of a piece with the commencement. Almost every month brought some new disaster or disgrace. To the war with France was soon added a war with Spain. The opponents of the ministry were numerous, able and active. His most useful coadjutors he soon lost. Sickness deprived him of the help of Lord Harrowby. It was discovered that Lord Melville had been guilty of highly culpable laxity in transactions relating to public money. He was censured by the House of Commons, driven from office, ejected from the privy council and impeached of high crimes and misdemeanours. The blow fell heavy on Pitt. His difficulties compelled him to resort to various expedients. At one time Addington was persuaded to accept office with a peerage; but he brought no additional strength to the government. While he remained in place he was jealous and punctilious; and he soon retired again. At another time Pitt renewed his efforts to overcome his master's aversion to Fox; and it was rumoured that the king's obstinacy was gradually giving way. But, meanwhile, it was impossible for the minister to conceal from the public eye the decay of his health and the constant anxiety which gnawed at his heart. All who passed him in the park, all who had interviews with him in Downing Street, saw misery written in his face. The peculiar look which he wore during the last months of his life was often pathetically described by Wilberforce, who used to call it the Austerlitz look.

Still the vigour of Pitt's intellectual faculties and the intrepid haughtiness of his spirit remained unaltered. He had staked everything on a great venture. He had succeeded in forming another mighty coalition against the French ascendancy. The united forces of Austria, Russia and England might, he hoped, oppose an insurmountable barrier to the ambition of the common enemy. But the genius and energy of Napoleon prevailed. While the English troops were preparing to embark for Germany, while the Russian troops were slowly coming up from Poland, he, with rapidity unprecedented in modern war, moved a hundred thousand men from the shores of the ocean to the Black Forest, and compelled a great Austrian army to surrender at Ulm. To the first faint rumours of this calamity Pitt would give no credit. He was irritated by the alarms of those around him. "Do not believe a word of it" he said; "it is all a fiction." The next day he received a Dutch newspaper containing the capitulation. He knew no Dutch. It was Sunday, and the public offices were shut. He carried the paper to Lord Malmesbury, who had been minister in Holland; and Lord Malmesbury translated it. Pitt tried to bear up, but the shock was too great; and he went away with death in his face.

The news of the battle of Trafalgar arrived four days later, and seemed for a moment to revive him. Forty-eight hours after that most glorious and most mournful of victories had been announced to the country came the Lord Mayor's Day; and Pitt dined at Guildhall. His popularity had declined. But on this occasion the multitude, greatly excited by the recent tidings, welcomed him enthusiastically, took off his horses in Cheapside, and drew his carriage up King Street. When his health was drunk, he returned thanks in two or three of those stately sentences of which he had a boundless command. Several of those who heard him laid up his words in their hearts; for they were the last words that he ever uttered in public: "Let us hope that England, having saved herself by her energy, may save Europe by her example."

This was but a momentary rally. Austerlitz soon completed what Ulm had begun. Early in December Pitt had retired to Bath, in the hope that he might there gather strength for the approaching session. While he was languishing there on his sofa arrived the news that a decisive battle had been fought and lost in Moravia, that the coalition was dissolved, that the Continent was at the feet of France. He sank down under the blow. Ten days later he was so emaciated that his most intimate friends hardly knew him. He came up from Bath by slow journeys, and on the 11th of January 1806 reached his villa at Putney. Parliament was to meet on the 21st. On the 20th was to be the parliamentary dinner at the house of the first lord of the treasury in Downing Street; and the cards were already issued. But the days of the great minister were numbered. On the day on which he was carried into his bedroom at Putney, the Marquess Wellesley, whom he had long loved, whom he had sent to govern India, and whose administration had been eminently able, energetic and successful, arrived in London after an absence of eight years. The friends saw each other once more. There was an affectionate meeting and a last parting. That it was a last parting Pitt did not seem to be aware. He fancied himself to be recovering, talked on various subjects cheerfully and with an unclouded mind, and pronounced a warm and discerning eulogium on the marquis's brother Arthur. "I never," he said, "met with any military man with whom it was so satisfactory to converse." The excitement and exertion of this interview were too much for the sick man. He fainted away; and Lord Wellesley left the house convinced that the close was fast approaching.

Death.

And now members of parliament were fast coming up to London. The chiefs of the Opposition met for the purpose of considering the course to be taken on the first day of the session. It was easy to guess what would be the language of the king's speech, and of the address which would be moved in answer to that speech. An amendment condemning the policy of the government had been prepared, and was to have been proposed in the House of Commons by Lord Henry Petty (afterwards 3rd marquess of Lansdowne). He was unwilling, however, to come forward as the accuser of one who was incapable of defending himself. Lord Grenville, who had been informed of Pitt's state by Lord Wellesley, and had been deeply affected by it, earnestly recommended forbearance; and Fox, with characteristic generosity and good nature, gave his voice against attacking his now helpless rival. "Sunt lacrymae rerum," he said, "et mentem mortalia tangunt." On the first day, therefore, there was no debate. It was rumoured that evening that Pitt was better. But on the following morning his physicians pronounced that there were no hopes. It was asserted in many after-dinner speeches, Grub Street elegies and academic prize poems and prize declamations that the great minister died exclaiming, "Oh my country!" This is a fable, but it is true that the last words which he uttered, while he knew what he said, were broken exclamations about the alarming state of public affairs. He ceased to breathe on the morning of the 23rd of January 1806, the twenty-fifth anniversary of the day on which he first took his seat in parliament.

It was moved in the House of Commons that Pitt should be honoured with a public funeral and a monument. The motion was opposed by Fox in a speech which deserves to be studied as a model of good taste and good feeling. The task was the most invidious that ever an orator undertook; but it was performed with a humanity and delicacy which were warmly acknowledged by the mourning friends of him who was gone. The motion was carried by 288 votes to 89. The 22nd of February was fixed for the funeral. The corpse, having lain in state during two days in the Painted Chamber, was borne with great pomp to the northern transept of the Abbey. A splendid train of princes, nobles, bishops and privy councillors followed. The grave of Pitt had been made near to the spot where his great father lay, near also to the spot where his great rival was soon to lie. Wilberforce, who carried the banner before the hearse, described the awful ceremony with deep feeling. As the coffin descended into the earth, he said, the eagle face of Chatham from above seemed to look down with consternation into the dark house which was receiving all that remained of so much power and glory.

Character.

Pitt was emphatically the man of parliamentary government, the type of his class, the minion, the child, the spoiled child, of the House of Commons. He was a distinguished member of the House of Commons at twenty-one. The ability which he had displayed in the House of Commons made him the most powerful subject in Europe before he was twenty-five. It was when the House of Commons was to be convinced and persuaded that he put forth all his powers. Of those powers we must form our estimate chiefly from tradition; for, of all the eminent speakers of that age, Pitt has suffered most from the reporters. Even while he was still living, critics remarked that his eloquence could not be preserved, that he must be heard to be appreciated. They more than once applied to him the sentence in which Tacitus describes the fate of a senator whose rhetoric was admired in the Augustan age: "Haterii canorum illud et profluens cum ipso simul exstinctum est." There is, however, abundant evidence that nature had bestowed on Pitt the talents of a great orator; and those talents had been developed in a very peculiar manner, first by his education, and secondly by the high official position to which he rose early, and in which he passed the greater part of his public life.

At his first appearance in parliament he showed himself superior to all his contemporaries in command of language. He could pour forth a long succession of round and stately periods, without premeditation, without ever pausing for a word, without ever repeating a word, in a voice of silver clearness, and with a pronunciation so articulate that not a letter was slurred over. He had less amplitude of mind and less richness of imagination than Burke, less ingenuity than Windham, less wit than Sheridan, less perfect mastery of dialectical fence and less of that highest sort of eloquence which consists of reason and passion fused together than Fox. Yet the almost unanimous judgment of those who were in the habit of listening to that remarkable race of men placed Pitt, as a speaker, above Burke, above Windham, above Sheridan and not below Fox. His declamation was copious, polished and splendid. In power of sarcasm he was probably not surpassed by any speaker, ancient or modern; and of this formidable weapon he made merciless use. In two parts of the oratorical art which are of the highest value to a minister of state he was singularly expert. No man knew better how to be luminous or how to be obscure. When he wished to be understood, he never failed to make himself understood. Nothing was out of place; nothing was forgotten; minute details, dates, sums of money, were all faithfully preserved in his memory. On the other hand, when he did not wish to be explicit—and no man who is at the head of affairs always wishes to be explicit—he had a marvellous power of saying nothing in language which left on his audience the impression that he had said a great deal.

The effect of oratory will always to a great extent depend on the character of the orator. There perhaps never were two speakers whose eloquence had more of what may be called the race, more of the flavour imparted by moral qualities, than Fox and Pitt. The speeches of Fox owe a great part of their charm to that warmth and softness of heart, that sympathy with human suffering, that admiration for everything great and beautiful, and that hatred of cruelty and injustice, which interest and delight us even in the most defective reports. No person, on the other hand, could hear Pitt without perceiving him to be a man of high, intrepid and commanding spirit, proudly conscious of his own rectitude and of his own intellectual superiority, incapable of the low vices of fear and envy, but too prone to feel and to show disdain. Pride, indeed, pervaded the whole man, was written in the harsh, rigid lines of his face, was marked by the way in which he walked, in which he sat, in which he stood, and above all, in which he bowed. Such pride, of course, inflicted many wounds. But his pride, though it made him bitterly disliked by individuals, inspired the great body of his followers in parliament and throughout the country with respect and confidence. It was that of the magnanimous man so finely described by Aristotle in the *Ethics*, of the man who thinks himself worthy of great things, being in truth worthy. It was closely connected, too, with an ambition which had no mixture of low cupidity. There was something noble in the cynical disdain with which the mighty minister scattered riches and titles to right and left among those who valued them, while he spurned them out of his way. Poor himself, he was surrounded by friends on whom he had bestowed three thousand, six thousand, ten thousand a year. Plain Mister himself, he had made more lords than any three ministers that had preceded him. The garter, for which the first dukes in the kingdom were contending, was repeatedly offered to him, and offered in vain.

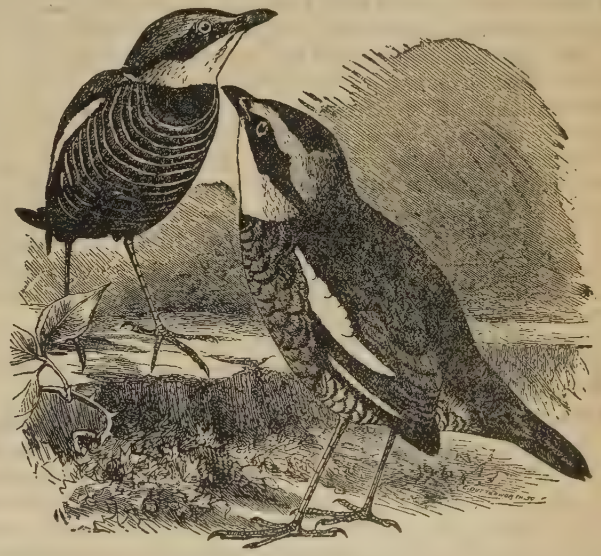
The correctness of his private life added much to the dignity of his public character. In the relations of son, brother, uncle, master, friend, his conduct was exemplary. In the small circle of his intimate associates he was amiable, affectionate, even playful. He indulged, indeed, somewhat too freely in wine, which he had early been directed to take as a medicine, and which use had made a necessary of life to him. But it was very seldom that any indication of undue excess could be detected in his tones or gestures; and, in truth, two bottles of port were little more to him than two dishes of tea. He had, when he was first introduced into the clubs of St James's Street, shown a strong sense for play; but he had the prudence and the resolution to stop before this taste had acquired the strength of habit. From the passion which generally exercises the most tyrannical dominion over the young he possessed an immunity, which is probably to be ascribed partly to his temperament and partly to his situation. His constitution was feeble; he was very shy; and he was very busy. The strictness of his morals furnished such buffoons as Peter Pindar and Captain Morris with an inexhaustible theme for merriment of no very delicate kind. But the great body of the middle class of Englishmen could not see the joke. They warmly praised the young statesman for commanding his passions, and for covering his frailties, if he had frailties, with decorous obscurity.

Estimates of Pitt.

The memory of Pitt has been assailed, times innumerable, often justly, often unjustly; but it has suffered much less from his assailants than from his eulogists. For, during many years, his name was the rallying cry of a class of men with whom, at one of those terrible conjunctures which confound all ordinary distinctions, he was accidentally and temporally connected, but to whom, on almost all great questions of principle, he was diametrically opposed. The haters of parliamentary reform called themselves Pittites, not choosing to remember that Pitt made three motions for parliamentary reform, and that, though he thought that such a reform could not safely be made while the passions excited by the French Revolution were raging, he never uttered a word indicating that he should not be prepared at a more convenient season to bring the question forward a fourth time. The toast of Protestant ascendancy was drunk on Pitt's birthday by a set of Pittites who could not but be aware that Pitt had resigned his office because he could not carry Catholic emancipation. The defenders of the Test Act called themselves Pittites, though they could not be ignorant that Pitt had laid before George III. unanswerable reasons for abolishing the Test Act. The enemies of free trade called themselves Pittites, though Pitt was far more deeply imbued with the doctrines of Adam Smith than either Fox or Grey. The very negro-drivers invoked the name of Pitt, whose eloquence was never more conspicuously displayed than when he spoke of the wrongs of the negro. This mythical Pitt, who resembles the genuine Pitt as little as the Charlemagne of Ariosto resembles the Charlemagne of Eginhard, has had his day. History will vindicate the real man from calumny disguised under the semblance of adulation, and will exhibit him as what he was—a minister of great talents, honest intentions and liberal opinions, pre-eminently qualified, intellectually and morally, for the part of a parliamentary leader, and capable of administering with prudence and moderation the government of a prosperous and tranquil country, but unequal to surprising and terrible emergencies, and liable in such emergencies to err grievously, both on the side of weakness and on the side of violence. (M.)

AUTHORITIES.—Lord Macaulay's article, a classic on its subject, written in 1859 for this *Encyclopaedia* and included in the 9th edition unaltered, is preserved above in its essentials, but has been shortened and readjusted. Among standard biographies are the 5th Earl Stanhope's important *Life* (4 vols., 2nd ed., 1862), and Lord Rosebery's masterly study in the "Twelve English Statesmen Series" (1891). See also the bibliographical note to the Rev. William Hunt's article on Pitt in the *Dict. Nat. Biog.*, and also the same historian's app. i., pp. 461–462, to his vol. x. (for the years 1760–1801) of *The Political History of England* (1905), dealing with the authorities for the period.

PITTA, in ornithology, from the Telugu *pitta*, meaning a small bird, latinized by Vieillot in 1816 (*Analyse*, p. 42) as the name of a genus, and since adopted by English ornithologists as the general name for a group of birds, called by the French *Brêves*, and remarkable for their great beauty.[1] For a long while the pittas were commonly supposed to be allied to the Turdidae, and some English writers applied to them the name of "water-thrushes" and "ant-thrushes," though there was no evidence of their having aquatic habits or predilections, or of their preying especially upon ants; but the fact that they formed a separate



Pitta elegans, male and female.

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[1] In ornithology the word is first found as part of the native name, "Ponnunky pitta," of a bird, given in 1713 by Petiver, in the "mantissa" to Ray's *Synopsis* (p. 195), on the authority of Buckley, (see ORNITHOLOGY). This bird is the *Pitta bengalensis* of modern ornithologists, and is said by Jerdon (*Birds of India*, i. 503) now to bear the Telugu name of *Pona-inki*.

family was gradually admitted. Their position was partly determined by A. H. Garrod, who, having obtained examples for dissection, in a communication to the Zoological Society of London, printed in its *Proceedings* for 1876, proved (pp. 512, 513) that the Pittidae belonged to that section of Passerine birds which he named Mesomyodi, since their syrinx, like that of the Tyrannidae (see King-Bird), has its muscles attached to the middle of its half-rings, instead of to their extremities as in the higher Passerines or Acromyodi. They are now placed as a separate family Pittidae of the Clamatores division of the Anisomyodine Passeres. There are about fifty species, divided into a number of genera, confined to the Old World, and ranging from India and North China to Australia, New Guinea and New Britain, with one species in West Africa, the greatest number being found in Borneo and Sumatra. Few birds can vie with the pittas in brightly-contrasted coloration. Deep velvety black, pure white and intensely vivid scarlet, turquoise-blue and beryl-green—mostly occupying a considerable extent of surface—are found in a great many of the species—to say nothing of other composite or intermediate hues; and, though in some a modification of these tints is observable, there is scarcely a trace of any blending of shade, each patch of colour standing out distinctly. This is perhaps the more remarkable as the feathers have hardly any lustre to heighten the effect produced, and in some species the brightest colours are exhibited by the plumage of the lower parts of the body. Pittas vary in size from that of a jay to that of a lark, and generally have a strong bill, a thick-set form, which is mounted on rather high legs with scutellated "tarsi," and a very short tail. In many of the forms there is little or no external difference between the sexes.

Placed originally among the Pittidae, but now created to form an allied family Philepittidae, is the genus Philepitta, consisting of two species peculiar to Madagascar. The two species which compose it have little outward resemblance to the pittas, not having the same style of coloration and being apparently of more arboreal habits. The sexes differ greatly in plumage, and the males have the skin round the eyes bare of feathers and carunculated. (A. N.)

PITTACUS, of Mytilene in Lesbos (*c.* 650–570 B.C.), one of the Seven Sages of Greece. About 611, with the assistance of the brothers of the poet Alcaeus, he overthrew Melanchrus, tyrant of Lesbos. In a war (606) between the Mytilenaeans and Athenians for the possession of Sigeum on the Hellespont he slew the Athenian commander Phrynon in single combat. In 589 his fellow citizens entrusted Pittacus with despotic power (with the title of Aesymnetes) for the purpose of protecting them against the exiled nobles, at the head of whom were Alcaeus and his brother Antimenides. He resigned the government after holding it for ten years, and died ten years later. According to Diogenes Laërtius, who credits him with an undoubtedly spurious letter to Croesus (with whom his connexion was probably legendary), Pittacus was a writer of elegiac poems, from which he quotes five lines. His favourite sayings were: "It is hard to be good," and "Know when to act."

See Herodotus v. 27, 94; Diog. Laërt. i. 4; Lucian, *Macrobii*, 18; Strabo xiii. 600, 617–618; Aristotle, *Politics*, ii. 12, iii. 14; T. Bergk, *Poetae lyrici graeci*.

PITTANCE (through O. Fr. *pitance*, from Lat. *pietas*, loving-kindness), properly a gift to the members of a religious house for masses, consisting usually of an extra allowance of food or wine on occasions such as the anniversary of the donor's death, festivals and the like. The word was early transferred to a charitable donation and to any small gift of food or money.

PITT-RIVERS, AUGUSTUS HENRY LANE-FOX (1827–1900), English soldier and archaeologist, son of W. A. Lane-Fox, was born on the 14th of April 1827. It was not till 1880 that he assumed the name of Pitt-Rivers, on inheriting the Dorsetshire and Wiltshire estates of his great-uncle, the second Lord Rivers. Educated at Sandhurst, he received a commission in the Grenadier Guards in 1845, being captain 1850, lieutenant-colonel 1857, colonel 1867, major-general 1877 and lieutenant-general 1882. He served in the Crimean War, and was at the Alma and the siege of Sebastopol. His talent for experimental research was utilized in investigation into improvements of the army rifle, and he was largely responsible for starting the Hythe School of Musketry. It is not, however, for his military career, but for his work as an anthropologist and archaeologist, that General Pitt-Rivers will be remembered. His interest in the evolution of the rifle early extended itself to other weapons and instruments in the history of man, and he became a collector of articles illustrating the development of human invention. His collection became famous, and, after being exhibited in 1874–1875 at the Bethnal Green Museum, was presented in 1883 to the university of Oxford. When, in 1880, General Pitt-Rivers obtained possession of his great-uncle's estates—practically untouched by the excavator since they had been the battleground of the West Saxons, the Romans and the Britons—he devoted himself to exploring them. His excavations round Rushmore resulted in valuable "finds"; he founded a local museum and published several illustrated volumes. As a scientific archaeologist he attained high rank. Oxford gave him the D.C.L. in 1886; he was president of the Anthropological Institute, and F.R.S. He married, in 1853, Alice Margaret, daughter of the second Lord Stanley of Alderley, and had a numerous family; his second daughter became in 1884 the wife of Sir John Lubbock (Lord Avebury). General Pitt-Rivers died at Rushmore on the 4th of May 1900.

PITTSBURG, a city of Crawford county, Kansas, U.S.A., about 130 m. S. of Kansas City. Pop. (1880), 624; (1890), 6697; (1900) 10,112, of whom 860 were foreign-born; (1910 census), 14,755. It is situated at the intersection of four great railway systems—the Atchison Topeka & Santa Fé, the St Louis & San Francisco, the Kansas City Southern (which maintains shops here), and the Missouri Pacific, and is served by inter-urban electric railways. The city is the seat of the State Manual Training Normal School (1903) and of the Pittsburg Business College. Pittsburg is situated near the lead and zinc region of south-east Kansas and south-west Missouri, is in the midst of a large and rich bituminous coalfield, and lies near natural gas and oil fields. Among the manufactures are zinc spelter—there are large smelters here—clay products (chiefly vitrified brick, sewer pipe and tile; the clay being obtained from a great underlying bed of shale), blasting powder, packing-house products and planing-mill products. The total value of the city's factory products in 1905 was $1,824,929. Pittsburg was settled about 1879, was chartered as a city in 1880, and became a city of the first class in 1908.

PITTSBURG, or Pittsburgh,[1] the second largest city of Pennsylvania, U.S.A., and the county-seat of Allegheny county, on the Allegheny, Monongahela and Ohio rivers, 440 m. by rail W. by S. of New York City, 360 m. W. by N. of Philadelphia, 368 m. N.W. of Washington and 468 m. E. by S. of Chicago. Pop. (1890), 238,617;[2] (1900), 321,616, of whom 84,878 were foreign-born, 17,040 were negroes and 154 were Chinese; (1910 census, after the annexation of Allegheny), 533,905. Of the 84,878 foreign-born in 1900, 21,222 were natives of Germany, 18,620 of Ireland, 8902 of England, 6243 of Russian Poland, 5709 of Italy, 4107 of Russia, 3553 of Austria, 3515 of German Poland, 2539 of Wales, 2264 of Scotland, 2124 of Hungary, 1072 of Sweden and 1023 of Austrian Poland. Area (including Allegheny, annexed in 1906), 40·67 sq. m. Pittsburg is served by the Pennsylvania (several divisions), the Baltimore & Ohio, the Pittsburg & Lake Erie (controlled by the New York Central System), the Pittsburg, Cincinnati, Chicago & St Louis (controlled by the Pennsylvania Company), the Pittsburg, Chartiers & Youghiogheny (controlled jointly by the two preceding railways; 21 m. of track), the Buffalo, Rochester & Pittsburg, and the Wabash-Pittsburg Terminal (60 m. to Pittsburg Junction, Ohio; controlled by the Wabash railway), and the Pittsburg Terminal (also controlled by the Wabash and operating the

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[1] "Pittsburgh" is the official spelling of the charter and seal; but "Pittsburg" is the spelling adopted by the U.S. Geographic Board and is in more general use.

[2] In previous census years the population was as follows: (1800), 1565; (1820), 7248; (1840), 21,115; (1860), 49,221; (1880), 156,389.

West Side Belt, from Pittsburg to Clairton, 21 m.) railways, and by river boats on the Ohio, Monongahela and Allegheny.

Picturesque rolling plateaus, the three rivers and narrow valleys, from which rise high hills or precipitous bluffs, are the principal natural features of the district over which the city extends. Retail houses, wholesale houses, banks, tall office buildings, hotels, theatres and railway terminals are crowded into the angle, or "The Point," formed at the confluence of the Allegheny and Monongahela rivers, with Fifth Avenue as the principal thoroughfare, especially for the retail houses, and Fourth Avenue as the great banking thoroughfare. Factories extend for miles along the banks of all three rivers into the tributary valleys, and are the cause of Pittsburg's nickname, "The Smoky City." The more attractive residential districts are on the plateau in the eastern portion of the district between the Allegheny and Monongahela rivers and on the hills overlooking the Allegheny river from the north. Overlooking the Monongahela river is Schenley Park (about 422 acres), the first city park, of which about 400 acres were given to the city in 1890 by Mrs. Mary E. Schenley. About 2 m. to the north, overlooking the Allegheny river, is Highland Park (about 366 acres), which contains the city reservoirs and a picturesque lake. Adjacent to Schenley Park are Homewood and Calvary cemeteries; and adjacent to Highland Park is Allegheny cemetery. Across the Allegheny river, in the Allegheny district, are the beautiful Riverview Park (240 acres), in which is the Allegheny Observatory, and West Park (about 100 acres). A number of bridges span the rivers.

The city has some fine public buildings, office buildings and churches. The Allegheny county court-house (1884–1888) is one of H. H. Richardson's masterpieces. The Nixon theatre is also notable architecturally. The high Frick Office building has exterior walls of white granite; in its main hall is a stained-glass window by John La Farge representing Fortune and her wheel. A large government building of polished granite contains the post office and the customs offices. St Paul's Cathedral (Roman Catholic, 1903–1906) is largely of Indiana limestone. The city is the see of a Roman Catholic and a Protestant Episcopal bishop. In Schenley Park is the Carnegie Institute (established by a gift of $10,000,000 from Andrew Carnegie, who made further contributions of $9,000,000 for its maintenance), with a main building containing a library, a department of fine arts, a museum (see MUSEUMS OF SCIENCE) and a music hall, and several separate buildings for the technical schools, which had 2102 students in 1909. The main building, dedicated in April 1907, is 660 ft. long and 400 ft. wide; in its great entrance hall is a series of mural decorations by John White Alexander, a native of the city. The library, in which the institution had its beginning in 1895, contains about 306,000 volumes. The Phipps Conservatory was presented to the city in 1893 by Henry Phipps (b. 1839), a steel manufacturer associated with Andrew Carnegie. It is the largest in America, and, with its Hall of Botany, which is utilized in instructing school children in botany, is situated in Schenley Park. The conservatory is maintained by municipal appropriations. There is a zoological garden in Highland Park. In December 1907 it was decided that the several departments of the Western University of Pennsylvania, then in different parts of the city, should be brought together on a new campus of 43 acres near the Carnegie Institute. In July 1908 the name was changed to "The University of Pittsburgh." The university embraces a college and engineering school, the Western Pennsylvania School of Mines and Mining Engineering, a graduate department, an evening school of economics, accounts and finances, a summer school, evening classes, Saturday clasess, and departments of astronomy (the Allegheny Observatory, in the Allegheny district), law (the Pittsburg Law School), medicine (the Western Pennsylvania Medical College), pharmacy (the Pittsburgh College of Pharmacy) and dentistry (the Pittsburgh Dental College). The institution had its beginning in the Pittsburgh Academy, which was opened about 1770 and was incorporated in 1787. It was incorporated as the Western University of Pennsylvania in 1819, but was only a college from that date until 1892, when the Western Pennsylvania Medical College became its department of medicine. In 1895 the department of law was added, the Pittsburgh College of Pharmacy was united to the university, and women were for the first time admitted. In 1896 the department of dentistry was established. In 1909 the university had 151 instructors and 1243 students. In the east end is the Pennsylvania College for Women (Presbyterian; chartered in 1869), with preparatory, collegiate and musical departments. In the Allegheny district are the Allegheny Theological Seminary (United Presbyterian, 1825), the Western Theological Seminary (Presbyterian, opened 1827), and the Reformed Presbyterian Theological Seminary (1856). Although Allegheny is now a part of Pittsburg, the two public school systems remain independent. The Pittsburg High School (five buildings in 1910) has a normal course; and there are various private schools and academies.

The Pittsburg *Gazette-Times* is probably the oldest newspaper west of the Alleghany Mountains; the *Gazette* was founded in 1786 and in 1906 was consolidated with the *Times* (1879). Other prominent newspapers of the city are the *Dispatch* (1846), the *Chronicle Telegraph* (1841), the *Post* (1792; daily, 1842), which is one of the few influential Democratic newspapers in Pennsylvania, the *Leader* (Sunday, 1864; daily, 1870) and the *Press* (1883). Two German dailies, one Slavonic daily, one Slavonic weekly, two Italian weeklies, and iron, building, coal and glass trade journals are published in the city. In Pittsburg is the publishing house of the United Presbyterian Church, and *The Christian Advocate* (weekly, Methodist Episcopal, 1834) is published here under the auspices of the general conference.

The oldest hospital is the Reineman (private; 1803) for maternity cases; the municipal hospital (1878) is for contagious diseases; the Sisters of Charity, the Sisters of Mercy, the Institution of Protestant Deaconesses, the Presbyterian Church and the United Presbyterian Woman's Association each have charge of a hospital; and there is also an eye, ear and throat hospital (1895). The Western Pennsylvania Institution for the instruction of the deaf and dumb (1876), in Edgewood Park, is in part maintained by the state. And the state assists the Home for Aged and Infirm Colored Women (1882), and the Home for Colored Children (1881). Among other charitable institutions are the Curtis Home (1894) for destitute women and girls, the Bethesda Home (1890) for homeless girls and their children, the Florence Crittenton Home (1893) for homeless and unfortunate women, the Roselia Foundling Asylum and Maternity Hospital (1891), the Protestant Home for Incurables (1883), the Pittsburg Newsboys' Home (1894), the Children's Aid Society of Western Pennsylvania, the Pittsburg Association for the Improvement of the Poor and the Western Pennsylvania Humane Society.

Pittsburg is in the midst of the most productive coalfields in the country; the region is also rich in petroleum and natural gas. The city is on one of the main lines of communication between the east and the west, is the centre of a vast railway system, and has freight yards with a total capacity for more than 60,000 cars. Its harbour has a total length on the three rivers of 27·2 m., and an average width of about 1000 ft., and has been deepened by the construction (in 1877–1885) of the Davis Island dam, by dredging, under a federal project of 1899. Slack water navigation has been secured on the Allegheny by locks and dams (1890 and 1896 sqq.) at an expense up to July 1909 of $1,658,804; and up to that time $263,625 had been spent for open-channel work. The Monongahela from Pittsburg to the West Virginia state line (91·5 m.) was improved in 1836 sqq. by a private company which built seven locks and dams; this property was condemned and bought for $3,761,615 by the United States government in 1897, and, under the project of 1899 for rebuilding three of the locks and enlarging another, and that of 1907 for a new lock and dam and for other improvements, $2,675,692 was spent up to July 1909. Coal is brought to the city from the coalfields by boats on the Allegheny and Monongahela rivers as well as by rail, and great fleets of barges carry coal and other heavy freight, such as steel rails, cotton ties, sheet iron, wire and nails, down the Ohio in the winter and spring. A ship canal to provide water communication between Pittsburg and Lake Erie has been projected. The railways have a heavy tonnage of coal, coke and iron and steel products, and a large portion of the iron ore that is produced in the Lake Superior region is brought to Pittsburg. In 1908 the river traffic amounted to 9,090,146 tons, most of which was carried on barges down the Ohio. Pittsburg is also a port of entry; in 1907 the value of its imports amounted to $2,416,367, and in 1909 to $2,062,162.

The value of the factory products in 1905 was $165,428,881, and to this may be added $45,830,272 for those of the city of Allegheny, making a total of $211,259,153. In the manufacture of iron and steel products Pittsburg ranks first among the cities of the United States, the value of these products amounting in 1905 to $88,250,805 or 53·3% of the total for all manufactures; if the manufactures of Allegheny be added they amounted to $92,939,860 or 43·7%. Several neighbouring cities and towns are also extensively engaged in the same industry, and in 1902 Allegheny county produced about 24% of the pig-iron, nearly 34% of the Bessemer steel, more than 44% of the open-hearth steel, more than 53% of the crucible steel, more then 24% of the steel rails, and more than 59% of the structural shapes that were made in that year in the United States. In 1905 the value of Pittsburg's foundry and machine shop-products was $9,631,514; of the product of steam railway repair shops, $3,726,990 (being 424·8% more than in 1900); of malt liquors, $3,166,829; of slaughtering and meat-packing products, $2,732,027; of cigars and cigarettes, $2,297,228; of glass, $2,130,540; and of tin and terne plate, $1,645,570. Electrical machinery, apparatus and supplies were manufactured largely in the city (value in 1905, $1,796,557), and there was another large plant for their manufacture immediately outside of the city limits. Coke, cut cork, rolled brass and copper were other important products in 1905. In 1900, and for a long period preceding, Pittsburg ranked first among American cities in the manufacture of glass, but in 1905 it was outranked in this industry by Muncie, Indiana, Millville, New Jersey, and Washington, Pennsylvania; but in the district outside of the city limits of Pittsburg much glass is manufactured, so that the Pittsburg glass district is the greatest in the country, and there are large glass factories at Washington (18 m. south-west), Charleroi (20 m. south) and Tarentum (15 m. north-east). In Pittsburg or the immediate vicinity are the more important plants of the United States Steel Corporation, including that of the Carnegie Company. Here, too, are the plants of the Westinghouse Company for the manufacture of electrical apparatus, of air brakes invented by George Westinghouse (born 1846), and of devices for railway signals which he also invented. In the Allegheny district the H. J. Heinz Company has its main pickle plant, the largest establishment of the kind in the country.

The Pittsburg charter of 1816 vested the more important powers of the city government in a common council of 15 members and a select council of 9 members, and until 1834 the mayor was appointed annually by these city councils from their own number. By the Wallace Act of the state legislature in 1874 a form of government was provided for cities of three classes, and Pittsburg became a city of the second class (population between 100,000 and 300,000); under the act of 1895 a new classification was made, under which Pittsburg remains in the second class. An act of 1887 had amended the provisions of the Wallace Act in regard to second class cities by changing the terms of select councilmen from two to four years and of common councilmen from one to two years. In 1901 a new act was passed for the government of cities of the second class. It provided that the executive be a "city recorder"; this provision was repealed in 1903, when the title of mayor again came into use. The mayor holds office for three years, has the powers and jurisdiction of a justice of the peace, appoints the heads of departments (public safety, public works, collector of delinquent taxes, assessors, city treasurer, law, charities and correction, and sinking fund commission), and may remove any of the officers he has appointed, by a written order, showing cause, to the select council. The city controller is elected by popular vote. The legislative bodies are the select and common council, elected under the law of 1887; by a three-fifths vote it may pass resolutions or ordinances over the mayor's veto. The department of public safety controls the bureaus of police, detectives, fire, health, electricity and building inspection; the department of public works controls bureaus of surveys, construction, highways and sewers, city property, water, assessment of water rents, parks, deed registry, bridges and light. In 1909 the taxable valuation was $100,771,321, and the tax rate was 13·8 mills for city property, 9·2 mills on rural property and 6·9 mills on agricultural property. The tax rate for separate indebtedness varied from 6 mills in Allegheny to 16·2 mills in the 43rd ward. The water-supply of Pittsburg is taken from the Allegheny river and pumped into reservoirs, the highest of which, in Highland Park, is 367 ft. above the river; and there is a slow sand filtration plant for the filtration of the entire supply.

Pittsburg owed its origin to the strategic value of its site in the struggle between the English and the French for the possession of the North American continent. A few Frenchmen attempted to establish a settlement here in 1731, but were soon driven away by the Indians. In 1753, after the French had laid formal claim to this region and the Ohio Land Company had been formed with a view to establishing a settlement within it, Robert Dinwiddie, governor of Virginia and a shareholder in the Ohio Company, sent George Washington with a letter to "the commandant of the French forces on the Ohio" (then stationed at Fort Le Bœuf, near the present Waterford, about 115 m. north of the head-waters of that river) asking him to account for his invasion of territory claimed by the English. This was Washington's first important public service. He reached the present site of Pittsburg on the 24th of November 1753, and subsequently reported[1] that what is now called "The Point," *i.e.* the tongue of land formed by the confluence of the Monongahela and Allegheny rivers, was a much more favourable situation for a fort and trading post than the one about two miles up the Monongahela (near the present site of McKees Rocks) which had been tentatively selected by the Ohio Company. Accordingly, on the 17th of February 1754, a detachment of about 40 soldiers, under the command of Captain William Trent,[2] reached "The Point," and began to build a fortification (under the auspices of the Ohio Company), which it seems to have been the intention to call Fort Trent, and which was the beginning of the permanent settlement here by whites. On the 17th of the following April, however, Ensign Edward Ward, commanding the soldiers, in the absence of Captain Trent, was forced to evacuate the unfinished fortification by a party of about 1000 French and Indians, under Captain Contrecœur, who immediately occupied the works, which he enlarged and completed, and named Fort Duquesne, in honour of Duquesne de Menneville, governor of New France in 1752–1755. In the following summer Washington attempted to recover this fort, in a campaign which included the skirmish

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[1] His *Journal*, published in 1754, gives a concise and lucid account of this expedition.

[2] William Trent (*c.* 1715–1778) was a native of Lancaster county, Pennsylvania, became a captain in the state militia in 1746 and served against the French and Indians, was for many years, after 1749, a justice of the court of common pleas and general sessions of the peace for Cumberland county, Pennsylvania, and in 1750–1756 was the partner of George Crogan in an extensive trade with the Indians. According to one account, he visited the site of Pittsburg, and examined its availability for fortification, in August 1753—before the arrival of Washington. In 1755 he became a member of the council of Lieut.-Governor Robert H. Morris, and in 1758 he accompanied General Forbes's expedition against Fort Duquesne. He acted many times as Indian agent; his lucrative trade with the Indians, conducted from a trading house near Fort Pitt, was ruined during Pontiac's conspiracy. At the beginning of the War of Independence he was given a major's commission to raise troops in Western Pennsylvania. See *Journal of Captain William Trent* (Cincinnati, Ohio, 1871), edited by Alfred T. Goodman.

(commonly considered the beginning of the French and Indian—Seven Years'—War) on the 28th of May 1754, at Great Meadows (in what is now Wharton township, Fayette county, Pennsylvania, about 50 m. south-east of Pittsburg), between a detachment under his command and a scouting party under N. Coulon de Jumonville, in which Jumonville and several of his men were killed; the building, at Great Meadows, by Washington, of Fort Necessity, and its capitulation (July 3); and the retreat of Washington to Virginia. Another expedition, led by Major-General Edward Braddock, resulted in the engagement known as "Braddock's Defeat" (July 9, 1755), fought within the present borough of Braddock (about 8 m. east of Fort Duquesne), in which Braddock's force was practically annihilated, and Braddock was mortally wounded, dying four days later. The fort was finally recaptured by the English in 1758, as the result of an elaborate expedition (involving about 7000 troops) planned by Brigadier-General John Forbes (1710–1759), and prosecuted, with the assistance of Colonel George Washington and Colonel Henry Bouquet, in the face of great difficulties. General Forbes himself was so ill that he had to be carried in a litter throughout the campaign. The troops having rendezvoused during the summer (of 1758) at Ray's Town (now Bedford, Pennsylvania), and at Loyalhanna creek (now in Westmoreland county), about 50 m. to the north-west (where Fort Ligonier was built), Colonel Bouquet, commanding the division at the latter place, despatched Major James Grant (1720–1806) at the head of about 850 men to reconnoitre the fort. Grant advanced to a hill (still known by his name, and upon the crest of which the court-house now stands) within about a quarter of a mile of the fort. Here he rashly divided his force, and in a sortie of French and Indians, on the morning of the 14th of September, one of his divisions was surrounded, and a general rout ensued in which about 270 of Grant's men were killed, about 40 were wounded, and others (including Grant) were taken prisoners. Forbes's army advanced to within about 15 m. of the fort on the 24th of November, whereupon the French blew up part of the works, set fire to the buildings and retreated down the Ohio in boats. The English occupied the place on the next day and General Forbes ordered the immediate erection of a stockade fort near the site of the old one. In reporting to Lieut.-Governor William Denny (Nov. 26) the success of the expedition he dated his letter from Fort Duquesne "or now Pitts-Bourgh," and this name, with its subsequent modification "Pittsburgh," was thereafter more commonly used than that of Fort Pitt, which, as designating the fortification proper appears to have been first applied by General John Stanwix to the enlarged fort built (at a cost, it was estimated, of £60,000) chiefly under his direction during 1759–1760.

The first considerable settlement around the fort sprang up in 1760; it was composed of two groups of houses and cabins, the "lower town," near the fort's ramparts; and the "upper town," built chiefly along the banks of the Monongahela, and extending as far as the present Market Street. In April 1761, according to a census of the settlement, outside of the fort, taken for Colonel Bouquet, there were 332 inhabitants and 104 houses.

Fort Pitt was one of the important objective points of Pontiac's conspiracy (1763), and as soon as the intentions of the Indians became evident, Captain Simeon Ecuyer, the Swiss officer in command of the garrison (which then numbered about 330), had the houses outside the ramparts levelled and prepared for a siege. The Indians attacked the fort on the 22nd of June (1763), and kept up a continuous, though ineffective, fire upon it from the 27th of July until the 1st of August, when they drew off and advanced to meet the relieving party under Colonel Bouquet. They were defeated at Bushy Run, and Colonel Bouquet relieved the fort on the 10th of August (see PONTIAC). In 1764 Colonel Bouquet added to the fort a redoubt, the "Block House," which still stands, the sole remaining trace of Fort Pitt, and is owned and cared for by the Daughters of the American Revolution.

A second town, laid out in 1764, by Colonel John Campbell (with the permission of the commandant at Fort Pitt), is bounded in the present city by Water Street, Market Street, Second Avenue and Ferry Street, and comprises four blocks. In November 1768, at a general council of the Six Nations with Sir William Johnson and representatives of Pennsylvania and Virginia, held at Fort Stanwix, on the site of the present Rome, New York (*q.v.*), at which was signed a treaty establishing the boundary line between the English possessions and the territory claimed by the Six Nations, the Indians sold for $10,000 to Thomas Penn (1702–1775) and Richard Penn (1706–1771), respectively, the second and third sons of William Penn—the founder of Pennsylvania—by his second wife, the remaining land in the province of Pennsylvania to which they claimed title, namely the tract lying south of the west branch of the Susquehanna river and of a straight line from the north-west corner of what is now Cambria county to the present Kittanning (in Armstrong county), and all of the territory east of the Allegheny river below Kittanning and south of the Ohio river. To this transaction the commissioner from Virginia seems to have made no objection, though the tract included the Fort Pitt region and other territory then claimed by Virginia. In January-March 1769 the Penns caused to be surveyed the "Manor of Pittsburgh," a tract of about 5700 acres, including much of the original city, intending to reserve it for their private use; but in the following April they offered at public sale the lands in the remainder of their purchase of the preceding year.[1] At this time the settlement about Fort Pitt consisted of about twenty houses, occupied chiefly by Indian traders. By order of General Thomas Gage the fort was abandoned as a military post in October 1772, and was partly dismantled. In January 1774 it was occupied by an armed force under Dr John Connolly, a partisan of Lord Dunmore, governor of Virginia, and by him was named Fort Dunmore (which name, however, was never formally recognized), this being one of Dunmore's overt acts ostensibly in support of his contention that the Fort Pitt region was included in Augusta county, Virginia. In the following April Connolly took forcible possession of the court-house at Hanna's Town (near the present Greensburg), the county-seat of Westmoreland county (which then included the Fort Pitt region), a few days afterwards arrested the three justices who lived in Pittsburg, and for the remainder of the year terrorized the settlement. Lord Dunmore himself issued a proclamation dated "Fort Dunmore," 17th September (1774), in which he called upon the inhabitants to ignore the authority of Pennsylvania, and to recognize only that of Virginia. A year afterwards Fort Pitt was occupied by a company of Virginia soldiers by order of the Virginia Provincial Convention (assembled at Williamsburg in August 1775), but this move apparently was more for the defence of the frontier in the coming war than an expression on the Pennsylvania-Virginia boundary dispute; and, in November, Connolly was arrested at Fredericksburg, Maryland, on the charge of furthering Dunmore's plans for invading the western frontier. The boundary itself was in controversy until 1780, and the marking of the boundary lines was not completed until 1785. During the War of Independence the fort was maintained as a frontier Indian post, and as a protection against the British at Detroit. Soon after the close of the war it was neglected, and by 1791 it was in bad repair; therefore at the time of the Indian hostilities of 1792 another stockade fort was built near the bank of the Allegheny river and about a quarter of a mile above the site of Fort Pitt, this new fort being named Fort Lafayette, or, as it was more commonly called, Fort Fayette. After General Anthony Wayne's defeat of the Indians, at Fallen Timbers, Ohio (Aug. 20, 1794), Pittsburg lost its importance as a frontier post.

In January 1784 the sale of the land included in the "Manor of Pittsburgh" was begun by the grandsons of William Penn, John Penn (1729–1795), the second son of Richard Penn and lieutenant-governor of Pennsylvania in 1763–1771 and in 1773–1776; and John Penn (1760–1834), the fourth son of Thomas Penn; and in the following June a new series of town lots was laid out in which was incorporated Colonel Campbell's survey. Thereafter, settlers, chiefly Scotch and Irish, came rapidly.

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[1] This tract was confiscated by Pennsylvania in 1779.

Pittsburg and its vicinity witnessed much of the disorder, and some of the violence against person and property, incident to the Whisky Insurrection of 1791–94. Delegates from Allegheny, Westmoreland, Washington and Fayette counties met here on the 7th of September 1791, and passed resolutions severely denouncing the excise tax; and a similarly constituted gathering, on the 24th of August 1792, voted to proscribe all persons who assisted in the enforcement of laws taxing the manufacture of liquor. Thereafter various persons who had paid the excise tax, or had assisted in collecting it, were tarred and feathered or had their houses or barns burned. General John Neville (1731–1803), having accepted the office of chief excise inspector for Western Pennsylvania, his fine country residence, about 7 m. south-west of Pittsburg, was attacked by a mob of about 500 men on the 16th and 17th of July 1794. The defenders of the property (who included a squad of soldiers from the garrison at Pittsburg) killed two and wounded several of the attacking party, but they were finally forced to surrender, and General Neville's mansion and other buildings were burned to the ground. A mass meeting of about 5000 citizens of the above-mentioned counties (many of them armed militiamen), at Braddock's Field, on the 1st and 2nd of August 1794, threatened to take possession of Fort Lafayette and to burn Pittsburg, but cooler counsel prevailed, and after voting to proscribe several persons, and marching in a body through the streets of the town, the crowd dispersed without doing any damage. Upon the arrival in the following November of the troops sent by President Washington, a military court of inquiry, held at Pittsburg, caused the arrest of several persons, who were sent to Philadelphia for trial, where some of them were found guilty and sentenced to terms of imprisonment, but the sentences were not enforced.

The town was made the county-seat in 1791, it was incorporated as a borough in 1794, the charter was revived in 1804, and the borough was chartered as a city in 1816. As early as the year of its incorporation as a borough Philadelphia and Baltimore merchants had established an important trade with it. Their goods were carried in Conestoga wagons to Shippensburg and Chambersburg, Pennsylvania, and Hagerstown, Maryland, taken from there to Pittsburg on pack horses, and exchanged for Pittsburg products; these products were carried by boat to New Orleans, where they were exchanged for sugar, molasses, &c., and these were carried through the gulf and along the coast to Baltimore and Philadelphia. Boat-building was begun in Pittsburg in 1797 or earlier; the galley "President Adams," built by the government, was launched here in 1798, and the "Senator Ross," completed in the same year, was launched in 1799. In 1797 glassworks which were the first to use coal as a fuel in making glass were built here; later Pittsburg profited greatly by the use of its great store of natural gas in the manufacture of glass. In 1806 the manufacture of iron was well begun, and by 1825 this had become the leading industry. On the 10th of April 1845 a considerable portion of the city was swept by fire, and in July 1877, during the great railway strike of that year, a large amount of property was destroyed by a mob. The commercial importance of the city was increased by the canal from Pittsburg to Philadelphia, built by the state in 1834 at a cost of $10,000,000. The first petroleum pipe line reached Pittsburg in 1875. A movement to consolidate the cities of Pittsburg and Allegheny, together with some adjacent boroughs, was begun in 1853–1854. It failed entirely in that year but in 1867 Lawrenceville, Peebles, Collins, Liberty, Pitt and Oakland, all lying between the two rivers, were annexed to Pittsburg; in 1872 there was a further annexation of a district embracing 27 sq. m. south of the Monongahela river; in 1906 Allegheny (*q.v.*), although a large majority of those voting on the question in that city were opposed to it, was annexed, and in November 1907 the Supreme Court of the United States declared valid the act of the state legislature under which the vote was taken.

See N. B. Craig, *The History of Pittsburgh* (Pittsburg, 1851); *Early History of Western Pennsylvania and the West*, by a gentleman of the bar—J. D. Rupp (Pittsburg, 1848); William H. Egle, *Illustrated History of the Commonwealth of Pennsylvania* (Harrisburg, Pa., 1876); Sarah H. Killikelly, *The History of Pittsburgh, Its Rise and Progress* (Pittsburg, 1906); S. H. Church, "Pittsburgh the Industrial City," in L. P. Powell's *Historic Towns of the Middle States* (New York, 1899); G. H. Thurston, *Pittsburgh and Allegheny in the Centennial Year* (Pittsburg, 1876); for a history of the various forts as such, *Report of the Commission to Locate the Frontier Forts of Pennsylvania*, vol. ii. (Harrisburg, Pa., 1896); and for a thorough study of economic and social conditions in Pittsburg, P. U. Kellogg (ed.), *The Pittsburg Survey* (6 vols., New York, 1910 sqq.), prepared under the direction of the Sage Foundation.

PITTSFIELD, a city and the county-seat of Berkshire county, Massachusetts, U.S.A., in the western part of the state among the Berkshire Hills, and about 150 m. W. of Boston. Pop. (1890), 17,281; (1900), 21,766, of whom 4344 were foreign-born; (1910 census), 32,121. Area, about 41 sq. m. It is served by the New York, New Haven & Hartford and the Boston & Albany (New York Central & Hudson River) railways, and by two inter-urban electric lines. Pittsfield is a popular summer resort; it lies in a plain about 1000 ft. above sea-level, is surrounded by the picturesque Berkshire Hills, and is situated in a region of numerous lakes, one of the largest—Lake Pontoosuc—being a summer pleasure resort. On either side of the city flow the east and west branches of the Housatonic river. Standing in the public green, in the centre of the city, is the original statue (by Launt Thompson) of the "Massachusetts Color Bearer," which has been reproduced on the battlefield of Gettysburg, Pennsylvania. The principal institutions are the House of Mercy Hospital, with which is connected the Henry W. Bishop Memorial Training School for nurses, the Berkshire Home for aged women, the Berkshire Athenaeum, containing the public library, the Crane Art Museum and a Young Men's Christian Association. Prominent buildings are St Joseph's Cathedral and the buildings of the Berkshire Life Insurance Company, the Agricultural National Bank and the Berkshire County Savings Bank. In the south-western part of Pittsfield, on the boundary between it and Hancock, is Shaker Village, settled about 1790 by Shakers. Pittsfield has water-power and important manufacturing industries. In 1905 its factory products were valued at $8,577,358, or 49·1% more than in 1900. Fully half of the manufactures consist of textile goods.

The first settlement in what is now Pittsfield was made in 1743, but was soon abandoned on account of Indian troubles. In 1749 the settlement was revived, but the settlers did not bring their families to the frontier until 1752. The settlement was first called "Boston Plantation," or "Poontoosuck," but in 1761, when it was incorporated as a township, the name was changed to Pittsfield, in honour of the elder William Pitt. In 1891 Pittsfield was chartered as a city. It was here, in the Appleton (or Plunkett) House, known as "Elm Knoll," and built by Thomas Gold, father-in-law of Nathan Appleton, that in 1845 Henry W. Longfellow (who married Nathan Appleton's daughter) wrote his poem "The Old Clock on the Stairs." For thirty years (1842–1872) Pittsfield was the home of the Rev. John Todd (1800–1873), the author of numerous books, of which *Lectures to Children* (1834; 2nd series, 1858) and *The Student's Manual* (1835) were once widely read. From 1807 to 1816 Elkanah Watson (1758–1842), a prominent farmer and merchant, lived at what is now the Country Club, and while there introduced the merino sheep into Berkshire county and organized the Berkshire Agricultural Society; he is remembered for his advocacy of the building of a canal connecting the Great Lakes with the Atlantic Ocean, and as the author of *Memoirs: Men and Times of the Revolution* (1855), edited by his son, W. C. Watson.

PITTSTON, a city of Luzerne county, Pennsylvania, U.S.A., on the Susquehanna river just below the mouth of the Lackawanna, about 11 m. S.W. of Scranton and about 9 m. N.E. of Wilkes-Barré. Pop. (1890), 10,302; (1900), 12,556, of whom 3394 were foreign-born; (1910 census), 16,267. It is served by the Erie, the Lehigh Valley, the Delaware, Lackawanna & Western, the Central of New Jersey, the Delaware & Hudson, and the Lackawanna & Wyoming Valley railways; there is an electric railway from Pittston to Scranton, and a belt-line electric railway connects Pittston with Avoca, Nanticoke, Plymouth and Wilkes-Barre. Two bridges connect the city with the borough of West Pittston (pop., 1910, 6848). Pittston is in the midst of the richest anthracite coal region of the state, and fire-clay also abounds in the vicinity. In 1905 the value of the factory products was $1,474,928 (47·8% more than in 1900). Pittston, named in honour of William Pitt, earl of Chatham, was one of the five original towns founded in the Wyoming Valley by the Susquehanna Company of Connecticut; it was first settled about 1770 and was incorporated as a borough in 1803. It was chartered as a city in 1894.

PITYRIASIS VERSICOLOR (Gr. πιτυρίασις, scurf, from πίτυρον, bran), a skin disease, consisting of patches of brownish discolorations of various sizes and shapes, mostly on the front of the body, and often attended with itching, especially after heating exercise. The pigmentation seems to radiate from the orifices of hair-follicles. The epidermis is in a scaly condition over the patch, and among the *débris* of the epidermic cell there may be seen minute oval spores due to a vegetable parasite, the *Microsporon furfur*. The disease is mostly one of adult age, found all over the world, and not associated in any special way with poor general health. The treatment consists of rubbing in an ointment of potassium sulphide or one of the mercurial ointments, or using sulphur-soap habitually.

PIURA, the northernmost maritime department of Peru, bounded north by the Gulf of Guayaquil, N.E. by Ecuador, S. by the departments of Cajamarca and Lambayeque, and W. by the Pacific. Area, 14,849 sq. m.; pop. (1906, estimate), 154,080—both totals exclusive of the province of Tumbes, or Tumbez (area, about 1980 sq. m.; pop., in 1906, about 8000), which has been administratively separated from the department for military reasons. The department belongs partly to the arid coastal plain that extends from the Gulf of Guayaquil southward nearly to Valparaiso, and partly to a broken mountainous region belonging to the Western Cordilleras. The coastal zone is traversed by the Tumbes, Chira and Piura rivers, which have their sources in the melting snows of the higher Andes and flow westward across the desert to the coast. The valleys of the Chira and Piura are irrigated and maintain large populations. Rough cotton, called "vegetable wool," and tobacco are the principal products, and are also produced in the valley of the Tumbes and in some of the elevated mountain districts. On the upland pastures cattle have long been raised, and goat-breeding has been added in modern times. Mules also are reared. Petroleum is an important product, and there are wells at a number of places along the coast, from Tumbes to Sechura, the most productive being those of Talara and Zorritos. There are sulphur deposits in the Sechura desert, and salt is manufactured at some places on the southern coast. The making of Panama hats from the fibre of the "toquilla" palm is a household industry. The capital is Piura (est. pop. 9100 in 1906), on the Piura river, about 35 m. (direct) E.S.E. of Paita, and 164 ft. above sea-level. It was founded by Pizarro in 1531 under the name of San Miguel, at a place called Tangarara, nearer Paita, but the present site was afterwards adopted. A railway (60 m. long) by way of Sullana connects with the port of Paita, and an extension of 6 m. runs S.S.E. to Catacaos. Other towns of the department, with their estimated populations in 1906, are: Tumbes, or Tumbez (2300), the most northern port of Peru, on the Gulf of Guayaquil, celebrated as the place where Pizarro landed in 1531; Paita; Sechura (6450), on Sechura Bay in the southern part of the department, with exports of salt and sulphur; Sullana (5300), an inland town with railway connexions in the fertile Chira valley; Moropon (3800) on the upper Piura; Huancabamba, the centre of a tobacco district in the mountains; and Tambo Grande (6100) and Chulucanas (4600), both in the fertile Piura valley above the capital.

PIUS, the name of ten popes.

Pius I., pope from about 141 to 154. He was the brother of Hermas, author of the *Shepherd*.

Pius II. (Enea Silvio de' Piccolomini, known in literature as Aeneas Silvius), pope from 1458 to 1464, was born on the 18th of October 1405, at Corsignano (afterward called Pienza after him), near Siena. His family, though poor, was noble, and claimed to trace descent from Romulus. The eldest of eighteen children, he had to work on the farm with his father, until a priest taught him the rudiments of letters, which enabled him, at the age of eighteen, to go as a poor student to Siena, dividing his time between severe humanistic studies and a life of sensual pleasure. He was attracted to Florence by the teaching of Filelfo. His father urged him to become a lawyer, but he accepted the position of secretary to Domenico Capranica, bishop of Fermo, and went with him to the council of Basel, where he stayed several years (1431–1435), changing masters whenever he could improve his position. As secretary of the bishop of Novara he became engaged in a conspiracy against Pope Eugenius IV.; his master was caught and imprisoned, and Aeneas only saved himself by a hasty flight. He was next (1435) employed as secretary of Cardinal Nicholas Albergati (d. 1443) at the congress of Arras, where peace was made between France and Burgundy. From here he took a long journey to Scotland and England, on a secret diplomatic mission; he had numerous adventures, in one of which he nearly lost his life. In 1436 he was back at Basel, and, although a layman, obtained a seat in the council and exercised considerable influence. In order to control it better Eugenius tried to get the council to move to Florence; a minority agreed and seceded; the majority, however, stayed where they were and took vigorous measures against the pope, culminating in his deposition on the 25th of June 1438. Aeneas took an active part in the council; and though he still declined to take orders, he was given a position on the conciliar conclave which elected Amadeus of Savoy as pope under the title of Felix V. In return for his services Felix made Aeneas papal secretary.

A new period of his career opened in 1442, when he was sent by the council to take part in the diet of Frankfort-on-Main. Here he met Frederick III. of Germany, who made him poet laureate and his private secretary. He ingratiated himself with the chancellor, Kaspar Schlick, at Vienna, one of whose adventures he celebrated in *Lucretia and Eurialus*, a novel in the style of Boccaccio. At this period he also wrote his witty, but immoral play, *Chrisis*. In 1446 he took orders as subdeacon, and wrote that he meant to reform, "forsaking Venus for Bacchus," chiefly on the ground of satiety, and also, as he frankly wrote, because the clerical profession offered him more advantages than he could secure outside it.

Aeneas was useful to Frederick as a diplomatist, and managed to give all parties the impression that he was the devoted advocate of each. During the struggle between pope and council he induced Frederick to be neutral for a while. He took an important part in the diet of Nuremberg (1444), and being sent on an embassy to Eugenius in the following year he made his peace with the pope. At the diet of Frankfort (Sept. 1446) Aeneas was instrumental in changing the majority of the electors from their hostile position towards pope and emperor into a friendly one. He brought the good news to Eugenius shortly before his death (Feb. 7, 1447), and made friends with the new pope, Nicholas V., by whom he was made bishop of Siena. He was an agent of Frederick in making the celebrated concordat of Vienna (also called concordat of Aschaffenburg) in February 1448. His services to pope and emperor brought him the titles of prince of the empire and cardinal, positions which he used rather unscrupulously to get as many lucrative benefices into his hands as possible. Those in Germany brought him two thousand ducats a year.

The death of Calixtus III. (who succeeded Nicholas V.) occurred on the 5th of August 1458. After a hot fight in the conclave, in which it seemed that the wealthy French cardinal, Guillaume d'Estouteville, archbishop of Rouen and bishop of Ostia, would be elected, the intrigues of Aeneas and of his friend Rodrigo Borgia (later the notorious Alexander VI.) gave the victory to the cardinal of Siena, who took the title Pius II., with a reminiscence of Virgil's "pius Aeneas." The humanists hailed his election with joy, and flocked around to secure a share of the good things, but they were bitterly disappointed, as Pius did not prove himself the liberal and undiscriminating patron they hoped. The fall of Constantinople in 1453 had made a deep impression upon Pius, and he never ceased to preach the crusade against the Turk. In September 1459 he opened a congress at Mantua for the purpose of considering what could be done in this direction. His proposals for the raising of troops and money met with general opposition. The French were angry because Pius had crowned the Spanish claimant, Ferdinand, king of Naples, and thus disposed of the pretensions of René of Anjou. The Germans also objected to Pius's plans, but finally agreed to furnish some troops and money, promises which they did not carry out. Pius felt how much the position of the papacy had fallen in importance since the days of Urban and Innocent III., and, believing that the change was due to the general councils which had asserted power over the popes, he changed his position, which before his election to the papal throne had been that of a warm advocate of the conciliar claims, and issued (Jan. 1460) the bull *Execrabilis et in pristinis temporibus inauditus*, in which he condemned as heretical the doctrine that the councils were superior to the popes, and proclaimed the anathema against any one who should dare to appeal to one. He issued another bull at the same time, promising forgiveness of sins to those who would take part in the crusade, and then dissolved the congress.

While Pius was at Mantua war broke out between the French and Spanish in southern Italy, and a rising of the barons devastated the Campagna. Hurrying back to Rome Pius succeeded in quelling the disorders, and sent his nephew Antonio Todeschini to the aid of Ferdinand, who made him duke of Amalfi and gave him his natural daughter Maria in marriage. This measure still further alienated the pope from the French, with whom he was at that time negotiating for the abrogation of the Pragmatic Sanction. When Louis XI. came to the throne (Nov. 1461), he sent to Pius saying that he had abolished the Pragmatic Sanction, hoping in return to get the kingdom of Naples for his countryman René of Anjou. When Pius refused to do anything to the prejudice of Ferdinand, Louis changed his attitude, and allowed the protests of the university of Paris and the parlements to persuade him to restore the ancient liberties of the Gallican Church. At the same time a serious quarrel with the Germans prevented anything being done towards a crusade. George Podiebrad, king of Bohemia, was plotting to depose the emperor Frederick III., who was supported by Pius. Diether, archbishop of Mainz, took the side of Podiebrad, and replied to Pius's measures by appealing to a general council. He was declared deposed by the pope, but kept his seat, and in 1464 compelled the pope to recognize him again. The quarrel with Podiebrad, who was accused of supporting the Utraquist heresy, continued with increasing bitterness, but without any decisive result, until the death of Pius. In the meantime the pope did what he could to further the cause of the crusade. The discovery of alum mines at Tolfa gave him an unexpected pecuniary resource, and to stimulate the zeal of Christendom, Pius took the cross on the 18th of June 1464. He set out for Venice, where he intended to sail for the East, but he was attacked with a fever, and on the 14th of August 1464 he died.

Pius II. was a voluminous author. Besides poems, a novel and a play, he wrote a number of orations, which were considered models of eloquence in their day. His most valuable work, however, is his *Commentaries*, a history of his own life and times, told in an interesting and rational manner. He is very frank about himself, and most of the adverse judgments which have been pronounced on his character have been based on his own confessions. He was an opportunist, sailing along with any favourable breeze, and not quite enough in earnest about anything to pursue the same tack steadily for long. We must give him the credit, however, of advocating a statesmanlike policy in the interests of the whole of Europe in trying to get the powers to unite against the Turks, who threatened to overwhelm them all.

See Herzog-Hauck, *Realencyklopädie* (1904), vol. xv., where a full bibliography will be found; M. Creighton, *History of the Papacy during the Reformation*, vol. ii. (London, 1882); L. Pastor, *History of the Popes from the close of the Middle Ages* (Eng. trans., 1896, vol. ii.); Voigt, *Pius II.* (1856–1863). The *Commentaries* of Pius were published in 1584, under the name of Gobelinus Persona. His other works are found in *Aeneae Silvii opera omnia* (Basel, 1551). See also W. Boulting, *Aeneas Silvius* (1909). (P. Sm.)

Pius III. (Francesco Nanni-Todeschini-Piccolomini), pope from the 22nd of September to the 18th of October 1503, was born at Siena on the 9th of May 1439. After studying law at Perugia, he was made archbishop of Siena and cardinal-deacon of St Eustachio, when only twenty-two years of age, by his uncle Pius II., who permitted him to assume the name and arms of the Piccolomini. He was employed by subsequent popes in several important legations, as by Paul II. at the diet of Regensburg, and by Sixtus IV. to secure the restoration of ecclesiastical authority in Umbria. He bravely opposed the policy of Alexander VI., and was elected pope, amid the disturbances consequent upon the death of the latter, through the interested influence of Cardinal della Rovere, afterwards Julius II., and was crowned on the 8th of October 1503. He permitted Cesare Borgia to return to Rome, but promptly took in hand the reform of the curia. Pius was a man of blameless life, and would doubtless have accomplished much had he lived. His successor was Julius II.

See L. Pastor, *History of the Popes*, vol. vi., trans. by F. I. Antrobus (London, 1898); M. Creighton, *History of the Papacy*, vol. v. (London, 1901); F. Gregorovius, *Rome in the Middle Ages*, vol. viii., trans. by Mrs G. W. Hamilton (London, 1900–1902); Piccolomini, "Il Pontificato di Pio III.," in *Archivio stor. ital.*, vol. v. (Firenze, 1903).

Pius IV. (Giovanni Angelo Medici, or "Medighino"), pope from 1559 to 1565, was born at Milan on the 31st of March 1499, of an obscure family, not related to the Medici of Florence (a claim to such relationship was advanced after Giovanni Angelo had attained to prominence). The fortune of the family was established by an elder brother, Gian Giacomo, who fought his way to the marquisate of Marignano and distinguished himself in the service of the emperor. Giovanni Angelo studied in Bologna and Pavia, and for some time followed the law. Entering the service of the Church, he found favour with Paul III., who entrusted him with the governorship of several important towns, and in 1549 made him a cardinal. Julius III. sent him upon missions to Germany and Hungary. With Paul IV. he was out of favour, because not in sympathy with his policy, and accordingly retired to Milan. In the protracted and momentous conclave that followed the death of Paul the election of Pius (Dec. 25, 1559) was due to a compromise between the Spanish and French factions.

In temperament and habit Pius was the antithesis of his predecessor: affable, vivacious, convivial. He was, moreover, astute, diplomatic and experienced in affairs. He allowed the reform movement free course, but tried to repair certain injustices of Paul IV. (for example, releasing and reinstating Morone, who had been imprisoned on a charge of heresy), and mitigated some of his extreme decrees. But to the nephews of Paul he showed no mercy: they were charged with various crimes, condemned, upon testimony of suspicious validity, and executed on the 5th of March 1561. The Colonnesi, who had been active in the prosecution, recovered Paliano. But under Pius V. judgment was reversed, the memory of the Caraffa rehabilitated, and restitution made to the family. Pius IV. himself was not guiltless of nepotism; but the bestowment of the cardinalate and the archbishopric of Milan upon his nephew, the pure and upright Carlo Borromeo, redounded to the honour of his pontificate and the welfare of the church.

With England lost to the papacy, Germany overwhelmingly Protestant, and France on the verge of civil war, Pius realized how fatuous was the anti-Spanish policy of his predecessor. He therefore recognized Ferdinand as emperor, and conciliated Philip II. with extensive ecclesiastical privileges. But subsequently, antagonized by Philip's arrogance, he inclined towards France, and gave troops and money for the war against the Huguenots.

After a suspension of ten years the council of Trent reconvened on the 18th of January 1562. Among the demands presented by the various nations were, the recognition of the equality of the episcopate, communion in both kinds, clerical marriage, and the use of the vernacular in Church services. It required all the pope's diplomacy to avoid compliance on the one hand, and a breach with the powers on the other. Thanks to Morone and Borromeo, however, he achieved his end. The council was dissolved on the 4th of December 1563, and its decrees and definitions confirmed by the pope (Jan. 26, 1564), who reserved to himself the sole right of interpretation. The decrees were immediately accepted by most of the Catholic states; only tardily, however, and with reservation by France and Spain. Various measures were taken for carrying the decrees into effect: residence was strictly enjoined; plurality of benefices prohibited; the Inquisition resumed, under the presidency of Ghislieri (afterwards Pius V.); a new edition of the Index published (1564); and the "Tridentine creed" promulgated (Nov. 13, 1564).

After the termination of the council Pius indulged his desire for ease and pleasure, to the great offence of the rigorists. A certain fanatic, Benedetto Accolti, brooding over the pope's unworthiness, felt inspired to remove him, but his plot was discovered and punished (1565). Pius fortified Rome, and contributed much to the embellishment of the city—among other works, the church of Sta Maria degli Angeli in the Baths of Diocletian; the Porta Pia; the Villa Pia in the Vatican Gardens; and the Palace of the Conservatori. He died on the 9th of December, and was succeeded by Pius V.

See Panvinio, continuator of Platina, *De vitis pontiff. rom.* (a contemporary of Pius); Ciaconius, *Vitae et res gestae summorum pontiff. rom.* (Rome 1601–1602; also contemporary); T. Müller, *Das Konklave Pius IV.* (Gotha, 1889; more comprehensive than the title suggests); Ranke, *Popes* (Eng. trans., Austin), i. 323 seq., 358 seq.; and v. Reumont, *Gesch. der Stadt Rom.* iii. 2, 534 seq., 730 seq. (T. F. C.)

Pius V. (Michele Ghislieri), pope from 1566 to 1572, was born on the 17th of January 1504, in the Milanese. At the age of fourteen he became a Dominican monk. His austere life, his vehemence in attacking heresy and his rigorous discipline as prior of several monasteries proved his fitness for the work of reform, and he was appointed inquisitor in Como, where his zeal provoked such opposition as to compel his recall (1550). The chief inquisitor, Caraffa, convinced of his value, straightway sent him upon a mission to Lombardy, and in 1551 appointed him commissary-general of the Holy Office. When Caraffa became pope, Ghislieri was made bishop of Nepi and Sutri, cardinal (1557), and finally grand inquisitor, which office he discharged in a manner to make the name of "Fra Michele dell' Inquisizione" a terror. In this office he was continued by Pius IV., whom, however, he repelled by his excessive severity, and antagonized by his censoriousness and obstinacy. But the movement with which he was so fully identified was irresistible; and, after the death of Pius IV., the rigorists, led by Borromeo, had no difficulty in making him pope (Jan. 7, 1566).

Though pope, Pius did not cease to be a monk: his ascetic mode of life and his devotions suffered no interruption. Without delay he applied himself to the work of reform. Decrees and ordinances were issued with astonishing rapidity: the papal court was rid of everything unseemly, and became a model of sobriety; prostitutes were driven from the city, or confined to a certain quarter; severe penalties were attached to Sunday desecration, profanity and animal baiting; clerical residence was enforced; conventuals were compelled to live in strict seclusion according to their vows; catechetical instruction was enjoined. A new catechism appeared in 1566, followed by an improved breviary (1568), and an improved missal (1570). The use of indulgences and dispensations was restricted, and the penitential system reformed.

Pius was the avowed enemy of nepotism. One nephew, it is true, he made cardinal, but allowed him no influence: the rest of his relatives he kept at a distance. By the constitution *Admonet nos* (March 29, 1567), he forbade the reinvestiture of fiefs that should revert to the Holy See, and bound the cardinals by oath to observe it. In March 1569 Pius ordered the expulsion of the Jews from the states of the Church. For commercial reasons they were allowed to remain in Rome and Ancona, but only upon humiliating conditions. In February 1571, the Umiliati, a degenerate monastic order of Milan, was suppressed on account of its complicity in an attempt upon the life of the archbishop, Carlo Borromeo.

The election of Pius to the papacy was the enthronement of the Inquisition: the utter extinction of heresy was his darling ambition, and the possession of power only intensified his passion. The rules governing the Holy Office were sharpened; old charges, long suspended, were revived; rank offered no protection, but rather exposed its possessor to fiercer attack; none were pursued more relentlessly than the cultured, among whom many of the Protestant doctrines had found acceptance; princes and states withdrew their protection, and courted the favour of the Holy See by surrendering distinguished offenders. Cosmo de' Medici handed over Pietro Carnesecchi (and two years later received in reward the title of grand duke, Sept. 1569); Venice delivered Guido Zanetti; Philip II., Bartolomé de Carranza, the archbishop of Toledo. In March 1571 the Congregation of the Index was established and greater thoroughness introduced into the pursuit of heretical literature. The result was the flight of hundreds of printers to Switzerland and Germany. Thus heresy was hunted out of Italy: the only regret of Pius was that he had sometimes been too lenient. In 1567 Pius condemned the doctrines of Michael Baius, a professor of Louvain, who taught justification by faith, asserted the sufficiency of the Scriptures, and disparaged outward forms. Baius submitted; but his doctrines were afterwards taken up by the Jansenists.

The political activities of Pius were controlled by one principle, war upon the heretic and infidel. He spurred Philip II. on in the Netherlands, and approved the bloody work of Alva. He denounced all temporizing with the Huguenots, and commanded their utter extermination (*ad internecionem usque*). While it cannot be proven that he was privy to the massacre of St Bartholomew, still his violent counsels could not fail to stir up the most savage passions. He exclaimed loudly against the emperor's toleration of Protestantism, and all but wished his defeat at the hands of the Turks. He urged a general coalition of the Catholic states against the Protestants; and yet published, in sharper form, the bull *In coena domini* (1568), which was regarded by these very states as an attack upon their sovereignty. One of his cherished schemes was the invasion of England and the dethronement of Elizabeth, whom he excommunicated and declared a usurper (Feb. 25, 1570); but he was obliged to content himself with abetting plots and fomenting rebellions. He did, however, effect an alliance with Spain and Venice against the Turks, and contributed to the victory of Lepanto (Oct. 6, 1571).

Thus lived and wrought Pius, presenting "a strange union of singleness of purpose, magnanimity, austerity and profound religious feeling with sour bigotry, relentless hatred and bloody persecution" (Ranke). He died on the 1st of May 1572; and was canonized by Clement XI. in 1712.

See Ciaconius, *Vitae et res gestae summorum pontiff. rom.* (Rome, 1601–1602; a contemporary of Pius); *Acta sanctorum, maij*, tom. i. pp. 616 seq., containing the life by Gabuzio (1605), based upon an earlier one by Catena (1586); Falloux, *Hist. de St Pie V.* (3rd ed., Paris, 1858), eulogistic; Mendham, *Life and Pontificate of St Pius V.* (London, 1832), a bitter polemic. The life of Pius has also been written by Fuenmayor (Madrid, 1595), Paolo Alessandro Maffei (Rome, 1712), and by T. M. Granello (Bologna, 1877). His letters have been edited by Catena (*vide supra*), Goubau (Antwerp, 1640), and a select number in a French translation, by de Potter (Paris, 1826). See also Hilliger, *Die Wahl Pius V. zum Papste* (Leipzig, 1891); Ranke, *Popes* (Eng. trans., Austin), i. 361 seq., 384 seq.; and von Reumont, *Gesch. der Stadt Rom.* iii. 2, 557 seq. (T. F. C.)

Pius VI. (Giovanni Angelo Braschi), pope from 1775 to 1799, was born at Cesena, on the 27th of December 1717. After taking the degree of doctor of laws he went to Ferrara and became the private secretary of Cardinal Ruffo, in whose bishopric of Ostia and Velletri he held the post of *uditore* until 1753. His skill in the conduct of a mission to the court of Naples won him the esteem of Benedict XIV., who appointed him one of his secretaries and canon of St Peter's. In 1758 he was raised to the prelature, and in 1766 to the treasurership of the apostolic chamber by Clement XIII. Those who chafed under his conscientious economies cunningly induced Clement XIV. to create him cardinal-priest of San Onofrio on the 26th of April 1773, a promotion which rendered him for the time innocuous. In the four months' conclave which followed the death of Clement XIV., Spain, France and Portugal at length dropped their objection to Braschi, who was after all one of the more moderate opponents of the anti-Jesuit policy of the previous pope, and he was elected to the vacant see on the 15th of February 1775.

His earlier acts gave fair promise of liberal rule and reform in the defective administration of the papal states. He showed discrimination in his benevolences, reprimanded Potenziani, the governor of Rome, for unsuppressed disorders, appointed a council of cardinals to remedy the state of the finances and relieve the pressure of imposts, called to account Nicolo Bischi for the expenditure of moneys intended for the purchase of grain, reduced the annual disbursements by the suppression of several pensions, and adopted a system of bounties for the encouragement of agriculture. The circumstances of his election, however, involved him in difficulties from the outset of his pontificate. He had received the support of the ministers of the Crowns and the anti-Jesuit party upon a tacit understanding that he would continue the action of Clement, by whose brief *Dominus ac redemptor* (1773) the dissolution of the Society of Jesus had been pronounced. On the other hand the *zelanti*, who believed him secretly inclined towards Jesuitism, expected from him some reparation for the alleged wrongs of the previous reign. As a result of these complications Pius was led into a series of half measures which gave little satisfaction to either party: although it is perhaps largely due to him that the order was able to escape shipwreck in White Russia and Silesia; at but one juncture did he even seriously consider its universal re-establishment, namely in 1792, as a bulwark against revolutionary ideas. Besides facing dissatisfaction with this temporizing policy, Pius met with practical protests tending to the limitation of papal authority. To be sure "Febronius," the chief German literary exponent of the old Gallican ideas, was himself led (not without scandal) to retract; but his positions were adopted in Austria. Here the social and ecclesiastical reforms undertaken by Joseph II. and his minister Kaunitz touched the supremacy of Rome so nearly that in the hope of staying them Pius adopted the exceptional course of visiting Vienna in person. He left Rome on the 27th of February 1782, and, though magnificently received by the emperor, his mission proved a fiasco; he was, however, able a few years later to curb those German archbishops who, in 1786 at the Congress at Ems, had shown a tendency towards independence. In Naples difficulties necessitating certain concessions in respect of feudal homage were raised by the minister Tannucci, and more serious disagreements arose with Leopold I. and Scipione de' Ricci, bishop of Pistoia and Prato, upon the questions of reform in Tuscany; but Pius did not think fit to condemn the offensive decrees of the synod of Pistoia (1786) till nearly eight years had elapsed. At the outbreak of the French Revolution Pius was compelled to see the old Gallican Church suppressed, the pontifical and ecclesiastical possessions in France confiscated and an effigy of himself burnt by the populace at the Palais Royal. The murder of the republican agent, Hugo Basseville, in the streets of Rome (January 1793) gave new ground of offence; the papal court was charged with complicity by the French Convention; and Pius threw in his lot with the league against France. In 1796 Napoleon invaded Italy, defeated the papal troops and occupied Ancona and Loreto. Pius sued for peace, which was granted at Tolentino on the 19th of February 1797; but on the 28th of December of that year, in a riot created by some Italian and French revolutionists, General Duphot of the French embassy was killed and a new pretext furnished for invasion. General Berthier marched to Rome, entered it unopposed on the 13th of February 1798, and, proclaiming a republic, demanded of the pope the renunciation of his temporal authority. Upon his refusal he was taken prisoner, and on the 20th of February was escorted from the Vatican to Siena, and thence to the Certosa near Florence. The French declaration of war against Tuscany led to his removal by way of Parma, Piacenza, Turin and Grenoble to the citadel of Valence, where he died six weeks later, on the 29th of August 1799. Pius VII. succeeded him.

The name of Pius VI. is associated with many and often unpopular attempts to revive the splendour of Leo X. in the promotion of art and public works—the words "Munificentia Pii VI. P. M." graven in all parts of the city, giving rise amongst his impoverished subjects to such satire as the insertion of a minute loaf in the hands of Pasquin with that inscription beneath it. He is best remembered in connexion with the establishment of the museum of the Vatican, begun at his suggestion by his predecessor, and with an unpractical and expensive attempt to drain the Pontine marshes.

Authorities.—Zöpffel and Benrath, "Pius VI.," in Herzog-Hauck, *Realencyklopädie*, 3rd ed., vol. xv. pp. 441–451 (Leipzig, 1904, with elaborate bibliography); F. Nielsen, *History of the Papacy in the 19th Century*, vol. i. chap. vii. (London, 1906); J. Gendry, *Pie VI. sa vie, son pontificat, d'après les archives vaticanes et de nombreux documents inédits* (2 vols., Paris, 1907). (W. W. R.*)

Pius VII. (Luigi Barnaba Chiaramonti), pope from 1800 to 1823, the son of Count Scipione Chiaramonti and the deeply religious Countess Ghini, was born at Cesena on the 14th of August 1740 (not 1742). After studying at Ravenna, at the age of sixteen he entered the Benedictine monastery of St Mary in his native town: here he was known as Gregorio. Almost immediately he was sent by his superiors to Padua and to Rome for a further course of studies in theology. He then held various teaching appointments in the colleges of his order at Parma and at Rome. He was created an abbot of his order by his relative Pius VI., who also appointed him bishop of Tivoli on the 16th of December 1782, and on the 14th of February 1785, because of excellent conduct of office, raised him to the cardinalate and the see of Imola. At the death of Pius VI. the conclave met at Venice on the 30th of November 1799, with the result that Chiaramonti, the candidate of the French cardinal-archbishop Maury, who was most skilfully supported by the secretary of the conclave Ercole Consalvi, was elected pope on the 14th of March 1800. He was crowned on the 21st of that month; in the following July he entered Rome, on the 11th of August appointed Consalvi cardinal-deacon and secretary of state, and busied himself with administrative reforms.

His attention was at once directed to the ecclesiastical anarchy of France, where, apart from the broad schism on the question of submission to the civil constitution of the clergy, discipline had been so far neglected that a large proportion of the churches were closed, dioceses existed without bishops or with more than one, Jansenism and clerical marriage were on the increase, and indifference or hostility widely prevailed amongst the people. Encouraged by Napoleon's desire for the re-establishment of the Roman Catholic religion in France, Pius negotiated the celebrated concordat, which was signed at Paris on the 15th of July and ratified by Pius on the 14th of August 1801 (see Concordat). The importance of this agreement was, however, considerably lessened by the "articles organiques" appended to it by the French government on the 8th of April 1802. In 1804 Napoleon opened negotiations to secure at the pope's hands his formal consecration as emperor. After some hesitation Pius was induced to perform the ceremony at Notre Dame and to extend his visit to Paris for four months; but in return for these favours he was able to obtain from Napoleon merely one or two minor concessions. Pius, who arrived in Rome on the 16th of May 1805, gave to the college of cardinals a rose-coloured report of his experiences; but disillusionment was rapid. Napoleon soon began to disregard the Italian concordat of 1803, and himself decreed the dissolution of the marriage of his brother Jerome with Miss Patterson of Baltimore. The irritation between France and the Vatican increased so rapidly that on the 2nd of February 1808 Rome was occupied by General Miollis; a month later the provinces of Ancona, Macerata, Fermo and Urbino were united to the kingdom of Italy, and diplomatic relations between Napoleon and Rome were broken off; finally, by a decree issued from Schönbrunn on the 17th of May 1809, the emperor united the papal states to France. Pius retaliated by a bull excommunicating the invaders; and, to prevent insurrection, Miollis—either on his own responsibility, as Napoleon afterwards asserted, or by order of the latter—employed General Radet to take possession of the pope's person. The palace on the Quirinal was broken open during the night of July 5th, and, on the persistent refusal of Pius to rescind the bull of excommunication and to renounce his temporal authority, he was carried off, first to Grenoble, thence after an interval to Savona on the Gulf of Genoa. Here he steadfastly refused canonical institution to the bishops nominated by Napoleon; and, when it was discovered that he was maintaining a secret correspondence, he was deprived of all books, even of pen and ink. At length, his nerves shattered by insomnia and fever, he was willing to give satisfactory oral assurances as to the institution of the French bishops.

In May 1812 Napoleon, on the pretext that the English might liberate the pope if he were left at Savona, caused the aged and sick pontiff to be transported to Fontainebleau; the journey was so hard that on Mount Cenis Pius received the viaticum. Arriving safely, however, at Fontainebleau, he was lodged in a suite of regal magnificence to await the return of the emperor from Moscow. When Napoleon arrived, he entered into personal negotiations with the pope, who on the 25th of January 1813 assented to a concordat so degrading that his conscience found no relief till the 24th of March, when, on the advice of the cardinal Pacca and Consalvi, he abrogated it; and on the 9th of May he proceeded to defy the emperor by declaring invalid all the official acts of the new French bishops. In consequence of the battle of Leipzig and the entry of the allied forces into France, Napoleon ordered in January 1814 that the pope be returned to Savona for safe keeping; but soon the course of events forced him to liberate the pope and give back the States of the Church. On the 19th of March Pius left Savona, and was received with rejoicing at Rome on the 24th of May. While Consalvi at the Congress of Vienna was securing the restitution of nearly all the papal territory, reaction had full swing at Rome; the Jesuits were restored; the French legislation, much of which was of great social value, was repealed; the Index and the Inquisition were revived. On his return Consalvi conducted a more enlightened and highly centralized administration, based largely on the famous *Motu proprio* of 1816; nevertheless the finances were in a desperate condition. Discontent centred perhaps in the *Carbonari*, a Liberal secret society condemned by the pope in 1821. The chief triumphs of Consalvi were the negotiation of a series of valuable concordats with all the Roman Catholic powers save Austria. In the latter years of Pius's life royalty often came to Rome; the pope was very gracious to exiled kings and showed notable magnanimity toward the family of Napoleon. He also attracted many artists to the city, including the greatest sculptors of the time, one of whom, the Protestant Thorwaldsen, prepared the tomb in which repose the remains of the gentle and courageous pontiff, who passed into rest on the 20th of August 1823. His successor was Leo XII.

Authorities.—Zöpffel and Benrath, "Pius VII.," in Herzog-Hauck, *Realencyklopädie*, xv. 451–458 (Leipzig, 1904), (long list of older literature); Ilario Rinieri, *La Diplomazia pontificia nel secolo XIX.* (Rome, 1902), two volumes treating the years 1800–1805, based largely on Vatican sources; I. Rinieri, *Napoleone Pio VII. (1804–1813), relazioni storiche su documenti inediti dell' archivio vaticano* (Turin, 1906); H. Chotard, *Le Pape Pie VII. à Savone* (Paris, 1887); Mary H. Allies, *Pius the Seventh* (London, 1897), a popular Roman Catholic biography; Leo König, S.J. *Pius VII. Die Säkularisation und das Reichskonkordat* (Innsbruck, 1904), based chiefly on Vienna material; H. Welschinger, *Le Pape et l'empereur, 1804–1815* (Paris, 1905); Louis Madelin, *La Rome de Napoléon: la domination française à Rome de 1809 à 1814* (Paris, 1906), an elaborate study; L. G. Wickham-Legg, "The Concordats" (*Cambridge Modern History*, vol. ix. ch. 7, 1906); Lady Blennerhassett, "The Papacy and the Catholic Church" (*Cambridge Modern History*, vol. x. ch. 5, 1907). Both these last have good bibliographies. (W. W. R.*)

Pius VIII. (Francesco Xaviero Castiglioni), pope from 1829 to 1830, who came of a notable family at Cingoli near Ancona, was born on the 20th of November 1761. He studied canon law at Rome, became vicar-general at Anagni and later at Fano, and in 1800 was appointed bishop of Montalto. Because he refused the oath of allegiance to the Napoleonic king of Italy he was carried captive to France; but in 1816 his steadfastness was rewarded by his being created cardinal-priest of Sta Maria in Trastevere; and this same year he was translated from the see of Montalto to that of Cesena. In 1821 he was made cardinal-bishop of Frascati, also grand penitentiary; and later he became prefect of the Congregation of the Index. In the conclave which followed the death of Leo XII., Castiglioni, the candidate of France, was elected pope on the 31st of March 1829. He avoided nepotism, abandoned the system of espionage employed by his predecessor, and published an encyclical condemning Bible societies and secret associations. He rejoiced over Catholic emancipation in England, recognized Louis Philippe as king of the French, and exhibited a pacific spirit in dealing with the problem of mixed marriages in Germany. Worn out with work, he died on the morning of the 1st of December 1830. His successor was Gregory XVI.

Authorities.—Zöpffel and Benrath, "Pius VIII.," in Herzog-Hauck, *Realencyklopädie*, xv. 458 seq. (Leipzig, 1904, with bibliography); F. Nielsen, *A History of the Papacy in the 19th Century*, ii. 31–50 (London, 1906); P. B. Gams, *Series episcoporum ecclesiae catholicae* (Regensburg, 1873). (W. W. R.*)

Pius IX. (Giovanni Maria Mastai-Ferretti), pope from 1846 to 1878, was born on the 13th of May 1792 at Sinigaglia, the fourth son of Count Jerome and Countess Catherine Vollazi; the family of Mastai was of ancient descent, and the title of count came to it in the 17th century, while later the elder branch, allied by marriage with the Ferretti family, took that name in addition. He spent some time at the College of Piarists in Volaterra, and then proceeded to Rome with the intention of entering the pontifical guard as an officer. In spite of his good connexions, he was disappointed in this aim as it became known that he suffered from epilepsy. The malady, however, was surmounted; and in 1819 he was ordained priest. After ministering for some time in his native town, he accompanied Cardinal Muzzi to Chile (1823). On his return he was entrusted by Leo XII. with the direction of the Roman hospital of San Michele: in 1830 he received the archbishopric of Spoleto, in 1832 the bishopric of Imola, and in 1840 Gregory XVI. created him a cardinal, with the title Santi Pietro e Marecellino.

On the death of Gregory XVI. (June 1, 1846) the College of Cardinals met in conclave on the 14th of June. But their deliberations were destined to last but a short while; for, on the 16th of June, Cardinal Mastai Ferretti had already obtained the requisite two-thirds majority, and ascended the papal chair under the title of Pius IX. In his various capacities he had gained much popularity: he had shown himself to be of a kindly disposition and a zealous churchman, and his reputation for piety and tact stood high; he possessed, too, a winning personality and a handsome presence.

The reign of Pius IX. began at an extremely critical time. The problem of the government of the Papal States, transmitted to him by his predecessor, stood in urgent need of solution, for the actual conditions were altogether intolerable. The irritation of the populace had risen to such a pitch that it found vent in revolts which could only be quelled by the intervention of foreign powers; and the ferment in the dominions of the Church was accentuated by the fact that the revolutionary spirit was in the ascendant in all the states of Europe. The proclamation of a general amnesty for all political offenders made an excellent impression on the people; and Pius at once instituted preparations for a reform of the administration, the judicature and the financial system. The regulations affecting the censorship were mitigated, and a breath of political liberalism vitalized the whole government. Pius at once acquired the reputation of a reforming pope. But the prestige so gained was not sufficient to calm the people permanently, and two demands were urged with ever increasing energy—a share in the government and a national

Italian policy. The problem of giving the people a due share in the government was one of peculiar difficulty in the papal states. It was not simply a question of adjusting the claims of monarch and subject: it was necessary, at the same time, to oust the clergy—who, till then, had held all the more important offices in their own hands—from their dominant position, or at least to limit their privileges. That the clerical character of the administration could not be indefinitely retained was plain enough, it would seem, to any clear-thinking statesman: for, since the restoration of the papal state in 1814, the pernicious effects of this confusion of the spiritual and the secular power could no longer be denied. But Pius IX. lacked the courage and perspicacity to draw the inevitable conclusions from these premises; and the higher clergy at Rome were naturally opposed to a policy which, by laicizing the administration, would have deprived them of the power and privileges they had so long enjoyed. In these circumstances it is not surprising that the pope, while making concessions to his people, did so with reservations which, so far from restoring peace, served only to aggravate the turmoil.

By a *motu proprio* of the 2nd of October 1847 the government of the city of Rome was reorganized and vested in a council of 100 members, not more than four of whom were to be clerics. But the pope reserved to himself the right of nominating the first members, and the new senate was only later to have the right of filling up vacancies by co-optation. The institution of a state council (*consulta*) was announced on the 19th of April 1847; and on the 14th of October it was called into existence by a *motu proprio*. It consisted of 24 councillors, who were to be selected by the pope from a list of candidates to be submitted by the provincial assemblies. A cardinal and one other prelate were to be at its head. The consulta was to be divided into four sections, dealing with (1) legislation, (2) finance, (3) internal administration, (4) the army and public works. Matters of importance were, however, to be submitted to the College of Cardinals, after being debated in the consulta. A *motu proprio* of the 29th of December altered the constitution of the ministerial council. Nine mutually independent ministries were formed, and the principle of the responsibility of the ministers was established: but all the positions were filled by clerics.

The agitation for constitutional government was urgent in the demand for further concessions; but they came too late. On the 12th of February a proclamation of the pope transferred three portfolios to the laity; but the impression produced by the news of the revolution in Paris nullified the effect. At the formation of the Antonelli ministry (March 11), only the three departments of foreign affairs, finance and education, were reserved by the clergy; while the remaining six were entrusted to laymen. On the 14th of March 1848 Pius took the last step, and published a constitution (*Fundamental Statute for the Secular Government of the States of the Church*). Two chambers were to be formed. The first (*alto consiglio*) consisted of members nominated for life by the pope; the second, of a hundred elected deputies. The laws adopted by these two chambers had first to undergo the scrutiny of the College of Cardinals, before being submitted to the pope for his assent or rejection. Ecclesiastical, or ecclesiastico-political, affairs were exempted from the jurisdiction of the parliament; which was further required to abstain from the enactment of laws conflicting with the discipline of the Church, and from criticism of the diplomatic and religious relations of the Holy See with foreign powers.

The utility of this constitution was never tested; for the demand for an extension of popular rights was now eclipsed by a still more passionate aspiration towards the national unity of Italy. This nationalist movement at once took head against Austria. On the 18th of March the revolution broke out in Milan, and King Albert of Sardinia undertook the conduct of the war against the emperor. When news of the events at Milan reached Rome the populace was swept away in a whirlwind of enthusiasm: the Austrian embassy was mobbed; the imperial arms, surmounting the main gate of the palace, were torn down; and great troops of volunteers clamoured to be led against Austria. Pius was carried away at first on the flood-tide of excitement, and seemed, after his proclamation of the 30th of March, on the point of conferring his blessing upon the war against Austria. But the course of political events during the next few weeks damped his ardour. When, on the 29th of April, in his allocation to the cardinals, he proclaimed the papal neutrality, the Romans received his vacillation as a sign of treachery; and the storm, precluded from discharging its fury on Austria, broke over his head. When the ministry in power resigned office on the 1st of May, the Mamiani administration was formed, only one cleric being included. Mamiani himself, whose writings were on the Index, had little sympathy with the pope, and did all that was possible to complete the secularization of government in the States of the Church. He received his dismissal on the 1st of August, and was followed by Count Fabbri, then by Count de Rossi, who made the last attempt to restore order by a moderate liberal policy. On the 15th of November, as he was about to open the Chambers, he was assassinated on the staircase leading to the hall of session. A state of anarchy ensued. Armed bands gathered before the Quirinal, and attempted to storm it. To avoid further bloodshed the pope was compelled to assent to the formation of a radically democratic ministry under Galetti. The Swiss, who composed the papal guard, were disbanded; and the protection of the pontiff was transferred to the civil militia; in other words, Pius IX. was a prisoner. On the evening of the 24th of November he contrived by the aid of the French and Bavarian ambassadors—the duc d'Harcourt and Count Spaur—to leave the palace unobserved, in the dress of a common priest, and to reach Gaeta in the kingdom of Naples. From this refuge he issued a breve on the 27th of November, protesting against the sacrilege practised on himself, declaring all actions forced upon him null and void, and appointing a commission to carry on the government in his absence. Since the Chamber declined to recognize this step, and the pope was equally resolute in refusing to hold any intercourse with the deputation which it despatched to him, a supreme *Giunta* was provisionally created by the Chamber on the 11th of December to discharge all the functions assigned to the executive power by the constitution. On the 17th of the same month Pius made a public protest; and, as soon as the elections for a national assembly were announced, he forbade any participation in them, menacing the disobedient with the penalties of the Church (Jan. 1, 1849). The elections, however, were held; and on the 9th of February the constituent assembly decreed, by 142 votes to 23, the erection of a Roman republic. Pius answered by a protest dated the 14th of February. All the ecclesiastical property of the Roman state was now declared to be vested in the republic; convents and religious edifices were requisitioned for secular purposes; benevolent institutions were withdrawn from clerical influence; and church establishments were deprived of the right to realize their possessions. In the beginning of December Pius had already appealed to the European powers for assistance; and on the 7th of February 1849 it was resolved in the Consistory to approach officially France, Austria, Spain and Naples, with a view to their armed intervention. The French republic, under the presidency of Louis Napoleon, was the first state to throw troops into Italy. On the 24th of April General Oudinot appeared before Civita Vecchia; only to be defeated at first by Garibaldi. But, after receiving reinforcements, he prosecuted the war successfully, and made his entry into Rome on the 3rd of July; while, in the early part of May an Austrian army advanced into the north of the papal states. On the 14th of July Oudinot proclaimed the restoration of the pontifical dominion; and, three days later, Pius IX. issued a manifesto entrusting the government to a commission appointed by himself.

On the 12th of April 1850 Pius returned to Rome, supported by foreign arms, embittered, and hostile henceforward to every form of political liberalism or national sentiment. In Gaeta he had mentally cut himself loose from all ideas of progress, and had thrown himself into the arms of the Jesuits. His subsequent policy was stamped by reaction. Whether it might have been possible to avoid the catastrophe of 1870 is a difficult question. But there can be no question whatever that the policy which

Pius now inaugurated, of restoring the old pre-revolutionary conditions, sealed the fate of the temporal dominion of the papacy. He made no attempt to regain the estranged affections of the populace, and took no measures to liberate himself and his subjects from the incubus of the last few years. He even sought to exact vengeance for the events of that period: the state officials, who had compromised themselves, lost their offices; and all grants in aid were forfeited if the recipients were discovered by the secret commissions (*consigli di censura*) to have taken part in the revolutionary movement. The tribunals extorted declarations on the part of witnesses by flogging, deprivation of food, and like methods of torture. In many cases the death sentence was executed at their instance, though the guilt of the accused was never established. The system of precautionary arrest, as it was termed, rendered it possible for any man to be thrown into prison, without trial and without verdict, simply on the ground that he lay under suspicion of plotting against the government. The priests, who usurped the judicial function, displayed such cruelty on several occasions that officers of the Austrian army were compelled to record a protest. The consequence of these methods was that every victim—innocent or guilty—ranked as a martyr in the estimation of his fellow-citizens. A subsidiary result was the revival of brigandage, which found a suspicious degree of support among the people. Corruption was rampant among the officials; the police were accused of illicit bargaining with criminals; and nothing but contempt was entertained for the papal army, which was recruited from the dregs of humanity. To this was added a disastrous financial administration, under which the efficiency and credit of the country sank to appalling depths. The system of taxation was calculated with a view to relieving the Church and the clergy, and imposing the main burden upon the laity. In this department the family of Cardinal Antonelli seems to have played a fatal part. The secretary of state was born in humble circumstances: when he died he left a fortune of more than 100,000,000 lire, to which a daughter succeeded in establishing her claim. His brother Felippo was president of the Roman Bank, and his brother Luigi the head of the Annona—an office created to regulate the import of grain. The pope himself had neither the will nor the power to institute searching financial reforms; possibly, also, he was ignorant of the facts.

The mismanagement which obtained in the papal dominions could not escape the observation of the other powers. As early as the Congress of Paris in 1856 the English ambassador, Lord Clarendon, had directed an annihilating criticism against the government of the pontiff; and a convincing proof of the justice of his verdict was given by Pius himself, in his treatment of the famous Mortara case. A Jewish boy of this name had been torn from his parents in Rome and the rite of baptism performed on him without their knowledge or consent. The pope flatly refused to restore the "Christian" to his Jewish parents, and turned a deaf ear both to the protest of public opinion and the diplomatic representations of France and England. The sequel to this mode of government was that the growing embitterment of the subjects of the Church came to be sympathized with outside the bounds of Italy, and the question whether the secular authority of the papacy could be allowed to continue became a much-debated problem. Even the expression of the doubt was symptomatic. In 1859 appeared an anonymous brochure, *Le Pape et le congrès*, composed by Laguerronnière, the friend of Napoleon III., in which it was proposed to ensure the pope "un revenu considérable" and the city of Rome, but to relieve him of a political task to which he was not competent. In 1861 another anonymous pamphlet, *Pro causa italica ad episcopos catholicos*, was published in Florence, advocating the ecclesiastico-political programme of Cavour; and the pope was horrified when he discovered that it came from the pen of Passaglia, the professor of dogmatic theology. In spite of all, the national idea gained strength in Italy, and the movement towards unity found powerful champions in King Victor Emmanuel of Sardinia and his great statesman Cavour. Free scope was given when the understanding between the two powers protecting the papal state—France and Austria—broke down. So soon as Napoleon and Cavour had come to an agreement war ensued, France and Sardinia being ranged against Austria (1859). The result was that Austria lost the greater part of her Italian possessions, while the pope also forfeited two-thirds of his dominions. By the war of 1866, in which Italy fought on the Prussian side, Victor Emmanuel gained Venice in addition; so that the States of the Church now formed the last remaining obstacle to complete national unity. In September 1864, France—who had been the protectress of these states since 1849—had concluded a treaty with Victor Emmanuel, undertaking to withdraw her garrison from Rome in two years time; while, on his part, the king agreed to abstain from any attack on the papal dominions, and to guarantee the safety of the pope and the *patrimonium Petri*. The emperor Napoleon had, in point of fact, recalled his troops in 1866; but in 1867, when Garibaldi crossed the frontiers of the papal state at the head of his volunteers, he declared the treaty violated and again threw his regiments into Rome. Three years later the time came when he could employ his arms more advantageously elsewhere, and after the outbreak of the war with Germany Rome was evacuated. The news that the French Empire had fallen produced an electrical effect in Italy: the Italian parliament called on the king to occupy Rome; on the 8th of September Victor Emmanuel crossed the borders; and on the 20th of September the green-white-and-red of the tricolour floated over the Capitol. The protests of Pius IX. remained unheeded, and his attempts to secure another foreign intervention met with no success. On the 2nd of October Victor Emmanuel instituted a *plébiscite* in Rome and the possessions of the Church to decide the question of annexation. The result of the suffrage was that 153,681 votes were given in favour of union with Italy, and 1507 against the proposed incorporation: that is to say only the direct dependants of the Vatican were opposed to the change. The papal state was now merged in the kingdom of Italy, which proceeded to define its diplomatic relations with the Holy See by the law of the 13th of May 1871 (see ITALY: *History*).

In his capacity as head of the Church, Pius IX. adhered to the principles of the Ultramontanist party, and contributed materially to the victory of that cause. The political reaction which followed the revolutionary era in most quarters of Europe offered a favourite soil for his efforts; and in several countries he found it possible to regulate the relations between Church and state from the standpoint of the curia. In 1851 he concluded a concordat with Queen Isabella II. of Spain, proclaiming Roman Catholicism the sole religion of the Spanish people, to the exclusion of every other creed (art. 1); and we find the same provision in another concordat with the South American republic of Ecuador (1862). A third concordat, negotiated with the emperor Francis Joseph I. of Austria (1855), entrusted the supervision of schools and the censorship of literature to the clergy, recognized the canon law, and repealed all secular legislation conflicting with it. France came into line with the wishes of the pope in every respect, as Napoleon needed clerical support in his political designs. Even in Germany he found no resistance; on the contrary, he was able to secure advantageous compacts from individual states (Hesse, 1854; Württemberg, 1857). In fact, the growing tendency to romanize Catholicism—to bring it, that is to say, into close connexion with Rome, and to a state of dependency on the guidance and instructions of the curia—made special progress in Germany.

Among the most important acts of Pius IX. must be counted his proclamation of the dogma of the Immaculate Conception of the Virgin Mary, by the bull *Ineffabilis Deus*, on the 8th of December 1854. In this bull the preservation of Mary from every stain of hereditary sin, in the first moment of her conception, was declared to be a divinely revealed truth, which consequently demanded universal acceptance (see IMMACULATE CONCEPTION). By this means a view, which till then had been no more than a pious belief, was elevated into a dogma to be held *de fide*; though grave doubts on the subject had always been entertained, even in the midst of the Church itself. For the inner life of that

Church this solution of the controversy was of great significance, and created a desire for further dogmatic decisions on the Virgin Mary—her resurrection and ascension. But the procedure of Pius IX. proved of far-reaching importance from another point of view. True, he had taken the opinion of the bishops on the subject, and had received the assent of a large majority; none the less, the verdict was pronounced by himself alone, not by an ecumenical council. Thus, by arrogating the function formerly exercised by the ecumenical council, he virtually laid claim to the infallibility which had always been regarded as inherent only in the doctrinal pronouncements of such a council: in other words, he availed himself of a privilege not accorded to him till the 18th of July 1870.

Though the Marian dogma of 1854 received, with very few exceptions, an enthusiastic welcome in Roman Catholic circles, another measure of the pope, ten years later, excited a painful sensation even among the orthodox members of the Church. As reigning sovereign of the papal states Pius IX. had passed through a "liberal period": as head of the Church, he had never been liable to attacks of liberalism. Nevertheless, his return from exile left its mark on his spiritual administration. For from this period onwards he deliberately and stubbornly set his face against the influence of modernism on ecclesiastical life; showed his displeasure at and distrust of the scientific theology and philosophy which marked a moderate advance (Günther, Frohschammer and Döllinger); and, entrenched in the stronghold of medieval ideals, combated the transformations of the new order of society, and the changes in the relationship between Church and state, which obtained in most countries of Europe since the French Revolution. After long and careful consultation, the adverse criticisms which he had expressed on various occasions were published on the 8th of December 1864, together with the encyclical *Quanta cura*, under the title *Syllabus complectens praecipuos nostrae aetatis errores* (see SYLLABUS). In this Pius claimed for the Church the control of all culture and all science, and of the whole educational system. He rejected the liberty of faith, conscience and worship enjoyed by other creeds; and bade an easy farewell to the idea of tolerance. He claimed the complete independence of the Church from state control; upheld the necessity of a continuance of the temporal power of the Roman See; and finally, in the last clause, declared that "the pontiff neither can be nor ought to be reconciled with progress, liberalism and modern civilization." The publication of this syllabus created a profound impression: for it declared war on modern society, and committed the papacy to the principles of Ultramontanism (*q.v.*). But, as any attempt to translate its precepts into practice would entail a disastrous conflict with the existing régime as established by law, Roman Catholic circles have frequently shown a tendency to belittle the significance of the manifesto and to deny that its rules are absolutely binding. But these well-meant explanations, however comprehensible, are refuted by the unequivocal pronouncements of Pius IX., Leo XIII., and many recognized ecclesiastical authorities—*e.g.* Cardinal Manning, archbishop of Westminster, who described the syllabus as an emanation from the highest doctrinal authority in the Church.

The zenith of Pius's pontificate was attained on the 18th of July 1870 when the Vatican council proclaimed the infallibility of the pope and the universality of his episcopate, thus elevating him to a pinnacle which none of his predecessors had reached and at the same time fulfilling his dearest wish. That, personally, he laid great stress on the acceptance of the dogma, was a fact which he did not attempt to conceal during the long preliminary deliberations of the council; and his attitude was a not inconsiderable factor in determining its final resolutions. But the loss of the papal states, immediately afterwards, was a blow from which he never recovered. Whenever he brought himself to speak of the subject—and it was not rarely—he repeated his protest in the bitterest terms, and, to the end of his days, refused to be reconciled with the "sacrilegious" king of Italy. When, in Germany, the situation created by the Vatican council led to the outbreak of the Kulturkampf, Pius IX. failed to display the tact peculiar to his successor. For, in the encyclical *Quod numquam* (Feb. 5, 1875), he took the rash step of declaring invalid the Prussian laws regulating the relationship between Church and state—the only result being that the feud was still further embittered.

In these later years the dark days of his "captivity" were amply compensated by the proofs of reverence displayed by Roman Catholic Christianity, which accorded him magnificent ovations as his period of jubilee began to fall due. The twenty-fifth anniversary of his pontificate was celebrated with great splendour on the 16th of June 1871; for he was the first pope who had thus reached the traditional "years of Peter." In 1872 his 80th birthday gave occasion for new demonstrations; and 1875 was a so-called "year of jubilee." Finally, in 1877, the fifty years of his priesthood were completed: an event which brought him innumerable expressions of loyalty and led to a great manifestation of devotion to the Holy See from all the Roman Catholic world. On the 7th of February 1878 Pius IX. died. His successor was Leo XIII.

BIOGRAPHIES.—Hülskamp, *Papst Pius IX. in seinem Leben und Wirken* (2nd ed., Münster, 1870); Legge, *Pius IX.* (London, 2 vols., 1872); Gillet, *Pie IX., sa vie et les actes de son pontificat* (Paris, 1877); Shea, *Life and Pontificate of Pius IX.* (New York, 1877); Trollope, *Life of Pius IX.* (London, 2 vols., 1877); F. v. Döllinger "Pius IX." in his *Kleine Schriften*, ed. Reusch (Stuttgart, 1890), p. 558 sqq.); Stepischnegg, *Papst Pius IX. und seine Zeit* (2 vols., Vienna, 1879); Wappmansperger, *Leben und Wirken des Papstes Pius IX.* (Regensburg, 1879); Pougeois, *Histoire de Pie IX., son pontificat et son siècle* (6 vols., Paris, 1877–1886); Fr. Nielsen, *The History of the Papacy in the 19th Century*, translated under the direction of A. F. Mason, vol. ii. (London, 1906). For his work as sovereign of the papal states, see F. v. Döllinger, *Kirche und Kirchen, Papsttum und Kirchenstaat* (Munich, 1861); M. Brosch, *Geschichte des Kirchenstaates*, vol. ii. (Gotha, 1882); A. F. Nurnberger, *Papsttum und Kirchenstaat* (3 vols., Mainz, 1897–1900); C. Mirbt "Die Geschichtschreibung des vatikanischen Konzils," in the *Historische Zeitschrift*, 101. Bd. (3. Folge, 5 Bd.) 1908, p. 529–600.

SOURCES.—*Acta Pii IX.* (4 vols., Rome, 1854 sqq.); *Acta sanctae sedis* (Rome, 1865 sqq.). A selection of the documents for the history of Pius IX. will be found in C. Mirbt, *Quellen zur Geschichte des Papsttums und des römischen Katholicismus* (2nd ed., Tübingen, 1901), §§ 422–442, pp. 361–390. (C. M.)

PIUS X. (GIUSEPPE SARTO), elected pope in 1903, was born on the 2nd of June 1835, of humble parents, at the little town of Riete in the province of Treviso, Italy. He studied theology at the episcopal seminaries of Treviso and Padua, and was ordained priest in 1858. For seventeen years he acted as parish priest at various small places in Venetia, until in 1875 he was appointed canon of the cathedral and superior of the seminary at Treviso. In 1880 he refused the bishopric of Treviso, but in 1884, on the express command of Leo XIII., he accepted that of Mantua. On the 12th of June 1893 he was created a cardinal, and three days later was nominated patriarch of Venice. In Venice he made himself very popular owing to his piety, his simplicity and geniality, and by his readiness to act in harmony with the Italian government. He succeeded Leo XIII. in his election to the papal chair on the 4th of August 1903. (See PAPACY, *ad fin.*)

PIVOT (Fr. *pivot*; probably connected with Ital. *pivolo*, peg, pin, diminutive of *piva*, *pipa*, pipe), that on which something turns, specifically a metal pointed pin or short shaft in machinery, such as the end of an axle or spindle. The term occurs frequently in combination with other words, chiefly in technical usage, *e.g.* "pivot-gearing," for a system of gearing in machinery which admits of the shifting of the axis of a driving wheel, so that the power may be communicated in various directions.

PIZARRO, FRANCISCO (*c.* 1471 or 1475–1541), discoverer and conqueror of Peru, was born at Trujillo in Estremadura, Spain, about 1471 (or 1475). He was an illegitimate son of Gonzalo Pizarro, who as colonel of infantry afterwards served in Italy under Gonsalvo de Cordova, and in Navarre, with some distinction. Of Pizarro's early years hardly anything is known; but he appears to have been poorly cared for, and his education was neglected. Shortly after the news of the discovery of the New World had reached Spain he was in Seville, and thence found his way across the Atlantic. There he is heard of in 1510 as having taken part in an expedition from Hispaniola to Urabá under Alonzo de Ojeda, by whom he was entrusted with the charge of the unfortunate settlement at San Sebastian. He accompanied Balboa (whom he afterwards helped to bring to the block) in the discovery of the Pacific; and under Pedrarias d'Avila he received a *repartimento*, and became a cattle-farmer at Panama. Here in 1522 he entered into a partnership with a priest named Hernando de Luque, and a soldier named Diego de Almagro, for purposes of exploration and conquest towards the south. Pizarro, Almagro and Luque afterwards renewed their compact in a more solemn and explicit manner, agreeing to conquer and divide equally among themselves the opulent empire they hoped to reach. Explorations were then undertaken down the west coast of South America, in which Pizarro, though left for months with but thirteen followers on a small island without ship or stores, persisted till he had coasted as far as about 9° S. and obtained distinct accounts of the Peruvian Empire. The governor of Panama showing little disposition to encourage the adventurers, Pizarro resolved to apply to the sovereign in person for help, and with this object sailed from Panama for Spain in the spring of 1528, reaching Seville in early summer. Charles V. was won over, and on the 26th of July 1529 was executed at Toledo the famous *capitulacion*, by which Pizarro was upon certain conditions made governor and captain-general of the province of New Castile for the distance of 200 leagues along the newly discovered coast, and invested with all the authority and prerogatives of a viceroy, his associates being left in wholly secondary positions. One of the conditions of the grant was that within six months Pizarro should raise a sufficiently equipped force of two hundred and fifty men, of whom one hundred might be drawn from the colonies; as he could not make up his due complement he sailed clandestinely from San Lucar in January 1530. He was afterwards joined by his brother Hernando with the remaining vessels, and when the expedition left Panama in January of the following year it numbered three ships, one hundred and eighty men, and twenty-seven horses. The subsequent movements of Pizarro belong to the history of Peru (*q.v.*). After the final effort of the Incas to recover Cuzco in 1536–37 had been defeated by Diego de Almagro, a dispute occurred between him and Pizarro respecting the limits of their jurisdiction. This led to battle; Almagro was defeated (1538) and executed; but his supporters conspired, and assassinated Pizarro on the 26th of June 1541.

PIZZICATO (from Ital. *pizzicare*, to pluck or twitch), a term in music for a direction to the players of stringed instruments, that the passage so marked is to be played by plucking the strings with the fingers instead of using the bow.

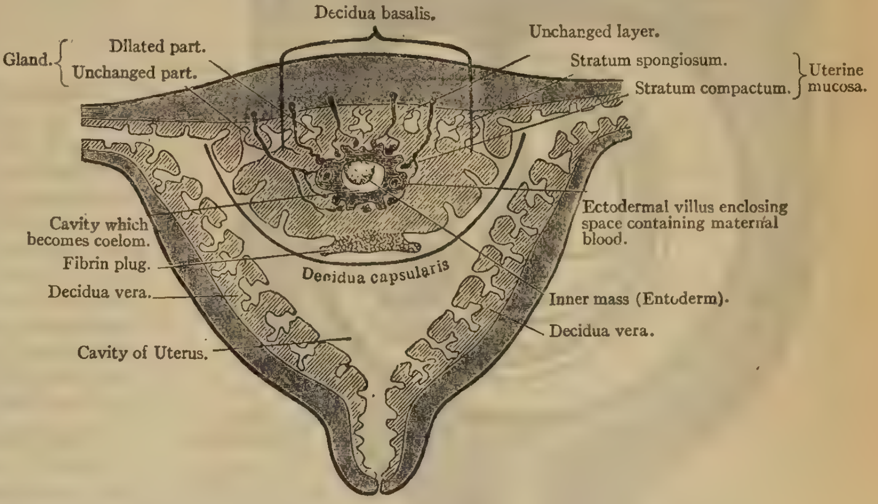
PIZZO, a seaport of Calabria, Italy in the province of Catanzaro, 72 m. by rail N.E. of Reggio, situated on a steep cliff overlooking the Gulf of Santa Eufemia, 351 ft. above sea-level. Pop. (1901), 9172. It has an old castle, in which Joachim Murat, ex-king of Naples, was shot on the 13th of October 1815. The people engage in tunny- and coral-fishing. In 1783 the town was almost destroyed by an earthquake, and it suffered some damage from the same cause in 1905.

PLACARD (15th cent. Fr. *plackart*, from *plaquier*; mod. *plaquer*, to plaster), a bill or poster pasted or affixed to a wall or in any prominent position for the purpose of giving notice to the public of a proclamation, police or other regulations, or of forthcoming events or the like.

PLACE (through Fr. from Lat. *platea*, street; Gr. πλατύς, wide), a definite position in space, whether of limited or unlimited extent, situation or locality; also position in a series or rank; or an office, or employment, particularly one in the service of a government. Special applications are to an open space in a town, a group of buildings, row of houses, or as the name of a residence or manor-house. In certain cases this latter use accounts for the occurrence of parts of a town being known as Place, *e.g.* Ely Place in London, formerly the site of the town residence of the bishops of Ely. A "place of arms" (Fr. *place d'armes*), in fortification, means the wide spaces (suitable for the assembly of troops for a sortie) made by the salients and re-entrants of the covered way. The phrase is also used in a strategic sense to express an entrenched camp or fortress in which a large army can be collected under cover previous to taking the field.

PLACENTA (Lat. for a cake), in anatomy, the organ by which the embryo is nourished within the womb of its mother. When the young one is born the placenta and membranes come away as the "afterbirth." In human anatomy the organ is a circular disk about seven or eight inches in diameter and one and a quarter inches in thickness at its centre, while at its margin it is very thin and is continuous with the foetal membranes. It weighs about a pound.

In order to explain the formation of the placenta it is necessary to encroach to some extent on the domain of physiology. Before each menstrual period, during the child-bearing age of a woman, the mucous membrane of the uterus hypertrophies, and, at the period, is cast off and renewed, but if a fertilized ovum reaches the uterus the casting off is postponed until the birth of the child. From the fact that the thickened mucous membrane lining the interior of the uterus is cast off sooner or later, it is spoken of as the "decidua." The fertilized ovum, on reaching the uterus, sinks into and embeds itself in the already prepared decidua, and, as it enlarges, there is one part of the decidua lying between it and the uterine wall ("decidua serrotina" or "basalis"), one part stretched over the surface of the enlarging ovum ("decidua reflexa" or "capsularis") and one part lining the rest of the uterus ("decidua vera") (see fig 1.).



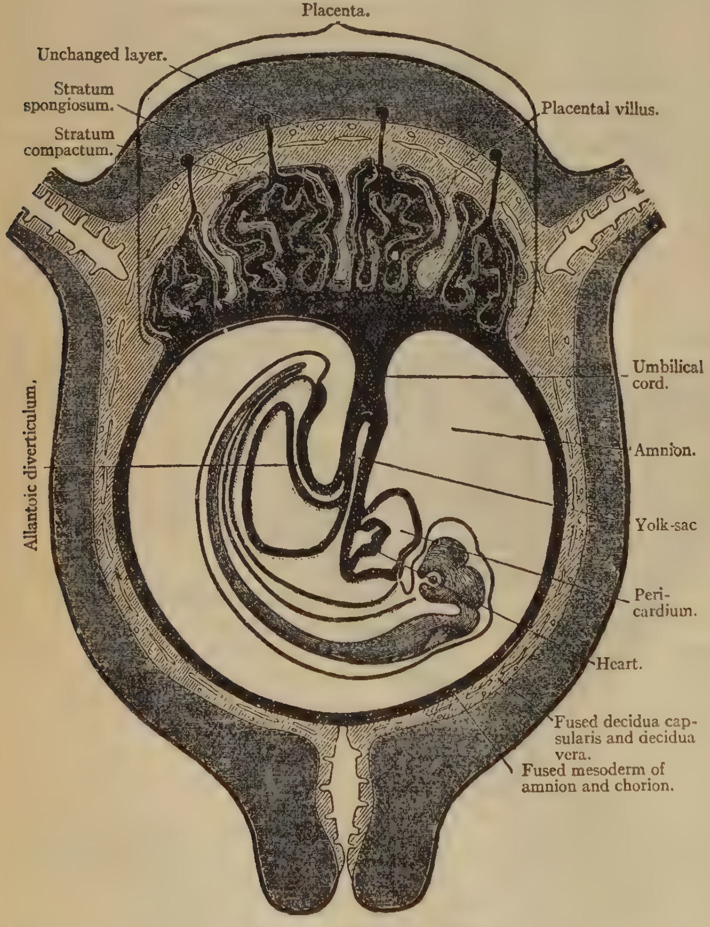
From A. H. Young and A. Robinson, in Cunningham's *Text-Book of Anatomy*.

FIG. 1.—Diagram representing a very young human ovum almost immediately after its entrance into the decidua, and whilst the place of its entrance is still covered with a plug of fibrin. The ectoderm has already proliferated and embraced spaces which contain maternal blood and are continuous with the maternal blood-vessels.

It is the decidua basalis which is specially interesting in considering the formation of the placenta. That part which is nearest the ovum is called the "stratum compactum," but farther away the uterine glands dilate and give a spongy appearance to the mucous membrane which earns this particular layer the name of "stratum spongiosum." Processes grow out from the surface of the ovum which penetrate the stratum compactum of the decidua basalis and capsularis and push their way into the enlarged maternal blood sinuses; these are the "chorionic villi." Later, the "allantoic" or "abdominal stalk" grows from the mesoderm of the hind end of the embryo into the chorionic villi which enter the decidua basalis, and in this blood-vessels pass which push their way into the maternal blood sinuses. Eventually the original walls of these sinuses, together with the false amnion, disappear, and nothing now separates the maternal from the foetal blood except the delicate walls of the foetal vessels covered by some nucleated noncellular tissue, known as *syncytium*, derived from the chorionic epithelium, so that the embryo is able to take its supply of oxygen and materials for growth from the blood of its mother and to give up carbonic acid and excretory matters. It is the gradual enlargement of the chorionic villi in the decidua basalis together with the intervillous maternal blood sinuses that forms the placenta; the decidua capsularis and vera eventually become pressed together as the embryo enlarges, and then, as pressure continues, atrophy. The allantoic stalk elongates enormously, and in its later stages contains two arteries (umbilical) and only one vein (owing to the obliteration of the right one) embedded in some loose connective tissue known as "Wharton's jelly." At first the stalk of the yolk-sac is quite distinct from this, but later the two structures become bound up together (see fig. 2), after which they are known as the "umbilical cord." A distinction must be made between the allantoic stalk and the allantois; the latter is an entodermal outgrowth from the hind end of the mesodaeum or primitive alimentary canal, which in the human subject only reaches a little way toward the placenta. The allantoic stalk is the mass of mesoderm containing blood-vessels which is pushed in front of the allantois and, as has been shown, reaches and blends with the decidua basalis to form the placenta.

For further details see Quain's *Anatomy*, vol. i. (London, 1908); and, for literature, O. Hertwig's *Handbuch der Entwickelungslehre* (Jena).

Comparative Anatomy.—If the placenta is to be regarded as a close union between the vascular system of the parent and embryo, the condition may be found casually scattered throughout the phylum of the Chordata. In such a very lowly member of the phylum as Salpa, a placenta is formed, and the embryo is nourished within the body of its parent. In some of the viviparous sharks, *e.g.* the blue shark (Carcharias), the yolk-sac has ridges which fit into grooves in the wall of the oviduct and allow an interchange of materials between the maternal and foetal blood. This is an example of an "umbilical placenta." In the viviparous blennies (*Zoarces viviparus*), among the teleostean fishes, two or three hundred young are nourished in the hollow ovary, which develops villi secreting nutritive material. Among the Amphibia the alpine salamander (*Salamandra atra*) nourishes its young in its oviducts until the gilled stage of development is past, while in the Reptilia the young of a viviparous lizard (*Seps chalcides*) establish a communication between the yolk-sac anteriorly and the allantois posteriorly, on the one hand, and the walls of the oviduct on the other. In this way both an umbilical and an allantoic placenta are formed.



From A. H. Young and A. Robinson, in Cunningham's *Text-Book of Anatomy*.

Fig 2.—Diagram. Later stage in the development of the placenta, showing the relations of the foetal villi to the placental sinuses, the fusion of the amnion with the inner surface of the chorion, and the thinning of the fused deciduae (capsularis and vera).

The mammals are divided into Placentalia and Aplacentalia; in the latter group, to which the monotremes and most marsupials belong, the ova have a great deal of yolk, and the young, born in a very immature condition, finish their development in their mother's pouch; but although these mammals have no allantoic placenta there is an intimate connexion between the walls of the yolk-sac and the uterine mucous membrane, and so an umbilical or omphalic placenta exists. The name Aplacentalia therefore only means that they have no allantoic placenta. Among the Placentalia the umbilical and allantoic placentae sometimes coexist for some time, as in the case of the hedgehog, the bandicoot and the mouse. In most of the lower placental mammals the allantois is much more developed than in man, and the most primitive type of placenta is that in which villi are formed over the whole surface of the chorion projecting into the decidua of the tubular cornu of the uterus. This is known as a "diffuse placenta," and is met with in the pangolin, pig, hippopotamus, camel, chevrotain, horse, rhinoceros, tapir and whale. When the villi are collected into a number of round tufts or cotyledons, as in most ruminants, the type is spoken of as a "cotyledonous placenta," and an intermediate stage between this and the last is found in the giraffe.

In the Carnivora, elephant, procavia (Hyrax) and aard vark (Orycteropus), there is a "zonary-placenta" which forms a girdle round the embryo. In sloths and lemurs the placenta is dome-shaped, while in rodents, insectivores and bats, it is a ventral disk or closely applied pair of disks, thus differing from the dorsal disk of the ant-eater, armadillo and higher Primates, which is known as a "metadiscoidal placenta." It will thus be seen that the form of the placenta is not an altogether trustworthy indication of the systemic position of its owner. In the diffuse and cotyledonous placentae the villi do not penetrate very deeply into the decidua, and at birth are simply withdrawn, the decidua being left behind in the uterus, so that these placentae are spoken of as non-deciduate while other kinds are deciduate.

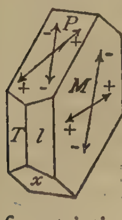
For further details see S. W. W. Turner, *Lectures on the Comparative Anatomy of the Placenta* (Edinburgh, 1876); A. Robinson, "Mammalian Ova and the Formation of the Placenta," *Journ. Anat. and Phys.* (1904) xxxviii., 186, 325. For literature up to 1906, R. Wiedersheim's *Comparative Anatomy of Vertebrates*, translated and adapted by W. N. Parker (London, 1907).

(F. G. P.)

PLAGIARISM, an appropriation or copying from the work of another, in literature or art, and the passing off of the same as original or without acknowledgment of the real authorship or source. The Lat. *plagiarius* meant a kidnapper, stealer or abductor of a slave or child, though it is also used in the modern sense of a literary pilferer or purloiner by Martial (I. 53, 9). The word *plagium* is used in the Digest of the offence of kidnapping or abduction, and the ultimate source is probably to be found in *plaga*, net, snare, trap, cognate with Gr. πλέκειν, to weave, plait. The idea of plagiarism as a wrong is comparatively modern, and has grown up with the increasing sense of property in works of the intellect. (See Copyright.)

PLAGIOCLASE, an important group of rock-forming minerals, constituting an isomorphous series between albite, or soda-felspar and anorthite, or lime-felspar. Intermediate members are thus soda-lime-felspars, which in their crystallographical, optical and other physical characters vary progressively with the chemical composition between the two extremes albite ($NaAlSi_3O_8$) and anorthite ($CaAl_2Si_2O_8$). This variation is continuous in the series, but specific names are applied to members falling between certain arbitrary limits, viz.: Albite, Ab ($=NaAlSi_3O_8$); Oligoclase, Ab_6An_1 to Ab_3An_1; Andesine, Ab_3An_1 to Ab_1An_1; Labradorite, Ab_1An_1 to Ab_1An_3; Bytownite, Ab_1An_3 to Ab_1An_6; Anorthite, An ($=CaAl_2Si_2O_8$).

All the members of the series crystallize in the anorthic (triclinic) system. They possess a perfect cleavage parallel to the basal pinacoid P (001) and a somewhat less pronounced cleavage parallel to the pinacoid M (010). The angle between these two cleavages varies from 86° 24′ in albite to 85° 50′ in anorthite. It was on account of the oblique angle between the cleavages that A. Breithaupt in 1847 gave the name plagioclase (Gr. πλάγιος, oblique, and κλᾶν, to cleave) to these felspars, to distinguish them from the orthoclase felspar in which the corresponding cleavage angle is a right angle. It should be noted that the potash—and potash-soda-felspars, microcline (*q.v.*) an anorthoclase, though also anorthic, are not included in the plagioclase series of soda-lime-felspars. Crystals are usually tabular in habit, parallel to the plane *M*, as shown in the accompanying figure; sometimes, however, they are flattened parallel to *P*, this being a characteristic habit of the pericline variety of albite; microlitic crystals forming the ground-mass of volcanic rocks are usually elongated in the direction of the edge between *P* and *M*.



Twinning is an important character, which is almost invariably present and affords a ready means of distinguishing the plagioclases from other felspars. Most frequent is the twinning according to the "albite law" with *M* as twin-plane. One half of the twin is turned through 180° about the normal to this plane and the two portions are united along the same plane (for figures of twinned crystals see ALBITE). The basal planes of the two portions are inclined to each other at a salient or re-entrant angle of 7° 12′ in albite and 8° 20′ in anorthite. This twinning is usually polysynthetic, being many times repeated, and giving rise to numerous thin lamellae, which are the cause of the fine striations on the cleavage planes *P* and parallel to the edge *PM*, so characteristic of the plagioclases as seen in hand specimens. Viewed in polarized light, thin sections of twinned crystals show a very characteristic banded structure parallel to *M*. A second twin-law is known as the "pericline-law" because of its frequent occurrence in pericline. Here the axis of rotation is the edge *x P* (the crystallographic axis *b*) and the plane of composition is the "rhombic section": the latter is a plane which intersects the prism faces *T* and *l* in a rhomb; it is not a possible face of the crystal, and its position varies in the different species. In addition to being twinned according to these two laws, plagioclase may also be twinned on the Carlsbad-, Baveno- and Manebach-laws, as in orthoclase (*q.v.*).

Constants of Plagioclase Felspars.

Composition.	SiO_2.	Al_2O_3.	Na_2O.	CaO.	Sp. gr.	Melting-point (Centigrade).	Cleavage Angle *PM*.	Angle of Rhombic Section.*	Mean Refractive Index β.	Optical Extinction.		
										On *P*.*	On *M*.*	In sections ⊥M.
Ab	68·7	19·5	11·8	0	2·624	—	86° 24′	+ 27°	1·534	+ 4° 30′	+19°	−16°
Ab_3An_1	62·0	24·0	8·7	5·3	2·659	1340°	86° 8′	+ 3°	1·542	+ 1° 4′	+ 4° 36′	+ 7°
Ab_1An_1	55·6	28·3	5·7	10·4	2·694	1419°	86° 14′	− 1°	1·558	− 5° 10′	−16°	+27°
Ab_1Ab_3	49·3	32·6	2·8	15·3	2·728	1477°	86° 4′	− 9°	1·570	−17° 40′	−29° 28′	+48°
An	43·2	36·7	0	20·1	2·758	1532°	85° 50′	− 16°	1·582	−37°	−36°	+53°

* Angles measured to the edge *PM*.

The optical characters of the plagioclases have been the subject of much study, since they are of great value in determining the constituents of rocks in thin sections under the microscope. The mean indices of refraction and the angles of extinction on the cleavages *P* and *M* are given in the accompanying table. (The meaning of the + and − directions will be seen from the figure, where the face *P* slopes from left to right, *i.e.* the angle between the normals to the faces lettered *P* and *M* is less than 90°). The extinction angles on other faces, or in sections of known orientation in the crystal, also give constants of determinative value: for example, in sections perpendicular to the plane *M* the extinctions, which in crystals twinned according to the albite-law are symmetrical with respect to this place, reach the maximum values given in the table. Not only do the directions of extinction (axes of light-elasticity) vary in the different species, but also the optic axial angle, so that while albite is optically positive, anorthite is negative, and a member near andesine has an axial angle of 90°. The figures seen in convergent polarized light through the *P* and *M* cleavages are characteristic of the different species. A detailed summary of the optical characters and their employment in discriminating the several members of the plagioclase series is given by H. Rosenbuch, *Mikroskopische Physiographie der Mineralien und Gesteine* (4th ed. Stuttgart, 1905).

The plagioclases occur as primary constituents of igneous rocks of almost every kind, and are also frequent as secondary minerals in metamorphic rocks. Albite and oligoclase are more characteristic of acidic rocks, whilst the basic members at the anorthite end of the series are characteristic of rocks containing less silica. The composition may, however, vary even in the same crystal, zoned crystals with a basic nucleus and with shells successively more and more acid towards the exterior being common.

For further particulars respecting individual species and their modes of occurrence see ALBITE; ANDESINE; ANORTHITE; BYTOWNITE LABRADORITE; OLIGOCLASE. (L. J. S.)

PLAGUE (in Gr. λοιμός; in Lat. *pestis*, *pestilentia*), in medicine, a term given to any epidemic disease causing a great mortality, and used in this sense by Galen and the ancient medical writers, but now confined to a special disease, otherwise called Oriental, Levantine, or Bubonic Plague, which may be shortly defined as a specific infectious fever, one variety being characterized by buboes (glandular swellings) and carbuncles. This definition excludes many of the celebrated pestilences recorded in history—such as the plague of Athens, described by Thucydides; that not less celebrated one which occurred in the reign of Marcus Aurelius and spread over nearly the whole of the Roman world (A.D. 164–180),[1] which is referred to, though not fully described, by the contemporary pen of Galen; and that of the 3rd century (about 253), the symptoms of which are known from the allusions of St Cyprian (*Sermo de mortalitate*). There is a certain resemblance between all these, but they were very different from Oriental plague. "Plague" was formerly divided into two chief varieties: (1) mild plague, *pestis minor*, larval plague (Radcliffe), *peste fruste*, in which the special symptoms are accompanied by little fever or general disturbance; and (2) ordinary epidemic or severe plague, *pestis major*, in which the general disturbance is very severe. Cases which are rapidly fatal from the general disturbance without marked local symptoms have been distinguished as fulminant plague (*pestis siderans*, *peste foudroyante*).

History up to 1880.—The first historical notice of the plague is contained in a fragment of the physician Rufus of Ephesus, who lived in the time of Trajan, preserved in the *Collections of Oribasius*.[2] Rufus speaks of the buboes called pestilential as being specially fatal, and as being found chiefly in Libya, Egypt and Syria. He refers to the testimony of a physician Dionysius, who lived probably in the 3rd century B.C. or earlier, and to Dioscorides and Posidonius, who fully described these buboes in a work on the plague which prevailed in Libya in their time. Whatever the precise date of these physicians may have been, this passage shows the antiquity of the plague in northern Africa, which for centuries was considered as its home. The great plague referred to by Livy (lx. *Epitome*) and more fully by Orosius (*Histor.* iv. 11) was probably the same, though the symptoms are not recorded. It is reported to have destroyed a million of persons in Africa, but is not stated to have passed into Europe.

It is not till the 6th century of our era, in the reign of Justinian, that we find bubonic plague in Europe, as a part of the great cycle of pestilence, accompanied by extraordinary natural phenomena, which lasted fifty years, and is described with a singular misunderstanding of medical terms by Gibbon in his forty-third chapter. The descriptions of the contemporary writers Procopius, Evagrius and Gregory of Tours are quite unmistakable.[3] The plague of Justinian began at Pelusium in Egypt in A.D. 542; it spread over Egypt, and in the same or the next year passed to Constantinople, where it carried off 10,000 persons in one day, with all the symptoms of bubonic plague. It appeared in Gaul in 546, where it is described by Gregory of Tours with the same symptoms as *lues inguinaria* (from the frequent seat of buboes in the groin). In Italy there was a great mortality in 543, but the most notable epidemic was in 565, which so depopulated the country as to leave it an easy prey to the Lombards. In 571 it is again recorded in Liguria, and in 590 a great epidemic at Rome is connected with the pontificate of Gregory the Great. But it spread in fact over the whole Roman world, beginning in maritime towns and radiating inland. In another direction it extended from Egypt along the north coast of Africa. Whether the numerous pestilences recorded in the 7th century were the plague cannot now be said; but it is possible the pestilences in England chronicled by Bede in the years 664, 672, 679 and 683 may have been of this disease, especially as in 690 *pestis inguinaria* is again recorded in Rome. For the epidemics of the succeeding centuries we must refer to more detailed works.[1]

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[1] Amm. Marcell. xxiii. 7; see Hecker, *De peste Antoniana* (Berlin, 1835).

[2] Lib. xliv. cap. 17—*Œuvres de Oribase*, ed. Bussemaker and Daremberg (Paris, 1851), iii. 607.

[3] Evagrius, *Hist. eccles.* iv. 29; Procopius, *De bello persico*, ii. 22, 23.

The Black Death.

It is impossible, however, to pass over the great cycle of epidemics in the 14th century known as the Black Death. Whether in all the pestilences known by this name the disease was really the same may admit of doubt, but it is clear that in some at least it was the bubonic plague. Contemporary observers agree that the disease was introduced from the East; and one eyewitness, Gabriel de Mussis, an Italian lawyer, traced, or indeed accompanied, the march of the plague from the Crimea (whither it was said to have been introduced from Tartary) to Genoa, where with a handful of survivors of a Genoese expedition he landed probably at the end of the year 1347. He narrates how the few that had themselves escaped the pest transmitted the contagion to all they met.[2] Other accounts, especially old Russian chronicles, place the origin of the disease still farther east, in Cathay (or China), where, as is confirmed to some extent by Chinese records, pestilence and destructive inundations are said to have destroyed the enormous number of thirteen millions. It appears to have passed by way of Armenia into Asia Minor and thence to Egypt and northern Africa. Nearly the whole of Europe was gradually overrun by the pestilence. It reached Sicily in 1346, Constantinople, Greece and parts of Italy early in 1347, and towards the end of that year Marseilles. In 1348 it attacked Spain, northern Italy and Rome, eastern Germany, many parts of France including Paris, and England; from England it is said to have been conveyed to the Scandinavian countries. In England the western counties were first invaded early in the year, and London in November. In 1349 we hear of it in the midlands; and in subsequent years, at least till 1357, it prevailed in parts of the country, or generally, especially in the towns. In 1352 Oxford lost two-thirds of her academical population. The outbreaks of 1361 and 1368, known as the second and third plagues of the reign of Edward III., were doubtless of the same disease, though by some historians not called the black death. Scotland and Ireland, though later affected, did not escape.

The nature of this pestilence has been a matter of much controversy, and some have doubted its being truly the plague. But when the symptoms are fully described they seem to justify this conclusion, one character only being thought to make a distinction between this and Oriental plague, viz. the special implication of the lungs as shown by spitting of blood and other symptoms. Guy de Chauliac notes this feature in the earlier epidemic at Avignon, not in the later. Moreover, as this complication was a marked feature in certain epidemics of plague in India, the hypothesis has been framed by Hirsch that a special variety of plague, *pestis indica*, still found in India, is that which overran the world in the 14th century. But the same symptoms (haemoptysis) have been seen, though less notably, in many plague epidemics, even in the latest, that in Russia in 1878–1879, and, moreover, according to the latest accounts, are not a special feature of Indian plague. According to a Surgeon-General Francis (*Trans. Epidem. Soc.* v. 398) "haemorrhage is not an ordinary accompaniment" of Indian plague, though when seen it is in the form of haemoptysis. It seems, therefore, impossible to make a special variety of Indian plague, or to refer the black death to any such special form. Gabriel de Mussis describes it even in the East, before its arrival in Europe, as a bubonic disease.

The mortality of the black death was, as is well known, enormous. It is estimated in various parts of Europe at two-thirds or three-fourths of the population in the first pestilence, in England even higher; but some countries were much less severely affected. Hecker calculates that one-fourth of the population of Europe, or 25 millions of persons, died in the whole of the epidemics.

In the 15th century the plague recurred frequently in nearly all parts of Europe. In the first quarter it was very destructive in Italy, in Spain (especially Barcelona and Seville), in Germany and in England, where London was severely visited in 1400 and 1406, and again in 1428. In 1427, 80,000 persons died in Dantzic and the neighbourhood. In 1438–1439 the plague was in Germany, and its occurrence at Basel was described by Aeneas Sylvius, afterwards Pope Pius II. In 1448–1450 Italy (Kircher), Germany (Lersch, from old chronicles), France and Spain, were ravaged by a plague supposed to have arisen in Asia, scarcely less destructive than the black death. England was probably seldom quite free from plague, but the next great outbreak is recorded in 1472 and following years. In 1466, 40,000 persons died of plague in Paris; in 1477–1485 the cities of northern Italy were devastated, and in 1485 Brussels. In the fifteenth year of Henry VII. (1499–1500) a severe plague in London caused the king to retire to Calais.

The 16th century was not more free from plague than the 15th. Simultaneously with a terrible pestilence which is reported to have nearly depopulated China, plague prevailed over Germany, Holland, Italy and Spain, in the first decade of the century, and revived at various times in the first half. In 1529 there was plague in Edinburgh; in London in 1537–1539, and again 1547–1548; and also in the north of England, though probably not absent before. Some of the epidemics of this period in Italy and Germany are known by the accounts of eminent physicians, as Vochs, Fracastor, Mercurialis, Borgarucci, Ingrassia, Massaria, Amici, &c.,[3] whose writings are important because the question of contagion first began to be raised, and also plague had to be distinguished from typhus fever, which began in this century to appear in Europe.

The epidemic of 1563–1564 in London and England was very severe, a thousand dying weekly in London. In Paris about this time plague was an everyday occurrence, of which some were less afraid than of a headache (Borgarucci). In 1570, 200,000 persons died in Moscow and the neighbourhood, in 1572, 50,000 at Lyons; in 1568 and 1574 plague was at Edinburgh, and in 1570 at Newcastle. When, however, in 1575 a new wave of plague passed over Europe, its origin was referred to Constantinople, whence it was said to have spread by sea to Malta, Sicily and Italy, and by land through the Austrian territories to Germany. Others contended that the disease originated locally; and, indeed, considering previous history, no importation of plague would seem necessary to explain its presence in Europe. Italy suffered severely (Venice, in 1576, lost 70,000); North Europe not less, though later; London in 1580–1582. In 1585 Breslau witnessed the most destructive plague known in its history. The great plague of 1592 in London seems to have been a part of the same epidemic, which was hardly extinguished by the end of the century, and is noted in London again in 1599. On the whole, this century shows a decrease of plague in Europe.

In the first half of the 17th century plague was still prevalent in Europe, though considerably less so than in the middle ages. In the second half a still greater decline is observable, and by the third quarter the disease had disappeared or was disappearing from a great part of western Europe. The epidemics in England will be most conveniently considered in one series. From this time onwards we have the guidance of the "Bills of Mortality" issued in London, which, though drawn up on the evidence of ignorant persons, are doubtless roughly true. The accession of James I. in 1603 was marked by a very destructive plague which killed 38,000 in London. In this and subsequent years the disease was widely diffused in England—for instance, Oxford, Derbyshire, Newcastle It prevailed at the same time in Holland, and had done so some years previously in northern Germany. In the same year (1603) one million persons are said to have died of plague in Egypt. This plague is said to have lasted eight years in London. At all events in 1609 we have the second great plague year, with a mortality of 11,785. After this there is a remission till about 1620, when plague again began to spread in northern Europe, especially Germany and Holland, which was at that time ravaged by war. In 1625 (the year of the siege of Breda in Holland) is the third great London plague with 35,417 deaths—though the year 1624 was remarkably exempt, and 1626 nearly so. In 1630 was the great plague of Milan, described by Ripamonti.[1] In 1632 a severe epidemic, apparently plague, was in Derbyshire. 1636 is the fourth great plague year in London with a mortality of 10,400, and even in the next year 3082 persons died of the same disease. The same year 7000 out of 20,000 inhabitants of Newcastle died of plague; in 1635 it was at Hull. About the same time, 1635–1637, plague was prevalent in Holland, and the epidemic of Nijmwegen is celebrated as having been described by Diemerbroeck, whose work (*Tractatus de peste*, 4to, 1641–1665) is one of the most important on the subject. The English epidemic was widely spread and lasted till 1647, in which year, the mortality amounting to 3597, we have the fifth epidemic in London. The army diseases of the Civil Wars were chiefly typhus and malarial fevers, but plague was not unknown among them, as at Wallingford Castle (Willis, "Of Feavers," *Works*, ed. 1681, p. 131) and Dunstar Castle. From this time till 1664 little was heard of plague in England, though it did not cease on the Continent. In Ireland it is said to have been seen for the last time in 1650.[2]

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[1] See Noah Webster's *History of Epidemic Diseases*, 8vo (2 vols., London, 1800) (a work which makes no pretension to medical learning, but exhibits the history of epidemics in connexion with physical disasters—as earthquakes, famines, &c.); Lersch, *Kleine Pest-Chronik* (8vo, 1880) (a convenient short compendium, but not always accurate); "Athanasii Kircheri Chronologia Pestium" (to A.D. 1656), in *Scrutinium pestis* (Rome, 1658; Leipzig, 1671, 4to); Bascome, *History of Epidemic Pestilences* (London, 1851, 8vo). The most complete medical history of epidemics is Häser's *Geschichte der epidemischen Krankheiten* (3rd ed., Jena, 1882), forming the third volume of his *History of Medicine.*

[2] See the original account reprinted with other documents in Häser, *op. cit.*; also Hecker, *Epidemics of the Middle Ages*, trans. by Babington, Sydenham Soc. (London, 1844); *Volkskrankheiten des Mittelalters*, ed. Hirsch (Berlin, 1865); R. Hoeniger, *Der schwarze Tod in Deutschland* (Berlin, 1882).

[3] Vochs, *Opusculum de pestilentia* (1537); Fracastorius, "De Contagione, &c.," *Opera* (Venice, 1555); Hieron. Mercurialis, *De peste, praesertim de Veneta et Patavina* (Basel, 1577); Prosper Borgarutius, *De peste* (Venice, 1565), 8vo; Filippo Ingrassia, *Informatione del pestifero morbo . . . Palermo e . . . regno di Sicilia* (1575–1576, 4to, Palermo, 1576–1577); A. Massaria, *De peste* (Venice, 1597); Diomedes Amicus, *Tres tractatus* (Venice, 1599), 4to; Victor de Bonagentibus, *Decem problemata de peste* (Venice, 1556), 8vo; Georgius Agricola, *De peste libri tres* (Basel, 1554) 8vo. The works of English physicians of this period are of little medical value; but Lodge's *Treatise of the Plague* (London, 1603) deserves mention.

In 1656 one of the most destructive of all recorded epidemics in Europe raged in Naples; it is said to have carried off 300,000 persons in the space of five months. It passed to Rome, but there was much less fatal, making 14,000 victims only—a result attributed by some to the precautions and sanitary measures introduced by Cardinal Gastaldi, whose work, a splendid folio, written on this occasion (*Tractatus de avertenda et profliganda peste politico-legalis*, Bologna, 1684) is historically one of the most important on the subject of quarantine, &c. Genoa lost 60,000 inhabitants from the same disease, but Tuscany remained untouched. The comparatively limited spread of this frightful epidemic in Italy at this time is a most noteworthy fact. Minorca is said to have been depopulated. Nevertheless the epidemic spread in the next few years over Spain and Germany, and a little later to Holland, where Amsterdam in 1663–1664 was again ravaged with a mortality given as 50,000, also Rotterdam and Haarlem. Hamburg suffered in 1664.

Great Plague of London.

The Great Plague of London.—The preceding enumeration will have prepared the reader to view the great plague of 1664–1665 in its true relation to others, and not as an isolated phenomenon. The preceding years had been unusually free from plague, and it was not mentioned in the bills of mortality till in the autumn of 1664 (Nov. 2) a few isolated cases were observed in the parishes of St Giles and St Martin's, Westminster, and a few occurred in the following winter, which was very severe. About May 1665 the disease again became noticeable, and spread, but somewhat slowly. Boghurst, a contemporary doctor, notices that it crept down Holborn and took six months to travel from the western suburbs (St Giles) to the eastern (Stepney) through the city. The mortality rapidly rose from 43 in May to 590 in June, 6137 in July, 17,036 in August, 31,159 in September, after which it began to decline. The total number of deaths from plague in that year, according to the bills of mortality, was 68,596, in a population estimated at 460,000,[3] out of whom two-thirds are supposed to have fled to escape the contagion. This number is likely to be rather too low than too high, since of the 6432 deaths from spotted fever many were probably really from plague, though not declared so to avoid painful restrictions. In December there was a sudden fall in the mortality which continued through the winter; but in 1666 nearly 2000 deaths from plague are recorded.

According to some authorities, especially Hodges, the plague was imported into London by bales of merchandise from Holland, which came originally from the Levant; according to others it was introduced by Dutch prisoners of war; but Boghurst regarded it as of local origin. It is in favour of the theory that it spread by some means from Holland that plague had been all but extinct in London for some seventeen years, and prevailed in Holland in 1663–1664. But from its past history and local conditions, London might well be deemed capable of producing such an epidemic. In the bills of mortality since 1603 there are only three years when no deaths from plague are recorded. The uncleanliness of the city was comparable to that of oriental cities at the present day, and, according to contemporary testimony (Garencières, *Angliae flagellum*, London, 1647, p. 85), little improved since Erasmus wrote his well-known description. The spread of the disease only partially supported the doctrine of contagion, as Boghurst says: "The disease spread not altogether by contagion at first, nor began only at one place and spread further and further as an eating sore doth all over the body, but fell upon several places of city and suburbs like rain." In fact dissemination seems to have taken place, as usual, by the conversion of one house after another into a focus of disease, a process favoured by the fatal custom of shutting up infected houses with all their inmates, which was not only almost equivalent to a sentence of death on all therein, but caused a dangerous concentration of the poison. The well-known custom of marking such houses with a red cross and the legend "God have mercy upon us!" was no new thing: it is found in a proclamation in the possession of the present writer dated 1641; and it was probably older still. Hodges testifies to the futility and injurious effects of these regulations. The lord mayor and magistrates not only carried out the appointed administrative measures, but looked to the cleanliness of the city and the relief of the poor, so that there was little or no actual want; and the burial arrangements appear to have been well attended to. The college of physicians, by royal command, put forth such advice and prescriptions as were thought best for the emergency. But it is clear that neither these measures nor medical treatment had any effect in checking the disease. Early in November with colder weather it began to decline; and in December there was so little fear of contagion that those who had left the city "crowded back as thick as they fled." As has often been observed in other plague epidemics, sound people could enter infected houses and even sleep in the beds of those who had died of the plague "before they were even cold or cleansed from the stench of the diseased" (Hodges). The symptoms of the disease being such as have been generally observed need not be here considered. The disease was, as always, most destructive in squalid, dirty neighbourhoods and among the poor, so as to be called the "poor's plague." Those who lived in the town in barges or ships did not take the disease; and the houses on London Bridge were but little affected. Of those doctors who remained in the city some eight or nine died, not a large proportion. Some had the rare courage to investigate the mysterious disease by dissecting the bodies of the dead. Hodges implies that he did so, though he left no full account of his observations. Dr George Thomson, a chemist and a disciple of Van Helmont, followed the example, and nearly lost his life by an attack which immediately followed.[4]

The plague of 1665 was widely spread over England, and was generally regarded as having been transmitted from London, as it appeared mostly later than in the metropolis, and in many cases the importation by a particular person could be traced. Places near London were earliest affected, as Brentford, Greenwich, Deptford; but in July or August 1665 it was already in Southampton, Sunderland, Newcastle, &c. A wider distribution occurred in the next year. Oxford entirely escaped, though the residence of the court and in constant communication with London. The exemption was attributed to cleanliness and good drainage.

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[1] Josephus Ripamontius, *De peste anni 1630* (Milan, 1641), 4to.

[2] For this period see Index to *Remembrancia* in *Archives of City of London 1579–1664* (London, 1878); Richardson, *Plague and Pestilence in North of England* (Newcastle, 1852).

[3] Graunt, *Observations on the Bills of Mortality* (3rd ed., London, 1665).

[4] On the plague of 1665 see Nath. Hodges, *Loimologia sive pestis nuperae apud populum londinensem narratio* (London, 1672) 8vo—in English by Quincy (London, 1720), (the chief authority); *Λοιμογραφία or an Experimental Relation of the last Plague in the City of London*, by William Boghurst, apothecary in St Giles's-in-the-Fields (London, 1666),—a MS in British Museum (Sloane 349), containing important details; George Thomson, ΛΟΙΜΟΤΟΜΙΑ, *or the Pest Anatomized*, 8vo (London, 1666); Sydenham, "Febris pestilentialis et pestis annorum 1665–1666," *Opera*, ed. Greenhill, p. 96 (London, 1844); *Collection of Scarce Pieces on the Plague in 1665* (London, 1721), 8vo; Defoe's fascinating *Journal of a Citizen*, which should be read and admired as a fiction, but accepted with caution as history; T. Vincent (minister of the gospel), *God's Terrible Voice in the City*, 8vo (London, 1667); *Calendar of State Papers* (1665–1666; "Domestic" series), by M. E. Green.

After 1666 there was no epidemic of plague in London or any part of England, though sporadic cases appear in bills of mortality up to 1679; and a column filled up with "0" was left till 1703, when it finally disappeared. The disappearance of plague in London was attributed to the Great Fire, but no such cause existed in other cities. It has also been ascribed to quarantine, but no effective quarantine was established till 1720, so that the cessation of plague in England must be regarded as spontaneous.

But this was no isolated fact. A similar cessation of plague was noted soon after in the greater part of western Europe. In 1666 a severe plague raged in Cologne and on the Rhine, which was prolonged till 1670 in the district. In the Netherlands there was plague in 1667–1669, but there are no definite notices of it after 1672. France saw the last plague epidemic in 1668, till it reappeared in 1720. In the years 1675–1684 a new plague epidemic appeared in North Africa, Turkey, Poland, Hungary, Austria and Germany, progressing generally northward. Malta lost 11,000 persons in 1675. The plague of Vienna in 1679 was very severe, causing 76,000 or probably more deaths. Prague in 1681 lost 83,000 by plague. Dresden was affected in 1680, Magdeburg and Halle in 1682—in the latter town with a mortality of 4397 out of a population of about 10,000. Many North German cities suffered about the same time; but in 1683 the plague disappeared from Germany till the epidemic of 1707. In Spain it ceased about 1681; in Italy certain cities were attacked till the end of the century, but not later (Hirsch).

Plague in the 18th Century.—At the beginning of this period plague was very prevalent in Constantinople and along the Danube. In 1703 it caused great destruction in the Ukraine. In 1704 it began to spread through Poland, and later to Silesia, Lithuania, Prussia and a great part of Germany and Scandinavia. In Prussia and Lithuania 283,000 persons perished; Dantzig, Hamburg and other northern cities suffered severely. Copenhagen was attacked in 1710. In Stockholm there was a mortality of 40,000. Certain places near Brunswick (10° E.) marked the western limit of the epidemic; and cholera was arrested at the same spot in later years (Häser).

At the same time the plague spread westward from the Danube to Transylvania and Styria, and (1713) appeared in Austria and Bohemia, causing great mortality in Vienna. Thence it passed to Prague and Ratisbon—to the former, possibly to the latter, almost certainly conveyed by human intercourse. This city (12° E.) was the western limit reached in this year. Häser states that the plague disappeared everywhere in Europe after the great hurricane of the 27th of February 1714.

In 1717 plague raged severely in Constantinople; and in 1719 it made a fresh progress westward into Transylvania, Hungary, Galicia and Poland, but not farther (about 20° E.). It thus appears that each successive invasion had a more easterly western limit, and that the gradual narrowing of the range of plague, which began in the 17th century, was still going on.

This process suffered a temporary interruption by the outbreak of plague of southern France in 1720–1722. In 1720 Marseilles became affected with an epidemic plague, the origin of which was attributed by some to contagion through the ship of a Captain Chataud which arrived on the 20th of May 1720, from Syria, where plague at that time prevailed, though not epidemically when he sailed. Six of the crew had died on the voyage to Leghorn, but the disease was declared not to be plague. Cases of plague occurred, however, on the ship, and on the 22nd of June among porters unloading the cargo. Hence, according to believers in contagion, the disease passed to families in the "old town," the poorest and unhealthiest quarter. In the meantime other ships had arrived from Syria, which were put in quarantine. According to others the plague arose in Marseilles from local causes; and recently discovered data show that suspicious cases of contagious disease occurred in the town before the arrival of Chataud's ship.[1] Opinions were divided, and the evidence appears even now nearly balanced, though the believers in contagion and importation gained the victory in public opinion. The pestilence was fearfully severe. Thousands of unburied corpses filled the streets, and in all 40,000 to 60,000 persons were carried off. In December 1721 the plague passed away, though isolated cases occurred in 1722. It passed to, or at least broke out in, Arles and Aix in 1720, causing great mortality, but in Toulon not till 1721, when it destroyed two-thirds of the population. The epidemic spread generally over Provence, but not to other parts of France, notwithstanding that, as confessed by D'Antrechaus, consul of Toulon, a believer in the exclusive power of contagion, there were abundant opportunities. The disease was in fact, as in other cases, self-limited. In all 87,659 persons are said to have died out of a population of nearly 250,000.[2]

This great epidemic caused a panic in England which led to the introduction (under Mead's advice) of quarantine regulations, never previously enforced, and also led to the publication of many pamphlets, &c., beside Mead's well-known *Discourse on Pestilential Contagion* (London, 1720).

Plague in Sicily in 1743.—An outbreak of plague at Messina in 1743 is important, not only for its fatality, but as one of the strongest cases in favour of the theory of imported contagion. Messina had been free from plague since 1624, and the Sicilians prided themselves on the rigour of the quarantine laws which were thought to have preserved them. In May 1743 a vessel arrived from Corfu, on board of which had occurred some suspicious deaths. The ship and cargo were burnt, but soon after cases of a suspicious form of disease were observed in the hospital and in the poorest parts of the town; and in the summer a fearful epidemic of plague developed itself which destroyed 40,000 or 50,000 persons, and then became extinct without spreading to other parts of Sicily.

Spread of Plague from the East.—Independent of the episodes of Marseilles and Messina, the spread of plague from the East continued to exhibit the above-mentioned law of limitation. In 1738–1744 the disease was in the Ukraine, Hungary, the borders of Carniola, Moravia and Austria, extending along the Carpathians as far as Poland (20° E.), and also in Bukowina (25° E.). It lasted till 1745, and then disappeared from those parts for fifteen years. In 1755–1757 plague prevailed in parts of European Turkey, whence it on one occasion extended into Transylvania, in the neighbourhood of Cronstadt, where it was checked (25·5° E.).[3]

In 1770 a destructive plague arose in Moldavia during the Russo-Turkish War, and shortly afterwards in Wallachia, apparently endemic in the former country at least. It affected also Transylvania and part of Hungary, and still more severely Poland, but was confined to Podolia, Volhynia, the Ukraine and east Galicia (5° E.), not even penetrating as far as Warsaw. After destroying, it is said, 300,000 persons, and without being checked by any quarantine regulations, the plague died out finally in March 1771, being remarkable for its short duration and spontaneous limitation (Häser).

In another direction the plague spread over Little Russia in 1770, and desolated Kieff, while in the next year it broke out in Moscow and produced one of the most destructive epidemics of modern times. More than 50,000 persons, nearly one-fourth of the population, were carried off.[4]

The remaining European plague-epidemics of the 18th century were inconsiderable, but on that very account noteworthy. Transylvania was again affected in 1785, Slavonia and Livonia (a district of eastern Galicia) in 1795–1796 (25° E.), Volhynia in 1798. The disease, while reappearing in the seats of the terrible earlier epidemics, was more limited in its range and of shorter duration.[5] An epidemic in Dalmatia in 1783–1784 is noteworthy in connexion with later outbreaks in the same region. In the last years of the century (1799–1800) there was a new epidemic in Syria and Egypt, where it affected the French and afterwards the English army.

Plague in the 19th Century.—Plague appeared at Constantinople in 1802–1803, about the same time in Armenia (Kars), and in 1801 in Bagdad. It had prevailed since 1798 in Georgia and the Caucasus, and in 1803–1806 began to spread from the north of the Caucasus into Russia, till in 1806 it was established at or near Astrakhan, and in 1807 reached Zareff, 200 m. higher up the Volga. These localities are interesting as being near those where plague appeared in 1877–1878. It is also said to have entered the government of Saratov, but probably no great distance.[6] The plague remained in the Caucasus and Georgia till 1819 at least. In 1828–1831 it was in Armenia, and again in 1840–1843, since which time it has not been heard of in that country.

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[1] *Relation historique de la peste de Marseille* (Cologne, 1721, Paris, 1722, &c.); Chicoyneau, Verny, &c., *Observations et reflexions . . . de la peste* (Marseilles, 1721); Chicoyneau, *Traité de la peste*, Paris, 1744); Littré, article "Peste," in *Dictionnaire de médicine*, xxiv. (Paris, 1841).

[2] D'Antrechaus, *Relation de la peste de Toulon en 1721* (Paris, 1756); G. Lambert, *Histoire de la peste de Toulon en 1721* (Toulon, 1861), quoted by Häser, *Gesch. der epidem. Krankh.*

[3] Adam Chenot, *Abhandlung von der Pest* (Dresden, 1776); *De Peste* (Vienna, 1766).

[4] Samoilowitz, *Mémoire sur la peste en Russie, 1771* (Paris, 1783); Mertens, *De la peste en 1771* (Paris, 1784).

[5] Lorinser, *Pest des orients* (Berlin, 1837) p. 103; Schraud, *Pest in Syrmien*, 1795 (2 vols., Pesth, 1801).

[6] From the annals of the Moravian community of Sarepta on the Volga, *Geschichte der Brüder-Gemeinde Sarepta*, by A. Glitsch (Sarepta and Berlin, 1865); also Tholozan, *Epidémies de peste du Caucase* (Paris, 1879).

In 1808 plague was at Constantinople, in 1809 at Smyrna. In 1812 was a more general epidemic affecting these places and also Egypt. An outbreak at Odessa is supposed to have been brought from Constantinople, and thence to have passed to Transylvania. In 1813 a severe plague at Bucharest is supposed to have been brought from Constantinople. About the same time plague prevailed in Bosnia, and is supposed to have passed thence to Dalmatia in 1815. In 1814–1815 it again appeared in Egypt, and once more invaded the continent of Europe in Albania and Bosnia. Two insular outbreaks, Malta in 1813 and Corfu in 1815, attracted much attention as being both thought to be cases of importation by sea-traffic,[1] and there seems good reason for this opinion.

A panic spread through Europe in 1815 in consequence of an outbreak in Noja on the eastern coast of Italy. According to one view it was imported from the opposite coast of Dalmatia, though no definite history of contagion was established; according to others, it originated endemically in that place. It remained, however, strictly confined to a small district, perhaps in consequence of the extraordinarily rigorous measures of isolation adopted by the Italian government. In 1828 an isolated epidemic appeared in Greece in the Morea, supposed to have been brought by troops from Egypt.[2] In 1824–1825 an outbreak took place at Tutchkoff in Bessarabia; the town was strictly isolated by a military cordon and the disease did not spread.[3] Cronstadt in Transylvania was the scene of a small outbreak in 1828, which was said to be isolated by similar measures (Lorinser). A far more serious epidemic was connected with the campaign of the Russian army against Turkey in 1828–1829. Moldavia, Wallachia and Bessarabia were widely affected; the disease broke out also in Odessa and the Crimea, and isolated cases occurred in Transylvania. The most northerly points reached by the plague were near Czernowitz on the frontier of Bessarabia and Bukowina, and its limitation was as before attributed to the Russian and Austrian military cordons.

In 1831 another epidemic occurred in Constantinople and Roumelia; in 1837 again in Roumelia and in Odessa—its last appearance in these regions, and the last on the European continent except an isolated outbreak in Dalmatia in 1840, and one in Constantinople in 1841.[4]

The plague-epidemics in Egypt between 1833 and 1845 are very important in the history of plague, since the disease was almost for the first time scientifically studied in its home by skilled European physicians, chiefly French. The disease was found to be less contagious than reported to be by popular tradition, and most of the French school went so far as to deny the contagiousness of the disease altogether. The epidemic of 1834–1835 was not less destructive than many of those notorious in history; but in 1844–1845 the disease disappeared.

In 1853 plague appeared in a district of western Arabia, the Asīr country in North Yemen, and it is known to have occurred in the same district in 1815, as it did afterwards in 1874 and 1879. In 1874 the disease extended within four days' march of Mecca. From the scantiness of population the mortality was not great, but it became clear that this is one of the endemic seats of plague.[5]

In June 1858 intelligence was received in Constantinople of an outbreak of disease at the small town Benghazi, in the district of Barca, province of Tripoli, North Africa, which though at first misunderstood was clearly bubonic plague. From later researches there is reason to believe that it began in 1856 or in 1855. The disease did not spread, and ceased in the autumn, to return with less violence in 1859, when it died out. In the autumn of 1873 it returned, but came again to a spontaneous termination.[6]

After the epidemic of Benghazi in 1856–1859, plague was next heard of in the district of Maku, in the extreme north-west of Persia in November 1863. It occurred in a scattered population, and the mortality was not absolutely large.[7]

In 1867 an outbreak of plague was reported in Mesopotamia (Irak), among the marshes of Hindieh bordering on the lower Euphrates. The epidemic began in December 1866 (or probably earlier) and ceased in June 1867. But numerous cases of non-fatal mild bubonic disease (mild plague or *pestis minor*) occurred both before and after the epidemic, and according to Tholozan similar cases had been observed nearly every year from 1856 to 1865.[8]

The next severe epidemic of plague in Irak began in December 1873. But facts collected by Tholozan show that *pestis minor*, or sporadic cases of true plague, had appeared in 1868 and subsequent years. The outbreak of 1873–1874 began about 60 m. from the origin of that of 1867. It caused a much greater mortality and extended over a much wider area than that of 1867, including the towns of Kerbela and Hilleh. After a short interval it reappeared at Divanieh in December 1874, and spread over a much wider area than in the previous epidemics. This epidemic was carefully studied by Surgeon-Major Colvill.[9] He estimated the mortality at 4000. The epidemic ceased in July, but broke out again early in 1876, and in this year extended northwards to Bagdad and beyond. The whole area now affected extended 250 m. from north-west to south-east, and the total number of deaths was believed to be 20,000. In 1877 plague also occurred at Shuster in south-west Persia, probably conveyed by pilgrims returning from Irak, and caused great mortality.

After its customary cessation in the autumn the epidemic began again in October 1876, though sporadic cases occurred all the summer. The disease appeared in 1877 in other parts of Mesopotamia also with less severity than in 1876, but over a wider area, being now announced at Samara, a town 70 m. above Bagdad on the Tigris. The existence of plague in Bagdad or Mesopotamia was not again announced till the year 1884, when accounts again appeared in the newspapers, and in that July the usual official statement was made that the plague had been stamped out.

In 1870–1871 it appeared in a district of Mukri in Persian Kurdistan to the south of Lake Urumiah (far removed from the outbreak of 1863). The epidemic appears, however, to have died out in 1871, and no further accounts of plague there were received. The district had suffered in the great epidemic of plague in Persia in 1829–1835. In the winter 1876–1877 a disease which appears to have been plague appeared in two villages in the extreme north of the province of Khorāsān, about 25 leagues from the south-east angle of the Caspian Sea. In March 1877 plague broke out in Resht, a town of 20,000 inhabitants, in the province of Ghilan, near the Caspian Sea at its south-west angle, from which there is a certain amount of trade with Astrakhan. In 1832 a very destructive plague had carried off half the inhabitants. In 1877 the plague was very fatal. From March to September 4000 persons were calculated to have died. The disease continued till the spring of 1878. In 1877 there was a doubtful report of the same disease at Astrabad, and also in some parts near the Perso-Afghan frontier. In 1878 plague again occurred in Kurdistan in the district of So-uj-Bulak, said by Dr Tholozan to be the same as in the district of Mukri where it occurred in 1870–1871. These scattered outbreaks of plague in Persian territory are the more remarkable because that country had been generally noted for its freedom from plague (as compared with Asiatic Turkey and the Levant).

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[1] Faulkner, *On the Plague in Malta* (London, 1820), 8vo; J. D. Tully, *History of the Plague in Malta, Gozo, Corfu and Cephalonia* (London, 1821), 8vo; White, *Treatise on the Plague* (at Corfu) (London 1847); Calvert, "On the Plague in Malta, 1813," *Med.-Chi. Transactions*, vi. 1.

[2] L. A. Gosse, *Relation de la peste en Grèce, 1827–1828* (Paris, 1838).

[3] Lorinser, *Pest des orients*, p. 319.

[4] For the authorities, see Häser, *Op. cit.*

[5] J. N. Radcliffe, *Report of Local Government Board 1879–1880*, suppl., p. 42.

[6] Tholozan, *La Peste en Turquie dans les temps modernes* (Paris, 1880).

[7] J. Netten Radcliffe, *Report of the Medical Officer of the Privy Council*, &c. (1875); also in *Papers on Levantine Plague*, presented to parliament (1879), p. 7.

[8] Tholozan, *La Peste en Turquie*, p. 86.

[9] See his report cited by Radcliffe, *Papers on Levantine Plague* (1879).

A few cases of plague occurred in January 1877 at Baku on the west shore of the Caspian, in Russian territory.[1]

An outbreak of plague on European soil in 1878–1879 on the banks of the Volga caused a panic throughout Europe.[2] In the summer of 1877 a disease prevailed in several villages in the neighbourhood of Astrakhan and in the city itself, which was clearly a mild form of plague (*pestis minor*). It caused no deaths (or only one due to a complication) and died out apparently spontaneously. An official physician, Dr Kastorsky, who investigated the matter for the government, declared the disease to be identical with that prevailing in the same year at Resht in Persia; another physician, Dr Janizky, even gave it the name of *pestis nostras*. In October 1878 some cases appeared in the *stanitza* or Cossack military settlement of Vetlanka, 130 m. from Astrakhan on the right bank of the Volga, which seem to have puzzled the physicians who first observed them, but on the 30th of November were recognized as being but the same mild plague as had been observed the year before near Astrakhan by Dr Döppner, chief medical officer of the Cossacks of Astrakhan. His report on the epidemic is the only original one we have. At the end of November[3] the disease became suddenly more severe, and most of those attacked died; and from the 21st of December it became still more malignant, death occurring in some cases in a few hours, and without any buboes being formed. No case of recovery was known in this period. At the end of the year it rapidly declined, and in the first weeks of January still more so. The last death was on the 24th of January. In the second half of December, when the disease had already lasted two months, cases of plague occurred in several neighbouring villages, all of an extremely malignant type, so that in some places all who were attacked died. In most of these cases the disease began with persons who had been at Vetlanka, though this was not universally established. The inhabitants of these villages, terrified at the accounts from Vetlanka, strictly isolated the sick, and thus probably checked the spread of the disease. But it evidently suffered a spontaneous decline. By the end of January there were no cases left in the district except at one village (Selitrennoye), where the last occurred on the 9th of February. The total number of cases in Vetlanka, out of a population of about 1700, was 417, of whom 362 died. In the other villages there were about 62 deaths from plague, and not more than two or three cases of recovery. In consequence of the alarm excited by this appearance of plague upon European soil, most European governments sent special commissions to the spot. The British commissioners were Surgeon-Major Colvill and Dr J. F. Payne, who, like all the foreign commissioners, reached the spot when the epidemic was over. With respect to the origin of this epidemic, the possibility of its having originated on the spot, as in Resht and on the Euphrates in very similar situations, is not to be denied. An attempt was made to show that the contagion was brought home by Cossacks returning from the Turkish War, but on absolutely no evidence. In the opinion of Dr Payne the real beginning of the disease was in the year 1877, in the vicinity of Astrakhan, and the sudden development of the malignant out of a mild form of the disease was no more than had been observed in other places. The Astrakhan disease may have been imported from Resht or Baku, or may have been caused concurrently with the epidemics of these places by some cause affecting the basin of the Caspian generally.

Plague in India.—It used to be held as a maxim that plague never appeared east of the Indus; nevertheless it was observed during the 19th century in more than one distinct centre in India. So long ago as 1815 the disease appeared in Guzerat, Kattywar and Cutch, "after three years of severe famine." It reappeared early next year, in the same locality, when it extended to Sind as far as Hyderabad, and in another direction south-east as far as Ahmedabad and Dhollerah. But it disappeared from these parts in 1820 or early in 1821, and was not heard of again till July 1836, when a disease broke out into violence at the town of Pali in Marwar in Rajputana. It spread from Pali to the province of Meywar, but died out spontaneously in the hot season of 1837. The origin of these two epidemics was obscure. No importation from other countries could be traced.

In 1823 (though not officially known till later) an epidemic broke out at Kedarnath in Gurwhal, a sub-district of Kumaon on the south-west of the Himalayas, on a high situation. In 1834 and 1836 other epidemics occurred, which at last attracted the attention of government. In 1849–1850, and again in 1852, the disease raged very severely and spread southward. In 1853 Dr Francis and Dr Pearson were appointed a commission to inquire into the malady. In 1876–1877 another outbreak occurred. The symptoms of this disease, called *maha murree* or *mahamari* by the natives, were precisely those of oriental plague. The feature of blood-spitting, to which much importance had been attached, appeared to be not a common one. A very remarkable circumstance was the death of animals (rats, and more rarely snakes) at the outbreak of an epidemic. The rats brought up blood, and the body of one examined after death by Dr Francis showed an affection of the lungs.[4]

Oriental plague was observed in the Chinese province of Yunnan from 1871, and also at Pakhoi, a port in the Tongking Gulf, in 1882—being said to have prevailed there at least fifteen years. In both places the symptoms were the same, of undoubted bubonic plague. At Pakhoi it recurs nearly every year.[5]

In 1880 therefore plague existed or had existed within ten years, in the following parts of the world: (1) Benghazi, Africa; (2) Persian Kurdistan; (3) Irak, on the Tigris and Euphrates; (4) the Asīr country, western Arabia; (5) on the lower Volga, Russia; (6) northern Persia and the shores of the Caspian; (7) Kumaon and Gurhwal, India; (8) Yunnan and Pakhoi, China.

LITERATURE.—See the following works, besides those already quoted: Kamintus, *Regimen contra epidimiam sive pestem*, 4to, *c.* 1494 (many editions); Jacobus Soldus, *Opus insigne de peste*, 4to (Bologna, 1478); Alex. Benedictus, *De observatione in pestilentia*, 4to (Venice, 1493); Nicolaus Massa, *De febre pestilentia*, 4to (Venice, 1556, &c.); Fioravanti, *Regimento della peste*, 8vo, Venice, 1556; John Woodall, *The Surgeon's Mate*, folio (London, 1639); Van Helmont, *Tumulus pestis*, 8vo (Cologne, 1644, &c.); Muratori, *Trattato del governo della peste*, Modena, 1714; John Howard, *An Account of Lazarettoes in Europe*, &c., 4to (London, 1789); Patrick Russell, *A Treatise of the Plague*, 4to (London, 1791); Thomas Hancock, *Researches into the Laws of Pestilence*, 8vo (London, 1821); Foderé, *Leçons sur les épidémies*, &c., 4 vols. 8vo (Paris, 1822–1824); Ségur Dupeyron, *Recherches historiques*, &c., *sur la peste* (1837); Bulard, *La Peste orientale*, 8vo (Paris, 1839); Griesinger, *Die Infectionskrankheiten* (2nd ed., 8vo, Erlangen, 1864). (J. F. P.)

History since 1880.—The most striking feature of the early history of plague summarized above is the gradual retrocession of plague from the west, after a series of exceedingly destructive outbreaks extending over several centuries, and its eventual disappearance from Europe. It appears to have come to a sudden end in one country after another, and to have been seen there no more. Those lying most to the west were the first to be freed from its presence, namely, England, Portugal and Spain. From all these it finally disappeared about 1680, at the close of a period of pandemic prevalence. Northern and central Europe became free about 1714, and the south of France in 1722. The last outbreak in northern Russia occurred in 1770. After this plague only appeared in the south-east of Europe, where in turn it gradually died away during the first half of the 19th century. In 1841 its long reign on this continent came to an end with an isolated outbreak in Turkey. From that time until quite recently it remained extinct, except in the East. The province of Astrakhan, where a very small and limited outbreak occurred in 1878, is politically in Europe, but geographically it belongs rather to Asia. And even in the East plague was confined to more or less clearly localized epidemics; it showed no power of pandemic diffusion. In short, if we regard the history of this disease as a whole, it appears to have lost such power from the time of the Great Plague of London in 1665, which was part of a pandemic wave, until the present day. There was not merely a gradual withdrawal eastwards lasting nearly two hundred years, but the outbreaks which occurred during that period, violent as some of them were, showed a constantly diminishing power of diffusion and an increasing tendency to localization. The sudden reversal of that long process is therefore a very remarkable occurrence. Emerging from the remote endemic centres to which it had retreated, plague has once more taken its place among the zymotic diseases with which Western communities have to reckon, and that which has for more than a century been little more than a name and a tradition has become the familiar object of investigation, carried on with all the ardour and all the resources of modern science. In what follows an attempt will be made to summarize the facts and indicate the conclusions to be drawn from recent experience.

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[1] J. Netten Radcliffe, *Reports*; Tholozan, *Histoire de la peste bubonique en Perse* (Paris, 1874).

[2] See Radcliffe, *Reports* (1879–1880); Hirsch and Sommerbrodt, *Pest-Epidemie 1878–1879 in Astrachan* (Berlin, 1880); Zuber, *La Peste d'Astrakhan en 1878–1879* (Paris, 1880); Colvill and Payne, *Report to the Lord President of the Council* (1879).

[3] The dates are all reduced to new style.

[4] On Indian plague, see Francis, *Trans. Epidem. Soc. Lond.* iv. 407–408; John Murray, ibid., vol. iv. part 2; J. N. Radcliffe, *Reports of Local Government Board* (1875, 1876, 1877 and for 1879–1880); *Parliamentary Papers* (1879); Frederick Forbes, *On Plague in North-West Provinces of India* (Edinburgh, 1840) (Dissertation); Hirsch, *Handbuch der historischen-geogr. Pathologie*, i. 209 (1860), (Eng. trans. by Creighton, London, 1883); Hecker's *Volkskrankheiten des Mittelalters* (Berlin, 1865), p. 101; Webb, *Pathologia indica* (2nd ed., Calcutta, 1848).

[5] See J. N. Radcliffe's *Report* for 1879–1880, p. 45; Manson in *Reports of Imperial Chinese Customs*, special series No. 2, for half-year ended the 31st of March 1878, 15th issue (Shanghai); Lowry, "Notes on Epidemic Disease at Pakhoi" (1882), ibid., 24th issue, p. 31.

Diffusion.—At the outset it is characteristic of this subtle disorder that the present pandemic diffusion cannot be traced with certainty to a definite time or place of origin. Herein it differs notably from other exotic diseases liable to similar diffusion. For instance, the last visitation of cholera could be traced clearly and definitely to a point of origin in northern India in the spring of 1892, and could be followed thence step by step in its march westward (see CHOLERA). Similarly, though not with equal precision, the last wave of influenza was shown to have started from central Asia in the spring of 1889, to have travelled through Europe from east to west, to have been carried thence across the sea to America and the Antipodes, until it eventually invaded every inhabited part of the globe (see INFLUENZA). In both cases no doubt remains that the all-important means of dissemination is human intercourse. The movements of plague cannot be followed in the same way. With regard to origin, several endemic centres are now recognized in Asia and Africa, namely, (1) the district of Assyr in Arabia, on the eastern shore of the Red Sea; (2) parts of Mesopotamia and Persia; (3) the district of Garwhal and Kumaon in the North-West Provinces of India; (4) Yunnan in China; (5) East and Central Africa. The last was recently discovered by Dr Koch. It includes the district of Kisiba in German East Africa, and extends into Uganda. In applying the term "endemic centres" to these localities, no very precise meaning can be attached to the word. They are for the most part so remote, and the information about them so scanty, that our knowledge is largely guesswork. What we mean is that there is evidence to show that under various names a disease identical with plague has been more or less continuously prevalent for a number of years, but how long and how continuously is not known. Whether any of them are permanent homes of plague the evidence does not enable us to say. They seem, at any rate, to have harboured it since its disappearance from Europe, and probably further investigation would disclose a still wider prevalence. For instance, there are good reasons for believing that the island of Réunion has been subject, since 1840 or thereabouts, to outbreaks under the name of "*lymphangite infectieuse,*" an elegant euphemism characteristically French. In all the countries named plague appears to behave very much as it used to do in Europe from the time of the Black Death onwards. That is to say, there are periods of quiescence, with epidemic outbreaks which attract notice at irregular intervals.

Taking up the story at the point where the earlier historical summary leaves off, we get the following list of countries in which plague is known to have been present in each year (see Local Government Board's Reports): 1880, Mesopotamia; 1881, Mesopotamia, Persia and China; 1882, Persia and China; 1883, China; 1884, China and India (as *mahamari*); 1885, Persia; 1886, 1887, 1888, India (as *mahamari*); 1889, Arabia, Persia and China; 1890, Arabia, Persia and China; 1891, Arabia, China and India (as *mahamari*); 1892, Mesopotamia, Persia, China, Russia (in central Asia); 1893, Arabia, China, Russia and India (as *mahamari*); 1894, Arabia, China and India (as *mahamari*); 1895, Arabia and China; 1896, Arabia, Asia Minor, China, Japan, Russia and India (Bombay); 1897, Arabia, China, Japan, India, Russia and East Africa; 1898, Arabia, Persia, China, Japan, Russia, East Africa, Madagascar and Vienna; 1899, Arabia, Persia, China, Japan, Mesopotamia, East Africa, West Africa, Philippine Islands, Straits Settlements, Madagascar, Mauritius, Réunion, Egypt, European Russia, Portugal, Sandwich Islands, New Caledonia, Paraguay, Argentine, Brazil: 1900, to the foregoing should be added Turkey, Australia, California, Mexico and Glasgow; in 1901, South Africa and in 1902 Russia chiefly at Odessa.

This list is probably by no means exhaustive, but it sufficiently indicates in a summary fashion the extent of that wave of diffusion which set in during the closing years of the 19th century. It did not fully gather way till 1896, when plague appeared in Bombay, but our modern knowledge of the disease dates from 1894, when it attacked Hong Kong and first presented itself to accurate observation. From this point a more detailed account may be given. Plague was recognized at Hong Kong in May 1894, and there can be little doubt that it was imported from Canton, where a violent outbreak—said to have caused 100,000 deaths—was in progress a few months earlier, being part of an extensive wave of infection which is believed to have come originally out of the province of Yunnan, one of the recognized endemic centres, and to have invaded a large number of places in that part of China, including Pakhoi and other seaports. Hong Kong was severely affected, and has never since been entirely free from plague. In two intermediate years—1895 and 1897—very few cases were recorded, but more recently the epidemic has gathered force again. The following table gives the cases and deaths in each of the six years 1894–1899:—

Year.	Cases.	Deaths.	Case Mortality.
			%
1894	2833	2550	90
1895	45	36	80
1896	1204	1078	89
1897	21	18	85
1898	1320	1175	89
1899	1486	1415	95
Total . .	6909	6272	90·7

The excessively high rate of mortality is probably due in part to under-statement of the number of cases. Concealment is practised by the Chinese, who are chiefly attacked, and it is easier to conceal sickness than death. Plague appears to have been equally persistent and destructive on the mainland in southern China during the period indicated, but no accurate details are available. In 1897 the Portuguese settlements of Lappa and Macao were invaded. In addition to the provinces of Yunnan, Kwang-si and Kwang-tung in southern China, plague is reported to have been present for several years in a district in Mongolia to the north of Peking, and distant about "twelve days' ride." More recently several localities in Mongolia and Manchuria have been affected. Formosa was attacked in 1896, and suffered considerably in subsequent years; in 1899 the Japanese government officially reported 2633 cases, with

1974 deaths. Japan itself has had a certain amount of imported plague, but not on a large scale. Speaking generally, the disease has persisted and spread in the Far East since 1894, but precise information is lacking, except with regard to Hong Kong. W. J. Simpson in his *Report on the Causes of the Plague in Hong Kong* (1903) reports the endemicity of the plague in that colony to be maintained by (*a*) infection among rats often connected with infectious material in rat runs or in houses, the virus of which has not been destroyed, (*b*) retention of infection in houses which are rat-ridden, and (*c*) infected clothing of people who have been ill or died of plague. He considers the outbreaks are favoured by the seasonal heat and moisture of the spring and early summer, and the movement from place to place of infected rats or persons. He also believes that human beings may infect rats. In 310 cases of plague examined by Simpson 56% were bubonic, 40% septic and 4% pneumonic.

In 1896 plague appeared in the city of Bombay. It was certainly present in August, but was not recognized until the 23rd of September, and the diagnosis was not bacteriologically confirmed until the 13th of October. This fact should be remembered when failure to recognize the disease on its first appearance occurs elsewhere. The origin of the Bombay invasion is shrouded in obscurity. It is not even known when or in what part of the city it began (Condon, *The Bombay Plague*). Several theories have been put forward, and importation by sea from China is the theory which has met with most acceptance. The native form of plague, known as *mahamari*, is confined to the southern slopes of the Himalaya. It is described above, but that account may be supplemented by some earlier references unearthed by the *Bombay Gazetteer* (vol. iv.). Ibn Batesta notices two destructive pestilences in the 14th century, and Ferishta one in 1443, which he calls *ta'un*, and describes as very unusual in India. At the end of the 16th century there was a pestilence following a prolonged famine, and in the 17th century two violent epidemics are recorded under the names *ta'un* and *wāba*. In the second of these, which occurred in the Ahmedabad district of the Bombay Presidency in 1683–89, buboes are distinctly described. In the 18th century several pestilences are recorded without description. It is at least probable from these notes that even before the undoubted outbreak, which began in Cutch in 1812, India was no stranger to epidemic plague. To return to Bombay and 1896: the infection spread gradually and slowly at first, but during the first three months of 1897 not only was the town of Bombay severely affected, but district after district in the presidency was attacked, notably Poona, Karachi, Cutch Mandvi, Bhiwandi and Daman. The number of cases and deaths reported in the presidency, exclusive of the city, in each year down to the end of 1899, was as follows:—

Year.	Cases.	Deaths.	Case Mortality.
			%
1896	367	273	74·3
1897	49,125	36,797	74·7
1898	90,506	68,061	75·2
1899	131,794	101,485	77·0
Total . .	271,792	206,616	75·8

The corresponding figures for Bombay city are:—

Year.	Cases.	Deaths.	Case Mortality.
			%
1896	2,530	1,801	71·1
1897	11,963	10,232	85·7
1898	19,863	18,160	91·2
1899	19,484	15,830	81·3
Total . .	53,840	46,023	85·4

The total for the presidency, including the city, in four years was 325,632 cases with 252,549 deaths in a population of 26,960,421 (census of 1891). The population of the city is 821,764, but during the earlier plague period large numbers fled, so that the foregoing figures do not give the true plague incidence according to population. Moreover, concealment was extensively practised. The most striking fact brought out by the tables just given is the large and steady increase year by year in the presidency, in spite of all efforts to arrest the spread of infection. It has gone on since 1899, and it has not been confined to Bombay, but has extended over the whole of India. In 1897 it had already penetrated to Rajputana, the Punjab, the North West Provinces and the Central Provinces. In the following year Bengal, Madras, Haidarabad and Mysore were invaded. Not all these provinces suffered alike, but on the whole plague steadily strengthened its hold on India generally, and hardly relaxed it in any part. The most noteworthy details available are as follows, taken from the plague mortality returns published June 1908. In the Punjab from 179 deaths in 1897 the mortality reached a maximum of 334,897 in 1905, in Agra and Oudh they rose from 72 in 1897 to 383,802 in 1905, and in Madras Presidency from 1658 in 1899 to 20,125 in 1904.

The most striking figures, however, are those for Bombay and Bengal which are given below, as well as the total mortality in India.

Year.	Bengal Presidency (including Calcutta).	Bombay Presidency (including Bombay City).	All India.
1896	—	2,219	2,219
1897	—	47,710	47,974
1898	219	86,191	89,265
1899	3,264	96,592	102,369
1900	38,412	33,196	73,576
1901	78,629	128,259	236,433
1902	32,967	184,752	452,655
1903	65,680	281,269	684,445
1904	75,438	223,957	938,010
1905	126,084	71,363	940,821
1906	59,619	51,525	300,355

Outside China and India plague has caused no great mortality in any of the countries in which it has appeared, with the exception perhaps of Arabia, about which very little is known. But some of the outbreaks are interesting for other reasons, and require notice. The first case is the singular occurrence of three deaths at Vienna in October 1898. The earliest victim was an attendant named Barisch, employed in the pathological laboratory of the Vienna General Hospital, and told off to look after the animals and bacteriological apparatus devoted to the investigation of plague, cultures of which had been brought from India by the medical commissioners sent by the Royal Academy of Science in 1897. Barisch was drunk and out all night on the 8th of October; on the 14th of October he fell ill. Plague was suspected, but Dr Müller, who attended the man and had studied the disease in India, would not admit the diagnosis on clinical grounds, nor was it bacteriologically established until the 19th of October. Barisch died on the 18th of October. On the 20th one of the nurses, and on the 21st Dr Müller, fell ill. Both died of pneumonic plague, from which also Barisch had undoubtedly suffered. A second nurse and a sister of mercy had feverish attacks, but no further case occurred. Barisch was shown to have been careless in the performance of his duties, and to have disregarded instructions; and the inference is that he conveyed the infection to his mouth, and so to the lungs, from the bacteriological specimens or inoculated animals. The melancholy incident illustrates several points of interest: (1) the correctness of the bacterial theory of causation, and the identity of the *bacillus pestis* as the cause; (2) the infectious character of the pneumonic type of disease; (3) its high fatality; (4) the difficulty of diagnosis.

The next occurrence of special interest is the appearance of plague in Portugal in 1899, after an absence of more than 200 years. Its origin is shrouded in obscurity. Oporto, the seat of the outbreak, had no connexion by sea with any place known to be infected, and all attempts to trace introduction ended in speculation or assumption. The most probable theory was that soldiers returning home from infected Portuguese possessions in the East brought it with them, but this does not explain the selection of Oporto and the escape of other places. The earliest cases, according to retrospective inquiry, occurred in June 1899; suspicions were aroused in July, but the diagnosis was not established until August. The conclusion reached, after careful investigation by Dr Jorge, the medical officer of health, that the commencement really dated from June, is confirmed by the fact that about that time the riverside labourers, who were first affected, began to notice an illness among themselves sufficiently novel to attract their attention and that of an English ship-owner, who from their description suspected plague. Through him the suspicion was conveyed to the *Medical Times and Gazette*, in which the suggestion of plague at Oporto was made before any public mention of it in the town itself. The outbreak never assumed large proportions. It gained ground by degrees until October, after which it declined, and eventually ceased in February 1900. No recrudescence has been officially announced. The number of cases recorded in a population of 150,000 was 310, with 114 deaths, representing a case mortality of 36·7%. They were widely scattered about the town and outlying suburbs; but no further extension occurred, except some isolated cases at Braga, a town 35 m. distant, and one at Lisbon, in the person of the distinguished bacteriologist, Professor Camara Pestana, who contracted the disease in making a *post-mortem* at Oporto, and died in Lisbon.

The only other appearance of plague in Europe in 1899 was on the Volga. Three places were affected, namely, Kolobovka, and Krasnoyarsk, in the province of Astrakhan, and Samara, higher up the river. All three outbreaks were small and limited, and no further extension took place. A commission appointed by the Russian government pronounced the disease to be undoubtedly plague, and it appears to have been very fatal. The origin was not ascertained.

The most interesting extensions of plague in 1900 were those in Australia and Glasgow. The following towns were affected in Australia: Sydney, in New South Wales; Adelaide, in South Australia; Melbourne, in Victoria; Brisbane, Rockhampton, Townsville, Cairns and Ipswich, in Queensland; Freemantle, Perth and Coolgardie, in West Australia. In none of these, with the exception of Sydney, did plague obtain a serious hold. The total number of cases reported in Queensland was only 123, with 53 deaths. In Sydney there was 303 cases, with 103 deaths, a case mortality of 34%. The infection is supposed to have been brought from Noumea, in New Caledonia, where it was present at the end of 1899; and the medical authorities believe that the first case, which occurred on the 19th of January, was recognized. The outbreak, which hardly reached epidemic proportions, lasted about six months. That in Glasgow was on a still smaller scale. It began, so far as could be ascertained, in August 1900, and during the two months it lasted there were 34 cases and 15 deaths. Once more the disease was not at first recognized, and its origin could not be traced. In 1901 plague invaded South Africa, and obtained a distinct footing both at Cape Town and Port Elizabeth. The total number of cases down to July was 760, with 362 deaths; the number of Europeans attacked was 196, with 68 deaths, the rest being natives, Malays, Indians, Chinese and negroes. With regard to Great Britain, a few ship-borne cases have been dealt with at different ports from time to time since 1896, but except at Glasgow the disease has nowhere obtained a footing on land.

Causation.—Plague is a specific infectious fever, caused by the *bacillus pestis*, which was identified in 1894 by Kitasato, and subsequently, but independently, by Yersin (see PARASITIC DISEASES). It is found in the buboes in ordinary cases, in the blood in the so-called "septicaemic" cases, and in the sputum of pneumonic cases. It may also be present in the urine. *Post mortem* it is found in great abundance in the spleen and liver. Nothing is known of its natural history outside the body, but on cultivation it is apt to undergo numerous involution forms. Its presence in a patient is regarded as positive diagnostic proof of plague; but failure to find or to identify it does not possess an equal negative value, and should not be too readily accepted, for many instances are recorded in which expert observers have only succeeded in demonstrating its presence after repeated attempts. It is clear, from the extreme variations in the severity of the illness, that the resisting power of individuals varies greatly. According to the Plague Research Committee of Bombay, the predisposing causes are "those leading to a lower state of vitality," of which insufficient food is probably the most important. There is no evidence that age, sex or race exercises a distinct predisposing influence. The largest incidence in Bombay was on young adults; but then they are more numerous and more exposed to infection, because they go about more than the younger and the older. Similarly, the comparative immunity of Europeans in the East may be explained by their different conditions of life. It is doubtful whether the distinction drawn between *pestis minor* and *pestis major* has a real aetiological basis. Very mild cases occurring in the course of an outbreak of typical plague may be explained by greater power of resistance in individuals, but the epidemic prevalence of a mild illness preceding the appearance of undoubted plague suggests some difference or modification of the exciting cause. "It is impossible," writes Sir Richard Thorne (Local Government Board Report, 1898–1899), "to read the medical history of this disease in almost every part of the world without being impressed with the frequency with which recognized plague has been preceded by ailments of such slight severity, involving some bubonic enlargement of glands and some rise in body-temperature, as to mask the real nature of the malady." Considering the great importance of arresting the spread of infection at the outset, and the implicit reliance placed upon bacteriological criteria, the aetiology of such antecedent ailments deserves more attention than has hitherto been paid to it. Of course plague does not stand alone in this respect. Epidemic outbreaks of other diseases—for instance, cholera, diphtheria and typhoid fever—are often preceded and followed by the prevalence of mild illness of an allied type; and the true significance of this fact is one of the most important problems in epidemiology. In plague, however, it is of special importance, on account of the peculiarly insidious manner in which this disease fastens itself upon a locality.

The path by which the bacillus enters the body varies. In pneumonic cases it is presumed to enter by the air-passages, and in bubonic cases by the skin. The Bombay Plague Research Committee, whose experience is unequalled, say: "In a number of instances points of inoculation were found on the extremities of patients, from which plague cultures were obtained, and in these cases buboes were found above the point of inoculation. In the majority of instances, however, no local indication could be found marking the point at which the microbe was implanted." From the fact that bacilli are hardly ever found in the blood of bubonic cases it may be inferred that they are arrested by the lymphatic glands next above the seat of inoculation, and that the fight—which is the illness—takes place largely in the bubo; in non-bubonic cases they are not so arrested, and the fight takes place in the general circulatory system, or in the lungs. As might be expected from these considerations, the bubonic type is very little infectious, while pneumonic cases are highly so, the patients no doubt charging the surrounding atmosphere by coughing. Whether infection can be introduced through the digestive tract by infected food is doubtful. The bacillus is non-resistant and easily killed by heat and germicide substances, particularly acids. Little is known of its toxic action; only a weak toxin has been obtained from cultures. Of the lower animals, mice, rats, guinea-pigs, rabbits, squirrels and monkeys are susceptible to the bacillus; horses, cattle, sheep, goats, pigs, dogs and cats are more or less resistant, but cats and dogs have been known to die of plague (Oporto, Daman, Cutch and Poona). In the Great Plague of London they were believed to carry the infection, and were killed in vast numbers. The bacillus has been demonstrated in the bodies of fleas, flies, bugs and ants.

Clinical Characters.—One of the results of recent observation is the classification of plague cases under three heads, which have already been mentioned several times: (1) bubonic, (2) pneumonic, (3) septicaemic. (The word "pesti-caemic" is also used instead of "septi-caemic," and though etymologically objectionable, it is otherwise better, as "septicaemic" already has a specific and quite different meaning.) It should be understood that this classification is a clinical one, and that the second and third varieties are just as much plague as the first. It is necessary to say this, because a misleading use of the word "bubonic" has given rise to the erroneous idea that true plague is necessarily bubonic, and that non-bubonic types are a different disease altogether. The word "plague"—or "pest," which is the name used in other languages—had originally a general meaning, and may have required qualifications when applied to this particular fever; but it has now become a specific label, and the prefix "bubonic" should be dropped.

The illness varies within the widest limits, and exhibits all gradations of severity, from a mere indisposition, which may pass almost unnoticed, to an extreme violence, only equalled by the most violent forms of cholera. The mild cases are always bubonic; the other varieties are invariably severe, and almost always fatal. Incubation is generally from four to six days, but it has been observed as short as thirty-six hours and as long as ten days (Bombay Research Committee). Incubation, however, is so difficult a thing to determine that it is unwise to lay down any positive limit. As a rule the onset is sudden and well marked. The symptoms may be described under the headings given above. (1) Bubonic cases usually constitute three-fourths of the whole, and the symptoms may therefore be called typical. In a well-marked case there is usually an initial rigor—in children convulsions—followed by a rise of temperature, with vomiting, headache, giddiness, intolerance to light; pain in epigastrium, back and limbs; sleeplessness, apathy or delirium. The headache is described as splitting; delirium is of the busy type, like delirium tremens. The temperature varies greatly; it is not usually high on the first day—from 101° to 103°—and may even be normal, but sometimes it rises rapidly to 104° or 105° or even 107° F.; a fall of two or three degrees on the second or third day has frequently been observed. The eyes are red and injected; the tongue is somewhat swollen, and at first covered with a thin white fur, except at the tip and edges, but later it is dry, and the fur yellow or brownish. Prostration is marked. Constipation is the rule at first, but diarrhoea may be present, and is a bad sign. A characteristic symptom in severe cases is that the patient appears dazed and stupid, is thick in speech, and staggers. The condition has often been mistaken for intoxication. There is nothing, however, in all these symptoms positively distinctive of plague, unless it is already prevalent. The really pathognomonic sign is the appearance of buboes or inflamed glands, which happens early in the illness, usually on the second day; sometimes they are present from the outset, sometimes they cannot be detected before the third day, or even later. The commonest seat is the groin, and next to that the axilla; the cervical, submaxillary and femoral glands are less frequently affected. Sometimes the buboes are multiple and on both sides, but more commonly they are unilateral. The pain is described as lancinating. If left, they usually suppurate and open outwards by sloughing of the skin, but they may subside spontaneously, or remain hard and indurated. Petechiae occur over buboes or on the abdomen, but they are not very common, except in fatal cases, when they appear shortly before death. Boils and carbuncles are rare. (2) Pneumonic plague was observed and described in many of the old epidemics, and particularly by two medical men, Dr Gilder and Dr Whyte, in the outbreak in Kathiawar in 1816; but its precise significance was first recognized by Childe in Bombay. He demonstrated the presence of the bacilli in the sputa, and showed that the inflammation in the lungs was set up by primary plague infection. The pneumonia is usually lobular, the onset marked by rigors, with difficult and hurried breathing, cough and expectoration. The prostration is great and the course of the illness rapid. The breathing becomes very hurried—forty to sixty respirations in the minute—and the face dusky. The expectoration soon becomes watery and profuse, with little whitish specks, which contain great quantities of bacilli. The temperature is high and irregular. The physical signs are those of broncho-pneumonia; oedema of the lungs soon supervenes, and death occurs in three or four days. (3) In septicaemic cases the symptoms are those of the bubonic type, but more severe and without buboes. Prostration and cerebral symptoms are particularly marked; the temperature rises rapidly and very high. The patient may die comatose within twenty-four hours, but more commonly death occurs on the second or third day. Recovery is very rare.

There is no reason for doubting that the disease described above is identical with the European plagues of the 14th and subsequent centuries. It does not differ from them in its clinical features more than epidemics of other diseases are apt to vary at different times, or more than can be accounted for by difference of handling. The swellings and discolorations of the skin which play so large a part in old descriptions would probably be equally striking now but for the surgical treatment of buboes. Similarly, the comparatively small destructiveness of modern plague, even in India, may be explained by the improved sanitary conditions and energetic measures dictated by modern knowledge. The case mortality still remains exceedingly high. The lowest recorded is 34% in Sydney, and the highest 95% at Hong Kong in 1899. During the first few weeks in Bombay it was calculated by Dr Viegas to be as high as 99%. It is very much higher among Orientals than among Europeans. In the Bombay hospitals it was about 70% among the former, and between 30 and 40% among the latter, which was much the same as in Oporto, Sydney and Cape Town. It appears, therefore, that plague is less fatal to Europeans than cholera. The average duration of fatal cases is five or six days; in the House of Correction at Byculla, where the exact period could be well observed, it was five and a half days. Patients who survive the tenth or twelfth day have a good chance of recovery. Convalescence is usually prolonged. Second attacks are rare, but have been known to occur.

Diagnosis.—When plague is prevalent in a locality, the diagnosis is easy in fairly well-marked cases of the bubonic type, but less so in the other varieties. When it is not prevalent the diagnosis is never easy, and in pneumonic and septicaemic cases it is impossible without bacteriological assistance. The earliest cases have hardly ever been even suspected at the time in any outbreak in a fresh locality. It may be taken at first for almost any fever, particularly typhoid, or for venereal disease or lymphangitis. In plague countries the diseases with which it is most liable to be confounded are malaria, relapsing fever and typhus, or broncho-pneumonia in pneumonic cases.

Treatment.—The treatment of plague is still symptomatic. The points requiring most attention are the cerebral symptoms —headache, sleeplessness, delirium, &c.—and the state of the heart. Alcohol and cardiac stimulants may be required to prevent heart failure. Speaking generally, it is important to preserve strength and guard against collapse. Extracts of supra-renal gland have been found useful. Buboes should be treated on ordinary surgical principles. An antitoxic serum has been prepared from horses by the Institut Pasteur in France, but has not met with success. The results in India obtained by British and various foreign observers were uniformly unfavourable, and the verdict of the Research Committee (1900) was that the serum had "failed to influence favourably the mortality among those attacked." Success was somewhat noisily claimed for an improved method tried in Oporto, but the evidence is of little or no value. Of 142 cases treated, 21 died; while of 72 cases not treated, 46 died; but the former were all hospital patients, and included several convalescents and many cases of extreme mildness, whereas the non-serum cases were treated at home or not at all, some being only discovered when death had made further concealment impossible. Later observations have, however, established that the Yersin-Roux serum is of undoubted benefit when used early in the case, in fact during the first twenty-four hours. Very large doses, so much as 150 cc. may be injected subcutaneously or preferably intravenously, and it is stated to modify the whole course of the disease. Another serum has been prepared by Lustig and Galeotti.

Morbid Anatomy.—(1) Bubonic cases. A bubo is found to consist of a chain of enlarged glands, surrounded by a mass of engorged connective tissue, coagulated blood and serum Nearly all the lymphatic glands in the body are a little swollen, but the lymphatic vessels show little or no change. The spleen and liver are always enlarged, the former to sometimes twice or thrice its natural size. The lungs are engorged and oedematous, and often show haemorrhages. The kidneys are enlarged and congested. The serous membranes show petechiae and haemorrhages. The right side of the heart is frequently dilated, with clots in the cavities. The heart muscle is normal, or soft and friable. The substance of the brain, spinal cord and nerve-trunks is normal, but the membranes are engorged. (2) Pneumonic cases. The lymphatic glands are hardly affected. There is general engorgement and oedema of the lungs, with pneumonic patches varying in size and irregularly distributed. (3) Septicaemic cases. Nearly all the lymphatic glands in the body are involved, and have a characteristic appearance. They are enlarged to the size of an almond, rounded, firm and pink; there is some engorgement and oedema on section; the substance is rather soft, and can be scraped off with a knife. The surrounding tissue is not engorged or oedematous. The description of the other organs given under (1) applies also to (2) and (3).

Dissemination.—Given the bacillus, the questions arise, How is it disseminated? and What are the conditions that favour its propagation? That it is conveyed from person to person is an undoubted fact, proved by innumerable cases, and tacitly implied by the word “ infectious,” which is universally allowed. The sick are a source of danger and one means of dissemination, and, since the illness may be so slight as to pass unrecognized, an obviously insidious one. The ambulatory plague patient goes far to explain the spread of the disease without leaving any track. But there is evidence that persons may carry the infection and give it to others without being ill at all themselves. One such case occurred at Glasgow, and another at Oporto. In the Glasgow case the wife of a laundryman employed in handling plague linen contracted the disease. She was brought into connexion with it in no other way, and there can be no doubt that she took it from her husband, though he was not ill at all himself. The Oporto instance is still more conclusive. Two little girls had plague at Argoncilhe, a suburb some miles from Oporto, and were the only cases which occurred in that place. Their father was a riverside labourer, who lodged during the week in Oporto, but went home for Sunday. He was not ill, but several cases of plague occurred in the house in which he lodged. How the poison passes from one person to another is less clear. In pneumonic cases patients no doubt spread it around them by coughing, and others may take it up through the air-passages or the skin; but even then the range of infection is small, and such cases are comparatively rare. In the vast majority of cases the bacilli are in the lymphatic or the circulatory system, and aerial convection, even for a short distance, seems highly improbable. This view is borne out by the experience in hospitals and with “ contacts,” which goes to show that with reasonable care and under fair conditions the risk of infection from ordinary plague patients is very small. When persons live crowded together in close contact, and when they are careless with regard to discharges of all kinds from patients, the risk is obviously much increased. Discharges—vomited matters, sputa, urine and faeces—are possible media by which plague is spread from person to person. They also contaminate clothing, which thus becomes another means of dissemination capable of acting at a distance. This is the most probable explanation of the two cases of indirect infection related above. Failure to catch or induce plague from clothing that has been worn by plague patients proves nothing. Such clothing is not necessarily infectious; indeed, the probability is that it is not, unless contaminated by discharges. There is no evidence that merchandise and food-stuffs are means of dissemination, but a great deal of evidence against such a theory. Then we come to the lower animals. Attention has been concentrated on rats, and some observers seem disposed to lay upon them the whole blame for the propagation and spread of plague, which is held to be essentially a rat-borne disease. The susceptibility of rats has been noted from remote times and in many countries, particularly in China, but it has never attracted so much attention as during the recent prevalence of plague. From one place after another a great mortality among rats was reported, and the broad fact that they do die of plague is incontestable. It is therefore easily intelligible that they may play an important part in multiplying and fixing the poison on a locality. As to how they convey it from man to man the greatest probability is in favour of the flea as an intermediary. Mortality among rats is said to precede the appearance of human plague, but the evidence of this is always retrospective and of a very loose character. At Sydney a careful investigation was made; and the conclusion reached by Dr Tidswell was that “ there was no ground for even a suspicion that our epidemic was being maintained by any process of direct contagion between man and man,” but that rats were the carriers. In Glasgow the experience was just the contrary. Personal connexion was traced in every case, and rats excluded; there was no mortality among them, and of 300 caught and examined none had plague (Chalmers). Similarly, at Oporto, personal connexion was traced in all the earlier cases; there was no mortality among rats, and no evidence to connect them with the outbreak (Jorge). Again, a comparison between rat-infested and rat-free districts in Bombay showed a much higher incidence of plague in the latter. A campaign against rats in Bombay, by which 50,000 or 60,000 were killed in a short time, had no effect in checking the disease. Plague-rats have rarely been found in ships sailing from infected ports; and though millions of these animals must have been carried backwards and forwards from quay to quay between Hong-Kong, Bombay and the great European ports, they have not brought the disease ashore.

By far the most important communication on the rôle of rats in the spread of plague is formed by the “ Report on the Plague Investigations in India ” (*Journal of Hygiene*, vol. vi. No. 4; vol. vii. No. 3, 1907). The chief conclusions arrived at in the report as the result of experiments are the following:—

“1. Healthy rats contracted plague from infected rats when the only apparent means of communication between the two was the rat flea (*pulex cheopis*).

2. In 21 experiments out of 38, 55 % of healthy rats living in flea-proof cages have contracted plague after receiving fleas collected from rats either dead or dying of septicaemic plague; consequently it is proved the rat flea can transmit plague from rat to rat.

3. Close and continuous contact of plague-infected animals with healthy ones does not infect the latter if fleas are excluded.

4. Should fleas be present an epizootic at once starts and spreads in porportion to the number of fleas present.

5. Guinea-pigs set free in plague-infected houses become infected with the rat flea and develop plague in a certain percentage.

6. Fleas caught on plague-infected rats are able to infect rats placed in flea-proof cages.

7. Guinea-pigs placed in plague-infected houses do not contract plague if they are protected from fleas; those placed in cages protected by a border of sticky paper at least six inches in radius, which the fleas cannot jump over, do not contract plague; the others not similarly protected, do.

8. Chronic plague may prevail in rats.

On this report it may, therefore, be taken that aerial infection, except, perhaps, in pneumonic cases, may be excluded, and that the chief source of infection is the flea. It was also shown that animals may become infected through the faeces of a flea which has been fed on plague-infected rats. This may serve to explain the manner in which plague-infected linen and clothing may convey the disease. The report also considers it proved that the bacillus *pestis* multiplies in the stomach of a flea and may remain a considerable time within its host.

Browning Smith says the following facts are admitted as known. (1) Plague can be carried by fleas from an unhealthy rat. (2) A flea can retain the plague bacilli alive for seven or eight days. (3) Man is, in the majority of cases, infected through the skin, though the puncture may not be seen. (4) The rat flea, when finding no rats, will attack man and it will also attack other animals

Very little light has been thrown on the conditions which favour the prevalence of plague. We do not know why it has developed a diffusive activity of late years, nor why it has attacked some places and consistently passed by others, such as Singapore. The words "dirt" and "insanitary conditions" are much used, but such general terms explain nothing. Singapore, where plague has several times been introduced, but never taken hold, is probably quite as dirty and insanitary as Hong-Kong, and it is pertinently remarked by the Bombay Research Committee that filth *per se* has but little influence, inasmuch as "there occurred in the House of Correction at Byculla, where cleanliness is brought as near to perfection as is attainable, an outbreak which exceeded in severity that in any of the filthy *chawls* and tenements around." Again, in Oporto there is an area which combines every possible sanitary defect—dense overcrowding, great poverty, no light, no air, no drainage, no scavenging, water brought in buckets. Plague got into this quarter, but did not spread there; on the other hand, it appeared in other and vastly superior parts of the town. Yet in at least one case neither the patient nor the "contacts" were removed, but were all shut up in one room with a sentry at the door and another in the street. The seasonal variations have been well marked and extremely regular in Bombay. The disease begins to be active in late autumn or the beginning of winter, and reaches its height in February or March, dying down in the summer. Baldwin Latham made an elaborate examination of the meteorological conditions, and more particularly of the vapour tension, from which he draws the conclusion that the seasonal variations are due to exhalation from the ground. His observations are original and worth attention. A simpler explanation is that the people live more indoors, and are so more exposed to infection during the plague season. The curve shows two rises, one at the beginning of winter, and the other at the commencement of the monsoon, and at both these times the people are driven indoors. A broad survey of the epidemiological facts suggests some general conclusions. The outbreaks fall into two well-defined groups: (1) those in which the disease is destructive and persistent, (2) those in which its effects are slight and transient. In the former the poison clearly fastens on the locality, and gradually increases its hold. The place is infected, not merely the people in it; for if they evacuate it, the disease soon ceases among them, and if they return in a short time, they are again attacked. Now the poison is contained, as we have already seen, in the discharges from patients, and in such infected localities the standing conditions and the habits of the people combine to retain the discharges on the premises. The floors, mostly of mud covered with dung, are fouled with spittle, vomit, and urine, and, being seldom or never cleaned out, foster a gradual accumulation of poison, to which infected rats and the concealment of illness contribute. These are just the conditions which prevailed in Europe in the old plague days. They do not prevail now in those "white countries" which have been invaded but have repelled the attack with comparative ease and little loss. It may be concluded, with some confidence, from experience and theory alike, that localities where they do not prevail may fail to keep plague out, but have very little to fear from it, except the disturbance of trade caused by the traditional terrors that still cling to the name.

Prevention.—The principles are the same as those which govern the prevention of other infectious diseases. "Sanitary cordons" and the like are obsolete. International procedure is supposed to be regulated by the Venice convention of 1897 (see QUARANTINE), but that instrument contains an optional clause, which allows countries to do as they please with their own frontiers. Except Great Britain and Germany, they all retain quarantine in a more or less stringent form at seaports. It is generally used as a system of local extortion imposed upon travellers and shipping. According to the Venice convention, ships are divided into (1) healthy, (2) suspected, (3) infected. (1) Healthy are those free from plague throughout the voyage; (2) suspected, those in which plague has occurred, but no fresh case within twelve days; (3) infected, those in which plague has occurred within twelve days. Great Britain relies on medical inspection, removal of sick or suspected cases, and supervision of the healthy arriving on an infected ship; infected clothing is burnt and infected ships are disinfected. The procedure is the same as for cholera, but it has been equally successful. Ships passing through the Suez Canal are subject to similar inspection; sick persons are landed at Moses Wells, and suspected ones detained. The risk of importing plague from India has been materially lessened by medical inspection of outward-bound ships at the principal ports. This has been very thoroughly carried out at Bombay with good results. In 1897 pilgrimages from India to the Hedjaz were prohibited. By the Venice convention a number of articles of merchandise are classed as susceptible and liable to be refused admission, but the only ones which there is any reason to consider dangerous are used clothing and rags. A watch should be kept on rats at ports of arrival and on board ships from infected countries.

When plague is present in a place, the measures to be taken are the usual ones for dealing with infectious disease, with some additions. The sick and suspected should be removed in special ambulances to an isolation hospital, their soiled linen, &c., should be burnt, and the premises disinfected. Corrosive sublimate in an acid solution is the best disinfectant, but sulphuric acid, 1 in 250, is efficient and cheaper. Suspected cases should be bestowed in a special isolated building until the diagnosis is fully determined. "Contacts" should be kept under observation. Rats should be exterminated as far as possible, especially by means of the Danysz virus, which spreads a disease amongst rats which cannot be communicated to man. The greatest care should be taken in dealing with the hospital linen and discharges from patients. Hospital staffs should be kept apart. Inoculation with Haffkine's prophylactic fluid should be offered to all persons willing to avail themselves of it. It is especially desirable for hospital and ambulance staffs to be inoculated with a vaccine prepared from sterilized cultures of plague bacillus. Inoculation is harmless, and the results obtained in India justify a favourable opinion of its protective efficacy.[1] At Hubli, where nearly the whole population was inoculated between the 11th of May and the 27th of September

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[1] The system of inoculation against plague with a fluid prepared from sterilized virus of the disease was introduced in India by Professor Haffkine early in 1897. The composition of this fluid was subjected to a searching inquiry by the Indian Plague Commission, who pronounced its employment to be free from danger, and it was used on a large scale in various parts of India without producing injurious effects. In September 1902 the standard method of manufacturing this fluid was changed by the director of the Plague Institute on his own authority, with the object of expediting the process, and thus meeting the heavy demand then being made by the Punjab government in connexion with a large scheme of inoculation. The change involved the omission of a small proportion of carbolic acid which had up till then been added to the original fluid as a further precaution against contamination. The new fluid, or water agar process, contained no carbolic acid, other methods being relied upon to ensure its purity. On the 6th of November 1902, nineteen persons who had been inoculated on the 30th of October in the village of Malkowal from a single bottle (labelled 53-n) of the new fluid were found to be suffering from tetanus, and all of them subsequently died. A commission, consisting of Sir Lawrence Jenkins, Lieut.-Colonel Bomford, M.D., principal of the Medical College, Calcutta, and Major Semple, R.A.M.C., director of the Pasteur Institute, Kasauli, was appointed by the government of India to inquire into the disaster. They found that the germ of tetanus had been introduced into the fluid before the bottle was opened at Malkowal, and they thought it probable that this might have occurred owing either to insufficient sterilization or to the process of filling the bottle from a larger flask having been performed with defective precautions. They also expressed the opinion that carbolic acid was a valuable agent in restraining tetanus growth when added to plague prophylactic, and they, therefore, thought that its omission was a grave mistake. Experiments undertaken in India by two independent inquiries appeared to confirm the view, and their conclusions, together with the data on which they were based, were submitted with the report of the commission for examination and further experiment to the Lister Institute in London. With reference to the findings of the Malkowal commission the Institute were asked to report: (1) On the comparative efficacy of the standard and new fluids as a

1898, the mean mortality among the inoculated was 1·3%; among the uninoculated 13·2%. At Daman the mortality was—inoculated 1·6%, uninoculated 24·6%; at Dharwar, inoculated 1·2%, uninoculated 5·2%. In all these cases the numbers dealt with were large and the test fair.

Simpson, in *The Practitioner* (Dec. 1906), gives an analysis of the results of Haffkine's serum inoculations as follows:—

Year.	Case Mortality.	
	Uninoculated.	Inoculated.
1897–1900 average	60·99	36·55
1900–1901 ,,	60·59	36·50
1901–1902 ,,	65·12	35·07
1902–1903 ,,	60·1	23·9

In Poona, out of 5595 uninoculated cases the incidence was 6·8%, while in 1300 inoculated cases it was only 0·33%. Klein also prepares a new prophylactic from the dried organs of a guinea-pig, and one of the most interesting experiments is that of Strong (*Archiv für Schiffs- und tropische Hygiene*, April, 1906), who uses for producing immunity in man a living virulent culture of the bacillus *pestis*. He immunized 40 persons without mishap and with no more unpleasant results than those occurring after vaccination. Inoculation protects against attack, and greatly modifies the illness when it fails to protect. How long the protection lasts has not been determined, but it appears to be several months at least.

The main authorities for the researches into plague are in the official reports of recent years from India and elsewhere. See generally W. J. Simpson, *A Treatise on Plague* (1905).

(A. Sl.; H. L. H.)

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protection against plague; (2) on the comparative liability of each fluid to contamination; and (3) on the probable origin of tetanus virus in the Malkowal cases. Their report on these points (Dec. 1904) contained the following conclusions: (1) "The Institute sees no reason to differ from the conclusions of the commission that the new prophylactic is not less efficacious than the old. (2) The Institute is of opinion that in the hands of more or less unskilled workers it is easier to ensure freedom from contamination by Haffkine's 'standard method' of manufacturing plague vaccine than with the 'water agar process' as employed by him. (3) The Institute is in entire agreement with the commission as to the value of 5% carbolic acid in restraining tetanus growth when added to plague prophylactic, and its experiments emphasize still further the importance of this addition in preventing growth and toxin formation in a vaccine which might be liable to the possibility of contamination with spores of tetanus. (4) The conclusions of the Institute coincide with those of the commission that in all probability tetanus was at the time of inoculation in the fluid contained in the bottle, but that it is impossible to determine at what stage in its history or in what way the bottle (53-n) became contaminated."

The government decided, on the advice of the director, that only the standard fluid should be manufactured at the plague institute. This fluid was sterilized by methods approved by the Indian Plague Commission and contained the requisite proportion of carbolic acid. It was bottled by a new method patented by Dr E. Maynard.

The result of the inquiries by the commission and the Lister Institute led to a protracted controversy with regard to the responsibility of Mr Haffkine's laboratory, and to his subsequent treatment by the government of India; and the leading bacteriologists in England warmly took up his cause. A parliamentary "Return of Papers" was issued in June 1907, and in *The Times* of the 29th of July there appeared a letter signed by the distinguished pathologists, Ronald Ross, R. T. Hewlett, A. S. Grunbaum, W. J. Simpson, R. F. C. Leith, W. R. Smith, G. Sims Woodhead, E. Klein, S. Flexner and C. Hunter Stewart, pointing out that the evidence, so far from showing that Mr Haffkine's laboratory was to blame, made it clear to those acquainted with bacteriological work that it could have had nothing to do with the occurrence. They agreed that there was strong evidence to show that "the contamination took place when the bottle was opened at Malkowal, owing to the abolition by the plague authorities of the technique prescribed by the Bombay laboratory, and to the consequent failure to sterilize the forceps which were used in opening the bottle, and which during the process were dropped on the ground"; and they complained of the inadequacy of the inquiries made by the Indian government, and called for Mr Haffkine's exoneration. The evidence showed that it had been much too readily believed that the tetanus germs had entered the fluid before the bottle was opened, and that a grave injustice had been done to Mr Haffkine. Acting on this view, in November 1907, the Indian government invited Mr Haffkine again to take up work in India.

PLAICE (*Pleuronectes platessa*), a species of flat-fish, common on the coasts of northern Europe from Iceland to the Bay of Biscay. It is readily recognized by the yellow or orange-coloured spots which are placed in a row along the dorsal and anal fins, and scattered over the body. The eyes are on the right side, and the teeth in the jaws compressed and truncate. The scales are minute and smooth. Plaice, like other flat-fishes, prefer a sandy flat bottom to a rocky ground, and occur in suitable localities in great abundance; they spawn early in spring, and are in finest condition in the month of May. Individuals of seven or eight pounds weight are considered fish of large size, but specimens of double that weight have been caught.

See the monograph by F. J. Cole and J. Johnstone (Liverpool, 1901); and W. Garstang's "Reports on the Natural History of the Plaice" (*Rapports et procès-verbaux du conseil international pour l'exploration de la mer*, 1905 seq.).

PLAID (Gael. *plaide*, Ir. *ploid*, usually taken to be derived from Gael. *peall*, sheepskin, Lat. *pellis*, skin), an outer garment, consisting of an oblong piece of woollen cloth, which has formed the principal outer part of the costume of the Highlanders of Scotland. The wearer wrapped himself in the plaid, the lower portion, reaching to the knees and belted, forming the kilt. Later the lower portion was separated, being called the *philibeg*, the plaid being used as a covering for the shoulders and upper part of the body. The plaids were usually of a checked or tartan pattern. The word is thus used of any cloth made with such a pattern. "Shepherd's plaid" is a cloth with a chequer of black on a white ground.

PLAIN (O. Fr. *plain*, from Lat. *planum*), a level surface; hence in physical geography a tract of country generally quite flat or comparatively so (see GEOGRAPHY). The adjective "plain" signifies "level," and thence smooth, clear, simple, ordinary, &c.

PLAINFIELD, a city of Union county, New Jersey, U.S.A., about 24 m. W. by S. of New York City. Pop. (1910 U.S. census), 20,550. It is served by the Central Railroad of New Jersey and by electric lines connecting with neighbouring towns. It is situated for the most part on a plain; north-east are heights occupied by the suburb of Netherwood, and north in Somerset county, on the slope of the first Watchung Mountain, is the borough of North Plainfield (pop. 1910 U.S. census, 6117), which forms with Plainfield virtually a single residential and business community. Plainfield is one of the most attractive residential suburbs of New York. The city has an excellent public school system, a good public library, with an art gallery and museum. The Muhlenberg hospital, club houses and a driving track are features of the city. The value of the factory products increased from $2,437,434 in 1900 to $3,572,134 in 1905, or 46·6%. Plainfield was settled in 1684, but it was not until 1735 that the first frame house was erected. In 1760 a grist mill was erected, and for several years the place was called Milltown. The township of Plainfield was created out of Westfield township in 1847, and in 1867 Plainfield was chartered as a city.

PLAIN SONG, or PLAIN CHANT (*Gregorian Music*; Lat. *cantus planus*; Ital. *canto gregoriano*; Fr. *plain chant*), a style of unisonous music, easily recognizable by certain strongly marked characteristics, some very ancient fragments of which are believed to have been in use under the Jewish dispensation from a remote period, and to have been thence transferred to the ritual of the Christian Church.

The theories advanced as to the origin of this solemn form of ecclesiastical music are innumerable. The most widely spread opinion is that the older portion of it originated with the Psalms themselves, or at least sprang from the later synagogue music. Another theory traces the origin of plain song to the early Greeks; and the supporters of this view lay much stress on the fact that the scales in which its melodies are composed are named after the old Greek "modes." But, beyond the name, no connexion whatever exists between the two tonalities. Less reasonable hypotheses attribute the origin of the plain song to the Phoenicians, to the Egyptians, to the early Christian converts, and to the musicians of the middle ages.

Towards the close of the 4th century Ambrose of Milan, fearing the loss or corruption of the venerable melodies which had been preserved by means of oral tradition only, endeavoured to restore them to their primitive purity, and to teach the clergy to sing them with greater precision. A still more extensive work of the same nature was undertaken, two centuries later, by Pope Gregory the Great. And thus arose two schools of ecclesiastical music, still known as the "Ambrosian" and the "Gregorian chant"—the first of which is practised only in the diocese of Milan, while the latter is universally accepted as the authorized "Roman use." In order to explain the essential differences between these two schools, we must describe in detail some of the peculiar characteristics of plain song.

The melodies which form the *répertoire* of plain chant are not written in modern major and minor scales, but in certain tonalities bearing names analogous to those of the early Greek "modes," though constructed on very different principles. Of these "modes," fourteen exist in theory, though twelve only are in practical use. The intervals of each "mode" are derived from a fundamental sound, called its "final."[1] The compass of each mode comprises eight sounds—that of the first, third, fifth, seventh, ninth, eleventh and thirteenth "modes" extending to the octave above the "final," and that of the second, fourth, sixth, eighth, tenth, twelfth and fourteenth extending from the fourth note below the final to the fifth note above it. Consequently, the "finals" of the first series, called the "authentic modes," occupy the lowest place in each system of sounds, and those of the second series, called the "plagal modes," the middle place—the same "final" being common to one "authentic" and one "plagal mode." The following table exhibits the entire system, expressed in the alphabetical notation peculiar to modern English music—the "final" being indicated in each case by an asterisk, and the position of the semitones, from which each mode derives its distinctive character, by brackets.

Authentic Modes.	*Plagal Modes.*
1. Dorian, *D, $\overparen{E, F}$, G, A, $\overparen{B, C}$, D.	2. Hypodorian, A, $\overparen{B, C}$, *D, $\overparen{E, F}$, G, A.
3. Phrygian, $\overparen{*E, F}$, G, A, $\overparen{B, C}$, D, E.	4. Hypophrygian, $\overparen{B, C}$, D, $\overparen{*E, F}$, G, A, B.
5. Lydian, *F, G, A, $\overparen{B, C}$, D, $\overparen{E, F}$.	6. Hypolydian, C, D, $\overparen{E, *F}$, G, A, $\overparen{B, C}$.
7. Mixolydian, *G, A, $\overparen{B, C}$, D, $\overparen{E, F}$, G.	8. Hypomixolydian, D, $\overparen{E, F}$, *G, A, $\overparen{B, C}$, D.
9. Aeolian, *A, $\overparen{B, C}$, D, $\overparen{E, F}$, G, A.	10. Hypoaeolian, $\overparen{E, F}$, G, *A, $\overparen{B, C}$, D, E.
11. *Locrian*, $\overparen{*B, C}$, *D*, $\overparen{E, F}$, *G*, *A*, *B*.	12. *Hypolocrian*, *F*, *G*, *A*, $\overparen{*B, C}$, *D*, $\overparen{E, F}$.
13. Ionian, *C, D, $\overparen{E, F}$, G, A, $\overparen{B, C}$.	14. Hypoionian, G, A, $\overparen{B, *C}$, D, $\overparen{E, F}$, G.

Nos. 11 and 12 in this series are rejected, for technical reasons into which we have not space to enter; they are practically useless.[2]

Of these modes Ambrose used four only—the first four "authentic modes," now numbered 1, 3, 5 and 7. Gregory acknowledged, and is said by some historians of credit to have invented, the first four "plagal modes"—Nos. 2, 4, 6 and 8. The use of the remaining "modes," except perhaps the ninth, was not formally authorized until the reign of Charlemagne, who published an official decision upon the subject. In one or other of the twelve "modes" recognized by this decision every plain-chant melody is composed. The number of such melodies preserved to us, the genuineness of which is undoubted, is very large; and the collection is divided into several distinct classes, the most important of which are the melodies proper to the *Psalm-Tones* and *Antiphons*; the *Ordinarium Missae*, the *Introits*, *Graduals* and *Offertoria*; the *Praefationes*, *Versiculi* and *Responsoria*; the *Hymns* and *Sequences*; and the *Lamentationes*, *Exultet* and other music used in Holy Week.

Of these classes the most interesting by far is that which includes the psalm-tones, or psalm-tunes, called by modern English historians, the "Gregorian tones." The oldest of these are tones 1, 3, 5 and 7, as sung by Ambrose. The antiquity of tones 2, 4, 6 and 8 is less firmly established, though there is no doubt that Gregory the Great sanctioned their use on strong traditional evidence. In addition to these, a peculiarly beautiful melody in mode 9, known as the *Tonus peregrinus*, has been sung from time immemorial only to the psalm *In exitu Israel*. The oldest version of this melody now extant is undoubtedly to a certain extent impure; but tradition imputes to it a very high antiquity, and even our doubts as to the authenticity of the now generally accepted reading extend only to one single note. A widely accepted tradition points out this melody as the tune sung to *In exitu Israel*, as part of the Great Hallel (see Psalms), which is generally (but hardly rightly) identified with the hymn sung by Christ and His apostles immediately after the Last Supper.

One very powerful argument in favour of the Jewish origin of the psalm-tones lies in the peculiarity of their construction. It is impossible to ignore the perfect adaptation of these venerable melodies to the laws of Hebrew poetry, as opposed to those which governed Greek and Latin verse. The division of the tune into two distinct strains, exactly balancing each other, points assuredly to the intention of singing it to the two contrasted phrases which, inseparable from the constitution of a Hebrew verse, find no place in any later form of poetry. And it is very remarkable that this constructional peculiarity was never imitated, either in the earliest hymns or antiphons we possess or in those of the middle ages—evidently because it was found impossible to adapt it to any medieval form of verse—even to the *Te Deum*, which, though a manifest reproduction of the Hebrew psalm, was adapted by Ambrose to a melody of very different formation, and naturally so since so many of its phrases consist of a single clause only, balanced in the following verse. This peculiarity now passes for the most part unnoticed; and the *Te Deum* is constantly sung to a psalm-tone, very much to the detriment of both. But in the middle ages this abuse was unknown; and so it came to pass that, until the "School of the Restoration" gave birth, in England, to the single chant, avowedly built upon the lines of its Gregorian predecessor, and a somewhat later period to the double one, so constructed as to weld two verses of the psalm into one, often with utter disregard to the sense of the words, the venerable psalm-tones stood quite alone—the only melodies in existence to which the psalms could be chanted. And so intimate is the adaptation of these plain-chant melodies to the rhythm as well as to the sense of the sacred text, even after its translation into more modern languages, so strongly do they swing with the one and emphasize the other, that it is difficult to believe that the composition of the music was not coeval with that of the poetry.

Next in antiquity to the psalm-tones are the melodies adapted to the antiphons, the offertoria, the graduals and the introits, sung at High Mass. Those proper to the *Ordinarium missae* are probably of later date. Those belonging to hymns and sequences are of all ages. Among the latest we possess—perhaps the very latest of any great importance—is that of *Lauda Sion*, a very fine one, in modes 7 and 8, adapted to the celebrated sequence written by Thomas Aquinas about 1261.

To the melodies adapted to the *Lamentationes* and the *Exultet*, as sung in the Church of Rome during Holy Week, it is absolutely impossible to assign any date at all. All we know is that they are of extreme antiquity, and beautiful beyond all description. The melody of *Exultet* is, indeed, very frequently cited as the finest example of plain song in existence.

To assert that melodies so old as these have been handed down to us in their original purity would be absurd. But the presence of corruption rarely passes undetected by the initiated; and vigorous efforts have been made from time to time to purify the received text by reference to the oldest and most trustworthy MSS. attainable. Such an effort was begun on a very extensive scale by the "Congregation of Rites," at the instigation of Pope Pius IX., in the year 1868; and the labours of that learned body, together with those of the monks of Solesmes and elsewhere, have done much towards the restoration of plain chant to the highest state of purity possible. In England the Plain-Song and Medieval Music Society, founded in 1888, has also done valuable work by its publications. (W. S. R.)

PLAINTIFF, one who brings a "plaint" (Low Lat. *plancta plangere*, beat the breast, lament), the name, in law, of the party who brings an action against another, who is called the

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[1] Analogous to the tonic or key-note of the modern scale.

[2] For fuller information on the subject see the article "Modes," in Grove's *Dictionary of Music*.

"defendant." In suits for divorce the party bringing the suit is styled the "petitioner," the party against whom it is brought the "respondent."

PLAIT (through O. Fr. *pleit*, from Lat. *plicitum*, folded, *plicare*, to fold), properly a fold, especially a fold of cloth, now usually in the collateral form "pleat." "Plait" is now principally applied to entwined strands of ribbon, hair, straw or fibre.

PLAN (from Lat. *planus*, flat), a diagram on a flat surface; hence by analogy any deliberate scheme or design. In architecture, a "plan" is a horizontal geometrical section of the walls of a building, or indications, on a horizontal plane, of the relative positions of the walls and partitions, with the various openings, such as windows and doors, recesses and projections, chimneys and chimney-breasts, columns, pilasters, &c. This term is sometimes incorrectly used in the sense of design (*q.v.*).

PLANARIANS, a well-defined group of animals, characterized externally by their ovoid or vermiform shape, their gliding movement and their soft, unsegmented, ciliated bodies: internally by that combination of low somatic type of structure and complex gonidial organization which is characteristic of the Platyelmia (*q.v.*). Their low type of bodily structure may be exemplified by the facts that the mouth is the only means of ingress to and egress from the blind alimentary sac, and that no vascular system is differentiated. Most Planarians are aquatic and the cilia that cover the body produce by their beating a stirring of the water. Hence the class is generally known by the name Turbellaria.

Planarians form one of the basal groups of the animal kingdom. They are the simplest of multicellular creeping things. In them the gliding movement has become habitual. The lowest Planarians are still largely free-swimming animalculæ and we can trace within the limits of the group the development of the creeping habit and the consequences that flow from it. It has led to the differentiation of anterior and posterior extremities; to the formation of bilateral symmetry; and to the development of a mucilage protecting the body against friction. It entails the concentration of the scattered nervous system on the ventral surface and at the anterior end, and it has induced the segregation of the diffused sense-organs in the head. The Planarians occupy a position midway between the simple planula larva of Coelenterates and the segmented Annelids. They have probably sprung either from an early Coelomate stock, or represent an independent class descended from a two-layered parentage distinct from that of the Coelenterates; a view which is adopted in the present article.

Occurrence.—Most Turbellaria are aquatic. They abound on the seashore and in fresh water, amongst weeds or under cover of stones, shells and sand. Few of them are pelagic or deep-water forms, and only some half-dozen Planarians are known to be parasitic. A large number of land Planarians are known, chiefly from tropical and south temperate countries.

The majority of marine Planarians are nocturnal or cryptozoic, hiding away during the period of low tide to avoid desiccation of their soft sticky bodies and coming out at night or during high tide to feed. They are mostly carnivorous, and their movements are correlated largely with the nature of their food. The smaller, more active species occur in companies amongst the finer seaweeds over which they creep or swim in pursuit of their food. The larger marine species occur singly or in pairs on Ascidians, Nullipores or Polyzoa, from whence as the tide rises they issue to feed. By the time the next low tide exposes them, these Planarians have so completely digested their meal that we know very little of its nature. The common fresh-water Planarians form either little companies of a dozen or more, usually of a single species, huddled together under a stone or in some cranny (see Pearl [8][1]), or societies of several species that inhabit *Sphagnum* and other fresh-water vegetation. This fresh-water planarian fauna is of two kinds, the fauna of permanent and that of temporary sheets of water and both show a certain adaptation to their environment. The latter, being subject to greater extremes of temperature than the lacustrine Planarians, produce thick-shelled eggs only. The development of these eggs is rapid in warm water, slow in cold: so that a pool after a few days of early spring sunshine is soon populated and provision is made for the continuance of the race should a cold snap follow. The lacustrine Planarians exhibit a different form of adaptation. The eggs laid by many of these animals are either thin-shelled and rapidly hatched or thick-shelled and slowly hatched. The lake-water, however, is in spring, even after sunshine, of a much lower temperature than that of pool-water, but the masses of Sphagnum and other weeds that border lakes and marshes are often warmer than the open water and may be as much as 13° or 15° C. higher in temperature. Here the Planarians assemble to benefit by the warmth, and under such favourable conditions lay thin-shelled eggs which rapidly develop; whilst in colder surroundings or at the onset of winter thick-shelled resting eggs are laid. In this manner we can understand the abundance of Planarian life in cold meres and transitory pools in Great Britain, Scandinavia, Finland, Denmark and North America.

In contrast to the general habit among Turbellaria of haunting dim or dark places, the station chosen by a few species is exposed and strongly illuminated. The marine *Convoluta* and *Polychaerus* and the fresh-water *Vortex viridis* may be taken as examples. *Convoluta paradosa* occurs among brown weeds which receive much light during neap tides and strong direct sun or light every fortnight. *Polychaerus* creeps about the New England shore without resorting habitually to cover, and is also strongly insolated. *Vortex* resembles the green Hydra of our ponds in choosing the lightest side of its surroundings; and finally, *Convoluta roscoffensis* paints the beach green in Brittany, part of Normandy and Natal. In every such case the Planarian is coloured brown or green by the presence of photosynthetically active cells and the singular heliotropic habit of these Turbellaria is associated with the illumination necessary for the activity of their coloured cells.

Only one branch of the Planarians has become terrestrial, but this has spread over almost all the whole globe. One species (*Rhynchodemus terrestris*, fig. 1, *e*) is fairly common in Great Britain under stones, logs and occasionally on fungi, but the Holarctic countries (North America, Europe and North Africa, North Asia) are extremely poor in terrestrial species. In countries lying in the centre and in the south of the great continents and in the south temperate continental islands and archipelagoes these land Planarians become more abundant and varied; and being frequently transported with earth or plants they are often found in hothouses and botanical gardens far from their native country. Their distribution offers some points of special interest showing a close relationship between the South American fauna and that of Australia and New Zealand: between the land Planarians of Madagascar, of Ceylon and of Indo-Malaya: and a marked contrast between Japan and the rest of the Palaearctic region (see Von Graff [1], 1899).

External Characters.—Planarians range from the minute forms no larger than Infusoria to ovate, marine species, 6 in. in diameter and to ribbon-like land forms 8 in. in length. The majority are small, somewhat cylindrical organisms with a flat creeping surface. Others, comprising the common fresh-water and marine forms, are flattened and leaf-like, often provided with a pair of tentacles near the front end of the body, and in some cases the whole dorsal surface is beset with papillae. The land forms are elongate and smooth, and their anterior extremity is often modified into the arcuate shape of a cheese-cutter. Their movements are usually of a gliding character. The minuter forms perform short excursions into the water round their station, and in so doing recall Infusoria. The larger forms, in addition to gliding like pellicles, fold the expanded anterior part of their body into a couple of fins, with which they swim after the fashion of a skate. The folded margins of other forms clasp the weeds on which they live. Adhesion is effected by the mucous investment of the body and frequently by some specially developed local secretion of slime, or by a sucker. By these means, aided by their algal-frequenting and cryptic habits, the Turbellaria, though soft-bodied, are able to withstand the violence of the waves.

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[1] These references are to the literature at the end of this article.

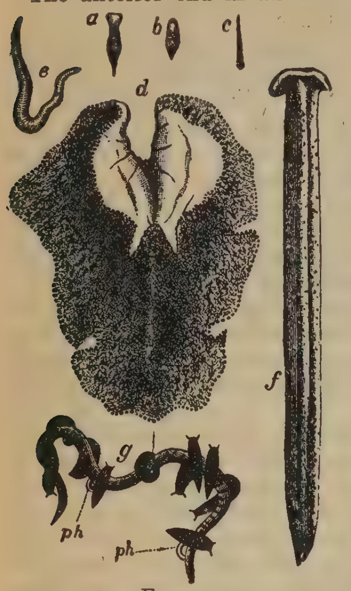

FIG. 1.

a, *Convoluta paradoxa*, Oe.
b, *Vortex viridis*, M. Sch.
c, *Monotus fuscus*, Gff.
d, *Thysanozoon brochii*, Gr., with elevated anterior extremity (after Joh. Schmidt).
e, *Rhynchodemus terrestris*, O. F. Müller (after Kennel).
f, *Bipalium ceres*, Mos. (after Moseley).
g, *Polycelis cornuta*, O. Sch., attached by the pharynx (*ph*) to a dead worm (after Johnson).

All the figures of natural size, and viewed from the dorsal surface. *a*, *c* and *d* are marine, *b* and *g* are fresh-water, *e* and *f* are terrestrial. All found in Great Britain except *d*.

The anterior end in all Turbellaria is the site of the chief sense-organs, and in some forms (Proboscida) becomes transformed into an invaginable proboscis of highly tactile nature. Such forms lead naturally to the Nemertina (*q.v.*).

Coloration.—The coloration of Planarians is of interest. The flattened marine forms are often brilliantly coloured on the dorsal surface, either uniformly or with some striking marginal band; or they may exhibit longitudinal bands of contrasting tints or a mottled appearance. The significance of these colours is not fully understood, but in some cases of sympathetic coloration the derivative function of the pigments is probably to aid cryptic resemblance. The terrestrial Planarians exhibit the most striking patterns in longitudinal striping and cross-bars which appear to have no relation to the environment of these essentially nocturnal animals. The fresh-water forms are colourless or dusky, often dark-brown, possibly in relation to the retention of heat; but in a number of both fresh-water and marine Planarians a green colour is present, constantly in some species, sporadically in others.

This green effect is due to the infection of the Planarian by a minute alga which multiplies in the tissues and may profoundly affect the habits and even the structure of its "host." The planarian so affected acquires a heliotropic habit; it becomes gregarious and in extreme cases ceases to ingest solid food. In *Convoluta roscoffensis* the green cells have become indispensable. They function both as the nutritive and excretory organs of the Planarian, and the young animal cannot develop until it is infected and has acquired a supply of these green cells which become incorporated into its tissues (Gamble and Keeble [7]). Brown algal cells (Zooxanthellae) are known in other species of *Convoluta*.

Food.—The food of Turbellarians consists, in the smaller species, of diatoms, unicellular algae, microscopic animals and other Turbellarians; in the larger ones, of worms, mollusca and insects. The fine feeders capture their food chiefly at night by gulping down the minute organisms that settle or swim in their neighbourhood. The coarse feeders enclose their prey with a coating of slime and then proceed either to engulf it in their expansible mouth or to perforate it by their trumpet-like pharynx. The mouth is remarkably variable in position (fig. 2). In many flattened Planarians it is placed centrally on the ventral surface somewhat as in a jelly-fish. In the majority it is nearer the anterior end, but in a few remarkably elongate forms it occupies a position near the hinder end of the animal. In the cylindrical forms (Rhabdocoels) a similar variability in the position of the mouth is met with.

Anatomy.—The structure of the Turbellaria though greatly varied in detail, conforms to a single type of somatic organization which is transitory in the higher invertebrates. The sexual organs, on the other hand, are founded on two or more types, and the astounding complications of these structures suggest that their evolution has been governed by quite other factors or combinations of factors than those that have guided the somatic evolution of the group.

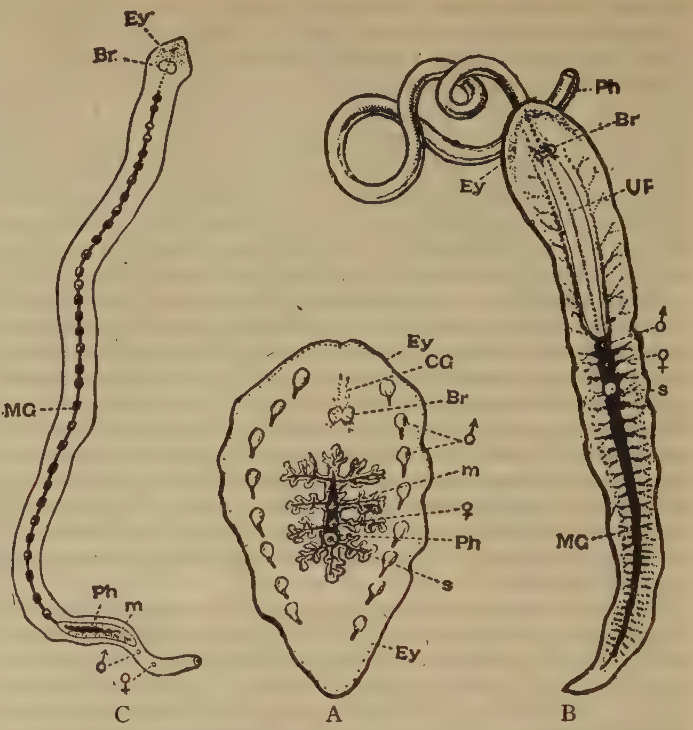

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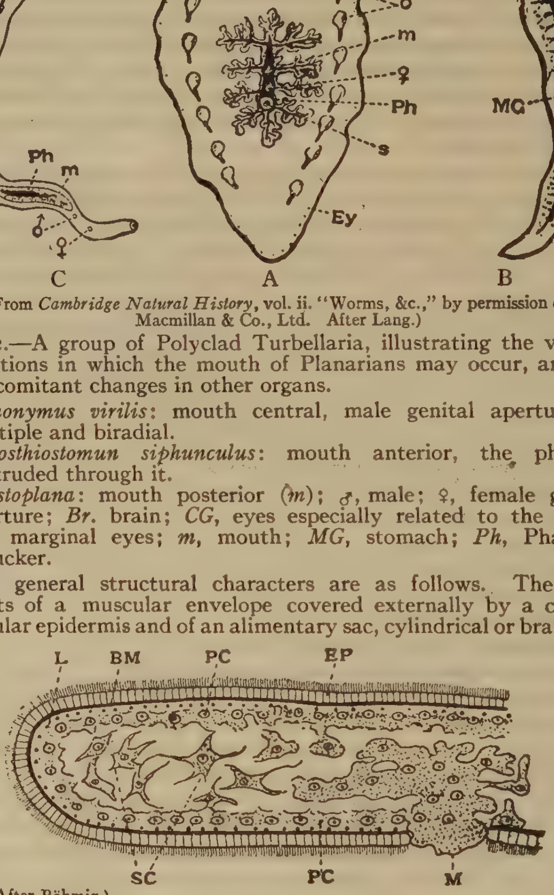
FIG. 2.—A group of Polyclad Turbellaria, illustrating the various positions in which the mouth of Planarians may occur, and the concomitant changes in other organs.

A, *Anonymus virilis*: mouth central, male genital aperture (♂) multiple and biradial.

B, *Prosthiostomun siphunculus*: mouth anterior, the pharynx protruded through it.

C, *Cestoplana*: mouth posterior (*m*); ♂, male; ♀, female genital aperture; *Br.* brain; *CG*, eyes especially related to the brain; *Ey*, marginal eyes; *m*, mouth; *MG*, stomach; *Ph*, Pharynx; *s*, sucker.

The general structural characters are as follows. The body consists of a muscular envelope covered externally by a ciliated glandular epidermis and of an alimentary sac, cylindrical or branched, for which the mouth serves both as ingress and egress. Between this aproctous gut and the integument the body consists of a jelly-like, vacuolated mesenchyme made up of branched gland-cells, excretory cells, pigment- and muscle-cells. A space may be secondarily hollowed out around part of the gut; but no coelomic or true perivisceral cavity exists in the sense in which these terms are used in higher animals. A nervous system is present and consists of an anterior "brain" and of ramifying ganglionic trunks that are developed in relation to the muscular integument and to the sense-organs for the perception of light and pressure. No



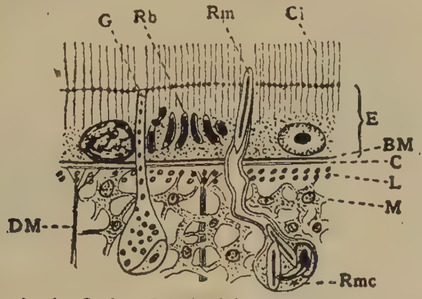
(After Böhmig.)

FIG. 3.—To show the structure of the simplest Turbellaria.

The figure represents the left half of a transverse section across the body of the Acoelous planarian *Haplodiscus*. The mouth (*M*) is plugged up with a digestive polynuclear mass of cytoplasm and the transitions from this to the stellate scattered central parenchyma (*SC*) and again from the latter to a firmer peripteral zone (*PC*) are shown. The outermost layer (*EP*) is a ciliated epidermis resting on (*BM*), a basement membrane (dark line); the row of dots beneath this represents the longitudinal muscles (*L*).

respiratory organs are developed, probably in correlation with the absence of a blood-vascular system. On the other hand, the process of reproduction is elaborately organized. The Planarians are hermaphrodite and, as in so many other small animals, the body, after attaining maturity, becomes in many Planarians practically a genital sac and is soon exhausted by the repeated calls upon its reserves that are involved in the rapid production of eggs and spermatozoa. The intervals between successive clutches has been found in *Convoluta roscoffensis* to be a month, thus suggesting the influence of the lunar tides upon maturation.

Integument.—The epidermis is ciliated and highly glandular. It consists of a single layer of cubical or oblong cells with the structure seen in fig. 3. The glandular secretion takes various forms, such as mucus, mucinoid granular blocks, or fusiform refringent homogeneous rods. These rods or "rhabdites" are frequently coloured red or yellow, and are highly characteristic of the Turbellaria. Their real use is unknown. In only two genera does the epidermis produce cuticular spines (*Acanthozoon*, *Enantia*) on the surface, but chitinoid hooks, spines and spirals occur frequently on the lining membrane of the male and female copulatory ducts.



(Partly after Luther: *Zeitschrift für wissenschaft. Zoologie*, by permission of Wilhelm Engelmann.)

FIG. 4.—Portion of a transverse section of *Mesostoma ehrenbergii*.

The epidermis (*E*) consists of cells divided into an outer and inner zone, the latter containing rhabdites (*Rb*); the cilia (*Ci*) are thickened about the middle of their length. Below the epidermis is the basement-membrane (*BM*), a layer of circular muscles (*C*) and of longitudinal ones (*L*). Below this again is the mesenchyma (*M*), made up of branched cells and dorso-ventral muscle-fibres (*DM*). The mesenchymatous glands (*Rmc*) are producing rhammites (*Rm*) which pass outwards.

Below the epidermis is a firm basement membrane into which the subjacent muscles are inserted. They are divided into outer circular and inner longitudinal groups and subdivided in the larger forms by diagonal fibres, and in the most highly differentiated Planarians there are six muscular layers, two of each kind. In a number of Turbellaria the musculature is modified to form a sucker either single or double and anterior or posterior, and it undergoes further modification in connexion with the pharynx and reproductive organs.

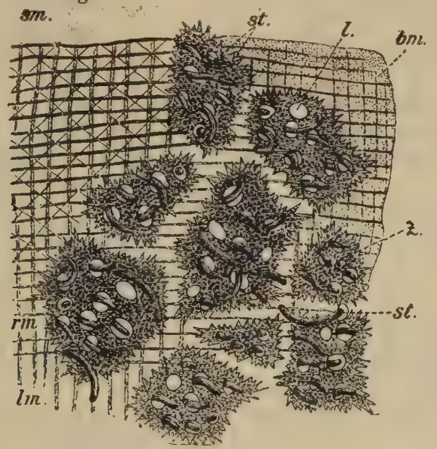


FIG. 5.—Integument of *Mesostoma lingua*, O. Sch.

On the right hand is the epidermis (*z*) with perforations (*l*) through which the rhabdites (*st*) project. Beneath this the basement membrane (*bm*), and beneath this again the muscular layers consisting of circular (*rm*), diagonal (*sm*), and longitudinal (*lm*) fibres.

Alimentary Sac.—The alimentary sac consists of a muscular pharynx opening outwards through the mouth and inwards into a median digestive organ which may be solid or hollow, and in the latter case straight, lobate or branched. These characters are correlated with such a number of distinctive features that the classification of the Planarian is based on them. Thus we have the *Rhabdocoelida* with straight gut and the *Tricladida* and the *Polycladida* with triple and multiple branches to the gut. The Rhabdocoelida are further divided into three groups: the Acoela with a simple syncytial gut not sharply separated from the surrounding mesenchyma; the Rhabdocoela, with a hollow gut and a perivisceral schizocoelic span; and the Alloeocoela with a lobate gut and reduced schizocoele. The last group leads one naturally to the Tricladida; the Polyclads being an independent group.

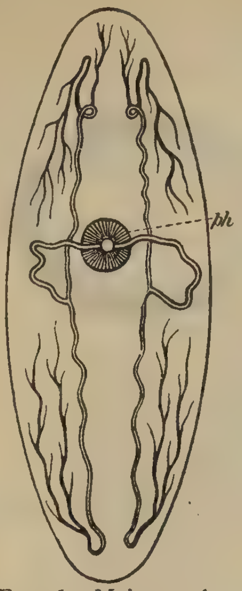
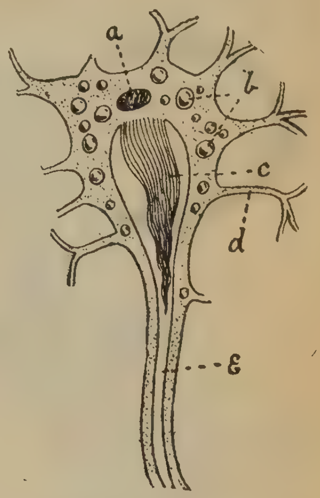


FIG. 6.—Main trunks of the Excretory System of *Mesostoma ehrenbergii*, O. Sch., opening to the exterior through the mouth; *ph*, Pharynx.



(From Lankester's *Treatise on Zoology*, Part IV.)

FIG. 7.—Flame-cell from the Excretory System.

a, nucleus; *b*, excretory granules; *c*, "flame"; *d*, branches of cell; *e*, beginning of excretory tube.

The pharynx varies widely in structure. In the Acoela it is a mere thickening and pitting of the integument. In the Rhabdocoela a great number of elaborate modifications are found. These are based on the type of a buccal invagination, which forms the pharyngeal sheath, and from the bottom of this there springs a muscular outwardly directed tube or fold. In the Alloeocoela and Tricladida the pharynx is an elongate protrusible cylinder, and in the Polyclads it may be an immensely distensible frilled organ, the folds of which have independent movement, or an elongate tube. At the base of the pharynx lie the openings of salivary glands. In the Polycladida the section of the alimentary sac into which the pharynx opens is a median stomach from which the intestinal branches radiate. The stomach in few forms is provided with digestive glands. The branches possess an independent musculature and exhibit active peristalsis. The intestine of Planarians is not ciliated, and digestion appears to be largely intracellular and not cavitary.

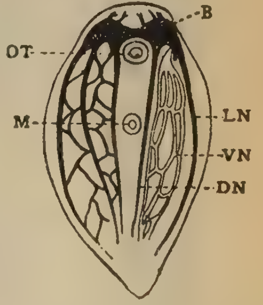


FIG. 8.—The Nervous System of a Simple Planarian (*Haplodiscus*, one of the Acoela).

B, the brain which gives off a dorsal (*DN*) and a ventral (*VN*) plexus and also lateral nerves (*LN*). The mouth (*M*) and the otocyst (*OT*) are shown. The former is ventral, the latter dorsal in position.

Mesenchyma. — The mesenchyma (Bohmig: parenchyma *auctt.*) consists of a mass of branched vacuolated cells, imbedded in which lie gland-cells, pigment-cells and the excretory system. It envelops the genital organs, which though in the mesenchyma are not of it, and it forms an investment to the gut and to the space (schizocoel) which often occurs between the gut and the mass of the mesenchyma. The mesenchymatous gland-cells are of different kinds. (1) Single cells in which rods (rhammites) are developed (fig. 4, *Rmc*). Such cells in embryonic life give rise to a process which perforates the soft basement-membrane and penetrates between the epidermal cells. The process becomes hollow, and the rhammites pass outwards along it on to the surface of the animal, forming in many Turbellarians thickly set rows of rods on the head. (2) Similar cells contain nematocysts in a few Planarians (*Microstoma*, *Stenostoma*, *Anonymus virilis* and *Stylochoplana tarda*). Whether these nematocysts develop in the Turbellarian is doubtful, and it is not impossible that they are derived from the tissues of some coelenterate animals eaten by the Planarian, as has been shown to be the case in the nematocysts of Eolids. (3) Cells producing aciculate spicules, sometimes associated with a spiral thread. These structures are often associated together in batteries, notably so in the remarkable genus *Anonymus*.

Excretory System.—The excretory system consists of protonephridia, that is, of tubes opening to the exterior by one or more apertures, and after branching extensively in the mesenchyma end blindly in peculiar hollow cells (flame-cells) provided with a bunch of synchronously vibrating cilia. The excretory tubules have a markedly sinuous course and are provided with cilia. The motion of these cilia and of the flame-cells is to induce an outward current of the fluid from the canals, but the process of excretion seems to be performed chiefly by the branched mesenchymatous flame-cells. The position of the external opening varies greatly. It may be single or paired, mid-ventral or terminal, or again multiple and arranged in pairs along the dorsal surface (Tricladida and probably in Polycladida). The flame-cells are arranged in pairs in Tricladida, but lie less regularly in the mesenchyma of most forms. Finally, it is noteworthy that in the Acoela no excretory system is known.

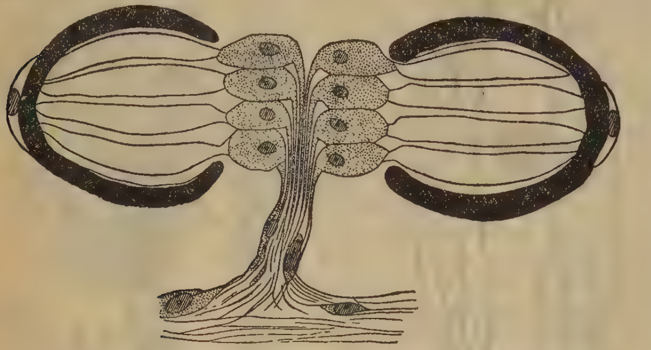


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Fig. 9.—Double Eye found on the brain of Polyclads. Each consists of a pigment-cup and of four nerve-end cells (rod-cells) in which the nerves terminate.

N, nerve fibres and cells. *Pc*, pigment-cell. *Rc*, rod cell.

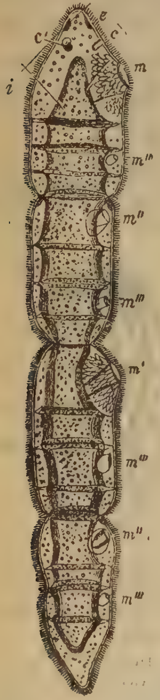


Fig. 10.—*Microstoma lineare*, Oe., undergoing division. There are 16 individuals. 8 with mouth apertures, showing the buds of the first (*m*), second (*m'*), third (*m''*), and fourth (*m'''*) generation. The fifth generation has not yet acquired a mouth aperture. *c*, ciliated grooves; *e*, eye spots; *i*, intestine.

Nervous System.—The nervous system is present in all divisions of the order. It consists of a paired, anterior ganglion lying ventral to the gut, and from this are given off, right and left, dorsal, lateral and ventral fibres interconnected by a plexus. The nerve-cells are scattered throughout the plexus. The chief development of the system occurs in relation to the muscular body-wall, sense-organs and the pharynx. In these characters the nervous system of Planarians shows an interesting transition from the scattered plexus of Coelenterates to the segmental ganglia and sympathetic nervous system of Annelids.

Sense-organs.—These occur in the form of tactile organs, otocysts and eyes. The whole skin of many Planarians is sensitive, and amongst the ordinary locomotor cilia long stiff ones are found which it is natural to think are tactile organs. The head-end is often provided with specialized cells that appear to subserve the sense of touch and possibly of taste also. The abundance of rhammites, of long stiff cilia, and the great mobility and sensitiveness of this region, bear out this conclusion. A further development of cephalic, sensory structures occurs in the form of a crescentic groove (Polyclads) of paired, lateral pits (*Microstoma*, fig. 10) of mobile papillae on the extreme front margin (Land Triclads) and of extensible tentacles, marginal or nuchal in most Polyclads.

The otocyst occurs constantly in the Acoela and sporadically in every other division of the group. It is with one exception a single median organ placed over the brain, and consists of a uni- or bi-cellular sac containing a calcareous concretion lying in a fluid. From what is known of these organs in higher invertebrates we may infer that they serve to increase the perception of slow wave-movement and enhance the control of the muscular sense.

Eyes are generally present in Planarians. Two types are distinguishable—eyes with a cup-shaped retina facing outwards, and those with an inverted retina facing inwards. The former occur in Triclads and Polyclads around the margin of the body often a hundred or more may be present. The latter occur in all groups except the Acoela, but are limited to the neighbourhood of the brain or bases of the nuchal tentacles. Recent investigation has shown that the essential part of the eyes has in all cases a complicated structure and is not a mere epidermal cell-group enclosed by pigment and provided with an optic nerve. On the contrary (Hesse [10]), adequately known eyes are composed of rod-cells that contain each an axial filament or bundle of fibrillae (the termination of the nerve), and the distal end of the rod-cell is converted into a striated usually broad border where the action of light commences. A group of such specialized rod-cells is enclosed in a pigmented cup opening either outwards or inwards and pierced by an optic nerve. The whole is usually depressed beneath the epidermis, but in some Acoela and Alloeocoela the eyes retain a surface-position. In the Polyclads eyes may increase by division and in Triclads may decrease in number by fusion (Carrière [11]). The marginal and often radial disposition of the scattered eyes, and the prostomial position of the paired eyes, afford interesting evidence of the intermediate position that Planarians occupy between the radiate Coelentera and the bilateral Annelids.

Reproduction.—All Turbellaria are hermaphrodite, and reproduce sexually, but a few forms (Microstomidae and some Triclads) increase during the summer by fission and during the winter by eggs. The body of the Microstomidae becomes constricted and partially subdivided into two, the posterior half regenerates a brain and pharynx. Subsequently each becomes again converted into two zooids, and the process is repeated until a chain is formed as in fig. 10. This breaks up into its constituent members, each of which repeats the process until the onset of reproduction. The

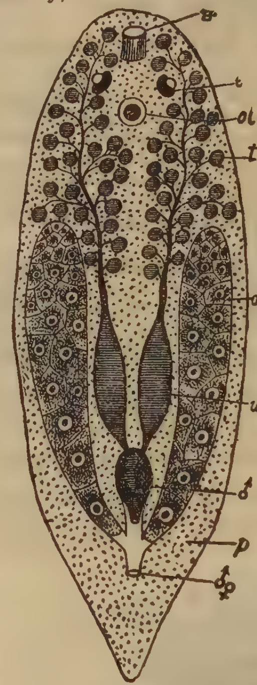


Fig. 11.—Plan of an Acoelous Turbellarian.

e,	Eye.
m,	Mucous gland, formerly mistaken for the mouth, which lies in the centre of the body.
ot,	Otolith.
ov,	Ovary.
p,	Digesting parenchyma.
t,	Testicular follicles.
vs,	Vesicula seminalis.
♂,	Male-organ of copulation.
♂♀,	Common sexual aperture.

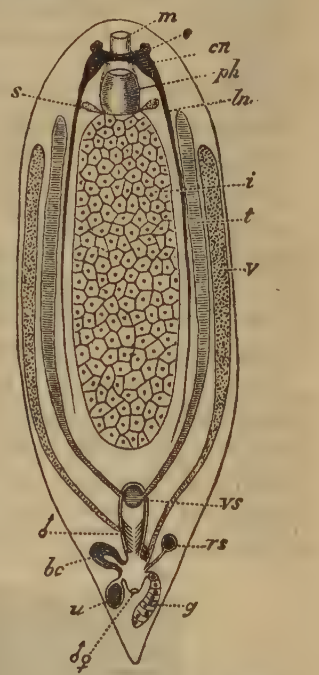


Fig. 12.—Plan of a Rhabdocoelous Turbellarian.

bc,	Bursa copulatrix.
cn,	Brain.
e,	Eye.
g,	Germarium.
i,	Intestine.
ln,	Longitudinal nerve trunk.
m,	Mouth.
ph,	Pharynx.
rs,	Receptaculum seminis.
s,	Salivary gland.
t,	Testis.
u,	Uterus (containing an egg).
v,	Yelk gland.
vs,	Vesicula seminalis.
♂,	Chitinous copulatory organ.
♂♀,	Common sexual aperture.
bc,	Bursa copulatrix.

Triclads, on the other hand, fragment, without undergoing preparatory changes.

The male and female genital ducts (gono-ducts) open to the exterior, either through a common chamber on the ventral surface (most Rhabdocoelida and all Tricladida, figs. 12, 14) or by separate apertures that are also usually ventral. In the latter case, the male gonopore is usually in front of the female one (all Polycladida and some Rhabdocoelida). A separate opening is sometimes acquired by one or other of the accessory reproductive organs (as by the spermotheca in some Rhabdocoelida in which it is dorsal).

The generative organs of the Planarians are complex. Male and female germ-cells develop in one and the same individual and reach the exterior by independent ducts. These ducts are provided with accessory glands along their course and terminate in penial or vaginal structures, often of great complexity, which are surrounded by an "atrium" or invagination of the ventral body-wall. From this invagination a special vesicle "uterus" is often developed for the reception of the fertilized egg previous to oviposition.

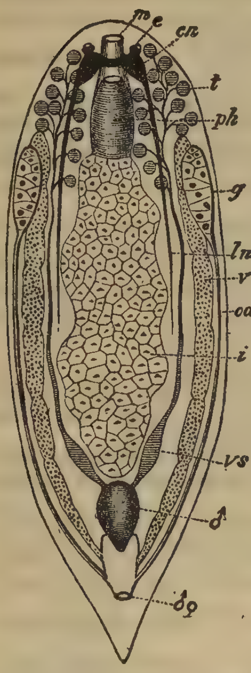


FIG. 13.—Plan of an Alloeocoelous Turbellarian. Lettering as in fig. 12.

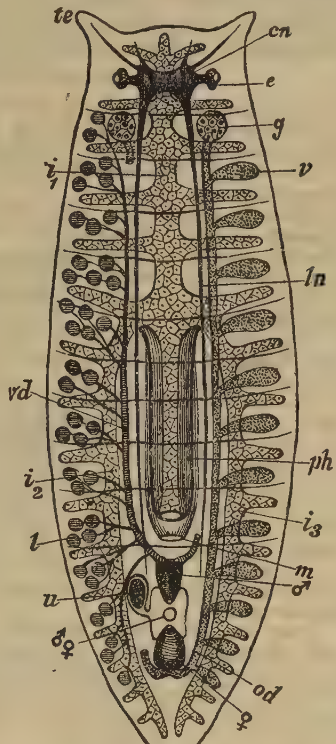


FIG. 14.—Plan of a Tricladid.

i_1, Anterior, and i_2, i_3, paired posterior branches of intestine.
od, Oviduct.
te, Tentacle.
vd, Vas deferens.
♂, Male, and ♀, female copulatory organ. Other letters as in fig. 12.

The Acoela present the simplest arrangement. In this group (fig. 11) the male germ-cells arise in follicles each of which is the product of a single sperm-mother-cell. From these follicles, the motile spermatozoa enter the paired sperm-duct, which opens by a single aperture near the hinder end of the animal, and is provided with a simple unarmed glandular penis. The female germ-cells or ova arise from a paired ovary, some of the cells of which appear to act as nurse-cells, supplying the young eggs with nourishment. When mature the eggs are transferred to the oviduct. At the point where the two oviducts join in order to open to the exterior they receive a conical sac (spermotheca) which contains spermatozoa. At this point the eggs are fertilized, and deposited in a mucilaginous mass which is attached to algae or buried in the sand. It is characteristic of the Acoela that the testes and ovaries should not be continuous with either the sperm-duct or the oviduct respectively.

In one genus of the Acoelous Turbellaria—*Polychaerus*—this primitive arrangement undergoes a development which foreshadows the complicated ovaria and vitellaria of higher forms. In *Polychaerus* the eggs mature in a special roomy chamber and are here provided with yolk which is elaborated by a sterile part of the ovary. Thus we have a differentiation of germ-cells into two portions allocated to two chambers: fertile ova which open eventually into the oviduct, and sterile ova that become yolk-cells and open into the brood-pouch.

The remaining Rhabdocoelida possess separate ovaries and yolk-glands. The union between the two sets of ducts takes place in the genital atrium which is provided with a spermotheca for the fertilization of the ova, but in at least one sub-family (*Cylindrostominae*) the spermotheca opens by a special dorsal pore. These ova, together with the yolk and spermatozoa, are then transferred to another atrial diverticulum—the uterus, in which a shell is formed and from which they are deposited in the form of a cocoon. In addition, a muscular pouch, the so-called "bursa copulatrix," is usually present. The male organs of Rhabdocoelida are no less complex. The testes are either follicular (Alloeocoela) or compact (Rhabdocoela), and communicate indirectly or directly with the paired seminal ducts. The ducts unite at the base of an evaginable penis. This muscular organ is provided with glandular and chitinoid appendages of considerable complexity, and, in addition to these, a poison gland and duct are sometimes present. In certain genera (*Macrorhynchus, Prorhynchus*) the penis is used for catching prey, perhaps exclusively so in the former genus. The opening of the atrium into the oral cavity in Cylindrostominae and of the male organ into the mouth of *Prorhynchus* is possibly explained by this fact.

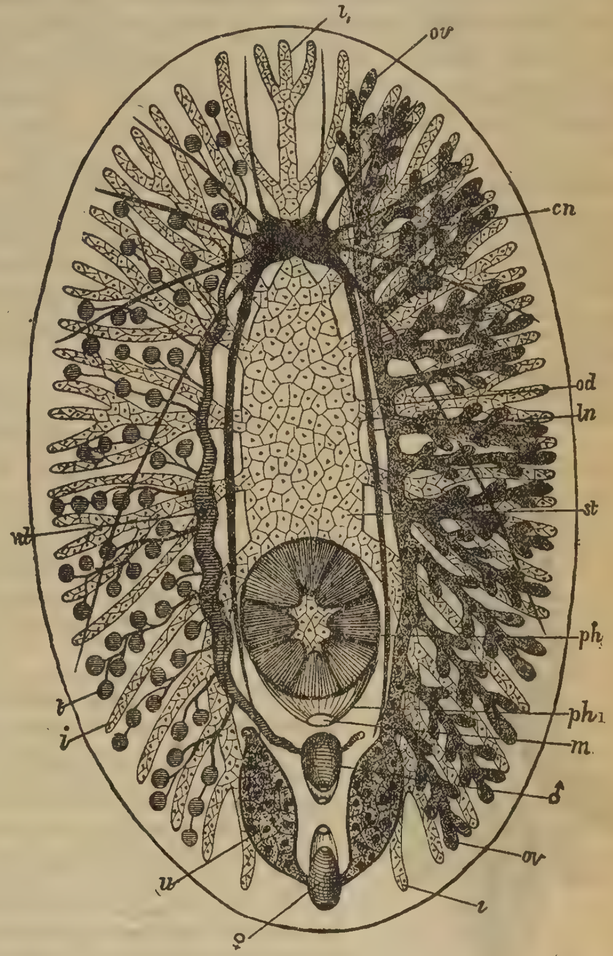


FIG. 15.—Plan of a Polycladid.

cn, Brain.
i, Intestinal branches.
i_1, Anterior unpaired intestinal branch.
ln, Longitudinal nerve cord.
m, Mouth.
od, Oviduct.
ov, Ovarian follicle.
ph, Pharynx.
ph_1, Pharyngeal pouch.
st, Stomach.
t, Testicular follicle.
u, Uterus.
vd, Vas deferens.
♂, Male copulatory organ, with the male aperture behind.
♀, Female copulatory organ, with the female aperture before it. The eyes are omitted.

From the Alloeocoela we pass readily to the Triclads. In both of these groups the reproductive organs are based on the same plan; but in Triclads the separation of ovarian and vitellarian portions of the gonad is less perfectly effected. The oviduct transmits the eggs from the anteriorly placed ovary, and receives in its course the openings of numerous vitellaria (fig. 14). No distinct spermotheca is developed, but a cocoon is formed in a special chamber—

the uterus—which may either be a dilatation of the common oviduct (vagina) or of the atrium, and may open to the exterior independently (single in *Uteriporus*, paired in *Syncoelidium*). In *Bdelloura* the uterus is said to act as a spermotheca. In addition to these structures, accessory muscular organs are found in *Dendrocoelum* and developed to a high degree in land Planarians, where they form the so-called adenocheiri and adenodactyli (see von Graff, 1899).

Lastly, the Polyclads offer certain distinctive sexual characters. The ovaries are follicular, very numerous, and the ova elaborate their own yolk (fig. 15). The oviducts open into a chamber which, after receiving a voluminous shell-gland, opens by a muscular bursa to the exterior. No special uterus is developed, but from the point of union of the two egg-chambers a vesicle is given off which may open separately to the exterior (*Trigonoporus*). The testes are equally diffused and the seminal vesicles usually form a median muscular eversible sac which opens in front of the female genital pore. In *Stylostomum*, however, this penial organ opens through the mouth, as in certain Rhabdocoelida. Moreover, it may be paired (*Thysanozoon*) or multiple. Thus in *Anonymus* twelve or more pairs occur. In *Cryptocelides* two, four or six may be present, but in this genus they all lie in a common sac. In *Polypostia* twenty pores occur ranged about the female pore, but the most posteriorly placed of these structures are devoid of a seminal duct. This condition supports the view that in Polyclads the penis was at first a glandular organ probably used for attacking prey and that it has become secondarily connected with reproduction. In confirmation of this conclusion we have the observations of Lang (5) that *Yungia* stabs the body of other Polyclads with its penis when brought into contact with them. (See Whitman [9].) The genus *Laidlavia* differs from all other Polyclads in possessing a dorsal genital opening.

Development.—The development of the Planarians is fairly well known. Except for one or two species of Polyclads, development is direct and without metamorphosis; but in *Thysanozoon* and *Yungia* the embryo develops eight strongly ciliated lobes which form a circumoral band of larval processes. These have been compared with the girdle of Trochosphere larvae and also with the eight rows of swimming plates in Ctenophores. From the name of their discoverer these girdled larvae are called Müller's larvae (fig. 16).

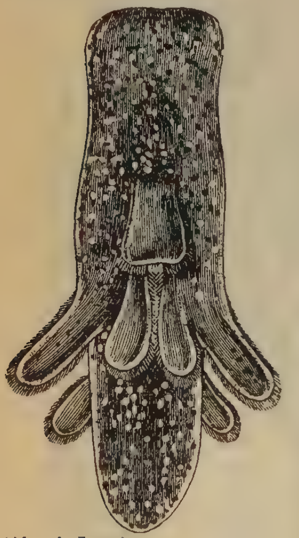

(After A. Lang.)

FIG. 16.—Larva of *Yungia aurantica*, L. (*Polycladida*), with provisional ciliated processes.

In the Rhabdocoelida the eggs are usually laid in a shell which has characteristic shapes. Each capsule contains a single ovum and several yolk-cells. Segmentation results in the formation of dislocated megacytes and microcytes. The latter give rise to the epidermis which is laid down in bilateral sheets, the former to the various internal organs. There is no distinction of germ-layers, and the gut is gradually organized from the mesenchyme, the rest of which gives rise to the parenchyma. The pharynx and the rudiment of the gonads are the first organs to appear (Breslau [13], 1905). The development of the Acoela differs in certain particulars from that of other Rhabdocoelida. The ova contain yolk-granules, and yolk-cells are absent. Groups of such eggs, each with its own shell, are laid in a gelatinous envelope. Each ovum segments into a two-layered embryo composed of a ciliated outer layer and a central syncytium. No trace of a distinct enteron or gut is visible, but as the embryo grows the syncytium becomes differentiated into a more fluid central portion and a firmer peripteral zone. The former, together with the wandering phagocytes, corresponds functionally to the separate gut of other Rhabdocoelida. Pelagic larvae with a coat of long cilia have been identified by Uljanin as belonging to the Acoela.

The development of the Tricladida offers other peculiarities. From four to twenty or more ova are surrounded by several hundred amoeboid yolk-cells in each cocoon. Each egg-cell divides; but, as happens in the capsular ova of certain Mollusca and Oligochaeta, they do not all survive, some being used up as food by the remainder. The segmented ovum becomes dislocated as in some Rhabdocoels, the blastomeres moving apart from one another. The details of organ-formation are still imperfectly understood.

The eggs of the Polyclads are laid somewhat like those of the Acoela in a gelatinous envelope, each ovum being provided with yolk and an egg-shell which may be operculate. The majority of species go through a direct development. The segmentation of the egg in *Discocelis* and *Leptoplana* has been worked out by Lang and his results re-interpreted by Wilson and others (Hubrecht [12]). In Polyclads a distinction of germ-layers similar to that occurring in the development of Mollusca, Chaetopod-Annelids and certain other Invertebrates, is early apparent. The ovum by unequal segmentation gives rise to megameres and micromeres, and between the two, intermediate cells form one origin for the mesenchyma. The micromeres surround the intermediate and centrally placed macromeres. The latter undergo division into hypoblast cells and yolk-masses. The similarity of cell-lineage in Polyclads and Coelomate Invertebrates, together with the trochosphere-like Polyclad larval form (Müller's larva), have been the two chief arguments in support of the view that this group is a link between the Planarian and Coelomata. It is at present, however, doubtful whether such highly organized animals as Polyclads can be regarded as in any sense ancestral forms. Their relations to other Turbellaria are quite uncertain, and on present evidence it seems legitimate to hold that they are the most highly differentiated division both in embryonic and adult structure.

Systematic Arrangement.

Order *Turbellaria.*—Free-living Platyelmia with a ciliated epidermis. A well-developed nervous system and sense-organs concentrated at the anterior end of the body, diffused elsewhere.

Sub-order A. *Rhabdocoelida.*—Gut syncytial or tubular. Female gonads always compact.

Tribe I. *Acoela* (fig. 11).—Mesenchyma not differentiated into separate gut and parenchyma. No excretory organs of protonephridial type. A simple pharynx. A median otocyst (statocyst) over the brain. Small, often flattened forms. All marine and many infected by brown or green algal cells. One species parasitic in Echinoderms.

Tribe II. *Rhabdocoela* (fig. 12).—Gut and parenchyma separate, the former a simple straight sac. Vitellaria usually present. Testes compact. Penis and pharynx often complex, occasionally protruded through a common opening. Marine and fresh-water. Many fresh-water forms infected by algal cells. *Typhloplana*, *Graffilla*, *Anoplodium*, are respectively parasitic in *Nephthys*, in Gastropods and Holothurians.

Tribe III. *Alloeocoela.*—Gut and parenchyma distinct. Intestine straight or lobate. Testes follicular. Penis and pharynx simple. One family with otolith. All marine except *Plagiostoma lemani* (deep-water, Geneva) and the *Bothrioplanidae*.

Sub-order B. *Dendrocoelida.*—Large forms with flattened body, branched intestine, follicular testes and follicular ovaries or compact ovaries and yolk-glands.

Tribe I. *Tricladida.*—Intestine with three main branches. A pair of compact ovaria and numerous yolk-glands connected by a common duct. A single genital aperture. Fresh-water forms: *Planaria*, *Dendrocoelum*, *Polycelis*, common. Peculiar forms in Lake Baikal. Marine forms: *Gunda segmentata*, *Bdelloura* (external parasite of *Limulus*). Terrestrial forms: *Rhynchodemus*, *Geoplana*, *Bipalium*.

Tribe II. *Polycladida.*—Body leaf-like. Intestine composed of a median stomach with many branched or reticulate coeca; testes and ovaries follicular; genital openings usually separate, the male gonopore preceding the female one. Multiple male gonopores in some forms. All marine and widely distributed; some genera cosmopolitan.

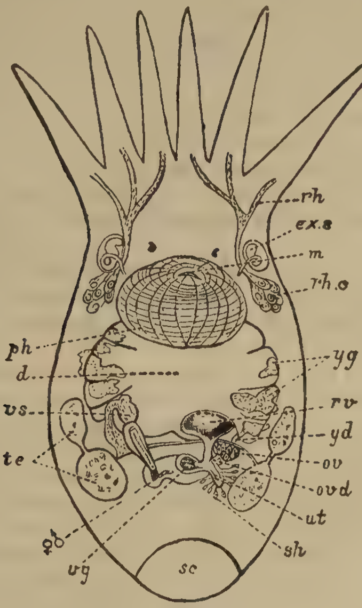
LITERATURE.—(1) L. von Graff (Rhabdocoela, Acoela, Tricladida), *Monographie d. Turbellarien* (1882), vol. i., (1899) vol. ii.; *Die Acoela* (1891); (2) *Arbeiten aus der zool. Institut zu Graz* (1904, 1905, 1906); (3) "Turbellaria," in Bronn's *Klassen v. Ordnungen d. Thierreichs*, vol. ii.; (4) *Turbellaria als Parasiten v. Wirthe* (Graz, 1904); (5) A. Lang, "Die Polycladen," *Fauna and Flora of the Gulf of Naples*, vol. ii. (1884); (6) F. F. Laidlaw (Polyclads) in Zoological Results of Expeditions conducted by Dr Willey, Stanley Gardiner and C. Crossland, Cambridge Univ. Press, and *Proc. Zool. Soc.* (1902–1906); (7) Gamble and Keeble (Green cells of *Convoluta*), *Quart. Jour. Micro. Sci.* (1903, 1907); (8) E. R. Pearl (Bionomics of Planarians), ibid. (1903); (9) Whitman (Hypodermic Impregnation), *Jour. Morphology* (1890), iv. 361; (10) Hesse (Eyes of Planarians), *Zeitschr. f. wiss. Zool.*, vol. lxi. (1897); (11) Carrière (ditto), "Die Sehorgane der Thiere" (1885); (12) A. A. W. Hubrecht (affinities), *Zeitschr. f. Naturwiss* (Jena, 1905); (13) Breslau (Development of Rhabdocoels), *Zeitschr. f. wiss. Zool.* (1905). Besides these special works, useful general accounts of the Turbellaria will be found in *Cambridge Natural History*, ii. 1–50; *A Treatise on Zoology* (Black), iv. 1–42, and the references given by these works.

Appendix to the Turbellaria.

Class *Temnocephaloidea.*—This small class of Platyelmia possesses a special interest. It connects the Turbellaria (and in particular the Vorticid rhsbdocoela) with the Trematoda. At the same time the Temnocephaloidea present certain peculiar structural features which entitle the class to an independent position.

The name of the class is derived from the digitate tentacles which occur on the anterior or lateral margins of the body. The body measures about 5 mm. in length, and the flattened ventral surface is armed with a sucker. It presents in most genera the appearance of a minute cephalopod, but in *Craspedella* the posterior part of the dorsal surface is raised up into three transverse fringed lamellae. These animals are epizoic, *i.e.* they live attached to the outer surface of other organisms, but are not ectoparasitic for they ingest Infusoria, Rotifera and Diatoms. Most of the species occur on fresh-water crayfish and crabs in Chile, Madagascar, the Malay Archipelago and Australasia. Two Brazilian forms are known, one from the pulmonary chamber of the Mollusc *Ampullaria* and the other from water tortoises. The genus *Temnocephala* is found in all the countries mentioned. The two others, *Craspedella* and *Actinodactylella* are only known from Australia.

The epidermis offers an interesting transitional structure. It is still, as in Turbellaria, cellular, or rather syncytial without cell-boundaries, but in most species has lost its cilia and developed a thick cuticle as in Trematodes, pierced by the necks of subdermal gland-cells. These cells, however, still retain the Turbellarian character of secreting rhabdites and form thickly-grouped tracts. The mouth, which is placed near the anterior end, leads into a bulbous pharynx from which a short, broad digestive sac is given off. The excretory system is peculiar. Besides the ordinary flame cells, single large canaliculated cells may form the commencement of the tubules, composed of comparatively few cells with large nuclei. They open to the exterior by a pair of contractile sacs situated dorsally at the level of the mouth as in certain Trematoda. Each sac is the product of a single cell, and is said to contain several branches of "flames" or synchronously contractile cilia. The reproductive system recalls that of certain Rhabdocoels, whilst the nervous system has retained a more primitive condition. The brain, which is placed over the mouth, gives rise to six main longitudinal tracts interconnected by a subdermal network. A pair of eyes is placed above the brain.



(From *Cambridge Natural History*, vol. ii. "WORMS," &c., by permission of Macmillan & Co., Ltd.)

FIG. 17.—The anatomy of Temnocephala (after Haswell).

♀ ♂, Common genital aperture.
d, Gut.
ex.s, Excretory sac.
m, Mouth.
ov, Ovary.
ovd, Oviduct.
ph, Pharynx.
rv, Receptaculum vitelli.
rh, Rhabdites.
rh.c, Rhabdite-forming cells.
sc, Sucker.
sh, Shell-gland.
te, Testis.
ut, Uterus.
vg, Vagina.
vs, Vesicula seminalis.

Class and order *Temnocepholoidea.*—Platyelmia in which the flattened body is produced into anterior or anterior and lateral tentacular processes and carries a ventral sucker. The epidermis is a syncytium covered by a thick cuticle. Cilia and rhabdites are present. Family I.: Temnocephalidae: 4–12 anterior tentacles. Family II.: Actinodactylellidae. Lateral tentacular processes.

See Haswell, *Macleay Memorial Volume* (1893); Plate, *Sitzberich. Akad. Wiss. Berlin* (1894), p. 527. (F. W. GA.)

PLANCEER, or PLANCHIER (O. Fr. *plancier*, or *planchier*, planking), in architecture, a term sometimes used in the same sense as a soffit, but more correctly applied to the soffit of the corona in a cornice.

PLANCHE, JEAN BAPTISTE GUSTAVE (1808–1857), French critic, was born in Paris on the 16th of February 1808. Introduced by Alfred de Vigny to François Buloz, he began to write for the *Revue des deux mondes*, and continued to do so until 1840. He resumed his connexion with the journal in 1846 and contributed to it until his death in Paris on the 18th of September 1857. Gustave Planche was an altogether honest critic and refused to accept a place from Napoleon III. for fear of compromising his freedom. He was in early life a fervent admirer of George Sand, and he lavished praise on De Vigny. But he had nothing but scorn for Victor Hugo, whose earlier dramas he characterized as odes, those following *Le Roi s'amuse* as antitheses, and the later ones as nothing but *spectacle*. His critical papers were collected under the titles: *Portraits littéraires* (1836–1849); *Nouveaux portraits littéraires* (1854); and art criticisms, *Études sur l'école française* (1855).

See Ernest Montégut, in the *Revue des deux mondes* (June 1858); Hatzfeld and Meunier, *Les Critiques littéraires du XIX^e^ siècle* (1891).

PLANCHÉ, JAMES ROBINSON (1796–1880), English dramatist and antiquary, was born in London on the 27th of February 1796, the son of a watchmaker of Huguenot descent. In 1810 he was articled to a bookseller. In 1818 his first dramatic piece, a burlesque entitled *Amoroso, King of Little Britain*, was produced at Drury Lane theatre. From this time onwards he made play-writing his principal work. In 1820–1821 he wrote ten pieces for the Adelphi theatre. In 1823 he designed the dresses for Charles Kemble's revival of *King John* at Covent Garden, and superintended its production. This was the first time that an historical drama had been "dressed" in the costume of the period. In 1828 he began writing regularly for Covent Garden theatre, and in 1830 was manager of the Adelphi. On Mme Vestris taking the Olympic theatre in 1831, Planché entered into an agreement with her to write a series of plays. The first of these, *Olympic Revels*, a burlesque, was given on the opening night of the theatre, the performance being given in correct classical costume. In 1843 his *Fair One with the Golden Locks* was produced by Webster at the Haymarket. In 1847 Mme Vestris became manageress of the Lyceum theatre, and Planché was engaged as her leading author and designer, his principal success being the *Island of Jewels* (1849). Subsequently he wrote for a number of other managements, his last dramatic piece being *King Christmas* (1871), but he also wrote the songs for *Babil and Bijou* at Covent Garden (1872). In addition to his dramatic work Planché enjoyed a considerable reputation as an antiquary and heraldic student. He was a Fellow of the Society of Antiquaries, and aided in the foundation of the British Archaeological Association in 1843. In 1834 he published *The History of British Costumes*. In 1854 he was appointed Rouge Croix pursuivant of arms at the Heralds' College, and in 1866 Somerset herald. In 1869, at the request of the War Office, he arranged the collection of armour at the Tower of London in chronological order. He died at Chelsea on the 30th of May 1880.

Planché's *Recollections and Reflections* were published in 1872.

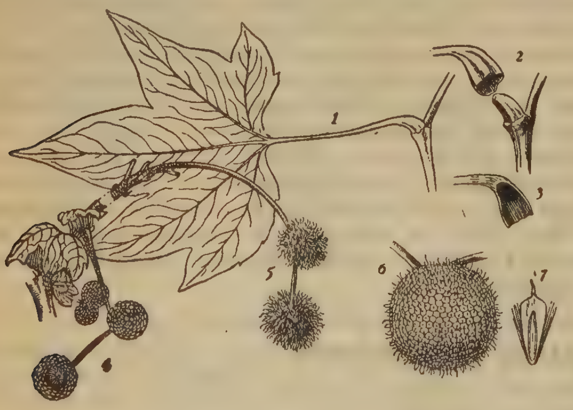
PLANCK, GOTTLIEB JAKOB (1751–1833), German Protestant divine and historian, was born at Nürtingen in Württemberg, where his father was a notary, on the 15th of November 1751. Educated for the Protestant ministry at Blaubeuren, Bebenhausen and Tübingen, he became *repentent* at Tübingen in 1774, preacher at Stuttgart in 1780, and professor of theology at Göttingen in 1784. At Tübingen he wrote *Das Tagebuch eines neuen Ehemannes*. In 1781 he published anonymously the first volume of his *Geschichte des protestantischen Lehrbegriffs*; the second, also anonymous, appearing in 1783, and it was completed in six volumes in 1800. It was followed by an extensive *Geschichte der christlich-kirchlichen Gesellschaftsverfassung* in five volumes (1803–1809). Both are works of considerable importance, and are characterized by abundant learning. He died on the 31st of August 1833. His son Heinrich Ludwig Planck (1785–1831), also professor of theology at Göttingen, published *Bemerkungen über den ersten Brief an den Timotheus* (1808) and *Abriss d. philos. Religionslehre* (1821).

PLANCK, KARL CHRISTIAN (1819–1880), German philosopher, was born at Stuttgart on the 17th of January 1819. He studied at Tübingen, where he became doctor of philosophy in 1840 and *Privatdozent* in 1848. During this period the influence of Reiff led him to oppose the dominant Hegelianism of the time. In 1850–1851 he published his great book, *Die Weltalter,* in which he developed a complete original system of philosophy, based on the realistic view that thought should proceed from nature to the highest forms of existence in the spiritual life. Not only did Planck oppose the idealism of his *confrères*; his views were, in another aspect, directly antagonistic to the Darwinian theory of descent, which he specifically attacked in *Wahrheit und Flachheit des Darwinismus* (Nördlingen, 1872). The natural consequence of this individuality of opinion was that his books were practically disregarded, and Planck was deeply incensed. The ill success of *Die Weltalter* nerved him to new efforts, and he repeated his views in *Katechismus des Rechts* (1852), *Grundlinen einer Wissenschaft der Natur* (1864), *Seele und Geist* (1871), and numerous other books, which, however, met with no better fate. In the meantime he left Tübingen for Ulm, whence he came finally to the seminary of Maulbronn. He died on the 7th of June 1880 in an asylum after a short period of nervous prostration. After his death a summary of his work came into the hands of K. Köstlin (author of *Aesthetics*, 1869), who published it in 1881 under the title *Testament eines Deutschen, Philosophie der Natur und der Menschheit.* Planck's views were elaborately developed, but his method of exposition told heavily against their acceptance. He regarded himself as the Messiah of the German people.

Beside the works above quoted, he wrote *System des reinen Idealismus* (1851); *Anthropologie und Psychologie auf naturwissenschaftlicher Grundlage* (1874); a political treatise, *Bismarck : Süddeutschland und der deutsche Nationalstaat* (1872); and *Logisches Causalgesetz und natürliche Zweckmässigkeit* (1874).

See Umfrid, *Karl Planck, dessen Werke und Wirken* (Tübingen, 1881); and Schmidt, "Das Lebensideal Karl Christian Plancks," in the *Vorträge der philosophischen Gesellschaft* (Berlin, 1896).

PLANE. 1. In botany, the common name of a handsome tree known botanically as *Platanus orientalis,* a native of Greece and western Asia, a favourite shade-tree of the ancient Greeks and Romans, and introduced by the latter to south-west Europe. It is one of the most successful trees in London and other large towns; the smooth face of the leaf is easily washed by rain; and the periodical peeling of the bark also serves to get rid of impurities. It is a large tree with widely spreading branches and alternate, palmately five-lobed leaves, resembling those of the sycamore in shape, but quite hairless and of a brighter green. The bud in the leaf axil is protected during its development by the hollow base of the leaf-stalk, which lifts off like an extinguisher when the leaf falls in autumn. The minute, unisexual flowers are borne in dense pendulous heads, which contain either male or female flowers; the small one-seeded fruits are densely crowded in a ball, from which they gradually separate in drying, and are readily carried by the wind. The wood, which is hard and heavy, though not strong, is used in Persia and other countries of western Asia for house construction and furniture. A variety of forms are known in cultivation, the commonest being the maple-leaved (*acerifolia*), the London plane, which has usually three-lobed leaves; var. *laciniata* has very deeply much divided leaves, and var. *variegata*, variegated foliage. *Platanus occidentalis,* an allied species, is a native of the United States, being most abundant and growing to its largest size in the bottom lands of the basins of the lower Ohio and the Mississippi rivers. It was introduced into England early in the 17th century, and is occasionally met with in western and central Europe. Professor C. S. Sargent (*Silva of North America*) refers to it as the most massive if not the tallest, deciduous-leaved tree of the North American forest; it is known in America as sycamore and buttonwood. It differs from *P. orientalis* in its less deeply lobed, more leathery pubescent leaves and in the usually solitary balls of fruit.



Plane (*Platanus orientalis*).
1, Leaf, ¼ nat. size.
2 and 3, Base of leaf-stalk showing bud-protecting cap, about ¼ nat. size.
4, Male, 5, Female inflorescence.
6, Head of fruits, about ½ nat. size.
7, A fruit with enclosed seed, cut lengthwise.

2. The name of a carpenter's hand-tool, used for levelling and smoothing (Lat. *planus*, level) the surface of wood. The machine tool used for a similar purpose for metals is generally known as a planing-machine or planer.

PLANET (Gr. πλανήτης, a wanderer), in the ancient astronomy, one of seven heavenly bodies characterized by being in motion relative to the fixed stars, which last appeared immovable upon the celestial sphere. As thus defined the planets were the sun, the moon, Mercury, Venus, Mars, Jupiter and Saturn. In modern astronomy since Copernicus, the term is applied to any opaque body moving around the sun. Taken in its widest sense it applies to the satellites which are sometimes termed *secondary planets.* Each of these moves around a planet larger than itself, which it accompanies in its revolution round the sun. A planet not revolving round another is termed a *primary* planet.

The primary planets are classified as major and minor. The former are eight in number and, with the sun, form the principal members of the solar system, under which head their arrangement is described. The earth on which we live is the third in the order of the major planets from the sun. With respect to the positions of their orbits relative to the earth, the other planets are distinguished as *inferior* and *superior*. The former, only two in number, comprise Mercury and Venus, which revolve between the earth and the sun. The superior planets are those whose orbits are outside that of the earth. The synodic revolution of an inferior planet is the time in which it performs a revolution relative to the line joining the earth and the sun. This is greater than its actual time of revolution. The phases or appearances presented by such a planet depend upon its configuration with respect to the earth and sun, and therefore go through their complete periods in a synodic revolution. At superior conjunction the illuminated hemisphere of the planet is presented to the earth so that it presents the form of a full moon. As it moves towards inferior conjunction, the lines from the planet to the sun and to the earth, or the angle sun-earth as seen from the planet, on which the phase depends, continually make a greater angle. At the time of greatest elongation this angle is 90°, and the planet appears one half illuminated, like the moon at first or last quarter. Then, as it approaches inferior conjunction, the visible portion of the disk assumes the crescent form, and while the circle bounding the disk continually increases owing to the approach of the planet to the earth, the crescent becomes thinner and thinner until, near inferior conjunction, the planet is no longer visible. After conjunction the phases occur in the reverse order. The brilliancy of the planet, as measured by the total amount of light we receive from it, goes through a similar cycle of change. The point of greatest brilliancy is between inferior conjunction and greatest elongation. In the case of Venus this phase occurs about three or four weeks before and after inferior conjunction.

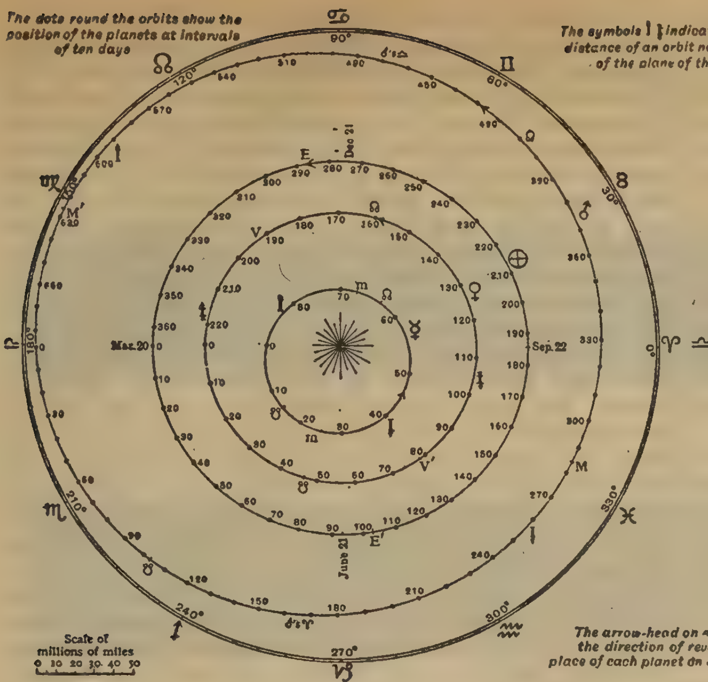

The dots round the orbits show the position of the planets at intervals of ten days
The symbols ⌇ ⌇ indicate the greatest distance of an orbit north and south of the plane of the Ecliptic
The arrow-head on each orbit shows the direction of revolution, also the place of each planet on Jan. 1st. 1910 at noon
Scale of millions of miles
0 10 20 30 40 50
90°
120°
150°
180°
210°
240°
270°
300°
330°
Sep. 22
Mar. 20
Dec 21
June 21
M
M'
V
V'
E
E'

FIG. 1.

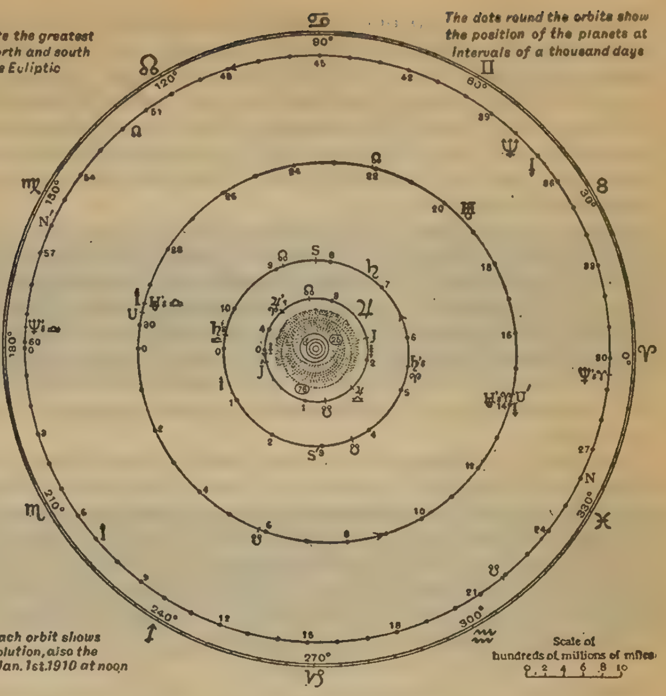
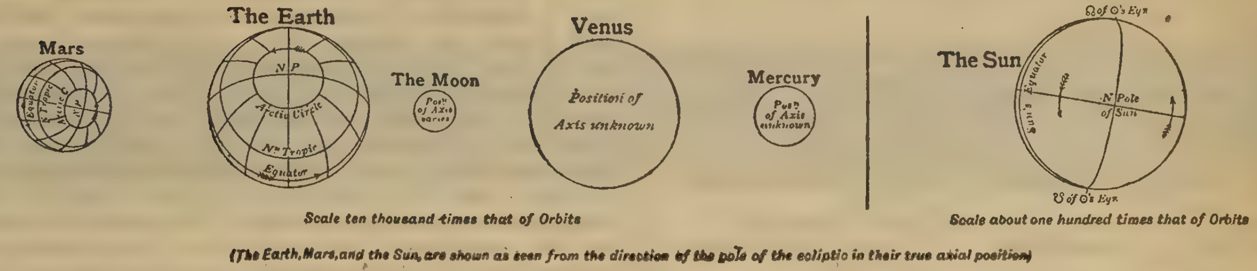
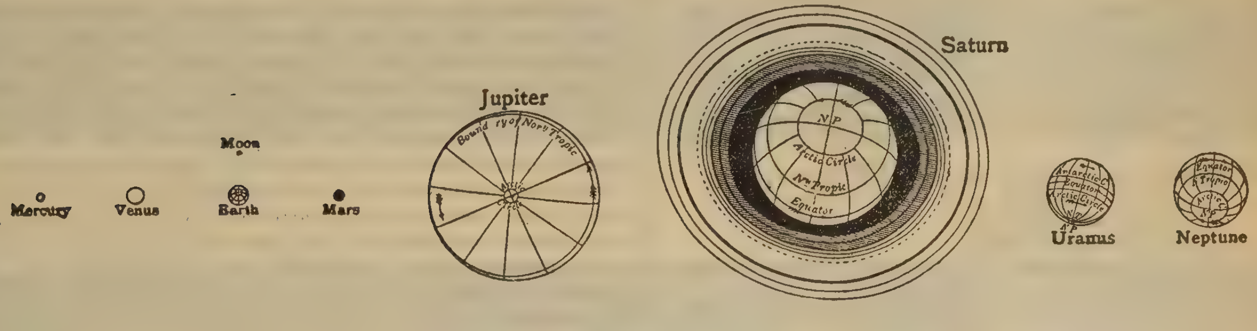

The dots round the orbits show the position of the planets at intervals of a thousand days
Scale of hundreds of millions of miles
0 2 4 6 8 10
90°
120°
150°
180°
210°
240°
270°
300°
330°
N
N'
U
U'
S
J

FIG. 2.


Mars
Equator
N. Tropic
Arctic Circle
The Earth
N P
Arctic Circle
Nn Tropic
Equator
The Moon
Posn of Axis varies
Venus
Position of Axis unknown
Mercury
Posn of Axis unknown
The Sun
☊ of ☉'s Eqr
☋ of ☉'s Eqr
Sun's Equator
N Pole of Sun
Scale ten thousand times that of Orbits
Scale about one hundred times that of Orbits

(The Earth, Mars, and the Sun, are shown as seen from the direction of the pole of the ecliptic in their true axial position)

FIG. 3.


Moon
Mercury
Venus
Earth
Mars
Jupiter
Boundary of Norn Tropic
Saturn
N P
Arctic Circle
Nn Tropic
Equator
Uranus
Antarctic Circle
Equator
Arctic Circle
Neptune
Equator
Tropic
Arctic
N P

Scale of Planets 20,000 times that of Orbits

FIG. 4.

(Jupiter and Saturn are shown in their true axial position, Uranus and Neptune in the axial positions inferred from the motions of their Satellites).

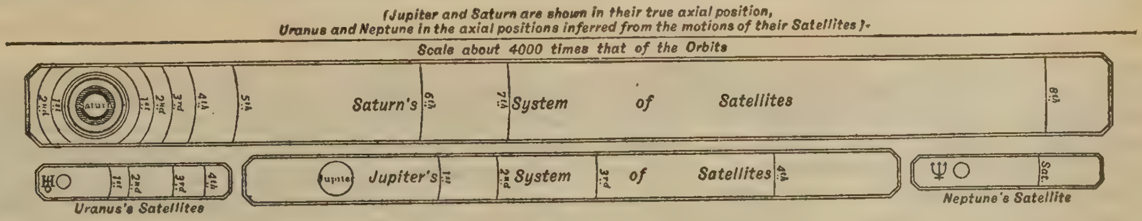

Scale about 4000 times that of the Orbits
Saturn
1st
2nd
1st
2nd
3rd
4th
5th
Saturn's
6th
7th
System
of
Satellites
8th
♅
1st
2nd
3rd
4th
Uranus's Satellites
Jupiter
Jupiter's
1st
2nd
System
3rd
of
Satellites
4th
♆
Sat.
Neptune's Satellite

FIG. 5.

In the figures given above are shown the relative orbits of the planets, the orbits of Mars, the Earth, Venus and Mercury (fig. 1) being drawn to a scale twenty times that of the outer ones—Neptune, Uranus, Saturn, Jupiter (fig. 2). The positions of the planets at ten-day intervals; their actual position on the 1st of January 1910 at noon, of their nodes and nearer apses, and the points when they are farthest distant north and south of the ecliptic, are also given. The relative sizes of the planets are also given, orientated in their true axial position with regard to the ecliptic. The nearer planets (and also the Moon) are separately compared (fig. 3); and then shown (on a smaller scale) in comparison with the more distant ones (fig. 4). Finally scale diagrams of the distances of the orbits of the satellite-systems of Saturn, Uranus, Jupiter and Neptune are given (fig. 5).

The phases of a superior planet are less strongly marked, because the lines from the planet to the earth and sun never increase to a right angle. The result is that although the apparent disk of Mars is sometimes gibbous in a very marked degree, it is always more than half illuminated. In the case of the other superior planets, from Jupiter outward, no variation in phase is perceptible even to telescopic vision. The entire disk always seems fully illuminated.

The most favourable time for viewing an inferior planet is near that of greatest brilliancy. As it recedes further from the earth, although a continually increasing proportion of its disk is illuminated by the sun, this advantage is neutralized by the diminution in its size produced by the increasing distance. When a superior planet is in opposition to the sun it rises at sunset and is visible all night. This is also the time when nearest the earth, and therefore when the circumstances are most favourable for observation.

The greater the distance of a planet from the sun the less is the speed with which it moves in its orbit. The orbit being larger, the time of its revolution is greater in a yet larger degree. An approximation to the general laws of speed in different planets is that the linear speed is inversely proportional to the square root of the mean distance. From this follows Kepler's third law, that the squares of the times of revolution are proportional to the cubes of the mean distances.

Notes on the Plate showing Planetary Spectra.

Only those lines and bands are mentioned which are peculiar to the planets; the Fraunhofer lines are therefore omitted.

Wave length.	Remarks.	
4600		Neptune.
4800	F hydrogen, $H\beta$ strong.	Neptune, Uranus, Saturn (?)
5090		Neptune, Uranus.
5190±	Broad.	Neptune, Uranus.
5370		Neptune, Uranus.
5430	Broad, unsymmetrical, strong.	Neptune, Uranus, Saturn, Jupiter.
5570±		Neptune, Uranus (?).
5700±	Broad, unsymmetrical, strong.	Neptune, Uranus, Saturn (?) Jupiter (?).
5980	Strong.	Neptune, Uranus.
6090		Neptune, Uranus.
6190	Very strong.	Neptune, Uranus, Saturn, Jupiter.
6400	Broad (?).	Neptune, Uranus.
6500±		Neptune, Uranus, Jupiter, Saturn (?).
6560	C hydrogen, $H\alpha$.	Neptune, Uranus.
6670±	Broad band.	Neptune, Uranus, Saturn, Jupiter.
[6780	Bright region due to absence of selective absorption which is strong both above and below.	Neptune, Uranus.
6820	Strong, narrow, near above B.	Neptune, Uranus, Saturn, Jupiter.
7020	Strong, broad.	Neptune, Uranus, Saturn, Jupiter.
[7140	Bright, unabsorbed region similar to that at 6780.	Neptune, Uranus.
7260	Strongest band present.	Saturn, Jupiter.
7500	Band (?).	Saturn.

Spectra and Atmospheres of the Planets.

It was once supposed that the planets were surrounded by comparatively dense atmospheres. The question whether such is the case, and, if so, what is the physical constitution of the atmospheres, is a difficult one, on which little light is thrown except by the spectroscope. If any of these bodies is surrounded by a transparent atmosphere like that of the earth, the light which reaches us from it will have passed twice through this atmosphere. If the latter were materially different in its constitution from that of the earth, that fact would be made known by the spectrum showing absorption lines or bands different from those found in the solar spectrum as we observe it. If, however, the planetary atmosphere had the same composition as ours we should see only an intensification of the atmospheric lines, which might be imperceptible were the atmosphere rare.

Actual observation has thus far shown no well marked deviation in the spectra of any of the inner group of planets, Mercury, Venus and Mars, from the solar spectrum as we see it. It follows that any atmospheres these planets may have must, if transparent, be rare. The evidence in the cases of Venus and Mars is given in the articles on these planets. Taking the outer group of planets, it is found that the spectrum of Jupiter shows one or more very faint shaded bands not found in that of the sun. In Saturn these bands become more marked, and in Uranus and Neptune many more are seen. The spectra in question have been observed both optically and photographically by several observers, among whom Huggins, Vogel and Lowell have been most successful. It may be said, in a general way, that seven or eight well marked dark bands, as well as some fainter ones are observable in the spectra of the two outer planets. The general conclusion from this is that these planets are surrounded by deep and dense atmospheres, semi-transparent, of a constitution which is probably very different from that of the earth's atmosphere. But it has not, up to the present time, been found practicable to determine the chemical constitution of these appendages, except that hydrogen seems to be an important constituent. (See Plate.)

Stability of Planetary Atmospheres.

Intimately associated with this subject is the question of the conditions necessary to the permanence of an atmosphere round a planet. Dr Johnstone Stoney investigated these conditions, taking as the basis of his work the kinetic theory of gases (*Trans. Roy. Dubl. Soc.* vi. 305). On this theory every molecule of a gaseous mass is completely disconnected from every other and is in rapid motion, its velocity, which may amount to one or more thousand feet per second, depending on the temperature and on the atomic weight of the gas. At any temperature the velocities of individual molecules may now and then increase without any well-defined limit. If at the boundary of an atmosphere the velocity should exceed a certain limit fixed by the mass and force of gravity of the planet, molecules might fly away through space as independent bodies. The absence of hydrogen from the atmosphere of the earth, and of an atmosphere from the moon, may be thus explained. If the fundamental hypotheses of Dr Stoney's investigations are correct and complete, it would follow that neither the satellites and minor planets of the solar system nor Mercury can have any atmosphere. If the separate molecules thus flying away moved according to the laws which would govern an ordinary body, they would, after leaving their respective planets, move round the sun in independent orbits. The possibility is thus suggested that the matter producing the zodiacal light may be an agglomeration of gaseous molecules moving round the sun; but several questions respecting the intimate constitution of matter will have to be settled before any definite conclusions on this point can be reached. It is not to be assumed that a molecule would move through the ether without resistance as the minutest known body does, and there is probably a radical difference between the minutest particle of meteoric matter and the molecule of a gas. The relations of identity or difference between such finely-divided matter as smoke and atmospheric haze and a true gas have yet to be fully established, and until this is done a definite and satisfactory theory of the subject does not seem possible.

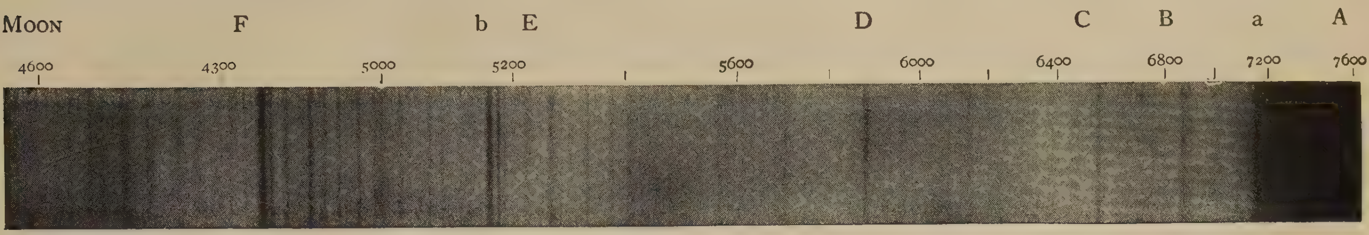
Temperature of the Planets.

Since the radiation of heat by a planet is, with our present instruments, scarcely capable of detection and measurement, the temperature of these bodies can be estimated only from general physical laws. The laws governing the radiation of heat have been so developed during recent years that it is now possible to state at least the general principle on which a conclusion as to the temperature of a planet may be reached. At the same time our knowledge of the conditions which prevail on other planets is so limited, especially as regards their atmospheres, that only more or less probable estimates of the temperature of their surfaces can even now be made. Summarily stated, some of the physical principles are these:—

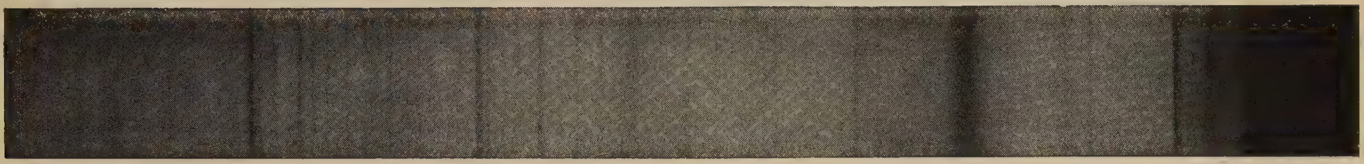
1. A neutrally coloured body—understanding by that term

PLANETARY SPECTRA, PHOTOGRAPHED AT LOWELL OBSERVATORY, FLAGSTAFF, ARIZONA,
BY V. M. SLIPHER.

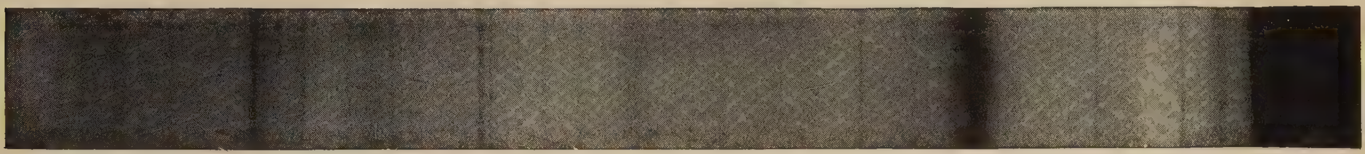
MOON


F
b E
D
C
B
a
A
4600
4300
5000
5200
5600
6000
6400
6800
7200
7600

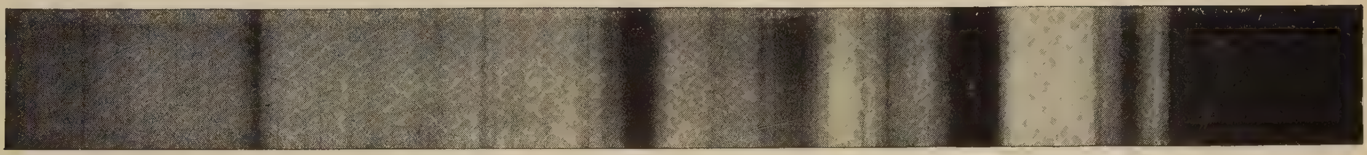
JUPITER.



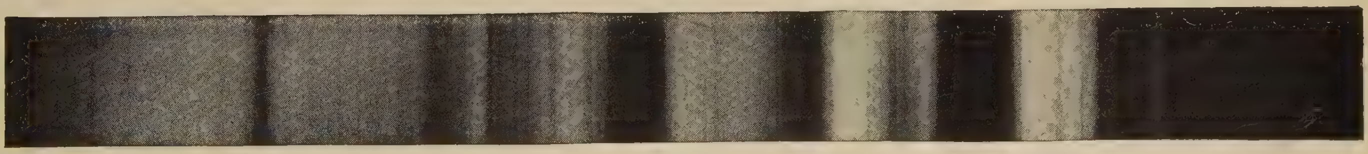
SATURN.

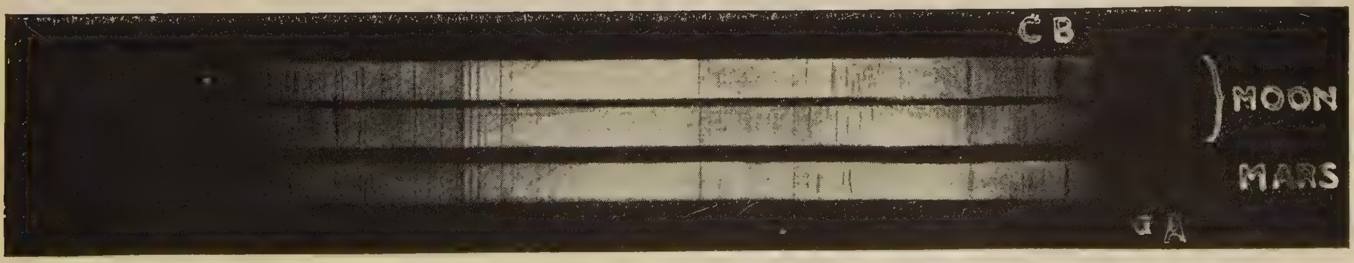


URANUS.



NEPTUNE.




C B
MOON
MARS
a A

Comparison spectrograms of the Moon and Mars, showing absorption bands in that of the latter, which denote the presence of water vapour in the Martian atmosphere (see MARS).

PLANET

REPRESENTATIVE STELLAR SPECTRA, PHOTOGRAPHED AT LOWELL OBSERVATORY, FLAGSTAFF, ARIZONA, BY V. M. SLIPHER.

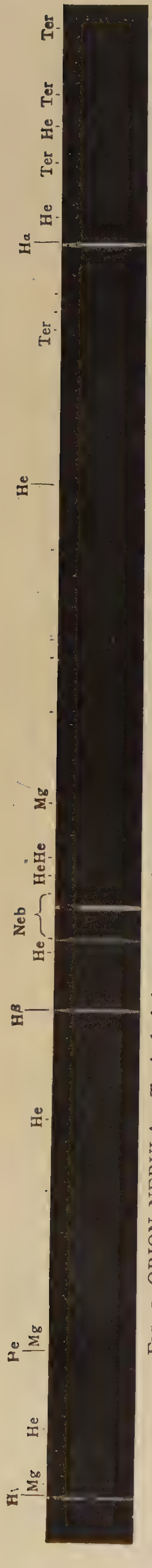


FIG. 1. ORION NEBULA.—Typical of the spectrum of the gaseous nebulae; contains bright lines of nebulum, hydrogen and helium. (The helium lines are too faint to show in this reproduction.)

FIG. 2. RIGEL.—Typical of the helium star spectrum; contains, in addition to the helium series and so-called Orion lines, dark lines of hydrogen.

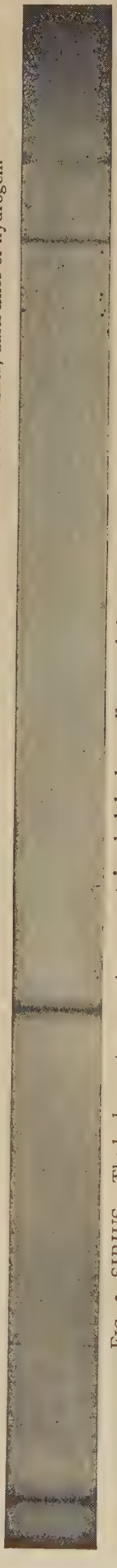


FIG. 3. SIRIUS.—The hydrogen type spectrum; contains dark hydrogen lines at their greatest strength and many fine metallic lines.

FIG. 4. PROCYON. Transition or hydrogen-to-solar type spectrum. The hydrogen lines are weaker, the metallic lines stronger, than in Sirius.

FIG. 5. SUN.—Hydrogen absorption fainter, metallic lines stronger and more numerous.

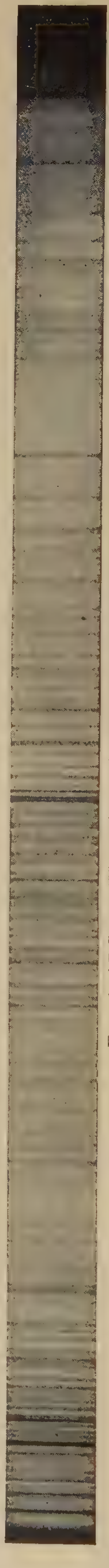


FIG. 6. ARCTURUS.—Advanced solar type spectrum.

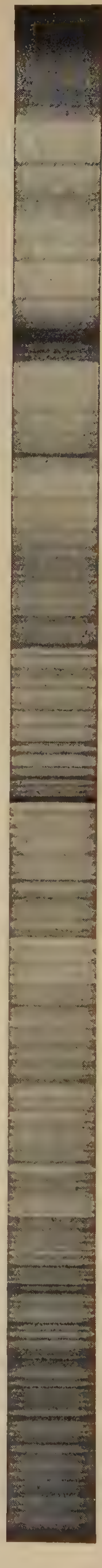


FIG. 7. BETELGEUSE.—Typical of the spectrum partaking of the nature of that of the sun and that of the long period variable star exemplified in Fig. 8.

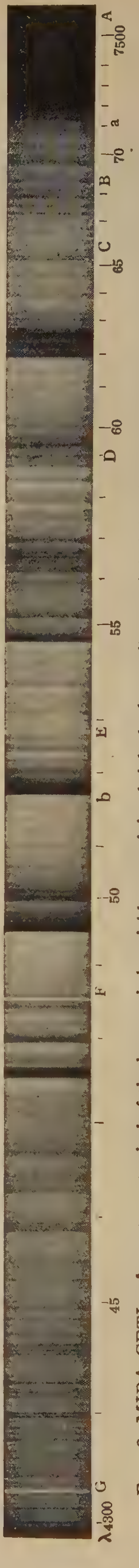


FIG. 8. MIRA CETI.—A spectrum typical of the long-period variable, containing bright hydrogen lines and dark bands or flutings which are sharply defined on the more refrangible edge. [Plate used in photographing this spectrum was not sensitive below λ 7200, hence no light-action below that point.]

one which absorbs the same fraction of the thermal radiation falling upon it whatever the wave length of this radiation—exposed to the sun's radiation in void space tends to assume a definite temperature, called the normal temperature, the degree of which depends upon the distance of the body from the sun. This is a result of Kirchhoff's laws of radiation.

2. An atmosphere surrounding such a body, if at rest, will tend to assume a state of thermal equilibrium, in which the temperature will be the same at all heights.

3. If the atmosphere is kept in constant motion by an interchange between its higher and lower portions, the tendency is towards adiabatic equilibrium, in which the temperature diminishes at a constant rate with the height, until it may approach the absolute zero. The rate of diminution depends upon the intensity of gravity and the physical constants of the gases composing the atmosphere.

4. In the actual case of a planet surrounded by an atmosphere and exposed to the sun's radiation, the actual rate of diminution of temperature with height above the surface of the planet lies between the extreme limits just defined, the rate varying widely with the conditions. The general tendency will be towards a condition in which the temperature at the base of the atmosphere is higher than the normal, while in the upper regions it is lower. The temperature of the surface of the planet on which the atmosphere rests is determined partly by the sun's radiation and partly by the temperature of the air. What we should generally expect in the absence of any selective absorption by the air is that the temperature of the lower air would be higher than that of the material surface on which it rests. But this condition might be reversed by the effect of such absorption in either the air or the material of the planet.

It would follow from these laws that the temperature of the superior planets diminishes rapidly with distance from the sun, and must therefore be far below that of the earth, unless they are surrounded by atmospheres of such height and density as to be practically opaque to the rays of heat, or unless they have no solid crust.

The resemblance of the spectra of Mars, Jupiter and Saturn to that of the sun leads to the conclusion that the atmospheres of these planets are transparent down to the reflecting surface of the body. The temperature of these surfaces must therefore be determined by Kirchhoff's law, unless they resemble the sun in being entirely liquid or gaseous, or in having only solid nuclei surrounded by liquid matter in a condition of continual movement. Something of this sort has been suspected in the case of Jupiter, which has several points of resemblance to the sun. The planets Uranus and Neptune which, but for their atmospheres, would approximate to the absolute zero in temperature, may be prevented from doing so by the dense atmosphere which the spectroscope shows around them.

A very elaborate investigation of the probable mean temperatures of the surfaces of the several planets has been made by J. H. Poynting, *Phil. Trans.* (vol. 202A, 1904).

Tables of Planetary Elements and Constants.

Table I. gives the elements determining the motions of each major planet, and Table II. certain numbers pertaining to its physical condition. For explanation of terms used see ORBIT. The elements are given for the epoch 1900, Jan. 0, Greenwich mean time, except the mean longitudes, which are for 1910, Jan. 0.

In interpreting or using the numbers it must be remembered that only the mean distances and mean daily motions can be regarded as well determined and invariable quantities. The other elements are subject to a secular variation, and all vary more or less from the action of the planets. In Table II. the reciprocal of the mass is given, the mass of the sun being unity. Some of these and other quantities are extremely uncertain. This is especially the case with the mass of Mercury, which the astronomical tables put at 1/6,000,000 that of the sun, while G. W. Hill has computed from an estimate of the probable density of the planet that it is probably less than 1/11,000,000. In the table we assume the round number 1/10,000,000. The volumes are derived from micrometric measures of the diameters, which are more or less uncertain. From these and the mass follows the density of each planet. From this again is derived the intensity of gravity at the surface; this is also frequently uncertain. Finally the normal temperature is that which a black or neutrally coloured body would assume when every part of it is equally exposed to the sun's rays by a rapid revolution. As has already been intimated, the actual temperature may also depend upon the interior heat of the planet, which is an unknown quantity. (S. N.)

TABLE I.—Elements of the Orbits of the Eight Major Planets.

Planet.	Mean Distance from Sun. Astronomical Units.	Mean Distance from Sun. Thousands of Miles.	Eccentricity of Orbit.	Longitude of Perihelion.	Longitude of Node.	Inclination.	Period of Revolution.	Mean Daily Motion.	Mean Longitude 1910, Jan. 0.
							Days.		
Mercury	0·3870987	36,000	0·205614	75° 54′	47° 9′	7° 0′	87·969256	4°·0927	3° 32′
Venus	0·7233315	67,269	0·006821	130° 10′	75° 47′	3° 24′	224·700798	1°·6021	73° 53′
Earth	1·0000000	92,998	0·016751	101° 13′	—	—	365·256360	0°·9856	99° 17′
Mars	1·523688	141,701	0·093309	334° 13′	48° 47′	1° 51′	686·979702	0°·52403	47° 39′
Jupiter	5·202804	483,853	0·048254	12° 36′	99° 37′	1° 19′	4332·5879	0°·083091	181° 43′
Saturn	9·538844	887,098	0·056061	90° 49′	113° 3′	2° 30′	10759·2010	0°·033460	28° 56′
Uranus	19·19096	1,784,732	0·047044	169° 3′	73° 29′	0° 46′	30586·29	0°·011770	286° 42′
Neptune	30·07067	2,796,528	0·008533	43° 45′	130° 41′	1° 47′	60187·65	0°·006020	107° 1′

TABLE II.—Physical Constants pertaining to the Major Planets.

Planet.	Angular Semidiameter. Equatorial.	Angular Semidiameter. Polar.	At Dist.	Diameter in Miles.	Reciprocal of Mass. (☉'s mass = 1)	Density. (Water = 1)	Density. (⊕ = 1)	Gravity at Surface. (⊕ = 1)	Orbital Velocity. Miles per sec.	Normal Temperature. Centigrade.
Mercury	3·30″	3·30″	1	2,976	10,000,000	3·5	·633	0·24	29·76	195°
Venus	8·46″	8·46″	1	7,629	408,000	5·05	·913	0·880	21·77	70°
Earth	8·79″	8·76″	1	7,917	333,430	5·53	1·000	1·00	18·52	19°
Mars	4·80″	4·76″	1	4,316	3,093,500	3·68	·666	0·363	15·00	− 36°
Jupiter	18·75″	17·65″	5·203	86,259	1,047·35	1·363	·247	2·68	8·12	−144°
Saturn	8·75″	7·88″	9·539	72,772	3,500	0·678	·123	1·13	6·00	−177°
Uranus	1·90″	1·90″	19·19	32,879	22,869	1·13	·204	0·85	4·24	−205°
Neptune	1·10″	1·10″	30·07	29,827	19,314	1·79	·322	1·22	3·40	−218°

PLANETS, MINOR. The minor planets, commonly known as *asteroids* or *planetoids*, form a remarkable group of small planetary bodies, of which all the known members but three move between the orbits of Mars and Jupiter. Until recently they were all supposed to be contained within the region just mentioned; but the discovery of one, which at perihelion comes far within the orbit of Mars, and of two others, which at aphelion pass outside the orbit of Jupiter, shows that no well-defined limit can be set to the zone containing them. Before the existence of this group was known, the apparent vacancy in the region occupied by it, as indicated by the arrangement of the planets according to Bode's law, had excited remark and led to the belief that a planet would eventually be found there. Towards the end of the 18th century the conviction that such a planet existed was so strong that an association of astronomers was formed to search for it. The first discovery of the looked-for planet was not, however, made by any member of this association, but by Giuseppe Piazzi of Palermo. On the 1st of January 1801 he noted a small star in Taurus, which, two days later, had changed its place, thus showing it to be a planet. Shortly after Piazzi's discovery the body was lost in the rays of the sun, and was not again seen until near the following opposition in 1801–1802. The orbit was then computed by C. F. Gauss, who found its mean distance from the sun to correspond with Bode's law, thus giving rise to the impression that the gap in the system was filled up. The planet received the name Ceres.

On the 28th of March 1802 H. W. M. Olbers (1758–1840) discovered a second planet, which was found to move in an orbit a little larger than that of Ceres, but with a very large eccentricity and inclination. This received the name of Pallas. The existence of two planets where only one was expected led Olbers to his celebrated hypothesis that these bodies were fragments of a larger planet which had been shattered by an internal convulsion; and he proposed that search should be made near the common node of the two orbits to see whether other fragments could be found. Within the next few years two other planets of the group were discovered, making four. No others were found for more than a generation; then on the 8th of December 1845 a fifth, Astrea, was discovered by K. L. Hencke of Driesen. The same observer added a sixth in 1847. Two more were found by J. R. Hind of London during the same year, and from that time discovery has gone on at an increasing rate, until the number now known is more than six hundred and is growing at the rate of thirty or more annually.

Up to 1890 discoveries of these bodies were made by skilful search with the telescope and the eye. Among the most successful discoverers were Johann Palisa of Vienna, C. H. F. Peters (1813–1890) of Clinton, New York, and James Craig Watson (1838–1880) of Ann Arbor, Michigan. In recent times the discoveries are made almost entirely by photography. When a picture of the stars is taken with a telescope moved by clockwork, so as to follow the stellar sphere in its apparent diurnal rotation, the stars appear on the plates as minute dots. But if the image of a planet is imprinted on the plate it will generally appear as a short line, owing to its motion relative to the stars. Any such body can therefore be detected on the plate by careful examination much more expeditiously than by the old method of visual search. The number now known is so great that it is a question whether they can be much longer individually followed up so as to keep the run of their movements.

Among the distinctive features of the planets of this group one is their small size. None exists which approaches either Mercury or the moon in dimensions. The two largest, Ceres and Juno, present at opposition a visible disk about 1″ in diameter, corresponding to about 400 miles. The successively discovered ones naturally have, in the general average, been smaller and smaller. Appearing only as points of light, even in the most powerful telescopes, nothing like a measure of their size is possible. It can only be inferred from their apparent magnitude that the diameters of those now known may range from fifteen or twenty miles upwards to three or four hundred, the great majority being near the lower limit. There is yet no sign of a limit to their number or minuteness. From the increasing rate at which new ones approaching the limit of visibility are being discovered, it seems probable that below this limit the number of unknown ones is simply countless; and it may well be that, could samples of the entire group be observed, they would include bodies as small as those which form the meteors which so frequently strike our atmosphere. Such being the case, the question may arise whether the total mass of the group may be so great that its action on the major planets admits of detection. The computations of the probable mass of those known, based upon their probable diameter as concluded from the light which they reflect, have led to the result that their combined action must be very minute. But it may well be a question whether the total mass of the countless unknown planets may not exceed that of the known. The best answer that can be made to this question is that, unless the smaller members of the group are almost perfectly black, a number great enough to produce any observable effect by their attraction would be visible as a faintly illuminated band in the sky. Such a band is occasionally visible to very keen eyes; but the observations on it are, up to the present time, so few and uncertain that nothing can positively be said on the subject. On the other hand, the faint "Gegenschein" opposite the sun is sometimes regarded as an intensification of this supposed band of light, due to the increased reflection of the sun's light when thrown back perpendicularly (see ZODIACAL LIGHT). But this supposition, though it may be well founded, does not seem to fit with all the facts. All that can be said is that, while it is possible that the light reflected from the entire group may reach the extreme limit of visibility, it seems scarcely possible that the mass can be such as to produce any measurable effect by its attraction.

Another feature of the group is the generally large inclinations and eccentricities of the orbits. Comparatively few of these are either nearly circular or near any common plane. Considering the relations statistically, the best conception of the distribution of the planes of the orbits may be gained by considering the position of their poles on the celestial sphere. The pole of each orbit is defined as the point in which an axis perpendicular to the plane intersects the celestial sphere. When the poles are marked as points on this sphere it is found that they tend to group themselves around a certain position, not far from the pole of the invariable plane of the planetary system, which again is very near that of the orbit of Jupiter. This statistical result of observation is also inferred from theory, which shows that the pole of each orbit revolves around a point near the pole of the invariable plane with an angular motion varying with the mean distance of the body. This would result in a tendency toward an equal scattering of the poles around that of Jupiter, the latter being the centre of position of the whole group. From this it would follow that, if we referred the planes of the orbit to that of Jupiter, the nodes upon the orbit of that planet should also be uniformly scattered. Examination, however, shows a seeming tendency of the nodes to crowd into two nearly opposite regions, in longitudes of about 180° and 330°. But it is difficult to regard this as anything but the result of accident, because as the nodes move along at unequal rates they must eventually scatter, and must have been scattered in past ages. In other words it does not seem that any other than a uniform distribution can be a permanent feature of the system.

A similar law holds true of the eccentricities and the perihelia. These may both be defined by the position of the centre of the orbit relative to the sun. If a be the mean distance and e the eccentricity of an orbit, the geometry of the ellipse shows that the centre of the orbit is situated at the distance ae from the sun, in the direction of the aphelion of the body. When the centres of the orbits are laid down on a diagram it is found that they are not scattered equally around the sun but around a point lying in the direction of the centre of the orbit of Jupiter. The statistical law governing these may be seen from fig. 1. Here S represents the position of the sun, and J that of the centre of the orbit of Jupiter. The direction JS produced is that of the perihelion of Jupiter, which is now near longitude 12°. As the perihelion moves by its secular variation, the line SJ revolves around S. Theory then shows that for every asteroid there will be a certain point A near the line SJ and moving with it. Let C be the actual position of the centre of the planetoid. Theory shows that C is in motion around A as a centre in the direction shown by the arrow, the linear eccentricity ae being represented by the line SC. It follows that e will be at a minimum when AC passes through S, and at a maximum when in the opposite direction. The position of A is different in the case of different planetoids, but is generally about two-thirds of the way from S to J. The lines AC for different bodies are at any time scattered miscellaneously around the region A as a centre. AC may be called the constant of eccentricity of the planetoid, while SC represents its actual but varying eccentricity,

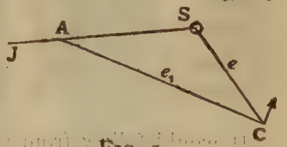


FIG. 1.

Grouping of the Planetoids.—A curious feature of these bodies is that when they are classified according to their distances from the sun a tendency is seen to cluster into groups. Since the mean distance and mean motion of each planet are connected by Kepler's third law, it follows that this grouping may also be described as a tendency toward certain times of revolution or certain values of the mean motion around the sun. This feature was first noticed by D. Kirkwood in 1870, but at that time the number of planetoids known was not sufficient to bring out its true nature. The seeming fact pointed out by Kirkwood was that, when these bodies are arranged in the order of their mean motions, there are found to be gaps in the series at those points where the mean motion is commensurable with that of Jupiter; that is to say, there seem to be no mean daily motions near the values 598″, 748″ and 898″, which are respectively 2, 2½ and 3 times that of Jupiter. Such mean motions are nearly commensurable with that of Jupiter, and it is shown in celestial mechanics that when they exist the perturbations of the planet by Jupiter will be very large. It was therefore supposed that if the commensurability should be exact the orbit of the planet would be unstable. But it is now known that such is not the case, and that the only effect of even an exact commensurability would be a libration of long period in the mean motion of the planetoid. The gaps cannot therefore be accounted for on what seemed to be the plausible supposition that the bodies required to fill these gaps originally existed but were thrown out of their orbits by the action of Jupiter. The fact can now be more precisely stated by saying that we have not so much a broken series as a tendency to an accumulation of orbits between the points of commensurability. The law in question can be most readily shown in a graphical form. In fig. 2 the horizontal line represents distances from the sun, increasing toward the left, of which certain equidistant numerical values are given below the line. Points on the line corresponding to each 0·01 of the distances are then taken, and at each point a perpendicular line of dots is drawn, of which the number is equal to that of the planetoids having this mean distance, no account being taken of fractions less than 0·01. The accumulations between the points of close commensurability with the mean motion of Jupiter may be seen by inspection. For example, at the point 2·59 the mean motion is three times that of Jupiter; at the point 2·81 twice the mean motion is equal to five times that of Jupiter; at 3·24 the mean motion is twice that of Jupiter. It will be seen that there is a strong tendency toward grouping near the values 2·75, and a lesser tendency toward 3·1 and 2·4. It is probable that the grouping had its origin in the original formation of these bodies and may be plausibly attributed to the formation of three or more separate rings which were broken up to form the group.

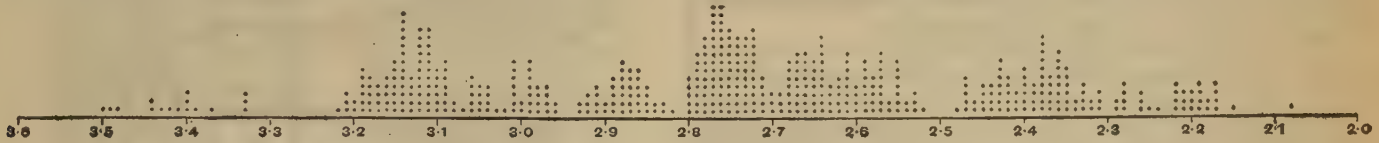


FIG. 2.

Continuing the question beyond these large collections, it will be seen that between the values 3·22 and 3·33 there are no orbits at all. Then between 3·3 and 3·5 there are nine orbits. The space between 3·5 and 3·9 is thus far a complete blank; then there are three orbits between 3·90 and 3·95, not shown in the diagram.

A group of great interest, of which only three members are yet known, was discovered during the years 1906–1907. The mean distance of each member of this group, and therefore its time of revolution, is so near that of Jupiter that the relations of the respective orbits are yet unknown. The case thus offered for study is quite unique in the solar system, but its exact nature cannot be determined until several more years of observation are available.

Several planetoids of much interest are situated without the limits of the groups shown in the figure. Eros is so near the sun, and its orbit is so eccentric, that at perihelion it is only about 0·16 outside the orbit of the earth. On those rare occasions when the earth is passing the perihelion point of the orbit at nearly the same time with Eros itself, the parallax of the latter will be nearly six times that of the sun. Measurements of parallax made at these times will therefore afford a more precise value of the solar parallax than can be obtained by any other purely geometrical measurement. An approach almost as close as the nearest geometrically possible one occurred during the winter of 1893–1894. Unfortunately the existence of the planet was then unknown, but after the actual discovery it was found that during this opposition its image imprinted itself a number of times upon the photographs of the heavens made by the Harvard Observatory. The positions thus discovered have been extremely useful in determining the elements of the orbit. The next near approach occurred in the winter of 1900–1901, when the planet approached within 0·32 of the earth. A combined effort was made by a number of observatories at this time to determine the parallax, both by micrometric measures and by photography. Owing to the great number of stars with which the planet had to be compared, and the labour of determining their positions and reducing the observations, only some fragmentary results of this work are now available. These are mentioned in the article PARALLAX. So far as can yet be seen, no other approach so near as this will take place until January 1931.

A few of the minor planets are of such special interest that some pains will doubtless be taken to determine their orbits and continue observations upon them at every available opposition. To this class belong those of which the orbits are so eccentric that they either pass near that of Jupiter or approach near that of the earth. With most of the others little more can be done than to compute their elements with a view of subsequently identifying the object when desired. Unless followed up at several oppositions after discovery, the planet is liable to be quite lost. Of those discovered before 1890 about fifteen have not again been found, so that if discovered, as they doubtless will be, identification will be difficult.

The system of nomenclature of these bodies is not free from difficulty. When discoveries began to go on at a rapid rate, the system was introduced of assigning to each a number, in the order of its discovery, and using as its symbol its number enclosed in a circle. Thus Ceres was designated by the symbol ①; Pallas by ②, &c., in regular order. This system has been continued to the present time. When photography was applied to the search it was frequently doubtful whether the planet of which the image was detected on the plates was or was not previously known. This led to the use of capital letters in alphabetical order as a temporary designation. When the alphabet was exhausted a second letter was added. Thus there are planetoids temporarily designated as A, B, &c., and AB, AC, &c. The practice of applying a name to be selected by the discoverer has also been continued to the present time. Originally the names were selected from those of the gods or goddesses of classical mythology, but these have been so far exhausted that the name is now left to the discretion of the person selecting it. At present it is customary to use both the number and the name, the former being necessary to the ready finding of the planetoid in a list, while the name serves for more certain identification. (S. N.)

PLANK, a flat piece of timber, sawn and planed; it is technically distinguished from a "board" by its greater thickness, and should measure from 2 to 4 in. in thickness and from 10 to 11 in.

in width. The word comes through the Fr. *planche* (from post-Augustan, Lat. *planca*, a nasalized adaptation probably of Gr. πλάξ, something flat, especially a flat stone. The use of the word “ plank ” in the sense of an article in a political programme is of American origin and is due to the use of “ platform ” for the programme itself.

PLANKTON, a name invented by Professor Victor Hensen for the drifting population of the sea. This is a convenient heading under which to discuss not only *plankton* proper, but the *benthos*, or crawling population of the sea-bottom. Scientific investigation of these subjects dates from the reports of the “ Challenger ” expedition, which, despite its many successors, still stands out as the most important of the oceanographic expeditions, alike by the work achieved, the distance traversed, the time occupied, and the money devoted to the publication of the results. It laid the foundation of our knowledge of the physics and chemistry of ocean water, of oceanic and atmospheric currents, of the contour of the sea-bottom, and of the main features of distribution of deep-sea life. Later work has confirmed and expanded, but not revoked, the conclusions thus attained. But, in spite of this and of several subsequent expeditions, it cannot be pretended that we are in a position to formulate general canons of marine distribution other than of the most tentative character. Two fallacies underlie many attempts to define distributional oceanic areas for special groups: the one, that such areas can be made to bear some relation to existing geographical or even national divisions; the other, that what is true for one group of the animal kingdom must hold good equally for another. It is necessary at the outset to divest oneself of these errors; oceanic conditions depend only very indirectly upon the distribution of the land, and strongly swimming or freely floating animals are not to be confined by the same factors as determine the distribution of sessile forms, whose range is governed by a variety of circumstances.

As Wyville Thomson pointed out long ago, there is but one ocean. This surrounds the southern half of the globe, and has two large gulfs, generally called the Atlantic and Pacific Oceans, which meet through narrow channels in the small Arctic Ocean, and a half gulf, the Indian Ocean. The Atlantic and Pacific exhibit a striking homology of atmospheric pressure and of prevalent wind and current; the Indian, to a great extent, resembles the southern half of a larger one, but this resemblance is modified by the neighbourhood of vast land masses. The prevalent winds, dependent on the fairly constant distribution of atmospheric pressure over the great oceans, are the most important determinant of currents. As at most points in the ocean the temperature, salinity and chemical composition of the water are mainly determined by the currents—that is, by the condition at the place whence the water came—it is obvious that a study of currents must precede any general view of the distribution of marine forms.

Regard must be had not merely to the superficial currents indicated in fig. 1, but also to the movements of the deeper layer. Ice melting at the poles, together with polar precipitation of hail, snow and rain, yields large quantities of water of low salinity and very low temperature; this water sinks under the warmer salter surface water drifted from lower latitudes, and, creeping slowly north and south from the poles, covers the bottom of all the great open oceans at very uniformly low temperatures (in some cases as low as 30° F.). Between surface and bottom the temperature gradually decreases (except where affected by local circumstances), and in the middle layers the existence of slow currents is suspected. The cold bottom water wells up to the surface in certain areas, replacing the surface water drained away by currents, notably to the westward of the great land masses. Ocean water is remarkably uniform as regards its contained salts and gases, and it does not seem likely that we can look to these to explain the facts of distribution. In its temperature, on the contrary, there is enormous variation. While the bottom water of the ocean is very cold, and the mid-water of a more or less intermediate temperature, the surface water, according as it has drifted from the equator polewards or in the reverse direction, has a mean annual temperature somewhere between 84° and 30° F., losing or gaining heat on its way. In the case of narrow or “ closed ” seas, and near land masses, sea-water does not exhibit that uniformity of composition which characterizes the open ocean; but even in such cases the temperature is largely influenced by adjacent currents, and, though less obviously than in the open ocean, seems to be a very important agent in distribution.

The fauna of the sea is divisible into the *plankton*, the swimming or drifting fauna which never rests on the bottom (generally taken now to include E. Haeckel’s *nekton*, the strong swimmers, such as fish and cephalopods), and the *benthos*, which is fixed to or crawls upon the bottom. These groups require a further subdivision according to depth—the more necessarily since, to some zoologists, any water over 100 fathoms is “ deep ” or even “ abyssal.” It is simplest to begin with the benthos. From the shore seawards we may distinguish several zones. Even the tidal zone, between high and low water-mark, is subdivisible by its fauna and flora. There generally follows on this a very gentle slope to the depth of about 100 fathoms, locally subdivisible into many lesser zones. It has been termed the continental shelf or littoral zone, not very appropriately, since it occurs round many oceanic islands, and even away from any land. In this zone, if near land, fall to the bottom the heavy materials produced by land waste and river drainage. The fauna of this zone, generally very well characterized, may be

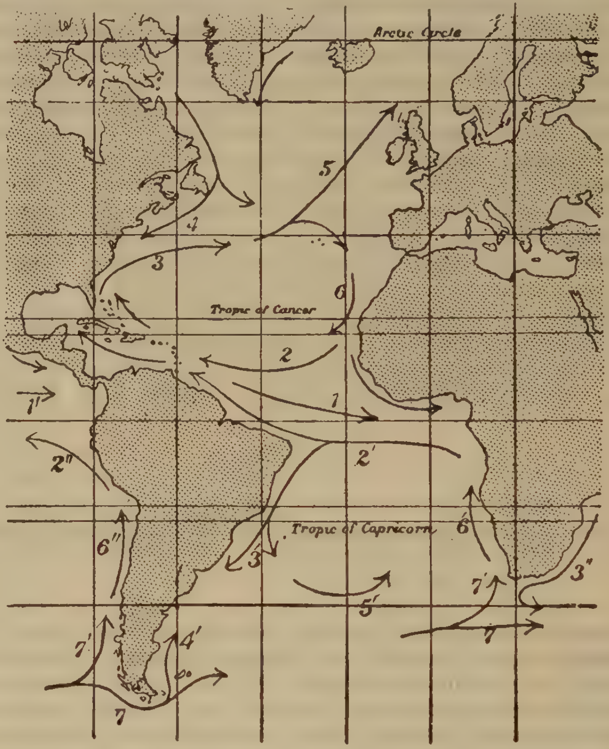


Fig. 1.—Diagram of the Atlantic Ocean, showing the Main Surface Currents (some are seasonal only): the corresponding Indian and Pacific currents are cited in parentheses; they are rarely so strongly marked as in the Atlantic.

1. Counterequatorial (also 1′ Pacific and Indian).
2. North Equatorial (also Pacific).
2′. The Equatorial (also 2″ Pacific and Indian).
3. Gulf Stream proper (Japan Stream).
3′. Brazil Current (Australian Current).
3″. Mozambique Current (recurved off Cape Agulhas).
4. Labrador Current (Kamchatka Current).
4′. Falkland Current.
5. North Atlantic Drift, generally called Gulf Stream (North Pacific Drift).
5′. South Atlantic Drift, ill defined (South Pacific Drift).
6. North African Current (Mexico Current).
6′. Benguela Current.
6″. Peru Current.
7. Antarctic Circumpolar Drift. 7′, its northerly branches on the west sides of Africa and South America.

distinguished as the *epibenthos*. As with the shallowest or tidal zone, its nature varies much more according to latitude and the character of the coast than the deeper zones. Everywhere, however, the epibenthic fauna is exposed to certain definite environmental conditions, as compared with a deeper fauna: namely, a high or fairly high temperature (except near the poles); a fairly good light, with its important consequence, a vegetable basis of food supply; tide and current to distribute the larvae to a suitable habitat, which the varied nature of the bottom near land is likely to furnish. Passing farther seawards, we find a steeper slope to about the 500-fathom line, the so-called continental slope. In this zone the environment is absolutely different. The water, no longer subject to seasonal variations of temperature, or to direct sunlight, is cold, and of a nearly uniform annual temperature (300 fathoms, ± 44·7° F.). Light has disappeared from all but the shallower part, and with it plant life; tide and current are no longer felt. To the latter fact is due, however, a great part of the food supply, which maintains in this zone an abundant fauna: a great quantity of organic matter, brought down by river action, produced by disintegrated sea-weed, and due to the death of surface organisms, together with the finer clayey materials of land waste, settles to the bottom in quiet water, near the 100-fathom contour, thus making the *mud-line* the richest feeding-ground in the ocean (Murray). The mud-line is the real upper limit of this zone; it typically begins at about 100 fathoms, but may begin at 5 to 20 fathoms in deep sheltered firths, or be pushed down to 300 fathoms where currents are strong. The fauna of this zone may be termed the *mesobenthos*; it is not so abundant, nor so sharply characterized, as the epibenthos, and yet is sufficiently distinct to deserve at any rate a provisional name. Another difference of condition between epibenthos and mesobenthos is the pressure of the water; at a depth of 500 fathoms this is, roughly speaking, half a ton to the square inch. It is very doubtful whether this enormous pressure makes the slightest difference to marine invertebrates, the tissues of which are uniformly permeated by fluids, so that the pressure is uniform in every direction; but animals with free gases naturally require time to adjust the gas-pressure when altering their levels. As regards the penetration of light, assimilative rays useful to plant life probably do not reach beyond 150 fathoms. Photographic rays have been detected as low as 220 fathoms, and if any light penetrate beyond this depth, it will consist only of blue, violet and ultra-violet rays: it has been suggested that the red colour prevalent in many deep-sea animals may be a screen from these hurtful rays. Below the 500-fathom line the ocean bottom exhibits almost uniform conditions everywhere, varied only by the character of the bottom deposit and the amount of food supply. In this zone, which extends from about 500 fathoms to the greatest depths (which may in some cases exceed 5000 fathoms, or more than 5½ m.), the temperature at any given point is uniform throughout the year, and is always very low: the mean at 2200 fathoms is 35·2° F.; at greater depths and in special circumstances less than 30° F. has been recorded. The darkness is probably absolute; for food the animals are dependent upon each other and upon the incessant rain of dead plankton from higher levels; the pressure may be anything between half a ton and five tons per square inch. To the fauna which lives in these remarkable circumstances the name *hypobenthos* may be applied.

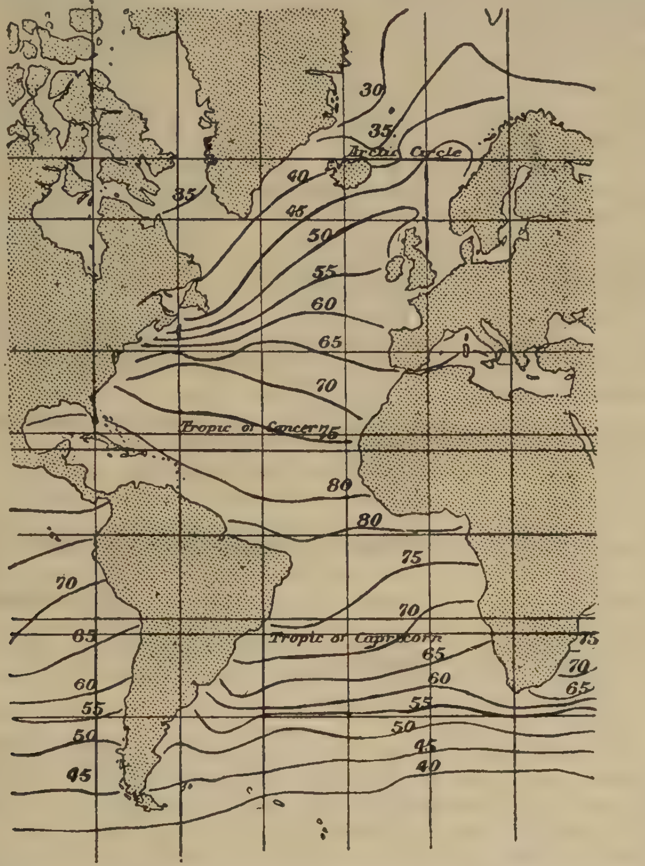


FIG. 2.—Mean Annual Surface Isotherms of the Atlantic. (After Buchan, "*Challenger*" *Report* on "Oceanic Circulation") On the north-east and south-west sides they are deflected polewards by the warm North Atlantic Drift and Brazil Current; on the south-east and north-west sides equatorwards by the cold Labrador and Benguela Currents. Note the markedly different latitudes of the same isotherms east and west of South America and Africa; also the effect of the Falkland Current against the Brazil Current.

That each of the three benthic groups is well characterized by a special fauna is shown by the following table, out of the total numbers of species captured by the "Challenger" at seventy stations in these three zones:—

	Species confined to this Zone.	Species occurring in other Zones.
Epibenthos	91 %	8 %
Mesobenthos . . .	74 ,,	25 ,,
Hypobenthos . . .	61 ,,	38 ,,

Out of the 25 % of its species which the mesobenthos shares with other zones, 59 % occur also in the epibenthos, about 40 % in the hypobenthos; the mesobenthos, therefore, on these figures, may be taken to consist of 74 % of peculiar species, 15 % shared with the epibenthos, 10 % with the hypobenthos. Speaking of the benthos as a whole, it may be said that the following statement holds good: The number of individuals, the proportion of species to genera, and the number of individuals of a given species, all decrease with increasing depth. Animal life also tends to diminish with increasing distance from land; this may be partly due to the greater food supply near land, partly to the fact that population is obviously thinnest on the advancing fringe of a migration.

The plankton can be subdivided into at least two groups. The fauna to which light and warmth are more or less necessary, which feeds either upon plants or upon organisms nearly dependent upon plant life, may be termed the *epiplankton*. This fauna is capable of a good deal of vertical movement upwards and downwards, the causes of which are still obscure, but most of its members seem rarely to descend lower than about 100 fathoms. Below this depth the fauna may be called the *mesoplankton*. In every area this appears to have its peculiar species, but the careful study by opening and closing tow-nets of the distribution of the mesoplankton is of so recent a growth that no statistics, such as we have of the benthos, are available. It is now generally admitted that the mesoplankton extends to the lowest depths yet searched (2730 to 2402 fathoms, Valdivia); but the number of specimens decreases rapidly after 200 fathoms, and below 1000 fathoms very little is captured. The conditions of light, temperature, pressure, &c., are practically those of the corresponding depths of the benthos; as regards the food, however, the mesoplankton can only depend on intercepting dead organisms which are falling from higher horizons, or on capturing the scanty prey of its own zone. It is possible that the plankton immediately over the bottom may prove to be sufficiently distinct to be separately classed as *hypoplankton*.

Epibenthos.

The main subdivisions of the marine fauna having thus been briefly sketched, it is advisable to consider them in somewhat more detail. The *epibenthos* is obviously that fauna to which, except in polar regions, light and warmth are necessary; and the absence of these at greater depths is probably the chief barrier to its vertical extension; the food supply is sufficiently plentiful in, at any rate, the upper parts of the mesobenthic zone to present no obvious barrier. The chemical constitution of the water (except to animals in brackish water near river mouths) and the pressure appear to exert little or no influence; and only those species which attach themselves to clean hard substances would be repelled by the mud-line.

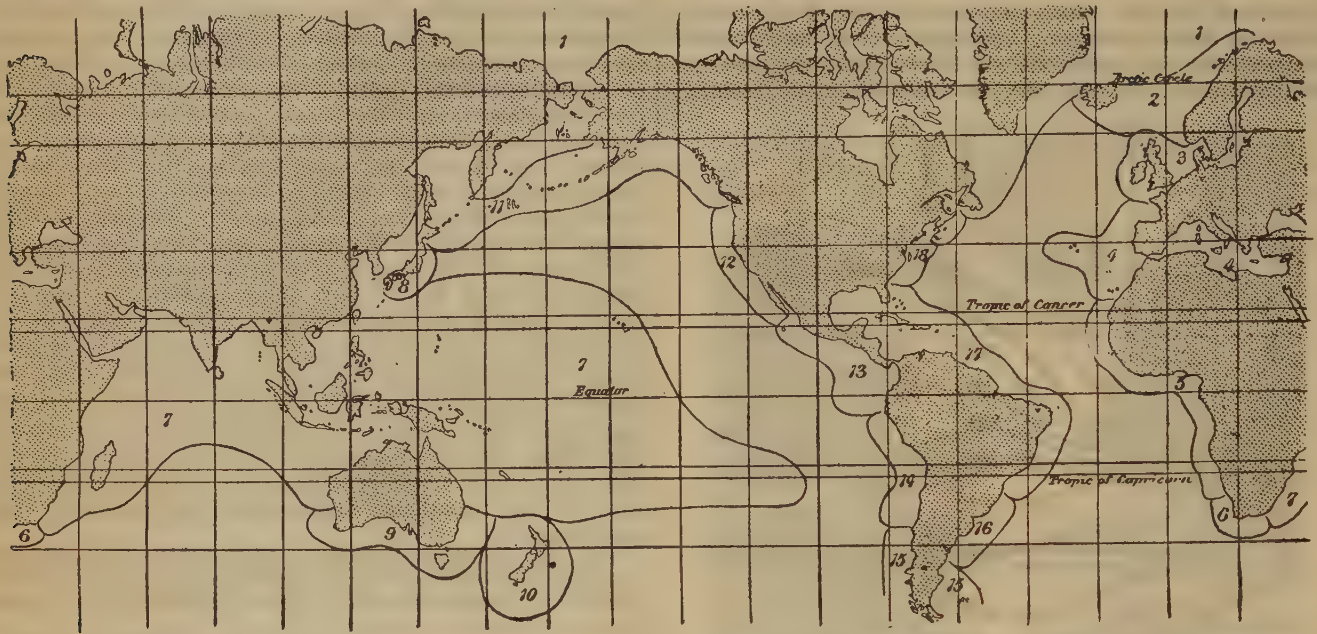


Fig. 3.—Diagram showing the Coastwise (*not* seaward) Extension of the Provinces of Epibenthic Gastropods and Lamellibranchs. Provinces:—

1. Arctic.
2. Boreal of East Atlantic.
2′. Boreal of West Atlantic.
3. Celtic.
4. Lusitanian.
5. West African.
6. South African.
7. Indo-Pacific.
8. Japanese.
9. Australian.
10. New Zealand.
11. Aleutian.
12. Californian.
13. Panama.
14. Peruvian.
15. Generally termed Patagonian or Magellanic for purely epibenthic forms, but in many Orders part of the circumpolar Antarctic region.
16. Argentinian.
17. Caribbean.
18. Transatlantic.

The chief barrier to a horizontal extension of the epibenthos is undoubtedly temperature. As an example of its distribution may be taken the Gastropod and Lamellibranch Molluscs, as groups of which the distribution has been studied for many years by specialists. The shallow-water species fall into provinces (compare Cooke, *Camb. Nat. Hist.* vol. "Molluscs," ch. xii.), and a comparison of figs. 1 and 3 shows at once the profound influence upon them of the great currents. Taking the Atlantic Ocean, we find the Arctic species, tempted southwards by the cold Labrador Current, repelled northwards by the warm North Atlantic Drift. The Boreal or sub-Arctic species, many of which are identical on both sides of the ocean (2 and 2′, fig. 3), lie much farther southwards on the west than on the east side, from the same causes. The warm-water molluscs of West Africa (5) are cut off from those of the east side (7) by the cold water from the great easterly Antarctic Drift, which impinges on the Cape, giving it a special fauna (6). On the South American coasts the tropical and temperate fauna reach respectively to 28° S. and 45° S. on the east coast, owing to the warm Brazil Current; but the corresponding groups on the west coast only to 5° S. and 37° S., being kept back by cold upwelling and Humboldt's Current. This influence is visible in individual species as well as in the facies of a fauna: *Purpura lapillus*, a temperate form, reaches on the east side of the Pacific to 24° N. and on the East Atlantic to 32° N.; but on the West Pacific only to 41° N. and the West Atlantic to 42° N., being repelled by the Japan stream (and other warm currents of the south-west monsoon) and Gulf Stream respectively.

But while some species may be confined to a bay, others to a province, others to an ocean, there are cosmopolitan species which either vertical or horizontal barriers, or both, fail to restrain. In relation to temperature the wide-ranging species are termed *eurythermal*, the limited, *stenothermal* (Moebius); the terms are useful to record a fact, but are not explanatory. It seems to be the case that to every organism is assigned a minimum temperature below which it dies, a maximum temperature above which it dies, and an optimum temperature at which it thrives best; but these have to be studied separately for every species. Similarly, in regard to depth, species have been classed as *eurybathic* and *stenobathic*, but, since increased depth practically means diminished temperature, these are probably merely expressions of the same fact in another form. That an Arctic shallow-water species should stretch to considerable depths is not surprising, but it is remarkable to find such forms as, for example, *Venus mesodesma* on a New Zealand beach at 55° F. and in 1000 fathoms at 37° F. off Tristan d'Acunha. The provinces of zoological distribution, like the geographical divisions of mankind, must be taken merely to indicate the facies of a well-characterized fauna, not to imply the restriction of all its habitants to that area.

In considering the effect of temperature (and this applies to plankton as well as to benthos down to 100 fathoms), attention must be directed not only to the question of general warmth or cold as expressed by the mean annual temperature, but also to the range between the annual extremes: these ranges of variation have been carefully mapped by Sir J. Murray (*Geog. Journ.* xii. 113; compare ibid. xiv. 34). Still more important to the death-rate than these is the suddenness with which such variations occur: many animals are known to endure great extremes of heat and cold if exposed to them gradually, but to succumb to rapid alterations of temperature. Hence the frontier districts (*Mischgebiete*) between opposing currents are characterized by a heavy death-rate, and constitute marked barriers. A conspicuous instance of such a barrier in distribution is afforded at the Cape. The warm Mozambique Current, with a south-westerly direction off Natal, meets a north-east branch of the cold Antarctic Drift, and is beaten back eastwards: a result of the constant warring of these hot and cold currents is a high range of sudden temperature variation. Hence the Cape fauna consists mainly of only such species from neighbouring provinces as can endure high sudden variations; and the district is practically impassable. For example, nineteen species of Echinoids are known from the Cape district. Of these twelve are peculiar to the Indo-Pacific province, which stretches from East Africa to the Sandwich Islands and from Japan to Australia; two species are Southern Ocean forms, all but confined to south of 40° S.; four species are peculiar to the Atlantic Ocean: of these eighteen not one gets past the Cape into the next province; the nineteenth is practically a cosmopolitan (A. Agassiz, "*Challenger*" *Reports*: "Echinoidea"; compare also C. Chun, *Aus den Tiefen des Weltmeeres*, pp. 157, 158).

Among the barriers to the horizontal extension of epibenthos must be mentioned a wide deep ocean. The Indo-Pacific fauna ranges from East Africa to about 108° W., stepping from island to island over the Pacific; but this continuity is then broken by 37 degrees of longitude and more than 2000 fathoms of water, and such sessile species as are most Mollusca (cf. fig. 3) are unable to reach the American coast. This is presumably due to the fact that the planktonic larvae of epibenthic adults must settle on a suitable bottom within a certain period or die. In spite of the direct set of the currents from Florida to the British Isles, the epibenthos of the two is absolutely dissimilar; the similarity of the two Boreal provinces (2 and 2′, fig. 3) is to be assigned to a former continuity by way of Greenland, Iceland and Faeroe; a similar continuity, still unbroken, is exhibited by the Aleutian province on both sides of the Pacific. Though larvae cannot cross wide oceans, adults may no doubt traverse great stretches occasionally on floating timber, &c.

This barrier by distance may be instanced in another way. In the Arctic regions land masses are continuous or contiguous, and there are many circumpolar species, as, for example, *Rhynchonella psittacea*; towards the South Pole the southern continent is almost ice-bound, and the available land consists only of the tips of the continents and of the few oceanic islands. Hence few if any littoral species are circumpolar. For example, not a single littoral Ophiurid surrounds the South Pole, but five or six species are circumpolar in the northern hemisphere.

Mesobenthos; Hypobenthos.

Taking next the *mesobenthos* and *hypobenthos*, living at depths where temperature is constant and current practically negligible, there appears theoretically to be no reason why an organism which can thrive at 500 fathoms should not have a world-wide range over the bottom of all oceans. Yet this is not often, although occasionally, known to be the case; and although perhaps, speaking generally, hypobenthic species have wider ranges than epibenthic, still they also seem to be limited. It must, however, be remembered that the ocean is large, deep hauls of trawl or dredge few, and individuals at great depths scattered, so that too much stress must not be laid on this point. The "Challenger" results seem to allow of at least one generalization—the deeper the fauna, the wider its range. This is shown by the following table of the "Challenger" benthos: the first column gives the number of benthos species captured at depths indicated in fathoms by the second column; the percentage of these species which is known to have been captured between the tropics, as well as south and north of the tropics, is shown in the third column:—

Number of Specimens.	Horizon.	S. T. N.
4248	0–100	0·6
1887	100–500	2
616	500–1000	4
493	1000–1500	7
394	1500–2000	7
247	2000–2500	9
153	over 2500	9

We can only guess at the causes of the apparently limited range of many deep-sea types. (*a*) One of these is probably the limited food supply: presumably, as with a land fauna, there are as many mouths in a given area as it will support, and an equilibrium of species is maintained which will at least hinder the extension of any one. For food the bulk of the deep-water fauna is dependent upon the rain of dead organisms falling from higher levels, these, slowly disintegrating (probably under chemical, not bacterial, action), seem to form with the bottom deposit a kind of nitrogenous ooze, through which many deep-sea organisms slowly swallow their way, as an earthworm goes through earth extracting nutriment. (*b*) Another hindrance to the extension of many deep-sea species is that they are *holobenthic*, that is, do not pass through a free-swimming larval stage; the means of dispersal is therefore regulated by the animal's own power of locomotion. Generally speaking, as might be expected, the freely-moving hypobenthos, fish and crustacea, have the widest ranges, and even these are not helped by currents, as are epibenthic or planktonic forms. The larval history of deep-water forms is, however, unfortunately obscure. (*c*) Lastly, extension of area of a species being at best difficult in deep water for non-swimmers, the place and date of their first migration must be taken into account; forms which have comparatively recently adopted deep-water life cannot be expected to have spread far from their original centre. As regards this point, in the first place, it is with migration, not with local evolution, that we have to deal: no classes and orders, only a few families and genera, rarely sub-orders, are peculiar to the hypobenthos; the deep members of each group consist for the most part of widely separated genera, the species do not grade into each other, as is so often the case in the epibenthos; and evolution could hardly have produced these species and genera under the uniformity of their present environment. This migration downwards from the mud-line has no doubt occurred all over the world, notably in the Southern Ocean, if we may judge by the richness of the deep-water fauna there to-day; probably also largely in Arctic and sub-Arctic regions, less so in tropical and temperate zones. As to the date of migration, the following fact seems to show that it is of comparatively recent origin, and is indeed still in progress: taking the "Challenger" species from the epibenthos, from the mesobenthos, and then from zones of 500 fathoms down to 2500, each zone shares a larger percentage of species with the zone above it than with that below it (except in one case where they are nearly equal). But it is not to be supposed that all our present-day deep-water forms began their migration simultaneously, and we can say with fair certainty that migration to deep water did not begin before the close of the Mesozoic epoch. Had it begun earlier, we should find typical Mesozoic and even older forms, or their congeners, at great depths: so far is this from being the case that the most venerable animals of to-day—*Lingula*, *Amphioxus*, *Limulus*, 75% of Crinoids, 90% of Brachiopoda, &c.—are epibenthic or mesobenthic. On the other hand, it is extremely likely that the Cretaceous epoch marked the commencement of migration. The hexactinellidan sponges are known to have lived in quite shallow water at the date of deposition of the Inferior Oolite; to-day none occur at a less depth than 95 fathoms; and as only two genera are known from the shallow Tertiary deposits, it would seem that the migration began about Cretaceous times ("*Challenger*" *Reports*: "Hexactinellida," F. E. Schulze). In 1881 (A. Agassiz, "*Challenger*" *Reports*: "Echinoidea") 105 living genera of Echinoidea were admitted; of these 23% were known from Cretaceous but not from Tertiary deposits, 35% from Tertiary but not Cretaceous, and 40% as Recent only. The species of Cretaceous genera constituted only 29% of the epibenthic Echinoids, 44% of the mesobenthic, and no less than 55% of the hypobenthic. These species of Cretaceous genera were distributed fairly evenly over all three zones, but 72% of the species of Tertiary genera and 55% of the Recent forms were confined to the epibenthos. As out of the twenty-five living genera known from the Cretaceous only seven are known also from Jurassic deposits, it is obvious that the close relationship is between Cretaceous and hypobenthos, rather than between any other geological and bathymetric horizons. Other instances, such as that of the Eryonidae, seem to point to similar conclusions.

Excepting the essential air-breathers, practically every phylum and class and most orders are represented in the benthos. The epibenthos of warm seas appears to be especially wealthy in such forms as secrete heavy calcareous skeletons; but in colder water, among the epibenthos of polar or sub-polar regions, and the hypobenthos everywhere in open oceans, the predominant forms are those which exhibit little or no calcareous secretion: even the apparent exceptions, Madreporaria and Echinoderma from great depths, tend to develop slighter skeletons than their warm-water congeners. The following table will serve to illustrate this point, and to give an idea of the composition of the epibenthos of cold and warm seas and of the hypobenthos: the figures are the percentages of total species captured in each locality by H.M.S. "Challenger," the balance being made up by few specimens in scattered groups:—

	Kerguelen Area—over 1260 fm.	Kerguelen Area—0 to 150 fm.	Cape York—0 to 12 fm.	
Madreporaria	0·8	0·0	3·3	Calcareous skeleton well developed.
Alcyonaria	1·2	1·0	3·3	
Shelled Mollusca	8·0	19·7	57·3	
Decapoda	3·6	0·8	8·1	
Echinodermata	33·6	11·7	7·9	
Actiniaria Hydrozoa	6·8	4·6	1·7	Calcareous skeleton light or absent.
Annelida	6·8	8·0	0·9	
Crustacea except Decapoda	16·5	25·0	7·6	
Tunicata	4·4	6·8	1·1	
	81·7	77·6	91·2	

While the Madreporaria represent only 3·3% of the species at the tropical station, it must be remembered that they probably made up 80% or more of the weight.

Epiplankton.

The *epiplankton* is dependent either directly or proximately upon light, warmth and the presence of plant life. The wealth of minute organisms near the surface is inconceivable to those who have not seen the working of a two-net: it may be gauged by the fact that a single species is sometimes present in such quantities as to colour the sea over an appreciable area, and by the estimate that the skeletons of epiplankton from a square mile of tropical ocean a hundred fathoms deep would yield 16 tons of lime. In the tropics the wealth of species, and towards the poles the number of individuals of comparatively few species, are characteristic of the latitudes. In temperate and tropical regions there is a great difference between the epiplankton near land and that far out at sea: the former is termed *neritic*; it extends, roughly speaking, at least as far out as the mud-line, and is characterized by the predominance of what may be termed *hemibenthic* forms, that is, benthic forms with a planktonic larval stage (*Decapoda*, *Polychaeta*, &c.), or with a planktonic phase (metagenetic Medusae). The horizontal barriers to the neritic plankton are practically those mentioned as governing the epibenthos; indeed, it would seem that the distribution of hemibenthic adults is determined by that of their more delicate larvae. Special conditions of wind and current may of course carry into the neritic zone forms which are characteristic of the open sea, and vice versa. In the neritic epiplankton of polar waters the larvae of hemibenthic forms are almost absent; indeed, the development of cold-water benthos, whether shallow or abyssal, appears to be in most cases direct, this is, without a larval metamorphosis. The epiplankton of the open sea is described as *oceanic*; it consists almost entirely of *holoplanktonic* forms and their larvae. The chief barrier to horizontal distribution, here as elsewhere, is doubtless temperature. For example, through the reports of the "National" cruise (German Plankton Expedition) runs the same story; one fauna characterized their course from Shetland to Greenland and Newfoundland, another the traverse of the Gulf Stream, Sargasso Sea and the Equatorial Currents. The influence of temperature may be gauged in another way: where hot and cold currents meet, occur "frontier" districts, in which the respective organisms are intermingled, and can only exist till their maxima or minima are reached. Well-marked examples of such districts occur off New Jersey (Gulf Stream and Labrador Current), in the China Sea (warm currents of the south-west monsoon and Kamchatka Current), in the Faeroe Channel, south of the Cape (recurving of the Agulhas Current): in some of these the range of variation amounts to as much as 50° F. in the year, with the result of a colossal death-rate of the plankton, and its corollary, a rich bottom fauna, for which food is thus amply supplied. The majority of the oceanic epiplankton appears to be stenothermal; for example, few components of the well-characterized fauna of the Gulf Stream and Sargasso Sea ever reach the British shores alive, although, if current and salinity were the determining factors and not temperature, this fauna should reach to Shetland, and even to Lofoten. It will only be possible to make satisfactory distributional areas for these oceanic forms by such systematic traverses as that of the "National"; at present it would seem that adjacent species have such different maxima and minima that every species must be mapped separately (compare the distribution-maps of the "National" Plankton Expedition). Some members of the epiplankton are, however, extraordinarily eurythermal and eurybathic; for example, *Calanus finmarchicus* ranges from 76° N. to 52° S. (excepting perhaps for 10° each side of the equator), and is apparently indifferent to depth.

In the first hundred fathoms at sea the fall of temperature is gradual and slight, and forms practically no hindrance to the *diurnal oscillation* of the oceanic epiplankton—the alleged rise and fall of almost the entire fauna. Roughly speaking, the greatest number of animals is nearest the surface at midnight; but different species sink and rise at different times, and to or from different depths. Apart from this diurnal oscillation, unfavourable conditions at the surface send or keep the fauna down in a remarkable way: for example, in the Bay of Biscay few organisms are to be found in the first fathom in bright sunlight, but on a still, hot day the next few fathoms teem with life; yet after a few minutes' wind or rain these upper layers will be found almost deserted. This leads to the consideration of the *hydrostatics* of the plankton: apart from strong swimmers, the majority contests the tendency to sink either by some means of diminishing specific gravity (increasing floating power) or by increased frictional resistance. The former is generally attained (*a*) by increase of bulk through development of a fluid secretion of low specific gravity (vacuoles of *Foraminifera, Radiolaria*, &c.); (*b*) or of a gelatinous secretion of low specific gravity (*Medusae*, Chaetopod and Echinoderm larvae, *Chaetognatha, Thaliacea:* the characteristic transparence of so many oceanic forms is probably attributable to this); (*c*) by secretion or retention of air or other gas (*Physalia, Minyas, Evadne*); (*d*) by development of oil globules (*Copepoda, Cladocera*, fish ova). Increased frictional resistance is obtained by flattening out of the body (*Phyllosoma, Sapphirina*), or by its expansion into lateral processes (*Tomopteris, Glaucus*), or by the development of long delicate spines or hairs (pelagic *Foraminifera*, many *Radiolaria*, many Chaetopod and Decapod larvae). In many cases two or more of these are combined in the same organism. Notwithstanding the above adaptations, some of which are adjustable, it is difficult to understand the mechanics of the comparatively rapid oscillations of the epiplankton, of which both causes and methods are still obscure.

It will be seen from the distribution of the Thecosomatous Pteropoda—a purely oceanic group—how difficult it will prove to draw distributional areas for classes of epiplankton. P. Pelseneer recognizes in all ten such provinces ("*Challenger*" *Reports*: "Zool.," xix., xxiii.) and 42 good species: of the latter 1 is confined to the Arctic, 4 to the Antarctic province, but of the remaining 37 species and eight provinces 30% occur in all eight, 16% in seven, and only 35% have as yet been captured in a single province only.

Mesoplankton.

The *mesoplankton* has only received serious attention during the last few years. In the "Challenger," open nets towed at various depths seemed to show the existence of a deep-water plankton, but this method gives no certain information as to the horizon of capture, the nets being open in their passage down and up. C. Chun constructed the first efficient net which could be opened and shut at known depths, using a propeller mechanism (*Bibl. Zool.* vol. i.); and he improved his original pattern for the "National" and "Valdivia" expeditions. The present writer has devised a net, of which the opening and closing are effected from the deck by heavy weights; this has been used successfully on the "Siboga" expedition and in cruises of the "Research" (*Proc. Zool. Soc.*, 1898). W. Garstang has constructed an ingenious net which is useful in comparatively shallow water, but is open to criticism as being too light for depths beyond 100 fathoms; and several other types are in use. The existence of a mesoplankton, that is, of a plankton living between 100 fathoms from the surface and the bottom, has been generally considered as definitely proved by these nets. On the other hand, A. Agassiz, using the Tanner tow-nets, contends that while a mixture of surface and bottom species may occur in a closed sea near land, there is no intermediate fauna in the open ocean between about 200 fathoms from the surface and the bottom; his conclusions, based on negative evidence, have not met with general acceptance. Animals captured below the first hundred fathoms in the open sea (the Mediterranean, for special physical reasons, is on a special footing) are divisible into at least three categories: (1) those which are eurythermal and eurybathic, *e.g. Calanus finmarchicus*; (2) those which, so far as we know, are purely mesoplanktonic and never come to the surface, for example, the Radiolarian family *Tuscaroridae*; (3) those which, like some *Schizopoda*, spend a larval period in the epiplankton, and seek deeper water when adult, rising to the surface, if at all, only at night. But until the publication of the results of expeditions provided with efficient mesoplankton nets, generalizations about this fauna had better be stated with all reserve. There is, however, a certain amount of evidence to show that the mesoplankton includes different organisms in different latitudes; that surface animals of the north and south, unable to spread into the warmer surface water of lower latitudes, there sink into the cooler waters of the mesoplankton; the distributional area of such an organism will be in three dimensions bounded by isotherms (isobathytherms) and isothermobaths. As with the hypobenthos, there seems to be no theoretical reason against the universal distribution of the mesoplankton.

When a more systematic investigation of the various horizons has been carried out, many of the present cases of supposed *discontinuous distribution* will doubtless disappear. There are, however, undoubted cases of discontinuity where physical barriers have cut across a distributional area, an example of which may be cited here. The Isthmus of Panama was apparently only upraised about Miocene time, having been previously an archipelago through which a great circumequatorial current could pass; consequently the benthos of the Panama region shows marked alliance with the Caribbean, with which it was formerly continuous, but practically none with the Indo-Pacific. To the same cause is doubtless attributable the distribution of the five Decapoda which are characteristic of the Sargasso Sea, which are circumequatorial oceanic types, only occasionally littoral: three of these are known only from the Atlantic, one occurs in the Atlantic and Pacific, one in the Atlantic, Pacific and Indian Oceans. The damming of a great circumequatorial current by the Isthmus of Panama is probably also responsible for that dislocation of currents which resulted in the present relations of the Gulf Stream and North Atlantic Drift to the Labrador Current, and cut the Atlantic Boreal fauna into two discontinuous districts (2 and 2′, fig. 3).

Under the head of discontinuous distribution, the alleged phenomenon known as *bipolarity* must be mentioned. In summarizing the work of the "Challenger," Sir John Murray maintained on the basis of the reports that numerous species occurred in both polar and sub-polar areas which were absent from the tropic. He regarded them as the hardy survivors of a universal fauna which had withstood that polar cooling which set in towards the close of the Mesozoic period (Murray, *Trans. Roy. Soc. Edin.* vol. xxxviii., 1896; G. Pfeffer, *Verh. deutsch. Zool. Gesellsch.* ix. 1899). This view and the facts on which it was based have been acutely contested, and the question is still far from settlement (for lists of the literature see A. E. Ortmann, *Am. Nat.* xxxiii. 583; and Miss E. M. Pratt, *Mem. Manchester Soc.* vol. xlv., 1901). As regards the purely epibenthic and sessile fauna, there are a few undoubted instances of actual specific identity; in some classes, however, such as the Echinoderms, this does not appear to hold (*Hamburger Magalhaensche Sammelreise*; and F. Römer and F. Schaudinn's *Fauna arctica*); but even in these the general composition of the fauna and the presence of certain identical and peculiar genera seem to point to something more than a mere "convergence" due to similar environment. As regards the plankton of the two polar regions and such epibenthic forms as extend also into deep water, the suggestion has been made that the Arctic and Antarctic benthos and plankton are really continuous by way of deep water in the main oceans, where the organisms can find a suitably low temperature. As an instance of this, C. Chun (*Bezieh. zwischen dem arkt. und antarkt. Plankton*, 1897) cites *Krohnia hamata*, a characteristic Arctic and sub-Arctic constituent of the epiplankton and mesoplankton, known only from the mesoplankton in the tropics, but rising to 38 fathoms at 40° S. 26° E. More exact information, such as may be expected from the various Antarctic expeditions, is required to settle this interesting question with its far-reaching corollaries. (G. H. Fo.)

See also ZOOLOGICAL DISTRIBUTION: § *Marine*.

PLANQUETTE, ROBERT (1850–), French musical composer, was born in Paris on the 31st of July 1850, and educated at the Conservatoire. As a boy he wrote songs and operettas for café concerts, and sprang into fame as the composer of *Les Cloches de Corneville* (Paris, 1877; London, 1878). In this work he showed a fertile vein of melody, which won instant recognition. There is in his music a touch of pathos and romantic feeling, which, had he cared to cultivate it, would have placed him far above contemporary writers of *opéra bouffe*. Unfortunately, he did little but repeat the formula which originally brought him reputation. *Le Chevalier Gaston* was produced in 1879 with little success. In 1880 came *Les Voltigeurs du 32^{me}*, which had a long run in London in 1887 as *The Old Guard*, and *La Cantinière*, which was translated into English as *Nectarine*, though never produced. In 1882 *Rip van Winkle* was produced in London, being subsequently given in Paris as *Rip*, in both cases with remarkable success. The libretto, an adaptation by H. B. Farnie of Washington Irving's famous tale, brought out what was best in Planquette's talent. In 1884 the phenomenon of an opera by a French composer being produced in London previously to being heard in Paris was repeated in *Nell Gwynne*, which was tolerably successful, but failed completely when produced in Paris as *La Princesse Colombine*. It was followed by *La Crémaillère* (Paris, 1885), *Surcouf* (Paris, 1887; London, as *Paul Jones*, 1889), *Captain Thérèse* (London, 1887), *La Cocarde tricolore* (Paris, 1892), *Le Talisman* (Paris, 1892), *Panurge* (Paris, 1895) and *Mam'zelle Quat'sous* (Paris, 1897).

PLANTAGENET, a surname conveniently, but unhistorically, applied to the royal line descended from the union of Geoffrey, count of Anjou, with the empress Maud, who are now styled by historians the Angevin house. It was, historically, only a personal nickname of Geoffrey, as was "Beauclerc" of his father-in-law (Henry I.) and "Curtmantel" of his son (Henry II.), and was derived from his wearing in his cap a sprig of the broom (*genet*) plant, "which in early summer makes the open country of Anjou and Maine a blaze of living gold." When the fashion of personal nicknames passed away, the members of the royal house were usually named from their birthplace, as Thomas "of Brotherton," Thomas "of Woodstock," Edmund "of Woodstock," Edmund "of Langley," Lionel "of Antwerp," and so forth. But Edward I. and his younger brother, the founder of the house of Lancaster, had still nicknames respectively, as "Longshanks" and "Crouchback." In the later days of the dynasty the surname of Beaufort was adopted by the legitimated issue of John of Gaunt by Katherine Swynford, but that of Plantagenet was bestowed on Arthur, natural son of Edward IV., who was created Viscount L'Isle. It appears, however, to have been adopted as a surname by Richard duke of York (father of Edward IV.) some twelve years before his death.

At the death of Geoffrey's grandson, Richard I., the succession was in doubt, John's elder brother Geoffrey having left, by the heiress of Brittany, a son and a daughter. But at that epoch the law of inheritance was in such a case unsettled, and their right was not clear. Arthur's fate is well known, and Eleanor, the daughter, was kept captive till her death in 1241. John's younger son Richard, king of the Romans, left a son Edmund, earl of Cornwall, with whom his line ended; his elder son Henry III. left two sons, of whom the younger was created earl of Lancaster and was grandfather of Henry, earl of Lancaster, whose heiress married John of Gaunt (*i.e.* Ghent). Edward I., the elder son, was grandfather of Edward III., the marriages of whose numerous children greatly affected English history. Edward his heir, the "Black Prince," left an only son, who succeeded his grandfather as Richard II., on whose death (1399) this line became extinct. Lionel, the next surviving brother of the Black Prince, left an only child Philippa, who married the earl of March, in whose heirs was the right to the succession. But John of Gaunt, the next brother, who had married the heiress of Lancaster and had been created duke of Lancaster in consequence, refounded the Lancastrian line, which obtained the throne in the person of his only son by her, Henry IV., on the deposition of Richard II., to the exclusion of the infant earl of March. His next brother, Edmund of Langley, who was created duke of York (1385), founded the Yorkist line, and was father, by a daughter and co-heiress of Pedro the Cruel, king of Castile, of two sons, Edward, second duke, who was slain at Agincourt, and Richard, earl of Cambridge, who by marrying the granddaughter and eventual heiress of Lionel's daughter Philippa, brought the right to the succession into the house of York.

Between their son and Henry VI. (grandson of Henry IV.) and Edward and Henry, sons and heirs of these rivals, was fought out the dynastic struggle known as "the Wars of the Roses," which proved fatal to several members of both houses. Richard, the son of Richard and Anne Mortimer, became third duke of York (1425), and was made protector of the realm 1454–1455, being finally declared heir to the throne on the triumph of his side in 1460; but he was slain at the battle of Wakefield (Dec. 31, 1460). Of his four sons, Edward, the eldest, became king as Edward IV. within three months of his death; Edmund, the second, was slain with his father at Wakefield; George, the third, duke of Clarence, was put to death in 1478; and Richard, the fourth, duke of Gloucester, became king as Richard III. in 1483 and was slain on Bosworth Field in 1485. King Edward IV.'s two surviving sons, Edward and Richard (the princes in the Tower), had been mysteriously put to death in 1483, so that the only male descendant of the house of York, and indeed of the whole Plantagenet race, was the duke of Clarence's son Edward, earl of Warwick (grandson of "the Kingmaker"), who was imprisoned by Richard III. (his father's younger brother) in 1483, and finally executed on Tower Hill, under Henry VII., in 1499.

Of the house of Lancaster, the only son of Henry VI. was slain after the battle of Tewkesbury (1471), while Edmund (Beaufort) duke of Somerset, a grandson of John of Gaunt, was slain at the first battle of St Albans (1455), and all his three sons were slain or beheaded. On the death of Henry VI. and his son in 1471, so complete was the extinction of their line that its representation vested in the heirs of the two daughters of John of Gaunt by the heiress of Lancaster, viz. Philippa queen of Portugal and Elizabeth countess of Huntingdon. But by his second wife, the heiress of Castile, John had left an only daughter, wife of Henry III., king of Castile and Leon, who also left descendants, and from his third but ambiguous union sprang the house of Beaufort, whose doubtful claims to his heirship passed with his great-granddaughter Margaret, by her husband Edmund Tudor, to their son Henry VII. Although Henry was careful to claim the crown in his own right (1485), he soon fortified that claim by marrying Elizabeth, eldest daughter of Edward IV. and rightful heiress to the throne. The marriage of their eldest daughter Margaret to James IV. of Scotland in 1503 resulted in the accession of James VI. of Scotland, a century later, as next heir to the throne (see Stewart).

Although no other dynasty has reigned so long over England since the Norman Conquest, the whole legitimate male issue of Count Geoffrey Plantagenet is clearly proved to have become extinct in 1499. Of its illegitimate descendants the house of Cornwall was founded by Richard, a natural son of Richard, king of the Romans and earl of Cornwall, who was ancestor of Lord Cornewall of Fanhope, temp. Henry VI., of the Cornewalls, "barons of Burford," and other families; but the principal house is that which was founded, at a later date, by Sir Charles Somerset, natural son of Henry (Beaufort) duke of Somerset (beheaded 1464), who was created earl of Worcester in 1513, and whose descendant Henry, marquess and earl of Worcester, obtained the dukedom of Beaufort in 1682. From him descend the ducal house, who bear the ancient arms of France and England, quarterly, within a bordure. (J. H. R.)

PLANTAIN (Lat. *plantago*), a name given to certain plants with broad leaves. This is the case with certain species of *Plantago*, *Alisma* and *Musa*, to all of which the term is popularly applied. The species of *Plantago* are mostly weeds with a dense tuft of radical leaves and scapes bearing terminal spikes of small flowers; the long spikes of *P. major*, when in seed, are used for feeding cage-birds; *P. lanceolata*, so called from its narrow lanceolate 3–6-ribbed leaves, is popularly known as ribwort; *Alisma P.* is the water-plantain, so called from the resemblance of its broad ribbed aerial leaves to those of *P. major*. The tropical fruit known as plantain belongs to the genus *Musa* (see Banana).

PLANTATION (Lat. *plantare*, to plant), literally the placing of plants in the ground, hence a place planted or a collection of growing things, &c., particularly used of ground planted with young trees. The term was early applied, in a figurative sense, to the settlement of people, and particularly to the colonization of North America in the early part of the 17th century and to the settlement of Scotch and English in the forfeited lands in Ireland (see below). The practice of sending convicted criminals to serve on the plantations in the colonies became common in the 17th century (see Deportation). These plantations were chiefly in the cotton, sugar and tobacco growing colonies, and the term "plantation" is thus particularly applied to estates in tropical or semi-tropical countries; the proprietors of such estates are specifically styled "planters."

Plantation Songs.

The negroes on the plantations of the Southern States of North America sang their songs and hymns and danced to tunes which were traditional, and are frequently known as "Plantation Songs." It has been claimed for some of them that they represent the folk songs brought by the first slaves from Africa; but the more generally accepted view is that they were those European hymn and song tunes which the negroes picked up from the revivalist preachers or from the Europeans around them, and adapted to their own strongly marked rhythms, which are certainly of African origin. The earliest song which became familiar to those outside the Southern States was "Jim Crow," sung by Dan Rice, and introduced to England about 1836. The "Jubilee Singers," a troupe from Fisk University, Nashville, Tennessee, toured the United States and Europe in 1871; but the great popularity of the negro songs and dances, and the traditional instruments, the bones and tambourine (the banjo was not originally used by the genuine negro), was due to the so-called "negro minstrel" troupes, of which the best known in England were Christy's, whence the generic name of Christy Minstrels, and later of the Moore and Burgess troupe at St James's Hall, London, started in 1862 and finally dissolved in 1904.

The best collection of genuine "plantation songs" and their words is *Slave Songs of the United States* (New York, 1871); see also

C. L. Edwards, *Bahama Songs and Stories* (Boston, 1895); J. B. T. Marsh, *The Story of the Jubilee Singers* (Boston, 1895); and articles by G. W. Cable on "The Creole Slave Dance" and "Creole Slave Songs," in the *Century*, February and April 1886.

Plantation of Ulster.—The Irish rebellion, which had disturbed Ulster during the closing years of Elizabeth's reign, was followed under James I. by further trouble, due partly to the inability of the English government to understand the system of land ownership prevalent in Ireland. At this time the chief offenders against the authority of England were the earls of Tyrconnell and Tyrone, but in September 1607 these once powerful nobles fled from the country. The English lawyers declared that the extensive estates which they held, not in their personal capacity, but as the heads respectively of the tribes of O'Neill and O'Donnell, had become the property of the English crown; and the problem which now confronted James I. and his advisers was what to do with the land, which was much too large to be cultivated properly by the scanty population living thereon. The idea of a plantation or colonization of Ulster, which was put forward as an answer to this question, is due mainly to Sir Arthur Chichester, the Irish lord deputy; its object was to secure the better cultivation of the land and to strengthen the English influence in Ulster by granting estates to English and Scottish settlers. Chichester proposed that the native inhabitants should be allowed to occupy as much land as they could cultivate, for he said, "that many of the natives in each county claim freehold in the lands they possess, and albeit these demands are not justifiable by law, yet it is hard and almost impossible to displant them." Even if this advice were carried out on a generous scale, the deputy considered that there would be abundance of land to offer to colonists, and also to reward the class of men known as servitors, those who had served the English king in Ireland. He submitted his ideas to Sir James Ley and Sir John Davies, two of the ministers of James I.; they reported to the English privy council, which signified its approval, and after the question had been illuminated by Bacon's great intellect, a committee was appointed to make the necessary arrangements. But those responsible for the plantation made one cardinal mistake, a mistake which was to cost the country much in the future. They rejected Chichester's idea of allotting land to the natives on a liberal scale, preferring to turn them out and to parcel out the whole of the forfeited district anew.

The forfeited lands lay in six counties, Tyrone, Donegal, Armagh, Fermanagh, Cavan and Coleraine (Londonderry), and the scheme for the plantation having been drawn up, the necessary survey began in May 1609. This was very inaccurate, but it served its purpose. The land was divided into three sections. One block was set apart for English and Scottish settlers, who were not to be allowed to have any Irish tenants; another was allotted to the servitors, who might have either English or Irish tenants; and a third was reserved for the Irish. Applications were then entertained from those willing to take up the land, and under Chichester's direction the settlement was proceeded with. The land was divided into portions of 1000, 1500 and 2000 acres, each colonist undertaking in return for his grant to build a castle or a walled enclosure, and to keep, train and arm sufficient men for its defence. Moreover he must take the oath of supremacy to James, and must not alienate his estate to an Irishman. He was given two years in which to do the necessary building; during this period he was freed from paying rent, but afterwards he must pay a quit-rent to the Crown. A scale of rents was drawn up, the native Irish paying at a higher rate than the English and Scottish settlers. Out of the forfeited lands provision was made for the maintenance of churches and schools, which were to be erected in conformity with the scheme.

The work progressed very slowly and much of the building was not even begun within the required time. Then in 1611 James I., who had from the first taken a lively interest in the plantation, sent Lord Carew to report on it. Carew's inspection did not reveal a very favourable condition of affairs, and in 1615 Sir Josiah Bodley was sent to make a further report about the progress of the work. A third report and survey was made three years later by Nicholas Pynnar, who found in the six counties 1974 British families, with 6215 men capable of bearing arms. He said that even on the lands occupied by the colonists the cultivation of the soil was still very much neglected The words spoken by Bacon in 1617 with reference to the plantation had come true. "Take it from me," he said, "that the bane of a plantation is when the undertakers or planters make such haste to a little mechanical present profit, as disturbeth the whole frame and nobleness of the work for times to come." Another survey took place in 1622, when various changes were suggested, but no serious alterations were made. On the whole the plantation had been a failure. Very few of the settlers had carried out their undertaking. In many cases the Irish had remained on the land allotted to the colonists, living under exactly the same conditions as they had done before the plantation, and holding on "whether the legal landlords liked it or not." As actually carried out the plantation dealt with 511,465 acres. Two-fifths of this was assigned to British colonists, being divided about equally between Englishmen and Scotchmen. Rather more than one-fifth went to the Church and about the same amount to the servitors and the natives. The best settlers were the Scots, although their tendency to marry with the Irish was noted and condemned during the early years of the settlement.

An important part of the plantation was the settlement of the county of Coleraine by the corporation of the city of London. Receiving a grant of practically the whole of the county the corporation undertook to spend £20,000, and within two years to build 200 houses in Derry and 100 in Coleraine. This was the most successful part of the settlement, and to it Londonderry owes its present name.

The expulsion of the Irish from the land in which by law and custom they had a certain proprietary and hereditary right, although not carried out on the scale originally contemplated, naturally aroused great indignation among them. Attacks on the settlers were followed by reprisals, and the plantation may fairly be regarded as one of the causes which led to the terrible massacre in Ulster in 1641. During Elizabeth's reign a scheme for the plantation of Munster was considered, and under Charles I. there was a suggestion for the plantation of Connaught, but eventually both were abandoned.

The "Orders and Conditions of Plantation" are printed in Walter Harris's *Hibernica* (Dublin, 1770); and in George Hill's *Historical Account of the Plantation in Ulster, 1608–1620* (Belfast, 1877). See also S. R. Gardiner, *History of England* (1899), vol. i.; and R. Bagwell, *Ireland under the Stuarts* (1909), vol. i.

PLANTIN, CHRISTOPHE (1514–1589), French printer, was born in a village near Tours (probably Saint-Avertin). He learned bookbinding and bookselling at Caen, and, having married in that town, settled in 1549 as bookbinder in Antwerp, where he was soon known as the first in his profession. A bad wound in the arm seems to have been the cause that first led him (about 1555) to apply himself to typography. The first known book printed in his office was *La Institutione di una fanciulla nata nobilmente*, by J. M. Bruto, with a French translation, and this was soon followed by many other works in French and Latin, which in point of execution rivalled the best printing of his time, while the masters in the art of engraving then flourishing in the Netherlands illustrated many of his editions. In 1562, Plantin himself being absent in Paris, his workmen printed an heretical pamphlet, which caused his movables to be seized and sold. It seems, however, that he recovered a great deal of the money, and in 1563 he associated himself with some friends to carry on his business on a larger scale. Among them were two grand-nephews of Dan. Bomberg, who furnished him with the fine Hebrew types of that renowned Venetian printer. His editions of the Bible in Hebrew, Latin and Dutch, his *Corpus juris*, Latin and Greek classics, and many other works produced at this period are renowned for their beautiful execution and accuracy. A much greater enterprise was planned by him in those years—the publication of a *Biblia polyglotta*, which should fix the original text of Old and New Testaments on a scientific basis. In spite of clerical opposition he was supported by Philip II. king of Spain, who sent him the learned Benedictus Arias Montanus to take the leading part in the work of editorship. With his zealous help the work was finished in five years (1569–1573, 8 vols. folio). Plantin earned little profit, but received the privilege of printing all liturgical books for the states of King Philip, and the office of "prototypographus regius." Though outwardly a faithful son of the church, he was till his death the partisan of a mystical sect of heretics; and it is now proved that many of their books published without the name of a printer came from his presses together with the missals, breviaries, &c., for the Roman Catholic Church.

Besides the polyglot Bible, Plantin published in those years many other works of note, such as editions of St Augustine and St Jerome, the botanical works of Dodonaeus, Clusius and Lobelius, the description of the Netherlands by Guicciardini, &c. In 1575 his printing-office reckoned more than twenty presses and seventy-three workmen, besides a similar number that worked for the office at home. But in November 1576 the town was plundered and in part burnt by the Spaniards, and Plantin had to pay an exorbitant ransom. He established a branch of his office in Paris; and when in 1583 the states of Holland sought a typographer for the newly erected university at Leiden, he left his much reduced business in Antwerp to his sons-in-law John Moerentorf (Moretus) and Francis van Ravelinghen (Raphelengius), and settled there. When in 1585 Antwerp was taken by the prince of Parma and affairs became there more settled, he left the office in Leiden to Raphelengius and returned to Antwerp, where he laboured till his death on the 1st of July 1589. His son-in-law, John Moretus, and his descendants continued to print many works of note "in officina Plantiniana," but from the second half of the 17th century the house began to decline. It continued, however, in the possession of the Moretus family, which religiously left everything in the office untouched, and when in 1876 the town of Antwerp acquired the old buildings with all their contents, for 1,200,000 francs, the authorities were able with little trouble to create one of the most remarkable museums in existence (the Musée Plantin, opened August 19, 1877).

See Max Rooses, *Christophe Plantin imprimeur anversois* (Antwerp, 1882); Aug. de Backer and Ch. Ruelens, *Annales de l'imprimerie Plantinienne* (Brussels, 1865); Degeorge, *La Maison Plantin* (2nd ed., Brussels, 1878). (P. A. T.)

PLANTS. In the most generally used sense, a plant is a member of the lower or vegetable order of living organized things; the term is also popularly applied to the smaller herbaceous plants, thus excluding trees and shrubs. The early use of the word is for a twig, shoot, cutting or sapling, which was the meaning of Lat. *planta* (for *plancta*, the root being that seen in *planus*, flat, cf. Gr. πλατύς, broad; *planta* thus meant a spreading shoot or sucker). Other meanings of "plant" are derived from the verb "to plant" (Lat. *plantare*, to fix in position or place). It is thus used of the fixtures, machinery, apparatus necessary for the carrying on of an industry or business, and in colloquial or slang use, of a swindle, a carefully arranged plot or trap laid or fixed to deceive; cf. also PLANTATION. In the following sections the botanical sense of the word is followed, the term being used generally as opposed to "animals."

Classification of Plants

Some account of the history of plant classification and the development of a natural system in which an attempt is made to show the actual relationships of plants, is given in the article BOTANY. The plant world falls into two great divisions, the higher or flowering plants (*Phanerogams*), characterized by the formation of a seed, and the lower or flowerless plants (*Cryptogams*), in which no seed is formed but the plants are disseminated by means of unicellular bodies termed spores. The term Cryptogam is archaic, implying a hidden method of reproduction as compared with the obvious method represented by the flower of the Phanerogam; with the aid of a good microscope it is, however, easier to follow the process of fertilization in many Cryptogams than in the flowering plants. These two great divisions are moreover of unequal value, for the Cryptogams comprise several groups differing from each other by characters as marked as those which separate some of them from the Phanerogams. The following groups or sub-kingdoms are those which are now generally recognized:—

Cryptogams {
I. Thallophyta.
II. Bryophyta.
III. Pteridophyta.
Phanerogams or IV. Spermatophyta.

Thallophyta are the most lowly organized plants and include a great variety of forms, the vegetative portion of which consists of a single cell or a number of cells forming a more or less branched thallus. They are characterized by the absence of that differentiation of the body into root, stem and leaf which is so marked a feature in the higher plants, and by the simplicity of their internal structure. Both sexual and asexual reproduction occur, but there is usually no definite succession of the two modes marking that alternation of sexual generation (gametophyte) and asexual generation (sporophyte) which characterizes the higher groups. The group has until recent years been regarded as comprising three classes distinguished by well-marked physiological features—the Algae (including the Seaweeds) which contain chlorophyll, the Fungi which have no chlorophyll and therefore lead a saprophytic or parasitic mode of life, and the Lichens which are composite organisms consisting of an alga and a fungus living together in a mutual parasitism (symbiosis); Bacteria were regarded as a section of Fungi. Such a system of classification, although convenient, is not the most natural one, and a sketch of the system which better expresses the relationships between the various subdivisions is given here. It has however been deemed advisable to retain the older groups for purpose of treatment in this work, and articles will be found under the headings ALGAE, FUNGI, BACTERIA, and LICHENS. The study of phylogeny has suggested fourteen classes arranged in the following sequence: (1) Bacteria; (2) Cyanophyceae (Blue-green algae); (3) Flagellatae; (4) Myxomycetes (Slime-fungi); (5) Peridineae; (6) Conjugatae; (7) Diatomaceae (Diatoms); (8) Heteroconteae; (9) Chlorophyceae (Green Algae); (10) Characeae (Stoneworts); (11) Rhodophyceae (Red Algae); (12) Eumycetes (Fungi); (13) Phycomycetes (Algal fungi); (14) Phaeophyceae (Brown Algae). Bacteria (see BACTERIOLOGY) and Cyanophyceae (see ALGAE), which are often grouped together as Schizophyta, are from points of view of both structure and reproduction extremely simple organisms, and stand apart from the remaining groups, which are presumed to have originated directly or indirectly from the Flagellatae, a group of unicellular aquatic organisms combining animal and plant characteristics which may be regarded as the starting-point of unicellular Thallophytes on the one hand and of the Protozoa on the other. Thus simple forms included in the Heteroconteae, Chlorophyceae and Phaeophyceae show an obvious connexion with the Flagellatae; the Peridineae may be regarded as a further developed branch; the Conjugatae and Diatomaceae cannot be directly connected; the origin of the Rhodophyceae is also obscure; while the Characeae are an advanced and isolated group (see ALGAE). The Mycetozoa (*q.v.*) or Myxomycetes are a saprophytic group without chlorophyll, of simple structure and isolated position. The algal fungi, Phycomycetes, are obviously derived from the Green Algae, while the remaining Fungi, the Eumycetes, appear to have sprung from the same stock as the Rhodophyceae (see FUNGI). Owing to the similarity of structure and mode of life it is convenient to treat the Lichens (*q.v.*) as a distinct class, while recognizing that the component fungus and alga are representatives of their own classes.

The *Bryophyta* and *Pteridophyta* have sprung from the higher Thallophyta, and together form the larger group Archegoniatae, so-called from the form of the organ (*archegonium*) in which the egg-cell is developed. The Archegoniatae are characterized by a well-marked alternation of gametophyte and sporophyte generations; the former bears the sexual organs which are of characteristic structure and known as antheridia (male) and archegonia (female) respectively; the fertilized egg-cell on germination gives rise to the spore-bearing generation, and the spores on germination give rise directly or indirectly to a second gametophyte.

The Mosses and Liverworts (see BRYOPHYTA) include forms with a more or less leaf-like thallus, such as many of the liverworts, and forms in which the plant shows a differentiation into a stem bearing remarkably simple leaves, as in the true mosses. They have no true roots, and their structure is purely cellular or conducting bundles of a very simple structure are present. The independent plant which is generally attached to the soil by hair-like structures is the sexual generation, the sporophyte is a stalked or sessile capsule which remains always attached to the gametophyte from which it derives the whole or part of its nourishment.

The Ferns and fern-like plants (see PTERIDOPHYTA) have on the other hand a well developed independent sporophyte which is differentiated into stem, leaf and root with highly organized internal structure including true vascular bundles. In general structure they approach the Phanerogams with which they form collectively the Vascular Plants as contrasted with the Cellular Plants—Thallophyta and Bryophyta. The gametophyte is a small thalloid structure which shows varying degrees of independence affording an interesting transition to the next group.

Spermatophyta are characterized by an extreme reduction of the gametophyte generation. The sporophyte is the plant which is differentiated into stem, leaf and root, which show a wonderful variety of form; the internal structure also shows increased complexity and variety as compared with the other group of vascular plants, the Pteridophyta. The spores, as in the heterosporous Pteridophyta, are of two kinds—microspores (pollen grains) borne in microsporangia (pollen sacs) on special leaves (sporophylls) known as stamens, and macrospores (embryo-sac) borne in macrosporangia (ovules) on sporophylls known as carpels. The fertile leaves or sporophylls are generally aggregated on special shoots to form flowers which may contain one or both kinds. The microspores are set free from the sporangium and carried generally by wind or insect agency to the vicinity of the macrospore, which never leaves the ovule. The male gametophyte is represented by one or few cells and, except in a few primitive forms where the male cell still retains the motile character as in the Pteridophyta, is carried passively to the macrospore in a development of the pollen grain, the pollen tube. The Spermatophyta are thus land plants *par excellence* and have, with the few exceptions cited, lost all trace of an aquatic ancestry. Aquatic plants occur among seed plants but these are readaptations of land plants to an aquatic environment. After fertilization the female cell, now called the oospore, divides and part of it develops into the embryo (new sporophyte), which remains dormant for a time still protected by the ovule which has developed to become the seed. The seed is a new structure characteristic of this group, which is therefore often referred to as the Seed-plants. The seed is set free from the parent plant and serves as the means of dissemination (see FLOWER; POLLINATION; FRUIT, and SEED). The Spermatophyta fall into two classes, Gymnosperms (*q.v.*) and Angiosperms (*q.v.*); the former are the more primitive group, appearing earlier in geological time and showing more resemblance in the course of their life-history to the Pteridophyta. A recently discovered fossil group, the Pteridospermae (see PALAEOBOTANY) have characters intermediate between the Pteridophyta and the more primitive seed-plants.

In GYMNOSPERMS—so-called because the ovules (and seeds) are borne on an open sporophyll or carpel—the microsporophylls and macrosporophylls are not as a rule associated in the same shoot and are generally arranged in cone-like structures; one or two small prothallial cells are formed in the germination of the microspore; the male cells are in some older members of the group motile though usually passive. The ovule is not enclosed in an ovary, and the usually solitary macrospore becomes filled with a prothallus, in the upper part of which are formed several rudimentary archegonia. The fertilized egg-cell (oospore) forms a filamentous structure, the proembryo, from a restricted basal portion of which one or more embryos develop, one only as a rule reaching maturity. The embryo consists of an axis bearing two or more cotyledons and ending below in a radicle; it lies in a generally copious food-storing tissue (endosperm) which is the remains of the female prothallus. The plant has a well-developed main root (tap-root) and a single or branched leafy stem which is provided with a means of secondary increase in thickness. The leaves are generally tough-skinned and last for more than one season.

The ANGIOSPERMS, which are much the larger class, derive their name from the fact that the carpel or carpels form a closed chamber, the ovary, in which the ovules are developed—associated with this is the development of a receptive or *stigmatic* surface on which the pollen grain is deposited. The sporophylls (stamens and carpels) are generally associated with other leaves, known as the perianth, to form a flower; these subsidiary leaves are protective and attractive in function and their development is correlated with the transport of pollen by insect agency (see ANGIOSPERMS; POLLINATION, and FLOWER). The male gametophyte is sometimes represented by a transitory prothallial cell; the two male cells are carried passively down into the ovary and into the mouth of the ovule by means of the pollen-tube. The female gametophyte is extremely reduced; there is a sexual apparatus of naked cells, one of which is the egg-cell which, after fusion with a male cell, divides to form a large "suspensorial" cell and a terminal embryo. Endosperm is formed as the result of the fusion of the second male cell with the so-called "definitive nucleus" of the embryo-sac (see ANGIOSPERMS). The embryo consists of an axis bearing one (Monocotyledons) or two (Dicotyledons) cotyledons, which protect the stem bud (*plumule*) of the future plant, and ending below in a radicle. The seed is enclosed when ripe in the fruit, a development of the ovary as a result of fertilization of the egg-cell. (A. B. R.)

Anatomy of Plants

The term "Anatomy," originally employed in biological science to denote a description of the facts of structure revealed on cutting up an organism, whether with or without the aid of lenses for the purposes of magnification, is restricted in the present article, in accordance with a common modern use, to those facts of internal structure not concerned with the constitution of the individual *cell*, the structural unit of which the plant is composed.

An account of the structure of plants naturally begins with the cell which is the proximate unit of organic structure. The cell is essentially an individualized mass of protoplasm containing a differentiated protoplasmic body, called a *nucleus*. But all cells which are permanent tissue-elements of the plant-body possess, in addition, a more or less rigid limiting membrane or *cell-wall*, consisting primarily of cellulose or some allied substance. It is the cell-walls which connect the different cells of a tissue (see below), and it is upon their characters (thickness, sculpture and constitution) that the qualities of the tissue largely depend. In many cases, indeed, after the completion of the cell-wall (which is secreted by the living cell-body) the protoplasm dies, and a tissue in which this has occurred consists solely of the dead framework of cell-walls, enclosing in the cavities, originally occupied by the protoplasm, simply water or air. In such cases the characters of the adult tissue clearly depend solely upon the characters of the cell-walls, and it is usual in plant-anatomy to speak of the wall with its enclosed

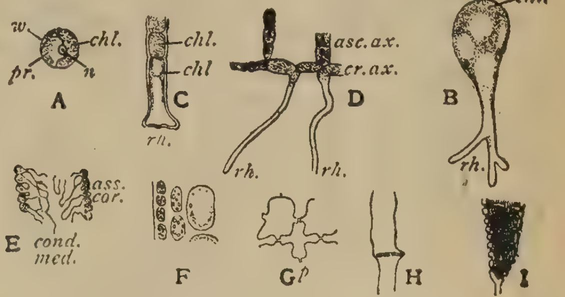


FIG. 1.—Examples of the differentiation of the cells of plants.

A, Cell (individual) of the unicellular Green Alga *Pleurococcus*, as an example of an undifferentiated autonomous assimilating cell. *pr.*, Cell protoplasm; *n.*, nucleus; *chl.*, chloroplast; *c.w.*, cell-wall.

B, Plant of the primitive Siphoneous Green Alga *Protosiphon botryoides*. The primitive cell sends colourless tubelets (rhizoids, *rh.*) into the mud on which it grows. The subaerial part is tubular or ovoid, and contains the chloroplast (*chl.*). There are several nuclei.

C, Base of the multicellular filamentous Green Alga *Chaetomorpha aerea*. The basal cell has less chlorophyll than the others, and is expanded and fixed firmly to the rock on which the plant grows by the basal surface, *rh*, thus forming a rudimentary rhizoid.

D, Part of branched filamentous thallus of the multicellular Green Alga *Oedocladium*. *cr. ax.*, Green axis creeping on the surface of damp soil; *rh.*, colourless rhizoids penetrating the soil; *asc. ax.*, ascending axes of green cells.

E, Vertical section of frond of the complicated Siphoneous Green Alga *Halimeda*. The substance of the frond is made up by a single much-branched tube, with interwoven branches. *cond. med.*, Longitudinally running comparatively colourless central (medullary) branches, which conduct food substances and support the (*ass. cor.*) green assimilating cortical branches, which are the ends of branches from the medulla and fit tightly together, forming the continuous surface of the plant.

F, Section through the surface tissue of the Brown Alga *Cutleria multifida*, showing the surface layer of assimilating cells densely packed with phaeoplasts. The layers below have progressively fewer of these, the central cells being quite colourless.

G, Section showing thick-walled cells of the cortex in a Brown Alga (seaweed). Simple pits (*p.*) enable conduction to take place readily from one to another.

H, Two adjacent cells (leptoids) of a food-conducting strand in *Fucus* (a Brown seaweed). The wall between them is perforated, giving passage to coarse strands of protoplasm.

I, End of hydroid of the thalloid Liverwort *Blyttia*, showing the thick lignified wall penetrated by simple pits.

cavity as "the cell," and the contained protoplasm or other substances, if present, as *cell-contents.* This is in accordance with the original use of the term "cell," which was applied in the 17th century to the cavities of plant-tissues on the analogy of the cells of honeycomb. The use of the term to mean the individualized nucleated mass of living protoplasm, which, whether with or without a limiting membrane, primitively forms the proximate histological element of the body of every organism, dates from the second quarter of the 19th century. For a more detailed description of the cell see CYTOLOGY and the section on *Cytology of Plants* below). In all but the very simplest forms the plant-body is built up of a number of these cells, associated in more or less definite ways. In the higher (more complicated) plants the cells differ very much among themselves, and the body is composed of definite systems of these units, each system with its own characteristic structure, depending partly on the characters of the component cells and partly on the method of association. Such a system is called a *tissue-system*, the word tissue being employed for any collection of cells with common structural, developmental, or functional characters to which it may be conveniently applied. The word is derived from the general resemblance of the texture of plant substance to that of a textile fabric, and dates from a period when the fundamental constitution of plant substance from individual cells was not yet discovered. It is convenient here to define the two chief types of cell-form which characterize tissues of the higher plants. The term *parenchyma* is applied to tissues whose cells are isodiametric or cylindrical in shape, *prosenchyma* tissues consisting of long narrow cells, with pointed ends.

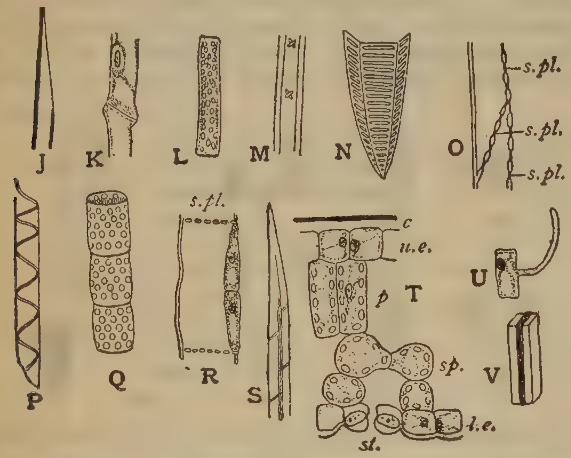


FIG. 1*a*.—Examples of the differentiation of the tissue of plants.

J, End of hydroid of the Moss *Mnium*, showing particularly thin oblique end-wall. No pits.

K, Optical section of two adjacent leptoids of the Moss *Polytrichum juniperinum.* The leptoids are living and nucleated. They bulge in the neighbourhood of the very thin cross-wall. Note resemblance to *H* and *R*.

L, Optical section of cell of parenchyma in the same moss. Embedded in the protoplasm are a number of starch grains.

M, Part of elongated stereid of a Moss. Note thick walls and oblique slit-like pits with opposite inclination on the two sides of the cell seen in surface view.

N, One side of the end of hydroid (tracheid) of a Pteridophyte (fern), with scalariform pits.

O, Optical section of two adjacent leptoids (sieve-tube segments) of Pteridophyte, with sieve plates (*s. pl.*) on oblique end-wall and side-walls.

P, Part of spiral hydroid (tracheid) of Phanerogam (Flowering Plant).

Q, Three segments of a "pitted" vessel of Phanerogam.

R, Optical section of leptoid (sieve-tube segment) of Phanerogam, with two proteid (companion) cells. *s. pl.*, sieve-plate.

S, Optical section of part of thick-walled stereid of Phanerogam, with almost obliterated cavity and narrow slit-like oblique pits.

T, Part of vertical section through blade of typical leaf of Phanerogam. *u.e.*, Upper epidermal cells, with (*c*) cuticle. (*p*) Assimilating (palisade) cells. *sp.*, Assimilating (spongy) cells with large lacunae. *l.e.*, Lower epidermis, with *st.*, stoma.

U, Absorbing cell, with process (root-hair) from piliferous layer of root of Phanerogam.

V, Endodermal cell of Phanerogam, with suberized central band on radial and transverse walls.

We may now proceed to a systematic account of the anatomy of the different groups of plants, beginning with the simplest, and passing to the more complicated forms.

Thallophyta.—The simplest members of both the Algae and the Fungi (*q.v.*) (the two divisions of the *Thallophyta*, which is the lowest of the four great groups into which the plant-kingdom is divided) have their bodies each composed of a single cell. In the Algae such a cell consists essentially of: (1) a mass of protoplasm provided with (2) a nucleus and (3) an assimilating apparatus consisting of a coloured protoplasmic body, called a *chromatophore*, the pigment of which in the pure green forms is chlorophyll, and which may then be called a *chloroplast.* The whole of these living structures are covered externally by the dead cell-membrane (fig. 1 A). It is from such a living and assimilating cell, performing as it does all the vital functions of a green plant, that, according to current theory, all the different cell-forms of a higher plant have been differentiated in the course of descent.

Cell and Tissue Differentiation in Algæ.

Among the Green Algae the differentiation of cells is comparatively slight. Many forms, even when multicellular, have all their cells identical in structure and function, and are often spoken of as "physiologically unicellular." The cells are commonly joined end to end in simple or branched filaments. Such differentiation as exists in the higher types mainly takes two directions. In the fixed forms the cell or cells which attach the plant to the substratum often have a peculiar form, containing chlorophyll and constituting a rudimentary fixing organ or *rhizoid* (fig. 1 C). In certain types living on damp soil, the rhizoids penetrate the substratum, and in addition to fixing the plant absorb food substances (dissolved salts) from the substratum (fig. 1 B and D).

The second type of differentiation is that between supporting axis and assimilating appendages. The cells of the axis are commonly stouter and have much less chlorophyll than those of the appendages (*Draparnaldia*). This differentiation is parallel with that between stem and leaf of the higher plants. In the group of the Siphoneae both these types of differentiation may exist in the single, long, branched, tube-like and multinucleate "cell" (*coenocyte*) which here forms the plant-body. *Protosiphon* (fig. 1 B) is an example parallel with *Oedocladium*; *Bryopsis*, with *Draparnaldia.* In *Caulerpa* the imitation of a higher plant by the differentiation of fixing, supporting and assimilating organs (root, stem and leaf) from different branches of the single cell is strikingly complete. In the Siphoneous family of *Codiaceae* the branches of the primitive cell become considerably interwoven one with another, so that a dense tissue-like structure is often produced. In this we get a further differentiation between the central tubes (branches of the primitive cell), which run in a longitudinal direction through the body, possess little or no chlorophyll, and no doubt serve to conduct food substances from one region to another, and the peripheral ones, which are directed perpendicularly to the surface of the body, ending blindly there, contain abundant chlorophyll, and are the assimilating organs (fig. 1 E).

None of the existing Red Seaweeds (Rhodophyceae) has a unicellular body. The thallus in all cases consists of a branched filament of cells placed end to end, as in many of the Green Algae. Each branch grows simply by the transverse division of its apical cell. The branches may be quite free or they may be united laterally to form a solid body of more or less firm and compact consistency. This may have a radial stem-like organization, a central cell-thread giving off from every side a number of short sometimes unicellular branches, which together form a cortex round the central thread, the whole structure having a cylindrical form which only branches when one of the short cell-branches from the central thread grows out beyond the general surface and forms in its turn a new central thread, from whose cells arise new short branches. Or the thallus may have a leaf-like form, the branches from the central threads which form the midrib growing out mainly in one plane and forming a lamina, extended right and left of the midrib. Numerous variations and modifications of these forms exist. In all cases, while the internal threads which bear the cortical branches consist of elongated cells with few chromatophores, and no doubt serve mainly for conduction of food substances, the superficial cells of the branches themselves are packed with chromatophores and form the chief assimilating tissue of the plant. In the bulky forms colourless branches frequently grow out from some of the cortical cells, and, pushing among the already-formed threads in a longitudinal direction, serve to strengthen the thallus by weaving its original threads together. The cells belonging to any given thread may be recognized at an early stage of growth, because each cell is connected with its neighbours belonging to the same thread by two depressions or pits, one at each end. The common wall separating the pits of the two adjoining cells is pierced by strands of protoplasm. The whole structure, consisting of the two pits and the wall between is known as a *genetic pit.* Other pits, connecting cells not belonging to the same branch, are, however, formed at a later stage.

Many of the lower forms of Brown Seaweeds (Phoeophyceae) have a thallus consisting of simple or branched cell threads, as in the green and red forms. The lateral union of the branches to form a solid thallus is not, however, so common, nor is it carried to so high a pitch of elaboration as in the Rhodophyceae. In a few of the lower forms (Sphacelariaceae), and in the higher forms which possess a solid thallus, often of very large size, the plant-body is no longer formed entirely of branched cell-threads, but consists of what is called a true parenchymatous tissue, *i.e.* a solid mass of cells, formed by cell division in all directions of space. In the Laminariaceae this tissue is formed by cell division at what is called an *intercalary growing point, i.e.* a *meristematic* (cell-dividing) region occupying the whole of a certain transverse zone of the thallus, and cutting off new cells to add to the permanent tissue on both sides. In the Fucaceae, on the other hand, there is a single prismatic *apical cell* situated at the bottom of a groove at the growing apex of the thallus, which cuts off cells from its sides to add to the peripheral, and from its base to add to the central permanent cells. The whole of the tissue of the plant is formed by the division of this apical cell. In whatever way the tissues are originally formed, however, the main features of their differentiation are the same. According to a law which, as we have seen, applies also to the green and red forms, the superficial cells are packed with chromatophores and form the assimilating tissue (fig. 1, F). In these brown types with bodies of considerable thickness (Laminariaceae and Fucaceae), there is, however, a further differentiation of the internal tissues. The cells immediately subjacent to the superficial assimilating layer form a colourless, or nearly colourless, parenchymatous *cortex*, which acts as a food storage tissue (fig. 1, G), and surrounds a central *medulla* of elongated conducting cells. The latter are often swollen at the ends, so that the cross-wall separating two successive cells has a larger surface than if the cells were of uniform width along their entire length. Cells of this type are often called *trumpet-hyphae* (though they have no connexion with the hyphae of Fungi), and in some genera of Laminariaceae those at the periphery of the medulla simulate the *sieve-tubes* of the higher plants in a striking degree, even (like these latter) developing the peculiar substance *callose* on or in the perforated cross-walls or sieve-plates. A specialized conducting tissue of this kind, used mainly for transmitting organic substances, is always developed in plants where the region of assimilative activity is local in the plant-body, as it is in practically all the higher plants. This is the case in the Fucaceae, and in a very marked degree in the Laminariaceae in question, where the assimilative *frond* is borne at the end of an extremely long supporting and conducting *stipe.* A similar state of things exists in some of the more highly differentiated Red Seaweeds. The tissue developed to meet the demands for conduction in such cases always shows some of the characters described. It is known as *leptom,* each constituent cell being a *leptoid* (fig. 1, H). In addition to the cell types described, it is a very common occurrence in these bulky forms for rhizoid-like branches of the cells to grow out, mostly from the cells at the periphery of the medulla, and grow down between the cells, strengthening the whole tissue, as in the Rhodophyceae. This process may result in a considerable thickening of the thallus. In many Laminariaceae the thallus also grows regularly in thickness by division of its surface layer, adding to the subjacent permanent tissue and thus forming a *secondary meristem.*

Tissue Differentiation in Fungi.

The simpler Fungi, like the simpler Green Algae, consist of single cells or simple or branched cell-threads, but among the higher kinds a massive body is often formed, particularly in connexion with the formation of spores, and this may exhibit considerable tissue-differentiation. A characteristic feature of the fungal vegetative plant-body (*mycelium*) is its formation from independent coenocytic tubes or cell-threads. These branch, and may be packed or interwoven to form a very solid structure; but each grows in length independently of the others and retains its own individuality, though its growth in those types with a definite external form is of course correlated with that of its neighbours and is subject to the laws governing the general form of the body. Such an independent coenocytic branch or cell-thread is called a *hypha.* Similar modes of growth occur among the Siphoneous Green Algae and also among the Red Seaweeds. A solid fungal body may usually be seen to consist of separate hyphae, but in some cases these are so bent and closely interwoven that an appearance like that of ordinary parenchymatous tissue is obtained in section, the structure being called *pseudoparenchyma.* By the formation of numerous cross-walls the resemblance to parenchyma is increased. The *surface-layer* of the body in the massive Fungi differs in character according to its function, which is not constant throughout the class, as in the Algae, because of the very various conditions of life to which different Fungi are exposed. In many forms its hyphae are particularly thick-walled, and may strikingly resemble the epidermis of a vascular plant. This is especially the case in the lichens (symbiotic organisms composed of a fungal mycelium in association with algal cells), which are usually exposed to very severe fluctuations in external conditions. The formation of a massive body naturally involves the localization of the absorptive region, and the function of absorption (which in the simpler forms is carried out by the whole of the vegetative part of the mycelium penetrating a solid or immersed in a liquid substratum) is subserved by the outgrowth of the hyphae of the surface-layer of that region into *rhizoids,* which, like those of the Algae living on soil, resemble the root-hairs of the higher plants. The *internal tissue* of the body of the solid higher Fungi, particularly the elongated stalks (*stipes*) of the fructifications of the Agarics, consists of hyphae running in a longitudinal direction, which no doubt serve for the conduction of organic food substances, just as do the "trumpet-hyphae," similar in appearance, though not in origin, of the higher Brown Seaweeds. (In one genus (*Lactarius*) "milk-tubes," recalling the laticiferous tubes of many vascular plants, are found.) These elongated hyphae are frequently thick-walled, and in some cases form a central strand, which may serve to resist longitudinal pulling strains. This is particularly marked in certain lichens of shrubby habit. The internal tissues, either consisting of obvious hyphae or of pseudoparenchyma, may also serve as a storehouse of plastic food substances.

Looking back over the progress of form and tissue-differentiation in the Thallophyta, we find that, starting from the simplest unicellular forms with no external differentiation of the body, we can trace an increase in complexity of organization everywhere determined by the principles of the division of physiological labour and of the adaptation of the organism to the needs of its environment. In the first place there is a differentiation of fixing organs, which in forms living on a soft nutrient substratum penetrate it and become absorbing organs. Secondly, in the Algae, which build up their own food from inorganic materials, we have a differentiation of supporting axes from assimilating appendages, and as the body increases in size and becomes a solid mass of cells or interwoven threads, a corresponding differentiation of a superficial assimilative system from the deep-lying parts. In both Algae and Fungi the latter are primarily supporting and food-conducting, and in some bulky Brown Seaweeds, where assimilation is strongly localized, some of the deep cells are highly specialized for the latter function. In the higher forms a storage and a mechanically-strengthening system may also be developed, and in some aerial Fungi an external protective tissue. The "hyphal" mode of growth, *i.e.* the formation of the thallus, whatever its external form, by branched, continuous or septate, coenocytic tubes (Siphoneae and Fungi), or by simple or branched cell-threads (Red and many Green Algae), in both cases growing mainly or entirely at the apex of each branch, is almost universal in the group, the exceptions being met with almost entirely among the higher Brown Seaweeds, in which is found parenchyma produced by the segmentation of an apical cell of the whole shoot, or by cell division in some other type of meristem.

Bryophyta.—The Bryophyta [including the Liverworts (Hepaticae) and Mosses (Musci)], the first group of mainly terrestrial plants, exhibit considerably more advanced tissue differentiation, in response to the greater complexity in the conditions of life on land. In a general way this greater complexity may be said to consist (1) in the restriction of regular absorption of water to those parts of the plant-body embedded in the soil, (2) in the evaporation of water from the parts exposed to the air (transpiration). But these two principles do not find their full expression till we come, in the ascending series, to the Vascular Plants. In the Bryophytes water is still absorbed, not only from the soil but also largely from rain, dew, &c., through the general surface of the subaerial body (thallus), or in the more differentiated forms through the leaves. The lowest Hepaticae have an extremely simple vegetative structure, little more advanced than that found in some of the higher Green Algae and very much simpler than in the large Red and Brown Seaweeds. The plant-body (thallus) is always small and normally lives in very damp air, so that the demands of terrestrial life are at a minimum. It always consists of true parenchyma, and is entirely formed by the cutting off of segments from an apical cell.

Liverworts.

A sufficient description of the thallus of the liverworts will be found in the article BRYOPHYTA. We may note the universal occurrence on the lower surface of the thallus of fixing and absorbing rhizoids in accordance with the terrestrial life on soil (cf. *Oedocladium* among the Green Algae). The Marchantiaceae (see article BRYOPHYTA) show considerable tissue-differentiation, possessing a distinct assimilative system of cells, consisting of branched cell threads packed with chloroplasts and arising from the basal cells of large cavities in the upper part of the thallus. These cavities are completely roofed by a layer of cells; in the centre of the roof is a pore surrounded by a ring of special cells. The whole arrangement has a strong resemblance to the lacunae, mesophyll and stomata, which form the assimilative and transpiring (water-evaporating) apparatus in the leaves of flowering plants. The frondose (thalloid) Jungermanniales show no such differentiation of an assimilating tissue, though the upper cells of the thallus usually have more chlorophyll than the rest. In three genera—*Blyttia*, *Symphyogyna* and *Hymenophytum*—there are one or more strands or bundles consisting of long thick-walled fibre-like (prosenchymatous) cells, pointed at the ends and running longitudinally through the thick midrib. The walls of these cells are strongly lignified (*i.e.* consist of woody substance) and are irregularly but thickly studded with simple pits (see CYTOLOGY), which are usually arranged in spirals running round the cells, and are often elongated in the direction of the spiral (fig. 1, I). These cells are not living in the adult state, though they sometimes contain the disorganized remains of protoplasm. They serve to conduct water through the thallus, the assimilating parts of which are in these forms often raised above the soil and are comparatively remote from the rhizoid-bearing (water-absorbing) region. Such differentiated water-conducting cells we call *hydroids*, the tissue they form *hydrom*. The sporogonium of the liverworts is in the simpler forms simply a spore-capsule with arrangements for the development, protection and distribution of the spores. As such its consideration falls outside the scheme of this article, but in one small and peculiar group of these plants, the Anthoceroteae, a distinct assimilating and transpiring system is found in the wall of the very long cylindrical capsule, clearly rendering the sporogonium largely independent of the supply of elaborated organic food from the thallus of the mother plant (the gametophyte). A richly chlorophyllous tissue with numerous intercellular spaces communicates with the exterior by stomata, strikingly similar to those of the vascular plants (see below). If the axis of such a sporogonium were prolonged downwards into the soil to form a fixing and absorptive root, the whole structure would become a physiologically independent plant, exhibiting in many though by no means all respects the leading features of the *sporophyte* or ordinary vegetative and spore-bearing individual in Pteridophytes and Phanerogams. These facts, among others, have led to the theory, plausible in some respects, of the origin of this sporophyte by descent from an Anthoceros-like sporogonium (see PTERIDOPHYTA). But in the Bryophytes the *sporogonium* never becomes a *sporophyte* producing leaves and roots, and always remains dependent upon the gametophyte for its water and mineral food, and the facts give us no warrant for asserting homology (*i.e.* morphological identity) between the differentiated tissues of an Anthocerotean sporogonium and those of the sporophyte in the higher plants. Opposed to the thalloid forms are the group of leafy Liverworts (Acrogynae), whose plant-body consists of a thin supporting stem bearing leaves. The latter are plates of green tissue one cell thick, while the stem consists of uniform more or less elongated cylindrical cells. The base of the stem bears numerous cell-filaments (rhizoids) which fix the plant to the substratum upon which it is growing.

Mosses.

In the Mosses the plant-body (gametophyte) is always separable into a radially organized, supporting and conducting axis (stem) and thin, flat, assimilating, and transpiring appendages (leaves). To the base of the stem are attached a number of branched cell-threads (*rhizoids*) which ramify in the soil, fixing the plant and absorbing water from soil. [For the histology of the comparatively simple but in many respects aberrant Bog-mosses (Sphagnaceae), see BRYOPHYTA.] The stems of the other mosses resemble one another in their main histological features. In a few cases there is a special surface or epidermal layer, but usually all the outer layers of the stem are composed of brown, thick-walled, lignified, prosenchymatous, fibre-like cells forming a peripheral *stereom* (mechanical or supporting tissue) which forms the *outer cortex*. This passes gradually into the thinner-walled parenchyma of the *inner cortex*. The whole of the cortex, stereom and parenchyma alike, is commonly living, and its cells often contain starch. The centre of the stem in the forms living on soil is occupied by a strand of narrow elongated hydroids, which differ from those of the liverworts in being thin-walled, unlignified, and very seldom pitted (fig. 1, J). The hydrom strand has in most cases no connexion with the leaves, but runs straight up the stem and spreads out below the sexual organs or the foot of the sporogonium. It has been shown that it conducts water with considerable rapidity. In the stalk of the sporogonium there is a similar strand, which is of course not in direct connexion with, but continues the conduction of water from, the strand of the gametophytic axis. In the aquatic, semi-aquatic, and xerophilous types, where the whole surface of the plant absorbs water, perpetually in the first two cases and during rain in the last, the hydrom strand is either much reduced or altogether absent. In accordance with the general principle already indicated, it is only where absorption is localized (*i.e.* where the plant lives on soil from which it absorbs its main supply of water by means of its basal rhizoids) that a water-conducting (hydrom) strand is developed. The leaves of most mosses are flat plates, each consisting of a single layer of square or oblong assimilating (chlorophyllous) cells. In many cases the cells bordering the leaf are produced into teeth, and very frequently they are thick-walled so as to form a supporting rim. The centre of the leaf is often occupied by a *midrib* consisting of several layers of cells. These are elongated in the direction of the length of the leaf, are always poor in chlorophyll and form a channel for conducting the products of assimilation away from the leaf into the stem. This is the first indication of a conducting foliar strand or *leaf bundle* and forms an approach to leptom, though it is not so specialized as the leptom of the higher Phaeophyceae. Associated with the conducting parenchyma are frequently found hydroids identical in character with those of the central strand of the stem, and no doubt serving to conduct water to or from the leaf according as the latter is acting as a transpiring or a water-absorbing organ. In a few cases the hydrom strand is continued into the cortex of the stem as a *leaf-trace* bundle (the anatomically demonstrable *trace* of the leaf in the stem). This in several cases runs vertically downwards for some distance in the outer cortex, and ends blindly—the lower end or the whole of the trace being band-shaped or star-shaped so as to present a large surface for the absorption of water from the adjacent cortical cells. In other cases the trace passes inwards and joins the central hydrom strand, so that a connected water-conducting system between stem and leaf is established.

In the highest family of mosses, Polytrichaceae, the differentiation of conducting tissue reaches a decidedly higher level. In addition to the water-conducting tissue or *hydrom* there is a well-developed tissue (*leptom*) inferred to be a conducting channel for organic substances. This leptom is not so highly differentiated as in the most advanced Laminariaceae, but shows some of the characters of sieve-tubes with great distinctness. Each leptoid is an elongated living cell with nucleus and a thin layer of protoplasm lining the wall (fig. 1, K). The whole cavity of the cell is sometimes stuffed with proteid contents. The end of the cell is slightly swollen, fitting on to the similar swollen end of the next leptoid of the row exactly after the fashion of a trumpet-hypha. The end wall is usually very thin, and the protoplasm on artificial contraction commonly sticks to it just as in a sieve-tube, though no perforation of the wall has been found. Associated with the leptoids are similar cells without swollen ends and with thicker cross-walls. Besides the hydrom and leptom, and situated between them, there is a tissue which perhaps serves to conduct soluble carbohydrates, and whose cells are ordinarily full of starch. This may be called *amylom*. The stem in this family falls into two divisions, an underground portion bearing rhizoids and scales, the *rhizome*, and a *leafy aerial stem* forming its direct upward continuation. The leaf consists of a central midrib, several cells thick, and two wings, one cell thick. The midrib bears above a series of closely set, vertical, longitudinally-running plates of green assimilative cells over which the wings close in dry air so as to protect the assimilative and transpiring plates from excessive evaporation of water. The midrib has a strong band of stereom above and below. In its centre is a band-shaped bundle consisting of rows of leptom, hydrom and amylon cells. This bundle is continued down into the cortex of the stem as a leaf-trace, and passing very slowly through the sclerenchymatous external cortex and the parenchymatous, starchy internal cortex to join the central cylinder. The latter has a central strand consisting of files of large hydroids, separated from one another by very thin walls, each file being separated from its neighbour by stout, dark-brown walls. This is probably homologous with the hydrom cylinder in the stems of other mosses. It is surrounded by (1) a thin-walled, smaller-celled hydrom mantle; (2) an amylom sheath; (3) a leptom mantle, interrupted here and there by starch cells. These three concentric tissue mantles are evidently formed by the conjoined bases of the leaf traces, each of which is composed of the same three tissues. As the aerial stem is traced down into the underground rhizome portion, these three mantles die out almost entirely—the central hydrom strand forming the bulk of the cylinder and its elements becoming mixed with thick-walled stereids; at the same time this central hydrom-stereom strand becomes three-lobed, with deep furrows between the lobes in which the few remaining leptoids run, separated from the central mass by a few starchy cells, the remains of the amylom sheath. At the periphery of the lobes are some comparatively thin-walled living cells mixed with a few thin-walled hydroids, the remains of the thin-walled hydrom mantle of the aerial stem. Outside this are three arcs of large cells showing characters typical of the endodermis in a vascular plant; these are interrupted by strands of narrow, elongated, thick-walled cells, which send branches into the little brown scales borne by the rhizome. The surface layer of the rhizome bears rhizoids, and its whole structure strikingly resembles that of the typical root of a vascular plant. In *Catharinea* *undulata* the central hydrom cylinder of the aerial stem is a loose tissue, its interstices being filled up with thin-walled, starchy parenchyma. In *Dawsonia superba*, a large New Zealand moss, the hydroids of the central cylinder of the aerial stem are mixed with thick-walled stereids forming a hydrom-stereom strand somewhat like that of the rhizome in other Polytrichaceae.

The central hydrom strand in the seta of the sporogonium of most mosses has already been alluded to. Besides this there is usually a living conducting tissue, sometimes differentiated as leptom, forming a mantle round the hydrom, and bounded externally by a more or less well-differentiated endodermis, abutting on an irregularly cylindrical lacuna; the latter separates the central conducting cylinder from the cortex of the seta, which, like the cortex of the gametophyte stem, is usually differentiated into an outer thick-walled stereom and an inner starchy parenchyma. Frequently, also, a considerable differentiation of vegetative tissue occurs in the wall of the spore-capsule itself, and in some of the higher forms a special assimilating and transpiring organ situated just below the capsule at the top of the seta, with a richly lacunar chlorophyllous parenchyma and stomata like those of the wall of the capsule in the Anthocerotean liverworts. Thus the histological differentiation of the sporogonium of the higher mosses is one of considerable complexity; but there is here even less reason to suppose that these tissues have any homology (phylogenetic community of origin) with the similar ones met with in the higher plants.

The features of histological structure seen in the Bryophytic series are such as we should expect to be developed in response to the exigencies of increasing adaptation to terrestrial life on soil, and of increasing size of the plant-body. In the liverworts we find fixation of the thallus by water-absorbing rhizoids; in certain forms with a localized region of water-absorption the development of a primitive hydrom or water-conducting system; and in others with rather a massive type of thallus the differentiation of a special assimilative and transpiring system. In the more highly developed series, the mosses, this last division of labour takes the form of the differentiation of special assimilative organs, the leaves, commonly with a midrib containing elongated cells for the ready removal of the products of assimilation; and in the typical forms with a localized absorptive region, a well-developed hydrom in the axis of the plant, as well as similar hydrom strands in the leaf-midribs, are constantly met with. In higher forms the conducting strands of the leaves are continued downwards into the stem, and eventually come into connexion with the central hydrom cylinder, forming a complete cylindrical investment apparently distinct from the latter, and exhibiting a differentiation into hydrom, leptom and amylom which almost completely parallels that found among the true vascular plants. Similar differentiation, differing in some details, takes place independently in the other generation, the sporogonium. The stereom of the moss is found mainly in the outer cortex of the stem and in the midrib of the leaf.

Vascular Plants.—In the Vascular Plants (Pteridophytes, *i.e.* ferns, horse-tails, club mosses, &c., and Phanerogams or Flowering Plants) the main plant-body, that which we speak of in ordinary language as "the plant," is called the *sporophyte* because it bears the asexual reproductive cells or *spores*. The gametophyte, which bears the sexual organs, is either a free-living thallus corresponding in degree of differentiation with the lower liverworts, or it is a mass of cells which always remains enclosed in a spore and is parasitic upon the sporophyte.

The body of the sporophyte in the great majority of the vascular plants shows a considerable increase in complexity over that found in the gametophyte of Bryophytes. The principal new feature in the external conformation of the body is the acquirement of "true" *roots*, the nearest approach to which in the lower forms we saw in the "rhizome" of Polytrichaceae. The primary root is a downward prolongation of the primary axis of the plant. From this, as well as from various parts of the shoot system, other roots may originate. The root differs from the shoot in the characters of its surface tissues, in the absence of the green assimilative pigment chlorophyll, in the arrangement of its vascular system and in the mode of growth at the apex, all features which are in direct relation to its normally subterranean life and its fixative and absorptive functions. Within the limits of the sporophyte generation the Pteridophytes and Phanerogams also differ from the Bryophytes in possessing special assimilative and transpiring organs, the leaves, though these organs are developed, as we have seen, in the gametophyte of many liverworts and of all the mosses. The leaves, again, have special histological features adapted to the performance of their special functions.

Tissue Systems.

Alike in root, stem and leaf, we can trace a *three-fold division of tissue systems*, a division of which there are indications among the lower plants, and which is the expression of the fundamental conditions of the evolution of a bulky differentiated plant-body. From the primitive uniform mass of undifferentiated assimilating cells, which we may conceive of as the starting-point of differentiation, though such an undifferentiated body is only actually realized in the thallus of the lower Algae, there is, (1) on the one hand, a specialization of a surface layer regulating the immediate relations of the plant with its surroundings. In the typically submerged Algæ and in submerged plants of every group this is the absorptive and the main assimilative layer, and may also by the production of mucilage be of use in the protection of the body in various ways. In the terrestrial plants it differs in the subterranean and subaerial parts, being in the former pre-eminently absorptive, and in the latter protective—provision at the same time being made for the gaseous interchange of oxygen and carbon dioxide necessary for respiration and feeding. This surface layer in the typically subaerial "shoot" of the sporophyte in Pteridophytes and Phanerogams is known as the *epidermis*, though the name is restricted by some writers, on account of developmental differences, to the surface layer of the shoot of Angiosperms, and by others extended to the surface layer of the whole plant in both these groups. On the other hand, we have (2) an internal differentiation of *conducting tissue*, the main features of which as seen in the gametophyte of Bryophytes have already been fully described. In the Vascular Plants this tissue is collectively known as the *vascular system*. The remaining tissue of the plant-body, a tissue that we must regard phylogenetically as the remnant of the undifferentiated tissue of the primitive thallus, but which often undergoes further differentiation of its own, the better to fulfil its characteristically vital functions for the whole plant, is known, from its peripheral position in relation to the primitively central conducting tissue, as (3) the *cortex*. Besides absorption, assimilation, conduction and protection there is another very important function for which provision has to be made in any plant-body of considerable size, especially when raised into the air, that of *support*. Special tissues (*stereom*) may be developed for this purpose in the cortex, or in immediate connexion with the conducting system, according to the varying needs of the particular type of plant-body. The important function of *aeration*, by which the inner living tissues of the bulky plant-body obtain the oxygen necessary for their respiration, is secured by the development of an extensive system of *intercellular spaces* communicating with the external air.

Epidermis.

In relation to its characteristic function of protection, the epidermis, which, as above defined, consists of a single layer of cells has typically thickened and cuticularized outer walls. These serve not only to protect the plant against slight mechanical injury from without, and against the entry of smaller parasites, such as fungi and bacteria, but also and especially to prevent the evaporation of water from within.

Stomata.

At intervals it is interrupted by pores (*stomata*) leading from the air outside to the system of intercellular spaces below. Each stoma is surrounded by a pair of peculiarly modified epidermal cells called *guard-cells* (fig. 1, T), which open and close the pore according to the need for transpiration. The structure of the stomata of the sporophyte of vascular plants is fundamentally the same as that of the stomata on the sporogonium of the true mosses and of the liverwort *Anthoceros*. Stomata are often situated at the bottom of pits in the surface of the leaf. This arrangement is a method of checking transpiration by creating a still atmosphere above the pore of the stoma, so that water vapour collects in it and diminishes the further outflow of vapour. This type of structure, which is extremely various in its details, is found especially, as we should expect, in plants which have to economize their water supply. The stomata serve for all gaseous interchange between the plant and the surrounding air. The guard-cells contain chlorophyll, which is absent from typical epidermal cells, the latter acting as a tissue for water storage. Sometimes the epidermis is considerably more developed by tangential division of its cells, forming a many-layered *water-tissue*. This is found especially in plants which during certain hours of the day are unable to cover the water lost through transpiration by the supply coming from the roots. The water stored in such a time supplies the immediate need of the transpiring cells and prevents the injury which would result from their excessive depletion.

Hairs.

The epidermis of a very large number of species bears *hairs* of various kinds. The simplest type consists simply of a single elongated cell projecting above the general level of the epidermis. Other hairs consist of a chain of cells; others, again, are branched in various ways; while yet others have the form of a flat plate of cells placed parallel to the leaf surface and inserted on a stalk. The cells of hairs may have living contents or they may simply contain air. A very common function of hairs is to diminish transpiration, by creating a still atmosphere between them, as in the case of the sunk stomata already mentioned. But hairs have a variety of other functions. They may, for instance, be glandular or stinging, as in the common stinging nettle, where the top of the hair is very brittle, easily breaking off when touched. The sharp, broken end penetrates the skin, and into the slight wound thus formed the formic acid contained by the hair is injected.

Hydathodes.

Mention may be made here of a class of epidermal organ, the *hydathodes*, the wide distribution and variety of which have been revealed by recent research. These are special organs, usually situated on foliage leaves, for the excretion of water in liquid form when transpiration is diminished so that the pressure in the water-channels of the plant has come to exceed a certain limit. They are widely distributed, but are particularly abundant in certain tropical climates where active root absorption goes on while the air is nearly saturated with water vapour. In one type they may take the form of specially-modified single epidermal cells or multicellular hairs without any direct connexion with the vascular system. The cells concerned, like all secreting organs, have abundant protoplasm with large nuclei, and sometimes, in addition, part of the cell-wall is modified as a filter. In a second type they are situated at the ends of tracheal strands and consist of groups of richly protoplasmic cells belonging to the epidermis (as in the leaves of many ferns), or to the subjacent tissue (the commonest type in flowering plants); in this last case the cells in question are known as *epithem*. The epithem is penetrated by a network of fine intercellular spaces, which are normally filled with water and debouch on one or more intercellular cavities below the epidermis. Above each cavity is situated a so-called *water-stoma*, no doubt derived phylogenetically from an ordinary stoma, and enclosed by guard-cells which have nearly or entirely lost the power of movement. The pores of the water-stomata are the outlets of the hydathode. The epithem is frequently surrounded by a sheath of cuticularized cells. In other cases the epithem may be absent altogether, the tracheal strand debouching directly on the lacunae of the mesophyll. This last type of hydathode is usually situated on the edge of the leaf. Some hydathodes are active *glands*, secreting the water they expel from the leaf. [Many other types of glands also exist, either in connexion with the epidermis or not, such as nectaries, digestive glands, oil, resin and mucilage glands, &c. They serve the most various purposes in the life of the plant, but they are not of significance in relation to the primary vital activities, and cannot be dealt with in the limits of the present article.] The typical epidermis of the shoot of a land plant does not absorb water, but some plants living in situations where they cannot depend on a regular supply from the roots (*e.g.* epiphytic plants and desert plants) have absorptive hairs or scales on the leaf epidermis through which rain and dew can be absorbed. Some hydathodes also are capable of absorbing as well as excreting water.

Epidermis of Root.

The surface layer of the root, sometimes included under the term epidermis, is fundamentally different from the epidermis of the stem. In correspondence with its water-absorbing function it is not cuticularized, but remains usually thin-walled; the absorbing surface is increased by its cells being produced into delicate tubes which curl round and adhere firmly to particles of soil, thus at once fixing the root firmly in the soil, and enabling the hair to absorb readily the thin films of water ordinarily surrounding the particles (fig. 1, U). The *root-hair* ends blindly and is simply an outgrowth from a surface cell, having no cross-walls. It corresponds in function with the rhizoid of a Bryophyte. At the apex of a root, covering and protecting the delicate tissue of the growing point, is a special *root-cap* consisting of a number of layers of tissue whose cells break down into mucilage towards the outer surface, thus facilitating the passage of the apex as it is pushed between the particles of soil.

Cortex.

The cortex, as has been said, is in its origin the remains of the primitive assimilating tissue of the plant, after differentiation of the surface layer and the conducting system. It consists primitively of typical living parenchyma; but its differentiation may be extremely varied, since in the complex bodies of the higher plants its functions are numerous. In all green plants which have a special protective epidermis, the cortex of the shoot has to perform the primitive fundamental function of carbon assimilation. In the leafy shoot this function is mainly localized in the cortical tissue of the leaves, known as *mesophyll*, which is essentially a parenchymatous tissue containing chloroplasts, and is penetrated by a system of intercellular spaces, so that the surfaces of the assimilating cells are brought into contact with air to as large an extent as possible, in order to facilitate gaseous interchange between the assimilating cells and the atmosphere. At the same time the cells of the mesophyll are transpiring cells—*i.e.* the evaporation of water from the leaf goes on from them into the intercellular spaces. The only pathways for the gases which thus pass between the cells of the mesophyll and the outside air are the stomata. A land plant has nearly always to protect itself against over-transpiration, and for this reason the stomata of the typical *dorsiventral leaf* (fig. 2, A), which has distinct upper and lower faces, are placed mainly or exclusively on the lower side of the leaf, where the water vapour that escapes from them, being lighter than air, cannot pass away from the surface of the leaf, but remains in contact with it and thus tends to check further transpiration. The stomata are in direct communication with the ample system of intercellular spaces which is found in the loosely arranged mesophyll (*spongy tissue*) on that side. This is the main transpiring tissue, and is protected from direct illumination and consequent too great evaporation. The main assimilating tissue, on the other hand, is under the upper epidermis, where it is well illuminated, and consists of oblong cells densely packed with chloroplasts and with their long axes perpendicular to the surface (*palisade tissue*). The intercellular spaces are here very narrow channels between the palisade cells. Leaves whose blades are normally held in a vertical position possess palisade tissue and stomata on both sides (*isobilateral leaves*) (fig. 2, B), since there is no difference in the illumination and other external conditions, while those which are cylindrical or of similar shape (*centric leaves*) have it all round. The leaves of shade plants have little or no differentiation of palisade tissue. In fleshy leaves which contain a great bulk of tissue in relation to their chlorophyll content, the central mesophyll contains little or no chlorophyll and acts as water-storage tissue. The cortex of a young stem is usually green, and plays a more or less important part in the assimilative function. It also always possesses a well-developed lacunar system communicating with the external air through stomata (in the young stem) or *lenticels* (see below). This lacunar system not only enables the cells of the cortex itself to respire, but also forms channels through which air can pass to the deeper lying tissues. The cortex of the older stem of the root frequently acts as a reserve store-house for food, which generally takes the form of starch, and it also assists largely in providing the stereom of the plant. In the leaf-blade this sometimes appears as a layer of thickened subepidermal cells, the *hypoderm*, often also as subepidermal bundles of sclerenchymatous fibres, or as similar bundles extending right across the leaf from one epidermis to the other and thus acting as struts. Isolated cells (*idioblasts*), thickened in various ways, are not uncommonly found supporting the tissues of the leaf. In the larger veins of the leaf, especially in the midrib, in the petiole, and in the young stem, an extremely frequent type of mechanical tissue is *collenchyma*. This consists of elongated cells with cellulose walls, which are locally thickened along the original corners of the cells, reducing the lumen to a cylinder, so that a number of vertical pillars of cellulose connected by comparatively thin walls form the framework of the tissue. This tissue remains living and is usually formed quite early, just below the epidermis, where it provides the first peripheral support for a still growing stem or petiole. Sclerenchyma may be formed later in various positions in the cortex, according to local needs. Scattered single stereids or bundles of fibres are not uncommon in the cortex of the root.

Mesophyll.

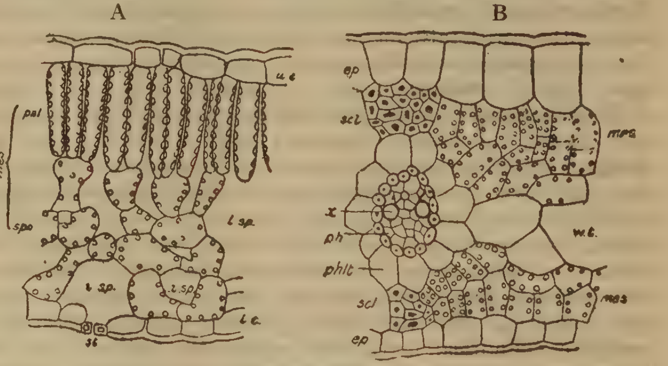


FIG. 2.—Transverse Sections of Leaves.

A, Dorsiventral leaf. *B*, Isobilateral leaf.
ep, epidermis; *st*, stoma; *mes*, mesophyll; *pal*, palisade; *spo*, spongy tissue; *i.sp*, intercellular space; *w.t.*, water tissue; *x*, xylem; *ph*, phloem; *phlt*, phloeoterma; *scl*, sclerenchyma.

Phloeoterma.

The innermost layer of the cortex, abutting on the central cylinder of the stem or on the bundles of the leaves, is called the *phloeoterma*, and is often differentiated. In the leaf-blade it takes the form of special parenchymatous sheaths to the bundles. The cells of these sheaths are often distinguished from the rest of the mesophyll by containing little or no chlorophyll. Occasionally, however, they are particularly rich in chloroplasts. These bundle sheaths are important in the conduction of carbohydrates away from the assimilating cells to other parts of the plant. Rarely in the leaf, frequently in the stem (particularly in Pteridophytes), and universally in the root, the phloeoterma is developed as an *endodermis* (see below). In other cases it does not differ histologically from the parenchyma of the rest of the cortex, though it is often distinguished by containing particularly abundant starch, in which case it is known as a *starch sheath*.

Vascular System.

One of the most striking characters common to the two highest groups of plants, the Pteridophytes and Phanerogams, is the possession of a double (hydrom-leptom) conducting system, such as we saw among the highest mosses, but with sharply characterized and peculiar features, probably indicating common descent throughout both these groups. It is confined to the sporophyte, which forms the leafy plant in these groups, and is known as the *vascular system*. Associated with it are other tissues, consisting of parenchyma, mainly starchy, and in the Phanerogams particularly, of special stereom. The whole tissue system is known as the *stelar system* (from the way in which in primitive forms it runs through the whole axis of the plant in the form of a column). The stelar system of Vascular Plants has no direct phylogenetic connexion with that of the mosses. The origin of the Pteridophyta (*q.v.*) is very obscure, but it may be regarded as certain that it is not to be sought among the mosses, which are an extremely specialized and peculiarly differentiated group. Furthermore, both the hydrom and leptom of Pteridophytes have marked peculiarities to which no parallel is to be found among the Bryophytes. Hence we must conclude that the conducting system of the Pteridophytes has had an entirely separate evolution. All the surviving forms, however, have a completely established double system with the specific characters alluded to, and since there is every reason to believe that the conditions of evolution of the primitive Pteridophyte must have been essentially similar to those of the Bryophytes, the various stages in the evolution of the conducting system of the latter (p. 732) are very useful to compare with the arrangements met with in the former.

Tissue Elements.

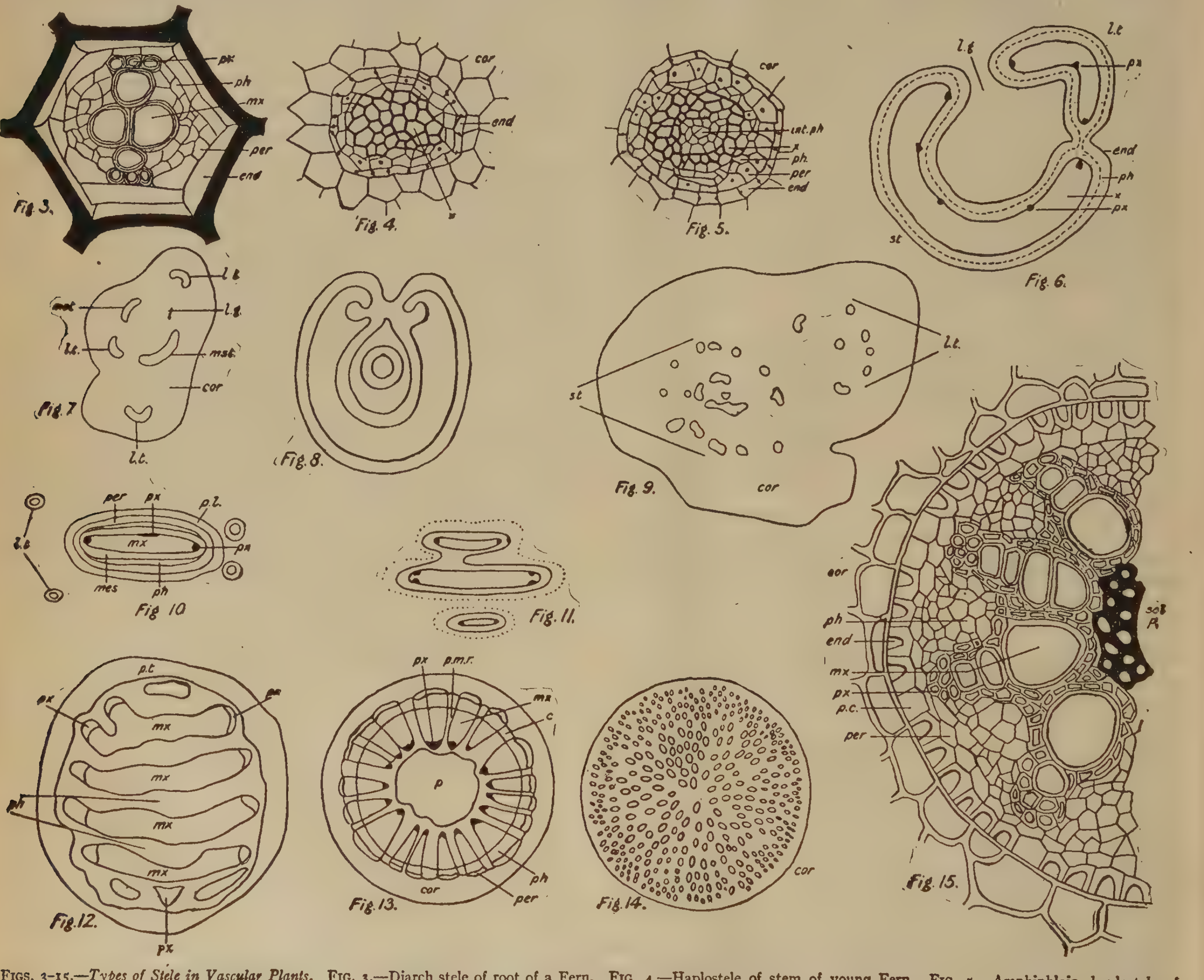
The hydroid of a Pteridophyte or of a Phanerogam is characteristically a dead, usually elongated, cell containing air and water, and either thin-walled with lignified (woody) spiral (fig. 1, P.) or annular thickenings, or with thick lignified walls, incompletely perforated by pits (fig. 1, Q.) (usually bordered pits) of various shapes, *e.g.* the pits may be separated by a network of thickenings when the tracheid is *reticulate* or they may be transversely elongated and separated by bars of thickening like the rungs of a ladder (scalariform thickening). When, in place of a number of such cells called *tracheids*, we have a continuous tube with the same kind of wall thickening, but composed of a number of cells whose cross walls have disappeared, the resulting structure is called a *vessel*. Vessels are common in the Angiospermous group of Flowering Plants. The scalariform hydroids of Ferns (fig. 1, N.) have been quite recently shown to possess a peculiar structure. The whole of the middle lamella or originally formed cell-wall separating one from another disappears before the adult state is reached, so that the walls of the hydroids consist of a framework of lignified bars with open communication between the cell cavities. The tracheids or vessels, indifferently called *tracheal elements*, together with the immediately associated cells (usually amylom in Pteridophytes) constitute the *xylem* of the plant. This is a morphological term given to the particular type of hydrom found in both Pteridophytes and Phanerogams, together with the parenchyma or stereom, or both, included within the boundaries of the hydrom tissue strand. The leptoid of a Pteridophyte (fig. 1, O.) is also an elongated cell, with a thin lining of protoplasm, but destitute of a nucleus, and always in communication with the next cell of the leptom strand by perforations (in Pteridophytes often not easily demonstrable), through which originally pass strings of protoplasm which are bored out by a ferment and converted into relatively coarse "slime strings," along which pass, we must suppose, the organic substances which it is the special function of the leptoids to conduct from one part of the plant to another. The peculiar substance called *callose*, chemically allied to cellulose, is frequently formed over the surface of the perforated end-walls. The structure formed by a number of such cells placed end to end is called a *sieve-tube* (obviously comparable with a xylem-vessel), and the end-wall or area of end-wall occupied by a group of perforations, a *sieve-plate*. When the sieve-tube has ceased to function and the protoplasm, slime strings, and callose have disappeared, the perforations through which the slime strings passed are left as relatively large holes, easily visible in some cases with low powers of the microscope, piercing the sieve-plate. The sieve-tubes, with their accompanying parenchyma or stereom, constitute the tissue called *phloem*. This is the term for a morphologically defined tissue system, *i.e.* the leptom found in Pteridophytes and Phanerogams with its associated cells, and is entirely parallel with the xylem. The sieve-tubes differ, however, from the tracheids in being immediately associated, apparently constantly, not with starchy parenchyma, but with parenchymatous cells, containing particularly abundant proteid contents, which seem to have a function intimately connected with the conducting function of the sieve-tubes, and which we may call *proteid-cells*. In the Angiosperms there are always sister-cells of sieve-tube segments and are called companion-cells (fig. 1, R.).

Arrangement in Strands: the Central Cylinder.

The xylem and phloem are nearly always found in close association in strands of various shapes in all the three main organs of the sporophyte—root, stem and leaf—and form a connected tissue-system running through the whole body. In the primary axis of the plant among Pteridophytes and many Phanerogams, at any rate in its first formed part, the xylem and phloem are associated in the form of a cylinder (stele), with xylem occupying the centre, and the phloem (in the upward-growing part or primary stem) forming a mantle at the periphery (fig. 4). In the downward growing part of the axis (primary root), however, the peripheral mantle of phloem is interrupted, the xylem coming to the surface of the cylinder along (usually) two or (sometimes) more vertical lines. Such an arrangement of vascular tissue is called *radial*, and is characteristic of all roots (figs. 3 and 10). The cylinder is surrounded by a mantle of one or more layers of parenchymatous cells, the *pericycle*, and the xylem is generally separated from the phloem in the stem by a similar layer, the *mesocycle* (corresponding with the amylom sheath in mosses). The pericycle and mesocycle together form the *conjunctive tissue* of the stele in these simplest types. When the diameter of the stele is greater, parenchymatous conjunctive tissue often occupies its centre and is frequently called the *pith*. In the root the mesocycle, like the phloem, is interrupted, and runs into the pericycle where the xylem touches the latter (fig. 3). The whole cylinder is enclosed by the peculiarly differentiated innermost cell-layer of the cortex, known as the *endodermis*. This layer has its cells closely united and sealed to one another, so to speak, by the conversion of the radial and transverse walls (which separate each cell from the other cells of the layer), or of a band running in the centre of these, into corky substance (fig. 1, V.), so that the endodermal cells cannot be split apart to admit of the formation of intercellular spaces, and an air-tight sheath is formed round the cylinder. Such a vascular cylinder is called a *haplostele*, and the axis containing it is said to be *haplostelic*. In the stele of the root the strands of tracheids along the lines where the xylem touches the pericycle are spiral or annular, and are the xylem elements first formed when the cylinder is developing. Each strand of spiral or annular first-formed tracheids is called a *protoxylem* strand, as distinct from the *metaxylem* or rest of the xylem, which consists of thick-walled tracheids, the pits of which are often scalariform. The thin-walled spiral or annular tracheae of the protoxylem allow of longitudinal stretching brought about by the active growth in length of the neighbouring living parenchymatous cells of a growing organ. During the process the thin walls are stretched and the turns of the spiral become pulled apart without rupturing the wall of the tracheid or vessel. If the pitted type of tracheal element were similarly stretched its continuously thickened walls would resist the stretching and eventually break. Hence such tracheae are only laid down in organs whose growth in length has ceased. The stele is called *monarch*, *diarch*, . . . *polyarch* according as it contains one, two, . . . or many protoxylems. When the protoxylem strands are situated at the periphery of the stele, abutting on the pericycle, as in all roots, and many of the more primitive Pteridophyte stems, the stele is said to be *exarch*. When there is a single protoxylem strand in the centre of the stele, or when, as is more commonly the case, there are several protoxylem strands situated at the internal limit of the xylem, the centre of the stem being occupied by parenchyma, the stele is *endarch*. This is the case in the stems of most Phanerogams and of some Pteridophytes. When the protoxylems have an intermediate position the stele is *mesarch* (many Pteridophytes and some of the more primitive Phanerogams). In many cases external *protophloem*, usually consisting of narrow sieve-tubes often with swollen walls, can be distinguished from *metaphloem*.

Evolution of the Stele in Pteridophytes.

As the primitive stele of a Pteridophyte is traced upwards from the primary root into the stem, the phloem becomes continuous round the xylem. At the same time the stele becomes more bulky, all its elements increasing in number (fig. 4). Soon a bundle goes off to the first leaf. This consists of a few xylem elements, a segment of phloem, pericycle, and usually an arc of endodermis, which closes round the bundle as it detaches itself from the stele. As the stele is traced farther upwards it becomes bulkier, as do the successive leaf-bundles which leave it. In many Pteridophytes the solid haplostele is maintained throughout the axis. In others a central parenchyma or *primitive pith*—a new region of the primitive stelar conjunctive—appears in the centre of the xylem. In most ferns *internal phloem* appears instead of a parenchymatous pith (fig. 5). Sometimes this condition, that of the *amphiphloic haplostele*, is maintained throughout the adult stem (*Lindsaya*). In the majority of ferns, at a higher level, after the stele has increased greatly in diameter, a large-celled *true pith* or *medulla*, resembling the cortex in its characters, and quite distinct from conjunctive, from which it is separated by an *internal endodermis*, appears in the centre. These successive new tissues, appearing in the centre of the stele, as the stem of a higher fern is traced upwards from its first formed parts, are all in continuity with the respective corresponding external tissues at the point of origin of each leaf trace (see below). Where internal phloem is present this is separated from the internal endodermis by an *endocycle* or "internal pericycle," as it is sometimes called, and from the xylem by an *internal mesocycle*—these two layers, together with the outer mesocycle and pericycle, constituting the conjunctive tissue of the now hollow cylindrical stele. (The conjunctive frequently forms a connected whole with bands of starchy *xylem-parenchyma*, which, when the xylem is bulky, usually appear among the tracheids, the phloem also often being penetrated by similar bands of *phloem-parenchyma*.)



Figs. 3–15.—*Types of Stele in Vascular Plants.* Fig. 3.—Diarch stele of root of a Fern. Fig. 4.—Haplostele of stem of young Fern. Fig. 5.—Amphiphloic haplostele of stem of young Fern. Fig. 6.—Solenostele of stem of Fern showing detachment of leaf-trace and leaf-gap. Fig. 7.—Dictyostele of Fern. Fig. 8.—Tricyclic solenostele of *Matonia.* Fig. 9.—Tricyclic dictyostele of *Danæa.* Fig. 10.—Diarch haplostele of *Selaginella.* Fig. 11.—Tristelic stem of *Selaginella.* Fig. 12.—Modified haplostele of *Lycopodium.* Fig. 13.—Typical siphonostele of dicotyledon. Fig. 14.—Stele of monocotyledon. Fig. 15.—Polyarch root of *Veratrum* (a monocotyledon).

Explanation of Lettering: st. stele; *mst.* meristele; *l.t.* leaf-trace; *l.g.* leaf-gap; *cor.* cortex; *p.t.* peristelar tissue; *p.l.* peristelar lacuna; *end.* endodermis; *p.c.* passage cell; *per.* pericycle; *ph.* phloem; *mes.* mesocycle; *x.* xylem; *px.* protoxylem; *mx.* metaxylem; *p.* pith; *scl. p.* sclerised pith; *c.* cambium; *p.m.r.* primary, medullary, ray.

Siphonostely.

In the other groups of Pteridophytes internal phloem is not found and an internal endodermis but rarely. The centre of the stele is however often occupied by a large-celled pith resembling the cortex in structure, the cortex and pith together being classed as *ground tissue.* To this type of stele having a "ground-tissue pith," whether with or without internal phloem, is given the name *siphonostele* to distinguish it from the solid *haplostele* characteristic of the root, the first-formed portion of the stem, and in the more primitive Pteridophytes, of the whole of the axis. The type of siphonostele characteristic of many ferns, in which are found internal phloem, and an internal endodermis separating the vascular conjunctive from the pith, is known as a *solenostele.* The solenostele of the ferns is broken by the departure of each leaf-bundle, the outer and inner endodermis joining so that the stele becomes horseshoe-shaped and the cortex continuous with the pith (fig. 6). Such a break is known as a *leaf-gap.* A little above the departure of the leaf-bundle the stele again closes up, only to be again broken by the departure of the next leaf-bundle. Where the leaves are crowded, a given leaf-gap is not closed before the next ones appear, and the solenostele thus becomes split up into a number of segments, sometimes band-shaped or semilunar, sometimes isodiametric in cross-section (fig. 7). **Dictyostely.** In the latter case each segment of the solenostele frequently resembles a haplostele, the segments of inner endodermis, pericycle, phloem and mesocycle joining with the corresponding outer segments to form a nearly concentric structure. For this reason a stem in which the vascular system has this type of structure used to be spoken of as *polystelic*, the term "stele" being transferred from the primary central cylinder of the axis and applied to the vascular strands just described. In this use the term loses, of course, its morphological value, and it is better to call such a segment of a broken-up stele a *meristele*, the whole solenostele with overlapping leaf-gaps being called a *dictyostele.* The splitting up of the vascular tube into separate strands does not depend wholly upon the occurrence of leaf-gaps. In some forms other gaps (*perforations*) appear in the vascular tube placing the pith and cortex in communication.

In other cases the leaf-gaps are very broad and long, the meristeles separating them being reduced to comparatively slender strands, while there is present in each gap a network of fine vascular threads, some of which run out to the leaf, while others form cross-connexions between these "leaf-trace" strands and also with the main cauline meristeles. Finally the cauline meristeles themselves may be resolved into a number of fine threads. Such a structure may be spoken of as a dissected *dictyostele*.

Polycycly.

In some solenostelic ferns, and in many dictyostelic ones additional vascular strands are present which do not form part of the primary vascular tube. They usually run freely in the pith and join the primary tube in the neighbourhood of the leaf-gaps. Sometimes a complete internal vascular cylinder, having the same structure as the primary one, and concentric with it, occurs in the pith, and others may appear, internal to the first (*Matonia, Saccoloma*). Junctions of the first internal cylinder are made with the primary (external) cylinder at the leaf-gaps, and of the second internal cylinder with the first in the same neighbourhood (fig. 8). In dictyostelic ferns similar internal (dictyostelic) cylinders are found in some forms, and occasionally a large series of such concentric cylinders is developed (Marattiaceae) (fig. 9). In such cases the vascular system is said to be *polycyclic* in contrast with the ordinary *monocyclic* condition. These internal strands or cylinders are to be regarded as peculiar types of elaboration of the stele, and probably act as reservoirs for water-storage which can be drawn upon when the water supply from the root is deficient.

Leaf-trace and Petiolar Strands.

The vascular supply of the leaf (leaf-trace) consists of a single strand only in the haplostelic and some of the more primitive siphonostelic forms. In the "microphyllous" groups of Pteridophytes (Lycopodiales and Equisetales) in which the leaves are small relatively to the stem, the single bundle destined for each leaf is a small strand whose departure causes no disturbance in the cauline stele. In the "megaphyllous" forms, on the other hand, (Ferns) whose leaves are large relatively to the stem, the departure of the correspondingly large trace causes a gap (leaf-gap) in the vascular cylinder, as already described. In the haplostelic ferns the leaf-trace appears as a single strand with a tendency to assume the shape of a horseshoe on cross-section, and this type is also found in the more primitive solenostelic types. In the more highly developed forms, as already indicated, the leaf-trace is split up into a number of strands which leave the base and sides of the leaf-gap independently. In the petiole these strands may increase in number by branching, and though usually reducible to the outline of the primitive "horseshoe," more or less elaborated, they may in some of the complex polycylic dictyostelic types (Marattiaceae) be arranged in several concentric circles, thus imitating the arrangement of strands formed in the stem. The evolution of the vascular structure of the petiole in the higher ferns is strikingly parallel with that of the stem, except in some few special cases.

Parallel of Ontogeny with Phylogeny.

There is good reason to believe that the haplostele is primitive in the evolution of the vascular system. It is found in most of those Pteridophytes which we have other reasons for considering as primitive types, and essentially the same type is found, as we have seen, in the independently developed primitive conducting system of the moss-stem. This type of stem is therefore often spoken of as *protostelic*. In the Ferns there is clear evidence that the amphiphloic haplostele or protostele succeeded the simple (ectophloic) protostele in evolution, and that this in its turn gave rise to the *solenostele*, which was again succeeded by the *dictyostele*. Polycycly was derived independently from monocycly in solenostelic and in dictyostelic forms. In the formation of the stem of any fern characterized in the adult condition by one of the more advanced types of vascular structure all stages of increase in complexity from the haplostele of the first-formed stem to the particular condition characteristic of the adult stem are gradually passed through by a series of changes exactly parallel with those which we are led to suppose, from the evidence obtained by a comparison of the adult forms, must have taken place in the evolution of the race. There is no more striking case in the plant-kingdom of the parallel between ontogeny (development of the individual) and phylogeny (development of the race) so well known in many groups of animals.

Aberrant Stelar Systems of Pteridophytes.

The stele of most Lycopods is a more or less modified protostele, but in the genus *Lycopodium* a peculiar arrangement of the xylem and phloem is found, in which the latter, instead of being confined to a peripheral mantle of tissue, forms bands running across the stele and alternating with similar bands of xylem (fig. 12). In *Selaginella* the stelar system shows profounder modifications. In some forms we find a simple protostele, exarch-polyarch in one species (*S. spinosa*), exarch-diarch in several (fig. 10). In other species, however, a peculiar type of *polystely* is met with, in which the original diarch stele gives rise to so-called dorsal and ventral stelar "cords" which at first lie on the surface of the primary stele, but eventually, at a higher level separate from it and form distinct "secondary" steles resembling the primary one. Similar cords may be formed on, and may separate from, these secondary steles, thus giving rise to a series of steles arranged in a single file (fig. 11). In the creeping stem of one species (*S. Lyallii*) a polycyclic solenostele is found exactly parallel with that of the rhizome of ferns. The gaps in the outer tubular stele, however, are formed by the departure of aerial branch-traces, instead of leaf-traces as in the ferns. The first formed portion of the stem in all species of *Selaginella* which have been investigated possesses an exarch haplostele. The stele of *Equisetum* is of a very peculiar type whose relations are not completely clear. It consists of a ring of endarch collateral bundles, surrounding a hollow pith. The protoxylem of each is a leaf-trace, while the metaxylem consisting of a right and a left portion forms a quite distinct cauline system. All the metaxylems join at the nodes into a complete ring of xylem. The whole stele may be surrounded by a common external endodermis; sometimes there is an internal endodermis in addition, separating the bundles from the pith; while in other cases each bundle possesses a separate endodermis surrounding it. At the nodes the relation of the endodermis to the bundles undergoes rather complex but definite changes. It is probable that this type of stele is a modification of a primitive protostele, in which the main mass of stelar xylem has become much reduced and incidentally separated from the leaf-traces.

Stelar System of Cycadofilices.

During recent years a number of fossil (Carboniferous and Permian) plants have been very thoroughly investigated in the light of modern anatomical knowledge, and as a result it has become clear that in those times a large series of plants existed intermediate in structure between the modern ferns and the modern Gymnosperms (especially Cycads), and to these the general name "Cycadofilices" has been applied. We now know that many at least of the Cycadofilices bore seeds, of a type much more complex than that of most modern seed plants, and in some cases approximating to the seeds of existing Cycads. Among the Cycadofilices a series of stages is found leading from the primitive fern-protostele to the type of siphonostele characteristic of the Cycads which agrees in essentials in all the Spermophytes. The main events in this transition appear to have been (1) disappearance of the central xylem of the protostele and replacement by pith, leading to the survival of a number of (mesarch) collateral bundles (see below) at the periphery of the stele; (2) passage from mesarchy to endarchy of these bundles correlated with a great increase in secondary thickening of the stele. The leaves of the more primitive members of this series were entirely fern-like and possessed a fern-like vascular strand; while in the later members, including the modern Cycads, the leaf bundles, remaining unaffected by secondary thickening, are mesarch, while those of the stem-stele have become endarch. Besides the types forming this series, there are a number of others (Medulloseae and allied forms) which show numerous, often very complex, types of stelar structure, in some cases polystelic, whose origin and relationship with the simpler and better known types is frequently obscure. Among the existing Cycads, though the type of vascular system conforms on the whole with that of the other existing seed-plants, peculiar structures are often found (*e.g.* indications of polystely, frequent occurrence of extra-stelar concentric bundles, "anomalous" secondary thickening) which recall these complex types of stelar structure in the fossil Cycadofilices.

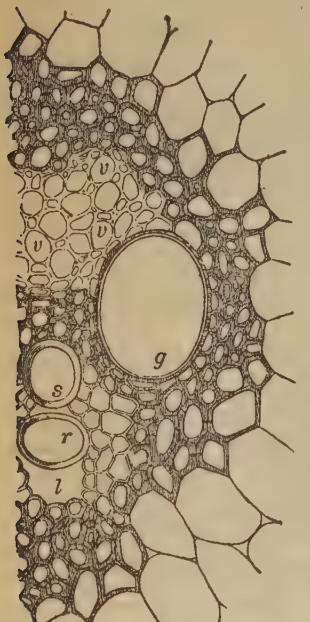
Structure of the Stele in Seed-plants.

The typical structure of the vascular cylinder of the adult primary stem in the Gymnosperms and Dicotyledons is, like that of the higher ferns, a hollow cylinder of vascular tissue enclosing a central parenchymatous pith. But, unlike the ferns, there is in the seed-plants no internal phloem (except as a special development in certain families) and no internal endodermis. The xylem and phloem also, rarely form perfectly continuous layers as they do in a solenostelic fern. The vascular tissue is typically separable into distinct *collateral bundles* (figs. 13, 23), the xylem of which is usually wedge-shaped in cross-section with the protoxylem elements at the inner extremity, while the phloem forms a band on the outer side of the xylem, and separated from it by a band of conjunctive tissue (*mesodesm*). These collateral bundles are separated from one another by bands of conjunctive tissues called *primary medullary rays*, which may be quite narrow or of considerable width. When the pith is large celled, the xylems of the bundles are separated from it by a distinct layer of conjunctive tissue called the *endocycle*, and a similar layer, the *pericycle*, separates the phloem from the cortex. The inner layer of the cortex (*phloeoterma*) may form a well-marked *endodermis*, or differ in other ways from the rest of the cortex. The pericycle, medullary rays, endocycle and mesoderm all form parts of one tissue system, the *external conjunctive*, and are only topographically separable. The external conjunctive is usually a living comparatively small-celled tissue, whose cells are considerably elongated in the direction of the stem-axis and frequently contain abundant starch. Certain regions of it, particularly the whole or part of the pericycle, but sometimes also the endocycle, are typically converted into thick-walled hard (sclerenchymatous) tissue usually of the prosenchymatous (fibrous) type, which is important in strengthening the stem, particularly in enabling it to resist *bending strains*. The relatively peripheral position in the stem of the pericycle is important in this connexion. Various *secondary meristems* (see p. 741) also arise in the external conjunctive.

Most of the collateral bundles of this spermophytic type of siphonostele are leaf-trace bundles, *i.e.* they can be traced upwards from any given point till they are found to pass out of the cylinder, travel through the cortex of the stem and enter a leaf. The remaining bundles (*compensation bundles*) which go to make up the cylinder are such as have branched off from the leaf-traces, and will, after joining with others similarly given off, themselves form the traces of leaves situated at a higher level on the stem. Purely cauline vascular strands (*i.e.* confined to the stem) such as are found in the dictyosteles of ferns are rare in the flowering plants. The leaf trace of any given leaf rarely consists of a single bundle only (*unifascicular*); the number of bundles of any given trace is always odd; they may either be situated all together before they leave the stele or they may be distributed at intervals round the stele. The median bundles of the trace are typically the largest, and at any given level of the stem the bundles destined for the next leaf above are as a whole larger than the others which are destined to supply higher leaves. *Leaf-gaps* are formed in essentially the same way as in the ferns, but when in the case of a plurifascicular trace the bundles are distributed at intervals round the cylinder it is obvious that several gaps must be formed as the different bundles leave the stele. The gaps, are, however, often filled as they are formed by the development of external conjunctive tissue immediately above the points at which the bundles begin to bend out of the stele, so that sharply defined open gaps such as occur in fern-steles are but rarely met with in flowering plants. The constitution of the stele of a flowering plant entirely from endarch collateral bundles, which are either themselves leaf-traces or will form leaf-traces after junction with other similar bundles, is the great characteristic of the stem-stele of flowering plants. These collateral bundles are obviously highly individualized. The external conjunctive tissue is often arranged in relation to each bundle separately, the pericyclic fibres for instance, already referred to, being often confined to the bands of pericyclic tissue abutting on the phloem of each bundle, while the cortex and pith frequently form rays in the intervals between the adjacent bundles.

Aberrant Types of Stele in Angiosperms.

In some cases this individualization is carried further, the cortex and pith becoming continuous between the bundles which appear as isolated strands embedded in a general ground-tissue. Each bundle has its own investment of tissue corresponding with external conjunctive, and now called *peridesm.* The bundles sometimes keep their arrangement in a ring corresponding with the stele, though the continuous cylinder no longer exists (species of Ranunculus). This condition is known as *astely.* In some astelic stems (Nymphaeaceae) the number of bundles is greatly increased and they are scattered throughout the ground tissue. A "polystelic" condition arises in some members of this order by the association of collateral bundles round common centres. A similar phenomenon is seen in two widely separated genera of flowering plants: *Primula* § *Auricula* and *Gunnera* (Halorageae).



(Sachs.)

FIG. 16.—Transverse section of the closed vascular bundle of a monocotyledon.
r. Annular vessel.
s. Spiral vessel.
l. Inter-cellular canal.
g. Pitted vessel.
v.v. Sieve-tubes with accompanying companion-cells.
scl.p. Sclerized peridesm.
p. Surrounding parenchyma. Outer cells *a* of the bundle are parenchymatous, *i* marks the inner side of the bundle.

Monocotyledonous Type.

The monocotyledons, one of the primary divisions of angiosperms, typically possess large leaves with broad sheathing bases containing a very great number of bundles. This results in the number of bundles present at any given level of the stem being enormously increased. These bundles are scattered in a definite though not superficially obvious order through the conjunctive tissue of the stele, which occupies nearly the whole diameter of the stem, the cortex being reduced to a very narrow layer, or disappearing altogether (fig. 3). The mass of conjunctive tissue is developed as a large-celled "ground-tissue," and round each bundle there is a "peridesm" which is often fibrous (fig. 16). It is possible to suppose that this condition is derived from the astelic condition already referred to, but the evidence on the whole leads to the conclusion that it has arisen by an increase in the number of the bundles within the stele, the individuality of the bundle asserting itself after its escape from the original bundle-ring of the primitive cylinder.

Reduced Haplostelic Type.

In the stems of many water-plants various stages of reduction of the vascular system, especially of the xylem, are met with, and very often this reduction leads to the formation of a compact stele in which the individuality of the separate bundles may be suppressed, so that a closed cylinder of xylem surrounds a pith. The phloem is generally unreduced, and there is normally a well marked endodermis (fig. 17).

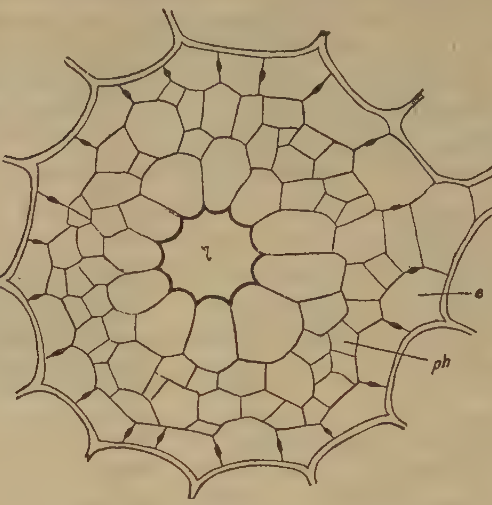


FIG. 17.—Transverse section of the stele of the stem of a water-plant (*Naias*); *l.* intercellular channel representing xylem; *ph.* phloem; *e.* endodermis.

In other cases the reduction goes much further, till the endodermis eventually comes to surround nothing but an intercellular channel formed in place of the stelar tissue.

Stelar Tissue of Leaf and Root.

In the blade of a typical leaf of a vascular plant—essentially a thin plate of assimilating tissue—the vascular system takes the form of a number of separate, usually branching and anastomosing strands. These, with their associated stereom, form a kind of framework which is of great importance in supporting the mesophyll; but also, and chiefly, they provide a number of channels, penetrating every part of the leaf, along which water and dissolved salts are conveyed to, and elaborated food-substances from, the mesophyll cells. The bundle-system is of course continuous with that of the petiole and stem. The leaf-bundles are always collateral (the phloem being turned downwards and the xylem upwards), even in Ferns, where the petiolar strands are concentric, and they have the ordinary mesodesm and peridesm of the collateral bundle. The latter is often sclerized, especially opposite the phloem, and to a less extent opposite the xylem, as in the stem. As a bundle is traced towards its blind termination in the mesophyll the peridesmic stereom first disappears, the sieve-tubes of the phloem are replaced by narrow elongated parenchyma cells, which soon die out, and the bundle ends with a strand of tracheids covered by the phloeotermic sheath.

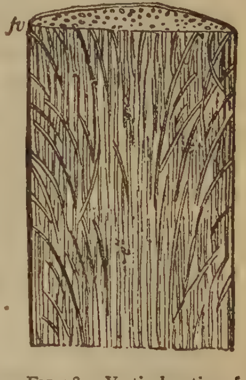


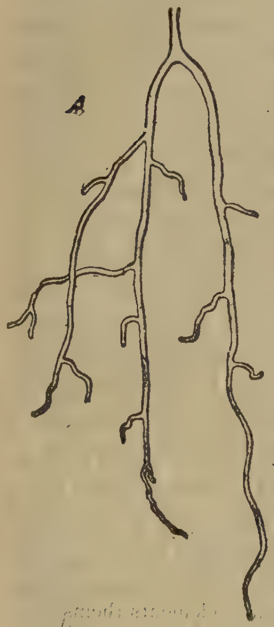
FIG. 18.—Vertical section of a Palm-stem, showing the vascular bundles, *fv*, curving inwards and then outwards.

The structure of the stele of the primary root as it is found in most Pteridophytes and many Phanerogams has been already described. The radial structure is characteristic of all root-steles, which have in essential points a remarkably uniform structure throughout the vascular plants, a fact no doubt largely dependent on the very uniform conditions under which they live. While the stele of the primary root in both Gymnosperms and Angiosperms is usually diarch or tetrarch, the large primary root-steles of many adventitious roots are frequently polyarch, sometimes with a very large number of protoxylems. Such a stele seldom has the centre filled up with xylem, this being replaced by a large-celled pith, so that a siphonostelic structure is acquired (fig. 15). Sometimes, however, the centre of a bulky root stele has strands of metaxylem (to which may be added strands of metaphloem) scattered through it, the interstices being filled with conjunctive. The conjunctive of a root-stele possessing a pith is often sclerized between the pith and the pericycle. Sometimes all the parenchyma within the stele undergoes this change. In the roots of some palms and orchids a "polystelic" structure obtains.

In certain families of Angiosperms a peculiar tissue, called *laticiferous tissue* is met with. This takes the form of long usually

Laticiferous Tissue.

richly branched tubes which penetrate the other tissues of the plant mainly in a longitudinal direction. They possess a delicate layer of protoplasm, with numerous small nuclei lining the walls, while the interior of the tube (corresponding with the cell-vacuole) contains a fluid called *latex*, consisting of an emulsion of fine granules and drops of very various substances suspended in a watery medium in which various other substances (salts, sugars, rubber-producers, tannins, alkaloids and various enzymes) are dissolved. Of the suspended substances, grains of caoutchouc, drops of resin and oil, proteid crystals and starch grains may be mentioned. Of this varied mixture of substances some are undoubtedly *plastic* (*i.e.* of use in constructing new plant-tissue), others are apparently end-products of metabolism, in other words *excreta*, though they are not actually cast out from the plant-body. The relation of the laticiferous tissue to the assimilating cells under which they often end, and the fact that where this tissue is richly developed the conducting parenchyma of the bundles, and sometimes also the sieve-tubes, are poorly developed, as well as various other facts, point to the conclusion that the laticiferous system has an important function in conducting plastic substances, in addition to acting as an excretory reservoir. As a secondary function we may recognize, in certain cases, the power of closing wounds, which results from the rapid coagulation of exuded latex in contact with the air. The use of certain plants as rubber-producers (notably *Hevea brasiliensis*, the Para rubber-tree) depends on this property. The trees are regularly tapped and the coagulated latex which exudes is collected and worked up into rubber. Opium is obtained from the latex of the opium poppy (*Papaver somniferum*), which contains the alkaloid morphine.



(After Haberlandt. From Vines' *Text-Book of Botany*, by permission.)

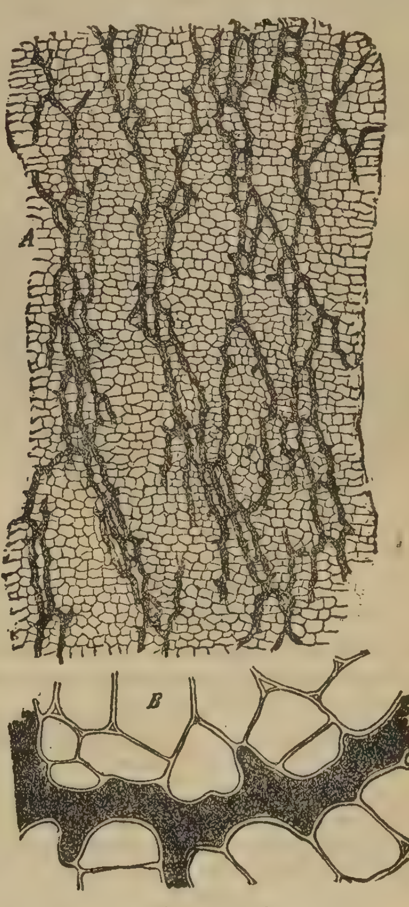
Fig. 19—A portion of a laticiferous coenocyte dissected out of the leaf of a Euphorbia (×120).

Laticiferous tissue is of two kinds: (1) *laticiferous cells* (coenocytes) (fig. 19) which branch but do not anastomose, and the apices of which keep pace in their growth with that of the other tissues of the plant (Apocynaceae, most Euphorbiaceae, &c.); (2) *laticiferous vessels* (fig. 20) which are formed from rows of meristematic cells, the walls separating the cells breaking down, so that a network of laticiferous tubes arises (Papaveraceae, *Hevea*, &c.). In some cases (*Allium*, Convolvulaceae, &c.) rows of cells with latex-like contents occur, but the walls separating the individual cells do not break down.

Development of Primary Tissue.

The body of a vascular plant is developed in the first place by repeated division of the fertilized egg and the growth of the products of division. The body thus formed is called the *embryo*, and this develops into the adult plant, not by continued growth of all its parts as in an animal, but by localization of the regions of cell-division and growth, such a localized region being called a *growing-point*. This localization takes place first at the two free ends of the primary axis, the descending part of which is the primary root, and the ascending the primary shoot. Later, the axis branches by the formation of new growing-points, and in this way the complex system of axes forming the body of the ordinary vascular plant is built up. In the flowering plants the embryo, after developing up to a certain point, stops growing and rests, enclosed within the *seed*. It is only on "germination" of the latter that the development of the embryo into the free plant is begun. In the Pteridophytes, on the other hand, development from the egg is continuous.

The triple division of tissues is laid down in most cases at a very early period of development—in the flowering plants usually before the resting stage is reached. In many Pteridophytes the first leaf is formed very early, and the first vascular strand is developed at its base, usually becoming continuous with the cylinder of the root; the strand of the second leaf is formed in a similar way and runs down to join that of the first, so that the stem stele is formed by the joined bases of the leaf-traces. In other cases, however, a continuous primitive stele is developed, extending from the primary stem to the primary root, the leaf-traces arising later. This is correlated with the comparatively late formation and small development of the first leaves. The evidence scarcely admits of a decision as to which of these methods is to be regarded as primitive in descent. In the seed-forming plants (*Phanerogams*) one or more primary leaves (*cotyledons*) are already formed in the resting embryo. In cases where the development of the embryo is advanced at the resting period, traces run from the cotyledons and determine the symmetry of the stele of the primitive axis, the upper part of which often shows stem-structure, in some respects at least, and is called the hypocotyledonary stem or *hypocotyl*, while the lower part is the primary root (*radicle*). In other cases the root structure of the stele continues up to the cotyledonary node, though the hypocotyl is still to be distinguished from the primary root by the character of its epidermis. On germination of the seed the radicle first grows out, increasing in size as a whole, and soon adding to its tissues by cell division at its apical growing-point. The hypocotyl usually elongates, by its cells increasing very greatly in the longitudinal direction both in number and size, so that the cotyledons are raised into the air as the first foliage-leaves. Further growth in length of the stem is thenceforward confined to the apical growing point situated between the cotyledons. In other cases this growing-point becomes active at once, there being little or no elongation of the hypocotyl and the cotyledon or cotyledons remaining in the seed.



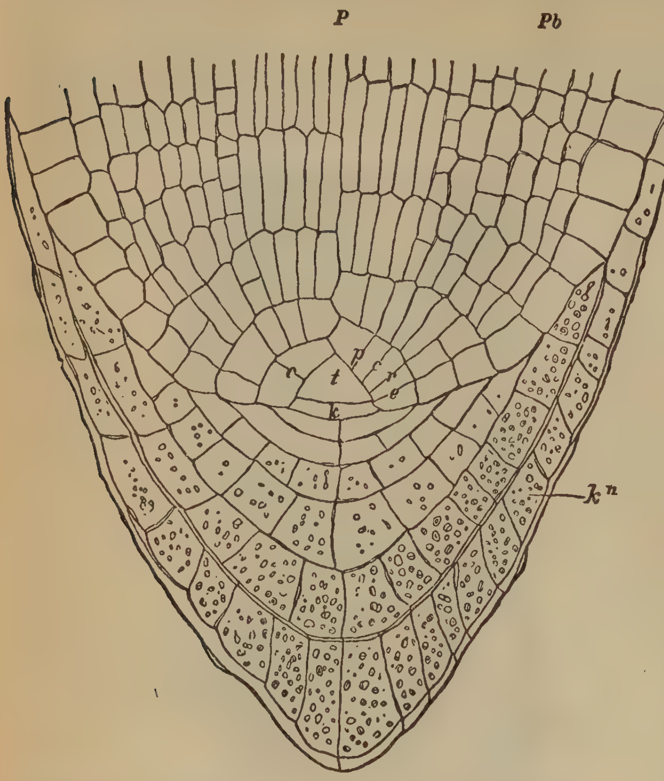
(After Sachs. From Vines' *Text-Book of Botany*, by permission.)

Fig. 20.—Laticiferous Vessels from the cortex of the root *Scorzonera hispanica*, tangential section.

A, Slightly magnified. *B*, A small portion highly magnified.

Growing-points.

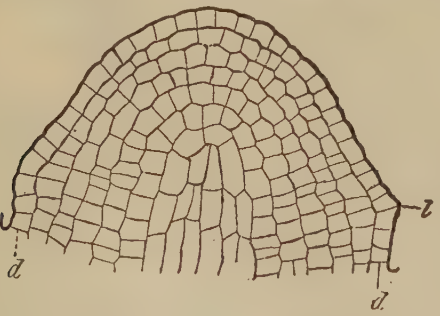
The structure of the growing-points or apical meristems varies much in different cases. In most Pteridophytes there is a single large *apical cell* at the end of each stem and root axis. This usually has the form of a tetrahedron, with its base occupying the surface of the body of the axis and its apex pointing towards the interior. In the stem, segments are successively cut off from the sides of the tetrahedron, and by their subsequent division the body of the stem is produced. In the root exactly the same thing occurs, but segments are cut off also from the base of the tetrahedron, and by the division of these the root-cap is formed (fig. 21). In both stem and root early walls separate the cortex from the stele. The epidermis in the stem and the surface layer of the root soon becomes differentiated from the underlying tissue. In some Pteridophyte stems the apical cell is wedge-shaped, in others prismatic; in the latter case segments are cut off from the end of the prism turned towards the body of the stem. In other cases, again, a group of two or four prismatic cells takes the place of the apical cell. Segments are then cut off



(After Strasburger. From Vines' *Text-Book of Botany*, by permission.)

FIG. 21.—Median Longitudinal Section through the Apex of the Root of *Pteris cretica*.

t, Apical cell.
k, Initial segment of root-cap.
kn, Outermost layer of root-cap.
p, Wall marking limit between the plerome *P* and the pleriblem *Pb*.
c, Wall marking the inner limit of the outer cortex.



(After De Bary. From Vines' *Text-Book of Botany*, by permission.)

FIG. 22.—Median Longitudinal Section of the Growing Point of the Stem of *Hippuris vulgaris*, showing a many-layered meristem.

l, Rudiment of leaf; *d*, dermatogen.

from the outer sides of these *initial cells*. In most of the Phanerogams the *apical* (or *primary*) *meristem*, instead of consisting of a single apical cell or a group of initials, is stratified—*i.e.* there is more than one layer of initials (fig. 22). Throughout the Angiosperms the epidermis of the shoot originates from separate initials, which never divide tangentially, so that the young shoot is covered by a single layer of dividing cells, the *dermatogen*. Below this are the initials of the cortex and central cylinder Whether these are always in layers which remain separate is not known, but it is certain that in many cases such layers cannot be distinguished. This, however, may be due to irregularity of division and displacement of the cells by irregular tensions destroying the obvious layered arrangement. In some cases there is a perfectly definite line of separation between the young cylinder (*plerome*) and young cortex (*periblem*), the latter having one or more layers of initials at the actual apex. This clear separation between periblem and plerome is mostly found in plants whose stem-apex forms a naked cone, the leaves being produced relatively late, so that the stele of the young stem is obvious above the youngest leaf-traces (fig. 22). Where the leaves are developed early, they often quite overshadow the actual apex of the stem, and the rapid formation of leaf-tissue disturbs the obviousness of, and perhaps actually destroys, the stratified arrangement of the shoot initials. In this case also, the differentiation of leaf-bundles, which typically begins at the base of the leaf and extends upwards into the leaf and downwards into the stem, is the first phenomenon in the development of vascular tissue, and is seen at a higher level than the formation of a stele. The latter is produced (except in cases of complete astely where a cylinder is never formed) after a number of leaf-traces have appeared on different sides of the stem so as to form a circle as seen in transverse section, the spaces intervening between adjacent bundles becoming bridged by small-celled tissue closing the cylinder. In this tissue fresh bundles may become differentiated, and what remains of it becomes the rays of the fully-formed stele. Many cases exist which are intermediate between the two extreme types described. In these the stele becomes obvious in transverse section at about the same level as that at which the first leaf-traces are developed. Where a large-celled pith is developed this often becomes obvious very early, and in some cases it appears to have separate initials situated below those of the hollow vascular cylinder. In some cases where there is apparently a well-marked plerome at the apex, this is really the young pith, the distinction between the stelar and cortical initials, if it exists, being, as is so often the case, impossible to make out. The young tissue of the stelar cylinder, in the case of the modified siphonostele characteristic of the dicotyledonous stem, differs from the adjoining pith and cortex in its narrow elongated cells, a difference produced by the stopping of transverse and the increased frequency of longitudinal divisions. This is especially the case in the young vascular bundles themselves (*desmogen strands*). The protoxylem and protophloem are developed a few cells from the inner and outer margins respectively of the desmogen strand, the desmogenic tissue left over giving rise to the segments of endocycle and pericycle capping the bundle. Differentiation of the xylem progresses outwards, of the phloem inwards, but the two tissues never meet in the centre. Sometimes development stops altogether, and a layer of undifferentiated parenchyma (the mesodesm) is left between them; or it may continue indefinitely, the central cells keeping pace by their tangential division with the differentiation of tissue on each side. In this case the formation of the primary bundle passes straight over into the formation of secondary tissue by a cambium, and no line can be drawn between the two processes. The differentiation of the stelar stereom, which usually takes the form of a sclerized pericycle, and may extend to the endocycle and parts of the rays, takes place in most cases later than the formation of the primary vascular strand. In the very frequent cases where the bundles have considerable individuality, the fibrous "pericyclic" cap very clearly has a common origin from the same strand of tissue as the vascular elements themselves. In such cases it is part of the peridesm or sheath of elongated narrow-celled tissue surrounding the individual bundle.

The separation of layers in the apical meristem of the root is usually very much more obvious than in that of the stem. The outermost is the *calyptrogen*, which gives rise to the root-cap, and in Dicotyledons to the piliferous layer as well. The *periblem*, one cell thick at the apex, produces the cortex, to which the piliferous layer belongs in Monocotyledons; and the *plerome*, which is nearly always sharply separated from the periblem, gives rise to the vascular cylinder. In a few cases the boundaries of the different layers are not traceable. The protoxylems and the phloem strands are developed alternately, just within the outer limit of the young cylinder. The differentiation of metaxylem follows according to the type of root-stele, and, finally, any stereom there may be is developed. Differentiation is very much more rapid—*i.e.* the tissues are completely formed much nearer to the apex, than is the case in the stem. This is owing to the elongating region (in which protoxylem and protophloem alone are differentiated) being very much shorter than in the stem. The root hairs grow out from the cells of the piliferous layer immediately behind the elongating region.

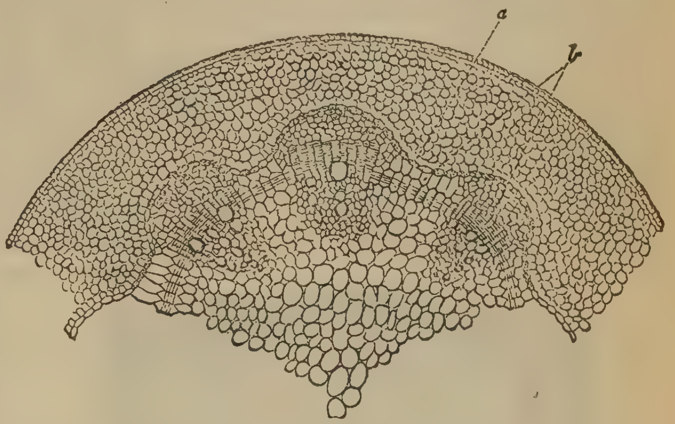
The branches of the stem arise by multiplication of the cells of the epidermis and cortex at a given spot, giving rise to a protuberance, at the end of which an apical meristem is established. The vascular system is connected in various ways with that of the parent axis by the differentiation of bundle-connexions across the cortex of the latter. This is known as *exogenous* branch-formation. In the root, on the other hand, the origin of branches is *endogenous*. The cells of the pericycle, usually opposite a protoxylem strand, divide tangentially and give rise to a new growing-point. The new root thus laid down burrows through the cortex of the mother-root and finally emerges into the soil. The connexions of its stele with that of the parent axis are made across the pericycle of the latter. Its cortex is never in connexion with the cortex of the parent, but with its pericycle. *Adventitious roots*, arising from stems, usually take origin in the pericycle, but sometimes from other parts of the conjunctive.

Secondary Tissues.

In most of the existing Pteridophytes, in the Monocotyledons, and in annual plants among the Dicotyledons, there is no further growth of much structural importance in the tissues after differentiation from the primary meristems. But in nearly all perennial Dicotyledons, in all dicotyledonous and gymnospermous trees and shrubs, and in fossil Pteridophytes belonging to all the great groups, certain layers of cells remain meristematic among the permanent tissues, or after passing through a resting stage reacquire meristematic properties, and give rise to *secondary tissues.* Such meristematic layers are called *secondary meristems.* There are two chief secondary meristems, the *cambium* and the *phellogen.* The formation of secondary tissues is characteristic of most woody plants, to whatever class they belong. Every great group or phylum of vascular plants, when it has become dominant in the vegetation of the world, has produced members with the tree habit arising by the formation of a thick woody trunk, in most cases by the activity of a cambium.

The *cambium* in the typical case, which is by far the most frequent, continues the primary differentiation of xylem and phloem in the desmogen strand (see above), or arises in the resting mesodesm or mesocycle and adds new (secondary) xylem and phloem to the primary tissues. New tangential walls arise in the cells which are the seat of cambial activity, and an *initial layer* of cells is established which cuts off *tissue mother-cells* on the inside and outside, alternately contributing to the xylem and to the phloem. A tissue mother-cell of the xylem may, in the most advanced types of Dicotyledons, give rise to—(1) a tracheid; (2) a segment of a vessel; (3) a xylem-fibre; or (4) a vertical file of xylem-parenchyma cells. In the last case the mother-cell divides by a number of horizontal walls. A tissue mother-cell of the phloem may give rise to (1) a segment of a sieve-tube with its companion cell or cells; (2) a phloem fibre; (3) a single phloem-parenchyma (cambiform) cell, or a vertical file of short parenchyma cells. At certain points the cambium does not give rise to xylem and phloem elements, but cuts off cells on both sides which elongate radially and divide by horizontal walls. When a given initial cell of the cambium has once begun to produce cells of this sort it continues the process, so that a radial plate of parenchyma cells is formed stretching in one plane through the xylem and phloem. Such a cell-plate is called a *medullary ray.* It is essentially a living tissue, and serves to place all the living cells of the secondary vascular tissues in communication. It conducts plastic substances inwards from the cortex, and its cells are frequently full of starch, which they store in winter. They are accompanied by intercellular channels serving for the conduction of oxygen to, and carbon dioxide from, the living cells in the interior of the wood, which would otherwise be cut off from the means of respiration. The xylem and phloem parenchyma consist of living cells, fundamentally similar in most respects to the medullary ray cells, which sometimes replace them altogether. The parenchyma is often arranged in tangential bands between the layers of sieve-tubes and tracheal elements. The xylem parenchyma is often found in strands associated with the tracheal elements. These strands are not isolated, but form a connected network through the wood. The xylem parenchyma cells are connected, as are the medullary ray cells, with the tracheal elements by one-sided bordered pits—*i.e.* pits with a border on the tracheal element side, and simple on the parenchyma cell side. The fibres are frequently found in tangential bands between similar bands of tracheae or sieve-tubes. The fibrous bands are generally formed towards the end of the year's growth in thickness. The fibres belong to the same morphological category as the parenchyma, various transitions being found between them; thus there may be thin-walled cells of the shape of fibres, or ordinary fibres may be divided into a number of superposed cells. These intermediate cells, like the ordinary parenchyma, frequently store starch, and the fibres themselves, though usually dead, sometimes retain their protoplasm, and in that case may also be used for starch accumulations. The vessels and tracheids are very various in size, shape and structure in different plants. They are nearly always aggregated in strands, which, like those of the parenchyma, are not isolated, but are connected with one another. In a few cases some of the tracheids have very thick walls and reduced cavities, functioning as mechanical rather than as water-conducting elements. All transitions are found between such forms and typical tracheids. These *fibre-tracheids* are easily confused on superficial view with the true wood-fibres belonging to the parenchymatous system; but their pits are always bordered, though in the extreme type they are reduced to mere slits in the wall. The sieve-tubes of the secondary phloem usually have very oblique end-walls bearing a row of sieve-plates; plates also occur on the radial side-walls.

The tissue-elements just described are found only in the more complicated secondary vascular tissues of certain Dicotyledons. A considerable evolution in complexity can be traced in passing from the simplest forms of xylem and phloem found in the primary vascular tissues both among Pteridophytes and Phanerogams to these highly differentiated types. In the simplest condition we have merely tracheae and sieve-tubes, respectively associated with parenchyma, which in the former case is usually amylom, *i.e.* consists of starch-containing cells, and in the latter of proteid cells. This type is found in nearly all Pteridophytes and, so far as is known, in Cycadofilices, both in primary and secondary tissue. The stereom is furnished either by cortical cells or by the tracheal elements, in a few cases by fibres which are probably homologous with sieve-tubes. Among Gymnosperms the secondary xylem is similarly simple, consisting of tracheids which act as stereom as well as hydrom, and a little amylom; while the phloem-parenchyma sometimes undergoes a differentiation, part being developed as amylom, part as proteid cells immediately associated with the sieve-tube. In other cases the proteid cells of the secondary phloem do not form part of the phloem-parenchyma, but occupy the top and bottom cell-rows of the medullary rays, the middle rows consisting of ordinary starchy cells. The top and bottom rows of the xylem rays are often developed as irregularly-thickened radially-elongated tracheids which serve for the radial conduction of water, and communicate with the ordinary tracheids of the secondary xylem by large bordered pits. The primary vascular tissues of Angiosperms are likewise nearly always simple, consisting merely of tracheae and sieve-tubes often associated with amylom. A characteristic peculiarity, both in the primary and secondary tissue, is that the proteid cells of the phloem are here always sister-cells of the leptoids and are known as *companion-cells.* In the secondary tissues of Dicotyledons we may have, as already described, considerably more differentiation of the cells, all the varieties being referable, however, on the one hand to the tracheal or sieve-tube type, on the other to the parenchyma type. The main feature is the development of special vascular stereom and storage tissue. In some cases special secreting tissues, resin ducts, oil glands, laticiferous tissue, crystal sacs, &c., may be developed among the ordinary secondary vascular elements.



(From Green's *Vegetable Physiology*, by permission.)

FIG. 23.—Section of part of hypocotyledonary stem of *Ricinus communis.*

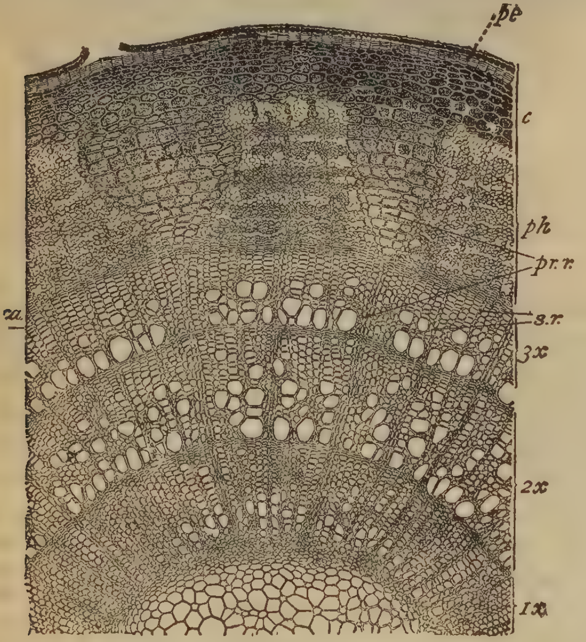
a, Starch sheath; at the extremities of the figure its cells are represented as empty; *b*, cambium layer.

Annual Rings.

The limit of each year's increment of secondary wood, in those plants whose yearly activity is interrupted by a regular winter or dry season, is marked by a more or less distinct line, which is produced by the sharp contrast between the wood formed in the late summer of one year (characterized by the sparseness or small diameter of the tracheal elements, or by the preponderance of fibres, or by a combination of these characters, giving a denseness to the wood) and the loose spring wood of the next year, with its absence of fibres, or its numerous large tracheae. The abundance of water-conducting channels is in relation to the need for a large and rapid supply of water to the unfolding leaves in the spring and early summer. In Gymnosperms, where vessels and fibres are absent, the late summer wood is composed of radially narrow thick-walled tracheids, the wood of the succeeding spring being wide-celled and thin-walled, so that the limit of the year's growth is very well marked. The older wood of a large tree forming a cylinder in the centre of the trunk frequently undergoes marked changes in character. The living elements die, and the walls of all the cells often become hardened, owing to the deposit in them of special substances. Wood thus altered is known as heart-wood, or *duramen*, as distinguished from the young sap-wood, or *alburnum*, which, forming a cylinder next the cambium, remains alive and carries on the active functions of the xylem, particularly the conduction of water. The heart-wood ceases to be of any use to the tree except as a support, but owing to its dryness and hardness it alone is of much use for industrial purposes. The great hardness of teak is due to the silica deposited in the heart-wood, and the special colouring matters of various woods, such as satinwood, ebony, &c., are confined to the heart-wood. In some cases the heart-wood, instead of becoming specially hard, remains soft and easily rots, so that the trunk of the tree frequently becomes hollow, as is commonly the case in the willow. Heart-wood is first formed at very different epochs in the life of a tree, according to the species—*e.g.* after fifteen to twenty years in the oak, forty years in the ash, &c.

Cambium in Stems.

In many annual plants no cambium is formed at all, and the same is true of most perennial Pteridophytes and Monocotyledons. When the vascular tissue of such plants is arranged in separate bundles these are said to be *closed.* The bundles of plants which form cambium are, on the contrary, called *open.* In stems with open bundles the formation of cambium and secondary tissue may be confined to these, when it is said to be entirely *fascicular.* In that case either very little secondary tissue is formed, as in the gourds, some Ranunculaceae, &c., or a considerable amount may be produced (clematis, barberry, ivy). In the latter event the cells of the primary rays are either merely stretched radially, or they divide to keep pace with the growth of the bundles. If this division occurs by means of a localized secondary meristem connecting the cambial layers of adjacent bundles, an *interfascicular* is formed in addition to the fascicular cambium. The interfascicular cambium may form nothing but parenchymatous tissue, producing merely continuations of the primary rays. Such rays are usually broader and more conspicuous than the secondary rays formed within the wedges of wood opposite the primary bundles, and are distinguished as *principal rays* from these narrower *subordinate* or *fascicular rays* (fig. 24). This is the typical case in most trees where the primary bundles are close together. Where the primary bundles are farther apart, so that the primary rays are wider, the interfascicular cambium may form several fairly broad (principal) secondary rays in continuation of certain radial bands of the primary ray, and between these, wedges of secondary xylem and phloem: or, finally, secondary xylem and phloem may be formed by the whole circumference of the cambium, fascicular and interfascicular alike, interrupted only by narrow secondary rays, which have no relation to the primary ones.



(After Kuy, from Green's *Vegetable Physiology*, by permission.)

FIG. 24.—Section of three-year-old stem of Lime.

pe, periderm; *c*, cortex; *ph*, phloem with alternating strands of fibres, sieve-tubes and parenchyma; *pr.r.*, principal ray; *s.r.*, subordinate rays; *ca*, cambium.

In a good many cases, sometimes in isolated genera or species, sometimes characteristic of whole families, so-called *anomalous cambial layers* are formed in the stem, either as an extension of, or in addition to, the original cambial cylinder. They are frequently associated with irregularities in the activity of the original cambium. Irregularity of cambium occurs in various families of woody dicotyledonous plants, mostly among the woody climbers, known as *lianes,* characteristic of tropical and sub-tropical forests. In the simplest cases the cambium produces xylem more freely along certain tracts of the circumference than along others, so that the stem loses its original cylindrical form and becomes elliptical or lobed in section. In others the secondary phloem is produced more abundantly in those places where the secondary xylem is deficient, so that the stem remains cylindrical in section, the phloem occupying the bays left in the xylem mass. Sometimes in such cases the cambium ceases to be active round these bays and joins across the outside of the bay, where it resumes its normal activity, thus isolating a phloem strand, or, as it is sometimes called, a *phloem island,* in the midst of the xylem. The significance of these phenomena, which present many minor modifications in different cases, is not fully understood, but one purpose of the formation of phloem promontories and islands seems to be the protection of the sieve-tubes from crushing by the often considerable peripheral pressure that is exercised on the stems of these lianes. Sometimes the original cambial ring is broken into several arcs, each of which is completed into an independent circle, so that several independent secondary vascular cylinders are formed. The formation of additional cambial cylinders or bands occurs in the most various families of Dicotyledons and in some Gymnosperms. They may arise in the pericycle or endocycle of the stele, in the cortex of the stem, or in the parenchyma of the secondary xylem or phloem. The activity of the new cambium is often associated with the stoppage of the original one. Sometimes the activity of the successive cambiums simply results in the formation of concentric rings or arcs of secondary xylem and phloem. In other cases a most intricate arrangement of secondary tissue masses is produced, quite impossible to interpret unless all stages of their development have been followed. Sometimes in lianes the whole stem breaks up into separate woody strands, often twisted like the strands of a rope, and running into one another at intervals. An ordinary cambium is scarcely ever found in the Monocotyledons, but in certain woody forms a secondary meristem is formed outside the primary bundles, and gives rise externally to a little secondary cortex, and internally to a secondary parenchyma in which are developed numerous zones of additional bundles, usually of concentric structure, with phloem surrounded by xylem.

Cambium in Roots.

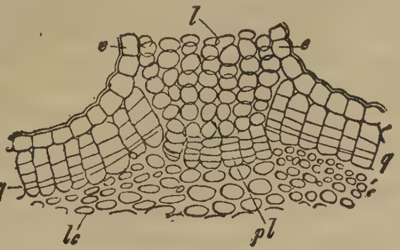
The cambium in the root, which is found generally in those plants which possess a cambium in the stem, always begins in the conjunctive tissue internal to the primary phloems, and forms new (secondary) phloem in contact with the primary, and secondary xylem internally. In roots which thicken but slightly, whose cambium usually appears late, it is confined to these regions. If the development of secondary tissues is to proceed further, arcs of cambium are formed in the pericycle external to the primary xylems, and the two sets of cambial arcs join, forming a continuous, wavy line on transverse section, with bays opposite the primary phloems and promontories opposite the primary xylems. Owing to the resistance offered by the hard first-formed secondary xylem, the bays are pushed outwards as growth proceeds, and the wavy line becomes a circle. Opposite the primary xylems, the cambium either (*a*) forms parenchyma on both sides, making a broad, secondary (principal) ray, which interrupts the vascular ring and is divided at its inner extremity by the islet of primary xylem; or (*b*) forms secondary xylem and phloem in the ordinary way, completing the vascular ring. In either case, narrow, secondary rays are formed at intervals, just as in the stem. Thus the structure of an old thickened root approximates to that of an old thickened stem, and so far as the vascular tissue is concerned can often only be distinguished from the latter by the position and orientation of the primary xylems. The cambium of the primary root, together with the tissues which it forms, is always directly continuous with that of the primary stem, just in the same way as the tissues of the primary stele. The so-called anomalous cambiums in roots follow the same lines as those of the stem.

Phellogen and Periderm.

In nearly all plants which produce secondary vascular tissues by means of a cambium there is another layer of secondary meristem arising externally to, but in quite the same fashion as, the cambium, and producing like the latter an external and an internal secondary tissue. This is the *phellogen,* and the whole of the tissue it gives rise to is known as *periderm.* The phellogen derives its name from the fact that its external product is the characteristic tissue known as *cork.* This consists typically of close-fitting layers of cells with completely suberized walls, intended to replace the epidermis as the external protective layer of the plant when the latter, incapable as it is of further growth after its original formation, is broken and cast off by the increase in thickness of the stem through the activity of the cambium. Cork is also formed similarly in the root after the latter has passed through its primary stage as an absorptive organ, and its structure is becoming assimilated to that of the stem. The internal tissue formed by the phellogen is known as *phelloderm,* and consists usually of ordinary parenchyma. The phellogen may arise, in the first place, in any tissue of the axis external to the actual vascular tissues—*i.e.* in the epidermis itself (rarely), in any layer of the cortex, or in the pericycle. Its most usual seat of origin in the stem is the external layer of the cortex immediately below the epidermis; in the root, the pericycle. All the tissues external to the cork are cast off by the plant. The extent of development of the phelloderm is dependent upon whether the phellogen has a superficial or a deep-seated origin. In the former case the formation of phelloderm is trivial in amount; in the latter, considerable, since this tissue has to replace the cast-off cortex, as a metabolic and particularly a storage tissue.

Lenticels.

Provision is made for gaseous interchange between the internal tissues and the external air after the formation of cork, by the development of *lenticels.* These are special organs which interrupt the continuity of the impermeable layer of ordinary cork-cells. A lenticel is formed by the phellogen at a given spot dividing very actively and giving rise to a loose tissue of rounded cells which soon lose their contents, and between which air can pass to the tissues below (fig. 25). A lenticel appears to the naked eye as a rounded or elongated scar, often forming a distinct prominence on the surface of the organ. The lenticels of the stem are usually formed beneath stomata, whose function they take up after the stomata have been ruptured and cast off with the rest of the epidermis. Both cork and phelloderm may be differentiated in various ways. The former often has its cells lignified, and may consist of alternate layers of hard and soft cells. The latter may develop stereom, and may also be the seat of origin of new formations of various kinds—*e.g.* supplementary vascular bundles, anomalous cambial zones, &c. It is often enormously developed and forms a very important tissue in roots. In the stem of a tree the original phellogen is replaced by successive new phellogenic layers of deeper and deeper origin, each forming its own layer of cork. Eventually the new phellogens reach the level of the secondary phloem, and are formed in the parenchyma of the latter, keeping pace in their inward march with the formation of fresh secondary phloem by the cambium. The complex system of dead and dying tissues cut off by these successive periderms, together with the latter themselves—in fact, everything outside the innermost phellogen, constitutes what is often known botanically as the *bark* of the tree. *Rhytidome* is, however, a preferable term, as the word bark has long been established in popular usage to mean all the tissue that can easily be peeled off—*i.e.* everything down to the wood of the tree. The rough surface of the bark of many trees is due to the successive phellogens not arising in regular concentric zones, but forming in arcs which join with the earlier-formed arcs, and thus causing the bark to come off in flakes or thick chunks. A layer of cork is regularly formed in most Phanerogams across the base of the petiole before leaf fall, so as to cover the wound caused by the separation of the leaf from the stem. Special "wound-cork" is also often formed round accidental injuries so as to prevent the rotting of the tissues by the soaking in of rain and the entrance of fungal spores and bacteria. A peculiar modification of periderm is formed by the phellogen in the submerged organs (roots or stems) of many aquatic or marsh-loving plants. This may take various forms and may cover the whole of the organ or be localized in special regions; but its cells are always living and are separated by very large intercellular spaces containing air. This tissue is called *aerenchym*, and no doubt its function is to facilitate the respiration of the organs on which it is formed and to which the access of oxygen is difficult. In other cases, a similar formation of spongy but dead periderm tissue may occur for the same purpose in special patches, called *pneumatodes*, on the roots of certain trees living in marshy places, which rise above the soil in order to obtain air.



(From Vines' *Text-Book of Botany*, by permission.)

FIG. 25.—Lenticel in the transverse section of a twig of Elder.

E, epidermis; *q*, phellogen; *l*, cells, and *pl*, the phellogen of the lenticel; *lc*, cortical parenchyma, containing chlorophyll.

History and Bibliography.—The study of plant anatomy was begun in the middle of the seventeenth century as a direct result of the construction of microscopes, with which a clear view of the structure of plant tissues could be obtained. The Englishman Grew and the Italian Malpighi almost simultaneously published illustrated works on the subject, in which they described, for the most part very accurately, what they saw with the new instruments. The subject was practically dormant for nearly a century and a half, largely owing to the dominance of classificatory botany under the influence of Linnaeus. It was revived by several German workers, prominent among whom were Treviranus and Link, and later Moldenhawer, as well as by the Frenchmen Mirbel, at the beginning of the 19th century. The new work largely centred round a discussion of the nature and origin of *vessels*, conspicuous features in young plant tissues which thus acquired an importance in the contemporary literature out of proportion to their real significance in the construction of the vascular plant. The whole of the writings of this time are dominated by a preoccupation with the functions of the different tissues, in itself an excellent standpoint for investigation, but frequently leading in the case of these early investigators to one-sided and distorted views of the facts of structure. The pioneer of modern plant anatomy was Hugo von Mohl (*fl.* 1840), who carefully investigated and described the facts of anatomical structure without attempting to fit them into preconceived views of their meaning. He produced a solid body of accurately described facts which has formed the secure groundwork of subsequent advance. From Mohl down to the eighth decade of the century the study of anatomy was entirely in the hands of a group of German investigators, prominent among whom were several of the most eminent founders of modern scientific botany—such, for instance, as Nägeli, Sanio and De Bary. To the first we owe the secure foundation of our knowledge of the structure and course of the vascular strands of the higher plants ("Ueber den Bau und die Anordnung der Gefässbündel bei den Stamm und Wurzel der Phanerogamen," *Beiträge zur wissenschaftlichen Botanik*, Heft i., Leipzig, 1859); to the second the establishment of the sound morphological doctrine of the central cylinder of the axis as the starting-point for the consideration of the general arrangement of the tissues, and the first clear distinction between primary and secondary tissues (*Botanische Zeitung*, 1861 and 1863); to the last the putting together of the facts of plant anatomy known up to the middle of the eighth decade of the century in that great encyclopaedia of plant anatomy, the *Vergleichende Anatomie der Vegetationsorgane bei den Phanerogamen und Farnen* (Stuttgart, 1876; Eng. trans., *Comparative Anatomy of the Vegetative Organs of the Phanerogams and Ferns*, Oxford, 1882). In 1870–1871 Van Tieghem published his great work, "Sur la Racine," *Ann. sci. nat. bot.* (Paris). This was not only in itself an important contribution to plant anatomy, but served as the starting-point of a series of researches by Van Tieghem and his pupils, which has considerably advanced our knowledge of the details of histology, and also culminated in the foundation of the doctrine of the stele (Van Tieghem and Douliot, "Sur la polystélie," *Ann. sci. nat. bot.*, 1887; Van Tieghem, *Traité de botanique* (2nd ed. Paris, 1889–1891). This has had a most important effect on the development in recent years of morphological anatomy.

Modern Progress of the Subject.

In the progress of the last three decades, since the publication of De Bary's great work, five or six main lines of advance can be distinguished. First, the knowledge of the details of histology has of course advanced greatly in the direction through the ceaseless activity of very numerous, mainly German, workers, though no fundamentally new types of tissue have been discovered. Secondly, the histology of fossil plants, particularly woody plants of the carboniferous period, has been placed on a sound basis, assimilated with general histological doctrine, and has considerably enlarged our conceptions of plant anatomy as a whole, though again without revealing any entirely new types of structure. This branch of the subject, founded by Corda, Göppert, Stenzel and others in Germany, was enormously advanced by Williamson's work on the Coal Measures plants, recorded in the magnificent series of memoirs, "Researches on the Organization of Fossil Plants of the Coal Measures" (*Phil. Trans. Roy. Soc.*, vols. i.-xix., 1871–1893). The work of Solms Laubach in Germany, Renault and Bertrand in France, and in recent years, of Zeiller in France, and Scott, Seward and others in England, has advanced our knowledge of the anatomy of fossil plants in an important degree. While convincing us that the plants of past ages in the earth's history were exposed to very similar conditions of life, and made very much the same adaptive responses as their modern representatives, one of the main results of this line of work has been to reveal important data enabling us to fill various gaps in our morphological knowledge and to obtain a more complete picture of the evolution of tissues in the vascular plants. One of the most striking incidents in the progress has been the recognition within the last few years of the existence of an extinct group of plants lying on the borderland between Filicales and Gymnosperms, and known as the Cycadofilices, a group in which, curiously enough, the reproductive organs remained undiscovered for some time after the anatomy of the vegetative organs was sufficiently well known to afford clear evidence of their true affinities. Thirdly, we have to record very considerable progress in our knowledge of distinctively morphological anatomy, *i.e.* the study of tissues from the standpoint of evolution. The Russian plant-anatomist, Russow, may be said to have founded the consideration of plant tissues from the point of view of descent (*Vergleichende Untersuchungen über die Leitbündelkryptogamen*, St Petersburg, 1872; and *Betrachtungen über Leitbündel und Grundgewebe*, Dorpat, 1875). He was ably followed by Strasburger (*Ueber den Bau und die Verrichtungen der Leitungsbahnen in den Pflanzen*, Jena, 1891), Haberlandt and others. The explicit adoption of this point of view has had the effect of clearing up and rendering definite the older morphological doctrines, which for the most part had no fixed criterion by which they could be tested.

Since about 1895 this branch has been most actively pursued in England, where the work of Boodle and of Gwynne-Vaughan especially on Ferns) has been the most important, leading to a coherent theory of the evolution of the vascular system in these plants (Tansley, *Evolution of the Filicinean Vascular System*, Cambridge, 1908); and in America, where Jeffrey has published important papers on the morphology of the vascular tissues of the various groups of Pteridophytes and Phanerogams and has sought to express his conclusions in a general morphological theory with appropriate terminology. As a result of this activity Van Tieghem's so-called "Stelar theory" has been revised and modified in the light of more extended and detailed anatomical and developmental knowledge. Schoute's *Die Stelär-Theorie* (Gröningen, 1902), gives an important critical account of this subject.

Fourthly, attention must be called to the great development of what is called "Systematic Anatomy," *i.e.* the study of the anatomical features characteristic of the smaller groups of flowering plants, *i.e.* the orders, families, genera and species. Radlkofer (1883) was the first to call attention to the great importance of this method in systematic botany, as providing fresh characters on which to base a natural classification. Solereder's great work, *Systematische Anatomie der Dicotyledonen* (Stuttgart, 1898–1908; Eng. trans., *Systematic Anatomy of Dicotyledons*, Oxford, 1908), brings together so many of the facts as are at present known in an orderly arrangement. Theoretically this branch of the subject should connect with and form the completion of "morphological anatomy," but the field has not yet been sufficiently explored to allow of the necessary synthesis. The true relation of "systematic" to "ecological" anatomy (see below) also awaits proper elucidation.

Fifthly, we have to record the foundation of the modern study of "physiological anatomy" (*i.e.* the study of the specific functions of the various tissues) by Schwendener (*Das mechanische Princip im Bau der Monocotylen*, 1874, and other works), followed by numerous pupils and others, among whom Haberlandt (*Physiologische Pflanzen-Anatomie*, Leipzig, 1st ed., 1884, 4th ed., 1909, and other works) is pre-eminent. The pursuit of this study has not only thrown valuable light on the economy of the plant as a whole, but forms an indispensable condition of the advance of morphological anatomy. A great deal of work still remains to be done in this department, which at the present time affords one of the most promising fields of anatomical investigation.

Finally we may mention "ecological anatomy," *i.e.* the study of anatomical features directly related to the habitat. A very considerable body of knowledge relating to this subject already exists, but further work on experimental lines is urgently required to enable us to understand the actual economy of plants growing under different conditions of life and the true relation of the hereditary anatomical characters which form the subject matter of "systematic anatomy" to those which vary according to the conditions in which the individual plant is placed. On these lines the future of anatomical study presents almost inexhaustible possibilities. (A. G. T.)

PHYSIOLOGY OF PLANTS

The so-called *vegetable physiology* of a generation ago was in arrear of *animal*, and particularly of *human*, physiology, the study of the latter being followed by many more observers, and from its relative degree of advancement being the more capable of rapid development. It was fully recognized by its followers that the dominating influence in the structure and working of the body was the protoplasm, and the division of labour which it exhibited, with the accompanying or resulting differentiation into various tissues, was the special subject of investigation. Many who followed the study of vegetable structure did not at that time give an equal prominence to this view. The early histological researches of botanists led them to the recognition of the vegetable cell, and the leading writers in the middle of the 19th century pointed out the probable identity of Von Mohl's "protoplasm" with the "sarcode" of zoologists. They laid great stress on the nitrogenous nature of protoplasm, and noted that it preceded the formation of the cell-membrane. But by the ordinary student of thirty years later their work was to some extent overlooked, and the *cell-wall* assumed a prominence to which it was not entitled. The study of the *differentiation* of protoplasm was at that time seldom undertaken, and no particular attention was paid either to fixing it, to enable staining methods to be accurately applied to it, or to studying the action of chemical reagents upon it. It is only comparatively recently that the methods of histological investigation used by animal physiologists have been carefully and systematically applied to the study of the vegetable organisms. They have, however, been attended with wonderful results, and have revolutionized the whole study of vegetable structure. They have emphasized the statements of Von Mohl, Cohn, and other writers alluded to, that the protoplasm is here also the dominant factor of the body, and that all the peculiarities of the cell-wall can only be interpreted in the light of the needs of the living substance.

The Nature of the Organization of the Plant, and the Relations of the Cell-Membrane and the Protoplasm.—This view of the structure of the plant and this method of investigation lead us to a greatly modified conception of its organization, and afford more completely an explanation of the peculiarities of form found in the vegetable kingdom.

The study of simple organisms, many of which consist of nothing but a little mass of protoplasm, exhibiting a very rudimentary degree of differentiation, so far as our methods enable us to determine any at all, shows that the duties of existence can be discharged in the absence of any cell-wall. Those organisms which possess the latter are a little higher in the scale of life than those which remain unclothed by it, but a comparison of the behaviour of the two quickly enables us to say that the membrane is of but secondary importance, and that for those which possess it, it is nothing more than a protective covering for the living substance. Its physical properties, permeability by water, extensibility and elasticity, receive their interpretation in the needs of the latter. We come, accordingly, to regard it as practically an exoskeleton, and its functions as distinctly subordinate to those of the protoplasm which it clothes. If we pass a little higher up the scale of life we meet with forms consisting of two or more cells, each of which contains a similar minute mass of living substance. A study of them shows that each is practically independent of the others; in fact, the connexion between them is so slight that they can separate and each become free without the slightest disadvantage to another. So long as they are connected together mechanically they have apparently the power of influencing one another in various ways, and of passing liquid or gaseous materials from one to another. The conjoined organism is, in fact, a colony or association of the protoplasmic units, though each unit retains its independence. When we pass, again, from these to examine more bulky, and consequently more complex, plants, we find that the differences which can be observed between them and the simple lowly forms are capable of being referred to the increased number of the protoplasmic units and the consequent enlarged bulk of the mass or colony. Every plant is thus found to be composed of a number of these protoplasmic units, or, as they may preferably be termed, *protoplasts*, all of which are at first exactly alike in appearance and in properties. This is evident in the case of such plants as have a body consisting of filaments or plates of cells, and is little less conspicuous in those whose mass is but small, though the cells are evidently capable of computation in three dimensions. It does not at first appear to be the same with the bulkier plants, such as the ordinary green herbs, shrubs or trees, but a study of their earlier development indicates that they do not at the outset differ in any way from the simple undifferentiated forms. Each commences its existence as a simple naked protoplast, in the embroyo-sac or the archegonium, as the case may be. After the curious fusion with another similar protoplast, which constitutes what we call fertilization, the next stage in complexity already noted may be observed, the protoplasm becoming clothed by a cell-membrane. Very soon the single cell gives rise to a chain of cells, and this in turn to a cell mass, the individual units of which are at first quite uniform. With increase of number, however, and consequently enlargement of bulk in the colony, differentiation becomes compulsory. The requirements of the several protoplasts must be met by supplies from without, and, as many of them are deep seated, varieties of need arise, so that various members of the colony are set apart for special duties, masses of them being devoted to the discharge of one function, others to that of another, and so on. Such limitations of the powers and properties of the individuals have for their object the well-being of the community of which those individuals are constituents.

Physiological and Morphological Differentiation.—The first indication of this differentiation in the vegetative body of the plant can be seen not only in the terrestrial green plants which have been particularly referred to, but also in the bulkier seaweeds. It is an extension of the first differentiation which was observable in the simple protoplasts first discussed, the formation, that is, of a protective covering. *Fucus* and its allies, which form conspicuous members of the larger Algae, have their external cells much smaller, more closely put together, and generally much denser than the rest of their tissue. In the lowly as well as the higher green plants we have evidence of specialization of the external protoplasts for the same purpose, which takes various shapes and shows different degrees of completeness, culminating in the elaborate barks which clothe our forest trees.

The second prominent differentiation which presents itself takes the form of a provision to supply the living substance with water. This is a primal necessity of the protoplast, and every cell gives evidence of its need by adopting one of the various ways in which such need is supplied. What little differentiation can be found to exist in the protoplasm of the simple unicellular organism shows the importance of an adequate water-supply, and indeed, the dependence of life upon it. The naked cells which have been alluded to live in water, and call therefore for no differentiation in connexion with this necessity; but those which are surrounded by a cell-wall always develop within themselves a *vacuole* or cavity which occupies the greater part of their interior, and the hydrostatic pressure of whose contents keeps the protoplasm in contact with the membrane, setting up a condition of turgidity.

The need for a constant supply of water is partly based upon the constitution of protoplasm, so far as we know it. The apparently structureless substance is saturated with it; and if once a cell is completely dried, even at a low temperature, in the enormous majority of cases its life is gone and the restoration of water fails to enable it to recover. Besides this intimate relationship, however, we can point to other features of the necessity for a constantly renewed water supply. The protoplasm derives its food from substances in solution in the water; the various waste products which are incident to its life are excreted into it, and so removed from the sphere of its activity. The raw materials from which the food is constructed are absorbed from the exterior in solution in water, and the latter is the medium through which the gaseous constituents necessary for life reach the protoplasm. Moreover, growth is essentially dependent upon water-supply. There is little wonder, then, that in a colony of protoplasts such as constitute a large plant a considerable degree of differentiation is evident, bearing upon the question of water supply. Certain cells of the exterior are set apart for absorption of water from the soil, this being the source from which supplies are derived. Others are devoted to the work of carrying it to the protoplasts situated in the interior and at the extremities of the plant, a *conducting system* of considerable complexity being the result.

Other collections of cells are in many cases set apart for giving rigidity and strength to the mass of the plant. It is evident that as the latter increases in bulk, more and more attention must be paid to the dangers of uprooting by winds and storms. Various mechanisms have been adopted in different cases, some connected with the subterranean and others with the sub-aerial portions of the plant. Another kind of differentiation in such a cell-mass as we are dealing with is the setting apart of particular groups of cells for various metabolic purposes. We have the formation of numerous mechanisms which have arisen in connexion with the question of food supply, which may not only involve particular cells, but also lead to differentiation in the protoplasm of those cells, as in the development of the chloroplastids of the leaves and other green parts.

The inter-relations of the members of a large colony of protoplasts such as constitute a tree, demand much adjustment. Relations with the exterior are continually changing, and the needs of different regions of the interior are continually varying, from time to time. Two features which are essentially protoplasmic assume a great importance when we consider these relations. They are the power of receiving impressions or stimuli from the exterior, and of communicating with each other, with the view of co-ordinating a suitable response. We have nothing structural which corresponds to the former of these. In this matter, differentiation has proceeded very differently in animals and plants respectively, no nerves or sense organs being structurally recognizable. Communication between the various protoplasts of the colony is, however, carried on by means of fine protoplasmic threads, which are continuous through the cell-walls.

All the peculiarities of structure which we encounter consequently support the view with which we started, that the protoplasm of the plant is the dominant factor in vegetable structure, and that there need be but one subject of physiology, which must embrace the behaviour of protoplasm wherever found. There can be no doubt that there is no fundamental difference between the living substance of animals and plants, for many forms exist which cannot be referred with certainty to either kingdom. Free-swimming organisms without cell-membranes exist in both, and from them series of forms can be traced in both directions. Cellulose, the material of which vegetable cell-walls are almost universally composed, at any rate in their early condition, is known to occur, though only seldom, among animal organisms. Such forms as *Volvox* and the group of the *Myxomycetes* have been continually referred to both kingdoms, and their true systematic position is still a subject of controversy. All physiology, consequently, must be based upon the identity of the protoplasm of all living beings.

This method of study has to a large extent modified our ideas of the relative importance of the parts of such an organism as a large tree. The interest with which we regard the latter no longer turns upon the details of the structure of its trunk, limbs and roots, to which the living substance of the more superficial parts was subordinated. Instead of regarding these as only ministering to the construction of the bulky portions, the living protoplasts take the first place as the essential portion of the tree, and all the other features are important mainly as ministering to their individual well-being and to their multiplication. The latter feature is the *growth* of the tree, the well-being of the protoplasts is its *life* and *health*. The interest passes from the bulky dense interior, with the elaborate features of its cell-walls, to the superficial parts, where its life is in evidence. We see herein the reason for the great subdivision of the body, with its finely cut twigs and their ultimate expansions, the leaves, and we recognize that this subdivision is only an expression of the need to place the living substance in direct relationship with the environment. The formation and gradually increasing thickness of its bark are explained by the continually increasing need of adequate protection to the living cortex, under the strain of the increasing framework which the enormous multiplication of its living protoplasts demands, and the development of which leads to continual rupture of the exterior. The increasing development of the wood as the tree grows older is largely due to the demands for the conduction of water and mineral matters dissolved in it, which are made by the increased number of leaves which from year to year it bears, and which must each be put into communication with the central mass by the formation of new vascular bundles. Similar considerations apply to the peculiar features of the root-system. All these points of structure can only be correctly interpreted after a consideration of the needs of the individual protoplasts, and of the large colony of which they are members.

Gaseous Interchanges and their Mechanism.—Another feature of the construction of the plant has in recent years come into greater prominence than was formerly the case. The organism is largely dependent for its vital processes upon gaseous interchanges. It must receive a large constituent of what ultimately becomes its food from the air which surrounds it, and it must also take in from the same source the oxygen of its respiratory processes. On the other hand, the aerial environment presents considerable danger to the young and tender parts, where the protoplasts are most exposed to extremes of heat, cold, wet, &c. These must in some way be harmonized. No doubt the primary object of the cell-wall of even the humblest protoplast is protection, and this too is the meaning of the coarser tegumentary structures of a bulkier plant. These vary considerably in completeness with its age; in its younger parts the outer cells wall undergoes the change known as *cuticularization*, the material being changed both in chemical composition and in physical properties. The corky layers which take so prominent a share in the formation of the bark are similarly modified and subserve the same purpose. But these protective layers are in the main impermeable by gases and by either liquid or vapour, and prevent the access of either to the protoplasts which need them. Investigations carried out by Blackman, and by Brown and Escombe, have shown clearly that the view put forward by Boussingault, that such absorption of gases takes place through the cuticular covering of the younger parts of the plant, is erroneous and can no longer be supported. The difficulty is solved by the provision of a complete system of minute intercellular spaces which form a continuous series of delicate canals between the cells, extending throughout the whole substance of the plant. Every protoplast, except in the very young regions, has part of its surface abutting on these, so that its wall is accessible to the gases necessary for its vital processes. There is no need for cuticularization here, as the external dangerous influences do not reach the interior, and the processes of absorption which Boussingault attributed to the external cuticularized cells can take place freely through the delicate cell-walls of the interior, saturated as these are with water. This system of channels is in communication with the outer atmosphere through numerous small apertures, known as *stomata,* which are abundant upon the leaves and young twigs, and gaseous interchange between the plant and the air is by their assistance rendered constant and safe. This system of intercellular spaces, extending throughout the plant, constitutes a reservoir, charged with an atmosphere which differs somewhat in its composition from the external air, its gaseous constituents varying from time to time and from place to place, in consequence of the interchanges between itself and the protoplasts. It constitutes practically the exterior environment of the protoplasts, though it is ramifying through the interior of the plant.

The importance of this provision in the case of aquatic vascular plants of sturdy bulk is even greater than in that of terrestrial organisms, as their environment offers considerable obstacles to the renewal of the air in their interior. They are without stomata on their submerged portions, and the entry of gases can only take place by diffusion from the water through their external cells, which are not cuticularized. Those which are only partially submerged bear stomata on their exposed portions, so that their environment approximates towards that of a terrestrial plant, but the communication even in their case is much less easy and complete, so that they need a much larger reservoir of air in their interior. This is secured by the development of much larger intercellular spaces, amounting to lacunæ or passages of very considerable size, which are found ramifying in different ways in their interior.

Transpiration.—In the case of terrestrial plants, the continual renewal of the water contained in the vacuoles of the protoplasts demands a copious and continuous evaporation. This serves a double purpose, bringing up from the soil continually a supply of the soluble mineral matters necessary for their metabolic processes, which only enter the plant in solutions of extreme dilution, and at the same time keeping the plant cool by the process of evaporation. The latter function has been found to be of extreme importance in the case of plants exposed to the direct access of the sun's rays, the heat of which would rapidly cause the death of the protoplasts were it not employed in the evaporation of the water. Brown and Escombe have shown that the amount of solar energy taken up by a green leaf may often be fifty times as much as it can utilize in the constructive processes of which it is the seat. If the heat were allowed to accumulate in the leaf unchecked, they have computed that its temperature would rise during bright sunshine at the rate of more than 12° C. per minute, with of course very rapidly fatal results. What is not used in the constructive processes is employed in the evaporation of the water, the leaf being thus kept cool. Whether the leaf is brightly or only moderately illuminated, the same relative proportions of the total energy absorbed are devoted to the purposes of composition and construction respectively. This large evaporation, which constitutes the so-called *transpiration* of plants, takes place not into the external air but into this same intercellular space system, being possible only through the delicate cell-walls upon which it abuts, as the external coating, whether bark, cork or cuticle, is impermeable by watery vapour. The latter ultimately reaches the external air by diffusion through the stomata, whose dimensions vary in proportion as the amount of water in the epidermal cells becomes greater or less.

Mechanism and Function of Stomata.—It is not quite exact to speak of either the gaseous interchanges or the transpiration as taking place through the stomata. The entry of gases into, and exit from, the cells, as well as the actual exhalation of watery vapour from the latter, take place in the intercellular space system of which the stomata are the outlets. The opening and closing of the stomata is the result of variation in the turgidity of their guard cells, which is immediately affected by the condition of turgidity of the cells of the epidermis contiguous to them. The amount of watery vapour in the air passing through a stoma has no effect upon it, as the surfaces of the guard cells abutting on the air chamber are strongly cuticularized, and therefore impermeable. The only way in which their turgidity is modified is by the entry of water into them from the contiguous cells of the general epidermis and its subsequent withdrawal through the same channel. This opening and closing of the stomata must be looked upon as having a direct bearing only on the emission of watery vapour. There is a distinct advantage in the regulation of this escape, and the mechanism is directly connected with the greater or smaller quantity of water in the plant, and especially in its epidermal cells. This power of varying the area of the apertures by which gases enter the internal reservoirs is not advantageous to the gaseous interchanges—indeed it may be directly the reverse. It may lead to an incipient asphyxiation, as the supply of oxygen may be greatly interfered with and the escape of carbon dioxide may be almost stopped. It may at other times lead to great difficulties in the supply of the gaseous constituents which are used in the manufacture of food. The importance of transpiration, is, however, so great, that these risks must be run.

The Ascent of Water in Trees.—The supply of water to the peripheral protoplasts of a tree is consequently of the first importance. The means by which such a supply is ensured are by no means clearly understood, but many agencies are probably at work. The natural source of the water is in all cases the soil, and few plants normally obtain any from elsewhere. The water of the soil, which in well-drained soil is met with in the form of delicate films surrounding the particles of solid matter, is absorbed into the plant by the delicate hairs borne by the young roots, the entry being effected by a process of modified osmosis. Multitudes of such hairs on the branches of the roots cause the entry of great quantities of water, which by a subsequent similar osmotic action accumulates in the cortex of the roots. The great turgidity which is thus caused exerts a considerable hydrostatic pressure on the stele of the root, the vessels of the wood of which are sometimes filled with water, but at other times contain air, and this often under a pressure less than the ordinary atmospheric pressure. This pressure of the turgid cortex on the central stele is known as *root pressure*, and is of very considerable amount. This pressure leads to the filling of the vessels of the wood of both root and stem in the early part of the year, before the leaves have expanded, and gives rise to the exudation of fluid known as *bleeding* when young stems are cut in early spring.

Root pressure is one of the forces co-operating in the forcing of the water upwards. The evaporation which is associated with transpiration is no doubt another, but by themselves they are insufficient to explain the process of lifting water to the tops of tall trees. There is at present also a want of agreement among botanists as to the path which the water takes in the structural elements of the tree, two views being held. The older is that the water travels in the woody cell-walls of the vascular bundles, mainly under the action of the forces of root pressure and transpiration, and that the cavities of the vessels contain only air. The other is that the vessels are not empty, but that the water travels in their cavities, which contain columns of water in the course of which are large bubbles of air. On this view the water flows upwards under the influence of variations of pressure and tension in the vessels. These forces however fail to furnish a complete explanation of the ascent of the current, and others have been thought to supplement them, which have more or less weight. Westermaier and Godlewski put forward the view that the living cells of the medullary rays of the wood, by a species of osmosis, act as a kind of pumping apparatus, by the aid of which the water is lifted to the top of the tree, a series of pumping-stations being formed. Though this at first met with some acceptance, Strasburger showed that the action goes on in great lengths of stem the cells of which have been killed by poison or by the action of heat. More recently, Dixon and Joly in Dublin and Askenasy in Germany have suggested the action of another force. They have shown that columns of water of very small diameter can so resist tensile strain that they can be lifted bodily instead of flowing along the channel. They suggest that the forces causing the movement are complex, and draw particular attention to the pull upwards in consequence of disturbances in the leaves. In these we have (1) the evaporation from the damp delicate cell-walls into the intercellular spaces; (2) the imbibition by the cell-wall of water from the vacuole; (3) osmotic action, consequent upon the subsequent increased concentration of the cell sap, drawing water from the wood cells or vessels which abut upon the leaf parenchyma. They do not, of course, deny the co-operation of the other forces which have been suggested, except so far as these are inconsistent with the motion of the water in the form of separate columns rather than a flowing stream. This view requires the existence of certain anatomical arrangements to secure the isolation of the separate columns, and cannot be said to be fully established.

Nature of the Food of Plants.—The recognition of the fundamental identity of the living substance in animals and plants has directed attention to the manner in which plants are nourished, and especially to the exact nature of their food. The idea was till recently currently accepted, that anything which plants absorbed from without, and which went to build up their organic substance, or to supply them with energy, or to exert some beneficial influence upon their metabolism, constituted their *food*. Now, as the materials which plants absorb are carbon dioxide from the air, and various inorganic compounds from the soil, together with water, it is clear that if this view is correct, vegetable protoplasm must be fed in a very different way from animal, and on very different materials. A study of the whole vegetable kingdom, however, negatives the theory that the compounds absorbed are in the strict sense to be called food. Fungal and phanerogamic parasites can make no use of such substances as carbon dioxide, but draw elaborated products from the bodies of their hosts. Those Fungi which are saprophytic can only live when supplied with organic compounds of some complexity, which they derive from decomposing animal or vegetable matter. Even in the higher flowering plants, in which the processes of the absorption of substances from the environment has been most fully studied, there is a stage in their life in which the nutritive processes approximate very closely to those of the group last mentioned. When the young sporophyte first begins its independent life—when, that is, it exists in the form of the embryo in the seed—its living substance has no power of utilizing the simple inorganic compounds spoken of. Its nutritive pabulum is supplied to it in the shape of certain complex organic substances which have been stored in some part or other of the seed, sometimes even in its own tissues, by the parent plant from which it springs. When the tuber of a potato begins to germinate the shoots which it puts out derive their food from the accumulated store of nutritive material which has been laid up in the cells of the tuber. If we examine the seat of active growth in a young root or twig, we find that the cells in which the organic substance, the protoplasm, of the plant is being formed and increased, are not supplied with carbon dioxide and mineral matter, but with such elaborated material as sugar and proteid substances, or others closely allied to them.

Identity of the Food of Animals and Plants.—It is evidently to the actual seats of consumption of food, and of consequent nutrition and increase of living substance, that we should turn when we wish to inquire what are the nutritive materials of plants. If we go back to the first instance cited, the embryo in the seed and its development during germination, we can ascertain what is necessary for its life by inquiring what are the materials which are deposited in the seed, and which become exhausted by consumption as growth and development proceed. We find them to consist of representatives of the great classes of foodstuffs on which animal protoplasm is nourished, and whose presence renders seeds such valuable material for animal consumption. They are mainly carbohydrates such as starch and sugar, proteids in the form of globulins or albumoses, and in many cases fats and oils, while certain other bodies of similar nutritive value are less widely distributed.

The differences between the nutritive processes of the animal and the plant are not therefore fundamental, as they were formerly held to be. The general vegetable protoplasm has not the capacity of being nourished by inorganic substances which are denied to the living substance of the animal world. Differences connected with the mode of supply of nutritive material do exist, but they are mainly correlated with the structure of the organisms, which makes the method of absorption different. The cell-walls of plants render the entry of solid material into the organism impossible. The food must enter in solution in order to pass the walls. Moreover, the stationary habit of plants, and the almost total absence of locomotion, makes it impossible for them to seek their food.

The Special Apparatus of Plants for constructing Food.—The explanation of the apparent difference of food supply is very simple. Plants are furnished with a constructive mechanism by which they are enabled to fabricate the food on which they live from the inorganic, gaseous and liquid matters which they absorb. The fact of such absorption does not render these substances food; they are taken in not as food, but as raw materials to be subjected to the action of this constructive mechanism, and by it to be converted into substances that can nourish protoplasm, both vegetable and animal. It is sometimes forgotten, when discussing questions of animal nutrition, that all the food materials of all living organisms are prepared originally from inorganic substances in exactly the same way, in exactly the same place, and by the same machinery, which is the *chlorophyll apparatus* of the vegetable kingdom. A consideration of these facts emphasizes still more fully the view with which we set out, that all living substance is fundamentally the same, though differentiated both anatomically and physiologically in many directions and in different degrees. All is nourished alike on materials originally prepared by a mechanism attached to the higher vegetable organism, and capable of being dissociated, in theory at least, from its own special means of nutrition, if by the latter term we understand the appropriation by the protoplasm of the materials so constructed.

The chlorophyll apparatus of plants demands a certain description. It consists essentially of a number of minute corpuscles or plastids, the protoplasmic substance of which is impregnated with a green colouring matter. These bodies, known technically as *chloroplasts*, are found embedded in the protoplasm of the cells of the mesophyll of foliage leaves, of certain of the cells of some of the leaves of the flower, and of the cortex of the young twigs and petioles. Usually they are absent from the cells of the epidermis, though in some of the lower plants they are met with there also. The plastids are not rigidly embedded in the cytoplasm, but are capable of a certain amount of movement therein. Each is a small protoplasmic body, in the meshes of whose substance the green colouring matter *chlorophyll* is contained in some form of solution. Various solvents, such as benzene, alcohol and chloroform, will dissolve out the pigment, leaving the plastid colourless. Chlorophyll is not soluble in water, nor in acids or alkalies without decomposition.

These plastids are especially charged with the duty of manufacturing carbohydrates from the carbon dioxide which the air contains, and which is absorbed from it after it has entered the intercellular passages and has so reached the cells containing the plastids. This action is found to take place only in the presence of light, preferably moderate sunlight. The reason for the distribution of the chloroplasts described above is consequently seen. The relation of the chlorophyll to light has been studied by many observers. If a solution of the pigment is placed in the path of a beam of light which is then allowed to fall on a prism, the resulting spectrum will be found to be modified. Instead of presenting the appearance of a continuous band in which all the colours are represented, it is interrupted by seven vertical dark spaces. The rays which in the absence of the solution of chlorophyll would have occupied those spaces have no power to pass through it, or in other words chlorophyll absorbs those particular rays of light which are missing.

The absorption of these rays implies that the pigment absorbs radiant energy from the sun, and gives us some explanation of its power of constructing the carbohydrates which has been mentioned as the special work of the apparatus. The working of it is not at all completely understood at present, nor can we say exactly what is the part played by the pigment and what is the rôle of the protoplasm of the plastid. It is not certain either whether the action of the chlorophyll apparatus is confined to the manufacture of carbohydrates or whether it is concerned, and if so how far, with the construction of proteids also.

As the action of the chlorophyll apparatus is directly dependent upon light, and the immediate result of its activity is the building up of complex compounds, it has become usual to speak of the processes it sets up under the name of *photosynthesis*.

Photosynthesis.—In the presence of light and when the plant is subjected to a suitable temperature, photosynthesis commences, provided that the plant has access to air containing its normal amount of carbon dioxide, about 3 parts, or rather less, in 10,000. The process involves the inter-action of water also, and this, as we have seen, is always present in the cell. In addition, certain inorganic salts, particularly certain compounds of potassium, are apparently necessary, but they seem to take no part in the chemical changes which take place. The original hypothesis of Baeyer suggested that the course of events is the following: the carbon dioxide is decomposed into carbon monoxide and oxygen, while water is simultaneously split up into hydrogen and oxygen; the hydrogen and the carbon monoxide unite to form formaldehyde and the oxygen is exhaled. This explanation is unsatisfactory from many points of view, but till quite recently no acceptable alternative has been advanced. There is no evidence that carbon monoxide is ever produced, indeed there are strong reasons for disbelieving in its occurrence. The formation of formaldehyde has till recently not been satisfactorily proved, though it has been obtained from certain leaves by distillation. Certain Algae have been found capable of forming nutritive carbohydrates in darkness, when supplied with a compound of this body with sodium-hydrogen-sulphite. But it is certain that it can only be present in a cell in very small amount at any moment, for an extremely dilute solution acts as a poison to protoplasm. If formed, as it probably is, it is immediately changed into some more complex combination, and so rendered incapable of exerting its poisonous action.

Baeyer's hypothesis was entertained by botanists partly because it explained the gaseous interchanges accompanying photosynthesis. These show that a definite intake of carbon dioxide is always accompanied by an exhalation of an equal volume of oxygen.

Recent investigations have confirmed Baeyer's view of the formation of formaldehyde, but a different explanation has been recently advanced. The first chemical change suggested is an interaction between carbon dioxide and water, under the influence of light acting through chlorophyll, which leads to the simultaneous formation of formaldehyde and hydrogen peroxide. The formaldehyde at once undergoes a process of condensation or polymerization by the protoplasm of the plastid, while the hydrogen peroxide is said to be decomposed into water and free oxygen by another agency in the cell, of the nature of one of the enzymes of which we shall speak later.

Polymerization of the aldehyde was also a feature of Baeyer's hypothesis, so that this view does not very materially differ from those he advanced. More emphasis is, however, now laid on the action of the plastid in polymerization, while the initial stages are still not definitely explained.

The steps which lead from the appearance of formaldehyde to that of the first well-defined carbohydrate are again matters of speculation. There are many possibilities, but no definite body of simpler composition than a sugar has so far been detected. Nor is the nature of the first formed sugar certain; the general opinion has been that it is a simple hexose such as glucose or fructose, $C_6H_{12}O_6$. Brown and Morris in 1892 advanced strong reasons for thinking that cane-sugar, $C_{12}H_{22}O_{11}$, is the first carbohydrate synthesized, and that the hexoses found in the plant result from the decomposition of this. The whole story of the different sugars existing in the plant—their relations and their several functions—requires renewed investigation.

The first visible carbohydrate formed, one which appears so rapidly on the commencement of photosynthesis as to have been regarded as the first evidence of the setting up of the process, is starch. This is met with in the form of small granular specks in the substance of the chloroplast, specks which assume a blue colour when treated with a solution of iodine. Its very prompt appearance, as soon as the apparatus became active, led to the opinion formerly held, that the work of the latter was complete only when the starch was formed. We have seen that the starch is preceded by the formation of sugar, and its appearance is now interpreted as a sign of surplus manufacture. As much sugar as is produced in excess of the immediate requirements of the cell is converted into the insoluble form of starch by the plastids of the chlorophyll apparatus, and is so withdrawn from the sphere of action, thereby enabling the construction of further quantities of sugar to take place. The presence of too much sugar in solution in the sap of the cell inhibits the activity of the chloroplasts; hence the necessity for its removal. Starch, indeed, wherever it appears in the plant seems to be a reserve store of carbohydrate material, deposited where it is found for longer or shorter periods till it is needed for consumption. The readiness with which it is converted into sugar fits it especially to be a reserve or stored material.

Proteid Formation.—We have seen that it has been suggested that the chlorophyll apparatus may perhaps be concerned in the manufacture of proteids as well as of carbohydrates. If not, there must exist in the green plant, side by side with it, another mechanism which is concerned with the manufacture of the complex compounds in which nitrogen is present. The independence of the two is suggested by the fact that fungi can live, thrive and grow in nutritive media which contain carbohydrates together with certain salts of ammonia, but which are free from proteids. It is certain that their protoplasm cannot be nourished by inorganic compounds of nitrogen, any more than that of animals. We must therefore surmise their possession of a mechanism which can construct proteids, if supplied with these compounds of nitrogen together with sugar.

The probability is that this mechanism is to be found in green plants in the leaves—at any rate there is a certain body of evidence pointing in this direction. It may be, however, that there is no special mechanism, but that this power is a particular differentiation of a physiological kind, existing in all vegetable protoplasm, or in that of certain cells. The idea of an identity of protoplasm does not involve a denial of special powers developed in it in different situations, and the possession of such a power by the vegetable cell is not more striking than the location of the powers of co-ordination and thought in the protoplasm of cells of the human brain.

But if we accept either view we have still to examine the process of construction in detail, with a view to ascertaining the stages by which proteid is built up. Here unfortunately we find ourselves in the region of speculation and hypothesis rather than in that of fact. The nitrogen is absorbed by the plant in some form of combination from the soil. The green plant prefers as a rule nitrates of various metals, such as calcium, magnesium or potassium. The fungus seems to do better when supplied with compounds of ammonia. The nitrogen of the atmosphere is not called into requisition, except by a few plants and under special conditions, as will be explained later. The fate of these inorganic compounds has not been certainly traced, but they give rise later on to the presence in the plant of various amino acid amides, such as leucin, glycin, asparagin, &c. That these are stages on the way to proteids has been inferred from the fact that when proteids are split up by various means, and especially by the digestive secretions, these nitrogen-containing acids are among the products which result.

While we know little of the processes of proteid-construction, we are almost completely in the dark also as to what are the particular proteids which are first constructed.

Opinions are conflicting also as to the conditions under which proteids are formed. There is a certain amount of evidence that at any rate in some cases light is necessary, and that the violet rays of the spectrum are chiefly concerned. But the subject requires elucidation from both chemical and biological points of view.

The normal green plant is seen thus to be in possession of a complete machinery for the manufacture of its own food. The way in which such food when manufactured is incorporated into, and enabled to build up, the living substance is again hidden in obscurity. This is, however, also the case with the nutrition of animal protoplasm.

The building up and nutrition of the living substance by the foods manufactured or absorbed is properly spoken of as the assimilation of such food. Up to very recently the original absorption and subsequent treatment of the carbon dioxide and the compounds of nitrogen has been called by the same term. We frequently find the expression used, "the 'assimilation' of carbon dioxide, or of nitrogen." As this is not the incorporation of either into the living substance, but is only its manufacture into the complex substances which we find in the plant, it seems preferable to limit the term "assimilation" to the processes by which foods are actually taken into the protoplasm.

Symbiosis.—Though green plants thus possess a very complete mechanism for the manufacture of their different foodstuffs, it is not always exercised to the fullest extent. Many of them are known to supplement it, and some almost entirely to replace it, by absorbing the food they need in a fully prepared condition from their environment. It may be that they procure it from decomposing organic matter in the soil, or they may get it by absorption from other plants to which they attach themselves, or they may in rare cases obtain it by preying upon insect life. The power of green plants, not even specialized in any of these directions, to absorb certain carbohydrates, particularly sugars, from the soil was demonstrated by Acton in 1889. Similar observations have been made in the case of various compounds of nitrogen, though these have not been so complex as the proteids. It was formerly the custom to regard as parasites all those plants which inserted roots or root-like organs into the tissues of other plants and absorbed the contents of the latter. The most conspicuous case, perhaps, of all these is the mistletoe, which flourishes luxuriantly upon the apple, the poplar and other trees. Bonnier has drawn attention to the fact that the mistletoe in its turn, remaining green in the winter, contributes food material to its host when the latter has lost its leaves. The relationship thus existing he showed to be mutually beneficial, each at one time or another supplying the necessities of the other. Such a relationship is known as *symbiosis*, and the large majority of the cases of so-called parasitism among green plants can be referred to it. Bonnier showed that the same relationship could be proved in the cases of such plants as the rattle (*Rhinanthus*), the eye-bright (*Euphrasia*), and other members of the Natural Orders, Scrophulariaceae and Santalaceae, which effect a union between their roots and the roots of other plants growing near them. The union taking place underground, while the bulk of both partners in the symbiosis rises into the air, renders the association a little difficult to see, but there is no doubt that the plants in question do afford each other assistance, forming, as it were, a kind of partnership. The most pronounced case of parasitism, that of *Cuscuta*, the dodder, which infests particularly clover fields, appears to differ only in degree from those mentioned, for the plant, bare of leaves as it is, yet contains a little chlorophyll. The advantages it can offer to its host are, however, infinitesimal when compared with the injury it does it. Many other cases of symbiosis have been investigated with some completeness, especially those in which lower plants than the Phanerogams are concerned. The relations of the Alga and the Fungus, which have formed a close associationship in the structure known as the Lichen, were established many years ago. Since about 1880 our knowledge of the species which can enter into such relationships has been materially extended, and the fungal constituents of the Lichens are known to include Basidiomycetes as well as Ascomycetes.

Mycorhizas.—The most interesting cases, however, in which Fungi form symbiotic relationships with green plants have been discovered in connexion with forest trees. The roots of many of the latter, while growing freely in the soil are found to be surrounded with a dense feltwork of fungal mycelium, which sometimes forms a mass of considerable size. The plants showing it are not all forest trees, but include also some Pteridophytes and some of the prothallia of the Ferns, Club-mosses, Liverworts and Horsetails. The true nature of the relationship was first recognized by Pfeffer in 1877, but few cases were known till recent years. Very complete examination, however, has now been made of many instances, and the name *mycorhiza* has been given to the symbiotic union. Two classes are recognized. In the first, which are called *ectotropic*, the fungal filaments form a thick felt or sheath round the root, either completely enclosing it or leaving the apex free. They seldom penetrate the living cells, though they do so in a few cases. The root-hairs penetrate between masses of the hyphae of the Fungus. This type of mycorhiza is found among the Poplars, Oaks and Fir trees. The other type is called *endotropic*. The fungal filaments either penetrate the epidermis of the root, or enter it from the stem and ramify in the interior. Some make their way through the cells of the outer part of the cortex towards the root-tip, and form a mycelium or feltwork of hyphae, which generally occupies two or three layers of cells. From this branches pass into the middle region of the cortex and ramify through the interior half of its cells. They often cause a considerable hypertrophy of the tissue. From the outer cortical mycelium, again, branches pass through the epidermis and grow out in the soil. In such cases the roots of the plants are usually found spreading in soils which contain a large amount of humus, or decaying vegetable matter. The organic compounds of the latter are absorbed by the protruding fungal filaments, which take the place of root-hairs, the tree ceasing to develop the latter. The food so absorbed passes to the outer cortical mycelium, and from this to the inner hyphae, which appear to be the organs of the interchange of substance, for they are attracted to the neighbourhood of the nuclei of the cells, which they enter, and in which they form agglomerations of interwoven filaments. The prothalli of the Pteridophytes, which form similar symbioses, show a somewhat different mode of arrangement, the Fungi occupying the external or the lower layers of the thalloid body.

The discovery of the widespread occurrence of this mycorhizal symbiosis must be held to be one of the most important results of research upon the nutritive processes of plants during the closing decade of the 19th century. Among green plants the symbionts include Conifers, Orchids, Heaths, Oaks, Poplars and Beeches, though all do not derive equal advantages from the association. *Monotropas* afford an extreme case of it, having lost their chlorophyll almost entirely, and come to depend upon the Fungi for their nutriment. The fungal constituents vary considerably. Each species of green plant may form a mycorhiza with two or three different Fungi, and a single species of Fungus may enter into symbiosis with several green plants. The Fungi that have been discovered taking part in the union include *Eurotium*, *Pythium*, *Boletus*, *Agaricus*, *Lactarius*, *Penicillium* and many others of less frequent occurrence. All the known species belong to the Oomycetes, the Pyrenomycetes, the Hymenomycetes or the Gasteromycetes. The habit of forming mycorhizas is found more frequently in warm climates than cold; indeed, the percentage of the flora exhibiting this peculiarity seems to increase with a certain regularity from the Arctic Circle to the equator.

Fixation of Nitrogen.—Another, and perhaps an even more important, instance of symbiotic association has come to the front during the same period. It is an alliance between the plants of the Natural Order Leguminosae and certain bacterium-like forms which find a home within the tissues of their roots. The importance of the symbiosis can only be understood by considering the relationship in which plants stand with regard to the free nitrogen of the air. Long ago the view that this gas might be the source of the combined nitrogen found in different forms within the plant, was critically examined, particularly by Boussingault, and later by Lawes and Gilbert and by Pugh, and it was ascertained to be erroneous, the plants only taking nitrogen into their substance when it is presented to their roots in the form of nitrates of various metals, or compounds of ammonia. Many writers in recent years, among whom may be named especially Hellriegel and Wilfarth, Lawes and Gilbert, and Schlœsing and Laurent, have shown that the Leguminosae as a group form conspicuous exceptions to this rule. While they are quite capable of taking up nitrates from the soil where and so long as these are present, they can grow and thrive in soil which contains no combined nitrogen at all, deriving their supplies of this element in these cases from the air. The phenomena have been the subject of very careful and critical examination for many years, and may be regarded as satisfactorily established. The power of fixing atmospheric nitrogen by the higher plants seems to be confined to this solitary group, though it has been stated by various observers with more or less emphasis that it is shared by others. Frank has claimed to have found oats, buckbeans, spurry, turnips, mustard, potatoes and Norway maples exercising it; Nobbe and others have imputed its possession to *Elaeagnus*. There is little direct evidence pointing to this extension of the power, and many experimenters directly contradict the statements of Frank.

The power exercised by the Leguminosae is associated with the presence of curious tubercular swellings upon their roots, which are developed at a very early age, as they are cultivated in ordinary soil. If experimental plants are grown in sterilized soil, these swellings do not appear, and the plant can then use no atmospheric nitrogen. The swellings have been found to be due to a curious hypertrophy of the tissue of the part, the cells being filled with an immense number of minute bacterium-like organisms of V, X or Y shape. The development of these structures has been studied by many observers, both in England and on the continent of Europe. They appear to be present in large numbers in the soil, and to infect the Leguminous plant by attacking its root-hairs. One of these hairs can be seen to be penetrated at a particular spot, and the entering body is then found to grow along the length of the hair till it reaches the cortex of the root. It has the appearance of a delicate tube which has granular contents, and is provided with an apex that appears to be open. The wall of the tube is very thin and delicate, and does not seem to be composed of cellulose or any modification of it. Careful staining shows that the granular substance of the interior really consists of a large number of delicate rod-like bodies. As the tube grows down the hair it maintains its own independence, and does not fuse with the contents of the root-hair, whose protoplasm remains quite distinct and separate. After making its way into the interior, the intruder sets up a considerable hypertrophy of the tissue, causing the formation of a tubercle, which soon shows a certain differentiation, branches of the vascular bundles of the root being supplied to it. The rod-like bodies from the interior of the tube, which has considerable resemblance to the zoogloea of many Bacteria, are liberated into the interior of the cells of the tubercle and fill it, increasing by a process of branching and fission. When this stage is reached the invading tubes and their ramifications frequently disappear, leaving the cells full of the bacterioids, as they have been called. When the root dies later such of these as remain are discharged into the soil, and are then ready to infect new plants. In some cases the zoogloea thread or tube has not been seen, the organism consisting entirely of the bacterioids.

This peculiar relationship suggests at once a symbiosis, the Fungus gaining its nutriment mainly or entirely from the green plant, while the latter in some way or other is able to utilize the free nitrogen of the air. The exact way in which the utilization or *fixation* of the nitrogen is effected remains undecided. Two views are still receiving certain support, though the second of them appears the more probable. These are: (1) That the green plant is so stimulated by the symbiotic association which leads to the hypertrophy, that it is able to fix the nitrogen or cause it to enter into combination. (2) That the fixation of the gas is carried out by the fungal organism either in the soil or in the plant, and the nitrogenous substance so produced is absorbed by the organism, which is in turn consumed by the green plant. Certain evidence which supports this view will be referred to later.

Whichever opinion is held on this point, there seems no room for doubt that the fixation of the nitrogen is concerned only with the root, and that the green leaves take no part in it. The nodules, in particular, appear to play the important part in the process. Marshall Ward has directed attention to several points of their structure which bear out this view. They are supplied with a regular system of conducting vascular bundles communicating with those of the roots. Their cells during the period of incubation of the symbiotic organism are abundantly supplied with starch. The cells in which the fungoid organism is vigorously flourishing are exceedingly active, showing large size, brilliant nuclei, protoplasm and vacuole, all of which give signs of intense metabolic activity. The sap in these active tissues is alkaline, which has been interpreted as being in accordance with Lœw's suggestion that the living protoplasm in presence of an alkali and free nitrogen can build up ammonium nitrate, or some similar body. It is, however, at present entirely unknown what substances are formed at the expense of the atmospheric nitrogen.

The idea that the atmospheric nitrogen is gradually being made use of by plants, although it is clearly not easily or commonly utilized, has been growing steadily. Besides the phenomena of the symbiosis just discussed, certain experiments tend to show that we have a constant fixation of this gas in the soil by various Bacteria. Researches which have been carried out since 1885 by Berthelot, Andrée, Laurent and Schlœsing, and more recently by Kossowitsch, seem to establish the fact, though the details of the process remain undiscovered. Berthelot imputes it to the action of several species of soil Bacteria and Fungi, including the Bacterium of the Leguminosae, when the latter is cultivated free from its ordinary host. Laurent and Schlœsing affirm that the free nitrogen of the air can be fixed by a number of humble green plants, principally lowly green Algae. They must be exposed freely to light and air during the process, or they fail to effect it. Frank has stated that *Penicillium cladiosporioides* can flourish in a medium to which no nitrogen but that of the atmosphere has access. Kossowitsch claims to have proved that fixation of nitrogen takes place under the influence of a symbiosis of certain Algae and soil Bacteria, the process being much facilitated by the presence of sugar. The Algae include *Nostoc*, *Cystococcus*, *Cylindrospermum* and a few other forms. In the symbiosis the Algae are supplied with nitrogen by the bacteria, and in turn they construct carbohydrate material, part of which goes to the microbes. This is supported by the fact that if the mixed culture is placed in the light there is a greater fixation than when it is left in darkness. If there is a plentiful supply of carbon dioxide, more nitrogen is fixed.

Nitrification and Denitrification in the Soil.—Another aspect of the nitrogen question has been the subject of much investigation and controversy since 1877. The round of changes which nitrogenous organic matter undergoes in the soil, and how it is ultimately made use of again by plants, presents some curious features. We have seen that when nitrogenous matter is present in the condition of humus, some plants can absorb it by their roots or by the aid of mycorhizas. But the changes in it in the usual course of nature are much more profound than these. It becomes in the soil the prey of various microbes. Ammonia appears immediately as a product of the disruption of the nitrogen-containing organic molecule. Later, oxidation processes take place, and the ammonia gives rise to nitrates, which are absorbed by plants. These two processes go on successively rather than simultaneously, so that it is only towards the end of the decomposition of the organic matter that nitrification of the ammonia which is formed is set up. In this process of nitrification we can distinguish two phases, first the formation of nitrites, and secondly their oxidation to nitrates. The researches of Warington in England and Winogradsky on the Continent have satisfactorily shown that two distinct organisms are concerned in it, and that probably more than one species of each exists. One of them comprising the genera *Nitrosomonas* and *Nitrosococcus*, has the power of oxidizing salts of ammonium to the condition of compounds of nitrous acid. When in a pure culture this stage has been reached no further oxidation takes place. The oxidation of the nitrites into nitrates is effected by another organism, much smaller than the first. The name *Nitrobacter* has been given to this genus, most of our knowledge of which is due to the researches of Winogradsky.

The two kinds of organism are usually both present in the same soil, those of the second type immediately oxidizing the nitrites which those of the first form from ammonium salts. The *Nitrobacter* forms not only cannot oxidize the latter bodies, but they are very injuriously affected by the presence of free ammonia. When cultivated upon a suitable nutritive material in the laboratory, the organism was killed by the presence of ·015 % of this gas, and seriously inconvenienced by one-third as much. Except in this respect, however, the two classes show great similarity. A very interesting peculiarity attaching to them is their distaste for organic nutriment. They can be cultivated most readily on masses of gelatinous silica impregnated with the appropriate compounds of nitrogen, and their growth takes place most copiously in the absence of light. They need a little carbonate in the nutrient material, and the source of the carbon which is found in the increased bulk of the plant is partly that and partly the carbon dioxide of the air.

We have in these plants a power which appears special to them, in the possession of some mechanism for the construction of organic substance which differs essentially from the chlorophyll apparatus of green plants, and yet brings about substantially similar results. The steps by which this carbon dioxide is built up into a compound capable of being assimilated by the protoplasm of the cells are not known. The energy for the purpose appears to be supplied by the oxidation of the molecules containing nitrogen, so that it is dependent upon such oxidation taking place. Winogradsky has investigated this point with great care, and he has come to the conclusion that about 35 milligrammes of nitrogen are oxidized for each milligramme of carbon absorbed and fixed.

Deposition and Digestion of Reserve Materials in Plants and Animals.—As we have seen, the tendency of recent research is to prove the identity of the mode of nutrition of vegetable and animal organisms. The material on which they feed is of the same description and its treatment in the body is precisely similar. In both groups we find the presence of nutritive material in two forms, one specially fitted for transport, the other for storage. We have seen that in the plant the processes of construction go on in the seats of manufacture faster than those of consumption. We have the surplus sugar, for instance, deposited as starch in the chloroplasts themselves. The manufacture goes on very actively so long as light shines upon the leaves, and we find towards night a very great surplus stored in the cells. This excess of manufacture is one of the features of plant life, and is exhibited, though in various degrees, by all green plants. The accumulated material is made to minister to the need of the plant in various ways; it may be by increasing the bulk of the plant, as by the formation of the wood of the trunk, branches and roots; or it may be by laying up a store of nutritive materials for purposes of propagation, as in tubers, corms, seeds, &c. In any case the surplus is continuously being removed from the seats of its construction and deposited for longer or shorter periods in other parts of the structure, usually near the regions at which its ultimate consumption will take place. We have the deposition of starch, aleurone grains, amorphous proteids, fats, &c., in the neighbourhood of growing points, cambium rings and phellogens; also the more prolonged storage in tubers, seeds and other reproductive bodies. Turning to the animal, we meet with similar provisions in the storage of glycogen in the liver and other parts, of fat in various internal regions, and so on. In both we find the reserve of food, so far as it is in excess of immediate need, existing in two conditions, the one suitable for transport, the other for storage, and we see continually the transformation of the one into the other. The formation of the storage form at the expense of the travelling stream is due to the activity of some protoplasmic structure—it may be a plastid or the general protoplasm of the cell—and is a process of secretion. The converse process is one of a true digestion, which deserves the name no less because it is intracellular. We find processes of digestion strictly comparable to those of the alimentary canal of an animal in the case of the insectivorous *Nepenthes*, *Drosera* and other similar plants, and in the saprophytic Fungi. Those which now concern us recall the utilization of the glycogen of the liver, the stored fats and proteids of other parts of the animal body being like them intracellular.

Enzymes.—The agents which effect the digestive changes in plants have been studied with much care. They have been found to be mainly enzymes, which are in many cases identical with those of animal origin. A vast number of them have been discovered and investigated, and the majority call for a brief notice. Their number, indeed, renders it necessary to classify them, and rather to look at groups of them than to examine them one by one. They are usually classified according to the materials on which they work, and we may here notice especially four principal groups, the members of which take part in the digestion of reserve materials as well as in the processes of external digestion. These decompose respectively carbohydrates, glucosides, proteids and fats or oils. The action of the enzyme in nearly every case is one of hydration, the body acted on being made to take up water and to undergo a subsequent decomposition.

Among those which act on carbohydrates the most important are: the two varieties of *diastase*, which convert starch into maltose or malt sugar; *inulase*, which forms fructose from inulin; *invertase*, which converts cane sugar into glucose (grape sugar) and fructose; *glucase* or *maltase*, which produces grape sugar from maltose; and *cytase*, which hydrolyses cellulose. Another enzyme which does not appear to be concerned with digestion so directly as the others is *pectase*, which forms vegetable jelly from pectic substances occurring in the cell-wall.

The enzymes which act upon glucosides are many; the best known are *emulsin* and *myrosin*, which split up respectively *amygdalin*, the special glucoside of certain plants of the Rosaceae; and *sinigrin*, which has a wide distribution among those of the Cruciferae. Others of less frequent occurrence are *erythrozym*, *rhamnase* and *gaultherase*.

The proteolytic enzymes, or those which digest proteids, are usually divided into two groups, one which breaks down ordinary proteids into diffusible bodies, known as peptones, which are themselves proteid in character. Such an enzyme is the *pepsin* of the stomach of the higher animals. The other group attacks these peptones and breaks them down into the amino-acids of which we have spoken before. This group is represented by the *erepsin* of the pancreas and other organs. A third enzyme, the *trypsin* of the pancreas, possesses the power of both pepsin and erepsin. The relationships existing between these enzymes are still the subjects of experiment, and we cannot regard them as exhaustively examined. It is not quite certain whether a true pepsin exists in plants, but many trypsins have been discovered, and one form of erepsin, at least, is very widespread. Among the trypsins we have the *papäin* of the Papaw fruit (*Carica Papaya*), the *bromelin* of the Pine-apple, and the enzymes present in many germinating seeds, in the seedlings of several plants, and in other parts. Another enzyme, *rennet*, which in the animal body is proteolytic, is frequently met with in plants, but its function has not been ascertained.

The digestion of fat or oil has not been adequately investigated, but its decomposition in germinating seeds has been found to be due to an enzyme, which has been called *lipase*. It splits it into a fatty acid and glycerine, but seems to have no further action. The details of the further transformations have not yet been completely followed.

Oxidases.—Another class of enzymes has been discovered in both animals and plants, but they do not apparently take any part in digestion. They set up a process of oxidation in the substances which they attack, and have consequently been named *oxidases*. Very little is known about them.

In many cases the digestion of reserve food materials is effected by the direct action of the protoplasm, without the intervention of enzymes. This property of living substance can be proved in the case of the cells of the higher plants, but it is especially prominent in many of the more lowly organisms, such as the Bacteria. The processes of putrefaction may be alluded to as affording an instance of such a power in the vegetable organisms. At the same time it must be remembered that the secretion of enzymes by Bacteria is of widespread occurrence.

Supply and Distribution of Energy in Plants.—It is well known that one of the conditions of life is the maintenance of the process which is known as *respiration*. It is marked by the constant and continuous absorption of a certain quantity of oxygen and by the exhalation of a certain volume of carbon dioxide and water vapour. There is no direct connexion between the two, the oxygen is absorbed almost immediately by the protoplasm, and appears to enter into some kind of chemical union with it. The protoplasm is in a condition of instability and is continually breaking down to a certain extent, giving rise to various substances of different degrees of complexity, some of which are again built up by it into its own substances, and others, more simple in composition, are given off. Of these carbon dioxide and water are the most prominent. These respiratory processes are associated with the liberation of energy by the protoplasm, energy which it applies to various purposes. The assimilation of complex foods consequently may be regarded as supplying the protoplasm with a potential store of energy, as well as building up its substance. Whenever complex bodies are built up from simple ones we have an absorption of energy in some form and its conversion into potential energy; whenever decomposition of complex bodies into simpler ones takes place we have the liberation of some or all of the energy that was used in their construction.

Since about 1880 considerable attention has been directed to the question of the supply, distribution and expenditure of energy in the vegetable kingdom. This is an extremely important question, since the supply of energy to the animal world has been found to depend entirely upon the vegetable one. The supply of energy to the several protoplasts which make up the body of a plant is as necessary as is the transport to them of the food they need; indeed, the two things are inseparably connected. The source of energy which is the only one accessible to the ordinary plant as a whole is the radiant energy of the rays of the sun, and its absorption is mainly due to the properties of chlorophyll. This colouring matter, as shown by its absorption spectrum, picks out of the ordinary beam of light a large proportion of its red and blue rays, together with some of the green and yellow. This energy is obtained especially by the chloroplastids, and part of it is at once devoted to the construction of carbohydrate material, being thus turned from the kinetic to the potential condition. The other constructive processes, which are dependent partly upon the oxidation of the carbohydrates so formed, and therefore upon an expenditure of part of such energy, also mark the storage of energy in the potential form. Indeed, the construction of protoplasm itself indicates the same thing. Thus even in these constructive processes there occurs a constant passage of energy backwards and forwards from the kinetic to the potential condition and vice versa. The outcome of the whole round of changes, however, is the fixation of a certain part of the radiant energy absorbed by the chlorophyll. The rays of the visible spectrum do not supply all the energy which the plant obtains. It has been suggested by several botanists, with considerable plausibility, that the ultra-violet or chemical rays can be absorbed and utilized by the protoplasm without the intervention of any pigment such as chlorophyll. There is some evidence pointing to the existence of this power in the cells of the higher plants. Again, we have evidence of the power of plants to avail themselves of the heat rays. There is, no doubt, a direct interchange of heat between the plant and the air, which in many cases results in a gain of heat by the plant. Indeed, the tendency to absorb heat in this way, either from the air or directly from the sunlight, has already been pointed out as a danger which needs to be averted by transpiration.

There is probably but little transformation of one form of kinetic energy into another in the plant. It has been suggested that the red pigment *Anthocyan*, which is found very commonly in young developing shoots, petioles and midribs, effects a conversion of light rays into heating ones, so facilitating the metabolic processes of the plant. This is, however, rather a matter of speculation. The various electrical phenomena of plants also are obscure.

Certain plants possess another source of energy which is common to them and the animal world. This is the absorption of elaborated compounds from their environment, by whose decomposition the potential energy expended in their construction can be liberated. Such a source is commonly met with among the Fungi, the insectivorous plants, and such of the higher plants as have a saprophytic habit. This source is not, however, anything new, for the elaborated compounds so absorbed have been primarily constructed by other plants through the mechanism which has just been described.

The question of the distribution of this stored energy to the separate protoplasts of the plant can be seen to be the same problem as the distribution of the food. The material and the energy go together, the decomposition of the one in the cell setting free the other, which is used at once in the vital processes of the cell, being in fact largely employed in constructing protoplasm or storing various products. The actual liberation in any cell is only very gradual, and generally takes the form of heat. The metabolic changes in the cells, however, concern other decompositions side by side with those which involve the building up of protoplasm from the products of which it feeds. So long as food is supplied the living substance is the seat of transformations which are continually proceeding, being partially decomposed and again constructed, the new food being incorporated into it. The changes involve a continual liberation of energy, which in most cases is caused by the respiration of the protoplasm and the oxidation of the substances it contains. The need of the protoplasm for oxygen has already been spoken of: in its absence death soon supervenes, respiration being stopped. Respiration, indeed, is the expression of the liberation of the potential energy of the protoplasm itself. It is not certain how far substances in the protoplasm are directly oxidized without entering into the composition of the living substance, though this appears to take place. Even their oxidation, however, is effected by the protoplasm acting as an oxygen carrier.

The supply of oxygen to a plant is thus seen to be as directly connected with the utilization of the energy of a cell as is that of food concerned in its nutrition. If the access of oxygen to a protoplast is interfered with its normal respiration soon ceases, but frequently other changes supervene. The partial asphyxiation or suffocation stimulates the protoplasm to set up a new and perhaps supplementary series of decompositions, which result in the liberation of energy just as do those of the respiratory process. One of the constant features of respiration—the exhalation of carbon dioxide—can still be observed. This comes in almost all such cases from the decomposition of sugar, which is split up by the protoplasm into alcohol and carbon dioxide. Such decompositions are now generally spoken of as *anaërobic* respiration. The decomposition of the complex molecule of the sugar liberates a certain amount of energy, as can be seen from the study of the fermentation set up by yeast, which is a process of this kind, in that it is intensified by the absence of oxygen. The liberated energy takes the form of heat, which raises the temperature of the fermenting wort. It has been ascertained that in many cases this decomposition is effected by the secretion of an enzyme, which has been termed *zymase*. This body has been prepared from active yeast, and from fruits and other parts which have been kept for some time in the absence of oxygen. The protoplasm appears to be able also to bring about the change without secreting any enzyme.

Expenditure of Energy by Plants.—The energy of the plant is, as we have seen, derived originally from the kinetic radiant energy of the sun. In such cells as are capable of absorbing it, by virtue of their chlorophyll apparatus, the greater part of it is converted into the potential form, and by the transport from cell to cell of the compounds constructed every part of the plant is put into possession of the energy it needs. The store of energy thus accumulated and distributed has to subserve various purposes in the economy of the plant. A certain part of it is devoted to the maintenance of the framework of the fabric of the cell, and the construction of a continuously increasing skeleton; part is used in maintaining the normal temperature of the plant, part in constructing various substances which are met with in the interior, which serve various purposes in the working of the vital mechanism. A great part again is utilized in that increase of the body of the plant which we call growth.

Growth, as usually spoken of, includes two essentially different processes. The first of these, which may be regarded as growth proper, is the manufacture of additional quantities of living substance. The second, which is usually included in the term, is the increase of such accessories of living substance as are necessary for its well-being. These include cell walls and the various stored products found in growing cells. There is clearly a difference between these two categories. The formation of living substance is a process of building up from simple or relatively simple materials; the construction of its cellulose framework and supporting substance is done by the living substance after its own formation is completed, and is attended by a partial decomposition of such living substance.

Growth is always going on in plants while they are alive. Even the oldest trees put out continually new leaves and twigs. It does not, of course, follow that increase of bulk is always conspicuous; in such trees death is present side by side with life, and the one often counterbalances the other. As, however, we can easily see that the constructive processes are much greater than those which lead to the disappearance of material from the plant-body, there is generally to be seen a conspicuous increase in the substance of the plant. This is, in nearly all cases, attended by a permanent change in form. This is not perhaps so evident in the case of axial organs as it is in that of leaves and their modifications, but even in them it can be detected to a certain extent.

In the lowliest plants growth may be co-extensive with the plant-body; in all plants of any considerable size, however, it is localized in particular regions, and in them it is associated with the formation of new protoplasts or cells. These regions have been called *growing points*. In such stems and roots as increase in thickness there are other growing regions, which consist of cylindrical sheaths known as *cambium layers* or *phellogens*. By the multiplication of the protoplasts in these merismatic areas the substance of the plant is increased. In other words, as these growing regions consist of cells, the growth of the entire organ or plant will depend upon the behaviour of the cells or protoplasts of which the merismatic tissues are composed.

The growth of such a cell will be found to depend mainly upon five conditions: (1) There must be a supply of nutritive or plastic materials, at the expense of which the increase of its living substance can take place, and which supply the needed potential energy. (2) There must be a supply of water to such an extent as to set up a certain hydrostatic pressure in the cell, for only turgid cells can grow. (3) The supply of water must be associated with the formation of osmotic substances in the cell, or it cannot be made to enter it. (4) The cell must have a certain temperature, for the activity of a protoplast is only possible within certain limits, which differ in the case of different plants. (5) There must be a supply of oxygen to the growing cell, for the protoplast is dependent upon this gas for the performance of its vital functions, and particularly for the liberation of the energy which is demanded in the constructive processes. This is evident from the consideration that the growth of the cells is attended by the growth in surface of the cell wall, and as the latter is a secretion from the protoplasm, such a decomposition cannot readily take place unless oxygen is admitted to it.

When these conditions are present, the course of the growth of a cell appears to be the following: The young cell, immediately it is cut off from its fellow, absorbs water, in consequence of the presence in it of osmotically active substances. With the water it takes in the various nutritive substances which the former contains in solution. There is set up at once a certain hydrostatic pressure, due to the turgidity which ensues upon such absorption, and the extensible cell wall stretches, at first in all directions. The growth or increase of the protoplasm at the expense of the nutritive matter for a time keeps pace with the increased size of the cell, but by and by it becomes vacuolated as more and more water is attracted into the interior. Eventually the protoplasm usually forms only a lining to the cell wall, and a large vacuole filled with cell sap occupies the centre. The growth of the protoplasm, though considerable, is therefore not commensurate with the increase in the size of the cell. The stretching of the cell wall by the hydrostatic pressure is fixed by a secretion of new particles and their deposition upon the original wall, which as it becomes slightly thicker is capable of still greater extension, much in the same way as a thick band of india-rubber is capable of undergoing greater stretching than a thin one. The increase in surface of the cell wall is thus due—firstly to the stretching caused by turgidity, and secondly to the formation and deposition of new substance upon the old. When the limit of extensibility is reached the cell wall increases in thickness from the continuation of the latter of the two processes.

The rate of growth of a cell varies gradually throughout its course; it begins slowly, increases to a maximum, and then becomes slower till it stops. The time during which these regular changes in the rate can be observed is generally spoken of as the *grand period of growth*.

If we consider the behaviour of a growing organ such as a root, we find that, like a cell, it shows a grand period of growth. Just behind its apex the cells are found to be all in process of active division. Growth is small, and consists mainly in an increase of the quantity of protoplasm, for the cells divide again as soon as they have reached a certain size. As new cells are continually formed in the merismatic mass those which are farthest from the apex gradually cease to divide and a different process of growth takes place in them, which is associated more particularly with the formation of the vacuoles, consequent upon the establishment of considerable hydrostatic pressure in them, thus causing the bulk of the cells to be greatly enlarged. Here it is that the actual extension in length of the root takes place, and the cells reach the maximum point of the grand period. They then gradually lose the power of growth, the oldest ones or those farthest from the apex parting with it first, and they pass gradually over into the condition of the permanent tissues.

The same order of events may be ascertained to take place in the stem; but in this region it is complicated by the occurrence of nodes and internodes, growth in length being confined to the latter, many of which may be growing simultaneously. The region of growth in the stem is, as a rule, much longer than that of the root. The growth of the leaf is at first apical, but this is not very prolonged, and the subsequent enlargement is due to an intercalary growing region near the base.

The turgidity in the cells of a growing member is not uniform, but shows a fairly rhythmical variation in its different parts. If the member is one which shows a difference of structure on two sides, such as a leaf, the two sides frequently show a difference of degree of turgidity, and consequently of rate of growth. If we consider a leaf of the common fern we find that in its young condition it is closely rolled up, the upper or ventral surface being quite concealed. As it gets older it gradually unfolds and expands into the adult form. This is due to the fact that while young the turgidity and consequent growth are greater in the dorsal side of the leaf, so that it becomes rolled up. As it develops the maximum turgidity and growth change to its upper side, and so it becomes unfolded or expanded. These two conditions are generally described under the names of *hyponasty* and *epinasty* respectively.

Cylindrical organs may exhibit similar phenomena. One side of a stem may be more turgid than the opposite one, and the maximum turgidity, with its consequent growth, may alternate between two opposite sides. The growing apex of such a stem will alternately incline, first to one side and then to the other, exhibiting a kind of nodding movement in the two directions. More frequently the region of maximum turgidity passes gradually round the growing zone. The apex in this case will describe a circle, or rather a spiral, as it is elongating all the time, pointing to all points of the compass in succession. This continuous change of position has been called *circumnutation*, and is held to be universal in all growing cylindrical organs. The passage of the maximum turgidity round the stem may vary in rapidity in different places, causing the circle to be replaced by an ellipse. The bending to two sides alternately, described above, often called *simple nutation*, may be regarded as only an extreme instance of the latter.

Nervous System of Plants.—So far we have considered the plant almost exclusively as an individual organism, carrying out its own vital processes, and unaffected by its surroundings except in so far as these supply it with the materials for its well-being. When we consider, however, the great variability in those surroundings and the consequent changes a plant must encounter, it appears obvious that interaction and adjustment between the plant and its environment must be constant and well balanced. That such adjustment shall take place postulates on the part of the plant a kind of perception or appreciation of the changing conditions which affect it.

Careful examination soon shows an observer that such perceptions exist, and that they are followed by certain purposeful changes in the plant, sometimes mechanical, sometimes chemical, the object being evidently to secure some advantage for the plant, to ward off some danger, or to extricate it from some difficulty. We may speak, indeed, of the plant as possessed of a rudimentary nervous system, by the aid of which necessary adjustments are brought about. The most constantly occurring changes that beset a plant are connected with illumination, temperature, moisture, and contact with foreign bodies. Setting aside other susceptibilities, we have evidence that most plants are sensitive to all these.

If a growing stem receives stronger illumination on one side than another, its apex slowly turns from the vertical in the direction of the light source, continuing its change of position until it is in a direct line with the incident rays. If a root is similarly illuminated, a similar change of direction of growth follows, but in this case the organ grows away from the light. These movements are spoken of as *heliotropic* and *apheliotropic* curvatures. The purpose of the movements bears out the contention that the plant is trying to adjust itself to its environment. The stem, by pointing directly to the light source, secures the best illumination possible for all of its leaves, the latter being distributed symmetrically around it. The root is made to press its way into the darker cracks and crannies of the soil, so bringing its root-hairs into better contact with the particles round which the hygroscopic water hangs. Leaves respond in another way to the same influence, placing themselves across the path of the beam of light.

Similar sensitivenesses can be demonstrated in other cases. When a root comes in contact at its tip with some hard body, such as might impede its progress, a curvature of the growing part is set up, which takes the young tip away from the stone, or what-not, with which it is in contact. When a sensitive tendril comes into contact with a foreign body, its growth becomes so modified that it twines round it. Many instances might be given of appreciation of and response to other changes in the environment by the growing parts of plants; among them we may mention the opening and closing of flowers during the days of their expansion. One somewhat similar phenomenon, differing in a few respects, marks the relation of the plant to the attraction of gravity. Observation of germinating seedlings makes it clear that somehow they have a perception of direction. The young roots grow vertically downwards, the young stems vertically upwards. Any attempt to interfere with these directions, by placing the seedlings in abnormal positions, is frustrated by the seedlings themselves, which change their direction of growth by bringing about curvatures of the different parts of their axes, so that the root soon grows vertically downward again and the stem in the opposite direction. Other and older plants give evidence of the same perception, though they do not respond all in the same way. Speaking generally, stems grow upwards and roots downwards. But some stems grow parallel to the surface of the soil, while the branches both of stems and roots tend to grow at a definite angle to the main axis from which they come. These movements are spoken of as different kinds of *geotropic* curvatures. This power of perception and response is not by any means confined to the growing organs, though in these it is especially striking, and plays a very evident part in the disposition of the growing organs in advantageous positions. It can, however, be seen in adult organs, though instances are less numerous.

When the pinnate leaf of a *Mimosa pudica*, the so-called sensitive plant, is pinched or struck, the leaf droops rapidly and the leaflets become approximated together, so that their upper surfaces are in contact. The extent to which the disturbance spreads depends on the violence of the stimulation—it may be confined to a few leaflets or it may extend to all the leaves of the plant.

The leaves and leaflets of many plants, *e.g.* the telegraph plant, *Desmodium gyrans*, behave in a similar way under the stimulus of approaching darkness.

A peculiar sensitiveness is manifested by the leaves of the so-called insectivorous plants. In the case of *Dionaea muscipula* we find a two-lobed lamina, the two lobes being connected by a midrib, which can play the part of a kind of hinge. Six sensitive hairs spring from the upper surface of the lobes, three from each; when one of these is touched the two lobes rapidly close, bringing their upper surfaces into contact and imprisoning anything which for the moment is between them. The mechanism is applied to the capture of insects alighting on the leaf.

Drosera, another of this insectivorous group, has leaves which are furnished with long glandular tentacles. When these are excited by the settling of an insect on the leaf they slowly bend over and imprison the intruder, which is detained there meanwhile by a sticky excretion poured out by the glands.

In both these cases the stimulation is followed, not only by movement, but by the secretion of an acid liquid containing a digestive juice, by virtue of which the insect is digested after being killed.

The purposeful character of all these movements or changes of position indicates that they are of nervous origin. We have in them evidence of two factors, a perception of some features of the environment and following this, after a longer or shorter interval, a response calculated to secure some advantage to the responding organ. We find on further investigation that these two conditions are traceable to different parts of the organs concerned. The perception of the changes, or, in other words, the reception of the stimulus, is associated for example, with the tips of roots and the apices of stems. The first recognition of a specially receptive part was made by Charles Darwin, who identified the perception of stimulation with the tip of the young growing root. Amputation of this part involved the cessation of the response, even when the conditions normally causing the stimulation were maintained. Francis Darwin later demonstrated that the tips of the plumules of grasses were sensitive parts. The responding part is situated some little distance farther back, being in fact the region where growth is active. This bending part has been proved to be insensitive to the stimuli. There is consequently a transmission of the stimulus from the sensitive organ to a kind of motor mechanism situated some little way off. We find thus three factors of a nervous mechanism present, a receptive, a conducting, and a responding part. The differentiation of the plant's substance so indicated is, however, physiological only; there is no histological difference between the cells of these regions that can be associated with the several properties they possess. Even the root tip, which shows a certain differentiation into root cap and root apex, cannot be said to be a definite sense organ in the same way as the sense organs of an animal. The root is continually growing and so the sensitive part is continually changing its composition, cells being formed, growing and becoming permanent tissue. The cells of the tip at any given moment may be sensitive, but in a few days the power of receiving the stimulus has passed to other and younger cells which then constitute the tip. The power of appreciating the environment is therefore to be associated with the protoplasm only at a particular stage of its development and is transitory in its character.

What the nature of the stimulation is we are not able to say. The protoplasm is sensitive to particular influences, perhaps of vibration, or of contact or of chemical action. We can imagine though perhaps only vaguely, the way in which light, temperature, moisture, contact, &c., can affect it. The perception of direction or the influence of gravity presents greater difficulty, as we have no clear idea of the form which the force of gravity takes. Recently some investigations by Haberlandt, Noll, Darwin and others have suggested an explanation which has much to recommend it. The sensitive cells must clearly be influenced in some way by weight—not the weight of external organs but of some weight within them. This may possibly be the cell sap in their interior, which must exercise a slightly different hydrostatic pressure on the basal and the lateral walls of the cells. Or more probably it may be the weight of definite particulate structures in their vacuoles. Many experiments point to certain small grains of starch which are capable of displacement as the position of the cell is altered. Such small granules have been observed in the sensitive cells, and there is an evident correlation between these and the power of receiving the geotropic stimulus. It has been shown that if the organ containing them is shaken for some time, so that the contact between them and the protoplasm of the cells is emphasized, the stimulus becomes more efficient in producing movement. This reduces the stimulus to one of contact, which is in harmony with the observations made upon roots similarly stimulated from the exterior. The stimulating particles, whether starch grains in all cases, or other particles as well, have been termed *statoliths*.

We have spoken of the absence of structural differentiation in the sense organs. There is a similar difficulty in tracing the paths by which the impulses are transmitted to the growing and curving regions. The conduction of such stimulation to parts removed some distance from the sense organ suggests paths of transmission comparable to those which transmit nervous impulses in animals. Again, the degree of differentiation is very slight anatomically, but delicate protoplasmic threads have been shown to extend through all cell-walls, connecting together all the protoplasts of a plant. These may well serve as conductors of nervous impulses. The nervous mechanism thus formed is very rudimentary, but in an organism the conditions of whose life render locomotion impossible great elaboration would seem superfluous. There is, however, very great delicacy of perception or appreciation on the part of the sense organ, stimuli being responded to which are quite incapable of impressing themselves upon the most highly differentiated animal.

The power of response is seen most easily in the case of young growing organs, and the parts which show the motor mechanism are mainly the young growing cells. We do not find their behaviour like that of the motor mechanism of an animal. The active contraction of muscular tissue has no counterpart in the plant. The peculiarity of the protoplasm in almost every cell is that it is especially active in the regulation of its permeability by water. Under different conditions it can retain it more strongly or allow it to escape more freely. This regulation of turgor is as characteristic of vegetable protoplasm as contraction is of muscle. The response to the stimulus takes the form of increasing the permeability of particular cells of the growing structures, and so modifying the degree of the turgidity that is the precursor of growth in them. The extent of the area affected and of the variation in the turgor depends upon many circumstances, but we have no doubt that in the process of modifying its own permeability by some molecular change we have the counterpart of muscular contractibility.

The response made by the adult parts of plants, to which reference has been made, is brought about by a mechanism similar in nature though rather differently applied. If the leaf of *Mimosa* or *Desmodium* be examined, it will be seen that at the base of each leaflet and each leaf, just at the junction with the respective axes, is a swelling known as a *pulvinus*. This has a relatively large development of succulent parenchyma on its upper and lower sides. In the erect position of the leaf the lower side has its cells extremely turgid, and the pulvinus thus forms a cushion, holding up the petiole. On stimulation these cells part with their water, the lower side of the organ becomes flaccid and the weight of the leaf causes it to fall. The small pulvini of the leaflets, by similar changes of the distribution of turgidity, take up their respective positions after receiving the stimulus. In some cases the two sides of the pulvini vary their turgidity in turns; in others only the lower side becomes modified.

Similar turgescence changes, taking place with similar rapidity in the midrib of the leaf of *Dionaea*, explain the closing of the lobes upon their hinge. More slowly, but yet in the same way, we may note the change in turgidity of certain cells of the *Drosera* tentacles, as they close over the imprisoned insect.

Organic Rhythm.—It is a remarkable fact that during the process of growth we meet with rhythmic variation of such turgidity. The existence of rhythm of this kind has been observed and studied with some completeness. It is the immediate cause of the phenomena of circumnutation, each cell of the circumnutating organ showing a rhythmic enlargement and decrease of its dimensions, due to the admission of more and less water into its interior. The restraint of the protoplasm changes gradually and rhythmically. The sequence of the phases of the rhythm of the various cells are co-ordinated to produce the movement. Nor is it only in growing organs that the rhythm can be observed, for many plants exhibit it during a much longer period than that of growth. It is easy to realize how such a rhythm can be modified by the reception of stimuli, and can consequently serve as the basis for the movement of the stimulated organ. This rhythmic affection of vegetable protoplasm can be observed in very many of its functions. What have been described as "periodicities," such as the daily variations of root-pressure, afford familiar instances of it. It reminds us of a similar property of animal protoplasm which finds its expression in the rhythmic beat of the heart and other phenomena.

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Pathology of Plants

"Phytopathology" or plant pathology (Gr. φυτόν, plant), comprises our knowledge of the symptoms, course, causes and remedies of the maladies which threaten the life of plants, or which result in abnormalities of structure that are regarded, whether directly injurious or not to life, as unsightly or undesirable. In its systematized form, as a branch of botanical study, it is of recent date, and, as now understood, the subject first received special attention about 1850, when the nature of parasitism began to be intelligible; but many disjointed references to diseased conditions of plants had appeared long before this. The existence of blights and mildews of cereals had been observed and recorded in very ancient times, as witness the Bible, where half a dozen references to such scourges occur in the Old Testament alone. The epidemic nature of wheat-rust was known to Aristotle about 350 B.C., and the Greeks and Romans knew these epidemics well, their philosophers having shrewd speculations as to causes, while the people held characteristic superstitions regarding them, which found vent in the dedication of special festivals and deities to the pests. Pliny knew that flies emerge from galls. The few records during the middle ages are borne out by what is known of famines and pestilence. Shakespeare's reference in *King Lear* (Act III., sc. iv.) may be quoted as evincing acquaintance with mildew in the 17th century, as also the interesting Rouen law of Loverdo (1660). Malpighi in 1679 gave excellent figures and accounts of leaf-rolling and gall insects, and Grew in 1682 equally good descriptions of a leaf-mining caterpillar. During the 18th century more academic treatment of the subject began to replace the scattered notes. Hales (1727–1733) discussed the rotting of wounds, cankers, &c., but much had to be done with the microscope before any real progress was possible, and it is easily intelligible that until the theory of nutrition of the higher plants had been founded by the work of Ingenhouss, Priestley and De Saussure, the way was not even prepared for accurate knowledge of cryptogamic parasites and the diseases they induce. It was not till De Bary (1866) made known the true nature of parasitic Fungi, based on his researches between 1853–1863, that the vast domain of epidemic diseases of plants was opened up to fruitful investigation, and such modern treatises as those of Frank (1880 and 1895), Sorauer (1886), Kirchner (1890), were gradually made possible.

Plant pathology embraces several branches of study, and may be conveniently divided as follows:—

1. The observation and accurate description of symptoms (*Diagnosis*).
2. The study of causes or agencies inducing disease (*Aetiology*).
3. The practise of preventive and remedial measures (*Therapeutics*).

In plants, however, the *symptoms of disease* are apt to exhibit themselves in a very general manner. Our perceptions differentiate but imperfectly symptoms which are due to very different causes and reactions, probably because the organization of the plant is so much less highly specialized than that of higher animals. The yellowing and subsequent casting of leaves, for instance, is a very general symptom of disease in plants, and may be induced by drought, extremes of temperature, insufficient or excessive illumination, excess of water at the roots, the action of parasitic Fungi, insects, worms, &c., or of poisonous gases, and so forth; and extreme caution is necessary in dealing with amateur descriptions of such symptoms, especially when the untrained eye has taken no cognisance of, or has only vaguely observed, the numerous collateral circumstances of the case.

The *causes of disease* may be provisionally classified somewhat as follows, but it may be remarked at the outset that no one of these proximal causes, or agents, is ever solely responsible; and it is very easy to err in attributing a diseased condition to any of them, unless the relative importance of primary and subordinate agencies is discoverable. For instance, a Fungus epidemic is impossible unless the climatic conditions are such as to favour the dispersal and germination of the spores; and when plants are killed off owing to the supersaturation of the soil with water, it is by no means obvious whether the excess of water and dissolved materials, or the exclusion of oxygen from the root-hairs, or the lowering of the temperature, or the accumulation of foul products of decomposition should be put into the foreground. In every case there are chains of causation concerned, and the same factors will be differently grouped in different cases.

Bearing in mind these precautions, we may classify the proximal causal agents of disease as—

I.—External agencies.
  A. Non-living.
    a. Material.
      1. Physical—
        Soil.
        Water.
        Atmosphere.
      2. Chemical—
        Soil.
        Water.
        Atmosphere.
    b. Non-material.
      1. Temperature.
      2. Illumination.
      3. Other agencies.
  B. Living.
    a. Animals.
      1. Vertebrata.
      2. Invertebrata.
    b. Plants.
      1. Phanerogams.
      2. Cryptogams.
II.—Internal agencies.

While such a classification may serve its purpose as a sort of index, it must be confessed that the limits of its usefulness are soon reached. In the first place, the so-called "internal causes" of disease is probably a mere phrase covering our ignorance of the factors at work, and although a certain convenience attaches to the distinction between those cases where tender breeds of plants apparently exhibit internal predisposition to suffer more readily than others from parasites, low temperatures, excessive growth, &c.—as is the case with some grafted plants, cultivated hybrids, &c.—the mystery involved in the phrase "internal causes" only exists until we find what action of the living or non-living environment of the essential mechanism of the plant has upset its equilibrium.

I.—Passing to the recognized *external agencies*, the physical condition of the *soil* is a fruitful source of disease. If too closely packed, the soil particles present mechanical obstacles to growth; if too retentive of moisture, the root-hairs suffer, as already hinted; if too open or over-drained, the plant succumbs to drought. All those properties of soil known as texture, porosity, depth, inclination to the horizon, &c., are concerned here. Many maladies of plants are traceable to the chemical composition of soils—*e.g.* deficiency of nutritive salts, especially nitrates and phosphates; the presence of poisonous salts of iron, copper, &c., or (in the soil about the roots of trees in towns) of coal-gas and so forth. But it is worthy of special attention that the mere chemical composition of agricultural and garden soils is, as a rule, the least important feature about them, popular opinion to the contrary notwithstanding. Ordinary soils will almost always provide the necessary chemical ingredients if of proper physical texture, depth, &c. (see FUNGI and BACTERIOLOGY).

As regards *water*, its deficiency or excess is a relative matter, and although many of the minor maladies of pot-plants in windows and greenhouses controlled by amateurs depend on its misuse, water alone is probably never a primary cause of disease. Its over-supply is, however, a frequent cause of predisposition to the attacks of parasitic Fungi—*e.g.* the damping off of seedlings—and in saturated soils not only are the roots and root-hairs killed by asphyxiation, but the whole course of soil fermentation is altered, and it takes time to "sweeten" such by draining, because not only must the noxious bodies be gradually washed out and the lost salts restored, but the balance of suitable bacterial and fungal life must be restored.

The *atmosphere* is a cause of disease in the neighbourhood of chemical works, large towns, volcanoes, &c., in so far as it carries acid gases and poisons to the leaves and roots; but it is usual to associate with it the action of excessive humidity which brings about those tender watery and more or less etiolated conditions which favour parasitic Fungi, and diminish transpiration and therefore nutrition. It is customary to speak of the disastrous effects of cold winds, snow, hail and frost, lightning, &c., under the heading of atmospheric influences, which only shows once more how impossible it is to separate causes individually.

Turning to the *non-material external agents*, probably no factors are more responsible for ill-health in plants than *temperature* and *light.* Every plant is constrained to carry out its functions of germination, growth, nutrition, reproduction, &c., between certain limits of temperature, and somewhere between the extremes of these limits each function finds an optimum temperature at which the working of the living machinery is at its best, and, other things being equal, any great departure from this may induce pathological conditions; and many disasters are due to the failure to provide such suitable temperatures—*e.g.* in greenhouses where plants requiring very different optimum temperatures and illumination are kept together. Equally disastrous are those climatic or seasonal changes which involve temperatures in themselves not excessive but in wrong sequence; how many more useful plants could be grown in the open in the United Kingdom if the deceptively mild springs were not so often followed by frosts in May and June! The indirect effects of temperature are also important. Trees, of which the young buds are "nipped" by frost, would frequently not suffer material injury, were it not that the small frost-cracks serve as points of entry for Fungi; and numerous cases are known where even high temperatures can be endured on rich, deep, retentive soils by plants which at once succumb to drought on shallow or non-retentive soils.

All chlorophyll plants require *light*, but in very different degrees, as exemplified even in the United Kingdom by the shade-bearing beech and yew contrasted with the light-demanding larch and birch; and as with temperature so with light, every plant and even every organ has its optimum of illumination. The "drawn" or etiolated condition of over-shaded plants is a case in point, though here again the soft, watery plant often really succumbs to other disease agents—*e.g.* parasitic Fungi—supervening on its non-resistant condition.

Animals and plants as agents of disease or injury form part of the larger subject of the struggle for existence between living organisms, as is recognized even by those who do not so readily apprehend that diseased conditions in general are always signs of defeat in the struggle for existence between the suffering organism and its environment, living and non-living.

The Vertebrata come within the scope of our subject, chiefly as destructive agents which cause wounds or devour young shoots and foliage, &c. Rabbits and other burrowing animals injure roots, squirrels and birds snip off buds, horned cattle strip off bark, and so forth. It is among the Invertebrata that epidemics of destruction are referred to, though we should bear in mind that it is only the difference in numerical proportion that prevents our speaking of an epidemic of elephants or of rabbits, though we use the term when speaking of blight insects; there is little consistency in the matter, as it is usual to speak of an invasion or scourge of locusts, caterpillars, &c. Insect injuries are very varied in degree and in kind. Locusts devour all before them; caterpillars defoliate the plant, and necessitate the premature utilization of its reserves; other insects (*e.g. Grapholitha*) eat the buds or the roots (*e.g.* wire-worms), and so maim the plant that its foliage suffers from want of water and assimilation is diminished, or actual withering follows. Many aphides, &c., puncture the leaves, suck out the sap, and induce various local deformations, arrest of growth, pustular swellings, &c., and if numerous all the evils of defoliation may follow. Others (*e.g.* miners) tunnel into the leaf parenchyma, and so put the assimilating areas out of action in another way. It should be remembered that a single complete defoliation of a herbaceous annual may so incapacitate the assimilation that no stores are available for seeds, tubers, &c., for another year, or at most so little that feeble plants only come up. In the case of a tree matters run somewhat differently; most large trees in full foliage have far more assimilatory surface than is immediately necessary, and if the injury is confined to a single year it may be a small event in the life of the tree, but if repeated the cambium, bud-stores and fruiting may all suffer. Many larvae of beetles, moths, &c., bore into bark, and injure the cambium, or even the wood and pith; in addition to direct injury, the interference with the transpiration current and the access of other parasites through the wounds are also to be feared in proportion to the numbers of insects at work. Various local hypertrophies, including galls, result from the increased growth of young tissues irritated by the punctures of insects, or by the presence of eggs or larvae left behind. They may occur on all parts, buds, leaves, stems or roots, as shown by the numerous species of *Cynips* on oak, *Phylloxera* on vines, &c. The local damage is small, but the general injury to assimilation, absorption and other functions, may be important if the numbers increase. In addition to insects, various kinds of worms, molluscs, &c., are sometimes of importance as pests. The so-called eel-worms (*Nematodes*) may do immense damage on roots and in the grains of cereals, and every one knows how predatory slugs and snails are. (See ECONOMIC ENTOMOLOGY.)

Plants as agents of damage and disease may be divided into those larger forms which as weeds, epiphytes and so forth, do injury by dominating and shading more delicate species, or by gradually exhausting the soil, &c., and true parasites which actually live on and in the tissues of the plants. It must be remembered that phanerogams also include parasitic species—*e.g. Cuscuta, Loranthus, Viscum, Thesium, Rhinanthus,* &c.—with various capacities for injury. These enemies are as a rule so conspicuous that we do not look on their depredations as diseases, though the gradual deterioration of hay under the exhausting effects of root-parasites like *Rhinanthus*, and the onslaught of *Cuscuta* when unduly abundant, should teach us how unimportant to the definition the question of size may be.

It is, however, among the Fungi that we find the most disastrous and elusive agents of disease. *Parasitic Fungi* may be, as regards their direct action, purely local—*e.g.* *Schinzia*, which forms gall-like swellings on the roots of rushes; *Gymnosporangium*, causing excrescences on juniper stems; numerous leaf Fungi such as *Puccinia*, *Aecidium*, *Septoria*, &c., causing yellow, brown or black spots on leaves; or *Ustilago* in the anthers of certain flowers. In such cases the immediate damage done may be slight; but the effects of prolonged action and the summation of numerous attacks at numerous points are often enormous, certain of these leaf-diseases costing millions sterling annually to some planting and agricultural communities. In other cases the Fungus is virulent and rampant, and, instead of a local effect, exerts a general destructive action throughout the plant—*e.g.* *Pythium*, which causes the "damping off" of seedlings, reducing them to a putrid mass in a few hours, and *Phytophthora*, the agent of the potato disease. Many Fungi, in themselves not very aggressive, slowly bring about important and far-reaching secondary effects. Thus, many Hymenomycetes (Agarics, Polyporei, &c.) live on the wood of trees. This wood is in great part already dead substance, but the mycelium gradually invades the vessels occupied with the transmission of water up the trunk, cuts off the current, and so kills the tree; in other cases such Fungi attack the roots, and so induce rot and starvation of oxygen, resulting in "fouling." Numerous Fungi, though conspicuous as parasites, cannot be said to do much individual injury to the host. The extraordinary malformations known as "Witches' Brooms," caused by the repeated branching and tufting of twigs in which the mycelium of *Exoascus* (on birch) or *Aecidium* (on silver fir) are living, may be borne in considerable numbers for years without any very extensive apparent injury to the tree. Again, the curious distortions on the stems of nettles attacked by the *Aecidium* form of the heteroecious *Puccina Caricis* (see FUNGI for Heteroecism), or on maize stems and leaves attacked by *Ustilago Maydis*, or on the inflorescence of crucifers infested with *Cystopus*, &c., are not individually very destructive; it is the cumulative effects of numerous attacks or of extensive epidemics which eventually tell. Some very curious details are observable in these cases of malformation. For instance, the *Aecidium elatinum* first referred to causes the new shoots to differ in direction, duration and arrangement, and even shape of foliage leaves from the normal; and the shoots of *Euphorbia* infected with the aecidia of *Uromyces Pisi* depart so much from the normal in appearance that the attacked plants have been taken for a different species. Similarly with *Anemone* infested with *Puccinia* and *Vaccinium* with *Calyptospora*, and many other cases of deformations due to hypertrophy or atrophy. Instances of what we may term tolerated parasitism, where the host plant seems to accommodate itself very well to the presence of the Fungus, paying the tax it extorts and nevertheless not succumbing but managing to provide itself with sufficient material to go on with, are not rare; and these seem to lead to those cases where the mutual accommodation between host and guest has been carried so far that each derives some benefit from the association—symbiosis (see FUNGI).

II. The *kinds of disease* due to these various agencies are very different. A plant may be diseased as a whole, because nearly all its tissues are in a morbid or pathological condition, owing to some Fungus pervading the whole—*e.g.* *Pythium* in seedlings—or to a poison diffusing from cell to cell; in the case of unicellular plants—*e.g.* an alga infested with a *Chytridium*—indeed, matters can hardly be otherwise. But the case is obviously different where a plant dies because some essential organ or tissue tract has been destroyed, and other parts have suffered because supplies are cut off—*e.g.* when the upper parts of a tree die off owing to destruction of the roots, or to the ringing of the stem lower down, and consequent interference with the transpiration current. In a large number of cases, however, the disease is purely local, and does not itself extend far into the organ or tissue affected.

If a mass of living plant-tissue is cut, the first change observed is one of colour: the white "flesh" of a potato or an apple turns brown as the air enters, and closer examination shows that cell walls and contents are alike affected. The cut cells die, and oxidized products are concerned in the change of colour, the brown juices exuding and soaking into the cell-walls. The next change observable after some hours is that the untouched cells below the cut grow larger, push up the dead surface, and divide by walls tangential to it, with the formation of tabloid cork-cells. The layer of cork thus formed cuts out the dead débris and serves to protect the uninjured cells below. Such healing by cork formation is accompanied by a rise of temperature: the active growth of the dividing cells is accompanied by vigorous metabolism and respiration, and a state of "wound fever" supervenes until the healing is completed. The phenomena described occur in all cases of cicatrization of wounds in nature—*e.g.* leaf-tissue, young stems, roots, &c., when cut or pierced by insects, thorns and so forth. They are concerned in the occlusion of broken twigs and of falling leaves, and it is from the actively growing "callus" developed at the surface of the wounded tissues of cuttings, buddings, prunings, &c., that the healing and renewal of tissues occur of which advantage is taken in the practice of what might well be termed plant surgery. A third phenomenon observable in such healing tissues is the increased flow and accumulation of plastic materials at the seat of injury. The enhanced metabolism creates a current of draught on the supplies of available food-stuffs around. The phenomenon of irritability here concerned is well shown in certain cases where a parasitic organism gains access to a cell—*e.g.* *Pleotrachelus* causes the invaded *Pilobolus* to swell up, and changes the whole course of its cell metabolism, and similarly with *Plasmodiophora* in the roots of turnips, and many other cases.

Irritation and hypertrophy of cells are common signs of the presence of parasites, as evinced by the numerous malformations, galls, witches'-brooms, &c., on diseased plants. The now well-known fact that small doses of poisonous substances may act as stimuli to living protoplasm, and that respiratory activity and growth may be accelerated by chloroform, ether and even powerful mineral poisons, such as mercuric chloride, in minimal doses, offers some explanation of these phenomena of hypertrophy, "wound fever," and other responses to the presence of irritating agents. Still further insight is afforded by our increasing knowledge of the enzymes, and it is to be remarked that both poisons and enzymes are very common in just such parasitic Fungi as induce discolorations, hypertrophies and the death of cells—*e.g.* *Botrytis*, *Ergot*, &c. Now it is clear that if an organism gains access to all parts of a plant, and stimulates all or most of its cells to hypertrophy, we may have the latter behaving abnormally—*i.e.* it may be diseased throughout; and such actually occurs in the case of *Euphorbia* pervaded with *Uromyces Pisi*, the presence of which alters the whole aspect of the host-plant. If such a general parasite carries its activities farther, every cell may be killed and the plant forthwith destroyed—*e.g.* *Phytophthora* in potatoes. If, on the other hand, the irritating agent is local in its action, causing only a few cells to react, we have the various pimples, excrescences, outgrowths, &c., exhibited in such cases as *Ustilago Maydis* on the maize, various galls, witches'-brooms, &c.

It must not be overlooked that the living cells of the plant react upon the parasite as well as to all external agencies, and the nature of disease becomes intelligible only if we bear in mind that it consists in such altered metabolism—deflected physiology—as is here implied. The reaction of the cells may be in two directions, moreover. For instance, suppose the effect of a falling temperature is to so modify the metabolism of the cells that they fill up more and more with watery sap; as the freezing-point is reached this may result in destructive changes, and death from cold may result. If, on the contrary, the gradual cooling is met by a corresponding depletion of the cells of water, even intense cold may be sustained without injury.

Or, take another case. If the attack of a parasite is met by the formation of some substance in the protoplasm which is chemotactically repulsive to the invader, it may be totally incapable of penetrating the cell, even though equipped with a whole armoury of cytases, diastatic and other enzymes, and poisons which would easily overcome the more passive resistances offered by mere cell-walls and cell-contents of other plants, the protoplasm of which forms bodies chemotactically attractive to the Fungus.

The various *degrees of parasitism* are to a certain extent explained by the foregoing. In order that a Fungus may enter a plant, it must be able to overcome not merely the resistance of cell-walls, but that of the living protoplasm; if it cannot do this, it must remain outside as a mere epiphyte, *e.g.* *Fumago*, *Herpotrichia*, &c., or, at most, vegetate in the intercellular spaces and anchor itself to the cell-walls, *e.g.* *Trichosphaeria*. The inability to enter the cells may be due to the lack of chemotactic bodies, to incapacity to form cellulose-dissolving enzymes, to the existence in the host-cells of antagonistic bodies which neutralize or destroy the acids, enzymes or poisons formed by the hyphae, or even to the formation and excretion of bodies which poison the Fungus. But even when inside it does not follow that the Fungus can kill the cell, and many cases are known where the Fungus can break through the cell's first lines of defence (cell-wall and protoplasmic lining); but the struggle goes on at close quarters, and various degrees of hypertrophy, accumulation of plastic bodies or secretions, discolorations, &c., indicate the suffering of the still living cell. Finally, cases occur where the invaded cell so adapts itself to the presence of the intruder that life in common—symbiosis—results.

The *dissemination* of plant parasites is favoured by many circumstances not always obvious, whence an air of mystery regarding epidemics was easily created in earlier times. The spores of Rusts, Erysipheae and other Fungi may be conveyed from plant to plant by snails; those of tree-killing polyporei, &c., by mice, rabbits, rats, &c., which rub their fur against the hymenophores. Bees carry the spores of *Sclerotinia* as they do the pollen of the bilberries, and flies convey the conidia of ergot from grain to grain. Insects, indeed, are largely concerned in disseminating Fungi, either on their bodies or via the alimentary canal. Worms bring spores to the surface of soil, ducks and other birds convey them on their muddy feet, and, as is well-known, wind and other physical agencies are very efficient in dissemination. The part played by man also counts for much. Gardeners and farm labourers convey spores from one bed or field to another; carted soil, manure, &c., may abound in spores of Smuts, *Fusarium*, Polyporei and in sclerotia; and articles through the post and so forth often carry infective spores. Every time a carpenter saws fresh timber with a saw recently put through wood attacked with dry-rot, he risks infecting it with the Fungus; and similarly in pruning, in propagating by cuttings, &c.

The annual losses due to epidemic plant diseases attain proportions not easily estimated. As regards money value alone the following figures may serve in illustration. In 1882 the United States was calculated to have lost £40,000,000 to £60,000,000 from insect and other pests. The wheat-rust costs Australia £2,000,000 to £3,000,000 annually, and in 1891 alone the loss which Prussia suffered from grain-rusts was estimated at £20,000,000 sterling.

The terrible losses sustained by whole communities of farmers, planters, foresters, &c., from plant diseases have naturally stimulated the search for remedies, but even now the search is too often conducted in the spirit of the believer in quack medicines, although the agricultural world is awakening to the fact that before any measures likely to be successful can be attempted, the whole chain of causation of the disease must be investigated. Experience with epidemics, dearly bought in the past, has shown that one fruitful cause is the laying open to the inroads of some Fungus or insect, hitherto leading a quiet endemic life in the fields and forests, large tracts of its special food, along which it may range rampant without check to its dispersal, nutrition and reproduction. Numerous wild hypotheses as to changes in the constitution of the host-plant, leading to supposed vulnerability previously non-existent, would probably never have seen the light had the full significance of the truth been grasped that an epidemic results when the external factors favour a parasite somewhat more than they do the host. It may be that in particular cases particular modes of cultivation disfavour the host; or that the soil, climate or seasons do so; but overwhelming evidence exists to show that the principal causes of epidemics reside in circumstances which favour the spread, nutrition and reproduction of the pest, and the lesson to be learnt is that precautions against the establishment of such favouring conditions must be sought. Nevertheless, epidemics occur, and practical measures are devised to meet the various cases and to check the ravages already begun. The procedure consists in most cases in spraying the affected plants with poisonous solutions or emulsions, or in dusting them with fungicidal or insecticidal powders, or applying the fumes of lethal gases. For the composition of the numerous liquids and powders special works must be consulted, but the following principles apply generally. The poison must not be strong enough to injure the roots, leaves, &c., of the host-plant, or allowed to act long enough to bring about such injury. Care and intelligence are especially needed with certain insecticides such as poisonous gases, or the operators may suffer. It is worse than useless to apply drastic remedies if the main facts of the life-history of the pest are not known; *e.g.* the application of ordinary antiseptic powders to leaves inside which a Fungus, such as a *Uredo* or *Ustilago*, is growing can only result in failure, and similarly if tobacco fumes, for instance, are applied when the insects concerned are hibernating in the ground beneath. Such applications at the moment when spores are germinating on the leaves, *e.g.* *Peronospora*, or to the young mycelia of epiphytic parasites, *e.g.* *Erysiphe*, or the steeping in hot water of thoroughly ripe hard grains to which spores are attached, *e.g.* *Ustilago*, and filling a greenhouse with hydrocyanic acid gas when young insects are commencing their ravages, *e.g.* Red-spider—all these and similar procedures timed to catch the pest at a vulnerable stage are intelligent and profitable prophylactic measures, as has been repeatedly shown. Numerous special methods of preventing the spread of Fungi, or the migrations of insects, or of trapping various animals; of leaving infested ground fallow, or of growing another crop useless to the pest, &c., are also to be found in the practical treatises. More indirect methods, such as the grafting of less resistant scions on more vigorous stocks, of raising special late or early varieties by crossing or selection, and so on, have also met with success; but it must be understood that "resistant" in such cases usually means that some peculiarity of quick growth, early ripening or other life-feature in the plant is for the time being taken advantage of. Among the most interesting modern means of waging war against epidemic pests is that of introducing other epidemics among the pests themselves—*e.g.* the infection of rats and mice with disease bacilli, or of locusts with insect-killing Fungi, and signs of the successful carrying out of such measures are not wanting. That the encouragement of insectivorous birds has been profitable is well established, and it is equally well-known that their destruction may lead to disastrous insect plagues.

Diseases and Symptoms.—The symptoms of plant diseases are, as already said, apt to be very general in their nature, and are sometimes so vaguely defined that little can be learned from them as to the causes at work. We may often distinguish between primary symptoms and secondary or subordinate symptoms, but for the purposes of classification in an article of this scope we shall only attempt to group the various cases under the more obvious signs of disease exhibited.

1. *Discolorations* are among the commonest of all signs that a plant is "sickly" or diseased. The principal symptom may show itself in general pallor, including all cases where the normal healthy green hue is replaced by a sickly yellowish hue indicating that the chlorophyll apparatus is deficient. It may be due to insufficient illumination (*Etiolation*), as seen in geraniums kept in too shaded a situation, and is then accompanied by soft tissues, elongation of internodes, leaves usually reduced in size, &c. The laying of wheat is a particular case. False etiolation may occur from too low a temperature, often seen in young wheat in cold springs. Cases of pallor due to too intense illumination and destruction of chlorophyll must also be distinguished. *Chlorosis* is a form of pallor where the chlorophyll remains in abeyance owing to a want of iron, and can be cured by adding ferrous salts. Lack of other ingredients may also induce chlorotic conditions. Yellowing is a common sign of water-logged roots, and if accompanied by wilting may be due to drought. Over-transpiration in bright wintry weather, when the roots are not absorbing, often results in yellowing. In other cases the presence of insects, Fungi or poisons at the roots may be looked for. *Albinism*, with which variegated foliage may be considered, concerns a different set of causes, still obscure, and usually regarded as internal, though experiments go to show that some variegations are infectious.

2. *Spotted Leaves, &c.*—Discoloured spots or patches on leaves and other herbaceous parts are common symptoms of disease, and often furnish clues to identification of causes, though it must be remembered that no sharp line divides this class of symptoms from the preceding. By far the greater number of spot-diseases are due to Fungi, as indicated by the numerous "leaf-diseases" described, but such is by no means always the case. The spot or patch is an area of injury; on (or in) it the cell-contents are suffering destruction from shading, blocking of stomata, loss of substance or direct mechanical injury, and the plant suffers in proportion to the area of leaf surface put out of action. It is somewhat artificial to classify these diseases according to the colour of the spots, and often impossible, because the colour may differ according to the age of the part attacked and the stage of injury attained; many Fungi, for instance, induce yellow spots which become red, brown or black as they get older, and so on. White or grey spots may be due to *Peronospora*, *Erysiphe*, *Cystopus*, *Entyloma* and other Fungi, the mycelium of which will be detected in the discoloured area; or they may be scale insects, or the results of punctures by Red-spider, &c. Yellow spots, and especially bright orange spots, commonly indicate Rust Fungi or other Uredineae; but *Phyllosticta*, *Exoascus*, *Clasterosporium*, *Synchytrium*, &c., also induce similar symptoms. Certain Aphides, Red-spider, Phylloxera and other insects also betray their presence by such spots. It is a very common event to find the early stages of injury indicated by pale yellow spots, which turn darker, brown, red, black, &c., later, *e.g.* *Dilophia*, *Rhytisma*, &c. Moreover, variegations deceptively like these disease spots are known, *e.g.* *Senecio Kaempferi*. Red spots may indicate the presence of Fungi, *e.g.* *Polystigma*, or insects, *e.g.* *Phytoptus*. Brown spots are characteristic of *Phytophthora*, *Puccinia*, &c., and black ones of *Fusicladium*, *Ustilago*, *Rhytisma*, &c. Both are common as advanced symptoms of destruction by Fungi and insects. Brilliantly coloured spots and patches follow the action of acid fumes on the vegetation near towns and factories, and such particoloured leaves often present striking resemblance to autumn foliage. Symptoms of scorching owing to abnormal insolation—*e.g.* in greenhouses where the sun's rays are concentrated on particular spots—and a certain class of obscure diseases, such as "silver-leaf" in plums, "foxy leaves" in various plants, may also be placed here.

3. *Wounds.*—The principal phenomena resulting from a simple wound, and the response of the irritated cells in healing by cork and in the formation of callus, have been indicated above. Any clean cut, fracture or bruise which injures the cambium over a limited area is met with the same response. The injured cells die and turn brown; the living cells beneath grow out, and form cork, and under the released pressure bulge outwards and repeatedly divide, forming a mass of succulent regenerative tissue known as *callus*. Living cells of the pith, phloem, cortex, &c., may also co-operate in this formation of regenerative tissue, and if the wound is a mere knife-cut in the "bark," the protruding lips of callus formed at the edges of the wound soon meet, and the slit is healed over—occluded. If a piece of bark and cortex are torn off, the occlusion takes longer, because the tissues have to creep over the exposed area of wood; and the same is true of a transverse cut severing the branch, as may be seen in any properly pruned tree. Wounds may be artificially grouped under such heads as the following: Burrows and excavations in bark and wood due to boring insects, especially beetles. Breakages and abrasions due to wind, snow, lightning, and other climatic agents. Cuts, breakages, &c., due to man and other vertebrate animals. Erosions of leaves and herbaceous parts by caterpillars, slugs, earwigs and so forth. Frost-cracks, scorching of bark by sun and fire, &c., and

wounds due to plants which entwine, pierce or otherwise materially injure trees, &c., on a large scale.

4. *Excrescences.*—Outgrowths, more or less abnormal in character, are frequent signs of diseased organs. They are due to hypertrophy of young tissues, which may undergo profound alterations subsequently, and occur on all parts of the plants. The injury which initiates them may be very slight in the first place—a mere abrasion, puncture or Fungus infection—but the minute wound or other disturbance, instead of healing over normally, is frequently maintained as a perennial source of irritation, and the regenerative tissues grow on month after month or year after year, resulting in extraordinary outgrowths often of large size and remarkable shape. Excrescences may be divided into those occurring on herbaceous tissues, of which *Galls* are well-known examples, and those found on the woody stem, branches, &c., and themselves eventually woody, of which *Burrs* of various kinds afford common illustrations. Among the simplest examples of the former are the hairs which follow the irritation of the cells by mites. These hairs often occur in tufts, and are so coloured and arranged that they were long taken for Fungi and placed in the "genus" *Erineum.*

Cecidia or galls arise by the hypertrophy of the subepidermal cells of a leaf, cortex, &c., which has been pierced by the ovipositor of an insect, and in which the egg is deposited. The irritation set up by the hatching egg and its resulting larva appears to be the stimulus to development, and not a poison or enzyme injected by the insect. The extraordinary forms, colours and textures of the true galls have always formed some of the most interesting of biological questions, for not only is there definite co-operation between a given species of insect and of plant, as shown by the facts that the same insect may induce galls of different kinds on different plants or organs, while different insects induce different galls on the same plant—*e.g.* the numerous galls on the oak—but the gall itself furnishes well adapted protection and abundant stores of nutriment to its particular larva, and often appears to be borne without injury to the plant. This latter fact is no doubt due to the production of an excess of plastic materials over and above what the tree requires for its immediate needs. Galls in the wide sense—technically *Cecidia*—are not always due to insects. The nodules on the roots of leguminous plants are induced by the presence of a minute organism now known to do no injury to the plant. Those on turnips and other Cruciferae are due to the infection of *Plasmodiophora*, a dangerously parasitic Myxomycete. Nodules due to "eel-worms" (Nematodes) are produced on numerous classes of plants, and frequently result in great losses—*e.g.* tomatoes, cucumbers, &c.; and the only too well known Phylloxera, which cost France and other vine-growing countries many millions sterling, is another case in point. Fungus-galls on leaves and stems are exemplified by the "pocket-plums" caused by the *Exoasceae*, the black blistering swellings of *Ustilago Maydis*, the yellow swellings on nettles due to *Aecidium*, &c.

In many cases the swellings on leaves are minute, and may be termed *pustules*—*e.g.* those due to *Synchytrium*, *Protomyces*, *Cystopus*, many Ustilagineae, &c. These cases are not easily distinguished superficially from the pustular outgrowth of actual mycelia and spores (stromata) of such Fungi as *Nectria*, *Puccinia*, &c. The cylindrical stem-swellings due to *Calyptospora*, *Epichloe*, &c., may also be mentioned here, and the tyro may easily confound with these the layers and cushions of eggs laid on similar organs by moths. There is a class of gall-like or pustular outgrowths for which no external cause has as yet been determined, and which are therefore often ascribed to internal causes of disease. Such are the cork-warts on elms, maples, &c., and the class of outgrowths known as *Intumescences.* Recent researches point to definite external conditions of moisture, affecting the processes of respiration and transpiration, &c., as being responsible for some of these. The "scab" of potatoes is another case in point. Frost blisters are pustular swellings due to the up-growth of callus-tissue into cavities caused by the uprising of the superficial cortex under the action of intense cold.

Turning now to outgrowths of a woody nature, the well-known *burrs* or "knaurs," so common on elms and other trees are cases in point. They are due to some injury—*e.g.* bruising by a cartwheel, insects—having started a callus on which adventitious buds arise, or to the destruction of buds at an early stage. Then, stores of food-material being accumulated at the injured place, other buds arise at the base of or around the injured one. If matters are propitious to the development of these buds, then a tuft of twigs is formed and no burr; but if the incipient twigs are also destroyed at an early stage, new buds are again formed, and in larger numbers than before, and the continued repetition of these processes leads to a sort of conglomerate woody mass of fused bud-bases, not dead, but unable to grow out, and thus each contributing a crowded portion of woody material as it slowly grows. There are many varieties of burrs, though all woody outgrowths of old trees are not to be confounded with them, *e.g.* the "knees" of *Taxodium*, &c. Many typical burrs might be described as witches'-brooms, with all the twigs arrested to extremely short outgrowths. Witches'-brooms are the tufted bunches of twigs found on silver firs, birches and other trees, and often present resemblances to birds' nests or clumps of mistletoe if only seen from a distance. They are branches in which a perennial Fungus (*Aecidium*, *Exoascus*, &c.) has obtained a hold. This Fungus stimulates the main twig to shoot out more twigs than usual; the mycelium then enters each incipient twig and stimulates it to a repetition of the process, and so in the course of years large broom-like tufts result, often markedly different from the normal.

But undoubtedly the most important of the woody excrescences on trees are *cankers.* A canker is the result of repeated frustrated attempts on the part of the callus to heal up a wound. If a clean cut remains clean, the cambium and cortical tissues soon form callus over it, and in this callus—regenerative tissue—new wood, &c., soon forms, and if the wound was a small one, no trace is visible after a few years. But the occluding callus is a mass of delicate succulent cells, and offers a dainty morsel to certain insects—*e.g.* Aphides—and may be easily penetrated by certain Fungi such as *Peziza*, *Nectria*; and when thus attacked, the repeated conflicts between the cambium and callus, on the one hand, trying to heal over the wound, and the insect or Fungus, on the other, destroying the new tissues as they are formed, results in irregular growths; the still uninjured cambium area goes on thickening the branch, the dead parts, of course, remain unthickened, and the portion in which the Fungus is at work may for the time being grow more rapidly. Such cankers often commence in mere insect punctures, frosted buds, cracks in the cortex, &c., into which a germinating spore sends its hypha. The seriousness of the damage done is illustrated by the ravages of the larch disease, apple canker, &c.

5. *Exudations and Rotting.*—The outward symptoms of many diseases consist in excessive discharges of moisture, often accompanied by bursting of over-turgid cells, and eventually by putrefactive changes. Conditions of hyper-turgescence are common in herbaceous plants in wet seasons, or when overcrowded and in situations too moist for them. This unhealthy state is frequently combined with etiolation: what is termed rankness is a particular case, and if the factors concerned are removed by drainage, weeding out, free transpiration, &c., no permanent harm may result. With seedlings and tender plants, however, matters are frequently complicated by the onslaughts of Fungi—*e.g. Pythium*, *Peronospora*, *Completoria*, *Volutella*, *Botrytis*, &c. That such over-turgescence should lead to the bursting of fleshy fruits, such as gooseberries, tomatoes and grapes, is not surprising, nor can we wonder that fermentation and mould Fungi rapidly spread in such fruits; and the same is true for bulbs and herbaceous organs generally. The rotting of rhizomes, roots, &c., also comes into this category; but while it is extremely difficult in given cases to explain the course of events in detail, certain Fungi and bacteria have been so definitely associated with these roots—*e.g.* beet-rot, turnip disease, wet-rot of potatoes—that we have to consider each case separately. It is, of course, impossible to do this here, but I will briefly discuss one or two groups of cases.

Honey-dew.—The sticky condition of leaves of trees—*e.g.* lime—in hot weather is owing to exudations of sugar. In many cases the punctures of Aphides and Coccideae are shown to be responsible for such exudations, and at least one instance is known where a Fungus—*Claviceps*—causes it. But it also appears that honey-dew may be excreted by ordinary processes of over-turgescence pressing the liquid through water-pores, as in the tropical *Caesalpinia*, *Calliandra*, &c. That these exudations on leaves should afterwards serve as pabulum for Fungi—*e.g. Fumago*, *Antennaria*—is not surprising, and the leaves of limes are often black with them.

Flux.—A common event in the exudation of turbid, frothing liquids from wounds in the bark of trees, and the odours of putrefaction and even alcoholic fermentation in these are sufficiently explained by the coexistence of albuminous and saccharine matters with fungi, yeasts and bacteria in such fluxes. It is clear that in these cases the obvious symptom—the flux—is not the primary one. Some wound in the succulent tissues has become infected by the organisms referred to, and their continued action prevents healing. At certain seasons the wound "bleeds," and the organisms—some of which, by the bye, are remarkable and interesting forms—multiply in the nutritious sap and ferment it. The phenomenon is, in fact, very like that of the fermentation of palm wine and pulque, where the juices are obtained from artificial cuts.

Comparable with these cases is that of *Cuckoo-spit*, due to the juices sucked out by *Aphrophthora* on herbaceous plants of all kinds. Outflows of resin—*Resinosis*—also come under this general heading; but although some resin-fluxes are traced to the destructive action of *Agaricus melleus* in Conifers, others, as well as certain forms of Gummosis, are still in need of explanation.

Bacteriosis.—Many of the plant diseases involving rot have been ascribed to the action of bacteria, and in some cases—*e.g.* cabbage-rot, bulb-rot of hyacinths, &c., carnation disease—there is evidence that bacteria are causally connected with the disease. It is not sufficient to find bacteria in the rotting tissues, however, nor even to be successful in infecting the plant through an artificial wound, unless very special and critical precautions are taken, and in many of the alleged cases of bacteriosis the saprophytic bacteria in the tissues are to be regarded as merely secondary agents.

6. *Necrosis.*—A number of diseases the obvious symptoms of which are the local drying up and death of tissues, in many cases

with secondary results on organs or parts of organs, may be brought together under this heading. No sharp line can be drawn between these diseases and some of the preceding, inasmuch as it often depends on the external conditions whether necrosis is a dry-rot, in the sense I employ the term here, or a wet-rot, when it would come under the preceding category. The "dying back" of the twigs of trees and shrubs is a frequent case. The cortical tissues gradually shrink and dry up, turning brown and black in patches or all over, and when at length the cambium and medullary ray tissues dry up the whole twig dies off. This may be due to frost, especially in "thin-barked" trees, and often occurs in beeches, pears, &c.; or it may result from bruising by wind, hailstones, gun-shot wounds in coverts, &c., the latter of course very local. It is the common result of fires passing along too rapidly to burn the trees; and "thin-barked" trees—hornbeam, beech, firs, &c.—may exhibit it as the results of sunburn, especially when exposed to the south-west after the removal of shelter. The effects of frost and of sunburn are frequently quite local. The usual necrosis of the injured cortex occurs—drying up, shrivelling, and consequent stretching and cracking of the dead cortex on the wood beneath. Such frost-cracks, sun-cracks, &c., may then be slowly healed over by callus, but if the conditions for necrosis recur the crack may be again opened, or if Fungi, &c., interfere with occlusion, the healing is prevented; in such cases the local necrosis may give rise to cankers. The dying back of twigs may be brought about by many causes. General attacks of leaf-diseases invariably lead to starvation and necrosis of twigs, and similarly with the ravages of caterpillars and other insects. Drought and consequent defoliation result in the same, and these considerations help us to understand how old-established trees in parks, &c., apparently in good general health, become "stag-headed" by the necrosis of their upper twigs and smaller branches: the roots have here penetrated into subsoil or other unsuitable medium, or some drainage scheme has deprived them of water, &c., and a dry summer just turns the scale. Such phenomena are not uncommon in towns, where trees with their roots under pavement or other impervious covering do well for a time, but suddenly fail to supply the crown sufficiently with water during some hot summer.

7. *Monstrosities.*—A large class of cases of departure from the normal form, depending on different and often obscure causes, may be grouped together under this heading; most of them are of the kind termed *Teratological*, and it is difficult to decide how far they should be regarded as pathological if we insist that a disease threatens the existence of the plant, since many of these malformations—*e.g.* double flowers, phyllody of floral parts, contortions and fascinations, dwarfing, malformed leaves, &c.—can not only be transmitted in cultivation, but occur in nature without evident injury to the variety. In many cases, however, monstrosities of flowers have been shown to be due to the irritating action of minute insects or Fungi, and others are known which, although induced by causes unknown to us, and regarded as internal, would not be likely to survive in the wild condition. This subject brings the domain of pathology, however, into touch with that of variation, and we are profoundly ignorant as to the complex of external conditions which would decide in any given case how far a variation in form would be prejudicial or otherwise to the continued existence of a species. Under the head of malformations we place cases of atrophy of parts or general dwarfing, due to starvation, the attacks of Fungi or minute insects, the presence of unsuitable food-materials and so on, as well as cases of transformation of stamens into petals, carpels into leaves, and so forth. Roots are often flattened, twisted and otherwise distorted by mechanical obstacles; stems by excess of food in rich soils, the attacks of minute parasites, overgrowth by climbing plants, &c. Leaves are especially apt to vary, and although the formation of crests, pitchers, puckers, &c., must be put down to the results of abnormal development, it is often difficult to draw the line between teratological and merely varietal phenomena. For instance, the difference between the long-stalked and finely-cut leaves of *Anemone* attacked with rust and the normal leaves with broad segments, or between the urceolate leaves occasionally found on cabbages and the ordinary form—in these cases undoubtedly pathological and teratological respectively—is nothing like so great as between the upper and lower normal-leaves of many Umbelliferae or the submerged and floating leaves of an aquatic *Ranunculus* or *Cabomba*. When we come to phenomena such as proliferations, vivipary, the development of "Lammas shoots," adventitious buds, epicormic branches, and to those malformations of flowers known as peloria, phyllody, virescence, &c. while assured that definite, and in many cases recognizable, physiological disturbances are at work, we find ourselves on the borderland between pathological and physiological variation, where each case must be examined with due regard to all the circumstances, and no generalization seems possible beyond what has been sketched. This is equally true of the phenomena of apogamy and apospory in the light of recent researches into the effects of external conditions on reproduction.

This sketch of an enormous subject shows us that the pathology of plants is a special department of the study of variations which threaten injury to the plant, and passes imperceptibly into the study of variations in general. Moreover, we have good reasons for inferring that different constellations of external causes may determine whether the internal physiological disturbances induced by a given agent shall lead to pathological and dangerous variations, or to changes which may be harmless or even advantageous to the plant concerned.

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ECOLOGY OF PLANTS

Introduction.—The word *ecology* is derived from οἶκος, a house (habitat), and λόγος, a discourse. As a botanical term, ecology denotes that branch of botany which comprises the study of the relations of the individual plant, or the species, or the plant community with the habitat. Following Schröter[1] (Flahault and Schröter, 1910 : 24), the term *autecology* may be used for the study of the habitat conditions in relation to the single species, and the term *synecology* for this study in relation to plant communities.

From the phytogeographical standpoint, ecology is frequently termed *ecological plant geography*. Thus Warming[2] (1901 : 1 and 2) subdivided plant geography into floristic plant geography and ecological plant geography. The former is concerned with the division of the earth's surface into major districts characterized by particular plants or taxonomic groups of plants, with the subdivision of these floristic districts, and with the geographical distribution (both past and present) of the various taxonomic units, such as species, genera, and families. On the other hand, ecological plant geography seeks to ascertain the distribution of plant communities, such as associations and formations, and enquires into the nature of the factors of the habitat which are related to the distribution of plants—plant forms, species, and communities. In a general way, floristic plant geography is concerned with species, ecological plant geography with vegetation. The study of the distribution of species dates back to the time of the early systematists, the study of vegetation to the time of the early botanical travellers. Humboldt,[1] for example, defined his view of the scope of plant geography as follows: "C'est cette science qui considère les vegetaux sous les rapports de leur association locale dans les différents climats" (1807: 14).

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[1] Flahault and Schröter, *Phytogeographical Nomenclature: reports and propositions* (Zurich, 1910).

[2] Warming, *Oecology of Plants* (Oxford, 1909).

The Habitat.—The term *habitat*, in its widest sense, includes all the factors of the environment which affect a plant or a plant community, though the term is frequently used to signify only some of these factors. The factors of the habitat may be grouped as follows: geographical, physical, and biological.

Geographical Factors.—Geographical position determines the particular species of plants which grow in any particular locality. This matter is bound up with the centres of origin and with the past migrations of species; and such questions are usually treated as a part of floristic plant geography. Here, therefore, floristics and ecology meet. Flahault and Schröter,[2] in defining the term habitat, appear to exclude all geographical factors. They state that "the term habitat is understood to include everything relating to the factors operative in a geographically defined locality, so far as these factors influence plants" (1910: 24); but the exclusion of geographical and historical factors from the concept of the habitat does not appear to be either desirable or logical.

Physical Factors.—These are frequently classified as edaphic or soil factors and climatic factors; but there is no sharp line of demarcation between them. Edaphic factors include all those relating to the soil. The water content of the soil, its mineral content, its humus content, its temperature, and its physical characteristics, such as its depth and the size of its component particles are all edaphic factors. Climatic factors include all those relating to atmospheric temperature, rainfall, atmospheric humidity, and light and shade. Factors connected with altitude, aspect, and exposure to winds are also climatic: such are often spoken of as *physiographical factors.* The difficulty of sharply delimiting edaphic and climatic factors is seen in the case of temperature. Soil temperature is partly dependent on the direct rays of the sun, partly on the colour and constitution of the soil, and partly on the water content of the soil. Again, the temperature of the air is affected by radiation from the soil; and radiation differs in various soils.

Biological Factors.—These include the reactions of plants and animals on the habitat. Here again, no sharp boundary-line can be drawn. In one sense, the accumulation of humus and peat is a biological factor, as it is related to the work of organisms in the soil; but the occurrence or otherwise of these organisms in the soil is probably related to definite edaphic and climatic conditions. Again, the well-known action of earthworms may be said to be a biological work; but the resulting aeration of the soil causes edaphic differences; and earthworms are absent from certain soils, such as peat. The pollination of flowers and the dispersal of seeds by various animals are biological factors; but pollination and dispersal by the wind cannot be so regarded. The influence of man on plants and vegetation is also a biological factor, which is frequently ignored as such, and treated as if it were a thing apart.

When the nature and effect of ecological factors have become more fully understood, it will be possible to dispense with the above artificial classification of factors, and to frame one depending on the action of the various factors; but such a classification is not possible in the present state of knowledge.

Ecology and Physiology.—Whilst our knowledge of the nature and effect of habitat is still in a very rudimentary condition, much progress has been made in recent years in the study of plant communities; but even here the questions involved in relating the facts of the distribution of plant communities to the factors of the habitat are very imperfectly understood. This is due to a lack of precise knowledge of the various habitat factors and also of the responses made by plants to these factors. Until much more advance has been made by ecologists in the investigation of the nature of habitat factors, and until the effect of the factors on the plants has been more closely investigated by physiologists, it will remain impossible to place ecology on a physiological basis: all that is possible at present is to give a physiological bias to certain aspects of ecological research. Obviously no more than this is possible until physiologists are able to state much more precisely than at present what is the influence of common salt on the plants of salt-marshes, of the action of calcium carbonate on plants of calcareous soils, and of the action of humous compounds on plants of fens and peat moors.

Ecological Classes.—Many attempts have been made to divide plants and plant communities into classes depending on habitat factors. One of the best known classifications on these lines is that by Warming.[3] Warming recognized and defined four ecological classes as follows:—

Hydrophytes.—These live in a watery or wet substratum, with at least 80 % of water. Warming included plants of peat-bogs among his hydrophytes.

Xerophytes.—These are plants which live in very dry places, where the substratum has less than 10 % of water.

Halophytes.—These are plants living in situations where the substratum contains a high proportion of sodium chloride.

Mesophytes.—These are plants which live in localities which are neither specially dry nor specially wet nor specially salty.

Such terms as hydrophytes, xerophytes, and halophytes had been used by plant geographers before Warming's time *e.g.*, by Schouw;[4] and the terms evidently supply a want felt by botanists as they have come into general use. However, the terms are incapable of exact definition, and are only useful when used in a very general way. The above classification by Warming, although it was without doubt the best ecological classification which had, at the time, been put forward, has not escaped criticism. The criticisms were directed chiefly to the inclusion of sand dune plants among halophytes, to the exclusion of halophytes from xerophytes, to the inclusion of "bog xerophytes" among hydrophytes, to the inclusion of all conifers among xerophytes and of all deciduous trees among mesophytes, and to the group of mesophytes in general.

Schimper[5] made a distinct advance when he distinguished between physical and physiological dryness or wetness of the soil. A soil may be physically wet; but if the plants absorb the water only with difficulty, as in a salt marsh, then the soil is, as regards plants, physiologically dry. All soils which are physically dry are also physiologically dry; and hence only the physiological dryness or wetness of soils need be considered in ecology.

Schimper used the term *xerophytes* to include plants which live in soils which are physiologically dry, and the term *hygrophytes* those which live in soils which are physiologically wet or damp. Schimper recognized that the two classes are connected by transitional forms, and that it is useless to attempt to give the matter a statistical basis. It is only in a general sense like Schimper's that such ecological terms as xerophytes have any value; and it is not possible, at least at present, to frame ecological classes, which shall have a high scientific value, on a basis of this nature. Whilst Schimper objected to the constitution of a special category, such as mesophytes, to include all plants which are neither pronounced xerophytes nor pronounced hygrophytes, he recognized the necessity of a third class in which to place those plants which, like deciduous trees and bulbous plants, are hygrophytes during one season of the year and xerophytes during another season of the year. Such plants, which comprise the great majority of the species of the central European flora, Schimper termed *tropophytes.*

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[1] Humboldt and Bonpland, *Essai sur la géographie des plantes* (Paris, 1807).

[2] Flahault and Schröter (*op. cit.*).

[3] Warming, *Plantesamfund*, Kjöbenhavn, 1895. (See German trans. by Knoblauch, "Lehrbuch der ökologischen Pflanzengeographie" (Berlin, 1896); new German ed. by Graebner (Berlin, 1902).

[4] Schouw, *Grundtraek til en almindelig Plantegeografie* (Kjöbenhavn, 1822); German trans., "Grundzüge einer allegemeinen Pflanzengeographie" (Berlin, 1823).

[5] Schimper, *Pflanzengeographie auf physiologischer Grundlage* (Berlin, 1898); Eng. trans. by Fisher, "Plant Geography upon a Physiological Basis" (Oxford, 1903–1904).

Recently, Warming[1] (1909 : 136), assisted by Vahl, has modified his earlier classification, and adopted the following:—

A. The soil (in the widest sense) is very wet, and the abundant water is available to the plant (at least in hydrophytes).

1. *Hydrophytes.*—These include plants of the *plankton*, or microphytes that float free on water, of the *pleuston*, or macrophytes which float on or are suspended in water, and of the *benthos*, or all aquatic plants which are fixed to the substratum.

2. *Helophytes.*—These are marsh plants which normally have their roots in soaking soil but whose branches and foliage are more or less aerial. Warming admits there is no sharp limit between marsh plants and land plants; and it seems equally obvious that there is no sharp limit between some of his helophytes and some of his hydrophytes. For example, the difference between aquatic plants with floating leaves, such as the yellow water-lily (*Nymphaea lutea*) and those with erect leaves, such as *Typha angustifolia*, is probably more apparent than real. Among helophytes, Warming places plants of the reed swamp, and includes such trees as the alder (*Alnus rotundifolia*), willows (*e.g., Salix alba, S. fragilis, S. cinerea, S. pentandra*), birch, and pine, when these grow in marshy places.

B. The soil is physiologically dry.

3. *Oxylophytes.*—These plants, sometimes spoken of as "*bog xerophytes,*" grow in soils which contain an abundance of free humous compounds, and include plants which grow on fens and moors.

4. *Psychrophytes.*—These include the plants which grow on the cold soils of subniveal and polar districts.

5. *Halophytes.*—These are plants which grow on saline soils.

C. The soil is physically dry.

6. *Lithophytes.*—These are plants which grow on "true rock," but not "on the loose soil covering rock, even though this may entertain species that are very intimately associated with the rock. Still to this limitation an exception must be made in favour of the vegetation growing in clefts and niches" (Warming, 1909 : 240). Many Algae, lichens, and mosses are included among lithophytes, and also *Saxifraga Aizoon, S. oppositifolia, Silene acaulis*, and *Gnaphalium luteo-album.*

7. *Psammophytes.*—These are plants which grow on sand and gravel. Plants of sand-dunes, whether in maritime or inland localities, are psammophytes, as well as plants (such as *Calluna vulgaris*) of dune heaths, dune "bushland" or scrub, and dune forest.

8. *Chersophytes.*—Here are placed certain "xerophytic perennial herbs" which occur on "particular dry kinds of soil, such as limestone rocks, stiff clay, and so forth" (Warming, 1909 : 289).

D. The climate is very dry, and the properties of the soil are decided by climate.

9. *Eremophytes.*—Under this term, are placed plants of deserts and steppes.

10. *Psilophytes.*—Here are placed plants found in "savannah-vegetation," viz. (i.) "thorny savannah-vegetation, including: (*a*) orchard-scrub, (*b*) thorn-bushland and thorn-forest; (ii.) true savannah: tropical and sub-tropical savannah; (iii.) savannah-forest, including bush-forest in Africa and 'campos serrados,' in Brazil" (Warming, 1909 : 293 et seq.).

11. *Sclerophyllous formations, e.g.*, garigues, mäquis, and forests of evergreen oaks (*Q. Ilex, Q. Ballota, Q. Suber*), and of *Eucalyptus* spp.

E. The soil is physically or physiologically dry.

12. *Coniferous forest formations, e.g.*, of *Pinus sylvestris, Picea excelsa, Abies pectinata, Larix sibirica, L. decidua.*

F. "Soil and climate favour the development of mesophilous formations."

13. *Mesophytes.*—Warming defines mesophytes as "plants that show a preference for soil and air of moderate humidity, and avoid soil with standing water or containing a great abundance of salts" (1909 : 317). Under mesophytes, Warming places plants occurring in "Arctic and Alpine mat-grassland and mat-herbage," in "mat-vegetation of the Alps," in meadows, in pasture on cultivated soil, in "mesophytic bushland," in deciduous dicotyledonous forests, and in evergreen dicotyledonous forests.

This new system of Warming's, whilst probably too involved ever to come into general use, must be taken as superseding his older one;[2] and perhaps the best course open to botanists is to select such terms as appear to be helpful, and to use the selected terms in a general kind of way and without demanding any precise definitions of them: it must also be borne in mind that the various classes are neither mutually exclusive nor of equivalent rank. From this point of view, the following terms will perhaps be found the most serviceable:—

Hydrophytes (submerged aquatic plants).—Plants whose vegetative organs live wholly in water; *e.g.*, most Algae, many mosses, such as *Fontinalis* spp., and liverworts, such as *Jungermannia* spp.; a few Pteridophytes, such as *Pilularia* spp., *Isoëtes* spp.; several flowering plants, such as *Poiamogeton pectinatus, Ceratophyllum* spp., *Hottonia palustris, Utricularia* spp., *Littorella lacustris.*

Hemi-hydrophytes (swamp plants, marsh plants, &c.).—Plants whose vegetative organs are partly submerged and partly aerial; *Vaucheria terrestris, Philonotis fontana, Scapania undulata, Marsilia* spp., *Salvinia natans, Azolla* spp., *Equisetum limosum, Typha angustifolia, Phragmites communis, Scirpus lacustris, Nymphaea lutea, Oenanthe fistulosa, Bidens cernua.*

Hygrophytes.—Plants which are sub-evergreen or evergreen but not sclerophyllous, and which live in moist soils; *e.g., Lastraea Filix-mas, Poa pratensis, Carex ovalis, Plantago lanceolata*, and *Achillaea Millefolium.*

Xerophytes.—Plants which grow in very dry soils; *e.g.*, most lichens, *Ammophila* (*Psamma*) *arenaria, Elymus arenarius, Anabasis aretioides, Zilla macroptera, Sedum acre, Bupleurum spinosum, Artemisia herba-alba, Zollikofferia arborescens.*

Halophytes.—Plants which grow in very saline soils; *e.g., Triglochin maritimum, Salicornia* spp., *Zygophyllum cornutum, Aster Tripolium, Artemisia maritima.* It should be recognized, however, that "a halophyte, in fact, is one form of xerophyte" (Warming, 1909: 219).

Sclerophyllous Plants.—These are plants with evergreen leathery leaves, and typical of tropical, sub-tropical, and warm temperate regions; *e.g., Quercus Suber, Ilex Aquifolium, Hedera Helix, Eucalyptus Globulus, Rosmarinus officinalis.* Sclerophyllous leaves are usually characterized by entire or sub-entire margins, a thick cuticle, small but rarely sunken stomata, a well-developed and close-set palisade tissue and a feeble system of air-spaces.

Hydro-xerophytes ("bog xerophytes").—Plants which live in wet, peaty soils, and which possess aeration channels and xerophilous leaves; *e.g., Cladium Mariscus, Eriophorum angustifolium, Rubus Chamaemorus*, and *Vaccinium Vitis-Idaea.* The term "oxylophyte" is open to the objection that some peaty waters are alkaline, and not acidic as the term implies. Many plants of peaty soils are sclerophylious.

Tropophytes.—Plants which are hygrophytes during some favourable part of the year and xerophytes during the rest of the year; *e.g.*, deciduous trees and shrubs, deciduous herbaceous plants with underground perennating organs, and annuals and ephemerals.

Plant Communities.—The study of plant communities (*Formationslehre* or *synecology*) has made much progress in recent years. Even here, however, general agreement has not been reached; and the questions involved in relating the facts of the distribution of plant communities to the factors of the habitat are very imperfectly understood. Plant communities may be classified as follows:—

A *plant association* is a community of definite floristic composition: it may be characterized by a single dominant species; or, on the other hand, it may be characterized by a number of prominent species, one of which is abundant here, another there, whilst elsewhere two or more species may share dominance. The former are *pure associations*, and are well illustrated by a heather moor, where *Calluna vulgaris* is the dominant plant. The latter are *mixed associations*, such as fens, where different *facies* are produced by the varying abundance of characteristic plants, such as *Cladium Mariscus, Phragmites communis, Molinia coerulea, Calamagrostis lanceolata*, and *Juncus obtusiflorus.* The different facies are possibly related to slight differences in a generally uniform habitat: it is unscientific to regard them as due to chance; still, in the majority of cases, the causes of the different facies have not been demonstrated. A local aggregation of a species other than the dominant one in an association brings about a *plant society*; for example, societies of *Erica Tetralix*, of *Scirpus caespitosus*, of *Molinia coerulea*, of *Carex curta*, of *Narthecium ossifragum*, and others may occur within an association of *Calluna vulgaris.* The plant societies are also doubtless due to slight variations of the habitat.

The plant association is sometimes referred to in technical language;[3] the termination *-etum* is added to the stem of the generic name, and the specific name is put in the genitive. Thus an association of *Quercus sessiliflora* may be referred to as a *Quercetum sessiliflorae*.

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[1] Warming (1909, *op. cit.*).

[2] Ibid. (1894, *op. cit.*).

[3] See Moss, "The Fundamental Units of Vegetation: historical development of the concepts of the plant association and the plant formation." *Botany School* (Cambridge, 1910).

A *plant formation* is a group of associations occupying habitats which are in essentials identical with each other. Thus, associations of *Agropyrum* (*Triticum*) *junceum*, of *Carex arenaria*, of *Ammophila* (*Psamma*) *arenaria*, and of other plants occur on sand dunes: the associations are related by the general identity of the habitat conditions, namely, the physiological dryness and the loose soil; but they are separated by differences in floristic composition, especially by different dominant species, and by minor differences of the common habitat. The whole set of associations on the sand dunes constitutes a plant formation.

The plant formation may be designated in technical language by the termination *-ion* added to a stem denoting the habitat. Thus, a sand dune formation may be termed an *Arenarion*. The associational term, in the genitive, may be added to the formational term to indicate the relationship of the formation and the association; thus, a plant association of *Ammophila arenaria* belonging to the plant formation of the sand dunes may be designated an *Arenarion Ammophilae-arenariae* (cf. Moss, *op. cit.* 1910: 43).

The question of universal names for vegetation units is bound up with that of the universality or otherwise of particular formations. "Remote regions which are floristically distinct . . . may possess areas physically almost identical and yet be covered by different formations" (Clements,[1] 1905: 203). For example, the sand dunes of North America and those of western Europe are widely separated in geographical position and therefore in floristic composition, yet they are related by common physical factors. This relationship may be indicated by the addition of some prefix to the formational name. For example, an Arenarion in one climatic or geographical region might be termed an α-Arenarion and one in a different region a β-Arenarion, and so on (Moss, *loc. cit.*).

It is, however, frequently desirable to consider such allied formations as a single group. Such a group of formations may be designated a *plant federation*: and this term may be defined as a group of formations, which are characterized by common edaphic factors of the habitat, and which occur in any geographical region. Thus, different geographical or climatic regions are characterized by salt marshes. The latter all agree in their edaphic characteristics; but they differ climatically and in floristic composition. The salt marshes of a given region constitute a single plant formation: the salt marsh formations of the whole world constitute a plant federation.

Again, it is possible to arrange plant associations into groups related by a common plant form. Thus woodland associations may be classified as deciduous forests, coniferous forests, sclerophyllous forests, &c. These, in a general way, are the "formations" of Warming,[2] and (in part) the "climatic formations" of Schimper.[3] Thus the various reed-swamps of the whole world constitute a "formation" in Warming's sense (1909: 187).

There is much difference of opinion among ecologists and plant geographers as to which of these points of view is the most fundamental. Among British authorities, it is now customary to adopt the position of Clements, who states (1905: 292) that "the connexion between formation and habitat is so close that any application of the term to a division greater or smaller than the habitat is both illogical and unfortunate," and that (1905: 18) "habitats are inseparable from the formations which they bear" (cf. Moss, 1910).

From the standpoint of plant communities, it is convenient to divide the earth's surface into (1) tropical districts;[4] (2) subtropical and warm temperate districts; (3) temperate districts; (4) cold temperate and frigid districts.

1. *Tropical Districts.*—The vegetation of tropical districts has been subdivided by Schimper (1903: 260, et seq.) as follows:—(i.) Tropical woodland: (*a*) rain forest, (*b*) monsoon forest, (*c*) savana forest, (*d*) thorn forest. (ii.) Tropical grassland: (*a*) savana, (*b*) steppe. (iii.) Tropical desert: (*a*) scrub, (*b*) succulent plants, (*c*) perennial herbs.

Schimper regards the minor divisions as groups of "climatic formations"; and he also distinguishes certain tropical "edaphic formations," such as mangrove swamps. He states that rain forests and high monsoon forests in the tropics occur when the average rainfall is over 70 in. (178 cm.) per annum, and that tropical thorn forest may prevail when the mean annual rainfall is below 35 in.

A tropical rain forest exhibits great variety both of species of plant and of plant forms. There is great diversity in the trees and masses of tangled lianes, and a wealth of flowers in the leafy forest crown. Humboldt[5] points out that whilst temperate forests frequently furnish pure associations, such uniformity of association is usually absent from the tropics. Some tropical forests exhibit dense foliage from the forest floor to the topmost leafy layer; and the traveller finds the mass of foliage almost impenetrable. Other tropical forests afford a free passage and a clear outlook. It is obvious that tropical forests will eventually be subdivided into plant associations; but the difficulties of determining the relative abundance of the species of plants in the upper layers of tropical rain and monsoon forests are very great. One of the best known results of the great struggle for light which takes place in tropical forests is the number of epiphytic plants which grow on the high branches of the trees.

The leaves of the trees are frequently of leathery consistency, very glossy, usually evergreen, entire or nearly so, and seldom hairy; and thus they agree closely with the leaves of sclerophyllous forest generally.

Monsoon forests are characteristic of localities with a seasonal rainfall. The trees usually lose their foliage during the dry season and renew it during the monsoon rains. With a less abundant rainfall, savana forest and thorn forest occur. Less precipitation induces tropical grassland, which, according to Schimper (1903: 346) is of the savana type; but Warming (1909: 327) thinks that all grassland in the tropics is artificial. Still greater drought induces desert vegetation; but, as deserts are more characteristic of subtropical districts, they are discussed later on.

Mangrove swamps, or tropical tidal forests, occur in saline or brackish swamps on flat, muddy shores in the tropics; and, being almost independent of atmospheric precipitations, Schimper regards them as "edaphic formations." However, they are climatic communities in the sense that they occur only in hot districts. Cases such as this illustrate the difficulty of regarding the distinction between "climatic formations" and "edaphic formations" as absolute. The plants exhibit markedly xerophilous structures; and many of the fruits and seeds of the mangrove trees and shrubs are provided with devices to enable them to float and with curious pneumatophores or "prop roots." The latter serve as supports and also as a means of supplying air to the parts buried in the mud. The seedlings of characteristic species of Rhizophoraceae germinate on the trees, and probably perform some assimilatory work by means of the hypocotyl.

Other tropical "edaphic formations" occur on sandy shores, where the creeping *Ipomoea biloba* (*Pes-caprae*) and trees of *Barringtonia* form characteristic plant associations.

The succession of associations on new soils of a tropical shore has recently been described by Ernst.[6]

2. *Warm Temperate and Subtropical Districts.*—In subtropical and warm temperate districts, characterized by mild and rainy winters and hot and dry summers, we find two types of forests. First, there are forests of evergreen trees, with thick, leathery leaves. Such forests are known as sclerophyllous forests, and they occur in the Mediterranean region, in south-west Africa, in south and south-west Australia, in central Chile, and in western California. In the Mediterranean district, forests of this type are sometimes dominated by the Cork Oak (*Quercus Suber*), sometimes by the Holm Oak (*Q. Ilex*). When these forests become degenerate, mäquis and garigues respectively are produced. Mäquis and garigues are characterized by the abundance of shrubs and undershrubs, especially by shrubby Leguminous plants, and by species Cistus and Lavandula. Secondly, there are forests of coniferous trees. In the Mediterranean region, even at comparatively low altitudes, forests occur of the maritime pine (*Pinus maritima*) and of the Aleppo pine (*P. halepensis*); and these forests are also related to mäquis and garigues respectively in the same way as the evergreen oaks. The occurrence of forests of this type in the Mediterranean and in Arctic regions, whose dominant species belong to the same genus (*Pinus*) and to the same plant form, renders it

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[1] F. E. Clements, *Research Methods in Ecology* (1905), Lincoln, Neb., U.S.A.

[2] Warming (1909, *op. cit.*).

[3] Schimper (1898, *op. cit.*).

[4] The nomenclature of the terms (floristic as well as ecological) used in geographical botany is in a very confused state. In the present article, the term "district" is used in a general sense to indicate any definite portion of the earth's surface. For a discussion of such phytogeographical terms, see Flahault, "Premier essai de nomenclature phytogéographique," in *Bull. Soc. languedocienne de Géogr.* (1901); and also in *Bull. Torr. Bot. Club* (1901).

[5] Humboldt, Eng. trans. by Sabine, *Aspects of Nature* (London, 1849).

[6] Eng. trans. by Seward, *The New Flora of the Volcanic Island of Krakatau* (Cambridge, 1908).

difficult to regard "coniferous forests" as a natural ecological group. At much higher altitudes, in the south-west of the Mediterranean region, forests occur of the Atlantic cedar (*Cedrus atlantica*). These occur from about 4000 ft. (1219 m.) to about 7000 ft. (2133 m.) on the Atlas Mountains. Some sclerophyllous forests of the eastern Atlas Mountains are, owing to a comparatively high rainfall, characterized by many deciduous trees, such as *Fraxinus oxyphylla*, *Ulmus campestris* (auct. alg.), *Alnus rotundifolia*, *Salix pedicellata*, *Prunus avium*, &c.; and thus they have some elements in common with the deciduous forests of central Europe.

The forests of these subtropical and warm temperate regions are situated near the sea or in mountainous regions, and (as already stated) are characterized by winter rains. In inland localities, where the rainfall is much lower, *steppes* occur. For example, in southern Algeria, a region of steppes is situated on a flat plateau, about 3000 ft. (914 metres) high, between the southern slopes of the Tell Atlas and the northern slopes of the Saharan Atlas. The rainfall, which occurs chiefly in winter, only averages about 10 in. (254 mm.) per annum. Here we find open plant associations of Halfa or Esparto Grass (*Stipa tenacissima*) alternating with steppes of Chih (*Artemisia herba-alba*); and each plant association extends for several scores of miles. In the hollows of this steppe region, salt water lakes occur, known as Chotts; and on the saline soils surrounding the Chotts, a salt marsh formation occurs, with species of Salicornia, some of which are undershrubs.

Where the rainfall is still lower, *deserts* occur. At Ghardaia, in south-eastern Algeria, the mean annual rainfall, from 1887 to 1892, was about 4½ in. (114 mm.). In 1890, it fell as low as 2 in. (53 mm.) (Schimper, 1903 : 606). At Beni Ounif and Colomb Béchar, in south-western Algeria, I was informed, in March 1910, that there had been no rain for about three years. Here the gravelly desert is characterized by "cushion plants," such as *Anabasis aretioides*; by "switch plants," such as *Retama Retam*; and specially by spiny plants, such as *Zizyphus Lotus* and *Zilla macropteris*; whereas succulent plants are rare. Both in the steppe and in the desert, small ephemeral species occur on the bare ground away from the large plants and especially in the wadis. Steppe and desert formations are of the open type.

3. *Temperate Districts.*—Temperate districts are characterized by forests of deciduous trees and of coniferous trees, the latter being of different species from those of the warm temperate districts, but frequently of the same plant form. The identity of plant form of many of the conifers of both temperate and of warm temperate districts is probably a matter of phylogenetic and not of ecological importance.

Britain is fairly typical of the west European district. In these islands, we find forests[1] or woods of oak (*Quercus Robur* and *Q. sessiliflora*), of birch (*Betula tomentosa*), of ash (*Fraxinus excelsior*), and of beech (*Fagus sylvatica*). In central Scotland, forests occur of *Pinus sylvestris*; and, in south-eastern England, extensive plantations and self-sown woods occur of the same species.

Just as in the Mediterranean region, the degeneration of forests has given rise to mâquis and garigues, so in western Europe, the degeneration of forests has brought about different types of grassland, heaths, and moors.

4. *Cold Temperate and Frigid Districts.*—In the coldest portion of the north temperate zone, forests of dwarfed trees occur, and these occasionally spread into the Arctic region itself (Schimper, 1904: 685). Schimper distinguishes *moss tundra*, *Polytrichum tundra*, and *lichen tundra*; and the lichen tundra is subdivided into *Cladonia tundra*, *Platysma tundra*, and *Alectoria heath*. Where the climate is most rigorous, *rock tundra* occurs (p. 685).

The types of vegetation (tropical forests, sclerophyllous forest, temperate forests, tundra, &c.) thus briefly outlined are groups of Schimper's "climatic formations." Such groups are interesting in that they are vegetation units whose physiognomy is, in a broad sense, related more to climatic than to edaphic conditions. For example, Schimper, after describing the sclerophyllous woodland of the Mediterranean district and of the Cape district, says: "The scrub of West and South Australia in its ecological aspect resembles so completely the other sclerophyllous formations that a description of it must seem a repetition." This resemblance, however, only has reference to the general aspect or physiognomy of the vegetation and to the plant forms: the floristic composition of the various sclerophyllous—and other physiognomically allied—associations in the various geographical districts is very different; and indeed it is true that, just as the general physiognomy of plant associations is related to climate, so their floristic composition is related to geographical position. Hence, in any cosmopolitan treatment of vegetation, it is necessary to consider the groups of plant communities from the standpoint of the climatic or geographical district in which they occur; and this indeed is consistently done by Schimper. Finally, within any district of constant or fairly constant climatic conditions, it is possible to distinguish plant communities which are related chiefly to edaphic or soil conditions; and the vegetation units of these definite edaphic areas are the plant formations of some writers, and, in part, the "edaphic formations" of Schimper.

When a district like England is divided into edaphic areas, a general classification such as the following may be obtained:—

1. *Physically and physiologically wet habitats*, with the accompanying plant communities of *lakes*, *reed swamps*, and *marshes*.
2. *Physically wet but physiologically dry habitats*,[2] with the accompanying plant communities of *fens*, *moors*, and *salt marshes*.
3. *Physically and physiologically dry habitats*, with the accompanying plant communities of *sand dunes* and *sandy heaths* with little humus in the soil.
4. *Habitats of medium wetness*, with the accompanying plant communities of *woodlands and grasslands*. This class may be subdivided as follows:—

a. Habitats poor in mineral salts, especially calcium carbonate, often rich in acidic humous compounds, and characterized by oak and birch woods, siliceous pasture, and heaths with much acidic humus in the sandy soil.

b. Habitats rich in mineral salts, especially calcium carbonate, poor in acidic humous compounds, and characterized by ash woods, beech woods, and calcareous pasture.

Ecological Adaptations.—It is now possible to consider the ecological adaptations which the members of plant communties show in a given geographical district such as western Europe, of which England of course forms a part. In the present state of knowledge, however, this can only be done in a very meagre fashion; as the effect of habitat factors on plants is but little understood as yet either by physiologists or ecologists.

Hydrophytes and hemi-hydrophytes (aquatic plants).—Of marine hydrophytes, there are, in this country, only the grass-wracks (*Zostera marina* and *Z. nana*) among the higher plants. Even these species are sometimes left stranded by low spring tides, though the mud in which they are rooted remains saturated with sea-water. Although many plants typical of fresh water are able to grow also in brackish water, there are only a few species which appear to be quite confined to the latter habitats in this country. Such species perhaps include *Ruppia maritima*, *R. spiralis*, *Zannichellia maritima*, *Z. polycarpa*, *Potamogeton interruptus* (=P. *flabellatus*), and *Naias marina*.

In freshwater lakes and ponds, especially if the water is stagnant, aquatic plants are abundant. Aquatic vegetation may be conveniently classified as follows:—

Aquatic plants with submerged leaves: *Chara* spp., *Naias* spp., *Potamogeton pectinatus*, *Ceratophyllum* spp., *Myriophyllum* spp., *Hottonia palustris*, *Utricularia* spp.

Aquatic plants with submerged and floating leaves: *Glyceria fluitans*, *Ranunculus peltatus*, *Nymphaea* (*Nuphar*) *lutea*, *Callitriche stagnalis*, *Potamogeton polygonifolius*.

Aquatic plants with floating leaves: *Lemna* spp., *Hydrocharis Morsus-ranae*, *Castalia* (*Nymphaea*) *alba*.

Aquatic plants with submerged leaves and erect leaves or stems: *Sagittaria sagittifolia*, *Scirpus lacustris*, *Hippuris vulgaris*, *Sium latifolium*.

Aquatic plants with erect leaves or stems (reed swamp plants): *Equisetum palustre*, *Phragmites communis*, *Glyceria aquatica*, *Carex riparia*, *Iris Pseudacorus*, *Rumex Hydrolapathum*, *Oenanthe fistulosa*, *Bidens* spp.

Marsh plants: *Alopecurus geniculatus*, *Carex disticha*, *Juncus* spp., *Caltha palustris*, *Nasturtium palustre*.

In many aquatic plants, the endosperm of the seed is absent or very scanty. The root-system is usually small. Root-hairs are frequently missing. The submerged stems are slender or hollow. Strengthening tissue of all kinds (and sometimes even the phloem) is more or less rudimentary. The stems are frequently characterized by aeration channels, which connect the aerial parts with the parts which are buried in practically airless mud or silt. Submerged leaves are usually filamentous or narrowly ribbon-shaped, thus exposing a large amount of surface to the water, some of the dissolved gases of which they must absorb, and into which they must also excrete certain gases. Stomata are often absent, absorption and excretion of gases in solution being carried on through the epidermal layer. Chloroplastids are frequently present in the epidermal cells, as in some shade plants. Very few aquatic plants are pollinated under water, but this is well-known to occur in species of *Zostera* and of *Naias*. In such plants, the pollen grains are sometimes filiform and not spherical in shape. In the case of aquatic plants with aerial flowers, the latter obey the ordinary laws of pollination. Heterophylly is rather common among aquatic plants, and is well seen in several aquatic species of *Ranunculus*, many species of *Potamogeton*, *Sagittaria sagittifolia*, *Scirpus lacustris*, *Castalia* (*Nymphaea*) *alba*, *Hippuris vulgaris*, *Callitriche* spp., *Sium latifolium*.

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[1] See Moss, Rankin, and Tansley, "British Woodlands." *Botany School* (Cambridge, 1910).

[2] As very little experimental work has been done with regard to physiological dryness in physically wet habitats, any classification such as the above must be of a tentative nature.

Insectivorous species occur among aquatic plants; *e.g. Utricularia* spp., which are locally abundant in peaty waters, are insectivorous.

Xerophytes.—These plants have devices (*a*) for procuring water, (*b*) or for storing water, (*c*) or for limiting transpiration; and these adaptations are obviously related to the physically or physiologically dry habitats in which the plants live. Plants of physically dry habitats, such as deserts and sand dunes, have frequently long tap-roots which doubtless, in some cases, reach down to a subterranean water supply. The same plants have sometimes a superficial root system in addition, and are thus able to utilize immediately the water from rain showers and perhaps also from dew, as Volkens[1] maintains. Root-hairs give an enlarged superficial area to the roots of plants, and thus are related to the procuring of water.

The stems of some xerophytes, *e.g.* Cactaceous and Crassulaceous plants, may be succulent, *i.e.* they have tissues in which water is stored. Some deserts, like those of Central America, are specially characterized by succulents; in other deserts, such as the Sahara, succulents are not a prominent feature. Other xerophytes again are spinous. "Switch plants," such as *Retama Retam* and broom (*Cytisus scoparius*), have reduced leaves and some assimilating tissue in their stems; and stomata occur in grooves on the stem.

The transpiring surface of xerophytes is frequently reduced. The ordinary leaves may be small, absent, or spinous. In "cushion plants" the leaves are very small, very close together, and the low habit is protective against winds. The latter, of course, greatly increase transpiration. A "cushion plant" (*Anabasis aretioides*) of the north-western Sahara, frequently shows dead leaves on the exposed side whilst the plant is in full vigour on the sheltered side. The buds and leaves on the exposed side are probably killed by sand blasts. Many xerophytes are hairy or have sunken stomata which may be further protected by partial plugs of wax: the stomata are frequently in grooves: the leaves are frequently rolled—sometimes permanently so, whilst sometimes the leaves roll up only during unfavourable weather. These adaptations tend to lessen the amount of transpiration by protecting the stomata from the movements of the air. In species of *Eucalyptus*, the leaves are placed edge-wise to the incident rays of light and heat. The coriaceous leaves of "sclerophyllous plants" also, to some extent, are similarly protective. In such leaves, there are a well-marked cuticle, a thick epidermis, a thick hypodermis at least on the upper side of the leaf, well-developed palisade tissue, and a poorly developed system of air-spaces. Such adaptations are well seen in the leaf of the holly (*Ilex aquifolium*). Warming, however, states that "*Ilex aquifolium* is undubitably a mesophyte" (1909: 135).

Halophytes, or plants which live in saline soils, have xerophytic adaptations. A considerable proportion of halophytes are succulents, *i.e.* their leaves and, to some extent, their stems have much water-storing tissue and few intercellular spaces. Some halophytes tend to lose their succulence when cultivated in a non-saline soil; and some non-halophytes tend to become succulent when cultivated in a salty soil; there is, it need scarcely be stated, little or no evidence that such characters are transmitted. British salt marshes furnish few instances of spiny plants, though such occur occasionally on the inland salt marshes of continental districts. *Salsola Kali* is British, and a hemi-halophyte at least; and it is rather spiny. Warming states that "the stomata of true, succulent, littoral halophytic herbs, in cases so far investigated, are not sunken" (1909 : 221). It is possible, however, that the absence of sunken stomata, and the occurrence of some other halophytic features, are related merely to the succulent habit and not to halophytism, for succulent species often occur on non-saline soils. Similarly, the small amount of cuticular and of epidermal protection, and of lignification in succulent halophytes may also be related to the same circumstance. Forms of "stone cells" or "stereids" occur in some of the more suffruticose halophytes, as in *Arthrocnemum glaucum*. The interesting occurrence of certain halophytes and hemi-halophytes on sea-shores and also on mountains is probably to be explained by the past distribution of the species in question. At one time, such plants were probably of more general occurrence: now they have been extirpated in the intermediate localities, chiefly owing to the cultivation of the land in these places by man. In the west of Ireland and in the Faröes, where certain inland and lowland localities are still uncultivated, *Plantago maritima* and other halophytes occur in quantity and side by side with some "Alpine species," such as *Dryas octopetala*.

The effect of common salt on the metabolism of plants is not understood. Lesage[2] has shown that the height of certain plants is decreased by cultivation in a saline soil, and that the leaves of plants under such conditions become smaller and more succulent. He showed further, that the increase of common salt in the soil is correlated with a reduction in the number and size of the chloroplastids, and therefore in the amount of chlorophyll. On the other hand, some plants did not respond to the action of common salt, whilst others were killed. Warming (1909: 220) quotes Griffon (1898), to the effect that "the assimilatory activity is less in the halophytic form than in the ordinary form of the same species." Schimper had previously maintained that the action of common salt in the cell-sap is detrimental as regards assimilation. Many marine Algae appear to be able to regulate their osmotic capacity to the surrounding medium; and T. G. Hill[3] has shown that the root-hairs of *Salicornia* possess this property. There has, however, been performed upon halophytes very little physiologically experimental work which commands general acceptance.

Bog Xerophytes live in the peaty soil of fens and moors which are physically wet, but which are said to be physiologically dry. Related to the physiological drought, such plants possess some xerophytic characters; and, related to the physical wetness, the plants possess the aeration channels which characterize many hydrophytes and hemi-hydrophytes. The occurrence of xerophytic characters in plants of this type has given rise to much difference of opinion. It is sometimes maintained, for example, by Schimper, that their xerophytic characters are related to the physiological dryness of the habitat: this, however, is denied by others who maintain (Clements, 1905: 127) that the xerophytism is due to the persistence of ancestral structures. It is possible, of course, that each explanation is correct in particular cases, as the views are by no means mutually exclusive. With regard to the occurrence of plants, such as *Juncus effusus*, which possess xerophytic characters and yet live in situations which are not ordinarily of marked physiological dryness, it should be remembered that such habitats are liable to occasional physical drought; and a plant must eventually succumb if it is not adapted to the extreme conditions of its habitat. The xerophytic characters being present, it is not surprising that many marsh plants, like *Juncus effusus* and *Iris pseudacorus*, are able to survive in dry situations, such as banks and even garden rockeries.

Tropophytes.—These plants are characterized by being xerophytic during the unfavourable season. For example, deciduous trees shed their leaves in winter: geophytes go through a period of dormancy by means of bulbs, rhizomes, or other underground organs with buds; whilst annuals and ephemerals similarly protect themselves by means of the seed habit. All such plants agree in reducing transpiration to zero during the unfavourable season, although few or no xerophytic characters may be demonstrable during the period favourable to growth.

Hygrophytes.—Living, as these plants do, under medium conditions as regards soil, moisture and climate, they exhibit no characters which are markedly xerophytic or hydrophytic. Hence, such plants are frequently termed *mesophytes.* Assimilation goes on during the whole year, except during periods of frost or when the plants are buried by snow. An interesting special case of hygrophytes is seen with regard to plants which live in the shade of forests. Such plants have been termed *sciophytes.* Their stomata are frequently not limited to the underside of the leaves, but may occur scattered all over the epidermal surface. The epidermal cells may contain chlorophyll. Strengthening tissue is feebly developed. Many sciophytes are herbaceous tropophytes, and are dormant for more than half the year, usually during late summer, autumn and early winter. It may be that this is a hereditary character (cf. "bog xerophytes"), or that the physical drought of summer is unfavourable to shade-loving plants. In this connexion, it is interesting that in the east of England with the lowest summer rainfall of this country, many common sciophytes are absent or rare in the woods, such, for example, as *Melica uniflora*, *Allium ursinum*, *Lychnis dioica*, *Oxalis Acetosella*, and *Asperula odorata.* However, the cause of the absence or presence of a given species from a given locality is a department of ecology which has been studied with little or no thoroughness.

Calcicole and Calcifuge Species.—Plants which invariably inhabit calcareous soils are sometimes termed calcicoles; calcifuge species are those which are found rarely or never on such soils. The effect of lime on plants is less understood even than the effect of common salt. Doubtless, the excess of any soluble mineral salt or salts interferes with the osmotic absorption of the roots; and although calcium carbonate is insoluble in pure water, it is slightly soluble in water containing carbon dioxide. In England, the following species are confined or almost confined to calcareous soils: *Asplenium Ruta-muraria*, *Melica nutans*, *Carex digitata*, *Aceras anthropophora*, *Ophrys apifera*, *Thalictrum minus*, *Helianthemum Chamaecistus*, *Viola hirta*, *Linum perenne*, *Geranium lucidum*, *Hippocrepis comosa*, *Potentila verna*, *Viburnum Lantana*, *Galium asperum* (= *G. sylvestre*), *Asperula cynanchica*, *Senecio campestris.* The following plants, in England, are calcifuge: *Lastraea Oreopteris*, *Holcus mollis*, *Carex echinata*, *Spergula arvensis*, *Polygala serpyllacea*, *Cytisus*

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[1] Volkens, *Die Flora der ägyptisch-arabischen Wüste* (Berlin, 1887).

[2] Lesage, "Recherches expérimentales sur les modifications des feuilles chez les plantes maritimes," in *Rev. gén. de bot.* (1890), vol. ii.

[3] T. G. Hill, "Observations on the Osmotic Properties of the Root-Hairs of certain Salt Marsh Plants," in *The New Phytologist* (1908), vol. vii.

scoparius, Potentilla procumbens, Galium hercynicum (=*G. saxatile*), *Gnaphalium sylvaticum, Digitalis purpurea*. Other plants occur indifferently both on calcareous and on non-calcareous soils.

It is sometimes said that lime acts as a poison on some plants and not on others, and sometimes that it is the physiological dryness of calcareous soils that is the important factor. In relation to the latter theory, it is pointed out that some markedly calcicole species occur on sand dunes; but this may be due to the lime which is frequently present in dune sand as well as to the physical dryness of the soil. Further, no theory of calciolous and calcifugous plants can be regarded as satisfactory which fails to account for the fact that both kinds of plants occur among aquatic as well as among terrestrial plants. Schimper (1903: 102) thinks that in the case of aquatic plants, the difference must depend on the amount of lime in the water, for the physical nature of the substratum is the same in each case. Again, acidic humus does not form in calcareous soils; and hence one does not expect to find plants characteristic of acidic peat or humus on calcareous soils. Some such species are *Blechnum boreale, Aira flexuosa, Calluna vulgaris, Vaccinium, Myrtillus, Rubus, Chamaemorus, Empetrum nigrum, Drosera* spp. Some, at least, of these species possess mycorhiza in their roots, and are perhaps unable to live in soils where such organisms are absent.

In England, the number of calcicole species is greater than the number of silicolous species. It would therefore be curious if it were proved that lime acts on plants as a poison. It is said that some plants may be calcicoles in one geographical district and not in another. However, until more is known of the exact chemical composition of natural—as contrasted with agricultural—soils, and until more is known of the physiological effects of lime, it is impossible to decide the vexed question of the relation of lime-loving and lime-shunning plants to the presence or absence of calcium carbonate in the soil. From such points of view as this, it is indeed true, as Warming has recently stated, "that ecology is only in its infancy." (C. E. M.)

Cytology of Plants

The elementary unit of plant structure, as of animal structure, is the cell. Within it or its modifications all the vital phenomena of which living organisms are capable have their origin. Upon our knowledge of its minute structure or cytology, combined with a study of its physiological activities, depends the ultimate solution of all the important problems of nutrition and growth, reception and conduction of stimuli, heredity, variation, sex and reproduction.

The Cell Theory.—For a general and historical account of the cell theory see Cytology. It is sufficient to note here that cells were first of all discovered in various vegetable tissues by Robert Hooke in 1665 (Micrographia); Malpighi and Grew (1674–1682) gave the first clear indications of the importance of cells in the building up of plant tissues, but it was not until the beginning of the 19th century that any insight into the real nature of the cell and its functions was obtained. Hugo von Mohl (1846) was the first to recognize that the essential vital constituent of the plant cell is the slimy mass—protoplasm—inside it, and not the cell wall as was formerly supposed. The nucleus was definitely recognized in the plant cell by Robert Brown in 1831, but its presence had been previously indicated by various observers and it had been seen by Fontana in some animal cells as early as 1781. The cell theory so far as it relates to plants was established by Schleiden in 1838. He showed that all the organs of plants are built up of cells, that the plant embryo originates from a single cell, and that the physiological activities of the plant are dependent upon the individual activities of these vital units. This conception of the plant as an aggregate or colony of independent vital units governing the nutrition, growth and reproduction of the whole cannot, however, be maintained. It is true that in the unicellular plants all the vital activities are performed by a single cell, but in the multicellular plants there is a more or less highly developed differentiation of physiological activity giving rise to different tissues or groups of cells, each with a special function. The cell in such a division of labour cannot therefore be regarded as an independent unit. It is an integral part of an individual organization and as such the exercise of its functions must be governed by the organism as a whole.

General Structure and Differentiation of the Vegetable Cell.—The simplest cell forms are found in embryonic tissues, in reproductive cells and in the parenchymatous cells, found in various parts of the plant. The epidermal, conducting and strengthening tissues show on the other hand considerable modifications both in form and structure.

The protoplasm of a living cell consists of a semifluid granular substance, called the cytoplasm, one or more nuclei, and sometimes centrosomes and plastids. Cells from different parts of a plant differ very much in their cell-contents. Young cells are full of cytoplasm, old cells generally contain a large vacuole or vacuoles, containing cell-sap, and with only a thin, almost invisible layer of cytoplasm on their walls. Chlorophyll grains, chromatophores, starch-grains and oil-globules, all of which can be distinguished either by their appearance or by chemical reagents, may also be present. Very little is known of the finer structure of the cytoplasm of a vegetable cell. It is sometimes differentiated into a clearer outer layer, of hyaloplasm, commonly called the ectoplasm, and an inner granular endoplasm. In some cases it shows, when submitted to a careful examination under the highest powers of the microscope, and especially when treated with reagents of various kinds, traces of a more or less definite structure in the form of a meshwork consisting of a clear homogeneous substance containing numerous minute bodies known as *microsomes*, the spaces being filled by a more fluid *ground-substance.* This structure, which is visible both in living cells and in cells treated by reagents, has been interpreted by many observers as a network of threads embedded in a homogeneous ground-substance. Bütschli, on the other hand, interprets it as a finely vacuolated foam-structure or emulsion, comparable to that which is observed when small drops of a mixture of finely powdered potash and oil are placed in water, the vacuoles or alveoli being spaces filled with liquid, the more solid portion representing the mesh-work in which the microsomes are placed. Evidence is not wanting, however, that the cytoplasm must be regarded as, fundamentally, a semifluid, homogeneous substance in which by its own activity, granules, vacuoles, fibrils, &c., can be formed as secondary structures. The cytoplasm is largely concerned in the formation of spindle fibres and centrosomes, and such structures as the cell membrane, cilia, or flagella, the coenocentrum, *nematoplasts* or *vibrioids* and *physodes* are also products of its activity.

Protoplasmic Movements.—In the cells of many plants the cytoplasm frequently exhibits movements of *circulation* or *rotation.* The cells of the staminal hairs of *Tradescantia virginica* contain a large sap-cavity across which run, in all directions, numerous protoplasmic threads or bridges. In these, under favourable conditions, streaming movements of the cytoplasm in various directions can be observed. In other forms such as *Elodea, Nitella, Chara,* &c., where the cytoplasm is mainly restricted to the periphery of the sap vacuole and lining the cell wall, the streaming movement is exhibited in one direction only. In some cases both the nucleus and the chromatophores may be carried along in the rotating stream, but in others, such as *Nitella*, the chloroplasts may remain motionless in a non-motile layer of the cytoplasm in direct contact with the cell wall.[1]

Desmids, Diatoms and *Oscillaria* show creeping movements probably due to the secretion of slime by the cells; the swarm-spores and plasmodium of the Myxomycetes exhibit amoeboid movements; and the motile spores of Fungi and Algae, the spermatozoids of mosses, ferns, &c., move by means of delicate prolongations, cilia or flagella of the protoplast.

Chromatophores.—The chromatophores or plastids are protoplasmic structures, denser than the cytoplasm, and easily distinguishable from it by their colour or greater refractive power. They are spherical, oval, fusiform, or rod-like, and are always found in the cytoplasm, never in the cell-sap. They appear to be permanent organs of the cell, and are transmitted from one cell to another by division. In young cells the chromatophores are small, colourless, highly refractive bodies, principally located around the nucleus. As the cell grows they may become converted into *leucoplasts* (starch-formers), *chloroplasts* (chlorophyll-bodies), or *chromoplasts* (colour-bodies). And all three structures may be converted one into the other (Schimper). The chloroplasts are generally distinguished by their green colour, which is due to the presence of chlorophyll; but in many Algae this is masked by another colouring matter—*Phycoerythrin* in the Florideae, *Phycophaein* in the Phaeophyceae, and *Phycocyanin* in the Cyanophyceae. These substances can, however, be dissolved out in water, and the green colouring matter of the chloroplast then becomes visible. The chloroplast consists of two parts, a colourless ground substance, and a green colouring matter, which is contained either in the form of fibrils, or in more or less regular spherical masses, in the colourless ground-mass. The chloroplasts increase in number by division, which takes place in higher plants when they have attained a certain size, independent of the division of the cell. In *Spirogyra* and allied forms the chloroplast grows as the cell grows, and only divides when this divides. The division in all cases takes place by constriction, or by a simultaneous splitting along an equatorial plane. Chloroplasts are very sensitive to light and are capable in some plants of changing their position in the cell under the stimulus of a variation in the intensity of the light rays which fall upon them. In the chromatophores of many Algae and in the Liverwort *Anthoceros* there are present homogeneous, highly refractive, crystal-like bodies, called *pyrenoids* or starch-centres, which are composed of proteid substances and surrounded by an envelope of starch-grains. In *Spirogyra* the pyrenoids are distinctly connected by cytoplasmic strands to the central mass of cytoplasm, which surrounds the nucleus, and according to some observers, they increase exclusively by division, followed by a splitting of the cytoplasmic strands. Those chromatophores which remain colourless, and serve simply as starch-formers in parts of the plant not exposed to the light, are called leucoplasts or amyloplasts. They are composed of a homogeneous proteid substance, and often contain albuminoid or proteid crystals of the same kind as those which form the pyrenoid. If exposed to light they may become converted into chloroplasts. The formation of starch may take place in any part of the leucoplast. When formed inside it, the starch-grains exhibit a concentric stratification; when formed externally in the outer layers, the stratification is excentric, and the hilum occurs on that side farthest removed from the leucoplast. As the starch-grains grow, the leucoplasts gradually disappear.

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[1] Ewart, *On the Physics and Physiology of Protoplasmic Streaming in Plants.* (Oxford, 1903), gives an excellent account of the phenomena of protoplasmic streaming with a full discussion of the probable causes to which it is due.

Chromoplasts are the yellow, orange or red colour-bodies found in some flowers and fruits. They arise either from the leucoplasts or chloroplasts. The fundamental substance or stroma is colourless and homogeneous. The colour is due to the presence of xanthophyll, or carotin or both. The colouring matters are not dissolved in the stroma of the chromoplast, but exist as amorphous granules, with or without the presence of a protein crystal, or in the form of fine crystalline needles, frequently curved and sometimes present in large numbers, which are grouped together in various ways in bundles and give the plastids their fusiform or triangular crystalline shape. Such crystalline plastids occur in many fruits and flowers (*e.g. Tamus communis*, *Asparagus*, *Lonicera*, berries of Solaneae, flowers of *Cacalia coccinea*, *Tropaeolum*, bracts of *Strelitzia*, &c.), and in the root of the carrot. In some cases the plastid disappears and the crystalline pigment only is left. In the red variety of *Cucurbita pepo* these crystals may consist of rods, thin plates, flat ribbons or spirals. Starch grains may often be seen in contact with the pigment crystals. The crystalline form appears to be due entirely to the carotin, which can be artificially crystallized from an alcohol or ether solution. In addition to the plastids, there are found in some plant-cells, *e.g.* in the epidermal cells of the leaf of species of *Vanilla* (Wakker), and in the epidermis of different parts of the flower of *Funkia*, *Ornithogalum*, &c. (Zimmermann), highly refractive bodies of globular form, *elaioplasts*, which consist of a granular protein ground-substance containing drops of oil. They are stained deep red in dilute solution of alkanin.

Substances contained in the Protoplasm.—Starch may be found in the chlorophyll bodies in the form of minute granules as the first visible product of the assimilation of carbon dioxide, and it occurs in large quantities as a reserve food material in the cells of various parts of plants. It is highly probable that starch is only produced as the result of the activity of chromatophores, either in connexion with chromoplasts, chloroplasts or leucoplasts. Starch exists, in the majority of cases, in the form of grains, which are composed of stratified layers arranged around a nucleus or hilum. The stratification, which may be concentric or excentric, appears to be due to a difference in density of the various layers. The outer layers are denser than the inner, the density decreasing more or less uniformly from the outside layers to the centre of hilum. The outermost, newly formed layer is composed of a more homogeneous, denser substance than the inner one, and can be distinguished in all starch-grains that are in process of development. The separate layers of the starch-grain are deposited on it by the activity of the chromatophore, and according to Meyer the grain is always surrounded by a thin layer of the chromatophore which completely separates it from the cytoplasm. The layers appear to be made up of elements which are arranged radially. These are, according to Meyer, acicular crystals, which he calls *trichites*. The starch grain may thus be regarded as a crystalline structure of the nature of a sphere-crystal, as has been suggested by many observers.

Whether the formation of the starch grain is due to a secretion from the plastid (Meyer, 1895) or to a direct transformation of the proteid of the plastid (Timberlake, 1901) has not been definitely established.

Aleurone.—Aleurone is a proteid substance which occurs in seeds especially those containing oil, in the form of minute granules or large grains. It may be in the form of an albumen crystal sometimes associated with a more or less spherical body—globoid—composed of a combination of an organic substance with a double phosphate of magnesium and calcium. Albumen crystals are also to be found in the cytoplasm, in leucoplasts and rarely in the nucleus.

Glycogen, a substance related to starch and sugar, is found in the Fungi and Cyanophyceae as a food reserve. It gives a characteristic red-brown reaction with iodine solution. In the yeast cell it accumulates and disappears very rapidly according to the conditions of nutrition and is sometimes so abundant as to fill the cell almost entirely (Errera, 1882, 1895: Wager and Peniston, 1910).

Volutin occurs in the cytoplasm of various Fungi, Bacteria, Cyanophyceae, diatoms, &c., in the form of minute granules which have a characteristic reaction towards methylene blue (Meyer). It appears to have some of the characteristics of nucleic acid, and according to Meyer may be a combination of nucleic acid with an unknown organic base.

Numerous other substances are also found in the cytoplasm, such as tannin, fats and oil, resins, mucilage, caoutchouc, gutta-percha, sulphur and calcium oxalate crystals. The cell sap contains various substances in solution such as sugars, inulin, alkaloids, glucosides, organic acids and various inorganic salts. The colours of flowers are due to colouring matters contained in the sap of which the chief is anthocyanin.

Reference must also be made here to the enzymes or unorganized ferments which occur so largely in the cytoplasm. It is probable that most, if not all, the metabolic changes which take place in a cell, such as the transformation of starch, proteids, sugar, cellulose; and the decomposition of numerous other organic substances which would otherwise require a high temperature or powerful reagents is also due to their activity. Their mode of action is similar to that of ordinary mechanical catalytic agents, such as finely divided platinum (see Bayliss, *The Nature of Enzyme Action*, and J. R. Green, *The Soluble Ferments*).

The Nucleus.—The nucleus has been demonstrated in all plants with the exception of the Cyanophyceae and Bacteria, and even here structures have been observed which resemble nuclei in some of their characteristics. The nucleus is regarded as a controlling centre of cell-activity, upon which the growth and development of the cell in large measure depends, and as the agent by which the transmission of specific qualities from one generation to another is brought about. If it is absent, the cell loses its power of assimilation and growth, and soon dies. Haberlandt has shown that in plant cells, when any new formation of membrane is to take place in a given spot, the nucleus is found in its immediate vicinity; and Klebs found that only that portion of the protoplasm of a cell which contains the nucleus is capable of forming a cell-wall; whilst Townsend has further shown that if the non-nucleated mass is connected by strands of protoplasm to the nucleated mass, either of the same cell or of a neighbouring cell, it retains the power of forming a cell-membrane.

The Structure of the Nucleus.—In the living condition the resting nucleus appears to consist of a homogeneous ground substance containing a large number of small chromatin granules and one or more large spherical granules—nucleoli—the whole being surrounded by a limiting membrane which separates it from the cytoplasm. When fixed and stained this granular mass is resolved into a more or less distinct granular network which consists of a substance called *Linin*, only slightly stained by the ordinary nuclear stains, and, embedded in it, a more deeply stainable substance called *Chromatin*. The nucleolus appears to form a part of the *Linin* network, but has usually also a strong affinity for nuclear stains. The staining reactions of the various parts of the nucleus depend to some extent upon their chemical constitution. The chromatin is practically identical with nuclein. This has a strong attraction for basic aniline dyes, and can usually be distinguished from other parts of the cell which are more easily coloured by acid anilines. But the staining reactions of nuclei may vary at different stages of their development; and it is probable that there is no method of staining which differentiates with certainty the various morphological constituents of the nucleus.

Our knowledge of the chemical constitutions of the nucleus is due to the pioneer researches of Sir Lauder Brunton, Plosz, Miescher, Kossel and a host of more recent investigators. Nuclein is a complex albuminoid substance containing phosphorus and iron in organic combination (Macallum). It appears to be a combination of a protein with nucleic acid. Recent researches have shown that the nucleic acid can be broken up by chemical means into a number of different compounds or bases. The results at first obtained were very confusing and seemed to show that nucleic acid is very variable in constitution, but thanks to the work of Schmiedeberg and Stendel (Germany), Ivar Bang (Sweden) and Walter Jones and Levene (America), the confusion has been reduced to some sort of order, and it now seems probable that all ordinary nucleic acids yield two purine bases, adenine and guanine; two pyrimidine bases, cytosine and thymine and a hexose carbohydrate, the identity of which is uncertain.[1]

The Nucleolus.—In the majority of plant-nuclei, both in the higher and lower plants, there is found, in addition to the chromatin network, a deeply stained spherical or slightly irregular body (sometimes more than one) called the nucleolus (fig. 2, A to D). It is often vacuolar, sometimes granular, and in other cases it is a homogeneous body with no visible structure or differentiation. The special function of this organ has been a source of controversy during the past few years, and much uncertainty still exists as to its true nature. It forms a part of the linin or plastin network of the nucleus and may become impregnated with varying quantities of chromatin stored up for use in the formation of the chromosomes and other nuclear activities. The relation of the nucleolus to the chromosomes is clearly seen in the reconstruction of the daughter nuclei after division in the cells of the root-apex of *Phaseolus* (fig. 1, A to F). The chromosomes (fig. 1, A) unite to form an irregular mass (fig. 1, B) out of which is evolved the nucleolus and nuclear network (figs. 1, E, F) by a fusion of the chromosomes (fig. 1, C, D).

Centrosome.—The centrosome is a minute homogeneous granule found in the cytoplasm of some cells in the neighbourhood of the nucleus. It is generally surrounded by a granular or radiating cytoplasmic substance. In plant cells its presence has been demonstrated in the Thallophytes and Bryophytes. In the higher plants the structures which have been often described as centrosomes are too indefinite in their constitution to allow of this interpretation being placed upon them, and many of them are probably nothing more than granules of the fragmented nucleolus. The centrosomes in plants do not appear to be permanent organs of the cell. They are prominent during cell-division, but many disappear in the resting stage. They are more easily seen, when the nucleus is about to undergo mitosis, at the ends of the spindle, where they form the centres towards which the radiating fibres in the cytoplasm converge (see fig. 7, E G). The centrosome or centrosphere is usually regarded as the dynamic centre of the cell and a special organ of division; but its absence in many groups of plants does not lend support to this view so far as plant-cells are concerned.

Nuclear Division.—The formation of new cells is, in the case of uninucleate cells, preceded by or accompanied by the division of the nucleus. In multinucleate cells the division of the nucleus is independent of the division of the cell. Nuclear division may be indirect or direct, that is to say it may either be accompanied by a series of complicated changes in the nuclear structures called *mitosis* or *karyokinesis* (fig. 2), or it may take place by simple direct division, *amitosis*, or fragmentation. Direct division is a much less common phenomenon than was formerly supposed to be the case. It occurs most frequently in old cells, or in cells which are placed under abnormal conditions. It may also take place where rapid proliferation of the cell is going on, as in the budding of the Yeast plant. It takes place in the internodal cells of Characeae; in the old internodal cells of *Tradescantia*; and in various other cells which have lost their power of division. It has been shown that, in cells of *Spirogyra* placed under special conditions, amitotic division can be induced, and that normal mitosis is resumed when they are placed again under normal conditions. Amitosis is probably connected by a series of intermediate gradations with karyokinesis.

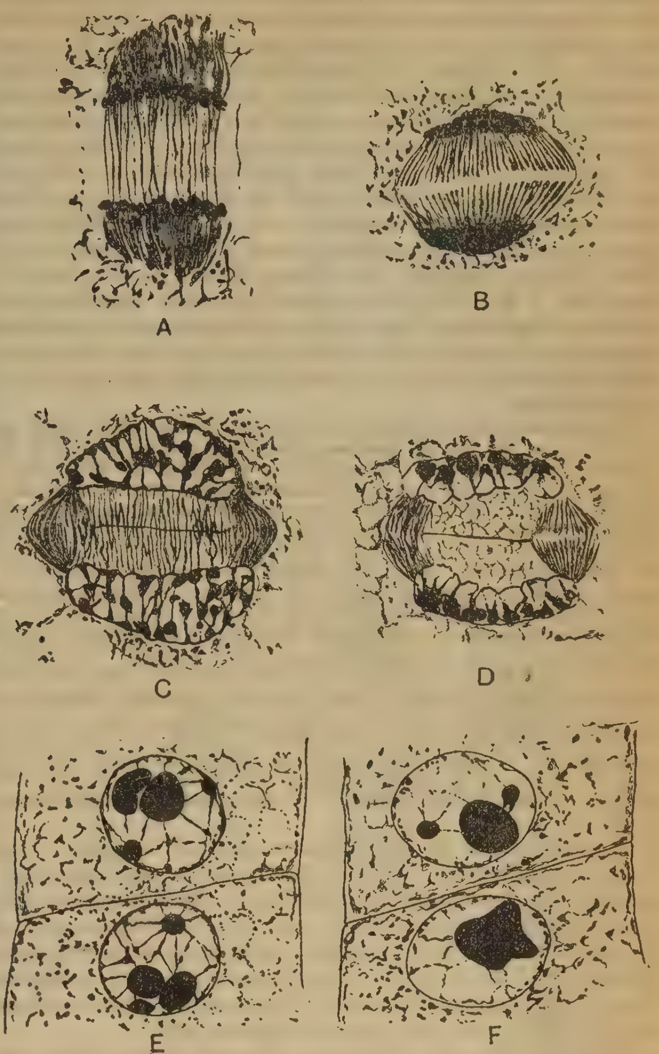

FIG. 1.—Reconstruction of the daughter nuclei of *Phaseolus*.

Mitosis.—In indirect nuclear division the nucleus undergoes a series of complicated changes, which result in an equal division of the chromatic substance between the two daughter nuclei. Four stages can be recognized. (1) *Prophase.*—The nucleus increases in size; the network disappears, and a much convoluted thread takes its place (fig. 2, B). The chromatin substance increases in amount; the thread stains more deeply, and in most cases presents a homogeneous appearance. This is commonly called the spirem-figure. The chromatin thread next becomes shorter and thicker, the nucleoli begin to disappear, and the thread breaks up into a number of segments—*chromosomes*—which vary in number in different species, but are fairly constant in the same species (fig. 2, C, D). Coincident with these changes the nuclear membrane disappears and a spindle-shaped or barrel-shaped group of threads makes its appearance in the midst of the chromosomes, the longitudinal axis of which is at right angles to the plane of the division (fig. 2, F). At each pole of this spindle figure there often occur fibres radiating in all directions into the cytoplasm, and sometimes a minute granular body, the *centrosome*, is also found there. (2) *Metaphase.*—The chromosomes pass to the equator of the spindle and become attached to the spindle-fibres in such a way that they form a radiating star-shaped figure—*Aster*—when seen from the pole of the spindle. This is called the nuclear plate (fig. 2, E, F, G, H). As they pass into this position they undergo a longitudinal splitting by which the chromatin in each chromosome becomes divided into equal halves. (3) *Anaphase.*—The longitudinal division of the chromosomes is completed by the time they have taken up their position in the nuclear plate, and the halves of the chromosomes then begin to move along the spindle-fibres to opposite poles of the spindle (fig. 2, I, J). Many observers hold the view that the chromosomes are pulled apart by the contraction of the fibres to which they are attached. (4) *Telophase.*—When they reach the poles the chromosomes group themselves again in the form of stars—*Diaster*—with spindle-fibres extending between them (fig. 2, K). The chromosomes then fuse together again to form a single thread (fig. 2, L), a nucleolus appears, a nuclear membrane is formed, and daughter nuclei are thus constituted which possess the same structure and staining reactions as the mother nucleus.

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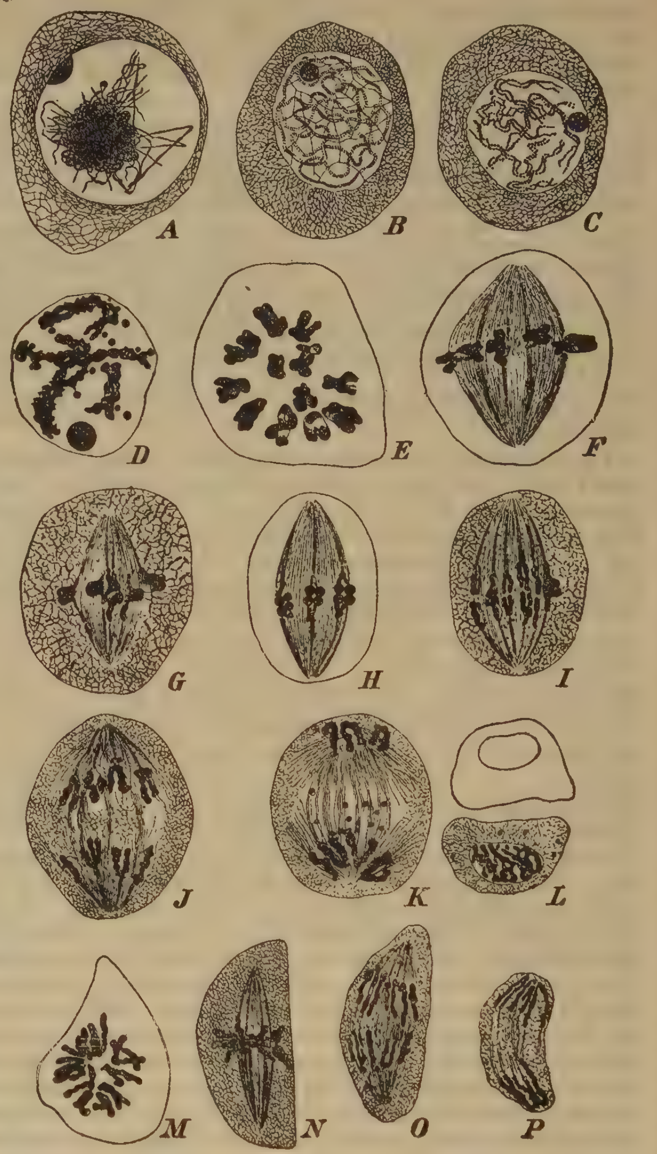
[1] See Halliburton, *Science Progress in the 20th Century* (1909), vol. iv

The spindle figure is probably the expression of forces which are set up in the cell for the purpose of causing the separation of the daughter chromosomes. Hartog has endeavoured to show that it can only be formed by a dual force, analagous to that of magnetism, the spindle-fibres being comparable to the lines of force in a magnetic field and possibly due to electrical differences in the cell. The spindle arises partly from the cytoplasm, partly from the nucleus, or it may be derived entirely from the nucleus—intranuclear spindle—as occurs in many of the lower plants (Fungi, &c.). The formation of the spindle begins in the prophases of division. A layer of delicate filamentous cytoplasm—kinoplasm—may collect around the nucleus, or at its poles, out of which the spindle is formed. As division proceeds, the filamentous nature of this cytoplasm becomes more prominent and the threads begin either to converge towards the poles of the nucleus, to form a bipolar spindle, or may converge towards, or radiate from, several different points, to form a multipolar spindle. The wall of the nucleus breaks down, and the cytoplasmic spindle-fibres become mixed with those derived from the nuclear network. The formation of the spindle differs in details in different plants.

The significance of this complex series of changes is very largely hypothetical. It is clear, however, that an equal quantitative division and distribution of the chromatin to the daughter cells is brought about; and if, as has been suggested, the chromatin consists of minute particles or units which are the carriers of the hereditary characteristics, the nuclear division also probably results in the equal division and distribution of one half of each of these units to each daughter cell.

Reduction Divisions (Meiosis).—The divisions which take place leading to the formation of the sexual cells show a reduction in the number of chromosomes to one-half. This is a necessary consequence of the fusion of two nuclei in fertilization, unless the chromosomes are to be doubled at each generation. In the vascular cryptogams and phanerogams it takes place in the spore mother cells and the reduced number is found in all the cells of the gametophyte, the full number in those of the sporophyte. We know very little of the details of reduction in the lower plants, but it probably occurs at some stage in the life history of all plants in which sexual nuclear fusion takes place. The reduction is brought about simply by the segmentation of the spirem thread into half the number of segments instead of the normal number. In order to effect this the individual chromosomes must become associated in some way, for there is no diminution in the actual amount of nuclear substance, and this leads to certain modifications in the division which are not seen in the vegetative nuclei. The two divisions of the spore mother cell in which the reduction takes place, follow each other very rapidly and are known as *Heterotype* and *Homotype* (Flemming), or according to the terminology of Farmer and Moore (1905) as the *meiotic phase.* In the heterotype division the spirem thread is divided longitudinally before the segmentation occurs (fig. 2, B), and this is preceded by a peculiar contraction of the thread around the nucleolus which has been termed *synapsis* (fig. 1, A). A second contraction may take place later, immediately preceding the segmentation of the thread. It has been suggested that synapsis may be connected with the early longitudinal splitting of the thread or with the pairing of the chromosomes, but it is possible that it may be connected with the transference of nucleolar substance to the nuclear thread. The segments of each chromosome are usually twisted upon each other and may be much contorted (fig. 2, C, D), and appearances are observed which suggest a second longitudinal division, but which are more probably due to a folding of the segment by which the two halves come to lie more or less parallel to each other, and form variously shaped figures of greater or less regularity (fig. 2, E). The chromosomes now become attached to the spindle-fibres (fig. 2, F, G) and as the daughter chromosomes become pulled asunder they often appear more or less V-shaped so that each pair appears as a closed ring of irregular shape, the ends of the V's being in contact thus—<> (fig. 2, H, I, J, K). This V has been variously interpreted. Some observers consider that it represents a *longitudinal* half of the original segment of the spireme, others that it is a half of the segment produced by *transverse* division by means of which a true qualitative separation of the chromatin is brought about. The problem is a very difficult one and cannot be regarded as definitely settled, but it is difficult to understand why all this additional complexity in the division of the nucleus should be necessary if the final result is only a *quantitative* separation of the chromatin. It seems to be fairly well established that in the meiotic phase there is a true qualitative division brought about by the pairing of the chromosomes during synapsis, and the subsequent separation of whole



(After Grégoire.)

FIG. 2.—Various Stages in the Nuclear Division of the Pollen Mother-cells of Lilium.

chromosomes to the daughter nuclei. The method by which this is brought about is, however, the subject of much controversy. There are two main theories: (1) that the chromosomes which finally separate are at first paired side by side (Allen, Grégoire, Berghs, Strasburger and others), and (2) that they are joined together or paired end to end (Farmer and Moore, Gregory, Mottier and others). Good cytological evidence has been adduced in favour of both theories, but further investigation is necessary before any definite conclusion can be arrived at. The second or homotype division which immediately follows reverts to the normal type except that the already split chromosomes at once separate to form the daughter nuclei without the intervention of a resting stage.

Cell Division.—With the exception of a few plants among the Thallophytes, which consist of a single multinucleate cell, *Caulerpa*, *Vaucheria*, &c., the division of the nucleus is followed by the division of the cell either at once, in uninucleate cells, or after a certain number of nuclear divisions, in multinucleate cells. This may take place in various ways. In the higher plants, after the separation of the daughter nuclei, minute granular swellings appear, in the equatorial region, on the connecting fibres which still persist between the two nuclei, to form what is called the cell-plate. These fuse together to form a membrane (fig. 1, C, D) which splits into two layers between which the new cell-wall is laid down. In the Thallophytes the cytoplasm may be segmented by constriction, due to the in-growth of a new cell wall from the old one, as in *Spirogyra* and *Cladophora*, or by the formation of cleavage furrows in which the new cell-wall is secreted, as occurs in the formation of the spores in many Algae and Fungi. Cell budding takes place in yeast and in the formation of the conidia of Fungi.

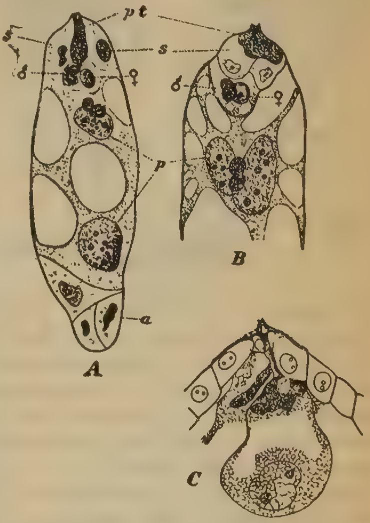
In a few cases both among the higher and the lower plants, of which the formation of spores in the ascus is a typical example, new cells are formed by the aggregation of portions of the cytoplasm around the nuclei which become delimited from the rest of the cell contents by a membrane. This is known as free cell formation.

In *Fucus* and allied forms the spindle-fibres between the daughter nuclei disappear early and the new cell-wall is formed in the cytoplasm.

Cell Membrane.—The membrane which surrounds the protoplasts in the majority of plants is typically composed of cellulose, together with a number of other substances which are known as pectic compounds. Some of these have a neutral reaction, others react as feeble acids. They can be distinguished by their insolubility in cuprammonia, which dissolves cellulose, and by their behaviour towards stains, some of which stain pectic substances but not cellulose. Cellulose has an affinity for acid stains, pectic substances for basic stains. The cell-membrane may become modified by the process of lignification, suberization, cuticularization or gelatinization. In the Fungi it is usually composed of a modified form of cellulose known as fungus cellulose, which, according to Mangin, consists of callose in combination either with cellulose or pectic compounds. The growth of the cell-wall takes place by the addition of new layers to those already formed. These layers are secreted by the protoplasm by the direct apposition of substances on those already in existence; and they may go on increasing in thickness, both by apposition and by the intussusception of particles probably carried in through the protoplasmic fibres, which penetrate the cell-wall as long as the cell lives. The growth of the cell-wall is very rarely uniform. It is thickened more in some places than in others, and thus are formed the spiral, annular and other markings, as well as the pits which occur on various cells and vessels. Besides the internal or centripetal growth, some cell-walls are thickened on the outside, such as pollen grains, oospores of Fungi, cells of Peridineae, &c. This centrifugal growth must apparently take place by the activity of protoplasm external to the cell. The outer protective walls of the oospores of some Fungi are formed out of protoplasm containing numerous nuclei, which is at an early stage separated from the protoplasm of the oospore. In the Peridineae, Diatoms and Desmids, according to recent researches, the thickenings on the outer walls of the cells are due to the passage of protoplasm from the interior of the cell to the outside, through pores which are found perforating the wall on all sides.

Cell-walls may become modified by the impregnation of various substances. Woody or lignified cell-walls appear to contain substances called *coniferin* and *vanillin*, in addition to various other compounds which are imperfectly known. Lignified tissues are coloured yellow by aniline sulphate or aniline chloride, violet with phloroglucin and hydrochloric acid, and characteristic reactions are also given by mixtures containing phenol, indol, skatol, thallin, sulphate, &c. (see Zimmermann's *Microtechnique*). Staining reagents can also be used to differentiate lignified cell-walls. Cuticularized or suberized cell-walls occur especially in those cells which perform a protective function. They are impervious to water and gases. Both cuticularized and suberized membranes are insoluble in cuprammonia, and are coloured yellow or brown in a solution of chlor-iodide of zinc. It is probable that the corky or suberized cells do not contain any cellulose (Gilson, Wisselingh); whilst cuticularized cells are only modified in their outer layers, cellulose inner layers being still recognizable. The suberized and cuticularized cell-walls appear to contain a fatty body called suberin, and such cell-walls can be stained red by a solution of alcanin, the lignified and cellulose membranes remaining unstained.

Fertilization.—The formation of the zygote or egg-cell takes place usually by the fusion of the contents of two cells, and always includes, as an essential feature, the fusion of two germ nuclei. In many of the lower plants the fusing cells—*gametes*—are precisely similar so far as size and general appearance are concerned; and the whole contents of the two cells fuse together, cytoplasm with cytoplasm, nucleus with nucleus, nucleolus with nucleolus and plastid with plastid. The gametes may be motile (some Algae) or non-motile, as in *Spirogyra*, *Mucor*, *Basidiobolus*, &c. In many of the lower plants and in all higher plants there is a difference in size in the fusing cells, the male cell being the smaller. The reduction in size is due to the absence of cytoplasm, which is in some cases so small in amount that the cell consists mainly of a nucleus. In all cases of complete sexual differentiation the egg-cell is quiescent; the male cell may be motile or non-motile. In many of the Fungi the non-motile male cell or nucleus is carried by means of a fertilizing tube actually into the interior of the egg-cell, and is extruded through the apex in close proximity to the egg nucleus. In the Florideae, Lichens and Laboulbeniaceae the male cell is a non-motile spermatium, which is carried to the female organ by movements in the water. In *Monoblepharis*, one of the lower Fungi, in some Algae, in the Vascular Cryptograms, in Cycads (*Zamia* and *Cycas*), and in *Ginkgo*, an isolated genus of Gymnosperms, the male cell is a motile spermatozoid with two or more cilia. In the Algae, such as *Fucus*, *Volvox*, *Oedogonium*, *Bulbochaete*, and in the Fungus *Monoblepharis*, the spermatozoid is a small oval or elongate cell containing nucleus, cytoplasm and sometimes plastids. In the Characeae, the Vascular Cryptogams, in *Zamia* and *Cycas*, and in *Ginkgo*, the spermatozoids are more or less highly modified cells with two or more cilia, and resemble in many respects, both in their



(From Wilson. After Guignard and Mottier.)

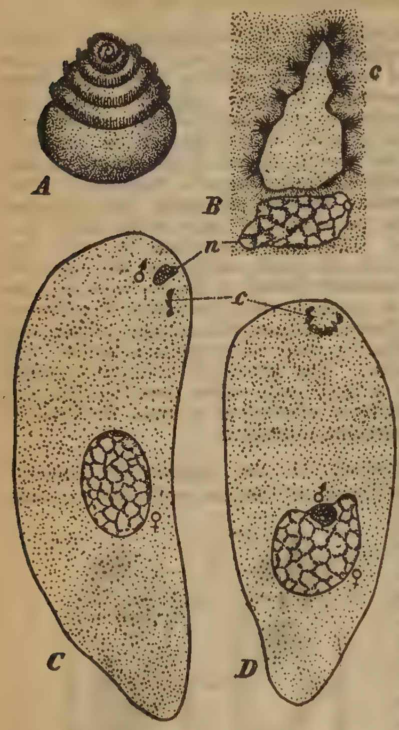
FIG. 3.—Fertilization in the Lily.

a, Antipodal cell; *sp*, polar nuclei; *pt*, pollen tube.

A, Two vermiform nuclei in the embryo sac; one approaching the egg-nucleus, the other uniting with the upper polar nucleus.

B, Union of the vermiform nuclei with the egg-nucleus and the two polar nuclei.

C, Fusion of the germ nuclei in the egg-cell.



(After Webber.)

FIG. 4.—Spermatozoid and Fertilization in Zamia.

structure and mode of formation, the spermatozoids of animals. In Characeae and Muscineae they are of elongate spiral form, and consist of an elongate dense nucleus and a small quantity of cytoplasm. At the anterior end are attached two cilia or flagella. In the Vascular Cryptogams the structure is much the same, but a more or less spherical mass of cytoplasm remains attached to the posterior spirals, and a large number of cilia are grouped along the cytoplasmic anterior portion of the spiral. In *Zamia* (fig. 4, A), *Cycas* and *Ginkgo* they consist of large spherical or oval cells with a coiled band of cilia at one end, and a large nucleus which nearly fills the cell. They are carried by the pollen tube to the apex of the prothallus, where they are extruded, and by means of their cilia swim through a small quantity of liquid, contained in a slight depression to the oosphere. In the other Phanerogams the male cell, which is non-motile, is carried to the oosphere by means of a pollen tube. In the spermatozoids of *Chara*, Vascular Cryptogams, and in those of *Cycas*, *Zamia* and *Ginkgo*, the cilia arise from a centrosome-like body which is found on one side of the nucleus of the spermatozoid mother-cell. This body has been called a *blepharoplast*, and in the Pteridophytes, Cycads and *Ginkgo* it gives rise to the spiral band on which the cilia are formed. Belajeff regards it as a true centrosome; but this is doubtful, for while in some cases it appears to be connected with the division of the cell, in others it is independent of it. The egg-cell or oosphere is a large cell containing a single large nucleus, and in the green plants the rudiments of plastids. In plants with multinucleate cells, such as *Albugo*, *Peronospora* and *Vaucheria*, it is usually a uninucleate cell differentiated by separation of the nuclei from a multinucleate cell, but in *Albugo bliti* it is multinucleate, and in *Sphaeroplea* it may contain more than one nucleus. In some cases the region where the penetration of the male organ takes place is indicated on the oosphere by a hyaline receptive spot (*Oedogonium*, *Vaucheria*, &c.), or by a receptive papilla consisting of hyaline cytoplasm (Peronosporeae). Fertilization is effected by the union of two nuclei in all those cases which have been carefully investigated. Even in the multinucleate oosphere of *Albugo bliti* the nuclei fuse in pairs; and in the oospheres of *Sphaeroplea*, which may contain more than one nucleus, the egg nucleus is formed by the fusion of one only of these with the spermatozoid nucleus (Klebahn). In the higher Fungi nuclear fusions take place in basidia or asci which involve the union of two (fig. 7, A) nuclei, which may be regarded as physiologically equivalent to a sexual fusion. The union of the germ nuclei has now been observed in all the main groups of Angiosperms, Gymnosperms, Ferns, Mosses, Algae and Fungi, and presents a striking resemblance in all. In nearly all cases the nuclei appear to fuse in the resting stage (fig. 3, C). In many Gymnosperms the male nucleus penetrates the female nucleus before fusing with it (Blackman, Ikeno). In other cases the two nuclei place themselves side by side, the nuclear membrane between them disappears, and the contents fuse together—nuclear thread with nuclear thread, and nucleolus with nucleolus—so completely that the separate constituents of the nuclei are not visible. It was at one time thought that the centrosomes played an important part in the fertilization of plants, but recent researches seem to indicate that this is not so. Even in those cases where the cilia band, which is the product of the centrosome-like body or blepharoplast, enters the ovum, as in *Zamia* (*c* in fig. 4, B, C, D), it appears to take no part in the fertilization phenomena, nor in the subsequent division of the nucleus. During the process of fertilization in the Angiosperms it has been shown by the researches of Nawaschin and Guignard that in *Lilium* and *Fritillaria* both generative nuclei enter the embryo sac, one fusing with the oosphere nucleus, the other with the polar nuclei (fig. 3, A, B). A double fertilization thus takes place. Both nuclei are elongated vermiform structures, and as they enter the embryo sac present a twisted appearance like a spermatozoid without cilia (fig. 3, A, B). It has since been shown by other observers that this double fertilization occurs in many other Angiosperms, both Dicotyledons and Monocotyledons, so that it is probably of general occurrence throughout the group (see ANGIOSPERMS).

The Nucleus in Relation to Heredity.—There is a certain amount of cytological evidence to show that the nucleus is largely concerned with the transmission of hereditary characters. Whether this is entirely confined to the nucleus is, however, not certain. The strongest direct evidence seems to be that the nuclear substances are the only parts of the cells which are always equivalent in quantity, and that in the higher plants and animals the male organ or spermatozoid is composed almost entirely of the nucleus, and that the male nucleus is carried into the female cell without a particle of cytoplasm.[1]

Since, however, the nucleus of the female cell is always accompanied by a larger or smaller quantity of cytoplasm, and that in a large majority of the power plants and animals the male cell also contains cytoplasm, it cannot yet be definitely stated that the cytoplasm does not play some part in the process. On the other hand, the complex structure of the nucleus with its separate units, the chromosomes, and possibly even smaller units represented by the chromatin granules, and the means taken through the complex phenomena of mitosis to ensure that an exact and equal division of the chromosomes shall take place, emphasizes the importance of the nucleus in heredity. Further, it is only in the nucleus and in its chromosomes that we have any visible evidence to account for the Mendelian segregation of characters in hybrids which are known to occur. Visible differences in the chromosomes have even been observed, especially in insects, which are due apparently to an unequal division by which an additional or accessory chromosome is produced, or in some cases one or two extra chromosomes which differ in size from the others. These differences indicate a separation of different elements in the formation of the chromosomes and have been definitely associated with the determination of sex. It is possible, however, that the segregation of characters in the gametes may depend upon something far more subtle and elusive than the chromosomes or even of possible combinations of units within the chromosomes, but so far as we can see at present these are the only structures in the cell with which it can be satisfactorily associated. Boveri in fact has put forward the view that the chromosomes are elementary units which maintain an organic continuity and independent existence in the cell. The cytological evidence for this appears to be made stronger for animal than for plant cells. From numerous investigations which have been made to trace the chromosomes through the various stages of the nuclear ontogeny of plant cells, it appears that the individuality and continuity of the chromosomes can only be conceived as possible if we assume the existence of something like chromosome centres in the resting nucleus around which the chromosomes become organized for purposes of division. Rosenberg (1909) adduces evidence for the existence of chromosomes or "prochromosomes" in resting nuclei in a large number of plants, but most observers consider that the chromosomes during the resting stage become completely resolved into a nuclear network in which no trace of the original chromosomes can be seen.

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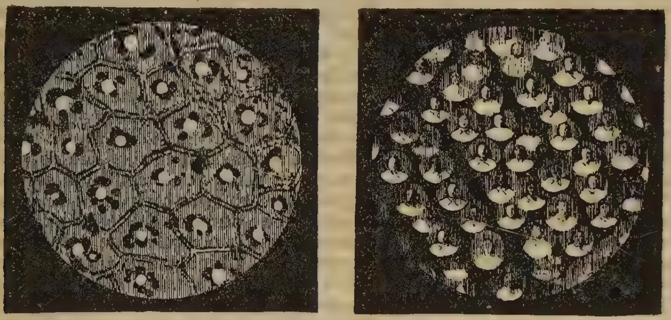
[1] Strasburger (1909) states very definitely that he has observed the entrance of the male nucleus into the egg without a trace of cytoplasm.

Special Cell-Modifications for the Reception of Stimuli.—In studying the physiology of movement in plants certain modifications of cell-structure have been observed which appear to have been developed for the reception of the stimuli by which the response to light, gravity and contact are brought about. Our knowledge of these structures is due mainly to Haberlandt.

Organs which respond to the mechanical stimulus of contact are found to possess special contrivances in certain of their cells—(1) sensitive spots, consisting of places here and there on the epidermal cells where the wall is thin and in close contact with protoplasmic projections. These occur on the tips of tendrils and on the tentacles of Drosera; (2) sensitive papillae found on the irritable filaments of certain stamens; and (3) sensitive hairs or bristles on the leaves of *Dionaea muscipula* and *Mimosa pudica*—all of which are so constructed that any pressure exerted on them at once reacts on the protoplasm.

Response to the action of gravity appears to be associated with the movements of starch grains in certain cells—statolith cells—by which pressure is exerted on the cytoplasm and a stimulus set up which results in the geotropic response.

The response to the action of light in diatropic leaves is, according to Haberlandt, due to the presence of epidermal cells which are shaped like a lens, or with lens-shaped thickenings of the cuticle, through which convergence of the light rays takes place and causes a differential illumination of the lining layer of protoplasm on the basal walls of the epidermal cells, by which the stimulus resulting in the orientation of the leaf is brought about. Fig. 5, A, shows the convergence of the light to a bright spot on the basal walls of the epidermal cells of *Saxifraga hirsutum* and fig. 5, B, shows a photograph taken from life through the epidermal cells of *Tradescantia fluminensis*. Notwithstanding the fact, however, that these cells are capable of acting as very efficient lenses the explanation given by Haberlandt has not been widely accepted and evidence both morphological and physiological has been brought forward against it.

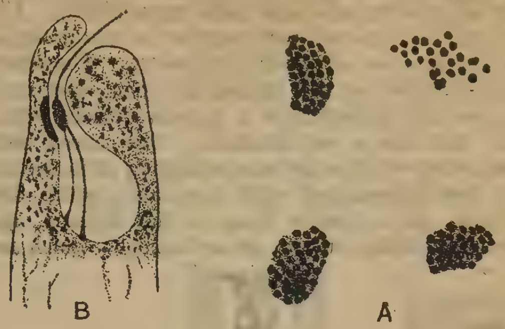


A FIG. 5. B

A, Epidermal cells of *Saxifraga hirsutum*.
B, of *Tradescantia fluminensis*.

The presence of an eye-spot in many motile unicellular Algae and swarm spores is also probably concerned with the active response to light exhibited by these organisms. In *Euglena viridis*, which has been most carefully studied in this respect, the flagellum which brings about the movement bears near its base a minute spherical or oval refractive granule or swelling which is located just in the hollow of the red pigment-spot (fig. 6); and it has been suggested that the association of these two is analogous to the association of the rods and cones of the animal eye with their pigment layer, the light absorbed by the red pigment-spot setting up changes which react upon the refractive granule and being transmitted to the flagellum bring about those modifications in its vibrations by which the direction of movement of the organism is regulated.

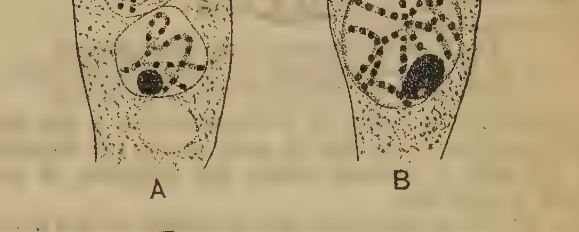
The Nuclei of the Lower Plants.—It is only in comparatively recent times that it has been possible to determine with any degree of certainty that the minute deeply stainable bodies described more especially by Schmitz (1879) in many Algae and Fungi could be regarded as true nuclei. The researches of the last twenty years have shown that the structure of the nucleus and the phenomena of nuclear division in these lower forms conforms in all essential details to those in the higher plants. Thus in the Basidiomycetes (fig. 7) the nuclei possess all the structures found in the higher plants, nuclear membrane, chromatin network and nucleolus (fig. 7, B), and in the process of division, chromosomes, nuclear spindle and centrosomes are to be seen (fig. 7, C–G). The investigations of Dangeard, Harper, Blackman, Miss Fraser and many others have also shown that in the Ascomycetes, Rust Fungi, &c., the same structure obtains so far as all essential details are concerned.



(From the *Journal of the Linnean Society*, "Zoology" vol. xxvii.)

FIG. 6.—A, Eye-spots of *Euglena viridis*. B, Anterior end of *Euglena* showing the flagellum with its swelling just in the hollow of the eye-spot.

The only groups of plants in which typical nuclei have not been found are the Cyanophyceae, Bacteria and Yeast Fungi.

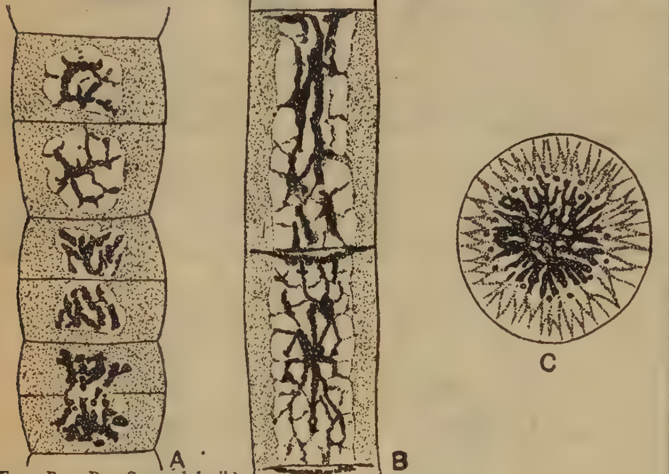


(From the *Annals of Botany*, vols. vii. and viii.)

FIG. 7.—Nuclei and Nuclear Division in the Basidiomycetes.
A to D, *Amanita muscarius*; E to G, *Mycena galericulatus*.

A, Basidium with two nuclei. B, single nucleus due to the fusion of the two pre-existing nuclei. C, Nuclear thread segmenting. D, Nuclear cavity with chromosomes. E, Chromosomes on the spindle. F, Separation of the chromosomes into two groups. G, Chromosomes grouped at opposite ends of the spindle to form the daughter nuclei.

In the Cyanophyceae the contents of the cell are differentiated into a central colourless region, and a peripheral layer containing the chlorophyll and other colouring matters together with granules of a reserve substance called cyanophycin. Chromatin is contained in the central part together with granules known as volutin, the function of which is unknown. The central body probably plays the part of a nucleus and some observers consider that it has the characters of a typical nucleus with mitotic division. But this is very doubtful. The central body seems to consist merely of a spongy mass of slightly stainable substance, more or less impregnated with chromatin, which divides by constriction. At a certain stage in the division figures are produced resembling a mitotic phase (fig. 8, 1), which are not, in the opinion of the writer, to be interpreted as a true mitosis. It is interesting to note that in many species the formation of new cell-walls is initiated before any indication of nuclear division is to be seen.



(From *Proc. Roy. Soc.*, vol. lxxii.)

FIG. 8.—Cell Structure of the Cyanophyceae.
A and B, *Tolypothrix lanata*: (1) Young, (2) Old cells.
C, *Oscillaria limosa*: transverse microtome section.

The bacteria, in most cases, have no definite nucleus or central body. The chromatin is distributed throughout the cytoplasm in the form of granules which may be regarded as a distributed nucleus corresponding to what Hertwig has designated, in protozoa, *chromidia*.

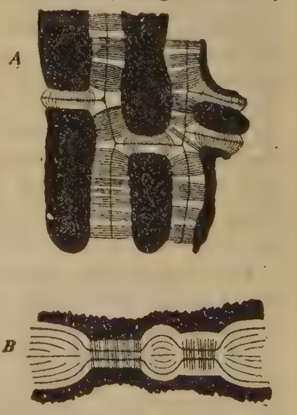
In the yeast cell the nucleus is represented by a homogenous granule, probably of a nucleolar nature, surrounded and perhaps to some extent impregnated by chromatin and closely connected with a vacuole which often has chromatin at its periphery, and contains one or more volutin granules which appear to consist of nucleic acid in combination with an unknown base. Some observers consider that the yeast nucleus possesses a typical nuclear structure, and exhibits division by mitosis, but the evidence for this is not very satisfactory.

Tissues.—The component parts of the tissues of which plants are composed may consist of but slightly modified cells with copious protoplasmic contents, or of cells which have been modified in various ways to perform their several functions. In some the protoplasmic contents may persist, in others they disappear. The formation of the conducting tubes or secretory sacs which occur in all parts of the higher plants is due either to the elongation of single cells or to the fusion of cells together in rows by the absorption of the cell-walls separating them. Such cell-fusions may be partial or complete. Cases of complete fusion occur in the formation of laticiferous vessels, and in the spiral, annular and reticulate vessels of the xylem. Incomplete fusion occurs in sieve tubes. Tubes formed by the elongation of single cells are found in bast fibres, tracheides, and especially in laticiferous cells.

Laticiferous Tissue.—The laticiferous tissue consists of a network of branching or anastomosing tubes which contain a coagulable fluid known as latex. These tubes penetrate to all parts of the plant and occur in all parts of the root, stem and leaves. A protoplasmic lining is found on their walls which contains nuclei. The walls are pitted, and protoplasmic connexions between the laticiferous tubes and neighbouring parenchyma-cells have been seen. There are two types of laticiferous tissue—non-articulate and articulate. The non-articulate tissue which occurs in Euphorbiaceae, Apocynaceae, Urticaceae, Asclepiadaceae, consists of long tubes, equivalent to single multinucleate cells, which ramify in all directions throughout the plant. Laticiferous vessels arise by the coalescence of originally distinct cells. The cells not only fuse together in longitudinal and transverse rows, but put out transverse projections, which fuse with others of a similar nature, and thus form an anastomosing network of tubes which extends to all parts of the plant. They are found in the Compositae (*Cichoriaceae*), Campanulaceae, Papaveraceae, Lobeliaceae, Papayaceae, in some Aroideae and Musaceae, and in Euphorbiaceae (*Manihot*, *Hevea*). The nuclei of the original cells persist in the protoplasmic membrane. The rows of cells from which the laticiferous vessels are formed can be distinguished in many cases in the young embryo while still in the dry seed (Scott), but the latex vessels in process of formation are more easily seen when germination has begun. In the process of cell-fusion the cell-wall swells slightly and then begins to dissolve gradually at some one point. The opening, which is at first very small, increases in size, and before the cross-wall has entirely disappeared the contents of the two cells become continuous (Scott). The absorption of the cell-walls takes place very early in the germinating seedling.

Sieve Tubes.—The sieve tubes consist of partially fused rows of cells, the transverse or lateral walls being perforated by minute openings, through which the contents of the cells are connected with each other, and which after a certain time become closed by the formation of callus on the sieve plates. The sieve tubes contain a thin lining layer of protoplasm on their walls, but no nuclei, and the cell sap contains albuminous substances which are coagulable by heat. Starch grains are sometimes present. In close contact with the segments of the sieve tubes are companion cells which communicate with the sieve tubes by delicate protoplasmic strands; they can be distinguished from ordinary parenchymatous cells by their small size and dense protoplasm. Companion cells are not found in the Pteridophyta and Gymnosperms. In the latter their place is taken by certain cells of the medullary rays and bast parenchyma. The companion cells are cut off from the same cells as those which unite to form the sieve tube. The mode of formation of the sieve plate is not certainly known; but from the fact that delicate connecting threads of protoplasm are present between the cells from their first development it is probable that it is a special case of the normal protoplasmic continuity, the sieve pores being produced by a secondary enlargement of the minute openings through which these delicate strands pass. According to Lecomte, the young wall consists partly of cellulose and partly of a substance which is not cellulose, the latter existing in the form of slight depressions, which mark the position of the future pores. As the sieve plate grows these non-cellulose regions swell and gradually become converted into the same kind of mucous substance as that contained in the tube; the two cells are thus placed in open communication. If this is correct it is easy to see that the changes which take place may be initiated by the original delicate protoplasmic strands which pass through the cell-wall. (For further information regarding tissues, see the section on *Anatomy* above.)

Protoplasmic Continuity.—Except in the unicellular plants the cell is not an independent unit. Apart from their dependence in various ways upon neighbouring cells, the protoplasts of all plants are probably connected together by fine strands of protoplasm which pass through the cell-wall (Tangl, Russow, Gardiner, Kienitz-Gerloff and others) (fig. 9). In *Pinus* the presence of connecting threads has recently been demonstrated throughout all the tissues of the plant. These protoplasmic strands are, except in the case of sieve tubes, so delicate that special methods have to be employed to make them visible. The basis of these methods consists in causing a swelling of the cell-wall by means of sulphuric acid or zinc chloride, and subsequent staining with Hoffmann's blue or other aniline dyes. The results so far obtained show that the connecting threads may be either "pit-threads" which traverse the closing membrane of the pits in the cell-walls (fig. 9, B), or "wall-threads" which are present in the wall of the cell (fig. 9, A). Both



(After Gardiner.)

FIG. 9.—Continuity of protoplasm of cells of *Tamus communis* (A) and endosperm of *Lilium Martagon* (B).

pit-threads and wall-threads may occur in the same cell, but more often the threads are limited to the pits. The pit-threads are larger and stain more readily than the wall-threads. The threads vary in size in different plants. They are very thick in *Viscum album*, and are well seen in *Phaseolus multiflorus* and *Lilium Martagon*. They are present from the beginning of the development of the cell-wall, and arise from the spindle fibres, all of which may be continued as connecting threads (endosperm of *Tamus communis*), or part of them may be overlaid by cellulose lamellae (endosperm of *Lilium Martagon*), or they may be all overlaid as in pollen mother-cells and pollen grains of *Helleborus foetidus*. The presence of these threads between all the cells of the plant shows that the plant body must be regarded as a connected whole; the threads themselves probably play an important part in the growth of the cell-wall, the conduction of food and water, the process of secretion and the transmission of impulses.

LITERATURE.—The following is a list of a few of the more important papers in which further information and a more complete list of literature will be found: Allen, "Nuclear Division in the Pollen Mother-cells of Lilium canadense," *Annals of Botany* (1905), vol. xix.; Berghs, "La Formation des chromosomes hétérotypiques dans la sporogénèse végétale," *La Cellule* (1904), vol. xxi.; Blackman, "On the Fertilization, Alternation of Generations, and General Cytology of the Uredineae," *Ann. of Bot.* (1904), vol. xviii.; Bütschli, *Untersuchungen über mikroskopische Schäume und das Protoplasma* (Leipzig, 1892; Eng. trans. by Minchin, London, 1894); also *Untersuchungen über Struktur* (Leipzig, 1898); Courchet, "Recherches sur les Chromoleucites," *Ann. d. sci. nat.* (*bot.*): (1888); Delage, *L'Année biologique: comptes rendus annuels des travaux de biologie générale* (Paris, 1895), &c.; Farmer, "Recent Advances in Vegetable Cytology," *Science Progress* (1896), vol. v.; "The Cell and some of its Constituent Structures," *Science Progress* (1897); Farmer and Moore, "On the Meiotic Phase in Animals and Plants," *Quart. 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MORPHOLOGY OF PLANTS

The term *morphology*, which was introduced into science by Goethe (1817), designates, in the first place, the study of the form and composition of the body and of the parts of which the body may consist; secondly, the relations of the parts of the same body; thirdly, the comparison of the bodies or parts of the bodies of plants of different kinds; fourthly, the study of the development of the body and of its parts (*ontogeny*); fifthly, the investigation of the historical origin and descent of the body and its parts (*phylogeny*); and, lastly, the consideration of the relation of the parts of the body to their various functions, a study that is known as *organography*.

It is this last department of morphology that was the first to be pursued. The earliest scientific result of the study of plants was the recognition of the fact that the various parts of the body are associated with the performance of different kinds of physiological work; that they are, in fact, *organs* discharging special functions. The origin of the organography of the present day may be traced back to Aristotle, who described the parts of plants as "organs, though very simple ones." It was not until many centuries had passed that the parts began to be regarded from the point of view of their essential nature and of their mutual relations; that is, morphologically instead of organographically. Joachim Jung, in his *Isagoge phytoscopica* (1678), recognized that the plant-body consists of certain definite *members*, root, stem and leaf, and defined them by their different form and by their mutual relations. This point of view was further developed in the following century by Caspar Friedrich Wolff (*Theoria generationis*, 1759), who first followed the development of the members at the growing-point of the stem. He observed that the "appendicular organs," as he called the leaves, are developed in the same way, whether they be foliage-leaves, or parts of the flower, and stated his conclusions thus: "In the entire plant, whose parts we wonder at as being, at the first glance, so extraordinarily diverse, I finally perceive and recognize nothing beyond leaves and stem (for the root may be regarded as a stem). Consequently all parts of the plant, except the stem, are modified leaves." Similar views were arrived at by Goethe, though by the deductive rather than the inductive method, and were propounded in his famous pamphlet, *Versuch die Metamorphose der Pflanzen zu erklären* (1790), from which the following is a quotation: "The underlying relationship between the various external parts of the plant, such as the leaves, the calyx, the corolla, the stamens, which develop one after the other and, as it were, out of one another, has long been generally recognized by investigators, and has in fact been specially studied; and the operation by which one and the same organ presents itself to us in various forms has been termed *Metamorphosis of Plants*."

Pure Morphology.—Thus it became apparent that the many and various organs of plants are, for the most part, different forms of a small number of *members* of the body, which have been distinguished as follows, without any reference to function. The *thallus* (thallome) is a plant-body which is not differentiated into the members root, stem and leaf; it is the morphologically simplest body, such as is of common occurrence in the lower plants (*e.g.* Thallophyta). In a differentiated body the *stem* (caulome) is an axis capable of bearing leaves and (directly or indirectly) the proper reproductive organs. The *leaf* (phyllome) is an appendicular member only borne by a stem, but differing from it more or less obviously in form and development, though co-ordinate with it in complexity of structure. The *root* is an axis which never bears either leaves or the proper reproductive organs (whether sexual or asexual) of the plant. The *hair* (trichome) is a superficial appendage of simple structure, which may be borne by any of the other members. The *emergence* is also an appendicular member of more complex structure than the hair (*e.g.* the prickles of the rose). Further, it has been found convenient to designate the leaf-bearing stem as a whole by the term *shoot*, so that the body may, as Sachs suggested, be primarily analysed into shoot and root.

At the present time some objection is being taken to this purely morphological conception of the body and its parts as being too abstract. It is urged that the various parts are, as a matter of fact, organs; and that it is therefore inadmissible to ignore their functions, as is done in the foregoing definitions. To this it may be replied that pure morphology and organography are not alternatives, but are two complementary and equally necessary modes of considering the composition of the plant-body. Moreover, the abstract terms "stem," "leaf," "root," &c., are absolutely indispensable; and are continually used in this sense by the most ardent organographers. It has not yet been suggested that they should be replaced by organographical terms; were this accomplished, descriptive botany would become impossible.

It is also urged against these definitions that they are not of universal applicability; that there are exceptional structures which cannot be brought within the limits of any one of them. But admitting the validity of this criticism, and even going so far as to question the possibility of ever devising absolutely inclusive and, at the same time, exclusive definitions, no sufficient reason is adduced for giving up all attempt at morphological analysis.

Homology.—All members belonging to the same morphological category are said to be *homologous*, however diverse their functions. Thus, in a phanerogam, the sepals, petals, stamens and foliage-leaves all come under the category *leaf*, though some are parts of the perianth, others are spore-bearing organs (*sporophylls*), and others carry on nutritive processes. The homology of members was based, in the first instance, upon similarity of development and upon similar relations to the other parts of the body, that is, upon *ontogeny*. But since the general adoption of the theory of evolution, similarity of descent, that is of *phylogeny*, has come to form an essential part of this conception; in other words, in order that their homology may be established the parts compared must be proved to be *homogenetic*.

The introduction of the phylogenetic factor has very much increased the difficulty of determining homologies; for the data necessary for tracing phylogeny can only be obtained by the study of a series of allied, presumably ancestral, forms. One of the chief difficulties met with in this line of research, which is one of the more striking developments of modern morphology, is that of distinguishing between organs which are "reduced," and those which are really "primitive." The object of the phylogenetic study of any organ is to trace it back to its primitive form. But, as will be pointed out later, organs are often found to have undergone "degeneration" or "reduction," and such reduced or degenerate structures may easily be mistaken for primitive structures, and so the investigator may be misled.

The effect of the phylogenetic factor in homology may be illustrated in the following cases. The leaves of the true mosses and those of the club-mosses (*Lycopodium*, *Selaginella*) being somewhat alike in general appearance and in ontogeny, might be, and indeed have been, regarded as homologous on that ground. However, they belong respectively to two different forms in the life-history of the plants; the leaves of the mosses are borne by the gametophyte, those of the club-mosses by the sporophyte. In accordance with the prevalent antithetic view of the alternation of generations in these plants (see PLANTS, REPRODUCTION OF), the forms distinguished as sporophyte and gametophyte are not homogenetic; consequently their leaves are not homologous, but are only functionally similar (homoplastic; see *infra*).

Another effect is that different degrees of homology have to be recognized, just as there are different degrees of relationship or affinity between individual plants. When two organs can be traced along the same line of descent to one primitive form, that is when they are found to be *monophyletic*, their homology is *complete*; when, however, they are traceable to two primitive forms, though these forms belong to the same morphological series, they are *polyphyletic* and therefore only *incompletely* homologous. For instance, all the leaves of the Bryophyta are *generally homologous* inasmuch as they are all developments of the gametophyte. But there is reason to believe that they have been differentiated quite independently in various groups, such as the Marchantiaceae, the Jungermanniaceae, and the mosses proper; consequently their phylogeny is not the same, they are polyphyletic, and therefore they are not completely homologous, but are *parallel developments*.

Analogy.—Considering the parts of the body in relation to their functions, that is as *organs*, they are found to present peculiarities of form and structure which are correlated with the functions that they have to discharge; in other words, the organ shows adaptation to its functions. All organs performing the same function and showing similar adaptations are said to be *analogous* or *homoplastic*, whatever their morphological nature may be; hence organs are sometimes both homologous and analogous, sometimes only analogous. The tendrils of a vetch and of a cucumber are analogous, and also homologous because they both belong to the category *leaf*; but they are only analogous to the tendrils of the vine and of the passion-flower, which belong to the category *stem*.

Metamorphosis.—It has already been pointed out that each kind of member of the body may present a variety of forms. For example, a *stem* may be a tree-trunk, or a twining stem, or a tendril, or a thorn, or a creeping rhizome, or a tuber; a *leaf* may be a green foliage-leaf, or a scale protecting a bud, or a tendril, or a pitcher, or a floral leaf, either sepal, petal, stamen or carpel (sporophyll); a *root* may be a fibrous root, or a swollen tap-root like that of the beet or the turnip. All these various forms are organs discharging some special function, and are examples of what Wolff called "modification," and Goethe "metamorphosis." It may be inquired what meaning is to be attached to these expressions, and what are the conditions and the nature of the changes assumed by them. The leaf of the higher plants will be taken as the illustrative case because it is the most "plastic" of the members, the one, that is, which presents the greatest variety of adaptations, and because it has been most thoroughly studied.

In this, as in all morphological inquiries, two lines of investigation have to be followed, the phylogenetic and the ontogenetic. Beginning with its phylogeny, it appears, so far as present knowledge goes, that the differentiation of the shoot of the sporophyte into stem and leaf first occurred in the Pteridophyta; and, in accordance with the views of Bower (*Origin of a Land-Flora*), the primitive leaf was a reproductive leaf, a sporophyll, from which the foliage-leaf was derived by progressive sterilization. From the nature of the case, this view is not, and could not be, based upon actual observation, nor is it universally accepted; however, it seems to correspond more closely than any other to the facts of comparative morphology. It was formerly assumed, and the view is still held, that the foliage-leaf was the primitive form from which all others were derived, mainly on the ground that, in ontogeny, the foliage-leaf generally precedes the sporophyll. The phylogeny of the various floral leaves, for instance, was generally traced as follows: foliage-leaf, bract, sepal, petal, stamen and carpel (sporophylls)—in accordance with what Goethe termed "ascending metamorphosis." Recent researches, however, more especially those of Celakovsky, tend to prove that the perianth-leaves have been derived from the stamens (*i.e.* from sporophylls); that is, they are the result of "descending metamorphosis." Moreover there is the fact that the flowers of nearly all the primitive phanerogams, such as the Gymnosperms, consist solely of sporophylls, having no perianth. There is thus a considerable body of evidence to support Bower's view of the primitive nature of the sporophyll.

Accepting this view of the phylogeny of the leaf, the perianth-leaves (sepals and petals) and the foliage-leaves may be regarded as "modified" or "metamorphosed" sporophylls; that is, as leaves which are adapted to functions other than the bearing of spores. The sepals are generally organs for the protection of the flower-bud; the petals, for attracting insects by their conspicuous form and colour; the foliage-leaves, for the assimilation of carbon dioxide and other associated functions. But this phylogenetic differentiation of the organs was not what Wolff and Goethe had in mind; what they contemplated was an ontogenetic change, and there is abundant evidence that such changes actually occur. Taking first the conversion of members of one morphological category into those of another, this has been actually observed, though rarely. Goebel (*Organography*) gives several instances of the conversion of the root into a shoot in ferns, and a few in phanerogams (*Listera ovata, Neottia nidus-avis, Anthurium longifolium*). Much more common is the conversion of one form of a member into another form. The most varied changes of this kind have been described, and are generally familiar as "monstrosities"; the study of them constitutes, under the name of *teratology*, a distinct department of biology. A simple case is that of "double" flowers, in which the number of the petals is increased by the "metamorphosis" of stamens; or again the conversion of floral leaves into green leaves, a change known as "chloranthy." These changes may be brought about by external causes, such as the attacks of insects or of fungi, alterations in external conditions, &c., or by some unexplained internal disturbance of the morphological equilibrium. They can also be effected experimentally. Goebel has shown that if the developing foliage-leaves of the fern *Onoclea struthiopteris* be removed as they are formed, the subsequently developed sporophylls assume more or less completely the habit of foliage-leaves, and may be sterile. Similarly bud-scales can be caused to develop into foliage-leaves, if the buds to which they belong are caused to grow out in the year of their formation by the removal of the existing foliage-leaves.

Useful and suggestive as they often are, teratological facts played, at one time, too large a part in the framing of morphological theories; for it was thought that the "monstrous" form gave a clue to the essential nature of the organ assuming it. There is, however, no sufficient reason for regarding the monstrous form as necessarily primitive or ancestral, nor even as a stage in the ontogeny of the organ. For when the older morphologists spoke of a stamen as a "metamorphosed" leaf, it was implied that it originated as a foliage-leaf and subsequently became a stamen. As a matter of fact, a stamen is a stamen and nothing else, from the very beginning. The development of the organ is already determined at its first appearance upon the growing-point; though, as already explained, the normal course of its ontogeny may be interfered with by some abnormal external or internal condition. The word "metamorphosis" cannot, in fact, be used any longer in its original sense, for the change which it implied does not normally occur in ontogeny, and in phylogeny the idea is more accurately expressed by the term "differentiation." However, it may still be useful in describing "monstrosities," and perhaps also those cases in which an organ serves first one purpose and then another, as when a leafy shoot eventually becomes a thorn, or the base of a foliage-leaf becomes a bud-scale.

Differentiation.—Any account of the general morphology of living organisms is incomplete if it does not include some attempt at an explanation of its causation; though such an attempt cannot be carried far at the present time. A survey of the vegetable kingdom indicates that evolution has proceeded, on the whole, from the simple to the complex; at the same time, as has been already mentioned, evidence of reduction or degeneration in common. Thus in the series Bryophyta, Pteridophyta, Phanerogamia, whilst the sporophyte presents progressive development, the gametophyte presents continuous reduction.

Evolution means the gradual development of "highly organized" from "lowly organized" forms; that is, of forms in which the "physiological division of labour" is more complete, from those in which it is less complete; of forms possessing a variety of organs, from forms possessing but few. Differentiation means the development and the specialization as organs of various parts of the body. It presents itself in two aspects: there is morphological differentiation, which can be traced in the distinction of the members of the body, root, stem, leaf, &c.; there is physiological differentiation, which can be traced in the adaptation of these members to various functions. But, in actual operation, these two processes are simultaneous; every member is developed as an organ for the performance of some special function.

Factors in Evolution.—Evolution in the race involves progressive differentiation in the individual; hence the causes of evolution and of differentiation must be the same. The evolution of higher from lower plants, it is generally assumed, has proceeded by variation. With regard to the causation of variation Darwin says (*Origin of Species*, ch. v.): "In all cases there are two factors, the nature of the organism, which is much the most important of the two, and the nature of the conditions. The direct action of changed conditions leads to definite or indefinite results. In the latter case the organization seems to become plastic, and we have much fluctuating variability. In the former case the nature of the organism is such that it yields readily, when subjected to certain conditions, and all or nearly all the individuals become modified in the same way."

In spite of the statement that the "nature of the organism" is the most important factor in variation, the tendency amongst evolutionists has been to take much more account of the influence of external conditions. Exceptions to this attitude are Lamarck, who speaks with regard to animals (but not to plants!) of "la composition croissante de l'organisation" (*Philosophie zoologique*, t. i.), and Nägeli, who attributes variation to causes inherent in the "idioplasm," and has elaborately worked out the view in his *Abstammungslehre.*

The position assumed in this article is in agreement with the views of Lamarck and of Nägeli. All but the lowest plants visibly tend towards or actually achieve in various degrees the differentiation of the body, whether sporophyte or gametophyte, into stem, leaf, root, &c., that is, the differentiation of parts not previously present. It is inconceivable that external conditions can impart to an organism the capacity to develop something that it does not already possess: can impart to it, that is, the capacity for variation in the direction of higher complexity. The alternative, which is here accepted, is that differentiation is essentially the expression of a developmental tendency inherent in the protoplasm of plants. Just as every crystallizable chemical substance assumes a definite and constant crystalline form which cannot be accounted for otherwise than by regarding it as one of the properties of the substance, so every living organism assumes a characteristic form which is the outcome of the properties of its protoplasm. But whereas the crystalline form of a chemical substance is stable and fixed, the organized form of a living organism is unstable and subject to change.

Influence of External Conditions.—This position does not, however, exclude the influence of external conditions; that influence is undeniable. Darwin's expression "the nature of the organism" has been interpreted in the preceding paragraph to mean an inherent tendency towards higher organization; that interpretation may now be completed by adding that the organism is susceptible to, and can respond to, the action of external conditions. There is every reason to believe that plants are as "irritable" to varying external conditions as they are to light or to gravity. A change in its external conditions may act as a "stimulus," evoking in the organism a response of the nature of a change in its form. As Darwin has pointed out, this response may be direct or indirect. In illustration of the indirect response, the evolution of the Bryophyta and of more highly organized plants may be briefly considered. It is generally admitted that life originated in water, and that the earliest plants were Algae. The study of existing Algae, that is of plants that have continued to live in water, shows that under these conditions no high degree of organization has been reached, though some of them have attained gigantic dimensions. The primitive water-plants were succeeded by land-plants, a land-flora being gradually established. With the transition from water to land came the progressive development of the sporophyte which is the characteristic feature of the morphology of the Bryophyta and of all plants above them in the scale of life (see Bower, *Origin of a Land-Flora*). This evolution of the sporophyte is no doubt to be correlated with the great change in the external conditions of life. There is no conclusive ground for regarding the action of this change as having been direct, it is more reasonable to regard it as indirect, having acted as a general stimulus to which the ever-increasing complexity of the sporophyte was the response.

Adaptation.—The morphological and physiological differentiation of the plant-body has, so far, been attributed to (1) "the nature of the organism," that is to its inherent tendency towards higher organization, and (2) to the "indefinite results" of the external conditions acting as a stimulus which excites the organism to variation, but does not direct the course of variation. The "definite results" of the action of external conditions have still to be considered.

It is a familiar observation that climatic and edaphic (nature of soil) conditions exert an influence upon the form and structure of plants (see PLANTS: Ecology of). For instance, some xerophytes are dry and hard in structure, whilst others are succulent and fleshy. This so-called *direct* effect of external conditions upon the form and structure of the body differs from the *indirect* effect in that the resulting variations bear a relation, of the nature of adaptation, to those conditions; the effect of the conditions is not only to cause variation, but to cause variation in a particular direction. Thus all existing hygrophytes (excepting the Algae) are considered to have been derived from land-plants which have adapted themselves to a watery habitat. The effect can also be demonstrated experimentally: thus it has been observed that a xerophyte grown in moist air will lose its characteristic adaptive features, and may even assume those of a hygrophyte.

Climatic and edaphic conditions are not, however, the only ones to affect the structure and composition of the body or its parts; other conditions are of importance, particularly the relations of the plant to animals and to other plants. For instance, the "animal traps" of carnivorous plants (*Drosera*, *Nepenthes*, &c.) did not, presumably, originate as such; they began as organs of quite another kind which became adapted to their present function in consequence of animals having been accidentally caught. It is also probable that the various forms of the angiospermous flower, with its many specialized mechanisms for pollination, may be the result of insect-visits, the flowers becoming adapted to certain kinds of insects, and the insects having undergone corresponding modification. Parasites, again, were derived from normal autotrophic plants, which, as the parasitic habit became more pronounced, acquired the corresponding characteristics of form and structure; there is, in fact, the group of hemi-parasites, plants which still retain autotrophic characters though they are root-parasites.

Though adaptation to the environment seems sometimes to be considered, especially by neo-Lamarckians, as equivalent to, or at least as involving, the evolution of higher forms from lower, there does not appear to be any evidence that this is the case. The effect of external conditions is confined to the modification in various directions of members or organs already existing, and one very common direction is that of reduction or entire disappearance of parts: for instance, the foliage-leaves of certain xerophytes (*e.g.* Cactaceae, Euphorbiaceae), of parasites, and of saprophytes. Moreover, had the evolution of plants proceeded along the line of adaptation, the vegetable kingdom could not be subdivided, as it is, into the morphological groups Thallophyta, Bryophyta, Pteridophyta, Phanerogamia, but only into physiological groups, Xerophyta, Hygrophyta, Tropophyta, &c.

In endeavouring to trace the causation of adaptation, it is obvious that it must be due quite as much to properties inherent in the plant as to the action of external conditions; the plant must possess adaptive capacity. In other words, the plant must be irritable to the stimulus exerted from without, and be capable of responding to it by changes of form and structure. Thus there is no essential difference between the "direct" and the "indirect" action of external conditions, the difference is one of degree only. In the one case the stimulus induces indefinite variation, in the other definite; but no hard-and-fast line can be drawn between them.

Adaptive characters are often hereditary, for instance, the seed of a parasite will produce a parasite, and the same is true of a carnivorous plant. On the other hand, adaptations, especially those evoked by climatic or edaphic conditions, may only be shown by the seedling if grown under the appropriate external conditions; here what is hereditary is not the actual adaptation, but the capacity for responding in a particular way to a certain set of external conditions.

Summary.—The general theory of differentiation propounded in this article is an attempt at an analysis of the factors termed by Darwin "the nature of the organism" and "the nature of the conditions." It is assumed, as an inevitable conclusion from the facts of evolution, that plant-protoplasm possesses (1) an inherent tendency towards higher organization, and (2) that it is irritable to external conditions, or to changes in them, and can respond to them by changes of form which may be either indefinite or definite (adaptive). Thus it is that the variations are produced upon which natural selection has to work.

Material Cause of Differentiation.—It may be inquired, in conclusion, if there are any facts which throw light upon the internal mechanism of differentiation, whether spontaneous or induced; if it is possible to refer it to any material cause. It may be replied that there are such facts, and though they are but few as yet, they suffice to suggest an hypothesis that may eventually prove to be a law. Sachs was the first to formulate the theory that morphological differences are the expression of differences in material composition. He considered, for instance, that stems, leaves, roots and flowers differ as they do because the plastic substances entering into their structure are diverse. This view he subsequently modified to this—that a relatively small proportion of diverse substance in each of these parts would suffice to account for their morphological differences. This modification is important, because it transfers the formative influence from the plastic substances to the protoplasm, suggesting that the diverse constituents are produced (whether spontaneously or as the result of stimulation) as secretions by the protoplasm. It is an obvious inference that if a small quantity of a substance can affect the development of an entire organ it probably acts after the manner of an enzyme. Beyerinck has, in fact, gone so far as to speak of "formative enzymes."

It is not possible to go into all the facts that might be adduced in support of this view: one case, perhaps the most pregnant, must suffice. Beyerinck was led to take up the decided position just mentioned by his researches into the conditions determining the formation of plant-galls as the result of injury by insects. He found that the development of a gall is due to a temporary modification of the part affected, not, as is generally thought, in consequence of the deposition of an egg by the insect, but of the injection of a poisonous substance which has the effect of stimulating the protoplasm to develop a gall instead of normal structure. If this be so, it may justifiably be inferred that both normal and abnormal morphological features may be due to the presence of enzymatic substances secreted by the protoplasm that determine the course of development. At any rate this hypothesis suggests an explanation of many hitherto inexplicable facts. For instance, it has been pointed out in the article on the reproduction of plants that the effect of the fertilization of the female cell in the ovule of a phanerogam is not confined to the female cell, but extends more or less widely outside it, inducing growth and tissue-change. The ovule develops into the seed; and the gynaeceum and even more remote parts of the flower, develop into the fruit. The facts are familiar, but there is no means of explaining them. In the light of Sachs's theory the interpretation is this, that the act of fertilization causes the formation in the female cell of substances which are transmitted to adjacent structures and stimulate them to further development.

LITERATURE.—As the scope of this article limits it to the general principles of the morphology of plants, comparatively few facts have been adduced. Full morphological and organographical details are given in the articles on the various groups of plants, such as those on the Algae, Bryophyta, Pteridophyta, Angiosperms, Gymnosperms, &c. The following works may also be consulted: Schimper, *Plant-Geography* (Clarendon Press, Oxford); Goebel, *Organography* (Clarendon Press, Oxford); Bower, *The Origin of a Land-Flora* (Macmillan); Beyerinck, "Ueber Cecidien," (*Bot. Zeitung*, 1888). (S. H. V.*)

DISTRIBUTION OF PLANTS

Common experience shows that temperature is the most important condition which controls the distribution of plants. Those of warmer countries cannot be cultivated in British gardens without protection from the rigours of winter; still less are they able to hold their own unaided in an unfavourable climate. Temperature, then, is the fundamental limit which nature opposes to the indefinite extension of any one species. Buffon remarked "that the same temperature might have been expected, all other circumstances being equal, to produce the same beings in different parts of the globe, both in the animal and vegetable kingdoms." Yet lawns in the United States are destitute of the common English daisy, the wild hyacinth of the woods of the United Kingdom is absent from Germany, and the foxglove from Switzerland. We owe to Buffon the recognition of the limitation of groups of species to regions separated from one another by "natural barriers." When by the aid of man they surmount these, they often dominate with unexpected vigour the native vegetation amongst which they are colonists. The cardoon and milk thistle, both European plants, cover tracts of country in South America with impenetrable thickets in which both man and beast may be hopelessly lost. The watercress blocks the rivers of New Zealand into which it has been introduced from Europe. The problem, then, which plant-distribution presents is twofold: it has first to map out the earth's surface into "regions" or "areas of vegetation," and secondly to trace the causes which have brought them about and led to their restriction and to their mutual relations.

The earliest attempts to deal with the first branch of the inquiry may be called physiognomical. They endeavoured to define "aspects of vegetation" in which the "forms" exhibited an obvious adaptation to their climatic surroundings. This has been done with success and in great detail by Grisebach, whose *Vegetation der Erde* from this point of view is still unsurpassed. With it may be studied with advantage the unique collection at Kew of pictures of plant-life in its broadest aspects, brought together by the industry and munificence of Miss Marianne North. Grisebach declined to see anything in such "forms" but the production by nature of that which responds to external conditions and can only exist as long as they remain unchanged. We may agree with Schimper that such a point of view is obsolete without rejecting as valueless the admirable accumulation of data of which it admittedly fails to give any rational explanation. A single example will be sufficient to illustrate this. The genus *Senecio*, with some 1000 species, is practically cosmopolitan. In external habit these exhibit adaptations to every kind of climatic or physical condition: they may be mere weeds like groundsels or ragworts, or climbers masquerading like ivy, or succulent and almost leafless, or they may be shrubs and even trees. Yet throughout they agree in the essential structure of their floral organs. The cause of such agreement is, according to Grisebach, shrouded in the deepest obscurity, but it finds its obvious and complete explanation in the descent from a common ancestor which he would unhesitatingly reject.

From this point of view it is not sufficient, in attempting to map out the earth's surface into "regions of vegetation," to have regard alone to adaptations to physical conditions. We are compelled to take into account the actual affinity of the plants inhabiting them. Anything short of this is merely descriptive and empirical, and affords no rational basis for inquiry into the mode in which the distribution of plant-life has been brought about. Our regions will not be "natural" unless they mark out real discontinuities both of origin and affinity, and these we can only seek to explain by reference to past changes in the earth's history. We arrive thus at "the essential aim of geographical botany," which, as stated by Schimper, is "an inquiry into the causes of differences existing among the various floras." To quote further: "Existing floras exhibit only one moment in the history of the earth's vegetation. A transformation which is sometimes rapid, sometimes slow, but always continuous, is wrought by the reciprocal action of the innate variability of plants and of the variability of the external factors. This change is due partly to the migrations of plants, but chiefly to a transformation of the plants covering the earth." This transformation is due to new characters arising through variation. "If the new characters be useful, they are selected and perfected in the descendants, and constitute the so-called 'adaptations' in which the external factors acting on the plants are reflected." The study of the nature of these adaptations, which are often extremely subtle and by no means merely superficial, is termed *Ecology* (see above).

The remark may conveniently find its place here that plants which have reached a high degree of adaptive specialization have come to the end of their tether: a too complicated adjustment has deprived them of the elasticity which would enable them to adapt themselves to any further change in their surroundings, and they would pass away with conditions with which they are too inextricably bound up. Vast floras have doubtless thus found their grave in geologic change. That wrought by man in destroying forests and cultivating the land will be no less effective, and already specimens in our herbaria alone represent species no longer to be found in a living state. Extinction may come about indirectly and even more surely. This is easy to happen with plants dependent on insects for their fertilization. Kronfeld has shown that aconites are dependent for this on the visits of a *Bombus* and cannot exist outside the area where it occurs.

The actual and past distribution of plants must obviously be controlled by the facts of physical geography. It is concerned with the land-surface, and this is more symmetrically disposed than would at first sight appear from a glance at a map of the world. Lyell points out that the eye of an observer placed above a point between Pembroke and Wexford, lat. 52° N. and long. 6° W., would behold at one view the greatest possible quantity of land, while the opposite hemisphere would contain the greatest quantity of water. The continental area is on one side of the sphere and the oceanic on the other. Love has shown (*Nature*, Aug. 1, 1907, p. 328) that this is the result of physical causes and that the existence of the Pacific Ocean "shows that the centre of gravity of the earth does not coincide with the centre of figure." One half of the earth has therefore a greater density than the other. But "under the influence of the rotation the parts of greater density tend to recede further from the axis than the parts of less density . . . , the effect must be to produce a sort of furrowed surface." The furrows are the great ocean basins, and these would still persist even if the land surface were enlarged to the 1400 fathoms contour. These considerations preclude the possibility of solving difficulties in geographical distribution by the construction of hypothetical land-surfaces, an expedient which Darwin always stoutly opposed (*Life and Letters*, ii. 74–78). The furrowed surface of the earth gives the land-area a star-shaped figure, which may from time to time have varied in outline, but in the main has been permanent. It is excentric as regards the pole and sends tapering extensions towards the south. Sir George Darwin finds a possible explanation of these in the screwing motion which the earth would suffer in its plastic state. The polar regions travelled a little from west to east relatively to the equatorial, which lagged behind.

The great primary divisions of the earth's flora present themselves at a glance. The tropics of Cancer and Capricorn cut off with surprising precision (the latter somewhat less so) the tropical from the north and south temperate zones. The north temperate region is more sharply separated from the other two than the south temperate region from the tropical.

I. North Temperate Region (*Holarctic*).—This is the largest of all, circumpolar, and but for the break at Bering Straits, would be, as it has been in the past, continuous in both the old and new worlds. It is characterized by its needle-leaved Coniferae, its catkin-bearing (Amentaceae) and other trees, deciduous in winter, and its profusion of herbaceous species.

II. South Temperate Region.—This occupies widely separated areas in South Africa, Australia, New Zealand and South America. These are connected by the presence of peculiar types, Proteaceae, Restiaceae, Rutaceae, &c., mostly shrubby in habit and on the whole somewhat intolerant of a moist climate. Individual species are extremely numerous and often very restricted in area.

III. Tropical Region.—This is characterized by the presence of gigantic Monocotyledons, palms, Musaceae and bamboos, and of evergreen polypetalous trees and figs. Herbaceous plants are rare and mostly epiphytic.

A consideration of these regions makes it apparent that they are to a large extent adaptive. The boreal is cold, the austral warm, and the tropical affords conditions of heat and moisture to which the vegetation of the others would be intolerant. If we take with Drude the number of known families of flowering plants at 240, 92 are generally dispersed, 17 are more restricted, while the remainder are either dominant in or peculiar to separate regions. Of these 40 are boreal, 22 austral and 69 tropical. If we add to the latter figure the families which are widely dispersed, we find that the tropics possess 161 or almost exactly two-thirds of the large groups comprised in the world's vegetation. M. Casimir de Candolle has made an independent investigation, based on Hooker and Bentham's *Genera plantarum*. The result is unfortunately (1910) unpublished, but he informs the present writer that the result leads to the striking conclusion: "La végétation est un phénomène surtout intertropical, dont nous ne voyons plus que restes affaiblis dans nos régions tempérées." In attempting to account for the distribution of existing vegetation we must take into account palaeontological evidence. The results arrived at may be read as a sequel to the article on Palaeobotany.

The vegetation of the Palaeozoic era, till towards its close, was apparently remarkably homogeneous all over the world. It was characterized by arborescent vascular Cryptogams and Gymnosperms of a type (Cordaiteae) which have left no descendants beyond it. In the southern hemisphere the Palaeozoic flora appears ultimately to have been profoundly modified by a lowering of temperature and the existence of glacial conditions over a wide area. It was replaced by the *Glossopteris* flora which is assumed to have originated in a vast continental area (Gondwana land), of which remnants remain in South America, South Africa and Australia.

The *Glossopteris* flora gradually spread to the northern hemisphere and intermingled with the later Palaeozoic flora which still persisted. Both were in turn replaced by the Lower Mesozoic flora, which again is thought to have had its birth in the hypothetical Gondwana land, and in which Gymnosperms played the leading part formerly taken by vascular Cryptogams. The abundance of Cycadean plants is one of its most striking features. They attained the highest degree of structural complexity in the Bennettiteae, which have been thought even to foreshadow a floral organization. Though now on the way to extinction, Cycadeae are still widely represented in the southern hemisphere by genera which, however, have no counterpart in the Mesozoic era. Amongst Conifers the archaic genera, *Ginkgo* and *Araucaria* still persist. Once widely distributed in the Jurassic period throughout the world, they are now dying out: the former is represented by the solitary maiden-hair tree of China and Japan; the latter by some ten species confined to the southern hemisphere, once perhaps their original home. With them may be associated the anomalous *Sciadopitys* of Japan.

So far the evolution of the vegetable kingdom has proceeded without any conspicuous break. Successive types have arisen in ascending sequence, taken the lead and in turn given way to others. But the later period of the Mesozoic era saw the almost sudden advent of a fully developed angiospermous vegetation which rapidly occupied the earth's surface, and which it is not easy to link on with any that preceded it. The closed ovary implies a mode of fertilization which is profoundly different, and which was probably correlated with a simultaneous development of insect life. This was accompanied by a vegetative organization of which there is no obvious foreshadowing. As Clement Reid remarked: "World-wide floras, such as seem to characterize some of the older periods, have ceased to be, and plants are distributed more markedly according to geographical provinces and in climatic zones." The field of evolution has now been transferred to the northern hemisphere. Though Angiosperms become dominant in all known plant-bearing Upper Cretaceous deposits, their origin dates even earlier. In Europe Heer's *Populus primaeva* from the Lower Cretaceous in Greenland was long accepted as the oldest dicotyledonous plant. Other undoubted Dicotyledons, though of uncertain affinity, of similar age have now been detected in North America. The Cenomanian rocks of Bohemia have yielded remains of a sub-tropical flora which has been compared with that existing at present in Australia. Upper Cretaceous formations in America have yielded a copious flora of a warm-temperate climate from which it is evident that at least the generic types of numerous not closely related existing dicotyledonous trees had already come into existence. It may be admitted that the identification of fragmentary leaf-remains is at most precarious. Even, however, with this reservation, it is difficult to resist the mass of evidence as a whole. And it is a plausible conjecture that the vegetation of the globe had already in its main features been constituted at this period much as it exists at the present moment. There were oaks, beeches (scarcely distinguishable from existing species), birches, planes and willows (one closely related to the living *Salix candida*), laurels, represented by *Sassafras* and *Cinnamomum*, magnolias and tulip trees (*Liriodendron*), myrtles, *Liquidambar*, *Diospyros* and ivy. This is a flora which, thinned out by losses, practically exists to this day in the southern United States. And one essentially similar but adapted to slightly cooler conditions existed as far north as the latitude of Greenland.

The tertiary era opens with a climate in which during the Eocene period something like existing tropical conditions must have obtained in the northern hemisphere. The remains of palms (*Sabal* and *Nipa*) as well as of other large-leaved Monocotyledons are preserved. *Sequoia* (which had already appeared in the American Upper Cretaceous) and the deciduous cypress (*Taxodium distichum*) are found in Europe. Starkie Gardner has argued with much plausibility that the Tertiary floras which have been found in the far north must have been of Eocene age. That of Grinnell Land in lat. 81° consisted of Conifers (including the living spruce), poplars and willows, such as would be found now 25° to the south. The flora of Disco Island in lat. 70° contained *Sequoia*, planes, maples and magnolias, and closely agrees with the Miocene flora of central Europe. Of this copious remains have been found in Switzerland and have been investigated with great ability by O. Heer. They point to cooler conditions in the northern hemisphere; palms and tropical types diminish; deciduous trees increase. *Sequoia* and the tulip-tree still remain; figs are abundant; laurels are represented by *Sassafras* and camphor; herbaceous plants (Ranunculaceae, Cruciferae, Umbelliferae) are present, though, as might be expected, only fragmentarily preserved.

We may draw with some certainty the conclusion that a general movement southward of vegetation had been brought about. While Europe and probably North America were occupied by a warm temperate flora, tropical types had been driven southward, while the adaptation of others to arctic conditions had become accentuated. A gradual refrigeration proceeded through the Pliocene period. This was accompanied in Europe by a drastic weeding out of Miocene types, ultimately leaving the flora pretty much as it now exists. This, as will be explained, did not take place to anything like the same extent in North America, the vegetation of which still preserves a more Miocene facies. *Torreya*, now confined to North America and Japan, still lingered, as did *Ocotea*, now profusely developed in the tropics, but in north temperate regions only existing in the Canaries: the evergreen oaks, so characteristic of the Miocene, were reduced to the existing *Quercus ilex*. At the close of the Pliocene the European flora was apparently little different from that now existing, though some warmer types such as the water-chestnut (*Trapa natans*) had a more northern extension. The glacial period effected in Europe a wholesale extermination of temperate types accompanied by a southern extension of the arctic flora. But its operation was in great measure local. The Pliocene flora found refuges in favoured localities from which at its close the lowlands were restocked while the arctic plants were left behind on the mountains. During the milder interglacial period some southern types, such as *Rhododendron ponticum*, still held their own, but ultimately succumbed.

The evidence which has thus been briefly summarized, points unmistakably to the conclusion that existing vegetation originated in the northern hemisphere and under climatic conditions corresponding to what would now be termed sub-tropical. It occupied a continuous circumpolar area which allowed free communication between the old and new worlds. The gradual differentiation of their floras has been brought about rather by extermination than specialization, and their distinctive facies by the development and multiplication of the surviving types.

The distribution of mountain barriers in the Old and New Worlds is in striking contrast. In the former they run from east to west; in the latter from north to south. In the Old World the boreal zone is almost sharply cut off and afforded no means of escape for the Miocene vegetation when the climate became more severe. Thus in the Mediterranean region the large groups of palms, figs, myrtles and laurels are each only represented by single surviving species. The great tropical family of the Gesneraceae has left behind a few outliers: *Ramondia* in the Pyrenees, *Haberlea* in the Balkans, and *Jankaea* in Thessaly; the Pyrenees also possess a minute *Dioscorea*, sole European survivor of the yams of the tropics.

In North America there is no such barrier: the Miocene flora has been able to escape by migration the fluctuations of climate and to return when they ameliorated. It has preserved its characteristic types, such as *Magnolia*, *Liriodendron*, *Liquidambar*, *Torreya*, *Taxodium* and *Sequoia*. While it has been customary to describe the Miocene flora of Europe as of a North American type, it would be more accurate to describe the latter as having in great measure preserved its Miocene character.

If mountains serve as barriers which arrest the migration of the vegetation at their base, their upper levels and summits afford lines of communication by which the floras of colder regions in the northern hemisphere can obtain a southern extension even across the tropics. They doubtless equally supply a path by which southern temperate types may have extended northwards. Thus the characteristic assemblage of plants to which Sir Joseph Hooker has given the name Scandinavian "is present in every latitude of the globe, and is the only one that is so" (*Trans. Linn. Soc.* xxiii. 253). In the mountains of Peru we find such characteristic northern genera as *Draba*, *Alchemilla*, *Saxifraga*, *Valeriana*, *Gentiana* and *Bartsia*. High elevations reproduce the physical conditions of high latitudes. The aqueous vapour in the atmosphere is transparent to luminous but opaque to obscure heat-rays. The latter are retained to warm the air at lower levels, while it remains cold at higher. It results that besides a horizontal distribution of plants, there is also an altitudinal: a fact of cardinal importance, the first observation of which has been attributed to Tournefort.

Speaking generally, all plants tend to exhaust particular constituents of the soil on which they grow. Nature therefore has provided various contrivances by which their seeds are disseminated beyond the actual position they occupy. In a large number of cases these only provide for migration within sufficient but narrow limits; such plants would be content to remain *local*. But other physical agencies come into play which may be briefly noticed. The first of these is wind: it cannot be doubted that small seeds can be swept up like dust and transported to considerable distances. This is certainly the case with fern-spores. The vegetation of Krakatoa was completely exterminated in 1883 by a thick coat of red-hot pumice. Yet in 1886 Treub found that it was beginning to cover itself again with plants, including eleven species of ferns; but the nearest source of supply was 10 m. distant. Seeds are carried with more facility when provided with plumes or wings. Treub found on Krakatoa four species of composites and two grasses. Water is another obvious means of transport. The littoral vegetation of coral islands is derived from sea-borne fruits. The seeds of West Indian plants are thrown on the western shores of the British Isles, and as they are capable of germination, the species are only prevented from establishing themselves by an uncongenial climate. Travers picked up a seed of *Edwardsia* in the Chatham Islands, evidently washed ashore from New Zealand (*Linn. Soc. Journ.* ix. 1865). Rivers bring down the plants of the upper levels of their basins to the lower: thus species characteristic of the chalk are found on the banks of the Thames near London. Birds are even more effective than wind in transporting seeds to long distances. Seeds are carried in soil adhering to their feet and plumage, and aquatic plants have in consequence for the most part an exceptionally wide range. Fruit-pigeons are an effective means of transport in the tropics by the undigested seeds which they void in their excrement. Quadrupeds also play their part by carrying seeds or fruits entangled in their coats. *Xanthium spinosum* has spread from the Russian steppes to every stock-raising country in the world, and in some cases has made the industry impossible. Even insects, as in the case of South African locusts, have been found to be a means of distributing seeds.

The primary regions of vegetation, already indicated, and their subordinate provinces may now be considered more in detail.

1. North Temperate Region.—Many writers on the distribution of animals prefer to separate this into two regions of "primary rank": the *Palaearctic* and the *Nearctic*. But to justify such a division it is necessary to establish either an exclusive possession or a marked predominance of types in the one which are correspondingly deficient in the other. This cannot apparently be done for insects or for birds; Newton accordingly unites the two into the *Holarctic* region. It equally fails for plants. To take, for example, one of the most characteristic features of the Palaearctic region, its catkin-bearing deciduous trees: in North America we find precisely the same genera as in the Old World—oaks, chestnuts, beeches, hazels, hornbeams, birches, alders, willows and poplars. Or to take the small but well-defined group of five-leaved pines, all the species of which may be seen growing side by side at Kew under identical conditions: we have the Weymouth pine (*Pinus Strobus*) in eastern North America, *P. monticola* and the sugar pine (*P. Lambertiana*) in California, *P. Ayacahuite* in Mexico, the Arolla pine (*P. Cembra*) in Switzerland and Siberia, *P. Peuce* in Greece, the Bhotan pine (*P. excelsa*) in the Himalayas, and two other species in Japan. Amongst broad-leaved trees *Juglans* has a similar Holarctic range, descending to the West Indies; so has *Aesculus*, were it not lacking in Europe; it becomes tropical in South America and Malaya. If we turn to herbaceous plants, Hemsley has pointed out that of the thirteen genera of Ranunculaceae in California, eleven are British.

While the tropics preserve for us what remains of the pre-Tertiary or, at the latest, Eocene vegetation of the earth, which formerly had a much wider extension, the flora of the North Temperate region is often described as the survival of the Miocene. Engler therefore calls it *Arcto-Tertiary.* We must, however, agree with Starkie Gardner that it is only Miocene as regards its present position, which was originally farther north, and that its actual origin was much earlier. There has been in effect a successive shifting of zones of vegetation southwards from the pole. Their distinctive and adaptive characteristics doubtless began to be established as soon as the phanerogamic flora was constituted. There is no reason to suppose that the peculiarities of the arctic flora are more modern than those of any other, though there is no fossil evidence to prove that it was not so.

The North Temperate region admits of subdivision into several well-marked sub-regions. The general method by which this is effected in this and other cases is statistical. As A. de Candolle, however, points out, exclusive reliance on this may be misleading unless we also take into account the character and affinities of the plants dealt with (*Geogr. Bot.* i. 1166). The numerical predominance of certain families or their absence affords criteria for marking out boundary lines and tracing relationships. The analysis of the flora of the British Isles will afford an illustration. This was first attempted in 1835 by H. C. Watson, and his conclusions were enforced ten years later by Edward Forbes, who dealt also with the fauna. Watson showed that Scotland primarily, and to a less extent the north of England, possessed species which do not reach the south. Such are the crowberry (*Empetrum nigrum*), *Trientalis europaea*, *Rubus saxatilis* and the globe-flower (*Trollius europaeus*). He further found that there was an element which he termed "boreal . . . in a more intense degree," which amounted to about "a fifteenth of the whole flora." This was not confined to the north but may occur on the mountains of England and Wales: *Salix herbacea*, *Silene acaulis* and *Dryas octopetala* will serve as examples. Even so small an area as that of Britain illustrates what has already been pointed out, that the species of a flora change both with latitude and altitude. Watson further brought out the striking fact that the west and east of Britain each had species peculiar to it; the former he characterized as Atlantic, the latter as Germanic. The Cornish heath (*Erica vagans*) and the maiden-hair fern (*Adiantum Capillus-Veneris*) may serve as instances of the one, the man-orchis (*Aceras anthropophora*) and *Reseda lutea* of the other. Ireland illustrates the same fact. It possesses about 1000 species, or about two-thirds the number of Britain. On its western shores there are some twenty, such as *Saxifraga umbrosa*, *Erica mediterranea* and *Arbutus unedo*, which are not found in Britain at all. The British Phanerogamic flora, it may be remarked, does not contain a single endemic species, and 38% of the total number are common to the three northern continents.

The analysis of larger areas yields results of the same kind. Within the same region we may expect to find considerable differences as we pass from one meridian to another. Assuming that in its circumpolar origin the North Temperate flora was fairly homogeneous, it would meet in its centrifugal extension with a wide range of local conditions; these would favour the preservation of numerous species in some genera, their greater or less elimination in others. Thus comparing the Nearctic and Palaearctic floras we find striking differences overlying the points of agreement already indicated. The former is poor in Cruciferae, Caryophyllaceae, Umbelliferae, Primulaceae and Labiatae; but for the occurrence of *Calluna* in Newfoundland it would have no heaths. On the other hand, it is rich in Compositae, especially *Solidago* and *Aster*, Polemoniaceae, Asclepiadaceae, Hydrophyllaceae and Cyperaceae, and it has the endemic *Sarracenia*, type of a family structurally allied to poppies, of which of the remaining genera *Darlingtonia* is Californian, and *Heliamphora* Venezuelan. These distinctions led Sir Joseph Hooker to claim for the two divisions the rank of primary regions. Darwin doubted, however, whether they ought to be separated (*Life*, iii. 230). Lyell, discussing the facts of zoological distribution, admits that "the farther we go north . . . the more the discordance in genera and species diminishes" (*Principles*, ii. 340); and Hemsley finds that not less than 75% of the genera in the flora of eastern North America "are represented in the old world," and, according to Asa Gray, 50% in Europe.

Latitudinally the region subdivides naturally into several well-marked sub-regions which must be briefly discussed.

1. The *Arctic-Alpine* sub-region consists of races of plants belonging originally to the general flora, and recruited by subsequent additions, which have been specialized in low stature and great capacity of endurance to survive long dormant periods, sometimes even unbroken in successive years by the transitory activity of the brief summer. It is continuous round the pole and roughly is bounded by the arctic circle. Mature seeds are highly tolerant of cold and have been shown to be capable of withstanding the temperature even of liquid hydrogen. Arctic plants make their brief growth and flower at a temperature little above freezing-point, and are dependent for their heat on the direct rays of the sun. Characteristic representatives are *Papaver nudicaule*, *Saxifraga oppositifolia*, which forms a profuse carpet, and *Dryas octopetala*. Such plants perhaps extend to the most northern lands at present known. On May 30th, in Ward Hunt's Island, lat. 83° 5′, Sir George Nares found that "vegetation was fairly represented as regards quantity in the poppy, saxifrage and small tufts of grass." We may compare this with extreme alpine conditions: on a spot above the Aletsch glacier at a height of 10,700 ft. Ball found the temperature one inch below the surface to be 83°, and he collected "over forty species in flower." Taking the whole arctic flora at 762 species, Hooker found that 616 occurred in arctic Europe, and of these 586 are Scandinavian. Beyond the arctic circle some 200, or more than a quarter, are confined to the mountains of the northern hemisphere and of "still more southern regions." This led Hooker to the striking observation already quoted. The arctic flora contains no genus that is peculiar to it, and only some fifty species that are so. Christ has objected to terming the arctic flora Scandinavian, but the name implies nothing more than that Scandinavia has been its chief centre of preservation.

A detailed examination of mountain floras shows that a large local element is present in each besides the arctic. The one is in fact the result of similar physical conditions to that which has produced the other. Thus *Saxifraga cernua* is regarded as an alpine form of the lowland *S. granulata*. Comparing the Alps with the Pyrenees, according to Ball, each has about half its flora common to the other: "the Alps have 172 endemic species and at least 15 genera that are not found in the Pyrenees, while the latter range counts about 100 endemic species with several (six or seven) genera not found in the Alps." Drude has accordingly suggested the substitution of the term "High-mountain floras" for Alpine, which he regards as misleading. Its meaning has, however, become synonymous and is consecrated by usage.

The repetition of the same species in the arctic regions and in the high mountains of the North Temperate region is generally attributed to the exchange which took place during the glacial period. This was first suggested by Edward Forbes in 1846, though the idea had earlier suggested itself to Darwin (*Life*, i. 88). It took place southwards, for the arctic flora is remarkably uniform, and, as Chodat points out, it shows no evidence of having been recruited from the several mountain floras. That the arctic flora was driven south into Central Europe cannot be contested in the face of the evidence collected by Nathorst from deposits connected with the boulder-clay. And Reid has shown that during the glacial period the existing flora was replaced by an arctic one represented by such plants as *Salix polaris*, *S. herbacea*, *S. reticulata* and *Betula nana*. At the same time the then existing alpine floras descended to lower levels, though we may agree with Ball that they did not necessarily become extinct at higher ones as long as any land-surface remained uncovered by ice. At the close of the glacial period the alpine floras retreated to the mountains accompanied by an arctic contingent, though doubtless many species of the latter, such as *Salix polaris*, failed to establish themselves. Christ, while admitting an ancient endemic element, such as *Campanula excisa* in the arctic-alpine flora of Europe, objects that a Scandinavian colonization could not furnish such characteristic plants as the larch and edelweiss. He traces the original home of the bulk of existing alpine plants to northern Asia, the mountains of which appear to have escaped glaciation. At the close of the glacial epoch the north Asiatic flora spread westwards into Europe and intermingled with the surviving vegetation. Some species, such as *Anemone alpina*, which are wanting in the Arctic flora of the Old World, he thinks must have reached Europe by way of Greenland from north-east America.

2. The *Intermediate sub-region* comprises the vegetation of the large area occupied by the steppes of the Old World, the prairies of the new and the forest region of both. The former support a copious herbaceous flora, the characteristics of which in the Old and New Worlds have been already briefly summarized. In the former that of Europe and of Central Asia are continuous. Of species common to the two, Maximowicz finds that Manchuria possesses 40% and scarcely 9% that are endemic. Of a collection of about 500 species made in that country by Sir Henry James nearly a third are British. This confirms the theory of Christ that Europe was restocked mainly from Asia after the close of the glacial epoch, the south being closed to it. In the new world no southern barriers existed and it is more difficult to draw the line between contiguous sub-regions.

The dominant characteristics of the arboreous vegetation are, besides deciduous and amentiferous trees, Coniferae, especially the more recent tribe of Abietineae—pines, silver-firs, hemlocks, spruces and larches, of which, unlike the older types, no representative crosses the tropic. The prominent deciduous trees of Europe appear to be of eastern origin, and the progress of western migration has continued to historic times. The evidence of the peat bogs shows that the Scots fir, which is now extinct, was abundant in Denmark in the Roman period. It was succeeded by the sessile-fruited oak, which was in turn supplanted by the pedunculate form of the same tree. *Quercus Robur* has left no trace in the Tertiary deposits of Europe and it is most nearly allied to east Asiatic species. The oak in turn has been almost superseded in Denmark by the beech, which, if we may trust Julius Caesar, had not reached Britain in his time, though it existed there in the pre-glacial period, but is not native in either Scotland or Ireland. Its eastern limit in Europe is a line from Königsberg to the Caucasus; thence through China it is continued by varietal forms to Japan. It has a solitary representative in North America.

Broadly speaking, the American portion of the sub-region consists of an Atlantic and Pacific forest area and an intervening non-forest one, partly occupied by the Rocky Mountains, partly by intervening plains. Its arboreal vegetation is richer both in genera and species than that corresponding to it in the Old World. Glacial elimination has been less severe, or rather there has been, at any rate on the Atlantic side, an unimpeded return of Miocene types. The Atlantic area has five magnolias, a tulip tree, an Anonacea (*Asimina*), two Ternstroemiaceae (*Stuartia* and *Gordonia*), *Liquidambar*, *Vitis* (the fox-grape, *V. Labrusca*, reappears in Japan), and others; an assemblage, as long ago pointed out by Asa Gray, which can only be paralleled in the Chino-Japanese region, another centre of preservation of Miocene types. All these are wanting in the Pacific area, though there are indications in its gold-bearing gravels that it once possessed them. On the other hand, the latter "is rich in coniferous types beyond any country except Japan" (A. Gray), but till we reach California these are boreal in type. The Atlantic flora has also numerous oaks and maples, signalized by their autumnal coloration. These were abundant in Tertiary Europe, as they are now in Japan, and represent perhaps a cooler element in the flora than that indicated above. The highlands of Central America and the West Indies have preserved a number of Chino-Japanese types—*Bocconia*, *Deutzia*, *Abelia*, &c.—not met with elsewhere in the New World.

3. The *Mediterraneo-Oriental sub-region* contrasts no less vividly with the Intermediate than the Arctic-Alpine. It includes the Azores and Canaries, the Mediterranean basin, northern Africa as far as the Atlas and Sahara, Asia Minor, Persia and the countries eastward as far as Sind, being bounded to the north by the mountains which run from the Caucasus to the Hindu-Kush. Its extreme richness in number of species (it comprises six-sevenths of the European flora) and the extremely restricted areas of many of them point to a great antiquity. The Mediterranean basin has been a centre of preservation of Miocene vegetation: the oleander is said to have been found in local deposits of even earlier age, and the holm oak (*Quercus Ilex*) is the living representative of a Miocene ancestor. Extensions of the flora occur southwards of the high mountains of tropical Africa; *Adenocarpus*, a characteristic Mediterranean genus, has been found on Kilimanjaro and 2000 m. distant on the Cameroons. Two British plants may be added which both reach North Africa: *Sanicula europaea* extends from Abyssinia to the Cameroons and southwards to Cape Colony and Madagascar; *Sambucus Ebulus* reaches Uganda. The Mediterranean, however, has apparently been a barrier to the southward passage of the arcto-alpine flora which is totally wanting on the Atlas. The vegetation of the sub-region is rich in shrubs: myrtle, bay, *Cistus*, *Pistacia*, *Arbutus*, heaths in its western portion, and the ground-palm (*Chamaerops*). It is even richer in more herbaceous plants tolerant of a hot summer; giant Umbelliferae (such as *Ferula*) are especially characteristic and yield gum-resins which have long been reckoned valuable. Of the 1000 known species of *Astragalus* it possesses 800. Evergreen oaks and Conifers form the forests. Asia Minor has a *Liquidambar*. The Argan tree (*Argania Sideroxylon*), which forms forests in Morocco, is a remarkable survivor of a tropical family (Sapotaceae). Amongst Conifers *Cedrus* is especially noteworthy; it is represented by geographical races in the north-west Himalaya, in Syria, Cyprus and North Africa.

This well-marked sub-region has a deeper interest than the botanical. It has been the cradle of civilization, and to it is due the majority of cultivated plants. Such are the date in Mesopotamia (a second species of *Phoenix* occurs in the Canaries); most European fruits, *e.g.* the vine, fig, mulberry, cherry, apricot, walnut; pulses, *e.g.* the bean, pea and lentil; pot-herbs, *e.g.* lettuce, endive, beet, radish, cress; cereals; and fodder plants such as lucerne and carob.

4. The *Chino-Japanese sub-region.*—Of the vegetation of China till recently very little has been known. In 1873 Elwes pointed out that the Himalayan avifauna extended into north-west China and established the Himalo-Chinese sub-region. Shortly afterwards the collections of Prejewalsky confirmed it for the flora. And we now know that, excluding the southern tropical area, it has the same character throughout the whole of China proper. We may therefore regard the Himalayan flora as a westward extension of the Chinese rather than the latter as a development of the former. Of four genera which Hooker singles out as the largest in Sikkim, in China *Corydalis* has 76 species, *Saxifraga* 58, *Pedicularis* 129, and *Primula* 77. Of *Rhododendron* there are 134 species. Upwards of 8000

species are known out of a probable total of not less than 12,000, and of these more than half are endemic. The number of species to a genus, 3, is only half that found in other large areas. This aggregation of genera and of endemic species is characteristic of the circumferential portions of the earth's land surface: the expansion of the one and the further advance of the other is arrested. The sub-region is probably sharply cut off from the Intermediate. Maximowicz finds that 40% of the plants of Manchuria are common to Europe and Asia, but the proportion falls sharply to 16% in the case of Japan. Its connexion with the Mediterraneo-Oriental sub-region is still more remote. China has no *Cistus* or heath, only a single *Ferula*, while *Astragalus* is reduced to 35 species. There are two species of *Pistacia* and four of *Liquidambar*. The affinity to Atlantic North America is strongly marked as it has long been known to be in Japan. China has 66 species of *Quercus*, 35 of *Vitis*, 2 of *Aesculus*, 42 of *Acer*, 33 Magnoliaceae (including two species of *Liriodendron*), 12 Anonaceae, 71 Ternstroemiaceae (including the tea-plant), and 4 of *Clethra*, which has a solitary western representative in Madeira. *Trachycarpus* and *Rhapis* are characteristic palms, and Cycadeae are represented by *Cycas*.

5. The *Mexico-American sub-region* has as its northern boundary the parallel of lat. 36° as far as New Mexico and then northwards to the Pacific coast at lat. 40°. The eastern and western halves are contrasted in climate—the former being moist and the latter dry—and have been distinguished by some zoologists as distinct sub-regions. They are in fact in some degree comparable to sub-regions 3 and 4 in the Old World. The absence of marked natural boundaries makes any precise north and south limitation difficult. But it has been a centre of preservation of the Taxodieae, a tribe of Coniferae of great antiquity. *Taxodium* (with single species in China and Mexico) is represented by the deciduous cypress (*T. distichum*), which extends from Florida to Texas. The two species of *Sequoia*, the "Wellingtonia" (*S. gigantea*) and the redwood (*S. sempervirens*), are confined to California. In the eastern forests the prevalence of Magnoliaceae and of *Clethra* and *Rhododendron* continues the alliance with eastern Asia. Florida derives a tropical element from the Antilles. Amongst palms the Corypheae are represented by *Sabal* and *Thrinax*, and there is a solitary *Zamia* amongst Cycads. The western dry areas have the old-world leguminous *Astragalus* and *Prosopis* (Mesquit), but are especially characterized by the northward extension of the new-world tropical Cactaceae, *Mammillaria*, *Cereus* and *Opuntia*, by succulent Amaryllideae such as *Agave* (of which the so-called "American aloe" is a type), and by arborescent Liliaceae (*Yucca*). Amongst palms *Washingtonia*, *Brahea* and *Erythea* (all Corypheae) replace the eastern genera. On the west coast *Cupressus Lawsoniana* replaces the northern *Thuya gigantea*, and a laurel (*Umbellularia* of isolated affinity) forms forests. California and Arizona have each a species of *Platanus*, a dying-out genus. Elsewhere it is only represented by *P. occidentalis*, the largest tree of the Atlantic forests from Maine to Oregon, and by *P. orientalis* in the eastern Mediterranean. Otherwise the Californian flora is entirely deficient in the characteristic features of that of eastern North America. Nor, with perhaps the interesting exception of *Castanopsis chrysophylla*, the solitary representative in the New World of an east Asiatic genus, which ranges from Oregon to California, has it any affinity with the Chino-Japanese sub-region. Its closest connexion is with the South American Andine.

II. THE TROPICAL REGION.—The permanence of continents and great oceans was first insisted upon by J. D. Dana, but, as already stated, has later received support on purely physical grounds. It precludes the explanation of any common features in the dissevered portions of the tropical area of vegetation by lateral communications, and throws back their origin to the remotest geological antiquity. In point of fact, resemblance is in the main confined to the higher groups, such as families and large genera; the smaller genera and species are entirely different. No genus or species of palm, for example, is common to the Old and New Worlds. The ancient broad-leaved Gymnosperm *Gnetum* has a few surviving species scattered through the tropics of both worlds, one reaching Polynesia.

1. *African sub-region.*—Western Arabia must be added to the African continent, which, with this exception and possibly a former European connexion in the far west, has had apparently from a very early period an almost insular character. Bentham remarks (*Journ. Linn. Soc.* xiii. 492): "Here, more perhaps than in any other part of the globe, in Compositae as in so many other orders, we may fancy we see the scattered remains of ancient races dwindling down to their last representatives." It is remarkable that the characteristic features of the Miocene flora, which in other parts of the world have spread and developed southwards, are conspicuously absent from the African tropical flora. It has no Magnoliaceae, no maples, Pomaceae, or Vacciniaceae, no *Rhododendron* and no Abietineae. Perhaps even more striking is the absence of Cupuliferae; *Quercus*, in particular, which from Tertiary times has been a conspicuous northern type and in Malayan tropical conditions has developed others which are widely divergent. Palms are strikingly deficient: there are only three out of 79 genera of Areceae, and the Corypheae are entirely absent. But including the Mascarene Islands and Seychelles the Borasseae are exclusively African. Aroideae are poorly represented compared with either South America or Malays. A peculiar feature in which tropical Africa stands alone is that at least one-fifth and probably more of the species are common to both sides of the continent and presumably stretch right across it. An Indian element derived from the north-east is most marked on the eastern side: the Himalayan *Gloriosa* will suffice as an example, and of more tropical types *Phoenix* and *Calamus* amongst palms. The forest flora of Madagascar, though including an endemic family Chlaenaceae, is essentially tropical African, and the upland flora south temperate.

2. The *Indo-Malayan sub-region* includes the Indian and Malayan peninsulas, Cochin-China and southern China, the Malayan archipelago, and Philippines, with New Guinea and Polynesia, excluding the Sandwich Islands. Probably in point of number of species the preponderant family is Orchideae, though, as Hemsley remarks, they do not "give character to the scenery, or constitute the bulk of the vegetation." In Malaya and eastward the forests are rich in arborescent figs, laurels, myrtles, nutmegs, oaks and bamboos. Dipterocarpeae and Nepenthaceae only extend with a few outliers into the African sub-region. Screw pines have a closer connexion. Compositae are deficient. Amongst palms Areceae and Calameae are preponderant. Cycads are represented by *Cycas* itself, which in several species ranges from southern India to Polynesia. In India proper, with a dryer climate, grasses and Leguminosae take the lead in the number of species. But it has few distinctive botanical features. In the north-west it meets the *Mediterraneo-Oriental* and in the north-east the *Chino-Japanese* sub-regions, while south India and Ceylon have received a Malayan contribution. Bengal has no *Cycas*, oaks or nutmegs. Apart from the occurrence of *Cycas*, the Asiatic character of the Polynesian flora is illustrated by the distribution of Meliaceae. C. de Candolle finds that with one exception the species belong to genera represented in one or other of the Indian peninsulas.

3. The *South American sub-region* is perhaps richer in peculiar and distinctive types than either of the preceding. As in the Indo-Malayan sub-region, epiphytic orchids are probably most numerous in point of species, but the genera and even sub-tribes are far more restricted in their range than in the Old World; 4 sub-tribes with 74 genera of Vandeae are confined to South America, though varying in range of climate and altitude. Amongst arboreous families Leguminosae and Euphorbiaceae are prominent; *Hevea* belonging to the latter is widely distributed in various species in the Amazon basin, and yields Para and other kinds of rubber. Amongst Rubiaceae, Cinchoneae with some outliers in the Old World have their headquarters at cooler levels. In Brazil the myrtles are represented by "monkey-pots" (Lecythideae). Nearly related to myrtles are Melastomaceae which, poorly represented in the Old World, have attained here so prodigious a development in genera and species, that Ball looks upon it as the seat of origin of the family. Amongst Ternstroemiaceae, the singular Marcgravieae are endemic. So also are the Vochysiaceae allied to the "milkworts." Cactaceae are widely spread and both northwards and southwards extend into temperate regions. Screw pines are replaced by the nearly allied Cyclanthaceae. The Amazon basin is the richest area in the world in palms, of which the Cocoineae are confined to South America, except the coco-nut, which has perhaps spread thence into Polynesia and eastward. The singular shrubby Amaryllids, Vellozieae, are common to tropical and South Africa, Madagascar and Brazil. Aroids, of which the tribes are not restricted in their distribution, have two large endemic genera, *Philodendron* and *Anthurium*. Amongst Cycads, *Zamia* is confined to the New World, and amongst Conifers, *Araucaria*, limited to the southern hemisphere, has scarcely less antiquity; *Pinus* reaches as far south as Cuba and Nicaragua.

The flora of the Hawaiian Islands has complicated relations. Out of the 860 indigenous plants, 80% are endemic, but Hillebrand finds that a large number are of American affinity.

III. THE SOUTH TEMPERATE REGION contrasts remarkably with the northern. Instead of large continuous areas, in which local characteristics sometimes blend, it occupies widely dissevered territories in which specialization, intensified by long separation, has mostly effaced the possibility of comparing species and even genera, and compels us to seek for points of contact in groups of a higher order. The resemblances consist, in fact, not so much in the existence of one general facies running through the regions, as is the case with the northern flora, but in the presence of peculiar types, such as those belonging to the families Restiaceae, Proteaceae, Ericaceae, Mutisiaceae and Rutaceae.

1. The *South African sub-region* has a flora richer perhaps in number of species than any other; and these are often extremely local and restricted in area. It exhibits in a marked degree the density of species which, as already pointed out, is explicable by the arrest of further southern expansion. Hemsley remarks that "the northern genus *Erica*, which covers thousands of square miles in Europe with very few species, is represented by hundreds of species in a comparatively small area in South Africa." There is an interesting connexion with Europe through the so-called Iberian flora. Bentham (*Pres. addr. Linn. Soc.*, 1869, p. 25) points out that "the west-European species of *Erica*, Genisteae, *Lobelia*, *Gladiolus*, &c., are some of them more nearly allied to corresponding Cape species than they are to each other; and many of the somewhat higher races, groups of species and genera, have evidently diverged from stocks

now unrepresented anywhere but in South Africa." This flora extends from Ireland to the Canaries and reappears on the highlands of Angola. On the eastern side the southern flora finds representatives in Abyssinia, including *Protea*, and on the mountains of equatorial Africa, *Calodendron capense* occurring on Kilimanjaro. This is the most northern representative of the Rutaceous Diosmeae, which are replaced in Australia by the Boronieae. The Proteaceous genus, *Faurea*, occurs in Angola and Madagascar. The characteristic genus *Pelargonium* has a few Mediterranean representatives, and one even occurs in Asia Minor. In all these cases it is a nice question whether we are tracing an ascending or descending stream. Darwin thought that the migration southwards would always be preponderant (*Origin of Species*, 5th ed., 458). Other characteristic features of the flora are the abundance of Compositae, Asclepiadeae, and petaloid Monocotyledons generally, but especially Orchideae (terrestrial species predominating) and Iridaceae. There is a marked tendency towards a succulent habit. The nearly related Ficoideae replace the new-world Cactaceae, but the habit of the latter is simulated by fleshy Euphorbias and Asclepiads, just as that of *Agave* is by the liliaceous *Aloe*. South Africa has only two palms (*Phoenix* and *Hyphaene*). In the Gnetaceous *Welwitschia* it possesses a vegetable type whose extraordinary peculiarities make it seem amongst contemporary vegetation much as some strange and extinct animal form would if suddenly endowed with life. Conifers are scantily represented by *Callitris* and *Podocarpus*, which is common to all three sub-regions; and Cycads by the endemic *Encephalartos* and *Stangeria*.

2. The *Australian sub-region* consists of Australia, Tasmania, New Caledonia and New Zealand, and, though partly lying within the tropic is most naturally treated as a whole. They are linked together by the presence of Proteaceae and of Epacrideae, which take the place of the nearly allied heaths in South Africa. The most dominant order in Australia is Leguminosae, including the acacias with leaf-like phyllodes (absent in New Zealand). Myrtaceae comes next with *Eucalyptus*, which forms three-fourths of the forests, and *Melaleuca*; both are absent from New Caledonia and New Zealand; a few species of the former extend to New Guinea and one of the latter to Malaya. Cupuliferae are absent except *Fagus* in Australia and New Zealand. The so-called "oaks" of Australia are *Casuarina*, which also occurs in New Caledonia, but is wanting in New Zealand. The giant rushes *Xanthorrhoea* and *Kingia* are peculiar to Australia. Palms are poorly represented in the sub-region and are of an Indo-Malayan type. Amongst Conifers, *Podocarpus* is found throughout, *Agathis* is common to Australia, New Zealand and New Caledonia; *Araucaria* to the first and last. Of Cycads, Australia and New Caledonia have *Cycas*, and the former the endemic *Macrozamia* and *Bowenia*. The Australian land-surface must be of great antiquity, possibly Jurassic, and its isolation scarcely less ancient. In Lower Eocene times its flora appears to have been distinctly related to the existing one. Little confidence can, however, be placed in the identification of Proteaceous or, indeed, of any distinctively Australian plants in Tertiary deposits in the northern hemisphere. The Australian flora has extensions at high levels in the tropics; such exists on Kinabalu in Borneo under the equator. The Proteaceous genus *Helicia* reaches as far north as China, but whether it is starting or returning must as in other cases be left an open question.

While the flora of New Caledonia is rich in species (3000), that of New Zealand is poor (1400). While so many conspicuous Australian elements are wanting in New Zealand, one-eighth of its flora belongs to South American genera. Especially noteworthy are the Andine *Acaena*, *Gunnera*, *Fuchsia* and *Calceolaria*. By the same path it has received a remarkable contribution from the North Temperate region; such familiar genera as *Ranunculus*, *Epilobium* and *Veronica* form more than 9% of the flowering plants. And it is interesting to note that while the tropical forms of *Quercus* failed to reach Australia from Malaya, the temperate *Fagus* crept in by a back door. Three-quarters of the native species are endemic; they seem, however, to be quite unable to resist the invasion of new-comers, and already 600 plants of foreign origin have succeeded in establishing themselves.

3. The *Andine sub-region* extends from Peru to the Argentine and follows roughly the watershed of the Amazon. In the New World, as already explained, the path of communication between the northern and southern hemispheres has always been more or less open, and the temperate flora of southern America does not exhibit the isolation characteristic of the southern region of the Old World. Taking, however, the Andean flora as typical, it contains a very marked endemic element; Ball finds that half the genera and four-fifths of the species are limited to it; on the other hand, that half the species of Gamopetalae belong to cosmopolitan genera such as *Valeriana*, *Gentiana*, *Bartsia* and *Gnaphalium*. The relation to the other sub-regions is slight. Ericeae are wholly absent, and it has but a single Epacrid in Fuegia. Proteaceae are more marked in *Guevina* and *Embothrium*. Of Restiaceae, a single *Leptocarpus* has been found in Chile. On the other hand, it is the headquarters of Mutisiaceae, represented in South Africa by such genera as *Oldenburgia* and *Gerbera* and by *Trichocline* in Australia. *Tropaeolum* takes the place of the nearly allied South African *Pelargonium*. There has been an interchange between it and the Mexico-American sub-region, but as usual the northern has been preponderant. *Prosopis* extends to the Argentine; other characteristic genera are *Oenothera*, *Godetia* *Collomia*, *Heliotropium* and *Eritrichium*. In the ascending stream may be mentioned—*Larrea*, a small genus of Zygophylleae with headquarters in Paraguay and Chile, of which one species, *L. mexicana*, is the creosote plant of the Colorado desert, where it forms dense scrub; *Acaena*; the Loasaceae, of which *Mentzelia* reaches North America; *Petunia* and *Lippia*. Compositae compose a quarter of the Andean flora, which is a greater proportion than in any in the world. *Baccharis*, with some 250 species, ranges over the whole continent from the Straits of Magellan and, with seven species, to California. Melastomaceae, copiously represented in tropical America, are more feebly so in Peru and wholly wanting in Chile. A few Cactaceae extend to Chile. Of Cupuliferae, *Quercus* in three species only reaches Colombia, but *Fagus*, with only a single one in North America, is represented by several from Chile southwards and thence extends to New Zealand and Tasmania. The Magnoliaceous genus *Drimys*, with a single species in the new world, follows the same track. Bromeliaceae are represented by *Rhodostachys* and the temperate *Puya*. Palms as usual are few and not nearly related. *Wettinia* occurs in Peru, *Trithrinax* in Chile with the monotypic *Jubaea*, *Juania*, also monotypic, is confined to Juan Fernandez. Amongst Coniferae *Podocarpus* is common to this and preceding sub-regions; *Libocedrus* extends from California to New Zealand and New Caledonia; *Fitzroya* is found in Chile and Tasmania; and *Araucaria* in its most familiar species occurs in Chile.

4. The *Antarctic-Alpine region* is the complement of the Arctic-Alpine, but unlike the latter, its scattered distribution over numerous isolated points of land, remote from great continental areas, from which, during migrations like those attending the glacial period in the northern hemisphere, it could have been recruited, at once accounts for its limited number of species and their contracted range in the world. On the whole, it consists of local species of some widely distributed northern genera, such as *Carex*, *Poa*, *Ranunculus*, &c., with alpine types of strictly south temperate genera, characteristic of the separate localities. The monotypic *Pringlea antiscorbutica*, the "Kerguelen Island cabbage," has no near ally in the southern hemisphere, but is closely related to the northern *Cochlearia*.

Such a summary of the salient facts in the geographical distribution of plants sufficiently indicates the tangled fabric of the earth's existing floral covering. Its complexity reflects the corresponding intricacy of geographical and geological evolution.

If the surface of the globe had been symmetrically divided into sea and land, and these had been distributed in bands bounded by parallels of latitude, the character of vegetation would depend on temperature alone; and as regards its aggregate mass, we should find it attaining its maximum at the equator and sinking to its minimum at the poles. Under such circumstances the earth's vegetation would be very different from what it is, and the study of plant distribution would be a simple affair.

It is true that the earth's physical geography presents certain broad features to which plants are adapted. But within these there is the greatest local diversity of moisture, elevation and isolation. Plants can only exist, as Darwin has said, where they *must*, not where they can. New Zealand was poorly stocked with a weak flora; the more robust and aggressive one of the north temperate region was ready at any moment to invade it, but was held back by physical barriers which human aid has alone enabled it to surpass.

Palaeontological evidence conclusively proves that the surface of the earth has been successively occupied by vegetative forms of increasing complexity, rising from the simplest algae to the most highly organized flowering plant. We find the ultimate explanation of this in the facts that all organisms vary, and that their variations are inherited and, if useful, perpetuated. Structural complexity is brought about by the superposition of new variations on preceding ones. Continued existence implies perpetual adaptation to new conditions, and, as the adjustment becomes more refined, the corresponding structural organization becomes more elaborate. Inheritance preserves what exists, and this can only be modified and added to. Thus Asclepiadeae and Orchideae owe their extraordinary floral complexity to adaptation to insect fertilization.

All organisms, then, are closely adapted to their surroundings. If these change, as we know they have changed, the organisms must change too, or perish. In some cases they survive by migration, but this is often prohibited by physical barriers.

These, however, have often protected them from the competition of more vigorous invading races. *Fagus*, starting from the northern hemisphere, has more than held its own in Europe and Asia, but has all but died out in North America, finding conditions favourable for a fresh start in Australasia. The older types of Gymnosperms are inelastic and dying out. Even *Pinus* has found the task of crossing the tropics insuperable.

The whole story points to a general distribution of flowering plants from the northern hemisphere southwards. It confirms the general belief on geological grounds that this was the seat of their development at the close of the Mesozoic era. It is certain that they originally existed under warmer conditions of climate than now obtain, and that progressive refrigeration has supplied a powerful impulse to migration. The tropics eventually became, what they are now, great areas of preservation. The Northern Temperate region was denuded of its floral wealth, of which it only retains a comparatively scanty wreck. High mountain levels supplied paths of communication for stocking the South Temperate region, the floras of which were enriched by adapted forms of tropical types. Such profound changes must necessarily have been accompanied by enormous elimination; the migrating hosts were perpetually thinned by falling out on the way. Further development was, however, not stopped, but in many cases stimulated by migration and settlement in new homes. The northern *Quercus*, arrested at the tropic in the new world, expanded in that of the old into new and striking races. And it cannot be doubted that the profusion of Melastomaceae in South America was not derived from elsewhere, but the result of local evolution. There is some evidence of a returning stream from the south, but as Hooker and A. de Candolle have pointed out, it is insignificant as compared with the outgoing one. Darwin attributes this to the fact that "the northern forms were the more powerful" (*Origin of Species*, 5th ed., p. 458).

The result of migration is that races of widely different origin and habit have had to adapt themselves to similar conditions. This has brought about superficial resemblance in the floras of different countries. At first sight a South African *Euphorbia* might be mistaken for a South American *Cactus*, an *Aloe* for an *Agave*, a *Senecio* for ivy, or a New Zealand *Veronica* for a European *Salicornia*. A geographical botany based on such resemblances is only in reality a study of adaptations. The investigation of these may raise and solve interesting physiological problems, but throw no light on the facts and genetic relationship which a rational explanation of distribution requires. If we study a population and sort it into soldiers, sailors, ecclesiastics, lawyers and artisans, we may obtain facts of sociological value but learn nothing as to its racial origin and composition.

In the attempt that has been made to map out the land surface of the earth, probable community of origin has been relied upon more than the possession of obvious characters. That sub-regions framed on this principle should show interrelations and some degree of overlapping is only what might have been expected, and, in fact, confirms the validity of the principle adopted. It is interesting to observe that though deduced exclusively from the study of flowering plants, they are in substantial agreement with those now generally adopted by zoologists, and may therefore be presumed to be on the whole "natural."

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PLANUDES, MAXIMUS (*c.* 1260–1330), Byzantine grammarian and theologian, flourished during the reigns of Michael VIII. and Andronicus II. Palaeologi. He was born at Nicomedia in Bithynia, but the greater part of his life was spent in Constantinople, where as a monk he devoted himself to study and teaching. On entering the monastery he changed his original name Manuel to Maximus. Planudes possessed a knowledge of Latin remarkable at a time when Rome and Italy were regarded with hatred and contempt by the Byzantines. To this accomplishment he probably owed his selection as one of the ambassadors sent by Andronicus II. in 1327 to remonstrate with the Venetians for their attack upon the Genoese settlement in Pera. A more important result was that Planudes, especially by his translations, paved the way for the introduction of the Greek language and literature into the West.

He was the author of numerous works; notably a Greek grammar in the form of question and answer, like the 'Ερωτήματα of Moschopulus, with an appendix on the so-called "political" verse; a treatise on syntax; a biography of Aesop and a prose version of the fables; scholia on certain Greek authors; two hexameter poems, one a eulogy of Claudius Ptolemaeus, the other an account of the sudden change of an ox into a mouse; a treatise on the method of calculating in use amongst the Indians (ed. C. J. Gerhardt, Halle, 1865); and scholia to the first two books of the *Arithmetic* of Diophantus. His numerous translations from the Latin included Cicero's *Somnium Scipionis* with the commentary of Macrobius; Caesar's *Gallic War*; Ovid's *Heroides* and *Metamorphoses*; Boetius, *De consolatione philosophiae*; Augustine, *De trinitate*. These translations were very popular during the middle ages as textbooks for the study of Greek. It is, however, as the editor and compiler of the collection of minor poems known by his name (see ANTHOLOGY: *Greek*) that he is chiefly remembered.

See Fabricius, *Bibliotheca graeca*, ed. Harles, xi. 682; theological writings in Migne, *Patrologia graeca*, cxlvii; correspondence, ed. M. Treu (1890), with a valuable commentary; K. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897); J. E. Sandys, *Hist. of Class. Schol.* (1906), vol. i.

PLAQUE, a French term for a small flat plate or tablet, applied particularly to rectangular or circular ornamental plates or tablets of bronze, silver, lead or other metal, or of porcelain or ivory. Small plaques, *plaquettes*, in low relief in bronze or lead, were produced in great perfection in Italy at the end of the 15th and beginning of the 16th centuries, and were usually copies of ancient engraved gems, earlier goldsmith work and the like.

PLASENCIA, a city of Spain and an episcopal see, in the north of the province of Caceres. Pop. (1900), 8208. Plasencia is situated on the river Jerte, a subtributary of the Tagus, and at the foot of the sierras of Bejar and Vera. The place has some interest on account of its fine walls, built in 1197 by Alphonso VIII. of Castile, and its cathedral, begun in 1498, a favourable specimen of the ornate Gothic of its period. The Hieronymite convent of Yuste, the scene of the last years of the emperor Charles V. (1500–1558), is 24 m. east.

PLASSEY (*Palāsi*), a village of Bengal on the river Bhagirathi, the scene of Clive's victory of the 23rd of June 1757, over the forces of the nawab Suraj-ud-Dowlah. The fall of Calcutta and the "Black Hole" atrocity led to instant action by the East India Company, and Clive, with as many troops as could be spared, undertook a campaign against the nawab, and soon reoccupied Calcutta. Long and intricate negotiations, or rather intrigues, followed, and at the time of the battle the loyalty of most of the nawab's generals had been effectually undermined, though assistance, active or passive, could hardly be counted on. With this doubtful advantage, Clive, with 1100 European and 2100 native soldiers, and 10 field-pieces, took the field against the nawab, who had 50,000 men, 53 heavy guns, and some French artillery under M. de St Frais. Only the river Bhagirathi separated Clive's little force from the entrenched camp of the enemy, when the English leader, for once undecided, called a council of war. Clive and the majority were against fighting, Major Eyre Coote, of the 39th Foot, and a few others for action. Coote's soldierly advice powerfully impressed Clive, and after deep consideration he altered his mind and issued orders to cross the river. After a fatiguing march, the force bivouacked in a grove near Plassey early on the 23rd. The nawab's host came out of its lines and was drawn up in a huge semicircle almost enclosing the little force in the grove, and St Frais' gunners on the right wing opened fire. Clive replied, and was soon subjected to the converging fire of 50 heavy guns. For hours the unequal fight was maintained, until a rainstorm stopped it. The English covered up their guns, but the enemy took no such precaution. Mir Mudin, the only loyal general of the nawab's army, thinking that Clive's guns were as useless as his own, made a disastrous cavalry charge upon them; he lost his own life, and his colleagues then had the game in their hands. Mir Jagar persuaded the nawab to retire into the entrenchments. St Frais stood fast until one of Clive's officers, Major Kilpatrick, successfully drove him in. Clive followed up this success by cannonading the camp at close range. But the rank and file of the native army, ignorant of the treachery of their leaders, made a furious sortie. For a time Clive was hard pressed, but his cool generalship held its own against the undisciplined valour of the enemy, and, noticing Mir Jagar's division in his rear made no move against him, he led his troops straight against the works. After a short resistance, made chiefly by St Frais, the whole camp fell into his hands. At a cost of 23 killed and 49 wounded this day's work decided the fate of Bengal. The historic grove of mangoes, in which Clive encamped on the previous night, has been entirely washed away by changes in the course of the river; but other relics of the day remain, and a monument has recently been erected.

PLASTER, a mixture of lime, hair and sand, used to cover rough walling of lathwork between timbers (see PLASTER-WORK); also a fine white plaster of gypsum, generally known as "plaster of Paris." The word (also as "plaister") is used in medicine of adhesive mixtures employed externally for the protection of injured surfaces, for support of weak muscular or other structures, or as counter-irritants, soothing applications &c. The ultimate derivation of the word is the Gr. ἔμπλαστρον or ἔμπλαστον in the medical sense, from ἐν, on, and πλάσσειν, to daub or smear.

PLASTER OF PARIS, a variety of calcined gypsum (calcium sulphate) which forms a hard cement when treated with water (see CEMENT). The substance obtained its name in consequence of being largely manufactured in the neighbourhood of Paris.

PLASTER-WORK, in building. Plastering is one of the most ancient of handicrafts employed in connexion with building operations, the earliest evidence showing that the dwellings of primitive man were erected in a simple fashion with sticks and plastered with mud. Soon a more lasting and sightly material was found and employed to take the place of mud or slime, and that perfection in the compounding of plastering materials was approached at a very remote period is made evident by the fact that some of the earliest plastering which has remained undisturbed excels in its scientific composition that which we use at the present day. The pyramids in Egypt contain plaster-work executed at least four thousand years ago (probably much earlier) and yet existing, hard and durable, at the present time. From recent discoveries it has been ascertained that the principal tools of the plasterer of that time were practically identical in design, shape and purpose with those used to-day. For their finest work the Egyptians used a plaster made from calcined gypsum just like the "plaster of Paris" of the present time, and their methods of plastering on reeds resemble in every way our "lath, plaster, float and set" work. Hair was introduced to strengthen the "stuff," and the whole finished somewhat under an inch thick. Very early in the history of Greek architecture we find the use of plaster of a fine white lime stucco. Such has been found at Mycenae. The art had reached perfection in Greece more than five centuries before Christ, and plaster was frequently used to cover temples externally and internally, in some cases even where the building was of marble. It formed a splendid ground for decorative painting, which at this period of Grecian history had reached a very high degree of beauty. The temple of Apollo at Bassae, built of yellow sandstone about 470 B.C., is an excellent example. Pavements of thick, hard plaster, stained with various pigments, were commonly laid in Greek temples. The Roman architect Vitruvius, in his book on architecture written about 16 B.C., gives detailed information concerning the methods of making plaster and the manner of using it. "The lime used for stucco," he writes, "should be of the best quality and tempered a long time before it is wanted for use. The Greeks, besides making their stucco work hard with thin coats of marble-dust plaster polished with chalk or marble, caused the plaster when being mixed to be beaten with wooden staves by a great number of men. Some persons cutting slabs of such plaster from ancient walls use them for tables and mirrors." Pliny the elder tells us that "no builder should employ lime which had not been slaked at least three years," and that "the Greeks used to grind their lime very fine and beat it with pestles of wood." In England the walls of large houses and mansions were formerly plastered above the wainscoting and coloured, while the ornamented plaster ceilings of the time of Henry VIII., Elizabeth and James I., are still the admiration of lovers of the art. Still earlier specimens of the plasterer's skill are extant in the pargeted and ornamented fronts of half-timbered houses. With regard to the smaller buildings, comprising small dwelling-houses and cottages, the general application of plaster is of comparatively late date; for wainscoted walls and boarded ceilings or naked joists alone are frequently found in houses of not more than a century old both in England and on the Continent.

In the more common operations of plastering, comparatively few tools and few materials are required, but the workman efficient in all branches of the craft will possess a very large variety of implements. The materials of the workman are laths, lath nails, lime, sand, hair, plaster of paris, and a variety of cements, together with various ingredients to form colouring washes, &c.

Lathing.

Wood laths are narrow strips of some straight-grained wood, generally Baltic or American fir, in lengths of from two to four or five feet to suit the distances at which the timbers of a floor or partition are set. Laths are about an inch wide, and are made in three thicknesses; "single" ($\frac{1}{8}$ to $\frac{3}{16}$ in. thick), "lath and a half" ($\frac{1}{4}$ in. thick), and "double" ($\frac{3}{8}$ to $\frac{1}{2}$ in. thick). The thicker laths should be used in ceilings, to stand the extra strain, and the thinner variety in vertical work such as partitions, except where the latter will be subjected to rough usage, in which case thicker laths become necessary. Laths are usually nailed with a space of about $\frac{3}{8}$ in. between them to form a key for the plaster. Laths were formerly all made by hand. A large quantity, however, are now made by machinery and are known as sawn laths, those made by hand being called rent or riven laths. Rent laths give the best results, as they split in a line with the grain of the wood, and are stronger and not so liable to twist as machine-made laths, some of the fibres of which are usually cut in the process of sawing. Laths must be nailed so as to break joint in bays three or four feet wide with ends butted one against the other. By breaking the joints of the lathing in this way, the tendency for the plaster to crack along the line of joints is diminished and a better key is obtained. Every lath should be nailed at each end and wherever it crosses a joist or stud. All timbers over three inches wide should be counter-lathed, that is, have a fillet or double lath nailed along the centre upon which the laths are then nailed. This is done to preserve a good key for the plaster. Walls liable to damp are sometimes battened and lathed in order to form an air cavity between the damp wall and the plastering.

Metal Lathing.

Lathing of metal, either of wire or in the form of perforated sheets, is now extensively used on account of its fire-proof and lasting quality. There are very many kinds of this material made in different designs under various patents, the best-known in England being the Jhilmil, the Bostwick, and the Expanded Metal lathing. The two last-named are also widely used in America.

Lathing nails are usually of iron, cut, wrought or cast—and in the better class of work they are galvanized to prevent rusting. Zinc nails are sometimes used, but are costly.

Limes.

The lime principally used for internal plastering is that calcined from chalk or other nearly pure limestone, and is known as fat, pure, chalk or rich lime. Hydraulic limes, which are referred to in the articles BRICKWORK and MORTAR, are also used by the plasterer, chiefly for external work. Perfect slaking of the calcined lime before being used is very important as, if used in a partially slaked condition, it will "blow" when in position and blister the work. Lime should therefore be run as soon as the building is begun, and at least three weeks should elapse between the operation of running the lime and its use.

Hair.

Hair is used in plaster as a binding medium, and gives tenacity to the material. Ox-hair, which is sold in three qualities, is the kind usually specified; but horsehair, which is shorter, is sometimes substituted in its stead or mixed with the ox-hair in the lower qualities. Good hair should be long, strong, and free from grease and dirt, and before use must be well beaten to separate the lumps. In America, goats' hair is frequently used, though it is not so strong as ox-hair. The quantity used in good work is one pound of hair to two or three cubic feet of coarse stuff.

Substitutes for Hair.

Manila hemp fibre has been used as a substitute for hair. As a result of experiments to ascertain its strength as compared with that of other materials, it was found that plaster slabs made with Manila hemp fibre broke at 195 ℔, plaster mixed with Sisal hemp at 150 ℔, jute at 145 ℔, and goats' hair at 144½ ℔. Another test was made in the following manner. Two barrels of mortar were made up of equal proportions of lime and sand, one containing the usual quantity of goats' hair, and the other Manila fibre. After remaining in a dry cellar for nine months the barrels were opened. It was found that the hair had been almost entirely eaten away by the action of the lime, and the mortar consequently broke up and crumbled quite easily. The mortar containing the Manila hemp, on the other hand, showed great cohesion, and required some effort to pull it apart, the hemp fibre being apparently quite uninjured. Sawdust has been used as a substitute for hair and also instead of sand as an aggregate. It will enable mortar to stand the effects of frost and rough weather. It is useful sometimes for heavy cornices and similar work, as it renders the material light and strong. The sawdust should be used dry.

Sand.

Some remarks are made on the ordinary sands for building in the articles on Brickwork and Mortar. For fine plasterer's work special sands, not hitherto referred to, are used, such as silver sand, which is used when a light colour and fine texture are required. In England this fine white sand is procured chiefly from Leighton Buzzard.

External Work.

For external work Portland cement is undoubtedly the best material on account of its strength, durability, and weather resisting properties. The first coat or rendering is from ½ to ¾ in. thick, and is mixed in the proportions of from one part of cement to two of sand to one part to five of sand. The finishing or setting coat is about $\frac{3}{16}$ in. thick, and is worked with a hand float on the surface of the rendering, which must first be well wetted.

Stucco.

Stucco is a term loosely applied to nearly all kinds of external plastering, whether composed of lime or of cement. At the present time it has fallen into disfavour, but in the early part of the 19th century a great deal of this work was done. The principal varieties of stucco are common, rough, trowelled and bastard. Cement has largely superseded lime for this work. Common stucco for external work is usually composed of one part hydraulic lime and three parts sand. The wall should be sufficiently rough to form a key and well wetted to prevent the moisture being absorbed from the plaster.

Rough stucco is used to imitate stonework. It is worked with a hand float covered with rough felt, which forms a sand surface on the plaster. Lines are ruled before the stuff is set to represent the joints of stonework. *Trowelled stucco*, the finishing coat of this work, consists of three parts sand to two parts fine stuff. A very fine smooth surface is produced by means of the hand float. *Bastard stucco* is of similar composition, but less labour is expended on it. It is laid on in two coats with a skimming float, scoured off at once, and then trowelled. *Coloured stucco*: lime stucco may be executed in colours, the desired tints being obtained by mixing with the lime various oxides. Black and greys are obtained by using forge ashes in varying proportions, greens by green enamel, reds by using litharge or red lead, and blues by mixing oxide or carbonate of copper with the other materials.

Rough-cast or *Pebble-dash* plastering is a rough form of external plastering in much use for country houses. In Scotland it is termed "harling." It is one of the oldest forms of external plastering. In Tudor times it was employed to fill in between the woodwork of half-timbered framing. When well executed with good material this kind of plastering is very durable. Rough-casting is performed by first rendering the wall or laths with a coat of well-haired coarse stuff composed either of good hydraulic lime or of Portland cement. This layer is well scratched to give a key for the next coat, which is also composed of coarse stuff knocked up to a smooth and uniform consistency. While this coat is still soft, gravel, shingle or other small stones are evenly thrown on with a small scoop and then brushed over with thin lime mortar to give a uniform surface. The shingle is often dipped in hot lime paste, well stirred up, and used as required.

Sgraffito (Italian for "scratched") is scratched ornament in plaster. Scratched ornament is the oldest form of surface decoration, and at the present day it is much used on the continent of Europe, especially in Germany and Italy, in both external and internal situations. Properly treated, the work is durable, effective and inexpensive. The process is carried out in this way: A first coat or rendering of Portland cement and sand, in the proportion of one to three, is laid on about ½ in. thick; then follows the colour coat, sometimes put on in patches of different tints as required for the finished design. When this coat is nearly dry, it is finished with a smooth-skimming, $\frac{1}{12}$ to ⅛ in. thick, of Parian, selenitic or other fine cement or lime, only as much as can be finished in one day being laid on. Then by pouncing through the pricked cartoon, the design is transferred to the plastered surface. Broad spaces of background are now exposed by removing the finishing coat, thus revealing the coloured plaster beneath, and following this the outlines of the rest of the design are scratched with an iron knife through the outer skimming to the underlying tinted surface. Sometimes the coats are in three different colours, such as brown for the first, red for the second, and white or grey for the final coat. The pigments used for this work include Indian red, Turkey red, Antwerp blue, German blue, umber, ochre, purple brown, bone black or oxide of manganese for black. Combinations of these colours are made to produce any desired tone.

Internal Work.

Lime plastering is composed of lime, sand, hair and water in proportions varying according to the nature of the work to be done. In all cases good materials, well mixed and skilfully applied, are essential to a perfect result. Plaster is applied in successive coats or layers on walls or lathing, and gains its name from the number of these coats. "One coat" work is the coarsest and cheapest class of plastering, and is limited to inferior buildings, such as outhouses, where merely a rough coating is required to keep out the weather and draughts. This is described as "render" on brickwork, and "lath and lay" or "lath and plaster one coat" on studding. "Two coat" work is often used for factories or warehouses and the less important rooms of residences. The first coat is of coarse stuff finished fair with the darby float and scoured. A thin coat of setting stuff is then laid on, and trowelled and brushed smooth. "Two coat" work is described as "render and set" on walls, and "lath, plaster and set," or "lath, lay and set" on laths. "Three coat" work is usually specified for all good work. It consists, as its name implies, of three layers of material, and is described as "render, float and set" on walls and "lath, plaster, float and set," or "lath, lay, float and set," on lathwork. This makes a strong, straight, sanitary coating for walls and ceilings. The process for "three coat" work is as follows: For the first coat a layer of well-haired coarse stuff, about ½ in. thick, is put on with the laying trowel. This is termed "pricking up" in London, and in America "scratch coating." It should be laid on diagonally, each trowelful overlapping the previous one. When on laths the stuff should be plastic enough to be worked through the spaces between the laths to form a key, yet so firm as not to drop off. The surface while still soft is scratched with a lath to give a key for the next coat, which is known as the second or "floating coat," and is ¼ to ⅜ in. thick. In Scotland this part of the process is termed "straightening" and in America "browning," and is performed when the first coat is dry, so as to form a straight surface to receive the finishing coat. Four operations are involved in laying the second coat, namely, forming the screeds; filling in the spaces between the screeds; scouring the surface; keying the face for finishing. Wall screeds are plumbed and ceiling screeds levelled. Screeds are narrow strips of plastering, carefully plumbed and levelled, so as to form a guide upon which the floating rule is run, thus securing a perfectly horizontal or vertical surface, or, in the case of circular work, a uniform curve.

The "filling in," or "flanking," consists of laying the spaces between the screeds with coarse stuff, which is brought flush with the level of the screeds with the floating rule.

The "scouring" of the floating coat is of great importance, for it consolidates the material, and, besides hardening it, prevents it from cracking. It is done by the plasterer with a hand float which he applies vigorously with a rapid circular motion, at the same time sprinkling the work with water from a stock brush in the other hand. Any small holes or inequalities are filled up as he proceeds. The whole surface should be uniformly scoured two or three times, with an interval between each operation of from six to twenty-four hours. This process leaves the plaster with a close-grained and fairly smooth surface, offering little or no key to the coat which is to follow. To obtain proper cohesion, however, a roughened face is necessary, and this is obtained by "keying" the surface with a wire brush or nail float, that is, a hand float with the point of a nail sticking through and projecting about ⅛ in.; sometimes a point is put at each corner of the float. After the floating is finished to the walls and ceiling, the next part of internal plastering is the running of the cornice, followed by the finishing of the ceiling and walls.

The third and final coat is the "setting coat," which should be about ⅛ in. thick. In Scotland it is termed the "finishing," and in America the "hard finish" or "putty coat." Considerable skill is required at this juncture to bring the work to a perfectly true finish, uniform in colour and texture. Setting stuff should not be applied until the floating is quite firm and nearly dry, but it must not be too dry or the moisture will be drawn from the setting stuff.

The coarse stuff applied as the first coat is composed of sand and lime, usually in proportions approximating to two to one, with hair mixed into it in quantities of about a pound to two or three cubic feet of mortar. It should be mixed with clean water to such a consistency that a quantity picked up on the point of a trowel holds well together and does not drop.

Floating stuff is of finer texture than that used for "pricking up," and is used in a softer state, enabling it to be worked well into the keying of the first coat. A smaller proportion of hair is also used.

Fine stuff mixed with sand is used for the setting coat. Fine stuff, or lime putty, is pure lime which has been slaked and then mixed with water to a semi-fluid consistency, and allowed to stand until it has developed into a soft paste. For use in setting it is mixed with fine washed sand in the ratio of one to three.

For cornices and for setting when the second coat is not allowed time to dry properly, a special compound must be used. This is often "gauged" stuff, composed of three or four parts of lime putty and one part of plaster of Paris, mixed up in small quantities immediately before use. The plaster in the material causes it to set rapidly, but if it is present in too large a proportion the work will crack in setting.

The hard cements used for plastering, such as Parian, Keene's, and Martin's, are laid generally in two coats, the first of cement and sand $\frac{1}{2}$ to $\frac{3}{4}$ in. in thickness, the second or setting coat of neat cement about $\frac{1}{8}$ in. thick. These and similar cements have gypsum as a base, to which a certain proportion of another substance, such as alum, borax or carbonate of soda, is added, and the whole baked or calcined at a low temperature. The plaster they contain causes them to set quickly with a very hard smooth surface, which may be painted or papered within a few hours of its being finished.

The by-laws made by the London County Council under § 31 of the London Council (General Powers) Act 1890 set forth the description and quality of the substances of which plastering is to be made for use in buildings erected under its jurisdiction.

Mouldings. Plain, or unenriched, mouldings are formed with a running mould of zinc cut to the required profile. Enrichments may be added after the main outline moulding is set, and are cast in moulds made of gelatine or plaster of paris. For a cornice moulding two running rules are usual, one on the wall, the other on the ceiling, upon which the mould is worked to and fro by one workman, while another man roughly lays on the plaster to the shape of the moulding. The mitres at the angles are finished off with joint rules made of sheet steel of various lengths, three or four inches wide, and about one-eighth inch thick, with one end cut to an angle of about 30°. In some cases the steel plate is let into a "stock" or handle of hardwood.

Cracks. Cracks in plastering may be caused by settlement of the building, and by the use of inferior materials or by bad workmanship, but apart from these causes, and taking the materials and labour as being of the best, cracks may yet ensue by the too fast drying of the work, caused through the laying of plaster on dry walls which suck from the composition the moisture required to enable it to set, by the application of external heat or the heat of the sun, by the laying of a coat upon one which has not properly set, the cracking in this case being caused by unequal contraction, or by the use of too small a proportion of sand.

Slabs. For partitions and ceilings, plaster slabs are now in very general use when work has to be finished quickly. For ceilings they require simply to be nailed to the joists, the joints being made with plaster, and the whole finished with a thin setting coat. In some cases, with fire-proof floors, for instance, the slabs are hung up with wire hangers so as to allow a space of several inches between the soffit of the concrete floor and the ceiling. For partitions the slabs frequently have the edges tongued and grooved to form a better connexion; often, too, they are holed through vertically, so that, when grouted in with semi-fluid plaster, the whole partition is bound together, as it were, with plaster dowels. Where very great strength is required the work may be reinforced by small iron rods through the slabs. This forms a very strong and rigid partition which is at the same time fire-resisting and of light weight, and when finished measures only from two to four inches thick. The slabs may be obtained either with a keyed surface, which requires finishing with a setting coat when the partition or ceiling is in position, or a smooth finished face, which may be papered or painted immediately the joints have been carefully made. Partitions are also formed with one or other of the forms of metal lathing previously referred to, fixed to iron uprights and plastered on both sides. So strong is the result that partitions of this class only two or three inches thick were used for temporary cells for prisoners at Newgate Gaol during the rebuilding of the new sessions house in the Old Bailey, London.

Fibrous Plaster. Fibrous plaster is given by plasterers the suggestive name "stick and rag," and this is a rough description of the material, for it is composed of plaster laid upon a backing of canvas stretched on wood. It is much used for mouldings, circular and enriched casings to columns and girders and ornamental work, which, being worked in the shop and then nailed or otherwise fixed in position, saves the delay often attendant upon the working of ornament in position.

Desachy, a French modeller, took out in 1856 a patent for "producing architectural mouldings, ornaments and other works of art, with surfaces of plaster," with the aid of plaster, glue, wood, wire, and canvas or other woven fabric. The modern use of this material may be said to have started then, but the use of fibrous plaster was known and practised by the Egyptians long before the Christian era; for ancient coffins and mummies still preserved prove that linen stiffened with plaster was used for decorating coffins and making masks. Cennino Cennini, writing in 1437, says that fine linen soaked in glue and plaster and laid on wood was used for forming grounds for painting. Canvas and mortar were in general use in Great Britain up to the middle of the last century. This work is also much used for temporary work, such as exhibition buildings.

The principal books of reference on the subject are: W. Millar. *Plastering, Plain and Decorative*; G. R. Burnell, *Limes, Cements, Mortars and Mastics*; Rivington, *Notes on Building Construction*, Part III. "Building Materials"; the works on architecture of Robert and James Adam. (J. Br.)

PLATA, RIO DE LA, or River Plate, a funnel-shaped estuary, on the east side of South America, extending W.N.W. from the sea about 170 m. The discovery of the South Sea by Balboa, then governor of Castilla del Oro, of which Darien formed a part, created a lively desire to learn something of its coast-line, and the year following (in 1514), the Spanish monarch concluded a navigation contract with Juan Diaz de Solis, then Piloto Mayor, to search for a strait connecting the Atlantic with the newly found ocean, explore the coasts of the latter and communicate with Pedrarias de Avila, the new governor of Castilla del Oro; and, if it were found to be an island, to report to the superior authorities of Cuba. De Solis set sail from the port of Lepe on the 8th of October 1515, reached the Bay of Rio de Janeiro on the 1st of January 1516, and continuing southward to lat. 35° entered the great estuary now known as the Plata, which, for a short period of time, was called the de Solis and the Mar Dulce. Ascending it to the vicinity of the island of Martin Garcia, near the mouth of the Paraná river, de Solis was ambushed and killed in the early part of 1516 by Guarani Indians while attempting to capture some of them. In the first months of 1520 Magellan explored the Rio de la Plata, and afterwards, in the same year, discovered and navigated the straits which bear his name. This discovery led to the voyage of Sebastian Cabot, who fitted out an expedition in 1526 to reach the Spice Islands by the Magellan route. Owing, however, to shortness of provisions and the insubordination of his men Cabot abandoned his proposed voyage to the Moluccas, and, ascending the Mar Dulce, discovered the Paraná river and reached a point on the Paraguay near the site of the present city of Asuncion. Here he met many Guarani Indians wearing silver ornaments, probably obtained in trade across the Gran Chaco, from the frontier of the Inca Empire. In exchange for beads and trinkets Cabot acquired many of these ornaments and sent them to Spain as evidence of the richness of the country in precious metals and the great importance of his discoveries. The receipt of these silver baubles caused the name of Rio de la Plata to be applied to the third (perhaps the second) greatest river of the Western Continent.

The extreme breadth of the river at its mouth is 138 m. It narrows quickly to 57 m. at Montevideo, and at its head, where it receives the united Paraná and Uruguay rivers, its width is about 25 m. Its northern or Uruguayan shore is somewhat elevated and rocky, while the southern or Buenos Airean one is very low. The whole estuary is very shallow, and in no place above Montevideo exceeds 36 ft. in depth when the river is low. The bottom generally consists of enormous banks of sand covered with from 10 to 20 ft. of water, and there is a continuous and intricate channel, of about 22 ft. depth only, to within 14 m. of the port of Buenos Aires. The remaining distance has a depth of 18 ft. in the uncertain channel. The Plata is simply the estuarine receptacle of two mighty streams, the Uruguay and Paraná, which drain the Plata basin. This has an area of 1,198,000 sq. m., or over two and one-half times that of the Pacific slope of the Andes, and comprises the most fertile, healthiest and best part of Brazil, a large portion of the Argentine Republic, the whole of Paraguay and south-eastern Bolivia, and most of Uruguay.

The Uruguay and Affluents. The Uruguay river has a length of about 1000 m. Many small streams from the western slope of the Brazilian Serra do Mar unite, in about 27° 45′ S., to form this river, which then flows W.N.W., serving as the boundary between the states of Santa Catharina and Rio Grande do Sul, as far as 52° W., near which it receives a considerable tributary from the north, called the Pepiri-guazú. Between 27° 58′ and 33° 34′ S. three important tributaries join it from the east—the Ipui-guazú, the Ibicui and the Negro, the last being its main affluent

The Pepiri-guazú was one of the limits between the possessions of Portugal and Spain. Its lower course is about 250 ft. wide, but higher up it narrows to about 30 ft., and runs with great violence between high wooded banks. It is navigable for canoes for about 70 m. above its mouth, as far as its first fall. The Rio Negro has a delta of several large islands at its confluence with the Uruguay. Its head-waters are in the southern part of Rio Grande do Sul, but the main river belongs entirely to the state of Uruguay, which it cuts midway in its course from north-east to south-west. Its lower reaches are navigable for craft of moderate draught.

Course of the Uruguay.

From the time the Uruguay leaves the coast range of Brazil it runs for a long distance through a beautiful, open, hilly country, but afterwards enters a forest belt of high lands. At the river Pepiri-guazú it turns suddenly to the south-west, and continues this course to its junction with the Paraná and Plata. Near Fray Bentos, 61 m. before reaching the Plata, it forms a great lake, about 56 m. long and from 4 to 6 m. wide. At Punta Gorda, where it debouches into the Plata, it is only 1 m. to 1⅛ m. wide, but is 90 ft. deep. From the Pepiri-guazú junction its banks are high and covered with forest as far down as 27° 30′ S., where the river is 2300 ft. wide and from 10 to 40 ft. deep. The Uruguay is much obstructed by rocky barriers. Four miles below its confluence with the Pepiri-guazú it has a cataract, about 8 m. long, with a total fall of 26 ft. at low water. The river near the Pepiri-guazú is 1550 ft. wide, but about 1½ m. before reaching the cataract its width is reduced to 600 ft. Along the cataract it is closed in between high precipitous walls of black rock only 70 ft. apart. Above Punta Gorda, 212 m., is the Salto Grande, which has a length of 15 m. of rapids, the greatest single fall being 12 ft., and the difference of level for the entire length of the reefs 25 ft. These cross the river diagonally, and during floods all, excepting a length of 1½ m. of them, are submerged. Nine miles below the Salto Grande is the Salto Chico, which bars navigation during six months of the year, but in flood-time may be passed in craft drawing 5 ft. of water. The Uruguay can be navigated at all seasons by vessels of 4½ ft. draught as far up as the Salto Chico, and of 14 ft. up to Paysandú for a greater part of the year. Fray Bentos may be reached all the year round by any vessel that can ascend the Paraná. Above the navigable lower river there is launch and canoe navigation for many hundreds of miles upon the main artery and its branches, between the rapids which are met with from time to time. The Uruguay has its annual floods, due to the rains in its upper basin. They begin at the end of July and continue to November, attaining their maximum during September and October. At the narrow places the river rises as high as 30 ft., but its average rise is 16 ft. It flows almost for its entire course over a rocky bed, generally of red sandstone, at times very coarse and then again of extremely fine composition. Except in floods, it is a clear-water stream, and even at its highest level carries comparatively little silt.

The Paraná and its Affluents.

The Paraná (the "Mother of the Sea" in Guarani) drains a vast area of southern Brazil. It is formed by the union of the Rio Grande and Paranáhyba, and is about 1600 m. long from its extreme source in Goyaz to its junction with the Paraguay, and thence 600 more to the Plata estuary. Its average width for the latter length is from 1 to 3 m. Its Rio Grande branch descends from the slope of the Serra da Mantiqueira, in the region where the orographic system of Brazil culminates near the peak of Itatiaia-assú, almost in sight of Rio de Janeiro. It is about 680 m. long, but only navigable in the stretches between the many reefs, falls and rapids which interrupt its regular flow. Among its numerous affluents the principal one is the Rio das Mortes, rising in the Serra Mantiqueira. It is 180 m. long, with two sections, of a total of 120 m., which are navigable for launches. The main branch of the Paraná, the Paranáhyba, rises in about 15° 30′ S., on the southern slopes of the Pyreneos Mountains. It drains a little-known region of Goyaz and western Minas Geraes, lying upon the immediate southern watershed of Brazil.

Besides these rivers, the Paraná has many long and powerful affluents from the Brazilian states of São Paulo and Paraná. Most of them, although obstructed by rapids, are navigable for launches and canoes. Among the eastern tributaries are the Tiété, the Paraná-panema, formerly known as the Anemby, and the Iguazú.

The Tiété, over 700 m. long, rises in the Serra Paranápicaba and flows in a north-west direction. Its course is broken by fifty-four rapids, and the lower river by two falls, the Avanhandava, 44 ft. drop, and the Itapurá, 65 ft.

The Paraná-panema is about 600 m. long, and rises in a ramification of the Serra Paranápicaba which overlooks the Atlantic Ocean. Its general course is north-west. It is navigable for a distance of only about 30 m. above its mouth, and for its whole course it has so many obstructions that it is useless for commercial purposes.

The Iguazú, also called the Rio Grande de Curutiba, has its sources on the slopes of the Serra do Mar of Brazil, and flows nearly west, through thick forests, along the line of 26° S. Its navigation is difficult even for small craft, as it is full of reefs, rapids and cataracts. Sixteen miles above its mouth is the magnificent Salto del Iguazú, sometimes called the Victoria Fall, round which canoes have to be transported 37 m. before quiet water is reached again. The width of the falls, measured along their crest or edge, is 2½ m.; part of the river takes two leaps of about 100 ft. each, but a portion of it plunges down the whole depth in unbroken mass. Its mouth is about 800 ft. wide, and the depth in mid-river 40 ft.

Course of the Paraná.

The Paraná, at a point 28 m. above the mouth of the Tiété, is interrupted by the falls of Urubuponga, but below these it has unobstructed navigation for about 400 m., as far down as the falls of Guaira, in 24° 3′ S., where the river forms a lake 4½ m. long and 2½ m. wide, preparatory to breaching the Serra de Mbaracayú, which there disputes its right of way. It has torn a deep gorge through the mountains for a length of about 2 m., where it is divided into several channels, filled with rapids and cataracts. It finally gathers its waters into a single volume, to plunge with frightful velocity through a long cañon only about 200 ft. wide. From these so-called falls of Guaira, or "Sete Quedas," as far as its confluence with the Paraguay river, the Paraná has carved a narrow bed through an immense cap of red sandstone, along which it sometimes flows with great rapidity, occasionally being interrupted by dangerous narrows and rapids, where the banks in some places close in to a width of 450 to 600 ft., although the average is from 1200 to 1600 ft. At the south-east angle of Paraguay the Paraná is prevented from continuing its natural southern course to the river Uruguay by the highlands which cross the Argentine province of Misiones, and connect those of Rio Grande do Sul with the Caa-guazú range of Paraguay. Here, therefore, it is turned westwards; but before escaping from its great sandstone bed it is obstructed by several reefs, notably at the rapids of Apipé, which are the last before it joins the placid Paraguay, 130 m. farther on. From the Apipé rapids there is a vast triangular space at the south-western corner of Paraguay but little above sea-level, consisting of low, sandy ground and morasses, at times flooded by the Paraguay river. This district, united to the equally enormous area occupied by the Yberá lagoon and its surrounding morasses, in the northern part of the Argentine province of Corrientes, was probably the delta of the Paraná river when it emptied into the ancient Pampean Sea.

The Paraguay.

The river Paraguay, the main affluent of the Paraná, rises in Matto Grosso, in the vicinity of the town of Diamantino, about 14° 24′ S. It flows south-westwards, as far as Villa Maria, along the foot of the high plateau which divides it from the Cuyabá River to the east, and then, turning southwards, soon reaches the morass expansion of Xarayes, which it traverses for about 100 m. A few miles below Villa Maria it receives an affluent from the north-west, the Jaurá, which has its source nearly in contact with the head-waters of the Guaporé branch of the river Madeira. The Cuyabá, which is known as the São Lourenço for 90 m. above its confluence with the Paraguay, has its sources in 13° 45′ S., almost in touch with those of the Tapajos branch of the Amazon. Above the town of Cuyabá it is from 150 to 400 ft. wide, and may be navigated up stream by canoes for 150 m.; but there are many rapids. The town may be reached from the Paraguay River, at low water, by craft drawing 18 in. According to the observations of Clauss, Cuyabá is only 660 ft. above sea-level. From the junction of the São Lourenço (or Cuyabá) with the river Paraguay, the latter, now a great stream, moves sluggishly southwards, spreading its waters, in the rainy season, for hundreds of miles to the right and left, as far south as 20°, turning vast swamps into great lakes—in fact, temporarily restoring the region, for thousands of square miles, to its ancient lacustrine condition.

Lagoons of Upper Paraguay.

On the west side of the upper Paraguay, between about 17° 30′ and 19° S., are several large, shallow *lagunas* or lakes which receive the drainage of the southern slopes of the Chiquitos sierras, but represent mainly the south-west overflow of the vast morass of Xarayas. The principal of these lakes, naming them from north to south, are the Uberaba, the Gaiba, Mandioré and the "Bahia" de Caceres. The Uberaba is the largest. The northern division of the lake belongs entirely to Brazil, but the southern one, about two-thirds of its area, is bisected from north to south by the boundary line between Brazil and Bolivia, according to the treaty of 1867. It is in great part surrounded by high ground and hills, but its southern coast is swampy and flooded during the rainy season. The west shore is historic. Here, in 1543, the *conquistador*, Martinez de Irala, founded the "Puerto de los Reyes," with the idea that it might become the port for Peru; and from Lake Gaiba several expeditions, in Spanish colonial days, penetrated 500 m. across the Chaco to the frontier of the empire of the Incas. At the Puerto de los Reyes Bolivia laid out a town in December 1900, in the forlorn hope that the "Port" may serve as an outlet for that commercially suffocated country, there being no other equally good accessible point for Bolivia on the Paraguay River.

Affluents of the Paraguay.

South of the São Lourenço, the first river of importance which enters the Paraguay from the east is the Taquary, about 19° S. It rises in the Serra Cayapó, on the southern extension of the Matto Grosso table-land. South of this stream about 50 m. a considerable river, the Mondego, with many branches, draining a great area of extreme southern Matto Grosso, also flows into the Paraguay; and still farther south, near 21°, is the Apá tributary, which forms the boundary between Paraguay and Brazilian Matto Grosso.

The Pilcomayo.

The Pilcomayo is of more importance from its length than from its volume. It rises among the Bolivian Andes north of Potosi and north-west of Sucre, races down the mountains to their base, crosses the Chaco plains, and pours into the river Paraguay near Asuncion. Nor does it receive any branch of importance until it reaches about 21° S., where it is joined from the south-west by the river Pelaya, upon which Tupiza, the most southerly city of Bolivia, is situated. The Pelaya rises upon the lofty inter-Andean plateau, and, taking an easterly course, saws its way across the inland Andean range, turns northwards and then eastwards to unite with the Pilcomayo, which it is said at least to equal in volume. Just below the junction is the fall of Guarapetendi, 23 ft. high. From this point to the mouth of the Pilcomayo the distance in a straight line is 480 m., although by the curves of the river, which is extremely tortuous, it is about double that distance. According to Storm, who quotes Captain Baldrich, the river bifurcates at 21° 51′ S., but again becomes a single stream at 23° 43′, the right channel being the greater in volume. It is probable that between 23° and 24° S. it throws E.S.E. three great arms to the river Paraguay, the upper portions of which have yet to be explored, but the lower parts have been examined for 100 to 200 m. up from the Paraguay. Enumerating from north to south, they are called the Esperanza, the Montelindo and the Macá. From 180 to 200 m. above its mouth the Pilcomayo filters through a vast swamp about 100 m. in diameter, through which there is no principal channel. This swamp, or perhaps shallow lagoon, is probably partly drained by the river Confuso, which reaches the Paraguay between the Pilcomayo and Macá. A northern branch of the Pilcomayo, the Fontana, the junction being at 24° 56′ S., is probably also a drainage outlet of the same great swamp.

For the first 100 m. below the fall of Guarapetendi the Pilcomayo is from 600 to 1000 ft. wide, but it so distributes its waters through its many bifurcations, and loses so much from infiltration and in swamps, and by evaporation from the numerous lagoons it forms on either side of its course, that its channel is greatly contracted before it reaches the Paraguay. From Sucre to the Andean margin of the Chaco, a distance of about 350 m. by the river, the fall is at least 8000 ft.—a sufficient indication that its upper course is useless for purposes of navigation.

The missionaries in 1556 first reported the existence of the Pilcomayo, which for a long period of time was known as the Araguay. In 1721 Patiño and Rodriguez partially explored it, and since then numerous attempts have been made to test its navigability, all of which have been failures; and several of them have ended in disaster and loss of life, so that the Pilcomayo now has a sinister reputation.

The Bermejo.

The Bermejo river flows parallel to the Pilcomayo, and enters the Paraguay a few miles above the junction of this with the Paraná. Its numerous sources are on the eastern frontage of the inland Andes, between the Bolivian town of Tarija and the Argentine city of Jujuy. Its most northerly tributary is the San Lorenzo, which, after being augmented by several small streams, takes the name of Rio de Tarija. This running east, and then taking a general south-easterly course, joins the Bermejo in 22° 50′ S. at a point called the Juntas de San Antonio. Thence, flying southwards, the Bermejo finally, in 23° 50′ S., receives its main affluent, the San Francisco, from the south-west. The latter has its source in about 22° 30′ S., and, under the name of Rio Grande, runs directly southwards, in a deep mountain valley, as far as Jujuy. It then turns eastwards for 50 m., and is joined by the Lavayen from the south-west. These two streams form the San Francisco, which, from their junction, runs north-eastwards to the Bermejo. The average width of the San Francisco is about 400 ft.; it is seldom over 2 ft. deep, and has many shoals and sand-banks. From its junction with the latter stream the Bermejo flows south-eastwards to the Paraguay with an average width in its main channel of about 650 ft., although narrowing at times to 160 and even 100. In its course, however, it bifurcates and ramifies into many channels, forming enormous islands, and frequently leaves old beds for new ones.

Since the exploration of the Bermejo by Patiño in 1721, it has often been examined from its sources to its mouth, with a view to ascertain its navigability. Captain Page in 1854 and 1859 found it impracticable to ascend it over 135 m. in the dry season, with a little steamer drawing 23 in. of water; but in flood-time, in December 1871, he succeeded, in 60 days, in reaching a point 720 m. from its mouth, in the steamer "Alpha," 53 ft. long and 30 in. draught. He afterwards penetrated another 100 m. up stream. The round voyage took a year, owing to the swift currents, shoals, quicksands, snags and fallen trees.

The Salado.

The Salado, about 250 m. south-west of and approximately parallel to the Bermejo, is the only great tributary which the Paraná receives from the west below its confluence with the Paraguay. Its extreme head-waters are in the Argentine province of Salta, and they drain a much broken Andean region lying between 24° and 26° 30′ south. The most westerly sources are the rivers Santa Maria and Calchaqui, which unite near the town of San Carlos and form the river Guáchipas. Having received the Arias, the Guáchipas runs north-eastwards about 50 m., and then it changes its name to the Juramento, which is retained until the river reaches the Chaco plains at the base of the foot-hills of the Andes. Here it becomes the Salado, a name it preserves for the remainder of its course. It joins the Paraná near Santa Fé in 31° 39′ south and 60° 41′ west. Explorers of the Salado, inclusive of Captain Page in 1855, claim that its lower half is navigable, but the many efforts which have been made to utilize it as a commercial route have all resulted in failure.

As the Pilcomayo, the Bermejo and the Salado wander about the country, ever in search of new channels, they erode and tear away great quantities of the Pampean material, dissolve it into silt, and pour it into the Paraguay and Paraná rivers. The engineer Pelleschi estimates that "the soil annually subtracted from the territory of the Chaco by the Bermejo alone equals 6,400,000 cubic yards."

South-easterly Course of Paraná.

South of its confluence with the river Paraguay, the Paraná washes the western foot of a series of sandstone bluffs for 30 miles. Thence for 240 m. the bordering hills are about 80 ft. high, but at Goya the country is almost on a level with the river. Near the boundary-line between Corrientes and Entre Rios the banks are very low on both sides of the river, and continue so for nearly 100 m.; but farther down, for 150 m., the left bank is margined, as far as Diamante, by a range of hills from 125 to 160 ft. high, at times boldly escarped. At Diamante they trend inland, south-eastwards, for about 50 m., and probably once bordered an ancient channel of the river. From 31° 30′ south to the head of the Plata estuary the western bank of the Paraná is a precipitous bluff of reddish clay, varying from 25 to 75 ft. above mean river level. It is being gradually undermined, and tumbles into the water in great blocks, adding to the immense volume of silt which the river carries. According to Ramon Lista, "the lowest level of the Paraná is in October and November, and, save an occasional freshet, it remains stationary until the beginning of summer, when its waters begin to rise, reaching their maximum about the middle of February in the lower part of their course." The difference between low and high river is generally about 12 ft., depending upon the varying quantity of rains in Brazil and the melting of the Andean snows. Below its junction with the Paraguay the Paraná has an average current of 2½ m. an hour, and the river varies in width from 1 to 3 m., at low water; but in floods it seems almost a continuous lake, broadening to 10 and 30 m. and burying many of its numerous islands and marginal swamps under a vast sheet of water, and obliterating its many parallel lateral channels and intricate systems of connecting canals.

Islands of Paraná.

In the middle Paraná, from the mouth of the Iguazú to the mouth of the Paraguay river, there are many islands, some of them large, rocky and high above the river. From Paraguay to the city of Rosario, islands are numerous, many of them of great area; and again below Rosario they soon increase in number and size until the Plata estuary is reached. In flood-time the upper portion of the trees being out of water, they have the appearance of floating forests. Then the river often makes wild work with its banks, and builds up or sweeps away entire islands, leaving deep channels instead. Mouchez in 1857, searching for two islands the position of which he had fixed in the previous year, found in their place 25 and 32 ft. of water. The lower delta of the Paraná does not share in these phenomena; its islands and main channels appear more fixed. This probably is due to the less elevation attained by the waters in flood-time, and the numerous branches which distribute them into the Plata estuary. This must have extended, in a very recent geological period, inland from its present head to at least 32° S.; but the enormous quantity of silt which the Paraná receives from its Paraguay affluent, and from the tributaries which reach it from the Andes, has filled this length of about 220 m. with these muddy islands, which rest upon a sandy bed of great depth.

Paraná Delta.

The frontage of the Paraná delta is 40 m. across, almost in a straight line from north to south. Through this the river finds its way to the Plata by eleven outlets, large and small, the two principal ones being the Paraná-guazú and the Paraná de las Palmas.

The mean flow of the Mississippi river at New Orleans is 675,000 cub. ft. per second, and its flood maximum about 1,000,000 ft. The minimum of the Plata past Buenos Aires is 534,000, the maximum 2,145,000. It may therefore be fairly assumed that the yearly discharge of the great North American river is not superior, and may be inferior, to that of the Plata.

The Paraná is navigable at all times as far up as the São Lourenço river by craft drawing 3 ft. of water, and to within a few miles of Asuncion, the capital of Paraguay, by vessels drawing 9 ft. The city of Paraná may always be reached with a draught of 12 and Rosario with 15 ft. of water.

Commerce.

The commercial development of the Plata basin may be conveniently illustrated by statistics for the year 1822, which marks the beginning of independent rule in its republics; for 1854, when the steamboat and the railway first began to play a part in this quarter of the world; and in 1898 and 1899, as indicating approximately the state of affairs at the end of the 19th century. In Buenos Aires, for example, the foreign trade (entered and cleared) in 1822 aggregated 107,170 tons; in 1854, 342,463 tons; and in 1899, 5,046,847 tons. The coasting and river trade of the same port increased from 150,741 tons in 1854 to 3,695,088 tons in 1899. But taking into account all the Argentine ports, except those which lie to the south of the Plata, there was for the six years ending with 1899 an annual average of 14,000,000 tons for the overseas commerce and 11,000,000 tons for the river and coasting trade. On the other, or northern, bank of the stream the chief port is Montevideo; and its foreign commerce increased from an aggregate of 50,000 tons in 1822 to 150,000 tons in 1854 and to 4,069,870 tons in 1898, the river and coasting trade having increased from 50,000 tons in 1822 to 150,000 tons in 1854 and to 3,915,421 tons in 1898. The total foreign trade of the Plata valley thus increased from over 157,000 tons in 1822 to nearly 18,100,000 tons in 1898–1899. Its growth since the opening of the 20th century has been phenomenal and promises to become gigantic. The Andes on the west, the interior of South America on the north, great rivers, and the Brazilian mountains on the east of the Plata basin are obstacles which compel the rich and varied products of at least 1,500,000 sq. m. of fertile country to seek access to the ocean by a single avenue—the Plata estuary. (G. E. C.)

PLATAEA, or PLATAEAE, an ancient Greek city of Boeotia, situated close under Mt Cithaeron, near the passes leading from Peloponnesus and Attica to Thebes, and separated from the latter city's territory by the river Asopus. Though one of the smallest Boeotian towns, it stubbornly resisted the centralizing policy of Thebes. In 519 B.C. it invoked Sparta's help against its powerful neighbour, but was referred by king Cleomenes to Athens (for the date, see Grote's *History of Greece*, ed. 1907, p. 82, note 4). The Athenians secured Plataea's independence, and thus secured its enduring friendship. In 490 the Plataeans sent their full levy to the assistance of the Athenians at Marathon, and during the invasion of Xerxes they joined eagerly in the national defence. At Artemisium they volunteered to man several Athenian ships, and subsequently abandoned their town to be burnt by Xerxes. In 479 they fought against the Persians under Mardonius in the decisive battle which bears the name of the city. In this campaign the Persian commander, retiring from Attica before the combined Peloponnesian and Athenian levy, had encamped in the Asopus plain in order to give battle on ground suited to his numerous cavalry. The Greeks under the Spartan regent Pausanias at first did not venture beyond the spurs of Cithaeron, but, encouraged by successful skirmishing, advanced towards the river and attempted a flanking movement so as to cut Mardonius off from his base at Thebes. The operation miscarried, and in their exposed condition the Greeks were severely harassed by the enemy's horse, which also blocked the Cithaeron passes against their supply columns. Pausanias thereupon ordered a night retreat to the hilly ground near Plataea, but the movement was badly executed; for whereas the Peloponnesians in the centre retired beyond their proper station, the Spartans and Athenians on the wings were still in the plain at daybreak. The Persians immediately fell upon these isolated contingents, but the Spartan infantry bore the brunt of the attack with admirable steadiness, and both wings ultimately rolled back their opponents upon the camp. When this was stormed the enemy's resistance collapsed, and Mardonius's army was almost annihilated. This great victory was celebrated by annual sacrifices and a Festival of Liberation (*Eleutheria*) in every fourth year at Plataea, whose territory moreover was declared inviolate.

In spite of this guarantee Plataea was attacked by Thebes at the beginning of the Peloponnesian War (431) and formally besieged by the Peloponnesians (429–27). The garrison after capitulating was put to death, and the city razed by the Thebans. The remaining Plataeans received a qualified franchise in Athens, and in 421 were settled on the territory of Scione. Expelled by Lysander in 404 they returned to Athens, until in 387 Sparta restored them in their native town as a check upon Thebes. The city was again destroyed by Thebes in 373, and the inhabitants once more became citizens of Athens. Plataea was rebuilt by Philip and Alexander of Macedon, and during the rest of antiquity enjoyed a safe but obscure existence. It continued to flourish in Byzantine and Frankish times. The walls of the town, which at various periods occupied different portions of the triangular ledge on which it stood, remain partly visible. Recent excavations have discovered the Heraeum; but the temple of Athena the Warlike, built from the Persian spoils and adorned by the most famous artists, has not been identified.

AUTHORITIES.—Strabo p. 411; Pausanias ix. 1–4; Herodotus vi. 108, viii. 1, ix. 25–85; Plutarch, *Aristides*, 11–21; Thucydides ii. 1–16, 71–78, iii. 20–24, 52–68; Isocrates, *Plataicus*; G. B. Grundy, *The Topography of the Battle of Plataea* (London, 1894) and *Great Persian War* (London, 1901), ch. xi.; W. Woodhouse in *Journal of Hellenic Studies* (1898), pp. 33–59; H. B. Wright, *The Campaign of Plataea* (New Haven, 1904); R. W. Macan, *Herodotus*, vii.-ix. (London, 1908), appendix; W. M. Leake, *Travels in Northern Greece*, ch. xvi., pp. 323–367 (London, 1835); *Amer. Journ. of Archaeology*, 1890, pp. 445–475; 1891, pp. 390–405; B. V. Head, *Historia numorum*, p. 294 (Oxford, 1887). (M. O. B. C.)

PLATE. The word "plate" (connected with Gr. *πλατύς*, flat, Late Lat. *plata=lamina*, and Span. *plata*, silver), in the sense to which it is restricted in the following article, is employed to denote works in silver or gold which belong to any class other than those of personal ornaments or coins.[1] As implying a thin sheet of metal, the term has come to be used in various technical connexions, and has been transferred by analogy to other materials (*e.g.* glass). A "plate," as the common name for the table utensil (of whatever material), derives its usage partly from the metal prototype and partly from an etymological connexion with French *plat*, dish, Latin *plattus*, flat. (See also PEWTER; SHEFFIELD PLATE; METAL-WORK.)

On account of the ease with which gold can be worked and the pure state in which it is generally found, it is probable that this was the first metal used by man; and it is certain that, in some countries at least, he attained to the most marvellous skill in its manipulation at a time when the other arts were in a very elementary condition. As an instance of this we may mention a sword of the bronze age, found in a barrow near Stonehenge, and placed in the museum at Devizes.[2] The hilt of this sword is covered with the most microscopically minute gold mosaic. A simple design is formed by fixing tesserae, or rather pins, of red and yellow gold into the wooden core of the handle. Incredible as it may appear, there are more than two thousand of these gold tesserae to the square inch. The use of silver appears to belong to a rather later period, probably because, though a widely spread metal in almost all parts of the world, it is usually found in a less pure state than gold, and requires some skill to smelt and refine it. Though both these precious metals were largely and skilfully used by prehistoric races, they were generally employed as personal ornaments or decorations for weapons. Except in Scandinavian countries, but little that can be called "plate" has been discovered in the early barrows of the prehistoric period in western Europe.

Ancient Egypt.—An enormous amount of the precious metals was annually brought as tribute to the Egyptian kings; according to Diodorus, who quotes the authority of Hecataeus, the yearly produce of the royal gold and silver mines amounted to 32 millions of minae—that is, about 133 millions sterling of modern money. Though this estimate is probably an exaggeration, the amount must have been very great. The gold chiefly came from the Nubian mines in the western desert in the Wadi ʽAlāḳi and the neighbouring valleys. A map of these mines, dating from the time of Rameses II. (1300 B.C.), has been preserved. Silver was not mined in Egypt itself, and came mostly from Asia Minor even at the earliest period. Then gold was comparatively common, silver a great rarity. Later, gold appears to have been relatively more abundant than silver, and the difference in value between them was very much less than it is now.

In the language of the hieroglyphs silver is called "white gold," and gold is the generic name for money—unlike most languages, in which silver usually has this special meaning—a fact which points strongly to the priority of the use of gold, which archaeological discoveries have rendered very probable. Among the treasures of the "royal tombs" at Abydos, dating to the Ist and IInd Dynasties, much gold was found, but no silver. On the walls of one of the tombs at Beni Hassan there is an interesting representation of a gold- and silver-smith's workshop, showing the various processes employed—weighing, melting, or soldering with the blow-pipe, refining the metal, and polishing the almost finished bowl or vase. Owing to the Egyptian practice of burying with their dead personal ornaments and jewelry, rather than other possessions less intimately connected with the person of the deceased, but few specimens of either gold or silver plate have survived to our times, whereas the amount of gold jewelry that has been discovered is very large, and shows the highest degree of skill in working the precious metals. We can, however, form some notion of what the larger works, such as plates and vases in gold and silver, were like from the frequent representations of them in mural sculpture and paintings. In many cases they were extremely elaborate and fanciful in shape, formed with the bodies or heads of griffins, horses, and other animals real or imaginary. Others are simple and graceful in outline, enriched with delicate surface ornament of leaves, wave and guilloche patterns, hieroglyphs, or sacred animals. Fig. 1 shows a gold vase of the time of Tethmosis (Thothmes) III. (Dynasty XVIII., about 1500 B.C.), taken from a wall-painting in one of the tombs at Thebes. The figure on its side is the hieroglyph for "gold." Others appear to have been very large and massive, with human figures in silver or gold supporting a great bowl or crater of the same metal. Vases of this type were, of course, manufactured in Egypt itself, but many of those represented in the Theban tombs were tribute, mostly of Phoenician workmanship. Already as early as the time of Tethmosis III., when, as we know, the Phoenician cities had already existed for centuries, we find the ships of Arvad, of Byblos and of Tyre well known in the harbours of the Delta, and even bringing tribute of foreign vases to the river quays of Thebes itself. We cannot doubt that much of the precious plate of gold and silver used by the Egyptians at this time and specifically described as foreign tribute was made in Egyptian or egyptizing style by Phoenician artists. But plate of really foreign type as well as origin was also brought to Egypt at this time by the Phoenician "Kefti ships" from Kefti, the island of Crete, where the "Minoan" culture of Cnossos and Phaestus was now at its apogee. Ambassadors from Kefti also brought gold and silver vases as presents for the Egyptian king, and on the walls of the tomb of Senmut, Queen Hatshepsut's architect, at Thebes, we see a Keftian carrying a vase of gold and silver which is the duplicate of an actual vase discovered at Cnossos by Dr Arthur Evans. The art of the "Minoan" and "Mycenaean" goldsmiths exercised considerable influence upon that of the Egyptians; under the XXth Dynasty, about 1150 B.C., we find depicted on the tomb of Rameses III. golden stirrup-vases (*Bügelkannen*) of the well-known Mycenaean type, and in that of Imadua, an officer of Rameses IX., golden vases imitating the ancient Cretan shape of the cups of Vaphio. In fact, it is more than probable that the Egyptians and Phoenicians manufactured plate of "Minoan" and "Mycenaean" types long after the ancient culture of Crete and the Aegean had come to an end. In the time of Rameses III., about 1300 B.C., a clearly defined Asiatic influence appears in the decoration of some of the gold plate. A gold basket represented in the tomb of this king at Thebes, has on its side a relief of the sacred tree between two beasts, an Asiatic idea.

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[1] In medieval English the term "a plate" was occasionally used in the sense of a silver vessel. A curious survival of this use of the word still exists at Queen's College, Oxford, where the servants may yet be heard asking at the buttery for so many "plates of beer," that is, silver tankards.

[2] Hoare, *Ancient Wiltshire* (1840).

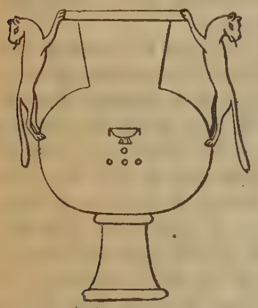

FIG. 1.—Gold Vase, from wall-paintings at Thebes.

The chief existing specimens of Egyptian plate are five silver *phialae* (bowls), found at the ancient Thmuis in the Delta, and now in the Cairo Museum (Nos. 482–486 in the catalogue). These are modelled in the form of a lotus blossom, most graceful in design, but are apparently not earlier than the 4th century B.C. Of the splendid toreutic art of a thousand years before, of which we gain an idea from the wall-paintings mentioned above, but few actual specimens have survived. The Louvre possesses a fine gold patera, 6½ in. across, with figures of fishes within a lotus border in *repoussé* work; an inscription on the rim shows it to have belonged to Thutii, an officer of Tethmosis III. (*Mém. soc. ant. de France*, xxiv. 1858). Thutii's bowl is a typical specimen of the Egyptian plate of the XVIIIth Dynasty, and its design is precisely that of the hundreds of blue glazed faïence bowls which were made at the time, and of which some perfect specimens and many fragments (especially from Deir el-Bahri) are in our museums. These were imitated from metal originals, just as most of the early Cretan pottery vessels were.

A splendid bronze bowl, which shows us what some of the finer gold and silver plate was like, was found in the tomb of Hetaai, a dignitary of the XVIIIth Dynasty, at Thebes a few years ago, and is now in the Cairo Museum (No. 3553 in von Bissing's catalogue). The engraved decoration, representing birds and animals in the papyrus-marshes, is very fine and evidently of native Egyptian work. The silver bowl at Berlin, said by di Cesnola to have come from Athienou in Cyprus, is certainly of XVIIIth Dynasty date, but, though purely Egyptian in style, more probably of Phoenician than Egyptian workmanship.

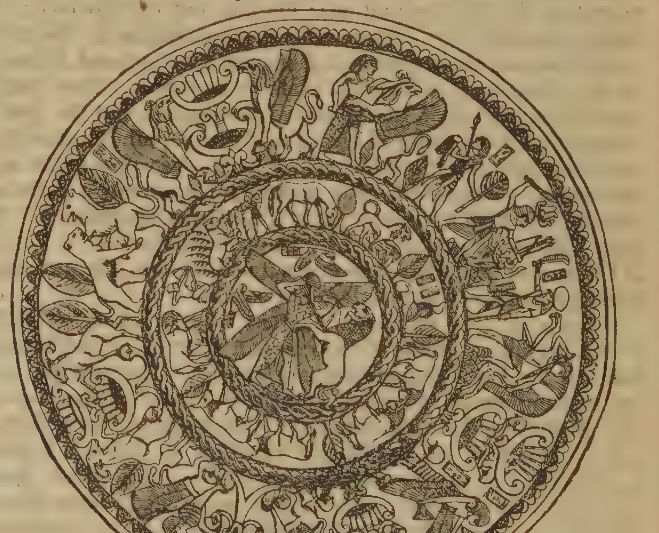

FIG. 2.—Silver Bowl, about 7 in. in diameter, found in a tomb in Cyprus, with *repoussé* reliefs of Egyptian and Assyrian style.

Assyrian and Phoenician Plate.—The art of making gold and silver plate, whether it originated in Egypt and passed thence to Crete or not, was evidently on its own ground in Egypt and in Minoan Crete. In Asia it was an exotic art, introduced from Egypt through the Phoenicians. In fact, it may be doubted whether any of the bronze imitations of plate found in Assyria are of Assyrian manufacture; they are probably Phoenician imports. The British Museum possesses a fine collection of these bowls, mostly found in the palace at Nimrud, and so dating from the 9th and 8th centuries (reigns of Assur-nazir-pal to Sargon). Though they are made of bronze, and only occasionally ornamented with a few silver studs, they are evidently the production of artists who were accustomed to work in the precious metals, some of them in fact being almost identical in form and design with the silver phialae found at Curium and elsewhere in Cyprus. They are ornamented in a very delicate and minute manner, partly by incised lines, and partly by the *repoussé* process, finally completed by chasing. Their designs consist of a central geometrical pattern, with one or more concentric bands round it of figures of gods and men, with various animals and plants, such as antelopes amid papyri, which are derived from the Egyptian designs of the XVIIIth Dynasty. Often there is a strange admixture of Assyrian and Egyptian style.

Bulls, for instance, are usually represented as with a single mighty horn, curving to the front (in the style of the ancient Babylonian seals), rather than with both horns showing, in Egyptian fashion. When figures of gods and men are shown, the principal groups are purely Assyrian imitations of Assyrian temple-reliefs, in fact—such as the sacred tree between the two attendant beasts, or the king engaged in combat and vanquishing a lion single-handed; while mingled with these are figures and groups purely Egyptian in style, such as the hawk-headed deity, or a king slaying a whole crowd of captives at one blow. Occasionally one sees traces of the ancient Mycenaean influence, or perhaps rather of the young Ionian art which had now arisen out of the ashes of that of Mycenae. These Phoenician imitative designs are still good imitations. But a century or so later we meet with them again on the silver bowls and dishes from Cyprus, in which the imitations have become bad. The same mixture of subjects was still in vogue, but confusion has been superadded to mixture, and we find kings in Assyrian robes and Egyptian wigs slaying Syrian dragons with Egyptian wings, and so on. Fig. 2 gives a silver dish from Curium containing examples of the above-mentioned subjects. It is a characteristic specimen of this mixed Phoenician art, of which di Cesnola seems to have collected a remarkable number of examples. In addition to the numerous silver phialae some were found, with similar decoration, made of pure gold. To the same period as these bowls from Cyprus belong the similar specimens of Phoenician plate from Etruscan graves at Praeneste and Cervetri in Italy. Those from the Regulini-Galassi tomb can hardly be earlier than the 6th century, so that this peculiar *Mischkunst* of the later type may well be dated to the 7th–5th centuries.

REFERENCES.—Von Bissing, "Metallgefässe" *Cairo Museum Catalogue* (1901); "Eine Bronzeschale mykenischer Zeit," *Jahrb. Inst.* (1898); L. P. di Cesnola, *Cyprus*; Layard, *Nineveh*, &c. (H. R. H.)

Prehistoric Greece: "Minoan" and "Mycenaean" Periods.—In the early history of the goldsmith's art no period is more important than that of the Greek Bronze age, the period of the prehistoric civilization which we call "Minoan" and "Mycenaean," which antedated the classical civilization of Greece by many centuries, and was in fact contemporary and probably coeval with the ancient culture of Egypt. In Greece during this, her first, period of civilization, metal-work was extensively used, perhaps more extensively than it ever was in the history of later Greek art. So generally was metal used for vases that even as early as the "Middle Minoan" period of Cretan art (some 2000 years B.C.) the pottery forms are obvious imitations of metal-work. The art of the metal-worker dominated and influenced that of the potter, a circumstance rarely noted in Egypt, where, in all probability, the toreutic art was never so much patronized as in Minoan Greece, although beautiful specimens of plate were produced by Egyptian and Phoenician artists. Also but few of these have come down to us, and we are forced to rely upon pictured representations for much of our knowledge of them. It is otherwise in early Greece. We possess in our museums unrivalled treasures of ancient toreutic art in the precious metals from Greece, which date from about 2500 to 1400 B.C., and as far as mass and weight of gold are concerned are rivalled only by the Scythian finds. These are the well-known results of the excavations of Schliemann at Troy and Mycenae and of others elsewhere. They do not by any means suffer in point of additional interest from the fact that they were made and used by the most ancient Greeks, the men of the Heroic age, probably before the Greek language was spoken in Greece.

The most ancient of these "treasures" is that discovered by Schliemann in 1873 buried, apparently in the remains of a box, deep in the fortification wall of Hissarlik the ancient Troy. It consists of vases and dishes of gold and silver, and of long tongue-shaped ingots of silver. In consonance with the early date (perhaps about 2500 B.C.) to which they are probably to be assigned (Schliemann ascribes them to the second Trojan city) these objects are all of simple type, some of the vases being unornamented jugs with tubular suspension-handles on the sides. Here we have metal imitating stonework, as, later, pottery imitates metal. These are of silver. A unique form in gold is a boat-shaped cup with handles at the sides (Plate I., fig. 23), at Berlin, which weighs 600 grammes. One vase is of electrum (one part of silver to four of gold).

A treasure of much the same date (the second "Early Minoan" period, about 2500 B.C. or before) was discovered in May 1908 in graves on the island of Mochlos, off the coast of Crete, by R. B. Seager. This is, however, of funerary character, like part of the treasures discovered in the shaft-graves of Mycenae, and, while including diadems, golden flowers, olive branches, chains, and so forth, for the adornment of the dead, does not include much gold used by the deceased during life.

The much later Mycenaean treasures include both funerary objects of thin gold and objects of plate that had actually been used. Among the former should be especially noted the breast-plates, diadems and masks which were placed on the bodies of the chieftains whom Schliemann, great in faith as in works, honestly believed to be Agamemnon and his court (and he may not have been very far wrong). Among the latter we may mention the small flat objects of gold plate, little sphinxes and octopuses modelled in relief, small temples with doves, roundels with spiral designs, and so on, which were ornaments for clothing, and the golden plate decorations of weapon-handles. The great cast-silver bull's head with the gold rosette on its forehead may perhaps have been regarded simply as a beautiful object of price, and buried with its owner. Similar *protomae* of bulls (of gold or silver) were brought by Minoan ambassadors as presents to the Egyptian court in the reign of Thothmes III. Gold and silver vases were found both in the shaft-graves, in the treasure-pit close by, and in chamber tombs at Mycenae. The most usual shape in the shaft-tombs is that well known to us from the vases of Vaphio, described below; among other types may be mentioned specially the *δέπας ἀμφικύπελλον* with doves feeding above its handles (Plate I., fig. 21; from a restored reproduction) — *δοιαὶ δὲ πελειάδες ἀμφὶς ἕκαστον χρύσειαι νεμέθοντο*; the golden jug with spiral decoration from the fourth grave; and the cup with lions of Egyptian appearance chasing each other round its bowl, found in grave 5. The fragment of a silver vase with a scene in high relief of slingers and bowmen defending their town against besiegers from grave 4 (Plate I., fig. 22), is an object unrivalled in ancient art. On this, as on the bull's head, we have gold overlaid on silver (with an intermediate plating of copper); on a silver cup from the same grave we find gold inlay, and on another silver cup, from a chamber-tomb, enamel and gold inlaid. How the Minoan goldsmith could combine silver with gold and the two with bronze we see on the marvellous inlaid dagger-blades from Mycenae, with their pictures in many-coloured metals of lion-hunts, cats chasing birds, and so forth, which show that he was perhaps the greatest master of all time in this art.

We speak of him as "Minoan," because most of the metal objects found at Mycenae are, if not of actual Minoan workmanship and imported from Crete, at any rate designed in accordance with the Minoan taste of the "Great Palace Period" (Late Minoan i. and ii.) at Cnossus. They are only "Mycenaean" in the sense that they were found at Mycenae. Of the art of the gold vase maker in the Mycenaean period properly speaking (Late Minoan iii.) we obtain an idea from the pictures of golden *Bügelkannen* with incised designs of zigzags, &c., represented on the walls of the tomb of Rameses III. at Egyptian Thebes. The objects from the Mycenaean shaft-graves are much older than this, as are also those from the next treasure we shall mention, that from Aegina, now in the British Museum. The gold cups and other objects of this treasure, with their fine but simple decoration, are certainly to be ascribed to the best Minoan period, although when first published Dr A. J. Evans was inclined to assign them to so late a date as *c.* A.D. 800. They are surely some seven hundred years older, having no characteristic of the decadent "sub-Mycenaean" period, as

Dr Evans would doubtless now agree. These objects were probably found in a tomb.

Dr Evans's excavations at Cnossus, those of the Italians at Phaestos and Hagia Triada and those of the British school at Palaikastro have not produced any very striking examples of the Minoan goldsmith's art in his own country, though splendid bronze bowls and vases have been found, which give us a good idea of what the plate must have been like, as do also the gilt steatite imitations of plate mentioned below. One of the bronze vases from Cnossus exactly resembles one of gold and silver which was brought to Egypt by the ambassadors in Queen Hatshepsut's time (fresco in the tomb of Senmut). But we possess a fine silver cup (of the Middle Minoan period) from the American excavations at Gournia, and two examples of the finest Minoan gold plate, which were discovered outside Crete, in the famous "Vaphio cups," with their embossed representations of bull-netting, which have been illustrated so often as triumphs of ancient art (Plate I., figs. 24, 25). These are of Cretan workmanship, though found in Laconia, and are no doubt contemporary with the vases of black steatite with reliefs showing a harvest-home procession, gladiatorial combats, and a king receiving or bidding farewell to a warrior with his armed followers, which have been found by the Italians at Hagia Triada in Crete. These were originally overlaid with gold leaf, and are undoubtedly imitations in a cheap material of golden embossed vases of the same style as those found at Vaphio.

Next in order of time came the objects of gold and silver plate found by the expedition of the British Museum at Enkomi in Cyprus, which perhaps represent a somewhat later phase of Minoan art, but certainly cannot now any longer be regarded as belonging to the very late period to which they were at first assigned. One silver vase found at Enkomi is of the "Vaphio" shape, which first appears in Cretan pottery as early as the Middle Minoan period, contemporary with the XIIth Egyptian Dynasty (*c.* 2000 B.C.), and even then is clearly an imitation of a metal original. Slightly modified, this type remained late in use, as we find it represented among other golden vases on the walls of the tomb of Imisib or Imadua, an Egyptian official of the time of Rameses IX. (*c.* 1100 B.C.) at Thebes. But some, at least, of the Enkomi finds must be earlier than this.

The Egyptian representations of Minoan vases of gold and silver in the tomb of Senmut at Thebes (*c.* 1500 B.C.) and of later Mycenaean golden *Bügelkannen* in that of Rameses III. (*c.* 1150 B.C.) have been mentioned already. During the age of Mycenaean and sub-Mycenaean decadence the art of the Greek goldsmith necessarily passed through a period of eclipse, to arise again, with the other arts, in rich and luxurious Ionia probably. The Homeric poems preserved for later days a traditional echo of the glorious works of the metal-workers of the Heroic age.

REFERENCES.—Troy and Mycenae: Schuchhardt, *Schliemann's Excavations*; Tsountas-Manatt, *The Mycenaean Age*, passim. Vaphio: Tsountas-Manatt, *Aigina*; A. J. Evans in *Journ. Hell. Stud.*, xiii. 195–226. Cnossus: Evans, *Ann. Sch. Ath.* (1901–1907). Hagia Triada: Savignoni, Pernier and others, *Rendiconti della R. Accademia dei Lincei* (Rome, 1902–1906); Gournià: Mrs Boyd Hawes, *Gournià* (Philadelphia, 1908), pl. c.; Mochlos (unpublished). For Egyptian references see Hall, *Ann. Sch. Ath.* (1904), "Keftiu and the Peoples of the Sea" (1905); "The Keftiu-fresco in the Tomb of Senmut." (H. R. H.)

Etruscan Plate.—The Etruscans were specially renowned for their skill in working all the metals, and above all in their gold work. Large quantities of exquisite gold jewelry have been found in Etruscan tombs, including, in addition to smaller objects, sceptres, wreaths of olive, and plates decorated with filigree-work and animal figures, which were used as personal ornaments (breastplates, girdles, diadems, &c.). In the Museo Kircheriano in Rome is a magnificent specimen of the last form of ornament; it is covered with nearly a hundred little statuettes of lions arranged in parallel rows; and the Vatican (Museo Gregoriano) possesses a very fine collection of similar objects from the "Regulini-Galassi" tomb at Caere. Little, however, that can be classed under the head of plate has yet been found.

Hellenic Plate.—The period of "geometrical" art which followed the Mycenaean age was one of decline in material prosperity and artistic skill. We possess some specimens of the work then produced in the precious metals in the gold diadems placed on the head of corpses interred at Athens (*Archäologische Zeitung*, 1884, pls. viii., ix.; cf. *Athenische Mittheilungen*, 1896, p. 367; and G. Perrot and C. Chipiez, *Histoire de l'art dans l'antiquité*, vii. 245). The period of Oriental influence is represented by the finds of gold ornaments made at Camirus in Rhodes (see GREEK ART, fig. 11). Fig. 3 shows a silver cup, with gold mounts, also found at Camirus, apparently a work of the same early date. A remarkable find of gold objects was made in 1882 at Vettersfelde in Brandenburg; the principal piece was a gold fish (see GREEK ART, fig. 10) with ornaments in relief. These objects recall by their style early Ionic art, but were probably produced in one of the Black Sea colonies, since similar objects have been found, together with later work, in Crimean graves (see below), and exchanged for the amber of the Baltic coasts. Croesus especially encouraged the art, and paid enormous sums for silver vases and cups to the most renowned artists of his time, such as Glaucus and Theodorus the Samian.

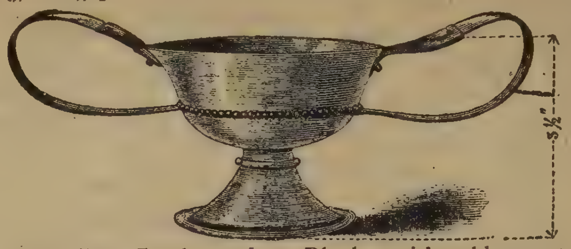

FIG. 3.—Silver Cantharus from Rhodes, with gold mounts. Possibly the form of the Homeric δέπας ἀμφικύπελλον.

The British Museum possesses a fine specimen of archaic Greek plate, found at Agrigentum in Sicily. This is a gold phiale or bowl, about 5 in. across, with central boss or omphalos (φιάλη μεσόμφαλος) which seems once to have contained a large jewel. Round the inside of the bowl are six figures of oxen *repoussé* in relief, and at one side a crescent, formed by punched dots. A delicate twisted moulding surrounds the edge; the workmanship of the whole is very skilful (see fig. 4).

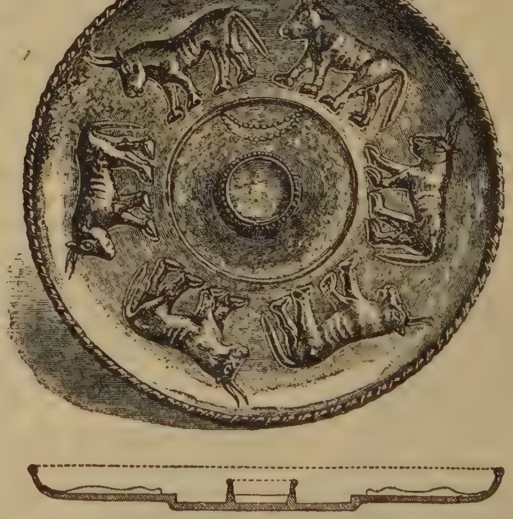

FIG. 4.—Archaic Gold Phiale, found at Agrigentum, now in the British Museum. It is shown in section below. It is 5 in. in diameter.

Pliny (*N. H.* xxxiii. 154 sqq.) gives a brief valuable account of the art of silver chasing (*caelatura*, Gr. τορευτική).

In the best times of Greek art the chief works in gold and silver seem to have been dedicated to religious purposes, and to have been seldom used for the ostentation of private individuals. Vessels for the use of the temples, tripods in gold or silver

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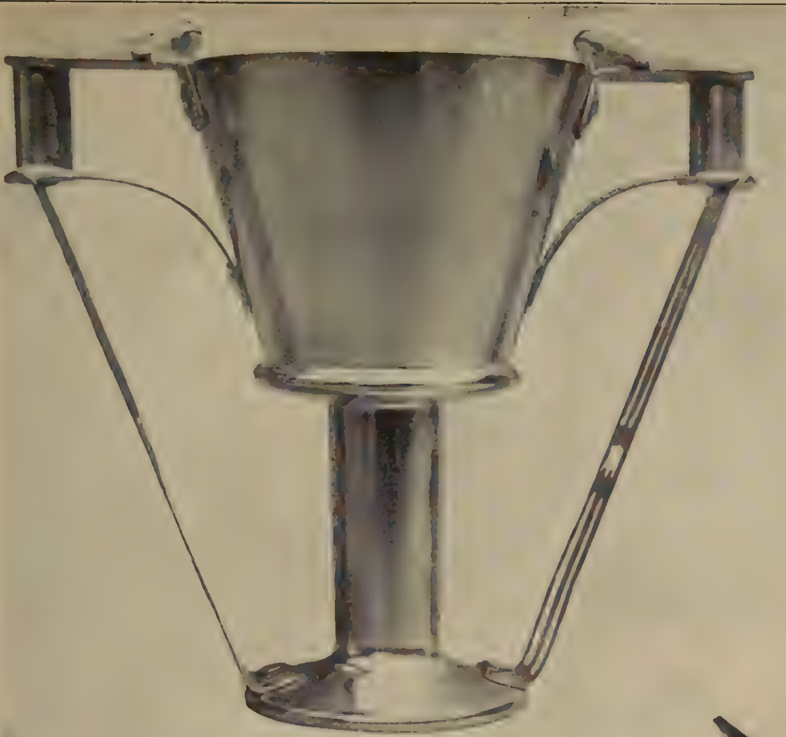

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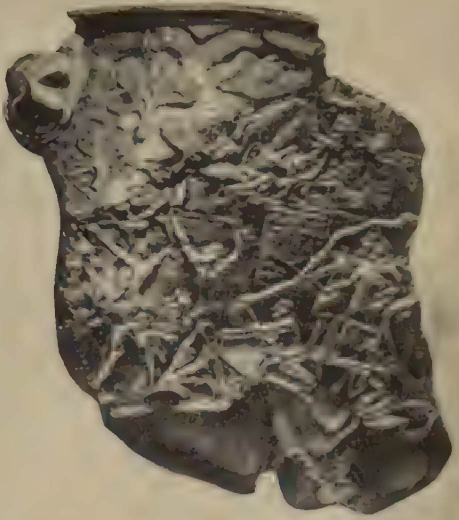

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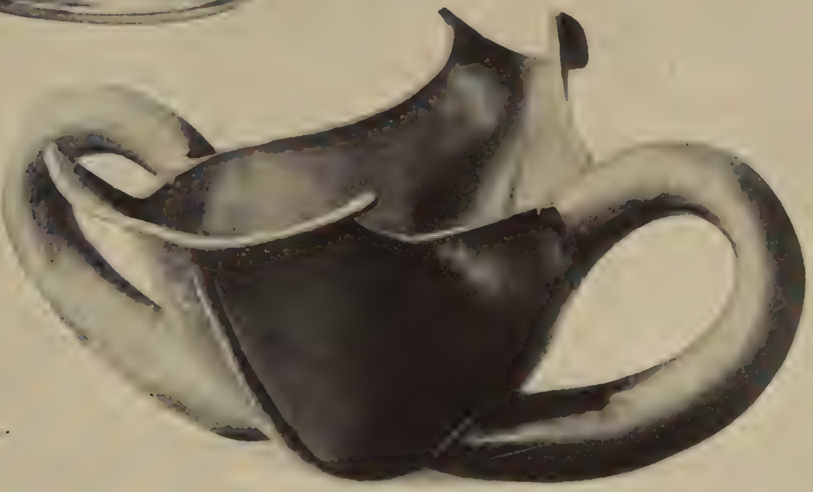

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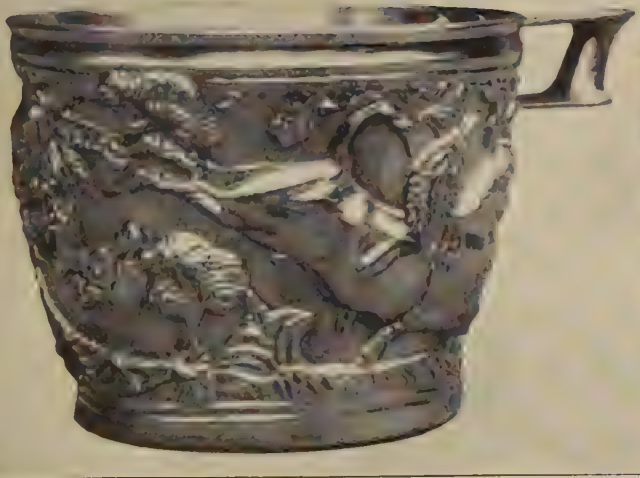

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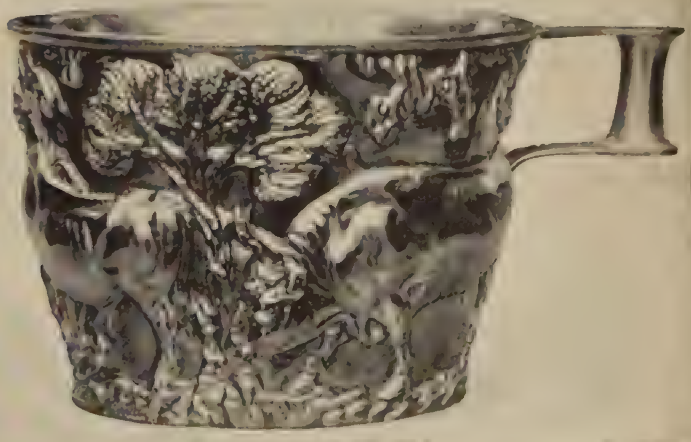
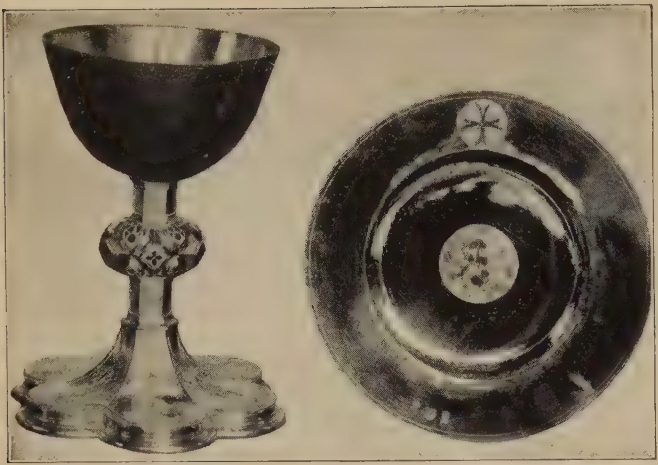


FIG. 21.—Golden Δέπας ἀμφικύπελλον from Mycenae (Late Minoan i.; about 1600 B.C.).
FIG. 22.—Fragment of a Silver Vase with Relief Design, showing the Defence of a City; from Mycenae (Late Minoan i.).
FIG. 23.—Golden Cup from Troy (Early Minoan iii.; 2500 B.C. or earlier).
FIG. 24, 25.—Gold Cups of Valphio (Late Minoan i.).

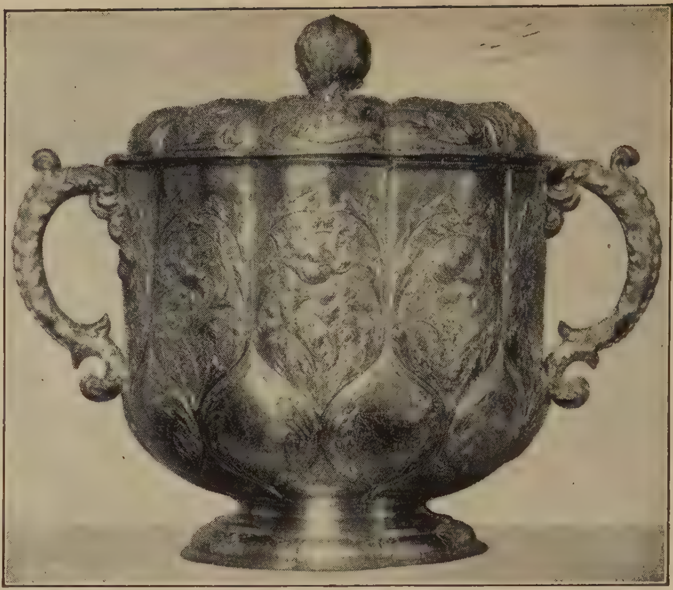
GREEK PLATE OF THE BRONZE AGE (PREHISTORIC PERIOD).

PLATE



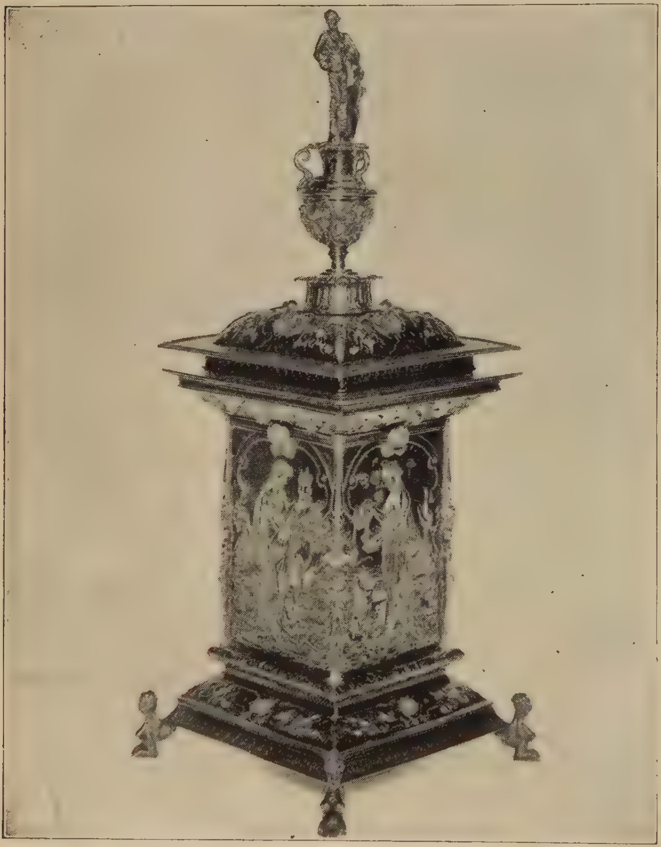
Photo, Hills & Saunders, by permission of Corpus Christi College.

FIG. 26.—GOLD CHALICE AND PATEN OF BISHOP FOXE.



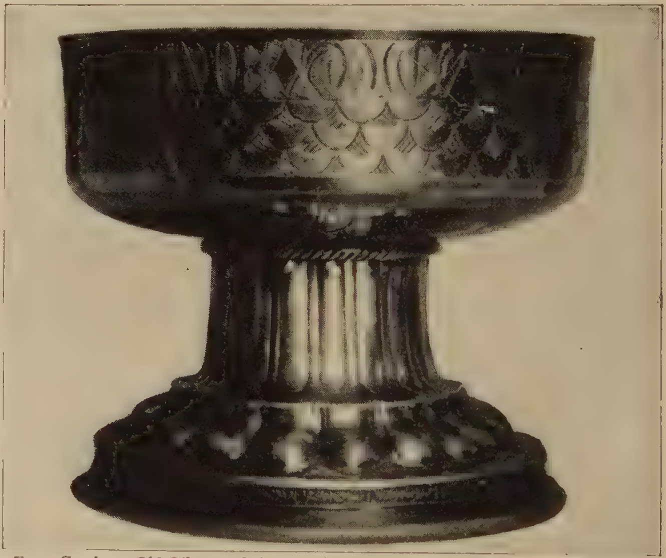
From Jackson, *History of English Plate*, by permission of C. J. Jackson, F.S.A.

FIG. 29.—GOLD CUP AND COVER, CHARLES II.



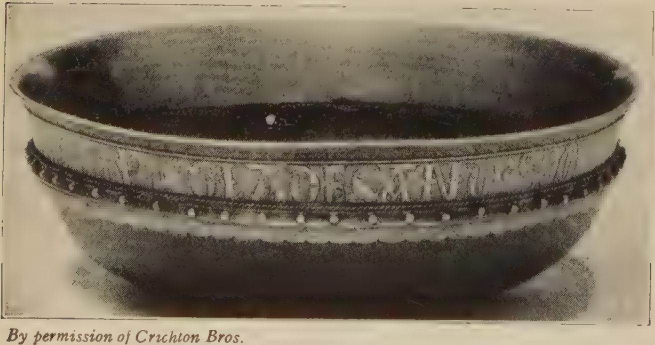
Photo, Southwark Photo Eng. Co.

FIG. 27.—SALT OF THE VINTNERS' COMPANY (ELIZABETHAN).



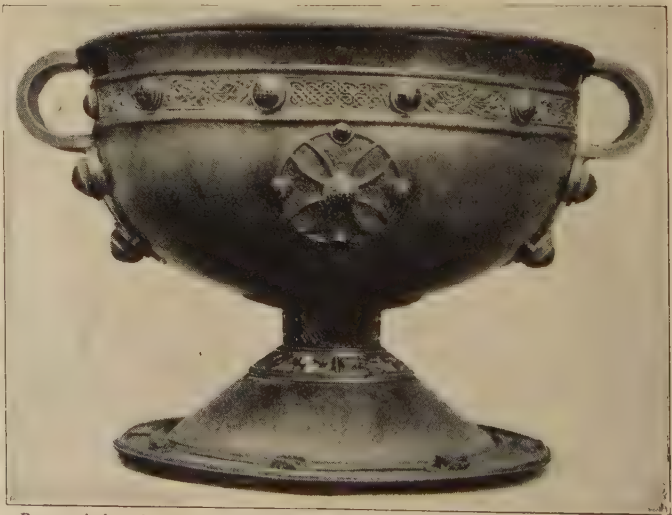
From Gardner, *Old Silverwork*, by permission of B. T. Batsford.

FIG. 30.—TUDOR CUP.



By permission of Crichton Bros.

FIG. 28.—BRAIKENBRIDGE MAZER BOWL.



By permission of the Royal Irish Academy.

FIG. 31.—ARDAGH CHALICE.

of the richest work, and statues of the gods were the chief objects on which the precious metals were lavished.[1]

The gold used by the Greeks probably came from Asia Minor or Egypt, while the mines of Laurium, in the mountains which form the promontory of Sunium in Attica, supplied an abundant amount of silver for many centuries. According to Pliny, Pheidias was the first sculptor who produced works of great merit in the precious metals; he mentions a number of other Greek artists who were celebrated for this class of work, but does not give their dates. The chief of these were Mentor and Mys (both of the 5th century B.C.), Acragas, Boethus, the sculptors Myron and Stratonicus, as well as the well-known Praxiteles and Scopas. In Pliny's time many works in gold and silver by these artists still existed in Rhodes and elsewhere. Among later workers he specially mentions Zopyrus, who made two silver cups, embossed with the scene of the judgment of Orestes by the Areopagite court,[2] and Pytheas, who made a bowl with reliefs of Ulysses and Diomedes carrying off the Palladium. Enormous prices were given by wealthy Romans for ancient silver plate made by distinguished Greek artists; according to Pliny, the last-mentioned cup, which weighed 2 oz., was sold for 10,000 denarii (£350). It is worthy of note that a large number of the artists named by Pliny were natives of Asia Minor; and it is very probable that the Asiatic school of silversmiths had at least as much influence on Roman *caelatura* as that of Alexandria, whose importance has been overrated by Schreiber.

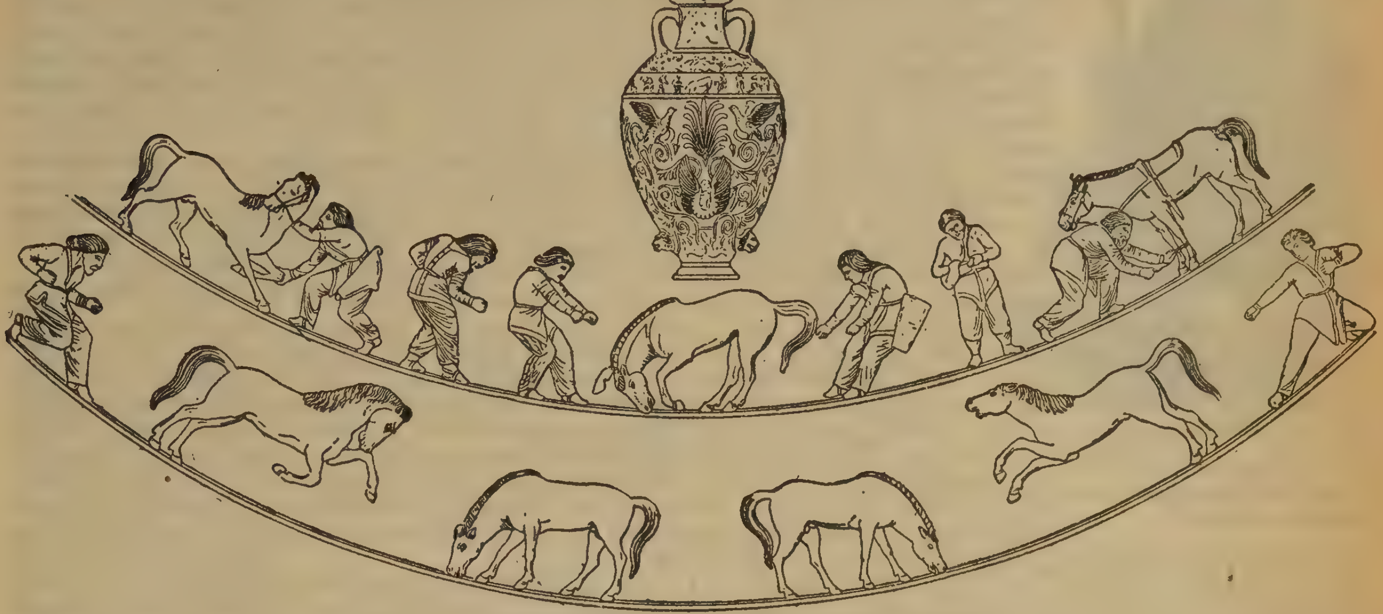


FIG. 5.—Greek Silver Vase, 4th century B.C., from South Russia.

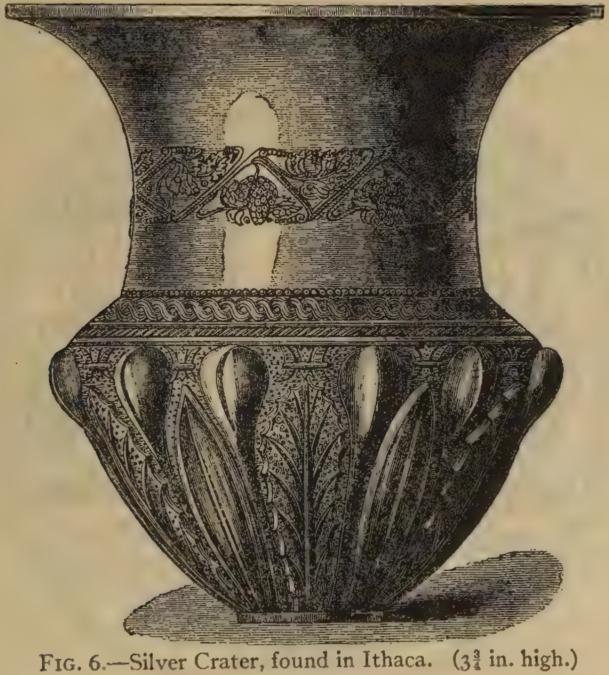


FIG. 6.—Silver Crater, found in Ithaca. (3¾ in. high.)

The finest extant examples of Greek plate are those found in the tumuli of south Russia, especially in the neighbourhood of Kertch, the ancient Panticapaeum. Fig. 5 shows a silver vase found in 1862 at Nikopol in the tomb of a native Scythian prince. The native horse-tamers of the steppes are represented on the shoulder with wonderful naturalism, and the work is beyond doubt that of an Athenian artist of the 4th century B.C. Splendid examples of goldwork were found in the tumulus of Kuloba, about 6½ kilometres from Kertch, which was excavated in 1830 and found to be the burial-place of a Scythian prince and his wife. The jewelry and plate found in this tomb, which were clearly of Greek origin, comprised (amongst other objects) an electrum vase 13 cm. high, representing Scythians in their native costume, one of whom is extracting a neighbour's tooth, another binding up a wound, a third stringing a bow, besides several silver vases and two gold medallions with reproductions of the head of the Athena Parthenos of Pheidias. In these Crimean tombs are often found golden crowns in the form of oak leaves, some of which belong to late Roman times. The finest extant example of a gold wreath, however, is that discovered at Armento in south Italy and preserved in the Antiquarium at Munich; it bears an inscription of the 4th century B.C., showing that it was dedicated by a certain Kreithonios. In 1812 Dr Lee discovered at Ithaca a beautiful crater, 3¾ in. high (see fig. 6), and a phiale or patera, 9½ in. across, both of silver, *repoussé* and chased, with very rich and graceful patterns of leaves and flowers picked out with gilding.[3] These are probably not later than the 5th century B.C. Many silver mirror-cases, with *repoussé* figure-subjects in high relief, have been found at various places; as, for instance, one with a beautiful seated figure of Aphrodite found at Tarentum and now in the British Museum.[4]

[1] The gold eagles on the sacred omphalos at Delphi were notable examples of this; see Pindar, *Pyth.* iv. 4.

[2] It has been thought that a silver cup in the Corsini collection at Rome (Michaelis, *Das corsinische Silbergefäss*, 1859; cf. W. Amelung, in *Römische Mitteilungen*, 1906, pp. 289 sqq.) may reproduce the design of Zopyrus.

[3] See *Archaeologia*, xxxiii. 36-54.

[4] Ibid. xxxiv. 265-272.

The Victoria and Albert Museum contains an exquisite little silver vase, found in the baths of Apollo at Vicarello in Italy (fig. 7), enriched with a band in low relief of storks devouring serpents executed with gem-like minuteness and finish—probably not later than the 3rd century B.C. The British Museum has a little vase of similar form and almost equal beauty, though perhaps later in date; it is decorated with bands of vine branches in a graceful flowing pattern, and is partly gilt.

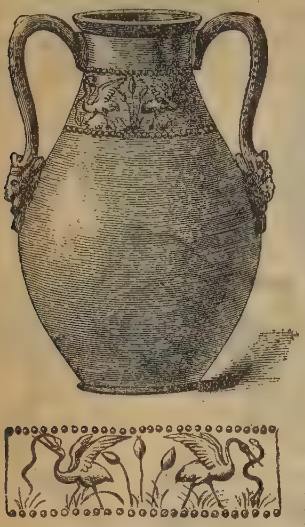


Fig. 7.—Greek Silver Vase, 5 in. high, c. 3rd century B.C. The ornamental band is shown below in plano. (Victoria and Albert Museum.)

Graeco-Roman Plate.—During the last century of the Republic the growing luxury and ostentation of the wealthy Romans found expression in the collection of elaborate specimens of plate.

The works of the old Greek masters were the most highly prized, but contemporary artists, such as Pasiteles, also attained distinction in this branch of art. Amongst the numerous finds of silver plate made in modern times we may distinguish (*a*) temple treasures made of up of votive offerings, such as the treasure of Bernay in France (dep. Eure), discovered in 1830 and preserved in the Cabinet des Médailles, which belonged to the shrine of Mercurius Canetonnensis; (*b*) private collections. The most famous of these are the Hildesheim treasure, in the Berlin Museum, discovered in 1869, which has been thought (without adequate reason) to have formed part of the campaigning equipment of a Roman military commander, and the Bosco Reale treasure, found in 1895 in a villa near Pompeii, whence its owner was endeavouring to remove it when buried by the eruption of Vesuvius. These collections contain pieces of various dates. The Bernay treasure, in part belonging to the 2nd century A.D., contains *oenochoai* (ewers) with mythological subjects in relief inspired by classical Greek models—the theft of the Palladium was the subject of a famous cup of Pytheas, mentioned by Pliny—which must belong to the early imperial period. The Hildesheim treasure, again, contains two barbaric vases, without feet or handles, together with such fine pieces as the crater figured (fig. 8), whose decoration recalls that of the Ara Pacis Augustae (see Roman Art), and a cylix with a seated figure of Athena in high relief, soldered on to the centre of the bowl, which appears to be of Greek workmanship. Such detachable figures were termed *emblemata*; in the Bosco Reale treasure is a cup with such a bust, typifying the province of Africa. Great value was also set upon *crustae*, *i.e.* bands of *repoussé* work forming an outer covering to a smooth silver cup (cf. the Rothschild vases, Roman Art). Such works commonly have Latin inscriptions incised on the foot giving the weight of the piece, the cup and *emblema* being weighed separately. The artistic value of Roman plate is discussed under Roman Art.

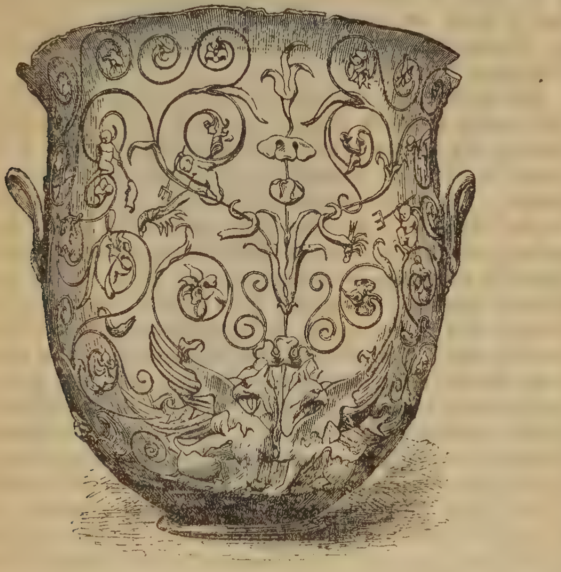


Fig. 8.—Silver Crater, 15½ in. high, from the Hildesheim find. (Berlin Museum.)

Among later specimens of Roman plate the most remarkable is the gold patera, nearly 10 in. in diameter, found at Rennes in 1777, and now in the Paris Bibliothèque—a work of the most marvellous delicacy and high finish—almost gem-like in its minuteness of detail. Though not earlier than about 210 A.D., a slight clumsiness in the proportion of its embossed figures is the only visible sign of decadence. The outer rim is set with sixteen fine gold coins—*aurei* of various members of the Antonine family from Hadrian to Geta. The central *emblema* or medallion represents the drinking contest between Bacchus and Hercules, and round this medallion is a band of *repoussé* figures showing the triumphal procession of Bacchus after winning the contest. He sits triumphant in his leopard-drawn car, while Hercules is led along, helplessly intoxicated, supported by bacchanals. A long line of nymphs, fauns and satyrs complete the circular band.

Late Roman plate is also represented by a series of large silver dishes, to which the name *missorium* is often, though perhaps wrongly, applied. These were used for presentations by emperors (whose portraits they sometimes bear) and distinguished officials. Three are preserved in the Cabinet des Médailles of the Bibliothèque Nationale at Paris—the "shield of Scipio," found in the Rhone near Avignon, about 26 in. in diameter, with a relief representing the restoration of Briseis to Achilles;[1] the "shield of Hannibal,"[2] chiefly remarkable for its size (it is 72 cms. in diameter and weighs 10 kilogrammes); and a third, decorated with a group of Hercules and the Nemean lion.[3] Other well-known examples of this form of art are the

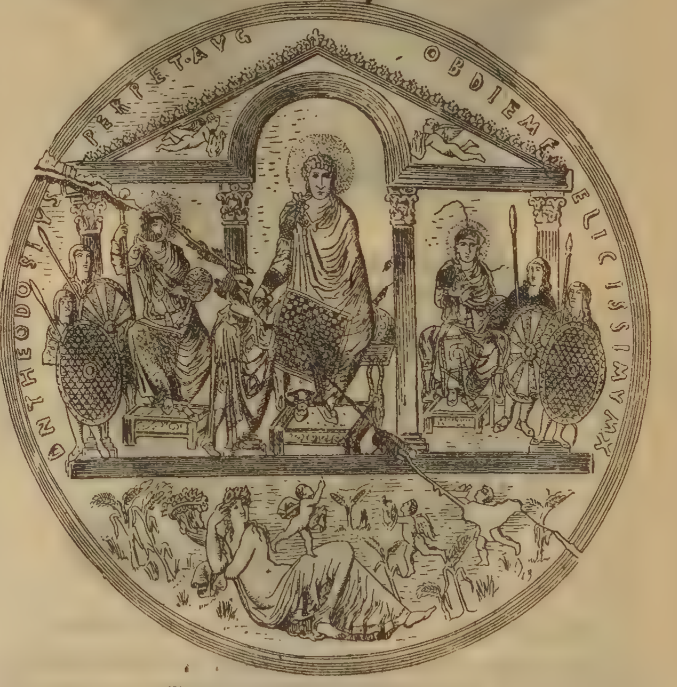


Fig. 9.—Shield of Theodosius.

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[1] Cf. S. Reinach in *Gazette des beaux-arts* (1896).

[2] Cf. E. Babelon, in *Bulletin de la société des antiquaires de la France* (1890), p. 228.

[3] Cf. E. Piot, in *Gazette archéologique* (1886).

"shield of Theodosius" at Madrid (fig. 9), which represents the emperor seated between Valentinian II. and Arcadius[1]; the "shield of Valentinian" at Geneva[2]; the "shield of Aspar" at Florence[3]; and a fine dish found at Aquileia, now at Vienna.[4]

The British Museum contains some fine specimens of late Roman silver work, found on the Esquiline in 1793 (cf. Visconti, *Una Supellettile d'argento*, Rome, 1825; the objects are published and described in Mr Dalton's *Catalogue of the Early Christian Antiquities in the British Museum*, pp. 61 sqq., pls. xiii.–xx.). The most remarkable of these are: (i.) a silver casket decorated in *repoussé*, with the inscription SECONDE ET PROJECTA VIVATIS IN CRISTO, doubtless a wedding gift to a couple bearing the names of Secundus and Projecta, whose portraits appear in a medallion on the centre of the lid; (ii.) four statuettes representing personified cities—Rome, Constantinople, Antioch and Alexandria (cf. P. Gardiner in *J. H. S.*, 1888, ix. 77 sqq.). This treasure appears to belong in the main to the 5th century A.D., though some minor pieces may be earlier.

BIBLIOGRAPHY.—A general account will be found in Smith's *Dictionary of Antiquities*, 3rd ed., *s.v.* "Caelatura" (without illustrations), and in Daremberg and Saglio's *Dictionnaire des antiquités*, under the same heading (with several cuts). The passages in ancient writers which refer to the art will be found in Oberbeck's *Antike Schriftquellen* Nos. 2167–2205; Pliny's account is most conveniently studied in K. Jex-Blake and E. Sellers, *The Elder Pliny's Chapters on the History of Art*, pp. 2 sqq. The finds made in southern Russia were published in the *Antiquités du Bosphore cimmérien* (St Petersburg, 1854); the *Comptes rendus de la commission impériale* (St Petersburg, 1859 sqq.); and the *Recueil des antiquités de la Scythie* (1866–1873). The first of these works, which is very rare, has been republished on a reduced scale by M. Salomon Reinach, in his *Bibliothèque des monuments figurés* (Paris, 1892) with notes; and all the more important objects are figured in *Antiquités de la Russie méridionale*, by Kondakoff, Tolstoy and Reinach (Paris, 1891–1892). For Graeco-Roman plate the most important works are Héron de Villefosse's publication of the Bosco Reale treasure in the *Monuments Piot*, vol. v. (cf. the articles by the same author and M. Thédenat on "Les Trésors de vaisselle d'argent trouvés en Gaule," *Gazette archéologique*, 1883–1884), and *Der hildesheimer Silberfund*, by E. Pernice and F. Winter (Berlin, 1901). Reference should also be made to T. Schreiber, "Die alexandrinische Toreutik," (*Abhandlungen der sächs. Gesellsch. der Wissenschaften*, 1894, vol. xiv.), whose theories are somewhat exaggerated; and A. Odobescu, *Le Trésor de Petrossa* (1889–1900), which deals with a find of barbaric plate and jewelry made in Rumania, but gives much information on the history of the art. For early Greek work, see R. Schneider, "Goldtypen des griechischen Ostens," *Berichte der sächs. Gesellschaft der Wissenschaften* (1891, p. 204), and A. Furtwängler, *Der Goldfund von Vettersfelde* (1883). For Etruscan metal-work, see J. Martha, *L'Art étrusque*, ch. xvii. An interesting popular account of ancient work in precious metals will be found in E. T. Cook's *Popular Handbook to the Greek and Roman Antiquities in the British Museum*, pp. 569 sqq. (H. S. J.)

Oriental, African Plate, &c.—Some very curious pieces of plate, both in gold and in silver, have been found in northern India in which country the goldsmith's art is of great antiquity;[5] these appear to be of native workmanship, but the subjects with which they are embossed, and the modelling of the figures, show that they were produced under late Roman influence, or in some cases possibly even Greek influence in a highly degraded state, handed down from the time of Alexander's Indian conquests. A fine gold casket (Buddhist relic) said to date from about 50 B.C. is worthy of note.[6] In the British Museum are an Indian silver dish (3rd–4th century A.D.)[7] and an earlier one, ascribed to *c.* A.D. 200.

Under the Sassanian kings of Persia (from the 3rd to 6th centuries) very massive and richly decorated gold vases, bowls, and bottles were made (fig. 10). Those which still exist show a curious mingling of ancient Assyrian art with that of Rome in its decline. Reliefs representing winged lions, or the sacred tree between its attendant beasts, alternate with subjects from Roman mythology, such as the rape of Ganymede; but all are treated alike with much originality, and in a highly decorative manner. A fine example of Persian work of the early 19th century (dated 1817) is the circular gold dish, richly enamelled, which is in the Victoria and Albert Museum, where a large collection of Oriental plate may be studied. Here may be seen a gold rose-water sprinkler of gold, entirely covered with richly enamelled flowers, Mogul work, 17th century; fine Burmese gold work found in A.D. 1484–1485 in a Buddhist temple, Rangoon; remarkable gold ornaments of the Burmese regalia; and a large elephant howdah, from the Punjab, made of silver, parcel gilt, the top covered with silver plates of large *repoussé* foliage. Tibetan craftsmen work is represented by numerous vessels for sacred and domestic purposes, mostly of metal, partially mounted in silver, which display the skill of the Tibetans in the 19th century. Of the skill of the Hindus as goldsmiths, abundant evidence is afforded by the *Ramayana* and *Mahābhārata*, though very little of their ancient gold and silver work has survived. In India the people of the Cashmere valley have long been famous for their natural superiority as craftsmen, as was Lucknow for its utensils of gold and silver, much of it richly enamelled in the 18th and 19th centuries. Chanda in the Central Provinces was once celebrated for its skilled goldsmiths, and the plate of Cutch and Gujarat in the Bombay Presidency has enjoyed a well-deserved reputation. The uncontaminated indigenous designs of the Sind goldsmiths' work call for special notice. Indian plate, as is quite natural, has often been influenced by European designs: for instance, the beautiful gold and silver work of Cutch is Dutch in origin, while the ornate throne of wood covered with plates of gold, early 19th century, used by Ranjit Singh (at South Kensington) also displays European influence. Much of the Siamese decorative plate of the 18th and 19th centuries is of silver-gilt and nielloed. In the Rijks museum, Amsterdam, is a collection of silver dishes, boxes of gold and silver, jewelry, &c., all of excellent workmanship, from Lombok. African goldsmiths' work is represented in the British Museum by the gold ornaments from Ashanti, where there are also some gold ornaments from graves in Central America and Colombia. Ancient Abyssinian work can be studied at the Victoria and Albert Museum in the gold chalice, gold crown of the Abuna of Abyssinia, another more ornate crown of silver-gilt, a fine shield with silver-gilt filigree, and other objects.

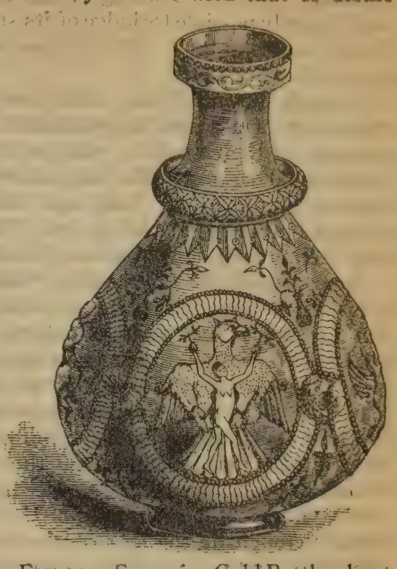

FIG. 10.—Sassanian Gold Bottle, about 10 in. high. In the Vienna Museum.

The gold and silver work of Russia resembles in style that of Byzantium at an early period. Shrines and other magnificent pieces of plate in the treasury of the cathedral at Moscow (see Weltmann, *Le Trésor de Moscou*, 1861), though executed at the end of the 15th and 16th century, are similar in design to Byzantine work of the 11th or 12th century, and even since then but little change or development of style has taken place.

The caliphs of Bagdad, the sultans of Egypt, and other Moslem rulers were once famed for their rich stores of plate, which was probably of extreme beauty both in design and workmanship. Little or nothing of this Moslem plate now remains, and it is only possible to judge of its style and magnificence from the fine works in brass and other less valuable metals which have survived to our time.

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[1] Cf. E. Hübner, *Die antiken Bildwerke in Madrid*, pp. 213 sqq.

[2] A. Odobescu, *Le Trésor de Petrossa*, pp. 153 sqq., fig. 68.

[3] D. Bracci, *Dissertazione sopra un clipeo votivo* (Lucca, 1771).

[4] See R. v. Schneider, *Album auserlesenster Gegenstände der Antikensammlung des allerhöchsten Kaiserhauses* (1895); and cf. *Verhandlungen der 42 Versammlung deutscher Philologen* (1893), pp. 297 sqq.

[5] Sir G. Birdwood, *Industrial Arts of India* (1880).

[6] Wilson's *Arcana antiqua* (1841).

[7] *Archaeologia*, lv. 534.

Towards the end of the 10th century the Rhine valley became the centre of a school of goldsmiths, who produced splendid examples of their work—a mixture of Byzantine art with their own original designs. The book-covers, portable altars and other objects, preserved at Trier and Aix-la-Chapelle, are notable examples produced at that centre. The magnificent book-cover from Echternach, now at Gotha, is of the school of Trier.

Early Medieval Plate.—The Gothic, Gaulish and other semi-barbarian peoples, who in the 6th century were masters of Spain, France and parts of central Europe, produced great quantities of work in the precious metals, especially gold, often of great magnificence of design and not without some skill in workmanship. The Merovingians encouraged the art of the goldsmith by spending immense sums of money on plate and jewelry, though only two examples of their great wealth in church vessels have survived—the gold chalice and paten of Gourdon, now at Paris. Fine examples of Carlovingian work, which was mainly wrought in the monasteries in the north of the Frankish dominions and on the Rhine, may be studied in the covers for the Gospels, in the Bibliothèque Nationale in Paris. In 1837 a large number of pieces of very massive gold plate were found at Petrossa in Rumania; much of this find was unfortunately broken up and melted, but a considerable portion was saved, and is now in the museum at Bucharest. These magnificent objects are all of solid gold, and consist of large dishes, vases, ewers, baskets of open work, and personal ornaments (fig. 11). Some of them show a strong Roman influence in their design, others are more purely barbaric in style. To the first of these classes belongs a very fine phiale or patera, 10 in. in diameter. In the centre is a seated statuette of a goddess, holding a cup, while all round, in high relief, are standing figures of various male and female deities, purely Roman in style. Though the execution is somewhat clumsy, there is much reminiscence of classical grace in the attitudes and drapery of these figures. A large basket and other pieces, made of square bars of gold arranged so as to form an open pattern of stiff geometrical design, have nothing in common with the vessels in which Roman influence is apparent, and can hardly be the work of the same school of goldsmiths.[1] The date of this Petrossa treasure is supposed to be the 6th century. The celebrated Gourdon gold cup and tray now preserved in Paris belong to about the same date. They are very rich and magnificent, quite free from any survival of classic influence, and in style resemble the Merovingian gold work which was found in the tomb of Childeric I. The cup is 3 in. high, shaped like a miniature two-handled chalice; its companion oblong tray or plate has a large cross in high relief in the centre. They are elaborately ornamented with inlaid work of turquoises and garnets, and delicate filigree patterns in gold, soldered on.

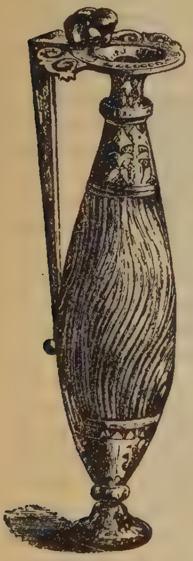

Fig. 11.—Gold Ewer, 15 in. high, from the Petrossa treasure.

In the 6th century Byzantium was the chief centre for the production of large and magnificent works in the precious metals. The religious fervour and the great wealth of Justinian and his successors filled the churches of Byzantium, not only with enormous quantities of gold and silver chalices, shrines, and other smaller pieces of ecclesiastical plate, but even large altars, with tall pillared baldacchini over them, fonts, massive candelabra, statues, and high screens, all made of the precious metals. The wealth and artistic splendour with which St Peter's in Rome and St Sophia in Constantinople were enriched is now almost inconceivable. To read the mere inventories of these treasures dazzles the imagination—such as that given in the *Liber pontificalis* of Anastasius Bibliothecarius, which includes the long list of treasures given by Constantine to St Peter's before he transferred his seat of empire to Byzantium (330), and the scarcely less wonderful list of gold and silver plate presented to the same basilica by Pope Symmachus (498–514).[2]

Some early Byzantine plate of the 6th century is in the British Museum; an inscribed paten of the 10th and 11th centuries is in Halberstadt Cathedral in Germany, and numerous ecclesiastical vessels are in the Treasury of St Mark's, Venice.

Early in the medieval period France and other Western countries were but little behind Italy and Byzantium in their production of massive works, both secular and religious, in the precious metals. At this time every cathedral or abbey church in Germany, France and even England began to accumulate rich treasures of every kind in gold and silver, enriched with jewels and enamel; but few specimens, however, still exist of the work of this early period. The most notable are Charlemagne's regalia[3] and other treasures at Aix-la-Chapelle, a few preserved at St Peter's in Rome, and the remarkable set of ecclesiastical utensils which still exist in the cathedral of Monza near Milan—the gift of Queen Theodelinda in the early part of the 7th century.[4] The treasure of Nagy-Szent-Miklos, consisting of several vessels of gold, of Hungarian origin (8th–9th century), is in the Imperial Museum at Vienna.

The existing examples of magnificent early work in the precious metals mostly belong to a somewhat later period. The chief are the gold and silver altar in Sant' Ambrogio at Milan, of the 9th century; the "Pala d'Oro," or gold retable, in St Mark's at Venice, begun in the 10th century; the silver altar-front in St Domenico's Church at Palermo; the shrine of silver-gilt (with later additions) in the church of St Simeon at Zara, Dalmatia, by Francesco di Antonio of Sesto near Milan, 1380; and the gold altar-frontal given by the emperor Henry II. and his wife Cunigunde, at the beginning of the 11th century, to the cathedral at Basel. The last is about 4 ft. high by 6 ft. long, *repoussé* in high relief, with figures of Christ, the three archangels, and St Benedict, standing under an arcade of round arches; it is now in the Musée Cluny in Paris.[5] A similar gold frontal, of equal splendour, was that made for the archbishop of Sens in 999. This was melted down by Louis XV. in 1760, but fortunately a drawing of it was preserved, and is published by Du Sommerard (*Album*, 9th series, pl. xiii.). Reliquaries of great splendour were made of the precious metals, one of the most notable being that containing the skulls of the three kings in Cologne Cathedral. This shrine, which resembles in form a building of two storeys, was wrought in the 12th century. The covers of the Textus in the Victoria and Albert Museum are highly important examples of goldsmiths' work; they are of gold and silver, decorated with enamel and set with stones, probably dating from the 12th century.

Celtic.—The skill in metal-working of the Celtic people in the British Islands, especially in Ireland, in Pagan and Christian times, is well known, and need hardly be emphasized here. While much has perished, much happily remains in proof of their extraordinary skill in working gold and silver, particularly in jewelry. The most remarkable specimen of their technical skill and artistic perception is the famous Ardagh chalice of the 9th–10th century (in the museum at Dublin) (Plate II., fig. 31), which is composed chiefly of silver, with enrichments of gold and gilt bronze, and with exquisite enamels. The interlaced ornament is a feature of Celtic work, and may further be studied in the celebrated Tara brooch, with its seventy-six varieties of designs as well as in other exquisite examples of jewelry. Further evidence of Celtic skill is forthcoming in the shrines for the sacred bells in Ireland, not to mention other ecclesiastical ornaments. These are of great beauty, and the silver shrine of the bell of St Patrick (1091–1105) displays the interlaced scroll ornament in a striking degree. With the introduction of Gothic art into Britain the special characteristics of Christian Celtic art in Ireland gradually died out.

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[1] Soden Smith, *Treasure of Petrossa* (1869).

[2] See D'Agincourt, *Histoire de l'art* (1823).

[3] Bock, *Die Kleinodien des heil. römischen Reiches* (1864).

[4] *Arch. Jour*, xiv. 8.

[5] *Archaeologia*, xxx. 144–148.

Anglo-Saxon.—Judged by the examples of Anglo-Saxon jewelry discovered, the Anglo-Saxon craftsmen brought their art to a high state of perfection, though hardly equal in merit to the Celtic. A large quantity of their metal-work is of bronze, frequently enriched with gold and enamel. Happily, there is preserved one priceless specimen of the goldsmith's art of this period—namely, the famous Alfred jewel of gold, now in the Ashmolean Museum at Oxford, with a portrait, believed to be of Alfred the Great, in *cloisonné* enamel. Another notable specimen is the Ethelwulf ring in the British Museum. Though ecclesiastical vessels, doubtless of the precious metals, appear in Anglo-Saxon illuminated manuscripts, the only piece of plate of that time at present known is the plain silver cup of the latter part of the 9th century, found with gold and silver jewelry and pennies at Trewhiddle in Cornwall, which is now in the British Museum.[1] There is, however, an important example of metal-work embellished with silver plates—namely, the portable altar of St Cuthbert at Durham.

A most valuable description of the various methods of work practised by gold- and silversmiths in the 11th and 12th centuries is given by the monk Theophilus in his *Diversarum artium schedula* (Hendrie's ed., 1847). He minutely describes every possible process that could be employed in making and ornamenting elaborate pieces of ecclesiastical plate—such as smelting, refining, hammering, chasing and *repoussé* work, soldering, casting (by the "cire perdue" process), wire-drawing, gilding with mercury amalgam, and the application of niello, enamel and gems.

The silversmith of those days, as in classical times, was not only a thorough artist with a complete sense of beauty and fitness in his work, but he was also a craftsman of the most varied fertility of resource, and made himself thoroughly responsible for every part of his work and every stage through which it passed—a most striking contrast to the modern subdivision of labour, and eagerness to produce a show of neatness without regard to real excellence of work, which is the curse of all 19th-century handicrafts, and one of the main reasons why our modern productions are in the main neither works of true art nor objects of real lasting utility.

Italian Plate.—Before the latter part of the 15th century, large pieces of silver work were made more for ecclesiastical use than for the gratification of private luxury. The great silver shrine in Orvieto Cathedral, made to contain the blood-stained corporal of the famous Bolsena miracle, is one of the chief of these. It is a very large and elaborate work in solid silver, made to imitate the west front of a cathedral, and decorated in the most sumptuous way with figures cast and chased in relief, and a wonderful series of miniature-like pictures embossed in low relief and covered with translucent enamels of various brilliant colours. This splendid piece of silver work was executed about 1338 by Ugolino da Siena, one of whose other works, a fine reliquary, is also at Orvieto. The other most important pieces of silver work in Italy are the frontal and retable of St James in the cathedral at Pistoia [2] and the altar of San Giovanni at Florence. On these two works were employed a whole series of the chief Tuscan artists of the 14th and 15th centuries, many of whom, though of great reputation in other branches of art, such as painting, sculpture on a large scale, and architecture, did not disdain to devote their utmost skill and years of labour, to work which we now as a rule consign to craftsmen of the very smallest capacity. The following celebrated artists were employed upon the altar at Florence: Antonio Pollaiuolo, Michelozzo, Verrocchio, as well as less prominent artificers, Betto Geri, Leonardo di Ser Giovanni and Betto di Francesco Betti.

Among the distinguished names of Florentines who during the space of one century only, the 15th, worked in gold and silver, the following may be given to suggest the high rank which this class of work took among the arts: Brunelleschi, Ghiberti, Donatello, Luca della Robbia, the two Pollaiuoli, Verrocchio, Michelozzo, Ghirlandaio, Botticelli, Lorenzo di Credi, Baccio Baldini and Francia. The cities of Italy which chiefly excelled in this religious and beautiful class of silver work during the 14th and 15th centuries were Florence, Siena, Arezzo, Pisa, Pistoia, Bologna, where there are fine 14th-century silver reliquaries executed by Jacopo Roseto da Bologna for the heads of St Dominic and St Petronio in the church of St Stefano, Perugia, where Paolo Vanni, Roscetto and others worked in the 14th and early 15th centuries, and Rome.

Owing to the demoralization and increase of luxury which grew in Italy with such startling rapidity during the early years of the 16th century, the wealth and artistic skill which in the previous centuries had been mainly devoted to religious objects were diverted into a different channel, and became for the most part absorbed in the production of magnificent pieces of plate—vases, ewers, dishes, and the like—of large size, and decorated in the most lavish way with the fanciful and over-luxuriant forms of ornament introduced by the already declining taste of the Renaissance. This demand created a new school of metal-workers, among whom Benvenuto Cellini (1500–1571) was perhaps the ablest and certainly the most prominent. His graphic autobiography makes him one of the foremost and most vivid figures of the wonderful 16th century, in which often the most bestial self-indulgence was mingled with the keenest enthusiasm for art. The large salt-cellar made for Francis I., now at Vienna, is the only piece of plate which can be definitely assigned to Cellini. The splendid Farnese casket, with crystal plaques engraved by Giovanni di Bernardi, in the Naples Museum, has been wrongly attributed to Cellini. His influence on the design of plate was very great, not only in Italy and France, but also in Germany.[3] During the 17th century fine pieces of plate were produced in Italy, many of them still retaining some of the grace and refinement of the earlier Renaissance.

The papal treasure, containing priceless examples of the goldsmith's art, was almost entirely depleted by Pius VI. to pay the indemnity demanded by Napoleon. The tiara of Julius II. by Caradosso, and the splendid morse of Clement VII. by Benvenuto Cellini, coloured drawings of which are preserved in the Print Room, British Museum, are among the objects then destroyed.

A valuable source of study of Italian plate (now destroyed) is contained in the three volumes of drawings, executed between 1755 and 1764, by Grauenbroch, in the Museo Correr at Venice.

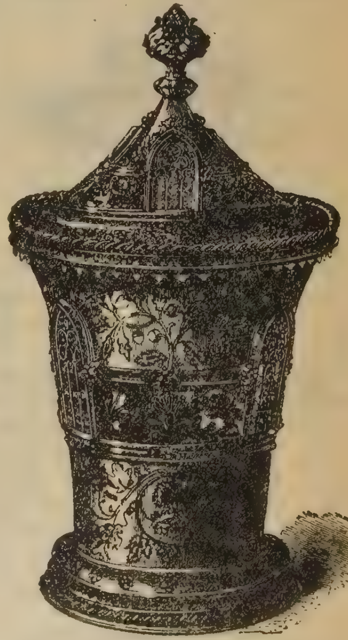

Fig. 12.—Silver Beaker, decorated with open work, filled in with translucent enamels. German or Flemish, of the 15th century. (S. K. M.)

Germany.—From very early times Germany was specially famed for its works in the precious metals, mostly for ecclesiastical use. In the 15th century a large quantity of secular plate was produced of beautiful design and skilful workmanship. Tall covered cups on stems, modelled with a series of bosses something like a pineapple, beakers and tankards, enriched with Gothic cresting and foliage, are among the most important pieces of plate. During the 16th century Augsburg and Nuremberg, long celebrated for their silver work, developed a school of craftsmen whose splendid productions have often been ascribed to the great Cellini himself. In the first decade of the 16th century, Paul Müllner, a Nuremberg goldsmith, furnished Frederick the Wise with several silver-gilt reliquaries for his collection at Wittenberg. Later in the same century came the Jamnitzer family of Nuremberg, chief among them being Wentzel Jamnitzer, one of whose masterpieces, an enamelled silver centre-piece, belongs to the baroness James de Rothschild of Paris. Mathaeus Wallbaum of Augsburg was another celebrated goldsmith of the 16th century. His chief works are religious ornaments of ebony mounted in silver, and the *Pommerscher Kunstschrank* in the Kunstgewerbe Museum, Berlin. But the chief German goldsmith of the 16th century was Anton Eisenhoit[1] of Warburg, who wrought the fine crucifix (1589), the chalice and other ecclesiastical vessels which belong to the Fürstenberg family. Other notable craftsmen of this period were Hans Petzolt and Melchior Bayr, the latter having made the silver altar (with scenes from the Life of Christ after Dürer) for the king of Poland, which is in the Sigismund chapel in Cracow Cathedral.[2] Jakob Mores, the elder, of Hamburg, was employed by the royal house of Denmark. A large number of his original designs for plate are in the public art library at Berlin. Jakob Mores, the younger, executed the silver altar at Frederiksborg in the 17th century. In Germany the traditions of earlier Gothic art were less rapidly broken with, and many purely Gothic forms survived there till the end of the 16th century, and Gothic decorative features even later. In the first half of the 17th century, though the technical skill of the German silversmiths reached a high standard of merit, there was some falling off in the execution and in the purity of outline in their designs. Germany is richer in secular plate than any other country. The remarkable royal collections of plate in the green vaults at Dresden, Gotha and Munich, as well as public museums in Germany, including the treasure of Lüneburg at Berlin, afford excellent opportunities for the study of the German goldsmith's art, the remarkable chalice, 12th century, of St Gothard's church, Hildesheim; the celebrated *Kaiserbecher* of Osnabrück of the 13th century; the cup given by the emperor Frederick III. and Mathias Corvinus to Vienna in 1462, and the splendid ewer of Goslar, 1477, are notable specimens of early German work. In England the only public collections of German plate worthy of notice are the "Waddesdon" in the British Museum, and the Victoria and Albert Museum. Prior to its dispersal among his five daughters, the late baron Carl von Rothschild's collection at Frankfort-on-Main was the most extensive private collection in existence. The Gutmann collection, acquired by Mr J. Pierpont Morgan, contains many rare pieces, as does that of the baronesses Alphonse and Salomon de Rothschild in Paris.

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[1] *Victoria History of Cornwall*, i. 375.

[2] E. Alfred Jones, "The Altar of Pistoia," *The Reliquary* (January, 906), pp. 19–28.

[3] See Eugène Plon, *Benvenuto Cellini, sa vie, &c.* (1883); also Cellini's own work, *Dell' Oreficeria* (1568).

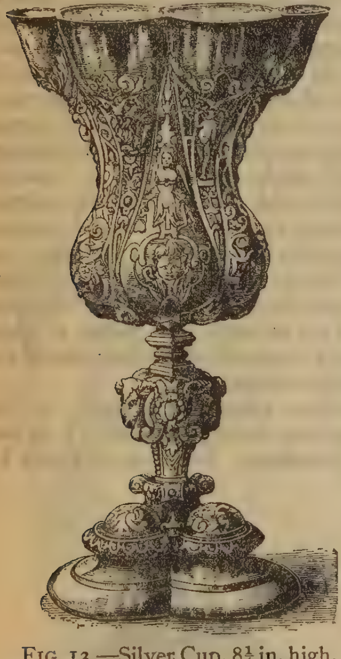
Fig. 13.—Silver Cup, 8¼ in. high, usually attributed to Jamnitzer, but more probably by Paul Flint. Made at Nuremberg about the middle of the 16th century. (S. K. M.)

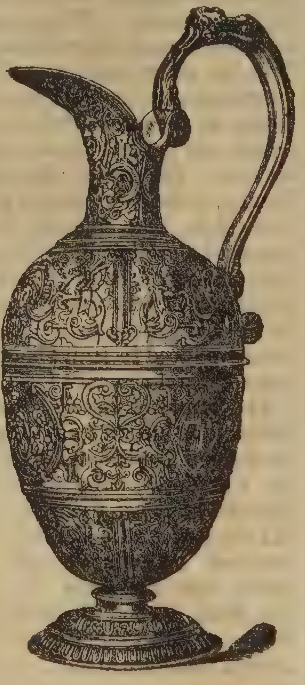
Fig. 14.—Ewer by François Briot, about 10 in. high. Middle of 16th century.

Many of the most beautiful vessels of crystal, agate, &c., formerly attributed to Italian artists, were carved and engraved and set in beautiful enamelled gold and silver mounts, in southern Germany in the 16th and 17th centuries. At the end of the 17th and the beginning of the 18th centuries household plate and other ornaments were frequently decorated with painted enamels, mostly originating from Augsburg. Dinglinger of Dresden and his school at about this time exercised considerable influence in the production of ornaments in pearl and other materials, elaborately carved, mounted and enamelled.

Several specimens exist of the models of cups required of candidates for the rank of master-craftsmen in the second half of the 16th century. One of these, at the Victoria and Albert Museum, is believed to have been wrought by Martin Rehlein of Nuremberg in 1572–1573.[3]

Many of the famous 15th and 16th century artists—such as Martin Schön, Israel von Mecken, Aldegrever, Altdorfer, Brosamer, Peter Flötner, the Behams, Hopfer and Hans Holbein the younger, supplied the silversmiths with designs for plate. Several of Holbein's original designs, including one for the gold cup probably wrought by his friend, John of Antwerp, for Queen Jane Seymour, are in the Print Room, British Museum, where there is also an original design for a table fountain by the celebrated artist, Albrecht Dürer. Virgil Solis of Nuremberg (1514–1562) was especially fertile in designing plate, and he executed a large series of etchings of designs for vases, cups, ewers, tazze, &c.[4] Many of the German silver ewers and basins resemble those made in pewter at the end of the 16th century by François Briot and Gaspar Enderlein, who migrated from Switzerland to Germany.

Switzerland.—This country produced several silversmiths whose work in the main follows that of the German school. The three historical beakers in the national library at Zurich were made in that city from money sent out as gifts from England by the three English bishops, Jewel of Salisbury, Horn of Winchester, and Parkhurst of Norwich, in appreciation of the hospitality afforded them during their exile at Zürich, in the reign of Queen Mary I.[5] Important plate was wrought at Berne, Rappersweil and other Swiss towns.

Russia.—In no country is the ecclesiastical and secular plate of greater interest than in Russia, where so many different influences have been at work in its designs and decoration—Byzantine, Oriental, Gothic, Renaissance, &c. The "golden age" of ecclesiastical art was undoubtedly the 17th century, when the churches and monasteries were being enriched with many priceless ornaments in the precious metals. Enamels of great richness—which had been introduced there by Hungarian artists—niello and precious stones were employed in the decoration. A drinking-cup or bowl exclusively Russian in form and character, known as *bratina*, was largely made (see the fine one of gold, enamelled and set with precious stones, in the royal collection at Vienna), as was a smaller bowl, called *czarka*, with a single handle. Another secular vessel, peculiarly Russian, is the *kovsh*, a pointed or boat-shaped bowl with a long handle. Much of the domestic plate after Peter the Great's time was influenced by that of western countries, particularly Germany.

Poland.—Though not without a character of its own, the ecclesiastical plate of Poland[1] came under the influence both of Germany and Hungary. Many of the sacred vessels of late medieval times are decorated with enamels and niello. In the 17th century ecclesiastical vessels encrusted with corals are met with, such as those given by Michael Wisniowiecki, king of Poland, to the church of Czeustochowa. A magnificent 17th-century chalice of gold, beautifully enamelled, given by the bishop of Plock and Breslau, son of Sigismund III., is in Plock cathedral. Many important pieces of plate still exist in churches in Poland, though a Polish origin is not claimed for them; for instance, the 10th-century chalice at Trzemeszno, where there is also another chalice of about the same period. The cathedral of Cracow contains many priceless examples, such as the 14th-century gold cross given by Casimir the Great; the gold crucifix of Mathias Corvinus, and the gold reliquary, 16th century, of St Stanislas, bishop of Cracow.

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[1] Lessing, *Die Silber-Arbeiten von Anton Eisenhoit* (1880).

[2] Illustrated by Ordzywolski, in *Renesaus w Polsce*, pls. 11–12.

[3] See Rosenberg in *Kunst und Gewerbe* (1885).

[4] See twenty-one facsimiles of these etchings published by J. Rimell (London, 1862).

[5] Keller, "Three Silver Cups at Zürich," *Arch. Journ.* xvi. 158.

France.—France, like England, has suffered grievous losses in its plate, though it can show a larger array of medieval church vessels than can England. The chief specimens of medieval plate are the 9th-century casket and the seated statuette of St Foy (10th century) in the treasure of Conques; the cross of Laon (*c.* 1200) in the Louvre; the ciborium (early 13th century) in the treasury of Sens; the cross of the same period in Amiens Cathedral; the caskets of St Taurin (*c.* 1250); the reliquary of St Epine, given by St Louis; the virgin of the abbey of Roncevaux (Navarre, 14th century); and the virgin given by Queen Jeanne d'Evreux to St Denis in 1339. One of the most cherished possessions of the British Museum is the celebrated gold and enamel cup of the kings of England, French work of the 14th century. No doubt the visit to Paris of Cellini exercised a great influence in the goldsmith's art there, though, unfortunately, no examples have survived. The extravagances of Louis XIV. and his court led to the destruction of all the royal plate of France, as did the Revolution of 1789 of vast quantities of domestic plate. It was not until the early part of the 18th century that any signs of revival are visible in the art of the silversmith. Chief among the Paris goldsmiths of that time are Claude Ballin the younger, Thomas Germain, and, later in the century, François Thomas Germain, who made the royal plate of Portugal and several pieces for the court of Russia.

The Low Countries.—Flemish silversmiths of the late medieval period were as skilful as they were in the Renaissance. So little Flemish plate remains that pictures of the Flemish school are recommended as the chief sources of study of ecclesiastical vessels. A fine covered silver beaker, decorated with open work and translucent enamel in the South Kensington Museum, and another covered with figures and foliage in niello, in the print room of the British Museum, are notable examples of Flemish work of the 15th century. A large triptych, 13th century, is in the Rothschild bequest to the Louvre. Ornate rosewater ewers and basins, which came in with the Renaissance, such as the important pair dated 1535 in the Louvre, were made at Antwerp and other places.

The Utrecht silversmith, Paul van Vianen (early 17th century) wrought many fine pieces of plate, including the silver bas-reliefs in the Rijks Museum at Amsterdam, where there are five fine bas-reliefs in silver by the Belgian silversmith, Mathias Melin. Two other members of the same family, Adam and Christian van Vianen, were also prominent silversmiths of this time. An earlier Dutch silversmith, Christian van Vianen of Utrecht, made the vessels for the altar of St George's Chapel, Windsor, for Henry VIII.

Two important pieces of Dutch plate are the covered tazza-shaped cup of William the Silent, date about 1573, belonging to the earl of Yarborough,[2] and another large cup of the same form (1595), known as the "Breda cup," in the possession of the Hohenlohe family. Considerable quantities of plate were produced at Amsterdam (where Johann Lutma the elder—d. 1669— was a well-known silversmith), Haarlem, the Hague and many other places. The numerous 17th-century Dutch pictures of still-life and other subjects afford opportunities for the study of tazze, beakers and other domestic vessels in silver. Hendrik Janssens, a Dutch engraver of about 1640, executed many designs for goldsmiths and jewellers.

Spain and Portugal.—Spanish plate was largely influenced in the middle ages by that of France and Flanders and the art of the Moors. But little medieval plate exists in Spain, most of it having been destroyed at the time when a taste for more elaborate ornaments sprang up as a result of the introduction of fresh wealth from the colonies in the New World. The following examples may be singled out: a cross of wood, covered with gold filigree work, set with stones (A.D. 808), in Oviedo Cathedral, where there is also a larger cross of wood and gold, dating from later in the same century. A Moorish casket of wood covered with thin silver plates is in Gerona Cathedral. The reliquary of Alphonso III. and his queen (A.D. 866–896 covered with embossed silver plates of the symbols of the evangelists; the 11th-century chalice at Silos; chalices of the 13th and early 14th centuries in the cathedrals of Santiago and Toledo; and Don Martin's great armchair, of wood covered with elaborate silver-gilt plates, in Barcelona cathedral. The Spanish monstrances of the 15th century are noticeable because of the Flemish influence displayed, while those of the early part of the 16th century, such as that by the celebrated silversmith, Enrique Arfe, in the cathedral of Cordova, is remarkable for its ornate character. The latter's grandson, Juan de Arfe y Villafane (who wrote *De varia conmensuracion*, 1585, on silverwork and other arts) became a chief maker of these magnificent monstrances; for instance, the celebrated example in Seville cathedral. He was associated with Pacheco in executing statues. About the 15th century Barcelona became famed as a centre for the silversmith's art, and the *Libros de pasantia*, or silversmiths' examination books, still preserved in that city, contain a large number of designs for jewel-work. Seville likewise had an important gild of silversmiths, as did the following cities: Toledo, Valladolid, Burgos, Cordova and Salamanca. The celebrated family of Becerril wrought fine plate at Cuenca in the 16th century. Many chalices and some domestic plate of the 16th and early 17th centuries are embellished with small enamelled disks, some of which show Saracenic influence in details. The Victoria and Albert Museum possesses a fine collection of Spanish goldsmith's work.

Portuguese plate displays in its Gothic features a very florid style, in imitation of that adopted by architects in the reign of Don Manuel (1495–1521). A typical example of this extravagance of Gothic motives may be seen in the monstrance of Belem, which was made from gold brought from the East by Vasco da Gama.

Austria and Hungary.—Austrian plate is, like that of Switzerland, largely based on German models. The ecclesiastical plate of Hungary in the 15th and 16th centuries is celebrated for its enamelled work of a flowered design enclosed in filigree wire—introduced from Italy. This enamelled decoration was continued in the 17th century, but without the filigree wire, and it is then described as "Transylvanian." Much of the secular plate of the 16th and 17th centuries in north and east Hungary is influenced by German plate, while that in Transylvania is frequently inspired by Oriental designs.

English.—There is strong evidence of the importance attached to English medieval plate by Continental peoples, as there was to the magnificent English illuminated MSS., and, later, to the embroidered vestments, *opus anglicanum*. But, unfortunately, the ruthless destruction of plate during the Wars of the Roses, the Reformation and the Great Rebellion has spared but few medieval pieces to which we can point. Under the name of Protestantism every ecclesiastical vessel with a device savouring of "popish superstition" was instantly destroyed. The inventories of the great cathedrals and religious houses plainly reveal their marvellous wealth in gold and silver vessels.

Norfolk is richer than any other county in pre-Reformation chalices and patens.[3] The well-known "Gloucester" candlestick, though composed of inferior metal, is an illustration of the fine plate wrought in England in the 12th century, while the ancient anointing spoon of the sovereigns of England at the Tower of London is an historical relic of the end of the 12th century (with the bowl altered for Charles II.). The earl of Carysfort is the fortunate possessor of a silver-gilt censer of about 1375 and an incense ship, of about 1400, found in Whittlesea Mere in 1850, and formerly belonging to Ramsey Abbey.[1] Only one pre-Reformation English gold chalice has survived, which with its paten and a silver crosier was given to Corpus Christi College, Oxford, by its founder, Bishop Foxe (Plate II., fig. 26). Both bear the London date-letter for 1507–1508. Another historical relic which has come down to the present day, though in a restored form, is the gold ampulla of about the end of the 14th century in the Tower of London. The universities of Oxford and Cambridge, though sadly depleted of their plate, can still show some notable pieces. The earliest example at each is a drinking horn, both of the 14th century, at Queen's College, Oxford, and Corpus Christi College, Cambridge. Other notable horns are the Pusey horn[2]; the celebrated Bruce horn with the seals of John of Gaunt attached, and one at Christ's Hospital.

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[1] Pozczdziecke and Rastawiecki, *Polish Silver Work* (1853–1869).

[2] *Archaeologia*, lix. 83.

[3] *Norfolk Arch.* xii. 85.

Mazer bowls, made of wood mounted in silver and even in gold, and frequently engraved with scriptural and other inscriptions (see Plate II., fig. 28), were popular drinking vessels in England in medieval times. Many of these have survived, the earliest specimen being one of Edward II. at Harbledown hospital. They ceased to be made after the reign of Elizabeth (*Archaeologia*, i. 129). Medieval coco-nut cups, mounted in silver, are of frequent occurrence in England, the best known examples being in the possession of the colleges at Oxford and Cambridge and several of the city companies. As has been mentioned before, but few examples of early plate exist; the following is a brief list of some of the most notable pieces, other than those previously enumerated: the "Sokborn" cup (*c.* 1450), and the "Anathema" cup (1481–1482) at Pembroke College, Cambridge; the Leigh cup (1499) at Mercers' Hall; the ivory and silver cup (1525–1526) of the duke of Norfolk; the pastoral staff (*c.* 1367) at New College, Oxford; the Richmond cup (*c.* 1510) at Armourers' Hall; the "election cup" (*c.* 1520) at Winchester College; and the Foundress' plate, consisting of a fine covered cup (1435–1440), two salts (*c.* 1500), a beaker and cover (1507–1508), and a salt (1507–1508) at Christ's College, Cambridge. Of Elizabeth's reign, the finest examples are probably the salt of the Vintners' Company (Plate II., fig. 27), and the rosewater dish and ewer of the duke of Rutland. Stoneware jugs, as the well-known example (1581) from West Malling, Kent, and Chinese porcelain vessels were elaborately mounted in Elizabethan times, a goodly proportion of the former having been done by goldsmiths at Exeter.

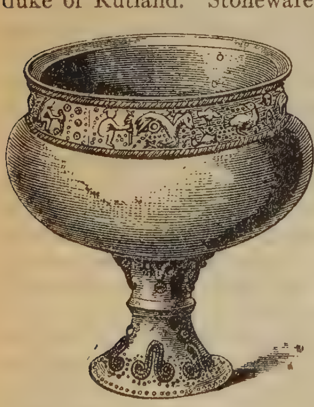
FIG. 15.—Silver Cup, 4¾ in. high, with embossed gold band; found in a grave in the east of Zealand (Denmark). This cup dates from the earlier part of the Iron Age.

The Celtic races of both England and Ireland appear to have possessed great wealth in gold and silver, but especially the former. It seems, however, to have been mostly used in the manufacture of personal ornaments, such as torques, fibulae and the like. A magnificent suit of gold armour, *repoussé* with simple patterns of lines and dots, was found some years ago at Mold in Flintshire, and is now in the British Museum.[3] The amount of old jewelry found in Ireland during the past century has been enormous; but, owing to the unfortunate law of "treasure-trove," by far the greater part was immediately melted down by the finders. Little of this period that can be called plate has been discovered in the British Isles—unlike Denmark and other Scandinavian countries, where the excavation of tombs has in many cases yielded rich results in the way of massive cups, bowls, ladles and horns of solid gold, mostly decorated with simple designs of spirals, concentric circles, or interlaced grotesques. Others are of silver, parcel-gilt, and some have figure subjects in low relief (fig. 15). In like manner, during the Saxon period, though gold and silver jewelry was common, yet little plate appears to have been made, with the exception of shrines, altar-frontals and vessels for ecclesiastical use, of which every important church in England must have possessed a magnificent stock. With regard to English secular plate, though but few early examples still exist, we know from various records, such as wills and inventories, that the 14th century was one in which every rich lord or burgher prided himself on his fine and massive collection of silver vessels; on festive occasions this was displayed, not only on the dinner-table, but also on sideboards, arranged with tiers of steps, one above the other, so as to show off to advantage the weighty silver vases, flagons and dishes with which it was loaded. The central object on every rich man's table was the "nef"—a large silver casket, usually (as the name suggests) in the form of a ship, and arranged to contain the host's napkin, goblet, spoon and knife, with an assortment of spices and salt. No old English "nefs" are now known. Great sums were often spent on this large and elaborate piece of plate, *e.g.* one made for the duke of Anjou in the 14th century weighed 348 marks of gold. The English silversmiths of this period were highly skilled in their art, and produced objects of great beauty both in design and workmanship. One of the finest specimens of Edward III.'s plate which still exists is a silver cup belonging to the mayor and corporation of King's Lynn. It is graceful and chalice-like in form, skilfully chased, and decorated in a very rich and elaborate way with coloured translucent enamels (fig. 16) of ladies and youths, several with hawks on their wrists. Silver salt-cellars were among the most elaborate pieces of plate produced during the 15th century. Several colleges at Oxford and Cambridge still possess fine specimens of these (fig. 17); a favourite shape was a kind of hour-glass form richly ornamented, made between about 1480 and 1525.

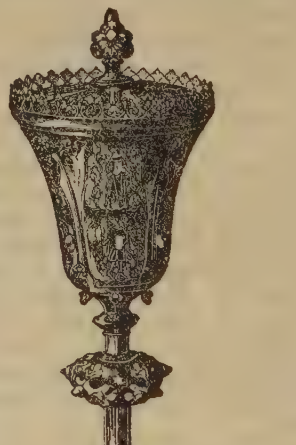
FIG. 16.—Silver Cup, with translucent enamels. Probably English work of the 14th century.

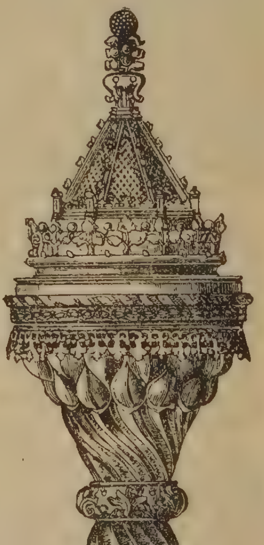
FIG. 17.—Silver-gilt Salt-cellar, 14½ in. high. Given to New College, Oxford, in 1493.

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[1] Illustrated in *Old Cambridge Plate*, pp. 102–103.

[2] *Archaeologia*, iii. 3, xii. 377.

[3] Ibid. xxvi. 422.

But few existing specimens of English plate are older than the beginning of the 15th century. Among the few that remain the principal are chalices—such as the two large silver-gilt ones found in the coffin of an archbishop of York, now used for holy communion in the cathedral, and a fine silver chalice from the church of Berwick St James, Wilts, now in the British Museum. Both this and the York chalices are devoid of ornament, and, judging from their shape, appear to be of the first half of the 13th century, which is the date of the fine medieval chalice and paten found near Dolgelly some years ago (the latter now believed in some quarters to be of German origin). Several Tudor cups are in existence: the celebrated one of 1521 (Plate II., fig. 30), an earlier one, 1500; two covered ones of about 1510 and 1512 at Sandwich and Wymeswold, respectively; one (1515) at Corpus Christi College, Oxford, and the Bodkin cup (1525) of the Corporation of Portsmouth. A very early beaker (1496) is in a private collection, as is also a small Tudor bowl (1525–1526). The earliest known chalices of silver include the Gourdon chalice and paten, the St Gozlin chalice at Nancy (10th century); the 12th-century specimen in the abbey of Wilten in Tirol.

Chalices.

It is interesting to note the various changes of form through which the ecclesiastical chalice passed from early Christian times till the 16th century. It was at first an ordinary secular cup with two handles, classical in form and of large capacity, because the laity as well as the clergy received the wine. The double handles were of practical use in passing the cup round like a modern "loving cup." The first alteration was the omission of the handles, so that it took the form of a large hemispherical bowl, with a round foot, and a knop for security in holding it. For some centuries it appears to have been the custom for the priest to hold the chalice, while the communicant sucked the wine through a silver tube or "fistula." Some of the most magnificent early examples of this form of chalice have the bowl mounted in bands, set with jewels, and enriched with minute filigree work—a design which appears to have been taken from those cups, such as the four magnificent examples in the treasury of St Mark's at Venice, which have their bowl cut out of crystal, onyx or some other precious stone.[1] The finest examples of this class are the Ardagh chalice, now in the Dublin Museum, and the chalice of St Remigius, in Reims cathedral; both are most magnificent specimens of the taste and skill of 10th to 11th century goldsmiths. In the 12th and 13th centuries the design becomes simpler; there is a distinct shaft, extending above and below the knop; and on the foot is marked a cross, not found in the earlier ones, to show which side the priest is to hold towards himself at celebration. The next alteration in the form of chalice, which occurred in the 14th century, was to make the foot not circular in plan but polygonal or lobed, so that the cup might not roll when laid on its side to drain, after it had been rinsed out. This form lasted in most countries till about 1500, and in England till the Reformation. Then the bowl, which in the previous two or three centuries had been slowly reduced in size, owing to the gradually introduced practice of refusing the wine to the laity, was suddenly made more capacious, and the form was altered to the shape shown in fig. 18, in order that the Protestant "communion cup" might bear no resemblance to the old Catholic "massing chalice." This was ordered to be done in 1562 (see *Arch. Journ.* xxv. 44–53). The best account of the evolution in the form of English medieval chalices and patens is by W. H. St John Hope and T. M. Fallow, in *Archaeologia*, vol. xliii.

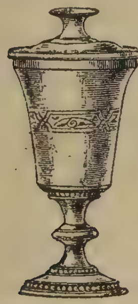

Fig. 18.—Elizabethan Chalice.

Secular plate during the 15th and 16th centuries was frequently similar in style to that made in Germany, though the English silversmiths of the latter century never quite equalled the skill or artistic talent of the great Nuremberg and Augsburg silver-workers. In the 17th century, during the reigns of James I. and Charles I., many fine pieces of plate, especially tall cups and tankards, were made of very graceful form and decoration. The greater part of this, and all earlier plate, especially the fine collections belonging to the universities, were melted down during the Civil War. In Charles II.'s reign returning prosperity and the increase of luxury in England caused the production of many magnificent pieces of plate, often on a large scale, such as toilet services, wine-coolers, and even fire-dogs and other furniture. These are very florid in their ornament, much of it under Dutch influence, and mostly have lost the beautiful forms of the century before (fig. 19 and Plate II., fig. 29). In the early part of the 18th century the designs of English plate were to some extent influenced by the introduction of French ornaments by the large band of French silversmiths who sought refuge in England after the revocation of the edict of Nantes. Chief among these Frenchmen (though probably not a refugee himself) was Paul Lamerie, who produced a large number of notable specimens, the largest of which is a fine wine-cooler in the Winter Palace, St Petersburg. Through the greater part of the reign of George III. English plate is more remarkable for its plain solidity than for artistic merit. With the advent, however, of the talented architects, the brothers Adam, came a taste for plate with classical characteristics. The South Kensington Museum has a small, though fine, collection of plate, varying in date from 1770 to 1788, in the Adam style. Many of Flaxman's designs were produced in plate, among the most important being the "Shield of Achilles," in silver-gilt, at Windsor Castle. Thomas Stothard, the painter, executed several designs for goldsmith's work for Rundell and Bridge.

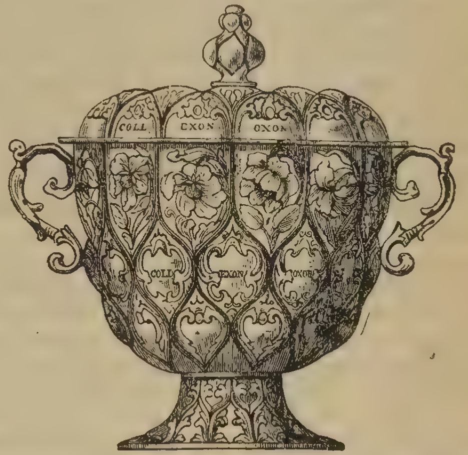

Fig. 19.—Covered Cup of Solid Gold, 6 in. high, *c.* 1660–1670. Given to Exeter College, Oxford, by George Hall, Bishop of Chester.

The Assay of Gold and Silver Plate.—The primitive method of testing the purity of the metal was by marking a streak with it on the touchstone, and comparing the colour of the mark with that made by various pieces of gold or silver of known degrees of purity. Assay by cupellation is now employed for silver: a piece of the silver to be tested is melted with some lead in a cupel or bone-ash crucible; the lead is oxidized, and rapidly sinks into the bone-ash, carrying with it any other impurities which are present. The residue of pure silver is then weighed, and by its loss shows how much alloy it contained. Gold is now tested by an elaborate chemical process by which the trial bit is dissolved in acid, and then thrown down in the form of precipitate, which can be examined by a careful quantitative analysis (see ASSAYING).

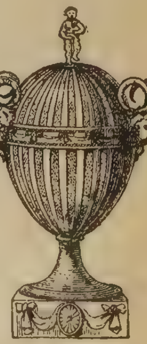

Fig. 20.—Silver Vase, 11 in. high, dated 1772. Designed by the brothers Adam.

The standard of purity required in the time of Edward I. was, for gold, that it should be of the "Paris touch," *i.e.* 19⅕ carats out of 24. Before then 22 carats was the standard. Silver was to be "of the sterling alloy," viz. 11 oz. 2 dwt. to the pound. Except for a time during the 16th century this standard of silver has been kept up, and is still required by law.

Hall-marks on Silver.—In the 13th century the English Gild of Gold- and Silver-smiths had grown into great importance, and had acquired monopolies and many special privileges. In order to keep the standard up to the required purity the system of requiring each article to be stamped with certain marks was introduced by royal command. The first of these was the

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[1] See De Fleury, *La Messe* (Paris, 1882), &c.

king's mark—a leopard's or lion's head crowned. This was introduced in 1300 by Edward I. (29 Edw. I. stat. 3, c. 30). The second, the *maker's mark*, was instituted in 1363 (37 Edw. III. c. 7). This might be any badge or initial chosen by the master silversmith himself. The third was the *Year letter* or *assayer's mark*; this was an alphabet, one letter being used for a year, counting from the day of the annual election of the warden of the Goldsmiths' Company. When one alphabet was exhausted another with differently shaped letters was begun. The earliest existing piece of plate which has the three marks is the chalice (with paten, 1479–1480), at Nettlecombe, Somerset. Other marks, subsequently introduced, were the lion passant, first used in 1544; the lion's head erased; and a full-length figure of Britannia, used only between 1697 and 1719–1720; and, lastly, the portrait of the reigning sovereign, which was used from 1784 to 1890, when the duty on gold and silver plate ceased. In addition to these general hall-marks, the plate made in various provincial towns had certain special assay and hall-marks.

The best work on hall-marked plate and the marks themselves, with the history of the Goldsmiths' Company, is C. J. Jackson's *English Goldsmiths and their Marks* (1905), where will be found illustrations of the marks found on plate wrought in Scotland and Ireland, and at English provincial gilds—York, Norwich, Exeter, Chester, Lincoln, Newcastle, Birmingham, Sheffield and other places. E. Alfred Jones's book, *Old English Gold Plate* (1907), illustrates and describes gold plate only.

Modern Plate in the East.—Though little plate of real artistic merit is now made in Europe, in the East among the Moslem and Hindu races there still survive some real taste in design and skill in execution. Delhi, Benares, Lucknow, Cutch and other places in India and Kashmir still produce a quantity of beautiful silver and gold work—chiefly ewers, basins, rose-water sprinklers, salvers, coffee-pots and the like. These are of graceful form, covered with rich *repoussé* work, or more often with very delicate chased patterns. Their style in the main is Moslem, but some combine an Arab form with native Indian surface decoration. This class of work is not a revival, but has been practised and handed down by unbroken tradition, and with little or no change in style from the 16th century or even earlier.[1] The silversmiths of Persia, Damascus and other Eastern places are still skilful, and retain some good tradition in their designs. They are, however, more occupied in the production of personal ornaments than in making larger works of silver or gold.

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[1] See Birdwood, *Industrial Arts of India* (1880), p. 144.

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PLATEAU, JOSEPH ANTOINE FERDINAND (1801–1883), Belgian physicist, was born at Brussels on the 14th of October 1801, and died on the 15th of September 1883 at Ghent, where he had been professor of physics from 1835. He was a pupil and friend of L. A. J. Quetelet, who had much influence on the early part of his career. The more original investigations of Plateau refer chiefly to portions of one or other of two branches of science—physiological optics and molecular forces. We owe to him the "stroboscopic" method of studying the motion of a vibrating body, by looking at it through equidistant radial slits in a revolving disk. In 1829 he imprudently gazed at the midday sun for 20 seconds, with the view of studying the after effects. The result was blindness for some days, succeeded by a temporary recovery; but for the next fourteen years his sight gradually deteriorated, and in 1843 he became permanently blind. This calamity did not interrupt his scientific activity. Aided by his wife and son, and afterwards by his son-in-law G. L. van der Mensbrugghe, he continued to the end of his life his researches on vision—directing the course of the experiments which they made for him, and interpreting the bearing of the results. He also published a valuable analytical catalogue of all the more important memoirs which had been written, from the earliest times to the end of the 18th century, on his favourite theme of subjective visual phenomena. But even more extraordinary were this blind man's investigations about molecular forces, embracing hundreds of novel experiments whose results he saw only with others' eyes. These form the subject of his great work *Statique expérimentale et théorique des liquides soumis aux seules forces moleculaires* (2 vols., 1873), a valuable contribution to our knowledge of capillary phenomena. His son, Félix Auguste Joseph Plateau (b. 1841), became professor of zoology and comparative anatomy at Ghent in 1870.

PLATEAU (a French term, older *platel*, for a flat piece of wood, metal, &c., from *plat*, flat), in physical geography, an elevated region of level or gently undulating land-surface, the term being synonymous with "table-land." The most clearly defined plateaus have steep flanks in contrast with their level summits, but the term does not necessarily connote a steep ascent from the surrounding country. Indeed, it is applied to such diverse forms as the high-lying plains encircled by the higher elevations of the Andes, and to those of the west of North America, which rise almost imperceptibly from the low central plains. A plateau may have its origin either in the upheaval of strata which preserve their original horizontal position during the process, or in the prolonged denudation of an originally broken surface. The two forms are distinguished respectively as Plateaus of Deposition and Plateaus of Erosion.

PLATED WARE, articles chiefly intended for table use consisting of an inferior metal or alloy covered by one of the precious metals, with the object of giving them the appearance of gold or silver. Before the introduction of electro-plating the method employed for silver-plating (the invention of which in 1742 is associated with the name of Thomas Bolsover, of Sheffield) was to fuse or burn together, by a flux of borax, a thin sheet of silver on each side of an ingot of base metal, generally copper, or German silver, which is an alloy of copper. The silver plates were firmly wired to the ingot, which was then placed in a heated furnace and brought nearly to the fusing-point of the silver. The artisan knew the exact moment to withdraw the ingot. When cold it was rolled down to a sheet, and from such sheets "silver-plated" articles were made. Articles like dish-covers were originally only silver-plated on one side, and after being worked into shape were tinned inside with pure tin. In Birmingham bar-copper was the base metal used; when bare of silver this showed blood-red. The Sheffield manufacturers, on the other hand, used shot-copper mixed with brass (an alloy of copper and zinc) in the proportion of 4 or 6 to 1. In this way they got rid of the redness of the copper and rendered it harder, and their product is the "old Sheffield plate" (*q.v.*) that has become famous all over the world. This method of plating rapidly declined with the introduction of the newer process of electro-plating (*q.v.*), by which it has been superseded. Plating with nickel is extensively used for bedsteads and other articles of upholstery, and for various parts of bicycles, steamships, railway carriages, &c. Steel sheets are also plated with nickel for cooking purposes, and iron is plated with brass.

PLATEN-HALLERMUND, AUGUST, Graf von (1796–1835), German poet and dramatist, was born on the 24th of October 1796 at Ansbach, the son of the *Oberforstmeister* in the little principality of that name. The latter, together with other Franconian principalities, having shortly after his birth become incorporated with Bavaria, he entered the school of cadets (*Kadettenhaus*) in Munich, where he showed early promise of poetical talent. In 1810 he passed into the royal school of pages (*königliche Pagerie*), and in 1814 was appointed lieutenant in the regiment of Bavarian life-guards. With it he took part in the short campaign in France of 1815, being in bivouac for several months near Mannheim and in the department of the Yonne. He saw no fighting, however, and returned home with his regiment towards the close of the same year. Possessed of an intense desire for study, and finding garrison life distasteful and irksome, he obtained a long leave of absence, and after a tour in Switzerland and the Bavarian Alps, entered the university of Würzburg in 1818 as a student of philosophy and philology. In the following year he migrated to that of Erlangen, where he sat at the feet of F. W. J. von Schelling, and became one of his most enthusiastic admirers. As a result of his Oriental studies he published a little volume of poems—*Ghaselen* (1821), each consisting of ten to twenty verses, in which he imitates the style of Rückert; *Lyrische Blätter* (1821); *Spiegel der Hasis* (1822); *Vermischte Schriften* (1822); and *Neue Ghaselen* (1823). These productions attracted the attention of eminent men of letters, among them Goethe, both by reason of their contents, which breathe the spirit of the East, and also of the purity and elegance of their form and diction. Though he was at first influenced by the school of Romanticism, and particularly by Spanish models, yet the plays written during his university life at Erlangen, *Der gläserne Pantoffel*, *Der Schatz des Rhampsinit*, *Berengar*, *Treue um Treue*, *Der Turm mit sieben Pforten*, show a clearness of plot and expression foreign to the Romantic style. His antagonism to the literature of his day became more and more pronounced, and he vented his indignation at the want of art shown by the later Romanticists, the inanity of the lyricists, and the bad taste of the so-called fate tragedies (*Schicksalstragödien*), in the witty "Aristophanic" comedies *Die verhängnisvolle Gabel* (1826) and *Der romantische Oedipus* (1828).

The want of interest, amounting even to hostility, with which Platen's enthusiasm for the purity and dignity of poetry was received in many literary circles in Germany increased the poet's indignation and disgust. In 1826 he visited Italy, which he henceforth made his home, living at Florence, Rome and Naples. His means were slender, but, though frequently necessitous, he felt happy in the life he had chosen, that of a "wandering rhapsodist." *Der romantische Oedipus* earned for him the bitter enmity of Karl Immermann and Heinrich Heine, and in the literary feud which ensued Heine launched the most baseless calumnies at the poet, which had the effect of prejudicing public opinion against him. But he retained many stanch admirers, who delighted in the purity of the subject matter of his productions and their beauty of form and diction. In Naples, where he formed the friendship of August Kopisch, the poet and painter, were written his last drama *Die Liga von Cambrai* (1833) and the delightful epic fairy-tale *Die Abbassiden* (1830; 1834), besides numerous lyrical poems, odes and ballads. He also essayed historical work in a fragment, *Geschichten des Königreichs Neapel* (1838), without, however, achieving any marked success. In 1832 his father died, and after an absence of eight years Platen returned to Germany for a while, and in the winter of 1832–1833 lived at Munich, where he revised the first complete edition of his poems, *Gedichte* (1833). In the summer of 1834 he returned to Italy, and, after living in Florence and Naples, proceeded in 1835 to Sicily. Dread of the cholera, which was at that time very prevalent, induced him to move from place to place, and in November of that year he was taken ill at Syracuse, where he died on the 5th of December 1835. Like Heine himself, Platen failed in the drama, but his odes and sonnets, to which must be added his *Polenlieder* (1831), in which he gives vent to his warm sympathy for the Poles in their rising against the rule of the Tsar, are in language and metre so artistically finished as to rank among the best classical poems of modern times.

Platen's *Gesammelte Werke* were first published in one volume in 1839, and have been frequently reprinted; a convenient edition is that edited by K. Goedeke in Cotta's *Bibliothek der Weltliteratur* (4 vols., 1882). His *Tagebuch* (1796–1825), was published in its entirety by G. von Laubmann and L. von Scheffler (2 vols., 1896–1900). See J. Minckwitz, *Graf Platen als Mensch und Dichter* (1838); P. Besson, *Platen, étude biographique et littéraire* (1894); O. Greulich, *Platens Literaturkomödien* (1901); A. Fries, *Platen-Forschungen* (1903); and R. Unger, *Platen in seinem Verhältnis zu Goethe* (1903).

PLATERSPIEL, BLATERPFEIFE, a medieval simplified bagpipe, consisting of an insufflation tube, a bladder and a chaunter; the double reed in its socket at the top of the chaunter being concealed within the bladder. In the platerspiel we recognize the early medieval *chorus*, a word which in medieval Latin was frequently used also for the bagpipe. In the earlier forms of platerspiels of which we possess illustrations, such as the well-known example of the 13th century reproduced by Martin Gerbert from a MS. at St Blasius, the bladder is unusually large, and the chaunter has, instead of a bell, the grotesque head of an animal with gaping jaws. At first the chaunter was a straight conical tube terminating in a bell, as in the bagpipe. The later instruments have a pipe of larger calibre more or less curved and bent back as in the *cromorne*. One of these appears in the 13th-century Spanish MS., known as the *Cantigas de Santa Maria*[1] in the Escurial, together with a platerspiel having two pipes, a chaunter and a drone side by side. Another is figured by Virdung (1511).

There was practically no technical difference between the bent platerspiel and the cromorne, the only distinction being the form and size of the air-chamber in which the reed was set in vibration by the compressed air forced into it through the insufflation tube or the raised slit respectively of the two instruments. The earlier form of platerspiel is found at the end of the 15th century, in the magnificent Book of Hours, known as the *Sforza Book*[2] (Brit. Mus.). An interesting allusion to the platerspiel occurs in an old English ballad.[3] Eight shepherds were playing on various instruments: "the fyrst hed ane drone bagpipe, the next hed *ane pipe maid of ane bleddir and of ane reid*, the thrid playit on ane trump, &c.," from which it is evident that the platerspiel retained its individuality and did not become merged in the bagpipe. (K. S.)

PLATFORM (Fr. *plateforme*, *i.e.* ground plan), a word now generally confined to a raised flat structure or stage, temporary or permanent, erected in a building or in the open air, from which speeches, addresses, lectures, &c., can be delivered at a public or other meeting. Similar structures of wood, brick or stone, are used in railway stations at such a level above the rails as to enable passengers to have easy access to the carriages; and in fortification the word is used of the raised level surface on which guns are mounted. The earlier uses of the word, such as for a plane geometrical figure, the ground plan of a building, and figuratively, for a plan, design, scheme, &c., are now obsolete. In a figurative sense the term is applied to a common basis on which members of a political party may agree, and especially in the United States to the declaration made by a party at a national or state convention.

PLATINUM [symbol Pt, atomic weight 195·0 (O=16)], a metallic chemical element. The name, derived from *platina*, the diminutive of Span. *plata* (silver), was first given to a mineral, platinum ore or native platinum, originally discovered in South America, from the resemblance to silver. Russia furnishes about 95% of the world's annual supply of platinum.

Native platinum occurs usually in small metallic scales or flat grains, sometimes in the form of irregular nuggets, and occasionally, though rarely, in small crystals belonging to the cubic system. Grains of platinum have been found embedded, with chromite, in serpentine derived from an olivine-rock, the metal having probably separated out from an original basic magma. It is said to occur also in veins in syenitic and other rocks. Usually, however, platinum is found in detrital deposits, especially in auriferous sands, where it is associated with osmiridium (known also as iridosmine), chromite, magnetite, corundum, zircon, &c. The platinum has a steel grey or silver-white colour and a metallic lustre; is often magnetic, sometimes with polarity; has a hardness of about 4·5 and a specific gravity varying with its composition from 14 to 19. Native platinum usually contains more or less iron and copper, often gold, and invariably a small proportion of some of the allied metals—iridium, osmium, ruthenium, rhodium and palladium. From the associated metals it was named by J. F. L. Hausmann polyxene (Gr. πολύς, many, and ξένος, a guest), whilst from its occurrence as a white metal in auriferous alluvia it is sometimes known to miners as "white gold."

Platina del Pinto was the name by which native platinum was first introduced into Europe from South America about the middle of the 18th century. Although it appears to have been known locally much earlier, the attention of scientific men in Europe was first directed to it by Antonio de Ulloa y Garcia de La Torre, a Spaniard who joined a French scientific expedition to Peru in 1735, and published in 1748 an account of his journey, in which he refers to platinum, though not under that name, as occurring with gold in New Granada (now Colombia). Sir William Watson, an English physicist, had, however, in 1741 received some grains of the mineral, probably from the same locality, though brought by way of Jamaica; and it was he who first described it in 1750 as a new metal.

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[1] Reproduced by J. F. Riaño, in *Studies of Early Spanish Music* (London, 1887).

[2] See facsimile edited by Dr George Warner, pl. xxviii. fol. 51.

[3] See F. J. Furnivall, *Captain Cox, his ballads and Books*, or *Robert Laneham's Letter* A.D. 1575 (London, 1871), clx. 86.

Native platinum was discovered in 1819 in the gold washings of Verkhniy-Isetsk, in the Urals, but it was not until 1822 that its true nature was recognized. The chief Russian localities are in the districts of Nizhne Tagilsk and Goroblagodatsk, where it is found in shallow drift deposits, containing pebbles of serpentine, which represent the original matrix. The Iset district has acquired importance in recent years. Although the platinum-bearing gravels usually contain a very small proportion of the metal, the average in 1895 being only 1½ dwt. to the ton, rich discoveries have occasionally been made in the history of the workings, and nuggets of exceptional size have been unearthed. The largest recorded specimens are one of 310 oz. from Nizhne Tagilsk, and another of 72½ oz. from the Goroblagodatsk district.

In 1831 platinum ore was recognized in the gold-bearing deposits of Borneo, where it had previously been regarded as worthless, being known to the natives as *mas kodok* (frog gold). Although recorded from various parts of the island, its occurrence seems to be definitely known only in Tanah-Laut, in the south-east of Borneo. In Australia platinum ore has been found near Fifield (near Condobolin), New South Wales; whilst in New Zealand it occurs in sands and gravels in the Thames gold-field, the Takaka River and the Gorge River flowing into Awarua Bay. Many localities in North America have yielded platinum, generally in beach sands or in auriferous alluvia, and in some cases the deposits are of commercial importance. The metal is found in Alaska, British Columbia, Oregon (Douglas county) and California (Butte county, Trinity county, Del Norte county). It has been recorded also from the states of New York and North Carolina. In a nickeliferous sulphide ore worked at Sudbury, in Ontario, platinum has been discovered in the form of an arsenide (Pt As_2), which has been called sperrylite by H. L. Wells, who analysed it in 1889, and named it after F. L. Sperry, of Sudbury. It belongs to the pyrites group, and is interesting as being the only known mineral in which platinum occurs in combination except as alloy.

Native platinum seems to be a mineral of rather wide distribution, but in very sparse quantity. The sands of the Rhine, derived from Alpine rocks, have been found to contain platinum in the proportion of 0·0004%. It has also been found in the sands of the Ivalo River in Lapland; it is recorded from Röros in Norway; and it was detected by W. Mallet in some of the gold-sands of the streams in Co. Wicklow, Ireland.

The table shows the *official* amount (in ounces Troy) of platinum produced in Russia for certain years, the *actual* amounts are much larger:—

Year.	Amount.	Year.	Amount.
1890	116,640	1904	161,950
1895	141,757	1905	167,950
1900	163,060	1906	185,492
1901	203,257	1907	172,758
1902	197,024	1908	157,005
1903	192,976		

(Rothwell's *Mineral Industry*, 1908.)

Platinum is largely used for the manufacture of chemical apparatus, incandescent lamps, thermo-couples; in the manufacture of sulphuric acid by the contact process, in photography, and in jewelry. The price of the metal has risen considerably, not so much on account of the restricted supply, but chiefly because the sources of supply have passed into the hands of a few individuals. The following data show the fluctuations in the average price of platinum ingot per once Troy:—

	£	s.	d.		£	s.	d.
1874–1898:	1	5	2	to	2	2	0
1899–1905:	3	13	6	,,	4	10	4
1906:	4	15	2	,,	7	19	8
1907:	7	0	0	,,	6	18	8
1908:	5	2	6 (average) price.				

Platinum may be extracted from its ore by both wet and dry processes. In the latter method, due to H. Sainte-Claire-Deville and H. J. Debray, the ore is smelted in a furnace constructed of two blocks of lime, and the metallic button so obtained is re-melted in a reverberatory furnace with galena or litharge, the lead platinum alloy being then cupeled, and the platinum fused into an ingot by re-smelting in a lime furnace (see Dingler's *Polytech. Journ.* 1859, 153, p. 38; 1859, 154, p. 383; 1862, 165, p. 205). The platinum so obtained is not pure. In Wollaston's wet method the ore is dissolved in aqua regia, the osmiridium, ruthenium and rhodium being left unattacked, and the platinum precipitated as ammonium platinochloride by adding ammonium chloride in the presence of an excess of acid. The double chloride is then washed, dried and ignited, leaving a residue of metal. G. Matthey (*Chem. News*, 1879, 39, p. 175) obtains pure platinum from the commercial metal by fusing the latter with a large excess of lead. The lead alloy is then treated with a dilute nitric acid and the insoluble portion taken up in dilute aqua regia. From the solution so obtained lead is precipitated as sulphate, and platinum and rhodium as double ammonium chlorides. The rhodium ammonium chloride is converted by fusing with potassium and ammonium bisulphates into rhodium sulphate, which is then removed by extraction with water, when a residue of finely divided platinum remains. The German firm of Heräus (in Hanover) heat the raw ore with aqua regia and water under pressure, evaporate the solution to dryness, and heat the residue to 125° C. A clear aqueous extract of the residue is then acidified with hydrochloric acid and precipitated with ammonium chloride. The double chloride is ignited and the finely divided platinum so obtained is fused in the oxyhydrogen blowpipe.

Platinum is a greyish-white metal which is exceedingly malleable and ductile; the addition of a small quantity of iridium hardens it and diminishes its ductility very considerably. Its specific gravity is 20·85 to 21·71, and its mean specific heat from 0 to 100° C. is 0·0323 (J. Violle, *Comptes rendus*, 1877, 85, p. 543); W. P. White (*Amer. Journ. Sci.*, 1909, iv. 28, p. 334) gives the general formula $S_t=0{\cdot}03198+3{\cdot}4\times10^{-6}t$. S_t being the specific heat at t°C. Its temperature of fusion is in the neighbourhood of 1700 to 1800°C., various intermediate values having been obtained by different investigators (see J. A. Harker, *Chem. News*, 1905, 91, p. 262; C. Féry and C. Chéneveau, *Comptes rendus*, 1909, 148, p. 401; also C. W. Waidner and G. H. Burgess, ibid., 1909, 148, p. 1177). Its latent heat of fusion is 27·18 calories (Violle, *loc. cit*). The metal has been obtained in the crystalline condition by distillation in the electric furnace, or by decomposing its fluoride at a red heat (H. Moissan). Platinum, like palladium, absorbs large quantities of hydrogen and other gases, the occluded gas then becoming more "active"; for this reason platinum is used largely as a catalytic agent. Several forms of platinum, other than the massive form, may be obtained. *Spongy platinum* is produced when ammonium platinochloride is ignited; *platinum black* on the reduction of acid solutions of platinum salts; and *colloidal platinum* by passing an electric arc between two platinum wires under the surface of pure water (G. Bredig, *Zeit. phys. Chem.*, 1901, 37, pp. 1, 323). Platinum is practically unoxidizable; it combines directly with phosphorus, arsenic, antimony, silicon, boron, and fluorine, and with almost all other metals. It is practically unattacked by all acids, dissolving only in aqua regia or in mixtures which generate chlorine. When fused with alkaline hydroxides in the presence of air it forms platinates. It is readily attacked by fused nitrates, and by potassium cyanide and ferrocyanide. All the platinum compounds when heated strongly decompose, and leave a residue of the metal. Of platinum salts, in the true sense of the word, none exist; there is no carbonate, nitrate, sulphate, &c; halide salts, however, are known, but are obtained in an indirect manner.

Platinum monoxide, PtO, obtained by heating the corresponding hydrate, is a dark-coloured powder which is easily reduced to the metal (L. Wöhler, *Ber.*, 1903, 36, p. 3475). The hydrated form, $PtO{\cdot}2H_2O$, is obtained impure by precipitating the dichloride with caustic soda, or by adding caustic soda to a boiling solution of potassium platinous chloride, K_2PtCl_4, the precipitate being rapidly washed and dried *in vacuo* (L. Wöhler, *Zeit. anorg. Chem.*, 1904, 40, p. 423). It is a black powder; when freshly prepared it is soluble in concentrated acids, but when dried it is insoluble. It is an acidic oxide, the dioxide being both acidic and basic. It behaves as a strong oxidizing and reducing agent. C. Engler and L. Wöhler (*Zeit. anorg. Chem.*, 1901, 29, p. 1) have shown that platinum black, containing occluded oxygen, is soluble in dilute hydrochloric acid and also liberates iodine from potassium iodide, and that the ratio between the amount of platinum dissolved and the amount of oxygen occluded agrees with the formation of a compound corresponding to the formula PtO. *Platinum dioxide* (platinic oxide), $PtO_2 \cdot 4H_2O$, is obtained by adding an excess of caustic soda solution to a boiling solution of chlorplatinic acid, the hot solution being diluted and neutralized with acetic acid. It loses its water of hydration when heated, finally decomposing into platinum and oxygen. When freshly prepared it is soluble in dilute acids. Other hydrated forms of composition, $PtO_2 \cdot 3H_2O$ and $PtO_2 \cdot 2H_2O$, have been described (E. Prost, *Bull. soc. chim.*, 1886, 46, p. 156; H. Topsoë, *Ber.*, 1870, 3, p. 462). The tetrahydrate may be considered as an acid, $H_2Pt(OH)_6$, for salts are known (namely the platinates) corresponding to it, those of the alkali metals being soluble in water, and possessing an alkaline reaction (M. Blondel, *Ann. chim. phys.*, 1905 [viii.], 6, p. 81). A similar set of chlorine-holding compounds is also known, the chlorine replacing one or more hydroxyl groups and giving rise to complexes of composition, $H_2[PtCl_5(OH)]$, $H_2[PtCl_4(OH)_2]$, $H_2[PtCl_2(OH)_4]$ and $H_2[PtCl(OH)_5]$. The platinic salts (derived from PtO_2) are yellow or brown solids, which are readily reduced to the metallic condition. They give with sulphuretted hydrogen a dark brown precipitate, soluble in excess of ammonium sulphide. Potassium iodide gives a brown solution with gradual formation of a precipitate. They form characteristic precipitates with potassium and ammonium chlorides. The platinous salts are brown or colourless solids which, with sulphuretted hydrogen, give a dark brown precipitate of platinum sulphide, and with potassium iodide a gradual precipitation of platinic iodide, PtI_2. *Platinum trioxide*, PtO_3, is obtained as $K_2O \cdot 3PtO_3$, by electrolysing a solution of platinic hydroxide in potash, this compound with acetic acid giving the oxide as a brown, easily decomposable powder (L. Wöhler and F. Martin, *Ber.*, 1909, 42, p. 3326).

Platinum bichloride, $PtCl_2$, is obtained by heating chlorplatinic acid to 300–350° C. (J. J. Berzelius), or, mixed with more or less platinic chloride, by passing chlorine over spongy platinum at a temperature of 250° C. (P. Schutzenberger, *Comptes rendus*, 1870, 70, pp. 1134, 1287). It may also be obtained by the decomposition of the compound $HCl \cdot PtCl_2 \cdot 2H_2O$ (see below) at 100° C., this method giving a very pure product (L. F. Nilson, *Journ. prak. Chem.*, 1877 (2), 15, p. 260). It is a brown or greyish green coloured solid, which is soluble in hydrochloric acid. It decomposes into its constituent elements when heated. It combines with many chlorides to form characteristic double salts. Platinum bichloride combines with carbon monoxide, yielding compounds of composition, $PtCl_2.CO$, $PtCl_2 \cdot 2CO$, $2PtCl_2 \cdot 3CO$ (P. Schutzenberger, *Ann. chim. phys.*, 1870 (4), 21, p. 350). Hydrogen platinochloride or chlorplatinous acid, H_2PtCl_4, is only known in solution, and as such is obtained when platinum bichloride is dissolved in hydrochloric acid, or by decomposing the barium salt with sulphuric acid, or the silver salt with hydrochloric acid. Its salts, the platinochlorides or chlorplatinites, are obtained by reducing the chlorplatinates or directly from the acid itself. They are mostly soluble in water giving red solutions. They are readily oxidized, and nascent hydrogen reduces them to metallic platinum. *Potassium platinochloride* or *chlorplatinite*, K_2PtCl_4, is prepared by reducing hydrogen platinichloride with sulphur dioxide, or potassium platinichloride with potassium oxalate in the presence of iridium (Klason, *Ber.*, 1904, 37, p. 1360); or by adding potassium chloride to a solution of platinum bichloride in hydrochloric acid. It crystallizes in dark red prisms, is readily soluble in water, but insoluble in alcohol. The solution of the free acid when concentrated *in vacuo* leaves a residue of $HCl.PtCl_2.2H_2O$. When the free acid is reduced by alcohol, or when ethylene is passed into a solution of platinum bichloride in hydrochloric acid, $PtCl_2 \cdot C_2H_4$ is obtained as a brown amorphous mass which decomposes when heated. When the bichloride is heated in a current of carbon monoxide, a sublimate of platinomonocarbonyl dichloride, $PtCl_2CO$, dicarbonyl dichloride, $PtCl_2(CO)_2$, and tricarbonyl tetrachloride, $Pt_2Cl_4(CO)_3$, is obtained. The first forms bright yellow needles and the second white acicular crystals. The bichloride also combines with phosgene to form $PtCl_2.2COCl_2$.

Platinic chloride, $PtCl_4$, is obtained when chlorplatinic acid is heated in a current of dry hydrochloric acid gas to 165° C. (W. Pullinger, *Journ. Chem. Soc.*, 1892, 61, p. 422) or in a current of dry chlorine at 275° C. (A. Rosenheim and W. Löwenstamm, *Zeit. anorg. Chem.*, 1903, 37, p. 394). It forms a reddish brown crystalline mass which is very hygroscopic. Numerous hydrates are known. The chloride is characterized by the readiness with which it forms double salts with the metallic chlorides and with the hydrochlorides of most organic bases. *Chlorplatinic acid*, $H_2PtCl_6 \cdot 6H_2O$, is obtained by dissolving platinum in aqua regia containing an excess of hydrochloric acid, or by the action of chlorine (dissolved in hydrochloric acid) on platinum sponge. It crystallizes in needles, which are very deliquescent and dissolve easily in water. It melts in its own water of crystallization at 70° C., and when heated *in vacuo* to 100° C. it leaves a residue of composition $HCl.PtCl_4.2H_2O$. The potassium and ammonium salts and the salts it forms with organic bases are characterized by their exceedingly small solubility in water. The aqueous solution of the acid reddens litmus and decomposes the metallic carbonates. Its salts may be prepared by the direct action of the acid on the metallic hydroxides or carbonates, and are usually of an orange or yellow colour and are mostly soluble in water. *Potassium chlorplatinate*, K_2PtCl_6, is obtained, in the form of a yellow crystalline precipitate, when a concentrated solution of a potassium salt is added to a solution of chlorplatinic acid. It crystallizes in octahedra which are scarcely soluble in water, and practically insoluble in absolute alcohol. It decomposes at a red heat into platinum, chlorine and potassium chloride. The corresponding sodium salt, $Na_2PtCl_6.6H_2O$, is much more soluble in water and in alcohol. The ammonium salt, $(NH_4)_2PtCl_6$, resembles the potassium salt in its solubility in water and in alcohol. Corresponding bromo- and iodo- compounds are known. *Platinum bifluoride* and *tetrafluoride*, PtF_2 and PtF_4, were obtained simultaneously by H Moissan (*Ann. chim. phys.*, 1894 (6), 24, p. 282) by the action of fluorine on platinum at 500–600° C. They may be separated by taking advantage of their different solubilities in water.

Platinum monosulphide, PtS, is obtained by the direct union of platinum and sulphur; by heating ammonium chlorplatinate with sulphur; or by the action of sulphuretted hydrogen on the chlorplatinites. It is a dark coloured powder which is almost insoluble in aqua regia. It decomposes when heated strongly leaving a residue of metallic platinum, the same reduction taking place at comparatively low temperatures when it is heated in a current of hydrogen. *Platinic sulphide*, PtS_2, is formed when the chlorplatinates are heated with sulphuretted hydrogen to 60° C. The precipitate must be rapidly washed and dried *in vacuo*, since it oxidizes rapidly on exposure to air. It is a black powder, which when heated strongly in air decomposes and leaves a residue of platinum, but if heated in absence of air leaves a residue of the monosulphide. It is scarcely affected by acids and is little soluble in solutions of the alkaline sulphides. Sulphides of composition Pt_2S_3 and Pt_5S_6 have been described (R. Schneider, *Pogg. Ann.*, 1869, 138, p. 604; 1873, 148, p. 633; 1873, 149, p. 381). A salt of composition, $Pt(OH)_4.H_2SO_4.H_2O$, has been prepared by M. Blondel (*Ann. chim. phys.*, 1905, (8), 6, p. 81) by the solution of the hydrate $H_2Pt(OH)_6$, *i.e.* $PtO_2 \cdot 4H_2O$, in dilute sulphuric acid (1:1) at 0° C. On the addition of cold concentrated sulphuric acid to the solution so obtained, the above salt is precipitated in the form of minute needles, which readily decompose in the presence of water. A *platinum sulphate*, $Pt(SO_4)_2.2H_2O$, has been obtained by L. Stuchlik (*Ber.*, 1904, 37, p. 2913) by the action of sulphuric acid (s.g. 1·84) on platinum under the influence of an alternating current. A crystalline precipitate is obtained, which is soluble in water and is very hygroscopic.

The *platinonitrites* of composition $M_2Pt(NO_2)_4$ are mostly obtained by double decomposition from the potassium salt, which is formed by adding a warm aqueous solution of potassium nitrite to one of potassium chlorplatinate. They are mostly colourless or pale yellow solids which are more or less soluble in water (L. F. Nilson, *Ber.*, 1876, 9, p. 1722). The corresponding platino-oxalates $M_2Pt(C_2O_4)_2$ were first obtained by J. W. Döbereiner (*Pogg. Ann.*, 1833, 104, p. 180) and their constitution was determined by H. G. Söderbaum (*Ber.*, 1888, 21, p. 567 R; *Zeit. anorg. Chem.*, 1894, 6, p. 45). The sodium salt, from which the others are obtained by double decomposition, is formed by adding a warm solution of oxalic acid to sodium platinate. On recrystallization from alkaline solutions the salts are obtained in yellow or orange crystals (see M. Vezes, *Bull. soc. chim.*, 1898 (3), 19, p. 875). These salts are scarcely soluble in water and decompose explosively when suddenly heated. The free acid is obtained by decomposing the silver salt with hydrochloric acid, the indigo blue solution so obtained on concentration *in vacuo* yielding a red crystalline mass, which dissolves in water with an indigo blue colour, changing to yellow on dilution.

Platinum cyanide, $Pt(CN)_2$, is formed by the addition of mercuric cyanide to a solution of a chlorplatinite, or by the decomposition of mercury or ammonium platinocyanide by heat. It is an amorphous powder which is insoluble in water, acids or alkalis, but is soluble in a solution of hydrocyanic acid. It burns when heated. The platinocyanides are derived from the acid $H_2Pt(CN)_6$, which is formed by the decomposition of the mercury or copper-salt with sulphuretted hydrogen, or of the barium salt with sulphuric acid. It crystallizes from water in cinnabar-red prisms which contain five molecules of water of crystallization; in the anhydrous condition it is of a yellowish green colour. It decomposes carbonates. Its salts, which are characterized by the property of polychroism, may be prepared by the usual methods, or by the solution of metallic platinum in the alkaline cyanides or alkaline earth cyanides under the influence of an alternating current (A. Brochet and J. Petit, *Ann. chim. phys.*, 1904 (8), 3, p. 460; M. Berthelot, *Comptes rendus*, 1904, 138, p. 1130). Those of the alkali and alkaline earth metals are soluble in water. Many combine with the halogen elements to form complex salts of the type $M_2Pt(CN)_4.Cl_2.\,x\,H_2O$. By the decomposition of the barium salts of this type, addition products of the free acid, of composition $H_2Pt(CN)_4.Cl_2.4H_2O$ and $H_2Pt(CN)_4.Br_2$, have been obtained (C. Blomstrand, *Ber.*, 1869, 2, p. 202). They are deliquescent solids which are exceedingly soluble in water. *Potassium platinocyanide*, $K_2Pt(CN)_4.3H_2O$, is obtained by dissolving platinum bichloride in potassium cyanide; by heating potassium ferrocyanide with spongy platinum; or by heating ammonium chlorplatinate with potassium cyanide. It crystallizes in needles which effloresce readily. The dry salt is exceedingly hygroscopic and is very soluble in water. When boiled with aqua regia it forms the chlorine addition product, $K_2Pt(CN)_4.Cl_2.2H_2O$. It combines directly with iodine. *Barium platinocyanide*, $BaPt(CN)_4.4H_2O$, is prepared by the action of baryta water on the copper salt; by dissolving platinum in barium cyanide under the influence of an alternating current; by the addition of barium cyanide to platinum bichloride; or by the simultaneous action of hydrocyanic and sulphurous acids on a mixture of baryta and chlorplatinic acid (P. Bergsoe, *Zeit. anorg. Chem.*, 1899, 19, p. 318). It crystallizes in yellow monoclinic prisms and is soluble in hot water. It is employed for the manufacture of fluorescent screens used for the detection of X-rays.

The platinum salts combine with ammonia to form numerous derivatives which can be considered as salts of characteristic bases. The first compound of this type was isolated in 1828 by Magnus, who obtained a green salt by the action of ammonia on platinum bichloride. Two series of these salts are known, one in which the metal corresponds to bivalent platinum, the other in which it corresponds to tetravalent platinum. The general formulae of the groups in each series are shown below, the method of classification being that due to Werner.

Divalent (platinous) Salts.		Tetravalent (platinic) Salts.	
		Hexammine salts	$[Pt(NH_3)_6]X_4$
Tetrammine salts	$[Pt(NH_3)_4]X_2$	Tetrammine ,,	$[Pt(NH_3)_4X_2]X_2$
Triammine ,,	$[Pt(NH_2)_3X]X$	Triammine ,,	$[Pt(NH_3)_3X_3]X$
Diammine ,,	$[Pt(NH_3)_2X_2]$	Diammine ,,	$[Pt(NH_3)_2X_4]$
Monammine ,,	$[Pt(NH_3)X_3]R$	Monammine ,,	$[Pt(NH_3)X_5]R$

In the above table X represents a monovalent acid radical and R a monovalent basic radical. For methods of preparation of salts of these series see P. T. Cleve, *Bull. soc. chim.* 1867 et seq.; S. M. Jörgensen, *Journ. prak. Chem.* 1877 et seq.; C. W. Blomstrand, *Ber.* 1871 et seq.; and A. Werner, *Zeit. anorg. Chem.* 1893 et seq. A very complete account of the method of classification and the general theory of the metal ammonia compounds is given by A. Werner, *Ber.* 1907, 40, p. 15.

Platinum also forms a series of complex phosphorus compounds. At 250° finely divided platinum and phosphorus pentachloride combine to form $PtCl_2.PCl_3$, as dark claret-coloured crystals. With chlorine this substance gives $PtCl_3.PCl_4$ as a yellow powder, and with water it yields phosphoplatinic acid, $PtCl_2.P(OH)_3$, which may be obtained as orange-red deliquescent prisms.

The atomic weight of platinum was determined by K. Seubert (*Ann.* 1888, 207, p. 1; *Ber.* 1888, 21, p. 2179) by analyses of ammonium and potassium platinochlorides, the value 194·86 being obtained.

PLATO, the great Athenian philosopher, was born in 427 B.C., and lived to the age of eighty. His literary activity may be roughly said to have extended over the first half of the 4th century B.C. His father's name was Ariston, said to have been a descendant of Codrus; and his mother's family, which claimed descent from Solon, included Critias, one of the thirty tyrants, and other well-known Athenians of the early 4th century B.C. That throughout his early manhood he was the devoted friend of Socrates, that in middle life he taught those who resorted to him in the grove named Academus, near the Cephisus, and there founded the first great philosophical school, that (with alleged interruptions) he continued to preside over the Academy until his death, are matters of established fact. It is said by Aristotle that he was at one time intimate with Cratylus the Heraclitean. Beyond this we have no authentic record of his outward life. That his name was at first Aristocles, and was changed to Plato because of the breadth of his shoulders or of his style or of his forehead, that he wrestled well,[1] that he wrote poetry[2] which he burnt on hearing Socrates, fought in three great battles,[3] that he had a thin voice, that (as is told of other Greek philosophers) he travelled to Cyrene and conversed with priests in Egypt, are statements of Diogenes Laërtius, which rest on more or less uncertain tradition. The express assertion—which this author attributes to Hermodorus—that after the death of Socrates Plato and other Socratics took refuge with Euclides in Megara, has a somewhat stronger claim to authenticity. But the fact cannot be regarded as certain, still less the elaborate inferences which have been drawn from it. The romantic legend of Plato's journeys to Sicily, and of his relations there with the younger Dionysius and the princely but unfortunate Dion, had obtained some degree of consistency before the age of Cicero, and at an unknown but probably early time was worked up into ~~the~~ so-called *Epistles* of Plato, now all but universally discredited. Nor is there sufficient ground for supposing, as some have done, that an authentic tradition is perceptible behind the myth.

Antecedent Conditions.

The later years of the Peloponnesian War witnessed much mental disturbance and restlessness at Athens. More than at any time since the age of Cleisthenes, the city was divided, and a man's foes were often men of his own tribe or deme. Contention in the law-courts and rivalries in the assembly had for many men a more absorbing interest than questions of peace and war. Hereditary traditions had relaxed their hold, and political principles were not yet formulated. Yet there was not less scope on this account for personal ambition, while the progress of democracy, the necessity of conciliating the people, and the apportionment of public offices by lot had a distracting and, to reflecting persons, often a discouraging effect. For those amongst whom Plato was brought up this effect was aggravated by the sequel of the oligarchical revolution, while, on the other hand, for some years after the restoration of the democracy, a new stimulus had been imparted, which, though of short duration, was universally felt.

These events appear in two ways to have encouraged the diffusion of ideas. The ambitious seem to have welcomed them as a means of influence, while those who turned from public life were the more stimulated to speculative disputation. However this may have been, it is manifest that before the beginning of the 4th century B.C. the intellectual atmosphere was already charged with a new force, which although essentially one may be differently described, according to the mode of its development, as (1) rhetorical and (2) theoretical and "sophistical." This last word indicates the channel through which the current influences were mostly derived. A new want, in the shape both of interested and of disinterested curiosity, had insensibly created a new profession. Men of various fatherlands, some native Athenians, but more from other parts of Hellas,[4] had set themselves to supplement the deficiencies of ordinary education, and to train men for the requirements of civic life. More or less consciously they based their teachings on the philosophical dogmas of an earlier time, when the speculations of Xenophanes, Heraclitus or Parmenides had interested only a few "wise men." Those great thoughts were now to be expounded, so that "even cobblers might understand."[5] The self-appointed teachers found a rich field and abundant harvest among the wealthier youth, to the chagrin of the old-fashioned Athenian, who sighed with Aristophanes for the good old days when men knew less and listened to their elders and obeyed the customs of their fathers. And such distrust was not wholly unfounded. For, amidst much that was graceful and improving, these novel questionings had an influence that, besides being unsettling, was aimless and unreal. A later criticism may discern in them the two great tendencies of naturalism and humanism. But it may be doubted if the sophist was himself aware of the direction of his own thoughts. For, although Prodicus or Hippias could debate a thesis and moralize with effect, they do not appear to have been capable of speculative reasoning. What passed for such was often either verbal quibbling or the pushing to an extreme of some isolated abstract notion. That *prudens quaestio* which is *dimidium scientiae* had not yet been put. And yet the hour for putting it concerning human life was fully come. For the sea on which men were drifting was profoundly troubled, and would not sink back into its former calm. Conservative reaction was not less hopeless than the dreams of theorists were mischievously wild. In random talk, with gay, irresponsible energy, the youth were debating problems which have exercised great minds in Europe through all after time.

Men's thoughts had begun to be thus disturbed and eager when Socrates (*q.v.*) arose. To understand him is the most necessary preliminary to the study of Plato. There is no reason to doubt

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[1] See *Laws*, vii. 814 C.

[2] Some epigrams in the *Anthology* are attributed to him.

[3] This is told on the authority of Aristoxenus. But Plato cannot have been at Delium.

[4] It had been the policy of Pericles to invite distinguished foreigners to Athens.

[5] *Theaet.* 180 D.

Socrates.

the general truth of the assertion, which Plato attributes to him in the *Apologia*, that he felt a divine vocation to examine himself by questioning other men. He was really doing for Athenians, whether they would or no, what the sophist professed to do for his adherents, and what such men as Protagoras and Prodicus had actually done in part. One obvious difference was that he would take no fee. But there was another and more deep-lying difference, which distinguished him not only from the contemporary sophists but from the thinkers of the previous age. This was the Socratic attitude of inquiry. The sceptical movement had confused men's notions as to the value of ethical ideas.[1] If "right is one thing in Athens and another in Sparta, why strive to follow right rather than expediency? The laws put restraint on nature, which is prior to them. Then why submit to law?" And the ingenuities of rhetoric had stirred much unmeaning disputation. Every case seemed capable of being argued in opposite ways. Even on the great question of the ultimate constitution of things, the conflicting theories of absolute immutability and eternal change appeared to be equally irrefragable and equally untenable. Men's minds had been confused by contradictory voices—one crying "All is motion," another "All is rest"; one "The absolute is unattainable," another "The relative alone is real"; some upholding a vague sentiment of traditional right, while some declared for arbitrary convention and some for the law "of nature." Some held that virtue was spontaneous, some that it was due to training, and some paradoxically denied that either vice or falsehood had any meaning. The faith of Socrates, whether instinctive or inspired, remained untroubled by these jarring tones. He did not ask "Is virtue a reality?" or "Is goodness a delusion?" But, with perfect confidence that there was an answer, he asked himself and others "What is it?" (τί ἐστι); or, more particularly, as Xenophon testifies, "What is a state? What is a statesman? What is just? What is unjust? What is government? What is it to be a ruler of men?" In this form of question, however simple, the originality of Socrates is typified; and by means of it he laid the first stone, not only of the fabric of ethical philosophy, but of scientific method, at least in ethics, logic and psychology. Socrates never doubted that if men once knew what was best, they would also do it. They erred, he thought, from not seeing the good, and not because they would not follow it if seen. This is expressed in the Socratic *dicta*: "Vice is ignorance," "Virtue is knowledge." This lifelong work of Socrates, in which the germs of ethics, psychology and logic were contained, was idealized, developed, dramatized—first embodied and then extended beyond its original scope—in the writings of Plato, which may be described as the literary outcome of the profound impression made by Socrates upon his greatest follower. These writings (in pursuance of the importance given by Socrates to conversation) are all cast in the form of imaginary dialogue. But in those which are presumably the latest in order of composition this imaginative form interferes but little with the direct expression of the philosopher's own thoughts. The many-coloured veil at first inseparable from the features is gradually worn thinner, and at last becomes almost imperceptible.

Plato's Dialogues.

Plato's philosophy, as embodied in his dialogues, has at once an intellectual and a mystical aspect; and both are dominated by a pervading ethical motive. In obeying the Socratic impulse, his speculative genius absorbed and harmonized the various conceptions which were present in contemporary thought, bringing them out of their dogmatic isolation into living correlation with one another, and with the life and experience of mankind. His poetical feeling and imagination, taking advantage of Pythagorean and Orphic suggestions, surrounded his abstract reasonings with a halo of mythology which made them more fascinating, but also more difficult for the prosaic intellect to comprehend. Convinced through the conversations of Socrates that truth and good exist and that they are inseparable, persuaded of the unity of virtue and of its dependence upon knowledge, he set forth upon a course of inquiry, in which he could not rest until the discrepancies of ordinary thinking were not only exposed but accounted for, and resolved in relation to a comprehensive theory. In this "pathway towards reality," from the consideration of particular virtues he passed to the contemplation of virtue in general, and thence to the nature of universals, and to the unity of knowledge and being. Rising still higher on the road of generalization, he discussed the problem of unity and diversity, the one and the many. But in these lofty speculations the facts of human experience were not lost to view. The one, the good, the true, is otherwise regarded by him as the moral ideal, and this is examined as realized both in the individual and in the state. Thus ethical and political speculations are combined. And as the method of inquiry is developed, the leading principles both of logic and of psychology become progressively more distinct and clear. Notwithstanding his high estimate of mathematical principles, to him the type of exactness and certitude, Plato contributed little directly to physical science. Though he speaks with sympathy and respect of Hippocrates, he had no vocation for the patient inductive observation of natural processes, through which the Coan physicians, though they obtained few lasting results, yet founded a branch of science that was destined to be beneficently fruitful. And he turned scornfully aside from the Atomists, Leucippus and Democritus, whose first principle, the basis of so much in modern physics, appeared to him to be tainted with materialism. Yet his discursive thought, as in later years he held high intercourse with Archytas and other contemporary minds, could not fail, unlike his master's, to include a theory of the *Cosmos* in its purview. In this regard, however, the poet-philosopher brought imagination to the aid of reason, thus creating a new mythology, of which the *Timaeus* is the most conspicuous example.

Amidst great diversity, both of subject and of treatment, Plato's dialogues are pervaded by two dominant motives, a passion for human improvement and a persistent faith in the power and supremacy of mind. What is commonly known as his doctrine of Ideas is only one phase in a continuous progress towards the realization of a system of philosophy in which the supreme factor is reason guiding will. But the objectivity, which from the first was characteristic of all Greek thinking, and his own power of poetic presentation, obscured for a time, even for Plato himself, the essential spirituality of his conceptions, and at one time even threatened to arrest them at a stage in which the universal was divorced from the particular, the permanent from the transient, being from becoming, and in which the first principles of reality were isolated from one another as well as from the actual world. Gradually the veil was lifted, and the relation between the senses and the intellect, phenomena and general laws, the active and the contemplative powers, came to be more clearly conceived. The true nature of abstraction and generalization, and of predication and inference, began to be discerned, and speculation was verified through experience. The ideas were seen as categories, or forms of thought, under which the infinite variety of natural processes might be comprised. And thus the dialogues present, as in a series of dissolving views, a sort of model or compendium of the history of philosophy. Plato's system is nowhere distinctly formulated, nor are the views put forward in his dialogues always consistent with each other, but much especially of his later thought is systematized, and as it were crystallized in the treatises of Aristotle; by whom the point of view which Plato had approached, but not finally attained, was made the starting-point for more precise metaphysical determinations and carried into concrete theories having the stamp of a more rigid logical method. The departments of ethics and politics, of dialectic and of psychology, of physics and metaphysics, thus came to be more clearly distinguished, but something was lost of the unity and intensity of spiritual insight which had vitalized these various elements, and fused them in a dynamic harmony.

The student of philosophy, whatever may be the modern system to which he is most inclined, sensational, intuitional, conceptional, transcendental, will find his account in returning to this well-spring of European thought, in which all previous movements are absorbed, and from which all subsequent lines of reflection may be said to diverge. As was observed by Jowett (*St Paul*, 1855), "the germs of all ideas, even of most Christian ones, are to be found in Plato."

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[1] See Caird, *Hegel*, p. 168.

Historical Influence of Plato.

Two great forces are persistent in Plato: the love of truth and zeal for human improvement. In the period culminating with the *Republic*, these two motives, the speculative and the practical, are combined in one harmonious working. In the succeeding period, without excluding one another, they operate with alternate intensity. In the varied outcome of his long literary career, the metaphysical "doctrine of ideas" which has been associated with Plato's name underwent many important changes. But pervading all these there is the same constant belief in the supremacy of reason and the identity of truth and good. From that abiding root spring forth a multitude of thoughts concerning the mind and human things—turning chiefly on the principles of psychology, education and political reform—thoughts which, although unverified, and often needing correction from experience, still constitute Plato the most fruitful of philosophical writers. While general ideas are powerful for good or ill, while abstractions are necessary to science, while mankind are apt to crave after perfection, and ideals, either in art or life, have an acknowledged value, so long the renown of Plato will continue. "All philosophic truth is Plato rightly divined; all philosophic error is Plato misunderstood"—is the verdict of one of the keenest of modern metaphysicians.[1]

Plato's followers, however, have seldom kept the proportions of his teaching. The diverse elements of his doctrine have survived the spirit that informed them. The pythagorizing mysticism of the *Timaeus* has been more prized than the subtle and clear thinking of the *Theaetetus*. Logical inquiries have been hardened into a barren ontology. Semi-mythical statements have been construed literally and mystic fancies perpetuated without the genuine thought which underlay them. A part (and not the essential part) of his philosophy has been treated as the whole. But the influence of Plato has extended far beyond the limits of the Platonic schools. The debt of Aristotle to his master has never yet been fully estimated. Zeno, Chrysippus, Epicurus borrowed from Plato more than they knew. The moral ideal of Plutarch and that of the Roman Stoics, which have both so deeply affected the modern world, could not have existed without him. Neopythagoreanism was really a crude Neoplatonism. And the Sceptics availed themselves of weapons either forged by Plato or borrowed by him from the Sophists. A wholly distinct line of infiltration is suggested by the mention of Philo and the Alexandrian school (cf. section in *Arabian Philosophy*, ii. 26bc, 9th edition), and of Clement and Origen, while Gnostic heresies and even Talmudic mysticism betray perversions of the same influence. The effect of Hellenic thought on Christian theology and on the life of Christendom is a subject for a volume, and has been pointed out in part by E. Zeller and others (cf. NEOPLATONISM). Yet when Plotinus in the 3rd century (after hearing Ammonius), amidst the revival of religious paganism, founded a new spiritualistic philosophy upon the study of Plato and Aristotle combined, this return to the fountain head had all the effect of novelty. And for more than two centuries, from Plotinus to Proclus, the great effort to base life anew on the Platonic wisdom was continued. But it was rather the ghost than the spirit of Plato that was so "unsphered." Instead of striving to reform the world, the Neoplatonist sought after a retired and cloistered virtue. Instead of vitalizing science with fresh thought, he lost hold of all reality in the contemplation of infinite unity. He had skill in dealing with abstractions, but laid a feeble hold upon the actual world.

"Hermes Trismegistus" and "Dionysius Areopagita" are names that mark the continuation of this influence into the middle ages. The pseudo-Dionysius was translated by Erigena in the 9th century.

Two more "Platonic" revivals have to be recorded—at Florence in the 15th and at Cambridge in the 17th century. Both were enthusiastic and both uncritical. The translation of the dialogues into Latin by Marsilio Ficino was the most lasting effect of the former movement, which was tinged with the unscientific ardour of the Renaissance. The preference still accorded to the *Timaeus* is a fair indication of the tendency to bring *fumum ex fulgore* which probably marred the discussions of the Florentine Academy concerning the "chief good." The new humanism had also a sentimental cast, which was alien from Plato. Yet the effect of this spirit on art and literature was very great, and may be clearly traced not only in Italian but in English poetry.

The "Cambridge Platonists" have been described by Principal Tulloch in his important work on *Rational Theology in England in the 17th century*, and again by Professor J. A. Stewart in the concluding chapter of his volume on the *Myths of Plato*. Their views were mainly due to a reaction from the philosophy of Hobbes, and were at first suggested as much by Plotinus as by Plato. It is curious to find that, just as Socrates and Ammonius (the teacher of Plotinus) left no writings, so Whichcote, the founder of this school, worked chiefly through conversation and preaching. His pupils exercised a considerable influence for good, especially on English theology; and in aspiration if not in thought they derived something from Plato, but they seem to have been incapable of separating his meaning from that of his interpreters, and Cudworth, their most consistent writer, was at once more systematic and less scientific than the Athenian philosopher. The translations of Sydenham and Taylor in the 18th century and the beginning of the 19th are proofs of the continued influence of Platonism in England.

Critical History.

The critical study of Plato begins from Schleiermacher, who did good work as an interpreter, and tried to arrange the dialogues in the order of composition. His attempt, which, like many efforts of constructive criticism, went far beyond possibility, was vitiated by the ground-fallacy of supposing that Plato had from the first a complete system in his mind which he partially and gradually revealed in writing. At a considerably later time Karl Friedrich Hermann, to whom all students of Plato are indebted, renewed the same endeavour on the far more plausible assumption that the dialogues faithfully reflect the growth of Plato's mind. But he also was too sanguine, and exaggerated the possibility of tracing a connexion between the outward events of Plato's life and the progress of his thoughts. This great question of the order of the dialogues, which has been debated by numberless writers, is one which only admits of an approximate solution. Much confusion, however, has been obviated by the hypothesis (first hinted at by Ueberweg, and since supported by Lewis Campbell and others) that the *Sophistes* and *Politicus*, whose genuineness had been called in question by Joseph Socher, are really intermediate between the *Republic* and the *Laws*. The allocation of these dialogues, not only on grounds of metaphysical criticism, but also on philological and other evidence of a more tangible kind, supplies a point of view from which it becomes possible to trace with confidence the general outlines of Plato's literary and philosophical development. Reflecting at first in various aspects the impressions received from Socrates, he is gradually touched with an inspiration which becomes his own, and which seeks utterance in half-poetical forms. Then first the ethical and by and by the metaphysical interest becomes predominant. And for a while this last is all absorbing, as he confronts the central problems which his own thoughts have raised. But, again, the hard-won acquisitions of this dialectical movement must be fused anew with imagination and applied to life. And in a final effort to use his intellectual wealth for the subvention of human need the great spirit passed away.

Order of Dialogues.

It may not be amiss to recapitulate the steps through which the above position respecting the order of the dialogues has become established. Lovers of Hegel had observed that the point reached in the *Sophistes* in defining "not being" was dialectically in advance of the *Republic*. But Kantian interpreters might obviously have said the same of the *Parmenides*: and Grote as a consistent utilitarian looked upon the *Protagoras* as the most mature production of Plato's genius. It seemed desirable to find some criterion that was not bound up with philosophical points of view. Dr Thompson, the Master of Trinity College, Cambridge, had vindicated the genuineness of the *Sophistes* against the objections of Socher, but had not accounted for the peculiarities of language, which that acute critic had perceived. By comparing those peculiarities with the style of the *Laws*, Plato's latest work, and with that of the *Timaeus* and *Critias*, which presupposed the *Republic*, Lewis Campbell argued in 1867 that the *Sophistes* and *Politicus*, with the *Philebus*, were in chronological sequence intermediate between the *Republic* and the *Laws*. Thus a further defence of their authenticity was at the same time a long step towards the solution of the problem which Schleiermacher had proposed. Many years afterwards the more detailed stylistic investigations of W. Dittenberger, Constantin Ritter and others arrived independently at the same conclusion. It was vehemently supported by W. Lutoslawski in his work on *Plato's Logic*, and has been frankly accepted with ample acknowledgments by the high authority of Dr Theodor Gomperz (see especially the Notes to his *Greek Thinkers*, iii. 310, 315 of English translation).

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[1] Ferrier, *Institutes of Metaphysics*, p. 169 (§ i. prop. vi. § 12).

THE WORKS OF PLATO

The Platonic dialogues are not merely the embodiment of the mind of Socrates and of the reflections of Plato. They are the portraiture of the highest intellectual life of Hellas in the time of Plato—a life but distantly related to military and political events, and scarcely interrupted by them. Athens appears as the centre of the excitable Hellenic mind, profoundly stirred by the arrival of great sophists, and keenly alive to the questions of Socrates, although in the pages of Plato, even more than in reality, he only "whispers with a few striplings in a corner." For, in the Platonic grouping, the agora, which was the chief scene of action for the real Socrates, retires into the background, and he is principally seen consorting with his chosen companions, who are also friends of Plato, and with the acquaintances whom he makes through them. The scene is narrowed (for the Academy was remote from the bustle of resort, and Plato judged the Hellenic world securely from the vantage-ground of partial retirement)—but the figures are distinct and full of life. In reading the dialogues we not only breathe the most refined intellectual atmosphere, but are also present witnesses of the urbanity, the freedom, the playfulness, the generous warmth of the "best society" in Athens. For Plato has a numerous repertory of *dramatis personae*, who stand in various relations to his chief character—the impetuous Chaerephon, Apollodorus the inseparable weak brother, old Crito the true-hearted, Phaedo the beloved disciple, Simmias and Cebes, who have been with Philolaus, the graceful and ingenuous Phaedrus, the petulant Philebus, Theaetetus of the philosophic nature, who is cut off in his prime, and the incorrigible Alcibiades; then Plato's own kinsmen—Glaucon the irrepressible in politics, in quarrel and in love; Adeimantus, solid and grave; Critias in his phase of amateur philosopher, and not as what he afterwards became; Charmides, not in fiery manhood, but in his first bloom of diffident youth; and many others who appear as mere acquaintances, but have an interest of their own—the accomplished Agathon, the gay Aristophanes, Eryximachus the all-worthy physician; Meno, light of spirit; Callias, entertainer of sophists; Callicles the wilful man of the world; Cephalus the aged father of Lysias; and Nicias the honoured soldier. All these appear, not as some of them do on the page of history, in sanguinary contention or fierce rivalry, but as peaceful Athenians, in momentary contact with Socrates, whose electric touch now benumbs and now exhilarates, and sometimes goads to frenzy of love or anger. Still more distantly related to him, as it were standing in an outer circle, are the imposing forms of Gorgias and Protagoras, surrounded with the lesser lights of Hippias, Prodicus and Polus. Thrasymachus, Euthydemus, Dionysodorus hang round like comic masks, adding piquancy to the design. The adversaries Anytus and Meletus are allowed to appear for a moment, but soon vanish. The older philosophers, though Socrates turned away from them, also make their entrance on the Platonic stage. Parmenides with his magnificent depth is made to converse with the imaginary Socrates, who is still quite young. A stranger from Elea plays an important part in some later dialogues, and Timaeus the Pythagorean is introduced discoursing of the creation of the world. In these dialogues Socrates is mostly silent; in the *Philebus* he has lost himself in Plato; and in the twelve books of the *Laws*, where an unnamed Athenian is the chief speaker, even the Platonic Socrates finally disappears.

Now, in evolving his philosophy from the Socratic basis, Plato works along three main lines—the ethical and political, the metaphysical or scientific, and the mystical. All three are often intimately blended, as in the close of *Rep.*, bk. vi., and even where one element is uppermost the others are not wholly suppressed. But this distinction, like that sometimes made in modern philosophy between the good, the true and the beautiful, is one which, if not unduly pressed, may be usefully borne in mind.

Having noted this once for all, we pass to the more detailed consideration of the several dialogues.

I. *Laches, Charmides, Lysis*.—In this first group Socrates is dealing tentatively with single ethical notions. The result in each case is a confession of ignorance, but the subject has been so handled as to point the way to more fruitful discussions in the future. And suggestions are casually thrown out which anticipate some of the most far-reaching of Plato's subsequent contemplations.

Laches.

The *Laches* is a vigorous sketch, in which the characters of the soldier, the aged citizen, and the prudent general are well preserved; and Socrates is seen conversing with his elders, although with reference to the treatment of the young. The question raised is the definition of courage; and the humour of the piece consists in showing that three men, all of whom are unquestionably brave, are unable to give an account of bravery, or to decide whether courage is an animal instinct or a mental accomplishment.

Charmides.

Similarly, in the dialogue which bears his name, the temperate Charmides, of whom all testify that (as Aristophanes has it),[1] he "fills up the gracious mould of modesty," is hopelessly embarrassed when challenged by the Socratic method to put in words his conception of the modesty or temperance which he possesses, and which, as Socrates assures him, is a priceless gift. The *Charmides* contains some hints of Platonic notions, such as that of knowledge as self-consciousness, and of virtue as "doing one's own business."

Lysis.

The graceful little dialogue which bears the name of *Lysis* ends, like the two former, with a confession of failure. Socrates, Lysis and Menexenus are all friends, and think highly of friendship, yet after many efforts they are unable to tell "what friendship is." Yet some of the suggestions which are here laid aside are afterwards allowed to reappear. The notion that "what is neither good nor evil loves the good because of the presence of evil" is expanded and emphasized in the *Symposium*. And the conception of an ideal object of friendship, an αὐτὸ φίλον (though rejected as in the criticism of Aristotle by the characteristic *reductio ad infinitum*), is destined to have a wider scope in the history of Platonism.

II. *Protagoras, Io, Meno*.—The previous dialogues have marked the distinction between unconscious and conscious morality, and have also brought out the Socratic tendency to identify virtue with the knowledge of good. Now, the more strongly it is felt that knowledge is inseparable from virtue the more strange and doubtful appears such unconscious excellence as that of Laches, Charmides or Lysis. Hence arises the further paradox of Socrates: "Virtue is not taught, and that which is commonly regarded as virtue springs up spontaneously or is received unconsciously by a kind of inspiration."

Protagoras, in the dialogue named after him, is the professor of popular, unscientific, self-complacent excellence; while

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[1] *Nub.*, 995, τῆς αἰδοῦς μέλλεις τἄγαλμ' ἀναπλῆσαι.

Protagoras.

Socrates appears in his life-long search after the ideal knowledge of the best. The two men are naturally at cross purposes. Protagoras contends that virtue is taught by himself and others more or less successfully, and is not one but many. Socrates disputes the possibility of teaching virtue (since all men equally profess it, and even statesmen fail to give it to their sons), but affirms that, if it can be taught, virtue is not many, but one. The discussion, as in the former dialogues, ends inconclusively. But in the course of it Plato vividly sets forth the natural opposition between the empiric and scientific points of view, between a conventional and an intellectual standard. He does full justice to the thesis of Protagoras, and it is not to be supposed that he was contented to remain in the attitude which he has here attributed to Socrates. In his ideal state, where the earlier training of the best citizens is a refinement on the actual Hellenic education, he has to some extent reconciled the conceptions which are here dramatically opposed.

The preparations for the encounter and the description of it include many life-like touches—such as the eagerness of the young Athenian gentleman to hear the sophist, though he would be ashamed to be thought a sophist himself; the confusion into which the house of Callias has been thrown by the crowd of strangers and by the self-importance of rival professors; the graceful dignity of the man who has been forty years a teacher, the graphic description of the whole scene, the characteristic speeches of Prodicus and Hippias (from which some critics have elicited a theory of their doctrines), and the continued irony with which Socrates bears them all in hand and soothes the great man after disconcerting him.

In the argument there are two points which chiefly deserve notice. (1) Protagoras, in accordance with his relative view of things (which Plato afterwards criticized in the *Theaetetus*), claims not to teach men principles but to improve them in those virtues which Providence has given in some measure to all civilized men. (2) Socrates in postulating a scientific principle, which he expressly reserves for future consideration, would have it tested by the power of calculating the amount of pleasure. Grote dwells with some complacency on the "utilitarianism" of Socrates in the *Protagoras*. And it is true that a principle of utility is here opposed to conventional sentiment. But this opposition is intended to prepare the way for the wider and deeper contrast between an arbitrary and a scientific standard, or between impressions and conceptions or ideas. And when Plato (in the *Gorgias* and *Philebus*) endeavours to define the art of measurement, which is here anticipated, it is not wonderful that differences here unthought of should come into view, or that the pleasant should be again contradistinguished from the good. In all three dialogues he is equally asserting the supremacy of reason.

On the first vision of that transcendental knowledge[1] which is to be the key at once to truth and good, philosophy is apt to lose her balance, and to look with scorn upon "the trivial round, the common task," and the respectable commonplaces of "ordinary thinking." Yet, as Socrates is reminded by Protagoras, this unconscious wisdom also has a value. And Plato, who, when most ideal, ever strives to keep touch with experience, is fully convinced of the reality of this lower truth, of this unphilosophic virtue. But he is long puzzled how to conceive of it. For, if knowledge is all in all, what are we to make of wisdom and goodness in those who do not know? Protagoras had boldly spoken of honour and right as a direct gift from Zeus, and Socrates, in the *Io* and *Meno*, is represented as adopting an hypothesis of inspiration in order to account for these unaccredited graces of the soul.

Io.

Socrates has observed that rhapsodists and even poets have no definite knowledge of the things which they so powerfully represent (cf. *Apol.* 22; *Phaed.*, 245 A.; *Rep.* iii. 398 A). He brings the rhapsode Io to admit this, and to conclude that he is the inspired medium of a magnetic influence. The Muse is the chief magnet, and the poet is the first of a series of magnetic rings. Then follow the rhapsode and the actor, who are rings of inferior power, and the last ring is the hearer or spectator.

Meno.

The *Meno* raises again the more serious question, Can virtue be taught? Socrates here states explicitly the paradox with which the *Protagoras* ended. "Virtue is knowledge; therefore virtue can be taught. But virtue is not taught. Therefore (in the highest sense) there can be no virtue." And he repeats several of his former reasons—that Athenian statesmen failed to teach their sons, and that the education given by sophists is unsatisfying. (The sophists are here denounced by Anytus, who is angered by Socrates's ironical praise of them.) But the paradox is softened in two ways: (1) the absence of knowledge does not preclude inquiry, and (2) though virtue cannot be taught, yet there is a sense in which virtue exists.

1. Meno begins in gaiety of heart to define virtue, but is soon "benumbed" by the "torpedo" shock of Socrates, and asks "How can one inquire about that which he does not know?" Socrates meets this "eristic" difficulty with the doctrine of reminiscence (ἀνάμνησις). All knowledge is latent in the mind from birth and through kindred (or association of) ideas much may be recovered, if only a beginning is made. Pindar and other poets have said that the soul is immortal and that she has passed through many previous states.[2] And Socrates now gives a practical illustration of the truth that knowledge is evolved from ignorance. He elicits, from a Greek slave of Meno's, the demonstration of a geometrical theorem.[3] About the middle of the process he turns to Meno and observes that the slave (who has made a false start) is now becoming conscious of ignorance. He then gradually draws from the man, by leading questions, the positive proof.

2. Though virtue is not yet defined, it may be affirmed "hypothetically" that, if virtue is knowledge, virtue can be taught. And experience leads us to admit two phases of virtue—the one a mode of life based on scientific principle, which hitherto is an ideal only; the other sporadic, springing of itself, yet of divine origin, relying upon true opinion, which it is, however, unable to make fast through demonstration of the cause or reason. But if there were a virtuous man who could teach virtue he would stand amongst his fellows like Teiresias amongst the shades.[4]

This mystical account of ordinary morality is in keeping with the semi-mythical defence of the process of inquiry—that all knowledge is implicit in the mind from birth.

III. *Euthyphro, Apologia, Crito, Phaedo.*—There is no ground for supposing that these four dialogues were written consecutively, or that they belong strictly to the same period of Plato's industry. But they are linked together for the reader by their common reference to the trial and death of Socrates; no one of them has been proved to be in the author's earliest or latest manner; and they may therefore fitly end the series of dialogues in which the personal traits of the historic Socrates are most apparent, and Plato's own peculiar doctrines are as yet but partially disclosed.

Euthyphro.

The little dialogue known by the name of *Euthyphro* might have been classed with the *Laches*, *Charmides* and *Lysis*, as dealing inconclusively with a single notion. But, although slight and tentative in form, it has an undertone of deeper significance, in keeping with the gravity of the occasion. Plato implies that Socrates had thought more deeply on the nature of piety than his accusers had, and also that his piety was of a higher mood than that of ordinary religious men.

Euthyphro is a soothsayer, well-disposed to Socrates, but not one of his particular friends. They meet at the door of the king Archon, whither Socrates has been summoned for the "precognition" (ἀνάκρισις) preliminary to his trial. Both men are interested in cases of alleged impiety. For Euthyphro's business is to impeach his father, who has inadvertently caused the death of a criminal labourer. The prophet feels the duty of purging the stain of blood to be more imperative the nearer home. Socrates is struck by the strong opinion thus evinced respecting the nature of piety and detains Euthyphro at the entrance of the court, that he may learn from so clear an authority "what piety is," and so be fortified against Meletus. He leads his respondent from point to point, until the doubt is raised whether God loves holiness because it is holy, or it is holy because loved by God. Does God will what is righteous, or is that righteous which is willed by God? Here they find themselves wandering round and round. Socrates proves himself an involuntary Daedalus who makes opinions move, while he seeks for one which he can "bind fast with reason."

"The holy is a portion of the just." But what portion? "Due service of the gods by prayer and sacrifice." But how does this affect the gods? "It pleases them." Again we are found to be reasoning in a circle.

"Thus far has Socrates proceeded in placing religion on a moral foundation. He is seeking to realize the harmony of religion and morality, which the great poets Aeschylus, Sophocles and Pindar had unconsciously anticipated, and which is the universal want of all men. To this the soothsayer adds the ceremonial element, 'attending upon the gods.' When further interrogated by Socrates as to the nature of this 'attention to the gods,' he replies that piety is an affair of business, a science of giving and asking and the like. Socrates points out the anthropomorphism of these notions. But when we expect him to go on and show that the true service of the gods is the service of the spirit and co-operation with them in all things true and good, he stops short; this was a lesson which the soothsayer could not have been made to understand, and which everyone must learn for himself."[1]

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[1] *Phaed.* 82 B; *Rep.* x. 619 C.

[2] The origin of this traditional belief is very obscure. The Greeks themselves were apt to associate it with Pythagoras and with the "Orphic" mysteries.

[3] *Eucl.* i. 47 (the case where the triangle is isosceles).

[4] Hom. *Odyss.* x. 495, *Οἴῳ πεπνῦσθαι, ταὶ δὲ σκιαὶ ἀΐσσουσιν.*

Apology.

In Plato's *Apology* the fate of Socrates is no longer the subject of mere allusions, such as the rage of Anytus at the end of the *Meno*, and the scene and occasion of the *Euthyphro*. He is now seen face to face with his accusers, and with his countrymen who are condemning him to death.

What most aggravated his danger (after life-long impunity) is thus stated by James Riddell, in the introduction to his edition of the dialogue: "The ἐπιείκεια" (clemency) "of the restored people did not last long, and was naturally succeeded by a sensitive and fanatical zeal for their revived political institutions. Inquiry into the foundations of civil society was obviously rather perilous for the inquirer at such a time. Socrates knew the full extent of his danger. But, according to Xenophon (*Mem.* iv. c. 8, § 14), he prepared no defence, alleging that his whole life had been a preparation for that hour."

The tone of the Platonic *Apology* is in full accordance with that saying; but it is too elaborate a work of art to be taken literally as a report of what was actually said. Jowett well compares it to "those speeches of Thucydides in which he has embodied his conception of the lofty character and policy of the great Pericles." Yet "it is significant that Plato is said to have been present at the defence, as he is also said to have been absent at the last scene of the *Phaedo*. Some of the topics may have been actually used by Socrates, and the recollection of his very words may have rung in the ears of his disciple."

The Platonic *Apology* is in three parts: (1) before conviction, (2) after conviction and before sentence, (3) after the sentence.

1. Socrates cares not for acquittal. But he does care to explain his life. And he selects those aspects of it which there is hope of making his audience understand. That he partly succeeded in this is shown by the large number of those (220 out of 500) who voted for his acquittal.

a. His answer to Meletus, as least important, is reserved for the middle of his speech. He addresses himself first to "other accusers"—comic poets and the rest, who have prejudiced his reputation by falsely identifying him with the physical philosophers and the sophists. But what then is the strange pursuit which has given to Socrates the name of wise? It is the practice of cross-examining, to which he was first impelled by the oracle at Delphi, and which he has followed ever since as a religious mission. The god said "Socrates is wise," when he was conscious of no wisdom great or small. So he went in search of some one wiser than himself, but could find none, though he found many who had conceit of wisdom. And he inferred that the god must mean "He is wisest who, like Socrates, is most aware of his own ignorance." This unceasing quest has left him in great poverty, and has made him enemies, who are represented by Anytus, Meletus and Lycon. And their enmity is further embittered by the pleasure which young men take in seeing pretence unmasked, and in imitating the process of refutation. Hence has arisen the false charge that Socrates is a corrupter of youth.

b. Here he turns to Meletus. "If I corrupt the youth, who does them good?" *Mel.* "The laws, the judges, the audience, the Athenians generally" (cf. *Protagoras* and *Meno*). "Strange, that here only should be one to corrupt and many to improve; or that any one should be so infatuated as to wish to have bad neighbours." *Mel.* "Socrates is an atheist. He believes the sun to be a stone." "You are accusing Anaxagoras. I have said that I knew nothing of such theories. And you accuse me of introducing novel notions about divine things. How can I believe in divine things (δαιμόνια) and not in divine beings (δαίμονες)? and how in divine beings, if not in gods who are their authors?"

c. That is a sufficient answer for his present accuser. He returns to the general long-standing defamation, which may well be his death, as slander has often been and again will be the death of many a man.

Yet if spared he will continue the same course of life, in spite of the danger. As at Potidaea and Delium he faced death where the Athenians posted him, so now he will remain at the post where he is stationed by the god. For to fear death is to assume pretended knowledge.

One thing is certain. A worse man cannot harm a better. But if the Athenians kill Socrates they will harm themselves. For they will lose the stimulus of his exhortations—and his poverty is a sufficient witness that he was sincere. Not that he would engage in politics. If he had done that he would have perished long before,[2] as he nearly did for his independent vote after the battle of Arginusae, and for disobeying the murderous command of the Thirty Tyrants.

But have not Socrates's disciples, Alcibiades, Critias, Charmides, proved bad citizens? He has no disciples. Any one, bad or good, may come and hear him, and the talk which is his life-work is not unamusing. But why are no witnesses brought to substantiate this charge? There are elder friends of his companions, who would be angry if he had used his influence for harm. But these men's confidence in Socrates is unshaken.

He will not appeal *ad misericordiam.* That would be a disgrace for one who (rightly or not) has been reputed wise, and to admit such an appeal in any case is a violation of the juror's oath.

Socrates has told the Athenians the whole truth, so far as a mixed audience of them could receive it. Elaboration and subtlety could have no place in addressing the Heliastic court, nor could that universal truth towards which he was leading men be made intelligible to a new audience while the clepsydra was running. But his tone and attitude must have made a strong appeal to the better nature of his hearers. With Meletus he "played rather than fought," but he has shown clearly that he has no fear of death, that he chooses to obey God rather than man, and that for very love of the Athenians he will not be swayed by their desires.

2. One convicted on a capital charge had the right of pleading before sentence in mitigation of the penalty proposed by his accuser. Socrates was convicted by fewer votes than he himself anticipated. The indictment of Meletus was ineffectual, and if it had not been for the speeches of Anytus and Lycon the defendant would have been triumphantly acquitted. Could he but have conversed with his judges more than once, he might have removed their prejudices. In no spirit of bravado, therefore, but in simple justice to himself, he meets the claim of Meletus that he shall be punished with death by the counterclaim that he shall be maintained in the prytaneum as a public benefactor. He cannot ask that death, which may be a good, shall be commuted for imprisonment or exile, which are certainly evils. A fine would be no evil: but he has no money—he can offer a mina. Here Plato and others interpose, and with their friendly help he offers thirty minae.

3. He is sentenced to death, and the public business of the court is ended. But while the record is being entered and the magistrates are thus occupied, Socrates is imagined as addressing (*a*) the majority, and (*b*) the minority in the court.

a. To those who have condemned him he speaks in a prophetic tone. "For the sake of depriving an old man of the last dregs of life they have given Athens a bad name. He would not run away, and so death has overtaken him. But his accusers are overtaken by unrighteousness, and must reap the fruits of it.

"Nor will the Athenians find the desired relief. Other reprovers, whom Socrates has hitherto restrained, will now arise, not in a friendly but in a hostile spirit. The only way for the citizens to escape reproof is to reform their lives."

b. To the minority, who would have acquitted him, he speaks with gentle solemnity. "Let them know to their comfort that the divine voice has not once checked him throughout that day. This indicates that death is not an evil. And reason shows that death is either a long untroubled sleep, or removal to a better world, where there are no unjust judges.

"No evil can happen to a good man either in life or after death. Wherefore Socrates will not be angry with his condemners, who have done him no harm, although they meant him anything but good. He will only ask of them to do to the sons of Socrates as Socrates has done to them."

Crito.

Is the love of truth consistent with civic duties? Is the philosopher a good citizen? are questions which are sure to arise where the truth involves practical improvement. In the *Apology* Socrates appears as an intrepid reformer; the *Crito* gives an impressive picture of him as a loyal and law-abiding Athenian.

Execution had been delayed during the annual mission to Delos (during which no one could be put to death). But the returning vessel had just been reported as descried from Sunium. At early dawn Crito, the oldest friend of Socrates, obtained access to his cell, and found him sleeping peacefully. Presently he awoke, and Crito told him of the approach of the fatal ship. Socrates replies by telling his dream. A fair form stood over him and said,

> "The third day hence to Phthia shalt thou come"

And it would seem that the day after to-morrow will really be the day for going home.

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[1] Jowett.

[2] Cf. *Gorg.* 521; *Rep.* vi. 496.

Crito then reveals his plan for an escape. And Socrates argues the question in the old familiar way. "Crito's zeal is excellent, and most men would think his object right. But the few who think soundly say that it is wrong to return evil for evil. The laws of Athens (through the fault of men) are doing Socrates harm. But ought he therefore to infringe the law? Might not the laws of his country plead with him and say: 'You owe to us your birth and breeding; and when grown up you voluntarily submitted to us. For you might have gone elsewhere. But you preferred us to all other laws, and have been the most constant resident in Athens. Even at the last you accepted death rather than exile. If you now break your covenant you will ruin your friends and will be rejected by all well-ordered cities. You might be received in Thessaly, but could only live there by cringing to foreigners for food. Where in that case will be your talk about virtue? You would not take your sons thither. And your friends would be equally kind to them if you were dead. Think not of life and children first and of justice afterwards, but think of justice first, that you may be justified in the world below.'"

Crito admits these arguments to be unanswerable.

Phaedo,

The *Meno* referred to the immortality and pre-existence of the soul as a traditional doctrine, and it was there associated with the possibility of inquiry. In the *Phaedo* Plato undertakes to substantiate this belief and base it anew by narrating the last hours of Socrates, who is represented as calmly discussing the question with his friends when his own death was immediately at hand. The argument turns chiefly on the eternity of knowledge, and is far from satisfying. For, granting that eternity of knowledge involves eternity of mind, does the eternity of mind assure continued being to the individual?[1] Yet no unprejudiced reader of the *Phaedo* can doubt that Plato, at the time of writing it, sincerely believed in a conscious personal existence after death. The words of Socrates, when he declares his hope of going to be with other friends, are absolutely unambiguous, and his reply to Crito's question, "How shall we bury you?" has a convincing force beyond all dialectic: "I cannot persuade Crito that I here am Socrates—I who am now reasoning and ordering discourse. He imagines Socrates to be that other, whom he will see by and by, a corpse." This and similar touches not only stamp the *Phaedo* as a marvel of art, but are indisputable evidence of the writer's profound belief. They may be inventions, but they have nothing "mythical" about them, any more than the charge of Socrates to his friends, that they would best fulfil his wishes by attending to their own lives.

The narrative, to be appreciated, must be read in full. But a short abstract of the argument may be given here.

1. Death is merely the separation of soul and body. And this is the very consummation at which philosophy aims. The body hinders thought. The mind attains to truth by retiring into herself. Through no bodily sense does she perceive justice, beauty, goodness and other ideas. The philosopher has a life-long quarrel with bodily desires, and he should welcome the release of his soul. Thus he alone can have true courage, even as temperance and all the virtues are real in him alone.

But does the soul exist after death?

a. An old tradition tells of many successive births, the soul departing to Hades and returning again, so that the living are born from the dead. And if the dead had no existence, this could not be, since from nothing nothing can arise. Moreover, experience shows that opposite states come from their opposites, and that such a process is always reciprocal. Death certainly succeeds to life. Then life must succeed to death. And that which undergoes these changes must exist through all. If the dead came from the living, and not the living from the dead, the universe would ultimately be consumed in death.

This presumption is confirmed by the doctrine (here attributed to Socrates, cf. *Meno*) that knowledge comes from recollection. What is recollected must be previously known. Now we have never since birth had intuition of the absolute equality of which (through association) we are reminded by the sight of things approximately equal. And we cannot have seen it at the moment of birth, for at what other moment can we have forgotten it? Therefore, if ideals be not vain, our souls must have existed before birth, and, according to the doctrine of opposites above stated, will have continued existence after death.

b. To charm away the fears of the "child within," Socrates adds, as further considerations:—

i. The soul is uncompounded, incorporeal, invisible, and therefore indissoluble and immutable.

ii. The soul commands, the body serves; therefore the soul is akin to the divine.

iii. Yet even the body holds together long after death, and the bones are all but indestructible.

The soul, if pure, departs to the invisible world; but, if tainted by communion with the body, she lingers hovering near the earth, and is afterwards born into the likeness of some lower form. That which true philosophy has purified alone rises ultimately to the gods. The lesson is impressively applied.

2. A pause ensues; and Simmias and Cebes are invited to express their doubts. For, as the swan dies singing, Socrates would die discoursing.

a. Simmias desires not to rest short of demonstration, though he is willing to make the highest attainable probability the guide of life.

If the soul is the harmony of the body, what becomes of her "when the lute is broken"?

b. Cebes compares the body to a garment which the soul keeps weaving at. The garment in which the weaver dies outlasts him. So the soul may have woven and worn many bodies in one lifetime, yet may perish and leave a body behind. Or even supposing her to have many lives, does even this hypothesis exempt her from ultimate decay?

Socrates warns his friends against losing faith in inquiry. Theories, like men, are disappointing; yet we should be neither misanthropists nor misologists. Then he answers his two friends.

a—i. The soul is acknowledged to be prior to the body. But no harmony is prior to the elements which are harmonized.

ii. The soul has virtue and vice, *i.e.* harmony and discord. Is there harmony of harmony? Cf. *Rep.* x. 609.

iii. All soul is equally soul, but all harmony is not equally harmonious.

iv. If the soul were the harmony of the body they would be agreed; but, as has been already shown, they are perpetually quarrelling.

v. The soul is not conditioned by the bodily elements, but has the power of controlling them.

b. Cebes has raised the wide question whether the soul is independent of generation and corruption. Socrates owns that he himself (*i.e.* Plato?) had once been fascinated by natural philosophy, and had sought to give a physical account of everything. Then, hearing out of Anaxagoras that mind was the disposer of all, he had hoped to learn not only how things were, but also why. But he found Anaxagoras forsaking his own first principle and jumbling causes with conditions. ("The cause why Socrates sits here is not a certain disposition of joints and sinews, but that he has thought best to undergo his sentence—else the joints and sinews would have been ere this, by Crito's advice, on the way to Thessaly.") Physical science never thinks of a power which orders everything for good, but expects to find another Atlas to sustain the world more strong and lasting than the reason of the best.

Socrates had turned from such philosophers and found for himself a way, not to gaze directly on the universal reason, but to seek an image of it in the world of mind, wherein are reflected the ideas, as, for example, the idea of beauty, through partaking of which beautiful things are beautiful. Assuming the existence of the ideas, he felt his way from hypothesis to hypothesis.

Now the participation of objects in ideas is in some cases essential and inseparable. Snow is essentially cold, fire hot, three odd, two even. And things thus essentially opposite are inclusive of each other's attributes. (When it was said above that opposites come from opposites, not opposite things were meant, but opposite states or conditions of one thing). Snow cannot admit heat, nor fire cold; for they are inseparable vehicles of heat and cold respectively. The soul is the inseparable vehicle of life, and therefore, by parity of reasoning, the soul cannot admit of death, but is immortal and imperishable.

3. What follows is in the true sense *mythological*, and is admitted by Socrates to be uncertain: "Howbeit, since the soul is proved to be immortal, men ought to charm their spirits with such tales."

The earth, a globe self-balanced in the midst of space, has many mansions for the soul,[2] some higher and brighter, some lower and darker than our present habitation. We who dwell about the Mediterranean Sea are like frogs at the bottom of a pool. In some higher place, under the true heaven, our souls may dwell hereafter, and see not only colours and forms in their ideal purity but truth and justice as they are.

In the *Phaedo*, more than elsewhere, Plato preaches withdrawal from the world. The Delian solemnity is to Socrates and his friends a period of "retreat," in which their eyes are turned from earthly things to dwell on the eternal. The theory of ideas here assumes its most transcendental aspect, and it is from portions of this dialogue and of the *Phaedrus* and *Timaeus* that the popular conception of Platonism has been principally derived. But to understand Plato rightly it is not enough to study isolated passages which happen to charm the imagination; nor should single expressions be interpreted without regard to the manner in which he presents the truth elsewhere.

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[1] In the *Timaeus* immortality is made to rest on the goodwill of God, because "only an evil being would wish to dissolve that which is harmonious and happy" (*Tim.* 41 A).

[2] Cf. Milton, *Il Penseroso*, 88–92—

"To unsphere
The spirit of Plato, to unfold
What worlds or what vast regions hold
The immortal mind that hath forsook
Her mansion in this fleshly nook."

It has already been shown (1) that Socratic inquiry implied a standard of truth and good, undiscovered but endlessly discoverable, and to be approached inductively; and (2) that in Plato this implicit assumption becomes explicit, in the identification of virtue with knowledge (*Lach.*, *Charm.*) as an art of measurement (*Protag.*), and in the vision (towards the end of the *Lysis*) of an absolute object of desire. The Socratic "self-knowledge" has been developed (*Charm.*) into a science of mind or consciousness, apart from which no physical studies can be fruitful. (3) Co-ordinate with these theoretical tendencies there has appeared in Plato the determination not to break with experience. In the *Phaedo*, a long step is made in the direction of pure idealism. The ordinary virtue, which in the *Protagoras* and *Meno* was questioned but not condemned, is here rejected as unreal, and the task proposed to the philosopher is less to understand the world than to escape from it. The universal has assumed the form of the ideal, which is supposed, as elsewhere in Plato, to include mathematical as well as moral notions. The only function of perception is to awaken in us some reminiscence of this ideal. By following the clue thus given, and by searching for clearer images of truth in the world of mind, we may hope to be emancipated from sensation, and to lay hold upon the sole object of pure reason.

It is obvious that when he wrote the *Phaedo* Plato conceived of universals as objective entities rather than as forms of thought. The notion of "ideal colours" (though occurring in the myth) is an indication of his ontological mood. Yet even here the εἴδη are not consistently hypostatized. The notion of "what is best" has a distinctly practical side, and the "knowledge through reminiscence" is in one aspect a process of reflection on experience, turning on the laws of association.[1] It is also said that objects "partake" of the ideas, and some concrete natures are regarded as embodiments or vehicles of some of them. Still if regarded as a whole, notwithstanding the scientific attitude of Socrates, the *Phaedo* is rather a meditation than an inquiry—a study of the soul as self-existent, and of the mind and truth as coeternal.

IV. *Symposium*, *Phaedrus*, *Cratylus*.—Socrates is again imagined as in the fullness of life. But the real Socrates is becoming more and more inextricably blended with Platonic thought and fancy. In the *Apology* there is a distinct echo of the voice of Socrates; the *Phaedo* gives many personal traits of him; but the dialogues which are now to follow are replete with original invention, based in part, no doubt, on personal recollections.

Symposium.

The *Symposium* admits both of comparison and of contrast with the *Phaedo*. Both dialogues are mystical, both are spiritual, but the spirituality in either is of a different order. That is here immanent which was there transcendent; the beautiful takes the place of the good. The world is not now to be annihilated, but rather transfigured, until particular objects are lost in universal light. Instead of flying from the region of growth and decay, the mind, through intercourse with beauty, is now the active cause of production. Yet the life of contemplation is still the highest life, and philosophy the truest μουσική.

The leading conception of the *Symposium* has been anticipated in the *Lysis*, where it was said that "the indifferent loves the good, because of the presence of evil."

The banqueters (including Socrates), who are met to celebrate the tragic victory of Agathon, happen not to be disposed for hard drinking. They send away the flute-girl and entertain each other with the praise of Love. Phaedrus tells how Love inspires to honourable deeds, and how Alcestis and Achilles died for Love. Pausanias rhetorically distinguishes the earthly from the heavenly Love. The physician Eryximachus, admitting the distinction, yet holds that Love pervades all nature, and that art consists in following the higher Love in each particular sphere. So Empedocles had spoken of Love as overcoming previous discord. For opposites cannot, as Heraclitus fancied, coexist. Aristophanes, in a comic myth, describes the origin of Love as an imperfect creature's longing for completion. The original double human beings were growing impious, and Zeus split them in twain, ever since which act the bereaved halves wander in search of one another. Agathon speaks, or rather sings, of Love and his works. He is the youngest, not the eldest of gods, living and moving delicately wherever bloom is and in the hearts of men—the author of all virtue and of all good works, obeyed by gods, fair and causing all things fair, making men to be of one mind at feasts—pilot, defender, saviour, in whose footsteps all should follow, chanting strains of love.

Socrates will not attempt to rival the poet, and begins by stipulating that he may tell the truth. He accepts the distinction between Love and his works, but points out that, since desire implies want, and the desire of Love is toward beauty, Love, as wanting beauty, is not beautiful. So much being established in the Socratic manner, he proceeds to unfold the mystery, once revealed to him by Diotima, the Mantinean wise woman. Love is neither beautiful nor ugly, neither wise nor foolish, neither god nor mortal. Between gods and mortals is the world of mediating spirits (τὸ δαιμόνιον). And Love is a great spirit, child of Resource (the son of Prudence) and Poverty the beggar maid, who conceived him at the birthday feast of Aphrodite. He is far from living "delicately," but is ragged and shoeless, always in difficulties, yet always brimming with invention, a mighty hunter after wisdom and all things fair; sometimes "all full with feasting" on them, the next moment "clean starved" for lack; never absolutely knowing nor quite ignorant. That is to say, he is a "philosopher." For knowledge is the most beautiful thing, and love is of the beautiful.

But what does love desire of the beautiful? The possession is enough. But there is one kind of love—called "being in love"—which desires beauty for a peculiar end. The lover is seeking, not his "other half," but possession of the beautiful and *birth in beauty*. For there is a season of puberty both in body and mind, when human nature longs to create, and it cannot, save in presence of beauty. This yearning is the earnest of immortality. Even in the bird's devotion to its mate and to its young there is a craving after continued being. In individual lives there is a flux, not only of the body, but in the mind. Nay the sciences themselves also come and go (here the contrast to the *Phaedo* is at its height). But in mortal things the shadow of continuity is succession.

The love of fame is a somewhat brighter image of immortality than the love of offspring. Creative souls would bring into being not children of their body, but good deeds. And such a one is readiest to fall in love with a fair mind in a fair body, and then is filled with enthusiasm and begets noble thoughts. Homer, Hesiod, Lycurgus, Solon, were such genial minds. But they stopped at the threshold (cf. *Prot.*, *Meno*), and saw not the higher mysteries, which are reserved for those who rise from noble actions, institutions, laws, to universal beauty. The true order is to advance from one to all fair forms, then to fair practices, fair thoughts, and lastly to the single thought of absolute beauty. In that communion only, beholding beauty with the eye of the mind, one shall bring forth realities and become the friend of God and be immortal, if mortal man may.

Alcibiades here breaks in and is vociferously welcomed. He is crowning Agathon, when, on perceiving Socrates, he declares that he will crown him too. Then he announces himself king of the feast, and insists upon hard drinking (though this will make no difference to Socrates). Eryximachus demands from the newcomer a speech in praise of love. But Alcibiades will praise no one else when Socrates is near. And with the freedom of one who is deep in wine he proceeds with his strange encomium of "this Marsyas." "In face and outward bearing he is like a Satyr or Silenus, and by his voice he charms more powerfully than they do by their pipings. The eloquence of Pericles has no effect in comparison with his. His words alone move Alcibiades to shame, and fascinate him until he stops his ears and runs from him."—"I often wish him dead. Yet that would break my heart. He brings me to my wit's end."—"And, as carved Sileni are made to encase images of gods, so this Silenus-mask entreasures things divine. He affects ignorance and susceptibility to beauty. Thus he mocks mankind. But he cares nothing for outward shows, and his temperance (σωφροσύνη) is wonderful." To prove this Alcibiades reveals his own heart-secret (He is not ashamed to speak it amongst others who have felt the pang which Socrates inflicts). And he makes it abundantly manifest that in their widely rumoured intercourse (cf. *Protag.* init.) Socrates had never cared for anything but what was best for his younger friend. Alcibiades then relates as an eyewitness the endurance shown by Socrates at Potidaea, his strange persistence in solitary meditation—standing absorbed in thought for a day and a night together—and his intrepid conduct in the retreat from Delium (cf. *Laches*). "The talk of Socrates is of pack-asses and cobblers, and he is ever saying the same things in the same words; but one who lifts the mask and looks within will find that no other words have meaning." Alcibiades ends by warning his companions against the wiles of Socrates.

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[1] Cf. *Theaet.* 184–186.

Some raillery follows, and they are invaded by another band of revellers, who compel them to drink still more deeply. The soberly inclined (led by Eryximachus) slink off, and Aristodemus, the reporter of the scene, only remembers further that when he awoke at cock-crow Socrates was still conversing with Agathon and Aristophanes, and showing them that tragedy and comedy were essentially one. He talked them both asleep, and at daybreak went about his usual business.

The philosopher of the *Symposium* is in the world and yet not of it, apparently yielding but really overcoming. In the *Phaedo* the soul was exhorted to "live upon her servant's loss," as in Shakespeare's most religious sonnet; this dialogue tells of a "soul within sense" in the spirit of some more recent poetry. By force of imagination rather than of reason, the reconciliation of becoming (γένεσις) with being (οὐσία), of the temporal with the eternal, is anticipated. But through the bright haze of fancy and behind the mask of irony, Socrates still appears the same strong, pure, upright and beneficent human being as in the *Apology*, *Crito* and *Phaedo*.

Phaedrus.

The impassioned contemplation of the beautiful is again imagined as the beginning of philosophy. But the "limitless ocean of beauty" is replaced by a world of supramundane forms, beheld by unembodied souls, and remembered here on earth through enthusiasm, proceeding by dialectic from multiform impressions to one rational conception, and distinguishing the "lines and veins" of truth. The *Phaedrus* records Plato's highest "hour of insight," when he willed the various tasks hereafter to be fulfilled. In it he soars to a pitch of contemplation from whence he takes a comprehensive and keen-eyed survey of the country to be explored, marking off the blind alleys and paths that lead astray, laying down the main roads and chief branches, and taking note of the erroneous wanderings of others. Reversing the vulgar adage, he flies that he may walk.

The transcendent aspiration of the *Phaedo* and the mystic glow of the *Symposium* are here combined with the notion of a scientific process. No longer asking, as in the *Protagoras*, Is virtue one or many? Plato rises to the conception of a scientific one and many, to be contemplated through dialectic—no barren abstraction, but a method of classification according to nature. This method is to be applied especially to psychology, not merely with a speculative, but also with a practical aim. For the "birth in beauty" of the *Symposium* is here developed into an art of education, of which the true rhetoric is but the means, and true statesmanship an accidental outcome.

Like all imaginative critics, Plato falls to some extent under the influence of that which he criticizes. The art of rhetoric which he so often travestied had a lasting effect upon his style. Readers of his latest works are often reminded of the mock grandiloquence of the *Phaedrus*. But in this dialogue the poetical side of his genius is at the height. Not only can he express or imitate anything, and produce any effect at will, but he is standing behind his creation and disposing it with the most perfect mastery, preserving unity amidst profuse variety, and giving harmony to a wildness bordering on the grotesque.

The person of Socrates is here deliberately modified. He no longer (as in the *Symposium*) teaches positive wisdom under the pretence of repeating what he has heard, but is himself caught by an exceptional inspiration, which is accounted for by the unusual circumstance of his finding himself in the country and alone with Phaedrus. He has been hitherto a stranger to the woods and fields, which would tempt him away from studying himself through intercourse with men. But by the promise of discourse—especially of talk with Phaedrus—he may be drawn anywhither.

Phaedrus has been charmed by a discourse of Lysias, which after some coy excuses he consents to read.

It is a frigid erotic diatribe, in which one not in love pleads for preference over the lover. Socrates hints at criticism, and is challenged to produce something better on the same theme.

1. **Distinguishing** desire from true opinion, he defines love as desire prevailing against truth, and then expatiates on the harmful tendencies of love as so defined. But he becomes alarmed at his own unwonted eloquence, and is about to remove, when the "divine token" warns him that he must first recite a "palinode" in praise of love. For no divine power can be the cause of evil.

2. Love is madness; but there is a noble madness, as is shown by soothsayers (called μάντεις from μαίνομαι). And of the higher madness there are four kinds.

To explain this it is necessary to understand psychology. The soul is self-existent and self-moving, and therefore eternal. And her form is like a pair of winged steeds with their charioteer. In divine souls both steeds are good, but in human souls one of them is bad. Now before entering the body the soul lost her wings, which in her unembodied state were nourished by beauty, wisdom, goodness, and all that is divine. For at the festival of souls, in which they visit the heaven that is above the heavens, the unruly steed caused the charioteer to see imperfectly. So the soul cast her feathers and fell down and passed into the human form. And, according to the comparative clearness or dimness of that first vision, her earthly lot is varied from that of a philosopher or artist down through nine grades (including woman) to that of a tyrant. On her conduct in this state of probation depends her condition when again born into the world. And only in ten thousand years can she return to her pristine state, except through a life of philosophy (cf. *Phaedo*) or of pure and noble love (cf. *Symposium*).

The mind of the philosopher alone has wings. He is ever being initiated into perfect mysteries, and his soul alone becomes complete. But the vulgar deem him mad and rebuke him; they do not see that he is inspired.

This divine madness (the fourth kind of those above mentioned) is kindled through the renewed vision of beauty. For wisdom is not seen; her loveliness would have been transporting if she had a visible form. The struggle of the higher passion with the lower is then described with extraordinary vividness, under the image of the two steeds. When the higher impulse triumphs the issue is a philosophic friendship, at once passionate and absolutely pure.

3. From his "palinode" Socrates returns to Lysias, who is advised to leave speech-writing for philosophy.

a. Phaedrus remarks that the speech-writer is despised by the politician. Socrates replies that speech-writing and politics are one concern. The real difference is between those who base their teaching on philosophy and those who are content with rules of art. For example, if the first speech of Socrates is compared with that of Lysias, the one is found to distinguish and define, the other not; the one observes order in discourse, the other "begins where he should end," and his utterance is like a disordered chain. A speech should be an organic whole, a "creature having hands and feet." So in the "palinode" there was a classification of the kinds of madness, which led the way to "a possibly true though partly erring myth." This approximation to truth in the midst of much that was playful was due to the observance of two principles, generalization and division (συναγωγή, διαίρεσις). Whoever sees the one and many in nature, him Socrates follows and walks in his footsteps, as if he were a god. In comparison of dialectic, as thus conceived, the frigid rules of Lysias, Thrasymachus, Theodorus, Evenus, Tisias, Gorgias, Polus and Protagoras are futile and absurd.

b. Another condition of teaching (or true rhetoric) is the science of mind. Whether the soul be one or many, complex or multiform, and if multiform what are its parts and kinds, are questions which the teacher must have already solved. And he must likewise have classified all arguments and know them in their various applicability to divers souls. An art of speaking that should fulfil this condition is non-existent. Yet how can even verisimilitude be attained without knowledge of truth?

c. The art of writing is kindred to the art of speech. But Socrates maintains that oral teaching through the living contact of mind with mind has many advantages over written composition, which is, comparatively speaking, a dead thing. Men may write for amusement or to record the intercourse that has been. But the serious occupation of the true thinker and teacher is the communication of truth through vital converse with others like-minded —the creation of "thoughts that breathe" in spirits conscious of their value.

In conclusion, a friendly hint is given to Isocrates that he may do better than Lysias if he will but turn his attention to philosophy.

The *Phaedrus* anticipates much that Plato afterwards slowly elaborated, and retains some things which he at last eliminated. (1) The presence of movement or impulse in the highest region is an aspect of truth which reappears in the *Sophistes* and other later dialogues. It has been thought strange that it should be found so early as in the *Phaedrus*. But does not this remark imply an unwarrantable assumption, viz. that Plato's idealism took its departure from the being of Parmenides? Is it not rather the fact that his own theory was formulated before the Megarian ascendancy led him to examine the Eleatic doctrine, and that it was by a tendency from the first inherent in Platonism that that doctrine was modified in his final teaching? (2) The outlines of method which are thrown out at white heat in the *Phaedrus* are a preparation for the more sober treatment of the ideas in the dialectical dialogues. In these, however, the conception of classification is somewhat altered through contact with Eleaticism. (3) The *Phaedrus* aims, not merely at realizing universals, but at grasping them in and through particulars. This is an ideal of knowledge which was "lost as soon as seen," but one which in some of his latest dialogues, such as the *Politicus* and *Philebus*, Plato again endeavoured to work out. (4) The *Phaedrus* contains the elements of that true psychology into which the ontological theory of the ideas is gradually transmuted in Plato's more advanced writings, when the difficulties of his ideal doctrine in its cruder forms have been clearly felt and understood. (5) Plato here appears as a professor of education preferring oral intercourse to authorship. In this paradox he at once exalts the work of Socrates and avows his own vocation as a teacher. The passage throws an interesting light upon the form of dialogue in which his works are cast. But it is not to be supposed that he remained long unconscious of the influence he was destined to wield by writing. In executing a great task like the *Republic*, he practically diverged from the untenable view asserted here; and in the *Laws* he recommends his longest and least dramatic work as a suitable basis for the education of the future. (6) It must always appear strange, even to those most familiar with the conditions of Hellenic life, that in portraying the idealizing power of passionate love Plato should have taken his departure from unnatural feeling.

On this subject he has sung his own "palinode" in the *Laws*, which he intended as his final legacy to mankind.[1] Not that he ceased to exalt genius and originality above mere talent, or to demand for philosophy the service of the heart as well as the head, nor yet that friendship was less valued by him in later years. All this remained unchanged. And in the *Republic* the passion of love is still distantly referred to as the symbol of ideal aspiration. But a time came when he had learned to frown on the aberration of feeling which in the *Symposium* and *Phaedrus* he appears to regard as the legitimate stimulus of intellectual enthusiasm. And already in the *Theaetetus* not love but wonder is described as the only beginning of philosophy.

While calling attention to this change of sentiment, it is right to add that Platonic love in the "erotic" dialogues of Plato is very different from what has often been so named, and that nothing even in the noble passage of the *Laws* above referred to casts the slightest shadow of blame on the Socrates of the *Symposium*. Such changes are, amongst other things, a ground for caution in comparing the two steeds of the *Phaedrus* with the spirit (*θυμός*) and desire (*ἐπιθυμία*) of the *Republic* and *Timaeus*. The *Phaedrus*, in common with these dialogues, asserts the existence of higher and lower impulses in human nature, but there is no sufficient ground for supposing that when Plato wrote the *Phaedrus* he would have defined them precisely as they are defined in the *Republic*.

Cratylus.

The *Cratylus* is full of curious interest as marking the highest point reached by the "science of language" in antiquity; but, as this dialogue "hardly derives any light from Plato's other writings,"[2] so neither does it reflect much light on them. It deals slightly with the contrast between Heracliteanism and Eleaticism, the importance of dialectic, the difficulty about the existence of falsehood, and ends with a brief allusion to the doctrine of ideas—but these topics are all more fully discussed elsewhere.

Three persons maintain different views respecting the nature and origin of language.

Hermogenes affirms that language is conventional, Cratylus (the Heraclitean) that it is natural. Socrates, mediating between these sophistical extremes, declares that language, like other institutions, is rational, and therefore (1) is based on nature, but (2) modified by convention.

In his dialectical treatment of the subject, Socrates displays a tissue of wild etymologies in reliance on the "inspiration" of Euthyphro. Presently a distinction appears between primary and secondary words. Many primary words convey the notion of movement and change. It follows that the legislator or word-maker held Heraclitean views. Socrates thus far presses on Hermogenes the view of Cratylus. Then turning to Cratylus he asks if there are no false names. "False language," Cratylus argues, "is impossible." Socrates shows that a true image may be inadequate, so that we have a right to criticize the work of the word-maker. And the facts indicate an element of meaningless convention. Nor was the original word-maker consistently Heraclitean. For some important words point not to motion but to rest.

But the question returns—Are we sure that the theory of nature which the word-maker held was true? This difficulty cannot be touched by verbal arguments. In seeking to resolve it we must consider, not words, but things. If there is a true beauty and a true good, which are immutable, and if these are accessible to knowledge, that world of truth can have nothing to do with flux and change.

V. *Gorgias*, *Republic*.—In the *Symposium* and *Phaedrus* Plato largely redeems the promise implied in the *Phaedo*, where Socrates tells his friends to look among themselves for a charmer who may soothe away the fear of death. But he was pledged also to a sterner duty by the warning of Socrates to the Athenians, in the *Apology*, that after he was gone there would arise others for their reproof more harsh than he had been. To this graver task, which he had but partially fulfilled with the light satire upon Lysias or the gentle message to Isocrates, the philosopher now directs his powers, by holding up the mirror of what ought to be against what is, the principles of truth and right against the practice of men. For the good has more than one aspect. The beautiful or noble when realized in action becomes the just. And to the question, What is just? are closely allied those other questions of Socrates—What is a state? What is it to be a statesman?

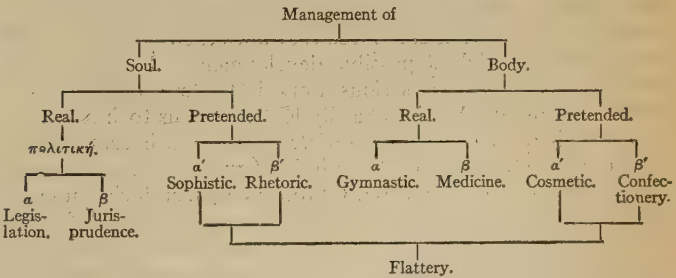
In the *Gorgias* Plato asserts the absolute supremacy of justice through the dramatic portraiture of Socrates in his opposition to the world; in the *Republic* he strives at greater length to define the nature of justice through the imaginary creation of an ideal community.

Gorgias.

In the *Gorgias* the Platonic Socrates appears in direct antagonism with the Athenian world. The shadow of his fate is impending. Chaerephon (who is still alive) understands him, but to the other interlocutors, Gorgias, Polus, Callicles, he appears perversely paradoxical. Yet he effectively dominates them all. And to the reader of the dialogue this image of "Socrates contra mundum" is hardly less impressive than that other image of Socrates confronting death.

1. Gorgias asserts that rhetoric is an art concerned with justice, and that persuasion is the secret of power.

a. Socrates, after suggesting some ironical doubts, declares his opinion that rhetoric is no art, but a knack of pleasing, or in other words "the counterfeit of a subsection of statesmanship." This oracular definition rouses the interest of Gorgias, and Socrates proceeds with the following "generalization and division":—



Flattery influences men through pleasure without knowledge. And the rhetor is a kind of confectioner, who can with difficulty be distinguished from the sophist.

b. Rhetoric, then, is not an art. And persuasion is not the secret of power. Here Socrates maintains against Polus the three paradoxes:—

The tyrant does what he chooses but not what he wishes;

It is less evil to suffer wrong than to do wrong;

It is better for the wrongdoer to be punished than to escape punishment.

The only use of rhetoric, therefore, is for self-accusation, and (if it is ever permissible to do harm) to prevent the punishment of one's enemy.

2. Callicles here loses patience and breaks in. He propounds his theory, which is based on the opposition of nature and custom.

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[1] *Laws* viii. 836.

[2] Jowett—who has, notwithstanding, thrown much light on the *Cratylus* in his brilliant introduction.

"There is no natural right but the right of the stronger. And natural nobility is to have strong passions and power to gratify them. The lawful

is a word that cowards use,
Devised at first to keep the strong in awe."

Socrates entangles him in an argument in which it is proved that pleasure is different from good, and that there are good and bad pleasures.

Now the question is whether the life of philosophy, or the life which Callicles defends, is conducive to good. And it has been shown that rhetoric is one of a class of pursuits which minister to pleasure without discriminating what is good.

Callicles again becomes impatient. Did not Themistocles, Cimon, Pericles labour for their country's good? Socrates then renews his demonstration, proving that if the just man is wronged the evil lies with the wrongdoer, not with him, and that it is worst for the wrongdoer if he escape. And for avoidance of this greatest evil not rhetoric avails anything, nor any of the arts which save life (seeing that life may be used well or ill), nor even such an art of politics as Themistocles, Cimon, or Pericles knew, but another science of politics which Socrates alone of the Athenians practises. The pursuit of it may well endanger him; but his strength lies in having done no wrong. For in the world to come he can present his soul faultless before her judge. Not the show of justice but the reality will avail him there.

This truth is enforced by an impressive myth. And Callicles is invited to leave the life which relies on rhetoric and to follow Socrates in practising the life of philosophic virtue.

Republic.

The value of justice has been shown. But what is justice? Is the life upheld by Socrates sufficiently definite for practical guidance? The views of Callicles have been overborne; but have they been thoroughly examined? Socrates claims to be the only politician. But how can that deserve the name of policy which results in doing nothing? These and cognate questions may well have haunted Plato when he planned the *Republic*, the greatest of his works. For that which lay deepest in him was not mere speculative interest or poetic fervour, but the practical enthusiasm of a reformer. The example of Socrates had fired him with an ideal of wisdom, courage, temperance and righteousness, which under various guises, both abstract and concrete, has appeared and reappeared in the preceding dialogues. But the more vividly he conceived of this ideal life, the more keenly he felt its isolation in the present world—that of the restored Athenian democracy. For to a Greek mind above all others life was nothing without the social environment, and justice, of all virtues, could least be realized apart from a community. Hence it became necessary to imagine a form of society in which the ideal man might find himself at home, a state to which the philosopher might stand in harmonious relationship, no longer as an alien sojourner, but as a native citizen, not standing aloof in lonely contemplation, but acting with the full consent of other men and ruling in the right of wisdom. Plato did not regard his own republic as a barren dream. He believed that sooner or later in the course of time a state essentially resembling his ideal commonwealth would come into being. Still more firmly was he convinced that until then mankind would not attain their highest possible development. To ignore this real aspect of his most serious work is to lose much of the author's meaning. Yet it is hardly less erroneous to interpret a great imaginative creation *au pied de la lettre*, as if examining a piece of actual legislation. Even in his *Laws*, a far more prosaic writing, Plato himself repeatedly protests against such criticism. In his most aspiring flights he is well aware of the difference between the imaginary and actual embodiment of an ideal,[1] although as a literary artist he gives to his creations, whether in anticipation or retrospect, an air of sober reality and matter-of-fact. He is more in earnest about principles than about details, and if questioned would probably be found more confident with regard to moral than to political truth. He may have been wholly unconscious of the inconsistencies of his scheme, but it would not have greatly disconcerted him to have discovered them, or to have been told that this or that arrangement would not "work." He would have trusted the correction of his own rough draft to the philosopher-kings of the future.

The *Republic* falls naturally into five portions. (1) Bk. i. is preliminary, raising the main question about justice. (2) Bks. ii., iii., iv. contain the outlines of the perfect state, including the education of the "guardians," and leading up to the definition of justice (*a*) in the state, and (*b*) in the individual. (3) Bks. v., vi., vii. (which to some critics present the appearance of an afterthought or excrescence on the original design) contain the cardinal provisions (1) of communism (for the guardians only), (2) that philosophers shall be kings, (3) of higher education for the rulers (viz. the philosopher-kings). This third provision occupies bks. vi. and vii. (which have again, as some think, the appearance of an outgrowth from bk. v.). (4) Bks. viii. and ix., resuming the general subject from bk. iv., present the reverse of the medal by showing the declension of the state and individual through four stages, until in the life of tyranny is found the image of ideal injustice, as that of justice was found in the life of the perfect state. (5) Bk. x. forms a concluding chapter, in which several of the foregoing enactments are reviewed, and the work ends, like the *Gorgias*, with a vision of judgment.

Thus the main outlines of the scheme are contained in bks. ii., iii., iv., viii., ix. And yet bks. v., vi., vii. form the central portion, a sort of inner kernel, and are of the highest significance.

In speculating about the composition of the *Republic* (as is the fashion of some interpreters) it is important to bear in mind the general character of Plato's writings.

"The conception of unity," says Jowett,[2] "really applies in very different degrees to different kinds of art—to a statue, for example, far more than to any kind of literary composition, and to some species of literature far more than to others. Nor does the dialogue appear to be a style of composition in which the requirement of unity is most stringent; nor should the idea of unity derived from one sort of art be hastily transferred to another. . . . Plato subjects himself to no rule of this sort. Like every great artist he gives unity of form to the different and apparently distracting topics which he brings together. He works freely, and is not to be supposed to have arranged every part of the dialogue before he begins to write. He fastens or weaves together the frame of his discourse loosely and imperfectly, and which is the warp and which the woof cannot always be determined."

It should be added, that as Dialectic was still a "world not realized," and he was continually conscious of using imperfect methods, he was not solicitous to bind himself to any one method, or to watch carefully over the logical coherence of his work. "Sailing with the wind of his argument," he often tacks and veers, changing his method with his subject-matter, much as a poet might adopt a change of rhythm. Absorbed as he is in each new phase of his subject, all that precedes is cancelled for the time. And much of what is to come is deliberately kept out of view, because ideas of high importance are reserved for the place where their introduction will have most effect. Another cause of apparent inconsequence in Plato is what he himself would call the use of hypothesis. He works less deductively and more from masses of generalized experience than Platonists have been ready to admit. And in the *Republic* he is as much engaged with the criticism of an actual as with the projection of an ideal condition of society. If we knew more of the working of Attic institutions as he observed them, we should often understand him better.

These general considerations should be weighed against the inequalities which have led some critics to suppose that the "first sketch of the state" in bks. ii.–iv. is much earlier than the more exalted views of bks. v.–vii.[3] If in these later books new conditions for choosing the future rulers are allowed to emerge, if in discussing the higher intellectual virtues the simple psychology of bk. iv. is lost sight of (it reappears in the *Timaeus*), if the "knowledge of the expedient" at first required falls far short of the conception of knowledge afterwards attained, all this is quite in keeping with Plato's manner elsewhere, and may be sufficiently accounted for by artistic and dialectical reserve. It can hardly be an altogether fortuitous circumstance that the culminating crisis, the third and highest "wave" of difficulty—the declaration that philosophers must be kings and kings philosophers—comes in precisely at the central point of the whole long work.

The great principle of the political supremacy of mind, though thus held back through half the dialogue, really dominates the whole. It may be read between the lines all through, even in the institution of gymnastic and the appraisement of the cardinal virtues. It is a genuine development of Socratic thought. And it is this more than any other single feature which gives the *Republic* a prophetic significance as "an attempt towards anticipating the work of future generations."[1]

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[1] See especially *Rep.* v. 472; *Legg.* v. 746.

[2] Introd. to the *Phaedrus*.

[3] Krohn, *Der platonische Staat* (Halle, 1876).

Other aspects of the great dialogue, the Dorian framework, so inevitable in the reaction from Ionian life, the traces of Pythagorean influence, the estimate of oligarchy and democracy, the characters of the interlocutors in their bearing on the exposition, have been fully treated by recent writers, and for brevity's sake are here passed over.

There are other points, however, which must not be omitted, because they are more intimately related to the general development of Plato's thoughts.

1. The question debated by Proclus has been raised before and since, whether the proper subject of the *Republic* is justice or the state. The doubt would be more suggestive if put in a somewhat different form: Is Plato more interested in the state or the individual? That he is in earnest about both, and that in his view of them they are inseparable, is an obvious answer. And it is almost a truism to say that political relations were prior to ethical in the mind of a Greek. Yet if in some passages the political analogy reacts on moral notions (as in the definition of temperance), in others the state is spoken of in language borrowed from individual life. And it remains questionable whether the ethics or the politics of the *Republic* are less complete. On the whole Plato himself seems to be conscious that the ideal derived from the life-work of Socrates could be more readily stamped on individual lives than on communities of men (see especially *Rep.* vii. 528 A, ix. 592).

2. The analogy of the individual is often used to enforce the requirement of political unity and simplicity (see especially v. 462 C). This is also to be referred, however, to Plato's general tendency to strain after abstractions. He had not yet reached a point of view from which he could look steadily on particulars in the light of universal principles. He recurs often to experience, but is soon carried off again into the abstract region which to him seemed higher and purer.[2] "It has been said that Plato flies as well as walks, but this hardly expresses the whole truth, for he flies and walks at the same time, and is in the air and on firm ground in successive instants" (Jowett). Plato's scheme of communism had been suggested to him partly by Dorian institutions and partly by the Pythagorean rule. But it was further commended by the general consideration that the state is a higher and more abstract unity than the family. The lower obligation must give way to the higher; the universal must overrule the particular bond.

3. Similarly it may be argued that, while the subordination of music to state discipline, and the importance attached to rhythm and harmony in education, had likewise a connexion with Sparta and the Pythagoreans severally, Plato's deliberate attitude towards poetry and art could hardly be other than it is. Philosophy, while still engaged in generalization, could not assign to the imagination its proper function. "Aesthetik" could not enter into her purview. For a moment, in the *Symposium*, the ancient quarrel of poetry and philosophy had seemed to be melted in a dominant tone, but this was only a fond anticipation. Plato, if man ever did so, had felt the siren charm, but he is now embarked on a more severe endeavour, and, until the supreme unity of truth and good is grasped, vagrant fancy must be subdued and silent.

4. In the early education of the guardians a place is found for the unconscious virtue acquired through habit, which the *Protagoras* and *Meno* stumbled over and the *Phaedo* treated with disdain. In the ideal state, however, this lower excellence is no longer a wild plant, springing of itself through some uncovenanted grace of inspiration, but cultivated through an education which has been purified by philosophy so as to be in harmony with reason. But if Plato were cross-questioned as to the intrinsic value of habits so induced as a preservative for his pupils against temptation, he would have replied, "I do not pretend to have removed all difficulties from their path. Enough of evil still surrounds them to test their moral strength. I have but cleared the well-springs of the noxious weeds that have been fatal to so many, in order that they may have little to unlearn, and be exposed only to such dangers as are inevitable."

5. It is a singular fact, and worth the attention of those who look for system in Plato, that the definition of justice here so laboriously wrought out, viz. the right division of labour between the three classes in the state and between the three corresponding faculties in the individual soul, is nowhere else repeated or applied, although the tripartite division of the soul recurs in the *Timaeus*, and the notion of justice is of great importance to the arguments of the *Politicus* and the *Laws*.

6. Before leaving the *Republic*, it is important to mark the stage which has now been reached by Plato's doctrine of ideas. The statements of the *Republic* on this subject are by no means everywhere consistent.

a. Towards the end of bk. v. philosophers are defined as lovers of the whole, who recognize the unity of justice, goodness, beauty, each in itself, as distinguished from the many just or good or beautiful things. The former are said to be objects of knowledge, the latter of opinion, which is intermediate between knowledge and ignorance. Knowledge is of being, ignorance of the non-existent, opinion of that which is and is not.

b. In bk. vi. there is a more elaborate statement, implying a more advanced point of view. The "contemplation of all time and all existence" is a riper conception than "the love of each thing as a whole." Ignorance and nonentity have now disappeared, and the scale is graduated from the most evanescent impression of sense to the highest reach of absolute knowledge. And in the highest region there is again a gradation, rising to the form of good, and descending from it to the true forms of all things. In the application of this scheme to the theory of education in bk. vii. there are still further refinements. The psychological analysis becomes more subtle, and more stress is laid on the connexion of ideas.

c. The doctrine reverts to a cruder aspect in bk. x., where we are told of an ideal bed, which is one only and the pattern of all the many actual beds.

d. A yet different phase of idealism presents itself in bk. ix. (*sub fin.*), in the mention of a "pattern" of the perfect state laid up in heaven which the philosopher is to make his rule of life.

What is said above concerning Plato's mode of composition has some bearing on these inconsistencies of expression. And that bks. vi., vii., as being the most important, were finished last is a not untenable hypothesis. But that Plato, in preparing the way for what he had in contemplation, should content himself with provisional expressions which he had himself outgrown, or that in a casual illustration (as in bk. x.) he should go back to a crude or even childish form of his own theory, is equally conceivable and in accordance with his manner elsewhere. Socrates in the *Parmenides* confessedly wavers on this very point. And there are "ideas" of the four elements in the *Timaeus*.

VI. *Euthydemus*, *Parmenides*, *Theaetetus*, *Sophist*, *Statesman*, *Philebus* (the dialectical dialogues).—Even in the most advanced metaphysics of the *Republic* there is a hyperbolical, transcendental tendency, from which Plato ultimately to some extent worked himself free. But it was not in conversation with "dear Glaucon," or "between the lines" of an ethico-political writing, that this partial emancipation could be effectually attained. We have now to consider a series of dialogues, probably intended for a narrower circle of readers, in which Plato grapples directly with the central difficulties of his own theory of knowing and being. It is not necessary to assume that all of these are later than the *Republic*. The position of the *Euthydemus* and *Parmenides* in the order of composition is very uncertain. The *Theaetetus* has points of affinity with the *Republic*. The *Sophist*, *Politicus* and *Philebus* are in a later style. But, on account of their cognate subject-matter, these six dialogues may be conveniently classed together in a group by themselves. And the right place for such a group is intermediate between the *Republic* and the *Laws*.

The unity of the object of definition, the identity of virtue and knowledge, the existence of an absolute good, which would be universally followed if universally known, and of a standard of truth which is implied in the confession of ignorance, were postulates underlying the Socratic process, which in so far made no claim to be a "philosophy without assumptions." These postulates, when once apprehended, drew Plato on to speculate concerning the nature, the object and the method of knowledge. Now, so far as we have hitherto followed him, his speculation has either been associated with ethical inquiry, or has been projected in a poetical and semi-mythical form. In the *Phaedrus* however, the vision of ideas was expressly conjoined with an outline of psychology and a foreshadowing of scientific method. And, while the opposition of ideas to phenomena and of knowledge to opinion has been repeatedly assumed, it has also been implied that there is a way between them, and that the truth can only be approached by man through interrogation of experience. For it is nowhere supposed that the human inquirer is from the first in a position to deduce facts from ideas. Much rather, the light of the ideas is one which fitfully breaks in upon experience as men struggle towards the universal.

But it is not less true that the metaphysical aspirations from which Socrates had seemed to recall men's thoughts had been reawakened in consequence of the impulse which Socrates himself had given. From asking, Is virtue one? Can virtue be taught? Plato passes on to ask, What is unity? What are knowledge and being? From criticizing imperfect modes of teaching virtue, he has begun to speculate about the right and wrong uses of the intellect, and from dramatic portraits of the individual Protagoras or Gorgias goes on to the ideal delineation of the sophist. He has entered upon the "longer way," and is no longer contented with mere "hypotheses." With this demand for scientific precision his conception of the ideas themselves is modified, and he strives anew to conceive of them in relation to one another, to the mind, and to the world. As the balance of ethical truth was restored by admitting an unconscious (or inspired) conformity to reason, so now a fresh attempt is made on the intellectual side to bridge the gulf between sense and knowledge.

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[1] Grote.

[2] See, for example, the admission of luxury and the after-purification through "music," bks. ii., iii.

This endeavour involves, not only an expansion of the method of Socrates, but an examination of the earlier philosophies from which Socrates had turned away. Their influence on Plato has been traceable in the preceding dialogues, though, except in the case of Pythagoreanism (*Gorg.*, *Phaed.*, *Rep.*) it has been mostly indirect and casual. But in these dialectical dialogues he manifests his serious conviction that the contemporary fallacies which formed the chief hindrance to inquiry were deeply rooted in forms of thought created by earlier thinkers, above all by Heraclitus and Parmenides. To the exclusiveness of their first principles as held by their followers Plato attributed the barrennesss and impracticable unreality of many discussions, which put shadow-fighting and controversy in the place of real investigation, and led men to think that truth was unattainable. He therefore enters into conversation, as it were, with the great minds of former times, and in the spirit of Socrates compels each of them to yield up his secret, and to acknowledge a supplemental truth. To this effort he may very probably have been stimulated by the dialectical activity of his Socratic friends at Megara, whose logical tastes had drawn them towards Eleaticism. But, unlike them, while strengthening his metaphysical theory, he was also led to give to his political speculations a more practical turn.

Euthydemus.

The *Euthydemus* is a treatise "De Sophisticis Elenchis" in the form of a farce, and may serve to introduce the five other dialogues, as the encounter with Thrasymachus introduces the serious part of the *Republic*. Under the mask of mockery there is more of concentrated thought, and also more of bitterness, in this dialogue than in the *Protagoras* or the *Gorgias*.

A sample of educational dialectic—in which Socrates draws out of young Cleinias the admissions (1) that a philosophy is needed, (2) that the highest philosophy is a science of kingcraft, which remains for the present undefined—is contrasted with a series of ridiculous sophisms, propounded by Dionysodorus and his brother Euthydemus, in which absolute and relative notions, whether affirmative or negative, object and subject, universal and particular, substance and attribute, action and modality, are capriciously confused. Crito, to whom Socrates narrates the scene, is moved to contempt. But Socrates warns him not on this account to despair of philosophy. In conclusion, Isocrates, or some one else, who prematurely mixes up philosophy with practical politics, is cautioned against spoiling two good things.

Such puzzles as—How can I learn either what I know or what I do not know?[1] How can things become what they are not? How is falsehood or denial possible?—although treated jocularly here, will be found returning afterwards to "trouble the mind's eye."

Parmenides.

Plato appears in the same act to have become aware of his affinity with Parmenides, and to have been led to reconsider the foundations of his own doctrine. The one being of Parmenides was a more abstract notion than justice, beauty or the good. And the Zenonian method had more pretension to exactness than the Socratic. But it remained barren, because contented to repeat its own first essays in the destructive analysis of experience, without rising to the examination of its own first principles. For this higher criticism, of which he himself also stood in need, Plato looks up from the disciples to the master Parmenides. The appeal to him is put into the mouth of Socrates, as a very young man, who has framed for himself a theory of ideas, and would gladly see the Zenonian process applied to the notions of sameness, difference, likeness, unlikeness, unity and being.

Parmenides, whom Plato treats with tender reverence not unmixed with irony, proposes to the youth a series of questions which reveal the crudity of the doctrine of εἴδη. (1) Are there ideas of trivial things?[2] (2) How do things "partake" of them? (3) Must not idealism proceed *in infinitum*? (4) If ideas are thoughts, do they and their participants think? (5) If they are patterns, and things resemble them, must there not be a pattern of the resemblance, and so on *in infinitum*? (6) If absolute, are they thinkable by man?

These difficulties are real, and yet to deny ideas is to destroy philosophy. (As the paradoxical doubts in the *Protagoras* do not shake the faith of Socrates in the existence of good, so neither does Plato here intend for a moment to derogate from the belief in the existence of the One and the True.)

Parmenides advises Socrates to arm himself for the further pursuit of truth (1) by the higher application and (2) by the extension or completion of the Zenonian method. (1) The method is to be applied to abstractions. (2) It is not enough to show the inferences which may be drawn from the admission of an hypothesis, but account must also be taken of the inferences which follow from its rejection.

Parmenides exemplifies his suggestion by examining his own first principle in conversation with a youth who, while a contemporary of Socrates, is a namesake of Plato's pupil Aristotle.[3] Not content with the affirmative and negative hypotheses, he pursues either along two lines, according as either term of the proposition is emphasized, and this not only as regards the hypothesis of unity, but also as applied to the alternative hypothesis of plurality. The result, as in the *Protagoras*, is purely destructive, and the dialogue ends abruptly without a word of reply from Socrates.

The second part of the *Parmenides* may be regarded as an experiment in which Plato "assays to go" in Eleatic armour. Yet the strange web is "shot" with colours of original thought. The mode of conceiving time and becoming, and the vision of nothingness towards the end, may be noted as especially Platonic. These passages may be regarded in the same light as the wise words of Protagoras or the sober truths which occur amidst the wild fancies of the *Cratylus*. They should not mislead the interpreter into a search for recondite meanings.

Theaetetus.

The Zenonian method has been carried out to the utmost in application to the highest subject, and has led the mind into a maze of contradiction. It remains to call in question the method itself, and the notion of absolute identity and difference on which it hinges, and so to lay anew the foundation-stone of thought. Before this can be attempted, however, another set of difficulties have to be met, and another set of philosophers examined. For the current scepticism had undermined the conception of knowledge as well as that of being, and the fame of Heraclitus was hardly second to that of Parmenides. Protagoras appeared in a former dialogue as the champion of ordinary morality; he is now made the exponent of ordinary thinking. His saying "Man the measure" is shown to rest on the unstable basis of the Heraclitean flux. By an elaborate criticism of both theories knowledge is at last separated from the relativity of sense; but the subsequent attempt to distinguish on abstract grounds between true and false opinion, and to define knowledge as true opinion with a reason (cf. *Meno*), proves ineffectual. Plato still shows traces of Megarian influence. But the disjunctive method of the *Parmenides* is not resumed. The indirect proofs are so arranged as to exhibit the skill of Socrates in "bringing to the birth" the germs of thought in a richly endowed and "pregnant" young mind. Theaetetus is the embodiment of the philosophic nature described in *Rep.* bk. vi., and has already been trained by Theodorus of Cyrene in geometry and the other preparatory sciences of

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[1] Cf. *Meno*.

[2] Cf. *Rep.* x. 597.

[3] Cf. the younger Socrates of the *Politicus*. It would be precarious to draw any inference from this minute fact.

Rep. bk. vii. It is in conversation with Theodorus that Socrates impressively contrasts the lives of the lawyer and the philosopher. The *Theaetetus* marks a great advance in clearness of metaphysical and psychological expression. See for example the passage (184–186) in which the independent function of the mind is asserted, and ideas are shown to be the truth of experience. There is also a distinct approach towards a critical and historical method in philosophy, while the perfection of style continues unimpaired, and the person of Socrates is as vividly represented as in any dialogue.

Notwithstanding the persistence of an indirect and negative method, the spirit of this dialogue also is the reverse of sceptical. "Socrates must assume the reality of knowledge or deny himself" (197 A). Perhaps in no metaphysical writing is the balance more firmly held between experience, imagination and reflection. Plato would seem to have made a compact with himself to abstain rigidly from snatching at the golden fruit that has so often eluded his grasp, and to content himself with laboriously "cutting steps" towards the summit that was still unscaled.

Sophist.

With Plato, as with other inventive writers, a time seems to have arrived when he desired to connect successive works in a series. Thus in planning the *Sophistes* he linked it to the *Theaetetus* (which had been written without any such intention), and projected a whole tetralogy of dialectical dialogues, *Theaetetus*, *Sophistes*, *Politicus*, *Philosophus*, of which the last piece seems never to have been written.

After an interval, of which our only measure is a change of style, the philosopher returns to the great central question of knowledge and being. The obstacle in his path, on which he has often played with light satire, dramatic portraiture and indirect allusion, is now to be made the object of a seriously planned attack. He has made his approaches, and the enemy's fortress is to be forthwith sapped and overthrown. This hostile position is not merely the "Sophistik" which, as some tell us, is an invention of the Germans, and as Plato himself declares is only the reflection or embodiment of the average mind,[1] but the fallacy of fallacies, the prime falsehood (πρῶτον ψεῦδος) of all contemporary thought. This is nothing else than the crude absoluteness of affirmation and negation which was ridiculed in the *Euthydemus*, and has been elsewhere mentioned as the first principle of the art of controversy.[2] For dramatic purposes this general error is personified. And the word "sophist," which had somehow become the *bête noire* of the Platonic school, thus for the first time fixedly acquires the significance which has since clung to the name. That Plato himself would not adhere pedantically to the connotation here implied is shown by the admission, at the opening of the dialogue, that amongst other disguises under which the philosopher walks the earth the sophist is one.

In the *Sophistes*, as in the *Parmenides*, a new method is introduced, and again by an Eleatic teacher. This method is repeated with improvements in the *Politicus*, and once more referred to in the *Philebus*. It bears a strong resemblance to the "synagogē" and "diaeresis" of the *Phaedrus*, but is applied by the "friend from Elea" with a degree of pedantry which Socrates nowhere betrays. And the two methods, although kindred, have probably come through different channels—the classifications of the *Phaedrus* being Plato's own generalization of the Socratic process, while the dichotomies of the *Sophistes* and *Politicus* are a caricature of Socrates cast in the Megarian mould. Plato seems to have regarded this method as an implement which might be used with advantage only when the cardinal principles on which it turned had been fully criticized.

1. After various attempts to "catch the sophist," he is defined as the maker of an unreal likeness of truth. Here the difficulty begins—for the definition implies the existence of the unreal, *i.e.* of not-being. In our extremity it is necessary to "lay hands on our father Parmenides."

2. The contradictions attendant on the notion of "being," whether as held by Parmenides or his opponents or by the "less exact" thinkers who came after them, are then examined, and in an extremely subtle and suggestive passage (246–249) an attempt is made to mediate between idealism and materialism. The result is that while consummate being is exempt from change it cannot be devoid of life and motion. "Like children, 'Give us both,' say we."

3. This leads up to the main question: (*a*) are different notions incommunicable, or (*b*) are all ideas indiscriminately communicable, or (*c*) is there communion of some kinds and not of others? The last view is alone tenable, and is confirmed by experience. And of the true combination and separation of kinds the philosopher is judge.

4. Then it is asked (in order to "bind the sophist") whether being is predicable of not-being.

Five chief kinds (or categories) are now examined, viz. being, rest, motion, sameness, difference. Rest and motion are mutually incommunicable, but difference is no less universal than being itself. For everything is "other" than the rest, *i.e.* is not. Thus positive and negative not only coexist but are coextensive.

5. And, in spite of Parmenides, we have discovered the existence, and also the nature, of not-being. It follows that the mere pursuit of contradictions is childish and useless and wholly incompatible with a philosophic spirit.

Negation, falsity, contradiction, are three notions which Plato from his height of abstraction does not hold apart. His position is the converse of the Spinozistic saying, "Omnis determinatio est negatio." According to him, every negative implies an affirmative. And his main point is that true negation is correlative to true affirmation, much as he has said in the *Phaedrus* that the dialectician separates kinds according to the "lines and veins of nature." The *Sophistes* is a standing protest against the error of marring the finely-graduated lineaments of truth, and so destroying the vitality of thought.

The idealists whom the Eleatic stranger treats so gently have been identified with the Megarians. But may not Plato be reflecting on a Megarian influence operating within the Academy?

Here, as partly already in the *Parmenides* and *Theaetetus*, the ideas assume the nature of categories, and being is the sum of positive attributes, while negation, as the shadow of affirmation, is likewise finally comprehended in the totality of being.

The remark made incidentally, but with intense emphasis, that the universe lives and moves "according to God,"[1] is an indication of the religious tone which reappears increasingly in the *Politicus*, *Philebus*, *Timaeus* and *Laws*.

Politicus (Statesman).

In passing on to consider the statesman, true and false, the Eleatic stranger does not forget the lesson which has just been learned. While continuing his method of dichotomies, he is careful to look on both sides of each alternative, and he no longer insists on dividing between this and not-this when another mode of classification is more natural. A rule not hitherto applied is now brought forward, the rule of proportion or right measure (τὸ μέτριον), as distinguished from arbitrary limitations. Nor is formal logical treatment any longer felt to be adequate to the subject in hand, but an elaborate myth is introduced. On the ethico-political side also a change has come over Plato. As he has stripped his ideas of transcendental imagery, so in reconsidering his philosopher-king he turns away from the smiling optimism of the *Republic* and looks for a scientific statesmanship that shall lay a strong grasp upon the actual world. He also feels more bitterly towards the demagogues and other rulers of Hellas. The author of the *Politicus* must have had some great quarrel with mankind. But so far as they will receive it he is still intent on doing them good.

1. The king is first defined as a herdsman of men, who as "slow bipeds" are distinguished from the pig and the ape. But the king is not all in all to his charges, as the herdsman is. The above definition confuses human with divine rule.

2. Now the universe is like a top, which God first winds in one direction and then leaves to spin the other way. In the former or divine cycle all was spontaneous, and mankind who had all things in common, were under the immediate care of gods. They were happy, if they used their leisure in interrogating nature. But in this reign of Zeus it is far otherwise. Men have to order their own ways and try to imitate in some far-off manner the all-but forgotten divine rule.

3. Therefore in our present definition the term "superintendent" must be substituted for "herdsman."

What special kind of superintendence is true statesmanship?

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[1] *Rep.* vi. 493.

[2] ἀντιλογική.

[1] *Soph.* 265 D.

4. By way of an example, the art of weaving is defined. The example shows that kingcraft has first to be separated from other kindred arts, both causal and co-operative. Nine categories are adduced which exhaust social functions. Eight are eliminated, and the ninth, the class of ministers, remains. Of these (*a*) slaves, (*b*) hirelings, (*c*) traders, (*d*) officials, (*e*) priests are again parted off, although the last are only with difficulty separated from the king, when (*f*) a strange medley of monstrous creatures come into view. Some are fierce like lions, some crafty like the fox, and some have mixed natures like centaurs and satyrs. These are the actual rulers of mankind, more sophistical and juggling than the sophist himself. And they too must be separated from the true king.

5. The familiar tripartite distinction of monarchy, oligarchy, democracy, is doubled by introducing into each the distinction involved in the presence or absence of wealth, and in the observance or non-observance of law. But no one of the six carries in itself a scientific principle.

The true government is the rule, not of many, but of one or of a few. "And they may govern, whether poor or rich, by free-will or compulsion, and either with or without law, so long as they govern scientifically."

6. The respondent, a youthful namesake of Socrates, is shocked at the remark that the true ruler may govern without law.

This leads to a discussion of the nature of law, which is compared to the prescription left by a physician. If present, he might dispense with his own rule. So the presence of a competent ruler is better than the sovereignty of law, which makes no allowance for nature or circumstance, but tyrannically forces its own way. Imagine medicine, navigation, &c., similarly conducted by time-honoured prescription, with penalties for innovation;—what would become of civilization? Yet if law is disregarded by rulers who are unscientific and warped by self-interest, this leads to far worse evils. For the laws are based on some experience and wisdom. Hence, in the continued absence of the true ruler, the best course, though only second best, is the strict observance of law. And he who so rules in humble imitation of the scientific governor may be truly called a king, although if the divine lawgiver were to appear his living will would supersede the law.

7. As it is, though cities survive many evils, yet many are shipwrecked because of the ignorance of those at the helm. The order of badness in the actual states is—

1. Constitutional monarchy.
2. Constitutional oligarchy.
3. Law-abiding democracy.
4. Law-breaking democracy.
5. Law-defying oligarchy.
6. Tyranny.

8. It remains to separate from the true ruler those who co-operate with him as subordinates, the general, the judge, the orator. His own peculiar function is an art of weaving strength (the warp) with gentleness (the woof), when education has prepared them—and this (1) by administration, (2) by marriage.

The four preceding dialogues have shown (1) the gradual transformation of the Platonic ideas (while still objective) into forms of thought, (2) the tendency to group them into series of categories, (3) a corresponding advance in psychological classification, (4) an increasing importance given to method, (5) the inclination to inquire into processes (γενέσεις) as well as into the nature of being.

Philebus.

Meanwhile Plato's approach to the Eleatics, though in the way of criticism, has brought into prominence the notions of unity, being, sameness, difference, and has left somewhat in abeyance the idea of good. To this "highest of all studies" Plato now returns, equipped with his improved instruments, and ready to forge new ones in the same laboratory, or in some other, should occasion serve. His converse with Parmenides ended in his assertion of an element of difference pervading all things—in other words, of an indeterminate element underlying all determinations. This brings him again into relation with the Pythagoreans, who had similarly asserted the combination of finite and infinite in the universe. Taking advantage of their help, he gains a more advanced (but still ideal) conception of the concrete harmony of things, and approaches the definition of that which in the *Republic* he but shadowed forth. With this most serious inquiry there is combined (as in the *Sophistes* and *Politicus*) an ironical and controversial use of dialectic, by which the juggler and false pretender (who is in this case the goddess of pleasure), after claiming the highest place, is thrust down to the lowest.

It must be admitted that the style of the *Philebus* is far from brilliant, or even clear. In the effort of connecting abstractions Plato's movement is more laboured than in his first glad realization of them.

Instead of attempting here to follow the windings of the dialogue, it must suffice to state the main result. Neither pleasure nor knowledge is the highest good, and the good eludes definition; but the shrine, or habitation, of the good is a complex life of which the elements are, in order of merit: (1) measure, the cause of all right mixture; (2) (*a*) beauty, the effect, and (*b*) reality, the inseparable condition; (3) intellect; (4) science, art and right opinion; (5) pure pleasure unaccompanied with pain. "Not all the animal kingdom shall induce us to put pleasure first."

The *Philebus* introduces us to the interior of the Academy in the lifetime of the master. More than any other of the dialogues it recalls Aristotle's description of Plato's teaching. But, while his followers seem early to have fallen under the dominance of the latest phase of his doctrine, Plato himself, even in the *Philebus*, is still detached from any servitude to the creations of his own mind. He manipulates them as the medium for expressing his fresh thoughts, but they are not yet crystallized into a system.

"I will remind you," Socrates, "of what has been omitted," says Protarchus at the conclusion of this dialogue. The last (presumably) of Plato's metaphysical writings thus fitly ends with a confession of incompleteness. But if, as Renan says, "the most fatal error is to believe that one serves one's country by calumniating those who founded it," neither is it for the interest of science to ignore these imperfect anticipations. By methods elaborated in the course of centuries, and far more sure than any which Plato had at his command, mankind have gained an extent of knowledge which he dreamt not of.[1] But the Greek metaphysician is none the less a pioneer of knowledge,[2] while the special sciences of ethics and psychology had been carried from infancy to adolescence in a single lifetime.

VII. *Timaeus*, *Critias* [*Hermocrates*].—As the *Sophistes* and *Politicus* were written in continuation of the *Theaetetus*, so, at some uncertain time, Plato conceived the design of writing a great trilogy, for which the ideal state depicted in the *Republic* should be the point of departure. The grand outline there sketched by Socrates was now to be filled up by Critias and Hermocrates. The form set up by reasoning should be made alive, the "airy burghers" should be seen "making history." As a prelude to this magnificent celebration, Timaeus, the Pythagorean philosopher, who is present at the Panathenaea, is invited to discourse of the origin of all things, and to bring down the glorious theme to the creation of man. What should have followed this, but is only commenced in the fragment of the *Critias*, would have been the story, not of a fall, but of the triumph of reason in humanity.

In the *Philebus* (59 A, cf. 62 D) Plato speaks with a touch of contempt of the life-long investigation of nature, as being concerned only with this visible universe, and immersed in the study of phenomena, whether past, present or to come, which admit of no stability and therefore of no certainty. "These things have no absolute first principle, and can never be the objects of reason and true science."

Yet even this lower knowledge is there admitted as an element of that life which is the habitation of the good. And there are not wanting signs in his later dialogues that Plato's imagination had again been strongly drawn towards those physical studies which, as the *Phaedo* shows, had fascinated him in youth. That nature and the world proceed "according to God and not according to chance" is the belief of the Eleatic stranger, to which he perceives that Theaetetus will be irresistibly drawn as he grows older (*Soph.* 265 D). In the midst of dialectical abstractions, the processes of actual production (γενέσεις) have been increasingly borne in mind. And the myth in the *Politicus* turns on cosmological conceptions which, although differing from those in the *Timaeus*, and more accordant with Plato's bitterest mood, yet throw a new light on the deeper current of his thoughts. In the same passage (272 C) there occurs the first clear anticipation of an *interrogatio naturae.*

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[1] See, however, *Polit.* 272 C, D.

[2] See Jowett, Introd. to the *Timaeus*.

The impulse in this new direction, if not originated, was manifestly reinforced, through closer intercourse with the Pythagorean school. And the choice of Timaeus the Pythagorean as chief speaker is an acknowledgment of this obvious tendency. If in the course of the dialogue there occur ideas apparently borrowed from the Atomists, whom Plato persistently ignored, this fact ought probably to be referred to some early reaction of Atomic on Pythagorean doctrine. It is important to observe, however, that not only the *Timaeus*, but the unfinished whole of which it forms the introduction, is professedly an imaginative creation. For the legend of prehistoric Athens and of Atlantis, whereof Critias was to relate what belonged to internal policy and Hermocrates the conduct of the war, would have been no other than a prose poem, a "mythological lie," conceived in the spirit of the *Republic*, and in the form of a fictitious narrative. And, therefore, when Timaeus professes to give only a probable account of shadowy truths, he must be taken at his word, and not criticized in too exacting a spirit. His descriptions have much the same relation to the natural philosophy of Plato's time that Milton's cosmology has to the serious investigations of Galileo or Copernicus—except that all physical speculation hitherto partook in some measure of this half-mythological character, and that Plato's mind, although working in an unfamiliar region, is still that of a speculative philosopher.

Timaeus. As Parmenides, after demonstrating the nonentity of growth and decay, was yet impelled to give some account of this nonexistent and unintelligible phenomenal world, so Plato, although warned off by Socrates, must needs attempt to give a probable and comprehensive description of the visible universe and its creation. In doing so he acknowledges an imperfect truth in theories which his dialectic had previously set aside. In examining the earlier philosophers he has already transgressed the limits prescribed by Socrates, and the effort to connect ideas has made him more and more conscious of the gap between the ideal and the actual. He cannot rest until he has done his utmost to fill up the chasm—calling in the help of imagination where reason fails him. His dominant thought is still that of a deduction from the "reason of the best," as in the *Phaedo*, or "the idea of good," as in the *Republic*. But both his abstract idealism and his absolute optimism were by this time considerably modified, and, although not confounding "causes with conditions," as he once accused Anaxagoras of doing, he yet assigns more scope to "second causes" than he would then have been willing to attribute to them. This partly comes of ripening experience and a deepening sense of the persistency of evil, and partly from the feeling—which seems to have grown upon him in later life—of the distance between God and man.

Timaeus begins by assuming (1) that the universe being corporeal is caused and had a beginning, and (2) that its mysterious author made it after an everlasting pattern. Yet, being bodily and visible, it can only be made the subject, humanly speaking, of probable discourse. Thus much being premised, he proceeds to unfold—(*a*) the work of mind in creation, (*b*) the effects of necessity, including the general and specific attributes of bodies, (*c*) the principles of physiology, and (*d*) an outline of pathology and medicine.

To give a full account of such a comprehensive treatise is beyond our scope, and the *Timaeus*, however great and interesting, has been well described as an out-building of the great fabric of original Platonism. A very few scattered observations are all that there is space for here.

a. 1. In the mythology of the *Timaeus* some of the conceptions which attained logical clearness in the *Sophist* and *Philebus* resume an ontological form. Thus, in compounding the soul-stuff of the universe, the father of all takes of the continuous and discrete and fuses them into an essence (the composite being of the *Philebus*). Again he takes of the same and other (cf. the *Sophist*), overcoming their inherent repugnance by his sovereign act.

2. The notion of an economy or reservation in Plato has been often exaggerated and misapplied. But it is difficult to acquit him of intentional obscurity in speaking of the creation of the Earth. It is clear, though Plato does not say so, that she is meant to have been created together with the Heaven and together with Time, and so before the other "gods within the heaven," *i.e.* the sun and moon and five planets, and it is a plausible supposition that she is the "artificer of day and night," by interposing her bulk to the sun's rays. If the word *ειλλομένη* in p. 40 implies motion (as Aristotle thought[1]), it cannot be, as Grote supposed, a motion consentaneous with that of the outer sphere, but either some far slower motion, perhaps assumed in order to account for the shifting of the seasons, or an equal retrograde motion which is supposed to neutralize in her case the "motion of the same." She clings to the centre, as her natural abode. And the diurnal motion of the heavens is due not to any mechanical force but to the soul of the world extending from the centre to the poles and comprehending all.

3. Immortality is in the *Timaeus* dependent on the will of the Eternal. And the sublime idea of eternity is here first formulated.

4. The phenomena of vision and hearing are included among the works of reason, because the final cause of these higher senses is to give men perception of number, through contemplation of the measures of time.

b. 1. It has been commonly said that the four elements of the *Timaeus* are geometrical figures, without content. This is not true. For what purpose does Plato introduce, "besides the archetype and the created form, a third kind, dim and hard to conceive, a sort of limbec or matrix of creation," if not to fill up the triangles which are elements of elements, and to be the vehicle of the forms compounded of them? It has been supposed that this "nurse of generation" is identical with "space," and it cannot be said that they are clearly kept apart by Plato. But he had a distinct nomenclature for either, and, although gravity is explained away (so that his molecules, unlike Clerk Maxwell's, may be called imponderable), yet extension, or the property of filling space, is sufficiently implied.

2. The difference of size in the triangles and varying sharpness of their outlines are ingenious though inadequate expedients, adopted in order to account for qualitative difference and physical change.

3. In criticizing the illusory notion of "up and down," Plato, apparently for the first time, broaches the conception of antipodes.

4. More distinctly than in the *Philebus*, bodily pleasure is explained by "a sudden and sensible return to nature" (cf. Ar. *Rhet.* i. 11, § 1; *N.E.*, vii. 10).

5. Natural philosophers are warned against experimenting on the mixture of colours, which is a divine process and forbidden to man (*Tim.* 68D). (Ancient science was at a loss for a theory of colours.)

c. 1. Plato tends more and more in his later writings to account for moral evil by physical conditions, thus arriving at the Socratic principle of the involuntariness of vice by a different road.

Hence in the *Timaeus* not the body only is made by the inferior gods, but they also create the lower and mortal parts of the human soul: the principle of anger which is planted in the breast, within hearing of reason, and that of appetite which is lodged below the diaphragm like an animal tied in a stall, with the stomach for a crib and the liver for a "soothsaying" looking-glass to soothe or terrify it when tempted to break loose.

2. The brain-pan was left bare of protecting flesh "because the sons of God who framed us deliberately chose for us a precarious life with capability of reason, in preference to a long secure existence with obstruction of thought."

3. The nails are a rudimentary provision for the lower animals, into which degenerate souls were afterwards to be transformed.

4. Vegetables have sensation but not motion.

5. By way of illustrating the very curious account here given of respiration, it is asserted that what is commonly thought to be the attraction of the magnet is really due to rotatory motion and displacement: a remarkable anticipation (*Tim.* 80C).

6. When the original particles wear out, and the bonds of soul and body in the marrow give way, the soul escapes delightedly and flies away. This is the painless death of natural decay.

d. 1. The dependence of mental disease on bodily conditions is more fully recognized in the *Timaeus* than elsewhere in Plato (contrast the *Charmides*, for example).

2. He has also changed his mind about the treatment of disease, and shows more respect for regimen and diet than in the *Republic*. Diseases are a kind of second nature, and should be treated accordingly.

3. It is also a remark in contrast with the *Republic*, that overstudy leads to head complications, which physicians ascribe to chill and find intractable.

Lastly, it is one of the strange irregularities in the composition of the *Timaeus* that the creation of woman and the relation of the sexes[2] to each other are subjects reserved to the end, because this is the place given to the lower animals, and woman (cf. the *Phaedrus*) is the first transmigration from the form of man. This order is probably not to be attributed to Plato's own thought, but to some peculiarity of Pythagorean or Orphic tradition.

VIII. *The Laws.*—The two series of dialogues, the dialectical and the imaginative—*Sophistes*, *Politicus*, *Philosophus*—*Timaeus*, *Critias*, *Hermocrates*—were left incomplete. For Plato had concentrated his declining powers, in the evening of

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[1] Aristotle, however uses *εἰλουμένη*, a different word.

[2] There is an anticipation of microscopic observation in the words *ἀόρατα ὑπὸ σμικρότητος καὶ ἀδιάπλαστα ζῷα* = spermatozoa.

Laws.

his life,[1] upon a different task. He was resolved to leave behind him, if he could so far overcome the infirmities of age,[2] a code of laws, conceived in a spirit of concession, and such as he still hoped that some Hellenic state might sanction. The motive for this great work may be gathered from the *Politicus*. The physician in departing is to give a written prescription, adapted as far as possible to the condition of those from whom he goes away. This is the second-best course, in the absence of the philosopher-king. And, as the Hellenic world will not listen to Plato's heroic remedy, he accommodates his counsel to their preconceptions. He returns once more from abstract discussions to study the application of ideas to life, and though, by the conditions of the problem, his course is "nearer earth and less in light," this long writing, which is said to have been posthumous,[3] has a peculiar interest. The ripeness of accumulated experience and the mellowness of wise contemplation make up for the loss of prophetic insight and poetic charm.

The form of dialogue is still retained, and an aged Athenian is imagined as discoursing of legislation with the Lacedaemonian Megillus and the Cretan Cleinias, who has in view the foundation of a new colony, and is on his way with his two companions from Cnossus to the temple and oracle of Zeus.

Plato now aims at moderating between Dorian and Ionian law, freely criticizing both, and refining on them from a higher point of view. "The praise of obedience, the authority assigned to elders, the prohibition of dowries, the enforcement of marriage, the common meals, the distribution and inalienability of land, the institution of the Crypteia, the freedom of bequest to a favourite son, the dislike of city walls—all reflect the custom of Sparta." . . . "The use of the lot, the scrutiny of magistrates, the monthly courses of the council, the pardon of the forgiven homicide, most of the regulations about testaments and the guardianship of orphans, the degrees of consanguinity recognized by law, correspond to Athenian laws and customs" (Jowett).

The philosopher's own thoughts come out most strongly in the "preludes" to the laws,[4] and in the regulations concerning education, marriage and the punishment of impiety (*i.e.* 1st, atheism; 2nd, denial of providence; 3rd and worst, immoral superstition). The difficulty which is met in the *Politicus* by the abandonment of the world for a time, and in the *Timaeus* by the lieutenancy of lower gods, here leads to the hypothesis of an evil soul. The priority of mind (often before asserted) and the increased importance attached to numbers are the chief indications of Plato's latest thoughts about the intelligible world. But it must be remembered that the higher education (answering to *Rep.* vi., vii.) is expressly reserved.[5] Had Plato written his own *Epinomis*, the proportions of the whole work (not then "acephalous") might have been vastly changed.

The severity of the penalties attached to the three forms of heresy, especially to the third and worst of them, has led to the remark that Plato, after asserting "liberty of prophesying," had become intolerant and bigoted in his old age (Grote). But the idea of toleration in the modern sense was never distinctly present to the mind of any ancient philosopher. And, if in the *Laws* the lines of thought have in one way hardened, there are other ways in which experience has softened them. Plato's "second-best" constitution contains a provision, which was not admissible in the "perfect state," for possible changes and readaptations in the future. The power of self-reformation is hedged round indeed with extreme precautions; and no young or middle-aged citizen is ever to hear a word said in depreciation of any jot or tittle of the existing law. But that it should be provided, however guardedly, that select commissioners, after travelling far and wide, should bring back of the fruit of their observations for the consideration of the nocturnal council, and that a power of constitutionally amending the laws should thus be admitted into the state, is sufficiently remarkable, when the would-be finality of ancient legislation is considered. Plato even comes near to the reflexion that "constitutions are not made, but grow" (iv. 709 A).

Plato in the *Laws* desists finally from impersonating Socrates. But he is in some ways nearer to his master in spirit than when he composed the *Phaedrus*. The sympathy with common life, the acceptance of Greek religion, the deepening humanity, are no less essentially Socratic than the love of truth which breathes in every page. And some particular aspects of Socratism reappear, such as the question about courage[6] and that concerning the unity of virtue.[7]

Doubtful and Spurious Works.—Of the dialogues forming part of the "Platonic canon," and not included in the preceding survey, the *Lesser Hippias*, *First Alcibiades* and *Menexenus* are the most Platonic, though probably not Plato's. The *Greater Hippias* and the *Clitophon* are also admitted to have some plausibility. The *Second-Alcibiades* (on Prayer), the *Hipparchus* (touching on Peisistratus and Homer), *Minos* ("de lege"), *Epinomis*, *Erastae*, *Theages*, are generally condemned, though most of them are very early forgeries or academic exercises.[8] And the *Axiochus* (though sometimes prized for its subject, "the contempt of death"), the *De justo*, *De virtute*, *Demodocus*, *Sisyphus*, *Eryxias* (a not-uninteresting treatise on the use of money), together with the so-called *Definitions*, were rejected in ancient times, and are marked as spurious in the MSS.

EDITIONS.—(1) Complete: Aldine, Ven., 1513; H. Stephanus, 3 vols. (1578), with Latin version by Serranus (*i.e.* De Serre, the real editor), (the paging of this edition is preserved for convenience of reference on the margins of most subsequent editions); G. Stallbaum, (12 vols., 1821–1825); G. Stallbaum, the text in 1 vol. (1850); C. F. Hermann (6 vols., 1851–1853); Immanuel Bekker (1816–1823); the Zurich edition by Baiter, Orelli and Winkelmann (1839–1842); Hirschig and Schneider, in Didot's series (1856–1873); M. von Schanz, with critical notes (1875–1887); J. Burnet (Oxford, 1902). (2) Partial: L. F. Heindorf, *Lysis, Charmides, Hippias Major, Phaedrus, Gorgias, Theaetetus, Cratylus, Parmenides, Euthydemus, Phaedo, Sophist, Protagoras*; *Philebus*, C. Badham, E. Poste (1861), R. G. Bury; *Apologia*, J. Riddell (with *Digest of Platonic Idioms*) (1861); *Protagoras*, Wayte (1854) 1871; *Theaetetus*, L. Campbell (1861) 1883, B. Kennedy; *Sophist* and *Politicus*, L. Campbell (1867); *Phaedo*, W. Geddes, Archer Hind; *Timaeus*, Archer Hind (1888); *Parmenides*, Waddell (1894); *Meno*, J. Adam, Seymer Thompson; *Apologia, Crito, Meno*, St G. Stock; *Euthydemus*, Gifford; *Phaedrus, Gorgias*, W. H. Thompson; *Symposium, Euthydemus, Laches*, C. Badham; *Parmenides*, Stallbaum, Maguire, Waddell; *Leges*, F. Ast (1814), C. Ritter (*Commentary*) (1896); *Republic*, Jowett and Campbell (1894), J. Adam (1902).

TRANSLATIONS.—Latin: A Latin version of the *Timaeus* by Chalcidius existed in the middle ages and was known to Dante. It was printed at Paris in 1520 (Teubner, 1876). The complete rendering by Marsiglio Ficino (1496) formed the basis of other Latin translations, such as that of Serranus (*supra*), which accompanied the edition of Stephanus. It was printed in the Basel edition of 1534. English: (1) Complete: Sydenham and Taylor (1804); Jowett (1871–1892). (2) Partial: *Republic*, Davies and Vaughan, Jowett (in a separate volume; 3rd ed., 2 vols., 1908); *Philebus*, E. Poste; *Georgias*, Cope; *Timaeus*, Archer Hind (in his edition); *Apology, Crito, Phaedo*, Church, Jowett (reprinted from the complete translation with preface by E. Caird); *Theaetetus*, Paley, Kennedy; German: Schleiermacher (1817–1828), J. H. Müller (1850–1866); French: V. Cousin (13 vols., 1822–1840). Italian: Bonghi.

DISSERTATIONS.—English: F. Schleiermacher's *Introductions*, translated by W. Dobson (1836); Ed. Zeller's *Plato and the Older Academy*, translated by F. Alleyne, &c. (1876); B. Jowett's *Introductions*, in his complete translation, final edition (1892); G. Grote, *Plato and the other Companions of Socrates* (1865); F. C. Conybeare on an Armenian version (1891); W. Pater, *Plato and Platonism* (1893); R. L. Nettleship, *Lectures on the Republic*, &c. (1898) (cf. also his essay in *Hellenica*, 1880); Th. Gomperz, *Greek Thinkers*, vols. ii. and iii. in Eng. trans. (1905); W. Lutoslawski, *Plato's Logic*, &c.; L. Campbell on *Plato's Republic* in Murray's "Home and School Series" (1902); L. Campbell, *Religion in Greek Literature* (London, 1898); J. A. Stewart, *The Myths of Plato* (1905); A. E. Taylor, *Plato* (1908); J. A. Stewart, *Plato's Doctrine of Ideas* (1909). German:

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[1] *ἡμεῖς δ' ἐν δυσμαῖς τοῦ βίου*, *Legg.* vi. 770 A.

[2] *ἄν . . . γήρως ἐπικρατῶμεν γε τοσοῦτον*, *Legg.* vi. 752 A.

[3] Published by Philippus the Opuntian.

[4] See especially iv. 716 seq.; v. 727 seq.; 735 seq.; vi. 766; vii. 773 seq., 777, 794, 803 seq., 811, 817; viii. 835 seq.; ix. 875; x. 887 seq. 897 seq., 904 seq.

[5] *Legg.* xii. 968 E. (Ath.) "I am willing to share with you the danger of stating to you my views about education and nurture, which is the question coming to the surface again."

[6] Cf. *Laches*.

[7] Cf. *Protagoras*.

[8] According to Schaarschmidt, only nine dialogues are genuine—*Protag., Phaedr., Symp., Apol., Crito, Phaedo, Rep., Tim., Leges.*

C. F. Hermann, *Geschichte und System*, &c. (1839); A. Boeckh, *Untersuchungen* (1852); Ed. Zeller, *Geschichte der gr. Philosophie*; Fr. Überweg, *Untersuchungen* (1861); S. Ribbing, *Genetische Darstellung* (1863); Fr. Susemihl, *Genetische Entwicklung* (1855–1898); E. Alberti, *Geist und Ordnung* (1864); C. Schaarschmidt, *Die Sammlung der platonischen Schriften* (1866); M. Vermehren, *Plat. Studien* (1870); D. Peipers, *Untersuchungen über das System Platons*. Teil i., "Die Erkenntnisstheorie" (Leipzig, 1874); O. Apelt, *Beiträge zur Geschichte der griechischen Philosophien*; L. Spengel, *Isocrates und Platon* (1863); A. Krohn, *Die platonische Frage* (1878); E. Teichmüller, *Literarische Fehder* (1881); H. Bonitz, *Platonische Studien* (especially valuable) (1886); E. Pfleiderer, *Socrates und Platon* (1896); H. Windenband, *Platon* (1900); C. Ritter, *Untersuchungen*; Th. Gomperz, *Platonische Aufsätze*: *Griechische Denker*, vol. ii.; P. Natorp, *Pl. Ideenlehre* (1903); C. Ritter, *Platon: sein Leben, seine Schriften, seine Lehre* (1909), vol. i.; and *Neue Untersuchungen* (1910). Other references will be found in the volumes named. French: V. Cousin; T. H. Martin, *Études sur la Timée* (1841). Italian: Felice Tocco.

Dictionaries and Indices.—Mitchell's *Index to Plato*; F. Ast, *Lexicon platonicum*; E. Abbott, *Index to Plato* (English, 1875).

On the MSS.—See especially Bekker's edition; Gaisford's *Lectiones platonicae* (1820); M. Schanz's edition with critical notes; Jowett and Campbell's *Republic*, vol. ii.; J. Burnett's Oxford edition. The important *Codex Clarkianus* in the Bodleian library has been reproduced in facsimile, with a preface by T. W. Allen (1898–1899). (L. C.)

PLATO, Athenian comic poet of the Old Comedy, flourished between 428–389 B.C. According to Suïdas, he was the author of thirty comedies. Some of these deal with political matters. Such were the *Cleophon* and *Hyperbolus*, directed against the well-known demagogues, and the *Symmachia*, referring to a coalition formed by Nicias, Alcibiades and Phaeax to get rid of Hyperbolus by ostracism. His later plays treat the vices and failings of mankind in the spirit of burlesque and parody. Such were the *Sophistae*, akin to the *Clouds* of Aristophanes; the *Cinesias*, an attack on a contemporary poet; the *Festivals*, satirizing the useless expenditure and extravagance common on such occasions; mythological subjects—*Adonis*, *Europe*, *Io*, the *Ants* (on the Aeginetan legend of the change of ants into men); *Phaon*, the story of the Lesbian ferryman, who was presented by Aphrodite with a marvellous ointment, the use of which made women madly in love with him.

See T. Kock, *Comicorum atticorum fragmenta*, i. (1880); A. Meineke, *Poetarum comicorum graecorum fragmenta* (1855).

PLATON, LEVSHIN (1737–1812), Russian divine, was born at Chashnikovo near Moscow, and educated in the academy of that city. In 1763 the empress Catherine II. invited him to instruct her son Paul in theology, and he became one of the court chaplains. Three years afterwards Platon was appointed archimandrite of the monastery of the Trinity (Troitskaya Lavra) near Moscow, in 1770 archbishop of Tver, and in 1787 archbishop of Moscow and metropolitan. He died in 1812, one of his last acts having been to write an encouraging letter to the emperor Alexander I. in view of the French invasion. Platon was a brilliant and learned man, and the author of several works which enjoyed a high reputation in their time, including *A Short History of the Russian Church*, which has been translated into English.

PLATONIC LOVE, a term commonly applied to an affectionate relation between a man and a woman into which the sexual element does not enter. The term in English goes back as far as Sir William Davenant's *Platonic Lovers* (1636). It is derived from the conception, in Plato's *Symposium*, of the love of the idea of good which lies at the root of all virtue and truth. *Amor platonicus* was used, *e.g.* by Marsilio Ficino (15th century), as a synonym for *amor socraticus*, referring to the affection which subsisted between Socrates and his pupils.

PLATOON (Fr. *peloton*, from Fr. *pelote*, a ball or pellet; cf. Ger. *Haufe*, heap), a small group of soldiers. In the early 17th century it was a definite tactical unit of infantry, corresponding to the modern section or half company. In the 18th century the battalion, irrespective of its organization into companies, was told off on parade into six, eight or ten platoons of equal strength. "Platoon fire" was the systematic and regulated fire of platoon volleys, the platoons firing one after the other. Hence a "platoon" sometimes means a volley. The fire of a long line of infantry was as a rule conducted on the same principles, each battalion of the front line employing platoon fire, which is often picturesquely described as a "rolling platoon fire," or "rolling volleys." The word is obsolete in the British army, but is used in the United States, and, in various forms, in the armies of France and other Latin nations.

PLATT, THOMAS COLLIER (1833–1910), American politician, was born in Owego, Tioga county, New York, on the 15th of July 1833. He studied in 1849–1852 at Yale, from which he received the honorary degree of A.M. in 1876. He made money in lumbering out West, and returning to Owego became a banker and railway director. He helped to organize its Republican party in Tioga county, and in 1873–1877 was a representative in Congress. In 1877 he was chairman of the state Republican Convention at Rochester. On the 18th of January 1881 he was elected United States senator, but resigned, with his colleague, Roscoe Conkling, on the 16th of May following, chiefly because President Garfield, in spite of their protest, had appointed as collector of the port of New York, Judge William H. Robertson, a political opponent. Within ten years he became the acknowledged Republican "boss" of the state, and he again served in the United States Senate from 1897 to 1909. But his power waned steadily after about 1903. He died in New York City on the 6th of March 1910.

PLATTE (so named, from the French, because of its shallowness), or Nebraska, a river system of Colorado, Wyoming and Nebraska, tributary to the Missouri river, which it enters immediately north of Plattsmouth, Nebraska, 18 m. below Omaha, in about 41° 3′ N. lat. Including the North Platte it is about 900 m. long from its headwaters, with a drainage basin for the entire system of 90,000 sq. m. The Platte proper is formed by the junction of the North Platte and the South Platte, sometimes called the North and South Forks of the Platte, immediately below the city of North Platte in Lincoln county, Nebraska. The North Platte and South Platte rise respectively in North Park and South Park in Colorado. The tributaries of the main stream all flow in from the north; the most important being the Loup, which empties immediately east of Columbus in Platte county, and the Elkhorn, which joins the Platte in Douglas county, due west of Omaha.

See J. C. Stevens, *Surface Water Supply of Nebraska* (Washington, 1909).

PLATTNER, KARL FRIEDRICH (1800–1858), German metallurgical chemist, was born at Kleinwaltersdorf, near Freiberg in Saxony, on the 2nd of January, 1800. His father, though only a poor working miner, found the means to have him educated first at the Bergschule and then at the Bergakademie of Freiberg, and after he had completed his courses there in 1820 he obtained employment, chiefly as assayer, in connexion with the royal mines and metal works. Having taken up the idea of quantitative mouth-blowpipe assaying, which was then almost unknown—except that E. Harkort (1797–1835) in 1827, while a student in Freiberg Academy, had worked out a blowpipe assay for silver—he succeeded in devising trustworthy methods for all the ordinary useful metals; in particular his modes of assaying for nickel and cobalt quickly found favour with metallurgists. He also devoted himself to the improvement of qualitative blowpipe analysis, and summed up his experience in a treatise *Die Probierkunst mit dem Löthrohr* (1835), which became a standard authority. In 1840 he was made chief of the royal department of assaying. Two years later he was deputed to complete a course of lectures on metallurgy at the Bergakademie in place of W. A. Lampadius (1772–1842), whom he subsequently succeeded as professor. He died at Freiberg on the 22nd of January 1858.

In addition to many memoirs on metallurgical subjects he also published *Die metallurgischen Rostprocesse theoretisch betrachtet* (1856), and posthumously *Vorlesungen über allgemeine Hüttenkunde* (1860).

PLATTSBURG, a city, port of entry and the county-seat of Clinton county, New York, U.S.A., situated on the west shore of Lake Champlain, at the mouth of the Saranac river, 168 m.

(by rail) N.N.E. of Albany. Pop. (1890), 7010; (1900), 8434, of whom 1053 were foreign-born; (1910, census), 11,138. It is served by the Delaware & Hudson railway, and has steamer connexions with lake ports. Its situation in the region of lakes and mountains and its delightful climate have made it a summer resort. Among its institutions are the Samuel F. Vilas Home (for aged and infirm women); the Home for the Friendless of Northern New York (1874), for the care of homeless children; the Plattsburg State Normal and Training School, the D'Youville Academy for girls (founded in 1860, chartered in 1871), under the direction of the Grey Nuns; the Collège St Pierre (Roman Catholic, 1903), and the Champlain Valley Hospital. The barracks, about a mile away, is an important military post. Cliff Haven, 2 m. south, is the seat of the Catholic summer school. Plattsburg has a fine harbour and is the port of entry of the Champlain customs district; in 1909 its exports were valued at $15,169,502 and its imports at $8,167,527. Among the city's manufactures are lumber, wood pulp, paper, shirts, sewing-machines and automobiles. The total value of the factory products in 1905 was $1,056,702.

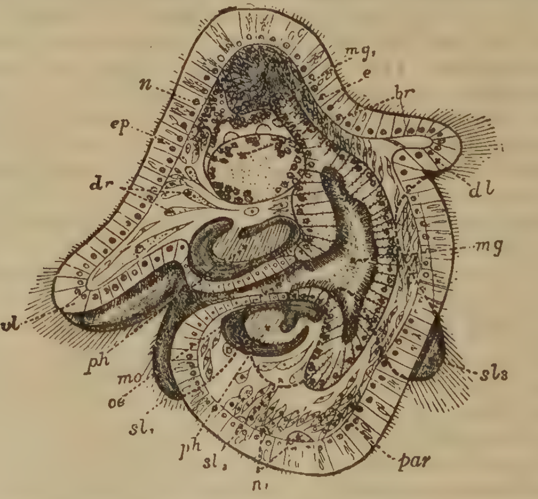
Plattsburg was incorporated as a village in 1795, and derived its name from Zephaniah Platt (1740–1807), who had led a colony of settlers to this place from Long Island; it became a city in 1902. About Valcour Island (5 m. south-east of Plattsburg), on the 11th of October 1776, a British fleet under Captain Thomas Pringle and an American flotilla under Benedict Arnold engaged in the first conflict between American and British fleets, the British being victorious. On the outbreak of the War of 1812 the village became the headquarters of the American army on the northern frontier. On the 11th of September 1814, in Plattsburg (or Cumberland) Bay, Captain George Downie, commanding a British flotilla, was defeated by an American flotilla commanded by Commodore Thomas Macdonough, losing his life in the engagement (see CHAMPLAIN, LAKE).

PLATTSMOUTH, a city and the county-seat of Cass county, Nebraska, U.S.A., situated in the valley and on the bluffs of the Missouri river near the mouth of the Platte. Pop. (1900), 4964 (979 foreign-born); (1910) 4287. It is served by the Chicago, Burlington & Quincy, and the Missouri Pacific railway systems. There are railway car-shops, and a considerable trade is done in grain and cattle. A trading-post licensed by the United States government was opened here in 1853, and a town platted in 1854. Plattsmouth was first incorporated as a city in 1855, being one of the oldest settlements and cities of the state.

PLATYELMIA, a phylum of the animal kingdom which comprises three classes, the Planarians, Trematodes (*q.v.*) and Cestodes. It is the group of animals in which the act of creeping has first become habitual. In association with this movement in a definite direction the body has become vermiform and bilaterally symmetrical. One end of the body, through contact, during locomotion, with fresh tracts of medium and other forms of stimuli, has become more specialized than the rest, and here the nervous system and sense-organs are more densely aggregated than elsewhere, forming a means of controlling locomotion and of correlating the activities of the inner organs with the varying stimuli that impinge upon the body. The form and habits of the group vary widely. The Planarians are free-living animals, the Trematodes are parasitic upon and within animals, and the Cestodes are wholly endoparasitic.

Structure.—The chief features which Platyelmia possess in common are the following. The body is not metamerically segmented and is composed of a muscular tunic covered externally by a more or less modified cellular layer. Within this muscular tube lies a parenchymatous tissue which may be uniform (Cestodes) or differentiated into a central or digestive, and a peripheral portion (some Turbellaria), or finally the central portion becomes tubular and forms the digestive sac (Trematodes), while the peripheral portion is separated from it by a space lined in some forms by a flattened epithelium (most Planarians). It is characteristic of the group that the mouth should be the only means of ingress to and egress from the digestive sac and that no true perivisceral space or coelom exists in the sense in which these terms are used in higher Invertebrates. The peripheral parenchyma gives rise to protonephridia, that is to coiled tubes commencing in pyriform cells containing a flame-like bundle of cilia and provided with branched outgrowths, and communicating with the exterior by long convoluted canals which open at the surface of the body. These protonephridia are the excretory organs. The nervous system, though centralized at one end of the body, contains diffused nerve-cells in the course of its tracts, which are disposed in two or more longitudinal bundles interconnected by transverse bands. The Platyelmia are hermaphrodite and the reproductive organs are complex. The male organs consist of paired testes communicating by delicate canals with a protrusible penis. This organ is generally single but sometimes paired and occasionally multiple. It is frequently armed with spines, hooks or stylets, and is further complicated by the addition of a nutritive secretion (the prostate gland) which may open at its base or pass separately by a special duct to the exterior. There is some reason to believe that this complicated and variable apparatus is used for stabbing the body of another animal and that beginning as a weapon for catching prey it has become modified for hypodermic impregnation and only gradually adapted for insertion into the bursa copulatrix. The female organs are no less complex. They consist of solid or tubular ovaries which may be single, double or multiple. In the majority of Platyelmia the primitive ovary becomes divided into fertile and sterile portions, *i.e.* into distinct ovarian and vitellarian regions. The yolk prepared by the latter is conducted by one or more specialized ducts to the oviduct and the point of union is distinguished by the opening of a "shell-gland" which secretes a membrane around the conjoined mass of ovum and yolk. From this junction there proceeds an oviduct or "uterus" (paired or single) which before opening to the exterior expands to form a muscular protrusible pouch—the bursa copulatrix. Frequently also from this junction of the ovaria and the vitellaria a median tube is given off which either opens to the exterior or into the intestine, in the latter case it appears to serve as means of conveying superfluous yolk to the gut, where it may serve as food.

Inter-relationships.—The inter-relationships of the three members of the Platyelmia are of a more doubtful nature than is the unity of the phylum. The Turbellaria undoubtedly form the most primitive division, as is shown by their free-living habits, ciliation and sense-organs. The Trematodes are somewhat modified in accordance with their ecto- or endoparasitic life, but they exhibit such a close similarity of structure with the Turbellaria that their origin from Planarians can hardly be doubted, and indeed the Temnocephaloidea (see PLANARIANS) form an almost ideal annectant group linking the ectoparasitic Trematodes and Rhabdocoel Planarians. The Cestodes, however, are connected by no such intermediate forms with the other Platyelmia. Their adaptations to parasitic life in vertebrate animals appear to have involved such modifications of structure and development that their affinities are quite problematical. The entire absence of any trace of a distinct alimentary tract, the loss of true regenerative power, the peculiar gametic segmentation of the body into hundreds of "proglottides" budded off from



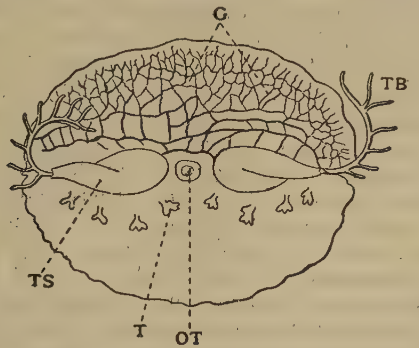
(From *Cambridge Natural History*, vol. ii., "Worms, &c.," by permission of Macmillan & Co., Ltd.)

FIG. 1.—Free-swimming Larva (Müller's Larva) of a Polyclad Planarian to illustrate the trochosphere-hypothesis of the origin of Platyelmia. The larva is seen in optical section, and its distinguishing feature is the ciliated lobed band (*vl*, *sl*, *dl*), which corresponds to the pre-oral ciliated band of a trochosphere-larva. It is here drawn out into eight processes, of which six are shown, their continuity being expressed by the dotted line.

br, Brain.
dr, Glands.
ep, Epidermis.
mo, Mouth.
mg, Stomach.
n, Nerves.
ph, Pharynx.
par, Parenchyma.

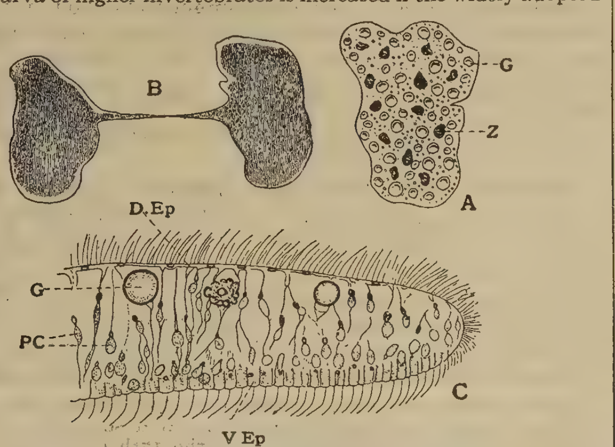
one extremity, and the absence of any morphologically distinct anterior extremity, are adaptations to the wholly parasitic life of this class. Their structure is similar to that of Trematodes, from which in the opinion of most zoologists they have been derived.

Affinities.—As the Turbellaria (Planarians) are the most primitive division of the Platyelmia, the problem of the affinities of this phylum resolves itself into that of the relationships of the Turbellaria. With regard to the origin of this class two divergent views are still held. On the one hand the Turbellaria are considered to be an offshoot of the early Coelomate stock, on the other they are held to be descendants of a simpler two-layered stock. The former hypothesis with its variants may be called the Trochosphere-hypothesis, the latter the Gastraea-hypothesis. The Trochosphere-hypothesis (2), (3) is based chiefly on the occurrence in certain Polyclad Turbellaria, of a larval form (Müller's larva) which is comparable to a certain stage (pro-trochula) in the development of the Trochosphere-larva. This Trochosphere is the characteristic larva of Mollusca, Annelida and some Gephyrea; and the Rotifera appear to remain throughout life as modified Trochospheres. It is a top-shaped, free-swimming organism provided with a preoral band of cilia, an apical sense-organ, a simple gut, protonephridia and schizocoele. The importance of this resemblance between the Polyclad larva and the Trochosphere-larva of higher invertebrates is increased if the widely adopted view (held on other grounds) that the Polyclads are the most primitive of the Turbellaria, is soundly based. The grounds for this view are the radial symmetry of several Polyclads and the supposed origin of gonads and excretory flame-cells from the walls of gut, the occurrence of nematocysts in *Anonymus*, one of the most radially constructed Polyclads, and lastly the presence of two peculiar animals *Ctenoplana* and *Coeloplana*, which suggests a transition from Ctenophora to Polyclads. At the present time, however, none of these grounds can be said to possess so much force as they did some years ago (4). The argument has come to rest on the agreement between the cell-lineage of Polyclads and that of certain Mollusca and Annelids. This resemblance is considered by Hubrecht (5) to give reason for concluding that the Polyclads are an offshoot, and possibly a degenerate offshoot, from the early Coelomate stock.



(After Abbott, Tōkyō Zool. Society's *Annot. Zoologicae Japonensis*, iv. 4, 2 and 3.)

FIG. 2.—Dorsal view of *Coeloplana* to illustrate the similarity between Ctenophora and Turbellaria. The branched intestine (*G*) is drawn on one side of the animal only; it opens to the exterior by means of a pharynx (not shown). The mouth is shown by the line surrounding the otolith (*OT*) in the centre. The mouth is ventral, the otolith dorsal. The two branched tentacles (*TB*) are seen partially extruded from their sheaths (*TS*); when fully extended they exceed the diameter of the animal five or six times. The short tentacles (*T*) are drawn on one side only. *Coeloplana* has been found in shallow water in the Red Sea and on the coast of Japan. Ctenophora possess two similar long branched tentacles, a ventral mouth and dorsal otolith.



(After F. E. Schultze, *Kgl. Preuss. Akad. der Wissenschaft*, Berlin, 1891.)

FIG. 3.—*Trichoplax adhaerens*, an organism considered, on the Gastraea-hypothesis, to be closely allied to the progenitors of the Platyelmia. (The recent work by Krumbach [*Zoolog. Anzeiger* 1907, xxxi. 450], serves to show that *Trichoplax* is the planula-larva of a Hydromedusa.)

A, a small specimen drawn from life. The spherical granules (*G*) are probably gland-secretions; the dark bodies (*Z*) are probably xanthellae, *i.e.* algal cells living in association with the animal.

B, a specimen undergoing fission.
C, part of a vertical section.
D.Ep, The dorsal epidermis.
G, Refringent corpuscles.
PC, Parenchymatous cells.
V.Ep, Ventral epidermis. The hair-like processes are cilia.

The Gastraea-hypothesis is founded on quite other considerations. In effect (6) it traces the Turbellaria to small two-layered organisms consisting of an outer ciliated epidermis and a central syncytial tissue. Such an organism is found in the peculiar *Trichoplax*, *Lohmanniella*, &c. The early stages of most animals pass through such a stage, which is known as a "planula." From such beginnings the evolution of the Turbellaria leads first through the Acoelous forms in which the central syncytium is partly differentiated into digestive, muscular and skeletotrophic tissue, then to the more specialized Rhabdocoela, and so through the Alloeocoela to the Triclads and finally to the Polyclads. The careful study of the development of one Acoelous form and of certain Rhabdocoels has strengthened this hypothesis by showing that no definite enteron or gut is at first laid down, but that certain embryonic syncytial tracts become digestive tracts, others excretory, others again muscular. The study of Rhabdocoels (7) has led to the important discovery that the rudiment of the gonads and that of the pharynx are the first organs to appear, and that the alimentary sac arises independently of them. This segregation of the germ cells and their independence of the intestinal sac is an indication that the origin of these cells is not coelomic nor enteric, and until we possess further information as to the evolution of the complex genitalia of the higher Turbellaria we cannot hope to understand the presence of such highly modified structures in animals of an otherwise low grade or organization.

LITERATURE.—Recent discussions of the affinities of the Platyelmia will be found in (1) A. Sedgwick, *Textbook of Zoology* (1898), i. 212; (2) Hatschek, *Lehrbuch der Zoologie* (1891), pp. 316–326; (3) A. Lang, *Die Trophocoel-Theorie* (Jena, 1903); (4) E. Ray Lankester, *Treatise on Zoology* (1900), pt. ii. Introduction and ch. vii. pp. 15–19; (5) A. A. W. Hubrecht, *Jenaische Zeitschrift für Naturwissenschaft* (1905), pp. 151–176; (6) Von Graff, *Die Acoela*, p. 519 (Leipzig, 1891). For the development of Rhabdocoelida see (7) Bresslau, *Zeitschrift für wissenschaftliche Zoologie* (1904), vol. 76.

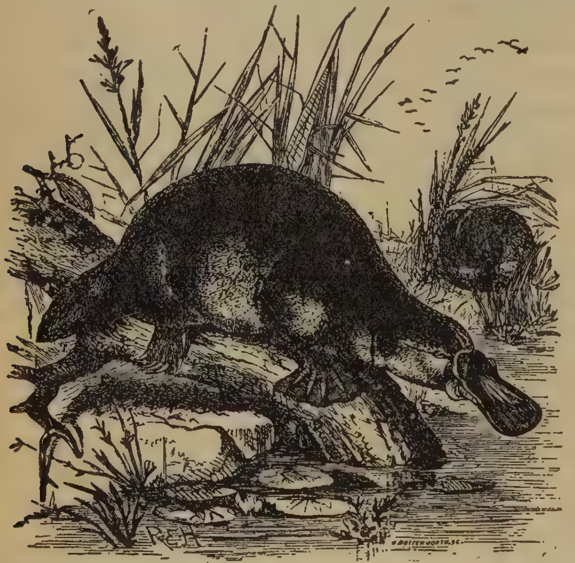
(F. W. GA.)

PLATYPUS. The duck-billed platypus (*Platypus anatinus*) was the name assigned to one of the most remarkable of known animals by George Shaw (1751–1813), who had the good fortune to introduce it to the notice of the scientific world in the *Naturalist's Miscellany* (vol. x., 1799). In the following year it was independently described by Blumenbach (*Voigts Magazin*, ii. 205) under the name of *Ornithorhynchus paradoxus*. Shaw's generic name, although having priority to that of Blumenbach, could not be retained, as it had been used at a still earlier time (1793) by Herbst for a genus of Coleoptera. *Ornithorhynchus* (Gr. ὄρνις, ὄρνιθος, bird, and ῥύγχος, bill) is therefore now universally adopted as the scientific designation, although duck-billed platypus (Gr. πλατύς, flat, and πούς, foot) may be conveniently retained as a vernacular appellation. By the colonists it is called "water-mole," but its affinities with the true moles are of the slightest and most superficial description.

The anatomical differences by which the platypus, and its only allies the echidnas, are separated from all other mammals, so as to form a distinct sub-class, are described in the article MONOTREMATA, where also will be found the main distinctive characters of the two existing representatives of the group. It is there stated that the early stages of the development of the young are not yet fully known. Sir R. Owen, and later E. B. Poulton, showed that the ovum of the platypus was large compared with that of other mammals, whilst W. H. Caldwell showed that it was filled with yolk, and finally established the fact that *Platypus* as well as *Echidna* is oviparous. Two eggs are produced at a time, each measuring about three-fourths of an inch in its long and half an inch in its short axis, and enclosed in a strong, flexible, white shell.

The platypus is pretty generally distributed in situations suitable to its aquatic habits throughout the island of Tasmania and the southern and eastern portions of Australia.

The length of the animal when full grown is from 18 to 20 in. from the extremity of the beak to the end of the tail, the male being slightly larger than the female. The fur is short, dense and rather soft to the touch, and composed of an extremely fine and close under-fur, and of longer hairs which project beyond this, each of which is very slender at the base, and expanded, flattened and glossy towards the free end. The general colour is deep brown, but paler on the under parts. The tail is short, broad and depressed, and covered with coarse hairs, which in old animals generally become worn off from the under surface. There are no true teeth in the adult, although the young possess a set which are shed after being worn down by friction with food and sand, their purposes being afterward served by horny prominences, two on each side of each jaw—those in the front narrow, longitudinal, sharp-edged ridges, and those behind broad, flattened and molariform. The upper surface of the lateral edges of the mandible has also a number of parallel fine transverse ridges, like those on the bill of a duck. In the cheeks are tolerably capacious pouches, which appear to be used as receptacles for food.



(From Gould's *Mammals of Australia*.)

Platypus.

The limbs are strong and short, each with five well-developed toes provided with strong claws. In the fore feet the web not only fills the interspaces between the toes, but extends considerably beyond the ends of the long, broad and somewhat flattened nails, giving great expanse to the foot when used for swimming, though capable of being folded back on the palm when the animal is burrowing or walking on the land. On the hind foot the nails are long, curved and pointed, and the web extends only to their base. On the heel of the male is a strong, curved sharply pointed, movable horny spur, directed upwards and backwards, attached by its expanded base to the accessory bone of the tarsus. This spur, which attains the length of nearly an inch, is traversed by a minute canal, terminating in a fine longitudinal slit near the point, and connected at its base with the duct of a large gland situated at the back part of the thigh. The whole apparatus is so exactly analogous in structure to the poison-gland and tooth of a venomous snake as to suggest a similar function, and there is now evidence that it employs this organ as an offensive weapon.

The platypus is aquatic in its habits, passing most of its time in the water or close to the margin of lakes and streams, swimming and diving with the greatest ease, and forming for the purpose of sleeping and breeding deep burrows in the banks, which generally have two orifices, one just above the water level, concealed among long grass and leaves, and the other below the surface. The passage at first runs obliquely upwards in the bank, sometimes to a distance of as much as 50 ft., and expands at its termination into a cavity, the floor of which is lined with dried grass and leaves, and in which, it is said, the eggs are laid[1] and the young brought up. Their food consists of aquatic insects, small crustaceans and worms, which are caught under water, the sand and small stones at the bottom being turned over with their bills to find them. They appear at first to deposit what they have thus collected in their cheek pouches, and when these are filled they rise to the surface and quietly triturate their meal with the horny teeth before swallowing it. Swimming is effected chiefly by the action of the broad forepaws, the hind feet and tail taking little share in locomotion in the water. When asleep they roll themselves into a ball, as shown in the figure. In their native haunts they are extremely timid and wary, and very difficult to approach, being rarely seen out of their burrows in the daytime. Mr A. B. Crowther, who supplemented the often quoted observations of Dr George Bennett upon the habits of these animals in confinement, states: "They soon become very tame in captivity; in a few days the young ones appeared to recognize a call, swimming rapidly to the hand paddling the water; and it is curious to see their attempts to procure a worm enclosed in the hand, which they greedily take when offered to them. I have noticed that they appear to be able to smell whether or not a worm is contained in the closed hand to which they swim, for they desisted from their efforts if an empty fist was offered." (W. H. F.; H. Sc.)

PLAUEN, a town of Germany, in the kingdom of Saxony, on the Weisse Elster, 60 m. south of Leipzig, on the railway to Hof and Munich and at the junction of lines to Eger and Gera. Pop. (1890), 47,007; (1900), 73,891; (1905), 105,383. It was formerly the capital of Vogtland, or Voigtland, a territory governed by the imperial vogt, or bailiff, and this name still clings in popular speech to the hilly district in which the town lies. Of its three Evangelical churches the most prominent is the fine Gothic church of St John, with twin spires, which was restored in 1886. Other buildings of note are the town hall, dating from about 1550; and the old castle of Hradschin, now used as a law court. Plauen is now the chief place in Germany for the manufacture of embroidered white goods of all kinds, for the finishing of woven cotton fabrics, known as Plauen goods, and for the making of lace.

Plauen was probably founded by the Slavs. First mentioned in 1122, it passed under the authority of Bohemia in 1327 and came to Saxony in 1466, remaining permanently united with the electorate since 1569. The manufacture of white goods was introduced by Swabian, or Swiss, immigrants about 1570. The advance in its material prosperity has been especially rapid since the incorporation of Saxony in the German Zollverein.

See Fiedler, *Die Stadt Plauen im Vogtland* (Plauen, 1874); and *Beiträge zur Geschichte der Stadt Plauen* (Plauen, 1876); Metzner, *Führer durch Plauen* (1903); and the publications of the *Altertumsverein zu Plauen* (1875 seq.).

PLAUTUS, TITUS MACCIUS (originally perhaps Maccus; cf. *Asin.* Prol. 11), the great comic dramatist of ancient Rome, was born at Sarsina in Umbria according to the testimony of Festus, who calls him *Umber Sarsinas*, and Jerome. The date of his death was 184 B.C. (Cicero, *Brutus*, xv. 60). The date of his birth depends upon an inference based on the statement of Cicero (*De senectute*, xiv. 50) that he was an old man when he wrote his *Truculentus* and *Pseudolus*. The latter play was produced in 191 B.C.; hence we get 254–251 B.C. as the approximate date of his birth. The only record that we possess as to his life is that contained in Aulus Gellius iii. 3, 14 (based on Varro), the historical character of which is doubted by Leo (*Plautinische Forschungen*, p. 60, sqq.). According to this statement he left his native town at an early age and settled at Rome, where he got employment in a theatre, though it is not clear in what capacity. The words of Gellius *in operis artificum scaenicorum*, are interpreted by F. Marx as indicating that Plautus was a member of the theatrical staff of Livius Andronicus. At Rome he saved a little money, and embarked on some mercantile enterprise, probably abroad. Having lost his money he returned to Rome penniless, and was driven to support himself by manual labour in a mill (*cum . . . ad circumagendas molas quae trusatiles appellantur operam pistori locasset*); and in this *pistrinum* he wrote three of his plays (the *Saturio*, the *Addictus* and another). The main body of his works belongs, so far as can be ascertained from the scanty evidence which we have, to the latter half of his life; 206 B.C. is the approximate date of the *Miles gloriosus*; cf. line 211 seq., *quoi bini custodes . . . occubant* (present tense), which alludes to the imprisonment of Naevius, an event which cannot be proved to be earlier than 206 B.C. The defects of construction and the absence of "cantica" in the *Miles* also point to this as one of his early plays. On the other hand it is hardly likely that all his comedies (which greatly exceeded in number the extant twenty) were produced during the last twenty years of his life. Radermacher assigns the *Asinaria* to a date as early as 212 B.C. Of the extant plays the *Cistellaria* and the *Stichus* must be associated with the *Miles* as comparatively early works; for the former was clearly produced before (though not long before) the conclusion of the Second Punic War, see l. 201 seq.; and the *Stichus* is proved by its didascalia to have been produced in 200 B.C. The *Pseudolus* and the *Truculentus* fall within the last seven years of his life. The dates of the rest of the extant plays, here given in alphabetical order, are quite uncertain, namely, *Amphitruo*, *Aulularia*, *Bacchides*, *Captivi*, *Casina*, *Curculio*, *Epidicus*, *Menaechmi*, *Mercator* (probably later than the *Rudens*, as shown by F. Marx), *Mostellaria*, *Persa*, *Poenulus*, *Rudens*, *Trinummus* (later than 194 B.C.; cf. *novi aediles* in l. 990). Of the *Vidularia* we possess only the fragments contained in the Codex Ambrosianus.

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[1] Some doubt has been expressed as to whether the eggs are extruded or hatched within the body. At a scientific meeting of the Zoological Society of London, on the 17th of December 1901, Mr Oldfield Thomas read a letter from Mr G. Metcalfe, who had lived many years in a region inhabited by these animals. He had made special inquiries of the authorities of the Sydney, Melbourne, Brisbane and Hobart museums, and published questions in the newspapers, but no evidence has reached him that the eggs of *Ornithorhyncus* have ever been obtained except by the dissection of the mother. Mr Thomas laid stress on what had been advanced on the other side by Mr Caldwell (*Philosophical Transactions*, clxxviii. 463), Professor Spencer (*Nature*, xxxi. 132) and Mr J. Douglas Ogilby (*Catalogue of Australian Mammals*, p. 1, Sydney, 1902), but expressed the hope "that further inquiries might be made by naturalists in Australia as to the actual finding of such eggs in the burrows, so that this most interesting point might be finally settled."

The plays of Plautus are all based on Greek originals.[1] To what extent he is dependent on these originals, and how far he departed from them, we shall perhaps never know exactly. But such evidence as we have points to a pretty close imitation on the part of the Roman poet: there are passages in which he does not hesitate to take over from his originals allusions which can hardly have been intelligible to a Roman audience, *e.g.* the reference to Stratonicus, a musician of the time of Alexander the Great (*Rudens*, 932); and in the delineation of character we have no reason to suppose that he improved on his models (cf. Aul. Gell. ii. 23). Even the prologues, which later researches have shown to be in the main by the hand of Plautus himself, though certain passages were clearly added at a later date, *e.g. Cas. prol.* 5–20, may in most cases have formed part of the Greek original. Plautus must therefore be regarded as primarily a translator or adapter, so far as our present knowledge goes. Where he varies his plot on lines of his own by amalgamating the plots of two distinct Greek comedies (*e.g.* in the *Miles* and the *Poenulus*) the result is generally not happy; and the romanization of the plays by way of allusions to towns in Italy, to the streets, gates and markets of Rome, to Roman magistrates and their duties, to Roman laws and the business of Roman law-courts, banks, comitia and senate, &c., involves the poet in all the difficulties of attempting to blend two different civilizations. The inconsistency of his attitude is shown by his use, side by side, of the contemptuous expressions *barbarus* (applied to the Romans) and *pergraecari* (applied to the Greeks). In some passages the poet seems to take delight in casting dramatic illusion to the winds (*e.g. Pseudolus*, 720; *Poenulus*, 550).

But as a translator Plautus is nothing less than masterly. His command of the art is such that his plays read like original works, and it may be at least said that some of his characters stand out so vividly from his canvas that they have ever since served as representatives of certain types of humanity, *e.g.* Euclio in the *Aulularia*, the model of Molière's miser. Alliteration, assonance, plays upon words and happy coinages of new terms, give his plays a charm of their own. "To read Plautus is to be once for all disabused of the impression that Latin is a dry and uninteresting language" (Skutsch, in *Die Cultur der Gegenwart*; 1905). It is a mistake to regard the Latin of Plautus as "vulgar" Latin. It is essentially a literary idiom, based in the main upon the language of intercourse of the cultivated Roman society of the day (cf. Cic. *De oratore*, iii. 12, 45); though from the lips of slaves and other low persons in the plays we no doubt hear expressions which, while they are quite in keeping with the characters to whom they are allotted, would have shocked the ears of polite society in the 2nd century B.C.

The characters in his plays are the stock characters of the new comedy of Athens, and they remind us also of the standing figures of the *Fabulae atellanae* (Maccus, Bucco, Dossennus, &c.). We may miss the finer insight into human nature and the delicate touch in drawing character which Terence presents to us in his reproductions of Menander, but there is wonderful life and vigour and considerable variety in the Plautine embodiments of these different types. And the careful reader will take note of occasional touches of serious thought, as in the enumeration of the ten deadly political sins (*Persa*, 555 seq.) and allusions to ethical philosophy (*Pseud.* 972 seq.; *Stich.* 124; *Trin.* 305 sqq., 320 sqq., 363 seq., 447; *Rud.* 767, 1235–1248, &c.). Virtue is often held up for admiration, and vice painted in revolting colours or derided. The plots of Plautus also are more varied than those of Terence. We have from him one mythological burlesque, the *Amphitruo*, and several plays dealing with domestic subjects like the *Captivi*, *Cistellaria*, *Rudens*, *Stichus* and *Trinummus*; but most of his plays depend for their main interest on intrigue, such as the *Pseudolus*, *Bacchides*, *Mostellaria*. In the *Menaechmi* and, as a subordinate incident, in the *Amphitruo* we have a "comedy of errors."

In one respect Plautus must be regarded as distinctly original, viz. in his development of the lyrical element in his plays. The new comedy of Greece was probably limited for the most part to scenes written in the metres of dialogue; it remained for Plautus, as Leo has shown, to enliven his plays with *cantica* modelled on the contemporary lyric verse of Greece or Magna Graecia, which was in its turn a development of the dramatic lyrics of Euripides. A new light has been thrown on the *παρακλαυσίθυρον* of the *Curculio* (147–155) by the discovery of the Alexandrian erotic fragment published by Grenfell and Hunt (Oxford, 1896). The lyrical metres of Plautus are wonderfully varied, and the textual critic does well not to attempt to limit the possibilities of original metrical combinations and developments in the Roman comedian. Recent investigation has considerably extended the list of his *numeri innumeri*.

Plautus was a general favourite in the days of republican Rome. Cicero, though he found fault with the iambics of the Latin comedians generally as *abiecti*, "prosaic" (*Orator*, lv. 184), admired Plautus as *elegans*, *urbanus*, *ingeniosus*, *facetus* (*De offic.* i. 29, 104). To the fastidious critics of the Augustan age, such as Horace, he seemed rude (cf. *Ars Poetica*, 270–274), just as Addison declared Spenser to be no longer fitted to please "a cultivated age." In another passage (*Epist.* ii. 1, 170–176) Horace accuses him of clumsiness in the construction of his plays and the drawing of his characters, and indifference to everything excepting immediate success: *gestit enim nummum in loculos demittere, post hoc securus cadat an recto stet fabula talo.* That there are many inconsistencies and signs of carelessness in his work has been proved in detail by Langen. But that he found many admirers, even in the Augustan age, Horace himself bears witness (ibid. l. 58), where he says that Plautus was regarded as a second Epicharmus: *Plautus ad exemplar Siculi properare Epicharmi*—a passage which is important as suggesting that

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[1] See further P. E. Legrand, *Daos: tableau de la comédie grecque pendant la période dite nouvelle* (1910).

Plautus was under some obligation to the Sicilian representatives of the old Dorian comedy; cf. Varro's statement (in Priscian ix. 32), *deinde ad Siculos se applicavit.* It is possible that Plautus may have been working on the lines of the old comedy in the tell-tale names which he is so fond of inventing for his characters, such as Polymachaeroplagides (*Pseud.* 988), Pyrgopolinices (*Mil.* 56), Thensaurochrysonicochrysides (*Capt.* 285)—names which stand in remarkable contrast to the more commonplace Greek names employed by Terence.

In the middle ages Plautus was little regarded, and twelve of his plays (*Bacchides–Truculentus*) disappeared from view until they were discovered (in the MS. called *D*) by Nicholas of Trèves in the year 1429. Apparently some early archetype had been divided into two volumes, of which only the first (containing eight plays, *Amphitruo–Epidicus*) had escaped oblivion or destruction. After the revival of learning Plautus was reinstated, and took rank as one of the great dramatists of antiquity; cf. Shakespeare, *Hamlet*, I. ii. 420, where Polonius says, "The best actors in the world . . . Seneca cannot be too heavy nor Plautus too light."

Manuscripts.—The chief MSS. of Plautus belong to two families, which are proved by the errors which they have in common to be descended from a single source (Sicker, "Novae quaestiones plautinae," in *Philologus suppl.* xi. 2; 1908): (i.) that represented by the fragmentary palimpsest of the Ambrosian Library at Milan (*A*, 4th century A.D.), discovered in 1815 by Cardinal Mai and now accessible in the *Apograph* of Studemund, edited by Seyffert (1889); (ii.) that represented by the Palatine MSS. (*P*, 10th–12th century), viz. *B*, now in the Vatican, containing all the twenty plays preceded by the spurious *Querolus*; *C*, now at Heidelberg, containing the last twelve plays, *i.e. Bacchides-Truculentus; D*, now in the Vatican, containing the *Amphitruo*, *Asinaria*, *Aulularia*, half of the *Captivi* and the last twelve plays: to the same family belong the following less important MSS.: *E* (at Milan), *V* (at Leiden), *J* (in the British Museum), *O* (in the Vatican).

Editions.—The *editio princeps*, based mainly on a transcript of *D*, was printed at Venice, 1472: the first scientific text, based on *B*, *C* and *D*, was that of Camerarius, completed 1552, in whose steps followed Lambinus (with a commentary which is still useful), 1576; Taubmann, 1605–1621; Pareus (a meritorious edition), 1619 and 1623; Guyet, edited by Marolles, 1658; Gronovius (the "Vulgate"), 1664–1684; then, after the lapse of more than a century, came the editions of Bothe, 1809–1811; Naudet, 1830; and Weise, 1837–1848. A new era began with the great critical edition of certain plays by Ritschl, 1848–1854, in which a collation of *A* was used; a revised and completed form of this work was commenced by Ritschl himself and continued by his disciples Goetz, Loewe and Schoell, 1871–1894: and of this an entirely rewritten *editio minor* by Goetz and Schoell appeared in 1893–1896 (continued by a 2nd ed. of Fasciculus ii. in 1904), which is still the most useful of modern editions for a critical study of the text, exhibiting, as it does, the MS. tradition with only such emendations as are securely established by the results of modern investigation. The other modern editions of the text are those of Fleckeisen (containing ten plays, excellent for his time), 1859; Ussing (with a commentary), 1875–1887, 2nd ed. of vol. iii. 1888; Leo (a very important work), 1895–1896; Lindsay, 1904–1905. Among modern editions of separate plays with commentaries the following are probably the most useful: *Amphitruo* by Palmer, 1890, and Havet, 1895; *Asinaria* by Gray, 1894; *Aulularia* by Wagner, 1866 and 1876; *Captivi* by Brix, 6th ed., revised by Niemeyer, 1910; an English edition of this work by Sonnenschein (with introduction on prosody), 1880; same play by Lindsay (with metrical introduction), 1900; *Epidicus* by Gray, 1893; *Menaechmi* by Brix, 4th ed., revised by Niemeyer, 1891; *Miles gloriosus* by Lorenz, 2nd ed., 1886; by Brix, 3rd ed., revised by Niemeyer, 1901; by Tyrrell, 3rd ed., 1894; *Mostellaria* by Lorenz, 2nd ed., 1883; by Sonnenschein, 2nd ed., 1907; *Pseudolus* by Lorenz, 1876; *Rudens* by Sonnenschein, 1891, *editio minor* (with a metrical appendix), 1901; *Trinummus* (with a metrical introduction) by Brix, 5th ed., revised by Niemeyer, 1907; by Gray, 1897; *Truculentus* by Spengel and Studemund, 1898.

Criticism.—Good characterizations of Plautus, from the literary point of view, are given by Sellar in his *Roman Poets of the Republic*, and Wight Duff, in his *Literary History of Rome* (1909). A summary of recent critical works bearing on the text and interpretation is given by Seyffert in his admirable reports (in Bursian's *Jahresberichte über die Fortschritte der klassischen Altertumswissenschaft*), 1883–1885, 1886–1889, 1890–1894, continued by Lindsay, 1895–1906. Important contributions to textual criticism are contained in Ritschl *Parerga* (1845), *Neue plautinische Excurse* (1869), and his collected *Opuscula philologica*; Studemund, *Studia in priscos scriptores latinos* (vol. i. 1873, vol. ii. 1891); Langen, *Beiträge* (1877) and *Plautinische Studien* (1886); Leo, *Plautinische Forschungen* (1895); Lindsay, *Codex Turnebi* (1898). Bentley's *Plautine Emendations* were published by Sonnenschein partly in his edition of the *Captivi* (1880), partly in the *Anecdota oxoniensia* series (1883).

Metre and Prosody.—The most important treatises (apart from those mentioned under "Editions") are Müller, *Plautinische Prosodie* (1869); Spengel, *Reformvorschläge zur Metrik der lyrischen Versarten*(1882); Klotz, *Grundzüge altrömischer Metrik* (1890); Skutsch, *Forschungen zur lateinischen Grammatik und Metrik* (1892), *Iambenkürzung und Synizese* (Satura Viadrina) (1896), continued by the author in a work called Γέρας (1903); Leo, *Die plautinischen Cantica und die hellenistische Lyrik* (1897); Maurenbrecher, *Hiatus und Verschleifung im alten Latein* (1899); Ahlberg, *De proceleusmaticis* (1900), *De correptione iambica plautina* (1901); Jacobsohn, *Quaestiones plautinae* (1904); Radford, on the "Recession of the Latin Accent" (in *Amer. Journ. Phil.*, 1904), "Studies in Latin Accent and Metric" (in *Trans. Amer. Phil. Assoc.*, 1904), "Plautine synizesis" (ibid., 1905, continued in *Amer. Journ. Phil.*, 1906), (a work on cognate subjects is promised by Exon); Sudhaus, *Der Aufbau der plautinischen Cantica* (1909).

Syntax.—The most recent works bearing on Old Latin syntax, are Sjögren, *Zum Gebrauch des Futurums im Altlateinischen* (1906); Lindsay, *Syntax of Plautus* (1907); Sonnenschein, *The Unity of the Latin Subjunctive* (1910). A work by H. Thomas, entitled *A catalogue raisonné of the Subjunctive in Plautus, in support of the theory of the unity of origin of the Latin Subjunctive*, is announced as in preparation.

Lexica.—The only completed lexicon (apart from the *Indices* of Naudet, 1832, and Weise, 1838) is that of Pareus (2nd ed., 1634). New lexica have been begun by Waltzing (1900; apparently not to be continued) and Lodge (1901; in progress). The latter work, when completed, will be indispensable.

Translations and Adaptations.—A comprehensive view of the influence of Plautus on modern literatures is given by Reinhardstoettner, *Spätere Bearbeitungen plautinischer Lustspiele* (1886). Many adaptations for the Italian stage were produced between the years 1486 and 1550, the earliest (the *Menaechmi*) under the direction of Ercole I., duke of Ferrara. From Italy the practice spread to France, Spain, England and other countries.

Of English plays, the interlude called *Jack Juggler* (between 1547 and 1553) was based on the *Amphitruo*, and the lost play called the *Historie of Error* (acted in 1577) was probably based on the *Menae-chmi*; Nicholas Udall's *Ralph Royster Doyster*, the first English comedy (acted before 1551, first printed 1566), is founded on the *Miles gloriosus*; Shakespeare's *Comedy of Errors* (about 1591) is an adaptation of the *Menaechmi*; and his Falstaff may be regarded as an idealized reproduction or development of the braggart soldier of Plautus and Terence—a type of character which reappears in other forms not only in English literature (*e.g.* in Shakespeare's Parolles and Ben Jonson's Captain Bobadil) but also in most of the literatures of modern Europe. Shakespeare's *Taming of the Shrew* has been influenced in several respects (including the names *Tranio* and *Grumio*) by the *Mostellaria*. Ben Jonson produced a skilful amalgamation of the *Aulularia* and the *Captivi* in his early play *The Case is Altered* (written before 1599). Thomas Heywood adapted the *Amphitruo* in his *Silver Age* (1613), the *Rudens* in his *Captives* (licensed 1624), and the *Mostellaria* in his *English Traveller* (1633). Dryden's *Amphitryon or the two Sosias* (1690) is based partly on the *Amphitruo*, partly on Molière's adaptation thereof; Fielding's *Miser* (acted 1732) on Molière's *L'Avare* rather than on the *Aulularia*, and his *Intriguing Chambermaid* (acted 1733) on Regnard's *Le Retour imprévu* rather than on the *Mostellaria*. There was no English translation, strictly so called, of any play of Plautus in the 16th or 17th century, except that of the *Menaechmi* by W. W. (probably William Warner), first printed in 1595, which Shakespeare may possibly have used (in MS.) for his *Comedy of Errors*. A translation of the whole of Plautus in "familiar blank verse" by Bonnell Thornton and others appeared in 1767 (2nd ed., 1769–1774). Five plays have been translated in the metres of the original by Sugden (1893).

(E. A. So.)

PLAY, a word of which the primary meaning is that of free or active movement or exercise. The O. Eng. *plegan* or *plegian*, from which comes the substantive *plega*, play, is apparently cognate with Ger. *pflegen*, to take care or charge of, and *Pflege*, care, and the connexion in sense is to be found in the primary meaning, that of exercise or active movement. In its primary meaning "play" is used of the rapid changing movement of light and colour, and also figuratively of thought or fancy, and specifically of the free movement of parts of a mechanism on each other, of a joint or limb, &c. To play a musical instrument is to move the fingers upon it, and until the 18th century the verb was intransitive, and "on" or "upon" was always used with the name of the instrument. The very general use of the word for sport, game or amusement, is an early and easy development from the meaning of active movement or exercise as a recreation after work; that of a dramatic performance (see Drama) is very early; the *New English Dictionary* quotes from King Alfred's *Orosius* (*c.* 893).

The primitive play instinct or play impulse in man has been much discussed in recent years by psychologists in connexion with child-study (see Child), and with the expression of the emotions (see J. Sully, *On Laughter*, 1902, &c.; also Aesthetics). See generally Carl Groos, *The Play of Animals* (1898) and *The Play of Man* (1901); and Baldwin's *Dict. of Philosophy*, *s.v.*

PLAYA (a Spanish word meaning "shore"), the name applied in America to a level plain formed of the deposits of a river which has no outlet to the sea or a lake. If at seasons of high water a river floods any area and temporarily converts it into a lake, which subsequently dries up in hot weather, the tract thus left dry is called a playa. The barren Black Rock Desert in north-western Nevada, about 100 m. in length by 15 in breadth, is typical.

PLAYFAIR, JOHN (1748–1819), Scottish mathematician and physicist, was born at Benvie, Forfarshire, where his father was parish minister, on the 10th of March 1748. He was educated at home until the age of fourteen, when he entered the university of St Andrews. In 1766, when only eighteen, he was candidate for the chair of mathematics in Marischal College, Aberdeen, and, although he was unsuccessful, his claims were admitted to be high. Six years later he made application for the chair of natural philosophy in his own university, but again without success, and in 1773 he was offered and accepted the living of the united parishes of Liff and Benvie, vacant by the death of his father. He continued, however, to carry on his mathematical and physical studies, and in 1782 he resigned his charge in order to become the tutor of Ferguson of Raith. By this arrangement he was able to be frequently in Edinburgh, and to cultivate the literary and scientific society for which it was at that time specially distinguished; and through Maskelyne, whose acquaintance he had first made in the course of the celebrated Schiehallion experiments in 1774, he also gained access to the scientific circles of London. In 1785 when Dugald Stewart succeeded Ferguson in the Edinburgh chair of moral philosophy, Playfair succeeded the former in that of mathematics. In 1802 he published his celebrated volume entitled *Illustrations of the Huttonian Theory of the Earth*. To its publication the influence exerted by James Hutton on the progress of geological knowledge is largely due. In 1805 he exchanged the chair of mathematics for that of natural philosophy in succession to Dr John Robison, whom also he succeeded as general secretary to the Royal Society of Edinburgh. He took a prominent part, on the Liberal side, in the ecclesiastical controversy which arose in connexion with Leslie's appointment to the post he had vacated, and published a satirical *Letter* (1806) which was greatly admired by his friends. He was elected F.R.S. in 1807. He died in Edinburgh on the 20th of July 1819.

A collected edition of Playfair's works, with a memoir by James G. Playfair, appeared at Edinburgh in 4 vols. 8vo. His writings include a number of essays contributed to the *Edinburgh Review* from 1804 onwards, various papers in the *Phil. Trans.* (including his earliest publication, "On the Arithmetic of Impossible Quantities," 1779, and an "Account of the Lithological Survey of Schehallion," 1811) and in the *Transactions* of the Royal Society of Edinburgh ("On the Causes which affect the Accuracy of Barometrical Measurements," &c.), also the articles "Aepinus" and "Physical Astronomy," and a "Dissertation on the Progress of Mathematical and Physical Science since the Revival of Learning in Europe," in the *Encyclopaedia Britannica* (Supplement to fourth, fifth and sixth editions). His *Elements of Geometry* first appeared in 1795 and have passed through many editions; his *Outlines of Natural Philosophy* (2 vols., 1812–1816) consist of the propositions and formulae which were the basis of his class lectures. Playfair's contributions to pure mathematics were not considerable, his paper "On the Arithmetic of Impossible Quantities," that "On the Causes which affect the Accuracy of Barometrical Measurements," and his *Elements of Geometry*, all already referred to, being the most important. His lives of Matthew Stewart, Hutton, Robison, many of his reviews, and above all his "Dissertation" are of the utmost value.

PLAYFAIR, LYON PLAYFAIR, 1st Baron (1818–1898), was born at Chunar, Bengal province, on the 21st of May 1818. He was sent to Europe by his father at an early age, and received his first education at St Andrews. Subsequently he studied medicine at Glasgow and Edinburgh. A short visit to India (in 1837–1838) was followed by his return to Europe to study chemistry, which had always attracted him. This he did at University College, London, and afterwards under Liebig at Giessen, where he took his doctor's degree. At Liebig's request, Playfair translated into English the former's work on the *Chemistry of Agriculture*, and represented Liebig at a meeting of the British Association at Glasgow. The outcome of his studies was his engagement in 1841 as chemical manager of the Primrose print-works at Clitheroe, a post which he held for rather more than a year. In 1843 he was elected honorary professor of chemistry to the Royal Institution of Manchester, and soon afterwards was appointed a member of the Royal Commission on the Health of Towns, a body whose investigations may be said to have laid the foundations of modern sanitation. In 1846 he was appointed chemist to the geological survey, and thenceforward was constantly employed by the public departments in matters of sanitary and chemical inspection. The opportunity of his life came with the 1851 Exhibition, of which he was one of the special commissioners. For his services in this connexion he was made C.B., and his work had the additional advantage of bringing him into close personal relations with the Prince Consort, who appointed him gentleman usher in his household. From 1856 to 1869 he was professor of chemistry at Edinburgh University. In 1868 he was elected to represent the universities of Edinburgh and St Andrews in parliament, and retained his seat till 1885, from which date until 1892 he sat as member for Leeds. In 1873 he was made postmaster-general, and in the following year, after the dissolution of parliament, was applied to by the incoming Tory government to preside over a commission to inquire into the working of the civil service. Its report established a completely new system, which has ever since been officially known as the "Playfair scheme." The return of Mr Gladstone to power in 1880 afforded opportunity for Playfair to resume his interrupted parliamentary career, and from that time until 1883 he acted as chairman of committees during a period when the obstructive tactics of the Irish party were at their height. On his retirement from the post he was made K.C.B. In 1892 he was created Baron Playfair of St Andrews, and a little later was appointed lord-in-waiting to the queen. In 1895 he was given the G.C.B. In spite of failing health the last years of his life were full of activity, one of his latest public acts being his suggestion that Queen Victoria's Diamond Jubilee of 1897 should be commemorated by the completion of the South Kensington Museum. He died in London, after a short illness, on the 29th of May 1898, and was buried at St Andrews. He was three times married. He was the author of a number of papers on scientific and social topics, a selection from which he published in 1889 under the title of *Subjects of Social Welfare*.

A memoir by Sir Wemyss Reid was published in 1899.

PLEADING (Fr. *plaider*, *plaidoyer*), the term applied in English law to the preparation of the statement of the facts on which either party to a criminal prosecution or a civil action founds his claim to a decision in his favour on the questions involved in the proceeding; and also to the document in which these statements are embodied. The term "pleadings" is used for the collected whole of the statements of both parties; the term "pleading" for each separate part of the pleadings. The term "plea" (*placitum*, plaid)[1] is now applied in England oftenest to the defence made by an accused person. To "plead" is to make a pleading or plea.[2]

All systems of law agree in making it necessary to bring the grounds of a claim or defence before the court in a more or less definite and technical form.

Roman System.—In Roman law the action passed through three stages (see Action), and the manner of pleading changed with the action. In the earliest historical period, that of the *legis actiones*, the pleadings were verbal, and made in court by the parties themselves, the proceedings imitating as far as possible the natural conduct of persons who had been disputing, but who suffered their quarrel to be appeased (Maine, *Ancient Law*, ch. x.). The use of technical language in pleading at an early date came to be regarded as so important that, as Gaius tells us, the party who made even the most trifling mistake would lose his suit. This excessive reverence for formality is a universal characteristic of archaic law. In the second period, that of the procedure by *formulae*, the issue which the *judex* decided was made up by the *praetor* in writing from the statements of the parties before him. The *formula* was a short summary of the facts in dispute in technical language, with instructions to the *judex*, and corresponded to what would now be called the submission or terms of reference to an arbitrator chosen by the parties. The part of the *formula* which contained the plaintiff's claim was called the *intentio*. Any equitable defence included in the *formula* was set up by means of an *exceptio*, which was either peremptory, denying the right of the plaintiff to recover at all, or dilatory, denying only that the action could be brought at the time or by the particular plaintiff. The plaintiff might meet the *exceptio* by a *replicatio*, the defendant on his side might set up a *duplicatio*, and the plaintiff might traverse the *duplicatio* by a *triplicatio*. The parties might proceed even further, but beyond this point the pleadings had no special names. Actions *bonae fidei* implied every *exceptio* that could be set up; in other actions the *exceptio* must be specially pleaded. From the *formula* the *judex* derived his whole authority, and he was liable to an action for exceeding it. He could not amend the *formula*: that could only be done by the *praetor*. In the third period the *formula* did not exist, the plaintiff's claim appeared in the summons (*libellus conventionis*), and the defendant might take any defence that he pleased, all actions being placed on the footing of actions *bonae fidei*. The issue to be tried was determined by the judge from the oral statements of the parties.

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[1] In Scots and ecclesiastical law the word "plea" is used as to the statements of both parties to a cause.

[2] In French law *plaider* and *plaidoyer* are still applied to the oral arguments of counsel, and in English popular speech "to plead" has much the same sense.

English System.—The English system of pleading seems to have drawn largely from, if it was not directly based upon, the Roman. Bracton (*temp.* Henry III.) uses many of the Roman technical terms. Pleading was oral as late as the reign of Henry VIII., but in the reign of Edward III. pleadings began to be drawn up in writing, perhaps at first more for the purpose of entry on the court records than for the instruction of the court (see 2 Reeves, *History of English Law*, p. 398). The French language was used until 1362, after which English was used for oral pleading, but Latin for enrolment, except for a short period during the Commonwealth. Latin was the language of written pleadings at common law until 1731. The period of the Roman *formula* has its analogue in the period of the original writ in England.[1] The writ was at first a formal commission from the Crown to a judicial officer to do justice between the parties, the claim being made by a count (*conte, narrative*). The issue of the writ was part of the prerogative of the Crown, unlimited until the Provisions of Oxford (1258) forbade the issue of fresh writs except "writs of course" (*de cursu*) without the consent of the council. Gradually the writ came to absorb the count and included the plaintiff's claim and sometimes the nature of his evidence. The defendant pleaded to the writ. The writ became the universal form of instituting proceedings in the king's court, irrespective of the method of trial which followed, and probably grew fixed in form about the reign of Henry II. (see Bigelow, *History of Procedure*, ch. iv.). At a later date the writ again tended to approach its earlier form and to split into two parts—the writ of summons and the declaration or plaintiff's claim. The writ of summons was addressed to the defendant, and not, as the original writ, to a judicial officer. The pleadings became the act of the party, differing in this from Roman law, in which they were a judicial act. The writs became precedents for the forms of action, which, like the writs, were limited in number. The plaintiff's declaration was a substantial repetition of the writ. In the writ, as in the *formula*, the slightest failure in form was as a rule fatal. "The assigning of a writ of a particular frame and scope to each particular cause of action, the appropriating process of one kind to one action and of a different kind to another, these and the like distinctions rendered proceedings very nice and complex, and made the conduct of an action a matter of considerable difficulty" (1 Reeves, *Hist. of English Law*, p. 147). Fines were levied for mistakes in pleading, non-liability to which was sometimes granted by charter as a special privilege to favoured towns. In both Roman and English law fictions, equity and legislation came to mitigate the rigour of the law. In England this result was largely attained by the framing of the action of trespass on the case under the powers of the Statute of Westminster the Second (1285), and by the extension of the action of *assumpsit* to non-feasance. The difficulties and technicalities of the common law system were met by elaboration of what is known as "special pleading,"[2] which became an art of the utmost nicety, depending on numerous rules, some of them highly technical (see Coke upon Littleton, p. 303). Those who made it their business to frame pleadings were called special pleaders. They were not necessarily members of the bar, but might be licensed to practise under the bar. At one time it was usual to practise for a time as a special pleader before call to the bar. Such licences are now rarely sought, and the *Law List* of 1906 contained only one name of a special pleader who was not a barrister. The art became necessary because of the absolute particularity with which claims must be framed, and the narrowness of the powers of amendment possessed by the courts. The result was that substantive law was smothered in procedure, and the practical questions at issue were of less moment than the phraseology in which they were to be stated. As an extreme instance, a learned judge in the 19th century challenged a pleading for putting the year without adding A.D., on the ground that "*non constat* that A.C. might not be intended."

Some of the difficulties as to amendment were removed by the statutes of Jeofails (*j'ai failli*) beginning in 1340. But until the 19th century the courts of common law and equity worked side by side in Westminster Hall, administering each their own system without due regard to the other; and even in so simple a matter as the right of a defendant to set off against a claim on him a debt due to him from the plaintiff required statutory provision. Many of the defects and technicalities of the common law system were removed by the Common Law Procedure Acts and the general rules of practice made thereunder. Wide powers of amendment were given, and the parties were allowed to raise and try claims which theretofore could have been dealt with only in courts of equity. In the court of chancery the pleadings used were bill (or in certain public matters an information by the attorney-general), answer and replication.[3] Demurrers were used, or "exceptions" could be taken to the bill or answer. They differed from the common law forms by being much more diffuse, by pleading matters of evidence, and in that the answer was on oath. Beyond the replication chancery proceedings did not go, the place of further pleadings being supplied by amendment. Exceptions might be taken to the bill or answer on various grounds. Equity pleadings were signed by counsel. On the creation of the divorce court the pleadings authorized were (and still are) as follows: petition (which must be verified by oath), answer (which is so verified if it goes beyond a mere denial) and reply; and a special pleading called "act on petition" (derived from the ecclesiastical courts) with answer thereto, generally used for the determination of some preliminary question in the suit, *e.g.* the domicile of the husband. In the court of admiralty the pleadings used were petition, answer, reply and conclusion. In the probate court the common law terms were used (declaration, plea and replication), but the procedure was not the same as in the common law courts.

Under the old common law system[4] as modified in the 19th century the pleadings in use were as follows:—

1. Declaration, made up of one or more counts (*contes*), or modes of framing the plaintiff's claim so as to state his grievances in fact in a form suggesting the appropriate remedy at law, and concluding by demand for a plea. The counts were spoken of as common or special according as the facts of the case allowed the use of common

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[1] The original writ was so called to distinguish it from the judicial writ, which was a part of the process of the court. The judicial writs still exist, *e.g.* writs of *certiorari* or *fieri facias*.

[2] The ingenuity of the pleader showing itself chiefly in framing special as opposed to general pleas, the term "special pleading" grew to be used for the whole proceedings of which it was the most important part.

[3] In Chancery the "English Bill," so called from its being in the English language, had existed, according to G. Spence, as early as the reign of Henry V. (*Equitable Jurisdiction*, i. 348).

[4] Bullen and Leake, *Precedents of Pleading* (3rd ed., 1868).

forms or required special statement. The declaration corresponds to the Roman *formula* and *intentio*.

2. Plea by the defendant to the counts of the declaration. The plea corresponds to the Roman *exceptio*.

3. Replication by the plaintiff to the plea. In this pleading the plaintiff usually took issue upon the statements in the defence; but he might do what was termed "new assign," *e.g.* complain of acts in excess of a justification alleged in the plea.

4. Rejoinder by the defendant to the replication, answering to the Roman *duplicatio*.

5. Surrejoinder by the plaintiff to the rejoinder, answering to the Roman *triplicatio*.

6. Rebutter by the defendant to the surrejoinder.

7. Surrebutter by the plaintiff to the rebutter.

Nos. 4, 5, 6 and 7 were rarely necessary, as the parties usually came to a definite issue on the facts in the replication, and the last of them is only kept in legal memory because Lord Wensleydale (the last and best versed of the old common law pleaders) was nicknamed Chief Baron Surrebutter. At any stage of the pleadings after (1), the party might instead of pleading to the preceding document demur, *i.e.* admit the facts as therein stated and contend that assuming the truth of those facts the document was insufficient in law to found a claim or a defence as the case might be. Demurrers (*q.v.*) were general or special according as they went to the substance of the claim or plea or to a mere defect in the mode of statement. When the pleadings had reached a stage at which the parties were in flat contradiction on matters of fact, they concluded by joinder of issue, upon which the record was made up and the action was ripe for trial.

Pleas fell into the following classes:—

1. In abatement, also described as temporary or dilatory (terms of Roman law), directed either to the jurisdiction of the court or to the abatement or defeat of the action for defects of form.

2. In bar, also described as peremptory, which answered the alleged cause of action by denying facts stated in the declaration which were material, or by confessing their truth, but stating new matter of fact which destroyed their legal effect.

Some of these were by way of justification or excuse, *e.g.* by setting up the truth of matter alleged to be defamatory, or legal warrant for an arrest complained of as illegal; others were by way of discharge, *e.g.* of an alleged debt by payment.

Pleas in denial were known (*a*) as general traverses or general issues, when they denied in a general and appropriate form one or more of the facts alleged (*e.g.* "never indebted" to a claim in assumpsit or "not guilty" to a claim for tort); (*b*) as specific traverses of separate and material allegations in the declaration, setting out with particularity the facts relied on.

It was permissible to plead alternatively, *i.e.* to set up a number of different answers to the facts on which the claim was based. As a general rule a plea must be "issuable," *i.e.* must put the merits of the cause in issue on the facts or the law, so that the decision of judge and jury thereon would put an end to the action upon the merits.

All the above forms of pleading, except in matrimonial causes, were abolished by the Judicature Acts, and a new system was set up by these acts and the rules of the Supreme Court. Under this system the pleadings proper are "statement of claim," "defence," "reply," and, if need be, "rejoinder."

When pleadings are allowed they must contain, and contain only, a statement in a summary form of the material facts on which the party pleading relies for his claim or defence, as the case may be, but not the evidence by which they are to be proved; and must, when necessary, be divided into paragraphs, numbered consecutively. Dates, sums and numbers are expressed in figures and not in words. Signature of counsel is not necessary; but where pleadings have been settled by counsel or a special pleader they are to be signed by him, and if not so settled they are to be signed by the solicitor or by the party if he sues or defends in person (O. 19, r. 4).[1] There has been a growing disposition to dispense with formal pleadings in the simpler kinds of action. A plaintiff is allowed to proceed to trial without pleadings if the writ of summons is endorsed in a manner sufficient to indicate the nature of his claim and the relief or remedy which he seeks (O. 18a), and contains a notice of his intention. In no case is a statement of claim other than that endorsed on the writ necessary unless the defendant on appearance asks for one, and his right to insist has been cut down by the provisions presently to be stated. In commercial cases a statement by the parties to the points of law and fact which they propose to raise is substituted for ordinary pleadings. In cases where the demand is for a liquidated sum certain, or to recover land from a tenant on expiration of his term or its forfeiture for non-payment of rent, the statement of claim must be endorsed on the writ; and in all other cases no statement of claim beyond that on the writ may be delivered except under order of the master or judge at chambers (Ords. 18a and 30). A statement of defence may not be delivered except under order made on the summons for directions (which must be taken out immediately after the appearance of the defendant in answer to the writ), nor a reply without special leave. The result of the present practice is to substitute "particulars," *i.e.* specific statement of the details which the parties intend to prove, for the more general terms in which pleadings were formerly framed.

Besides the rules applicable to all pleadings, there are certain rules specially relating to statements of claim, with reference to the nature of the causes of action which may be included and the relief which may be claimed (O. 20). As to the defence proper, there are also special rules intended to prevent evasive, inadequate or unnecessary contradiction of the plaintiff's statements (O. 19, 20). The defendant is allowed to "set off" against the claim sums due to him from the plaintiff or to raise by way of counter-claim any right or claim against the plaintiff or a third party, whether "sounding" as damages or not. The counter-claim is in substance a conjoined action in which the defendant is plaintiff and the plaintiff or third party affected may put in a defence to it. Except in such a case the reply and subsequent pleadings are now seldom permitted. Both the parties and the court or a judge have large powers of amending the pleadings both before and at the trial. Issues are in certain cases settled by the court or a judge. Demurrers are abolished, and a party is now entitled to raise by his pleading any point of law. Where decision of a point of law would put an end to the action steps may be taken for obtaining such decision so as to obviate the necessity of trying the issues of fact raised on the pleadings. Forms of pleading are given in Appendices C, D and E to the *Supreme Court Rules*. In all actions such ground of defence or reply as if not raised would be likely to take the opposite party by surprise, or would raise issues of fact not arising out of the preceding pleadings, must be specially pleaded. Such are compulsory pilotage, fraud, the Statute of Limitations, the Statute of Frauds and the Gaming Act. The *Supreme Court Rules* do not apply to proceedings in Crown suits or in the Crown side of the king's bench division. In actions for damages by collision between ships each party must as a general rule file a sealed document called a *preliminary act* containing details as to the time and place of collision, the speed, tide, lights, &c. The case may be tried on the preliminary act without pleadings, but if there are pleadings the act may not be unsealed until they are completed and certain consents given. The document was peculiar to the court of admiralty, but may now be used in all divisions of the High Court (O. 19, r. 28). The High Court system of pleadings has been adopted in the chancery courts of the counties palatine of Lancaster and Durham. The place of the "record" is supplied by copies of the pleadings delivered for the use of the judge and of the officer entering the judgment (O. 36, r. 30; O. 41, r. 1).

County Courts.

In the county courts proceedings are commenced by a *plaint*, followed by an *ordinary* or *default summons*. No "pleadings" are necessary, but the defendant is precluded from setting up certain special defences such as set-off or infancy, or statutory defences, without the consent of the plaintiff, unless he has given timely notice in writing of his intention to set up the special defence. This system is made workable by insisting on the insertion of adequate details or particulars of the nature of the claim in the plaint. But in cases where a special defence is not required considerable inconvenience is caused by uncertainty as to the line of defence.

Inferior Local Courts of Record.

In some of the local civil courts of record which have survived the creation of the county courts, the pleadings are still in the form recognized by the Common Law Procedure Acts. This is the case in the Mayor's Court of London. In others (*e.g.* the Liverpool Court of Passage and the Salford Hundred Court) the system of the Judicature Acts has been adopted with or without official sanction. The policy of the lord chancellor and the treasury has been to refuse reform of procedure to all but the most used of these local courts so as to extinguish them in favour of the county courts.

Ecclesiastical.

In the ecclesiastical courts the statements of the parties are called generally *pleas*. The statement of the plaintiff in civil suits is called a *libel*; of the promoter in criminal suits *articles*. Every subsequent plea is called an *allegation*. To the responsive allegation of the defendant the promoter may plead a counter-allegation. The cause is concluded when the parties renounce any further allegation. There exists in addition a more short and summary mode of pleading called an *act on petition*.

In Roman criminal procedure the indictment (*inscriptio* or

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[1] Before the Judicature Acts equity pleadings were signed by counsel, but common law pleadings were not.

Criminal.

libellus accusationis) was usually in writing, and contained a formal statement of the offence. In some cases oral accusations were allowed. The pleading of the accused seems to have been informal. In English criminal cases the expression "pleadings" is limited to those tried on indictment or information before a jury. In matters dealt with by justices of the peace there are informations sometimes in writing, but they are never regarded as "pleadings." English criminal pleading has been less affected by legislation than civil pleading, and retains more of what is called the common law system. Cases in which the Crown was a party early became known as "pleas of the Crown" (*placita coronae*), as distinguished from "common pleas" (*communia placita*), or pleas between subject and subject—that is to say, ordinary civil actions. Pleas of the Crown originally included all matters in which the Crown was concerned, such as exchequer cases, franchises and liberties, but gradually became confined to criminal matters, strictly to the greater crimes triable only in the king's courts. In criminal pleading the Crown states the case in an *indictment* or *information*. The answer of the accused is a *plea*, which must be pleaded by the accused in person, except in certain cases of misdemeanour tried in the High Court (*Crown Office Rules*, 1906). The plea, according to Blackstone, is either to the jurisdiction, a demurrer, in abatement, special in bar, or the general issue. The last is the only plea that often occurs in practice; it consists in the answer (usually oral) of "guilty" or "not guilty" to the charge. A demurrer is strictly not a plea at all, but an objection on legal grounds. Pleas to the jurisdiction or in abatement do not go to the merits of the case, but allege that the court has no jurisdiction to try the particular offence, or that there is a misnomer or some other technical ground for stay of proceedings. The powers of amendment given in 1851 (14 & 15 Vict. c. 100) and the procedure by motion in arrest of judgment have rendered these pleas of no practical importance. The special pleas in bar are *autrefois convict* or *autrefois acquit* (alleging a previous conviction or aquittal for the same crime) and pardon (see Pardon). The plea of *autrefois attaint* has fallen out of use since the abolition of attainder by the Forfeitures Act 1870. There are also special pleas of justification to indictments for defamatory libel under the Libel Act 1843; and to indictments for non-repair of highways and bridges the accused may plead that the liability to repair falls upon another person. These special pleas are usually, and in some cases must be, in writing. When there is a special plea in writing the Crown puts in a *replication* in writing.

Ireland.—The practice as to civil and criminal pleading in Ireland is substantially the same as in England, though to some extent based on different statutes and rules of court.

Scotland.—In Scotland an action in the Court of Session begins by a *summons* on the part of the pursuer, to which is annexed a *condescendence*, containing the allegations in fact on which the action is founded. The *pleas in law*, or statement of the legal rule or rules relied upon (introduced by the Court of Session Act 1825), are subjoined to the condescendence. The term *libel* is also used (as in Roman law) as a general term to express the claim of the pursuer or the accusation of the prosecutor. The statement of the defender, including his pleas in law, is called his *defences*. They are either dilatory or peremptory. There is no formal joinder of issue, as in England, but the same end is attained by adjustment of the pleadings and the closing of the record. Large powers of amendment and revisal are given by the Court of Session Act 1868. In the sheriff court pleadings are very similar to those in the Court of Session. They are commenced by a *petition*, which includes a condescendence and a note of the pursuer's pleas in law. The defender may upon notice lodge defences. The procedure is now governed by the Sheriff Courts Scotland Act 1876. The term "pleas of the Crown" is confined in Scotland to four offences—murder, rape, robbery and fire-raising. The criminal procedure of Scotland was simplified and amended in 1887. The old procedure by criminal letters has been abolished, and prosecutions for the public interest whether in the high court of justiciary or before the sheriff with a jury are by indictment in the name of His Majesty's advocate. The Scots indictment differs from the English in not being found by a grand jury, except in cases of high treason, and resembles rather the *ex officio* information of English law. Until 1887 it was in the form of a syllogism, the major proposition stating the nature of the crime, the minor the actual offence committed and that it constitutes the crime named in the major, the conclusion that on conviction of the panel he ought to suffer punishment. Under the present practice it is in the second person addressed to the accused, and follows the forms scheduled to the act of 1887, which also makes specific provisions for simplification, and if need be for amendment (s. 70). A copy of the indictment with a list of the witnesses and the productions must be served on the accused. There are two sittings (diets) to deal with the indictment. At the first, held before the sheriff, the accused (termed the panel) may plead guilty or raise preliminary objections to the relevancy of the indictment, &c., or otherwise (such as want of jurisdiction or *res judicata*); or without taking such objections, or after they are overruled, may plead not guilty. The second diet is the diet of trial. If the trial is before the sheriff his rulings at the first diet are final, if before the court of justiciary his rulings may be reviewed. At the second diet, besides his plea of not guilty, the panel may rely on certain special defences, *e.g.* insanity or alibi, but only if his special and written plea was tendered and recorded at the first diet or the delay explained, and he cannot call evidence in support of these pleas except on written notice specifying the names of the witnesses and the documents not included in the prosecutor's lists (s. 36). (See Macdonald, *Criminal Law of Scotland.*)

British Dominions Beyond Seas.—In most of the Australian states, and in Ontario and New Zealand, civil pleadings are governed by rules adopted from the English Judicature Acts. In New South Wales a system based on the Common Law Procedure Acts is retained. Civil pleadings in India are regulated by the Civil Procedure Code. Indictments, except in India, are based on the English system as modified by the criminal codes or other legislation of the colony. Indictments in India are regulated by the Criminal Procedure Code of 1898.

United States.—In the United States two systems of pleading in civil procedure exist side by side. Up to 1848 the pleading did not materially differ from that in use in England at the same date. But in 1848 the New York legislature made a radical change in the system, and the example of New York has been followed by many states. The New York Civil Code of 1848 established a uniform procedure called the civil action, applicable indifferently to common law and equity. The pleadings are called *complaint*, *answer* (which includes *counterclaim*) and *reply*. The *demurrer* also is still used. In some states which follow this procedure the complaint bears the name of *petition*. In inferior courts, such as courts of justices of the peace, the pleadings are more simple, and in many cases oral. In states which do not adopt the amended procedure the pleading is much the same as it was in the days of Blackstone, and the old double jurisdiction of common law and equity still remains. Criminal pleading is on the lines of the common law system of England. (W. F. C.)

PLEASURE (through Fr. *plaisir* from Lat. *placere*, to please; Gr. *ἡδονή*), a term used loosely in ordinary language as practically synonymous with "enjoyment." As such it is applied equally to what are known as the "higher" or "intellectual" pleasures, and to purely "sensual," "animal" or "lower" pleasures. The conditions under which a man is pleased are the subject both or psychological and of ethical investigation. In general it may be said that pleasure and pain follow respectively upon the success of the failure of some effort, mental or physical (see Psychology); they may also attend upon purely passive sensations, *e.g.* a warm sun, a heavy shower, or upon associations with previous states of mind (*i.e.* a man may enjoy a sensation which is intrinsically painful, if it has pleasant associations). Recognition of the fact that mankind seeks pleasure and avoids pain has led some moralists to the conclusion that all human conduct is actuated by hedonic considerations: this is the direct antithesis to ethical theories which maintain an absolute criterion of right and wrong (see Hedonism; Ethics). Aristotle took a middle view, holding that pleasure, though not the end of virtuous action yet necessarily follows upon it (*ἐπιγενόμενόν τι τέλος*).

PLEBISCITE (Lat. *plebiscitum*, a decree of the *plebs*), a term borrowed from the French for a vote of all the electors in a country taken on some specific question (see also Referendum). The most familiar example of the use of the plebiscite in French history was in 1852, when the *coup d'état* of 1851 was confirmed and the title of emperor was given to Napoleon III. In Roman constitutional law the *plebiscitum* was a decree enacted in the assembly of the *plebs*, the *comitia tributa*, presided over by a plebeian magistrate.

PLEBS (from the root seen in Lat. *plenus*, full; cf. Gr. πλῆθος), the "multitude," or unprivileged class in the early Roman state. For the origin and history of this order see Patricians and Nobility. Its disqualifications were originally based on descent; but after the political equalization of the two orders the name was applied to the lower classes of the population without reference to their descent. Under the empire the word is regularly used of the city proletariate, or of the commons as distinct from knights and senators.

PLEDGE,[1] or PAWN, in law "a bailment of personal property as a security for some debt or engagement" (Story on *Bailments*, § 286). The term is also used to denote the property which constitutes the security. Pledge is the *pignus* of Roman law, from which most of the modern law on the subject is derived. It differs from hypothec and from the more usual kind of mortgage in that the pledge is in the possession of the pledgee; it also differs from mortgage in being confined to personal property. A mortgage of personal property in most cases takes the name and form of a bill of sale. The chief difference between Roman and English law is that certain things, *e.g.* wearing apparel, furniture and instruments of tillage, could not be pledged in Roman law, while there is no such restriction in English law. In the case of a pledge, a special property passes to the pledgee, sufficient to enable him to maintain an action against a wrongdoer, but the general property, that is the property subject to the pledge, remains in the pledgor. As the pledge is for the benefit of both parties, the pledgee is bound to exercise only ordinary care over the pledge. The pledgee has the right of selling the pledge if the pledgor make default in payment at the stipulated time. No right is acquired by the wrongful sale of a pledge except in the case of property passing by delivery, such as money or negotiable securities. In the case of a wrongful sale by a pledgee, the pledgor cannot recover the value of the pledge without a tender of the amount due.

The law of Scotland as to pledge generally agrees with that of England, as does also that of the United States. The main difference is that in Scotland and in Louisiana a pledge cannot be sold unless with judicial authority. In some of the American states the common law as it existed apart from the Factors' Acts is still followed; in others the factor has more or less restricted power to give a title by pledge.

See also FACTOR and PAWNBROKING.

PLEHVE, VIATSCHESLAF KONSTANTINOVICH (1846–1904), Russian statesman, was born of Lithuanian stock in 1846. He was educated at Warsaw and studied law at the university in St Petersburg before he entered the bureaucracy in the department of justice, in which he rose rapidly to be assistant solicitor-general in Warsaw, then solicitor-general in St Petersburg, and in 1881 director of the state police. As assistant to the minister of the interior he attracted the attention of Alexander III. by the skill he showed in investigating the circumstances of the assassination of Alexander II. He received the title of secretary of state in 1894, became a member of the council of the empire, and in 1902 succeeded Sipiaguine as minister of the interior. Plehve carried out the "russification" of the alien provinces within the Russian Empire, and earned bitter hatred in Poland, in Lithuania and especially in Finland. He despoiled the Armenian Church, and was credited with being accessory to the Kishinev massacres. His logical mind and determined support of the autocratic principle gained the tsar's entire confidence. He opposed commercial development on ordinary European lines on the ground that it involved the existence both of a dangerous proletariat and of a prosperous middle class equally inimical to autocracy. He was thus a determined opponent of M. de Witte's policy. An attempt was made on his life early in 1904, and he was assassinated on the 28th of July of the same year by a bomb thrown under his carriage as he was on his way to Peterhof to make his report to the tsar; the assassin, Sasonov, was a member of the fighting organization of the socialist revolutionary party.

PLEIAD (Gr. Πλειάς), in Greek literature, the name given (by analogy from PLEIADES, below) by the Alexandrian critics to seven tragic poets who flourished during the reign of Ptolemy Philadelphus (285–247 B.C.). In French literature, in addition to the Pleiad of Charlemagne, there were two famous groups of the kind. The first, during the reign of Henri III. (1574–1589), the chief member of which was Pierre de Ronsard, sought to improve the French language and literature by enthusiastic imitation of the classics; the second, under Louis XIII. (1610–1643), consisted of authors who excelled in the composition of Latin verse.

PLEIADES, in Greek mythology, the seven daughters of Atlas and Pleïone, and sisters of the Hyades. Owing to their grief at the death of their sisters or at the sufferings of their father, they were changed into stars. In another account, the Pleiades and their mother met the hunter Orion in Boeotia, and the sight of them inflamed his passion. For five years he pursued them through the woods, until Zeus translated them all—Pleïone and her daughters, Orion, and his dog—to the sky. The Pleiades rose in the middle of May and set at the end of October, and their connexion with spring and autumn explains the legend. As bringers of the fertilizing rains of spring, which have their origin in the west, they are the daughters of Atlas; as the forerunners of the storms of autumn, they are represented as being driven onward by Orion in pursuit. The word is probably connected with *πλείων*, either in the sense of "many in number," since the stars formed a close group, resembling a bunch of grapes (hence sometimes called *βότρυς*), or as "more in number" than their sisters. Others derive the name from *πλεῖν* (to sail), because navigation began at the time of their rising. They are probably alluded to in Homer (*Odyssey*, xii. 62) as the doves (*πελειάδες*) who brought ambrosia from the west to Zeus. One of these doves was always lost during the passage of the *Planctae* (wandering rocks), referring to the fact that one of the seven Pleiades was always invisible. This was Merope, who hid her light from shame at having had intercourse with a mortal, Sisyphus. All the Pleiades became the ancestresses of divine or heroic families. They were called Vergiliae (probably connected with *ver*, spring) by the Romans.

See Hesiod, *Works and Days*, 383; Apollodorus iii. 10; Diod. Sic. iii. 60; Theocritus xiii. 25; Hyginus, *Astronom.* ii. 21; Ovid, *Fasti*, iv. 169, v. 599.

PLEIADES, ATLANTIDES or VERGILIAE, in astronomy, a group of stars situated in the constellation Taurus. They are supposed to be referred to in the Old Testament (Job. ix. 9, xxxviii. 31). This group is particularly rich in bright stars, and is full of nebulosity, but there are fewer faint stars than in equal areas of the surrounding sky; the central star is Alcyone (3rd magnitude); Pleïone and Atlas are also of the 3rd magnitude.

PLEISTOCENE, in geology, the epoch which succeeded the Pliocene; it is the last of the Tertiary periods, and hence the lower subdivision of the quaternary or modern era. The name was introduced by Sir C. Lyell in 1839 (from Gr. *πλεῖστον*, most, and *καινός*, recent), the rocks of this period containing a higher percentage of living forms than the youngest of the Tertiary formations. By many writers "Pleistocene" has been regarded as synonymous with "Glacial Period" or the "Diluvium" of some geologists. In the northern hemisphere the protracted period of glaciation, with its predominating influence upon modern topography and faunal distribution, was undoubtedly the outstanding feature of the time. The phenomena of the Glacial period (*q.v.*), which was by no means strictly limited to the northern latitudes, are dealt with under that head, but there are certain other characteristics of the Pleistocene period which bear no direct relationship to glaciation, and these will be dealt with here.

The gradual inception of colder conditions in the northern hemisphere which lead up to the more extreme conditions of glaciation clearly began in the latter part of the Pliocene period, and the effects of this cooling are seen not only in northern Europe and America but as far south as the Mediterranean. The result of this is that there is a certain indefiniteness as to the exact base line to be adopted for the Pleistocene formations; thus the Forest Bed of Cromer and certain beds in Sicily and Italy are by some authors placed in this period and by others in the Pliocene (*q.v.*). Again it is clear that in parts of northern Europe, Siberia and North America, the conditions characteristic of a glacial period are still existent; even in Scotland and Norway the last traces of glacial action are remarkably fresh, and the last remnants of great glacial centres still linger in the Alps and other lofty southern mountains. Many of the formations of this period can be shown by their fossil contents to belong to early quaternary time, but since so many of these deposits are strictly local in character, and since the fauna and flora present in any one spot have been determined by local geographical conditions which have assisted or retarded the migration of certain forms, it is a matter of extreme difficulty—one may say impossibility—to reduce the Pleistocene formations to any generally applicable chronological order. For similar reasons it is impossible to define strictly the upper limit of the formations of this period, and to say where the Pleistocene ends and where the Recent or Holocene period begins.

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[1] The word "pledge" is adapted from the O. Fr. *plege*, mod. *pleige*, security, hostage, Med. Lat. *plivium*. This is a formation form Med. Lat. *plevire* or *plebire*, to undertake or engage for some-one, cf. "replevin"; it is now considered to be a word of Teutonic origin and connected with Ger. *pflegen* and "plight."

The composition and distribution of the Pleistocene fauna and flora present many points of extreme interest. The feature of greatest importance is that man existed somewhere and in some condition before and in this period; but no really satisfactory proof has so far been forthcoming which will set back his first appearance before the beginning of the glacial period (*Pithecanthropus erectus* found by E. Dubois in Java is regarded as of Pliocene age). The presence of the remains of man or of his works might reasonably be taken as a criterion of the Pleistocene age of a deposit—if we omit the remains of historical time. But here again it has to be borne in mind that historical time is continually being set back by archaeological research, and further, the difficulty of employing *artefacs* of stone as chronological indicators is shown by the fact that even at the present day implements of stone are still in use, and that different local races of early men must have been in diverse stages of development in Pleistocene as in later ages. It is, therefore, only with the utmost caution that chronological subdivisions of the period, such as those mentioned below, based upon the form and degree of finish of stone implements, can be used in anything but local correlations unless the evidence is supported by satisfactory fossils.

Next to the appearance of man the most striking characteristic of the land fauna was the existence of numerous large-bodied mammals; *Elephas antiquus*, for instance, attained a more excessive bulk than any other proboscidean either before or since, the woolly rhinoceros, the great hippopotamus, the cave bear, cave lion and giant deer were all larger than their living representatives. No less striking is the disappearance of these large forms together with highly specialized creatures such as *Machaerodus* within the same period, through the action of the same causes which had removed the bulky and specialized reptiles of an earlier geological period. The Pleistocene mammalia of Europe include *Elephas antiquus*, *E. primogenius* (mammoth), *R. antiquitatis* (*tichorhinus*) (the woolly rhinoceros), *R. mercki* (especially in Silesia), *R. leptorhinus* (south-east Europe), *Elasmotherium* (Silesia and south Russia), *Hippopotamus major*, *Bos primigenius* (aurochs, extinct in historical time), *Bison priscus*, *Bison europaeus* (still living in the Caucasus and Lithuania), *Bos* (*Bubalus*) *pallasi* (north Europe), camels in south Russia and Rumania, *Equus fossilis* and varieties, *Cervus* (*Megaceros*) *giganteus* (=*hibernicus*) (the great Irish "elk" and its varieties); *Cervus elaphus*, *C. aleus*, *Rangifer tarandus* and *R. groenlandicus* (reindeer), *Capreolus caprea*, *Capra ibex*, *Saiga tatarica*, *Ovibos moschatus*, *Felis spelaeus*, *Hyaena spelaea*, *Ursus spelaeus*, badger, weasel, glutton, hare, lemming (*Myodes torquatus* and *M. lemmus*), *Spermophilus*, *Alactaga*, *Arctomys*, *Castor fiber*, *Lagomys*, *Trogontherium*. In North America there were numerous mammals common to Europe and North Asia, including the musk-ox, mammoth and horse; the mastodon held on into this period in America but not in Europe; there were also lamas, tapirs, camels (*Camelus auchenia*), *Machaerodus*, *Mylodon*, *Procyon*, *Alces*. In South America there was at first a very characteristic endemic fauna including *Megatherium*, *Mylodon*, *Grypotherium*, *Lestodon*, *Toxodon*, *Typotherium*, *Glyptodon*, *Macrauchenia*, *Capybara*, *Rhea*, to which were added later, *Mastodon*, *Machaerodus*, *Lama* and other North American forms. In Australia a very distinct assemblage of large marsupials and monotremes lived in the Pleistocene period; including *Phascolus*, *Diprotodon*, *Thylacoleo*, *Nototherium* and a large extinct *Echidna*; placental mammals were not then known in this region. In Madagascar the *Aepiornis*, *Megaladapis*, and certain extinct lemuroid creatures have left their remains.

The advance and retreat of glacial conditions in northern latitudes had a marked influence upon animal and plant life, and was the means of determining the present distribution of many of the living mammalia and plants; some were driven permanently southward, some northern forms still live isolated on the higher mountain regions, others like the reindeer and musk-ox returned northward as soon as the conditions permitted. The apparently curious admixture of what are now often regarded as tropical or sub-tropical forms (lion, hyena, rhinoceros and elephants) with cold-temperate or arctic genera, presents no real difficulty, since their distribution was doubtless merely a matter of food supply; and some of these, like the woolly rhinoceros and mammoth, were provided with a thick hairy pelt.

Although in the main the arrangement of land and sea was little different from that which obtains at the present time, one or two features existed in the Pleistocene period which had a considerable influence on faunal migration. For instance, the absence of the Bering Straits permitted free communication between Europe and North America, and the absence of the Straits of Dover allowed a similar interchange between Great Britain and France; while an extension of the sea in the Caspian region and of the Arctic Sea in northern Russia acted as a bar to free passage between Europe and Asia in those regions.

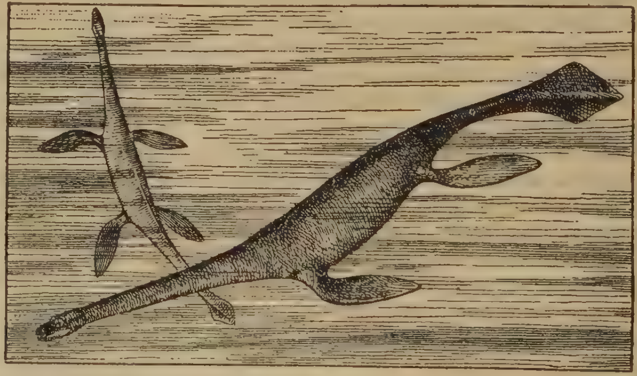
The formations of Pleistocene age, other than those of direct glacial origin, include deposits on the floors of caves in limestone and dolomitic rocks, calcareous sinter (travertine or tufa) formed by springs, ancient river and lake alluvial and lacustrine terraces, elevated marine beaches, submerged forests, ancient lake deposits and peat beds, laterite, loess and sand dunes.

Some of the prevalent styles of classifying the deposits of the glacial formations of this period are mentioned in the article GLACIAL PERIOD. The following subdivisions are often employed by European geologists: a younger division, Reindeer time = Magdalénien[1] stage; a middle division, Mammoth time = Salutréen[2] stage; and an older division, *Elephas antiquus* time = Chelléen[3] stage. While some authors include all the above in the "glacial period," others would place the Magdalénien in a post-glacial division. The terms Magdalénien, &c., are really archaeological, based upon the characters of the implements found in the deposits, and like the similar terms "eolithic" and "palaeolithic" they are of little value in geological chronology unless they are supported by palaeontological evidence.

See E. Geinitz, *Das Quartär von nord Europa* (Stuttgart, 1904), with very full references; T. C. Chamberlin and R. D. Salisbury, *Geology*, vol. iii. (New York, 1906), for references to American authorities. (J. A. H.)

PLEONASM (Gr. πλεονασμός, from πλεονάζειν, to abound or be superfluous, πλέον, comparative of πολύς, many, great, large), redundancy or superfluity in speaking or writing, hence an unnecessary work or phrase. The word, more usually in the Latin form "pleonasmus," is used in pathology of an abnormal growth or formation.

PLESIOSAURUS, an extinct marine reptile belonging to the Order Sauropterygia, which characterized the Mesozoic period and had an almost world-wide distribution (see REPTILES). The animal is best known by nearly complete skeletons from the Lias of England and Germany. It was named *Plesiosaurus* (Gr. more-lizard) by W. D. Conybeare in 1821, to indicate that it was much more nearly a normal reptile than the strange *Ichthyosaurus*, which had been found in the same Liassic formation a few years previously. It has a small head, a long and slender neck, a round body, a very short tail, and two pairs of large, elongated paddles. The snout is short, but the gape of the mouth is wide, and the jaws are provided with a series of conical teeth in sockets, much like those of the living gavial



(From a memoir by Professor W. Dames in the *Abhandlungen der kg. preuss. Akad. d. Wiss.*)

Plesiosaurus guilelmi-imperatoris, restored.

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[1] Magdalénien from the caves of Madelaine, Perigord.

[2] Salutré, Bourgogne.

[3] Chelles, near Paris. Other subordinate stages are the Moustérien from Moustier, Dordogne, and Acheuléen, Saint Acheul.

of Indian rivers. The neck, though long and slender, must have been rather stiff, because the bodies of the vertebrae are nearly flat-ended, while they bear short ribs: it could not have been bent in the swan-fashion represented in many restorations. The other vertebrae are similarly almost flat-ended and firmly united, but there is no sacrum. The ribs are single-headed, and in the middle of the trunk, between the supports of the paired limbs, they meet a dense plastron of abdominal ribs. The short tail is straight and rapidly tapering, but one specimen in Berlin suggests that it was provided with a rhomboidal flap of skin in a vertical plane. The bones in the ventral wall of the body which support the paired limbs are remarkably expanded, and those of the pectoral arch have often been compared with the corresponding bones of turtles. The limbs are elongated paddles, with five complete digits, of which the constituent bones (phalanges) are unusually numerous. The only traces of skin hitherto discovered suggest that it was smooth. The reptile must have been almost exclusively aquatic, feeding on cuttle-fishes, fishes and other animal prey. It propelled itself chiefly by the paddles, scarcely by the tail.

The typical species is *Plesiosaurus dolichodeirus*, from the Lower Lias of Lyme Regis, which attains a length of about three metres. Other species from the same formation seem to have measured five to six metres in length, and there are species of allied genera from the Upper Lias which are probably still larger. A fine large skeleton from the Upper Lias of Württemberg, now in the Berlin Museum, is named *Plesiosaurus guilelmi-imperatoris* (see figure above). *Cryptoclidus*, known by complete skeletons from the Oxford Clay of Peterborough, differs very little from *Plesiosaurus*. The Cretaceous *Cimoliosaurus*, found in North and South America, Europe and New Zealand, is also very similar. The fossilized contents of the stomach in some of the later Plesiosaurs show that these reptiles swallowed stones for digestive purposes like the existing crocodiles.

References.—R. Owen, *Fossil Reptilia of the Liassic Formations*, pt. iii. (Monogr. Palaeont. Soc., 1865); W. Dames, paper in *Abhandl. k. preuss. Akad. Wiss.* (1895), p. 1. (A. S. Wo.)

PLEURISY, or Pleuritis (Gr. πλεῦρα = ribs), inflammation of the pleura, caused by invasion by certain specific micro-organisms. (See Respiratory System: *Pathology*.) Secondary pleurisies may occur from extension of inflammation from neighbouring organs.

The morbid changes which the pleura undergoes when inflamed consist of three chief conditions or stages of progress. (1) Inflammatory congestion and infiltration of the pleura, which may spread to the tissues of the lung on the one hand, and to those of the chest wall on the other. (2) Exudation of lymph on the pleural surfaces. This lymph is of variable consistence, sometimes composed of thin and easily separated pellicles, or of extensive thick masses or strata, or again showing itself in the form of a tough membrane. It is of greyish-yellow colour, and microscopically consists mainly of coagulated fibrin along with epithelial cells and red and white blood corpuscles. Its presence causes roughening of the two pleural surfaces, which, slightly separated in health, may now be brought into contact by bands of lymph extending between them. These bands may break up or may become organized by the development of new blood vessels, and adhering permanently may obliterate throughout a greater or less space the pleural sac, and interfere to some extent with the free play of the lungs. (3) Effusion of fluid into the pleural cavity. This fluid may vary in its characters.

The chief varieties of pleurisy are classified according to the variety of the effusion, should effusion take place. (1) Some pleurisies do not reach the stage of effusion, the inflammation terminating in the exudation of lymph. This is termed *dry pleurisy*. (2) Fibrinous or plastic pleurisy. In this variety the pleura is covered by a thick layer of granular, fibrinous material. Fibrinous pleurisy is usually secondary to acute diseases of the lung such as pneumonia, cancer, abscess or tuberculosis. (3) Sero-fibrinous pleurisy. This is the most common variety, and produces the condition commonly known as pleurisy with effusion. The amount may vary from an almost inappreciable quantity to a gallon or more. When large in quantity it may fill to distension the pleural sac, bulge out the thoracic wall externally, and compress the lung, which may in such cases have all its air displaced and be reduced to a mere fraction of its natural bulk. Other organs, such as the heart and liver, may in consequence of the presence of the fluid be shifted away from their normal position. In favourable cases the fluid is absorbed more or less completely and the pleural surfaces again may unite by adhesions; or, all traces of inflammatory products having disappeared, the pleura may be restored to its normal condition. When the fluid is not speedily absorbed it may remain long in the cavity and compress the lung to such a degree as to render it incapable of re-expansion as the effusion passes slowly away. The consequence is that the chest wall falls in, the ribs become approximated, the shoulder is lowered, the spine becomes curved and internal organs permanently displaced, while the affected side scarcely moves in respiration. Sometimes the unabsorbed fluid becomes purulent, and an *empyema* is the result.

The symptoms of pleurisy vary; the onset is sometimes obscure but usually well marked. It may be ushered in by rigors, fever and a sharp pain in the side, especially on breathing. Pain is felt in the side or breast, of a severe cutting character, referred usually to the neighbourhood of the nipple, but it may be also at some distance from the affected part, such as through the middle of the body or in the abdominal or iliac regions. On auscultation the physician recognizes sooner or later "friction," a superficial rough rubbing sound, occurring only with the respiratory acts and ceasing when the breath is held. It is due to the coming together during respiration of the two pleural surfaces which are roughened by the exuded lymph. The pain is greatest at the outset, and tends to abate as the effusion takes place. A dry cough is almost always present, which is particularly distressing owing to the increased pain the effort excites. At the outset there may be dyspnoea, due to fever and pain; later it may result from compression of the lung.

On physical examination of the chest the following are among the chief points observed: (1) On inspection there is more or less bulging of the side affected, should effusion be present, obliteration of the intercostal spaces, and sometimes elevation of the shoulder. (2) On palpation with the hand applied to the side there is diminished expansion of one-half of the thorax, and the normal vocal fremitus is abolished. Should the effusion be on the right side and copious, the liver may be felt to have been pushed downwards, and the heart somewhat displaced to the left; while if the effusion be on the left side the heart is displaced to the right. (3) On percussion there is absolute dullness over the seat of the effusion. If the fluid does not fill the pleural sac the floating lung may yield a hyper-resonant note. (4) On auscultation the natural breath sound is inaudible over the effusion. Should the latter be only partial the breathing is clear and somewhat harsh, with or without friction, and the voice sound is aegophonic. Posteriorly there may be heard tubular breathing with aegophony. These various physical signs render it impossible to mistake the disease for other maladies the symptoms of which may bear a resemblance to it, such as pleurodynia.

The absorption or removal of the fluid is marked by the disappearance or diminution of the above-mentioned physical signs, except that of percussion dullness, which may last a long time, and is probably due in part to the thickened pleura. Friction may again be heard as the fluid passes away and the two pleural surfaces come together. The displaced organs are restored to their position, and the compressed lung re-expanded. Frequently this expansion is only partial.

In most instances the termination is favourable, the acute symptoms subsiding and the fluid (if not drawn off) becoming absorbed, sometimes after reaccumulation. On the other hand it may remain long without undergoing much change, and thus a condition of *chronic pleurisy* becomes established.

Pleurisy may exist in a latent form, the patient going about for weeks with a large accumulation of fluid in his thorax, the ordinary acute symptoms never having been present in any marked degree. Cases of this sort are often protracted, and their results unsatisfactory as regards complete recovery.

In the treatment of early pleurisy, pain may be relieved by a hypodermic of morphia or the application of leeches. A purgative is essential. Fixation of the affected side of the thorax by strapping with adhesive plaster gives great relief. The ice-bag is useful in the early stages, as in pneumonia. The open-air treatment of cases is recommended, as the majority of the cases are of tuberculous origin. When effusion has taken place, counter irritation and the exhibition of iodide of potassium are useful. Dry diet and saline purgatives have been well spoken of. The most satisfactory method of treatment is *early* and if necessary repeated aspiration of the fluid. The operation (*thoracentesis*) was practised by ancient physicians, but was revived in modern times by Armand Trousseau (1801–1867) in France and Henry I. Bowditch (1808–1892) in America; by the latter an excellent instrument was devised for emptying the chest, which, however, has been displaced in practice by the still more convenient aspirator. The chest is punctured in the lateral or posterior regions, and in most cases the greater portion or all of the fluid may be safely drawn off. In many instances not only is the removal of distressing symptoms speedy and complete, but the lung is relieved from pressure in time to enable it to resume its normal function.

In cases of chronic pleurisy after the failure of repeated aspirations, Samuel West reports well of free incision and drainage. He has reported cases of recovery of effusion, fifteen or eighteen months standing. Sir James Barr has advocated the treatment of these cases by the withdrawal of the fluid and the substitution of sterilized air and solution of supra-renal extract; others have introduced physiological salt solution or formalin solution into the cavity, after the removal of the fluid. Vaquez injects nitrogen into the cavity and reports a number of cases in which it prevented recurrence.

PLEURO-PNEUMONIA, or Lung-Plague, a contagious disease peculiar to cattle, generally affecting the lungs and the lining membrane of the chest, producing a particular form of lobar or lobular pleuro-pneumonia, and, in the majority of cases, transmitted by the living diseased animal, or, exceptionally, by mediate contagion. It cannot be communicated to animals other than those of the bovine race. Inoculation of healthy cattle with the fluid from the diseased lungs produces, after a certain interval, characteristic changes at the seat of inoculation, and though it does not develop the lung lesions always observed in natural infection, yet there is a local anatomical similarity or identity. Though numerous investigations have been made, the nature of the infective agent remains doubtful. In 1888 Arloing, of Lyons, described various bacilli obtained from the lesions, but the pathogenic organism of lung-plague has not been discovered.

The earliest notices of this disease testify that it first prevailed in central Europe, and in the 18th century it was present in certain parts of southern Germany, Switzerland and France, and had also appeared in upper Italy. Though Valentine described an epizooty occurring among cattle in 1693 in Hesse, doubts have been entertained as to whether it was this malady. It was not until 1769 that it was definitely described as prevailing in Franche-Comté by the name of "murie." From that date down to 1789 it appears to have remained more or less limited to the Swiss mountains, the Jura, Dauphiné and Vosges, Piedmont and upper Silesia; it showed itself in Champagne and Bourbonnais about the time of the Revolution, when its spread was greatly accelerated by the wars that followed. In the 19th century its diffusion was accurately determined. It invaded Prussia in 1802, and soon spread over north Germany. It was first described as existing in Russia in 1824; it reached Belgium in 1827, Holland in 1833, the United Kingdom in 1841, Sweden in 1847, Denmark in 1848, Finland in 1850, South Africa in 1854, the United States—Brooklyn in 1843, New Jersey in 1847, Brooklyn again in 1850 and Boston in 1850; it was also carried to Melbourne in 1858, and to New South Wales in 1860; New Zealand and Tasmania received it in 1864, but it was eradicated in both countries by the sanitary measures adopted. It was carried to Asia Minor, and made its presence felt at Damascus. It prevails in various parts of China, India, Africa and Australia, and until quite recently it existed in every country in Europe, except Scandinavia, Holland, Spain and Portugal. In Great Britain cases occurred in 1897.

Symptoms.—The malady lasts from two to three weeks to as many months, the chief symptoms being fever, diminished appetite, a short cough of a peculiar and pathognomonic character, with quickened breathing and pulse, and physical indications of lung and chest disease. Towards the end there is great debility and emaciation, death generally ensuing after hectic fever has set in. Complete recovery is rare.

The pathological changes are generally limited to the chest and its contents, and consist in a peculiar marbled-like appearance of the lungs on section, and fibrinous deposits on the pleural membrane, with oftentimes great effusion into the cavity of the thorax.

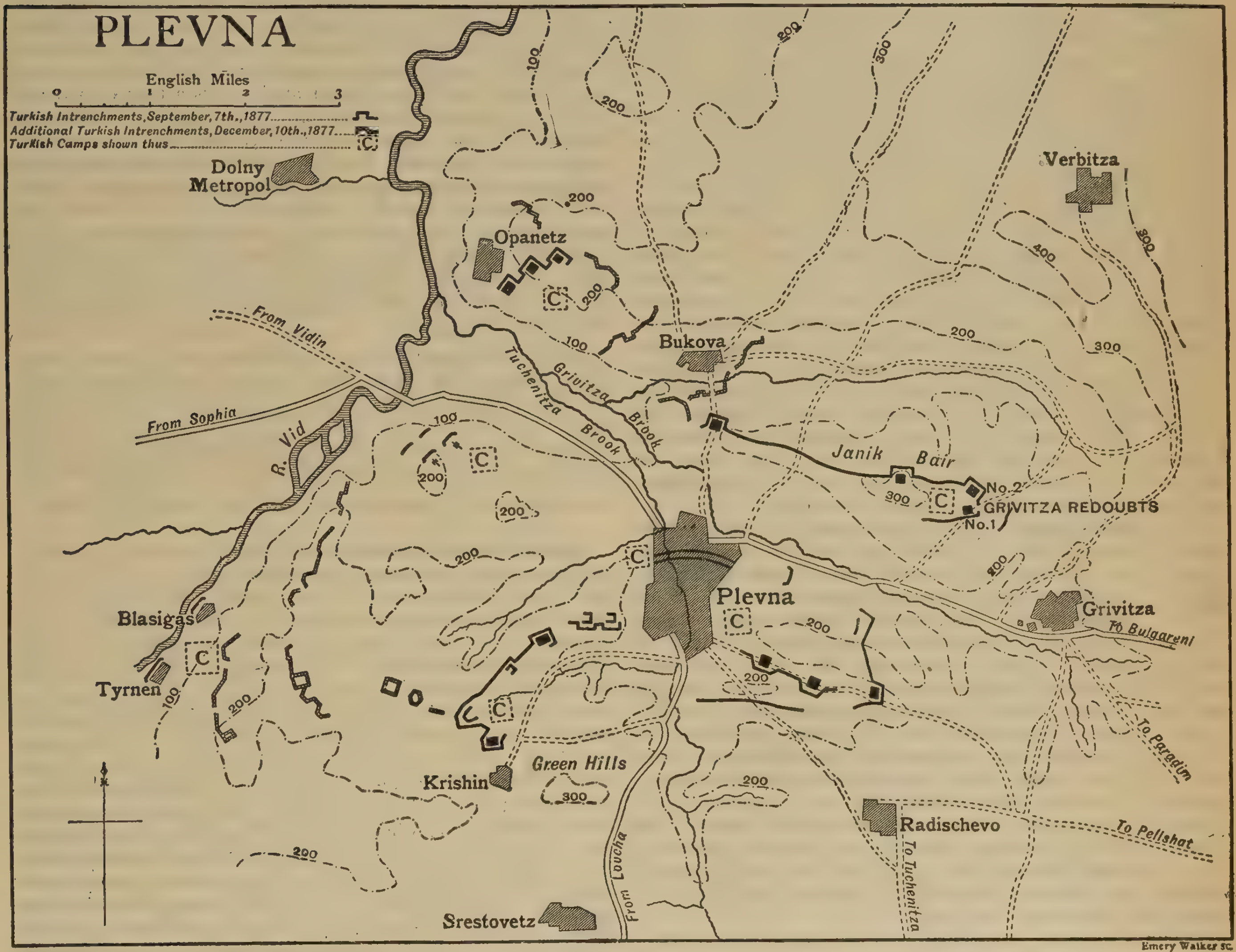
Willems of Hasselt (Belgium) in 1852 introduced and practised inoculation as a protective measure for this scourge, employing for this purpose the lymph obtained from a diseased lung. Since that time inoculation has been extensively resorted to, not only in Europe, but also in Australia and South Africa, and its protective value has been generally recognized. When properly performed, and when certain precautions are adopted, it would appear to confer temporary immunity from the disease. The usual seat of inoculation is the extremity of the tail, the virus being introduced beneath the skin by means of a syringe or a worsted thread impregnated with the lymph. Protection against infection can also be secured by subcutaneous or intravenous injection of a culture of Arloing's pneumo-bacillus on Martin's bouillon, and by intravenous injection of the lymph from a diseased lung, or from a subcutaneous lesion produced in a calf by previous inoculation.

PLEVNA (Bulgarian *Pleven*), the chief town of the department of Plevna, Bulgaria; 85 m. N.E. of Sofia, on the Tutchinitza, an affluent of Vid, which flows north into the Danube and on the Sofia-Varna railway (opened in 1899). Pop. (1906), 21,208. A branch line, 25 m. long, connects Plevna with Samovit on the Danube, where a port has been formed. After the events of 1877, it was almost entirely forsaken by the Turks, and most of the mosques have gone to ruin; but, peopled now mainly by Bulgarians, it has quite recovered its prosperity, and has a large commerce in cattle and wine.

Battles of 1877.—Plevna, prior to the Russo-Turkish War of 1877 (see Russo-Turkish Wars) a small and unknown town without fortifications became celebrated throughout the world as the scene of Osman Pasha's victories and his five months' defence of the entrenched camp which he constructed around the town, a defence which upset the Russians' plans and induced them to devote their whole energies to its capture. Osman Pasha left Widin on the 13th of July with a column consisting of 19 battalions, 6 squadrons and 9 batteries, a total of 12,000 men and 54 guns. Hearing that he was too late to relieve Nikopol, he pushed on to Plevna, where there was a garrison of 3 battalions and 4 guns, under Atouf Pasha.

The First Battle of Plevna.

Passing through Plevna on the afternoon of the 19th of July he at once took up a position, previously selected by Atouf Pasha, on the hills covering the town to the north and east. The column had been joined *en route* by 3 battalions from the banks of the Danube, so that Osman's command now consisted of 25 battalions. He was none too soon. General Schilder-Schuldner, commanding the 5th division of the IX. corps, which had just captured Nikopol, had been ordered to occupy Plevna, and his guns were already in action. The Turkish batteries came into action as soon as they arrived and returned the fire. A desultory artillery duel was carried on till nightfall, but no attack was made by the Russians on the 19th. Osman distributed his troops in three sections: on the Janik Bair, facing north, were 13 battalions and 4 batteries, with advanced posts of 2 battalions and 1 battery each, at Opanetz and Bukova, facing east and north-east, 5 battalions and 10 guns were posted on the eastern end of the Janik Bair; to the hills south of the Bulgareni road 4 battalions and 2 batteries were allotted, and on either side of the road, under cover, in rear of them, most of the cavalry was placed. The remaining troops formed a general reserve, which was posted on the hill just east of the town. The hills to the north and east of Plevna were perfectly bare. The Turks had covered the 115 m. from Widin in seven days, in trying heat, and were exhausted, but a few trenches were thrown up. On the 20th of July at 5 a.m., having made no preliminary reconnaissance, the Russian commander brought his guns into action, and, after a short bombardment, advanced his infantry in four separate columns. On the north flank they pressed into Bukova, and also succeeded in driving back the Turkish right wing; but in both cases Turkish reinforcements arrived and with vigorous counter-attacks pressed back the Russians, with the result that by noon they were in full retreat, having lost 2800 men out of a total of 8000. The Turks lost 2000. Osman made no attempt to reap the fruits of his victory by pursuit. He at once drew up plans for the fortification of the position, and the troops were employed night and day constructing redoubts and entrenchments. A plentiful supply of tools and daily convoys of stores reached Plevna from Orchanie, and on the 24th of July Osman's strength was increased by 14 battalions and a battery from Sofia. In order to secure his line of communications, on the 25th of July he sent a force of 6 battalions and 1 battery under Rifaat Pasha to occupy Lovcha (Lovatz), where they entrenched themselves.


PLEVNA
English Miles
0
1
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3
Turkish Intrenchments, September, 7th., 1877
Additional Turkish Intrenchments, December, 10th., 1877
Turkish Camps shown thus
C
Dolny Metropol
Opanetz
Bukova
Verbitza
From Vidin
From Sophia
R. Vid
Tuchenitza Brook
Grivitza Brook
Janik Bair
No. 2
No. 1
GRIVITZA REDOUBTS
Plevna
Grivitza
To Bulgareni
To Paradim
To Pellshat
To Tuchenitza
Radischevo
Green Hills
Krishin
From Lovcha
Srestovetz
Blasigas
Tyrnen
100
200
300
400

Emery Walker sc.

The Plevna garrison now numbered 20,000 (35 battalions, 8 squadrons, 57 guns and 400 mounted irregulars), who were organized in two wings with a general reserve. Adil Pasha commanded the left wing consisting of 12 battalions, 3 batteries and 2 squadrons, and held the ground from the Vid bridge to Grivitza, Hassan Sabri Pasha commanded the right wing, of equal strength, covering from Grivitza to the south. The remainder, as general reserve, was posted on the crest and slopes of the hill east of the town, with one battalion in Plevna itself. The west front was not fortified till October. Trenches were 4 ft. deep and the redoubts had a command of 10 to 16 ft., with parapets about 14 ft. thick. In addition to the trenches to the flanks, there were in some cases two lines of trench to the front, thus giving three tiers of fire.

Second Battle of Plevna.

In accordance with orders from the Russian headquarters at Tirnova, a fresh attack was made by General Krüdener on the 30th of July. He had been reinforced by three brigades of infantry and one of cavalry under General Shakovskoi, and his force numbered over 30,000 with 176 guns. After a preliminary cannonade the infantry advanced at 3 p.m., as before in widely spread columns. The columns attacking from the north and north-east were repulsed with heavy loss. Shakovskoi advancing from Radischevo, his left flank safeguarded by Skobelev from the neighbourhood of Krishin, temporarily occupied two redoubts, but a heavy counter-stroke by the Turkish reserves forced him back with severe loss. The Russians retreated, the northern column to Tristenik and Karagakh, the southern to Poradim. Their losses amounted to 7300, while the Turkish losses exceeded 2000. Had the Turkish garrison of Lovcha been called in, the result would have been still more disastrous to the Russians.

The victory was decisive, but Osman again failed to pursue. His troops were elated by success, the moral of the enemy severely shaken, the undefended Russian bridge over the Danube was within 40 m. of him, but he lost his opportunity, and contented himself with strengthening his defensive works. It is said that he was tied down to Plevna by orders from Constantinople.

The Russians now concentrated all their available forces against Plevna and called in the aid of the Rumanians. By the end of August they had assembled a force of 74,000 infantry, 10,000 cavalry and 440 guns, including 24 siege guns, about 100,000 men in all. On the 30th of August Osman moved out of Plevna with all his cavalry, 3 batteries of artillery and 19 battalions of infantry, and on the 31st attacked the Russians about Pelishat. He returned to Plevna the same evening. The Turks lost 1300 and the Russians 1000 men. The Russians determined to occupy Lovcha, and so cut Osman's communications before again attacking Plevna. After three days' fighting this was accomplished by Skobelev, acting under Imeretinski, with a force of 20,000 men, on the 3rd of September. Osman moved out to the relief of the garrison that day with a strong column, but, finding he was too late, returned to Plevna on the 6th. The survivors from Lovcha were re-formed into 3 battalions, including which Osman had been reinforced by 13 battalions, 2½ batteries of artillery and 11 squadrons of cavalry. His strength was now 30,000, with 72 guns, 46 battalions, 19 squadrons and 12 batteries. This force was organized in 4 approximately equal commands, the northern, south-eastern and southern, and a general reserve.

Third Battle of Plevna.

The Russians moved to their preliminary positions on the night of September 6th–7th. Their plan was for the Rumanians, the IX. and IV. corps and Imeretinski's column to attack the north-east, south-east and south fronts simultaneously. An artillery bombardment began at 6 a.m. on the 7th of September, was carried on till 3 p.m. on the 11th, when the infantry advanced. The Rumanians took one Grivitza redoubt; Skobelev occupied two redoubts on the south front, but the centre attack on the Radishevo front failed. On the 12th the Turks recaptured the southern redoubts, the Rumanians remained in possession of the Grivitza redoubt, but the Russian losses already amounted to 18,000 and they withdrew, and entrenched themselves on a line Verbitza-Radishevo, with cavalry on either flank to the Vid. The Turkish losses totalled 5000, of which only a few hundred were caused by the artillery fire of the first few days. There was no question of pursuit. The Russians were greatly superior in numbers and the Turks were completely exhausted.

Several causes contributed to the Russian defeat. The Russian bombardment, at ranges beyond the powers of their guns and lacking the co-operation of the infantry to give them a target, had been useless. No reconnaissance had been made of the position. The infantry attacks were not simultaneous, and were beaten in detail, besides which, they were spread over the whole of a strongly fortified front in equal strength, instead of being pressed home at definite points. The lack of unity of command, in that the commander-in-chief interfered with the dispositions and conduct of the operations as arranged by the commander of the Plevna forces also militated against the Russian success.

Investment and Fall of Plevna.

This was the last open-force attack on Osman's lines. General Todleben, the defender of Sevastopol, was now entrusted with the conduct of the siege, and he determined to complete the investment, which was accomplished by the 24th of October, Osman's request to retire from Plevna having been refused by Constantinople. Supplies eventually gave out and a sortie on the night of the 9th–10th of December failed, with the result that he and his army capitulated.

Plevna is a striking example of the futility of the purely passive defence, which is doomed to failure however tenaciously carried out. Osman Pasha repelled three Russian attacks and practically held the whole Russian army. It remained for the other Turkish forces in the field to take the offensive and by a vigorous counterstroke to reap the fruits of his successes. Victories which are not followed up are useless. War without strategy is mere butchery. The position of Plevna, threatening the Russian bridge and communications, was strategically important, but there was no necessity for the Russians to attack the position. On the eastern flank was an army stronger than Osman's and the fortress of Rustchuk was nearer the bridge than Plevna, but they did not consider it necessary to attack them. They might have contained Osman's force as they did the army under Mehemet Ali, and either awaited his attack or attacked when he evacuated the position. They failed to realize the resisting force of improvised fortifications and the strength conferred by extensive and well-placed entrenchments, and despising their adversary made direct frontal attacks on a well-fortified position, instead of aiming at a flank or the rear. The part played by Plevna in the war was due in the first place to the imaginary importance set by the Russians on its capture, and later to their faulty procedure in attack on the one hand, and to the skill evinced by the Turks in fortifying and defending the position on the other. (J. H. V. C.)

See W. V. Herbert, *The Defence of Plevna, 1877* (London, 1895); F. V. Greene, *The Russian Army and its Campaign in Turkey* (London, 1880); General Kuropatkin (Ger. trans. by Krahmer), *Kritische Rückblicke auf den russisch-türkischen Krieg*; Mouzaffer Pacha and Talaat Bey, *Défense de Plevna*; Krahmer's German translation of the Russian Official History; General H. Langlois, *Lessons of Two Recent Wars* (Eng. trans., War Office, 1910); Th. von Trotha, *Kampf um Plewna* (Berlin, 1878); Vacaresco (Ger. trans.), *Rumäniens Antheil am Kriege, 1877–1878* (Leipzig, 1888).

PLEYEL, IGNAZ JOSEPH (1757–1831), Austrian musician, was born at Ruppersthal, near Vienna, on the 1st of June 1757, the twenty-fourth son of a poor village schoolmaster. He studied the pianoforte under Van Hal (known in England as Vanhall), and in 1772 learned composition from Haydn, who became his dearest friend. He was appointed temporary *maître de chapelle* at Strasburg in 1783, receiving a permanent appointment to the office in 1789. In 1791 he paid a successful visit to London. He narrowly escaped the guillotine on returning to Strasburg, and was only saved by the existence of a cantata which he had written, and in which the inspiration could fairly be claimed to be on the side of liberty; so that he was permitted to remain until 1795, when he migrated to Paris. Here he opened a large music shop, published the first complete edition of Haydn's quartets, and founded, in 1807, the pianoforte manufactory which still bears his name. The latter years of his life were spent in agricultural pursuits. The July revolution of 1830 inflicted upon him a severe shock, and on the 14th of November 1831 he died in Paris.

MARIA PLEYEL, *née* Moke (1811–1875), the wife of his eldest son, Camille, was one of the most accomplished pianists of her time.

PLIGHT, an homonymous word now used chiefly with two meanings, (1) pledge, and (2) condition or state. The first appears more generally in the verbal form, "to plight one's troth," &c., and the second with a direct or implied sense of misfortune. The derivations of the two words show they are quite distinct in origin. The O. Eng. *pliht* meant danger or risk, hence risk of obligation (cf. Ger. *Pflicht*, Du. *plicht*, care, duty). The root *pleh-* or *pleg-* is probably also to be seen in the much disputed word "pledge." The M. Eng. *plit* or *plyt*, on the other hand, is an adaptation of O. Fr. *ploit*, fold, and therefore a doublet of "plait," but appears in the 14th century with the neutral sense of condition or state in general.

PLIMER, ANDREW (*c.* 1763–1837), English miniature painter, was the son of a clock-maker at Wellington. Disliking his father's business, he and his brother Nathaniel joined a party of gypsies and wandered about with them, eventually reaching London, where he presented himself to Mrs Cosway in 1781 and was engaged by her as studio boy. His skill in painting was quickly detected by Cosway, who sent him to a friend to learn drawing, and then received him into his own studio, where he remained until 1785, when he set up for himself in Great Maddox Street. It was of this artist that Cosway said "Andrew will be my Elisha," adding with characteristic vanity, "if I am not constrained to carry my mantle up to Paradise with me." Plimer married Joanna Louisa Knight, whose sister, Mary Ann, was his pupil and a well-known artist. He had five children, only one of whom, Louisa, married. He exhibited many times in the Royal Academy, resided for a while in Exeter, travelled a good deal through England, and died at Brighton and was buried at Hove. His miniatures are of great brilliance and in considerable demand among collectors. They are to be distinguished by the peculiar wiry treatment of the hair and by the large full expressive eyes Plimer invariably gave to his female sitters, eyes resembling those of his own wife and daughters.

See *Andrew and Nathaniel Plimer*, by G. C. Williamson (London, 1903). (G. C. W.)

PLIMER, NATHANIEL (1757–*c.* 1822), English miniature painter, was the brother of Andrew Plimer (*q.v.*). He worked for a while with Henry Bone the enameller, eventually entering Cosway's studio. He exhibited at the Royal Academy from 1787 until 1815, when he is lost sight of, although he is said to have lived until 1822. He had four daughters, one of whom married the painter, Andrew Geddes, and left children. He exhibited twenty-six works, and many of his smaller portraits are of extreme beauty.

See *Andrew and Nathaniel Plimer*, by G. C. Williamson (London, 1903). (G. C. W.)

PLIMSOLL, SAMUEL (1824–1898), British politician and social reformer, was born at Bristol on the 10th of February 1824. Leaving school at an early age, he became a clerk, and rose to be manager of a brewery in Yorkshire. In 1853 he endeavoured to set up a business of his own in London as a coal merchant. The venture proved a failure, and Plimsoll was reduced to destitution. He has himself related how for a time he lived in a common lodging-house on 7s. 9½d. a week. Through this experience he learnt to sympathize with the struggles of the poor; and when the success of his enterprise placed him in possession of a competence, he resolved to devote his leisure to the amelioration of their lot. His efforts were directed more especially against what were known as "coffin-ships"—unseaworthy and overloaded vessels, often heavily insured, in which unscrupulous owners were allowed by the law to risk the lives of their crews. Plimsoll entered parliament as Liberal member for Derby in 1868, and endeavoured in vain to pass a bill dealing with the subject. In 1872 he published a work entitled *Our Seamen*, which made a great impression throughout the country. Accordingly, on Plimsoll's motion in 1873, a royal commission was appointed, and in 1875 a government bill was introduced, which Plimsoll, though regarding it as inadequate, resolved to accept. On the 22nd of July, the premier, Disraeli, announced that the bill would be dropped. Plimsoll lost his self-control, applied the term "villains" to members of the house, and shook his fist in the Speaker's face. Disraeli moved that he be reprimanded, but on the suggestion of Lord Hartington agreed to adjourn the matter for a week to allow Plimsoll time for reflection. Eventually Plimsoll made an apology. The country, however, shared his view that the bill had been stifled by the pressure of the shipowners, and the popular agitation forced the government to pass a bill, which in the following year was amended into the Merchant Shipping Act. This gave stringent powers of inspection to the Board of Trade. The mark that indicates the limit to which a ship may be loaded is generally known as Plimsoll's mark. Plimsoll was re-elected for Derby at the general election of 1880 by a great majority, but gave up his seat to Sir W. Harcourt, in the belief that the latter, as home secretary, could advance the sailors' interests more effectively than any private member. Though offered a seat by some thirty constituencies, he did not re-enter the house, and subsequently became estranged from the Liberal leaders by what he regarded as their breach of faith in neglecting the question of shipping reform. He held for some years the presidency of the Sailors' and Firemen's Union, raised a further agitation, marred by obvious exaggeration, about the horrors of the cattle-ships. Later he visited the United States with the object, in which he did good service, of securing the adoption of a less bitter tone towards England in the historical textbooks used in American schools. He died at Folkestone on the 3rd of June 1898.

PLINLIMMON (*Plynlimmon*, *Pumplumon*, *Pumlumon*, *Penlumon*: Pumlumon is the name used locally: *pump* means five: *lumon*, chimney, flag or beacon; *pen*, head), a mountain of Wales of the height of 2463 ft., equidistant (about 10 m.) from Machynlleth and Llanidloes. Much inferior in elevation to Snowdon or Cader Idris, Plinlimmon is certainly the most dangerous of the Welsh hills because of its quaking bogs. The scenery is comparatively poor, consisting chiefly of sheep-downs (in Montgomeryshire) and barren turbaries (in Cardiganshire). If the name means "five-beacons," only three of these are high, with a *carnedd* (stone-pile, probably a military or other landmark, rather than the legendary barrow or tomb) on each of the three. Plinlimmon is notable as the source of five streams—three small: the Rheidol, the Llyfnant and the Clywedog; and two larger and famous: the Wye (*Gwy*) and the Severn (*Hafren*).

The morasses of Plinlimmon saw many a struggle, notably the war to the knife between Owen Cyfeilog (*fl. c.* 900), prince of Powys, and Hywel ab Cadogan. Here also Owen Glendower unfurled the banner of Welsh independence; from here, in 1401, he harassed the country, sacking Montgomery, burning Welshpool, and destroying Cwm Hir (long "combe," or valley) abbey, of which some columns are said to be now in Llanidloes old church. On the side of Plinlimmon, some 2 m. from the Steddfagurig inn, is Blaen Gwy (the point of the Wye), the course of the streamlet being traceable up to Pont-rhyd-galed (the hard ford bridge), some 4 m. distant from the inn. Near this bridge are numerous barrows and cairns, on the right from Aberystwyth. There are slate quarries, with lead and copper mines. Machynlleth (perhaps *Maglona* in Roman times) has Owen Glendower's "senate house" (1402), and is known as the scene of Glendower's attempted assassination by Dafydd Gam. Llyn pen rhaiadr (the waterfall-head pool), or Pistyll y llyn (pool spout), is some 6 m. south of Machynlleth. Llanidloes has a trade in Plinlimmon slates and minerals besides flannel and wool manufactures.

PLINTH (Gr. πλίνθος, a square tile), the term in architecture given to the lower mouldings of a podium, pedestal or skirting, also to any rectangular block on which a statue or vase is placed, and in the Classic Orders to the square block of moderate height, under the base mouldings of the column or pedestal.

PLINY, THE ELDER. Gaius Plinius Secundus (*c.* A.D. 23–79), the author of the *Naturalis historia*, was the son of a Roman *eques* by the daughter of the senator Gaius Caecilius of Novum Comum. He was born at Comum, not (as is sometimes supposed) at Verona: it is only as a native of Gallia Transpadana that he calls Catullus of Verona his *conterraneus*, or fellow-countryman, not his *municeps*, or fellow-townsman (*Praef.* § 1). Before A.D. 35 (*N. H.* xxxvii. 81) his father took him to Rome, where he was educated under his father's friend, the poet and military commander, P. Pomponius Secundus, who inspired him with a lifelong love of learning. Two centuries after the death of the Gracchi Pliny saw some of their autograph writings in his preceptor's library (xiii. 83), and he afterwards wrote that preceptor's *Life*. He makes mention of the grammarians and rhetoricians, Remmius Palaemon and Arellius Fuscus (xiv. 49, xxxiii. 152), and he may have been instructed by them. In Rome he studied botany in the garden of the aged Antonius Castor (xxv. 9), and saw the fine old lotus-trees in the grounds that had once belonged to Crassus (xvii. 5). He also viewed the vast structure raised by Caligula (xxxvi. 111), and probably witnessed the triumph of Claudius over Britain (iii. 119; A.D. 44). Under the influence of Seneca he became a keen student of philosophy and rhetoric, and began practising as an advocate. He saw military service under Corbulo in Lower Germany (A.D. 47), taking part in the Roman conquest of the Chauci and the construction of the canal between the Maas and the Rhine (xvi. 2 and 5). As a young commander of cavalry (*praefectus alae*) he wrote in his winter-quarters a work on the use of missiles on horseback (*de jaculatione equestri*), with some account of the points of a good horse (viii. 162). In Gaul and Spain he learnt the meanings of a number of Celtic words (xxx. 40). He took note of sites associated with the Roman invasion of Germany, and, amid the scenes of the victories of Drusus, he had a dream in which the victor enjoined him to transmit his exploits to posterity (Plin. *Epp.* iii. 5, 4). The dream prompted Pliny to begin forthwith a history of all the wars between the Romans and the Germans. He probably accompanied his father's friend, Pomponius, on an expedition against the Chatti (A.D. 50), and visited Germany for a third time (57) as a comrade of the future emperor, Titus (*Praef.* § 3). Under Nero he lived mainly in Rome. He mentions the map of Armenia and the neighbourhood of the Caspian Sea, which was sent to Rome by the staff of Corbulo in A.D. 58 (vi. 40). He also saw the building of Nero's "golden house" after the fire of 64 (xxxvi. 111). Meanwhile he was completing the twenty books of his *History of the German Wars*, the only authority expressly quoted in the first six books of the *Annals* of Tacitus (i. 69), and probably one of the principal authorities for the *Germania*. It was superseded by the writings of Tacitus, and, early in the 5th century, Symmachus had little hope of finding a copy (*Epp.* xiv. 8). He also devoted much of his time to writing on the comparatively safe subjects of grammar and rhetoric. A detailed work on rhetoric, entitled *Studiosus*, was followed by eight books, *Dubii sermonis* (A.D. 67). Under his friend Vespasian he returned to the service of the state, serving as *procurator* in Gallia Narbonensis (70) and Hispania Tarraconensis (73), and also visiting the Provincia Belgica (74). During his stay in Spain he became familiar with the agriculture and the mines of the country, besides paying a visit to Africa (vii. 37). On his return to Italy he accepted office under Vespasian, whom he used to visit before daybreak for instructions before proceeding to his official duties, after the discharge of which he devoted all the rest of his time to study (Plin. *Epp.* iii. 5, 9). He completed a *History of his Times* in thirty-one books, possibly extending from the reign of Nero to that of Vespasian, and deliberately reserved it for publication after his decease (*N. H.*, *Praef.* 20). It is quoted by Tacitus (*Ann.* xiii. 20, xv. 53; *Hist.* iii. 29), and is one of the authorities followed by Suetonius and Plutarch. He also virtually completed his great work, the *Naturalis historia*. The work had been planned under the rule of Nero. The materials collected for this purpose filled rather less than 160 volumes in A.D. 23, when Larcius Licinus, the praetorian legate of Hispania Tarraconensis, vainly offered to purchase them for a sum equivalent to more than £3200. He dedicated the work to Titus in A.D. 77. Soon afterwards he received from Vespasian the appointment of praefect of the Roman fleet at Misenum. On the 24th of August A.D. 79 he was stationed at Misenum, at the time of the great eruption of Vesuvius, which overwhelmed Pompeii and Herculaneum. A desire to observe the phenomenon from a nearer point of view, and also to rescue some of his friends, from their perilous position on the shore of the Bay of Naples, led to his launching his galleys and crossing the bay to Stabiae (Castellamare), where he perished, in the fifty-sixth year of his age. The story of his last hours is told in an interesting letter addressed twenty-seven years afterwards to Tacitus by the Elder Pliny's nephew and heir, the Younger Pliny (Epp. vi. 16), who also sends to another correspondent an account of his uncle's writings and his manner of life (iii. 5):—

> "He began to work long before daybreak. . . . He read nothing without making extracts; he used even to say that there was no book so bad as not to contain something of value. In the country it was only the time when he was actually in his bath that was exempted from study. When travelling, as though freed from every other care, he devoted himself to study alone. . . . In short, he deemed all time wasted that was not employed in study."

The only fruit of all this unwearied industry that has survived to our own times is the *Naturalis historia*, a work which in its present form consists of thirty-seven books, the first book including a characteristic preface and tables of contents, as well as lists of authorities, which were originally prefixed to each of the books separately. The contents of the remaining books are as follows: ii., mathematical and physical description of the world; iii.–vi., geography and ethnography; vii., anthropology and human physiology; viii.–xi., zoology; xii.–xxvii., botany, including agriculture, horticulture and *materia medica;* xxviii.–xxxii., medical zoology; xxxiii.–xxxvii., mineralogy, especially in its application to life and art, including chasing in silver (xxxiii. 154–157), statuary in bronze (xxxiv.), painting (xxxv. 15–149), modelling (151–158), and sculpture in marble (xxxvi.).

He apparently published the first ten books himself in A.D. 77, and was engaged on revising and enlarging the rest during the two remaining years of his life. The work was probably published with little, if any, revision by the author's nephew, who, when telling the story of a tame dolphin, and describing the floating islands of the Vadimonian Lake, thirty years later (viii. 20, ix. 33), has apparently forgotten that both are to be found in his uncle's work (ii. 209, ix. 26). He describes the *Naturalis historia*, as a *Naturae historia*, and characterizes it as a "work that is learned and full of matter, and as varied as nature herself." The absence of the author's final revision may partly account for many repetitions, and for some contradictions, for mistakes in passages borrowed from Greek authors, and for the insertion of marginal additions at wrong places in the text.

In the preface the author claims to have stated 20,000 facts gathered from some 2000 books and from 100 select authors. The extant lists of his authorities amount to many more than 400, including 146 of Roman and 327 of Greek and other sources of information. The lists, as a general rule, follow the order of the subject matter of each book. This has been clearly shown in Heinrich Brunn's *Disputatio* (Bonn, 1856).

Pliny's principal authority is Varro. In the geographical books Varro is supplemented by the topographical commentaries of Agrippa which were completed by the emperor Augustus; for his zoology he relies largely on Aristotle and on Juba, the scholarly Mauretanian king, *studiorum claritate memorabilior quam regno* (v. 16). Juba is also his principal guide in botany. Theophrastus is also named in his *Indices*. In the *History of Art* the original Greek authorities are Duris of Samos (born *c.* 340 B.C.), Xenocrates of Sicyon (*fl.* 280), and Antigonous of Carystus (born *c.* 295 B.C.). The anecdotic element has been ascribed to Duris (xxxiv. 61, *Lysippum Sicyonium Duris negat ullius fuisse discipulum*, &c.); the notices of the successive developments of art, and the list of workers in bronze and painters, to Xenocrates; and a large amount of miscellaneous information to Antigonus. The last two authorities are named in connexion with Parrhasius (xxxv. 68, *hanc ei gloriam concessere Antigonus et Xenocrates, qui de pictura scripsere*), while Antigonus is named in the *Indices* of xxxiii.-xxxiv. as a writer on the "toreutic" art. Greek epigrams contribute their share in Pliny's descriptions of pictures and statues. One of the minor authorities for books xxxiv.–xxxv. is Heliodorus (*fl.* 150 B.C.), the author of a work on the monuments of Athens. In the *Indices* to xxxiii.–xxxvi. an important place is assigned to Pasiteles of Naples (*fl.* 88 B.C.), the author of a work in five volumes on famous works of art xxxvi. 40), probably incorporating the substance of the earlier Greek treatises; but Pliny's indebtedness to Pasiteles is denied by Kalkmann, who holds that Pliny used the chronological work of Apollodorus, as well as a current catalogue of artists. Pliny's knowledge of the Greek authorities was probably mainly due to Varro, whom he often quotes (*e.g.* xxxiv. 56, xxxv. 113, 156, xxxvi. 17, 39, 41). Varro probably dealt with the history of art in connexion with architecture, which was included in his *Disciplinae*. For a number of items relating to works of art near the coast of Asia Minor, and in the adjacent islands, Pliny was indebted to the general, statesman, orator and historian, Gaius Licinius Mucianus, who died before A.D. 77. Pliny mentions the works of art collected by Vespasian in the Temple of Peace and in his other galleries (xxxiv. 84), but much of his information as to the position of such works in Rome is due to books, and not to personal observation. The main merit of his account of ancient art, the only classical work of its kind, is that it is a compilation ultimately founded on the lost text-books of Xenocrates and on the biographies of Duris and Antigonus.

He shows no special aptitude for art criticism; in several passages, however, he gives proof of independent observation (xxxiv. 38, 46, 63, xxxv. 17, 20, 116 seq.). He prefers the marble *Laocoon* in the palace of Titus to all the pictures and bronzes in the world (xxxvi. 37); in the temple near the Flaminian Circus he admires the *Ares* and the *Aphrodite* of Scopas, "which would suffice to give renown to any other spot." "At Rome indeed (he adds) the works of art are legion; besides, one effaces another from the memory and, however beautiful they may be, we are distracted by the overpowering claims of duty and business; for to admire art we need leisure and profound stillness" (ibid. 26–27).

Like many of the finest spirits under the early empire, Pliny was an adherent to the Stoics. He was acquainted with their noblest representative, Thrasea Paetus, and he also came under the influence of Seneca. The Stoics were given to the study of nature, while their moral teaching was agreeable to one who, in his literary work, was unselfishly eager to benefit and to instruct his contemporaries (*Praef.* 16, xxviii. 2, xxix. 1). He was also influenced by the Epicurean and the Academic and the revived Pythagorean schools. But his view of nature and of God is essentially Stoic. It was only (he declares) the weakness of humanity that had embodied the Being of God in many human forms endued with human faults and vices (ii. 148). The Godhead was really one; it was the soul of the eternal world, displaying its beneficence on the earth, as well as in the sun and stars (ii. 12 seq., 154 seq.). The existence of a divine Providence was uncertain (ii. 19), but the belief in its existence and in the punishment of wrong-doing was salutary (ii. 26); and the reward of virtue consisted in the elevation to Godhead of those who resembled God in doing good to man (ii. 18, *Deus est mortali juvare mortalem, et haec ad aeternam gloriam via*). It was wrong to inquire into the future and do violence to nature by resorting to magical arts (ii. 114, xxx. 3); but the significance of prodigies and portents is not denied (ii. 92, 199, 232). Pliny's view of life is gloomy; he regards the human race as plunged in ruin and in misery (ii. 24, vii. 130). Against luxury and moral corruption he indulges in declamations, which are so frequent that (like those of Seneca) they at last pall upon the reader; and his rhetorical flourishes against practically useful inventions (such as the art of navigation) are wanting in good sense and good taste (xix. 6).

With the proud national spirit of a Roman he combines an admiration of the virtues by which the republic had attained its greatness (xvi. 14, xxvii. 3, xxxvii. 201). He does not suppress historical facts unfavourable to Rome (xxxiv. 139), and while he honours eminent members of distinguished Roman houses, he is free from Livy's undue partiality for the aristocracy. The agricultural classes and the old landlords of the equestrian order (Cincinnatus, Curius Dentatus, Serranus and the Elder Cato) are to him the pillars of the state; and he bitterly laments the decline of agriculture in Italy (xviii. 21 and 35, *latifundia perdidere Italiam*). Accordingly, for the early history of Rome, he prefers following the prae-Augustan writers; but he regards the imperial power as indispensable for the government of the empire, and he hails the *salutaris exortus Vespasiani* (xxxiii. 51). At the conclusion of his literary labours, as the only Roman who had ever taken for his theme the whole realm of nature, he prays for the blessing of the universal mother on his completed work.

In literature he assigns the highest place to Homer and to Cicero (xvii. 37 seq.); and the next to Virgil. He takes a keen interest in nature, and in the natural sciences, studying them in a way that was then new in Rome, while the small esteem in which studies of this kind were held does not deter him from endeavouring to be of service to his fellow countrymen (xxii. 15). The scheme of his great work is vast and comprehensive, being nothing short of an encyclopaedia of learning and of art so far as they are connected with nature or draw their materials from it. With a view to this work he studied the original authorities on each subject and was most assiduous in making excerpts from their pages. His *indices auctorum* are, in some cases, the authorities which he has actually consulted (though in this respect they are not exhaustive); in other cases, they represent the principal writers on the subject, whose names are borrowed second-hand for his immediate authorities. He frankly acknowledges his obligations to all his predecessors in a phrase that deserves to be proverbial (*Praef.* 21, *plenum ingenui pudoris fateri per quos profeceris*). He had neither the temperament for original investigation, nor the leisure necessary for the purpose. It is obvious that one who spent all his time in reading and in writing, and in making excerpts from his predecessors, had none left for mature and independent thought, or for patient experimental observation of the phenomena of nature. But it must not be forgotten that it was his scientific curiosity as to the phenomena of the eruption of Vesuvius that brought his life of unwearied study to a premature end; and any criticism of his faults of omission is disarmed by the candour of the confession in his preface: *nec dubitamus multa esse quae et nos praeterierint; homines enim sumus et occupati officiis.*

His style betrays the unhealthy influence of Seneca. It aims less at clearness and vividness than at epigrammatic point. It abounds not only in antitheses, but also in questions and exclamations, tropes and metaphors, and other mannerisms of the silver age. The rhythmical and artistic form of the sentence is sacrificed to a passion for emphasis that delights in deferring the point to the close of the period. The structure of the sentence is also apt to be loose and straggling. There is an excessive use of the ablative absolute, and ablative phrases are often appended in a kind of vague "apposition" to express the author's own opinion of an immediately previous statement, *e.g.* xxxv. 80, dixit (Apelles) . . . *uno se praestare, quod manum de tabula sciret tollere, memorabili praecepto nocere saepe nimiam diligentiam.*

About the middle of the 3rd century an abstract of the geographical portions of Pliny's work was produced by Solinus; and, early in the 4th, the medical passages were collected in the *Medicina Plinii.* Early in the 8th we find Bede in possession of an excellent MS. of the whole work. In the 9th Alcuin sends to Charles the Great for a copy of the earlier books (*Epp.* 103, Jaffé); and Dicuil gathers extracts from the pages of Pliny for his own *Mensura orbis terrae* (*c.* 825). Pliny's work was held in high esteem in the middle ages. The number of extant MSS. is about 200; but the best of the more ancient MSS., that at Bamberg, contains only books xxxii.–xxxvii. Robert of Cricklade, prior of St Frideswide at Oxford, dedicated to Henry II. a *Defloratio* consisting of nine books of selections taken from one of the MSS. of this class, which has been recently recognized as sometimes supplying us with the only evidence for the true text. Among the later MSS. the *codex Vesontinus*, formerly at Besançon (11th century), has been divided into three portions, now in Rome, Paris and Leiden respectively, while there is also a transcript of the whole of this MS. at Leiden.

In modern times the work has been the theme of a generous appreciation in several pages of Humboldt's *Cosmos* (ii. 195–199, E. T., 1848). Jacob Grimm, in the first paragraph of *c.* 37 of his *Deutsche Mythologie*, writing with his own fellow-countrymen in view, has commended Pliny for condescending, in the midst of his survey of the sciences of botany and zoology, to tell of the folklore of plants and animals, and has even praised him for the pains that he bestowed on his style. It may be added that a special interest attaches to his account of the manufacture of the papyrus (xiii. 68–83), and of the different kinds of purple dye (ix. 130), while his description of the notes of the nightingale is an elaborate example of his occasional felicity of phrase (xxix. 81 seq.). Most of the recent research on Pliny has been concentrated on the investigation of his authorities, especially those which he followed in his chapters on the history of art—the only ancient account of that subject which has survived.

A carnelian inscribed with the letters C. PLIN. has been reproduced by Cades (v. 211) from the original in the Vannutelli collection. It represents an ancient Roman with an almost completely bald forehead and a double chin; and is almost certainly a portrait, not of Pliny the Elder, but of Pompey the Great. Seated statues of both the Plinies, clad in the garb of scholars of the year 1500, may be seen in the niches on either side of the main entrance to the cathedral church of Como. The elder Pliny's anecdotes of Greek artists supplied Vasari with the subjects of the frescoes which still adorn the interior of his former home at Arezzo.

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PLINY, THE YOUNGER. Publius Caecilius Secundus, later known as Gaius Plinius Caecilius Secundus (A.D. *c.* 61–*c.* 113), Latin author of the *Letters* and the *Panegyric on Trajan*, was the second son of Lucius Caecilius Cilo, by Plinia, the sister of the Elder Pliny. He was born at Novum Comum, the modern Como, the date of his birth being approximately determined by the fact that he was in his 18th year at the death of his uncle in August A.D. 79 (*Epp.* vi. 20, 5). Having lost his father at an early age, he owed much to his mother and to his guardian, Verginius Rufus, who had twice filled the office of consul and had twice refused the purple (ii. 1, 8). He owed still more to his uncle. When the Elder Pliny was summoned to Rome by Vespasian in A.D. 72, he was probably accompanied by his nephew, who there went through the usual course of education in Roman literature and in Greek, and at the age of fourteen composed a "Greek tragedy" (vii. 4, 2). He afterwards studied philosophy and rhetoric under Nicetes Sacerdos and Quintilian (vi. 6, 3, ii. 14, 9), and modelled his own oratorical style on that of Demosthenes, Cicero and Calvus (i. 2). The Elder Pliny inspired his nephew with something of his own indomitable industry; and in August 79, when the author of the *Historia naturalis* lost his life in the famous eruption of Vesuvius, it was the sister of the Elder and the mother of the Younger Pliny who first descried the signs of the approaching visitation, and, some twenty-seven years later, it was the Younger Pliny who wrote a graphic account of the last hours of his uncle, in a letter addressed to the historian Tacitus (vi. 16). By his will the Elder Pliny had made his nephew his adopted son, and the latter now assumed the *nomen* and *praenomen* of his adoptive father.

A year later he made his first public appearance as an advocate (v. 8, 8), and soon afterwards became a member of the board of *decemviri stlitibus judicandis*, which was associated with the praetor in the presidency of the centumviral court. Early in the reign of Domitian he served as a military tribune in Syria (A.D. 81 or 82), devoting part of his leisure to the study of philosophy under the Stoic Euphrates (i. 10, 2). On returning to Rome he was nominated to the honorary office of *sevir equitum romanorum*, and was actively engaged as a pleader before the *centumviri*, the chancery court of Rome (vi. 12, 2).

His official career began in A.D. 89, when he was nominated by Domitian as one of the twenty quaestors. He thus became a member of the senate for the rest of his life. In December 91 he was made tribune, and, during his tenure of that office, withdrew from practice at the bar (i. 23). Early in 93 he was appointed praetor (iii. 11, 2), and, in his year of office, was one of the counsel for the impeachment of Baebius Massa, the procurator of Hispania Baetica (iii. 4, vi. 29, vii. 33). During the latest and darkest years of Domitian he deemed it prudent to withdraw from public affairs, but his financial abilities were recognized by his nomination in 94 or 95 to the *praefectura aerarii militaris* (ix. 13, 11).

On the death of Domitian and the accession of Nerva he delivered a speech (subsequently published) in prosecution of Publicius Certus, who had been foremost in the attack on Helvidius Priscus (ix. 13). Early in 98 he was promoted to the position of praefect of the public treasury in the temple of Saturn. After the accession of Trajan in the same year, Pliny was associated with Tacitus in the impeachment of Marius Priscus for his maladministration of the province of Africa (ii. 11). The trial was held under the presidency of the emperor, who had already nominated him *consul suffectus* for part of the year A.D. 100. The formal oration of thanks for this nomination, described by Pliny himself as his *gratiarum actio* (iii. 13, 1 and 18, 1), is called in the MSS. the *Panegyricus Trajano dictus*.

The following year was marked by the death of Silius Italicus and Martial, who are gracefully commemorated in two of his *Letters* (iii. 7 and 21). It is probable that in 103–104 he was promoted to a place in the college of Augurs, vacated by his friend Frontinus (iv. 8), and that in 105 he was appointed curator of the river Tiber (v. 14, 2). In the same year he employed part of his leisure in producing a volume of hendecasyllabic verse (iv. 14, v. 10). He usually spent the winter at his seaside villa on the Latian coast near Laurentum, and the summer at one of his country houses, either among the Tuscan hills, near Tifernum, or on the lake of Como, or at Tusculum, Tibur or Praeneste.

It was probably in 104, and again in 106, that he was retained for the defence of a governor of Bithynia, thus becoming familiar with the affairs of a province which needed a thorough reorganization. Accordingly, about 111, he was selected by Trajan as governor of Bithynia, under the special title of "legate propraetor with consular power." He reached Bithynia in September, held office for fifteen months or more, and probably died in 113.

His health was far from robust. He speaks of his delicate frame (*gracilitas mea*); and he was apt to suffer from weakness of the eyes (vii. 21) and of the throat or chest (ii. 11, 15). Frugal and abstemious in his diet (i. 15; iii. 1 and 12), studious and methodical in his habits (i. 6, v. 18, ix. 36 and 40), he took a quiet delight in some of the gentler forms of outdoor recreation. We are startled to find him telling Tacitus of his interest in hunting the wild boar, but he is careful to add that, while the beaters were at work, he sat beside the nets and was busily taking notes, thus combining the cult of Minerva with that of Diana (i. 6). He also tells the historian that, when his uncle left Misenum to take a nearer view of the eruption of Vesuvius, he preferred to stay behind, making an abstract of a book of Livy (vi. 20, 5).

Among his friends were Tacitus and Suetonius, as well as Frontinus, Martial and Silius Italicus; and the Stoics, Musonius and Helvidius Priscus. He was thrice married; on the death of his second wife without issue, Trajan conferred on him the *jus trium liberorum* (A.D. 98), and, before 105, he found a third wife in the accomplished and amiable Calpurnia (iv. 19). He was generous in his private and his public benefactions (i. 19, 2, ii. 4, 2, vi. 32). At his Tuscan villa near Tifernum Tiberinum (iv. 1, 4), the modern Città di Castello, he set up a temple at his own expense and adorned it with statues of Nerva and Trajan (x. 8). In his lifetime he founded and endowed a library at his native place (i. 8, v. 7), and, besides promoting local education (iv. 13), established an institute for the maintenance and instruction of the sons and daughters of free-born parents (vii. 18). By his will he left a large sum for the building and the perpetual repair of public baths, and the interest of a still larger sum for the benefit of one hundred freedmen of the testator and, ultimately, for an annual banquet.

On a marble slab that once adorned the public baths at Comum, his distinctions were recorded in a long inscription, which was afterwards removed to Milan. It was there broken into six square pieces, four of which were built into a tomb within the great church of Sant' Ambrogio. Of these four fragments only one survives, but with the aid of transcripts of the other three made by Cyriacus of Ancona in 1442, the whole was restored by Mommsen [*C.I.L.* v. 5262]. It is to the following effect:—

> Gaius Plinius Caecilius <Secundus>, son of Lucius, of the Ufentine tribe; <consul;> augur; legate-propraetor of the province of Pontus and Bithynia, with consular power, by decree of the senate sent into the said province by the emperor Nerva Trajan <Augustus, Germanicus, Dacicus, *pater patriae*>; curator of the bed and banks of the Tiber and of the <sewers of the city>; praefect of the Treasury of Saturn; praefect of the Treasury of War; <praetor>, tribune of the plebs; emperor's quaestor, sevir of the <Roman> knights; military tribune of the <third> Gallic legion; <decemvir> for the adjudication of <suits>; provided by will for the erection of baths at a cost of . . ., adding for the furnishing of the same 300,000 sesterces (£2400) and furthermore, for maintenance, 200,000 sesterces (£1600); likewise, for the support of one hundred of his own freedmen <he bequeathed> to the township 1,866,666 sesterces (*c.* £15,000), the eventual accretions <whereof> he devised to the townsfolk for a public entertainment; . . . <likewise, in his lifetime> he gave for the support of sons and daughters of the townsfolk <500,000> sesterces (£4000); <likewise a library, and>, for the maintenance of the library, 100,000 sesterces (£800).

With the exception of two mediocre sets of verses, quoted by himself (vii. 4 and 9), his poems have perished. His speeches were apt to be prolix, and he defended their prolixity on principle (i. 20). He was apparently the first to make a practice of reciting his speeches before a gathering of his friends before finally publishing them (iii. 18). The only speech that has survived is the *Panegyric on Trajan*, first delivered by Pliny in the emperor's presence, next recited to the orator's friends for the space of three days, and ultimately published in an expanded form (*Epp.* iii. 18). It is unduly florid and redundant in style, but it supplies us with the fullest account of the emperor's antecedents, and of his policy during the first two years and a half of his rule.

It describes his entering Rome on foot, amid the rejoicings of the citizens; his liberality towards his soldiers and to the citizens of Rome, a liberality that was extended even to persons under eleven years of age; his charities for the maintenance of the children of the poor; his remission of succession-duties in cases where the property was small or the heirs members of the testator's family; his establishment of free trade in corn between the various parts of the empire; his abandonment of vexatious and petty prosecutions for "high treason"; his punishment of informers; his abolition of pantomimes; his repairs of public buildings and his extension and embellishment of the Circus Maximus. The speech was discovered by Aurispa at Mainz in 1432, as part of a collection of *Panegyrici*; and was first printed by Fr. Puteolanus at Milan about fifty years later.

Besides the *Panegyric*, we possess the nine books of Pliny's *Letters*, and a separate book containing his *Correspondence with Trajan*.

In the first letter of the first book Pliny states that he has collected certain of his letters without regard to chronological order (*non servato temporis ordine*). Pliny's learned biographer, the Dutch scholar, Jean Masson (1709), wrongly assumed that this statement referred to the whole of the collection. He inferred that all the nine books were published simultaneously; and he also held that Pliny was governor of Bithynia in A.D. 103–105. It was afterwards maintained by Mommsen (1868) that the *books* were in strictly chronological order, that the *letters* in each book were in general arranged in order of date, that all of them were later than the death of Domitian (September 96), that the several books were probably published in the following order: i. (97); ii. (100); iii. (101–102); iv. (105); v. and vi. (106); vii. (107); viii. (108); and ix. (not later than 109); and, lastly, that Pliny was governor of Bithynia from A.D. 111–112 to 113. The letter which is probably the earliest (ii. 20) has since been assigned to the last part of the reign of Domitian, and it has been suggested by Professor Merrill that the nine books were published in three groups: i.–ii. (97 or 98); iii.–vi. (106); vii.–ix. (108 or 109).

In his *Letters* Pliny presents us with a picture of the varied interests of a cultivated Roman gentleman. The etiquette of the imperial circle, scenes from the law-courts and the recitation-room, the reunions of dilettanti and philosophers, the busy life of the capital or of the municipal town, the recreations of the seaside and of the country—all these he brings vividly before our eyes. He elaborately describes his Laurentine and his Tuscan villa, and frankly tells us how he spends the day at each (ii. 17, v. 6, ix. 36 and 40); expatiates on his verses and his speeches, his holiday-tasks in Umbria (vii. 9, ix. 10), and his happy memories of the Lake of Como (i. 6). He gives an enthusiastic account of a statuette of Corinthian bronze he has recently purchased (iii. 6). He is interested in providing a teacher of rhetoric for the place of his birth (iv. 13); he exults in the devotion of his wife, Calpurnia (vi. 19); towards his servants he is an indulgent master (viii. 16); he intercedes on behalf of the freedman of a friend (ix. 21), and, when a freedman of his own is in delicate health, sends him first to Egypt and afterwards to the Riviera (v. 19). He consults Suetonius on the interpretation of dreams (i. 18); he presents another of his correspondents with a batch of ghost-stories (vii. 27) or a marvellous tale about a tame dolphin on the north coast of Africa (ix. 33). He discourses on the beauties of the Clitumnus (viii. 8) and the floating islands of the Vadimonian lake (viii. 20). He describes an eruption of Vesuvius in connexion with the last days of the Elder Pliny (vi. 16 and 20), giving elsewhere an account of his manner of life and a list of his writings (iii. 5). He laments the death of Silius Italicus (iii. 7), of Martial (iii. 21), and of Verginius Rufus (ii. 1), and of others less known to fame. He takes as his models Cicero and Tacitus (vii. 20), whose name is so often (to his delight) associated with his own (ix. 23). He rejoices to learn that his writings are read at Lyons (ix. 11). He complains of the inanity of circus-races (ix. 6), of the decay of interest in public recitations (i. 13), of bad taste in matters of hospitality (ii. 6), and of the way in which time is frittered away in the social duties of Rome (i. 9). He lays down the principles that should guide a Roman governor in Greece (viii. 24); he maintains the cause of the oppressed provinces of Spain and Africa; and he exposes the iniquities of the informer Regulus, the only living man whom he attacks in his *Letters*, going so far as to denounce him as *omnium bipedum nequissimus* (i. 5, 14).

The *Letters* are models of graceful thought and refined expression, each of them dealing with a single topic and generally ending with an epigrammatic point. They were imitated by Symmachus (Macrobius v. 1, 7) and by Apollinaris Sidonius (*Epp.* ix. 1, 1). In the middle ages they were known to Ratherius of Verona (10th century), who quotes a passage from i. 5, 16 (Migne, cxxxvi. p. 391). Selections were included in a volume of *Flores* compiled at Verona in 1329; and a MS. of bks. i.–vii. and ix. was discovered by Guarino at Venice in 1419. These books were printed in the *editio princeps* (Venice, 1471). Part of bk. viii. appeared for the first time at the end of the next edition (Rome, *c.* 1474). The whole of bk. viii. was first published in its proper place by Aldus Manutius (Venice, 1508).

Pliny's *Correspondence with Trajan* supplies us with many interesting details as to the government of Bithynia, and as to the relations between the governor and the central authority. It reflects the greatest credit on the strict and almost punctilious conscientiousness of the governor, and on the assiduity and the high principle which animated the emperor.

On reaching the province, Pliny celebrates the emperor's birthday, and proceeds to examine the finances of Prusa. His request for a surveyor to check the outlay on the public works is refused on the ground that the emperor has hardly enough surveyors for the works he is carrying on in Rome. He asks the emperor to sanction the repair of the ancient baths at Prusa, the building of an aqueduct at Nicomedia and a theatre at Nicaea, and the covering in of a stream that has become a public nuisance at Amastris. When he consults the emperor as to the baths at Claudiopolis, the emperor sensibly replies: "You, who are on the spot, will be best able to decide" (40). When Pliny hesitates about a small affair relating to Dio Chrysostom (the Bithynian friend of Nerva and Trajan), the emperor betrays a not unnatural impatience in his response: *potuisti non haerere, mi Secunde carissime* (82). Pliny also asks for a decision on the status and maintenance of deserted children (65), and on the custom of distributing public doles on the occasion of interesting events in the life of a private citizen. The emperor agrees that the custom might lead to "political factions," and should therefore be strictly controlled (117). Owing to a destructive fire at Nicomedia, Pliny suggests the formation of a volunteer fire-brigade, limited to 150 members. The emperor is afraid that the fire-brigade might become a "political club," and cautiously contents himself with approving the provision of a fire-engine (34).

Trajan's fear of factions and clubs in these two last cases has sometimes been connected with the question of his attitude towards the Christians in Bithynia. Pliny (*Epp.* 96) states that he had never taken part in formal trials of Christians, and was therefore unfamiliar with precedents as to the extent of the investigation, and as to the degree of punishment. He felt that a distinction might be drawn between adults and those of tender years; and that allowance might be made for any one who recanted. There was also the question whether any one should be punished simply for bearing the name of Christian or only if he was found guilty of "crimes associated with that name." Hitherto, in the case of those who were brought before him, he had asked them three distinct times whether they were Christians, and, if they persisted in the admission, had ordered them to be taken to execution. Whatever might be the real character of their profession, he held that such obstinate persistence ought to be punished. There were others no less "demented," who, being Roman citizens, would be sent to Rome for trial. Soon, as the natural consequence of these proceedings, a variety of cases had come under his notice. He had received an anonymous statement giving a list of accused persons. Some of them, who denied that they had ever been Christians, had consented to pray to the gods, to adore the image of the emperor, and to blaspheme Christ; these he had dismissed. Others admitted that they were Christians, but presently denied it, adding that they had ceased to be Christians for some years. All of these worshipped images of the gods and of the emperor, and blasphemed Christ. They averred that the sum and substance of their "fault" was that they had been accustomed to meet on a fixed day before daylight to sing in turns a hymn to Christ as God, and to bind themselves by a solemn oath (*sacramento*) to abstain from theft or robbery, and from adultery, perjury and dishonesty; after which they were wont to separate and to meet again for a common meal. This, however, they had ceased to do as soon as Pliny had published a decree against *collegia*, in accordance with the emperor's edict. To ascertain the truth, he had also put to the torture two maid-servants described as deaconesses, but had discovered nothing beyond a perverse and extravagant superstition. He had accordingly put off the formal trial with a view to consulting the emperor. The question appeared to be worthy of such a consultation, especially in view of the number of persons of all ages and ranks, and of both sexes, who were imperilled. The contagion had spread through towns and villages and the open country, but it might still be stayed. Temples that had been wellnigh deserted were already beginning to be frequented, rites long intermitted were being renewed, and the trade in fodder for sacrificial victims was reviving. It might be inferred from this how large a number might be reclaimed, if only room were granted for repentance.

Trajan in his reply (*Epp.* 97) expresses approval of Pliny's course of action in the case of the Christians brought before him. It was impossible (he adds) to lay down any uniform or definite rule. The persons in question were not to be hunted out, but if they were reported and were found guilty, they were to be punished. If, however, any one denied that he was a Christian, and ratified his denial by worshipping the gods of Rome, he was to receive pardon. But no attention was to be paid to *anonymous* charges. It would be a bad precedent and unworthy of the spirit of the age.

The view that the Christians were punished for being members of a *collegium* or *sodalitas* (once held by E. G. Hardy, and still maintained by Professor Merrill) is hard to reconcile with Pliny's own statement that the Christians had promptly obeyed the emperor's decree against *collegia* (§ 7). Further reasons against this view have been urged by Ramsay, who sums up his main results as follows: (1) There was no express law or formal edict against the Christians. (2) They were not prosecuted or punished for contravening any formal law of a wider character. (3) They were judged and condemned by Pliny (with Trajan's full approval) by virtue of the *imperium* delegated to him, and in accordance with the instructions issued to governors of provinces to search out and punish sacrilegious persons. (4) They had already been classed as outlaws, and the name of Christian in itself entailed condemnation. (5) This treatment was a settled principle of imperial policy, not established by the capricious action of a single emperor. (6) While Trajan felt bound to carry out the established principle his personal view was to some extent opposed to it. (7) A definite form of procedure had been established. (8) This procedure was followed by Pliny (W. M. Ramsay, *The Church in the Roman Empire*, p. 223).

It has been well observed by E. G. Hardy that the "*double* aspect of Trajan's rescript, which, while it theoretically condemned the Christians, practically gave them a certain security," explains "the different views which have since been taken of it; but by most of the church writers, and perhaps on the whole with justice, it has been regarded as favourable and as rather discouraging persecution than legalizing it" (*Pliny's Correspondence with Trajan*, 63, 210–217).

Authorities.—The correspondence with Trajan was apparently preserved in a single Paris MS.; *Epp.* 41–121 were first printed by Avantius of Verona (1502); and *Epp.* 1–40 by Aldus Manutius (1508). The original MS. has vanished; but the "copy" supplied to the printers of the Aldine text was discovered by Mr. E. G. Hardy in the Bodleian in 1888. The two letters on the Christians were known to Tertullian (*Apol.* c. 2). The attacks on the genuineness of the whole or part of the collection have been refuted by Wilde (Leiden, 1889).

For a critical edition of text, see H. Keil (Leipzig, 1870), with full index of names by Mommsen; for plain text, Keil (1853), &c., C. F. W. Müller (1903); the best annotated editions are those of Gesner and Schaefer (1805) and G. E. Gierig (1796–1806); of the *Letters* alone, G. Kortte (1734), and the less trustworthy edition of M. Döring (1843); of bks. i. and ii., Cowan (1889); of iii., Mayor (1880, with *Life* by G. H. Rendall); of vi., Duff (1906); of the *Panegyricus*, C. G. Schwarz (1846); of the *Correspondence with Trajan*, E. G. Hardy (1889); of *Selected Letters*, E. T. Merrill (1903); best Eng. trans. by J. D. Lewis (1879).

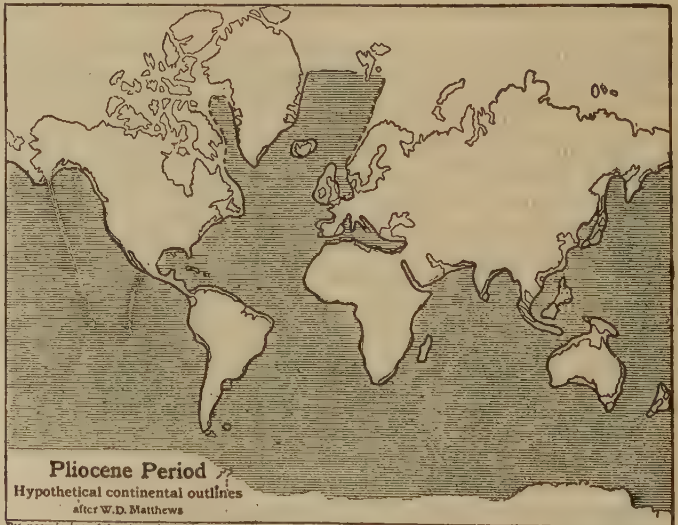
On Pliny's life, see the works by J. Masson (Amsterdam, 1709); H. Schöntag (Hof, 1876); and Giesen (Bonn, 1885). On the chronology of the letters, &c., Mommsen, in *Hermes*, iii. 31–114 (1868; trans. into French by Morel, 1873); criticized by Stobbe (*Philologus*, 1870); Gemoll (Halle, 1872); C. Peter (*Philologus*, 1873); Asbach (*Rhein. Mus.*, 1881); and Schultz (Berlin, 1899). For style, the works of H. Holstein (1862–1869); K. Kraut (1872); J. P. Lagergren (1872); and Morillot (Grenoble, 1888). On the villas, Burn's *Rome and the Campagna* (1871), 411–415; Aitchison, in the *Builder* (Feb. 8, 1890); Winnefeld, in *Jahrb. des arch. Inst.* (1891), pp. 201–217; and Magoun, in *Trans. Amer. Philol. Assoc.* (1895).

See also bibliography in Hübner and Mayor's *Lat. Lit.* (1875), pp. 147–149; and in Schanz, *Röm. Lit.* §§ 444–449.

For recent literature on Pliny and the Christians, see C. F. Arnold, *Studien* (Königsberg, 1887); Lightfoot, *Apostolic Fathers*, ii. 7 (ed. 1889); Neumann, *Der römische Staat und die allgemeine Kirche* (1890) vol. i.; Mommsen, in *Hist. Zeitschrift* (1890); W. M. Ramsay, *The Church in the Roman Empire* (ed. 1893), ch. 10, pp. 196–225; and E. G. Hardy, *Christianity and the Roman Government* (1894), reprinted in *Studies in Roman History* (1906), pp. 1–162; with the literature quoted in these works and in Schanz, *Röm. Lit.* § 641.

(J. E. S.*)

PLIOCENE (from the Gr. πλεῖον, more, and καινός, recent), in geology, the name given by Sir C. Lyell to the formations above the Miocene and below the Pleistocene (Newer Pliocene) strata. During this period the great land masses of the earth were rapidly approaching to the configuration which they exhibit at the present day. The marine Pliocene deposits are limited to comparatively few areas; in Europe, in the beginning of the period, the sea washed the shores of East Anglia and parts of the south coast of England; it extended well into Belgium and Holland and just touched here and there on the northern and north-western coasts of France; it sent an arm some distance up the valley of the Guadalquivir and formed small bays on several points of the southern coast of France; and up the Rhone basin a considerable gulf reached as far as Lyons. Early in the period the sea covered much of Italy and Sicily; but the eastward extension of the ancient Mediterranean in south-east Europe, through the Danube basin, the Aral, north Caucasian and Caspian regions, continued to suffer the process of conversion to lagoons and large lakes which had begun in the Miocene.



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Generally all over the world the majority of Pliocene formations are non-marine, and the limited and local nature of the elevations since the inception of the period has exposed to view only the shallow marginal marine deposits. The principal exception to the last statement is to be found in the Pliocene of Italy and Sicily, where a continuous crustal depression permitted the accumulation of great thicknesses of material, which later on, towards the close of the period, were elevated some thousands of feet. With these deformatory movements are associated the Italian volcanoes; Etna certainly began its career beneath the sea, for its older tuffs are found interstratified with marine beds, and possibly some of the others had a similar origin. At the same time volcanic outbursts, some apparently comparable to that of Martinique in recent times, were taking place in central France, while far away in southern Sumatra thousands of feet of submarine tuffs were being thrown out and deposited, and great lava flows were being erupted in Australasia.

Considerable differences of opinion are exhibited among geologists as to the lower limits of the Pliocene formations; this is partly to be accounted for by the absence of widely-spread marine deposits, and partly by the comparatively short time-differences between one deposit and another, and hence the similarity of the faunas of contiguous strata-groups in local vertical series of beds. Following A. de Lapparent (*Traité de géologie*, 5th ed., 1906), we shall regard the Pliocene as divisible into three stages: an upper Sicilian stage, a middle Astian stage, and a lower Plaisancian stage. Other writers, however, have selected a different nomenclature, which often involves a different grouping of the formations; thus E. Kayser in his *Formationskunde* (3rd ed., 1908) distinguishes three stages under the names Arnian (upper), Astian (middle) and Messinian (lower) = Zanclean. The lower stage, however, includes the Pontian, Epplesheim, Pikermi and other formations which are here placed in the Miocene. This stage has been referred to a so-called Mio-Pliocene inter-period.

The Pliocene rocks of Britain now occupy but a small area in Norfolk, Suffolk and part of Essex; but from the presence of small outlying patches in Cornwall (St Erth and St Agnes), Dorsetshire (Dewlish) and Kent (Lenham), it is evident that the Pliocene Sea covered a considerable part of southern England. Moreover, these patches show by their present altitude above the sea that the Downs of Kent must have been elevated more than 850 ft., and the west coast of Cornwall 400 ft. since Pliocene times. The Pliocene rocks rest with strong unconformity upon the older strata in Britain. In the eastern counties the shelly, sandy beds are called "Crag"; this name has come into very general use for all the members of the series, and it is frequently employed as a synonym for Pliocene.

The English Pliocene strata are classified by the Geological Survey of England and Wales as follows:—

Newer Pliocene	*Yoldia* (*Leda*) *myalis bed* (provisionally placed here). Forest-bed group and Dewlish gravels with *Elephas meridionalis*. Weybourne crag (and Chillesford clay?). Chillesford crag. Norwich crag and *Scrobicularia crag*. Red crag of Butley. Red crag of Walton, Newbourn and Oakley.
Older Pliocene	St Erth and St Agnes beds. Coralline crag. Lenham beds (Diestian). Box-stones and phosphatic beds with derived early Pliocene and other fossils.

The box-stones are rounded pieces of brown earthy sandstone containing casts of fossils; the phosphatic beds contain the phosphatized bones of whale, deer, mastodon, pig, tapir, rhinoceros, &c., and have been worked as a source of manure. These basal conglomerate deposits underlie the red crag and sometimes the coralline crag. The last-named formation, known also as the "white" or "Suffolk crag," or as the "Bryozoan crag" (it was the presence of Bryozoa which led to the name coralline), is essentially a shell bank, which was accumulated at a depth of from 20 to 40 fathoms. It is best exposed near Aldeburgh and Gedgrave in Suffolk. The Red Crags are sandy, marine, shallow-water deposits, with an abundant fauna; they vary rapidly from point to point, and in general the more southern localities are richer in southern (older) forms than those farther north. The Norwich crag (fluvio-marine or mammaliferous crag) is not always very clearly marked off from the Red Crags. Marine fresh-water and land shells are found in these beds, together with many mammalian remains, including *Elephas antiquus*, *Mastodon arvernensis*, *Equus stenonis*, *Cervus carnutorum*, and dolphins, cod and other fish. The Forest-Bed group or Cromer forest-bed is exposed beneath the boulder clay cliffs of the Norfolk coast; it contains transported stumps of trees and many plants still familiar in Britain, many living fresh-water and estuarine molluscs and a large number of mammals, many of which are extinct (*Machaerodus*, *Canis lupus*, *Ursus spelaeus*, *Hyaena crocuta*, *Hippopotamus amphibius*, *Rhinoceros etruscus*, *Elephas antiquus* and *E. meridionalis*, *Bison bonasus*, *Ovibos moschatus*, numerous species of deer, *Equus caballus* and *E. stenonis*, *Castor fiber*, *Talpa europaea* and many others). The only record of Pliocene remains in the northern part of England consists of a few teeth of *Elephas meridionalis* found in a fissure in the limestone at Dove Holes, Derbyshire.

The Pliocene deposits of Belgium and Holland and the northern extremity of France are closely related with those of Britain, though as a whole they are very much thicker. The older marine beds may be traced from Lenham across the Channel at Calais and through Cassel to Diest. The newer marine Pliocene runs in a parallel belt to the north of the older beds through Antwerp. Belgian geologists have divided the local Pliocene into the following groups (from above downwards): Poederlian, Scaldisian, Casterlian, Diestian. F. W. Harmer (*Quart. Journ. Geol. Soc.*, 1898 and 1900) proposed the following scheme for the Pliocene of Britain and the Low Countries:—

Cromerian = Forest-bed of Cromer.
(Iceno-Cromerian = Chillesford beds and Weybourne crag.
Icenian = marine crag of Norwich.
Amstelian = Red Crag, comprising the Newbournian and Butleyan sub-stages.
Waltonian = Walton crag and Poederlian and Scaldisian.
Gedgravian = Coralline crag and Casterlian.
Lenhamian = Diestian.

In addition to the deposits just mentioned in French Flanders, the early Pliocene sea has left numerous small patches of marls and sands in Brittany and Normandy. In southern France marine sands, gravels and marls of Plaisancian and Astian ages occur in the depression of Roussillon, followed by Sicilian marls and gravels. In Languedoc (Montpellier, Nîmes, Béziers) marine marls and sands are followed by calcareous conglomerate (40 metres) or by marls and lignite; gravels and loams constitute the uppermost beds. In the Rhone basin the earliest deposits are the Congeria beds of Bollene (Vaucluse); this brackish formation differs from the beds of the same name in Vienna, but resembles those of Italy and Rumania. Then followed a marine invasion (*groupe de Saint-Aries*); these beds are now found at considerable elevations increasing northward and westward. The later formations in this area are fluviatile or lacustrine in origin, with remarkable torrential gravel deposits at several horizons. The marine Pliocene of the maritime Alps, consisting of blue and yellow clays and limestone, are now elevated 170 metres above the sea, and even up to 350 m. in the neighbourhood of Nice. In central France no marine beds are found, but many interesting and in some cases highly fossiliferous deposits occur in association with volcanic rocks, such as the lower conglomerate and upper trachytic breccia of Perrier (Issoire), the fine tuffs (cinerites) with plants of Cantal, the lignitiferous sandstones beneath the basalt of Cézallier, the diatomite of Ceyssac, &c. In Italy, Pliocene rocks form the low ranges of hills on both sides of the Apennines, hence the term "sub-Apennine" given to these rocks by A. d'Orbigny. They are marine marls and sands; the blue marls which crop out near Rome at the base of Mt Mario and Mt Vatican with the succeeding sands and gravels; the conglomerate followed by deep-sea marls of Calabria, and the marls, sands, limestones and blue clay of Sicily, all belong to the Plaisancian stage. To the next stage belong the yellow sands full of massive fossils, including the conglomerate of Castrovillari in Calabria and the white marls of the Val d'Arno. In the final (Sicilian) stage fluvio-lacustrine sands and gravels are found in Italy, except in Calabria and in Sicily where thick marine beds were formed. In Switzerland some of the deposits of *Nagelfluh* and *Deckenschotter*, glacial plateau gravels, belong to the Sicilian stage. In south-eastern Europe a great series of sands and marls with lignites, termed the Paludina beds, rests directly upon the Pontian formation. From their great development in the Levant, they have been given the rank of a "Levantine stage" by F. von Hochstetter; they are found in Dalmatia, Croatia, Slavonia, Bosnia, Rumania, Bulgaria, southern Russia, the Cyclades, and the Caspian region. On the north coast of Africa marine and brackish sands and marls occur in Morocco, Algeria and Egypt; and the "rifts" of the Red Sea and Suez have been assigned to this period.

In North America marine Pliocene is found fringing the coasts of California and the Gulf of Mexico. In the latter region marine marls, clays and limestones are best developed in Florida and can be traced into the Carolinas and Virginia; they have been classed as the Lafayette group (with lignites), the Florida group, and the Caloosahatchie stage. On the Pacific coast the marine beds have attained great thicknesses, notably in the Merced series of San Francisco. In the San Luis Obispo region the non-marine Paso Robles beds, said to be 1000 ft. thick, belong to this period. Other local formations of marine origin in California are those of San Diego and Wild Cat. In the Rocky Mountains are large lacustrine formations of considerable thickness, and certain conglomerates in Wyoming and Bishop Mountain are assigned to this age. The sands and clays with gypsum of Entre Rios in South America contain fossils of the Atlantic type.

Lignitiferous shale with petroleum and great thickness of volcanic tuffs have been found in southern Sumatra. In New South Wales Pliocene river terraces and alluvial deposits are covered by Mid-Pliocene lavas and from these "deep leads" or buried river beds much gold has been obtained. In Victoria great basaltic and doleritic flows have filled up the Pliocene river valleys, and marine beds have been found at elevations of 1000 ft. above present sea-level. Very similar deposits and volcanic rock, belonging to the Wanganui system of F. W. Hutton, are found in New Zealand.

TABLE OF PLIOCENE FORMATIONS.

Stages.	England.	Belgium and Holland.	Rhone Basin.	Languedoc and Roussillon.	Italy.	Eastern Europe.	Other Countries.
Sicilian.	Cromer Forest Bed. Fluvio-marine Norwich crag. Red crag of Suffolk.	Clays of Campine. Amstelian.	Marls of St Cosme. Gravels of Chagny. Conglomerates of Chambaran. Sands of Trevoux and Mollon. Travertine of Meximieux.	Durfort beds with *Elephas meridionalis*.	Sands of Val d'Arno. Limestones of Palermo and clays with northern mollusca.	Upper Paludina (Vivipara) beds.	Marine beds of Entre Rios. Volcanic tuffs of S. Sumatra.
Astian.	Base of Red crag.	Poederlian. Scaldisian sands with *Trophon antiquum*.		Conglomerates of Montpellier and Fourres. Sands of Roussillon with *Mastodon arvernensis*.	Marls of Val d'Arno with *Mastodon arvernensis*. Yellow sands of Asti, Plaisantin, Monte Maria and Tuscany. Conglomerates of Castrovillari.	Middle Paludina beds.	Petroleum-bearing beds of Sumatra. Marine sands of Moghara and Mokatta.
Plaisancian.	Coralline crag. Lenham beds.	Sands with *Isocardia car.* Diestian sandstones.	Marine marls of Bresse, Hauterives. Congeria beds of Bollene.	Yellow sands of Montpellier. Blue marls of Millas.	Blue marls of Piacenza, Bologna, and Vatican.	Lower Paludina beds.	Marine beds of Florida. Lacustrine beds of Rocky Mountains.

Life of the Pliocene Period.—Sir C. Lyell defined the Pliocene strata as those which contained from 36–95% of living marine molluscs. This rule can no longer be strictly applied to the widely scattered marine deposits, and it is of course inapplicable to the very numerous formations of lacustrine and fluviatile origin. On the whole the marine organisms are very like their living representatives, and there is often practically no specific difference; *Nassa*, *Voluta*, *Chenopus*, *Dentalium*, *Fusus*, *Arca*, *Pecten*, *Pectunculus*, *Panopoea*, *Cyprina* and *Mactra* may be mentioned among the marine genera; *Congeria* (*Dreyssensia*), *Auricula*, *Paludina*, *Melanopsis* and *Helix* are found in the lacustrine deposits. One of the most interesting facts exposed by the study of the mollusca is the gradual lowering of the temperature of Europe during the period. In Britain the early Pliocene was, if anything, warmer than at present, but the percentage of northern forms ascends steadily through the higher beds, and finally arctic forms, such as *Buccinum groenlandicum*, *Trichopteris borealis*, *Mya truncata*, *Cyprina islandica*, &c., appear on the coasts of Norfolk and Suffolk, and some of the northern species even reached the Mediterranean (Sicily) at the close of the period. The flora exhibits the same gradual change, the large palms and camphor trees disappeared from Europe, the sabal palm lingered in Languedoc, and *Chamerops humilis* lived about Marseilles until the end; the sequoias and bamboos held on for some time, and the aspect of the vegetation in mid-Pliocene times was not unlike that of Portugal, Algeria and Japan of to-day. Not a few species that dwelt in Pliocene Europe are found in the forests of America. The flora of the Cromer forest beds is very like that of the same district at the present time. The mammals of the British Pliocene show a curious blending of northern and southern forms; they include *Machaerodus* (the sabre-toothed lion), hyenas, dogs, fox, wolf, glutton, marten, bears, *Ursus arvernensis* and the grizzly and cave bear, seals, whales, dolphins, bisons, musk ox, gazelle, the red deer and many others now extinct, the roebuck, pigs and wild boar, hippopotamus, hipparion and horse (*Equus caballus* and *E. stenonis*), several species of rhinoceros, tapir, hyrax, elephants (*Elephas meridionalis* and *E. antiquus*), several mastodons, squirrel, beaver, hare, mice, voles, &c. The mastodon disappeared from Europe before the close of the period, but lived much longer in America. No generally accepted fossil man has been found in the Pliocene; *Pithecanthropus erectus*, found by E. Dubois in Java, is the nearest to the human type. Monkeys, *Macacus* and *Semnopithecus*, occur in the Pliocene of Europe. At this time the Pliocene mammals of North America were able to migrate into South America, and a few of the southern forms travelled northwards.

See C. Reid, "The Pliocene Deposits of Britain" (*Mem. Geol. Survey*, 1890); E. T. Newton, "The Vertebrates of the Pliocene Deposits of Britain" (*Mem. Geol. Survey*, 1891) (both contain a bibliography): C. Reid, *Origin of the British Flora* (1899); and "Geological Literature" (*Geol. Soc. London Annual*, since 1893). (J. A. H.)

PLOCK, or PLOTSK, a government of Russian Poland, on the right bank of the Vistula, having the Prussian provinces of West and East Prussia on the N. and the Polish governments of Lomza on the E. and Warsaw on the S. Its area is 4160 sq. m. Its flat surface, 350 to 500 ft. above the sea-level, rises gently towards the north, where it merges into the Baltic coast-ridge of the Prussian lake district. Only a few hills reach 600 ft. above the sea, while the broad valley of the Vistula has an elevation of only 130 to 150 ft. In the west (district of Lipno) broad terraces, covered with forests, small lakes and ponds, and very poor in vegetation, descend from the Baltic lake-district towards the plains of Plock; and in the central district of Mlawa extensive marshes fill the upper basin of the Wkra. The Vistula borders the government on the south, almost all the way from Warsaw to Thorn, receiving the Skrwa and Wkra. The Drwęca, or Drewenz, flows along the north-west boundary, while several small tributaries of the Narew drain the north-eastern district of Ciechanow. Peat-bogs, used for fuel, and marshes containing bog-iron, fill many depressions in the north, while the more elevated parts of the plains are covered with fertile clays, or a kind of "black earth." Lacustrine post-Glacial deposits fill all the depressions of the thick sheet of boulder clay, with Scandinavian erratic boulders, which extends everywhere over the Tertiary sands and marls—these last containing masses of silicated wood and lignite. Layers of gypsum are found in the hills beside the Vistula.

The estimated population in 1906 was 619,000. About one-third are Jews and 36,000 Germans. The government is divided into seven districts, of which the chief towns are Plock, Ciechanow, Lipno, Mlawa, Prasnysz, Rypin and Sierpc. Agriculture is the chief industry. The principal crops are rye, oats, barley, wheat and potatoes; beetroot is cultivated for sugar, especially on the large estates of the west, where modern machinery is used. Gardening and bee-keeping are extensively practised. In the north the property is much divided, and the landholders, very numerous in Ciechanow, are far from prosperous. The forests have been lavishly cut, but Plock is still one of the best wooded governments (20%) in Poland. Other occupations are provided by shipping on the Vistula, mining and various domestic industries, such as the fabrication of wooden cars, sledges and wheels, and textile industry. The manufactures include flour-mills, saw-mills, sugar factories, distilleries, tanneries, breweries, agricultural implement works, match factories and ironworks. There is some export trade, especially in the Lipno district; but its development is hampered by lack of communications, the best being those offered by the Vistula. The railway from Warsaw to Danzig, via Ciechanow and Mlawa, serves the eastern part of the government.

After the second dismemberment of Poland in 1793, what is now the government of Plock became part of Prussia. It fell under Russian dominion after the treaty of Vienna (1815), and, in the division of that time into five provinces, extended over the western part of the present government of Lomza, which was created in 1864 from the Ostrolenka and Pultusk districts of Plock, together with parts of the province of Augustowo.

PLOCK, or **Plotsk**, a town of Russia, capital of the government of the same name, on the right bank of the Vistula, 67 m. by the Vistula W.N.W. of Warsaw. Pop. 27,073. It has a cathedral, dating from the 12th century, but restored in 1903, which contains tombs of Polish dukes and of Kings Ladislaus and Boleslav (of the 11th and 12th centuries). There is considerable navigation on the Vistula, grain, flour, wool and beetroot being exported, while coal, petroleum, salt and fish are imported.

PLOEN, a town of Germany, in Schleswig-Holstein, beautifully situated between two lakes, the large and the small Ploener-See, 20 m. S. from Kiel by the railway to Eutin and Lubeck. Pop. (1905), 3735. It has a palace built about 1630 and now converted into a cadet school, a gymnasium and a biological station. Tobacco, soap, soda, beer and furniture are manufactured, and there is a considerable trade in timber and grain. The lakes afford good fishing, and are navigated in summer by steamboats.

Ploen is mentioned as early as the 11th century as a Wendish settlement, and a fortified place. It passed in 1559 to Duke John the Younger, founder of the line of Holstein-Sonderburg, on the extinction of which, in 1761, it fell to Denmark, and in 1867, with Schleswig-Holstein, to Prussia. The sons of the emperor William II. received their early education here.

See H. Eggers, *Schloss und Stadt Ploen* (Kiel, 1877), and J. C. Kinder, *Urkundenbuch zur Chronik der Stadt Ploen* (Plön, 1890).

PLOENNIES, LUISE VON (1803–1872), German poet, was born at Hanau on the 7th of November 1803, the daughter of the naturalist Philipp Achilles Leisler. In 1824 she married the physician August von Ploennies in Darmstadt. After his death in 1847 she resided for some years in Belgium, then at Jugenheim on the Bergstrasse, but finally at Darmstadt, where she died on the 22nd of January 1872. Between 1844 and 1870 she published several volumes of verse, being particularly happy in eclectic love songs, patriotic poems and descriptions of scenery. She also wrote two biblical dramas, *Maria Magdalena* (1870) and *David* (1873).

As a translator from the English, Luise von Ploennies published two collections of poems, *Britannia* (1843) and *Englische Lyriker des 19ten Jahrhunderts* (1863, 3rd ed., 1867).

PLOËRMEL, a town of western France, capital of an arrondissement in the department of Morbihan, 36 m. N.N.E. of Vannes by rail. Pop. (1906), town, 2492; commune, 5424. The Renaissance church of St Armel (16th century) is remarkable for the delicate carving of the north façade and for fine stained glass. It also possesses statues of John II. and John III., dukes of Brittany, which were transferred to the church from their tomb in an ancient Carmelite monastery founded in 1273 and destroyed by the Protestants in 1592 and again at the Revolution. The lower ecclesiastical seminary has an apartment in which the Estates of Brittany held several meetings. Remains of ramparts of the 15th century and some houses of the 16th century are also of interest. Farm-implements are manufactured, slate quarries are worked in the neighbourhood, and there is trade in cattle, wool, hemp, cloth, &c. Ploërmel (Plou Armel, people of Armel) owes its name to Armel, a hermit who lived in the district in the 6th century.

PLOESCI (*Ploescii*), the capital of the department of Prahova, Rumania; at the southern entrance of a valley among the Carpathian foothills, through which flows the river Prahova; and at the junction of railways to Buzeu, Bucharest and Hermannstadt in Transylvania. Pop. (1900), 42,687. As the name Ploesci (*pluviena*, rainy) implies, the climate is moist. The surrounding hills are rich in petroleum, salt and lignite. There are cardboard factories, roperies, tanneries and oil mills. Ploesci possesses schools of commerce and of arts and crafts, several banks, and many synagogues and churches, including the Orthodox church of St Mary, built in 1740 by Matthew Bassarab.

PLOMBIÈRES, a town of eastern France, in the department of Vosges, on a branch line of the Eastern railway, 17 m. S. of Epinal by road. Pop. (1906), 1882. The town is situated at a height of 1410 ft. in a picturesque valley watered by the Augronne. It is well known for its mineral springs, containing sodium sulphate and silicic acid, varying from 66° to 166° F. Plombières has a handsome modern church and a statue of the painter Louis Français, born in the town in 1814. The waters were utilized by the Romans and during the middle ages. In later times Montaigne, Richelieu, Stanislas, duke of Lorraine and Voltaire were among the distinguished people who visited the place. Napoleon III. built the most important of the bathing establishments and made other improvements.

PLOT, ROBERT (1640–1696), English naturalist and antiquary, was born at Borden in Kent in 1640. He was educated at Wye, and at Magdalen Hall, Oxford, where he graduated B.A. in 1661, and proceeded to M.A. (1664) and D.C.L. (1671). He was distinguished for his folio work *The Natural History of Oxfordshire* (1677), in which various fossils, as well as other objects of interest, were figured and described. It was regarded as a model for many subsequent works. In 1677 Plot was elected F.R.S., and he was secretary for the Royal Society from 1682 to 1684. He was appointed in 1683 the first keeper of the Ashmolean Museum at Oxford, and in the same year he became professor of chemistry. In 1686 he wrote *The Natural History of Staffordshire*. Two years later he became historiographer-royal. He died on the 30th of April 1696.

PLOT, a term originally meaning a space of ground used for a specific purpose, especially as a building site, formerly in frequent usage in the sense of a plan, a surveyed space of ground; hence the literary sense of a plan or design. The word is of doubtful origin; there is a collateral form "plat," which appears in the 16th century, according to the *New English Dictionary*, under the influence of "plat," flat place, surface (Fr. *plat*, Late Lat. *plattus*, probably from Gr. πλατύς, broad). Skeat (*Etym. Dict.*) refers "plot," in the sense of a space of ground, to the O. Eng. *plaec*, Mid. Eng. *pleck*, later *platch*, patch. "Plot," in the sense of plan, scheme, would then be identical with "plot," a conspiracy, which may be a shortened form of "complot," a French word, also of doubtful origin, meaning in the 12th century "a compact body of men"; in the 14th century "conspiracy."

PLOTINUS (A.D. 204–270), the most important representative of Neoplatonism, was born of Roman parents at Lycopolis in Egypt. At Alexandria he attended the lectures of Ammonius Saccas (*q.v.*), the founder of the system, until 242, when he joined the Persian expedition of Gordian III., with the object of studying Persian and Indian philosophy on the spot. After the assassination of Gordian in 244, Plotinus was obliged to take refuge in Antioch, whence he made his way to Rome and set up as a teacher there. He soon attracted a large number of pupils, the most distinguished of whom were Amelius, Eustochius and Porphyry. The emperor Gallienus and his wife Salonina were also his enthusiastic admirers, and favoured his idea of founding a Platonic Commonwealth (Platonopolis) in Campania (cf. Bishop Berkeley's scheme for the Bermuda islands), but the opposition of Gallienus's counsellors and the death of Plotinus prevented the plan from being carried out. Plotinus's wide popularity was due partly to the lucidity of his teaching, but perhaps even more to his strong personality. Assent developed into veneration; he was considered to be divinely inspired, and generally credited with miraculous powers. In spite of ill-health, he continued to teach and write until his death, which took place on the estate of one of his friends near Minturnae in Campania.

Under Ammonius Plotinus became imbued with the eclectic spirit of the Alexandrian school. Having accepted the Platonic metaphysical doctrine, he applied to it the Neo-Pythagorean principles and the Oriental doctrine of Emanation (*q.v.*). The results of this introspective mysticism were collected by him in a series of fifty-four (originally forty-eight) treatises, arranged in six "Enneads," which constitute the most authoritative exposition of Neoplatonism. This arrangement is probably due to Porphyry, to whose editorial care they were consigned. There was also another ancient edition by Eustochius, but all the existing MSS. are based on Porphyry's edition.

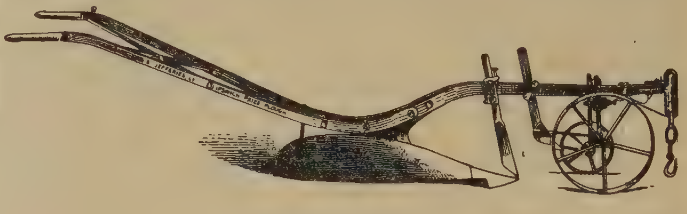
The *Enneades* of Plotinus were first made known in the Latin translation of Marsilio Ficino (Florence, 1492) which was reprinted at Basel in 1580, with the Greek text of Petrus Perna. Later editions by Creuzer and Moser ("Didot Series," 1855), A. Kirchhoff (1856), H. F. Müller (1878–1880), R. Volkmann (1883–1884). There is an English translation of selected portions by Thomas Taylor, re-edited in Bohn's *Philosophical Library* (1895, with introduction and bibliography by G. R. S. Mead).

On Plotinus generally see article in Suïdas; *Eunapius vitae sophistarum*; and above all the *Vita Plotini* by his pupil Porphyry. Among modern works, see the treatises on the school of Alexandria by J. F. Simon, i. (1845), and É. Vacherot (1846); A. Richter, *Ueber Leben und Geistesentwicklung des Plotin* (Halle, 1864–1867); T. Whittaker, *The Neoplatonists* (1901); A. Drews, *Plotin und der Untergang der antiken Weltanschauung* (1907); E. Caird, *Evolution of Theology in the Greek Philosophers* (1904), ii. 210–257; Rufus M. Jones, *Studies in Mystical Religion* (1909). A detailed account of Plotinus's philosophical system and an estimate of its importance will be found in the article NEOPLATONISM, the works above referred to, and the histories of philosophy. For his list of categories, see CATEGORIES; also LOGOS; MYSTICISM; MAGIC.

PLOUGH AND PLOUGHING. To enable the soil to grow good crops the upper layer must be pulverized and weathered. This operation, performed in the garden by means of the spade, is carried on in the field on a larger scale by the plough,[1] which breaks the soil and by inverting the furrow-slice, exposes fresh surfaces to the disintegrating influence of air, rain and frost.

The first recorded form of plough is found on the monuments of Egypt, where it consists simply of a wooden wedge tipped with iron and fastened to a handle projecting backwards and a beam, pulled by men or oxen, projecting forwards. Many references to the plough are found in the Old Testament, notably that in 1 Sam. xiii. 20: "All the Israelites went down to the Philistines to sharpen every man his *share* and his *coulter*." Descriptions of ploughs found in Hesiod's *Works and Days* and in Virgil's *Georgics* i. 169–175, show little development in the implement. The same may be said of the Anglo-Saxon ploughs. These are shown with coulter and share and also with wheels, which had in earlier times been fitted to ploughs by the Greeks and also by the natives of Cis-Alpine Gaul (Pliny, *Hist. nat.* 18, 18). A mattock with which to break the clods is often found represented in Anglo-Saxon drawings as subsidiary to the plough. All these types of plough are virtually hoes pulled through the ground, breaking but not inverting the soil. In the first half of the 18th century a plough with a short convex mould-board of wood was introduced from the Netherlands into England and, as improved at Rotherham in Yorkshire, became known as the Rotherham plough and enjoyed considerable vogue. At this period ploughs were made almost wholly of wood, the mould-board being cased with plates of iron. Small, of Berwickshire, brought out a plough in which beam and handle were of wrought iron, the mould-board of cast iron. The shares, when made of the same material, required constant sharpening; this necessity was removed by the device, patented by Robert Ransome in 1803, of chilling and so hardening the under-surface of the share; the upper surface, which is soft, then wears away more quickly than the chilled part, whereby a sharp edge is always assured. Nowadays the mould-board is of steel with a chilled and polished surface to give greater wearing qualities and to reduce friction. In the latter part of the 19th century there were numerous improvements but no fundamental alterations in the construction of the ordinary plough.

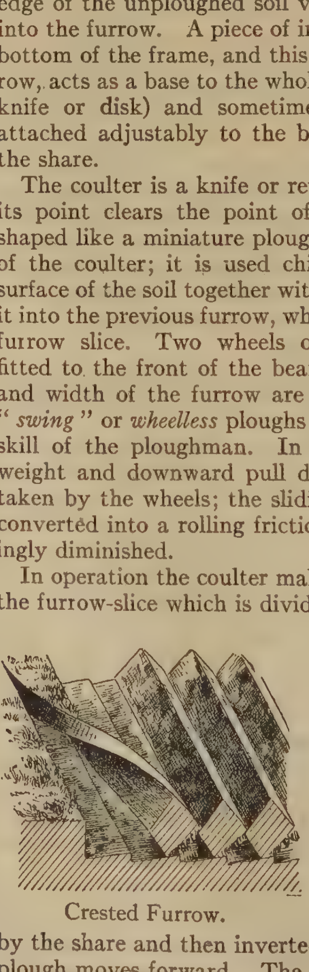
The working parts of the plough are the *coulter*, the *share*, and the *breast* or *mould-board*. These are carried on the *beam*, to which are attached the *handles* or *tilts* at the back, and the *hake* or *clevis* and *draught-chain* at the front. The hake is notched so that, by moving the draught-chain higher or lower thereon, the plough is caused to go more or less deeply into the ground. It may also be adjusted to suit the height of the horses used. The hake moves laterally on a quadrant and it is thus possible to give the plough a tendency to left or right by moving the hake in the reverse direction. A *frame* is bolted to the beam and this carries the breast or mould-board to the fore-end of which the share is fitted. The *side-cap*, a plate of iron fixed to the land-side of the frame, is intended to keep the edge of the unploughed soil vertical and prevent it from falling into the furrow. A piece of iron called the *slade* is bolted to the bottom of the frame, and this, running along the sole of the furrow, acts as a base to the whole implement. The coulter (either knife or disk) and sometimes a *skim-coulter* (or *jointer*) are attached adjustably to the beam, so as to act in the front of the share.



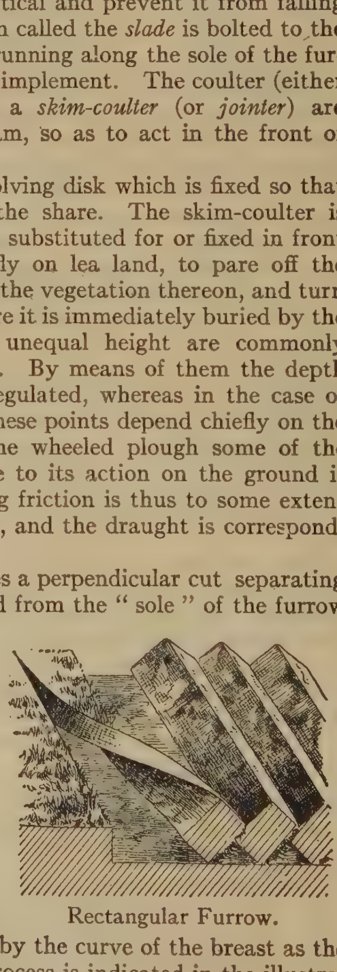
Newcastle Plough.

The coulter is a knife or revolving disk which is fixed so that its point clears the point of the share. The skim-coulter is shaped like a miniature plough, substituted for or fixed in front of the coulter; it is used chiefly on lea land, to pare off the surface of the soil together with the vegetation thereon, and turn it into the previous furrow, where it is immediately buried by the furrow slice. Two wheels of unequal height are commonly fitted to the front of the beam. By means of them the depth and width of the furrow are regulated, whereas in the case of "*swing*" or *wheelless* ploughs these points depend chiefly on the skill of the ploughman. In the wheeled plough some of the weight and downward pull due to its action on the ground is taken by the wheels; the sliding friction is thus to some extent converted into a rolling friction, and the draught is correspondingly diminished.

In operation the coulter makes a perpendicular cut separating the furrow-slice which is divided from the "sole" of the furrow by the share and then inverted by the curve of the breast as the plough moves forward. The process is indicated in the illustration of different types of furrow. The form of a furrow is



Crested Furrow.



Rectangular Furrow.

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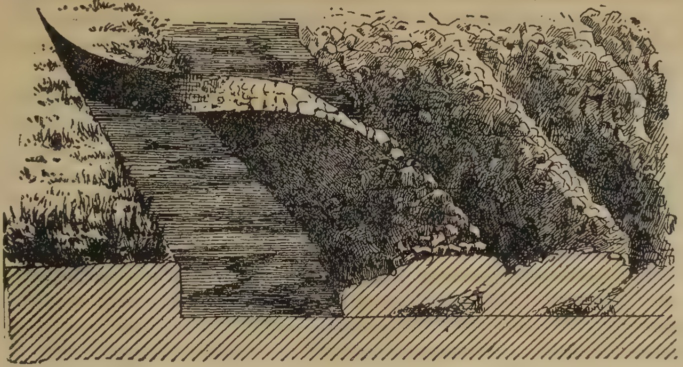
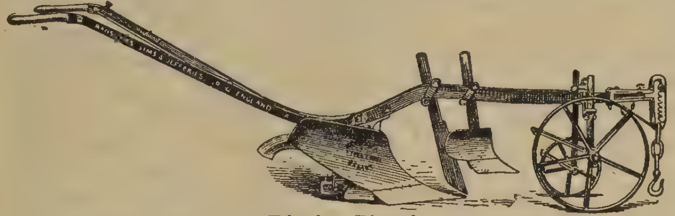
[1] The O. Eng. form is *ploh*, which is usually found in the sense of "plough-land," a unit for the assessment of land (see HIDE), the regular O. Eng. word for the implement being *sulh*, still found in some dialects in the form *sull*. It appears in many Teutonic languages, cf. Du. *ploeg*, Ger. *Pflug*, Swed. *plog*, Dan. *plov*. The Slavonic forms, such as Russ. or Pol. *plug*, are borrowed from the German. It does not appear in Gothic, where the word used is *hoha*. The ultimate origin of "plough" is unknown. Max-Müller (*Science of Language*, i. 296) connects the word with the Indo-European root meaning "to float," seen in the Gr. πλοτον, a boat or ship; the same word would be applied to the ship "ploughing" through the waves, and to the implement "ploughing" through the earth. A Celtic origin has been suggested, connecting the word with Gael. *ploe*, stump of a tree, as forming the original plough. The form "plow" was common in English until the beginning of the 18th century, and is usual in America.

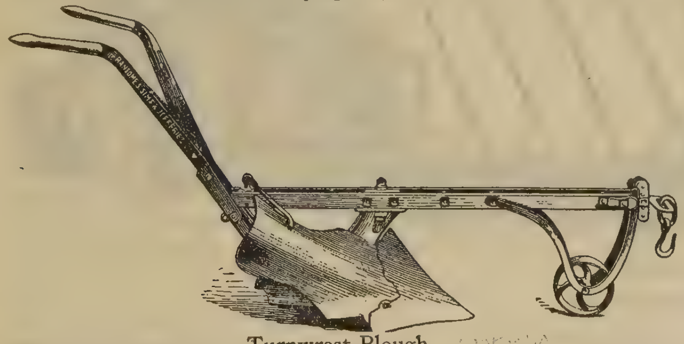
regulated by the shape and width of the share, working in combination with a proper shaped breast. A "crested" furrow is obtained by the use of a share, the wing of which is set at a higher altitude than the point, but this type of furrow is less generally found than the "rectangular" form obtained by a level-edged share, which leaves a flat bottom.


Wide Broken Furrow.

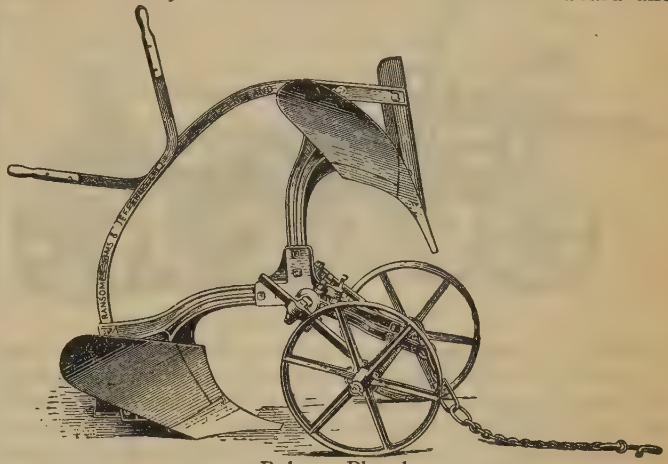
During the greater part of the 19th century the ideal of ploughing was to preserve the furrow-slice unbroken, and this object was attained by the use of long mould-boards which turned the slices gently and gradually, laying them over against one another at an angle of 45°, thus providing drainage at the bottom of the furrow, and exposing the greatest possible surface to the influences of the weather. Subsequently the digging plough came into vogue; the share being wider, a wider furrow is cut, while the slice is inverted by a short concave mould-board with a sharp turn which at the same time breaks up and pulverizes the soil after the fashion of a spade. Except on extremely heavy soils or on shallow soils with a subsoil which it is unwise to bring upon the surface, the modern tendency is in favour of the digging plough.


Digging Plough.

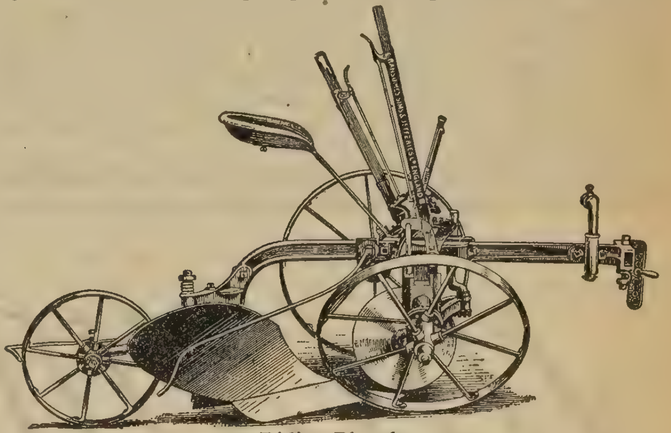
A ploughed field is divided into lands or sections of equal width separated by furrows. On light easy draining land 22 yds. is the usual width; on the heaviest lands it may be as little as 5 yds., and in the latter case the furrows will act as drains into which the water flows from the intervening ridges.[1]


Turnwrest Plough.

Certain important variations of the ordinary plough demand consideration. The one-way plough lays the furrows alternately to its left and right, so that they all slope in the same direction. This is found advantageous on hill-sides where the work is easier if all the furrows are turned downhill; or from another point of view the furrows may be all laid uphill so as to counteract the tendency for the soil to work down the slope. One-way ploughs also leave the land level and dispense with the wide open furrows between the ridges which are left by the ordinary plough. They are made on different principles. One type comprises two separate ploughs, one right hand and one left, which revolve on the beam, one working, while the other stands vertically above it. In another the mould-board and share are shaped so that they can be swung on a swivel under the beam when the latter is lifted. A third type is made on the "balance" principle, two plough beams with mould-boards being placed at right angles to one another, so that while the right-hand plough is at work the left-hand is elevated above the ground.


Balance Plough.

Double-furrow or *multiple ploughs* are a combination of two or more ploughs arranged in echelon so as to plough two or more furrows. The weight of these implements necessitates some provision for turning them at the headlands, and this is supplied either by a bowl wheel, enabling the plough to be turned on one side, or by a pair of wheels cranked so that they can be raised by a lever when the plough is working. The double-furrow plough was known as early as the 17th century, but, till the introduction of the latter device by Ransome in 1873, cannot be said to have been in successful use.


Riding Plough.

The "*sulky*" or *riding plough* is little known in the United Kingdom, but on the larger arable tracts of other countries where quick work is essential and the character of the surface permits, it is in general use. In this form of plough the frame is mounted on three wheels, one of which runs on the land, and the other two in the furrow. The furrow wheels are placed on inclined axles, the plough beam being carried on swing links, operated by a hand lever when it is necessary to raise the plough out of the furrow. The land wheel and the forward furrow wheel are adjustable vertically with reference to the frame, for the purpose of controlling the action of the plough.

In the disk plough, which is built both as a riding and a walking plough, the essential feature is the substitution of a concavo-convex disk, pivoted on the plough beam, for the mould-board and share of the ordinary plough. This disk is carried on an axle inclined to the line of draught, and also to a vertical plane. As the machine is drawn forward the disk revolves and cuts deeply into the ground, and by reason of its inclination crowds the earth outwards and thus turns a furrow. A scraper is provided to keep the disk clean and prevent sticking. The controlling levers and draught arrangements are similar to those in the "sulky" plough. The advantage of this plough over the ordinary form is in the absence of sliding friction, and in the mellow and porous condition in which it leaves the bottom of the furrow.

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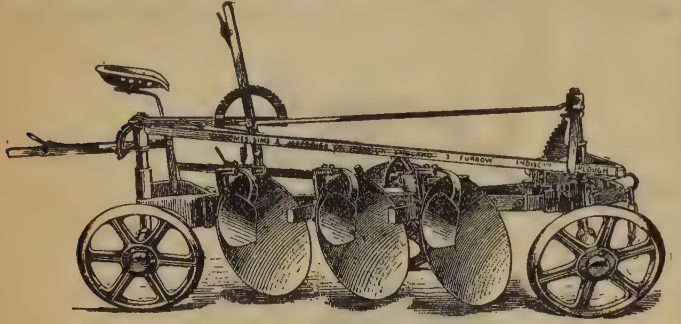
[1] Methods of the "setting-out" of land to be ploughed together with a full discussion of other technical details relating to ploughing will be found in ch. vii. of W. J. Malden's *Workman's Technical Instructor* (London, 1905).

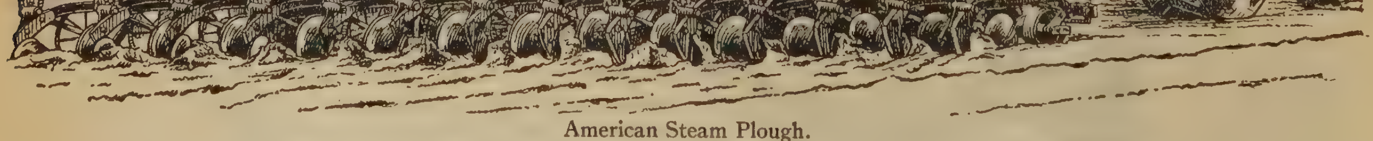


Multiple Disk Plough.

Disk ploughs are unsuitable for heavy sticky soils and for stony land, but may be used with effect on stubbles and on land in a dry hard state. Perhaps their most common use is in ploughing on a large scale in conjunction with steam power.

Steam is employed as motive power when it is necessary to plough large areas in a short time. In the United Kingdom steam ploughing is generally carried on on the double-engine system (introduced by Messrs John Fowler about 1865), in which case two sets of ploughs are arranged on the one-way balance principle, so that while one set is at work the other is carried clear of the ground. In this arrangement, a pair of locomotive engines, each having a plain winding drum fixed underneath the boiler, are placed opposite to each other at the ends of the field to be operated upon; the rope of each of the engines is attached to the plough, or other tillage implement, which is drawn to and fro betwixt them by each working in turn. While the engine in gear is coiling in its rope and drawing the plough towards itself, the rope of the other engine is paid out with merely so much drag on it as to keep it from kinking or getting ravelled on the drum.

In the United States and elsewhere engines drawing behind them a number of ploughs, arranged in echelon and taking perhaps 30 ft. at a time, are frequently seen. On smaller areas petrol motors with one or more ploughs attached are sometimes used.



American Steam Plough.

There is a large variety of ploughs which differ in their purpose from the ordinary plough.

The *ridging plough* is an implement with a mould-board on each side, terminating in front in a flat point, and used for moulding up potatoes, and for throwing up the ridge on which to plant roots.

The *sub-soil plough* has the beam and body but not the mould-board of an ordinary plough. Following in the furrow of an ordinary plough it breaks through the sub-soil to a depth of several inches, making it porous and penetrable by plant roots.

Gripping and *draining ploughs* are employed in opening the grips and trenches necessary both in surface and underground drainage.

See Davidson and Chase, *Farm Motors and Farm Machinery*; articles in L. H. Bailey's *Cyclopedia of American Agriculture* (New York, 1907) and *Standard Encyclopaedia* (London, 1908), &c.

PLOVER, a bird whose name (Fr. *pluvier*, O. Fr. *plovier*) doubtless has its origin in the Latin *pluvia*, rain (as witness the German equivalent *Regenpfeifer*, rain-fifer). P. Belon (1555) says that the name *Pluvier* is bestowed " pour ce qu'on le prend mieux en temps pluvieux qu'en nulle autre saison," which is not in accordance with modern observation, for in rainy weather plovers are wilder and harder to approach than in fine. Others have thought it is from the spotted (as though with rain-drops) upper plumage of two of the commonest species of plovers, to which the name especially belongs—the *Charadrius pluvialis* of Linnaeus, or golden plover, and the *Squatarola helvetica* of recent ornithologists, or grey plover. Both these birds are very similar in general appearance, but the latter is the larger and has an aborted hind-toe on each foot.[1] Its axillary feathers are also black, while in the golden plover they are pure white. The grey plover is a bird of almost circumpolar range, breeding in the far north of America, Asia and eastern Europe, frequenting in spring and autumn the coasts of the more temperate parts of each continent, and generally retiring farther southward in winter—examples not unfrequently reaching Cape Colony, Ceylon, Australia and even Tasmania. *Charadrius pluvialis* has a much narrower distribution, though where it occurs it is much more numerous. Its breeding quarters do not extend farther than from Iceland to western Siberia, but include the more elevated tracts in the British Islands, whence in autumn it spreads itself, often in immense flocks, over the cultivated districts if the fields be sufficiently open. Here some will remain so long as the absence of frost or snow permits, but the majority make for the Mediterranean basin, or the countries beyond, in which to winter; and stragglers find their way to the southern extremity of Africa. Two other cognate forms, *C. virginicus* and *C. fulvus*, respectively represent *C. pluvialis* in America and eastern Asia, where they are also known by the same English name. The discrimination of these two birds from one another requires a very acute eye,[2] but both are easily distinguished from their European ally by their smaller size, their greyish-brown axillary feathers, and their proportionally longer and more slender legs. All, however—and the same is the case with the grey plover—undergo precisely the same seasonal change of colour, greatly altering their appearance and equally affecting both sexes. In spring or early summer nearly the whole of the lower plumage from the chin to the vent, which during winter has been nearly pure white, becomes deep black. A corresponding alteration is at the same season observable in the upper plumage.

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[1] But for this really unimportant distinction both birds could doubtless have been kept by ornithologists in the same genus, for they agree in most other structural characters.

[2] Schlegel (*Mus. Pays-Bas, Cursores*, p. 53) states that in some examples it seems impossible to determine the form to which they belong; but ordinarily American specimens are rather larger and stouter, and have shorter toes than those from Asia.

Though the birds just spoken of are those most emphatically entitled to be called plovers, the group of ringed plovers (see Killdeer and Lapwing), with its allies, has, according to usage, hardly less claim to the name, which is also extended to some other more distant forms that can here have only the briefest notice. Among them one of the most remarkable is the "Zick-zack" (so-called from its cry)—the τροχίλος of Herodotus (see Humming-bird), the *Pluvianus* or *Hyas aegyptius* of ornithologists, celebrated for the services it is said to render to the crocodile—a small bird whose plumage of delicate lavender and cream colour is relieved by markings of black and white. This belongs to the small family *Glareolidae*, of which the members best known are the coursers, *Cursorius*, with some eight or ten species inhabiting the deserts of Africa and India, while one, *C. gallicus*, occasionally strays to Europe and even to England. Allied to them are the curious pratincoles (*q.v.*), also peculiar to the Old World, while the genera *Thinocoris* and *Attagis* form an outlying group peculiar to South America, that is by some systematists regarded as a separate family *Thinocoridae*, near which are often placed the singular Sheathbills (*q.v.*). By most authorities the Stone-curlews (see Curlew), the Oyster-catchers (*q.v.*) and Turnstones (*q.v.*) are also regarded as belonging to the family *Charadriidae*, and some would add the Avocets (*Recurvirostra*) and Stilts (*q.v.*), among which the Cavalier, or Crab-plover, *Dromas ardeola*—a form that has been bandied about from one family and even order to another—should possibly find its resting-place. It frequents the sandy shores of the Indian Ocean and Bay of Bengal from Natal to Aden, and thence to Ceylon, the Malabar coast, and the Andaman and Nicobar Islands—a white and black bird, mounted on long legs, with webbed feet, and a bill so shaped as to have made some of the best ornithologists lodge it among the Terns (*q.v.*).

Though the various forms here spoken of as plovers are almost certainly closely allied, they must be regarded as constituting a very indefinite group, for hardly any strong line of demarcation can be drawn between them and the Sandpipers and Snipes (*q.v.*). United, however, with both of the latter under the name of *Limicolae*, after the method approved by the most recent systematists, the whole form an assemblage the compactness of which no observant ornithologist can hesitate to admit, even if he be uncertain of the exact kinship.

For "plovers' eggs" see Lapwing. (A. N.)

PLUCK, to pull or pick off something, as flowers from a plant, feathers from a bird. The word in O. Eng. is *pluccian* or *ploccian* and is represented by numerous forms in Teutonic languages, cf. Ger. *pflücken*, Du. *plukken*, Dan. *plakke*, &c. In sense and form a plausible identification has been found with Ital. *piluccare*, to pick grapes, hair, feathers, cf. Fr. *éplucher*, pick. These romanic words are to be referred to Lat. *pilus*, hair, which has also given "peruke" or "periwig" and "plush." Difficulties of phonology, history and chronology, however, seem to show that this close similarity is only a coincidence. "Pluck," in the sense of courage, was originally a slang word of the prize-ring, and Sir W. Scott (*Journal*, Sept. 4, 1827) speaks of the "want of that article blackguardly called *pluck*." In butcher's parlance the "pluck" of an animal is the heart, liver and lungs, probably so called from their being "plucked" or pulled out of the carcase immediately after slaughtering. The heart being the typical seat of courage, the transference is obvious. In university colloquial or slang use, "to pluck" is to refuse to pass a candidate on examination; the more usual colloquial word is now "to plough." At the granting of degrees at Oxford objection to a candidate could be taken for other reasons than failure at examination, and the person thus challenging drew the attention of the proctor in congregation by "plucking" a piece of black silk attached to the back of his gown.

PLÜCKER, JULIUS (1801–1868), German mathematician and physicist, was born at Elberfeld on the 16th of June 1801. After being educated at Düsseldorf and at the universities of Bonn, Heidelberg and Berlin he went in 1823 to Paris, where he came under the influence of the great school of French geometers, whose founder, Gaspard Monge, was only recently dead. In 1825 he was received as *Privatdozent* at Bonn, and after three years he was made professor extraordinary The title of his "habilitationsschrift," *Generalem analyseos applicationem ad ea quae geometriae altioris et mechanicae basis et fundamenta sunt e serie Tayloria deducit Julius Plücker* (Bonn, 1824), indicated the course of his future researches. The mathematical influence of Monge had two sides represented respectively by his two great works, the *Géométrie descriptive* and the *Application de l'analyse à la géométrie*. Plücker aimed at furnishing modern geometry with suitable analytical methods so as to give it an independent analytical development. In this effort he was as successful as were his great contemporaries Poncelet and J. Steiner in cultivating geometry in its purely synthetic form. From his lectures and researches at Bonn sprang his first great work, *Analytisch-geometrische Entwickelungen* (vol. i., 1828; vol. ii., 1831).

In the first volume of this treatise Plücker introduced for the first time the method of abridged notation which has become one of the characteristic features of modern analytical geometry (see Geometry, Analytical). In the first volume of the *Entwickelungen* he applied the method of abridged notation to the straight line, circle and conic sections, and he subsequently used it with great effect in many of his researches, notably in his theory of cubic curves. In the second volume of the *Entwickelungen* he clearly established on a firm and independent basis the great principle of duality.

Another subject of importance which Plücker took up in the *Entwickelungen* was the curious paradox noticed by L. Euler and G. Cramer, that, when a certain number of the intersections of two algebraical curves are given, the rest are thereby determined. Gergonne had shown that when a number of the intersections of two curves of the $(p+q)$th degree lie on a curve of the pth degree the rest lie on a curve of the qth degree. Plücker finally (*Gergonne Ann.*, 1828–1829) showed how many points must be taken on a curve of any degree so that curves of the same degree (infinite in number) may be drawn through them, and proved that all the points, beyond the given ones, in which these curves intersect the given one are fixed by the original choice. Later, simultaneously with C. G. J. Jacobi, he extended these results to curves and surfaces of unequal order. Allied to the matter just mentioned was Plücker's discovery of the six equations connecting the numbers of singularities in algebraical curves (see Curve). Plücker communicated his formulae in the first place to *Crelle's Journal* (1834), vol. xii., and gave a further extension and complete account of his theory in his *Theorie der algebraischen Curven* (1839).

In 1833 Plücker left Bonn for Berlin, where he occupied a post in the Friedrich Wilhelm's Gymnasium. He was then called in 1834 as ordinary professor of mathematics to Halle. While there he published his *System der analytischen Geometrie, auf neue Betrachtungsweisen gegründet, und insbesondere eine ausführliche Theorie der Curven dritter Ordnung enthaltend* (Berlin, 1835). In this work he introduced the use of linear functions in place of the ordinary co-ordinates; he also made the fullest use of the principles of collineation and reciprocity. His discussion of curves of the third order turned mainly on the nature of their asymptotes, and depended on the fact that the equation to every such curve can be put into the form $pqr+\mu s=0$. He gives a complete enumeration of them, including two hundred and nineteen species. In 1836 Plücker returned to Bonn as ordinary professor of mathematics. Here he published his *Theorie der algebraischen Curven*, which formed a continuation of the *System der analytischen Geometrie*. The work falls into two parts, which treat of the asymptotes and singularities of algebraical curves respectively; and extensive use is made of the method of counting constants which plays so large a part in modern geometrical researches.

From this time Plücker's geometrical researches practically ceased, only to be resumed towards the end of his life. It is true that he published in 1846 his *System der Geometrie des*

Raumes in neuer analytischer Behandlungsweise, but this contains merely a more systematic and polished rendering of his earlier results. In 1847 he was made professor of physics at Bonn; and from that time his scientific activity took a new and astonishing turn.

His first physical memoir, published in *Poggendorffs Annalen* (1847), vol. lxxii., contains his great discovery of magnecrystallic action. Then followed a long series of researches, mostly published in the same journal, on the properties of magnetic and diamagnetic bodies, establishing results which are now part and parcel of our magnetic knowledge. In 1858 (*Pogg. Ann.* vol. ciii.) he published the first of his classical researches on the action of the magnet on the electric discharge in rarefied gases.

Plücker, first by himself and afterwards in conjunction with J. W. Hittorf, made many important discoveries in the spectroscopy of gases. He was the first to use the vacuum tube with the capillary part now called a Geissler's tube, by means of which the luminous intensity of feeble electric discharges was raised sufficiently to allow of spectroscopic investigation. He anticipated R. W. Y. Bunsen and G. Kirchhoff in announcing that the lines of the spectrum were characteristic of the chemical substance which emitted them, and in indicating the value of this discovery in chemical analysis. According to Hittorf he was the first who saw the three lines of the hydrogen spectrum, which a few months after his death were recognized in the spectrum of the solar protuberances, and thus solved one of the mysteries of modern astronomy.

Hittorf tells us that Plücker never attained great manual dexterity as an experimenter. He had always, however, very clear conceptions as to what was wanted, and possessed in a high degree the power of putting others in possession of his ideas and rendering them enthusiastic in carrying them into practice. Thus he was able to secure from the Sayner Hütte in 1846 the great electromagnet which he turned to such use in his magnetic researches; thus he attached to his service his former pupil the skilful mechanic Fessel; and thus he discovered and fully availed himself of the ability of the great glass-blower Geissler.

Induced by the encouragement of his mathematical friends in England, Plücker in 1865 returned to the field in which he first became famous, and adorned it by one more great achievement —the invention of what is now called "line geometry." His first memoir on the subject was published in the *Philosophical Transactions* of the Royal Society of London. It became the source of a large literature in which the new science was developed. Plücker himself worked out the theory of complexes of the first and second order, introducing in his investigation of the latter the famous complex surfaces of which he caused those models to be constructed which are now so well known to the student of the higher mathematics. He was engaged in bringing out a large work embodying the results of his researches in line geometry when he died on the 22nd of May 1868. The work was so far advanced that his pupil and assistant Felix Klein was able to complete and publish it (see GEOMETRY, LINE). Among the very numerous honours bestowed on Plücker by the various scientific societies of Europe was the Copley medal, awarded to him by the Royal Society two years before his death.

See R. F. A. Clebsch's obituary notice (*Abh. d. kön. Ges. d. Wiss. z. Göttingen*, 1871, vol. xvi.), to which is appended an appreciation of Plücker's physical researches by Hittorf, and a list of Plücker's works by F. Klein. See also C. I. Gerhardt, *Geschichte der Mathematik in Deutschland*, p. 282, and Plücker's life by A. Dronke (Bonn, 1871).

PLUM, the English name both for certain kinds of tree and also generally for their fruit. The plum tree belongs to the genus *Prunus*, natural order Rosaceae. Cultivated plums are supposed to have originated from one or other of the species *P. domestica* (wild plum) or *P. insititia* (bullace). The young shoots of *P. domestica* are glabrous, and the fruit oblong; in *P. insititia* the young shoots are pubescent, and the fruit more or less globose. A third species, the common sloe or blackthorn, *P. spinosa*, has stout spines; its flowers expand before the leaves; and its fruit is very rough to the taste, in which particulars it differs from the two preceding. These distinctions, however, are not maintained with much constancy. *P. domestica* is a native of Anatolia and the Caucasus, and is considered to be the only species naturalized in Europe. *P. insititia* is wild in southern Europe, in Armenia, and along the shores of the Caspian. In the Swiss lake-dwellings stones of the *P. insititia* as well as of *P. spinosa* have been found, but not those of *P. domestica*. Nevertheless, the Romans cultivated large numbers of plums. The cultivated forms are extremely numerous, some of the groups, such as the greengages, the damsons and the egg plums being very distinct, and sometimes reproducing themselves from seed. The colour of the fruit varies from green to deep purple, the size from that of a small cherry to that of a hen's egg; the form is oblong acute or obtuse at both ends, or globular; the stones or kernels vary in like manner; and the flavour, season of ripening and duration are all subject to variation. From its hardihood the plum is one of the most valuable fruit trees, as it is not particular as to soil, and the crop is less likely to be destroyed by spring frosts. Prunes and French plums are merely plums dried in the sun. Their preparation is carried on on a large scale in Bosnia and Servia, as well as in Spain, Portugal and southern France.

Plums are propagated chiefly by budding on stocks of the Mussel, Brussels, St Julien and Pear plums. The damson, wine-sour and other varieties, planted as standards, are generally increased by suckers. For planting against walls, trees which have been trained for two years in the nursery are preferred, but maiden trees can be very successfully introduced, and by liberal treatment may be speedily got to a fruiting state. Any good well-drained loamy soil is suitable for plums, that of medium quality as to lightness being decidedly preferable. Walls with an east or west aspect are generally allowed to them. The horizontal mode of training and the fan or half-fan forms are commonly followed; where there is sufficient height probably the fan system is the best. The shoots should be laid in nearly or quite at full length. The fruit is produced on small spurs on branches at least two years old, and the same spurs continue fruitful for several years. Standard plum trees should be planted 25 ft. apart each way, and dwarfs 15 or 20 ft. The latter are now largely grown for market purposes, being more easily supported when carrying heavy crops, fruiting earlier, and the fruit being gathered more easily from the dwarf bush than from standard trees.

The following is a selection of good varieties of plums, with their times of ripening:—

Dessert Plums.

Early Green-gage	e.	July	Transparent Gage	b.	Sept.
Early Transparent Gage	b.	Aug.	Jefferson	b.	Sept.
Denniston's Superb	b.	Aug.	Kirke's	m.	Sept.
Oullin's Golden	m.	Aug.	Coe's Golden Drop	e.	Sept.
Green-gage	m.e.	Aug.	Reine Claude de Bavay	e. b.	Sept. Oct.
M'Laughlin's	e.	Aug.	Ickworth Impératrice	b.	Oct.
Angelina Burdett	b.	Sept.	Late Rivers	e. b.	Oct. Nov.

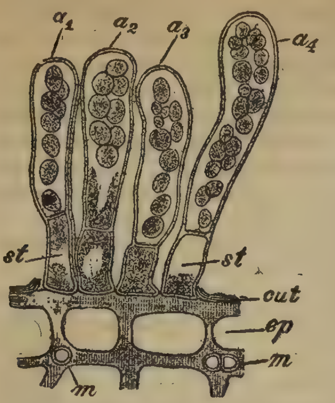
Culinary Plums.

Early Prolific	e.	July	Victoria		Sept.
Belle de Louvain		Aug.	White Magnum Bonum		Sept.
Belgian Purple	m.	Aug.	Pond's Seedling	m.	Sept.
Czar	e.	Aug.	Diamond	m.	Sept.
Pershore	e.	Aug.	Monarch	e.	Sept.
Prince Englebert	e.	Aug.	Grand Duke		Oct.
Mitchelsons'	b.	Sept.	Wyedale	e.	Oct.

Diseases.—The Plum is subject to several diseases of fungal origin. A widespread disease known as pocket-plums or bladder-plums is due to an ascomycetous fungus, *Exoascus pruni*, the mycelium of which lives parasitically in the tissues of the host plant, passes into the ovary of the flower and causes the characteristic malformation of the fruit which becomes a deformed, sometimes curved or flattened, wrinkled dry structure, with a hollow occupying the place of the stone; the bladder plums are yellow at first, subsequently dingy red. The reproductive spores are borne in sacs (*asci*) which form a dense layer on the surface, appearing like a bloom in July; they are scattered by the wind and propagate the disease. The only remedy is to cut off and burn the diseased branches.

Plum-leaf blister is caused by *Polystigma rubrum*, a pyrenomycetous fungus which forms thick fleshy reddish patches on the leaves.

The reproductive spores are formed in embedded flesh-shaped receptacles (perithecia) and scattered after the leaves have fallen. The spots are not often so numerous as to do much harm to the leaves, but where the disease is serious diseased leaves should be collected and burned. Sloes and bird-cherries should be removed from the neighbourhood of plum-trees, as the various disease-producing insects and fungi live also on these species. The branches are sometimes attacked by weevils (*Rhyncites*) and the larvae of various moths, and saw-flies (chiefly *Eriocampa*) feed on the leaves, and young branches and leaves are sometimes invaded by Aphides. Leaf-feeding beetles and larvae of moths are best got rid of by shaking the branches and collecting the insects. Slug-worms or saw-fly larvae require treatment by washing with soapsuds, tobacco and lime-water or hellebore solution, and Aphides by syringing from below and removing all surplus young twigs.



(After Sadebeck. From Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.)

Taphrina Pruni.—Transverse section through the epidermis of an infected plum. Four ripe asci, a_1, a_2, with eight spores a_3, a_4, with yeast-like conidia abstricted from the spores.

st, Stalk-cells of the asci.
m, Filaments of the mycelium cut transversely.
cut, Cuticle.
ep, Epidermis.

PLUMBAGO (from Lat. *plumbum*, lead), a name frequently applied to graphite (*q.v.*), in allusion to its remote resemblance to lead, whence it is popularly called "black-lead." It was formerly held in repute in medicine, but is now regarded as having no medicinal properties of any value.

PLUMBAGO DRAWINGS. What we should now speak of as pencil drawings were in the 17th and 18th centuries usually known as drawings "in plumbago," and there is a group of artists whose work is remarkable for their exquisite portraits drawn with finely pointed pieces of graphite and upon vellum. In some books of reference they are grouped as engravers, and as such Horace Walpole describes several of them. There is no doubt that many of their fine pencil drawings were prepared for the purpose of engraving, but this is not likely to have been the case with all, and we have evidence of certain commissions executed, by Forster for example, when the portrait was not required for the preparation of a plate. One of the earliest of this group of workers was Simon Van de Pass (1595?–1647), and in all probability his pencil drawings were either for reproduction on silver tablets or counters or for engraved plates. A very few pencil portraits by Abraham Blooteling, the Dutch engraver, have been preserved, which appear to have been first sketches, from which plates were afterwards engraved. They are of exceedingly delicate workmanship, and one in the present writer's collection is signed and dated. By David Loggan (1635–1700), a pupil of Van de Pass, there also remain a few portraits, as a rule drawn on vellum and executed with the utmost dexterity and with marvellous minuteness, the lines expressing the intricacies of a lace ruffle or the curls of a wig being perfectly rendered. It is evident that these were not always prepared for engraving, because there is one representing Charles II., set in a beautiful gold snuff box, which was given by the king to the duchess of Portsmouth and now belongs to the duke of Richmond, and a similar portrait of Cromwell in the possession of Lord Verulam, while several others belong to Lord Caledon, and there are no engravings corresponding to these. On the other hand, a large drawing by Loggan in the writer's collection, representing Charles II., is the sketch for the finished engraving and bears a declaration to that effect. An artist who is better known to the general collector is William Faithorne (1616–1691). He was the pupil of Sir Robert Peake, the engraver, but derived much of his skill from the time he spent with Nanteuil, whose involved minute style he closely followed, triumphing over technical difficulties with great success. There are important drawings by him in the Bodleian, at Welbeck Abbey and at Montagu House, and two fine portraits in the British Museum. Thomas Forster (*fl.* 1695–1712) was one of the greatest draughtsmen in this particular form of portraiture. His drawings are both on vellum and on paper, as a rule on vellum. Of the details of his life very little is known. He engraved a few prints, but they are of the utmost rarity. His finest portraits are executed with very great refinement and delicacy, the modelling of the face being quite wonderful. It is in fact one of the marvels of this type of portraiture how such exquisite lines could have been drawn with the roughly cut pieces of graphite which were at the disposal of the artists. In some instances in Forster's work the lines representing the modelling of the face are so fine as to be quite indistinguishable without the aid of a glass. His work can be studied at Welbeck Abbey, in the Holburne Museum at Bath, in the Victoria and Albert Museum and elsewhere. Two other Englishmen should be referred to, Robert and George White, father and son. The former (1645–1704) was a pupil of Loggan and a prolific engraver, and most of his drawings, executed on vellum, were for the purpose of engraving. George White (*c.* 1684–1732) was taught by his father, and finished some of his father's plates. His own pencil drawings are of even finer execution than those of Robert White. These three men, Forster and the two Whites, carefully signed their drawings and dated them. By Robert White there are remarkable portraits of Bunyan and Sir Matthew Hale in the British Museum, and his own portrait at Welbeck; and by him and his son there are other drawings in private collections, depicting Sir Godfrey Kneller, Archbishop Tennyson and others. The two Fabers (1660?–1721 and 1695?–1756) were from Holland, the elder having been born at the Hague, as he himself states on his portrait which was in Vertue's collection. In addition to the portraits these two men usually added beautiful drawn inscriptions, often found within circles around the portraits and occasionally extending to many lines below them. The son was the greater artist and a famous mezzotinter. The portrait painter Jonathan Richardson (1665–1745) executed many fine drawings in pencil, examples of which can be seen in the British Museum. One of the best of these plumbago draughtsmen was a Scotsman, whose work is of the utmost rarity, David Paton, who worked in 1670. The chief of his drawings belong to the earl of Dysart and are at Ham House, and two examples of his portraiture are in the possession of the Dalzell family. Of Paton's history nothing is known save that he was a Catholic who worked for more than one Dominican house, a devoted adherent of the Stuart cause, and was attached to the court of Charles II., when the king was in Scotland. At that time he drew his remarkable portrait of the king now at Ham House. There are drawings of the same character as his, the work of George Glover (d. 1618) and Thomas Cecill (*fl.* 1630), but they are of extraordinary rarity and were evidently first studies for engravings. Of Glover's work the only signed example known is in the writer's collection. A Swiss artist, Joseph Werner (b. 1637) or Waerner, drew well in pencil, adopting brown paper as the material upon which his best drawings were done, and in some cases heightening them with touches of white paint. The most notable of his portraits is one which is in the collection at Welbeck Abbey.

The earlier miniature painters also drew in this manner, notably Hilliard in preparing designs for jewels and seals, and Isaac and Peter Oliver in portraits. By Isaac Oliver there is a fine drawing in Lord Derby's collection; and one by Peter, a marvellous likeness of Sir Bevil Grenville, in that of the writer. The later men, Hone, Grimaldi, Lens and Downman, also drew finely in plumbago. Other notable exponents of this delightful art were Thomas Worlidge (1700–1766), F. Steele (*c.* 1714), W. Robins (*c.* 1730), G. A. Wolffgang (1692–1775), George Vertue the engraver (1684–1756), Johann Zoffany (1733–1810), and the Swede, Charles Bancks (*c.* 1748), who resided in England for some years. (G. C. W.)

PLUMBING, properly working in lead (Lat. *plumbum*), now a term embracing all work not only in lead, but also in tin, zinc and other metals, connected with the installation, fitting, repairing, soldering, &c., of pipes for water, gas, drainage, on cisterns, roofs and the like in any building, *i.e.* the general work of a plumber. (See Building and Sewerage.)

PLUMPTRE, EDWARD HAYES (1821–1891), English divine and scholar, was born in London on the 6th of August 1821. A scholar of University College, Oxford, he graduated with a double-first class in 1844, and in the same year he was elected fellow of Brasenose College. He was ordained in 1847, and shortly afterwards appointed chaplain, and then professor of pastoral theology, at King's College, London. In 1863 he was given a prebendal stall at St Paul's, and from 1869 to 1874 he was a member of the committee appointed by Convocation to revise the authorized version of the Old Testament. He was Boyle lecturer in 1866–1867 ("Christ and Christendom"), and Grinfield lecturer on the Septuagint at Oxford 1872–1874. After successively holding the livings of Pluckley and Brickley in Kent, he was installed in 1881 as dean of Wells. He died on the 1st of February 1891.

Plumptre was a man of great versatility and attained high reputation as a translator of the plays of Sophocles (1865) and Aeschylus (1868), and of the *Divina commedia* of Dante (1886). In verse his main achievements were *Lazarus* (1864), and *Master and Scholar* (1866). Among his many theological works may be mentioned *An Exposition of the Epistles to the Seven Churches of Asia* (1877), *The Spirits in Prison* (1884), "The Book of Proverbs" (which he annotated in the Speaker's *Commentary*), the "Synoptic Gospels, Acts, and II. Corinthians," in Bishop Ellicott's *New Testament Commentary*, and *Life of Bishop Ken* (1888).

PLUNDER, to rob, to pillage, especially in war. The word came into English usage directly from Ger. *plundern* (derived from a substantive *Plunder* meaning "household stuff," bedclothes, clothing, &c.), particularly with reference to the pillaging of the Thirty Years' War. Thomas May (*History of the Long Parliament*, 1647; quoted in the *New English Dictionary*) says: "Many Tounes and Villages he (Prince Rupert) plundered, which is to say robb'd, for at that time first was the word plunder used in England, being borne in Germany." The *New English Dictionary's* earliest quotation is from the *Swedish Intelligencer* (1632).

PLUNKET, OLIVER (1629–1681), Irish Roman Catholic divine, was born at Loughcrew, Co. Meath. He was educated privately and at Rome, whither he went with Father Scarampi in 1645. From 1657 to 1669 he was professor of theology at the College of the Propaganda, enjoyed the friendship of the historian, Pallavicini, and acted as representative of Irish ecclesiastical affairs at Rome. Pope Clement IX. appointed him to the archbishopric of Armagh and primacy of Ireland in July 1669, and in November he was consecrated at Ghent, reaching Ireland in March 1670. Lord Berkeley of Stratton, the viceroy, showed him much kindness and allowed him to establish a Jesuit school in Dublin. Plunket showed amazing diligence in furthering the cause of his Church. He was in very straitened circumstances, the revenue of his see being only £62 in good years. The repressive measures following on the Test Act bore hardly upon him, and in December 1678 he was imprisoned in Dublin Castle for six weeks. Accused of a share in the Irish branch of the "Popish Plot," he was brought to London, and in June 1681 arraigned in the King's Bench, charged with conspiring to bring a French army to Carlingford. He made a good defence, but on the absurdest of evidence the jury convicted him of treason, and on the 1st of July he was hanged, drawn and quartered at Tyburn.

PLUNKET, WILLIAM CONYNGHAM PLUNKET, 1st Baron (1764–1854), Irish lawyer, orator and statesman, was born in the county of Fermanagh in July 1764.[1] He was educated first by his father, a Presbyterian minister of considerable ability and reputation, and in 1779 he became a student of Trinity College, Dublin. He was conspicuous as the acknowledged leader of the Historical Society, the debating club of Trinity College, then full of young men of remarkable promise. Having entered Lincoln's Inn in 1784, Plunket was called to the Irish bar in 1787. He gradually obtained a considerable practice in equity; and was made a king's counsel in 1797.

In 1798 he entered the Irish parliament as member for Charlemont. He was an anti-Jacobin Whig of the school of Burke, not ungracefully filled with a fervent Irish patriotism. But he was a sincere admirer of the constitutional government of England as established in 1688; he even justified the ascendancy it had given to the Established Church, although he thought that the time had arrived for extending toleration to Roman Catholics and dissenters. To transfer it to Ireland as thus modified, and under an independent legislature. was the only reform he sought for his country; he opposed the union because he thought it incompatible with this object.

When Plunket entered the Irish parliament, the Irish Whig party was almost extinct, and Pitt was feeling his way to accomplish the union. In this he was seconded ably by Lord Castlereagh, by the panic caused by a wild insurrection, and by the secession of Grattan from politics. When, however, the measure was brought forward, among the ablest and fiercest of its adversaries was Plunket, whose powers as a great orator were now universally recognized. His speeches raised him immediately to the front rank of his party; and when Grattan re-entered the moribund senate he took his seat next to Plunket, thus significantly recognizing the place the latter had attained.

After the union Plunket returned to the practice of his profession, and became at once a leader of the equity bar. In 1803, after Emmet's rebellion, he was selected as one of the Crown lawyers to prosecute the unfortunate enthusiast, and at the trial, in summing up the evidence, delivered a speech of remarkable power, which shows his characteristic dislike of revolutionary outbursts. For this speech he was exposed to much unmerited obloquy, and more especially to the abuse of Cobbett, against whom he brought a successful action for damages. In 1803, in Pitt's second administration, he became solicitor-general, and in 1805 attorney-general for Ireland; and he continued in office when Lord Grenville came into power in 1806. Plunket held a seat in the Imperial parliament during this period, and there made several able speeches in favour of Catholic emancipation, and of continuing the war with France; but when the Grenville cabinet was dissolved he returned once more to professional life.

In 1812, having amassed a considerable fortune, he re-entered parliament as member for Trinity College, and identified himself with the Grenville or anti-Gallican Whigs. He was soon acknowledged as one of the first orators, if not the first, of the House of Commons. His reverence for the English constitution in church and state, his steady advocacy of the war with Napoleon, and his antipathy to anything like democracy made him popular with the Tory party. In 1822 Plunket was once more attorney-general for Ireland, with Lord Wellesley as lord-lieutenant. One of his first official acts was to prosecute for the "bottle riot," an attempt on his part to put down the Orange faction in Ireland. He strenuously opposed the Catholic Association, which about this time, under the guidance of O'Connell, began its agitation. In 1825 he made a powerful speech against it; thus the curious spectacle was seen of the ablest champion of an oppressed church doing all in his power to check its efforts to emancipate itself.

In 1827 Plunket was made master of the rolls in England; but, owing to the professional jealousy of the bar, who regarded an Irishman as an intruder, he resigned in a few days. Soon afterwards he became chief justice of the common pleas in Ireland, and was then created a peer of the United Kingdom. In 1830 he was appointed lord chancellor of Ireland, and held the office, with an interval of a few months only, until 1841, when he finally retired from public life. He died on the 4th of January 1854, and was succeeded by his eldest son, the bishop of Tuam (1792–1866) as 2nd baron. The 4th baron (1828–1897) was bishop of Meath and afterwards archbishop of Dublin and primate of Ireland, and an active ecclesiastical statesman; and his younger brother David Plunket (b. 1838), solicitor-general for Ireland in 1875–1877, and first commissioner of works in the Unionist administration of 1885–1892, was in 1895 created Baron

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[1] The Irish Plunkets are distinguished by the spelling of the name from the Plunketts of the families of the barons Dunsany (cr. 1439) and the earls of Fingall (cr. 1628), though the earlier members of these houses are often given the spelling of Plunket.

Rathmore. William Lee Plunket, 5th baron (b. 1864), was governor of New Zealand from 1904 to 1910.

PLUNKETT, SIR HORACE CURZON (1854–), Irish politician, third son of Edward, 16th baron Dunsany, was born on the 24th of October 1854, and was educated at Eton and University College, Oxford, of which college he became honorary fellow in 1909. He spent ten years (1879–1889) ranching in Montana, U.S.A., where, together with a substantial fortune, he acquired experience that proved invaluable in the work of agricultural education, improvement and development, to which he devoted himself on his return to Ireland in 1889. At first Plunkett resolved to hold himself aloof from party politics, and he set himself to bring together men of all political views for the promotion of the material prosperity of the Irish people. In 1894 he founded the Irish Agricultural Organization Society, which accomplished a work of incalculable importance by introducing co-operation among Irish farmers, and by proving to the latter the benefits obtainable through more economical and efficient management. But already in 1892 he had felt compelled to abandon his non-political attitude, and he entered parliament as Unionist member for south Dublin (county). Continuing, however, his policy of conciliation, Plunkett suggested in August 1895 that a few prominent persons of various political opinions should meet to discuss and frame a scheme of practical legislation. The outcome of this proposal was the formation of the "Recess Committee" with Plunkett as chairman, which included men of such divergent views as the earl of Mayo, Mr John Redmond, The O'Conor Don and Mr Thomas Sinclair. In July 1896 the Recess Committee issued a report, of which Plunkett was the author, containing valuable accounts of the systems of state aid to agriculture and of technical instruction in foreign countries. This report, and the growing influence of Plunkett, who became a member of the Irish Privy Council in 1897, led to the passing of an act in 1899 which established a department of agriculture and technical instruction in Ireland, of which the chief secretary was to be president *ex officio*. Plunkett was appointed vice-president, a position which gave him control of the department's operations. It was intended that the vice-president should be responsible for the department in the House of Commons, but at the general election of 1900 Plunkett lost his seat. An extensively signed memorial, supported by the Agricultural Council, prayed that he might not be removed from office, and at the government's request he continued to direct the policy of the department without a seat in parliament. He was created K.C.V.O. in 1903.

On the accession of the Liberal party to power in 1906, Sir Horace Plunkett was requested by Mr Bryce, the new chief secretary, to remain at the head of the department he had created. But, having sat in the House of Commons as a Unionist, Plunkett had incurred the hostility of the Nationalist party, whose resentment had been further excited by the bold statement of certain unpalatable truths in his book, *Ireland in the New Century* (1904), in which he described the economic condition and needs of the country and the nature of the agricultural improvement schemes he had inaugurated. A determined effort was therefore made by the Nationalists to drive from office the man who had probably done more than any one else of his generation to benefit the Irish people; and in moving a resolution in the House of Commons with this object in 1907, a Nationalist declared that his party "took their stand on the principle that the industrial revival could only go hand in hand with the national movement." The government gave way, and in the summer of 1907 Sir Horace Plunkett retired from office. Since the year 1900 a grant of about £4000 had been made annually by the Department of Agriculture to the Irish Agricultural Organization Society; but the new vice-president, Mr T. W. Russell, who had been himself previously a member of the Unionist administration, withdrew in 1907 this modest support of an association with which Sir Horace Plunkett was so closely identified, and of which he continued to be the guiding spirit. In addition to the publication mentioned, Sir Horace Plunkett published *Noblesse Oblige: An Irish Rendering* (1908), and *Rural Life Problems of the United States* (1910).

See Sir Horace Plunkett, *Ireland in the New Century* (London, 1904); *Report of the Committee of Inquiry: Department of Agriculture and Technical Instruction (Ireland)*, (Cd. 3572) (1907).

PLURALISM (Lat. *plus*, *plures*, many, several), a term used generally in the sense of plurality (see below), and in philosophy for any theory which postulates more than one absolutely distinct being or principle of being, opposed to monism. Pluralistic systems are based on the difficulty of reconciling with the monistic principle the principles of variety and freewill. The chief difficulty which besets any such view is that if the elements are absolutely independent, the cosmos disappears and we are left with chaos: if, on the other hand, there is interrelation (as in Lotze's system), the elements are not ultimate in any intelligible sense.

PLURALITY (O. Fr. *pluralité*, Late Lat. *pluralitas*, plural number), in a general sense, a word denoting more than one; applied particularly to the holding of two or more offices by the same person (called then a *pluralist*). In ecclesiastical law, plurality or the holding of more than one benefice or preferment was always discountenanced, and is now prohibited in England by the Pluralities Act 1838, as amended by the Pluralities Act 1850 and the Pluralities Acts Amendment Act 1885. By the latter act a provision was made that two benefices might be held together, by dispensation of the archbishop on the recommendation of the bishop, if the churches be within four miles of each other, and if the annual value of one does not exceed £200 (see BENEFICE). It was formerly a practice to evade enactments against plurality by means of *commendams*, *i.e.* by committing or commending a benefice to a holder of other benefices until an incumbent should be provided for it. Commendams were abolished by the Ecclesiastical Commissioners Act 1836 (6 & 7 Will. IV. c. 77, § 18). See also *Colt* v. *Bishop of Coventry*, 1613, Hob. 140 seq., where much learning on the subject will be found.

In elections, particularly where there are three or more candidates, and no one candidate receives an absolute majority of votes, the excess of votes polled by the first candidate over the second is often termed plurality, especially in the United States.

PLUSH (Fr. *peluche*), a textile fabric having a cut nap or pile the same as fustian or velvet. Originally the pile of plush consisted of mohair or worsted yarn, but now silk by itself or with a cotton backing is used for plush, the distinction from velvet being found in the longer and less dense pile of plush. The material is largely used for upholstery and furniture purposes, and is also much employed in dress and millinery.

PLUTARCH (Gr. Πλούταρχος) (*c.* A.D. 46–120), Greek biographer and miscellaneous writer, was born at Chaeronea in Boeotia. After having been trained in philosophy at Athens he travelled and stayed some time at Rome, where he lectured on philosophy and undertook the education of Hadrian.[1] Trajan bestowed consular rank upon him, and Hadrian appointed him procurator of Greece. He died in his native town, where he was archon and priest of the Pythian Apollo. In the *Consolation to his Wife* on the loss of his young daughter, he tells us (§ 2) that they had brought up four sons besides, one of whom was called by the name of Plutarch's brother, Lamprias. We learn incidentally from this treatise (§ 10) that the writer had been initiated in the secret mysteries of Dionysus, which held that the soul was imperishable. He seems to have been an independent thinker rather than an adherent of any particular school of philosophy. His vast acquaintance with the literature of his time is everywhere apparent.

The celebrity of Plutarch, or at least his popularity, is mainly founded on his forty-six *Parallel Lives*. He is thought to have written this work in his later years after his return to Chaeronea. His knowledge of Latin and of Roman history he must have partly derived from some years' residence in Rome and other parts of Italy,[1] though he says he was too much engaged in lecturing (doubtless in Greek, on philosophy) to turn his attention much to Roman literature during that period.

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[1] There seems no authority for this statement earlier than the middle ages.

Plutarch's design in writing the *Parallel Lives*—for this is the title which he gives them in dedicating *Theseus* and *Romulus* to Sosius Senecio—appears to have been the publication, in successive books, of authentic biographies in pairs, taking together a Greek and a Roman. In the introduction to the *Theseus* he speaks of having already issued his *Lycurgus* and *Numa*, viewing them, no doubt, as bearing a resemblance to each other in their legislative character. Theseus and Romulus are compared as the legendary founders of states. In the opening sentence of the life of Alexander he says that "*in this book* he has written the lives of Alexander and Caesar" (Julius), and in his *Demosthenes*, where he again (§ 1) mentions his friend Sosius, he calls the life of this orator and Cicero the fifth book.[2] It may therefore fairly be inferred that Plutarch's original idea was simply to set a Greek warrior, statesman, orator or legislator side by side with some noted Roman celebrated for the same qualities, or working under similar conditions. Nearly all the lives are in pairs; but the series concluded with single biographies of Artaxerxes, Aratus (of Sicyon), Galba and Otho. In the life of Aratus, not Sosius Senecio, but one Polycrates, is addressed.

The *Lives* are works of great learning and research, long lists of authorities are given, and they must for this very reason, as well as from their considerable length, have taken many years in compilation. It is true that many of the lives, especially of Romans, do not show such an extent of research. But Plutarch must have had access to a great store of books, and his diligence as an historian cannot be questioned, if his accuracy is in some points impeached. From the historian's point of view the weakness of the biographies is that their interest is primarily ethical. The author's sympathy with Doric characters and institutions is very evident; he delights to record the exploits, the maxims and virtues of Spartan kings and generals. This feeling is the key to his apparently unfair and virulent attack on Herodotus, who, as an Ionian, seemed to him to have exaggerated the prowess and the foresight of the Athenian leaders.

The voluminous and varied writings of Plutarch exclusive of the *Lives* are known under the common term *Opera moralia*. These consist of above sixty essays, some of them long and many of them rather difficult, some too of very doubtful genuineness. Their literary value is greatly enhanced by the large number of citations from lost Greek poems, especially verses of the dramatists, among whom Euripides holds by far the first place. The principal treatises in the *Opera moralia* are the following:—

On the Education of Children (regarded as spurious by some) recommends (1) good birth, and sobriety in the father; (2) good disposition and good training are alike necessary for virtue; (3) a mother ought to nurse her own offspring, on the analogy of all animals; (4) the *paedogogus* must be honest and trustworthy; (5) all the advantages of life and fortune must be held secondary to education; (6) mere mob-oratory is no part of a good education; (7) philosophy should form the principal study, but not to the exclusion of the other sciences; (8) gymnastics are to be practised; (9) kindness and advice are better than blows; (10) over-pressure in learning is to be avoided, and plenty of relaxation is to be allowed; (11) self-control, and not least over the tongue, is to be learned; (12) the grown-up youth should be under the eye and advice of his father, and all bad company avoided, flatterers included; (13) fathers should not be too harsh and exacting, but remember that they were themselves once young; (14) marriage is recommended, and without disparity of rank; (15) above all, a father should be an example of virtue to a son.

How a Young Man ought to Hear Poetry is largely made up of quotations from Homer and the tragic poets. The points of the essay are the moral effects of poetry as combining the true with the false, the praises of virtue and heroism with a mythology depraved and unworthy of gods, εἰ θεοί τι δρῶσι φαῦλον, οὐκ εἰσὶν θεοί (§ 21).

On the Right Way of Hearing (περὶ τοῦ ἀκούειν) advocates the listening in silence to what is being said, and not giving a precipitate reply to statements which may yet receive some addition or modification from the speaker (§ 4). The hearer is warned not to give too much weight to the style, manner or tone of the speaker (§ 7), not to be either too apathetic or too prone to praise, not to be impatient if he finds his faults reproved by the lecturer (§ 16). He concludes with the maxim, "to hear rightly is the beginning of living rightly," and perhaps he has in view throughout his own profession as a lecturer.

How a Flatterer may be Distinguished from a Friend is a rather long and uninteresting treatise. The ancient writers are full of warnings against flatterers, who do not seem to exercise much influence in modern society. The really dangerous flatterer (§ 4) is not the parasite, but the pretender to a disinterested friendship—one who affects similar tastes, and so insinuates himself into your confidence. Your accomplished flatterer does not always praise, but flatters by act, as when he occupies a good seat at a public meeting for the express purpose of resigning it to his patron (§ 15). A true friend, on the contrary, speaks freely on proper occasions. A good part of the essay turns on παρρησία, the honest expression of opinion. The citations, which are fairly numerous, are mostly from Homer.

How one may be Conscious of Progress in Goodness is addressed to Sosius Senecio, who was consul in the last years of Nerva, and more than once (99, 102, 107) under Trajan. If, says Plutarch, a man could become suddenly wise instead of foolish, he could not be ignorant of the change; but it is otherwise with moral or mental processes. Gradual advance in virtue is like steady sailing over a wide sea, and can only be measured by the time taken and the forces applied (§ 3). Zeno tested advance by dreams (§ 12); if no excess or immorality presented itself to the imagination of the sleeper, his mind had been purged by reason and philosophy. When we love the truly good, and adapt ourselves to their looks and manners, and this even with the loss of worldly prosperity, then we are really getting on in goodness ourselves (§ 15). Lastly, the avoidance of little sins is an evidence of a scrupulous conscience (§ 17).

How to get Benefit out of Enemies argues that, as primitive man had savage animals to fight against, but learnt to make use of their skins for clothing and their flesh for food, so we are bound to turn even our enemies to some good purpose. One service they do to us is to make us live warily against plots; another is, they induce us to live honestly, so as to vex our rivals not by scolding them, but by making them secretly jealous of us (§ 4). Again, finding fault leads us to consider if we are ourselves faultless, and to be found fault with by a foe is likely to be plain truth speaking, ἀκουστέον ἐστὶ παρὰ τῶν ἐχθρῶν τὴν ἀλήθειαν (§ 6). Jealousies and strifes, so natural to man, are diverted from our friends by being legitimately expended on our enemies (§ 10).

On Having Many Friends, *On Chance*, *On Virtue and Vice*, are three short essays, the first advocating the concentration of one's affections on a few who are worthy (τοὺς ἀξίους φιλίας διώκειν, § 4), rather than diluting them, as it were, on the many; the second pleads that intelligence, φρόνησις, not mere luck, is the ruling principle of all success; the third shows that virtue and vice are but other names for happiness and misery. All these are interspersed with citations from the poets, several of them unknown from other sources.

A longer treatise, well and clearly written, and not less valuable for its many quotations, is the *Consolation addressed to Apollonius* (considered spurious by some) on the early death of his "generally beloved and religious and dutiful son." Equality of mind both in prosperity and in adversity is recommended (§ 4), since there are "ups and downs" (ὕψος καὶ ταπεινότης) in life, as there are storms and calms on the sea, and good and bad seasons on the earth. That man is born to reverses he illustrates by citing fifteen fine verses from Menander (§ 5). The uselessness of indulging in grief is pointed out, death being a debt to all and not to be regarded as an evil (§§ 10–12), Plato's doctrine is cited (§ 13) that the body is a burden and an impediment to the soul. Death may be annihilation, and therefore the dead are in the same category as the unborn (§ 15). The lamenting a death because it is untimely or premature has something of selfishness in it (§ 19), besides that it only means that one has arrived sooner than another at the end of a common journey. If a death is more grievous because it is untimely, a new-born infant's death would be the most grievous of all (§ 23). One who has died early may have been spared many woes rather than have been deprived of many blessings; and, after all, to die is but to pay a debt due to the gods when they ask for it (§ 28). Examples are given of fortitude and resignation under such affliction (§ 33). If, says the author in conclusion, there is a heaven for the good hereafter, be sure that such a son will have a place in it. The author has borrowed from the Περὶ πένθους of Crantor.

Precepts about Health commences as a dialogue, and extends to some length as a lecture. It is technical and difficult throughout, and contains but little that falls in with modern ideas. Milk, he says, should be taken for food rather than for drink, and wine should not be indulged in after hard work or mental effort, for it does but tend to increase the bodily disturbance (§ 17). Better than purges or emetics is a temperate diet, which induces the bodily functions to act of themselves (§ 20). Another wise saying is that idleness does not conduce to health (*οὐδ' ἀληθές ἐστι τὸ μᾶλλον ὑγιαίνειν τοὺς ἡσυχίαν ἄγοντας*) (§ 21), and yet another that a man should learn by experience his bodily capabilities without always consulting a physician (§ 26).

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[1] *Demosth.* § 2. Plutarch's orthography of Roman words and names is important as bearing on the question of pronunciation. A curious example (*De fortun. Rom.* § 5) is *Virtutis et honoris*, written Οὐιρτοῦτίς τε καὶ Ὁνῶρις. The Volsci are Οὐολοῦσκοι, ibid.

[2] It is quite evident that the original order of the books has been altered in the series of *Lives* as we now have them.

Advice to the Married is addressed to his newly wedded friends Pollianus and Eurydice. It is simply and plainly written, and consists chiefly of short maxims and anecdotes, with but few citations from the poets.

The Banquet of the Seven Wise Men (considered spurious by some) is a longer treatise, one of the several "Symposia" or imaginary conversations that have come down to us. It is supposed to be given by Periander in the public banqueting-room (*ἑστιατόριον*) near the harbour of Corinth (Lechaeum) on the occasion of a sacrifice to Aphrodite. The whole party consisted of "more than twice seven," the friends of the principal guests being also present. Like Plato's *Symposium* this treatise takes the form of a narrative of what was said and done, the narrator being one Diocles, a friend of Periander, who professes to give Nicarchus a correct account as having been present. The dinner was simple, and in contrast with the usual splendour of "tyrants" (§ 4). The conversation turns on various topics; Solon is credited with the remarkable opinion that "a king or tyrant is most likely to become celebrated if he makes a democracy out of a monarchy" (§ 7). There is much playful banter throughout, but neither the wit nor the wisdom seems of a very high standard. Solon delivers a speech on food being a necessity rather than a pleasure of life (§ 16), and one Gorgus, a brother of the host, comes in to relate how he has just shaken hands with Arion, brought across the sea on the back of a dolphin (§ 18), which brings on a discussion about the habits of that creature. Among the speakers are Aesop, Anacharsis, Thales, Chilo, Cleobulus and one Chersias, a poet.

A short essay *On Superstition* contains a good many quotations from the poets. It opens with the wise remark that ignorance about the gods, which makes the obstinate man an atheist, also begets credulity in weak and pliant minds. The atheist fears nothing because he believes nothing; the superstitious man believes there are gods, but that they are unfriendly to him (§ 2). A man who fears the gods is never free from fear, whatever he may do or whatever may befall him. He extends his fears beyond his death, and believes in the "gates of hell," and its fires, in the darkness, the ghosts, the infernal judges, and what not (§ 4). The atheist does not believe in the gods; the superstitious man wishes he did not, but fears to disbelieve (§ 11). On the whole, this is a most interesting treatise.

On Isis and Osiris is a rather long treatise on Egyptian symbolism, interesting chiefly to students of Egyptology. It gives an exposition of the strange myths and superstitions of this ancient solar cult, including a full account of the great antagonist of Osiris, Typhon, or the Egyptian Satan. Plutarch thus lays down the Zoroastrian theory of good and bad agencies (§ 45): "If nothing can happen without cause, and good cannot furnish cause for evil, it follows that the nature of evil, as of good, must have an origin and principle of its own."

On the Cessation of Oracles is a dialogue, discussing the reasons why divine inspiration seemed to be withdrawn from the old seats of prophetic lore. The real reason of their decline in popularity is probably very simple; when the Greek cities became Roman provinces the fashion of consulting oracles fell off, as unsuited to the more practical influences of Roman thought and Roman politics. The question is discussed whether there are such intermediate beings as daemons, who according to Plato communicate the will of the gods to men, and the prayers and vows of men to the gods. The possibility of a plurality of worlds is entertained, and of the planets being more or less composed of the essence of the five elements, fire, ether, earth, air and water (§ 37). The whole treatise is metaphysical, but it concludes with remarks on the exhalations at Delphi having different effects on different people and at different times. The ancient notion doubtless was that the vapour was the breath of some mysterious being sent up from the under-world.

On the Pythian Responses, why no longer given in Verse, is also a dialogue, the first part of which is occupied mainly with conversation and anecdotes about the statues and other offerings at Delphi. It is rather an amusing essay, and may be regarded as a kind of appendix to the last. The theory propounded (§ 24) is that verse was the older vehicle of philosophy, history and religion, but that plain prose has become the later fashion, and therefore that oracles are now generally delivered "in the same form as laws speak to citizens, kings reply to their subjects, and scholars hear their teachers speak." Discredit, too, was brought on the verse-oracle by the facility with which it was employed by impostors (§ 25). Moreover, verse is better suited to ambiguity, and oracles nowadays have less need to be ambiguous (§ 88).

On the E at Delphi is an inquiry why that letter or symbol was written on or in the Delphic temple. Some thought it represented the number five, others that it introduced the inquiry of oracle-seekers, *If* so-and-so was to be done; while one of the speakers, Ammonius, decides that it means Εἶ, "thou art," an address to Apollo containing the predication of existence (§ 17).

On the Face of the Moon's Disk is a long and curious if somewhat trifling speculation, yet not without interest from its calculations of the sizes and the distance from earth of the sun and moon (§ 10), and from the contrast between ancient lunar theories and modern mathematics. The cause of the moon's light, its peculiar colour, the possibility of its being inhabited and many kindred questions are discussed in this dialogue, the beginning and end of which are alike abrupt. Some of the "guesses at truth" are very near the mark, as when it is suggested (§§ 21–22) that the moon, like the earth, contains deep recesses into which the sun's light does not descend, and the appearance of the "face" is nothing but the shadows of streams or of deep ravines.

On the Late Vengeance of the Deity is a dialogue consequent on a supposed lecture by Epicurus. An objection is raised to the ordinary dealings of providence, that long-delayed punishment encourages the sinner and disappoints the injured, the reply to which is (§ 5) that the god sets man an example to avoid hasty and precipitate resentment, and that he is willing to give time for repentance (§ 6). Moreover, he may wish to await the birth of good progeny from erring parents (§ 7). Another fine reflection is that sin has its own punishment in causing misery to the sinner, and thus the longer the life the greater is the share of misery (§ 9). The essay concludes with a long story about one Thespesius, and the treatment which he saw, during a trance, of the souls in the other world.

On Fate (probably spurious) discusses the law of chance as against the overruling of providence. This treatise ends abruptly; the point of the argument is that both fate and providence have their due influence in mundane affairs (§ 9), and that all things are constituted for the best.

On the Genius of Socrates is a long essay, and, like so many of the rest, in the form of a dialogue. The experiences of one Timarchus, and his supernatural visions in the cave of Trophonius, are related at length in the Platonic style (§ 22), and the true nature of the *δαίμονες* is revealed to him. They are the souls of the just, who still retain regard for human affairs and assist the good in their efforts after virtue (§ 28). The dialogue ends with an interesting narrative of the concealment of Pelopidas and some of the Theban conspirators against the Spartans in the house of Charon.

On Exile is a fine essay, rendered the more interesting from its numerous quotations from the poets, including several from the *Phoenissae*. Man is not a plant that grows only in one soil; he belongs to heaven rather than to earth, and wherever he goes there are the same sun, the same seasons, the same providence, the same laws of virtue and justice (§ 5). There is no discredit in being driven from one's country; Apollo himself was banished from heaven and condemned to live for a time on earth (§ 18).

The *Consolation to his Wife*, on the early death of their only daughter Timoxena (§ 7), is a feeling and sensible exhortation to moderate her grief.

Nine books of *Symposiaca* extend to a great length, discussing inquiries (*προβλήματα*) on a vast number of subjects. The general treatment of these, in which great literary knowledge is displayed, is not unlike the style of Athenaeus.

The Amorous Man is a dialogue of some length, describing a conversation on the nature of love held at Helicon, pending a quinquennial feast of the Thespians, who specially worshipped that deity along with the Muses. It is amply illustrated by poetical quotations. In § 24 mention is made of the emperor Vespasian. It is followed by a short treatise entitled *Love Stories*, giving a few narratives of sensational adventures of lovers.

Short Sayings (*ἀποφθέγματα*), dedicated to Trajan, extend to a great length, and are divided into three parts: (1) of kings and commanders (including many Roman); (2) of Spartans; (3) of Spartan women (a short treatise on Spartan institutions being interposed between the last two). The names of the authors are added, and to some of them a large number of maxims are attributed.

A rather long treatise *On the Virtues of Women* contains a series of narratives of noble deeds done by the sex in times of danger and trouble, especially from "tyrants." Many of the stories are interesting, and the style is easy and good.

Another long and learned work bears the rather obscure title *Κεφαλαίων καταγραφή*. It is generally known as *Quaestiones Romanae* and *Graecae*, in two parts. In the former, which contains one hundred and thirteen headings, the inquiry (on some matter political, religious or antiquarian) always commences with *διὰ τί*, usually followed by *πότερον*, with alternative explanations. In the *Greek Questions* the form of inquiry is more often *τίς* or *τίνες*, not followed by *πότερον*. This treatise is of great interest and importance to classical archaeology, though the inquiries seem occasionally trifling, and sometimes the answers are clearly wrong.

Parallels (spurious) are a series of similar incidents which occurred respectively to Greeks and Romans, the Greek standing first and the Roman counterpart following. Many of the characters are mythological, though Plutarch regards them as historical.

On the Fortune of the Romans discusses whether, on the whole, good luck or valour had more influence in giving the Romans the supremacy. This is followed by two discourses on the same question as applicable to the career of Alexander the Great, and *Whether the Athenians were more renowned for War or for Wisdom?* The conclusion is (§ 7) that it was not so much by the fame of their poets as by the deeds of their heroes that Athens became renowned.

Gryllus is a most amusing dialogue, in which Circe, Odysseus and a talking pig take part. Odysseus wishes that all the human beings that have been changed by the sorceress into bestial forms should be restored; but the pig argues that in moral virtues, such as true bravery, chastity, temperance and general simplicity of life and contentment, animals are very far superior to man.

Whether Land Animals or Water Animals are the Cleverer is a rather long dialogue on the intelligence of ants, bees, elephants, spiders, dogs, &c., on the one hand, and the crocodile, the dolphin, the tunny and many kinds of fish, on the other. This is a good essay, much in the style of Aristotle's *History of Animals*.

On Flesh-eating, in two orations, discusses the origin of the practice, viz. necessity, and makes a touching appeal to man not to destroy life for mere gluttony (§ 4). This is a short but very sensible and interesting argument. *Questions on Plato* are ten in number, each heading subdivided into several speculative replies. The subjects are for the most part metaphysical; the essay is not long, but it concerns Platonists only. *Whether Water or Fire is more Useful* is also short; after discussing the uses of both elements it decides in favour of the latter, since nothing can exceed in importance the warmth of life and the light of the sun. *On Primary Cold* is a physical speculation on the true nature and origin of the quality antithetical to heat. *Physical Reasons* (*Quaestiones Naturales*) are replies to inquiries as to why certain facts or phenomena occur, *e.g.* "Why is salt the only flavour not in fruits?" "Why do fishing-nets rot in winter more than in summer?" "Why does pouring oil on the sea produce a calm?" *On the Opinions accepted by the Philosophers* (spurious), in five books, is a valuable compendium of the views of the Ionic school and the Stoics on the phenomena of the universe and of life. *On the Ill-nature of Herodotus* is a well-known critique of the historian for his unfairness, not only to the Boeotians and Lacedaemonians, but to the Corinthians and other Greek states. It is easy to say that this essay "neither requires nor merits refutation"; but Plutarch knew history, and he writes like one who thoroughly understands the charges which he brings against the historian. The *Lives of the Ten Orators* from Antiphon to Dinarchus (now considered spurious) are biographies of various lengths, compiled, doubtless, from materials now lost.

Two rather long essays, *Should a Man engage in Politics when he is no longer Young*, and *Precepts for Governing* (πολιτικὰ παραγγέλματα), are interspersed with valuable quotations. In favour of the former view the administrations of Pericles, of Agesilaus, of Augustus, are cited (§ 2), and the preference of older men for the pleasures of doing good over the pleasures of the senses (§ 5). In the latter, the true use of eloquence is discussed, and a contrast drawn between the brilliant and risky and the slow and safe policy (§ 10). The choice of friends, and the caution against enmities, the dangers of love, of gain and of ambition, with many topics of the like kind, are sensibly advanced and illustrated by examples.

(F. A. P.; J. M. M.)

Bibliography.—Editio princeps, by H. Stephanus (1572); other complete editions by J. J. Reiske (1774–1782), J. G. Hutten (1791–1804), T. Döhner and F. Dübner (1846–1855). Of the *Lives*, there are editions by A. Coray (1809–1814), C. Sintenis (1839–1846; ed. min., 1874–1881), and of many separate lives by Siefert-Blass, Sintenis-Fuhr, Holden, Hardy and others. There are many English translations, of which the most popular is that by John and William Langhorne; also the old French version by Jacques Amyot (1559) from which Sir Thomas North's (1579) was made, newly edited by G. Wyndham (1895); many of the Roman lives have been translated, with notes, by George Long. The *Moralia* has been edited by D. Wyttenbach (1795–1830), and G. N. Bernardakes (1888–1896). The old English translation by Philemon Holland (1603) has been revised by C. W. King and A. R. Shilleto in Bohn's *Classical Library* (1882–1888), and a later translation by various hands (London, 1684–1694), edited by W. W. Goodwin with introduction by R. W. Emerson, has been republished at Cambridge, Massachusetts (1874–1878). Mention may also be made of P. Holland's *Romane Questions*, edited with introductory dissertations by F. B. Jevons (1892); *Roman Problems*, with essay on "Roman Worship and Belief," by G. C. Allen (1904); *De la Musique*, ed. H. Weil and Th. Reinach (1900); J. Oakesmith, *The Religion of Plutarch as expounded in his Ethics* (1902); Archbishop Trench, *A Popular Introduction to Plutarch* (1873); O. Gréard, *De la Morale de Plutarque* (1866); R. Volkmann, *Leben, Schriften und Philosophie des Plutarch* (1869). The earlier literature of Plutarch is very extensive, for which W. Engelmann, *Scriptores graeci* (1881), may be consulted.

PLUTARCH, of Athens (*c.* 350–430), Greek philosopher, head of the Neoplatonist school at Athens at the beginning of the 5th century, was the son of Nestorius and father of Hierius and Asclepigenia, who were his colleagues in the school. The origin of Neoplatonism in Athens is not known, but Plutarch and his followers (the "Platonic Succession") claim to be the disciples of Iamblichus, and through him of Porphyry and Plotinus. Plutarch's main principle was that the study of Aristotle must precede that of Plato, and that the student should be taught to realize primarily the fundamental points of agreement between them. With this object he wrote a commentary on the *De anima* which was the most important contribution to Aristotelian literature since the time of Alexander of Aphrodisias. His example was followed by Syrianus and others of the school. This critical spirit reached its greatest height in Proclus, the ablest exponent of this latter-day syncretism. Plutarch was versed in all the theurgic traditions of the school, and believed in the possibility of attaining to communion with the Deity by the medium of the theurgic rites. Unlike the Alexandrists and the early Renaissance writers, he maintained that the soul which is bound up in the body by the ties of imagination and sensation does not perish with the corporeal media of sensation. In psychology, while believing that Reason is the basis and foundation of all consciousness, he interposed between sensation and thought the faculty of Imagination, which, as distinct from both, is the activity of the soul under the stimulus of unceasing sensation. In other words, it provides the raw material for the operation of Reason. Reason is present in children as an inoperative potentiality, in adults as working upon the data of sensation and imagination, and, in its pure activity, it is the transcendental or pure intelligence of God.

See Marinus, *Vita Procli*, 6, 12; Zeller's *History of Greek Philosophy*; Bouillet, *Ennéades de Plotin*, ii. 667–668; Windelband, *History of Philosophy* (trans. J. H. Tufts, p. 225).

PLUTO (Πλούτων), in Greek mythology, the god of the lower world. His oldest name was Hades, Aïdes or Aïdoneus, "the Unseen." He was the son of Cronus and Rhea, and brother of Zeus and Poseidon. Having deposed Cronus, the brothers cast lots for the kingdoms of the heaven, the sea, and the infernal regions. The last, afterwards known as Hades from their ruler, fell to Pluto. Here he ruled with his wife Persephone over the other powers below and over the dead. He is stern and pitiless, deaf to prayer or flattery, and sacrifice to him is of no avail; only the music of Orpheus prevailed upon him to restore his wife Eurydice. His helmet, given him by the Cyclopes after their release from Tartarus, rendered him invisible (like the Tarn—or Nebelkappe of German mythology). He is hated and feared by gods and men, who, afraid to utter his name, both in daily life and on solemn occasions make use of euphemistic epithets: Polydectes (the receiver of many), Clymenus (the Illustrious), Eubulus (the giver of good counsel). Later, owing to his connexion with Persephone and under the influence of the Eleusinian mysteries, the idea of his character underwent a radical change. Instead of the life-hating god of death, he became a beneficent god, the bestower of grain, minerals, and other blessings produced in the depths of the earth. In this aspect he was called Pluto, the "giver of wealth" (a name that first occurs in the Attic poets of the 5th century), and at most of the centres of his cult he was so worshipped; at Elis alone he was Hades, the god of the dead. The plants sacred to him were the cypress and narcissus; black victims were sacrificed to him, not white, like those offered to the other gods. In art he was represented like Zeus and Poseidon; his features are gloomy, his hair falls over his forehead; his attributes are a sceptre and Cerberus; he carries the key of the world below (cf. the epithet πυλάρτης, "keeper of the gate"), and is frequently in company with Persephone. He is sometimes represented as an agricultural god, carrying a *cornu copiae* and a two-pronged fork. Amongst the Romans Hades was usually called Dis pater (the "wealthy father") and Orcus, although the name Pluto is often used. Orcus, however, was rather the actual slayer, the angel of death, while Father Dis was the ruler of the dead. The Etruscan god of death was represented as a savage old man with wings and a hammer; at the gladiatorial games of Rome a man masked after this fashion removed the corpses from the arena. In Romanesque folk-lore Orcus (possibly English "ogre," *q.v.*) has passed into a forest-elf, a black, hairy, man-eating monster, upon whose house children lost in the woods are apt to stumble, and who sometimes shows himself kindly and helpful.

The "house of Hades" was a dreadful abode deep down in the earth, and the god was invoked by rapping on the ground. According to another view, the realm of Hades was beyond the ocean in the far west, which to the Greek was always the region of darkness and death, as the east of light and life. This is the view of Hades presented in the *Odyssey*. Besides this gloomy region, we find in another passage of the *Odyssey* (iv. 561 seq.) a picture of Elysium, a happy land at the ends of the earth, where rain and snow fall not, but the cool west wind blows and men live at ease. After Homer this happy land, the abode of the good after death, was known as the Isles of the Blest (*q.v.*).[1] But in the oldest Greek mythology the "house of Hades" was simply the home of the dead, good and bad alike, who led a dim and shadowy reflection of life on earth.

See article "Hades," in Roscher's *Lexikon der Mythologie*; Preller-Robert, *Griechische Mythologie* (1894); L. Farnell, *Cults of the Greek States*, vol. iii., who regards Hades as an evolution from Zeus and his counterpart; according to J. E. Harrison, in *Classical Review* (Feb. 1908), Hades is the under-world sun.

PLUTOCRACY (Gr. *πλουτοκρατία*, from *πλοῦτος*, wealth, and *κράτος*, power), government or power exercised by the possessors of wealth, power obtained by the mere possession of riches; hence a body or ruling class whose influence is due only to their money.

PLUTO MONKEY, a guenon, *Cercopithecus* (*Mona*) *leucampyx*, nearly allied to the MONA (*q.v.*), which takes its name from the black fur of the under-parts, passing into blackish grey on the head and back. The violet-coloured face, which has no beard, is fringed by large bushy whiskers and surmounted by a white band above the brows. The range of the species extends from the Congo and Angola to Nyasaland. (See PRIMATES.)

PLUTUS, in Greek mythology, son of Iasion and Demeter, the personification of wealth (πλοῦτος). According to Aristophanes, he was blinded by Zeus because he distributed his gifts without regard to merit. At Thebes there was a statue of Fortune holding the child Plutus in her arms; at Athens he was similarly represented in the arms of Peace; at Thespiae he was represented standing beside Athena the Worker. Elsewhere he was represented as a boy with a *cornu copiae*. He is the subject of one of the extant comedies of Aristophanes, the *Plutus*.

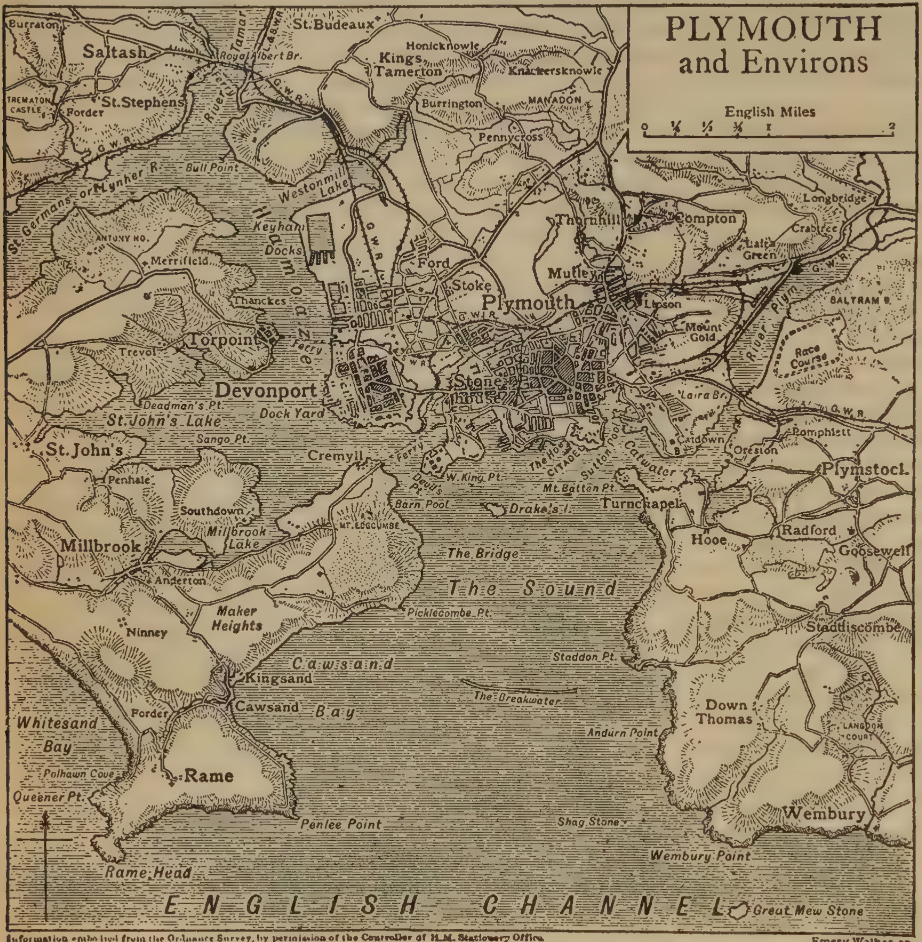
PLYMOUTH, EARLS OF, a title first borne by Charles (1657–1680), an illegitimate son of the English king Charles II. by Catharine Pegge, who was created earl in 1675. The title became extinct on his death in October 1680. In 1682 Thomas Windsor Hickman-Windsor, 7th Baron Windsor de Stanwell (*c.* 1627–1687), who had fought for Charles I. at Naseby, was created earl of Plymouth. His father was Dixie Hickman of Kew, Surrey, and his mother, Elizabeth, was a sister of Thomas Windsor, 6th Baron Windsor de Stanwell (1596–1641); having inherited the estates of his uncle and taken the additional name of Windsor, the abeyance of the barony of Windsor de Stanwell was terminated in his favour and he became the 7th baron. From 1661–1663 he was nominally governor of Jamaica. His grandson Other (1679–1725) was the 2nd earl, and the earldom became extinct when Henry, the 8th earl, died in December 1843. Called again out of abeyance, the barony of Windsor came in 1855 to Harriet, a daughter of Other Archer, the 6th earl (1789–1833), and the wife of Robert Henry Clive (1789–1854), a younger son of Edward Clive, 1st earl of Powis. She was succeeded in 1869 by her grandson, Robert George Windsor-Clive, who became the 14th Baron Windsor. After serving as paymaster-general in 1891–1892 and first commissioner of works from 1902–1905, Lord Windsor was created earl of Plymouth in 1905.

PLYMOUTH, a municipal county (1888, extended 1896) and parliamentary borough and seaport of Devonshire, England, 231 m. W.S.W. of London. Pop. (1910), 126,266. It lies at the head of Plymouth Sound, stretching westward from the river Plym towards the mouth of the Tamar, from which it is separated by the township of East Stonehouse and the borough of Devonport, the two later constituting with it the "Three Towns." The prince of Wales is lord high steward of the borough, which is divided into 14 wards, under a mayor, 14 aldermen and 42 councillors. The parliamentary borough, returning two members, is not coextensive with the municipal borough, part of the latter being in the Tavistock (county) division of Devon. The water frontage of the Three Towns consists of Plymouth Sound, with its inlets, in order from east to west, the Catwater, Sutton Pool, Mill Bay, Stonehouse Pool and the Hamoaze. The Catwater and Hamoaze are flanked on the east and west respectively by high ground, on which are built forts that command the harbour and its approaches. On the western side of the entrance to Catwater is the Citadel, founded in the reign of Henry VIII. and rebuilt by Charles II. The adjacent Hoe extends along the northern edge of the Sound, and from it can be obtained a splendid view, embracing the rugged Staddon Heights on the east and the wooded slopes of Mount Edgcumbe on the west. To the north is seen the town of Plymouth rising up to the hills known as Mannamead. On the site of an old Trinity House obelisk landmark is Smeaton's lighthouse tower, removed from its original position on the Eddystone Reef in 1884. It is now used as a wind-recording station in connexion with the adjoining Meteorological Observatory. On the Hoe there stands the striking Drake statue by Sir Edgar Boehm, and the Armada Memorial, while at the north-east end is an obelisk monument to the memory of troops engaged in the South African War. A municipal bowling-green recalls a probable early use of the Hoe. Adjacent to the Citadel, at its south-west angle, is the Marine Biological Station, and, further west, projects the Promenade Pier. In the Sound is Drake's (formerly St Nicholas's) Island, now strongly fortified, at one time the property of the corporation, and serving in Stuart times as a place of imprisonment of certain Plymouth Baptist ministers. Few evidences, however, of the antiquity of the town remain. Below, and to the north-east of the Citadel, is the Barbican with its "Mayflower" commemoration stone, a large fish-buying trade being done on the adjacent quay, near which is the Custom House. From the Barbican winding streets lead past the old Guildhall (1800) which contained the municipal library, pending its removal to more commodious quarters in the new museum, opposite the technical and art schools, situated in the most northern part of the town. At a short distance west stands the new Guildhall, with the enlarged post office, central police station, law courts and municipal buildings in close proximity. Opened in 1874, the Guildhall is built in a bold, rather exotic, Early Pointed French style. The tower at the south-west end is 190 ft. high, and the building is ornamented with a series of coloured windows relating to events in the history of Plymouth or commemorating men and families connected with the town. The large hall contains a fine organ. In the mayor's parlour is a contemporary portrait of Sir Francis Drake and some interesting prints of the town of Plymouth.

Near the eastern entrance to Guildhall Square is St Andrews, the mother church of Plymouth, erected on the site of a chapel dedicated to the Virgin. The church is typical of the Devonshire Perpendicular style of 1480–1520, but, though large, presents few features of artistic or archaeological interest. It underwent complete restoration in 1874. The burying-ground on the north side has been levelled, and on it erected a stone monument. The church, furnished with one of the finest organs in the west of England, contains the tombs of a son of Admiral Vernon, of Sir John Skelton (a former governor of the Citadel), and of Charles Mathews the comedian, as well as portions of the bodies of Frobisher and Drake. Here Katherine of Aragon returned thanks for a safe voyage from Spain to Plymouth. In 1640 a second parish was formed with Charles

[1] The Samoan Islanders unite the two conceptions: the entrance to their spirit-land is at the westernmost point of the westernmost island, where the ghosts descend by two holes into the under-world. Long ago the inhabitants of the French coast of the English Channel believed that the souls of the dead were ferried across to Britain, and there are still traces of this belief in the folk-lore of Brittany (Tylor, *Primitive Culture*, ii. 64; Grimm, *Deutsche Mythologie*, ii. 694). In classical mythology the underground Hades prevailed over the western. It was an Etruscan custom at the foundation of a city to dig a deep hole in the earth and close it with a stone; on three days in the year this stone was removed and the ghosts were then supposed to ascend from the lower world. In Asia Minor caves filled with mephitic vapours or containing hot springs were known as Plutonia or Charonia. The most famous entrances to the under-world were at Taenarum in Laconia, Heraclea on the Euxine, and at the Lake Avernus in Italy.

Church (1658) at its head, the last-named being popularly known as New Church, in contradistinction to St Andrews or "Old Church." The New Church is an interesting specimen of Stuart "debased" Gothic architecture. South of Andrews church is the site of a Franciscan Friary with some early 15th-century remains. Near the church are a few old houses scattered along the crooked little streets going down to the water. These houses date from Elizabethan times, but are not of any unusual interest. The Citadel (now used as army headquarters and barracks) is a fine specimen of 17th-century military architecture. It is an irregular bastioned pentagon in trace. It possesses a fine florid classical gateway. In the centre stands a dignified Jacobean house, once the residence of the governor of Plymouth.


PLYMOUTH
and Environs
English Miles
0 ¼ ½ ¾ 1 2
Burraton
Saltash
St. Budeaux
Tamar
L.&S.W.R.
Royal Albert Br.
River
Ferry
G.W.R.
Honicknowle
Kings Tamerton
Knackersknowle
Trematon Castle
Porder
St. Stephens
Burrington
Manadon
Pennycross
Bull Point
St. Germans or Lynher R.
Weston mill Lake
Keyham
Docks
Hamoaze
Antony Ho.
Merrifield
Thornhill
Compton
Longbridge
Crabtree
Efford
Green
Ford
Stoke
Mutley
Plymouth
Lipson
Mount Gold
Plym
Saltram
Race Course
Thanckes
Torpoint
Trevol
Ferry
Devonport
Stonehouse
Laira Br.
Deadman's Pt.
Dock Yard
St. John's Lake
Sango Pt.
St. John's
Cremyll
Ferry
Cattedown
Oreston
Pomphlett
Plymstock
Penhale
W. King Pt.
Devil's Pt.
The Hoe
Citadel
Sutton Pool
Catwater
Mt. Batten Pt.
Barn Pool
Drake's I.
Turnchapel
Southdown
Millbrook Lake
Mt. Edgcumbe
Hooe
Radford
Goosewell
Millbrook
The Bridge
Anderton
The Sound
Pickelcombe Pt.
Maker Heights
Staddiscombe
Ninney
Cawsand
Staddon Pt.
Kingsand
The Breakwater
Cawsand Bay
Down Thomas
Porder
Whitesand Bay
Langdon Court
Andurn Point
Polhawn Cove
Rame
Queener Pt.
Penlee Point
Shag Stone
Wembury
Wembury Point
Rame Head
ENGLISH CHANNEL
Great Mew Stone

Information embodied from the Ordnance Survey, by permission of the Controller of H.M. Stationery Office.
Emery Walker sc.

Plymouth is the seat of a Roman Catholic bishopric founded in 1851, the cathedral, in Wyndham Street, being completed in 1858 through the efforts of Bishop Vaughan, who was the second occupant of the see (until 1902). The building is in the Early English style, and adjoining are the bishop's house and the convent of Notre Dame. In the immediate vicinity is the only Presbyterian church in the Three Towns. Noteworthy among the many Nonconformist places of worship are the Baptist chapel (George Street), with its tablet recording the imprisonment of ministers on Drake's Island; Sherwell (Congregational) on the Tavistock Road, the most ornate in its style of architecture; the Wesleyan Methodist chapel in the main thoroughfare of the residential suburb of Mutley, unique among Methodist edifices in the town in respect of its fine spire. All the principal religious bodies have places for worship or for assembly in the town, and the borough has given, in popular speech, the name of "Plymouth Brethren" to one body.

In addition to the Plymouth College (for boys), there are several educational institutions administered by the borough council, comprising a science, art and technical school, a mixed secondary school replacing the corporation grammar school of Elizabethan foundation, and intermediate day and evening school and numerous primary departments. The philanthropic institutions include the enlarged South Devon and East Cornwall hospital, eye infirmary, homoeopathic hospital, blind institution and female orphan asylum.

The public recreation grounds, other than the Hoe, are few and small; Hartley Reservoir Grounds at the northern extremity of the town commands extensive moorland views; the Freedom Park, by its plain, unfinished monument, recalls the siege of Plymouth by the Royalists in 1646, and the Beaumont Park contains the temporary home of the nucleus for a museum and art gallery. The Victoria Park, reclaimed from a part of Stonehouse Creek, is under the joint administration of Plymouth, Stonehouse and Devonport.

The township of East Stonehouse, having Plymouth on the east, is separated from Devonport on the west by the Stonehouse Pool Creek, which is crossed by a toll-bridge and thoroughfare known locally as the "Half-penny Gate Bridge." A manor of the Mount Edgcumbe family, East Stonehouse, is an urban district, in the administrative county of Devon, with a council of 15 members, but is united for parliamentary purposes with Devonport, with which it returns two members. Within the boundaries of Stonehouse are the Royal Naval Hospital (1762), the Royal Marine Barracks (1795) in Durnford Street, and the Royal William Victualling Yard (1825), the last-named having frontage on the Hamoaze, which separates the Devon from the Cornish portion of the Stonehouse manor.

The Stanehus(e) of Domesday Book ultimately passed into the hands of the Valletorts, whose hamlet of West Stonehouse stood on the Cornish side of the Tamar, for (to quote Carew's *Survey*) "certaine old ruines yet remaining confirm the neighbours' report that near the water's side, there stood once a towne called West stone house until the French (1350?) by fire and sword overthrew it."

St George's (1798) is the oldest of the three parishes of Stonehouse, and on the site of the present church stood the chapel of St George, in which, during the years 1681–1682, worshipped, in addition to the English congregation, one composed, as at Plymouth, of Huguenots who fled from France at the Revocation of the Edict of Nantes.

Facing the Sound are Stone Hall and the Winter Villa. The former, occupied by the lords of the manor before the building of Mount Edgcumbe House, was originally a castellated building, and the latter was built primarily as an alternative residence for a countess of Mount Edgcumbe. A link with the past is the Mill Bridge Causeway, over what was the "Dead Lake," now a road, which, at the head of Stonehouse Creek, is the second approach to the Stoke Damerel portion of Devonport. Built in 1525, it possesses a toll-gate house at which payment from vehicles is still demanded.

In addition to the Victualling Yard, with its naval ordnance department, repairing shops and armoury, the Barracks, accommodating some 1500 men, and the Naval Hospital of 24 acres, abutting on the Creek, there are within the boundaries a theatre seating over 2000 persons, the Devonport Corporation Electricity Works, a clothing factory and part of the Great Western Railway Docks. The stationary character of the township—which from its situation is incapable of expansion—is seen from the statistics of population:(1881), 15,041; (1901), 15,108; (1910), 15,111.

The "Port of Plymouth" in 1311 embraced Plympton, Modbury and Newton Ferrers, and received a customs grant from Richard II. In 1435 sixty-five cargoes were imported, and in the reign of Elizabeth it rose to be the foremost port in England. The 18th century saw a great development of trade with Virginia and the West Indies, resulting in the establishment of a sugar-refining industry that was maintained until a recent date.

In 1749 the "town's water" was carried to the Barbican to supply shipping. The port of Plymouth, as at present constituted, embraces "the waters of Plymouth Sound and the Hamoaze, including all bays, creeks, lakes, pools, ponds and rivers as far as the tide flows within or to the northward of a straight line drawn across the entrance of Plymouth Sound from Penlee Point on the west to the Shagstone on the east." The chief water area within the limits of the port is the Sound with its inlets, the Catwater (200 acres), Sutton Pool, Mill Bay, Stonehouse Pool and the Hamoaze. The Sound itself covers an area of 4500 acres and is sheltered from south-west gales by the breakwater completed in 1841 at a cost of 1½ million sterling. It lies 2½ m. south of the Hoe, and is nearly a mile long, 360 ft. wide at the base and 45 ft. at the top. Its cants bend inwards at angles of 120°; at the western end is a lighthouse and at the eastern extremity is a pyramidal beacon with a cage capable of accommodating several men.

The town is served by the Great Western and the London & South-Western railways. The former company has a main line entering from the west through Devonport and going east to Exeter, having Dartmoor on the west; the latter company has a terminal station in the eastern quarter of the town, and its route to Exeter is by way of the Tamar valley, and the western and northern moorland districts.

The industries of Plymouth include soap manufacture, preparation of artificial manure and sulphuric acid and paper staining. The water supply, inaugurated by Drake in 1590, and drawn from the Dartmoor watershed, is the most important municipal undertaking. The service of electricity both for lighting and tramway traction is in the hands of the town, but the gasworks belong to a private company.

Plymouth, the Suton of Domesday, was afterwards divided into the town of Sutton Prior, the hamlet of Sutton Valletort and the tithing of Sutton Ralph, the greater part belonging to the priory of Plympton. The market, established about 1253, became in 1311 town property, with the mayor as clerk of the market. In 1292 the town first returned members to parliament. In the 14th century it was frequently the port of embarcation and of disembarcation in connexion with expeditions to France, and suffered considerably at the hands of the French. In 1412 the inhabitants petitioned for a charter, which, after strenuous opposition from the priors of Plympton, was granted by Henry VI. in 1439. In the discovery of the New World it played a part of great importance. Cockeram, a native of the town, sailed with John Cabot in 1497. Sir John Hawkins and his father William were also natives, the former being port admiral and (in 1571) M.P. From Plymouth in 1577 Drake set out on his voyage round the world; in 1581 he became mayor and represented the borough in parliament during 1592–1593. Sir Humphrey Gilbert (M.P. 1571) sailed on his second colonizing expedition to America in 1583 from the port, and hither Drake brought the remnant of Raleigh's Virginian colony. Plymouth supplied seven ships against the Armada, and it was in the Sound that the English fleet awaited the sighting of the Spaniards. A stone on a quay at the Barbican records the fact that this was the last port touched by the Pilgrim Fathers on their voyage to America.

During the Civil War Plymouth was closely invested by the Royalists, whose great defeat is commemorated by the monument at Freedom Park. It was the only town in the west that never fell into their hands. It early declared for William of Orange, in whose reign the neighbouring dockyard was begun.

AUTHORITIES.—*Histories* of Plymouth by Jewitt and Worth; Wright's *Plymouth with its Surroundings* and *Story of Plymouth*; Whitfeld, *Plymouth and Devonport, in times of War and Peace; Municipal Records* (Plymouth Corporation); Worth, "Notes on Early History of Stonehouse" (*Plymouth Instit. Proc.*).

(H. G. DE W.)

PLYMOUTH, a township and the county-seat of Plymouth county, Massachusetts, U.S.A., in the south-eastern part of the state, on Plymouth Bay, about 37 m. S.E. of Boston. Pop. (1905) 11,119; (1910) 12,141. It is served by the New York, New Haven & Hartford railway, by inter-urban electric lines and in summer by steamers to Boston. The harbour is well sheltered but generally shallow; it has been considerably improved by the United States government and also by the state, which in 1909 was making a channel 18 ft. deep and 150 ft. wide from deep water to one of the township's wharves. The township has an area of 107·3 sq. m., is 18 m. long on the water front and is from 5 to 9 m. wide. Plymouth is a popular resort for visitors, having, in addition to its wealth of historic associations and a healthy summer climate, thousands of acres of hilly woodland and numerous lakes and ponds well stocked with fish. Morton Park contains 200 acres of woodland bordering the shores of Billington Sea (a freshwater lake).

Few, if any, other places in America contain so many interesting landmarks as Plymouth. The famous Plymouth Rock, a granite boulder on which the Pilgrims are said to have landed from the shallop of the "Mayflower," lies on the harbour shore near the site of the first houses built on Leyden Street, and is now sheltered by a granite canopy. Rising above the Rock is Cole's Hill, where during their first winter in America the Pilgrims buried half their number, levelling the graves and sowing grain over them in the spring in order to conceal their misfortunes from the Indians. Some human bones found on this hill when the town waterworks were built in 1855 have been placed in a chamber in the top of the canopy over the Rock. Burial Hill (originally called Fort Hill, as it was first used for defensive purposes) contains the graves of several Pilgrims and of many of their descendants. The oldest stone bears the date 1681; many of the stones were made in England, and bear quaint inscriptions. Here also are a tablet marking the location of the old fort (1621), which was also used as a place of worship, a tablet showing the site of the watch-tower built in 1643, and a marble obelisk erected in 1825 in memory of Governor William Bradford. Pilgrim Hall, a large stone building erected by the Pilgrim Society (formed in Plymouth in 1820 as the successor of the Old Colony Club, founded in 1769) in 1824 and remodelled in 1880, is rich in relics of the Pilgrims and of early colonial times, and contains a portrait of Edward Winslow (the only extant portrait of a "Mayflower" passenger), and others of later worthies, and paintings illustrating the history of the Pilgrims; the hall library contains many old and valuable books and manuscripts—including Governor Bradford's Bible, a copy of Eliot's Indian Bible, and the patent of 1621 from the Council for New England—and Captain Myles Standish's sword. The national monument to the Forefathers, designed by Hammatt Billings, and dedicated on the 1st of August 1889, thirty years after its corner-stone was laid, stands in the northern part of the town. It is built entirely of granite. On a main pedestal, 45 ft. high, stands a figure, 36 ft. high, representing the Pilgrim Faith. From the main pedestal project four buttresses, on which are seated four monolith figures representing Morality, Education, Law, and Freedom. On the faces of the buttresses below the statues are marble alto-reliefs illustrating scenes from the early history of the Pilgrims. On high panels between the buttresses are the names of the passengers of the "Mayflower." The court-house was built in 1820, and was remodelled in 1857. From it have been transferred to the fireproof building of the Registry of Deeds many interesting historical documents, among them the records of the Plymouth colony, the will of Myles Standish, and the original patent of the 23rd of January 1630 (N.S.).

Modern Plymouth has varied and important manufactures comprising cordage, woollens, rubber goods, &c. In 1905 the total value of the factory products was $11,115,713, the worsted goods and cordage constituting about nine-tenths of the whole product. The cordage works are among the largest in the world, and consume immense quantities of sisal fibre imported from Mexico and manila from the Philippine Islands; binder-twine for binding wheat is one of the principal products. From 1900 to 1905 the capital invested in manufactures increased 83% and the value of the product 101%. Large quantities of cranberries are raised in the township. Plymouth is a port of entry, but its foreign commerce is unimportant; it has a considerable coasting trade, especially in coal and lumber. The township owns its waterworks.

Plymouth was the first permanent white settlement in New England, and dates its founding from the landing here from the "Mayflower" shallop of an exploring party of twelve Pilgrims, including William Bradford, on the 21st of December (N.S.) 1620. The Indian name of the place was Patuxet, but the colonists called it New Plymouth, because they had sailed from Plymouth, England, and possibly because they were aware that the name of Plymouth had been given to the place six years before by Captain John Smith. When and how the town and the colony of Plymouth became differentiated is not clear. Plymouth was never incorporated as a township, but in 1633 the General Court of the colony recognized it as such by ordering that "the chiefe government be tyed to the towne of Plymouth." In 1686 the colony submitted to Sir Edmund Andros, who had been commissioned governor of all New England, and chose representatives to sit in his council. Plymouth remained the seat of government of the colony until 1692, when Plymouth Colony, and with it the town of Plymouth, was united to Massachusetts Bay under the charter of 1691 (see MASSACHUSETTS: *History*). Part of Plymouth was established as Plympton in 1707, and part as Kingston in 1726.

BIBLIOGRAPHY.—For the sources of the early history of Plymouth consult (George) *Mourt's Relation, or Journal of the Plantation of Plymouth* (Boston, 1865, and numerous other editions); William Bradford's *History of the Plimouth Plantation* (Boston, 1858, and several later editions), the most important source of information concerning Plymouth before 1646; the *Plymouth Colony Records* (12 vols., Boston, 1855–1861); the *Records of the Town of Plymouth* (3 vols., Plymouth, 1889–1903); J. A. Young's *Chronicles of the Pilgrim Fathers* (Boston, 1841); and E. Arber's *Story of the Pilgrim Fathers* (London, 1897), the two last containing excerpts from the leading sources. See also, James Thacher's *History of the Town of Plymouth* (Boston, 1832); W. T. Davis's *History of the Town of Plymouth* (Philadelphia, 1885); also his *Ancient Landmarks of Plymouth* (Boston, 2nd ed., 1899); and his *Plymouth Memories of an Octogenarian* (Plymouth, 1906); and John A. Goodwin, *The Pilgrim Republic* (Boston, 1888). For accounts in general histories, see J. G. Palfrey's *History of New England*, I. (Boston, 1858); the appreciative sketch by J. A. Doyle, in his *English Colonies in America*, II. (New York, 1889); and, especially, the monograph by Franklin B. Dexter, in Justin Winsor's *Narrative and Critical History of America*, vol. iii. (Boston, 1884). As to the truth of the tradition that the Pilgrims landed on Plymouth Rock, consult the *Proceedings of the Massachusetts Historical Society* (1903), 2nd series, vol. xvii. containing articles by E. Channing and W. W. Goodwin; the article by Herbert B. Adams in the *Magazine of American History*, ix. 31 sqq., and that by S. H. Gay in the *Atlantic Monthly*, xlviii. 612 sqq.

PLYMOUTH, a borough of Luzerne county, Pennsylvania, U.S.A., on the north branch of the Susquehanna river, immediately west of and across the river from Wilkes-Barre, of which it is a suburb. Pop. (1910), 16,996. Plymouth is served by the Delaware, Lackawanna & Western railroad. The borough is finely situated in the Wyoming Valley among the rich anthracite coalfields of eastern Pennsylvania, and its inhabitants are chiefly engaged in the coal industry; in 1906 and 1907 (when it shipped 24,081,491 tons) Luzerne county shipped more anthracite coal than any other county in Pennsylvania. In 1905 the total value of the factory products was $902,758, 69·4% more than in 1900. Before the coming of white settlers there was an Indian village called Shawnee on the site of the present borough. The township of Plymouth was settled in 1769 by immigrants from New England—many originally from Plymouth, Litchfield county, Connecticut, whence the name—under the auspices of the Susquehanna Company, which claimed this region as a part of Connecticut, and Plymouth became a centre of the contest between the "Pennamites" and the "Yankees" (representing respectively Pennsylvania and Connecticut), which grew out of the conflict of the royal charter of Pennsylvania (granted in 1681) with the royal charter of Connecticut (granted in 1662), a matter which was not settled until 1799. (See WYOMING VALLEY.) In its earlier history the region was agricultural. Two brothers, Abijah and John Smith, originally of Derby, Conn., settled in Plymouth in 1806 and began shipping coal thence in 1808; this was the beginning of the anthracite coal trade in the United States. The borough was incorporated in 1866, being then separated from the township of Plymouth, which had a population in 1890 of 8363 and in 1900 of 9655.

See H. B. Wright's *Historical Sketches of Plymouth* (Philadelphia, 1873).

PLYMOUTH BRETHREN, a community of Christians who received the name in 1830 when the Rev. J. N. Darby induced many of the inhabitants of Plymouth, England, to associate themselves with him for the promulgation of his opinions. Although small Christian communities existed in Ireland and elsewhere calling themselves *Brethren*, and holding similar views, the accession to the ranks of Darby so increased their numbers and influence that he is usually reckoned the founder of Plymouthism. Darby (born in Nov. 1800 in London; graduated at Trinity College, Dublin, in 1819; died April 29, 1882, at Bournemouth) was a curate in Wicklow 1825–1827, when he felt himself constrained to leave the Anglican communion; going to Dublin, he became associated with several devout people who met statedly for public worship, and called themselves "Brethren." Among these were A. N. Groves and J. G. Bellett, who deserve to rank among the founders of the movement. In 1830 Darby at Plymouth won over many people to his way of thinking, among them James L. Harris, a Plymouth clergyman, and the well-known Biblical scholar Samuel Prideaux Tregelles. The Brethren started a periodical, *The Christian Witness*, continued from 1849 as *The Present Testimony*, with Harris as editor and Darby as the most important contributor. During the next eight years the progress of the sect was rapid, and communities were founded in many of the principal towns in England.

In 1838 Darby went to reside in French Switzerland, and made many disciples. Congregations were formed in Geneva, at Lausanne, where most of the Methodist and other dissenters joined the Brethren, at Vevey and elsewhere in Vaud. His opinions also found their way into France, Germany, German Switzerland, and Italy; but French Switzerland has always remained the stronghold of Plymouthism on the Continent, and for his followers there Darby wrote two of his most important tracts, *Le Ministère considéré dans sa nature* and *De la Présence et de l'action du S. Esprit dans l'église.* The revolution in the canton Vaud, brought about by Jesuit intrigue in 1845, brought persecution to the Brethren in the canton and in other parts of French Switzerland, and Darby's life was in great jeopardy.

He returned to England, and his reappearance was followed by divisions among the Brethren at home. These divisions began at Plymouth. Benjamin Wills Newton, head of the community there, who had been a fellow of Exeter College, Oxford, was accused of departing from the testimony of the Brethren by reintroducing the spirit of clericalism. Unable to detach the congregation from the teacher, Darby began a rival assembly. The majority of the Brethren out of Plymouth supported Darby, but a minority remained with Newton. The separation became wider in 1847 on the discovery of supposed heretical teaching by Newton. In 1848 another division took place. The Bethesda congregation at Bristol, where George Müller was the most influential member, received into communion several of Newton's followers and justified their action. Out of this came the separation into Neutral Brethren, led by Müller, and Exclusive Brethren or Darbyites, who refused to hold communion with the followers of Newton or Müller. The Exclusives, who were the more numerous, suffered further divisions. An Irish clergyman named Samuel O'Malley Cluff had adopted views similar to those of Pearsall Smith, who preached a doctrine of sanctification called "Death to Nature" as an antidote to the supposed prevalent Laodiceanism, and when these were repudiated seceded with his followers. The most important division among the Exclusives came to a crisis in 1881, when William Kelly and Darby became the recognized leaders of two sections who separated on a point of discipline. This was followed (1885) by the disruption of the strict Darbyite section, two communions being formed out of it upon points of doctrine.

There were thus six sections of Plymouthists: (1) the followers of B. W. Newton, who promulgated the prophetic views peculiar to their leader; (2) the Neutrals—open brethren, leaning to Baptist views and to the Congregationalist idea that each assembly should judge for itself in matters of discipline, headed by George Müller; (3) the Exclusives, the Darbyites, holding what may be described as a Pauline view of the Church, who claim to be the original Brethren, represented by J. B. Stoney and C. H. Mackintosh; (4) the Exclusives associated in Great Britain with C. E. Stuart, in America with F. W. Grant; (5) the Exclusives who followed W. Kelly, giving a general adhesion to Darby but with a tendency to place conscience above church action, holding the Pauline view of the Church modified by Johannine elements; and (6) the Exclusives who followed Cluff. The fundamental principle of the Exclusives, "Separation from evil God's principle of unity," has led to many unimportant excommunications and separations besides those mentioned.

The theological views of the Brethren differ considerably from those held by evangelical Protestants (for a list of divergences, see Teulon, *History and Doctrines of the Plymouth Brethren*). They make the baptism of infants an open question and celebrate the Lord's Supper weekly. Their distinctive doctrines are ecclesiastical. They hold that all official ministry, whether on Episcopalian, Presbyterian or Congregationalist theories, is a denial of the spiritual priesthood of all believers, and sets aside the Holy Spirit's guidance. The gradual growth of this opinion, and perhaps the reasons for holding it, may be traced in Darby's earlier writings. While a curate in Ireland he was indignant with Archbishop Magee, who had stopped the progress of mission work among Roman Catholics by imposing on all who joined the church the oath of supremacy. This led Darby to the idea that established churches are as foreign to the spirit of Christianity as the papacy is ("Considerations addressed to the Archbishop of Dublin," &c., *Coll. Works*, i. 1). The parochial system, when enforced to the extent of prohibiting the preaching of the gospel within a parish where the incumbent was opposed to it, led him to consider the whole system a hindrance to the proper work of the church and therefore anti-Christian ("Thoughts on the present position of the Home Mission," *Coll. Works*, i. 78). And the waste of power implied in the refusal to sanction lay preaching seemed to him to lead to the conclusion that an official ministry was a refusal of the gifts of the Spirit to the church ("On Lay Preaching," *Coll. Works*, p. 200). The movement, if it has had small results in the formation of a sect, has at least set churches to consider how they might make their machinery more elastic. Perhaps one of the reasons of the comparatively small number of Brethren may be found in their idea that their mission is not to the heathen but to the "awakened in the churches."

The movement has a distinct interest for students of church history: (1) as illustrating again the desire of certain Christians to pass over the garnered experience of the centuries, and by going straight to the Bible to make a fresh start without any other authority, precedent or guidance; (2) in its development alongside the Evangelical, Tractarian and Broad Church movements of the 19th century and its affinities with them all. A certain haphazardism that has always marked the Brethren is responsible for the present lack of qualified leaders. The early enthusiasm has waned, and no provision was made for proper theological study.

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PLYMPTON ST MARY and **PLYMPTON MAURICE** (or EARL'S), two small adjacent towns in the southern parliamentary division of Devonshire, England, 5 m. E.N.E. of Plymouth, on the Great Western railway. Pop. (1901), Plympton St Mary, 3587; Plympton Maurice, 1139. Plympton St Mary contains a fine Decorated and Perpendicular church, with a lofty tower of the later period. Near it are remains of the former rich Augustinian priory of Plympton, founded by William Warelwast, bishop of Exeter (1107–1136). They include an Early English refectory with Norman undercroft, the kitchen and other fragments; but there are no remains of the great priory church. At Plympton Maurice are slight ruins of the castle built by Richard de Redvers, 1st earl of Devon (whence the variant of the name), in the time of Henry I. There are several picturesque old houses in the town, together with a guildhall dated 1696, and a grammar school founded in 1658, of which Sir Joshua Reynolds's father was master.

Plympton (*Plintona*) bears traces of very ancient settlement, the earthworks on which in the 12th century Richard de Redvers reared his Norman castle being probably of British origin, while a Saxon document dated 904 records a grant by Edward the Elder to Asser, bishop of Sherborne, of twelve manors in exchange for the monastery of "Plymentun." According to the Domesday survey "Plintona" was a royal manor assessed at 2½ hides, and the fact that the canons of Plympton held two hides apart from these shows the origin of the later division into the priory parish of Plympton St Mary and the secular borough of Plympton Erle. In the 12th century Plympton appears as a mesne borough under the lordship of the Redvers, earls of Devon, and in 1224 the burgesses claimed to have received a charter from William, the 6th earl, of which however nothing further is known, and the first charter of which a copy is extant was issued by Baldwin de Redvers in 1242, granting to the burgesses of Plympton the borough, with fairs and markets, and the liberties enjoyed by the citizens of Exeter, in consideration of a yearly payment of £24, 2s. 2d. In 1437 a charter from Edward IV. granted to the burgesses an eight-days' fair at the Feast of the Nativity of St John the Baptist, but at this period the growing importance of Plymouth was steadily robbing Plympton of its position as head of the district. In 1602, in response to a petition of the burgesses, Elizabeth issued a charter of incorporation, instituting a common council to consist of a mayor and 8 principal burgesses; a Saturday market, and fairs at the Feasts of the Ascension and the Annunciation. A code of by-laws dated 1623 mentions a fair on St Luke's Day in addition to the three above mentioned. The borough surrendered its charter to Charles II. in 1684, and in 1685 received a fresh charter from James II. instituting an additional market on Wednesday and a fair on the 1st of August. This charter was declared invalid in 1690, but its provisions were reaffirmed in 1692, with the addition of an eight-days' fair to begin on the 14th of February. The borough, which had returned two members to parliament since 1295, was disfranchised by the Reform Act of 1832 and from this date the municipal privileges gradually lapsed, and in 1859 were finally abolished.

See *Victoria County History: Devonshire*; William Cotton, *Some Account of the Ancient Borough Town of Plympton St Maurice* (London, 1859); J. Brooking Rowe, *Notes of Plympton Castle* (Plymouth, 1880).

PNEUMATIC DESPATCH, the name given to a system of transport of written despatches through long narrow tubes by the agency of air pressure. It was introduced in 1853 by J. Latimer Clark, between the Central and Stock Exchange stations of the Electric and International Telegraph Company in London. The stations were connected by a tube 1½ in. in diameter and 220 yds. long. Carriers containing batches of telegrams, and fitting piston-wise in the tube, were sucked through it (in one direction only) by the production of a partial vacuum at one end. In 1858 C. F. Varley improved the system by using compressed air to force the carriers in one direction, a partial vacuum being still used to draw them in the other direction. This improvement enables single radiating lines of pipe to be used both for sending and for receiving telegrams between a central station supplied with pumping machinery and outlying stations not so supplied.

Radial System.—In the hands of R. S. Culley and R. Sabine the radial system of pneumatic despatch was in 1870 brought to great perfection in connexion with the telegraphic department of the British post office, since that date the total length of tubes (which are employed for telegrams only) has been very largely increased (in 1909 there was in London a total length of

40 m.), whilst in all large and also in very many smaller provincial towns there are installations; these are constantly being added to, as it is found more economical to transmit local message-work by tube rather than by wire, as skilled telegraphists are not required, but only tube attendants. In some cases only a single tube is necessary, but three or four, or even more, are in use in some towns, according to local circumstances. Short tubes, known as "house tubes" are in use in a great number of offices; such tubes, which are worked either by hand-pumps (when the tubes are very short and the traffic inconsiderable) or by power, are usually 1½ in. in diameter, and are used for the purpose of conveying messages from one part of a telegraph instrument-room to another, or from the instrument-room to the public counter. The underground, or "street" tubes are chiefly 2¼ in. in diameter, but there are also a number of 3-in. tubes in use; those in the large provincial towns (Birmingham, Bradford, Cardiff, Edinburgh, Glasgow, Grimsby, Liverpool, Manchester, Newport, Leeds, Newcastle, Southampton and Swansea) are 2¼ in. in diameter; but in Dublin, Gloucester, Lowestoft and Milford 1½-in. tubes are employed. There are fifty street tubes in London, varying in length from 100 to 2000 yds. (central office to the Houses of Parliament), and also seventy-five house tubes; the pumps for the whole system are worked by four 100 horse-power steam-engines. At Cardiff, Edinburgh, Gloucester, Leeds, Lowestoft, Newport, Southampton and Swansea the pumps are driven by electric motors; at Bradford and Grimsby gas-engines are used, and at Milford an oil-engine.

The tubes are in all cases of lead, the 2¼-in. tubes weighing 8 ℔ per foot run and being made in lengths of 28 ft.; they are enclosed in 3-in. cast-iron pipes made in lengths of 9 ft.

Great care is exercised in making the joints in the lead pipes. Before the tube is placed in its trench a strong chain is passed through it, and a polished steel mandrel, 6 in. long and slightly less in diameter than the diameter of the tube, is heated and attached to the chain, and pushed half its length into the end of the tube already laid; the new length of tube is then forced over the projecting end of the mandrel until the tube ends (which have been previously cut flat) butt perfectly together; an ordinary plumber's joint is then made. By this means the tube is made perfectly air-tight, and the mandrel keeps the surface of the tube under the joint as smooth as at any other part of its length. After the joint is completed the mandrel is drawn out by the chain attached to it, the next length is drawn on, and the above process repeated. The tubes are laid about 2 ft. below the surface of the ground.

Working.

The tubes radiate from the central to the branch offices, the principal offices having two tubes, one for "inward" and the other for "outward" traffic. At the smaller offices both the inward and the outward traffic is carried on through one tube. The "carriers" are made with gutta-percha bodies, covered with felt, the front of the carrier being provided with a buffer or piston formed of several disks of felt which closely fit the tube; the messages are prevented from getting out of the carrier by the end being closed by an elastic band, which can be stretched sufficiently to allow the message forms to be inserted. The 3-in. carriers will hold 75 ordinary message forms, the 2¼-in. carriers 25 forms, and the 1½-in. carriers 20 forms. The carriers are propelled in one direction (from the central office) by "pressure," and drawn in the opposite direction by "vacuum," the standard pressure and vacuum being 10 ℔ and 6½ ℔ per sq. in. respectively, which values give approximately the same speed.

The time of transit of a carrier through a tube when the air pressure does not exceed 20 ℔ per square inch is given very approximately by the empirical formula:—

$$t = \cdot00872\sqrt{\frac{l^3}{Pd}};$$

where l=length of tube in yards, d=diameter of tube in inches, P=effective air-pressure in pounds per square inch, t=transit time in seconds. For vacuum the formula is:—

$$t = \frac{\cdot00825}{1 - \cdot234\sqrt{15\cdot5 - P_1}}\sqrt{\frac{l^3}{d}};$$

where P_1=effective vacuum in pounds per square inch.

The horse-power required to propel a carrier is approximately, for pressure:—

$$\text{H.P.} = (\cdot574 + \cdot0011P)\sqrt{\frac{P^3d^5}{l}};$$

for vacuum:—

$$\text{H.P.} = (5\cdot187 - 1\cdot214\sqrt{15\cdot5 - P_1})P_1\sqrt{\frac{d^5}{l}}.$$

For a given transit time the actual horse-power required is much less in the case of vacuum than in the case of pressure working, owing to the density of the air column moved being much less: thus, for example, the transit time for 10 ℔ pressure is the same as for 6½ ℔ vacuum, but the horse-power required in the two cases is as 1·83 to 1. A tube 1 m. long, 2¼ in. in diameter, and worked at 10 ℔ per square inch pressure, will have a transit time of 2¼ minutes, and will theoretically require 3·35 horse-power to be expended in working it, although actually 25 % more horse-power than this must be allowed for, owing to losses through various causes. The transit time for a 2¼-in. tube is 16 % more than for a 3-in. tube of the same length, when both are worked at the same pressure, but the horse-power required is 50 % less; it is not advisable, therefore, to use a tube larger than is absolutely necessary to carry the volume of traffic required.

Despatching and Receiving Apparatus.

The somewhat complicated pattern of "double sluice valve" originally used at the central stations has been superseded by a simpler form, known as the "D" box—so named from the shape of its cross section. This box is of cast iron, and is provided with a close-fitting, brass-framed, sliding lid with a glass panel. This lid fits air-tight, and closes the box after a carrier has been inserted into the mouth of the tube; the latter enters at one end of the box and is there bell-mouthed. A supply pipe, to which is connected a "3-way" cock, is joined on to the box and allows communication at will with either the "pressure" or "vacuum" mains, so that the apparatus becomes available for either sending (by pressure) or receiving (by vacuum) a carrier. Automatic working, by which the air supply is automatically turned on on the introduction of the carrier into a tube and on closing of the D box, and is cut off when the carrier arrives, was introduced in 1909.

On the long tubes (over about 1000 yds.) a modification of the "D" box in its simplest form is necessary; this modification consists in the addition of a "sluice" valve placed at a distance of about 9 in. (*i.e.* rather more than the length of a carrier) from the mouth of the tube. The sluice valve, by means of an interlocking arrangement, is so connected with the sliding lid of the box that the lid cannot be moved to the open position unless the sluice valve has closed the tube, nor can the sluice valve be opened unless the sliding lid is closed. The object of this sluice valve is to prevent the back rush of air which would take place into the tube when the sliding lid is opened to take out a carrier immediately on the arrival of the latter; for although the vacuum may be turned off by the 3-way cock, yet, owing to the great length of the tube, equilibrium does not immediately take place in the latter, and the back rush of air into the vacuum when the lid is opened to extract the carrier will cause the latter to be driven back into the tube. The sluice also prevents a similar, but reverse, action from taking place when pressure working is being carried on.

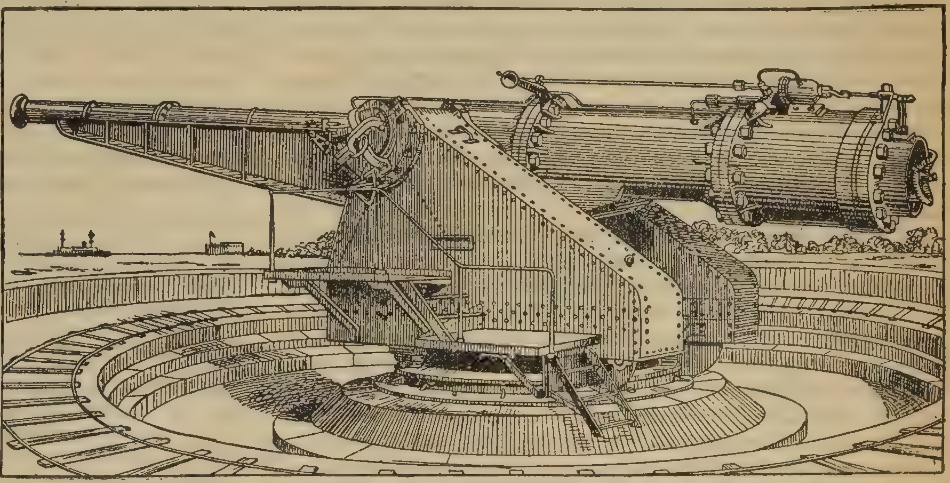
As a rule, only one carrier is despatched at a time, and no second carrier is inserted in the tube until the arrival of the first one at the farther end is automatically signalled (by an electric apparatus) to the despatching office. On some of the long tubes a carrier, when it passes the midway point in the tube, strikes a trigger and sends back an electrical signal indicating its passage; on the receipt of this signal a second carrier may be despatched. This arrangement has been almost entirely superseded by a signalling apparatus which by a clock movement actuates an indicating hand and moves the latter to "tube clear" a certain definite time (30 to 40 seconds) after a carrier has been inserted in the tube. By this arrangement carriers can be despatched one after the other at comparatively short intervals of time, so that several carriers (separated by distinct intervals) may be travelling through the tube simultaneously. It is necessary that the carriers be separated by a definite interval, otherwise they tend to overtake one another and become jammed in the tube. Although the stoppage of a carrier in a tube is of exceedingly rare occurrence, it does occasionally take place, through picks being driven into the tube by workmen executing repairs to gas or water pipes, but the locality of such a stoppage is easily determined by a simple inspection along the route of the tube. In no case is any special means of testing for the locality from the central office found necessary.

Circuit System.—Another method of working, extensively used in Paris and other continental cities, is the circuit system, in which stations are grouped on circular or loop lines, round which carriers travel in one direction only. In one form of circuit system—that of Messrs Siemens—a continuous current of air is kept up in the tube, and rocking switches are provided by which carriers can be quickly introduced or removed at any one of the stations on the line without interfering with the movement of other carriers in other parts of the circuit. More usually, however, the circuit system is worked by despatching carriers, or trains of carriers, at relatively long intervals, the pressure or vacuum which gives motive power being applied only while such trains are on the line. On long circuits means are provided at several stations for putting on pressure or vacuum, so that the action may be limited to that section of the line on which the carriers are travelling at any time. In America, in New York, Boston and Philadelphia, tubes (Batcheller system) up to 8 in. in diameter are in use. The tubes are of cast iron made in 12-ft. lengths and are carefully bored; they resemble ordinary water pipe. Short bends are made in seamless brass tube carefully bent to a uniform radius of twelve times the diameter of the tube, the tube being slightly larger in diameter than the main tube. The sending apparatus, or transmitter, is similar to the Siemens switch before described, and consists of two sections of the tube supported in a swinging frame so arranged that either section can be brought into line with the main tube, in which a current of air is constantly flowing. One of these tube sections maintains the continuity of the main tube, while the other is swung to one side to receive a carrier. In despatching, a carrier is placed in an iron trough and then pushed into the open tube section. The frame carrying the two tube sections is then swung until the section containing the carrier is brought into line with the main tube, when the carrier is swept along with the current of air. When the frame is swinging from one position to another the air is prevented from escaping by plates that cover the ends of the tube, and a by-pass is provided so that the current is not interrupted. An air-motor, consisting of a cylinder and piston, furnishes the power to swing the frame, the operation requiring an instant only. When the controlling lever is pulled and latched the frame swings, and as the carrier passes out of the apparatus it trips the lever, and the frame swings back automatically into position to receive another carrier. To prevent carriers from being despatched too frequently and overtaking each other a time lock is attached to the sending apparatus; this locks the controlling valve when a carrier is despatched, and keeps it locked for a given period of time, varying from five to fifteen or twenty seconds, according to the adjustment of the lock. The carrier is received at the farther end of the tube into an air cushion formed by closing the end of the tube with a sluice-gate, and allowing the air to flow out into a branch pipe through slots in the tube located about 4 ft. in the rear of the sluice-gate. When a carrier arrives it passes over the slots, enters the air cushion and is brought to rest without injury or shock. The carriers are thin steel cylinders closed at the front end by a convex disk of the same material carrying a buffer of felt and leather; the rear end is closed by a hinged lid secured by a lock. The shell of the carrier is 24 in. long and 7 in. in diameter for the 8-in. tube; it is secured by two bearing-rings of woven cotton fabric clasped between metal rings; the rings are renewed after about 2000 m. of travel. The tubes are worked at a pressure of 6 ℔ per sq. in., and for a distance of 4500 ft. require about 30 horse-power, the transit speed being 30 m. per hour.

In addition to its use for postal and telegraphic purposes the pneumatic despatch is employed for internal communication in offices, hotels, &c., and also in shops for the transport of money and bills between the cashier's desk and the counters.

References.—The system as used in the United Kingdom is fully described in a paper by Messrs Culley and Sabine (*Min. Proc. Inst. Civ. Eng.* vol. xliii.). The same volume contains a description of the pneumatic telegraphs of Paris and of experiments on them by M. Bontemps, and also a discussion of the theory of pneumatic transmission by Professor W. C. Unwin. Reference should also be made to a paper, by C. Siemens (*Min. Proc. Inst. Civ. Eng.* vol. xxxiii.), describing the Siemens circuit system; and to *Les Télégraphes*, by M. A. L. Ternant (Paris, 1881); *General Post Office Technical Instructions*, vol x., "Pneumatic Tubes"; Kempe's *Engineers' Year-Book* (1908 edition). (H. R. K.)

PNEUMATIC GUN. Air as a propellant has in recent years been applied to guns of large calibre, in which its comparatively gentle action has proved advantageous when high explosives contained in their shells are employed as projectiles. In 1883 Mr Mefford of Ohio utilized an air pressure of 500 ℔ per sq. in. in a 2-in. gun, and succeeded in propelling a projectile 2100 yds. The arrangement was of the simplest form—a hose with an ordinary cock by which the air was admitted into the gun behind the projectile. The question was then taken up by Capt. E. L. Zalinski (1849–1909) of the United States Artillery, who in 1888 reduced the so-called "dynamite gun" to a practical shape and obtained excellent firing results.


Dynamite gun, mounted at Sandy Hook, New York Harbour.

The principal features of his system are: (1) An extremely ingenious balanced valve admitting the air pressure into the gun. This valve is opened and closed by a simple movement of the firing lever, and is capable of adjustment so that the propelling force, and consequently the range, can be regulated. (2) A light steel projectile carrying the bursting charge, and provided with a tail to which vanes are attached in order to give rotation. (3) Electric fuses of entirely original design. Each shell carries a wet battery, the current from which fires the charge on impact with any solid object, and a dry battery which becomes active after the shell has dived below the surface of the water, and ignites the charge after delay capable of regulation. For safety all the electric circuits are made to pass through a disconnector, which prevents them from being completed until the shell has been fired. The gun is a built-up smooth-bore tube, 15 in. or less in diameter. The full-calibre shell weighs 1000 ℔, and carries a bursting charge of 600 ℔ of blasting gelatine, cut into the form of cheeses, fitting the steel envelope, and provided with a core of dry gun-cotton as a primer. Sub-calibre projectiles, 10 in. and 8 in., can also be used. In their case, rotation is given by vanes or fins attached to the body of the shell. Air at 1000 ℔ pressure is stored in tubes close to the gun, and is supplied from primary reservoirs, to which it is directly pumped at a pressure of about 2000 ℔. There is always, therefore, a considerable reserve of power available without pumping. Pneumatic guns of this description (see figure) have been mounted for the protection of New York and San Francisco. With a full-calibre shell (1000 ℔) these guns have a range of 2400 yds.; with a sub-calibre 8-in. shell (250 ℔) the maximum range is 6000 yds. The official trials showed remarkable accuracy. At 5000 yds. 75% of the projectiles fell in an area of 360 × 90 ft. When the gun was tried at Shoeburyness the accuracy was far greater than could be obtained with howitzer shells propelled by explosives. On account of the power of exploding the shell under water, and thus securing a torpedo action, a direct hit upon a ship is not required, and the target offered is largely in excess of the deck plan. The gun is, in fact, capable of replacing systems of submarine mines with economy, and without the great objection of interfering with a waterway.

The only employment of the dynamite gun afloat has been in the case of the U.S. gunboat "Vesuvius," carrying three in the bows. These guns are fixed at a constant angle of elevation, and the range is regulated by the air valve, training being given by the helm. Thus mounted on an unstable platform, the accuracy of fire obtainable must evidently be much less than on shore. The "Vesuvius" was employed during the Spanish-American War of 1898, when on several nights in succession she approached the defences of Santiago under cover of darkness and discharged three projectiles. Fire delivered under such conditions could not be sufficiently accurate to injure coast defences; but the shells burst well, and made large craters. A small dynamite gun on a field-carriage was used in the land operations above Santiago in the same war.

PNEUMATICS (Gr. πνεῦμα, wind, air), the branch of physical science concerned with the properties of gases and vapours (see GAS). A pneumatic trough is simply a basin containing water or some other liquid used for collecting gases.

PNEUMATOLYSIS (Gr. πνεῦμα, vapour, and λύειν, to set free), in petrology, the discharge of vapours from igneous magmas and the effects produced by them on rock masses. In all volcanic eruptions the gases given off by the molten lavas are powerful agencies. The slaggy clots of lava thrown out from the crater are so full of gas that when they cool they resemble spongy pieces of bread. The lava streams as they flow down the slopes of the volcano are covered with white steam clouds, while over the orifice of the crater hangs a canopy of vapour which is often darkened by fine particles of ash. Most authors ascribe volcanic explosions to the liberation of steam from the magma which held it in solution, and the enormous expansive powers which free water vapour possesses at very high temperatures.

Of these gases the principal are water and carbonic acid, but by analysis of the discharges from the smaller fumaroles, for the active crater is generally too hot to be approached during an eruption, it has been ascertained that hydrogen, nitrogen, hydrochloric acid, boron, fluorine, sulphuretted hydrogen and sulphurous acid are all emitted by volcanoes. A recent lava flow has been likened to a great fumarole pouring out volatile substances at every crack in its slaggy crust. Many minerals are deposited in these fissures, and among the substances produced in this way are ammonium chloride, ferric chloride and oxide, copper oxide (tenorite and cuprite) and sulphur; by reacting on the minerals of the rock many zeolites and other secondary products are formed. These processes have been described as "juvenile" or "post eruptive," and it is believed that the amygdales which occupy the cavities of many porous lavas are not due really to weathering by surface waters percolating in from above, but to the action of the steam and other gases set free as the lava crystallizes. The zeolites are the principal group of minerals which originate in this way together with chlorite, chalcedony and calcite. The larger cavities (or geodes) are often lined with beautiful crystal groups of natrolite, scolecite, thomsonite, stilbite, and other minerals of this order.

The active gases were evidently in solution in the magma as it rose to the surface. Some geologists believe it is of subterranean origin like the lava itself, and is an essential or original component of the magma. They point to the existence of gases in considerable quantity in meteorites, and, comparing the earth to a great aerolite, insist that it should contain gases in solution like the smaller masses of the same kind. Others hold it more probable that the water has percolated in from the surface, or seeing that many volcanoes stand near the sea margin and by their linear disposition may be disposed along fissures or lines of weakening in the crust, they argue that the water of the sea may have filtered down even in spite of the great outward pressure exerted by the steam generated by contact with the intensely heated rock. The abundance of chlorides and hydrochloric acid is appealed to also in favour of a marine origin for the water. Against this we may place the fact that at great depths whence active magmas ascend the rocks are under so great pressures that every fissure is closed up; in fact in some of the deepest mines the quantity of water found in the workings is often exceedingly small. Probably there is some truth in both theories, but the balance of probability seems to incline in favour of the view that the water is an original and essential part of the magma and not an introduction from above.

Long after a lava has cooled down and become rigid the vapours continue to ooze out through its fissures, and around many volcanoes which are believed to be extinct there are orifices discharging gas in great quantities. This state of activity is said to be "solfataric," and a good example of it is the volcano called the Solfatara near Naples. The numerous "Soufrières" of the West Indies are further instances. The prevalent gas is steam with sulphuretted hydrogen and carbonic acid. At the Grotto del Cane in the Phlegraean Fields (Italy) the carbonic acid rising from fissures in the bottom of a cave covers the floor as a heavy layer, and a dog placed in the interior of the cave becomes stupefied by the narcotic gas; such gas-springs have been called "mofettes." Around them there is often a deposit of sulphur, produced by oxidation of the sulphuretted hydrogen, and the rocks are bleached, softened and decomposed. White crusts of alum, various sulphates, and sulphides such as pyrites, also carbonates of soda and other bases, are formed by the action of the acid vapours on the volcanic rocks. The final manifestation of volcanic activity in such a region may be the discharge of heated waters, which have ascended from the deep-seated magma far below the surface, and make their appearance as groups of hot springs; these springs persist long after the volcanoes which give rise to them have become quite extinct.

It is now believed by a large number of geologists and mining engineers that these ascending hot waters are of paramount importance in the genesis of some of the most important types of ore deposits. Analyses have proved that the igneous rocks often contain distinct though very small quantities of the heavy metals; it is also established beyond doubt that veins of gold, silver, lead, tin and mercury most commonly occur in the vicinity of intrusive igneous masses. At Steamboat in Nevada, hot springs, probably of magmatic origin, are forming deposits of cinnabar. At Cripple Creek, Colorado, and in many other places gold-bearing veins occur in and around intrusive plugs of igneous rock. Tin ores in all parts of the world are found in association with tourmaline granites. In all cases the veins bear evidence of having been filled from below by hot waters set free during the cooling of the igneous intrusions. Volcanic rocks are consequently the parent sources of many valuable mineral deposits, and the agency by which they were brought into their present situations is the volatile products discharged as the magma crystallized. The process was no doubt a long one and it is most probable that both steam and water took part in it. Above 365° C. water is a gas under all pressures and the action is strictly *pneumatolytic*; below that temperature steam is changed to water by pressure and the action may be described as *hydatogenetic*. The distinction is unessential, and in our ignorance of the temperatures and pressures prevailing at considerable depths we lack the means of classification. In what condition the metallic ores are dissolved and by what reactions they are precipitated depends on many factors only partly understood. The tin ores are so often associated with minerals containing boron and fluorine that it is quite probable that they were combined with these elements in some way, but they were deposited in nearly all cases as oxides. Other gaseous substances, such as sulphuretted hydrogen, carbonic acid and hydrochloric acid, probably have an important part in dissolving certain metals; and the alkaline carbonates, sulphides and chlorides have been shown by experiment to act also as solvents. In these ore deposits not only the heavy metals are found, but often a much larger quantity of minerals such as calcite, barytes, fluorspar, quartz and tourmaline which serve as a matrix or gangue, and have been deposited by the same agencies, and often at the same time as the valuable minerals.

In their passage upwards and outwards through the rocks of the earth's crust, these gases and liquids not only deposit minerals in the fissures along which they ascend, but attack the surrounding rocks and alter them in many ways. The granite or other plutonic mass from which the vapours are derived is especially liable to these transformations, probably because it is at a high temperature, not having yet completely cooled down. Around the tin-bearing veins in granite there is extensive replacement of felspar and biotite by quartz, tourmaline and white micas (the last-named often rich in lithia). In this way certain types of altered granite are produced, such as greisen (*q.v.*) and schorl rock (see SCHORL). In the slates adjacent to the tin veins tourmalinization also goes on, converting them into schorl-schists. The alteration of felspar into kaolin or china clay is also a pneumatolytic process, and is often found along with tin veins or other types of mineral deposit; probably both fluorine and carbonic acid operated in this instance along with water. Equally common and important is the silicification of rocks near mineral veins which carry gold, copper, lead and other metals. Granites and felsites may be converted into hard cherty masses of silica. Limestones undergo this transformation very readily; at the same time they are regarded as rocks very favourable to the deposition of ores. Probably the great frequency with which they undergo silicification and other types of metasomatic replacement is one of the main causes of the abundance of valuable deposits in them. The process known as "propylitization," which has extensively affected the andesites of the Hungarian goldfields, is believed to be also a consequence of the action of pneumatolytic gases. The andesites change to dull, soft, greenish masses, and their original minerals are to a large extent replaced by quartz, epidote, chlorite, sericite and kaolin. Around granites intrusive into serpentine and other rocks containing much magnesia, there is often extensive "steatisation," or the deposit of talc and steatite in place of the original minerals of the rock. Some of the apatite veins of Canada and Norway accompany basic rocks of the gabbro group; it has been argued that the apatite (which contains phosphorus and chlorine) was laid down by vapours or solutions containing those gases, which may play a similar part in the basic rocks to that taken by fluorine and boron in the pneumatolytic veins around granites. In the country rock around the veins scapolite (*q.v.*), a lime alumina silicate, containing chlorine, often is substituted for lime-felspar.

These extensive changes attending the formation of mineral veins are by no means common phenomena, but in many plutonic masses pneumatolytic action has contributed to the formation of pegmatites (*q.v.*). (J. S .F.)

PNEUMONIA (Gr. *πνεύμων*, lung), a term used for inflammation of the lung substance. Formerly the disease was divided into three varieties: (1) Acute Croupous or lobar pneumonia; (2) Catarrhal or Broncho-pneumonia; (3) Interstitial or Chronic pneumonia.

1. *Acute Croupous or Lobar Pneumonia* (Pneumonic Fever) is now classed as an acute infective disease of the lung, characterized by fever and toxaemia, running a definite course and being the direct result of a specific micro-organism or micro-organisms. The micrococcus lanceolatus (pneumococcus, or diplococcus pneumoniae) of Fränkel and Weichselbaum is present in a large number of cases in the bronchial secretions, in the affected lung and in the blood. This organism is also present in many other infective processes which may complicate or terminate lobar pneumonia, such as pericarditis, endocarditis, peritonitis and empyema. The bacillus pneumoniae of Friedländer is also present in a proportion of cases, but is probably not the cause of true lobar pneumonia. Various other organisms may be associated with these, but they are to be regarded as in the nature of a secondary invasion. Lobar pneumonia may be considered as an acute endemic disease of temperate climates, though epidemic forms have been described. It has a distinct seasonal incidence, being most frequent in the winter and spring. Osler strongly supports the view that it is an infectious disease, quoting the outbreaks reported by W. L. Rodman of Frankfort, Kentucky, where in a prison of 735 inhabitants there were 118 cases in one year; but direct contagion does not seem to be well proved, and it is undoubted that the pneumococcus is present in the fauces of numbers of healthy persons and seems to require a lowered power of resistance or other favouring condition for the production of an attack.

Lobar Pneumonia begins by the setting up of an acute inflammatory process in the alveoli. The changes which take place in the lung are chiefly three. (1) *Congestion*, or engorgement, the blood-vessels being distended and the lung more voluminous and heavier than normal, and of dark red colour. Its air cells still contain air. (2) *Red Hepatization*, so called from its resemblance to liver tissue. In this stage there is poured into the air cells of the affected part an exudation consisting of amorphous fibrin together with epithelial cells and red and white blood corpuscles, the whole forming a viscid mass which occupies not only the cells but also the finer bronchi, and which speedily coagulates, causing the lung to become firmly consolidated. In this condition the cells are entirely emptied of air, their blood-vessels are pressed upon by the exudation, and the lung substance, rendered brittle, sinks in water. The appearance of a section of the lung in this stage has been likened to that of red granite. It is to the character of the exudation, consisting largely of coagulable fibrin, that the term croupous is due. (3) *Grey Hepatization*. In this stage the lung still retains its liver-like consistence, but its colour is now grey, not unlike the appearance of grey granite. This is due to the change taking place in the exudation, which undergoes resolution by a process of fatty degeneration, pus formation, liquefaction and ultimately absorption—so that in a comparatively short period the air vesicles get rid of their morbid contents and resume their normal function. During resolution the changes in the exudate take place by a process of autolysis or peptonization of the inflammatory products by unorganized ferments, absorption taking place into the lymphatics and circulation. The absorbed exudate is mainly excreted by the kidneys, excess of nitrogen being found in the urine during this period. This is happily the termination of the majority of cases of lobar pneumonia. One of the most remarkable phenomena is the rapidity with which the lung tissue clears up, and its freedom from alteration or from infiltration into the connective tissue as frequently takes place after broncho-pneumonia. When resolution does not take place, death may occur from extension of the disease and subsequent toxaemia, from circulatory failure, from the formation of one or more abscesses or more rarely from gangrene of the lung or from the complication mentioned below. Chronic interstitial pneumonia is infrequent, following on the acute variety. The most frequent seat of pneumonia is the base or lower lobes, but occasionally the apices are the only parts affected. The right lung is the most often attacked. Pneumonia may extend to the entire lung or it may affect both lungs. The death rate of acute lobar pneumonia in the chief London hospitals is 20%. With an organism so prevalent as the pneumococcus it follows that alcoholism, diabetes and other general diseases and intoxications must render the body liable to an attack. Males are more commonly attacked than females, and a previous attack seems to give a special liability to another. The incubation period of pneumonia is unknown; it is probably very short.

The symptoms are generally well marked from the beginning. The attack is usually ushered in by a rigor (or in children a convulsion), and the speedy development of the febrile condition, the temperature rising to a considerable degree—101° to 104° or more. The pulse is quickened, and there is a marked disturbance in the respiration, which is rapid, shallow and difficult, the rate being usually accelerated to some two or three times its normal amount. The lips are livid, and the face has a dusky flush. Pain in the side is felt, especially should any amount of pleurisy be present, as is often the case. Cough is an early symptom. It is at first frequent and hacking, and is accompanied with a little tough colourless expectoration, which soon, however, becomes more copious and of a rusty red colour, either tenacious or frothy and liquid. Microscopically this consists mainly of epithelium, casts of the air cells and fine bronchi, together with granular matter, blood and pus corpuscles and haematoidin crystals. The micro-organisms usually present are the pneumococcus, Friedländer's bacillus, and sometimes the influenza bacillus. The following are the chief physical signs in the various stages of the disease. In the stage of congestion fine crackling or crepitation is heard over the affected area; sometimes there is very little change from the natural breathing. In the stage of red hepatization the affected side of the chest is seen to expand less freely than the opposite side; there is dullness on percussion, and increase of the vocal fremitus; while on auscultation the breath sounds are tubular or bronchial in character, with, it may be, some amount of fine crepitation in certain parts. In the stage of grey hepatization the percussion note is still dull and the breathing tubular, but crepitations of coarser quality than before are also audible. These various physical signs disappear more or less rapidly during convalescence. With the progress of the inflammation the febrile symptoms and rapid breathing continue. The patient during the greater part of the disease lies on the back or on the affected side. The pulse, which at first was full, becomes small and soft owing to the interruption to the pulmonary circulation. Occasionally slight jaundice is present, due probably to a similar cause. The urine is scanty, sometimes albuminous, and its chlorides are diminished. In favourable cases, however severe, there generally occurs after six or eight days a distinct crisis, marked by a rapid fall of the temperature accompanied with perspiration and with a copious discharge of lithates in the urine. Although no material change is as yet noticed in the physical signs, the patient breathes more easily, sleep returns, and convalescence advances rapidly in the majority of instances. In unfavourable cases death may take place either from the extent of the inflammatory action, especially if the pneumonia is double, from excessive fever, from failure of the heart's action or general strength at about the period of the crisis, or again from the disease assuming from the first a low adynamic form with delirium and with scanty expectoration of greenish or "prune juice" appearance. Such cases are seen in persons worn out in strength, in the aged, and especially in the intemperate.

The complications of acute pneumonia are pleurisy, which is practically inevitably present, empyema (in which the pneumococcus is frequently present and occasionally the streptococcus), pericarditis and endocarditis, both due to septic poisoning, while perhaps the most serious complication is meningitis, which is responsible for a large percentage of the fatal cases. The pneumococcus has been found in the exudate. Secondary pneumonias chiefly follow the specific fevers, as diphtheria, enteric fever, measles and influenza, and are the result of a direct poisoning. Bacteriologically a number of different organisms have been found, together with the specific microbe of the primary disease; the striking features of primary lobar pneumonia are often masked in these types.

The treatment of acute pneumonia has of late undergone a marked change, and may be divided into 3 heads: (1) General hygienic treatment; (2) the treatment of special symptoms; (3) treatment by vaccines and sera. The same treatment of absolute rest should be carried out as in enteric fever; this absolute rest is necessary to limit the auto-inoculation by the absorption of toxins. Fresh air in abundance and even open-air treatment if possible has been attended with good results. Ice poultices over the affected part are useful in the relief of pain, while tepid sponging and tepid or even cold baths may be freely given, and the patient's strength supported by milk, soups and other light forms of nourishment. Stimulants may be called for, and strychnine and digitalin are the most valuable; disinfection of the sputum should be systematically carried out. Many trials have been made with antipneumococcic serum, but it has not been shown to have a very marked effect in cutting short the disease. The polyvalent serum of Römer has given the best results. Much more favourable results have been obtained from the use of a vaccine. The results of vaccine treatment obtained by Boellke in 30 cases of severe pneumonia and one case of pneumococcic endocarditis are encouraging. The vaccine, to produce the best effects, should be made from the patient's own pneumococcus, as it is evident there are different strains of pneumococci, the doses (5 to 50 million dead pneumococci) being regulated by the guidance of the opsonic index. The objection to the preparation of the vaccine from the patient's own organisms is the time (several days) which is required, valuable time being thereby lost; but the results are much more certain than with the use of a "stock" vaccine.

2. *Broncho-Pneumonia* (Catarrhal or Lobular-Pneumonia or Capillary Bronchitis). An acute form of lobular pneumonia has been described, having all the characters of acute lobar pneumonia except that the pneumonic patches are disseminated. The term "broncho-pneumonia" is however here used to denote a widespread catarrhal inflammation of the smaller bronchi which spreads in places to the alveoli and produces consolidation. All forms of broncho-pneumonia depend on the invasion of the lung by micro-organisms. No one organism has however been constantly found which can be said to be specific, as in lobar pneumonia; the influenza bacillus, micrococcus catarrhalis, pneumococcus, Friedländer's bacillus and various staphylococci having been found. John Eyre, in Allbutt's *System of Medicine*, gives 62% of mixed infection in the cases investigated by him. Broncho-pneumonia may occur as an acute primary affection in children, but is more usually secondary. It may be a sequence of infectious fevers, measles, diphtheria, whooping cough, scarlet fever and sometimes typhoid fever. In these it forms a frequent and often a fatal complication. The large majority of the fatal cases are those of early childhood. In adults it may follow influenza or complicate chronic Bright's disease or various other disorders. Broncho-pneumonia also may follow operations on the mouth or trachea, or the inhalation of foreign bodies into the trachea. It is a frequent complication of pulmonary tuberculosis.

The following changes take place in the lung: at first the affected patches are dense, non-crepitant, with a bluish red appearance tending to become grey or yellow. Under the microscope the air vesicles and finer bronchi are crowded with cells, the result of the inflammatory process, but there is no fibrinous exudation such as is present in croupous pneumonia. In favourable cases resolution takes place by fatty degeneration, liquefaction, and absorption of the cells, but on the other hand they may undergo caseous degenerative changes, abscesses may form, or a condition of chronic interstitial pneumonia be developed, in both of which cases the condition passes into one of pulmonary tuberculosis. Evidence of previous bronchitis is usually present in the lungs affected with catarrhal pneumonia. In the great majority of instances catarrhal pneumonia occurs as an accompaniment or sequel of bronchitis, either from the inflammation passing from the finer bronchi to the pulmonary air vesicles, or from its affecting portions of lung which have undergone collapse.

The symptoms characterizing the onset of catarrhal pneumonia in its more acute form are the occurrence during an attack of bronchitis or the convalescence from measles or whooping cough, of a sudden and marked elevation of temperature, together with a quickened pulse and increased difficulty in breathing. The cough becomes short and painful, and there is little or no expectoration. The physical signs are not distinct, being mixed up with those of the antecedent bronchitis; but, should the pneumonia be extensive. there may be an impaired percussion note with tubular breathing and some bronchophony. Dyspnoea may be present in a marked degree; and death frequently occurs from paralysis of the heart. Broncho-pneumonia is a serious disease, the death-rate in children under five has been estimated at 30 to 50%.

The treatment of broncho-pneumonia is mainly symptomatic. At the outset a mild purgative is given, and should the secretion accumulate in the bronchial tubes an emetic is useful. Inhalations are useful to relieve the cough, and circulatory stimulants such as strychnine are valuable, together with belladonna and oxygen. When orthopnoea and lividity are present, with distension of the right heart, venesection is necessary. The treatment of broncho-pneumonia by serum and vaccines is not so successful as in lobar pneumonia, owing to the difficulty of ascertaining the precise bacterial infection. The great danger of broncho-pneumonia is the subsequent development of pulmonary tuberculosis.

3. *Chronic Interstitial Pneumonia* (Cirrhosis of the Lung) is a fibroid change in the lung, chiefly affecting the fibrous stroma and may be either local or diffuse. The changes produced in the lung by this disease are marked chiefly by the growth of nucleated fibroid tissue around the walls of the bronchi and vessels, and in the intervesicular septa, which proceeds to such an extent as to invade and obliterate the air cells. The lung, which is at first enlarged, becomes shrunken, dense in texture and solid, any unaffected portions being emphysematous; the bronchi are dilated, the pleura thickened, and the lung substance often deeply pigmented, especially in the case of miners, who are apt to suffer from this disease. The other lung is always greatly enlarged and distended from emphysema; the heart becomes hypertrophied, particularly the right ventricle; and there may be marked atheromatous changes in the

blood vessels. Later the lung becomes converted into a series of bronchiectatic cavities. This condition is usually present to a greater or less degree in almost all chronic diseases of the lungs and bronchi, but it is specially apt to arise in an extensive form from pre-existing catarrhal pneumonia, and not unfrequently occurs in connexion with occupations which necessitate the habitual inhalation of particles of dust, such as those of colliers, flax-dressers, stonemasons, millers, &c., to which the term pneumonokoniosis is now applied (including anthracosis, siderosis, chalicosis and the so-called "grinder's rot").

The symptoms are very similar to those of chronic phthisis (see TUBERCULOSIS), especially increasing difficulty of breathing, particularly on exertion, cough either dry or with expectoration, sometimes copious and fetid. In the case of coal-miners the sputum is black from containing carbonaceous matter. The physical signs are deficient expansion of the affected side—the disease being mostly confined to one lung—increasing dullness on percussion, tubular breathing and moist sounds. As the disease progresses retraction of the side becomes manifest, and the heart and liver may be displaced. Ultimately the condition, both as regards physical signs and symptoms, takes the characters of the later stages of pulmonary phthisis with colliquative symptoms, increasing emaciation and death. Occasionally dropsy is present from the heart becoming affected in the course of the disease. The malady is usually of long duration, many cases remaining for years in a stationary condition and even undergoing temporary improvement in mild weather, but the tendency is on the whole downward.

See Allbutt and Rolleston, *System of Medicine* (1909); R. W. Allen, *Vaccine Therapy and the Opsonic Method of Treatment* (1908); Osler, *Practice of Medicine* (1909); *The Practitioner* (May 1908); *Clinical Journal* (Jan. 1908); *American Journal of the Medical Sciences* (Jan. 1908); W. C. Bosanquet and J. Eyre, *Serums, Vaccines and Toxines* (1909).

PNOM-PENH, a town of French Indo-China, capital, since 1866, of the protectorate of Cambodia and seat of the resident-superior. Pop. about 60,000, consisting of Cambodians, Annamese, Chinese, Malays, Indians and about 600 Europeans. It is situated on the Mekong about 173 m. from its mouth at the point where it divides into two arms and is joined by the branch connecting it with the Great Lake (Tonlé-Sap). Its position makes it the market for the products of Cambodia, Laos, Upper Burma and part of Siam (dried fish, rice, cotton, indigo, cardamoms, &c.) The town is lighted by electricity. The palace of the king of Cambodia occupies a large space in the Cambodian quarter. The town gets its name from the Pnôm, a central hill surmounted by an ancient pagoda.

PO (anc. *Padus*, Gr. Πάδος), a river of northern Italy, and the largest in the whole country, with a total length of about 310 m. direct from the source to the mouth, but, including its many windings, of some 417 m. The navigable portion from Casale Monferrato to the mouth is 337 m.; the minimum width of this portion 656 ft., and its minimum depth 7 ft. Owing to the prevalence of shallows and sandbanks, navigation is difficult.

The Po is the dominating factor in north Italian geography, north Italy practically consisting of the Po basin, with the surrounding slopes of the Alps and Apennines. For a description of its course, and a list of its principal tributaries see ITALY. The area of its basin, which includes portions of Switzerland and Austria, is estimated at 26,798 sq. m.

In the first 21 m. of its course, down to Revello (west of Saluzzo), the Po descends no less than 5250 ft., or a fall of 47·3: 1000, forming a very remarkable contrast to its fall lower down. From the confluence of the Ticino its fall is about 0·3:1000; from the beginning of the delta below Ferrara, 0·08:1000. At Turin it has an average width of 400 to 415 ft., a mean depth of $3\frac{1}{2}$ to $5\frac{1}{2}$ ft., and a velocity of 1 to 3 ft. in the second. The mean depth from the confluence of the Ticino (altitude 217 ft.) downwards is 6 to 15 ft. The river is embanked from Piacenza, and continuously from Cremona, the total length of the embankments exceeding 600 m. Owing to its confinement between these high banks, and to the great amount of sedimentary matter which the river brings down with it, its bed has been gradually raised, so that in its lower course it is in many places above the level of the surrounding country. A result of confining the stream between its containing banks is the rapid growth of the delta. Lombardini calculated that the annual increase in the area of the Po delta during the period 1300 to 1600 amounted to 127 acres; but during the period 1600 to 1830 it rose to 324 acres. Marinelli [1] estimated that between the years 1823 and 1893 the annual increase was at the average rate of 173 to 175 acres, and the total accretion at about 20 sq. m.; and the total area of inundated land north and south of the delta at nearly 60 sq. m.[1] He further estimated that the Po della Maestra advances 282 ft. annually, the Po delle Tolle 262 ft., the Po della Gnocca $111\frac{1}{2}$ ft., and the Po di Goro 259 ft. The low ground between the lower Po and the lower Adige and the sea is known as Polesine, a name the derivation of which is much discussed. It is generally applied only to the province of Rovigo, but is sometimes extended to the neighbourhood of Adria and Ferrara. All along its course from Chivasso (below Turin) down to the delta the river is connected with several of its tributaries by canals, and at the same time other canals connect the tributaries and carry off their waters and the waters of the Po purely for purposes of irrigation.

The researches of Helbig (*Die Italiker in der Po-Ebene*, Leipzig, 1879) show that the lower valley of the Po was at an early period occupied by people of the Palaeolithic and Neolithic stages of civilization, who built houses on piles along the swampy borders of the streams. It is possible that even they may have begun by crude dikes the great system by which the waters are now controlled; at least it is certain that these works date their origin from pre-Roman antiquity. Pliny refers them to the Etruscans. The reclaiming and protecting of the riparian lands went on rapidly under the Romans, and in several places the rectangular divisions of the ground, still remarkably distinct, show the military character of some of the agricultural colonies. During the time of the barbarian invasions much of the protective system was allowed to fall into decay; but the latter part of the middle ages saw the works resumed with great energy, so that the main features of the present arrangement were in existence by the close of the 15th century.

The earlier Roman writers speak of the region between the northern boundaries of Etruria and Umbria and the Alps as Gallia Cisalpina. It was separate from Italy proper, the Aesis first and then the Rubicon being the boundary on the east, and the Arnus the boundary on the west, so that, for example, Luca remained outside the boundaries of Italy proper, even in 89 B.C. Romanization had, however, progressed considerably, the foundation of colonies and the construction of roads had gone on during the 2nd century, and the whole district as far as the Padus was given the Roman franchise in 89 B.C., while the Transpadanes received Latin rights, and were fully enfranchised forty years later. Cisalpine Gaul was apparently formed into a province by Sulla in 81 B.C. and continued to be so until the fall of the Republic.

The Ligurian name of the Po was Bodincus or Bodencus, *i.e.* the bottomless. The name Padus was taken from the Celts or the Veneti. Thus we find Bodincomagus as a town name (Industria) on the upper course, and Παδόα (Padua, *Catull.* 95, 7) as a name of one of the mouths of the river. The name Ἠριδανός (Eridanus) of Greek poetry was identified with it at a comparatively late period.

POACH (probably from Fr. *poche*, bag, or Eng. "poke," thrust into), to trespass on private property in pursuit of game or fish; also, generally, to catch game or fish by means or at times not permitted by the law, or in an unsportsmanlike manner (see GAME LAWS). The etymology is rather obscure, but as used in the independent sense of "poaching" an egg, *i.e.* cooking by breaking into boiling water, the word appears to be from the same original.

POBÊDONOSTSEV, CONSTANTINE PETROVICH (1827–1907), Russian jurist, state official, and writer on philosophical and literary subjects. Born in Moscow in 1827, he studied at the School of Law in St Petersburg, and entered the public service as an official in one of the Moscow departments of the senate. From 1860 to 1865 he was professor of Russian civil law in the Moscow University, and instructed the sons of Alexander II. in the theory of law and administration. In 1868 he became a senator in St Petersburg, in 1872 a member of the council of the empire, and in 1880 chief procurator of the Holy Synod. He always showed himself an uncompromising Conservative, and never shrank from expressing boldly his opinions. Consequently, in the so-called Liberal camp he was always denounced an an "obscurantist" and an enemy of progress. In the early years of the reign of Alexander II. (1855–1881), Pobêdonostsev maintained, though keeping aloof from the Slavophils, that Occidental institutions were radically bad in themselves and totally inapplicable to Russia. Parliamentary methods of administration, modern judicial organization and procedure, trial by jury, freedom of the press, secular education—these were among the principal objects of his aversion. He subjected all of them to a severe analysis in his *Reflections of a Russian Statesman* (English by R. C. Long, London, 1898). To these dangerous products of Occidental rationalism he found a counterpoise in popular *vis inertiae*, and in the respect of the masses for institutions developed slowly and automatically during the past centuries of national life. Among the practical deductions drawn from these premisses is the necessity of preserving the autocratic power, and of fostering among the people the traditional veneration for the ritual of the national Church. In the sphere of practical politics he exercised considerable influence by inspiring and encouraging the Russification policy of Alexander III. (1881–1894), which found expression in an administrative Nationalist propaganda and led to a good deal of religious persecution. After the death of Alexander III. he lost much of his influence, for Nicholas II., while clinging to his father's Russification policy and even extending it to Finland, disliked the idea of systematic religious persecution, and was not wholly averse from the partial emancipation of the Russian Church from civil control. During the revolutionary tumult which followed the disastrous war with Japan Pobêdonostsev, being nearly 80 years of age, retired from public affairs. He died on the 23rd of March 1907.

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[1] See G. Marinelli, in *Atti inst. veneto sci.*, 8th series, vol. viii. (1896–1897); and "L'Accrescimento del Delta del Po nel Secolo XIX.," in *Riv. Georg. Ital.* (1898), vol. v.

POCHARD, POCKARD, or POKER,[1] names properly belonging to the male of a species of duck (the female of which is known as the Dunbird), the *Anas ferina* of Linnaeus, and *Nyroca ferina* of later ornithologists—but names very often applied by writers in a general way to most of the group or sub-family *Fuligulinae*, commonly called Diving or Sea-Ducks (see DUCK). The Pochard in full plumage is a very handsome bird, with a coppery-red head, on the sides of which sparkle the ruby irides of his eyes, relieved by the greyish-blue of the basal half of his broad bill, and the deep black of his breast, while his back and flanks appear of a light grey, being really of a dull white closely barred by fine undulating black lines. The tail-coverts both above and below are black, the quill feathers brownish-black, and the lower surface of a dull white. The Dunbird has the head and neck reddish-brown, with ill-defined whitish patches on the cheeks and chin; the back and upper tail-coverts are dull brown, and the rest of the plumage, except the lower tail-coverts, which are brownish-grey, resembles that of the Pochard. This species is very abundant in many parts of Europe, northern Asia, and North America, generally frequenting in winter the larger open waters, and extending its migrations to Barbary and Egypt, but in summer retiring northward and inland to breed. The American Pochard is slightly larger, has yellow eyes, and is now regarded as specifically distinct under the name of *Nyroca americana*; but America has a perfectly distinct though allied species in the celebrated canvas-back duck, *N. vallisneria*, a much larger bird, with a longer, higher and narrower bill, which has no blue at the base, and, though the plumage of both, especially in the females, is very similar, the male canvas-back has a darker head, and the black lines on the back and flanks are much broken up and farther asunder, so that the effect is to give these parts a much lighter colour, and from this has arisen the bird's common though fanciful name. Its scientific epithet is derived from the fresh-water plant, a species of *Vallisneria*, usually known as "wild celery," from feeding on which its flesh is believed to acquire the delicate flavour that is held in so great a repute. The Pochard and Dunbird in Europe are in much request for the table (as the German name of the species, *Tafelente*, testifies) when they frequent fresh-water; birds killed on the seacoast are so rank as to be almost worthless.

Among other species nearly allied to the Pochard that frequent the northern hemisphere may be mentioned the Scaup-Duck, *Fuligula marila*, with its American representative *F. affinis*, in both of which the male has the head black, glossed with blue or green; but these are nearly always uneatable from the nature of their food, which is mostly gathered at low tide on the "scaups" or "scalps,"—as the banks on which mussels and other marine molluscs grow are in many places termed. Then there are the Tufted Duck, *F. cristata*—black with a crest and white flanks—and its American equivalent *F. collaris*, and the White-eyed Pochard, *F. nyroca*, and the Red-crested Pochard, *F. rufina*—both peculiar to the Old World, and well known in India. In the southern hemisphere the genus is represented by three species, *F. capensis*, *F. australis* and *F. novae-zealandiae*, whose respective names indicate the country each inhabits, and in South America exists a somewhat divergent form which has been placed in a distinct genus as *Metopiana peposaca*.

Generally classed with the *Fuligulinae* is the small group known as the Eiders, which differ from them in several respects: the bulb at the base of the trachea in the male, so largely developed in the members of the genus *Fuligula*, is here much smaller and wholly of bone; the males take a much longer time, two or even three years, to attain their full plumage, and some of the feathers on the head, when that plumage is completed, are always stiff, glistening and of a peculiar pale-green colour. This little group of hardly more than half a dozen species may be fairly considered to form a separate genus under the name of *Somateria*. Many authors indeed have—unjustifiably, as it seems to the present writer—broken it up into three or four genera. The well-known Eider, *S. mollissima*, is the largest of this group, and, beautiful as it is, is excelled in beauty by the King-Duck, *S. spectabilis*, and the little *S. stelleri*. A most interesting form generally, but obviously in error, placed among them, is the Logger-head, Racehorse or Steamer-Duck, *Micropterus* (or more probably *Tachyeres*) *cinereus* of Chile, the Falkland Islands and Straits of Magellan—nearly as large as a tame goose, and subject to the, so far as known, unique peculiarity of losing its power of flight after reaching maturity. Its habits have been well described by C. Darwin in his *Journal of Researches*, and its anatomy is the subject of an excellent paper in the Zoological Society's *Transactions* (vii. 493–501, pls. lviii.–lxii.) by R. O. Cunningham. (A. N.)

POCKET, a small bag, particularly a bag-like receptacle either fastened to or inserted in an article of clothing. As a measure of capacity "pocket" is now only used for hops; it equals 168 ℔. The word appears in Mid. Eng. as *poket*, and is taken from a Norman diminutive of O. Fr. *poke*, *pouque*, mod. *poche*, cf. "pouch." The form "poke" is now only used dialectically, or in such proverbial sayings as a "pig in a poke," and possibly in the "poke-bonnet," the coal-scuttle bonnet fashionable during the first part of the 19th century, and now worn by the female members of the Salvation Army; more probably the name of the bonnet is connected with "poke," to thrust forward, dig. The origin of this is obscure. Dutch has *poken*, *pook*, a dagger; Swedish *påk*, a stick.

POCKET-GOPHER (*i.e.* pouched rat), the name of a group of, chiefly North, American rat-like rodents, characterized by the possession of large cheek-pouches, the openings of which are external to the mouth; while their inner surface is lined with fur. The cheek-teeth, which comprise two pairs of premolars and three of molars in each jaw, are in the form of simple prisms of enamel, which do not develop roots. The fore and hind limbs are of approximately equal length, but the second and third front-claws are greatly enlarged, and all the claws are furnished at the base with bristles. The eyes are small, and the external ears rudimentary.

Pocket-gophers, which typify a family, the *Geomyidae*, spend the whole of their time underground, and are specially organized for such a mode of existence, their powerful claws being adapted for digging, while the bristles on the toes prevent the earth from passing between them. The upper incisor teeth are employed to loosen the ground, like a fork; and the little rodents are able to move both backwards and forwards in their runs. The cheek-pouches are employed solely in carrying food, which consists largely of roots. In the typical genus *Geomys* the upper incisors are grooved, but in the allied *Thomomys* they are smooth. The common pocket-gopher, *Geomys bursarius*, of the Mississippi Valley measures about 8 in. in length, with a tail of between 2 and 3 in.; its colour being rufous brown and greyish beneath. A well-known representative of the second genus is *Thomomys talpoides*, which is considerably smaller than the former. To the farmer and the gardener pocket-gophers are an unmitigated source of annoyance. (See RODENTIA.)

POCKET-MOUSE, the name of a number of small jerboa-like, chiefly North, American rodents belonging to the family *Geomyidae*, and constituting the genus *Perognathus* and *Heteromys*. They are nearly allied to the American kangaroo-rats (see

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[1] The derivation of these words, in the first of which the *ch* is pronounced hard (though Dr Johnson made it soft), and the *o* in all of them generally long, is very uncertain. Cotgrave has *pocheculier* (modern French *poche-cuiller*), which he renders "Shoueler," nowadays the name of a kind of duck, but in his time meaning the bird we commonly call Spoonbill (*q.v.*). Littré gives *pochard* as a popular French word signifying drunkard.

Kangaroo-Rat), but differ in having rooted molar teeth. The typical pocket-mouse *P. fasciatus*, which is a native of Montana, Missouri, and Wyoming, is a sandy-coloured rodent marked with black lines above and with white beneath, and measuring about 6 in. in length, this length being equally divided between the head and body and the tail. (See Rodentia.)

POCOCK, SIR GEORGE (1706–1792), British admiral, son of Thomas Pocock, chaplain in the navy, was born on the 6th of March 1706, and entered the navy under the protection of his maternal uncle, Captain Streynsham Master (1682–1724), in the "Superbe" in 1718. He became lieutenant in April 1725, commander in 1733, and post-captain in 1738. After serving in the West Indies he was sent to the East Indies in 1754 as captain of the "Cumberland" (58) with Rear-Admiral Charles Watson (1714–1757). Watson's squadron co-operated with Clive in the conquest of Bengal. In 1755 Pocock became rear-admiral, and was promoted vice-admiral in 1756. On the death of Watson he took the command of the naval forces in the eastern seas. In 1758 he was joined by Commodore Charles Steevens (d. 1761), but the reinforcement only raised the squadron to seven small line-of-battle ships. War being now in progress between France and England the French sent a naval force from their islands in the Indian Ocean into the Bay of Bengal to the assistance of Pondicherry. To intercept the arrival of these reinforcements for the enemy now became the object of Pocock. The French force was indeed of less intrinsic strength than his own. Count D'Aché (1700?–1775), who commanded, had to make up his line by including several Indiamen, which were only armed merchant ships. Yet the number of the French was superior and Pocock was required by the practice of his time to fight by the old official fighting instructions. He had to bring his ships into action in a line with the enemy, and to preserve his formation while the engagement lasted. All Pocock's encounters with D'Aché were indecisive. The first battle, on the 29th of April 1758, failed to prevent the Frenchmen from reaching Pondicherry. After a second and more severe engagement on the 3rd of August, the French admiral returned to the Mauritius, and when the monsoon set in Pocock went round to Bombay. He was back early in spring, but the French admiral did not return to the Bay of Bengal till September. Again Pocock was unable to prevent his opponent from reaching Pondicherry, and a well-contested battle between them on the 10th of September 1759 proved again indecisive. The French government was nearly bankrupt, and D'Aché could get no stores for his squadron. He was compelled to return to the islands, and the English were left in possession of the Coromandel and Malabar coasts. Pocock went home in 1760, and in 1761 was made Knight of the Bath and admiral. In 1762 he was appointed to the command of the naval forces in the combined expedition which took Havana. The siege, which began on the 7th of June, and lasted till the 13th of August, was rendered deadly by the climate. The final victory was largely attributable to the vigorous and intelligent aid which Pocock gave to the troops. His share in the prize money was no less than £122,697. On his return to England Pocock is said to have been disappointed because another officer, Sir Charles Saunders (1713–1775), was chosen in preference to himself as a member of the admiralty board, and to have resigned in consequence. It is certain that he resigned his commission in 1766. He died on the 3rd of April 1792. His monument is in Westminster Abbey.

POCOCKE, EDWARD (1604–1691), English Orientalist and biblical scholar, was born in 1604, the son of a Berkshire clergyman, and received his education at the free school of Thame in Oxfordshire and at Corpus Christi College, Oxford (scholar in 1620, fellow in 1628). The first-fruit of his studies was an edition from a Bodleian MS. of the four New Testament epistles (2 Peter, 2 and 3 John, Jude) which were not in the old Syriac canon, and were not contained in European editions of the Peshito. This was published at Leiden at the instigation of G. Vossius in 1630, and in the same year Pococke sailed for Aleppo as chaplain to the English factory. At Aleppo he made himself a profound Arabic scholar, and collected many valuable MSS. At this time Wm. Laud was bishop of London and chancellor of the university of Oxford, and Pococke became known to him as one who could help his schemes for enriching the university. Laud founded an Arabic chair at Oxford, and invited Pococke home to fill it, and he entered on his duties on the 10th of August 1636; but next summer he sailed again for Constantinople to prosecute further studies and collect more books, and remained there for about three years. When he returned to England Laud was in the Tower, but had taken the precaution to place the Arabic chair on a permanent footing. Pococke does not seem to have been an extreme churchman or to have meddled actively in politics. His rare scholarship and personal qualities raised him up influential friends among the opposite party, foremost among these being John Selden and John Owen. Through their offices he was even advanced in 1648 to the chair of Hebrew, though as he could not take the engagement of 1649 he lost the emoluments of the post soon after, and did not recover them till the Restoration. These cares seriously hampered Pococke in his studies, as he complains in the preface to his *Eutychius*; he seems to have felt most deeply the attempts to remove him from his parish of Childrey, a college living which he had accepted in 1643. In 1649 he published the *Specimen historiae arabum*, a short account of the origin and manners of the Arabs, taken from Barhebraeus (Abulfaragius), with notes from a vast number of MS. sources which are still valuable. This was followed in 1655 by the *Porta Mosis*, extracts from the Arabic commentary of Maimonides on the Mishna, with translation and very learned notes; and in 1656 by the annals of *Eutychius* in Arabic and Latin. He also gave active assistance to Brian Walton's polyglot bible, and the preface to the various readings of the Arabic Pentateuch is from his hand. After the Restoration Pococke's political and pecuniary troubles were removed, but the reception of his *Magnum opus*—a complete edition of the Arabic history of Barhebraeus (*Greg. Abulfaragii historia compendiosa dynastiarum*), which he dedicated to the king in 1663, showed that the new order of things was not very favourable to profound scholarship. After this his most important works were a *Lexicon heptaglotton* (1669) and English commentaries on Micah (1677), Malachi (1677), Hosea (1685) and Joel (1691), which are still worth reading. An Arabic translation of Grotius's *De veritate*, which appeared in 1660, may also be mentioned as a proof of Pococke's interest in the propagation of Christianity in the East. This was an old plan, which he had talked over with Grotius at Paris on his way back from Constantinople. Pococke married in 1646, and died in 1691. One of his sons, Edward (1648–1727), published several contributions to Arabic literature—a fragment of Abdallatif's description of Egypt and the *Philosophus autodidactus* of Ibn Tufail.

The theological works of Pococke were collected, in two volumes, in 1740, with a curious account of his life and writings by L. Twells.

PODĚBRAD, GEORGE OF (1420–1471), king of Bohemia, was the son of Victoria of Kunstat and Poděbrad, a Bohemian nobleman, who was one of the leaders of the "Orphans" or modern Taborites during the Hussite wars. George himself as a boy of fourteen took part in the great battle of Lipan, which marks the downfall of the more advanced Taborites. Early in life, as one of the leaders of the Calixtine party, he defeated the Austrian troops of the German King Albert II., son-in-law and successor of King Sigismund. He soon became a prominent member of the national or Calixtine party, and after the death of Ptacek of Pirkstein its leader. During the minority of Ladislas, son of Albert, who was born after his father's death, Bohemia was divided into two parties—the Romanist or Austrian one, led by Ulrich von Rosenberg (1403–1462), and the national one, led by Poděbrad. After various attempts at reconciliation, Poděbrad decided to appeal to the force of arms. He gradually raised an armed force in north-eastern Bohemia, where the Calixtine cause had most adherents and where his ancestral castle was situated. With this army, consisting of about 9000 men, he marched in 1448 from Kutna Hora to Prague, and obtained possession of the capital almost without resistance. Civil war, however, broke out, but Podĕbrad succeeded in defeating the Romanist nobles. In 1451 the emperor Frederick III., as guardian of the young king Ladislas, entrusted Podĕbrad with the administration of Bohemia. In the same year a diet assembled at Prague also conferred on Podĕbrad the regency. The struggle of the Bohemians against Rome continued uninterruptedly, and the position of Podĕbrad became a very difficult one when the young king Ladislas, who was crowned in 1453, expressed his sympathies for the Roman Church, though he had recognized the compacts and the ancient privileges of Bohemia. In 1457 King Ladislas died suddenly, and public opinion from an early period accused Podĕbrad of having poisoned him. The Bohemian historian, Palacky, fifty years ago thoroughly disproved this accusation, and, though it has recently been revived by German historians, it must undoubtedly be considered as a calumny. On the 27th of February 1458 the estates of Bohemia unanimously chose Podĕbrad as king; even the adherents of the Austrian party voted for him, not wishing at that moment to oppose the popular feeling, which demanded the election of a national sovereign. A year after the accession of Podĕbrad Pius II. (Aeneas Sylvius) became pope, and his incessant hostility proved one of the most serious obstacles to Podĕbrad's rule. Though he rejected the demand of the pope, who wished him to consent to the abolition of the compacts, he endeavoured to curry favour with the Roman see by punishing severely all the more advanced opponents of papacy in Bohemia. Podĕbrad's persecution of the newly-founded community of the Bohemian brethren is certainly a blemish on his career. All Podĕbrad's endeavours to establish peace with Rome proved ineffectual, and though the death of Pius II. prevented him from carrying out his planned crusade against Bohemia, his successor was a scarcely less bitter enemy of the country. Though the rule of Podĕbrad had proved very successful and Bohemia had under it obtained a degree of prosperity which had been unknown since the time of Charles IV., the Calixtine king had many enemies among the Romanist members of the powerful Bohemian nobility. The malcontent nobles met at Zelena Hora (Grüneberg) on the 28th of November 1465, and concluded an alliance against the king, bringing forward many—mostly untrue—accusations against him. The confederacy was from its beginning supported by the Roman see, though Podĕbrad after the death of his implacable enemy, Pius II., attempted to negotiate with the new pope, Paul II. These negotiations ended when the pontiff grossly insulted the envoys of the king of Bohemia. On the 23rd of December 1466 Paul II. excommunicated Podĕbrad and pronounced his deposition as king of Bohemia, forbidding all Romanists to continue in his allegiance. The emperor Frederick III., and King Matthias of Hungary, Podĕbrad's former ally, joined the insurgent Bohemian nobles. King Matthias conquered a large part of Moravia, and was crowned in the capital of that country, Brno (Brünn), as king of Bohemia on the 3rd of May 1469. In the following year Podĕbrad was more successful in his resistance to his many enemies, but his death on the 22nd of March 1471 put a stop to the war. In spite of the misfortunes of the last years of his reign, Podĕbrad's memory has always been cherished by the Bohemians. He was the only king of Bohemia who belonged to that nation, and the only one who was not a Roman Catholic.

See H. Markgraf, *Über das Verhältniss des Königs Georg von Podĕbrad zu Papst Pius II.* (1867); Jordan, *Das Königthum Georgs von Podĕbrad* (1861); A. Bachmann, *Ein Jahr böhmischer Geschichte* (1876), and *Urkunden . . . zur oesterreichischen Geschichte . . . im Zeitalter Georgs von Podĕbrad* (1879); E. W. Kanter, *Die Ermordung König Ladislaus* (1906); Novotry, *Über den Tod König Ladislaws Postumus* (1906). All histories of Bohemia, particularly that of F. Palacky (1836–1867), contain detailed accounts of the career of King George of Podĕbrad. (L.)

PODESTÀ (Lat. *potestas*, power), the name given during the later middle ages to a high official in many Italian cities. Podestàs or rectors were first appointed by the emperor Frederick I. when about 1158 he began to assert his Imperial rights over the cities of northern Italy. Their business was to enforce these rights; from the first they were very unpopular, and their arbitrary behaviour was a factor in bringing about the formation of the Lombard league and the rising against Frederick in 1167.

Although the emperor's experiment was short-lived podestàs soon became general in northern Italy, making their appearance in most communes about 1200. These officials, however, were now appointed by the citizens or by their representatives. They exercised the supreme power in the city, both in peace and war, both in foreign and domestic matters, but they only held office for a period of a year. In order to avoid the intestine strife so common in Italian civic life, it soon became the custom to select a stranger to fill this position. Venetians were in special request for this purpose during the 12th and 13th centuries, probably because at this time, at least, they were less concerned than other Italians in the affairs of the mainland. Afterwards in a few cases the term of office was extended to cover a period of years, or even a lifetime.

During the later part of the 12th and the whole of the 13th century most of the Italian cities were governed by podestàs. Concerning Rome, Gregorovius says that in 1205 "the pope changed the form of the civic government; the executive power lying henceforward in the hand of a single senator or podestà, who, directly or indirectly, was appointed by the pope." In Florence soon after 1180 the chief authority was transferred from the consuls to the podestà, and Milan and other cities were also ruled by these officials. There were, moreover, podestàs in some of the cities of Provence. Gradually the podestàs became more despotic and more corrupt, and sometimes a special official was appointed to hear complaints against them; in the 13th century in Florence and some other cities a *capitano del popolo* was chosen to look after the interests of the lower classes. In other ways also the power of the podestàs was reduced; they were confined more and more to judicial functions until they disappeared early in the 16th century.

The officials who were sent by the Italian republics to administer the affairs of dependent cities were sometimes called podestàs. At the present day the cities of Trent and Trieste give the name of podestà to their chief magistrate.

The example of Italy in the matter of podestàs was sometimes followed by cities and republics in northern Europe in the middle ages, notably by such as had trade relations with Italy. The officers thus elected sometimes bore the title of *podestà* or *podestat*. Thus in East Friesland there were podestàs identical in name and functions with those of the Italian republics; sometimes each province had one, sometimes the federal diet elected a podestà-general for the whole country, the term of office being for a limited period or for life (see J. L. Motley, *Dutch Republic*, i. 44, ed. 1903).

Lists of the Italian podestàs are given in Stokvis, *Manuel d'histoire*; vol. iii. (Leiden, 1889). See also W. F. Butler, *The Lombard Communes* (1906).

PODGORITSA (Croatian, *Podgorica*), the largest town in Montenegro; on the left bank of the river Moracha, and in a fertile valley which strikes inland for 18 m. from the shores of Lake Scutari to the mountains of central and eastern Montenegro. Pop. (1900), about 5500. Spread out on a perfectly flat plain, Podgoritsa has two distinct parts: the picturesque Turkish quarter, with its mosques and ruined ramparts, and the Montenegrin quarter, built since 1877, and containing a prison and an agricultural college. These quarters are separated by the river Ribnitsa, a tributary of the Moracha. A fine old Turkish bridge crosses the main stream. Podgoritsa receives from the eastern plains and the north-eastern highlands a great quantity of tobacco, fruit, cereals, honey, silk, livestock and other commodities, which it distributes through Plavnitsa, its port on Lake Scutari, and through Riyeka to Cettigne and Cattaro. After being captured from Turkey in 1877, Podgoritsa was in 1878 recognized as Montenegrin territory by the Treaty of Berlin.

PODIUM (Gr. πόδιον, diminutive of πούς, foot), the name in architecture for a continuous pedestal, or low wall on which columns are carried, consisting of a cornice or capping, a dado or die, and a moulded plinth. In the Etruscan and Roman temples the whole structure was raised on a podium, with a flight of steps on the principal front, enclosed between the prolongation of the podium wall.

PODOLIA, a government of south-western Russia, having Volhynia on the N., Kiev and Kherson on the E. and S., Bessarabia on the S.W., and Galicia (Austria) on the W., from which it is separated by the Zbrucz, or Rodvocha, a tributary of the Dniester. It has an area of 16,219 sq. m., extending for 200 m. from N.W. to S.E. on the left bank of the Dniester. In the same direction the government is traversed by two ranges of hills separated by the Bug, ramifications of the Avratynsk heights. These hills nowhere exceed an elevation of 1185 ft. Two large rivers, which numerous tributaries, drain the government—the Dniester, which forms its boundary with Bessarabia and is navigable throughout its length, and the Bug, which flows almost parallel to the former in a higher, sometimes swampy, valley, and is interrupted at several places by rapids. The Dniester is an important channel for trade, corn, spirits and timber being exported from Mogilev, Kalus, Zhvanets, Porog and other Podolian river-ports. The rapid smaller tributaries of the Dniester supply numerous flour-mills with motive power. The soil is almost throughout "black earth," and Podolia is one of the most fertile governments of Russia. Forests cover nearly 15% of the total area. Marshes occur only beside the Bug. The climate is moderate, the average temperature of the year at Kamenets being 48·3° (24·5° in January, 69° in July).

The estimated population in 1906 was 3,543,700. It consists chiefly of Little Russians, Poles (3½%), and Jews (12%). There are besides a few Armenians, some Germans, and 50,000 Moldavians. There are many Nonconformists (18,000) among the Russians, Tulchin being the seat of their bishops and a centre of propaganda. After Moscow, Podolia is the most densely inhabited government of Russia outside Poland. It is divided into twelve districts, the chief towns of which are Kamenets-Podolskiy, the capital, Balta, Bratslav, Gaisin, Letichev, Litin, Mogilev-on-Dniester, Novaya-Ushitsa, Olgopol, Proskurov, Vinnitsa and Yampol. The chief occupations of the people are agriculture and gardening. The principal crops are wheat, rye, oats, barley, maize, hemp, flax, potatoes, beetroot and tobacco. Podolia is famous for its cherries and mulberries, its melons, gourds and cucumbers. Nearly 67,000 gallons of wine are obtained annually. Large numbers of horses, cattle and sheep are bred, the cattle being famous. Bee-keeping is an important industry. Sugar factories, distilleries, flour-mills, woollen mills, tanneries, potteries, tobacco factories, breweries, candle and soap factories, have an annual output valued at £4,000,000. An active trade is carried on with Austria, especially through the Isakovets and Gusyatin custom-houses, corn, cattle, horses, skins, wool, linseed and hemp seed being exported, in exchange for wooden wares, linen, woollen stuffs, cotton, glass and agricultural implements. The trade with the interior is also carried on very briskly, especially at the twenty-six fairs, the chief of which are Balta and Yarmolintsy. Podolia is traversed by a railway which runs parallel to the Dniester, from Lemberg to Odessa, and has two branch lines, to Kiev (from Zhmerinka) and to Poltava (from Balta).

History.—The country has been inhabited since the beginning of the Neolithic period. Herodotus mentions it as the seat of the Graeco-Scythian Alazones and the Scythian Neuri, who were followed by the Dacians and the Getae. The Romans left traces of their rule in the Wall of Trajan, which stretches through the modern districts of Kamenets, Ushitsa and Proskurov. During the great migrations many nationalities passed through this territory, or settled within it for some time, leaving traces in numerous archaeological remains. Nestor mentions that the Bujanes and Dulebes occupied the Bug, while the Tivertsi and Ugliches, apparently all four Slav tribes, were settled on the Dniester. These peoples were conquered by the Avars in the 7th century. Oleg, prince of Kiev, extended his rule over this territory—the *Ponizie*, or "lowlands," which became later a part of the principalities of Volhynia, Kiev and Galicia. In the 13th century the Ponizie was plundered by the Mongols; a hundred years afterwards Olgierd, prince of Lithuania, freed it from their rule, annexing it to his own territories under the name of Podolia, a word which has the same meaning as Ponizie. After the death (1430) of the Lithuanian prince Vitovt, Podolia was annexed to Poland, with the exception of its eastern part, the province of Bratslav, which remained under Lithuania until its union (1501) with Poland. The Poles retained Podolia until the third division of their country in 1793, when it was taken by Russia. (P. A. K.; J. T. Be.)

PODOLSK, a town of Russia, in the government of Moscow, 26 m. S. of the city of Moscow, at the junction of the two main roads from Moscow to the Crimea and to Warsaw. Pop. (1881), 11,000; (1897), 3808. It is picturesquely built on the hilly banks of the Pakhra, here crossed by a suspension bridge for carriages as well as by the railway bridge. Down to 1781 the wealthy village of Podol was a dependency of the Danilov monastery in Moscow. Before the opening of the southern railway the caravans of wagons and sledges to and from Moscow used to halt here; the principal occupation of the inhabitants was innkeeping and supplying the caravans with provisions and other necessaries of travel. The limestone quarries, at the confluence of the Desna and the Pakhra, supply the capital with good building material; and there are a cement, lime and brick factory and a paper-mill.

PODOPHYLLIN, a drug obtained from the rhizome of the American mandrake or may apple, *Podophyllum peltatum*, an herbaceous perennial belonging to the natural order Berberidaceae, indigenous in woods in Canada and the United States. The plant is about 1 ft. high, bearing two peltate, deeply-divided leaves, which are about 5 in. in diameter, and bear in the axil a solitary, stalked, white flower, about the size and shape of the garden anemone, with six or more petals and twice as many hypogynous stamens. The fruit is ripe in July, and is an oval, yellowish, fleshy berry, containing twelve or more seeds, each surrounded by a pulpy outer coat or aril. The rhizome, as met with in commerce, occurs in cylindrical pieces 2 or 3 in. long and about ¼ in. in diameter, of a chocolate or purplish-brown colour, smooth, and slightly enlarged where the juncture of the leafy stem is indicated by a circular scar on the upper and a few broken rootlets on the under side. The odour is heavy and disagreeable, and the taste acrid and bitter.

Podophyllin is a resinous powder obtained by precipitating an alcoholic tincture of the rhizome by means of water acidulated with hydrochloric acid. It varies in colour from greyish to bright yellow or greenish-brown, the first-named being the purest. The powder is soluble in alcohol and strong solutions of alkalis, such as ammonia. Its composition is somewhat complex. There are certainly at least two resins in the powder (which is known officially as *Podophylli resina*), one of them being soluble and the other insoluble in ether. Each of these contains an active substance, which can be obtained in crystalline form, and is known as podophyllotoxin. It is soluble in alcohol, ether, chloroform and boiling water. Alkalis decompose it into picro-podophyllic acid and picro-podophyllin, minute traces of both of which occur in a free state in the rhizome. The acid is inert, but picro-podophyllin is the active principle. It is a crystalline body, soluble only in concentrated alcohol. Hence the inutility of the pharmacopeial *tinctura podophylli*, which cannot be diluted before administration. The properties of podophyllin resin vary with the reaction of the tissue with which it is in contact; where this is acid the drug is inert, the picro-podophyllin being precipitated.

The resin does not affect the unbroken skin, but may be absorbed from a raw surface, and will then cause purging. When taken internally it is both a secretory and an excretory cholagogue, but so irritant and powerful that its use in cases of jaundice is generally undesirable. Its value, however, in certain cases of constipation of hepatic origin is undeniable. It is largely used in patent medicines, usually as an auxiliary to aloes. The best method of prescribing podophyllin is in pill form. In toxic doses podophyllin causes intense enteritis, with all its characteristic symptoms, and severe depression, which may end in death. The treatment is symptomatic, there being no specific antidote.

POE, EDGAR ALLAN (1809–1849), American poet, writer of fiction and critic, was born at Boston, Massachusetts, on the 19th of January 1809. The family was of English origin, but was settled in Ireland, whence the poet's great-grandfather emigrated to Maryland. His grandfather, David Poe, served with credit as a soldier in the War of Independence, was known to Washington, and was the friend of Lafayette. His son David Poe was bred as a lawyer, but deeply offended his family by marrying an actress of English birth, Mrs Elizabeth Hopkins, *née* Arnold, and by himself going on the stage. In 1811 he and his wife died, leaving three children—William, Edgar, and a daughter Rosalie—wholly destitute. William died young, and Rosalie became mad. Edgar was adopted by John Allan, a tobacco merchant of Scottish extraction, seemingly at the request of his wife, who was childless. The boy was indulged in every way, and encouraged to believe that he would inherit Mr Allan's fortune. Mr Allan, having come to England in 1815, placed Edgar in a school at Stoke Newington, kept by a Dr Bransby. In 1820 Mr Allan returned to Richmond, Virginia, and Edgar was first placed at school in the town and then sent to the university of Virginia at Charlottesville in 1826. Here the effects of a very unwise training on a temperament of inherited neurotic tendency were soon seen. He was fond of athletics, and was a strong and ardent swimmer; but he developed a passion for gambling and drink. His disorders made it necessary to remove him, and he was taken away by Mr Allan, who refused to pay his debts of honour. He enlisted on the 26th of May 1827 at Boston, and served for two years in the United States army. As a soldier his conduct must have been exemplary, for he was promoted sergeant-major on the 1st of January 1829. It is to be noted that throughout his life, when under orders, Poe could be a diligent and capable subordinate. In May 1829 Mr Allan secured his discharge from the army, and in 1830 obtained a nomination for him to the West Point military academy. As a student he showed considerable faculty for mathematics, but his aloofness prevented him from being popular with his comrades, and he neglected his duty. When court-martialled he made no answer to the charges, and was expelled on the 6th of March 1831. Mr Allan's generosity was now exhausted. The death of his first wife in 1829 had doubtless removed an influence favourable to Poe. A second marriage brought him children, and at his death in 1834 he left his adopted son nothing. A last meeting between the two, shortly before Mr Allan's death, led only to a scene of painful violence.

In 1827 Poe had published his first volume of poetry, *Tamerlane and other Poems*, at Boston. He did not publish under his name, but as "A Bostonian." In 1831 he published a volume of *Poems* under his name at New York. His life immediately after he left West Point is very obscure, but in 1833 he was living at Baltimore with his paternal aunt, Mrs Clemm, who was throughout life his protector, and, in so far as extreme poverty permitted, his support. In 1833 he won a prize of $100 offered for the best story by the Baltimore *Saturday Visitor*. He would have won the prize for the best poem if the judges had not thought it wrong to give both rewards to one competitor. The story, *MS. found in a Bottle*, is one of the most mediocre of his tales, but his success gave him an introduction to editors and publishers, who were attracted by his striking personal appearance and his fine manners, and were also touched by his manifest poverty. From 1833 till his death he was employed on different magazines at Richmond, New York and Philadelphia. His famous poem "The Raven" was published first in 1845, and soon became extraordinarily popular; but Poe only got £2 for it.

The facts of his life have been the subject of very ill-judged controversy. The acrimonious tone of the biography by Rufus Griswold, prefixed to the first collected edition of his works in 1850, gave natural offence, and attempts have been made to show that the biographer was wrong as to the facts. But it is no real kindness to Poe's memory to deny the sad truth that he was subject to chronic alcoholism. He was not a boon companion, and never became callous to his vice. When it seized him he drank raw spirits, and was disordered by a very little. But when he was free from the maddening influence of alcohol he was gentle, well-bred, and a hard worker on the staff of a magazine, willing and able to write reviews, answer correspondents, propound riddles or invent and solve cryptograms. His value as a contributor and sub-editor secured him successive engagements on the *Southern Literary Messenger* of Richmond, on the New York *Quarterly Review*, and on *Graham's Magazine* at Philadelphia. It enabled him in 1843 to have a magazine of his own, the *Stylus*. His mania sooner or later broke off all his engagements and ruined his own venture. In 1835 he married his cousin, Virginia Clemm, a beautiful girl of fourteen years of age. A false statement as to her age was made at the time of the marriage. She died after a long decline in 1847. Poe made two attempts to marry women of fortune—Mrs Whitman and Mrs Shelton. The first of these engagements was broken off. The second was terminated by his death in hospital at Baltimore, Md., on the 7th of October 1849.

His life and death had many precedents, and will always recur among Bohemian men of letters and artists. What was individual in Poe, and what alone renders him memorable, was his narrow but profound and original genius (see AMERICAN LITERATURE). In the midst of much hack-work and not a few failures in his own field he produced a small body of verse, and a handful of short stories of rare and peculiar excellence. The poems express a melancholy sensuous emotion in a penetrating melody all his own. The stories give form to horror and fear with an exquisite exactness of touch, or construct and unravel mysteries with extreme dexterity. He was a conscientious literary artist who revised and perfected his work with care. His criticism, though often commonplace and sometimes ill-natured, as when he attacked Longfellow for plagiarism, was trenchant and sagacious at his best.

BIBLIOGRAPHY.—*The Life and Letters of Edgar Allan Poe*, by J. A. Harrison (New York, 1903) and *The Life of Edgar Allan Poe* (Boston, new ed. 1909), by G. E. Woodberry, are the best biographies. The standard edition of his *Works* is that published in 1894–1895 at Chicago, in ten volumes, by E. C. Stedman and G. E. Woodberry. There have been many partial reprints. For Poe's influence in France, which has been great, see C. Baudelaire, *Histoires extraordinaires* (Paris, 1856); S. Mallarmé, *Poèmes d'Edgar Poe* (Brussels, 1888); and *Les Névrosés*, by Arvède Barine (Paris, 1899). (D. H.)

POERIO, ALESSANDRO (1802–1848), Italian poet and patriot, was descended from an old Calabrian family, his father, Baron Giuseppe Poerio, being a distinguished lawyer of Naples. In 1815 he and his brother Carlo accompanied their father, who had been identified with Murat's cause, into exile, and settled at Florence. In 1818 they were allowed to return to Naples, and on the proclamation of the constitution in 1820 the Poerios were among the stoutest defenders of the newly-won freedom. Allessandro fought as a volunteer, under General Guglielmo Pepe, against the Austrians in 1821, but when the latter reoccupied Naples and the king abolished the constitution, the family was again exiled and settled at Gratz. Alessandro devoted himself to study in various German universities, and at Weimar he became the friend of Goethe. In 1835 the Poerios returned to Naples, and Alessandro, while practising law with his father, published a number of lyrics. In 1848 he accompanied Pepe as a volunteer to fight the Austrians in northern Italy, and on the recall of the Neapolitan contingent Alessandro followed Pepe to Venice and displayed great bravery during the siege. He was severely wounded in the fighting round Mestre, and died on the 3rd of November 1848. His poetry "reveals the idealism of a tender and delicate mind which was diligent in storing up sensations and images that for others would have been at most the transient impressions of a moment." But he could also sound the clarion note of patriotism, as in his stirring poem *Il Risorgimento*.

His brother Carlo (1803–1867), after returning to Naples, practised as an advocate, and from 1837 to 1848 was frequently arrested and imprisoned; but when King Ferdinand, moved by the demonstration of the 27th of January of the latter year, promulgated a constitution, he was made minister of education. Discovering, however, that the king was acting in bad faith, he resigned office in April and returned to Naples to take his seat in parliament, where he led the constitutional opposition. The Austrian victory of Novara (March 1849) set the king free to dissolve parliament and trample on the constitution, and on the 19th of July 1849 Poerio was arrested, tried, and condemned to nineteen years in irons. Chained in pairs, he and other political prisoners were confined in one small room in the bagno of Nisida, near the lazaretto. The eloquent exposure (1851) of the horrors of the Neapolitan dungeons by Gladstone, who emphasized especially the case of Poerio, awakened the universal indignation of Europe, but he did not obtain his liberty till 1858. He and other exiles were than placed on board a ship bound for the United States, but the son of Settembrini, another of the exiles, who was on board in disguise, compelled the crew to land them at Cork, whence Poerio made his way to London. In the following year he returned to Italy, and in 1860 he was elected deputy to the parliament of Turin, of which he was chosen vice-president in 1861. He died at Florence on the 28th of April 1867.

See Baldachini, *Della Vita e de' tempi di Carlo Poerio* (1867); W. E. Gladstone, *Two Letters to the Earl of Aberdeen* (1851); *Carlo Poerio and the Neapolitan Police* (London, 1858); Vannucci, *I Martiri della libertà italiana*, vol. iii. (Milan, 1880); Imbriani, *Alessandro Poerio a Venezia* (Naples, 1884); Del Giudice, *I Fratelli Poerio* (Turin, 1899); Countess Martinengo Cesaresco, *Italian Characters* (London, 1901).

POETRY. In modern criticism the word poetry (*i.e.* the art of the poet, Gr. ποιητής, maker, from ποιεῖν, to make) is used sometimes to denote any expression (artistic or other) of imaginative feeling, sometimes to designate a precise literary art, which ranks as one of the fine arts. As an expression of imaginative feeling, as the movement of an energy, as one of those great primal human forces which go to the development of the race, poetry in the wide sense has played as important a part as science. In some literatures (such as that of England) poetic energy and in others (such as that of Rome) poetic art is the dominant quality. It is the same with individual writers. In classical literature Pindar may perhaps be taken as a type of the poets of energy; Virgil of the poets of art. With all his wealth of poetic art Pindar's mastery over symmetrical methods never taught him to "sow with the hand," as Corinna declared, while his poetic energy always impelled him to "sow with the whole sack." In English poetical literature Elizabeth Barrett Browning typifies, perhaps, the poets of energy; while Keats (notwithstanding all his unquestionable inspiration) is mostly taken as a type of the poets of art. In French literature Hugo, notwithstanding all his mastery over poetic methods, represents the poets of energy.

In some writers, and these the very greatest—in Homer, Aeschylus, Sophocles, Dante, Shakespeare, Milton, and perhaps Goethe—poetic energy and poetic art are seen in something like equipoise. It is of poetry as an art, however, that we have mainly to speak here; and all we have to say upon poetry as an energy is that the critic who, like Aristotle, takes this wide view of poetry—the critic who, like him, recognizes the importance of poetry in its relations to man's other expressions of spiritual force, claims a place in point of true critical sagacity above that of a critic who, like Plato, fails to recognize that importance. And assuredly no philosophy of history can be other than inadequate should it ignore the fact that poetry has had as much effect upon human destiny as that other great human energy by aid of which, from the discovery of the use of fire to that of the electric light, the useful arts have been developed.

With regard to poetry as an art, most of the great poems of the world are dealt with elsewhere in this work, either in connexion with the names of the writers or with the various literatures to which they belong; consequently these remarks must be confined to general principles. Under VERSE the detailed questions of prosody are considered; here we are concerned with the essential principles which underlie the meaning of poetry as such.

All that can be attempted is to inquire: (1) What is poetry? (2) What is the position it takes up in relation to the other arts? (3) What is its value and degree of expressional power in relation to these? and, finally, (4) What varieties of poetic art are the outcome of the two great kinds of poetic impulse, dramatic imagination and lyric or egoistic imagination?

1. *What is Poetry?*—Definitions are for the most part alike unsatisfactory and treacherous; but definitions of poetry are proverbially so. Is it possible to lay down invariable principles of poetry, such as those famous "invariable principles" of William Lisle Bowles, which in the earlier part of the century awoke the admiration of Southey and the wrath of Byron? Is it possible for a critic to say of any metrical phrase, stanza or verse, "This is poetry," or "This is not poetry"? Can he, with anything like the authority with which the man of science pronounces upon the natural objects brought before him, pronounce upon the qualities of a poem? These are questions that have engaged the attention of critics ever since the time of Aristotle. Byron, in his rough and ready way, answered them in one of those letters to his publisher John Murray, which, rich as they are in nonsense, are almost as rich in sense. "So far are principles of poetry from being invariable," says he, "that they never were nor ever will be settled. These principles mean nothing more than the predilections of a particular age, and every age has its own and a different from its predecessor. It is now Homer and now Virgil; once Dryden and since Sir Walter Scott; now Corneille and now Racine; now Crébillon and now Voltaire." This is putting the case very strongly—perhaps too strongly. But if we remember that Sophocles lost the first prize for the *Oedipus tyrannus*; if we remember what in Dante's time (owing partly, no doubt, to the universal ignorance of Greek) were the relative positions of Homer and Virgil, what in the time of Milton were the relative positions of Milton himself, of Shakespeare, and of Beaumont and Fletcher; again, if we remember Jeffrey's famous classification of the poets of his day, we shall be driven to pause over Byron's words before dismissing them. Yet some definition, for the purpose of this essay, must be here attempted; and, using the phrase "absolute poetry" as the musical critics use the phrase "absolute music," we may, perhaps, without too great presumption submit the following:—

Definition.

Absolute poetry is the concrete and artistic expression of the human mind in emotional and rhythmical language.

This at least will be granted, that no literary expression can, properly speaking, be called poetry that is not in a certain deep sense emotional, whatever may be its subject-matter, concrete in its method and its diction, rhythmical in movement, and artistic in form.

That the expression of all real poetry must be concrete in method and diction is obvious, and yet this dictum would exclude from the definition much of what is called didactic poetry. With abstractions the poet has nothing to do, save to take them and turn them into concretions; for, as artist, he is simply the man who by instinct embodies in concrete forms that "universal idea" which Gravina speaks of—that which is essential and elemental in nature and in man; as poetic artist he is simply the man who by instinct chooses for his concrete forms metrical language. And the questions to be asked concerning any work of art are simply these—Is that which is here embodied really permanent, universal and elemental? and, Is the concrete form embodying it really beautiful—acknowledged as beautiful by the soul of man in its highest moods? Any other question is an impertinence.

As an example of the absence of concrete form in verse take the following lines from George Eliot's *Spanish Gypsy*:—

> "Speech is but broken light upon the depth
> Of the unspoken; even your loved words
> Float in the larger meaning of your voice
> As something dimmer."

Without discussing the question of blank verse cadence and the weakness of a line where the main accent falls upon a positive hiatus, "of the unspoken," we would point out that this powerful passage shows the spirit of poetry without its concrete form. The abstract method is substituted for the concrete. Such an abstract phrase as "the unspoken" belongs entirely to prose.

As to what is called ratiocinative poetry, it might perhaps be shown that it does not exist at all. Not by syllogism, but *per saltum*, must the poet reach in every case his conclusions. We listen to the poet—we allow him to address us in rhythm or in rhyme—we allow him to sing to us while other men are only allowed to talk, not because he argues more logically than they, but because he feels more deeply and perhaps more truly. It is for his listeners to be knowing and ratiocinative; it is for him to be gnomic and divinely wise.

That poetry must be metrical or even rhythmical in movement, however, is what some have denied. Here we touch at once the very root of the subject. The difference between all literature and mere "word-kneading" is that, while literature is alive, word-kneading is without life. This literary life, while it is only bipartite in prose, seems to be tripartite in poetry; that is to say, while prose requires intellectual life and emotional life, poetry seems to require not only intellectual life and emotional life but rhythmic life, this last being the most important of all according to many critics, though Aristotle is not among these. Here indeed is the "fork" between the old critics and the new. Unless the rhythm of any metrical passage is so vigorous, so natural, and so free that it seems as though it could live, if need were, by its rhythm alone, has that passage any right to exist? and should it not, if the substance is good, be forthwith demetricized and turned into prose? Thoreau has affirmed that prose, at its best, has high qualities of its own beyond the ken of poetry; to compensate for the sacrifice of these, should not the metrical gains of any passage be beyond all cavil?

Importance of Metrical Questions.

This argument might be pressed farther still. It might seem bold to assert that, in many cases, the mental value of poetry may actually depend upon form and colour, but would it not be true? The mental value of poetry must be judged by a standard not applicable to prose; but, even with regard to the different kinds of poetry, we must not compare poetry whose mental value consists in a distinct and logical enunciation of ideas, such as that of Lucretius and Wordsworth, and poetry whose mental value consists partly in the suggestive richness of passion or symbol latent in rhythm (such as that of Sappho sometimes, Pindar often, Shelley always), or latent in colour, such as that of some of the Persian poets. To discuss the question, Which of these two kinds of poetry is the more precious? would be idle, but are we not driven to admit that certain poems whose strength is rhythm, and certain other poems whose strength is colour, while devoid of any logical statement of thought, may be as fruitful of thoughts and emotions too deep for words as a shaken prism is fruitful of tinted lights? The mental forces at work in the production of a poem like the *Excursion* are of a very different kind from the mental forces at work in the production of a poem like Shelley's "Ode to the West Wind." In the one case the poet's artistic methods, like those of the Greek architect, show, and are intended to show, the solid strength of the structure. In the other, the poet's artistic methods, like those of the Arabian architect, contradict the idea of solid strength—make the structure appear to hang over our heads like the cloud pageantry of heaven. But, in both cases, the solid strength is, and must be, there, at the base. Before the poet begins to write he should ask himself which of these artistic methods is natural to him; he should ask himself whether his natural impulse is towards the weighty iambic movement whose primary function is to state, or towards those lighter movements which we still call, for want of more convenient words, anapaestic and dactylic, whose primary function is to suggest. Whenever Wordsworth and Keats pass from the former to the latter they pass at once into doggerel. Nor is it difficult to see why English anapaestic and dactylic verse must suggest, and not state, as even so comparatively successful a *tour de force* as Shelley's "Sensitive Plant" shows. Conciseness is a primary virtue of all statement. The moment the English poet tries to "pack" his anapaestic or dactylic line as he can pack his iambic line, his versification becomes rugged, harsh, pebbly—becomes so of necessity. Nor is this all: anapaestic and dactylic verse must in English be obtrusively alliterative, or the same pebbly effect begins to be felt. The anapaestic line is so full of syllables that in a language where the consonants dominate the vowels (as in English), these syllables grate against each other, unless their corners are artfully bevelled by one of the only two smoothing processes at the command of an English versifier—obtrusive alliteration, or an obtrusive use of liquids. Now these demands of form may be turned by the perfect artist to good account if his appeal to the listener's soul is primarily that of suggestion by sound or symbol, but if his appeal is that of direct and logical statement the diffuseness inseparable from good anapaestic and dactylic verse is a source of weakness such as the true artist should find intolerable.

Form and Matter.

Using the word "form" in a wider sense still, a sense that includes "composition," it can be shown that poetry, to be entitled to the name, must be artistic in form. Whether a poem be a Welsh *triban* or a *stornello* improvised by an Italian peasant girl, whether it be an ode by Keats or a tragedy by Sophocles, it is equally a work of art. The artist's command over form may be shown in the peasant girl's power of spontaneously rendering in simple verse, in her *stornello* or *rispetto*, her emotions through nature's symbols; it may be shown by Keats in that perfect fusion of all poetic elements of which he was such a master, in the manipulation of language so beautiful both for form and colour that thought and words seem but one blended loveliness; or it may be shown by Sophocles in a mastery over what in painting is called composition, in the exercise of that wise vision of the artist which, looking before and after, sees the thing of beauty as a whole, and enables him to grasp the eternal laws of cause and effect in art and bend them to his own wizard will. In every case, indeed, form is an essential part of poetry; and, although George Sand's saying that "L'art est une forme" applies perhaps more strictly to the plastic arts (where the soul is reached partly through mechanical means), its application to poetry can hardly be exaggerated.

Owing, however, to the fact that the word ποιητής (first used to designate the poetic artist by Herodotus) means maker, Aristotle seems to have assumed that the indispensable basis of poetry is invention. He appears to have thought that a poet is a poet more on account of the composition of the action than on account of the composition of his verses. Indeed he said as much as this. Of epic poetry he declared emphatically that it produces its imitations either by mere articulate words or by metre superadded. This is to widen the definition of poetry so as to include all imaginative literature, and Plato seems to have given an equally wide meaning to the word ποίησις. Only, while Aristotle considered ποίησις to be an imitation of the facts of nature, Plato considered it to be an imitation of the dreams of man. Aristotle ignored, and Plato slighted, the importance of versification (though Plato on one occasion admitted that he who did not know rhythm could be called neither musician nor poet).

Perhaps the first critic who tacitly revolted against the dictum that substance, and not form, is the indispensable basis of poetry was Dionysius of Halicarnassus, whose treatise upon the arrangement of words is really a very fine piece of literary criticism. In his acute remarks upon the arrangement of the words in the sixteenth book of the *Odyssey*, as compared with that in the story of Gyges by Herodotus, was perhaps first enunciated clearly the doctrine that poetry is fundamentally a matter of style. The Aristotelian theory as to invention, however, dominated all criticism after as well as before Dionysius. When Bacon came to discuss the subject (and afterwards) the only division between the poetical critics was perhaps between the followers of Aristotle and those of Plato as to what poetry should, and what it should not, imitate. It is curious to speculate as to what would have been the result had the poets followed the critics in this matter. Had not the instinct of the poet been too strong for the schools, would poetry as an art have been lost and merged in such imaginative prose as Plato's? Or is not the instinct for form too strong to be stifled? By the poets themselves metre was always considered to be the one indispensable requisite of a poem, though, as regards criticism, even in the time of the appearance of the *Waverley Novels*, the *Quarterly Review* would sometimes speak of them as "poems"; and perhaps even later the same might be said of romances so concrete in method and diction, and so full of poetic energy, as *Wuthering Heights* and *Jane Eyre*, where we get absolutely all that Aristotle requires for a poem. On the whole, however, the theory that versification is not an indispensable requisite of a poem seems to have become nearly obsolete. Perhaps, indeed, many critics would now go so far in the contrary direction as to say with Hegel (*Aesthetik*, ii. 289) that "metre is the first and only condition absolutely demanded by poetry, yea even more necessary than a figurative picturesque diction." At all events this at least may be said, that the division between poetical critics is not now between Aristotelians and Baconians; it is of a different kind altogether. While one group of critics may still perhaps say with Dryden that "a poet is a maker, as the name signifies," and that "he who cannot make, that is, invent, has his name for nothing," another group contends that it is not the invention but the artistic treatment, the form, which determines whether an imaginative writer is a poet or a writer of prose—contends, in short, that emotion is the basis of all true poetic expression, whatever be the subject-matter, that thoughts must be expressed in an emotional manner before they can be brought into poetry, and that this emotive expression demands even yet something else, viz. style and form.

The Importance of Ideas and Attitude.

Although many critics are now agreed that "L'art est une forme," that without metre and without form there can be no poetry, there are few who would contend that poetry can exist by virtue of any one of these alone, or even by virtue of all these combined. Quite independent of verbal melody, though mostly accompanying it, and quite independent of "composition," there is an atmosphere floating around the poet through which he sees everything, an atmosphere which stamps his utterances as poetry; for instance, among all the versifiers contemporary with Donne there was none so rugged as he occasionally was, and yet such songs as "Sweetest love, I do not go for weariness of thee" prove how true a poet he was whenever he could master those technicalities which far inferior poets find comparatively easy. While rhythm may to a very considerable degree be acquired (though, of course, the highest rhythmical effects never can), the power of looking at the world through the atmosphere that floats before the poet's eyes is not to be learned and not to be taught. This atmosphere is what we call *poetic imagination.* But first it seems necessary to say a word or two upon that high temper of the soul which in truly great poetry gives birth to this poetic imagination.

The "message" of poetry must be more unequivocal, more thoroughly accentuated, than that of any of the other fine arts. With regard to modern poetry, indeed, it may almost be said that if any writer's verse embodies a message, true, direct and pathetic, we cannot stay to inquire too curiously about the degree of artistic perfection with which it is delivered, for Wordsworth's saying "That which comes from the heart goes to the heart" applies very closely indeed to modern poetry. The most truly passionate poet in Greece was no doubt in a deep sense the most artistic poet; but in her case art and passion were one, and that is why she has been so cruelly misunderstood. The most truly passionate nature, and perhaps the greatest soul, that in recent years has expressed itself in English verse is Elizabeth Barrett Browning; at least it is certain that, with the single exception of Hood in the "Song of the Shirt," no writer of the 19th century really touched English hearts with a hand so powerful as hers—and this notwithstanding violations of poetic form, or defective rhymes, such as would appal some of the contemporary versifiers of England and France "who lisp in numbers for the numbers [and nothing else] come." The truth is that in order to produce poetry the soul must for the time being have reached that state of exaltation, that state of freedom from self-consciousness, depicted in the lines:—

> "I started once, or seemed to start, in pain,
> Resolved on noble things, and strove to speak,
> As when a great thought strikes along the brain,
> And flushes all the cheek."

Whatsoever may be the poet's "knowledge of his art," into this mood he must always pass before he can write a truly poetic line. For, notwithstanding all that may be said upon poetry as a fine art, it is in the deepest sense of the word an "inspiration." No man can write a line of genuine poetry without having been "born again" (or, as the true rendering of the text says, "born from above"); and then the mastery over those highest reaches of form which are beyond the ken of the mere versifier comes to him as a result of the change. Hence, with all Mrs Browning's metrical blemishes, the splendour of her metrical triumphs at her best.

For what is the deep distinction between poet and proseman? A writer may be many things besides a poet; he may be a warrior like Aeschylus, a man of business like Shakespeare, a courtier like Chaucer, or a cosmopolitan philosopher like Goethe; but the moment the poetic mood is upon him all the trappings of the world with which for years he may perhaps have been clothing his soul—the world's knowingness, its cynicism, its self-seeking, its ambition—fall away, and the man becomes an inspired child again, with ears attuned to nothing but the whispers of those spirits from the Golden Age, who, according to Hesiod, haunt and bless the degenerate earth. What such a man produces may greatly delight and astonish his readers, yet not so greatly as it delights and astonishes himself. His passages of pathos draw no tears so deep or so sweet as those that fall from his own eyes while he writes; his sublime passages overawe no soul so imperiously as his own; his humour draws no laughter so rich or so deep as that stirred within his own breast.

It might almost be said, indeed, that Sincerity and Conscience, the two angels that bring to the poet the wonders of the poetic dream, bring him also the deepest, truest delight of form. It might almost be said that by aid of sincerity and conscience the poet is enabled to see more clearly than other men the eternal limits of his own art—to see with Sophocles that nothing, not even poetry itself, is of any worth to man, invested as he is by the whole army of evil, unless it is in the deepest and highest sense good, unless it comes linking us all together by closer bonds of sympathy and pity, strengthening us to fight the foes with whom fate and even Nature, the mother who bore us, sometimes seem in league—to see with Milton that the high quality of man's soul which in English is expressed by the word virtue is greater than even the great poem he prized, greater than all the rhythms of all the tongues that have been spoken since Babel—and to see with Shakespeare and with Shelley that the high passion which in English is called love is lovelier than all art, lovelier than all the marble Mercuries that "await the chisel of the sculptor" in all the marble hills.

Poetry in Relation to the other Arts.

2. *What Position does Poetry take up in Relation to the other Arts?*—Notwithstanding the labours of Lessing and his followers, the position accorded by criticism to poetry in relation to the other arts has never been so uncertain and anomalous as in recent years. On the one hand there are critics who, judging from their perpetual comparison of poems to pictures, claim her as a sort of handmaid of painting and sculpture. On the other hand the disciples of Wagner, while professing to do homage to poetry, have claimed her as the handmaid of music. With regard to the relations of poetry to painting and sculpture, it seems necessary to glance for a moment at the saying of Simonides, as recorded by Plutarch, that poetry is a speaking picture and that painting is a mute poetry. It appears to have had upon modern criticism as much influence since the publication of Lessing's *Laocoon* as it had before. Perhaps it is in some measure answerable for the modern vice of excessive word-painting. Beyond this one saying, there is little or nothing in Greek literature to show that the Greeks recognized between poetry and the plastic and pictorial arts an affinity closer than that which exists between poetry and music and dancing. Understanding artistic methods more profoundly than the moderns, and far too profoundly to suppose that there is any special and peculiar affinity between an art whose medium of expression is marble and an art whose medium of expression is a growth of oral symbols, the Greeks seem to have studied poetry not so much in its relation to painting and sculpture as in its relation to music and dancing. It is matter of familiar knowledge, for instance, that at the Dionysian festival it was to the poet as "teacher of the chorus" (χοροδιδάσκαλος) that the prize was awarded, even though the "teacher of the chorus" were Aeschylus himself or Sophocles. And this recognition of the relation of poetry to music is perhaps one of the many causes of the superiority of Greek to all other poetry in adapting artistic means to artistic ends. In Greek poetry, even in Homer's description of the shield of Achilles, even in the famous description by Sophocles of his native woods in the *Oedipus coloneus*, such word-painting as occurs seems, if not inevitable and unconscious, so alive with imaginative feeling as to become part and parcel of the

dramatic or lyric movement itself. And whenever description is so introduced the reader of Greek poetry need not be told that the scenery itself rises before the listener's imagination with a clearness of outline and a vigour of colour such as no amount of detailed word painting in the modern fashion can achieve. The picture even in the glorious verses at the end of the eighth book of the *Iliad* rises before our eyes—seems actually to act upon our bodily senses—simply because the poet's eagerness to use the picture for merely illustrating the solemnity and importance of his story lends to the picture that very authenticity which the work of the modern word-painter lacks.

That the true place of poetry lies between music on the one hand and prose, or loosened speech, on the other, was, we say, taken for granted by the one people in whom the artistic instinct was fully developed. No doubt they used the word music in a very wide sense, in a sense that might include several arts. But it is a suggestive fact that, in the Greek language, long before poetic art was called "making" it was called "singing." The poet was not ποιητής but ἀοιδός. And as regards the Romans it is curious to see how every now and then the old idea that poetry is singing rather than making will disclose itself. It will be remembered for instance how Terence, in the prologue of *Phormio*, alludes to poets as musicians. That the ancients were right in this could well be shown by a history of poetry: music and the lyrical function of the poet began together, but here, as in other things, the progress of art from the implicit to the explicit has separated the two. Every art has its special function, has a certain work which it can do better than any one of its sister arts. Hence its right of existence. For instance, before the "sea of emotion" within the soul has become "curdled into thoughts," it can be expressed in inarticulate tone. Hence, among the fine arts, music is specially adapted for rendering it. It was perhaps a perception of this fact which made the Syrian Gnostics define life to be "moving music." When this sea of emotion has "curdled into thoughts," articulate language rhythmically arranged—words steeped in music and colour, but at the same time embodying ideas—can do what no mere wordless music is able to achieve in giving it expression, just as unrhythmical language, language mortised in a foundation of logic, that is to say prose, can best express these ideas as soon as they have cooled and settled and cleared themselves of emotion altogether. Yet every art can in some degree invade the domain of her sisters, and the nearer these sisters stand to each other the more easily and completely can this invasion be accomplished. Prose, for instance, can sometimes, as in the case of Plato, do some of the work of poetry (however imperfectly, and however trammelled by heavy conditions); and sometimes poetry, as in Pindar's odes and the waves of the Greek chorus, can do, though in the same imperfect way, the work of music.

The poems of Sappho, however, are a good case in point. Here the poet's passion is expressed so completely by the mere sound of her verses that a good recitation of them to a person ignorant of Greek would convey something of that passion to the listener; and similar examples almost as felicitous might be culled from Homer, from Aeschylus and from Sophocles. Nor is this power confined to the Greek poets. The students of Virgil have often and with justice commented on such lines as *Aen*. v. 481 (where the sudden sinking of a stricken ox is rendered by means of rhythm), and such lines as *Georg*. ii. 441, where, by means of verbal sounds, the gusts of wind about a tree are rendered as completely as though the voice were that of the wind itself. In the case of Sappho the effect is produced by the intensity of her passion, in the case of Homer by the intensity of the dramatic vision, in the case of Virgil by a supreme poetic art. But it can also be produced by the mere ingenuity of the artist, as in Edgar Poe's "Ulalume." The poet's object in that remarkable *tour de force* was to express dull and hopeless gloom in the same way that the mere musician would have expressed it—that is to say, by monotonous reiterations, by hollow and dreadful reverberations of gloomy sounds—though as an artist whose vehicle was articulate speech he was obliged to add gloomy ideas, in order to give to his work the intellectual coherence necessary for its existence as a poem. He evidently set out to do this, and he did it, and "Ulalume" properly intoned would produce something like the same effect upon a listener knowing no word of English that it produces upon us.

On the other hand, music can trench very far upon the domain of articulate speech, as we perceive in the wonderful instrumentation of Wagner. Yet, while it can be shown that the place of poetry is scarcely so close to sculpture and painting as to music on the one side and loosened speech on the other, the affinity of poetry to music must not be exaggerated. We must be cautious how we follow the canons of Wagner and the more enthusiastic of his disciples, who almost seem to think that inarticulate tone can not only suggest ideas but express them—can give voice to the *Verstand*, in short, as well as to the *Vernunft* of man. Even the Greeks drew a fundamental distinction between melic poetry (poetry written to be sung) and poetry that was written to be recited. It is a pity that, while modern critics of poetry have understood, or at least have given attention to painting and sculpture, so few have possessed any knowledge of music—a fact which makes Dante's treatise *De vulgari eloquio* so important. Dante was a musician, and seems to have had a considerable knowledge of the relations between musical and metrical laws. But he did not, we think, assume that these laws are identical.

If it is indeed possible to establish the identity of musical and metrical laws, it can only be done by a purely scientific investigation; it can only be done by a most searching inquiry into the subtle relations that we know must exist throughout the universe between all the laws of undulation. And it is curious to remember that some of the greatest masters of verbal melody have had no knowledge of music, while some have not even shown any love of it. All Greek boys were taught music, but whether Pindar's unusual musical skill was born of natural instinct and inevitable passion, or came from the accidental circumstance that his father was, as has been alleged, a musician, and that he was as a boy elaborately taught musical science by Lasus of Hermione, we have no means of knowing. Nor can we now learn how much of Milton's musical knowledge resulted from a like exceptional "environment," or from the fact that his father was a musician. But when we find that Shelley seems to have been without the real passion for music, that Rossetti disliked it, and that Coleridge's apprehension of musical effects was of the ordinary nebulous kind, we must hesitate before accepting the theory of Wagner.

The question cannot be pursued here; but if it should on inquiry be found that, although poetry is more closely related to music than to any of the other arts, yet the power over verbal melody at its very highest is so all-sufficing to its possessor, as in the case of Shelley and Coleridge, that absolute music becomes a superfluity, this would only be another illustration of that intense egoism and concentration of force—the impulse of all high artistic energy—which is required in order to achieve the rarest miracles of art.

With regard to the relation of poetry to prose, Coleridge once asserted in conversation that the real antithesis of poetry was not prose but science. If he was right the difference in kind lies, not between the poet and the prose writer, but between the literary artist (the man whose instinct is to manipulate language) and the man of facts and of action whose instinct impels him to act, or, if not to act, to inquire. One thing is at least certain, that prose, however fervid and emotional it may become, must always be directed, or seem to be directed, by the reins of logic. Or, to vary the metaphor, like a captive balloon it can never really leave the earth.

Indeed, with the literature of knowledge as opposed to the literature of power poetry has nothing to do. Facts have no place in poetry until they are brought into relation with the human soul. But a mere catalogue of ships may become poetical if it tends to show the strength and pride and glory of the warriors who invested Troy; a detailed description of the designs upon a shield, however beautiful and poetical in itself, becomes still more so if it tends to show the skill of the divine artificer and the invincible splendour of a hero like Achilles. But mere dry exactitude of imitation is not for poetry but for loosened speech. Hence, most of the so-called poetry of Hesiod is not poetry at all. The Muses who spoke to him about "truth" on Mt Helicon made the common mistake of confounding fact with truth. And here we touch upon a very important matter. The reason why in prose speech is loosened is that, untrammelled by the laws of metre, language is able with more exactitude to imitate nature, though of course speech, even when "loosened," cannot, when actual sensible objects are to be depicted, compete in any real degree with the plastic arts in accuracy of imitation, for the simple reason that its media are not colours nor solids but symbols—arbitrary symbols which can be made to indicate, but never to reproduce, colours and solids. Accuracy of imitation is the first requisite of prose. But the moment language has to be governed by the laws of metre—the moment the conflict begins between the claims of verbal music and the claims of colour and form—then prosaic accuracy has to yield; sharpness of outline, mere fidelity of imitation, such as is within the compass of prose, have in some degree to be sacrificed. But, just as with regard to the relations between poetry and music the greatest master is he who borrows the most that can be borrowed from music, and loses the least that can be lost from metre, so with regard to the relations between poetry and prose the greatest master is he who borrows the most that can be borrowed from prose and loses the least that can be lost from verse. No doubt this is what every poet tries to do by instinct; but some sacrifice on either side there must be, and, with regard to poetry and prose, modern poets at least might be divided into those who make picturesqueness yield to verbal melody, and those who make verbal melody yield to picturesqueness.

With one class of poets, fine as is perhaps the melody, it is made subservient to outline or to colour; with the other class colour and outline both yield to metre. The chief aim of the first class is to paint a picture; the chief aim of the second is to sing a song. Weber, in driving through a beautiful country, could only enjoy its beauty by translating it into music. The same may be said of some poets with regard to verbal melody. The supreme artist, however, is he whose pictorial and musical power are so interfused that each seems born of the other, as is the case with Sappho, Homer, Aeschylus, Sophocles, and indeed most of the great Greek poets. Among English poets (leaving the two supreme masters undiscussed) Keats and Coleridge have certainly done this. The colour seems born of the music and the music born of the colour. In French poetry the same triumph has been achieved in Victor Hugo's magnificent poem "En marchant la nuit dans un bois," which, as a rendering through verbal music of the witchery of nature, stands alone in the poetry of France. For there the poet conquers that crowning difficulty we have been alluding to, the difficulty of stealing from prose as much distinctness of colour and clearness of outline as can be imported into verse with as little sacrifice as possible of melody.

If poetry can in some degree invade the domain of prose, so on the other hand prose can at times invade the domain of poetry, and no doubt the prose of Plato—what is called poetical prose—is a legitimate form of art. Poetry, the earliest form of literature, is also the final and ideal form of all pure literature; and, when Landor insists that poetry and poetical prose are antagonistic, we must remember that Landor's judgments are mostly based on feeling, and that his hatred of Plato would be quite sufficient basis with him for an entire system of criticism upon poetical prose. As with Carlyle, there was a time in his life when Plato had serious thoughts of becoming a poet. And perhaps, like Carlyle, having the good sense to see his true function, he himself desisted from writing, and strictly forbade other men to write, in verse. If we consider this, and if we consider that certain of the great English masters of poetic prose of the 17th century were as incapable of writing in metre as their followers Richter and Carlyle, we shall hardly escape the conclusion on the one hand that the faculty of writing poetry is quite another faculty than that of producing work in the arts most closely allied to it, music and prose, but that on the other hand there is nothing antagonistic between these faculties.

3. *Comparative Value in Expressional Power.*—There is one great point of superiority that musical art exhibits over metrical art. This consists, not in the capacity for melody, but in the capacity for harmony in the musician's sense. The finest music of Aeschylus, of Pindar, of Shakespeare, of Milton, is after all only a succession of melodious notes, and, in endeavouring to catch the harmonic intent of strophe, antistrophe and epode in the Greek chorus and in the true ode (that of Pindar), we can only succeed by pressing memory into our service. We have to recall by memory the waves that have gone before, and then to imagine their harmonic power in relation to the waves at present occupying the ear. Counterpoint, therefore, is not to be achieved by the metricist, even though he be Pindar himself; but in music this perfect ideal harmony was foreshadowed perhaps in the earliest writing. We know at least that as early as the 12th century counterpoint began to show a vigorous life, and the study of it is now a familiar branch of musical science. Now, inasmuch as "nature's own hymn" is and must be the harmonic blending of apparently independent and apparently discordant notes, among the arts whose appeal is through the ear that which can achieve counterpoint must perhaps rank as a pure art above one which cannot achieve it. We are of course speaking here of metre only. We have not space to inquire whether the counterpoint of absolute poetry is the harmony underlying apparently discordant emotions—the emotion produced by a word being more persistent than the emotion produced by an inarticulate sound. But if poetry falls behind music in rhythmic scope, it is capable of rendering emotion after emotion has become disintegrated into thoughts, and here, as we have seen, it enters into direct competition with the art of prose. It can use the emphasis of sound, not for its own sake merely, but to strengthen the emphasis of sense, and can thus give a fuller and more adequate expression to the soul of man than music at its highest can give. With regard to prose, no doubt such writing as Plato's description of the chariot of the soul, his description of the island of Atlantis, or of Er's visit to the place of departed souls, comes but a short way behind poetry in imaginative and even rhythmic appeal. It is impossible, however, here to do more than touch upon the subject of the rhythm of prose in its relation to the rhythm of poetry; for in this matter the genius of each individual language has to be taken into account.

Rhythm.

Perhaps it may be said that deeper than all the rhythm of art is that rhythm which art would fain catch, the rhythm of nature; for the rhythm of nature is the rhythm of life itself. This rhythm can be caught by prose as well as by poetry, such prose, for instance, as that of the English Bible. Certainly the rhythm of verse at its highest, such, for instance, as that of Shakespeare's greatest writings, is nothing more and nothing less than the metre of that energy of the spirit which surges within the bosom of him who speaks, whether he speak in verse or in impassioned prose. Being rhythm, it is of course governed by law, but it is a law which transcends in subtlety the conscious art of the metricist and is only caught by the poet in his most inspired moods, a law which, being part of nature's own sanctions, can of course never be formulated but only expressed, as it is expressed in the melody of the bird, in the inscrutable harmony of the entire bird-chorus of a thicket, in the whisper of the leaves of the tree, and in the song or wail of wind and sea. Now is not this rhythm of nature represented by that "sense rhythm" which prose can catch as well as poetry, that sense rhythm whose finest expressions are to be found in the Bible, Hebrew and English, and in the biblical movements of the English Prayer Book, and in the dramatic prose of Shakespeare at its best? Whether it is caught by prose or by verse, one of the virtues of the rhythm of nature is that it is translatable. Hamlet's peroration about man and Raleigh's apostrophe to death are as translatable into other languages as are the Hebrew psalms, or as is Manu's magnificent passage about the singleness of man:—

> "Single is each man born into the world; single he dies; single he receives the reward of his good deeds, and single the punishment of his evil deeds. When he dies his body lies like a fallen tree upon the earth, but his virtue accompanies his soul. Wherefore let man harvest and garner virtue, so that he may have an inseparable companion in traversing that gloom which is so hard to be traversed."

Here the rhythm, being the inevitable movement of emotion and "sense," can be caught and translated by every literature under the sun. While, however, the great goal before the poet is to compel the listener to expect his caesuric effects, the great goal before the writer of poetic prose is in the very opposite direction; it is to make use of the concrete figures and impassioned diction of the poet, but at the same time to avoid the recognized and expected metrical bars upon which the poet depends. The moment the prose poet passes from the rhythm of prose to the rhythm of metre the apparent sincerity of his writing is destroyed.

Plastic Imitation.

As compared with sculpture and painting the great infirmity of poetry, as an "imitation" of nature, is of course that the medium is always and of necessity words—even when no words could, in the dramatic situation, have been spoken. It is not only Homer who is obliged sometimes to forget that passion when at white heat is never voluble, is scarcely even articulate; the dramatists also are obliged to forget that in love and in hate, at their tensest, words seem weak and foolish when compared with the silent and satisfying triumph and glory of deeds, such as the plastic arts can render. This becomes manifest enough when we compare the Niobe group or the Laocoon group, or the great dramatic paintings of the modern world, with even the finest efforts of dramatic poetry, such as the speech of Andromache to Hector, or the speech of Priam to Achilles, nay such as even the cries of Cassandra in the *Agamemnon*, or the wailings of Lear over the dead Cordelia. Even when writing the words uttered by Oedipus, as the terrible truth breaks in upon his soul, Sophocles must have felt that in the holiest chambers of sorrow and in the highest agonies of suffering reigns that awful silence which not poetry, but painting sometimes, and sculpture always, can render. What human sounds could render the agony of Niobe, or the agony of Laocoon, as we see them in the sculptor's rendering? Not articulate speech at all; not words but wails. It is the same with hate; it is the same with love. We are not speaking merely of the unpacking of the heart in which the angry warriors of the *Iliad* indulge. Even such subtle writing as that of Aeschylus and Sophocles falls below the work of the painter. Hate, though voluble perhaps, as Clytaemnestra's when hate is at that red-heat glow which the poet can render, changes in a moment whenever that redness has been fanned to hatred's own last complexion—whiteness as of iron at the melting-point—when the heart has grown far too big to be "unpacked" at all, and even the bitter epigrams of hate's own rhetoric, though brief as the terrier's snap before he fleshes his teeth, or as the short snarl of the tigress as she springs before her cubs in danger, are all too slow and sluggish for a soul to which language at its tensest has become idle play. But this is just what cannot be rendered by an art whose medium consists solely of words.

It is in giving voice, not to emotion at its tensest, but to the variations of emotion, it is in expressing the countless shifting movements of the soul from passion to passion, that poetry shows in spite of all her infirmities her superiority to the plastic arts. *Hamlet* and the *Agamemnon*, the *Iliad* and the *Oedipus Tyrannus*, are adequate to the entire breadth and depth of man's soul.

Varieties of Poetic Art.—We have now reached the inquiry: What varieties of poetic art are the outcome of the two kinds of poetic impulse, dramatic imagination and lyric or egoistic imagination? It would be impossible here to examine fully the subject of poetic imagination. In order to do so we should have to enter upon the vast question of the effect of artistic environment upon the development of man's poetic imagination; we should have to inquire how the instinctive methods of each poet and of each group of poets have been modified and often governed by the methods characteristic of their own time and country. We should have to inquire, for instance, how far such landscape as that of Sophocles in the *Oedipus Coloneus* and such landscape as that of Wordsworth depends upon difference of individual temperament, and how far upon difference of artistic environment. That, in any thorough and exhaustive discussion of poetic imagination, the question of artistic environment must be taken into account, the case of the *Iliad* is alone sufficient to show. Ages before Phrynichus, ages before an acted drama was dreamed of, a dramatic poet of the first order arose, and, though he was obliged to express his splendid dramatic imagination through epic forms, he expressed it almost as fully as if he had inherited the method and the stage of Sophocles. And if Homer never lived at all, then an entire group of dramatic poets arose in remote times whose method was epic instead of dramatic simply because there was then no stage. This, contrasted with the fact that in a single half-century the tragic art of Greece arose with Aeschylus, culminated with Sophocles, and decayed with Euripides, and contrasted also with the fact that in England at one time, and in Spain at one time, almost the entire poetic imagination of the country found expression in the acted drama alone, is sufficient to show that a poet's artistic methods are very largely influenced by the artistic environments of his country and time. So vast a subject as this, however, is beyond our scope, and we can only point to the familiar instance of the troubadours and the trouvères and then pass on.

With the trouvère (the poet of the *langue d'oïl*), the story or situation is always the end of which the musical language is the means; with the troubadour (the poet of the *langue d'oc*), the form is so beloved, the musical language so enthralling, that, however beautiful may be the story or situation, it is felt to be no more than the means to a more beloved and beautiful end. But then nature makes her own troubadours and her own trouvères irrespective of fashion and of time—irrespective of *langue d'oc* and *langue d'oïl*. And, in comparing the troubadours with the trouvères, this is what strikes us at once—there are certain troubadours who by temperament, by original endowment of nature, ought to have been trouvères, and there are certain trouvères who by temperament ought to have been troubadours. Surrounding conditions alone have made them what they are. There are those whose impulse (though writing in obedience to contemporary fashions lyrics in the *langue d'oc*) is manifestly to narrate, and there are those whose impulse (though writing in obedience to contemporary fashions *fabliaux* in the *langue d'oïl*) is simply to sing. In other words, there are those who, though writing after the fashion of their brother-troubadours, are more impressed with the romance and wonderfulness of the human life outside them than with the romance and wonderfulness of their own passions, and who delight in depicting the external world in any form that may be the popular form of their time; and there are those who, though writing after the fashion of their brother-trouvères, are far more occupied with the life within them than with that outer life which the taste of their time and country calls upon them to paint—born rhythmists who must sing, who translate everything external as well as internal into verbal melody. Of the former class Pierre Vidal, of the latter class the author of *Le Lay de l'oiselet*, may be taken as the respective types.

That the same forces are seen at work in all literatures few students of poetry will deny—though in some poetical groups these forces are no doubt more potent than in others, as, for instance, with the great parable poets of Persia, in some of whom there is perpetually apparent a conflict between the dominance of the Oriental taste for allegory and subtle suggestion, as expressed in the Zoroastrian definition of poetry—"apparent pictures of unapparent realities"—and the opposite yearning to represent human life with the freshness and natural freedom characteristic of Western poetry.

Absolute and Relative Vision.

Allowing, however, for all the potency of external influences, we shall not be wrong in saying that of poetic imagination there are two distinct kinds—(1) the kind of poetic imagination seen at its highest in Aeschylus, Sophocles, Shakespeare and Homer, and (2) the kind of poetic imagination seen at its highest in Pindar, Dante and Milton, or else in Sappho, Heine and Shelley. The former, being in its highest dramatic exercise unconditioned by the personal or lyrical impulse of the poet, might perhaps be called *absolute* dramatic vision; the latter, being more or less conditioned by the personal or lyrical impulse of the poet, might be called *relative* dramatic vision. It seems impossible to classify poets, or to classify the different varieties of poetry, without drawing some such distinction as this, whatever words of definition we may choose to adopt.

For the achievement of all pure lyric poetry, such as the ode, the song, the elegy, the idyll, the sonnet, the stornello, it is evident that the imaginative force we have called relative vision will suffice. And if we consider the matter thoroughly, in many other forms of poetic art—forms which at first sight might seem to require absolute vision—we shall find nothing but relative vision at work.

Even in Dante, and even in Milton and Virgil, it might be difficult to trace the working of any other than relative vision. And as to the entire body of Asiatic poets it might perhaps be found (even in view of the Indian drama) that relative vision suffices to do all their work. Indeed the temper which produces true drama is, it might almost be said, a growth of the Western mind. For, unless it be Semitic, as seen in the dramatic narratives of the Bible, or Chinese, as seen in that remarkable prose story, *The Two Fair Cousins*, translated by Rémusat, absolute vision seems to have but small place in the literatures of Asia. The wonderfulness of the world and the romantic possibilities of fate, or circumstance, or chance—not the wonderfulness of the character to whom these possibilities befall—are ever present to the mind of the Asiatic poet. Even in so late a writer as the poet of the *Shāh Nāmeh*, the hero Irij, the hero Zal and the hero Zohreb are in character the same person, the virtuous young man who combines the courage of youth with the wisdom and forbearance of age. And, as regards the earlier poets of Asia, it was not till the shadowy demigods and heroes of the Asiatic races crossed the Caucasus, and breathed a more bracing air, that they became really individual characters. But among the many qualities of man's mind that were invigorated and rejuvenated by that great exodus from the dreamy plains of Asia is to be counted, above all others, his poetic imagination. The mere sense of wonder, which had formerly been an all-sufficing source of pleasure to him, was all-sufficing no longer. The wonderful adventure must now be connected with a real and interesting individual character. It was left for the poets of Europe to show that, given the interesting character, given the Achilles, the Odysseus, the Helen, the Priam, any adventure happening to such a character becomes interesting.

What then is this absolute vision, this true dramatic imagination which can hardly be found in Asia—which even in Europe cannot be found except in rare cases? Between relative and absolute vision the difference seems to be this, that the former only enables the poet, even in its very highest exercise, to make his own individuality, or else humanity as represented by his own individuality, live in the imagined situation; the latter enables him in its highest exercise to make special individual characters other than the poet's own live in the imagined situation.

"That which exists in nature," says Hegel, "is a something purely individual and particular. Art, on the contrary, is essentially destined to manifest the general." And no doubt this is true as regards the plastic arts, and true also as regards literary art, save in the very highest reaches of pure drama and pure lyric, when it seems to become art no longer—when it seems to become the very voice of Nature herself. The cry of Priam when he puts to his lips the hand that slew his son is not merely the cry of a bereaved and aged parent; it is the cry of the individual king of Troy, and expresses above everything else that most naïve, pathetic and winsome character. Put the words into the mouth of the irascible and passionate Lear and they would be entirely out of keeping.

Lyric, Epic and Dramatic Singers.

It may be said then that, while the poet of relative vision, even in its very highest exercise, can only, when depicting the external world, deal with the general, the poet of absolute vision can compete with Nature herself and deal with both general and particular. If this is really so we may perhaps find a basis for a classification of poetry and of poets. That all poets must be singers has already been maintained. But singers seem to be divisible into three classes: first the pure lyrists, each of whom can with his one voice sing only one tune; secondly the epic poets, save Homer, the bulk of the narrative poets, and the quasi-dramatists, each of whom can with his one voice sing several tunes; and thirdly the true dramatists, who, having, like the nightingale of Gongora, many tongues, can sing all tunes.

It is to the first-named of these classes that most poets belong. With regard to the second class, there are not of course many poets left for it: the first absorbs so many. But, when we come to consider that among those who, with each his one voice, can sing many tunes, are Pindar, Firdausi, Jami, Virgil, Dante, Milton, Spenser, Goethe, Byron, Coleridge, Shelley, Keats, Schiller, Victor Hugo, the second class is so various that no generalization save such a broad one as ours could embrace its members. And now we come to class three, and must pause. The third class is necessarily very small. In it can only be placed such names as Shakespeare, Aeschylus, Sophocles, Homer and (hardly) Chaucer.

These three kinds of poets represent three totally different kinds of poetic activity.

With regard to the first, the pure lyrists, the impulse is pure egoism. Many of them have less of even relative vision at its highest than the mass of mankind. They are often too much engaged with the emotions within to have any deep sympathy with the life around them. Of every poet of this class it may be said that his mind to him "a kingdom is," and that the smaller the poet the bigger to him is that kingdom. To make use of a homely image—like the chaffinch whose eyes have been pricked by the bird-fancier, the pure lyrist is sometimes a warbler because he is blind. Still he feels that the Muse loves him exceedingly. She takes away his eyesight, but she gives him sweet song. And his song is very sweet, very sad, and very beautiful; but it is all about the world within his own soul—its sorrows, joys, fears and aspirations.

With regard to the second class the impulse here is no doubt a kind of egoism too; yet the poets of this class are all of a different temper from the pure lyrists. They have a wide imagination; but it is still relative, still egoistic. They have splendid eyes, but eyes that never get beyond seeing general, universal humanity (typified by themselves) in the imagined situation. Not even to these is it given to break through that law of centrality by which every "me" feels itself to be the central "me"—the only "me" of the universe, round which all other spurious "me's" revolve. This "me" of theirs they can transmute into many shapes, but they cannot create other "me's"—nay, for egoism, some of them scarcely would, perhaps, if they could.

The third class, the true dramatists, whose impulse is the simple yearning to create akin to that which made "the great Vishnu yearn to create a world," are "of imagination all compact"—so much so that when at work "the divinity" which Iamblichus speaks of "seizes for the time the soul and guides it as he will."

Examples of Relative and Absolute Vision.

The distinction between the pure lyrists and the other two classes of poets is obvious enough. But the distinction between the quasi-dramatists and the pure dramatists requires a word of explanation before we proceed to touch upon the various kinds of poetry that spring from the exercise of relative and absolute vision. Sometimes, to be sure, the vision of the true dramatists—the greatest dramatists—will suddenly become narrowed and obscured, as in that part of the *Oedipus tyrannus* where Sophocles makes Oedipus ignorant of what every one in Thebes must have known, the murder of Laius. And again, finely as Sophocles has conceived the character of Electra, he makes her, in her dispute with Chrysothemis, give expression to sentiments that, in another play of his own, come far more appropriately from the lofty character of Antigone in a parallel dispute with Ismene. And, on the other hand, examples of relative vision in its furthest reaches can be found in abundance everywhere, especially in Virgil, Dante, Calderon and Milton. Some of the most remarkable examples of that high kind of relative vision which may easily be mistaken for absolute vision may be found in those great prose epics of the North which Aristotle would have called poems. Here is one from the *Völsunga Saga*. While the brothers of Gudrun are about their treacherous business of murdering Sigurd, her husband, as he lies asleep in her arms, Brynhild, Sigurd's former love, who in the frenzy of "love turned to hate" has instigated the murderers to the deed, hovers outside the chamber with Gunnar, her husband, and listens to the wail of her rival who is weltering in Sigurd's blood. At the sound of that wail Brynhild laughs:—

> "Then said Gunnar to her, Thou laughest not because thy heart roots are gladded, *or else why doth thy visage wax so wan?*"[1]

This is of course very fine; but, as any two characters in that dramatic situation might have done that dramatic business, fine as it is—as the sagaman gives us the general and not the particular—the vision at work is not absolute but relative at its very highest exercise. But our examples will be more interesting if taken from English poets. In Coleridge's "Ancient Mariner" we find an immense amount of relative vision of so high a kind that at first it seems absolute vision. When the ancient mariner, in his narrative to the wedding guest, reaches the slaying of the albatross, he stops, he can proceed no farther, and the wedding guest exclaims:—

> "God save thee, Ancient Mariner,
> From the fiends that plague thee thus!
> Why look'st thou so?" "With my cross-bow
> I shot the albatross."

But there are instances of relative vision—especially in the great master of absolute vision, Shakespeare—which are higher still—so high indeed that not to relegate them to absolute vision seems at first sight pedantic. Such an example is the famous speech of Lady Macbeth in the second act, where she says:—

> "Had he not resembled
> My father as he slept, I had done 't."

Marvellously subtle as is this speech, it will be found, if analysed, that it expresses the general human soul rather than any one special human soul. Indeed Leigh Hunt records the case of a bargeman who, charged with robbing a sleeping traveller in his barge, used in his confession almost identical words—"Had he not looked like my father as he slept, I should have killed as well as robbed him." Again, the thousand and one cases (to be found in every literature) where a character, overwhelmed by some sudden surprise or terror, asks whether the action going on is that of a dream or of real life, must all, on severe analysis, be classed under relative rather than under absolute vision—even such a fine speech, for instance, as that where Pericles, on discovering Marina, exclaims:—

> "This is the rarest dream that e'er dull sleep
> Did mock sad fools withal";

or as that in the third act of *Titus Andronicus*, where Titus, beholding his mutilated and ruined daughter, asks:—

> "When will this fearful slumber have an end?"

even here, we say, the humanity rendered is general and not particular, the vision at work is relative and not absolute. The poet, as representing the whole human race, throwing himself into the imagined situation, gives us what general humanity would have thought, felt, said or done in that situation, not what one particular individual and he alone would have thought, felt, said or done.

Now what we have called absolute vision operates in a very different way. So vividly is the poet's mere creative instinct at work that the *ego* sinks into passivity—becomes insensitive to all impressions other than those dictated by the vision—by the "divinity" which has "seized the soul." Shakespeare is full of examples. Take the scene in the first act of *Hamlet* where Hamlet hears for the first time, from Horatio, that his father's ghost haunts the castle. Having by short sharp questions elicited the salient facts attending the apparition, Hamlet says, "I would I had been there." To this Horatio makes the very commonplace reply, "It would have much amazed you." Note the marvellously dramatic reply of Hamlet —"Very like, very like! Stayed it long?" Suppose that this dialogue had been attempted by any other poet than a true dramatist, or by a true dramatist in any other mood than his very highest, Hamlet, on hearing Horatio's commonplace remarks upon phenomena which to Hamlet were more subversive of the very order of the universe than if a dozen stars had fallen from their courses, would have burst out with: "Amazed me!" and then would have followed an eloquent declamation about the "amazing" nature of the phenomena and their effect upon him. But so entirely has the poet become Hamlet, so completely has "the divinity seized his soul," that all language seems equally weak for expressing the turbulence within the soul of the character, and Hamlet exclaims in a sort of meditative irony, "Very like, very like!" It is exactly this one man Hamlet, and no other man, who in this situation would have so expressed himself. Charles Knight has some pertinent remarks upon this speech of Hamlet; yet he misses its true value, and treats it from the general rather than from the particular side. Instances of absolute vision in Shakespeare crowd upon us; but we can find room for only one other. In the pathetic speech of Othello, just before he kills himself, he declares himself to be:—

> "One not easily jealous, but, being *wrought*,
> Perplexed in the extreme."

Consider the marvellous *timbre* of the word "wrought," as coming from a character like Othello. When writing this passage, especially when writing this word, the poet had become entirely the simple English soldier-hero, as the Moor really is—he had become Othello, looking upon himself "as not easily jealous," whereas he was "wrought" and "perplexed in the extreme" by tricks which Hamlet would have seen through in a moment.

Dramatic Imagination.

While all other forms of poetic art can be vitalized by relative vision, there are two forms (and these the greatest) in which absolute vision is demanded, viz. the drama, and in a lesser degree the Greek epic, especially the *Iliad*. This will be seen more plainly perhaps if we now vary our definitions and call relative vision *egoistic imagination*; absolute vision *dramatic imagination*.

Very much of the dramatist's work can be, and in fact is, effected by egoistic imagination, while true dramatic imagination is only called into play on comparatively rare occasions. Not only fine but sublime dramatic poems have been written, however, where the vitalizing power has been entirely that of lyrical imagination. We need only instance the *Prometheus Bound* of Aeschylus, the most sublime poem in the world. The dramas of Shelley too, like those of Victor Hugo and Calderon, are informed entirely by egoistic imagination. In all these splendid poems the dramatist places himself in the imagined situation, or at most he places there some typical conception of universal humanity. There is not in all Calderon any such display of dramatic imagination as we get in that wonderful speech of Priam's in the last book of the *Iliad*, to which we have before alluded. There is not in the *Cenci* such a display of dramatic imagination as we get in the sudden burst of anger from the spoilt child of gods and men, Achilles (anger which alarms the hero himself as much as it alarms Priam), when the prattle of the old man has carried him too far. It may seem bold to say that the drama of Goethe is informed by egoistic imagination only—assuredly the prison-scene in *Faust* is unsurpassed in the literatures of the world. Yet, perhaps, it could be shown of the passion and the pathos of Gretchen throughout the entire play that it betrays a female character general and typical rather than individual and particular.

The nature of this absolute vision or true dramatic imagination is easily seen if we compare the dramatic work of writers without absolute vision, such as Calderon, Goethe, Ben Jonson, Fletcher and others, with the dramatic work of Aeschylus and of Shakespeare. While of the former group it may be said that each poet skilfully works his imagination, of Aeschylus and Shakespeare it must be said that each in his highest dramatic mood does not work, but is worked *by* his imagination. Note, for instance, how the character of Clytaemnestra grows and glows under the hand of Aeschylus. The poet of the *Odyssey* had distinctly said that Aegisthus, her paramour, had struck the blow, but the dramatist, having imagined the greatest tragic female in all poetry, finds it impossible to let a man like Aegisthus assist such a woman in a homicide so daring and so momentous. And when in that terrible speech of hers she justifies her crime (ostensibly to the outer world, but really to her own conscience), the way in which, by the sheer magnetism of irresistible personality, she draws our sympathy to herself and her crime is unrivalled out of Shakespeare and not surpassed even there. In the Great Drama, in the *Agamemnon*, in *Othello*, in *Hamlet*, in *Macbeth*, there is an imagination at work whose laws are inexorable, are inevitable, as the laws by the operation of which the planets move around the sun. But in this essay our business with drama is confined entirely to its relations to epic.

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[1] Translation of Morris and Magnusson.

Epic and Drama Compared.

Considering how large and on the whole how good is the body of modern criticism upon drama, it is surprising how poor is the modern criticism upon epic. Aristotle, comparing tragedy with epic, gives the palm to tragedy as being the more perfect art, and nothing can be more ingenious than the way in which he has marshalled his reasons. He tells us that tragedy as well as epic is capable of producing its effect even without action; we can judge of it perfectly, says he, by reading. He goes so far as to say that, even in reading as well as in representation, tragedy has an advantage over the epic, the advantage of greater clearness and distinctness of impression. And in some measure this was perhaps true of Greek tragedy, for as Müller in his *Dissertations on the Eumenides* has well said, the ancients always remained and wished to remain conscious that the whole was a Dionysian entertainment; the quest of a commonplace ἀπάτη came afterwards. And even of Romantic Drama it may be said that in the time of Shakespeare, and indeed down through the 18th century, it never lost entirely its character of a recitation as well as a drama. It was not till melodrama began to be recognized as a legitimate form of dramatic art that the dialogue had to be struck from the dramatic action "at full speed"—struck like sparks from the roadster's shoes. The truth is, however, that it was idle for Aristotle to inquire which is the more important branch of poetry, epic or tragedy. Equally idle would it be for the modern critic to inquire how much romantic drama gained and how much it lost by abandoning the chorus.

Much has been said as to the scope and the limits of epic and dramatic poetry. If in epic the poet has the power to take the imagination of his audience away from the dramatic centre and show what is going on at the other end of the great web of the world, he can do the same thing in drama by the chorus, and also by the introduction into the dramatic circle of messengers and others from the outside world. But, as regards epic poetry, is it right that we should hear, as we sometimes do hear, the voice of the poet himself as chorus bidding us contrast the present picture with other pictures afar off, in order to enforce its teaching and illustrate its pathos? This is a favourite method with modern poets and a still more favourite one with prose narrators. Does it not give an air of self-consciousness to poetry? Does it not disturb the intensity of the poetic vision? Yet it has the sanction of Homer; and who shall dare to challenge the methods of the great father of epic? An instance occurs in *Iliad* v. 158, where, in the midst of all the stress of fight, the poet leaves the dramatic action to tell us what became of the inheritance of Phaenops, after his two sons had been slain by Diomedes. Another instance occurs in iii. 243-244, where the poet, after Helen's pathetic mention of her brothers, comments on the causes of their absence, "criticizes life" in the approved modern way, generalizes upon the impotence of human intelligence—the impotence even of human love—to pierce the darkness in which the web of human fate is woven. Thus she spoke (the poet tells us); but the life-giving earth already possessed them, there in Lacedaemon, in their dear native land:—

ὣς φάτο· τοὺς δ᾽ ἤδη κάτεχεν φυσίζοος αἶα
ἐν Λακεδαίμονι αὖθι, φίλῃ ἐν πατρίδι γαίῃ.

This, of course, is "beautiful exceedingly," but, inasmuch as the imagination at work is egoistic or lyrical, not dramatic; inasmuch as the vision is relative, not absolute, it does not represent that epic strength at its very highest which we call specially "Homeric," unless indeed we remember that with Homer the Muses are omniscient: this certainly may give the passage a deep dramatic value it otherwise seems to lack.

The deepest of all the distinctions between dramatic and epic methods has relation, however, to the nature of the dialogue. Aristotle failed to point it out, and this is remarkable until we remember that his work is but a fragment of a great system of criticism. In epic poetry, and in all poetry that narrates, whether the poet be Homer, Chaucer, Thomas the Rhymer, Gottfried von Strasburg, or Turoldus, the action, of course, moved by aid partly of narrative and partly by aid of dialogue, but in drama the dialogue has a quality of suggestiveness and subtle inference which we do not expect to find in any other poetic form save perhaps that of the purely dramatic ballad. In ancient drama this quality of suggestiveness and subtle inference is seen not only in the dialogue, but in the choral odes. The third ode of the *Agamemnon* is an extreme case in point, where, by a kind of *double entendre*, the relations of Clytaemnestra and Aegisthus are darkly alluded to under cover of allusions to Paris and Helen. Of this dramatic subtlety Sophocles is perhaps the greatest master; and certain critics have been led to speak as though irony were heart-thought of Sophoclean drama. But the suggestiveness of Sophocles is pathetic (as Professor Lewis Campbell has well pointed out), not ironical. This is one reason why drama more than epic seems to satisfy the mere intellect of the reader, though this may be counterbalanced by the hardness of mechanical structure which sometimes disturbs the reader's imagination in tragedy.

When, for instance, a dramatist pays so much attention to the evolution of the plot as Sophocles does, it is inévitable that his characters should be more or less plot-ridden; they have to say and do now and then certain things which they would not say and do but for the exigencies of the plot. Indeed one of the advantages which epic certainly has over drama is that the story can be made to move as rapidly as the poet may desire without these mechanical modifications of character.

The Greek Epic.

The only kind of epic for Aristotle to consider was Greek epic, between which and all other epic the difference is one of kind, if the *Iliad* alone is taken to represent Greek epic. In speaking of the effect that surrounding conditions seem to have upon the form in which the poetic energy of any time or country should express itself, we instanced the *Iliad* as a typical case. The imagination vivifying it is mainly dramatic. The characters represent much more than the mere variety of mood of the delineator. Notwithstanding all the splendid works of Calderon, Marlowe, Webster and Goethe, it is doubtful whether as a born dramatist the poet of the *Iliad* does not come nearer to Aeschylus and Shakespeare than does any other poet. His passion for making the heroes speak for themselves is almost a fault in the *Iliad* considered as pure epic, and the unconscious way in which each actor is made to depict his own character is in the highest spirit of drama. It is owing to this speciality of the *Iliad* that it stands apart from all other epic save that of the *Odyssey*, where, however, the dramatic vision is less vivid. It is owing to the dramatic imagination displayed in the *Iliad* that it is impossible to say, from internal evidence, whether the poem is to be classified with the epics of growth or with the epics of art. All epics are clearly divisible into two classes, first those which are a mere accretion of poems or traditionary ballads, and second, those which, though based indeed on tradition or history, have become so fused in the mind of one great poet, so stained, therefore, with the colour and temper of that mind, as to become new crystallizations—inventions, in short, as we understand that word. Each kind of epic has excellencies peculiar to itself, accompanied by peculiar and indeed necessary defects. In the one we get the freedom—apparently schemeless and motiveless—of nature, but, as a consequence, miss that "hard acorn of thought" (to use the picturesque definition in the *Völsunga Saga* of the heart of a man) which the mind asks for as the core of every work of art. In the other this great requisite of an adequate central thought is found, but accompanied by a constriction, a lack of freedom, a cold artificiality, the obtrusion of a pedantic scheme, which would be intolerable to the natural mind unsophisticated by literary study. The flow of the one is as that of a river, the flow of the other as that of a canal. Yet, as has been already hinted, though the great charm of Nature herself is that she never teases us with any obtrusive exhibitions of scheme, she doubtless has a scheme somewhere, she does somewhere hide a "hard acorn of thought" of which the poem of the universe is the expanded expression. And, this being so, art should have a scheme too; but in such a dilemma is she placed in this matter that the epic poet, unless he is evidently telling the story for its own sake, scornful of purposes ethic or aesthetic, must sacrifice illusion.

Among the former class of epics are to be placed the great epics of growth, such as the *Mahābhārata*, the Nibelung story, &c.; among the latter the *Odyssey*, the *Aeneid*, *Paradise Lost*, the *Gerusalemme liberata*, the *Lusiadas*.

But where in this classification are we to find a place for the *Iliad*? The heart-thought of the greatest epic in all literature is simply that Achilles was vexed and that the fortunes of the world depended upon the whim of a sulky hero. Yet, notwithstanding all the acute criticisms of Wolff, it remains difficult for us to find a place for the *Iliad* among the epics of growth. And why? Because throughout the *Iliad* the dramatic imagination shown is of the first order; and, if we are to suppose a multiplicity of authors for the poem, we must also suppose that ages before the time of Pericles there existed a group of dramatists more nearly akin to the masters of the Great Drama, Aeschylus, Sophocles and Shakespeare, than any group that has ever existed since. Yet it is equally difficult to find a place for it amongst the epics of art. In the matter of *artistic motive* the *Odyssey* stands alone among the epics of art of the world, as we are going to see.

The Epic of Art.

It is manifest that, as the pleasure derived from the epic of art is that of recognizing a conscious scheme, if the epic of art fails through confusion of scheme it fails altogether. What is demanded of the epic of art (as some kind of compensation for that natural freedom of evolution which it can never achieve, that sweet *abandon*, which belongs to nature and to the epic of growth alike) is unity of impression, harmonious and symmetrical development of a conscious heart-thought or motive. This being so, where are we to place the *Aeneid*, and where are we to place the *Shāh Nāmeh*? Starting with the intention, as it seems, of fusing into one harmonious whole the myths and legends upon which the Roman story is based, Virgil, by the time he reaches the middle of his epic, forgets all about this primary intent, and gives us his own thoughts and reflections on things in general. Fine as is the speech of Anchises to Aeneas in Elysium (*Aen.* vi. 724–755), its incongruity with the general scheme of the poem as developed in the previous books shows how entirely Virgil lacked that artistic power shown in the *Odyssey* of making a story become the natural and inevitable outcome of an artistic idea.

In the *Shāh Nāmeh* there is the artistic redaction of Virgil, but with even less attention to a central thought than Virgil exhibits. Firdausi relies for his effects upon the very qualities which characterize not the epic of art but the epic of growth—a natural and not an artificial flow of the story; so much indeed that, if the *Shāh Nāmeh* were studied in connexion with the *Iliad* on the one hand and with the *Kalevala* on the other, it might throw a light upon the way in which an epic may be at one and the same time an aggregation of the national ballad poems and the work of a single artificer. That Firdausi was capable of working from a centre not only artistic but philosophic his *Yūsuf and Zuleikha* shows; and if we consider what was the artistic temper of the Persians in Firdausi's time, what indeed has been that temper during the whole of the Mahommedan period, the subtle temper of the parable poet—the *Shāh Nāmeh*, with its direct appeal to popular sympathies, is a standing wonder in poetic literature.

With regard, however, to Virgil's defective power of working from an artistic motive, as compared with the poet of the *Odyssey*, this is an infirmity he shares with all the poets of the Western world. Certainly he shares it with the writer of *Paradise Lost*, who, setting out to "justify the ways of God to man," forgets occasionally the original worker of the evil, as where, for instance, he substitutes chance as soon as he comes (at the end of the second book) to the point upon which the entire epic movement turns, the escape of Satan from hell and his journey to earth for the ruin of man:—

> "At last his sail-broad vans
> He spreads for flight, and, in the surging smoke
> Uplifted, spurns the ground; thence many a league,
> As in a cloudy chair, ascending rides
> Audacious; but, that seat soon failing, meets
> A vast vacuity; all unawares,
> Fluttering his pinions vain, plumb down he drops
> Ten thousand fathoms deep, and to this hour
> Down had been falling, had not, by ILL CHANCE,
> The strong rebuff of some tumultuous cloud,
> Instinct with fire and nitre, hurried him
> As many miles aloft."

In Milton's case, however, the truth is that he made the mistake of trying to disturb the motive of the story for artistic purposes—a fatal mistake, as we shall see when we come to speak of the *Nibelungenlied* in relation to the old Norse epic cycle.

Though Vondel's mystery play of *Lucifer* is, in its execution, rhetorical more than poetical, it did, beyond all question, influence Milton when he came to write *Paradise Lost*. The famous line which is generally quoted as the keynote of Satan's character—

> "Better to reign in hell than serve in heaven"—

seems to have been taken bodily from Vondel's play, and Milton's entire epic shows a study of it. While Marlowe's majestic movements alone are traceable in Satan's speech (written some years before the rest of *Paradise Lost*, when the dramatic and not the epic form had been selected), Milton's Satan became afterwards a splendid amalgam not of the Mephistopheles but of the *Faustus* of Marlowe and the *Lucifer* of Vondel. Vondel's play must have possessed a peculiar attraction for a poet of Milton's views of human progress. Defective as the play is in execution, it is far otherwise in motive. This motive, if we consider it aright, is nothing less than an explanation of man's anomalous condition on the earth—spirit incarnate in matter, created by God, a little lower than the angels—in order that he may advance by means of these very manacles which imprison him, in order that he may ascend by the staircase of the world, the ladder of fleshly conditions, above those cherubim and seraphim who, lacking the education of sense, have not the knowledge wide and deep which brings man close to God.

Here Milton found his own favourite doctrine of human development and self-education in a concrete and vividly artistic form. Much, however, as such a motive must have struck a man of Milton's instincts, his intellect was too much chained by Calvinism to permit of his treating the subject with Vondel's philosophic breadth. The cause of Lucifer's wrath had to be changed from jealousy of human progress to jealousy of the Son's proclaimed superiority. And the history of poetry shows that once begin to tamper with the central thought around which any group of incidents has crystallized and the entire story becomes thereby rewritten, as we have seen in the case of the *Agamemnon* of Aeschylus. Of the motive of his own epic, after he had abandoned the motive of Vondel, Milton had as little permanent grasp as Virgil had of his. As regards the *Odyssey*, however, we need scarcely say that its motive is merely artistic, not philosophic. And now we come to philosophic motive.

The artist's power of thought is properly shown not in the direct enunciation of ideas but in mastery over motive. Here Aeschylus is by far the greatest figure in Western poetry—a proof perhaps among many proofs of the Oriental strain of his genius. (As regards pure drama, however, important as is motive, freedom, organic vitality in every part, is of more importance than even motive, and in this freedom and easy abandonment the concluding part of the Oresteia is deficient as compared with such a play as *Othello* or *Lear*.) Notwithstanding the splendid exception of Aeschylus, the truth seems to be that the faculty of developing a poetical narrative from a philosophic thought is Oriental, and on the whole foreign to the genius of the Western mind. Neither in Western drama nor in Western epic do we find, save in such rare cases as that of Vondel, anything like that power of developing a story from an idea which not only Jami but all the parable poets of Persia show.

In modern English poetry the motive of Shelley's dramatic poem *Prometheus Unbound* is a notable illustration of what is here contended. Starting with the full intent of developing a drama from a motive—starting with a universalism, a belief that good shall be the final goal of ill—Shelley cannot finish his first three hundred lines without shifting (in the curse of Prometheus) into a Manichaeism as pure as that of Manes himself:—

> "Heap on thy soul, by virtue of this curse,
> Ill deeds, then be thou damned, beholding good;
> *Both* infinite as is the universe."

According to the central thought of the poem human nature, through the heroic protest and struggle of the human mind typified by Prometheus, can at last dethrone that supernatural terror and tyranny (Jupiter) which the human mind had itself installed. But, after its dethronement (when human nature becomes infinitely perfectible), how can the supernatural tyranny exist apart from the human mind that imagined it? How can it be as "infinite as the universe"?

The motive of *Paradise Lost* is assailed with much vigour by Victor Hugo in his poem *Religions et Religion*. But when Hugo, in the after parts of the poem, having destroyed Milton's "God," sets up an entirely French "Dieu" of his own and tries "to justify" him, we perceive how pardonable was Milton's failure after all. Compare such defect of mental grip and such nebulosity of thought as is displayed by Milton, Shelley and Hugo with the strength of hand shown in the "Sālāmān" and "Absal" of Jami, and indeed by the Sufi poets generally.

There is, however, one exception to this rule that Western poetry is nebulous as to motive. There is, besides the *Iliad*, one epic that refuses to be classified, though for entirely different reasons. This is the Nibelung story, where we find unity of purpose and also entire freedom of movement. We find combined here beauties which are nowhere else combined—which are, in fact, at war with each other everywhere else. We find a scheme, a real "acorn of thought," in an epic which is not the self-conscious work of a single poetic artificer, but is as much the slow growth of various times and various minds as is the *Mahābhārata*, in which the heart-thought is merely that the Kauravas defeated their relatives at dice and refused to disgorge their winnings.

This Northern epic-tree, as we find it in the Icelandic sagas, the Norns themselves must have watered; for it combines the virtues of the epic of growth with those of the epic of art. Though not written in metre, it may usefully be compared with the epics of Greece and of India and Persia. Free in movement as the wind, which "bloweth where it listeth," it listeth to move by law. Its action is that of free will, but free will at play within a ring of necessity. Within this ring there throbs all the warm and passionate life of the world outside, and all the freedom apparently. Yet from that world it is enisled by a cordon of curses—by a zone of defiant flames more impregnable than that which girdled the beautiful Brynhild at Hindfell. Natural laws, familiar emotions, are at work everywhere in the story; yet the "Ring of Andvari," whose circumference is but that of a woman's finger, encircles the whole mimic world of the sagaman as the Midgard snake encircles the earth. For this artistic perfection in an epic of growth there are, of course, many causes, some of them traceable and some of them beyond all discovery—causes no doubt akin to those which gave birth to many of the beauties of other epics of growth. Originally Sinfiotli and Sigurd were the same person, and note how vast has been the artistic effect of the separation of the two! Again, there were several different versions of the story of Brynhild. The sagamen, finding all these versions too interesting and too much beloved to be discarded, adopted them all—worked them up into one legend, so that, in the *Völsunga Saga* we have a heroine possessing all the charms of goddess, demi-goddess, earthly princess and amazon—a heroine surpassing perhaps in fascination all other heroines that have ever figured in poetry.

It is when we come to consider such imaginative work as this that we are compelled to pause before challenging the Aristotelian doctrine that metrical structure is but an accidental quality of epic.

In speaking of the Nibelung story we do not, of course, speak of the German version, the *Nibelungenlied*, a fine epic still, though a degradation of the elder form. Between the two the differences are fundamental in the artistic sense, and form an excellent illustration of what has just been said upon the disturbance of motive in epic, and indeed in all poetic art. It is not merely that the endings of the three principal characters, Sigurd (Siegfried), Gudrun (Kriemhilt), and Brynhild are entirely different; it is not merely that the Icelandic version, by missing the blood-bath at Fafnir's lair, loses the pathetic situation of Gudrun's becoming afterwards an unwilling instrument of her husband's death; it is not merely that, on the other hand, the German version, by omitting the early love passages between Brynhild and Sigurd at Hindfell, misses entirely the tragic meaning of her story and the terrible hate that is love resulting from the breaking of the troth; but the conclusion of each version is so exactly the opposite of that of the other that, while the German story is called (and very properly) "Kriemhilt's Revenge," the story of the *Völsunga Saga* might, with equal propriety, be called Gudrun's Forgiveness.

Temper of East and West.

If it be said that, in both cases, the motive shows the same Titanic temper, that is because the Titanic temper is the special characteristic of the North-Western mind. The temper of revolt against authority seems indeed to belong to that energy which succeeds in the modern development of the great racial struggle for life. Although no epic, Eastern or Western, can exist without a struggle between good and evil—and a struggle upon apparently equal terms—it must not be supposed that the warring of conflicting forces which is the motive of Eastern epic has much real relation to the warring of conflicting forces which is the motive of Western epic.

And, as regards the machinery of epic, there is, we suspect, a deeper significance than is commonly apprehended in the fact that the Satan or Shaitan of the Eastern world becomes in Vondel and Milton a sublime Titan who attracts to himself the admiration which in Eastern poetry belongs entirely to the authority of heaven. In Asia, save perhaps among the pure Arabs of the desert, underlying all religious forms, there is apparent a temper of resignation to the irresistible authority of heaven. And as regards the Aryans it is probable that the Titanic temper—the temper of revolt against authority—did not begin to show itself till they had moved across the Caucasus. But what concerns us here is the fact that the farther they moved to the north-west the more vigorously this temper asserted itself, the prouder grew man in his attitude towards the gods, till at last in the Scandinavian cycle he became their equal and struggled alongside them, shoulder to shoulder, in the defence of heaven against the assaults of hell. Therefore, as we say, the student of epic poetry must not suppose that there is any real parallel between the attitude of Vishnu (as Rama) towards Ravana and the attitude of Prometheus towards Zeus, or the attitude of the human heroes towards Odin in Scandinavian poetry. Had Ravana been clothed with a properly constituted authority, had he been a legitimate god instead of a demon, the Eastern doctrine of recognition of authority would most likely have come in and the world would have been spared one at least of its enormous epics. Indeed, the Ravana of the *Rāmāyana* answers somewhat to the Fafnir of the *Völsunga Saga*; and to plot against demons is not to rebel against authority. The vast field of Indian epic, however, is quite beyond us here.

Nor can we do more than glance at the *Kalevala*. From one point of view that group of ballads might be taken, no doubt, as a simple record of how the men of Kalevala were skilful in capturing the sisters of the Pojohla men. But from another point of view the universal struggle of the male for the female seems typified in this so-called epic of the Finns by the picture of the "Lady of the Rainbow" sitting upon her glowing arc and weaving her golden threads, while the hero is doing battle with the malevolent forces of nature.

But it is in the Nibelung story that the temper of Western epic is at its best—the temper of the simple fighter, whose business it is to fight. The ideal Western fighter was not known in Greece till ages after Homer, when in the pass of Thermopylae the companions of Leonidas combed their long hair in the sun. The business of the fighter in Scandinavian epic is to yield to no power whatsoever, whether of earth or heaven or hell—to take a buffet from the Allfather himself, and to return it; to look Destiny herself in the face, crying out for quarter neither to gods nor demons nor Norns. This is the true temper of pure "heroic poetry" as it has hitherto flourished on this side the Caucasus—the temper of the fighter who is invincible because he feels that Fate herself falters when the hero of the true strain defies—the fighter who feels that the very Norns themselves must cringe at last before the simple courage of man standing naked and bare of hope against all assaults, whether of heaven or hell or doom. The proud heroes of the *Völsunga Saga* utter no moans and shed no Homeric tears, knowing as they know that the day prophesied is sure when, shoulder to shoulder, gods and men shall stand up to fight the entire brood of night and evil, storming the very gates of Asgard.

That this temper is not the highest from the ethical point of view is no doubt true. Against the beautiful resignation of Buddhism it may seem barbaric, and if moral suasion could supplant physical force in epic—if Siddartha could take the place of Achilles or Sigurd—it might be better for the human race.

The Lyric Imagination.

But we must now give undivided attention to pure egoistic or lyric imagination. This, as has been said, is sufficient to vitalize all forms of poetic art save drama and the Greek epic. It would be impossible to discuss adequately here the Hebrew poets, who have produced a lyric so different in kind from all other lyrics as to stand in a class by itself. As it is equal in importance to the Great Drama of Shakespeare, Aeschylus and Sophocles, we may perhaps be allowed to call it the "Great Lyric." The Great Lyric must be religious—it must, it would seem, be an outpouring of the soul, not towards man but towards God, like that of the God-intoxicated prophets and psalmists of Scripture. Even the lyric fire of Pindar owes much to the fact that he had a childlike belief in the myths to which so many of his contemporaries had begun to give a languid assent. But there is nothing in Pindar, or indeed elsewhere in Greek poetry, like the rapturous song, combining unconscious power with unconscious grace, which we have called the Great Lyric. It might perhaps be said indeed that the Great Lyric is purely Hebrew. But, although we could hardly expect to find it among those whose language, complex of syntax and alive with self-conscious inflexions, bespeaks the scientific knowingness of the Western mind, to call the temper of the Great Lyric broadly "Asiatic" would be rash. It seems to belong as a birthright to those descendants of Shem who, yearning always to look straight into the face of God and live, could (when the Great Lyric was sung) see not much else.

Though two of the artistic elements of the Great Lyric, unconsciousness and power, are no doubt plentiful enough in India, the element of grace is lacking for the most part. The Vedic hymns are both nebulous and unemotional, as compared with Semitic hymns. And as to the Persians, they, it would seem, have the grace always, the power often, but the unconsciousness almost never. This is inevitable if we consider for a moment the chief characteristic of the Persian imagination—an imagination whose wings are not so much "bright with beauty" as heavy with it—heavy as the wings of a golden pheasant—steeped in beauty like the "tiger-moth's deep damasked wings." Now beauty of this kind does not go to the making of the Great Lyric.

Then there comes that poetry which, being ethnologically Semitic, might be supposed to exhibit something at least of the Hebrew temper—the Arabian. But, whatever may be said of the oldest Arabic poetry, with its deep sense of fate and pain, it would seem that nothing can be more unlike than the Hebrew temper and the Arabian temper as seen in later poets. It is not with Hebrew but with Persian poetry that Arabian poetry can be usefully compared. If the wings of the Persian imagination are heavy with beauty, those of the later Arabian imagination are bright with beauty—brilliant as an Eastern butterfly, quick and agile as a dragon-fly or a humming-bird. To the eye of the Persian poet the hues of earth are (as Firdausi says of the garden of Afrasiab) “ like the tapestry of the kings of Ormuz, the air is perfumed with musk, and the waters of the brooks are the essence of roses.” And to the later Arabian no less than to the Persian the earth is beautiful; but it is the clear and sparkling beauty of the earth as she “ wakes up to life, greeting the Sabaean morning ”; we feel the light more than the colour. But it is neither the Persian's instinct for beauty nor the Arabian's quenchless wit and exhaustless animal spirits that go to the making of the Great Lyric; far from it. In a word, the Great Lyric, as we have said, cannot be assigned to the Asiatic temper generally any more than it can be assigned to the European temper.

The Ode.

In the poetry of Europe, if we cannot say of Pindar, devout as he is, that he produced the Great Lyric, what can we say of any other European poet? The truth is that, like the Great Drama, so straight and so warm does it seem to come from the heart of man in its highest moods that we scarcely feel it to be literature at all. Passing, however, from this supreme expression of lyrical imagination, we come to the artistic ode, upon which subject the present writer can only reiterate here what he has more fully said upon a former occasion. Whatever may have been said to the contrary, enthusiasm is, in the nature of things, the very basis of the ode; for the ode is a mono-drama, the actor in which is the poet himself; and, as Marmontel has well pointed out, if the actor in the mono-drama is not affected by the sentiments he expresses, the ode must be cold and lifeless. But, although the ode is a natural poetic method of the poet considered as prophet—although it is the voice of poetry as a fine frenzy—it must not be supposed that there is anything lawless in its structure. “ Pindar,” says the Italian critic Gravina, “ launches his verses upon the bosom of the sea; he spreads out all his sails; he confronts the tempest and the rocks; the waves arise and are ready to engulf him; already he has disappeared from the spectator's view; when suddenly he springs up in the midst of the waters, and reaches happily the shore.” Now it is this Pindaric discursiveness, this Pindaric unrestraint as to the matter, which has led poets to attempt to imitate him by adopting an unrestraint as to form. Although no two odes of Pindar exhibit the same metrical structure (the Aeolian and Lydian rhythms being mingled with the Doric in different proportions), yet each ode is in itself obedient, severely obedient, to structural law. This we feel; but what the law is no metricist has perhaps ever yet been able to explain.

It was a strange misconception that led people for centuries to use the word “ Pindaric ” and irregular as synonymous terms; whereas the very essence of the odes of Pindar (of the few, alas! which survive to us) is their regularity. There is no more difficult form of poetry than this, and for this reason: when in any poetical composition the metres are varied, there must, as the present writer has before pointed out, be a reason for such freedom, and that reason is properly subjective—the varying form must embody and express the varying emotions of the singer. But when these metrical variations are governed by no subjective law at all, but by arbitrary rules supposed to be evolved from the practice of Pindar, then that very variety which should aid the poet in expressing his emotion crystallizes it and makes the ode the most frigid of all compositions. Great as Pindar undoubtedly is, it is deeply to be regretted that no other poet survives to represent the triumphal ode of Greece—the digressions of his subject matter are so wide, and his volubility is so great.

In modern literature the ode has been ruined by theories and experiments. A poet like La Mothe, for instance, writes execrable odes, and then writes a treatise to prove that all odes should be written on the same model. There is much confusion of mind prevalent among poets as to what is and what is not an ode. All odes are, no doubt, divisible into two great classes: those which, following an arrangement in stanzas, are commonly called regular, and those which, following no such arrangement, are commonly called irregular.

We do not agree with those who assert that irregular metres are of necessity inimical to poetic art. On the contrary, we believe that in modern prosody the arrangement of the rhymes and the length of the lines in any rhymed metrical passage may be determined either by a fixed stanzaic law or by a law infinitely deeper—by the law which impels the soul, in a state of poetic exaltation, to seize hold of every kind of metrical aid, such as rhyme, caesura, &c. for the purpose of accentuating and marking off each shade of emotion as it arises, regardless of any demands of stanza. But between the irregularity of makeshift, such as we find it in Cowley and his imitators, and the irregularity of the “ fine frenzy ” of such a poem, for instance, as Coleridge's *Kubla Khan*, there is a difference in kind. Strange that it is not in an ode at all but in this unique lyric *Kubla Khan*, descriptive of imaginative landscape, that an English poet has at last conquered the crowning difficulty of writing in irregular metres. Having broken away from all restraints of couplet and stanza—having caused his rhymes and pauses to fall just where and just when the emotion demands that they should fall, scorning the exigencies of makeshift no less than the exigencies of stanza—he has found what every writer of irregular English odes has sought in vain, a music as entrancing, as natural, and at the same time as inscrutable, as the music of the winds or of the sea.

Stanzaic Law and Emotional Law.

The prearranged effects of sharp contrasts and antiphonal movements, such as some poets have been able to compass, do not of course come under the present definition of irregular metres at all. If a metrical passage does not gain immensely by being written independently of stanzaic law, it loses immensely; and for this reason, perhaps, that the great charm of the music of all verse, as distinguished from the music of prose, is inevitableness of cadence. In regular metres we enjoy the pleasure of feeling that the rhymes will inevitably fall under a recognized law of couplet or stanza. But if the passage flows independently of these, it must still flow inevitably—it must, in short, show that it is governed by another and a yet deeper force, the inevitableness of emotional expression. The lines must be long or short, the rhymes must be arranged after this or after that interval, not because it is convenient so to arrange them, but because the emotion of the poet inexorably demands these and no other arrangements. When, however, Coleridge came to try his hand at irregular odes, such as the odes “ To the Departing Year ” and “ To the Duchess of Devonshire,” he certainly did not succeed.

As to Wordsworth's magnificent “ Ode on Intimations of Immortality,” the sole impeachment of it, but it is a grave one, is that the length of the lines and the arrangement of the rhymes are not always inevitable; they are, except on rare occasions, governed neither by stanzaic nor by emotional law. For instance, what emotional necessity was there for the following rhyme-arrangement?

> “ My heart is at your festival,
> My head hath its coronal,
> The fulness of your bliss I feel—I feel it all.
> Oh, evil day! if I were sullen
> While earth herself is adorning,
> This sweet May morning;
> And the children are culling,
> On every side,
> In a thousand valleys far and wide,
> Fresh flowers.”

Beautiful as is the substance of this entire passage, so far from gaining, it loses by rhyme—loses, not in perspicuity, for Wordsworth like all his contemporaries (except Shelley) is mostly perspicuous, but in that metrical emphasis the quest of which is one of the impulses that leads a poet to write in rhyme. In spite, however, of its metrical defects, this famous ode of Wordsworth's is the finest irregular ode in the language; for, although Coleridge's “ Ode to the Departing Year ” excels it in Pindaric fire, it is below Wordsworth's masterpiece in almost every other quality save rhythm. Among the writers of English irregular odes, next to Wordsworth, stands Dryden. The second stanza of the “ Ode for St Cecilia's Day ” is a great triumph.

Leaving the irregular and turning to the regular ode, it is natural to divide these into two classes: (1) those which are really Pindaric in so far as they consist of strophes, antistrophes and epodes, variously arranged and contrasted; and (2) those which consist of a regular succession of regular stanzas. Perhaps all Pindaric odes tend to show that this form of art is in English a mistake. It is easy enough to write one stanza and call it a strophe, another in a different movement and call it an antistrophe, a third in a different movement still and call it an epode. But in modern prosody, disconnected as it is from musical and from terpsichorean science, what are these? No poet and no critic can say.

What is requisite is that the ear of the reader should catch a great metrical scheme, of which these three varieties of movement are necessary parts—should catch, in short, that inevitableness of structure upon which we have already touched. In order to justify a poet in writing a poem in three different kinds of movement, governed by no musical and no terpsichorean necessity, a necessity of another kind should make itself apparent; that is, the metrical wave moving in the strophe should be metrically answered by the counter-wave moving in the antistrophe, while the epode—which, as originally conceived by Stesichorus, was merely a standing still after the balanced movements of the strophe and antistrophe—should clearly, in a language like ours, be a blended echo of these two. A mere metrical contrast such as some poets labour to effect is not a metrical answer. And if the reply to this criticism be that in Pindar himself no such metrical scheme is apparent, that is the strongest possible argument in support of our position. If indeed the metrical scheme of Pindar is not apparent, that is because, having been written for chanting, it was subordinate to the lost musical scheme of the musician. It has been contended, and is likely enough, that this musical scheme was simple—as simple, perhaps, as the scheme of a cathedral chant; but to it, whatever it was, the metrical scheme of the poet was subordinated. It need scarcely be said that the phrase "metrical scheme" is used here not in the narrow sense as indicating the position and movement of strophe and antistrophe by way of simple contrast, but in the deep metrical sense as indicating the value of each of these component parts of the ode, as a counter-wave balancing and explaining the other waves in the harmony of the entire composition. We touch upon this matter in order to show that the moment odes ceased to be chanted, the words strophe, antistrophe, and epode lost the musical value they had among the Greeks, and pretended to a complex metrical value which their actual metrical structure does not appear to justify. It does not follow from this that odes should not be so arranged, but it does follow that the poet's arrangement should justify itself by disclosing an entire metrical scheme in place of the musical scheme to which the Greek choral lyric was evidently subordinated. But even if the poet were a sufficiently skilled metricist to compass a scheme embracing a wave, an answering wave, and an echo gathering up the tones of each, *i.e.* the strophe, the antistrophe and the epode, the ear of the reader, unaided by the musical emphasis which supported the rhythms of the old choral lyric, is, it should seem, incapable of gathering up and remembering the sounds further than the strophe and the antistrophe, after which it demands not an epode but a return to the strophe. That is to say, an epode, as alternating in the body of the modern ode, is a mistake; a single epode at the end of a group of strophes and antistrophes (as in some of the Greek odes) has, of course, a different function altogether.

The great difficulty of the English ode is that of preventing the apparent spontaneity of the impulse from being marred by the apparent artifice of the form; for, assuredly, no writer subsequent to Coleridge and to Keats would dream of writing an ode on the cold Horatian principles adopted by Warton, and even by Collins, in his beautiful "Ode to Evening."

Of the second kind of regular odes, those consisting of a regular succession of regular stanzas, the so-called odes of Sappho are, of course, so transcendent that no other amatory lyrics can be compared with them. Never before these songs were sung and never since did the human soul, in the grip of a fiery passion, utter a cry like hers; and from the executive point of view, in directness, in lucidity, in that high imperious verbal economy which only nature herself can teach the artist, she has no equal, and none worthy to take the place of second—not even in Heine, nor even in Burns. Turning, however, to modern poetry, there are some magnificent examples of this simple form of ode in English poetry—Spenser's immortal "Epithalamion" leading the way in point of time, and probably also in point of excellence.

Fervour being absolutely essential, we think, to a great English ode, fluidity of metrical movement can never be dispensed with. The more billowy the metrical waves the better suited are they to render the emotions expressed by the ode, as the reader will see by referring to Coleridge's "Ode to France" (the finest ode in the English language, according to Shelley), and giving special attention to the first stanza—to the way in which the first metrical wave, after it had gently fallen at the end of the first quatrain, leaps up again on the double rhymes (which are expressly introduced for this effect), and goes bounding on, billow after billow, to the end of the stanza. Not that this fine ode is quite free from the great vice of the English ode, rhetoric. If we except Spenser and, in one instance, Collins, it can hardly be said that any English writer before Shelley and Keats produced odes independent of rhetoric and supported by pure poetry alone. But fervid as are Shelley's "Ode to the West Wind" and Keats's odes "To a Nightingale" and "On a Grecian Urn," they are entirely free from rhetorical flavour. Notwithstanding that in the "Ode on a Grecian Urn" the first stanza does not match in rhyme arrangement with the others, while the second stanza of the "Ode to a Nightingale" varies from the rest by running on four rhyme-sounds instead of five, vexing the ear at first by disappointed expectation, these two odes are, after Coleridge's "France," the finest regular odes perhaps in the English language.

With regard to the French ode, Malherbe was the first writer who brought it to perfection. Malherbe showed also more variety of mood than it is the fashion just now to credit him with. This may be especially noted in his "Ode to Louis XIII." His disciple Racan is not of much account. There is certainly much vigour in the odes of Rousseau, but it is not till we reach Victor Hugo that we realize what French poetry can achieve in this line; and contemporary poetry can hardly be examined here. We may say, however, that some of Hugo's odes are truly magnificent. As a pure lyrist his place among the greatest poets of the world is very high. Here, though writing in an inferior language, he ranks with the greatest masters of Greece, of England, and of Germany. Had he attempted no other kind of poetry than lyrical, his would still have been the first name in French poetry. Whatever is defective in his work arises, as in the case of Euripides, from the importation of lyrical force where dramatic force is mainly needed.

The Song.

The main varieties of lyrical poetry, such as the idyll, the satire, the ballad, the sonnet, &c., are treated in separate articles; but a word or two must be said here about the song and the elegy. To write a good song requires that simplicity of grammatical structure which is foreign to many natures—that mastery over direct and simple speech which only true passion and feeling can give, and which "coming from the heart goes to the heart." Without going so far as to say that no man is a poet who cannot write a good song, it may certainly be said that no man can write a good song who is not a good poet. In modern times we have, of course, nothing in any way representing those choral dance-songs of the Greeks, which, originating in the primitive Cretan war-dances, became, in Pindar's time, a splendid blending of song and ballet. Nor have we anything exactly representing the Greek scolia, those short drinking songs of which Terpander is said to have been the inventor. That these scolia were written, not only by poets like Alcaeus, Anacreon, Praxilla, Simonides, but also by Sappho and by Pindar, shows in what high esteem they were held by the Greeks. These songs seem to have been as brief as the stornelli of the Italian peasant. They were accompanied by the lyre, which was handed from singer to singer as the time for each scolion came round.

With regard to the stornello, many critics seem to confound it with the rispetto, a very different kind of song. The Italian *rispetto* consists of a stanza of inter-rhyming lines ranging from six to ten in number, but often not exceeding eight. The Tuscan and Umbrian *stornello* is much shorter, consisting, indeed, of a hemistich naming some natural object which suggests the motive of the little poem. The nearest approach to the Italian stornello appears to be, not the rispetto, but the Welsh triban.

Perhaps the mere difficulty of rhyming in English and the facility of rhyming in Italian must be taken into account when we inquire why there is nothing in Scotland—of course there could be nothing in England—answering to the nature-poetry of the Italian peasant. Most of the Italian rispetti and stornelli seem to be improvisations; and to improvise in English is as difficult as to improvise is easy in Italian. Nothing indeed is more interesting than the improvisatorial poetry of the Italian peasants, such as the canzone. If the peasantry discover who is the composer of a canzone, they will not sing it. The speciality of Italian peasant poetry is that the symbol which is mostly erotic is of the purest and most tender kind. A peasant girl will improvise a song as impassioned as "Come into the Garden, Maud," and as free from unwholesome taint.

With regard to English songs, the critic cannot but ask—Wherein lies the lost ring and charm of the Elizabethan song-writers? Since the Jacobean period at least, few have succeeded in the art of writing real songs as distinguished from mere book lyrics. Between songs to be sung and songs to be read there is in our time a difference as wide as that which exists between plays for the closet and plays for the boards.

Heartiness and melody—the two requisites of a song which can never be dispensed with—can rarely be compassed, it seems, by one and the same individual. In both these qualities the Elizabethan poets stand pre-eminent, though even with them the melody is not so singable as it might be made. Since their time heartiness has, perhaps, been a Scottish rather than an English endowment of the song-writer. It is difficult to imagine an Englishman writing a song like "Tullochgorum" or a song like "Maggie Lauder," where the heartiness and impulse of the poet's mood conquer all impediments of close vowels and rugged consonantal combinations. Of Scottish song-writers Burns is, of course, the head; for the songs of John Skinner, the heartiest song-writer that has appeared in Great Britain (not excluding Herrick), are too few in number to entitle him to be placed beside a poet so prolific in heartiness and melody as Burns. With regard to Campbell's heartiness, this is quite a different quality from the heartiness of Burns and Skinner, and is in quality English rather than Scottish, though, no doubt, it is of a fine and rare strain, especially in "The Battle of the Baltic." His songs illustrate an infirmity which even the Scottish song-writers share with the English—a defective sense of that true song-warble which we get in the stornelli and rispetti of the Italian peasants. A poet may have heartiness in plenty, but if he has that love of consonantal effects which Donne displays he will never write a first-rate song. Here, indeed, is the crowning difficulty of song-writing. An extreme simplicity of structure and of diction must be accompanied by an instinctive apprehension of the melodic capabilities of verbal sounds, and of what Samuel Lover, the Irish song-writer, called "singing" words, which is rare in this country, and seems to belong to the Celtic rather than to the Saxon ear. "The song-writer," says Lover, "must frame his song of open vowels with as few guttural or hissing sounds as possible, and he must be content sometimes to sacrifice grandeur and vigour to the necessity of selecting singing words and not reading words." And he exemplifies the distinction between singing words and reading words by a line from one of Shelley's songs—

"'The fresh earth in new leaves drest,'

"where nearly every word shuts up the mouth instead of opening it." But closeness of vowel sounds is by no means the only thing to be avoided in song-writing. A phrase may be absolutely unsingable, though the vowels be open enough, if it is loaded with consonants. The truth is that in song-writing it is quite as important, in a consonantal language like ours, to attend to the consonants as to the vowels; and perhaps the first thing to avoid in writing English songs is the frequent recurrence of the sibilant. But this applies to all the brief and quintessential forms of poetry, such as the sonnet, the elegy, &c.

The Elegy.

As to the elegy—a form of poetic art which has more relation to the objects of the external world than the song, but less relation to these than the stornello—its scope seems to be wide indeed, as practised by such various writers as Tyrtaeus, Theognis, Catullus, Tibullus, and our own Gray. It may almost be said that perfection of form is more necessary here and in the sonnet than in the song, inasmuch as the artistic pretensions are more pronounced. Hence even such apparent minutiae as those we have hinted at above must not be neglected here.

Phonetic Perfection.

We have quoted Dionysius of Halicarnassus in relation to the arrangement of words in poetry. His remarks on sibilants are equally deserving of attention. He goes so far as to say that σ is entirely disagreeable, and, when it often recurs, insupportable. The hiss seems to him to be more appropriate to the beast than to man. Hence certain writers, he says, often avoid it, and employ it with regret. Some, he tells us, have composed entire odes without it. But if sibilation is a defect in Greek odes, where the softening effect of the vowel sounds is so potent, it is much more so in English poetry, where the consonants dominate, though it will be only specially noticeable in the brief and quintessential forms such as the song, the sonnet, the elegy. Many poets only attend to their sibilants when these clog the rhythm. To write even the briefest song without a sibilant would be a *tour de force*; to write a good one would no doubt be next to impossible. It is singular that the only metricist who ever attempted it was John Thelwall, the famous "Citizen John," friend of Lamb and Coleridge, and editor of the famous *Champion* newspaper, where many of Lamb's epigrams appeared. Thelwall gave much attention to metrical questions, and tried his hand at various metres. Though "Citizen John's" sapphics might certainly have been better, he had a very remarkable critical insight into the rationale of metrical effects, and his "Song without a Sibilant" is extremely neat and ingenious. Of course, however, it would be mere pedantry to exaggerate this objection to sibilants even in these brief forms of poetry. (T. W.-D.)

POGGENDORFF, JOHANN CHRISTIAN (1796–1877), German physicist, was born in Hamburg on the 29th of December 1796. His father, a wealthy manufacturer, having been all but ruined by the French siege, he had, when only sixteen, to apprentice himself to an apothecary in Hamburg, and when twenty-two began to earn his living as an apothecary's assistant at Itzehoe. Ambition and a strong inclination towards a scientific career led him to throw up his business and remove to Berlin, where he entered the university in 1820. Here his abilities were speedily recognized, and in 1823 he was appointed meteorological observer to the Academy of Sciences. Even at this early period he had conceived the idea of founding a physical and chemical scientific journal, and the realization of this plan was hastened by the sudden death of L. W. Gilbert, the editor of *Gilberts Annalen der Physik*, in 1824. Poggendorff immediately put himself in communication with the publisher, Barth of Leipzig, with the result that he was installed as editor of a scientific journal, *Annalen der Physik und Chemie*, which was to be a continuation of *Gilberts Annalen* on a somewhat extended plan. Poggendorff was admirably qualified for the post. He had an extraordinary memory, well stored with scientific knowledge, both modern and historical, a cool and impartial judgment, and a strong preference for facts as against theory of the speculative kind. He was thus able to throw himself into the spirit of modern experimental science. He possessed in abundant measure the German virtue of orderliness in the arrangement of knowledge and in the conduct of business. Further he had an engaging geniality of manner and much tact in dealing with men. These qualities soon made *Poggendorffs Annalen* the foremost scientific journal in Europe.

In the course of his fifty-two years' editorship of the *Annalen* Poggendorff could not fail to acquire an unusual acquaintance with the labours of modern men of science. This knowledge, joined to what he had gathered by historical reading of equally unusual extent, he carefully digested and gave to the world in his *Biographisch-literarisches Handwörterbuch zur Geschichte der exacten Wissenschaften*, containing notices of the lives and labours of mathematicians, astronomers, physicists, and chemists, of all peoples and all ages. This work contains an astounding collection of facts invaluable to the scientific biographer and historian. The first two volumes were published in 1863; after his death a third volume appeared in 1898, covering the period 1858–1883, and a fourth in 1904, coming down to the beginning of the 20th century.

Poggendorff was a physicist of high although not of the very highest rank. He was wanting in mathematical ability, and never displayed in any remarkable degree the still more important power of scientific generalization, which, whether accompanied by mathematical skill or not, never fails to mark the highest genius in physical science. He was, however, an able and conscientious experimenter, and was very fertile and ingenious in devising physical apparatus. By far the greater and more important part of his work related to electricity and magnetism. His literary and scientific reputation speedily brought him honourable recognition. In 1830 he was made royal professor, in 1834 Hon. Ph.D. and extraordinary professor in the university of Berlin, and in 1839 member of the Berlin Academy of Sciences. Many offers of ordinary professorships were made to him, but he declined them all, devoting himself to his duties as editor of the *Annalen*, and to the pursuit of his scientific researches. He died at Berlin on the 24th of January 1877.

POGGIO (1380–1459). Gian Francesco Poggio Bracciolini, Italian scholar of the Renaissance, was born in 1380 at Terranuova, a village in the territory of Florence. He studied Latin under John of Ravenna, and Greek under Manuel Chrysoloras. His distinguished abilities and his dexterity as a copyist of MSS. brought him into early notice with the chief scholars of Florence. Coluccio Salutati and Niccolo de' Niccoli befriended him, and in the year 1402 or 1403 he was received into the service of the Roman curia. His functions were those of a secretary; and, though he profited by benefices conferred on him in lieu of salary, he remained a layman to the end of his life. It is noticeable that, while he held his office in the curia through that momentous period of fifty years which witnessed the Councils of Constance and of Basel, and the final restoration of the papacy under Nicholas V., his sympathies were never attracted to ecclesiastical affairs. Nothing marks the secular attitude of the Italians at an epoch which decided the future course of both Renaissance and Reformation more strongly than the mundane proclivities of this apostolic secretary, heart and soul devoted to the resuscitation of classical studies amid conflicts of popes and antipopes, cardinals and councils, in all of which he bore an official part. Thus, when his duties called him to Constance in 1414, he employed his leisure in exploring the libraries of Swiss and Swabian convents. The treasures he brought to light at Reichenau, Weingarten, and above all St Gall, restored many lost masterpieces of Latin literature, and supplied students with the texts of authors whose works had hitherto been accessible only in mutilated copies. In one of his epistles he describes how he recovered Quintilian, part of Valerius Flaccus, and the commentaries of Asconius Pedianus at St Gall. MSS. of Lucretius, Columella, Silius Italicus, Manilius and Vitruvius were unearthed, copied by his hand, and communicated to the learned. Wherever Poggio went he carried on the same industry of research. At Langres he discovered Cicero's *Oration for Caecina*, at Monte Cassino a MS. of Frontinus. He also could boast of having recovered Ammianus Marcellinus, Nonius Marcellus, Probus, Flavius Caper and Eutyches. If a codex could not be obtained by fair means, he was ready to use fraud, as when he bribed a monk to abstract a Livy and an Ammianus from the convent library of Hersfield. Resolute in recognizing erudition as the chief concern of man, he sighed over the folly of popes and princes, who spent their time in wars and ecclesiastical disputes when they might have been more profitably employed in reviving the lost learning of antiquity. This point of view is eminently characteristic of the earlier Italian Renaissance. The men of that nation and of that epoch were bent on creating a new intellectual atmosphere for Europe by means of vital contact with antiquity. Poggio, like Aeneas Sylvius Piccolomini (Pius II.), was a great traveller, and wherever he went he brought enlightened powers of observation trained in liberal studies to bear upon the manners of the countries he visited. We owe to his pen curious remarks on English and Swiss customs, valuable notes on the remains of antique art in Rome, and a singularly striking portrait of Jerome of Prague as he appeared before the judges who condemned him to the stake. It is necessary to dwell at length upon Poggio's devotion to the task of recovering the classics, and upon his disengagement from all but humanistic interests, because these were the most marked feature of his character and career. In literature he embraced the whole sphere of contemporary studies, and distinguished himself as an orator, a writer of rhetorical treatises, a panegyrist of the dead, a violent impugner of the living, a translator from the Greek, an epistolographer and grave historian and a facetious compiler of fabliaux in Latin. On his moral essays it may suffice to notice the dissertations *On Nobility*, *On Vicissitudes of Fortune*, *On the Misery of Human Life*, *On the Infelicity of Princes* and *On Marriage in Old Age*. These compositions belonged to a species which, since Petrarch set the fashion, were very popular among Italian scholars. They have lost their value, except for the few matters of fact embedded in a mass of commonplace meditation, and for some occasionally brilliant illustrations. Poggio's *History of Florence*, written in avowed imitation of Livy's manner, requires separate mention, since it exemplifies by its defects the weakness of that merely stylistic treatment which deprived so much of Bruni's, Carlo Aretino's and Bembo's work of historical weight. A somewhat different criticism must be passed on the *Facetiae*, a collection of humorous and indecent tales expressed in such Latinity as Poggio could command. This book is chiefly remarkable for its unsparing satires on the monastic orders and the secular clergy. It is also noticeable as illustrating the latinizing tendency of an age which gave classic form to the lightest essays of the fancy. Poggio, it may be observed, was a fluent and copious writer in the Latin tongue, but not an elegant scholar. His knowledge of the ancient authors was wide, but his taste was not select, and his erudition was superficial. His translation of Xenophon's *Cyropaedia* into Latin cannot be praised for accuracy. Among contemporaries he passed for one of the most formidable polemical or gladiatorial rhetoricians; and a considerable section of his extant works are invectives. One of these, the *Dialogue against Hypocrites*, was aimed in a spirit of vindictive hatred at the vices of ecclesiastics; another, written at the request of Nicholas V., covered the anti-pope Felix with scurrilous abuse. But his most famous compositions in this kind are the personal invectives which he discharged against Filelfo and Valla. All the resources of a copious and unclean Latin vocabulary were employed to degrade the objects of his satire; and every crime of which humanity is capable was ascribed to them without discrimination. In Filelfo and Valla Poggio found his match; and Italy was amused for years with the spectacle of their indecent combats. To dwell upon such literary infamies would be below the dignity of the historian, were it not that these habits of the early Italian humanists imposed a fashion upon Europe which extended to the later age of Scaliger's contentions with Scioppius and Milton's with Salmasius. The greater part of Poggio's long life was spent in attendance to his duties in the papal curia at Rome and elsewhere. But about the year 1452 he finally retired to Florence, where he was admitted to the burghership, and on the death of Carlo Aretino in 1453 was appointed chancellor and historiographer to the republic. He had already built himself a villa in Valdarno, which he adorned with a collection of antique sculpture, coins and inscriptions. In 1435 he had married a girl of eighteen named Vaggia, of the famous Buondelmonte blood. His declining days were spent in the discharge of his honourable Florentine office and in the composition of his history. He died in 1459, and was buried in the church of Santa Croce. A statue by Donatello and a picture by Antonio del Pollajuolo remained to commemorate a citizen who chiefly for his services to humanistic literature deserved the notice of posterity.

Poggio's works were printed at Basel in 1538, "ex aedibus Henrici Petri." Dr Shepherd's *Life of Poggio Bracciolini* (1802) is a good authority on his biography. For his position in the history of the revival, see Voigt's *Wiederbelebung des classischen Alterthums*, and Symonds's *Renaissance in Italy*. (J. A. S.)

POGLIZZA (Serbo-Croatian, Poljica), a tract of mountainous land in Dalmatia, Austria; formerly the seat of an independent republic. The territories of Poglizza lay chiefly within the south-easterly curve made by the river Cetina before it enters the Adriatic at Almissa (Omiš). They also comprised the fastnesses of the Mossor range (4500 ft.) and the fertile strip of coast from Almissa to Stobrez, 10 m. W.N.W. The inhabitants lived in scattered villages, each ruled by its count, and all together ruled by the supreme count. These officers, with the three judges, were always of noble birth, though elected by the whole body of citizens. There were two orders of nobles; the higher, including about 20 families, claimed Hungarian descent; the lower, claiming kinship with the Bosnian aristocracy. Below these ranked the commoners and the serfs. At a very early date the warlike highlanders of Poglizza became the friends and allies of the Almissan corsairs, who were thus enabled to harass the seaborne trade of their neighbours without fear of a sudden attack by land. Almissa received a charter from Andrew II. of Hungary in 1207, and remained under the nominal protection of Hungary until 1444, when both Almissa and Poglizza accepted the suzerainty of Venice, while retaining their internal freedom. The population of Poglizza numbered 6566 in 1806. In the following year, however, the republic incurred the enmity of Napoleon by rendering aid to the Russians and Montenegrins in Dalmatia; and it was invaded by French troops, who plundered its villages, massacred its inhabitants, and finally deprived it of independence.

See the *Annuario Dalmatico* for 1885 (published at Zara); and A. Fortis, *Travels into Dalmatia* (London, 1778).

POINCARÉ, RAYMOND (1860–), French statesman, was born at Bar-le-duc on the 20th of August 1860, the son of Nicolas Antoinin Hélène Poincaré, a distinguished civil servant and meteorologist. Educated at the university of Paris, Raymond was called to the Paris bar, and was for some time law editor of the *Voltaire*. He had served for over a year in the department of agriculture when in 1887 he was elected deputy for the Meuse. He made a great reputation in the Chamber as an economist, and sat on the budget commissions of 1890–1891 and 1892. He was minister of education, fine arts and religion in the first cabinet (April–Nov. 1893) of Charles Dupuy, and minister of finance in the second and third (May 1894–Jan. 1895). In the succeeding Ribot cabinet Poincaré became minister of public instruction. Although he was excluded from the Radical cabinet which followed, the revised scheme of death duties proposed by the new ministry was based upon his proposals of the previous year. He became vice-president of the chamber in the autumn of 1895, and in spite of the bitter hostility of the Radicals retained his position in 1896 and 1897. In 1906 he returned to the ministry of finance in the short-lived Sarrien ministry. Poincaré had retained his practice at the bar during his political career, and he published several volumes of essays on literary and political subjects.

His brother, Lucien Poincaré (b. 1862), famous as a physicist, became inspector-general of public instruction in 1902. He is the author of *La Physique moderne* (1906) and *L'Électricité* (1907). Jules Henri Poincaré (b. 1854), also a distinguished physicist, belongs to another branch of the same family.

POINSETTIA. The *Poinsettia pulcherrima* of gardens (*Euphorbia pulcherrima* of botanists), a native of Mexico and Central America, with its brilliant scarlet bracts, stands unrivalled amongst decorative plants. The white-bracted sort, var. *alba*, is not so effective, but the double-flowered, var. *plenissima*, in which the brilliant inflorescence is branched, is as brilliant as the type, and keeps long in flower. They are increased by cuttings in spring, which when taken off with a heel strike freely in brisk heat. They require good turfy loam, with an addition of one-sixth of leaf-mould and a little sand, and should be kept in a heat of from 65° to 70° at night, with a rise of 10° by day. To prevent their growing lanky, they should be kept with their heads almost touching the glass; and as the pots get filled with roots they must be shifted into others, 7 or 8 in. in diameter. About August they may be inured to a heat of 50° at night, and should be brought to bear air night and day whilst the weather is warm, or they may be placed out of doors for a month under a south wall in the full sun. This treatment matures and prepares them for flowering. In autumn they must be removed to a house where the temperature is 50° at night, and by the end of September some of them may be put in the stove, where they will come into flower, the remainder being placed under heat later for succession. When in bloom they may be kept at about 55° by night, and so placed will last longer than if kept in a higher temperature.

POINSOT, LOUIS (1777–1859), French mathematician, was born at Paris on the 3rd of January 1777. In 1794 he became a scholar at the École Polytechnique, which he left in 1796 to act as a civil engineer. In 1804 he was appointed professor of mathematics at the Lycée, in 1809 professor of analysis and mechanics, and in 1816 examiner at the École Polytechnique. On the death of J. L. Lagrange, in 1813, Poinsot was elected to his place in the Académie des Sciences; and in 1840 he became a member of the superior council of public instruction. In 1846 he was made an officer of the Legion of Honour; and on the formation of the senate in 1852 he was chosen a member of that body. He died at Paris on the 5th of December 1859.

Poinsot's earliest work was his *Élémens de statique* (1803; 9th edition, 1848), in which he introduces the idea of statical couples and investigates their properties. In the *Théorie nouvelle de la rotation des corps* (1834) he treats the motion of a rigid body geometrically, and shows that the most general motion of such a body can be represented at any instant by a rotation about an axis combined with a translation parallel to this axis, and that any motion of a body of which one point is fixed may be produced by the rolling of a cone fixed in the body on a cone fixed in space. The previous treatment of the motion of a rigid body had in every case been purely analytical, and so gave no aid to the formation of a mental picture of the body's motion; and the great value of this work lies in the fact that, as Poinsot himself says in the introduction, it enables us to represent to ourselves the motion of a rigid body as clearly as that of a moving point. In addition to publishing a number of works on geometrical and mechanical subjects, Poinsot also contributed a number of papers on pure and applied mathematics to *Lionville's Journal* and other scientific periodicals.

See J. L. F. Bertrand, *Discours aux funérailles de Poinsot* (Paris, 1860).

POINT PLEASANT, a town and the county-seat of Mason county, West Virginia, U.S.A., on the Ohio river, at the mouth of the Kanawha river, and about midway between Pittsburg and Cincinnati. Pop. (1900) 1934; (1910) 2045. It is served directly by the Baltimore & Ohio and the Kanawha & Michigan (controlled by the Hocking Valley) railways, and by the Hocking Valley railway on the opposite side of the Ohio river. The Kanawha river is navigable (by the use of locks and dams) for 90 m. above the town, and Point Pleasant is a re-shipping point for Kanawha coal. Coal and salt are mined in the vicinity, but the surrounding country is principally agricultural.

The battle of Point Pleasant, the only important engagement in "Lord Dunmore's War," was fought here on the 10th of October 1774 between about 1100 Virginia militiamen, under General Andrew Lewis (*c.* 1720–1781),[1] and about 1000 Shawnees and their allies, under their chief, Cornstalk (*c.* 1720–1777).[2] Lewis had been ordered to meet Lord Dunmore here with a body of militiamen (recruited from Botetourt, West Augusta and Fincastle counties), but when he reached the mouth of the Kanawha, after marching 160 m. from Fort Union (now Lewisburg, W. Va.), Dunmore's force, which was to have gone over the Braddock trail to Fort Pitt, and thence down the Ohio river, had not arrived. Early on the morning of the 10th the Indians suddenly attacked, and the battle continued fiercely throughout the day. At night the Indians crossed the Ohio river, leaving behind many of their dead. The whites lost about 144 in killed and wounded, Colonel Charles Lewis (1733–1774), a brother of the commanding officer, being among the former. In December Lord Dunmore concluded a treaty with the Indians, by which they surrendered their claim to lands south of the Ohio and agreed not to molest whites travelling to the western country. The battle, which overawed the Indians, and the treaty, which was not seriously broken for three years, made possible the rapid settlement of the western country, especially of Kentucky, during the early years of the War of Independence.[3] Four years before the battle the Virginia House of Burgesses had awarded to General Lewis, for his earlier services in the French and Indian War, 9876 acres of land, including the present site of Point Pleasant; the survey of this grant was made by George Washington. After the battle General Lewis sent a detachment to build a fort (called Fort Blair) here; in 1776 Fort Randolph (abandoned in 1779) was erected on the same site, and in 1785 (from which year the permanent settlement of the town may be dated) a third fort was built here. Daniel Boone lived here from 1788 until about 1799. In 1794 the village of Point Pleasant was platted; it was incorporated as a town in 1833. A granite monument (86 ft. high) commemorating the battle was unveiled on the 10th of October 1909.

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[1] General Lewis was born in Donegal, Ireland; served with Washington at Fort Necessity and at Braddock's defeat; was commissioner from Virginia to conclude the treaty with the Six Nations at Fort Stanwix (1768); was a member of the Virginia House of Burgesses for several years; served as a brigadier-general in the War of Independence; and in 1776 forced Lord Dunmore to retire from Gwynn's Island, in Chesapeake Bay, where he had taken refuge.

[2] Cornstalk and his son were killed within the fort at Point Pleasant in November 1777 by Virginian soldiers (contrary to the protests of their commanding officers), who thus avenged the death of a comrade. He was at the time warning the garrison of his inability to hold the Shawnees to the terms of the treaty of 1774. There is a granite monument (erected in 1899) over his grave in the yard of the court-house.

[3] Various American writers have asserted that Lord Dunmore incited the Indians to attack the frontier in order to divert the colonists from their opposition to Great Britain, and that he purposely refrained from effecting a junction with Lewis, so that Lewis might be defeated and Virginia thus be greatly crippled on the eve of the threatened war with the mother country; and the battle itself has accordingly frequently been referred to as the first battle of the War of Independence. The assertions with regard to Lord Dunmore, however, rest on circumstantial evidence alone, and have never been conclusively proved.

See J. T. McAllister's article, "The Battle of Point Pleasant," in the *Virginia Magazine of History and Biography* (1901–1902), vol. x., and Virgil A. Lewis, *History of the Battle of Point Pleasant* (Charleston, W. Va., 1909).

POISON. An exact definition of the word "poison" (derived through Fr. from Lat. *potio*, *potionem*, a drink; *i.e.* a deadly draught) is by no means easy. There is no legal definition of what constitutes a poison, and the definitions usually proposed are apt to include either too much or too little. Generally, a poison may be defined to be a substance having an inherent deleterious property, rendering it capable of destroying life by whatever avenue it is taken into the system; or it is a substance which when introduced into the system, or applied externally, injures health or destroys life irrespective of mechanical means or direct thermal changes. In popular language a poison is a substance capable of destroying life when taken in small quantity; but a substance which destroys life by mechanical means as, *e.g.* powdered glass, is not, strictly speaking, a poison.

The subject of toxicology forms one of the most important branches of medical jurisprudence (*q.v.*). The medical jurist should be familiar with the nature and actions of poisons, the symptoms which they produce, the circumstances which modify their working, the pathological results of their action, and the methods of combating these.

Action of Poisons.—Poisons may exert a twofold action. This may be either local, or remote, or both local and remote. The local action of a poison is usually one of corrosion, inflammation, or a direct effect upon the sensory or motor nerves. The remote actions of poisons are usually of a specific character, though some writers group the remote effects of poisons under two heads, and speak of the common and the specific remote effects of a poison. The local action of a poison of the corrosive class is usually so well marked and obvious that the fact of the administration of a poison of this class is generally unmistakable. The same may be said, in a less degree, of the irritant poisons, especially the mineral irritants; but here the symptoms sometimes so closely simulate those of natural disease as to render the recognition of the administration of poison a matter of difficulty. Hence an accurate acquaintance with the remote specific effects of the various poisons is indispensable to the medical jurist. The class of poisons which has been administered or taken will thus be suggested to his mind by the observation of the symptoms; and not unfrequently the specific poison taken will be suspected. It is almost universally admitted that absorption of a poison is necessary for the production of its specific remote effects, and the old notion that a poison may kill, by its action through the nervous system, without absorption, is abandoned.

Modifying Circumstances.—The ordinary action of a poison may be greatly modified by the largeness of the dose, by the state of aggregation, admixture, or of chemical combination of the poison, by the part or membrane to which it is applied, and by the condition of the patient. Thus, for example, opium may be a medicine or a poison, according to the dose in which it is given; and a dose of the drug which may be beneficial to an adult in certain states of the system may be fatal to a child, or to an adult when suffering from some forms of disease. All barium salts, again, are poisonous, except the quite insoluble sulphate. The simple cyanides, and many double cyanides, are highly poisonous; but yellow prussiate of potash, which is a double cyanide of iron and potassium, is almost without action upon the system. The part or tissue to which a poison is applied greatly affects the activity of a poison, owing to the varying rapidity with which absorption takes place through the cutaneous, mucous and serous surfaces, and by the other tissues of the body. Curare, an arrow poison, may be swallowed in considerable quantity without appreciable result, whilst a minute quantity of the same substance introduced into a wound is speedily fatal. Idiosyncrasy has an important bearing in toxicology. Pork, mutton, certain kinds of fish, more especially shell-fish so-called, and mushrooms have each produced all the symptoms of violent irritant poisoning, whilst other persons who have partaken of the same food at the same time have experienced no ill effects. Some persons are stated, on good authority, to be capable of taking with impunity such poisons as opium, corrosive sublimate, or arsenic, in enormous doses—and this irrespective of habit, which is known to have such an influence in modifying the effects of some poisons, notably the narcotics. A tolerance of poisons is sometimes engendered by disease, so that a poison may fail to produce its customary effect. Thus, opium is tolerated in large quantities in tetanus and in delirium tremens; and mercurial compounds may in some febrile affections fail to produce the usual constitutional effects of the metal. On the other hand, diseases which impede the elimination of a poison may intensify its effects.

The *evidence* that a poison has been administered is based upon the symptoms produced, on the appearances met with in the body after death, on the analysis of articles of food and drink, of excreta and ejecta, and of the organs of the body after death, and on physiological experiments made with substances extracted from the same articles. These physiological experiments are usually made upon animals, but in some cases, as for instance when aconite has to be searched for, the physiological experiments must be made also upon the human subject. The evidence obtained from one or more of these sources, as compared with the properties or effects of various known poisons, will enable the medical jurist to form an opinion as to the administration or non-administration of a poison.

The *symptoms* exhibited by the patient during life rarely fail to afford some clue to the poison taken. Persons may, however, be found dead of whose history nothing can be learned. Here post mortem appearances, chemical analysis, and, it may be, physiological experiments, are all-important for the elucidation of the nature of the case.

Poisoning may be *acute* or *chronic*. The general conditions which should arouse a suspicion of acute poisoning are the sudden onset of serious and increasingly alarming symptoms in a person previously in good health, especially if there be pain in the region of the stomach, or, where there is complete prostration of the vital powers, a cadaveric aspect, and speedy death. In all such cases the aid of the analytical chemist must be called in either to confirm well-founded or to rebut ill-founded suspicions.

The *mode of treatment* to be adopted in the case of poisoned persons varies greatly according to the nature of the poison. The first indication, when the poison has been swallowed, is to evacuate the stomach; and this may usually be done by means of the stomach-pump when the poison is not of the corrosive class; or the stomach may be gently washed out by means of a funnel and flexible siphon-tube. In many cases emetics are valuable. Antidotes and counter-poisons may then be given. The former are such substances as chalk to neutralize the mineral acids and oxalic acid; the latter have a physiological counteraction, and are such as atropine, which is a counter-poison to morphia. These may usually be administered most effectively by hypodermic injection. The stomach may to a certain degree be protected from the injurious effects of irritants by the administration of mucilaginous drinks; alkaloids may be rendered sparingly soluble by means of astringent substances containing tannin; and pain may be relieved by means of opium, unless contra-indicated by the nature of the poison. The effects of the convulsant poisons, such as strychnine, may be combated by means of the inhalation of chloroform.

The *classification* of poisons is a matter of difficulty. Various attempts have been made to classify them scientifically, but with no signal success; and perhaps the best system is that which groups the various poisons according to the more obvious symptoms which they produce. Our knowledge of the more intimate action of poisons is still too imperfect to admit of any useful classification according to the manner in which they specifically affect the vital organs. Poisons may in the manner indicated be classified as (1) *Corrosives*, (2) *Irritants*, (3) *Neurotics*, and (4) *Gaseous Poisons*.

1. *Corrosives*.

The typical member of this class is corrosive sublimate, the soluble chloride of mercury. In it are included also the concentrated mineral acids (sulphuric, nitric and hydrochloric); oxalic acid; the alkalies (potash, soda, and ammonia) and their carbonates; acid, alkaline, and corrosive salts of the metals (such as bisulphate of potash, alum, butter of antimony and nitrate of silver); also carbolic acid.

The symptoms produced by the mineral acids and the alkalies are almost altogether referable to local action; but some corrosive poisons, such as carbolic acid, produce, besides a local action, remote and specific constitutional effects. The symptoms of corrosive poisoning are marked and unmistakable, except in infants. Immediately on swallowing the corrosive substance, an acid, caustic or metallic burning sensation is experienced in the mouth, fauces, gullet and region of the stomach, and this speedily extends over the whole belly; as a rule vomiting speedily follows. In the case of the mineral acids, and in oxalic acid poisoning, the vomit is so acid that if it falls upon a marble or concrete floor effervescence ensues. No relief follows the evacuation of the stomach. The ejected matters contain blood, and even fragments of the corroded walls of the alimentary canal. The belly becomes distended with gas and horribly tender. High fever prevails. The mouth is found to be corroded. Death usually ensues within a few hours; or, if the patient survives, he or she may perish miserably, months after the poison was taken, through starvation consequent upon the gradual contraction of the gullet, brought about by its corrosion and subsequent healing.

The treatment of corrosive poisoning consists in very gently emptying and washing out the stomach by means of a soft siphon-tube. The stomach-pump cannot be used with safety in consequence of the weakening of the walls of the stomach by corrosion. Demulcents and opiates may be subsequently administered. After death from corrosive poisoning the walls of the stomach are found corroded and even perforated.

1. *Corrosive Sublimate.*—Here all the signs and symptoms of corrosive poisoning are produced in their severest form. A grain or two of this poison may prove fatal. Fortunately there is an efficient antidote in white of egg, the albumen of which, if administered at once, renders the salt insoluble. The eggs should be divested of their yolks, beaten up with water, and given promptly, repeatedly, and abundantly, followed by emetics. Poisoning by corrosive sublimate may be followed by the specific toxic effects of mercury, such as salivation and tremor.

Workers in mercury, such as water-gilders, looking-glass makers, and the makers of barometers and thermometers, are apt to suffer from a peculiar form of shaking palsy, known as "the trembles," or mercurial tremor. This disease affects most frequently those who are exposed to mercurial fumes. The victim is affected with tremors when an endeavour is made to exert the muscles, so that he is unable, for instance, to convey a glass of water to the lips steadily, and when he walks he breaks into a dancing trot. The treatment consists in removal from the mercurial atmosphere, baths, fresh air, and the administration of iron and other tonics.

2. *Mineral Acids.*—These are oil of vitriol or sulphuric acid, aqua fortis or nitric acid, and spirit of salt or hydrochloric (muriatic) acid. These, when taken in a concentrated form, produce well-marked symptoms of corrosion. When they are diluted, the symptoms are those of an irritant poison. Nitric acid stains the mouth and skin of a yellow colour. The treatment consists in the administration of the alkalies or other carbonates, chalk, whiting, or even uncoloured plaster scraped off the walls or ceiling, with the view of neutralizing the acid.

3. *Oxalic acid* is a vegetable acid. When taken in the state of concentrated solution it acts as a corrosive, but when diluted as an irritant. But it also exerts a specific effect, killing the patient by cardiac syncope not unfrequently within a few minutes. When a person after taking a crystalline substance, tasting strongly acid, dies within 15 or 30 minutes, after the manifestation of great weakness, small pulse and failure of the heart's power, poisoning by oxalic acid is almost certain. The treatment consists in promptly administering an emetic, followed by chalk, whiting, or any substance containing carbonate of calcium. The alkaline carbonates are valueless, for the alkaline oxalates are almost as poisonous as oxalic acid itself.

4. *The Alkalis.*—Caustic potash and caustic soda produce symptoms resembling those of the mineral acids, except that purging is a usual accompaniment.

5. *Carbolic acid* when taken in the form of a concentrated liquid acts as a corrosive, causing whitening and shrinking of all the animal membranes with which it comes in contact. The patient, however, becomes speedily comatose, the poison acting profoundly upon the great nervous centres. A curious phenomenon—black or dark green urine—is commonly observed after the administration of this poison. Saccharated lime-water, diluted and drunk freely, and a solution of sulphate of soda are perhaps the most useful remedies.

2. *Irritant Poisons.*

Irritant poisons are of two classes—metallic irritants and vegetable and animal irritants, these latter being for convenience grouped together. Perhaps none of the irritants act purely as such, the irritant symptoms being usually accompanied by well-marked effects upon the nervous system. An irritant is a substance which causes inflammation of the part to which it is applied—usually the alimentary canal. Arsenic is by far the most important of the metallic irritants. Other irritants are the moderately diluted acids, many metallic salts, such as those of antimony, lead, copper, zinc and chromium. Elaterium, gamboge, aloes, colocynth and croton oil are good examples of vegetable irritants; and cantharides of animal irritants. Animal and vegetable food when decomposed, or infested with certain organisms known as bacteria, may produce violent irritant symptoms. The symptoms produced by irritant poisons are usually more slow in their development than where a corrosive has been administered. Usually, after an interval, greater or less according to the specific nature of the irritant swallowed, a burning pain is felt in the mouth, throat and gullet, with a sense of constriction of the parts, and followed by burning pain in the region of the stomach. This is increased, and not alleviated, by pressure, a mark which serves to distinguish the attack from one of ordinary colic. Nausea, vomiting and thirst ensue, speedily followed by distension of the whole abdomen, which is exceedingly tender to the touch. Ordinarily the vomiting is followed by profuse diarrhoea. Should the poison not be speedily eliminated in the vomited and faecal matters, inflammatory fever sets in, followed by collapse; and death may ensue in a few hours.

There is danger of confounding irritant poisoning with some forms of natural disease, such as gastritis and gastric ulcer, colic, peritonitis, cholera and rupture of the intestines.

1. *Arsenic* is a specific irritant poison. Almost all the compounds of this metal are poisonous. The term "arsenic" is, however, most commonly applied, not to the metal itself, but to its lower oxide, arsenious oxide, which is also known as *white arsenic*. By whatever channel arsenic is introduced into the system, it invariably affects specifically the stomach and intestines, causing congestion or inflammation. The common sources of arsenical poisoning are the taking of white arsenic, which causes acute poisoning, and the inhalation of dust from arsenical wall-papers and textile fabrics, whereby a chronic form of poisoning is induced.

The symptoms and treatment of arsenical poisoning are described under Arsenic (*q.v.*).

Arsenic-eating, or the ability of some persons to take relatively large doses of arsenic habitually, is a well-established fact. The cause of this singular immunity from the ordinary results of arsenic is unknown.

2. *Lead.*—The salts of lead, more especially the acetate (sugar of lead), are irritant poisons of no very great activity; and, though occasionally death ensues, recovery is the rule. Chrome yellow, or lead chromate, is a powerful irritant poison. All chromates are, indeed, irritant poisons. (See LEAD POISONING.)

3. *Copper.*—The soluble salts of copper, such as blue vitriol (the sulphate) and verdigris (subcarbonate and subacetate), are emetic and irritant salts. Their emetic effects usually, but not invariably, secure their prompt rejection by the stomach. Occasionally fatal effects have resulted from their administration. Copper becomes accidentally mixed with articles of dietary in a variety of modes. It is also used for improving the colour of preserved fruits and vegetables. Its deleterious properties when thus used in minute quantities have been both asserted and denied. There is, however, a large body of evidence in favour of the at all events occasional poisonous effects of minute quantities of copper.

4. *Zinc salts* and *barium salts*, except the quite insoluble barium sulphate, are irritant poisons; and barium compounds act also upon the central nervous system.

5. *Chromates*, *e.g.* bichromate of potash, are violent irritants. Chrome yellow, or lead chromate, has already been mentioned.

6. *Phosphorus.*—Of the two chief forms of the elements—the yellow or ordinary and the red or amorphous—the former only is poisonous. Rarely there is met with a chronic form of poisoning among workers in the material, arising from the inhalation of phosphorus vapours. Its special characteristic is a peculiar necrosis or death of the bony structure of the lower jaw. Acute phosphorus poisoning is more common. Phosphorus is used for tipping matches, and is also the basis of several vermin destroyers. (See PHOSPHORUS and MATCH.)

7. *Vegetable Irritants.*—These produce drastic purgative effects. Frequently the nature of the illness may be ascertained by the discovery of portions of the vegetable substance—recognizable by the microscope—in the matters ejected by the patient.

8. *Cantharides.*—The administration of cantharides (*q.v.*) is followed by vomiting, purging, strangury, or even entire inability to pass the urine. In the ejecta portions of the shining elytra or wing-cases of the fly may often be recognized. There is often great excitement of the sexual proclivities. The active principle of the fly, cantharidin, may be extracted from suspected matters by means of chloroform, and the residue left after the evaporation of this blisters the lip or any tender mucous surface to which it is applied. Demulcent remedies, with opiate enemata and injections, afford the best relief by way of treatment.

3. *Neurotics.*

1. *Prussic or Hydrocyanic Acid.*—Hydrocyanic acid is one of the best known poisons, and a very deadly one. In the pure state it is said to kill with lightning-like rapidity. It is met with in commerce only in a dilute state. In Great Britain two kinds of acid are commonly sold—the pharmacopoeial acid, containing 2% of anhydrous prussic acid, and Scheele's acid, containing 4 to 5%. Less than a teaspoonful of the 2% acid has caused death. Given in fatal doses, the symptons of prussic-acid poisoning set in with great rapidity; and, in consequence of the readiness with which the poison is absorbed from the stomach and diffused through the circulation, the onset of symptoms is reckoned by seconds rather than by minutes. Occasionally the victim may be able to perform a few voluntary actions before alarming symptoms are developed. There is first a very brief stage of difficult breathing, and slow action of the heart, with a tendency for the organ to stop in the state of dilatation. With widely-dilated pupils of the eye, the patient is then seized with violent irregular convulsive movements. The rhythm of the respiratory movements is disturbed, and the countenance becomes of a bluish cast. The patient now sinks to the ground with complete loss of muscular power; and the third or asphyxial stage is reached, in which there are slow gasping respirations, loss of pulse, and paralysis of motion. Death is frequently preceded by muscular spasms. The *foudroyant* character of the illness, and the speedy death of the patient, coupled with the peculiar odour of the acid in the breath and atmosphere around the body, seldom leave any doubt as to the nature of the case. The treatment consists in inhalation of fumes of strong ammonia, drinks of warm and cold water alternately, friction of the limbs, and artificial respiration. The subcutaneous injection of atropine, which acts as a cardiac stimulant, may prove serviceable.

Other soluble cyanides, more especially cyanide of potassium, a salt largely used in photography and in the arts, are equally poisonous with hydrocyanic acid. (See PRUSSIC ACID.)

2. *Opium.*—In consequence of the extent to which opium, its preparations, and its active alkaloid morphia are used for the relief of pain, poisoning by opium is of frequent occurrence. It is largely used by suicides; and children, being very susceptible to its influence, frequently die from misadventure after administration of an overdose of the drug. The ordinary preparations of opium are the drug itself, which is the inspissated juice of the oriental poppy, and the tincture, commonly known as laudanum. Opium contains a variety of more or less active principles, the chief of which is the alkaloid morphia, which is present in good opium to the extent of about 10% in combination with meconic acid, which is physiologically inactive. Opium is largely used by Eastern nations for smoking, and there is great discrepancy of opinion as to the extent to which opium smoking is deleterious. The preponderance of opinion is in favour of the view that opium smoking is a demoralizing, degrading, and pernicious habit, and that its victims are sufferers both in body and mind from its use. (See OPIUM and MORPHINE.)

3. *Strychnine and Strychnine-yielding Plants.*—The alkaloids strychnine and brucine, as well as all the plants in which they are found, all act in the same manner, being highly poisonous, and causing death after spasms of a severe character. Many verminkillers contain strychnine as their active ingredient.

Strychnine, and all substances containing that alkaloid, produce their effects within a very few minutes—usually within ten or fifteen minutes. The patient complains of stiffness about the neck, and his aspect exhibits terror. There is an impression of impending calamity or death. Very speedily the head is jerked back, the limbs extended, the back arched (opisthotonos), so that the body may rest on the head and heels only. In a few moments these symptoms pass off, and there is complete relaxation of the spasm. The spasmodic condition speedily returns, and is brought about by the slightest touch or movement of the patient. Accessions and remissions of the tetanic state ensue rapidly till the patient succumbs, usually within half an hour of the administration of the poison. The best treatment is to put, and keep, the patient under the influence of chloroform till time is given for the excretion of the alkaloid, having previously given a full dose of chloral hydrate. (See STRYCHNINE.)

4. *Aconite Poisoning.*—The ordinary blue rocket, wolfsbane or monkshood, *Acontium Napellus*, and an alkaloid extracted from it, aconitine, are perhaps the most deadly of known poisons. One-sixteenth of a grain of aconitine has proved fatal to a man. All the preparations of aconite produce a peculiar burning, tingling, and numbness of the parts to which they are applied. When given in large doses they produce violent vomiting, as a rule, more or less paralysis of motion and sensation, and great depression of the heart, usually ending in death from syncope. Intelligence remains unaffected till almost the last. The treatment consists in the hypodermic injection of digitalin, which is a counter-poison in its action upon the heart. The root of aconite has been eaten in mistake for that of horse-radish.

5. *Belladonna.*—The belladonna or deadly nightshade, *Atropa Belladonna*, contains an alkaloid, atropine, which is largely used by oculists to procure dilatation of the pupils of the eye. The bright scarlet berries of the plant have been eaten by children, who are attracted by their tempting appearance. Belladonna produces dilatation of the pupils, rapid pulse, hot dry flushed skin, with an eruption not unlike that of scarlatina, soreness of the throat, with difficulty of swallowing, intense thirst, and gay, mirthful delirium. The treatment consists in evacuation of the poison by means of the stomach-pump, and the hypodermic injection of morphia as a counter-poison.

4. *Gaseous Poisons.*

The effects of these are varied—some of them acting as irritants, while others have a specific effect, apparently in consequence of their forming chemical compounds with the red pigment of the blood, and thus destroying its capability of acting as a carrier of oxygen.

1. *Chlorine* and *bromine* act as powerful irritants. They provoke spasm of the glottis when inhaled, and subsequently induce inflammation of the respiratory mucous membrane, which may prove speedily fatal. Inhalation of diluted ammonia vapour is the best remedy.

2. *Hydrochloric* or *muriatic acid gas* and *hydrofluoric* or *fluoric acid gas* are irritating and destructive to life. The former is more destructive to vegetable life than even chlorine. They are emitted in many processes of manufacture, and especially in the manufacture of carbonate of soda from common salt by Le Blanc's process, in the salt-glazing of earthenware, and in the manufacture of artificial manures.

3. *Sulphurous Acid Gas.*—The gas given off by burning sulphur is most suffocating and irritating. Its inhalation, even in a highly diluted state, may cause speedy death from spasmodic closure of the glottis.

4. *Nitrous vapours*, or gaseous oxides of nitrogen (except nitrous oxide), are given off from galvanic batteries excited by nitric acid; also in the process of etching on copper. They produce, when diluted, little immediate irritation, but are exceedingly dangerous, setting up extensive and fatal inflammation of the lungs.

5. *Ammonia gas* is highly irritant, but does not often prove fatal.

6. *Carbon dioxide gas* is heavier than atmospheric air, is totally irrespirable when pure, and is fatal when present in large quantities in respired air. It is given off from burning fuel, accumulates in pits and wells as choke-damp, and constitutes the deadly after-damp of coal-mines. It is also formed during alcoholic fermentation, and hence accumulates in partially filled vats in which fermented liquors are stored. When it is breathed in a concentrated state, death is almost instantaneous. Persons descending into wells foul with this gas sink down powerless, and are usually dead before they can be removed from the vitiated atmosphere. In these cases there is true asphyxia; but carbonic acid is also a narcotic gas. Persons exposed to an atmosphere partially composed of this gas, but not long enough to produce fatal results, are affected with stertorous breathings, oppression, flushed face, prominent eyes, swollen tongue and feeble pulse. The proper treatment is removal from the foul atmosphere, alternate cold and tepid douches to the chest, friction of the limbs and trunk, and artificial respiration. When animation is restored the patient should be put to bed and kept quiet, but should be carefully watched in case of relapse.

7. *Carbon monoxide gas* is given off by burning charcoal and other forms of fuel, mixed with carbonic acid. The poisonous effects of charcoal fumes are perhaps due rather to the more poisonous carbonic oxide than to the less poisonous carbonic acid. An atmosphere containing less than 1% of carbonic oxide would doubtless be fatal if breathed for many minutes. Carbonic oxide forms with haemoglobin, the red pigment of the blood, a bright scarlet compound. The compound is very stable, and the oxide cannot be displaced by atmospheric oxygen. Hence the blood after death from the inhalation of carbonic oxide is of a bright arterial hue, which it retains on exposure to air.

8. *Coal-gas* acts as an asphyxiant and narcotic. The appearances met with after death—more especially the fluid state of the blood—are similar to those observed after death from carbonic oxide gas, which is a constituent of coal-gas, and to which the chief effect of coal-gas may be due.

9. *Sulphuretted hydrogen gas* is highly poisonous by whatever channel it gains access to the body. In a concentrated form it produces almost instant death from asphyxia. Even in a diluted state it produces colic, nausea, vomiting and drowsiness. This may pass into insensibility with lividity and feeble respiration. The skin is cold and clammy, or bathed in perspiration. The red blood corpuscles are disintegrated. The treatment consists in removal from the contaminated atmosphere, friction to the surface

of the body, warmth, and the administration of stimulants. The inhalation of chlorine gas has been recommended on chemical grounds; but it must be remembered that chlorine is itself poisonous.

10. *Anaesthetics.*—Nitrous oxide, or laughing gas, and the gases or vapours of other anaesthetic substances, such as chloroform, may, if improperly administered, produce death by asphyxia, and perhaps otherwise. Obviously, as a rule, medical assistance is at hand. The treatment consists in artificial respiration, and the use of galvanic current.

11. *Vapours of Hydrocarbons.*—The volatile vapours of the natural hydrocarbons known as benzoline, petroleum, &c., are poisonous when inhaled for lengthened periods. (T. S.*)

POISSON, SIMÉON DENIS (1781–1840), French mathematician, was born at Pithiviers in the department of Loiret, on the 21st of June 1781. His father, Siméon Poisson, served as a common soldier in the Hanoverian wars; but, disgusted by the ill-treatment he received from his patrician officers, he deserted. About the time of the birth of his son, Siméon Denis, he occupied a small administrative post at Pithiviers, and seems to have been at the head of the local government of the place during the revolutionary period. Poisson was first sent to an uncle, a surgeon at Fontainebleau, and began to take lessons in bleeding and blistering, but made little progress. Having given promise of mathematical talent he was sent to the École Centrale of Fontainebleau, and was fortunate in having a kind and sympathetic teacher, M. Billy, who, when he speedily found that his pupil was becoming his master, devoted himself to the study of higher mathematics in order to follow and appreciate him, and predicted his future fame by the punning quotation from Lafontaine[1]:—

> " Petit Poisson deviendra grand
> Pourvu que Dieu lui prête vie."

In 1798 he entered the École Polytechnique at Paris as first in his year, and immediately began to attract the notice of the professors of the school, who left him free to follow the studies of his predilection. In 1800, less than two years after his entry, he published two memoirs, one on É. Bezout's method of elimination, the other on the number of integrals of an equation of finite differences. The latter of these memoirs was examined by S. F. Lacroix and A. M. Legendre, who recommended that it should be published in the *Recueil des savants étrangers*, an unparalleled honour for a youth of eighteen. This success at once procured for Poisson an entry into scientific circles. J. L. Lagrange, whose lectures on the theory of functions he attended at the École Polytechnique, early recognized his talent, and became his friend; while P. S. Laplace, in whose footsteps Poisson followed, regarded him almost as his son. The rest of his career, till his death on the 25th of April 1840, was almost entirely occupied in the composition and publication of his many works, and in discharging the duties of the numerous educational offices to which he was successively appointed. Immediately after finishing his course at the École Polytechnique he was appointed *repetiteur* there, an office which he had discharged as an amateur while still a pupil in the school; for it had been the custom of his comrades often to resort to his room after an unusually difficult lecture to hear him repeat and explain it. He was made *professeur suppléant* in 1802, and full professor in succession to J. Fourier in 1806. In 1808 he became astronomer to the Bureau des Longitudes; and when the Faculté des Sciences was instituted in 1809 he was appointed *professeur de la mécanique rationelle.* He further became member of the Institute in 1812, examiner at the military school at St Cyr in 1815, leaving examiner at the École Polytechnique in 1816, councillor of the university in 1820, and geometer to the Bureau des Longitudes in succession to P. S. Laplace in 1827. His father, whose early experiences led him to hate aristocrats, bred him in the stern creed of the first republic. Throughout the empire Poisson faithfully adhered to the family principles, and refused to worship Napoleon. When the Bourbons were restored, his hatred against Napoleon led him to become a Legitimist—a conclusion which says more for the simplicity of his character than for the strength or logic of his political creed. He was faithful to the Bourbons during the Hundred Days; in fact, was with difficulty dissuaded from volunteering to fight in their cause. After the second restoration his fidelity was recognized by his elevation to the dignity of baron in 1825; but he never either took out his diploma or used the title. The revolution of July 1830 threatened him with the loss of all his honours; but this disgrace to the government of Louis Philippe was adroitly averted by F. Arago, who, while his " revocation " was being plotted by the council of ministers, procured him an invitation to dine at the Palais Royale, where he was openly and effusively received by the citizen king, who " remembered " him. After this, of course, his degradation was impossible, and seven years later he was made a peer of France, not for political reasons, but as a representative of French science.

As a teacher of mathematics Poisson is said to have been more than ordinarily successful, as might have been expected from his early promise as a *repetiteur* at the École Polytechnique. As a scientific worker his activity has rarely if ever been equalled. Notwithstanding his many official duties, he found time to publish more than three hundred works, several of them extensive treatises, and many of them memoirs dealing with the most abstruse branches of pure and applied mathematics. There are two remarks of his, or perhaps two versions of the same remark, that explain how he accomplished so much: one, " La vie n'est bonne qu'à deux choses—à faire des mathématiques et à les professeur; " the other, " La vie c'est le travail."

A list of Poisson's works, drawn up by himself, is given at the end of Arago's biography. A lengthened analysis of them would be out of place here, and all that is possible is a brief mention of the more important. There are few branches of mathematics to which he did not contribute something, but it was in the application of mathematics to physical subjects that his greatest services to science were performed. Perhaps the most original, and certainly the most permanent in their influence, were his memoirs on the theory of electricity and magnetism, which virtually created a new branch of mathematical physics. Next (perhaps in the opinion of some first) in importance stand the memoirs on celestial mechanics, in which he proved himself a worthy successor to P. S. Laplace. The most important of these are his memoirs " Sur les inégalités séculaires des moyens mouvements des planètes," " Sur la variation des constantes arbitraires dans les questions de mécanique," both published in the *Journal* of the École Polytechnique (1809); " Sur la libration de la lune," in *Connaiss. d. temps* (1821), &c.; and " Sur la mouvement de la terre autour de son centre de gravité," in *Mém. d. l'acad.* (1827), &c. In the first of these memoirs Poisson discusses the famous question of the stability of the planetary orbits, which had already been settled by Lagrange to the first degree of approximation for the disturbing forces. Poisson showed that the result could be extended to a second approximation, and thus made an important advance in the planetary theory. The memoir is remarkable inasmuch as it roused Lagrange, after an interval of inactivity, to compose in his old age one of the greatest of his memoirs, viz. that *Sur la théorie des variations des éléments des planètes, et en particulier des variations des grands axes de leurs orbites.* So highly did he think of Poisson's memoir that he made a copy of it with his own hand, which was found among his papers after his death. Poisson made important contributions to the theory of attraction. His well-known correction of Laplace's partial differential equation for the potential was first published in the *Bulletin de la société philomatique* (1813). His two most important memoirs on the subject are " Sur l'attraction des sphéroides " (*Connaiss. d. temps*, 1829), and " Sur l'attraction d'un ellipsoide homogène " (*Mém. d. l'acad.*, 1835). In concluding our selection from his physical memoirs we may mention his memoir on the theory of waves (*Mém. d. l'acad.*, 1825).

In pure mathematics, his most important works were his series of memoirs on definite integrals, and his discussion of Fourier's series, which paved the way for the classical researches of L. Dirichlet and B. Riemann on the same subject; these are to be found in the *Journal* of the École Polytechnique from 1813 to 1823, and in the *Memoirs de l'académie* for 1823. In addition we may also mention his essay on the calculus of variations (*Mem. d. l'acad.*, 1833), and his memoirs on the probability of the mean results of observations (*Connaiss. d. temps*, 1827, &c.).

Besides his many memoirs Poisson published a number of treatises, most of which were intended to form part of a great work on mathematical physics, which he did not live to complete. Among these may be mentioned his *Traité de mécanique* (2 vols. 8vo, 1811 and 1833), which was long a standard work; *Théorie nouvelle de l'action cappillaire* (4to, 1831); *Théorie mathématique de la chaleur* (4to, 1835); *Supplément* to the same (4to, 1837); *Recherches sur la probabilité des jugements en matières criminelles*, &c. (4to, 1837), all published at Paris.

See F. Arago, *Biographie de Poisson*, read before the Académie des Sciences on the 16th of December 1850.

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[1] This prediction is sometimes attributed to Laplace.

POISSY, a town of northern France, in the department of Seine-et-Oise, 17 m. W.N.W. of Paris, on the railway from Paris to Rouen. Pop. (1906), 6043. The church, supposed to have been built in the first half of the 12th century, and eventually restored under the direction of Viollet le Duc, is of special architectural interest, as affording one of the earliest and best examples of transition from the Romanesque to the Pointed style. The bridge of Poissy, a very ancient foundation, has been widened and modernized; of the mills which formerly bordered it one was known as Queen Blanche's. A statue of the painter J. L. E. Meissonier was erected in 1894, close to his house. Poissy supplied butchers' meat to Paris during six centuries, but in 1867 the market was removed to the metropolis. A handsome fountain stands in the old market-place. Distilling and the manufacture of chairs and flour-milling equipment are carried on and ragstone is quarried.

Poissy, the ancient *Pinciacum*, was the capital of the country of the Carnutes. In the time of Charlemagne it had a royal palace, where during the 9th century four national assemblies were held. Later it became a favourite residence of Blanche of Castille, and her son, afterwards St Louis, is supposed to have been born there. Philip the Fair gave the castle to the Dominicans, by whom it was completely transformed, and it was in the refectory of the abbey that the famous conference (see below) between the Roman Catholics and Protestants took place in 1561.

POISSY, COLLOQUY OF, a conference held in 1561 with the object of effecting a reconciliation between the Catholics and Protestants of France. It was initiated by Queen Catherine de' Medici, regent during the minority of her son Charles IX. In the policy of which it was the outcome she enjoyed the support of the Chancellor Michel de l'Hôpital and the lieutenant-general of the kingdom, Anthony of Navarre; while on the other hand the heads of the Catholic party had attempted to frustrate any form of negotiation. Theodore Beza from Geneva and Peter Martyr Vermigli from Zürich appeared at the colloquy; the German theologians to whom invitations had been despatched only arrived in Paris after the discussion was broken off. The conference was opened on the 9th of September in the refectory of the convent of Poissy, the king himself being present. The spokesman of the Reformed Church was Beza, who, in the first session, gave a lengthy exposition of its tenets, but excited such repugnance by his pronouncements on the Communion that he was interrupted by Cardinal Tournon. In the second session (Sept. 16) he was answered by the cardinal of Lorraine, who discharged his task with skill and moderation. On the motion, however, of Ippolito d'Este, the papal legate, exception was taken to the further conduct of the negotiations in full conclave; and a committee of twenty-four representatives, twelve from each party, was appointed—ostensibly to facilitate a satisfactory decision. On the Catholic side, as was speedily demonstrated, there existed no sort of tendency to conciliation. On the contrary, the cardinal of Lorraine, by his question whether the Calvinists were prepared to sign the Confession of Augsburg, attempted to sow dissension between them and the Lutheran Protestants of Germany, on whose continued support they calculated. The Catholic delegates, moreover, discovered a powerful auxiliary when Lainez, the general of the Jesuit order, which had been admitted into France a short time previously, entered the debate; and the acrimony with which he opposed the Protestants was of material service in clarifying the situation. Still a further reduction was made in the number of members, and a small residuum consisting of five Catholics and five Protestants undertook the task of devising a formula on which the two churches might unite with regard to the question of the Communion. Their difficult labours even seemed on the point of success when the assemblage of prelates refused assent, and the conference broke up on the 9th of October—a result which barred the way to a pacific understanding with the Huguenots.

See H. Küpffel, *Le Colloque de Poissy* (Paris, 1868); E. Lacheinmann in Herzog-Hauck, *Realencyklopädie f. protest. Theologie* (3rd ed., 1904), xv. 497. (C. M.)

POITIERS, a town of western France, formerly the capital of Poitou, and now the chief town of the department of Vienne, 61 m. S.S.W. of Tours on the railway to Bordeaux. Pop. (1906), town, 31,532; commune, 39,302. Poitiers is situated at the junction of the Boivre with the Clain (a tributary of the Loire by the Vienne), and occupies the slopes and summit of a plateau which rises 130 ft. above the level of the streams by which it is surrounded on three sides. The town is picturesque; and its streets are interesting for their remains of ancient architecture, especially of the Romanesque period, and the memories of great historical events. Blossac park, named after the intendant of the "generality" of Poitiers (1751–1786), and situated on the south side of the town, and the botanical garden on the north-east, are the two principal promenades. Till 1857 Poitiers contained the ruins of a Roman amphitheatre more extensive than that of Nîmes; remains of Roman baths, constructed in the 1st and demolished in the 3rd century, were laid bare in 1877; and in 1879 a burial-place and the tombs of a number of Christian martyrs were discovered on the heights to the south-east—the names of some of the Christians being preserved in paintings and inscriptions. Not far from these tombs is a huge dolmen (the "Pierre Levée"), 22 ft. long, 16 ft. broad and 6 or 7 ft. high, around which used to be held the great fair of St Luke.

The cathedral of St Peter, begun in 1162 by Henry II. of England and Eleanor of Guienne on the ruins of a Roman basilica, and well advanced by the end of the 12th century, is a building in the Romanesque and Early Gothic style, the latter predominating. It consists of three naves almost equal in height and width, both of which decrease towards the west, thus enhancing the perspective. Its length is 308 ft., and the keystone of the central vaulted roof is 89 ft. above the pavement. There is no apse, and the exterior generally has a heavy appearance. The principal front, the width of which is excessive in proportion to its height, has unfinished side-towers 105 and 110 ft. in height, begun in the 13th century. Most of the windows of the choir and the transepts preserve their stained glass of the 12th and 13th centuries; the end window, which is certainly the first in the order of time, contains the figures of Henry II. and Eleanor. The choir stalls, carved between 1235 and 1257, are among the oldest in France. The church of St Jean near the cathedral is the most ancient Christian monument in the country. Built as a baptistery in the first half of the 4th century, it was enlarged in the 7th century, since when it has suffered little structural alteration. It contains frescoes of the 12th century and a collection of tombs of the Merovingian period. The church of St Hilaire was erected at the close of the 4th century over the tomb of the celebrated bishop. At first an oratory, it was rebuilt on a larger scale by Clovis, and afterwards became, in the 10th, 11th and 12th centuries, a sumptuous collegiate church, of which the nave was flanked by triple aisles and surmounted by six cupolas. Great damage was done to it in the Wars of Religion and the French Revolution, and the façade was entirely rebuilt in the 19th century. The confessional or oratory under the choir contains the relics of St Hilary and a Christian sarcophagus of the 4th century. The church of St Radegonde, a great resort of pilgrims, commemorates the consort of Clotaire (d. 587), and preserves in its crypt the tomb of Radegonde, who founded at Poitiers the abbey of the Holy Cross, and two others reputed to be those of St Agnes and St Disciola. The choir and tower above the entrance are of the 11th century, while the nave (late 12th century) is in the Angevin style. In a recess in the nave known as the Chapelle du Pas de Dieu, there is a footprint which tradition asserts to be that of Christ, who appeared in a vision to St Radegonde. Notre-Dame la Grande, which dates from the close of the 11th century, and represents a collegiate church of one or two hundred years older, has a sculptured Romanesque façade rivalled in richness only by that of St Pierre of Angoulême. The first stone of the church of Montierneuf (*Monasterium Novum*) was laid in 1077 by William VI., duke of Aquitaine and count of Poitiers, who is buried within its walls; and the choir (in the 13th century modified by the erection of a "lantern") was solemnly consecrated by Urban II. in 1096. Mutilated about 1640 and during the Revolution, the building was partly restored between 1850 and 1860. The tower of St Porchaire, a precious remnant of 11th-century architecture, was restored in the 19th century under the auspices of the well-known *Société des antiquaires de l'ouest.*

Among the secular buildings the first place belongs to the law courts, formerly the palace of the dukes of Aquitaine and counts of Poitiers, and rebuilt between the 12th and the 15th century. The Salle des Pas Perdus forms a fine nave 160 ft. long by 56 ft. wide, with a vaulted wooden roof. The southern wall is the work of duke Jean de Berry (d. 1416), brother of Charles V.; above its three vast fireplaces are mullioned windows filled with stained glass. The Maubergeon tower attached to the palace by the same duke represented the feudal centre of all the lordships of the countship of Poitiers. The house known as the *prévôté* or provost's mansion, built about 1500, has a fine façade flanked by turrets, and there are other houses of the 15th, 16th and 17th centuries. In the Hôtel de Ville, erected between 1869 and 1876, are museums of natural history and painting. The museum of the *Antiquaires de l'ouest* occupies the chapel and the great hall of the old university, adjoining the old Hôtel de Ville; it is a valuable collection comprising Roman antiquities, Merovingian sculptures, medals, a fine Renaissance fireplace, &c. The building devoted to the faculties also contains the library. The municipal records are very rich in charters of Eleanor of Guienne, Philip Augustus, Alphonse of Poitiers, &c.

Poitiers is the seat of a bishop, a prefect, a court of appeal and a court of assizes, and centre of an educational division (*académie*), and has tribunals of first instance and of commerce, a board of trade arbitration, a chamber of commerce and a branch of the Bank of France. Its educational institutions comprise a university with faculties of law, science and letters, and a preparatory school of medicine and pharmacy, a school of theology, training colleges for both sexes, a lycée for boys and a school of fine art. Trade is in farm produce, wine, cattle, wool, honey, goose-quills and leather. The industries include the preparation of goose-skins, printing, tanning, and the manufacture of brushes, paint and candles.

Poitiers, called *Limonum* at the time of the Roman Conquest, afterwards took the name of its Gallic founders, the Pictones or Pictavi. Christianity was introduced in the 3rd century, and the first bishop of Poitiers, from 350 to 367, was St Hilarius. Fifty years later the city had fallen into the hands of the Arian Visigoths, and became one of the principal residences of their kings. Alaric II., one of their number, was defeated by Clovis at Vouillé, not far from Poitiers, in 507, and the town became a part of the Frankish dominion. This was the first occasion on which the peoples of northern and southern Gaul met in conflict in the neighbourhood of the town which was destined to see them so frequently join battle. By his victory in 732 over the Mahommedans at Moussais-la-Bataille in this region, Charles Martel proved the saviour of Christendom. Eleanor of Guienne frequently resided in the city, which she embellished and fortified, and in 1199 entrusted with communal rights. Alphonse of Poitiers, at a plenary court held in 1241 in the great hall of the Palais de Justice, received the homage of his numerous vassals. After the battle of Poitiers in 1356 (see below), Poitou was recognized as an English possession by the treaty of Brétigny (1360); but by 1373 it was recovered by Bertrand Du Guesclin. It was at Poitiers that Charles VII. was proclaimed king (1432); and he removed thither the parlement and university of Paris, which remained in exile till the English withdrew from the capital in 1436. During this interval (1429) Joan of Arc was subjected to a formal inquest in the town. The university was founded in 1432. Calvin had numerous converts at Poitiers. Of the violent proceedings which attended the Wars of Religion the city had its share. In 1569 it was defended by Gui de Daillon, comte du Lude, against Gaspard de Coligny, who after an unsuccessful bombardment retired from the siege at the end of seven weeks.

Counts of Poitiers.—In the time of Charlemagne the countship of Poitiers, which was then a part of the kingdom of Aquitaine, was represented by a certain Abbon. Renoul (Ranulph), who was created count of Poitiers by the emperor Louis the Pious in 839, was the ancestor of a family which was distinguished in the 9th and 10th centuries for its attachment to the Carolingian dynasty. One of his successors, Ebles the Bastard (d. 935), took the title of duke of Aquitaine; and his descendants, who bore the hereditary name of William, retained the same title. William IV., Fièrebrace, joined Hugh Capet, his brother-in-law, in 987. William V. the Great (993–1030) was a patron of letters, and received from the Italian lords the offer of the imperial crown after the death of the emperor Henry II. in 1024. William IX. (1086–1127) went on crusade in 1100, and had violent quarrels with the Papacy. His son William X. (1127–1137) sided with the anti-pope Anacletus against Innocent II. In accordance with the dying wishes of William X. his daughter Eleanor was married in 1137 to Louis, the son of Louis VI. of France. Sole heiress of her father, she brought her husband a large dowry, comprising Poitou, Saintonge, Aunis, a part of Touraine and Berry, Marche, Angoumois, Périgord, Auvergne, Limousin, Bordelais, Agénois and Gascony. After the dissensions between Louis VII. and Eleanor had resulted in a divorce in 1152, Eleanor married the count of Anjou, Henry Plantagenet, who became king of England as Henry II. The west of France thus passed into the hands of England, a transfer which gave rise to long wars between the two kingdoms. Philip Augustus reconquered Poitou in 1204, and the province became in succession an apanage of Alphonse, son of Louis VIII., in 1241; of Philip the Tall, son of Philip the Fair, in 1311; of John, son of Philip of Valois, in 1344; and of John, duc de Berry, son of John the Good, in 1356; and passed to the dauphins John (1416) and Charles (1417), sons of Charles VI. When Charles VII. ascended the throne he finally united the countship of Poitiers to the Crown.

See P. Guérin, *Recueil des documents concernant le Poitou* (Paris, 1880–1906); and A. Richards, *Histoire des comtes de Poitou* (Paris, 1903).

Battle of Poitiers.—This battle, fought on the 19th of September 1356 between the armies of King John of France and Edward the "Black Prince," was the second of the three great English victories of the Hundred Years' War. From Bordeaux the prince had led an army of his father's Guienne vassals, with which there was a force of English archers and men-at-arms, into central France and had amassed an enormous booty. King John, hitherto engaged against the army of John of Gaunt duke of Lancaster, in Normandy, hurried south to intercept the raiding army and to bar its homeward road. The Black Prince, by forced marching, was able to slip past the French, but reaching Maupertuis, 7 m. south-east of Poitiers, with the king's army in chase, he found himself compelled to choose between fighting and abandoning his spoil. He chose the former course, in spite of the enemy's great superiority in numbers (16,000 to 6500), and in order to give his trains time to draw off took up a defensive position on the 18th of September, with a slight hollow in front and a wood behind, between the Poitiers-Bordeaux main road and the River Maussion.[1] John, instead of manœuvring to envelop the English, allowed the Cardinal Talleyrand de Périgord to attempt to negotiate a peace. This proving vain, the French army attacked without any attempt at manœuvre or reconnaissance, and on a front so narrow that the advantage of superior numbers was forfeited. Moreover, King John ordered all but the leading line to dismount and to attack on foot (tactics suggested by the success on the *defensive* of the dismounted English men-at-arms at Crecy and the Scots at Bannockburn), and thus condemned the best part of his army to a fatiguing advance on foot across difficult country in full armour.

The French arblasters, who might have crushed the relatively few English archers present, were mingled with the 300 picked mounted men in first line, but, as the latter charged, their advance masked the fire of the arblasters in the first few seconds, besides leaving the other, dismounted, lines far in rear. Thus the first attack on the Black Prince's line, which was greatly strengthened by trees and hedges in front of it, was promptly brought to a standstill by the arrows of the archers lining a hedge which overlooked the hollow in front; and the earl of Oxford hastily drawing out a body of archers beyond the defenders' left, into the low-lying ground of the Maussion valley, completed their rout by firing up the hollow into their flank. But it was not so easy to deal with the second line of dismounted men-at-arms, led by the dauphin, which was the next to arrive on the French side. The hedge indeed was held, and the assailants, unable to advance beyond the hollow, gave way, but to achieve this the prince had to use all but 400 of his men. Had the third body of the French advanced with equal spirit the battle would probably have ended there and then, but the duke of Orleans, who commanded it, was so demoralized by the retirement of the dauphin's division that he led his whole force off the field without striking a blow. Thereupon the king himself advanced furiously with the fourth and last line, and as it came on the situation of the English seemed so desperate that the prince was advised to retreat. But his determined courage was unshaken; seeing that this was the last attack he put his reserve into line, and rallying around this nucleus all men who could still fight, he prepared not only to repulse but to counter-attack the French. He despatched a small force under the Captal de Buch to ride round the flank of the enemy and to appear in their rear at the crisis of the fight. Though a medieval knight, he knew as well as Napoleon at Arcola that when the moral force of both sides has passed its culminating point even a materially insignificant threat serves to turn the balance. And so it fell out. When both lines were fighting hand-to-hand, the fifty horsemen of the Captal de Buch appeared in rear of the French. The front ranks fought on, but the rear of the French melted away rapidly, and at last only a group of the bravest, with King John and his son Philip, a boy of fourteen, in their midst, were left. This band continued their hopeless resistance for a time, but in the end they were killed or captured to a man. The rest of the French army, totally dispersed, was pursued by the victors until nightfall. Two thousand five hundred of the French, 2000 of them knights and men-at-arms, were killed, including the constable, one of the marshals, the standard-bearer and six other great lords. The prisoners included the king and his son Philip, the other marshal and 25 great lords, and 1933 knights and men-at-arms as well as 500 others.

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[1] The view adopted is that of Professor Oman, *Art of War Middle Ages*, p. 631.

POITOU, one of the old provinces of France, which also formed one of the great military governments of the kingdom, was bounded on the N. by Brittany, Anjou and Touraine; on the S. by Angoumois and Aunis; on the E. by Touraine, Berri and Marche; and on the W. by the ocean. It was divided into Lower Poitou, which corresponded to the modern department of La Vendée, and Upper Poitou, now split into the departments of Deux-Sèvres and Vienne. The principal towns in Upper Poitou were Poitiers the capital, Mirebeau, Châtellerault, Richelieu, Loudun, Thouars, Mauléon, Parthenay, Niort, &c.; and in Lower Poitou Fontenay-le-Comte, Maillezais, Luçon and Roche-sur-Yon. Île d'Yeu or Île-Dieu and Noirmoutier belonged to the province. Ecclesiastically, Poitou was a diocese which was broken up in 1317 to form two new dioceses of Luçon and Maillezais; the seat of the latter was transferred in the 17th century to La Rochelle. For the administration of justice, Poitou was attached to the parlement of Paris. After 778 it formed part of the domain of the counts of Poitiers (*q.v.*). Poitou (Poictou, Pictavia) takes its name from the Pictones or Pictavi, a Gallic nation mentioned by Caesar, Strabo and Ptolemy, and described by Strabo as separated from the Namnetes on the north by the Loire. It formed part of the territory known as Aquitaine (*q.v.*).

For the history see the *Mémoires* of the Société des Antiquaires de l'Ouest (1835 sqq.) and the documents published by the *Archives historiques du Poitou* (1872 sqq.); also the *Dictionnaire topographique de la Vienne*, by L. Rédet (1881).

POKEBERRY, POKEWEED (from the American-Indian *pocan*, applied to any plant yielding a red or yellow dye), in botany, the popular name of *Phytolacca decandra*, a strong-smelling perennial herb, a native of North America, with ovate-lanceolate sharp-pointed leaves, racemes of small greenish-white flowers and flattish berries nearly ½ in. in diameter, which contain a crimson juice. The young asparagus-like shoots are sometimes used as a pot-herb, but the roots are poisonous. The plant is often cultivated in Europe, and has become naturalized in the Mediterranean region.

POKER, a game at cards. By most writers its origin has been ascribed to *Il Frusso*, an Italian game of the 15th century, from which the game of *Primiera*, called in Spain *Primero*, and *La Prime* in France, in which country it was elaborated into *L'Ambigu* or *Le Meslé*. In England the game was played under the name of *Post and Pair*, of which the modern *Brag* is only a variation. But Mr R. F. Foster proves that, though poker is probably a descendant of *Primero*, and perhaps of a much more ancient Persian game called *As ras*, it is not a development of the English *Brag*, but was introduced from France into the colony of Louisiana, the name being merely an English mispronunciation of *Poque*, a game described as early as 1718 in the *Académie universelle des jeux*, and still played in Germany under the name *Pochen*. The earliest mention of the game in America is in G. B. Zieber's *Exposure of the Arts and Miseries of Gambling* (1843), and it is probable that poker was generally played on the Mississippi steamboats as early as 1830, twenty cards being used, "full-deck poker" with 52 cards being invented later. "Draw-poker" was introduced about 1860.

Poker is played for money stakes, markers or "chips" of different value being used. These are either divided equally among the players, or, more usually, one player acts as banker and sells chips to the other players, redeeming them at the end of the game. There are several varieties of the game, but *Draw Poker*, played by from 2 to 6 or even 7 persons with a pack of 52 cards, is the most popular. The player who wins the cut for deal shuffles the pack, which is then cut by the player at his right. He then deals five cards, one by one, to each player. If a card is faced during the deal the player must accept it; if two are exposed a new deal must ensue. Before the deal is complete the player at the dealer's left, who is said to *hold the age*, and is called "the age," places (or *puts up*) on the table in front of him half the stake for which he wishes to play. This is called *blind*. The player at the age's left then looks at his hand and announces whether he will play. If his hand seems too weak he throws his cards away face-down and "drops out" of the game. If he elects to play he puts up his *ante*, which is twice the amount of the *blind*. The other players, including the dealer, then either come in, *i.e.* elect to play, each putting up his *ante*, or, deeming their hands worthless, drop out. The age, who has the last say, may then himself drop out, forfeiting his half-stake already put up, or he may come in and *make good his ante*, *i.e.* put up his unpaid half of the *blind*. Each player in his turn has the privilege of increasing the stake to any amount not exceeding the limit,[1] which is always agreed upon before the game begins. Thus, if the limit is £1, and the age has put up 6d. as his *blind*, any player may, when his turn comes to declare whether he will play, say, "I play and make it 10s. (or a sovereign) more to draw cards," at the same time placing the *ante* plus 10s. (or a sovereign) in the middle of the table. Thereupon all the other players, each in turn, must *see the raise*, *i.e.* pay in the additional sum, or drop out of the game, forfeiting what they have already paid into the pool. The "age" being the last to complete, is in the best position to raise, as a player who has already completed is less likely to sacrifice his stake and withdraw from the game. On the other hand each player has the right, in his turn, after paying the extra stake called for, of raising it further on his own account, and this goes on until the players who have not dropped out have paid an equal sum into the pool and no one cares to raise further. Each player then throws away as many of his five cards as he chooses and receives from the dealer new ones in their place. In this supplementary deal no player may accept a faced card, but receives one in its place after all the other players have been served. The number of new cards taken by each one should be carefully noted by the other players, as it gives a valuable clue to the probable value of his hand. The following list shows the value of hands, beginning with the lowest.

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[1] "Table stakes" means playing strictly for cash; "unlimited" explains itself, although even when this is the rule a certain high limit is pretty generally observed.

1. *One Pair* (accompanied by three cards of different denominations). If two players each hold a pair, the higher wins; if similar pairs (*e.g.* a pair of kings each) then the next highest card wins.
2. *Two Pairs.*
3. *Triplets* or *Threes of a Kind* (*e.g.* three kings, accompanied by two other cards not forming a pair).
4. *Straight*, a sequence of five cards, not all of the same suit. Sometimes, but very rarely, these straights are not admitted. An ace may either begin or end a straight. For example: ace, king, queen, knave and 10 is the highest straight; 5, 4, 3, 2, and ace is the lowest. An ace cannot be in the middle. For example, 3, 2, ace, king, queen is not a straight.
5. *Flush*, five cards of the same suit, not in sequence. If two flushes are held, that containing the highest card wins; if the highest cards are similar, the next highest wins, &c.
6. *Full*, or *Full House*, meaning three cards of the same denomination together with a pair; *e.g.* three sixes and a pair of fours. If more than one player holds a full, the highest triplet wins.
7. *Fours*, or four cards of the same denomination; *e.g.* four queens, which beat four knaves and under.
8. *Straight Flush*, a sequence of five cards all of the same suit; *e.g.* knave, 10, 9, 8, 7, of hearts.
9. *Royal Flush*, the highest possible straight flush; *e.g.* ace, king, queen, knave and 10 of spades.

If no player holds at least one pair, then the hand containing the highest card wins.

Each player having received the new cards called for, the betting is opened by the player sitting at the age's left, should he consider his hand worth it; otherwise he throws down his cards and is out of the game, and the next player (whom we will call C) makes the first bet, which may be of any amount up to the limit, but is usually a small one, with a view to later developments. The next player, D, either drops out, *trails*, *i.e.* puts up the amount bet by C (also called *seeing* and *calling*), or raises C's bet; in other words puts in the amount bet by C plus as much more (within the limit) as he cares to risk. This raise on D's part means either that he thinks he holds a better hand than C, or that he is trying to frighten C out. The last manœuvre illustrates the principle of the *bluff*, the most salient characteristic of the game of Poker. If C, with two small pairs in the hand, bets half a crown, and D, with a hand of no value whatever, covers, or *sees* C's bet and raises it to a sovereign, it is very likely that C will throw down his cards rather than risk a sovereign on his own by no means strong hand. In this case C has been bluffed by D, who, without even having to show his cards, wins the pool, although intrinsically his hand was far inferior to C's. The ability to bluff successfully depends upon self-command, keen observation, judgment and knowledge of character, so as to attempt the bluff when the bluffer is sure that there are no very strong hands out against him. Otherwise he will surely be *called* in his turn, and, having nothing of value, will lose the pool, besides suffering the ignominy of throwing away his money for nothing.

Two players with strong hands will often raise each other's bets repeatedly, until one of them calls the other, upon which the hands are shown and the stronger wins. The complete hands of the caller and the called must be shown. The common practice of throwing away unshown, for purposes of concealment, a losing hand that has called is illegal. No player who is not called is obliged to show his hand, so that the company is often in doubt whether or not the winner has bluffed. When two hands are of exactly equal value the pool is divided.

The game is often varied by a player *going blind*, *i.e.* raising the ante before the deal. Another variation is *straddling the blind*. This is done by the player sitting next the age, who puts up twice the amount of the blind with the words "I straddle." This has the effect of doubling the stake, as every player must then pay twice the amount of the straddle (instead of the blind) in order to play. The straddle may be straddled again in its turn if the aggregate amount does not pass the limit. The straddle does not carry with it the privilege of betting last, but merely raises the amount of the stake.

The regular Draw-Poker game is usually varied by occasional *Jack-Pots*, which are played once in so many deals, or when all have refused to play, or when the player deals who holds the *buck*, a marker placed in the pool with every jack-pot. In a jack-pot each player puts up an equal stake and receives a hand. The pot must then be *opened* by a player holding a hand of the value of a pair of knaves (jacks) or better. If no player holds so valuable a hand the deal passes and each player adds a small sum to the pot or pool. When the pot is opened the opener does so by putting up any sum he chooses, within the limit, and his companions must pay in the same amount or "drop." They also possess the right to raise the opener. The new cards called for are then dealt and the opener starts the betting, the play proceeding as in the regular game. If *Progressive Jack-Pots* are played, the minimum value of the opening hand is raised one degree every deal in which the pot is not opened. Thus the opening hand must in the first deal be at least a pair of knaves; but if the pot is not opened the minimum for the second deal is a pair of queens, for the third a pair of kings, &c. Jack-Pots were introduced about 1870.

Straight Poker, or *Bluff*, is played without drawing extra cards. It was the only variety of the game played, although 52 cards are now used instead of 20, as formerly. The first dealer is provided with a marker called a *buck*, and having, before dealing, put up the antes of all the players, passes the buck to the next dealer, who must in his turn ante for all when he deals. The rules for betting, raising, &c., are the same as at Draw-Poker. The hands, of course, average smaller.

Stud-Poker is played like Draw-Poker, except that there is no draw and, in dealing, the first card only is dealt face down, the rest being exposed. Each player in turn looks at his turned card and makes his bet or raise. A common variation of Stud-Poker consists in stopping the deal after two cards, one face up and the other face down, have been dealt, and betting on those two cards. A third card is then dealt and betting again takes place, the process being repeated after the fourth and fifth cards have been dealt, the value of the different hands changing with each added card. A player failing to "stand" any raise must retire from that pot.

Whiskey-Poker is also played without a draw. An extra hand, called the *widow*, is dealt to the table face down. The first bettor then examines his hand and has the option of taking up the widow and placing his own hand on the table face up in its place, or of passing and allowing the following players in turn the choice. After an exposed hand has been laid on the table in place of the widow the next player may either take up one card from the new widow replacing it with one from his own hand, or he may exchange his entire hand for the widow, or he may knock on the table. If he knocks every other player in turn may exchange one card or his whole hand, and the betting then begins, or there may be an agreement that the best hand wins from all the rest, or that the poorest hand pays a chip to the pool.

Technical Terms.

Big Dog.—Ace high and nine low; not usually played. If played it beats a *Little Dog.*

Blaze.—Five court cards; not usually played. If played it beats any two pairs.

Bobtail.—Four cards of a flush or straight, the fifth card not filling.

Bone.—The smallest counter or chip.

Buck.—A marker, to show when a jack-pot is to be played, viz. when it is the holder's deal.

Burnt Card.—Card on the bottom of the pack turned up to prevent being seen.

Chips.—Counters.

Cold Feet.—Any excuse of a winner for leaving the game before the time agreed upon.

Deadwood.—The discard pile.

Deck.—Pack.

Fatten.—Adding chips and a jack-pot after a failure to open.

Freeze Out.—A game in which a player having lost a certain agreed capital must stop playing.

Inside Straight.—Intermediate straight, *e.g.* 2, 3, 5, 6.

Kilter.—Hand with no pair and no card above the nine; seldom played.

Kitty.—A fund, to pay for cards or refreshments, made by taking a chip from each jack-pot, or paid by a winner holding a valuable hand.

Little Dog.—Deuce low and seven high; not usually played. When played it beats a straight.

Milking.—Shuffling by taking a card from the top and one from the bottom of the pack with the same movement.

Mistigris.—Poker with the joker added; the joker may be called any card the holder chooses.

Monkey Flush.—Three cards of a flush.

Natural Jacks.—Jack-pots played because there has been no ante in the previous deal.

Openers.—A hand on which a jack-pot may be opened.

Pat Hand.—A hand to which no card is drawn.

Pool.—The chips in the middle of the table.

Show-down.—Laying the hands face-up on the table after a call.

Show.—Part of a pool to which a player is entitled who has bet as long as his capital lasted but is not able to stand further raises. If his hand is the best he wins whatever was in the pool at the time when he put into it the last of his capital.

Shy.—Not having put up the jack-pot ante.

Splitting.—Having opened a jack-pot with one pair, and holding four other cards of one suit, to throw away one of the pair on the chance of making a flush.

Sweeten.—Chipping to a jack-pot after a failure to open.

Triplets.—Three of a kind.

Under the Gun.—The first player to bet.

Whangdoodle.—Compulsory round of jack-pots, usually agreed upon to follow a very large hand.

Widow.—An extra hand dealt to the table, as in Whiskey-Poker.

See *Practical-Poker*, by R. F. Foster (1904), the most authoritative work.

A very important attribute of a successful poker player is sound judgment in discarding, and this is principally based on the following mathematical table of approximate chances.

To improve any hand in the draw, the chances are:—

Having in Hand	To make the Hand below.	The Chance is
1 pair	To get two pairs (3-card draw)	1 in 4½
1 pair	To get three of a kind (3-card draw)	1 in 9
1 pair	To improve either way average value	1 in 3
1 pair and 1 odd card	To improve either way by drawing two cards	1 in 7
2 pairs	To get a full hand drawing one card	1 in 12
3's	To get a full hand drawing two cards	1 in 15½
3's	To get four of kind drawing two cards	1 in 23½
3's	To improve either way drawing two cards	1 in 9⅔
3's and 1 odd card	To get a full hand by drawing one card	1 in 15⅓
3's and 1 odd card	To improve either way by drawing one card	1 in 11¾
4 straight	To fill when open at one end only or in middle as 3 4 6 7, or A 2 3 4	1 in 11¾
4 straight	To fill when open at both ends as 3 4 5 6	1 in 6
4 flush	To fill the flush drawing one card	1 in 5
4-straight flush	To fill the straight flush drawing one card	1 in 23½
3-card flush	To make a flush drawing two cards	1 in 24

Of course these chances are somewhat improved by the fact that, in actual play, pairs and threes are, on account of careless shuffling, apt to lie together more or less.

POLA (Gr. Πόλα or Πόλαι; Slovene, *Pulj*), a seaport of Austria, in Istria, 86 m. S. of Trieste by rail. Pop. (1900), 45,052. It is the principal naval harbour and arsenal of the Austro-Hungarian monarchy, and is situated near the southern extremity of the peninsula of Istria. It lies at the head of the Bay of Pola, and possesses a safe and commodious harbour almost completely landlocked. An extensive system of fortifications, constructed on the hills, which enclose the harbour, defends its entrance, while it also possesses a good roadstead in the large channel of Fasana. This channel separates the mainland from the Brionian Islands, which dominate the entrance to the bay. The harbour has an area of 3·32 sq. m., and is divided into two basins by a chain of three small islands. The inner basin is subdivided by the large Olive Island into the naval harbour, lying to the south, and the commercial harbour, lying to the north. The Olive Island is connected with the coast by a chain-bridge, and is provided with wharfs and dry and floating docks. The town proper lies opposite the Olive Island, round the base of a hill formerly crowned by the Roman capitol and now by a castle from the 17th century. Besides the castle the chief buildings are the cathedral, dating from the 15th century; the new garrison church, completed in 1898 in the Basilica style, with a fine marble façade; the Franciscan convent dating from the 13th century, and now used as a military magazine; the huge infantry barracks; and the town-hall, dating from the beginning of the 14th century. To the south-west, along the coast, extends the marine arsenal, a vast and well-planned establishment possessing all the requisites for the equipment of a large fleet. It contains an interesting naval museum, and is supplemented by the docks and wharves of the Scoglio Olivi. The artillery laboratory and the powder magazine are on the north bank of the harbour. Behind the arsenal lies the suburb of San Policarpo, almost exclusively occupied by the naval population and containing large naval barracks and hospitals. In the middle of it is a pleasant park, with a handsome monument to the emperor Maximilian of Mexico, who had been a rear-admiral in the Austrian navy. To the north, between San Policarpo and the town proper, rises the Monte Zaro, surmounted by an observatory and a statue of Admiral Tegetthoff. Pola has no manufactures outside of its naval stores, but its shipping trade is now considerable, the exports consisting of fish, timber and quartz sand used in making Venetian glass, and the imports of manufactured and colonial wares. To many people, however, the chief interest of Pola centres in its fine Roman remains. The most extensive of these is the amphitheatre built in A.D. 198–211, in honour of the emperors Septimius Severus and Caracalla, which is 79 ft. high, 400 ft. long and 320 ft. wide, and could accommodate 20,000 spectators. It is remarkable as the only Roman amphitheatre of which the outer walls have been preserved intact; the interior, however, is now completely bare—though the arrangements for the naumachiae, or naval contests, can still be traced. The oldest Roman relic is the fine triumphal arch of the Sergii, in the Corinthian style, erected soon after the battle of Actium; and of not much later date is the elegant and well-preserved temple of Augustus and Roma erected in the year 19 B.C. Among the other antiquities are three of the old town gates and a fragment of a temple of Diana.

The foundation of Pola is usually carried back to the mythic period, and ascribed to the Colchian pursuers of Jason and the Argonauts. In all probability it was a Thracian colony, but its verifiable history begins with its capture by the Romans in 178 B.C. It was destroyed by Augustus on account of its espousal of the cause of Pompey, but was rebuilt on the intercession of his daughter Julia, and received (according to Pliny) the name of Pietas Julia. It became a Roman colony either under the triumviri or under Octavian, and was mainly important as a harbour. It seems to have attained its greatest prosperity about the time of the emperor Septimius Severus (193–211 A.D.), when it was an important war harbour and contained 35,000 to 50,000 inhabitants. At a later period Pola became the capital of the margraves of Istria, and was captured by the Venetians in 1148. It was several times captured and plundered by the Genoese, and recaptured by the Venetians. In 1379 the Genoese, after defeating the Venetians in a great naval battle off the coast, took and destroyed Pola, which disappears from history for the next four hundred and fifty years. It remained under Venetian supremacy down to 1797, and has been permanently united with Austria since 1815. In 1848 a new era began for Pola in its being selected as the principal naval harbour of Austria.

See Th. Mommsen in *Corp. inscr. latin.* v. 3 sqq. (Berlin, 1883); T. G. Jackson, *Dalmatia, the Quarnero and Istria*, vol. iii. (Oxford, 1887).

POLABS (*Po*=on, *Laba*=Elbe), the Slavs (*q.v.*) who dwelt upon the Elbe and eastwards to the Oder. Their chief tribes were the Vagri in Holstein, the Bodriči or Obotritae in Mecklenburg, the Ljutiči or Wiltzi in western Pomerania, the Sprevane on the Spree and the Glomači or Dalemintsi in Saxony. Except the Lithuanians they were the last Europeans to be christianized; their chief sanctuary was at Arcona on the Isle of Rügen. They were converted and conquered by the 12th century and systematically germanized. By the 17th century Slavonic survived only in a tiny patch in the east of Hanover about Lüchow, where a few words were still understood at the beginning of the 19th century. The population of the district still goes by the name of Wends (*q.v.*). The chief remains of the language are a paternoster, a few phrases and a short vocabulary written down by Pastor Chr. Henning (*c.* 1700), and the diary of J. Paruns Schultze (d. 1734). These were edited by A. Hilferding (St Petersburg, 1856), and a grammar was published there by A. Schleicher (1871). M. Porzezinski and Fr. Lorentz are the chief later authorities. Polabian agrees mostly with Polish and Kašube with its nasalized vowels and highly palatalized consonants. It had, however, long vowels and a free accent. The remains of it are most corrupt, having been written down when the language was full of Low German by people who did not know Slavonic.

POLACCA, the Italian name for a three-masted merchant vessel, formerly common in the eastern waters of the Mediterranean. The masts were of one piece and the sails were square or lateen-shaped. The name appears in various forms in other languages, *e.g.* Fr. *polaque* or *polacre*, Sp. *polacra*, Du. *polaak* or Ger. *Polack*, and certainly means Polish, although there is no explanation to be found for any connexion between Poland and such a Mediterranean vessel.

POLAND (Polish *Polska*, Ger. *Polen*), (see POLAND, RUSSIAN, below), a country of Europe which till the end of the 18th century was a kingdom extending (with Lithuania) over the basins of the Warta, Vistula, Dwina, Dnieper and upper Dniester, and had under its dominion, besides the Poles proper and the Baltic Slavs, the Lithuanians, the White Russians and the Little Russians or Ruthenians.

Origins of Poland.

We possess no certain historical data relating to Poland till the end of the 10th century. It would seem, from a somewhat obscure passage in the chronicle compiled from older sources by Nestor, a monk of Kiev (d. *c.* 1115), that the progenitors of the Poles, originally established on the Danube, were driven from thence by the Romans to the still wilder wilderness of central Europe, settling finally among the virgin forests and impenetrable morasses of the basin of the upper waters of the Oder and the Vistula. Here the Lechici, as they called themselves (a name derived from the mythical patriarch, Lech), seemed to have lived for centuries, in loosely connected communities, the simple lives of huntsmen, herdsmen and tillers of the soil, till the pressure of rapacious neighbours compelled them to combine for mutual defence. Of this infant state, the so-called kingdom of the Piasts (from Piast its supposed founder), we know next to nothing. Its origin, its territory, its institutions are so many insoluble riddles. The earliest Polish chroniclers, from Gallus in the early 12th century to Janko of Czarnkow[1] in the 14th, are of little help to us. The only facts of importance to be gleaned from them are that Prince Ziemovit, the great-grandfather of Mieszko (Mieczyslaw) I. (962–992), wrested from the vast but tottering Moravian Empire the province of Chrobacyja (extending from the Carpathians to the Bug), and that Christianity was first preached on the Vistula by Greek Orthodox missionary monks. Mieszko himself was converted by Jordan, the chaplain of his Bohemian consort, Dobrawa or Bona, and when Jordan became the first bishop of Posen, the people seem to have followed the example of their prince. But the whole movement was apparently the outcome not of religious conviction, but of political necessity. The Slavonic peoples, whose territories then extended to the Elbe, and embraced the whole southern shore of the Baltic, were beginning to recoil before the vigorous impetus of the Germans in the West, who regarded their pagan neighbours in much the same way as the Spanish Conquistadores regarded the Aztecs and the Incas. To accept Christianity, at least formally, was therefore a prudential safeguard on the part of the Slavonians. This was thoroughly understood by Mieszko's son Boleslaus I. (992–1025), who went a considerable step farther than his father. Mieszko had been content to be received on almost any terms into the Christian community, Boleslaus aimed at securing the independence of the Polish Church as an additional guarantee of the independence of the Polish nation. It was Boleslaus who made the church at Gnesen in Great Poland a national shrine by translating thither the relics of the martyred missionary, St Adalbert of Prague. Subsequently he elevated Gnesen into the metropolitan see of Poland, with jurisdiction over the bishoprics of Cracow, Breslau and Kolberg, all three of these new sees, it is important to notice, being in territory conquered by Boleslaus; for hitherto both Cracow and Breslau had been Bohemian cities, while Kolberg was founded to curb the lately subjugated Pomeranians. Boleslaus was also the first Polish prince to bear the royal title, which seems to have been conferred upon him by Otto III. in 1000, though as Boleslaus crowned himself king a second time in 1025, it is evident that he regarded the validity of his first coronation as somewhat doubtful. He was primarily a warrior, whose reign, an almost uninterrupted warfare, resulted in the formation of a vast kingdom extending from the Baltic to the Carpathians, and from the Elbe to the Bug. But this imposing superstructure rested on the flimsiest of foundations. In less than twenty years after the death of its founder, it collapsed before a combined attack of all Poland's enemies, and simultaneously a terrible pagan reaction swept away the poor remnants of Christianity and civilization. For a time Poland proper became a smoking wilderness, and wild beasts made their lairs in the ruined and desecrated churches. Under Boleslaus II. (1058–1079) and Boleslaus III. (1102–1139) some of the lost provinces, notably Silesia and Pomerania, were recovered and Poland was at least able to maintain her independence against the Germans. Boleslaus III., moreover, with the aid of St Otto, bishop of Bamberg, succeeded in converting the heathen Pomeranians (1124–1128), and making head against paganism generally.

Conversion to Christianity.

Boleslaus I., King.

Partitional Period, 1138-1305.

The last act of Boleslaus III. was to divide his territories among his sons, whereby Poland was partitioned into no fewer than four, and ultimately into as many as eight, principalities, many of which (Silesia and Great Poland, for instance) in process of time split up into still smaller fractions all of them more or less bitterly hostile to each other. This partitional period, as Polish historians generally call it, lasted from 1138 to 1305, during which Poland lost all political significance, and became an easy prey to her neighbours. The duke of Little Poland, who generally styled himself duke of Poland, or *dux totius Poloniae*, claimed a sort of supremacy among these little states, a claim materially strengthened by the wealth and growing importance of his capital, Cracow, especially after Little Poland had annexed the central principality of Sieradia (Sieradz). But Masovia to the north, and Great Poland to the north-west, refused to recognize the supremacy of Little Poland, while Silesia soon became completely germanized. It was at the beginning of this period too, between 1216 and 1224, that Pomerania, under an energetic native dynasty, freed herself from the Polish suzerainty. Nearly a generation later (1241) the Tatar hordes, under Batu, appeared for the first time on the confines of Poland. The Polish princes opposed a valiant but ineffectual resistance; the towns of Sandomir and Cracow were reduced to ashes, and all who were able fled to the mountains of Hungary or the forests of Moravia. Pursuing his way to Silesia, Batu overthrew the confederated Silesian princes at Liegnitz (April 9), and, after burning all the Silesian towns, invaded Hungary, where he routed King Bela IV. on the banks of the Sajo. But this marked the limit of his triumph. Exhausted and diminished by the stout and successful opposition of the Moravians at Olmütz, the Tatars vanished as suddenly as they had appeared, leaving a smoking wilderness behind them.

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[1] Archdeacon of Gnesen 1367: vice-chancellor of Poland; d. *c.* 1387.

Tatar Invasion.

Foreign Immigrants. Rise of Cities.

Batu's invasion had an important influence upon the social and political development of Poland. The only way of filling up the gaps in the population of the ravaged land was to invite foreign immigrants of a superior class, chapmen and handicraftsmen, not only given to peaceful pursuits and accustomed to law and order, but capable of building and defending strong cities. Such immigrants could naturally be obtained only from the civilized west, and on their own terms. Thus it came about that the middle class element was introduced into Polish society for the first time. Immediately dependent upon the prince, from whom they obtained their privileges, the most important of which were self-government and freedom from taxation, these traders soon became an important factor in the state, counterpoising, to some extent, the influence of the gentry, enriching the land by developing its resources, and promoting civilization by raising the standard of comfort.

The Knights of the Sword.

The Teutonic Order.

Most of these German citizens in process of time were absorbed by the Polish population, and became devoted, heart and soul, to their adopted country; but these were not the only Germans with whom the young Polish state had now to deal. In the first year of the 13th century, the Knights of the Sword, one of the numerous orders of crusading military monks, had been founded in Livonia to "convert" the pagan Letts, and, in 1208, the still more powerful Teutonic order was invited by Duke Conrad of Masovia to settle in the district of Kulm (roughly corresponding to modern East Prussia) to protect his territories against the incursions of the savage Prussians, a race closely akin to the Lithuanians. Conrad has been loudly blamed by Polish historians for introducing this foreign, and as it ultimately proved, dangerous element into Poland. But the unfortunate prince had to choose between dependence and extermination, for his unaided resources were powerless against the persistent attacks of the unconquerable Prussians. The Teutonic Order, which had just been expelled from Hungary by Andrew II., joyfully accepted this new domicile, and its position in the north was definitely established by the compact of Kruschwitz in 1230, whereby it obtained absolute possession of the maritime district between Pomerania and Courland, and southwards as far as Thorn. So far were the Poles from anticipating any danger from the Teutonic Order, that, from 1243 to 1255, they actually assisted it to overthrow the independent Pomeranian princes, the most formidable opponents of the Knights in the earlier years of their existence. A second Tatar raid in 1259, less dangerous, perhaps, but certainly more ruinous, than the first invasion—for the principalities of Little Poland and Sandomir were systematically ravaged for three months—still further depressed the land, and, at this very time, another enemy appeared in the east—the Lithuanians.

The Lithuanians.

This interesting people, whose origin is to this day the most baffling of ethnographical puzzles, originally dwelt amidst the forests and marshes of the Upper Niemen. Thanks to the impenetrability of their fastnesses, they preserved their original savagery longer than any of their neighbours, and this savagery was coupled with a valour so tenacious and enterprising as to make them formidable to all who dwelt near them. The Russians fled at the sight of them, "like hares before hunters." The Livs and Letts were as much the prey of the Lithuanians "as sheep are the prey of wolves." The German chroniclers describe them as the most terrible of all the barbarians. The Lithuanians first emerge into the light of history at the time of the settlement of the Teutonic Order in the North. Rumours of the war of extermination conducted against their kinsmen, the wild Prussians, by the Knights, first woke the Lithuanians to a sense of their own danger, and induced them to abandon their loose communal system in favour of a monarchical form of government, which concentrated the whole power of the state in a single hand. Fortunately, too, at this crisis of their history, the Lithuanians were blessed with an altogether exceptional series of great rulers, who showed themselves fully capable of taking care of themselves. There was, for instance, Mendovg (1240–1263), who submitted to baptism for purely political reasons, checkmated the Teutonic Knights by adroitly seeking the protection of the Holy See, and annexed the principality of Plock to his ever-widening grand duchy, which already included Black Russia, and formed a huge wedge extending southwards from Courland, thus separating Poland from Russia. A still greater prince was Gedymin (1315–1342) who did his utmost to civilize Lithuania by building towns, introducing foreigners, and tolerating all religions, though he himself remained a pagan for political reasons. Gedymin still further extended the limits of Lithuania by annexing Kiev, Chernigov and other old Russian principalities.

Wladislaus I., 1306-1333.

Casimir III. the Great, 1333-1370.

At the very time when Lithuania was thus becoming a compact, united, powerful state, Poland seemed literally to be dropping to pieces. Not even the exhortations of the popes could make her score of princes unite for mutual defence against the barbarians who environed them. For a time it seemed highly probable that Poland would be completely germanized, like Silesia, or become a part of the new Bohemian Empire which Wenceslaus II. (crowned king of Poland in 1300) had inherited from his father, Ottakar II. From this fate she was saved by the valour of Wladislaus Lokietek, duke of Great Poland (1306–1333), who reunited Great and Little Poland, revived the royal dignity in 1320, and saved the kingdom from annihilation by his great victory over the Teutonic Knights at Plowce in 1332. The whole reign of Wladislaus I. was indeed an unceasing struggle against all the forces of anarchy and disintegration; but the fruits of his labours were richly reaped by his son Casimir III. the Great (1333–1370), Poland's first great statesman in the modern sense of the word, who, by a most skilful system of matrimonial alliances, reintroduced isolated Poland into the European system, and gave the exhausted country an inestimably beneficial breathing space of thirty-seven years. A born ruler, Casimir introduced a whole series of administrative and economical reforms. He was the especial protector of the cities and the peasants, and, though averse from violent measures, punished aristocratic tyranny with an iron hand. Casimir's few wars were waged entirely for profit, not glory. It is to him that Poland owed the important acquisition of the greater part of Red Russia, or Galicia, which enabled her to secure her fair share of the northern and eastern trade. In default of male issue, Casimir left the Polish throne to his nephew, Louis of Hungary, who ruled the country (1370–1382) through his mother, Queen Elizabeth, Wladislaus Lokietek's daughter. Louis well deserved the epithet of "great" bestowed upon him by his contemporaries;

but Poland formed but a small portion of his vast domains, and Poland's interests were subordinated to the larger demands of an imperial policy which embraced half Europe within its orbit

Wladislaus II. Jagiello. Union of Poland and Lithuania.

On the death of Louis there ensued an interregnum of two years marked by fierce civil wars, instigated by duke Ziemovit of Masovia, the northernmost province of Poland, which continued to exist as an independent principality alongside of the kingdom of Poland. Ziemovit aimed at the Polish crown, proposing to marry the infant princess Jadwiga of Hungary, who, as the daughter of Louis the Great and the granddaughter of Wladislaus Lokietek, had an equal right, by inheritance, to the thrones of Hungary and Poland. By an agreement with the queen mother of Hungary at Kassa in 1383, the Poles finally accepted Jadwiga as their queen, and, on the 18th of February 1386, greatly against her will, the young princess, already betrothed to William of Austria, was wedded to Jagiello, grand duke of Lithuania, who had been crowned king of Poland at Cracow, three days previously, under the title of Wladislaus II.

The union of Poland and Lithuania as separate states under one king had been brought about by their common fear of the Teutonic Order. Five years after the death of Gedymin, Olgierd, the most capable of his seven sons, had been placed upon the throne of Lithuania by his devoted brother Kiejstut, and for the next two-and-thirty years (1345–1377) the two princes still further extended the sway of Lithuania, principally at the expense of Muscovy and the Tatars. Kiejstut ruled the western portion of the land where the Teutonic Knights were a constant menace, while Olgierd drove the Tatar hordes out of the south-eastern steppes, and compelled them to seek a refuge in the Crimea. During Olgierd's reign the southern boundaries of Lithuania touched the Black Sea, including the whole tract of land between the mouth of the Bug and the mouth of the Dnieper. Olgierd was succeeded by his son Jagiello as grand duke in 1377, while Kiejstut was left in possession of Samogitia, Troki and Grodno; but the Teutonic Order, alarmed at the growth of Lithuania, succeeded in estranging uncle and nephew, and Kiejstut was treacherously assassinated by Jagiello's orders, at Krewo, on the 15th of August 1382. Three weeks later Jagiello was compelled to cede Samogitia, as far as the Dubissa, to the Knights, and, in the following year they set up against him Kiejstut's son Witowt. The eyes of Jagiello were now opened to the fact that the machiavellian policy of the Knights aimed at subjugating Lithuania by dividing it. He at once made peace with his cousin; restored him his patrimony; and, to secure Lithuania against the future vengeance of the Knights, Jagiello made overtures to Poland for the hand of Jadwiga, and received the Polish crown along with it, as already mentioned

Before proceeding to describe the Jagiellonic period of Polish history, it is necessary to cast a rapid glance at the social and political condition of the country in the preceding Piast period.

Beginnings of the Polish Constitution.

The paucity and taciturnity of our sources make it impossible to give anything like an adequate picture of Old Poland during the first four centuries of its existence. A glimpse here and there of the political development of the country is the utmost that the most diligent scrutiny can glean from the scanty record of the early chronicles. External pressure, here as elsewhere, created a patriotic military caste, and the subsequent partitional period, when every little prince had his own separate court, still further established the growing influence of the *szlachta*, or gentry, who were not backward in claiming and obtaining special privileges in return for their services. The first authentic *pacta conventa* made between the Polish nobility and the Crown dates from the compact of Kassa (September 17, 1374), when Louis of Hungary agreed to exempt the *szlachta* from all taxation, except two Polish groschen per hide of land, and to compensate them for the expenses of all military service rendered beyond the confines of the realm. The clergy received their chief privileges much earlier. It was at the synod of Leczyca, nearly a century before the compact of Kassa, that the property of the Church was first safeguarded against the encroachments of the state. The beneficial influence of the Church of Poland in these early times was incalculable. To say nothing of the labours of the Cistercians as colonists, pioneers and church-builders, or of the missions of the Dominicans and Franciscans (the former of whom were introduced into Poland by Ivo, bishop of Cracow,[1] the personal friend of Dominic), the Church was the one stable and unifying element in an age of centrifugal particularism. The frequent synods represented the whole of Poland, and kept alive, as nothing else could, the idea of national solidarity. The Holy See had also a considerable share in promoting the political development of the land. In the 13th century alone no fewer than forty-nine papal legates visited Poland, and thirty provincial synods were held by them to regulate church affairs and promote good government. Moreover the clergy, to their eternal honour, consistently protected the lower from the tyranny of the upper classes.

Growth of the Towns.

The growth of the towns was slower. During the heroic Boleslawic period there had been a premature outcrop of civil life. As early as the 11th century Kruschwitz, the old Polish capital, and Gnesen, the metropolitan see, were of considerable importance, and played a leading part in public life. But in the ensuing anarchic period both cities were utterly ruined, and the centre of political gravity was transferred from Great Poland to Little Poland, where Cracow, singularly favoured by her position, soon became the capital of the monarchy, and one of the wealthiest cities in Europe. At the end of the 14th century we find all the great trade gilds established there, and the cloth manufactured at Cracow was eagerly sought after, from Prague to Great Novgorod. So wealthy did Cracow become at last that Casimir the Great felt it necessary to restrain the luxury of her citizens by sumptuary ordinances. Towards the end of the 14th century the Polish towns even attained some degree of political influence, and their delegates sat with the nobles and clergy in the king's councils, a right formally conceded to them at Radom in March 1384. Even the peasants, who had suffered severely from the wholesale establishment of prisoners of war as serfs on the estates of the nobles, still preserved the rights of personal liberty and free transit from place to place, whence their name of *lazigi*. The only portion of the community which had no privileges were the Jews, first introduced into Poland by Boleslaus the Pious, duke of Great Poland, in 1264, when bitter persecutions had driven them northwards from the shores of the Adriatic. Casimir the Great extended their liberty of domicile over the whole kingdom (1334). From the first they were better treated in Poland than elsewhere, though frequently exposed to outbreaks of popular fanaticism.

Wladislaus II. and the Teutonic Order.

The transformation of the pagan Lithuanian chieftain Jagiello into the catholic king of Poland, Wladislaus II., was an event of capital importance in the history of eastern Europe. Its immediate and inevitable consequence was the formal reception of the Lithuanian nations into the fold of the Church. What the Teutonic Order had vainly endeavoured to bring about by fire and sword, for two centuries, was peacefully accomplished by Jagiello within a single generation, the Lithuanians, for the most part, willingly yielding to the arguments of a prince of their own blood, who promptly rewarded his converts with peculiar and exclusive privileges. The conversion of Lithuania menaced the very existence of the Teutonic Knights. Originally planted on the Baltic shore for the express purpose of christianizing their savage neighbours, these crusading monks had freely exploited the wealth and the valour of the West, ostensibly in the cause of religion, really for the purpose of founding a dominion of their own which, as time went on, lost more and more of its religious character, and was now little more than a German military forepost, extending from Pomerania to the Niemen, which deliberately excluded the Slavs from the sea and thrived at their expense. The mere instinct of self-preservation had, at last, drawn the Poles and Lithuanians together against these ruthless and masterful intruders, and the coronation of Jagiello at Cracow on the 15th of February 1386, was both a warning and a challenge to the Knights. But if the Order had now become a superfluous anachronism, it had still to be disposed of, and this was no easy task. For if it had failed utterly as a mission *in partibus*, it had succeeded in establishing on the Baltic one of the strongest military organizations in Europe. In the art of war the Knights were immeasurably superior to all their neighbours. The pick of the feudal chivalry composed their ranks; with all Europe to draw upon, their resources seemed inexhaustible, and centuries of political experience made them as formidable in diplomacy as they were valiant in warfare. And indeed, for the next twenty years, the Teutonic Order more than held its own. Skilfully taking advantage of the jealousies of Poland and Lithuania, as they were accentuated by the personal antagonism of Jagiello and Witowt (*q.v.*), with the latter of whom the Knights more than once contracted profitable alliances, they even contrived (Treaty of Salin, 1378) to extend their territory by getting possession of the province of Samogitia, the original seat of the Lithuanians, where paganism still persisted, and where their inhuman cruelties finally excited the horror and indignation of Christian Europe. By this time, however, the prudent Jagiello had become convinced that Lithuania was too strong to be ruled by or from Poland, and yet not strong enough to stand alone, and by the compact of Vilna (January 18, 1401, confirmed by the compact of Radowo, March 10) he surrendered the whole grand duchy to Witowt, on the understanding that the two states should have a common policy, and that neither of them should elect a new prince without the consent of the other. The wisdom of this arrangement was made manifest in 1410, when Jagiello and Witowt combined their forces for the purpose of delivering Samogitia from the intolerable tyranny of the Knights. The issue was fought out on the field of Tannenberg, or Grünewald (July 15, 1410), when the Knights sustained a crushing defeat, which shook their political organization to its very foundations. A few weeks after the victory the towns of Thorn, Elbing, Braunsberg and Danzig submitted to the Polish king, and all the Prussian bishops voluntarily offered to render him homage. But the excessive caution of Jagiello gave the Knights time to recover from the blow; the Polish levies proved unruly and incompetent; Witowt was suddenly recalled to Lithuania by a Tatar invasion, and thus it came about that, when peace was concluded at Thorn, on the 1st of February 1411, Samogitia (which was to revert to the Order on the death of Jagiello and Witowt), Dobrzyn, and a war indemnity of 100,000 marks payable in four instalments, were the best terms Poland could obtain from the Knights, whose territory practically remained intact. Jagiello's signal for the attack at the battle of Grünewald, "Cracow and Vilna" (the respective capitals of Poland and Lithuania) had eloquently demonstrated the solidarity of the two states. This solidarity was still further strengthened by the Union of Horodlo (October 2, 1413) which enacted that henceforth Lithuania was to have the same order of dignitaries[1] as Poland, as well as a council of state, or senate, similar to the Polish senate. The power of the grand-duke was also greatly increased. He was now declared to be the equal of the Polish king, and his successor could be elected only by the senates of Poland and Lithuania in conjunction. The Union of Horodlo also established absolute parity between the nobility of Poland and Lithuania, but the privileges of the latter were made conditional upon their profession of the Roman Catholic faith, experience having shown that difference of religion in Lithuania meant difference of politics, and a tendency Moscow-wards, the majority of the Lithuanian boyars being of the Greek Orthodox Confession.

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[1] Archbishop of Gnesen 1219–1220. Died at Modena 1229.

During the remainder of the reign of Wladislaus II. the Teutonic Order gave Poland much trouble, but no serious anxiety. The trouble was due mainly to the repeated efforts of the Knights to evade the fulfilment of the obligations of the Treaty of Thorn. In these endeavours they were materially assisted by the emperor Sigismund, who was also king of Hungary. Sigismund, in 1422, even went so far as to propose a partition of Poland between Hungary, the empire and the Silesian princes, a scheme which foundered upon Sigismund's impecuniosity and the reluctance of the Magyars to injure the Poles. More than once Wladislaus II. was even obliged to renew the war against the Knights, and, in 1422, he compelled them to renounce all claims upon Samogitia; but the long struggle, still undecided at his death, was fought mainly with diplomatic weapons at Rome, where the popes, generally speaking, listened rather to the victorious monarch who had added an ecclesiastical province to the Church than to the discomfited and turbulent Knights.

Had Wladislaus II. been as great a warrior as Witowt he might, perhaps, have subdued the Knights altogether. But by nature he was pre-eminently a diplomatist, and it must in fairness be admitted that his diplomacy in every direction was distinctly beneficial to Poland. He successfully thwarted all the schemes of the emperor Sigismund, by adroitly supporting the revolutionary party in Bohemia (*q.v.*). In return Hussite mercenaries fought on the Polish side at Tannenburg, and Czech patriots repeatedly offered the crown of Bohemia to Wladislaus. The Polish king was always ready enough to support the Czechs against Sigismund; but the necessity of justifying his own orthodoxy (which the Knights were for ever impugning) at Rome and in the face of Europe prevented him from accepting the crown of St Wenceslaus from the hands of heretics.

Wladislaus II. died at Lemberg in 1434, at the age of eighty-three. During his long reign of forty-nine years Poland had gradually risen to the rank of a great power, a result due in no small measure to the insight and sagacity of the first Jagiello, who sacrificed every other consideration to the vital necessity of welding the central Slavs into a compact and homogeneous state. The next ten years severely tested the stability of his great work, but it stood the test triumphantly. Neither a turbulent minority, nor the neglect of an absentee king; neither the revival of separatist tendencies in Lithuania, nor the outbreaks of aristocratic lawlessness in Poland, could do more than shake the superstructure of the imposing edifice. After the death at Varna, in 1444, of Jagiello's eldest son and successor, Wladislaus III. (whose history belongs rather to Hungary than to Poland), another great statesman, in no wise inferior to Wladislaus II., completed and consolidated his work. This was Wladislaus's second son, already grandduke of Lithuania, who ascended the Polish throne as Casimir IV. in 1447, thus reuniting Poland and Lithuania under one monarch.

Casimir IV., 1447–1492.

Enormous were the difficulties of Casimir IV. He instinctively recognized not only the vital necessity of the maintenance of the union between the two states, but also the fact that the chief source of danger to the union lay in Lithuania, in those days a maelstrom of conflicting political currents. To begin with, Lithuania was a far less composite state than Poland. Two-thirds of the grandduchy consisted of old Russian lands inhabited by men who spoke the Ruthenian language and professed the Orthodox Greek religion, while in the north were the Lithuanians proper, semi-savage and semi-catholic, justly proud of their heroic forefathers of the house of Gedymin, and very sensitive of the pretensions of Poland to the provinces of Volhynia and Podolia, the fruits of Lithuanian valour. A Lithuanian himself, Casimir strenuously resisted the attempts of Poland to wrest these provinces from the grandduchy. Moreover, during the earlier years of his reign, he was obliged to reside for the most part in Lithuania, where his tranquilizing influence was needed. His supposed preference for Lithuania was the real cause of his unpopularity in Poland, where, to the very end of his reign, he was regarded with suspicion, and where every effort was made to thwart his far-seeing and patriotic political combinations, which were beyond the comprehension of his self-seeking and narrow-minded contemporaries. This was notably the case as regards his dealings with the old enemy of his race, the Teutonic Order, whose destruction was the chief aim of his ambition.

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[1] All the chief offices of state were consequently duplicated, *e.g.* the *hetman wielki koronny*, *i.e.* "grand hetman of the crown," as the Polish commander-in-chief was called, had his counterpart in Lithuania, who bore the title of *wielki hetman litewski*, *i.e.* "grand hetman of Lithuania," and so on.

The Teutonic Order had long since failed as a religious institution; it was now to show its inadequacy as a political organization. In the domain of the Knights the gentry, parochial clergy and townsmen, who, beneath its protection, had attained to a high degree of wealth and civilization, for long remained without the slightest political influence, though they bore nearly the whole burden of taxation. In 1414, however, intimidated by the growing discontent, which frequently took the form of armed rebellion, the Knights consented to the establishment of a diet, which was re-formed on a more aristocratic basis in 1430. But the old abuses continuing to multiply, the Prussian towns and gentry at last took their affairs into their own hands, and formed a so-called Prussian League, which demanded an equal share in the government of the country. This league was excommunicated by the pope, and placed under the ban of the empire almost simultaneously in 1453, whereupon it placed itself beneath the protection of its nearest powerful neighbour, the king of Poland, who (March 6, 1454) issued a manifesto incorporating all the Prussian provinces with Poland, but, at the same time, granting them local autonomy and free trade.

But provinces are not conquered by manifestoes, and Casimir's acceptance of the homage of the Prussian League at once involved him in a war with the desperate Teutonic Knights, which lasted twelve years, but might easily have been concluded in a twelvemonth had he only been loyally supported by his own subjects, for whose benefit he had embarked upon this great enterprise. But instead of support, Casimir encountered obstinate obstruction at every point. No patriotic Pole, we imagine, can read the history of this miserable war without feeling heartily ashamed of his countrymen. The acquisition of the Prussian lands was vital to the existence of Poland. It meant the excision of an alien element which fed like a cancer on the body politic; it meant the recovery, at comparatively little cost, of the command of the principal rivers of Poland, the Vistula and the Niemen; it meant the obtaining of a seaboard with the corollaries of sea-power and world-wide commerce. Yet, except in the border province of Great Poland, which was interested commercially, the whole enterprise was regarded with such indifference that the king, in the very crisis of the struggle, could only with the utmost difficulty obtain contributions for war expenses from the half-dozen local diets of Poland, which extorted from the helplessness of their distracted and impecunious sovereign fresh privileges for every subsidy they grudgingly granted. Moreover Casimir's difficulties were materially increased by the necessity of paying for Czech mercenaries, the *pospolite ruszenie*, or Polish militia, proving utterly useless at the very beginning of the war. Indeed, from first to last, the Polish gentry as a body took good care to pay and fight as little as possible, and Casimir depended for the most part upon the liberality of the Church and the Prussian towns, and the valour of the Hussite infantry, 170,000 of whom, fighting on both sides, are said to have perished. Not till the victory of Puck (September 17, 1462), one of the very few pitched battles in a war of raids, skirmishes and sieges, did fortune incline decisively to the side of the Poles, who maintained and improved their advantage till absolute exhaustion compelled the Knights to accept the mediation of a papal legate, and the second peace of Thorn (October 14, 1466) concluded a struggle which had reduced the Prussian provinces to a wilderness.[1] By the second peace of Thorn, Poland recovered the provinces of Pomerelia, Kulm and Michalow, with the bishopric of Ermeland, numerous cities and fortresses, including Marienburg, Elbing, Danzig and Thorn. The territory of the Knights was now reduced to Prussia proper, embracing, roughly speaking, the district between the Baltic, the lower Vistula and the lower Niemen, with Königsberg as its capital. For this territory the grand-masters, within nine months of their election, were in future to render homage to the Polish king; but, on the other hand, the king undertook not to make war or engage in any important enterprise without the consent of the Prussian province, and vice versa. Thus Prussia was now confederated with Poland, but she occupied a subordinate position as compared with Lithuania, inasmuch as the grand-master, though filling the first place in the royal council, was still a subject of the Polish crown. Thus the high hopes entertained by Casimir at the beginning of the war had not been realized. The final settlement with the Poles was of the nature of a compromise. Still the Knights had been driven beyond the Vistula, and Poland had secured a seaboard; and it was due entirely to the infinite patience and tenacity of the king that even as much as this was won at last.

The whole foreign policy of Casimir IV. was more or less conditioned by the Prussian question, and here also his superior diplomacy triumphantly asserted itself. At the beginning of the war both the empire and the pope were against him, but he neutralized their hostility by allying himself with George of Podvebrad, whom the Hussites had placed on the throne of Bohemia. On the death of George, Casimir's eldest son Wladislaus was elected king of Bohemia by the Utraquist party, despite the determined opposition of Matthias Corvinus, king of Hungary, whose ability and audacity henceforth made him Casimir's most dangerous rival. Sure of the support of the pope, Matthias (*q.v.*) deliberately set about traversing all the plans of Casimir. He encouraged the Teutonic Order to rebel against Poland; he entertained at his court anti-Polish embassies from Moscow; he encouraged the Tatars to ravage Lithuania; he thwarted Casimir's policy in Moldavia. The death of the brilliant adventurer at Vienna in 1490 came therefore as a distinct relief to Poland, and all danger from the side of Hungary was removed in 1490 when Casimir's son Wladislaus, already king of Bohemia, was elected king of Hungary also.

Poland and the Turks.

It was in the reign of Casimir IV. that Poland first came into direct collision with the Turks. The Republic was never, indeed, the "Buckler of Christendom." That glorious epithet belonged of right to Hungary, which had already borne the brunt of the struggle with the Ottoman power for more than a century. It is true that Wladislaus II. of Poland had fallen on the field of Varna, but it was as a Magyar king at the head of a Magyar army that the young monarch met his fate. Poland, indeed, was far less able to cope with the Turks than compact, wealthy Hungary, which throughout the 15th century was one of the most efficient military monarchies in Europe. The Jagiellos, as a rule, prudently avoided committing themselves to any political system which might irritate the still distant but much-dreaded Turk, but when their dominions extended so far southwards as to embrace Moldavia, the observance of a strict neutrality became exceedingly difficult. Poland had established a sort of suzerainty over Moldavia as early as the end of the 14th century; but at best it was a loose and vague overlordship which the Hospodars repudiated whenever they were strong enough to do so. The Turks themselves were too much occupied elsewhere to pay much attention to the Danubian principalities till the middle of the 15th century. In 1478 Mahomet II. had indeed attempted their subjugation, with but indifferent success; but it was not till 1484 that the Ottomans became inconvenient neighbours to Poland. In that year a Turkish fleet captured the strongholds of Kilia and Akkerman, commanding respectively the mouths of the Danube and Dniester. This aggression seriously threatened the trade of Poland, and induced Casimir IV. to accede to a general league against the Porte. In 1485, after driving the Turks out of Moldavia, the Polish king, at the head of 20,000 men, proceeded to Kolomea on the

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[1] 18,000 of their 21,000 villages were destroyed, 1000 churches were razed to the ground, and the population was diminished by more than a quarter of a million.

Pruth, where Bayezid II., then embarrassed by the Egyptian war, offered peace, but as no agreement concerning the captured fortresses could be arrived at, hostilities were suspended by a truce. During the remainder of his reign the Turks gave no trouble.

John I. Albert, 1492-1501.

It was a fortunate thing for Poland that, during the first century of her ascension to the rank of a great power, political exigencies compelled her to appropriate almost more territory than her primitive and centrifugal government could properly assimilate; it was fortunate that throughout this period of expansion her destinies should, with one brief interval, have been controlled by a couple of superior statesmen, each of whom ruled for nearly fifty years. During the fourteen years (1492-1506) which separate the reigns of Casimir IV. and Sigismund I. she was not so lucky. The controlling hand of Casimir IV. was no sooner withdrawn than the unruly elements, ever present in the Republic, and ultimately the casue of its ruin, at once burst forth. The first symptom of this lawlessness was the separation of Poland and Lithuania, the Lithuanians proceeding to elect Alexander, Casimir's fourth son, as their grand-duke, without even consulting the Polish senate, in flagrant violation of the union of Horodlo. The breach, happily, was of no very long duration. A disastrous war with Ivan III., the first Muscovite tsar, speedily convinced the Lithuanians that they were not strong enough to stand alone, and in 1499 they voluntarily renewed the union. Much more dangerous was the political revolution proceeding simultaneously in Poland, where John Albert, the third son of Casimir, had been elected king on the death of his father. The nature of this revolution will be considered in detail when we come to speak of the growth of the Polish constitution. Suffice it here to say that it was both anti-monarchical and anti-democratic, tending, as it did, to place all political authority in the hands of the *szlachta*, or gentry. The impecunious monarch submitted to the dictation of the diet in the hope of obtaining sufficient money to prosecute his ambitious designs. With his elder brother Wladislaus reigning over Bohemia and Hungary the credit of the Jagiellos in Europe had never been so great as it was now, and John Albert, bent upon military glory, eagerly placed himself at the head of what was to have been a great anti-Turkish league, but ultimately dwindled down to a raid upon Moldavia which ended in disaster. The sole advantage which John Albert reaped from his championship of the Christian cause was the favour of the Curia, and the ascendancy which that favour gave him over the Teutonic Knights, whose new grand-master, Albert of Saxony, was reluctantly compelled to render due homage to the Polish king.

Alexander, 1501-1506.

Russia and Lithuania.

Sigismund I., 1506-1548.

Under Alexander (*q.v.*), who succeeded his brother in 1501, matters went from bad to worse. Alexander's election cemented, indeed, once for all, the union between Poland and Lithuania, inasmuch as, on the eve of it (Oct. 3, 1501) the senates of both countries agreed that, in future, the king of Poland should always be grand-duke of Lithuania; but this was the sole benefit which the Republic derived from the reign of Alexander, under whom the Polish government has been well described as a rudderless ship in a stormy sea, with nothing but the grace of God between it and destruction. In Lithuania the increasing pressure of the Muscovite was the chief danger. Till the accession of Ivan III. in 1462 Muscovy had been a negligible factor in Polish politics. During the earlier part of the 15th century the Lithuanian princes had successfully contested Muscovite influence even in Pskov and Great Novgorod. Many Russian historians even maintain that, but for the fact that Witowt had simultaneously to cope with the Teutonic Order and the Tatars, that energetic prince would certainly have extinguished struggling Muscovy altogether. But since the death of Witowt (1430) the military efficiency of Lithuania had sensibly declined; single-handed she was no longer a match for her ancient rival. This was owing partly to the evils of an oligarchic government; partly to the weakness resulting from the natural attraction of the Orthodox-Greek element in Lithuania towards Muscovy, especially after the fall of Constantinople, but chiefly to the administrative superiority of the highly centralized Muscovite government. During the reign of Alexander, who was too poor to maintain any adequate standing army in Lithuania, the Muscovites and Tatars ravaged the whole country at will, and were prevented from conquering it altogether only by their inability to capture the chief fortresses. In Poland, meanwhile, something very like anarchy prevailed. Alexander had practically surrendered his authority to an incapable aristocracy, whose sole idea of ruling was systematically to oppress and humiliate the lower classes. In foreign affairs a policy of drift prevailed which encouraged all the enemies of the Republic to raise their heads, while the dependent states of Prussia in the north and Moldavia in the south made strenuous efforts to break away from Poland. Fortunately for the integrity of the Polish state the premature death of Alexander in 1506 brought upon the throne his capable brother Sigismund, the fifth son of Casimir IV., whose long reign of forty-two years was salutary, and would have been altogether recuperative, had his statesmanship only been loyally supported by his subjects. Eminently practical, Sigismund recognized that the first need of Poland was a standing army. The miserable collapse of the Polish chivalry during the Bukovinian campaign of 1497 had convinced every one that the *ruszenie pospolite* was useless for serious military purposes, and that Poland, in order to hold her own, must in future follow the example of the West, and wage her warfare with trained mercenaries. But professional soldiers could not be hired without money, and the difficulty was to persuade the diet to loose its purse-strings. All that the gentry contributed at present was two pence (groschen) per hide of land, and this only for defensive service at home. If the king led the *ruszenie pospolite* abroad he was obliged to pay so much per pike out of his own pocket, notwithstanding the fact that the heavily mortgaged crown lands were practically valueless. At the diet of 1510 the chancellor and primate, Adam Laski, proposed an income-tax of 50% at once, and 5% for subsequent years, payable by both the lay and clerical estates. In view of the fact that Poland was the most defenceless country in Europe, with no natural boundaries, and constantly exposed to attacks from every quarter, it was not unreasonable to expect even this patriotic sacrifice from the privileged classes, who held at least two-thirds of the land by military tenure. Nevertheless, the diet refused to consider the scheme. In the following year a more modest proposal was made by the Crown in the shape of a capitation of six gulden, to be levied on every nobleman at the beginning of a campaign, for the hiring of mercenaries. This also was rejected. In 1512 the king came forward with a third scheme. He proposed to divide the country into five circles, corresponding to the five provinces, each of which was to undertake to defend the realm in turn should occasion arise. Moreover, every one who so desired it might pay a commutation in lieu of personal service, and the amount so realized was to be re-used to levy troops. To this the dietines, or local diets, of Great Poland, and Little Poland, agreed, but at the last moment the whole project foundered on the question who was the proper custodian of the new assessment rolls, and the king had to be content with the renewal of former subsidies, varying from twelve to fifteen groats per hide of land for three years. Well might the disappointed monarch exclaim: "It is vain to labour for the welfare of those who do not care a jot about it themselves." Matters improved somewhat in 1527, when the *szlachta*, by a special act, placed the mightiest magnates on the same level as the humblest squire as regards military service, and proposed at the same time a more general assessment for the purpose, the control of the money so realized to be placed in the hands of the king. In consequence of this law the great lords were compelled to put forces in the field proportioned to their enormous fortunes, and Sigismund was able in 1529 to raise 300 foot and 3200 horse from the province of Podolia alone. But though the treasury was thus temporarily replenished and the army increased, the gentry who had been so generous at the expense of their richer neighbours would hear of no additional burdens being laid on themselves, and the king only obtained what he wanted by sacrificing his principles to his necessities, and helping the *szlachta* to pull down the magnates. This fatal parsimony had the most serious political consequences, for it crippled the king at every step. Strive and scheme as he might, his needs were so urgent, his enemies so numerous, that, though generally successful in the end, he had always to be content with compromises, adjustments and semi-victories. Thus he was obliged, in 1525, to grant local autonomy to the province of Prussia instead of annexing it; he was unable to succour his unfortunate nephew, Louis of Hungary, against the Turkish peril; he was compelled to submit to the occupation of one Lithuanian province after the other by the Muscovites, and look on helplessly while myriads of Tatars penetrated to the very heart of his domains, wasting with fire and sword everything they could not carry away with them.

The Cossacks.

Again, it should have been the first duty of the Republic adequately to fortify the *dzikie pola*, or "savage steppe," as the vast plain was called which extended from Kiev to the Black Sea, and some feeble attempts to do so were at last made. Thus, in the reign of Alexander, the fugitive serfs whom tyranny or idleness had driven into this wilderness (they were subsequently known as Kazaki, or Cossacks, a Tatar word meaning freebooters) were formed into companies (*c.* 1504) and placed at the disposal of the frontier *starostas*, or lord marchers, of Kaniev, Kamenets, Czerkask on the Don and other places. But these measures proved inadequate, and in 1533 the lord marcher, Ostafi Daszkiewicz, the hero of Kaniev, which he had successfully defended against a countless host of Turks and Tatars, was consulted by the diet as to the best way of defending the Ukraine permanently against such inroads. The veteran expert advised the populating and fortifying of the islands of the Dnieper. Two thousand men would suffice, he said, and the Cossacks supplied excellent military material ready to hand. The diet unanimously approved of this simple and inexpensive plan; a special commission examined and approved of its details, and it was submitted to the next diet, which rejected it. So nothing at all was done officially, and the defence of the eastern Ukraine was left to providence. Oddly enough the selfish prudence of Sigismund's rapacious consort, Queen Bona, did more for the national defence than the Polish state could do. Thus, to defend her immense possessions in Volhynia and Podolia, she converted the castles of Bar and Krzemieniec into first-class fortresses, and placed the former in the hands of her Silesian steward, who acquitted himself so manfully of his charge[1] that "the Tatars fell away from the frontier all the days of Pan Pretficz," and a large population settled securely beneath the walls of Bar, henceforth known as "the bastion of Podolia." Nothing, perhaps, illustrates so forcibly the casual character of the Polish government in the most vital matters as this single incident.

The most important political event during the reign of Sigismund was the collapse of the ancient Hungarian monarchy at Mohacs in 1526. Poland, as the next neighbour of Hungary, was more seriously affected than any other European power by this catastrophe, but her politicians differed as to the best way of facing it. Immediately after the death of King Louis, who fell on the field of battle, the emperor Ferdinand and John Zapolya, voivode of Transylvania, competed for the vacant crown, and both were elected almost simultaneously. In Poland Zapolya's was the popular cause, and he also found powerful support in the influential and highly gifted Laski family, as represented by the Polish chancellor and his nephews John and Hieronymus. Sigismund, on the other hand, favoured Ferdinand of Austria. Though bound by family ties with both competitors, he regarded the situation from a purely political point of view. He argued that the best way to keep the Turk from Poland was for Austria to incorporate Hungary, in which case the Austrian dominion would be a strong and permanent barrier against a Mussulman invasion of Europe. History has more than justified him, and the long duel which ensued between Ferdinand and Zapolya (see HUNGARY: *History*) enabled the Polish monarch to maintain to the end a cautious but observant neutrality. More than once, indeed, Sigismund was seriously compromised by the diplomatic vagaries of Hieronymus Laski, who entered the service of Zapolya (since 1529 the protégé of the sultan), and greatly alarmed both the emperor and the pope by his disturbing philo-Turk proclivities. It was owing to Laski's intrigues that the new hospodar of Moldavia, Petrylo, after doing homage to the Porte, intervened in the struggle as the foe of both Ferdinand and Sigismund, and besieged the Grand Hetman of the Crown, Jan Tarnowski, in Obertyn, where, however, the Moldavians (August 22, 1531) sustained a crushing defeat, and Petrylo was slain. Nevertheless, so anxious was Sigismund to avoid a collision with the Turks, that he forbade the victorious Tarnowski to cross the Moldavian frontier, and sent a letter of explanation to Constantinople. On the death of John Zapolya, the Austro-Polish alliance was still further cemented by the marriage of Sigismund's son and heir, Sigismund Augustus, with the archduchess Elizabeth. In the reign of Sigismund was effected the incorporation of the duchy of Masovia with the Polish crown, after an independent existence of five hundred years. In 1526 the male line of the ancient dynasty became extinct, and on the 26th of August Sigismund received the homage of the Masovians at Warsaw, the capital of the duchy and ere long of the whole kingdom. Almost every acre of densely populated Masovia was in the hands of her sturdy, ultra-conservative squires, in point of culture far below their brethren in Great and Little Poland. The additional revenue gained by the Crown from Masovia was at first but 14,000 gulden *per annum*.

The four and twenty years of Sigismund II.'s reign was a critical period of Polish history. Complications with the Turk were avoided by the adroit diplomacy of the king, while the superior discipline and efficiency of the Polish armies under the great Tarnowski (*q.v.*) and his pupils overawed the Tatars and extruded the Muscovites, neither of whom were so troublesome as they had been during the last reign. All the more disquieting was the internal condition of the country, due mainly to the invasion of Poland by the Reformation, and the coincidence of this invasion with an internal revolution of a quasi-democratic character, which aimed at substituting the rule of the *szlachta* for the rule of the senate.

The Reformation in Poland.

Hitherto the Republic had given the Holy See but little anxiety. Hussite influences, in the beginning of the 15th century, had been superficial and transitory. The Polish government had employed Hussite mercenaries, but rejected Hussite propagandists. The edict of Wielun (1424), remarkable as the first anti-heretical decree issued in Poland, crushed the new sect in its infancy. Lutheranism, moreover, was at first regarded with grave suspicion by the intensely patriotic Polish gentry, because of its German origin. Nevertheless, the extremely severe penal edicts issued during the reign of Sigismund I., though seldom applied, seem to point to the fact that heresy was spreading widely throughout the country. For a time, therefore, the Protestants had to be cautious in Poland proper, but they found a sure refuge in Prussia, where Lutheranism was already the established religion, and where the newly erected university of Königsberg became a seminary for Polish ministers and preachers.

While Lutheranism was thus threatening the Polish Church from the north, Calvinism had already invaded her from the west. Calvinism, indeed, rather recommended itself to the Poles as being of non-German origin, and Calvin actually dedicated his *Commentary on the Mass* to the young *krolewicz* (or crown prince) Sigismund Augustus, from whom protestantism, erroneously enough, expected much in the future. Meanwhile conversion to Calvinism, among the higher classes in Poland, became more and more frequent. We hear of crowded Calvinist conventicles in Little Poland from 1545 onwards, and Calvinism continued to spread throughout the kingdom during the latter years of Sigismund I. Another sect, which ultimately found even more favour in Poland than the Calvinists, was that of the Bohemian Brethren. We first hear of them in Great Poland in 1548. A royal decree promptly banished them to Prussia, where they soon increased so rapidly as to be able to hold their own against the Lutherans. The death of the uncompromising Sigismund I. came as a great relief to the Protestants, who entertained high hopes of his son and successor. He was known to be familiar with the works of the leading reformers; he was surrounded by Protestant counsellors, and he was actually married to Barbara, daughter of Prince Nicholas Radziwill, "Black Radziwill," the all-powerful chief of the Lithuanian Calvinists. It was not so generally known that Sigismund II. was by conviction a sincere though not a bigoted Catholic; and nobody suspected that beneath his diplomatic urbanity lay a patriotic firmness and statesmanlike qualities of the first order. Moreover, they ignored the fact that the success of the Protestant propaganda was due rather to political than to religious causes. The Polish gentry's jealousy of the clerical estate, whose privileges even exceeded their own, was at the bottom of the whole matter. Any opponent of the established clergy was the natural ally of the *szlachta*, and the scandalous state of the Church herself provided them with a most formidable weapon against her. It is not too much to say that the condition of the Catholic Church in Poland was almost as bad as it was in Scotland during the same period. The bishops were, for the most part, elegant triflers, as pliant as reeds, with no fixed principles and saturated with a false humanism. Some of them were notorious evil-livers. "Pint-pot" Latuski, bishop of Posen, had purchased his office for 12,000 ducats from Queen Bona; while another of her creatures, Peter, popularly known as the "wencher," was appointed bishop of Przemysl with the promise of the reversion of the still richer see of Cracow. Moreover, despite her immense wealth (in the province of Little Poland alone she owned at this time 26 towns, 83 landed estates and 772 villages), the Church claimed exemption from all public burdens, from all political responsibilities, although her prelates continued to exercise an altogether disproportionate political influence. Education was shamefully neglected, the masses being left in almost heathen ignorance—and this, too, at a time when the upper classes were greedily appropriating the ripe fruits of the Renaissance and when, to use the words of a contemporary, there were "more Latinists in Poland than there used to be in Latium." The university of Cracow, the sole source of knowledge in the vast Polish realm, still moved in the vicious circle of scholastic formularies. The provincial schools, dependent upon so decrepit an *alma mater*, were suffered to decay. This criminal neglect of national education brought along with it its own punishment. The sons of the gentry, denied proper instruction at home, betook themselves to the nearest universities across the border, to Goldberg in Silesia, to Wittemberg, to Leipzig. Here they fell in with the adherents of the new faith, grave, earnest men who professed to reform the abuses which had grown up in the Church; and a sense of equity as much as a love of novelty moved them, on their return home, to propagate wholesome doctrines and clamour for the reformation of their own degenerate prelates. Finally the poorer clergy, neglected by their bishops, and excluded from all preferment, took part with the *szlachta* against their own spiritual rulers and eagerly devoured and imparted to their flocks, in their own language, the contents of the religious tracts which reached them by divers ways from Goldberg and Königsberg. Nothing indeed did so much to popularize the new doctrines in Poland as this beneficial revival of the long-neglected vernacular by the reformers.

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[1] Pretficz won no fewer than 70 engagements over the Tatars.

Sigismund II., 1548–1572.

Such was the situation when Sigismund II. began his reign. The bishops at once made a high bid for the favour of the new king by consenting to the coronation of his Calvinist consort (Dec. 7, 1550) and the king five days afterwards issued the celebrated edict in which he pledged his royal word to preserve intact the unity of the Church and to enforce the law of the land against heresy. Encouraged by this pleasing symptom of orthodoxy the bishops, instead of first attempting to put their own dilapidated house in order, at once proceeded to institute prosecutions for heresy against all and sundry. This at once led to an explosion, and at the diet of Piotrkow, 1552, the *szlachta* accepted a proposition of the king, by way of compromise, that the jurisdiction of the clerical courts should be suspended for twelve months, on condition that the gentry continued to pay tithes as heretofore. Then began a religious *interim*, which was gradually prolonged for ten years, during which time Protestantism in Poland flourished exceedingly. Presently reformers of every shade of opinion, even those who were tolerated nowhere else, poured into Poland, which speedily became the battle-ground of all the sects of Europe. Soon the Protestants became numerous enough to form ecclesiastical districts of their own. The first Calvinist synod in Poland was held at Pinczow in 1550. The Bohemian Brethren evangelized Little Poland, but ultimately coalesced with the Calvinists at the synod of Kozminek (August 1555). In the diet itself the Protestants were absolutely supreme, and invariably elected a Calvinist to be their marshal. At the diet of 1555 they boldly demanded a national synod, absolute toleration, and the equalization of all the sects except the Anti-trinitarians. But the king intervened and the existing interim was indefinitely prolonged. At the diet of Piotrkow, 1558–1559, the onslaught of the *szlachta* on the clergy was fiercer than ever, and they even demanded the exclusion of the bishops from the senate. The king, however, perceiving a danger to the constitution in the violence of the *szlachta*, not only supported the bishops, but quashed a subsequent reiterated demand for a national synod. The diet of 1558–1559 indicates the high-water mark of Polish Protestantism. From this time forward it began to subside, very gradually but unmistakably. The chief cause of this subsidence was the division among the reformers themselves. From the chaos of creeds resulted a chaos of ideas on all imaginable subjects, politics included. The Anti-trinitarian proved to be the chief dissolvent, and from 1560 onwards the relations between the two principal Protestant sects, the Lutherans and the Calvinists, were fratricidal rather than fraternal. An auxiliary cause of the decline of Protestantism was the beginning of a Catholic reaction. The bulk of the population still held persistently, if languidly, to the faith of its fathers; the new bishops were holy and learned men, very unlike the creations of Queen Bona, and the Holy See gave to the slowly reviving zeal of both clergy and laity the very necessary impetus from without. For Poland, unlike Scotland, was fortunately, in those days of difficult inter-communication, not too far off, and it is indisputable that in the first instance it was the papal nuncios, men like Berard of Camerino and Giovanni Commendone, who reorganized the scattered and faint-hearted battalions of the Church militant in Poland and led them back to victory. At the diet of Piotrkow in 1562, indeed, the king's sore need of subsidies induced him, at the demand of the *szlachta*, to abolish altogether the jurisdiction of the ecclesiastical courts in cases of heresy; but, on the other hand, at the diet of 1564 he accepted from Commendone the Tridentine decrees and issued an edict banishing all foreign, and especially Anti-trinitarian, heretics from the land. At the diet of 1565 Sigismund went still farther. He rejected a petition for a national pacificatory synod as unnecessary, inasmuch as the council of Trent had already settled all religious questions, and at the same time consented to the introduction into Poland of the most formidable adversaries of the Reformation, the Jesuits. These had already been installed at Poltusk, and were permitted, after the diet rose, to found establishments in the dioceses of Posen, Ermeland and Vilna, which henceforth became centres of a vigorous and victorious propaganda. Thus the Republic recovered her catholicity and her internal harmony at the same time.

The Counter-Reformation in Poland.

With rare sagacity Sigismund II. had thus piloted the Republic through the most difficult internal crisis it had yet encountered. In purely political matters also both initiative and fulfilment came entirely from the Crown, and to the last of the Jagiellos Poland owed the important acquisition of Livonia and the welding together of her loosely connected component parts into a single state by the Union of Lublin.

In the middle of the 16th century the ancient order of the Knights of the Sword, whose territory embraced Esthonia, Livonia, Courland, Semgallen and the islands of Dagö and Oesel, was tottering to its fall. All the Baltic powers were more or less interested in the apportionment of this vast tract of land, whose geographical position made it not only the chief commercial link between east and west, but also the emporium whence the English, Dutch, Swedes, Danes and Germans obtained their corn, timber and most of the raw products of Lithuania and Muscovy. Matters were complicated by the curious political intricacies of this long-coveted domain, where the grand-master, the archbishop of Riga, and the estates of Livonia possessed concurrent and generally conflicting jurisdictions. Poland and Muscovy as the nearest neighbours of this moribund state, which had so long excluded them from the sea, were vitally concerned in its fate. After an anarchic period of suspense, lasting from 1546 to 1561, during which Sweden secured Esthonia, while Ivan the Terrible fearlessly ravaged Livonia, in the hope of making it valueless to any other potentate, Sigismund II., to whom both the grand-master and the archbishop had appealed more than once for protection, at length intervened decisively. Both he and his chancellor, Piotr Myszkowski (d. 1591), were well aware of the importance of securing a coast-land which would enable Poland to become a naval power. But the diet, with almost incredible short-sightedness, refused to waste a penny on an undertaking which, they argued, concerned only Lithuania, and it was not as king of Poland, but as grand-duke of Lithuania, and with purely Lithuanian troops, that Sigismund, in 1561, occupied Livonia. At his camp before Riga the last grand-master, Gotthard von Ketteler, who had long been at the head of the Polish party in Livonia, and William of Brandenburg, archbishop of Riga, gladly placed themselves beneath his protection, and by a subsequent convention signed at Vilna (Nov. 28, 1561), Livonia was incorporated with Lithuania in much the same way as Prussia had been incorporated with Poland thirty-six years previously. Ketteler, who had adopted Lutheranism during a visit to Germany in 1553, now professed the Augsburg Confession, and became the first duke of a new Protestant duchy, which he was to hold as a fief of the Polish crown, with local autonomy and absolute freedom of worship. The southern provinces of the ancient territory of the Order, Courland and Semgallen, had first been ceded on the 24th of June 1559 to Lithuania on similar conditions, the matter being finally adjusted by the compact of March 1562.

Complete Union of Lithuania and Poland, 1569.

The apathy of Poland in such a vital matter as the Livonian question must have convinced so statesmanlike a prince as Sigismund II. of the necessity of preventing any possibility of cleavage in the future between the two halves of his dominions whose absolute solidarity was essential to their existence as a great power. To this patriotic design he devoted the remainder of his life. A personal union, under one monarch, however close, had proved inadequate. A further step must be taken—the two independent countries must be transformed into a single state. The great obstacle in the way of this, the only true solution of the difficulty, was the opposition of the Lithuanian magnates, who feared to lose the absolute dominancy they possessed in the grand-duchy if they were merged in the *szlachta* of the kingdom. But, at the last moment, the dread of another Muscovite invasion made them more pliable and, at a Polish diet held at Warsaw from November 1563 to June 1564, which the Lithuanians attended, the question of an absolute union was hotly debated. When things came to a deadlock the king tactfully intervened and voluntarily relinquished his hereditary title to Lithuania, thus placing the two countries on a constitutional equality and preparing the way for fresh negotiations in the future. The death, in 1565, of Black Radziwill, the chief opponent of the union, still further weakened the Lithuanians, and the negotiations were reopened with more prospect of success at the diet which met at Lublin on the 10th of January 1569. But even now the Lithuanians were indisposed towards a complete union, and finally they quitted the diet, leaving two commissioners behind to watch their interests. Then Sigismund executed his master stroke. Knowing the sensitiveness of the Lithuanians as regards Volhynia and Podolia, he suddenly, of his own authority, formally incorporated both these provinces with the kingdom of Poland, whereupon, amidst great enthusiasm, the Volhynian and Podolian deputies took their places on the same benches as their Polish brethren. The hands of the Lithuanians were forced. Even a complete union on equal terms was better than mutilated independence. Accordingly they returned to the diet, and the complete union was unanimously adopted on the 1st of July 1569. Henceforth the kingdom of Poland and the grand duchy of Lithuania were to constitute one inseparable and indivisible body politic, under one sovereign, elected in common, with one diet and one currency. All dependencies and colonies, including Prussia and Livonia, were to belong to Poland and Lithuania in common. The retention of the old duality of dignities was the one reminiscence of the original separation. No decision, however, could be come to as to the successor of the childless king, partly because of the multiplicity of candidates, partly because of Austrian intrigue, and this, the most momentous question of all, was still unsettled when Sigismund II. expired on the 6th of July 1572.

Character of the Jagiellonic Period, 1386–1572.

The Jagiellonic period (1386–1572) is the history of the consolidation and fusion into one homogeneous, political whole of numerous national elements, more or less akin ethnologically, but differing immensely in language, religion and, above all, in degrees of civilization. Out of the ancient Piast kingdom, mutilated by the loss of Silesia and the Baltic shore, arose a republic consisting at first of various loosely connected entities, naturally centrifugal, but temporarily drawn together by the urgent need of combination against a superior foe, who threatened them separately with extinction. Beneath the guidance of a dynasty of princes which, curiously enough, was supplied by the least civilized portion of this congeries of nationalities, the nascent republic gradually grew into a power which subjugated its former oppressors and, viewed externally, seemed to bear upon it the promise of empire. It is dangerous to prophesy, but all the facts and circumstances before us point irresistibly to the conclusion that had the Jagiellonic dynasty but endured this promise of empire might well have been realized. The extraordinary thing about the Jagiellos was the equable persistency of their genius. Not only were five of the seven great statesmen, but they were statesmen of the same stamp. We are disturbed by no such sharp contrasts as are to be found among the Plantagenets, the Vasas and the Bourbons. The Jagiellos were all of the same mould and pattern, but the mould was a strong one and the pattern was good. Their predominant and constant characteristic is a sober sagacity which instinctively judges aright and imperturbably realized its inspirations. The Jagiellos were rarely brilliant, but they were always perspicacious. Above all, they alone seem to have had the gift of guiding the most difficult of nations properly. Two centuries of Jagiellonic rule made Poland great despite her grave external difficulties. Had that dynasty been prolonged for another century, there is every reason to suppose that it would also have dealt satisfactorily with Poland's still more dangerous internal difficulties, and arrested the development of that anarchical constitution which was the ruling factor in the ruin of the Republic.

Simultaneously with the transformation into a great power of the petty principalities which composed ancient Poland, another and equally momentous political transformation was proceeding within the country itself.

The origin of the Polish constitution is to be sought in the *wiece* or councils of the Polish princes, during the partitional period (*c.* 1279–1370). The privileges conferred upon the magnates of which these councils were composed, especially upon the magnates of Little Poland, who brought the Jagiellos to the throne, directed their policy, and grew rich upon their liberality, revolted the less favoured *szlachta*, or gentry, who, towards the end of the 14th century, combined for mutual defence in their *sejmiki*, or local diets, of which originally there were five, three in Great Poland, one in Little Poland and one in Posen-Kalisz.[1] In these *sejmiki* the deputies of the few great towns were also represented. The Polish towns, notably Cracow, had obtained their privileges, including freedom from tolls and municipal government, from the Crown in return for important services, such as warding off the Tatars, while the cities of German origin were protected by the Magdeburg law. Casimir the Great even tried to make municipal government as democratic as possible by enacting that one half of the town council of Cracow should be elected from the civic patriciate, but the other half from the commonalty. Louis the Great placed the burgesses on a level with the gentry by granting to the town council of Cracow jurisdiction over all the serfs in the extra-rural estates of the citizens. From this time forth deputies from the cities were summoned to the *sejmiki* on all important occasions, such, for instance, as the ratification of treaties, a right formally conceded to them by the *sejmik* of Radom in 1384. Thus at this period Poland was a confederation of half a dozen semi-independent states. The first general assembly of which we have certain notice is the *zjazd walny* which was summoned to Koszyce in November 1404, to relieve the financial embarrassments of Wladislaus, and granted him an extraordinary subsidy of twenty groats per hide of land to enable him to purchase Dobrzyn from the Teutonic Knights. Such subsidies were generally the price for the confirmation of ancient or the concession of new privileges. Thus at the diet of Brześć Kujawski, in 1425, the *szlachta* obtained its first habeas corpus act in return for acknowledging the right of the infant *krolewicz* Wladislaus to his father's throne. The great opportunity of the *szlachta* was, of course, the election of a new king, especially the election of a minor, an event always accompanied and succeeded by disorders. Thus at the election of the infant Wladislaus III., his guardians promised in his name to confirm all the privileges granted by his father. If, on attaining his majority, the king refused to ratify these promises, his subjects were *ipso facto* absolved from their obedience. This is the first existence of the mischievous principle *de prestanda obedientia*, subsequently elevated into a statute. It is in this reign, too, that we meet with the first *rokosz*, or insurrection of the nobility against the executive. The extraordinary difficulties of Casimir IV. were freely exploited by the *szlachta*, who granted that ever impecunious monarch as little as possible, but got full value for every penny they grudgingly gave. Thus by the Articles of Cerekwica presented to him by the *sejmik* or dietine of Great Poland in 1454 on the outbreak of the Teutonic War, he conceded the principle that no war should in future be begun without the consent of the local diets. A few months later he was obliged to grant the Privileges of Nieszawa, which confirmed and extended the operation of the Articles of Cerekwica. The *sejmiki* had thus added to their original privilege of self-taxation the right to declare war and control the national militia.[2] This was a serious political retrogression. A strongly centralized government had ever been Poland's greatest need, and Casimir the Great had striven successfully against all centrifugal tendencies. And now, eighty-four years after his death, Poland was once more split up into half a dozen loosely federated states in the hands of country gentlemen too ignorant and prejudiced to look beyond the boundaries of their own provinces. The only way of saving the Republic from disintegration was to concentrate all its political factors into a *sejm-walny* or general diet. But to this the magnates and the *szlachta* were equally opposed, the former because they feared the rivalry of a national assembly, the latter because they were of more importance in their local diets than they could possibly hope to be in a general diet. The first *sejm* to legislate for the whole of Poland was the diet of Piotrkow (1493), summoned by John Albert to grant him subsidies; but the mandates of its deputies were limited to twelve months, and its decrees were to have force for only three years. John Albert's second diet (1496), after granting subsidies the burden of which fell entirely on the towns and peasantry, passed a series of statutes benefiting the nobility at the expense of the other classes. Thus one statute permitted the *szlachta* henceforth to export and import goods duty free, to the great detriment of the towns and the treasury. Another statute prohibited the burgesses from holding landed property and enjoying the privileges attaching thereto. A third statute disqualified plebeians from being elected to canonries or bishoprics. A fourth endeavoured to bind the peasantry more closely to the soil by forbidding emigration. The condition of the serfs was subsequently (1520) still further deteriorated by the introduction of socage. In a word, this diet disturbed the equilibrium of the state by enfeebling and degrading the middle classes. Nevertheless, so long as the Jagiello dynasty lasted, the political rights of the cities were jealously protected by the Crown against the usurpations of the nobility. Deputies from the towns took part in the election of John Albert (1492), and the burgesses of Cracow, the most enlightened economists in the kingdom, supplied Sigismund I. with his most capable counsellors during the first twenty years of his reign (1506–1526). Again and again the nobility attempted to exclude the deputies of Cracow from the diet, in spite of a severe edict issued by Sigismund I. in 1509, threatening to prosecute for treason all persons who dared to infringe the liberties of the citizens. During Sigismund's reign, moreover, the Crown recovered many of the prerogatives of which it had been deprived during the reign of his feeble predecessor, Alexander, who, to say nothing of the curtailments of the prerogative, had been forced to accept the statute *nihil novi* (1505) which gave the *sejm* and the senate an equal voice with the Crown in all executive matters. In the latter years of Sigismund I. (1530–1548) the political influence of the *szlachta* grew rapidly at the expense of the executive, and the gentry in diet assembled succeeded in curtailing the functions of all the great officers of state. During the reign of Sigismund II. (1548–1572) they diverted their attention to the abuses of the Church and considerably reduced both her wealth and her privileges. In this respect both the Crown and the country were with them, so that their interference, if violent, was on the whole distinctly beneficial.

The Polish Constitution.

Interregnum, 1572-1573.

The childless Sigismund II. died suddenly without leaving any regulations as to the election of his successor. Fortunately for Poland the political horizon was absolutely unclouded. The Turks, still reeling from the shock of Lepanto, could with difficulty hold their own against the united forces of the pope, Spain and Venice; while Ivan the Terrible had just concluded a truce with Poland. Domestic affairs, on the other hand, were in an almost anarchical condition. The Union of Lublin, barely three years old, was anything but consolidated, and in Lithuania it continued to be extremely unpopular. In Poland proper the *szlachta* were fiercely opposed to the magnates; and the Protestants seemed bent upon still further castigating the clergy. Worst of all, there existed no recognized authority in the land to curb and control its jarring centrifugal political elements. It was nearly two hundred years since the Republic had suffered from an interregnum, and the precedents of 1382 were obsolete. The primate, on hearing of the demise of the Crown, at once invited all the senators of Great Poland to a conference at Lowicz, but passed over the *szlachta* altogether. In an instant the whole Republic was seething like a caldron, and a rival assembly was simultaneously summoned to Cracow by Jan Ferlej, the head of the Protestant party. Civil war was happily averted at the last moment, and a national convention, composed of senators and deputies from all parts of the country, assembled at Warsaw, in April 1573, for the purpose of electing a new king. Five candidates for the throne were already in the field. Lithuania favoured Ivan IV. In Poland the bishops and most of the Catholic magnates were for an Austrian archduke, while the strongly anti-German *szlachta* were inclined to accept almost any candidate but a German, so long as he came with a gift in his hand and was not a Muscovite. In these circumstances it was an easy task for the adroit and energetic French ambassador, Jean de Montluc (d. 1579), brother of the famous marshal, and bishop of Valence, to procure the election of the French candidate, Henry, duke of Anjou. Well provided with funds, he speedily bought over many of the leading magnates, and his popularity reached its height when he strenuously advocated the adoption of the mode of election by the gentry *en masse* (which the *szlachta* proposed to revive), as opposed to the usual and more orderly "secret election" by a congress of senators and deputies, sitting with closed doors. The religious difficulty, meanwhile, had been adjusted to the satisfaction of all parties by the compact of Warsaw (Jan. 28, 1573), which granted absolute religious liberty to all non-Catholic denominations (*dissidentes de religione*, as they now began to be called) without exception, thus exhibiting a far more liberal intention than the Germans had manifested in the religious peace of Augsburg eighteen years before. Finally, early in April 1573, the election diet assembled at Warsaw, and on the 11th of May, in the midst of intrigue, corruption, violence and confusion, Henry of Valois was elected king of Poland.

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[1] The Red Russian sejmik was of later origin, *c.* 1433.

[2] In view of the frequency of the Tatar inroads, the control of the militia was re-transferred to the Crown in 1501.

Henry of Valois, king, 1573-1574.

The election had, however, been preceded by a *correctura jurum*, or reform of the constitution, which resulted in the famous "Henrican Articles" which converted Poland from a limited monarchy into a republic with an elective chief magistrate. Henceforward the king was to have no voice in the choice of his successor. He was not to use the word *haeres*, not being an hereditary sovereign. He was to marry a wife selected for him by the senate. He was neither to seek for a divorce nor give occasion for one. He was to be neutral in all religious matters. He was not to lead the militia across the border except with the consent of the *szlachta*, and then only for three months at a time. Every year the senate was to appoint sixteen of its number to be in constant attendance upon the king in rotas of four, which *sedecimvirs* were to supervise all his actions. Should the king fail to observe any one of these articles, the nation was *ipso facto* absolved from its allegiance. This constitutional reform was severely criticized by contemporary political experts. Some strongly condemned the clause justifying renunciation of allegiance, as tending to treason and anarchy. Others protested against the anomalous and helpless position of the so-called king, who, if he could do no harm, was certainly powerless for good. But such Cassandras prophesied to heedless ears. The Republic had deliberately cast itself upon the downward grade which was to lead to ruin.

The reign of Henry of Valois lasted thirteen months. The tidings of the death of his brother Charles IX., which reached him on the 14th of June 1574, determined him to exchange a thorny for what he hoped would be a flowery throne, and at midnight on the 18th of June 1574 he literally fled from Poland, pursued to the frontier by his indignant and bewildered subjects. Eighteen months later (Dec. 14, 1575), mainly through the influence of Jan Zamoyski, Stephen Báthory, prince of Transylvania, was elected king of Poland by the *szlachta* in opposition to the emperor Maximilian, who had been elected two days previously by the senate, after disturbances which would have rent any other state but Poland to pieces.

Stephen Báthory, 1575-1586.

The glorious career of Stephen Báthory (1575–1586) is dealt with elsewhere (see STEPHEN, *King of Poland*). His example demonstrates the superiority of genius and valour over the most difficult circumstances. But his reign was too brief to be permanently beneficial.

Sigismund III., 1587-1632.

The Vasa period of Polish history which began with the election of Sigismund, son of John III., king of Sweden, was the epoch of last and lost chances. The collapse of the Muscovite tsardom in the east, and the submersion of the German Empire in the west by the Thirty Years' War, presented Poland with an unprecedented opportunity of consolidating, once for all, her hard-won position as the dominating power of central Europe. Everywhere circumstances were favourable to her, and in Żolkiewski, Chodkiewicz and Koniecpolski she possessed three of the greatest captains of that or any other age. With all the means at her disposal cheerfully placed in the hands of such valiant and capable ministers, it would have been no difficult task for the Republic to have wrested the best part of the Baltic littoral from the Scandinavian powers, and driven the distracted Muscovites beyond the Volga. Permanent greatness and secular security were within her reach at the commencement of the Vasa period; how was it, then, that at the end of that period, only fifty years later, Poland had already sunk irredeemably into much the same position as Turkey occupies now, the position of a moribund state, existing on sufferance simply because none was yet quite prepared to administer the *coup de grâce?* There is only one answer; the principal cause of this complete and irretrievable collapse is to be sought for in the folly, egotism and selfishness of the Polish gentry, whose insane dislike of all discipline, including even the salutary discipline of regular government, converted Poland into something very like a primitive tribal community at the very time when every European statesman, including the more enlightened of the Poles themselves, clearly recognized that the political future belonged to the strongly centralized monarchies, which were everywhere rising on the ruins of feudalism. Of course there were other contributory causes. The tenacity with which Sigismund III. clung to his hereditary rights to the Swedish Crown involved Poland in a quite unnecessary series of wars with Charles IX. and Gustavus Adolphus, when her forces were sorely needed elsewhere. The adhesion of the same monarch to the League of the Catholic Reaction certainly added to the difficulties of Polish diplomacy, and still further divided the already distracted diet, besides alienating from the court the powerful and popular chancellor Zamoyski. Yet Sigismund III. was a far more clear-sighted statesman than any of his counsellors or contradictors. For instance, he was never misled by the successes of the false Demetrius in Muscovy, and wisely insisted on recovering the great eastern fortress of Smolensk rather than attempting the conquest of Moscow. His much-decried alliance with the emperor at the outbreak of the Thirty Years' War was eminently sagacious. He perceived at once that it was the only way of counteracting the restlessness of the sultan's protégés, the Protestant princes of Transylvania, whose undisciplined hordes, scarcely less savage than their allies the Turks and Tatars, were a perpetual menace both to Austria and to Poland. Finally he was bent upon reforming the Polish constitution by substituting the decision of all matters by a plurality of votes for a unanimity impossible to count upon.

When we turn to the *szlachta* who absolutely controlled the diet, we find not the slightest trace, I will not say of political foresight—that they never possessed—but of common patriotism, or ordinary public spirit. The most urgent national necessities were powerless to stir their hearts or open their purses. The diets during the reign of Sigismund III. were even more niggardly than they had been under the Jagiellos, and on the single occasion when the terrors of an imminent Tatar invasion constrained them to grant extraordinary subsidies, they saw to it that such subsidies should rest entirely on the shoulders of the burgesses (who had in the meantime been deprived of the franchise) and the already overburdened peasantry. In the very crisis of the Swedish War, the diminutive army of the victorious Chodkiewicz was left unpaid, with the result that the soldiers mutinied, and marched off *en masse*. Both Chodkiewicz and Żolkiewski frequently had to pay the expenses of their campaigns out of their own pockets, and were expected to conquer empires and defend hundreds of miles of frontier with armies of 3000 or 4000 men at most. When they retreated before overwhelming odds they were publicly accused of cowardice and incompetence. The determination to limit still further the power of the executive was at the bottom of this fatal parsimony, with the inevitable consequence that, while the king and the senate were powerless, every great noble or lord-marcher was free to do what he chose in his own domains, so long as he flattered his "little brothers," the *szlachta*. Incredible as it may seem, the expedition to place the false Demetrius on the Muscovite throne was a private speculation of a few Lithuanian magnates, and similar enterprises on the part of other irresponsible noblemen on the Danube or Dniester brought upon unhappy Poland retaliatory Tatar raids, which reduced whole provinces to ashes. Every attempt to improve matters, by reforming the impossible constitution, stranded on the opposition of the gentry. Take, for instance, the typical and highly instructive case of Zebrzydowski's rebellion. Nicholas Zebrzydowski, a follower of the chancellor Zamoyski, was one of the wealthiest and most respectable magnates in Poland. As palatine of Cracow he held one of the highest and most lucrative dignities in the state, and was equally famous for his valour, piety and liberality. Disappointed in his hope of obtaining the great seal on the death of Zamoyski, he at once conceived that the whole of the nobility had been insulted in his person, and proceeded to make all government impossible for the next three years. On the 7th of March 1606 Sigismund summoned a diet for the express purpose of introducing the principle of decision by majority in the diet, whereupon Zebrzydowski summoned a counter-confederation to Stenczyn in Little Poland, whose first act was to open negotiations with the prince of Transylvania, Stephen Bocskay, with the view of hiring mercenaries from him for further operations. At a subsequent confederation, held at Lublin in June, Zebrzydowski was reinforced by another great nobleman, Stanislaus Stadnicki, called the Devil, who "had more crimes on his conscience than hairs on his head," and was in the habit of cropping the ears and noses of small squires and chaining his serfs to the walls of his underground dungeons for months at a time. This champion of freedom was very eloquent as to the wrongs of the *szlachta*, and proposed that the assembly should proceed in a body to Warsaw and there formally renounce their allegiance. The upshot of his oratory was the summoning of a *rokosz*, or national insurrection, to Sandomir, which was speedily joined by the majority of the *szlachta* all over the country, who openly proclaimed their intention of dethroning the king and chastising the senate, and sent Stadnicki to Transylvania to obtain the armed assistance of Stephen Bocskay. Only the clergy, naturally conservative, still clung to the king, and Sigismund III., who was no coward, at once proceeded to Cracow to overawe the *rokoszanie*, or insurrectionists, by his proximity, and take the necessary measures for his own protection. By the advice of his senators he summoned a *zjazd*, or armed convention, to Wiślica openly to oppose the insurrection of Sandomir, which *zjazd* was to be the first step towards the formation of a general confederation for the defence of the throne. Civil war seemed inevitable, when the *szlachta* of Red Russia and Sieradz suddenly rallied to the king, who at once ordered his army to advance, and after defeating the insurrectionists at Janowiec (in October), granted them a full pardon, on the sole condition that they should refrain from all such acts of rebellion in future. Despite their promises, Zebrzydowski and his colleagues a few months later were again in arms. In the beginning of 1607 they summoned another *rokosz* to Jendrzejow, at the very time when the diet was assembling at Warsaw. The diet authorized the king to issue a proclamation dissolving the *rokosz*, and the *rokosz* retorted with a manifesto in which an insurrection was declared to be as much superior to a parliament as a general council was to a pope. In a second manifesto published at Jezierna, on the 24th of June, the insurrectionists again renounced their allegiance to the king. Oddly enough, the diet before dissolving had, apparently in order to meet the *rokosz* half-way, issued the famous edict *De non praestanda obedientia*, whereby, in case of future malpractices by the king and his subsequent neglect of at least two solemn warnings there-anent by the primate and the senate, he was to be formally deposed by the next succeeding diet. But even this was not enough for the insurrectionists. It was not the contingent but the actual deposition of the king that they demanded, and they had their candidate for the throne ready in the person of Gabriel Bethlen, the new prince of Transylvania. But the limits of even Polish complacency had at last been reached, and Żolkiewski and Chodkiewicz were sent against the rebels, whom they routed at Oransk near Guzow, after a desperate encounter, on the 6th of July 1607. But, though driven from the field, the agitation simmered all over the country for nearly two years longer, and was only terminated, in 1609, by a general amnesty which excluded every prospect of constitutional reform.

Wladislaus IV., 1632-1648.

Wladislaus IV., who succeeded his father in 1632, was the most popular monarch who ever sat on the Polish throne. The *szlachta*, who had had a "King Log" in Sigismund, were determined that Wladislaus should be "a King Bee who will give us nothing but honey"—in other words they hoped to wheedle him out of even more than they had wrested from his predecessor. Wladislaus submitted to everything. He promised never to declare war or levy troops without the consent of the *sejm*, undertook to fill all vacancies within a certain time, and released the *szlachta* from the payment of income-tax, their one remaining fiscal obligation. This boundless complacency was due to policy, not weakness. The second Polish Vasa was a man of genius, fully conscious of his powers, and determined to use them for the benefit of his country. The events of the last reign had demonstrated the incompetence of the Poles to govern themselves. Any amelioration of the existing anarchy must be extra-parliamentary and proceed from the throne. But a reforming monarch was inconceivable unless he possessed the confidence of the nation, and such confidence, Wladislaus naturally argued, could only be won by striking and undeniable public services. On these principles he acted with brilliant results. Within three years of his accession he compelled the Muscovites (Treaty of Polyankova, May 28, 1634) to retrocede Smolensk and the eastern provinces lost by Sigismund II., overawed the Porte by a military demonstration in October of the same year, and, by the Truce of Stumdorf (Sept. 12, 1635), recovered the Prussian provinces and the Baltic seaboard from Sweden. But these achievements excited not the gratitude but the suspicion of the *szlachta*. They were shrewd enough to guess that the royal triumph might prejudice their influence, and for the next five years they deliberately thwarted the enlightened and far-reaching projects of the king for creating a navy and increasing the revenue without burdening the estates, by a system of tolls levied on the trade of the Baltic ports (see WLADISLAUS IV.), even going so far as to refuse for nine years to refund the expenses of the Muscovite War, which he had defrayed out of his privy purse. From sheer weariness and disgust the king refrained from any intervention in public affairs for nearly ten years, looking on indifferently while the ever shorter and stormier diets wrangled perpetually over questions of preferment and the best way of dealing with the extreme dissenters, to the utter neglect of public business. But towards the end of his reign the energy of Wladislaus revived, and he began to occupy himself with another scheme for regenerating his country, in its own despite, by means of the Cossacks. First, however, it is necessary to describe briefly the origin and previous history of these romantic freebooters who during the second half of the 17th century were the determining factor of Polish and Muscovite politics.

The Cossacks.

At the beginning of the 16th century the illimitable steppe of south-eastern Europe, extending from the Dnieper to the Urals, had no settled population. Hunters and fishermen frequented its innumerable rivers, returning home laden with rich store of fish and pelts, while runaway serfs occasionally settled in small communities beneath the shelter of the fortresses built, from time to time, to guard the southern frontiers of Poland and Muscovy. Obliged, for fear of the Tatars, to go about with arms in their hands, these settlers gradually grew strong enough to raid their raiders, selling the booty thus acquired to the merchants of Muscovy and Poland. Moreover, the Turks and Tatars being the natural enemies of Christendom, a war of extermination against them was regarded by the Cossacks as a sacred duty. Curiously enough, these champions of orthodoxy borrowed the name, which has stuck to them ever since, from their "dog-headed" adversaries. The rank and file of the Tatar soldiery were known as *Kazaki*, or Cossacks, a word meaning "freebooters," and this term came to be applied indiscriminately to all the free dwellers in the *Ukraine*, or border-lands. As time went on the Cossacks multiplied exceedingly. Their daring grew with their numbers, and at last they came to be a constant annoyance to all their neighbours, both Christian and Mussulman, frequently involving Poland in dangerous and unprofitable wars with the Ottoman Empire. Indeed, it is not too much to say that, until the days of Sobieski, the Cossacks were invariably the chief cause of the breaches between the Porte and the Republic. We have seen how carefully the Jagiellos avoided participating in any of the crusades directed by the Holy See against the arch-enemies of the Cross. So successful was their prudential abstention that no regular war occurred between Turkey and Poland during the two centuries of their sway. The first actual collisions, the Cecora campaign of 1620 and the Khotin War of 1621 (for John Albert's Moldavian raid does not count), were due to the depredations of the Cossacks upon the dominions of the sultan by land and sea, and in all subsequent treaties between the two powers the most essential clause was always that which bound the Republic to keep its freebooters in order.

But in the meantime the Cossacks themselves had become a semi-independent community. The origin of the Cossack state is still somewhat obscure, but the germs of it are visible as early as the beginning of the 16th century. The union of Lublin, which led to the polonization of Lithuania, was the immediate occasion of a considerable exodus to the lowlands of the Dnieper of those serfs who desired to escape from the taxes of the Polish government and the tyranny of the Polish landlords. Stephen Bâthory presently converted the pick of them into six registered regiments of 1000 each for the defence of the border. Ultimately the island of Hortica, just below the falls of the Dnieper, was fixed upon as their headquarters; and on the numerous islands of that broad river there gradually arose the famous Cossack community known as the *Zaporozhskaya Syech*, or Settlement behind the Falls, whence the Dnieperian Cossacks were known, generally, as *Zaporozhians*, or Backfallsmen.[1] The Cossack *kosh*, or commonwealth, had the privilege of electing its *hetman*, or chief, and his chief officers, the *starshins*. The *hetman*, after election, received from the king of Poland direct the insignia of his office, viz. the *bulawa*, or bâton, the *bunchuk*, or horse-tail standard, and his official seal; but he was responsible for his actions to the *kosh* alone, and an inquiry into his conduct was held at the expiration of his term of office in the *obschaya shkoda*, or general assembly. In time of peace his power was little more than that of the responsible minister of a constitutional republic; but in time of warfare he was a dictator, and disobedience to his orders in the field was punishable by death.

The Cossacks were supposed to be left alone as much as possible by the Polish government so long as they faithfully fulfilled their chief obligation of guarding the frontiers of the Republic from Tatar raids. But the relations between a community of freebooters, mostly composed of fugitive serfs and refugees, and a government of small squires who regarded the Cossacks as a mere rabble were bound to be difficult at the best of times, and political and religious differences presently supervened. The Cossacks, mostly of Lithuanian origin, belonged to the Orthodox religion, so far as they belonged to any religion at all, and the Jagiellos had been very careful to safeguard the religious liberties of their Lithuanian subjects, especially as the Poles themselves were indifferent on the subject. But, at the beginning of the 17th century, when the current of the Catholic reaction was running very strongly and the Jesuits, after subduing the Protestants, began to undermine the position of the Orthodox Church in Lithuania, a more intolerant spirit began to prevail. The old Calvinist nobility of Lithuania were speedily reconverted; a Uniate Church in connexion with Rome was established; Greek Orthodox congregations, if not generally persecuted, were at least depressed and straitened; and the Cossacks began to hate the *Pans*, or Polish lords, not merely as tyrants, but as heretics. Yet all these obstacles to a good understanding might, perhaps, have been surmounted if only the Polish diet had treated the Cossacks with common fairness and common sense. In 1619 the Polish government was obliged to prohibit absolutely the piratical raids of the Cossacks in the Black Sea, where they habitually destroyed Turkish property to the value of millions. At the same time, by the compact of Rastawica, the *sejm* undertook to allow the Cossacks, partly as wages, partly as compensation, 40,000 (raised by the compact of Kurukow to 60,000) *gulden* and 170 wagons of cloth per annum. These terms were never kept, despite the earnest remonstrances of the king, and the complaints of the aggrieved borderers. Parsimony prevailed, as usual, over prudence, and when the Cossacks showed unmistakable signs of restiveness, the Poles irritated them still further by ordering the construction of the strong fortress of Kudak at the confluence of the Dnieper and the Samara, to overawe the Zaporozhian community. This further act of repression led to two terrible Cossack risings, in 1635 and 1636, put down only with the utmost difficulty, whereupon the diet of 1638 deprived the Cossacks of all their ancient privileges, abolished the elective hetmanship, and substituted for it a commission of Polish noblemen with absolute power, so that the Cossacks might well declare that those who hated them were lords over them.

Such was the condition of affairs in the Ukraine when Wladislaus IV. proposed to make the Cossacks the pivot of his foreign policy and his domestic reforms. His far-reaching plans were based upon two facts, the absolute devotion of the Zaporozhians to himself personally, and the knowledge, secretly conveyed to him by Stanislaus Koniecpolski (*q.v.*), that the whole of the Ukraine was in a ferment. He proposed to provoke the Tatars to a rupture by repudiating the humiliating tribute with which the Republic had so long and so vainly endeavoured to buy off their incessant raids. In case of such rupture he meant, at the head of 100,000 Cossacks, to fall upon the Crimea itself, the seat of their power, and exterminate the Khanate. This he calculated would bring about a retaliatory invasion of Poland by the Turks, which would justify him in taking the field against them also with all the forces of the Republic. In case of success he would be able to impose the will of a victorious king upon a discredited diet, and reform the constitution on an English or Swedish model. Events seemed at first to favour this audacious speculation. Almost simultaneously a civil war broke out in the Crimea and the Porte declared war against the Venetian republic, with which Wladislaus at once concluded an offensive and defensive alliance (1645). He then bade the Cossacks prepare their boats for a raid upon the Turkish galleys, and secured the co-operation of the tsar in the Crimean expedition by a special treaty. Unfortunately, Venice, for her own safety's sake, insisted on the publication of Wladislaus's anti-Turkish alliance; the Porte, well informed of the course of Polish affairs, remained strictly neutral despite the most outrageous provocations; and Wladislaus, bound by his coronation oath not to undertake an offensive war, found himself at the mercy of the diet which, full of consternation and rage, assembled at Warsaw on the 2nd of May 1647. It is needless to say that the Venetian alliance was repudiated and the royal power still further reduced. A year later Wladislaus died at his hunting-box at Merecz, at the very moment when the long-impending tempest which he himself had conjured up burst with overwhelming fury over the territories of the Republic.

The prime mover of the great rebellion of 1648, which shook the Polish state to its very foundations, was the Cossack Bohdan Chmielnicki (*q.v.*), who had been initiated in all the plans of Wladislaus IV. and, with good reason, feared to be the first victim of the Polish magnates when the king's designs were

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[1] Cf. American, Backwoodsmen.

Cossack Rebellion of 1648.

John II. Casimir, 1648-1668.

unmasked and frustrated. To save himself he hit upon the novel and terrible expedient of uniting the Tatars and the Cossacks in a determined onslaught upon the Republic, whose inward weakness, despite its brave outward show, he had been quick to discern. On the 18th of April 1648, at the general assembly of the Zaporozhians, he openly expressed his intention of proceeding against the Poles and was elected hetman by acclamation; on the 19th of May he annihilated a small detached Polish corps on the banks of the river Zheltndya Vodui, and seven days later overwhelmed the army of the Polish grand-hetman, massacring 8500 of his 10,000 men and sending the grand-hetman himself and all his officers in chains to the Crimea. The immediate consequence of these victories was the outburst of a *khlopskaya zloba*, or "serfs' fury." Throughout the Ukraine the gentry were hunted down, flayed, burnt, blinded and sawn asunder. Every manor-house and castle was reduced to ashes. Every Uniate or Catholic priest who could be caught was hung up before his own high altar, along with a Jew and a hog. The panic-stricken inhabitants fled to the nearest strongholds, and soon the rebels were swarming over the palatinates of Volhynia and Podolia. Meanwhile the Polish army, 40,000 strong, with 100 guns, was assembling on the frontier. It consisted almost entirely of the noble militia, and was tricked out with a splendour more befitting a bridal pageant than a battle array. For Chmielnicki and his host these splendid cavaliers expressed the utmost contempt. "This rabble must be chased with whips, not smitten with swords," they cried. On the 23rd of September the two armies encountered near Pildawa, and after a stubborn three days' contest the gallant Polish pageant was scattered to the winds. The steppe for miles around was strewn with corpses, and the Cossacks are said to have reaped 10,000,000 guldens worth of booty when the fight was over. All Poland now lay at Chmielnicki's feet, and the road to the defenceless capital was open before him; but he wasted two precious months in vain before the fortress of Zamość, and then the newly elected king of Poland, John Casimir, Wladislaus IV.'s brother, privately opened negotiations with the rebel, officially recognized him by sending him the *bulawa* and the other insignia of the *hetman's* dignity, and promised his "faithful Zaporozhians" the restoration of all their ancient liberties if they would break off their alliance with the Tatars and await the arrival of peace commissioners at Pereyaslavl. But the negotiations at Pereyaslavl came to nothing. Chmielnicki's conditions of peace were so extravagant that the Polish commissioners durst not accept them, and in 1649 he again invaded Poland with a countless host of Cossacks and Tatars. Again, however, he made the mistake of attacking a fortress, which delayed his advance for a month, and gave John Casimir time to collect an army for the relief of the besieged. By the compact of Zborów (Aug 21, 1649) Chmielnicki was recognized as *hetman* of the Zaporozhians, whose registered number was now raised from 6000 to 40,000; a general amnesty was also granted, and it was agreed that all official dignities in the Orthodox palatinates of Lithuania should henceforth be held solely by the Orthodox gentry. For the next eighteen months Chmielnicki ruled the Ukraine like a sovereign prince. He made Chigirin, his native place, the Cossack capital, subdivided the country into sixteen provinces, and entered into direct relations with foreign powers. His attempt to carve a principality for his son out of Moldavia led to the outbreak of a third war between suzerain and subject in February 1651. But fortune, so long Bohdan's friend, now deserted him, and at Beresteczko (July 1, 1651) the Cossack chieftain was utterly routed by Stephen Czarniecki. All hope of an independent Cossackdom was now at an end; yet it was not Poland but Muscovy which reaped the fruits of Czarniecki's victory.

The Russians invade Poland.

Invasion of Charles X. of Sweden, 1655.

The Truce of Andrussowo, 1667.

Chmielnicki, by suddenly laying bare the nakedness of the Polish republic, had opened the eyes of Muscovy to the fact that her secular enemy was no longer formidable. Three years after his defeat at Beresteczko, Chmielnicki, finding himself unable to cope with the Poles single-handed, very reluctantly transferred his allegiance to the tsar, and the same year the tsar's armies invaded Poland, still bleeding from the all but mortal wounds inflicted on her by the Cossacks. The war thus begun, and known in Russian history as the Thirteen Years' War, far exceeded even the Thirty Years' War in grossness and brutality. It resembled nothing so much as a hideous scramble of ravening beasts and obscene fowls for the dismembered limbs of a headless carcase, for such did Poland seem to all the world before the war was half over. In the summer of 1655, moreover, while the Republic was still reeling beneath the shock of the Muscovite invasion, Charles X. of Sweden, on the flimsiest of pretexts, forced a war upon reluctant and inoffensive Poland, simply to gratify his greed of martial glory, and before the year was out his forces had occupied the capital, the coronation city and the best half of the land. King John Casimir, betrayed and abandoned by his own subjects, fled to Silesia, and profiting by the cataclysm which, for the moment, had swept the Polish state out of existence, the Muscovites, unopposed, quickly appropriated nearly everything which was not already occupied by the Swedes. At this crisis Poland owed her salvation to two events—the formation of a general league against Sweden, brought about by the apprehensive court of Vienna and an almost simultaneous popular outburst of religious enthusiasm on the part of the Polish people. The first of these events, to be dated from the alliance between the emperor Leopold and John Casimir, on the 27th of May 1657, led to a truce with the tsar and the welcome diversion of all the Muscovite forces against Swedish Livonia. The second event, which began with the heroic and successful defence of the monastery of Czenstochowa by Prior Kordecki against the Swedes, resulted in the return of the Polish king from exile, the formation of a national army under Stephen Czarniecki and the recovery of almost all the lost provinces from the Swedes, who were driven back headlong to the sea, where with difficulty they held their own. On the sudden death of Charles X. (Feb. 13, 1660), Poland gladly seized the opportunity of adjusting all her outstanding differences with Sweden. By the peace of Oliva (May 3, 1660), made under French mediation, John Casimir ceded Livonia, and renounced all claim to the Swedish crown. The war with Muscovy was then prosecuted with renewed energy and extraordinary success. In the autumn of 1661 the Russian commanders were routed at Zeromsk, and nearly all the eastern provinces were recovered. In 1664 a peace congress was opened at Durovicha and the prospects of Poland seemed most brilliant; but at the very moment when she needed all her armed strength to sustain her diplomacy, the rebellion of one of her leading magnates, Prince Lubomirsky, involved her in a dangerous civil war, compelled her to reopen negotiations with the Muscovites, at Andrussowo, under far more unfavourable conditions, and after protracted negotiations practically to accept the Muscovite terms. By the truce of Andrussowo (Feb. 11, 1667) Poland received back from Muscovy Vitebsk, Polotsk and Polish Livonia, but ceded in perpetuity Smolensk, Syeversk, Chernigov and the whole of the eastern bank of the Dnieper, including the towns of Konotop, Gadyach, Pereyaslavl, Mirgorod, Poltava and Izyum. The Cossacks of the Dnieper were henceforth to be under the joint dominion of the tsar and the king of Poland. Kiev, the religious metropolis of western Russia, was to remain in the hands of Muscovy for two years.

The "truce" of Andrussowo proved to be one of the most permanent peaces in history, and Kiev, though only pledged for two years, was never again to be separated from the Orthodox Slavonic state to which it rightly belonged. But for the terrible and persistent ill-luck of Poland it is doubtful whether the "truce" of Andrussowo would ever have been signed. The war which it concluded was to be the last open struggle between the two powers. Henceforth the influence of Russia over Poland was steadily to increase, without any struggle at all, the Republic being already stricken with that creeping paralysis which ultimately left her a prey to her neighbours. Muscovy had done with Poland as an adversary, and had no longer any reason to fear her ancient enemy.

Growing Corruption in Poland.

Poland had, in fact, emerged from the cataclysm of 1648–1667 a moribund state, though her not unskilful diplomacy had enabled her for a time to save appearances. Her territorial losses, though considerable, were, in the circumstances, not excessive, and she was still a considerable power in the opinion of Europe. But a fatal change had come over the country during the age of the Vasas. We have already seen how the ambition of the oligarchs and the lawlessness of the *szlachta* had reduced the executive to impotence, and rendered anything like rational government impossible. But these demoralizing and disintegrating influences had been suspended by the religious revival due to the Catholic reaction and the Jesuit propaganda, a revival which reached its height towards the end of the 16th century. This, on the whole, salutary and edifying movement permeated public life, and produced a series of great captains who cheerfully sacrificed themselves for their country, and would have been saints if they had not been heroes. But this extraordinary religious revival had wellnigh spent itself by the middle of the 17th century. Its last manifestation was the successful defence of the monastery of Czenstochowa by Prior Kordecki against the finest troops in Europe, its last representative was Stephen Czarniecki, who brought the fugitive John Casimir back from exile and reinstalled him on his tottering throne. The succeeding age was an age of unmitigated egoism, in which the old ideals were abandoned and the old examples were forgotten. It synchronized with, and was partly determined by, the new political system which was spreading all over Europe, the system of dynastic diplomatic competition and the unscrupulous employment of unlimited secret service funds. This system, which dates from Richelieu and culminated in the reign of Louis XIV., was based on the secular rivalry of the houses of Bourbon and Habsburg, and presently divided all Europe into two hostile camps. Louis XIV. is said to have expended 50,000,000 livres a year for bribing purposes, the court of Vienna was scarcely less liberal, and very soon nearly all the monarchs of the Continent and their ministers were in the pay of one or other of the antagonists. Poland was no exception to the general rule. Her magnates, having already got all they could out of their own country, looked eagerly abroad for fresh El Dorados. Before long most of them had become the hirelings of France or Austria, and the value demanded for their wages was, not infrequently, the betrayal of their own country. To do them justice, the *szlachta* at first were not only free from the taint of official corruption, but endeavoured to fight against it. Thus, at the election diet of 1669, one of the deputies, Pieniaszek, moved that a new and hitherto unheard-of clause should be inserted in the agenda of the general confederation, to the effect that every senator and deputy should solemnly swear not to take bribes, while another *szlacic* proposed that the ambassadors of foreign Powers should be excluded permanently from the Polish elective assemblies. But the flighty and ignorant *szlachta* not only were incapable of any sustained political action, but they themselves unconsciously played into the hands of the enemies of their country by making the so-called *liberum veto* an integral part of the Polish constitution. The *liberum veto* was based on the assumption of the absolute political equality of every Polish gentleman, with the inevitable corollary that every measure introduced into the Polish diet must be adopted unanimously. Consequently, if any single deputy believed that a measure already approved of by the rest of the house might be injurious to his constituency, he had the right to rise and exclaim *nie pozwalam*, "I disapprove," when the measure in question fell at once to the ground. Subsequently this vicious principle was extended still further. A deputy, by interposing his individual veto, could at any time dissolve the diet, when all measures previously passed had to be re-submitted to the consideration of the following diet. The *liberum veto* seems to have been originally devised to cut short interminable debates in times of acute crisis, but it was generally used either by highly placed criminals, anxious to avoid an inquiry into their misdeeds,[1] or by malcontents, desirous of embarrassing the executive. The origin of the *liberum veto* is obscure, but it was first employed by the deputy Władisłaus Siciński, who dissolved the diet of 1652 by means of it, and before the end of the 17th century it was used so frequently and recklessly that all business was frequently brought to a standstill. In later days it became the chief instrument of foreign ambassadors for dissolving inconvenient diets, as a deputy could always be bribed to exercise his veto for a handsome consideration.

Election of Michael Wiśniowiecki, 1669–1673.

John III. Sobieski, 1674–1696.

The Polish crown first became an object of universal competition in 1573, when Henry of Valois was elected. In 1575, and again in 1587, it was put up for public auction, when the Hungarian Báthory and the Swede Sigismund respectively gained the prize. But at all three elections, though money and intrigue were freely employed, they were not the determining factors of the contest. The Polish gentry were still the umpires as well as the stake-holders; the best candidates generally won the day; and the defeated competitors were driven out of the country by force of arms if they did not take their discomfiture, after a fair fight, like sportsmen. But with the election of Michael Wiśniowiecki in 1669 a new era began. In this case a native Pole was freely elected by the unanimous vote of his countrymen. Yet a few weeks later the Polish commander-in-chief formed a whole series of conspiracies for the purpose of dethroning his lawful sovereign, and openly placed himself beneath the protection of Louis XIV. of France, just as the rebels of the 18th century placed themselves under the protection of Catherine II. of Russia. And this rebel was none other than John Sobieski, at a later day the heroic deliverer of Vienna! If heroes could so debase themselves, can we wonder if men who were not heroes lent themselves to every sort of villainy? We have come, in fact, to the age of utter shamelessness, when disappointed place-hunters openly invoked foreign aid against their own country. Sobieski himself, as John III. (he succeeded Michael in 1674), was to pay the penalty of his past lawlessness, to the uttermost farthing. Despite his brilliant military achievements (see JOHN III., KING OF POLAND), his reign of twenty-two years was a failure. His victories over the Turks were fruitless so far as Poland was concerned. His belated attempts to reform the constitution only led to conspiracies against his life and crown, in which the French faction, which he had been the first to encourage, took an active part. In his later years Lithuania was in a state of chronic revolt, while Poland was bankrupt both morally and materially. He died a broken-hearted man, prophesying the inevitable ruin of a nation which he himself had done so much to demoralize.

It scarcely seemed possible for Poland to sink lower than she had sunk already. Yet an era was now to follow, compared with which even the age of Sobieski seemed to be an age of gold. This was the Saxon period which, with occasional violent interruptions, was to drag on for nearly seventy years. By the time it was over Poland was irretrievably doomed. It only remained to be seen how that doom would be accomplished.

Augustus II., 1697–1704.

On the death of John III. no fewer than eighteen candidates for the vacant Polish throne presented themselves. Austria supported James Sobieski, the eldest son of the late king, France Francis Louis Prince of Conti (1664–1709), but the successful competitor was Frederick Augustus, elector of Saxony, who cheerfully renounced Lutheranism for the coveted crown, and won the day because he happened to arrive last of all, with fresh funds, when the agents of his rivals had spent all their money. He was crowned, as Augustus II., on the 15th of September 1697, and his first act was to expel from the country the prince of Conti, the elect of a respectable minority, directed by the cardinal primate Michal Radziejowski (1645–1705), whom Augustus II. subsequently bought over for 75,000 thalers.

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[1] Thus the Sapiehas, who had been living on rapine for years, dissolved the diet of 1688 by means of the veto of one of their hirelings, for fear of an investigation into their conduct.

War with Charles XII. of Sweden.

Stanislaus Leszczyński.

Good luck attended the opening years of the new reign. In 1699 the long Turkish War, which had been going on ever since 1683, was concluded by the peace of Karlowitz, whereby Podolia, the Ukraine and the fortress of Kamenets Podolskiy were retroceded to the Republic by the Ottoman Porte. Immediately afterwards Augustus was persuaded by the plausible Livonian exile, Johan Reinhold Patkul, to form a nefarious league with Frederick of Denmark and Peter of Russia, for the purpose of despoiling the youthful king of Sweden, Charles XII. (see SWEDEN: *History*). This he did as elector of Saxony, but it was the unfortunate Polish republic which paid for the hazardous speculation of its newly elected king. Throughout the Great Northern War (see SWEDEN: *History*), which wasted northern and central Europe for twenty years (1700–1720), all the belligerents treated Poland as if she had no political existence. Swedes, Saxons and Russians not only lived upon the country, but plundered it systematically. The diet was the humble servant of the conqueror of the moment, and the leading magnates chose their own sides without the slightest regard for the interests of their country, the Lithuanians for the most part supporting Charles XII., while the Poles divided their allegiance between Augustus and Stanislaus Leszczyński, whom Charles placed upon the throne in 1704 and kept there till 1709. At the end of the war Poland was ruined materially as well as politically. Augustus attempted to indemnify himself for his failure to obtain Livonia, his covenanted share of the Swedish plunder, by offering Frederick William of Prussia Courland, Polish Prussia and even part of Great Poland, provided that he were allowed a free hand in the disposal of the rest of the country. When Prussia declined this tempting offer for fear of Russia, Augustus went a step farther and actually suggested that "the four[1] eagles" should divide the banquet between them. He died, however (Feb. 1, 1733) before he could give effect to this shameless design.

Augustus III., 1733-1763.

On the death of Augustus II., Stanislaus Leszczyński, who had, in the meantime, become the father-in-law of Louis XV., attempted to regain his throne with the aid of a small French army corps and 4,000,000 livres from Versailles. Some of the best men in Poland, including the Czartoryscy, were also in his favour, and on the 26th of August 1733 he was elected king for the second time. But there were many malcontents, principally among the Lithuanians, who solicited the intervention of Russia in favour of the elector of Saxony, son of the late king, and in October 1733 a Russian army appeared before Warsaw and compelled a phantom diet (it consisted of but 15 senators and 500 of the *szlachta*) to proclaim Augustus III. From the end of 1733 till the 30th of June 1734 Stanislaus and his partisans were besieged by the Russians in Danzig, their last refuge, and with the surrender of that fortress the cause of Stanislaus was lost. He retired once more to his little court in Lorraine, with the title of king, leaving Augustus III. in possession of the kingdom.

Augustus III. was disqualified by constitutional indolence from taking any active part in affairs. He left everything to his omnipotent minister, Count Heinrich Brühl, and Brühl entrusted the government of Poland to the Czartoryscy, who had intimate relations of long standing with the court of Dresden.

The Czartoryscy, who were to dominate Polish politics for the next half-century, came of an ancient Ruthenian stock which had intermarried with the Jagiellos at an early date, and had always been remarkable for their civic virtues and political sagacity. They had powerfully contributed to the adoption of the Union of Lublin; were subsequently received into the Roman Catholic Church; and dated the beginning of their influence in Poland proper from the time (1674) when Florian Czartoryski became primate there. Florian's nephews, Fryderyk Michal and Augustus, were now the principal representatives of "the Family," as their opponents sarcastically called them. The former, through the influence of Augustus's minister and favourite Brühl, had become, in his twenty-eighth year, vice-chancellor and subsequently grand chancellor of Lithuania, was always the political head of the family. His brother and Augustus, after fighting with great distinction against the Turks both by land and sea (Prince Eugene decorated him with a sword of honour for his valour at the siege of Belgrade), had returned home to marry Sophia Sieniawska, whose fabulous dowry won for her husband the sobriquet of "the Family Croesus." Their sister Constantia had already married Stanislaus Poniatowski, the father of the future king. Thus wealth, position, court influence and ability combined gave the Czartoryscy a commanding position in Poland, and, to their honour be it said, they had determined from the first to save the Republic, whose impending ruin in existing circumstances they clearly foresaw, by a radical constitutional reconstruction which was to include the abolition of the *liberum veto* and the formation of a standing army.

Unfortunately the other great families of Poland were obstinately opposed to any reform or, as they called it, any "violation" of the existing constitution. The Potoccy, whose possessions in south Poland and the Ukraine covered thousands of square miles, the Radziwiłłowie, who were omnipotent in Lithuania and included half a dozen millionaires[2] amongst them, the Lubomirscy and their fellows, hated the Czartoryscy because they were too eminent, and successfully obstructed all their well-meant efforts. The castles of these great lords were the foci of the social and political life of their respective provinces. Here they lived like little princes, surrounded by thousands of retainers, whom they kept for show alone, making no attempt to organize and discipline this excellent military material for the defence of their defenceless country. Here congregated hundreds of the younger *szlachta*, fresh from their school benches, whence they brought nothing but a smattering of Latin and a determination to make their way by absolute subservience to their "elder brethren," the *pans*. These were the men who, a little later, at the bidding of their "benefactors," dissolved one inconvenient diet after another; for it is a significant fact that during the reigns of the two Augustuses every diet was dissolved in this way by the hirelings of some great lord or, still worse, of some foreign potentate. In a word constitutional government had practically ceased, and Poland had become an arena in which contesting clans strove together for the mastery.

It was against this primitive state of things that the Czartoryscy struggled, and struggled in vain. First they attempted to abolish the *liberum veto* with the assistance of the Saxon court where they were supreme, but fear of foreign complications and the opposition of the Potoccy prevented anything being done. Then they broke with their old friend Brühl and turned to Russia. Their chief intermediary was their nephew Stanislaus Poniatowski, whom they sent, as Saxon minister, to the Russian court in the suite of the English minister Hanbury Williams, in 1755. The handsome and insinuating Poniatowski speedily won the susceptible heart of the grand-duchess Catherine, but he won nothing else and returned to Poland in 1759 somewhat discredited. Disappointed in their hopes of Russia, the Czartoryscy next attempted to form a confederation for the deposition of Augustus III., but while the strife of factions was still at its height the absentee monarch put an end to the struggle by expiring, conveniently, on the 5th of October 1763.

The interregnum occurring on the death of Augustus III. befell at a time when all the European powers, exhausted by the Seven Years' War, earnestly desired peace. The position of Poland was, consequently, much more advantageous than it had been on every other similar occasion, and if only the contending factions had been able to agree and unite, the final catastrophe might, perhaps, even now, have been averted. The Czartoryscy, of all men, were bound by their principles and professions to set their fellow citizens an example of fraternal concord. Yet they rejected with scorn and derision the pacific overtures of their political opponents, the Potoccy, the Radziwiłłowie, and the Braniscy, Prince Michal openly declaring that of two tyrannies he preferred the tyranny of the Muscovite to the tyranny of his equals. He had in fact already summoned a Russian army corps to assist him to reform his country, which sufficiently explains his own haughtiness and the unwonted compliancy of the rival magnates.

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[1] The fourth eagle was the White Eagle, *i.e.* Poland.

[2] Michal Kazimierz Radziwiłł alone was worth thirty millions.

Stanislaus II. Poniatowski, 1764–1795.

Catherine II. of Russia and Poland.

The simplicity of the Czartoryscy was even more mischievous than their haughtiness. When the most enlightened statesmen of the Republic could seriously believe in the benevolent intentions of Russia the end was not far off. Their naïve expectations were very speedily disappointed. Catherine II. and Frederick II. had already determined (Treaty of St Petersburg, April 22, 1764) that the existing state of things in Poland must be maintained, and as early as the 18th of October 1763 Catherine had recommended the election of Stanislaus Poniatowski as "the individual most convenient for our common interests." The personal question did not interest Frederick: so long as Poland was kept in an anarchical condition he cared not who was called king. Moreover, the opponents of the Czartoryscy made no serious attempt to oppose the entry of the Russian troops. At least 40,000 men were necessary for the purpose, and these could have been obtained for 200,000 ducats; but a congress of magnates, whose collective fortunes amounted to hundreds of millions, having decided that it was impossible to raise this sum, there was nothing for it but to fight a few skirmishes and then take refuge abroad. The Czartoryscy now fancied themselves the masters of the situation. They at once proceeded to pass through the convocation diet a whole series of salutary measures. Four special commissions were appointed to superintend the administration of justice, the police and the finances. The extravagant powers of the grand *hetmans* and the grand marshals were reduced. All financial and economical questions before the diet were henceforth to be decided by a majority of votes. Shortly afterwards Stanislaus Poniatowski was elected king (Sept. 7, 1764) and crowned (Nov. 25). But at the beginning of 1766 Prince Nicholas Repnin was sent as Russian minister to Warsaw with instructions which can only be described as a carefully elaborated plan for destroying the Republic. The first weapon employed was the dissident question. At that time the population of Poland was, in round numbers, 11,500,000, of whom about 1,000,000 were dissidents or dissenters. Half of these were the Protestants of the towns of Polish Prussia and Great Poland, the other half was composed of the Orthodox population of Lithuania. The dissidents had no political rights, and their religious liberties had also been unjustly restricted; but two-thirds of them being agricultural labourers, and most of the rest artisans or petty tradesmen, they had no desire to enter public life, and were so ignorant and illiterate that their new protectors, on a closer acquaintance, became heartily ashamed of them. Yet it was for these persons that Repnin, in the name of the empress, now demanded absolute equality, political and religious, with the gentlemen of Poland. He was well aware that an aristocratic and Catholic assembly like the *sejm* would never concede so preposterous a demand. He also calculated that the demand itself would make the *szlachta* suspicious of all reform, including the Czartoryscian reforms, especially as both the king and his uncles were generally unpopular, as being innovators under foreign influence. His calculations were correct. The *sejm* of 1766 not only rejected the dissident bill, but repealed all the Czartoryscian reforms and insisted on the retention of the *liberum veto* as the foundation of the national liberties. The discredit into which Stanislaus had now fallen encouraged the Saxon party, led by Gabriel Podoski (1719–1777), to form a combination for the purpose of dethroning the king. Repnin knew that the allied courts would never consent to such a measure; but he secretly encouraged the plot for his own purposes, with signal success. Early in 1767 the malcontents, fortified by the adhesion of the leading political refugees, formed a confederation at Radom, whose first act was to send a deputation to St Petersburg, petitioning Catherine to guarantee the liberties of the Republic, and allow the form of the Polish constitution to be settled by the Russian ambassador at Warsaw. With this *carte blanche* in his pocket, Repnin proceeded to treat the diet as if it were already the slave of the Russian empress. But despite threats, wholesale corruption and the presence of Russian troops outside and even inside the *izba*, or chamber of deputies, the patriots, headed by four bishops, Woclaw Hieronim Sierakowski (1699–1784) of Lemberg, Feliks Pawel Turski of Chelm (1729–1800), Kajetan Ignaty Soltyk of Cracow (1715–1788), and Józef Jendrzej Zaluski of Kiev (1702–1774), offered a determined resistance to Repnin's demands. Only when brute force in its extremest form had been ruthlessly employed, only when three senators and some deputies had been arrested in full session by Russian grenadiers and sent as prisoners to Kaluga, did the opposition collapse. The *liberum veto* and all the other ancient abuses were now declared unalterable parts of the Polish constitution, which was placed under the guarantee of Russia. All the edicts against the dissidents were, at the same time, repealed.

Confederation of Bar.

First Partition of Poland, 1772.

This shameful surrender led to a Catholic patriotic uprising, known as the Confederation of Bar, which was formed on the 29th of February 1768, at Bar in the Ukraine, by a handful of small squires. It never had a chance of permanent success, though, feebly fed by French subsidies and French volunteers, it lingered on for four years, till finally suppressed in 1772. But, insignificant itself, it was the cause of great events. Some of the Bar confederates, scattered by the Russian regulars, fled over the Turkish border, pursued by their victors. The Turks, already alarmed at the progress of the Russians in Poland, and stimulated by Vergennes, at that time French ambassador at Constantinople, at once declared war against Russia. Seriously disturbed at the prospect of Russian aggrandizement, the idea occurred, almost simultaneously, to the courts of Berlin and Vienna that the best mode of preserving the equilibrium of Europe was for all three powers to readjust their territories at the expense of Poland. The idea of a partition of Poland was nothing new, but the vastness of the country, and the absence of sufficiently powerful and united enemies, had hitherto saved the Republic from spoliation. But now that Poland lay utterly helpless and surrounded by the three great military monarchies of Europe, nothing could save her. In February 1769 Frederick sent Count Rochus Friedrich Lynar (1708–1783) to St Petersburg to sound the empress as to the expediency of a partition, in August Joseph II. solicited an interview with Frederick, and in the course of the summer the two monarchs met, first at Neisse in Silesia and again at Neustadt in Moravia. Nothing definite as to Poland seems to have been arranged, but Prince Kaunitz, the Austrian chancellor, was now encouraged to take the first step by occupying, in 1770, the county of Zips, which had been hypothecated by Hungary to Poland in 1442 and never redeemed. This act decided the other confederates. In June 1770 Frederick surrounded those of the Polish provinces he coveted with a military cordon, ostensibly to keep out the cattle plague. Catherine's consent had been previously obtained by a special mission of Prince Henry of Prussia to the Russian capital. The first treaty of partition was signed at St Petersburg between Prussia and Russia on the 6–17th of February 1772; the second treaty, which admitted Austria also to a share of the spoil, on the 5–16th of August the same year. It is unnecessary to recapitulate the unheard-of atrocities by which the consent of the *sejm* to this act of brigandage was at last extorted (Aug. 18, 1773). Russia obtained the palatinates of Vitebsk, Polotsk Mscislaw: 1586 sq. m. of territory, with a population of 550,000 and an annual revenue of 920,000 Polish gulden. Austria got the greater part of Galicia, minus Cracow: 1710 sq. m., with a population of 816,000 and an annual revenue of 1,408,000 gulden. Prussia received the maritime palatinate minus Danzig, the palatinate of Kulm minus Thorn, Great Poland as far as the Nitza, and the palatinates of Marienburg and Ermeland: 629 sq. m., with a population of 378,000, and an annual revenue of 534,000 thalers. In fine, Poland lost about one-fifth of her population and one-fourth of her territory.

In return for these enormous concessions the partitioning powers presented the Poles with a constitution superior to anything they had ever been able to devise for themselves. The most mischievous of the ancient abuses, the elective monarchy and the *liberum veto*, were of course retained. Poland was to be dependent on her despoilers, but they evidently meant to make her a serviceable dependant. The government was henceforth to be in the hands of a *rada nieustajaca*, or permanent council of thirty-six members, eighteen senators and eighteen deputies, elected biennially by the *sejm* in secret ballot, subdivided into the five departments of foreign affairs, police, war, justice and the exchequer, whose principal members and assistants, as well as all other public functionaries, were to have fixed salaries. The royal prerogative was still further reduced. The king was indeed the president of the permanent council, but he could not summon the diet without its consent, and in all cases of preferment was bound to select one out of three of the council's nominees. The annual budget was fixed at 30,000,000 Polish gulden,[1] out of which a regular army of 30,000[2] men was to be maintained. Sentiment apart, the constitution of 1775 was of distinct benefit to Poland. It made for internal stability, order and economy, and enabled her to develop and husband her resources, and devote herself uninterruptedly to the now burning question of national education. For the shock of the first partition was so far salutary that it awoke the public conscience to a sense of the national inferiority; stimulated the younger generation to extraordinary patriotic efforts; and thus went far to produce the native reformers who were to do such wonders during the great quadrennial diet.

It was the second Turkish War of Catherine II. which gave patriotic Poland her last opportunity of re-establishing her independence. The death of Frederick the Great (Aug. 17, 1786) completely deranged the balance of power in Europe. The long-standing accord between Prussia and Russia came to an end, and while the latter drew nearer to Austria, the former began to look to the Western powers. In August 1787 Russia and Austria provoked the Porte to declare war against them both, and two months later a defensive alliance was concluded between Prussia, England and Holland, as a counterpoise to the alarming preponderance of Russia. In June 1788 Gustavus III. of Sweden also attacked Russia, with 50,000 men, while in the south the Turks held the Muscovites at bay beneath the walls of Ochakov, and drove back the Austrian invaders into Transylvania. Prussia, emboldened by Russia's difficulties, now went so far as to invite Poland also to forsake the Russian alliance, and placed an army corps of 40,000 men at her disposal.

Reform of the Constitution, 1788.

It was under these exceptional circumstances that the "four years' diet" assembled (Oct. 6, 1788). Its leaders, Stanislaw Malachowski, Hugo Kollontaj and Ignaty Potocki, were men of character and capacity, and its measures were correspondingly vigorous. Within a few months of its assembling it had abolished the permanent council; enlarged the royal prerogative; raised the army to 65,000 men; established direct communications with the Western powers; rejected an alliance which Russia, alarmed at the rapid progress of events, had hastened to offer; declared its own session permanent; and finally settled down to the crucial task of reforming the constitution on modern lines. But the difficulties of the patriots were commensurate with their energies, and though the new constitution was drafted so early as December 1789, it was not till May 1791 that it could safely be presented to the diet. Meanwhile Poland endeavoured to strengthen her position by an advantageous alliance with Prussia. Frederick William II. stipulated, at first, that Poland should surrender Danzig and Thorn, and Pitt himself endeavoured to persuade the Polish minister Michal Kleophas Oginski (1765–1833) that the protection of Prussia was worth the sacrifice. But the Poles proving obstinate, and Austria simultaneously displaying a disquieting interest in the welfare of the Republic, Prussia, on the 20th of March 1791, concluded an alliance with Poland which engaged the two powers to guarantee each other's possessions and render mutual assistance in case either were attacked.

But external aid was useless so long as Poland was hampered by her anarchical constitution. Hitherto the proceedings of the diet had not been encouraging. The most indispensable reforms had been frantically opposed, the debate on the reorganization of the army had alone lasted six months. It was only by an audacious surprise that Kollontaj and his associates contrived to carry through the new constitution. Taking advantage of the Easter recess, when most of the malcontents were out of town, they suddenly, on the 3rd of May, brought the whole question before the diet and demanded urgency for it. Before the opposition could remonstrate, the marshal of the diet produced the latest foreign despatches, which unanimously predicted another partition, whereupon, at the solemn adjuration of Ignaty Potocki, King Stanislaus exhorted the deputies to accept the new constitution as the last means of saving their country, and himself set the example by swearing to defend it.

The revolution of the 3rd of May 1791 converted Poland into an hereditary[3] limited monarchy, with ministerial responsibility and duennial parliaments. The *liberum veto* and all the intricate and obstructive machinery of the anomalous old system were for ever abolished. All invidious class distinctions were done away with. The franchise was extended to the towns. Serfdom was mitigated, preparatorily to its entire abolition; absolute religious toleration was established, and every citizen declared equal before the law. Frederick William II. officially congratulated Stanislaus on the success of "the happy revolution which has at last given Poland a wise and regular government," and declared it should henceforth be his "chief care to maintain and confirm the ties which unite us." Cobenzl, the Austrian minister at St Petersburg, writing to his court immediately after the reception of the tidings at the Russian capital, describes the empress as full of consternation at the idea that Poland under an hereditary dynasty might once more become a considerable power. But Catherine, still in difficulties, was obliged to watch in silence the collapse of her party in Poland, and submit to the double humiliation of recalling her ambassador and withdrawing her army from the country. Even when the peace of Jassy (Jan. 9, 1792) finally freed her from the Turk, she waited patiently for the Polish malcontents to afford her a pretext and an opportunity for direct and decisive interference. She had not long to wait. The constitution of the 3rd of May had scarce been signed when Felix Potocki, Severin Rzewuski and Xavier Branicki, three of the chief dignitaries of Poland, hastened to St Petersburg, and there entered into a secret convention with the empress, whereby she undertook to restore the old constitution by force of arms, but at the same time promised to respect the territorial integrity of the Republic. On the 14th of May 1792 the conspirators formed a confederation, consisting, in the first instance, of only ten other persons, at the little town of Targowica in the Ukraine, protesting against the constitution of the 3rd of May as tyrannous and revolutionary, and at the same time the new Russian minister at Warsaw presented a formal declaration of war to the king and the diet. The diet met the crisis with dignity and firmness. The army was at once despatched to the frontier; the male population was called to arms, and Ignaty Potocki was sent to Berlin to claim the assistance stipulated by the treaty of the 19th of March 1791. The king of Prussia, in direct violation of all his oaths and promises, declined to defend a constitution which had never had his "concurrence." Thus Poland was left entirely to her own resources. The little Polish army of 46,000 men, under Prince Joseph Poniatowski and Tadeusz Kościuszko, did all that was possible under the circumstances. For more than three months they kept back the invader, and, after winning three pitched battles, retired in perfect order on the capital (see PONIATOWSKI, and

Russia overthrows the Constitution.

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[1] 1 Pol. gulden = 5 silber groschen.

[2] At the very next diet, 1776, the Poles themselves reduced the army to 18,000 men.

[3] On the death of Stanislaus, the crown was to pass to the family of the elector of Saxony.

Kościuszko). But the king, and even Kollontaj, despairing of success, now acceded to the confederation; hostilities were suspended; the indignant officers threw up their commissions; the rank and file were distributed all over the country; the reformers fled abroad; and the constitution of the 3rd of May was abolished by the Targowicians as "a dangerous novelty." The Russians then poured into eastern Poland; the Prussians, at the beginning of 1793, alarmed lest Catherine should appropriate the whole Republic, occupied Great Poland; and a diminutive, debased and helpless assembly met at Grodno in order, in the midst of a Russian army corps, "to come to an amicable understanding" with the partitioning powers. After every conceivable means of intimidation had been unscrupulously applied for twelve weeks, the second treaty of partition was signed at three o'clock on the morning of the 23rd of September 1793. By this *pactum subjectionis*, as the Polish patriots called it, Russia got all the eastern provinces of Poland, extending from Livonia to Moldavia, comprising a quarter of a million of square miles, while Prussia got Dobrzyn, Kujavia and the greater part of Great Poland, with Thorn and Danzig. Poland was now reduced to one-third of her original dimensions, with a population of about three and a half millions.

Second Partition of Poland.

Kościuszko.

The focus of Polish nationality was now transferred from Warsaw, where the Targowicians and their Russian patrons reigned supreme, to Leipzig, whither the Polish patriots, Kościuszko, Kollontaj and Ignaty Potocki among the number, assembled from all quarters. From the first they meditated a national rising, but their ignorance, enthusiasm and simplicity led them to commit blunder after blunder. The first of such blunders was Kościuszko's mission to Paris, in January 1794. He was full of the idea of a league of republics against the league of sovereigns; but he was unaware that the Jacobins themselves were already considering the best mode of detaching Prussia, Poland's worst enemy, from the anti-French coalition. With a hypocrisy worthy of the diplomacy of "the tyrants," the committee of public safety declared that it could not support an insurrection engineered by aristocrats, and Kościuszko returned to Leipzig empty-handed. The next blunder of the Polish refugees was to allow themselves to be drawn into a premature rising by certain Polish officers in Poland who, to prevent the incorporation of their regiments in the Russian army, openly revolted and led their troops from Warsaw to Cracow. Kościuszko himself condemned their hastiness; but, when the Russian troops began to concentrate, his feelings grew too strong for him, and early in April he himself appeared at Cracow. In an instant the mutiny became a revolution. The details of the heroic but useless struggle will be found elsewhere (see Kościuszko, Kollontaj, Potocki, Ignaty, Dombrowski). Throughout April the Polish arms were almost universally successful. The Russians were defeated in more than one pitched battle; three-quarters of the ancient territory was recovered, and Warsaw and Vilna, the capitals of Poland and Lithuania respectively, were liberated. Kościuszko was appointed dictator, and a supreme council was established to assist him. The first serious reverse, at Szczekociny (June 5), was more than made up for by the successful defence of Warsaw against the Russians and Prussians (July 9 to Sept. 6); but in the meantime the inveterate lawlessness of the Poles had asserted itself, as usual, and violent and ceaseless dissensions, both in the supreme council and in the army, neutralized the superhuman efforts of the unfortunate but still undaunted dictator. The death-blow to the movement was the disaster of Maciejowice (Oct. 10), and it expired amidst the carnage of Praga (Oct. 29), though the last Polish army corps did not capitulate till the 18th of November. Yet all the glory of the bitter struggle was with the vanquished, and if the Poles, to the last, had shown themselves children in the science of government, they had at least died on the field of battle like men. The greed of the three partitioning powers very nearly led to a rupture between Austria and Prussia; but the tact and statesmanship of the empress of Russia finally adjusted all difficulties. On the 24th of October 1795 Prussia acceded to the Austro-Russian partition compact of the 3rd of January, and the distribution of the conquered provinces was finally regulated on the 10th of October 1796. By the third treaty of partition Austria had to be content with Western Galicia and Southern Masovia; Prussia took Podlachia, and the rest of Masovia, with Warsaw; and Russia all the rest.

Third Partition of Poland, 1796.

The immediate result of the third partition was an immense emigration of the more high-spirited Poles who, during the next ten years, fought the battles of the French Republic and of Napoleon all over Europe, but principally against their own enemies, the partitioning powers. They were known as the Polish legions, and were commanded by the best Polish generals, *e.g.* Joseph Poniatowski and Dombrowski. Only Kościuszko stood aloof. Even when, after the peace of Tilsit, the independent grand-duchy of Warsaw was constructed out of the central provinces of Prussian Poland, his distrust of Napoleon proved to be invincible. He was amply justified by the course of events. Napoleon's anxiety to conciliate Russia effectually prevented him from making Poland large and strong enough to be self-supporting. The grand-duchy of Warsaw originally consisted of about 1850 sq. m., to which Western Galicia and Cracow, about 900 sq. m. more, were added in 1809. The grand-duchy was, from first to last, a mere recruiting-ground for the French emperor. Its army was limited, on paper, to 30,000 men; but in January 1812 65,000, and in November the same year 97,000 recruits were drawn from it. The constitution of the little state was dictated by Napoleon, and, subject to the exigencies of war, was on the French model. Equality before the law, absolute religious toleration and local autonomy, were its salient features. The king of Saxony, as grand-duke, took the initiative in all legislative matters; but the administration was practically controlled by the French. (R.N.B.)

Alexander I. and Poland.

The Congress of Vienna.

The Congress Kingdom, 1813–1863.—The Grand Duchy of Warsaw perished with the Grand Army in the retreat from Moscow in 1812. The Polish troops had taken a prominent part in the invasion of Russia, and their share in the plundering of Smolensk and of Moscow had intensified the racial hatred felt for them by the Russians. Those of them who survived or escaped the disasters of the retreat fled before the tsar's army and followed the fortunes of Napoleon in 1813 and 1814. The Russians occupied Warsaw on the 18th of February 1813 and overran the grand duchy, which thus came into their possession by conquest. Some of the Poles continued to hope that Alexander would remember his old favour for them, and would restore their kingdom under his own rule. Nor was the tsar unwilling to encourage their delusion. He himself cherished the desire to re-establish the kingdom for his own advantage. As early as the 13th of January 1813 he wrote to assure his former favourite and confidant, Prince Adam Czartoryski, that, "Whatever the Poles do now to aid in my success, will at the same time serve to forward the realization of their hopes." But the schemes of Alexander could be carried out only with the co-operation of other powers. They refused to consent to the annexation of Saxony by Prussia, and other territorial arrangements which would have enabled him to unite all Poland in his own hand. By the final act of the Congress of Vienna, signed on the 9th of June 1815, Poland was divided between Prussia, Austria and Russia, with one trifling exception: Cracow with its population of 61,000 was erected into a republic embedded in Galicia. Posen and Gnesen, with a population of 810,000, were left to Prussia. Austria remained in possession of Galicia with its 1,500,000 inhabitants. Lithuania and the Ruthenian Palatinates, the spoil of former partitions, continued to be incorporated with Russia. The remnant was constituted as the so-called Congress Kingdom under the emperor of Russia as king (tsar) of Poland. It had been stipulated by the Final Act that the Poles under foreign rule should be endowed with institutions to preserve their national existence according to such forms of political existence as the governments to which they belong shall think fit to allow them.

The New Polish Constitution, 1815.

Alexander, who had a sentimental regard for freedom, so long as it was obedient to himself, had promised the Poles a constitution in April 1815 in a letter to Ostrovskiy, the president of the senate at Warsaw. His promise was publicly proclaimed on the 25th of May, and was reaffirmed in the Zamok or palace at Warsaw and the cathedral of St John on the 20th of June. The constitution thus promised was duly drafted, and was signed on the 30th of November. It contained 165 articles divided under seven heads. The kingdom of Poland was declared to be united to Russia, in the person of the tsar, as a separate political entity. The kingdom was the Congress Kingdom, for the vague promises of an extension to the east which Alexander had made to the Poles were never fulfilled. Lithuania and the Ruthenian Palatinates continued to be incorporated with Russia as the Western Provinces and were divided from the Congress Kingdom by a customs barrier till the reign of Nicholas I. The kingdom of Poland thus defined was to have at its head a lieutenant of the emperor (*namiestnik*), who must be a member of the Imperial house or a Pole. The first holder of the office, General Zajonczek (1752–1826), was a veteran who had served Napoleon. Roman Catholicism was recognized as the religion of the state, but other religions were tolerated. Liberty of the Press was promised subject to the passing of a law to restrain its abuses. Individual liberty, the use of the Polish language in the law courts, and the exclusive employment of Poles in the civil government were secured by the constitution. The machinery of government was framed of a council of state, at which the Imperial government was represented by a commissioner plenipotentiary, and a diet divided into a senate composed of the princes of the blood, the palatines and councillors named for life, and a house of *nuntii* elected for seven years, 77 chosen by the "dietines" of the nobles, and 51 by the commons. The diet was to meet every other year for a session of thirty days, and was to be renewed by thirds every two years. Poland retained its flag, and a national army based on that which had been raised by and had fought for Napoleon. The command of the army was given to the emperor's brother Constantine, a man of somewhat erratic character, who did much to offend the Poles by violence, but also a good deal to please them by his marriage with Johanna Grudzinska, a Polish lady afterwards created Princess Lowicz, for whose sake he renounced his right to the throne of Russia (see CONSTANTINE PAVLOVICH).

The diet met three times during the reign of Alexander, in 1818, in 1820 and in 1825, and was on all three occasions opened by the tsar, who was compelled to address his subjects in French, since he did not speak, and would not learn, their language. It is highly doubtful whether, with the best efforts on both sides, a constitutional government could have been worked by a Russian autocrat, and an assembly of men who inherited the memories and characters of the Poles. In fact the tsar and the diet soon quarrelled. The Poles would not abolish the jury to please the tsar, nor conform as he wished them to do to the Russian law of divorce. Opposition soon arose, and as Alexander could not understand a freedom which differed from himself, and would not condescend to the use of corruption, by which the ancient Polish diets had been managed, he was driven to use force. The third session of the diet—13th of May to 13th of June 1825—was a mere formality. All publicity was suppressed, and one whole district was disfranchised because it persisted in electing candidates who were disapproved of at court. On the other hand, the Poles were also to blame for the failure of constitutional government. They would agitate by means of the so-called National Masonry, or National Patriotic Society as it was afterwards called, for the restoration of the full kingdom of Poland. The nobles who dominated the diet did nothing to remove the most crying evil of the country—the miserable state of the peasants, who had been freed from personal serfdom by Napoleon in 1807, but were being steadily driven from their holdings by the landlords. In spite of the general prosperity of the country due to peace, and the execution of public works mostly at the expense of Russia, the state of the agricultural class grew, if anything, worse.

The Grand Duke Constantine.

Yet no open breach occurred during the reign of Alexander, nor for five years after his death in 1825. The Decembrist movement in Russia had little or no echo in Poland. On the death of Zajonczek in 1826, the grand duke Constantine became Imperial lieutenant, and his administration, though erratic, was not unfavourable to displays of Polish nationality. The Polish army had no share in the Turkish War of 1829, largely, it is said, at the request of Constantine, who loved parades and thought that war was the ruin of soldiers. No attempt was made to profit by the embarrassments of the Russians in their war with Turkey. A plot to murder Nicholas at his coronation on the 24th of May 1829 was not carried out, and when he held the fourth diet on the 30th of May 1830, the Poles made an ostentatious show of their nationality which Nicholas was provoked to describe as possibly patriotic but certainly not civil. Nevertheless, he respected the settlement of 1815. In the meantime the Patriotic Society had divided into a White or Moderate party and a Red or Extreme party, which was subdivided into the Academics or Republicans and the Military or Terrorists. The latter were very busy and were supported by the Roman Catholic Church, which did little for the Prussian Poles and nothing for the Austrian Poles, but was active in harassing the schismatical government of Russia.

Polish Rising of 1830.

The outbreak of the French Revolution in 1830 and the revolt of Belgium produced a great effect in Poland. The spread of a belief, partly justified by the language of Nicholas, that the Polish army would be used to coerce the Belgians, caused great irritation. At last, on the 29th of November 1830, a military revolt took place in Warsaw accompanied by the murder of the minister of war, Hauke, himself a Pole, and other loyal officers. The extraordinary weakness of the grand duke allowed the rising to gather strength. He evacuated Warsaw and finally left the country, dying at Vitebsk on the 27th of June 1831 (see CONSTANTINE PAVLOVICH). The war lasted from January till September 1831. The fact that the Poles possessed a well-drilled army of 23,800 foot, 6800 horse and 108 guns, which they were able to recruit to a total strength of 80,821 men with 158 guns, gave solidity to the rising. The Russians, who had endeavoured to overawe Europe by the report of their immense military power, had the utmost difficulty in putting 114,000 men into the field, yet in less than a year, under the leadership of Diebitsch, and then of Paskevich, they mastered the Poles. On the political and administrative side the struggle of the Poles was weakened by the faults which had been the ruin of their kingdom—faction pushed to the point of anarchy, want of discipline, intrigue and violence, as shown by the abominable massacre which took place in Warsaw when the defeat of the army was known. The Poles had begun by protesting that they only wished to defend their rights against the tsar, but they soon proceeded to proclaim his deposition. Their appeal to the powers of Europe for protection was inevitably disregarded.

Poland a Russian Province.

When the Congress Kingdom had been reconquered it was immediately reduced to the position of a Russian province. No remnant of Poland's separate political existence remained save the minute republic of Cracow. Unable to acquiesce sincerely in its insignificance and even unable to enforce its neutrality, Cracow was a centre of disturbance, and, after Russia, Prussia, and Austria had in 1846 agreed to its suppression, was finally occupied by Austria on the 6th of November 1848, as a consequence of the troubles, more agrarian than political, which convulsed Galicia. The administration established by Nicholas I. in Russian Poland was harsh and aimed avowedly at destroying the nationality, and even the language of Poland. The Polish universities of Warsaw and Vilna were suppressed, and the students compelled to go to St Petersburg and Kiev. Polish recruits were distributed in Russian regiments, and the use of the Russian language was enforced as far as possible in the civil administration and in the law courts. The customs barrier between Lithuania and the former Congress Kingdom was removed, in the hope that the influence of Russia would spread more easily over Poland. A very hostile policy was adopted against the Roman Catholic Church. But though these measures cowed the Poles, they failed to achieve their main purpose. Polish national sentiment was not destroyed, but intensified. It even spread to Lithuania. The failure of Nicholas was in good part due to mistaken measures of what he hoped would be conciliation. He supported Polish students at Russian universities on condition that they then spent a number of years in the public service. It was the hope of the emperor that they would thus become united in interest with the Russians. But these Polish officials made use of their positions to aid their countrymen, and were grasping and corrupt with patriotic intentions. The Poles in Russia, whether at the universities or in the public service, formed an element which refused to assimilate with the Russians. In Poland itself the tsar left much of the current civil administration in the hands of the nobles, whose power over their peasants was hardly diminished and was misused as of old. The Polish exiles who filled Europe after 1830 intrigued from abroad, and maintained a constant agitation. The stern government of Nicholas was, however, so far effective that Poland remained quiescent during the Crimean War, in which many Polish soldiers fought in the Russian army. The Russian government felt safe enough to reduce the garrison of Poland largely. It was not till 1863, eight years after the death of the tsar in 1855, that the last attempt of the Poles to achieve independence by arms was made.

Insurrection of 1863.

The rising of 1863 may without injustice be said to be due to the more humane policy of the tsar Alexander II. Exiles were allowed to return to Poland, the Church was propitiated, the weight of the Russian administration was lightened, police rules as to passports were relaxed, and the Poles were allowed to form an agricultural society and to meet for a common purpose for the first time after many years. Poland in short shared in the new era of milder rule which began in Russia. In April 1856 Alexander II. was crowned king in the Roman Catholic cathedral of Warsaw, and addressed a flattering speech to his Polish subjects in French, for he too could not speak their language. His warning, "No nonsense, gentlemen" (*Point de rêveries, Messieurs*), was taken in very ill part, and it was perhaps naturally, but beyond question most unhappily, the truth that the tsar's concessions only served to encourage the Poles to revolt, and to produce a strong Russian reaction against his liberal policy. As the Poles could no longer dispose of an army, they were unable to assail Russia as openly as in 1830. They had recourse to the so-called "unarmed agitation," which was in effect a policy of constant provocation designed to bring on measures of repression to be represented to Europe as examples of Russian brutality. They began in 1860 at the funeral of the widow of General Sobinski, killed in 1830, and on the 27th of February 1861 they led to the so-called Warsaw massacres, when the troops fired on a crowd which refused to disperse. The history of the agitation which culminated in the disorderly rising of 1863 is one of intrigue, secret agitation, and in the end of sheer terrorism by a secret society, which organized political assassination. The weakness of the Russian governor, General Gorchakov, in 1861 was a repetition of the feebleness of the Grand Duke Constantine in 1830. He allowed the Poles who organized the demonstration of the 27th of February to form a kind of provisional government. Alongside of such want of firmness as this were, however, to be found such measures of ill-timed repression as the order given in 1860 to the agricultural society not to discuss the question of the settlement of the peasants on the land. Concession and repression were employed alternately. The Poles, encouraged by the one and exasperated by the other, finally broke into the partial revolt of 1863–1864. It was a struggle of ill-armed partisans, who were never even numerous, against regular troops, and was marked by no real battle. The suppression of the rising was followed by a return to the hard methods of Nicholas. The Polish nobles, gentry and Church—the educated classes generally—were crushed. It must, however, be noted that one class of the measures taken to punish the old governing part of the population of Poland has been very favourable to the majority. The peasants were freed in Lithuania, and in Poland proper much was done to improve their position. The Russian government has benefited by their comparative prosperity, and by the incurable hatred they continue to feel for the classes which were once their oppressors. The national history of Poland closes with the rising of 1863. (D. H.)

Bibliography.—The best general history of Poland is still Józef Szujski's monumental *History of Poland according to the latest investigations* (4 vols., Pol., Lemberg, 1865–1866), a work which has all the authority of careful criticism and easy scholarship. It adopts, throughout, the conservative-monarchical standpoint. Szujski's book has superseded even Joachim Lelewel's learned *History of Poland* (Pol., Brussels, 1837), of which there are excellent French (Paris, 1844) and German (Leipzig, 1846) editions. The best contemporary general history is August Sokolowski's *Illustrated History of Poland* (Pol., Vienna, 1896–1900). The best independent German history of Poland is, on the whole, Roepell (Richard) and Caro's (Jakab) *Geschichte Polens* (Hamburg and Gotha, 1840–1888). Scholars desiring to explore for themselves the sources of Polish history from the 11th century to the 18th have immense fields of research lying open before them in the *Acta historica res gestas Poloniae illustrantia* (1878, &c.), the *Scriptores rerum polonicarum* (1872, &c.), and the *Historical Dissertations* (Pol., 1874, &c.), all three collections published, under the most careful editorship, by the University of Cracow. To the same order belong Ludwik Finkel's *Fontes rerum polonicarum* (Lemberg, 1901, &c.), and the innumerable essays and articles in *The Historical Quarterly Review of Poland* (Pol., Lemberg, 1887, &c.). The soundest history of Lithuania, before its union with Poland, is still Lelewel's *History of Lithuania* (Pol., Leipzig, 1839), of which a French translation was published at Paris in 1861. Proceeding to the earlier history of Poland, Lelewel's *Poland in the Middle Ages* (4 vols., Posen, 1846–1851) is still a standard work, though the greatest authority on Polish antiquities is now Tadeusz Wojciechowski, who unites astounding learning with a perfect style. His *Historical Sketches of the Eleventh Century* (Pol., Cracow, 1904) is a very notable work. Karol Szajnocha's great monograph, justly described as "a pearl of historical literature," *Jadwiga and Jagiello* (4 vols., Lemberg, 1861), the result of twelve years of exhaustive study, is our best authority on the first union between Poland and Lithuania. On the other hand, his *Boleslaus the Bold, &c.* (Lemberg, 1859) would now be considered too romantic and picturesque. The relations between Poland, Prussia and Livonia are adequately dealt with by two sound German books, Theodor Schiemann's *Russland, Polen und Livland bis ins* xviii. *Jahrhundert* (Berlin, 1885–1887) and Max Perlbach's *Preussisch-polnische Studien* (Halle, 1886). A good guide to the history of the Jagiellonic period, 1386–1572, is also Adolf Pawinski's *Poland in the 15th Century* (Pol., Warsaw, 1883–1886). Of the numerous works relating to the reign of the heroic Stephen Báthory, 1575–1586, Ignaty Janicki's *Acta historica res gestas Stephani Bathorei illustrantia* (Cracow, 1881), and Paul Pierling's *Un arbitrage pontifical entre la Pologne et la Russie 1581–1582* (Brussels, 1890) can be recommended. The best Polish work on the subject is Wincenty Zakrzewski's *The Reign of Stephen Báthory* (Pol., Cracow, 1887). Of the books relating to the Polish Vasas the most notable is Szajnocha's *Two Years of our History, 1646–1648* (Lemberg, 1865), which deals exhaustively with the little-known but remarkable attempt (the last practical attempt of its kind) of Ladislaus IV. to abolish the incurably vicious Polish constitution. Another first-class work, relating to the same period and dealing specifically with the mode of warfare of heroic Poland, is Józef Tretiak's *History of the War of Chocim* (Pol., Lemberg, 1893). For works relating to the Sobieskian, Saxon and Partitional periods of Polish history, the reader is referred to the bibliographical notes appended to the biographies of John III., king of Poland, Michal Czartoryski, Stanislaus II., Tadeusz Andrzej Kościuszko, Józef Poniatowski, and the other chief actors of these periods. But the following additional authorities should also be noted. (1) Lelewel's *History of the Reign of Stanislaus Augustus* (Pol., Warsaw, 1831; Fr. ed., Paris, 1839); the book is important as being based on unpublished memoirs in the exclusive possession of the author's family. (2) *Materials for the History of the last century of the Republic*, by S. Korwin (Cracow, 1890). (3) *Die letzte polnische Königswahl*, by Szymon Askenazy (Cracow, 1882–1886). (4) The extremely valuable *Prince Repnin in Poland* by Aleksander Kraushar (Warsaw, 1900), one of the most thorough of contemporary Polish historians. Innumerable are the works relating to the Partitional period. Perhaps the best of all is Walery Jan Kalinka's great work in four volumes, *Der vierjährige polnische Reichstag* (Berlin, 1896–1898). Kalinka is, however, far too severe upon the patriots and much too indulgent towards

King Stanislaus. Albert Sorel's *La Question d'Orient au XVIII^e. siècle* (Paris, 1889) is lucid and accurate, but somewhat superficial. Wolfgang Michael's *Englands Stellung zur ersten Teilung Polens* (Hamburg, 1890) is of especial interest to Englishmen. Maryan Dubiecki's *Karol Prozor* (Pol., Cracow, 1897) shows with what self-sacrificing devotion the gentry and people supported Kościuszko's rising. For more complete bibliography see Jozef Korzeniowski's *Catalogus actorum et documentarum res gestas Poloniae illustrantium* (Cracow, 1889), and Ludwik Finkel's *Bibliography of Polish History* (Pol., Lemberg, 1891). For the period 1815–1863 see also N. A. Day, *The Russian Government in Poland* (London, 1867); Theodor Schiemann, *Russland unter Kaiser Nikolaus I.*, vol. i. (Berlin, 1904).

POLISH LITERATURE

The Polish language belongs to the western branch of the Slavonic tongues, and exhibits the closest affinities with the Czech or Bohemian and Lusatian Wendish. Unlike the people of other Slavonic countries, the Poles are comparatively poor in popular and legendary poetry, but such compositions undoubtedly existed in early times, as may be seen by the writings of their chroniclers; thus Gallus translated into Latin a poem written on Boleslaus the Brave, and a few old Polish songs are included in Wojcicki's *Library of Ancient Writers.* A great deal of the early literature written in Poland is in Latin. The earliest specimen of the Polish language is the so-called Psalter of Queen Margaret, discovered in 1826 at the convent of St Florian. The date of the manuscript appears to be the middle of the 14th century, and probably in its present form it is only a copy of a much older text; there is also a translation of the fiftieth psalm belonging to the 13th century.[1] The ancient Polish hymn or war song, *Piesn Boga Rodzica,* was an address to the Virgin, sung by the Poles when about to fight. The oldest manuscript of this production is dated 1408, and is preserved at Cracow. By a legend which subsequently grew up the composition of it was assigned to St Adalbert. John Lodzia, bishop of Posen from 1335 to 1346, composed several religious songs in Latin.

The next monument of Polish literature to which we come is the Bible of Queen Sophia or Bible of Szaroszpatak. It is imperfect, and only contains the early books, viz. the Pentateuch, Joshua, Ruth and Kings; there are, however, fragments of three others. It is said to have been written for Sophia, the fourth wife of Jagiello, about the year 1455. It has been edited with great care by Małecki. Five religious songs in Polish dating from the 15th century have been preserved; they are ascribed to Andrew Slopuchowski, prior of the monastery of the Holy Cross on Łysa Góra. There is also the fragment of a hymn in praise of Wycliffe. To these fragments may be added the prayer-book of a certain Wacław, a sermon on marriage, and some Polish glosses. These are all the existing memorials of the Polish language before the 16th century.

The Latin Chronicles.

Perhaps a few words should be said concerning the writers in Latin. Martin Gallus lived in Poland between 1110 and 1135. From his name he has been supposed by some to have been a Frenchman or Walloon, and we must remember that Poland swarmed at that time with foreign ecclesiastics. Lelewel, the Polish historian, considers that it is merely a translation into Latin of some such name as *Kura*, signifying "a fowl." Others suppose him to have been an Italian, or a monk from the convent of St Gall in Switzerland. He has plenty of legends to tell us, and writes altogether in a poetical style, so that his prose seems to fall into rhythm unconsciously. His quotations from the classics, Sallust, Lucan and others, show the extent of his reading. Gallus was followed by Matthew Cholewa and Vincent Kadlubek, two bishops of Cracow, and Bogufal or Boguchwal (Gottlob), bishop of Posen, who all used Latin. The work of Kadlubek is more ornate in diction than that of Bogufal, and for a long time enjoyed great popularity. He was born in 1160, educated at the university of Paris, and died in Poland in 1223 as a Cistercian monk. His Latin, like that of Gallus, is far from classical, but he writes with spirit and throws a good deal of light upon the events of his time. The education of the country was wholly in the hands of the ecclesiastics, many of whom were foreigners. In this way we must explain the great prevalence of the Latin language. Such a system would be sure to stifle all national outgrowth, and accordingly we have among the Poles none of those early monuments of the language which other countries boast. For instance, there are no *bîlinî* or legendary poems, such as are found among the Russians, although many passages in the ancient chroniclers from their poetical colouring seem to be borrowed from old songs or legends, and the first verses of some of these compositions have been preserved. Mention may here be made of other chroniclers such as Martin the Pole (Polonus), who died in 1279 or 1280, and Jan of Czarnkow, who died in 1389; the latter was the historian and panegyrist of Casimir the Great. With the reign of Casimir III. (1333–1370) must be associated the statutes of Wislica. Jadwiga, the wife of Jagiello, was mainly instrumental in creating the university of Cracow, which received a charter in 1364, but did not come into effective existence till its reconstitution in 1400. In this institution for many years all the great men of Poland were trained—among others Gregory of Sanok, Dlugosz and Copernicus. Casimir the Great may be said to have laid the foundation of this university. Having obtained the consent of Pope Urban V., he established at Cracow a *studium generale* on the model of the university of Bologna. It consisted of three faculties—Roman law, medicine and philosophy. But the aristocratic youth still preferred frequenting the universities of Prague, Padua and Paris, and accordingly the newly founded *studium* languished. Jadwiga, however, obtained from Boniface IX. permission to create a new chair, that of theology; and the university of Cracow was remodelled, having been reorganized on the same basis as that of Paris. Another university was founded later at Vilna by Báthory, and one at Zamość by the chancellor Zamoyski. There were also good schools in various places, such as the Collegium Lubranskiego of Posen and the school of St Mary at Cracow. In the year 1474 a press was set up in the latter city, where Günther Zainer printed the first book. The first press from which books in the Polish language appeared was that of Hieronymus Wietor, a Silesian, who commenced publishing in 1515. A few fragments printed in Polish had appeared before this, as the Lord's Prayer in the statutes of the bishops of Breslau in 1475, the story of Pope Urban in Latin, German and Polish in 1505, &c.; but the first complete work in the Polish language appeared from the press of this printer at Cracow in 1521, under the title, *Speeches of the Wise King Solomon.* The translation was executed by Jan Koszycki, as the printer informs us in the preface, and the work is dedicated to Anna Wojnicka, the wife of a castellan. In 1522, a Polish translation of Ecclesiastes appeared from that press, and before the conclusion of that year *The Life of Christ*, with woodcuts, translated into Polish by Balthasar Opec. Many other presses were soon established. Printers of repute at Cracow, during the 16th and beginning of the 17th century, were Sybeneicher and Piotrkowczyk.

Dlugosz.

Little as yet had been produced in Polish, as the chroniclers still adhered to Latin; and here mention must be made of Jan Dlugosz, who called himself Longinus. He was bishop of Lemberg, the capital of Galicia, and has left us a very valuable history which has merits of style and shows considerable research. So anxious was Dlugosz to make his work as perfect as he could that he learned Russian so as to be able to read the *Chronicle* of Nestor. The best part of his book is that which treats of the period between 1386 and 1480. About 1500 was written an interesting little work entitled "Memoirs of a Polish Janissary" (*Pamietniki ianczara polaka*). Although written in the Polish language, it was probably the production of a Serb, Michael Constantinovich of Ostrovitza. He was taken prisoner by the Turks in 1455 and served ten years among the Janissaries, after which he escaped into Hungary. About this time also flourished Nicholas Copernicus, a native of Thorn, one of the few Poles who have made themselves known beyond the limits of their country.

The Poles call the period between 1548 and 1606 their golden age. Poland was the great land of eastern Europe, and owing to the universal toleration encouraged by the government, Protestantism was widely spread. Many of the chief nobility were Calvinists, and the Socini came to reside in the country. All this, however, was to pass away under the great Jesuit reaction. At Rakow in Poland was published the catechism of the Socinian doctrines in 1605. The Jesuits made their appearance in Poland in 1564, and soon succeeded in getting the schools of the country into their hands. Besides extirpating the various sects of Protestants, they also busied themselves with destroying the Greek Church in Lithuania. Latin poetry was cultivated with great success by Clement Janicki (1516–1543), but the earliest poet of repute who wrote in Polish is Rej of Nagłowice (1505–1569). After a somewhat idle youth he betook himself to poetry. He was a Protestant, and among other religious works translated the Psalms. His best work was *Zwierciadło albo zywot poczciwego człowieka* (The Mirror or Life of an Honourable Man)—a somewhat tedious didactic piece. He was also the author of a kind of play—a mystery we may term it, and productions of this sort seem to have been common in Poland from a very early time—entitled *Life of Joseph in Egypt*. This piece is interesting merely from an antiquarian point of view; there is but little poetry in it. It teems with anachronisms; thus we have mention of the mass and organs, and also of a German servant. Lucas Goinicki (1527–1603) wrote many historical works, and *Dworzanin polski*, an imitation of the *Cortegiano* of Castiglione.

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[1] The Psalter is called after Margaret, the first wife of King Louis, who died in 1349, by a mere conjecture. Caro thinks it more probable that the book belonged to Mary, his daughter.

Kochanowski.

Jan Kochanowski[1] (1530–1584), called the prince of Polish poets, came of a poetical family, having a brother, a cousin and a nephew who all enriched the literature of their country with some productions. Kochanowski studied for some time at the university of Padua, and also resided in Paris, where he made the acquaintance of Ronsard. Returning to Poland, he became in 1564 secretary to Sigismund Augustus. He has left *The Game of Chess*, an imitation of Vida, and *Proporzec albo hold pruski* (The Standard or Investiture of Prussia), where he describes the fealty done by Albert of Brandenburg to Sigismund Augustus. He also executed a translation of the Psalms. He wrote a play—a piece of one act, with twelve scenes—*The Despatch of the Greek Ambassadors*. It is written in rhymeless five-foot iambics, and is altogether a product of the Renaissance, reminding us of some of the productions of George Buchanan. Rhyme is employed in the choruses only. It was acted on the marriage of the chancellor Jan Zamoyski with Christine Radziwiłł, in the presence of King Stephen and his wife, at Ujazdowo near Warsaw in 1578. The poet's most popular work, however, is his *Treny* or "Lamentations," written on the death of his daughter Ursula. These beautiful elegies have been justly praised by Mickiewicz; they are enough to raise Kochanowski far above the level of a merely artificial poet. Besides poems in Polish, he also wrote some in Latin. It will be observed that we get this double-sided authorship in many Polish writers. They composed for an exclusive and learned circle, certainly not for the Jew, the German trader of the town, or the utterly illiterate peasant. It may be said with truth of Kochanowski that, although the form of his poetry is classical and imitated from classical writers, the matter is Polish, and there is much national feeling in what he has left us. Mention must also be made of his epigrams, which he styled "Trifles" (*Fraszki*); they are full of spirit and geniality. Stanislaus Grochowski (1554–1612) was a priest; but his poetry is of little merit, although he was celebrated in his time as a writer of panegyrics. His satire *Babie Kolo* (The Women's Circle) gave offence on account of its personalities. A great partisan of the Catholics in the time of Sigismund III. was Caspar Miaskowski, whose *Waleta Włoszłzonowska* (Farewell to his Native Country) deserves mention. Szarzyński, who died young in 1581, deserves notice as having introduced the sonnet to the Poles. This species of poetry was afterward to be carried to great perfection by Mickiewicz and Gaszynski.

Szymonowicz.

Szymonowicz (1554–1624) was a writer of good pastorals. Although they are imitated from classical writers, he has introduced many scenes of national life, which he describes with much vigour. Among the best are "The Lovers," "The Reapers," and "The Cake" (*Kołacz*). Mickiewicz is very loud in his praise, and considers him one of the best followers of Theocritus. The condition, however, of the Polish peasants was too miserable to admit of their being easily made subjects for bucolic poetry. There is an artificial air about the idylls of Szymonowicz which makes one feel too keenly that they are productions of the Renaissance; one of their best features is the humane spirit towards the miserable peasantry which they everywhere display. Another excellent writer of pastorals was Zimorowicz, a native of Lemberg, who died at the early age of twenty-five. Some of his short lyrics are very elegant, and remind us of Herrick and Carew—*e.g.* that beginning "*Ukochana Lancelloto! Ciebie nie proszę o złoto.*" Another writer of pastorals, but not of equal merit, was Jan Gawinski, a native of Cracow. Some good Latin poetry was written by Casimir Sarbiewski, better known in the west of Europe as Sarbievius (d. 1640). He was considered to have approached Horace more nearly than any other modern poet, and a gold medal was given him by Pope Urban VIII. Martin Kromer (1512–1589) wrote a history of Poland in thirty books, and another volume, giving a description of the country and its institutions—both in Latin. The history is written in an easy style and is a work of great merit. A poet of some importance was Sebastian Fabian Klonowicz (1545–1602), who latinized his name into Acernus, *Klon* being the Polish for maple, and wrote in both Latin and Polish, and through his inclination to reform drew down on himself the anger of the clergy. Sometimes he is descriptive, as in his Polish poem entitled *Flis* ("The Boatman"), in which he gives a detailed account of the scenery on the banks of the Vistula. There is some poetry in this composition, but it alternates with very prosaic details. In another piece, *Rhoxolania*, in Latin, he describes the beauties of Galicia. Occasionally he is didactic, as in *Worek Judaszow* (The Bag of Judas) and *Victoria deorum*, where, under the allegory of the gods of Olympus, he represents the struggles of parties in Poland, not without severely satirizing the nobility and ecclesiastics. A curious work called *Quincunx*, written by Orzechowski (1515–1566), is concerned with religious polemics. Andrew Modrzewski, a Protestant, in his work *De republica emendanda* (1551), recommended the establishment of a national church which should be independent of Rome, something upon the model of the Anglican.

Skarga.

A florid Jesuitical style of oratory became very popular in the time of Sigismund III., not without rhetorical power, but frequently becoming tawdry. The chief representative of this school was Piotr Skarga (1536–1612), one of the main agents in extirpating Calvinism in Poland and the Greek Church in Lithuania. Among his numerous writings may be mentioned *Lives of the Saints*, *Discourses on the Seven Sacraments*, and especially his sermons preached before the diet, in which he lashed the Poles for their want of patriotism and prophesied the downfall of the country. Mecherzynski, in his "History of Eloquence in Poland" (*Historya wymowy w Polsce*), especially praises his two funeral sermons on the burial of Anna Jagiełłonka, widow of Stephen Bâtory, and Anna of Austria, first wife of Sigismund III. Besides the Latin histories of Wapowski and Gwagnin (Guagnini, of Italian origin), we have the first historical work in Polish by Martin Bielski, a Protestant, viz. *Kronika polska*, which was afterwards continued by his son. The author was born in 1495 on his father's estate, Biała, and was educated, like so many other of his illustrious contemporaries, at the university of Cracow. He lived to the age of eighty; but, however great were the merits of his *Chronicle*, it was long considered a suspicious book on account of the leanings of the author to Calvinism. After his death his work was continued by his son Joachim (1540–1599). There is also a *Chronicle* by Bartholomew Paprocki. In 1582 was also published the *Chronicle* of Stryjkowski, full of curious learning, and still of great use to the student of history. Five years later appeared the *Annales Poloniae* of Sarnicki. The last three works are in Latin.

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[1] His collected works were printed in 1584; they were many times reprinted, the best edition being that of Warsaw (4 vols., 1884). His life was written by Przyborowski (Posen, 1857).

Spread of Protestantism.

A few words may be said here about the spread of Protestantism in Poland, which is so intimately mixed up with the development of the national language. The doctrines of Hus had entered the country in very early times, and we find Polish recensions of Bohemian hymns; even the hymn to the Virgin previously mentioned is supposed to have a Czech basis. The bishops were soon active against those who refused to conform to the doctrines of the Roman church. Thus we find that Bishop Andrew of Bnin seized five Hussite priests and caused them to be burnt in the market of Posen in 1439. A hundred years afterwards a certain Katharina Malcher, on account of her Utraquist opinions, was condemned by Gamrat, the bishop of Cracow, to be burnt, which sentence was accordingly carried out in the ragmarket at Cracow. As early as 1530 Lutheran hymns were sung in the Polish language at Thorn. In Königsberg, John Seklucyan, a personal friend of Luther, published a collection of *Christian Songs*. He was born in Great Poland, and was at first a Roman Catholic priest in Posen, but afterwards embraced the Protestant faith and was invited by Duke Albert as a preacher to Königsberg, where he died in 1578. He executed the first translation of the New Testament in 1551. Four years afterwards appeared a complete Polish Bible published by Scharffenberg at Cracow. In 1553 appeared at Brześć the Protestant translation of the whole Bible made by a committee of learned men and divines, and published at the expense of Nicholas Radziwiłł, a very rich Polish magnate who had embraced the Protestant doctrines. This book is now of great rarity because his son Christopher, having been induced to become a Roman Catholic by the Jesuit Skarga, caused all copies of his father's Bible which he could find to be burnt. One, however, is to be seen in the Bodleian Library, and another in the library of Christ Church at Oxford. A Socinian Bible was issued by Simon Budny in 1570 at Nieświez, as he professed to find many faults in the version issued under the patronage of Radziwiłł; in 1597 appeared the Roman Catholic version of the Jesuit Wujek; and in 1632 the so-called Danzig Bible, which is in use among Protestants and is still the most frequently reprinted.

Macaronic Period.

Up to this time Polish literature, although frequently rhetorical and too much tinctured with classical influences, had still exhibited signs of genius. But now, owing to the frivolous studies introduced by the Jesuits, the so-called macaronic period supervened, which lasted from 1606 to 1764, and was a time of great degradation for the language and literature. The former was now mixed with Latin and classical expressions; much of the literature consists of fulsome panegyric, verses written on the marriages and funerals of nobles, with conceits and fantastic ideas, devoid of all taste, drawn from their coats of arms. The poets of this period are, as may be imagined, in most cases mere rhymesters; there are, however, a few whose names are worth recapitulating, such as Wacław Potocki (*c.* 1622–*c.* 1696), now known to have been the author of the *Wojna Chocimska*, or "War of Khotin," the same campaign which afterwards formed the subject of the epic of Krasicki. At first the author was supposed to have been Andrew Lipski, but the real poet was traced by the historian Szajnocha. The epic, which remained in manuscript till 1850, is a genuine representation of Polish life; no picture so faithful appeared till the *Pan Tadeusz* of Mickiewicz. Moreover, Potocki had the good taste to avoid the macaronic style so much in vogue; his language is pure and vigorous. He does not hesitate to introduce occasionally satirical remarks on the luxury of the times, which he compares, to its disadvantage, with the simplicity of the old Polish life. There is also another poem attributed to Potocki called the *New Mercury*. In one passage he censures King Michael for ceding Podolia to the Turks. Samuel Twardowski (1600–1660) wąs the most prolific poet of the period of the Vasas. His most important poem is *Wladysłaus IV., King of Poland*, in which he sings in a very bombastic strain the various expeditions of the Polish monarch. A bitter satirist appeared in the person of Christopher Opalinski (1609–1656). His works were published under the title of *Juvenalis redivivus*, and, although boasting but little poetical merit, give us very curious pictures of the times. Hieronymus Vespasian Kohcowski (1633–1699) was a soldier-poet, who went through the campaigns against the Swedes and Cossacks; he has left several books of lyrics full of vivacity, a Christian epic and a Polish psalmody. Another poet was Andrew Morsztyn (born about 1620, died about the commencement of the 18th century), an astute courtier, who was finance minister (*podskárbi*) under John Casimir, and was a devoted adherent of the French party at court, in consequence of which, in the reign of Sobieski, he was compelled to leave his native country and settle in France. His poems are elegant and free from the conceits and pedantry of the earlier writers. In fact, he introduced into Poland the easy French manner of such writers as Voiture. He translated the *Cid* of Corneille, and wrote a poem on the subject of Psyche, based upon the well-known Greek myth. History in the macaronic period made a backward step: it had been written in the Polish language in the golden age; it was now again to take a Latin form, as in the *Chronica Gestarum in Europa singularium* of the ecclesiastic Paul Piasecki (1580–1649), who is an authority for the reigns of Sigismund III. and Wladisłaus IV., and Rudawski, who describes events from the accession of John Casimir to the peace of Oliva (1648–1660); and as valuable materials for history may be mentioned the five huge volumes of Andrew Chrysostom Załuski (1711), bishop of Warmia. This work is entitled *Epistolae historico-familiares*. It would be impossible to recapitulate here the great quantity of material in the shape of memoirs which has come down, but mention must be made of those of John Chrysostom Pasek, a nobleman of Masovia, who has left us very graphic accounts of life and society in Poland; after a variety of adventures and many a well-fought battle, he returned to the neighbourhood of Cracow, where he died between 1699 and 1701. Some of the most characteristic stories illustrating Polish history are drawn from this book. A later period, that of the miserable epoch of Augustus III., is described very graphically in the memoirs of Matuszewicz, first edited by Pawinski at Warsaw in 1876. Relating to the same period are also the memoirs of Bartholomew Michałowski (*Pamietniki Bartłomieja Michałowskiego*). A curious insight into the course of education which a young Polish nobleman underwent is furnished by the instructions which James Sobieski, the father of the celebrated John, gave to Orchowski, the tutor of his sons. This has been twice printed in comparatively recent times (*Instrukcya Jakóba Sobieskiego kasztelana Krakowskiego dana panu Orchowskiemu ze strony synów*, Vilna, 1840). The old gentleman in his aristocratic imperiousness frequently reminds us of the amusing directions given by Sir John Wynne to his chaplain, quoted in Pennant's *Tour in Wales*.

A *History of the Lithuanians* in Latin was published by the Jesuit Koiałowicz; the first volume appeared at Danzig in 1650. A valuable work on the condition of Poland was written by Stanislaus Leszczynski, who was twice chosen king, entitled *Głos wolny wolność ubezpieczający* (A Free Voice Guaranteeing Freedom), where he tells the Poles some homely and perhaps disagreeable truths illustrating the maxim *Summa libertas etiam perire volentibus*.

A notable man was Joseph Andrew Załuski, bishop of Kiev, a Pole who had become thoroughly frenchified—so much so, that he preached in French to the fashionable congregations of Warsaw. He collected a splendid library of about 300,000 volumes and 15,000 manuscripts, which he bequeathed to the Polish nation; but it was afterwards carried off to St Petersburg, where it formed the foundation of the imperial public library. According to Nitschmann in his *Geschichte der polnischen*

Litteratur—a work which has been of service in the preparation of this article—the books were transported to Russia very carelessly, and many of them injured by the way. It was especially rich in works relating to Polish history. Konarski edited in six volumes a valuable work entitled *Volumina legum*, containing a complete collection of Polish laws from the time of the statute of Wislica. He did much good also in founding throughout the country schools for the education of the sons of the upper classes, but as yet nothing had been done for popular education properly so-called. About the close of this period we have some valuable writers on Polish history, which now began to be studied critically, such as Hartknoch in his *Alt- und Neues Preussen* (1684), a work in which are preserved interesting specimens of the old Prussian language, and Lengnich (1689–1774), author of the valuable *Jus publicum regni Poloniae*, which appeared in 1742.

We now come to the reign of the last Polish king, Stanislaus Poniatowski, and the few quiet years before the final division of the country, during which the French taste was all-powerful. This is the second great period of the development of Polish literature, which has known nothing of medieval romanticism. The literature of the first or Renaissance period gives us some good poets, who although occasionally imitators are not without national feeling, and a goodly array of chroniclers, most of whom made use of Latin. In the second or French period we get verse-makers rather than poets, who long to be Frenchmen, and sigh over the barbarism of their country; but the study of history in a critical spirit is beginning under the influence of Naruszewicz, Albertrandi and others. In the third period, that of modern romanticism, we get true nationalism, but it is too often the literature of exile and despair. Here may be mentioned, although living a little time before the reign of Stanislaus, a Polish poetess, Elizabeth Druzbacka (1695–1760), whose writings show a feeling for nature at a time when verse-making of the most artificial type was prevalent throughout the country. The portrait prefixed to the Leipzig edition of her works is a striking one, representing a handsome, intellectual-looking woman, dressed in the garb of some religious order. Her *Life of David* in verse appears tedious, but many of the descriptions in the *Seasons* are elegant. Unfortunately she introduces latinisms, so that her Polish is by no means pure. A national theatre was founded at Warsaw in 1765 under the influence of the court, but it was not till long afterwards that anything really national connected with the drama appeared in Poland. Thomas Kajetan Węgierski (1755–1787), who was chamberlain to the king, enjoyed a considerable reputation among his countrymen for his satirical writing. He was a kind of Polish Churchill, and like his English parallel died young. His life also appears to have been as irregular as Churchill's. In consequence of an attack on the empress of Russia, he was compelled to leave Poland, and accordingly made a tour in Italy, France, America, and England, dying at Marseilles at the early age of thirty-three. His poetry shows the influence of the French taste, then prevalent throughout Europe. In times of great national disasters he deserves to be remembered as a true patriot; but the spirit of his poetry is altogether unwholesome. It is the wailing cry of a moribund nation. The great laureate of the court of Stanislaus was Trembecki (1722–1812), whose sympathies were too much with the Russian invaders of his country. He was little more than a fluent poetaster, and is now almost forgotten. One of his most celebrated pieces was *Zofjowka*, written on the country seat of Felix Potocki, a Polish magnate, for this was the age of descriptive as well as didactic poetry. Perhaps the English gave the hint in such productions as "Cooper's Hill." The old age of Trembecki appears to have been ignoble and neglected; he had indeed "fallen upon evil days and evil tongues"; and when he died at an advanced age all the gay courtiers of whom he had been the parasite were either dead or had submitted to the Muscovite yoke. He comes before us as a belated epicurean, whose airy trifles cannot be warbled in an atmosphere surcharged with tempests and gunpowder. The end of the 18th century was not the period for a court poet in Poland.

Krasicki.

The most conspicuous poet, however, of the time was Ignatius Krasicki, bishop of Warmia (1735–1801). He was the friend of Frederick the Great and a prominent member of the king's literary club at Sans Souci. Krasicki wrote an epic on the war of Khotin—the same as had furnished the subject of the poem of Potocki, of which Krasicki in all probability had never heard, and also that of the Dalmatian Gundulich. Krasicki's poem is at best but a dull affair, in fact a pale copy of a poor original, the *Henriade* of Voltaire. His mock heroics are, to say the least, amusing, and among these may be mentioned *Myszeis*, where he describes how King Popiel, according to the legend, was eaten up by rats. His *Monachomachia* is in six cantos, and is a satire upon the monks. The bishop was also the writer of some pretty good comedies. In fact most styles of composition were attempted by him—of course satires and fables among the number. He presents himself to us much more like a transplanted French abbé than a Pole. In the year 1801 he travelled to Berlin, and died there after a short illness. Among his other works the bishop published in 1781–1782, in two volumes, a kind of encyclopaedia of *belles lettres* entitled *Zbiór Wiadomości*. His estimates of various great poets are not very accurate. Of course he finds Shakespeare a very "incorrect" author, although he is willing to allow him considerable praise for his vigour. F. Morawski (1783–1861) published some excellent *Fables* (1800) in the manner of Krasicki, and in 1851 an epic entitled *My Grandfather's Farm*. Adam Naruszewicz (1733–1796) was bishop and poet. The existence of so many ecclesiastical writers was a natural feature in Polish literature; they formed the only really cultured class in the community, which consisted besides of a haughty ignorant nobility living among their serfs, and (at a vast distance) those serfs themselves, in a brutalized condition. Burghers there were, properly speaking, none, for most of the citizens in the large towns were foreigners governed by the *Jus magdeburgicum*. Naruszewicz has not the happy vivacity of Krasicki; he attempts all kinds of poetry, especially satire and fable. He is at best but a mediocre poet; but he has succeeded better as a historian, and especially to be praised is his "History of the Polish Nation" (*Historya narodu polskiego*), which, however, he was not able to carry further than the year 1386. He also wrote an account of the Polish general Chodkiewicz, and translated Tacitus and Horace. Interesting memoirs have been published by Kilinski, a Warsaw shoemaker, and Kosmian, state referendary, who lived about this time and saw much of the War of Independence and other political affairs. Among the smaller poets of this period may be mentioned Karpiński (1741–1828), a writer of sentimental elegies in the style then so very much in fashion, and Franciszek Dyonizy Kniaźnin (1750–1807), who nourished his muse on classical themes and wrote several plays. He was the court poet of Prince Adam Czartoryski at Pulawy, and furnished odes in commemoration of all the important events which occurred in the household. He lost his reason on the downfall of Poland, and died after eleven years' insanity in 1807. Julian Ursin Niemcewicz (1758–1841) was one of the most popular of Polish poets at the commencement of the present century (see NIEMCEWICZ). His most popular work is the "Collection of Historical Songs" (*Spiewy historyczne*), where he treats of the chief heroes of Polish history. Besides these he wrote one or two good plays, and a novel in letters, on the story of two Jewish lovers. John Paul Woronicz (1757–1829) born in Volhynia, and at the close of his life bishop of Warsaw and primate of Poland, was a very eloquent divine, and has been called the modern Skarga. A valuable worker in the field of Slavonic philology was Linde, the author of an excellent Polish dictionary in six volumes. For a long time the cultivation of Polish philology was in a low state, owing to the prevalence of Latin in the 17th century and French in the 18th. No Polish grammar worthy of the name appeared till that of Kopczyński at the close of the 18th century, but the reproach has been taken away in modern times by the excellent works by Małecki and Malinowski. Rakowiecki, who edited the *Rousskaia Pravda*, and Macieiowski (who died in 1883, aged ninety), author of a valuable work on Slavonic law, may here be mentioned. Here we have a complete survey of the leading codes of Slavonic jurisprudence. At a later period (in 1856) appeared the work of Helcel, *Starodawne prawa polskiégo pomniki* ("Ancient Memorials of Polish Law"). Aloysius Feliński (1771–1820) produced an historical tragedy, *Barbara Radziwiłł*, and some good comedies were written by Count Alexander Fredro (1793–1876). **Polish Drama.** In fact Fredro may be considered the most entertaining writer for the stage which Poland has produced. He introduced genuine comedy among his countrymen. The influence of Molière can be very clearly seen in his pieces; his youth was spent chiefly in France, where he formed one of the soldiers of the Polish legion of Napoleon and joined in the expedition to Russia. His first production was *Pan Geldhab*, written in 1819 and produced at Warsaw in 1821. From 1819 to 1835 he wrote about seventeen pieces and then abandoned publishing, having taken offence at some severe criticisms. At his death he left several comedies, which were issued in a posthumous edition. There is a good deal of local colouring in the pieces of Fredro; although the style is French, the characters are taken from Polish life. From him may be said to date the formation of anything like a national Polish theatre, so that his name marks an epoch. The Poles, like many of the other nations of Europe, had religious plays at an early period. They were originally performed in churches; but Pope Innocent II. finding fault with this arrangement, the acting was transferred to churchyards. Mention has already been made of plays written by Rej and Kochanowski; they are mere fruits of the Renaissance, and cannot in any way be considered national. The wife of John Casimir, a Frenchwoman, Marie Louise, hired a troop of French actors and first familiarized the Poles with something which resembled the modern stage. The Princess Franciszka Radziwiłł composed plays which were acted at her private residence, but they are spoken of as inartistic and long and tedious. The national theatre was really founded in the reign of Stanislaus Augustus; and good plays were produced by Bohomolec, Kamiński, Kropiński, Boguslawski, Zabłocki, and others. Perhaps, however, with the exception of the works of Fredro, the Poles have not produced anything of much merit in this line. A great statesman and writer of the later days of Polish nationality was Kołłątaj, born at Sandomir in 1750. He was a man of liberal sentiments, and, had his plans been carried out, Poland might have been saved. He wished to abolish serfdom and throw open state employments to all. The nobility, however, were too infatuated to be willing to adopt these wise measures. Like the French aristocrats with the reforms of Necker, they would not listen till ruin had overtaken them. During the last war of Poland as an independent country Kołłątaj betook himself to the camp of Kościuszko, but when he saw that there was no longer hope he went to Galicia, but was captured by the Austrians and imprisoned at Olmütz till 1803. He died in 1812. An active co-operator with Kołłątaj was Salesius Jezierski, who founded clubs for the discussion of political questions, and Stanislaus Staszic, who did much for education and improved the condition of the university of Warsaw.

Romanticism. The reputation of all preceding poets in Poland was now destined to be thrown into the shade by the appearance of Mickiewicz (1798–1855), the great introducer of romanticism into the country (see MICKIEWICZ). Poland, as has been said before, is not rich in national songs and legendary poetry, in which respect it cannot compare with its sister Slavonic countries Russia and Servia. Collections have appeared, however, by Wacław Zaleski, who writes under the pseudonyms of Wacław z Oleska, Wojcicki, Roger, Żegota Pauli, and especially Oskar Kolberg. Poland and Lithuania, however, abounded with superstitions and legends which only awaited the coming poet to put them into verse. In the year 1851 Romuald Zieńkiewicz published *Songs of the People of Pinsk*, and collections have even appeared of those of the Kashoubes, a remnant of the Poles living near Danzig. Mickiewicz had had a predecessor, but of far less talent, Casimir Brodzinski (1791–1835). He served under Napoleon in the Polish legion, and has left a small collection of poems, the most important being the idyl *Wiesław*, in which the manners of the peasants of the district of Cracow are faithfully portrayed. The second great poet of the romantic school who appeared in Poland after Mickiewicz was Julius Słowacki (1809–1849), born at Krzemieniec. In 1831 he left his native country and chose Paris as his residence, where he died. His writings are full of the fire of youth, and show great beauty and elegance of expression. We can trace in them the influence of Byron and Victor Hugo. He is justly considered one of the greatest of the modern poets of Poland. His most celebrated pieces are *Hugo*; *Mnich* ("The Monk"); *Lambro*, a Greek corsair, quite in the style of Byron; *Anhelli*, a very Dantesque poem expressing under the form of an allegory the sufferings of Poland; *Krol duch* ("The Spirit King"), another mysterious and allegorical poem; *Wacław*, on the same subject as the *Marya* of Malczewski, to be afterwards noticed; *Beniowski*, a long poem in *ottava rima* on this strange adventurer, something in the style of Byron's humorous poems; *Kordyan*, of the same school as the English poet's *Manfred*; *Lilla Weneda*, a poem dealing with the early period of Slavonic history. The life of Słowacki has been published by Professor Anton Małecki in two volumes.

Mickiewicz and Słowacki were both more or less mystics, but even more we may assign this characteristic to Sigismund Krasiński, who was born in 1812 at Paris, and died there in 1859. It would be impossible to analyse here his extraordinary poem *Nieboska komedja* ("The Undivine Comedy"), *Irydion*, and others. In them Poland, veiled under different allegories, is always the central figure. They are powerful poems written with great vigour of language, but enveloped in clouds of mysticism. The life of Krasiński was embittered by the fact that he was the son of General Vincent Krasiński, who had become unpopular among the Poles by his adherence to the Russian government; the son wrote anonymously in consequence, and was therefore called "The Unknown Poet." Among his latest productions are his "Psalms of the Future" (*Psalmy przyszłosci*), which were attacked by the democratic party as a defence of aristocratic views which had already ruined Poland. His friend Słowacki answered them in some taunting verses, and this led to a quarrel between the poets. One of the most striking pieces of Krasiński has the title "Resurrecturis." The sorrows of his country and his own physical sufferings have communicated a melancholy tone to the writings of Krasiński, which read like a dirge, or as if the poet stood always by an open grave—and the grave is that of Poland. He must be considered as, next to Mickiewicz, the greatest poet of the country. Other poets of the romantic school of considerable merit were Gorecki, Witwicki, Odyniec, and Gaszynski; the last-named wrote many exquisite sonnets, which ought alone to embalm his name. Witwicki (1800–1847) was son of a professor at Krzemieniec. He was a writer of ballads and poems dealing with rural life, which enjoyed great popularity among his countrymen and had the good fortune to be set to music by Chopin. The works of Lelewel have separate mention (see LELEWEL); but here may be specified the labours of Narbutt, *Dzieje starozytne arodu litewskiego* ("Early History of the Lithuanian People"), published at Vilna in nine volumes, and the valuable *Monumenta Poloniae historica*, edited at Lemberg by Bielowski, of which several volumes have appeared, containing reprints of most of the early chroniclers. Bielowski died in 1876.

Ukraine School. A further development of romanticism was the so-called Ukraine school of poets, such as Malczewski, Goszczynski, and Zaleski. Anton Malczewski (1793–1826) wrote one poem, *Marya*, a Ukrainian tale which passed unnoticed at the time of its publication, but after its author's death became very popular. Malczewski was one of Napoleon's officers; he led a wandering life and was intimate with Byron at Venice; he is said to have suggested to the latter the story of Mazeppa. *Marya* is a narrative in verse in the manner of Byron. It is written with much feeling and elegance, and in a most harmonious metre. The chief poem is Severin Goszczynski (1803–1876) is *Zamek Kaniowski* ("The Tower of Kaniow"). The most interesting poem of Bogdan Zaleski is his "Spirit of the Steppe" (*Duch od stepu*). Other poets of the so-called Ukraine school, which has been so well inspired by the romantic legends of that part of Russia, are Thomas or Timko Padoura (who also wrote in the Malo-Russian, or Little-Russian, language), Alexander Groza, and Thomas Olizarowski. For many of the original songs and legends we must turn to the work of Messrs Antonovich and Dragomanov. Bogdan Joseph Zaleski was born in 1802 in the Ukraine village, Bohaterka. In 1820 he was sent to the university of Warsaw, where he had Goszczynski as a fellow student. Besides the longer poem previously mentioned, he is the author of many charming lyrics in the style of the Little Russian poems, such as Shevchenko has written in that language. He died at Villepreux, in France, in 1886, after more than fifty years of exile. Michael Grabowski (1805–1863) belongs also to this school by his fine *Melodies of the Ukraine* (1828). Maurice Goslawski also won fame by his *Poems of a Polish Outlaw* in the struggle of 1830–1831. A poet of great vigour was Stephen Garczynski (1806–1833), the friend of Mickiewicz, celebrated for his *War Sonnets* and his poem entitled *The Deeds of Wacław.*

Wincenty Poi (1807–1872) was born at Lublin, and though of foreign extraction by both parents proved an ardent patriot. He wrote a fine descriptive work, *Obrazy z zycia i podrózy* ("Pictures of Life and Travel"), and also a poem, *Piesn o ziemi naszej* ("Song of our Land"). For about three years from 1849 he was professor of geography in the university of Cracow. In 1855 he published *Mohort*, a poem relating to the times of Stanisłaus Poniatowski. Ludwik Władysław Kondratowicz (who wrote chiefly under the name of Syrokomla) was born in 1823 in the government of Minsk, and died on the 15th of September 1862 at Vilna. His parents were poor, and he received a meagre education, but made up for it by careful self-culture. One of his most remarkable poems is his *Jan Dęborog*, in which, like Mickiewicz, he has well described the scenery of his native Lithuania. He everywhere appears as the advocate of the suffering peasants, and has consecrated to them many beautiful lyrics. In Kaczkowski the Poles found a novelist who treated many periods of their history with great success. His sympathies, however, were mostly aristocratic, though modified by the desire of progress. An important writer of history is Karl Szajnocha (1818–1868), born in Galicia of Czech parents. He began his labours with *The Age of Casimir the Great* (1848), and *Bolesław the Brave* (1849), following these with *Jadwiga and Jagiello*, in three volumes (1855–1856)—a work which Spasovich, in his Russian *History of Slavonic Literature*, compares in vigour of style and fullness of colour with Macaulay's *History of England* and Thierry's *Norman Conquest.* Our author was still further to resemble the latter writer in a great misfortune; from overwork he lost his sight in 1857. Szajnocha, however, like Thierry and the American Prescott, did not abandon his studies. His excellent memory helped him in his affliction. In 1858 he published a work in which he traced the origin of Poland from the Varangians (*Lechicki początek polski*), thus making them identical in origin with the Russians. He began to write the history of John Sobieski, but did not live to finish it. dying in 1868, soon after completing a history of the Cossack wars, *Dwa lata dziejów naszych* ("Two Years of Our History"). A writer of romances of considerable power was Joseph Korzeniowski (1797–1863), tutor in early youth to the poet Krasiński, and afterwards director of a school at Kharkov. Besides some plays now forgotten, he was author of some popular novels, such as *Wedrówki oryginata* ("Tours of an Original"), 1848; *Garbaty* ("The Hunchback"), 1852, &c. But the most fertile of Polish authors was J. I. Kraszewski (*q.v.*). His works constitute a library in themselves; they are chiefly historical and political novels, some or which treat of early times in Poland, and some of its condition under the Saxon kings. As lyrical poets may also be mentioned Jachowicz; Jáskowski, author of a fine poem, *The Beginning of Winter*; Edmund Wasilewski (1814–1846), the author of many popular songs; and Holowinski, archbishop of Mogilev (1807–1855), author of religious poems. The style of poetry in vogue in the Polish parts of Europe at the present time is chiefly lyrical. Other writers deserving mention are Cornelius Ujejski (1823–1897), the poet of the last revolt of 1863; Theophilus Lenartowicz (born 1822), who wrote some very graceful poetry; Sigismund Milkowski (T. T. Težˇ, born in 1820), author of romances drawn from Polish history, for the novel of the school of Sir Walter Scott still flourishes vigorously among the Poles. Among the very numerous writers of romances may be mentioned Henry Rzewuski (1791–1866); Joseph Dzierzkowski wrote novels on aristocratic life, and Michael Czajkowski (1808–1876) romances of the Ukraine; Valerius Wielogłowski (1865) gave pictures of country life.

In 1882 the Poles lost, in the prime of life, a very promising historian Szujski (born in 1835), and also Schmitt, who died in his sixty-sixth year. Szujski commenced his literary career in 1859 with poems and dramas; in 1860 appeared his first historical production, *Rzut oka na Historye Polski* ("A Glance at Polish History"), which attracted universal attention; and in 1862 he commenced the publication in parts of his work *Dzieje Polski* ("The History of Poland"), the printing of which ceased in 1866. The value of this book is great both on account of the research it displays and its philosophical and unprejudiced style. One of the last works of Szujski, written in German, *Die Polen und Ruthenen in Galizien*, attracted a great deal of attention at the time of its appearance. Schmitt got mixed up with some of the political questions of the day—he was a native of Galicia and therefore a subject of the Austrian emperor—and was sentenced to death in 1846, but the penalty was commuted into imprisonment in Spielberg, whence he was released by the revolution of 1848. In 1863 he took part in the Polish rebellion, and was compelled to fly to Paris, where he only returned in 1871. His chief works are *History of the Polish People from the Earliest Times to the year 1763* (1854), *History of Poland in the 18th and 19th Centuries* (1866), and *History of Poland from the time of the Partition* (1868), which he carried down to the year 1832. In opposition to the opinion of many historians, his contemporaries, that Poland fell through the nobility and the diets, Schmitt held (as did Lelewel) that the country was brought to ruin by the kings, who always preferred dynastic interests to those of the country, and by the pernicious influence of the Jesuits. Adalbert Kętrzyński, who succeeded Bielowski in 1877 in his post of director of the Ossolinski Institute at Lemberg, is the author of some valuable monographs on the history of Poland. He was born in 1838. Casimir Stadnicki has treated of the period of the Jagiełłons; and Szaraniewicz, professor at the university of Lemberg, has written on the early history of Galicia. Thaddeus Wojciechowski has published a clever work on Slavonic antiquities. Xavier Liske, born in 1838, professor of universal history at Lemberg, has published many historical essays of considerable value, and separate works by him have appeared in the German, Polish, Swedish, Danish and Spanish languages. The "Sketch of the History of Poland" (*Dzieje Polskie w zarysie*) by Michael Bobrzyński, born in 1849 in Cracow (professor of Polish and German law), is a very spirited work, and has given rise to a great deal of controversy on account of the opposition of many of its views to those of the school of Lelewel. Vincent Zakrzewski, professor of history at Cracow, has written some works which have attracted considerable attention, such as *On the Origin and Growth of the Reformation in Poland*, and *After the Flight of King Henry*, in which he describes the condition of the country during the period between that king's departure from Poland and the election of Stephen Batory. Smołka has published a history entitled *Mieszko the Elder and his Age.* Władysław Wisłocki has prepared a catalogue of manuscripts in the Jagiełłon library at Cracow. Dr Joseph Casimir Plebański, besides editing the *Biblioteka warszawska*, a very valuable literary journal which stands at the head of all works of the kind in Poland, has also written a dissertation (in Latin) on the *liberum veto*, which puts that institution in a new light. Felix Jezierski, the previous editor of the above-mentioned journal, published in it translations of parts of Homer, and is also the author of an excellent version of *Faust.*

The history of Polish literature has not been neglected. We first have the early history of Felix Bentkowski (1781–1852), followed by that of Michael Wiszniewski (1794–1865), which, however, only extends to the 17th century, and is at best but a quarry of materials for subsequent writers, the style being very heavy. A "History of Eloquence" (*Historya wymowy w Polsce*) was published by Karl Mecherzyski. An elaborate history of Polish literature has been written by Anton Małecki, who is the author of the best Polish grammar (*Gramatyka historyczno-porównawcza jezyka polskiego*, 2 vols., Lemberg, 1879). The Polish bibliography of Karl Estreicher, director of the Jagiełłon library at Cracow, is a work of the highest importance. One of the most active writers on Polish philology and literature is Wladysław Nehring, whose numerous contributions to the *Archiv für slavische Philologie* of Professor Jagic entitle him to the gratitude of all who have devoted themselves to Slavonic studies. Władimir Spasowicz, a lawyer of St Petersburg, assisted Pîpin in his valuable work on Slavonic literature. The lectures of Professor Cybulski (d. 1867) on Polish literature in the first half of the 19th century are written with much spirit and appreciation. The larger poetical works which appear during that time are carefully analysed.

In recent times many interesting geological and anthropological investigations have been carried on in Poland. In 1868 Count Constantine Tyszkiewicz published a valuable monograph on the *Tombs of Lithuania and Western Ruthenia.* And Professor Joseph Łepkowski, of Cracow, has greatly enriched the archaeological museum of his native city.

In philosophy the Poles (as the Slavs generally) have produced but few remarkable names. Goluchowski, the brothers Andrew and John Sniadecki, the latter of whom gained a reputation almost European, Bronisław Trentowski, Karol Liebelt and Joseph Kremer deserve mention. August Cieszkowski has written on philosophical and economic subjects. Moritz Straszewski, professor of philosophy at the university of Cracow, has also published some remarkable works.

Mention has already been made of the poetess Elizabeth Druzbacka. Female writers are not very common among Slavonic nations. Perhaps the most celebrated Polish authoress was Klementina Hoffmann, whose maiden name was Tanska, born at Warsaw in 1798. She married Karl Boromäus Hoffmann, and accompanied her husband, in 1831, to Passy near Paris, where she died in 1845. Her novels still enjoy great popularity in Poland. Of the poetesses of later times Gabriele Narzyssa Zmichowska (1825–1878), Maria Ilnicka, translator of Scott's *Lord of the Isles*, and Jadwiga Luszczewska may be mentioned.

A poet of considerable merit is Adam Asnyk (1838–1897). In his poetry we seem to trace the steps between romanticism and the modern realistic school, such as we see in the Russian poet Nekrasov. In some of the flights of his muse he reminds us of Słowacki, in the melody of his verse of Zaleski. Besides showing talent as a poet, he has also written some good plays, as "The Jew" (*Zid*), *Cola di Rienzi*, and *Kiejstut*. Other poets worthy of mention are Zagorski, Czerwienski, and Maria Konopnicka, who has published two volumes of poems that have been very favourably noticed. Mention must also be made of Bałucki (1837–1901), author of novels and comedies, and Narzymski (1839–1872), who was educated in France, but spent part of his short life in Cracow, author of some very popular tales.

The four centres of Polish literature, which, in spite of the attempts which have been made to denationalize the country, is fairly active, are Cracow, Posen, Lemberg and Warsaw. A cheap edition of the leading Polish classics, well adapted for dissemination among the people, has been published, under the title of *Biblioteka Polska*, at Cracow. Not only are the professors of Cracow University some of the most eminent living Poles, but it has been chosen as a place of residence by many Polish literary men. The academy of sciences, founded in 1872, celebrated the bicentenary of the raising of the siege of Vienna by Sobieski by publishing the valuable *Acta Joannis III. regis Poloniae*. Some good Polish works have been issued at Posen. At Lemberg, the capital of Austrian Galicia, there is an active Polish press. Here appeared the *Monumenta Poloniae historica* of Bielowski, previously mentioned; but Polish in this province has to struggle with the Red-Russian or Ruthenian, a language or dialect which for all practical purposes is the same as the Southern or Little Russian. At Warsaw, since the last insurrection, the university has become entirly Russianized, and its *Transactions* are published in Russian; but Polish works of merit still issue from the press—among others the leading Polish literary journal, *Biblioteka warszawska*.

Perhaps the most popular modern writer in Poland is Eliza Orszeszko, of whose novels a complete "Jubilee" edition has appeared. Many of her tales—as, for instance, *Argonauci* ("The Argonauts")—have appeared in the *Tygodnik*, or weekly illustrated journal of Warsaw. *Meir Ezofowicz* has enjoyed great popularity. The object of this tale is to bridge over the gulf between the Jew and Christian in Poland. Adolf Dygasinski writes clever village tales of the "kail-yard" school, as it has been sometimes termed in England. Waclaw Sieroszewski has written *Twelve Years in the Land of the Jakuts*, a contribution to the literature of folk-lore and ethnology such as only a real artist could produce. Among the latest poets we may mention Wyspianski, Kisiliewski, Reymont, Mme Zapolska; the latter is the author of some powerful realistic novels and plays, and she has been called the Polish Zola. It is this kind of poetry and traces of the decadent school which we find in the later Polish poets. A pessimistic spirit is apparent, as in the writings of Wenceslaus Berent. Since the death of Asnyk and Ujejski the most prominent poet is Marya Konopnicka (1846). Some good critical work has been done in the leading reviews by Swietochowski and others. Historical work has been produced by Hirschberg, Pappée, Sobieski, Czermak and others, and the histories of Polish literature by Stanislaus Tarnowski and Piotr Chmielowski are of the highest value, the former dealing more with the aesthetic side of literature and the latter with the historical. The Poles are busy in reviving their great past. Hence the enthusiasm for historical studies, and the *Biblioteka pisarzow polskich*, which shows us what abundance of literature was produced in Poland in the 16th and beginning of the 17th century. In Henryk Sienkiewicz (*q.v.*), the historical novelist, Poland has a modern writer of European reputation.

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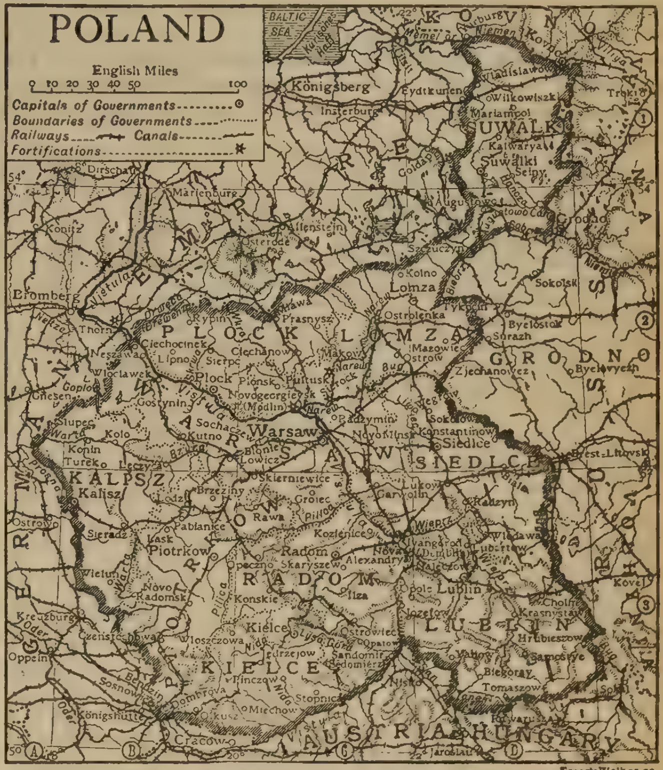
POLAND, RUSSIAN, a territory consisting of ten governments which formerly constituted the kingdom of Poland (see above), but now are officially described as the "governments on the Vistula," or occasionally as the "territory on the Vistula." It is bounded N. by the Prussian provinces of West and East Prussia, W. by those of Posen and Prussian Silesia, S. by the Austrian crownland of Galicia, and E. by the Russian governments of Volhynia, Vilna, Grodno, and Kovno.

Physical Features.—The territory consists for the most part of an undulating plain, 300 to 450 ft. above the sea, which connects the lowlands of Brandenburg on the west with the great plain of central Russia on the east. A low swelling separates it from the Baltic Sea; while in the south it rises gradually to a series of plateaus, which merge imperceptibly into the northern spurs of the Carpathians. These plateaus, with an average elevation of 800 to 1000 ft., are mostly covered with forests of oak, beech and lime, and are deeply cut by river valleys, some being narrow and craggy, and others broad, with gentle slopes and marshy bottoms. Narrow ravines intersect them in all directions, and they often assume, especially in the east, the character of wild, impassable, woody and marshy tracts. In the south-eastern corner of Poland they are called podlasie, and are in a measure akin to the polyesie of the Pripet. The Vistula, which skirts them on the south-west, cuts its way through them to the great plain of Poland, and thence to the Baltic. Its valley divides the hilly tracts into two parts—the Lublin heights on the east, and the Sędomierz (Sandomir) or central heights on the west. These last are diversified by several ranges which run east-south-east, parallel to the Beskides of the Carpathian system, the highest of them being the Lysa Góra, which reach 1910 ft. and 2010 ft. above the sea. Another short ridge, the Chęcinski hills in Kielce, follows the same direction along the Nida river and reaches 1345 ft. south of the Nida; the Olkusz hills, linked on to spurs of the Beskides, fill up the south-west corner of Poland, reaching 1620 ft., and containing the chief mineral wealth of the country; while a fourth range, 1000 to 1300 ft. high, runs north-west past Częnstochowa, separating the Oder from the Warta (Warthe). In the north, the plain of Poland is bordered by a flat, broad swelling, 600 to 700 ft. above the sea, dotted with lakes, and recalling the lacustrine regions of north-western Russia. Wide tracts of sand, marshes, peat-bogs, ponds, and small lakes, among which the streams lazily meander from one marsh to another, the whole covered with thin pine-forests and scanty vegetation, with occasional patches of fertile


POLAND
English Miles
0 10 20 30 40 50 100
Capitals of Governments
Boundaries of Governments
Railways
Canals
Fortifications
BALTIC SEA
Kurisches Haff
K O V N O
Memel or Niemen
Tilsit
Kovno
Viliya
Königsberg
Eydtkunen
Wladislawow
Wilkowiszk
Troki
Insterburg
Mariampol
SUWALKI
Kalwarya
Suwalki
Seiny
Goldap
Hancza
Augustowo
Augustowo Canal
Grodno
Dirschau
Marienburg
Konitz
Allenstein
Osterode
Szczuczyn
Kolno
Lomza
Biebrza
Sokolsk
Bromberg
Vistula
Netze
Thorn
Drweca
Mlawa
Prasnysz
Rypin
Ostrolenka
Tykocin
Byelostok
Sorazh
P L O C K
L O M Z A
G R O D N O
Ciechocinek
Ciechanow
Makov
Mazowiec
Ostrow
Zjechanowez
Byelovyezh
Neszawa
Lipno
Sierpc
Narew
Bug
Wloclawek
Plock
Plonsk
Pultusk
Goplo
Gnesen
Gostynin
Novogeorgievsk (Modlin)
Radzymin
Sokolow
Slupec
Warta
Kolo
Sochaczew
Kutno
Warsaw
Novo Minsk
Konstantinow
Siedlce
Konin
Turek
Leczyca
Bzura
Blonie
Lowicz
W A R S A W
S I E D L C E
Brest-Litovsk
K A L I S Z
Kalisz
Prosna
Skierniewice
Lukow
Garwolin
Biala
Radzyn
Lodz
Brzeziny
Grojec
Rawa
Pilica
Wieprz
Wlodawa
Lubartow
Ostrowo
Sieradz
Lask
Pablanice
Piotrkow
Kozienice
Radom
Ivangorod (Demblin)
Nova Alexandrya
Naleczow
Opoczno
Skaryszewo
Wielun
P I O T R K O W
R A D O M
Opole
Lublin
Kovel
Novo Radomsk
Konskie
Ilza
Cholm
Krasnystaw
Kreuzburg
Oder
Czenstochowa
Kielce
Ostrowiec
Jozefow
L U B L I N
Hrubieszow
Wloszczowa
Lysa Gora
Opatow
Samoscye
Oppeln
Jedrzejow
Sandomir (Sedomierz)
K I E L C E
Pinczow
Nida
Bilgoraj
Tomaszow
Sosnowice
Bendzin
Dombrova
Stopnica
Nisko
San
Sokal
Königshütte
Olkusz
Miechow
Rawaruska
Cracow
A U S T R I A - H U N G A R Y
Jaroslau
V O L H Y N I A
G E R M A N Y
P R U S S I A
54°
50°
18°
20°
22°
A
B
C
D
1
2
3
Emery Walker sc.

soil—such are the general characters of the northern border-region of the great plain of central Poland. The rivers flow across the plain in broad, level valleys, only a few hundred or even only a few dozen feet lower than the watersheds; they separate into many branches, enclosing islands, forming creeks, and drowning wide tracts of land during inundations. Their basins, especially in the west, interpenetrate one another in the most intricate way, the whole bearing unmistakable evidences of having been in recent geological, and partly in historical times the bottom of extensive lakes, whose alluvial deposits now yield heavy crops. The fertility of the soil and the facility of communication by land and by water have made this plain the cradle of the Polish nationality. The very name of Poland is derived from it—Wielkopolska and Wielkopolane being the Slav terms for the great plain and its inhabitants.

Rivers and Canals.—Russian Poland belongs mostly, though not entirely, to the basin of the Vistula—its western parts extending into the upper basin of the Warta, a tributary of the Oder, and its north-east spur (Suwalki) penetrating into the basin of the Memel, of which it occupies the left bank. For many centuries, however, the Poles have been driven back from the mouths of their rivers by the German race, maintaining only the middle parts of their basins. About Jozefow (51° N.) the Vistula enters the great central plain and flows north and west-north-west between low banks, with a breadth of 1000 yds. Its inundations, dangerous even at Cracow, become still more so in the plain, when the accumulations of ice in its lower course obstruct the outflow, or the heavy rains in the Carpathians raise its level. Embankments 20 to 24 ft. high are maintained for 60 m., but they do not always prevent the river from inundating the plains of Opole in Lublin and Kozienice in Radom, the waters sometimes extending for 150 m. to the east. Thousands of rafts and boats of all descriptions descend the stream every year with cargoes of corn, wool, timber and wooden wares, giving occupation to a large number of men. Steamers ply as far as Sandomir. The Wieprz (180 m.), a right-hand tributary of the Vistula, is the chief artery of the Lublin government; it is navigable for small boats and rafts for 105 m. from Krasnystaw. The Bug, another right-hand tributary of the Vistula, describes a wide curve concentric with those of the middle Vistula and the Narew, and separates the Polish governments of Lublin and Siedlce from the Russian governments of Volhynia and Grodno. Only light boats (*galary*) are floated down this broad, shallow stream, whose flat and open valley is often inundated. Its tributary, the Narew (250 m.), brings the forest-lands of Byelovyezh in Grodno into communication with Poland, timber being floated down from Surazh and light boats from Tykocin in Lomza. The Pilica, which joins the Vistula from the left 30 m. above Warsaw, rises in the south-western corner of Poland, and flows for 200 m. north and east in a broad, flat, sandy and marshy valley, of evil repute for its unhealthiness.

The Warta (450 m.) rises in the Częstochowa hills, 900 ft. above the sea, and flows north and west past Sieradz and Kolo. Below Częstochowa it traverses a flat lowland, whose surface rises only 2 to 5 ft. above the level of the river, and the inhabitants have a constant struggle to keep it to its bed; every spring an immense lake is formed by the river at the mouth of the Ner, a little above Kolo.

The Memel flows along the north-east frontier of Poland, from Grodno to Yurburg, separating it from Lithuania. The yellowish sandy plains on its left will grow nothing except oats, buckwheat and some rye. The river often changes its bed, and, notwithstanding repeated attempts to regulate it, offers great difficulties to navigation. Still, large amounts of corn, wool and timber are floated down, especially after its confluence with the Black Hancza.

Though navigable for a few months only, the rivers of Poland have always been of considerable importance for the traffic of the country, and their importance is further increased by several canals connecting them with the Russian and German rivers. The Memel is connected with the Dnieper by the Oginsky canal, situated in the Russian government of Minsk. The Dnieper and Bug canal in Grodno connects the Mukhavets, a tributary of the Bug, with the Pina in the basin of the Pripet, that is, the Dnieper with the Vistula. The Vistula is connected also with the Oder by the Bromberg canal in Prussia, which links the Brahe, in the basin of the Vistula, with the Netze, a tributary of the Warta. All these canals are, however, beyond Russian Poland. In Poland proper, the Augustowo canal connects the Vistula with the Memel, by means of the rivers Black Hancza, Netta, Biebrz and Narew. Another canal, to the west of Łęczyca, connects the Bzura, a tributary of the Vistula, with the Ner and the Warta; and the bed of the former has been altered so as to obtain regular irrigation of the meadows along its banks.

Lakes.—Lakes are numerous in the government of Suwalki, but are all small and mostly hidden in thick coniferous or birch forests, and their waters penetrate with undefined banks amidst marshes, sandy tracts and accumulations of moss-grown boulders. Another group of small lakes is situated in the basin of the Warta (north part of Kalisz), the largest being Goplo, 18 m. long and 100 ft. deep.

Climate.—With the exception of the Lysa Góra hilly tracts (Kielce and south Radom), which lie within the isotherms of 41° and 42°, Poland is situated between the isotherms of 42° and 46°. The isotheres and isocheims (*i.e.* lines of equal mean summer and winter temperature respectively) crossing one another at right angles, and the former running east-north-east, Poland is included between the isotheres of 64° and 61° and the isocheims of 35·7° and 39·2°. The prevailing winds are westerly, with north-north-east and south winds in autumn and winter, and east winds in spring. There is an average of 21·7 to 23·6 in. of rainfall in central Poland, and the quantity increases slowly towards the south on account of the proximity of the Carpathians, where it is 30·3 in. Owing to this distribution the snow-sheet in Poland is not very thick, and spring sets in early. Still, frosts of −4° to −22° Fahr. are not uncommon, and the rivers are generally icebound for two and a half to three months—the Warta being under ice for 70 to 80 days, the Vistula at Warsaw for 80 days and (exceptionally) even for 116, and the Memel for 100 (exceptionally for 140).

The following averages will serve to illustrate the climate of Poland:—

	Warsaw.	Vilna (in Russia).
Earliest frost	Oct. 18	Oct. 17
Latest frost	March 15	March 25
Absolute maximum temperature	95·5°	89·3°
Absolute minimum temperature	−37·6°	39·0°
Annual rainfall (total)	22·8 in.	7·6 in.

Flora.—The flora of Poland is more akin to that of Germany than to that of Russia, several middle European species finding their north-east limits in the basin of the Memel or in the marshes of Lithuania. Coniferous forests, consisting mostly of pine (*Pinus sylvestris*) and birch, cover large tracts in Mazovia in the north, extend across the Baltic lake-ridge southwards as far as the confluence of the Bug with the Narew, and join in the south-east the Polysie of the Pripet. The pine covers the Lysa Góra hills and the hills in the extreme south-west. The larch, which three centuries ago covered large tracts, has almost entirely disappeared. *Pinus cembra* is only remembered, as also *Taxus baccata*. *Picea obovata* is cultivated.

Of deciduous trees, the common beech is the most typical; it extends from the Carpathians to 52° N. and reaches three degrees farther north in small groups or isolated specimens; the confluence of the Bug and the Narew may be regarded as its eastern limit. The white beech (*Carpinus betulus*), the aspen, and two elms (*Ulmus campestris*, *U. effusa*) are found nearly everywhere. The lime appears in groves only in the east (Memel, Pripet, Lublin). It is the most popular tree with the Poles, as the birch with the Russians; judgment of old was pronounced under its shade, and all the folk-songs repeat its name. The oak—a highly venerated tree in Poland, though not so much as in Lithuania—grows in forests only on the most fertile land, but it is of common occurrence in conjunction with the beech, elm, &c. The maples (*Acer platanoides* and *A. pseudo-platanus*) are somewhat rare; the black alder (*Alnus glutinosa*) lines the banks of the rivers and canals, and the *Alnus incana* is common. The willow and orchard trees—apple, pear, plum and cherry—are cultivated everywhere.

Fauna.—The fauna of Poland belongs to the middle European zoological group; within the historical period it has lost such species as formerly gave it a subarctic character. The reindeer now occurs only as a fossil; the sable, mentioned in the annals, has migrated eastwards; the wild horse, described by the annals as intermediate between the horse and the ass—probably similar to the *Equus przewalskii* of central Asia—is reputed to have been met with in the 13th century in the basin of the Warta, and two centuries later in the forests of Lithuania. The wild goat, bison and elk have migrated to the Lithuanian forests. The lynx and beaver have disappeared. The brown bear continues to haunt the forests of the south, but is becoming rarer; the wolf, the wild boar, and the fox are most common throughout the great plain, as also the hare and several species of *Arvicola*. The mammals in Poland, however, do not exceed fifty species. The avi-fauna, which does not differ from that of central Europe, is represented by some one hundred and twenty species, among which the singing birds (*Dentirostrae* and *Conirostrae*) are the most numerous. On the whole, Poland lies to the westward of the most frequented route of the migratory birds, and is less visited by them than the steppes of south-west Russia. Numerous aquatic birds breed on the waters of the Baltic lake-region.

Population.—The population of Poland, 6,193,710 in 1871, reached 7,319,980 in 1881, and 10,500,000 in 1897. The estimated population in 1906 was 10,747,300. Details for 1897 are shown in the subjoined table.

Governments.	Area, sq. m.	Domiciled Population, 1897.	Urban Population.	Density per sq. m.
Kalisz	4,390	844,358	113,609	193
Kielce	3,896	765,212	57,814	196
Lomza	4,666	585,033	69,834	125
Lublin	6,500	1,165,122	148,196	179
Piotrków	4,728	1,406,427	509,699	297
Płock	4,199	557,229	89,821	133
Radom	4,768	818,044	94,318	171
Siedlce	5,533	775,326	110,995	140
Suwałki	4,845	610,154	73,308	126
Warsaw	5,605	1,929,200	791,746	344
Total	49,130	9,456,105	2,059,340	193

The non-domiciled population numbered about 1,000,000, and by 1904 the total was estimated to have increased to 12,000,000, the rate of increase between 1889 and 1904 having been 46·6. Poland, with 193 (domiciled) inhabitants or 213 inhabitants in all to the square mile in 1897, and 240 to the square mile in 1904, has a denser population than any other region in the Russian empire, the next to it being the governments of Moscow, with 189 inhabitants to the square mile, Podolia with 186, and Kiev with 181. The drift townwards of the rural population began in 1890, when the urban population amounted to only 18% of the whole, whereas in 1904 it reached 24%, as compared with 13% for the urban population of Russia as a whole. Of the towns of Poland 32 have a population each exceeding 10,000, the largest being Warsaw the capital, with 638,208 inhabitants in 1897 and 756,426 in 1901; Lodz, with 315,209 in 1897 and 351,570 in 1900; Czenstochowa, with 45,130 in 1897 and 53,650 in 1900; and Lublin, with 50,152 in 1897. According to nationalities, the population was made up as follows in 1897: 6,755,503 Poles, equal to 64·6% of the total; 1,267,194 Jews, equal to 12·1%; 631,844 Russians (6%); 391,440 Germans (4%); 310,386 Lithuanians and Letts (3%); with a few thousands each of Tatars, Bohemians, Rumanians, and Esthonians, and a few Gypsies and Hungarians.

During prehistoric times the basin of the Vistula seems to have been inhabited by a dolichocephalic race, different from the brachycephalic Poles of the present day; but from the dawn of history Slavs (Poles), intermingled to some extent with Lithuanians, have to be found on the plains of the Vistula and the Warta. The purest Polish type exists in the basin of the middle Vistula and in Posen. The Poles extend but little beyond the limits of Russian Poland. In East Prussia they occupy the southern slope of the Baltic swelling (the Mazurs), and extend down the left bank of the lower Vistula to its mouth (the Kaszubes or Kassubians). Westward they stretch down the Warta as far as Birnbaum (100 m. east of Berlin); and in the south they extend along the right bank of the Vistula to the river San in western Galicia. In Russia they constitute, with Jews, Lithuanians, Ruthenians and White Russians, the town population, as also the landed nobility and the country gentry, in several governments west of the Dvina and the Dnieper.

According to the localities which they inhabit, the Poles take different names. They are called Wielkopolanie on the plains of middle Poland, while the name of Malopolanie is reserved for those on the Warta. The name of Lęczycanie is given to the inhabitants of the marshes of the Ner, that of Kurpie to those of the Podlasie; Kujawiący, Szlący in the Silesia, and Górale in the Carpathians. The Kaszubes, and especially the Mazurs, may be considered as separate stocks of the Polish family. The Mazurs are distinguished from the Poles by their lower stature, broad shoulders and massive frame, and still more by their national dress, which has nothing of the smartness of that of the southern Poles, and by their ancient customs; they have also a dialect of their own, containing many words now obsolete in Poland, and several grammatical forms bearing witness to Lithuanian influence. They submit without difficulty to German culture, and in Prussia are Lutherans. The language of the Kaszubes can also be considered as a separate dialect. The Poles proper are on the whole of medium stature (5 ft. 4·6 in.), finely built, dark in the south and fair in the north, richly endowed by nature, inclined to deeds of heroism, but perhaps deficient in that energy which characterizes the northern races of Europe, and in that sense of unity which has been the strength of their present rulers.

The German element is annually increasing both in number and in influence. The Lodz manufacturing district, the Polish Birmingham, is becoming more German than Polish; and throughout the governments west of the Vistula German immigration is going on at a steadily increasing rate, especially in the governments of Plock, Kalisz, Piotrków and Warsaw.

The Jews, who are found everywhere throughout Poland, are nowhere agricultural; in the larger towns many of them are artisans, but in the villages they are almost exclusively engaged as shopkeepers, second-hand traders, dealers on commission, innkeepers and usurers. In the country, both commerce and agriculture are in the hands of their intimately connected trading associations. Their relations with Poles and Ruthenians are anything but cordial, and "Jew-baiting" is of frequent occurrence. They are increasing much more rapidly than the Slavs.

Agriculture.—From remote antiquity Poland has been celebrated for the production and export of grain. Both, however, greatly declined in the 18th century; and towards the beginning of the 19th, the peasants, ruined by their proprietors, or abandoned to the Jews, were in a more wretched condition than even their Russian neighbours. Serfdom was abolished in 1807; but the liberated peasants received no allotments of land, and the old patrimonial jurisdictions were retained. Compelled to accept the conditions imposed by the landlords, the peasants had to pay rack-rents and to give compulsory labour in various forms for the use of their land. Only a limited number were considered as permanent farmers, while nearly one-half of them became mere *proletaires.* Pursuing a policy intended to reconcile the peasantry to Russian rule and to break the power of the Polish nobility, the Russian government promulgated, during the outbreak in 1864, a law by which those peasants who were holders of land on estates belonging to private persons, institutions (such as monasteries and the like), or the Crown were recognized as proprietors of the soil—the state paying compensation to the landlords in bonds, and the peasants having to pay a yearly annuity to the state until the debt thus contracted had been cleared off. The valuation of these allotments was made at a rate much more advantageous than in Russia, and the average size of holding amounted to 15 acres per family. Of those who held no land a number received grants out of the confiscated estates of the nobility and monasteries. At the same time the self-government of the peasants was organized on democratic principles. The so-called "servitudes," however—that is, the right to pasture on and take wood from the landlord's estates—were maintained for political reasons. These reforms resulted in a temporary increase of prosperity, or at any rate an alleviation of the previous misery of the peasants. But whereas between 1864 and 1873 the peasantry as a whole purchased, in addition to the land granted to them by the government, 297,000 acres, in the period 1873–1893, they bought 540,000 acres and between 1893 and 1905 as much as 1,620,000 acres. Thus the process of breaking up the larger estates is proceeding rapidly and at an accelerated rate. In ten years (1864–1873) the area of cultivated soil increased by 1,350,000 acres, while during the fourteen years 1845–1859 its increase had been only 540,000 acres. But the maintenance of the "servitudes," the want of pasture-land, the lack of money for improvements, and the very rapid increase in the price of land, all helped to counteract the benefits of the agrarian measures of 1864.

In 1904 the village communities (peasantry) owned 43·8% of the total area; private owners, mostly nobles, 40·6%; the Crown and imperial family, 6%; and public bodies, such as towns and monasteries, 2·6%; while 3% was in the hands of the Jews. The holdings of the peasant families vary generally from 8 to 13 acres, the minimum in Russia being 16 to 22 acres. By a law of 1891 further subdivision below 8·3 acres is prohibited. But out of a total of some 7,000,000 peasants no fewer than 3,000,000 possess no land. In consequence of this every summer no fewer than 800,000 emigrate temporarily to Germany in quest of work.

Forests cover over 21·3% of the surface, of which nearly one-third belong to the Crown, and only 515,000 acres (7·7%) to the peasantry.

Agriculture in Poland is on the whole carried on according to more advanced methods than in Russia. The extensive cultivation of beetroot, of potatoes for distilleries, and of fodder crops has led to the introduction of a rotation of several years instead of the former "three-fields" system; and agricultural machinery is in more general use, especially on the larger estates of the west. Winter wheat is extensively cultivated, especially in the south, the Sandomir (Sedomierz) wheat having a wide repute. Of the land in the possession of the peasants no less than 70% is under crops, and of the land in the larger estates 52%; of the former category 11%, and of the latter 8%, is meadow. Altogether nearly 16 million acres of Russian Poland, or almost one-half of the total area, are under crops, principally rye, oats, wheat, barley, potatoes and hay, with some flax, hemp, peas, buckwheat and hops. After local wants are supplied, there remains every year a surplus of about 3½ million quarters of cereals for export. Beetroot is largely grown for the manufacture of sugar. Potatoes are extensively grown for use in the distilleries. The cultivation of tobacco is successfully carried on, especially in the governments of Warsaw, Płock and Lublin. The breeding of livestock (cattle, sheep and horses), is an important source of income. Fine breeds of horses and cattle are kept on the larger estates of the nobility, and cattle are exported to Austria. Bee-keeping is widely followed, especially in the south-east. Fishing is carried on remuneratively, more particularly on the Vistula and its tributaries.

Manufactures and Mines.—Since 1864, and more especially since 1875, there has been a remarkable development of manufacturing enterprise in Poland, the branch of industry which has shown the greatest progress being the textile. Whereas in 1864 the annual production of all factories in Poland was valued at not more than 5½ millions sterling, in 1875, when the workers numbered 27,000, the output was estimated at even less; but in 1905 the value of the industrial production reached 53 millions sterling. The principal industrial centres are Lodz (textiles), Warsaw (sugar, leather and miscellaneous) and Bendzin—Sosnowice—Dombrowa, in Piotrków (mining). The sugar factories and refineries, situated chiefly in the governments of Warsaw, Lublin and Płock, turn out approximately one million tons of sugar in the year, the Polish sugar industry being exceeded in Russia only by that of Kiev. Cotton is the principal product of the mills at Lodz and Lask, both in Piotrków; though woollen cloth, silk and linen are also produced. Tanning is centred in Warsaw and Radom; Polish (*i.e.* Warsaw) boots and shoes have a great reputation throughout the Russian empire. Other notable branches of manufacturing industry, besides those already named, are flour-mills, jute, hosiery, lace, paper, cement, hats, haberdashery, machinery, tobacco, soap and candle factories, iron and steel works, distilleries, breweries, potteries, vinegar, chocolate, varnish, furniture, clothing and brickworks. The cottage industries, such as pottery and basket-making, formerly of considerable importance, are gradually being replaced by the factory system of working.

Southern Poland possesses abundant minerals, especially in the Kielce mountains and the region adjacent to Prussian Silesia. The Devonian sandstones contain malachite ores near Kielce, and copper has been worked there since the 15th century, though the mines are now neglected. The brown iron ores of Kielce contain no less than 40% of iron. The zinc ores of the Olkusz district, more than 50 ft. thick, contain 8 to 14%, sometimes 25%, of zinc. The tin ores of Olkusz are still more important, and were extensively wrought as early as the 16th century. Brown iron ores, appearing in the neighbourhood of Bendzin as lenticular masses 55 ft. thick, and containing 25 to 33% of iron, accompany the zinc ores. Spherosiderites and brown iron ores are plentiful also in the "Keuper formation." Sulphur is wrought in the district of Pińczow; the deposits, which contain 25% of sulphur, reach a thickness of 7 to 70 ft. Coal occurs in south-west Poland over an area of 200 sq. m. in the districts of Bendzin and Olkusz. Brown coal, or lignite, which appears in the Olkusz district in beds 3 to 7 ft. thick, has been worked out. The output of coal is 4,000,000 to 6,000,000 tons in the year, the number of hands employed being 18,000 to 20,000. The yield of lignite is less than 100,000 tons annually; of zinc 10,000 to 12,000 tons; of copper and lead small. The production of iron and steel increased from 13,000 tons in 1862 to about 500,000 tons in 1905. Of other mineral produce, chalk, exported from Lublin, a few quarries of marble and many of building stones, are worthy of notice. Mineral waters are used medicinally at Ciechocinek in Plock and Nałęczow in Lublin.

Communications.—The railways of Poland have an aggregate length of 1300 m. A line of great importance, connecting Vienna with St Petersburg, crosses the country from south-west to north-east, passing through the mining district and through Warsaw, and sending a short branch to Lodz. Another important line, connecting Danzig with Odessa, crosses Poland from north-west to south-east. A branch line, parallel to this last, connects Skierniewice with Thorn and Bromberg; while a military railway connects the fortresses of Warsaw and Ivangorod with Brest-Litovsk, via Siedlce and Lukow. The line from Berlin to St Petersburg traverses the north of Suwalki for 54 m. between Eydtkunen and Kovno.

Commerce.—The general trade of Poland is merged in that of Russia, under which heading it is treated. With the extension of the railways the fairs have lost much of their importance, but their aggregate yearly returns are still estimated at £3,000,000. The principal fairs are held at Warsaw (wool, hemp, hops), Łęczyca in Kalisz, Skaryszew in Radom, Ciechanoviec in Lomza, and Lowicz in Warsaw.

Administration.—The entire administration of Poland is under the governor-general residing at Warsaw. He is at the same time the commander of the military forces of the "Warsaw military district." Justice is represented by the *gmina* tribunals, which correspond to those of the *mir* in Russia; the justices of the peace (nominated by government); the *syezd*, or "court" of the justices of the peace; the district tribunals (assizes) in each government; and the Warsaw courts of appeal and cassation. Poland has had no separate budget since 1867; its income and expenditure are included in those of the empire.

After the insurrection of 1863 all towns with less than 2000 inhabitants were deprived of their municipal rights, and were included, under the designation of *posads*, in the *gminas*. Viewed with suspicion by the Russian government, the Polish towns received no self-government like the villages. The elective municipal councils, which enjoyed *de jure* very large rights, including that of maintaining their own police, although in reality they were under the rule of the nobility, were practically abolished, and Russian officials were nominated in their place and entrusted with all their rights. The municipal councils were, however, maintained to carry out the orders of the military chiefs. The new municipal law of 1870, first introduced at Warsaw, reduced the functions of the municipal council almost to nothing. The burgomaster is entirely dependent upon the police and the chief of the district, and has to discharge all sorts of functions (bailiff, policeman, &c.) which have nothing to do with municipal affairs. In all official communications the Russian language is obligatory, and a gradual elimination of Poles from the administration has been effected.

Defence.—Poland contains the first line of defence of the Russian empire on its western frontier. The marshy lowlands, covered with forests on the western bank of the Vistula, are a natural defence against an army advancing from the west, and they are strengthened by the fortresses on that river. The centre of these latter is Warsaw, with Novogeorgievsk, formerly Modlin, in the north, at the mouth of the Bug, and Ivangorod, formerly Demblin, in the south, at the mouth of the Wieprz. Novogeorgievsk is a strongly fortified camp which requires a garrison of 12,000 men, and may shelter an army of 50,000 men. The town of Sierock, at the confluence of the Bug and the Narew, is fortified to protect the rear of Novogeorgievsk. The Vistula line of fortresses labours, however, under the great disadvantage of being easily turned from the rear by armies advancing from East Prussia or Galicia. Brest-Litovsk, at the western issue from the marshes of the Pripet, the towns of Dubno, Lutsk and Bobruisk constitute the second line of defence.

Religion and Education.—The prevalent religion is the Roman Catholic, to which over 75% of the total population belong. Protestants (mostly Lutherans) amount to 6%, while about 5% are members of the Orthodox Greek Church. After the insurrection of 1863, measures were taken to reduce the numbers of the Roman Catholic clergy in Poland. One diocese (Podlasie) was abolished, and a new one established at Kielce, while several bishops were sent out of the country. Poland is now divided into four dioceses—Warsaw, Sędomierz, Lublin and Plock.

The educational institutions of Poland are represented by a university at Warsaw, with 1500 students. Teaching has been carried on in Russian since 1873. There are excellent technical schools, an institute of agriculture and forestry at Nowa-Alexandrya, and several seminaries for teachers. At Warsaw there is a good musical conservatory. The Jewish children are mostly sent to the Jewish schools, but they receive almost no instruction at all. Although there has been a decided increase in the number of both the primary and the secondary schools, nevertheless the school accommodation has in neither category of school kept pace with the growth of the population. The proportion of primary schools has in fact been steadily decreasing, and the applications for admission to the secondary schools and colleges are on the average twice as great as the number of vacancies. All the same, Poland compares very favourably with Russia in the general level of education, for whereas those able to read and write in 1897 amounted in Poland to 30·5% of the population (only 9·3% in 1862), in Russia it was 19·8%.

(P. A. K.; J. T. Be.)

POLARITY (Lat. *polaris*, *polus*, pole), having two poles or parts at which certain properties are the opposite to one another, as in a magnet the ends of which have opposite magnetic characters. The act of producing polarity is termed polarization. For electrolytic polarization see Battery and Electrolysis, and for optical see Polarization of Light below.

POLARIZATION OF LIGHT. A stream of light coming directly from a natural source has no relation to space except that concerned in its direction of propagation, round which its properties are alike on all sides. That this is not a necessary characteristic of light was discovered by Christian Huygens, who found that, whereas a stream of sunlight in traversing a rhomb of spar in any but one direction always gives rise to two streams of equal brightness, each of these emergent streams is divided by a second rhomb into two portions having a relative intensity dependent upon the position with respect to one another of the principal planes of the faces of entry into the rhombs—the planes through the axes of the crystals perpendicular to the refracting surfaces. In certain cases, indeed, one portion vanishes entirely: thus the stream ordinarily refracted in the first rhomb gives an ordinary or an extraordinary stream alone in the second, according as the principal planes are parallel or perpendicular, the reverse being the case with the extraordinary stream of the first rhomb. In intermediate cases the intensities of the two beams are proportional to the squares of the cosines of the angles that the principal plane of the second rhomb makes with the positions in which they have the greatest intensity.

On the other hand, if the emergent streams overlap and the common part be examined, it is found to have all the properties of common light. To this phenomenon E. T Malus gave the name of *polarization*, as he attributed it, on the emission theory of light, to a kind of polarity of the light-corpuscles. This term has been retained and the ordinary stream is said to be plane polarized in the principal plane of the face of entry into the rhomb, and the extraordinary stream to be plane polarized in the perpendicular plane.

The phenomenon of polarization observed by Huygens remained an isolated fact for over a century, until Malus in 1808 discovered that polarization can be produced independently of double refraction, and must consequently be something closely connected with the nature of light itself. Examining the light reflected from the windows of the Luxemburg palace with a doubly refracting prism, he was led to infer (though more refined experiments have shown that this is not strictly the case) that light reflected at a certain angle, called the *polarizing angle*, from the surface of transparent substances has the same properties with respect to the plane of incidence as those of the ordinary stream in Iceland spar with respect to the principal plane of the crystal. Thus in accordance with the definition, it is polarized in the plane of incidence. Further, if polarized light fall at the polarizing angle on a reflecting surface, the intensity of the reflected stream depends upon the azimuth of the plane of incidence, being proportional to the square of the cosine of the angle between this plane and the plane of the polarization. At angles other than the polarizing angle common light gives a reflected stream that behaves as a mixture of common light with light polarized in the plane of incidence, and is accordingly said to be partially polarized in that plane. The refracted light, whatever be the angle of incidence, is found to be partially polarized in a plane perpendicular to the plane of incidence, and D. F. J. Arago showed that at all angles of incidence the reflected and refracted streams contain equal quantities of polarized light. The polarizing angle varies from one transparent substance to another, and Sir David Brewster in 1815 enunciated the law that the tangent of the polarizing angle is equal to the refractive index of the substance. It follows then that if a stream of light be incident at the polarizing angle on a pile of parallel transparent plates of the same nature, each surface in turn will be met by the light at the polarizing angle and will give rise to a reflected portion polarized in the plane of incidence. Hence the total reflected light will be polarized in this plane and will of necessity have a greater intensity than that produced by a single surface. The polarization of the light transmitted by the pile is never complete, but tends to become more nearly so as the number of the plates is increased and at the same time the angle of incidence for which the polarization is a maximum approaches indefinitely the polarizing angle (Sir G. G. Stokes, *Math. and Phys. Papers*, iv. 145).

In order to isolate a polarized pencil of rays with a rhomb of Iceland spar, it is necessary to have a crystal of such a thickness that the emergent streams are separated, so that one may be stopped by a screen. There are, however, certain crystals that with a moderate thickness give an emergent stream of light that is more or less completely polarized. The polarizing action of such crystals is due to the unequal absorption that they exert on polarized streams. Thus a plate of tourmaline of from 1 mm. to 2mm. in thickness with its faces perpendicular to the optic axis is nearly opaque to light falling normally upon it, and a plate of this thickness parallel to the axis permits of the passage of a single stream polarized in a plane perpendicular to the principal section. Such a plate acts in the same way on polarized light, stopping it or allowing it to pass, according as the plane of polarization is parallel or perpendicular to the principal section. Certain artificial salts, *e.g.* iodo-sulphate of quinine, act in a similar manner.

From the above instances we see that an instrumental appliance that polarizes a beam of light may be used as a means of detecting and examining polarization. This latter process is termed analysation, and an instrument is called a polarizer or an analyser according as it is used for the first or the second of these purposes.

In addition to the above facts of polarization mention may be made of the partial polarization, in a plane perpendicular to that of emission, of the light emitted in an oblique direction from a white-hot solid, and of the polarization produced by diffraction. Experiments with gratings have been instituted by Sir G. Gabriel Stokes, C. H. A. Holtzmann, F. Eisenlohr and others, with the view of determining the direction of the vibrations in polarized light (*vide infra*), but the results have not been consistent, and H. Fizeau and G. H. Quincke have shown that they depend upon the size and form of the apertures and upon the state of the surface on which they are traced. The polarization of the light reflected from a glass grating has also been investigated by I. Fröhlich, while L. G. Gouy has studied the more simple case of diffraction at a straight edge. The polarization of the light scattered by small particles has been examined by G. Govi, J. Tyndall, L. Soret and A. Lallemand, and in the case of ultra-microscopic particles by H. Siedentopf and R. Zsigmondy (*Drude Ann.* 1903, x. 1); an interesting case of this phenomenon is the polarization of the light from the sky—a subject that has been treated theoretically by Lord Rayleigh in an important series of papers (See SKY, COLOUR OF, and Rayleigh, *Scientific Works*, i. 87, 104, 518; iv. 397).

An important addition to the knowledge of polarization was made in 1816 by Augustin J. Fresnel and D. F. J. Arago, who summed up the results of a searching series of experiments in the following laws of the interference of polarized light: (1) Under the same conditions in which two streams of common light interfere, two streams polarized at right angles are without mutual influence. (2) Two streams polarized in parallel planes give the same phenomena of interference as common light. (3) Two streams polarized at right angles and coming from a stream of common light can be brought to the same plane of polarization without thereby acquiring the faculty of interfering. (4) Two streams polarized at right angles and coming from a stream of polarized light interfere as common light, when brought to the same plane of polarization. (5) In calculating the conditions of interference in the last case, it is necessary to add a half wave-length to the actual difference of path of the streams, unless the primitive and final planes of polarization lie in the same angle between the two perpendicular planes.

The lateral characteristics of a polarized stream lead at once to the conclusion that the stream may be represented by a vector, and since this vector must indicate the direction in which the light travels as well as the plane of polarization, it is natural to infer that it is transverse to the direction of propagation. That this is actually the case is proved by experiments on the interference of polarized light, from which it may be deduced that the polarization-vector of a train of plane waves of plane polarized light executes rectilinear vibrations in the plane of the waves. By symmetry the polarization-vector must be either parallel or perpendicular to the plane of polarization: which of these directions is assumed depends upon the physical characteristic that is attributed to the vector. In fact, whatever theory of light be adopted, there are two vectors to be considered, that are at right angles to one another and connected by purely geometrical relations.

The general expressions for the rectangular components of a vector transverse to the direction of propagation (z) in the case of waves of length λ travelling with speed v are:—

$$u=a\cos(\mathrm{T}-\alpha),\ v=b\cos(\mathrm{T}-\beta),$$

where $\mathrm{T}=2\pi(vt-z)/\lambda$. The path of the extremity of the vector is then in general an ellipse, traversed in a right-handed direction to an observer receiving the light when $\alpha-\beta$ is between 0 and π, or between $-\pi$ and -2π, and in a left-handed direction if this angle be between π and 2π, or between 0 and $-\pi$. In conformity with the form of the path, the light is said to be elliptically polarized, right- or left-handedly as the case may be, and the axes of the elliptic path are determined by the planes of maximum and minimum polarization of the light. In the particular case in which $a=b$ and $\alpha-\beta=\pm(2n+1)\pi/2$, the vibrations are circular and the light is said to be circularly polarized.

These different types of polarization may be obtained from a plane polarized stream by passing it through a quarter-wave plate, *i.e.* a crystalline plate of such a thickness that it introduces a relative retardation of a quarter of a wave between the component streams within it. Such plates are generally made of mica or selenite, and the normal to the plane of polarization of the most retarded stream is called "the axis of the plate." If this axis be parallel or perpendicular to the primitive plane of polarization, the emergent beam remains plane polarized; it is circularly polarized if the axis be at 45° to the plane of polarization, and in other cases it is elliptically polarized with the axes of the elliptic path parallel and perpendicular to the axis of the plate. Conversely a quarter-wave plate may be employed for reducing a circularly or elliptically polarized stream to a state of plane polarization.

Two streams are said to be oppositely polarized when the one is, so far as relates to its polarization, what the other becomes when it is turned through an azimuth of 90° and has its character reversed as regards right and left hand. An analytical investigation of the conditions of interference of polarized streams of the most general type leads to the result that there will be no interference only when the two streams are oppositely polarized, and that when the polarizations are identical the interference will be perfect, the fluctuations of intensity being the greatest that the difference of intensity of the streams admits (Sir G. G. Stokes, *Math. and Phys. Papers*, iii. 233).

It remains to consider the constitution of common unpolarized light. Since a beam of common light can be resolved into plane polarized streams and these on recomposition give a stream with properties indistinguishable from those of common light, whatever their relative retardation may be, it is natural to assume that an analytical representation of common light can be obtained in which no longitudinal vector occurs. On the other hand a stream of strictly monochromatic light with a polarization-vector that is entirely transversal must be (in general elliptically) polarized. Consequently it follows that common light cannot be absolutely monochromatic. The conditions that are necessary in order that a stream of light may behave as natural light have been investigated by Sir G. Gabriel Stokes (*loc. cit.*) and by E. Verdet (*Oeuvres*, i. 281), and it may be shown that two polarized streams of a definite character are analytically equivalent to common light provided that they are of equal intensity and oppositely polarized and that there is no common phase relation between the corresponding monochromatic constituents. Further a stream of light of the most general character is equivalent to the admixture of common and polarized light, the polarization being elliptical, circular or plane.

We see then that there are seven possible types of light: common light, polarized light and partially polarized light; the polarization in the two latter cases being elliptical, circular or plane. Common light, circularly polarized and partially circularly polarized light all have the characteristic of giving two streams of equal intensity on passing through a rhomb of Iceland spar, however it may be turned. They may, however, be distinguished by the fact that on previous transmission through a quarter-wave plate this property is retained in the case of common light, while with the two other types the relative intensity of the streams depends upon the orientation of the rhomb, and with circularly polarized light one stream may be made to vanish. Plane polarized light gives in general two streams of unequal intensity when examined with a rhomb, and for certain positions of the crystal there is only one emergent stream. Elliptically polarized, partially elliptically polarized and partially plane polarized light give with Iceland spar two streams of, in general, unequal intensity, neither of which can be made to vanish. They may be differentiated by first passing the light through a quarter-wave plate with its axis parallel or perpendicular to the plane of maximum polarization: for elliptically polarized light thereby becomes plane polarized and one of the streams is extinguished on rotating the rhomb; but with the other two kinds of light this is not the case, and the light is partially plane or partially elliptically polarized according as the plane of maximum polarization remains the same or is changed.

Colours of Crystalline Plates.—It was known to E. T. Malus that the interposition of a doubly refracting plate between a polarizer and an analyser regulated for extinction has the effect of partially restoring the light, and he used this property to discover double refraction in cases in which the separation of the two refracted streams was too slight to be directly detected. D. F. J. Arago in 1811 found that in the case of white light and with moderately thin plates the transmitted light is no longer white but coloured, a variation of brightness but not of tint being produced when the polarizer and analyser being crossed are rotated together, while the rotation of the analyser alone produces a change of colour, which passes through white into the complementary tint. This phenomenon was subjected to a detailed investigation by Jean Baptiste Biot during the years 1812 to 1814, and from the results of his experiments Thomas Young, with his brilliant acumen, was led to infer that the colours were to be attributed to interference between the ordinary and extraordinary streams in the plate of crystal. This explanation is incomplete, as it leaves out of account the action of the polarizer and analyser, and it was with the purpose of removing this defect that Fresnel and Arago undertook the investigations mentioned above and thus supplied what was wanting in Young's explanation. In Biot's earlier experiments the beam of light employed was nearly parallel: the phenomena of rings and brushes that are seen with a conical pencil of light were discovered by Sir David Brewster in the case of uniaxal crystals in 1813 and in that of biaxal crystals in 1815.

Let α, β, ψ be the angles that the primitive and final planes of polarization and the plane of polarization of the quicker wave within the plate make with a fixed plane, and let ρ be the relative retardation of phase of the two streams on emergence from the plate for light of period τ. On entry into the crystal the original polarized stream is resolved into components represented by

$$a\cos(\psi-\alpha)\cos T,\ a\sin(\psi-\alpha)\cos T,\ T=2\pi t/\tau,$$

and on emergence we may take as the expression of the waves

$$a\cos(\psi-\alpha)\cos T,\ a\sin(\psi-\alpha)\cos(T-\rho).$$

Finally after traversing the analyser the sum of the two resolved components is

$$a\cos(\psi-\alpha)\cos(\psi-\beta)\cos T+a\sin(\psi-\alpha)\sin(\psi-\beta)\cos(T-\rho),$$

of which the intensity is

$$\{a\cos(\psi-\alpha)\cos(\psi-\beta)+a\sin(\psi-\alpha)\sin(\psi-\beta)\cos\rho\}^2+a^2\sin^2(\psi-\alpha)\sin^2(\psi-\beta)\sin^2\rho=a^2\cos^2(\beta-\alpha)-a^2\sin 2(\psi-\alpha)\sin 2(\psi-\beta)\sin^2\tfrac{1}{2}\rho.$$

When the primitive light is white, this expression must be summed for the different monochromatic constituents. In strictness the angle ψ is dependent upon the frequency, but if the dispersion be weak relatively to the double refraction, the product $\sin 2(\psi-\alpha)\sin 2(\psi-\beta)$ has sensibly the same value for all terms of the summation, and we may write

$$I=\cos^2(\beta-\alpha)\Sigma a^2-\sin 2(\psi-\alpha)\sin 2(\psi-\beta)\Sigma a^2\sin^2\tfrac{1}{2}\rho.$$

This formula contains the whole theory of the colours of crystalline plates in polarized light. Since the first term represents a stream of white light, the plate will appear uncoloured whenever the plane of polarization of either stream transmitted by it coincides with either the primitive or final plane of polarization. In intermediate cases the field is coloured, and the tint changes to its complementary as the plate passes through one of these eight positions, since the second term in the above expression then changes sign. If, however, the primitive and final planes of polarization be parallel or crossed, the field exhibits only one colour during a complete revolution of the plate.

The crystalline plate shows no colour when it is very thin, and also when its thickness exceeds a moderate amount. In the former case the retardation of phase varies so little with the period that the intensity is nearly the same for all colours; in the latter case it alters so rapidly that for a small change in the period the intensity passes from a maximum or a minimum, and consequently so many constituents of the light are weakened and these are so close to one another in frequency, that the light presents to the eye the appearance of being white. The true character of the light in this case may be revealed by analysing it with a spectroscope, when a spectrum is obtained traversed by dark bands corresponding to the constituents that are weakened or annulled. The phenomenon of colour may, however, be obtained with thick plates by superposing two of them in a suitable manner, the combination acting as a thicker or a thinner plate according as the planes of polarization of the quicker waves within them are parallel or crossed. In this way a delicate test for slight traces of double refraction is obtained. When the retardation of phase for light of mean period is π or a small multiple of π a crystalline plate placed between a crossed polarizer and analyser exhibits in white light a distinctive greyish violet colour, known as a sensitive tint from the fact that it changes rapidly to blue or red, when the retardation is very slightly increased or diminished. If then the sensitive plate be cut in half and the two parts be placed side by side after the one has been turned through 90° in its own plane, the tint of the one half will be raised and that of the other will be lowered when the compound plate is associated with a second doubly refracting plate.

When light from an extended source is made to converge upon the crystal, the phenomenon of rings and brushes localized at infinity is obtained. The exact calculation of the intensity in this case is very complicated and the resulting expression is too unwieldy to be of any use, but as an approximation the formula for the case of a parallel beam may be employed, the quantities ψ and ρ therein occurring being regarded as functions of the angle and plane of incidence and consequently as variables. In monochromatic light, then, the interference pattern is characterized by three systems of curves: the curves of constant retardation ρ = const.; the lines of like polarization ψ = const.; the curves of constant intensity I = const. When $\rho = 2n\pi$ and also when $\psi = \alpha$ or $\alpha + \pi/2$ or $\psi = \beta$ or $\beta + \pi/2$, that is at points for which the streams within the plate are polarized in planes parallel and perpendicular to the planes of primitive and final polarization, the intensity (called the fundamental intensity) is the same as when the plate is removed. These conditions define two systems of curves called respectively the principal curves of constant retardation and the principal lines of like polarization, these latter lines dividing the field into regions in which the intensity is alternately greater and less than the fundamental intensity. When, however, the planes of polarization and analysation are parallel or crossed, the two pairs of principal lines of like polarization coincide, and the intensity is at all points in the former case not greater than, and in the latter case not less than, it was before the introduction of the plate. The determination of the curves of constant retardation depends upon expressing the retardation in terms of the optical constants of the crystal, the angle of incidence and the azimuth of the plane of incidence. P. A. Bertin has shown that a useful picture of the form of these curves may be obtained by taking sections, parallel to the plate, of a surface that he calls the "isochromatic surface," and that is the locus of points on the crystal at which the relative retardation of two plane waves passing simultaneously through a given point and travelling in the same direction has an assigned value. But as this surface is obtained by assuming that the interfering streams follow the same route in the crystal, and by neglecting the refraction out of the crystal, it does not lend itself to accurate numerical calculations. To the same degree of accuracy as that employed in obtaining the expression for the intensity, the form of the lines of like polarization is given by the section, parallel to the plate, of a cone, whose generating lines are the directions of propagation of waves that have their planes of polarization parallel and perpendicular to a given plane: the cone is in general of the third degree and passes through the optic axes of the crystal. We must limit ourselves in this article to indicating the chief features of the phenomenon in the more important cases. (Reference should be made to the article CRYSTALLOGRAPHY for illustrations, and for applications of these phenomena to the determination of crystal form.)

With an uniaxal plate perpendicular to the optic axis, the curves of constant retardation are concentric circles and the lines of like polarization are the radii: thus with polarizer and analyser regulated for extinction, the pattern consists of a series of bright and dark circles interrupted by a black cross with its arms parallel to the planes of polarization and analysation. In the case of a biaxal plate perpendicular to the bisector of the acute angle between the optic axes, the curves of constant retardation are approximately Cassini's ovals, and the lines of like polarization are equilateral hyperbolae passing through the points corresponding to the optic axes. With a crossed polarizer and analyser the rings are interrupted by a dark hyperbolic brush that cuts the plane of the optic axes at right angles, if this plane be at 45° to the planes of polarization and analysation—the so-called diagonal position—and that becomes a rectangular cross with its arms parallel and perpendicular to the plane of the optic axes when this plane coincides with the plane of primitive or final polarization—the normal position.

When white light is employed coloured rings are obtained, provided the relative retardation of the interfering streams be not too great. The isochromatic lines, unless the dispersion be excessive, follow in the main the course of the curves of constant retardation, and the principal lines of like polarization are with a crossed polarizer and analyser dark brushes, that in certain cases are fringed with colour. This state of things may, however, be considerably departed from if the axes of optical symmetry of the crystal are different for the various colours. The examination of dispersion of the optic axes in biaxal crystals (see REFRACTION, § *Double*) may be conveniently made with a plate perpendicular to the acute bisectrix placed in the diagonal position for light of mean period between a crossed polarizer and analyser. When the rings are coloured symmetrically with respect to two perpendicular lines the acute bisectrix and the plane of the optic axes are the same for all frequencies, and the colour for which the separation of the axes is the least is that on the concave side of the summit of the hyperbolic brushes. Crossed, inclined and horizontal dispersion are characterized respectively by a distribution of colour that is symmetrical with respect to the centre alone, the plane of the optic axes, and the perpendicular plane.

The phenomenon of interference produced by crystalline plates is considerably modified if the light be circularly or elliptically polarized or analysed by the interposition of a quarter-wave between the crystal and the polarizer or analyser. Thus in the two cases described above the brushes disappear and the rings are continuous when the light is both polarized and analysed circularly. But the most important case, on account of its practical application to determining the sign of a crystal, is that in which the light is plane polarized and circularly analysed or the reverse. Let us suppose that the light is circularly analysed and that the primitive and final planes of polarization are at right angles. Then with an uniaxal plate perpendicular to the optic axis, the black cross is replaced by two lines, on crossing which the rings are discontinuous, expansion or contraction occurring in the quadrants that contain the axis of the quarter-wave plate, according as the crystal is positive or negative. With a biaxal plate perpendicular to the optic axis in the diagonal position, the hyperbolic brush becomes an hyperbolic line and the rings are expanded or contracted on its concave side, with a positive plate, according as the plane of the optic axes is parallel or perpendicular to the axis of the quarter-wave plate, the reverse being the case with a negative plate.

With a combination of plates in plane-polarized and plane-analysed light the interference pattern with monochromatic light is generally very complicated, the dark curves when polarizer and analyser are crossed being replaced by isolated dark spots or segments of lines. When, however, the field is very small, or when the primitive light is white so that interference is only visible for small relative retardations, the problem becomes in many cases one of far less complexity. An instance of considerable importance is afforded by the combination known as Savart's plate. This consists of two plates of an uniaxal crystal of equal thickness, cut at the same inclination of about 45° to the optic axis and superposed with their principal planes at right angles. The interference pattern produced by this combination is, when the field is small, a system of parallel straight lines bisecting the angle between the principal planes of its constituents. These attain their maximum visibility when the plane of analysation is at 45° to these planes, and vanish when the plane of polarization is parallel to either of the principal planes.

The phenomena of chromatic polarization afford a ready means of detecting doubly refracting structure in cases, such as that produced in isotropic bodies by strain, in which its effects are very minute. Thus a bar of glass of sufficient thickness, placed in the diagonal position between a crossed polarizer and analyser and bent in a plane perpendicular to that of vision, exhibits two sets of coloured bands separated by a neutral line, the double refraction being positive on the dilated and negative on the compressed side. Again, a system of rings, similar to those of an uniaxal plate perpendicular to the axis, may be produced with a glass cylinder by transmitting heat from its surface to its axes by immersion in heated oil, and glass that has been raised to a red heat and then cooled rapidly at its edges gives in polarized light an interference pattern of a regular form dependent upon the shape of the contour.

Rotary Polarization.—In general a stream of plane-polarized light undergoes no change in traversing a plate of an uniaxal crystal in the direction of its axis, and when the emergent stream is analysed, the light, if originally white, is found to be colourless and to be extinguished when the polarizer and analyser are crossed. When, however, a plate of quartz is used in this experiment, the light is coloured and is in no case cut off by the analyser, the tint, however, changing as the analyser is rotated. This phenomenon may be explained, as D. F. J. Arago pointed out, by supposing that in passing through the plate the plane of polarization of each monochromatic constituent is rotated by an amount dependent upon the frequency—an explanation that may be at once verified either by using monochromatic light or by analysing the light with a spectroscope, the spectrum in the latter case being traversed by one or more dark bands, according to the thickness of the plate, that pass along the spectrum from end to end as the analyser is rotated. J. B. Biot further ascertained that this rotation of the plane of polarization varies as the distance traversed in the plate and very nearly as the inverse square of the wave-length, and found that with certain specimens of quartz the rotation is in a clockwise or right-handed direction to an observer receiving the light, while in others it is in the opposite direction, and that equal plates of the right- and left-hand varieties neutralize one another's effects.

A similar rotary property is possessed by other uniaxal crystals, such as cinnabar and the thiosulphates of potassium, lead and calcium, and as H. C. Pocklington (*Phil. Mag.*, 1901 [6], ii. 361) and J. H. Dufet (*Journ. de phys.*, 1904 [4], iii. 757) have shown by a few biaxal crystals, such as sugar and Rochelle salt, the rotation produced by a given thickness being in general different, and in some cases of opposite sign for the two optic axes. Further, certain cubic crystals, such as sodium chlorate and bromate, and also some liquids and even vapours, rotate the plane of polarization of the light that traverses them, whatever may be the direction of the stream.

In crystals the rotary property appears to be sometimes inherent in the crystalline arrangement of the molecules, as it is lost on fusion or solution, and in several cases belongs to enantiomorphous crystals, the two correlated forms of which are the one right-handed and the other left-handed optically as well as crystallographically, this being necessarily the case if the property be retained when the crystal is fused or dissolved. In organic bodies the rotary property, as the researches of J. A. Le Bel, J. H. van't Hoff and others have established, corresponds to the presence of one or more asymmetric atoms of carbon—that is, atoms directly united to elements or radicles all different from one another—and in every case there exists an isomer that rotates the plane of polarization to the same degree in the opposite direction. Absence of rotary power when asymmetric carbon atoms are present, may be caused by an internal compensation within the molecule as with the inactive tartaric acid (mesotartaric acid), or may be due to the fact that the compound is an equimolecular mixture of left- and right-hand varieties, this being the case with racemic acid that was broken by Louis Pasteur into laevo- and dextro-tartaric acid (see STEREO-ISOMERISM).

Substances that by reason of the structure or arrangement of their molecules rotate the plane of polarization are said to be structurally active, and the rotation produced by unit length is called their rotary power. If unit mass of a solution contain m grammes of an active substance and if δ be the density and ρ be the rotary power of the solution, the specific rotary power is defined by $\rho/m\delta$, and the molecular rotary power is obtained from this by multiplying by the hundredth part of the molecular mass. This quantity is not absolutely constant, and in many cases varies with the concentration of the solution and with the nature of the solvent. A mixture of two active substances, or even of an active and an inactive substance, in one solution sometimes produces anomalous effects.

Fresnel showed that rotary polarization could be explained kinematically by supposing that a plane-polarized stream is resolved on entering an active medium into two oppositely circularly polarized streams propagated with different speeds, the rotation being right- or left-handed according as the right- or left-handed stream travels at the greater rate.

The polarization-vector of the primitive stream being $\xi = a \cos nt$, the first circularly polarized stream after traversing a distance z in the medium may be represented by

$$\xi_1 = a \cos (nt - k_1 z),\ \eta_1 = a \sin (nt - k_1 z),$$

and the second by

$$\xi_2 = a \cos (nt - k_2 z),\ \eta_2 = - a \sin (nt - k_2 z).$$

The resultant of these is

$$\xi = 2a \cos \tfrac{1}{2} (k_2 - k_1)z \cos \{nt - \tfrac{1}{2}(k_2 + k_2)z\},$$
$$\eta = 2a \sin \tfrac{1}{2} (k_2 - k_1)z \cos \{nt - \tfrac{1}{2}(k_1 + k_2)z\},$$

which shows that for any fixed value of z the light is plane polarized in a plane making an angle $\frac{1}{2}(k_2 - k_1)z = \pi(\lambda_2^{-1} - \lambda_1^{-1})z$, with the initial plane of polarization, λ_1 and λ_2 being the wave-lengths of the circular components of the same frequency.

Since the two circular streams have different speeds, Fresnel argued that it would be possible to separate them by oblique refraction, and though the divergence is small, since the difference of their refractive indices in the case of quartz is only about 0·00007, he succeeded by a suitable arrangement of alternately right- and left-handed prisms of quartz in resolving a plane-polarized stream into two distinct circularly polarized streams. A similar arrangement was used by Ernst v. Fleischl for demonstrating circular polarization in liquids. This result is not, however, conclusive; for an application of Huygens's principle shows that it is a consequence of the rotation of the plane of polarization by an amount proportional to the distance traversed, independently of the state of affairs within the active medium. Not more convincing is a second experiment devised by Fresnel. If in the interference experiment with Fresnel's mirrors or biprism the slit be illuminated with white light that has passed through a polarizer and a quartz plate cut perpendicularly to the optic axis, it is found on analysing the light that in addition to the ordinary central set of coloured fringes two lateral systems are seen, one on either side of it. According to Fresnel's explanation the light in each of the interfering streams consists of two trains of waves that are circularly polarized in opposite direction and have a relative retardation of phase, introduced by the passage through the quartz: the central fringes are then due to the similarly polarized waves; the lateral systems are produced by the oppositely polarized streams, these on analysation being capable of interfering. A. Righi has, however, pointed out that this experiment may be explained by the fact that the function of the quartz plate and analyser is to eliminate the constituents of the composite stream of white light that mask the interference actually occurring at the positions of the lateral systems of fringes, and that any other method of removing them is equally effective. In fact, the lateral systems are obtained when a plate of selenite is substituted for the quartz.

Sir G. B. Airy extended Fresnel's hypothesis to directions inclined to the axis of uniaxal crystals by assuming that in any such direction the two waves, that can be propagated without alteration of their state of polarization, are oppositely elliptically polarized with their planes of maximum polarization parallel and perpendicular to the principal plane of the wave, these becoming practically plane polarized at a small inclination to the optic axis. Several investigations have been made to test the correctness of Airy's views, but it must be remembered that it is only possible to experiment on waves after they have left the crystal, and L. G. Gouy (*Journ. de phys.*, 1885 [2], iv. 149) has shown that the results deduced from Airy's waves of permanent type may be obtained by regarding the action of the medium as the superposition of the effects of ordinary double refraction and of an independent rotary power. As regards the course of the streams on refraction into the crystal, it is found that it is determined by the Huygenian law (see REFRACTION, § *Double*); as, however, the two streams in the direction of the axis have different speeds, the spherical and the spheroidal sheets of the wave-surface do not touch as in the case of inactive uniaxal crystals. On these principles Airy, by an elaborate mathematical investigation, successfully explained the interference patterns obtained with plates of quartz perpendicular to the optic axis. When the polarizer and analyser are parallel or crossed, the pattern is the same as with inactive plates, with the exception that the brushes do not extend to the centre of the field; but as the analyser is rotated a small cross begins to appear at the centre of the field, while the rings change their form and become nearly squares with rounded corners, when the planes of polarization and analysation are at 45°. With two plates of equal thickness and of opposite rotations, the pattern consists of a series of circles and of four similar spirals starting from the centre, each spiral being turned through 90° from that adjacent to it. When the light is circularly polarized or circularly analysed, a single plate gives two mutually inwrapping spirals, and similar spirals in circularly polarized light are obtained with plates of an active biaxal crystal perpendicular to one of the optic axes. It was in this way that the rotary property of certain biaxal crystals was first established by Pocklington.

F. E. Reusch has shown that a packet of identical inactive plates arranged in spiral fashion gives an artificial active system, and the behaviour of certain pseudosymmetric crystals indicates a formation of this character. On these results L. Sohncke (*Math. Ann.*, 1876, ix. 504) and E. Mallard (*Traité de cristallographie*, vol. ii. ch. ix.) have built up a theory of the structure of active media, but in the instances in which static spirality has been shown to be effective in producing optical rotation the coarse-grainedness of the structure is comparable with the wave-length of the radiation affected.

The rotary property may be induced in substances naturally inactive. Thus A. W. Ewell (*Amer. Jour. of Science*, 1899 [4], viii. 89) has shown the existence of a rotational effect in twisted glass and gelatine, the rotation being opposite to the direction of the twist. But a far more important instance of induced activity is afforded by Michael Faraday's discovery of the rotary polarization connected with a magnetic field. There is, however, a marked difference between this magnetic rotation and that of a structurally active medium, for in the latter it is always right-handed or always left-handed with respect to the direction of the ray, while in the former the sense of rotation is determined by the direction of magnetization and therefore remains the same though the ray be reversed. This subject is treated in the article MAGNETO-OPTICS, to which the reader is also referred for John Kerr's discovery of the effect on polarization produced by reflection from a magnetic pole, and for the action of a magnetic field on the radiation of a source—the "Zeeman effect."

Reflection and Refraction.—Huygens satisfactorily explained the laws of reflection and refraction on the principles of the wave theory, so far as the direction of the waves is concerned, but his explanation gives no account of the intensity and the polarization of the reflected light. This was supplied by Fresnel, who, starting from a mechanical hypothesis, showed by ingenious but not strictly dynamical reasoning that if the incident stream have unit amplitude, that of the reflected stream will be

$$- \sin (i-r)/\sin (i+r) \text{ or } \tan (i-r)/\tan (i+r),$$

according as the incident light is polarized in or perpendicularly to the plane of incidence i, r, being the angles of incidence and refraction connected by the formula $\sin i = \mu \sin r$. At normal incidence the intensity of the reflected light, measured by the square of the amplitude, is $\{(\mu-1)/(\mu+1)\}^2$ in both cases; but whereas in the former the intensity increases uniformly with i to the value unity for $i = 90°$, in the latter the intensity at first decreases as i increases, until it attains the value zero when $i+r = 90°$, or $\tan i = \mu$—the polarizing angle of Brewster—and then increases until it becomes unity at grazing incidence. If the incident light be polarized in a plane, making an angle α with the plane of incidence, the stream may be resolved into two that are polarized in the principal azimuths, and these will be reflected in accordance with the above laws. Hence if β be the angle between the plane of incidence and that in which the reflected light is polarized

$$\tan \beta = -\tan \alpha \cos (i+r)/\cos (i-r).$$

The expressions for the intensity of the refracted light may be obtained from those relating to the reflected light by the principle of energy. In order to avoid the question of the measurements of the intensity in different media, it is convenient to suppose that the refracted stream emerges into a medium similar to the first by a transition so gradual that no light is lost by reflection. The intensities of the incident, reflected and refracted streams are then measured in the same way, and we have merely to express that the square of the amplitude of the incident vibrations is equal to the sum of the squares of the amplitudes of the reflected and refracted vibrations.

Fresnel obtained his formulae by assuming that the optical difference of media is due to a change in the effective density of the ether, the elasticity being the same—an assumption inconsistent with his theory of double refraction—and was led to the result that the vibrations are perpendicular to the plane of polarization. Franz Neumann and James MacCullagh, starting from the opposite assumption of constant density and different elasticities, arrived at the same formulae for the intensities of the reflected light polarized in the principal azimuths, but in this case the vibrations must be regarded as parallel to the plane of polarization. The divergence of these views has led to a large number of experimental investigations, instituted with the idea of deciding between them. In the main such investigations have only an academic interest, as, whatever theory of light be adopted, we have to deal with two vectors that are parallel and perpendicular respectively to the plane of polarization. Thus certain experiments of Otto H. Wiener (*Wied. Ann.*, 1890, xl. 203) show that chemical action is to be referred to the latter of these vectors, but whether Fresnel's or Neumann's hypothesis be correct is only to be decided when we know if it be the mean kinetic energy or the mean potential energy that determines chemical action. Similarly on the electromagnetic theory the electric or the magnetic force will be perpendicular to the plane of polarization, according as chemical action depends upon the electric or the magnetic energy. Lord Rayleigh (*Scientific Papers*, i. 104) has, however, shown that the polarization of the light from the sky can only be explained on the elastic solid theory by Fresnel's hypothesis of a different density, and from the study of Hertzian oscillations, in which the direction of the electric vibrations can be a priori assigned, we learn that when these are in the plane of incidence there is no reflection at a certain angle, so that the electric force is perpendicular to the plane of polarization.

It has been supposed in the above that the medium into which the light enters at the reflecting-surface is the more refracting. In the contrary case, total reflection commences as soon as $\sin i=\mu^{-1}$, μ being still the relative refractive index of the more highly refracting medium; and for greater angles of incidence r becomes imaginary. Now Fresnel's formulae were obtained by assuming that the incident, reflected and refracted vibrations are in the same or opposite phases at the interface of the media, and since there is no real factor that converts cos T into cos $(T+\rho)$, he inferred that the occurrence of imaginary expressions for the coefficients of vibration denotes a change of phase other than π, this being represented by a change of sign. If this be so, it is clear that the factor $\sqrt{-1}$ denotes a change of phase of $\pi/2$, since this twice repeated converts cos T into $\cos(T+\pi)=-\cos T$, and hence that the factor $a+b\sqrt{-1}$ represents a change of phase of $\tan^{-1}(b/a)$. Applying this interpretation to the formulae given above, it follows that when the incident light is polarized at an azimuth α to the plane of incidence and the second medium is the less refracting, the reflected light at angles of incidence exceeding the critical angle is elliptically polarized with a difference of phase Δ between the components polarized in the principal azimuths that is given by

$$\tan(\Delta/2)=\cot i\sqrt{(1-\mu^{-2}\operatorname{cosec}^2 i)}.$$

Thus Δ is zero at grazing incidence and at the critical angle, and attains its maximum value $\pi-4\tan^{-1}(1/\mu)$ at an angle of incidence given by $\sin^2 i=2/(\mu^2+1)$.

It is of some interest to determine under what conditions it is possible to obtain a specified difference of phase. Solving for $\cot^2 i$ we obtain

$$2\cot^2 i=(\mu^2-1)^2\pm\sqrt{[(\mu^2-\tan^2(\pi-\Delta)/4)\{\mu^2-\cot^2(\pi-\Delta)/4\}]},$$

and since $\tan\{(\pi-\Delta)/4\}$ is less than unity, μ must exceed $\cot\{(\pi-\Delta)/4\}$ if $\cot^2 i$ is to be real. Thus if $\Delta=\pi/2$, μ must exceed $\pi/8$ or 2·414, that is, the substance must be at least as highly refracting as a diamond: if $\Delta=\pi/4$, μ must be greater than $3\pi/16$ or 1·4966, and when this is the case, it is possible by two reflections to convert into a circularly polarized stream a beam of light polarized at 45° to the plane of incidence. This is the principle of Fresnel's rhomb, that is sometimes employed instead of a quarter-wave plate for obtaining a stream of circularly polarized light. It consists of a parallelopiped glass so constructed that light falling normally on one end emerges at the other after two internal reflections at such an angle as to introduce a relative retardation of phase of $\pi/4$ between the components polarized in the principal azimuths.

Fresnel's formulae are sufficiently accurate for most practical purposes, but that they are not an exact representation of the facts of reflection was shown by Sir David Brewster and by Sir G. B. Airy. Detailed investigations by J. C. Jamin, G. H. Quincke, C. W. Wernicke and others have established that in general light polarized in any but the principal azimuths becomes elliptically polarized by reflection, the relative retardation of phase of the components polarized in these azimuths becoming $\pi/2$ at a certain angle of incidence, called the principal incidence. In some cases it is the component polarized in the plane of incidence that is most retarded and the reflection is then said to be positive: in the case of negative reflection the reverse takes place. It was at first supposed that the defect of Fresnel's formulae was due to the neglect of the superficial undulations that, on a rigorous elastic solid theory of the ether, are called into existence at reflection and refraction. But the result of taking these into account is far from being in accordance with the facts, and experiments of Lord Rayleigh and Paul Drude make it probable that we ought to assume that the transition from one medium to another, though taking place in a distance amounting to about one fiftieth of a wave-length, is gradual instead of abrupt. The effect of such a transition-layer can easily be calculated, at least approximately; but it is of little use to take account of it except in the case of a theory of reflection that gives Fresnel's formulae as the result of an abrupt transition. Lord Rayleigh has pointed out that all theories are defective in that they disregard the fact that one at least of the media is dispersive, and that it is probable that finite reflection would result at the interface of media of different dispersive powers, even in the case of waves for which the refractive indices are absolutely the same.

A more pronounced case of elliptic polarization by reflection is afforded by metals. Formulae for metallic reflection may be obtained from Fresnel's expressions by writing the ratio $\sin i/\sin r$ equal to a complex quantity, and interpreting the imaginary coefficients in the manner explained above. The optical constants (refractive index and co-efficient of extinction) of the metal may then be obtained from observations of the principal incidence and the elliptic polarization then produced. A detailed investigation of these constants has been made by Drude (*Wied. Ann*, 1890, xxxix. 504), who has found the remarkable result that copper, gold, magnesium and silver have refractive indices less than unity, and this has been completely confirmed by observations with metallic prisms of small refracting angle. He further showed that except in the cases of copper, lead and gold the dispersion is abnormal—the index for red light being greater than that for sodium light. The higher the co-efficient of extinction for light of a given period, the more copious will be reflection of that constituent of a mixed pencil. This fact has been employed for separating waves of large wave-length, and in this way waves of length 0·061 mm. have been isolated by five successive reflections from the surface of sylvite.

The Study of Polarization.—The best method of obtaining a strong beam of polarized light is to isolate one of the streams into which a beam of common light is resolved by double refraction. This is effected in polarizing prisms of the earlier type, devised by A. M. de Rochon, H. H. de Sénarmont and W. H. Wollaston, by blocking off one of the streams with a screen, sufficient lateral separation being obtained by combining two equal crystalline prisms cut differently with respect to the optic axis—an arrangement that achromatizes more or less completely the pencil that is allowed to pass. In a second type, called Nicol's prisms, one stream is removed by total reflection. Theoretically the best construction for prisms of this class is the following: a rectangular block of Iceland spar, of length about four times the width and having its end and two of its side faces parallel to the optic axis, is cut in half by a plane parallel to the optic axis and making an angle of about 14° with the sides; the two halves are then reunited with a cement whose refractive index is between the ordinary and extraordinary indices of the spar and as nearly as possible equal to the latter. Thus constructed, the prism produces no lateral shift of the transmitted pencil; a conical pencil, incident directly, has nearly constant polarization over its extent, and consequently the error in determining the polarization of a parallel pencil, incident not quite normally, is a minimum. In a Nicol's prism it is the extraordinary stream that passes; in a prism suggested by E. Sang and sometimes called a Bertrand's prism, it is the ordinary stream that is utilized. This is made by fixing a thin crystalline plate between two glass prisms turned in opposite directions by a cement of the same refractive index as the glass. This refractive index should be equal to the greatest index of the plate, and with a biaxal plate the mean axis of optical symmetry should be parallel to its faces and in the normal section of the prisms, while with an uniaxal plate the optic axis should be in a plane perpendicular to this normal section. These prisms have the advantage of economy of material and of a greater field than the ordinary Nicol's prism, but a difficulty seems to be experienced in finding a suitable permanent cement.

For an accurate determination of the plane of polarization analysers that act by extinction are not of much practical use, and a different device has to be employed. Savart's analyser consists of a Savart's plate (see above) connected to a Nicol's prism, the principal section of which bisects the angle between the principal planes of the plate: the plane of polarization is determined by turning the analyser until the bands, ordinarily seen, disappear, in which case it is parallel to one of the principal planes of the plate. Half-shade analysers depend upon the facility with which the eye can distinguish slight differences in the intensities of two streams seen in juxtaposition, when the illumination is not too bright. The field is divided into two parts that for most positions of the analyser have different intensities, and the setting is effected by turning the analyser until both halves are equally dark. These instruments are very sensitive, but care must be taken to avoid errors caused by changes in the relative intensities of parts of the source of light—a precaution that is sometimes overlooked in furnishing polarimeters with these analysers. In J. H. Jellet's and M. A. Cornu's analysers formed—the one from two parts of a rhomb of spar, the other from two portions of a Nicol's prism—the two halves of the field are analysed in slightly different planes; but these, though they have certain advantages, are now seldom employed, partly on account of a difficulty in their construction and partly because their sensitiveness cannot be adjusted. The more usual half-shade analyser is available for light of only one frequency, as it depends upon the action of a half-wave plate, in traversing which the plane of polarization is turned until it makes the same angle with the principal section as at first but on the opposite side: half the field is covered with the plate, to which is attached a Nicol's prism with its principal section inclined at a small angle to that of the plate. The eye must be focussed on the edge of the plate, and the two halves of the field will only be equally dark when the principal plane of the plate is parallel to the primitive plane of polarization. Another plan, due to J. H. Poynting, is before analysation to impress unequal rotations upon the plane of polarization of the two parts of the field, either by means of an active medium, or by oblique transmission through glass plates.

Elliptically polarized light is investigated by the reduction of the pencil to a state of plane polarization, and a determination of the resulting plane of polarization. One method consists in finding directly the elliptic constants of the vibration by means of a quarter-wave plate and an analyser; but the more usual plan is to measure the relative retardation of two rectangular components of the stream by a Babinet's compensator. This is a plate made of two equal wedges of quartz, that can be moved over one another so as to vary its thickness, and are cut so that the faces of the plate are parallel to the optic axis, which in the first wedge is perpendicular and in the second is parallel to the refracting edge. It is clear that direct transmission through the plate at a point where the thicknesses of the prisms are d_1 and d_2 will introduce a relative retardation of $(\mu_e - \mu_o)(d_1 - d_2)$ between streams polarized in planes parallel and perpendicular to the edges of the prisms, μ_o, and μ_e, being the ordinary and the extraordinary refractive indices; and it is hence possible by an adjustment of the thickness to reduce elliptically polarized to plane polarization at an assigned point marked off by two parallel lines. A subsequent determination of the plane of polarization gives the ratio of the amplitudes of the vibrations in the component streams.

For the observation and measurement of rings in crystals polariscopes are constructed on the following principle. Light from an extended source passes after polarization through two convex systems of lenses, between which the crystalline plate is placed, and is then received in an eyepiece furnished with an analyser. If measurements be required, the plate must have a motion round an axis perpendicular to that of the optical systems, and also about an axis normal to its faces; the polarizer and analyser must also be capable of adjustment. All the rays through a given point in the first principal focal plane of the anterior system of lenses traverse the plate as a parallel beam and reunite at the corresponding point of the second focal plane of the posterior system, each in its passage being divided into two by the plate having a given relative retardation. It is on this latter plane that the eyepiece must be focussed, and here the measuring web must be placed. The actual details of the systems of lenses depend upon the object for which the polariscope is intended, and are given for some of the principal types of instruments in Th. Liebisch's *Physikalische Kristallographie.*

Of polarimeters for the study of rotary polarization there are three principal forms. In Wild's polaristrobometer, light from a soda flame, rendered parallel by a lens, is polarized by a Nicol's prism, and after traversing the space into which the active substance is to be inserted, falls on a Savart's plate placed in front of an astronomical telescope of low power, that contains in its eyepiece a Nicol's prism, which with the plate forms a Savart's analyser. A web in the focal plane of telescope marks the point in the field at which the bands are to be made to disappear; this is effected by turning the polarizer by means of a rack and pinion worked by an arm from the observer's end of the instrument. The polarizing prism is fixed at the centre of a circular disk, that has a scale on its circumference, which with a fixed vernier determines the positions of the polarizer, for which the bands disappear at the assigned point of the field. Laurent's polarimeter is a half-shade instrument. Soda light, first sifted by passage through a plate of potassium bichromate, traverses in succession a lens, a Nicol's prism, and a glass plate half covered with a half-wave plate of quartz, that is cut parallel to the optic axis and has its principal section inclined at a small angle to that of the prism. This combination forms a half-shade polarizer, the sensitiveness of which can be varied by a slight adjustment that can be given to the Nicol. The light is finally received in a Galilean telescope, containing an analyser and carried at the centre of a circular plate, that is graduated on its rim and can be turned in front of a vernier by means of a rack and pinion. The telescope must be focussed on the edge of the quartz plate, and in order that all points of the field may be illuminated by the same part of the source, the flame must be so placed that its image is thrown by the lens on the diaphragm of the object glass of the telescope. The chief features of Soleil's saccharimeter are the biquartz and the compensator. The former consists of two semicircular plates of quartz, perpendicular to the optic axis and of opposite rotations, placed so as to have a common diameter and having such a thickness that each rotates the plane of polarization of mean yellow light through the same multiple of 90°. If then a stream of polarized white light traverse the biquartz, it is possible by an analyser to cut off the mean yellow light from each half of the field, and the whole will then have the sensitive tint; but a small change in the plane of analysation will give the one half a red and the other half a blue tone. A rotation of the plane of polarization is not, however, measured by an adjustment of the analyser, but by annulling the rotation with a compensator. This is made of two plates of quartz, cut normally to the optic axis and of opposite rotations, placed the one in front of the other: the thickness of the one plate is fixed, while that of the other can be varied, as it is formed of two equal prisms that can be moved over one another along their common face. When the plates are of equal thickness, their combined effect is *nil*, but by adjusting the second, a rotation in the one or the other direction may be introduced, a scale attached to one prism and a vernier to the other giving the thickness of the resultant quartz plate. At one end of the instrument is placed a polarizer and the biquartz, and at the other a Galilean telescope, that must be focused on the edge of biquartz, having in front of its object-glass the compensator and an analyser that is regulated for producing the sensitive tint, when the plates of the compensator have the same thickness. The sensitiveness of the instrument depends upon the exactness of the sensitive tint, when the colour of the two halves of the field are the same, and this is liable to be upset by absorption in the substance under investigation. In order to correct this, the light after analysation is passed through another plate of quartz and then the sensitive tint may be more or less restored by cutting off some colour, the same for the whole field, by a Nicol's prism placed in the eyepiece of the telescope. Soleil's saccharimeter, as its name implies, is designed for the study of solutions of sugar, and it is clear that it will only work satisfactorily with active media that have nearly the same rotary dispersion as quartz.

Bibliography.—A bibliography of the subjects treated in this article will be found at the end of the corresponding chapters of É. Verdet's *Leçons d'optique physique* (1869); this work has been brought to a later date in the German translation by Karl Exner (Braunschweig, 1881); references to later papers will be found in J. Walker's *The Analytical Theory of Light* (1904). In addition to the above the reader may consult for the general subject of polarization the following treatises: Th. Preston (3rd. ed. by C. J. Joly), *The Theory of Light* (1901); A. Schuster, *An Introduction to the Theory of Optics* (1904); R. W. Wood, *Physical Optics* (1905); E. Mascart, *Traité d'optique* (1889); and for the phenomena exhibited by crystals F. Pockel, *Lehrbuch der Kristalloptik* (1906); Th. Liebisch, *Physikalische Kristallographie* (1891). (J. Wal.*)

POLAR REGIONS, a general term for the regions about the North or South Pole, otherwise called the Arctic or Antarctic regions.

History of Arctic Exploration.

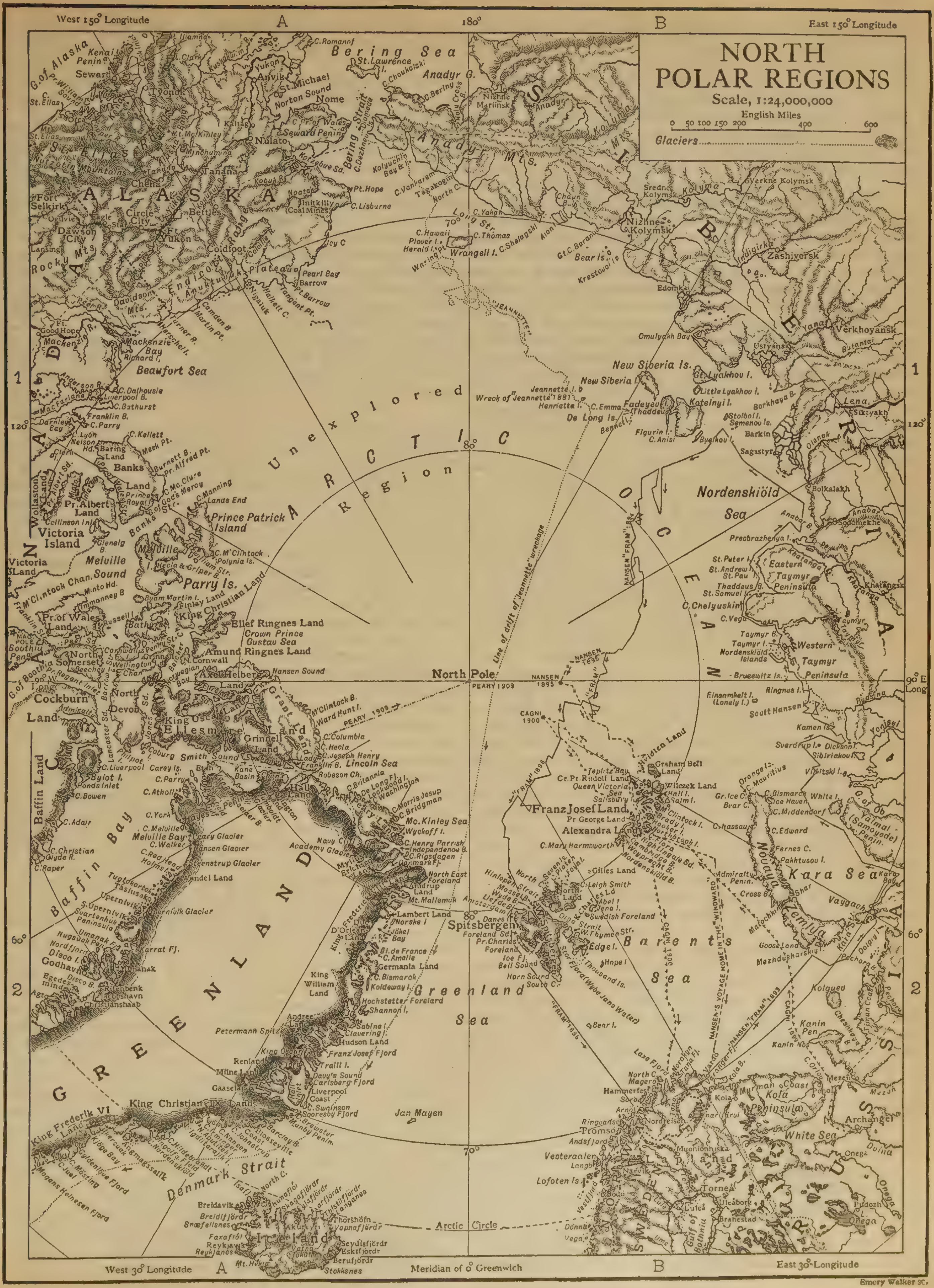
The ancients had no actual knowledge of the Polar regions. They had probably heard rumours of the light summer nights and the dark winter nights in the north, as is shown by Homer's description of the Laestrygons having the short nights and the Cimmerians living in perpetual darkness. By astronomical speculations the Greeks had come to the conclusion that north of the Arctic Circle there must be midnight sun at midsummer and no sun at midwinter. The general view was that the Polar regions, north and south, belonged to the uninhabitable frozen zones; while according to a less scientific notion there was a happy region north of the north wind (Boreas), where the sun was always shining and the Hyperboreans led a peaceful life.

Pytheas.

The first traveller of history who probably approached the Arctic Circle and reached the land of the midnight sun was the Greek Pytheas (*q.v.*), from Massalia (Marseilles), who about 325 B.C. made a voyage of discovery northwards along the west coast of Europe, which is one of the most remarkable in history. He visited England, Scotland, the Scottish isles, and probably also northern Norway, which he called Thule. He moved the limits of the known world from the south coast of England northward to the Arctic Circle. It seems probable that he made two or perhaps several voyages. He also discovered the northern coasts of Germany as far east as Jutland.

Irish Discovery of Iceland.

We hear of no other voyages towards the Arctic regions before the Irish monk Dicuil, writing about 825, mentions the discovery by Irish monks of a group of small islands (the Faeroes), and a greater island (Iceland), which he calls Thule, where there was hardly any night at midsummer. It is possible that Iceland and the Faeroes were inhabited by a small Celtic population before the Irish monks


NORTH POLAR REGIONS
Scale, 1:24,000,000
English Miles
0 50 100 150 200 400 600
Glaciers
West 150° Longitude
A
180°
B
East 150° Longitude
1
120°
90° E Long
60°
2
West 30° Longitude
Meridian of 0° Greenwich
East 30° Longitude
70°
80°
Arctic Circle
Unexplored Region
ARCTIC OCEAN
North Pole
PEARY 1909
NANSEN 1895
CAGNI 1900
Line of drift of "Jeannette" wreckage
"JEANNETTE"
NANSEN "FRAM" 1894
"FRAM" 1896
NANSEN'S VOYAGE HOME IN THE "WINDWARD"
Bering Sea
Bering Strait
ALASKA
St. Elias Mts.
Rocky Mts.
Endicott Mts.
Yukon
Nome
St. Michael
Norton Sound
Fairbanks
Dawson City
Fort Selkirk
Circle City
Ft. Yukon
Coldfoot
Pt. Barrow
Pearl Bay
Beaufort Sea
Mackenzie Bay
Banks Land
Victoria Island
Pr. Albert Land
Melville I.
Melville Sound
Prince Patrick Island
Parry Is.
King Christian Land
Ellef Ringnes Land
Amund Ringnes Land
Crown Prince Gustav Sea
Axel Heiberg Land
Nansen Sound
North Devon
Cockburn Land
North Somerset
Boothia Pen.
Pr. of Wales Land
Ellesmere Land
Grinnell Land
Grant Land
Smith Sound
Kane Basin
Robeson Ch.
Lincoln Sea
C. Columbia
C. Joseph Henry
C. Morris Jesup
Mc. Kinley Sea
Peary Land
Independence B.
North East Foreland
Baffin Land
Baffin Bay
Melville Bay
Lancaster Sd.
Bylot I.
Upernivik
Disco I.
Godhavn
Umanak Fd.
GREENLAND
Greenland Sea
King William Land
Germania Land
Shannon I.
Hudson Land
Franz Josef Fjord
Scoresby Fjord
King Christian IX Land
King Frederik VI Land
Denmark Strait
Iceland
Reykjavik
Jan Mayen
Spitsbergen
North East Land
Edge I.
Hope I.
Bear I.
Barents Sea
Franz Josef Land
Alexandra Land
Graham Bell Land
Wilczek Land
Hidden Land
Nova Zemlya
Kara Sea
Vaygach
Kolguev
Kanin Pen.
White Sea
Archangel
Kola Peninsula
Hammerfest
North C.
Tromso
Lofoten Is.
Lapland
SWEDEN
Gulf of Bothnia
Tornea
Onega
RUSSIA
SIBERIA
Anadyr G.
Anadyr Mts.
Nizhne Kolymsk
Wrangell I.
Herald I.
Long Str.
Bear Is.
New Siberia Is.
Jeannette I.
Henrietta I.
De Long Is.
Wreck of "Jeannette" 1881
Kotelnyi I.
Lena
Verkhoyansk
Ustyansk
Nordenskiöld Sea
Taymyr Peninsula
C. Chelyuskin
Nordenskiöld Islands
Scott Hansen
G. of Ob
Yalmal (Samoyede) Penin.
Yenisei
Khatangsk

Emery Walker sc.

came thither. The fact that Irish monks lived in Iceland before the Norsemen settled there in the end of the 9th century is verified by the Icelandic sagas.

Ottar.

In his translation of Orosius, King Alfred inserts the interesting story of the first known really Arctic voyage, told him by the Norwegian Ottar (Alfred calls him Ohthere), who about 870 rounded the North Cape, sailed eastwards along the Murman coast and discovered the White Sea, where he reached the south coast of the Kola Peninsula and the boundary of the land of the Biarmians (Beormas). Ottar told King Alfred that "he chiefly went thither, in addition to the seeing of the country, on account of the walruses."

After Ottar's time the king of Norway took possession of all land as far east as the White Sea and the land of the Biarmians, and the native "Finns" had to pay him tribute. Many voyages, mostly of hostile nature but also for trade purposes, were undertaken from Norway to the White Sea, and even kings went as far. It is told of King Eric, called Bloodyaxe, who died as king of York in England, that he made such a voyage, and fought with the Biarmians, about 920, and about 965 his son Harold Graafeld defeated the Biarmians and killed many people in a great battle near the river Dvina, where Archangel was built later.

Eric the Red.

After having settled in Iceland in the end of the 9th century, the Norsemen soon discovered Greenland and settled there. The first who is reported to have seen the coast of Greenland was a Norwegian, Gunnbjörn Ulfsson, who on his way to Iceland was storm-driven westwards. He came to some islands, afterwards called Gunnbjörnskier, and saw a coast, but, without exploring the new land, he had evidently continued his way till he reached Iceland. The real discoverer and explorer of Greenland was the Norwegian, Eric the Red, who, with his father had settled in Iceland. As he and his men had there been declared outlaws for having killed several people they had to leave Iceland for three years, and he went westward to find the land which Gunnbjörn was reported to have seen. He explored the west coast of Greenland for three years, probably about 982–985. He then returned to Iceland, but founded the following year a colony in Greenland (*q.v.*). Many colonists followed, and two Norse settlements were formed, viz. the *Eystrabygd* (*i.e.* eastern settlement) on the south-eastern part of the Greenland west coast, between Cape Farewell and about 61° N. lat., where Eric the Red had his house, Brattalid, at the Eiriksfjord; and the *Vestrabygd* (*i.e.* western settlement) in the region of the present Godthaab district, between 63° and 66° N. lat. The Norse settlers carried on their seal and whale-hunting still farther north along the west coast beyond the Arctic circle, and probably in the region of Disco Bay. A runic stone was found in a cairn on a small island in 72° 55′ N. lat. north of Upernivik, showing that Norsemen had been there. The stone probably dates from the 14th century. About 1267 an expedition was sent northwards along the west coast and may possibly have reached some distance north of Upernivik.

Pining and Scolvus.

The last known communication between the Norse settlements in Greenland and Norway was in 1410, when some Icelanders returned, who four years previously had been storm-driven to Greenland. After that time we possess no reliable information about the fate of these settlements. When Greenland was rediscovered in the 16th century no descendants of the Norse settlers were found. The probability is that having gradually been cut off from all communications with Europe, the remaining settlers who had not returned to the motherland were obliged to adopt the Eskimo mode of life, which in those surroundings was far superior to the European, and by intermarriage they would then soon be absorbed amongst the more numerous natives. There is evidence to show that an expedition was probably sent from Denmark or Norway to Greenland in the latter part of the 15th century (perhaps about 1476) under Pining and Pothorst (by Purchas called "Punnus and Pothorse"); and perhaps with Johan Scolvus as pilot. It is probable that this expedition had intercourse with the natives of Greenland, and possibly even reached Labrador, but it is unknown whether any remains of the Norse settlements were found on the Greenland west coast.

King Harold.

It is reported by Adam of Bremen (about 1070) that the Norwegian king Harold Haardraade (in the 11th century) made an expedition into the Arctic Sea (probably northwards) in order to examine how far it extended, but we know nothing more about this voyage.

Spitsbergen.

The Icelandic annals report that a land called *Svalbardi* was discovered in 1194. The name means the cold side or coast. The land was, according to the sagas, situated four days' sailing from north-eastern Iceland northwards in the *Hafsbotn* (*i.e.* the northern termination of the sea, which was supposed to end as a bay). There can be no doubt that this land was Spitsbergen. The Norsemen carried on seal, walrus and whale hunting, and it is believed on good ground that they extended their hunting expeditions eastwards as far as Novaya Zemlya and northwards to Spitsbergen.

On his way to Greenland from Norway in the year 1000 Leif Ericsson found America, probably Nova Scotia, which he called Wineland the Good. A few years later Thorfinn Karlsefni sailed from Greenland with three ships to make a settlement in the land discovered by Leif. They first came to Labrador, which they called *Helluland*, then to Newfoundland, which was called *Markland* (*i.e.* woodland), and then to Cape Breton and Nova Scotia (*Vinland*; Wineland). After three years they had to give up the undertaking on account of hostilities with the natives, probably Red Indians, and they returned to Greenland about 1006. We know of no later expedition of the Norsemen that reached Greenland; it is stated that Eric Uppri, the first bishop of Greenland, went in 1121 to seek Vinland, but it is not related whether he ever reached it, and the probability is that he never returned.

Newfoundland.

The Icelandic annals state that in 1347 a small Greenland ship which had sailed to Markland (Newfoundland) was afterwards storm-driven to Iceland with seventeen men. This is the last known voyage made by the Norsemen of Greenland which with certainty reached America.

The discoveries of the old Norsemen extended over the northern seas from Novaya Zemlya in the east to Labrador, Newfoundland and Nova Scotia in the west; they had visited all Arctic lands in these regions, and had explored the White Sea, the Barents Sea, the Spitsbergen and Greenland Sea, Davis Strait, and even some part of Baffin Bay. They were the first navigators in history who willingly left the coasts and sailed across the open ocean, and they crossed the Atlantic between Norway and America, thereby being the real discoverers of this ocean, as well as the pioneers in oceanic navigation. They were the teachers of the navigators of later centuries, and it is hardly an accident that the undertakings of England towards the west started from Bristol, where many Norwegians had settled, and which from the beginning of the 15th century had much trade with Iceland.

John Cabot.

John Cabot, sent out by the merchants of Bristol, rediscovered the American continent in 1497. He came to Cape Breton and Nova Scotia, probably the same land where Leif Ericsson had landed 500 years before. John Cabot started on a new expedition towards the west in 1498, but no more is known of this expedition, not even whether Cabot returned or not. There is no reliable evidence to prove that John Cabot or his son Sebastian ever discovered Labrador, as has been generally believed.

Corte-Real.

The Portuguese Gaspar Corte-Real rediscovered Greenland in 1500. He sailed along its east coast without being able to land on account of the ice. Whether he visited the west coast is uncertain. In 1501 he made a new expedition when he also rediscovered Newfoundland. One of his ships returned home to Lisbon, but he himself and his ship disappeared. His brother went in search of him the following year, but was heard of no more.

Cabot's and Corte-Real's discoveries were followed by the development of the Newfoundland and Labrador fisheries, and a whole fleet of English, Portuguese, Basque and Breton fishermen was soon met with in these waters, and they probably went along the Labrador coast northward as far as Hudson Strait, without having left any report of their discoveries.

It is believed, on good grounds, that expeditions (combined English-Portuguese) were sent out to the newly discovered regions from Bristol in 1501 and 1502. It is unknown what their discoveries were, but they may possibly have sailed along the coast of Labrador.

Sebastian Cabot.

It is possible that John Cabot's son, Sebastian Cabot, made an Arctic expedition in 1508–1509, in search of a short passage to China towards the north-west, and later, in 1521, King Henry VIII. made an attempt to persuade the merchants of London to support him in sending out an expedition, under Sebastian Cabot, to the north-western countries. It is uncertain whether it ever started, but it is certain that it achieved nothing of importance.

John Rut.

John Rut sailed from Plymouth in 1527, in order to seek a passage to China through the Arctic seas towards the north-west, following the suggestion of Robert Thorne of Bristol. He met ice in 53° N. lat. and returned to Newfoundland. Several other expeditions were sent out from various countries towards the north-west and west during this period, but no discoveries of importance are known to have been made in the Arctic regions.

Centurione.

Willoughby.

Chancelor.

There are rumours that the Portuguese, as early as 1484, under King John II., had sent out an expedition towards Novaya Zemlya in search of a north-east passage to India. The Genovese Paolo Centurione probably proposed to King Henry VIII. of England, in 1525, to make an expedition in search of such a passage to India north of Russia, and there is evidence to show that there had been much talk about an undertaking of this kind in England and at the English court during the following period, as it was hoped that a new market might be found for English merchandise, especially cloth. But it led to nothing until 1553, when Sebastian Cabot was one of the chief promoters. Three ships and 112 men under Sir Hugh Willoughby sailed from Ratcliffe on the 10th (20th) May 1553. Richard Chancelor commanded one of the ships, which was separated from the two others in a gale off northern Norway on the 3rd (13th) August. Willoughby, after having sighted land in various places, probably Kolguev Island, where they landed, the coast near the Pechora river and Kanin Nos, came on the 14th (24th) September to a good harbour on the northern coast of the Kola Peninsula. His one ship being leaky, Willoughby resolved to winter there, but he and all his men perished. Chancelor, after his separation from the two other ships, rounded the North Cape, to which he or his sailing-master, Stephen Borough, gave this name. He reached Vardöhus, and after having waited there in vain for Willoughby, he followed the route of the Norsemen to the White Sea and reached the bay of St Nicholas, with a monastery of this name, near the mouth of the Dvina river, where Archangel was built later. Chancelor undertook a journey to Moscow, made arrangements for commercial intercourse with Russia, and returned next year with his ship, which was, however, plundered by the Flemings, but he reached London safely with a letter from the tsar. In spite of the disaster of Willoughby and his men this expedition became of fundamental importance for the development of English trade. Chancelor's success and his so-called discovery of the passage to the White Sea, which was well known to the Norwegian traders in that region, proved to people in England the practical utility of polar voyages. It led to a charter being granted to the Association of Merchant Adventurers, also called the Muscovy or Russia Company, and gave a fresh impulse to Arctic discovery. Chancelor undertook a new expedition to the White Sea and Moscow in 1555; on his way home in the following year he was wrecked on the coast of Scotland and perished.

Borough.

Pet.

In 1556 Stephen Borough (Burrough), who had served with Chancelor, was sent out by the Muscovy Company in a small pinnace called the "Search-thrift," in order to try to reach the river Ob, of which rumours had been heard. Novaya Zemlya, Vaigach Island, and the Kara Strait leading into the Kara Sea, were discovered. Borough kept a careful journal of his voyage. In 1580 the company fitted out two vessels under Arthur Pet and Charles Jackman, with orders to sail eastwards north of Russia and Asia to the lands of the emperor of Cathay (China). They penetrated through the Kara Strait into the Kara Sea; they possibly saw the west coast of Yalmal, but met with much ice and were compelled to return. The two ships were separated on the way home, Pet reached London on December 26th in safety; Jackman wintered with his ship in Norway and sailed thence in February, but was never heard of again.

Vasqueanes Corte-Real.

About 1574 the Portuguese probably made an attempt to find the north-west passage under Vasqueanes Corte-Real. They reached "a great entrance," which may have been Hudson Strait, and they "passed above twentie leagues" into it, "without all impediment of ice," "but their victailes fayling them, . . . they returned backe agayne with ioy."

Frobisher.

After the expeditions in search of the north-east passage achieved the success of opening up a profitable trade with Russia, via the White Sea, new life was inspired in the undertakings of England on the sea, at the same time the power of the Hanseatic merchants, called the Easterlings, was much reduced. It was therefore only natural that the plan of seeking a north-west passage to China and India should again come to the front in England, and it was much discussed. It was Sir Martin Frobisher who opened that long series of expeditions all of which during three hundred years were sent from England in search of the north-west passage until the last expedition, which actually accomplished it, sailed from Norway. "Being persuaded of a new and neerer passage to Cataya" (China) towards the north-west, Frobisher "determined and resolved wyth himselfe, to go make full proofe thereof . . . or else never to retourne againe, knowing this to be the onely thing of the worlde that was left yet undone, whereby a notable mind mighte be made famous and fortunate." After having attempted in vain for fifteen years to find support for his enterprise, he at last obtained assistance from Ambrose Dudley, earl of Warwick, and through him the interest of Queen Elizabeth was also secured. The Muscovy Company was now obliged to give a licence for the voyage in 1574, and the necessary money was found by London merchants. Aided especially by Michael Lok, an influential merchant and diligent student of geography, Frobisher sailed, on the 7th (17th) of June 1576, from Deptford with two small vessels of 20 and 25 tons, called the "Gabriel" and "Michael," and a small pinnace of 10 tons; the crews amounted to 35 men all told. On the 8th (18th) of July they lost sight of the pinnace, which was seen no more. On the 11th (21st) of July they sighted a high, rugged land, but could not approach it for ice. This was the east coast of Greenland, but, misled by his charts, Frobisher assumed it to be the fictitious Frisland, which was the fabrication of a Venetian, Niccolo Zeno, who in 1558 published a spurious narrative and map (which he pretended to have found) as the work of an ancestor and his brother in the 14th century. The Zeno map was chiefly fabricated on the basis of a map by the Swede Olaus Magnus of 1537 and the map by the Dane Claudius Clavus of the 15th century. It was accepted at the time as a work of high authority, and its fictitious names and islands continued to appear on subsequent maps for at least a century, and have puzzled both geographers at home and explorers in the field. These islands had also been introduced on the charts of Mercator of 1569 and of Ortelius of 1570, which were probably used by Frobisher. Evidently frightened by the sight of the great quantities of ice off the Greenland coast, one ship, the "Michael," left him secretly, "and retourned home wyth greate reporte that he was cast awaye." The gallant Frobisher continued his voyage towards the north-west in the "Gabriel" alone, although his mast was sprung, his topmast blown overboard, and his "mizen-mast" had had to be cut away in a gale. On the 29th of July (Aug. 8) he sighted high

Land of Buss.

land which he called Queen Elizabeth's Foreland. This was the southern part of Baffin Land (Resolution Island) in about 62° N. lat. He was stopped by ice, but nearly two weeks later he reached the coast and entered an inlet which he considered to be the strait of the north-west passage, and he gave it his own name (it is now Frobisher Bay on Baffin Land). The land was called "Meta Incognita." Frobisher was not well prepared for going much farther, and after his boat with five men had disappeared he returned home, where, unfortunately, some "gold-finders" in London took it into their heads that a piece of dark heavy stone brought back contained gold ore. This caused great excitement; it was now considered much more important to collect this precious ore than to find the north-west passage, and much larger expeditions were sent out in the two following years. As many as fifteen vessels formed the third expedition of 1578, and it was the intention to form a colony with a hundred men in the gold land, but this scheme was given up. Frobisher came into Hudson Strait, which was at first thought to be Frobisher Strait and therefore called Mistaken Strait. There was an open sea without any land or ice towards the west, and Frobisher was certain that he could sail through to the "Mare del Sur" (Pacific Ocean) and "Kathaya," but his first goal was the "gold mines," and the vessels returned home with full loads of the ore. One of them, a buss (small ship) of Bridgwater, called the "Emmanuel," reported that on her voyage home she had first sighted Frisland on the 8th (18th) of September, but four days later she had sighted another land in the Atlantic and sailed along it till the following day; they reckoned its southern end to be in about 57½° N. lat. This land soon found its place on maps and charts south-west of Iceland under the name of Buss Island, and as it was never seen again it was after 1745 called "the sunken land of Buss." The explanation is that, misled by the maps, Frobisher assumed Greenland to be Frisland of the Zeno map and Baffin Land was afterwards assumed to be the east coast of Greenland. When the buss on her way home sighted Greenland in about 62° N., she therefore thought it to be Frisland, but when she four days later again sighted land near Cape Farewell and her dead reckoning probably had carried her about two degrees too far south, she naturally considered this to be a new land, which puzzled geographers and navigators for centuries. Owing to a similar mistake, not by Frobisher, but by later cartographers and especially by Davis, it was afterwards assumed that Frobisher Strait (and also Mistaken Strait) was not in Baffin Land but on the east coast of Greenland, where they remained on the maps till the 18th century.

Davis.

John Davis, who made the next attempt to discover a north-west passage, was one of the most scientific seamen of that age. He made three voyages in three successive years aided and fitted out by William Sanderson and other merchants. Sailing from Dartmouth on the 7th (17th) of June 1585, with two ships, he sighted on the 20th (30th) of July "the most deformed, rocky and mountainous land, that ever we sawe." He named it the Land of Desolation, although he understood that he had rediscovered "the shore which in ancient time was called Groenland." It was its east coast. He visited the west coast, where Frobisher had also landed mistaking it for Frisland. Davis anchored in a place called Gilbert's Sound in 64° 10′ (near the present Danish settlement of Godthaab) and had much intercourse with the Eskimo. He then, crossing the strait which bears his name, traced a portion of its western shore southwards from about 66° 40′ N. lat. and came into Cumberland Sound, which he thought to be the strait of the north-west passage, but returned home on account of contrary winds. In the second voyage (with four ships) Davis traced the western shore of Davis Strait still farther southwards, and sailed along the coast of Labrador. In the third voyage (with three ships) in 1587 he advanced far up his own strait along the west coast of Greenland in a small leaky pinnace, the "Ellin," and reached a lofty granite island in 72° 41′ N. lat., which he named Hope Sanderson. He met with ice in the sea west of this place, but reported that there was not "any yce towards the north, but a great sea, free, large, very salt and blew, and of an unsearcheable depth." By contrary winds, however, he was prevented from sailing in that direction. He sailed into Cumberland Sound, but now found that there was no passage. He also passed on his way southwards the entrance to Frobisher Strait, which he named Lumley Inlet, and Hudson Strait, without understanding the importance of the latter. When Davis came to Labrador, where his two larger ships were to have waited for him, they had sailed to England. The little "Ellin" now struck a sunken rock and sprung a leak, which was repaired, and he crossed the Atlantic in this small leaky craft. He still believed in the existence of a passage through Davis Strait, but could find no support for another Arctic voyage. Davis was not the first to discover this strait; it was well-known to the Norsemen. Gaspar Corte-Real had possibly also been there, and Frobisher had during his voyages crossed its southern part every year. The result of Davis's discoveries are shown on the Molyneux globe, which is now in the library of the Middle Temple; they are also shown on the "New Map" in Hakluyt's *Principal Navigations* (1598–1600). When Davis was trying to reconcile his discoveries with the previous ones, especially those of Frobisher, he made fatal mistakes as mentioned above.

Brunel.

As early as 1565, by the intervention of a certain Philip Winterkönig, an exile from Vardöhus in Norway, Dutch merchants formed a settlement in Kola, and in 1578 two Dutch ships anchored in the mouth of the river Dvina, and a Dutch settlement was established where Archangel was built a few years later. The leading man in these undertakings was Olivier Brunel, who is thus the founder of the White Sea trade of the Dutch; he was also their first Arctic navigator. He had travelled both overland and along the coast to Siberia and reached the river Ob; he had also visited Kostin Shar on Novaya Zemlya. He propounded plans for the discovery of the north-east passage to China, and in 1581 he went from Russia to Antwerp to prepare an expedition. He probably started with one ship in 1582, on the first Arctic expedition which left the Netherlands. Little is known of its fate except that it ended unsuccessfully with the wreck of the ship in the shallow Pechora Bay, possibly after a vain attempt to penetrate through the Yugor Strait into the Kara Sea. In 1583 we find Olivier Brunel in Bergen trying to organize a Norwegian undertaking, evidently towards the north-east, but it is uncertain whether it led to anything.

Barents and Nay.

The Dutch, however, had begun to see the importance of a northern route to China and India, especially as the routes through the southern seas were jealously guarded by the Spaniards and Portuguese, and after 1584 all trade with Portugal, where the Dutch got Indian goods, was forbidden. By Brunel's efforts their attention had been directed towards the north-east passage, but it was not until 1594 that a new expedition was sent out, one of the promoters being Peter Plancius, the learned cosmographer of Amsterdam. Four ships sailed from Huysdunen on the 5th (15th) of June 1594. Two of these ships from Amsterdam were under the command of Willem Barents, who sighted Novaya Zemlya, north of Matochkin Shar, on the 4th (14th) of July; and from that date until the 1st (11th) of August Barents continued perseveringly to seek a way through the ice-floes, and discovered the whole western coast as far as the Great Ice Cape, the latitude of which he, with his admirable accuracy, determined to be 77° N. Having reached the Orange Islands at the north-west extremity, he decided to return. The two other ships under the command of Cornelis Nay had discovered the Yugor Strait, through which they sailed into the Kara Sea on the 1st (11th) of August. They reached the west coast of Yalmal; being sure that they had passed the mouth of the river Ob, and finding the sea open, they thought they had found a free passage to Japan and China, and returned home on the 11th (21st) of August. A new expedition was made the following year, 1595, with seven ships under the command of Cornelis Nay, as admiral, and Willem Barents as chief pilot, but it merely made several unsuccessful attempts to enter the Kara Sea through the Yugor Strait. The third expedition was more important. Two vessels sailed from Amsterdam on the 10th (20th) of May 1596, under the command of Jacob van Heemskerck and Corneliszoon Rijp. Barents accompanied Heemskerck as pilot, and Gerrit de Veer, the historian of the voyage, was on board as mate. The masses of ice in the straits leading to the Sea of Kara, and the impenetrable nature of the pack near Novaya Zemlya, had suggested the advisability of avoiding the land and, by keeping a northerly course, of seeking a passage in the open sea. They sailed northwards, and on the 9th (19th) of June discovered Bear Island. Continuing on the same course they sighted a mountainous snow-covered land in about 80° N. lat., soon afterwards being stopped by the polar pack ice. This important discovery was named Spitsbergen, and was believed to be a part of Greenland. Arriving at Bear Island again on the 1st of July, Rijp parted company, while Heemskerck and Barents proceeded eastward, intending to pass round the northern extreme of Novaya Zemlya. On the 26th of August (Sept. 5) they reached Ice Haven, after rounding the northern extremity of the land. Here they wintered in a house built out of driftwood and planks from the 'tween decks and the deck-house of the vessel. In the spring they made their way in boats to the Lapland coast; but Barents died during the voyage. This was the first time that an arctic winter was successfully faced. The voyages of Barents stand in the first rank among the polar enterprises of the 16th century. They led to flourishing whale and seal fisheries which long enriched the Netherlands.

Waymouth.

The English enterprises were continued by the Muscovy Company, and by associations of patriotic merchants of London; and even the East India Company sent an expedition under Captain Waymouth in 1602 to seek for a passage by the opening seen by Davis, but it had no success.

Hudson.

The best servant of the Muscovy Company in the work of polar discovery was Henry Hudson. His first voyage was undertaken in 1607, when he discovered the most northern known point of the east coast of Greenland in 73° N. named "Hold with Hope," and examined the ice between Greenland and Spitsbergen, probably reaching Hakluyt's Headland in 79° 50′ N. On his way home he discovered the island now called Jan Mayen, which he named "Hudson's Tutches." In his second expedition, during the season of 1608, Hudson examined the edge of the ice between Spitsbergen and Novaya Zemlya. In his third voyage he was employed by the Dutch East India Company; he again approached Novaya Zemlya, but was compelled to return westwards, and he explored the coasts of North America, discovering the Hudson river. In 1610 he entered Hudson Strait, and discovered the great bay which bears and immortalizes his name. He was obliged to winter there, undergoing no small hardships. On his way home his crew mutinied and set him, his little son and some sick men adrift in a boat, and the explorer perished in the seas he had opened up.

Spitsbergen Whale Fishery.

The voyages of Hudson led immediately to the Spitsbergen whale fishery. From 1609 to 1612 Jonas Poole made four voyages for the prosecution of this lucrative business, and he was followed by Fotherby, Baffin, Joseph, and Edge. These bold seamen, while in the pursuit of whales, added considerably to the knowledge of the archipelago of islands known under the name of Spitsbergen, and in 1617 Captain Edge discovered an island to the eastward, which he named Wyche's Land.

Danish Voyages.

About the same period the kings of Denmark began to send expeditions for the rediscovery of the lost Greenland colony. In 1605 Christian IV. sent out three ships, under the Englishmen Cunningham and Hall and a Dane named Lindenov, which reached the western coast of Greenland and had much intercourse with the Eskimo. Other expeditions followed in 1606–1607.

Button.

Baffin.

Meanwhile, the merchant adventurers of London continued to push forward the western discovery. Sir Thomas Button, in command of two ships, the "Resolution" and "Discovery," sailed from England in May 1612. He entered Hudson Bay, crossed to its western shore, and wintered at the mouth of a river in 57° 10′ N. which was named Nelson river after the master of the ship, who died and was buried there. Next year Button explored the shore of Southampton Island as far as 65° N., and returned home in the autumn of 1613. An expedition under Captain Gibbons despatched in 1614 to Hudson Bay was a failure; but in 1615 Robert Bylot as master and William Baffin as pilot and navigator in the "Discovery" examined the coasts of Hudson Strait and to the north of Hudson Bay, and Baffin, who was the equal of Davis as a scientific seaman, made many valuable observations. In 1616 Bylot and Baffin again set out in the "Discovery." Sailing up Davis Strait they passed that navigator's farthest point at Sanderson's Hope, and sailed round the great channel with smaller channels leading from it which has been known ever since as Baffin Bay. Baffin named the most northern opening Smith Sound, after the first governor of the East India Company, and the munificent promoter of the voyage, Sir Thomas Smith. Lancaster Sound and Jones Sound were named after other promoters and friends of the voyage. The fame of Baffin mainly rests upon the discovery of a great channel extending north from Davis Strait; but it was unjustly dimmed for many years, owing to the omission of Purchas to publish the navigator's tabulated journal and map in his great collection of voyages. It was two hundred years before a new expedition sailed north through Baffin Bay. It may be mentioned, as an illustration of the value of these early voyages to modern science, that Professor Hansteen of Christiania made use of Baffin's magnetic observations in the compilation of his series of magnetic maps. In 1619 Denmark sent out an expedition, under the command of Jens Munk, in search of the north-west passage, with two ships and 64 men. They reached the west coast of Hudson Bay, where they wintered near Churchill river, but all died with the exception of one man, a boy, and Munk himself, who managed to sail home in the smallest ship.

Luke Fox; James.

In 1631 two expeditions were despatched, one by the merchants of London, the other by those of Bristol. In the London ship "Charles" Luke Fox explored the western side of Hudson Bay as far as the place called "Sir Thomas Roe's Welcome." In August he encountered Captain James and the Bristol ship "Maria" in the middle of Hudson Bay, and went north until he reached "North-west Fox his farthest," in 66° 47′ N. He then returned home and wrote an entertaining narrative. Captain James had to winter off Charlton Island, in James Bay, the southern extreme of Hudson Bay, and did not return until October 1632. Another English voyager, Captain Wood, attempted, without success, to discover a north-east passage in 1676 through the sea round the North Pole, but was wrecked on the coast of Novaya Zemlya.

The 16th and 17th centuries were periods of discovery and daring enterprise. Hudson Strait and Bay, Davis Strait and Baffin Bay, the icy seas from Greenland to Spitsbergen and from Spitsbergen to Novaya Zemlya had all been explored; but much more was not discovered than had been well known to the Norsemen five or six centuries earlier. The following century was rather a period of reaping the results of former efforts than of discovery. It saw the settlement of the Hudson Bay Territory and of Greenland, and the development of the whale and seal fisheries.

Scroggs.

The Hudson's Bay Company was incorporated in 1670, and Prince Rupert sent out Zachariah Gillan, who wintered at Rupert river. At first very slow progress was made. A voyage undertaken by Mr Knight, nearly 80 years old, who had been appointed governor of the factory at Nelson river, was unfortunate, as his two ships were lost and the crews perished. This was in 1719. In 1722 John Scroggs was sent from Churchill river in search of the missing ships, but merely entered Sir Thomas Roe's Welcome and returned. His reports were believed to offer decisive proofs of the existence of a passage into the Pacific; and a naval expedition was despatched under the command of Captain Christopher Middleton, consisting of the "Discovery" pink and the "Furnace" bomb. **Middleton.** Wintering in Churchill river, Middleton started in July 1742 and discovered Wager river and Repulse Bay. **Moor.** In 1746 Captain W. Moor made another voyage in the same direction, and explored the Wager Inlet. Later in the century the Hudson's Bay Company's servants made some important land journeys to discover the shores of the American polar ocean. From 1769 to 1772 Samuel Hearne descended the Coppermine River to the polar sea; and in 1789 Alexander Mackenzie discovered the mouth of the Mackenzie river. (For the establishment of the modern Danish settlements in Greenland, see GREENLAND.)

Dutch Whale Fishery.

The countrymen of Barents vied with the countrymen of Hudson in the perilous calling which annually brought fleets of ships to the Spitsbergen seas during the 17th and 18th centuries. The Dutch had their large summer station for boiling down blubber at Smeerenberg, near the northern extreme of the west coast of Spitsbergen. Captain Vlamingh, in 1664, advanced as far round the northern end of Novaya Zemlya as the winter quarters of Barents. In 1700 Captain Cornelis Roule is said by Witsen to have sailed north in the longitude of Novaya Zemlya and to have seen an extent of 40 m. of broken land, but Theunis Ys, one of the most experienced Dutch navigators, believed that no vessel had ever been north of the 82nd parallel. **Martens.** In 1671 Frederick Martens, a German surgeon, visited Spitsbergen, and wrote the best account of its physical features and natural history that existed previous to the time of Scoresby. In 1707 Captain Cornelis Gilies went far to the eastward along the northern shores of Spitsbergen, and saw land to the east in 80° N., which has since been known as Gilies Land. The Dutch geographical knowledge of Spitsbergen was embodied in the famous chart of the Van Keulens (father and son), 1700–1728. The Dutch whale fishery continued to flourish until the French Revolution, and formed a splendid nursery for training the seamen of the Netherlands. From 1700 to 1775 the whaling fleet numbered 100 ships and upwards. In 1719 the Dutch opened a whale fishery in Davis Strait, and continued to frequent the west coast of Greenland for upwards of sixty years from that time.

British Whale Fishery.

The most flourishing period of the British fishery in the Spitsbergen and Greenland seas was from 1752 to 1820. Bounties of 40s. per ton were granted by act of parliament; and in 1778 as many as 255 sail of whalers were employed. In order to encourage discovery £5000 was offered in 1776 to the first ship that should sail beyond the 89th parallel (16 Geo. III. c. 6). **Scoresby.** Among the numerous daring and able whaling captains, William Scoresby takes the first rank, alike as a successful whaler and a scientific observer. His admirable *Account of the Arctic Regions* is still a textbook for all students of the subject. In 1806 he succeeded in advancing his ship "Resolution" as far north as 81° 12′ 42″. In 1822 he forced his way through the ice which encumbers the approach to land on the east coast of Greenland, and surveyed that coast from 75° down to 69° N., a distance of 400 m. Scoresby combined the closest attention to his business with much valuable scientific work and no insignificant amount of exploration.

Russians.

The Russians, after the acquisition of Siberia, succeeded in gradually exploring the whole of the northern shores of that vast region. In 1648 a Cossack named Simon Dezhneff is said to have equipped a boat expedition in the river Kolyma, passed through the strait since named after Bering, and reached the Gulf of Anadyr. In 1738 a voyage was made by two Russian officers from Archangel to the mouths of the Ob and the Yenisei. Efforts were then made to effect a passage from the Yenisei to the Lena. **Chelyuskin.** In 1735 Lieut. T. Chelyuskin got as far as 77° 25′ N. near the cape which bears his name; and in 1743 he rounded that most northern point of Siberia in sledges, in 77° 41′ N. Captain Vitus Bering, a Dane, was appointed by Peter the Great to command an expedition in 1725. Two vessels were built at Okhotsk, and in July 1728 Bering ascertained the existence of a strait between Asia and America. **Bering.** In 1740 Bering was again employed. He sailed from Okhotsk in a vessel called the "St Paul," with G. W. Steller on board as naturalist. Their object was to discover the American side of the strait, and they sighted the magnificent peak named by Bering Mt St Elias. The Aleutian Islands were also explored, but the ship was wrecked on an island named after the ill-fated discoverer, and scurvy broke out amongst his crew. Bering himself died there on the 8th of December 1741.

Thirty years after the death of Bering a Russian merchant named Liakhoff discovered the New Siberia or Liakhoff Islands, and in 1771 he obtained the exclusive right from the empress Catherine to dig there for fossil ivory. **Hedenström.** These islands were more fully explored by an officer named Hedenström in 1809, and seekers for fossil ivory annually resorted to them. A Russian expedition under Captain Chitschakoff, sent to Spitsbergen in 1764, was only able to attain a latitude of 80° 30′ N.

From 1773 onwards to the end of the 19th century the objects of polar exploration were mainly the acquisition of knowledge in various branches of science. It was on these grounds that Daines Barrington and the Royal Society induced the British government to undertake arctic exploration once more. The result was that two vessels, the "Racehorse" and "Carcass" bombs, were commissioned, under the command of Captain J. C. Phipps. **Phipps.** The expedition sailed from the Nore on the 2nd of June 1773, and was stopped by the ice to the north of Hakluyt Headland, the north-western point of Spitsbergen. Phipps reached the Seven Islands and discovered Walden Island; but beyond this point progress was impossible. When he attained their highest latitude in 80° 48′ N., north of the central part of the Spitsbergen group, the ice at the edge of the pack was 24 ft. thick. Captain Phipps returned to England in September 1773. **Cook.** Five years afterwards James Cook received instructions to proceed northward from Kamchatka and search for a north-east or north-west passage from the Pacific to the Atlantic. In accordance with these orders Captain Cook, during his third voyage, reached Cape Prince of Wales, the western extremity of America, on the 9th of August 1778. His ships, the "Resolution" and "Discovery," arrived at the edge of the ice, after passing Bering Strait, in 70° 41′ N. On the 17th of August the farthest point seen on the American side was named Icy Cape. On the Asiatic side Cook's survey extended to Cape North. In the following year Captain Clerke, who had succeeded to the command, made another voyage, but his ship was beset in the ice, and so much damaged that further attempts were abandoned.

The wars following the French Revolution put an end to voyages of discovery till, after the peace of 1815, north polar research found a powerful and indefatigable advocate in Sir John Barrow. **Barrow.** Through his influence a measure for promoting polar discovery became law in 1818 (58 Geo. III. c. 20), by which a reward of £20,000 was offered for making the north-west passage, and of £5000 for reaching 89° N., while the commissioners of longitude were empowered to award proportionate sums to those who might achieve certain portions of such discoveries. In 1817 the icy seas were reported by Captain Scoresby and others to be remarkably open, and this circumstance enabled Barrow to obtain sanction for the despatch of two expeditions, each consisting of two whalers—one to attempt discoveries by way of Spitsbergen and the other by Baffin Bay. The vessels for the Spitsbergen route, the "Dorothea" and "Trent," were commanded by Captain David Buchan and Lieut. John Franklin, and sailed in April 1818. Driven into the pack by a heavy swell from the south, both vessels were severely nipped, and had to return to England. The other expedition, consisting of the "Isabella" and "Alexander," commanded by Captain John Ross and Lieut.

Edward Parry, followed in the wake of Baffin's voyage of 1616. Ross sailed from England in April 1818. The chief merit of his voyage was that it vindicated Baffin's accuracy as a discoverer. Its practical result was that the way was shown to a lucrative fishery in the "North Water" of Baffin Bay, which continued to be frequented by a fleet of whalers every year. Captain Ross thought that the inlets reported by Baffin were merely bays, while the opinion of his second in command was that a wide opening to the westward existed through the Lancaster Sound of Baffin.

Parry's First and Second Voyages.

Franklin's First Journey.

Parry was selected to command a new expedition in the following year. His two vessels, the "Hecla" and "Griper," passed through Lancaster Sound, the continuation of which was named Barrow Strait, and advanced westward, with an archipelago on the right, since known as the Parry Islands. He observed a wide opening to the north, which he named Wellington Channel, and sailed onwards for 300 m. to Melville Island. He was stopped by the impenetrable polar pack of vast thickness which surrounds the archipelago to the north of the American continent, and was obliged to winter in a harbour on the south coast of Melville Island. Parry's hygienic arrangements during the winter were judicious, and the scientific results of his expedition were valuable. The vessels returned in October 1820; and a fresh expedition in the "Fury" and "Hecla," again under the command of Captain Parry, sailed from the Nore on the 8th of May 1821, and passed their first winter on the coast of the newly discovered Melville Peninsula in 66° 11′ N. Still persevering, Parry passed his second winter among the Eskimo at Igloolik in 69° 20′ N., and discovered a channel leading westward from the head of Hudson Bay, which he named Fury and Hecla Strait. The expedition returned in the autumn of 1823. Meantime Parry's friend Franklin had been employed in attempts to reach by land the northern shores of America, hitherto only touched at two points by Hearne and Mackenzie. Franklin went out in 1819, with Dr John Richardson, George Back and Robert Hood. They landed at York factory, and proceeded to the Great Slave Lake. In August of the following year they started for the Coppermine river, and, embarking on it, reached its mouth on the 18th of July 1821. From that point 550 m. of coast-line were explored, the extreme point being called Cape Turnagain. Great sufferings, from starvation and cold, had to be endured during the return journey; but eventually Franklin, Richardson and Back arrived safely at Fort Chippewyan.

Parry's Third Voyage.

Franklin's Second Journey.

It was thought desirable that an attempt should be made to connect the Cape Turnagain of Franklin with the discoveries made by Parry during his second voyage; but the first effort, under Captain Lyon in the "Griper," was unsuccessful. In 1824 three combined attempts were organized. While Parry again entered by Lancaster Sound and pushed down a great opening he had seen to the south named Prince Regent Inlet, Captain Beechey was to enter Bering Strait, and Franklin was to make a second journey by land to the shores of Arctic America. Parry was unfortunate, but Beechey entered Bering Strait in the "Blossom" in August 1826, and extended our knowledge as far as Point Barrow in 71° 23′ 30″ N. lat. Franklin, in 1825–1826, descended the Mackenzie river to its mouth, and explored the coast for 374 m. to the westward; while Dr Richardson discovered the shore between the mouths of the Mackenzie and Coppermine, and sighted land to the northward, named by him Wollaston Land, the dividing channel being called Union and Dolphin Strait. They returned in the autumn of 1826.

Lütke.

Clavering.

Work was also being done in the Spitsbergen and Barents Seas. From 1821 to 1824 the Russian Captain Lütke was surveying the west coast of Novaya Zemlya as far as Cape Nassau, and examining the ice of the adjacent sea. In May 1823 the "Griper" sailed, under the command of Captain Clavering, to convey Captain Sabine to the polar regions in order to make pendulum observations. Clavering pushed through the ice in 75° 30′ N., and succeeded in reaching the east coast of Greenland, where observations were taken on Pendulum Island. He charted the coast-line from 76° to 72° N.

In Parry's attempt to reach the pole from the northern coast of Spitsbergen by means of sledge-boats (see PARRY), the highest latitude reached was 82° 45′ N., and the attempt was persevered in until it was found that the ice as a whole was drifting to the south more rapidly than it was possible to travel over it to the north.

Graah.

In 1829 the Danes undertook an interesting piece of exploration on the east coast of Greenland. Captain Graah of the Danish navy rounded Cape Farewell in boats, with four Europeans and twelve Eskimo. He advanced as far as 65° 18′ N. on the east coast, where he was stopped by an insurmountable barrier of ice. He wintered in 63° 22′ N., and returned to the settlements on the west side of Greenland in 1830.

The Rosses.

Back.

In the year 1829 Captain John Ross, with his nephew James Clark Ross, having been furnished with funds by a wealthy distiller named Felix Booth, undertook a private expedition of discovery in a small vessel called the "Victory." Ross proceeded down Prince Regent Inlet to the Gulf of Boothia, and wintered on the eastern side of a land named by him Boothia Felix. In the course of exploring excursions during the summer months James Ross crossed the land and discovered the position of the north magnetic pole on the western side of it, on the 1st of June 1831. He also discovered a land to the westward of Boothia which he named King William Land, and the northern shore of which he examined. The most northern point was called Cape Felix, and thence the coast trended south-west to Victory Point. The Rosses could not get their little vessel out of its winter quarters. They passed three winters there, and then fell back on the stores at Fury Beach, where they passed their fourth winter, 1832–1833. Eventually they were picked up by a whaler in Barrow Strait, and brought home. Great anxiety was naturally felt at their prolonged absence, and in 1833 Sir George Back, with Dr Richard King as a companion, set out by land in search of the missing explorers. Wintering at the Great Slave Lake, they left Fort Reliance on the 7th of June 1834, and descended the Great Fish river for 530 m. The mouth was reached in 67° 11′ N., and then the want of supplies obliged them to return. In 1836 Sir George Back was sent, at the suggestion of the Royal Geographical Society, to proceed to Repulse Bay in his ship, the "Terror," and then to cross an assumed isthmus and examine the coast-line thence to the mouth of the Great Fish river; but the ship was obliged to winter in the drifting pack, and was brought home in a sinking condition.

Simpson and Dease.

Rae.

The tracing of the polar shores of America was completed by the Hudson's Bay Company's servants. In June 1837 Thomas Simpson and P. W. Dease left Chippewyan, reached the mouth of the Mackenzie, and connected that position with Point Barrow, which had been discovered by the "Blossom" in 1826. In 1839 Simpson passed Cape Turnagain of Franklin, tracing the coast eastward so as to connect with Back's work at the mouth of the Great Fish river. He landed at Montreal Island in the mouth of that river, and then advanced eastward as far as Castor and Pollux river, his farthest eastern point. On his return he travelled along the north side of the channel, the south shore of the King William Island discovered by James Ross. The south-western point of this island was named Cape Herschel, and there Simpson built a cairn on the 26th of August 1839. Little remained to do in order to complete the delineation of the northern shores of the American continent, and this task was entrusted to Dr John Rae, a Hudson's Bay factor, in 1846. He went in boats to Repulse Bay, where he wintered in a stone hut nearly on the Arctic Circle; and there he and his six Orkney men maintained themselves on the deer they shot. During the spring of 1847 Dr Rae explored on foot the shores of a great gulf having 700 m. of coast-line. He thus connected the work of Parry, at the mouth of Fury and Hecla

Strait, with the work of Ross on the coast of Boothia, proving that Boothia was part of the American continent.

While British explorers were thus working hard to solve some of the geographical problems relating to Arctic America, the Russians were similarly engaged in Siberia. **Anjou.** In 1821 Lieut. P. F. Anjou made a complete survey of the New Siberia Islands, and came to the conclusion that it was not possible to advance far from them in a northerly direction, **Wrangell.** owing to the thinness of the ice and to open water existing within 20 or 30 m. Baron Wrangell prosecuted similar investigations from the mouth of the Kolyma between 1820 and 1823. He made four journeys with dog sledges, exploring the coast between Cape Chelagskoi and the Kolyma, and making attempts to extend his journeys to some distance from the land, but he was always stopped by thin ice. **Middendorf.** In 1843 Middendorf was sent to explore the region which terminates in Cape Chelyuskin. He reached Taimyr Bay in the height of the short summer, whence he saw open water and no ice blink in any direction. The whole arctic shore of Siberia had now been explored and delineated, but no vessel had yet rounded the extreme northern point.

The success of Sir James Ross's Antarctic expedition and the completion of the northern coast-line of America by the Hudson's Bay Company's servants gave rise in 1845 to a fresh **Franklin Expedition.** attempt to make the passage from Lancaster Sound to Bering Strait. The story of the unhappy expedition of Sir John Franklin, in the "Erebus" and "Terror," is told under FRANKLIN; but some geographical details may be given here. The heavy polar ice flows south-east between Melville and Baring Islands, down M'Clintock Channel, and impinges on the north-west coast of King William Land. It was this branch from the "palaeocrystic" sea which finally stopped the progress of Franklin's expedition. On leaving the winter quarters at Beechey Island in 1846 Franklin found a channel leading south, along the western shore of the land of North Somerset discovered by Parry in 1819. If he could reach the channel on the American coast, he knew that he would be able to make his way along it to Bering Strait. This channel, now called Peel Sound, pointed directly to the south. He sailed down it towards King William Island, with land on both sides. But directly the southern point of the western land was passed and no longer shielded the channel, the great ice stream from Melville Island, pressing on King William Island, was encountered and found impassable. Progress might have been made by rounding the eastern side of King William Island, but its insularity was then unknown.

It was not until 1848 that anxiety began to be felt about the Franklin expedition. In the spring of that year Sir James Ross **Search Expedition; Ross.** was sent with two ships, the "Enterprise" and "Investigator," by way of Lancaster Sound. He wintered at Leopold Harbour, near the north-east point of North Devon. In the spring he made a long sledge journey with Lieut. Leopold M'Clintock along the northern and western coasts of North Somerset, but found nothing.

On the return of the Ross expedition without any tidings, the country became thoroughly alarmed. An extensive plan of search **Austin.** was organized—the "Enterprise" and "Investigator" under Collinson and M'Clure proceeding by Bering Strait, while the "Assistance" and "Resolute," with two steam tenders, the "Pioneer" and "Intrepid," sailed on the 3rd of May 1850 to renew the search by Barrow Strait, under Captain Horatio Austin. Two brigs, the "Lady Franklin" and "Sophia," under William Penny, an energetic and able whaling captain, were sent by the same route. He had with him Dr Sutherland, a naturalist, who did much valuable scientific work. Austin and Penny entered Barrow Strait, and Franklin's winter quarters of 1845–1846 were discovered at Beechey Island; but there was no record of any kind indicating the direction taken by the ships. Stopped by the ice, Austin's expedition wintered (1850–1851) in the pack off Griffith Island, and Penny found refuge in a harbour on the south coast of Cornwallis Island. Austin, who had been with Parry during his third voyage, was an admirable organizer. His arrangements for passing the winter were carefully thought out and answered perfectly. In concert with Penny he planned a thorough and extensive system of search by means of sledge-travelling in the spring, and Lieut. M'Clintock superintended every detail of this part of the work with unfailing forethought and skill. Penny undertook the search by Wellington Channel. M'Clintock advanced to Melville Island, marching over 770 m. in eighty-one days; Captain Ommanney and Sherard Osborn pressed southward and discovered Prince of Wales Island. Lieut. Brown examined the western shore of Peel Sound. The search was exhaustive; but, except the winter quarters at Beechey Island, no record was discovered. The absence of any record made Captain Austin doubt whether Franklin had ever gone beyond Beechey Island; so he also examined the entrance of Jones Sound, the next inlet from Baffin Bay north of Lancaster Sound, on his way home, and returned to England in the autumn of 1851. This was a thoroughly well conducted expedition, especially as regards the sledge-travelling, which M'Clintock brought to great perfection. So far as the search for Franklin was concerned, nothing remained to be done west or north of Barrow Strait.

In 1851 the "Prince Albert" schooner was sent out by Lady Franklin, under Captain Wm. Kennedy, with Lieut. Bellot of the French navy as second. They wintered on the east coast of North Somerset, and in the spring of **Kennedy; Bellot.** 1852 the gallant Frenchman, in the course of a long sledging journey, discovered Bellot Strait, separating North Somerset from Boothia—thus proving that the Boothia coast facing the strait was the northern extremity of the continent of America.

The "Enterprise" and "Investigator" sailed from England in January 1850, but accidentally parted company before they reached Bering Strait. On the 6th of May 1851 the **Collinson.** "Enterprise" passed the strait, and rounded Point Barrow on the 25th. Collinson then made his way up the narrow Prince of Wales Strait, between Banks and Prince Albert Islands, and reached Princess Royal Islands, where M'Clure had been the previous year. Returning southwards, the "Enterprise" wintered in a sound in Prince Albert Island in 71° 35′ N. and 117° 35′ W. Three travelling parties were despatched in the spring of 1852—one to trace Prince Albert Land in a southerly direction, while the others explored Prince of Wales Strait, one of them reaching Melville Island. In September 1852 the ship was free, and Collinson pressed eastward along the coast of North America, reaching Cambridge Bay (Sept. 26), where the second winter was passed. In the spring he examined the shores of Victoria Land as far as 70° 26′ N. and 100° 45′ W.: here he was within a few miles of Point Victory, where the fate of Franklin would have been ascertained. The "Enterprise" again put to sea on the 5th of August 1853, and returned westward along the American coast, until she was stopped by ice and obliged to pass a third winter at Camden Bay, in 70° 8′ N. and 145° 29′ W. In 1854 this remarkable voyage was completed, and Captain Collinson brought the "Enterprise" back to England.

Meanwhile M'Clure in the "Investigator" had passed the winter of 1850–1851 at the Princess Royal Islands, only 30 m. from Barrow Strait. In October M'Clure ascended **M'Clure.** a hill whence he could see the frozen surface of Barrow Strait, which was navigated by Parry in 1819–1820. Thus, like the survivors of Franklin's crews when they reached Cape Herschel, M'Clure discovered a north-west passage. It was impossible to reach it, for the stream of heavily packed ice which stopped Franklin off King William Land lay athwart their northward course; so, as soon as he was free in 1851, M'Clure turned southwards, round the southern extreme of Banks Land, and commenced to force a passage to the northward between the western shore of that land and the enormous fields of ice which pressed upon it. The cliffs rose like walls on one side, while on the other the stupendous ice of the "palaeocrystic sea" rose from the water to a level with the "Investigator's" lower yards. After many hairbreadth escapes M'Clure took refuge in a bay on the northern shore of Banks Land, which he named the Bay of

God's Mercy. Here the "Investigator" remained, never to move again. After the winter of 1851–1852 M'Clure had made a journey across the ice to Melville Island, and left a record at Parry's winter harbour. Abundant supplies of musk ox were fortunately obtained, but a third winter had to be faced. In the spring of 1853 M'Clure was preparing to abandon the ship with all hands, and attempt, like Franklin's crews, to reach the American coast; but succour arrived in time.

Rae's Journeys.

The Hudson's Bay Company continued the search for Franklin. In 1848 Sir John Richardson and Dr Rae examined the American coast from the mouth of the Mackenzie to that of the Coppermine. In 1849 and 1850 Rae continued the search; and by a long sledge journey in the spring of 1851, and a boat voyage in the summer, he examined the shores of Wollaston and Victoria Lands, which were afterwards explored by Captain Collinson in the "Enterprise."

Belcher.

Kellett.

In 1852 the British government resolved to despatch another expedition by Lancaster Sound. Austin's four vessels were recommissioned, and the "North Star" was sent out as a dépôt ship at Beechey Island. Sir Edward Belcher commanded the "Assistance," with the "Pioneer" under Sherard Osborn as steam tender. He went up Wellington Channel to Northumberland Bay, where he wintered, passing a second winter lower down in Wellington Channel, and then abandoning his ships and coming home in 1854. But Sherard Osborn and Com. G. H. Richards did good work. They made sledge journeys to Melville Island, and thus discovered the northern side of the Parry group. Captain Kellett received command of the "Resolute," with M'Clintock in the steam tender "Intrepid." Among Kellett's officers were the best of Austin's sledge-travellers, M'Clintock, Mecham, and Vesey Hamilton, so that good work was sure to be done. George S. Nares, leader of the future expedition of 1874–1875, was also on board the "Resolute." Kellett pressed onwards to the westward and passed the winter of 1852–1853 at Melville Island. During the autumn Mecham discovered M'Clure's record, and the position of the "Investigator" was thus ascertained. Lieut. Pim made his way to this point early in the following spring, and the officers and crew of the "Investigator," led by M'Clure, arrived safely on board the "Resolute" on the 17th of June 1853. They reached England in the following year, having not only discovered but traversed a north-west passage, though not in the same ship and partly by travelling over ice. For this great feat M'Clure received the honour of knighthood, and a reward of £10,000 was granted to himself, the other officers, and the crew, by a vote of the House of Commons.

The travelling parties of Kellett's expedition, led by M'Clintock, Mecham and Vesey Hamilton, completed the discovery of the northern and western sides of Melville Island, and the whole outline of the large island of Prince Patrick, further west. M'Clintock was away from the ship with his sledge party for one hundred and five days, and travelled over 1328 m. Mecham was away ninety-four days, and travelled over 1163 m. Sherard Osborn, in 1853, was away ninety-seven days, and travelled over 935 m. The "Resolute" was obliged to winter in the pack in 1853–1854, and in the spring of 1854 Mecham made a remarkable journey in the hope of obtaining news of Captain Collinson at the Princess Royal Islands. Leaving the ship on the 3rd of April he was absent seventy days, out of which there were sixty-one and a half days of travelling. The distance gone over was 1336 statute miles. The average rate of the homeward journey was 23½ m. a day; the average time of travelling each day nine hours twenty-five minutes.

Inglefield.

Fearing detention for another winter, Sir Edward Belcher ordered all the ships to be abandoned in the ice, the officers and crews being taken home in the "North Star," and in the "Phœnix" and "Talbot," which had come out from England to communicate. They reached home in October 1854. In 1852 Captain Edward A. Inglefield, R.N., had made a voyage up Baffin Bay in the "Isabel" as far as the entrance of Smith Sound. In 1853 and 1854 he came out in the "Phœnix" to communicate with the "North Star" at Beechey Island.

Drift of the "Resolute."

The drift of the "Resolute" was a remarkable proof of the direction of the current out of Barrow Strait. She was abandoned in 74° 41′ N. and 101° 11′ W. on the 14th of May 1854. On the 10th of September 1855 an American whaler sighted the "Resolute" in 67° N. lat. about twenty miles from Cape Mercy, in Davis Strait. She had drifted nearly a thousand miles, and having been brought into an American port, was purchased by the United States and presented to the British government.

Rae's Discovery.

In 1853 Dr Rae was employed to connect a few points which would quite complete the examination of the coast of America, and establish the insularity of King Willian Land. He went up Chesterfield Inlet and the river Quoich, wintering with eight men at Repulse Bay, where venison and fish were abundant. In 1854 he set out on a journey which occupied fifty-six days in April and May. He succeeded in connecting the discoveries of Simpson with those of James Ross, and thus established the fact that King William Land was an island. Rae also brought home the first tidings and relics of Franklin's expedition gathered from the Eskimo, which decided the Admiralty to award him the £10,000 offered for definite news of Franklin's fate. Lady Franklin, however, sent out the "Fox" under the command of M'Clintock (see Franklin). M'Clintock prosecuted an exhaustive search over part of the west coast of Boothia, the whole of the shores of King William Island, the mouth of the Great Fish river and Montreal Island, and Allen Young completed the discovery of the southern side of Prince of Wales Island.

The catastrophe of Sir John Franklin's expedition led to 7000 m. of coast-line being discovered, and to a vast extent of unknown country being explored, securing very considerable additions to geographical knowledge.

Grinnell Expedition.

The American nation was first led to take an interest in Polar research through a noble and generous sympathy for Franklin and his companions. Mr Grinnell of New York gave practical expression to this feeling. In 1850 he equipped two vessels, the "Advance" and "Rescue," to aid in the search, commanded by Lieuts. de Haven and Griffith, and accompanied by Dr E. K. Kane. They reached Beechey Island on the 27th of August 1850, and assisted in the examination of Franklin's winter quarters, but returned without wintering.

Kane.

In 1853 Dr Kane, in the little brig "Advance," of 120 tons, undertook to lead an American expedition up Smith Sound, the most northern outlet from Baffin Bay. The "Advance" reached Smith Sound on the 7th of August 1853, but was stopped by ice in 78° 45′ N. only 17 m. from the entrance. Kane described the coast as consisting of precipitous cliffs 800 to 1200 ft. high, and at their base there was a belt of ice about 18 ft. thick, resting on the beach. Dr Kane adopted the Danish name of "ice-foot" (*is fod*) for this permanent frozen ledge. He named the place of his winter quarters Van Rensselaer Harbour. In the spring some interesting work was done. A great glacier was discovered with a sea face 45 m. long and named the Humboldt glacier. Dr Kane's steward, Morton, crossed the foot of this glacier with a team of dogs, and reached a point of land beyond named Cape Constitution. But sickness and want of means prevented much from being done by travelling parties. Scurvy attacked the whole party during the second winter, although the Eskimo supplied them with fresh meat and were true friends in need. On the 17th of May 1855 Dr Kane abandoned the brig, and reached the Danish settlement of Upernivik on the 5th of August. Lieut. Hartstene, who was sent out to search for Kane, reached the Van Rensselaer Harbour after he had gone, but took the retreating crew on board on his return voyage.

Hayes.

On the 10th of July 1860 Dr I. I. Hayes, who had served with Kane, sailed from Boston for Smith Sound, in the schooner "United States," of 130 tons and a crew of fifteen men. His object was to follow up the line of research opened by Dr Kane. He wintered at Port Foulke, in 78° 17′ N., but achieved nothing of importance, and his narrative is not to be depended on.

Hall.

Charles Hall (*q.v.*), in his first journey (1860–1862), discovered remains of a stone house which Sir Martin Frobisher built on the Countess of Warwick Island in 1578. In his second expedition (1864–1869) Hall reached the line of the retreat of the Franklin survivors, at Todd's Island and Peffer River, on the south coast of King William Island. He heard the story of the retreat and of the wreck of one of the ships from the Eskimo; he was told that seven bodies were buried at Todd Island; and he brought home some bones which are believed to be those of Lieut. Le Vescomte of the "Erebus." Finally, in 1871 he took the "Polaris" for 250 m. up the channel which leads northwards from Smith Sound. The various parts of this long channel are called Smith Sound, Kane Basin, Kennedy Channel and Robeson Channel. The "Polaris" was beset in 82° 11′ N. on the 30th of August; her winter quarters were in Thank God Harbour, 81° 38′ N., and here Hall died.

Norwegian Explorers.

The Spitsbergen seas were explored during last century by Norwegian fishermen as well as by Swedish and German expeditions and by British yachtsmen. In 1827 the Norwegian geologist Keilhau made an expedition to Bear Island and Spitsbergen which was the first purely scientific Arctic expedition. The Norwegian Spitsbergen fishery dates from 1820, but it was only in the latter part of the century that Professor Mohn of Christiania carefully collected information from the captains who had taken part in the work when at its height. In 1863 Captain Carlsen circumnavigated the Spitsbergen group for the first time in a brig called the "Jan Mayen." In 1864 Captain Tobiesen sailed round North-East Land. In 1872 Captains Altmann and Nils Johnsen visited Wiche's Land, which was discovered by Captain Edge in 1617. In that year there were twenty-three sailing vessels from Tromsö, twenty-four from Hammerfest, and one from Vardö engaged in the Arctic sealing trade, averaging from 35 to 40 tons, and carrying a dozen men. Exploration went on slowly, in the course of the sealing and fishing voyages, the records of which are not very full. In 1869 Carlsen crossed the Kara Sea and reached the mouth of the Ob. In 1870 there were about sixty Norwegian vessels in the Barents Sea, and Captain Johannesen circumnavigated Novaya Zemlya. In 1873 Captain Tobiesen was unfortunately obliged to winter on the Novaya Zemlya coast, owing to the loss of his schooner, and both he and his young son died in the spring. Two years previously Captain Carlsen had succeeded in reaching the winter quarters of Barents, the first visitor since 1597, an interval of two hundred and seventy-four years. He landed on the 9th of September 1871, and found the house still standing and full of interesting relics, which are now in the naval museum at the Hague.

Swedish Expeditions.

Between 1858 and 1872 the Swedes sent seven expeditions to Spitsbergen and two to Greenland, marking a new scientific era in Arctic exploration, of which Keilhau had been the pioneer. All returned with valuable scientific results. That of 1864 under A. E. Nordenskiöld and Duner made observations at 80 different places on the Spitsbergen shores, and fixed the heights of numerous mountains. In 1868, in an iron steamer, the "Sophia," the Swedes attained a latitude of 81° 42′ N. on the meridian of 18° E., during the month of September. In 1872 an expedition, consisting of the "Polhem" steamer and brig "Gladen," commanded by Professor Nordenskiöld and Lieut. Palander, wintered in Mossel Bay on the northern shore of Spitsbergen. In the spring an important sledging journey of sixty days' duration was made over North-East Land. The expedition was in some distress as regards supplies owing to two vessels, which were to have returned, having been forced to winter. But in the summer of 1873 they were visited by Mr Leigh Smith, in his yacht "Diana," who supplied them with fresh provisions.

Koldewey.

Dr A. Petermann of Gotha urged his countrymen to take their share in the work of polar discovery, and at his own risk he fitted out a small vessel called the "Germania," which sailed from Bergen in May 1868, under the command of Captain Koldewey. His cruise extended to Hinlopen Strait in Spitsbergen, but was merely tentative; and in 1870 Baron von Heuglin with Count Zeil explored the Stor Fjord in a Norwegian schooner, and also examined Walter Thymen Strait. After the return of the "Germania" in 1868 a regular expedition was organized under the command of Captain Koldewey, provisioned for two years. It consisted of the "Germania," a screw steamer of 140 tons, and the brig "Hansa," commanded by Captain Hegemann. Lieut. Julius Payer, the future explorer of Franz Josef Land, gained his first Arctic experience on board the "Germania." The expedition sailed from Bremen on the 15th of June 1869, its destination being the east coast of Greenland. But in latitude 70° 46′ N. the "Hansa" got separated from her consort and crushed in the ice. The crew built a house of patent fuel on the floe, and in this strange abode they passed their Christmas. In two months the current carried them 400 m. to the south. By May they had drifted 1100 m. on their ice-raft, and finally, on the 14th of June 1870, they arrived safely at the Moravian mission station of Friedriksthal, to the west of Cape Farewell. Fairer fortune attended the "Germania." She sailed up the east coast of Greenland as far as 75° 30′ N., and eventually wintered at the Pendulum Islands of Clavering in 74° 30′ N. In March 1870 a travelling party set out under Koldewey and Payer, and reached a distance of 100 m. from the ship to the northward, when want of provisions compelled them to return. A grim cape, named after Prince Bismarck, marked the northern limit of their discoveries. As soon as the vessel was free, a deep branching fjord, named Franz Josef Fjord, was discovered in 73° 15′ N. stretching for a long distance into the interior of Greenland. The expedition returned to Bremen on the 11th of September 1870.

Payer and Weyprecht.

Lieut. Payer was resolved to continue in the path of polar discovery. He and the naval officer Weyprecht chartered a Norwegian schooner called the "Isbjörn," and examined the edge of the ice between Spitsbergen and Novaya Zemlya, in the summer of 1871. Their observations led them to select the route by the north end of Novaya Zemlya with a view to making the north-east passage. It was to be an Austro-Hungarian expedition, and the idea was seized with enthusiasm by the whole monarchy. Weyprecht was to command the ship, while Julius Payer conducted the sledge parties. The steamer "Tegethoff," of 300 tons, was fitted out in the Elbe, and left Tromsö on the 14th of July 1872. The season was severe, and the vessel was closely beset near Cape Nassau, at the northern end of Novaya Zemlya, in the end of August. The summer of 1873 found her still a close prisoner drifting, not with a current, but chiefly in the direction of the prevailing wind. At length, on the 31st of August, a mountainous country was sighted about 14 m. to the north. In October the vessel was drifted within 3 m. of an island lying off the main mass of land. Payer landed on it, and found the latitude to be 79° 54′ N. It was named after Count Wilczek, one of the warmest friends of the expedition. Here the second winter was passed. Bears were numerous and sixty-seven were killed, their meat proving to be an efficient preventive of scurvy. In March 1874 Payer made a preliminary sledge journey in intense cold (thermometer at −58° F.). On the 24th of March he started for a more prolonged journey of thirty days. Payer believed that the newly discovered country equalled Spitsbergen in extent, and described it as consisting of two or more large masses—Wilczek Land to the east, Zichy Land to the west, intersected by numerous fjords and skirted by a large number of islands. A wide channel, named Austria Sound, was supposed to separate the two main masses of land, and extend to 82° N. The whole country was named Franz Josef Land. Payer's large land-masses have by later discoveries been broken up into groups of islands and much of the land he thought he saw towards the east was found by Nansen not to exist. Payer returned to the "Tegethoff" on the 24th of April; and a third journey was undertaken to explore a large island named after M'Clintock. It then became necessary to abandon the ship and attempt a retreat in boats. This perilous voyage was commenced on the 20th of May. Three boats stored with provisions were placed on sledges. It was not until the 14th of August that they reached the edge of the pack in 77° 40′ N., and launched the boats. Eventually they were picked up by a Russian schooner and arrived at Vardö on the 3rd of September 1874.

Whymper.

One of the most interesting problems connected with the physical geography of the polar regions is the actual condition of the vast elevated interior of Greenland, which is one enormous glacier. In 1867 Mr Edward Whymper planned an expedition to solve the question, and went to Greenland, accompanied by Dr Robert Brown; but their progress was stopped, after going a short distance over the ice, by the breaking down of the dog-sledges. The expedition brought home geological and natural history collections of value. Dr H. Rink, for many years royal inspector of South Greenland and the most distinguished authority on all Greenlandic questions, also visited the inland ice. An important inland journey was undertaken by Professor A. E. Nordenskiöld in 1870, accompanied by Dr Berggren, professor of botany at Lund. The difficulty of traversing the inland ice of Greenland is caused by the vast ice-cap being in constant motion, advancing slowly towards the sea. This movement gives rise to huge crevasses which bar the traveller's way. The chasms occur chiefly where the movement of the ice is most rapid, near the ice streams which reach the sea and discharge icebergs. Nordenskiöld therefore chose for a starting-point the northern arm of a deep inlet called Auleitsivikfjord, which is 60 m. south of the discharging glacier at Jakobshavn and 240 north of that at Godthaab. He commenced his inland journey on the 19th of July. The party consisted of himself, Dr Berggren, and two Greenlanders; and they advanced 30 m. over the glaciers to a height of 2200 ft. above the sea.

Nordenskiöld in Greenland.

British Expedition of 1875.

The gallant enterprises of other countries rekindled the zeal of Great Britain for Arctic discovery; and in 1874 the prime minister announced that an expedition would be despatched in the following year. Two powerful steamers, the "Alert" and "Discovery," were selected for the service, and Captain George S. Nares was recalled from the "Challenger" expedition to act as leader. Commander Albert H. Markham, who had made a cruise up Baffin Bay and Barrow Strait in a whaler during the previous year, Lieut. Pelham Aldrich, an accomplished surveyor, and Captain Henry Wemyss Feilden, R.A., as naturalist, were also in the "Alert." The "Discovery" was commanded by Captain Henry F. Stephenson, with Lieut. Lewis A. Beaumont as first lieutenant. The expedition left Portsmouth on the 29th of May 1875, and entered Smith Sound in the last days of July. After much difficulty with drifting ice Lady Franklin Bay was reached in 81° 44′ N., where the "Discovery" was established in winter quarters. The "Alert" pressed onwards, and reached the edge of the heavy ice named by Nares the palaeocrystic sea, the ice-floes being from 80 to 100 ft. in thickness. Leaving Robeson Channel, the vessel made progress between the land and the grounded floe pieces, and passed the winter off the open coast and facing the great polar pack, in 82° 27′ N. Autumn travelling parties were despatched in September and October to lay out dépôts; and during the winter a complete scheme was matured for the examination of as much of the unknown area as possible, by the combined efforts of sledging parties from the two ships, in the ensuing spring. The parties started on the 3rd of April 1876. Captain Markham with Lieut. Parr advanced, in the face of great difficulties, over the polar pack to the latitude of 83° 20′ N. Lieut. Aldrich explored the coast-line to the westward, facing the frozen polar ocean, for a distance of 220 m. Lieut. Beaumont made discoveries of great interest along the northern coast of Greenland. The parties were attacked by scurvy, which increased the difficulty and hardships of the work a hundredfold. The expedition returned to England in October 1876. The "Alert" reached a higher latitude and wintered farther north than any ship had ever done before. The results of the expedition were the discovery of 300 m. of new coast line, the examination of part of the frozen polar ocean, a series of meteorological, magnetic and tidal observations at two points farther north than any such observations had ever been taken before, and large geological and natural history collections.

Voyages of the "Pandora."

In the same year 1875 Sir Allen Young undertook a voyage in his steam yacht the "Pandora" to attempt to force his way down Peel Sound to the magnetic pole, and if possible to make the north-west passage by rounding the eastern shore of King William Island. The "Pandora" entered Peel Sound on the 29th of August 1875, and proceeded down it much farther than any vessel had gone since it was passed by Franklin's two ships in 1846. Sir Allen reached a latitude of 72° 14′ N., and sighted Cape Bird, at the northern side of the western entrance of Bellot Strait. But here ice barred his progress, and he was obliged to retrace his track, returning to England on the 16th of October 1875. In the following year Sir Allen Young made another voyage in the "Pandora" to the entrance of Smith Sound.

Dutch Expeditions.

Lieut. Koolemans Beynen, a young Dutch officer, who had shared Young's two polar voyages, on his return successfully endeavoured to interest his countrymen in polar discovery. It was wisely determined that the first expeditions of Holland should be summer reconnaissances on a small scale. A sailing schooner of 79 tons was built at Amsterdam, and named the "Willem Barents." In her first cruise she was commanded by Lieut. A. de Bruyne, with Koolemans Beynen as second, and she sailed from Holland on the 6th of May 1878. Her instructions were to examine the ice in the Barents and Spitsbergen seas, take deep-sea soundings, and make natural history collections. She was also to erect memorials to early Dutch polar worthies at certain designated points. These instructions were ably and zealously carried out. Beynen died in the following year, but the work he initiated was carried on, the "Willem Barents" continuing to make annual polar cruises for many years.

Gore-Booth and Markham.

In 1879 Sir Henry Gore-Booth and Captain A. H. Markham, R.N., in the Norwegian schooner "Isbjörn" sailed along the west coast of Novaya Zemlya to its most northern point, passed through the Matochkin Shar to the east coast, and examined the ice in the direction of Franz Josef Land as far as 78° 24′ N., bringing home collections in various branches of natural history, and making useful observations on the drift and nature of the ice in the Barents and Kara Seas.

Leigh Smith.

In 1880 Mr B. Leigh Smith, who had previously made three voyages to Spitsbergen, reached Franz Josef Land in the polar steam yacht "Eira." It was observed that, while the Greenland icebergs are generally angular and peaked, those of Franz Josef Land are flat on the top, like the Antarctic bergs. The "Eira" sailed along the south side of Franz Josef Land to the westward and discovered 110 m. of coast-line of a new island named Alexandra Land, until the coast trended north-west. A landing was effected at several points, and valuable collections were made in natural history. In the following year the same explorer left Peterhead on the 14th of July; Franz Josef Land was sighted on the 23rd of July, and the "Eira" reached a point farther west than had been possible in her previous voyage. But in August the ship was caught in the ice, was nipped, and sank. A hut was built on shore in which Mr Leigh Smith and his crew passed the winter of 1881–1882, their health being well maintained, thanks to the exertions of Dr W. H. Neale. On the 21st of June 1882 they started in four boats to reach some vessels on the Novaya Zemlya coast. It was a most laborious and perilous voyage. They were first seen and welcomed by the "Willem Barents" on the 2nd of August, and soon afterwards were taken on board the "Hope," a whaler which had come out to search for them under the command of Sir Allen Young.

Professor A. E. Nordenskiöld, when he projected the achievement of the north-east passage, was a veteran polar explorer, for he had been in six previous expeditions to Greenland and Spitsbergen. In 1875 he turned his attention to the possibility of navigating the seas along the northern coast of Siberia. Captain Joseph Wiggins of Sunderland was a pioneer of this route, and his voyages in 1874, 1875 and 1876 led the way for a trade between the ports of Europe and the mouth of the Yenisei River.

Nordenskiöld and the N.E. Passage.

In June 1875 Professor Nordenskiöld sailed from Tromsö in the Norwegian vessel, the "Proven," reached the Yenisei by way of the Kara Sea, and discovered an excellent harbour on the eastern side of its mouth, which was named Port Dickson, in honour of Baron Oscar Dickson of Gothenburg, the munificent supporter of the Swedish expeditions. It having been suggested that the success of this voyage was due to the unusual state of the ice in 1875, Nordenskiöld undertook a voyage in the following year in the "Ymer," which was equally successful. By a minute study of the history of former attempts, and a careful consideration of all the circumstances, Professor Nordenskiöld convinced himself that the achievement of the north-east passage was feasible. The king of Sweden, Baron Oscar Dickson, and M. Sibiriakoff, a wealthy Siberian proprietor, supplied the funds, and the steamer "Vega" was purchased. Nordenskiöld was leader of the expedition, Lieut. Palander was appointed commander of the ship, and there was an efficient staff of officers and naturalists, including Lieut. Hovgaard of the Danish and Lieut. Bove of the Italian navy. A small steamer called the "Lena" was to keep company with the "Vega" as far as the mouth of the Lena, and they sailed from Gothenburg on the 4th of July 1878. On the morning of the 10th of August they left Port Dickson, and on the 19th they reached the most northern point of Siberia, Cape Chelyuskin, in 77° 41′ N. On leaving the extreme northern point of Asia a south-easterly course was steered, the sea being free from ice and very shallow. This absence of ice is to some extent due to the mass of warm water discharged by the great Siberian rivers during the summer. On the 27th of August the mouth of the river Lena was passed, and the "Vega" parted company with the little "Lena," continuing her course eastward. Professor Nordenskiöld very nearly made the north-east passage in one season; but towards the end of September the "Vega" was frozen in off the shore of a low plain in 67° 7′ N. and 173° 20′ W. near the settlements of the Chukchis. During the voyage very large and important natural history collections were made, and the interesting aboriginal tribe among whom the winter was passed was studied with great care. The interior was also explored for some distance. On the 18th of July 1879, after having been imprisoned by the ice for 294 days, the "Vega" again proceeded on her voyage and passed Bering Strait on the 20th. Sir Hugh Willoughby made his disastrous attempt in 1553. After a lapse of 326 years of intermittent effort, the north-east passage had at length been accomplished without the loss of a single life and without damage to the vessel. The "Vega" arrived at Yokohama on the 2nd of September 1879.

Schwatka.

In 1879 an enterprise was undertaken in the United States, with the object of throwing further light on the sad history of the retreat of the officers and men of Sir John Franklin's expedition, by examining the west coast of King William Island in the summer, when the snow is off the ground. The party consisted of Lieut. Schwatka of the United States army and three others. Wintering near the entrance of Chesterfield Inlet in Hudson Bay, they set out overland for the estuary of the Great Fish river, assisted by Eskimo and dogs, on the 1st of April 1879. They took only one month's provisions, their main reliance being upon the game afforded by the region to be traversed. The party obtained, during the journeys out and home, no less than 522 reindeer. After collecting various stories from the Eskimo at Montreal Island and at an inlet west of Cape Richardson, Schwatka crossed over to Cape Herschel on King William Land in June. He examined the western shore of the island with the greatest care for relics of Sir John Franklin's parties, as far as Cape Felix, the northern extremity. The return journey was commenced in November by ascending the Great Fish river for some distance and then marching over the intervening region to Hudson Bay. The cold of the winter months in that country is intense, the thermometer falling as low as −70° F., so that the return journey was most remarkable, and reflects the highest credit on Lieut. Schwatka and his companions. As regards the search little was left to be done after M'Clintock, but some graves were found, as well as a medal belonging to Lieut. Irving of H.M.S. "Terror," and some bones believed to be his, which were brought home and interred at Edinburgh.

De Long.

Mr Gordon Bennett, the proprietor of the *New York Herald*, having resolved to despatch an expedition of discovery at his own expense by way of Bering Strait, the "Pandora" was purchased from Sir Allen Young, and rechristened the "Jeannette." Lieut. de Long of the United States navy was appointed to command, and it was made a national undertaking by special act of Congress, the vessel being placed under martial law and officered from the navy. The "Jeannette" sailed from San Francisco on the 8th of July 1879, and was last seen steaming towards Wrangell Land on the 3rd of September. This land had been seen by Captain Kellett, in H.M.S. "Herald" on the 17th of August 1879, but no one had landed on it, and it was shown on the charts by a long dotted line. The "Jeannette" was provisioned for three years, but as no tidings had been received of her by 1881, two steamers were sent up Bering Strait in search. One of these, the "Rodgers," under Lieut. Berry, anchored in a good harbour on the south coast of Wrangell Land, in 70° 57′ N., on the 26th of August 1881. The land was explored by the officers of the "Rodgers" and found to be an island about 70 m. long by 28, with a ridge of hills traversing it east and west, the 71st parallel running along its southern shore. Lieut. Berry then proceeded to examine the ice to the northward, and attained a higher latitude by 21 m. than had ever been reached before on the Bering Strait meridian—namely, 73° 44′ N. No news was obtained of the "Jeannette," but soon afterwards melancholy tidings arrived from Siberia. After having been beset in heavy pack ice for twenty-two months, the "Jeannette" was crushed and sunk on the 13th of June 1881, in 77° 15′ N. lat., and 155° E. long. The officers and men dragged their boats over the ice to an island which was named Bennett Island, where they landed on the 29th of July. They reached one of the New Siberia Islands on the 10th of September, and on the 12th they set out for the mouth of the Lena. But in the same evening the three boats were separated in a gale of wind. A boat's crew with Mr Melville, the engineer, reached the Lena delta and searching for the other parties found the ship's books on the 14th of November, and resuming the search at the earliest possible moment in spring, Melville discovered the dead bodies of De Long and two of his crew on the 23rd of March 1882. They had perished from exhaustion and want of food. Three survivors of De Long's party had succeeded in making their way to a Siberian village; but the third boat's crew was lost. The "Rodgers" was burnt in its winter quarters, and one of the officers, W. H. Gilder (1838–1900), made a hazardous journey homewards through north-east Siberia.

Helland.

The Norwegian geologist Professor Amund Helland made an expedition to Greenland in 1875 and discovered the marvellously rapid movements of the Greenland glaciers.

Danes in Greenland.

The Danes have been very active in prosecuting discoveries and scientific investigations in Greenland, since the journey of Nordenskiöld in 1870. Lieut. Jensen made a gallant attempt to penetrate the inland ice in 1878, collecting important observations, and Dr Steenstrup, with Lieut. Hammar, closely investigated the formation of ice masses at Omenak and Jacobshavn. In 1883 an expedition under Lieuts. Holm and Garde began to explore the east coast of Greenland. In the summer of 1879 Captain Mourier, of the Danish man-of-war "Ingolf," sighted the coast from the 6th to the 10th of July, and was enabled to observe and delineate it from 68° 10′ N. to 65° 55′ N., this being the gap left between the discoveries of Scoresby in 1822 and those of Graah in 1829. Nansen sighted part of the same coast in 1882. Lieut. Hovgaard of the Danish navy, who accompanied Nordenskiöld in his discovery of the north-east passage, planned an expedition to ascertain if land existed to the north of

Cape Chelyuskin. He fitted out a small steamer called the "Dymphna" and sailed from Copenhagen in July 1882, but was unfortunately beset and obliged to winter in the Kara Sea. In 1883 Baron A. E. Nordenskiöld undertook another journey over the inland ice of Greenland. Starting from Auleitsivikfjord on the 4th of July, his party penetrated 84 m. eastward, and to an altitude of 5000 ft. The Laplanders who were of the party were sent farther on snow-shoes, travelling over a desert of snow to a height of 7000 ft. Useful results in physical geography and biology were obtained.

Circumpolar Stations.

On the 18th of September 1875 Lieut. Weyprecht, one of the discoverers of Franz Josef Land, read a paper before a large meeting of German naturalists at Graz on the scientific results to be obtained from polar research and the best means of securing them. He urged the importance of establishing a number of stations within or near the Arctic Circle, and also a ring of stations as near as possible to the Antarctic Circle, in order to record complete series of synchronous meteorological and magnetic observations. Lieut. Weyprecht did not live to see his suggestions carried into execution, but they bore fruit in due time. The various nations of Europe were represented at an international polar conference held at Hamburg in 1879 under the presidency of Dr Georg Neumayer, and at another at Berne in 1880; and it was decided that each nation should establish one or more stations where synchronous observations should be taken for a year from August 1882. This fine project was matured and successfully carried into execution. The stations arranged for in the North Polar region were at the following localities:—

Norwegians: *Bossekop*, Alten Fjord, Norway (M. Aksel S. Steen).
Swedes: *Ice Fjord*, Spitsbergen (Professor N. Ekholm).
Dutch: *Port Dickson*, mouth of Yenisei, Siberia (Dr M. Snellen).
Russians: { *Sagastyr Island*, mouth of Lena, Siberia (Lieut. Jürgens).
Novaya Zemlya, 72° 23′ N. (Lieut. C. Andreief).
Finns: *Sodankyla*, Finland (Professor S. Lemström).
Americans: { *Point Barrow*, North America (Lieut. P. H. Ray, U.S.A.).
Lady Franklin Bay, 81° 44′ N. (Lieut. A. W. Greely, U.S.A).
British: *Great Slave Lake*, Dominion of Canada (Lieut. H. P. Dawson).
Germans: *Cumberland Bay*, west side of Davis Strait (Dr W. Giese).
Danes: *Godthaab*, Greenland (Dr A. Paulsen).
Austrians: *Jan Mayen*, North Atlantic, 71° N. (Lieut. Wohlgemuth).

The whole scheme was successfully accomplished with the exception of the part assigned to the Dutch at Port Dickson. They started in the "Varna" but were beset in the Kara Sea and obliged to winter there. The "Varna" was lost, and the crew took refuge on board Lieut. Hovgaard's vessel, which was also forced to winter in the pack during 1882–1883. The scientific observations were kept up on both vessels during the time they were drifting with the ice.

Greely.

The American stations commenced work in 1882 and one of these furnished a rare example of heroic devotion to duty in face of difficulties due to the fault of those who should have brought relief at the appointed time. Lieut. A. W. Greely's party consisted of two other lieutenants, twenty sergeants and privates of the United States army, and Dr Pavy, an enthusiastic explorer who had been educated in France and had passed the previous winter among the Eskimo of Greenland. On the 11th of August 1881 the steamer "Proteus" conveyed Lieut. Greely and his party to Lady Franklin Bay during an exceptionally favourable season; a house was built at the "Discovery's" winter quarters, and they were left with two years' provisions. The regular series of observations was at once commenced, and two winters were passed without accident. Travelling parties were also sent out in the summer, dogs having been obtained at Disco. Lieut. Lockwood with twelve men and eleven sledges made a journey along the north coast of Greenland and reached Lockwood Island in 83° 24′ N. and 42° 45′ W., the highest latitude reached up to that time. From this island at a height of 2600 ft. on a clear day an unbroken expanse of ice was seen stretching to the northward, the view extending far beyond the 84th parallel. A promontory of the north coast of Greenland seen to the north-east in 83° 35′ N. was named Cape Washington. Vegetation was found at the extreme position and animal life was represented by foxes, hares, lemmings and ptarmigan. The party returned to Fort Conger on the 1st of June 1882 after an absence of 59 days. Greely made two journeys westward into the interior of Grinnell Land following up the northern branch of Chandler Fjord to a great sheet of frozen fresh water, Hazen Lake, with an area of about 500 sq. m. Beyond this, 175 m. from Fort Conger, he climbed Mt Arthur, 4500 ft., the highest summit of Grinnell Land, and saw distant mountains beyond a fjord to the southwest. In the spring of 1883 Lockwood made still more extensive journeys, crossing Grinnell Land to Greely Fjord, which entered the western sea. The central depression of Grinnell Land abounded in musk oxen and was free from ice, though the higher land to north and south lay under permanent ice-caps. Important as these geographical discoveries were, the main object of the expedition was the series of scientific observations at the headquarters, and these were carried out during the whole period with the most scrupulous exactness. As neither the relief ship which was to have been despatched in 1882, nor that in 1883, sent the expected relief to the station at Fort Conger, Lieut. Greely started from Lady Franklin Bay with his men in a steam launch and three boats on the 9th of August, expecting to find a vessel in Smith Sound. The boats were beset and had to be abandoned, the party reaching the shore across the ice with great difficulty, carrying their supplies of food, now rapidly diminishing. On the 21st of October 1883 they were obliged to encamp at Cape Sabine, on the western shore of Smith Sound, and build a hut for wintering. A few dépôts were found, which had been left by Sir George Nares and Lieut. Beebe, but all supplies were exhausted before the spring. Then came a time of indescribable misery and acute suffering. The party proved insubordinate and the sternest measures were required to maintain military discipline. When the sun returned in 1884 the poor fellows began to die of actual starvation; but it was not until the 22nd of June 1884 that the relieving steamers "Thetis" and "Bear" reached Cape Sabine. Lieut. Greely and six suffering companions were found just alive, but with all their scientific records, their instruments in order and the great collections of specimens intact. The failure of the relief expeditions to overcome difficulties which were child's play to what Greely and his companions had come through only enhances the splendid courage and determination of the heroic survivors.

Danish expeditions under Lieut. G. Holm explored the east coast of Greenland from Cape Farewell northwards in Eskimo boats between 1883 and 1885, and at Angmagssalik they encountered a tribe of Eskimo who had never seen white men before. Lieut. Ryder and Lieut. T. V. Garde continued the exploration of East Greenland, and Ryder explored the great Scoresby Fjord. Captain Holm established a missionary and meteorological station at Angmagssalik Fjord in 1894, from which the Danish government take charge of the Eskimo of that region. In 1892–1893 an expedition sent out by the Berlin Geographical Society under Dr Erich von Drygalski studied the ice formations on the west of Greenland.

Peary and Nansen in Greenland.

In July 1886 Lieut. Robert E. Peary, civil engineer, U.S. Navy, accompanied by the Dane Christian Maigaard, made a journey on the inland ice of Greenland eastward from Disco Bay in about 69° 30′ N. They reached a height of 7500 ft., when according to Peary's observations they were 100 m. from the coast, and then returned. Dr Fridtjof Nansen with Otto Sverdrup and five other companions, after overcoming great difficulties in penetrating the ice-floes, succeeded in landing on the east coast of Greenland in August 1888 in 64° 23′ N. and reached a height of 8920 ft. on the inland ice, which was crossed on ski to the west coast. The interior was found to be a nearly flat plateau of snow resembling a frozen ocean, and at the high altitude of more than 8000 ft. the cold was intense. The crossing occupied more than two weeks, and the party not having dogs had themselves to haul all their gear on sledges. As they approached the western edge of the ice their progress was checked by dangerous crevasses; but on the 26th of September they succeeded in reaching the west coast at the head of the Ameralik Fjord in 64° 12′ N., having traversed 260 m. of glacier. Nansen discovered that in that latitude the inland ice of Greenland has the form of a huge shield rising rather rapidly but regularly from the east coast to nearly 9000 ft., flat and even in the middle and falling again regularly toward the western side, completely enveloping the land. An important principle acted on for the first time in Arctic travel on this journey was that of starting from the less accessible side and pushing straight through with no possibility of turning back, and thus with no necessity for forming a base or traversing the same route twice over.

Peary spent the winter of 1891–1892 at Inglefield Gulf on the north-west coast of Greenland, Mrs Peary, Dr F. A. Cook, Eivind Astrup and a coloured servant Matthew Henson being in his party, and a large number of the Etah Eskimo in the vicinity. In April 1892 he set out for a journey across the inland ice to the north-eastward in the hope of reaching the east coast and also the northern extremity of the land. After getting well up on the ice-covered plateau a supporting party returned to winter quarters, while Peary and Astrup, with two companions and sixteen dogs, entered on the serious part of their work. The highest part of the inland ice was found to be about 5700 ft., and as usual after the first part of the descent, towards the north-east in this case, the surface was broken by numerous dangerous crevasses, progress amongst which was very slow. Great hardships were experienced from cold, insufficiency of food and the wearing out of sledges and clothes, but on the 4th of July, having left the ice and got on bare land in 81° 37′ N., where musk oxen and other game were found and flowers were growing, Peary was rewarded by a glimpse of the sea to the north-eastward, and named it from the date Independence Bay. He also traced a channel to the north beyond which lay a new land largely free from snow, no doubt the southern part of the island along the north of which Markham and Lockwood had travelled to their farthest north. The return journey to Inglefield Gulf was a wonderful feat of endurance, which was completed on the 4th of August; the total distance marched on the whole journey out and home was 1300 m. Peary returned to northern Greenland in 1893, having spent the whole time between the two expeditions in writing and lecturing in order to raise funds, for he travelled at his own charges. He landed on the shore of Inglefield Gulf on the 3rd of August and wintered there with a party of thirteen, including Mrs Peary, and there their daughter was born. Astrup was taken ill after starting on the great journey in March 1894, which was to have extended the explorations of the previous year, and had to return; others were severely frost-bitten, disease broke out amongst the dogs, and a month after the start Peary was only 130 m. from his base and had to return. Peary with two of his party, Hugh J. Lee and Matthew Henson, remained at Inglefield Gulf for another winter, and on the 1st of April 1895, with deer and walrus meat in place of pemmican, the supply of which had been lost, set out for Independence Bay. They reached the ice-free land when their food was exhausted and fortunately fell in with a herd of musk oxen, the meat from which made it possible to get back to Inglefield Gulf, though without adding anything material to the results of 1892. The experience of ice-travel and of Eskimo nature gained in the four years' almost continuous residence in northern Greenland were however destined to bear rich fruit.

Nansen; Drift of the "Fram."

Dr Nansen, after making an exhaustive study of the winds and currents of the Arctic Sea, and influenced largely by the occurrence of driftwood on the shores past which the ice-laden waters flowed southward between Greenland and Spitsbergen, satisfied himself that there was a general drift across the polar basin and perhaps across the Pole. He planned an expedition to take advantage of this drift on the principle which guided his crossing of Greenland, that of entering at the least accessible point and not turning back, thus having no line of retreat and making a relief expedition impossible. He planned a ship, the "Fram," which was immensely strong, to resist crushing, and of such a section that if nipped in the ice the opposing ice-masses would pass under her and lift her on to the surface. The plan of the expedition was based on scientific reasoning, but the methods were totally at variance with those of previous explorers. Otto Sverdrup, who had been one of Nansen's party in crossing Greenland, was captain of the "Fram," and the party included eleven others, the whole ship's company of thirteen living together on terms of social equality. Nansen paid the greatest possible attention to the provisions, and all the arrangements for the health and happiness of those on board were carefully thought out. The clothing of the expedition was as original in design as the ship; instead of having furs, thick woollen underclothing was adopted, with a light wind-proof material for the outer dress. The "Fram" left Christiania in the summer of 1893 and made her way through the Kara Sea and along the north coast of Asia until on the 20th of September she was run into the ice in 77° 30′ N., off the New Siberia Islands, and the great drift commenced. As anticipated, she rose to the pressure of the ice and was borne on an even keel high above the water for the whole duration of the drift. The movement of the ice was irregular, and on the 7th of November the "Fram" was back at her starting-point, but on the whole the movement was north-westward until the 15th of November 1895, when the highest latitude of the ship was attained, 85° 55′ N. in 66° 31′ E., the meridian of the east of Novaya Zemlya; then it was westward and finally southward until the ice was broken by blasting round the ship in June in 83° N. lat.; and after being afloat, though unable to make much progress until the middle of July, the "Fram" broke out of the ice off the north coast of Spitsbergen on the 13th of August 1896. No ship before or since has reached so high a latitude. In all her drift the "Fram" came in sight of no new land, but the soundings made through the ice proved that the Arctic Sea was of great depth, increasing towards the Pole, the greatest depth exceeding 2000 fathoms. The great mass of water filling the polar basin was comparatively warm, indicating free circulation with the Atlantic. It was established that the ice formed off the coast of Asia drifted across the polar basin in a period of from three to five years, and the hypothesis on the truth of which Nansen risked his success was abundantly verified by facts. The ship's company all returned in perfect health. After the second winter on the "Fram" at a time when the northward movement of the drift seemed to be checked, Nansen, accompanied by Lieut. Hjalmar Johansen, left the ship in order to explore the regions towards the Pole by travelling on ski with dog sledges carrying kayaks. It was obviously hopeless to attempt to find the drifting ship on their return, and Nansen intended to make for Spitsbergen in the hope of meeting one of the tourist steamers there. A more daring plan was never formed, and it was justified by success. Leaving the ship on the 14th of March 1895 in 84° N. 102° E., they made a fairly rapid march northward, reaching a latitude of 86° 5′ N. on the 8th of April, the nearest approach to the Pole so far achieved. Turning south-westwards they travelled with much difficulty, sometimes on the ice, sometimes in kayaks in the open lanes of water, incurring great danger from the attacks of bears and walrus, but at length reaching a group of new islands east of Franz Josef Land. They travelled westward through this archipelago until the 28th of August, when they built a small stone hut roofed with their light silk tent, in which they passed the winter on a land since called Frederick Jackson Island. There they lived like Eskimo on bear and walrus meat cooked over a blubber lamp. The journey southward was resumed in the spring of 1896, and on the 15th of June they met Mr F. G. Jackson, in whose relief ship, the "Windward," they returned to Norway. Nansen and Johansen reached Vardö on the 13th of August 1896 full of anxiety for the fate of their old comrades, when by a coincidence unparalleled in the history of exploration, the "Fram" was on that very day breaking out of the ice off Spitsbergen and the original party of thirteen was reunited at Tromsö the following week and returned together to Christiania. On this remarkable expedition no life was lost and the ship came back undamaged under the skilled guidance of Sverdrup with a great harvest of scientific results.

Mr Frederick George Jackson planned an exploring expedition

Jackson-Harmsworth Expedition.

to attain a high latitude by the Franz Josef Land route and was supported financially by Mr A. C. Harmsworth (Lord Northcliffe). He was accompanied by Lieut. Albert Armitage, R.N.R., as second in command and six scientific men, including Dr Reginald Koettlitz; Dr W. S. Bruce also was one of the number in the second year. The Jackson-Harmsworth expedition sailed in 1894, and was landed at Cape Flora, where log houses were built. In the spring of 1895 Jackson made a journey northward to 81° 19′ N., the highest latitude reached, and added considerably to our knowledge of the archipelago by discovering a channel between groups of islands west of the Austria Sound of Payer. He made numerous other journeys by land and in boats, and surveyed a considerable portion of the islands on which he landed, the most interesting being that of 1897, to the western portion of the group. The geological collections were of some value and the specimens secured indicated that Franz Josef Land and Spitsbergen were parts of an extensive land existing in Tertiary times. The expedition returned in 1897.

In 1897 and subsequent years a party led by Sir Martin Conway explored the interior of Spitsbergen. Dr A. G. Nathorst, the Swedish geologist, explored the eastern coast and off-lying islands, and made important observations on North-East Land, circumnavigating the Spitsbergen archipelago in 1898. In 1899 Nathorst visited the north-east coast of Greenland in search of Andrée's balloon expedition, and here he mapped Franz Josef Fjord and discovered the great King Oscar Fjord in waters that had never been navigated before.

In subsequent years valuable surveys and scientific observations were made by the Prince of Monaco in his yacht "Princesse Alice," by Dr W. S. Bruce, notably on Prince Charles Foreland, and by others. Franz Josef Land was visited by the American explorer W. Wellman in 1898 and 1900, and his companion E. Baldwin in the former year made the discovery of several islands in the east of the archipelago. A wealthy American, W. Zeigler, also sent out expeditions to Franz Josef Land in 1901 and between 1903 and 1905, in the course of which A. Fiala reached the high latitude of 82° 4′ N. in the "America," but the ship was afterwards lost in Teplitz Bay. These expeditions added little to our knowledge of polar geography, but some useful meteorological, magnetic and tidal observations were made.

Duke of the Abruzzi.

The Italian expedition under the command of H.R.H. Prince Luigi, duke of the Abruzzi, was the most successful of all those which have attempted to reach high latitudes by way of Franz Josef Land. Embarking in the summer of 1899 on the "Stella Polare" (formerly the Norwegian whaler "Jason" which had landed Nansen on the east coast of Greenland in 1888) the expedition put into Teplitz Bay in Rudolf Land, where they wintered and there the ship was seriously damaged by the ice. In the spring of 1900 a determined effort was made to reach the North Pole by sledging over the sea-ice. The duke of the Abruzzi having been disabled by frost-bite, the leadership of the northern party devolved upon Captain Umberto Cagni of the Italian navy, who started on the 11th of March 1900 with ten men (Alpine guides and Italian sailors) and nearly a hundred dogs. His plan was to sledge northward over the sea-ice, sending back two parties as the diminishing stores allowed the advance party to take on the whole of the supplies destined to support them on their way to the Pole and back. Before losing sight of Rudolf Island three men forming the first party started to return, but they never reached winter quarters and all must have perished. The second party went back from latitude 83° 10′ N., and reached their base in safety. Cagni pushed on with three companions, determined if he could not reach the Pole at least to outdistance his predecessor Nansen, and on the 25th of April 1900 he succeeded in reaching 86° 34′ N. in 65° 20′ E. Diminishing food supplies made it necessary to turn at this point, and although he had reached it in 45 days it took Cagni 60 days to return. The advance of summer loosened the ice-floes, and the westward component of the drift of the pack became a more and more serious danger, threatening to carry the party past Franz Josef Land without sighting it. Fortunately Cape Mill, a headland of characteristic outline, was sighted just in time, and with this as a guide the party succeeded in reaching Teplitz Bay, having eaten the last of their dogs and been reduced to great extremities. At the farthest north no land was visible, the rough sea-ice extending to the horizon on every side.

Andrée.

As early as 1895 a scheme for an exploring expedition in a balloon was put forward seriously, and in 1897 the Swedish aeronaut S. A. Andrée carried it out. He had brought a balloon to Danes Island, in the north of Spitsbergen, the previous year, but the weather was unpropitious and the ascent had to be postponed. On the 11th of July 1897 he started in a new and larger balloon with about five tons of supplies and two companions. It was hoped that the balloon could be steered to some extent by the use of heavy guide ropes dragging over the ice, and Andrée had already made successful flights in this way. Rising at 2.30 p.m. the balloon was out of sight of Danes Island in an hour. At 10 p.m. Andrée threw out a buoy containing a message which was recovered, and this stated that the balloon was in 82° N. 25° E., moving towards the north-east at an altitude of 800 ft. above a rugged ice-field. This was the last news received, and although scarcely a year has passed without some rumour of the balloon having been found in Siberia or North America, nothing further has ever been ascertained.

Makaroff.

In 1899 Admiral Makaroff of the Russian navy arranged for the trial trip of the great ice-breaker "Yermak," which he designed, to take the form of an expedition into the sea-ice off Spitsbergen. Though no high latitude was attained on this occasion he formed the opinion that a vessel of sufficient size and power could force a passage even to the Pole. The Russian-Japanese War put an end to the polar projects of this gifted man of science.

Sverdrup.

Captain Otto Sverdrup, who had been Nansen's companion on his two polar expeditions, planned an Arctic voyage for the circumnavigation of Greenland, and the "Fram" was altered and refitted to suit her for the work. Starting in 1899, he was obliged to abandon the attempt to get northward through Smith Sound, and making his way westward into Jones Sound he spent three years in exploring and mapping the portion of the Arctic archipelago which lay to the north of the field of labour of the Franklin search expeditions. Ellesmere and Grinnell Lands were shown to be part of one large land mass called King Oscar Land, which is separated by a narrow channel, Eureka Sound, from an extensive island named Axel Heiberg Land. Two of his party (Isachsen and Hassel) discovered and explored two islands west of Heiberg Land, and Dr Schei made most valuable observations on the geology of the whole of the district examined. Sverdrup's journeys cleared up a great deal of uncertainty regarding the geography of the least known portion of the Arctic archipelago, and leave little more to be done in that quarter. He brought the "Fram" safely back to Norway in 1903.

Many American whalers working in the sea reached through Bering Strait believe that land of considerable extent lies farther west than the Arctic archipelago, north of the mouth of the Mackenzie River, but neither the English traveller A. H. Harrison in 1905, nor the Dane Einar Mikkelsen in 1907, was able to find any trace of it, though the latter sledged over the sea ice as far as 72° N., where in 150° W. he got a sounding of 339 fathoms with no bottom. This depth makes it somewhat improbable that land exists in that quarter.

Baron Toll.

Russian surveyors and explorers continued to map portions of the Siberian coast, and in 1886 Dr Bunge and Baron Toll visited the New Siberia Islands and made known the remarkable remains of mammoths which exist there in great numbers. In 1893 Baron Toll made an important geological expedition to the islands, discovering many well-preserved remains of mammoths and other extinct mammals and finding evidence that in the mammoth period trees grew at least as far as 74° N. Indefatigable in the pursuit of his studies, Toll set out once more in 1901 on board the

"Zarya," hoping to reach Sannikoff Island, the most northern and still unvisited portion of the New Siberia group. In August 1902 he reached Bennet Island with the astronomer Seeberg and two men; he found the island to be a plateau about 1500 ft. in elevation, and remained there until November studying the geological features. Nothing more was heard of the expedition, and a relief expedition in 1904, under Lieuts. Brusneff and Kolchak, failed to find any trace of the explorers beyond a record left on Bennet Island, which gave a summary of their movements up to the time of leaving the island.

Amundsen.

In 1901 Captain Roald Amundsen, a Norwegian, who had been mate on the "Belgica" in her Antarctic voyage, planned an expedition to the area of the north magnetic pole visited by Sir James Ross in 1831, in order to re-locate it, and as a secondary object he had in view the accomplishment of the North-West Passage by water for the first time, M'Clure not having carried his ship through from sea to sea. A small Norwegian sealing sloop, the "Gjöa," the cabin of which measured only 9 ft. by 6, was fitted with a petroleum motor engine of 39 h.p. for use in calm weather and strengthened to withstand ice-pressure. She left Christiania on the 17th of June 1903 with a total company of six men, second in command being Lieut. Godfred Hansen of the Danish navy. She passed through Lancaster Sound and worked her way down the west side of Boothia Felix in August, and took up winter quarters in Gjöa Harbour at the head of Petersen Bay in King William Land. Here the little vessel remained for two years while magnetic and meteorological observations were carried out, and sledging excursions were made to the magnetic pole and along the coasts of Victoria Land, which was charted up to 72° N. In August 1905 the "Gjöa" proceeded westward along the American coast but was frozen in off King Point for a third winter. On the 11th of July 1906 she got free, and after much difficulty with the ice reached Bering Strait on the 30th of August and entered the Pacific, the first ship to pass from ocean to ocean north of Patagonia.

Danish explorers have continued to concentrate their attention on the problems of Greenland, and especially the geography of the east coast. Lieut. G. D. Amdrup, in a series of expeditions between 1898 and 1900, charted the coast-line as far north as 70° 15′ N., and made important scientific observations and collections. From time to time whalers reached the east Greenland coast at points in high latitudes. The duke of Orleans in the "Belgica," under the command of Captain Gerlache, made an important voyage in 1905, in the course of which he cruised along the coast of Germania Land between 76° and 78° N., and fixed the general outline of the land up to that latitude. This expedition did a large amount of scientific work, especially in oceanography. The stream of sea-ice which presses outwards from the polar basin every summer bears close against the east coast of Greenland, and exploration by sea has always proved exceedingly difficult and precarious, success depending very much on the occurrence of chance leads amongst the ice. Taking advantage of all previous experience, the most important of the Danish expeditions was planned by L. Mylius-Erichsen in 1905, the expenses being partly raised by private subscriptions and partly provided by the Danish government. He sailed in the "Danmark" in June 1906 and found winter quarters in Danmarkhaven, 75° 43′ N., where the ship remained for two years, while systematic magnetic and meteorological observations were kept up at the base and the main work of exploring to the northward was carried on by sledge. From existing maps it was believed that about 620 m. of coast separated the winter quarters from the northern point of Greenland, but when the sledge expedition went out in 1907 the coast was found to curve much farther to the eastward than had been anticipated, and the outward journey extended to 800 m. Having left the winter quarters on the 28th of March 1907, Mylius-Erichsen, with Captain Koch, Hagen, an educated Eskimo, Brönlund and two others, reached North-East Foreland, the eastern extremity of Greenland (81° 20′ N., 11° 15′ W.). Here they divided; Koch with Berthelsen and the Eskimo Tobias went north-westward to explore the east coast of Peary Land, and succeeded in reaching the northernmost extremity of the land beyond Cape Bridgman in 83° 30′ N. From this great journey he returned in safety to winter quarters, arriving on the 24th of June. Meanwhile Mylius-Erichsen, with Hagen and the Eskimo Brönlund, followed the coast westward into what was believed to be the Independence Bay seen from a distance by Peary; this turned out to be a deep inlet now named Danmark Fjord. Keeping to the coast, they entered the great channel separating the mainland of Greenland from Peary Land, and surveyed Hagen Fjord on the southern shore and Brönlund Fjord on the northern shore of the strait. They had pushed on to Cape Glacier in 82° N. and 35° W. by the 14th of June 1907, within sight of Navy Cliff, which had been Peary's farthest coming from the west side, and here the softness of the snow kept them all summer. When they could travel, more than a fortnight was wasted adrift on a floe in the effort to cross Danmark Fjord. Here the sun left them, while they were without food, almost worn out and more than 500 m. from the ship. It was impossible to attempt the long journey round the coast, and the only chance of safety, and that a very slender one, was to make a way southward over the inland ice and so cut off the eastern horn of Greenland which the expedition had discovered. Under the most terrible difficulties, with only four starved dogs, and their equipment going to pieces, they accomplished the feat of marching 160 m. in 26 days, and reached the east coast again in 79° N. Hagen died on the way; Mylius-Erichsen himself struggled on until he nearly reached the provisions left on Lambert Island on the northern journey; but he too perished, and only Brönlund reached the supplies. He was frost-bitten and unable to proceed further, and after recording the tragedy of the return journey in his diary, he died also alone in the Arctic night. His body and the records of the great journey were discovered in the following year by Koch, who started on a relief expedition as soon as travelling became possible. The results of this expedition are a splendid monument to the courage and devotion of the leader and his followers. The channel between Spitsbergen and Greenland was shown by their efforts to be far narrower than had previously been supposed, and the outline of Greenland itself was fixed for the first time, and that by an extremely accurate survey.

Mylius-Erichsen.

Peary.

There only remains one further episode to bring the history of polar exploration up to 1910, but that is the crowning event of four hundred years of unceasing effort, the attainment of the Pole itself; and it was accomplished by the undaunted perseverance of one man who would never accept defeat. After the return of the Jackson-Harmsworth expedition, Lord Northcliffe presented the "Windward" to Lieut. Peary, who resumed in 1898 his systematic explorations of the Smith Sound region in the hope of finding a way to the Pole. He was not restrained by the precedents of earlier travellers and made some long sledge journeys in the winter of 1898–1899, having his feet badly frost-bitten and losing eight toes. Even this crippling did not stop his work. He wintered amongst the Etah Eskimo in 1899–1900 and next spring made a successful journey to the most northerly land north of Greenland in 83° 35′ where the land had an abundant flora and fauna, and he pushed north over the sea-ice for twenty miles farther, reaching 83° 54′ N. Peary wintered again at Fort Conger in 1900–1901, and for the fourth year in succession he went through the Arctic winter, 1901–1902, at Payer Harbour. In the spring of 1902 he made a great journey to Cape Hecla in the north of Grant Land and thence northward over the frozen sea to 84° 17′ N. in 70° W. Frequent open leads of water and the moving of the ice-floes made further advance impossible, and after an unparalleled sojourn in the farthest north, Peary returned to the United States. The Peary Arctic Club of New York, formed to support this indomitable explorer, provided funds for a new expedition and a ship differing in some respects from those hitherto employed and named the "Roosevelt." In her he proceeded in the summer of 1905 through Smith Sound and the northern channels to Cape Sheridan on the north coast of Grant Land, Captain Robert Bartlett being in command of the ship. From this point he advanced by sledge to Cape Hecla, whence he made a most strenuous attempt to reach the North Pole. Organizing his large following of trained Eskimo, whose confidence in him had been won by many years of friendship, and his few white companions in separate parties, each complete in itself and well furnished with dogs and food, he set off at the end of February 1906. A very broad lead of open water was encountered in 84° 38′ N., and as the party did not carry kayaks much time was lost in getting across. The floes had a marked eastward drift and it was difficult to make progress northward; however, Peary struggled on by forced marches to 87° 6′ N., which he reached on the 21st of April 1906, the most northerly point so far attained. His return journey was the most dangerous in his experience; many leads had to be crossed, sometimes on ice so thin that it bent beneath the weight of the explorers, provisions were exhausted and the men were reduced to eating their dogs before they made land at Cape Neumayer in the north of Greenland, where game was found, and whence the return to the ship was comparatively easy.

Peary's Journey to the North Pole.

Returning to America, Peary prepared for a last attempt. The "Roosevelt" was overhauled and various defects made good, but not in time for the summer of 1907. Leaving New York in July 1908 the "Roosevelt," again under the command of R. Bartlett, brought the party, with the Eskimo who were picked up on the way, to Cape Sheridan by the 5th of September. During the winter all supplies were transported to Cape Columbia, farther west on the coast of Grant Land. Here there were ready to start in the first light of the Arctic day seven explorers, 17 picked Eskimo and 133 of the best dogs in Greenland with 19 sledges. As the outcome of all Peary's experience the expedition was arranged to consist of a lightly equipped advance party to select the route and make the trail by clearing a way through rough ice, and a main party composed of units of four men each with sledges containing all their requirements marching one day behind the pioneer party. From this unit parties were to return southward at intervals with the empty sledges, leaving the diminished main party to push on fully provisioned. The "big lead" which marks the edge of the continental shelf in 84° N. was crossed after some delay and here the sun appeared for the first time on the 5th of March 1909. Dr MacMillan with three Eskimo and three sledges returned along the outward trail after the 7th of March from 84° 29′ N. A sounding at this point showed the depth of the sea to be 825 fathoms. After five more marches G. Borup turned back in 85° 23′ with three Eskimo and three sledges, the best Eskimo and dogs remaining with the main party. From this point the advance was regular; the pioneer party started from the snow-houses they had built and slept in when the main party arrived, and while the latter slept the pioneers marched, selected a camp, built new snow-houses, and slept till the main party came up. At 86° 38′ N. Prof. R. G. Marvin turned back, as usual with the three worst Eskimo and the worst dogs. His party reached the ship, but he himself was drowned in recrossing the "big lead," the only casualty of the expedition. At 88° N. Bartlett turned back on the 1st of April in accordance with the system with two Eskimo, one sledge and 18 dogs. Up to this point Peary had saved himself as much as possible, leaving the path-finding and the observations to his very competent colleagues; but now he put forth all his strength for the arduous 140 m. which separated him from the Pole. He was accompanied by Henson and four Eskimo. The ice improved as he went on and it was possible to do 25 m. in a daily march of 10 hours, and on one occasion 30 m. in 12 hours. On the 6th of April an observation gave 89° 57′ N., and here a camp was made and observations taken throughout 24 hours to fix the position, as well as excursions a few miles farther on and a few miles to right and left so as to be sure of actually reaching the Pole. No land was to be seen, and a sounding through the ice gave a depth of 1500 fathoms with no bottom. The American flag was hoisted; the goal of all the ages of exploration had been reached.

The return journey was quick and easy. The tracks kept open by the passage of the various return parties were distinct enough to follow, the snow-houses stood ready for sheltering at the end of each march, and a northerly gale kept the ice pressed well together and the leads closed. On the 23rd of April Cape Columbia was reached and soon after the party was safe on board the "Roosevelt." Success was due to the accumulated experience of twenty-three years' constant Arctic work, and to the thorough acquaintance with the Eskimo and their dogs, which enabled the best work to be got out of them.

F. A. Cook.

Dr F. A. Cook spent two years in the Arctic regions, 1907–1909, and claimed to have reached the Pole by sledging alone with two Eskimo a year before Peary. He submitted the evidence for this achievement to the university of Copenhagen, which failed to find it satisfactory, and Dr Cook did not appear to challenge this decision.

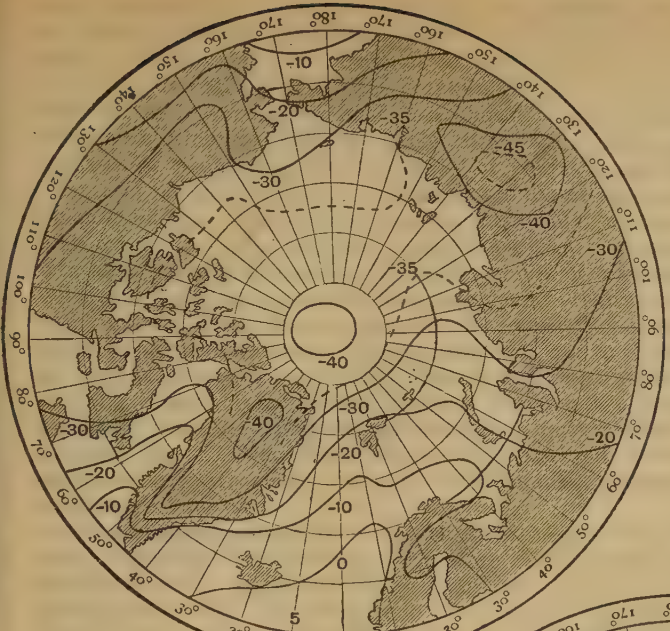
PHYSIOGRAPHY OF THE ARCTIC REGION

Geology.—Although much remains to be done in the exploration of the North Polar area, the main features of the physical geography of the region have been determined beyond any reasonable doubt. Within the Arctic Circle the northern portions of Europe, Asia, America and Greenland surround a central area of deep sea, the southern margin of which forms a broad continental shelf bearing many islands. The ring of land and shallow sea is broken only by the broad channel between Greenland and Europe through which Atlantic water gains an entrance to the Arctic Sea. The physical conditions of this sea, which covers the greater part of the Arctic regions, are dealt with later in detail; but there is less to be said regarding the land.

In a climate which taxes human powers to the utmost to carry on the simplest route-surveys in the course of an exploring expedition, and in the presence of a snow covering which is permanent on all high ground and only disappears for a short time in summer, even on the shores and islands, it is obvious that any knowledge of the geology must be difficult to obtain. On the earlier Arctic expeditions enthusiastic collectors brought together quantities of specimens, many of which it was found impossible to bring home, and they have been found abandoned by later travellers. As Arctic exploration was usually carried out on the sea or over the sea-ice even those expeditions in which experienced geologists took part furnished few opportunities for making investigations. The result is that the geology of the Arctic lands has to be inferred from observations made at isolated points where the fortune of the ice stopped the ship, or where on land journeys a favourable exposure was found. Almost every geological formation is known to be represented, from the Archaean to the Quaternary, and there is a general resemblance in the known geological features of most of the great Arctic islands. The fundamental rock in all appears to be Archaean gneiss. In the extreme north-east Carboniferous strata have recently been discovered similar to the Carboniferous rocks of Spitsbergen. The Jurassic rocks farther south are in places capped by Cretaceous beds, and closely resemble the Jurassic rocks of Spitsbergen, Franz Josef Land and the northern parts of Norway and Russia. Cretaceous and Tertiary rocks are found on the west coast of Greenland covered over by great flows of basalt, probably of Tertiary age, at Disco Island, Nugsuak Peninsula and various points farther north. The only mineral of economic value found in Greenland is cryolite, which is mined at Ivigtut in the south-west. Native iron occurs in considerable masses in several places, some of it undoubtedly of telluric origin, though some is probably meteoric.

The second "Fram" expedition confirmed and extended the geological observations of the Franklin search expeditions on the American Arctic archipelago, and showed the presence above the Archaean rocks of Cambrian, Silurian and Devonian strata, the Silurian being represented by a widespread brown limestone abounding in fossils. Carboniferous limestones also occur and less extensive beds of quartz sandstones, schists and limestones containing ammonites and other Mesozoic fossils. Tertiary

POLAR REGIONS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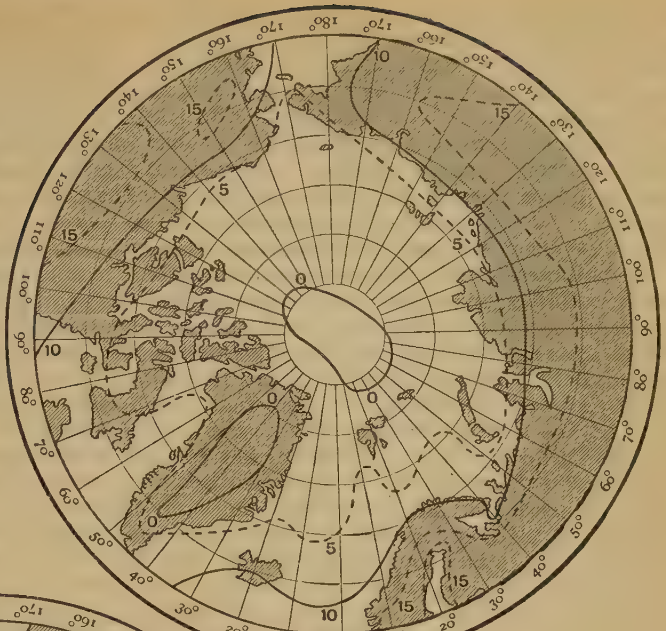
1. Isotherms, January.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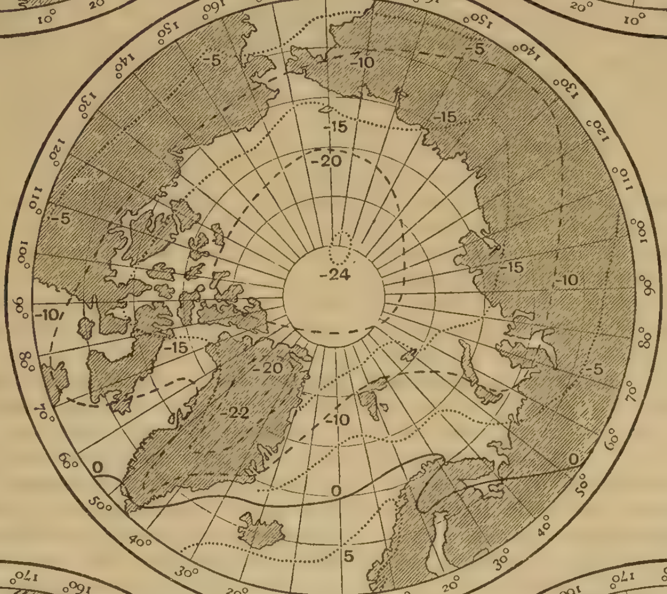
2. Isotherms, July.

ISOTHERMAL CHARTS.

Temperature in degrees Centigrade ; 0°=32° F., −17·8°=0° F.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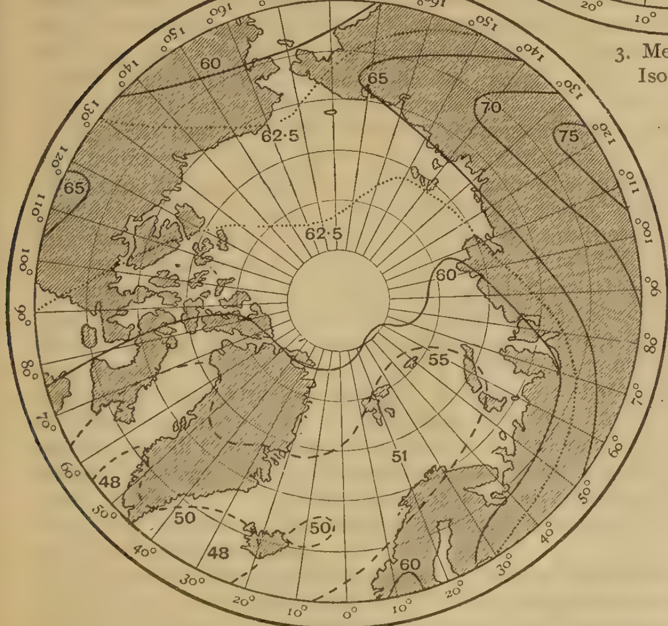
3. Mean Annual Isotherms.

ISOBARIC CHARTS

Pressure in millimetres, the Figures indicating the addition to 700. Thus on the charts 55 = 755 mm. = 29·7 in. to the nearest tenth ; 60=760 mm.=29·9 in. ; 65=765 mm.=30·1 in. ; 75=755 mm.=30·5 in.

4 Isobars, January.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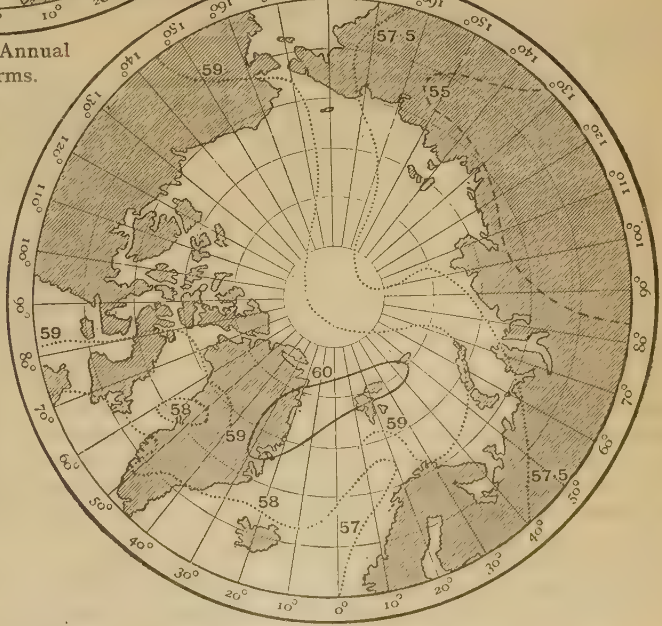
50
48
60

5. Isobars, July.


57·5
59
55
59
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57·5
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57

From the North Pole Expedition, 1893–1896, *Scientific Results*, edited by Fridtjof Nansen, by permission of the Fridtjof Nansen Fund for the Advancement of Science.

rocks including beds of lignite and plant fossils of Miocene age also occur, and they are interstratified and overspread with basalts and other eruptive rocks as in Greenland. In Grant Land Tertiary coal occurs in Lady Franklin Bay (81° 45′ N.), the most northerly deposit of fossil fuel known. Arctic Canada consists of Archaean and Palaeozoic rocks worn down into plateaux or plains and bearing marks of glacial action, the absence of which is the most remarkable feature of the tundra region of Siberia. The Siberian coast is superficially formed to a large extent of frozen soil and gravel sometimes interbedded with clear ice, and in this soil the frozen bodies of mammoths and other Quaternary animals have been found preserved in a fresh condition by the low temperature. The absence of a glacial period in northern Siberia is probably indirectly due to the very low temperature which prevailed there, preventing the access of water vapour from without and so stopping the supply required to produce sufficient precipitation to form glaciers or ice-caps. On the New Siberia Islands Silurian and Tertiary rocks have been recognized, the latter with abundant deposits of fossil wood.

The geological evidence is complete as to the existence of a genial climate in Tertiary times as far north as the present land extends, and of a climate less severe than that of to-day in the Quaternary period. The existence of raised sea margins in many Arctic lands and especially in the American Arctic archipelago bears evidence to a recent elevation of the land, or a withdrawal of the sea, which has been influential in forming some of the most prominent features of the present configuration.

It is noteworthy that no great mountain range runs into the Arctic region. The Rocky Mountains on the west and the Ural range on the east die down to insignificant elevations before reaching the Arctic Circle. The plateau of Greenland forms the loftiest mass of Arctic land, but the thickness of the ice cap is unknown. The one active volcano within the Arctic Circle is on the little island of Jan Mayen.

The Arctic Climate.—As the water of the Arctic Sea is free from ice around the margin only for a few months in summer, and is covered at all times over its great expanse with thick ice in slow uneasy motion, there is less contrast in climate between land and sea, especially in winter, than in other parts of the world. The climate of the polar area may be described as the most characteristic of all the natural features, and observations of temperature and pressure are more numerous and systematic than any other scientific observations. The Russian meteorological system includes Siberia, and long series of observations exist from stations up to and within the Arctic Circle. The Canadian Meteorological Service has secured like observations for the extreme north of North America, though the records are more fragmentary and of shorter duration. Norway and Iceland also yield many records on the margin of the Arctic Circle. The international circum-polar stations maintained during 1882 connected the Siberian, Norwegian and Canadian land stations with the more fragmentary work of the various polar expeditions which have wintered from time to time in high latitudes. The most valuable records and practically the only data available for the climate north of 84° are those of the first expedition of the "Fram" in her three years' drift across the polar basin. Later expeditions beyond the 84th parallel were merely dashes of a few weeks' duration, the records from which, however accurate, are of an altogether different order of importance. The data collected by the "Fram" were discussed in great detail by Professor H. Mohn in 1904, and that eminent authority combined them with all that had been known previously, and all that was ascertained by later explorers up to the return of Captain Sverdrup from the second "Fram" expedition, so as to give the completest account ever attempted of the climate of the North Polar regions, and on this we rely mainly for the following summary.

Temperature.—From Professor Mohn's maps of the isotherms north of 60° N. it is evident that the temperature reduced to sea-level is lowest in the winter months within an area stretching across the pole from the interior of Greenland to the middle of Siberia, the long axis of this very cold area being in the meridian of 40° W. and 140° E. For every month from October to April the mean temperature of this cold area is below 0° F., and in the two coldest months there are three very cold areas or poles of cold with temperatures below −40° arranged along the axis. These are the interior of Greenland, an area around the North Pole and the centre of Northern Siberia. Professor Mohn is satisfied that these three poles of cold are separated by somewhat warmer belts, as observations on the north coast of Greenland show a temperature higher both than the temperature of the interior reduced to sea-level and the temperature on the frozen sea farther north. As summer advances the temperature rises to the freezing point most rapidly in North America, the mean temperature for June, July and August for the American coast and the Arctic archipelago being above the freezing point. In July and August the Arctic shores in America, Asia and Europe have a mean air-temperature of about 40° F., but the interior of Greenland and the area round the North Pole remain below 32°, those two poles of cold persisting throughout the year while the winter cold pole in Asia disappears in summer.[1] There is no reason to doubt that in winter the Asiatic area is the coldest part of the Arctic region, and as it is permanently inhabited it is plain that low temperature alone is no bar to the wintering of expeditions in any part of the North Polar region. The lowest temperature experienced during the drift of the "Fram" was −62° F., on the 12th of March 1894 in lat. 79° 41′, long. 134° 17′ E. The minimum temperatures recorded on Sir George Nares's expedition were −73·8° F. on the "Alert" in 82° 27′ N. and −70·8° on the "Discovery" in 81° 44′ N., both in March 1876, and the minimum on Sverdrup's expedition in Jones Sound in 76° 50′ N. was −60° F. in January 1901. In February 1882 Greely recorded −66·2° at Fort Conger, 81° 44′ N., and at Fort Constance in Canada (66° 40′ N. 119° W.) a temperature of −72° F. was noted in January 1851. The lowest temperature ever recorded on the earth's surface was probably that experienced at Verkhoyansk in Siberia (67° 34′ N.) where the absolute minimum in the month of February was −93·6°, and minima of −70° or more have been recorded in every winter month from November to March inclusive, and as the absolute maximum in July was +92·7° F. the total range experienced is no less than 186·3°, far exceeding that known in any other part of the world.

The normal monthly mean temperatures for various parallels of latitude are given as follows by Professor Mohn, the last column showing the calculated conditions at the North Pole itself expressed to the nearest degree.

	Normal Air Temperature for Latitudes in °F.			
	65° N.	70° N.	80° N.	90° N.
January . . .	− 9·4	−15·3	−26·0	−42
February . . .	− 6·7	−14·5	−26·5	−42
March . . .	+ 3·0	− 8·3	−23·1	−31
April . . .	19·0	+ 6·8	− 8·9	−18
May . . .	34·7	24·1	+14·0	+ 9
June . . .	48·6	37·9	30·0	28
July . . .	54·7	45·0	35·6	30
August . . .	50·6	43·2	32·7	27
September . .	40·7	32·5	18·1	9
October . . .	24·6	15·3	− 2·4	−11
November . .	5·8	− 0·6	−11·0	−27
December . . .	− 5·1	−10·5	−19·1	−36
Year . . .	21·7	12·9	1·1	− 9

The interior of Greenland is believed to be below the normal temperature for the latitude in all months and so is the region between Bering Strait and the Pole; the Norwegian Sea, and the region north of it as far as the Pole, has a temperature above the normal for the latitude in all months; while the temperature in the northern continents is below the normal in winter and above the normal in summer.

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[1] It must be remembered that for cartographical purposes temperature is reduced to its value at sea-level, allowing for a change of 1° F. in about 300 ft. Thus the actual temperature on the snowcap of Greenland at the height of 9000 ft. is 30° F. lower at all seasons than is shown on an isothermal map, and that of Verkhoyansk (500 ft.) is only 1·5° F. lower than is charted.

The "Fram" observations showed that while the ordinary diurnal range of temperature prevailed for the months when the sun was above the horizon during some part of the day, there was also a diurnal range in the winter months when the sun did not appear, the minimum then occurring about 2 p.m. and the maximum about 1 a.m., the "day" being colder than the "night." Except in July and August the temperature was always found to be lower with the weaker winds and higher with the stronger winds irrespective of direction. Extraordinarily rapid variations of temperature have been observed in the winter months, on one occasion in February 1896 (north of 84° N.) the thermometer rising within 24 hours from −45·4° to +22·3° F., a rise of 67·7°.

Cloud and Precipitation.—The amount of cloud in the far north is greater in the daytime than at night, the summer months being cloudy, the winter very clear, and the amount is greater with the stronger winds and less with the weaker winds. Precipitation is most frequent in the summer months, the "Fram" results showing an average of 20 days per month from May to September; while from October to April the average was only 11½ days per month. Rain was only observed in the months from May to September; but snow occurs in every month and is most frequent in May and June, least frequent in November and December, which are the months of minimum precipitation. It has never been possible to make satisfactory measurements of the amount of precipitation in the Arctic regions on account of the drifting of snow with high wind. Fogs occur most frequently in July and August (20 or 16 days per month); they are practically unknown between November and April.

Pressure.—The "Fram" observations enabled Professor Mohn to revise and extend the isobaric maps of Dr Buchan, the correctness of which was strikingly confirmed. The Atlantic and Pacific low pressure areas are found at all seasons on the margin of the Arctic area, the position shifting a little in longitude from month to month. The two low pressures are separated in the winter months by a ridge of high pressure (exceeding 30·00 in.) stretching from the Canadian to the Siberian side between the North Pole and Bering Strait; this ridge has been termed by Professor Supan "the Arctic wind divide." In April the high pressure over Asia gives way and an intense low pressure area takes its place during the summer, uniting in August with the less intense low-pressure area which develops later over Canada, and reducing the Arctic high pressure area to an irregular belt extending from North Greenland to Franz Josef Land on the Atlantic side of the Pole. The general pressure over the polar area is much higher in winter than in summer and the gradients are steeper also in the cold weather, giving rise to stronger winds. The isobaric conditions indicate light variable winds in summer along the route of the "Fram" from the New Siberia Islands to the north of Spitsbergen, and in winter south-easterly or easterly winds of greater force; this is in accord with the observations made during the drift. Professor Mohn believes that the maximum pressure at the North Pole takes place in April, when it is about 30·08 in.; and the minimum pressure from June to September, when it is about 29·88 in., the annual range of monthly mean pressure being thus only 0·20 in., so that the Pole may be said to be in a region of permanently high atmospheric pressure. Cyclonic depressions crossed the region of the "Fram's" track with considerable frequency, 73 being experienced in the three years, the frequency being greatest in winter but the wind velocity in cyclones greatest in summer; the most common direction of movement was from west to east. The average velocity of the cyclonic winds encountered by the "Fram" was only about 29 m. per hour, the highest 40 m. per hour, the portion of the Arctic Sea she crossed being much less stormy than the coasts of the Arctic lands, where winds have been recorded of far greater severity, *e.g.* 45 m. per hour in Spitsbergen in 1882, 55 m. per hour in Teplitz Bay, Franz Josef Land, in 1900, 62 m. per hour on the Siberian coast in the "Vega" in 1879, and as much as 90 m. per hour at Karmakul in Novaya Zemlya in 1883. There seems little doubt that the interior of the polar area is a fair weather zone as compared with its margins, where the contrast of the seasons is more marked.

Flora.—The land flora of the Arctic regions, although necessarily confined to the lower levels which are free from snow for some time every year, and greatly reduced in luxuriance and number of species as compared with the flora of the temperate zone, is still in its own way both rich and varied, and it extends to the most northerly land known. In some of the fjords of western Greenland and also of Ellesmere Land almost on the 80th parallel the prevailing colour of the landscape in summer is due to vegetation and not to rock. The plants which occur on the margin of the Arctic Sea and in the polar islands represent the hardier species of the North European, Asiatic and American flora, the total number of species amounting to probably about a thousand phanerogams and a still larger number of cryptogams. The habit of all is lowly, but some grasses grow to a height of 1 ft. 6 in., and the mosses, of which the Eskimo make their lamp-wicks, frequently form cushions more than a foot in depth. Trees are absent north of 73° N., which is the extreme point reached in Siberia, or they are dwarfed to the height of shrubs as in southern Greenland, or farther north to that of the prevailing herbage. The flowers of many Arctic species of phanerogams have an intensely brilliant colour. The plains and lower slopes of the plateaux of Ellesmere Land and Heiberg Land and the plain of Peary Land north of Greenland are sufficiently clothed with vegetation to support large numbers of rodents and ruminants, the plants occurring not as occasional curiosities, but as the normal summer covering of the ground, playing their full part in the economy of nature. The cold of winter is not sufficient to put a stop to plant life even at the pole of cold in northern Siberia; and there is no reason to doubt that if there were islands close to the North Pole they would bear vegetation.

Fauna.—Animal life is comparatively abundant in the waters of the Arctic Sea, though the whalebone whale, *Balaena mysticetis*, has become almost extinct by reason of the energy with which its pursuit has been carried on. The white whale and narwhal still abound in the open waters as far north as ships can go. The walrus and several species of seal prey on the marine life, and the polar bear, the king of Arctic beasts, probably roams the whole surface of the frozen sea in pursuit of seals and the larger fish. The other Arctic carnivora include the Arctic fox and wolf, the latter attacking all the land mammalia except the polar bear and old musk-oxen. The wild reindeer is still found in all the circum-polar lands except Franz Josef Land; but its range does not extend so far to the north as that of the typical ruminant of the polar lands, the musk-ox (*Ovibos moschatus*), which now abounds only in Peary Land, north Greenland and in the American Arctic Archipelago, though it was formerly circum-polar in its distribution. The Arctic hare is almost equally characteristic and more abundant, and the lemming probably more common still. The ermine and other valuable fur-bearing animals also occur. The animals are either permanently white like the polar bear, or change their coats with the season, being brown in summer and white in winter like the hares and lemmings. The birds of the Arctic regions are all migrants, retreating southward in winter but nesting in incredible numbers on the Arctic coast-lands, and in summer probably finding their way as individuals to every part. They are mainly sea-birds, though the snow bunting, the Arctic owl and other land birds are amongst the summer visitors. It must be remembered that the elevated plateaux of the interior of Greenland and of many of the large islands are totally devoid of life of every kind on account of their unchanging covering of snow and the intensely rigorous climate due to their great altitude.

Arctic People.—The conditions of life in the continental parts of the Arctic regions are extremely severe as regards temperature in the winter, but it has been found possible for civilized people to live permanently both in the extreme north of North

America and in the north of Siberia. In the north of Norway where the winter is mild on account of the warm south-westerly winds from the open Atlantic, organized communities dwell within the Arctic Circle in free communication with the south by telegraph, telephone, steamer, and in some cases by rail also, all the year round. The climate on the coast of Norway is scarcely less favourable in the north than in the south except for the absence of light in winter when the sun never rises, and the absence of darkness in summer when the sun never sets. If there were natural products of sufficient value permanent settlements might arise in any part of the Arctic regions where there is land free from snow in summer; but as a rule Arctic land is poor in mineral wealth and the pursuit of whales and seals requires only a summer visit. The original people of the farthest north of Europe are now represented by the Lapps, who lead a migratory life, depending mainly on fishing and on their herds of reindeer. Farther east their place is taken by the Samoyedes who live along the coast of the Kara Sea and the Yalmal Peninsula; they have also a small settlement in Novaya Zemlya. The Samoyedes, like the Lapps, live on the produce of the sea in summer and on their herds of reindeer, moving rapidly over the frozen country in winter by means of reindeer and dog sledges. Spitsbergen and Franz Josef Land appear never to have had native inhabitants. Along the coast of Siberia there is no continuous population, except in the land of the Chukchis in the extreme east between the Kolyma river and Bering Strait; but small settlements of many tribes of pagan hyperboreans occur here and there. North American Indian tribes wander far to the north of the Arctic Circle in Canada and Alaska, keeping their hereditary enemies the Eskimo to the coast and islands. The Eskimo of the American coast are intermingling not only with the American whalers but also with the Polynesians who come north as part of the crew of the whalers, and the pure race is tending to disappear. The traces of Eskimo encampments in the Polar archipelago, where no Eskimo now live, may mark a former wider range of hunting grounds, or a greater extension of the population. The Greenland Eskimo are the most typical and the best known of their race. A few hundred live on the east coast, where they were formerly much more numerous. The greater part of the west coast Eskimo are now civilized members of the Danish colonies, and it is stated that whereas in 1855 only about 30% of the population were half-breeds, the blending of the Eskimo and Europeans is now so complete that no full-blooded Eskimo remain in Danish Greenland. The tribe of Eskimo living to the north of Melville Bay, the glaciers of which separate them from the people of Danish Greenland, was first described by Sir John Ross, who called them Arctic Highlanders. They have been fully studied by Commander Peary, who succeeded in utilizing them in his great series of journeys, and to their aid he attributes the success of his method of Arctic travelling.

The Arctic Sea.

According to its geographical position, the Arctic Sea might be described as the sea situated north of the Arctic Circle; but according to its natural configuration, it is better defined as the gulf-like northern termination of the long and relatively narrow Atlantic arm of the ocean which extends north between Europe on one side and America on the other. By this situation as the northern end of a long arm of the ocean its physical conditions are to a very great extent determined. This Arctic gulf is bounded by the northern coasts of Europe, Siberia, North America, the American Arctic archipelago, Greenland and Iceland. Its entrance is the opening between Europe and Labrador divided by Iceland, Greenland and the American Arctic islands; and its natural southern boundary would be the submarine ridge extending from Scotland and the Shetland Islands through the Faeroe Islands and Iceland to Greenland, and continuing on the other side of Greenland across Davis Strait to Baffin Land. This ridge separates the depression of the Arctic Sea, filled with cold water at the bottom, from the deep depression of the North Atlantic. The Arctic Sea communicates with the Pacific Ocean through Bering Strait, which is, however, only 49 m. broad and 27 fathoms deep. The area of the Arctic Sea may be estimated to be about 3,600,000 sq. m., of which nearly two-thirds (or 2,300,000 sq. m.) is continuously covered by floating ice.

The Arctic Sea may be divided into the following parts: (1) The *North Polar Basin* (including the Siberian Sea), bounded by the northern coasts of Siberia (from Bering Strait to the western Taimyr Peninsula), Franz Josef Land, Spitsbergen, Greenland, Grinnell Land, Axel Heiberg Land, Ringnes Land, the Parry Islands and Alaska; (2) the *Kara Sea*, between Novaya Zemlya and the Siberian coast, south of a line from the north point of the former to Lonely Island (Ensomheden) and Nordenskiöld Island; (3) the *Barents* and *Murman Sea*, bounded by Novaya Zemlya, Franz Josef Land, Spitsbergen, Bear Island and the northern coasts of Norway and Russia; (4) the *Norwegian Sea*, between Norway, Spitsbergen, Jan Mayen, Iceland and the Faeroes; (5) the *Greenland Sea*, between Spitsbergen, Jan Mayen, Iceland and Greenland; (6) *Baffin Bay* and *Davis Strait*, between Greenland, Ellesmere Land, North Devon and Baffin Land.

Depths.—The Arctic Sea forms an extended depression separating the two largest continental masses of the world—the European-Asiatic (Eurasia) and America. Along its centre this depression is deep, but around its whole margin, on both sides, it is unusually shallow—a shallow submarine plateau or drowned plain extending northward from both continents, forming the largest known continental shelf. North of Europe this shelf may be considered as reaching Spitsbergen and Franz Josef Land, extending over more than 10 degrees of latitude, although there is a somewhat deeper depression in between. North of Spitsbergen it reaches beyond 81° N., and north of Franz Josef Land probably somewhat north of 82° N. North of Siberia the shelf is 350 m. broad, or more, with depths of 50 to 80 fathoms, or less. In longitude 135° E. it reaches nearly 79° N., where the bottom suddenly sinks to form a deep sea with depths of 2000 fathoms or more. Farther east it probably has a similar northward extension. North of America and Greenland the shelf extends to about latitude 84° N. This shelf, or drowned plain, evidently marks an old extension of the continents, and its northern edge must be considered as the real margin of their masses, the coasts of which have probably been overflowed by the sea at some comparatively recent geological period. On this submarine plateau the Arctic lands are situated—Spitsbergen (with Seven Islands to the north, Bear Island and Hope Island to the south), Franz Josef Land, Novaya Zemlya, Lonely Island, the New Siberia Islands, Wrangel Island, the American Arctic archipelago. The depth of the shelf is, especially north of Siberia, very uniform, and usually not more than 50 to 80 fathoms. North of Europe it is intersected by a submarine fjord-like depression, or broad channel, extending eastward from the Norwegian Sea. Between Norway and Bear Island this depression is about 240 fathoms deep, and between Novaya Zemlya and Franz Josef Land 100 to 150 fathoms deep. It gives off several submerged fjords or channels towards the south-east into the shallow Murman Sea, *e.g.* one channel, more than 100 fathoms deep, along the Murman coast towards the entrance of the White Sea; another narrow channel, in parts 100 fathoms deep, along the south-west coast of Novaya Zemlya through Kara Strait. It also extends into the Kara Sea, rounding the north point of Novaya Zemlya and forming a narrow channel along its eastern coast. On the American side similar but much narrower submarine depressions, which may be called submarine fjords, extend from Baffin Bay into the continental shelf, northward through Smith Sound, Kane Basin and Kennedy Channel, and westward through Lancaster Sound.

The greatest depths in the Arctic Sea have been found in the North Polar Basin, where depths of 2100 fathoms, in about 81° N. and 130° E., have been measured with certainty. It is deeper than 1650 fathoms along the whole route of the "Fram," from about 79° N. and 138° E. to near Spitsbergen. In 84½° N. and about 75° E. the depth is 2020 fathoms, and in 83° N. and 13° E. it is 1860 fathoms. The northern and eastern extension of this deep basin is not known. Commander Peary reports a depth of 1500 fathoms with no bottom at 5 sea miles from the Pole (about 89° 55′ N.) where he tried to obtain a sounding. It was formerly believed that still greater depths existed west of Spitsbergen, in the so-called Swedish deep, where 2600 fathoms had been sounded, but the Nathorst expedition in 1898 found no greater depths there than about 1700 fathoms. The Norwegian Sea, farther south, is 2000 fathoms deep midway between Iceland and Norway, in about 68° N. This so-called Norwegian deep is, as before stated, separated from the North Atlantic Basin by the Wyville Thomson ridge and the Faeroe-Iceland ridge. Farther north there is a low transverse ridge extending eastwards from Jan Mayen, in about 72° N., which is about 1300 fathoms deep. North of this the sea is again deeper—1985 fathoms in 75° N. From the north-west corner of Spitsbergen a submarine ridge extends in a north-westerly direction, with depths of about 430 fathoms in 81° N. and about 4° E. How far this ridge extends is unknown, but there is a probability that it reaches Greenland, and thus separates the Swedish and the Norwegian deep from the deep depression of the North Polar Basin. Baffin Bay forms, probably, a relatively deep basin of about 1000 or 1200 fathoms, which is separated from the West Atlantic Basin by the shallow submarine ridge from Greenland to Baffin Land in about 65° or 66° N.

The *deposit* composing the bottom of the Arctic Sea contains in its northern part, in the North Polar Basin, extremely little matter of organic origin. It is formed mainly of mineral material, sandy clay of very fine grain, to an extent which is hardly found in any other part of the ocean with similar depths. It contains only from 1 to 4% of carbonate of lime. Farther south, in the sea between Spitsbergen and Greenland, the amount of carbonate of lime gradually increases owing to the shells of foraminifera (especially biloculinae); west of Spitsbergen the proportion rises to above 20 or even 30%, while in the direction of Greenland it is considerably lower.

The *circulation* of the Arctic Sea may be explained firstly by the vertical and horizontal distribution of temperature and salinity (*i.e.* density); secondly, by the influence of the winds, especially on the ice-covered surface. The currents in this sea may to some extent be considered as convection currents, caused by the cooling of the water near the surface, which becomes heavier, sinks, and must be replaced on the surface by warmer water coming from the south, which is also influenced by the prevailing winds. On account of the rotation of the earth the northward-running water on the surface, as well as the sinking water, will be driven in a north-easterly or easterly direction, while the southward-flowing water along the bottom, as well as the rising water, is driven south-west or westward. This very simple circulation, however, is to a great extent complicated on the one hand by the irregular configuration of the sea-bottom, especially the transverse submarine ridges—*e.g.* the Spitsbergen ridge, the Jan Mayen ridge, and the Scotland-Faeroe-Iceland ridge; and on the other hand by the circumstance that the upper water strata of the sea are comparatively light in spite of their low temperature. These strata, about 100 or 120 fathoms thick, are diluted by the addition of fresh water from the North European, Siberian, Canadian and Alaskan rivers, as well as by precipitation, while at the same time the evaporation from the surface of the mostly ice-covered sea is insignificant. The light surface strata will have a tendency to spread over the heavier water farther south, and thus the polar surface currents running southward along the east coasts of Greenland, Baffin Land and Labrador are formed, owing their westerly course to the rotation of the earth. These currents are certainly to a great extent helped and increased by the prevailing winds of the region. The winds get a firm hold on the rough surface of the floating ice, which, with its deep hummocks and ridges, gets a good grip of the water, transferring the movement of the surface immediately down to at least 5 or 10 fathoms.

The chief currents running into the Arctic Sea are the following:—

1. The *Gulf Stream*, or Atlantic drift, passing north-eastward over the Scotland-Faeroe-Iceland ridge, along the west coast of Norway, with one arm branching off eastward round the North Cape into the Barents Sea, and another branch running northward along the margin of the shelf between Norway, Bear Island and Spitsbergen, passing as a very narrow current along the west coast of the latter, over the Spitsbergen ridge (at its north-west corner), and into the North Polar Basin, where it flows gradually northward and eastward (on account of the rotation of the earth) below the cold but lighter layer, 100 fathoms thick, of polar water, and fills the whole basin below 100 or 120 fathoms to the bottom with Atlantic water.

2. The *Irminger Current*, running north along the west coast of Iceland. One part branches off westward and southward again in Denmark Strait, following the Greenland Polar Current, whilst another smaller part runs northward, eastward and south-eastward to the north and east of Iceland.

3. An Atlantic current runs northward along the west coast of Greenland, passes the ridge across Davis Strait, and flows into Baffin Bay, forming its deeper strata below the polar water in a similar way to the Gulf Stream in the North Polar Basin. There is a possibility that some slight portion of this current even reaches the latter along the bottom of the deep channel through Smith Sound.

4. A small current running northward into the North Polar Basin through Bering Strait.

The Arctic Sea receives also a contribution of fresh water from the rivers of northern Europe, Siberia and America, as well as from the glaciers of Greenland and the precipitation over the whole area of the sea itself.

The chief currents running out of the Arctic Sea are: (1) The Greenland Polar Current, running southward along the east coast of Greenland, and dividing into two branches north of Iceland—(*a*) the east Greenland branch, passing south through Denmark Strait and rounding Cape Farewell; (*b*) the east Iceland branch, running south-eastward between Iceland and Jan Mayen, towards the Faeroes. It seems as if only a small portion of this current actually passes the Faero-Iceland ridge and reaches the Atlantic Ocean. The greater part is partly mixed with the water of the Gulf Stream and is turned by the latter in a north-easterly direction, forming a kind of eddy or vortex movement in the southern Norwegian Sea. (2) The Labrador Polar Current, formed by the water running south through Smith Sound, Lancaster Sound and Jones Sound, as well as water from Baffin Bay, and also from the east Greenland current rounding Cape Farewell and crossing Davis Strait. (3) Along the south-east coast of Spitsbergen a polar current also passes in a south-westerly or westerly direction past South Cape, where it meets the Gulf Stream. (4) A small current probably also runs out along the western side of Bering Strait.

Temperature and Salinity.—While the temperature is comparatively uniform, with small variations, the difference in salinity between the upper and lower strata is greater than in most other parts of the ocean. In the North Polar Basin the vertical distribution of temperature as well as salinity is very much the same in all places examined. Near the surface, from 0 down to 100 fathoms, the water is below the freezing point of fresh water—with a minimum of between 28·7° (−1·8° C.) and 28·6° (−1·9° C.) at a depth of about 30 fathoms—and is much diluted with fresh water (see above), the salinity gradually increasing downward from about 29 or 30 per mille near the surface to nearly 35 per mille in 100 fathoms. Below 100 fathoms the temperature as well as the salinity gradually increases, until they approach their maximum in about 160 or 200 fathoms, where the temperature varies between 32·5° (0·3° C.), north of the New Siberia Islands, and about 33·8° (1° C.) north of Franz Josef Land; and the salinity is about 35·1 per mille. From this depth the temperature gradually sinks downward; 32° (0° C.) is found at about 490 fathoms in the western part of the basin—*e.g.* between about 84° N. 15° E. and 85½° N. 58° E., while it is found in about 400 fathoms farther east—*e.g.* in 81½° N. and 123° E. In depths between 1400 and 1600 fathoms the temperature has a second minimum between 30·6° (−0·8° C.) and 30·4° (−0·9° C.), below which depth the temperature again rises slowly, a few tenths of a degree towards the bottom. In all depths below 200 fathoms the salinity of the water remains very much the same, about 35·1 per mille, with very slight variations. This comparatively warm and saline water evidently originates from the branch of the Gulf Stream passing north across the submarine ridge from north-west Spitsbergen. The vertical distribution of temperature and salinity is very much the same, summer and winter, throughout the North Polar Basin, except near the surface, which in summer is covered by a layer of fresh water arising from the melting of the snow-covered surface of the floe-ice. This fresh-water layer may attain a thickness of 5 or 6 ft. between the floes. North of the Siberian coast the sea is, during summer, covered with a layer of warm water from the Siberian rivers, and the temperature of the surface may rise to several degrees above freezing-point.

In the Norwegian and Greenland Seas there are greater variations of temperature. Below a certain limit, which in the northern part (on the eastern side) is about 550 fathoms deep, and in the southern part between 300 and 400 fathoms deep, the whole basin of this sea is filled with water which has an unusually uniform salinity of about 34·92 per mille, and the temperature of which is below zero centigrade, gradually sinking downward from the above-mentioned limit, where it is 32° (0° C.); and down to 29·8° (−1·2° C.) or 29·6° (−1·3° C.) near the bottom in 1400 or 1600 fathoms. This cold underlying water of such a remarkably uniform and comparatively low salinity is formed chiefly in a small area between Jan Mayen and Spitsbergen, by the formation of ice and cooling down of the Atlantic surface water by radiation of heat during the winter. In this manner the surface water becomes heavier than the underlying water and gradually sinks to the bottom. This water seems to be distinctly different from the hitherto known water filling the deep of the North Polar Basin, as it has a lower salinity and lower temperature; the known bottom temperature of the North Polar Basin being between 30·7° (−0·7° C.) and 30·4° (−0·9° C.), and the salinity about 35·1 per mille. This fact seems to indicate that there can be no direct communication between the deep depression of the North Polar Basin and the Norwegian-Greenland Sea, which are probably separated by a submarine ridge running from the north-west corner of Spitsbergen to Greenland.

The above-mentioned layer of uniform cold water of the Norwegian-Greenland Sea is, along its eastern side, covered by the warm and saline water of the Gulf Stream flowing northward along the west coast of Norway, Bear Island and Spitsbergen, and forming the upper strata of the sea about 300 to 500 fathoms deep. The maximum temperature of this water is on the surface about 46° (8° C.) to 50° (10° C.) west of northern Norway, and about 37° (3° C.) to 39° (4° C.) west of Spitsbergen. The salinity is generally between 35·0 and 35·3 per mille.

Along the western side of this sea, towards the east coast of Greenland, the underlying cold water is covered by the less saline water of the polar current, which in the upper strata of the sea, from the surface down to about 100 fathoms, has very much the same temperature and salinity as in the upper cold and less saline strata of the North Polar Basin. Near the east coast of Greenland, a layer of comparatively warm and saline water, with a temperature of 32·7° (0·4° C.) and a salinity of 35·2 per mille, has been found (by the Ryder expedition in 1891) below the cold and lighter polar water in a depth of 70 to 90 fathoms. This warmer undercurrent is a continuation of the warm Spitsbergen current sending off a branch westward from Spitsbergen, and thus forming a great vortex movement in the Spitsbergen-Greenland Sea similar to the one mentioned farther south in the Norwegian Sea.

In *Barents Sea* the temperature and salinity are highest in the western part near Norway or between Norway and Bear Island, where the eastern branch of the Gulf Stream enters and where in summer the salinity generally is between 34·8 and 35 per mille from the surface down to the bottom, and the surface temperature generally is about 41° or 43° (5° C. or 6° C.), and the bottom temperature is above zero centigrade. The eastern part of Barents Sea is filled with water of a little lower salinity, the deeper strata of which are very cold, with temperature even as low as 28·9° (−1·7° C.), but often with salinity above 35·0 per mille. This cold and saline water is formed during the formation of ice on the sea-surface. The bottom temperature is everywhere in the eastern part below zero centigrade and generally below −1° C.

The *Kara Sea* is covered near the surface with a layer of cold water much diluted by the fresh water from the Siberian rivers, especially the Ob and the Yenisei. The salinity varies between 29 and 34 per mille; near the mouth of the rivers it is naturally much lower.

The vertical distribution of temperature and salinity in *Baffin Bay* seems to be very similar to that of the North Polar Basin, with a cold but less saline upper stratum of water—with a minimum temperature of about 28·9° (−1·7° C.)—and a warmer and more saline deeper stratum from 100 to 200 fathoms downwards, with a maximum temperature of 33·6° (0·9° C.) in about 200 fathoms, and the temperature slowly decreasing towards the bottom.

Arctic Ice.—As before mentioned, at least two-thirds of the Arctic Sea is constantly covered by drifting ice. This ice is mostly formed on the surface of the sea itself by freezing, the so-called floe-ice or sea-ice. A small part is also river-ice, formed on the rivers, especially those of Siberia, and carried into the sea during the spring or summer. Another comparatively small part of the ice originates from the glaciers of the Arctic lands. These pieces of glacier-ice or icebergs are, as a rule, easily distinguished from the floe-ice by their size and structure. They occur almost exclusively in the seas round Greenland, where they originate from the glaciers descending into the sea from the inland ice of Greenland. Some small icebergs are also formed in Franz Josef Land, Spitsbergen, Novaya Zemlya, Grinnell Land, &c., but they are comparatively insignificant, and are not as a rule carried far from the coasts. Sea-ice or floe-ice is formed during the autumn, winter and spring, especially in the North Polar Basin, but also in the Kara Sea, the greater part of Barents Sea, the northernmost part of the Norwegian Sea (near Bear Island and towards Jan Mayen), Greenland Sea and Baffin Bay. The floe-ice does not, as a rule, grow thicker than 7 or 8 ft. in one year, but when it floats in the water for some years it may attain a thickness of 16 ft. or more directly by freezing. By the constant upheaval from pressure much greater thicknesses are attained in the piled-up hummocks and rubble which may be 20 to 30 ft. high above the water when floating. During the summer the floe-ice decreases again by melting partly on the surface owing to the direct radiation of heat from the sun, partly on the under side owing to the higher temperature of the water in which it floats. The first kind of melting is that which prevails in the North Polar Basin, which the second occurs in more southern latitudes. The floe-ice is constantly more or less in movement, carried by winds and currents. The changing wind, and also to a great extent the changing tidal current, causes diverging movements in the ice by breaking it into larger or smaller floes. When the floes separate, lanes and channels are formed; when they meet, ice-pressures arise, and the floes are piled up to form hummocks or ridges, and thus the uneven polar ice arises. In the North Polar Basin the floe-ice is slowly carried by the prevailing winds and the currents in an average direction from Bering Strait and the New Siberia Islands, north of Franz Josef Land and Spitsbergen, near the North Pole, towards the Greenland Sea and southward along the east coast of Greenland. Such a drift of an ice-floe from the sea north of Bering Strait to the east coast of Greenland probably takes, as a rule, four or five years, and the floes found in this part of the sea are not, therefore, generally older. What the drift of the ice is on the American side of the North Polar Basin is still little known. But there it is probably more or less blocked up in its southward movement by the islands of the American Arctic archipelago, and the ice-floes may thus grow very old and thick. Commander Peary found a strong easterly movement of the floes in the region north of Grant Land in 1907. The southward distribution of the drifting floe-ice (the pack ice) in Barents Sea, Norwegian-Greenland Sea and Davis Strait may differ much from one year to another, and these variations are evidently due to more or less periodical variations in the currents and also in the directions of the prevailing winds. In most places the ice has its most southerly distribution during the late winter and spring, while the late summer and autumn (end of August and September) is the most open season.

Biological Conditions.—The development of organic life is comparatively poor in those parts of the Arctic Sea which are continuously covered by ice. This is, amongst other things, proved by the bottom deposits, which contain exceptionally little carbonate of lime of organic origin. The reason is evidently that the thick ice prevents to a great extent the development of plant life on the surface of the sea by absorbing the light; and as the plant life forms the base for the development of animal life, this has also very unfavourable conditions. The result is that—*e.g.* in the interior of the North Polar Basin—there is exceptionally little plant life in the sea under the ice-covering, and the animal life both near the surface and in deeper strata is very poor in individuals, whilst it is comparatively rich in species. Near the outskirts of the Arctic Sea, where the sea is more or less open during the greater part of the year, the pelagic plant life as well as animal life is unusually rich, and, especially during the early summer, there is often here such a development of plankton (*i.e.* pelagic life) on the sea-surface as is hardly found in any other part of the ocean. It seems as if the polar water is specially favourable for the development of pelagic plant life, which makes the flora, and consequently also the fauna, flourish as soon as the ice-covering disappears and the water surface is exposed to the full sunlight of the long Arctic day. At the same time the temperature of the water rises, and thus the conditions for the chemical changes of matter and nutritive assimilation are much improved. The Arctic Sea, more especially the North Polar Basin, might thus be considered as a lung or reservoir in the circulation of the ocean where the water produces very little life, and thus, as it were, gets time to rest and accumulate those substances necessary for organic life, which are everywhere present only in quite minimal quantities. It is also a remarkable fact of interest in this connexion that the greatest fisheries of the world seem to be limited to places where waters from the Arctic Ocean and from more southern seas meet—*e.g.* Newfoundland, Iceland, Lofoten and Finmarken in Norway.

The mammalian life is also exceptionally rich in individuals along the outskirts of the Arctic Sea. We meet in those waters, especially along the margin of the drifting ice, enormous quantities of seals of various kinds, as well as whales, which live on the plankton and the fishes in the water. A similar development of mammalian life is not met with anywhere else in the ocean, except perhaps in the Antarctic Ocean and Bering Sea, where, however, similar conditions are present. In the interior of the Arctic Sea or the North Polar Basin mammalian life is very poor, and consists mostly of some straggling polar bears which probably occasionally wander everywhere over the whole expanse of ice; some seals, especially *Phoca foetida*, which has been seen as far north as between 84° and 85° N.; and a few whales, especially the narwhal, which has been seen in about 85° N.

The bird life is also exceptionally rich on the outskirts of the Arctic Sea, and the coasts of most Arctic lands are every summer inhabited by millions of sea-birds, forming great colonies almost on every rock. These birds are also dependent for their living on the rich plankton of the surface of the sea. In the interior of the Arctic Sea the bird life is very poor, but straggling sea-birds may probably be met with occasionally everywhere, during summer-time, over the whole North Polar Basin.

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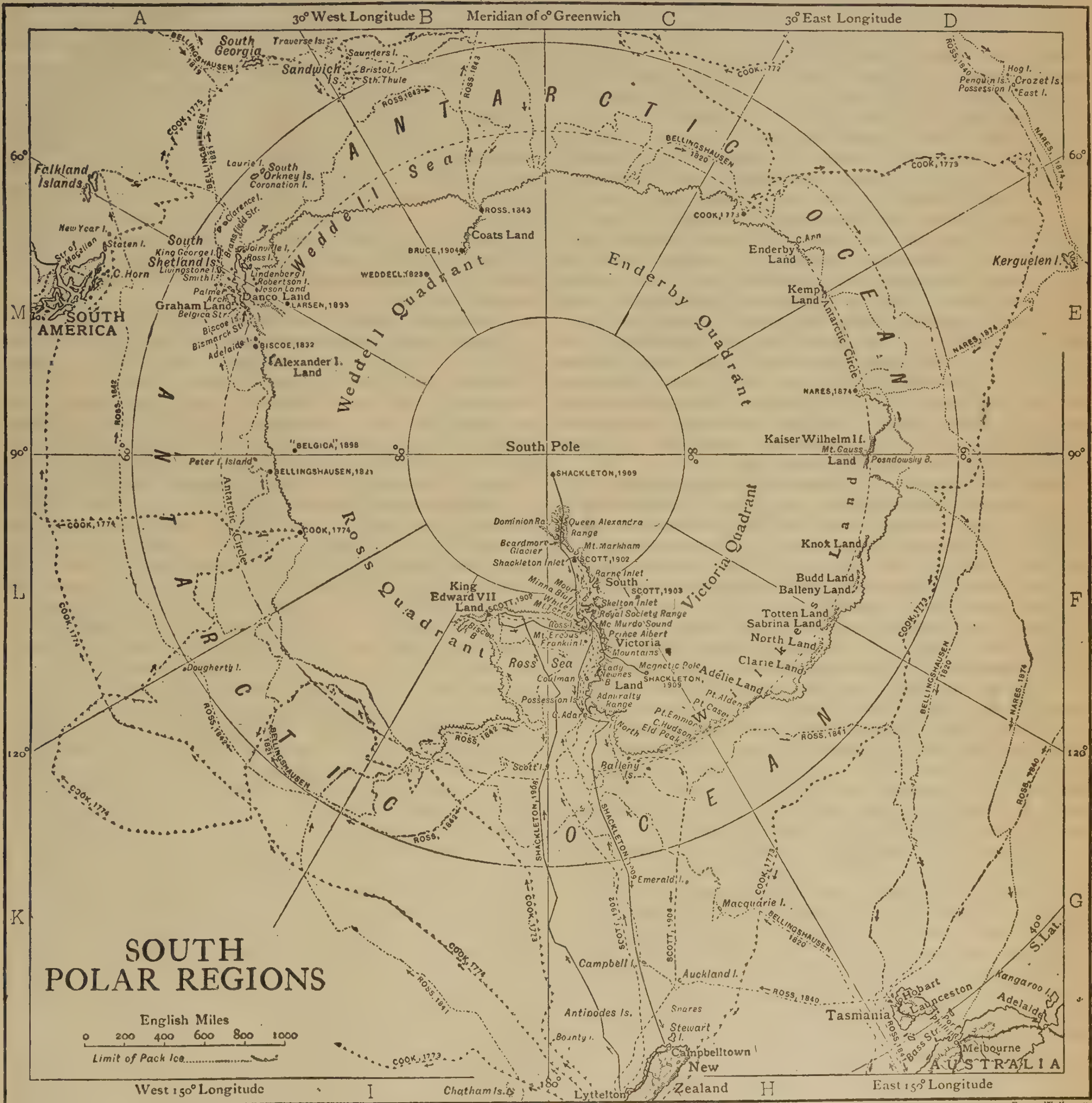
(H. R. M.; F. N.)

ANTARCTIC REGION

The "South Land."

History of Antarctic Exploration.—Although the Antarctic region was not reached by the first explorer until the Arctic region had been for centuries a resort of adventurers in search of the route to the East, the discovery of the south polar region was really the more direct outcome of the main stream of geographical exploration. It was early understood by the Greek geographers that the known world covered only a small portion of the northern hemisphere and that the whole southern hemisphere awaited exploration, with its torrid, temperate and frigid zones repeating the climatic regions familiar in the northern hemisphere, the habitable land of the south temperate zone being separated from the known world by the practically impassable belt of the torrid zone. During the middle ages the sphericity of the earth came to be viewed as contrary to Scripture and was generally discredited, and it was not until Prince Henry the Navigator began in 1418 to encourage the penetration of the torrid zone in the effort to reach India by circumnavigating Africa that the exploration of the southern hemisphere began. The doubling of the Cape of Good Hope in

1487 by Bartholomew Diaz first brought explorers within touch of the Antarctic cold, and proved that the ocean separated Africa from any Antarctic land that might exist. The passage of Magellan's Strait in 1520 showed that America and Asia also were separated from the Antarctic continent, which was then believed to extend from Tierra del Fuego southward. The doubling of Cape Horn by Drake in 1578 proved that the Tierra del Fuego archipelago was of small extent and that any continent which lay to the south must be within the region of perpetual winter. Before this, however, vague reports of land to the south of the Malay archipelago had led European geographers to connect on their globes the coast of Tierra del Fuego with the coast of New Guinea, and allowing their imaginations to run riot in the vast unknown spaces of the south Atlantic, south Indian and Pacific oceans, they sketched the outlines of a vast continent stretching in parts into the tropics. The search for this great south land or Third World was a leading motive of explorers in the 16th and the early part of the 17th centuries, and no illusion ever died a harder death. It is not to the purpose here to describe in detail how Schouten and Le Maire rediscovered the southern extremity of Tierra del Fuego and named Cape Horn in 1615, how Quiros in 1606 took possession for the king of Spain of all the lands he had discovered in Australia del Espiritu Santo (the New Hebrides) and those he would discover "even to the Pole," or how Tasman in 1642 showed that New Holland (Australia) was separated by sea from any continuous southern continent.


SOUTH POLAR REGIONS
English Miles
0 200 400 600 800 1000
Limit of Pack Ice
A
B
C
D
E
F
G
H
I
K
L
M
30° West Longitude
Meridian of 0° Greenwich
30° East Longitude
West 150° Longitude
East 150° Longitude
60°
90°
120°
80°
40° S. Lat.
South Pole
ANTARCTIC
ANTARCTIC
OCEAN
OCEAN
Weddell Sea
Ross Sea
Weddell Quadrant
Enderby Quadrant
Victoria Quadrant
Ross Quadrant
Antarctic Circle
South Georgia
Sandwich Is.
Saunders I.
Bristol I.
Sth. Thule
Traverse Is.
Falkland Islands
South Orkney Is.
Laurie I.
Coronation I.
South Shetland Is.
King George I.
Livingstone I.
Smith I.
Clarence I.
Joinville I.
Ross I.
New Year I.
Staten I.
Str. of Magellan
C. Horn
SOUTH AMERICA
Graham Land
Palmer Arch.
Danco Land
Lindenberg I.
Robertson I.
Jason Land
Belgica Str.
Biscoe Is.
Bismarck St.
Adelaide I.
Alexander I. Land
Peter I. Island
Dougherty I.
Coats Land
Enderby Land
C. Ann
Kemp Land
Kerguelen I.
Hog I.
Penguin Is.
Crozet Is.
Possession I.
East I.
Kaiser Wilhelm II. Land
Mt. Gauss
Posadowsky B.
Knox Land
Budd Land
Balleny Land
Totten Land
Sabrina Land
North Land
Clarie Land
Adélie Land
Pt. Alden
Pt. Case
Pt. Emmons
C. Hudson
North Eld Peak
Magnetic Pole
South Victoria Land
Dominion Ra.
Queen Alexandra Range
Beardmore Glacier
Mt. Markham
Shackleton Inlet
Barne Inlet
Skelton Inlet
Royal Society Range
Mc Murdo Sound
Prince Albert Mountains
Mt. Erebus
Franklin I.
Coulman I.
Lady Newnes B.
Admiralty Range
Possession Is.
C. Adare
King Edward VII Land
Balleny Is.
Scott I.
Emerald I.
Macquarie I.
Campbell I.
Auckland I.
Antipodes Is.
Bounty I.
Snares
Stewart I.
Campbelltown
New Zealand
Lyttelton
Chatham Is.
Tasmania
Hobart
Launceston
Bass Str.
Melbourne
Adelaide
Kangaroo I.
AUSTRALIA
COOK, 1773
COOK, 1774
COOK, 1775
ROSS, 1842
ROSS, 1843
ROSS, 1840
ROSS, 1841
BELLINGSHAUSEN, 1820
BELLINGSHAUSEN, 1821
WEDDELL, 1823
BRUCE, 1904
BISCOE, 1832
LARSEN, 1893
BELGICA, 1898
NARES, 1874
SHACKLETON, 1909
SCOTT, 1902
SCOTT, 1903
SCOTT, 1904
SHACKLETON, 1908

Emery Walker sc.

Voyagers round the Horn frequently met with contrary winds and were driven southward into snowy skies and ice-encumbered seas; but so far as can be ascertained none of them before 1770 reached the Antarctic circle, or knew it, if they did. The story of the discovery of land in 64° S. by Dirk Gerritsz on board the "Blijde Boodschap" in 1599 has recently been shown to be the result of the mistake of a commentator, Kasper Barlaeus, in 1622. Much controversy has arisen as to whether South Georgia was sighted in 1675 by La Roche, but the point is of no importance in the development of the history of exploration. It may safely be said that all the navigators who fell in with the southern ice up to 1750 did so by being driven off their course and not of set purpose. An exception may perhaps be made in favour of Halley's voyage in H.M.S. "Paramour" for magnetic investigations in the South Atlantic when he met the ice in 52° S. in January 1700; but that latitude was his farthest south. A determined effort on the part of the French naval officer Pierre Bouvet to discover the South Land described by a half legendary sieur de Gonneville resulted only in the discovery of Bouvet Island in 54° 10′ S., and in the navigation of 48 degrees of longitude of ice-cumbered sea nearly in 55° S. in 1739. In 1771 Yves Joseph Kerguelen sailed from France with instructions to proceed south from Mauritius in search of "a very large continent." He lighted upon a land in 50° S. which he called South France, and believed to be the central mass of the southern continent. He was sent out again to complete the exploration of the new land, and found it to be only an inhospitable island which he renamed in disgust the Isle of Desolation, but in which posterity has recognized his courageous efforts by naming it Kerguelen Land. The obsession of the undiscovered continent culminated in the brain of Alexander Dalrymple, the brilliant and erratic hydrographer who was nominated by the Royal Society to command the Transit of Venus expedition to Tahiti in 1769, a post he coveted less for its astronomical interest than for the opportunity it would afford him of confirming the truthfulness of his favourite explorer Quiros. The command of the expedition was given by the admiralty to Captain James Cook, whose geographical results were criticized by Dalrymple with a force and persistence which probably had some weight in deciding the admiralty to send Cook out again with explicit instructions to solve the problem of the southern continent.

James Cook.

Sailing in 1772 with the "Resolution," a vessel of 462 tons under his own command and the "Adventure" of 336 tons under Captain Tobias Furneaux, Cook first searched in vain for Bouvet Island, then sailed for 20 degrees of longitude to the westward in latitude 58° S., and then 30° eastward for the most part south of 60° S. a higher southern latitude than had ever been voluntarily entered before by any vessel. On the 17th of January 1773 the Antarctic Circle was crossed for the first time in history and the two ships reached 67° 15′ S. in 39° 35′ E., where their course was stopped by ice. There Cook turned northward to look for South France, of the discovery of which he had received news at Cape Town, but from the rough determination of his longitude by Kerguelen, Cook reached the assigned latitude 10° too far east and did not see it. He turned south again and was stopped by ice in 61° 52′ S. and 95° E. and continued eastward nearly on the parallel of 60° S. to 147° E. where on March 16th the approaching winter drove him northward for rest to New Zealand and the tropical islands of the Pacific. In November 1773 Cook left New Zealand, having parted company with the "Adventure," and reached 60° S. in 177° W., whence he sailed eastward keeping as far south as the floating ice allowed. The Antarctic Circle was crossed on the 20th of December and Cook remained south of it for three days, being compelled after reaching 67° 31′ S. to stand north again in 135° W. A long detour to 47° 50′ S. served to show that there was no land connexion between New Zealand and Tierra del Fuego, and turning south again Cook crossed the Antarctic circle for the third time in 109° 30′ W., and four days later his progress was blocked by ice in 71° 10′ S., 106° 54′ W. This point, reached on the 30th of January 1774, was the farthest south attained in the 18th century. With a great detour to the east, almost to the coast of South America, the expedition regained Tahiti for refreshment. In November 1774 Cook started from New Zealand and crossed the South Pacific without sighting land between 53° and 57° S. to Tierra del Fuego, then passing Cape Horn on the 29th of December he discovered the Isle of Georgia and Sandwich Land, the only ice-clad land he had seen, and crossed the South Atlantic to the Cape of Good Hope between 55° and 60° S., thereby wiping out Dalrymple's continent from all the oceans and laying open the way for future Antarctic exploration by exploding the myth of a habitable southern continent. Cook's most southerly discovery of land lay on the temperate side of the 60th parallel, and he convinced himself that if land lay farther south it was practically inaccessible and of no economic value.

Sealers' Voyages.

Soon after Cook's return sealers set out on voyages to South Georgia both from England and America, but no clear accounts of the southern limits of their voyages before the year 1819 can now be obtained. In February of that year William Smith of the brig "Williams" trading between Monte Video and Valparaiso, rounding the Horn with a wide sweep to the south, saw land in 62° 40′ S. Repeating the voyage in October he saw the land distinctly, and named it New South Shetland. The "Williams" was chartered by the British naval commander on the Pacific station, and in 1820 Edward Bransfield, master R.N., surveyed the group and went as far as 64° 30′ among the islands. Meanwhile American sealers from Stonington, Connecticut, had begun operations on the newly discovered land, and one of these, Nathaniel B. Palmer, discovered the mountainous archipelago still farther south which now bears his name. In 1821–1822 George Powell, apparently a British sealer, discovered and surveyed the South Orkney Islands which, though typical Antarctic lands, lie outside the Antarctic region.

Bellingshausen.

A voyage only second in importance to that of Cook was planned in Russia and sent out by the emperor Alexander I. under the command of Fabian von Bellingshausen in the "Vostok," with Lieut. Lazareff in the "Mirni" in company, both vessels being about 500 tons. The object of the expedition was to supplement that of Cook by circumnavigating the Antarctic area, taking care to keep as far south as possible in those longitudes where Cook had made his northward detours. Bellingshausen entered on his exploring work by sighting South Georgia at the end of December 1819, discovered the Traverse Islands, sighted the Sandwich group and met a solid ice-pack in 60° S., to get round which he made a wide detour, sailing east to the south of Cook's track, and getting south of the 60th parallel in 8° W. On the 26th of January he crossed the Antarctic Circle in 3° W. and by February 1st had reached 69° 25′ in 1° 11′ W., a latitude which has never been surpassed on that meridian. Being stopped by ice, Bellingshausen turned northward and then continued to the east well to the south of Cook's track, getting south again as the ice permitted and reaching 69° 6′ S. in 18° E. On this occasion he was able to sail for three degrees of longtitude within the circle before being forced north of it by a succession of heavy gales. He still kept eastward south of 65° S. and crossed the circle once more in 41° E., where the number of birds seen suggested the proximity of land, and in fact Enderby Land was not very far off, though out of sight. A storm of unexampled violence drove the ships northward, but they still held to the east south of 60° S. as far as 87° E., having followed the edge of the ice through those meridians south of Kerguelen Land where Cook had made a great detour to the north. Bellingshausen now made for Sydney to rest and refit, arriving there on the 29th of March 1820, after 131 days under sail from his last port. At Sydney Bellingshausen heard of the discovery of the South Shetlands, and leaving early in November reached the sixtieth parallel a month later in longitude 143° W., and sailing eastward kept south of that parallel through 145 degrees of longitude during sixty-five days, never out of sight of the ice, keeping close along the pack edge through the great gap left by Cook south of New Zealand. He managed to cross the circle three times more, in 164° 30′ W., in 120° W. and in 92° 10′ W., where he reached 69° 52′ S., the culminating point of the voyage. As the cruise was supplementary to Cook's, no attempt was made to get south of the meridian where that great navigator made his highest latitude. On the 22nd of January 1821, the day after reaching his highest latitude, Bellingshausen sighted the first land ever seen within the Antarctic Circle, the little island named after Peter I. A week later another and larger land, named after Alexander I., was seen at a distance of 40 m. and sketches made of its bold outline in which the black rock stood out in contrast to the snow.

Bellingshausen then made for the South Shetlands, where he met the American sealers, and thence returned to Russia. The voyage was a worthy pendant to that of Cook; it was carried out with a faithful devotion to instructions and consummate seamanship, and as a result it left only half the periphery of the Antarctic Circle within which land could possibly project beyond the Frigid Zone.

Weddell.

The next episode in the history of Antarctic exploration was the voyage of James Weddell, a retired master R.N., in 1823. Weddell was in command of the "Jane," a brig of 160 tons, with the cutter "Beaufoy" of 65 tons in company, and after cruising among the South Orkneys during January he started for the south on exploration, and as he was well equipped with chronometers his positions may be taken as of a far higher degree of accuracy than those of ordinary sealers. On the 20th of February he reached the highest latitude yet attained, 74° 15′ S. in 34° 17′ W., having seen much ice but no impenetrable pack, and at the farthest point the sea was clear and open, but the lateness of the season and the length of the return voyage decided him to go no farther. Weddell made interesting collections of Antarctic animals, including the type specimen of the seal which bears his name, and the book in which he describes his voyage testifies to the keenness of his observations and the soundness of his reasoning. The sea which he penetrated so far to the south he named after the reigning king, George IV., but it is now known as Weddell Sea.

In 1829 Captain Henry Foster, R.N., in H.M.S. "Chanticleer" spent some months in the South Shetlands carrying on pendulum and gravity observations at the most southerly harbour that could be found, and though he did not go south of 63° 50′ S. the careful observations which were made threw much light on the physical conditions of the Antarctic regions.

Biscoe.

The firm of Enderby Brothers of London took a conspicuous part in the exploration of the Antarctic seas during the first four decades of the 19th century. They encouraged the masters of the whaling and sealing craft which they sent to the southern seas to take every opportunity that offered for exploration and to fix the position of any land seen with the greatest possible accuracy. The voyage of the Enderbys' brig "Tula," under the command of John Biscoe, R.N., with the cutter "Lively" in company, is worthy to rank with Cook's and Bellingshausen's expeditions, for it repeated and advanced upon their achievements with a mere fraction of their resources. Biscoe, who apparently had never heard of Bellingshausen's discoveries, was a keen explorer and a man given to thinking over and reasoning upon all that he saw, and in many of his conclusions he was far in advance of his time. At the beginning of January 1831 Biscoe, who had been hunting vainly for seals on the Sandwich group, started on a voyage easterly to look for new islands, and in trying to get south of 60° S. he had to coast the impenetrable ice-pack as far as 10° W., and continuing he got within the Antarctic Circle in 1° E. on a track parallel to that of Bellingshausen but farther east. Contrary winds delayed the little vessels, no seal-bearing lands were to be found, but in spite of difficulties, constant danger from fogs and icebergs, and disappointed crews he held on eastward for five weeks far to the south of Cook's track, and, except at one or two points, to the south of Bellingshausen's also. Though his highest latitude was only 69° S. in 10° 43′ E. on the 28th of January, he remained south of the Antarctic Circle, or within a few miles of it, for another month, when, in longitude 49° 18′ E., he was rewarded by the discovery of land. But just as he was entering on a clear lead of water running straight for a promontory which he named Cape Ann, a terrific storm descended on the vessels, damaged them seriously and drove them helpless before it with the driving ice. A fortnight's struggle with the wind and ice brought Cape Ann into sight again on the 16th of March, but the weather was not to be conquered, the sea was beginning to freeze and half the crew were helpless with the effects of exposure, so Biscoe was compelled to give up the fight and reluctantly let the land—now known as Enderby Land—drop out of sight astern. With only three men able to stand, Biscoe brought the "Tula" into Hobart Town, Tasmania, and the "Lively," with only the master, one man, and a wounded boy alive, just escaped shipwreck in Port Philip Bay. After recruiting their health and completing their crews the two captains put to sea again and spent some time in sealing on the shores of New Zealand and neighbouring islands. They started south once more, and crossed 60° S. in 131° W. on the 28th of January 1832. Biscoe kept between 60° and the Antarctic Circle, north of Bellingshausen's route, for he dared not risk the lives of his second crew, but he got south to 67° S. in 72° W., and here, on the 14th of February, he again sighted land, which, in ignorance of Bellingshausen's discoveries in the same region, he believed was the most southerly land yet known. He named it Adelaide Land after the queen. A few days later he passed a row of low ice-covered islands—the Biscoe Islands—running from W.S.W. to E.N.E. Beyond these islands lay the mountains of an extensive land of which Biscoe took possession in the name of King William IV., and to which the name of Graham Land was subsequently given. Biscoe returned home after an arduous two months' sealing in the South Shetlands, and the splendid results of his relentless determination as an explorer won for him the gold medals of the young Geographical Societies of London and Paris.

Balleny.

In 1833 another of Enderbys' captains named Kemp reported the discovery of land in 66° S. and 60° E. about 10° east of Enderby Land. The last of the great voyages of exploration due to Enderby Brothers was the cruise of the "Eliza Scott" under the command of John Balleny, with the cutter "Sabrina" in company. This voyage is interesting because it was the first attempted in high latitudes from east to west, and all those made in the opposite direction had suffered much from the buffetings of head winds. Balleny left Campbell Island south of New Zealand on the 17th of January 1839 and crossed the Antarctic Circle in 178° E. on the 29th. Heavy pack ice stopped him in 69° S., a higher latitude than had previously been reached in that region. On the 9th of February, after the little vessels had been working north-westward along the edge of the pack ice for more than a week, land was seen and found to be a group of mountainous islands—the Balleny Islands—one of which rose to a height of 12,000 ft., and another was an active volcano. Captain Freeman of the "Sabrina" made a momentary landing on one of the islands and was nearly drowned in the attempt, but secured a few stones which showed the rocks to be volcanic. The vessels held on their way westward between latitudes 63° and 65° S., far south of any earlier voyager, and land, or an appearance of land, to which the name of the "Sabrina" was given, was reported in 121° E. In 103° 40′ E. an iceberg was passed with a rock embedded in the ice, clear proof of land existing to the southward. A few days later the "Sabrina" was lost in a gale, but Balleny returned in safety.

Dumont D'Urville.

About 1835 the importance of obtaining magnetic observations in the far south, and the scientific interest of the study of the south polar regions led to plans being put forward for expeditions in the United States, France and Great Britain. The French were first in the field; an expedition, equipped in the frigates "Astrolabe" and "Zelée" under Jules Dumont D'Urville for ethnographical research in the Pacific Islands, was instructed to make an attempt to surpass Weddell's latitude in the South Atlantic Ocean, and this D'Urville tried to do with conspicuous ill-success, for he never reached the Antarctic Circle though he spent the first two months of 1838 round the edge of the ice-pack south of the South Shetlands and the South Orkneys. Some portions of the land south of the South Shetlands were charted and named Joinville Island and Louis Philippe Land; but the addition to knowledge was not great. Two years later, after fulfilling the main purpose of his expedition in the Pacific, D'Urville resolved for the glory of France to attempt to reach the Magnetic Pole, towards which he was aware that a British and an American expedition were directing their course. He left Hobart Town on the 1st of January 1840, and on the 20th he crossed the 66th parallel in 140° E. and discovered land 3000 or 4000 ft. high, which he named Adélie Land and took possession of by landing on a rocky islet off the icebound coast. Ten days later in 64° 30′ S. D'Urville cruised westward along a high ice-barrier, which he believed to be connected with land, from longitude 131° E. and he named it the Clarie Coast. A few days later he left the Antarctic regions for the Pacific.

Wilkes.

As early as 1836 the United States Congress had authorized an American Exploring Expedition in the programme of which Antarctic exploration had a leading place. Lieut. Charles Wilkes was appointed to command the expedition of five vessels in August 1838, and his instructions, dated in that month, required him amongst other things (1) to follow Weddell's route as far as possible, (2) to visit the most southerly point reached by Cook in the Antarctic, and (3) to make an "attempt to penetrate within the Antarctic region, south of Van Diemen's Land, and as far west as longitude 45° E., or to Enderby Land." The ships were in bad repair and ill-adapted for navigation in the ice, and many of the officers were not devoted to their chief; but in spite of great difficulties Wilkes fulfilled his programme. In following Weddell's route Wilkes in March 1839 fared no better than D'Urville in the previous year, but the "Flying Fish" of 96 tons under Lieutenant Walker reached 70° S. in 105° W., thus nearly reaching Cook's position of 1774. The third item of the Antarctic programme was made the subject of the most strenuous endeavour. Wilkes sailed from Sydney in the "Vincennes" on the 26th of December 1839, accompanied by the "Peacock" under Lieut. William L. Hudson, the "Porpoise" under Lieut. Cadwaladar Ringgold, and the "Flying Fish" under Lieut. Pinkney. They went south to the west of the Balleny Islands, which they did not see, and cruised westward along the ice-barrier or as near it as the ice-pack allowed towards Enderby Land nearly on the Antarctic Circle. The weather was bad with fogs, snowstorms and frequent gales, and although land was reported (by each of the vessels) at several points along the route, it was rarely seen distinctly and the officers were not agreed amongst themselves in some cases. Unfortunate controversies have arisen at intervals during sixty years as to the reality of Wilkes's discoveries of land, and as to the justice of the claim he made to the discovery of the Antarctic continent. Some of the land claimed at the eastern end of his route has been shown by later expeditions not to exist; but there can be no doubt that Wilkes saw land along the line where Adélie Land, Kemp Land and Enderby Land are known to exist, even if the positions he assigns are not quite accurate. No one, however, could establish a claim to the discovery of a continent from sighting a discontinuous chain of high land along its coast, without making a landing. It seems no more than due to a gallant and much-persecuted officer, who did his best in most difficult circumstances, to leave the name of Wilkes Land on the map of the region he explored.

Ross.

Unlike the other two expeditions, that equipped by the British government in 1839 was intended solely for Antarctic exploration and primarily for magnetic surveys in the south polar seas. There were two ships, the "Erebus" of 370 tons, and the "Terror" of 340, stoutly built craft specially strengthened for navigation in the ice. Captain James Clark Ross, R.N., was in command of the "Erebus" and of the expedition; Commander Francis Rawdon Moira Crozier of the "Terror." A young surgeon, Joseph Dalton Hooker, joined the Royal Navy in order to go on the expedition, and he lived to take a keen interest in every subsequent Antarctic expedition down to that of Captain Scott in 1910. Ross had intended to make straight for the meridian of the Magnetic Pole, but, finding that D'Urville and Wilkes had already entered on those seas he determined to try to make a high latitude farther east, and leaving Hobart Town on the 12th of November 1840 he crossed the Antarctic Circle on the 1st of January 1841 and entered the pack ice on the 5th in 174° E. Instead of proving an impenetrable obstacle, the pack let the two ships work through in five days, and they emerged into open sea. Sailing towards the Magnetic Pole they found a chain of great mountains rising from a coast which ran due south from a prominent cape (Cape Adare) in 71° S. The continent was taken formal possession of for Queen Victoria by landing on Possession Island, the mainland being inaccessible, and the ships continued southward in sight of the coast of Victoria Land, where the loftiest mountain was named Mt Melbourne after the Prime Minister, until the twin volcanoes named Erebus and Terror were sighted in 78° S. on the 28th of January. From Cape Crozier, at the base of the mountains, a line of lofty cliffs of ice ran eastwards, the great ice-barrier, unlike any object in nature ever seen before, rising perpendicularly from the water to the height of 200 or 300 ft. and continuing unbroken for 250 m. Along the barrier the highest latitude of 78° 4′ S. was attained, and the farthest point to the east was 167° W., whence Ross turned to look for a winter harbour in Victoria Land. Being desirous to winter near the South Magnetic Pole, Ross did not explore McMurdo Bay between Mt Erebus and the north-running coast, where, as we now know, a harbour could have been found, and as he could not reach the land elsewhere on account of ice extending out from it for 15 or 16 m., after sighting the Balleny Islands at a great distance, on the 2nd of March the ships returned to Hobart. This was the most remarkable Antarctic voyage for striking discoveries ever made.

In November 1841 the "Erebus" and "Terror" returned to Antarctic waters, steering south-east from New Zealand and entering the ice-pack in about 60° S. and 146° W., the idea being to approach the great barrier from the eastward, but by the end of the year they had just struggled as far as the Antarctic Circle and they, together with the pack, were several times driven far to the northward by heavy gales in which the ships were at the mercy of the floating ice. During a storm of terrible severity on the 18th of January the rudders of both ships were smashed, and not until the 1st of February did they break out of the pack in 67° 29′ S., 159° W. The barrier was sighted on the 22nd and the ships reached 78° 10′ S. in 161° 27′ W., the highest latitude attained for 60 years. To the eastward the barrier surface rose to a mountainous height, but although Ross believed it to be land, he would only treat it officially as "an appearance of land," leaving the confirmation of its discovery as King Edward Land to the next century. No more work was done in this quarter; the "Erebus" and "Terror" turned the edge of the pack to the northward and on getting into clear water sailed eastward to Cape Horn, meeting the greatest danger of the whole cruise on the way by colliding with each other at night while passing between two icebergs in a gale.

After wintering in the Falkland Islands and making good the damage received, Ross made his third and last attack on the southern ice, and for six weeks he cruised amongst the pack off Joinville Island and Louis Philippe Land trying in vain to reach the Antarctic Circle. Failing in this attempt he turned to follow Weddell's route and skirted the pack eastward in 65° S., crossing Weddell's track on the 14th of February 1843, more than a degree farther south than D'Urville in his attempt four years before, but on the edge of an equally impenetrable pack. Coasting it eastward to 12° W. the "Erebus" and "Terror" at last rounded the pack and found the way open to the south, crossing the circle on the 1st of March. Four days later the pack was met with again and the ships were forced into it for 27 miles to latitude 71° 30′ S. in 14° 51′ W., nineteen degrees east of Weddell's farthest south. No sign of land was seen, a deep-sea sounding showed 4000 fathoms with no bottom, and although this was a mistake, for the real depth was later proved by Dr Bruce to be only 2660 fathoms, it showed at least that there was no land in the immediate neighbourhood.

This was Ross's last piece of Antarctic work, but the magnetic observations of his expedition were continued by Lieut. T. E. L. Moore, R.N., in the hired barque "Pagoda," which left Simon's Bay in January 1845 and proceeded south-east, crossing the Antarctic Circle in 30° 45′ E. and reaching a farthest south of 67° 50′, nine degrees farther east. An attempt to reach Enderby Land was frustrated by the weather, and Moore continued his voyage to Australia in a high latitude beating against contrary gales, a condition to which all previous experience pointed as likely to occur.

"Challenger."

No further attempt at South Polar exploration was made for nearly thirty years, except a short cruise by Mr Tapsell in the "Brisk," one of Enderby's ships which in February 1850, after passing the Balleny Islands, proceeded eastward to 143° E. at a higher latitude than Wilkes without sighting land. The first steamer to cross the Antarctic Circle was H.M.S. "Challenger," on the 16th of February 1874: she only penetrated to 66° 40′ S., in 78° 30′ E., south of Kerguelen Land; but she continued her course to Australia for some distance in a high latitude, passing within 15 m. of the position assigned to Wilkes's Termination Land without seeing any sign of land. Her dredgings and soundings yielded evidence as to the nature of the unknown region farther south. Sir John Murray believed that the soundings showed a general shoaling of the ocean towards the Antarctic ice, indicating the approach to a continent. By collecting and analysing all samples of deep-sea deposits which had been secured from the far south, he discovered a remarkable symmetry in the arrangement of the deposits. The globigerina ooze, or in deeper waters the red clay, carpeting the northern part of the Southern Oceans, merges on the southward into a great ring of diatom ooze, which gives place in turn, towards the ice, to a terrigenous blue mud. The fine rock particles of which the blue mud is composed are such as do not occur on oceanic islands, and the discovery of large blocks of sandstone dropped by icebergs proved the existence of sedimentary rocks within the Antarctic Circle.

Dallmann.

During the southern summer in which the "Challenger" visited Antarctic waters, a German whale-ship, the "Grönland," under Captain Dallmann, visited the western coast of the Antarctic land south of Tierra del Fuego, and modified the chart in several particulars. The chief discovery was a channel, named Bismarck Strait, in 65° S., which seemed to run between Palmer Land and Graham Land.

When the International Circumpolar observations were set on foot in 1882, two scientific stations were maintained for a year in the southern hemisphere in order to obtain data for comparison with the observations at twelve stations round the North Pole. One of these was occupied by French observers in Tierra del Fuego in 55° S., the other by German observers at Royal Bay on South Georgia in 54° 30′ S. The magnetic and meteorological observations were of considerable importance.

In 1892 four steamers of the Dundee whaling fleet—the "Balaena," "Active," "Diana" and "Polar Star"—went out to test Ross's statement that the "right whale" inhabited Antarctic waters. The surgeons of two of the vessels—on the "Balaena" Dr W. S. Bruce, on the "Active" Dr C. W. Donald—were selected for their scientific tastes, and equipped with all requisite instruments for observations and collecting. The result of the experiment was disappointing. No whales were obtained, and the ships devoted their attention to sealing on the east of Joinville Island and Louis Philippe Land, not going farther south than 65° S. (*Geographical Journal*, 1896, vii. 502–521, 625–643).

Larsen.

A Norwegian sealer, the "Jason," Captain Larsen, also visited those seas in the same season, but the captain landed and collected fossils at several points north of 65° S. In 1893–1894 the "Jason," accompanied by two other Norwegian vessels, the "Hertha" and the "Castor," returned to the Antarctic and entered the ice-laden waters in November at the very beginning of summer. Captain Larsen in the "Jason" made his way as far south as 68° 10′ in 60° W. on the eastern side of Graham Land, but several miles from the coast, which was bordered by a high ice-barrier. The land beyond this barrier was named Foyn Land, after a famous Norwegian whaleship owner. Returning northwards, two small islands, Lindenberg and Christensen, were discovered and found to be active volcanoes. Meanwhile the "Hertha," Captain Evensen, had reached the South Shetlands on the 1st of November 1893, and worked her way southward along the west side of Palmer Land and past the Biscoe Islands, reaching the Antarctic Circle on the 9th of November without meeting ice. This was the first time the Antarctic Circle had been crossed since the "Challenger" did so twenty years before. Captain Evensen sighted Alexander Land, and without experiencing any trouble from ice-floes he reached his farthest south, 69° 10′ S. in 76° 12′ W. (*Mitteilungen der Geographischen Gesellschaft*, Hamburg, 1895, pp. 245–304).

Borchgrevink, 1894.

In 1894 the well-known Norwegian whaler, Svend Foyn, sent out one of his vessels, the "Antarctic," Captain Christensen, to try his luck off the coast of Victoria Land. The "Antarctic" sailed from Melbourne in September, having on board Carstens Egeberg Borchgrevink, a young Norwegian resident in Australia, who, being determined to take part in a voyage he could join in no other way, shipped as an ordinary seaman. He made notes of the voyage, and published an account of it on his return to Europe (*Report of Sixth International Geographical Congress*, London, 1895, pp. 169–175). The "Antarctic" entered the pack in 62° 45′ S., 171° 30′ E., on the 8th of December 1894. The Balleny Islands were sighted on the 14th of December, and Cape Adare on Victoria Land two days later. On the 22nd of January 1895 the farthest point was reached at Coulman Island in 74° S.; the sea was then easily navigable to the south. On the 23rd of January a small party, including the captain and Mr Borchgrevink, landed on the mainland near Cape Adare, the first people to set foot on the Antarctic continent.

Gerlache; "Belgica."

Efforts had been made from time to time, by Professor Georg von Neumayer in Germany and by Sir John Murray and others in Great Britain, to induce learned societies to inaugurate a new era of scientific Antarctic research under Government or at least under national auspices. In 1895 Sir Clements Markham, as president of the Royal Geographical Society and of the International Geographical Congress, also took the matter up, and interest in the Antarctic regions began to be aroused in every civilized country. Captain Adrien de Gerlache organized and led a Belgian expedition, for which he raised the funds with difficulty. M. Georges Lecointe, captain of the "Belgica," and Lieut. Danco, magnetic observer, were Belgians; Mr Roald Amundsen, the mate, a Norwegian; M. Arçtowski, the geologist and physicist, a Pole; M. Racovitza, the biologist, a Rumanian; and Dr F. A. Cook, the surgeon, an American. On the 14th of January 1898, already long past midsummer, the "Belgica," left Staten Island for Antarctic waters. She sighted the South Shetlands on the 21st and proceeded to Hughes Gulf, from which a channel, Gerlache Strait, was explored leading south-westward between continuous land, named Danco Land, on the east (the northern extension of Graham Land), and Palmer Land on the west. Palmer Land was found to be a group of large islands. On the 12th of February the "Belgica" re-entered the open sea to the west at Cape Tuxen in 65° 15′ S. Much fog was experienced, but on the 16th Alexander Land was sighted in the distance. Continuing on a westerly course, the "Belgica" made every effort to enter the pack, which was successfully accomplished after a heavy storm on the 28th. By taking advantage of the leads, the expedition advanced to 71° 30′ S. in 85° 15′ W. by the 2nd of March, but the ship was blocked next day by the growth of young ice soldering the pack into one continuous mass. For more than a year further independent movement was impossible; but the ship drifted with the ice between the limits of 80° 30′ W. and 102° 10′ W., and of 69° 40′ and 71° 35′ S., which was the highest latitude attained (May 31, 1898). The sun did not rise for seventy days, and all on board suffered severely from depression of spirits and disorders of the circulation, which Dr Cook attributed to the darkness and to improper food. Lieut. Danco died during the period of darkness. On the 13th of March 1899, when a second winter in the ice began to seem probable, the "Belgica" was released in 69° 50′ S. and 102° 10′ W. The geographical results of this expedition were insignificant so far as the discovery of land or penetration to a high latitude is concerned. The ship passed several times to the south and west of Peter I. Island, proving that the land seen by Bellingshausen at that point is of very limited extent. During the drift in the ice the soundings were usually between 200 and 300 fathoms, which, compared with the great depths to the north, clearly indicated a continental shelf of considerable breadth, probably connected with land in the south. The scientific collections were of unique value and have been worked up and the results published at the expense of the Belgian government.

"Valdivia."

The Hamburg America Company's steamer "Valdivia," chartered by the German Government for a scientific voyage under the leadership of Professor Carl Chun of Leipzig, with Dr Gerhard Schott as oceanographer, left Cape Town on the 13th of November 1898, and on the 25th was fortunate in rediscovering Bouvet Island (54° 26′ S., 3° 24′ E.), which had been searched for in vain by Cook, Ross, Moore and many other sailors. Steering south, the "Valdivia," although an unprotected steel vessel, followed the edge of the pack from 8° E. to 58° E., reaching 64° 15′ S. in 54° 20′ E. on the 16th of December. At this point a depth of 2541 fathoms was found, so that if Enderby Land occupies its assigned position, 102 nautical miles farther south, the sub-oceanic slope must be of quite unusual steepness. The rocks dredged up contained specimens of gneiss, granite and schist, and one great block of red sandstone weighing 5 cwt. was secured, confirming the theory of the continental nature of the land to the south.

Borchgrevink, 1898.

On his return to England in 1895 Mr Borchgrevink made strenuous efforts to organize an Antarctic expedition under his own leadership, and in August 1898 he left the Thames on the "Southern Cross," in charge of a private expedition equipped by Sir George Newnes. His scientific staff included Lieut. Colbeck, R.N.R.; Mr Louis Bernacchi, a trained magnetic observer, and Mr N. Hanson, biologist. About fifty dogs were taken out, the intention being to land at Cape Adare and advance towards the magnetic, and perhaps also towards the geographical pole by sledge. The "Southern Cross" sighted one of the Balleny Islands on the 14th of January 1899, and after in vain attempting to get south about the meridian of 164° E., the ship forced her way eastward and emerged from the pack (after having been beset for forty-eight days) in 70° S., 174° E. She reached Cape Adare, and anchored in Robertson Bay on the 17th of February. The land party, consisting of ten men, was established in a house built on the strip of beach at the base of the steep ascent to the mountains, and the ship left on the 2nd of March. Mr Borchgrevink found it impossible to make any land journey of importance and the party spent the first year ever passed by man on Antarctic land in making natural history collections and keeping up meteorological and magnetic observations. The "Southern Cross" returned to Cape Adare on the 28th of January 1900, and after taking the winter party on board—diminished by the death of Mr Hanson—set out for the south on the 2nd of February. Landings were made on several islands, on the mainland at the base of Mt Melbourne, and on the 10th of February at the base of Mt Terror, near Cape Crozier. From this point the ship steamed eastward along the great ice-barrier to a point in 164° 10′ W., where an inlet in the ice was found and the ship reached her highest latitude, 78° 34′ S., on the 17th of February. The edge of the ice was found to be about 30 m. farther south than it had been when Ross visited it in 1842. Mr Borchgrevink was able to land on the ice with sledges and dogs, and advanced southward about 16 m., reaching 78° 50′ S. He discovered that plant life existed in the shape of mosses and lichens in some of the rocky islands, a fact not previously known.

Scott, "Discovery."

In the autumn of 1901 three well-equipped expeditions left Europe for Antarctic exploration. The British National Antarctic expedition was organized by a joint committee of the Royal Society and the Royal Geographical Society, and equipped under the superintendence of Sir Clements Markham. Most of the cost was borne by the government, the rest mainly by Mr L. W. Longstaff, who provided £30,000, the Royal Geographical Society, and Mr A. C. Harmsworth (afterwards Lord Northcliffe). A strong wooden ship of about 700 tons register (1700 tons displacement) was built at Dundee, and named the "Discovery." She was made entirely non-magnetic amidships, so that magnetic observations might be carried on without interference from local attraction. The expedition sailed under the command of Commander R. F. Scott, R.N., with Lieut. Albert Armitage, R.N.R., as second in command, Lieuts. Royds and Barne, R.N., Lieut. Shackleton, R.N.R., and Engineer-Lieut. Skelton, R.N. The crew of forty men were almost entirely sailors of the Royal Navy. The scientific staff included Dr Koettlitz, who had shared with Mr Armitage in the Jackson-Harmsworth arctic expedition; Mr Louis Bernacchi, who had wintered with Mr Borchgrevink at Cape Adare; Dr E. A. Wilson, Mr Hodgson, biologist, and Mr Ferrar, geologist. The "Discovery" sailed from New Zealand on the 24th of December 1901, met the pack ice on the Antarctic circle and was through into the open sea in 175° E. on the 8th of January 1902. She made a quick run to Cape Crozier and cruised along the great ice barrier, confirming Borchgrevink's discovery that it lay 30 m. farther south than in 1842, and at the eastern end of the barrier Scott discovered and named King Edward Land where Ross had recorded an "appearance" only. The sea in the neighbourhood had shoaled to less than 100 fathoms and the ice-barrier in places was so low that the "Discovery" was able to lie alongside as at a quay. A captive balloon ascent was made from the barrier but nothing was seen to the south. Returning to McMurdo Bay the "Discovery" found that Mts Erebus and Terror were on an island, the "bay" being really a sound. The ship was secured in winter quarters in 77° 49′ S. 166° E., and a hut erected on shore. From this base land-exploration in the Antarctic was initiated, and the history of exploration entered on a new phase. Although some symptoms of scurvy appeared during the winter they were checked by change of diet, and with the beginning of spring sledge journeys with dogs were commenced and a quantity of provisions was laid down in depots to assist the great journey which Scott had planned to the south. On the 2nd of November 1902 Captain Scott, with Lieut. E. H. Shackleton and Dr E. A. Wilson, set out with dog-sledges travelling south over the surface of the barrier in sight of a range of new mountains running parallel to their track on the west. The conditions of travelling were unlike those in the Arctic region, the weather being more inclement and the summer temperature much lower than in similar latitudes in the north. There were no bears to menace the safety of the travellers, and no wolves or foxes to plunder the depots; but on the other hand there was no game of any sort to be met with, and all food for men and dogs had to be carried on the sledges. The surface of the ice was often rough and much crevassed, especially near the western land, snow blizzards frequently occurred making travelling impossible and the heavy sledges had at first to be brought forward by relays, making it necessary to march three miles for every mile of southing made. The dogs also weakened and had to be killed one by one to feed the rest. On the 30th of December they were in 82° 17′ S. and Scott determined to try to reach the mountains to the west; but on approaching the land he found the ice so much crevassed and disturbed that the attempt had to be given up. Great peaks in 83° S. were named Mt Markham (15,100 ft.) and Mt Longstaff (9700 ft.) after the chief promoters of the expedition. The outward journey of 380 m. had taken 59 days, and was a splendid achievement, for the conditions to be encountered were totally unknown, and new methods had to be devised as the necessity arose, yet no previous polar explorer had ever advanced so far beyond his predecessor as Scott did. The return journey occupied 34 days and the ship was reached on the 3rd of February 1903, but Shackleton had broken down on the way and he had to return by the relief ship "Morning" on the 3rd of March, Lieut. Mulock, R.N., taking his place on the "Discovery." During the absence of the commander in the great southern journey Armitage and Skelton had found a way to ascend by a glacier in 78° S. to the summit of the vast snow-covered plateau beyond the granite summits of the western mountains. They reached a distance of 130 m. from the ship and an elevation of 9000 ft. Many shorter journeys were made; Ferrar studied the geology of the mountains and Hodgson was indefatigable in collecting marine fauna, while Bernacchi kept up the physical and meteorological observations. The second winter was lightened by the use of acetylene gas for the first time, and the dark months were passed in better spirits and better health than in the case of any previous polar wintering. In the spring of 1903–1904 Scott undertook a great journey on the western plateau, starting on the 26th of October without dogs. By the 30th of November he had reached a point on the featureless plateau of dead-level snow, 300 m. due west from the ship, the position being 77° 59′ S., 146° 33′ E. and 9000 ft. above sea-level. The ship was reached again on the 25th of December, and on the 5th of January the "Morning" arrived accompanied by a larger vessel, the "Terra Nova," sent out by the Admiralty with orders to Captain Scott to abandon the "Discovery" and return at once. Fortunately, although all the stores and collections had been transferred to the relief ships, the "Discovery" broke out of the ice on the 16th of February 1904 and Captain Scott had the satisfaction of bringing her home in perfect order. The relief ships had provided so little coal that a most promising voyage to the westward of the Balleny Islands had to be abandoned in 155° E.; but it showed that the land charted by Wilkes east of that meridian did not exist in the latitude assigned.

Drygalski; "Gauss."

Simultaneously with the "Discovery" expedition and in full co-operation with it as regards simultaneous meteorological and magnetic observations, the German government equipped an expedition in the "Gauss" which was specially built for the occasion. The expedition was under the charge of Professor Erich von Drygalski and the scientific staff included Professor Vanhöffen as naturalist, Dr Emil Philippi as geologist and Dr Friedrich Bidlingmaier as meteorologist and magnetician. The ship was under the command of Captain Hans Ruser of the Hamburg-American line. A supplementary expedition set up a station for simultaneous observations on Kerguelen Land. The "Gauss" crossed the parallel of 60° S. in 92° E. early in February 1902 and got within 60 m. of the charted position of Wilkes's Termination Land, where a depth of 1730 fathoms was found with no sign of land. The pack made it necessary to turn south-westward and land was seen to the eastward on February 1902 on the Antarctic Circle in the direction of Termination Land. Soon afterwards the "Gauss" was beset and spent the winter in the ice. Land of considerable extent was seen to the south and was named Kaiser Wilhelm II. Land; the most conspicuous feature on it was a hill of bare black rock with an elevation of about 1000 ft., which was called the Gaussberg, and was situated in 67° S., 90° E. This was the only bare land seen, and its neighbourhood was thoroughly investigated by sledge parties, but no distant journey was undertaken. In February 1903 the "Gauss" was freed from the ice; but although Drygalski struggled for two months to thread the maze of floes to the eastward and south he could gain no higher latitude and was able to force his way only to 80° E. before seeking the open sea. The scientific observations and collections were most extensive and of great value.

Nordenskjöld.

Two private expeditions organized by men of science were in the Antarctic region simultaneously with the British and German national expeditions, and the synchronous meteorological and magnetic observations added to the value of the scientific results of all the parties. Dr. Otto Nordenskjöld, nephew of the discoverer of the North-East Passage, led a Swedish party in the "Antarctic," with Captain C. A. Larsen in command of the ship, and reached the South Shetlands in January 1902, afterwards exploring on the east side of Joinville Island and Louis Philippe Land, and wintering on shore on Snow Hill Island in 64° 25′ S. From this point a long journey on ski over the flat sea ice bordering King Oscar Land was made to the south, but the Antarctic Circle was not reached. Meanwhile the "Antarctic" had succeeded in penetrating the pack in the Weddell Sea almost to the circle in 50° W., where D'Urville and Ross had failed to get so far south. A second winter was spent at the base on Snow Hill Island, and, the ship having been lost in the ice on her way to take them off, the party was rescued by a brilliant dash of the Argentine gunboat "Uruguay," under Captain Irizar, before the relief ship sent from Sweden arrived.

Bruce.

Meanwhile Dr W. S. Bruce, largely aided financially by Mr James Coats and Captain Andrew Coats, equipped a Scottish expedition in the "Scotia," with Captain Thomas Robertson in command of the ship, and a scientific staff including Mr R. C. Mossman as meteorologist, Mr R. N. Rudmose Brown as naturalist, and Dr J. H. H. Pirie as geologist. The principal object of the expedition was the exploration of the Weddell Sea. The "Scotia" sighted the South Orkneys on the 3rd of February 1903, and after a short struggle with the pack she found an open sea to 70° 25′ S., where she was beset on the 22nd in 18° W., and whence she returned by a more westerly course, recrossing the Antarctic Circle in 40° W. This important voyage midway between the tracks of Weddell and Ross, who alone of all who tried had reached 70° S. in this region, praccally demonstrated the navigability of Weddell Sea in favourable conditions, and the oceanographical observations made were the most valuable yet carried out in the Antarctic region. The following year, starting from the Sandwich group, Bruce crossed the Antarctic Circle about 22° W., and was able to make a straight run south to 74° 1′ S., where the "Scotia" was stopped by the ice in 159 fathoms of water, the sea having shoaled rapidly from a great depth. From the 3rd of March to the 13th the "Scotia" remained in shallow water, catching occasional glimpses of a great ice wall with snow-covered heights beyond it, along a line of 150 m., and dredging quantities of continental rocks. On this evidence the name Coats Land was given to the land within the barrier. The "Scotia" crossed the Antarctic Circle northward in 11° W., having in the two years explored a totally unknown sea for a distance of thirty degrees of longitude. A meteorological station was established by Mr Mossman on Laurie Island, in the South Orkneys (61° S.) in March 1903, and kept up by him for two years, when it was taken over by the Argentine government, and it now has the distinction of being the most southerly station at which continuous observations have ever been taken for over five years.

Charcot.

In January 1904 Dr Jean B. Charcot, a man of science and an accomplished yachtsman, left the Fuegian archipelago for the Antarctic in the "Français," in command of a French exploring expedition equipped at his own instance. He cruised through the islands of the Palmer Archipelago, and wintered in a cove of Wandel Island 65° 5′ S. near the southern entrance of Gerlache Strait. On the 25th of December 1904 the "Français" was free, and continued to cruise southward along the coast of Graham Land, to the south of which, on the 15th of January, when nearly in latitude 67°, a new coast appeared, mountainous and stretching to the south-west, but Charcot could not determine whether it was joined to Graham Land or to Alexander Land. While approaching the land the "Français" struck a rock, and was so much damaged that further exploration was impossible, and after naming the new discovery Loubet Land, the expedition returned. Charcot organized a second expedition in 1908 on board the "Pourquoi Pas?" and, leaving Punta Arenas in December, returned to the Palmer Archipelago, and during January 1909 made a detailed examination of the coast to the southward, finding that Loubet Land was practically continuous on the north with Graham Land and on the south with Alexander Land, which was approached within a mile at one point. Adelaide Island, reported by Biscoe as 8 m. long, was found to be a large island 70 m. in length, consisting of a series of summits rising out of an icefield. The Biscoe Islands were found to be much more numerous than was formerly supposed. The expedition wintered at Petermann Island in 65° 10′ S., and attempts were made to reach the interior of Graham Land, though with little success. After coaling from the whalers' dépôt at Deception

Island, the "Pourquoi Pas?" sailed on the 6th of January 1910 to the south-west, and reached 70° S. on the 11th, whence views of Alexander Land were obtained from a new position, and a new land discovered farther to the south-west. The highest latitude reached was about 70° 30′ S., and Charcot was able to steam westward nearly along this parallel crossing the region of the "Belgica's" drift, passing close to Peter I. Island across the meridian of Cook's highest latitude, where the ice seemed to promise an easy way south if coal had permitted, and on to 128° W. through an absolutely unknown sea, from which point a direct course was made for Punta Arenas. Frequent soundings and dredgings were made, and Dr Charcot satisfied himself from all the appearances that along the 20 degrees of longitude west of Gerlache's farthest, and more than half-way from Graham Land to King Edward Land, land was probably not far distant to the south.

Shackleton.

After his return invalided from the "Discovery," Lieut. Shackleton planned a fresh expedition, which he equipped at his own expense, aided by his personal friends, and he started in the small whaler "Nimrod" from Lyttelton, New Zealand, on the 1st of January 1908, being towed by a steamer to the Antarctic Circle, in order to save coal. The plan was to land a shore party on King Edward Land and return to take them off in the following year, but although a strenuous effort was made to reach the land the floe ice was too heavy, and it would have been madness to establish winter-quarters on the barrier, the coast-line of which had altered greatly since 1902, and was obviously liable to break off in great ice-islands. On the 26th of January the "Nimrod" began to return from the extreme east of the barrier, and the landing of stores commenced on the 3rd of February at Cape Royds, at the base of Mt Erebus, 20 m. north of the "Discovery's" winter-quarters. The shore party included the leader and fifteen companions, amongst them Professor T. W. Edgeworth David, of Sydney University; Lieut. Jameson Boyd Adams, R.N.R.; Sir Philip Brocklehurst, Bart.; Mr James Murray, biologist; Mr Raymond E. Priestley, geologist; Dr Alistair Forbes Mackay; Dr Eric Marshall; Mr Douglas Mawson, geologist; and Ernest Joyce and Frank Wild of the Royal Navy, who had taken part in the "Discovery" expedition. No casualty occurred during the whole duration of the expedition, special care having been taken to supply the best provisions, including fresh bread baked daily and dried milk in unlimited quantity, while abundant artificial light was secured by the use of acetylene gas. A motor-car was taken in the hope that it might be used on the barrier surface, but this was found impracticable, although it did good work in laying dépôts on the sea-ice. Another and more successful experiment in traction was the use of Manchurian ponies. Eight of these extraordinarily hardy creatures were taken south in the "Nimrod," but four died in the first month after landing. The others did good service. Nine dogs were also taken, but the experience on the "Discovery" expedition did not lead to much dependence being placed on them. The "Nimrod" left for the north on the 22nd of February and the scientific staff at once began the observations and collections which were kept up to the end. The discovery of a considerable fresh-water fauna and of a poor but characteristic flora was one of the most unexpected results. Apart from many minor excursions and surveys, the expedition performed three journeys of the first importance, each of them surpassing any previous land work in the Antarctic regions. Before winter set in, Professor David, with five companions, made the ascent of Mt Erebus, starting from the winter quarters on the 5th of March, and gaining the summit at an altitude of 13,300 ft. on the 10th; this was found to be the edge of an active crater, the abyss within being 900 ft. deep, though rarely visible on account of the steam and vapours which rose in a huge cloud 1000 ft. above the summit.

The second achievement was the attainment of the South Magnetic Pole by Professor David, with Mr Douglas Mawson and Dr Mackay. They left winter-quarters on the 6th of October 1908, dragging two sledges over the sea-ice. Proceeding along the coast they were able to supplement their provisions and fuel by seal-meat and blubber, and on the 1st of December they reached the Drygalski ice barrier in 75° S., which proved very difficult to cross. Leaving this ice-tongue on the 19th, they proceeded to ascend the plateau with one sledge, and ran great risks from the crevasses into which they were constantly falling. On reaching the summit of the plateau travelling became easier, and on the 16th of January 1909 the magnetic dip was 90°, and the position of the magnetic pole was determined as 72° 25′ S., 155° 16′ E., at an altitude of 7260 ft. and 260 m. from the dépôt of provisions left at the Drygalski glacier. The return journey to this point was accomplished by forced marches on the 3rd of February, and next day the party was picked up by the "Nimrod," which was scouting for them along the coast.

The third and greatest achievement of this remarkable expedition was Shackleton's great southern journey. Dépôts had been laid out in advance on the barrier ice, and the main southern party, consisting of Messrs Shackleton, Adams, Marshall and Wild, started from winter-quarters on the 29th of October 1908, with the four ponies and four 11-ft. sledges; a supporting party of five men accompanied the main division for ten days. In order to avoid the disturbed and crevassed ice near the great south-running mountain range, Shackleton kept about 40 m. farther to the east than Scott had done. The ponies enabled rapid progress to be made, but after passing the 81st parallel on the 21st of November, one pony broke down and had to be shot, the meat being left in a dépôt for the return journey. In spite of cold weather and frequent high winds, progress was made at the rate of 15 m. per day, and on the 26th of November the farthest south of the "Discovery" expedition was passed, and Mts Markham and Longstaff were full in view. New mountains continued to appear beyond these, and the range changed its southerly to a south-easterly trend, so that the path to the Pole led through the mountains. On the 28th a second pony became used up and was shot, and a dépôt was formed with provisions and stores for the return in 82° 38′ S., and progress was resumed with two sledges. The surface of the barrier ice formed great undulations of gentle slope. On the 1st of December a third pony had to be shot, in 83° 16′ S., and horseflesh became the principal article of diet; the remaining pony hauled one sledge, the four men took the other. On the 4th of December the party left the barrier, passing over a zone of much disturbed ice, and commenced the ascent of a great glacier (the Beardmore glacier) which descended from the mountains between magnificent granite cliffs 2000 ft. high. On the 7th, when toiling amongst a maze of crevasses on the glacier, 2000 ft. above sea-level, the last pony fell into a crevasse and was lost, though the loaded sledge was saved; the pony was to have been shot that night as it could not work on the disturbed ice; but its loss meant so much less food, and as far as can be judged this alone made it impossible for the party to reach the Pole. For the next few days of laborious advance one or other of the party was continually falling into a crevasse, but the sledge harness saved them, and no serious harm resulted. After climbing upwards for 100 m. on the glacier, a dépôt was made at a height of 6100 ft. of everything that could possibly be left behind, including all the warm clothing, for it was found possible with Jaegers and wind-proof Burberrys to meet any weather in which exertion was possible. By Christmas Day the plateau surface was fairly reached at a level of 9500 ft., in latitude 85° 55′ S., and there was no more difficulty to overcome as regarded the ground, but merely the effort of going on over a nearly level surface with insufficient food in a very low temperature, intensified by frequent blizzards. Rations were reduced in the hope of being able to push on to the Pole. Three days later the last crevasse was passed and the surface, now 12,200 ft. above sea-level, grew smoother, allowing 15 m. a day to be done with fair weather. At 4 a.m. on the 9th of January 1909 the four explorers left their sledge and racing, half walking, half running, they reached 88° 23′ S. in 162° E. at 9 a.m., the height above sea being 11,600 ft. The utmost had been done, though more food would have enabled the remaining 97 geographical miles to the South Pole to be accomplished. The camp was reached again at 3 p.m. The return journey of over 700 m. to the ship was one long nightmare of toil and suffering, but the length of the marches was unsurpassed in polar travel. Once and again all food was exhausted the day before the dépôt, on which the only hope of life depended, was picked up in the waste of snow. Snow-blindness and dysentery made life almost unendurable, but, despite it all, the ship was reached on the 1st of March, and the geological specimens from the southernmost mountains, which prevented the sledges of the exhausted men being lightened as they went on, were safely secured. Never in the history of polar exploration had any traveller outdistanced his predecessor by so vast a step towards either Pole.

During the return journey of the "Nimrod" Shackleton was able to do a little piece of exploration to the south of the Balleny Islands, tracing the coast of the mainland for 50 m. to the south-west beyond Cape North, thus indicating that the Antarctic continent has not a straight coast-line running from Cape Adare to Wilkes Land. The British government contributed £20,000 to the expenses of the expedition in recognition of the great results obtained, and the king conferred a knighthood on the explorer, the first given for Antarctic exploration since the time of Sir James Clark Ross.

Expeditions of 1910–1911.

Captain R. F. Scott left England in the summer of 1910 with a new expedition in the "Terra Nova," promoted by his own exertions, aided by a government grant, and with a carefully selected crew and a highly competent scientific staff. He intended to arrange for two parties, one leaving King Edward Land, the other McMurdo Sound, to converge on the South Pole. A German expedition under Lieut. Wilhelm Filchner was announced to leave early in 1911 with the hope of exploring inland from a base in the western part of Weddell Sea, and Dr W. S. Bruce has announced for the same year an expedition to the eastern part of Weddell Sea mainly for oceanographical exploration. It appears that the greatest extension of knowledge would now be obtained by a resolute attempt to cruise round the south polar area from east to west in the highest latitude which can be reached. This has never been attempted, and a modern Biscoe with steam power could not fail to make important discoveries on a westward circumnavigation.

Physiography of Antarctic Region.—In contrast to the Arctic region, the Antarctic is essentially a land area. It is almost certain that the South Pole lies on a great plateau, part of a land that must be larger and loftier than Greenland, and may probably be as large as Australia. This land area may be composed of two main masses, or of one continent and a great archipelago, but it can no longer be doubted that the whole is of continental character as regards its rocks, and that it is permanently massed into one surface with ice and snow, which in some parts at least unites lands separated by hundreds of miles of sea. But all round the land-mass there is a ring of deep ocean cutting off the Antarctic region from all other land of the earth and setting it apart as a region by itself, more unlike the rest of the world than any continent or island. The expedition of the "Scotia" showed the great depth of the Weddell Sea area, and the attention paid to soundings on other expeditions—notably that of the "Belgica"—has defined the beginning of a continental shelf which it cannot be doubted slopes up to land not yet sighted. In the Arctic region large areas within the Polar Circle belong to climatically temperate Europe, and to habitable lands of Asia and America; but in the Antarctic region extensive lands—Graham Land, Louis Philippe Land, Joinville Island and the Palmer archipelago outside the Polar Circle—partake of the typically polar character of the higher latitudes, and even the islands on the warmer side of the sixtieth parallel are of a sub-Antarctic nature, akin rather to lands of the frigid than to those of the temperate zone.

Geology.—Definite information as to the geology of Antarctic land is available from three areas—Graham Land and the archipelago to the north of it, Kaiser Wilhelm Land and Victoria Land. In the Graham Land region there seems to be a fundamental rock closely resembling the Archaean. Palaeozoic rocks have not been discovered so far in this region, although a graptolite fossil, probably of Ordovician age, shows that they occur in the South Orkneys. Mesozoic rocks have been found in various parts of the archipelago, a very rich Jurassic fossil flora of ferns, conifers and cycads having been studied by Nordenskjöld, some of the genera found being represented also in the rocks of South America, South Africa, India and Australia. Cretaceous ammonites have also been found, and Tertiary fossils, both of land and of marine forms, bring the geological record down probably to Miocene times, the fauna including five genera of extinct penguins. Raised beaches show an emergence of the land in Quaternary times. and there is evidence of a recent glacial period when the inland ice on Graham Land was a thousand feet higher than it is now. The most prominent features of the scenery are due to eruptive rocks, which have been identified as belonging to the eruptive system of the Andes, suggesting a geologically recent connection between South America and the Antarctic lands. Volcanic activity is not yet extinct in the region.

As regards Kaiser Wilhelm Land, the Gaussberg is a volcanic cone mainly composed of leucite-basalt, but its slopes are strewn with erratics presumably transported from the south and these include gneiss, mica-schist and quartzite, apparently Archaean.

Much more is known as to the geology of Victoria Land, and the results are well summarized by Professor David and Mr Priestley of Sir Ernest Shackleton's expedition, whom we follow. From Cape North (71° S.) to 86° S. a grand mountain range runs south curving to south-eastward, where it vanishes into the unknown; it is built up of gneiss and granite, and of horizontal beds of sandstone and limestone capped with eruptive rock, the peaks rising to heights of 8000, 10,000 and even 15,000 feet, the total length of the range so far as known being at least 1100 miles. This range rises abruptly from the sea, or from the ice of the Great Barrier, and forms a slightly higher edge to a vast snow plateau which has been traversed for several hundred miles in various directions, and may for aught we know extend farther for a thousand miles or more. The accumulated snows of this plateau discharge by the hugest glaciers in the world down the valleys between the mountains. About 78° S. a group of volcanic islands, of which Ross Island, with the active Mt Erebus is the largest, rise from the sea in front of the range, and at the northern extremity the volcanic peaks of the Balleny Islands match them in height. The composition of the volcanic rocks is similar to that of the volcanic rocks of the southern part of New Zealand. The oldest rocks of Victoria Land are apparently banded gneiss and gneissic granite, which may be taken as Archaean. Older Palaeozoic rocks are represented by greenish grey slates from the sides of the Beardmore glacier and by radiolarian cherts; but the most widespread of the sedimentary rocks occurring in vast beds in the mountain faces is that named by Ferrar the Beacon sandstones, which in the far south Shackleton found to be banded with seams of shale and coal amongst which a fossil occurred which has been identified as coniferous wood and suggests that the place of the formation is Lower Carboniferous or perhaps Upper Devonian. No Mesozoic strata have been discovered, but deposits of peat derived from fungi and moss are now being accumulated in the fresh-water lakes of Ross Island, and raised beaches show a recent change of level. The coast-line appears to be of the Atlantic, not the Pacific type, and may owe its position and trend to a great fault, or series of faults, in the line of which the range of volcanoes, Mt Melbourne, Mt Erebus, and Mt Discovery, stand. Boulders of gneiss, quartzite and sandstone have been dredged at so many points between the Balleny Islands and the Weddell Sea that there can be no doubt of the existence of similar continental land along the whole of that side, at least within the Antarctic Circle.

Antarctic Ice-Conditions.—It is difficult to decide whether the ice of the polar regions should be dealt with as a geological formation or a meteorological phenomenon; but in the Antarctic the ice is so characteristic a feature that it may well be considered by itself. So far as can be judged, the total annual precipitation in the Antarctic region is very slight, probably not more than the equivalent of 10 in. of rain, and perhaps less. It was formerly supposed that the immense accumulation of snow near the South Pole produced an ice-cap several miles in thickness which, creeping outward all round, terminated in the sea in vast ice-cliffs, such as those of Ross's Great Barrier, whence the huge flat-topped ice-islands broke off and floated away. Evidence, both in the Graham Land and in the Victoria Land areas, points to a former much greater extent of the ice-cap. Thus Shackleton found that the summit of Mt Hope, in 83° 30′ S., which stands 2000 feet above the ice of the surrounding glaciers, was strewn with erratics which must have been transported by ice from the higher mountains to the south and west. In McMurdo Sound, as in Graham Land, evidence was found that the surface of the ice-sheet was once at least a thousand feet above its present level. These facts appear to indicate a period of greater snowfall in the geologically recent past—*i.e.* a period of more genial climate allowing the air to carry more water vapour to the southern mountains. Whatever may have been the case in the past the Antarctic glaciers are now greatly shrunken and many of them no longer reach the sea. Others project into the sea a tongue of hard ice, which in the case of the Drygalski glacier tongue is 30 m. long, and afloat probably for a considerable distance. Some of these glacier tongues of smaller size appear now to be cut off at their shoreward end from the parent glacier. At one time the Victoria Land glacier tongues may have been confluent, forming a great ice barrier along the coast similar to the small ice-barriers which clothe the lower slopes of some of the islands in Gerlache Strait. The Great Ice Barrier is in many ways different from these. Captain Scott showed that it was afloat for at least 400 m. of its extent from west to east. Sir Ernest Shackleton followed it for 400 m. from north to south, finding its surface in part thrown into long gentle undulations, but with no evidence of the surface being otherwise than level on the average. The all-but-forgotten experiments and cogitations of Biscoe convinced that shrewd observer that all Antarctic icebergs were sea-ice thickened with snow "accumulated with time." The recent expeditions seem to confirm this view to a great extent in the case of the Barrier, which, so far as the scientific men on the "Nimrod" could see, was formed everywhere of compressed nevé, not of true glacier ice. Instances have been seen of tabular bergs floating with half their bulk above water, showing that they are of very much less density than solid ice. The thrust of the glaciers which descend from the western mountains upon the Barrier throws it into sharp crevassed folds near the point of contact, the disturbance extending 20 m. from the tip of the Beardmore glacier, and the seaward creep of the whole surface of the Barrier is possibly due to this impulse; the rate of movement at the eastern side of the Barrier was found to be at the rate of 500 yds. per annum for the seven years between Scott's and Shackleton's expeditions.

Pack ice composed of broken-up sea-ice and fragments of icebergs appears to form a floating breakwater round the Antarctic area. It is penetrated by powerful steamers with ease or with difficulty according to the action of the wind which loosens the pack when it drives it towards the open sea, and closes it up when it drives it against a coast or a barrier of fast ice. At every point but one around the circumpolar area the pack, be it light or dense, appears to extend up to the southern permanent ice or land, though, as in the Weddell Sea, the pack seems at times to be driven bodily away. The exceptional region is the opening of the Ross Sea east of Cape Adare, where a comparatively narrow band of pack ice has always been penetrated by the resolute advance even of sailing ships and led to an extensive open sea to the south. No doubt the set of the ocean currents accounts for this, but how they act is still obscure. The great flat-topped ice-islands which in some years drift out from the Antarctic area in great numbers are usually met with in all parts of the Southern Ocean south of 50° S., and worn-down icebergs have been sighted in the Atlantic even as far north as 26° 30′ S. The greater frequency of icebergs in the Southern Ocean in some years is attributed to earthquakes in the Antarctic breaking off masses of the floating edge of the Barrier.

Antarctic Climate.—Although a vast mass of observations has recently been accumulated, it is not yet possible to treat of the climate of the South Polar region in the same broad way as in the case of the North Polar region. The following table shows the mean temperatures of each month and of the year at all the stations at which the Antarctic winter has been passed. The result is to show that while the winter is on the whole less severe at high latitudes than at equal latitudes in the north, the summer is very much colder, and has little relation to latitude. Even in the South Orkneys, in latitude 60°, in the three warmest months the air scarcely rises above the freezing point as an average, while in Shetland (60° N.) the temperature of the three summer months averages 54° F. But on the other hand, the warmest month of the year even in 77° S. has had a mean temperature as high as 30°. A study of the figures quoted in the accompanying table shows that until longer records

	Belgica *ca.* 70° S.		Cape Adare 71° S.		Snow Hill 64° 30′ S.		Gauss 65° 2′ S.		Discovery 77° 51′ S.			Cape Royds 77° 32′ S.		S. Orkneys 60° 44′ S.		Wandel Island 65° S.		Peterman Island 65° 10′ S.	
	1898.	1899.	1899.	1900.	1902.	1903.	1902.	1903.	1902.	1903.	1904.	1908.	1909.	1903.	1904.	1904.	1905.	1908.	1909.
Jan.		+29·8		+33·0		+30·0		+30·6		+26·1	+22·5		+26·1	(+30·4)	+32·3		+32·9		(+34·9)
Feb.		+30·2	(+26·4)			+24·4		(+25·9)	(+15·9)	+11·2	(+21·5)		+20·4	(+30·4)	+32·6	+31·2			+34·5
Mar.	+15·6		+17·7		+14·1	+11·0	+16·9		+8·0	−0·8		+4·9		(+30·2)	+32·4	+29·8			+33·7
Apr.	+10·8		+10·3		+6·3	+6·7	+3·9		−7·1	−16·9		−10·9		+20·6	+25·1	+22·6			+23·0
May	+20·3		−4·6		+1·7	−1·6	+6·8		−12·5	−16·0		−5·5		+17·1	+10·5	+13·3			+22·7
June	+4·1		−11·8		−0·4	−6·8	+0·5		−16·0	−13·8		−7·1		+9·5	+16·8	+11·8			+20·3
July	−10·3		−8·6		−11·9	−0·2	−0·6		−8·1	−21·1		−17·0		+16·9	+7·0	−2·6			+19·7
Aug.	+11·7		−13·4		−9·7	+3·8	−7·4		−16·5	−16·5		−15·7		+18·8	+12·7	+20·5			+21·8
Sep.	−1·3		−11·9		+5·3	+0·3	+0·1		−12·0	−18·6		−5·7		+13·4	+20·5	+25·7			+21·4
Oct.	+17·8		−1·8		+8·9	+19·0	+8·6		−8·5	−6·8		+4·5		+27·0	+18·4	+18·7			+27·7
Nov.	+19·6		+17·8		+16·5		+19·9		+12·0	+15·4		+17·0		+29·3	+31·1	+31·5			+(29·9)
Dec.	+28·0		+31·8		+28·1		+30·0		+23·1	+25·7		+30·0		+31·5	+28·8	+31·2		(+33·9)	
Year	+14·7		+7·0		+9·4		+11·3		+0·4		−3·0		+3·4	+22·9	+22·4		+22·2		(+26·9)
	Mar. 1 to Feb. 28		Feb. to Jan. 31		Mar. 1 to Feb. 28		Feb. 19 to Feb. 18		Feb. 9 to Jan. 31		Feb. 1 to Jan. 31		Mar. to Feb.				Feb. to Jan.		Dec. 26 to Nov. 26

become available it is impossible to speak definitely as to the normal distribution of monthly temperature throughout the year, for even at the same station in consecutive years the months vary greatly. Thus at Snow Hill (65° S.) the mean temperature of August 1903 was 13·5° higher than that of August 1902, though June had been 7° colder; and at the "Discovery's" winter quarters July 1903 was 13° colder than July 1902 though June was 2° warmer, August having exactly the same mean temperature in each year. The mean temperature of the year is evidently higher in the position of the "Belgica's" drift than in Victoria Land at the same latitude; but it is noticeable that on the west side of Graham Land, where Charcot wintered, the average mean temperature was (taking the average of his two winterings) 15° higher than on the east side, where Nordenskjöld wintered in nearly the same latitude. The observations, however, were not synchronous, and it may not be right to compare them. We may perhaps say that along the whole of the known Antarctic coasts the temperature in the two midsummer months is within a degree or two of 32° F., and varies little from place to place or from year to year; but in the winter months the temperature is lower as the latitude increases and is subject to great variations from place to place and from year to year. It seems quite possible that at no place in the Antarctic region do the mean monthly sea-level winter temperatures fall so low as in the Arctic poles of cold, but data regarding winter temperatures in the interior are lacking. All the complete yearly series of temperature show that the winter six months from April to September have a low and nearly equal temperature, there being a very abrupt fall in February and March, and an equally abrupt rise in October and November. The warmest day experienced at the "Discovery's" winter-quarters had a mean temperature of 34·7°, and the coldest −45·7°, the extreme range of daily temperature being thus 80·4°.

The absolutely lowest temperature recorded in the Antarctic region was −66·8° on a journey southward from the "Discovery's" winter-quarters by Lieut. Barne on the 15th of September 1903; the lowest temperature at the winter-quarters was −58·5° on the 28th of September 1903. On Sir Ernest Shackleton's expedition the lowest temperature was −57°; but no other expedition met temperatures lower than −45·6° on the "Belgica," −43·1° at Cape Adare, and −41·4° on the "Gauss." Sudden rises of temperature during storms are common in the Antarctic region, from whichever quarter the wind blows.

During the ascent of Mt Erebus the temperature was found to fall as the height increased from 0° F. at sea-level to −24° at 5000 ft.; it remained stationary to 8600 ft., fell to −28° at 10,650 ft., and then rose to −22° at 11,500 ft., and fell a few degrees at the summit. It might appear as if the "isothermal layer" of the upper atmosphere had been reached at a remarkably low elevation; but the temperature variations may also be explained by differences in the temperature of the strong air currents which were passed through.

Pressure and Winds.—The normal fall of pressure southward, which gives rise to the strong westerly winds of the roaring forties, appears to be arrested about 65° S., and to be succeeded by a rise of pressure farther south. This view is supported by the frequency of south-easterly winds in the neighbourhood of the Antarctic Circle reported by all explorers, and the hypothesis of a south polar anticyclone or area of high pressure over the Antarctic continent has gained currency in advance of any observations to establish it. The complete data of Sir Ernest Shackleton's expedition are not available at the time of writing, but the yearly mean pressure as recorded at the "Discovery's" winter-quarters was 29·35 in. for 1902, and 29·23 in. for 1903. At Cape Adare it was 29·13 in. for 1899, in the "Belgica" 29·31 in. for 1898, and in the "Gauss" 29·13 in. for 1902. These figures, so far as they are comparable, show distinctly higher pressures in the higher latitudes, and the wind observations bear out the inference of a south-polar high pressure area, as at the "Discovery's" winter-quarters 80 % of the winds had an easterly component, and only 3 % a westerly component. It is bewildering, however, to find that on the sledge journeys there was an equally marked preponderance of wind with a westerly component, and in discussing the result in the published records of the expedition Mr R. H. Curtis, of the Meteorological Office, felt compelled to ask whether the correction for variation of the compass (in that region about 145°) was possibly omitted in the case of the sledge journeys. The "Gauss" observations and those at Cape Adare bore out the frequency of easterly winds, and on the "Scotia" it was observed that practically all of the easterly winds met with were to the south of the Antarctic Circle. The "Belgica" found rather more westerly than easterly winds in her drift; easterly winds predominating in summer, westerly winds in winter. At Cape Royds Shackleton found easterly winds to predominate, the most frequent direction being south-east; but on the great southern journey, south-south-east winds prevailed, occasionally swinging round to south-south-west, and even at the farthest south (88° S.) the ridges into which the snow was blown, 10,000 ft. above the sea, showed that south-south-easterly winds predominated. On the journey to the Magnetic Pole Professor David found that along the coast the prevailing winds were south-westerly, with occasional blizzards from the south-east, but he noticed that the westerly winds were of the nature of a land breeze, springing up soon after midnight and continuing to blow fresh until about 10 a.m. Thus the balance of probability inclines towards the hypothesis of a south-polar high-pressure area. An upper current of air blowing from a north-westerly direction was usually indicated by the clouds and smoke on Mt Erebus, and on the occasion of a great eruption, when the steam column reached more than 20,000 ft. above the sea it entered a still higher stratum of wind blowing from the south-east.

The intensity of the blizzards is worthy of remark, for the velocity of the wind often reached 40 or even 60 m. an hour, and they were usually accompanied by a rapid rise of temperature.

Observations of sunshine made at the "Discovery's" winter-quarters yielded many records of continuous sunshine extending throughout 24 consecutive hours, and in the summer months about 50 % of the possible sunshine was often recorded, the maximum being 490 hours, or 66 % of the total possible for December 1903. Thus, although the sun was above the horizon only for 246 days, it shone sufficiently to yield more than 1725 hours of bright sunshine for the year, an amount exceeded in few parts of England, where the sun may shine on 365 days. The intensity of solar radiation in the clear weather of the Antarctic makes it feel exceedingly hot even when the air temperature is far below the freezing point. There is a great difference between the clear skies of 78° S. and the extremely frequent fogs which shroud the coast near the Antarctic Circle and render navigation and surveying exceedingly difficult. Heavy snowstorms are frequent on the coast, but inland during the snow blizzards it is impossible to say whether the whirling snow-dust is falling from the air or being swept from the ground. Professor David is inclined to believe that the surface of the snow-plains is being lowered more by the action of the wind sweeping the snow out to sea than it is raised by precipitation, the total amount of which appears to be very small.

Flora and Fauna.—Recent expeditions have discovered that, despite the low temperature of the summer, in which no month has a mean temperature appreciably above the freezing point, there are on the exposed Antarctic land patches of ground with a sparse growth of cryptogamic vegetation consisting of mosses, lichens, fungi and fresh-water algae. The richest vegetation discovered on the "Nimrod" expedition consisted of sheets of a lichen or fungoid growth, covering the bottom of the fresh-water lakes near Cape Royds, and visible through the clear ice throughout the many months when the water is frozen. No flowering plants occur within the Antarctic Circle or in the immediately adjacent lands.

The marine fauna is very rich and abundant. All the expeditions obtained many new species, and the resemblance which occurs between many of the forms and those which inhabit the Arctic seas has given rise to the hypothesis that certain species have been able to pass from one frigid zone to the other. It is argued on the other hand that all the forms which resemble each other in the two polar areas are cosmopolitan, and occur also in the intermediate seas; but the so-called "problem of bipolarity" is still unsettled. Bird life on sea and land is fairly abundant, the most common forms being the skua gull, snow petrels, and the various species of penguins. The penguins are specially adapted for an aquatic life, and depend for their food entirely on marine animals. The largest species, the emperor penguin, inhabits the most southerly coast known on the edge of the Great Barrier, and there it breeds at mid-winter, very interesting specializations of structure and habit making this apparently impossible feat practicable. The social organization and habits of the various species of penguins have been carefully studied, and show that these birds have arrived at a stage of what might almost be called civilization worthy of the most intelligent beings native to their continent. The only mammalian life in the Antarctic is marine, in the form of various species of whales, but not the "right whale," and a few species of seals which live through the winter by keeping open blow-holes in the sea-ice. There is no trace of any land animal except a few species of minute wingless insects of a degenerate type. The fresh-water ponds teem with microscopic life, the tardigrada, or "water bears" and rotifers showing a remarkable power of resistance to low temperature, being thawed out alive after being frozen solid for months and perhaps for years.

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POLDER, the Dutch name for a piece of low-lying, marshy land reclaimed from the sea or other water by drainage and diking (see HOLLAND).

POLE (FAMILY). The family of the Poles, earls and dukes of Suffolk, which, but for Richard III.'s defeat at Bosworth, might have given the next king to England, had its origin in a house of merchants at Kingston-upon-Hull. It has been said that these Poles were the first English peers whose fortunes had been founded upon riches gained in trade; but the Berkeleys, descendants of Robert fitz Harding, the rich burghers of Gloucester, must perhaps be reckoned before them. Their pedigree begins with one William atte Pole (d. *c.* 1329), a merchant of Ravensrode who settled in Hull, where his widow became the wife of John Rotenhering, also a merchant. His sons, Sir Richard and Sir William atte Pole, were both famous for their wealth at a time when the Crown had great need of rich men's aid. Sir Richard (d. 1345), the king's butler in 1327, removed to London, and is styled a London citizen in his will. The male line of this, the elder branch of the Poles, failed with a grandson, John Pole, who by his marriage with Joan, daughter of John, Lord Cobham, was father of Joan, Lady of Cobham, the Kentish heiress whose lands brought her five knightly husbands, the fourth of them Sir John Oldcastle the Lollard.

Sir William atte Pole (d. 1366), the second son of William, joined his brother in advancing large sums to the government while keeping safely apart from politics. The first mayor of Hull, he sat for Hull in five parliaments, and was advanced to be knight banneret and a baron of the exchequer. He was counted "second to no merchant in England," but after his time his descendants left the counting-house, his four sons all serving in the French wars. The eldest son, Michael Pole, who had fought under the Black Prince and John of Gaunt, was summoned as a baron in 1366, before the father's death, and, as a stout supporter of the Crown, was appointed in 1381 governor of the person of the young king Richard II., whose marriage with the Lady Anne of Bohemia he had arranged on a visit to her brother the king of the Romans. In 1383 he became chancellor of England and thereafter, as the loyal servant and nearest counsellor of the king, he had to face the jealousy of the great lords and the hatred of the Commons. His wealth added to the envy of his enemies, for, to his inherited Yorkshire and Lincolnshire lands, his marriage with Catherine, daughter and heir of Sir John of Wingfield, added a great Suffolk estate, where, fortifying the manor-house of the Wingfields, he made his chief seat. In 1385 he was created earl of Suffolk, a grant from the Crown giving him the castle and honour of Eye with other East Anglian lands formerly held by the Ufford earls. In 1386 the opposition, led by Gloucester, the king's uncle, pulled him down. He was dismissed from his chancellorship, and impeached by the Commons on charges which, insufficient upon the face of them, secured his conviction. Richard was forced to send his minister into ward at Windsor until the parliament was dissolved, when Suffolk once more appeared as the leader of the king's party. But the opposition was insistent, and Suffolk, after Richard had been compelled to give his word that those who had advised him ill should answer for it to the next parliament, fled over sea to Calais. One of the earliest of the many popular songs that bark against the Poles tells joyfully of this flight of the detested "Jake." Sentence of death by the gallows was passed in his absence. The over-zealous governor of Calais who found him at his gates, clad as a poor Fleming, his chin shaved, packed him back to England, whence he escaped again, doubtless with the king's aid, reaching his native town of Hull, where he saw for the last time his "goodly house of brick." Old friends found him a ship that landed him in the Low Countries, and he died an exile in Paris in 1389.

The exile's son Michael, who had married Catherine, daughter of the earl of Stafford, was restored to the earldom in 1397, and, although his father's attainder was revived by the act of the first parliament of Henry IV., the earldom was restored once again in 1399, together with the castle and honour of Eye. His life was that of a soldier, and he was with the host before Harfleur in 1415, when he died of a violent dysentery. Michael, the eldest son and heir, marched from his father's deathbed to Agincourt, where he fell, Drayton's ballad recalling how he plied his axe on the great day. By his wife, a daughter of the first duke of Norfolk, he had three daughters, but no one of them marrying, his lands passed with the earldom to his brother William.

This William (1396–1450), the fourth earl of his name, had sailed with his father and elder brother to Harfleur, but had been sent home sick after the siege. He returned with the "viage" of 1417, leading thirty men-at-arms and ninety archers. Henry V. made him admiral of Normandy, and until the crowning of Henry VI. in Paris in 1431 he served in France without, by his own account, coming home or seeing England. He held the chief command before Orleans after Salisbury had fallen to a cannon-shot from the city, but was forced to surrender to Joan of Arc at Jargeau, where his brother Alexander was killed, another brother, John, being taken prisoner with the earl. A fourth brother, Thomas, a clerk, became hostage to Dunois until the vast ransom of the earl was paid down. After 1431 Suffolk turned to English politics. Like his grandfather, he found a king's uncle, another Gloucester, the chief of his enemies. Defeating Gloucester's project of an Armagnac match, Suffolk arranged for the young king's marriage with Margaret of Anjou, and brought home the bride to Portsmouth in 1445. In the year before he had been created marquess of Suffolk, being the fourth Englishman to take the style of marquess. His party and the queen's were on the point of overthrowing their opponent, Gloucester, when the "good duke" died suddenly in the hands of those who had arrested him. This death, followed by that of Cardinal Beaufort, left the field to Suffolk. Under a patent of 1443 Suffolk became earl of Pembroke at Duke Humphrey's death. His honours were capped in 1448 with a dukedom of Suffolk, he being then admiral of England, governor of Calais, constable of Dover, and warden of the Cinque Ports. But it seemed that long service in the foreign wars had not purged the offence of the name of Pole. All the old enmity which had driven his grandfather into exile was gathering against Suffolk. His peace policy had cost the cession of Maine and Anjou, while the blunders of his ally, Somerset, as lieutenant in France, lost Normandy to England. Early in 1450 the Commons, in spite of Suffolk's appeal to his years of loyal service, accused him of treason and he was sent to the Tower. A long indictment was reinforced by new accusations, and the king could do no more for his minister than set him free under a sentence of five years' banishment. He sailed from Ipswich on the May Day of 1450, but before he could enter the port of Calais he was cut off by a royal ship, the "Nicholas," whose master had him put overboard into the cock-boat, where his head was hacked off by an Irish knave's rusty sword. His body, cast headless upon Dover beach, was carried by the king's orders to the Poles' vault in Wingfield church, where his effigy may still be seen. Who sent out the "Nicholas," and by whose orders Suffolk died, are questions which remain unanswered. He was the third husband of Alice Chaucer, whom he married as the widow of Thomas, Earl of Salisbury, slain before Orleans. She was the daughter and heiress of Thomas Chaucer, of Ewelme, and, although direct evidence is wanting, the granddaughter, without doubt, of Geoffrey Chaucer, the poet. She lies at Ewelme, under a magnificent tomb.

John Pole (1442–1491), only son of the murdered duke, should have succeeded to the dukedom, his father having died unattainted. But the honours were apparently regarded as forfeited, and the dukedom was formally restored to the boy in 1455, the earldom of Pembroke being allowed to lapse. Although three generations of warrior lords lay between him and the Hull warehouses, the origin of his house was still fresh in men's memories. John Paston, writing in 1465, could tell every name in the duke's pedigree back to "William Pool of Hull," who had been "first a merchant and after a knight," and "what the father of the said William was" John Paston knew "right well." The duke's father was an upstart for the crowd, whose ballads pelted him with the name of "Jac Napes," suggested by his familiar badge of the ape's clog and chain. Nevertheless a wife of royal blood was found for the young duke, King Edward IV.'s own sister Elizabeth. The marriage confirmed him a partisan of the White Rose. The son of Margaret's faithful minister rode against her man at the second battle of St Albans. Before he was of age he was steward of England at his brother-in-law's crowning, and at Queen Elizabeth's crowning he bore her sceptre. Having held many offices under Edward IV. he was ready to bear a sceptre at Richard's coronation, and, after Bosworth, to swear fealty to the Tudor dynasty and to bear another sceptre for another Queen Elizabeth. He died in 1491, having safely kept his lands, his dukedom, and his head through perilous years.

But each advance in rank had brought danger and misfortune to the Poles. Before the death of the second duke they had begun to pay the price of their matching with the royal house. In the next generation their name was blotted out. John Pole, eldest son of Duke John and the Lady Elizabeth, had been created Earl of Lincoln by his uncle, Edward IV. Before he followed Richard to Bosworth, the young man had been chosen as heir to the throne, Clarence's son Warwick being put aside. He survived King Richard and Henry VII. spared him. But he egged on Simnel's plot, joined the rebels in Ireland, and was killed at Stoke in 1487, leaving no issue by his wife, the daughter of the earl of Arundel. Edmund, his younger brother, (*c.* 1472–1513) should have succeeded in 1491 as duke of Suffolk, but on coming of age he agreed to satisfy himself with the title of earl of Suffolk, the king grudgingly restoring some portion of the estates forfeited by his brother. In 1499 he suddenly left the kingdom, but was persuaded to return. But the death of the imprisoned earl of Warwick may have suggested to him that Henry's court was a dangerous place for those of the blood of York, and in 1501 he found his way to the emperor Maximilian in Tirol with a scheme for the invasion of England. Although the kaiser at first promised him men for the adventure, nothing came of his promises. Maximilian, persuaded by a gift of English money, bound himself not to succour English rebels. Suffolk, who had reassumed the ducal style, was attainted in 1504, and in the same year was seized by the duke of Guelders. From the duke's hands the prisoner was taken by Philip, king of Castile, who surrendered him to England on a promise that his life should be spared. But in 1513, when Richard, his brother, was in arms in the French service, Edmund Pole was taken from his prison in the Tower to the block.

Richard Pole, who in 1501 escaped from England with Edmund, had been received by the king of Hungary, and afterwards by Louis of France, who assigned him a pension. Commanding German Lanzknechts in the French service, he was the friend and companion in arms of the chevalier Bayard. At the death of his brother Edmund, he took the title of the duke of Suffolk, claiming the throne of England. In 1514 Louis gave him the leading of 12,000 riotous German mercenaries to essay the conquest of England. The treaty of peace stayed the adventure, but Louis refused to surrender Richard, and allowed him to depart for the imperial city of Metz. Francis I. continued the payment of his allowance, and gave him employment. In 1522 the anonymous writer of a journal describes the coming to Paris of "Richard de la Poulle, soydisant duc de Suffort et la Blanche Rose." In 1525 the White Rose was killed by the French king's side at Pavia. With him died the last descendant in the male line of William Pole, the Hull merchant.

By one of the strange chances of history, another family of the name of Pole, having no kinship with the house of Suffolk, owed, like the Suffolks, their advancement and their fall to a match with a princess of the royal house. Sir Richard Pole, a Buckinghamshire knight, was the son of Geoffrey Pole, a squire whose wife, Edith St John, was sister of the half-blood to the mother of Henry VII. About 1490 or 1491 he married the Lady Margaret, daughter of George, duke of Clarence. He died in 1505, and in 1513 King Henry VIII. created the widow countess of Salisbury, as some amends for the judicial murder of her brother, the Earl of Warwick. Four years later, the barony of Montague was revived for her eldest son Henry. Until the king's marriage with Anne Boleyn, the countess of Salisbury was about the court as governess of her godchild, the Lady Mary. When her son, the famous Cardinal Pole, published his treatise, *De unitate ecclesiastica*, the whole family fell under the displeasure of the king, who resolved to make an end of them. The Lord Montague was the first victim, beheaded in 1539 on a charge of treasonable conversations, evidence having been wrung from his unhappy brother, Sir Geoffrey Pole. In 1541 the aged countess, attainted with her son Montague, met her death at the barbarous hands of an unskilful headsman. Sir Geoffrey Pole, seeing that his house was doomed, fled the country, and joined the cardinal in exile. He returned with him at Mary's accession, both dying in 1558. His sons Arthur and Edmund, taken in 1562 as plotters against Queen Elizabeth, were committed to the Tower of London, where they died after eight years of imprisonment.

See T. Rymer's *Feodera*; C. Frost, *History of Hull* (1827); *Chronicon de Melsa* (Rolls Series); G. E. C., *Complete Peerage; Testamenta Eboracensia* (Surtees Soc.); Hon. and Rev. H. A. Napier, *Swincombe and Ewelme* (1858); *Dict. Nat. Biog.*, *s.v.* "Pole"; E. Foss, *Judges of England* (1848–1864); *Chronicon Angliae* (Rolls Series); *Paston Letters*, edited by J. Gairdner; Sir J. H. Ramsay, *Lancaster and York* (1892); *Letters and Papers of Richard III. and Henry VII.* (Rolls Series); Inquests *post mortem*, Close and Patent Rolls, Rolls of Parliament. (O. BA.)

POLE, REGINALD (1500–1558), English cardinal and archbishop of Canterbury, born at Stourton Castle, Staffordshire, was the third son of Sir Richard Pole, Knight of the Garter, and Margaret, countess of Salisbury, a daughter of George, duke of Clarence, and therefore niece of Edward IV. He was intended for the church from his youth; and when seven years old was sent for five years to the grammar school which Colet had founded near the Carthusian monastery at Sheen. Here he had Linacre and William Latimer as teachers. In his thirteenth year he went to Magdalen College, Oxford, and two years after took his degree in arts. In 1517 Henry VIII. appointed his young kinsman to a prebend in Salisbury, and soon afterwards to the deaneries of Wimborne and Exeter. He was a friend of Sir Thomas More, who says that Pole was as learned as he was noble and as virtuous as he was learned. In 1519, at the king's expense, he went to Padua, the Athens of Europe, according to Erasmus; and there, where Colet and Cuthbert Tunstall had also been educated, the "nobleman of England" as he was called, came into contact with the choicest minds of the later Italian Renaissance, and formed the friendships that influenced his life.

In 1525 he went to Rome for the Jubilee, and two years after returned to England and was initiated by Thomas Cromwell into the mysteries of statesmanship, that master telling him that the main point consisted in discovering and following the will of princes, who are not bound by the ordinary code of honour. When the divorce question arose, Pole, like many other excellent men, seems at first to have been in its favour. He probably took the same view that Wolsey had, viz. that the dispensation of Julius II. was insufficient, as of two existing diriment impediments only one had been dispensed. When however the king raised the theological argument which ended in disaster, Pole could not accept it; and, after the failure of Campeggio's mission, when the king asked him for his opinion, he excused himself on the score of inexperience, but went by Henry's order to Paris (1530) to obtain the judgment of the Sorbonne, making the condition that another should be joined with him to do the necessary business. At this time, he says, the more he saw into the case the less he knew how to act as he was desired. On his return to England he spoke strongly against the project to the king, who seems to have dealt gently with him in the hope of using him for his own ends. He offered him the sees of York or Winchester, and kept them vacant for ten months for his acceptance. There was a stormy interview at York Place; but Pole succeeded in mollifying the king's rage so far that Henry told him to put into writing his reasons against the divorce. This was done, and, recognizing the difficulties of the situation, the king gave him leave to travel abroad, and allowed him still to retain his revenues as dean of Exeter. In 1535, which saw by the deaths of Bishop Fisher and Sir Thomas More a change in Henry's policy, Pole received orders to send a formal opinion on the royal supremacy, and the king promised to find him suitable employment in England, even if the opinion were an adverse one. The parting of the ways had been reached. Pole's reply, which took a year to write, and was afterwards published with additions under the title *Pro unitate ecclesiae*, was sent to England (May 25, 1536) and was meant for the king's eye alone. It contained a vigorous and severe attack upon the royal policy, and did not shrink from warning Henry with temporal punishment at the hands of the emperor and the king of France if he did not repent of his cruelties and return to the Church. He was again summoned to return to England to explain himself, but declined until he could do so with honour and safety; but he was on the point of going at all risks, when he heard from his mother and brother that the whole family would suffer if he remained obstinate. Paul III. who had prepared a bull of excommunication and deposition against Henry, summoned Pole to Rome in October, and two months after created him cardinal. In January 1537 he received a sharp letter of rebuke from the king's council, together with the suggestion that the differences might be discussed with royal deputies either in France or Flanders, provided that Pole would attend without being commissioned by any one. He replied that he was willing and had the pope's leave to meet any deputies anywhere. Paul III. in the early spring of that year named him legate *a latere* to Charles V. and Francis I., for the purpose of securing their assistance in enforcing the bull by helping a projected rising in England against Henry's tyranny. The mission failed, as the mutual jealousy of the sovereigns would not allow either to begin operations. Moreover, the fear of Henry was sufficient to make the French king refuse to allow one who was attainted by act of parliament to remain in the kingdom; so Pole passed over to Flanders, to wait for the possible arrival of any royal deputies. The proposed conference never took place, and in August 1537 the cardinal returned to Rome. There he was appointed to the famous commission which Paul III. established for considering the reforms necessary for the church and Roman curia. The report *Consilium delectorium cardinalium* is, in its plain-spoken directness, one of the most noteworthy documents of the history of the period. Towards the end of 1539, after Henry had destroyed the shrine of St Thomas Becket, another attempt was made to launch the bull of deposition, and Pole again was sent to urge Charles V. to assist. Once more his efforts were in vain, and he retired to his friend Sadoleto at Carpentras. As Pole had escaped Henry's power the royal vengeance now fell on his mother, who was executed as a traitor on the 27th of May 1541. When the news came to the cardinal he said to his secretary Beccatelli that he had received good tidings: "Hitherto I have thought myself indebted to the divine goodness for having received my birth from one of the most noble and virtuous women in England; but henceforth my obligation will be much greater, as I understand I am now the son of a martyr. We have one patron more added to those we already have in heaven"; and returning to his oratory Pole found peace in his sorrow.

On the 21st of August 1541 the cardinal was appointed legate at Viterbo, and for a few years passed a happy and congenial life amid the friends that gathered round him. Here he came into close relations with Vittoria Colonna, Contarini, Sadoleto, Bembo, Morone, Marco Antonio, Flaminio, and other scholars and leaders of thought; and many of the questions raised by the Reformation in Germany were eagerly discussed in the circle of Viterbo. The burning question of the day, justification by faith, was a special subject of discussion. The "dolce libriccino," the famous *Trattato utilissimo del beneficio di Gesu Christo crocifisso verso i christiani*, which was the composition of a Sicilian Benedictine and had been touched up by the great latinist Flaminio, just appeared at Mantua in 1542 under the auspices of Morone, and had a wide circulation (over 40,000 copies of the second edition, Venice 1543, were sold). Containing extracts from the Hundred and Ten Divine Considerations of Juan Valdes (*q.v.*), it was soon regarded with the utmost horror by many. But at Viterbo it was in favour, and the orthodox interpretation was regarded rather than the other which might be taken in the Lutheran sense. Pole's own attitude to the question of justification by faith is given by Vittoria Colonna, to whom he said that she ought to set herself to believe as though she must be saved by faith alone and to act as though she must be saved by works alone. In the excited temper of the times any defender of justification by faith was looked upon by the old school as heretical; and Pole, with the circle at Viterbo, was denounced to the Inquisition, with all sorts of crimes imputed to him. Though the process went on from the pontificate of Paul III. to that of Paul IV., nothing was done against the cardinal until the time of the latter pope, who was his personal enemy. It is by no means certain that Pole ever knew about the process begun against him; and immediate subsequent events show that no credence was given to the charges.[1]

While at Viterbo his rule was firm but mild; and no charge of persecuting heretics is made against him. He regained many, such as his friend Flaminio, by patience and kindliness, to a reconsideration of their errors. During this time also he was still engaged in furthering a proposed armed expedition to Scotland to aid the papal party, and in 1545 he was again asking help from Charles V. But the Council of Trent (*q.v.*), first summoned in 1536, was at last on the point of meeting, and this required all his attention. In 1542 he had been appointed one of the presiding legates and had written in preparation his work *De concilio*; and now in 1545, after a brief visit to Rome, he went secretly, on account of fear of assassination by Henry's agents, to Trent, where he arrived on the 4th of May 1545. At the council he took a high spiritual line, and his learning and devout life made him a great leader in that assembly. He advocated that dogmatic decrees should go together with those on reform as affording the only stable foundation. His views on the subject of original sin, akin as it is to that of justification, were accepted and embodied in the decree. He was present when the latter subject was introduced, and he entreated the fathers to study the subject well before committing themselves to a decision. On the 28th of June 1546 he left Trent on account of ill-health and went to Padua. While he was there frequent communications passed between him and the council and the draft of the decree on justification was sent to him. His suggestions and amendments were accepted, and the decree embodies the doctrines that Pole had always held of justification by a living faith which showed itself in good works. This effectually disproves the story that he left the Council of Trent so as to avoid taking part in an adverse decree.

On the death of Henry (Jan. 28, 1547), Pole, by name, was left out of the general pardon; and in the subsequent rising in the West the insurgents demanded that he should be sent for and made the first on the record in the council. He wrote several times to England to prepare a conference, but only received a rude reply from Somerset, who sent him a copy of the Book of Common Prayer. At the conclave of 1549 Pole received two-thirds of the votes, but by a delay, caused by his sense of responsibility, he lost the election and Julius III. succeeded. He then retired to Magazzano on the Lake of Garda and occupied himself by editing his book *Pro unitate ecclesiae*, with an intended dedication to Edward VI.

The accession of Mary opens the third period of his life. On the 5th of August 1553 he was appointed legate to the new queen and began his negotiations. But many difficulties were put in the way of return. He was still under attainder; and the temper of England was not yet ripe for the presence of a cardinal. The project of the queen's marriage was also an obstacle. A marriage between her and Pole, who was then only a deacon, was proposed by some, but this did not at all meet the views of the emperor, who therefore hindered him the more from setting out for England. The marriage with Philip, of which Pole did not approve, having taken place (July 25, 1554), and Rome yielding on the practical difficulties of the lay holders of Church lands, a parliament favourable to the proposed reunion now assembled, and Pole was allowed to return to England as cardinal. On his landing he was informed that the attainder had been reversed; and he received the royal patent authorizing his performance of the legatine duties within the realm. Arriving at Whitehall, where he was received with joy by Mary and Philip on the 30th of November, he proceeded to parliament and there absolved the kingdom and accepted in the pope's name the demands respecting ecclesiastical property. He entered wisely on his work of reformation, for which he was well prepared. One of the most important matters he had to deal with was to rectify the canonical position of those who had been ordained or consecrated since the breach with Rome. Acting according to the instructions he had received from Rome, where the matter had been fully gone into, he made an investigation, and divided the clergy ordained after that period into two classes; one consisting of those ordained in schism, indeed, but according to the old Catholic rite, and the other of those who had been ordained by the new rite drawn up by Cranmer and enforced by act of parliament 1st of April 1550. The first class, after submission, were absolved from their irregularity, and, receiving penance, were reinstated; the second class were simply regarded as laymen and dismissed without penance or absolution. At his first convocation he exhorted the bishops to use gentleness rather than rigour in their dealings with heretics; and Pole, in himself, was true to his principle. He was not responsible for the cruel persecution by which the reign was disfigured. On the 4th of November 1555 Pole opened, in the chapel royal at Westminster, a legatine synod, consisting of the united convocations of the two provinces, for the purpose of laying the foundations of wise and solid reforms. In the *Reformatio Angliae* which he brought out in 1556, based on his Legatine Constitutions of 1555, he ordered that every cathedral church should have its seminary, and the very words he uses on this subject seem to have been copied by the Council of Trent in the twenty-third session (1563). He also ordered that the Catechism of Caranza, who, like him, was to suffer from the Inquisition for this very book, should be translated into English for the use of the laity. On Cranmer's deprivation, Pole became archbishop of Canterbury; and, having been ordained priest two days before, he was consecrated on the 22nd of March 1556, the day after Cranmer suffered at Oxford.

Soon afterwards the clouds began to gather round him. His personal enemy Caraffa had become pope under the name of Paul IV. and was biding his time. When Rome quarrelled with Spain, and France, on behalf of the pope, took up arms, England could no longer observe neutrality. To injure Spain and heedless of England's need, Paul IV. deprived Pole of his power both as legate *a latere* and *legatus natus* as archbishop of Canterbury (June 14, 1557); he also reconstituted the process of the Inquisition against the cardinal and summoned him to Rome to answer to the crime and heresies imputed to him. No remonstrances on the part of the queen, of Pole or the English clergy could induce the pope to withdraw his sentence except to declare that the cardinal still held the position of *legatus natus* inherent in the primatial see. In a dignified but strong letter Pole says: "As you are without example in what you have done against me, I am also without an example how I ought to behave to your Holiness": and he drew up a paper containing an account of the various acts of hostility he had experienced from the pope, but on second thoughts he burnt the document, saying it were not well to discover the shame of his father. Mary, who had been warned by her ambassador to the pope that prison awaited Pole, prevented the breve ordering the cardinal to proceed to Rome from being delivered, and so Pole remained in England. Broken down as much by the blow as by ill-health the cardinal died at Lambeth on the 17th of November 1558, twelve hours after Mary's death and under the unmerited disgrace of the papacy in defence of which he had spent his life. He was buried at Canterbury near the spot where the shrine of St Thomas Becket once stood.

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[1] See, however, Herzog-Hauck, *Realencyklopädie* (ed. 3) § "Pole," where it is said that "only his procrastination, and then his death saved him from appearing before the Inquisition." Within the institution of the Inquisition his name continued to be regarded as that of a heretic and misleader of others, as is proved by the mass of evidence accumulated against him in the *Compendium inquisitorum* (*v. archivio della società di storia patria*, Rome, 1880), p. 283, &c.—(Ed.)

The chief sources for Pole's biography are his life written in Italian by his secretary Beccatelli, which was translated into Latin by Andrew Dudith as *Vita Poli cardinalis* (Venice, 1563), and his letters (*Epistolae Reginaldi Poli*) edited by Girolamo Quirini and published in 5 volumes (Brescia, 1744–1757), a new edition of which is in preparation at Rome with additions from the Vatican Archives. See also the State Papers (foreign and domestic) of Henry VIII., Edward VI. and Mary; the Spanish and Venetian State Papers; vol. i. of A. Theiner's *Acta genuina S.S. Oecumenici Caecilii tridentini* (1874); the *Compendio dei processi del santo uffizio di Roma da Paolo III. a Paolo IV.* (Società romana di storia patria, *Archivio*, iii. 261 seq.); T. Phillipp's *History of the Life of R. Pole* (Oxford, 1764–1767); Athanasius Zimmermann, S.J., *Kardinal Pole sein Leben und seine Schriften* (Regensburg, 1893); Martin Haile, *Life of Reginald Pole* (1910); and F. G. Lee, *Reginald Pole*. (E. Tn.)

POLE, RICHARD DE LA (d. 1525), pretender to the English crown, was the fifth son of John de la Pole (1442–1491), 2nd duke of Suffolk, and Elizabeth, second daughter of Richard, duke of York and sister of Edward IV. His eldest brother John de la Pole, earl of Lincoln (*c.* 1464–1487), is said to have been named heir to the throne by his uncle Richard III., who gave him a pension and the reversion of the estates of Lady Margaret Beaufort. On the accession of Henry VII., however, Lincoln took the oath of allegiance, but in 1487 he joined the rebellion of Lambert Simnel, and was killed at the battle of Stoke. The second brother Edmund (*c.* 1472–1513), succeeded his father while still in his minority. His estates suffered under the attainder of his brother, and he was compelled to pay large sums to Henry VII. for the recovery of part of the forfeited lands, and also to exchange his title of duke for that of earl. In 1501 he sought the German King Maximilian in Tirol, and received from him a promise of substantial assistance in case of an attempt on the English crown. In consequence of these treasonable proceedings Henry seized his brother William de la Pole, with four other Yorkist noblemen. Two of them, Sir James Tyrell and Sir John Wyndham, were executed, William de la Pole was imprisoned and Suffolk outlawed. Then in July 1502 Henry concluded a treaty with Maximilian by which the king bound himself not to countenance English rebels. Presently Suffolk fell into the hands of Philip, king of Castile, who imprisoned him at Namur, and in 1506 surrendered him to Henry VII. on condition that his life was spared. He remained a prisoner until 1513, when he was beheaded at the time his brother Richard took up arms with the French king. Richard de la Pole joined Edmund abroad in 1504, and remained at Aix as surety for his elder brother's debts. The creditors threatened to surrender him to Henry VII., but, more fortunate than his brother, he found a safe refuge at Buda with King Ladislas VI. of Hungary. He was excepted from the general pardon proclaimed at the accession of Henry VIII., and when Louis XII. went to war with England in 1512 he recognized Pole's pretensions to the English crown, and gave him a command in the French army. In 1513, after the execution of Edmund, he assumed the title of earl of Suffolk. In 1514 he was given 12,000 German mercenaries ostensibly for the defence of Brittany, but really for an invasion of England. These he led to St Malo, but the conclusion of peace with England prevented their embarcation. Pole was required to leave France, and he established himself at Metz, in Lorraine, and built a palace at La Haute Pierre, near St Simphorien. He had numerous interviews with Francis I., and in 1523 he was permitted, in concert with John Stewart, duke of Albany, the Scottish regent, to arrange an invasion of England, which was never carried out. He was with Francis I. at Pavia and was killed on the field on the 24th of February 1525.

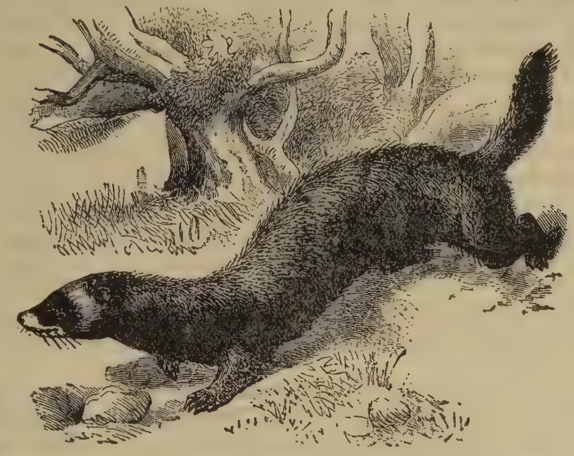
See *Letters and Papers Illustrative of the Reigns of Richard III. and Henry VII.*, edited by J. Gairdner (2 vols., "Rolls Series," 24, 1861); *Calendar of Letters and Papers, Foreign and Domestic, of the Reign of Henry VIII.*; and Sir William Dugdale, *The Baronage of England* (London, 1675).

POLE, WILLIAM (1814–1900), English engineer, was born at Birmingham on the 22nd of April 1814. He was a man of many accomplishments. Having spent his earlier years in various engineering occupations in England, he went out to India in 1844 as professor of engineering at Elphinstone College, Bombay, where he had to first organize the course of instruction for native students, but his health obliged him to return to England in 1848. For the next ten years he worked in London under James Simpson and J. M. Rendel, and the high reputation he achieved as a scientific engineer gained his appointment in 1859 to the chair of civil engineering in University College, London. He obtained a considerable amount of official work from the government. He served on the committees which considered the application of armour to ships and fortifications (1861–1864), and the comparative advantages of Whitworth and Armstrong guns (1863–1865). He was secretary to the Royal Commission on Railways (1865–1867), the duke of Richmond's Commission on London Water (1867–1869), also taking part in the subsequent proceedings for establishing a constant supply, the Royal Commission on the Disposal of London Sewage (1882–1884), and the departmental committee on the science museums at South Kensington in 1885. In 1871 he was employed by the War Office to report on the Martini-Henry rifle, and in the same year was appointed consulting engineer in London to the Japanese government, a position through which he exercised considerable influence on the development of the Japanese railway system. He was elected a fellow of the Royal Society in 1861, in recognition of some investigations on colour-blindness. Music was also one of his chief interests. At the age of twenty-two he was appointed organist of St Mark's, North Audley Street, in open competition, the next selected candidate being Dr E. J. Hopkins (1818–1901), who subsequently was for fifty years organist of the Temple Church. He took the degree of Bachelor of Music at Oxford in 1860, proceeding to his doctor's degree in 1867, and in 1879 published his *Philosophy of Music*. He was largely concerned in the institution of musical degrees by the University of London in 1877, and for many years acted as one of the examiners. His mathematical tastes found congenial occupation in the study of whist, and as an exponent of the scientific principles of that game he was even earlier in the field than "Cavendish." His literary work included treatises on the steam-engine and on iron construction, biographical studies of famous engineers, including Robert Stephenson and I. K. Brunel, Sir William Fairbairn and Sir W. Siemens, several books on musical subjects and on whist, and many papers for reviews and scientific periodicals. He died on the 30th of December 1900. His son, William Pole (1852–), became known as an actor and writer under the stage-name of William Poel, more especially for his studies in Shakespearian drama and his work in connexion with the Elizabethan Stage Society.

POLE (1) (O. Eng. *pâl*, cf. Ger. *Pfahl*, Du. *paal*, from Lat. *palus*, stake), a tapering cylindrical post or stake of some considerable length, used as a support in scaffolding, for telegraph or telephone wires, hops, &c., and as a means for taking jumps (see Pole-Vaulting), and also as a single shaft for a vehicle drawn by two or more horses. As a measure of length a "pole," also called "rod" or "perch," is equal to $5\frac{1}{2}$ yds. ($16\frac{1}{2}$ ft.), as a measure of area it is equal to $30\frac{1}{4}$ sq. yds. (2) (Lat. *polus*, adapted from Gr. πόλος, pivot, axis), one or other of the extremities of the axis of the earth; the "celestial pole" is one or other of the points in the heavens to which the earth's axis points; in the northern hemisphere this point is near the star Ursae minoris, better known as the Pole-star or Polaris (see Ursa Major). For the regions lying about the north and south poles of the earth see Polar Regions.

In mathematics the word pole has several meanings. In spherical trigonometry the "pole" of a circle on a sphere is the point where the diameter of the sphere perpendicular to the plane of the circle intersects the sphere. In crystallography (*q.v.*) the "pole" of a face is the intersection of a line perpendicular to the face with the sphere of projection. The term is also applied to a point from which lines radiate, as, for instance, the origin in a system of polar co-ordinates, or the common point of a pencil of rays. In the geometry of conic sections the "pole" of a line, termed the "polar" of the point, is the intersection of the tangents (either real or imaginary) at the points where the line meets the conic (see GEOMETRY: § *Projective*). The "magnetic poles" of the earth are the points on the earth's surface where the dipping needle is vertical (see TERRESTRIAL MAGNETISM); and the "poles" of a magnet are the points of the magnet where the magnetic intensity is greatest. In electricity, the term is applied to the elements of a galvanic battery (*q.v.*), or to the terminals of a frictional electrical machine.

POLECAT, the common name given to any member of the Musteline genus *Putorius* (see CARNIVORA). The polecats form a small group confined to the northern hemisphere, of which the best known and most widely distributed is the common polecat of Europe (*P. foetidus* or *P. putorius*). This animal, at least so far as its disposition, size and proportions are concerned, is well known in its domesticated condition as the ferret, which is but a tamed albino variety of the true polecat. The colour of the latter, however, instead of the familiar yellowish-white of the ferret, is of a dark brown tint above and black below, the face being variegated with dark brown and white markings. Its skull is rough, strongly ridged, and altogether of a far more powerful type than those of the stoats, weasels or martens; the skull of the female is very much smaller and lighter than that of the male. The fur is long, coarse, and of comparatively small value, and changes its colour very little, if at all, at the different seasons of the year.



The Common Polecat.

The polecat ranges over the greater part of Europe, reaching northwards into southern Sweden and in Russia to the region of the White Sea. It does not occur in the extreme south, but is common everywhere throughout central Europe. In the Alps it ranges far above the tree-line during the summer, but retreats in winter to lower ground. It is confined to the northern counties of England and Scotland, where it is becoming very rare, owing to persecutions from game-keepers, and in Ireland it appears to be extinct. In fine weather it lives either in the open air, in holes, fox-earths, rabbit-warrens, under rocks or in wood-stacks; while in winter it seeks the protection of deserted buildings, barns or stables. During the day it sleeps in its hiding place, sallying forth at night to plunder dovecots and hen-houses. It climbs but little, and shows far less activity than the marten. It feeds ordinarily on small mammals, such as rabbits, hamsters, rats and mice, on such birds as it can catch, especially poultry and pigeons, and also on snakes, lizards, frogs, fish and eggs. Its prey is devoured only in its lair; but, even though it can carry away but a single victim, it commonly kills everything that comes in its way, often destroying all the inhabitants of a hen-house in order to gratify its passion for slaughter. The pairing time is towards the end of the winter, and the young, from three to eight in number, are born in April or May, after a period of gestation of about two months. The young, if taken early, may be easily trained, like ferrets, for rabbit-catching. The polecat is very tenacious of life and will bear many severe wounds before succumbing; it is also said to receive with impunity the bite of the adder. Its fetid smell has become proverbial. To this it is indebted for its generic name *Putorius* (derived, as are also the low Lat. *putacius*, Fr. *putois*, and Ital. *puzzola*, from *puteo*), as well as the designation foumart (*i.e.* foul marten) and its other English names, fitchet, fitchew. Attempts to account for the first syllable of the word polecat rest entirely on conjecture.

The Siberian polecat (*Putorius eversmanni*) is very like the European in size, colour and proportions, but with head and back both nearly or quite white, and skull more heavily built and sharply constricted behind the orbits, at least in fully adult individuals. It inhabits the greater part of south-western Siberia, extending from Tibet into the steppes of south-eastern European Russia.

The black-footed or American polecat (*Putorius nigripes*) is a native of the central plateau of the United States, and extends southwards into Texas. It is often called the prairie-dog hunter, as it is nearly always found in the warrens of that animal. The fur is cream-yellow, the legs are brown, and the feet and tail-tip black.

The mottled polecat (*Putorius sarmaticus*), a species occurring in southern Russia and south-western Asia, and extending from eastern Poland to Afghanistan, differs from other polecats both by its smaller size and its remarkable coloration, the whole of the upper-parts being marbled with large irregular reddish spots on a white ground, while the under-side, limbs and tail are deep shining black. Its habits appear to be much like those of the common polecat. (R. L.*)

POLENTA, DA, the name of a castle in Romagna, from which came the noble and ancient Italian family of Da Polenta. The founder of the house is said to have been Guido, surnamed l'Antico or the Elder, who wielded great authority in Ravenna in the 13th century. His grandson Guido Novello upheld the power of the house and was also *capitano del popolo* at Bologna; he was overthrown in 1322 and died the following year. His chief claim to renown lies in the fact that in 1321 he gave hospitality to the poet Dante, who immortalized the tragic history of Guido's daughter Francesca, unhappily married to Malatesta, lord of Rimini, in an episode of the *Inferno*. Guido's kinsman Ostasio I. was lord of Cervia and Ravenna from 1322 to 1329, and, after being recognized as a vassal of the Holy See, again became independent and went over to the house of Este, whom he served faithfully in their struggles with the Church until his death in 1346. His son Bernardino, who succeeded him as lord of Ravenna in 1346, was deposed in 1347 by his brothers, Pandolfo and Lamberto II., but was reinstated a few months later and ruled until his death in 1359; he was famous for his profligacy and cruelty. His son Guido III. ruled more mildly and died in 1390. Then followed Ostasio II. (d. 1396), Obizzo (d. 1431), Pietro (d. 1404), Aldobrandino (d. 1406), all sons of Guido III. Ostasio III. (or V.), son of Obizzo, was at first allied with the Venetians; later he went over to the Milanese, and, although he again joined the Venetians, the latter never forgave his intrigue with their enemies, and in 1441 they deprived him of his dominions. He died in a monastery in 1447.

POLE-VAULTING, the art of springing over an obstacle with the aid of a pole or staff. It is probable that an exercise of the kind was a feature of Greek gymnastics, but with this exception there is no record of its ancient practice as a sport. As a practical means of passing over such natural obstacles as canals and brooks it has been made use of in many parts of the world, for instance in the marshy provinces along the North Sea and the great level of the fens of Cambridgeshire, Huntingdonshire, Lincolnshire and Norfolk. The artificial draining of these marshes brought into existence a network of open drains or canals intersecting each other at right angles. In order to cross these dryshod, and at the same time avoid tedious roundabout journeys over the bridges, a stack of jumping poles was kept at every house, which were commonly used for vaulting over the canals.

As a sport, pole-vaulting made its appearance in Germany in the first part of the 19th century, when it was added to the gymnastic exercises of the *Turner* by Johann C. F. Guts-Muths and Frederich L. Jahn. In Great Britain it was first commonly practised at the Caledonian games. It is now an event in the athletic championships of nearly all nations. Although strength and good physical condition are essential to efficiency in pole-vaulting, skill is a much more important element. Broad-jumping with the pole, though the original form of the sport, has never found its way into organized athletics, the high jump being the only form recognized. The object is to clear a bar or lath supported upon two uprights without knocking it down. The pole, of hickory or some other tough wood, is from 13 to 15 ft. long and 1¾ in. thick at the middle, tapering to 1¼ in. at the ends, the lower of which is truncated to prevent sinking into the earth and shod with a single spike to avoid slipping. A hole in which to place the end of the pole is often dug beneath the bar. In holding the pole the height of the cross-bar is first ascertained, and the right hand placed, with an undergrip, about 6 in. above this point, the left hand, with an over-grip, being from 14 to 30 in. below the right. The vaulter then runs towards the bar at full speed, plants the spiked end of the pole in the ground about 18 in. in front of the bar and springs into the air, grasping the pole firmly as he rises. As he nears the bar he throws his legs forward, and, pushing with shoulders and arms, clears it, letting the pole fall backwards. In Great Britain the vaulter is allowed to climb the pole when it is at the perpendicular. Tom Ray, of Ulverston in Lancashire, who was champion of the world in 1887, was able to gain several feet in this manner. In the United States climbing is not allowed. Among the best British vaulters, using the climbing privilege, have been Tom Ray, E. L. Stones, R. Watson and R. D. Dickinson; Dickinson having cleared 11 ft. 9 in. at Kidderminster in 1891. The record pole-vault is 12 ft. 6½ in., made by W. Dray of Yale in 1907.

POLICE (Fr. *police*, government, civil administration, a police force, Gr. πολιτεία, constitution, condition of a state, πόλις, city, state), a term used of the enforcement of law and order in a state or community, of the department concerned with that part of the civil administration, and of the body or force which has to carry it into execution. The word was adopted in English in the 18th century and was disliked as a symbol of foreign oppression. The first *official* use appears, according to the *New English Dictionary*, in the appointment of "Commissioners of Police" for Scotland in 1714. A police system has been devised for the purpose of preventing evils and providing benefits. In its first meaning it protects and defends society from the dissidents, those who decline to be bound by the general standard of conduct accepted by the larger number of the law-abiding, and in this sense it is chiefly concerned with the prevention and pursuit of crime. It has a second and more extensive meaning as applied to the regulation of public order and enforcing good government.

United Kingdom.—The establishment of a systematic police force was of slow growth in England, and came into effect long after its creation abroad. A French king, Charles V., is said to have been the first to invent a police, "to increase the happiness and security of his people." It developed into an engine of horrible oppression, and as such was repugnant to the feelings of a free people. Yet as far back as the 13th century a statute, known as that of "Watch and Ward," was passed in the 13th year of Edward I. (1285), aimed at the maintenance of peace in the city of London. Two centuries later (1585) an act was passed for the better government of the city and borough of Westminster, and this act was re-enacted with extended powers in 1737 and soon succeeded by another (1777) with wider and stricter provisions. The state of London at that date, and indeed of the whole country at large, was deplorable. Crime was rampant, highwaymen terrorized the roads, footpads infested the streets, burglaries were of constant occurrence, river thieves on the Thames committed depredations wholesale. The watchmen appointed by parishes were useless, inadequate, inefficient and untrustworthy, acting often as accessories in aiding and abetting crime. Year after year the shortcomings and defects were emphasized and some better means of protection were constantly advocated. At the commencement of the 19th century it was computed that there was one criminal to every twenty-two of the population. The efforts made at repression were pitifully unequal. In the district of Kensington, covering 15 sq. m., the protection afforded was dependent on three constables and three headboroughs. In the parish of Tottenham nineteen attempts at burglary were made in six weeks, and sixteen were entirely successful. In Spitalfields gangs of thieves stood at the street corners and openly rifled all who came near. In other parishes there was no police whatever, no defence, no protection afforded to the community but the voluntary exertions of individuals and "the honesty of the thieves." In those days victims of robberies constantly compounded with felonies and paid blackmail to thieves, promising not to prosecute on the restitution of a portion of the stolen property.

The crying need for reform and the introduction of a proper police was admitted by the government in 1829, when Sir Robert Peel laid the foundation of a better system. Much opposition was offered to the scheme, which was denounced as an insidious attempt to enslave the people by arbitrary and tyrannical methods. The police were to be employed, it was said, as the instruments of a new despotism, the enlisted members of a new standing army, under the centralized authority, riding roughshod over the peaceable citizens. But the guardians of order, under the judicious guidance of such sensible chiefs as Colonel Rowan and Sir Henry Maine, soon lived down the hostility first exhibited, and although one serious and lamentable collision occurred between the mob and the police in 1833, it was agreed two years later that the unfavourable impression at one time existing against the new police was rapidly diminishing, and that it had fully answered the purpose for which it was formed. Crime had already diminished; it was calculated that the annual losses inflicted on the public by the depredations of the dangerous classes had appreciably fallen and a larger number of convictions had been secured.

The formation of the metropolitan police was in due course followed by the extension of the principle to the provinces. Borough constabulary forces were established by the Municipal Corporation Act (1835), which entrusted their administration to the mayor and a watch committee, and this act was revised in 1882, when the general powers of this authority were defined. Acts of 1839 and 1840 permitted the formation by the justices of a paid county police force. Action in this case was optional, but after an interval of fifteen years the Police Act of 1856 made the rule compulsory, it being found that an efficient police force throughout England and Wales was necessary for the more effectual prevention and detection of crime, the suppression of vagrancy and the maintenance of good order. Local acts had already endowed Scotland with a police system, and in 1857, and again in 1862, counties were formed into police districts, and the police of towns and populous places was generally regulated. Ireland has two police forces; the Dublin metropolitan police originated in 1808, and in 1829 the provisions of Sir Robert Peel's act for London were embodied in the Police Law for Ireland.

The extent to which the metropolitan police has developed will best be realized by contrasting its numbers on first creation and the nature of the duties and functions that then appertained to it. The first act (the Metropolitan Police Act 1829) applied to the metropolis, exclusive of the city of London, and constituted a police area having a radius of 12 m. from Charing Cross. Two justices of the peace were appointed, presently named commissioners of police, to administer the act under the immediate direction of the secretary of state for the home department. The first police office was located in Whitehall in Scotland Yard, from which it was removed in the autumn of 1890 to the new and imposing edifice on the Embankment, in which all branches are now concentrated, known as New Scotland Yard. The first constables appointed were 3000 in number, who, when sworn in, enjoyed all the powers of the old constables under the common law, for preserving the peace, preventing robberies and other felonies, and apprehending offenders. The subdivision of the district into divisions, on much the same lines as now existing, was at once made for administrative convenience, and a proportion of officers was allotted to each in the various grades then first constituted and still preserved, comprising in ascending order, constables, sergeants, inspectors and superintendents. Some time later the grade of district superintendent was created, held by gentlemen of superior status and intelligence, to each of whom the control of a large section of the whole force, embracing a wide area, was entrusted. This grade has since been merged in that of chief constable, of whom there are four exercising powers of disciplinary supervision in the metropolitan districts, and a fifth who is assistant in the branch of criminal investigation. The supreme authority is vested in the home secretary, but the immediate command and control is exercised by the chief commissioner, with three assistants, replacing the two commissioners provided for in 1829.

After various parliamentary reports and some legislation by way of extension, an important act was passed in 1839 reciting that the system of police established had been found very inefficient and might be yet further improved (Metropolitan Police Act 1839). The metropolitan police district was extended to 15 m. from Charing Cross. The whole of the river Thames (which, in its course through London, so far as related to police matters, had been managed under distinct acts) was brought within it, and the collateral but not exclusive powers of the metropolitan police were extended to the royal palaces and 10 m. round, and to the counties adjacent to the district. Various summary powers for dealing with street and other offences were conferred. When the police was put on a more complete footing and the area enlarged, provision was made for the more effectual administration of justice by the magistrates of the metropolis (Metropolitan Police Courts Act 1839). The changes that occurred in magisterial functions are scarcely less remarkable than the transition from the parish constable to the organized police. The misdirected activity of the civil magistrate in the 17th century is illustrated by the familiar literature of Butler, Bunyan and others. The zeal of that age was succeeded by apathetic reaction, and it became necessary in the metropolis to secure the services of paid justices. At the beginning of the 19th century, outside of the city of London (where magisterial duties were, as now, performed by the lord mayor and aldermen), there were various public offices besides the Bow Street and Thames police offices where magistrates attended. To the Bow Street office was subsequently attached the "horse patrol"; each of the police offices had a fixed number of constables attached to it, and the Thames police had an establishment of constables and surveyors. The horse patrol was in 1836, as previously intended, placed under the new police. It became desirable that the horse patrol and constables allotted to the several police offices not interfered with by the Act of 1828 should be incorporated with the metropolitan police force. This was effected, and thus magisterial functions were completely separated from the duties of the executive police; for although the jurisdiction of the two justices, afterwards called commissioners, as magistrates extended to ordinary duties (except at courts of general or quarter sessions), from the first they took no part in the examination or committal for trial of persons charged with offences. No prisoners were brought before them. Their functions were in practice confined to the discipline of the force and the prevention and detection of offences, their action limited to having persons arrested or summoned to be dealt with by the ordinary magistrates, whose courts were not interfered with.

The aim and object of the police force remain the same as when first created, but its functions have been varied and extended in scope and intention. To secure obedience to the law is a first and principal duty; to deal with breaches of the rules made by authority, to detect, pursue and arrest offenders. Next comes the preservation of order, the protection of all reputable people, and the maintenance of public peace by checking riot and disturbance or noisy demonstration, by enforcing the observance of the thousand and one regulations laid down for the general good. The police have become the ministers of a social despotism resolute in its watchful care and control of the whole community, well-meaning and paternal, although when carried to extreme length the tendency is to diminish self-reliance and independence in the individual. The police are necessarily in close relation with the state; they are the direct representatives of the supreme government, the servants of the Crown and legislature. In England every constable when he joins the force makes a declaration and swears that he will serve the sovereign loyally and diligently, and so acquires the rights and privileges of a peace officer of and for the Crown. The state employs police solely in the interests of the public welfare. No sort of espionage is attempted, no effort made to penetrate privacy; no claim to pry into the secret actions of law-abiding persons is or would be tolerated; the agents of authority must not seek information by underhand or unworthy means. In other countries the police system has been worked more arbitrarily; it has been used to check free speech, to interfere with the right of public meetings, and condemn the expression of opinion hostile to or critical of the ruling powers. An all-powerful police, minutely organized, has in some foreign states grown into a terrible engine of oppression and made daily life nearly intolerable. In England the people are free to assemble as they please, to march in procession through the streets, to gather in open spaces, to listen to the harangues, often forcibly expressed, of mob orators, provided always that no obstruction is caused or that no disorder or breach of the peace is threatened.

The strength of the metropolitan police in 1908 was 18,167, comprising 32 superintendents, 572 inspectors, 2378 sergeants and 15,185 constables. At the head is a commissioner, appointed by the home office; he is assisted by four assistant commissioners, one of whom was appointed under the Police Act 1909, in accordance with the recommendation of the Royal Commission on the Metropolitan Police 1906, his duty especially being to deal with complaints made by the public against the police. The metropolitan police are divided into 21 divisions, to which letters of the alphabet are assigned for purposes of distinction. There is in addition the Thames division, recruited mostly from sailors, charged with the patrol of the river and the guardianship of the shipping. To the metropolitan police also are assigned the control and guardianship of the various naval dockyards and arsenals.

The city of London has its own distinct police organization under a commissioner and assistant commissioner, and its functions extend over an area of 673 statute acres containing two courts of justice, those of the Guildhall and Mansion House, where the lord mayor and the aldermen are the magistrates. Although the area is comparatively small the rateable value is enormous. The force comprises 2 superintendents, 48 inspectors, 86 sergeants and 865 constables; also some 60 constables on private service duty.

The total police force of England and Wales in 1908 was 30,376, almost equally divided between counties and boroughs; that of Scotland numbered 5575. In Ireland the Royal Irish Constabulary are a semi-military force, numbering over 10,500; they police the whole of Ireland, except the city of Dublin, which is under the Dublin metropolitan police, a particularly fine body.

The most active and by no means the least efficient branch of the modern English police is that especially devoted to criminal investigation or the detection of crime. The detective is the direct descendant of the old "Bow Street runners" or "Robin Redbreasts"—so styled from their scarlet waistcoats—officers in attendance upon the old-fashioned police offices and despatched by the sitting magistrates to follow up any very serious crime in the interests of the public or at the urgent request of private persons. The "runners" had disappeared when the police organization introduced by Sir Robert Peel came into force in 1829, and at first no part of the new force was especially attributed to the detection of crime. They were much missed, but fifteen years elapsed before Sir James Graham (then home secretary) decided to allot a few constables in plain clothes for that purpose as a tentative measure. The first "detectives" appointed numbered only a dozen, three inspectors and nine sergeants, to whom, however, six constables were shortly added as "auxiliaries," but the number was gradually enlarged as the manifest uses of the system became more and more obvious.

Other Countries.—*British India* is divided into police districts, the general arrangements of the system of the regular police, which dates from the disappearance of the East India Company, resembling in most respects those of the English police, but differing in details in the different presidencies. All are in uniform, trained to the use of firearms and drilled, and may be called upon to perform military duties. The superior officers are nearly all Europeans and many of them are military officers. The rest are natives, in Bombay chiefly Mahommedans. The organization of the police was not dealt with by the criminal code which came into force in 1883, but the code is full of provisions tending to make the force efficient. By that code as well as by the former code the police have a legal sanction for doing what by practice they do in England; they take evidence for their own information and guidance in the investigation of cases and are clothed with the power to compel the attendance of witnesses and question them. The smallness of the number of European magistrates, and other circumstances, make the police more important and relatively far more powerful in India than in England (Stephen). The difficulties in the way of ascertaining the truth and investigating false statements and suppressed cases are very great. As regards the rural police of India every village headman and the village watchman as well as the village police office are required by the code to communicate to the nearest magistrate or the officer in charge of the nearest police station, whichever is nearest, any information respecting offenders. On the whole the system is very efficient. The police, which has numerous duties over and above those of the prevention and detection of crime, greatly aids a government so paternal as that of India in keeping touch with the widely extended masses of the population.

France.—It is a matter of history that under Louis XIV., who created the police of Paris, and in succeeding times, the most unpopular and unjustifiable use was made of police as a secret instrument for the purposes of despotic government. Napoleon availed himself largely of police instruments, especially through his minister Fouché. On the restoration of constitutional government under Louis Philippe, police action was less dangerous, but the danger revived under the second empire. The ministry of police, created by the act of the Directory in 1796, was in 1818 suppressed as an independent office, and in 1852 it was united with the ministry of the interior. The regular police organization, which preserves order, checks evil-doing, and "runs in" malefactors, falls naturally and broadly into two grand divisions, the administrative and the active, the police "in the office" and the police "out of doors." The first attends to the clerical business, voluminous and incessant. An army of clerks in the numerous bureaus, hundreds of patient government employés, the *ronds de cuir*, as they are contemptuously called, because they sit for choice on round leather cushions, are engaged constantly writing and filling in forms for hours and hours, day after day. The active army of police out of doors, which constitutes the second half of the whole machine, is divided into two classes: that in uniform and that in plain clothes. Every visitor to Paris is familiar with the rather theatrical-looking policeman, in his short frock-coat or cape, smart *képi* cocked on one side of his head, and with a sword by his side. The first is known by the title of *agent, sergent de ville, gardien de la paix,* and is a very useful public servant. He is almost invariably an old soldier, a *sergent* who has left the army with a first-class character, honesty and sobriety being indispensable qualifications.

These uniformed police are not all employed in the streets and arrondissements, but there is a large reserve composed of the six central brigades, as they are called, a very smart body of old soldiers, well drilled, well dressed and fully equipped; armed, moreover, with rifles, with which they mount guard when employed as sentries at the doors or entrance of the prefecture. In Paris *argot* the men of these six central brigades are nicknamed "*vaisseaux*" (vessels), because they carry on their collars the badge of the city of Paris—an ancient ship—while the sergeants in the town districts wear only numbers, their own individual number, and that of the quarter in which they serve. These *vaisseaux* claim to be the *élite* of the force; they come in daily contact with the Gardes de Paris, horse and foot, a fine corps of city gendarmerie, and, as competing with them, take a particular pride in themselves. Their comrades in the quarters resent this pretension and declare that when in contact with the people the *vaisseaux* make bad blood by their arrogance and want of tact. The principal business of four at least of these central brigades is to be on call when required to reinforce the out-of-door police at special times.

Of the two remaining central brigades one controls public carriages, the other the Halles, the great central market by which Paris is provided with a large part of its food. Every cab-stand is under the charge of its own policeman, who knows the men, notes their arrival and departure, and marks their general behaviour. Other police officers of the central brigades superintend the street traffic.

So much for the police in uniform. That in plain clothes, *en bourgeois*, as the French call it, is not so numerous, but fulfils a higher, or at least a more confidential mission. Its members are styled inspectors, not agents, and their functions fall under four principal heads. There is, first of all, the service of the Sûreté—in other words, of public safety—the detective department, employed entirely in the pursuit and capture of criminals; next comes the police, now amalgamated with the Sûreté, that watches over the morals of the capital and possesses arbitrary powers under the existing laws of France; then there is the *brigade de garnis*, the police charged with the supervision of all lodging-houses, from the commonest "sleep-sellers'" shop, as it is called, to the grandest hotels. Last of all there is the brigade for enquiries, whose business it is to act as the eyes and ears of the prefecture.

The pay of the *gardiens de la paix* is from 1400 to 1700 francs; brigadiers get 2000 francs; *sous-brigadiers* 1800 francs; *officiers de paix* 3000 to 6000 francs. The proportion of police to inhabitants is one in 352.

Germany.—Taking the Berlin force as illustrative of the police system in the German Empire, police duties are as various as in France; the system includes a political police, controlling all matters relating to the press, societies, clubs and public and social amusements. Police duties are carried out under the direction of the royal police presidency, the executive police force comprising a police colonel, with, besides commissaries of criminal investigations, captains, lieutenants, acting-lieutenants, sergeant-majors and a large body of constables (*schutzmänner*).

It is computed that the proportion of population to police in Berlin is between 350 and 400 to each officer. The pay of the police is principally provided from fiscal sources and varies in an ascending scale from 1125 marks and lodging allowance for the lowest class of constable.

Austria.—Taking Vienna in the same way as illustrative of the Austrian police, it is to be observed that there are three branches: (1) administration; (2) public safety and judicial police; and (3) the government police. At the head of the police service in Vienna there is a president of police and at the head of each of the three branches there is an *Oberpolizeirath* or chief commissary. The head of the government branch sometimes fills the office of president. Each of the branches is subdivided into departments, at the head of which are *Polizeirathe.* Passing over the subdivisions of the administrative branch, the public safety and judicial branch includes the following departments: the office for public safety, the central inquiry office and the record or *Evidenzbureau.* The government police branch comprises three departments: the government police office, the press office, and the *Vereinsbureau* or office for the registration of societies. The proportion of police constables to the inhabitants is one to 436.

Belgium.—In Belgian municipalities the burgomasters are the heads of the force, which is under their control. The administrator of public safety is, however, specially under the minister of justice, who sees that the laws and regulations affecting the police are properly carried out, and he can call on all public functionaries to act in furtherance of that object. The administrator of public safety is specially charged with the administration of the law in regard to aliens, and this law is applied to persons stirring up sedition. The duty of the gendarmerie, who constitute the horse and foot police, is generally to maintain internal order and peace. In Brussels as elsewhere the burgomaster is the head, but for executive purposes there is a chief commissary (subject, however, to the orders of the burgomaster), with assistant commissaries, and commissaries of divisions and other officers and central and other bureaus, with a body of agents (police constables) in each.

There are two main classes of police functions recognized by law, the administrative and the judicial police, the former engaged in the daily maintenance of peace and order and so preventing offences, the latter in the investigation of crime and tracing offenders; but the duties are necessarily performed to a great extent by the same agents. The two other functions of the judicial police are, however, limited to the same classes of officers, and they perform the same duties as in Paris—the law in practice there being expressly adopted in Brussels.

In *Switzerland*, which is sometimes classed with Belgium as among the least-policed states of Europe, the laws of the cantons vary. In some respects they are stricter than in Belgium or even in France. Thus a *permis de séjour* is sometimes required where none is in practice necessary in Paris or Brussels.

Russia was till lately the most police-ridden country in the world; not even in France in the worst days of the monarchy were the people so much in the hands of the police. To give some idea of the wide-reaching functions of the police, the power assumed in matters momentous and quite insignificant, we may quote from the list of circulars issued by the minister of the interior to the governors of the various provinces during four recent years. The governors were directed to regulate religious instruction in secular schools, to prevent horse-stealing, to control subscriptions collected for the holy places in Palestine, to regulate the advertisements of medicines and the printing on cigarette papers, to examine the quality of quinine soap and overlook the cosmetics and other toilet articles—such as soap, starch, brillantine, tooth-brushes and insect-powder—provided by chemists. They were to issue regulations for the proper construction of houses and villages, to exercise an active censorship over published price-lists and printed notes of invitation and visiting cards, as well as seals and rubber stamps. All private meetings and public gatherings, with the expressions of opinion and the class of subjects discussed, were to be controlled by the police.

The political or state police was the invention of Nicholas I. Alexander I. had created a ministry of the interior, but it was Nicholas who devised the second branch, which he designed for his own protection and the security of the state. After the insurrection of 1865, he created a special bulwark for his defence, and invented that secret police which grew into the notorious "Third Section" of the emperor's own chancery, and while it lasted, was the most dreaded power in the empire. It was practically supreme in the state, a ministry independent of all other ministries, placed quite above them and responsible only to the tsar himself.

United States.—The organization of police forces in the United States differs more or less in the different states of the Union. As a rule the force in cities is under municipal control, but to this rule there are numerous exceptions. In Boston, for instance, the three commissioners at the head of the force are appointed by the governor of Massachusetts. The force in New York City, alike from the standpoint of numbers and of the size and character of the city, is the most important in the United States. It included in 1910 a commissioner appointed by the mayor and exercising a wide range of authority; four deputy commissioners; a chief inspector, who has immediate charge of the force and through whom all orders are issued; he is assisted by 18 inspectors, who are in charge of different sections of the city, and who carry out the orders of the chief; 87 captains, each of whom is in direct charge of a precinct; 583 sergeants; and last of all, the ordinary policemen, or patrolmen, as they are often called from the character of their duties. There is a separate branch, the detective bureau, composed of picked men, charged with the investigation and, still more, the prevention of crime. The total number of patrol men in 1909 was 8562. Appointments are for life, with pensions in case of disability and after a given number of years of service.

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POLICE COURTS, courts of summary jurisdiction, held in London and certain large towns of the United Kingdom by specially appointed and salaried magistrates. They were originally called "public offices" (Middlesex Justices Act 1792), but after the establishment of the police force, in 1829, they came to be called "police offices," although no change had taken place in their nature. They are so described in a report of a select committee which inquired into the system in 1837 and 1838; in the same report the magistrates who presided in the courts were first described as "police magistrates." Police offices were first officially described by their modern title in the Metropolitan Police Courts Act 1839. In 1839 there were nine police courts; since 1792 there had been three magistrates to each court, and the act of 1839 retained twenty-seven as the maximum number at any time (s. 2). In 1835 unsalaried justices ceased to sit in the police courts along with the paid magistrates. The Metropolitan Police Courts Act 1840 gave power to map out the whole of the metropolitan police district into police court divisions, and to establish police courts wherever necessary, the artificial limit of twenty-seven magistrates being at the same time preserved. Additional courts have from time to time been established by orders in council, and in 1910 there were in London fourteen courts with twenty-five magistrates. Their divisions are regulated by orders in council of 1903 and 1905; the nine original courts are Bow Street, Westminster, Marylebone, Marlborough Street, Worship Street, Clerkenwell, Thames, Tower Bridge and Lambeth.

The courts are held every day from 10 a.m. to 5 p.m. except on Sunday, Christmas Day, Good Friday or any day appointed for a public fast or thanksgiving or bank holiday. The Greenwich and Woolwich court, which comprises one division, is held at Greenwich in the morning and at Woolwich in the afternoon. The chief magistrate (sitting at Bow Street) receives a salary of £1800 a year and the other magistrates £1500 each. The magistrates are appointed by the Crown; they must have been practising barristers for seven years or stipendiary magistrates for some place in England or Wales. One police magistrate has the same powers as two justices, but may not act in anything which has to be done at special or petty sessions of all the justices acting in the division or at quarter sessions. He can do alone when sitting in a police court any act which any justice or justices can do under the Indictable Offences Act 1848, or under the Summary Jurisdiction Act; he has special powers under the Metropolitan Police Courts Act 1839, and is also given special powers under certain other acts. The Bow Street court has jurisdiction in extradition. The precedent of appointing salaried magistrates was followed for certain towns in the provinces by particular acts, and in 1863 the Stipendiary Magistrates Act gave power to towns and boroughs of 25,000 inhabitants and upwards to obtain a stipendiary magistrate.

POLIGNAC, an ancient French family, which had its seat in the Cevennes near Puy-en-Velay (Haute Loire). Its authentic pedigree can be traced to the 9th century, but in 1421 the male line became extinct. The heiress married Guillaume, sire de Chalancon (not to be confused with the barons of Chalançon in Vivarais), who assumed the name and arms of Polignac. The first member of the family who was of any historical importance was Cardinal Melchior de Polignac (1661–1742), a younger son of Armand XVI., marquis de Polignac, who at an early age achieved distinction as a diplomatist. In 1695 he was sent as ambassador to Poland, where he contrived to bring about the election of the prince of Conti as successor to John Sobieski (1697). The subsequent failure of this intrigue led to his temporary disgrace, but in 1702 he was restored to favour, and in 1712 he was sent as the plenipotentiary of Louis XIV. to the Congress of Utrecht. During the regency he became involved in the Cellamare plot, and was relegated to Flanders for three years. From 1725 to 1732 he acted for France at the Vatican. In 1726 he received the archbishopric of Auch, and he died at Paris in 1742. He left unfinished a metrical refutation of Lucretius which was published after his death by the abbé de Rothelin (*Anti-Lucretius*, 1745), and had considerable vogue in its day. Count Jules de Polignac (d. 1817), grandnephew of the preceding, was created duke by Louis XVI. in 1780, and in 1782 was made postmaster-general. His position and influence at court were largely due to his wife, Gabrielle de Polastron, the bosom friend of Marie Antoinette; the duke and duchess alike shared the unpopularity of the court, and were among the first to "emigrate" in 1789. The duchess died shortly after the queen, but her husband, who had received an estate from Catherine II. in the Ukraine, survived till 1817. Of their three sons the second, Prince Jules de Polignac (1780–1847), played a conspicuous part in the clerical and ultra-royalist reaction after the Revolution. Under the empire he was implicated in the conspiracy of Cadoudal and Pichegru (1804), and was imprisoned till 1813. After the restoration of the Bourbons he held various offices, received from the pope his title of "prince" in 1820, and in 1823 was made ambassador to the English court. On the 8th of August 1829 he was called by Charles X. to the ministry of foreign affairs, and in the following November he became president of the council. His appointment was taken as symbolical of the king's intention to overthrow the constitution, and Polignac, with the other ministers, was held responsible for the policy which culminated in the issue of the Four Ordinances which were the immediate cause of the revolution of July 1830. On the outbreak of this he fled for his life, but, after wandering for some time among the wilds of Normandy, was arrested at Granville. His trial before the chamber of peers resulted in his condemnation to perpetual imprisonment (at Ham), but he benefited by the amnesty of 1836, when the sentence was commuted to one of exile. During his captivity he wrote *Considérations politiques* (1832). He afterwards spent some years in England, but finally was permitted to re-enter France on condition that he did not take up his abode in Paris. He died at St Germain on the 29th of March 1847.

POLIGNY, a town of eastern France, capital of an arrondissement in the department of Jura, 18 m. N.N.E. of Lons-le-Saunier on the Paris–Lyons railway. Pop. (1906), 3756. The town lies in the valley of the Glantine at the base of a hill crowned by the ruins of the old castle of Grimont, once the repository of the archives of the county of Burgundy. The church of Montivillard, its most remarkable building, dates in the oldest portions from the 12th century, its chief features being a Romanesque tower and reredos of the Renaissance period. Amongst the other old buildings of the town, the church of St Hippolyte, of the first half of the 15th century, and a convent-church serving as corn market are of some interest. The tribunal of first instance belonging to the arrondissement is at Arbois. Poligny has a sub-prefecture, a communal college and a school of dairy instruction. Under the name of *Polemniacum* the town seems to have existed at the time of the Roman occupation.

POLISH SUCCESSION WAR (1733–1735), the name given to a war which arose out of the competition for the throne of Poland between the elector August of Saxony, son of August II. (the Strong), and Stanislaus Leszczynski, the king of Poland installed thirty years before by Charles XII. of Sweden and displaced by

August the Strong when Charles's projects collapsed. The claims of Stanislaus were supported by France, Spain and Sardinia, those of the Saxon prince by Russia and the empire, the local quarrel being made the pretext for the settlement of minor outstanding claims of the great powers amongst themselves. The war was therefore a typical 18th century "war with a limited object," in which no one but the cabinets and the professional armies were concerned. It was fought on two theatres, the Rhine and Italy. The Rhine campaigns were entirely unimportant, and are remembered only for the last appearance in the field of Prince Eugène and Marshal Berwick—the latter was killed at the siege of Philippsburg—and the baptism of fire of the young crown prince of Prussia, afterwards Frederick the Great. In Italy, however, there were three hard-fought—though indecisive—battles, Parma (June 29, 1734), Luzzara (Sept. 19, 1734) and Bitonto (May 25, 1735), the first and last won by the Austrians, the second by the French and their allies. In Poland itself, Stanislaus, elected king in September 1733, was soon expelled by a Russian army and was afterwards besieged in Danzig by the Russians and Saxons (Feb.–June 1733).

POLITIAN (1454–1494). Angelo Ambrogini, known in literary annals as Angelo Poliziano or Politianus from his birthplace, was born at Montepulciano in Tuscany on the 14th of July 1454. His father, Benedetto, a jurist of good family and distinguished ability, was murdered by political antagonists for adopting the cause of Piero de' Medici in Montepulciano; and this circumstance gave his eldest son, Angelo, a claim on the family of Medici. At the age of ten the boy came to prosecute his studies at Florence, where he learned Latin under Cristoforo Landino, and Greek under Argyropulos and Andronicos Kallistos. From Marsilio Ficino he imbibed the rudiments of philosophy. The precocity of his genius for scholarship and poetry was early manifested. At thirteen years of age he began to circulate Latin letters; at seventeen he sent forth essays in Greek versification; at eighteen he published an edition of Catullus. In 1470 he won for himself the title of *Homericus juvenis* by translating four books of the *Iliad* into Latin hexameters. Lorenzo de' Medici, who was then the autocrat of Florence and the chief patron of learning in Italy, took Poliziano into his household, made him the tutor of his children, and secured him a distinguished post in the university of Florence. Before he reached the age of thirty, Poliziano expounded the humanities with almost unexampled lustre even for that epoch of brilliant professors. Among his pupils could be numbered the chief students of Europe, the men who were destined to carry to their homes the *spolia opima* of Italian culture. Not to mention Italians, it will suffice to record the names of the German Reuchlin, the English Grocyn and Linacre, and the Portuguese Tessiras.

Poliziano had few advantages of person to recommend him. He was ungainly in form, with eyes that squinted, and a nose of disproportionate length. Yet his voice was rich and capable of fine modulation; his eloquence, ease of utterance and copious stream of erudition were incomparable. It was the method of professors at that period to read the Greek and Latin authors with their class, dictating philological and critical notes, emending corrupt passages in the received texts, offering elucidations of the matter, and pouring forth stores of acquired knowledge regarding the laws, manners, religious and philosophical opinions of the ancients. Poliziano covered nearly the whole ground of classical literature during the years of his professorship, and published the notes of his courses upon Ovid, Suetonius, Statius, the younger Pliny, Quintilian, and the writers of Augustan histories. He also undertook a recension of the text of the *Pandects* of Justinian, which formed the subject of one of his courses; and this recension, though it does not rank high in the scale of juristic erudition, gave an impulse to the scholarly criticism of the Roman code. At the same time he was busy as a translator from the Greek. His versions of Epictetus, Herodian, Hippocrates, Galen, Plutarch's *Eroticus* and Plato's *Charmides* delighted contemporaries by a certain limpid fluency of Latin style and grace of manner which distinguished him also as an original writer. Of these learned labours the most universally acceptable to the public of that time were a series of discursive essays on philology and criticism, first published in 1489 under the title of *Miscellanea*. They had an immediate, a lasting and a wide renown, encouraging the scholars of the next century and a half to throw their occasional discoveries in the field of scholarship into a form at once so attractive and so instructive. Poliziano was not, however, contented with these simply professorial and scholastic compositions. Nature had endowed him with literary and poetic gifts of the highest order. These he devoted to the composition of Latin and Greek verses, which count among the best of those produced by men of modern times in rivalry with ancient authors. The *Manto*, in which he pronounced a panegyric of Virgil; the *Ambra*, which contains a beautiful idyllic sketch of Tuscan landscape, and a studied eulogy of Homer; the *Rusticus*, which celebrated the pleasures of country life in no frigid or scholastic spirit; and the *Nutricia*, which was intended to serve as a general introduction to the study of ancient and modern poetry—these are the masterpieces of Poliziano in Latin verse, displaying an authenticity of inspiration, a sincerity of feeling, and a command of metrical resources which mark them out as original productions of poetic genius rather than as merely professorial lucubrations. Exception may be taken to their style, when compared with the best work of the Augustan or even of the Silver age. But what renders them always noteworthy to the student of modern humanistic literature is that they are in no sense imitative or conventional, but that they convey the genuine thoughts and emotions of a born poet in Latin diction and in metre moulded to suit the characteristics of the singer's temperament.

Poliziano was great as a scholar, as a professor, as a critic, and as a Latin poet at an age when the classics were still studied with the passion of assimilative curiosity, and not with the scientific industry of a later period. He was the representative hero of that age of scholarship in which students drew their ideal of life from antiquity and fondly dreamed that they might so restore the past as to compete with the classics in production and bequeath a golden age of resuscitated paganism to the modern world. Yet he was even greater as an Italian poet. Between Boccaccio and Ariosto, no single poet in the mother tongue of Italy deserves so high a place as Poliziano. What he might have achieved in this department of literature had he lived at a period less preoccupied with humanistic studies, and had he found a congenial sphere for his activity, can only be guessed. As it is, we must reckon him as decidedly the foremost and indubitably the most highly gifted among the Italian poets who obeyed Lorenzo de' Medici's demand for a resuscitation of the vulgar literature. Lorenzo led the way himself, and Poliziano was more a follower in his path than an initiator. Yet what Poliziano produced, impelled by a courtly wish to satisfy his patron's whim, proves his own immeasurable superiority as an artist. His principal Italian works are the stanzas called *La Giostra*, written upon Giuliano de' Medici's victory in a tournament; the *Orfeo*, a lyrical drama performed at Mantua with musical accompaniment; and a collection of fugitive pieces, reproducing various forms of Tuscan popular poetry. *La Giostra* had no plan, and remained imperfect; but it demonstrated the capacities of the octave stanza for rich, harmonious and sonorous metrical effect. The *Orfeo* is a slight piece of work, thrown off at a heat, yet abounding in unpremeditated lyrical beauties, and containing in itself the germ both of the pastoral play and of the opera. The Tuscan songs are distinguished by a "roseate fluency," an exquisite charm of half romantic, half humorous abandonment to fancy, which mark them out as improvisations of genius. It may be added that in all these departments of Italian composition Poliziano showed how the taste and learning of a classical scholar could be engrafted on the stock of the vernacular, and how the highest perfection of artistic form might be attained in Italian without a sacrifice of native spontaneity and natural flow of language.

It is difficult to combine in one view the several aspects presented to us by this many-sided man of literary genius. At a period when humanism took the lead in forming Italian character and giving tone to European culture, he climbed with facility to the height of achievement in all the branches of scholarship which were then most seriously prized—in varied knowledge of ancient authors, in critical capacity, in rhetorical and poetical exuberance. This was enough at that epoch to direct the attention of all the learned men of Europe on Poliziano. At the same time, almost against his own inclination, certainly with very little enthusiasm on his part, he lent himself so successfully to Lorenzo de' Medici's scheme for resuscitating the decayed literature of Tuscany that his slightest Italian effusions exercised a potent influence on the immediate future. He appears before us as the dictator of Italian culture in a double capacity—as the man who most perfectly expressed the Italian conception of humanism, and brought erudition into accord with the pursuit of noble and harmonious form, and also as the man whose vernacular compositions were more significant than any others of the great revolution in favour of Italian poetry which culminated in Ariosto. Beyond the sphere of pure scholarship and pure literature Poliziano did not venture. He was present, indeed, at the attack made by the Pazzi conspirators on the persons of Lorenzo and Giuliano de' Medici, and wrote an interesting account of its partial success. He also contributed a curious document on the death of Lorenzo de' Medici to the students of Florentine history. But he was not, like many other humanists of his age, concerned in public affairs of state or diplomacy, and he held no office except that of professor at Florence. His private life was also uneventful. He passed it as a house-friend and dependant of the Medici, as the idol of the learned world, and as a simple man of letters for whom (with truly Tuscan devotion to the Saturnian country) rural pleasures were always acceptable. He was never married; and his morals incurred suspicion, to which his own Greek verses lend a certain amount of plausible colouring. In character Poliziano was decidedly inferior to the intellectual and literary eminence which he displayed. He died, half broken-hearted by the loss of his friend and patron Lorenzo de' Medici, on the 24th of September 1494, just before the wave of foreign invasion which was gathering in France swept over Italy.

For the life and works of Politian, see F. O. Mencken (Leipzig, 1736), a vast repertory of accumulated erudition; Jac. Mähly, *Angelus Politianus* (Leipzig, 1864); Carducci's edition of the Italian poems (Florence, Barbera, 1863); Del Lungo's edition of the Italian prose works and Latin and Greek poems (Florence, Barbera, 1867); the *Opera omnia* (Basel, 1554); Greswell's English *Life of Politian* (1805); Roscoe's *Lorenzo de' Medici* (10th ed., 1851); J. Addington Symonds's *Renaissance in Italy*, and translations from Poliziano's Italian poems in Symonds's *Sketches and Studies in Italy*, which include the *Orfeo*. (J. A. S.)

POLK, JAMES KNOX (1795–1849), eleventh president of the United States, was born in Mecklenburg county, North Carolina, on the 2nd of November 1795. In 1806 he crossed the mountains with his parents and settled in what is now Maury county, Tennessee. He graduated from the university of North Carolina in 1818, studied law in the office of Felix Grundy (1777–1840) at Nashville in 1819–1820, was admitted to the bar in 1820, and began to practise in Columbia, the county-seat of Maury county. After two years of service (1823–1825) in the state House of Representatives, he represented the sixth Tennessee district in the National House of Representatives from 1825 to 1839. In the party conflicts which succeeded the presidential election of 1824 he sided with the Jackson-Van Buren faction, and soon became recognized as leader of the Democratic forces. He was speaker from 1835 until 1839, when he retired from Congress to become governor of Tennessee. His administration (1839–1841) was successful, but he was unable to overcome the popular Whig movement of that period, and was defeated in 1841 and again in 1843. When the Democratic national convention met in Baltimore in 1844 he was mentioned as a possible candidate for the vice-presidency, but was suddenly brought forward as a "dark horse" and selected to head the ticket. Finding it impossible under the two-thirds rule to nominate their candidate, the followers of Van Buren brought forward Polk, who was popular in the South, in order to defeat Lewis Cass and James Buchanan. George Bancroft, the historian, has asserted that this suggestion came originally from him, and Gideon J. Pillow, Polk's intimate friend, did much to bring about the nomination.

The unequivocal stand of Polk and his party in favour of the immediate annexation of Texas and the adoption of a vigorous policy in Oregon contrasted favourably with the timid vacillations of Henry Clay and the Whigs. Polk was elected, receiving 170 electoral votes to 105 for his opponent Clay. In forming his cabinet he secured the services of James Buchanan of Pennsylvania, as secretary of state, Robert J. Walker of Mississippi, as secretary of the treasury, William L. Marcy of New York, as secretary of war, and George Bancroft, then of Massachusetts, as secretary of the navy.[1] There is no doubt that each of these men, and Bancroft in particular, influenced the policy of the administration, yet the historian James Schouler, who has made a careful study of the Polk papers, is doubtless correct in saying that the president himself was "the framer of the public policy which he carried into so successful execution, and that instead of being led (as many might have imagined) by the more famous statesmen of his administration and party who surrounded him, he in reality led and shaped his own executive course." Bancroft's opinion is that Polk was "prudent, far-sighted, bold, exceeding any Democrat of his day in his undeviatingly correct exposition of Democratic principles."

The four chief events of President Polk's administration were the final establishment of the independent treasury system, the reduction of the tariff by the Walker Bill of 1846, the adjustment of the Oregon boundary dispute with Great Britain by the treaty concluded on the 15th of June 1846, and the war with Mexico and the consequent acquisition of territory in the south-west and west. The first three of these were recommended in his first annual message, and he privately announced to Bancroft his determination to seize California. The independent treasury plan originated during Van Buren's administration as a Democratic measure; it had been repealed by the Whigs in 1841, and was now re-enacted. Protectionists contend that the tariff legislation of 1846 was in direct violation of a pledge given to the Democrats of Pennsylvania in a letter written by Polk during the campaign to John K. Kane of Philadelphia. Briefly summarized, this letter approves of a tariff for revenue with incidental protection, whereas the annual message of the 2nd of December 1845 criticizes the whole theory of protection and urges the adoption of a revenue tariff just sufficient to meet the needs of the government conducted on an economical basis. It is difficult to determine whether this was always his idea of incidental protection, or whether his views were changed after 1844 through the influence of Walker and the example set by Sir Robert Peel in Great Britain, or whether he was simply "playing politics" to secure the protectionist vote in Pennsylvania.

The one overshadowing issue of the time, however, was territorial expansion. Polk was an ardent expansionist, but the old idea that his policy was determined entirely by a desire to advance the interests of slavery is no longer accepted. As a matter of fact, he was personally in favour of insisting upon 54° 40′ as the boundary in Oregon, and threw upon Congress the responsibility for accepting 49° as the boundary, and he approved the acquisition of California, Utah and New Mexico, territory from which slavery was excluded by geographical and climatic conditions. Furthermore a study of his manuscript diary now shows that he opposed the efforts of Walker and Buchanan in the Cabinet, and of Daniel S. Dickinson (1800–1866) of New York and Edward A. Hannegan (d. 1859) of Indiana, in the Senate, to retain the whole of Mexico, territory in which slavery might have thrived. At the close of his term (March 4, 1849) Polk retired to his home in Nashville, Tennessee, where he died on the 15th of the following June.

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[1] Bancroft served until September 1846, when he was appointed minister to England. He was succeeded as secretary of the navy by John J. Mason, who had previously held the office of attorney-general.

See John S. Jenkins, *James Knox Polk* (Auburn and Buffalo, 1850), and L. B. Chase, *History of the Polk Administration* (New York, 1850), both of which contain some documentary material, but are not discriminating in their method of treatment. George Bancroft contributed a good short sketch to J. G. Wilson's *Presidents of the United States* (New York, 2nd ed., 1894). He made copies of the Polk manuscripts and was working upon a detailed biography at the time of his death in 1891. These copies, now deposited in the Lenox Library, New York City, contain a diary in 24 typewritten volumes, besides some correspondence and other private papers. They have been used by James Schouler in his *Historical Briefs* (New York, 1896), and by E. G. Bourne in an article entitled "The Proposed Absorption of Mexico in 1847–1848," published in the *Annual Report of the American Historical Association for 1899*, i. 157–169 (Washington, 1900). Bourne discusses the part which Polk took in preventing the complete absorption of Mexico. See also the *Diary of James K. Polk . . . . 1845 to 1849* (Chicago, 4 vols., 1910), edited by M. M. Quaife.
(W. R. S.*)

POLK, LEONIDAS (1806–1864), American soldier, was born at Raleigh, North Carolina, on the 10th of April 1806, and was a cousin of James Knox Polk, president of the United States. He was educated at West Point, but afterwards studied theology and took orders in the Protestant Episcopal Church in 1831. In 1838 he became missionary bishop of the South-West, Arkansas, Indian Territory, Louisiana, Alabama and Mississippi, and in 1841 he was consecrated bishop of Louisiana. His work in the Church was largely of an educational kind, and he played a prominent part in movements for the establishment of higher educational institutions in the South. At the outbreak of the Civil War in 1861 he resigned his bishopric and, like many other clergymen and ministers of religion, entered the army which was raised to defend the Confederacy. His rank in the hierarchy and the universal respect in which he was held in the South, rather than his early military education, caused him to be appointed to the important rank of major-general. He fortified the post of Columbus, Kentucky, the foremost line of defence on the Mississippi, against which Brigadier-General U. S. Grant directed the offensive reconnaissance of Belmont in the autumn. In the following spring, the first line of defence having fallen, Polk commanded a corps at Shiloh in the field army commanded by Albert Sidney Johnston and Beauregard. In October 1862 he was promoted lieutenant-general, and thenceforward he commanded one of the three corps of the army of Tennessee under Bragg and afterwards was in charge of the Department of Alabama, Mississippi and East Louisiana. He was killed in the fighting in front of Marietta, while reconnoitring near Pine Mountain, Georgia, on the 14th of June 1864.

See *Life*, by his son W. M. Polk, (1893).

POLKA (either from the Czech *pulka*, half, with an allusion to the short steps characteristic of the dance, or from the Polish *Polka*, feminine of *Polak*, a Pole), a lively dance of Bohemian origin, danced to music written in $\frac{2}{4}$ time. (See DANCE.)

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G. C. W.	GEORGE CHARLES WILLIAMSON, LITT.D. Chevalier of the Legion of Honour. Author of *Portrait Miniatures*; *Life of Richard Cosway, R.A.*; *George Engleheart*; *Portrait Drawings*; &c. Editor of New Edition of Bryan's *Dictionary of Painters and Engravers*.	**Prieur, Pierre.**
G. E.*	ROBERT GEOFFREY ELLIS. Peterhouse, Cambridge. Barrister-at-Law, Inner Temple. Joint-editor of *English Reports*. Author of *Peerage Law and History*.	**Privy Council.**
G. G. S.	GEORGE GREGORY SMITH, M.A. Professor of English Literature, Queen's University, Belfast. Author of *The Days of James IV.*; *The Transition Period*; *Specimens of Middle Scots*; &c.	**Ramsay, Allan.**
G. J. A.	GEORGE JOHNSTON ALLMAN, M.A., LL.D., F.R.S., D.Sc. (1824–1905). Professor of Mathematics in Queen's College, Galway, and in Queen's University of Ireland, 1853–1893. Author of *Greek Geometry from Thales to Euclid*; &c.	**Ptolemy** *(in part)*; **Pythagoras:** *Geometry.*
G. J. T.	GEORGE JAMES TURNER. Barrister-at-Law, Lincoln's Inn. Editor of *Select Pleas of the Forests* for the Selden Society.	**Provision;** **Rape.**

G. Re.	Sir George Reid, LL.D. See the biographical article: Reid, Sir George.	**Portraiture.**
G. Sa.	George Saintsbury, LL.D., D.C.L. See the biographical article: Saintsbury, George E. B.	**Quinet; Rabelais;** **Racine.**
G. W. T.	Rev. Griffithes Wheeler Thatcher, M.A., B.D. Warden of Camden College, Sydney, N.S.W. Formerly Tutor in Hebrew and Old Testament History at Mansfield College, Oxford.	**Rāwendis.**
H. A. Y.	Horatio Arthur Yorke, C.B. Lieut.-Colonel, R.E. (retired). Chief Inspecting Officer of Railways, Board of Trade. Served in Afghan War, 1879–1880; Nile Expedition, 1884–1885.	**Railways:** *British Railway Legislation.*
H. D. W.	Sir Henry Drummond Wolff, G.C.B., G.C.M.G. (1830–1908). Ambassador Extraordinary and Plenipotentiary at Madrid, 1892–1900. M.P. for Christchurch, 1874–1880; for Portsmouth, 1880–1885. Author of *A Life of Napoleon at Elba*; &c.	**Primrose League.**
H. Fr.	Henri Frantz. Art Critic, *Gazette des beaux arts*, Paris.	**Puvis de Chavannes.**
H. F. G.	Hans Friedrich Gadow, F.R.S., Ph.D. Strickland Curator and Lecturer on Zoology in the University of Cambridge. Author of "Amphibia and Reptiles" in the *Cambridge Natural History*; &c.	**Python;** **Ratitae;** **Rattlesnake** (*in part*).
H. F. P.	Henry Francis Pelham, LL.D., D.C.L. See the biographical article: Pelham, H. F.	**Polybius** (*in part*).
H. M. R.	Hugh Munro Ross. Formerly Exhibitioner of Lincoln College, Oxford. Editor of *The Times Engineering Supplement*. Author of *British Railways*.	**Railways:** *Introduction, Construction, Rolling Stock.*
H. N. D.	Henry Newton Dickson, M.A., D.Sc., F.R.S.(Edin.), F.R.G.S. Professor of Geography at University College, Reading. Formerly Vice-President, Royal Meteorological Society. Lecturer in Physical Geography, Oxford University. Author of *Meteorology*; *Elements of Weather and Climate*; &c.	**Red Sea.**
H. O.	Hermann Oelsner, M.A., Ph.D. Taylorian Professor of the Romance Languages in the University of Oxford. Member of Council of the Philological Society. Author of *A History of Provençal Literature*; &c.	**Provençal Literature:** *Modern.*
H. R. L.	The Rev. Henry Richards Luard, M.A., D.D. (1825–1891). Registrary of the University of Cambridge, 1862–1891. Formerly Fellow, Bursar and Lecturer at Trinity College. Honorary Fellow of King's College, London. Editor of the *Annales Monastici*; the *Historia* of Matthew Paris and other works for the "Rolls" Series.	**Porson** (*in part*).
H. Ti.	Henry Tiedemann. London Editor of the *Nieuwe Rotterdamsche Courant*. Author of a Dutch biography, and various pamphlets and travel works, including *Via Flushing*.	**Potgieter.**
H. T. A.	Rev. Herbert Thomas Andrews. Professor of New Testament Exegesis, New College, London. Author of "The Commentary on Acts" in the *Westminster New Testament*; *Handbook on the Apocryphal Books* in the "Century" Bible.	**Polycarp;** **Presbyter.**
H. W. C. D.	Henry William Carless Davis, M.A. Fellow and Tutor of Balliol College, Oxford. Fellow of All Souls' College, Oxford, 1895–1902. Author of *England under the Normans and Angevins*; *Charlemagne*.	**Ralph of Coggeshall.**
H. Y.	Sir Henry Yule, K.C.S.I., C.B. See the biographical article: Yule, Sir Henry.	**Polo, Marco** (*in part*); **Prester John; Ramusio.**
I. A.	Israel Abrahams, M.A. Reader in Talmudic and Rabbinic Literature in the University of Cambridge. Formerly President, Jewish Historical Society of England. Author of *A Short History of Jewish Literature*; *Jewish Life in the Middle Ages*; *Judaism*; &c.	**Proselyte; Qaraites; Qaro;** **Raba Ben Joseph Ben Ḥama** **Rabbah Bar Naḥmani;** **Rapoport, Samuel;** **Rashbam; Rashi.**
J. A. B.	Sir Jervoise Athelstane Baines, C.S.I. President, Royal Statistical Society, 1909–1910. Census Commissioner under the Government of India, 1889–1893. Secretary to Royal Commission on Opium, 1894–1895. Author of Official *Reports on Provincial Administration of Indian Census Operations*; &c.	**Population.**
J. A. Bl.	John A. Black. Press reader of the New Volumes of the *Encyclopaedia Britannica* (10th ed.).	**Proof-reading** (*in part*).
J. A. H.	John Allen Howe, B.Sc. Curator and Librarian of the Museum of Practical Geology, London. Author of *The Geology of Building Stones*.	**Pre-Cambrian.**
J. A. S.	John Addington Symonds, LL.D. See the biographical article: Symonds, John A.	**Pontanus, Jovianus.**
J. E. S.*	John Edwin Sandys, M.A., Litt.D., LL.D. Public Orator in the University of Cambridge. Fellow of St John's College, Cambridge. Fellow of the British Academy. Author of *A History of Classical Scholarship*; &c.	**Porson** (*in part*).

J. F.-K.	James Fitzmaurice-Kelly, Litt.D., F.R.Hist.S. Gilmour Professor of Spanish Language and Literature, Liverpool University. Norman McColl Lecturer, Cambridge University. Fellow of the British Academy. Member of the Royal Spanish Academy. Knight Commander of the Order of Alphonso XII. Author of *A History of Spanish Literature*; &c.	**Quevedo y Villegas.**
J. G. C. A.	John George Clark Anderson, M.A. Student, Censor and Tutor of Christ Church, Oxford. Formerly Fellow of Lincoln College. Craven Fellow, Oxford, 1896. Conington Prizeman, 1893.	**Pontus.**
J. G. F.	Sir Joshua Girling Fitch, LL.D. See the biographical article: Fitch, Sir Joshua Girling.	**Polytechnic** (*in part*).
J. G. Fr.	James George Frazer, M.A., D.C.L., LL.D., Litt.D. Professor of Social Anthropology, Liverpool University. Fellow of Trinity College, Cambridge. Fellow of the British Academy. Author of *The Golden Bough*; &c.	**Praefect** (*in part*); **Praeneste** (*in part*); **Praetor** (*in part*); **Proserpine** (*in part*); **Province** (*in part*).
J. G. K.	John Graham Kerr, M.A., F.R.S. Regius Professor of Zoology in the University of Glasgow. Formerly Demonstrator in Animal Morphology in the University of Cambridge. Fellow of Christ's College, Cambridge, 1898–1904. Walsingham Medallist, 1898. Neill Prizeman, Royal Society of Edinburgh, 1904.	**Ray** (*in part*).
J. G. Sc.	Sir James George Scott, K.C.I.E. Superintendent and Political Officer, Southern Shan States. Author of *Burma*; *The Upper Burma Gazetteer*.	**Rangoon.**
J. Hn.	Justus Hashagen, Ph.D. Privatdozent in Medieval and Modern History, University of Bonn. Author of *Das Rheinland unter der Französische Herrschaft*.	**Puttkammer.**
J. H. M.	John Henry Middleton, M.A., Litt.D., F.S.A., D.C.L. (1846–1896). Slade Professor of Fine Art in the University of Cambridge, 1886–1895. Director of the Fitzwilliam Museum, Cambridge, 1889–1892. Art Director of the South Kensington Museum, 1892–1896. Author of *The Engraved Gems of Classical Times*; *Illuminated Manuscripts in Classical and Mediaeval Times*.	**Raphael.**
J. Ja.	Joseph Jacobs, Litt.D. Professor of English Literature in the Jewish Theological Seminary, New York. Formerly President of the Jewish Historical Society of England. Corresponding Member of the Royal Academy of History, Madrid. Author of *Jews of Angevin England*; *Studies in Biblical Archaeology*; &c.	**Purim.**
J. L.*	Sir Joseph Larmor, M.A., D.Sc., LL.D., F.R.S. Fellow of St John's College, Cambridge, and Lucasian Professor of Mathematics in the University. Secretary of the Royal Society. Professor of Natural Philosophy, Queen's College, Galway, 1880–1885. Author of *Ether and Matter*, and various memoirs on Mathematics and Physics.	**Radiation, Theory of;** **Radiometer.**
J. M.	Sir John Macdonell, C.B., LL.D. Master of the Supreme Court. Counsel to the Board of Trade and London Chamber of Commerce. Formerly Quain Professor of Comparative Law, University College, London. Editor of *State Trials*; *Civil Judicial Statistics*; &c. Author of *Survey of Political Economy*; *The Land Question*; &c.	**Protectorate.**
J. M. M.	John Malcolm Mitchell. Sometime Scholar of Queen's College, Oxford. Lecturer in Classics, East London College (University of London). Joint-editor of Grote's *History of Greece*.	**Pomponazzi, Pietro;** **Price, Richard.**
J. P. E.	Jean Paul Hippolyte Emmanuel Adhémar Esmein. Professor of Law in the University of Paris. Officer of the Legion of Honour. Member of the Institute of France. Author of *Cours élémentaire d'histoire du droit français*; &c.	**Prefect;** **Provost** (*in France*).
J. P. P.	John Percival Postgate, M.A., Litt.D. Professor of Latin in the University of Liverpool. Fellow of Trinity College, Cambridge. Fellow of the British Academy. Editor of the *Classical Quarterly*. Editor-in-chief of the *Corpus Poetarum Latinorum*; &c.	**Propertius, Sextus.**
J. R.*	John Randall. Formerly Secretary of the London Association of Correctors of the Press. Sub-editor of the *Athenaeum* and *Notes and Queries*.	**Proof-reading** (*in part*).
J. S. F.	John Smith Flett, D.Sc., F.G.S. Petrographer to the Geological Survey. Formerly Lecturer on Petrology in Edinburgh University. Neill Medallist of the Royal Society of Edinburgh. Bigsby Medallist of the Geological Society of London.	**Porphyry; Pumice;** **Pyroxenite;** **Quartzite; Quartz-Porphyry.**
J. S. R.	James Smith Reid, M.A., LL.D., Litt.D. Professor of Ancient History and Fellow and Tutor of Gonville and Caius College, Cambridge. Browne's and Chancellor's Medals. Editor of editions of Cicero's *Academia*, *De Amicitia*; &c.	**Quintilian.**
J. T. Be.	John Thomas Bealby. Joint-author of Stanford's *Europe*. Formerly Editor of the *Scottish Geographical Magazine*. Translator of Sven Hedin's *Through Asia*, *Central Asia and Tibet*; &c.	**Poltava** (*in part*); **Pskov** (*in part*); **Radom** (*in part*).

J. T. Cr.	James Troubridge Critchell. London Correspondent of the *Australasian Pastoralists' Review, North Queensland Herald*; &c. Fellow of the Royal Colonial Institute. Author of *Polynesian Labour in Queensland*; *Guide to Queensland*; &c.	**Queensland:** *History.*
J. W.	James Williams, D.C.L., LL.D. All Souls' Reader in Roman Law in the University of Oxford. Fellow of Lincoln College. Author of *Wills and Succession*; &c.	**Possession** (*law*); **Prescription** (*in part*)
J. W.*	James Ward, LL.D. See the biographical article: Ward, James.	**Psychology.**
J. W. G.	John Walter Gregory, D.Sc., F.R.S. Professor of Geology at the University of Glasgow. Professor of Geology and Mineralogy at the University of Melbourne, 1900–1904. Author of *The Dead Heart of Australia*; &c.	**Queensland:** *Geology*
K. G. J.	Kingsley Garland Jayne. Sometime Scholar of Wadham College, Oxford. Matthew Arnold Prizeman, 1903. Author of *Vasco da Gama and his Successors.*	**Portugal:** *Geography and History.*
K. S.	Kathleen Schlesinger. Editor of the *Portfolio of Musical Archaeology.* Author of *The Instruments of the Orchestra.*	**Pommer; Portative Organ;** **Positive Organ; Psaltery;** **Rackett; Ravanastron;** **Rebab; Rebec;** **Recorder** (*music*); **Reed Instruments.**
L.	Count Lützow, Litt.D. (Oxon.), D.Ph. (Prague), F.R.G.S. Chamberlain of H.M. the Emperor of Austria, King of Bohemia. Hon. Member of the Royal Society of Literature. Member of the Bohemian Academy, &c. Author of *Bohemia: a Historical Sketch*; *The Historians of Bohemia* (Ilchester Lecture, Oxford, 1904); *The Life and Times of John Hus*; &c.	**Prague.**
L. Bl.	Louis Bell, Ph.D. Consulting Engineer, Boston, U.S.A. Chief Engineer, Electric Power Transmission Department, General Electric Co., Boston. Formerly Editor of *Electrical World*, New York. Author of *Electric Power Transmission*; &c.	**Power Transmission:** *Electrical.*
L. J. S.	Leonard James Spencer, M.A. Assistant in Department of Mineralogy, British Museum. Formerly Scholar of Sidney Sussex College, Cambridge, and Harkness Scholar. Editor of the *Mineralogical Magazine.*	**Proustite; Pyrargyrite;** **Pyrolusite; Pyromorphite;** **Pyrrhotite; Quartz; Realgar.**
L. Wr.	Lewis Wright. Author of *The Practical Poultry Keeper*; *The New Book of Poultry*; &c.	**Poultry and Poultry-farming.**
L. W. V.-H.	L. W. Vernon-Harcourt (d. 1909). Barrister-at-Law. Author of *His Grace the Steward and the Trial of Peers.*	**Reclamation of Land.**
M. Br.	Margaret Bryant.	**Pope, Alexander** (*in part*).
M. Ha.	Marcus Hartog, M.A., D.Sc., F.L.S. Professor of Zoology, University College, Cork. Formerly Fellow of the Royal University of Ireland. Author of "Protozoa" in *Cambridge Natural History*; and papers for various scientific journals.	**Proteomyxa;** **Radiolaria.**
M. M. Bh.	Sir Mancherjee Merwanjee Bhownaggree, K.C.I.E. Fellow of Bombay University. M.P. for N.E. Bethnal Green, 1895–1906. Author of *History of the Constitution of the East India Company*; &c.	**Readymoney, Sir Cowasji Jehangir.**
M. N. T.	Marcus Niebuhr Tod, M.A. Fellow and Tutor of Oriel College, Oxford. University Lecturer in Epigraphy. Joint-author of *Catalogue of the Sparta Museum.*	**Pylos.**
M. O. B. C.	Maximilian Otto Bismarck Caspari, M.A. Reader in Ancient History at London University. Lecturer in Greek at Birmingham University, 1905–1908.	**Polycrates;** **Punic Wars.**
N. M.	Norman M'Lean, M.A. Lecturer in Aramaic, Cambridge University. Fellow and Hebrew Lecturer, Christ's College, Cambridge. Joint-editor of the larger Cambridge *Septuagint.*	**Rabbūlā.**
N. W. T.	Northcote Whitridge Thomas, M.A. Government Anthropologist to Southern Nigeria. Corresponding Member of the Société d'Anthropologie de Paris. Author of *Thought Transference*; *Kinship and Marriage in Australia*; &c.	**Possession** (*Psychology*).
O. C. W.	Rev. Owen Charles Whitehouse, M.A., D.D. Senior Theological Tutor and Lecturer in Hebrew, Cheshunt College, Cambridge. Formerly Principal and Professor of Biblical Exegesis and Theology in the Countess of Huntingdon's College, Cheshunt. Author of *Primer of Hebrew Antiquities*; &c.	**Priest** (*in part*); **Prophet** (*in part*).
O. H.	Olaus Magnus Friedrich Henrici, Ph.D., LL.D., F.R.S. Professor of Mechanics and Mathematics in the Central Technical College of the City and Guilds of London Institute. Author of *Vectors and Rotors*; *Congruent Figures*; &c.	**Projection.**
P. A. K.	Prince Peter Alexeivitch Kropotkin. See the biographical article: Kropotkin, Prince P. A.	**Poltava** (*in part*); **Pskov** (*in part*); **Radom** (*in part*).

P. C. Y.	Philip Chesney Yorke, M.A. Magdalen College, Oxford. Editor of *Letters of Princess Elizabeth of England.*	**Prynne, William** (*in part*); **Pym, John.**
P. G.	Percy Gardner, Litt.D., LL.D., F.S.A. See the biographical article: Gardner, Percy.	**Polyclitus; Polygnotus;** **Praxiteles.**
P. Gi.	Peter Giles, M.A., LL.D., Litt.D. Fellow and Classical Lecturer of Emmanuel College, Cambridge, and University Reader in Comparative Philology. Formerly Secretary of the Cambridge Philological Society.	**Q; R.**
P. G. K.	Paul George Konody. Art Critic of the *Observer* and the *Daily Mail.* Formerly Editor of the *Artist.* Author of *The Art of Walter Crane*; *Velasquez, Life and Work*; &c.	**Potter, Paul.**
P. G. T.	Peter Guthrie Tait, LL.D. See the biographical article: Tait, Peter Guthrie.	**Quaternions** (*in part*).
P. M.	Paul Meyer. See the biographical article: Meyer, Paul Hyacinthe.	**Provençal Language;** **Provençal Literature** (*in part*).
P. McC.	Primrose McConnell, F.G.S. Member of the Royal Agricultural Society. Author of *Diary of a Working Farmer*; &c.	**Reaping.**
R. H. K.	Rev. Robert Hatch Kennett, M.A., D.D. Regius Professor of Hebrew, Cambridge, and Canon of Ely. Formerly Fellow and Lecturer in Hebrew and Syriac, Queens' College, and University Lecturer in Aramaic. Author of *A Short Account of the Hebrew Tenses; In our Tongues*; &c.	**Psalms, Book of** (*in part*).
R. I. P.	Reginald Innes Pocock, F.Z.S. Superintendent of the Zoological Gardens, London.	**Pycnogonida.**
R. J. M.	Ronald John McNeill, M.A. Christ Church, Oxford. Barrister-at-Law. Formerly Editor of the *St James's Gazette*, London.	**Racquets.**
R. L.*	Richard Lydekker, F.R.S., F.Z.S., F.G.S. Member of the Staff of the Geological Survey of India, 1874–1882. Author of *Catalogues of Fossil Mammals, Reptiles and Birds in the British Museum*; *The Deer of all Lands*; &c.	**Porcupine** (*in part*); **Porpoise; Primates;** **Proboscidea; Prongbuck;** **Rabbit** (*in part*); **Rat; Ratel.**
R. Mo.	Ray Morris, M.A. Formerly Managing Editor, *Railway Age Gazette*, New York. Author of *Railroad Administration.*	**Railways:** *General Statistics and Financial Organization.*
R. M. L.	Robert Murray Leslie, M.A., M.D., M.R.C.P. Senior Physician, Prince of Wales's General Hospital, London. Lecturer on Medicine, London Post-Graduate College. Author of *Clinical Types of Pneumonia*; &c.	**Pygmy.**
R. M. W.	R. Mortimer Wheeler.	**Punch.**
R. N. B.	Robert Nisbet Bain (d. 1909). Assistant Librarian, British Museum, 1883–1909. Author of *Scandinavia: the Political History of Denmark, Norway and Sweden, 1513–1900*; *The First Romanovs, 1613–1725*; *Slavonic Europe: the Political History of Poland and Russia from 1469 to 1796*; &c.	**Poniatowski, Joseph A.;** **Potemkin, Prince;** **Potocki, Ignaty;** **Potocki, Stanislaw F.;** **Prokopovich; Pugachev;** **Rakóczy; Razin.**
R. Po.	René Poupardin, D.-ès-L. Secretary of the École des Chartes. Honorary Librarian at the Bibliothèque Nationale, Paris. Author of *Le Royaume de Provence sous les Carolingiens*; *Recueil des chartes de Saint-Germain*; &c.	**Provence;** **Quierzy, Capitulary of.**
R. P. S.	R. Phené Spiers, F.S.A., F.R.I.B.A. Formerly Master of the Architectural School, Royal Academy, London. Past President of Architectural Association. Associate and Fellow of King's College, London. Corresponding Member of the Institute of France. Editor of Fergusson's *History of Architecture.* Author of *Architecture: East and West*; &c.	**Porch.**
R. R. M.	Robert Ranulf Marett, M.A. Reader in Social Anthropology, Oxford University, and Fellow and Tutor of Exeter College. Author of *The Threshold of Religion.*	**Prayer.**
R. S. C.	Robert Seymour Conway, M.A., D.Litt. Professor of Latin and Indo-European Philology in the University of Manchester. Formerly Professor of Latin in University College, Cardiff; and Fellow of Gonville and Caius College, Cambridge. Author of *The Italic Dialects.*	**Pompeii:** *Oscan Inscriptions*; **Praeneste** (*in part*); **Praetuttii.**
St C.	Viscount St Cyres. See the biographical article: Iddesleigh, 1st Earl of.	**Quesnel, Pasquier;** **Quietism.**
S. F. H.	Sidney Frederic Harmer, D.Sc., F.R.S., F.Z.S. Keeper of Zoology, Natural History Departments, British Museum. Fellow, formerly Tutor and Lecturer, King's College, Cambridge. Joint-editor of *The Cambridge Natural History.*	**Polyzoa;** **Pterobranchia.**
St G. M.	St George Jackson Mivart, M.D., F.R.S. See the biographical article: Mivart, St George Jackson.	**Rattlesnake** (*in part*).
S. R. G.	Samuel Rawson Gardiner, LL.D., D.C.L. See the biographical article: Gardiner, S. R.	**Prynne, William** (*in part*).

T. As.	Thomas Ashby, M.A., D.Litt. Director of British School of Archaeology at Rome. Formerly Scholar of Christ Church, Oxford. Craven Fellow, 1897. Conington Prizeman, 1906. Member of the Imperial German Archaeological Institute. Author of *The Classical Topography of the Roman Campagna.*	**Pompeii** (*in part*); **Pomposa; Pomptine Marshes;** **Popilia, Via; Portus;** **Postumia, Via;** **Praeneste** (*in part*); **Praenestina, Via;** **Puteoli; Pyrgi;** **Ravenna** (*in part*).
T. A. C.	Timothy Augustine Coghlan, I.S.O. Agent-General for New South Wales. Government Statistician, New South Wales, 1886–1905. Honorary Fellow of the Royal Statistical Society. Author of *Wealth and Progress of New South Wales*; *Statistical Account of Australia and New Zealand*; &c.	**Queensland:** *Geography and Statistics.*
T. A. I.	Thomas Allan Ingram, M.A., LL.D. Trinity College, Dublin.	**Post and Postal Service;** **Pound** (*in part*); **Praemunire.**
T. Ba.	Sir Thomas Barclay. Member of the Institute of International Law. Officer of the Legion of Honour. Author of *Problems of International Practice and Diplomacy*; &c. M.P. for Blackburn, 1910.	**Privateer;** **Prize:** *War*; **Raid; Rebellion.**
T. F. D.	Thomas F. Dale, M.A. Queen's College, Oxford. Steward and Member of the Council of the Polo and Riding Pony Society. Author of *Polo, Past and Present*; &c.	**Polo.**
T. H.	Thomas Hodgkin, D.C.L., Litt.D. See the biographical article: Hodgkin, Thomas.	**Ravenna** (*in part*).
T. H. H.*	Sir Thomas Hungerford Holdich, K.C.M.G., K.C.I.E., D.Sc. Superintendent, Frontier Surveys, India, 1892–1898. Gold Medallist, R.G.S., London, 1887. Author of *The Indian Borderland*; *The Countries of the King's Award*; *India*; *Tibet.*	**Quetta.**
T. L. H.	Sir Thomas Little Heath, K.C.B., Sc.D. Assistant-Secretary to the Treasury, London. Fellow of Trinity College, Cambridge. Author of *Apollonius of Perga*; *Treatise on Conic Sections*; *The Thirteen Books of Euclid's Elements*; &c.	**Porism.**
T. Se.	Thomas Seccombe, M.A. Balliol College, Oxford. Lecturer in History, East London and Birkbeck Colleges, University of London. Stanhope Prizeman, Oxford, 1887. Assistant Editor of *Dictionary of National Biography*, 1891–1901. Author of *The Age of Johnson*; &c.	**Reeve, Henry.**
T. Wo.	Thomas Woodhouse. Head of the Weaving and Textile Designing Department, Technical College, Dundee.	**Ramie.**
W. A. B. C.	Rev. William Augustus Brevoort Coolidge, M.A., F.R.G.S., Ph.D. Fellow of Magdalen College, Oxford. Professor of English History, St David's College, Lampeter, 1880–1881. Author of *Guide du Haut Dauphiné*; *The Range of the Todi*; *Guide to Grindelwald*; *Guide to Switzerland*; *The Alps in Nature and in History*; &c. Editor of the *Alpine Journal*, 1880–1881; &c.	**Ragatz; Rambert.**
W. A. L.	William Alexander Lindsay, K.C., M.A., J.P., D.L., F.S.A. Windsor Herald. Bencher of the Middle Temple. Peerage Counsel. Author of *The Royal Household*, 1837–1897; &c.	**Precedence** (*in part*).
W. A. P.	Walter Alison Phillips, M.A. Formerly Exhibitioner of Merton College and Senior Scholar of St John's College, Oxford. Author of *Modern Europe*; &c.	**Prince;** **Provost** (*in part*).
W. Ba.	Wilhelm Bacher, Ph.D. Professor at the Rabbinical Seminary, Budapest. Knight of the Iron Crown. Author of *Die Agada der Tannaiten*; &c.	**Rabbi.**
W. B. P.	William Barclay Parsons, C.E., LL.D. Formerly Chief Engineer, Rapid Transit Commission, New York. Advisory Engineer, Royal Commission on London Traffic. Author of *Track*; *Turnouts*; &c.	**Railways:** *Intra-Urban Railways.*
W. E. D.	William Ernest Dalby, M.A., M.Inst.C.E. Professor of Civil and Mechanical Engineering at the City and Guilds of London Institute Central Technical College, South Kensington. Formerly University Demonstrator in the Engineering Department, Cambridge. Author of *The Balancing of Engines*; *Valves and Valve-Gear Mechanism*; &c.	**Power Transmission:** *Introductory and Mechanical*; **Railways:** *Locomotive Power.*
W. F. C.	William Feilden Craies, M.A. Barrister-at-Law, Inner Temple. Lecturer on Criminal Law, King's College, London. Editor of Archbold's *Criminal Pleading* (23rd edition).	**Quarter Sessions, Court of;** **Recognizance.**
W. G.	William Garnett, M.A., D.C.L. Educational Adviser to the London County Council. Formerly Fellow and Lecturer of St John's College, Cambridge. Principal and Professor of Mathematics, Durham College of Science, Newcastle-on-Tyne. Author of *Elementary Dynamics*; &c.	**Polytechnic** (*in part*).
W. H. F.	Sir William Henry Flower, F.R.S. See the biographical article: Flower, Sir W. H.	**Porcupine** (*in part*); **Rabbit** (*in part*).
W. H. L.	William H. Lang, M.B., D.Sc. Barker Professor of Cryptogamic Botany, University of Manchester.	**Pteridophyta.**

W. L. G.	William Lawson Grant, M.A. Professor at Queen's University, Kingston, Canada. Formerly Beit Lecturer in Colonial History at Oxford University. Editor of *Acts of the Privy Council* (Colonial Series); *Canadian Constitutional Development* (in collaboration).	**Prince Edward Island;** **Quebec:** *Province* (*in part*); **Quebec:** *City*.
W. M.	William Minto, M.A., LL.D. See the biographical article: Minto, William.	**Pope, Alexander** (*in part*).
W. M. F. P.	William Matthew Flinders Petrie, F.R.S., D.C.L., Litt.D. See the biographical article: Petrie, W. M. F.	**Pyramid.**
W. O. B.	Ven. Winfrid Oldfield Burrows, M.A. Archdeacon of Birmingham. Student and Tutor of Christ Church, Oxford, 1884–1891. Principal of Leeds Clergy School, 1891–1900. Author of *The Mystery of the Cross*.	**Prayers for the Dead.**
W. R. M.	William Richard Morfill, M.A. (d. 1910). Formerly Professor of Russian and the other Slavonic Languages in the University of Oxford. Curator of the Taylorian Institution, Oxford. Author of *Russia*; *Slavonic Literature*; &c.	**Pushkin.**
W. R. S.	William Robertson Smith, LL.D. See the biographical article: Smith, William Robertson.	**Priest** (*in part*); **Prophet** (*in part*); **Psalms, Book of** (*in part*); **Rameses** (*in part*).
W. W. F.*	William Warde Fowler, M.A. Fellow of Lincoln College, Oxford. Sub-Rector, 1881–1904. Gifford Lecturer, Edinburgh University, 1908. Author of *The City-State of the Greeks and Romans*; *The Roman Festivals of the Republican Period*; &c.	**Pontifex.**
W. Y.	Rev. William Young. Minister, Higher Broughton Presbyterian Church, Manchester, 1877–1901, and Association Secretary for the Religious Tract Society in the North of England.	**Presbyterianism.**

PRINCIPAL UNSIGNED ARTICLES

Pollination.
Polygon.
Polyhedron.
Polynesia.
Pomegranate.
Pomerania.
Pontoon.
Poor Law.
Poplar.
Porto Rico.
Portuguese Guinea.
Potassium.
Potato.
Potentiometer.
Prerogative.
Press Laws.
Primrose.
Primulaceae.
Princeton University.
Principal and Agent.
Probate.
Procession.
Proctor.
Prohibition.
Protestant.
Prussia.
Prussic Acid.
Public Health.
Publishing.
Puffin.
Pugilism.
Pump.
Punjab.
Pyrazoles.
Pyrenees.
Pyridine.
Pyrones.
Quarantine.
Quinine.
Quinoline.
Quinones.
Radium.
Rainbow.
Ranunculaceae.
Rare Earths.
Raspberry.
Rationalism.
Ravenna, Exarchate of.
Real Property.
Red River.

THE
ENCYCLOPÆDIA BRITANNICA

VOLUME 22

POLL TO REEVES

POLL, strictly the head, in men or animals. Skeat connects the word with O. Swed. *kolle* (initial *p* and *k* being interchangeable) and considers a Celtic origin probable; cf. Irish *coll*, Welsh *col*, peak, summit. "Poll" is chiefly used in various senses derived from that of a unit in an enumeration of persons or things, *e.g.* poll-tax (*q.v.*), or "challenge to the polls" in the case of a jury (*q.v.*). The most familiar derivative uses are those connected with voting at parliamentary or other elections; thus "to poll" is to vote or to secure a number of votes, and "the poll," the voting, the number of votes cast, or the time during which voting takes place. The verb "to poll" also means to clip or shear the top of anything, hence "polled" of hornless cattle, or "deed-poll" (*i.e.* a deed with smooth or unindented edges, as distinguished from an "indenture"). A tree which has been "polled," or cut back close in order to induce it to make short bushy growth, is called a "pollard."

At the university of Cambridge, a "pass" degree is known as a "poll-degree." This is generally explained as from the Greek *οἱ πολλοί*, the many, the common people.

POLLACK (*Gadus pollachius*), a fish of the family *Gadidae*, abundant on rocky coasts of northern Europe, and extending as far south as the western parts of the Mediterranean, where, however, it is much scarcer and does not attain to the same size as in its real northern home. In Scotland and some parts of Ireland it is called lythe. It is distinguished from other species of the genus *Gadus* by its long pointed snout, which is twice as long as the eye, with projecting lower jaw, and without a barbel at the chin. The vent is below the anterior half of the first dorsal fin. A black spot above the base of the pectoral fin is another distinguishing mark. Although pollack are well-flavoured fish, and smaller individuals (from 12 to 16 in.) excellent eating, they do not form any considerable article of trade, and are not preserved, the majority being consumed by the captors. Specimens of 12 ℔ are common, but the species is said to attain occasionally as much as 24 ℔ in weight. (See also COALFISH.)

POLLAIUOLO, the popular name of the brothers Antonio and Piero di Jacobo Benci, Florentines who contributed much to Italian art in the 15th century. They were called Pollaiuolo because their father was a poulterer. The nickname was also extended to Simone, the nephew of Antonio.

ANTONIO (1429–1498) distinguished himself as a sculptor, jeweller, painter and engraver, and did valuable service in perfecting the art of enamelling. His painting exhibits an excess of brutality, of which the characteristics can be studied in the "Saint Sebastian," painted in 1475, and now in the National Gallery, London. A "St Christopher and the Infant Christ" is in the Metropolitan Museum, New York. But it was as a sculptor and metal-worker that he achieved his greatest successes. The exact ascription of his works is doubtful, as his brother Piero did much in collaboration with him. The museum of Florence contains the bronze group "Hercules strangling Cacus" and the terra-cotta bust "The Young Warrior"; and in the South Kensington Museum, London, is a bas-relief representing a contest between naked men. In 1489 Antonio took up his residence in Rome, where he executed the tomb of Sixtus IV. (1493), a composition in which he again manifested the quality of exaggeration in the anatomical features of the figures. In 1496 he went to Florence in order to put the finishing touches to the work already begun in the sacristy of Santo Spirito. He died in 1498, having just finished his mausoleum of Innocent VIII., and was buried in the church of San Pietro in Vincula, where a monument was raised to him near that of his brother.

PIERO (1443–1496) was a painter, and his principal works were his "Coronation of the Virgin," an altar-piece painted in 1483, in the choir of the cathedral at San Gimignano; his "Three Saints," an altar-piece, and "Prudence" are both at the Uffizi Gallery.

SIMONE (1457–1508), nephew of Antonio Pollaiuolo, a celebrated architect, was born in Florence and went to Rome in 1484; there he entered his uncle's studio and studied architecture. On his return to Florence he was entrusted with the completion of the Strozzi palace begun by Benedetto de Maiano, and the cornice on the façade has earned him lasting fame. His highly coloured accounts of Rome earned for him the nickname of *il Cronaca* (chronicler). About 1498 he built the church of San Francesco at Monte and the vestibule of the sacristy of Santo Spirito. In collaboration with Guiliano da Sangallo he designed the great hall in the Palazzo Vecchio. He was a close friend and adherent of Savonarola.

See also Maud Cruttwell, *Antonio Pollaiuolo* (1907).

POLLAN (*Coregonus pollan*), the name given to a species of the Salmonoid genus *Coregonus* (whitefish) which has been found in the large and deep loughs of Ireland only. A full account of the fish by its first describer, W. Thompson, may be found in his *Natural History of Ireland*, iv. 168.

POLLARD, EDWARD ALBERT (1828–1872), American journalist, was born in Nelson county, Virginia, on the 27th of February 1828. He graduated at the university of Virginia in 1849, studied law at the College of William and Mary, and in Baltimore (where he was admitted to the bar), and was engaged in newspaper work in California until 1855. In 1857–1861 he was clerk of the judiciary committee of the National House of Representatives. By 1859 he had become an outspoken Secessionist, and during the Civil War he was one of the principal editors of the Richmond *Examiner*, which supported the Confederacy but was hostile to President Jefferson Davis. In 1864 Pollard sailed for England, but the vessel on which he sailed was captured as a blockade runner, and he was confined in Fort Warren in Boston Harbour from the 29th of May until the 12th of August, when he was paroled. In December he was placed in close confinement at Fort Monroe by order of Secretary Stanton, but was soon again paroled by General B. F. Butler, and in January proceeded to Richmond to be exchanged there for Albert D. Richardson (1833–1869), a well-known correspondent of the New York *Tribune*, who, however, had escaped before Pollard arrived. In 1867–1869 Pollard edited a weekly paper at Richmond, and he conducted the *Political Pamphlet* there during the presidential campaign of 1868.

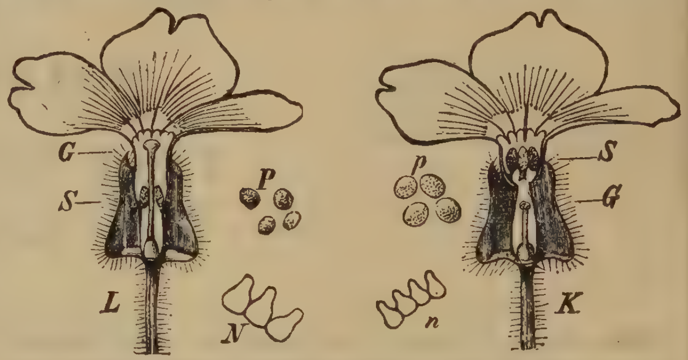
His publications include *Black Diamonds Gathered in the Darkey Homes of the South* (1859), in which he advocated a reopening of the slave trade; *The Southern History of the War* (3 vols.: *First Year of the War*, with B. M. DeWitt, 1862; *Second Year of the War*, 1864; *Third Year of the War*, 1864); *Observations in the North: Eight Months in Prison and on Parole* (1865); *The Lost Cause* (1866); *Lee and His Lieutenants* (1867); *The Lost Cause Regained* (1868), a southern view of reconstruction urging the necessity of white supremacy; *The Life of Jefferson Davis* (1869), an arraignment of the Confederate president; and *The Virginia Tourist* (1870).

POLLENTIA (mod. *Pollenzo*), an ancient town of Liguria, Italy, 10 m. to the north of Augusta Bagiennorum, on the left bank of the Tanarus (mod. Tanaro). Its position on the road from Augusta Taurinorum to the coast at Vada Sabatia, at the point of divergence of a road to Hasta (Asti) gave it military importance. Decimus Brutus managed to occupy it an hour before Mark Antony in 43 B.C.; and it was here that Stilicho on the 29th of March 403 fought the battle with Alaric which though undecided led the Goths to evacuate Italy. The place was famous for its brown wool, and for its pottery. Considerable remains of ancient buildings, an amphitheatre, a theatre and a temple still exist. The so-called temple of Diana is more probably a tomb.

See G. Franchi-Pont in *Atti dell' accademia di Tornio* (1805–1808), p. 321 sqq.

POLLINATION, in botany, the transference of the pollen from the stamen to the receptive surface, or stigma, of the pistil of a flower. The great variety in the form, colour and scent of flowers (see FLOWER) is intimately associated with pollination which is effected by aid of wind, insects and other agencies. Pollen may be transferred to the stigma of the same flower—self-pollination (or *autogamy*), or to the stigma of another flower on the same plant or another plant of the same species—cross-pollination (or *allogamy*). Effective pollination may also occur between flowers of different species, or occasionally, as in the case of several orchids, of different genera—this is known as hybridization.

The method of pollination is to some extent governed by the distribution of the stamens and pistil. In the case of unisexual flowers, whether monoecious, that is, with staminate and pistillate flowers on one and the same plant, such as many of our native trees—oak, beech, birch, alder, &c., or dioecious with staminate and pistillate flowers on different plants, as in willows and poplars, cross pollination only is possible. In bisexual or hermaphrodite flowers, that is, those in which both stamens and pistil are present, though self-pollination might seem the obvious course, this is often prevented or hindered by various arrangements which favour cross-pollination. Thus the anthers and stigmas in any given flower are often mature at different times; this condition, which is known as dichogamy and was first pointed out by Sprengel, may be so well marked that the stigma has ceased to be receptive before the anthers open, or the anthers have withered before the stigma becomes receptive, when cross-pollination only is possible, or the stages of maturity in the two organs are not so distinct, when self-pollination becomes possible later on. The flower is termed *proterandrous* or *proterogynous* according as anthers or stigmas mature first. The term *homogamy* is applied to the simultaneous maturity of stigma and anthers. Spontaneous self-pollination is rendered impossible in some homogamous flowers in consequence of the relative position of the anthers and stigma—this condition has been termed *herkogamy*. Flowers in which the relative position of the organs allows of spontaneous self-pollination may be all alike as regards length of style and stamens (*homomorphy* or *homostyly*), or differ in this respect (*heteromorphy*) the styles and stamens being of different lengths in different flowers (*heterostyly*) or the stamens only are of different lengths (*heteranthery*). Flowers which are closed at the time of maturity of anthers and stigmas are termed cleistogamous.



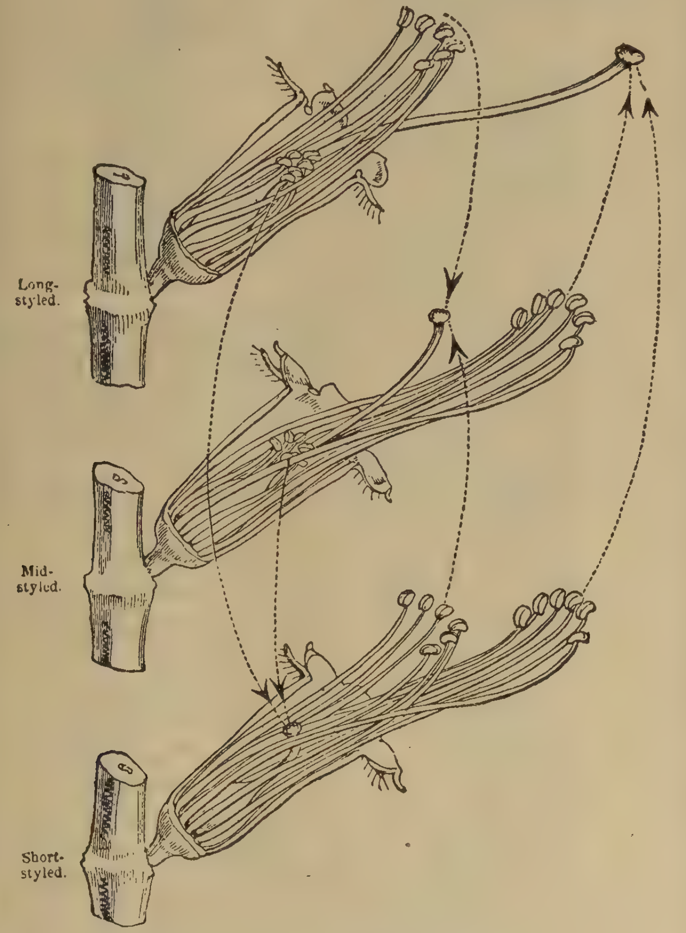
(From Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.)

FIG. 1.—Long-styled, L, and short-styled, K, flowers of *Primula sinensis*.

G, Level of stigma; *S*, level of anthers; *P*, *N*, pollen grains and stigmatic papillae of long-styled form; *p*, *n*, ditto of short-styled form.

Self-pollination is effected in very various ways. In the simplest case the anthers are close to the stigmas, covering these with pollen when they open; this occurs in a number of small annual plants, also in *Narcissus*, *Crocus*, &c. In snowdrop and other pendulous flowers the anthers form a cone around the style and the pollen falls on to the underlying stigmas, or in erect flowers the pollen may fall on to the stigmas which lie directly beneath the opening anthers (*e.g. Narthecium*). In very many cases the pollen is carried to the stigma by elongation, curvature or some other movement of the filament, the style or stigma, or corolla or some other part of the flower, or by correlated movements of two or more parts. For instance, in many flowers the filaments are at first directed outwards so that self-pollination is not possible, but later incline towards the stigmas and pollinate them (*e.g.* numerous Saxifragaceae, Cruciferae and others), or the style, which first projects beyond the anthers, shortens later on so that the anthers come into contact with the stigmas (*e.g.* species of Cactaceae), or the style bends so that the stigma is brought within the range of the pollen (*e.g.* species of *Oenothera*, *Epilobium*, most Malvaceae, &c.). In *Mirabilis Jalapa* and others the filaments and style finally become intertwined, so that pollen is brought in contact with the stigma. Self-pollination frequently becomes possible towards the end of the life of a flower which during its earlier stages has been capable only of cross-pollination. This is associated with the fact, so ably demonstrated by Darwin, that, at any rate in a large number of cases, cross-pollination yields better results, as measured by the number of seeds produced and the strength of the offspring, than self-pollination; the latter is, however, preferable to absence of pollination. In many cases pollen has no effect on the stigma of the same flower, the plants are self-sterile, in other cases external pollen is more effective (*pre-potent*) than pollen from the same flower; but in a very large number of cases experiment has shown that there is little or no difference between the effects of external pollen and that from the same flower.

Cross-pollination may occur between two flowers on the same plant (*geitonogamy*) or between flowers on distinct plants (*xenogamy*). The former, which is a somewhat less favourable method than the latter, is effected by air-currents, insect agency, the actual contact between stigmas and anthers in neighbouring flowers, where, as in the family Compositae, flowers are closely crowded, or by the fall of the pollen from a higher on to the stigmas of a lower flower. Anton Kerner has shown that crowded inflorescences such as those of Compositae and Umbelliferae are especially adapted for geitonogamy. Xenogamy is of course the only possible method in diclinous plants; it is also the usual method in monoclinous plants, owing to the fact that stamens and carpels often mature at different times (*dichogamy*), the plants being proterandrous or proterogynous. Even in homogamous flowers cross-pollination is in a large proportion of cases the effective method, at any rate at first, owing to the relative position of anther and stigma or the fact that the plant is self-sterile.



(From Darwin's *Different Forms of Flowers* by permission.)

FIG. 2.—Diagram of the flowers of the three forms of *Lythrum salicaria* in their natural position, with the petals and calyx removed on the near side. (× 6 times.)

The dotted lines with the arrow show the directions in which pollen must be carried to each stigma to ensure full fertility.

The subject of heterostyly was investigated by Darwin (see his *Forms of Flowers*) and later by Hildebrand. In the case of a dimorphic flower, such as *Primula*, four modes of pollination are possible, two distinguished by Darwin as legitimate, between anthers and stigmas on corresponding levels, and two so-called illegitimate unions, between anthers and stigmas at different levels (cf. fig. 1). In a trimorphic flower such as *Lythrum salicaria* there are six possible legitimate unions and twelve illegitimate (see fig. 2). Experiment showed that legitimate unions yield a larger quantity of seed than illegitimate.

Many plants produce, in addition to ordinary open flowers, so-called cleistogamous flowers, which remain permanently closed but which notwithstanding produce fruit; in these the corolla is inconspicuous or absent and the pollen grows from the anther on to the stigma of the same flower. Species of *Viola* (see fig. 3), *Oxalis acetosella* (wood sorrel) and *Lamium amplexicaule* are commonly occurring instances. The cleistogamous flowers are developed before or after the normal open flowers at seasons less favourable for cross-pollination. In some cases flowers, which open under normal circumstances, remain closed owing to unfavourable circumstances, and self-pollination occurs as in a typical cleistogamous flower—these have been distinguished as pseudo-cleistogamous. Instances occur in water plants, where flowers are unable to reach the surface (*e.g. Alisma natans*, water buttercup, &c.) or where flowers remain closed in dull or cold weather.

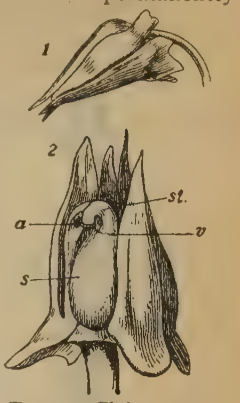


FIG. 3.—Cleistogamous flower of *Viola sylvatica*.
1, flower × 4.
2, flower more highly magnified and cut open. *a*, anther; *s*, pistil; *st*, style; *v*, stigmatic surface.

Systems of classification of flowers according to the agency by which pollination is effected have been proposed by Delpino, H. Müller and other workers on the subject. Knuth suggests the following, which is a modification of the systems proposed by Delpino and Müller.

A. *Water-pollinated plants, Hydrophilae.* A small group which is subdivided thus:—

- *a. Pollinated under the water; e.g. Najas* where the pollen grains are rather heavier than water, and sinking down are caught by the stigmas of the extremely simple female flowers.
- *b. Pollination on the surface*, a more frequent occurrence than (*a*). In these the pollen floats on the surface and reaches the stigmas of the female flowers as in *Callitriche, Ruppia, Zostera, Elodea.* In *Vallisneria* (fig. 4) the male flowers become detached and float on the surface of the water; the anthers are thus brought in contact with the stigmas of the female flowers.

B. *Wind-pollinated plants, Anemophilae.*—In these the pollen grains are smooth and light so as to be easily blown about, and are produced in great quantity; the stigmas are brush-like or feathery, and usually long and protruding so as readily to catch the pollen. As no means of attraction are required the flowers are inconspicuous and without scent or nectar. The male inflorescence is often a pendulous catkin, as in hazel and many native English trees (fig. 5); or the anthers are loosely fixed on long thread-like filaments as in grasses (fig. 6).

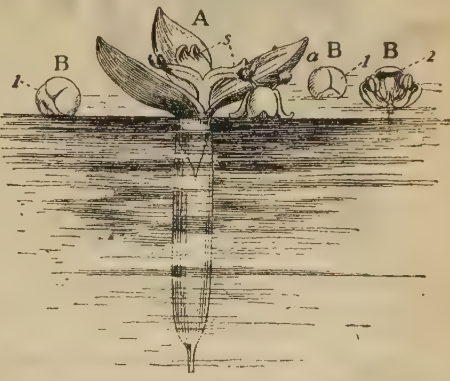


FIG. 4.—*Vallisneria spiralis.*

A, female flower; *s*, stigmas.
B, male flowers; 1 before; 2, after spreading of the petals. A male flower has floated alongside a female and one of its anthers, which have opened to set free the pollen, is in contact with a stigma. *a*, anther.

C. *Animal-pollinated plants, Zoidiophilae*, are subdivided according to the kind of animal by agency of which pollination is effected, thus:—

- *a. Bat-pollinated, Chiropterophilae.*—A *Freycinetia*, native of Java, and a species of *Bauhinia* in Trinidad are visited by bats which transfer the pollen.

b. Bird-pollinated, Ornithophilae.—Humming-birds and honey-suckers are agents of pollination in certain tropical plants; they visit the generally large and brightly-coloured flowers either for the honey which is secreted in considerable quantity or for the insects which have been attracted by the honey (fig. 7).

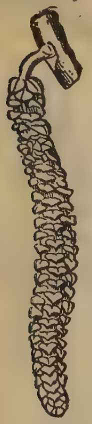


FIG. 5.—Catkin of Male Flowers of Hazel.

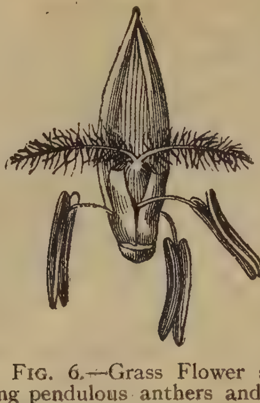
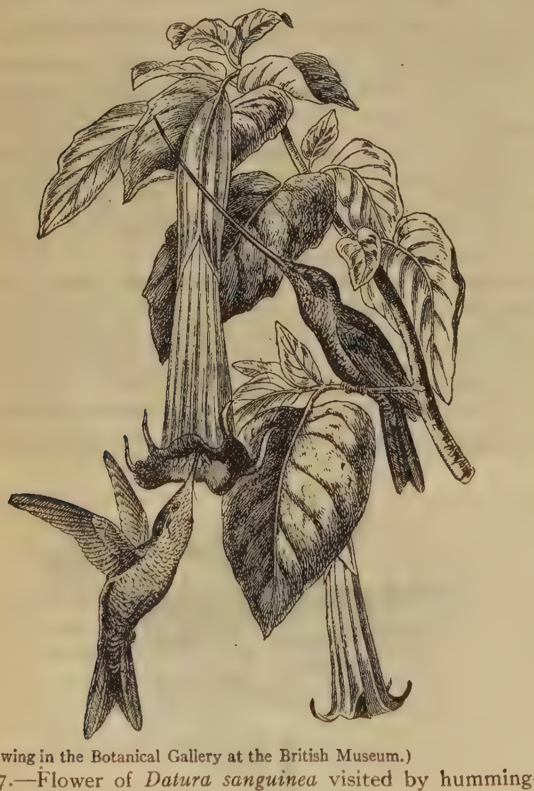


FIG. 6.—Grass Flower showing pendulous anthers and protruding hairy stigmas.

c. Snail or slug-pollinated flowers, Malacophilae.—In small flowers which are crowded at the same level or in flat flowers in which the stigmas and anthers project but little, slugs or snails creeping over their surface may transfer to the stigma the pollen which clings to the slimy foot. Such a transfer has been described in various Aroids, *Rohdea japonica* (Liliaceae), and other plants.



(From a drawing in the Botanical Gallery at the British Museum.)

FIG. 7.—Flower of *Datura sanguinea* visited by humming-bird *Docimastes ensiferus*.

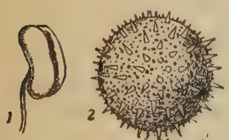


FIG. 8.—1, anther; 2, pollen grain of Hollyhock (*Althaea rosea*) enlarged. The pollen grain bears numerous spines, the dark spots indicate thin places in the outer wall.

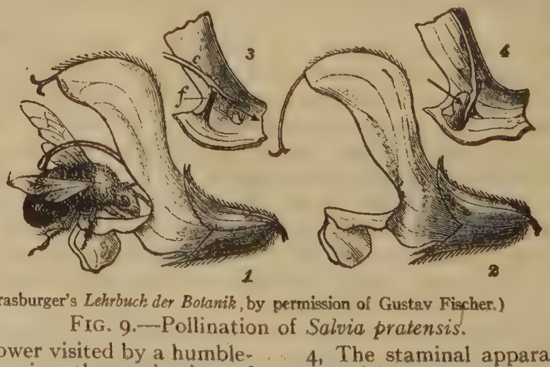
d. Insect-pollinated, Entomophilae, a very large class characterized by sticky pollen grains, the surface of which bears spines, warts or other projections (fig. 8) which facilitate adhesion to some part of the insect's body, and a relatively small stigma with a sticky surface. The flowers have an attractive floral envelope, are scented and often contain honey or a large amount of pollen; by these means the insect is enticed to visit it. The form, colour and scent of the flower vary widely, according to the class of insect whose aid is sought, and there are also numerous devices for protecting the pollen and nectar from rain and dew or from the visits of those insects which would not serve the purpose of pollen-transference (unbidden guests).[1] The following subdivisions have been suggested

A. *Pollen Flowers.*—These offer only pollen to their visitors, as species of anemone, poppy, rose, tulip, &c. They are simple in structure and regular in form, and the generally abundant pollen is usually freely exposed.

B. *Nectar Flowers.*—These contain nectar and include the following groups:—

1. *Flowers with exposed nectar*, readily visible and accessible to all visitors. These are very simple, open and generally regular flowers, white, greenish-yellow or yellow in colour and are chiefly visited by insects with a short proboscis, such as short-tongued wasps and flies, also beetles and more rarely bees. Examples are Umbelliferae as a family, saxifrages, holly, *Acer*, *Rhamnus*, *Euonymus*, *Euphorbia*, &c.
2. *Flowers with nectar partly concealed* and visible only in bright sunshine. The generally regular flowers are completely open only in bright sunshine, closing up into cups at other times. Such are most Cruciferae, buttercups, king-cup (*Caltha*), *Potentilla*. White and yellow colours predominate and insects with a proboscis of medium length are the common pollinating agents, such as short-tongued bees.
3. *Flowers with nectar concealed* by pouches, hairs, &c. Regular flowers predominate, *e.g. Geranium*, *Cardamine pratensis*, mallows, *Rubus*, *Oxalis*, *Epilobium*, &c., but many species show more or less well-marked median symmetry (zygomorphism) as *Euphrasia*, *Orchis*, thyme, &c., and red, blue and violet are the usual colours. Long-tongued insects such as the honey-bee are the most frequent visitors.
4. *Social flowers*, whose nectar is concealed as in (3), but the flowers are grouped in heads which render them strikingly conspicuous, and several flowers can be simultaneously pollinated. Such are Compositae as a class, also *Scabiosa*, *Armeria* (sea-pink) and others.
5. *Hymenopterid flowers*, which fall into the following groups: Bee-flowers proper, humble-bee flowers requiring a longer proboscis to reach the nectar, wasp-flowers such as fig-wort (*Scrophularia nodosa*) and ichneumon flowers such as tway-blade (*Listera ovata*).

   The shapes and colours are extremely varied; bilaterally symmetrical forms are most frequent with red, blue or violet colours. Such are Papilionaceous flowers, Violaceae, many Labiatae, Scrophulariaceae and others. Many are highly specialized so that pollination can be effected by a few species only. Examples of more special mechanisms are illustrated by *Salvia* (fig. 9). The long connective of the single stamen is hinged to the short filament and has a shorter arm ending in a blunt process and a longer arm bearing a half-anther. A large bee in probing for honey comes in contact with the end of the short arm of the lever and causes the longer arm to descend and the pollen is deposited on the back of the insect (fig. 9, 1). In a later stage (fig. 9, 2) the style elongates and the forked stigma occupies the same position as the anther in fig. 9, 1.



(From Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.)

FIG. 9.—Pollination of *Salvia pratensis*.

1, Flower visited by a humble-bee, showing the projection of the curved connective bearing the anther from the helmet-shaped upper lip and the deposition of the pollen on the back of the humble-bee.

2, Older flower, with connective drawn back, and elongated style.

4, The staminal apparatus at rest, with connective enclosed within the upper lip.

3, The same, when disturbed by the entrance of the proboscis of the bee in the direction of the arrow; *f*, filament; *c*, connective; *s*, the obstructing half of the anther.

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[1] See A. Kerner, *Plants and their Unbidden Guests*.

In Broom there is an explosive machanism; the pressure of the insect visitor on the keel of the corolla causes a sudden release of the stamens and the scattering of a cloud of pollen over its body.

6. *Lepidopterid flowers,* visited chiefly by Lepidoptera, which are able to reach the nectar concealed in deep, narrow tubes or spurs by means of their long slender proboscis. Such are: (*a*) Butterfly-flowers, usually red in colour, as *Dianthus carthusianorum*; (*b*) Moth-flowers, white or whitish, as honeysuckle (*Lonicera periclymenum*).

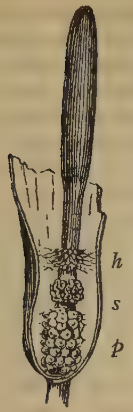


Fig. 10.—Spadix of *Arum maculatum* from which the greater part of the spathe has been cut away.

p, Pistillate, *s*, staminate flowers; *h*, sterile flowers forming a circlet of stiff hairs closing the mouth of the chamber formed by the lower part of the spathe.

7. *Fly flowers,* chiefly visited by Diptera, and including very different types:—

a. Nauseous flowers, dull and yellowish and dark purple in colour and often spotted, with a smell attractive to carrion flies and dung flies, *e.g.* species of *Saxifraga*.

b. Pitfall flowers such as *Asarum, Aristolochia* and *Arum maculatum,* when the insect is caught and detained until pollination is effected (fig. 10).

c. Pinch-trap flowers, as in the family Asclepiadaceae, where the proboscis, claw or bristle of the insect is caught in the clip to which the pairs of pollinia are attached. Bees, wasps and larger insects serve as pollinating agents

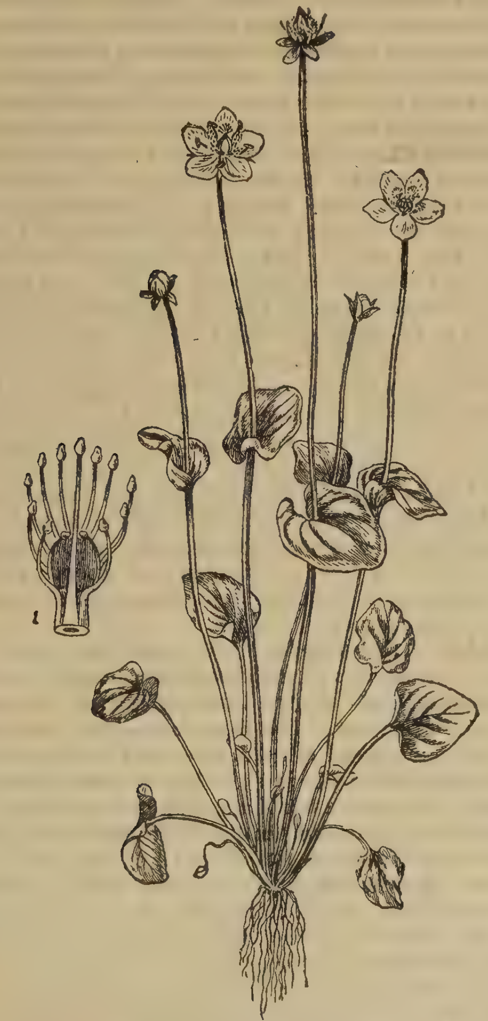


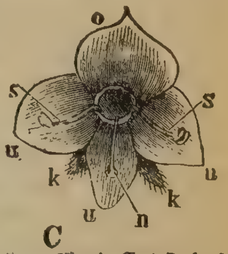
Fig. 11.—Grass of Parnassus (*Parnassia palustris*).

l, One of the scales which form the coronet in the flower, enlarged.

d. Deceptive flowers such as *Parnassia,* where the conspicuous coronet of glistening yellow balls suggests a plentiful supply of nectar drops (fig. 11).

e. Hoverfly flowers, small flowers which are beautifully coloured with radiating streaks pointing to a sharply-defined centre in which is the nectar, as in *Veronica chamaedrys* (fig. 12).

Literature.—Joseph Gottlieb Kölreuter [1] (d. 1806) was the first to study the pollination of flowers and to draw attention to the necessity of insect visits in many cases; he gave a clear account of cross-pollination by insect aid. He was followed by Christian Konrad Sprengel, whose work *Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen* (Berlin, 1793), contains a description of floral adaptations to insect visits in nearly 500 species of plants. Sprengel came very near to appreciating the meaning of cross-pollination in the life of plants when he states that "it seems that Nature is unwilling that any flower should be fertilized by its own pollen." In 1799 an Englishman, Thomas Andrew Knight, after experiments on the cross-fertilization of cultivated plants, formulated the conclusion that no plant fertilizes itself through many generations. Sprengel's work, which had been almost forgotten, was taken up again by Charles Darwin, who concluded that no organic being can fertilize itself through an unlimited number of generations; but a cross with other individuals is occasionally—perhaps at very long intervals—indispensable. Darwin's works on dimorphic flowers and the fertilization of orchids gave powerful support to this statement. The study of the fertilization, or as it is now generally called "pollination," of flowers, was continued by Darwin and taken up by other workers, notably Friedrich Hildebrand, Federico Delpino and the brothers Fritz and Hermann Müller. Hermann Müller's work on *The Fertilization of Flowers by Insects and their Reciprocal Adaptations* (1873), followed by subsequent works on the same lines, brought together a great number of observations on floral mechanisms and their relation to insect-visits. Müller also suggested a modification of the Knight-Darwin law, which had left unexplained the numerous instances of continued successful self-pollination, and restated it on these terms: "Whenever offspring resulting from crossing comes into serious conflict with offspring resulting from self-fertilization, the former is victorious. Only where there is no such struggle for existence does self-fertilization often prove satisfactory for many generations." An increasing number of workers in this field of plant biology in England, on the Continent and in America has produced a great mass of observations, which have recently been brought together in Dr Paul Knuth's classic work, *Handbook of Flower Pollination,* an English translation of which has been published (1908) by the Clarendon Press.



(From Vines's *Text Book of Botany*, by permission.)

Fig. 12.—Flower of Veronica.

k, Calyx.
u, *u*, *u*, The three lobes of the lower lip of the rotate corolla.
o, The upper lip.
s, *s*, The two stamens.
n, The stigma.

POLLIO, GAIUS ASINIUS (76 B.C.–A.D. 5; according to some, 75 B.C.–A.D. 4), Roman orator, poet and historian. In 54 he impeached unsuccessfully C. Porcius Cato, who in his tribunate (56) had acted as the tool of the triumvirs. In the civil war between Caesar and Pompey Pollio sided with Caesar, was present at the battle of Pharsalus (48), and commanded against Sextus Pompeius in Spain, where he was at the time of Caesar's assassination. He subsequently threw in his lot with M. Antonius. In the division of the provinces, Gaul fell to Antony, who entrusted Pollio with the administration of Gallia Transpadana. In superintending the distribution of the Mantuan territory amongst the veterans, he used his influence to save from confiscation the property of the poet Virgil. In 40 he helped to arrange the peace of Brundisium by which Octavian (Augustus) and Antonius were for a time reconciled. In the same year Pollio entered upon his consulship, which had been promised him in 43. It was at this time that Virgil addressed the famous fourth eclogue to him. Next year Pollio conducted a successful campaign against the Parthini, an Illyrian people who adhered to Brutus, and celebrated a triumph on the 25th of October. The eighth eclogue of Virgil was addressed to Pollio while engaged in this campaign. From the spoils of the war he constructed the first public library at Rome, in the Atrium Libertatis, also erected by him (Pliny, *Nat. hist.* xxxv. 10), which he adorned with statues of the most celebrated authors, both Greek and Roman. Thenceforward he withdrew from active life and devoted himself to literature. He seems to have maintained to a certain degree an attitude of independence, if not of opposition, towards Augustus. He died in his villa at Tusculum, regretted and esteemed by all.

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[1] *Vorläufige Nachricht von einigen das Geschlecht der Pflanzen betreffenden Versuchen und Beobachtungen*, 3, 4, 6 (Leipzig, 1761).

Pollio was a distinguished orator; his speeches showed ingenuity and care, but were marred by an affected archaism (Quintilian, *Inst.* x. 1, 113; Seneca, *Ep.* 100). He wrote tragedies also, which Virgil (*Ecl.* viii. 10) declared to be worthy of Sophocles, and a prose history of the civil wars of his time from the first triumvirate (60) down to the death of Cicero (43) or later. This history, in the composition of which Pollio received assistance from the grammarian Ateius Praetextatus, was used as an authority by Plutarch and Appian (Horace, *Odes*, ii. 1; Tacitus, *Annals*, iv. 34). As a literary critic Pollio was very severe. He censured Sallust (Suetonius, *Gram.* 10) and Cicero (Quintilian, *Inst.* xii. 1, 22) and professed to detect in Livy's style certain provincialisms of his native Padua (Quintilian, i. 5, 56, viii. 1, 3); he attacked the *Commentaries* of Julius Caesar, accusing their author of carelessness and credulity, if not of deliberate falsification (Suet. *Caesar*, 56). Pollio was the first Roman author who recited his writings to an audience of his friends, a practice which afterwards became common at Rome. The theory that Pollio was the author of the *Bellum africanum*, one of the supplements to Caesar's *Commentarii*, has met with little support. All his writings are lost except a few fragments of his speeches (H. Meyer, *Orat. rom. frag.*, 1842), and three letters addressed to Cicero (*Ad. Fam.* x. 31–33).

See Plutarch, *Caesar*, *Pompey*; Vell. Pat. ii. 36, 63, 73, 76; Florus iv. 12, 11; Dio Cassius xlv. 10, xlviii. 15; Appian, *Bell. civ.*; V. Gardthausen, *Augustus und seine Zeit* (1891), i.; P. Groebe, in Pauly-Wissowa's *Realencyclopädie* (1896), ii. pt. 2; Teuffel-Schwaben, *Hist. of Roman Literature* (Eng. trans.), § 221; M. Schanz, *Geschichte der römischen Litteratur*, pt. 2, p. 20 (2nd ed., 1899); Cicero, *Letters*, ed. Tyrrell and Purser, vi. introd. p. 80.

PÖLLNITZ, KARL LUDWIG, Freiherr von (1692–1775), German adventurer and writer, was born at Issum on the 25th of February 1692. His father, Wilhelm Ludwig von Pöllnitz (d. 1693), was in the military service of the elector of Brandenburg, and much of his son's youth was passed at the electoral court in Berlin. He was a man of restless and adventurous disposition, unscrupulous even for the age in which he lived, visited many of the European courts, and served as a soldier in Austria, Italy and Spain. Returning to Berlin in 1735 he obtained a position in the household of King Frederick William I. and afterwards in that of Frederick the Great, with whom he appears to have been a great favourite; and he died in Berlin on the 23rd of June 1775.

Pöllnitz's *Mémoires* (Liége, 1734), which were translated into German (Frankfort, 1735), give interesting glimpses of his life and the people whom he met, but they are very untrustworthy. He also wrote *Nouveaux mémoires* (Amsterdam, 1737); *État abrégé de la cour de Saxe sous le règne d'Auguste III.* (Frankfort, 1734; Ger. trans., Breslau, 1736); and *Mémoires pour servir à l'histoire des quatres derniers souverains de la maison de Brandenbourg*, published by F. L. Brunn (Berlin, 1791; Ger. trans., Berlin, 1791). Perhaps his most popular works are *La Saxe galante* (Amsterdam, 1734), an account of the private life of Augustus the Strong, elector of Saxony and king of Poland; and *Histoire secrète de la duchesse d'Hanovre, épouse de Georges I.* (London, 1732). There is an English translation of the *Mémoires* (London, 1738–1739). See P. von Pöllnitz, *Stammtafeln der Familie von Pöllnitz* (Berlin, 1894); and J. G. Droysen, *Geschichte der preussischen Politik*, pt. iv. (Leipzig, 1870).

POLLOCK, the name of an English family which has contributed many important members to the legal and other professions. David Pollock, who was the son of a Scotsman and built up a prosperous business in London as a saddler, had three distinguished sons: Sir David Pollock (1780–1847), chief justice of Bombay; Sir Jonathan Frederick Pollock, Bart. (1783–1870), chief baron of the exchequer; and Sir George Pollock, Bart. (1786–1872), field-marshal. Of these the more famous were the two last. Field Marshal Sir George Pollock, who rendered valuable military service in India, and especially in Afghanistan in 1841–1843, ended his days as constable of the Tower of London, and was buried in Westminster Abbey; his baronetcy, created in 1872, descended to his son Frederick (d. 1874), who assumed the name of Montagu-Pollock, and so to his heirs. Chief Baron Sir J. Frederick Pollock, who had been senior wrangler at Cambridge, and became F.R.S. in 1816, was raised to the bench in 1844, and created a baronet in 1866. He was twice married and had eight sons and ten daughters, his numerous descendants being prominent in many fields. The chief baron's eldest son, Sir William Frederick Pollock, 2nd Bart. (1815–1888), became a master of the Supreme Court (1846) and queen's remembrancer (1874); his eldest son, Sir Frederick Pollock, 3rd Bart. (b. 1845), being the well-known jurist and legal historian, fellow of Trinity College, Cambridge, and Corpus professor of jurisprudence at Oxford (1883–1903), and the second son, Walter Herries Pollock (b. 1850), being a well-known author and editor of the *Saturday Review* from 1883 to 1894. The chief baron's third son, George Frederick Pollock (b. 1821), became a master of the Supreme Court in 1851, and succeeded his brother as queen's (king's) remembrancer in 1886; among his sons were Dr W. Rivers Pollock (1859–1909), Ernest Murry Pollock, K.C. (b. 1861), and the Rt. Rev. Bertram Pollock (b. 1863), bishop of Norwich, and previously head master of Wellington College from 1893 till 1910. The chief baron's fourth son, Sir Charles Edward Pollock (1823–1897), had a successful career at the bar and in 1873 became a judge, being the last survivor of the old barons of the exchequer; he was thrice married and had issue by each wife.

POLLOK, ROBERT (1798–1827), Scottish poet, son of a small farmer, was born at North Moorhouse, Renfrewshire, on the 19th of October 1798. He was trained as a cabinet-maker and afterwards worked on his father's farm, but, having prepared himself for the university, he took his degree at Glasgow, and studied for the ministry of the United Secession Church. He published *Tales of the Covenanters* while he was a divinity student, and planned and completed a strongly Calvinistic poem on the spiritual life and destiny of man. This was the *Course of Time* (1827), which passed through many editions and became a favourite in serious households in Scotland. It was written in blank verse, in ten books, in the poetic diction of the 18th century, but with abundance of enthusiasm, impassioned elevation of feeling and copious force of words and images. The poem at once became popular, but within six months of its publication, on the 18th of September 1827, its author died of consumption.

POLLOKSHAWS, a police burgh and burgh of barony of Renfrewshire, Scotland, on the White Cart, now virtually a suburb of Glasgow, with which it is connected by electric tramway and the Glasgow & South-Western and Caledonian railways. Pop. (1901), 11,183. It is named from the *shaws* or woods (and is locally styled "the Shaws") and the lands of Pollok, which have been held by the Maxwells since the 13th century. The family is now called Stirling-Maxwell, the estate and baronetcy having devolved in 1865 upon Sir William Stirling of Keir, who then assumed the surname of Maxwell. Pollok House adjoins the town on the west. The staple industries are cotton-spinning and weaving, silk-weaving, dyeing, bleaching, calico-printing and the manufacture of chenille and tapestry, besides paper mills, potteries and large engineering works. Pollokshaws was created a burgh of barony in 1813, and is governed by a council and provost. About 2 m. southwest is the thriving town of Thornliebank (pop. 2452), which owes its existence to the cotton-works established towards the end of the 18th century.

POLL-TAX, a tax levied on the individual, and not on property or on articles of merchandise, so-called from the old English poll, a head. Raised thus *per capita*, it is sometimes called a capitation tax. The most famous poll-tax in English history is the one levied in 1380, which led to the revolt of the peasants under Wat Tyler in 1381, but the first instance of the kind was in 1377, when a tax of a groat a head was voted by both clergy and laity. In 1379 the tax was again levied, but on a graduated scale. John of Gaunt, duke of Lancaster, paid ten marks, and the scale descended from him to the peasants, who paid one groat each, every person over sixteen years of age being liable. In 1380 the tax was also graduated, but less steeply. For some years after the rising of 1381 money was only raised in this way from aliens, but in 1513 a general poll tax was imposed. This, however, only produced about £50,000, instead of £160,000 as was expected, but a poll-tax levied in 1641 resulted in a revenue of about £400,600. During the reign of

Charles II. money was obtained in this way on several occasions, although in 1676–1677 especially there was a good deal of resentment against the tax. For some years after 1688 poll-taxes were a favourite means of raising money for the prosecution of the war with France. Sometimes a single payment was asked for the year; at other times quarterly payments were required. The poll-tax of 1697 included a weekly tax of one penny from all persons not receiving alms. In 1698 a quarterly poll-tax produced £321,397. Nothing was required from the poor, and those who were liable may be divided roughly into three classes. Persons worth less than £300 paid one shilling; those worth £300, including the gentry and the professional classes, paid twenty shillings; while tradesmen and shopkeepers paid ten shillings. Non-jurors were charged double these rates. Like previous poll-taxes, the tax of 1698 did not produce as much as was anticipated, and it was the last of its kind in England.

Many of the states of the United States of America raise money by levying poll-taxes, or, as they are usually called, capitation taxes, the payment of this tax being a necessary preliminary to the exercise of the suffrage.

See S. Dowell, *History of Taxation and Taxes in England* (1888), vol. iii.; and W. Stubbs, *Constitutional History* (1896), vol. ii.

POLLUX, JULIUS, of Naucratis in Egypt, Greek grammarian and sophist of the 2nd century A.D. He taught at Athens, where, according to Philostratus (*Vit. Soph.*), he was appointed to the professorship of rhetoric by the emperor Commodus on account of his melodious voice. Suïdas gives a list of his rhetorical works, none of which has survived. Philostratus recognizes his natural abilities, but speaks of his rhetoric in very moderate terms. Pollux is probably the person attacked by Lucian in the *Lexiphanes* and *Teacher of Rhetoricians*. In the *Teacher of Rhetoricians* Lucian satirizes a worthless and ignorant person who gains a reputation as an orator by sheer effrontery; the *Lexiphanes*, a satire upon the use of obscure and obsolete words, may conceivably have been directed against Pollux as the author of the *Onomasticon*. This work, which we still possess, is a Greek dictionary in ten books, each dedicated to Commodus, and arranged not alphabetically but according to subject-matter. Though mainly a dictionary of synonyms and phrases, chiefly intended to furnish the reader with the Attic names for individual things, it supplies much rare and valuable information on many points of classical antiquity. It also contains numerous fragments of writers now lost. The chief authorities used were the lexicological works of Didymus, Tryphon, and Pamphilus; in the second book the extant treatise of Rufus of Ephesus *On the Names of the Parts of the Human Body* was specially consulted.

The chief editions of the *Onomasticon* are those of W. Dindorf (1824), with the notes of previous commentators, I. Bekker (1846), containing the Greek text only, and Bethe (1900). There are monographs on special portions of the vocabulary; by E. Rohde (on the theatrical terms, 1870), and F. von Stojentin (on constitutional antiquities, 1875).

POLLUX, or Pollucite, a rare mineral, consisting of hydrous caesium and aluminium silicate, $H_2Cs_4Al_4(SiO_3)_9$. Caesium oxide (Cs_2O) is present to the extent of 30–36 %, the amount varying somewhat owing to partial replacement by other alkalis, chiefly sodium. The mineral crystallizes in the cubic system. It is colourless and transparent, and has a vitreous lustre. There is no distinct cleavage and the fracture is conchoidal. The hardness is 6½ and the specific gravity 2·90. It occurs sparingly, together with the mineral "castor" (see Petalite), in cavities in the granite of the island of Elba, and with beryl in pegmatite veins at Rumford and Hebron in Maine.

POLO, GASPAR GIL (?1530–1591), Spanish novelist and poet, was born at Valencia about 1530. He is often confused with Gil Polo, professor of Greek at Valencia University between 1566 and 1573; but this professor was not named Gaspar. He is also confused with his own son, Gaspar Gil Polo, the author of *De origine et progressu juris romani* (1615) and other legal treatises, who pleaded before the Cortes as late as 1626. A notary by profession, Polo was attached to the treasury commission which visited Valencia in 1571, became coadjutor to the chief accountant in 1572, went on a special mission to Barcelona in 1580, and died there in 1591. Timoneda, in the *Sarao de amor* (1561), alludes to him as a poet of repute; but of his miscellaneous verses only two conventional, eulogistic sonnets and a song survive. Polo finds a place in the history of the novel as the author of *La Diana enamorada*, a continuation of Montemayor's *Diana*, and perhaps the most successful continuation ever written by another hand. Cervantes, punning on the writer's name, recommended that "the *Diana enamorada* should be guarded as carefully as though it were by Apollo himself"; the hyperbole is not wholly, nor even mainly, ironical.

The book is one of the most agreeable of Spanish pastorals; interesting in incident, written in fluent prose, and embellished with melodious poems, it was constantly reprinted, was imitated by Cervantes in the *Canto de Caliope*, and was translated into English, French, German and Latin. The English version of Bartholomew Young, published in 1598 but current in manuscript fifteen years earlier, is said to have suggested the Felismena episode in the *Two Gentlemen of Verona*; the Latin version of Caspar Barth, entitled *Erotodidascalus* (Hanover, 1625), is a performance of uncommon merit as well as a bibliographical curiosity.

POLO, MARCO (*c.* 1254–1324), the Venetian, greatest of medieval travellers. Venetian genealogies and traditions of uncertain value trace the Polo family to Sebenico in Dalmatia, and before the end of the 11th century one Domenico Polo is found in the great council of the republic (1094). But the ascertained line of the traveller begins only with his grandfather. Andrea Polo of S. Felice was the father of three sons, Marco, Nicolo and Maffeo, of whom the second was the father of the subject of this article. They were presumably "noble," *i.e.* belonging to the families who had seats in the great council, and were enrolled in the Libro d' Oro; for we know that Marco the traveller is officially so styled (*nobilis vir*). The three brothers were engaged in commerce; the elder Marco, resident apparently in Constantinople and in the Crimea (especially at Sudak), suggests, by his celebrated will, a long business partnership with Nicolo and Maffeo.

About 1260, and even perhaps as early as 1250, we find Nicolo and Maffeo at Constantinople. Nicolo was married and had left his wife there. The two brothers went on a speculation to the Crimea, whence a succession of chances and openings carried them to the court of Barka Khan at Sarai, further north up to Bolghar (Kazan), and eventually across the steppes to Bokhara. Here they fell in with certain envoys who had been on a mission from the great Khan Kublai to his brother Hulagu in Persia, and by them were persuaded to make the journey to Cathay in their company. Under the heading China the circumstances are noticed which in the last half of the 13th century and first half of the 14th threw Asia open to Western travellers to a degree unknown before and since—until the 19th century. Thus began the medieval period of intercourse between China and catholic Europe. Kublai, when the Polos reached his court, was either at Cambaluc (*Khanbaligh*, the Khan's city), *i.e.* Peking, which he had just rebuilt, or at his summer seat at Shangtu in the country north of the Great Wall. It was the first time that the khan, a man full of energy and intelligence, had fallen in with European gentlemen. He was delighted with the Venetian brothers, listened eagerly to all they had to tell of the Latin world, and decided to send them back as his envoys to the pope, with letters requesting the despatch of a large body of educated men to instruct his people in Christianity and the liberal arts. With Kublai, as with his predecessors, religion was chiefly a political engine. Kublai, the first of his house to rise above the essential barbarism of the Mongols, had perhaps discerned that the Christian Church could afford the aid he desired in taming his countrymen. It was only when Rome had failed to meet his advance that he fell back upon Buddhism as his chief civilizing instrument.

The brothers arrived at Acre in April 1269. They learned that Clement IV. had died the year before, and no new pope had yet been chosen. So they took counsel with an eminent churchman, Tedaldo, archdeacon of Liége and papal legate for the whole realm of Egypt, and, being advised by him to wait patiently, went home to Venice, where they found that Nicolo's wife was dead, but had left a son Marco, now fifteen. The papal interregnum was the longest that had been known, at least since the dark ages. After the Polos had spent two years at home there was still no pope, and the brothers resolved on starting again for the East, taking young Marco with them. At Acre they again saw Tedaldo, and were furnished by him with letters to authenticate the causes that had hindered their mission. They had not yet left Lajazzo, Layas, or Ayas on the Cilician coast (then one of the chief points for the arrival and departure of the land trade of Asia), when they heard that Tedaldo had been elected pope. They hastened back to Acre, and at last were able to execute Kublai's mission, and to obtain a papal reply. But, instead of the hundred teachers asked for by the Great Khan, the new pope (styled Gregory X.) could supply but two Dominicans; and these lost heart and turned back, when they had barely taken the first step of their journey.

The second start from Acre must have taken place about November 1271; and from a consideration of the indications and succession of chapters in Polo's book, it would seem that the party proceeded from Lajazzo to Sivas and Tabriz, and thence by Yezd and Kirman down to Hormuz (Hurmuz) at the mouth of the Persian Gulf, with the purpose of going on to China by sea; but that, abandoning their naval plans (perhaps from fear of the flimsy vessels employed on this navigation from the Gulf eastwards), they returned northward through Persia. Traversing Kirman and Khorasan they went on to Balkh and Badakshan, in which last country young Marco recovered from illness. In a passage touching on the climate of the Badakshan hills, Marco breaks into an enthusiasm which he rarely betrays, but which is easily understood by those who have known what it is, with fever in the blood, to escape to the exhilarating mountain air and fragrant pine-groves. They then ascended the upper Oxus through Wakhan to the plateau of Pamir (a name first heard in Marco's book). These regions were hardly described again by any European traveller (save Benedict Goes) till the expedition in 1838 of Lieut. John Wood of the Indian navy, whose narrative abounds in incidental illustration of Marco Polo. Crossing the Pamir the travellers descended upon Kashgar, Yarkand and Khotan (Khutan). These are regions which remained almost absolutely closed to our knowledge till after 1860, when the temporary overthrow of the Chinese power, and the enterprise of British, Russian and other explorers, again made them known.

From Khotan the Polos passed on to the vicinity of Lop-Nor, reached for the first time since Polo's journey by Prjevalsky in 1871. Thence the great desert of Gobi was crossed to Tangut, as the region at the extreme north-west of China, both within and without the Wall, was then called.

In his account of the Gobi, or desert of Lop, as he calls it, Polo gives some description of the terrors and superstitions of the waste, a description which strikingly reproduces that of the Chinese pilgrim Suan T'sang, in passing the same desert in the contrary direction six hundred years before.

The Venetians, in their further journey, were met and welcomed by the Great Khan's people, and at last reached his presence at Shangtu, in the spring of 1275. Kublai received them with great cordiality, and took kindly to young Marco, by this time about twenty-one years old. The "young bachelor," as the book calls him, applied himself diligently to the acquisition of the divers languages and written characters chiefly in use among the multifarious nationalities subject to the Khan; and Kublai, seeing that he was both clever and discreet, soon began to employ him in the public service. G. Pauthier found in the Chinese annals a record that in the year 1277 a certain Polo was nominated as a second-class commissioner or agent attached to the imperial council, a passage which we may apply to the young Venetian. Among his public missions was one which carried him through the provinces of Shansi, Shensi, and Szechuen, and the wild country on the borders of Tibet, to the remote province of Yunnan, called by the Mongols *Karajang*, and into northern Burma (Mien). Marco, during his stay at court, had observed the Khan's delight ~~in~~ hearing of strange countries, of their manners, marvels, and oddities, and had heard his frank expressions of disgust at the stupidity of envoys and commissioners who could tell of nothing but their official business. He took care to store his memory or his note-book with curious facts likely to interest Kublai, which, on his return to court, he related. This south-western journey led him through a country which till about 1860 was almost a *terra incognita*—though since the middle of the 19th century we have learned much regarding it through the journeys of Cooper, Garnier, Richthofen, Gill, Baber and others. In this region there existed and still exists in the deep valleys of the great rivers, and in the alpine regions which border them, a vast ethnological garden, as it were, of tribes of various origin, and in every stage of semi-civilization or barbarism; these afforded many strange products and eccentric traits to entertain Kublai.

Marco rose rapidly in favour and was often employed on distant missions as well as in domestic administration; but we gather few details of his employment. He held for three years the government of the great city of Yangchow; on another occasion he seems to have visited Kangchow, the capital of Tangut, just within the Great Wall, and perhaps Karakorum on the north of the Gobi, the former residence of the Great Khans: again we find him in Ciampa, or southern Cochin-China; and perhaps, once more, on a separate mission to the southern states of India. We are not informed whether his father and uncle shared in such employments, though they are mentioned as having rendered material service to the Khan, in forwarding the capture of Siang-yang (on the Han river) during the war against southern China, by the construction of powerful artillery engines—a story, however, perplexed by chronological difficulties.

All the Polos were gathering wealth which they longed to carry back to their home, and after their exile they began to dread what might follow Kublai's death. The Khan, however, was deaf to suggestions of departure and the opportunity only came by chance.

Arghun, khan of Persia, the grandson of Kublai's brother Hulagu, lost in 1286 his favourite wife, called by Polo *Balgana* (*i.e. Bulughan* or "Sable"). Her dying injunction was that her place should be filled only by a lady of her own Mongol tribe. Ambassadors were despatched to the court of Peking to obtain such a bride. The message was courteously received, and the choice fell on the lady Cocacin (Kukachin), a maiden of seventeen. The overland road from Peking to Tabriz was then imperilled by war, so Arghun's envoys proposed to return by sea. Having made acquaintance with the Venetians, and eager to profit by their experience, especially by that of Marco, who had just returned from a mission to the Indies, they begged the Khan to send the Franks in their company. He consented with reluctance, but fitted out the party nobly for the voyage, charging them with friendly messages to the potentates of Christendom, including the pope, and the kings of France, Spain and England. They sailed from *Zaiton* or Amoy Harbour in Fukien (a town corresponding either to the modern Changchow or less probably to Tswanchow or Chinchew), then one of the chief Chinese havens for foreign trade, in the beginning of 1292. The voyage involved long detention on the coast of Sumatra, and in south India, and two years or more passed before they arrived in Persia. Two of the three envoys and a vast proportion of their suite perished by the way; but the three Venetians survived all perils, and so did the young lady, who had come to look on them with filial regard. Arghun Khan had died even before they quitted China; his brother reigned in his stead; and his son Ghazan succeeded to the lady's hand. The Polos went on (apparently by Tabriz, Trebizond, Constantinople and Negropont) to Venice, which they seem to have reached about the end of 1295.

The first biographer of Marco Polo was the famous geographical collector John Baptist Ramusio, who wrote more than two centuries after the traveller's death. Facts and dates sometimes contradict his statements, but he often adds detail, evidently authentic, of great interest and value, and we need not hesitate to accept as a genuine tradition the substance of his story of the Polos' arrival at their family mansion in St John Chrysostom parish in worn and outlandish garb, of the scornful denial of their identity, and the stratagem by which they secured acknowledgment from Venetian society.

We next hear of Marco Polo in a militant capacity. Jealousies had been growing in bitterness between Venice and Genoa throughout the 13th century. In 1298 the Genoese prepared to strike at their rivals on their own ground, and a powerful fleet under Lamba Doria made for the Adriatic. Venice, on hearing of the Genoese armament, equipped a fleet still more numerous, and placed it under Andrea Dandolo. The crew of a Venetian galley at this time amounted, all told, to 250 men, under a *comito* or master, but besides this officer each galley carried a *sopracomito* or gentleman-commander, usually a noble. On one of the galleys of Dandolo's fleet Marco Polo seems to have gone in this last capacity. The hostile fleets met before Curzola Island on the 6th of September, and engaged next morning. The battle ended in a complete victory for Genoa, the details of which may still be read on the façade of St Matthew's church in that city. Sixty-six Venetian galleys were burnt in Curzola Bay, and eighteen were carried to Genoa, with 7000 prisoners, one of whom was Marco Polo. The captivity was of less than a year's duration; by the mediation of Milan peace was made, on honourable terms for both republics, by July 1299; and Marco was probably restored to his family during that or the following month.

But his captivity was memorable as the immediate cause of his *Book*. Up to this time he had doubtless often related his experiences among his friends; and from these stories, and the frequent employment in them (as it would seem) of grand numerical expressions, he had acquired the nickname of *Marco Millioni*. Yet it would seem that he had committed nothing to writing. The narratives not only of Marco Polo but of several other famous medieval travellers (*e.g.* Ibn Batuta, Friar Odoric, Nicolo Conti) seem to have been extorted from them by a kind of pressure, and committed to paper by other hands. Examples, perhaps, of that intense dislike to the use of pen and ink which still prevails among ordinary respectable folk on the shores of the Mediterranean.

In the prison of Genoa Marco Polo fell in with a certain person of writing propensities, Rusticiano or Rustichello of Pisa, also a captive of the Genoese. His name is otherwise known as that of a respectable literary hack, who abridged and recast several of the French romances of the Arthurian cycle, then in fashion. He wrote down Marco's experiences at his dictation.

We learn little of Marco Polo's personal or family history after this captivity; but we know that at his death he left a wife, Donata (perhaps of the Loredano family, but this is uncertain), and three daughters, Fantina and Bellela (married, the former to Marco Bragadino), and Moreta (then a spinster, but married at a later date to Ranuzzo Dolfino). One last glimpse of the traveller is gathered from his will, now in St Mark's library. On the 9th of January 1324 the traveller, in his seventieth year, sent for a neighbouring priest and notary to make his testament. We do not know the exact time of his death, but it fell almost certainly within the year 1324, for we know from a scanty series of documents, beginning in June 1325, that he had at the latter date been some time dead. He was buried, in accordance with his will, in the Church of St Lorenzo, where the family burying-place was marked by a sarcophagus, erected by his filial care for his father Nicolo, which existed till near the end of the 16th century. On the renewal of the church in 1592 this seems to have disappeared.

The archives of Venice have yielded a few traces of our traveller. Besides his own will just alluded to, there are the wills of his uncle Marco and of his younger brother Maffeo; a few legal documents connected with the house property in St John Chrysostom, and other papers of similar character; and two or three entries in the record of the Maggior Consiglio. We have mentioned the sobriquet of Marco Millioni. Ramusio tells us that he had himself noted the use of this name in the public books of the commonwealth, and this statement has been verified in an entry in the books of the Great Council (dated April 10, 1305), which records as one of the securities in a certain case the "Nobilis vir *Marchus Paulo* MILION." It is alleged that long after the traveller's death there was always in the Venetian masques one individual who assumed the character of Marco Millioni, and told Munchausen-like stories to divert the vulgar. There is also a record (March 9, 1311) of the judgment of the court of requests (Curia Petitionum) upon a suit brought by the "Nobilis vir Marcus Polo" against Paulo Girardo, who had been an agent of his, to recover the value of a certain quantity of musk for which Girardo had not accounted. Another document is a catalogue of certain curiosities and valuables which were collected in the house of Marino Faliero, and this catalogue comprises several objects that Marco Polo had given to one of the Faliero family.

The most tangible record of Polo's memory in Venice is a portion of the Ca' Polo—the mansion (there is reason to believe) where the three travellers, after their long absence, were denied entrance. The court in which it stands was known in Ramusio's time as the *Corte del millioni*, and now is called Corte Sabbionera. That which remains of the ancient edifice is a passage with a decorated archway of Italo-Byzantine character pertaining to the 13th century.

No genuine portrait of Marco Polo exists. There is a medallion portrait on the wall of the Sala dello Scudo in the ducal palace, which has become a kind of type; but it is a work of imagination no older than 1761. The oldest professed portrait is one in the gallery of Monsignor Badia at Rome, which is inscribed *Marcus Polus venetus totius orbis et Indie peregrator primus*. It is a good picture, but evidently of the 16th century at earliest. The Europeans at Canton have absurdly attached the name of Marco Polo to a figure in a Buddhist temple there containing a gallery of "Arhans" or Buddhist saints, and popularly known as the "temple of the five hundred gods." The Venetian municipality obtained a copy of this on the occasion of the geographical congress at Venice in 1881.

The book indited by Rusticiano is in two parts. The first, or prologue, as it is termed, is unfortunately the only part which consists of actual personal narrative. It relates in an interesting though extremely brief fashion the circumstances which led the two elder Polos to the Khan's court, together with those of their second journey (when accompanied by Marco), and of the return to the west by the Indian seas and Persia. The second and staple part consists of a series of chapters of unequal length and unsystematic structure, descriptive of the different states and provinces of Asia (certain African islands and regions included), with occasional notices of their sights and products, of curious manners and remarkable events, and especially regarding the Emperor Kublai, his court, wars and administration. A series of chapters near the close treats of sundry wars that took place between various branches of the house of Jenghiz in the latter half of the 13th century. This last series is either omitted or greatly curtailed in all the MS. copies and versions except one (Paris, National Library, Fonds Fr. 1116).

It was long doubtful in what language the work was originally written. That this had been some dialect of Italian was a natural presumption, and a contemporary statement could be alleged in its favour. But there is now no doubt that the original was French. This was first indicated by Count Baldelli-Boni, who published an elaborate edition of two of the Italian texts at Florence in 1827, and who found in the oldest of these indisputable signs that it was a translation from the French. The argument has since been followed up by others; and a manuscript in rude and peculiar French, belonging to the National Library of Paris (Fonds Fr. 1116), which was printed by the *Société de géographie* in 1824, is evidently either the original or a close transcript of the original dictation. A variety of its characteristics are strikingly indicative of the unrevised product of dictation, and are such as would necessarily have disappeared either in a translation or in a revised copy. Many illustrations could be adduced of the fact that the use of French was not a circumstance of surprising or unusual nature; for the language had at that time, in some points of view, even a wider diffusion than at present, and examples of its literary employment by writers who were not Frenchmen (like Rusticiano himself, a compiler of French romances) are very numerous.

Eighty-five MSS. of the book are known, and their texts exhibit considerable differences. These fall under four principal types. Of these, type i. is found completely only in that old French codex which has been mentioned (Paris, National Library, Fr. 1116). Type ii. is shown by several valuable MSS. in purer French (Paris, Nat. Libr., Fr. 2810; Fr. 5631; Fr. 5649; Bern, Canton Library, 125), which formed the basis of the edition prepared by the late M. Pauthier in 1865. It exhibits a text condensed and revised from the rude original, but without any exactness, though perhaps under some general direction by Marco Polo himself, for an inscription prefixed to certain MSS. (Bern, Canton Libr. 125; Paris, Nat. Libr., Fr. 5649) records the presentation of a copy by the traveller himself to the Seigneur Thiébault de Cépoy, a distinguished Frenchman known to history, at Venice in the year 1306. Type iii. is that of a Latin version prepared in Marco Polo's lifetime, though without any sign of his cognisance, by Francesco Pipino, a Dominican of Bologna, and translated from an Italian copy. In this, condensation and curtailment are carried a good deal further than in type ii. Some of the forms under which this type appears curiously illustrate the effects of absence of effective publication, not only before the invention of the press, but in its early days. Thus the Latin version published by Grynaeus at Basel in the *Novus Orbis* (1532) is different in its language from Pipino's, and yet is clearly traceable to that as its foundation. In fact it is a retranslation into Latin from some version of Pipino (Marsden thinks the Portuguese printed one of 1502). It introduces changes of its own, and is worthless as a text; yet Andreas Müller, who in the 17th century took so much trouble with Polo, unfortunately chose as his text this fifth-hand version. The French editions published in the middle of the 16th century were translations from Grynaeus's Latin. Hence they complete this curious and vicious circle of transmission—French, Italian, Pipino's Latin, Portuguese, Grynaeus's Latin, French.

Type iv. deviates largely from those already mentioned; its history and true character are involved in obscurity. It is only represented by the Italian version prepared for the press by John Baptist Ramusio, with interesting preliminary dissertations, and published at Venice two years after his death, in the second volume of the *Navigationi e viaggi*. Its peculiarities are great. Ramusio seems to imply that he made some use of Pipino's Latin, and various passages confirm this. But many new circumstances, and anecdotes occurring in no other copy, are introduced; many names assume a new shape; the whole style is more copious and literary than that of any other version. While a few of the changes and interpolations seem to carry us farther from the truth, others contain facts of Asiatic nature or history, as well as of Polo's alleged experiences, which it is difficult to ascribe to any hand but the traveller's own.

We recognize to a certain extent tampering with the text, as in cases where Polo's proper names have been identified, and more modern forms substituted. In some other cases the editorial spirit has gone astray. Thus the age of young Marco has been altered to correspond with a date which is itself erroneous. Ormuz is described as an island, contrary to the old texts, and to the fact in Polo's time. In speaking of the oil-springs of Caucasus the phrase "camel-loads" has been substituted for "ship-loads," in ignorance that the site was Baku on the Caspian.

But, on the other hand, there are a number of new circumstances certainly genuine, which can hardly be ascribed to any one but Polo himself. Such is the account which Ramusio's version gives of the oppressions exercised by Kublai's Mahommedan minister Ahmad, telling how the Cathayans rose against him and murdered him, with the addition that Messer Marco was on the spot when all this happened. Not only is the whole story in substantial accordance with the Chinese annals, even to the name of the chief conspirator (*Vanchu* in Ramusio, *Wangcheu* in the Chinese records), but the annals also tell of the frankness of "Polo, assessor of the privy council," in opening Kublai's eyes to the iniquities of his agent.

Polo was the first traveller to trace a route across the whole longitude of Asia, naming and describing kingdom after kingdom which he had seen; the first to speak of the new and brilliant court which had been established at Peking; the first to reveal China in all its wealth and vastness, and to tell of the nations on its borders; the first to tell more of Tibet than its name, to speak of Burma, of Laos, of Siam, of Cochin-China, of Japan, of Java, of Sumatra and of other islands of the archipelago, of the Nicobar and Andaman Islands, of Ceylon and its sacred peak, of India but as a country seen and partially explored; the first in medieval times to give any distinct account of the secluded Christian Empire of Abyssinia, and of the semi-Christian island of Sokotra, and to speak, however dimly, of Zanzibar, and of the vast and distant Madagascar; whilst he carries us also to the remotely opposite region of Siberia and the Arctic shores, to speak of dog-sledges, white bears and reindeer-riding Tunguses.

The diffusion of the book was hardly so rapid as has been sometimes alleged. We know from Gilles Mallet's catalogue of the books collected in the Louvre by Charles V., dating *c.* 1370–1375, that five copies of Marco Polo's work were then in the collection; but on the other hand, the 202 known MSS. and the numerous early printed editions of "Mandeville," with his lying wonders, indicates a much greater popularity. Dante, who lived twenty-three years after the book was dictated, and who touches so many things in the seen and unseen worlds, never alludes to Polo, nor, we believe, to anything that can be connected with him; nor can any trace of Polo be discovered in the book of his contemporary, Marino Sanudo the Elder, though this worthy is well acquainted with the work, later by some years, of Hayton the Armenian, and though many of the subjects on which he writes in his own book (*Secreta Fidelium Crucis*[1]) challenge a reference to Polo's experiences. "Mandeville" himself, who plundered right and left, hardly ever plunders Polo (see one example in *Dawn of Modern Geography*, iii. 323, note). The only literary works we know of the 14th century which show acquaintance with Polo's book or achievements are Pipino's *Chronicle*, Villani's *Florentine History*, Pietro d'Abano's *Conciliator*, the *Chronicle* of John of Ypres, and the poetical romance of *Baudouin de Sebourc*, which last borrows themes largely from Polo.

Within the traveller's own lifetime we find the earliest examples of the practical and truly scientific coast-charts (*Portolani*), based upon the experience of pilots, mariners, merchants, &c. In two of the most famous of the 14th century Portolani, we trace Marco Polo's influence—first, very slightly in the *Laurentian* or *Medicean Portolano* of 1351 (at Florence), but afterwards with clearness and in remarkable detail in the *Catalan Atlas* of 1375 (now at Paris). Both of these represent a very advanced stage of medieval knowledge, a careful attempt to represent the known world on the basis of collected fact, and a disregard for theological or pseudo-scientific theory; in the *Catalan Atlas*, as regards Central and Further Asia, and partially as regards India, Marco Polo's *Book* is the basis of the map. His names are often much perverted, and it is not always easy to understand the view that the compiler took of his itineraries. Still we have Cathay placed in the true position of China, as a great empire filling the south-east of Asia. The trans-Gangetic peninsula is absent, but that of India proper is, for the first time in the history of geography, represented with a fair approximation to correct form and position.

It is curious that, in the following age, owing partly to his unhappy reversion to the fancy of a circular disk, the map of Fra Mauro (1459), one of the greatest map-making enterprises in history, and the result of immense labour in the collection of facts and the endeavour to combine them, gives a much less accurate idea of Asia than the *Carta catalana.* Columbus possessed a printed copy of the Latin version of Polo's book made by Pipino, and on more than seventy pages of this there are manuscript notes in the admiral's handwriting, testifying, what is sufficiently evident from the whole history of the Columbian voyages, to the immense influence of the work of the Venetian merchant upon the discoverer of the new world.

When, in the 16th century, attempts were made to combine new and old knowledge, the results were unhappy. The earliest of such combinations tried to realize Columbus's ideas regarding the identity of his discoveries with the Great Khan's dominions; but even after America had vindicated its independent existence, and the new knowledge of the Portuguese had named *China* where the Catalan map had spoken of *Cathay*, the latter country, with the whole of Polo's nomenclature, was shunted to the north, forming a separate system. Henceforward the influence of Polo's work on maps was simply injurious; and when to his names was added a sprinkling of Ptolemy's, as was usual throughout the 16th century, the result was a hotchpotch conveying no approximation to facts (see further MAP).

As to the alleged introduction of important inventions into Europe by Polo—although the striking resemblance of early European block-books to those of China seems clearly to indicate the derivation of the art from that country, there is no reason for connecting this introduction (any more than that of gunpowder or the mariner's compass) with the name of Marco. In the 14th century not only were missions of the Roman Church established in some of the chief cities of eastern China, but a regular overland trade was carried on between Italy and China, by way of Tana (Azov), Astrakhan, Otrar, Kamul (Hami) and Kanchow. Many a traveller other than Marco Polo might have brought home the block-books, and some might have witnessed the process of making them. This is the less to be ascribed to Polo, because he so curiously omits to speak of the process of printing, when, in describing the block-printed paper-money of China, his subject seems absolutely to challenge a description of the art.

See the *Recueil* of the Paris Geographical Society (1824), vol. i., giving the text of the fundamental MS. (Nat. Libr. Paris, Fr. 1116; see above), as well as that of the oldest Latin version; G. Pauthier's edition, *Livre . . . de Marco Polo . . .* (Paris, 1865), based mainly upon the three Paris MSS. (Nat. Libr. Fr. 2810; Fr. 5631; Fr. 5649; see above) and accompanied by a commentary of great value; Baldelli-Boni's Italian edition, giving the oldest Italian version (Florence, 1827); Sir Henry Yule's edition, which in its final shape, as revised and augmented by Henri Cordier (. . . *Marco Polo* . . . London, 1903), is the most complete storehouse of Polo learning in existence, embodying the labours of all the best students of the subject, and giving the essence of such works as those of Major P. Molesworth Sykes (*Ten Thousand Miles in Persia*, &c.) so far as these touch Marco Polo; the Archimandrite Palladius Katharov's "Elucidations of Marco Polo" (from vol. x. of the *Journal* of the North China Branch of the Royal Asiatic Society (1876), pp. 1–54; F. von Richthofen, *Letters to Shangai Chamber of Commerce*; E. C. Baber, *Travels . . . in Western China*; G. Phillips, *Identity of . . . Zaitun with Chang-chau* in *T'oung Pao* (Oct. 1890), and other studies in *T'oung-Pao* (Dec. 1895 and July 1896). There are in all 10 French editions of Polo as well as 4 Latin editions, 27 Italian, 9 German, 4 Spanish, 1 Portuguese, 12 English, 2 Russian, 1 Dutch, 1 Bohemian (Chekh), 1 Danish and 1 Swedish. See also E. Bretschneider, *Mediaeval Researches from Eastern Asiatic Sources*, i. 239, 167; ii. 8, 71, 81–84, 184; Léon Cahun, *Introduction à l'histoire de l'Asie*, 339, 386; C. Raymond Beazley, *Dawn of Modern Geography*, iii. 15–160, 545–547, 554, 556–563. (H. Y.; C. R. B.)

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[1] Printed by Bongars in the collection called *Gesta Dei per Francos* (1611), ii. 1–281.

History.

POLO (Tibetan *pulu*, ball), the most ancient of games with stick and ball. Hockey, the Irish national game of hurling (and possibly golf and cricket) are derived from polo. The latter was called hockey or hurling on horseback in England and Ireland respectively, but historically hockey and hurling are polo on foot.

The earliest records of polo are Persian. From Persia the game spread westward to Constantinople, eastwards through Turkestan to Tibet, China and Japan. From Tibet polo travelled to Gilgit and Chitral, possibly also to Manipur. Polo also flourished in India in the 16th century. Then for 200 years its records in India cease, till in 1854 polo came into Bengal from Manipur by way of Cachar and in 1862 the game was played in the Punjab.

There have been twelve varieties of the game during its existence of at least 2000 years. (1) A primitive form consisting of feats of horsemanship and of skill with stick and ball. (2) Early Persian, described in *Shahnama*, a highly organized game with rules, played four a side. (3) Later Persian, 16th century, the grounds 300 by 170 yds. Sir Anthony Shirley says the game resembled the rough football of the same period in England. (4) The game in the 17th century in Persia. A more highly organized game than No. 3, as described by Chardin. (5) The Byzantine form played at Constantinople in the 12th century. A leathern ball the size of an apple and a racquet were used. (6) The Chinese game, about A.D. 600 played with a light wooden ball. The goal was formed by two posts with a boarding between, in the latter a hole being cut and a net attached to it in the form of a bag. The side which hit the ball into the bag were the winners. Another Chinese form was two teams ranged on opposite sides of the ground, each defending its own goal. The object of the game was to drive the ball through the enemy's goal. (7) The Japanese game, popular in feudal times, still survives under the name of Dakiu, or ball match. The Japanese game has a boarded goal; 5 ft. from the ground is a circular hole 1 ft. 2 in. in diameter with a bag behind. The balls are of paper with a cover of pebbles or bamboo fibre, diameter 1·7 in., weight 1½ oz. The sticks are racket shaped. The object is to lift over or carry the ball with the racket and place it in the bag. (8) Called *rōl*, played with a long stick with which the ball was dribbled along the ground. (9) Another ancient Indian form in which the sides ranged up on opposite sides of the ground and the ball was thrown in. This is probably the form of the game which reached India from Persia and is represented at the present day by Manipur and Gilgit polo, though these forms are probably rougher than the old Indian game. (10) Modern English with heavy ball and sticks, played in England and the colonies and wherever polo is played in Europe. Its characteristics are: offside; severe penalties for breach of the rules; close combination; rather short passing; low scoring, and a strong defence. (11) Indian polo has a lighter ball, no boards to the grounds, which are usually full-sized; a modified offside-rule, but the same system of penalties. It is a quicker game than the English. (12) The American game has no offside and no penalties, in the English sense. The attack is stronger, the passing longer, the pace greater and more sustained. American players are more certain goal-hitters and their scoring is higher. They defeated the English players in 1909 with ease.

Polo was first played in England by the 10th Hussars in 1869. The game spread rapidly and some good play was seen at Lillie Bridge. But the organization of polo in England dates from its adoption by the Hurlingham Club in 1873. The ground was boarded along the sides, and this device, which was employed as a remedy for the irregular shape of the Hurlingham ground has become almost universal and has greatly affected the development of the game. The club committee, in 1874, drew up the first code of rules, which reduced the number of players to five a side and included offside. The next step was the foundation of the Champion Cup, in 1877. Then came the rule dividing the game into periods of ten minutes, with intervals of two minutes for changing ponies after each period, and five minutes at half-time. The height of ponies was fixed at 14·2, and a little later an official measurer was appointed, no pony being allowed to play unless registered at Hurlingham. The next change was the present scale of penalties for offside, foul riding or dangerous play. A short time after, the crooking of the adversary's stick, unless in the act of hitting the ball, was forbidden. The game grew faster, partly as the result of these rules. Then the ten minutes' rule was revised. The period did not close until the ball went over the boundary. Thus the period might be extended to twelve or thirteen minutes, and although this time was deducted from the next period the strain of the extra minutes was too great on men and ponies. It was therefore laid down that the ball should go out of play on going out of bounds or striking the board, whichever happened first. In 1910 a polo handicap was established, based on the American system of estimating the number of goals a player was worth to his side. This was modified in the English handicap by assigning to each player a handicap number as at golf. The highest number is ten, the lowest one. The Hurlingham handicap is revised during the winter, again in May, June and July, each handicap coming into force one month after the date of issue. In tournaments under handicap the individual handicap numbers are added together, and the team with the higher aggregate concedes goals to that with the lower, according to the conditions of the tournament. The handicap serves to divide second from first class tournaments, for the former teams must not have an aggregate over 25.

The size of the polo ground is 300 yds. in length and from 160 to 200 yds. in width. The larger size is only found now where boards are not used. The ball is made of willow root, is 3¼ in. in diameter, weight not over 5½ oz. The polo stick has no standard size or weight, and square or cigar-shaped heads are used at the discretion of the player. On soft grounds, the former, on hard grounds the latter are the better, but Indian and American players nearly always prefer the cigar shape.

The goal posts, now generally made of papier mâché, are 8 yds. apart. This is the goal line. Thirty yards from the goal line a line is marked out, nearer than which to the goal no one of a fouled side may be when the side fouling has to hit out, as a penalty from behind the back line, which is the goal line produced. At 50 yds. from each goal there is generally a mark to guide the man who takes a free hit as a penalty.

Penalties are awarded by the umpires, who should be two in number, well mounted, and with a good knowledge of the rules of the game. The Hurlingham and Ranelagh clubs appoint official umpires. There should also be a referee in case of disagreement between the umpires, and it is usual to have a man with a flag behind each goal to signal when a goal is scored. The Hurlingham club makes and revises the rules of the game, and its code is, with some local modifications, in force in the United Kingdom, English-speaking colonies, the Argentine Republic, California, and throughout Europe. America and India are governed by their own polo associations.

The American rules have no offside, and their penalties consist of subtracting a goal or the fraction of a goal, according to the offence, from the side which has incurred a penalty for fouling. The differences between the Hurlingham and Indian rules are very slight, and they tend to assimilate more as time goes on.

Polo in the army is governed by an army polo committee, which fixes the date of the inter-regimental tournament. The semi-finals and finals are played at Hurlingham. The earlier ties take place at centres arranged by the army polo committee, who are charged by the military authorities with the duty of checking the expenditure of officers on the game. The value of polo as a military exercise is now fully recognized, and with the co-operation of Hurlingham, Ranelagh and Roehampton the expenses of inter-regimental tournaments have been regulated and restrained.

International Polo.

The County Polo Association has affiliated to it all the county clubs. It is a powerful body, arranging the conditions of county tournaments, constructing the handicaps for county players, and in conjunction with the Ranelagh club holding a polo week for county players in London. The London clubs are three—Hurlingham, Ranelagh and Roehampton. Except that they use Hurlingham rules the clubs are independent, and arrange the conditions and fix the dates of their own tournaments. Ranelagh has four, Roehampton three and Hurlingham two polo grounds. There are about 400 matches played at these clubs, besides members' games from May to July during the London season. At present the Meadowbrook still hold the cup which was won by an English team in 1886. In 1902 an American team made an attempt to recover it and failed. They lacked ponies and combination; but they bought the first and learned the second, and tried again successfully in 1909, thus depriving English polo of the championship of the world.

The Game.

Polo in England has passed through several stages. It was always a game of skill. The cavalry regiments in India in early polo days, the 5th, 9th, 12th and 17th Lancers, the 10th Hussars and the 13th Hussars, had all learned the value of combination. In very early days regimental players had learned the value of the backhanded stroke, placing the ball so as to give opportunities to their own side. The duty of supporting the other members of the team and riding off opponents so as to clear the way for players on the same side was understood. This combination was made easier when the teams were reduced from five a side to four. Great stress was laid on each man keeping his place, but a more flexible style of play existed from early days in the 17th Lancers and was improved and perfected at the Rugby Club by the late Colonel Gordon Renton and Captain E. D. Miller, who had belonged to that regiment. For a long time the Rugby style of play, with its close combination, short passes and steady defence, was the model on which other teams formed themselves. The secret of the success of Rugby was the close and unselfish combination and the hard work done by every member of the team. After the American victories of 1909 a bolder, harder hitting style was adopted, and the work of the forwards became more important, and longer passes are now the rule. But the main principles are the same. The forwards lead the attack and are supported by the half-back and back when playing towards the adversaries' goal. In defence the forwards hamper the opposing No. 3 and No. 4 and endeavour to clear the way for their own No. 3 and No. 4, who are trying not merely to keep the ball out of their own goal but to turn defence into attack. Each individual player must be a good horseman, able to make a pony gallop, must have a control of the ball, hitting hard and clean and in the direction he wishes it to go. He must keep his eye on the ball and yet know where the goal-posts are, must be careful not to incur penalties and quick to take advantage of an opportunity. Polo gives no time for second thoughts. A polo player must not be in a hurry, but he must never be slow nor dwell on his stroke. He must be able to hit when galloping his best pace on to the ball and able to use the speed of his pony in order to get pace. He must be able to hit a backhander or to meet a ball coming to him, as the tactics of the game require.

The Polo Pony.

Polo has given rise to a new type of horse, an animal of 14 hands 2 in. with the power of a hunter, the courage of a racehorse and the docility of a pony. At first the ponies were small, but now each pony must pass the Hurlingham official measurer and be entered on the register. The English system of measurement is the fairest and most humane possible. The pony stripped of his clothing is led by an attendant, not his own groom, into a box with a perfectly level floor and shut off from every distraction. A veterinary surgeon examines to see that the pony is neither drugged nor in any way improperly prepared. The pony is allowed to stand easily, and a measuring standard with a spirit-level is then placed on the highest point of the wither, and if the pony measures 14·2 and is five years old it is registered for life. Ponies are of many breeds. There are Arabs, Argentines, Americans, Irish and English ponies, the last two being the best. The Polo and Riding Pony Society, with headquarters at 12 Hanover Square, looks after the interests of the English and Irish pony and encourages their breeders. The English ponies are now bred largely for the game and are a blend of thoroughbred blood (the best are always the race-winning strains) or Arab and of the English native pony.

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POLONAISE (*i.e.* Polish, in French), a stately ceremonious dance, usually written in $\frac{3}{4}$ time. As a form of musical composition it has been employed by such composers as Bach, Handel, Beethoven, and above all by Chopin. It is usual to date the origin of the dance from the election (1573) of Henry duke of Anjou, afterwards Henry III. of France, to the throne of Poland. The ladies of the Polish nobility passed in ceremonial procession before him at Cracow to the sound of stately music. This procession of music became the regular opening ceremony at royal functions, and developed into the dance.

The term is also given to a form of skirted bodice, which has been fashionable for ladies at different periods.

POLONNARUWA, a ruined city and ancient capital of Ceylon. It first became a royal residence in A.D. 368, when the lake of Topawewa was formed, and succeeded Anuradhapura as the capital in the middle of the 8th century. The principal ruins date chiefly from the time of Prakrama Bahu (A.D. 1153–1186). The most imposing pile remaining is the Jetawanarama temple, a building 170 ft. in length, with walls about 80 ft. high and 12 ft. thick. The city is now entirely deserted, and, as in the case of Anuradhapura, its ruins have only recently been rescued from the jungle.

POLOTSK, a town of Russia, in the government of Vitebsk, at the confluence of the Polota with the Dvina, 62 m. by rail N.W. of the town of Vitebsk. Pop. 20,751. Owing to the continuous wars, of which, from its position on the line of communication between central Russia and the west it was for many centuries the scene, scarcely any of its remarkable antiquities remain. The upper castle, which stood at the confluence of the rivers and had a stone wall with seven towers, is in ruins, as is the lower castle formerly enclosed with strong walls and connected with the upper castle by a bridge. The cathedral of St Sophia in the upper castle, built in the 12th century, fell to ruins in the 18th century, whereupon the United Greek bishop substituted a modern structure. Upwards of two-thirds of the inhabitants are Jews; the remainder have belonged mostly to the Orthodox Greek Church since 1839, when they were compelled to abandon the United Greek Church. Flax, linseed, corn and timber are the leading articles of commerce.

Polotesk or Poltesk is mentioned in 862 as one of the towns given by the Scandinavian Rurik to his men. In 980 it had a prince of its own, Ragvald (Rogvolod or Rognvald), whose daughter is the subject of many legends. It remained an independent principality until the 12th century, resisting the repeated attacks of the princes of Kiev; those of Pskov, Lithuania, and the Livonian Knights, however, proved more effective, and Polotsk fell under Lithuanian rule in 1320. About 1385 its independence was destroyed by the Lithuanian prince Vitovt. It was five times besieged by Moscow in 1500–18, and was taken by Ivan the Terrible in 1563. Recaptured by Stephen Bathory, king of Poland, sixteen years later, it became Polish by the treaty of 1582. It was then a large and populous city, and carried on an active commerce. Pestilences and conflagrations were its ruin; the plague of 1566 wrought great havoc among its inhabitants, and that of 1600 destroyed 15,000. The castles, the town and its walls were burned in 1607 and 1642. The Russians continued their attacks, burning and plundering the town, and twice, in 1633 and 1705, taking possession of it for a few years. It was not definitely annexed, however, to Russia until 1772, after the first dismemberment of Poland. In 1812 its inhabitants resisted the French invasion, and the town was partially destroyed.

POLTAVA, a government of south-western Russia, bounded by the government of Chernigov on the N., Kharkov on the E., Ekaterinoslav and Kherson on the S., and Kiev on the W., and having an area of 19,260 sq. m. Its surface is an undulating plain 500 to 600 ft. above sea-level, with a few elevations reaching 670 ft. in the north, and gently sloping to 300 and 400 ft. in the south-west. Owing to the deep excavations of the rivers, their banks, especially those on the right, have the aspect of hilly tracts, while low plains stretch to the left. Almost the whole of the surface consists of Tertiary deposits; Cretaceous rocks appear in the north-east, at the bottom of the deeper ravines. The government touches the granitic region of the Dnieper only in the south, below Kremenchug. Limestone with dolerite veins occurs in the isolated hill of Isachek, which rises above the marshes of the Sula. The whole is covered with a layer, 20 to 60 ft. thick, of boulder clay, which again is often mantled with a thick sheet of loess. Sandstone (sometimes suitable for grindstones) and limestone are quarried, and a few beds of gypsum and peat-bog are known within the government. With the exception of some sandy tracts, the soil is on the whole very fertile. Poltava is drained by the Dnieper, which flows along its border, navigable throughout, and by its tributaries the Sula, Psiol, Vorskla, Orel, Trubezh, and several others, none of them navigable, although their courses vary from 150 to 270 m. each in length. Even those which used to be navigated within the historical period, such as the Trubezh and Supoi, are now drying up, while the others are being partially transformed into marshes. Deep sand-beds intersected by numberless ravines and old arms of the river stretch along the left bank of the Dnieper, where accordingly the settlements are few. Only 5% of the total area is under forest; timber, wooden wares, and pitch are imported.

The estimated population in 1906 was 3,312,400. The great majority are Little Russians. Agriculture is the principal pursuit, 60% of the total area being arable land. The crops chiefly grown are wheat, rye and oats; the sunflower is largely cultivated, especially for oil, and the growing of tobacco, always important, has made a great advance. Kitchen gardening, the cultivation of the plum, and the preparation of preserved fruits are important branches of industry. At Lubny, where an apothecaries' garden is maintained by the Crown, the collection and cultivation of medicinal plants are a speciality. The main source of wealth in Poltava always has been, and still is, its live-stock breeding—horses, cattle, sheep, pigs. Some of the wealthier landowners and many peasants rear finer breeds of horses. The land is chiefly owned by the peasants, who possess 52% of the cultivable area; 42% belongs to private persons, and the remainder to the Crown, the clergy, and the municipalities.

Among the manufactures distilleries hold the leading place, after which come flour-mills, tobacco factories, machine-making, tanneries, saw-mills, sugar-works and woollen manufactures. In the villages and towns several domestic trades are carried on, such as the preparation of sheepskins, plain woollen cloth, leather, boots and pottery. The fair of Poltava is of great importance for the whole woollen trade of Russia, and leather, cattle, horses, coarse woollen cloth, skins, and various domestic wares are exchanged for manufactures imported from Great Russia. The value of merchandise brought to the fair averages over £2,500,000. Several other fairs, the aggregate returns for which reach more than one-half of the above, are held at Romny (tobacco), Kremenchug (timber, corn, tallow and salt), and Kobelyaki (sheepskins). Corn is exported to a considerable extent to the west and to Odessa, as also saltpetre, spirits, wool, tallow, skins and woollen cloth. The Dnieper is the principal artery for the exports and for the import—timber. The chief river-ports are Kremenchug and Poltava. Steamers ply between Kiev and Ekaterinoslav; but the navigation is hampered by want of water and becomes active only in the south. Traffic mostly follows the railway. Poltava is divided into fifteen districts, of which the chief towns are Poltava, Gadyach, Khorol, Kobelyaki, Konstantinograd, Kremenchug, Lokhvitsa, Lubny, Mirgorod, Pereyaslavl, Piryatin, Priluki, Romny, Zenkov and Zolotonosha.

History.—At the dawn of Russian history the region now occupied by Poltava was inhabited by the Slav tribe of the Syeveryanes. As early as 988 the Russians erected several towns on the Sula and the Trubezh for their protection against the Turkish Petchenegs and Polovtsi, who held the south-eastern steppes. Population extended, and the towns of Pereyaslavl, Lubny, Priluki, Piryatin, Romny, begin to be mentioned in the 11th and 12th centuries. The Mongol invasion of 1239–42 destroyed most of them, and for two centuries afterwards they disappear from Russian annals. About 1331 Gedimin, prince of Lithuania, annexed the so-called "Syeversk towns" and on the recognition of the union of Lithuania with Poland they were included in the united kingdom along with the remainder of Little Russia. In 1476 a separate principality of Kiev under Polish rule and Polish institutions was formed out of Little Russia, and remained so until the rising of the Cossack chief Bogdan Chmielnicki in 1654. By the Andrussowo Treaty, the left bank of the Dnieper being ceded to Russia, Poltava became part of the dominions of the Zaporogian Cossacks, and was divided into "regiments," six of which (Poltava, Pereyaslavl, Priluki, Gadyach, Lubny and Mirgorod) lay within the limits of the present government. They lost their independence in 1764. (P. A. K.; J. T. Be.)

POLTAVA, a town of Russia, capital of the government of the same name, on the right bank of the Vorskla, 88 m. by rail W.S.W. of Kharkov. Pop. 53,060. The town is built on a plateau which descends by steep slopes on nearly every side. Several suburbs, inhabited by Cossacks, whose houses are buried amid gardens, and a German colony, surround the town. The oldest buildings are a monastery, erected in 1650, and a wooden church visited by Peter the Great after the battle of Poltava. There are a military school for cadets, a theological seminary and two girls' colleges; also flour-mills, tobacco works and a tannery.

Poltava is mentioned in Russian annals in 1174, under the name of Ltava, but does not again appear in history until 1430, when, together with Glinsk, it was given by Gedimin, prince of Lithuania, to the Tatar prince Leksada. Under the Cossack chief, Bogdan Chmielnicki, it was the chief town of the Poltava "regiment." Peter the Great of Russia defeated Charles XII. of Sweden in the immediate neighbourhood on the 27th of June 1709, and the victory is commemorated by a column over 50 ft. in height.

POLTERGEIST (Ger. for "racketing spirit"), the term applied to certain phenomena of an unexplained nature, such as movements of objects without any traceable cause, and noises equally untraced to their source; but in some cases exhibiting intelligence, as when raps answer a question by a code. In the word *Poltergeist*, the phenomena are attributed to the action of a *Geist*, or spirit: of old the popular explanation of all residuary phenomena. The hypothesis, in consequence of the diffusion of education, has been superseded by that of "electricity"; while sceptics in all ages and countries have accounted for all the phenomena by the theory of imposture. The last is at least a *vera causa*: imposture has often been detected; but it is not so certain that this theory accounts for all the circumstances. To the student of human nature the most interesting point in the character of poltergeist phenomena is their appearance in the earliest known stages of culture, their wide diffusion, and their astonishing uniformity. Almost all the beliefs usually styled "superstitious" are of early occurrence and of wide diffusion: the lowest savages believe in ghosts of the dead and in wraiths of the living. Such beliefs when found thriving in our own civilization might be explained as mere survivals from savagery, memories of all

> "The superstitions idle-headed eld
> Received and did deliver to our age."

But we have not to deal only with a belief that certain apparently impossible things may occur and have occurred in the past. We are met by the evidence of sane and credible witnesses, often highly educated, who maintain that they themselves have heard and beheld the unexplained sounds and sights. It appears, therefore, that in considering the phenomena of the poltergeist we are engaged with facts of one sort or another; facts produced either by skilled imposture, or resting on hallucinations of the witnesses; or on a mixture of fraud and of hallucination caused by "suggestion." There remains the chance that some agency of an unexplored nature is, at least in certain cases, actually at work.

A volume would be needed if we were to attempt to chronicle the phenomena of the poltergeist as believed in by savages and in ancient and medieval times. But among savages they are usually associated with the dead, or with the medicine-men of the tribes. These personages are professional "mediums," and like the mediums of Europe and America, may be said to have domesticated the poltergeist. At their séances, savage or civilized, the phenomena are reported to occur—such as rappings and other noises, loud or low, and "movements of objects without physical contact." (See, for a brief account, A. Lang, *Cock Lane and Common Sense*, "Savage Spiritualism"; and see the Jesuit *Lettres édifiantes*, North America, 1620–1770, and Kohl's *Kitchi Gami*.) But "induced phenomena," where professional mediums and professional medical men are the agents, need not here be considered. The evidence, unless in the case of Sir William Crookes's experiments with Daniel Dunglas Home, is generally worthless, and the laborious investigations of the Society for Psychical Research resulted only in the detection of fraud as far as "physical" manifestations by paid mediums were concerned.

The spontaneous poltergeist, where, at least, no professional is present, and no séance is being held, is much more curious and interesting than the simple tricks played in the dark by impudent charlatans. The phenomena are identical, as reported, literally "from China to Peru." The Cieza de Leon (1549) tells us that the cacique of Pirza, in Popyan, during his conversion to Christianity, was troubled by stones falling mysteriously through the air (the mysterious point was the question of whence they came, and what force urged them), while Christians saw at his table a glass of liquor raised in the air, by no visible hand, put down empty, and replenished! Mr Dennys (*Folk Lore of China*, 1876, p. 79) speaks of a Chinese householder who was driven to take refuge in a temple by the usual phenomena—throwing about of crockery and sounds of heavy footfalls—after the decease of an aggrieved monkey. This is only one of several Chinese cases of poltergeist; and the phenomena are described in Jesuit narratives of the 18th century, from Cochin China. In these papers no explanation is suggested. There is a famous example in a nunnery, recorded (1528) by a notable witness, Adrien de Montalembert, almoner to Francis I. The agent was supposed to be the spirit of a sister recently deceased.

Among multitudes of old cases, that of the "Drummer of Tedworth" (1662–1663; see Glanvil, *Sadducismus triumphatus*, 1666); that at Rerrick, recorded by the Rev. Mr Telfer in 1695; that of the Wesley household (1716–1717) chronicled in contemporary letters and diaries of the Wesley family (Southey's *Life of John Wesley*); that of Cideville (1851), from the records of the court which tried the law-suit arising out of the affair (*Proc. Soc. Psychical Research*, xviii. 454–463); and the Alresford case, attested by the great admiral, Lord St Vincent, are among the most remarkable. At Tedworth we have the evidence of Glanvil himself, though it does not amount to much; at Rerrick, Telfer was a good chronicler and gives most respectable signed vouchers for all the marvels: Samuel Wesley and his wife were people of sense, they were neither alarmed nor superstitious, merely puzzled; while the court which tried the Cideville case, only decided that "the cause of the events remains unknown." At Alresford, in Hampshire, the phenomena attested by Lord St Vincent and his sister Mrs Ricketts, who occupied the house, were peculiarly strange and emphatic: the house was therefore pulled down. At Willington Mill, near Morpeth (1831–1847), the phenomena are attested by the journal of Mr Procter, the occupant, a Quaker, a "tee-totaller," and a man of great resolution. He and his family endured unspeakable things for sixteen years, and could find no explanation of the sights and sounds, among which were phantasms of animals, as at Epworth, in the Wesley case.

Of all these cases that of the Wesleys has attracted most critical attention. It was not, in itself, an extreme instance of poltergeist: at Alresford, at the close of the 18th century, and at Willington Mill in the middle of the 19th the disturbances were much more violent and persistent than at Epworth, while our evidence is, in all three examples, derived from the contemporary narratives, letters and journals of educated persons. The Wesleys, however, were people so celebrated and so active in religion that many efforts have been made to explain their "old Jeffrey," as they called the disturbing agency. These attempts at explanation have been fruitless. The poet Coleridge, who said that he knew many cases, explained all by a theory of contagious epidemic hallucination of witnesses. Dr Salmon, of Trinity College, Dublin, set all down to imposture by Hetty Wesley, a vivacious girl (*Fortnightly Review*, 1866). The documents on which he relied, when closely studied, did not support his charges, for he made several important errors in dates, and on these his argument rested. F. Podmore, in several works (*e.g. Studies in Psychical Research*), adopted a theory of exaggerative memory in the narrators, as one element, with a dose of imposture and of hallucination begotten of excited expectation. The Wesley letters and journals, written from day to day, do not permit of exaggerative memory, and when the records of 1716–1717 are compared with the reminiscences collected from his family by John Wesley in 1726, the discrepancies are seen to be only such as occur in all human evidence about any sort of events, remote by nine or ten years. Thus, in 1726, Mrs Wesley mentioned a visionary badger seen by her. She did not write about it to her son Samuel in 1717, but her husband and her daughter did then describe it to Samuel, as an experience of his mother at that date. The whole family, in 1717, became familiar with the phenomena, and were tired of them and of Samuel's questions. (Mr Podmore's arguments are to be found in the *Journal of the Studies of Psychical Research*, ix. 40–45. Some dates are misprinted.) The theory of hallucination cannot account for the uniformity of statements, in many countries and at many dates, to the effect that the objects mysteriously set in motion moved in soft curves and swerves, or "wobbled." Suppose that an adroit impostor is throwing them, suppose that the spectators are excited, why should their excitement everywhere produce a uniform hallucination as to the mode of motion? It is better to confess ignorance, and remain in doubt, than to invent such theories.

A modern instance may be analysed, as the evidence was given contemporaneously with the events (Podmore, *Proc. Soc. Psychical Research*, xii. 45–58: "Poltergeists"). On the 20th or 21st of February 1883 a Mrs White, in a cottage at Worksop, was "washing up the tea-things at the table," with two of her children in the room, when "the table tilted up at a considerable angle," to her amazement. On the 26th of February, Mr White being from home, Mrs White extended hospitality to a girl, Eliza Rose, "the child of an imbecile mother." Eliza is later described as "half-witted," but no proof of this is given. On the 1st of March, White being from home, at about 11.30 p.m. a number of things "which had been in the kitchen a few minutes before" came tumbling down the kitchen stairs. Only Mrs White and Eliza Rose were then in the kitchen. Later some hot coals made an invasion. On the following night, White being at home in the kitchen, with his wife and Eliza, a miscellaneous throng of objects came in, Mr White made vain research upstairs, where was his brother Tom. On his return to the kitchen "a little china woman left the mantelpiece and flew into the corner." Being replaced, it repeated its flight, and was broken. White sent his brother to fetch a doctor; there also came a policeman, named Higgs; and the doctor and policeman saw, among other things, a basin and cream jug rise up automatically, fall on the floor and break. Next morning, a clock which had been silent for eighteen months struck; a crash was heard, and the clock was found to have leapt over a bed and fallen on the floor. All day many things kept flying about and breaking themselves, and Mr White sent Miss Rose about her business. Peace ensued.

Mr Podmore, who visited the scene on the 7th and 8th of April and collected depositions, says (writing in 1883): "It may be stated generally that there was no possibility, in most cases, of the objects having been thrown by hand. . . . Moreover it is hard to conceive by what mechanical appliances, under the circumstances described, the movements could have been effected. . . . To suppose that these various objects were all moved by mechanical contrivances argues incredible stupidity, amounting almost to imbecility, on the part of all the persons present who were not in the plot," whereas Higgs, Dr Lloyd and a miner named Curass, all "certainly not wanting in intelligence," examined the objects and could find no explanation. White attested that fresh invasions of the kitchen by inanimate objects occurred as Eliza was picking up the earlier arrivals; and he saw a salt-cellar fly from the table while Eliza was in another part of the room. The amount of things broken was valued by White at £9. No one was in the room when the clock struck and fell. Higgs saw White shut the cupboard doors, they instantly burst open, and a large glass jar flew into the yard and broke. "The jar could not go in a straight line from the cupboard out of the door; but it certainly did go" (Higgs). The depositions were signed by the witnesses (April 1883).

In 1896, Mr Podmore, after thirteen years of experience in examining reports of the poltergeist, produced his explanations. (1) The witnesses, though "honest and fairly intelligent," were "imperfectly educated, not skilled in accurate observation of any kind." (They described, like many others, in many lands, the "wobbling" movement of objects in flight.) (2) Mr Podmore took the evidence five weeks after date; there was time for exaggerated memories. (Mr Podmore did not consult, it seems, the *contemporary* evidence of Higgs in the *Retford and Gainsborough Times*, 9th of March 1883. On examination it proves to tally as precisely as possible with the testimonies which he gave to Mr Podmore, except that in March he mentioned one or two miracles which he omitted five weeks later! The evidence is published in Lang's *The Making of Religion*, 1898, p. 356.) (3) In the evidence given to Mr Podmore five weeks after date, there are discrepancies between Higgs and White as to the sequence of some events, and as to whether one Coulter was present when the clock fell: he asserts, Higgs and White deny it. (There is never evidence of several witnesses, five weeks after an event, without such discrepancies. If there were, the evidence would be suspected as "cooked." Higgs in April gave the same version as in March.) (4) As there are discrepancies, the statements that Eliza was not always present at the abnormal occurrences may be erroneous. "It is perhaps not unreasonable to conjecture that Eliza Rose herself, as the instrument of mysterious agencies, or simply as a half-witted girl gifted with abnormal cunning and love of mischief, may have been directly responsible for all that took place." (*How*, if, as we have seen, the theory of mechanical appliances is abandoned, "under the circumstances described"? We need to assume that all the circumstances are wrongly described. Yet events did occur, the breakages were lamentable, and we ask how could the most half-witted of girls damage so much property undetected, under the eyes of the owner, a policeman, a medical practitioner and others? How could she throw things from above into the room where she was picking up the things as they arrived? Or is that a misdescription? No evidence of Eliza's half-wittedness and abnormal cunning is adduced. If we call her "the instrument of mysterious agencies," the name of these agencies is—poltergeist! No later attempt to find and examine the abnormal girl is recorded.)

The explanations are not ideally satisfactory, but they are the result, in Mr Podmore's mind, of examination of several later cases of poltergeist.[1] In one a girl, carefully observed, was detected throwing things, and evidence that the phenomena occurred, in her absence, at another place and time, is discounted. In several other cases, exaggerations of memory, malobservation and trickery combined, are the explanations, and the conclusion is that there is "strong ground" for believing in trickery as the true explanation of all these eleven cases, including the Worksop affair. Mr Podmore asserts that, at Worksop, "the witnesses did not give their testimony until some weeks after the event." That is an erroneous statement as far as Higgs goes, the result apparently of malobservation of the local newspaper. More or less of the evidence was printed in the week when the events occurred. Something more than unconscious exaggeration, or malobservation, seems needed to explain the amazing statements made by Mr Newman, a gamekeeper of Lord Portman, on the 23rd of January 1895, at Durmeston in another case. Among other things, he said that on the 18th of December 1894, a boot flew out of a door. "I went and put my foot on the boot and said 'I defy anything to move this boot.' Just as I stepped off, it rose up behind me and knocked my hat off. There was nobody behind me." Gamekeepers are acute observers, and if the narrative be untrue, malobservation or defect of memory does not explain the fact. In this case, at Durmeston, the rector, Mr Anderson, gave an account of some of the minor phenomena. He could not explain them, and gave the best character to the Nonconformist mother of the child with whom the events were associated. No trickery was discovered.

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[1] The present writer criticized Mr Podmore's explanation in *The Making of Religion*. Mr Podmore replied (*Proc. Soc. Psychical Research*, xiv. 133, 136), pointing out an error in the critic's presentation of his meaning. He, in turn, said that the writer "champions the supernormal interpretation," which is not exact, as the writer has no theory on the subject, though he is not satisfied that "a naughty little girl" is a uniformly successful solution of the poltergeist problem.

The phenomena are frequently connected with a person, often a child, suffering from nervous malady or recent nervous shock. No such person appears in the Alresford, Willington, Epworth and Tedworth cases, and it is not stated that Eliza Rose at Worksop was subjected to a medical examination. In a curious case, given by Mrs Crewe, in *The Night Side of Nature*, the young person was the daughter of a Captain Molesworth. Her own health was bad, and she had been depressed by the death of a sister. Captain Molesworth occupied a semi-detached villa at Trinity, near Edinburgh; his landlord lived next door. The phenomena set in: the captain bored holes in the wall to discover a cause in trickery, and his landlord brought a suit against him in the sheriff's court at Edinburgh.

The papers are preserved, but the writer found that to discover them would be a herculean labour. He saw, however, a number of documents in the office of a firm of solicitors employed in the case. They proved the fact of the lawsuit but threw no other light on the matter. We often find that the phenomena occur after a nervous shock to the person who may be called the medium. The shock is frequently consequent on a threat from a supposed witch or wizard. This was the case at Cideville in 1850–1851. (See an abstract of the documents of the trial, *Proceedings S.P.R.* xviii. 454-463. The entire report was sent to the writer.) In 1901 there was a case at Great Grimsby; the usual flying of stones and other objects occurred. The woman of the house had been threatened by a witch, after that the poltergeist developed. No explanation was forthcoming. In *Proc. S.P.R.* xvii. 320 the Rev. Mr Deanley gives a curious parallel case with detection of imposture. In Miss O'Neal's *Devonshire Idylls* is an excellent account of the phenomena which occurred after a Devonshire girl of the best character, well known to Miss O'Neal, had been threatened by a witch. In the famous instance of Christian Shaw of Bargarran (1697) the child had been thrice formally cursed by a woman, who prayed to God that her soul "might be hurled through hell." Christian fell into a state which puzzled the medical faculty (especially when she floated in the air), and doubtless she herself caused, in an hysterical state, many phenomena which, however, were not precisely poltergeistish. A very marked set of phenomena, in the way of movements of objects, recently occurred in the Hudson Bay territory, after a half-breed girl had received a nervous shock from a flash of lightning that struck near her. Heavy weights automatically "tobogganed," as Red Indian spectators said, and there were the usual rappings in tent and wigwam. If we accept trickery as the sufficient explanation, the uniformity of tricks played by hysterical patients is very singular. Still more singular is a long series, continued through several years, of the same occurrences where no hysterical patient is known to exist. In a very curious example, a carpenter's shop being the scene, there was concerned nobody of an hysterical temperament, no young boy or girl, and there was no explanation (*Proc. S.P.R.* vii. 383-394). The events went on during six weeks. An excellent case of hysterical fraud by a girl in France is given by Dr Grasset, professor of clinical medicine at Montpellier (*Proc. S.P.R.* xviii. 464-480). But in this instance, though things were found in unusual places, nobody over eight years old saw them flying about; yet all concerned were deeply superstitious.

On the whole, while fraud, especially hysterical fraud, is a *vera causa* in some cases of poltergeist, it is not certain that the explanation fits all cases, and it is certain that detection of fraud has often been falsely asserted, as at Tedworth and Willington. No good chronic case, as at Alresford, Epworth, Spraiton (Bovet's *Pandaemonium*), Willington, and in other classical instances, has been for months sedulously observed by sceptics. In short-lived cases, as at Worksop, science appears on the scene long enough after date to make the theory of exaggeration of memory plausible. If we ask science to explain how the more remarkable occurrences could be produced by a girl *ex hypothese* half-witted, the reply is that the occurrences never occurred, they were only "described as occurring" by untrained observers with "patent double magnifying" memories; and with a capacity for being hallucinated in a uniform way all the world over. Yet great quantities of crockery and furniture were broken, before the eyes of observers, in a house near Ballarmina, in North Ireland, in January 1907. The experiment of exhibiting a girl who can break all the crockery without being detected, in the presence of a doctor and a policeman, and who can, at the same time, induce the spectators to believe that the flying objects waver, swerve and "wobble," has not been attempted.

An obvious difficulty in the search for authentic information is the circumstance that the poor and imperfectly educated are much more numerous than the well-to-do and well educated. It is therefore certain that most of the disturbances will occur in the houses of the poor and ill educated, and that their evidence will be rejected as insufficient. When an excellent case occurs in a palace, and is reported by the margravine of Bayreuth, sister of Frederick the Great, in her *Memoirs*, the objection is that her narrative was written long after the events. When we have contemporary journals and letters, or sworn evidence, as in the affairs of Sir Philip Francis, Cideville and Willington, criticism can probably find some other good reasons for setting these testimonies aside. It is certain that the royal, the rich and the well-educated observers tell, in many cases, precisely the same sort of stories about poltergeist phenomena as do the poor and the imperfectly instructed.

On the theory that there exist "mysterious agencies" which now and then produce the phenomena, we may ask what these agencies can possibly be? But no answer worthy of consideration has ever been given to this question. The usual reply is that some unknown but intelligent force is disengaged from the personality of the apparent medium. This apparent medium need not be present; he or she may be far away. The Highlanders attribute many poltergeist phenomena, inexplicable noises, sounds of viewless feet that pass, and so forth, to *tàradh*, an influence exerted unconsciously by unduly strong wishes on the part of a person at a distance. The phrase *falbh air fàrsaing* ("going uncontrolled") is also used (Campbell, *Witchcraft and Second Sight in the Scottish Highlands*, 1902, pp. 144-147). The present writer is well acquainted with cases attributed to *tàradh*, in a house where he has often been a guest. They excite no alarm, their cause being well understood. We may call this kind of thing *telethoryby*, a racket produced from a distance. A very marked case in Illinois would have been attributed in the Highlands to the *tàradh* of the late owner of the house, a dipsomaniac in another state. On his death the disturbances ceased (first-hand evidence from the disturbed lady of the house, May 1907). It may be worth while to note that the phenomena are often regarded as death-warnings by popular belief. The early incidents at the Wesleys' house were thought to indicate the death of a kinsman; or to announce the approaching decease of Mr Wesley *père*, who at first saw and heard nothing unusual. At Worksop the doctor was called in, because the phenomena were guessed to be "warnings" of the death of a sick child of the house. The writer has first-hand evidence from a lady and her son (afterwards a priest) of very singular movements of untouched objects in their presence, which did coincide with the death of a relation at a distance.

Bibliography.—The literature of the subject is profuse, but scattered. For modern instances the *Proceedings of the Society for Psychical Research* may be consulted, especially an essay by F. W. H. Myers, vii. 146–198, also iv. 29–38; with the essay by Podmore, already quoted. Books like Dale Owen's *Footfalls on the Boundary of Another World*, and Fresnoy's *Recueil des dissertations sur les apparitions*, are stronger in the quantity of anecdotes than in the quality of evidence. A. Lang's *Book of Dreams and Ghosts*, contains outlandish and Celtic examples, and Telfair's (Telfer's) *A True Relation of an Apparition* (1694–1696) shows unusual regard for securing signed evidence. Kiesewetter's *Geschichte des neueren Occultismus* and Graham Dalyell's *Darker Superstitions of Scotland*, with any collections of trials for witchcraft,

may be consulted, and Bovet's *Pandaemonium* (1684) is very rich in cases. The literature of the famous drummer of Tedworth (March 1662–April 1663) begins with an abstract of the sworn deposition of Mr Mompesson, whose house was the scene of the disturbances. The abstract is in the *Mercurius publicus* of April 1663, the evidence was given in a court of justice on the 15th of April. There is also a ballad, a rhymed news-sheet of 1662 (Anthony Wood's Collection 401 (193), Bodleian Library). Pepys mentions "books" about the affair in his *Diary* for June 1663. Glanvil's first known version is in his *Sadducismus triumphatus* of 1666. The sworn evidence of Mompesson proves at least that he was disturbed in an intolerable manner, certainly beyond any means at the disposal of his two daughters, aged nine and eleven or thereabouts. The agent may have been the *tàradh* of the drummer whom Mompesson offended. Glanvil in 1666 confused the dates, and, save for his own experiences, merely repeats the statements current in 1662–1663. The ballad and Mompesson's deposition are given in *Proc. S.P.R.* xvii. 304–336, in a discussion between the writer and Mr Podmore. The dated and contemporary narrative of Procter in the Willington Mill case (1835–1847), is printed in the *Journ. S.P.R.* (Dec. 1892), with some contemporary letters on the subject. Mr Procter endured the disturbances for sixteen years before he retreated from the place. There was no naughty little girl in the affair; no nervous or hysterical patient. The Celtic hypothesis of *tàradh*, exercised by "the spirit of the living," includes visual apparitions, and many a so-called "ghost" of the dead may be merely the *tàradh* of a living person. (A. L.)

POLTROON, a coward, a worthless rogue without courage or spirit. The word comes through Fr. *poltron* from Ital. *poltrone*, an idle fellow, one who lolls in a bed or couch (Milanese *polter*, Venetian *poltrona*, adapted from Ger. *Polster*, a pillow; cf. English "bolster"). The old guess that it was from Lat. *pollice truncus*, maimed in the thumb, and was first applied to those who avoided military service by self-mutilation, gave rise probably to the French application of *poltron* to a falcon whose talons were cut to prevent its attacking game.

POLTROT, JEAN DE (*c.* 1537–1563), sieur de Méré or Mérey, a nobleman of Angoumois, who murdered Francis, duke of Guise. He had lived some time in Spain, and his knowledge of Spanish, together with his swarthy complexion, which earned him the nickname of the "Espagnolet," procured him employment as a spy in the wars against Spain. Becoming a fanatical Huguenot, he determined to kill the duke of Guise, and gained admission as a deserter to the camp of the Catholics who were besieging Orleans. In the evening of the 18th of February 1563 he hid by the side of a road along which he knew the duke would pass, fired a pistol at him, and fled. But he was captured the next day, and was tried, tortured several times, and sentenced to be drawn and quartered. On the 18th of March 1563 he underwent a frightful punishment. The horses not being able to drag off his limbs, he was hacked to pieces with cutlasses. He had made several contradictory declarations regarding the complicity of Coligny. The admiral protested emphatically against the accusation, which appears to have had no foundation.

See *Mémoires du prince de Condé* (London, 1743); T. A. D'Aubigné, *Histoire universelle* (ed. by de Ruble, *Soc. de l'histoire de France*, 1886); A. de Ruble, *L'Assassinat du duc François de Lorraine* (Paris, 1897).

POLYAENUS, a Macedonian, who lived at Rome as a rhetorician and pleader in the 2nd century A.D. When the Parthian War (162–5) broke out, Polyaenus, too old to share in the campaign, dedicated to the emperors Marcus Aurelius and Lucius Verus a work, still extant, called *Strategica* or *Strategemata*, a historical collection of stratagems and maxims of strategy written in Greek and strung together in the form of anecdotes. It is not strictly confined to warlike stratagems, but includes also examples of wisdom, courage and cunning drawn from civil and political life. The work is uncritically written, but is nevertheless important on account of the extracts it has preserved from histories now lost. It is divided into eight books (parts of the sixth and seventh are lost), and originally contained nine hundred anecdotes, of which eight hundred and thirty-three are extant. Polyaenus intended to write a history of the Parthian War, but there is no evidence that he did so. His works on Macedonia, on Thebes, and on tactics (perhaps identical with the *Strategica*) are lost.

His *Strategica* seems to have been highly esteemed by the Roman emperors, and to have been handed down by them as a sort of heirloom. From Rome it passed to Constantinople; at the end of the 9th century it was diligently studied by Leo VI., who himself wrote a work on tactics; and in the middle of the 10th century Constantine Porphyrogenitus mentioned it as one of the most valuable books in the imperial library. It was used by Stobaeus, Suidas, and the anonymous author of the work Περὶ ἀπίστων (see PALAEPHATUS). It is arranged as follows: bks. i., ii., iii., stratagems occurring in Greek history; bk. iv., stratagems of the Macedonian kings and successors of Alexander the Great; bk. v., stratagems occurring in the history of Sicily and the Greek islands and colonies; bk. vi., stratagems of a whole people (Carthaginians, Lacedaemonians, Argives), together with some individuals (Philopoemen, Pyrrhus, Hannibal); bk. vii., stratagems of the barbarians (Medes, Persians, Egyptians, Thracians, Scythians, Celts); bk. viii., stratagems of Romans and women. This distribution is not, however, observed very strictly. Of the negligence or haste with which the work was written there are many instances: *e.g.* he confounds Dionysius the elder and Dionysius the younger, Mithradates satrap of Artaxerxes and Mithradates the Great, Scipio the elder and Scipio the younger, Perseus, king of Macedonia and Perseus the companion of Alexander; he mixes up the stratagems of Caesar and Pompey; he brings into immediate connexion events which were totally distinct; he narrates some events twice over, with variations according to the different authors from whom he draws. Though he usually abridges, he occasionally amplifies arbitrarily the narratives of his authorities. He never mentions his authorities, but amongst authors still extant he used Herodotus, Thucydides, Xenophon, Polybius, Diodorus, Plutarch, Frontinus and Suetonius; amongst authors of whom only fragments now remain he drew upon Ctesias, Ephorus, Timaeus, Phylarchus and Nicolaus Damascenus. His style is clear, but monotonous and inelegant. In the forms of his words he generally follows Attic usage.

The best edition of the text is Wölfflin and Melber (Teubner Series, 1887, with bibliography and editio princeps of the *Strategemata* of the emperor Leo); annotated editions by Isaac Casaubon (1589) and A. Coraës (1809); I. Melber, *Ueber die Quellen und Werth der Strategemensammlung Polyäns* (1885); Knott, *De fide et fontibus Polyaeni* (1883), who largely reduces the number of the authorities consulted by Polyaenus. Eng. trans. by R. Shepherd (1793).

POLYANDRY (Gr. πολύς, many, and ἀνήρ, man), the system of marriage between one woman and several men, who are her husbands exclusively (see FAMILY). The custom locally legalizing the marriage of one woman to more than one husband at a time has been variously accounted for as the result of poverty and of life in unfertile lands, where it was essential to check population as the consequence of female infanticide, or, in the opinion of J. F. McLennan and L. H. Morgan, as a natural phase through which human progress has necessarily passed. Polyandry is to be carefully differentiated from communal marriage, where the woman is the property of any and every member of the tribe. Two distinct kinds of polyandry are practised: one, often called Nair, in which, as among the Nairs of India, the husbands are not related to each other; and the second, the Tibetan or fraternal polyandry, in which the woman is married to all the brothers of one family. Polyandry is practised by the tribes of Tibet, Kashmir and the Himalayan regions, by the Todas, Koorgs, Nairs and other peoples of India, in Ceylon, New Zealand, by some of the Australian aborigines, in parts of Africa, in the Aleutian archipelago, among the Koryaks and on the Orinoco.

See McLennan's *Primitive Marriage* (London, 1885); *Studies in Ancient History* (London, 1886); "The Levirate and Polyandry," in *The Fortnightly Review*, new series, vol. xxi. (London, 1877); L. H. Morgan, *System of Consanguinity and Affinity of the Human Family* (Washington, 1869); Lord Avebury, *Origin of Civilization*; E. Westermarck, *History of Human Marriage*.

POLYANTHUS, one of the oldest of the florists' flowers, is probably derived from *P. variabilis*, itself a cross between the common primrose and the cowslip; it differs from the primrose in having the umbels of flowers carried up on a stalk. The florists' polyanthus has a golden margin, and is known as the gold-laced polyanthus, the properties being very distinctly laid down and rigidly adhered to. The chief of these are a clear, unshaded, blackish or reddish ground colour, an even margin or lacing of yellow extending round each segment and cutting through its centre down to the ground colour, and a yellow band surrounding the tube of exactly the same hue as the yellow of the lacing. The plants are quite hardy, and grow best in strong, loamy soil tolerably well enriched with well-decayed dung and leaf-mould;

they should be planted about the end of September or not later than October. Plants for exhibition present a much better and cleaner appearance if kept during winter in a cold well-aired frame.

For the flower borders what are called fancy polyanthuses are adopted. These are best raised annually from seed, the young crop each year blooming in succession. The seed should be sown as soon as ripe, the young plants being allowed to stand through the winter in the seed bed. In April or May they are planted out in a bed of rich garden soil, and they will bloom abundantly the following spring. A few of the better "thrum-eyed" sorts (those having the anthers in the eye, and the pistil sunk in the tube) should be allowed to ripen seed; the rest may be thrown away. In some remarkable forms which have been cultivated for centuries the ordinarily green calyx has become petaloid; when this is complete it forms the hose-in-hose primrose of gardeners. There are also a few well-known double-flowered varieties.

POLYBIUS (*c.* 204–122 B.C.), Greek historian, was a native of Megalopolis in Arcadia, the youngest of Greek cities (Paus. viii. 9), which, however, played an honourable part in the last days of Greek freedom as a stanch member of the Achaean League (*q.v.*). His father, Lycortas, was the intimate friend of Philopoemen, and on the death of the latter, in 182, succeeded him as leader of the league. The date of Polybius's birth is doubtful. He tells us himself that in 181 he had not yet reached the age (? thirty years, Polyb. xxix. 9) at which an Achaean was legally capable of holding office (xxiv. 6). We learn from Cicero (*Ad Fam.* v. 12) that he outlived the Numantine War, which ended in 132, and from Lucian (*Macrob.* 22) that he died at the age of eighty-two. The majority of authorities therefore place his birth between 214 and 204 B.C. Little is known of his early life. As the son of Lycortas he was naturally brought into close contact with the leading men of the Achaean League. With Philopoemen he seems to have been on intimate terms. After Philopoemen's tragic death in Messenia (182) he was entrusted with the honourable duty of conveying home the urn in which his ashes had been deposited (Plut. *Phil.* 21). In 181, together with his father, Lycortas and the younger Aratus, he was appointed, in spite of his youth, a member of the embassy which was to visit Ptolemy Epiphanes, king of Egypt, a mission, however, which the sudden death of Ptolemy brought to a premature end (xxv. 7). The next twelve years of his life are a blank, but in 169 he reappears as a trusted adviser of the Achaeans at a difficult crisis in the history of the League. In 171 war had broken out between Rome and the Macedonian king Perseus, and the Achaean statesmen were divided as to the policy to be pursued; there were good reasons for fearing that the Roman senate would regard neutrality as indicating a secret leaning towards Macedon. Polybius therefore declared for an open alliance with Rome, and his views were adopted. It was decided to send an Achaean force to co-operate with the Roman general, and Polybius was selected to command the cavalry. The Roman consul declined the proffered assistance, but Polybius accompanied him throughout the campaign, and thus gained his first insight into the military system of Rome. In the next year (168) both Lycortas and Polybius were on the point of starting at the head of 1200 Achaeans to take service in Egypt against the Syrians, when an intimation from the Roman commander that armed interference was undesirable put a stop to the expedition (xxix. 23). The success of Rome in the war with Perseus was now assured. The final victory was rapidly followed by the arrival in Achaea of Roman commissioners charged with the duty of establishing Roman interests there. Polybius was arrested with 1000 of the principal Achaeans, but, while his companions were condemned to a tedious incarceration in the country towns of Italy, he obtained permission to reside in Rome. This privilege he owed to the influence of L. Aemilius Paullus and his two sons, Scipio and Fabius (xxxii. 9). Polybius was received into Aemilius's house, and became the instructor of his sons. Between Scipio (P. Cornelius Scipio Africanus the younger), the future conqueror of Carthage, and himself a friendship soon sprang up, which ripened into a lifelong intimacy, and was of inestimable service to him throughout his career. It protected him from interference, opened to him the highest circles of Roman society, and enabled him to acquire a personal influence with the leading men, which stood him in good stead when he afterwards came forward to mediate between his countrymen and Rome. It placed within his reach opportunities for a close study of Rome and the Romans such as had fallen to no historian before him, and secured him the requisite leisure for using them, while Scipio's liberality more than once supplied him with the means of conducting difficult and costly historical investigations (Pliny, *N.H.* v. 9). In 151 the few surviving exiles were allowed to return to Greece. But the stay of Polybius in Achaea was brief. The estimation in which he was held at Rome is clearly shown by the anxiety of the consul Marcus (or Manlius) Manilius (149) to take him as his adviser on his expedition against Carthage. Polybius started to join him, but broke off his journey at Corcyra on learning that the Carthaginians were inclined to yield (xxxvi. 3). But when, in 147, Scipio himself took the command in Africa, Polybius hastened to join him, and was an eye-witness of the siege and destruction of Carthage. During his absence in Africa the Achaeans had made a last desperate attempt to assert their independence of Rome. He returned in 146 to find Corinth in ruins, the fairest cities of Achaea at the mercy of the Roman soldiery, and the famous Achaean League shattered to pieces (see ACHAEAN LEAGUE). All the influence he possessed was freely spent in endeavouring to shield his countrymen from the worst consequences of their rashness. The excesses of the soldiery were checked, and at his special intercession the statues of Aratus and Philopoemen were preserved (xxxix. 14). An even more difficult task was that entrusted to him by the Roman authorities themselves, of persuading the Achaeans to acquiesce in the new régime imposed upon them by their conquerors, and of setting the new machinery in working order. With this work, which he accomplished so as to earn the heartfelt gratitude of his countrymen (xxxix. 16), his public career seems to have closed. The rest of his life was, so far as we know, devoted to the great history which is the lasting monument of his fame. He died, at the age of eighty-two, of a fall from his horse (Lucian, *Macrob.* 22). The base of a statue erected to him by Elis was found at Olympia in 1877. It bears the inscription *ἡ πόλις ἡ ’Ηλείων Πολύβιον Λυκόρτα Μεγαλοπολίτην*.

Of the forty books which made up the history of Polybius, the first five alone have come down to us in a complete form; of the rest we have only more or less copious fragments. But the general plan and scope of the work are explained by Polybius himself. His intention was to make plain how and why it was that "all the known regions of the civilized world had fallen under the sway of Rome" (iii. 1). This empire of Rome, unprecedented in its extent and still more so in the rapidity with which it had been acquired, was the standing wonder of the age, and "who," he exclaims (i. 1), "is so poor-spirited or indolent as not to wish to know by what means, and thanks to what sort of constitution, the Romans subdued the world in something less than fifty-three years?" These fifty-three years are those between 220 (the point at which the work of Aratus ended) and 168 B.C., and extend therefore from the outbreak of the Hannibalic War to the defeat of Perseus at Pydna. To this period then the main portion of his history is devoted from the third to the thirtieth book inclusive. But for clearness' sake he prefixes in bks. i. and ii. such a preliminary sketch of the earlier history of Rome, of the First Punic War, and of the contemporary events in Greece and Asia, as will enable his readers more fully to understand what follows. This seems to have been his original plan, but at the opening of bk. iii., written apparently after 146, he explains that he thought it desirable to add some account of the manner in which the Romans exercised the power they had won, of their temperament and policy and of the final catastrophe which destroyed Carthage and for ever broke up the Achaean League (iii. 4, 5). To this appendix, giving the history from 168–146, the last ten books are devoted.

Whatever fault may be found with Polybius, there can be no question that he had formed a high conception of the task before him. He lays repeated stress on two qualities as distinguishing his history from the ordinary run of historical compositions. The first of these, its synoptic character, was partly necessitated by the nature of the period. The various states fringing the basin of the Mediterranean had become so inextricably interwoven that it was no longer possible to deal with them in isolation. Polybius therefore claims for his history that it will take a comprehensive view of the whole course of events in the civilized world, within the limits of the period (i. 4). He thus aims at placing before his readers at each stage a complete survey of the field of action from Spain to Syria and Egypt. This synoptic method proceeds from a true appreciation of what is now called the unity of history, and to Polybius must be given the credit of having first firmly grasped and clearly enforced a lesson which the events of his own time were especially well calculated to teach. It is the great merit of his work that it gives such a picture of the 2nd and 3rd centuries B.C. as no series of special narratives could have supplied.

The second quality upon which Polybius insists as distinguishing his history from all others is its "pragmatic" character. It deals, that is, with events and with their causes, and aims at an accurate record and explanation of ascertained facts. This "pragmatic method" (ix. 2) makes history intelligible by explaining the how and the why; and, secondly, it is only when so written that history can perform its true function of instructing and guiding those who study it. For the great use of history, according to Polybius, is to contribute to the right conduct of human life (i. 35). But this it can do only if the historian bears in mind the true nature of his task. He must remember that the historian should not write as the dramatist does to charm or excite his audience for the moment (ii. 56). He will aim simply at exhibiting events in their true light, setting forth "the why and the how" in each case, not confusing causes and occasions, or dragging in old wives' fables, prodigies and marvels (ii. 16, iii. 48). He will omit nothing which can help to explain the events he is dealing with: the genius and temperament of particular peoples, their political and military systems, the characters of the leading men, the geographical features of the country, must all be taken into account. To this conception of history Polybius is on the whole consistently faithful. It is true that his anxiety to instruct leads often to a rather wearisome iteration of his favourite maxims, and that his digressions, such as that on the military art, are occasionally provokingly long and didactic. But his comments and reflections are for the most part sound and instructive (*e.g.* those on the lessons to be learnt from the revolt of the mercenaries in Africa, i. 65; from the Celtic raids in Italy, ii. 35; and on the Roman character), while among his digressions are included such invaluable chapters as those on the Roman constitution (bk. vi), the graphic description of Cisalpine Gaul (bk. ii.) and the account of the rise and constitution of the Achaean League (ii. 38 seq.). To his anxiety again to trace back events to their first causes we owe, not only the careful inquiry (bk. iii.) into the origin of the Second Punic War, but the sketch of early Roman history in bk. i., and of the early treaties between Rome and Carthage in iii. 22 seq. Among the many defects which he censures in previous historians, not the least serious in his eyes are their inattention to the political and geographical surroundings of the history (ii. 16, iii. 36), and their neglect duly to set forth the causes of events (iii. 6).

Polybius is equally explicit as regards the personal qualifications necessary for a good historian, and in this respect too his practice is in close agreement with his theory. Without a personal knowledge of affairs a writer will inevitably distort the true relations and importance of events (xii. 28). Such experience would have saved accomplished and fluent Greek writers like Timaeus from many of their blunders (xii. 25a), but the shortcomings of Roman soldiers and senators like Q. Fabius Pictor show that it is not enough by itself. Equally indispensable is careful painstaking research. All available evidence must be collected, thoroughly sifted, soberly weighed, and, lastly, the historian must be animated by a sincere love of truth and a calm impartiality.

It is important to consider how far Polybius himself comes up to his standard. In his personal acquaintance with affairs, in the variety of his experience, and in his opportunities for forming a correct judgment on events he is without a rival among ancient historians. A great part of the period of which he treats fell within his own lifetime (iv. 2). He may just have remembered the battle of Cynoscephalae (197), and, as we have seen, he was actively engaged in the military and political affairs of the Achaean League. During his exile in Rome he was able to study the Roman constitution, and the peculiarities of the Roman temperament; he made the acquaintance of Roman senators, and became the intimate friend of the greatest Roman of the day. Lastly, he was able to survey with his own eyes the field on which the great struggle between Rome and Hannibal was fought out. He left Rome only to witness the crowning triumph of Roman arms in Africa, and to gain a practical acquaintance with Roman methods of government by assisting in the settlement of Achaea. When, in 146, his public life closed, he completed his preparation of himself for his great work by laborious investigations of archives and monuments, and by a careful personal examination of historical sites and scenes. To all this we must add that he was deeply read in the learning of his day, above all in the writings of earlier historians.

Of Polybius's anxiety to get at the truth no better proof can be given than his conscientious investigation of original documents and monuments, and his careful study of geography and topography—both of them points in which his predecessors, as well as his successor Livy, conspicuously failed. Polybius is careful constantly to remind us that he writes for those who are φιλομαθεῖς lovers of knowledge, with whom truth is the first consideration. He closely studied the bronze tablets in Rome on which were inscribed the early treaties concluded between Romans and Carthaginians. He quotes the actual language of the treaty which ended the First Punic War (i. 62), and of that between Hannibal and Philip of Macedon (vii. 9). In xvi. 15 he refers to a document which he had personally inspected in the archives at Rhodes, and in iii. 33 to the monument on the Lacinian promontory, recording the number of Hannibal's forces. According to Dionysius, i. 17, he got his date for the foundation of Rome from a tablet in the pontifical archives. As instances of his careful attention to geography and topography we have not only the fact of his widely extended travels, from the African coast and the Pillars of Hercules in the west, to the Euxine and the coasts of Asia Minor in the east, but also the geographical and topographical studies scattered throughout his history.

Next to the duty of original research, Polybius ranks that of impartiality. Some amount of bias in favour of one's own country may, he thinks, be pardoned as natural (xvi. 14); but it is unpardonable, he says, for the historian to set anything whatever above the truth. And on the whole, Polybius must be allowed here again to have practised what he preached. It is true that his affection for and pride in Arcadia appear in more than one passage (iv. 20, 21), as also does his dislike of the Aetolians (ii. 45, iv. 3, 16). His treatment of Aratus and Philopoemen, the heroes of the Achaean League, and of Cleomenes of Sparta, its most constant enemy, is perhaps open to severer criticism. Certainly Cleomenes does not receive full justice at his hands. Similarly his views of Rome and the Romans may have been influenced by his firm belief in the necessity of accepting the Roman supremacy as inevitable, and by his intimacy with Scipio. He had a deep admiration for the great republic, for her well-balanced constitution, for her military system, and for the character of her citizens. But just as his patriotism does not blind him to the faults and follies of his countrymen (xxxviii. 4, 5, 6), so he does not scruple to criticize Rome. He notices the incipient degeneracy of Rome after 146 (xviii. 35). He endeavours to hold the balance evenly between Rome and Carthage; he strongly condemns the Roman occupation of Sardinia as a breach of faith (iii. 28, 31); and he does full justice to Hannibal. Moreover, there can be no doubt that he sketched the Roman character in a masterly fashion.

His interest in the study of character and his skill in its delineation are everywhere noticeable. He believes, indeed, in an overruling fortune, which guides the course of events. It is fortune which has fashioned anew the face of the world in his own time (iv. 2), which has brought the whole civilized world into subjection to Rome (i. 4); and the Roman Empire itself is the most marvellous of her works (viii. 4). But under fortune not only political and geographical conditions but the characters and temperaments of nations and individuals play their part. The Romans had been fitted by their previous struggles for the conquest of the world (i. 63); they were chosen to punish the treachery of Philip of Macedon (xv. 4); and the greatest of them, Scipio himself, Polybius regards as the especial favourite of fortune (xxxii. 15; x. 5).

In respect of form, Polybius is far the inferior of Livy, partly owing to his very virtues. His laudable desire to present a picture of the whole political situation at each important moment is fatal to the continuity of his narrative. Thus the thrilling story of the Second Punic War is broken in upon by digressions on the contemporary affairs in Greece and Asia. More serious, however, than this excessive love of synchronism is his almost pedantic anxiety to edify. For grace and elegance of composition, and for the artistic presentation of events, he has a hardly concealed contempt. Hence a general and almost studied carelessness of effect, which mars his whole work. On the other hand he is never weary of preaching. His favourite theories of the nature and aims of history, of the distinction between the universal and special histories, of the duties of an historian, sound as most of them are in themselves, are enforced with wearisome iteration; more than once the effect of a graphic picture is spoilt by obtrusive moralizing. Nor, lastly, is Polybius's style itself such as to compensate for these defects. It is, indeed, often impressive from the evident earnestness of the writer, and from his sense of the gravity of his subject, and is unspoilt by rhetoric or conceit. It has about it the ring of reality; the language is sometimes pithy and vigorous; and now and then we meet with apt metaphors, such as those borrowed from boxing (i. 57), from cock-fighting (i. 58), from draughts (i. 84). But, in spite of these redeeming features, the prevailing baldness of Polybius's style excludes him from the first rank among classical writers; and it is impossible to quarrel with the verdict pronounced by Dionysius of Halicarnassus, who places him among those authors of later times who neglected the graces of style, and who paid for their neglect by leaving behind them works "which no one was patient enough to read through to the end."

It is to the value and variety of his matter, to his critical insight, breadth of view and wide research, and not least to the surpassing importance and interest of the period with which he deals, that Polybius owes his place among the writers of history. What is known as to the fortunes of his histories, and the reputation they enjoyed, fully bears out this conclusion. The silence respecting him maintained by Quintilian and by Lucian may reasonably be taken to imply their agreement with Dionysius as to his merits as a master of style. On the other hand, Cicero (*De off.* iii. 32) describes him as "bonus auctor in primis"; in the *De republica* (ii. 14) he praises highly his accuracy in matters of chronology; and Cicero's younger contemporary, Marcus Brutus, was a devoted student of Polybius, and was engaged on the eve of the battle of Pharsalia in compiling an epitome of his histories (Suïdas, *s.v.*; Plutarch, *Brut.* 4). Livy, however, notwithstanding the extent to which he used his writings (see LIVY), speaks of him in such qualified terms as to suggest the idea that his strong artistic sensibilities had been wounded by Polybius's literary defects. He has nothing better to say of him than that he is "by no means contemptible" (xxx. 45), and "not an untrustworthy author" (xxxiii. 10). Posidonius and Strabo, both of them Stoics like Polybius himself, are said to have written continuations of his history (Suïdas, *s.v.*; Strabo p. 515). Arrian in the early part of the 2nd and Aelian in the 3rd century both speak of him with respect, though with reference mainly to his excellence as an authority on the art of war. In addition to his *Histories* Polybius was the author of the following smaller works: a life of Philopoemen (Polyb. x. 24), a history of the Numantine War (Cic. *Ad Fam.* v. 12), a treatise on tactics (Polyb. ix. 20; Arrian, *Tactica*; Aelian, *Tact.* i.). The geographical treatise, referred to by Geminus, is possibly identical with the thirty-fourth book of the *Histories* (Schweighäuser, *Praef.* p. 184.

AUTHORITIES.—The complete books (i.–v.) of the *Histories* were first printed in a Latin translation by Nicholas Perotti in 1473. The date of the first Greek edition, that by Obsopaeus, is 1530. For a full account of these and of later editions, as well as of the extant MSS., see Schweighäuser's Preface to his edition of Polybius. Our knowledge of the contents of the fragmentary books is derived partly from quotations in ancient writers, but mainly from two collections of excerpts; one, probably the work of a late Byzantine compiler, was first printed at Basel in 1549 and contains extracts from books vi.–xviii. (περὶ πρεσβείων, περὶ ἀρετῆς καὶ κακίας); the other consists of two fragments from the "select passages" from Greek historians compiled by the directions of Constantine Porphyrogenitus in the 10th century. To these must be added the Vatican excerpts edited by Angelo Mai in the present century.

The following are the more important modern editions of Polybius: Ernesti (3 vols., 1763–1764); Schweighäuser (8 vols., 1793, and Oxford, 1823); Bekker (2 vols., 1844); L. Dindorf (4 vols., 1866–1868, 2nd ed., T. Büttner-Wobst, 5 vols., Leipzig, 1882–1904); Hultsch (4 vols., 1867–1871); J. L. Strachan-Davidson, *Selections from Polybius* (Oxford, 1888). For the literature of the subject, see Engelmann, *Biblioth. script. class.: Script. graeci*, pp. 646–650 (8th ed. Leipzig, 1880). See also W. W. Capes, *The History of the Achaean League* (London, 1888); F. Susemihl, *Gesch. d. griech. Litteratur in d. Alexandrinerzeit*, ii. 80–128 (Leipzig, 1891–1892); O. Cuntz, *Polybios und sein Werk* (Leipzig, 1902); R. v. Scala, *Die Studien des Polybios* (Stuttgart, 1890); J. B. Bury, *Ancient Greek Historians* (1909), "a whole-hearted appreciation of Polybius"; J. L. Strachan-Davidson, in *Hellenica*, pp. 353–387 (London, 1898), and in Appendix II. to *Selections from Polybius* pp. 642–668 (Oxford, 1888). (H. F. P.; X.)

POLYCARP (*c.* 69–*c.* 155), bishop of Smyrna and one of the Apostolic Fathers, derives much of his importance from the fact that he links together the apostolic age and that of nascent Catholicism. The sources from which we derive our knowledge of the life and activity of Polycarp are: (1) a few notices in the writings of Irenaeus, (2) the Epistle of Polycarp to the Church at Philippi, (3) the Epistle of Ignatius to Polycarp, (4) the Epistle of the Church at Smyrna to the Church at Philomelium, giving an account of the martyrdom of Polycarp. Since these authorities have all been more or less called in question and some of them entirely rejected by recent criticism, it is necessary to say a few words about each.

1. *The Statements of Irenaeus* are found (*a*) in his *Adversus haereses*, iii. 3, 4, (*b*) in the letter to Victor, where Irenaeus gives an account of Polycarp's visit to Rome, (*c*) in the letter to Florinus—a most important document which describes the intercourse between Irenaeus and Polycarp and Polycarp's relation with St John. No objection has been made against the genuineness of the statements in the *Adversus haereses*, but the authenticity of the two letters has been stoutly contested in recent times by van Manen.[1] The main attack is directed against the Epistle to Florinus, doubtless because of its importance. "The manifest exaggerations," says van Manen, "coupled with the fact that Irenaeus never shows any signs of acquaintance with Florinus . . . enable us to perceive clearly that a writer otherwise unknown is speaking to us here." The criticism of van Manen has, however, found no supporters outside the Dutch school. The epistle is quoted by Eusebius (v. 20), and is accepted as genuine by Harnack[2] and Krüger.[3] The relevant statements in the letter, moreover, are supported by the references to Polycarp which we find in the body of Irenaeus's great work.

2. *The Epistle of Polycarp.*—Though Irenaeus states that Polycarp wrote many "letters to the neighbouring churches or to certain of the brethren"[4] only one has been preserved, viz. the well-known letter to the Philippians. The epistle is largely involved in the Ignatian controversy (see IGNATIUS). The testimony which it affords to the Ignatian Epistles is so striking that those scholars who regard these letters as spurious are bound to reject the Epistle of Polycarp altogether, or at any rate to look upon it as largely interpolated. The former course has been adopted by Schwegler,[5] Zeller,[6] and Hilgenfeld,[7] the latter by Ritschl[8] and Lipsius.[9] The rehabilitation of the Ignatian letters in modern times has, however, practically destroyed the attack on the Epistles of Polycarp. The external evidence in its favour is of considerable weight. Irenaeus (iii. 3, 4) expressly mentions and commends a "very adequate" (ἱκανωτάτη) letter of Polycarp to the Philippians, and we have no reason for doubting the identity of this letter mentioned by Irenaeus with our epistle. Eusebius (iii. 36) quotes extracts from the epistle, and some of the extracts contain the very passages which the critics have marked as interpolations, and Jerome (*De Vir. Ill.* xvii.) testifies that in his time the epistle was publicly read in the Asiatic churches. The internal evidence is equally strong. There is absolutely no motive for a forgery in the contents of the epistle. As Harnack says, "There is no trace of any tendency beyond the immediate purpose of maintaining the true Christian life in the church and warning it against covetousness and against an unbrotherly spirit. The occasion of the letter was a case of embezzlement, the guilty individual being a presbyter at Philippi. It shows a fine combination of mildness with severity; the language is simple but powerful, and, while there is undoubtedly a lack of original ideas, the author shows remarkable skill in weaving together pregnant sentences and impressive warnings selected from the apostolic epistles and the first Epistle of Clement. In these circumstances it would never have occurred to any one to doubt the genuineness of the epistle or to suppose that it had been interpolated, but for the fact that in several passages reference is made to Ignatius and his epistles." The date of the epistle depends upon the date of the Ignatian letters and is now generally fixed between 112 and 118. An attempt has been made in some quarters to prove that certain allusions in the epistle imply the rise of the heresy of Marcion and that it cannot therefore be placed earlier than 140. Lightfoot, however, has proved that Polycarp's statements may equally well be directed against Corinthianism or any other form of Docetism, while some of his arguments are absolutely inapplicable to Marcionism.

3. *The Epistle of Ignatius to Polycarp.*—This epistle has of course been subjected to the same criticism as has been directed against the other epistles of Ignatius (see IGNATIUS). Over and above the general criticism, which may now be said to have been completely answered by the investigations of Zahn, Lightfoot and Harnack, one or two special arguments have been brought against the Epistle to Polycarp. Ussher, for instance, while accepting the other six epistles, rejected this on the ground that Jerome says that Ignatius only sent one letter to Smyrna—a mistake due to his misinterpretation of Eusebius. Some modern scholars (among whom Harnack was formerly numbered, though he has modified his views on the point) feel a difficulty about the peremptory tone which Ignatius adopts towards Polycarp. There was some force in this argument when the Ignatian Epistles were dated about 140, as in that case Polycarp would have been an old and venerable man at the time. But now that the date is put back to about 112 the difficulty vanishes, since Polycarp was not much over forty when he received the letter. We must remember, too, that Ignatius was writing under the consciousness of impending martyrdom and evidently felt that this gave him the right to criticize the bishops and churches of Asia.

4. *The Letter of the Church at Smyrna* to the Philomelians is a most important document, because we derive from it all our information with regard to Polycarp's martyrdom. Eusebius has preserved the greater part of this epistle (iv. 15), but we possess it entire with various concluding observations in several Greek MSS., and also in a Latin translation. The epistle gives a minute description of the persecution in Smyrna, of the last days of Polycarp and of his trial and martyrdom; and as it contains many instructive details and professes to have been written not long after the events to which it refers, it has always been regarded as one of the most precious remains of the 2nd century. Certain recent critics, however, have questioned the authenticity of the narrative.

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[1] *Ency. Bib.* iii. 3490.

[2] *Geschichte der altchristlichen Litteratur*, i. 593–594.

[3] *Early Christian Literature* (Eng. trans., 1897), p. 150.

[4] Letter to Florinus *ap.* Euseb. v. 20.

[5] *Nachapostolisches Zeitalter*, ii. 154.

[6] *Apostolgeschichte*, p. 52.

[7] *Apostolische Väter*, p. 272.

[8] *Entstehung der altkatholischen Kirche*, p. 584.

[9] *Ueber das Verhältniss, &c.*, p. 14.

Lipsius brings[1] the date of the epistle down to about 260, though he admits many of the statements as trustworthy. Keim, too,[2] endeavours to show that, although it was based on good information, it could not have been composed till the middle of the 3rd century. A similar position has also been taken up by Schürer,[3] Holtzmann,[4] Gebhardt,[5] Réville,[6] and van Manen.[7] The last named regards the document "as a decorated narrative of the saint's martyrdom framed after the pattern of Jesus' martyrdom," though he thinks that it cannot be put as late as 250, but must fall within the limits of the 2nd century. It cannot be said, however, that the case against the document has been at all substantiated, and the more moderate school of modern critics (*e.g.* Lightfoot,[8] Harnack,[9] Krüger)[10] is unanimous in regarding it as an authentic document, though it recognizes that here and there a few slight interpolations have been inserted.[11] Besides these we have no other sources for the life of Polycarp; the *Vita S. Polycarpi auctore Pionio* (published by Duchesne, Paris, 1881, and Lightfoot *Ignatius and Polycarp*, 1885, ii. 1015–1047) is worthless.

Assuming the genuineness of the documents mentioned, we now proceed to collect the scanty information which they afford with regard to Polycarp's career. Very little is known about his early life. He must have been born not later than the year 69, for on the day of his death (*c.* 155) he declared that he had served the Lord for eighty-six years (*Martyrium*, 9). The statement seems to imply that he was of Christian parentage; he cannot have been older than eighty-six at the time of his martyrdom, since he had paid a visit to Rome almost immediately before. Irenaeus tells us that in early life Polycarp "had been taught by apostles and lived in familiar intercourse with many that had seen Christ" (iii. 3, 4). This testimony is expanded in the remarkable words which Irenaeus addresses to Florinus: "I saw thee when I was still a boy (παῖς ἔτι ὤν) in Lower Asia in company with Polycarp . . . I can even now point out the place where the blessed Polycarp used to sit when he discoursed, and describe his goings out and his comings in, his manner of life and his personal appearance and the discourses which he delivered to the people, how he used to speak of his intercourse with John and with the rest of those who had seen the Lord, and how he would relate their words. And everything that he had heard from them about the Lord, about His miracles and about His teaching, Polycarp used to tell us as one who had received it from those who had seen the Word of Life with their own eyes, and all this in perfect harmony with the Scriptures. To these things I used to listen at the time, through the mercy of God vouchsafed to me, noting them down, not on paper but in my heart, and constantly by the grace of God I brood over my accurate recollections." These are priceless words, for they establish a chain of tradition (John-Polycarp-Irenaeus) which is without a parallel in early church history. Polycarp thus becomes the living link between the Apostolic age and the great writers who flourished at the end of the 2nd century. Recent criticism, however, has endeavoured to destroy the force of the words of Irenaeus. Harnack, for instance, attacks this link at both ends.[12] (*a*) The connexion of Irenaeus and Polycarp, he argues, is very weak, because Irenaeus was only a boy (παῖς) at the time, and his recollections therefore carry very little weight. The fact too that he never shows any signs of having been influenced by Polycarp and never once quotes his writings is a further proof that the relation between them was slight. (*b*) The connexion which Irenaeus tries to establish between Polycarp and John the apostle is probably due to a blunder. Irenaeus has confused John the apostle and John the presbyter. Polycarp was the disciple of the latter, not the former. In this second argument Harnack has the support of a considerable number of modern scholars who deny the Ephesian residence of John the apostle. But, as Gwatkin[13] has pointed out, Harnack's arguments are by no means decisive. (*a*) When Irenaeus describes himself as a boy (παῖς), he need not have meant a very young lad, under thirteen, as Harnack makes out. Lightfoot has cited many instances which prove that the word could be used of a man of thirty.[14] Nor does the alternative phrase which Irenaeus uses in iii. 3, 4 (ὅν καὶ ἡμεῖς ἑωράκαμεν ἐν τῇ πρωτῇ ἡμῶν ἡλικίᾳ) militate against this interpretation, for elsewhere Irenaeus himself distinctly says "triginta annorum aetas prima indoles est juvenis" (ii. 22, 5). It is true that Harnack has adduced arguments which cannot be discussed here to prove that Irenaeus was not born till about 140;[15] but against this we may quote the decision of Lipsius, who puts the date of his birth at 130,[16] while Lightfoot argues for 120.[17] The fact that Irenaeus never quotes Polycarp does not count for much. Polycarp wrote very little. He does not seem to have been a man of great mental capacity. "His influence was that of saintliness rather than that of intellect." (*b*) A discussion of Harnack's second line of argument is impossible here. His theory with regard to the confusion of names is a gratuitous assumption and cannot be proved. The tradition of St John's residence at Ephesus is too strong to be easily set aside. In spite therefore of much modern criticism there seems to be no solid reason for rejecting the statements of Irenaeus and regarding Polycarp as the link between the Apostolic age and the first of the Catholic fathers.

Though Polycarp must have been bishop of Smyrna for nearly half a century we know next to nothing about his career. We get only an occasional glimpse of his activity, and the period between 115 and 155 is practically a blank. The only points of sure information which we possess relate to (1) his relations with Ignatius, (2) his protests against heresy, (3) his visit to Rome in the time of Anicetus, (4) his martyrdom.

1. *His Relations with Ignatius.*—Ignatius, while on his way to Rome to suffer martyrdom, halted at Smyrna and received a warm welcome from the church and its bishop. Upon reaching Troas he despatched two letters, one to the church at Smyrna, another addressed personally to Polycarp. In these letters Ignatius charged Polycarp to write to all the churches between Smyrna and Syria (since his hurried departure from Troas made it impossible for him to do so in person) urging them to send letters and delegates to the church at Antioch to congratulate it upon the cessation of the persecution and to establish it in the faith. The letters of Ignatius illustrate the commanding position which Polycarp had already attained in Asia. It was in the discharge of the task which had been laid upon him by Ignatius that Polycarp was brought into correspondence with the Philippians. The Church at Philippi wrote to Polycarp asking him to forward their letters to Antioch. Polycarp replied, promising to carry out their request and enclosing a number of the letters of Ignatius which he had in his possession.

2. *Polycarp's Attack on Heresy.*—All through his life Polycarp appears to have been an uncompromising opponent of heresy. We find him in his epistle (ch. vii.) uttering a strong protest against certain false teachers (probably the followers of Cerinthus).

> For every one who shall not confess that Jesus Christ is come in the flesh is antichrist; and whosoever shall not confess the testimony of the Cross is of the devil; and whosoever shall pervert the oracles of the Lord to his own lusts and say that there is neither resurrection nor judgment, that man is the first-born of Satan. Wherefore let us forsake their vain doing and their false teaching and turn unto the word which was delivered unto us from the beginning."

Polycarp lived to see the rise of the Marcionite and Valentinian sects and vigorously opposed them. Irenaeus tells us that on one occasion Marcion endeavoured to establish relations with him and accosted him with the words, "Recognize us." But Polycarp displayed the same uncompromising attitude which his master John had shown towards Cerinthus and answered, "I recognize you as the first-born of Satan." The steady progress of the heretical movement in spite of all opposition was a cause of deep sorrow to Polycarp, so that in the last years of his life the words were constantly on his lips, "Oh good God, to what times hast thou spared me, that I must suffer such things!"

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[1] *Zeitschr. f. wissensch. Theol.* (1874), p. 200 seq.

[2] *Aus dem Urchristenthum* (1878), p. 90.

[3] *Zeitschr. f. hist. Theol.* (1870), p. 203 seq.

[4] *Zeitschr. f. wissensch. Theol.* (1877).

[5] *Zeitschr. f. hist. Theol.* (1875).

[6] *De anno Polycarpi* (1881).

[7] *Oud-Christ* (1861), and *Ency. Bib.* iii. 3479.

[8] *Ignatius and Polycarp*, i. 589 seq.

[9] *Gesch. d. altchrist. Lit.* II. i. 341.

[10] *Early Christian Lit.* (Eng. trans., 1897), p. 380.

[11] Amongst these we ought probably to include the expression ἡ καθολικὴ ἐκκλησία (xvi. 19), καθολικὸς being here used in the sense of orthodox—a usage which is not found elsewhere at so early a date.

[12] *Chronologie*, i. 325–329.

[13] *Contemp. Review*, February 1897.

[14] *Ignatius and Polycarp*, i. 432, for instance, Constantine (Euseb. *V.C.* ii. 51) describes himself as κομιδῇ παῖς, though he must have been over thirty at the time.

[15] *Chronologie*, i. 325–333.

[16] See Lightfoot, *op. cit.* i. 432.

[17] *Essays on Supernatural Religion*, 264, 265.

3. *Polycarp's Visit to Rome.*—It is one of the most interesting and important events in the church history of the 2nd century that Polycarp, shortly before his death, when he was considerably over eighty years old, undertook a journey to Rome in order to visit the bishop Anicetus. Irenaeus, to whom we are indebted for this information (*Haer.* iii. 3, 4; *Epist. ad victorem, ap.* Euseb. v. 24), gives as the reason for the journey the fact that differences existed between Asia and Rome "with regard to certain things" and especially about the time of the Easter festival. He might easily have told us what these "certain things" were and given us fuller details of the negotiations between the two great bishops, for in all probability he was himself in Rome at the time. But unfortunately all he says is that with regard to the certain things the two bishops speedily came to an understanding, while as to the time of Easter, each adhered to his own custom, without breaking off communion with the other. We learn further that Anicetus as a mark of special honour allowed Polycarp to celebrate the Eucharist in the church, and that many Marcionites and Valentinians were converted by him during his stay in Rome.

4. *Polycarp's Martyrdom.*—Not many months apparently after Polycarp's return from Rome a persecution broke out in Asia. A great festival was in progress at Smyrna. The proconsul Statius Quadratus was present on the occasion, and the asiarch Philip of Tralles was presiding over the games. Eleven Christians had been brought, mostly from Philadelphia, to be put to death. The appetite of the populace was inflamed by the spectacle of their martyrdom. A cry was raised "Away with the atheists. Let search be made for Polycarp." Polycarp took refuge in a country farm. His hiding-place, however, was betrayed and he was arrested and brought back into the city. Attempts were made by the officials to induce him to recant, but without effect. When he came into the theatre the proconsul urged him to "revile Christ," and promised, if he would consent to abjure his faith, that he would set him at liberty. To this appeal Polycarp made the memorable answer, "Eighty and six years have I served Him and He hath done me no wrong. How then can I speak evil of my King who saved me?" These words only intensified the fury of the mob. They clamoured for a lion to be let loose upon him there and then. The asiarch however refused, urging as an excuse that the games were over. When they next demanded that their victim should be burned, the proconsul did not interfere. Timber and faggots were hastily collected and Polycarp was placed upon the pyre. With calm dignity and unflinching courage he met his fate and crowned a noble life with an heroic death.

The question as to the date of the martyrdom has evoked considerable controversy. Eusebius in his *Chronicon* gives A.D. 166 as the date of Polycarp's death, and until the year 1867 this statement was never questioned. In that year appeared Waddington's *Mémoire sur la chronologie de la vie du rhéteur Aelius Aristide*, in which it was shown from a most acute combination of circumstances that the Quadratus whose name is mentioned in the *Martyrium* was proconsul of Asia in 155–156, and that consequently Polycarp was martyred on the 23rd of February 155. Waddington's conclusion has received overwhelming support amongst recent critics. His views have been accepted by (amongst many others) Renan,[1] Hilgenfeld,[2] Gebhardt,[3] Lipsius,[4] Harnack,[5] Zahn,[6] Lightfoot,[7] Randell.[8] Against this array of scholars only the following names of importance can be quoted in support of the traditional view—Keim,[9] Wieseler[10] and Uhlhorn.[11] The problem is too complex to admit of treatment here. There seems to be little doubt that the case for the earlier date has been proved. The only point upon which there is division of opinion is as to whether Waddington's date 155, or—as is suggested by Lipsius and supported by C. H. Turner[12]—the following year 156 is the more probable. The balance of opinion seems to favour the latter alternative, because it leaves more room for Polycarp's visit to Anicetus, who only became bishop of Rome in 154. Harnack, however, after careful investigation, prefers 155.

The significance of Polycarp in the history of the Church is out of all proportion to our knowledge of the facts of his career. The violent attack of the Smyrnaean mob is an eloquent tribute to his influence in Asia. "This is the teacher of Asia," they shouted, "this is the father of the Christians: this is the destroyer of our gods: this is the man who has taught so many no longer to sacrifice and no longer to pray to the gods."[13] And after the execution they refused to deliver up his bones to the Christians for burial on the ground that "the Christians would now forsake the Crucified and worship Polycarp."[14] Polycarp was indeed, as Polycrates says,[15] "one of the great luminaries" (μεγάλα στοιχεῖα) of the time. It was in no small degree due to his stanch and unwavering leadership that the Church was saved from the peril of being overwhelmed by the rising tide of the pagan revival which swept over Asia during the first half of the 2nd century, and it was his unfaltering allegiance to the Apostolic faith that secured the defeat of the many forms of heresy which threatened to destroy the Church from within. Polycarp had no creative genius. He was a "transmitter, not a maker," but herein lies his greatness. Much occurred between the Apostolic age and the age when the faith of the Church was fixed in the earliest creed and protected by the determination of the canon of the New Testament. This intervening period was the most perilous epoch in the history of the ante-Nicene Church. The Apostolic tradition might have been perverted and corrupted. The purity of the Gospel might have been defiled. The Christian ideal might have been lost. That the danger was so largely averted is to no small extent the result of the faithful witness of Polycarp. As Irenaeus says (iii. 3, 4), "Polycarp does not appear to have possessed qualifications for successfully conducting a controversial discussion with erroneous teachers . . . but he could not help feeling how unlike their speculations were to the doctrines which he had learned from the Apostles, and so he met with indignant reprobation their attempt to supersede Christ's gospel with fictions of their own devising." It is this that constitutes Polycarp's service to the Church, and no greater service has been rendered by any of its leaders in any age.

BIBLIOGRAPHY.—J. B. Lightfoot, *Apostolic Fathers*, pt. ii. (2nd ed., 1889). Polycarp is dealt with in i. 417–459, 530–704; ii. 897–1086; G. Volkmar, *Epistula Polycarpi Smyrnaei genuina* (Zürich, 1885); T. Zahn, *Forschungen zur Geschichte des Kanons, &c.*, iv. 249, 279; J. M. Cotterill, "The Epistle of Polycarp to the Philippians," *Journ. of Philol.* (1891), xix., 241–285; Harnack, *Chronologie der altchristlichen Litteratur* (1897). See also APOSTOLIC FATHERS. (H. T. A.)

POLYCLITUS, the name of two Greek sculptors of the school of Argos; the first belonging to the fifth century, the second to the early part of the fourth.

1. The elder and best known Polyclitus was a contemporary of Pheidias, and in the opinion of the Greeks his equal. He made a figure of an Amazon for Ephesus which was regarded as superior to the Amazon of Pheidias made at the same time; and his colossal Hera of gold and ivory which stood in the temple near Argos was considered as worthy to rank with the Zeus of Pheidias.

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[1] *Antichrist* (1873), p. 207. [2] *Zeitschr. f. wiss. Theol.* (1874), p. 325.

[3] *Zeitschr. f. hist. Theol.* (1875), p. 356.

[4] *Jahrb. f. prot. Theol.* (1883), p. 525. [5] *Chronologie*, i. 334–356.

[6] *Zeitschr. f. wiss. Theol.* (1882), p. 227; (1884), p. 216.

[7] *Ignatius and Polycarp*, i. 629–702. [8] *Studia biblica* (1885), i. 175.

[9] *Aus dem Urchristentum*, p. 90.

[10] *Die Christenverfolgungen der Caesaren* (1878), p. 34.

[11] *Studia biblica* (1890), ii. 105–156.

[12] *Realencyk. f. prot. Theol.*, 2nd ed. xii. 105.

[13] *Martyrium*, ch. 12.

[14] Ibid. 17.

[15] *Ap.* Euseb. v. 24.

It would be hard for a modern critic to rate Polyclitus so high: the reason is that balance, rhythm and the minute perfection of bodily form, which were the great merits of this sculptor, do not appeal to us as they did to the Greeks of the 5th century. He worked mainly in bronze.

As regards his chronology we have data in a papyrus published by Grenfell and Hunt containing lists of athletic victors. From this it appears that he made a statue of Cyniscus, a victorious athlete of 464 or 460 B.C., of Pythocles (452) and Aristion (452). He thus can scarcely have been born as late as 480 B.C. His statue of Hera is dated by Pliny to 420 B.C. His artistic activity must thus have been long and prolific.

Copies of his spearman (doryphorus) (see GREEK ART, Plate VI. fig. 80), and his victor winding a ribbon round his head (diadumenus) have long been recognized in our galleries. We see their excellence, but they inspire no enthusiasm, because they are more fleshy than modern figures of athletes, and want charm. They are chiefly valuable as showing us the square forms of body affected by Polyclitus, and the scheme he adopted, throwing the weight of the body (as Pliny says of him) on one leg. We must not, however, judge of a great Greek sculptor by Roman copies of his works. This has been enforced by the discovery at Delos, by the French excavators, of a diadumenus of far more pleasing type and greater finish, which also goes back to Polyclitus. The excavations at Olympia have also greatly widened our knowledge of the sculptor. Among the bases of statues found on that site were three signed by Polyclitus, still bearing on their surface the marks of attachment of the feet of the statues. This at once gives us their pose; and following up the clue, A. Furtwangler has identified several extant statues as copies of figures of boy athletes victorious at Olympia set up by Polyclitus. Among these the Westmacott athlete in the British Museum is conspicuous. And it is certain that these boys, although the anatomy of their bodies seems to be too mature, yet have a real charm, combining beauty of form with modesty and unaffected simplicity. They enable us better to understand the merit of the sculptor.

The Amazon of Polyclitus survives in several copies, among the best of which is one in the British Museum (for its type see GREEK ART, fig. 40). Here again we find a certain heaviness; and the womanly character of the Amazon scarcely appears through her robust limbs. But the Amazon of Pheidias, if rightly identified, is no better. The masterpiece of Polyclitus, his Hera of gold and ivory, has of course totally disappeared. The coins of Argos give us only the general type. Many archaeologists have tried to find a copy of the head. The most defensible of all these identifications is that of C. Waldstein, who shows that a head of a girl in the British Museum (labelled as Polyclitan) corresponds so nearly with that of Hera on 5th century coins of Argos that we must regard it as a reflex of the head of the great statue. It seems very hard and cold beside such noble heads of the goddess as those in the Ludovisi Gallery (Terme Museum) Rome. American archaeologists have in recent years conducted excavations on the site of the Argive temple of Hera (ARGOS and GREEK ART, fig. 39); but the sculptural fragments, heads and torsos, which seem to belong to the temple erected in the time of Polyclitus, have no close stylistic resemblance to other statues recognized as his; and at present their position in the history of art is matter of dispute.

The want of variety in the works of Polyclitus was brought as a reproach against him by ancient critics. Varro says that his statues were square and almost of one pattern. We have already observed that there was small variety in their attitudes. Except for the statue of Hera, which was the work of his old age, he produced scarcely any notable statue of a deity. His field was narrowly limited; but in that field he was unsurpassed.

2. The younger Polyclitus was of the same family as the elder, and the works of the two are not easily to be distinguished. Some existing bases, however, bearing the name are inscribed in characters of the 4th century, at which time the elder sculptor cannot have been alive. The most noted work of the younger artist was a statue in marble of Zeus Milichius (the Merciful) set up by the people of Argos after a shameful massacre which took place in 370 B.C. The elder artist is not known to have worked in marble. (P. G.)

POLYCRATES, tyrant of Samos (*c.* 535–515 B.C.). Having won popularity by donations to poorer citizens, he took advantage of a festival of Hera, which was being celebrated outside the walls, to make himself master of the city (about 535 B.C.). After getting rid of his brothers Pantagnotus and Syloson, who had at first shared his power, he established a despotism which is of great importance in the history of the island. Realizing clearly the value of sea-power for a Greek state, he equipped a fleet of 100 ships, and so became master of the Aegean basin. This ascendancy he abused by numerous acts of piracy which made him notorious throughout Greece; but his real purpose in building his navy was to become lord of all the islands of the archipelago and the mainland towns of Ionia. The details of his conquests are uncertain, but it is known that in the Cyclades he maintained an alliance with the tyrant Lygdamis of Naxos, and curried favour with the Delian Apollo by dedicating to him the island of Rheneia. He also encountered and heavily defeated a coalition of two great naval powers of the Asiatic coast, Miletus and Lesbos. Doubtless with the object of expanding the flourishing foreign trade of Samos, he entered into alliance with Amasis, king of Egypt, who, according to Herodotus, renounced his ally because he feared that the gods, in envy of Polycrates' excessive good fortune, would bring ruin upon him and his allies. It is more probable that the breach of the compact was due to Polycrates, for when Cambyses of Persia invaded Egypt (525) the Samian tyrant offered to support him with a naval contingent. This squadron never reached Egypt, for the crews, composed as they were of Polycrates' political enemies, suspecting that Cambyses was under agreement to slay them, put back to Samos and attacked their master. After a defeat by sea, Polycrates repelled an assault upon the walls, and subsequently withstood a siege by a joint armament of Spartans and Corinthians assembled to aid the rebels. He maintained his ascendancy until about 515, when Oroetes, the Persian governor of Lydia, who had been reproached for his failure to reduce Samos by force, lured him to the mainland by false promises of gain and put him to death by crucifixion.

Beside the political and commercial pre-eminence which he conferred upon Samos, Polycrates adorned the city with public works on a large scale—an aqueduct, a mole and a temple of Hera (see SAMOS; AQUEDUCTS). The splendour of his palace is attested by the proposal of the Roman emperor Caligula to rebuild it. Foreign artists worked for him at high wages; from Athens he brought Democedes, the greatest physician of the age, at an exceptional salary. He was also a patron of letters: he collected a library and lived on terms of intimate friendship with the poet Anacreon, whose verses were full of references to his patron. The philosopher Pythagoras, however, quitted Samos in order to escape his tyranny. (M. O. B. C.)

POLYCRATES, Athenian sophist and rhetorician, flourished in the 4th century B.C. He taught at Athens, and afterwards in Cyprus. He composed declamations on paradoxical themes —an *Encomium on Clytaemnestra*, an *Accusation of Socrates*, an *Encomium on Busiris* (a mythical king of Egypt, notorious for his inhumanity); also declamations on mice, pots and counters. His *Encomium on Busiris* was sharply criticized by Isocrates, in a work still extant, and Dionysius of Halicarnassus characterizes his style as frigid, vulgar and inelegant.

POLYGAMY (Gr. πολύς, many, and γάμος, marriage), or as it is sometimes termed, POLYGYNY (γυνή, woman), the system under which a man is married to several women at the same time. Derivatively it includes the practice of polyandry, but it has become definitely restricted to expressing what has been, and still is, far the commonest type of relations between the sexes (see FAMILY and MARRIAGE). Among Oriental nations plurality of legal wives is customary. Mahommedans are allowed four. A Hindu can have as many as he pleases: the high-caste sometimes having as many as a hundred. Polygamy is the rule among

African tribes, and is common among those of Australia and Polynesia. In China, however, only one wife is lawful. In many polygamous countries the practical obstacle of expense prevents men from taking advantage of their privileges. While polygamy was the rule in biblical days among the ancient Jews, and was permitted and even enjoined in certain cases by the Mosaic law, the Christian Church, though it is nowhere forbidden, except for "bishops," in the New Testament, has always set its face against it. There have, however, been divines who dissented from this general disapproval. The Anabaptists insisted on freedom in the matter, and Bernardino Ochino conditionally defended plurality of wives. When in 1540 Philip the Magnanimous, the reforming Landgrave of Hesse, determined (with his wife's approval, she being a confirmed invalid) to marry a second wife, Luther and Melanchthon approved "as his personal friends, though not as doctors of theology"; while Martin Bucer assisted at the marriage. In later times the Mormons (*q.v.*) in America provide the most notable instance of the revival of polygamy.

POLYGENISTS, the term applied to those anthropologists who contend that the several primary races of mankind are separate species of independent origin. (See MONOGENISTS.)

POLYGLOTT (Gr. πολύς, many, and γλῶττα, tongue), the term for a book which contains side by side versions of the same text in several different languages; the most important polyglotts are editions of the Bible, or its parts, in which the Hebrew and Greek originals are exhibited along with the great historical versions, which are of value for the history of the text and its interpretation. The first enterprise of this kind is the famous *Hexapla* of Origen in which the Old Testament Scriptures were written in six parallel columns, the first containing the Hebrew text, the second a transliteration of this in Greek letters, the third and fourth the Greek translations by Aquila and Symmachus, the fifth the Septuagint version as revised by Origen, the sixth the translation by Theodotion. Inasmuch, however, as only two languages, Hebrew and Greek, were employed the work was rather diglott than polyglott in the usual sense. After the invention of printing and the revival of philological studies, polyglotts became a favourite means of advancing the knowledge of Eastern languages (for which no good helps were available) as well as the study of Scripture. The series began with the *Complutensian* printed by Arnaldus Guilielmus de Brocario at the expense of Cardinal Ximenes at the university at Alcalá de Henares (Complutum). The first volume of this, containing the New Testament in Greek and Latin, was completed on the 10th of January 1514. In vols. ii.–v. (finished on July 10, 1517) the Hebrew text of the Old Testament was printed in the first column of each page, followed by the Latin Vulgate and then by the Septuagint version with an interlinear Latin translation. Below these stood the Chaldee, again with a Latin translation. The sixth volume containing an appendix is dated 1515, but the work did not receive the papal sanction till March 1520, and was apparently not issued till 1522. The chief editors were Juan de Vergara, Lopez de Zuñiga (Stunica), Nuñez de Guzman (Pincianus), Antonio de Librixa (Nebrissensis), and Demetrius Ducas. About half a century after the *Complutensian* came the *Antwerp Polyglott*, printed by Christopher Plantin (1569–1572, in 8 vols. folio). Of this the principal editor was Arias Montanus aided by Guido Fabricius Boderianus, Raphelengius, Masius, Lucas of Bruges and others. This work was under the patronage of Philip II. of Spain; it added a new language to those of the *Complutensian* by including the Syriac New Testament; and, while the earlier polyglott had only the Targum of Onkelos on the Pentateuch, the Antwerp Bible had also the Targum on the Prophets, and on Esther, Job, Psalms and the Salomonic writings. Next came Le Jay's *Paris Polyglott* (1645), which embraces the first printed texts of the Syriac Old Testament (edited by Gabriel Sionita, a Maronite, but the book of Ruth by Abraham Ecchelensis, also a Maronite) and of the Samaritan Pentateuch and version (by Morinus). It has also an Arabic version, or rather a series of various Arabic versions. The last great polyglott is Brian Walton's (London, 1657), which is much less beautiful than Le Jay's but more complete in various ways, including, among other things, the Syriac of Esther and of several apocryphal books for which it is wanting in the Paris Bible, Persian versions of the Pentateuch and Gospels, and the Psalms and New Testament in Ethiopic. Walton was aided by able scholars, and used much new manuscript material. His prolegomena, too, and collections of various readings mark an important advance in biblical criticism. It was in connexion with this polyglott that E. Castell produced his famous *Heptaglott Lexicon* (2 vols. folio, London, 1669), an astounding monument of industry and erudition even when allowance is made for the fact that for the Arabic he had the great MS. lexicon compiled and left to the university of Cambridge by the almost forgotten W. Bedwell. The liberality of Cardinal Ximenes, who is said to have spent half a million ducats on it, removed the *Complutensian* polyglott from the risks of commerce. The other three editions all brought their promoters to the verge of ruin. The later polyglotts are of little scientific importance, the best recent texts having been confined to a single language; but every biblical student still uses Walton and, if he can get it, Le Jay. Of the numerous polyglott editions of parts of the Bible it may suffice to mention the Genoa psalter of 1516, edited by Giustiniani, bishop of Nebbio. This is in Hebrew, Latin, Greek, Chaldee and Arabic, and is interesting from the character of the Chaldee text, being the first specimen of Western printing in the Arabic character, and from a curious note on Columbus and the discovery of America on the margin of Psalm xix. (A. W. Po.)

POLYGNOTUS, Greek painter in the middle of the 5th century B.C., son of Aglaophon, was a native of Thasos, but was adopted by the Athenians, and admitted to their citizenship. He painted for them in the time of Cimon a picture of the taking of Ilium on the walls of the Stoa Poecile, and another of the marriage of the daughters of Leucippus in the Anaceum. In the hall at the entrance to the Acropolis other works of his were preserved. The most important, however, of his paintings were his frescoes in a building erected at Delphi by the people of Cnidus. The subjects of these were the visit to Hades by Odysseus, and the taking of Ilium. Fortunately the traveller Pausanias has left us a careful description of these paintings, figure by figure (Paus. x. 25–31). The foundations of the building have been recovered in the course of the French excavations at Delphi. From this evidence, some modern archaeologists have tried to reconstruct the paintings, excepting of course the colours of them. The best of these reconstructions is by Carl Robert, who by the help of vase-paintings of the middle of the fifth century has succeeded in recovering both the perspective of Polygnotus and the character of his figures (see GREEK ART, fig. 29). The figures were detached and seldom overlapping, ranged in two or three rows one above another; and the farther were not smaller nor dimmer than the nearer. The designs are repeated in Frazer's *Pausanias*, v. 360 and 372. It will hence appear that paintings at this time were executed on almost precisely the same plan as contemporary sculptural reliefs. We learn also that Polygnotus employed but few colours, and those simple. Technically his art was primitive. His excellence lay in the beauty of his drawing of individual figures; but especially in the "ethical" and ideal character of his art. The contemporary, and perhaps the teacher, of Pheidias, he had the same grand manner. Simplicity, which was almost childlike, sentiment at once noble and gentle, extreme grace and charm of execution, marked his works, in contrast to the more animated, complicated and technically superior paintings of a later age. (P. G.)

POLYGON (Gr. πολύς, many, and γωνία, an angle), in geometry, a figure enclosed by any number of lines—the sides—which intersect in pairs at the corners or vertices. If the sides are coplanar, the polygon is said to be "plane"; if not, then it is a "skew" or "gauche" polygon. If the figure lies entirely to one side of each of the bounding lines the figure is "convex"; if not it is "re-entrant" or "concave." A "regular" polygon has all its sides and angles equal, *i.e.* it is equilateral and equiangular; if the sides and angles be not equal the polygon is "irregular." Of polygons inscriptible in a circle an equilateral figure is necessarily equiangular, but the converse is only true when the number of sides is odd. The term regular polygon is usually restricted to "convex" polygons; a special class of polygons (regular in the wider sense) has been named "star polygons" on account of their resemblance to star-rays; these are, however, concave.

Polygons, especially of the "regular" and "star" types, were extensively studied by the Greek geometers. There are two important corollaries to prop. 32, book i., of Euclid's *Elements* relating to polygons. Having proved that the sum of the angles of a triangle is a straight angle, *i.e.* two right angles, it is readily seen that the sum of the internal angles of a polygon (necessarily convex) of n sides is $n-2$ straight angles ($2n-4$ right angles), for the polygon can be divided into $n-2$ triangles by lines joining one vertex to the other vertices. The second corollary is that the sum of the supplements of the internal angles, measured in the same direction, is 4 right angles, and is thus independent of the number of sides.

The systematic discussion of regular polygons with respect to the inscribed and circumscribed circles is given in the fourth book of the *Elements.* (We may note that the construction of an equilateral triangle and square appear in the first book.) The triangle is discussed in props. 2–6; the square in props. 6–9; the pentagon (5-side) in props. 10–14; the hexagon (6-side) in prop. 15; and the quindecagon in prop. 16. The triangle and square call for no special mention here, other than that any triangle can be inscribed or circumscribed to a circle. The pentagon is of more interest. Euclid bases his construction upon the fact that the isosceles triangle formed by joining the extremities of one side of a regular pentagon to the opposite vertex has each angle at the base double the angle at the vertex. He constructs this triangle in prop. 10, by dividing a line in medial section, *i.e.* the square of one part equal to the product of the other part and the whole line (a construction given in book ii. 11), and then showing that the greater segment is the base of the required triangle, the remaining sides being each equal to the whole line. The inscription of a pentagon in a circle is effected by inscribing an isosceles triangle similar to that constructed in prop. 10, bisecting the angles at the base and producing the bisectors to meet the circle. Euclid then proves that these intersections and the three vertices of the triangle are the vertices of the required pentagon. The circumscription of a pentagon is effected by constructing an inscribed pentagon, and drawing tangents to the circle at the vertices. This supplies a general method for circumscribing a polygon if the inscribed be given, and conversely. In book xiii., prop. 10, an alternative method for inscribing a pentagon is indicated, for it is there shown that the sum of the squares of the sides of a square and hexagon inscribed in the same circle equals the square of the side of the pentagon. It may be incidentally noticed that Euclid's construction of the isosceles triangle which has its basal angles double the vertical angle solves the problem of quinquesecting a right angle; moreover, the base of the triangle is the side of the regular decagon inscribed in a circle having the vertex as centre and the sides of the triangle as radius. The inscription of a hexagon in a circle (prop. 15) reminds one of the Pythagorean result that six equilateral triangles placed about a common vertex form a plane; hence the bases form a regular hexagon. The side of a hexagon inscribed in a circle obviously equals the radius of the circle. The inscription of the quindecagon in a circle is made to depend upon the fact that the difference of the arcs of a circle intercepted by covertical sides of a regular pentagon and equilateral triangle is $\frac{1}{3}-\frac{1}{5}, = \frac{2}{15}$, of the whole circumference, and hence the bisection of this intercepted arc (by book iii., 30) gives the side of the quindecagon.

The methods of Euclid permit the construction of the following series of inscribed polygons: from the square, the 8-side or octagon, 16-, 32- . . ., or generally $4\cdot2^n$-side; from the hexagon, the 12-side or dodecagon, 24-, 48- . . ., or generally the $6\cdot2^n$-side; from the pentagon, the 10-side or decagon, 20-, 40- . . ., or generally $5\cdot2^n$-side; from the quindecagon, the 30-, 60- . . ., or generally $15\cdot2^n$-side. It was long supposed that no other inscribed polygons were possible of construction by elementary methods (*i.e.* by the ruler and compasses); Gauss disproved this by forming the 17-side, and he subsequently generalized his method for the (2^n+1)-side, when this number is prime.

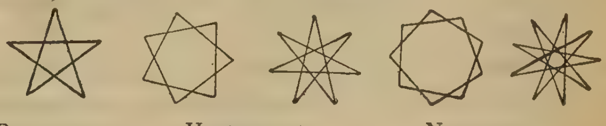
The problem of the construction of an inscribed heptagon, nonagon, or generally of any polygon having an odd number of sides, is readily reduced to the construction of a certain isosceles triangle. Suppose the polygon to have $(2n+1)$ sides. Join the extremities of one side to the opposite vertex, and consider the triangle so formed. It is readily seen that the angle at the base is n times the angle at the vertex. In the heptagon the ratio is 3, in the nonagon 4, and so on. The Arabian geometers of the 9th century showed that the heptagon required the solution of a cubic equation, thus resembling the Pythagorean problems of "duplicating the cube" and "trisecting an angle." Edmund Halley gave solutions for the heptagon and nonagon by means of the parabola and circle, and by a parabola and hyperbola respectively.

Although rigorous methods for inscribing the general polygons in a circle are wanting, many approximate ones have been devised. Two such methods are here given: (1) Divide the diameter of the circle into as many parts as the polygon has sides. On the diameter construct an equilateral triangle; and from its vertex draw a line through the *second* division along the diameter, measured from an extremity, and produce this line to intercept the circle. Then the chord joining this point to the extremity of the diameter is the side of the required polygon. (2) Divide the diameter as before, and draw also the perpendicular diameter. Take points on these diameters beyond the circle and at a distance from the circle equal to one division of the diameter. Join the points so obtained; and draw a line from the point nearest the divided diameter where this line intercepts the circle to the *third* division from the produced extremity; this line is the required length.

The construction of any regular polygon on a given side may be readily performed with a protractor or scale of chords, for it is only necessary to lay off from the extremities of the given side lines equal in length to the given base, at angles equal to the interior angle of the polygon, and repeating the process at each extremity so obtained, the angle being always taken on the same side; or lines may be laid off at one half of the interior angles, describing a circle having the meet of these lines as centre and their length as radius, and then measuring the given base around the circumference.

Star Polygons.—These figures were studied by the Pythagoreans, and subsequently engaged the attention of many geometers—Boethius, Athelard of Bath, Thomas Bradwardine, archbishop of Canterbury, Johannes Kepler and others. Mystical and magical properties were assigned to them at an early date; the Pythagoreans regarded the pentagram, the star polygon derived from the pentagon, as the symbol of health, the Platonists of well-being, while others used it to symbolize happiness. Engraven on metal, &c., it is worn in almost every country as a charm or amulet.

The pentagon gives rise to one star polygon, the hexagon gives none, the heptagon two, the octagon one, and the nonagon two. In general, the number of star polygons which can be drawn with the vertices of an n-point regular polygon is the number of numbers which are not factors of n and are less than $\frac{1}{2}n$.



Pentagrams. Heptagrams. Nonograms.

Number of n-point and n-side Polygons. A polygon may be regarded as determined by the joins of points or the meets of lines. The termination *-gram* is often applied to the figures determined by lines, *e.g.* pentagram, hexagram. It is of interest to know how many polygons can be formed with n given points as vertices (no three of which are collinear), or with n given lines as sides (no two of which are parallel). Considering the case of points it is obvious that we can join a chosen point with any one of the remaining $(n-1)$ points; any one of these $(n-1)$ points can be joined to any one of the remaining $(n-2)$, and by proceeding similarly it is seen that we can pass through the n points in $(n-1)\ (n-2)\ .\ .\ .\ 2\cdot1$ or $(n-1)!$ ways. It is obvious that the *direction* in which we pass is immaterial; hence we must divide this number by 2, thus obtaining $(n-1)!/2$ as the required number. In a similar manner it may be shown that the number of polygons determined by n lines is $(n-1)!/2$. Thus five points or lines determine 12 pentagons, 6 points or lines 60 hexagons, and so on.

Mensuration.—In the regular polygons the fact that they can be inscribed and circumscribed to a circle affords convenient expressions for their area, &c. In a n-gon, *i.e.* a polygon with n-sides, each side subtends at the centre the angle $2\pi/n$, *i.e.* $360°/n$, and each internal angle is $(n-2)\pi/n$ or $(n-2)\ 180°/n$. Calling the length of side a we may derive the following relations: Area

Number of sides.	3 Triangle.	4 Square.	5 Pentagon.	6 Hexagon.	7 Heptagon.	8 Octagon.	9 Nonagon.	10 Decagon.	11 Undecagon.	12 Dodecagon.
α	60°	90°	108°	120°	$128\frac{4}{7}°$	135°	140°	144°	$147\frac{3}{11}°$	150°
β	120°	90°	72°	60°	$51\frac{3}{7}°$	45°	40°	36°	$32\frac{8}{11}°$	30°
A	0·43301	1	1·72048	2·59808	3·63391	4·82843	6·18182	7·69421	9·36564	11·19615
R	0·57735	0·70710	0·85065	1	1·1523	1·3065	1·4619	1·6180	1·7747	1·9318
r	0·28867	0·5	0·68819	0·86602	1·0383	1·2071	1·3737	1·5388	1·7028	1·8660

$(A)=\frac{1}{4}\ a^2n\ \cot\ (\pi/n)$; radius of circum-circle $(R)=\frac{1}{2}\ a\ \operatorname{cosec}\ (\pi/n)$ radius of in-circle $(r)=\frac{1}{2}a\ \cot\ (\pi/n)$.

The table at foot of p. 1592 gives the value of the internal angle (α), the angle β subtended at the centre by a side, area (A), radius of the circum-circle (R), radius of the inscribed circle (r) for the simpler polygons, the length of the side being taken as unity.

POLYGONACEAE, in botany, a natural order of Dicotyledons, containing 30 genera with about 700 species, chiefly in the north temperate zone, and represented in Great Britain by three genera, *Polygonum*, *Rumex* (Dock, *q.v.*) and *Oxyria*. They are mostly herbs characterized by the union of the stipules into a sheath or *ocrea*, which protects the younger leaves in the bud stage (fig. 1). Some are climbers, as, for instance, the British *Polygonum Convolvulus* (black bindweed). In *Muehlenbeckia platyclada*, a native of the Solomon Islands, the stem and branches are flattened, forming ribbon-like cladodes jointed at the nodes. The leaves are alternate, simple and generally entire; the edges are rolled back in the bud.

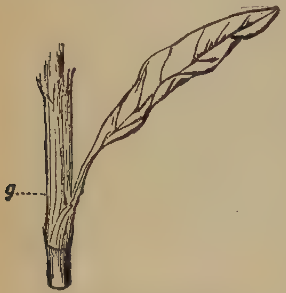


FIG. 1.—Leaf of Polygonum, with part of stem (*g*, ocrea).

They are generally smooth, but sometimes, especially in mountain species, woolly. The small regular, generally hermaphrodite flowers are borne in large numbers in compound inflorescences, the branches of which are cymose. The parts of the flower are whorled (cyclic) or acyclic. The former arrangement may be derived from a regular trimerous flower with two whorls of perianth leaves, two staminal whorls and a three-sided ovary—such a flower occurs in the Californian genus *Pterostegia* (fig. 2). The flower of rhubarb (*Rheum*) is derived from this by doubling in the outer staminal whorl (fig. 3), and that of the dock (*Rumex*) by doubling in the outer staminal whorl and suppression of the inner (fig. 4).

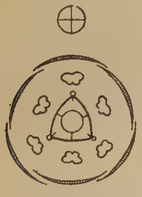


FIG. 2.—*Pterostegia*.

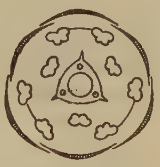


FIG. 3.—*Rheum*.

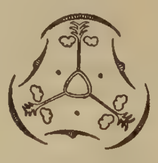


FIG. 4.—*Rumex*.

In *Koenigia*, a tiny annual less than an inch high, native in the arctic and sub-arctic regions and the Himalayas, there is one perianth and one staminal whorl only. Dimerous whorled flowers occur in *Oxyria* (mountain sorrel), another arctic and alpine genus, the flowers of which resemble those of *Rumex* but are dimerous (fig. 5). In the acyclic flowers a 5-merous perianth is followed by 5 to 8 stamens as in *Polygonum* (fig. 6).

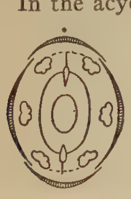


FIG. 5.—*Oxyria*.

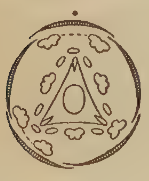


FIG. 6.—*Polygonum*.

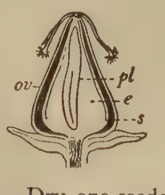


FIG. 7.—Dry one-seeded fruit of dock (*Rumex*) cut vertically (enlarged).

- *ov*, Pericarp formed from ovary wall.
- *s*, Seed.
- *e*, Endosperm.
- *pl*, Embryo with radicle pointing upwards and cotyledons downwards.

The perianth leaves are generally uniform and green, white or red in colour. They are free or more or less united, and persist till the fruit is ripe, often playing a part in its distribution, and affording useful characters for distinguishing genera or species. Thus in the docks the three inner leaves enlarge and envelope the fruit as three membranous wings one or more of which bear on the back large fleshy warts. Less often, as in the South American genus *Triplaris*, the three outer perianth leaves form the agent of distribution, developing into long flat membranous wings, the whole mechanism suggesting a shuttlecock. The number of the carpels is indicated by the three-sided (in dimerous flowers two-sided) ovary, and the number of the styles; the ovary is unilocular and contains a single erect ovule springing from the top of the floral axis (fig. 7). The fruit is a dry one-seeded nut, two-sided in bicarpellary flowers, as in *Oxyria*.

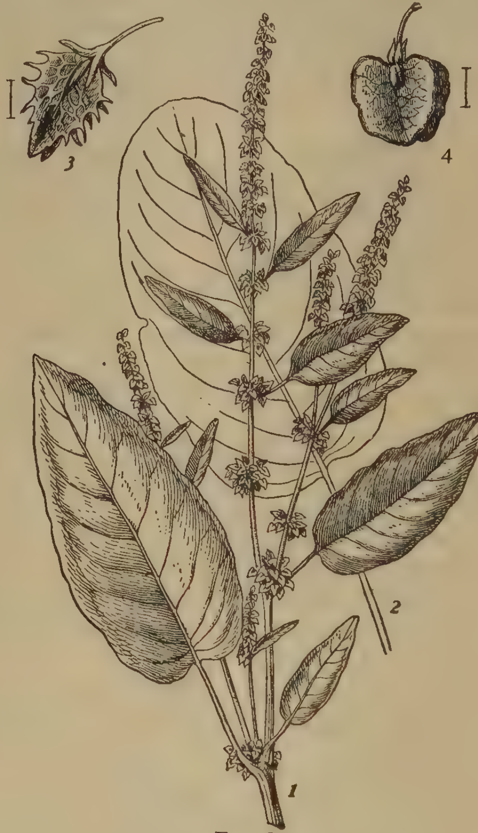


FIG. 8.

Rumex obtusifolius, Common Dock.

1. Upper part of plant, showing the flowers.
2. Leaf from base of the stem.
3. Fruit enlarged.
4. Fruit of *Rumex Acetosa* (sorrel) (enlarged).

The straight or curved embryo is embedded in a mealy endosperm. The flowers are wind-pollinated, as in the docks (*Rumex*), where they are pendulous on long slender stalks and have large hairy stigmas; or insect-pollinated, as in *Polygonum* or rhubarb (*Rheum*), where the stigmas are capitate and honey is secreted by glands near the base of the stamens. Insect-pollinated flowers are rendered conspicuous chiefly by their aggregation in large numbers, as for instance in Bistort (*Polygonum Bistorta*), where the perianth is red and the flowers are crowded in a spike. In buckwheat (*q.v.*, *P. Fagopyrum*) the numerous flowers have a white or red perianth and are perfumed; they are dimorphic, *i.e.* there are two forms of flowers, one with long styles and short stamens, the other with short styles and long stamens. In other cases self-pollination is the rule, as in knot-grass (*P. aviculare*), where the very small, solitary odourless flowers are very rarely visited by insects and pollinate themselves by the incurving of the three inner stamens on to the styles.

Polygonaceae is mainly a north temperate order. A few genera are tropical, *e.g. Coccoloba*, which has 125 species restricted to tropical and sub-tropical America. *Polygonum* has a very wide distribution spreading from the limits of vegetation in the northern hemisphere to the mountains of tropical Africa and South Africa, through the highlands of tropical Asia to Australia, and in America as far south as Chile. Most of the genera have, however, a limited distribution. Of the three which are native in the British Isles, *Polygonum* has

12 species; *Rumex* (fig. 8) (11 species) includes the various species of dock (*q.v.*) and sorrel (*R. Acetosa*); and *Oxyria digyna*, an alpine plant (mountain sorrel), takes its generic name (Gr. ὀξύς, sharp) from the acidity of its leaves. *Rheum* (Rhubarb, *q.v.*) is central Asiatic.

POLYGONAL NUMBERS, in mathematics. Suppose we have a number of equal circular counters, then the number of counters which can be placed on a regular polygon so that the tangents to the outer rows form the regular polygon and all the internal counters are in contact with its neighbours, is a "polygonal number" of the order of the polygon. If the polygon be a triangle then it is readily seen that the numbers are 3, 6, 10, 15 . . . and generally $\frac{1}{2}n(n+1)$; if a square, 4, 9, 16, . . . and generally n^2; if a pentagon, 5, 12, 22 . . . and generally $n(3n-1)$; if a hexagon, 6, 15, 28, . . . and generally $n(2n-1)$; and similarly for a polygon of r sides, the general expression for the corresponding polygonal number is $\frac{1}{2}n[(n-1)(r-2)+2]$.

Algebraically, polygonal numbers may be regarded as the sums of consecutive terms of the arithmetical progressions having 1 for the first term and 1, 2, 3, . . . for the common differences. Taking unit common difference we have the series 1; $1+2=3$; $1+2+3=6$; $1+2+3+4=10$; or generally $1+2+3 \ldots + n = \frac{1}{2}n(n+1)$; these are triangular numbers. With a common difference 2 we have 1; $1+3=4$; $1+3+5=9$; $1+3+5+7=16$; or generally $1+3+5+\ldots+(2n-1)=n^2$; and generally for the polygonal number of the rth order we take the sums of consecutive terms of the series

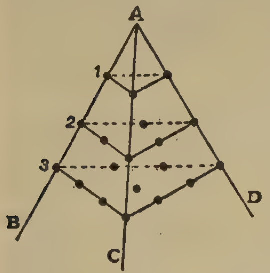
$$1,\ 1+(r-2),\ 1+2(r-2),\ \ldots\ 1+\overline{n-1}.\overline{r-2};$$

and hence the nth polygonal number of the rth order is the sum of n terms of this series, *i.e.*,

$$1+1+(r-2)+1+2(r-2)+\ldots+(1+\overline{n-1}.\overline{r-2})$$
$$=n+\tfrac{1}{2}n.\overline{n-1}.\overline{r-2}.$$

The series 1, 2, 3, 4, . . . or generally n, are the so-called "linear numbers" (cf. FIGURATE NUMBERS).

POLYHEDRAL NUMBERS, in mathematics. These numbers are related to the polyhedra (see POLYHEDRON) in a manner similar to the relation between polygonal numbers (see above) and polygons. Take the case of tetrahedral numbers. Let AB, AC, AD be three covertical edges of a regular tetrahedron. Divide AB, . . . into parts each equal to A 1, so that tetrahedra having the common vertex A are obtained, whose linear dimensions increase arithmetically. Imagine that we have a number of spheres (or shot) of a diameter equal to the distance A1. It is seen that 4 shot having their centres at the vertices of the tetrahedron A1 will form a pyramid. In the case of the tetrahedron of edge A2 we require 3 along each side of the base, *i.e.* 6, 3 along the base of A1, and 1 at A, making 10 in all. To add a third layer, we will require 4 along each base, *i.e.* 9, and 1 in the centre. Hence in the tetrahedron A3 we have 20 shot. The numbers 1, 4, 10, 20 are polyhedral numbers, and from their association with the tetrahedron are termed "tetrahedral numbers."



This illustration may serve for a definition of polyhedral numbers: a polyhedral number represents the number of equal spheres which can be placed within a polyhedron so that the spheres touch one another or the sides of the polyhedron.

In the case of the tetrahedron we have seen the numbers to be 1, 4, 10, 20; the general formula for the nth tetrahedral number is $\frac{1}{6}n(n+1)(n+2)$. Cubic numbers are 1, 8, 27, 64, 125, &c.; or generally n^3. Octahedral numbers are 1, 6, 19, 44, &c., or generally $\frac{1}{3}n(2n^2+1)$. Dodecahedral numbers are 1, 20, 84, 220, &c.; or generally $\frac{1}{2}n(9n^2-9n+2)$. Icosahedral numbers are 1, 12, 48, 124, &c., or generally $\frac{1}{2}n(5n^2-5n+2)$.

POLYHEDRON (Gr. πολύς, many, ἕδρα, a base), in geometry, a solid figure contained by plane faces. If the figure be entirely to one side of any face the polyhedron is said to be "convex," and it is obvious that the faces enwrap the centre once; if, on the other hand, the figure is to both sides of every face it is said to be "concave," and the centre is multiply enwrapped by the faces. "Regular polyhedra" are such as have their faces all equal regular polygons, and all their solid angles equal; the term is usually restricted to the five forms in which the centre is singly enclosed, viz. the Platonic solids, while the four polyhedra in which the centre is multiply enclosed are referred to as the Kepler-Poinsot solids, Kepler having discovered three, while Poinsot discovered the fourth. Another group of polyhedra are termed the "Archimedean solids," named after Archimedes, who, according to Pappus, invented them. These have faces which are all regular polygons, but not all of the same kind, while all their solid angles are equal. These figures are often termed "semi-regular solids," but it is more convenient to restrict this term to solids having all their angles, edges and faces equal, the latter, however, not being regular polygons.

Platonic Solids. The names of these five solids are: (1) the tetrahedron, enclosed by four equilateral triangles; (2) the cube or hexahedron, enclosed by 6 squares; (3) the octahedron, enclosed by 8 equilateral triangles; (4) the dodecahedron, enclosed by 12 pentagons; (5) the icosahedron, enclosed by 20 equilateral triangles.

The first three were certainly known to the Egyptians; and it is probable that the icosahedron and dodecahedron were added by the Greeks. The cube may have originated by placing three equal squares at a common vertex, so as to form a trihedral angle. Two such sets can be placed so that the free edges are brought into coincidence while the vertices are kept distinct. This solid has therefore 6 faces, 8 vertices and 12 edges. The equilateral triangle is the basis of the tetrahedron, octahedron and icosahedron.[1] If three equilateral triangles be placed at a common vertex with their covertical sides coincident in pairs, it is seen that the base is an equal equilateral triangle; hence four equal equilateral triangles enclose a space. This solid has 4 faces, 4 vertices and 6 edges. In a similar manner, four covertical equilateral triangles stand on a square base. Two such sets placed base to base form the octahedron, which consequently has 8 faces, 6 vertices and 12 edges. Five equilateral triangles covertically placed would stand on a pentagonal base, and it was found that, by forming several sets of such pyramids, a solid could be obtained which had 20 triangular faces, which met in pairs to form 30 edges, and in fives to form 12 vertices. This is the icosahedron. That the triangle could give rise to no other solid followed from the fact that six covertically placed triangles formed a plane. The pentagon is the basis of the dodecahedron. Three pentagons may be placed at a common vertex to form a solid angle, and by forming several such sets and placing them in juxtaposition a solid is obtained having 12 pentagonal faces, 30 edges, and 20 vertices.

These solids played an important part in the geometry of the Pythagoreans, and in their cosmology symbolized the five elements: fire (tetrahedron), air (octahedron), water (icosahedron), earth (cube), universe or ether (dodecahedron). They were also discussed by the Platonists, so much so that they became known as the "Platonic solids." Euclid discusses them in the thirteenth book of his *Elements*, where he proves that no more regular bodies are possible, and shows how to inscribe them in a sphere. This latter problem received the attention of the Arabian astronomer Abul Wefa (10th century A.D.), who solved it with a single opening of the compasses.

Mensuration of the Platonic Solids.—The mensuration of the regular polyhedra is readily investigated by the methods of elementary geometry, the property that these solids may be inscribed in and circumscribed to concentric spheres being especially useful.

If F be the number of faces, n the number of edges per face, m the number of faces per vertex, and l the length of an edge, and if we denote the angle between two adjacent faces by I, the area by A, the volume by V, the radius of the circum-sphere by R, and of the in-sphere by r, the following general formulae hold, α being written for $2\pi/n$, and β for $2\pi/m$:—

$$\text{Sin}\ \tfrac{1}{2}\text{I} = \cos\beta/\sin\alpha; \qquad \tan\tfrac{1}{2}\text{I} = \cos\beta/(\sin^2\alpha-\cos^2\beta)^{\frac{1}{2}}.$$
$$\text{A} = \tfrac{1}{4}\,l^2n\text{F}\cot\alpha.$$
$$\text{V} = \tfrac{1}{3}r\text{A} = \tfrac{1}{24}l^3n\ \text{F}\tan\tfrac{1}{2}\text{I}\cot^2\alpha$$
$$= \tfrac{1}{24}l^3n\ \text{F}\cot^2\alpha\cos\beta/(\sin^2\alpha-\cos^2\beta)^{\frac{1}{2}}.$$
$$\text{R} = \tfrac{1}{2}l\tan\tfrac{1}{2}\text{I}\tan\beta = \tfrac{1}{2}l\sin\beta/(\sin^2\alpha-\cos^2\beta)^{\frac{1}{2}}.$$
$$r = \tfrac{1}{2}l\tan\tfrac{1}{2}\text{I}\cot\alpha = \tfrac{1}{2}l\cot\alpha\cos\beta/(\sin^2\alpha-\cos^2\beta)^{\frac{1}{2}}.$$

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[1] In the language of Proclus, the commentator: "The equilateral triangle is the proximate cause of the three elements, 'fire,' 'air' and 'water'; but the square is annexed to the 'earth.'"

The following Table gives the values of A, V, R, r for the five Polyhedra:—

	A. Area.	Volume V.	Radius of Circum-sphere. R.	Radius of In-sphere. r.
Tetrahedron	$l^2.\sqrt{3}$ $(1{\cdot}7321\ l^2)$	$l^3/6\sqrt{2}$ $(0{\cdot}11785\ l^3)$	$l.\sqrt{6}/4$	$l.\sqrt{6}/12$
Cube	$6\ l^2$	l^3	$l.\sqrt{3}/2$	$\frac{1}{2}l$
Octahedron	$l^2.2\sqrt{3}$ $(3.4642\ l^2)$	$l^3.\sqrt{2}/3$ $(0{\cdot}47140\ l^3)$	$l/\sqrt{2}$	$l/\sqrt{6}$
Dodecahedron	$l^2.15\sqrt{(1+2\sqrt{5})}$ $(20{\cdot}64578\ l^2)$	$l^3.5\sqrt{\{(47+21\sqrt{5})/40\}}$ $(7{\cdot}663119\ l^3)$	$l.\frac{1}{2}\sqrt{\{(5+3\sqrt{5})/2\}}$	$l.\sqrt{\{(20+11\sqrt{5})/40\}}$
Icosahedron	$l^2.5\sqrt{3}$ $(8{\cdot}6605\ l^2)$	$l^3.\frac{5}{6}\sqrt{\{(7+3\sqrt{5})/2\}}$ $(2{\cdot}18169\ l^3)$	$l.\frac{1}{2}\sqrt{\{(5+\sqrt{5})/2\}}$	$l.\frac{1}{2}\sqrt{\{(7+3\sqrt{5})/6\}}$

Kepler-Poinsot Polyhedra.—These solids have all their faces equal regular polygons, and the angles at the vertices all equal. They bear a relation to the Platonic solids similar to the relation of "star polygons" to ordinary regular polygons, inasmuch as the centre is multiply enclosed in the former and singly in the latter. Four such solids exist: (1) small stellated dodecahedron; (2) great dodecahedron; (3) great stellated dodecahedron; (4) great icosahedron. Louis Poinsot discussed these solids in his memoir, "Sur les polygones et les polyédres" (*Journ. École poly.* [iv.] 1810), three of them having been previously considered by Kepler. They were afterwards treated by A. L. Cauchy (*Journ. École poly.* [ix.] 1813), who showed that they were derived from the Platonic solids, and that no more than four were possible. A. Cayley treated them in several papers (*e.g. Phil. Mag.*, 1859, 17, p. 123 seq.), considering them by means of their projections on the circumscribing sphere and not, as Cauchy, *in solido.*

The *small stellated dodecahedron* is formed by stellating the Platonic dodecahedron (by "stellating" is meant developing the faces contiguous to a specified base so as to form a regular pyramid). It has 12 pentagonal faces, and 30 edges, which intersect in fives to form 12 vertices. Each vertex is singly enclosed by the five faces; the centre of each face is doubly enclosed by the succession of faces about the face; and the centre of the solid is doubly enclosed by the faces. The *great dodecahedron* is determined by the intersections of the twelve planes which intersect the Platonic icosahedron in five of its edges; or each face has the same boundaries as the basal sides of five covertical faces of the icosahedron. It is the reciprocal (see below) of the small stellated dodecahedron. Each vertex is doubly enclosed by the succession of covertical faces, while the centre of the solid is triply enclosed by the faces. The *great stellated dodecahedron* is formed by stellating the faces of a great dodecahedron. It has 12 faces, which meet in 30 edges; these intersect in threes to form 20 vertices. Each vertex is singly enclosed by the succession of faces about it; and the centre of the solid is quadruply enclosed by the faces. The *great icosahedron* is the reciprocal of the great stellated dodecahedron. Each of the twenty triangular faces subtend at the centre the same angle as is subtended by four whole and six half faces of the Platonic icosahedron; in other words, the solid is determined by the twenty planes which can be drawn through the vertices of the three faces contiguous to any face of a Platonic icosahedron. The centre of the solid is septuply enclosed by the faces.

A connexion between the number of faces, vertices and edges of regular polyhedra was discovered by Euler, and the result, which assumes the form $E + 2 = F + V$, where E, F, V are the number of edges, faces and vertices, is known as Euler's theorem on polyhedra. This formula only holds for the Platonic solids. Poinsot gave the formula $E + 2k = eV + F$, in which k is the number of times the projections of the faces from the centre on to the surface of the circumscribing sphere make up the spherical surface, the area of a stellated face being reckoned once, and e is the ratio "angles at a vertex $/2\pi$" as projected on the sphere, E, V, F being the same as before. Cayley gave the formula $E + 2D = eV + e'F$, where e, E, V, F are the same as before, D is the same as Poinsot's k with the distinction that the area of a stellated face is reckoned as the sum of the triangles having their vertices at the centre of the face and standing on the sides, and e' is the ratio: "the angles subtended at the centre of a face by its sides $/2\pi$."

The following table gives these constants for the regular polyhedra; n denotes the number of sides to a face, n_1 the number of faces to a vertex:—

	F	V	E	n	n_1	e	e'	D	k
Tetrahedron	4	4	6	3	3	1	1	1	1
Cube	6	8	12	4	3	1	1	1	1
Octahedron	8	6	12	3	4	1	1	1	1
Dodecahedron	12	20	30	5	3	1	1	1	1
Icosahedron	20	12	30	3	5	1	1	1	1
Small stellated dodecahedron	12	12	30	5	5	1	2	3	2
Great dodecahedron	12	12	30	5	5	2	1	3	3
Great stellated dodecahedron	12	20	30	5	3	1	2	7	4
Great icosahedron	20	12	30	3	5	2	1	7	7

Archimedean Solids.—These solids are characterized by having all their angles equal and all their faces regular polygons, which are not all of the same species. Thirteen such solids exist.

1. The *truncated tetrahedron* is formed by truncating the vertices of a regular tetrahedron so as to leave the original faces hexagons. (By the truncation of a vertex or edge we mean the cutting away of the vertex or edge by a plane making equal angles with all the faces composing the vertex or with the two faces forming the edge.) It is bounded by 4 triangular and 4 hexagonal faces; there are 18 edges, and 12 vertices, at each of which two hexagons and one triangle are covertical.

2. The *cuboctahedron* is a tesserescae-decahedron (Gr. τεσσαρες-καιδεκα, fourteen) formed by truncating the vertices of a cube so as to leave the original faces squares. It is enclosed by 6 square and 8 triangular faces, the latter belonging to a coaxial octahedron. It is a common crystal form.

3. The *truncated cube* is formed in the same manner as the cuboctahedron, but the truncation is only carried far enough to leave the original faces octagons. It has 6 octagonal faces (belonging to the original cube), and 8 triangular ones (belonging to the coaxial octahedron).

4. The *truncated octahedron* is formed by truncating the vertices of an octahedron so as to leave the original faces hexagons; consequently it is bounded by 8 hexagonal and 6 square faces.

5, 6. *Rhombicuboctahedra.*—Two Archimedean solids of 26 faces are derived from the coaxial cube, octahedron and semi-regular (rhombic) dodecahedron (see below). The "small rhombicuboctahedron" is bounded by 12 pentagonal, 8 triangular and 6 square faces; the "great rhombicuboctahedra" by 12 decagonal, 8 triangular and 6 square faces.

7. The *icosidodecahedron* or dyocaetriacontahedron (Gr. δυο-καιτριάκοντα, thirty-two), is a 32-faced solid, formed by truncating the vertices of an icosahedron so that the original faces become triangles. It is enclosed by 20 triangular faces belonging to the original icosahedron, and 12 pentagonal faces belonging to the coaxial dodecahedron.

8. The *truncated icosahedron* is formed similarly to the icosidodecahedron, but the truncation is only carried far enough to leave the original faces hexagons. It is therefore enclosed by 20 hexagonal faces belonging to the icosahedron, and 12 pentagonal faces belonging to the coaxial dodecahedron.

9. The *truncated dodecahedron* is formed by truncating the vertices of a dodecahedron parallel to the faces of the coaxial icosahedron so as to leave the former decagons. It is enclosed by 20 triangular faces belonging to the icosahedron and 12 decagons belonging to the dodecahedron.

10. The *snub cube* is a 38-faced solid having at each corner 4 triangles and 1 square; 6 faces belong to a cube, 8 to the coaxial octahedron, and the remaining 24 to no regular solid.

11, 12. The *rhombicosidodecahedra.*—Two 62-faced solids are derived from the dodecahedron, icosahedron and the semi-regular triacontahedron. In the “ small rhombicosidodecahedron ” there are 12 pentagonal faces belonging to the dodecahedron, 20 triangular faces belonging to the icosahedron and 30 square faces belonging to the triacontahedron. In the “ great rhombicosidodecahedron ” the dodecahedral faces are decagons, the icosahedral hexagons and the triacontahedral squares; this solid is sometimes called the “ truncated icosidodecahedron.”

13. The *snub dodecahedron* is a 92-faced solid having 4 triangles and a pentagon at each corner. The pentagons belong to a dodecahedron, and 20 triangles to an icosahedron; the remaining 60 triangles belong to no regular solid.

Semi-regular Polyhedra.—Although this term is frequently given to the Archimedean solids, yet it is a convenient denotation for solids which have all their angles, faces, and edges equal, the faces *not* being regular polygons. Two such solids exist: (1) the “ rhombic dodecahedron,” formed by truncating the edges of a cube, is bounded by 12 equal rhombs; it is a common crystal form (see CRYSTALLOGRAPHY); and (2) the “ semi-regular triacontahedron,” which is enclosed by 30 equal rhombs.

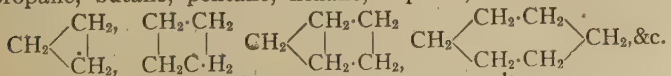
The interrelations of the polyhedra enumerated above are considerably elucidated by the introduction of the following terms: (1) *Correspondence.* Two polyhedra correspond when the radii vectores from their centres to the mid-point of the edges, centre of the faces, and to the vertices, can be brought into coincidence. (2) *Reciprocal.* Two polyhedra are reciprocal when the faces and vertices of one correspond to the vertices and faces of the other. (3) *Summital or facial.* A polyhedron (A) is said to be the summital or facial holohedron of another (B) when the faces or vertices of A correspond to the edges of B, and the vertices or faces of A correspond to the vertices and faces together of B. (4) *Hemihedral.* A polyhedron is said to be the hemihedral form of another polyhedron when its faces correspond to the alternate faces of the latter or holohedral form; consequently a hemihedral form has half the number of faces of the holohedral form. Hemihedral forms are of special importance in crystallography, to which article the reader is referred for a fuller explanation of these and other modifications of polyhedra (tetartohedral, enantiotropic, &c.).

It is readily seen that the tetrahedron is its own reciprocal, *i.e.* it is self-reciprocal; the cube and octahedron, the dodecahedron and icosahedron, the small stellated dodecahedron and great dodecahedron, and the great stellated dodecahedron and great icosahedron are examples of reciprocals. We may also note that of the Archimedean solids: the truncated tetrahedron, truncated cube, and truncated dodecahedron, are the reciprocals of the crystal forms triakistetrahedron, triakisoctahedron and triakisicosahedron. Since the tetrahedron is the hemihedral form of the octahedron, and the octahedron and cube are reciprocal, we may term these two latter solids “ reciprocal holohedra ” of the tetrahedron. Other examples of reciprocal holohedra are: the rhombic dodecahedron and cuboctahedron, with regard to the cube and octahedron; and the semi-regular triacontahedron and icosidodecahedron, with regard to the dodecahedron and icosahedron. As examples of facial holohedra we may notice the small rhombicuboctahedron and rhombic dodecahedron, and the small rhombicosidodecahedron and the semi-regular triacontahedron. The correspondence of the faces of polyhedra is also of importance, as may be seen from the manner in which one polyhedron may be derived from another. Thus the faces of the cuboctahedron, the truncated cube, and truncated octahedron, correspond; likewise with the truncated dodecahedron, truncated icosahedron, and icosidodecahedron; and with the small and great rhombicosidodecahedra.

The general theory of polyhedra properly belongs to combinatorial analysis. The determination of the number of different polyhedra of *n* faces, *i.e.* *n*-hedrons, is reducible to the problem: In how many ways can multiplets, *i.e.* triplets, quadruplets, &c., be made with *n* symbols, so that (1) every contiguous pair of symbols in one multiplet are a contiguous pair in some other, the first and last of any multiplet being considered contiguous, and (2) no three symbols in any multiplet shall occur in any other. This problem is treated by the Rev T. P. Kirkman in the *Manchester Memoirs* (1855, 1857–1860); and in the *Phil. Trans.* (1857).

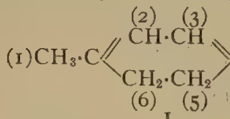
See Max Brückner, *Vielecke und Vielflache* (1900); V. Eberhard, *Zur Morphologie der Polyeder* (1891).

POLYMETHYLENES, in chemistry, cyclic compounds, the simplest members of which are saturated hydrocarbons of general formula C_nH_{2n}, where *n* may be 1 to 9, and known as tri-, tetra-, penta-, hexa-, and hepta-methylene, &c., or *cyclo*-propane, -butane, -pentane, -hexane, -heptane, &c.:—

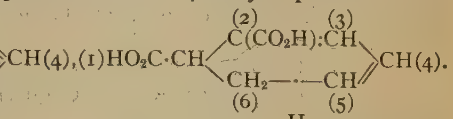


Cyclo-propane, -butane, -pentane, -hexane.

The unsaturated members of the series are named on the Geneva system in which the termination *-ane* is replaced by *-ene*, *-diene*, *-triene*, according to the number of double linkages in the compound, the position of such double linkages being shown by a numeral immediately following the suffix *-ene*; for example I. is methyl-*cyclo*-hexadiene—1. 3. An alternative method employs A. v. Baeyer's symbol Δ. Thus Δ 2·4 indicates the presence of two double bonds in the molecule situated immediately after the carbon atoms 2 and 4; for example II. is Δ 2·4 dihydrophthalic acid.



I.



II.

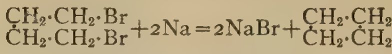
As to the stability of these compounds, most trimethylene derivatives are comparatively unstable, the ring being broken fairly readily; the tetramethylene derivatives are rather more stable and the penta- and hexa-methylene compounds are very stable, showing little tendency to form open chain compounds under ordinary conditions (see CHEMISTRY: *Organic*).

Isomerism.—No isomerism can occur in the monosubstitution derivatives but ordinary position isomerism exists in the di- and poly-substitution compounds. Stereo-isomerism may occur: the simplest examples are the dibasic acids, where a *cis*- (maleinoid) form and a *trans*- (fumaroid) form have been observed. These isomers may frequently be distinguished by the facts that the *cis*-acids yield anhydrides more readily than the *trans*-acids, and are generally converted into the *trans*-acids on heating with hydrochloric acid. O. Aschan (*Ber.*, 1902, 35, p. 3389) depicts these cases by representing the plane of the carbon atoms of the ring as a straight line and denoting the substituted hydrogen atoms by the letters X, Y, Z. Thus for dicarboxylic acids ($CO_2H = X$) the possibilities are represented by

$$\underline{X\quad X}\ \text{(cis)},\quad \underset{\qquad X}{\underline{\ X\qquad}}\ \text{(trans)},\quad \underset{X\qquad}{\underline{\qquad X\ }}\ \text{(I)}.$$

The *trans* compound is perfectly asymmetric and so its mirror image (I) should exist, and, as all the *trans* compounds synthetically prepared are optically inactive, they are presumably racemic compounds (see O. Aschan, *Chemie der alicyklischen Verbindungen*, p. 346 seq.).

General Methods of Formation.—*Hydrocarbons* may be obtained from the dihalogen paraffins by the action of sodium or zinc dust, provided that the halogen atoms are not attached to the same or to adjacent carbon atoms (A. Freund, *Monats.*, 1882, 3, p. 625; W. H. Perkin, jun., *Journ. Chem. Soc.*, 1888, 53, p. 213):—

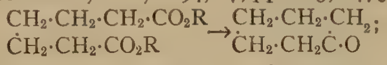


$$\begin{matrix}CH_2\cdot CH_2\cdot Br\\ CH_2\cdot CH_2\cdot Br\end{matrix} + 2Na = 2NaBr + \begin{matrix}CH_2\cdot CH_2\\ CH_2\cdot CH_2\end{matrix};$$

by the action of hydriodic acid and phosphorus or of phosphonium iodide on benzene hydrocarbons (F. Wreden, *Ann.*, 1877, 187, p. 153; A. v. Baeyer, ibid., 1870, 155, p. 266), benzene giving methylpentamethylene; by passing the vapour of benzene hydrocarbons over finely divided nickel at 180–250° C. (P. Sabatier and J. B. Senderens, *Comptes rendus*, 1901, 132, p. 210 seq.); and from hydrazines of the type $C_nH_{2n-1}\cdot NH\cdot NH_2$ by oxidation with alkaline potassium ferricyanide (N. Kijner, *Journ. prak. Chem.*, 1901, 64, p. 113). Unsaturated hydrocarbons of the series may be prepared from the corresponding alcohols by the elimination of a molecule of water, using either the xanthogenic ester method of L. Tschugaeff (*Ber.* 1899, 32, p. 3332): $C_nH_{2n-1}ONa \rightarrow C_nH_{2n-1}O\cdot CS\cdot SNa(R) \rightarrow C_nH_{2n-2} + COS + R\cdot SH$; or simply by dehydrating with anhydrous oxalic acid (N. Zelinsky, *Ber.*, 1901, 34, p. 3249); and by eliminating the halogen acid from mono- or di-halogen polymethylene compounds by heating them with quinoline.

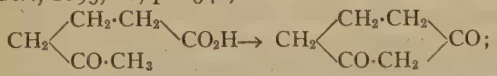
Alcohols are obtained from the corresponding halogen compounds by the action of moist silver oxide, or by warming them with silver acetate and acetic acid; by the reduction of ketones with metallic sodium; by passing the vapours of monohydric phenols and hydrogen over finely divided nickel (P. Sabatier and J. B. Senderens, *loc. cit.*); by the reduction of cyclic esters with sodium and alcohol (L. Bouveault and G. Blanc, *Comptes rendus*, 1903, 136, p. 1676; 137, p. 60); and by the addition of the elements of water to the unsaturated cyclic hydrocarbons on boiling with dilute acids.

Aldehydes and Ketones.—The aldehydes are prepared in the usual manner from primary alcohols and acids. The ketones are obtained by the dry distillation of the calcium salts of dibasic saturated aliphatic acids (J. Wislicenus, *Ann.*, 1893, 275, p. 309): $[CH_2\cdot CH_2\cdot CO_2]_2Ca\rightarrow[CH_2\cdot CH_2]_2CO$; by the action of sodium on the esters of acids of the adipic and pimelic acid series (W. Dieckmann, *Ber.*, 1894, 27, pp. 103, 2475):—



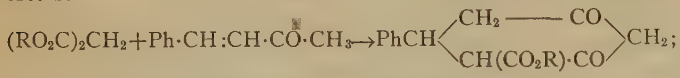
$$\begin{array}{l}CH_2\cdot CH_2\cdot CH_2\cdot CO_2R\\ CH_2\cdot CH_2\cdot CO_2R\end{array}\rightarrow\begin{array}{l}CH_2\cdot CH_2\cdot CH_2\\ CH_2\cdot CH_2C\cdot O\end{array};$$

by the action of sodium ethylate on δ-ketonic acids (D. Vorländer, *Ber.*, 1895, 28, p. 2348):—



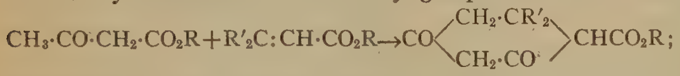
$$CH_2\left\langle\begin{array}{l}CH_2\cdot CH_2\\ CO\cdot CH_3\end{array}\right. CO_2H\rightarrow CH_2\left\langle\begin{array}{l}CH_2\cdot CH_2\\ CO\cdot CH_2\end{array}\right\rangle CO;$$

from sodio-malonic ester and αβ-unsaturated ketones or ketonic esters:—



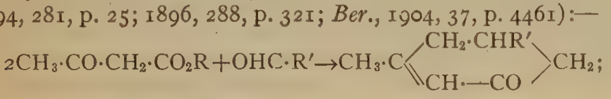
$$(RO_2C)_2CH_2+Ph\cdot CH:CH\cdot CO\cdot CH_3\rightarrow PhCH\left\langle\begin{array}{l}CH_2 —— CO\\ CH(CO_2R)\cdot CO\end{array}\right\rangle CH_2;$$

from aceto-acetic ester and esters of αβ-unsaturated acids, followed by elimination of the carboxyl group:—



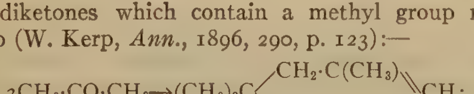
$$CH_3\cdot CO\cdot CH_2\cdot CO_2R+R'_2C:CH\cdot CO_2R\rightarrow CO\left\langle\begin{array}{l}CH_2\cdot CR'_2\\ CH_2\cdot CO\end{array}\right\rangle CHCO_2R;$$

by the condensation of two molecules of aceto-acetic ester with aldehydes followed by saponification (E. Knoevenagel, *Ann.*, 1894, 281, p. 25; 1896, 288, p. 321; *Ber.*, 1904, 37, p. 4461):—



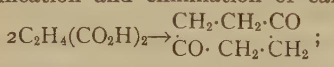
$$2CH_3\cdot CO\cdot CH_2\cdot CO_2R+OHC\cdot R'\rightarrow CH_3\cdot C\left\langle\begin{array}{l}CH_2\cdot CHR'\\ CH\cdot —CO\end{array}\right\rangle CH_2;$$

from 1·5-diketones which contain a methyl group next the keto-group (W. Kerp, *Ann.*, 1896, 290, p. 123):—



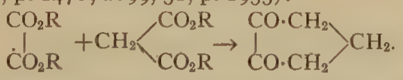
$$3CH_3\cdot CO\cdot CH_3\rightarrow(CH_3)_2C\left\langle\begin{array}{l}CH_2\cdot C(CH_3)\\ CH_2 —— CO\end{array}\right\rangle CH;$$

by the condensation of succinic acid with sodium ethylate, followed by saponification and elimination of carbon dioxide:—



$$2C_2H_4(CO_2H)_2\rightarrow\begin{array}{l}CH_2\cdot CH_2\cdot CO\\ CO\cdot CH_2\cdot CH_2\end{array};$$

and from the condensation of ethyl oxalate with esters of other dibasic acids in presence of sodium ethylate (W. Dieckmann, *Ber.*, 1897, 30, p. 1470; 1899, 32, p. 1933):—

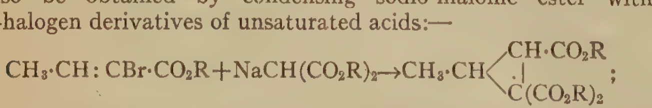


$$\begin{array}{l}CO_2R\\ |\\ CO_2R\end{array}+CH_2\left\langle\begin{array}{l}CO_2R\\ CO_2R\end{array}\right.\rightarrow\begin{array}{l}CO\cdot CH_2\\ |\\ CO\cdot CH_2\end{array}\!\!\Big\rangle CH_2.$$

Acids may be prepared by the action of dihalogen paraffins on sodio-malonic ester, or sodio-aceto-acetic ester (W. H. Perkin, jun., *Journ. Chem. Soc.*, 1888, 53, p. 194):—

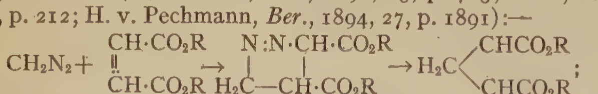
$$C_2H_4Br_2+2NaCH(CO_2R)_2\rightarrow(CH_2)_2C(CO_2R)_2+CH_2(CO_2R)_2;$$

ethyl butane tetracarboxylate is also formed which may be converted into a tetramethylene carboxylic ester by the action of bromine on its disodium derivative (W. H. Perkin and Sinclair, ibid., 1829, 61, p. 36). The esters of the acids may also be obtained by condensing sodio-malonic ester with α-halogen derivatives of unsaturated acids:—



$$CH_3\cdot CH:CBr\cdot CO_2R+NaCH(CO_2R)_2\rightarrow CH_3\cdot CH\left\langle\begin{array}{l}CH\cdot CO_2R\\ |\\ C(CO_2R)_2\end{array}\right.;$$

by the action of diazomethane or diazoacetic ester on the esters of unsaturated acids, the pyrazoline carboxylic esters so formed losing nitrogen when heated and yielding acids of the *cyclo*-propane series (E. Buchner, *Ber.*, 1890, 23, p. 703; *Ann.*, 1895, 284, p. 212; H. v. Pechmann, *Ber.*, 1894, 27, p. 1891):—



$$CH_2N_2+\begin{array}{l}CH\cdot CO_2R\\ \|\\ CH\cdot CO_2R\end{array}\rightarrow\begin{array}{l}N:N\cdot CH\cdot CO_2R\\ |\qquad\quad |\\ H_2C—CH\cdot CO_2R\end{array}\rightarrow H_2C\left\langle\begin{array}{l}CHCO_2R\\ CHCO_2R\end{array}\right.;$$

and by the Grignard reaction (S. Malmgren, *Ber.*, 1903, 36, pp. 668, 2622; N. Zelinsky, ibid., 1902, 35, p. 2687).

Cyclo-*propane Group.*

Trimethylene, C_3H_6, obtained by A. Freund (*Monats.*, 1882, 3, p. 625) by heating trimethylene bromide with sodium, is a gas, which may be liquefied, the liquid boiling at −35° C. (749 mm.). It dissolves gradually in concentrated sulphuric acid, forming propyl sulphate. Hydriodic acid converts it into *n*-propyl iodide. It is decomposed by chlorine in the presence of sunlight, with explosive violence. It is stable to cold potassium permanganate.

Cyclo-*propane carboxylic acid*, $C_3H_5\cdot CO_2H$, is prepared by heating the 1.1–dicarboxylic acid; and by the hydrolysis of its nitrile, formed by heating γ-chlorbutyro-nitrile with potash (L. Henry and P. Dalle, *Chem. Centralblatt*, 1901, 1, p. 1357; 1902, 1, p. 913). It is a colourless oil, moderately soluble in water.

The 1.1 *dicarboxylic acid* is prepared from ethylene dibromide and sodio-malonic ester. The ring is split by sulphuric or hydrobromic acids. The *cis* 1.2-cyclo-*propane dicarboxylic acid* is formed by eliminating carbon dioxide from *cyclo*-propane tricarboxylic acid −1.2.3 (from αβ-dibrompropionic ester and sodio-malonic ester). The *trans*-acid is produced on heating pyrazolin-4.5-dicarboxylic ester, or by the action of alcoholic potash on α-bromglutaric ester. It does not yield an anhydride.

Cyclo-*butane Group.*

Cyclo-*butane*, C_4H_8, was obtained by R. Willstätter (*Ber.*, 1907, 40, p. 3979) by the reduction of cyclobutene by the Sabatier and Senderens method. It is a colourless liquid which boils at 11–12° C., and its vapour burns with a luminous flame. Reduction at 180–200° C. by the above method gives *n*-butane.

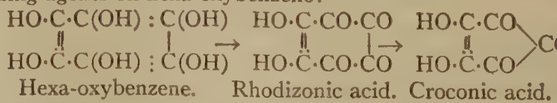
Cyclo-*butene*, C_4H_6, formed by distilling trimethyl-*cyclo*-butyl-ammonium hydroxide, boils at 1.5–2.0° C. (see N. Zelinsky, ibid., p. 4744; G. Schweter, ibid., p. 1604).

When sodio-malonic ester is condensed with trimethylene bromide the chief product is ethyl pentane tetracarboxylate, *tetramethylene* 1.1-*dicarboxylic* ester being also formed, and from this the free acid may be obtained on hydrolysis. It melts at 154–156° C., losing carbon dioxide and passing into *cyclo*-butane carboxylic acid, $C_4H_7CO_2H$. This basic acid yields a monobrom derivative which, by the action of aqueous potash, gives the corresponding hydroxy-*cyclo*-butane carboxylic acid, $C_4H_6(OH)\cdot CO_2H$. Attempts to eliminate water from this acid and so produce an unsaturated acid were unsuccessful; on warming with sulphuric acid, carbon monoxide is eliminated and *cyclo*-butanone (keto-tetramethylene) is probably formed.

The *truxillic acids*, $C_{18}H_{16}O_4$, which result by the hydrolytic splitting of truxilline, $C_{38}H_{46}N_2O_8$, are phenyl derivatives of *cyclo*-butane. Their constitution was determined by C. Liebermann (*Ber.*, 1888, 21, p. 2342; 1889, 22, p. 124 seq.). They are polymers of cinnamic acid, into which they readily pass on distillation. The α-acid on oxidation yields benzoic acid, whilst the β-acid yields benzil in addition. The α-acid is diphenyl-2.4-*cyclo*-butane dicarboxylic acid −1.3; and the β-acid diphenyl-3.4-cyclo-butane dicarboxylic acid −1.2. By alkalis they are transformed into stereo-isomers, the α-acid giving γ-truxillic acid, and the β-acid δ-truxillic acid. The α-acid was synthesized by C. N. Riiber (*Ber.*, 1902, 35, p. 2411; 1904, 37, p. 2274), by oxidizing diphenyl-2.4-*cyclo*-butane-bismethylene malonic acid (fron cinnamic aldehyde and malonic acid in the presence of quinoline) with potassium permanganate.

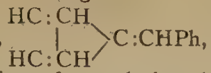
Cyclo-*pentane Group.*

Derivatives may be prepared in many cases by the breaking down of the benzene ring when it contains an accumulation of negative atoms (T. Zincke, *Ber.*, 1886–1894; A. Hantzsch, *Ber.*, 1887, 20, p. 2780; 1889, 22, p. 1238), this type of reaction being generally brought about by the action of chlorine on phenols in the presence of alkalis (see CHEMISTRY: *Organic*). A somewhat related example is seen in the case of croconic acid, which is formed by the action of alkaline oxidizing agents on hexa-oxybenzene:—



$$\begin{array}{l}HO\cdot C\cdot C(OH):C(OH)\\ \|\qquad\qquad\qquad |\\ HO\cdot C\cdot C(OH):C(OH)\end{array}\rightarrow\begin{array}{l}HO\cdot C\cdot CO\cdot CO\\ \|\qquad\qquad |\\ HO\cdot C\cdot CO\cdot CO\end{array}\rightarrow\begin{array}{l}HO\cdot C\cdot CO\\ \|\\ HO\cdot C\cdot CO\end{array}\!\!\Big\rangle CO$$

Hexa-oxybenzene. Rhodizonic acid. Croconic acid.

Cyclo-*pentane*, C_5H_{10}, is obtained from *cyclo*-pentanone by reducing it to the corresponding secondary alcohol, converting this into the iodo-compound, which is finally reduced to the hydrocarbon (J. Wislicenus, *Ann.*, 1893, 275, p. 327). It is a colourless liquid which boils at 50–51° C. *Methyl*-cyclo-*pentane*, $C_5H_9CH_3$, first obtained by F. Wreden (*Ann.*, 1877, 187, p. 163) by the action of hydriodic acid and red phosphorus on benzene, and considered to be hexahydrobenzene, is obtained synthetically by the action of sodium on 1·5 dibromhexane; and by the action of magnesium on acetylbutyl iodide (N. Zelinsky, *Ber.*, 1902, 35, p. 2684). It is a liquid boiling at 72° C. Nitric acid (sp. gr. 1·42) oxidizes it to succinic and acetic acids. Cyclo-*pentene*, C_5H_8, a liquid obtained by the action of alcoholic potash on iodo-*cyclo*-pentane, boils at 45° C. Cyclo-*pentadiene*, C_5H_6, is found in the first runnings from crude benzene distillations. It is a liquid which boils at 41° C. It rapidly polymerizes to di-*cyclo*-pentadiene. The $\cdot CH_2\cdot$ group is very reactive and behaves in a similar manner to the grouping $\cdot CO\cdot CH_2\cdot CO\cdot$ in open chain compounds, *e.g.* with aldehydes and ketones it gives the *fulvenes*, substances characterized by their intense orange-red colour (J. Thiele, *Ber.*, 1900, 33, p. 669). *Phenylfulven*,  $\begin{matrix}HC:CH\\ \vert \\ HC:CH\end{matrix}\rangle C:CHPh$, obtained from benzaldehyde and *cyclo*-pentadiene, forms dark red plates. *Diphenylfulven*, from benzophenone and *cyclo*-pentadiene, crystallizes in deep red prisms. *Dimethylfulven* is an orange-coloured oil which oxidizes rapidly on exposure. Concentrated sulphuric acid converts it into a deep red tar.

Cyclo-*pentanone*, C_5H_8O, first prepared pure by the distillation of calcium adipate (J. Wislicenus, *Ann.*, 1893, 275, p. 312), is also obtained by the action of sodium on the esters of pimelic acid; by the distillation of calcium succinate; and by hydrolysis of the *cyclo*-pentanone carboxylic acid, obtained by condensing adipic and oxalic esters in the presence of sodium ethylate. Reduction gives *cyclo*-pentanol, C_5H_9OH.

Croconic acid (dioxy–*cyclo*-pentene-trione), $C_5H_2O_5$, is formed when triquinoyl is boiled with water, or by the oxidation of hexa-oxybenzene or dioxydiquinoyl in alkaline solution (T. Zincke, *Ber.*, 1887, 20, p. 1267). It has the character of a quinone. On oxidation it yields *cyclo*-pentane-pentanone (*leuconic acid*).

Derivatives of the *cyclo*-pentane group are met with in the breaking-down products of the terpenes (*q.v.*).

Campholactone, $C_9H_{14}O_2$, is the lactone of trimethyl-2·2·3-*cyclo*-pentanol-5-carboxylic acid-3. For an isomer, *isocampholactone* (the lactone of trimethyl-2·2·3-*cyclo*-pentanol-3-carboxylic acid-1) see W. H. Perkin, jun., *Proc. Chem. Soc.*, 1903, 19, p. 61. *Lauronolic acid*, $C_9H_{14}O_2$, is trimethyl-2·2·3-*cyclo*-pentene-4-acid-1. *Isolauronolic acid*, $C_9H_{14}O_2$, is trimethyl-2·2·3-*cyclo*-pentene-3-acid-4.

Campholic acid, $C_{10}H_{18}O_2$, is tetramethyl-1·2·2·3-*cyclo*-pentane acid-3. *Camphononic acid*, $C_9H_{14}O_3$, is trimethyl-2·2·3-*cyclo*-pentanone-1-carboxylic acid-3. *Camphorphorone*, $C_9H_{14}O$, is methyl-2-isobuty-lene-5-*cyclo*-pentanone-1. *Isothujone*, $C_{10}H_{16}O$, is dimethyl-1·2-isopropyl-3-*cyclo*-pentene-1-one-5. (F. W. Semmler, *Ber.*, 1900, 33, p. 275.)

L. Bouveault and G. Blanc (*Comptes rendus*, 1903, 136, p. 1460), prepared hydrocarbons of the *cyclo*-pentane series from *cyclo*-hexane compounds by the exhaustive methylation process of A. W. Hofmann (see Pyridine). For phenyl derivatives of the *cyclo*-pentane group see F. R. Japp, *Jour. Chem. Soc.*, 1897, 71, pp. 139, 144; H. Stobbe, *Ann.*, 1901, 314, p. 111; 315, p. 219 seq.; 1903, 326, p. 347.

Cyclo-*hexane Group.*

Hydrocarbons.—Cyclo-*hexane*, or hexahydro benzene, C_6H_{12}, is obtained by the action of sodium on a boiling alcoholic solution of 1·6-dibromhexane, and by passing the vapour of benzene, mixed with hydrogen, over finely divided nickel. It is a liquid with an odour like that of benzene. It boils at 80–81° C. Nitric acid oxidizes it to adipic acid. When heated with bromine in a sealed tube for some days at 150–200° C., it yields 1·2·4·5–tetrabrombenzene (N. Zelinsky, *Ber.*, 1901, 34, p. 2803). It is stable towards halogens at ordinary temperature. *Benzene hexachloride*, $C_6H_6Cl_6$, is formed by the action of chlorine on benzene in sunlight. By recrystallization from hot benzene, the α form is obtained in large prisms which melt at 157° C., and at their boiling-point decompose into hydrochloric acid and trichlorbenzene. The β form results by chlorinating boiling benzene in sunlight, and may be separated from the α variety by distillation in a current of steam. It sublimes at about 310° C. Similar varieties of benzene hexabromide are known.

Hexahydrocymene (methyl-1-isopropyl-4-*cyclo*-hexane), $C_{10}H_{20}$, is important since it is the parent substance of many terpenes (*q.v.*). It is obtained by the reduction of 1·4 dibrommenthane with sodium (J. de Montgolfier, *Ann. chim. phys.*, 1880 [5], 19, p. 158), or of cymene, limonene, &c., by Sabatier and Senderens's method. It is a colourless liquid which boils at 180° C.

Cyclo-*hexene* (tetrahydrobenzene), C_6H_{10}, was obtained by A. v. Baeyer by removing the elements of hydriodic acid from iodo-*cyclo*-hexane on boiling it with quinoline. It is a liquid which boils at 82° C. Hypochlorous acid converts it into 2-chlor-*cyclo*-hexanol-1, whilst potassium permanganate oxidizes it to *cyclo*-hexandi-ol.

Cyclo-*hexadiene* (dihydrobenzene), C_6H_8.—Two isomers are possible, namely *cyclo*-hexadiene-1·3 and *cyclo*-hexadiene-1·4. A. v. Baeyer obtained what was probably a mixture of the two by heating 1·4 dibrom-*cyclo*-hexane with quinoline. C. Harries (*Ann.*, 1903, 328, p. 88) obtained them tolerably pure by the dry distillation of the phosphates of 1·3-diamino and 1·4-diamino-*cyclo*-hexane. The 1·3 compound boils at 81-82° C. and on oxidation yields succinic and oxalic acids. The 1·4 compound also boils at 81-82° C. and on oxidation gives succinic and malonic acids.

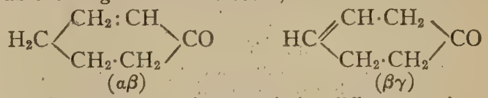
Alcohols.—Cyclo-*hexanol*, $C_6H_{11}OH$, is produced by the reduction of the corresponding ketone, or of the iodhydrin of quinite. Nitric acid oxidizes it to adipic acid, and chromic acid to *cyclo*-hexanone. *Quinite* (*cyclo*-hexanediol-1·4) is prepared by reducing the corresponding ketone with sodium amalgam, *cis*-, and *trans*-modifications being obtained which may be separated by their acetyl derivatives. *Phloroglucite* (*cyclo*-hexane-triol-1·3·5) is obtained by reducing an aqueous solution of phloroglucin with sodium (W. Wislicenus, *Ber.*, 1894, 27, p. 357). *Quercite* (*cyclo*-hexane-pentol-1·2·3·4·5), isolated from acorns in 1849 by H. Braconnot (*Ann. chim. phys.* [3], 27, p. 392), crystallizes in colourless prisms which melt at 234° C. When heated *in vacuo* to 240° C. it yields hydroquinone, quinone and pyrogallol. It is dextro-rotatory. A laevo-form occurs in the leaves of *Gymnema sylvestre* (F. B. Power, *Journ. Chem. Soc.*, 1904, 85, p. 624).

Inosite (*cyclo*-hexane-hexol), $C_6H_6(OH)_6$.—The inactive form occurs in the muscles of the heart and in other parts of the human body. The *d*-form is found as a methyl ether in pinite (from the juice of *Pinus lambertina*, and of caoutchouc from *Mateza roritina* of Madagascar), from which it may be obtained by heating with hydriodic acid. The *l*-form is also found as a methyl ether in quebrachite. By mixing the *d*- and *l*- forms, a racemic variety melting at 253° C. is obtained. A dimethyl ether of inactive inosite is dambonite which occurs in caoutchouc from Gabon.

Ketones.—Cyclo-*hexanone*, $C_6H_{10}O$, is obtained by the distillation of calcium pimelate, and by the electrolytic reduction of phenol, using an alternating current. It is a colourless liquid, possessing a peppermint odour and boiling at 155° C. Nitric acid oxidizes it to adipic acid. It condenses under the influence of sulphuric acid to form dodecahydrotriphenylene, $C_{18}H_{24}$, and a mixture of ketones (C. Mannul, *Ber.*, 1907, 40, p. 153). *Methyl*-1-cyclo-*hexanone*-3, $CH_3·C_6H_9O$, is prepared by the hydrolysis of pulegone. It is an optically active liquid which boils at 168–169° C. Homologues of menthone may be obtained from the ketone by successive treatment with sodium amide and alkyl halides (A. Haller, *Comptes rendus*, 1905, 140, p. 127). On oxidation with nitric acid (sp. gr. 1·4) at 60-70° C., a mixture of —and— -methyl adipic acids is obtained (W. Markownikoff, *Ann.*, 1905, 336, p. 299). It can be transformed into the isomeric *methyl*-1-cyclo-*hexanone-2* (O. Wallach, *Ann.*, 1904, 329, p. 368). For *methyl*-1-cyclo-*hexanone*-4, obtained by distilling γ-methyl pimelate with lime, see O. Wallach, *Ber.*, 1906, 39, p. 1492.

Cyclo-*hexane-dione*-1·3 (dihydroresorcin), $C_6H_8O_2$, was obtained by G. Merling (*Ann.*, 1894, 278, p. 28) by reducing resorcin in hot alcoholic solution with sodium amalgam. Cyclo-*hexane-dione*-1·4 is obtained by the hydrolysis of succino-succinic ester. On reduction it yields quinite. It combines with benzaldehyde, in the presence of hydrochloric acid, to form 2-benzyl-hydroquinone. Cyclo-*hexane-trione*-1·3·5 (phloroglucin) is obtained by the fusion of many resins and of resorcin with caustic alkali. It may be prepared synthetically by fusing its dicarboxylic ester (from malonic ester and sodio malonic ester at 145° C.) with potash (C. W. Moore, *Journ. Chem. Soc.*, 1904, 85, p. 165). It crystallizes in prisms, which melt at 218° C. With ferric chloride it gives a dark violet coloration. It exhibits tautomerization, since in many of its reactions it shows the properties of a hydroxylic substance. *Rhodizonic acid* (dioxydiquinoyl), $C_6H_2O_6$, is probably the enolic form of an oxypentaketo-*cyclo*-hexane. It is formed by the reduction of triquinoyl by aqueous sulphurous acid, or in the form of its potassium salt by washing potassium hexa-oxybenzene with alcohol (R. Nietzki, *Ber.*, 1885, 18, pp. 513, 1838). *Triquinoyl* (hexaketo-*cyclo*-hexane) $C_6O_6·8H_2O$, is formed on oxidizing rhodizonic acid or hexa-oxybenzene. Stannous chloride reduces it to hexa-oxybenzene, and when boiled with water it yields croconic acid (dioxy-*cyclo*-pentene-trione).

Cyclo-*hexenones.*—Two types of ketones are to be noted in this group, namely the αβ and βγ ketones, depending upon the position of the double linkage in the molecule, thus:


(αβ) (βγ)

These two classes show characteristic differences in properties. For example, on reduction with zinc and alcoholic potash, the αβ compounds give saturated ketones and also bi-molecular compounds, the βγ being unaffected; the βγ series react with hydroxylamine in a normal manner, the αβ yield oxamino-oximes.

Methyl-1-cyclo-*hexene*-1-one-3, $CH_3·C_6H_7O$, is obtained by condensing sodium aceto-acetate with methylene iodide, the ester so formed being then hydrolysed. *Isocamphorphorone*, $C_9H_{14}O$, is trimethyl 1·6·6.-*cyclo*-hexene-1-one 6. *Isocamphor*, $C_{10}H_{16}O$, is methyl-1-isopropyl-3-*cyclo*-hexene-1-one 6.

Acids.—*Hexahydrobenzoic acid*, $C_6H_{11}·CO_2H$, is obtained by the reduction of benzoic acid, or by the condensation of 1·5 dibrompentane with disodio-malonic ester. It crystallizes in small plates which melt at 30-31° C. and boil at 232–233° C. (J. C. Lumsden, *Journ. Chem. Soc.*, 1905, 87, p. 90). The sulphochloride of the acid on reduction with tin and hydrochloric acid gives *hexahydrothiophenol*, $C_6H_{11}SH$, a colourless oil which boils at 158–160° C. (W. Borsche, *Ber.*, 1906, 39, p. 392).

Quinic acid, $C_6H_7(OH)_4CO_2H$ (tetra-oxy-*cyclo*-hexane carboxylic acid), is found in coffee beans and in quinia bark. It crystallizes in colourless prisms and is optically active. When heated to about 250° C. it is transformed into quinide, probably a lactone, which on heating with baryta water gives an inactive quinic acid.

Hexahydrophthalic acids, $C_6H_{10}(CO_2H)_2$ (*cyclo*-hexanedicarboxylic acids).—Three acids of this group are known, containing the Carboxyl-groups in the 1·2, 1·3, and 1·4 positions, and each exists in two stereo-isomeric forms (*cis*- and *trans*-). The anhydride of the *cis*-1·2 acid obtained by heading the anhydride of the *trans-acid*, forms prisms which melt at 192° C. When heated with hydrochloric acid it passes into the *trans*-variety. The racemic *trans*-acid is produced by the reduction of the dihydrobromide of Δ^4-tetrahydrophthalic acid or $\Delta^{2\cdot6}$ dihydrophthalic acid. It is split into its active components by means of its quinine salt (A. Werner and H. E. Conrad, *Ber.*, 1899, 32, p. 3046). *Hexahydroisophthalic acids* (*cyclo*-hexane-1·3-dicarboxylic acids) are obtained by the action of methylene iodide on disodio-pentane tetracarboxylic ester (W. H. Perkin, *Journ. Chem. Soc.*, 1891, 59, p. 798); by the action of trimethylene bromide on disodio-propane tetracarboxylic ester; and by the reduction of isophthalic acid with sodium amalgam, the tetrahydro acids first formed being converted into hydrobromides and further reduced (A. v. Baeyer and V. Villiger, *Ann.*, 1893, 276, p. 255). The *cis*- and *trans*- forms can be separated by means of their sodium salts. The *trans*-acid is a racemic compound, which on heating with acetyl chloride gives the anhydride of the *cis*-acid.

Hexahydroterephthalic acids (*cyclo*-hexane-1·4-dicarboxylic acids). These acids are obtained by the reduction of the hydrobromides of the di- and tetra-hydroterephthalic acids or by the action of ethylene dibromide on disodio-butane tetracarboxylic acid. An important derivative is *succino-succinic acid*, $C_6H_6O_2(CO_2H)_2$, or *cyclo*-hexanedione-2·5-dicarboxylic acid-1·4, which is obtained as its ester by the action of sodium or sodium ethylate on succinic ester (H. Fehling, *Ann.*, 1844, 49, p. 192; F. Hermann, *Ann.*, 1882, 211, p. 306). It crystallizes in needles or prisms, and dissolves in alcohol to form a bright blue fluorescent liquid, which on the addition of ferric chloride becomes cherry red. The acid on heating loses CO_2 and gives *cyclo*-hexanedione-1·4.

Tetrahydrobenzoic acid (*cyclo*-hexene-1-carboxylic acid-1), $C_6H_9\cdot CO_2H$. Three structural isomers are possible. The Δ^1 acid results on boiling the Δ^2 acid with alkalis, or on eliminating hydrobromic acid from 1-brom-*cyclo*-hexane-carboxylic acid-1. The Δ^2 acid is formed on the reduction of benzoic acid with sodium amalgam. The Δ^3 acid is obtained by eliminating the elements of water from 4-oxy-*cyclo*-hexane-1-carboxylic acid (W. H. Perkin, jun., *Journ. Chem. Soc.*, 1904, 85, p. 431). *Shikimic acid* (3·4·6-trioxy-Δ^1-tetrahydrobenzoic acid) is found in the fruit of *Illicium religiosum*. On fusion with alkalis it yields para-oxybenzoic acid, and nascent hydrogen reduces it to hydroshikimic acid. *Sedanolic acid*, $C_{12}H_{20}O_3$, which is found along with sedanonic acid, $C_{12}H_{18}O_3$, in the higher boiling fractions of celery oil, is an ortho-oxyamyl-Δ^5-tetrahydrobenzoic acid, sedanonic acid being ortho-valeryl-Δ^1-tetrahydrobenzoic acid (G. Ciamician and P. Silber, *Ber.*, 1897, 30, pp. 492, 501, 1419 seq.). Sedanolic acid readily decomposes into water and its lactone sedanolid, $C_{12}H_{18}O_2$, the odorous constituent of celery oil.

Tetrahydrophthalic acids (*cyclo*-hexene dicarboxylic acids), $C_6H_8(CO_2H)_2$. Of the ortho-series four acids are known. The Δ^1 acid is obtained as its anhydride by heating the Δ^2 acid to 220° C., or by distilling hydropyromellitic acid. Alkaline potassium permanganate oxidizes it to adipic acid. The Δ^2 acid is formed along with the Δ^4 acid by reducing phthalic acid with sodium amalgam in hot solutions. The Δ^4 acid exists in *cis*- and *trans*-forms. The *trans*-variety is produced by reducing phthalic acid, and the *cis*-acid by reducing $\Delta^{2\cdot4}$ dihydrophthalic acid.

In the meta-series, four acids are also known. The Δ^2 acid is formed along with the Δ^4 (*cis*) acid by reducing isophthalic acid. The *trans* Δ^4 acid is formed by heating the *cis*-acid with hydrochloric acid under pressure. The Δ^3 acid is formed when the anhydride of tetrahydro rimesic acid is distilled (W. H. Perkin, junr., *Journ. Chem. Soc.*, 1905, 87, p. 293).

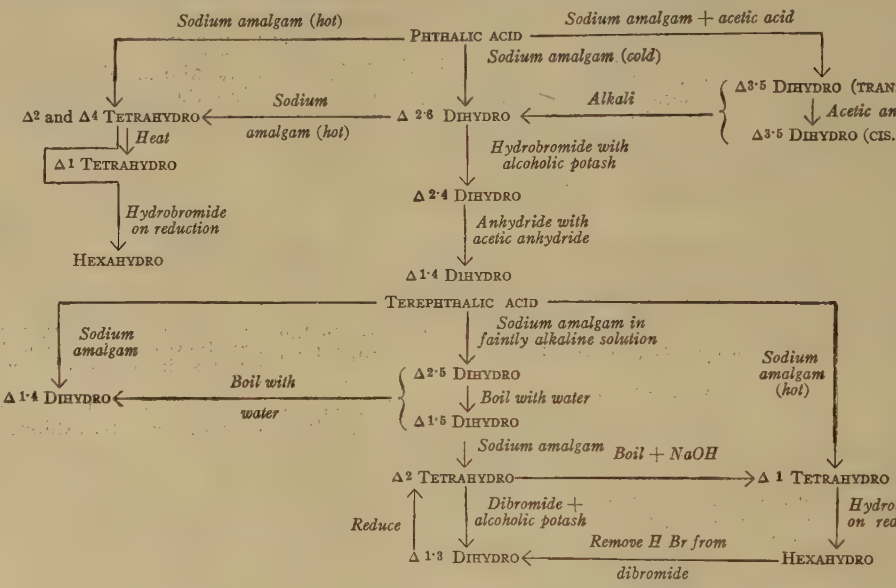
In the para-series, three acids are known. The Δ^1 acid is formed by the direct reduction of terephthalic acid; by boiling the Δ^2 acid with caustic soda; and by the reduction (in the heat) of $\Delta^{1\cdot4}$ dihydroterephthalic acid. The Δ^2 acid exists in *cis*- and *trans*- forms; these are produced simultaneously in the reduction of $\Delta^{1\cdot3}$ or $\Delta^{1\cdot5}$ dihydroterephthalic acids by sodium amalgam.

There are five possible dihydrobenzoic acids. One was obtained in the form of its amide by the reduction of benzamide in alkaline solution with sodium amalgam (A. Hutchinson, *Ber.*, 1891, 24, p. 177). The $\Delta^{1\cdot3}$ acid is obtained on oxidizing dihydrobenzaldehyde with silver oxide or by the reduction of meta-trimethylaminobenzoic acid (R. Willstätter, *Ber.*, 1904, 37, p. 1859).

Of the dihydrophthalic acids, five are known in the ortho-series, two of which are stereo-isomers of the *cis*- and *trans*-type, and a similar number are known in the para-series. The $\Delta^{1\cdot4}$ acid is obtained as its anhydride by heating $\Delta^{2\cdot4}$ dihydrophthalic anhydride with acetic anhydride. When boiled with caustic soda it isomerizes to a mixture of the $\Delta^{2\cdot4}$ and $\Delta^{2\cdot6}$ dihydrophthalic acids. The $\Delta^{2\cdot4}$ acid is obtained by boiling the dihydrobromide of the $\Delta^{2\cdot6}$ acid with alcoholic potash or by continued boiling of the $\Delta^{2\cdot6}$ acid with caustic soda.

The $\Delta^{2\cdot6}$ acid is formed when phthalic acid is reduced in the cold by sodium amalgam or by heating the $\Delta^{2\cdot4}$ and $\Delta^{3\cdot5}$ acids with caustic soda. The *trans*-modification of $\Delta^{3\cdot5}$ acid is produced when phthalic acid is reduced by sodium amalgam in the presence of acetic acid. When heated for some time with acetic anhydride it changes to the *cis*-form. The *trans*-acid has been resolved by means of its strychnine salts into two optically active isomerides, both of which readily pass to $\Delta^{2\cdot6}$ dihydrophthalic acid (A. Neville, *Journ. Chem. Soc.*, 1906, 89, p. 1744).

Of the dihydroterephthalic acids, the $\Delta^{1\cdot3}$ acid is obtained by heating the dibromide of the Δ^2 tetrahydro acid with alcoholic potash. It cannot be prepared by a direct reduction of terephthalic acid. On warming with caustic soda it is converted into the $\Delta^{1\cdot4}$ acid. The $\Delta^{1\cdot4}$ acid is also obtained by the direct reduction of terephthalic acid. It is the most stable of the dihydro acids. The $\Delta^{1\cdot5}$ acid is obtained by boiling the *cis*- and *trans*-$\Delta^{2\cdot5}$ acids with water, which are obtained on reducing terephthalic acid with sodium amalgam in faintly alkaline solution. The relationships existing between the various hydrophthalic acids may be shown as follows:—



Cyclo-*heptane Group.*

Cyclo-*heptane* (suberane), C_7H_{14}, obtained by the reduction of suberyl iodide, is a liquid which boils at 117° C. On treatment with bromine in the presence of aluminium bromide it gives chiefly pentabromtoluene. When heated with hydriodic acid to 230° C. it gives methylhexamethylene. On oxidation with nitric acid (sp. gr. 1·4) it yields pimelic acid. *Disuberyl*, $C_7H_{13}\cdot C_7H_{13}$, a thick oily liquid, boiling at 290–291° C., is obtained by the reduction of suberyl bromide.

Cyclo-*heptene*, C_7H_{12}, is obtained by the action of alcoholic potash on suberyl iodide; and from *cyclo*-heptane carboxylic acid, the amide of which by the action of sodium hypobromite is converted into *cyclo*-heptanamine, which, in its turn, is destructively methylated (R. Willstätter, *Ber.*, 1901, 34, 131). Cyclo-*heptadiene* 1·3, C_7H_{10}, is obtained from *cyclo*-heptene (Willstätter, *loc. cit.*). It is identical with the *hydrotropilidine*, which results by the destructive methylation of tropane.

Euterpene (trimethyl-1·4·4-*cyclo*-heptadiene 1·5), $C_{10}H_{16}$ is prepared from dihydroeucarveol. By the action of hydrobromic acid (in glacial acetic acid solution) and reduction of the resulting product it yields 1·2-dimethyl-4-ethylbenzene (A. v. Baeyer, *Ber.*, 1897, 30, p. 2075). Cyclo-*heptatriene* (tropilidine), C_7H_8, is formed on distilling tropine with baryta; and from *cyclo*-heptadiene by forming its addition product with bromine and heating this with quinoline to 150–160° C. (R. Willstätter, *loc. cit.*). Chromic acid oxidizes it to benzoic acid and benzaldehyde. With bromine it forms a dibromide, which then heated to 110° C. decomposes into hydrobromic acid and benzyl bromide.

Cyclo-*heptanol*, $C_1H_{13}OH$, is formed by the reduction of suberone, and by the action of silver nitrite on the hydrochloride of *cyclo*-hexanamine (N. Demjanow, *Centralblatt*, 1904, i. p. 1214).

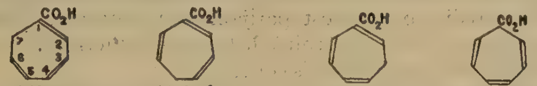
Cyclo-*heptanone* (suberone), $C_7H_{12}O$, is formed on the distillation of suberic acid with lime, and from α-brom-*cyclo*-heptane carboxylic acid by treatment with baryta and subsequent distillation over lead peroxide (R. Willstätter, *Ber.*, 1898, 31, p. 2507). It is a colourless liquid having a peppermint odour, and boiling at 178·5–179·5° C. Nitric acid oxidizes it to *n*-pimelic acid.

Tropilene, $C_7H_{10}O$, is obtained in small quantities by the distillation of α-methyltropine methyl hydroxide, and by the hydrolysis of β-methyltropidine with dilute hydrochloric acid. It is an oily liquid, with an odour resembling that of benzaldehyde. It forms a benzal compound, and gives an oyxmethylene derivative and cannot be oxidized to an acid, reactions which point to it being a ketone containing the grouping $\text{-}CH_2{\cdot}CO\text{-}$. It is thus to be regarded as a *cyclo*-heptene-1-one-7.

Cyclo-*heptane carboxylic acid* (suberanic acid), $C_7H_{13}CO_2H$, is obtained by the reduction of *cyclo*-heptene-1-carboxylic acid; from brom-*cyclo*-heptane by the Grignard reaction; and by the reduction of hydrotropilidine carboxylic acid by sodium in alcoholic solution (R. Willstätter, *Ber.*, 1898, 31, p. 2504). The corresponding oxyacid is obtained by the hydrolysis of the nitrile, which is formed by the addition of hydrocyanic acid to suberone (A. Spiegel, *Ann.*, 1882, 211, p. 117).

Four *cyclo*-heptene carboxylic acids are known. Cyclo-*heptene-1-carboxylic acid-1* is prepared from oxysuberanic acid. This acid when heated with concentrated hydrochloric acid to 120–130° C. yields a chlor-acid, which on warming with alcoholic potash is transformed into the *cyclo*-heptene compound. Cyclo-*heptene-2-carboxylic acid-1* is formed by the reduction of *cyclo*-heptatriene 2·4·6-carboxylic acid-1. On boiling with caustic soda it isomerizes to the corresponding 1-acid.

Cyclo-*heptatriene carboxylic acids*, $C_7H_7CO_2H$. All four are known. According to F. Buchner (*Ber.*, 1898, 31, p. 2242) they may be represented as follows:—



Δ.1,3,5 or α. Δ1,3,6 or β. Δ1,4.6 or γ Δ2,4,6 or δ

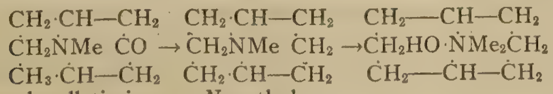
The *α-acid* (α-isophenylacetic acid) is obtained by the hydrolysis of pseudophenylacetamide, formed by condensing diazoacetic ester with benzene, the resulting pseudophenyl acetic ester being then left in contact with strong ammonia for a long time. *β-Isophenylacetic acid* is formed by strongly heating pseudophenylacetic ester in an air-free sealed tube and hydrolysing the resulting β-isophenylacetic ester. *γ-Isophenylacetic acid* is obtained by heating the β and δ acids for a long time with alcoholic potash (A. Einhorn, *Ber.*, 1894, 27, p. 2828; E. Buchner, *Ber.*, 1898, 31, p. 2249). *δ-Isophenylacetic acid* is obtained by heating the iodmethylate of anhydroecgonine ester with dilute caustic soda (A. Einhorn, *Ber.*, 1893, 26, p. 329).

Numerous amino-derivatives of the *cyclo*-heptane series have been prepared by R. Willstätter in the course of his investigations on the constitution of tropine (*q.v.*). *Amino*-cyclo-*heptane* (suberylamine) is obtained by the reduction of suberone oxime or by the action of sodium hypobromite on the amide of cycloheptane carboxylic acid.

Cyclo-*octane Group*.

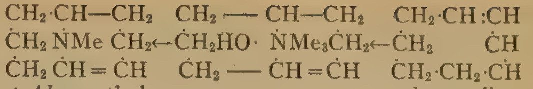
Few members of this group are known. By the distillation of the calcium salt of azelaic acid H. Mayer (*Ann.*, 1893, 275, p. 363) obtained azelain ketone, $C_8H_{14}O$, a liquid of peppermint odour. It boils at 90–91° C. (23 mm.) and is readily oxidized by potassium permanganate to oxysuberic acid. It is apparently *cyclo*-octanone (see also W. Miller and A. Tschitschkin, *Centralblatt*, 1899, 2., p. 181).

Pseudopelletierine (methyl granatonine), $C_9H_{15}NO$, an alkaloid of the pomegranate, is a derivative of *cyclo*-octane, and resembles tropine in that it contains a nitrogen bridge between two carbon atoms. It is an inactive base, and also has ketonic properties. On oxidation it yields methyl granatic ester, which, by the exhaustive methylation process, is converted into homopiperylene dicarboxylic ester, $HO_2C{\cdot}CH{:}CH{\cdot}CH_2{\cdot}CH_2{\cdot}CH{:}CH{\cdot}CO_2H$, from which suberic acid may be obtained on reduction. When reduced in alcoholic solution by means of sodium amalgam it yields methyl granatoline, $C_8H_{13}OH{\cdot}NCH_3$; this substance, on oxidation with cold potassium permanganate, is converted into granatoline, $C_8H_{15}NO$, which on distillation over zinc dust yields pyridine. Methyl granatoline on treatment with hydriodic acid and red phosphorus, followed by caustic potash, yields methyl granatinine, $C_9H_{15}N$, which when heated with hydriodic acid and phosphorus to 240° C. is converted into methyl granatanine, $C_8H_{14}.NCH_3$, and granatanine, $C_8H_{14}NH$. The hydrochloride of the latter base when distilled over zinc dust yields α-propyl pyridine. By the electrolytic reduction of pseudopelletierine, *N*-methyl granatanine is obtained, and this by exhaustive methylation is converted into Δ⁴*des*-dimethyl granatanine. This latter compound readily forms an iodmethylate, which on treatment with silver oxide yields the corresponding ammonium hydroxide. The ammonium hydroxide on distillation decomposes into trimethylamine, water and *cyclo*-octadiene·1·3.



$$\begin{array}{lll}
\mathrm{CH_2{\cdot}CH{-}CH_2} & \mathrm{CH_2{\cdot}CH{-}CH_2} & \mathrm{CH_2{-}CH{-}CH_2} \\
\mathrm{\dot{C}H_2\dot{N}Me\ \dot{C}O} \rightarrow & \mathrm{\dot{C}H_2\dot{N}Me\ \dot{C}H_2} \rightarrow & \mathrm{\dot{C}H_2HO{\cdot}\dot{N}Me_2\dot{C}H_2} \rightarrow \\
\mathrm{\dot{C}H_3{\cdot}\dot{C}H{-}\dot{C}H_2} & \mathrm{\dot{C}H_2{\cdot}\dot{C}H{-}\dot{C}H_2} & \mathrm{\dot{C}H_2{-}\dot{C}H{-}\dot{C}H_2}
\end{array}$$

Pseudopelletierine *N*-methyl granatanine



$$\begin{array}{lll}
\mathrm{CH_2{\cdot}CH{-}CH_2} & \mathrm{CH_2{-}CH{-}CH_2} & \mathrm{CH_2{\cdot}CH{:}CH} \\
\mathrm{\dot{C}H_2\,\dot{N}Me\ \dot{C}H_2} \leftarrow & \mathrm{\dot{C}H_2HO{\cdot}\ \dot{N}Me_3\dot{C}H_2} \leftarrow & \mathrm{\dot{C}H_2\qquad \dot{C}H} \\
\mathrm{\dot{C}H_2\,\dot{C}H{=}\dot{C}H} & \mathrm{\dot{C}H_2{-}\dot{C}H{=}\dot{C}H} & \mathrm{\dot{C}H_2{\cdot}CH_2{\cdot}\dot{C}H}
\end{array}$$

Δ-⁴*des*-methyl granatanine *cyclo*-octadiene

Cyclo-*octadiene*, C_8H_{12}, as above prepared, is a strong-smelling oil which decolorizes potassium permanganate solution instantaneously. It readily polymerizes to a di-*cyclo*-octadiene and polymer $(C_8H_{12})_n$ (R. Willstätter, *Ber.*, 1905, 38, pp. 1975, 1984; G. Ciamician and P. Silber, *Ber.*, 1893, 26, p. 2750; A. Piccinini, *Gazz.*, 1902, 32, 1 p. 260). β-cyclo-*octadiene* has been prepared from methyl granatinine iodmethylate.

Cyclo-*octane*, C_8H_{16} is obtained by the reduction of the above unsaturated hydrocarbon by the Sabatier and Senderens's method. It is a liquid which boils at 146·3–148° C. and possesses a strong camphor odour. On oxidation it yields suberic acid (R. Willstätter, *Ber.*, 1907, 40, pp. 957). O. Doebner (*Ber.*, 1902, 35, pp. 2129, 2538; 1903, 36, p. 4318) obtained compounds, which in all probability are *cyclo*-octadienes, by the distillation of β-vinylacrylic acid, sorbic acid, and cinnamenyl acrylic acid with anhydrous baryta.

Cyclo-*nonane Group*.

According to N. Zelinsky (*Ber.*, 1907, 40, p. 780) *cyclononanone*, $C_9H_{16}O$, a liquid boiling at 95–97° C., is formed on distilling sebacic acid with lime, and from this, by reduction to the corresponding secondary alcohol, conversion of the latter into the iodide, and subsequent reduction of this with zinc, cyclo-*nonane*, C_9H_{18}, a liquid boiling at 170–172° C. is obtained.

POLYNESIA, (Gr. πολύς, many, and νῆσος, island), a term sometimes used to cover the whole of the oceanic islands in the central and western Pacific, but properly for the eastern of the three great divisions of these islands. The chief groups thus included are Hawaii, the Ellice, Phoenix, Union, Manihiki and Marquesas groups, Samoa and Tonga, the Cook, Society, Tubuai and Tuamotu groups, and many other lesser islands. (See Pacific Ocean, section on *Island*, and separate articles on the principal groups, &c.)

The Polynesian Race.—For the ethnological problems offered by Polynesia no thoroughly satisfactory solutions have yet been found. By some the term Polynesian has been treated as a synonym for Malayo-Polynesian, and has been made to include all the brown races of Malaysia, Melanesia, Micronesia and Polynesia. Linguistically, physically and mentally this view is untenable. Whatever be the origin of the Polynesians, they are not Malays, though, themselves of mixed blood, they have probably certain racial elements in common with the latter, who are undoubtedly hybrids. There is every reason to believe that the Polynesians are ethnologically a far older race than the Malays, who, as they now exist, are a comparatively modern people; and thus Friedrich Müller's and D. G. Brinton's theory, that they form a branch of the Malays, fails. Joseph Deniker declares the Polynesians a separate ethnic group of the Indo-Pacific area, and in this view he is followed by A. H. Keane, who suggests that they are a branch of the Caucasic division of mankind who possibly migrated in the Neolithic period from the Asiatic mainland. Of the migration itself no doubt is now felt, but the first entrance of the Polynesians into the Pacific must have been an event so remote that neither by tradition nor otherwise can it be even approximately fixed. The journey of these Caucasians would naturally be in stages. Their earliest halting place was probably the Malay Archipelago, where a few of their kin linger in the Mentawi Islands on the west coast of Sumatra. Thence at a date within historic times a migration eastward took place. The absence of Sanskrit roots in the Polynesian languages appears to indicate that this migration was in pre-Sanskritic times. Whether anything like a definite date can be fixed for it may well be questioned. Abraham Fornander[1] has, however, with great probability, traced back the history of the Hawaiians to the 5th century. He has studied the folk-lore of those islands exhaustively, and from this source comes to the conclusion that the Polynesian migration from the Indian Archipelago may be approximately assigned to the close of the 1st or to the 2nd century. The traditions of many of the Polynesian peoples tend to make Savaii, the largest of the Samoan Islands, their ancestral home in the East Pacific, and linguistic and other evidence goes to support the theory that the first Polynesian settlement in the East Pacific was in Samoa, and that thence the various branches of the race made their way in all directions. Most likely Samoa was the first group permanently occupied by them. Owing to the admixture of the Polynesians with the Papuans in Fiji some authorities have thought the first settlement was in those islands, and that the settlers were eventually driven thence by the Papuan occupiers. We can, however, account for the presence of Polynesian blood in Fiji in another way, viz. by the intercourse that has been kept up between the people of Tonga and Fiji. If the first resting-place of the Polynesians was in that group, there is good reason to believe that Samoa was the first permanent home of the race.

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[1] *An Account of the Polynesian Race* (1878), i. 168.

It used to be doubted whether these people could have gone from the Indian archipelago so far eastward, because the prevailing winds and currents are from the east. But it is now well known that at times there are westerly winds in the region over which they would have to travel, and that there would be no insuperable difficulties in the way of such a voyage. The Polynesians are invariably navigators. There is ample evidence that in early times they were much better seamen than they are at present. Indeed their skill in navigation has greatly declined since they have become known to Europeans. They used to construct decked vessels capable of carrying one or two hundred persons, with water and stores sufficient for a voyage of some weeks duration. These vessels were made of planks well fitted and sewn together, the joints being caulked and pitched.[1] It is only in recent times that the construction of such vessels has ceased. The people had a knowledge of the stars, of the rising and setting of the constellations at different seasons of the year; by this means they determined the favourable season for making a voyage and directed their course.

The Polynesians were by no means a savage people when they entered the Pacific. Indeed their elaborate historical legends show that they possessed a considerable amount of civilization. Those who are familiar with these legends, and have studied native manners and customs, see many unmistakable proofs that the Polynesians had, at their migration, considerable knowledge and culture, and that the race has greatly deteriorated.

The Polynesians are physically a very fine race. On some islands they average 5 ft. 10 in. in height. De Quatrefages, in a table giving the stature of different races of men,[2] puts the natives of Samoa and Tonga as the tallest people in the world. He gives 5 ft. 9·92 in. as their average height. They are well developed in proportion to their height. Their colour is a brown, lighter or darker generally according to the amount of their exposure to the sun—being darker on some of the atolls where the people spend much time in fishing, and among fishermen on the volcanic islands, and lighter among women, chiefs and others less exposed than the bulk of the people. Their hair is dark brown or black; smooth and curly, very different from the frizzly mop of the Papuan or the lank straight locks of the Malay. They have very little beard. Their features are generally fairly regular and often beautiful; eyes invariably black, and in some persons oblique; jaws not projecting, except in a few instances; lips of medium thickness; the noses are naturally long, well shaped and arched, but many are artificially flattened at the bridge in infancy. Their foreheads are fairly high, but rather narrow. The young of both sexes are good-looking. The men often have more regular features than the women. Formerly the men paid more attention to personal appearance than the women. Polynesians generally are of singularly cleanly habits, love bathing, and have a taste for neatness and order. Their clothing is simple: a loin cloth for the men and for the women a girdle or petticoat of leaves. Sometimes women cover the shoulders, and on great occasions the men robe themselves in *tapa*, bark-cloth. The men are usually tattooed in elaborate designs from the navel to the thigh, and often around mouth and eyes.

As a race the Polynesians are somewhat apathetic. An enervating climate and lavish natural resources incline them to lead easy lives. On the more barren islands, and on those more distant from the equator, they show more energy. Under certain circumstances they become excitable, and manifest a kind of care-for-nothing spirit. As savages they were strict in their religious observances and religion came into almost every action of life, and they have been, in most instances, easily led to accept Christianity. Their essential trait is their perennial cheerfulness, and their fondness for dance and song and every sort of amusement.[3] They are shrewd, intelligent and possess much common sense. Where they have from early years enjoyed the advantages of a good education, Polynesian youths have proved themselves to possess intellectual powers of no mean order. They are almost invariably fluent speakers; with many of them oratory seems to be a natural gift; it is also carefully cultivated. An orator will hold the interest of his hearers for hours together at a political gathering, and in his speech he will bring in historical allusions and precedents, and will make apt quotations from ancient legends in a manner which would do credit to the best parliamentary orators. Many of them are very brave, and think little of self-sacrifice for others where duty or family honour is concerned.

Polynesian society is divided into the family and the clan. Each clan has a name which is usually borne by one of the oldest members, who is the chief or head for the time being. This clan system no doubt generally prevailed in early times, and was the origin of the principal chieftainships. But changes have been made in most of the islands. In some the head of one clan has become king over several. In many cases large clans have been divided into sections under secondary heads, and have even been subdivided.

As a rule near relations do not intermarry. In some islands this rule is rigidly adhered to. There have been exceptions, however, especially in the case of high chiefs; but usually great care is taken to prevent the union of those within the prescribed limits of consanguinity. Children generally dwell with their kin on the father's side, but they have equal rights on the mother's side, and sometimes they take up their abode with their mother's family. The only names used to express particular relationships are father and mother, son and daughter, brother and sister. There is usually no distinction between brothers (or sisters) and cousins, all the children of brothers and sisters speak of each other as brothers and sisters, and they call uncles and aunts fathers and mothers. Above the relationship of parents all are simply ancestors, no term being used for grandfather which would not equally apply to any more remote male ancestor. In the same way there is no distinctive term for grandchild. A man speaks of his grandchild as his son or daughter, or simply as his child.[4] Polygamy was often practised, especially by chiefs, and also concubinage. In some places a widow was taken by the brother of her deceased husband, or, failing the brother, by some other relative of the deceased, as an additional wife. Divorce was an easy matter, and of frequent occurrence; but, as a rule, a divorced wife would not marry again without the consent of her former husband. An adulterer was always liable to be killed by the aggrieved husband, or by some member of his clan. If the culprit himself could not be reached, any member of the clan was liable to suffer in his stead. In some islands female virtue was highly regarded. Perhaps of all the groups Samoa stood highest in this respect. There was a special ordeal through which a bride passed to prove her virginity, and a proof of her immorality brought disgrace upon all her relatives. But in other islands there was much freedom in the relations of the sexes. Owing to the almost promiscuous intercourse which prevailed among a portion of the race, in some groups titles descended through the mother and not through the father. In Hawaii there was a peculiar system of marriage relationship," brothers with their wives, and sisters with their husbands, possessing each other in common." There also, especially in the case of chiefs and chieftainesses, brothers and sisters sometimes intermarried. But these customs did not prevail in other groups. It is almost certain that they did not prevail in Hawaii in early times, but that they were the result of that deterioration in the race which their traditions and many of their customs indicate.[1]

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[1] Coco-nut fibre and the gum which exudes from the bread-fruit tree are generally used for "caulking" and "pitching" canoes.

[2] *The Human Species* (International Scientific Series), pp. 57-60.

[3] Wrestling and boxing, a kind of hockey and football, canoe and foot races, walking-matches, swimming, archery, cockfighting, fishing-matches and pigeon-catching are among their pastimes. Of indoor games they have a number, many being of a gambling nature. Much time is spent, especially after the evening meal, in asking riddles, in rhyming, &c. The recital of songs and myths is a common amusement, and on special occasions there is dancing. The night-dances were generally accompanied by much indecency and immorality.

[4] Dr Lewis H. Morgan, in *Ancient Society*, pp. 419–423, makes the Polynesians to have distinctive terms for grandfather, grandmother, grandson and granddaughter. In this he is mistaken. It is evident from his own lists that the Hawaiian *kupuna* means simply an ancestor. In like manner *moopuna* simply means a descendant of any generation after the first.

Women have always occupied a relatively high position among the Polynesians. In most groups they have great influence and are treated with much respect. In some cases they take hereditary titles and hold high offices. As among their congeners in Madagascar, so also in parts of Polynesia, there may be a queen or a chieftainess in her own right; and a woman in high position will command as much respect, and will exercise as great authority, as a man would in the same position. Everywhere infanticide prevailed; in some of the smaller islands it was regulated by law in order to prevent over-population. It was also a very common practice to destroy the foetus, but parents were affectionate towards their children. The practice of adopting children was, and still is, common. Often there is an exchange made between members of the same clan; but sometimes there is adoption from without. Tattooing generally prevailed among the men, different patterns being followed in different groups of islands. In some a larger portion of the body is tattooed than in others. A youth was considered to be in his minority until he was tattooed, and in former times he would have no chance of marrying until he had, by submitting to this process, proved himself to be a man. Puberty in the other sex was generally marked by feasting, or some other demonstration, among the female friends. Old age is generally honoured. Often an inferior chief will give up his title to a younger man, yet he himself will lose but little by so doing. The neglect of aged persons is extremely rare.

Property belonging to a clan is held in common. Each clan usually possesses land, and over this no one member has an exclusive right, but all have an equal right to use it. The chief or recognized head of the clan or section alone can properly dispose of it or assign its use for a time to an outsider; and even he is expected to obtain the consent of the heads of families before he alienates the property. Thus land is handed down through successive generations under the nominal control of the recognized head of the clan. Changes have been made in many islands in this respect; but there can be little reason to doubt that the joint ownership of property in clans was common among the entire race in former times.

In early times the head of each clan was supreme among his own people, but in all matters he had associated with him the principal men or heads of families in the clan. Their united authority extended over all the members and the possessions of the clan, and they were independent of every other clan. There are in some places vestiges of this primitive state of society still remaining; the transition to a limited or to a despotic monarchy may be traced by means of the ancient legends in some islands, and in others it is a matter of recent history. One clan being more numerous and stronger than another, and its chief being ambitious, it is easy to see how by conquering a neighbouring clan he increased the importance of his clan and extended his own power. In some of the islands this transition process has hardly yet developed into an absolute monarchy. We may even see two or three stages of the progress. In one instance a certain clan has the right to nominate the principal chief over an entire district; though it is known as the ruling clan, its rule is mainly confined to this nomination, and to decision for or against war. In all other respects the district enjoys the privilege of self-government. In another case the nominal king over a district, or over an entire island, can be elected only from among the members of a certain clan, the monarchy being elective within that alone; but this king has little authority. In other cases a more despotic monarchy has grown up—the prowess of one man leading to the subjugation of other clans. Even in this case the chiefs or heads of clans sometimes still hold their property and rule over their own people, only rendering a kind of feudal service and paying tribute to the king.

The Polynesians are exceedingly fond of rank and of titles. Much deference is paid to chiefs and to persons of rank; and special terms are generally employed in addressing these. Every part of a chief's body and all his belongings have names different from those employed for common people. The grade of rank which a person occupies will often be indicated by the language in which he is addressed. Thus, in Samoa there are four different terms for *to come*: *sau* is for a common man; *maliu mai* is a respectful term for a person without a title; *susu mai* for a titled chief; and *afio mai* for a member of the royal family. In addressing chiefs, or others to whom one wishes to be respectful, the singular number of the personal pronoun is rarely used; the dual is employed instead—the dual of dignity or of respect.

Offices and titles are seldom hereditary in our sense of the term, as descending from father to son. They are rather elective within the limits of the clan, or the division of a clan. A common practice is for the holder of a high title to nominate a successor; and his nomination is generally confirmed by the chiefs, or heads of households, with whom the right of election rests. In ancient times the authority of a high chief or king did not usually extend to any details of government. But in Hawaii there are traditions of a wise king who interested himself in promoting the social well-being of the people, and made good laws for their guidance.[2] Usually all matters affecting a district or an island were settled by the chiefs of the district, while those of a single village were settled by a council consisting of the chiefs and heads of households in the village. In some islands each clan, or each village, would feel itself at liberty to make war on another clan or village without consulting the views of any higher authority. Indeed the rule was for each clan or district to settle its own affairs. In the case of offences against individuals, either the person injured, or another member of his clan, would avenge the injury done. For most offences there was some generally recognized punishment—such as death for murder or adultery; but often vengeance would fall upon another person instead of the wrongdoer. In avenging wrong, a member of the village or of the clan to which the offender belonged would serve equally well to satisfy their ideas of justice if the culprit himself could not be easily reached. Sometimes all the members of the family, or of a village, to which a culprit belonged would flee from their homes and take refuge in another village, or seek the protection of a powerful chief. In some places, in cases of crime, the members of the family or village would convey the culprit bound—sometimes even carrying him like a pig that is to be killed—and place him with apologies before those against whom he had transgressed. The ignominy of such a proceeding was generally considered sufficient atonement for the gravest offences. There were slaves in many islands, either persons conquered in war, or those who had been condemned to lose their personal liberty on account of evil conduct.

Pottery was not manufactured by the Polynesians: a fact which, it has been argued, goes far to prove the remoteness of the Polynesian migration from the Malay Archipelago, where there is not a single tribe which does not possess the art. It may, however, be that, moving among small coral islands for scores of generations and thus without materials, they lost the art. Those of them who possessed pottery obtained it from the Papuans. In most of their manufactures they were, however, in advance of the Papuans. They made use of the vegetable fibres abounding in the islands, the women manufacturing cloth, chiefly from the bark of the paper mulberry (*Morus papyrifera*), but also in some islands from the bark of the bread-fruit tree and the hibiscus. This in former times furnished them with most of their clothing. They also made various kinds of mats, baskets and fans from the leaves of the pandanus, the bark of the hibiscus, from species of böhmeria or other Urticaceous plants. Some of their mats are very beautifully made, and in some islands they are the most valuable property the people possess. The people also use the various fibre-producing plants for the manufacture of ropes, coarse string and fine cord, and for making fishing nets. The nets are often very large, and are netted with a needle and mesh as in hand-netting among ourselves.

The Polynesians, who have always been entirely without metals, are clever workers in wood. Canoe and house building are trades usually confined to certain families. The large canoes in which they formerly made long voyages are no longer built, but various kinds of smaller canoes are made, from the commonest, which is simply a hollowed-out tree cut into form, to the finely shaped one built upon a keel, the joints of the various pieces being nicely fitted, and the whole stitched together with cord made from the husk of coconuts. Some of the larger canoes are ornamented with rude carving; and in some islands they are somewhat elaborately decorated with inlaid mother-of-pearl. The houses are generally well and elaborately made, but nearly all the ornamentation is put on the inside of the roof.

They manufacture several wooden utensils for household use, such as dishes or deep bowls, head-rests and stools. Having no metal or other vessels in which to boil water, all cooking is done by baking, generally in holes in the ground. They also make wooden gongs, or drums. They used to make wooden fishhooks, clubs, spears and bows. They still make wooden fishspears and carved and inlaid combs. They employ the bamboo for making drums and flutes. Formerly knives were made of bamboo, which is still sometimes used for that purpose. In the manufacture of these things they employed adzes made of stone, shell or hard wood, and a wooden drill pointed with stone, shell or bone. They made mother-of-pearl fishhooks, and they still use a part of those old hooks—or artificial bait—in combination with steel hooks, the native-made portion being generally shaped like a small fish. For water-vessels, &c., they employ gourds and large coco-nut shells, in preparing which they pour in water and allow the pulp or the kernel to decay, so that it may be removed without breaking the rind or shell. Their drinking cups are made of half a coco-nut shell. Sharks' teeth, shells and bamboo were formerly generally used as cutting instruments for shaving and surgical operations. They employ vegetable dyes for painting their bark-cloth, calabashes, &c. In some islands they also use a red earth for this purpose. Their cloth is generally ornamented with geometrical patterns. Any drawings of animals, &c., which they make are exceedingly inartistic, and no attempt is made at perspective. Their musical instruments are few and rude—consisting of the drums and flutes already mentioned, and shell trumpets.

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[1] Morgan has founded one of his forms of family—the consanguine—on the supposed existence in former times among the Malays and Polynesians of the custom of "intermarriage of brothers and sisters, own and collateral, in a group." All the evidence he finds in support of this is (1) the existence of the custom above mentioned in Hawaii; and (2) the absence of special terms for the relationship of uncle, aunt and cousin, this indicating, he thinks, that these were regarded as fathers, mothers, brothers and sisters. He admits that "the usages with respect to marriage which prevailed when the system was formed may not prevail at the present time." But he adds, "To sustain the deduction it is not necessary that they should" (*Ancient Society*, p. 408). Morgan has given special terms for grandfather and grandmother, because it would prove too much to show that the people had no grandfathers, &c. But these terms are used for ancestors of any generation. The terms used for grandchildren, in like manner, are used for any generation of descendants. He says (p. 406) the terms of husband and wife are used in common by a group of sisters or brothers, but the fact is that the words used for husband and wife in Hawaii simply mean male and female. In some islands there are terms used for wife in the most strict sense. The word wife is not used more exclusively among us than among some Polynesian people.

[2] See a remarkable example in Fornander's *Account of the Polynesian Race*, ii. 89.

The Polynesians were all polytheists. Without doubt many of their gods are deified men; but it is clear that some are the forces of Nature personified, while others appear to represent human passions which have become identified with particular persons who have an existence in their historical myths.[1] But the conception which they had of Tangaloa (Taaroa and Kanaloa in some islands) is of a higher order. Among the Tahitians he was regarded as "the first and principal god, uncreated and existing from the beginning, or from the time he emerged from *po*, or the world of darkness."[2] "He was said to be the father of all the gods, and creator of all things, yet was scarcely reckoned an object of worship."[3] Dr Turner says, "the unrestricted, or unconditioned, may fairly be regarded as the name of this Samoan Jupiter."[4]

The worship of certain of the great gods was common to all the people in a group of islands. Others were gods of villages or of families, while others were gods of individuals. The gods of clans were probably the spirits of the ancestors in their own line. In some islands, when the birth of a child was expected, the aid of the gods of the family was invoked, beginning with the god of the father. The god prayed to at the instant of birth became the god of the child. In other places the name of the child's god was declared when the umbilical cord was severed. The gods were supposed to dwell in various animals, in trees, or even in inanimate objects, as a stone, a shell, &c. In some islands idols bearing more or less resemblance to the human shape were made. But in all cases the material objects were regarded simply as the abodes of the immaterial spirits of the gods.

Their temples were either national, for a single village, or for the god of a family. They were sometimes large stone enclosures (*marae*), sometimes a grove, or a house. The principal priests were a particular order, the priesthood being hereditary. In some cases, however, the father of a family was priest in his own household and presented offerings and prayers to the family god.

In some islands human sacrifices were of frequent occurrence; in others they were offered only on very rare and exceptional occasions, when the demand was made by the priests for something specially valuable. The usual offerings to the gods were food. The system of *taboo* was connected with their religious rites. There were two ways by which things might become *taboo*: (1) by contact with anything belonging to the god, as his visible representation or his priest. Probably it was thought that a portion of the sacred essence of the god, or of a sacred person, was directly communicable to objects which they touched. (2) Things were made *taboo* by being dedicated to the god; and it is this form of *taboo* which is still kept up. If, *e.g.*, any one wishes to preserve his coco-nuts from being taken, he will put something upon the trees to indicate that they are sacred or dedicated. They cannot then be used until the *taboo* is removed. Disease and death were often connected with the violation of *taboo*, the offended gods thus punishing the offenders. Disease was generally attributed to the anger of the gods. Hence offerings, &c., were made to appease their anger. The first-fruits of a crop were usually dedicated to the gods to prevent them from being angry; and new canoes, fishing-nets, &c., were dedicated by prayers and offerings, in order that the gods might be propitious to their owners in their use.

The Polynesians invariably believe in the existence of the spirit of man after the death of the body. Their traditions on the condition of the dead vary considerably in different groups; yet there is a general agreement upon main points. Death is caused by the departure of the spirit from the body. The region of the dead is subterranean. When the spirit leaves the body it is conveyed by waiting spirits to the abode of spirits. In most islands the place of descent is known. It is generally towards the west. In some traditions there is a distinction between chief and common people in the spirit world. In others all are much alike in condition. Some traditions indicate a marked distinction between the spirits of warriors and those of others: the former go to a place where they are happy and are immortal, while the latter are devoured by the gods and are annihilated. In some, however, the spirits are said to live again after being eaten. Some speak of the abode of spirits as being in darkness; but usually the condition of things is similar to that which exists upon earth. Amongst all the people it is believed that the spirits of the dead are able to revisit the scenes of their earthly life. The visits are generally made in the night, and are often greatly dreaded, especially when there may be any supposed reason for spite on the part of the dead towards living relatives. Some writers have connected Polynesian cannibalism with religion. In the Cook and Society Islands, when a human being was offered as a sacrifice, the priest presented an eye of the victim to the king, who either ate it or pretended to do so. Probably the earliest human sacrifices were the bodies of enemies slain in battle. As it was supposed by some that the spirits of the dead were eaten by the gods, the bodies of those slain in battle may have been eaten by their victors in triumph. Mr Shortland appears to think that cannibalism among the Maories of New Zealand may have thus originated.[5] Among the Polynesians generally it appears to have been the practice at times to eat a portion of a slain enemy to make his degradation the greater. But where cannibalism was practised as a means of subsistence, it probably originated in times of actual want, such as may have occurred during the long voyages of the people.

The Polynesian race has been continuously, and in some places rapidly, decreasing since their first contact with Europeans. Doubts have been thrown on the current statements regarding the rate of decrease, which some good authorities believe to be not so great as is commonly represented. They hold that former estimates of the number of inhabitants in the various insular groups were mere guesswork. Thus it is pointed out that Cook's estimate of 240,000 for the Society Archipelago (Tahiti) was at the time reduced by his associate, Forster, to 150,000, so that the 300,000 credited by him to the Sandwich Islands should also be heavily discounted. That is probably true, and it may be admitted that, as a rule, the early calculations erred on the side of excess. But when full allowance is made for all such exaggerations, the following facts will show that the decrease has been excessive. The Tahitians, 150,000 in 1774, fell from 17,000 in 1880 to 10,300 in 1899; and in this group, while the pure stock appears to be dying out, there is a small increase amongst the half-breeds. When New Zealand was occupied (1840) the Maori were said to number 120,000, and were doubtfully stated to be still 56,000 in 1857; since then the returns of the 1881 and 1891 censuses gave 44,000 and 40,000 respectively. During the last two decades of the 19th century the decrease has been from 30,000 to 17,500 in Tonga; from 11,500 to 8400 in the Cook group; from 8000 to 3600 in Wallis; from 1600 to 100 in Manahiki; from 1400 to 1000 in Tubuai; and from 600 to 100 in Easter Island. A general decline seems thus to be placed beyond doubt, though it may be questioned whether it is to be attributed to a decayed vitality, as some hold, or to external causes, as is the more general opinion. The prevalence of elephantiasis and the occurrence of leprosy, for instance, in Hawaii, would seem to point at least in some places to a racial taint, due perhaps to the unbridled licentiousness of past generations. On the other hand, such a decrease as has occurred in Tahiti and Tonga, can be accounted for only by an accumulation of outward causes, such as wars, massacres, and raidings for the Australian and South American labour markets before this traffic was suppressed or regulated. Other destructive agencies were epidemics, such especially as measles and small-pox, which swept away 30,000 Fijians in 1875; the introduction of strong drinks, including, besides vile spirits, a most pernicious concoction brewed in Tahiti from oranges;

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[1] The following books may be consulted on this subject: Rev. W. W. Gill's *Myths and Songs from the South Pacific*; Dr Turner's *Samoa*; and Mr Shortland's *Maori Religion and Mythology*; Sir George Grey, *Polynesian Mythology*.

[2] *Polynesian Researches* i. 323.

[3] *Tahitian Dictionary.*

[4] *Samoa*, p. 52.

[5] *Maori Religion and Mythology*, p. 26.

the too sudden adoption of European clothing, rendering the body supersensitive to changes of temperature; lastly, the action of over-zealous missionaries in suppressing the dances, merry-making and free joyous life of pagan times, and the preaching of a sombre type of Christianity, with deadening effects on the buoyant temperament of these children of Nature. Most of these abuses have been checked or removed, and the results may perhaps be detected in a less accelerated rate of decline, which no longer proceeds in geometric proportion, and seems even almost arrested in some places, as in Samoa and New Zealand. If such be indeed the case, perhaps the noblest of all primitive races may yet be saved from what at one time seemed inevitable extinction; and the Maori, the Samoans, and Tahitians may, like the Hawaiians, take their place beside the Europeans as free citizens of the various states of which they are now subjects.

Authorities.—Jean L. A. de Quatrefages, *Les Polynésiens et leur migrations* (Paris, 1866); G. Turner, *Nineteen Years in Polynesia* (London, 1861); Pierre Adolphe Lesson, *Les Polynésiens, leur origine*, &c. (Paris, 1880–1884); Henri Mager, *Le Monde polynésien* (Paris, 1902); Maximilien Albert H. A. Le Grand, *Au pays des Canaques* (Paris, 1893); Sir George Grey, *Polynesian Mythology* (London, 1855); T. A. Moerenhout, *Voyages aux îles du Grand Océan*, &c. (Paris, 1837); Abraham Fornander, *An Account of the Polynesian Race* (1878). The account given above reproduces the main descriptive passages in the Rev. S. J. Whitmee's article in the 9th ed of the *Ency. Brit.*

POLYP, the name given by zoologists to the form of animal especially characteristic of the subphylum Cnidaria of the Coelentera (*q.v.*). In the subdivision Anthozoa, comprising the sea-anemones and corals, the individual is always a polyp; in the Hydrozoa, however, the individual may be either a polyp or a medusa (*q.v.*).

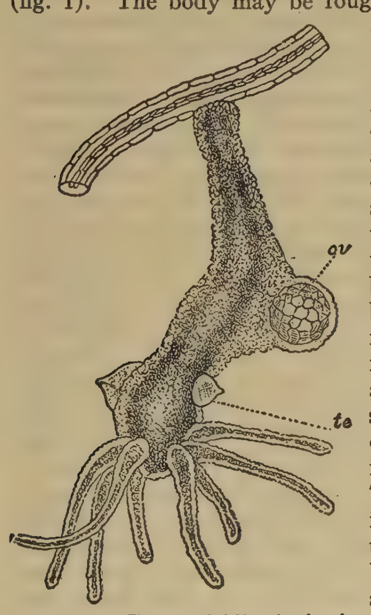


Fig. 1.—*Hydra viridis*, the fresh-water polyp. The animal is attached to the stem of a plant, and is represented with the base of attachment uppermost; the mouth, not actually seen in the drawing, is at the lower extremity of the body, surrounded by the circle of tentacles. *ov*, Ovary; *te*, testis.

A good example of a polyp may be seen in a common sea-anemone or in the well-known fresh-water polyp, *Hydra* (fig. 1). The body may be roughly compared in structure to a sac, the wall of which is composed of two layers of cells. The outer layer is known technically as the ectoderm, the inner layer as the endoderm. Between ectoderm and endoderm is a supporting layer of structureless gelatinous substance termed mesogloea, secreted by the cell-layers of the body-wall; the mesogloea may be a very thin layer, or may reach a fair thickness, and then sometimes contains skeletal elements formed by cells which have migrated into it from the ectoderm. The sac-like body built up in this way is attached usually to some firm object by its blind end, and bears at the upper end the mouth surrounded by a circle of tentacles. Each tentacle is a glove-finger-like outpushing of the whole wall of the sac and contains typically a prolongation of its internal cavity, so that primarily the tentacles are hollow; but in some cases the tentacle may become solid by obliteration of its cavity. The tentacles are organs which serve both for the tactile sense and for the capture of food. By means of the stinging nettle-cells or nematocysts with which the tentacles are thickly covered, living organisms of various kinds are firmly held and at the same time paralysed or killed, and by means of longitudinal muscular fibrils formed from the cells of the ectoderm the tentacles are contracted and convey the food to the mouth. By means of circularly disposed muscular fibrils formed from the endoderm the tentacles can be protracted or thrust out after contraction. By muscle-fibres belonging to the same two systems the whole body may be retracted or protruded.

We can distinguish therefore in the body of a polyp the column, circular or oval in section, forming the trunk, resting on a base or foot and surmounted by the crown of tentacles, which enclose an area termed the *peristome*, in the centre of which again is the mouth. As a rule there is no other opening to the body except the mouth, but in some cases excretory pores are known to occur in the foot, and pores may occur at the tips of the tentacles. Thus it is seen that a polyp is an animal of very simple structure.

The name polyp was given to these organisms from their supposed resemblance to an octopus (Fr. *poulpe*), with its circle of writhing arms round the mouth. This comparison, though far-fetched, is certainly more reasonable than the common name "coral-insects" applied to the polyps which form coral. It cannot be too emphatically stated that a coral-polyp is as far removed in organization from either an octopus or an insect as it is from man himself.

The external form of the polyp varies greatly in different cases. In the first place the column may be long and slender, or may be, on the contrary, so short in the vertical direction that the body becomes disk-like. The tentacles may number many hundreds or may be very few, in rare cases only one or two, or even absent altogether; they may be long and filamentous, or short and reduced to mere knobs or warts; they may be simple and unbranched, or they may be feathery in pattern. All these types are well illustrated by different species of British sea-anemones. The mouth may be level with the surface of the peristome, or may be projecting and trumpet-shaped. As regards internal structure, polyps exhibit two well-marked types of organization, each characteristic of one of the two classes, Hydrozoa and Anthozoa.

It is an almost universal attribute of polyps to possess the power of reproducing themselves non-sexually by the method of budding. This mode of reproduction may be combined with sexual reproductiveness, or may be the sole method by which the polyp produces offspring, in which case the polyp is entirely without sexual organs. In many cases the buds formed do not separate from the parent but remain in continuity with it, thus forming *colonies* or stocks, which may reach a great size and contain a vast number of individuals. Slight differences in the method of budding produce great variations in the form of the colonies, which may be distinguished in a general way as spreading, massive or arborescent. The reef-building corals are polyp-colonies, strengthened by the formation of a firm skeleton. For further details of colony-formation the reader is referred to the articles Anthozoa and Hydromedusae.

For figures of polyps see P. Gosse, *A History of the British Sea-Anemones and Corals* (London, 1860); A. Andres, "Le Attinie," in *Fauna and Flora des Golfes von Neapel*, ix. 1 (Leipzig, 1884); G. J. Allman, *A Monograph of the Gymnoblastic or Tubularian Hydroids* (Ray Society, 1871–1872). (E. A. M.)

POLYPERCHON (incorrectly Polysperchon), one of Alexander's generals, and the successor of Antipater as regent in Macedonia in 319 B.C. He was driven out by Cassander in 317 B.C. (See Phocion.)

POLYPHEMUS, in Greek mythology, the most famous of the Cyclopes, son of Poseidon and the nymph Thoösa. He dwelt in a cave in the south-west corner of Sicily, and was the owner of large flocks and herds. He was of gigantic stature, with one eye in the middle of his forehead, a consumer of human flesh, without respect for the laws of God or man. Odysseus, having been cast ashore on the coast of Sicily, fell into the hands of Polyphemus, who shut him up with twelve of his companions in his cave, and blocked the entrance with an enormous rock. Odysseus at length succeeded in making the giant drunk, blinded him by plunging a burning stake into his eye while he lay asleep, and with six of his friends (the others having been devoured by Polyphemus) made his escape by clinging to the bellies of the sheep let out to pasture. Euripides in the *Cyclops* essentially follows the Homeric account. A later story associates Polyphemus with Galatea (see Acis).

Homer, *Odyssey*, ix.; Ovid, *Metam.* xiii. 749; Theocritus xi. See W. Grimm, *Die Sage von Polyphem.* (1857); G. R. Holland, in *Leipziger Studien* (1884), vii. 139–312.

POLYPODIUM, in botany, a large genus of true ferns (*q.v.*), widely distributed throughout the world, but specially developed in the tropics. The name is derived from Gr. πολύς, many, and πόδιον, a little foot, on account of the foot-like appearance of the rhizome and its branches. The species differ greatly in size and general appearance and in the character of the frond; the sori or groups of spore-cases (*sporangia*) are borne on the back of the leaf, are globose and naked, that is, are not covered with a membrane (*indusium*) (see fig. 1). The common polypody (fig. 2) (*P. vulgare*) is widely diffused in the British Isles, where it is found on walls, banks, trees, &c.; the creeping, densely-scaly rootstock bears deeply pinnately cut fronds, the fertile ones bearing on the back the bright yellow naked groups of sporangia (*sori*). It is also known as adder's foot, golden maidenhair and wood-fern, and is the oak-fern of the old herbals. There are a large number of varieties, differing chiefly in the form and division of the pinnae; var. *cambricum* (originally found in Wales) has the pinnae themselves deeply cut into narrow segments; var. *cornubiense* is a very elegant plant with finely-divided fronds; var. *cristatum* is a handsome variety with fronds forking at the apex and the tips of all the pinnae crested and curled. *P. dryopteris*, generally known as oak-fern, is a very graceful plant with delicate fronds, 6 to 12 in. long, the three main branches of which are themselves pinnately divided; it is found in dry, shady places in mountain districts in Great Britain, but is very rare in Ireland. *P. phegopteris* (beechfern) is a graceful species with a black, slender root-stock, from which the pinnate fronds rise on long stalks, generally about 12 in. long, including the stalk; it is characterized by having the lower pinnae of the frond deflexed; it is generally distributed in Britain, though not common. Many other species from different parts of the world are known in greenhouse cultivation.

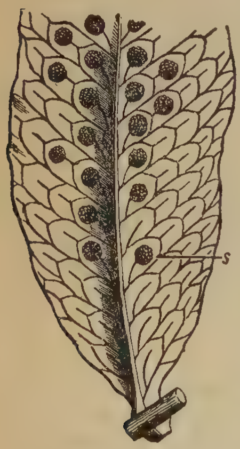


FIG. 1.—Portion of a pinna of leaf of *Polypodium* bearing sori, *s*, on its back.

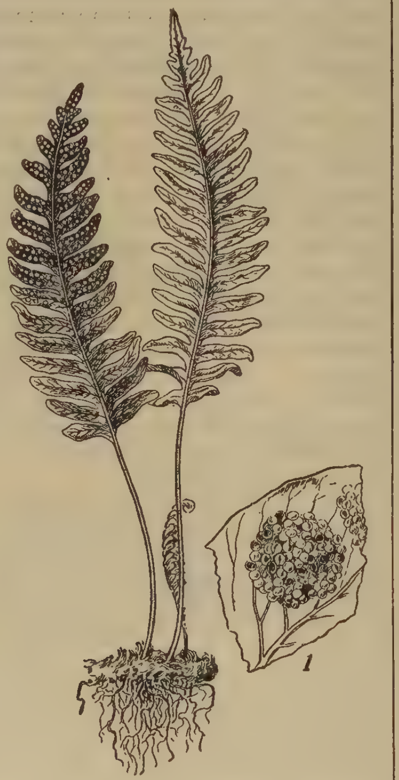


FIG. 2.—*Polypodium vulgare*, common polypody (about ⅓ nat. size).

1. Group of spore-cases (*sorus*) on back of leaf.

POLYPUS, a term signifying a tumour which is attached by a narrow neck to the walls of a cavity lined with mucous membrane. A polypus or polypoid tumour may belong to any variety of tumour, either simple or malignant. The most common variety is a polypus of the nose of simple character and easily removed. Polypi are also met with in the ear, larynx, uterus, bladder, vagina, and rectum. (See Tumour.)

POLYTECHNIC (Gr. πολύς, many, and τέχνη, an art), a term which may be held to designate any institution formed with a view to encourage or to illustrate various arts and sciences. It has, however, been used with different applications in several European countries. In France the first *école polytechnique* was founded by the National Convention at the end of the 18th century, as a practical protest against the almost exclusive devotion to literary and abstract studies in the places of higher learning. The institution is described as one "où l'on instruit les jeunes gens, destinés à entrer dans les écoles spéciales d'artillerie, du génie, des mines, des ponts et chaussées, créé en 1794 sous le nom d'école centrale des travaux publiques, et en 1795 sous celui qu'elle porte aujourd'hui" (*Littré*). In Germany there are nine technical colleges which, in like manner, have a special and industrial rather than a general educational purpose. In Switzerland the principal educational institution, which is not maintained or administered by the communal authorities, but is non-local and provided by the Federal government, is the Polytechnikum at Zurich. In all the important towns of the Federation there are trade and technical schools of a more or less special character, adapted to the local industries; *e.g.* schools for silk-weaving, wood-carving, watchmaking, or agriculture. But the Zurich Polytechnikum has a wider and more comprehensive range of work. It is a college designed to give instruction and practical training in those sciences which stand in the closest relation to manufactures and commerce and to skilled industry in general and its work is of university rank.

The First Polytechnics in England.

To the English public the word *polytechnic* has only recently become familiar, in connexion with some London institutions of an exceptional character. In the reign of William IV. there was an institution in London called after the name of his consort—"The Adelaide Gallery"—and devoted rather to the display of new scientific inventions and curiosities than to research or to the teaching of science. It enjoyed an ephemeral popularity, and was soon imitated by an institution called the Polytechnic in Regent Street, with a somewhat more pretentious programme, a diving-bell, electrical and mechanical apparatus, besides occasional illustrated lectures of a popular and more or less recreative character. In the popular mind this institution is inseparably associated with "Professor" Pepper, the author of *The Boy's Playbook of Science* and of *Pepper's Ghost.* Both of these institutions, after a few years of success, failed financially; and in 1880 Mr Quintin Hogg, an active and generous philanthropist, purchased the disused building in Regent Street, and reopened it on an altered basis, though still retaining the name of Polytechnic, to which, however, he gave a new significance. He had during sixteen years been singularly successful in gathering together young shopmen and artisans in London in the evenings and on Sunday for religious and social intercourse, and in acquiring their confidence. But by rapid degrees his enterprise, which began as an evangelistic effort, developed into an educational institution of a novel and comprehensive character, with classes for the serious study of science, art, and literature, a gymnasium, library, reading circles, laboratories for physics and chemistry, conversation and debating clubs, organized country excursions, swimming, rowing, and natural history societies, a savings bank, and choral singing, besides religious services, open to all the members, though not obligatory for any. The founder, who from the first took the closest personal interest in the students, well describes his own aims: "What we wanted to develop our institute into was a place which should recognize that God had given man more than one side to his character, and where we could gratify any reasonable taste, whether athletic, intellectual, spiritual or social. The success of this effort was remarkable. In the first winter

6800 members joined, paying fees of 3s. per term, or 10s. 6d. per year; and the members steadily increased, until in 1900 they reached a total of 15,000 The average daily attendance is 4000; six hundred classes in different grades and subjects are held weekly; and upwards of forty clubs and societies have been formed in connexion with the recreative and social departments.

Later Institutions of this Class.

The precedent thus established by private initiative has since been followed in the formation of the public institutions which, under the name of "Polytechnics," have become so prominent and have exercised such beneficent influence among the working population of London. The principal resources for the foundation and maintenance of these institutions have been derived from two funds—that administered under the City Parochial Charities Act of 1883, and that furnished by the London County Council, at first under the terms of the Local Taxation (Customs and Excise) Act of 1890, and the Technical Instruction Act 1889, but since the 1st of May 1904 under the Education Act 1902, as applied to London by the act of 1903. More detailed reference to these two acts seems to be necessary in this place.

The City Parochial Charities Act.

The royal commission of inquiry into the parochial charities of London was appointed in 1878, mainly at the instance of Mr James Bryce, and under the presidency of the Duke of Northumberland. Its report appeared in 1880, giving particulars of the income of the parishes, and revealing the fact that the funds had largely outgrown the original purposes of the endowments, which were ill adapted to the modern needs of the class for whose benefit they were intended. The act of parliament of 1883 was designed to give effect to the recommendations of the commissioners It provided that while five of the largest parishes were to retain the management of their own charitable funds, the endowments of the remaining 107 parishes in the city should be administered by a corporate body, to be entitled "the Trustees of the London Parochial Charities" (otherwise known in relation to the polytechnics as "the Central Governing Body"), this body to include five nominees of the Crown and four of the corporation of London. The remaining members were to be chosen under a subsequent scheme of the charity commission, which added four nominees of the London County Council, two of the Ecclesiastical Commissioners, and one each appointed by the university of London, University College, King's College, the City and Guilds institute, and the governing bodies of the Bishopsgate and the Cripplegate foundations. For the purpose of framing the scheme, a special commissioner, Mr James Anstie, Q.C., was temporarily attached to the charity commission, and it thus became the duty of the commission to prepare a statement of the charity property possessed by the 107 parishes, distinguishing between the secular and the ecclesiastical parts of the endowments. The annual income derived from the ecclesiastical fund was £35,000, and that from the secular portion of the fund £50,000. The scheme assigned capital grants amounting to £155,000 to the provision of open spaces, and £149,500 to various institutions, including free libraries in Bishopsgate and Cripplegate, the People's Palace, the Regent Street and Northampton Institutes, and the Victoria Hall. A capital sum of £49,355 out of the ecclesiastical fund was devoted to the repair of city churches; and the balance of the annual income of this fund, after allowances for certain vested interests, was directed to be paid to the Ecclesiastical Commissioners. This balance has varied by slight increases from year to year, and amounted in 1906 to £20,875. The remaining fund thus set free for secular purposes was by the scheme largely devoted to the erection and maintenance of polytechnic institutions, or "industrial institutes," as they were at first called. It was the opinion of Mr Anstie and his fellow-commissioners that in this way it would be possible to meet one of the most urgent of the intellectual needs of the metropolis, and to render service nearly akin to the original purposes of the obsolete charitable endowments. For the year 1906–1907 the grants made to the polytechnics and kindred institutions (the Working Men's College, College for Working Women, &c.) by the Central Governing Body amounted to £39,140, and the total amount contributed by the Central Governing Body since its creation amounts to £543,000.

A Typical Scheme under the Act.

The general scope and aims of the institutions thus contemplated by the commissioners are defined in the "general regulations for the management of an industrial institute," which are appended as a schedule to the several schemes, and which run as follows:—

> The object of this institution is the promotion of the industrial skill, general knowledge, health and well-being of young men and women belonging to the poorer classes by the following means:—
>
> i. Instruction in—
>
> *a.* The general rules and principles of the arts and sciences applicable to any handicraft, trade or business.
>
> *b.* The practical application of such general rules and principles in any handicraft, trade or business.
>
> *c.* Branches or details of any handicraft, trade or business, facilities for acquiring the knowledge of which cannot usually be obtained in the workshop or other place of business.
>
> The classes and lectures shall not be designed or arranged so as to be in substitution for the practical experience of the workshop or place of business, but so as to be supplementary thereto.
>
> ii. Instruction suitable for persons intending to emigrate.
>
> iii. Instruction in such other branches and subjects of art, science, language, literature and general knowledge as may be approved by the governing body.
>
> iv. Public lectures or courses of lectures, musical and other entertainments and exhibitions.
>
> v. Instruction and practice in gymnastics, drill, swimming and other bodily exercises.
>
> vi. Facilities for the formation and meeting of clubs and societies.
>
> vii. A library, museum and reading room or rooms.
>
> Within the limits prescribed, the governing body may from time to time, out of the funds at their disposal, provide and maintain buildings and grounds, including workshops and laboratories suitable for all the purposes herein specified, and the necessary furniture, fittings, apparatus, models and books, and may provide or receive by gift or on loan works of art or scientific construction, or objects of interest and curiosity, for the purpose of the institute, and for the purpose of temporary exhibition.

Other provisions in the scheme require: (1) that the educational benefits of the institute shall be available for both sexes equally, but that common rooms, refreshment rooms, gymnasia and swimming-baths may be established separately, under such suitable arrangements as may be approved by the governing body; (2) that the fees and subscriptions shall be so fixed as to place the benefits of the institute within the reach of the poorer classes; (3) that no intoxicating liquors, smoking or gambling shall be allowed in any part of the building; (4) that the buildings, ground and premises shall not be used for any political, denominational or sectarian purpose, although this rule shall not be deemed to prohibit the discussion of political subjects in any debating society approved by the governing body; (5) that no person under the age of sixteen or above twenty-five shall be admitted to membership except on special grounds, and that the number thus specially admitted shall not exceed 5% of the total number of members.

The Technical Board of the London County Council.

These and the like provisions have formed the common basis for all the metropolitan polytechnics. In 1890 a large sum was placed by the Local Taxation (Customs and Excise) Act at the disposal of the county and county borough councils for the general purposes of technical education, and in 1893 the London County Council determined to devote a considerable portion of this revenue to the further development and sustentation of polytechnics. While the funds granted by the Central Governing Body may be employed in aid of the social and recreative as well as the educational purposes of the various institutes, it is a statutory obligation that the sums contributed by the London County Council should be applied to educational work only.

Dr William Garnett, the educational adviser of the London County Council, has, in a published lecture delivered before the international congress on technical education in June 1897, thus described the conditions under which the council offers financial help to the London polytechnics:—

The objects which the technical education board has had in view in its dealings with the polytechnics have been:—

1. To allow to the several governing bodies the greatest possible freedom in the conduct of social, recreative and even religious work within the provisions of the schemes of the Charity Commissioners.

2. To secure to each polytechnic the services of an educational principal, who should be responsible to his governing body for the organization and conduct of the whole of the work of the institution.

3. To provide in each polytechnic a permanent staff of teachers, who should be heads of their respective departments and give their whole time to the work of the institution, and thus to establish a corporate or collegiate life in the polytechnic.

4. To ensure that all branches of experimental science are taught experimentally, and that the students have the opportunity of carrying out practical laboratory work, at an inclusive fee not exceeding ten shillings for any one subject.

5. To provide efficient workshop instruction in all practical trade subjects.

6. To secure that the number of students under the charge of any one teacher in laboratory or workshop classes, or in other classes in which personal supervision is of paramount importance, shall not exceed a stated limit (fifteen in the workshop, or twenty in the laboratory).

7. To exclude from classes students who, for want of preliminary training, are incapable of profiting by the instruction provided; and to this end to restrict the attendance at workshop classes to those who are actually engaged in the trades concerned, and have thus opportunities of acquiring the necessary manual dexterity in the performance of their daily duties.

8. To furnish an adequate fixed stipend for all teachers, in place of a contingent interest in fees and grants.

9. To encourage private subscriptions and donations.

10. To establish an efficient system of inspection.

11. To facilitate the advertisement of polytechnic classes, and especially to invite the co-operation of trade societies in supporting their respective classes.

12. To encourage the higher development of some special branch of study in each polytechnic.

13. To utilize the polytechnic buildings as far as possible in the daytime by the establishment of technical day schools, or otherwise.

14. To secure uniformity in the keeping of accounts.

The regulations under which the council has attempted to secure its objects by means of grants have been changed from time to time as the work of the polytechnics has developed, but they provide that the council's aid should be partly in the form of a fixed grant to each institution, partly a share of the salaries of the principal and the permanent teachers, partly a grant on attendance, the scale depending on the subject and character of the instruction, and partly a subsidy (15%) on voluntary contributions. In addition to the annual grants for maintenance, substantial grants for building and equipment are made from time to time.

The scale of grants adopted by the council for the session 1907–1908 was the following:—

i. A fixed grant assigned to each polytechnic.

ii. Three-fourths of the salary of the principal (subject to certain conditions).

iii. Fifty per cent. of the salaries of heads of approved departments.

iv. Ten per cent. of the salaries of other teachers.

v. Fifteen per cent. on (voluntary) annual subscriptions or donations.

vi. Attendance grants on evening classes varying from 1d. to 6d. per student-hour (subject to certain conditions of minimum attendance, eligibility, &c.).

vii. Special grants not exceeding £50 for courses of lectures on particular subjects required or approved by the council.

viii. Special grants towards any departments which the council may desire to see established or maintained.

ix. Equipment grants and building grants in accordance with the special requirements of the institutions.

The above grants are independent of any contributions which the council may make towards secondary day schools or day schools of domestic economy or training colleges of domestic economy in the polytechnics.

London Polytechnic Council.

With a view to a due division of labour, and also to the co-operation of the public bodies concerned, the "London Polytechnic Council" was created in 1894. It was composed of representatives of the Central Governing Body, the technical education board of the London County Council, and the City and Guilds of London Institute, and its duty was to consult as to the appropriation of funds, the organization of teaching, the holding of needful examinations, and the supervision of the work generally. After ten years of work the London polytechnic council was dissolved in the summer of 1904 in consequence of the abolition of the technical education board of the London County Council, when the council became responsible for all grades of education. A statement below shows the number and names of the several institutions, and the extent to which they have been severally aided by the Central Governing Body and the London County Council.

The People's Palace.

The "People's Palace" owes its origin in part to the popularity of a novel by Sir Walter Besant, entitled *All Sorts and Conditions of Men*, in which the writer pointed out the sore need of the inhabitants of East London for social improvement and healthy recreation, and set forth an imaginary picture of a "Palace of Delight," wherein this need might be partly satisfied. Much public interest was awakened, large subscriptions were given, and the Central Governing Body aided the project; but the munificence of the drapers' company in setting aside £7000 a year for its permanent maintenance released the London County Council from any obligation to make a grant. Apart from the social and recreative side of this popular institution, the educational section, under the name of the East London Technical College, steadily increased in numbers and influence under the fostering care of the drapers' company and has now been recognized as a "school" of the university of London under the title of "The East London College" and is being utilized by the London County Council in the same way as other "schools of the university."

Grants to the London Polytechnics during the Session 1906–1907.

	Central Governing Body.		London County Council.	
	Under Scheme.	Voluntary Grants.	Buildings and Equipment.	Maintenance.
Battersea Polytechnic	2,500	1,701	1,545	4,760
Birkbeck College	1,000	1,005	445	3,450
Borough Road Polytechnic	2,500	1,563	820	5,285
City of London College	1,000	901	515	3,725
East London College	3,500	224	nil	nil
Northampton Institute	3,350	1,555	3,415	4,525
Northern Polytechnic	1,500	2,183	2,660	4,145
Regent Street Polytechnic	3,500	3,916	965	7,665
South-Western Polytechnic	1,500	2,091	1,275	6,265
Woolwich Polytechnic	nil	1,000	2,525	5,495
Sir John Cass's Institute	nil	50	510	2,400
Total . . . . £	20,350	16,189	14,675	47,715

In the above table the grants are given to the nearest pound. Up to July 1907 the total expenditure of the council upon the polytechnics, apart from the day schools, training colleges, &c., conducted in them, was about £525,000, almost exactly the same as that of the Central Governing Body. The voluntary grants from the central governing body include a contribution towards a compassionate fund, and a pension fund based on endowment assurances for all permanent officers of the polytechnics in receipt of salaries of not less than £100 a year.

The grants received from the board of education amount to about £30,000 a year, while the fees of students and members produce about £45,000. Voluntary subscriptions, including those from city companies and other sources of income, produce about £30,000 in addition, so that out of a total expenditure of about £200,000 a year the council now contributes 30%, the Central Governing Body 18%, fees 22½%, the board of education 15% and city companies and other subscribers 15%.

The Goldsmiths' Institute at New Cross owed its existence and its annual maintenance to the generous initiative of the ancient city gild whose name it bore. It was therefore entirely independent of pecuniary subsidy from any other public body. In the year 1900 the number of class entries to this institute was 7574. In 1904 the goldsmiths' company presented the premises, together with an annual subsidy, to the university of London for the purposes of a training college for teachers, so that from that date it ceased to be one of the London polytechnics, although, pending the provision of other premises, many of the technical evening classes have been continued under the London County Council by permission of the university with the approval of the company. The clothworkers' company has also contributed £18,000 to the Northern Polytechnic at Holloway.

Aims and Methods.

In all these institutions the general aims have been practically the same, although special features have been differentiated in order to meet the local needs and the wishes of the inhabitants. In all there are laboratories and lecture rooms, trade classes, art studios, gymnasia, provision for manual training and domestic economy and applied science. In nearly all, at first, mechanical and manual instruction were the prominent objects in view, partly owing to the conditions under which grants were made by the science and art department. But of late increased attention has been paid year by year to literary and humaner studies, and to general mental cultivation, pursued *pari passu* with technical and scientific training. The aid of the London organization for university extension, now a department of the university, has been especially serviceable in providing courses of lectures and classes in literary subjects at nearly all the polytechnics. As subsidiary to their main work, some of them have established junior continuation schools, with a view to provide suitable instruction for scholars who have left the public elementary schools and are not yet prepared to enter the technical and trade classes. Although the workshops and the classes for artisans are used chiefly in the evenings, there is an increasing number of day students : *e.g.* at the Northampton Polytechnic Institute in Clerkenwell there is a very important day school of engineering conducted on the "sandwich system," the students entering engineering works for the summer months and returning to the polytechnic for the winter session; at the Battersea Polytechnic there is a very important training college for teachers of domestic economy; at Regent Street there are day schools in engineering, architecture, photo-process and carriage-building; at the South-Western Polytechnic there are important schools of mechanical and electrical engineering and a training college for women teachers of physical exercises; at the Northern Polytechnic, as at Battersea, there is a training college for teachers of domestic economy, and there are departments of commerce and of physics and chemistry, while the Woolwich Polytechnic receives in the daytime, by special arrangement with the war office, a large number of engineering apprentices employed in the arsenal. In short, the schemes of the several institutions are so elastic that the governing bodies are at liberty to open any classes or to try any educational or recreative experiment for which they can find a genuine local demand. The total number of scholars in the polytechnics and their branch institutions is variously estimated at from 40,000 to 50,000, and the total number of regular scholars in the evening schools of the council does not exceed 100,000. These figures may be usefully compared with the census returns, which show that within the metropolitan area there are 704,414 persons between the ages of thirteen and twenty-one. It is a noteworthy fact that, whereas in the population statistics for the whole of England and Wales the number at each year of age is regularly diminished by death from eight years onwards, there is a steady increase in London, year by year, from fourteen up to the age of thirty. This fact is owing to the constant immigration of young men and women from the provinces to the metropolis. The census commissioners in their report for 1901 (p. 15) computed that more than one-third of the population of London were not natives. They show also that, if all England and Wales be taken together, the number of persons between twenty and twenty-one is less by 12·8% than the number between thirteen and fourteen; but that, taking London alone, the number of persons between twenty and twenty-one is greater by 14·4% than the number between thirteen and fourteen. Hence, the proportion of the inhabitants who are of an age to benefit by polytechnics and continuation schools is in London exceptionally large. It would not be right for Londoners to complain that there is thus cast upon them the duty of providing suitable instruction for so many immigrants, for if the great city drains the rural districts of some of their best brain and muscle, she gains much from their industry and productive power. The figures, however, point to the necessity for taking every means possible to raise the standard, both physical and intellectual, of the London boy. The immigration into London of youths and young men means to a great extent the substitution of the provincially trained improver or artisan for the less fit London boy, who consequently falls into the ranks of the unskilled, then of the unemployed and ultimately of the unemployable.

But it follows from the particulars thus given that neither the supply of suitable provision for mental improvement and rational recreation for the wage-earning classes, nor the demand for such provision on the part of the workers themselves is commensurate with the moral and intellectual needs of a community of nearly seven millions of people (four and a half millions within the administrative county). The provision in evening schools, institutes, classes and polytechnics is still in some respects far inferior to that which is to be found in most German and Swiss towns, and needs to be greatly increased. In matters relating to the higher life, demand does not always precede supply; it is simply which is needed not only to satisfy the public demand, but to create it. As new and well-devised opportunities for mental culture are placed within reach, they will be more and more appreciated, new and healthier appetites will be stimulated, the art of employing leisure wisely and happily will be more systematically studied, and the polytechnics will become still more important centres of civilizing and educating influence than they have hitherto been.

In particular, the reconstituted university of London has been placed in new and most helpful relation to the best of the polytechnics. By the statutes the senate of the university is empowered to include in the list of "schools of the university" all institutions which are duly equipped and able to furnish suitable instruction of an advanced and scholarly type; and also to recognize all thoroughly qualified professors in their several faculties and subjects as "teachers of the university," although some of their classes may meet in the evening only, and no student is to be prevented from taking a degree as an internal student of the university solely because he can attend classes only in the evening. There is thus a way open for the due recognition of the polytechnics as part of the teaching machinery of the university, and for the admission of the best students as undergraduates, with all the rights of internal students. The great possibilities of the metropolitan university under its new conditions were at first hardly revealed or accurately foreseen. But there were during the session 1906–1907 no less than eighty-six recognized "teachers of the university" on the staffs of the London polytechnics and more than 750 students who were working for London University degrees in the polytechnic classes. There is no reason to fear that the recreative, social, manual and industrial training, to which at first the special attention of the founder of the Regent Street Polytechnic was directed, will suffer from a fuller expansion of the academic and literary side of "polytechnic" life. Rather it may be hoped that the due co-ordination of the practical with the purely intellectual purposes of these institutions will serve to give to all the students, whatever their future destination may be, a truer and broader conception of the value of mental culture for its own sake.

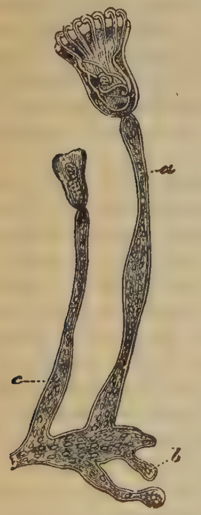
See also a paper by Mr Sidney Webb, *The London Polytechnic Institutes*, in the second volume of special reports on educational subjects (1898) issued by the Education Department; the *Report of the Central Governing Body of the London Parochial Charities*; the *Annual Reports of the London County Council*; the *Polytechnic Magazine*, published from time to time at the institute in Regent Street; and various memoirs and papers contained in the *Proceedings of the International Congress on Technical Education* (1897), especially two—that by Mr Quintin Hogg, detailing his own early experience in founding the first polytechnic, and that of Dr William Garnett, then secretary of the Technical Education Board.

(J. G. F.; W. G.)

POLYXENA, in Greek legend, daughter of Priam, king of Troy, and Hecuba. She had been betrothed to Achilles, who was slain by Paris in the temple of Apollo Thymbraeus, where the marriage was to have been celebrated (Hyginus, *Fab.* 110). The shade of Achilles afterwards appeared to the returning Greeks in the Thracian Chersonese and demanded the sacrifice of Polyxena, who was put to death by Neoptolemus, son of Achilles, on his father's grave (Ovid, *Metam.* xiii. 440 sqq.). The tragic story is the subject of the *Hecuba* of Euripides, the *Troades* of Seneca and the *Polyxena* of Sophocles, of which only a few fragments remain. According to Philostratus (*Heroica*, 20, 18), Polyxena fled to the Greeks after the murder of Achilles and committed suicide on his tomb.

POLYZOA, in zoology, a term (introduced by J. V. Thompson, 1830) synonymous with Bryozoa (Ehrenberg, 1831) for a group commonly included with the Brachiopoda in the Molluscoidea (Milne Edwards, 1843). The correctness of this association is questionable, and the Polyzoa are here treated as a primary division or phylum of the animal kingdom. They may be defined as aquatic animals, forming colonies by budding; with ciliated retractile tentacles and a U-shaped alimentary canal. The phylum is subdivided as follows.

Class I. ENTOPROCTA (Nitsche). Lophophore circular, including both mouth and anus. Tentacles infolded, during retraction, into a vestibule which can be closed by a sphincter. Body-wall not calcified, body-cavity absent. Definite excretory organs present. Reproductive organs with ducts leading to the vestibule. Zooids possessing a high degree of individuality. *Loxosoma Pedicellina* (fig. 1), *Urnatella.*



(After van Beneden.)

FIG. 1.—Part of the creeping stolon, with zooids, of *Pedicellina belgica.*

a, c, Stalks of zooids of different ages; *b*, bud.

Class II. ECTOPROCTA (Nitsche). Lophophore circular or horseshoe shaped, including the mouth but not the anus. Tentacles retractile into an introvert ("tentacle-sheath"). Body-wall membranous or calcified, body-cavity distinct. Specific excretory organs absent, with the doubtful exception of the Phylactolaemata. Reproductive organs not continuous with ducts. Zooids usually connected laterally with their neighbours.

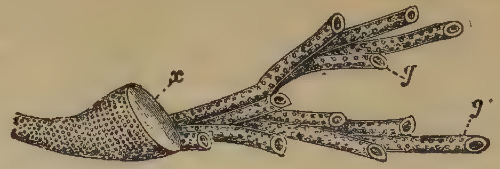
Order 1. GYMNOLAEMATA (Allman).—Lophophore circular, with no epistome. Body-cavities of zooids not continuous with one another. Body-wall not muscular.

Sub-order 1. TREPOSTOMATA (Ulrich); Fossil.—Zooecia, long and coherent, prismatic or cylindrical, with terminal orifices, their wall thin and simple in structure proximally, thickened and complicated distally. Cavity of the zooecium subdivided by transverse diaphragms, most numerous in the distal portion. Orifices of the zooecia often separated by pores (mesopores).

Sub-order 2. CRYPTOSTOMATA (Vine); Fossil.—Zooecia usually short. Orifice concealed at the bottom of a vestibular shaft, surrounded by a solid or vesicular calcareous deposit.

Sub-order 3. CYCLOSTOMATA (Busk).—Zooecia prismatic or cylindrical, with terminal, typically circular orifice, not protected by any special organ. The ovicells are modified zooecia, and contain numerous embryos which in the cases so far investigated arise by fission of a primary embryo developed from an egg. *Crisia* (fig. 2), *Tubulipora, Hornera, Lichenopora.*

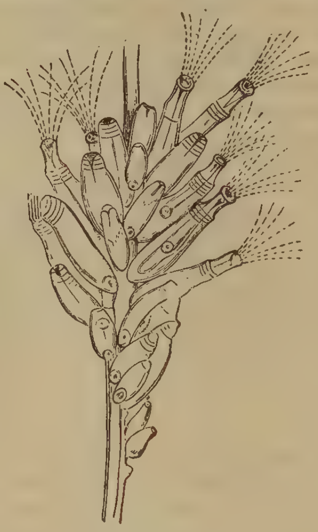
Sub-order 4. CTENOSTOMATA (Busk).—Zooecia with soft uncalcified[1] walls, the external part of the introvert being closed during retraction by a membranous collar. Zooecia either arising from a stolon, without lateral connexion with one another, or laterally united to form sheets. *Alcyonidium, Flustrella, Bowerbankia* (fig. 3), *Farrella, Victorella, Paludicella.*



(After Hincks.)

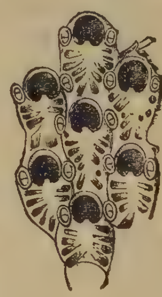
FIG. 2.—Part of a Branch of *Crisia eburnea.*
g, zooecia; *x*, imperfectly developed ovicell.

Sub-order 5. CHEILOSTOMATA (Busk).—Zooecia with more or less calcified walls. Orifice closed by a lid-like operculum. Polymorphism usually occurs, certain individuals having the form of avicularia or vibracula. The ovicells commonly found as globular swellings surmounting the orifices are not direct modifications of zooecia, and each typically contains a single egg or embryo. *Membranipora, Flustra, Onychocella, Lunulites, Steganoporella, Scrupocellaria, Menipea, Caberea, Bicellaria, Bugula, Beania, Membraniporella, Cribrilina, Cellaria, Micropora, Selenaria, Umbonula* (fig. 4), *Lepralia, Schizoporella, Cellepora, Mucronella, Smittia, Retepora, Catenicella, Microporella, Adeona.*



(After Hincks.)

FIG. 3.—Part of a branch of *Bowerbankia pustulosa*, showing the thread-like stolon from which arise young and mature zooecia. The tentacles are expanded in some of the latter.



(After Hincks.)

FIG. 4.—Zooecia of *Umbonula pavonella*, showing a pair of minute avicularia on either side of the orifice of each zooecium.

Order 2. PHYLACTOLAEMATA (Allman).—Lophophore horse-shoe shaped, or in *Fredericella* circular. Mouth guarded by an epistome. Body-cavities of zooids continuous with one another. Body-wall uncalcified and muscular. Reproduction sexual and by means of "statoblasts," peculiar internal buds protected by a chitinous shell. *Fredericella, Plumatella* (fig. 5), *Lophopus, Cristatella, Pectinatella.*

Hatschek (1888) treated the Entoprocta as a division of his group Scolecida, characterized by the possession of a primary body-cavity and of protonephridia; while he placed the Ectoprocta, with the Phoronida and Brachiopoda, in a distinct group, the Tentaculata. Against this view may be urged the essential similarity between the processes of budding in Entoprocta and Ectoprocta (cf. Seeliger, *Zeitschr. wiss. Zool.* xlix. 168; l., 560), and the resemblances in the development of the two classes.

Of the forms above indicated there is no palaeontological evidence with regard to the Entoprocta. The Trepostomata are in the main Palaeozoic, although *Heteropora*, of which recent species exist, is placed by Gregory in this division. The Cryptostomata are also Palaeozoic, and include the abundant and widely-distributed genus *Fenestella.* The Cyclostomata are numerous in Palaeozoic rocks, but attained a specially predominant position in the Cretaceous strata, where they are represented by a profusion of genera and species; while they still survive in considerable numbers at the present day. The Ctenostomata are ill adapted for preservation as fossils, though remains referred to this group have been described from Palaeozoic strata. They constitute a small proportion of the recent Polyzoa. The Cheilostomata are usually believed to have made their appearance in the Jurassic period. They are the dominant group at the present day, and are represented by a large number of genera and species. The Phylactolaemata are a small group confined to fresh water, and possess clear indications of adaptation to that habitat. The fresh-water fauna also contains a representative of the Entoprocta (*Urnatella*), two or three Ctenostomes, such as *Victorella* and *Paludicella*, and one or two species of Cheilostomata. With these exceptions, the existing Polyzoa are marine forms, occurring from between tide-marks to abyssal depths in the ocean.

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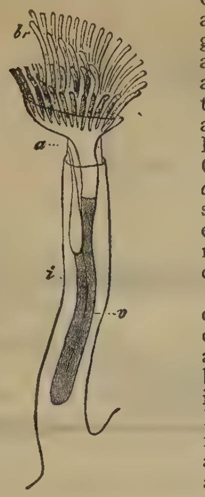
[1] Calcareous spicules have been described by Lomas in *Alcyonidium gelatinosum.*



(After Allman.)

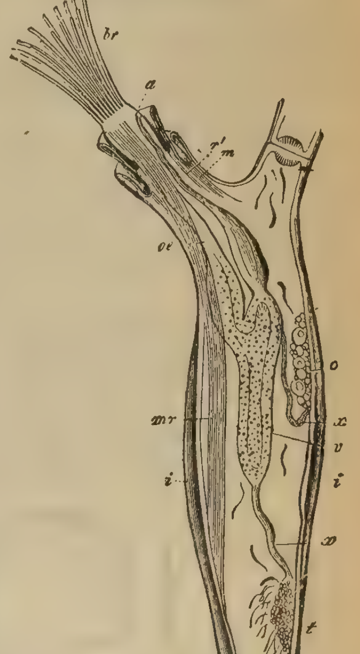
FIG. 5.—Zooid of *Plumatella*, with expanded tentacles.

a,	Anus;
br,	Tentacles, arranged on a horseshoe shaped lophophore;
i,	Ectocyst;
v,	Caecum of stomach.

The Polyzoa are colonial animals, the colony (zoarium) originating in most cases from a free-swimming larva, which attaches itself to some solid object and becomes metamorphosed into the primary individual, or "ancestrula." In the Phylactolaemata, however, a new colony may originate not only from a larva, but also from a peculiar form of bud known as a statoblast, or by the fission of a fully-developed colony. The ancestrula inaugurates a process of budding, continued by its progeny, and thus gives rise to the mature colony. In *Loxosoma* the buds break off as soon as they become mature, and a colonial form is thus hardly assumed. In other Entoprocta the buds retain a high degree of individuality, a thread-like stolon giving off the cylindrical stalks, each of which dilates at its end into the body of a zooid. In some of the Ctenostomata the colony is similarly constituted, a branched stolon giving off the zooids, which are not connected with one another. In the majority of Ectoprocta there is no stolon, the zooids growing out of one another and being usually apposed so as to form continuous sheets or branches. In the encrusting type, which is found in a large proportion of the genera, the zooids are usually in a single layer, with their orifices facing away from the substratum; but in certain species the colony becomes multilaminar by the continued superposition of new zooids over the free surfaces of the older ones, whose orifices they naturally occlude. The zoarium may rise up into erect growths composed of a single layer of zooids, the orifices of which are all on one surface, or of two layers of zooids placed back to back, with the orifices on both sides of the fronds or plates. The rigid Cheilostomes which have this habit were formerly placed in the genus *Eschara*, but the bilaminar type is common to a number of genera, and there can be no doubt that it is not in itself an indication of affinity. The body-wall is extensively calcified in the Cyclostomata and in most Cheilostomata, which may form elegant network-like colonies, as in the unilaminar genus *Retepora*, or may consist of wavy anastomosing plates, as in the bilaminar *Lepralia foliacea* of the British coasts, specimens of which may have a diameter of many inches. In other Cheilostomes the amount of calcification may be much less, the supporting skeleton being largely composed of the organic material chitin. In *Flustra* and other forms belonging to this type, the zoarium is accordingly flexible, and either bilaminar or unilaminar. In many calcareous forms, both Cheilostomes and Cyclostomes, the zoarium is rendered flexible by the interposition of chitinous joints at intervals. This habit is characteristic of the genera *Crisia*, *Cellaria*, *Catenicella* and others, while it occurs in certain species of other genera. The form of the colony may thus be a good generic character, or, on the contrary, a single genus or even species may assume a variety of different forms. While nearly all Polyzoa are permanently fixed to one spot, the colonies of *Cristatella* and *Lophopus* among the Phylactolaemata can crawl slowly from place to place.

Anatomy.—The zooids of which the colonies of Ectoprocta are composed consist of two parts: the body-wall and the visceral mass (figs. 6, 9). These were at one time believed to represent two individuals of different kinds, together constituting a zooid. The visceral mass was accordingly termed the "polypide" and the body-wall which contains it the "zooecium." This view depended principally on the fact that the life of the polypide and of the zooecium are not coextensive. It is one of the most remarkable facts in the natural history of the Polyzoa that a single zooecium may be tenanted by several polypides, which successively degenerate. The periodical histolysis may be partly due to the absence of specific excretory organs and to the accumulation of pigmented excretory substances in the wall of the alimentary canal. On the degeneration of the polypide, its nutritive material is apparently absorbed for the benefit of the zooid, while the pigmented substances assume a spheroidal form, which either remains as an inert "brown body" in the body-cavity or is discharged to the exterior by the alimentary canal of the new polypide. This is formed as a two-layered "polypide-bud," which usually develops from the inner side of the zooecial wall, and soon occupies the place of the previous polypide. The inner layer of the polypide-bud gives rise to the structures usually regarded as ectodermic and endodermic, the outer layer to the mesodermic organs.

The polypide consists of a "lophophore" bearing a series of ciliated tentacles by which Diatoms and other microscopic bodies are collected as food, of a U-shaped alimentary canal, and of a central nervous system. While the mouth is invariably encircled by the bases of the tentacles, the anus lies within the series in the Entoprocta and outside it in the Ectoprocta. The lophophore is a simple circle in all Polyzoa except in the Phylactolaemata, where it typically has the form of a horse shoe outlined by the bases of the tentacles. In *Fredericella* belonging to this order it is, however, circular, but the systematic position of the genus is sufficiently indicated by its possession of an "epistome," a lip-like structure guarding the anal side of the mouth in all Phylactolaemata and absent throughout the Gymnolaemata. The cavities of the hollow tentacles open into a circular canal which surrounds the oesophagus at the base of the lophophore. This is continuous with the general body-cavity in the Phylactolaemata, while in the Gymnolaemata it develops in the bud as a part of the body-cavity, from which it becomes completely separated. In the Entoprocta the tentacles are withdrawn by being infolded into the "vestibule," a depression of the oral surface which can be closed by a sphincter muscle. In the Ectoprocta they are retractile into an introvert, the "tentacle-sheath" (fig. 9), the external opening of which is the "orifice" of the zooecium. In the Cyclostomata, further distinguished by the cylindrical or prismatic form of their highly calcified zooecia, the orifice is typically circular, without any definite closing organ. In the Cheilostomata it is closed by a chitinous (rarely calcareous) "operculum" (fig. 9, C), while in the Ctenostomata it is guarded by a delicate membrane similar to a piece of paper rolled into a longitudinally creased cylinder. During retraction this "collar" lies concealed in the beginning of the introvert. It becomes visible when the polypide begins to protrude its tentacles, making its appearance through the orifice as a delicate hyaline frill through which the tentacles are pushed.

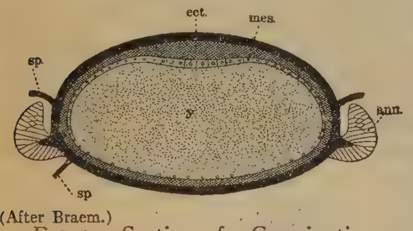


(After Allman.)

FIG. 6.—Zooid of *Paludicella articulata* (= *ehrenbergi*).

a,	Anus.
br,	Expanded tentacles.
i,	Ectocyst.
m, *r'*,	Parietovaginal muscles.
mr,	Retractor muscle.
o,	Ovary.
oe,	Oesophagus.
v,	Caecum of stomach.
t,	testis.
x, *x'*,	Funiculi.

In the Phylactolaemata the outermost layer of the body-wall is a flexible, uncalcified cuticle or "ectocyst," beneath which follow in succession the ectoderm, the muscular layers and the coelomic epithelium. In a few Gymnolaemata the ectocyst is merely chitinous, although in most cases the four vertical walls and the basal wall of the zooecium are calcareous. The free (frontal) wall may remain membranous and uncalcified, as in *Membranipora* (figs. 8 A, 9 A), but in many Cheilostomes the frontal surface is protected by a calcareous shield, which grows from near the free edges of the vertical walls and commonly increases in thickness as the zooecium grows older by the activity of the "epitheca," a layer of living tissue outside it. The body-wall is greatly simplified in the Gymnolaemata, in correlation with the functional importance of the skeletal part of the wall. Even the ectoderm can rarely be recognized as an obvious epithelium except in regions where budding is taking place, while muscular layers are always absent and a coelomic epithelium can seldom be observed. The body-cavity is, however, traversed by muscles, and by strands of mesodermic "funicular tissue," usually irregular, but sometimes constituting definite funiculi (fig. 6, *x*, *x'*). This tissue is continuous from zooecium to zooecium through perforated "rosette-plates" in the dividing walls. In the Phylactolaemata a single definite funiculus passes from the body-wall to the apex of the stomach. This latter organ is pigmented in all Polyzoa, and is produced, in the Ectoprocta, beyond the point where the intestine leaves it into a conspicuous caecum (fig. 6, *v*). The nervous system is represented by a ganglion situated between the mouth and the anus. The ovary (*o*) and the testis (*t*) of Ectoprocta are developed on the body-wall, on the stomach, or on the funiculus. Both kinds of reproductive organs may occur in a single zooecium, and the reproductive elements pass when ripe into the body-cavity. Their mode of escape is unknown in most cases. In some Gymnolaemata, polypides which develop an ovary possess a flask-shaped "intertentacular organ," situated between two of the tentacles, and affording a direct passage into the introvert for the eggs or even the spermatozoa developed in the same zooecium. In other cases the reproductive cells perhaps pass out by the atrophy of the polypide, whereby the body-cavity may become continuous with the exterior. The statoblasts of the Phylactolaemata originate on the funiculus, and are said to be derived partly from an ectodermic core possessed by this organ and partly from its external mesoderm (Braem), the former giving rise to the chitinous envelope and to a nucleated layer (fig. 7, *ect*), which later invaginates to form the inner vesicle of the polypide-bud. The mesodermic portion becomes charged with a yolk-like material (*y*), and, on the germination of the statoblast, gives rise to the outer layer (*mes*) of the bud. The production of a polypide by the statoblast thus differs in no essential respect from the formation of a polypide in an ordinary zooecium. The statoblasts require a period of rest before germination, and Braem has shown that their property of floating at the surface may be beneficial to them by exposing them to the action of frost, which in some cases improves the germinating power. The occurrence of Phylactolaemata in the tropics would show, however, without further evidence, that frost is not a factor essential for germination.



(After Braem.)

FIG. 7.—Section of a Germinating Statoblast of *Cristatella mucedo*.

ann, Chitinous annulus, containing air-cavities which enable the statoblast to float.
ect, Thickened part of the ectoderm, which will give rise to the inner layer of the polypide-bud.
mes, Mesoderm, forming the outer layer of the bud.
sp, Anchoring spines of the statoblast.
y, The yolk-like mesodermic mass.

The withdrawal of the extended polypide is effected by the contraction of the retractor muscles (fig. 6, *mr*), and must result in an increase in the volume of the contents of the body-cavity. The alternate increase and diminution of volume is easily understood in forms with flexible zooecia. Thus in the Phylactolaemata the contraction of the muscular body-wall exerts a pressure on the fluid of the body-cavity and is the cause of the protrusion of the polypide. In the Gymnolaemata protrusion is effected by the contraction of the parietal muscles, which pass freely across the body-cavity from one part of the body-wall to another. In the branching Ctenostomes the entire body-wall is flexible, so that the contraction of a parietal muscle acts equally on the two points with which it is connected. In encrusting Ctenostomes and in the *Membranipora*-like Cheilostomes (figs. 8 A, 9 A) the free surface or frontal wall is the only one in which any considerable amount of movement can take place. The parietal muscles (*p.m.*), which pass from the vertical walls to the frontal wall, thus act by depressing the latter and so exerting a pressure on the fluid of the body-cavity. In Cheilostomata with a rigid frontal wall Jullien showed that protrusion and retraction were rendered possible by the existence of a "compensation-sac," in communication with the external water.

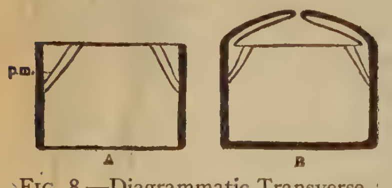


FIG. 8.—Diagrammatic Transverse Sections.

A, of *Membranipora*; B, of an immature zooecium of *Cribrilina*; *p.m.*, Parietal muscles.

In its most fully-developed condition (fig. 9, C) the compensation-sac (*c.s.*) is a large cavity which lies beneath the calcified frontal wall and opens to the exterior at the proximal border of the operculum (fig. 10). It is joined to the rigid body-wall by numerous muscle-fibres, the contraction of which must exert a pressure on the fluid of the body-cavity, thereby protruding the polypide. The exchange of fluid in the sac may well have a respiratory significance, in addition to its object of facilitating the movements of the tentacles.

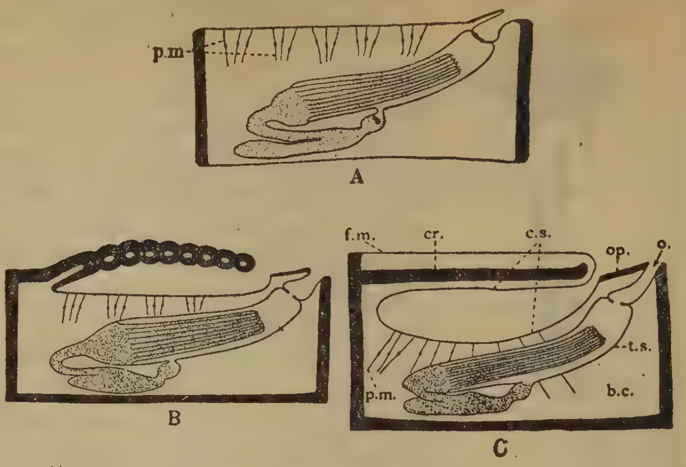


FIG. 9.—Diagrammatic Longitudinal Sections of Cheilostomatous Zooecia.

A, *Membranipora* (after Nitsche); B, *Cribrilina*; C, Some of the Lepralioid forms. *b.c.*, Body-cavity. *cr.*, Cryptocyst. *t.s.*, Compensation-sac. *f.m.*, Frontal membrane. *o.*, Orifice, through which the tentacles are protruded. *op.*, Operculum. *p.m.*, Parietal muscles. *t.s.*, Tentacle-sheath.

The evolution of the arrangements for protruding the polypide seems to have proceeded along several distinct lines: (i.) In certain species of *Membranipora* the "frontal membrane," or membranous free-wall, is protected by a series of calcareous spines, which start from its periphery and arch inwards. In *Cribrilina* similar spines are developed in the young zooecium, but they soon unite with one another laterally, leaving rows of pores along the sutural lines (fig. 10). The operculum retains its continuity with the frontal membrane (fig. 9, B) into which the parietal muscles are still inserted. As indications that the conditions described in *Membranipora* and *Cribrilina* are of special significance may be noted the fact that the ancestrula of many genera which have well-developed compensation-sacs in the rest of their zooecia is a *Membranipora*-like individual with a series of marginal calcareous spines, and the further fact that a considerable proportion of the Cretaceous Cheilostomes belong either to the Membraniporidae or to the Cribrilinidae. (ii.) In *Scrupocellaria*, *Menipea* and *Caberea* a single, greatly dilated marginal spine, the "scutum" or "fornix," may protect the frontal membrane. (iii.) In *Umbonula* the frontal membrane and parietal muscles of the young zooecium are like those of *Membranipora*, but they become covered by the growth, from the proximal and lateral sides, of a calcareous lamina covered externally by a soft membrane. The arrangement is perhaps derivable from a *Cribrilina*-like condition in which the outer layer of the spines has become membranous while the spines themselves are laterally united from the first. (iv.) In the Microporidae and Steganoporellidae the body-cavity becomes partially subdivided by a calcareous lamina ("cryptocyst," Jullien) which grows from the proximal and lateral sides in a plane parallel to the frontal membrane and not far below it. The parietal muscles are usually reduced to a single pair, which may pass through foramina ("opesiules") in the cryptocyst to reach their insertion. There is no compensation-sac in these families. (v.) Many of the Lepralioid forms offer special difficulties, but the calcareous layer of the frontal surface is probably a cryptocyst (as in fig. 9, C), the compensation-sac being developed round its distal border. The "epitheca" noticed above is in this case the persistent frontal membrane. (vi.) In *Microporella* the opening of the compensation-sac has become separated from the operculum by calcareous matter, and is known as the "median pore." Jullien believed that this pore opens into the tentacle-sheath, but it appears probable that it really communicates with the compensation-sac and not with the tentacle-sheath. The mechanism of protrusion in the Cyclostomata is a subject which requires further examination.

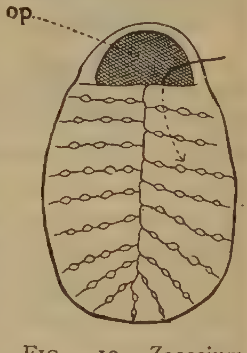
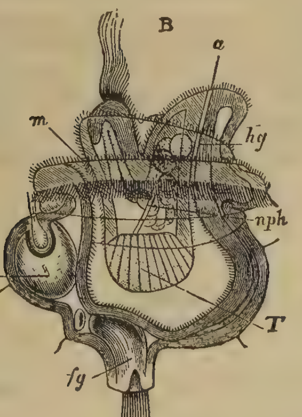


FIG. 10.—Zooecium of *Cribrilina*, showing the entrance to the compensation-sac on the proximal side of the operculum (*op*).

The most singular of the external appendages found in the Polyzoa are the avicularia and vibracula of the Cheilostomata. The avicularium is so called from its resemblance, in its most highly differentiated condition, to the head of a bird. In *Bugula*, for instance, a calcareous avicularium of this type is attached by a narrow neck to each zooecium. The avicularium can move as a whole by means of special muscles, and its chitinous lower jaw or "mandible" can be opened and closed. It is regarded as a modified zooecium, the polypide of which has become vestigial, although it is commonly represented by a sense-organ, bearing tactile hairs, situated on what may be termed the palate. The operculum of the normal zooecium has become the mandible, while the occlusor muscles have become enormous. In the vibraculum the part representing the zooecium is relatively smaller, and the mandible has become the "seta," an elongated chitinous lash which projects far beyond the zooecial portion of the structure. In *Caberea*, the vibracula are known to move synchronously, but co-ordination of this kind is otherwise unknown in the Polyzoa. The avicularia and vibracula give valuable aid to the systematic study of the Cheilostomata. In its least differentiated form the avicularium occupies the place of an ordinary zooecium ("vicarious avicularium"), from which it is distinguished by the greater development of the operculum and its muscles, while the polypide is normally not functional. Avicularia of this type occur in the common *Flustra foliacea*, in various species of *Membranipora*, and in particular in the Onychocellidae, a remarkable family common in the Cretaceous period and still existing. In the majority of Cheilostomes, the avicularia are, so to speak, forced out of the ordinary series of zooecia, with which they are rigidly connected. There are comparatively few cases in which, as in *Bugula*, they are mounted on a movable joint. Although at first sight the arrangement of the avicularia in Cheilostomes appears to follow no general law some method is probably to be made out on closer study. They occur in particular in relation with the orifice of the zooecium, and with that of the compensation-sac. This delicate structure is frequently guarded by an avicularium at its entrance, while avicularia are also commonly found on either side of the operculum or in other positions close to that structure. It can hardly be doubted that the function of these avicularia is the protection of the tentacles and compensation-sac. The suggestion that they are concerned in feeding does not rest on any definite evidence, and is probably erroneous. But avicularia or vibracula may also occur in other places—on the backs of unilaminar erect forms, along the sutural lines of the zooecia and on their frontal surface. These are probably important in checking overgrowth by encrusting organisms, and in particular by preventing larvae from fixing on the zoarium. Vibracula are of less frequent occurrence than avicularia, with which they may coexist as in *Scrupocellaria*, where they occur on the backs of the unilaminar branches. In the so-called Selenariidae, probably an unnatural association of genera which have assumed a free discoidal form of zoarium, they may reach a very high degree of development, but Busk's suggestion that in this group they "may be subservient to locomotion" needs verification.

Development and Affinities.—It is generally admitted that the larva of the Entoprocta (fig. 11) has the structure of a Trochosphere. This appears to indicate that the Polyzoa are remotely allied to other phyla in which this type of larva prevails, and in particular to the Mollusca and Chaetopoda, as well as to the Rotifera, which are regarded as persistent Trochospheres. The praeoral portion (lower in fig. 11) constitutes the greater part of the larva and contains most of the viscera. It is terminated by a well-developed structure (*fg*) corresponding with the apical sense-organ of ordinary Trochospheres, and an excretory organ (*nph*) of the type familiar in these larvae occurs on the ventral side of the stomach. The central nervous system (*x*) is highly developed, and in *Loxosoma* bears a pair of eyes. The larva swims by a ring of cilia, which corresponds with the praeoral circlet of a Trochosphere. The oral surface, on which are situated the mouth (*m*) and anus (*a*), is relatively small. The apical sense-organ is used for temporary attachment to the maternal vestibule in which development takes place, but permanent fixation is effected by the oral surface. This is followed by the atrophy of many of the larval organs, including the brain, the sense-organ and the ciliated ring. The alimentary canal persists and revolves in the median plane through an angle of 180°, accompanied by part of the larval vestibule, the space formed by the retraction of the oral surface. The vestibule breaks through to the exterior, and the tentacles, which have been developed within it, are brought into relation with the external water.



(After Hatschek.)

FIG. 11.—Larva of *Pedicellina*.

a,	Anus.
fg,	Apical sense-organ.
hg,	Intestine.
l,	Ventral wall of stomach.
m,	Mouth.
nph,	Excretory organ.
x,	Brain.

In the common and widely-distributed Cheilostome, *Membranipora pilosa*, the pelagic larva is known as *Cyphonautes*, and it has a structure not unlike that of the larval *Pedicellina*. The principal differences are the complication of the ciliated band, the absence of the excretory organ, the great lateral compression of the body, the possession of a pair of shells protecting the sides, the presence of an organ known as the "pyriform organ," and the occurrence of a sucker in a position corresponding with the depression seen between (*m*) and (*a*) in fig. 11. Fixation takes place by means of this sucker, which is everted for the purpose, part of its epithelium becoming the basal ectoderm of the ancestrula. The pyriform organ has probably assisted the larva to find an appropriate place for fixation (cf. Kupelwieser, 18); but, like the alimentary canal and most of the other larval organs, it undergoes a process of histolysis, and the larva becomes the ancestrula, containing the primary brown body derived from the purely larval organs. The polypide is formed, as in an ordinary zooecium after the loss of its polypide, from a polypide-bud.

The *Cyphonautes* type has been shown by Prouho (24) to occur in two or three widely different species of Cheilostomata and Ctenostomata in which the eggs are laid and develop in the external water. In most Ectoprocta, however, the development takes place internally or in an ovicell, and a considerable quantity of yolk is present. The alimentary canal, which may be represented by a vestigial structure, is accordingly not functional, and the larva does not become pelagic. A pyriform organ is present in most Gymnolaemata as well as the sucker by which fixation is effected. As in the case of *Cyphonautes*, the larval organs degenerate and the larva becomes the ancestrula from which a polypide is developed as a bud. In the Cyclostomata the primary embryo undergoes repeated fission without developing definite organs, and each of the numerous pieces so formed becomes a free larva, which possesses no alimentary canal. Finally, in the Phylactolaemata, the larva becomes an ancestrula before it is hatched, and one or several polypides may be present when fixation is effected.

The development of the Ectoprocta is intelligible on the hypothesis that the Entoprocta form the starting-point of the series. On the view that the Phylactolaemata are nearly related to *Phoronis* (see PHORONIDEA), it is extremely difficult to draw any conclusions with regard to the significance of the facts of development. If the Phylactolaemata were evolved from the type of structure represented by *Phoronis* or the Pterobranchia (*q.v.*), the Gymnolaemata should be a further modification of this type, and the comparative study of the embryology of the two orders would appear to be meaningless. It seems more natural to draw the conclusion that the resemblances of the Phylactolaemata to *Phoronis* are devoid of phylogenetic significance.

BIBLIOGRAPHY.—For general accounts of the structure and development of the Polyzoa the reader's attention is specially directed to 12, 14, 6, 25, 1, 2, 17, 26, 18, 23, 3, in the list given below; for an historical account to 1; for a full bibliography of the group, to 22; for fresh-water forms, to 1–3, 7–10, 17; for an indispensable synonymic list of recent marine forms, to 15; for Entoprocta, to 10, 11, 24; for the classification of Gymnolaemata, to 21, 14, 4, 13, 20; for Palaeontology, to 27, 22.

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(S. F. H.)

POMADE, or POMATUM, a scented ointment, used formerly for softening and beautifying the skin, as a lip-salve, &c., but now principally applied to the hair. It was made originally from the juice of apples (Lat. *pomum*), whence the name.

POMANDER (from Fr. *pomme d'ambre*, *i.e.* apple of amber), a ball made of perfumes, such as ambergris (whence the name), musk, civet, &c., and formerly worn or carried in a case, also known by the same name, as a protection against infection in times of pestilence or merely as a useful article to modify bad smells. The globular cases which contained the "pomanders" were hung from a neck-chain or attached to the girdle, and were usually perforated and made of gold or silver. Sometimes they contained several partitions, in each of which was placed a different perfume. There is an early Spanish pomander set with emeralds, and a fine 16th-century one, dredged from the Thames, in the British Museum.

POMBAL, SEBASTIÃO JOSE DE CARVALHO E MELLO, MARQUESS OF (1699–1782), Portuguese statesman, was born at Soure near Pomba, on the 13th of May 1699. He was the son of Manoel de Carvalho e Athayde, a country gentleman (*fidalgo*) and of his wife D. Theresa Luiza de Mendonça e Mello. He studied law at Coimbra University, served for a short time as a private in the army, and afterwards lived the life of a man about town in Lisbon, sharing in the diversions of the "Mohocks" who then infested the streets. In 1733 he abducted and married D. Theresa de Noronha, a widow belonging to one of the most distinguished families in Portugal. He then retired to Soure, where, on the recommendation of Cardinal de Motta, King John V. commissioned him to write a series of biographical studies. In 1739 he was sent as Portuguese ambassador to London, where he remained until 1745. He was then transferred to Vienna. His first wife having died on the 7th of January 1739, he married, on the 18th of December 1745, Leonora Ernestine Daun, daughter of General Count Daun. In 1749 he was recalled to take up the post of secretary of state for foreign affairs and war. The appointment was ratified on the 3rd of August 1750, by King Joseph, who had succeeded John V. in that year. Carvalho's career from 1750 to 1777 is part of the history of Portugal. Though he came into power only in his 51st year, without previous administrative experience, he was able to reorganize Portuguese education, finance, the army and the navy. He also built up new industries, promoted the development of Brazil and Macao, and expelled the Jesuits. His complete ascendancy over the mind of King Joseph dates from the time of the great Lisbon earthquake (Nov. 1, 1755). Though the famous words "Bury the dead and feed the living" were probably not spoken by him, they summarize his action at this time of calamity. In June 1759 his suppression of the so-called "Tavora plot" gained for him the title of count of Oeyras; and in September 1770 he was made marquess of Pombal. His severe administration had made many enemies, and his life had been attempted in 1769. Soon after the death of King Joseph, in 1777, Pombal was dismissed from office; and he was only saved from impeachment by the death of his bitterest opponent, the queen-mother, Mariana Victoria, in January 1781. On the 16th of August a royal decree forbade him to reside within twenty leagues of the court. He died at Pombal on the 8th of May 1782.

See, in addition to the works dealing with the period 1750–1777 and quoted under PORTUGAL: *History*; S.J.C.M. (Pombal), *Relação abreviada*, &c. (Paris, 1758); *Memoirs of the Court of Portugal*, &c. (London, 1765); *Anecdotes du ministère de Pombal* (Warsaw, 1781); *Administration du marquis de Pombal* (4 vols., Amsterdam, 1787); *Cartas . . . do marques de Pombal* (3 vols., Lisbon, 1820–1824); J. Smith, Count of Carnota, *Memoirs of the Marquess of Pombal*, &c. (London, 1843); F. L. Gomes, *Le Marquis de Pombal*, &c. (Paris, 1869); B. Duhr (S.J.), *Pombal*, &c. (Freiburg im Breisgau, 1891); C. J. de Menezes, *Os Jesuitas e o marques de Pombal* (Oporto, 1893). See also articles in the *Revue des deux mondes* for September 1870; the *Revue bleue* for September 1889, and the *Revue historique* for September 1895 and January 1896.

POMEGRANATE. The pomegranate (*Punica Granatum*) is of exceptional interest by reason of its structure, its history, and its utility. It forms a tree of small stature, or a bush, with opposite or alternate, shining, lance-shaped leaves, from the axils of some of which proceed the brilliant scarlet flowers. These are raised on a short stalk, and consist of a thick fleshy cylindrical or bell-shaped calyx-tube, with five to seven short lobes at the top. From the throat of the calyx proceed five to seven roundish, crumpled, scarlet or crimson petals, and below them very numerous slender stamens. The pistil consists of two rows of carpels placed one above another, both rows embedded in, and partially inseparate from, the inner surface of the calyx-tube. The styles are confluent into one slender column. The fruit, which usually attains the size of a large orange, consists of a hard leathery rind, enclosing a quantity of pulp derived from the coats of the numerous seeds. This pulp, filled as it is with refreshing acid juice, constitutes the chief value of the tree. The more highly cultivated forms contain more of it than the wild or half-wild varieties. The great structural peculiarity consists in the presence of the two rows of carpels one above another (a state of things which occurs exceptionally in apples and oranges), and in the fact that, while in the lower series the seeds are attached to the inner border or lower angle of the cavity, they occupy the outer side in the upper series, as if during growth the upper whorl had become completely bent over.

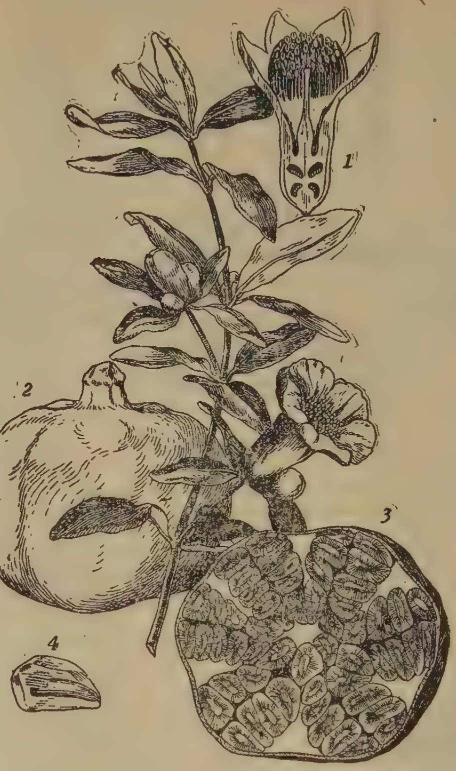
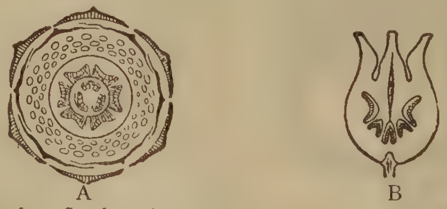


FIG. 1.—Pomegranate, *Punica Granatum*, flowering branch, half natural size.

1, Flower cut lengthwise; the petals have been removed.
2, Fruit, about one-third natural size.
3, Same cut across, showing seeds.
4, Seed, natural size.



(After Eichler, from Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.)

FIG. 2.—*Punica Granatum*.

A, Floral diagram. B, Longitudinal section of the ovary.

By Bentham and Hooker the *Punica* is included as an anomalous genus in the order Lythraceae; others consider it more nearly allied to the myrtles; while its peculiarities are so great as, in the opinion of many botanists, to justify its inclusion in a separate order, Punicaceae. Not only is the fruit valuable in hot countries for the sake of its pulp, but the rind and the bark and the outer part of the root (containing the alkaloid *pelletierine*) are valuable as astringents. The bark of the root is likewise valued as an anthelmintic in cases of tape-worm.

The tree is wild in Afghanistan, north-western India, and the districts south and south-west of the Caspian, but it has been so long cultivated that it is difficult to say whether it is really native in Palestine and the Mediterranean region. It has been cited as wild in northern Africa, but this appears to be a mistake. Professor Bayley Balfour met with a wild species, heretofore unknown, in the island of Socotra, the flowers of which have only a single row of carpels, which suggests the inference that it may have been the source of the cultivated varieties. But, on the other hand, in Afghanistan, where Aitchison met with the tree truly wild, a double row of carpels was present as usual. The antiquity of the tree as a cultivated plant is evidenced by the Sanskrit name *Dāḍimba*, and by the references to the fruit in the Old Testament, and in the *Odyssey*, where it is spoken of as cultivated in the gardens of the kings of Phaeacia and Phrygia. The fruit is frequently represented on ancient Assyrian and Egyptian sculptures, and had a religious significance in connexion with several Oriental cults, especially the Phrygian cult of Cybele (Arnob. v. 5 seq.; see also Baudissin, *Studien*, ii. 207 seq.). It was well known to the Greeks and Romans, who were acquainted with its medicinal properties and its use as a tanning material. The name given by the Romans, *malum punicum*, indicates that they received it from Carthage, as indeed is expressly stated by Pliny; and this circumstance has given rise to the notion that the tree was indigenous in northern Africa. On a review of the whole evidence, botanical, literary and linguistic, Alphonse de Candolle (*Origin of Cultivated Plants*) pronounces against its African origin, and decides in favour of its source in Persia and the neighbouring countries. According to Saporta, the pomegranate existed in a fossil state in beds of the Pliocene epoch near Meximieux in Burgundy. The pomegranate is sometimes met with in cultivation against a wall in England, but it is too tender to withstand a severe winter. The double-flowered varieties are specially desirable for the beauty and long duration of their flowers.

POMERANIA (German, *Pommern*), a territory of Germany and a maritime province of Prussia, bounded on the N. by the Baltic, on the W. by Mecklenburg, on the S. by Brandenburg, and on the E. by West Prussia. Its area is 11,630 sq. m., and the population in 1905 was 1,684,125, showing a density of 145 inhabitants to the square mile. The province is officially divided into the three districts of Stralsund, Stettin and Köslin, but more historical interest attaches to the names of Vorpommern and Hinterpommern, or Hither and Farther Pomerania, the former being applied to the territory to the west, and the latter to that to the east of the Oder. Pomerania is one of the flattest parts of Germany, although east of the Oder it is traversed by a range of low hills, and there are also a few isolated eminences to the west. Off the west coast, which is very irregular, lie the islands of Rügen, Usedom and Wollin; the coast of Farther Pomerania is smooth in outline and is bordered with dunes, or sandbanks. Besides the Oder and its affluents, the chief of which are the Peene, the Ücker and the Ihna, there are several smaller rivers flowing into the Baltic; a few of these are navigable for ships, but the greater number only carry rafts. Many of them end in small lakes, which are separated from the sea by narrow strips of land, through which the water escapes by one or more outlets. The interior of the province is also thickly sprinkled with lakes, the combined area of which is equal to about one-twentieth of the entire surface.

The soil of Pomerania is for the most part thin and sandy, but patches of good land are found here and there. About 55% of the whole is under tillage, while 16% consists of meadow and pasture and 21% is covered by forests. The principal crops are potatoes, rye and oats, but wheat and barley are grown in the more fertile districts; tobacco, flax, hops and beetroot are also cultivated. Agriculture is still carried on in a somewhat primitive fashion, and as a rule the livestock is of an inferior quality, though the breed of horses, of a heavy build and mostly used in agriculture, is held in high esteem. Large flocks of sheep are kept, both for their flesh and their wool, and there are in the province large numbers of horned cattle and of pigs. Geese and goose feathers form lucrative articles of export. Owing to the long line of coast and the numerous lakes, fishing forms an important industry, and large quantities of herrings, eels and lampreys are sent from Pomerania to other parts of Germany. With the exception of the almost inexhaustible layers of peat, the mineral wealth of the province is insignificant. Its industrial activity is not great, but there are manufactures of machinery, chemicals, paper, tobacco and sugar; these are made chiefly in or near the large towns, while linen-weaving is practised as a domestic industry. Ship-building is carried on at Stettin and at several places along the coast. The commerce of Pomerania is in a flourishing condition, its principal ports being Stettin, Stralsund and Swinemünde. Education is provided for by a university at Greifswald and by numerous schools. The province sends 14 members to the German Reichstag, and 26 to the Prussian house of representatives. The heir to the Prussian crown bears the title of governor of Pomerania.

History.—In prehistoric times the southern coast of the Baltic seems to have been occupied by Celts, who afterwards made way for tribes of Teutonic stock. These in their turn migrated to other settlements and were replaced, about the end of the 5th century of our era, by Slavonic tribes, the Wilzi and the Pomerani. The name of Pomore, or Pommern, meaning "on the sea," was given to the district by the latter of the tribes about the time of Charlemagne, and it has often changed its political and geographical significance. Originally it seems to have denoted the coast district between the Oder and the Vistula, a territory which was at first more or less dependent on Poland, but which, towards the end of the 12th century, was ruled by two native princes, who took the title of duke about 1170 and admitted the authority of the German king in 1181. Afterwards Pomerania extended much farther to the west, while being correspondingly curtailed on the east, and a distinction was made between Slavinia, or modern Pomerania, and Pomerellen. The latter, corresponding substantially to the present province of West Prussia, remained subject to Poland until 1309, when it was divided between Brandenburg and the Teutonic Order. Christianity was introduced in the 12th century, a bishopric being founded in the Island of Wollin, and its advance went rapidly hand in hand with the Germanizing of the district.

The history of Pomerania, as distinct from that of Pomerellen, consists mainly of an almost endless succession of divisions of territory among the different lines of the ducal house, and of numerous expansions and contractions of territory through constant hostilities with the elector of Brandenburg, who claimed to be the immediate feudal superior of Pomerania, and with other neighbouring rulers. The names of Vorpommern and Hinterpommern were at first synonymous with Pomerania proper, or Slavinia and Pomerellen, but towards the close of the 14th century they were transferred to the two duchies into which the former was divided. In 1625 the whole of Pomerania became united under the sway of Duke Bogislaus XIV., and on his death without issue, in 1637, Brandenburg claimed the duchy by virtue of a compact made in 1571. In the meantime, however, Pomerania had been devastated by the Thirty Years' War and occupied by the Swedes, who had taken possession of its towns and fortresses. At the peace of Westphalia they claimed the duchy, in opposition to the elector of Brandenburg, and the result was that the latter was obliged to content himself with eastern Pomerania (Hinterpommern), and to see the western part (Vorpommern) awarded to Sweden. In 1720, by the peace of Stockholm, Swedish Pomerania was curtailed by extensive concessions to Prussia, but the district to the west of the Peene remained in the possession of Sweden until the general European settlement of 1815. Then Sweden assigned her German possessions to Denmark in exchange for Norway, whereupon Prussia, partly by purchase and partly by the cession of the duchy of Lauenburg, finally succeeded in uniting the whole of Pomerania under her rule.

For the history, see J. Bugenhagen, *Pomerania*, edited by O. Heinemann (Stettin, 1900); von Bohlen, *Die Erwerbung Pommerns durch die Hohenzollern* (Berlin, 1865); H. Berghaus, *Landbuch des Herzogtums Pommern* (Berlin, 1865–1876); the *Codex Pomeraniae diplomaticus*, edited by K. F. W. Hasselbach and J. G. L. Kosegarten (Greifswald, 1862); the *Pommersches Urkundenbuch*, edited by R. Klempin and others (Stettin, 1868–1896); W. von Sommerfeld, *Geschichte der Germanisierung des Herzogtums Pommern* (Leipzig, 1896); F. W. Barthold, *Geschichte von Rügen und Pommern* (Hamburg, 1839–1845); K. Mass, *Pommersche Geschichte* (Stettin, 1899); M. Wehrmann, *Geschichte von Pommern* (Gotha, 1904–1906); and Uecker, *Pommern in Wort und Bild* (Stettin, 1904). See also the publications of the *Gesellschaft für pommersche Geschichte und Altertumskunde.*

POMEROY, a village and the county-seat of Meigs county, Ohio, U.S.A., on the Ohio river, about 85 m. S.S.E. of Columbus. Pop. (1890) 4726; (1900) 4639, including 453 foreign-born and 280 negroes; (1910) 4023. Pomeroy is served by the Hocking Valley and (across the river) Baltimore & Ohio railways, by inter-urban electric railway, and by passenger and freight boats to the leading river ports. It occupies a strip of ground between the river and a range of steep hills. Bituminous coal and salt abound in the district, and there are deposits of building stone, fireclay and glass sand. The first settlement here was established in 1816, coal mining was begun three years later, and in 1827 a town was laid out and named Nyesville. There was little progress, however, until 1833, when Samuel W. Pomeroy (in whose honour the present name was adopted) formed a company, which began mining coal on a large scale. Pomeroy was incorporated as a village and was made the county-seat in 1841. In 1850 the first of several salt wells, from 1000 to 1200 ft. in depth, was operated.

POMFRET, JOHN (1667–1702), English poet, son of Thomas Pomfret, vicar of Luton, was born in 1667. He was educated at Bedford grammar school and at Queens' College, Cambridge. He became rector of Maulden, Bedfordshire, in 1695, and of Millbrook in the same county in 1702. Dr Johnson says that the bishop of London refused to sanction preferment for him because in his *Choice* he declared that he would have no wife, although he expressed a wish for the occasional company of a modest and sprightly young lady. The poet was married in real life all the same, and—while waiting to clear up the misunderstanding with the bishop—he died in November 1702. *The Choice or Wish: A Poem written by a Person of Quality* (1700) expresses the epicurean desires of a cultivated man of Pomfret's time. It is smoothly written in the heroic couplet, and was widely popular. His *Miscellany Poems* were published in 1702.

POMMEL (through O. Fr. *pomel*, from a diminutive *pomellus* of Lat. *pomum*, fruit, apple), any rounded object resembling an apple, *e.g.* the rounded termination of a saddle-bow; in architecture, any round knob, as a boss, finial, &c.; more particularly the rounded end to the hilt of a sword, dagger or other hand weapon, used to prevent the hand from slipping, and as a balance to the blade. "Pommel" is also a term used of a piece of grooved wood used in graining leather. This word may be the same in origin, or more probably from Fr. *paumelle*, from *paume*, the hand, palm.

POMMER, or BOMBARD (Fr. *hautbois*; Ital. *bombardo, bombardone*), the alto, tenor and basses of the shawm or *Schalmey* family, and the forerunners respectively of the cor-anglais, bassoon or fagotto, and double bassoon or contrafagotto. The main difference to the casual observer between the medieval instruments and those of our orchestra which were evolved from them would be one of size. In the Pommers no attempt had been made to bend the tube, and its length, equal to that of an open organ pipe of the same pitch, was outstretched in all its unwieldiness in an oblique position in front of the performer. The great contrabass Pommer was 9 ft. long without the crook and reed, which, however, were bent downwards. It had five open fingerholes and five keys working inside a perforated case; in order to bring the holes within reach of the finger, they were cut obliquely through the tube. The compass extended from F below 8 ft. C to E or F in the bass stave, two octaves in all. The other members of the family were the bass Pommer, from 8 ft. C to middle C, corresponding to the modern bassoon or fagotto; the tenor or basset Pommer, a fifth higher in pitch; the alto pommer or *nicolo*, a fourth or a fifth above the tenor; and the high alto, or Klein Alt Pommer, an octave higher than the tenor, corresponding approximately to the cor-anglais.

For the history of the Pommer family see OBOE and BASSOON. (K. S.)

POMONA, an old Italian goddess of fruit and gardens. Ovid (*Met.* xiv. 623) tells the story of her courtship by the silvan deities and how Vertumnus, god of the turning year, wooed and won her. Corresponding to Pomona there seems to have been a male Italian deity, called Pomunus, who was perhaps identical with Vertumnus. Although chiefly worshipped in the country, Pomona had a special priest at Rome, the flamen Pomonalis, and a sacred grove near Ostia, called the Pomonal. She was represented as a beautiful maiden, with fruits in her bosom and a pruning-knife in her hand.

POMONA, a city of Los Angeles county, in southern California, U.S.A., about 33 m. E. of the city of Los Angeles. Pop. (1890) 3634; (1900) 5526 (567 foreign-born); (1910) 10,207. It is served by the Southern Pacific, the San Pedro, Los Angeles & Salt Lake, and the Atchison, Topeka & Santa Fe railways, and by an inter-urban electric line. The city is about 850 ft. above sea-level, and has a Carnegie library and several parks, including Ganesha park (45 acres), which commands a fine view. At Claremont, about 3 m. north, is Pomona College (1888, co-educational), which in 1908 had 34 instructors and 488 students. Pomona is in the midst of a prosperous fruit region, devoted especially to the growing of oranges. Orchards of oranges, lemons, apricots, peaches and prunes surround the city for miles, and some olives are grown; alfalfa and sugar-beets are raised in large quantities in the immediate neighbourhood. Pomona was settled by a colony of fruit-growers in 1875, and was chartered as a city in 1888.

POMONA, or MAINLAND, the central and largest island of the Orkneys, Scotland. Pop. (1901), 16,235. It is 25 m. long from N.W. to S.E. and 15 m. broad from E. to W.; area, 190 sq. m.; but where the coast is cut into, on the N. by Kirkwall Bay and on the S. by Scapa Flow, the land is less than 2 m. across. Consequently, the portion of the island to the west of the waist of Pomona is sometimes described as the West Island, and the portion to the East as the East Island. The west coast is almost unbroken, the bays of Birsay and Skaill being the only bays of any importance. The east and south shores, on the other hand, are extensively carved out. Thus on the east side are found Eynhallow Sound, Wood Wick, the bays of Isbister, Firth, Kirkwall, and Inganess and Dee Sound, and on the south Holm Sound, Scapa Bay, Swanbister Bay and Bay of Ireland. The highest points of the watershed from Costa Head to the Scapa shore are Milldoe (734 ft.) to the north-east of Isbister and Wideford Hill (740 ft.) to the west of Kirkwall. There are also a few eminences towards the south-west, Ward Hill (880 ft.) in the parish of Orphir being the highest peak in the island. There are numerous lakes, some of considerable size and most of them abounding with trout. Loch Harray is 4½ m. long by from ⅛ m. to about 2 m. wide, and Loch Stenness 3¼ m. long by from ⅛ to 2¼ m. wide. Lochs Swannay, Boardhouse and Hundland are situated in the extreme north, while Loch Kirbister lies near the south coast and Loch Tankerness adjoins Deer Sound. Off the east coast lie the islands of Rousay, Egilshay, Viera, Eynhallow, Gairsay and Shapinshay, and off the south Copinshay and Lamb Holm. The hilly country is mostly moorland, and peat-mosses are met with in some of the low-lying land, but many of the valleys contain fertile soil, and there are productive tracts on the eastern and northern seaboard. Kirkwall, the capital of the Orkneys, and Stromness are the only towns.

In Harray, the only parish in the Orkneys not trenched at some point by the sea, Norse customs have survived longer than elsewhere in the group save in North Ronaldshay. In Deerness the most easterly parish in Pomona, were buried 200 Covenanters, taken prisoners at the battle of Bothwell Brig. They were carried to Barbados, to be sold as slaves for the plantations, when the ship foundered in Deer Sound, and all were drowned. In Sandside Bay, in the same parish, the fleet of Malcolm Canmore was defeated by that of Jarl Thorfinn; and at Summersdale, towards the northern base of the hills of Orphir, Sir James Sinclair, governor of Kirkwall, vanquished Lord Sinclair and 500 Caithness men in 1529.

The antiquities of Pomona are of great interest. The examples of Pictish remains include *brochs* or round towers, chambered mounds, or buildings of stone covered in with earth, and weems, or underground dwellings afterwards roofed in. At Saverock, on the west wing of Kirkwall Bay, a good specimen of an earth-house will be found, and at Quanterness, 1 m. to the west of it, a chambered mound, containing seven rooms with beehive roofs. Farther west and 5 m. by road north-east of Stromness, and within a mile of the stone circles of Stenness, stands the great barrow or chambered mound of Maeshowe. The tumulus has the form of a blunted cone, is 36 ft. high, 300 ft. in circumference and 92 ft. in diameter, and at a distance of 90 ft. from its base is encircled by a moat 40 ft. wide and from 4 ft. to 8 ft. deep. The ground-plan shows that it was entered from the west by a passage, 54 ft. long, from 2 ft. to 3 ft. wide and from 2½ ft. to 4⅔ ft. high, which led to a central apartment about 15 ft. square, the walls of which ended in a beehive roof, the spring of which began at a height of 13 ft. from the floor. This room and the passage are built of undressed blocks and slabs of sandstone. About the middle of each side of the chamber, at a height of 3 ft. from the floor, there is an entrance to a small cell, 3 ft. high, 4½ ft. wide and from 5½ ft. to 7 ft. long. Mr James Farrer explored the mound in 1861, and discovered on the walls and certain stones rude drawings of crosses, a winged dragon, and a serpent curled round a pole, besides a variety of Runic inscriptions. One of these inscriptions stated that the tumulus had been rifled by Norse pilgrims (possibly crusaders) on their way to Jerusalem under Jarl Rognvald in the 12th century. There can be little doubt but that it was a sepulchral chamber. Joseph Anderson ascribes it to the Stone Age (that is, to the Picts), and James Fergusson to Norsemen of the 10th century.

The most interesting of all those links with a remote past are the stone circles forming the Ring of Brogar and the Ring of Stenness, often inaccurately described as the Stones of Stenness. The Ring of Brogar is situated to the north-west and the Ring of Stenness to the south-east of the Bridge of Brogar, as the narrow causeway of stone slabs is called which separates Loch Harray from Loch Stenness. The district lies some 4½ m. north-east of Stromness. The Ring of Brogar, once known as the Temple of the Sun, stands on a raised circular platform of turf, 340 ft. in diameter, surrounded by a moat about 6 ft. deep, which in turn is invested by a grassy rampart. The ring originally comprised 60 stones, set up at intervals of 17 ft. Only 13 are now erect. Ten, still entire, lie prostrate, while the stumps of 13 others can yet be recognized. The height of the stones varies from 9 ft. to 14 ft. The Ring of Stenness—the Temple of the Moon of local tradition—is of similar construction to the larger circle, except that its round platform is only 104 ft. in diameter. The stones are believed to have numbered 12, varying in height from 15 ft. to 17 ft. but only two remain upright. In the middle of the ring may be seen the relic of what was probably the sacrificial altar. The Stone of Odin, the great monolith, pierced by a hole at a height of 5 ft. from the ground, which figures so prominently in Scott's *Pirate*, stood 150 yds. to the north of the Ring of Stenness. The stones of both rings are of the native Old Red Sandstone.

POMPADOUR, JEANNE ANTOINETTE POISSON LE NORMANT D'ÉTIOLES, MARQUISE DE (1721–1764), mistress of Louis XV., was born in Paris on the 29th of December 1721, and baptized as the legitimate daughter of François Poisson, an officer in the household of the duke of Orleans, and his wife, Madeleine de la Motte, in the church of St Eustache; but she was suspected, as well as her brother, afterwards marquis of Marigny, to be the child of a very wealthy financier and farmer-general of the revenues, Le Normant de Tournehem. He at any rate took upon himself the charge of her education; and, as from the beauty and wit she showed from childhood she seemed to be born for some uncommon destiny, he declared her "un morceau de roi," and specially educated her to be a king's mistress. This idea was confirmed in her childish mind by the prophecy of an old woman, whom in after days she pensioned for the correctness of her prediction. In 1741 she was married to a nephew of her protector and guardian, Le Normant d'Étioles, who was passionately in love with her, and she soon became a queen of fashion. Yet the world of the financiers at Paris was far apart from the court world, where she wished to reign; she could get no introduction at court, and could only try to catch the king's eye when he went out hunting. But Louis XV. was then under the influence of Mme de Mailly, who carefully prevented any further intimacy with "la petite Étioles," and it was not until after her death that the king met the fair queen of the financial world of Paris at a ball given by the city to the dauphin in 1744, and he was immediately subjugated. She at once gave up her husband, and in 1745 was established at Versailles as "maîtresse en titre." Louis XV. bought her the estate of Pompadour, from which she took her title of marquise (raised in 1752 to that of duchess). She was hardly established firmly in power before she showed that ambition rather than love had guided her, and began to mix in politics. Knowing that the French people of that time were ruled by the literary kings of the time, she paid court to them, and tried to play the part of a Maecenas. Voltaire was her poet in chief, and the founder of the physiocrats, Quesnay, was her physician. In the arts she was even more successful; she was herself no mean etcher and engraver, and she encouraged and protected Vanloo, Boucher, Vien, Greuze, and the engraver Jacques Guay. Yet this policy did not prevent her from being lampooned, and the famous poissardes against her contributed to the ruin of many wits suspected of being among the authors, and notably of the Comte de Maurepas. The command of the political situation passed entirely into her hands; she it was who brought Belle-Isle into office with his vigorous policy; she corresponded regularly with the generals of the armies in the field, as her letters to the Comte de Clermont prove; and she introduced the Abbé de Bernis into the ministry in order to effect a very great alteration of French politics in 1756. The continuous policy of France since the days of Richelieu had been to weaken the house of Austria by alliances in Germany; but Mme de Pompadour changed this hereditary policy because Frederick the Great wrote scandalous verses on her; and because Maria Theresa wrote her a friendly letter she entered into an alliance with Austria. This alliance brought on the Seven Years' War, with all its disasters, the battle of Rosbach and the loss of Canada; but Mme de Pompadour persisted in her policy, and, when Bernis failed her, brought Choiseul into office and supported him in all his great plans, the Pacte de Famille, the suppression of the Jesuits, and the peace of Versailles. But it was to internal politics that this remarkable woman paid most attention; no one obtained office except through her; in imitation of Mme de Maintenon, she prepared all business for the king's eye with the ministers, and contrived that they should meet in her room; and she daily examined the letters sent through the post office with Janelle, the director of the post office. By this continuous labour she made herself indispensable to Louis. Yet, when after a year or two she had lost the heart of her lover, she had a difficult task before her; to maintain her influence she had not only to save the king as much trouble as possible, but to find him fresh pleasures. When he first began to weary of her she remembered her talent for acting and her private theatricals at Étioles, and established the "théâtre des petits cabinets," in which she acted with the greatest lords about the court for the king's pleasure in tragedies and comedies, operas and ballets. By this means and the "concerts spirituels" she kept in favour for a time; but at last she found a surer way, by encouraging the king in his debaucheries, and Louis wept over her kindness to his various mistresses. Only once, when the king was wounded by Damiens in 1757, did she receive a serious shock, and momentarily left the court; but on his recovery she returned more powerful than ever. She even ingratiated herself with the queen, after the example of Mme de Maintenon, and was made a lady-in-waiting; but the end was soon to come. "Ma vie est un combat," she said, and so it was, with business and pleasure she gradually grew weaker and weaker, and when told that death was at hand she dressed herself in full court costume, and met it bravely on the 15th of April 1764, at the age of forty-two.

See Capefigue, *Madame la marquise de Pompadour* (1858); E. and J. de Goncourt, *Les Maîtresses de Louis XV.*, vol. ii. (1860); and Campardon, *Madame de Pompadour et la cour de Louis XV. au milieu du dix-huitième siècle* (1867). Far more valuable are Malassis's two volumes of correspondence, *Correspondance de Madame de Pompadour avec son père M. Poisson, et son frère M. de Vandières*, &c. (1878), and Bonhomme, *Madame de Pompadour, général d'armée* (1880), containing her letters to the Comte de Clermont. For her artistic and theatrical tastes see particularly J. F. Leturcq, *Notice sur Jacques Guay, graveur sur pierres fines du roi Louis XV.: Documents inédits emanant de Guay et notes sur les œuvres de gravure en taille douce et en pierres durs de la marquise de Pompadour* (1873); and Adolphe Jullien, *Histoire du théâtre de Madame de Pompadour, dit Théâtre des Petits Cabinets* (1874). See also P. de Nolhac, *La Marquise de Pompadour* (1903).

POMPEII,[1] an ancient town of Campania, Italy, situated near the river Sarnus, nearly 2 m. from the shore of the Bay of Naples, almost at the foot of Mt Vesuvius. Of its history before 79 B.C. comparatively little is recorded; but it appears that it had a population of a very mixed character, and passed successively into the hands of several different peoples, each of which contributed an element to its composition. Its foundation was ascribed by Greek tradition to Heracles, in common with the neighbouring city of Herculaneum, but it is certain that it was not a Greek colony, in the proper sense of the term, as we know to have been the case with the more important cities of Cumae and Neapolis. Strabo (v. 4, 8), in whose time it was a populous and flourishing place, tells us that it was first occupied by the Oscans[2] (to whom we must attribute the Doric temple in the Foro Triangolare), afterwards by the Tyrrhenians (*i.e.* Etruscans) and Pelasgians, and lastly, by the Samnites. The conquest of Campania by the last-mentioned people is an undoubted historical fact, and there can be no doubt that Pompeii shared the fate of the neighbouring cities on this occasion, and afterwards passed in common with them under the yoke of Rome. But its name is only once mentioned during the wars of the Romans with the Samnites and Campanians in this region of Italy, and then only incidentally (Liv. ix. 38), when a Roman fleet landed near Pompeii in 309 B.C. and made an unsuccessful marauding expedition up the river valley as far as Nuceria.[3] At a later period, however, it took a prominent part in the outbreak of the nations of central Italy, known as the Social War (91–89 B.C.), when it withstood a long siege by Sulla, and was one of the last cities of Campania that were reduced by the Roman arms. The inhabitants were admitted to the Roman franchise, but a military colony was settled in their territory in 80 B.C. by Sulla (*Colonia Cornelia Veneria Pompeianorum*), and the whole population was rapidly Romanized. The municipal administration here, as elsewhere, was in the hands of two *duoviri iure dicundo* and two aediles, the supreme body being the city council (*decuriones*). Before the close of the republic it became a resort of the Roman nobles, many of whom acquired villas in the neighbourhood. Among them was Cicero, whose letters abound with allusions to his Pompeian villa. The same fashion continued under the empire, and there can be no doubt that, during the first century of the Christian era, Pompeii had become a flourishing place with a considerable population. Two events only are recorded of its history during this period. In A.D. 59 a tumult took place in the amphitheatre between the citizens and visitors from the neighbouring colony of Nuceria. Many were killed and wounded on both sides. The Pompeians were punished for this violent outbreak by the prohibition of all theatrical exhibitions for ten years (Tacitus, *Ann.* xiv. 17). A characteristic, though rude, painting, found on the walls of one of the houses gives a representation of this event.

Four years afterwards (A.D. 63) an earthquake, which affected all the neighbouring towns, vented its force especially upon Pompeii, a large part of which, including most of the public buildings, was either destroyed or so seriously damaged as to require to be rebuilt (Tac. *Ann.* xv. 22; Seneca, *Q.N.* vi. 1). From the existing remains it is clear that the inhabitants were still actively engaged in repairing and restoring the ruined edifices when the whole city was overwhelmed by the great eruption of A.D. 79. Vesuvius (*q.v.*), the volcanic forces of which had been slumbering for unknown ages, suddenly burst into violent eruption, which, while it carried devastation all around the beautiful gulf, buried the two cities of Herculaneum and Pompeii under dense beds of cinders and ashes. It is singular that, while we possess a detailed description of this famous eruption in two letters of the younger Pliny (*Epist.* vi. 16, 20), he does not even notice the destruction of Pompeii or Herculaneum, though his uncle perished in the immediate neighbourhood of the former city. But their fate is noticed by Dio Cassius, and its circumstances may be gathered with certainty from the condition in which the city has been found. These were such as to conduce to its preservation and interest as a relic of antiquity. Pompeii was merely covered with a bed of lighter substances, cinders, small stones and ashes, which fell in a dry state, while at Herculaneum the same substances, being drenched with water, hardened into a sort of tufa, which in places is 65 ft. deep. The whole of this superincumbent mass, attaining to an average thickness of from 18 to 20 ft., was the product of one eruption, though the materials may be divided generally into two distinct strata, the one consisting principally of cinders and small volcanic stones (called in Italian *lapilli*), and the other and uppermost layer of fine white ash, often consolidated by the action of water from above so as to take the moulds of objects contained in it (such as dead bodies, woodwork, &c.), like clay or plaster of Paris. It was found impossible to rebuild the town, and its territory was joined to that of Nola. But the survivors returned to the spot, and by digging down and tunnelling were able to remove all the objects of value, even the marble facing slabs of the large buildings.

In the middle ages, however, the very site was forgotten. Two inscriptions were found in making an underground aqueduct across the site in 1594–1600, but it was not until 1748 that a more careful inspection of this channel revealed the fact that beneath the vineyards and mulberry grounds which covered the site there lay entombed ruins far more accessible, if not more interesting, than those of Herculaneum. It was not till 1763 that systematic excavations were begun; and, though they were carried on during the rest of the 18th century, it was only in the beginning of the 19th that they assumed a regular character; the work, which had received a vigorous stimulus during the period of the French government (1806–1814), was prosecuted, though in a less methodical manner, under the rule of the Bourbon kings (1815–1861). Since 1861 it has been carried on under the Italian government in a more scientific manner, on a system devised by G. Fiorelli (d. 1896), according to which the town is for convenience divided into nine regions—though this rests on a misconception, for there is really no street between the Capua and the Nocera gates—and the results have been of the highest interest, though the rate of progress has been very slow.

The town was situated on rising ground less than a mile from the foot of Vesuvius. This eminence is itself due to an outflow of lava from that mountain, during some previous eruption in prehistoric times, for we know from Strabo that Vesuvius had been quiescent ever since the first records of the Greek settlements in this part of Italy. Pompeii in ancient times was a prosperous seaport town situated close to the seashore, from which it is now nearly 2 m. distant, and adjoining the mouth of the river Sarnus or Sarno, which now enters the sea nearly 2 m. from its site. The present course of this stream is due in part to modern alteration of its channel, as well as to the effects of the great eruption. The prosperity of Pompeii was due partly to its commerce, as the port of the neighbouring towns, partly to the fertility of its territory, which produced strong wine, olive oil (a comparatively small quantity), and vegetables; fish sauces were made here. Millstones and pumice were also exported, but for the former the more gritty lava of Rocca Monfina was later on preferred.

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[1] The etymology of the name is uncertain; the ancients derived it from *pompa* or πέμπω (Gr. send), in allusion to the journey of Heracles with the oxen of Geryon, but modern authorities refer it to the Oscan *pompa* (five).

[2] For the Oscan incriptions found in Pompeii see below *ad fin.*

[3] Pompeii was attacked as a member of the Nucerine League. See Conway, *Italic Dialects*, p. 51; J. Beloch, *Campanien*, 2nd ed., p. 239.

The area occupied by the ancient city was of an irregular oval form, and about 2 m. in circumference. It was surrounded by a wall, which is still preserved for more than two-thirds of its extent, but no traces of this are found on the side towards the sea, and there is no doubt that on this side it had been already demolished in ancient times, so as to give room for the free extension of houses and other buildings in that direction.[1] These walls are strengthened at intervals by numerous towers, occupying the full width of the wall, which occur in some parts at a distance of only about 100 yds., but in general much less frequently. They are, however, of a different style of construction from the walls, and appear to have been added at a later period, probably that of the Social War. Similar evidences of the addition of subsequent defences are to be traced also in the case of the gates, of which no less than eight are found in the existing circuit of the walls. Some of these present a very elaborate system of defence, but it is evident from the decayed condition of others, as well as of parts of the walls and towers, that they had ceased to be maintained for the purposes of fortification long before the destruction of the city. The names by which the gates and streets are known are entirely of modern origin.

The general plan of the town is very regular, the streets being generally straight, and crossing one another at right angles or nearly so. But exceptions are found on the west in the street leading from the Porta Ercolanese (gate of Herculaneum) to the forum, which, though it must have been one of the principal thoroughfares in the city, was crooked and irregular, as well as very narrow, in some parts not exceeding 12 to 14 ft. in width, including the raised footpaths on each side, which occupy a considerable part of the space, so that the carriage-way could only have admitted of the passage of one vehicle at a time. The explanation is that it follows the line of the demolished city wall. Another exception is to be found in the Strada Stabiana (Stabian Street) or Cardo, which, owing to the existence of a natural depression which affects also the line of the street just east of it, is not parallel to the other north and south streets. The other main streets are in some cases broader, but rarely exceed 20 ft. in width, and the broadest yet found is about 32, while the back streets running parallel to the main lines are only about 14 ft. (It is to be remembered, however, that the standard width of a Roman highroad in the neighbourhood of Rome itself is about 14 ft.) They are uniformly paved with large polygonal blocks of hard basaltic lava, fitted very closely together, though now in many cases marked with deep ruts from the passage of vehicles in ancient times. They are also in all cases bordered by raised footways on both sides, paved in a similar manner; and for the convenience of foot-passengers, which was evidently a more important consideration than the obstacle which the arrangement presented to the passage of vehicles, which indeed were probably only allowed for goods traffic, these are connected from place to place by stepping-stones raised above the level of the carriage-way. In other respects they must have resembled those of Oriental cities—the living apartments all opening towards the interior, and showing only blank walls towards the street; while the windows were generally to be found only in the upper storey, and were in all cases small and insignificant, without any attempt at architectural effect. In some instances indeed the monotony of their external appearance was broken by small shops, occupying the front of the principal houses, and let off separately; these were in some cases numerous enough to form a continuous façade to the street. This is seen especially in the case of the street from the Porta Ercolanese to the forum and the Strada Stabiana (or Cardo), both of which were among the most frequented thoroughfares. The streets were also diversified by fountains, small water-towers and reservoirs (of which an especially interesting example was found in 1902 close to the Porta del Vesuvio) and street shrines. The source of the water-supply is unknown.

The first-mentioned of the two principal streets was crossed, a little before it reached the forum, by the street which led directly to the gate of Nola (Strada delle Terme, della Fortuna, and di Nola). Parallel to this last to the south is a street which runs from the Porta Marina through the forum, and then, with a slight turn, to the Sarno gate, thus traversing the whole area of the city from east to west (Via Marina, Strada dell' Abbondanza, Strada dei Diadumeni). These two east and west streets are the two *decumani*.

The population of Pompeii at the time of its destruction cannot be fixed with certainty, but it may very likely have exceeded 20,000. It was of a mixed character; both Oscan and Greek inscriptions are still found up to the last, and, though there is no trace whatever of Christianity, evidences of the presence of Jews are not lacking—such are a wall-painting, probably representing the Judgment of Solomon, and a scratched inscription on a wall, "Sodoma, Gomora." It has been estimated, from the number of skeletons discovered, that about 2000 persons perished in the city itself in the eruption of A.D. 79.

Almost the whole portion of the city which lies to the west of the Strada Stabiana, towards the forum and the sea, has been more or less completely excavated. It is over one-half of the whole extent, and that the most important portion, inasmuch as it includes the forum, with the temples and public buildings adjacent to it, the thermae, theatres, amphitheatre, &c. The greater part of that on the other side of the Strada Stabiana remains still unexplored, with the exception of the amphitheatre, and a small space in its immediate neighbourhood.

The forum at Pompeii was, as at Rome itself and in all other Italian cities, the focus and centre of all the life and movement of the city. Hence it was surrounded on all sides by public buildings or edifices of a commanding character. It was not, however, of large size, as compared to the open spaces in modern towns, being only 467 ft. in length by 126 in breadth (excluding the colonnades). Nor was it accessible to any description of wheeled carriages, and the nature of its pavement, composed of broad flags of travertine, shows that it was only intended for foot-passengers. It was adorned with numerous statues, some of the imperial family, others of distinguished citizens. Some of the inscribed pedestals of the latter have been found. It was surrounded on three sides by a series of porticos supported on columns; and these porticos were originally surmounted by a gallery or upper storey, traces of the staircases leading to which still remain, though the gallery itself has altogether disappeared. It is, however, certain from the existing remains that both this portico and the adjacent buildings had suffered severely from the earthquake of 63, and that they were undergoing a process of restoration, involving material changes in the original arrangements, which was still incomplete at the time of their final destruction. The north end of the forum, where alone the portico is wanting, is occupied in great part by the imposing temple of Jupiter, Juno and Minerva being also worshipped here. It was raised on a *podium* 10 ft. high, and had a portico with six Corinthian columns in front. This magnificent edifice had, however, been evidently overthrown by the earthquake of 63, and is in its present condition a mere ruin, the rebuilding of which had not been begun at the time of the eruption, so that the cult of the three Capitoline divinities was then carried on in the so-called temple of Zeus Milichius. On each side of it were two arches, affording an entrance into the forum, but capable of being closed by gates. On the east side of the forum were four edifices; all of them are of a public character, but their names and attribution have been the subject of much controversy. The first (proceeding from the north), once known as the Pantheon, is generally regarded as a *macellum* or meat-market, consisting of a rectangular court surrounded by a colonnade, with a twelve-sided roofed building (*tholus*) in the centre. On the south side were shops, and in the centre of the east side a chapel for the worship of the imperial house. Next to this comes the sanctuary of the Lares of the city, a square room with a large apse; and beyond this, as Mau proves, the small temple of Vespasian. Beyond this again, bounded on the south by the street known as the Strada dell' Abbondanza, is a large and spacious edifice, which, as we learn from an extant inscription, was erected by a priestess named Eumachia. Its purpose is uncertain—possibly a cloth-exchange, as the fullers set up a statue to Eumachia here. It is an open court, oblong, surrounded on all four sides by a colonnade; in front is a portico facing the forum, and on the other three sides there is a corridor behind the colonnade with windows opening on it. On the south side of the Strada dell' Abbondanza was a building which Mau conjectures to have been the Comitium. At the south end of the forum are three halls side by side, similar in plan with a common façade—the central one, the curia or council chamber, the others the offices respectively of the duumvirs and aediles, the principal officials of the city; while the greater part of the west side is occupied by two large buildings—a basilica, which is the largest edifice in Pompeii, and the temple of Apollo, which presents its side to the forum, and hence fills up a large portion of the surrounding space. The former, as we learn from an inscription scratched on its walls, was anterior in date to the consulship of M. Lepidus and Q. Catulus (78 B.C.), and therefore belongs to the Oscan period of the city, before the introduction of the Roman colony. It was an oblong edifice divided by columns into a central hall and a corridor running round all the four sides with a tribunal opposite the main entrance; and, unlike the usual basilicae, it had, instead of a clerestory, openings in the walls of the corridor through which light was admitted, it being almost as lofty as the nave. The temple was an extensive edifice, having a comparatively small *cella*, raised upon a *podium*, and standing in the midst of a wide space surrounded by a portico of columns, outside which again is a wall, bounding the sacred enclosure. Between this temple and the basilica the Via Marina leads off direct to the Porta Marina.

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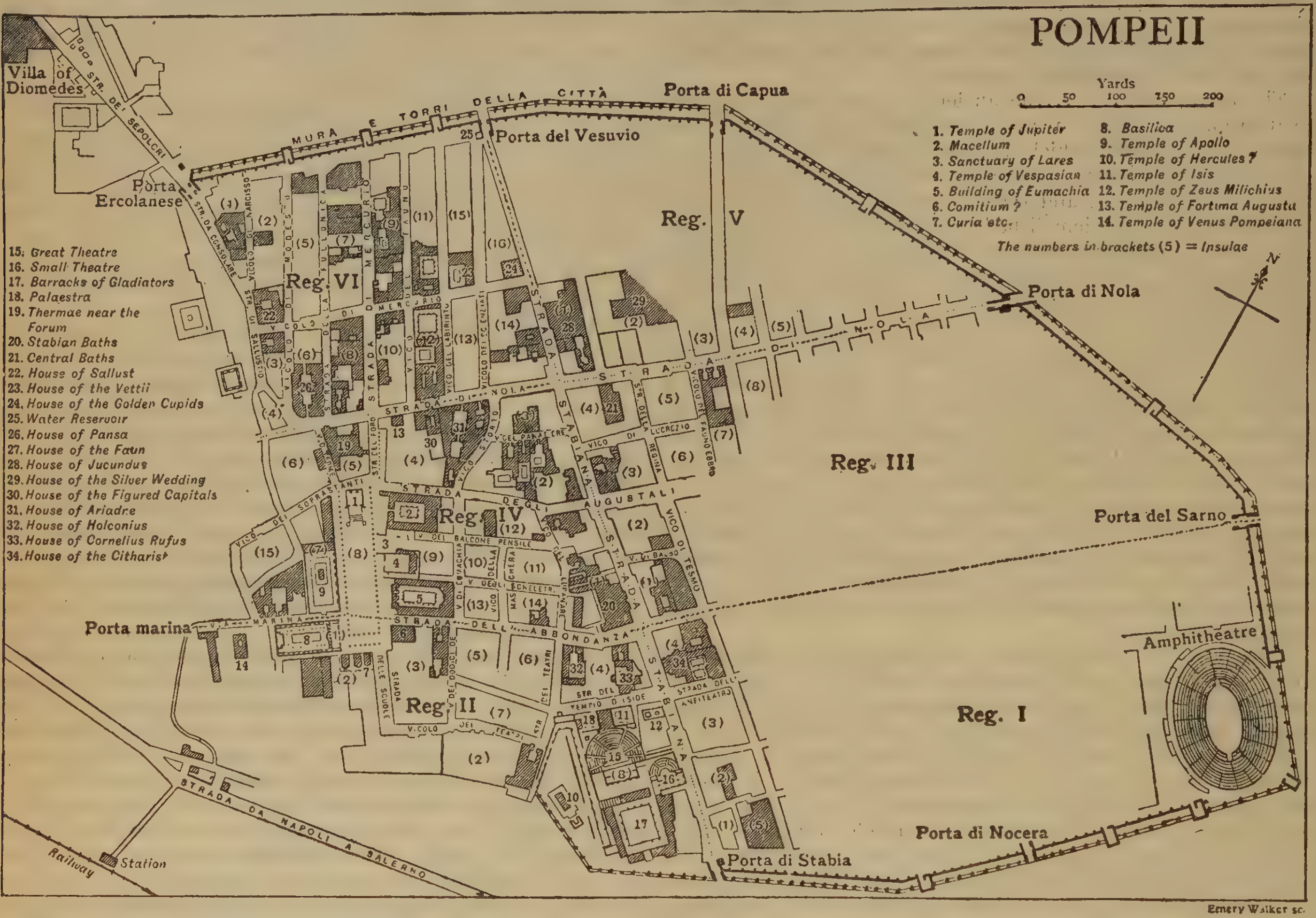
[1] It consisted of two parallel stone walls with buttresses, about 15 ft. apart and 28 in. thick, the intervening space being filled with earth, and there being an embankment on the inner side.


POMPEII
Yards
0 50 100 150 200
1. Temple of Jupiter
2. Macellum
3. Sanctuary of Lares
4. Temple of Vespasian
5. Building of Eumachia
6. Comitium ?
7. Curia etc.
8. Basilica
9. Temple of Apollo
10. Temple of Hercules ?
11. Temple of Isis
12. Temple of Zeus Milichius
13. Temple of Fortuna Augusta
14. Temple of Venus Pompeiana
The numbers in brackets (5) = Insulae
15. Great Theatre
16. Small Theatre
17. Barracks of Gladiators
18. Palaestra
19. Thermae near the Forum
20. Stabian Baths
21. Central Baths
22. House of Sallust
23. House of the Vettii
24. House of the Golden Cupids
25. Water Reservoir
26. House of Pansa
27. House of the Faun
28. House of Jucundus
29. House of the Silver Wedding
30. House of the Figured Capitals
31. House of Ariadne
32. House of Holconius
33. House of Cornelius Rufus
34. House of the Citharist
Villa of Diomedes
Str. dei Sepolcri
Porta Ercolanese
Str. da Consolare
Mura e Torri della Città
Porta del Vesuvio
Porta di Capua
Reg. VI
Reg. V
Porta di Nola
Strada di Nola
Strada Stabiana
Reg. III
Reg. IV
Porta del Sarno
Porta marina
Strada dell' Abbondanza
Reg. II
Reg. I
Amphitheatre
Porta di Nocera
Porta di Stabia
Strada da Napoli a Salerno
Railway
Station
N
Emery Walker sc.

(Redrawn by permission from Baedeker's *Southern Italy*.)

Besides the temples which surrounded the forum, the remains of five others have been discovered, three of which are situated in the immediate neighbourhood of the theatres. Of these by far the most interesting, though the least perfect, is one which is commonly known as the temple of Hercules (an appellation wholly without foundation), and which is not only by far the most ancient edifice in Pompeii, but presents us with all the characters of a true Greek temple, resembling in its proportions that of the earliest temple of Selinus, and probably of as remote antiquity (6th century B.C.). Unfortunately only the foundation and a few Doric capitals and other architectural fragments remain; they were coated with stucco which was brightly painted. In front of the temple is a monument which seems to have been the tomb of the founder or founders of the city; so that for a time this must have been the most important temple. The period of its destruction is unknown, for it appears certain that it cannot be ascribed wholly to the earthquake of 63. On the other hand the reverence attached to it in the later periods of the city is evidenced by its being left standing in the midst of a triangular space adjoining the great theatre, which is surrounded by a portico, so as to constitute a kind of forum (the so-called Foro

Triangolare). Not far off, and to the north of the great theatre, stood a small temple, which, as we learn from the inscription still remaining, was dedicated to Isis, and was rebuilt by a certain Popidius Celsinus at the age of six (really of course by his parents), after the original edifice had been reduced to ruin by the great earthquake of 63. Though of small size, and by no means remarkable in point of architecture, it is interesting as the only temple that has come down to us in a good state of preservation of those dedicated to the Egyptian goddess, whose worship became so popular under the Roman Empire. The decorations were of somewhat gaudy stucco. The plan is curious, and deviates much from the ordinary type; the internal arrangements are adapted for the performance of the peculiar rites of this deity. Close to this temple was another, of very small size, commonly known as the temple of Aesculapius, but probably dedicated to Zeus Milichius. More considerable and important was a temple which stood at no great distance from the forum at the point where the so-called Strada di Mercurio was crossed by the wide line of thoroughfare (Strada della Fortuna) leading to the gate of Nola. We learn from an inscription that this was dedicated to the Fortune of Augustus (Fortuna Augusta), and was erected, wholly at his own cost, by a citizen of the name of M. Tullius. This temple appears to have suffered very severely from the earthquake, and at present affords little evidence of its original architectural ornament; but we learn from existing remains that its walls were covered with slabs of marble, and that the columns of the portico were of the same material. The fifth temple, that of Venus Pompeiana, lay to the west of the basilica; traces of two earlier periods underlie the extant temple, which was in progress of rebuilding at the time of the eruption. Before the earthquake of 63 it must have been the largest and most splendid temple of the whole city. It was surrounded by a large colonnade, and the number of marble columns in the whole block has been reckoned at 296.

All the temples above described, except that ascribed to Hercules, which was approached by steps on all four sides, agree in being raised on an elevated *podium* or basement—an arrangement usual with all similar buildings of Roman date. Neither in materials nor in style does their architecture exceed what might reasonably be expected in a second-rate provincial town; and the same may be said in general of the other public buildings. Among these the most conspicuous are the theatres, of which there were two, placed, as was usual in Greek towns, in close juxtaposition with one another. The largest of these which was partly excavated in the side of the hill, was a building of considerable magnificence, being in great part cased with marble, and furnished with seats of the same material, which have, however, been almost wholly removed. Its internal construction and arrangements resemble those of the Roman theatres in general, though with some peculiarities that show Greek influence, and we learn from an inscription that it was erected in Roman times by two members of the same family, M. Holconius Rufus and M. Holconius Celer, both of whom held important municipal offices at Pompeii during the reign of Augustus. It appears, however, from a careful examination of the remains that their work was only a reconstruction of a more ancient edifice, the date of the original form of which cannot be fixed; while its first alteration belongs to the "tufa" period, and three other periods in its history can be traced. Recent investigations in regard to the vexed question of the position of the actors in the Greek theatre have as yet not led to any certain solution.[1] The smaller theatre, which was erected, as we learn from an inscription, by two magistrates specially appointed for the purpose by the decuriones of the city, was of older date than the large one, and must have been constructed a little before the amphitheatre, soon after the establishment of the Roman colony under Sulla. We learn also that it was permanently covered, and it was probably used for musical entertainments, but in the case of the larger theatre also the arrangements for the occasional extension of an awning (*velarium*) over the whole are distinctly found. The smaller theatre is computed to have been capable of containing fifteen hundred spectators, while the larger could accommodate five thousand.

Adjoining the theatres is a large rectangular enclosure, surrounded by a portico, at first the colonnade connected with the theatres, and converted, about the time of Nero, into the barracks of the gladiators, who were permanently maintained in the city with a view to the shows in the amphitheatre. This explains why it is so far from that building, which is situated at the south-eastern angle of the town, about 500 yds. from the theatres. Remains of gladiators' armour and weapons were found in some of the rooms, and in one, traces of the stocks used to confine insubordinate gladiators. The amphitheatre was erected by the same two magistrates who built the smaller theatre, C. Quinctius Valgus and M. Porcius (the former the father-in-law of that P. Servilius Rullus, in opposition to whose bill relating to the distribution of the public lands Cicero made his speech, *De lege agraria*), at a period when no permanent edifice of a similar kind had yet been erected in Rome itself, and is indeed the oldest structure of the kind known to us. But apart from its early date it has no special interest, and is wholly wanting in the external architectural decorations that give such grandeur of character to similar edifices in other instances. Being in great part excavated in the surface of the hill, instead of the seats being raised on arches, it is wanting also in the picturesque arched corridors which contribute so much to the effect of those other ruins. Nor are its dimensions (460 by 345 ft.) such as to place it in the first rank of structures of this class, nor are there any underground chambers below the arena, with devices for raising wild beasts, &c. But, as we learn from the case of their squabble with the people of Nuceria, the games celebrated in the amphitheatre on grand occasions would be visited by large numbers from the neighbouring towns. The seating capacity was about 20,000[2] (for illustration see AMPHITHEATRE).

Adjoining the amphitheatre was found a large open space, nearly square in form, which has been supposed to be a forum boarium or cattle-market, but, no buildings of interest being discovered around it, the excavation was filled up again, and this part of the city has not been since examined. Between the entrance to the triangular forum (so-called) and the temple of Isis is the Palaestra, an area surrounded by a colonnade; it is a structure of the pre-Roman period, intended for boys, not men.

Among the more important public buildings of Pompeii were the public baths (*thermae*). Three different establishments of this character have been discovered, of which the first, excavated in 1824, the baths near the forum, built about 80 B.C., was for a long time the only one known. Though the smallest of the three, it is in some respects the most complete and interesting; and it was until of late years the principal source from which we derived our knowledge of this important branch of the economy of Roman life. At Pompeii the baths are so well preserved as to show at a glance the purpose of all the different parts—while they are among the most richly decorated of all the buildings in the city. We trace without difficulty all the separate apartments that are described to us by Roman authors—the *apodyterium*, *frigidarium*, *tepidarium*, *caldarium*, &c. together with the apparatus for supplying both water and heat, the places for depositing the bather's clothes, and other minor details (see BATHS). The greater thermae (the so-called "Stabian" baths), which were originally built in the 2nd century B.C., and repaired about 80 B.C., are on a much more extensive scale than the others, and combine with the special purposes of the building a palaestra in the centre and other apartments for exercise or recreation. The arrangements of the baths themselves are, however, almost similar to those of the lesser thermae. In this case an inscription records the repair and restoration of the edifice after the earthquake of 63. It appears, however, that these two establishments were found inadequate to supply the wants of the inhabitants, and a third edifice of the same character, the so-called central baths, at the corner of the Strada Stabiana and the Strada di Nola, but on a still more extensive scale, intended for men only, while the other two had separate accommodation for both sexes, was in course of construction when the town was overwhelmed.

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[1] See A. Mau, *Pompeii in Leben und Kunst* (Leipzig, 1908), pp. 150 sqq.

[2] The interest taken by the Pompeians in the sports of the amphitheatre is shown by the contents of the numerous painted and scratched inscriptions relating to them which have been found in Pompeii—notices of combats, laudatory inscriptions, including even references to the admiration which gladiators won from the fair sex, &c.

Great as is the interest attached to the various public buildings of Pompeii, and valuable as is the light that they have in some instances thrown upon similar edifices in other ruined cities, far more curious and interesting is the insight afforded us by the numerous private houses and shops into the ordinary life and habits of the population of an ancient town. The houses at Pompeii are generally low, rarely exceeding two storeys in height, and it appears certain that the upper storey was generally of a slight construction, and occupied by small rooms, serving as garrets, or sleeping places for slaves, and perhaps for the females of the family. From the mode of destruction of the city these upper floors were in most cases crushed in and destroyed, and hence it was long believed that the houses for the most part had but one storey; but recent researches have in many cases brought to light incontestable evidence of the existence of an upper floor, and the frequent occurrence of a small staircase is in itself sufficient proof of the fact. The windows, as already mentioned, were generally small and insignificant, and contributed nothing to the external decoration or effect of the houses, which took both light and air from the inside, not from the outside. In some cases they were undoubtedly closed with glass, but its use appears to have been by no means general. The principal living rooms, as well as those intended for the reception of guests or clients, were all on the ground floor, the centre being formed by the *atrium*, or hall, which was almost always open above to the air, and in the larger houses was generally surrounded with columns. Into this opened other rooms, the entrances to which seem to have been rarely protected by doors, and could only have been closed by curtains. At the back was a garden. Later, under Greek influences, a peristyle with rooms round it was added in place of the garden. We notice that, as in modern Italy until quite recent years, elaborate precautions were taken against heat, but none against cold, which was patiently endured. Hypocausts are only found in connexion with bathrooms.

All the apartments and arrangements described by Vitruvius and other ancient writers may be readily traced in the houses of Pompeii, and in many instances these have for the first time enabled us to understand the technical terms and details transmitted to us by Latin authors. We must not, however, hastily assume that the examples thus preserved to us by a singular accident are to be taken as representing the style of building in all the Roman and Italian towns. We know from Cicero that Capua was remarkable for its broad streets and widespread buildings, and it is probable that the Campanian towns in general partook of the same character. At Pompeii indeed the streets were not wide, but they were straight and regular, and the houses of the better class occupied considerable spaces, presenting in this respect no doubt a striking contrast, not only with those of Rome itself, but with those of many other Italian towns, where the buildings would necessarily be huddled together from the circumstances of their position. Even at Pompeii itself, on the west side of the city, where the ground slopes somewhat steeply towards the sea, houses are found which consisted of three storeys or more.

The excavations have provided examples of houses of every description, from the humble dwelling-place of the artisan or proletarian, with only three or four small rooms, to the stately mansions of Sallust, of the Faun, of the Golden Cupids, of the Silver Wedding, of the Vettii, of Pansa,[1] &c.—the last of which is among the most regular in plan, and may be taken as an almost perfect model of a complete Roman house of a superior class. But the general similarity in their plan and arrangement is very striking, and in all those that rise above a very humble class the leading divisions of the interior, the *atrium*, *tablinum*, *peristyle*, &c. may be traced with unfailing regularity. Another peculiarity that is found in all the more considerable houses in Pompeii is that of the front, where it faces one of the principal streets, being occupied with shops, usually of small size, and without any communication with the interior of the mansion. In a few instances indeed such a communication is found, but in these cases it is probable that the shop was used for the sale of articles grown upon the estate of the proprietor, such as wine, fruit, oil, &c., a practice that is still common in Italy. In general the shop had a very small apartment behind it, and probably in most cases a sleeping chamber above it, though of this the only remaining evidence is usually a portion of the staircase that led to this upper room. The front of the shop was open to the street, but was capable of being closed with wooden shutters, the remains of which have in a few instances been preserved. Not only have the shops of silversmiths been recognized by the precious objects of that metal found in them, but large quantities of fruits of various kinds preserved in glass vessels, various descriptions of corn and pulse, loaves of bread, moulds for pastry, fishing-nets and many other objects too numerous to mention, have been found in such a condition as to be identified without difficulty. Inns and wine-shops appear to have been numerous; one of the latter we can see to have been a *thermopolium*, where hot drinks were sold. Bakers' shops are also frequent, though arrangements for grinding and baking appear to have formed part of every large family establishment. In other cases, however, these were on a larger scale, provided with numerous querns or hand-mills of the well-known form, evidently intended for public supply. Another establishment on a large scale was a *fullonica* (fuller's shop), where all the details of the business were illustrated by paintings still visible on the walls. Dyers' shops, a tannery and a shop where colours were ground and manufactured—an important business where almost all the rooms of every house were painted—are of special interest, as is also the house of a surgeon, where numerous surgical instruments were found, some of them of a very ingenious and elaborate description, but all made of bronze. Another curious discovery was that of the abode of a sculptor, containing his tools, as well as blocks of marble and half-finished statues. The number of utensils of various kinds found in the houses and shops is almost endless, and, as these are in most cases of bronze, they are generally in perfect preservation.

Of the numerous works of art discovered in the course of the excavations the statues and large works of sculpture, whether in marble or bronze, are inferior to those found at Herculaneum, but some of the bronze statuettes are of exquisite workmanship, while the profusion of ornamental works and objects in bronze and the elegance of their design, as well as the finished beauty of their execution, are such as to excite the utmost admiration—more especially when it is considered that these are the casual results of the examination of a second-rate provincial town, which had, further, been ransacked for valuables (as Herculaneum had not) after the eruption of 79. The same impression is produced in a still higher degree by the paintings with which the walls of the private houses, as well as those of the temples and other public buildings, are adorned, and which are not merely of a decorative character, but in many instances present us with elaborate compositions of figures, historical and mythological scenes, as well as representations of the ordinary life and manners of the people, which are full of interest to us, though often of inferior artistic execution. It has until lately been the practice to remove these to the museum at Naples; but the present tendency is to leave them (and even the movable objects found in the houses) *in situ* with all due precautions as to their preservation (as in the house of the Vettii, of the Silver Wedding, of the Golden Cupids, &c.), which adds immensely to the interest of the houses; indeed, with the help of judicious restoration, their original condition is in large measure reproduced.[1] In some cases it has even been possible to recover the original arrangement of the garden beds, and to replant them accordingly, thus giving an appropriate framework to the statues, &c. with which the gardens were decorated, and which have been found *in situ*. The same character of elaborate decoration, guided almost uniformly by good taste and artistic feeling, is displayed in the mosaic pavements, which in all but the humbler class of houses frequently form the ornament of their floors. One of these, in the House of the Faun, well known as the battle of Alexander, presents us with the most striking specimen of artistic composition that has been preserved to us from antiquity.

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[1] It may be observed that the names given in most cases to the houses are either arbitrary or founded in the first instance upon erroneous inferences.

The architecture of Pompeii must be regarded as presenting in general a transitional character from the pure Greek style to that of the Roman Empire. The temples (as already observed) have always the Roman peculiarity of being raised on a *podium* of considerable elevation; and the same characteristic is found in most of the other public buildings. All the three orders of Greek architecture—the Doric, Ionic and Corinthian—are found freely employed in the various edifices of the city, but rarely in strict accordance with the rules of art in their proportions and details; while the private houses naturally exhibit still more deviation and irregularity. In many of these indeed we find varieties in the ornamentation, and even in such leading features as the capitals of the columns, which remind one rather of the vagaries of medieval architecture than of the strict rules of Vitruvius or the regularity of Greek edifices. One practice which is especially prevalent, so as to strike every casual visitor, and dates from the early years of the empire, is that of filling up the flutings of the columns for about one-third of their height with a thick coat of stucco, so as to give them the appearance of being smooth columns without flutings below, and only fluted above. The unpleasing effect of this anomalous arrangement is greatly aggravated by the lower part of each column being almost always coloured with red or yellow ochre, so as to render the contrast between the two portions still stronger. The architecture of Pompeii suffers also from the inferior quality of the materials generally employed. No good building stone was at hand; and the public as well as private edifices were constructed either of volcanic tufa, or lava, or Sarno limestone, or brick (the latter only used for the corners of walls). In the private houses even the columns are mostly of brick, covered merely with a coat of stucco. In a few instances only do we find them making use of a whitish limestone wrongly called travertine, which, though inferior to the similar material so largely employed at Rome, was better adapted than the ordinary tufa for purposes where great solidity was required. The portion of the portico surrounding the forum which was in the process of rebuilding at the time when the city was destroyed was constructed of this material, while the earlier portions, as well as the principal temples that adjoined it, were composed in the ordinary manner of volcanic tufa. Marble appears to have been scarce, and was sparingly employed. In some instances where it had been freely introduced, as in the great theatre, it would seem that the slabs must have been removed at a period subsequent to the entombment of the city.

These materials are used in several different styles of construction belonging to the six different periods which Mau traces in the architectural history of Pompeii.

1. That of the Doric temple in the Foro Triangolare (6th century B.C.) and an old column built into a house in Region vi., Insula 5; also of the older parts of the city walls—date uncertain (Sarno limestone and grey tufa).

2. That of the limestone atriums (outer walls of the houses of ashlar-work of Sarno limestone, inner walls with framework of limestone blocks, filled in with small pieces of limestone). Date, before 200 B.C.

3. Grey tufa period; ashlar masonry of tufa, coated with fine white stucco; rubble work of lava. The artistic character is still Greek, and the period coincides with the first (incrustation) style of mural decoration, which (probably originating in Alexandria) aimed at the imitation in stucco of the appearance of a wall veneered with coloured marbles. No wall paintings exist, but there are often fine floor mosaics. To this belong a number of private houses (*e.g.* the House of the Faun), and the colonnade round the forum, the basilica, the temples of Apollo and Jupiter, the large theatre with the colonnades of the Foro Triangolare, and the barracks of the gladiators, the Stabian baths, the Palaestra, the exterior of the Porta Marina, and the interior of the other gates—all the public buildings indeed (except the Doric temple mentioned under (1), which do not belong to the time of the Roman colony). Date, 2nd century B.C.

4. The "quasi-reticulate" period—walling faced with masonry not yet quite so regular as *opus reticulatum*, and with brick quoins, coinciding with the second period of decoration (the architectural, partly imitating marble like the first style, but without relief, and by colour only, and partly making use of architectural designs). It is represented by the small theatre and the amphitheatre, the baths near the forum, the temple of Zeus Milichius, the Comitium and the original temple of Isis, but only a few private houses. The ornamentation is much less rich and beautiful than that of the preceding period. Date, from 80 B.C. until nearly the end of the Republic.

5. The period from the last decades of the Republic to the earthquake of A.D. 63. No homogeneous series of buildings—we find various styles of construction (quasi-reticulate, *opus reticulatum* of tufa with stone quoins, of the time of Augustus, *opus reticulatum* with brick quoins or with mingled stone and brick quoins, a little later); and three styles of wall decoration fall within its limits. The second, already mentioned, the third or ornate, with its freer use of ornament and its introduction of designs which suggest an Egyptian origin (originating in the time of Augustus), and the fourth or intricate, dating from about A.D. 50. Marble first appears as a building material in the temple of Fortuna Augusta (*c.* 3 B.C.).

6. The period from the earthquake of A.D. 63 to the final destruction of the city, the buildings of which can easily be recognized. The only wholly new edifice of any importance is the central baths.

Outside the Porta Ercolanese, or gate leading to Herculaneum, is found a house of a different character from all the others, which from its extent and arrangements was undoubtedly a suburban villa, belonging to a person of considerable fortune. It is called—as usual without any authority—the villa of Arrius Diomedes; but its remains are of peculiar interest to us, not only for comparison with the numerous ruins of similar buildings which occur elsewhere—often of greater extent, but in a much less perfect state of preservation—but as assisting us in understanding the description of ancient authors, such as Vitruvius and Pliny, of the numerous appurtenances frequently annexed to houses of this description.

In the cellar of this villa were discovered no less than twenty skeletons of the unfortunate inhabitants, who had evidently fled thither for protection, and fourteen in other parts of the house. Almost all the skeletons and remains of bodies found in the city were discovered in similar situations, in cellars or underground apartments—those who had sought refuge in flight having apparently for the most part escaped from destruction, or having perished under circumstances where their bodies were easily recovered by the survivors. According to Cassius Dio, a large number of the inhabitants were assembled in the theatre at the time of the catastrophe, but no bodies have been found there, and they were probably sought for and removed shortly afterwards. Of late years it has been found possible in many cases to take casts of the bodies found—a complete mould having been formed around them by the fine white ashes, partially consolidated by water.

An interesting farm-house (few examples have been so far discovered in Italy) is that at Boscoreale excavated in 1893–1894, which contained the treasure of one hundred and three silver vases now at the Louvre. The villa of P. Fannius Synhistor, not far off, was excavated in 1900; it contained fine wall paintings, which, despite their importance, were allowed to be exported, and sold by auction in Paris (some now in the Louvre). (See F. Barnabei, *La Villa pompeiana di P. Fannio Sinistore*; Rome, 1901.)

The road leading from the Porta Ercolanese towards Herculaneum is bordered on both sides for a considerable extent by rows of tombs, as was the case with all the great roads leading into Rome, and indeed in all large Roman towns. These tombs are in many instances monuments of considerable pretension, and of a highly ornamental character, and naturally present in the highest degree the peculiar advantage common to all that remains of Pompeii, in their perfect preservation. Hardly any scene even in this extraordinary city is more striking than the *coup d'œil* of this long street of tombs, preserving uninjured the records of successive generations eighteen centuries ago. Unfortunately the names are all otherwise unknown; but we learn from the inscriptions that they are for the most part those of local magistrates and municipal dignitaries of Pompeii. Most of them belong to the early empire.

There appears to have been in the same quarter a considerable suburb, outside the gate, extending on each side of the road towards Herculaneum, apparently much resembling those which are now found throughout almost the whole distance from thence to Naples. It was known by the name of Pagus Augustus Felix

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[1] The paintings of the house of the Vettii are perhaps the best-preserved in Pompeii, and extremely fine in conception and execution, especially the scenes in which Cupids take part.

Suburbanus. Other suburbs were situated at the harbour and at the saltworks (*salinae*).

No manuscripts have been discovered in Pompeii. Inscriptions have naturally been found in considerable numbers, and we are indebted to them for much information concerning the municipal arrangements of the town, as well as the construction of various edifices and other public works. The most interesting of these are such as are written in the Oscan dialect, which appears to have continued in official use down to the time when the Roman colony was introduced by Sulla. From that time the Latin language was certainly the only one officially employed, though Oscan may have still been spoken by a portion at least of the population. Still more curious, and almost peculiar to Pompeii, are the numerous writings painted upon the walls, which have generally a semi-public character, such as recommendations of candidates for municipal offices, advertisements, &c., and the scratched inscriptions (*graffiti*), which are generally the mere expression of individual impulse and feeling, frequently amatory, and not uncommonly conveyed in rude and imperfect verses. In one house also a whole box was found filled with written tablets—diptychs and triptychs—containing the record of the accounts of a banker named L. Caecilius Jucundus.

See A. Mau, *Pompeii: its Life and Art* (trans. by F. W. Kelsey, 2nd ed., New York and London, 1902; 2nd revised edition of the German original, *Pompeii in Leben und Kunst*, Leipzig, 1908), the best general account written by the greatest authority on the subject, to which our description owes much, with full references to other sources of information; and, for later excavations, *Notizie degli Scavi* and *Römische Mitteilungen* (in the latter, articles by Mau), *passim*. For the inscriptions on the tablets and on the walls, *Corpus inscriptionum latinarum*, vol. iv. (ed. Zangemeister and Mau). Recent works on the Pompeian frescoes are those of Berger, in *Die Maltechnik des Alterthums*, and A. P. Laurie, *Greek and Roman Methods of Painting* (1910). (E. H. B.; T. As.)

Oscan Inscriptions.—The surviving inscriptions which can be dated, mainly by the gradual changes in their alphabet, are of the 3rd and 2nd centuries B.C., some certainly belonging to the Gracchan period. The oldest of the Latin inscriptions are *C.I.L.* x. 794, the record of the building of colonnades in the forum by the "quaestor" V. Popidius, and two or three election placards (*C.I.L.* iv. 29, 30, 36) of one R. Caecilius, a candidate for the same office. It cannot be an accident that the alphabet of these inscriptions belongs distinctly to Sullan or pre-Sullan times, while no such officer as a quaestor appears in any later documents (*e.g.* in *C.I.L.* x. 844, it is the duoviri who build the small theatre), but does appear in the Oscan inscriptions. Hence it has been inferred that these oldest Latin inscriptions are also older than Sulla's colony; if so, Latin must have been in use, and in fairly common use (if the *programmata* were to be of any service), in Pompeii at that date. On the other hand, the good condition of many of the painted Oscan inscriptions at the times when they were first uncovered (1797 onwards) and their subsequent decay and the number of Oscan graffiti appear to make it probable that at the Christian era Oscan was still spoken in the town. The two languages undoubtedly existed side by side during the last century B.C., Latin being alone recognized officially and in society, while Oscan was preserved mainly by intercourse with the country folk who frequented the market. Thus beside many Latin *programmata* later than those just mentioned we have similar inscriptions in Oscan, addressed to Oscan-speaking voters, where *IIIner.* obviously relates to the quattuorvirate, a title characteristic of the Sullan and triumviral colonies. An interesting stone containing nine cavities for measures of capacity found in Pompeii and now preserved in the Naples Museum with Oscan inscriptions erased in antiquity shows that the Oscan system of measurement was modified so as to correspond more closely with the Roman, about 14 B.C., by the duoviri, who record their work in a Latin inscription (*C.I.L.* x. 793; for the Oscan see *Ital. Dial.* p. 67).

See further OSCA LINGUA, and R. S. Conway, *The Italic Dialects*, pp. 54 sqq.; Nissen, *Pompeianische Studien*; J. Beloch, *Campanien*, 2nd ed. (R. S. C.)

POMPEY, the common English form of Pompeius, the name of a Roman plebeian family.

1. GNAEUS POMPEIUS (106–48 B.C.), the triumvir, the first of his family to assume the surname MAGNUS, was born on the 30th of September in the same year as Cicero. When only seventeen he fought together with his father in the Social War. He took the side of Sulla against Marius and Cinna, but for a time, in consequence of the success of the Marians, he kept in the background. On the return of Sulla from the Mithradatic War Pompey joined him with an army of three legions, which he had raised in Picenum. Thus early in life he connected himself with the cause of the aristocracy, and a decisive victory which he won in 83 over the Marian armies gained for him from Sulla the title of *Imperator*. He followed up his successes in Italy by defeating the Marians in Sicily and Africa, and on his return to Rome in 81, though he was still merely an *eques* and not legally qualified to celebrate a triumph, he was allowed by general consent to enjoy this distinction, while Sulla greeted him with the surname of *Magnus*, a title he always retained and handed down to his sons. Latterly, his relations with Sulla were somewhat strained, but after his death he resisted the attempt of the consul M. Aemilius Lepidus to repeal the constitution. In conjunction with A. Lutatius Catulus, the other consul, he defeated Lepidus when he tried to march upon Rome, and drove him out of Italy (77). With some fears and misgivings the senate permitted him to retain the command of his victorious army, and decided on sending him to Spain, where the Marian party, under Sertorius, was still formidable. Pompey was fighting in Spain from 76 to 71, and though at first he met with serious reverses he was ultimately successful. After Sertorius had fallen a victim to assassination, Pompey easily defeated his successor Perperna and put an end to the war. In 71 he won fresh glory by finally crushing the slave insurrection of Spartacus. That same year, amid great popular enthusiasm, but without the hearty concurrence of the senate, whom he had alarmed by talking of restoring the dreaded power of the tribunes, he was elected with M. Licinius Crassus to the consulship, and entered Rome in triumph (December 31) for his Spanish victories. He was legally ineligible for the consulship, having held none of the lower offices of state and being under age. The following year saw the work of Sulla undone; the tribunate was restored, and the administration of justice was no longer left exclusively to the senate, but was to be shared by it with the wealthier portion of the middle class, the equites (*q.v.*) and the *tribuni aerarii*.[1] The change was really necessary, as the provincials could never get justice from a court composed of senators, and it was carried into effect by Pompey with Caesar's aid. Pompey rose still higher in popularity, and on the motion of the tribune Aulus Gabinius in 67 he was entrusted with an extraordinary command over the greater part of the empire, specially for the extermination of piracy in the Mediterranean, by which the corn supplies of Rome were seriously endangered, while the high prices of provisions caused great distress. He was completely successful; the price of corn fell immediately on his appointment, and in forty days the Mediterranean was cleared of the pirates. Next year, on the proposal of the tribune Manilius, his powers were still further extended, the care of all the provinces in the East being put under his control for three years together with the conduct of the war against Mithradates VI., who had recovered from the defeats he had sustained from Lucullus and regained his dominions. Both Caesar and Cicero supported the tribune's proposal, which was easily carried in spite of the interested opposition of the senate and the aristocracy, several of whom held provinces which would now be practically under Pompey's command. The result of Pompey's operations was eminently satisfactory. The wild tribes of the Caucasus were cowed by the Roman arms, and Mithradates himself fled across the Black Sea to Panticapaeum (modern Kertch). In the years 64 and 63 Syria and Palestine were annexed to Rome's empire. After the capture of Jerusalem Pompey is said to have entered the Temple, and even the Holy of Holies. Asia and the East generally were left under the subjection of petty kings who were mere vassals of Rome. Several cities had been founded which became centres of Greek life and civilization.

Pompey, now in his forty-fifth year, returned to Italy in 61 to celebrate the most magnificent triumph which Rome had ever witnessed, as the conqueror of Spain, Africa, and Asia (see A. Holm, *Hist. of Greece*, Eng. trans., vol. iv.). This triumph marked the turning-point of his career. As a soldier everything had gone well with him; as a politician he was a failure. He found a great change in public opinion, and the people indifferent to his achievements abroad. The optimates resented the extraordinary powers that had been conferred upon him; Lucullus and Crassus considered that they had been robbed by him of the honour of concluding the war against Mithradates. The senate refused to ratify the arrangements he made in Asia or to provide money and lands for distribution amongst his veterans. In these circumstances he drew closer to Caesar on his return from Spain, and became reconciled to Crassus. The result was the so-called first triumvirate (see Rome: *History*).

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[1] Their history and political character is obscure; they were at any rate connected with the knights (see AERARIUM).

The remainder of his life is inextricably interwoven with that of Caesar. He was married to Caesar's daughter Julia, and as yet the relations between the two had been friendly. On more than one occasion Caesar had supported Pompey's policy, which of late had been in a decidedly democratic direction. Pompey was now in fact ruler of the greater part of the empire, while Caesar had only the two provinces of Gaul. The control of the capital, the supreme command of the army in Italy and of the Mediterranean fleet, the governorship of the two Spains, the superintendence of the corn supplies, which were mainly drawn from Sicily and Africa, and on which the vast population of Rome was wholly dependent, were entirely in the hands of Pompey, who was gradually losing the confidence of all political parties in Rome. The senate and the aristocracy disliked and distrusted him, but they felt that, should things come to the worst, they might still find in him a champion of their cause. Hence the joint rule of Pompey and Caesar was not unwillingly accepted, and anything like a rupture between the two was greatly dreaded as the sure beginning of anarchy throughout the Roman world. With the deaths of Pompey's wife Julia (54) and of Crassus (53) the relations between him and Caesar became strained, and soon afterwards he drew closer to what we may call the old conservative party in the senate and aristocracy. The end was now near, and Pompey blundered into a false political position and an open quarrel with Caesar. In 50 the senate by a very large majority revoked the extraordinary powers conceded to Pompey and Caesar in Spain and Gaul respectively, and called upon them to disband their armies. Pompey's refusal to submit gave Caesar a good pretext for declaring war and marching at the head of his army into Italy. At the beginning of the contest the advantages were decidedly on the side of Pompey, but the superior political tact of his rival, combined with extraordinary promptitude and decision in following up his blows, soon turned the scale against him. Pompey's cause, with that of the senate and aristocracy, was finally ruined by his defeat in 48 in the neighbourhood of the Thessalian city Pharsalus. That same year he fled with the hope of finding a safe refuge in Egypt, but was treacherously murdered by one of his old centurions as he was landing. He was five times married, and three of his children survived him—Gnaeus, Sextus, and a daughter Pompeia.

Pompey, though he had some great and good qualities, hardly deserved his surname of "the Great." He was certainly a very good soldier, and is said to have excelled in all athletic exercises, but he fell short of being a first-rate general. He won great successes in Spain and more especially in the East, but for these he was no doubt partly indebted to what others had already done. Of the gifts which make a good statesman he had really none. As plainly appeared in the last years of his life, he was too weak and irresolute to choose a side and stand by it. But to his credit be it said that in a corrupt time he never used his opportunities for plunder and extortion, and his domestic life was pure and simple.

Authorities.—*Ancient*: Plutarch, *Pompey*; Dio Cassius; Appian; Velleius Paterculus; Caesar, *De bello civili*; Strabo xii., 555–560; Cicero, *passim*; Lucan, *Pharsalia*.

Modern: Histories of Rome in general (see Rome: *Ancient History, ad fin.*); works quoted under Caesar and Cicero. Also G. Boissier, *Cicero and His Friends* (Eng. trans., A. D. Jones, 1897); J. L. Strachan-Davidson's *Cicero* (1894); Warde Fowler's *Julius Caesar* (1892); C. W. Oman, *Seven Roman Statesmen of the Later Republic* (1902); notes in Tyrrell and Purser's *Correspondence of Cicero* (see index in vii. 80).

2. Gnaeus Pompeius, surnamed *Strabo* (squint-eyed), Roman statesman, father of the triumvir. He was successively quaestor in Sardinia (103 B.C.), praetor (94), propraetor in Sicily (93) and consul (89). He fought with success in the Social War, and was awarded a triumph for his services. Probably towards the end of the same year he brought forward the law (*lex Pompeia de Gallia Transpadana*), which conferred upon the inhabitants of that region the privileges granted to the Latin colonies. During the civil war between Marius and Sulla he seems to have shown no desire to attach himself definitely to either side. He certainly set out for Rome from the south of Italy (where he remained as proconsul) at the bidding of the aristocratic party, when the city was threatened by Marius and Cinna, but he displayed little energy, and the engagement which he fought before the Colline gate, although hotly contested, was indecisive. Soon afterwards he was killed by lightning (87). Although he possessed great military talents, Pompeius was the best-hated general of his time owing to his cruelty, avarice and perfidy. His body was dragged from the bier, while being conveyed to the funeral pile, and treated with the greatest indignity.

See Plutarch, *Pompey*, 1; Appian, *Bell. civ.* i. 50, 52, 66–68, 80; Vell. Pat. ii. 21; Livy, *Epit.* 74–79; Florus iii. 18.

3. Gnaeus Pompeius Magnus (*c.* 75–45 B.C.), the elder son of the triumvir. In 48 B.C. during the civil war he commanded his father's fleet in the Adriatic. After the battle of Pharsalus he set out for Africa with the remainder of the Pompeian party, but, meeting with little success, crossed over to Spain. Having been joined by his brother Sextus, he collected a considerable army, the numbers of which were increased by the Pompeians who fled from Africa after the battle of Thapsus (46). Caesar, who regarded him as a formidable opponent, set out against him in person. A battle took place at Munda on the 17th of March 45, in which the brothers were defeated. Gnaeus managed to make his escape after the engagement, but was soon (April 12) captured and put to death. He was generally unpopular owing to his cruelty and violent temper.

See Pseudo-Oppius, *Bellum hispaniense*, 1–39; Lucan, *Pharsalia*, ix. 120; Dio Cassius xliii. 28–40.

4. Sextus Pompeius Magnus (75–35 B.C.), the younger son of the triumvir. After his father's death he continued the struggle against the new rulers of the Roman Empire. From Cyprus, where he had taken refuge, he made his way to Africa, and after the defeat of the Pompeians at Thapsus (46) crossed over to Spain. After Caesar's victory at the battle of Munda (45), in which he took no actual part, he abandoned Corduba (Cordova), though for a time he held his ground in the south, and defeated Asinius Pollio, the governor of the province. In 43, the year of the triumvirate of Octavius, Antony, and Lepidus, he was proscribed along with the murderers of Caesar, and, not daring to show himself in Italy, he put himself at the head of a fleet manned chiefly by slaves or proscribed persons, with which he made himself master of Sicily, and from thence ravaged the coasts of Italy. Rome was threatened with a famine, as the corn supplies from Egypt and Africa were cut off by his ships, and it was thought prudent to negotiate a peace with him at Misenum (39), which was to leave him in possession of Sicily, Sardinia and Achaea, provided he would allow Italy to be freely supplied with corn. But the arrangement could not be carried into effect, as Sextus renewed the war and gained some considerable successes at sea. However, in 36 his fleet was defeated and destroyed by Agrippa at Naulochus off the north coast of Sicily. After his defeat he fled to Mytilene, and from there to Asia Minor. In the attempt to make his way to Armenia he was taken prisoner by Antony's troops, and put to death at Miletus. Like his father, he was a brave soldier, but a man of little culture.

See Dio Cassius, xlvi–xlix.; Appian, *Bell. civ.* iv. 84–117, v. 2–143; Vell. Pat. ii. 73–87; Plutarch, *Antony*; Livy, *Epit.* 123, 128, 129, 131; Cicero, *Philippica*, xiii., and many references in *Letters to Atticus*.

POMPIGNAN, JEAN JACQUES LEFRANC, Marquis de (1709–1784), French poet, was born on the 17th of August 1709, at Montauban, where his father was president of the *cour des aides*, and the son, who also followed the profession of the law, succeeded in 1745 to the same charge. The same year he was also appointed *conseiller d'honneur* of the parlement of Toulouse, but his courageous opposition to the abuses of the royal power, especially in the matter of taxation, brought down upon him so much vexation that he resigned his positions almost immediately, his marriage with a rich woman enabling him to devote himself to literature. His first play, *Didon* (1734), which owed much to Metastasio's opera on the same subject, gained a great success, and gave rise to expectations not fulfilled by the *Adieux de Mars* (1735) and some light operas that followed. His reputation was made by *Poésies sacrées et philosophiques* (1734), much mocked at by Voltaire who punned on the title: "*Sacrés ils sont, car personne n'y touche.*" Lefranc's odes on profane subjects hardly reach the same level, with the exception of the ode on the death of J. B. Rousseau, which secured him entrance to the Academy (1760). On his reception he made an ill-considered oration violently attacking the Encyclopaedists, many of whom were in his audience and had given him their votes. Lefranc soon had reason to repent of his rashness, for the epigrams and stories circulated by those whom he had attacked made it impossible for him to remain in Paris, and he took refuge in his native town, where he spent the rest of his life occupied in making numerous translations from the classics, none of great merit.

La Harpe, who is severe enough on Lefranc in his correspondence, does his abilities full justice in his *Cours littéraire*, and ranks him next to J. B. Rousseau among French lyric poets. With those of other 18th-century poets his works may be studied in the *Petits poètes français* (1838) of M. Prosper Poitevin. His *Œuvres complètes* (4 vols.) were published in 1781, selections (2 vols.) in 1800, 1813, 1822.

His brother, Jean Georges Lefranc de Pompignan (1715–1790), was the archbishop of Vienne against whose defence of the faith Voltaire launched the good-natured mockery of *Les Lettres d'un Quaker*. Elected to the Estates General, he passed over to the Liberal side, and led the 149 members of the clergy who united with the third estate to form the National Assembly. He was one of its first presidents, and was minister of public worship when the civil constitution was forced upon the clergy.

POMPONAZZI, PIETRO (Petrus Pomponatius) (1462–1525), Italian philosopher, was born at Mantua on the 16th of September 1462, and died at Bologna on the 18th of May 1525. His education, begun at Mantua, was completed at Padua, where he became doctor of medicine in 1487. In 1488 he was elected extraordinary professor of philosophy at Padua, where he was a colleague of Achillini, the Averroist. From about 1495 to 1509 he occupied the chair of natural philosophy until the closing of the schools of Padua, when he took a professorship at Ferrara where he lectured on the *De anima*. In 1512 he was invited to Bologna where he remained till his death and where he produced all his important works. The predominance of medical science at Padua had cramped his energies, but at Ferrara, and even more at Bologna, the study of psychology and theological speculation were more important. In 1516 he produced his great work *De immortalitate animi*, which gave rise to a storm of controversy between the orthodox Thomists of the Catholic Church, the Averroists headed by Agostino Nifo, and the so-called Alexandrist School. The treatise was burned at Venice, and Pomponazzi himself ran serious risk of death at the hands of the Catholics. Two pamphlets followed, the *Apologia* and the *Defensorium*, wherein he explained his paradoxical position as Catholic and philosophic materialist. His last two treatises, the *De incantationibus* and the *De fato*, were posthumously published in an edition of his works printed at Basel.

Pomponazzi is profoundly interesting as the herald of the Renaissance. He was born in the period of transition when scholastic formalism was losing its hold over men both in the Church and outside. Hitherto the dogma of the Church had been based on Aristotle as interpreted by Thomas Aquinas. So close was this identification that any attack on Aristotle, or even an attempt to reopen the old discussions on the Aristotelian problems, was regarded as a dangerous heresy. Pomponazzi claimed the right to study Aristotle for himself, and devoted himself to the *De anima* with the view of showing that Thomas Aquinas had entirely misconceived the Aristotelian theory of the active and the passive intellect. The Averroists had to some extent anticipated this attitude by their contention that immortality does not imply the eternal separate existence of the individual soul, that the active principle which is common to all men alone survives. Pomponazzi's revolt went further than this. He held, with Alexander of Aprodisias, that, as the soul is the form of the body (as Aquinas also asserted), it must, by hypothesis, perish with the body; form apart from matter is unthinkable. The ethical consequence of such a view is important, and in radical contrast to the practice of the period. Virtue can no longer be viewed solely in relation to reward and punishment in another existence. A new sanction is required. Pomponazzi found this criterion in τοῦ καλοῦ ἕνεκα—virtue for its own sake. "Praemium essentiale virtutis est ipsamet virtus quae hominem felicem facit," he says in the *De immortalitate*. Consequently, whether or not the soul be immortal, the ethical criterion remains the same: "Neque aliquo pacto declinandum est a virtute quicquid accidat post mortem." In spite of this philosophical materialism, Pomponazzi declared his adherence to the Catholic faith, and thus established the principle that religion and philosophy, faith and knowledge, may be diametrically opposed and yet coexist for the same thinker. This curious paradox he exemplifies in the *De incantatione*, where in one breath he sums up against the existence of demons and spirits on the basis of the Aristotelian theory of the cosmos, and, as a believing Christian, asserts his faith in their existence. In this work he insists emphatically upon the orderly sequence of nature, cause and effect. Men grow to maturity and then decay; so religions have their day and succumb. Even Christianity, he added (with the usual proviso that he is speaking as a philosopher) was showing indications of decline.

See A. H. Douglas, *Philosophy and Psychology of Pietro Pomponazzi* (1910); also Ritter, *Geschichte der Philosophie*; J. A. Symonds, *The Renaissance in Italy*; Windelband, *History of Philosophy* (trans. by James H. Tufts, pt. 4, c. 1); J. Burckhardt, *Die Kultur der Renaissance in Italien*; L. Ferri, *La Psicologia di P. Pomponazzi.* (J. M. M.)

POMPONIUS, LUCIUS, called *Bononiensis* from his birthplace Bononia, Latin comic poet, flourished about 90 B.C. (or earlier). He was the first to give an artistic form to the Atellanae Fabulae by arranging beforehand the details of the plot which had hitherto been left to improvisation, and providing a written text. The fragments show fondness for alliteration and playing upon words, skill in the use of rustic and farcical language, and a considerable amount of obscenity.

Fragments in O. Ribbeck, *Scenicae romanorum poesis fragmenta* (1897–1898); see Mommsen, *Hist. of Rome* (Eng. tr.), bk. iv. ch. 13; Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. tr.), § 151.

POMPOSA, an abbey of Emilia, Italy, in the province of Ferrara, 2 m. from Codigoro, which is 30 m. E. of Ferrara in the delta of the Po. The fine church, a work of the 10th (?) century, with interesting sculptures on the façade and a splendid Romanesque campanile, contains a good mosaic pavement, and interesting frescoes of the 14th century—a "Last Judgment" of the school of Giotto and others; and there are also paintings in the refectory. It was abandoned in 1550 on account of malaria.

See G. Agnelli, *Ferrara e Pomposa* (Bergamo, 1902). (T. As.)

POMPTINE MARSHES, a low tract of land in the province of Rome, Italy, varying in breadth between the Volscian mountains and the sea from 10 to 16 m., and extending N.W. to S.E. from

Velletri to Terracina (40 m.). In ancient days this low tract was fertile and well-cultivated, and contained several prosperous cities (Suessa Pometia, Ulubrae—perhaps the mod. Cisterna—&c.), but, owing to the dying out of the small proprietors, it had already become unhealthy at the end of the Republican period. Attempts to drain the marshes were made by Appius Claudius in 312 B.C., when he constructed the Via Appia through them (the road having previously followed a devious course at the foot of the Volscian mountains), and at various times during the Roman period. A canal ran through them parallel to the road, and for some reason that is not altogether clear it was used in preference to the road during the Augustan period. Trajan repaired the road, and Theodoric did the same some four hundred years later. But in the middle ages it had fallen into disrepair. Popes Boniface VIII., Martin V., Sixtus V., and Pius VI. all attempted to solve the problem, the last-named reconstructing the road admirably. The difficulty arises from the lack of fall in the soil, some parts no less than 10 m. from the coast being barely above sea-level, while they are separated from the sea by a series of sand-hills now covered with forest, which rise at some points over 100 ft. above sea-level. Springs also rise in the district, and the problem is further complicated by the flood-water and solid matter brought down by the mountain torrents, which choke up the channels made. By a law passed in 1899, the proprietors are bound to arrange for the safe outlet of the water from the mountains, keep the existing canals open, and reclaim the district exposed to inundation, within a period of twenty-four years. The sum of £280,000 has been granted towards the expense by the government.

See T. Berti, *Paludi pontine* (Rome, 1884); R. de la Blanchère, *Un Chapitre d'histoire pontine* (Paris, 1889). (T. As.)

PONANI, a seaport on the west coast of India, in Malabar district, Madras, at a mouth of a river of the same name. Pop. (1901), 10,562. It is the headquarters of the Moplah or Mappilla community of Mahommedans, with a religious college and many mosques, one of which is said to date from 1510. There is a large export of coco-nut products.

PONCA, a tribe of North-American Indians of Siouan stock. They were originally part of the Omaha tribe, with whom they lived near the Red River of the North. They were driven westward by the Dakotas, and halted on the Ponca river, Dakota. After a succession of treaties and removals they were placed on a reservation at the mouth of the Niobrara, where they were prospering, when their lands were forcibly taken from them, and they were removed to Indian Territory (Oklahoma). During the march thither and in their new quarters, the tribe's health suffered, so that in 1878 they revolted and made their way back to the Omahas. They were recaptured, but public attention having been drawn to their hard case they were liberated in 1880, after a long trial, which resulted in their being declared United States citizens. They number some 700, mostly in Oklahoma.

PONCE, a seaport and the second largest city of Porto Rico, the seat of government of the Department of Ponce, on the south coast, about 50 m. (84 m. by the military road) S.W. of San Juan. Pop. (1899), 27,952, of whom 2554 were negroes and 9942 of mixed races; (1910), 35,027. It is served by the American Railroad of Porto Rico, by a railway to Guayama (1910), and by steamboats from numerous ports; an old military road connects it with San Juan. Ponce consists of two parts: Ponce, or the city proper, and Ponce Playa, or the seaport; they are separated by the Portuguese River and are connected by an electric street railway. Ponce Playa is on a spacious bay and is accessible to vessels drawing 25 ft. of water; Ponce is 2 m. inland at the interior margin of a beautiful plain, with hills in the rear rising to a height of 1000 to 2000 ft. The city is supplied with water by an aqueduct about 2 m. long. There are two attractive public squares in the heart of the city: Plaza Principal and Plaza de las Delicias. Among prominent public buildings are the city hall, the custom-house, the Pearl theatre, several churches—Roman Catholic (including a finely decorated cathedral) and Protestant; St Luke's hospital and insane asylum, an asylum for the blind, a ladies' asylum, a home for the indigent and aged, and a military barracks. At the Quintana Baths near the city are thermal springs with medicinal properties. The surrounding country is devoted chiefly to the cultivation of sugar cane, tobacco, oranges and cacao, and to the grazing of cattle. Among the manufactures are sugar, molasses, rum, and ice, and prepared coffee for the market. Ponce, named in honour of Ponce de Leon, was founded in 1752 upon the site of a settlement which had been established in the preceding century, was incorporated as a town in 1848, and was made a city in 1878.

PONCELET, JEAN VICTOR (1788–1867), French mathematician and engineer, was born at Metz on the 1st of July 1788. From 1808 to 1810 he attended the *École polytechnique*, and afterwards, till 1812, the *École d'application* at Metz. He then became lieutenant of engineers, and took part in the Russian campaign, during which he was taken prisoner and was confined at Saratov on the Volga. It was during his imprisonment here that, "privé de toute espèce de livres et de secours, surtout distrait par les malheurs de ma patrie et les miens propres," as he himself puts it, he began his researches on projective geometry which led to his great treatise on that subject. This work, the *Traité des propriétés projectives des figures*, which was published in 1822 (2d ed., 2 vols. 1865–1866), is occupied with the investigation of the projective properties of figures (see GEOMETRY). This work entitles Poncelet to rank as one of the greatest of those who took part in the development of the modern geometry of which G. Monge was the founder. From 1815 to 1825 he was occupied with military engineering at Metz; and from 1825 to 1835 he was professor of mechanics at the *École d'application* there. In 1826, in his *Mémoire sur les roues hydrauliques à aubes courbes*, he brought forward improvements in the construction of water-wheels, which more than doubled their efficiency. In 1834 he became a member of the *Académie*; from 1838 to 1848 he was professor to the faculty of sciences at Paris, and from 1848 to 1850 commandant of the *École polytechnique*. At the London International Exhibition of 1851 he had charge of the department of machinery, and wrote a report on the machinery and tools on view at that exhibition. He died at Paris on the 23rd of December 1867.

See J. Bertrand, *Éloge historique de Poncelet* (Paris, 1875).

PONCHER, ÉTIENNE DE (1446–1524), French prelate and diplomatist. After studying law he was early provided with a prebend, and became councillor at the parlement of Paris in 1485 and president of the Chambre des Enquêtes in 1498. Elected bishop of Paris in 1503 at the instance of Louis XII., he was entrusted by the king with diplomatic missions in Germany and Italy. After being appointed chancellor of the duchy of Milan, he became keeper of the seals of France in 1512, and retained that post until the accession of Francis I., who employed him on various diplomatic missions. Poncher became archbishop of Sens in 1519. His valuable *Constitutions synodales* was published in 1514.

PONCHIELLI, AMILCARE (1834–1886), Italian musical composer, was born near Cremona on the 1st of September 1834. He studied at the Milan Conservatoire. His first dramatic work, written in collaboration with two other composers, was *Il Sindaco Babbeo* (1851). After completing his studies at Milan he returned to Cremona, where his opera *I Promessi sposi* was produced in 1856. This was followed by *La Savojarda* (1861, produced in a revised version as *Lina* in 1877), *Roderigo, rè dei Goti* (1864), and *La Stella del monte* (1867). A revised version of *I Promessi sposi*, which was produced at Milan in 1872, was his first genuine success. After this came a ballet, *Le Due Gemelle* (1873), and an opera, *I Lituani* (1874, produced in a revised version as *Alduna* in 1884). Ponchielli reached the zenith of his fame with *La Gioconda* (1876), written to a libretto founded by Arrigo Boito upon Victor Hugo's tragedy, *Angelo, Tyran de Padoue*. *La Gioconda* was followed by *Il Figliuol prodigo* (1880) and *Marion Delorme* (1885). Among his less important works are *Il Parlatore eterno*, a musical farce (1873), and a ballet, *Clarina* (1873). In 1881 Ponchielli was made maestro di cappella of Piacenza Cathedral. His music shows the influence of Verdi, but at its best it has a distinct value of its own, and an inexhaustible flow of typically Italian melody. His fondness for fanciful figures in his accompaniments has been slavishly imitated by Mascagni, Leoncavallo, and many of their contemporaries. Ponchielli died at Milan on the 17th of January 1886.

PONCHO (a South American Spanish word, adopted from the Araucanian *poncho* or *pontho* in the 17th century), a form of cloak worn originally by the South American Indians, and afterwards adopted by the Spaniards living in South America. It is merely a long strip of cloth, doubled, with a hole for the head.

POND, JOHN (*c.* 1767–1836), English astronomer-royal, was born about 1767 in London, where his father made a fortune in trade. He entered Trinity College, Cambridge, at the age of sixteen, but took no degree, his course being interrupted by severe pulmonary attacks which compelled a long residence abroad. In 1800 he settled at Westbury near Bristol, and began to determine star-places with a fine altitude and azimuth circle of 2½ ft. diameter by E. Troughton. His demonstration in 1806 (*Phil. Trans.* xcvi. 420) of a change of form in the Greenwich mural quadrant led to the introduction of astronomical circles at the Royal Observatory, and to his own appointment as its head. He was elected a fellow of the Royal Society on the 26th of February 1807; he married and went to live in London in the same year, and in 1811 succeeded Maskelyne as astronomer-royal.

During an administration of nearly twenty-five years Pond effected a reform of practical astronomy in England comparable to that effected by Bessel in Germany. In 1821 he began to employ the method of observation by reflection; and in 1825 he devised means (see *Mem. Roy. Astron. Soc.* ii. 499) of combining two mural circles in the determination of the place of a single object, the one serving for direct and the other for reflected vision. Under his auspices the instrumental equipment at Greenwich was completely changed, and the number of assistants increased from one to six. The superior accuracy of his determinations was attested by S. C. Chandler's discussion of them in 1894, in the course of his researches into the variation of latitude (*Astron. Journ.* Nos. 313, 315). He persistently controverted (1810–1824) the reality of J. Brinkley's imaginary star-parallaxes (*Phil. Trans.* cviii. 477, cxiii. 53). Delicacy of health compelled his retirement in the autumn of 1835. He died at Blackheath on the 7th of September 1836, and was buried beside Halley in the churchyard of Lee. The Copley medal was conferred upon him in 1823, and the Lalande prize in 1817 by the Paris Academy, of which he was a corresponding member. He published eight folio volumes of *Greenwich Observations*, translated Laplace's *Système du monde* (in 2 vols. 8vo., 1809), and contributed thirty-one papers to scientific collections. His catalogue of 1112 stars (1833) was of great value.

See *Mem. Roy. Astron. Soc.* x. 357; *Proc. Roy. Soc.* iii. 434; *Penny Cyclopaedia* (De Morgan); F. W. Bessel, *Pop. Vorlesungen*, p. 543; *Report Brit. Assoc.* i. 128, 136 (Airy); Sir G. Airy's *Autobiography*, p. 127; *Observatory*, xiii. 204, xxii. 357; *Annual Biography and Obituary* (1837); R. Grant, *Hist. of Phys. Astron.* p. 491; Royal Society's *Cat. Scient. Papers.*

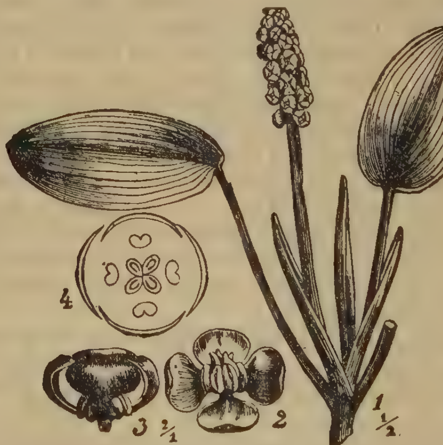
POND, a small pool or body of standing water, a word often applied to one for which the bed has been artificially constructed. The word is a variant of "pound" (*q.v.*), an enclosure.

PONDICHERRY, the capital of the French possessions in India, situated on the Coromandel or western coast, 122 m. by rail S. of Madras. The territory, which is entirely surrounded by the British district of South Arcot, has an area of 115 sq. m. with a population (1901) of 174,456. The chief crops are dry grains, rice, earth-nuts and a little indigo. The territory is traversed by a branch of the South Indian railway from Villapuram. The town has a population of 27,448. It is well laid out with fine public buildings; the water-supply is derived from artesian wells. It has an open roadstead, with a small iron pier. The port is visited yearly by 500 vessels, and has trade of the value of about some £1,300,000. The principal imports are areca-nuts, wines and liqueurs, and the chief exports ground-nuts, oil, cotton fabrics and rice. Of the export trade more than one-half is with France, but of the import trade only one-fourth. The weaving of various fabrics forms the principal industry.

Pondicherry was founded in 1683 by François Martin, on the site of a village given him by the governor of Gingee. In 1693 the Dutch took Pondicherry, but restored it, with the fortifications greatly improved, in 1697, at the peace of Ryswick. In 1748 Admiral Boscawen laid siege to it without success, but in 1761 it was taken by Colonel Coote from Lally. In 1763 it was restored to the French. In 1778 it was again taken by Sir Hector Munro, and its fortifications destroyed. In 1783 it was retransferred to the French, and in 1793 recaptured by the English. The treaty of Amiens in 1802 restored it to the French, but it was retaken in 1803. In 1816 it was finally restored to the French.

PONDO, a Kaffir people who have given their name to Pondoland, the country comprising much of the seaboard of Kaffraria, Cape province, immediately to the south-west of Natal. The Pondo, who number about 200,000, are divided into several tribal groups, but the native government, since the annexation of the country to Cape Colony in 1894, has been subject to the control of the colonial authorities. (See KAFFIRS.)

PONDWEED, a popular name for *Potamogeton natans*, a cosmopolitan aquatic plant found in ponds, lakes and ditches, with broad, more or less oblong-ovate, olive-green, floating leaves. The name is also applied to other species of *Potamogeton*, one of the characteristic genera of lakes, ponds and streams all over the world, but more abundant in temperate regions. It is the principal genus of the natural order of Monocotyledous Potamogetonaceae, and contains plants with slender branched stems, and submerged and translucent, or floating and opaque, alternate or opposite leaves, often with membranous united stipules. The small flowers are borne above the water in axillary or terminal spikes; they have four stamens, which bear at the back four small herbaceous petal-like structures, and four free carpels, which ripen to form four small green fleshy fruits, each containing one seed within a hard inner coat; the seed contains a large hooked embryo. An allied genus *Zannichellia* (named after Zanichelli, a Venetian botanist), occurring in fresh and brackish ditches and pools in Britain, and also widely distributed in temperate and tropical regions, is known as horned pondweed, from the curved fruit.



(After Wossidlo. From Strasburger's *Lehrbuch der Botanik.*)

Potamogeton natans.

1, Apex of flowering shoot.
2, Flower viewed from above.
3, Flower viewed from the side.
4, Diagram of flower.

PONIARD, a dagger, particularly one of small size, used for stabbing at close quarters. The French word *poignard*, from which the English is a 16th-century adaptation, is formed from *poing*, fist, the clenched hand in which the weapon is grasped. (See Dagger.)

PONIATOWSKI, the name of a Polish princely family of Italian origin, tracing descent from Giuseppe Torelli, who married about 1650 an heiress of the Lithuanian family of Poniator, whose name he assumed.

The first of the Poniatowskis to distinguish himself was Stanislaus Poniatowski (1677–1762), who only belonged to the family by adoption, being the reputed son of Prince Sapieha and a Jewess. He was born at Dereczyn in Lithuania, and was adopted by Sapieha's intendant, Poniatowski. With his father he attached himself to the party of Stanislaus Leszczynski, and became major-general in the army of Charles XII. of Sweden. After the defeat of Pultowa he conveyed Charles XII. across the Dnieper, and remained with him at Bender. From there he was sent to Constantinople, where he extracted from the sultan Achmet III. a promise to march to Moscow. When the grand vizier, Baltagi Mehemet, permitted the tsar Peter I. to retreat unharmed from the banks of the Pruth, Poniatowski exposed his treason. He rejoined Leszczynski in the duchy of Zweibrücken, Bavaria, of which he became governor. After the death of Charles XII. in 1718 he visited Sweden; and was subsequently reconciled with Leszczynski's rival on the throne of Poland, Augustus II., who made him grand treasurer of Lithuania in 1724. On the death of Augustus II. he tried to secure the reinstatement of Leszczynski, who then resumed his claims to the Polish crown. He was taken prisoner at Danzig by the Russians, and presently gave his allegiance to Augustus III., by whom he was made governor of Cracow. He died at Ryki on the 3rd of August 1762.

His second son Stanislaus Augustus became king of Poland (see Stanislaus II.). Of the other sons, Casimir (1721–1780) was his brother's chancellor; Andrew (1735–1773) entered the Austrian service, rising to the rank of feldzeugmeister; and Michael (1736–1794) became archbishop of Gnesen and primate of Poland. Joseph Anthony Poniatowski (*q.v.*), son of Andrew, became one of Napoleon's marshals.

Stanislaus Poniatowski (1757–1833), son of Casimir, shared in the aggrandisement of the family during the reign of Stanislaus II., becoming grand treasurer of Lithuania, starost of Podolia and lieutenant-general of the royal army. In 1793 he settled in Vienna, and subsequently in Rome, where he made a magnificent collection of antique gems in his house on the Via Flaminia. This collection was sold at Christie's in London in May 1839. He died in Florence on the 13th of February 1833, and with him the Polish and Austrian honours became extinct.

His natural, but recognized, son, Joseph Michael Xavier Francis John Poniatowski (1816–1873), was born at Rome and in 1847 was naturalized as a Tuscan subject. He received the title of prince in Tuscany (1847) and in Austria (1850). He had studied music under Ceccherini at Florence, and wrote numerous operas, in the first of which, *Giovanni di Procida*, he sang the title rôle himself at Lucca in 1838. He represented the court of Tuscany in Paris from 1848, and he was made a senator by Napoleon III., whom he followed to England in 1871. His last opera, *Gelmina*, was produced at Covent Garden in 1872. He died on the 3rd of July 1873, and was buried at Chislehurst. His son, Prince Stanislaus Augustus, married and settled in Paris. He was equerry to Napoleon III., and died in January 1908.

PONIATOWSKI, JOSEPH ANTHONY (1763–1813), Polish prince and marshal of France, son of Andrew Poniatowski and the countess Theresa Kinsky, was born at Warsaw in 1763. Adopting a military career, he joined the Imperial army when Austria declared war against the Turks in 1788, and distinguished himself at the storming of Sabac on the 25th of April, where he was seriously wounded. Recalled by his uncle King Stanislaus when the Polish army was reorganized, he received the rank of major-general, and subsequently that of lieutenant-general, and devoted himself zealously to the improvement of the national forces. In 1789, when Poland was threatened by the armed intervention of Russia, he was appointed commander of the Ukraine division at Braclaw on Bug. After the proclamation of the constitution of the 3rd of May 1791 he was appointed commander-in-chief, with instructions to guard the banks of the Dniester and Dnieper. On the outbreak of the war with Russia, Prince Joseph, aided by Kosciuszko, displayed great ability. Obliged constantly to retreat, but disputing every point of vantage, he turned on the pursuer whenever he pressed too closely, and won several notable victories. At Polonna the Russians were repulsed with the loss of 3000 men; at Dubienka the line of the Bug was defended for five days against fourfold odds; at Zielence the Poles won a still more signal victory. Finally the Polish arms converged upon Warsaw, and were preparing for a general engagement when a courier from the capital informed the generals that the king had acceded to the confederation of Targowica (see Poland: *History*) and had at the same time guaranteed the adhesion of the army. All hostilities were therefore to be suspended. After an indignant but fruitless protest, Poniatowski and most of the other generals threw up their commissions and emigrated. During the Kosciuszko rising he again fought gallantly for his country under his former subordinate, and after the fall of the republic resided as a private citizen at Warsaw for the next ten years. After Jena and the evacuation of the Polish provinces by Prussia, Poniatowski was offered the command of the National Guard; he set about reorganizing the Polish army, and on the creation of the grand duchy of Warsaw was nominated war minister. During the war of 1809, when an Austrian army corps under the archduke Ferdinand invaded the grand duchy, Poniatowski encountered them at the bloody battle of Radzyn, and though compelled to abandon Warsaw ultimately forced the enemy to evacuate the grand duchy, and captured Cracow. In Napoleon's campaign against Russia in 1812 Poniatowski commanded the fifth army corps; and after the disastrous retreat of the grand army, when many of the Poles began to waver in their allegiance to Napoleon, Poniatowski remained faithful and formed a new Polish army of 13,000 men with which he joined the emperor at Lützen. In the campaign of 1813 he guarded the passes of the Bohemian mountains and defended the left bank of the Elbe. As a reward for his brilliant services at the three days' battle of Leipzig he was made a marshal of France and entrusted with the honourable but dangerous duty of covering the retreat of the army. Poniatowski heroically defended Leipzig, losing half his corps in the attempt, finally falling back slowly upon the bridge over the Elster which the French in the general confusion blew up before he reached it. Contesting every step with the overwhelming forces of the pursuers, he refused to surrender, and covered with wounds plunged into the river, where he died fighting to the last. His relics were conveyed to Poland and buried in Cracow Cathedral, where he lies by the side of Tadeusz Kosciuszko and Jan Sobieski. Poniatowski's *Mes souvenirs sur la campagne de 1792* (Lemberg, 1863) is a valuable historical document.

See Stanislaw Kostka Boguslawski, *Life of Prince Joseph Poniatowski* (Pol.; Warsaw, 1831); Franciszek Paszkowski, *Prince Joseph Poniatowski* (Pol.; Cracow, 1898); *Correspondence of Poniatowski* (ed. E. Raczynski, Posen, 1843); Bronislaw Dembinski, *Stanislaus Augustus and Prince Joseph Poniatowski in the light of their Correspondence* (Fr.; Lemberg, 1904); Szymon Askenazy, *Prince Joseph Poniatowski* (Pol.; Warsaw, 1905). (R. N. B.)

PONS, JEAN LOUIS (1761–1831), French astronomer, was born at Peyres (Hautes Alpes) on the 24th of December 1761. He entered the Marseilles observatory in 1789, and in 1819 became the director of the new observatory at Marlia near Lucca, which he left in 1825 for the observatory of the museum at Florence. Here he died on the 14th of October 1831. Between 1801 and 1827 Pons discovered thirty-seven comets, one of which (observed on the 26th of November 1818) was named after J. F. Encke, who determined its remarkably short period.

See M. R. A. Henrion, *Annuaire biographique*, i. 288 (Paris, 1834); *Memoirs Roy. Astron. Soc.* v. 410; R. Wolf, *Geschichte der Astronomie*, p. 709; J. C. Poggendorff, *Biog. lit. Handwörterbuch.*

PONSARD, FRANÇOIS (1814–1867), French dramatist, was born at Vienne, department of Isère, on the 1st of June 1814. He was bred a lawyer, and his first performance in literature was a translation of *Manfred* (1837). His play *Lucrèce* was represented at the *Théâtre Français* on the 1st of April 1843. This date is a kind of epoch in literature and dramatic history, because it marked a reaction against the romantic style of Dumas and Hugo. He received in 1845 the prize awarded by the Academy for a tragedy "to oppose a dike to the waves of romanticism." Ponsard adopted the liberty of the romantics with regard to the unities of time and place, but he reverted to the more sober style of earlier French drama. The tastes and capacities of the greatest tragic actress of the day, Rachel, suited his methods, and this contributed greatly to his own popularity. He followed up *Lucrèce* with *Agnès de Méranie* (1846), *Charlotte Corday* (1850), and others. Ponsard accepted the empire, though with no very great enthusiasm, and received the post of librarian to the senate, which, however, he soon resigned, fighting a bloodless duel with a journalist on the subject. *L'Honneur et l'argent*, one of his most successful plays, was acted in 1853, and he became an Academician in 1855. For some years he did little, but in 1866 he obtained great success with *Le Lion amoureux*, another play dealing with the revolutionary epoch. His *Galilée*, which excited great opposition in the clerical camp, was produced early in 1867. He died in Paris on the 7th of July of the same year, soon after his nomination to the commandership of the Legion of Honour. Most of Ponsard's plays hold a certain steady level of literary and dramatic ability, but his popularity is in the main due to the fact that his appearance coincided with a certain public weariness of the extravagant and unequal style of 1830.

His *Œuvres complètes* were published in Paris (3 vols., 1865–1876). See *La Fin du théâtre romantique et François Ponsard d'après des documents inédits* (1899), by C. Latreille.

PONSONBY, JOHN (1713–1789), Irish politician, second son of Brabazon Ponsonby, 1st earl of Bessborough, was born on the 29th of March 1713. In 1739 he entered the Irish parliament and in 1744 he became first commissioner of the revenue; in 1746 he was appointed a privy councillor, and in 1756 Speaker of the Irish House of Commons. Belonging to one of the great families which at this time monopolized the government of Ireland, Ponsonby was one of the principal "undertakers," men who controlled the whole of the king's business in Ireland, and he retained the chief authority until the marquess Townshend became lord-lieutenant in 1767. Then followed a struggle for supremacy between the Ponsonby faction and the party dependent on Townshend, one result of this being that Ponsonby resigned the speakership in 1771. He died on the 12th of December 1789. His wife was Elizabeth, daughter of William Cavendish, 3rd duke of Devonshire, a connexion which was of great importance to the Ponsonbys.

Ponsonby's third son, George Ponsonby (1755–1817), lord chancellor of Ireland, was born on the 5th of March 1755 and was educated at Trinity College, Cambridge. A barrister, he became a member of the Irish parliament in 1776 and was chancellor of the Irish exchequer in 1782, afterwards taking a prominent part in the debates on the question of Roman Catholic relief, and leading the opposition to the union of the parliaments. After 1800 Ponsonby represented Wicklow and then Tavistock in the united parliament; in 1806 he was lord chancellor of Ireland, and from 1808 to 1817 he was the official leader of the opposition in the House of Commons. He left an only daughter when he died in London on the 8th of July 1817.

George Ponsonby's elder brother, William Brabazon Ponsonby, 1st Baron Ponsonby (1744–1806), was also a leading Whig politician, being a member of the Irish, and after 1800, of the British parliament. In 1806 shortly before his death he was created Baron Ponsonby of Imokilly. Three of his sons were men of note. The eldest was John (*c.* 1770–1855), who succeeded to the barony and was created a viscount in 1839; he was ambassador at Constantinople from 1832 to 1837 and at Vienna from 1846 to 1850. The second son was Major-General Sir William Ponsonby (1772–1815), who, after serving in the Peninsular War, was killed at the battle of Waterloo whilst leading a brigade of heavy cavalry. Another son was Richard Ponsonby (1772–1853), bishop of Derry. Sir William Ponsonby's posthumous son William (1816–1861) became 3rd Baron Ponsonby on the death of his uncle John, Viscount Ponsonby; he died childless and was succeeded by his cousin William Brabazon Ponsonby (1807–1866), only son of the bishop of Derry, on whose death the barony of Ponsonby became extinct.

Among other members of this family may be mentioned Major-General Sir Frederick Cavendish Ponsonby (1783–1837), son of the 3rd earl of Bessborough, a soldier who distinguished himself at the battles of Talavera, Salamanca and Vittoria, in the Peninsular War, and was wounded at Waterloo; he was governor of Malta from 1826 to 1835. His eldest son, Sir Henry Frederick Ponsonby (1825–1895), a soldier who served in the Crimea, is best remembered as private secretary to Queen Victoria from 1870 until a few months before his death.

PONSON DU TERRAIL [Pierre Alexis de Ponson], Vicomte de (1829–1871), French romance writer, was born at Montmaur (Isère) on the 8th of July 1829. He was a prolific novelist, producing in the space of two years some seventy-three volumes. Among his most successful productions were *Les Coulisses du monde* (1853), *Exploits de Rocambole* (1859), *Les Drames de Paris* (1865) and *Le Forgeron de la Cour-Dieu* (1869). He died at Bordeaux on the 20th of January 1871.

PONT (or Kylpont), **ROBERT** (1524–1606), Scottish reformer, was educated at St Andrews. In 1562 he was appointed minister at Dunblane and then at Dunkeld; in 1563, commissioner for Moray, Inverness and Banff. Then in succession he became minister of Birnie (1567), provost of Trinity College near Edinburgh (1571), a lord of session (1572), minister of St Cuthbert's, Edinburgh (1573) and at St Andrews (1581). Pont was a strenuous champion of ecclesiastical independence, and for protesting against parliamentary interference in church government he was obliged to leave his country. From 1584 to 1586 he was in England, but returning north he resumed his prominence in church matters and kept it until his death in 1606. His elder son Timothy Pont (1560?–1614?) was a good mathematician, surveyor, and "the first projector of a Scottish atlas."

PONTA DELGADA, the capital of an administrative district, comprising the islands of St Michael's and St Mary in the Portuguese archipelago of the Azores. Pop. (1900), 17,620. Ponta Delgada is built on the south coast of St Michael's, in 37° 40′ N. and 25° 36′ W. Its mild climate, and the fine scenery of its mountain background, render it very attractive to visitors; it is the commercial centre, and the most populous city of the archipelago. Besides the cathedral, it contains several interesting churches and monasteries, and an observatory. Formerly its natural inner harbour only admitted vessels of light draught, while larger ships were compelled to anchor in an open roadstead, which was inaccessible during the prevalence of southerly gales. But great improvements were effected after 1860 by the construction of a breakwater 2800 ft. long.

PONT-À-MOUSSON, a town of northern France in the department of Meurthe-et-Moselle, 17 m. N.N.W. of Nancy by rail. Pop. (1906), 12,282. The Moselle, which is canalized, divides the town into two quarters, united by a bridge of the late 16th century. The church of St Martin, dating from the 13th, 14th and 15th centuries, has a handsome façade with two towers, and in the interior a choir screen and Holy Sepulchre of the 15th century. The lower ecclesiastical seminary occupies the building of an old Premonstratensian convent. There are several interesting old houses. The town has a communal college and engineering workshops, blast furnaces, and manufactures of lacquered ware, paper, cardboard, cables and iron-ware. Dating from the 9th or 10th century, Pont-à-Mousson constituted a lordship, which was made a marquisate in 1354. It was from 1572 to 1763 the seat of a well-known university.

PONTANUS, JOVIANUS (1426–1503), Italian humanist and poet, was born in 1426 at Cerreto in the duchy of Spoleto, where his father was murdered in one of the frequent civil brawls which then disturbed the peace of Italian towns. His mother escaped with the boy to Perugia, and it was here that Pontano received his first instruction in languages and literature. Failing to recover his patrimony, he abandoned Umbria, and at the age of twenty-two established himself at Naples, which continued to be his chief place of residence during a long and prosperous career. He here began a close friendship with the distinguished scholar, Antonio Beccadelli, through whose influence he gained admission to the royal chancery of Alphonso the Magnanimous. Alphonso discerned the singular gifts of the young scholar, and made him tutor to his sons. Pontano's connexion with the Aragonese dynasty as political adviser, military secretary and chancellor was henceforth a close one; and the most doubtful passage in his diplomatic career is when he welcomed Charles VIII. of France upon the entry of that king into Naples in 1495, thus showing that he was too ready to abandon the princes upon whose generosity his fortunes had been raised. Pontano illustrates in a marked manner the position of power to which men of letters and learning had arrived in Italy. He entered Naples as a penniless scholar. He was almost immediately made the companion and trusted friend of its sovereign, loaded with honours, lodged in a fine house, enrolled among the nobles of the realm, enriched, and placed at the very height of social importance. Following the example of Pomponio Leto in Rome and of Cosimo de' Medici at Florence, Pontano founded an academy for the meetings of learned and distinguished men. This became the centre of fashion as well as of erudition in the southern capital, and subsisted long after its founder's death. In 1461 he married his first wife, Adriana Sassone, who bore him one son and three daughters before her death in 1491. Nothing distinguished Pontano more than the strength of his domestic feeling. He was passionately attached to his wife and children; and, while his friend Beccadelli signed the licentious verses of *Hermaphroditus*, his own Muse celebrated in liberal but loyal strains the pleasures of conjugal affection, the charm of infancy and the sorrows of a husband and a father in the loss of those he loved. Not long after the death of his first wife Pontano took in second marriage a beautiful girl of Ferrara, who is only known to us under the name of Stella. Although he was at least sixty-five years of age at this period, his poetic faculty displayed itself with more than usual warmth and lustre in the glowing series of elegies, styled *Eridanus*, which he poured forth to commemorate the rapture of this union. Stella's one child, Lucilio, survived his birth but fifty days; nor did his mother long remain to comfort the scholar's old age. Pontano had already lost his only son by the first marriage; therefore his declining years were solitary. He died in 1503 at Naples, where a remarkable group of terra-cotta figures, life-sized and painted, still adorns his tomb in the church of Monte Oliveto. He is there represented together with his patron Alphonso and his friend Sannazzaro in adoration before the dead Christ.

As a diplomatist and state official Pontano played a part of some importance in the affairs of southern Italy and in the Barons' War, the wars with Rome, and the expulsion and restoration of the Aragonese dynasty. But his chief claim upon the attentions of posterity is as a scholar. His writings divide themselves into dissertations upon such topics as the "Liberality of Princes" or "Ferocity," composed in the rhetorical style of the day, and poems. He was distinguished for energy of Latin style, for vigorous intellectual powers, and for the faculty, rare among his contemporaries, of expressing the facts of modern life, the actualities of personal emotion, in language sufficiently classical yet always characteristic of the man. His prose treatises are more useful to students of manners than the similar lucubrations of Poggio. Yet it was principally as a Latin poet that he exhibited his full strength. An ambitious didactic composition in hexameters, entitled *Urania*, embodying the astronomical science of the age, and adorning this high theme with brilliant mythological episodes, won the admiration of Italy. It still remains a monument of fertile invention, exuberant facility and energetic handling of material. Not less excellent is the didactic poem on orange trees, *De hortis Hesperidum*. His most original compositions in verse, however, are elegiac and hendecasyllabic pieces on personal topics—the *De conjugali amore*, *Eridanus*, *Tumuli*, *Naeniae*, *Baiae*, &c.—in which he uttered his vehemently passionate emotions with a warmth of southern colouring, an evident sincerity, and a truth of painting from reality which excuse their erotic freedom.

Pontano's prose and poems were printed by the Aldi at Venice. For his life see Ardito, *Giovanni Pontano e i suoi tempi* (Naples, 1871); for his place in the history of literature, Symonds, *Renaissance in Italy*. (J. A. S.)

PONTARLIER, a frontier town of eastern France, capital of an arrondissement in the department of Doubs, 36 m. S.E. of Besançon by road. Pop. (1906), 7896. It is situated 2750 ft. above sea-level on the Doubs, about four miles from the Swiss frontier, and forms an important strategic point at the mouth of the defile of La Cluse, one of the principal passes across the Jura. The pass is defended by the modern fort of Larmont, and by the Fort de Joux, which was originally built in the 10th century by the family of Joux and played a conspicuous part in the history of Franche-Comté. Pontarlier is the junction of railway lines to Neuchâtel, Lausanne, Lons-le-Saunier, Dôle and Besançon. A triumphal arch of the 18th century commemorates the reconstruction of the town after the destructive fire of 1736. It was at Pontarlier that the French army of the East made its last stand against the Prussians in 1871 before crossing the Swiss frontier. The distillation of herbs, extensively cultivated for the manufacture of absinthe, kirsch and other liqueurs, is the chief industry. The town is the seat of a subprefect and has a tribunal of first instance and a communal college.

PONT AUDEMER, a town of north-western France, capital of an arrondissement in the department of Eure, 39 m. N.W. of Evreux, on the Risle, a left-bank affluent of the Seine, and on the railway from Evreux to Honfleur. Pop. (1906), 5700. The church of St Ouen, which has fine stained glass of the 16th century, combines the late Gothic and Renaissance styles; its choir is Romanesque. Local institutions are the sub-prefecture, a tribunal of first instance, a board of trade-arbitration, a chamber and tribunal of commerce. Manufacturing industry is active, and includes the founding of malleable metal, a spur factory, the manufacture of glue and paper, cotton-spinning and various branches of leather manufacture. There is trade in flax, wool, grain, cattle, cider, paper, iron, wood and coal. The port has a length of over half a mile on the Risle, which is navigable for small vessels from this point to its mouth (10 m.). The town owes its name to Audomar, a Frank lord, who in the 7th or 8th century built a bridge over the Risle at this point. It was the scene of several provincial ecclesiastical councils in the 12th and 13th centuries and of meetings of the estates of Normandy in the 13th century.

PONTE (Ital. for "bridge"), a rough game peculiar to the city of Pisa, in which the players, divided into two sides and provided with padded costumes, contended for the possession of one of the bridges over the Arno. The weapon used, both for offence and defence, was a kind of shield which served as a club as well.

A history and description of the game may be found in William Heywood's *Palio and Ponte* (London, 1904).

PONTECORVO, a city of Campania, Italy, in the province of Caserta, on the Garigliano, about 48 m. from Caserta and 3 m. from Aquino on the railway from Rome to Naples. Pop. (1901), 10,518 (town); 12,492 (commune). The town is approached by a triumphal arch adorned with a statue of Pius IX. The principality of Pontecorvo (about 40 sq. m. in extent), once an independent state, belonged alternately to the Tomacelli and the abbots of Monte Cassino. Napoleon bestowed it on Bernadotte in 1806, and in 1810 it was incorporated with the French Empire.

PONTÉCOULANT, LOUIS GUSTAVE LE DOULCET, COMTE DE (1764–1853), French politician, was born at Caen on the 17th of November 1764. He began a career in the army in 1778.

A moderate supporter of the revolution, he was returned to the Convention for the department of Calvados in 1792, and became commissary with the army of the North. He voted for the imprisonment of Louis XVI. during the war, and his banishment after the peace. He then attached himself to the party of the Gironde, and in August 1793 was outlawed. He had refused to defend his compatriot Charlotte Corday, who wrote him a letter of reproach on her way to the scaffold. He returned to the Convention on the 8th of March 1795, and showed an unusual spirit of moderation by defending Prieur de la Marne and Robert Lindet. President of the Convention in July 1795, he was for some months a member of the council of public safety. He was subsequently elected to the council of five hundred, but was suspected of royalist leanings, and had to spend some time in retirement before the establishment of the consulate. Becoming senator in 1805, and count of the empire in 1808, he organized the national guard in Franche Comté in 1811, and the defence of the north-eastern frontier in 1813. At the first restoration Louis XVIII. made him a peer of France, and although he received a similar honour from Napoleon during the Hundred Days, he sat in the upper house under the Second Restoration. He died in Paris on the 3rd of April 1853, leaving memoirs and correspondence from which were extracted four volumes (1861–1865) of *Souvenirs historiques et parlementaires 1764–1848.*

His son Louis Adolphe Le Doulcet, comte de Pontécoulant (1794–1882), served under Napoleon in 1812 and 1814, and then emigrated to Brazil, where he took part in the abortive insurrection at Pernambuco in 1817. He also organized a French volunteer contingent in the Belgian revolution of 1830, and was wounded at Louvain. The rest of his life was spent in Paris in the study of ancient music and acoustics. Among his works was one on the *Musée instrumental du conservatoire de musique* (1864). A younger brother, Philippe Gustave Le Doulcet, comte de Pontécoulant (1795–1874), served in the army until 1849, when he retired to devote himself to mathematics and astronomy. His works include *Théorie analytique du système du monde* (Paris, 1829–1846) and *Traité élementaire de physique céleste* (2 vols., Paris, 1840).

PONTEFRACT (pronounced and sometimes written " Pomfret "), a market town and municipal and parliamentary borough in the West Riding of Yorkshire, England, 21 m. S.S.W. from York, served by the Midland, North-Eastern and Lancashire & Yorkshire railways. Pop. (1891), 9702; (1901), 13,427. It is well situated, mainly on an eminence, near the junction of the Aire and the Calder. The most important of the antiquarian remains are the ruins of the famous castle situated on a rocky height, originally covering with its precincts an area of over 8 acres, and containing in all eight round towers. The remains are principally of Norman date, and an unusual feature of the stronghold is the existence of various subterranean chambers in the rock. Below the castle is All Saints church, which suffered severely during the siege of the castle, but still retains some work of the 12th century. In 1837 the tower and transepts were fitted for divine service. The church of St Giles, formerly a chapel of ease to All Saints, but made parochial in the 18th century, is of Norman date, but most of the present structure is modern. The 17th-century spire was removed in 1707, and replaced by a square tower, which was rebuilt in 1797; the chancel was rebuilt in 1869. In Southgate is an ancient hermitage and oratory cut out of the solid rock, which dates from 1396. On St Thomas's Hill, where Thomas, earl of Lancaster, was beheaded in 1322, a chantry was erected in 1373, the site of which is now occupied by a windmill built of its stones. At Monkhill there are the remains of a Tudor building called the Old Hall, probably constructed out of the old priory of St John's. A grammar school of ancient foundation, renewed by Elizabeth and George III., occupies modern buildings. The town-hall was built at the close of the 18th century on the site of one erected in 1656, which succeeded the old moot-hall dating from Saxon times. Among other buildings are the court house, the market hall, the assembly rooms (a handsome building adjoining the town-hall), and large barracks. The foundation of the principal almshouse, that of St Nicholas, dates from before the Conquest. Trinity Hospital was founded by Sir Robert Knolles (d. 1407), an eminent military commander in the French wars of Edward III. At Ackworth, in the neighbourhood, there is a large school of the Society of Friends or Quakers (1778), in the foundation of which Dr John Fothergill (1712–1780) was a prime mover. There are extensive gardens and nurseries in the neighbourhood of Pontefract, and liquorice is largely grown for the manufacture of the celebrated Pomfret cakes. The town possesses ironfoundries, sack and matting manufactories, tanneries, breweries, corn mills and brick and terra-cotta works. The parliamentary borough, falling within the Osgoldcross division of the county, returns one member (before 1885 the number was two). The town is governed by a mayor, six aldermen and 18 councillors. Area, 4078 acres.

The remains of a Roman camp have been discovered near Pontefract, but there is no trace of settlement in the town itself until after the Conquest. At the time of the Domesday Survey Tateshall (now Tanshelf, a suburb of the town) was the chief manor and contained 60 burgesses, while Kirkby, which afterwards became the borough of Pontefract, was one of its members. The change was probably owing to the fact that Ilbert de Lacy, to whom the Conqueror had granted the whole of the honour of Pontefract, founded a castle at Kirkby, on a site said to have been occupied by a fortification raised by Ailric, a Saxon thane. Several reasons are given for the change of name but none is at all satisfactory. One account says that it was caused by a broken bridge which delayed the Conqueror's advance to the north, but this is known to have been at Ferrybridge, three miles away; a second says that the new name was derived from a Norman town called Pontfrete, which, however, never existed; and a third that it was caused by the breaking of a bridge in 1153 on the arrival of the archbishop of York, St William, when several people were miraculously preserved from drowning, although the town was already known as Pontefract in 1140 when Archbishop Thurstan died there. The manor remained in the Lacy family until it passed by marriage to Thomas, duke of Lancaster, who was beheaded on a hill outside the town after the battle of Boroughbridge. His estates were restored to his brother Henry, earl of Lancaster, on the accession of Edward III., and the manor has since then formed part of the duchy of Lancaster. The town took part in most of the rebellions in the north of England, and in 1399 Richard II. was imprisoned and secretly murdered in the castle. During the Wars of the Roses the town was loyal to Henry VI., and several of the Yorkist leaders were executed here after the battle of Wakefield. It was taken by Robert Aske, leader of the Pilgrimage of Grace, in 1536. In 1642 the castle was garrisoned for Charles I. and sustained four sieges, the second, in 1644, being successful, but two years later it was retaken by the royalists, who held it until after the execution of the king, when they surrendered to General Lambert and the castle was destroyed.

Roger de Lacy in 1194 granted a charter to the burgesses confirming their liberties and right to be a free borough at a fee-farm of 12d. yearly for every toft, granting them the same privileges as the burgesses of Grimsby, and that their reeve should be chosen annually by the lord of the manor at his court leet, preference being given to the burgesses if they would pay as much as others for the office. Henry de Lacy cofirmed this charter in 1278 and in 1484 Richard III. incorporated the town under the title of mayor and burgesses and granted a gild merchant with a hanse. His charter was withdrawn on the accession of Henry VII. and a similar one was granted, while in 1489 the king gave the burgesses licence to continue choosing a mayor as they had done in the time of Richard III. In 1606–1607 James I. confirmed the charter of Henry VII. and regulated the choice of the mayor by providing that he should be elected from among the chief burgesses by the burgesses themselves. The privilege of returning two members to parliament which had belonged to Pontefract at the end of the 13th century was revived in 1620–1621 on the grounds that the charter of 1606–1607 had restored all their privileges to the burgesses. Since the

Redistribution of Seats Act of 1885 one member only has been returned. Liquorice was largely grown as early as 1700–1701, when the corporation prohibited the sale of buds or sets of the plant. Richard III. by his incorporation charter granted the market rights in the borough to the burgesses, who still hold them under his charter.

See *Victoria County History*: *Yorkshire*; *Eighth Report of the Royal Commission on Historical Manuscripts* (1870–1897); *Book of Entries of the Pontefract Corporation, 1653–1726* (ed. by Richard Holmes, 1882); Benjamin Boothroyd, *The History of the Ancient Borough of Pontefract* (1807); George Fox, *The History of Pontefract* (1827).

PONTEVEDRA, a maritime province of north-western Spain, formed in 1833 of districts taken from Galicia, and bounded on the N. by Corunna, E. by Lugo and Orense, S. by Portugal and W. by the Atlantic. Pop. (1900), 457,262; area, 1695 sq. m. Pontevedra is the smallest of the provinces of Spain except the three Basque Provinces; its density of population, 269·8 inhabitants per square mile, is only excelled in the provinces of Barcelona and Biscay (Vizcaya). Both of these are mining and manufacturing districts, while Pontevedra is dependent on agriculture and fisheries. The surface is everywhere mountainous, and consists almost entirely of arable land, pasture or forest. The coast-line is deeply indented; navigation is rendered difficult by the prevalence of fogs in summer and storms in winter. The river Miño (Portuguese Minho) forms the southern frontier, and is navigable by small ships as far as Salvatierra; and the province is watered by many smaller streams, all flowing, like the Miño, into the Atlantic. The largest of these are the Ulla, which separates Pontevedra from Corunna, the Umia and the Lerez. Pontevedra has a mild climate, a fertile soil and a very heavy rainfall. Large agricultural fairs are held in the chief towns, and there is a considerable export trade in cattle to Great Britain and Portugal, hams, salt meat and fish, eggs, breadstuffs, leather and wine. Vigo is the headquarters of shipping, and one of the chief ports of northern Spain. There are also good harbours at Bayona, Carril, Marin, Villagarcia and elsewhere among the deep estuaries of the coast. At Tuy the Spanish and Portuguese railways meet, and from this town one line goes up the Miño valley to Orense, and another northward along the coast to Santiago de Compostela.

PONTEVEDRA, the capital of the Spanish province of Pontevedra; on the Tuy-Corunna railway, and on the river Lerez, which here enters the Ria de Pontevedra, an inlet of the Atlantic. Pop. (1900), 22,330. The name of the town is derived from the ancient Roman bridge (*pons vetus*) of twelve arches, which spans the Lerez near its mouth. Pontevedra is a picturesque town, mainly built of granite, and still partly enclosed by medieval fortifications. It contains handsome provincial and municipal halls erected in the 19th century, and many convents, some of which have been converted into hospitals or schools. Marin and Sangenjo are ports on the Ria de Pontevedra, which is the seat of a thriving sardine fishery. There is an active trade in grain, wine and fruit; cloth, hats, leather and pottery are manufactured.

PONTIAC (*c.* 1720–1769), Indian chief of the Ottawa and leader in the "Conspiracy of Pontiac" in 1763–64, was born between 1712 and 1720 probably on the Maumee river, near the mouth of the Auglaize. His father was an Ottawa, and his mother an Ojibwa. By 1755 he had become a chief of the Ottawa and a leader of the loose confederacy of the Ottawa, Potawatomi and Ojibwa. He was an ally of France and possibly commanded the Ottawa in the defeat (July 9, 1755) of General Edward Braddock. In November 1760 he met Major Robert Rogers, then on his way to occupy Michilimackinac and other forts surrendered by the French, and agreed to let the English troops pass unmolested on condition that he should be treated with respect by the British. Like other Indians he soon realized the difference between French and English rule—that the Indians were no longer welcomed at the forts and that they would ultimately be deprived of their hunting grounds by encroaching English settlements. French hunters and traders encouraged Indian disaffection with vague promises of help from France; in 1762 an Indian "prophet" among the Delawares on the Muskingum preached a union of the Indians to expel the English; and in that year (as in 1761) there were abortive conspiracies to massacre the English garrisons of Detroit, Fort Niagara and Fort Pitt (now Pittsburg). Pontiac seems to have been chief of a magic association (the *Metai*), and he took advantage of the religious fervour and the general unrest among the Indians to organize in the winter of 1762–63 a simultaneous attack on the English forts to be made in May 1763 at a certain phase of the moon. On the 27th of April 1763, before a meeting near Detroit of delegates from most of the Algonquian tribes, he outlined his plans. On the 7th of May, with 60 warriors, he attempted unsuccessfully to gain admission to Detroit, which then had a garrison of about 160 under Major Henry Gladwin (1730–1791); and then besieged the fort from the 9th of May to the end of October. On the 28th of May reinforcements from Fort Niagara were ambuscaded near the mouth of the Detroit. In June the Wyandot and Potawatomi withdrew from the siege, but on the 29th of July they attacked reinforcements (280 men, including 20 of Rogers's rangers) from Fort Niagara under Captain James Dalyell (or Dalzell), who, however, gained the fort, and in spite of Gladwin's opposition on the 31st of July attacked Pontiac's camp, but was ambuscaded on Bloody Run and was killed, nearly 60 others being killed or wounded. On the 12th of October the Potawatomi, Ojibwa and Wyandot made peace with the English; with the Ottawa Pontiac continued the siege until the 30th of October, when he learned from Neyon de la Vallière, commandant of Fort Chartres (among the Illinois) that he would not be aided by the French. Pontiac then withdrew to the Maumee.

Fort Pitt with a garrison of 330 men under Captain Simeon Ecuyer was attacked on the 22nd of June and was besieged from the 27th of July to the 1st of August, when the Indians withdrew to meet a relief expedition of 500 men, mostly Highlanders, under Colonel Henry Bouquet (1719–1766), who had set out from Carlisle, Pennsylvania, on the 18th of July, and relieved Fort Ligonier (on the site of the borough of Ligonier, Westmoreland county, Penn.) on the 2nd of August, but was surprised on the 5th, and fought (5th and 6th) the battle of Bushy Run (25 m. S.E. of Fort Pitt), finally flanking and routing the Indians after tricking them by a feinted retreat of a part of his force. Bouquet reached Fort Pitt on the 10th of August. At Michilimackinac (Mackinac), Michigan, on the 4th of June, the Indians gained admission to the fort by a trick, killed nearly a score of the garrison and captured the remainder, including Captain George Etherington, the commander, besides several English traders, including Alexander Henry (1739–1824).[1] Some of the captives were seized by the Ottawa, who had taken no part in the attack; a part of these were released, and reached Montreal on the 13th of August. Seven of the prisoners kept by the Ojibwa were killed in cold blood by one of their chiefs. Fort Sandusky (on the site of Sandusky, Ohio) was taken on the 16th of May by Wyandot; and Fort St Joseph (on the site of the present Niles, Mich.) was captured on the 25th of May and 11 men (out of its garrison of 14) were massacred, the others with the commandant, Ensign Schlosser, being taken to Detroit and exchanged for Indian prisoners. On the 27th of May Fort Miami (on the site of Fort Wayne, Indiana) surrendered to the Indians after its commander, Ensign Holmes, had been treacherously killed. Fort Ouiatanon (about 5 m. south-west of the present Lafayette, Indiana) and Fort Presque Isle (on the site of Erie, Penn.) were taken by the Indians on the 1st and 16th of June respectively; and Fort Le Boeuf (on the site of Waterford,

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[1] Henry, a native of New Brunswick, N.J., had become a fur-trader at Fort Michilimackinac in 1761. He was rescued by Wawatam, an Ottawa, who had adopted him as a brother; in 1764 he took part in Colonel John Bradstreet's expedition; in 1770, with Sir William Johnson, the duke of Gloucester and others, formed a Company to mine copper in the Lake Superior region; was a fur-trader again until 1796; and then became a merchant in Montreal. His *Travels and Adventures in Canada and the Indian Territories between the Years 1760 and 1776* (1809; reprinted 1901) is a valuable account of the fur trade and of his adventures at Michilimackinac. He is not to be confused with his nephew of the same name, also a fur-trader, whose journal was published in 1897 in 3 vols., as *New Light on the Early History of the Greater Northwest.*

Penn.) was surprised on the 18th, but its garrison escaped, and seven (out of 13) got safely to Fort Pitt. Fort Venango (near the site of the present Venango, Penn.) was taken and burnt about the same time by some Senecas (the only Iroquois in the conspiracy), who massacred the garrison and later burned the commander, Lieut. Gordon. About 500 Senecas on the 14th of September surprised a wagon train, escorted by 24 soldiers, from Fort Schlosser (2 m. above Niagara Falls), drove most of them over the brink of the Devil's Hole (below the cataract), and then nearly annihilated a party from Fort Niagara sent to the rescue.

In 1763, although the main attacks on Detroit and Fort Pitt had failed, nearly every minor fort attacked was captured, about 200 settlers and traders were killed, and in property destroyed or plundered the English lost about £100,000, the greatest loss in men and property being in western Pennsylvania.

In June 1764 Colonel John Bradstreet (1711–1774) led about 1200 men from Albany to Fort Niagara, where at a great gathering of the Indians several treaties were made in July; in August he made at Presque Isle a treaty (afterwards annulled by General Thomas Gage) with some Delaware and Shawnee chiefs; and in September made treaties (both unsatisfactory) with the Wyandot, Ottawa and Miami at Sandusky, and with various chiefs at Detroit. He sent Captain Howard to occupy the forts at Michilimackinac, Green Bay and Sault Ste Marie, and Captain Morris up the Maumee river, where he conferred with Pontiac, and then to Fort Miami, where he narrowly escaped death at the hands of the Miami; and with his men Bradstreet returned to Oswego in November, having accomplished little of value. An expedition of 1500 men under Colonel Bouquet left Carlisle, Pennsylvania, in August, and near the site of the present Tuscarawas, Ohio, induced the Indians to release their prisoners and to stop fighting—the practical end of the conspiracy. Pontiac himself made submission to Sir William Johnson on the 25th of July 1766 at Oswego, New York. In April 1769 he was murdered, when drunk, at Cahokia (nearly opposite St Louis) by a Kaskaskia Indian bribed by an English trader; and he was buried near the St Louis Fort. His death occasioned a bitter war in which a remnant of the Illinois was practically annihilated in 1770 at Starved Rock (between the present Ottawa and La Salle), Illinois, by the Potawatomi, who had been followers of Pontiac. Pontiac was one of the most remarkable men of the Indian race in American history, and was notable in particular for his power (rare among the Indians) of organization.

See Francis Parkman, *The Conspiracy of Pontiac* (2 vols., Boston, 1851; 10th ed., 1896).

PONTIAC, a city and the county-seat of Oakland county, Michigan, U.S.A., on the Clinton river, about 26 m. N.W. of Detroit. Pop. (1890), 6200; (1900) 9769, of whom 2020 were foreign-born; (1910 U.S. census) 14,532. It is served by the Grand Trunk and the Pontiac, Oxford & Northern railways (being the southern terminus of the latter), and by the Detroit & Pontiac and the North-Western electric inter-urban lines. In the surrounding country there are many small, picturesque lakes (the largest being Orchard, about 6 m. south-east of Pontiac, Cass and Elizabeth lakes), and there is good hunting and fishing in the vicinity. In Pontiac is the Eastern Michigan Asylum for the insane (1878), with grounds covering more than 500 acres. The city has various manufactures, and the value of the factory products increased from $2,470,887 in 1900 to $3,047,422 in 1904, or 23·3%. Agricultural products, fruit and wool from the surrounding country are shipped in considerable quantities. The municipality owns and operates its waterworks. Pontiac, named in honour of the famous Indian chief of that name, was laid out as a town in 1818, became the county-seat in 1820, was incorporated as a village in 1837, and was chartered in 1861.

PONTIANUS, pope from 230 to 235. He was exiled by the emperor Maximinus to Sardinia, and in consequence of this sentence resigned (Sept. 28, 235). He was succeeded by Anteros.

PONTIFEX. The collegium of the Pontifices was the most important priesthood of ancient Rome, being specially charged with the administration of the *jus divinum*, *i.e.* that part of the civil law which regulated the relations of the community with the deities recognized by the state officially, together with a general superintendence of the worship of gens and family. The name is clearly derived from *pons* and *facere*, but whether this should be taken as indicating any special connexion with the sacred bridge over the Tiber (*Pons Sublicius*), or what the original meaning may have been, cannot now be determined. The college existed under the monarchy, when its members were probably three in number; they may safely be considered as legal advisers of the rex in all matters of religion. Under the republic they emerge into prominence under a *pontifex maximus*, who took over the king's duties as chief administrator of religious law, just as his chief sacrificial duties were taken by the *rex sacrorum*; his dwelling was the *regia*, "the house of the king." During the republican period the number of pontifices increased, probably by multiples of three, until after Sulla (82 B.C.) we find them fifteen; for the year 57 B.C. we have a complete list of them in Cicero (*Harusp. resp.* 6, 12). Included in the collegium were also the rex sacrorum, the flamines, three assistant pontifices (minores), and the vestal virgins, who were all chosen by the pontifex maximus. Vacancies in the body of pontifices were originally filled by co-optation; but from the second Punic War onwards the pontifex maximus was chosen by a peculiar form of popular election, and in the last age of the republic this held good for all the members. They all held office for life.

The immense authority of the college centred in the pontifex maximus, the other pontifices forming his *consilium* or advising body. His functions were partly sacrificial or ritualistic, but these were the least important; the real power lay in the administration of the *jus divinum*, the chief departments of which may briefly be described as follows: (1) the regulation of all expiatory ceremonials needed as the result of pestilence, lightning, &c.; (2) the consecration of all temples and other sacred places and objects dedicated to the gods by the state through its magistrates; (3) the regulation of the calendar both astronomically and in detailed application to the public life of the state; (4) the administration of the law relating to burials and burying-places, and the worship of the Manes, or dead ancestors; (5) the superintendence of all marriages by confarreatio, *i.e.* originally of all legal patrician marriages; (6) the administration of the law of adoption and of testamentary succession. They had also the care of the state archives, of the lists of magistrates, and kept records of their own decisions (*commentarii*) and of the chief events of each year (*annales*).

It is obvious that a priesthood having such functions as these, and holding office for life, must have been a great power in the state, and for the first three centuries of the republic it is probable that the pontifex maximus was in fact its most powerful member. The office might be combined with a magistracy, and, though its powers were declaratory rather than executive, it may fairly be described as quasi-magisterial. Under the later republic it was coveted chiefly for the great dignity of the position; Julius Caesar held it for the last twenty years of his life, and Augustus took it after the death of Lepidus in 12 B.C., after which it became inseparable from the office of the reigning emperor. With the decay of the empire the title very naturally fell to the popes, whose functions as administrators of religious law closely resembled those of the ancient Roman priesthood, hence the modern use of "pontiff" and "pontifical."

For further details consult Marquardt, *Staatsverwaltung*, iii. 235 seq.; Wissowa, *Religion und Kultus der Römer*, 430 seq.; Bouché-Leclercq, *Les Pontifes, passim*. (W. W. F.*)

PONTIVY, a town of western France, chief town of an arrondissement in the department of Morbihan, 46 m. N.N.W. of Vannes by rail. Pop. (1906), 6312 (town); 9506 (commune). The town, situated on the Blavet, at its confluence with the Nantes-Brest canal, comprises two distinct parts—the old town and that to the south known as Napoléonville. The latter, built by order of Napoleon I., who desired to make it the military headquarters for Brittany, and consisting chiefly of barracks, subsequently gave its name to the whole town, but in 1871 the old name was resumed. The ancient castle (1485) of the dukes of Rohan, whose capital the town was, is occupied by the Musée le Brigant of art and archaeology. A monument to commemorate the Breton-Angevin Union, the deputies of which met at Pontivy in 1790, was erected in 1894, and there are statues of Dr Guépin, a democrat, and General de Lourmel (d. 1854). The town has a sub-prefecture, a tribunal of first instance, and a lycée for boys. Pontivy had its origin in a monastery founded in the 7th century by St Ivy, a monk of Lindisfarne.

PONT-L'ABBÉ, a town of western France in the department of Finistère, 13 m. S.W. of Quimper by rail. Pop. (1906), of the town 4485, of the commune 6432. The town is situated on the right bank of the estuary or river of Pont-l'Abbé, 2 m. from the sea. Its port carries on fishing, imports timber, coal, &c., and exports mine-props and the cereals and vegetables of the neighbourhood. Of the old buildings of the town the chief is a church of the 14th, 15th and 16th centuries, once attached to a Carmelite convent; an old castle is occupied by the hôtel de ville. The local costumes, trimmed with the bright-coloured embroideries for which the town is noted, are among the most striking in Brittany; the *bigouden* or head-dress of the women has given its name to the inhabitants. Pont-l'Abbé carries on flour-milling and the extraction of chemicals from seaweed.

PONTMARTIN, ARMAND AUGUSTIN JOSEPH MARIE FERRARD, COMTE DE (1811–1890), French critic and man of letters, was born at Avignon (Vaucluse) on the 16th of July 1811. Imbued by family tradition with legitimist sympathies, he began by attacking the followers of the encyclopaedists and their successors. In the *Assemblée nationale* he published his *Causeries littéraires*, a series of attacks on prominent Liberals, which created some sensation. Pontmartin was an indefatigable journalist, and most of his papers were eventually published in volume form: *Contes et rêveries d'un planteur de choux* (1845); *Causeries du samedi* (1857–1860); *Nouveaux samedis* (1865–1881), &c. But the most famous of all his books is *Les Jeudis de Mme. Charbonneau* (1862), which under the form of a novel offered a series of malicious and witty portraits of contemporary writers. Pontmartin died at Avignon on the 29th of March 1890.

See Hatzfeld and Meunier, *Les Critiques littéraires du XIX^e siècle* (1894).

PONTOISE, a town of northern France, capital of an arrondissement of the department of Seine-et-Oise, 18 m. N.W. of Paris on the railway to Dieppe. Pop. (1906), 7963. Pontoise is picturesquely situated on the right bank of the Oise where it is joined by the Viosne. The traffic on the main river is large, and the tributary drives numerous mills. Of the many churches that used to exist in the town two only remain: St Maclou, a church of the 12th century, altered and restored in the 15th and 16th centuries by Pierre Lemercier, the famous architect of St Eustache at Paris, and containing a fine holy sepulchre of the 16th century; and Notre-Dame, of the close of the 16th century, which contains the tomb of St Gautier, abbot of Meulan in the 12th century. At the top of the flight of steps by which St Maclou is approached is the statue of General Leclerc, a native of the town and husband of Pauline Bonaparte. Grain and flour are the principal staples of the trade; a well-known fair is held in November. The town has a sub-prefecture, tribunals of first instance and of commerce and a communal college. At Mériel, near Pontoise, there are interesting remains of the Cistercian abbey of Le Val. Pontoise existed in the time of the Gauls as *Briva Isarae* (Bridge of the Oise). It was destroyed by the Normans in the 9th century, united with Normandy in 1032, and acquired by Philip I. in 1064. Capital of the French Vexin, it possessed an important stronghold and played a conspicuous part in the wars between the French and the dukes of Normandy and in the Hundred Years' War. The English took it in 1419, and again in 1437. In 1441 Charles VII. took it by storm after a three months' siege. After belonging to the count of Charolais down to the treaty of Conflans, it was given as a dowry to Jeanne of France when she was divorced by Louis XII. The parlement of Paris several times met in the town; and in 1561 the states-general convoked at Orleans removed thither after the death of Francis II. During the Fronde it offered a refuge to Louis XIV. and Mazarin. Henry III. made it an apanage for his brother the duke of Anjou. At a later period it passed to the duke of Conti. Down to the Revolution it remained a monastic town.

PONTOON (Fr. *ponton*, from Lat. *pons*, a bridge), a flat-bottomed boat, used as a ferry boat or lighter; especially a boat of particular design intended to form part of a military bridge. In modern hydraulic engineering the words ponton and pontoon are used to designate hollow water-tight structures which are secured to sunken wrecks and bring them up to the surface, and also the hollow chambers which serve as gates for docks and sluices, and are lowered and raised by the admission and pumping out of water.

Military Pontoon Bridges.—From time immemorial floating bridges of vessels bearing a roadway of beams and planks have been employed to facilitate the passage of rivers and arms of the sea. Xerxes crossed the Hellespont on a double bridge, one line supported on three hundred and sixty, the other on three hundred and fourteen vessels, anchored head and stern with their keels in the direction of the current. Darius threw similar bridges across the Bosporus and the Danube in his war against the Scythians, and the Ten Thousand employed a bridge of boats to cross the river Tigris in their retreat from Persia. Floating bridges have been repeatedly constructed over rivers in Europe and Asia, not merely temporarily for the passage of an army, but permanently for the requirements of the country; and to this day many of the great rivers in India are crossed, on the lines of the principal roads, by floating bridges, which are for the most part supported on boats such as are employed for ordinary traffic on the river.

But light vessels which can be taken out of the water and lifted on to carriages are required for transport with an army in the field. Alexander the Great occasionally carried with his army vessels divided into portions, which were put together on reaching the banks of a river, as in crossing the Hydaspes; he is even said to have carried his army over the Oxus by means of rafts made of the hide tents of the soldiers stuffed with straw, when he found that all the river boats had been burnt. Cyrus crossed the Euphrates on stuffed skins. The practice of carrying about skins to be inflated when troops had to cross a river, which was adopted by both Greeks and Romans, still exists in the East. In the 4th century the emperor Julian crossed the Tigris, Euphrates and other rivers by bridges of boats made of skins stretched over osier frames. In the wars of the 17th century pontoons are found as regular components of the trains of armies, the Germans using a leather, the Dutch a tin and the French a copper "skin" over stout timber frames.

Modern military pontoons have been made of two forms, open as an undecked boat, or closed as a decked canoe or cylinder. During the Peninsular War the English employed open bateaux; but the experience gained in that war induced them to introduce the closed form. General Colleton devised a buoy pontoon, cylindrical with conical ends and made of wooden staves like a cask. Then General Sir Charles Pasley introduced demi-pontoons, like decked canoes with pointed bows and square sterns, a pair, attached sternwise, forming a single "pier" of support for the roadway; they were constructed of light timber frames covered with sheet copper and were decked with wood; each demi-pontoon was divided internally into separate compartments by partitions which were made as water-tight as possible, and also supplied with the means of pumping out water; when transported overland with an army a pair of demi-pontoons and the superstructure of one bay formed the load for a single carriage weighing 27·75 cwt. when loaded. The Pasley was superseded by the Blanshard pontoon, a tin coated cylinder with hemispherical ends, for which great mobility was claimed, two pontoons and two bays superstructure being carried on one waggon, giving a weight of about 45 cwt., which was intended to be drawn by four horses. The Blanshard pontoon was long used in the British army, but was ultimately discarded; and British engineers came to the conclusion that it was desirable to return to the form of the open bateau to which the engineers of all the

Continental armies had meanwhile constantly adhered. Captain Fowke, R.E., invented a folding open bateau, made of waterproof canvas attached to sliding ribs, so that for transport it could be collapsed like the bellows of an accordion and for use could be extended by a pair of stretchers. This was followed by the pontoon designed by Colonel Blood, R.E., an open bateau with decked ends and sides partly decked where the rowlock blocks were fixed. It consisted of six sets of framed ribs connected by a deep kelson, two side streaks, and three bottom streaks. The sides and bottom were of thin yellow pine with canvas secured to both surfaces by india-rubber solution, and coated outside with marine glue. The central interval between the pontoons in forming a bridge was invariably maintained at 15 ft.; for the support of the roadway five baulks were ordinarily employed, but nine for the passage of siege artillery and the heaviest loads; they fitted on to saddles resting on central saddle beams. The pontoons were not immersed to within 1 ft. of the tops of their "coamings" when carrying ordinary loads, as of infantry in marching order "in fours" crowded at a check, or the 16-pounder R.M.L. gun of position weighing 43 cwt.; nor were they immersed to within 6 in. when carrying extraordinary loads, such as disorganized infantry, or the 64-pounder R.M.L. gun weighing 98 cwt. In designing this pontoon the chief points attended to were—(1) improvement in power of support, (2) simplification in bridge construction, (3) reduction of weight in transport, and (4) adaptation for use singly as boats for ferrying purposes. One pontoon with the superstructure for a single bay constituted a load for one waggon, with a total weight behind horses of about 40 cwt.

The following table (from *Ency. Brit.* 9th ed.) shows the powers of various pontoons in use by different nations in the past. Modern improvements are comparatively few. The "working power of support" has been calculated in most instances by deducting from the "available buoyancy" one-fourth for open and one-tenth for closed vessels:—

In the English and French equipment the pontoons were originally made of two sizes, the smaller and lighter for the "advanced guard," the larger and heavier for the "reserve;" in both equipments the same size pontoon is now adopted for general requirements, the superstructure being strengthened when necessary for very heavy weights. The German army has an undivided galvanized iron pontoon, 24 ft. 6 in. long, handy as a boat, but of inadequate buoyancy for heavy traffic, with the result that the span has to be diminished and *ipso facto* the waterway obstructed. The Austrian and Italian pontoons are made in three pieces, two with bows and a middle piece without; not less than two pieces are ordinarily employed, and the third is introduced when great supporting power is required, but in all cases a constant interval is maintained between the pontoons. On the other hand, in the greater number of pontoon equipments greater supporting power is obtained not by increasing the number of supports but by diminishing the central interval between the pontoons. Within certain limits it does not matter whether the buoyancy is made up of a large number of small or a small number of large vessels, so long as the waterway is not unduly contracted and the obstruction offered to a swift current dangerously increased; but it is to be remembered that pontoon bridges have failed as frequently from being washed away as from insufficient buoyancy. In Austria efforts have been made to diminish the weight of the Birago equipment by the substitution of steel for iron. The present pontoon, in three pieces, is of steel, and 39 ft. 4 in. long, like the old pattern.

In the British army Colonel Blood's equipment was later modified by the introduction of a bipartite pontoon designed in 1889 by Lieut. Clauson, R.E. Each pontoon is carried on one waggon with a bay of superstructure, and consists of two sections, a bow-piece and a stern-piece, connected together by easily manipulated couplings of phosphor bronze. Decks and "coamings" are dispensed with, and the rowlock holes are sunk in a strong gunwale. The detachable saddle-beam, which receives the load on the centre of the thwarts, is made in sections, so as to form a continuous saddle of any length required. The baulks (or road-bearers) and chesses (or planks) remain unaltered, but chess-holders and chess-bearers are added for use in constructing light bridges for infantry in file. In this kind of bridge each pontoon section is used separately, with a roadway of chesses placed longitudinally four abreast. In the normal or medium bridge two sections, and in heavy bridge three sections are joined together. The chief advantages of the

Pontoon.	Length.	Displacement of Pontoon.	Actual Buoyancy of Pontoon.	Weight of Pontoon and one Bay of Superstructure.	Available Buoyancy.	Working Power of Support.	Central Interval in Bridge.	Power per lineal foot of Roadway.	Greatest ordinary Load per foot lineal.	Width of Roadway.	Greatest possible load at 100 lb per foot superficial of roadway.
	Ft.	Cub. Ft.	lb	lb	lb	lb	Ft.	lb	lb	Ft.	lb
Gribeauval: open bateau, oak	36·3	593	45,044	8,044	37,000	27,750	22·8	1,215	840	15·6	35,568
Austrian: open, wooden, 1799	27·0	354	22,123	3,332	18,791	14,093	16·6	849	560	11·4	18,924
Aust.-Birago: open, wooden; two pieces	28·0	303	18,907	3,249	15,658	11,744	21·7	542	560	9·3	20,181
,, ,, ,, three ,,	39·4	445	27,791	3,884	23,907	17,930	21·7	827	560	9·3	20,181
,, ,, iron; two pieces	28·0	353	22,090	3,698	18,392	13,794	21·7	636	560	9·3	20,181
,, ,, ,, three ,,	39·4	530	33,135	4,501	28,634	21,476	21·7	991	560	9·3	20,181
French: open, wooden; reserve	30·9	325	20,286	3,608	16,678	12,509	19·7	635	560	10·5	20,685
,, ,, ,, advanced guard	19·7	156	9,734	1,506	8,228	6,171	16·4	376	560	9·3	15,252
,, ,, ,, general	30·9	321	20,065	3,153	16,912	12,684	19·7	644	560	9·8	19,306
Prussian: open, wooden; open order	23·7	164	10,226	2,393	7,833	5,875	15·3	384	560	9·9	15,147
,, ,, ,, close order	23·7	164	10,226	2,213	8,013	6,010	11·2	535	560	9·9	11,088
,, ,, iron; open order	24·7	214	13,385	2,209	11,176	8,382	15·3	561	560	9·9	15,147
,, ,, ,, close order	24·7	214	13,385	2,029	11,356	8,517	11·2	759	560	9·9	11,088
Italian: open wooden; one piece	19·6	283	17,660	3,582	14,078	10,559	26·3	402	560	9·8	25,774
,, ,, ,, two pieces	39·2	565	35,320	4,572	30,748	23,061	26·3	878	560	9·8	25,774
,, modified; one piece	24·6	325	20,290	3,401	16,889	12,669	23·0	551	560	9·8	22,540
,, ,, two pieces	49·2	649	40,580	4,489	36,091	27,068	23·0	1,178	560	9·8	22,540
Russian open, canvas on open order	21·0	209	13,042	2,355	10,687	8,015	16·6	493	560	10·4	17,264
wooden framework; close order	21·0	209	13,042	2,083	10,959	8,219	11·7	705	560	10·4	12,168
Belgian: open, iron; one piece	24·8	297	18,584	3,336	15,248	11,436	19·7	580	560	9·5	18,715
,, ,, ,, two pieces	49·2	595	37,168	4,548	32,620	24,465	19·7	1,244	560	9·5	18,715
American india-rubber, three; open order	20·0	130	8,125	1,980	6,145	5,530	18·0	307	580	11·0	19,800
cylinders connected; close order	20·0	130	8,125	1,824	6,301	5,761	14·7	393	560	11·0	18,370
English Pontoons.											
Peninsular equipment open, tin; reserve	18·9	209	13,092	2,374	10,718	8,039	16·8	477	560	10·0	16,800
,, ,, advanced guard	15·1	120	7,520	1,654	5,866	4,400	14·0	314	560	9·0	12,600
Pasley: closed demi-canoe; copper	25·0	141	8,781	2,103	6,678	6,010	12·5	481	560	10·0	12,500
Blanshard: cylinder, tin; open order	22·5	109	6,785	1,600	5,185	4,667	12·5	373	560	10·0	12,500
,, ,, ,, close order	22·5	109	6,785	1,408	5,377	4,839	8·3	581	560	10·0	8,300
,, ,, ,, light pattern	15·5	26	1,640	340	1,300	1,170	5·3	220	280	7·0	3,710
Fowke: open, collapsible, canvas; open order	22·0	134	8,460	1,246	7,214	5,411	10·0	541	560	10·0	10,000
Forbes: closed, spherangular, tin; open order	24·2	128	7,977	1,689	6,288	5,659	11·0	514	560	10·0	11,000
Blood: open, wooden; general	21·6	280	17,500	2,300	15,200	13,350	15·0	890	560	10·0	15,000

equipment are (1) the buoyancy of the piers can be proportioned to the weight of traffic and to the roughness of the water; (2) owing to the special design of the bows, boats and rafts are easy to row, while the pontoons in bridge oppose little resistance to the current, and so require less anchor power; (3) transport rafts, pier-heads and flying bridges can be constructed with great ease, owing to the flush gunwales on which baulks can rest if necessary; (4) the pontoon sections are convenient to handle, easy to ship or to transport by rail, and can readily be replaced singly if damaged in bridge. A canoe pontoon and superstructure adapted for pack transport has also been adopted from designs by Colonel (Sir) Elliott Wood, C.B., R.E. The pontoon consists of four sections laced together, each section being a framework of wood covered with waterproof sheeting. Three pontoons and eight composite planks form a "unit," from which can be constructed 48 ft. of bridge for infantry in file, 84 ft. for infantry in single file, or a raft to carry 15 men or an empty wagon.

For the British army in India the standard pontoon for many years was the Pasley; it was seldom used, however, for boats could almost always be procured on the spot in sufficient numbers wherever a floating bridge had to be constructed. Later an equipment was prepared for the Indian army of demi-pontoons, similar to the Blood pontoon cut in half, and therefore more mobile; each has a bow and a square stern, and they are joined at the sterns when required to form a "pier"; they are fitted with movable covers and can therefore be used in much rougher water than pontoons of the home pattern, and their power of support and breadth of roadway are the same. The Chitral Relief Expedition of 1895, however, revealed certain defects. The shape of the bow was unsuited to rapid currents; the balance was not satisfactory, and the copper sheathing cracked. Experiments were then undertaken with the bipartite pontoon.

The india-rubber pontoon does not appear to have been generally employed even in America, where it was invented. The engineer officers with the army of the Potomac, after full experience of the india-rubber pontoon and countless other inventions of American genius, adopted the French equipment, which they found "most excellent, useful and reliable for all military purposes." The Russians, in crossing the Danube in their war with Turkey in 1878, employed the Austrian equipment. Aluminium pontoons have been tried in Germany, but have not been adopted.

For light bridging work the Berthon and other collapsible boats have been adopted in Germany and Great Britain, especially for cavalry work in advance of the army. The German folding boat is made of wood framework and canvas skin; two boats are easily carried on one "folding-boat wagon." The total length of the three sections together is 21 ft. 6 in. The British field troop R.E., attached to cavalry, carries two collapsible boats 18 ft. 6 in. long.

The methods of constructing pontoon bridges have been simplified of late years in most armies, and are usually restricted to (1) adding pontoons one by one to the head of the bridge; (2) connecting rafts of two or more pontoons into bridge by intermediate bays of superstructure; and (3) swinging across the river a bridge previously prepared alongside the shore. The formation of a bridge from rafts touching one another consumes an excessive amount of equipment, and opposes unnecessary resistance to the stream; it is therefore being discarded in most armies. "Booming out" the bridge bay by bay from the shore until the head reaches the opposite bank is unsuited for rapid currents, and is almost obsolete except for light infantry bridges.

In every army the pontoon service is in the hands of technical specialists.[1] But there are many other forms of military bridging, in which the specialist only supervises the work of the ordinary soldier, or indeed, takes no part whatever. Troops of all arms are expected to be familiar with certain methods of rough temporary bridging. In the British service the forms of temporary timber bridge usually employed are called trestle, lock and floating. The trestle bridge in its various forms consists of a series of two-legged or three-legged trestles carrying the road-bearers and chesses which form the roadway. Trestles can be improvised, but some are carried, ready for use, by mobile engineer units and they are frequently combined with pontoon bridges at the shore ends, where holding ground for the feet of the trestles is found. Lock bridges never touch water, forming single spans over a chasm. These consist of spars made into frames of which the feet rest in the banks of the river and the heads are interlocked, the whole being securely lashed. Another type of frame-bridge is the cantilever, which has been used in Indian frontier expeditions to bridge swift steep-banked streams. Improvised suspension bridges are also used. Floating bridges are made not only of pontoons but also of boats of all sorts, casks lashed together, and rafts. They are almost always combined with one or two bays of trestle bridging at the shore ends.

The organization of bridging personnel in different armies shows as much divergence of opinion as the design of pontoon equipment. In Great Britain, since the divisional reorganization, the bridging trains have been assigned to the "army troops," which include two "bridging trains," totalling 14 officers and 454 men with 92 vehicles, most of them six-horsed. Each train carries 32 pontoons and 32 bays of superstructure, as well as 16 trestles and 8 bays of the appropriate superstructure, and can construct 200 yds. of medium bridge in all. Besides these trains the divisional engineer units (2 field companies per division) bear with them in all 4 pontoons and 4 trestles, with the necessary bays of superstructure, their total bridging capacity being about 40 yds. of medium bridge. In France each army corps has a bridging train which admits of the construction of bridges to the extent of about 120 yds. of medium and 140 yds. of light bridging and bears besides 2 "advanced guard" trains which can provide 33 yds. of medium bridging each. Besides the corps trains there are also "army" trains, five in all, which can furnish 280 yds. of medium bridging apiece. These would be allotted in accordance with the requirements of particular campaigns. In Germany the increasing importance attached to independent cavalry operations has led to the assignment of a folding-boat wagon to every cavalry *regiment*. The regimental equipment provides for a ferry, capable of taking 25 to 30 infantrymen, one artillery vehicle or four horses at one journey, a foot-bridge 22 to 35 yds. in length, or a light bridge of 8 to 13 yds. By assembling the material of a whole cavalry division of 6 regiments, a foot-bridge of 110 to 210 yds. or a light bridge of 57 to 70 yds. can be constructed. The corps bridging train of a German army corps can construct 140 yds. of medium or 170 yds. of light bridging, and each of the two divisional trains, 40 yds. of medium and 48 yds. of light bridging.

PONTOPPIDAN, ERIK (1698–1764), Danish author, was born at Aarhus on the 24th of August 1698. He studied divinity at the university of Copenhagen, and for some time acted as a travelling tutor. In 1735 he became one of the chaplains of the king. In 1738 he was made professor extraordinary of theology at Copenhagen, and in 1745 bishop of Bergen, Norway, where he died on the 20th of December 1764.

His principal works are: *Theatrum Daniae veteris et modernae* (4to, 1730), a description of the geography, natural history, antiquities, &c., of Denmark; *Gesta et vestigia danorum extra Daniam* (3 vols. 8vo, 1740), a laborious but uncritical work; *Annales ecclesiae danicae* (3 vols., 1741–1747); *Marmora danica selectiora* (2 vols. fol., 1739–1741); *Glossarium norvegicum* (1749); *Det förste forsög Norges naturlige historie* (4to, 1752–1754); Eng. trans., *Natural History of Norway* (2 vols., 1755), containing curious accounts, often referred to, of the Kraaken, sea-serpent, and the like; *Origines hafnienses* (1760); *Menoza* (3 vols., 1742–1743), a religious novel. His *Danske Atlas* (7 vols. 4to), an historical and topographical account of Denmark, was mostly posthumous.

See an article by S. M. Gjellerup in *Danish Biografisk Lexikon* (vol. xiii., 1899).

PONTOPPIDAN, HENRIK (1857–), Danish author, son of a pastor, was born at Fredericia on the 24th of July 1857. He studied physics and mathematics at the university of Copenhagen, and when he was eighteen he travelled on foot through Germany and Switzerland. His novels show an intimate acquaintance with peasant life and character, the earlier ones showing clear evidence of the influence of Kjelland. An excellent example of his work is in the trilogy dealing with the history of Emanuel Hansted, a theorizing radical parson who marries a peasant wife. These three stories, *Muld* ("Soil," 1891), *Det Forjaettede Land* ("The Promised Land," 1892), and *Dommens Dag* (1895) are marked by fine discrimination and great narrative power. Among his other works are *Fra Hytterne* (1887), *Folkelivsskildringer* (2 parts, 1888–1890), and *Skyer* (1890). He began in 1898 a new series in *Lykke Per*, the story of a typical Jutlander.

See an article of Niels Möller in *Dansk Biografisk Lexikon* (vol. xiii., 1899).

PONTORMO, JACOPO DA (1494–1557), whose family name was Carucci, Italian painter of the Florentine school, was born at Pantormo in 1494, son of a painter of ordinary ability, was apprenticed to Leonardo da Vinci, and afterwards took lessons from Piero di Cosimo. At the age of eighteen he became a journeyman to Andrea del Sarto, and was remarked as a young man of exceptional accomplishment and promise. Later on, but still in early youth, he executed, in continuation of Andrea's labours, the "Visitation," in the cloister of the Servi in Florence—one of the principal surviving evidences of his powers. The most extensive series of works which he ever undertook was a set of frescoes in the church of S. Lorenzo, Florence, from the "Creation of Man to the Deluge," closing with the "Last Judgment." By this time, towards 1546, he had fallen under the dangerous spell of Michelangelo's colossal genius and superhuman style; and Pontormo, after working on at the frescoes for eleven years, left them incomplete, and the object of general disappointment and disparagement. They were finished by Angelo Bronzino, but have long since vanished under whitewash. Among the best works of Pontormo are his portraits, which include the likenesses of various members of the Medici family; they are vigorous, animated and highly finished. He was fond of new and odd experiments both in style of art and in method of painting. From Da Vinci he caught one of the marked physiognomic traits of his visages, smiles and dimples. At one time he took to direct imitation or reproduction of Albert Dürer, and executed a series of paintings founded on the Passion subjects of the German master, not only in composition, but even in such peculiarities as the treatment of draperies, &c. Pontormo died of dropsy on the 2nd of January 1557, mortified at the ill success of his frescoes in S. Lorenzo; he was buried below his work in the Servi.

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[1] In Germany, however, as mentioned below, light bridging material has been placed in the hands of the cavalry. This tendency, in accordance with the needs of modern armies, will probably become more pronounced in the future. It began with the provision of demolition equipment for the cavalry pioneers.

PONTREMOLI, a town and bishop's see of the province of Massa and Carrara, Tuscany, Italy, in the upper valley of the Magra, 25 m. N. by E. of Spezia by rail and 49 m. S.S.W. of Parma, 843 ft. above sea-level. Pop. (1901), 4107 (town); 14,570 (commune). It has a 17th-century cathedral. The church of the Annunziata with its Augustinian monastery is interesting. There are also mineral springs. The town, which is well situated among the mountains, was an independent republic in the 12th and 13th centuries, and in 1495 was sacked by the troops of Charles VIII. of France. It was much damaged by an earthquake in 1834.

PONTUS, a name applied in ancient times to extensive tracts of country in the north-east of Asia Minor bordering on the Euxine (Black Sea), which was often called simply *Pontos* (the Main), by the Greeks. The exact signification of this purely territorial name varied greatly at different times. The Greeks used it loosely of various parts of the shores of the Euxine, and the term did not get a definite connotation till after the establishment of the kingdom founded beyond the Halys during the troubled period following the death of Alexander the Great, about 301 B.C., by Mithradates I., *Ktistes*, son of a Persian satrap in the service of Antigonus, one of Alexander's successors, and ruled by a succession of kings, mostly bearing the same name, till 64 B.C. As the greater part of this kingdom lay within the immense region of Cappadocia, which in early ages extended from the borders of Cilicia to the Euxine, the kingdom as a whole was at first called "Cappadocia towards the Pontus" (πρὸς τῷ Πόντῳ), but afterwards simply "Pontus," the name Cappadocia being henceforth restricted to the southern half of the region previously included under that title. Under the last king, Mithradates Eupator, commonly called the Great, the realm of Pontus included not only Pontic Cappadocia but also the seaboard from the Bithynian frontier to Colchis, part of inland Paphlagonia, and Lesser Armenia (see under MITHRADATES). With the destruction of this kingdom by Pompey in 64 B.C., the meaning of the name Pontus underwent a change. Part of the kingdom was now annexed to the Roman Empire, being united with Bithynia in a double province called "Pontus and Bithynia": this part included (possibly from the first, but certainly from about 40 B.C. onwards) only the seaboard between Heracleia (*Eregli*) and Amisus (*Samsun*), the *ora Pontica*. Hereafter the simple name Pontus without qualification was regularly employed to denote the half of this dual province, especially by Romans and people speaking from the Roman point of view; it is so used almost always in the New Testament. But it was also frequently used to denote (in whole or part) that portion of the old Mithradatic kingdom which lay between the Halys (roughly) and the borders of Colchis, Lesser Armenia, Cappadocia and Galatia—the region properly designated by the title "Cappadocia towards the Pontus," which was always the nucleus of the Pontic kingdom.

This region is regarded by the geographer Strabo (A.D. 19–20), himself a native of the country, as Pontus in the strict sense of the term (*Geogr.* p. 678). Its native population was of the same stock as that of Cappadocia, of which it had formed a part, an Oriental race often called by the Greeks *Leucosyri* or White Syrians, as distinguished from the southern Syrians, who were of a darker complexion, but their precise ethnological relations are uncertain. Geographically it is a table-land, forming the north-east corner of the great plateau of Asia Minor, edged on the north by a lofty mountain rim, along the foot of which runs a fringe of coast-land. The table-land consists of a series of fertile plains, of varying size and elevation separated from each other by upland tracts or mountains, and it is drained almost entirely by the river Iris (*Yeshil Irmak*) and its numerous tributaries, the largest of which are the Scylax (*Tchekerek Irmak*) with many affluents and the Lycus (*Kalkid Irmak*), all three rising in the highlands near, or on, the frontier of Armenia Minor and flowing first in a westerly and then in a north-westerly direction to merge their waters in a joint stream, which (under the name of the Iris) pierces the mountain-wall and emerges on the east of Amisus (*Samsun*). Between the Halys and the Iris the mountain rim is comparatively low and broken, but east of the Iris it is a continuous lofty ridge (called by the ancients Paryadres and Scydises), whose rugged northern slopes are furrowed by torrent beds, down which a host of small streams (among them the Thermodon, famed in Amazon story) tumble to the sea. These inaccessible slopes were inhabited even in Strabo's time by wild, half-barbarous tribes, of whose ethnical relations we are ignorant—the Chalybes (identified by the Greeks with Homer's Chalybes), Tibareni, Mosynoeci and Macrones, on whose manners and condition some light is thrown by Xenophon (*Anab.* V). But the fringe of coast-land from Trebizond westward is one of the most beautiful parts of Asia Minor and is justly extolled by Strabo for its wonderful productiveness.

The sea-coast, like the rest of the south shore of the Euxine, was studded with Greek colonies founded from the 6th century onwards: Amisus, a colony of Miletus, which in the 5th century received a body of Athenian settlers, now the port of *Samsun*; Cotyora, now *Ordu*; Cerasus, the later Pharnacia, now *Kerasund*; and Trapezus (*Trebizond*), a famous city from Xenophon's time till the end of the middle ages. The last three were colonies of Sinope, itself a Milesian colony. The chief towns in the interior were Amasia, on the Iris, the birthplace of Strabo, the capital of Mithradates the Great, and the burial-place of the earlier kings, whose tombs still exist; Comana, higher up the river, a famous centre of the worship of the goddess Ma (or Cybele); Zela, another great religious centre, refounded by Pompey, now Zīleh; Eupatoria, refounded by Pompey as Magnopolis at the junction of the Lycus and Iris; Cabira, Pompey's Diospolis, afterwards Neocaesarea, now *Niksar*; Sebastopolis on the Scylax, now *Sulu Seraï*; Sebasteia, now *Sivas*; and Megalopolis, a foundation of Pompey, somewhere in the same district.

The history of this region is the history of the advance of the Roman Empire towards the Euphrates. Its political position between 64 and 41 B.C., when Mark Antony became master of the East, is not quite certain. Part of it was handed over by Pompey to client princes: the coast-land east of the Halys (except the territory of Amisus) and the hill-tribes of Paryadres were given, with Lesser Armenia, to the Galatian chief Deiotarus, with the title of king; Comana was left under the rule of its high-priest. The rest of the interior was partitioned by Pompey amongst the inland cities, almost all of which were founded by him, and, according to one view, was included together with the seaboard west of Amisus and the corner of north-east Paphlagonia possessed by Mithradates in his new province

Pontus-Bithynia. Others maintain that only the seaboard was included in the province, the inland cities being constituted self-governing, "protected" communities. The latter view is more in conformity with Roman policy in the East, which did not usually annex countries till they reached (under the rule of client princes) a certain level of civilization and order, but it is difficult to reconcile with Strabo's statements (p. 541 sqq.). In any case, during the years following 40 B.C. all inland Pontus was handed over, like north-east Paphlagonia, to native dynasts. The Pontic possessions of Deiotarus (d. 40 B.C.) were given with additions (*e.g.* Cabira) in 39 B.C. to Darius, son of Pharnaces, and in 36 B.C. to Polemon, son of a rhetorician of Laodicea on the Lycus. The high-priest of Comana, Lycomedes, received an accession of territory and the royal title. The territories of Zela and Megalopolis were divided between Lycomedes, the high-priest of Zela and Ateporix, who ruled the principality of Carana (later Sebastopolis). Amasia and Amisus were also given to native princes.

After the battle of Actium (31 B.C.) Augustus restored Amisus as a "free city" to the province of Bithynia-Pontus, but made no other serious change. Polemon retained his kingdom till his death in 8 B.C., when it passed to his widow Pythodoris. But presently the process of annexation began and the Pontic districts were gradually incorporated in the empire, each being attached to the province of Galatia, then the centre of Roman forward policy. (1) The western district was annexed in two sections, Sebastopolis and Amasia in 3–2 B.C., and Comana in A.D. 34–35. To distinguish this district from the province Pontus and Polemon's Pontus, it was henceforth called *Pontus galaticus* (as being the first part attached to Galatia). (2) Polemon's kingdom, ruled since A.D. 38 by Polemon II., grandson of the former king, was annexed by Nero in A.D. 64–65, and distinguished by the title of *Pontus polemoniacus*, which survived for centuries. [But the simple name Pontus, hitherto commonly used to designate Polemon's realm, is still employed to denote this district by itself or in conjunction with Pontus Galaticus, where the context makes the meaning clear (*e.g.* in inscriptions and on coins).] Polemoniacus included the sea-coast from the Thermodon to Cotyora and the inland cities Zela, Magnopolis, Megalopolis, Neocaesarea and Sebasteia (according to Ptolemy, but apparently annexed since 2 B.C., according to its coins). (3) Finally, at the same time (A.D. 64) was annexed the remaining eastern part of Pontus, which formed part of Polemon's realm but was attached to the province Cappadocia and distinguished by the epithet *cappadocicus*. These three districts formed distinct administrative divisions within the provinces to which they were attached, with separate capitals Amasia, Neocaesarea and Trapezus; but the first two were afterwards merged in one, sometimes called *Pontus mediterraneus*, with Neocaesarea as capital, probably when they were definitively transferred (about A.D. 114) to Cappadocia, then the great frontier military province.

With the reorganization of the provincial system under Diocletian (about A.D. 295), the Pontic districts were divided up between four provinces of the *dioecesis pontica*: (1) Paphlagonia, to which was attached most of the old province Pontus; (2) Diospontus, re-named Helenopontus by Constantine, containing the rest of the province Pontus and the adjoining district, eight cities in all (including Sinope, Amisus and Zela) with Amasia as capital; (3) Pontus Polemoniacus, containing Comana, Polemonium, Cerasus and Trapezus with Neocaesarea as capital; and (4) Armenia Minor, five cities, with Sebasteia, as capital. This rearrangement gave place in turn to the Byzantine system of military districts (*themes*).

Christianity was introduced into the province Pontus (the *Ora pontica*) by way of the sea in the 1st century after Christ and was deeply rooted when Pliny governed the province (A.D. 111–113). But the Christianization of the inland Pontic districts began only about the middle of the 3rd century and was largely due to the missionary zeal of Gregory Thaumaturgus, bishop of Neocaesarea.

See Ramsay, *Histor. Geogr. of Asia Minor* (1890); Anderson and Cumont, *Studia pontica* (1903 et seq.); Babelon and Reinach, *Recueil des monnaies d'Asie min.*, t. i. (1904); H. Grégoire, "Voyage dans le Pont" &c. in *Bull. de corres. hell.* (1909). (J. G. C. A.)

PONTUS DE TYARD (*c.* 1521–1605), French poet and member of the Pléiade (see Daurat), was seigneur of Bissy in Burgundy, where he was born in or about 1521. He was a friend of Antoine Héroet and Maurice Scève, and to a certain extent anticipated Ronsard and Joachim Du Bellay. His *Erreurs amoureuses*, originally published in 1549, was augmented with other poems in successive editions till 1573. On the whole his poetry is inferior to that of his companions, but he was one of the first to write sonnets in French (the actual priority belongs to Melin de St Gelais). It is also said that he introduced the sestine into France, or rather reintroduced it, for it was originally a Provençal invention. In his later years he gave himself up to the study of mathematics and philosophy. He became bishop of Châlons-sur-Saône in 1578, and in 1587 appeared his *Discours philosophiques*. He was a zealous defender of the cause of Henry III. against the pretensions of the Guises. This attitude brought down on him the vengeance of the league; he was driven from Châlons and his château at Bissy was plundered. He survived all the members of the Pléiade and lived to see the onslaught made on their doctrines by Malherbe. Pontus resigned his bishopric in 1594, and retired to the château de Bragny, where he died on the 23rd of September 1605.

His *Oeuvres poëtiques* may be found in the *Pléiade française* (1875) of M. Ch. Marty-Laveaux.

PONTYPOOL, a market town in the northern parliamentary division of Monmouthshire, England, 8 m. N. of Newport, served by the Great Western, London & North-Western, and Rhymney railways. Pop. of urban district (1901), 6126. It is beautifully situated on an acclivity above the Afon Lwyd, a tributary of the Usk. Its prosperity is due to its situation on the edge of the great coal- and iron-field of Monmouthshire and Glamorganshire. The earliest record of trade in iron is in 1588, but it was developed chiefly in the beginning of the 18th century by the family of Hanbury, the proprietors of Pontypool Park. Pontypool was formerly famed for its japanned goods, invented by Thomas Allwood, a native of Northampton, who settled in the town in the reign of Charles II., but the manufacture has long been transferred elsewhere. The town and neighbourhood contain large forges and iron mills for the manufacture of iron-work and tin-plate. Water communication is afforded with Newport by the Monmouthshire Canal. On the south-east of Pontypool is the urban district of Panteg, including Griffithstown, with a population (1901) of 7484.

PONTYPRIDD, a parish, market town, and urban district, in the eastern parliamentary division of Glamorganshire, Wales, situated on the Taff at its junction with the Rhondda, on the Taff Vale railway, and on the Glamorganshire Canal, 12 m. N.N.W. from Cardiff, 12 S. from Merthyr-Tydfil, and 169 by rail from London. It is also connected with Newport by a Great Western line 18¼ m. long. Pop. (1901), 32,316. It receives its name from a remarkable bridge of one arch spanning the Taff, erected in 1755 by William Edwards, a self-taught mason. The bridge is a perfect segment of a circle, the chord being 140 ft., and the height at low water 36 ft. A three-arched bridge was erected close to it in 1857. The town is built at the junction of the three parishes of Llanwonno, Llantwit Fardre and Eglwysilan, out of portions of which Glyntaff was formed into an ecclesiastical parish in 1848, and from this Pontypridd was carved in 1884. The urban district was constituted into a civil parish in 1894. The church of St Catherine, built in 1868, enlarged in 1885, is in early Decorated style; other places of worship are the Baptist, Calvinistic Methodist, Congregational, and Wesleyan chapels. The principal secular buildings are a masonic hall, town-hall built above the market, free library (1890), county intermediate school (1895) and court-house. Near the town is a far-famed rocking-stone 9½ tons in weight, known as the Maen Chwyf, round which a circle of small stones was set up in the middle of the 19th century under the direction of Myvyr Morganwg, who used to style himself archdruid of Wales. The place became, for a time, famous as a meeting place for neo-Druidic gatherings. Pontypridd was an insignificant village till the opening of the Taff Vale railway into the town in 1840, and it owed its progress chiefly to the development of the coal areas of the Rhondda Valley, for which district it serves as the market town and chief business centre. It also possesses anchor, chain, and cable works, chemical works, and iron and brass foundries. Pontypridd has, jointly with Rhondda, a stipendiary magistrate since 1872.

PONY (from the Lowland Scots *powney*, probably from O. Fr. *poulenet*, diminutive of *poulain*, a colt or foal; Late Lat. *pullanus*, Lat. *pullus*, a young animal), a horse of a small breed, sometimes confined to such as do not exceed 13 hands in height, but generally applied to any horse under 14 hands (see HORSE). The word is of frequent use as a slang term—*e.g.* for a sum of £25; for a liquor measure or glass containing less than a half-pint; and in America for a literal translation of a foreign or classical author, a "crib."

PONZA (anc. *Pontiae*), the principal of a small group of islands belonging to Italy. Pop. (1901), 4621. The group is of volcanic origin, and includes Palmarola (anc. Palmaria), Zannone (Sinonia), Ventotene (Pandateria, pop. in 1901, 1986) and San Stefano. It is situated about 20 m. S. of Monte Circeo and 70 m. W. of Naples, and belongs partly to the province of Caserta and partly to that of Naples (Ventotene). There is regular communication with Naples by steamer, and in summer with Anzio. The islands rise to a height of about 70 ft. above sea-level. They are now penal settlements, and their isolated character led to their being similarly used in ancient times. A colony with Latin rights was founded on Pontiae in 313 B.C. Nero, Germanicus's eldest son, and the sisters of Caligula, were confined upon it; while Pandateria was the place of banishment of Julia, daughter of Augustus, of her daughter Agrippina the elder, and of Octavia, the divorced wife of Nero.

POOD, a Russian weight, equivalent to 40 ℔ Russian and about 36 ℔ avoirdupois. A little more than 62 poods go to the ton. The word is an adaptation of the Low German or Norse *pund*, pound.

POOL. (1) A pond, or a small body of still water; also a place in a river or stream where the water is deep and still, so applied in the Thames to that part of the river known as The Pool, which reaches from below London Bridge to Limehouse. The word in Old English was *pōl*, which may be related to *pull* or *pyll*, and the similar Celtic words, *e.g.* Cornish *pol*, a creek, common on the Bristol Channel and estuary of the Severn, on the English side in the form "pill." A further connexion has been suggested with Lat. *palus*, marsh; Gr. πηλός, mud. (2) A name for the stakes, penalties, &c., in various card and other games when collected together to be paid out to the winners; also the name of a variety of games of billiards (*q.v.*). This word has a curious history. It is certainly adapted from Fr. *poule*, hen, chicken, apparently a slang term for the stakes in a game, possibly, as the *New English Dictionary* suggests, used as a synonym for plunder, booty. "Chicken-hazard" might be cited as a parallel, though that has been taken to be a corruption of "chequeen," a form of the Turkish coin, a sequin. When the word came into use in English at the end of the 17th century, it seems to have been at once identified with "pool," pond, as Fr. *fiche* (*ficher*, to fix), a counter, was with "fish," counters in card games often taking the form of "fish" made of mother-of-pearl, &c. "Pool," in the sense of a common fund, has been adopted as a commercial term for a combination for the purpose of speculating in stocks and shares, the several owners of securities "pooling" them and placing them under a single control, and sharing all losses and profits. Similarly the name is given to a form of trade combination, especially in railway or shipping companies, by which the receipts or profits are divided on a certain agreed-upon basis, for the purpose of avoiding competition (see TRUSTS).

POOLE, MATTHEW (1624–1679), English Nonconformist theologian, was born at York, educated at Emmanuel College, Cambridge, and from 1649 till the passing of the Act of Uniformity (1662) held the rectory of St Michael le Querne, London. Subsequent troubles led to his withdrawal to Holland, and he died at Amsterdam in 1679. The work with which his name is principally associated is the *Synopsis criticorum biblicorum* (5 vols. fol., 1669–1676), in which he summarizes the views of one hundred and fifty biblical critics. He also wrote *English Annotations on the Holy Bible*, as far as Isa. lviii.—a work which was completed by several of his Nonconformist brethren, and published in 2 vols. fol. in 1683.

POOLE, PAUL FALCONER (1806–1879), English painter, was born at Bristol in 1806. Though self-taught his fine feeling for colour, poetic sympathy and dramatic power gained for him a high position among British artists. He exhibited his first work in the Royal Academy at the age of twenty-five, the subject being "The Well," a scene in Naples. There was an interval of seven years before he next exhibited his "Farewell, Farewell" in 1837, which was followed by the "Emigrant's Departure," "Hermann and Dorothea" and "By the Waters of Babylon." In 1843 his position was made secure by his "Solomon Eagle," and by his success in the Cartoon Exhibition, in which he received from the Fine Art Commissioners a prize of £300 sterling. After his exhibition of the "Surrender of Syon House" he was elected an associate of the Royal Academy in 1846, and was made an academician in 1861. He died in 1879.

Poole's subjects divide themselves into two orders—one idyllic, the other dramatic. Of the former his "May Day" (1852) is a typical example. Of both styles there were excellent examples to be seen in the small collection of his works shown at Burlington House in the Winter Exhibition of 1883–1884. Among his early dramatic pictures was "Solomon Eagle exhorting the People to Repentance during the Plague of 1665," painted in 1843. To this class belongs also the "Messenger announcing to Job the Irruption of the Sabeans and the Slaughter of the Servants" (exhibited in 1850), and "Robert, Duke of Normandy and Arletta" (1848). Finer examples of his more mature power in this direction are to be found in his "Prodigal Son," painted in 1869; the "Escape of Glaucus and Ione with the blind girl Nydia from Pompeii" (1860); and "Cunstaunce sent adrift by the Constable of Alla, King of Northumberland," painted in 1868. More peaceful than these are the "Song of Troubadours" (painted in 1854) and the "Goths in Italy" (1851), the latter an important historical work of great power and beauty. Of a less lofty strain, but still more beautiful in its workmanship, is the "Seventh Day of the Decameron," painted in 1857. In this picture Poole rises to his full height as a colourist. In his pastorals he is soft and tender, as in the "Mountain Path" (1853), the "Water-cress Gatherers" (1870), the "Shepston Maiden" (1872). But when he turns to the grander and more sublime views of nature his work is bold and vigorous. Fine examples of this style may be seen in the "Vision of Ezekiel" of the National Gallery, "Solitude" (1876), the "Entrance to the Cave of Mammon" (1875), the "Dragon's Cavern" (1877), and perhaps best of all in the "Lion in the Path" (1873), a great representation of mountain and cloud form.

POOLE, REGINALD STUART (1832–1895), English archaeologist and orientalist, was born in London on the 27th of January 1832. His father was the Rev. Edward Poole, a well-known bibliophile. His mother, Sopha, authoress of *The Englishwoman in Egypt* (1844), was the sister of E. W. Lane, the Arabic scholar, with whom R. S. Poole lived in Cairo from 1842 to 1849, thus imbibing an early taste for Egyptian antiquities. In 1852 he became an assistant in the British Museum, and was assigned to the department of coins and medals, of which in 1870 he became keeper. In that capacity he did work of the highest value, alike as a writer, teacher and administrator. In 1882 he was largely responsible for founding the Egypt Exploration Fund, and in 1884 for starting the Society of English Medallists. He retired in 1893, and died on the 8th of February 1895. Some of Poole's best work was done in his articles for the *Ency. Brit.* (9th ed.) on Egypt, Hieroglyphics and Numismatics, and considerable portions have been retained in the present edition, even though later research has been active in his sphere of work; he also wrote for Smith's *Dictionary of the Bible*, and published several volumes dealing with his special subjects. He was for some time professor of archaeology at University College, London, and also lecturer at the Royal Academy.

His elder brother, Edward Stanley Poole (1830–1867), who was chief clerk in the science and art department at South Kensington, was an Arabic scholar, whose early death cut short a promising career. His two sons, Stanley Lane-Poole (b. 1854), professor of Arabic in Trinity College, Dublin, and Reginald Lane-Poole (b. 1857), keeper of the archives at Oxford, lecturer in diplomatic, and author of various historical works, carried on the family tradition of scholarship.

POOLE, a municipal borough, county in itself, market town and seaport in the eastern parliamentary division of Dorsetshire, England, 113½ m. S.W. by W. from London by the London & South-Western railway. Pop. (1901), 19,463. It is picturesquely situated on a peninsula between Holes Bay and the shallow irregular inlet of Poole Harbour. There are several modern churches, a guildhall, public library and school of art. Poole Harbour, extending inland 6 m., with a general breadth of 4 m., has a very narrow entrance, and is studded with low islands, on the largest of which, Brownsea or Branksea, is a castle, transformed into a residence, erected as a defence of the harbour in Tudor times, and strengthened by Charles I. Potters' clay is worked here. At low water the harbour is entirely emptied except a narrow channel, when there is a depth of 8½ ft. There are some valuable oyster beds. There is a considerable general coasting trade, and clay is exported to the Staffordshire potteries. Some shipbuilding is carried on, and there are manufacturers of cordage, netting and sailcloth. The town also possesses potteries, decorative tileworks, iron foundries, agricultural implement works and flour-mills. Poole Park, containing 40 acres of land and 62 acres of water, was acquired in 1887 and 1889, and Branksome Park, of 40 acres, in 1895. The borough is under a mayor, 6 aldermen and 18 councillors. Area, 5333 acres.

Although the neighbourhood abounds in British earthworks and barrows, and there are traces of a Roman road leading from Poole to Wimborne, Poole (La Pole) is not mentioned by the early chroniclers or in Domesday Book. The manor, part of that of Canford, belonged in 1086 to Edward of Salisbury, and passed by marriage to William Longespée, earl of Salisbury, thence to Edmund de Lacy, earl of Lincoln, and with his heiress to Thomas, earl of Lancaster, and so to the Crown. Poole is first mentioned in a writ of 1224, addressed to the bailiffs and good men of La Pole, ordering them to retain all ships within their port. Entries in the Patent Rolls show that Poole had considerable trade before William de Longespée, earl of Salisbury, granted the burgesses a charter about 1248 assuring to them all liberties and free customs within his borough. The bailiff was to be chosen by the lord from six men elected by the burgesses, and was to hold pleas for breach of measures and assizes. It is uncertain when the burgesses obtained their town at the fee-farm rent of £8, 13s. 4d. mentioned in 1312. The mayor, bailiffs and good men are first mentioned in 1311 and were required to provide two ships for service against Robert de Brus. In 1372 the burgesses obtained assize of bread and ale, and right to hold the courts of the lord of the manor, the prepositus being styled his mayor. The burgesses were licensed in 1433 to fortify the town; this was renewed in 1462, when the mayor was given cognisance of the staple. Elizabeth incorporated Poole in 1569 and made it a separate county; Charles II. gave a charter in 1667. The corporation was suspended after a writ of *quo warranto* in 1686, the town being governed by the commission of the peace until the charters were renewed in 1688. Poole returned two members to parliament in 1362 and 1368, and regularly from 1452 to 1867, when the representation was reduced, ceasing in 1885. It is uncertain when the Thursday market was granted, but the present fairs on the Feasts of SS Philip and James and All Saints were granted in 1453. Poole, as the headquarters of the Parliamentary forces in Dorset during the Civil War, escaped the siege that crippled so many of its neighbours. When Charles II. visited the town in 1665 a large trade was carried on in stockings, though the prosperity of Poole still depended on its usefulness as a port.

POONA, or Puna, a city and district of British India, in the Central division of Bombay. The city is at the confluence of the Mutha and Mula rivers, 1850 ft. above sea-level and 119 m. S.E. from Bombay on the Great Indian Peninsula railway. Municipal area, about 4 sq. m.; pop. (1901), 153,320. It is pleasantly situated amid extensive gardens, with a large number of modern public buildings, and also many temples and palaces dating from the 16th to the 19th century. The palace of the peshwas is a ruin, having been destroyed by fire in 1827. From its healthy situation Poona has been chosen not only as the headquarters of the 6th division of the Southern army, but also as the residence of the governor of Bombay during the rainy season, from June to September. The native town, along the river bank, is somewhat poorly built. The European quarter, including the cantonment, extends north-west towards Kirkee. The waterworks were constructed mainly by the munificence of Sir Jamsetjee Jeejeebhoy. Poona was never a great centre of trade or manufacture though still noted for brass-work, jewelry and other articles of luxury. Cotton-mills, paper-mills, a brewery (at Dapuri), flour-mills, factories of ice and mineral waters, and dairy farms furnish the chief industries. Educational institutions are numerous. They include the government Deccan College, with a law class; the aided Fergusson college; the government colleges of science and agriculture; high schools; training schools for masters and mistresses; medical school; and municipal technical school. The recent history of Poona has been painfully associated with the plague. During 1897, when the city was first attacked, the death-rate rose to 93 per 1000 in Poona city, 71 per 1000 in the cantonment, and 93 per 1000 in Kirkee.

The District of Poona has an area of 5349 sq. m. Population (1901), 995,330, showing an increase of 18% after the disastrous famine of 1876–1877, but a decrease of 7% in the last decade. Towards the west the country is undulating, and numerous spurs from the Western Ghats enter the district; to the east it opens out into plains. It is watered by many streams which, rising in the ghats, flow eastwards until they join the Bhima, a river which intersects the district from north to south. The principal crops are millets, pulses, oil-seeds, wheat, rice, sugarcane, vegetables and fruit (including grapes). The two most important irrigation works in the Deccan are the Mutha canal, with which the Poona waterworks are connected, and the Nira canal. There are manufactures of cotton, silk and blankets. The district is traversed by the Great Indian Peninsula railway, and also by the Southern Mahratta line, which starts from Poona city towards Satara. It is liable to drought, from which it suffered severely in 1866–1867, 1876–1877, and again in 1896–1897.

In the 17th century the district formed part of the Mahommedan kingdom of Ahmadnagar. Sivaji was born within its boundaries at Junnar in 1627, and he was brought up at Poona town as the headquarters of the hereditary fief of his father. The district thus was the early centre of the Mahratta power; and when Satara became first the capital and later the prison of the descendants of Sivaji, Poona continued to be the seat of government under their hereditary ministers, with the title of peshwa. Many stirring scenes in Mahratta history were enacted here. Holkar defeated the last peshwa under its walls, and his flight to Bassein led to the treaty by which he put himself under British protection. He was reinstated in 1802, but, unable to maintain friendly relations, he attacked the British at Kirkee in 1817, and his kingdom passed from him.

POOP (Lat. *puppis*, stern), the stern or after-part of a ship; in the 16th and 17th centuries a lofty and castellated deck. The verb "to poop" is used of a wave breaking over the stern of a vessel.

POORE (or Poor), **RICHARD** (d. 1237), English bishop, was a son of Richard of Ilchester, bishop of Winchester. About 1197 he was chosen dean of Sarum and, after being an unsuccessful candidate for the bishoprics of Winchester and of Durham, he became bishop of Chichester in 1214. In 1217 he was translated to Salisbury, where he succeeded his elder brother, Herbert Poore, and in 1228 to Durham. He died at Tarrant Monkton, Dorset, said by some to be his birthplace, on the 15th of April 1237. Poore took some part in public affairs, under Henry III., but the great work of his life was done at Salisbury. Having in 1219 removed his see from Old to New Sarum, or Salisbury, he began the building of the magnificent cathedral there; he laid the foundation stone in April 1220, and during his episcopate he found money and forwarded the work in other ways. For the city the bishop secured a charter from Henry III. and he was responsible for the plan on which it was built, a plan which to some extent it still retains. He had something to do with drawing up some statutes for his cathedral; he is said to be responsible for the final form of the "use of Sarum," and he was probably the author of the *Ancren Riwle*, a valuable "picture of contemporary life, manners and feeling" written in Middle English. His supposed identity with the jurist, Ricardus Anglicus, is more doubtful.

POOR LAW. The phrase "poor law" in English usage denotes the legislation embodying the measures taken by the state for the relief of paupers and its administration. The history of the subject and its problems generally are dealt with in the article Charity and Charities, and other information will be found in Unemployment and Vagrancy. This article will deal only with the practice in the United Kingdom as adopted after the reform of the poor law in 1834 and amended by subsequent acts. This reform was brought about mainly by the rapid increase of the poor rate at the beginning of the 19th century, showing that a change was necessary either in the poor law as it then existed or in the mode of its administration.

A commission was appointed in 1832 "to make diligent and full inquiry into the practical operation of the laws for the relief of the poor in England and Wales, and into the manner in which those laws were administered, and to report their opinion as to what beneficial alterations could be made." The commissioners reported "fully on the great abuse of the legislative provision for the poor as directed to be employed by the statute of Elizabeth," finding "that the great source of abuse was the outdoor relief afforded to the able-bodied on their own account or on that of their families, given either in kind or in money." They also reported that "great maladministration existed in the workhouses." To remedy the evils they proposed considerable alterations in the law, and the principal portion of their suggestions was embodied in the Poor Law Amendment Act 1834. By virtue of this act three commissioners were appointed (originally for five years, but subsequently continued from time to time), styled "the poor law commissioners for England and Wales," sitting as a board, and appointing assistant commissioners and other officers. The administration of relief according to the existing laws was subject to their direction and control, and to their orders and regulations for the government of workhouses and the guidance and control of guardians and vestries and the keeping and allowing of accounts and contracts, without interfering with ordinary relief in individual cases. The whole of England and Wales was divided into twenty-one districts, to each of which an assistant commissioner was appointed. The commissioners under their powers formed poor law unions by uniting parishes for general administration, and building workhouses, guardians elected by the ratepayers (or *ex officio*) having the general government and administration of relief. The expense was apportioned to each parish on settled principles and rules, with power, however, to treat the united parishes as one for certain purposes. Outdoor relief might be given, on the order of two justices, to poor persons wholly unable to work from old age or infirmity.

The obstacles which the act had to contend with in London chiefly arose from the confusion and perplexity of jurisdiction which existed in the one hundred and seventy parishes comprised within the city of London and the metropolitan district, some of these containing governing bodies of their own; in some the parish business was professedly managed by open vestries, in others by select vestries, and in addition to these there were elective vestries, while the majority of the large parishes were managed under local acts by boards of directors, governors and trustees. These governing bodies executed a great variety of functions besides regulating the management of the poor. The power, patronage and the indirect advantages which arose from the administration of the local funds were so great that much opposition took place when it was proposed to interfere by constituting a board to be annually chosen and freely elected by the ratepayers, on which the duty of regulating the expenditure for the relief of the poor was to depend. The general management of the poor was, however, on a somewhat better footing in London than in the country.

The act of 1834 was rather to restore the scope and intention of the statute of Elizabeth by placing its administration in the hands of responsible persons chosen by the ratepayers, and themselves controlled by the orders of a central body, than to create a new system of poor laws. The agents and instruments by which the administration of relief is afforded are the following. The description applies to the year 1910, but, as noticed below, the question of further reform was already to the fore, and the precise direction in which changes should go was a highly controversial matter.

Guardians.

The guardians of the poor regulate the cases and description of relief within the union; a certain number of guardians are elected from time to time by the ratepayers. The number was formerly determined by the central board,[1] by whom full directions as to the mode of election were given. In addition to those elected there were *ex officio* guardians, principally local magistrates. However, both these and nominated guardians were done away with by the Local Government Act 1894. The plural vote (which gave to the votes of the larger ratepayers a higher value) was also abolished; and in place of the old property qualification for the office of guardian a ratepaying or residential qualification was substituted. In urban districts the act in other respects left the board of guardians untouched, but in rural districts it inaugurated a policy of consolidating local authorities. In the rural districts the district council is practically amalgamated with the guardians, for, though each body retains a separate corporate existence, the district councillors are the guardians, and guardians as such are no longer elected. These electoral changes, extremely democratic in their character, brought about no marked general change in poor law administration. Here and there abrupt changes of policy were made, but the difficulty of bringing general principles to bear on the administration of the law remained much as before.

The guardians hold their meetings frequently, according to the exigencies of the union. Individual cases are brought to their notice—most cases of resident poor by the relieving officer of the union; the case of casual paupers by him or by the workhouse officers by whom they were admitted in the first instance. The resident poor frequently appear in person before the guardians. The mode of voting which the guardians follow in respect to any matter they differ on is minutely regulated, and all their proceedings, as well as those of their officers, are entered in prescribed books and forms. They have a clerk, generally a local solicitor of experience, who has a variety of responsible duties in advising, conducting correspondence and keeping books of accounts, and carrying out the directions of the guardians, who in their turn are subject to the general or special regulations of the local government board.

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[1] After an intermediate transfer in 1847 of the powers of the poor law commissioners, and the constitution of a fresh board styled "commissioners for administering the laws for relief of the poor in England," it was found expedient to concentrate in one department of the government the supervision of the laws relating to the public health, the relief of the poor and local government; and this concentration was in 1871 carried out by the establishment (by Act of Parliament 34 & 35 Vict. c. 70) of the local government board.

It may be mentioned here that the chief difficulty in understanding the English poor law arises from the fact that there are three authorities, each of them able to alter its administration fundamentally. The poor law is not only the creation of statutes passed by parliament; it is also controlled by the subordinate jurisdiction of the local government board, which in virtue of various acts has the power to issue orders. In a single year the local government board may issue nearly two thousand orders, over a thousand of them having special reference to the poor law. It is not possible therefore even to summarize the mass of subordinate legislation. A third source of authority is the local board of guardians, which, within the discretion allowed to it by statutes and orders, can so variously administer the law that it is difficult to understand how procedure so fundamentally different can be based on one and the same law. This elasticity, admirable or mischievous, as we choose to regard it, is the most characteristic feature of the English poor law system. The various officers of the union, from the medical officers to workhouse porters, including masters and matrons of workhouses, are generally appointed by the guardians, and the areas, duties and salaries of all the paid officers may be prescribed by the local government board.

Among a multitude of miscellaneous duties and powers of the guardians, apart from the ordinary duties of ordering or refusing relief in individual cases and superintending the officers of the union, the duties devolve on them of considering the adjustment of contributions to the common fund whether of divided or added parishes, and matters affecting other unions, the building of workhouses and raising of money for that and other purposes, the taking of land on lease, the hiring of buildings, special provisions as to superannuation and allowances to officers, the maintenance and orders as to lunatics apart from individual instances, and the consideration of questions of settlement and removal. A paramount obligation rests on the guardians to attend to the actual visitation of workhouses, schools and other institutions and places in which the poor are interested, and to call attention to and report on any irregularity or neglect of duty. Guardians may charge the rates with the expenses of attending conferences for the discussion of matters connected with their duties (Poor Law Conferences Act 1883). In relation to expenditure the guardians have very considerable but restricted powers. Their accounts are audited by district auditors appointed by the local government board.

Overseers.

Overseers of the poor are still appointed under the statute of Elizabeth, and the guardians cannot interfere with the appointment. As, however, the relief of the poor is administered by boards of guardians, the principal duties of overseers relate to the making and collection of rates and payments. The guardians, by order of the local government board, may appoint assistant overseers and collectors.

Conditions of Relief.

The conditions of persons entitled to relief are indicated by the terms of the statute of Elizabeth. If they fall within the definitions there given they have right to relief. A fundamental principle with respect to legal relief of the poor is that the condition of the pauper ought to be, on the whole, less eligible than that of the independent labourer. The pauper has no just ground for complaint, if, while his physical wants are adequately provided for, his condition is less eligible than that of the poorest class of those who contribute to his support. If a state of destitution exists, the failure of third persons to perform their duty, as a husband, or relative mentioned in the statute of Elizabeth, neglecting those he is under a legal obligation to support, is no answer to the application. The relief should be afforded, and is often a condition precedent to the right of parish officers to take proceedings against the relatives or to apply to other poor unions. The duty to give immediate relief must, however, vary with the circumstances. The case of wanderers under circumstances not admitting of delay may be different from that of persons resident on the spot where inquiry as to all the circumstances is practicable. The statute of Elizabeth contemplated that the relief was to be afforded to the poor resident in the parish, but it is contrary to the spirit of the law that any person shall be permitted to perish from starvation or want of medical assistance. Whoever is by sudden emergency or urgent distress deprived of the ordinary means of subsistence has a right to apply for immediate relief where he may happen to be. Persons comprehended within this class are called "casual poor," although the term "casuals" is generally used in reference to vagrants who take refuge for a short time in the "casual wards" of workhouses. Various tests are applied to ascertain whether applicants are really destitute. Labour tests are applied to the able-bodied, and workhouse tests are applied to those to whom entering a workhouse is made a condition of relief.

Nature and Kind of Relief.

As to the nature and kind of relief given under the poor laws the great distinction restored rather than introduced by the amendment of the poor law system in 1834 was giving all relief to able-bodied persons of their families in well-regulated workhouses (that is to say, places where they may be set to work according to the spirit and intention of the statute of Elizabeth), and confining outdoor relief to the impotent—that is, all except the able-bodied and their families. Although workhouses formed a conspicuous feature in legislation for the poor from an early period, the erection of those buildings for unions throughout the country where not already provided followed immediately on the amendment of the system in 1834. Since that time there has been a constant struggle between the pauper class and the administrators of the law, the former naturally wishing to be relieved at their own homes, and in many instances choosing rather to go without aid than to remove within the walls of the workhouse. Relief given in a workhouse is termed "in (or indoor) maintenance" relief, and when given at the homes of the paupers is termed "outdoor relief."

Workhouse Rules.

Admission to a workhouse may be by a written order of the board of guardians, or by the master or matron (or in their absence by the porter) without an order in any case of sudden or urgent necessity, or provisionally by a relieving officer, or overseer or churchwarden. Any person who is brought by a policeman as having been found wandering in a state of destitution may be admitted. It is to be observed generally, with respect to all persons who may apply for admission into the workhouse under circumstances of urgent necessity, that their destitution, coupled with the fact of being within the union or parish, entitles them to relief, altogether independently of their settlement, if they have one, which is a matter for subsequent inquiry.

The regulations for the government of workhouses fall under two classes: (1) those which are necessary for the maintenance of good order in any building in which considerable numbers of persons of both sexes and of different ages reside; (2) those which are necessary in order that these establishments may not be almshouses, but workhouses in the proper meaning of the term.

The inmates of a workhouse are necessarily separated into certain classes. In no well-managed institution of this sort, in any country, are males and females, the old and the young, the healthy and the sick, indiscriminately mixed together. Guardians are required to divide the paupers into certain classes, and to subdivide any one or more of these classes in any manner which may be advisable, and which the internal arrangements of the workhouse admit; and the guardians are required from time to time, after consulting the medical officer, to make necessary arrangements with regard to persons labouring under any disease of body or mind, and, so far as circumstances permit, to subdivide any of the enumerated classes with reference to the moral character or behaviour or the previous habits of the inmates, or to such other grounds as may seem expedient.

The separation of married couples was long a vexed question, the evils on the one hand arising from the former unrestricted practice being very great, while on the other hand the separation of old couples was felt as a great hardship, and by express statutory provision in 1847 husband and wife, both being above the age of sixty, received into a workhouse cannot be compelled to live separate and apart from each other (10 & 11 Vict. c. 109, § 23). This exemption was carried somewhat further by contemporaneous orders of the board, under which guardians were not compelled to separate infirm couples, provided they had a sleeping apartment separate from that of other paupers; and in 1876 guardians were empowered, at their discretion, to permit husband and wife where either of them is infirm, sick or disabled by any injury, or above sixty years of age to live together, but every such case must be reported to the local government board (39 & 40 Vict. c. 61, § 10).

The classification of children apart from adult paupers is peremptory. Even in those unions where what is called a workhouse school is maintained the children are kept in detached parts of the building, and do not associate with the adult paupers. The separate school is built on a separate and often distant site. Sometimes the separate school is one building, sometimes detached "blocks," and sometimes a group of cottage homes. There still remain ten district schools. In some places an experiment which is called the scattered homes system has been adopted. This consists in lodging-homes for the children placed in different parts of the town, from which the children attend the local public elementary schools. In the rural districts and in less populous unions the children generally attend the local public elementary school. To these expedients boarding-out must be added. The above refers of course only to those children who as inmates are under the charge of the guardians. Outdoor paupers are responsible for the education of their children, but guardians cannot legally continue outdoor relief if the children are not sent regularly to school.

The tendency too has been to improve administrative methods with reference to children.

Two important orders on the subject of the boarding-out of poor-law children were issued in 1889. By the Boarding of Children in Unions Order, orphan and deserted children can be boarded out with suitable foster-parents in the union by all boards of guardians except those in the metropolis. This can be done either through a voluntary committee or directly. By the Boarding Out Order, orphan and deserted children may be boarded out by all boards of guardians without the limits of their own unions, but in all cases this must be done through the offices of properly constituted local boarding-out committees. The sum payable to the foster-parents is not to exceed 4s. per week for each child. The local committee require to be approved by the Local Government Board.

The question of the education of poor law children was much discussed in later years. During the early years of the central authority, it was the object of the commissioners to induce boards of guardians to unite in districts for educational purposes. This was advocated on grounds of efficiency and economy. It was very unpopular with the local authorities, and the number of such districts has never exceeded a dozen. In London, where this aggregation was certainly less desirable than in rural unions, several districts were formed and large district schools were built. Adverse criticism, by Mrs Nassau Senior in 1874, and by a department committee appointed twenty years later, was directed against these large, or, as they are invidiously called, barrack schools. The justice of this condemnation has been disputed, but it seems probable that some of these schools had grown too large. Many of these have been dissolved by order of the local government board on the application of the unions concerned. This condemnation of some schools has in certain quarters been extended to all schools, and is construed by others as an unqualified recommendation of boarding out, a method of bringing up poor law children obviously requiring even more careful supervision than is needed in the publicity of a school.

Other acts to be noted are the Poor Law Act 1889 and the Custody of Children Act 1891, § 3. The evil of allowing children who have been reputably brought up in poor law schools to relapse into vicious habits on return to the custody of unworthy parents has been the subject of frequent remark. By the act of 1889, guardians are authorized to detain children who are under their charge, as having been deserted by their parents, up to the age of 16 if boys and of 18 if girls. By the Poor Law Act 1899 the principle is extended to orphans and the children of bad parents chargeable to the rates. The act of 1891 goes further, and enacts that where a parent has (*a*) abandoned or deserted his child, or (*b*) allowed his child to be brought up by another person at that person's expense, or by the guardians of a poor law union for such a length of time and in such circumstances as to satisfy the court that the parent was unmindful of his parental duties, the court shall not make an order for the delivery of the child to the parent unless the parent has satisfied the court that, having regard to the welfare of the child, he is a fit person to have the custody of the child.

Casual and poor wayfarers admitted by the master and matron are kept in a separate ward and dieted and set to work in such manner as the guardians by resolution direct; and whenever any vagrants or mendicants are received into a workhouse they are usually (as a precaution necessary for preventing the introduction of infectious or contagious diseases) kept entirely separate from the other inmates, unless their stay exceeds a single night.

For the guidance of guardians an important circular was issued from the local government board on the 15th of March 1886. It stated that while "the board have no doubt that the powers which the guardians possess are fully sufficient to enable them to deal with ordinary pauperism, and to meet the demand for relief from the classes who usually seek it," yet "these provisions do not in all cases meet the emergency. What is required to relieve artisans and others who have hitherto avoided poor law assistance, and who are temporarily deprived of employment, is—(1) Work which will not involve the stigma of pauperism; (2) work which all can perform, whatever may have been their previous occupations; (3) work which does not compete with that of other labourers at present in employment; and lastly, work which is not likely to interfere with the resumption of regular employment in their own trades by those who seek it."

The circular went on to recommend that guardians should confer with the local authorities, "and endeavour to arrange with the latter for the execution of works on which unskilled labour may be immediately employed." The conditions of such work were (1) the men to be employed must be recommended by the guardians; (2) the wages must be less than the wages ordinarily paid for such work.

The circular was widely distributed. Many boards that were inclined in that direction regarded it as an encouragement to open or to promote the opening of relief works. Others, again, looked closely at the conditions, and declared roundly that it was impossible to fulfil them. A poor law authority, they said, cannot give relief which will not subject the recipients to the legal (if any) and economic disabilities attaching to the receipt of poor law relief. Work which all can perform can only be found in the shape of task-work under adequate supervision. If the work is of a useful and necessary character, it must compete with the labour of others belonging to the trades affected. If the relief works are opened by authorities other than the poor law guardians, the conditions that the men were only to be employed when recommended by the guardians, and then paid less than the current rate of wages, were calculated, it was urged, to secure bad work, discontent, and all the "stigma of pauperism." The ambiguity of the circular indeed was such, that both action and inaction seem amply justified by it.

Medical Relief.

In the administration of medical relief to the sick, the objects kept in view are: (1) to provide medical aid for persons who are really destitute, and (2) to prevent medical relief from generating or encouraging pauperism, and with this view to withdraw from the labouring classes, as well as from the administrators of relief and the medical officers, all motives for applying for or administering medical relief, unless where the circumstances render it absolutely necessary.

Unions are formed into medical districts limited in area and population, to which a paid medical officer is appointed, who is furnished with a list of all such aged and infirm persons and persons permanently sick or disabled as are actually receiving relief and residing within the medical officer's district. Every person named in the list receives a ticket, and on exhibiting it to the medical officer is entitled to advice, attendance and medicine as his case may require. Medical outdoor relief in connexion with dispensaries is regulated in asylum districts of the metropolis by the Metropolitan Poor Act 1867 (30 & 31 Vict. c. 6). In connexion with medical relief must be noted the Medical Relief Disqualification Removal Act 1885. This act relieved voters from disqualification which would otherwise attach in consequence of the receipt by them or their families of medical or surgical assistance, or of medicine, at the expense of the poor rate. This does not apply to guardian elections, and it does not include persons who, in addition to medical relief, receive nourishment or other relief from the poor rate. The provisions which require the removal of the names of paupers from the electoral roll are, it is understood, very perfunctorily carried out. The Outdoor Relief Friendly Societies Act 1894 authorized guardians, in calculating the proper allowance to be made, to disregard an income derived from a friendly society, and to give relief as if the applicant in receipt of such an allowance was wholly destitute. This act is a curious illustration of the English poor law system. In earlier years, notably in what is known as Paget's letter (22nd Rep. Poor Law Board, p. 108), the central board, had, in answer to inquiry, pointed out that such preferential treatment given to men receiving benefit, insufficient to maintain them, from a friendly society, could not in equity be withheld from persons in receipt of an adequate benefit, or from those whose savings took the form of a deposit in a bank, of a share in a co-operative society, or of cottage property; and further, that an engagement on the part of guardians to supplement insufficient allowance from a friendly society was a bounty on inadequate and insolvent friendly society finance. The central board went so far as to say that relief given in such disregard of the pauper's income was illegal. They had, however, issued no peremptory order on the subject, nor had guardians been surcharged for neglect of the rule. The local authorities followed their own discretion, and a very general practice was to reckon friendly society allowances at half their value. The above act set aside the central board's earlier interpretation of the law. It made, however, no attempt to enforce its procedure on the numerous boards of guardians who regard the course thereby authorized as contrary to public policy.

Lunatics.

A lunatic asylum is required to be provided by a county or borough for the reception of pauper lunatics, with a committee of visitors who, among other duties, fix a weekly sum to be charged for the lodging, maintenance, medicine and clothing of each pauper lunatic confined in such asylum. Several acts were passed. The Lunacy Act 1890 consolidated the acts affecting lunatics. It was further amended by the Lunacy Act 1891.

An explanatory letter issued by the local government board will be found in the 20th Annual Report, p. 23. The tendency of this and of all recent legislation for an afflicted class has been to increase the care and the safeguards for their proper treatment.

A settlement is the right acquired in any one of the modes pointed out by the poor laws to become a recipient of the benefit of those laws in that parish or place where the right has been last acquired.

The Question of "Settlement."

No relief is given from the poor rates of a parish to any person who does not reside within the union, except where such person being casually within a parish becomes destitute by sudden distress, or where such person is entitled to receive relief from any parish where non-resident under justice's order (applicable to persons under orders of removal and to non-resident lunatics), and except to widows and legitimate children where the widow was resident with her husband at the time of his death out of the union in which she was not settled, or where a child under sixteen is maintained in a workhouse or establishment for the education of pauper children not situate in the union, and in some other exceptional cases.

Immediately before the passing of the Poor Law Amendment Act 1834 settlements were acquired by birth, hiring and service, apprenticeship, renting a tenement, estate, office or payment of rates. In addition to these an acknowledgment (by certificate), by relief or acts of acquiescence) has practically the effect of a settlement, for, if unexplained, such an acknowledgment stops the parish from disputing a settlement in the parish acknowledging. The Poor Law Amendment Act 1834 abolished settlement by hiring and service (or by residence under it) and by serving an office, and by apprenticeship in the sea service. Moreover the guardians of a union might agree (subject to the approval of the commissioners) that all the parishes forming it should for the purposes of settlement be considered as one parish.

It is to be observed that, for the purposes of relief, settlement and removal and burial, the workhouse of any parish is considered as situated in the parish to which each poor person is chargeable.

There may be a settlement by parentage, for legitimate children take the settlement of their father, or if he has no settlement they are entitled to the settlement of their mother; and it is only when both these sources fail discovery that their right of settlement by birth accrues; for until the settlement of the father or mother has been ascertained the settlement of a legitimate child, like that of a bastard, is in the place where the birth took place.

A settlement attaches to those persons who have a settlement of some kind. Foreigners born out of the country and not acquiring any in one of the modes pointed out must be provided for, if requiring relief, where they happen to be.

As the burden of maintaining the poor is thrown on the parish of settlement, when the necessity for immediate relief arises in another parish, the important question arises whether the pauper can be removed; for, although the parish where the pauper happens to be must afford immediate relief without waiting for removal, the parish of settlement cannot in general be charged with the cost unless the pauper is capable of being removed. The question of removability is distinct from settlement. A pauper often acquires a status or irremovability without gaining a settlement.

Irremovability is a principle of great public importance quite irrespective of the incident of cost as between one parish or another. Before the introduction of a status of irremovability removal might take place (subject to powers of suspension in case of sickness and otherwise) after any interval during which no legal settlement was obtained; mere length of residence without concurrent circumstances involving the acquisition of a settlement on obtaining relief gave no right to a person to remain in the parish where he resided.

In 1846 it was enacted that no person should be removed nor any warrant granted for the removal of any person from any parish in which such persons had resided for five years (9 & 10 Vict. c. 66). In 1861 three years was submitted for five (24 & 25 Vict. c. 55); and only four years later one year was substituted for three (28 & 29 Vict. c. 79). Apart from these reductions of time in giving the status of irremovability, actual removals to the parish of settlement were narrowed by provisions giving to residence in any part of a union the same effect as a residence in any parish of that union (24 & 25 Vict. c. 55). On the other hand the time during which parish relief is received, or during which the person is in any poorhouse or hospital or in a prison, is excluded from the computation of time (9 & 10 Vict. c. 66).

The removability as well as the settlement of the family, *i.e.* of the wife and unemancipated children, are practically subject to one and the same general rule. Wherever any person has a wife or children having another settlement, they are removable where he is removable, and are not removable from any parish or place from which he is not removable (11 & 12 Vict. c. 211).

It is to be borne in mind that no person exempted from liability to be removed acquires, by reason of such exemption, any settlement in any parish; but a residence for three years gives a qualified settlement (39 & 40 Vict. c. 61).

The cost of relief of paupers rendered irremovable is borne by the common fund of the union (11 & 12 Vict. c. 110, § 3) as union expenses (§ 6), and any question arising in the union with reference to the charging relief may be referred to and decided by the local government board (§ 4).

Poor Rate.

The poor rate is the fund from which the cost of relief is principally derived. The statute of Elizabeth (extended in some respects as to places by 13 & 14 Charles II. c. 12) embraced two classes of persons subject to taxation—occupiers of real property and inhabitants in respect of personal property, although the rateability under the latter head was reluctantly conceded by the courts of law, and was in practice only partially acted upon.

As regards occupiers of land and houses, the correct principles as to the persons liable to be rated were, after many erroneous views and decisions, established by the House of Lords in 1865 in the case of the Mersey docks. The only occupier exempt from the operation of the act of Elizabeth is the Crown, on the general principle that such liabilities are not imposed on the sovereign unless expressly mentioned, and that principle applies to the direct and immediate servants of the Crown, whose occupation is the occupation of the Crown itself. If there is a personal private beneficial occupation, so that the occupation is by the subject, that occupation is rateable. Thus for apartments in a royal palace, gratuitously assigned to a subject, who occupies them by permission of the sovereign but for the subject's benefit, the latter is rateable; on the other hand, where a lease of private property is taken in the name of a subject, but the occupation is by the sovereign or his subjects on his behalf, no rate can be imposed.

So far the ground of exemption is perfectly intelligible, but it has been carried a good deal further, and applied to many cases in which it can scarcely be said naturally, but only theoretically, that the sovereign or the servants of the sovereign are in occupation. A long series of cases have established that when property is occupied for the purposes of the government of the country, including under that head the police, and the administration of justice, no one is rateable in respect of such occupation. And this applies not only to property occupied for such purposes by the servants of the great departments of state and the post office, the Horse Guards, and the Admiralty, in all which cases the occupiers might strictly be called the servants of the Crown, but to county buildings occupied for the assizes and for the judge's lodgings, to stations for the local constabulary, to jails and to county courts where undertakings are carried out by or for the government and the government is in occupation; the same principles of exemption have been applied to property held by the office of works.

When the property is not *de facto* occupied by the Crown or for the Crown, it is rateable; and, although formerly the uses of property for public purposes, even where the Crown was not constructively interested in the way above pointed out, was treated as a ground for exemption, it is now settled that trustees who are in law the tenants and occupiers of valuable property in trust for public and even charitable purposes, such as hospitals or lunatic asylums, are in principle rateable notwithstanding that the buildings are actually occupied by paupers who are sick or insane, and that the notion that persons in the legal occupation of valuable property are not rateable if they occupy in a merely fiduciary character cannot be sustained.

With respect to the particular person to be rated where there is a rateable occupation, it is to be observed that the tenant, as distinguished from the landlord, is the person to be rated under the statute of Elizabeth; but occupiers of tenements let for short terms may deduct the poor rate paid by them from their rents, or the vestries may order such owners to be rated instead of the occupiers; such payments or deductions do not affect qualification and franchises depending on rating (Poor Rate Assessment and Collection Act 1869 and Amendment Act 1882).

To be rated the occupation must be such as to be of value, and in this sense the word beneficial occupation has been used in many cases. But it is not necessary that the occupation should be beneficial to the occupier; for, if that were necessary, trustees occupying for various purposes, having no beneficial occupation, would not be liable, and their general liability has been established as indicated in the examples just given.

As to the mode and amount of rating it is no exaggeration to say that the application of a landlord-and-tenant valuation in the terms already given in the Parochial Assessment Act, with the deductions there mentioned, has given rise to litigation on which millions of pounds have been spent with respect to the rating of railways alone, although the established principle applied to them, after much consideration, is to calculate the value of the land as increased by the line.

The Parochial Assessment Act referred to (6 & 7 Will. IV. c. 96), comprising various provisions as to the mode of assessing the rate so far as it authorized the making of a valuation, was repealed in 1869, in relation to the metropolis, and other provisions made for securing uniformity of the assessment of rateable property there (32 & 33 Vict. c. 67).

The mode in which a rate is made and recovered may be concisely stated thus. The guardians appoint an assessment committee of their body for the investigation and supervision of valuations, which are made out in the first instance by the overseers according to specific regulations and in a form showing among other headings the gross estimated rental of all property and the names of occupiers and owners, and the rateable value after the deductions specified in the Assessment Act already mentioned, and as prescribed by the central board. This valuation list, made and signed by the overseers, is published, and all persons assessed or liable to be assessed, and other interested parties, may, including the officers of other parishes, inspect and take copies of and extracts from that list. A multitude of provisions exist in relation to the valuation and supplemental valuation lists. Objections on the ground of unfairness or incorrectness are dealt with by the committee, who hold meetings to hear and determine such objections. The valuation list, where approved by the committee, is delivered to the overseers, who proceed to make the rate in accordance with the valuation lists and in a prescribed form of rate book. The parish officers certify to the examination and comparison of the rate book with the assessments, and obtain the consent of justices as required by the statute of Elizabeth. This consent or allowance of the rate is merely a ministerial act, and if the rate is good on the face of it the justices cannot inquire into its validity.

The rate is then published and open to inspection. Appeals may be made to special or quarter sessions against the rate, subject to the restriction that, if the objection were such that it might have been dealt with on the valuation lists, no appeal to sessions is permitted unless the valuation list has been duly objected to and the objector had failed to obtain such relief in the matter as he deemed to be just.

In the metropolis a common basis of value for the purposes of government and local taxation is provided, including the promotion of uniformity in the assessment of rateable property. Provision is made for the appointment of an assessment committee by guardians or vestries, and for the preparation of valuation lists, and the deposit and distribution of valuation lists, and for the periodical revision of valuation lists.

Many endeavours have been made to readjust the burden of local expenditure. The system of making grants from the national taxes in aid of local rates has been extended. The principle of the metropolitan common poor fund, a device for giving metropolitan grants assessed on the whole of London in aid of the London local poor law authorities, has been followed, *mutatis mutandis*, in the relations between the national and the local exchequers. At the time of the repeal of the corn laws, Sir Robert Peel expressed an opinion that this fiscal change necessitated some readjustment of local rates. In that year, 1846, a beginning of grants from the national exchequer in aid of local expenditure was made. The salaries of poor-law teachers, medical officers and auditors were provided from the larger area of taxation, and in 1867 the salaries of public vaccinators were added to the list. In 1874 a grant of 4s. per head per week was made for each pauper lunatic passed by the guardians to the care of a lunatic asylum. By the Local Government Act 1888, supplemented by the Local Taxation (Customs and Excise) Act 1890, this principle was more widely extended. The various grants in aid were abolished, and in substitution the proceeds of certain specified taxes were set aside for local purposes. From this source, the gross amount of which of course varies, there are now distributed to local poor-law authorities some 4s. a week for lunatics in asylums, and allowances based on their average expenditure in previous years in salaries of officials and other specified charges. In London, in order not to conflict with the operation of the common poor fund, which had already spread these charges over a wide area, the grant takes the form of a sum equivalent to about 4d. per diem for each indoor pauper. The number on which this calculation is based is not, however, to be the actual number, but the average of the last five years previous to the passing of the act. By this legislation something like one-quarter of the total expenditure on poor law relief is obtained from national taxes as opposed to local rates. By the Agricultural Rates Act 1896 the occupier of agricultural land was excused one-half of certain rates, including the poor rate. The deficiency is supplied by a contribution from the national exchequer. Meanwhile, the spending authority continue to be elected by the local ratepayers. In this connexion two further anomalies deserve notice. By the Poor Rate Assessment and Collection Act 1869 owners who compound to pay the rates in respect of tenement property are entitled to certain deductions by way of commission. Such payments by the owner are constructively payments by the occupier, who thereby is to be deemed duly rated for any qualification or franchise. Under these arrangements a large number of electors do not contribute directly to the rate. A converse process is also going on, whereby the ownership of an important and increasing body of property is practically unrepresented. This is due to the great growth of property in the hands of railway companies, docks and limited liability companies generally. The railways alone are said to pay considerably over 13% of the local taxation of the country, and they have no local representation. There is, in fact, in local administration a divorce between representation and taxation to a greater extent than is generally supposed, and it is impossible not to connect the fact with the rapid growth of local expenditure and indebtedness.

Royal Commission of 1905–1909.—The main points of the system of English poor relief, as still in force in 1910, are as outlined above. That it has been inadequate in dealing with the various problems of unemployment and pauperism, which the constantly changing conditions of the industrial world necessarily evolve had however been long acknowledged. Accordingly in 1905 a royal commission was appointed to inquire into the working of the law relating to the relief of poor persons, and into the various means adopted outside of the poor laws for meeting distress arising from want of employment, particularly during the periods of severe industrial depression. The commission took voluminous evidence[1] and its report was issued in

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[1] The appendix volumes to the Report of the Royal Commission number thirty-four. Their contents are as follows: vol. i. English Official Evidence, minutes of evidence mainly of the officers of the Local Government Board for England and Wales; vol. ii. London Evidence, minutes of evidence mainly of London witnesses; vol. iii. Associations and Critics, minutes of evidence mainly of critics of the Poor Law and of witnesses representing Poor Law and Charitable Associations; vol. iv Urban Centres, minutes of evidence containing the oral and written evidence of the British Medical Association and of witnesses from the following provincial urban centres—Liverpool and Manchester districts, West Yorkshire, Midland Towns; vol. v. Minutes of Evidence containing the oral and written evidence of witnesses from urban centres in the following districts—South Wales and North Eastern Counties; vol. vi. Minutes of Evidence relating to Scotland; vol. vii. Minutes of Evidence containing the oral and written evidence of witnesses from various rural centres in the South Western, Western and Eastern Counties, from the parish of Poplar Borough and from the National Conference of Friendly Societies; vol. viii. Minutes of Evidence containing the oral and written evidence of witnesses relating chiefly to the subject of "unemployment"; vol. ix. Evidence of further witnesses on the subject of unemployment; vol. x. Minutes of Evidence relating to Ireland; vol. xi. Miscellaneous Papers. Communications from Boards of Guardians and others, &c., vol. xii. Reports, Memoranda and Tables prepared by certain of the Commissioners; vol. xiii. Diocesan Reports on the Methods of administering charitable assistance and the extent and intensity of poverty in England and Wales; vol. xiv. Report on the Methods and Results of the present system of administering indoor and outdoor poor law medical relief in certain unions in England and Wales, by Dr J. C. McVail; vol. xv. Report on the Administrative Relation of Charity and the Poor Law, and the extent and the actual and potential utility of Endowed and Voluntary Charities in England and Scotland, by A. C. Kay and H. V. Toynbee; vol. xvi. Reports on the Relation of Industrial and Sanitary Conditions to Pauperism, by Steel Maitland and Miss R. E. Squire; vol. xvii. Reports on the effect of Outdoor Relief on Wages and the Conditions of Employment, by Thomas Jones and Miss Williams; vol. xviii. Report on the Condition of the Children who are in receipt of the various forms of Poor Law Relief in certain Unions in London and in the Provinces, by Dr Ethel Williams and Miss Longman and Miss Phillips; vol. xix. Reports on the Effects of Employment or Assistance given to the Unemployed since 1886 as a means of relieving distress outside the Poor Law in London, and generally throughout England and Wales, and in Scotland and Ireland, by Cyril Jackson and Rev. J. C. Pringle; vol. xx Report on Boy Labour in London and certain other typical towns, by Cyril Jackson, with a Memorandum from the General Post Office on the Conditions of Employment of Telegraph Messengers; vol. xxi. Reports on the Effect of the Refusal of Out-Relief on the Applicants for such Relief, by Miss G. Harlock; vol. xxii. Report on the Overlapping of the work of the Voluntary General Hospitals with that of Poor Law Medical Relief in certain districts of London, by Miss M. B. Roberts; vol. xxiii. Report on the Condition of the Children who are in receipt of the various forms of Poor Law Relief in certain parishes in Scotland, by Dr C. T. Parsons and Miss Longman and Miss Phillips; vol. xxiv. Report on a Comparison of the Physical Condition of "Ordinary" Paupers in certain Scottish Poorhouses with that of the Able-bodied Paupers in certain English Workhouses and Labour Yards, by Dr C. T. Parsons; vol. xxv. Statistical Memoranda and Tables relating to England and Wales, prepared by the Staff of the Commission and by Government Departments and others, and Actuarial Reports; vol. xxvi. Documents relating more especially to the administration of charities; vol. xxvii. Replies by Distress Committees in England and Wales to Questions circulated on the subject of the Unemployed Workmen Act 1905; vol. xxviii. Reports of Visits to Poor Law and Charitable Institutions and to Meetings of Local Authorities in the United Kingdom; vol. xxix. Report on the Methods of Administering Charitable Assistance and the extent and intensity of Poverty in Scotland, prepared by the Committee on Church Interests appointed by the General Assembly of the Church of Scotland; vol. xxx. Documents relating especially to Scotland; vol. xxxi. Statistical Memoranda and Tables relating to Ireland, &c.; vol. xxxii. Report on Visits paid by the Foreign Labour Colonies Committee of the Commission to certain Institutions in Holland, Belgium, Germany and Switzerland; vol. xxxiii. Foreign and Colonial Systems of Poor

1909. It consists of a majority report, signed by the chairman and 13 other members, and a minority report signed by 4 dissentient members. To this report and its appendices those who wish to obtain an exhaustive account of the working of the English poor law must necessarily have recourse.

Majority Report.

The "majority" report opens with a statistical survey of poor law problems, gives an historical sketch of the poor laws down to 1834, and proceeds to deal in detail with the historical development and present condition of the various branches of the poor law under their appropriate headings: (*a*) the central authority; (*b*) the local authority; (*c*) the officers of the local authority; (*d*) areas of administration; (*e*) indoor relief; (*f*) outdoor relief; (*g*) the aged; (*h*) the children; (*i*) the able-bodied under the poor law and (*j*) the causes of pauperism. Other portions of the report deal with medical relief, distress due to unemployment, and charities and the relief of distress. In reviewing these various subjects the commission lay bare the main defects of the present system, which they briefly summarize as follows:—

i. The inadequacy of existing poor law areas to meet the growing needs of administration.

ii. The excessive size of many boards of guardians.

iii. The absence of any general interest in poor law work and poor law elections, due in great part to the fact that poor law stands in no organic relation to the rest of local government.

iv. The lack of intelligent uniformity in the application of principles and in general administration.

v. The want of proper investigation and discrimination in dealing with applicants.

vi. The tendency in many boards of guardians to give outdoor relief without plan or purpose.

vii. The unsuitability of the general workhouse as a test or deterrent for the able-bodied; the aggregation in it of all classes without sufficient classification; and the absence of any system of friendly and restorative help.

viii. The lack of co-operation between poor law and charity.

ix. The tendency of candidates to make lavish promises of out-relief and of guardians to favour their constituents in its distribution.

x. General failure to attract capable social workers and leading citizens.

xi. The general rise in expenditure, not always accompanied by an increase of efficiency in administration.

xii. The want of sufficient control and continuity of policy on the part of the central authority.

The commission stated that these defects have produced a want of confidence in the local administration of the poor law, and that they have been mainly the cause of the introduction of other forms of relief from public funds which are unaccompanied by such conditions as are imperatively necessary as safeguards.

The commission proceed to formulate a scheme of reform, the main features of which are summarized below:—

Public Assistance.—The commissioners state that the name "poor law" has gathered about it associations of harshness, and still more of hopelessness, which might seriously obstruct the reforms they recommend, and they suggest that the title "public assistance" better expresses the system of help outlined in their report. They propose the abolition of the existing boards of guardians, the separation of their duties into two categories, and the calling into existence of two bodies for the discharge of the two sets of functions, viz. a local authority, known as the public assistance authority, with an area conterminous with the area of the county or county borough, for central administration and control; and local committees in existing union areas for dealing with applications, investigating and supervising cases and undertaking such other duties as may be delegated by the public assistance authority. They recommend that the public assistance authority should be a statutory committee of the County Council, with one-half of its members appointed by the council from persons who are members of the council, and the other half of its members appointed by the council from outside their number, and to consist of persons experienced in the local administration of public assistance or other cognate work, women to be eligible for appointment in either case.

Working in co-operation with the public assistance authorities are to be voluntary aid councils and committees (the former supervising, the latter executive) for aiding persons in distress whose cases do not appear to be suitable for treatment by the public assistance committee. The commission epitomize what they consider to be the main principles of a reformed poor law. They are (1) that the treatment of the poor who apply for public assistance should be adapted to the needs of the individual, and, if institutional, should be governed by classification; (2) that the public administration established for the assistance of the poor should work in co-operation with the local and private charities of the district; (3) that the system of public assistance thus established should include processes of help which would be preventive, curative, and restorative, and (4) that every effort should be made to foster the instincts of independence and self-maintenance amongst those assisted. They proceed to recommend:—

Indoor or "Institutional" Relief.—That general workhouses should be abolished. That indoor relief should be given in separate institutions appropriate to the following classes of applicants, viz. (*a*) children, (*b*) aged and infirm, (*c*) sick, (*d*) able-bodied men, (*e*) able-bodied women, (*f*) vagrants, and (*g*) feeble-minded and epileptics. Powers of removal to and detention in institutions should be given, with proper safeguards, to the public assistance authority. The treatment of inmates should be made as far as possible curative and restorative.

Outdoor Relief or "Home Assistance."—This should be given only after thorough inquiry, except in cases of sudden and urgent necessity; it should be adequate to meet the needs of those to whom it is given; persons so assisted should be subject to supervision; that such supervision should include in its purview the conditions, moral and sanitary, under which the recipient is living; that voluntary agencies should be utilized as far as possible for the personal care of individual cases, and that there should be one uniform order governing outdoor relief or home assistance.

Children.—Effective steps should be taken to secure that the maintenance of children in the workhouse be no longer recognized as a legitimate way of dealing with them. Boarding-out might and should be greatly extended. Power to adopt children of vicious parents should be more frequently exercised and accompanied by a strict dealing with the parent, and the public assistance authorities should retain supervision of adopted children up to the age of twenty-one. A local government board circular of June 1910 to boards of guardians embodied many of the recommendations of the commission. Some recommendations, of course, the guardians are not empowered, under existing legislation, to carry out.

The Aged.—As regards institutional relief, the aged should have accommodation and treatment apart from the able-bodied, and be housed on a separate site, and be further subdivided into classes as far as practicable with reference to their physical condition and their moral character. As regards outdoor relief, greater care should be taken to ensure adequacy of relief.

Medical Relief or Assistance.—A general system of provident dispensaries should be established, of which existing voluntary outdoor medical organizations should be invited to form an integral part, and every inducement should be offered to the working classes below a certain wage to become, or continue to be, members of a provident dispensary.

Unemployment.—The commission review the social and industrial developments since 1834, deal with the new problems, criticize the existing methods of relief, and on their summing up of the new factors and developments, arrive at the conclusions: (*a*) that there is an increasing aggregation of unskilled labour at the great ports and in certain populous districts; (*b*) that this aggregation of low-grade labour is so much in excess of the normal local wants as to promote and perpetuate under-employment, and (*c*) that this normal condition of under-employment, when aggravated by periodic contraction of trade or by inevitable changes in methods of production, assumes such dimensions as to require special machinery and organization for its relief and treatment. The commission proceed to make the following recommendations:—

Labour Exchanges.—A national system of labour exchanges should be established and worked by the board of trade for the general purpose of assisting the mobility of labour and of collecting accurate information as to unemployment. (These were established by the Labour Exchanges Act 1909; see UNEMPLOYMENT.)

Education and Training of the Young for Industrial Life.—The education in the public elementary schools should be much less literary and more practical, and better calculated than at present to adapt the child to its future occupation. Boys should be kept at school until the age of fifteen; exemption below fifteen should be granted only for boys leaving to learn a skilled trade, and there should be school supervision till sixteen and replacing in school if not properly employed.

Regularization of Employment.—Government departments and local and public authorities should be enjoined to regularize their work as far as possible, and to endeavour, as far as possible, to undertake their irregular work when the general demand for labour is slack.

Relief, with a memorandum on the Relief of Famines in India; vol. xxxiv. Alphabetical Lists of Oral and Non-oral Witnesses.

Unemployment Insurance.—The establishment and promotion of unemployment insurance, especially amongst unskilled and unorganized labour, is of paramount importance in averting distress arising from unemployment, and is of such national importance as to justify, under specified conditions, contributions from public funds towards its furtherance. The commission further state that this insurance can best be promoted by utilizing the agency of existing trade organizations, or of organizations of a similar character. They are of opinion that no scheme of unemployment insurance, either foreign or British, which has been brought before them, is so free from objections as to justify them in recommending it for general adoption.

Labour Colonies.—The commission recommend their establishment and use. (For these see VAGRANCY.)

Minority Report.

Four out of the seventeen members of the commission, being unable to agree with their colleagues, issued a separate report, which is very nearly as voluminous as that of the majority. Their recommendations were more drastic than those of the majority, and had for their aim not a reform of the poor law as it exists, but its entire break-up. The minority agree with the majority in recommending the abolition of workhouses, but instead of setting up new authorities, they consider that the duties of the guardians should be transferred to the county authorities, with an appropriate distribution among four existing committees of the county council. They recommend that the education committee become responsible for the entire care of children of school age. That the health committee should care for the sick and permanently incapacitated, infants under school age, and the aged requiring institutional care. The asylums committee should have charge of the mentally defective and the pension committee of the aged to whom pensions are awarded.

The minority consider there should be some systematic coordination, within each local area, of all forms of public assistance and, if possible, of all assistance dispensed by voluntary agencies, and they recommend the appointment, by the county or county borough council, of one or more responsible officers, called "registrars of public assistance." Their duties would be to keep a register of all persons receiving any form of public assistance within their districts; they would assess the charge to be made on individuals liable to pay any part of the cost of the service rendered to them or their dependants, and recover the amount thus due. They would also have to consider the proposals of the various committees of the council for the payment of out-relief, or, as the minority prefer to term it, "home aliment." Other various duties are allotted to them in the report.

The subject of unemployment was considered by the minority and they made the following recommendations:—

Ministry of Labour.—The duty of organizing the national labour market should be placed upon a minister responsible to parliament. The ministry of labour should have six distinct and separately organized divisions; viz. the national labour exchange; the trade insurance division; the maintenance and training division; the industrial regulation division; the emigration and immigration division, and the statistical division.

National Labour Exchange.—The function of the national labour exchange should be, not only, (*a*) to ascertain and report the surplus or shortage of labour of particular kinds, at particular places; and (*b*) to diminish the time and energy now spent in looking for work, and the consequent leaking between jobs; but also (*c*) so to dovetail casual and seasonal employments as to arrange for practical continuity of work for those now chronically unemployed.

Absorption of Surplus Labour.—To reduce the surplus of labour the minority recommend (*a*) that no child should be employed, in any occupation whatsoever, below the age of fifteen; no young person under eighteen for more than thirty hours per week, and all so employed should be required to attend some suitable public institution for not less than thirty hours per week for physical training and technical education; (*b*) the hours of labour of railway, omnibus and tramway employees should be reduced to a maximum of sixty, if not of forty-eight in any one week; and (*c*) wage-earning mothers of young children should be withdrawn from the industrial world by giving them sufficient public assistance for the support of their families.

Regularization of the National Demand for Labour.—In order to meet the periodically recurrent general depressions of trade the government should take advantage of there being at these periods as much unemployment of capital as there is unemployment of labour; that it should definitely undertake, as far as practicable, the regularization of the national demand for labour; and that it should, for this purpose, and to the extent of at least £4,000,000 a year, arrange a portion of the ordinary work required by each department on a ten years' programme; £40,000,000 worth of work for the decade being then put in hand, not by equal annual instalments, but exclusively in the lean years of the trade cycle; being paid for out of loans for short terms raised as they are required, and being executed with the best available labour, at standard rates, engaged in the ordinary way. That in this ten years' programme there should be included works of afforestation, coast protection and land reclamation; to be carried out by the board of agriculture exclusively in the lean years of the trade cycle; by the most suitable labour obtainable, taken on in the ordinary way at the rates locally current for the work, and paid for out of loans raised as required.

Trade Union Insurance.—In view of its probable adverse effect on trade union membership and organization the minority commissioners cannot recommend the establishment of any plan of government or compulsory insurance against unemployment. They recommend, however, a government subvention not exceeding one half of the sum actually paid in the last preceding year as out-of-work benefit should be offered to trade unions or other societies providing such benefit.

Maintenance and Training.—For the ultimate residuum of men in distress from want of employment the minority recommend that maintenance should be freely provided, without disfranchisement, on condition that they submit themselves to the physical and mental training that they may prove to require. Suitable day training depots or residential farm colonies should be established, where the men's whole working time would be absorbed in such varied beneficial training of body and mind as they proved capable of; their wives and families being, meanwhile, provided with adequate home aliment.

AUTHORITIES.—The Report and Evidence of the Royal Commission of 1905–1909 is a library in itself on the subject of pauperism. The contents of the various volumes are given *supra*. Other important publications are *Report and Evidence of Royal Commission on Aged Poor* (1895); *Report and Evidence of Select Committee of House of Commons on Distress from Want of Employment* (1895); *Report of Departmental Committee on Vagrancy* (1906). See also the references in the bibliography to CHARITY AND CHARITIES; and Sir G. Nicholls and T. Mackay, *A History of the English Poor Law* (3 vols., 1899); the publications of the Charity Organization Society; Reports of Poor Law Conferences. For list of subjects discussed, see index to *Report of Central Conferences.*

POPAYAN, a city of Colombia, capital of the department of Cauca, about 240 m. S.W. of Bogotá, on the old trade route between that city and Quito, in 2° 26′ N., 76° 49′ W. Pop. (1870), 8485; (1906, estimate), 10,000. Popayan is built on a great plain sloping N.W. from the foot of the volcano Purace, near the source of the Cauca and on one of its small tributaries, 5712 ft. above the sea. Its situation is singularly picturesque, the Purace rising to an elevation of 15,420 ft. about 20 m. south-east of the city, the Sotara volcano to approximately the same height about the same distance south by east, and behind these at a greater distance the Pan de Azucar, 15,978 ft. high. The ridge forming the water-parting between the basins of the Cauca and Patia rivers crosses between the Central and Western Cordilleras at this point and culminates a few miles to the south. Popayan is the seat of a bishopric dating from 1547, whose cathedral was built by the Jesuits; and in the days of its prosperity it possessed a university of considerable reputation. It has several old churches, a college, two seminaries founded about 1870 by the French Lazarists, who have restored and occupy the old Jesuit convent, and a mint established in 1749. The city was at one time an important commercial and mining centre, but much of its importance was lost through the transfer of trade to Cali and Pasto, through the decay of neighbouring mining industries, and through political disturbances. Earthquakes have also caused much damage to Popayan, especially those of 1827 and 1834. The modern city has some small manufacturing industries, including woollen fabrics for clothing, but its trade is much restricted, and its importance is political rather than commercial.

Popayan was founded by Sebastian Benalcazar in 1538 on the site of an Indian settlement, whose chief, Payan, had the unusual honour of having his name given to the usurping town. In 1558 it received a coat of arms and the title of "Muy noble y muy leal" from the king of Spain—a distinction of great significance in that disturbed period of colonial history. It is noted also as the birthplace of Càldas, the Colombian naturalist, and of Mosquera, the geographer. There are hot sulphurous springs near by on the flanks of the volcano Puracé, especially at Coconuco, which are much frequented by Colombians.

Names and Titles.

POPE (Gr. πάππας, post-classical Lat. *papa*, father), an ecclesiastical title now used exclusively to designate the head of the Roman Catholic Church. In the 4th and 5th centuries it was frequently used in the West of any bishop (Du Cange, *s.v.*); but it gradually came to be reserved to the bishop of Rome, becoming his official title. In the East, on the other hand, only the bishop of Alexandria seems to have used it as a title; but as a popular term it was applied to priests, and at the present day, in the Greek Church and in Russia, all the priests are called *pappas*, which is also translated "pope." Even in the case of the sovereign pontiff the word pope is officially only used as a less solemn style: though the ordinary signature and heading of briefs is, *e.g.* "Pius P.P.X.," the signature of bulls is "*Pius episcopus ecclesiae catholicae*," and the heading, "*Pius episcopus, servus servorum Dei*," this latter formula going back to the time of St Gregory the Great. Other styles met with in official documents are *Pontifex*, *Summus pontifex*, *Romanus pontifex*, *Sanctissimus*, *Sanctissimus pater*, *Sanctissimus dominus noster*, *Sanctitas sua*, *Beatissimus pater*, *Beatitudo sua*; while the pope is addressed in speaking as "*Sanctitas vestra*," or "*Beatissime pater*." In the middle ages is also found "*Dominus apostolicus*" (cf. still, in the litanies of the saints), or simply "*Apostolicus*."

Various Degrees of Jurisdiction.

The pope is pre-eminently, as successor of St Peter, bishop of Rome. Writers are fond of viewing him as representing all the degrees of the ecclesiastical hierarchy; they say that he is bishop of Rome, metropolitan of the Roman province, primate of Italy, patriarch of the western Church and head of the universal Church. This is strictly correct, but, with the exception of the first and last, these titles are seldom to be found in documents. And if these terms were intended to indicate so many degrees in the exercise of jurisdiction they would not be correct. As a matter of fact, from the earliest centuries (cf. can. 6 of Nicaea, in 325), we see that the popes exercised a special metropolitan jurisdiction not only over the bishops nearest to Rome, the future cardinal bishops, but also over all those of central and southern Italy, including Sicily (cf. Duchesne, *Origines du culte*, ch. 1), all of whom received their ordination at his hands. Northern Italy and the rest of the western Church, still more the eastern Church, did not depend upon him so closely for their administration. His influence was exercised, however, not only in dogmatic questions but in matters of discipline, by means of appeals, petitions and consultations, not to mention spontaneous intervention. This state of affairs was defined and developed in the course of centuries, till it produced the present state of centralization, according to a law which can equally be observed in other societies. In practice the different degrees of jurisdiction, as represented in the pope, are of no importance: he is bishop of Rome and governs his diocese by direct episcopal authority; he is also the head of the Church, and in this capacity governs all the dioceses, though the regular authority of each bishop in his own diocese is also ordinary and immediate, *i.e.* he is not a mere vicar of the pope.

Primacy.

But the mode of exercise of a power and its intensity are subject to variation, while the power remains essentially the same. This is the case with the power of the pope and his primacy, the exercise and manifestation of which have been continually developing. This primacy, a primacy of honour and jurisdiction, involving the plenitude of power over the teaching, the worship, the discipline and administration of the Church, is received by the pope as part of the succession of St Peter, together with the episcopate of Rome. The whole episcopal body, with the pope at its head, should be considered as succeeding to the apostolic college, presided over by St Peter; and the head of it, now as then, as personally invested with all the powers enjoyed by the whole body, including the head. Hence the pope, as supreme in matters of doctrine, possesses the same authority and the same infallibility as the whole Church; as legislator and judge he possesses the same power as the episcopal body gathered around and with him in oecumenical council. Such are the two essential prerogatives of the papal primacy: infallibility in his supreme pronouncements in matters of doctrine (see INFALLIBILITY); and immediate and sovereign jurisdiction, under all its aspects, over all the pastors and the faithful. These two privileges, having been claimed and enjoyed by the popes in the course of centuries, were solemnly defined at the Vatican Council by the constitution "*Pastor aeternus*" of the 18th of July 1870. The two principal passages in it are the following. (1) In the matter of jurisdiction: "If any one say that the Roman Pontiff has an office merely of inspection and direction, and not the full and supreme power of jurisdiction over the whole Church, not only in matters of faith and morals, but also as regards discipline and the government of the Church scattered throughout the whole world; or that he has only the principal portion and not the plenitude of that supreme power; or that his power is not ordinary and immediate, as much over each and every church as over each and every pastor and believer: anathema sit." (2) In the matter of infallibility: "We decree that when the Roman Pontiff speaks *ex cathedra*, that is to say, when, in his capacity as Pastor and Doctor of all Christians he defines, in virtue of his supreme apostolic authority, a certain doctrine concerning faith or morals to be held by the whole Church, he enjoys, by the divine assistance promised to him in the Blessed Peter, that infallibility with which the divine Redeemer has thought good to endow His Church in order to define its doctrine in matters of faith and morals; consequently, these definitions of the Roman Pontiff are irreformable in themselves and not in consequence of the consent of the Church."

For the history of the papacy, and associated questions, see PAPACY, CONCLAVE, CURIA ROMANA, CARDINAL, &c.

The ordinary costume of the pope is similar to that of the other clergy and bishops, but white in colour; his shoes alone are different, being low open shoes, red in colour, with a cross embroidered on the front; these are what are called the "mules," a substitute for the *compagi* of ancient times, formerly reserved to the pope and his clergy (cf. Duchesne, *op. cit.* ch. 11, 6). Over this costume the pope wears, on less solemn occasions, the lace rochet and the red mozetta, bordered with ermine, or the *camauro*, similar to the mozetta, but with the addition of a hood, and over all the stole embroidered with his arms. The pope's liturgical costume consists, in the first place, of all the elements comprising that of the bishops: stockings and sandals, amice, alb, cincture, tunicle and dalmatic, stole, ring, gloves, chasuble or cope, the latter, however, with a morse ornamented with precious stones, and for head-dress the mitre (see VESTMENTS). The tiara (*q.v.*), the pontifical head-dress, is not used strictly speaking in the course of the liturgical functions, but only for processions. To these vestments or insignia the pope adds: the *falda*, a kind of long skirt trailing on the ground all round, which the chaplains hold up while he is walking. Over the chasuble he wears the *fanone* (see AMICE); and after that the pallium (*q.v.*). He is preceded by the papal cross, carried with the crucifix turned towards him. When going to solemn ceremonies he is carried on the *sedia*, a portable chair of red velvet with a high back, and escorted by two *flabelli* of peacock feathers. The papal mass, now rarely celebrated, has preserved more faithfully the ancient liturgical usages of the 8th and 9th centuries.

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(A. Bo.*)

POPE, ALEXANDER (1688–1744), English poet, was born in Lombard Street, London, on the 21st of May 1688. His father, Alexander Pope, a Roman Catholic, was a linen-draper who afterwards retired from business with a small fortune, and fixed his residence about 1700 at Binfield in Windsor Forest. Pope's education was desultory. His father's religion would have excluded him from the public schools, even had there been no other impediment to his being sent there. Before he was twelve he had obtained a smattering of Latin and Greek from various masters, from a priest in Hampshire, from a schoolmaster at Twyford near Winchester, from Thomas Deane, who kept a school in Marylebone and afterwards at Hyde Park Corner, and finally from another priest at home. Between his twelfth and his seventeenth years excessive application to study undermined his health, and he developed the personal deformity which was in so many ways to distort his view of life. He thought himself dying, but through a friend, Thomas (afterwards the abbé) Southcote, he obtained the advice of the famous physician John Radcliffe, who prescribed diet and exercise. Under this treatment the boy recovered his strength and spirits. "He thought himself the better," Spence says, "in some respects for not having had a regular education. He (as he observed in particular) read originally for the sense, whereas we are taught for so many years to read only for words." He afterwards learnt French and Italian, probably in a similar way. He read translations of the Greek, Latin, French and Italian poets, and by the age of twelve, when he was finally settled at home and left to himself, he was not only a confirmed reader, but an eager aspirant to the highest honours in poetry. There is a story, which chronological considerations make extremely improbable, that in London he had crept into Will's coffee-house to look at Dryden, and a further tale that the old poet had given him a shilling for a translation of the story of Pyramus and Thisbe; he had lampooned his schoolmaster; he had made a play out of John Ogilby's *Iliad* for his schoolfellows; and before he was fifteen he had written an epic, his hero being Alcander, a prince of Rhodes, or, as he states elsewhere, Deucalion.

There were, among the Roman Catholic families near Binfield, men capable of giving a direction to his eager ambition, men of literary tastes, and connexions with the literary world. These held together as members of persecuted communities always do, and were kept in touch with one another by the family priests. Pope was thus brought under the notice of Sir William Trumbull, a retired diplomatist living at Easthampstead, within a few miles of Binfield. Thomas Dancastle, lord of the manor of Binfield, took an active interest in his writings, and at Whiteknights, near Reading, lived another Roman Catholic, Anthony Englefield, "a great lover of poets and poetry." Through him Pope made the acquaintance of Wycherley and of Henry Cromwell, who was a distant cousin of the Protector, a gay man about town, and something of a pedant. Wycherley introduced him to William Walsh, then of great renown as a critic.[1] Before the poet was seventeen he was admitted in this way to the society of London "wits" and men of fashion, and was cordially encouraged as a prodigy. Wycherley's correspondence with Pope was skilfully manipulated by the younger man to represent Wycherley as submitting, at first humbly and then with an ill-grace, to Pope's criticisms. The publication (Elwin and Courthope, vol. v.) of the originals of Wycherley's letters from MSS. at Longleat showed how seriously the relations between the two friends, which ceased in 1710, had been misrepresented in the version of the correspondence which Pope chose to submit to the public. Walsh's contribution to his development was the advice to study "correctness." "About fifteen," he says, "I got acquainted with Mr. Walsh. He used to encourage me much, and used to tell me that there was one way left of excelling; for, though we had several great poets, we never had any one great poet that was correct, and he desired me to make that my study and aim" (Spence, p. 280). Trumbull turned Pope's attention to the French critics, out of the study of whom grew the *Essay on Criticism;* he suggested the subject of *Windsor Forest*, and he started the idea of translating Homer.

It says something for Pope's docility at this stage that he recognized so soon that a long course of preparation was needed for such a *magnum opus*, and began steadily and patiently to discipline himself. The epic was put aside and afterwards burnt; versification was industriously practised in short "essays"; and an elaborate study was made of accepted critics and models. He learnt most, as he acknowledged, from Dryden, but the harmony of his verse also owed something to an earlier writer, George Sandys, the translator of Ovid. At the beginning of the 18th century Dryden's success had given great vogue to translations and modernizations. The air was full of theories as to the best way of doing such things. What Dryden had touched Pope did not presume to meddle with—Dryden was his hero and master; but there was much more of the same kind to be done. Dryden had rewritten three of the Canterbury tales; Pope tried his hand at the *Merchant's Tale*, and the *Prologue to the Wife of Bath's Tale*, and produced also an imitation of the *House of Fame*. Dryden had translated Virgil; Pope experimented on the *Thebais* of Statius, Ovid's *Heroides* and *Metamorphoses*, and the *Odyssey*. He knew little Latin and less Greek, but there were older versions in English which helped him to the sense; and, when the correspondents to whom he submitted his versions pointed out mistranslations, he could answer that he had always agreed with them, but that he had deferred to the older translators against his own judgment. It was one of Pope's little vanities to try to give the impression that his metrical skill was more precocious even than it was, and we cannot accept his published versions of Statius and Chaucer (published in "miscellanies" at intervals between 1709 and 1714) as incontrovertible evidence of his proficiency at the age of sixteen or seventeen, the date, according to his own assertion, of their composition. But it is indisputable that at the age of seventeen his skill in verse astonished a veteran critic like Walsh, and some of his pastorals were in the hands of Sir George Granville (afterwards Lord Lansdowne) before 1706. His metrical letter to Cromwell, which Elwin dates in 1707, when Pope was nineteen, is a brilliant feat of versification, and has turns of wit in it as easy and spirited as any to be found in his mature satires. Pope was twenty-one when he sent the "Ode on Solitude" to Cromwell, and said it was written before he was twelve years old.

Precocious Pope was, but he was also industrious; and he spent some eight or nine years in arduous and enthusiastic discipline, reading, studying, experimenting, taking the advice of some and laughing in his sleeve at the advice of others, "poetry his only business," he said, "and idleness his only pleasure," before anything of his appeared in print. In these preliminary studies he seems to have guided himself by the maxim formulated in a letter to Walsh (dated July 2, 1706) that "it seems not so much the perfection of sense to say things that had never been said before, as to express those best that have been said oftenest." His first publication was his "Pastorals." Jacob Tonson, the bookseller, had seen these pastorals in the hands of Walsh and Congreve, and sent a polite note (April 20, 1706) to Pope asking that he might have them for one of his miscellanies. They appeared accordingly in May 1709 at the end of the sixth volume of Tonson's *Poetical Miscellanies*, containing contributions from Ambrose Philips, Sheffield, Garth and Rowe, with "January and May," Pope's version of Chaucer's "Merchant's Tale."

Pope's next publication was the *Essay on Criticism* (1711), written two years earlier, and printed without the author's name. "In every work regard the writer's end" (l. 255) is one of its sensible precepts, and one that is often neglected by critics of the essay, who comment upon it as if Pope's end had been to produce an original and profound treatise on first principles.

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[1] The dates of Pope's correspondence with Wycherley are 1704–1710; with Walsh, 1705–1707, and with Cromwell, 1708–1727; with John Caryll (1666–1736) and his son, also neighbours, 1710–1735.

His aim was simply to condense, methodize, and give as perfect and novel expression as he could to floating opinions about the poet's aims and methods, and the critic's duties, to "what oft was thought, but ne'er so well expressed" (l. 298). "The town" was interested in *belles lettres*, and given to conversing on the subject; Pope's essay was simply a brilliant contribution to the fashionable conversation. The youthful author said that he did not expect the sale to be quick because "not one gentleman in sixty, even of liberal education, could understand it." The sales were slow until Pope caused copies to be sent to Lord Lansdowne and others, but its success was none the less brilliant for the delay. The town was fairly dazzled by the young poet's learning, judgment, and felicity of expression. Many of the admirers of the poem doubtless would have thought less of it if they had not believed all the maxims to be original. "I admired," said Lady Mary Wortley Montagu, "Mr Pope's *Essay on Criticism* at first very much, because I had not then read any of the ancient critics, and did not know that it was all stolen." Pope gained credit for much that might have been found, where he found it, in the *Institutes* of Quintilian, in the numerous critical writings of René Rapin, and in René le Bossu's treatise on epic poetry. Addison has been made responsible for the exaggerated value once set on the essay, but Addison's paper (*Spectator*, No. 253) was not unmixed praise. He deprecated the attacks made by Pope on contemporary literary reputations, although he did full justice to the poet's metrical skill. Addison and Pope became acquainted with one another, and Pope's sacred eclogue, "Messiah," was printed as No. 378 of the *Spectator*. In the *Essay on Criticism* Pope provoked one bitter personal enemy in John Dennis, the critic, by a description of him as Appius, who "stares, tremendous, with a threat'ning eye." Dennis retorted in *Reflections . . upon a late Rhapsody . .* (1711), abusing Pope among other things for his personal deformity. Pope never forgot this brutal attack, which he described in a note inserted after Dennis's death, as late as 1743, as written "in a manner perfectly lunatic."

The *Rape of the Lock* in its first form appeared in 1712 in *Lintot's Miscellanies*; the "machinery" of sylphs and gnomes was an afterthought, and the poem was republished as we now have it early in 1714. William, 4th Baron Petre, had surreptitiously cut off a lock of Miss Arabella Fermor's hair, and the liberty had been resented; Pope heard the story from his friend John Caryll, who suggested that the breach between the families might be healed by making the incident the subject of a mock-heroic poem like Boileau's *Lutrin*. Pope caught at the hint; the mock-heroic treatment of the pretty frivolities of fashionable life just suited his freakish sprightliness of wit, and his studies of the grand epic at the time put him in excellent vein. The *Rape of the Lock* is admitted to be a masterpiece of airiness, ingenuity, and exquisite finish. But the poem struck Taine as a piece of harsh, scornful, indelicate buffoonery, a mere succession of oddities and contrasts, of expressive figures unexpected and grinning, an example of English insensibility to French sweetness and refinement. Sir Leslie Stephen objected on somewhat different grounds to the poet's tone towards women. His laughter at Pope's raillery was checked by the fact that women are spoken of in the poem as if they were all like Belinda. The poem shows the hand of the satirist who was later to assert that "every woman is at heart a rake," in the epistle addressed to Martha Blount.

Windsor Forest, modelled on Sir John Denham's *Cooper's Hill*, had been begun, according to Pope's account, when he was sixteen or seventeen. It was published in March 1713 with a flattering dedication to the secretary for war, George Granville, Lord Lansdowne, and an opportune allusion to the peace of Utrecht. This was a nearer approach to taking a political side than Pope had yet made. His principle had been to keep clear of politics, and not to attach himself to any of the sets into which literary men were divided by party. Although inclined to the Jacobites by his religion, he never took any part in the plots for the restoration of the Stuarts, and he was on friendly terms with the Whig coterie, being a frequent guest at the coffee-house kept by Daniel Button, where Addison held his "little senate." He had contributed his poem, "The Messiah" to the *Spectator*; he had written an article or two in the *Guardian*, and he wrote a prologue for Addison's *Cato*. Nevertheless he induced Lintot the bookseller to obtain from John Dennis a criticism of *Cato*. On the publication of Dennis's remarks, the violence of which had, as Pope hoped, made their author ridiculous, Pope produced an anonymous pamphlet, *The Narrative of Dr Robert Norris concerning the . . . Frenzy of Mr John Dennis* (1713), which, though nominally in defence of Addison, had for its main purpose the gratification of Pope's own hostility to Dennis. Addison disavowed any connivance in this coarse attack in a letter written on his behalf by Steele to Lintot, saying that if he noticed Dennis's attack at all it would be in such a way as to allow him no just cause of complaint. Coolness between Addison and Pope naturally followed this episode. When the *Rape of the Lock* was published, Addison, who is said to have praised the poem highly to Pope in private, dismissed it in the *Spectator* with two sentences of patronizing faint praise to the young poet, and, coupling it with Tickell's "Ode on the Prospect of Peace," devoted the rest of the article to an elaborate puff of "the pastorals of Mr Philips."

When Pope showed a leaning to the Tories in *Windsor Forest*, the members of Addison's coterie made insidious war on him. Within a few weeks of the publication of the poem, and when it was the talk of the town, there began to appear in the *Guardian* (Nos. 22, 23, 28, 30, 32) a series of articles on "Pastorals." Not a word was said about *Windsor Forest*, but everybody knew to what the general principles referred. Modern pastoral poets were ridiculed for introducing Greek moral deities, Greek flowers and fruits, Greek names of shepherds, Greek sports and customs and religious rites. They ought to make use of English rural mythology—hobthrushes, fairies, goblins and witches; they should give English names to their shepherds; they should mention flowers indigenous to English climate and soil; and they should introduce English proverbial sayings, dress, and customs. All excellent principles, and all neglected by Pope in *Windsor Forest*. The poem was fairly open to criticism in these points; there are many beautiful passages in it, showing close though somewhat professional observation of nature, but the mixture of heathen deities and conventional archaic fancies with modern realities is incongruous, and the comparison of Queen Anne to Diana was ludicrous. But the sting of the articles did not lie in the truth of the oblique criticisms. The pastorals of Ambrose Philips, published four years before, were again trotted out. Here was a true pastoral poet, the eldest born of Spenser, the worthy successor of Theocritus and Virgil!

Pope took an amusing revenge, which turned the laugh against his assailants. He sent Steele an anonymous paper in continuation of the articles in the *Guardian* on pastoral poetry, reviewing the poems of Mr Pope by the light of the principles laid down. Ostensibly Pope was censured for breaking the rules, and Philips praised for conforming to them, quotations being given from both. The quotations were sufficient to dispose of the pretensions of poor Philips, and Pope did not choose his own worst passages, accusing himself of actually deviating sometimes into poetry. Although the *Guardian's* principles were also brought into ridicule by burlesque exemplifications of them after the manner of Gay's *Shepherd's Week*, Steele, misled by the opening sentences, was at first unwilling to print what appeared to be a direct attack on Pope, and is said to have asked Pope's consent to the publication, which was graciously granted.

The links that attached Pope to the Tory party were strengthened by a new friendship. His first letter to Swift, who became warmly attached to him, is dated the 8th of December 1713. Swift had been a leading member of the Brothers' Club, from which the famous Scriblerus Club seems to have been an offshoot. The leading members of this informal literary society were Swift, Arbuthnot, Congreve, Bishop Atterbury, Pope, Gay and Thomas Parnell. Their chief object was a general war against the dunces, waged with great spirit by Arbuthnot, Swift and Pope.

The estrangement from Addison was completed in connexion with Pope's translation of Homer. This enterprise was definitely undertaken in 1713. The work was to be published by subscription, as Dryden's Virgil had been. Men of all parties subscribed, their unanimity being a striking proof of the position Pope had attained at the age of twenty-five. It was as if he had received a national commission as by general consent the first poet of his time. But the unanimity was broken by a discordant note. A member of the Addison clique, Tickell, attempted to run a rival version. Pope suspected Addison's instigation; Tickell had at least Addison's encouragement. Pope's famous character of Addison as "Atticus" in the *Epistle to Dr Arbuthnot* (ii. 193–215) was, however, inspired by resentment at insults that existed chiefly in his own imagination, though Addison was certainly not among his warmest admirers. Pope afterwards claimed to have been magnanimous, but he spoiled his case by the petty inventions of his account of the quarrel.

The translation of Homer was Pope's chief employment for twelve years. The new pieces in the miscellanies published in 1717, his "Elegy on an Unfortunate Lady," and his "Eloisa to Abelard," were probably written some years before their publication. His "Eloisa to Abelard" was based on an English translation by John Hughes of a French version of the *Letters*, which differed very considerably from the original Latin. The *Iliad* was delivered to the subscribers in instalments in 1715, 1717, 1718 and 1720. Pope's own defective scholarship made help necessary. William Broome and John Jortin supplied the bulk of the notes, and Thomas Parnell the preface. For the translation of the *Odyssey* he took Elijah Fenton and Broome as coadjutors, who between them translated twelve out of the twenty-four books.[1] It was completed in 1725. The profitableness of the work was Pope's chief temptation to undertake it. His receipts for his earlier poems had totalled about £150, but he cleared more than £8000 by the two translations, after deducting all payments to coadjutors—a much larger sum than had ever been received by an English author before.

The translation of Homer had established Pope's reputation with his contemporaries, and has endangered it ever since it was challenged. Opinions have varied on the purely literary merits of the poem, but with regard to it as a translation few have differed from Bentley's criticism, "A fine poem, Mr Pope, but you must not call it Homer." His collaboration with Broome (*q.v.*) and Fenton (*q.v.*)[2] involved him in a series of recriminations. Broome was weak enough to sign a note at the end of the work understating the extent of Fenton's assistance as well as his own, and ascribing the merit of their translation, reduced to less than half its real proportions, to a regular revision and correction—mostly imaginary—at Pope's hands. These falsehoods were deemed necessary by Pope to protect himself against possible protests from the subscribers. In 1722 he edited the poems of Thomas Parnell, and in 1725 made a considerable sum by an unsatisfactory edition of Shakespeare, in which he had the assistance of Fenton and Gay.

Pope, with his economical habits, was rendered independent by the pecuniary success of his *Homer*, and enabled to live near London. The estate at Binfield was sold, and he removed with his parents to Mawson's Buildings, Chiswick, in 1716, and in 1719 to Twickenham, to the house with which his name is associated. Here he practised elaborate landscape gardening on a small scale, and built his famous grotto, which was really a tunnel under the road connecting the garden with the lawn on the Thames. He was constantly visited at Twickenham by his intimates, Dr John Arbuthnot, John Gay, Bolingbroke (after his return in 1723), and Swift (during his brief visits to England in 1726 and 1727), and by many other friends of the Tory party. With Atterbury, bishop of Rochester, he was on terms of affectionate intimacy, but he blundered in his evidence when he was called as a witness on his behalf in 1723.

In 1717 his father died, and he appears to have turned to the Blounts for sympathy in what was to him a very serious bereavement. He had early made the acquaintance of Martha and Teresa Blount, both of them intimately connected with his domestic history. Their home was at Mapledurham, near Reading, but Pope probably first met them at the house of his neighbour, Mr Englefield of Whiteknights, who was their grandfather. He begun to correspond with Martha Blount in 1712, and after 1717 the letters are much more serious in tone. He quarrelled with Teresa, who had apparently injured or prevented his suit to her sister; and although, after her father's death in 1718, he paid her an annuity, he seems to have regarded her as one of his most dangerous enemies. His friendship with Martha lasted all his life. So long as his mother lived he was unwearying in his attendance on her, but after her death in 1733 his association with Martha Blount was more constant. In defiance of the scandal-mongers, they paid visits together at the houses of common friends, and at Twickenham she spent part of each day with him. His earlier attachment to Lady Mary Wortley Montagu was apparently a more or less literary passion, which perished under Lady Mary's ridicule.

The year 1725 may be taken as the beginning of the third period of Pope's career, when he made his fame as a moralist and a satirist. It may be doubted whether Pope had the staying power necessary for the composition of a great imaginative work, whether his crazy constitution would have held together through the strain. He toyed with the idea of writing a grand epic. He told Spence that he had it all in his head, and gave him a vague (and it must be admitted not very promising) sketch of the subject and plan of it. But he never put any of it on paper. He shrank as with instinctive repulsion from the stress and strain of complicated designs. Even his prolonged task of translating weighed heavily on his spirits, and this was a much less formidable effort than creating an epic. He turned rather to designs that could be accomplished in detail, works of which the parts could be separately laboured at and put together with patient care, into which happy thoughts could be fitted, that had been struck out at odd moments and in ordinary levels of feeling.

Edward Young's satire, *The Universal Passion*, had just appeared, and been received with more enthusiasm than any thing published since Pope's own early successes. This alone would have been powerful inducement to Pope's emulous temper. Swift was finishing *Gulliver's Travels*, and came over to England in 1726. The survivors of the Scriblerus Club—Swift, Pope, Arbuthnot, and Gay—resumed their old amusement of parodying and otherwise ridiculing bad writers, especially bad writers in the Whig interest. Two volumes of their *Miscellanies in Prose and Verse* were published in 1727. A third volume appeared in 1728, and a fourth was added in 1732. According to Pope's own history of the *Dunciad, an Heroic Poem in Three Books*, which first appeared on the 28th of May 1728, the idea of it grew out of this. Among the Miscellanies was a "Treatise of the Bathos or the Art of Sinking in Poetry," in which poets were classified, with illustrations, according to their eminence in the various arts of debasing instead of elevating their subject. No names were mentioned, but the specimens of bathos were assigned to various letters of the alphabet, which, the authors boldly asserted, were taken at random. But no sooner was the treatise published than the scribblers proceeded to take the letters to themselves, and in revenge to fill the newspapers with the most abusive falsehoods and scurrilities they could devise. This gave Pope the opportunity he had hoped for, and provided him with an excuse for the personalities of the *Dunciad*, which had been in his mind as early as 1720. Among the most prominent objects of his satire were Lewis

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[1] 1, 4, 19 and 20 are by Fenton; 2, 6, 8, 11, 12, 16, 18, 23, with notes to all the books, by Broome.

[2] The correspondence with them is given in vol. viii. of Elwin and Courthope's edition.

Theobald, Colley Cibber, John Dennis, Richard Bentley, Aaron Hill and Bernard Lintot, who, in spite of his former relations with Pope, was now classed with the piratical Edmund Curll. The book was published with the greatest precautions. It was anonymous, and professed to be a reprint of a Dublin edition. When the success of the poem was assured, it was republished in 1729, and a copy was presented to the king by Sir Robert Walpole. Names took the place of initials, and a defence of the satire, written by Pope himself, but signed by his friend William Cleland, was printed as "A letter to the Publisher." Various indexes, notes and particulars of the attacks on Pope made by the different authors satirized were added. To avoid any danger of prosecution, the copyright was assigned to Lord Oxford, Lord Bathurst and Lord Burlington, whose position rendered them practically unassailable. We may admit that personal spite influenced Pope at least as much as disinterested zeal for the honour of literature, but in the dispute as to the comparative strength of these motives, a third is apt to be overlooked that was probably stronger than either. This was an unscrupulous elfish love of fun, and delight in the creations of a humorous imagination. Certainly to represent the *Dunciad* as the outcome of mere personal spite is to give an exaggerated idea of the malignity of Pope's disposition, and an utterly wrong impression of the character of his satire. He was not, except in rare cases, a morose, savage, indignant satirist, but airy and graceful in his malice, revengeful perhaps and excessively sensitive, but restored to good humour as he thought over his wrongs by the ludicrous conceptions with which he invested his adversaries. The most unprovoked assault was on Richard Bentley, whom he satirized in the reconstruction and enlargement of the *Dunciad* made in the last years of his life at the instigation, it is said, of William Warburton. In the earlier editions the place of hero had been occupied by Lewis Theobald, who had ventured to criticize Pope's *Shakespeare*. In the edition which appeared in Pope's *Works* (1742), he was dethroned in favour of Colley Cibber, who had just written his *Letter from Mr Cibber to Mr Pope inquiring into the motives that might induce him in his satyrical writings to be so frequently fond of Mr Cibber's name* (1742). Warburton's name is attached to many new notes, and one of the preliminary dissertations by Ricardus Aristarchus on the hero of the poem seems to be by him.

The four epistles of the *Essay on Man* (1733) were also intimately connected with passing controversies. They belong to the same intellectual movement with Butler's *Analogy*—the effort of the 18th century to put religion on a rational basis. But Pope was not a thinker like Butler. The subject was suggested to him by Henry St John, Lord Bolingbroke, who had returned from exile in 1723, and was a fellow-member of the Scriblerus Club. Bolingbroke is said—and the statement is supported by the contents of his posthumous works—to have furnished most of the arguments. Pope's contribution to the controversy consisted in brilliant epigram and illustration. In this didactic work, as in his *Essay on Criticism*, he put together on a sufficiently simple plan a series of happy sayings, separately elaborated, picking up the thoughts as he found them in miscellaneous reading and conversation, and trying only to fit them with perfect expression. His readers were too dazzled by the verse to be severely critical of the sense. Pope himself had not comprehended the drift of the arguments he had adopted from Bolingbroke, and was alarmed when he found that his poem was generally interpreted as an apology for the free-thinkers. Warburton is said to have qualified its doctrines as "rank atheism," and asserted that it was put together from the "worst passages of the worst authors." The essay was soon translated into the chief European languages, and in 1737 its orthodoxy was assailed by a Swiss professor, Jean Pierre de Crousaz, in an *Examen de l'essay de M. Pope sur l'homme*. Warburton now saw fit to revise his opinion of Pope's abilities and principles—for what reason does not appear. In any case he now became as enthusiastic in his praise of Pope's orthodoxy and his genius as he had before been scornful, and proceeded to employ his unrivalled powers of sophistry in a defence of the orthodoxy of the conflicting and inconsequent positions adopted in the *Essay on Man*. Pope was wise enough to accept with all gratitude an ally who was so useful a friend and so dangerous an enemy, and from that time onward Warburton was the authorized commentator of his works.

The *Essay on Man* was to have formed part of a series of philosophic poems on a systematic plan. The other pieces were to treat of human reason, of the use of learning, wit, education and riches, of civil and ecclesiastical polity, of the character of women, &c. Of the ten epistles of the *Moral Essays*, the first four, written between 1731 and 1735, are connected with this scheme, which was never executed.

There was much bitter, and sometimes unjust, satire in the *Moral Essays* and the *Imitations of Horace*. In these epistles and satires, which appeared at intervals, he was often the mouthpiece of his political friends, who were all of them in opposition to Walpole, then at the height of his power, and Pope chose the object of his attacks from among the minister's adherents. Epistle III., "Of the Use of Riches," addressed to Allen Bathurst, Lord Bathurst, in 1732, is a direct attack on Walpole's methods of corruption, and on his financial policy in general; and the two dialogues (1738) known as the "Epilogue to the Satires," professedly a defence of satire, form an eloquent attack on the court. Pope was attached to the prince of Wales's party, and he did not forget to insinuate, what was indeed the truth, that the queen had refused the prince her pardon on her deathbed. The "Epistle to Dr Arbuthnot" contains a description of his personal attitude towards the scribblers and is made to serve as a "prologue to the satires." The gross and unpardonable insults bestowed on Lord Hervey and on Lady Mary Wortley Montagu in the first satire "to Mr Fortescue" provoked angry retaliation from both. The description of Timon's ostentatious villa in Epistle IV., addressed to the earl of Burlington, was generally taken as a picture of Canons, the seat of John Brydges, duke of Chandos, one of Pope's patrons, and caused a great outcry, though in this case Pope seems to have been innocent of express allusion. Epistle II., addressed to Martha Blount, contained the picture of Atossa, which was taken to be a portrait of Sarah Jennings, duchess of Marlborough. One of the worst imputations on Pope's character was that he left this passage to be published when he had in effect received a bribe of £1000 from the duchess of Marlborough for its suppression through the agency of Nathanael Hooke (d. 1763). As the passage eventually stood, it might be applied to Katherine, duchess of Buckingham, a natural daughter of James II. Pope may have altered it with the intention of diverting the satire from the original object. He was scrupulously honest in money matters, and always independent in matters of patronage; but there is some evidence for this discreditable story beyond the gossip of Horace Walpole (*Works*, ed. P. Cunningham, i. cxliv.), though not sufficient to justify the acceptance it received by some of Pope's biographers. To appreciate fully the point of his allusions requires an intimate acquaintance with the political and social gossip of the time. But apart from their value as a brilliant strongly-coloured picture of the time Pope's satires have a permanent value as literature. It is justly remarked by Mark Pattison[1] that "these *Imitations* are among the most original of his writings." The vigour and terseness of the diction is still unsurpassed in English verse. Pope had gained complete mastery over his medium, the heroic couplet, before he used it to express his hatred of the political and social evils which he satirized. The elaborate periphrases and superfluous ornaments of his earlier manner, as exemplified in the *Pastorals* and the *Homer*, disappeared; he turned to the uses of verse the ordinary language of conversation, differing from everyday speech only in its exceptional brilliance and point. It is in these satires that his best work must be sought, and by them that his position among English poets must be fixed. It was the *Homer* chiefly that Wordsworth and Coleridge had in their eye when they began the polemic against the "poetic diction" of the 18th century, and struck at Pope as the arch-corrupter. They were historically unjust to Pope, who did not originate this diction, but only furnished the most finished examples of it. At the beginning of the 19th century Pope still had an ardent admirer in Byron, whose first satires are written in Pope's couplet. The much abused pseudo-poetic diction in substance consisted in an ambition to "rise above the vulgar style," to dress nature to advantage—a natural ambition when the arbiters of literature were people of fashion. If one compares Pope's "Messiah" or "Eloisa to Abelard," or an impassioned passage from the *Iliad*, with the originals that he paraphrased, one gets a more vivid idea of the consistence of pseudo-poetic diction than could be furnished by pages of analysis. But Pope merely made masterly use of the established diction of his time, which he eventually forsook for a far more direct and vigorous style. A passage from the *Guardian*, in which Philips was commended as against him, runs: "It is a nice piece of art to raise a proverb above the vulgar style and still keep it easy and unaffected. Thus the old wish, 'God rest his soul,' is very finely turned:—

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[1] In his edition of the *Satires and Epistles* (1866).

> "'Then gentle Sidney liv'd, the shepherd's friend,
> Eternal blessings on his shade attend!'"

Pope would have despised so easy a metamorphosis as this at any period in his career, and the work of his coadjutors in the *Odyssey* may be distinguished by this comparative cheapness of material. Broome's description of the clothes-washing by Nausicaa and her maidens in the sixth book may be compared with the original as a luminous specimen.

Pope's wit had won for him the friendship of many distinguished men, and his small fortune enabled him to meet them on a footing of independence. He paid long visits at many great houses, especially at Stanton Harcourt, the home of his friend Lord Chancellor Harcourt; at Oakley, the seat of Lord Bathurst; and at Prior Park, Bath, where his host was Ralph Allen. With the last named he had a temporary disagreement owing to some slight shown to Martha Blount, but he was reconciled to him before his death.

He died on the 30th of May 1744, and he was buried in the parish church of Twickenham. He left the income from his property to Martha Blount till her death, after which it was to go to his half-sister Magdalen Rackett and her children. His unpublished MSS. were left at the discretion of Lord Bolingbroke, and his copyrights to Warburton.

If we are to judge Pope, whether as a man or as a poet, with human fairness, and not merely by comparison with standards of abstract perfection, there are two features of his times that must be kept steadily in view—the character of political strife in those days and the political relations of men of letters. As long as the succession to the Crown was doubtful, and political failure might mean loss of property, banishment or death, politicians, playing for higher stakes, played more fiercely and unscrupulously than in modern days, and there was no controlling force of public opinion to keep them within the bounds of common honesty. Hence the age of Queen Anne is preeminently an age of intrigue. The government was almost as unsettled as in the early days of personal monarchy, and there was this difference—that it was policy rather than force upon which men depended for keeping their position. Secondly, men of letters were admitted to the inner circles of intrigue as they had never been before and as they have never been since. A generation later Walpole defied them, and paid the rougher instruments that he considered sufficient for his purpose in solid coin of the realm; but Queen Anne's statesmen, whether from difference of tastes or difference of policy, paid their principal literary champions with social privileges and honourable public appointments. Hence men of letters were directly infected by the low political morality of the unsettled time. And the character of their poetry also suffered. The most prominent defects of the age—the lack of high and sustained imagination, the genteel liking for "nature to advantage dressed," the incessant striving after wit—were fostered, if not generated, by the social atmosphere.

Pope's own ruling passion was the love of fame, and he had no scruples where this was concerned. His vanity and his childish love of intrigue are seen at their worst in his petty manœuvres to secure the publication of his letters during his lifetime. These intricate proceedings were unravelled with great patience and ingenuity by Charles Wentworth Dilke, when the false picture of his relations with his contemporaries which Pope had imposed on the public had been practically accepted for a century. Elizabeth Thomas, the mistress of Henry Cromwell, had sold Pope's early letters to Henry Cromwell to the bookseller Curll for ten guineas. These were published in Curll's *Miscellanea* in 1726 (dated 1727), and had considerable success. This surreptitious publication seems to have suggested to Pope the desirability of publishing his own correspondence, which he immediately began to collect from various friends on the plea of preventing a similar clandestine transaction. The publication by Wycherley's executors of a posthumous volume of the dramatist's prose and verse furnished Pope with an excuse for the appearance of his own correspondence with Wycherley, which was accompanied by a series of unnecessary deceptions. After manipulating his correspondence so as to place his own character in the best light, he deposited a copy in the library of Edward, second earl of Oxford, and then he had it printed. The sheets were offered to Curll by a person calling himself P.T., who professed a desire to injure Pope, but was no other than Pope himself. The copy was delivered to Curll in 1735 after long negotiations by an agent who called himself R. Smythe, with a few originals to vouch for their authenticity. P. T. had drawn up an advertisement stating that the book was to contain answers from various peers. Curll was summoned before the House of Lords for breach of privilege, but was acquitted, as the letters from peers were not in fact forthcoming. Difficulties then arose between Curll and P. T., and Pope induced a bookseller named Cooper to publish a *Narrative of the Method by which Mr Pope's Private Letters were procured by Edmund Curll, Bookseller* (1735). These preliminaries cleared the way for a show of indignation against piratical publishers and a "genuine" edition of the *Letters of Mr Alexander Pope* (1737, fol. and 4to). Unhappily for Pope's reputation, his friend Caryll, who died before the publication, had taken a copy of Pope's letters before returning them. This letter-book came to light in the middle of the 19th century, and showed the freedom which Pope permitted himself in editing. The correspondence with Lord Oxford, preserved at Longleat, afforded further evidence of his tortuous dealings. The methods he employed to secure his correspondence with Swift were even more discreditable. The proceedings can only be explained as the measures of a desperate man whose maladies seem to have engendered a passion for trickery. They are related in detail by Elwin in the introduction to vol. i. of Pope's *Works*. A man who is said to have "played the politician about cabbages and turnips," and who "hardly drank tea without a stratagem," was not likely to be straightforward in a matter in which his ruling passion was concerned. Against Pope's petulance and "general love of secrecy and cunning" have to be set, in any fair judgment of his character, his exemplary conduct as a son, the affection with which he was regarded in his own circle of intimates, and many well-authenticated instances of genuine and continued kindliness to persons in distress.

Bibliography.—Various collected editions of Pope's *Works* appeared during his lifetime, and in 1751 an edition in nine volumes was published by a syndicate of booksellers "with the commentaries of Mr Warburton." Warburton interpreted his editorial rights very liberally. By his notes he wilfully misrepresented the meaning of the allusions in the satires, and made them more agreeable to his friends and to the court, while he made opportunities for the gratification of his own spite against various individuals. Joseph Warton's edition in 1797 added to the mass of commentary without giving much new elucidation to the allusions of the text, which even Swift, with his exceptional facilities, had found obscure. In 1769–1807 an edition was issued which included Owen Ruffhead's *Life of Alexander*

Pope (1769), inspired by Warburton. The notes of many commentators, with some letters and a memoir, were included in the *Works of Alexander Pope*, edited by W. L. Bowles (10 vols., 1806). His *Poetical Works* were edited by Alexander Dyce (1856); by R. Carruthers (1858) for Bohn's Library; by A. W. Ward (*Globe Edition*, 1869), &c. Materials for a definitive edition were collected by John Wilson Croker, and formed the basis of what has become the standard version, *The Works of Alexander Pope* (10 vols., 1871–1898), including unpublished letters and other new material, with introduction and notes by W. Elwin and W. J. Courthope. The life of Pope in vol. v. was contributed by Professor Courthope. The chief original authority besides Pope's correspondence and Ruffhead's *Life* is Joseph Spence's *Anecdotes*, published by S. W. Singer in 1820. Samuel Johnson gives a good estimate of Pope in his *Lives of the Poets*. The best modern lives are that by Professor Courthope, already mentioned; and *Alexander Pope*, by Sir L. Stephen, in the *English Men of Letters* series (1880). See also George Paston, *Mr Pope: His Life and Times* (1909). The first check to the admiration that prevailed during Pope's lifetime was given by the publication of Joseph Warton's *Essay on the Writings and Genius of Pope* (vol. i., 1757; vol. ii., 1782). Warton had a sincere appreciation of Pope's work, but he began the reaction which culminated with the romantic writers of the beginning of the 19th century, and set the fashion of an undue disparagement of Pope's genius as a poet with enduring effects on popular opinion. Thomas Campbell's criticism in his *Specimens of the British Poets* provoked a controversy to which William Hazlitt, Byron and W. L. Bowles contributed. For a discussion of Pope's position as one of the great men of letters in the 18th century who emancipated themselves from patronage, see A. Beljame, *Le Public et les hommes de lettres en Angleterre au dix-huitième siècle* (1881); a section of Isaac D'Israeli's *Quarrels of Authors* is devoted to Pope's literary animosities; and most important contributions to many vexed questions in the biography of Pope, especially the publication of his letters, were made by C. W. Dilke in *Notes and Queries* and the *Athenaeum*. These articles were reprinted by his grandson, Sir Charles Dilke, in 1875, as *The Papers of a Critic*. (W. M.; M. Br.)

POPE, ALEXANDER (1763–1835), Irish actor and painter, was born in Cork, and was educated to follow his father's profession of miniature painting. He continued to paint miniatures and exhibit them at the Royal Academy as late as 1821; but at an early date he took the stage, first appearing in London as Oroonoko in 1785 at Covent Garden. He remained at this theatre almost continuously for nearly twenty years, then at the Haymarket until his retirement, playing leading parts, chiefly tragic. He was particularly esteemed as Othello and Henry VIII. He died on the 22nd of March 1835. Pope was thrice married. His first wife, Elizabeth Pope (*c.* 1744–1797), a favourite English actress of great versatility, was billed before her marriage as Miss Younge. His second wife, Maria Ann Pope (1775–1803), also a popular actress, was a member of an Irish family named Campion. His third wife, Clara Maria Pope (d. 1838), was the widow of the artist Francis Wheatley, and herself a skilful painter of figures and of flowers.

POPE, JANE (1742–1818), English actress, daughter of a London theatrical wig-maker, who began playing in a Lilliputian company for Garrick in 1756. From this she speedily developed into soubrette rôles. She was Mrs Candour in *The School for Scandal* at its first presentation (1777), and thereafter she had many important parts confided to her. She was the life-long friend of Mrs Clive, and erected the monument at Twickenham to the latter's memory. She was not only an admirable actress, but a woman of blameless life, and was praised by all the literary critics of her day—unused to such a combination. She died on the 30th of July 1818.

POPE, JOHN (1822–1892), American soldier, was the son of Nathaniel Pope (1784–1850), U.S. judge for the district of Illinois, and was born at Louisville, Kentucky, on the 16th of March 1822. He graduated at the United States Military Academy in 1842 and was assigned to the engineers. He served in the Mexican War, receiving the brevets of 1st lieutenant and captain for his conduct at Monterey and Buena Vista. Subsequently he was engaged in engineering and exploring work, mainly in New Mexico, and in surveying the route for a Pacific railroad. He was commissioned captain in 1856. He was actively opposed to the Buchanan administration, and a speech which he made in connexion with the presidential campaign of 1860 caused him to be summoned before a court-martial. Early in the Civil War he was placed, as a brigadier-general U.S.V., in charge of the district of Missouri, which by vigorous campaigning against guerrilla bands and severe administration of the civil population he quickly reduced to order. In 1862, along with the gunboat flotilla (commanded by Commodore A. H. Foote) on the Mississippi, Pope obtained a great success by the capture of the defences of New Madrid and Island No. 10, with nearly 7000 prisoners. Pope subsequently joined Halleck, and in command of the Army of the Mississippi took part in the siege of Corinth. He was now a major-general U.S.V. The reputation he had thus gained as an energetic leader quickly placed him in a high command, to which he proved to be quite unequal. The "Army of Virginia," as his new forces were styled, had but a brief career. At the very outset of his Virginian campaign Pope, by a most ill-advised order, in which he contrasted the performances of the Western troops with the failures of the troops in Virginia, forfeited the confidence of his officers and men. The feeling of the Army of the Potomac (which was ordered to his support) was equally hostile, and the short operations culminated in the disastrous defeat of the second battle of Bull Run. Pope was still sanguine and ready for another trial of strength, but he was soon compelled to realize the impossibility of retrieving his position, and resigned the command. Bitter controversy arose over these events. Halleck, the general-in-chief, was by no means free from blame, but the public odium chiefly fell upon generals McClellan and Fitz-John Porter, against whom Pope, while admitting his own mistakes, made grave charges. Pope was not again employed in the Civil War, but in command of the Department of the North-West he showed his former skill and vigour in dealing with Indian risings. In 1865 he was made brevet major-general U.S.A. (having become brigadier-general on his appointment to the Army of Virginia), and he subsequently was in charge of various military districts and departments until his retirement in 1886. In 1882 he was promoted to the full rank of major-general U.S.A. General Pope died at Sandusky, Ohio, on the 23rd of September 1892.

He was the author of various works and papers, including railway reports (*Pacific Railroad Reports* vol. iii.) and *The Campaign of Virginia* (Washington, 1865).

POPE, SIR THOMAS (*c.* 1507–1559), founder of Trinity College, Oxford, was born at Deddington, near Banbury, Oxfordshire, probably in 1507, for he was about sixteen years old when his father, a yeoman farmer, died in 1523. He was educated at Banbury school and Eton College, and entered the court of chancery. He there found a friend and patron in the lord-chancellor Thomas Audley. As clerk of briefs in the star chamber, warden of the mint (1534–1536), clerk of the Crown in chancery (1537), and second officer and treasurer of the court for the settlement of the confiscated property of the smaller religious foundations, he obtained wealth and influence. In this last office he was superseded in 1541, but from 1547 to 1553 he was again employed as fourth officer. He himself won by grant or purchase a considerable share in the spoils, for nearly thirty manors, which came sooner or later into his possession, were originally church property. "He could have rode," said Aubrey, "in his owne lands from Cogges (by Witney) to Banbury, about 18 miles." In 1537 he was knighted. The religious changes made by Edward VI. were repugnant to him, but at the beginning of Mary's reign he became a member of the privy council. In 1556 he was sent to reside as guardian in Elizabeth's house. As early as 1555 he had begun to arrange for the endowment of a college at Oxford, for which he bought the site and buildings of Durham College, the Oxford house of the abbey of Durham, from Dr George Owen and William Martyn. He received a royal charter for the establishment and endowment of a college of the "Holy and Undivided Trinity" on the 8th of March 1556. The foundation provided for a president, twelve fellows and eight scholars, with a schoolhouse at Hooknorton. The number of scholars was subsequently increased to twelve, the schoolhouse being given up. On the 28th of March the members of the college were put in possession of the site, and they were formally admitted on the 29th of May 1556. Pope died at Clerkenwell on the 29th of January 1559, and was buried at St Stephen's, Walbrook; but his remains were subsequently removed to Trinity College, where his widow erected a semi-Gothic alabaster monument to his memory. He was three times married, but left no children. Much of his property was left to charitable and religious foundations, and the bulk of his Oxfordshire estates passed to the family of his brother, John Pope of Wroxton, and his descendants, the viscounts Dillon and the earls of Guilford and barons North.

The life, by H. E. D. Blakiston, in the *Dict. Nat. Biog.*, corrects many errors in Thomas Warton's *Life of Sir Thomas Pope* (1772). Further notices by the same authority are in his *Trinity College* (1898), in the "College Histories" Series, and in the *English Historical Review* (April, 1896).

POPE-JOAN, a round game of cards, named after a legendary female Pope of the 9th century. An ordinary pack is used, from which the eight of diamonds has been removed, and a special round board in the form of eight compartments, named respectively Pope-Joan, Matrimony, Intrigue, Ace, King, Queen, Knave and Game (King, Queen and Knave are sometimes omitted). Each player—any number can play—contributes a stake, of which one counter is put into the divisions Ace, King, Queen, Knave and Game, two into Matrimony and Intrigue, and the rest into Pope-Joan. This is called "dressing the board." The cards are dealt round, with an extra hand for "stops," *i.e.* cards which stop, by their absence, the completion of a suit; thus the absence of the nine of spades stops the playing of the ten. The last card is turned up for trumps. Cards in excess may be dealt to "stops," or an agreed number may be left for the purpose, so that all players may have an equal number of cards. If an honour or "Pope" (nine of diamonds) is turned up, the dealer takes the counters in the compartment so marked. Sometimes the turning-up of Pope settles the hand, the dealer taking the whole pool. The Ace is the lowest card, the King the highest. The player on the dealer's left plays a card and names it; the player who has the next highest then plays it, till a stop is played, *i.e.* a card of which no one holds the next highest. All Kings are of course stops, also the seven of diamonds; also the cards next below the dealt stops, and the cards next below the played cards. After a stop the played cards are turned over, and the player of the stop (the card last played) leads again. The player who gets rid of all his cards first takes the counters in "Game," and receives a counter from each player for every card left in his hand, except from the player who may hold Pope but has not played it. The player of Ace, King, Queen or Knave of trumps takes the counters from that compartment. If King and Queen of trumps are in one hand, the holder takes the counters in "Matrimony"; if a Queen and Knave, those in "Intrigue"; if all three, those in the two compartments; if they are in different hands these counters are sometimes divided. Unclaimed stakes are left for the next pool. Pope is sometimes considered a universal "stop."

POPERINGHE, an ancient town of West Flanders, 12 m. W. of Ypres. Pop. (1904), 11,680. It contains a fine church of the 11th century, dedicated to St Betin. In the 14th century it promised to become one of the principal communes in Flanders; but having incurred the resentment of Ypres on a matter of trade rivalry it was attacked and captured by the citizens of that place, who reduced it to a very subordinate position. There are extensive hop gardens, bleaching grounds and tanneries in the neighbourhood of the town.

POPHAM, SIR HOME RIGGS (1762–1820), British admiral, was the son of Stephen Popham, consul at Tetuan, and was his mother's twenty-first child. He entered the navy in 1778, and served with the flag of Rodney till the end of the war. In 1783 he was promoted lieutenant, and was for a time engaged on survey service on the coast of Africa. Between 1787 and 1793 he was engaged in a curious series of adventures of a commercial nature in the Eastern Sea—sailing first for the Imperial Ostend Company, and then in a vessel which he purchased and in part loaded himself. During this time he took several surveys and rendered some services to the East India Company, which were officially acknowledged; but in 1793 his ship was seized, partly on the ground that he was carrying contraband and partly because he was infringing the East India Company's monopoly. His loss was put at £70,000, and he was entangled in litigation. In 1805 he obtained compensation to the amount of £25,000. The case was a hard one, for he was undoubtedly sailing with the knowledge of officials in India. While this dispute was going on Popham had resumed his career as a naval officer. He served with the army under the duke of York in Flanders as "superintendent of Inland Navigation" and won his confidence. The protection of the duke was exercised with so much effect that Popham was promoted commander in 1794 and post captain in 1795. He was now engaged for years in co-operating in a naval capacity with the troops of Great Britain and her allies. In the Red Sea he was engaged in transporting the Indian troops employed in the expulsion of the French from Egypt. His bills for the repair of his ship at Calcutta were made the excuse for an attack on him and for charging him with the amount. It was just the time of the general reform of the dockyards, and there was much suspicion in the air. It was also the case that St Vincent did not like Popham, and that Benjamin Tucker (1762–1829), secretary to the admiralty, who had been the admiral's secretary, was his creature and sycophant. Popham was not the man to be snuffed out without an effort. He brought his case before Parliament, and was able to prove that there had been, if not deliberate dishonesty, at least the very grossest carelessness on the part of his assailants. In 1806 he co-operated with Sir David Baird in the occupation of the Cape. He then persuaded the authorities that, as the Spanish Colonies were discontented, it would be easy to promote a rising in Buenos Ayres. The attempt was made with Popham's squadron and 1400 soldiers; but the Spanish colonists, though discontented, were not disposed to accept British help, which would in all probability have been made an excuse for establishing dominion. They rose on the soldiers who landed, and took them prisoners. Popham was recalled, and censured by a court martial for leaving his station; but the City of London presented him with a sword of honour for his endeavours to "open new markets," and the sentence did him no harm. He held other commands in connexion with the movements of troops, was promoted rear admiral in 1814, and made K.C.B. in 1815. He died at Cheltenham on the 10th of September 1820, leaving a large family. Popham was one of the most scientific seamen of his time. He did much useful survey work, and was the author of the code of signals adopted by the admiralty in 1803 and used for many years.

POPHAM, SIR JOHN (*c.* 1531–1607), English judge, was born at Huntworth, in Somerset, about 1531. He was educated at Balliol College, Oxford, and called to the bar at the Middle Temple. Concerning his early life little is known, but he was probably a member of the parliament of 1558. He was recorder of Bristol, and represented that city in parliament in 1571 and from 1572 to 1583. He was elected Speaker in 1580, and in 1581 became attorney-general, a post which he occupied until his appointment as lord chief justice in 1592. He presided at the trials of Sir Walter Raleigh and Guy Fawkes. Towards the end of his life Popham took a great interest in colonization, and was instrumental in procuring patents for the London and Plymouth companies for the colonization of Virginia. Popham was an advocate, too, of transportation abroad as a means of punishing rogues and vagabonds. His experiment in that direction, the Popham colony, an expedition under the leadership of his brother George (*c.* 1550–1608), had, however, but a brief career in its settlement (1607) on the Kennebec river. Popham died on the 10th of June 1607, and was buried at Wellington, Somerset.

See Foss, *Lives of the Judges*; J. Winsor, *History of America*, vol. iii.

POPILIA (or POPILLIA), **VIA,** the name of two ancient roads in Italy. (1) A highroad running from the Via Appia at Capua to Regium, a distance of 321 m. right along the length of the peninsula, and the main road through the interior of the country, not along the coast. It was built in 159 B.C. by the censor M. Popilius Laenas or in 132 B.C. by the consul P. Popilius. (2) A highroad from Ariminum to Aquileia along the Adriatic coast. It no doubt originally came into use when Aquileia was founded as a frontier fortress of Italy in 181 B.C., and Polybius gives the distance correctly as 178 m. In 132 it was reconstructed (*munita*) by the consul P. Popilius, one of whose milestones has been found near Atria. It ran along the shore strip (Lido) from Ariminum to Ravenna (33 m.), where it was usual in imperial times for travellers to take ship and go by canal to Altinum (*q.v.*), and there resume their journey by road, though we find the stations right through on the Tabula Peutingeriana, and Narses marched in 552 from Aquileia to Ravenna. (T. As.)

POPINJAY (O. Fr. *papegai*, or *popingay*, onomatopoeic, original), an old name for a parrot. Except in its transferred sense of a dressed-up, vain or conceited, empty-headed person, the word is now only used historically of a representation or image of a parrot swinging from a high pole and used as a mark for archery or shooting matches. This shooting at the popinjay (see ARCHERY) was formerly a favourite sport. "Popinjay" is still the proper heraldic term for a parrot as a bearing or charge.

POPLAR, an eastern metropolitan borough of London, England, bounded N. by Hackney, S. by the river Thames, and W. by Stepney and Bethnal Green, and extending E. to the boundary of the county of London. Pop. (1901), 168,822. The river Lea, which the eastern boundary generally follows, is believed to have been crossed towards the north of the modern borough by a Roman road, the existence of which is recalled by the district-name of Old Ford; while Bow (formerly Stratford-le-Bow or Stratford-atte-Bowe) was so named from the "bow" or arched bridge which took the place of the ford in the time of Henry II. South of these districts lies Bromley; in the south-east the borough includes Blackwall; and a deep southward bend of the Thames here embraces the Isle of Dogs. Poplar falls within the great area commonly associated with a poor and densely crowded population under the name of the "East End." It is a district of narrow, squalid streets and mean houses, among which, however, the march of modern improvement may be seen in the erection of model dwellings, mission houses and churches, and various public buildings. In the north a part of Victoria Park is included. In Blackwall and the Isle of Dogs streets give place to the extensive East and West India Docks (opened in 1806) and Millwall Dock, with shipbuilding, engineering, chemical and other works along the river. Blackwall has been a shipping centre from early times. From the south of the Isle of Dogs (the portion called Cubitt Town) a tunnel for foot-passengers (1902) connects with Greenwich on the opposite shore of the Thames, and lower down the river is the fine Blackwall tunnel, carrying a wide roadway, completed by the London County Council in 1897 at a cost, inclusive of incidental expenses, of £1,383,502. Among institutions the Poplar Accidents Hospital may be mentioned. Near the East India Docks is the settlement of St Frideswide, supported by Christ Church, Oxford. In Canning Town, which continues this district of poverty across the Lea, and so outside the county of London, are Mansfield House, founded from Mansfield College, Oxford; and a Women's Settlement, especially notable for its medical work. The metropolitan borough of Poplar includes the Bow and Bromley and the Poplar divisions of the Tower Hamlets parliamentary borough, each returning one member. The borough council consists of a mayor, 7 aldermen and 42 councillors. Area, 2327·7 acres.

POPLAR (Lat. *Populus*), the name of a small group of catkin-bearing trees belonging to the order *Salicaceae*. The catkins of the poplars differ from those of the nearly allied willows in the presence of a rudimentary perianth, of obliquely cup-shaped form, within the toothed bracteal scales; the male flowers contain from eight to thirty stamens; the fertile bear a one-celled (nearly divided) ovary, surmounted by the deeply cleft stigmas; the two-valved capsule contains several seeds, each furnished with a long tuft of silky or cotton-like hairs. The leaves are broader than in most willows, and are generally either deltoid or ovate in shape, often cordate at the base, and frequently with slender petioles vertically flattened. Many of the species attain a large size, and all are of very rapid growth. The poplars are almost entirely confined to the north temperate zone, but a few approach or even pass its northern limit, and they are widely distributed within that area; they show, like the willows, a partiality for moist ground and often line the river-sides in otherwise treeless districts. There are about twenty species, but the number cannot be very accurately defined—several, usually regarded as distinct, being probably merely variable forms of the same type, and the ease with which the trees intercross has led to the appearance of many hybrids. All yield a soft, easily-worked timber, which, though very perishable when exposed to weather, possesses sufficient durability when kept dry to give the trees a certain economic value. Many of the species are used for paper-making.

Of the European kinds one of the most important and best marked forms is the white poplar or abele, *P. alba*, a tree of large size, with rounded spreading head and curved branches, which, like the trunk, are covered with a greyish white bark, becoming much furrowed on old stems. The leaves are ovate or nearly round in general outline, but with deeply waved, more or less lobed and indented margins and cordate base; the upper side is of a dark green tint, but the lower surface is clothed with a dense white down, which likewise covers the young shoots—giving, with the bark, a hoary aspect to the whole tree. As in all poplars, the catkins expand in early spring, long before the leaves unfold; the ovaries bear four linear stigma lobes; the capsules ripen in May. A nearly related form, which may be regarded as a sub-species, *canescens*, the grey poplar of the nurseryman, is distinguished from the true abele by its smaller, less deeply cut leaves, which are grey on the upper side, but not so hoary beneath as those of *P. alba*; the pistil has eight stigma lobes. Both trees occasionally attain a height of 90 ft. or more, but rarely continue to form sound timber beyond the first half-century of growth, though the trunk will sometimes endure for a hundred and fifty years. The wood is very white, and, from its soft and even grain, is employed by turners and toy-makers, while, being tough and little liable to split, it is also serviceable for the construction of packing cases, the lining of carts and waggons, and many similar purposes; when thoroughly seasoned it makes good flooring planks, but shrinks much in drying, weighing about 58 lb per cubic foot when green, but only 33½ lb when dry. The white poplar is an ornamental tree, from its graceful, though somewhat irregular growth and its dense hoary foliage; it has, however, the disadvantage of throwing up numerous suckers for some yards around the trunk.

The grey and white poplars are usually multiplied by long cuttings; the growth is so rapid in a moist loamy soil that, according to Loudon, cuttings 9 ft. in length, planted beside a stream, formed in twelve years trunks 10 in. in diameter. Both these allied forms occur throughout central and southern Europe, but, though now abundant in England, it is doubtful whether they are there indigenous. *P. alba* suffers much from the ravages of wood-eating larvae, and also from fungoid growths, especially where the branches have been removed by pruning or accident.

P. nigra, the black poplar, is a tree of large growth, with dark, deeply-furrowed bark on the trunk, and ash-coloured branches; the smooth deltoid leaves, serrated regularly on the margin, are of the deep green tint which has given name to the tree; the petioles, slightly compressed, are only about half the length of the leaves. The black poplar is common in central and southern Europe and in some of the adjacent parts of Asia, but, though abundantly planted in Britain, is not there indigenous. The wood is of a yellowish tint. In former days this was the prevalent poplar in Britain, and the timber was employed for the purposes to which that of other species is applied, but has been superseded by *P. monilifera* and its varieties; it probably furnished the poplar wood of the Romans, which, from its lightness and soft tough grain, was in esteem for shield-making; in continental Europe it is still in some request; the bark, in Russia, is used for tanning leather, while in Kamchatka it is sometimes ground up and mixed with meal; the gum secreted by the buds was employed by the old herbalists for various medicinal purposes, but is probably nearly inert; the cotton-like down of the seed has been converted into a kind of vegetable felt, and has also been used in paper-making. A closely related form is the well-known Lombardy poplar, *P. fastigiata*, remarkable for its tall, cypress-like shape, caused by the nearly vertical growth of the branches. Probably a mere variety of the black poplar, its native land appears to have been Persia or some neighbouring country; it was unknown in Italy in the days of Pliny, while from remote times it has been an inhabitant of Kashmir, the Punjab, and Persia, where it is often planted along roadsides for the purpose of shade; it was probably brought from these countries to southern Europe, and derives its popular name from its abundance along the banks of the Po and other rivers of Lombardy, where it is said now to spring up naturally from seed, like the indigenous black poplar. It was introduced into France in 1749, and appears to have been grown in Germany and Britain soon after the middle of the last century, if not earlier. The Lombardy poplar is valuable chiefly as an ornamental tree, its timber being of very inferior quality; its tall, erect growth renders it useful to the landscape-gardener as a relief to the rounded forms of other trees, or in contrast to the horizontal lines of the lake or river-bank where it delights to grow. In Lombardy and France tall hedges are sometimes formed of this poplar for shelter or shade, while in the suburban parks of Britain it is serviceable as a screen for hiding buildings or other unsightly objects from view; its growth is extremely rapid, and it often attains a height of 100 ft. and upwards, while from 70 to 80 ft. is an ordinary size in favourable situations.

P. canadensis, the "cotton-wood" of the western prairies, and its varieties are perhaps the most useful trees of the genus, often forming almost the only arborescent vegetation on the great American plains. It is a tree of rather large growth, sometimes 100 ft. high, with rugged grey trunk 7 or 8 ft. in diameter, and with the shoots or young branches more or less angular; the glossy deltoid leaves are sharply pointed, somewhat cordate at the base, and with flattened petioles; the fertile catkins ripen about the middle of June, when their opening capsules discharge the cottony seeds which have given the tree its common western name; in New England it is sometimes called the "river poplar." The cotton-wood timber, though soft and perishable, is of value in its prairie habitats, where it is frequently the only available wood either for carpentry or fuel; it has been planted to a considerable extent in some parts of Europe, but in England a form of this species known as *P. monilifera* is generally preferred from its larger and more rapid growth. In this well-known variety the young shoots are but slightly angled, and the branches in the second year become round; the deltoid short-pointed leaves are usually straight or even rounded at the base, but sometimes are slightly cordate; the capsules ripen in Britain about the middle of May. This tree is of extremely rapid growth, and has been known to attain a height of 70 ft. in sixteen years; it succeeds best in deep loamy soil, but will flourish in nearly any moist but well-drained situation. The timber is much used in some rural districts for flooring, and is durable for indoor purposes when protected from dry-rot; it has, like most poplar woods, the property of resisting fire better than other timber. The native country of this form has been much disputed; but, though still known in many British nurseries as the "black Italian poplar," it is now well ascertained to be an indigenous tree in many parts of Canada and the States, and is a mere variety of *P. canadensis*; it seems to have been first brought to England from Canada in 1772. In America it seldom attains the large size it often acquires in England, and it is there of less rapid growth than the prevailing form of the western plains; the name of "cotton-wood" is locally given to other species. *P. macrophylla* or *candicans*, commonly known as the Ontario poplar, is remarkable for its very large heart-shaped leaves, sometimes 10 in. long; it is found in New England and the milder parts of Canada, and is frequently planted in Britain; its growth is extremely rapid in moist land; the buds are covered with a balsamic secretion. The true balsam poplar, or tacamahac, *P. balsamifera*, abundant in most parts of Canada and the northern States, is a tree of rather large growth, often of somewhat fastigiate habit, with round shoots and oblong-ovate sharp-pointed leaves, the base never cordate, the petioles round, and the disk deep glossy green above but somewhat downy below. This tree, the "liard" of the Canadian voyageur, abounds on many of the river sides of the north-western plains; it occurs in the neighbourhood of the Great Slave Lake and along the Mackenzie River, and forms much of the driftwood of the Arctic coast. In these northern habitats it attains a large size; the wood is very soft; the buds yield a gum-like balsam, from which the common name is derived; considered valuable as an antiscorbutic, this is said also to have diuretic properties; it was formerly imported into Europe in small quantities under the name of "baume focot," being scraped off in the spring and put into shells. This balsam gives the tree a fragrant odour when the leaves are unfolding. The tree grows well in Britain, and acquires occasionally a considerable size. Its fragrant shoots and the fine yellow green of the young leaves recommend it to the ornamental planter. It is said by Aiton to have been introduced into Britain about the end of the 17th century.

P. euphratica, believed to be the weeping willow of the Scriptures, is a large tree remarkable for the variability in the shape of its leaves, which are linear in young trees and vigorous shoots, and broad and ovate on older branches. It is a native of North Africa and Western and Central Asia, including North-West India. With the date palm it is believed to have furnished the rafters for the buildings of Nineveh.

POPLIN, or TABINET, a mixed textile fabric consisting of a silk warp with a weft of worsted yarn. As the weft is in the form of a stout cord the fabric has a ridged structure, like rep, which gives depth and softness to the lustre of the silky surface. Poplins are used for dress purposes, and for rich upholstery work. The manufacture is of French origin; but it was brought to England by the Huguenots, and has long been specially associated with Ireland. The French manufacturers distinguish between *popelines unies* or plain poplins and *popelines à dispositions* or *Écossaises*, equivalent to Scotch tartans, in both of which a large trade is done with the United States from Lyons.

POPOCATEPETL (Aztec *popoca* "to smoke," *tepetl* "mountain"), a dormant volcano in Mexico in lat. 18° 59′ 47″ N., long. 98° 33′ 1″ W., which with the neighbouring Ixtaccihuatl (Aztec "white woman") forms the south-eastern limit of the great basin known as the "Valley of Mexico." As it lies in the state of Puebla and is the dominating feature in the views from the city of that name, it is sometimes called the Puebla volcano. It is the second highest summit in Mexico, its shapely, snow-covered cone rising to a height of 17,876 ft., or 438 ft. short of that of Orizaba. This elevation was reported by the Mexican geological survey in 1895, and as the Mexican Geographical Society calculated the elevation at 17,888 ft., it may be accepted as nearly correct. The bulk of the mountain consists of andesite, but porphyry, obsidian, trachyte, basalt, and other similar rocks are also represented. It has a stratified cone showing a long period of activity. At the foot of the eastern slope stretches a vast lava field—the "malpays" (*malapais*) of Atlachayacatl—which, according to Humboldt, lies 60 to 80 ft. above the plain and extends 18,000 ft. east to west with a breadth of 6000 ft. Its formation must be of great antiquity. The ascent of Popocatepetl is made on the north-eastern slope, where rough roads are kept open by sulphur carriers and timber cutters. Describing his ascent in 1904, Hans Gadow states that the forested region begins in the foothills a little above 8000 ft., and continues up the slope to an elevation of over 13,000 ft. On the lower slopes the forest is composed in great part of the long-leaved *Pinus liophylla*, accompanied by deciduous oaks and a variety of other trees and shrubs. From about 9500 ft. to 11,500 ft. the Mexican "oyamel," or fir (*Abies religiosa*) becomes the principal species, interspersed with evergreen oak, arbutus and elder. Above this belt the firs gradually disappear and are succeeded by the short-leaved *Pinus montezumae*, or Mexican "ocote"—one of the largest species of pine in the republic. These continue to the upper tree-line, accompanied by red and purple *Pentstemon* and light blue lupins in the open spaces, some ferns, and occasional masses of alpine flowers. Above the tree line the vegetation continues only a comparatively short distance, consisting chiefly of tussocks of coarse grass, and occasional flowering plants, the highest noted being a little *Draba*. At about 14,500 ft. horses are left behind, though they could be forced farther up through the loose lava and ashes. On the snow-covered cone the heat of the sun is intense, though the thermometer recorded a temperature of 34° in September. The reflection of light from the snow is blinding. The rim of the crater is reached at an elevation of about 17,500 ft. Another description places the snow-line at 14,268 ft., and the upper tree-line a thousand feet lower. A detailed description of the volcano was published by the Mexican geological survey in 1895 according to which the crater is elliptical in form, 2008 by 1312 ft., and has a depth of 1657 ft. below the summit of the highest pinnacle and 673 ft. below the lowest part of the rim, which is very irregular in height. The steep, ragged walls of the crater show a great variety of colours, intensified by the light from the deep blue sky above. Huge patches of sulphur, some still smouldering, are everywhere visible, intermingled with the white streaks of snow and ice that fill the crevices and cover the ledges of the black rocks. The water from the melted snow forms a small lake at the bottom of the crater, from which it filters through fissures to the heated rocks below and thence escapes as steam or through other fissures to the mineral springs at the mountain's base. The Indian sulphur miners go down by means of ladders, or are lowered by rope and windlass, and the mineral is sent down the mountain side in a chute 2000 to 3000 ft. Some observers report that steam is to be seen rising from fissures in the bottom of the crater, and all are united in speaking of the fumes of burning sulphur that rise from its depths. That volcanic influences are still present may be inferred from the circumstance that the snow cap on Popocatepetl disappeared just before the remarkable series of earthquakes that shook the whole of central Mexico on the 30th and 31st of July 1909.

It is believed that Diego de Ordaz was the first European to reach the summit of Popocatepetl, though no proof of this remains further than that Cortés sent a party of ten men in 1519 to ascend a burning mountain. In 1522 Francisco Montaño made the ascent and had himself let down into the crater a depth of 400 or 500 ft. No second ascent is recorded until April and November 1827 (see Brantz Mayer, *Mexico*, vol. ii.). Other ascents were made in 1834, 1848 and subsequent years, members of the Mexican geological survey spending two days on the summit in 1895.

POPPER, DAVID (1846–), Bohemian violoncellist, was born at Prague, and educated musically at the conservatorium there, adopting the 'cello as his professional instrument. He was soon recognized, largely through von Bülow, as one of the finest soloists of the time, and played on tours throughout the European capitals. In 1872 he married the pianist Sophi Menter, from whom he was separated in 1886. In 1896 he became professor at the Royal Conservatoire at Budapest. He published various works, mainly compositions for the 'cello, together with four volumes of studies arranged as a violoncello school.

POPPO, ERNST FRIEDRICH (1794–1866), German classical scholar and schoolmaster, was born at Guben in Brandenburg on the 13th of August, 1794. In 1818 he was appointed director of the gymnasium at Frankfort-on-the-Oder, where he died on the 6th of November 1866, having resigned his post three years before. Poppo was an extremely successful teacher and organizer, and in a few years doubled the number of pupils at the gymnasium. He is chiefly known, however, for his exhaustive and complete edition of Thucydides in four parts (11 vols., 1821–1840), containing (i.) *prolegomena* on Thucydides as an historian and on his language and style (Eng. trans. by G. Burges, 1837), accompanied by historical and geographical essays; (ii.) text with *scholia* and critical notes; (iii.) commentary on the text and *scholia*; (iv.) indices and appendices. For the ordinary student a smaller edition (1843–1851) was prepared, revised after the author's death by J. M. Stahl (1875–1889).

See R. Schwarze in *Allgemeine deutsche Biographie* and authorities there referred to.

POPPY, in botany, a genus of plants known botanically as *papaver*, the type of the family or natural order Papaveraceae. They are annual and perennial erect herbs containing a milky juice, with lobed or cut leaves and generally long-stalked regular showy flowers, which are nodding in the bud stage. The sepals, very rarely three, which are two in number, fall off as the flower opens, the four (very rarely five or six) petals, which are crumpled in the bud stage, also fall readily. The numerous stamens surround the ovary, which is composed of 4 to 16 carpels and is surmounted by a flat or convex rayed disk bearing the stigmas. The ovary is incompletely divided into many chambers by the ingrowth of the placentas which bear numerous ovules and form in the fruit a many-seeded short capsule opening by small valves below the upper edge. The valves are hydroscopic, responding to increase in the amount of moisture in the atmosphere by closing the apertures. In dry weather the valves open, and the small seeds are ejected through the pores when the capsule is shaken by the wind on its long stiff slender stalk. The flowers contain no honey and are visited by pollen-seeking insects, which alight on the broad stigmatic surface. The genus contains about 40 species, mostly natives of central and south Europe and temperate Asia. Five species are British; *P. Rhoeas* is the common scarlet poppy found in cornfields and waste places. Cultivated forms of this, with exquisite shades of colour and without any blotch at the base of the petals, are known as Shirley poppies. *P. somniferum*, the opium poppy, with large white or blue-purple flowers, is widely cultivated (see OPIUM). The Oriental poppy (*P. orientale*) and its several varieties are fine garden plants, having huge bright crimson flowers with black blotches at the base. Many hybrid forms of varying shades of colour have been raised of late years. The Iceland poppy (*P. undicaule*), is one of the showiest species, having grey-green pinnate leaves and flowers varying in colour from pure white to deep orange-yellow, orange-scarlet, &c. Specially fine varieties with stalks 18–24 in. high are cultivated on a large scale by some growers for market. The Welsh poppy belongs to an allied genus, *Meconopsis*; it is a perennial herb with a yellow juice and pale yellow poppy-like flowers. It is native in the south-west and north of England, and in Wales; also in Ireland. The prickly poppy (*Argemone grandiflora*) is a fine Mexican perennial with large white flowers.

To the same family belongs the horned poppy, *Glaucium luteum*, found in sandy sea-shores and characterized by the waxy bloom of its leaves and large golden-yellow short-stalked flowers. Another member of the family is *Eschscholtzia californica*, a native of western North America, and well-known in gardens, with orange-coloured flowers and a long two-valved fruit pod.

The plume poppy (*Bocconia cordate* and *B. microcarpa*) are ornamental foliage plants of great beauty. The cyclamen poppy (*Eomecon chionantha*) is a pretty Chinese perennial, having roundish slightly lobed leaves and pure white flowers about 2 in. across. The tree poppy (*Dendromecon rigidum*) is a Californian shrub about 3 ft. high, having golden-yellow flowers about 2 in. across. The Californian poppy (*Platystemon californicus*) is a pretty annual about a foot high, having yellow flowers with 3 sepals and 6 petals; and the white bush poppy (*Romneya Coulteri*) is a very attractive perennial and semi-shrubby plant 2–8 ft. high, with pinnatifid leaves and large sweet scented white flowers often 6 in. across.

POPPY HEADS, a term, in architecture, given to the finials or other ornaments which terminate the tops of bench ends, either to pews or stalls. They are sometimes small human heads, sometimes richly carved images, knots of foliages or finials, and sometimes *fleurs-de-lis* simply cut out of the thickness of the bench end and chamfered. The term is probably derived from the French *poupée*, doll, puppet, used also in this sense, or from the flower, from a resemblance in shape.

POPPY OIL (*Oleum papaveris*), a vegetable oil obtained by pressure from the minute seeds of the garden or opium poppy, *Papaver somniferum.* The white-seeded and black-seeded varieties are both used for oil-pressing; but, when the production of oil is the principal object of the culture, the black seed is usually preferred. The qualities of the oil yielded by both varieties and the proportion they contain (from 50 to 60%) are the same. By cold pressing seeds of fine quality yield from 30 to 40% of virgin or white oil (*huile blanche*), a transparent limpid fluid with a slight yellowish tinge, bland and pleasant to taste, and with almost no perceptible smell. On second pressure with the aid of heat an additional 20 to 25% of inferior oil (*huile de fabrique* or *huile russe*) is obtained, reddish in colour, possessed of a biting taste, and a linseed-like smell. The oil belongs to the linoleic or drying series, having as its principal constituent linolein; and it possesses greater drying power than raw linseed oil. Its specific gravity at 15° C. is 0·925. Poppy oil is a valuable and much used medium for artistic oil painting. The fine qualities are largely used in the north of France (*huile d'œillette*) and in Germany as a salad oil, and are less liable than olive oil to rancidity. The absence of taste and characteristic smell in poppy oil also leads to its being much used for adulterating olive oil. The inferior qualities are principally consumed in soap-making and varnish-making, and for burning in lamps. The oil is very extensively used in the valley of the Ganges and other opium regions for food and domestic purposes. By native methods in India about 30% of oil is extracted, and the remaining oleaginous cake is used as food by the poor. Ordinary poppy-oil cake is a valuable feeding material, rich in nitrogenous constituents, with an ash showing an unusually large proportion of phosphoric acid. The seed of the yellow horned poppy, *Glaucium luteum*, yields from 30 to 35% of an oil having the same drying and other properties as poppy oil; and from the Mexican poppy, *Argemone mexicana*, is obtained a non-drying oil used as a lubricant and for burning.

POPULATION (Lat. *populus*, people; *populare*, to populate), a term used in two different significations, (1) for the total number of human beings existing within certain area at a given time, and (2) for the "peopling" of the area, or the influence of the various forces of which that number is the result. The population of a country, in the former sense of the word, is ascertained by means of a census (*q.v.*), which periodically records the number of people found in it on a certain date. Where, as is generally the case, detail of sex, age, conjugal condition and birthplace is included in the return, the census results can be co-ordinated with those of the parallel registration of marriages, births, deaths and migration, thus forming the basis of what are summarily termed *vital statistics*, the source of our information regarding the nature and causes of the process of "peopling," *i.e.* the movement of the population between one census and another. Neither of these two operations has yet reached perfection, either in scope or accuracy, though the census, being the subject of special and concentrated effort, is generally found the superior in the latter respect, and is in many cases taken in countries where registration has not yet been introduced. The countries where neither is in force are still, unfortunately, very numerous.

The Population of the World, and its Geographical Distribution.—Man is the only animal which has proved able to pass from dependence upon its environment to a greater or less control over it. He alone, accordingly, has spread over every quarter of the globe. The area and population of the world, as a whole, have been the subject of many estimates in scientific works for the last three centuries and are still to a considerable extent matters of rough approximation. Every decade, however, brings a diminution of the field of conjecture, as some form of civilized administration is extended over the more backward tracts, and is followed, in due course, by a survey and a census. It is not necessary, therefore, to cite the estimates framed before 1882, when a carefully revised summary was published by Boehm and H. Wagner. Since then the laborious investigations of P. F. Levasseur and L. Bodio have been completed in the case of Europe and America, and, for the rest of the world, the figures annually brought up to date in the *Statesman's Year Book* may be taken to be the best available. From these sources the abstract at foot of page has been derived.

The principal tracts still unmeasured and unenumerated (in any strict sense) in the Old World are the Turkish Empire, Persia, Afghanistan, China and the Indo-Chinese peninsula and nearly nine-tenths of Africa. In the same category must be placed a considerable proportion of central, southern and Polar America (see CENSUS). There is little of the world which is entirely uninhabited; still less permanently uninhabitable and unlikely to be required to support a population in the course of the expansion of the race beyond its present abodes. Probably the polar regions alone do not fall within the category of the potentially productive, as even sandy and alkaline desert is rendered habitable where irrigation can be introduced; and vast tracts of fertile soil adapted for immediate exploitation, especially in the temperate zones, both north and south, only remain unpeopled because they are not yet wanted for colonization. The geographical distribution of the population of the world is therefore extremely irregular, and, omitting from consideration areas but recently colonized, the density is regulated by the means of subsistence within reach. "La population," says G. de Molinari, "a tendance de se proportionner à son débouché." These, in their turn, depend mainly upon the character of the people who inhabit the country. Even amongst savages there are few communities, and those but sparse, which subsist entirely upon what is directly provided by nature. As human intelligence and industry come into play the means of livelihood are proportionately extended; population multiplies, and with this multiplication production increases. Thus, the higher densities are found in the eastern hemisphere, within the zone in which arose the great civilizations of the world, or, roughly speaking, between north parallels 25 and 40 towards the east, and 25 and 55 in the west. Here large areas with a mean density of over 500 to the sq. m. may be found either supported by the food directly produced by themselves, as in the great agricultural plains of the middle kingdom of China and the Ganges valley and delta; or else, as in western Europe, relying largely upon food from abroad, purchased by the products of manufacturing industry. In the one class the density is mainly rural, in the other it is chiefly due to the concentration of the population into large urban aggregates. It is chiefly from the populations of the south-west of Europe that the New World is being colonized; but the territories over which the settlers and their recruits from abroad are able to scatter are so extensive that even the lower densities of the Old World have not yet been attained, except in a few tracts along the eastern coasts of Australia and North America. Details of area and population are given under the headings of the respective countries, and the only general point in connexion with the relation between these two facts which may be mentioned here is the need to bear in mind that the larger the territory the less likely is its mean density-figure to be typical or really representative. Even in the case of small and comparatively homogeneous countries such as Holland, Belgium or Saxony there is considerable deviation from the mean in the density of the respective component subdivisions, a difference which when extended over more numerous aggregates often renders the general mean misleading or of little value.

Distribution of Population by Sex.—After geographical dispersion, the most general feature amongst the human race is its division by sex. The number of speculations as to the nature of this distinction has been, it is said, well-nigh doubled since Drelincourt, in the 18th century, brought together 262 "groundless hypotheses," and propounded on his own part a theory

TABLE I.

Continent.	Sq. m. in thousands (1907).	Population, in thousands.		Population per sq. m. (1907).	Unascertained Percentage of:	
		1882.	1907.		Area unsurveyed.	Population Unenumerated.
Europe	3,828*	327,743	405,759	106†	2·5*	1·3
Asia	15,773	795,591	918,324	58	43·2	59·4
Africa	11,507	205,823	126,734	11	90·1	77·4
America	17,208*	100,415	149,944	9†	50·0*	9·1
Oceania	3,448	4,232	5,881	1·7	5·4	19·6
Total	51,764	1,433,804	1,606,542	31·7†	50·4*	41·4

* Including Polar regions. † Excluding Polar regions.

which has since been held to be the 263rd in the series. It is not proposed to deal here with incidents appertaining to the "ante-natal gloom," and we are concerned only with human beings when once they have been born. In regard to the division of these into male and female, the first point to be noted is that, in all communities of western civilization, more boys are born than girls. The excess ranges from 20 to 60 per thousand. In Greece and Rumania it is exceptionally high, and in some Oriental or semi-Oriental countries it is said to give place to a deficit, though in the latter case the returns are probably not trustworthy. From the more accurate statistics available it appears that the excess of male births varies amongst different races and also at different times in the same community. It is high in new colonies and amongst the Latin races, with the exception of the French. These, with the English, show a much smaller excess of boy-births than the average of western Europe, and the proportion, moreover, seems to be somewhat declining in both these countries and in Belgium, from causes which have not yet been ascertained. As the mortality amongst boys, especially during the first year, is considerably above that of the other sex, numerical equilibrium between the two is established in early youth, and in most cases girls outnumber boys, except for a few years between twelve and sixteen. Then follows the chequered period of the prime of life and middle age, during which the liability of men to industrial accidents, war and other causes of special mortality, irrespective of their greater inclination to emigrate, is generally sufficient to outweigh the dangers of childbirth or premature decay among the women, who tend, accordingly, to predominate in number at this stage. In old age, again, their vitality rises superior to that of the men, and they continue to form the majority of the community. The general results are an excess of females over males throughout western Europe: but though the relative proportions vary from time to time, remaining always in favour of what is conventionally called the weaker sex, it is impossible, owing to disturbing factors like war and migration, to ascertain whether there is any general tendency for the proportion of females to increase or not. In comparatively new settlements, largely fed by immigration, the number of males is obviously likely to be greater than that of females, but in the case of countries in Asia and eastern Europe in which also a considerable deficiency of the latter sex is indicated by the returns, it is probable that the strict seclusion imposed by convention on women and the consequent reticence regarding them on the part of the householders answering the official inquiry tend towards a short count. On the other hand, the lower position there assigned to women and the very considerable amount of hard work exacted from them, may cause them to wear out earlier than under higher conditions, though not to the extent implied in the statistics. In the following table the latest available information on this head is given for representative countries of western and eastern Europe, the East and the New World.

TABLE II.

Country.	No. of females to 1000 males.	No. of girls born to 1000 boys.	Country.	No. of females to 1000 males.	No. of girls born to 1000 boys.
Sweden	1049	946	Galicia	1019	941
Norway	1064	944	Hungary	1009	949
Finland	1022	948	Rumania	964	902
Denmark	1053	950	Greece	921	879
England	1069	966	Servia	946	945
Scotland	1057	956	Bulgaria	959	927
Ireland	1028	946	Russia (Europe)	1011	948
Holland	1025	950	Russia (Asia)	893	—
Belgium	1013	956	Japan	983	—
Germany	1029	950	India	963	—
Austria	1042	947	Egypt	967	—
France	1033	960	United States	958	—
Italy	1011	947	Canada	952	—
Spain	1049	938	Argentine	893	—
Portugal	1093	899	Cape Colony	977	—
			Australia	906	950
			New Zealand	900	—

Distribution by Age.—Few facts are more uncertain about an individual than the number of years he will live. Few, on the contrary, as was pointed out by C. Babbage, are less subject to fluctuation than the duration of life amongst people taken in large aggregates. The age-constitution of a community does indeed vary, and to a considerable extent, in course of time, but the changes are usually gradual, and often spread over a generation or more. At the same time, it must be admitted that those which have recently taken place amongst most of the communities of western Europe are remarkable for both their rapidity and their extent; and are probably attributable, in part at least, to influences which were almost inoperative at the time when Babbage wrote. The distribution of a population amongst the different periods of life is regulated, in normal circumstances, by the birth-rate, and, as the mortality at some of the periods is far greater than at others, the death-rate falls indirectly under the same influence. The statistics of age, therefore, may be said to form a link between those of the population, considered as a fixed quantity, as at a census, and those which record its movement from year to year. To the correct interpretation of the latter, indeed, they are essential, as will appear below. Unfortunately, the return of age is amongst the less satisfactory results of a general enumeration, though its inaccuracy, when spread over millions of persons, is susceptible of correction mathematically, to an extent to make it serve its purpose in the directions above indicated. The error in the original return generally arises from ignorance. An illiterate population is very prone to state its age in even multiples of five, and even where education is widely spread this tendency is not altogether absent, as may be seen from the examples given in Table III. Deliberate mis-statements, too, are not unknown, especially amongst women. This has been repeatedly illustrated in the English census reports. Irrespective of the wish of women between 25 and 40 to return themselves as under 25, there appears to be the more practical motive of obtaining better terms in industrial insurance, whilst an overstatement of age often has, it is said, the object of getting better wages in domestic service, or better dietary in the workhouse! In all countries, moreover, there seems to be an inclination to exaggerate longevity after the three score years and ten have been passed. In order to minimize the results of such inaccuracy, the return of ages is compiled in aggregates of five or ten years and then redistributed over single years by the method of differences. The present purpose being merely to illustrate the variation of distribution amongst a few representative countries, it is unnecessary to enter into more detail than such as will serve to distinguish the proportions of the population in main divisions of life. Thus it may be said that in the west of Europe about one-third of the people, roughly speaking, are under fifteen; about one-half, between that age and fifty, and the remaining sixth older than fifty. The middle period

TABLE III.

Age.	Number returned at each age per 10,000 of Population.					
	Germany, 1900.	United States, 1900.		Russia, 1897.		India, 1891 Females.
		Native Whites.	Negroes.	Europe.	Asia, Females.	
19	180	196	204	166	112	64
20	182	200	252	223	385	505
21	181	191	204	143	113	54
29	130	146	119	92	60	42
30	149	170	218	269	456	624
31	145	125	76	74	74	30
49	88	72	62	45	38	12
50	94	84	156	196	257	386
51	89	61	38	35	34	12
59	62	43	30	25	18	10
60	70	49	105	163	179	281
61	60	33	15	22	25	11

may conveniently be extended to sixty and subdivided at forty, as is done in Table IV. The differences between the several countries in their age-constitution can best be appreciated by reference to some recognized general standard. The one here adopted is the result of the co-ordination of a long series of enumerations taken in Sweden during the last century and a half, prepared by Dr G. Sundbärg of Stockholm. It is true that for practical use in connexion with vital statistics for a given period, the aggregate age-distribution of the countries concerned would be a more accurate basis of comparison, but the wide period covered by the Swedish observations has the advantage of eliminating temporary disturbances of the balance of ages, and may thus be held to compensate for the comparatively narrow geographical extent of the field to which it relates.

TABLE IV.

Country.	Census Year.	Per 1000 of Population.			
		Under 15.	15–40.	40–60.	Over 60.
Standard . . .	—	*336*	*389*	*192*	*83*
Sweden . . .	1900	324	366	191	119
Norway . . .	,,	354	361	176	109
Finland . . .	,,	345	386	187	82
Denmark . .	,,	339	376	186	99
England . . .	1901	324	423	179	74
Scotland . . .	,,	334	416	173	77
Ireland . . .	,,	304	407	180	109
Holland . . .	1899	348	384	175	93
Belgium . . .	1900	317	404	184	95
Germany . .	,,	348	395	179	78
Austria . . .	,,	344	402	182	72
France . . .	1901	261	389	226	124
Italy . . .	,,	341	366	196	97
Portugal . . .	1900	338	375	191	96
Galicia . . .	,,	377	399	178	46
Hungary . .	,,	356	379	189	76
Servia . . .	,,	419	395	142	44
Bulgaria . .	,,	414	322	172	92
Greece . . .	1889	393	400	155	52
Russia (Europe)	1897	350	385	180	85
India (males) .	1891	391	399	163	47
Japan . . .	1898	335	384	193	88
United States .	1900	334	422	169	75
Canada . . .	1901	346	409	168	77
Australasia . .	,,	349	431	157	63
Cape Colony .	1904	415	409	129	47

As regards correspondence with the standard distribution, it will be noted that Finland, the next country to Sweden geographically, comes after Japan, far detached from northern Europe by both race and distance, and is followed by Portugal, where the conditions are also very dissimilar. The other Scandinavian countries, Norway and Denmark, appear, like Sweden itself in the present day, to bear in their age-distribution distinct marks of the emigration of adults, or, at least, the temporary absence from home of this class at the time of enumeration. The same can be said of Italy in its later returns and of Germany in those before 1895. On the contrary, the effect of the inflow of adult migrants is very marked, as is to be expected, in the returns for the new countries, such as the United States, Canada and Australasia. In the case of the Old World, the divergence from the standard which most deserves notice is the remarkable preponderance of the young in all the countries of eastern Europe, as well as in India, accompanied by an equally notable deficiency of the older elements in the population. Again, there are in the west two well-known instances of deficient reinforcement of the young, France and Ireland, in which countries the proportion of those under 15 falls respectively 75 and 32 per mille below the standard; throwing those over 60 up to 41 and 26 per mille above it. The table does not include figures for earlier enumerations, but one general characteristic in them should be mentioned, viz. the far higher proportion borne in them of the young, as compared with the more recent returns. In England, for instance, those under 15 amounted to 360 per mille in 1841, against 324 sixty years later. In Ireland the corresponding fall has been still more marked, from 382 to 304. The ratio in France was low throughout the 19th century, and during the last half fell only from 273 to 261, raising the proportion of the old above that resulting in northern Europe and Italy from emigration. It is remarkable that the same tendency for the proportion of the young to fall off is perceptible in new countries as well as in the older civilizations, setting aside the influence of immigration at the prime of life in depressing the proportion of children. The possible causes of this widespread tendency of the mean age of a western community to increase appertain to the subject of the movement of the population, which is dealt with below.

The Movement of Population.—"The true greatness of a State" says Bacon, "consisteth essentially in population and breed of men"; and an increasing population is one of the most certain signs of the well-being of a community. Successive accretions, however, being spread over so long a term as that of human life, it does not follow that the population at any given time is necessarily the result of *contemporary* prosperity. Conversely, the traces left by a casual set-back, such as famine, war, or an epidemic disease, remain long after it has been succeeded by a period of recuperation, and are to be found in the age-constitution and the current vital statistics. Population is continually in a state of motion, and in large aggregates the direction is invariably towards increase. The forces underlying the movement may differ from time to time in their respective intensity, and, in highly exceptional cases, may approach equilibrium, their natural tendencies being interrupted by special causes, but the instances of general decline are confined to wild and comparatively small communities brought into contact with alien and more civilized races. The factors upon which the growth of a population depend are internal, operating within the community, or external, arising out of the relations of the community with other countries. In the latter case, population already in existence is transferred from one territory to another by migration, a subject which will be referred to later. Far more important is the vegetative, or "natural" increase, through the excess of births over deaths. The principal influences upon this, in civilized life, are the number of the married, the age at which they marry or bear children, the fertility of marriages and the duration of life, each of which is in some way or other connected with the others.

Marriage.—In every country a small and generally diminishing proportion of the children is born out of wedlock, but the primary regulator of the native growth of a community is the institution of marriage. Wherever, it has been said, there is room for two to live up to the conventional standard of comfort, a marriage takes place. So close, indeed, up to recent times, was the connexion held to be between the prosperity of the country and the number of marriages, that Dr W. Farr used to call the latter the barometer of the former. The experience of the present generation, however, both in England and other countries, seems to justify some relaxation of that view, as will appear below. The tendency of a community towards matrimony, or its "nuptiality," as it is sometimes termed, is usually indicated by the ratio to the total population of the persons married each year. For the purpose of comparing the circumstances of the same community at successive periods this method is fairly trustworthy, assuming that there has been no material shifting of the age-proportions during the intervals. It is not a safe guide, however, when applied to the comparison of different communities, the age-composition of which is probably by no means identical, but in consideration of its familiarity it has been adopted in the first section of Table V. below, at three periods for each of the countries selected as representative.

One of the features which is prominent throughout the return is that in every country except Belgium the rate per mille attained a maximum in the early seventies, and has since shown a descending tendency, notwithstanding the fact, noted in the preceding paragraph, that the youthful population, which, of course, weighs down the rate, has also been relatively decreasing. Countries of Oriental and semi-Oriental habits have not been shown, owing to the difference in their marriage system from that of western Europe. It may be mentioned, however, in passing, that their marriage rate is generally considerably higher than that here indicated, as may be seen from the example of Galicia, which is here shown separately from cis-Leithian Austria. In the opposite direction will be noted the case of Ireland, where the rate is abnormally low; and returns more recent than those included in the table show that of late the rates in Sweden and Norway have also fallen to but little above 11 per mille. In regard to the necessity of taking into consideration the factor of age in the return of marriage-rates, an example may be here given from the data for England. The rate taken upon the total population was 16·7 per mille in 1870–1871 and 15·3 in 1905; by excluding the population under fifteen the corresponding figures are 57·2 and 46·6 per mille. Thus the decline, which by the first method is only 8%, becomes, by the second, 19%; and if the age-distribution of 1905 were reduced to that of the earlier period, the difference would increase to 22%, the most accurate figure of the three. For the present purpose it is sufficient to connect the rate of marriage with that of births by using as a basis for the former the number of women of conceptive age, or between 15 and 45 years old. The proportion of these is given in the latter portion of the table. Again taking England as an example, the women of the above ages bore the proportion to the total population of 23% in 1871 and had risen to 25% in 1901; but at the former time, 49·6% were married, whilst thirty years later, only 46·8 were thus situated. The table also shows that the proportion of the women of the ages in question who were married exceeds half only in Italy, France and Germany, not to mention Galicia. In other countries the average proportion is about 45%. In Sweden and Norway it is only 41 and in Ireland less than a third. In Scandinavia, and perhaps in Italy, the rate may be affected by the emigration of adult males, but the later columns of the table indicate that this is not the cause of the low rate in Ireland, which appears to be mainly due to abstinence from marriage at the ages specified.

TABLE V.

Country.	Per 1000 of Population.						
	Persons Married Yearly.			Women, 15 to 45 (1900).			Men, 20–50.
	1861–1870.	1871–1875.	1895–1904.	Total.	Married.	Unmarried.	Unmarried.
Sweden	13·1	14·0	12·0	215	88	123	83
Norway	13·3	14·6	13·2	218	91	102	71
Finland	15·5	17·9	14·1	219	103	115	70
Denmark	14·9	15·9	14·6	221	104	111	81
England	16·7	17·1	15·8	250	117	127	77
Scotland	14·0	14·9	14·3	242	102	135	90
Ireland	10·5	10·7	10·1	235	76	153	125
Holland	16·4	16·6	14·9	218	96	118	82
Germany	17·0	18·9	16·4	226	114	107	76
Belgium	15·0	15·1	16·4	230	108	117	85
Austria (W.)	16·1	17·7	15·7	227	106	115	85
France	15·6	16·9	15·2	228	120	100	82
Italy	15·2	15·6	14·4	214	116	92	71
Galicia	19·7	19·7	17·6	225	125	94	67

Next to the proportion of the married to the total marriageable the most important factor connected with the natural increase of the population is the age at which marriage takes place. Where the proportion of the married is high, the average age of the wives is low, and early marriage is conducive to relatively rapid increase. In the first place, the interval between generations is shortened, and the elder is contemporaneous with the younger for a longer period. Then, again, the fecundity of women amongst western peoples is at its maximum between 18 and 25 years of age and decreases rapidly as that period is left behind. A Swedish return of 1896–1900 shows that the annual births per thousand wives of 20–25 are fewer by nearly 17% than those of wives under 20. Between 25 and 30 the number falls off by one-fifth, and after 40 by about 44%. In the countries mentioned in Table V. the average proportion borne by wives under 30 to the total under 45 is just over one-third. That proportion is exceeded in southern Europe, where women develop earlier, and in Galicia. In England and France it stands at 36. In Ireland and Sweden it is only 28, and in Denmark, Holland and Norway, too, it is below the average. The registrar-general of England has pointed out a marked tendency towards the postponement of marriage in that country. Between 1876 and 1905, for instance, the proportion of minors married receded by 43% in the case of men and 32% amongst women. The mean age of husbands married in 1873 was 25·6 years and of wives 24·2, whereas thirty years later the corresponding ages were 28·6 and 26·4. The general results of the decline of the marriage-rate and the postponement of marriage upon the natural growth of population will be discussed in connection with the birth-rate, though the statistics available do not permit of the accurate measurement of the respective influence of these factors, and there are others, too, which have to be taken into consideration, as will appear below.

Births.—Apart from the information which the statistics of birth furnish as to the growth of population, they have, like those of marriage, and perhaps to even a greater extent, a special social interest from their bearings upon the moral conditions of the community to which they relate. It is in their former capacity, however, that they enter into the present subject. A birth-rate, taken as it usually is upon the total population, old and young, is open to the objections made above respecting the marriage-rate, and with even more force, as the basis is itself largely the product of the fact which is being measured by it. The internal variations of the rate in a single community, however, can be fairly indicated in this way, as is done in Table VI., which, it is to be noted, refers to those born alive only and excludes the still-born, statistics regarding whom are incomplete.

The crude birth-rate, it will be noted, is in general harmony with that of marriage. In the countries where the former is high the rate of marriage is also above the average. In eastern Europe, so far as the figures can be trusted, this is markedly the case, and the birth-rates range between 39 per mille in Hungary and 49 in Russia, where the tradition of encouraging prolificity amongst the peasantry has not been effaced. Among the lower rates which prevail in western Europe, however, the connexion is not so direct, and a low birth-rate is sometimes found with a relatively higher marriage rate and vice versa, a deviation from the natural course of events which will be discussed presently. The birth-rate, like the marriage-rate, seems to have reached its acme in the seventies, except in the three southern countries, France, Italy and Spain. The decline since the above period is very marked and exceeds that noted in the case of the rate of marriage. It is worth noting, too, that the fall in the crude birth-rate is not confined to the Old World, but has attracted special attention in Australia and New Zealand, where a rate of 40 per mille in the period 1861–1870 has now given place to one of 26. In Massachusetts and other of the older settlements of the United States, moreover, the same feature has been the subject of investigation.

TABLE VI.

Country.	(A) Born alive, per 1000 of Total Population.				(B) Legitimate Births, per 1000 Wives, 15 to 45 years old.			(C) Illegitimate Births, per 1000 Unmarried and Widowed Women, 15 to 45.
	1841–1850.	1861–1870.	1871–1875.	1900–1905.	1880–1882.	1890–1892.	1900–1902.	1896–1900.
Sweden	31·1	31·4	30·7	26·7	293	280	269	23·4
Norway	30·7	30·9	30·3	29·7	314	307	303	16·9
Finland	35·5	34·7	37·0	32·2	309	301	—	18·0
Denmark	30·5	31·0	30·8	29·7	287	278	259	23·6
England	34·6	36·0	36·0	29·0	286	264	235	8·8
Scotland	—	34·8	35·0	29·7	311	296	272	14·1
Ireland	—	26·1	26·4	23·2	283	288	289	3·9
Holland	33·0	35·3	36·1	32·1	347	339	315	9·0
Belgium	30·5	31·6	32·4	28·5	313	285	251	18·9
Germany	36·1	37·2	38·9	35·5	310	301	284	27·7
Austria (W.)	35·9	35·7	37·2	34·2	281	292	284	41·7
France	27·3	26·3	25·5	21·7	196	173	157	18·1
Italy	—	37·5	36·9	33·5	276	283	269	21·1
Spain	—	37·8	36·5	34·8	258	264	259	—

The crude rates which have been discussed above afford no explanation of this change, nor do they always illustrate its full extent. It is necessary, therefore, to eliminate the difference in the age-constitution of the countries in question by excluding from the field of observation, as before, all except possible mothers, basing the rate upon the respective numbers of women of the conceptive age, that is between 15 and 45. The proportion borne by this group to the total population is in most cases fairly up to that set forth by Dr Sundbärg in his standard. It is well above it in all three parts of the United Kingdom and falls materially below it only in Scandinavia and Italy. Indeed, during the last generation, this proportion has been in most cases slightly increased, in consequence of the fall of the birth-rate which set in anterior to this period. The stock, then, from which wives are drawn is ample. The question remains, how far advantage is taken of it. According to the Sundbärg standard the percentage married is 48. As has been shown in the preceding paragraph, this is surpassed in Italy, France and Germany, and approached in most of the rest, with the exception of Sweden, Norway and Scotland, which are six or seven points below it, and Ireland, where less than a third are married. The proportion married, moreover, has slightly increased since 1880, except in the United Kingdom. In England the marriage-rate (on the age basis) fell off by 4·6% and in Scotland by 2%, whilst the crude birth-rate declined by 15 and 11% respectively. In Ireland the case was different, as the marriage-rate declined by 12% and the birth-rate by no more than 5·7%. In New South Wales and New Zealand, too, the marriage-rates fell off in the same period by 11 and 28% respectively, whilst the decline in the birth-rates amounted to 35 and 31%. In the above countries, therefore, abstinence from matrimony may be said to have been a factor of some importance in the decline. On the continent of Europe, however, looking at the divergence in direction between the crude marriage-rate and that corrected to an age-basis, it is not improbable that the decline in the former may be attributable to some cause other than abstinence from marriage, at all events at the principal reproductive period; and perhaps to a decrease in marriage or remarriage after middle life, a period of which the weight in the age-distribution has been increasing of late. On the other hand, the postponement of marriage in the case of women of conceptive ages is a tendency which seems to be growing in other countries as well as in England and undoubtedly has a depressing effect upon the rate of births. It would conduce, therefore, to further accuracy in the comparison of the rates of different countries if the latter were to be correlated with greater subdivision of the ages amongst wives between 15 and 45. The proportion of wives below 30 to the total of that group was mentioned in connexion with the marriage-rate, and in the figures relating to some 30 years back some traces can be found of a connexion between a high birth-rate and a high proportion of young wives. In the present day, however, these indications do not appear, so it would seem that the tendency in question had been interrupted by some other influence, a point to which reference will be made below.

If abstinence from marriage and the curtailment of the reproductive period by postponement of marriage be insufficient to account for the material change which has taken place in the birth-rate within the last few decades, it is clear that the latter must be attributable to the diminished fertility of those who are married. On this question the figures in the second portion of Table VI. throws some light. Here the annual number of legitimate births is shown in its proportion to the mean number of married women of conceptive age at each of the three latest enumerations. The rate, it will be seen, has fallen in all the countries specified, except for a slight increase of 2% in Ireland and an almost stationary condition in Austria and Spain. The decline in Italy and Norway is small, but in France, where for a long time the fertility of the population has been very much below that of any other European country, the birth-rate thus calculated fell by nearly 20%, the same figure being approached in Belgium, where however, the fertility of married women is considerably greater. The case of England is remarkable. In the earlier period its crude birth and marriage-rates were above the average and its proportion of young wives well up to it. Its fertility-rate, however, which was by no means high in 1880, fell by nearly 18% by 1901, and since that date a further fall is reported by the registrar-general, to 24%, leaving the rate below that of all the other European countries except France. The States of Australasia, again, have experienced a decline even more marked. In 1880–1882 their fertility-rate ranged from 300 to 338, a low proportion for a new country, but nearly up to the European standard. By 1900–1902, however, the rate had fallen in all the larger States by from 23 to 31% and the highest rate recorded, 253 per thousand conceptive wives, was lower than that of any European country except France and Belgium. The cessation of assisted immigration early in the life of the present generation is alleged to have had considerable influence upon the rate, in Victoria, at least, owing to the curtailment of the supply of adult women of the more conceptive ages and the ageing of those who had reached the country at an earlier date. But neither this nor the diminution of the marriage-rate amongst women of those ages suffices to account for more than a fraction of the decline. The same tendency, moreover, is traceable in the New England States of America, so far as statistics are available.

It has been held by some that a phenomenon so widely diffused over the western world must be attributable to physiological causes, such as alcoholism, syphilis, the abuse of narcotics and so on. Herbert Spencer, again, before the decline in question set in, put forward the hypothesis that "the ability to maintain individual life and the ability to multiply vary inversely"; in other words, the strain upon the nervous system involved in the struggle for life under the conditions of modern civilization, by reacting on the reproductive powers, tends towards comparative sterility. These theories, however, being supported, according to the authorities of to-day, by no evidence, statistical or other, need not be here considered.

Nor, again, can the decline in fertility be connected with any diminution of material prosperity. On the contrary, the fertility-rate appears to be best maintained in countries by no means distinguished for their high standard of living, such as Spain, Italy, Ireland, and, perhaps, Austria. In this respect Holland stands by itself; but in the others mentioned, with the exception of Ireland, both marriage and birth-rates are high and there has been a comparatively insignificant fall in prolificity. The decline has been greatest where the standard of comfort is notoriously high, as in the United States, England and Australasia; also in France, where the general wellbeing reaches probably a lower depth in the community than in any other part of Europe. The comparison of the rates in France with those of Ireland is an instructive illustration of the point under consideration. In France more than half the women of conceptive age are married: in Ireland less than a third, and the proportion of youthful wives in the latter is 28% below that in France. In both the crude birth-rate is far below that of any other European country. But the fertility of the Irish wife exceeded that of her French compeer by 44% in 1880 and by no less than 84% twenty years later. So steady, indeed, has been the prolificity of Ireland, that from being ninth on the list at the earlier period mentioned, it is now inferior only to Holland and perhaps Finland in this respect.

It need not be assumed, however, that because these rates cannot be associated with the comparative degree of prosperity attained by the individual community they are altogether independent of the economic factors mainly contributing to that condition, such as trade, employment and prices. It is difficult, indeed, if not impracticable, to disentangle the effects which should be respectively attributed to influences so closely related to each other; but, of the three, prices alone tend to sufficient uniformity in their course in different countries to justify a supposition that they are in some way connected with a phenomenon so widely diffused as that of the decline in marriage and fertility. It is not improbable, therefore, that the fall in wholesale prices which, with temporary interruptions, persisted between 1870 and 1900, in general harmony with the other movement, may have conduced to reluctance on the part of those who have enlarged their notions of the standard of comfort to endanger their prospects of enjoying it by incurring the additional expenses of family life. Matrimony may be postponed, or, when entered upon, may be rendered a lighter burden upon the bread-winner. The economic element in the situation, which is imposed upon the individual by circumstances, is thus modified voluntarily into a moral or prudential consideration. In this case diminished prolificity where unaccompanied by a decrease in the number of marriages at reproductive ages, is attributable to the voluntary restriction of child-bearing on the part of the married. This explanation of the decline is supported by the almost unanimous opinion of the medical profession in the countries in question, and substantial evidence can be found everywhere of the extensive prevalence of the doctrine and practice of what has been termed, in further derogation of the repute of the "much misrepresented Malthus," *Neomalthusianism.* Preventive measures of this kind have long been in use in France, with the result shown in Tables V. and VI., and from that country they have spread, mostly since 1870, nearly all over western Europe, as well as to the Anglo-Saxon world beyond the seas; but are scarcely apparent in countries where the Roman church has a strong hold on the people. It is generally held that the practice of thus limiting families usually prevails, in the first instance, among the better-off classes, and in time filters down, as "the gospel of comfort" is accepted by those of less resources, until the prolificity of the whole community is more or less affected by it. The registrar general for England, indeed, has stated that whilst no more than about 17% of the decline in the birth-rate can be attributed to abstinence or postponement of marriage, nearly 70% should be ascribed to voluntary restriction.

The question of illegitimate births is the last to be here mentioned. It appears to be connected to a considerable extent with the subject dealt with above. In nearly every country the rate of these births has of late years shown a marked fall, which is by some ascribed to the adoption of the same expedients in illicit intercourse as are becoming conventional amongst the married. The rates given at the end of Table VI. are calculated upon the number of women most likely to produce them, that is, the spinsters, widows and divorced of conceptive age. In comparing the different countries, it may be noted that in some parts of Europe the rate is raised by the inclusion of the offspring of marriages not registered as demanded by law, though duly performed in church. Then, again, the possibility of legitimization by subsequent marriage tends to raise the rate. Italy and Scotland may be taken as examples of these two influences, and in Germany, too, the rates in Saxony and Bavaria, which are among the highest in Europe, are in part due to the non-registration of marriages sanctioned by religious ceremony only. The low rates in Ireland, Holland and England are especially noticeable, and in the last named, the decrease between 1870 and 1905 amounted to more than 50%, not, however, entirely due, it is said, to improved morality.

Deaths.—The forces tending towards the natural growth of population, which have been described above, differ from that which acts in the opposite direction in two material features. Marriage and child-bearing, in the first place, are operative amongst a fraction of the population only—those of conceptive age; whereas to the Urn of Death, as Dr Farr expressed it, all ages are called upon to contribute in their differing degrees. Then, again, the former are voluntary acts, entirely under the control of the individual; but mortality, though not beyond human regulation, is far less subject to it, and in order to have substantial results the control must be the outcome of collective rather than individual co-operation. The course of the marriage and birth-rates, set forth above, affords evidence that the control over both has been exercised of recent years to an unprecedented extent, and it will appear from what is stated below, that partly owing to this cause, partly, also, to improved hygienic conditions in western life, there has been an even more pronounced decline in the rate of mortality. The general results of both upon the natural increase of population in the countries selected for illustration of this subject will be found at the end of this paragraph. For the purpose of showing this, the crude death-rate, taken, like that of births, upon the whole population, without distinction of age or sex, will suffice. Where, however, the tendency to mortality, not its results, is in question, both the above factors must be taken into account, as they have been above in distinguishing the rate of fertility from that of births. The process of correcting the mere numbers of annual deaths per thousand of population into a form which renders the return comparable with those for communities differently constituted is somewhat complicated, but it is amply justified by its necessity in adapting the figures to the important services they perform in actuarial and sanitary science. This subject can only be dealt with here in outline. In the first place, sex must be distinguished, because, from infancy upwards, except between the ages of 10 and 20, the mortality amongst females is considerably less than amongst the other sex, and appears, too, to be declining more rapidly. So far as adult life is concerned this superior vitality is no doubt attributable to comparative immunity from the risks and hardships to which men are exposed, as, also, to the weaker inclination of women towards intemperance of different kinds. Thus, though the generally higher proportion of females in the community may seldom be enough to depress more than slightly the death-rate as a whole, it has a substantial effect upon it at the ages where women are in more marked numerical predominance, as in later life, and in places where the number of domestic servants is unusually great. Age is a factor still more important than sex in a return intended to serve as an index of mortality. The liability to death is extremely high amongst infants, decreasing with every month of life during the first year, but continuing above the mean rate until about the age of five. From the latter period until the fifteenth or sixteenth year vitality is at its best. The death-rate then gradually rises, slowly till 25, more rapidly later, when, from about 45 onward deterioration asserts itself more pronouncedly, and by three score years and ten the rate begins to exceed that of childhood. Thus, all other considerations being set aside, mortality tends to vary inversely with the proportion of the population at the healthy period 5 to 25. As the replenishment of this group depends upon the conditions prevailing at the earlier ages, it is to the mortality in childhood that most weight, from the standpoint of hygiene, must be attached. In most European countries not much less than half the annual deaths take place amongst children below five years of age, upon the total number of whom the incidence falls to the extent of from 40 to 120 per mille. The greater part of this is debitable, as just pointed out, to the first year, in which the mortality, calculated upon the number of births, ranged, in the decennium 1895–1904, between 70 per mille, in ~~the~~ exceptionally favourable circumstances of the Australasian States, to nearly 270 in European Russia. It should be remarked, in passing, that these rates are enormously higher amongst illegitimate children than amongst those born in wedlock, and that the proportion of still-born amongst the former is also in excess of that amongst the latter by some 50%. Infantile mortality is higher, too, in urban tracts, especially those associated with manufacturing industries. In Table VII. below, in which the crude rate alone is dealt with, evidence will be found of the general decline which has taken place in the mortality, thus expressed in different countries.

The difference in the rates for the various countries must not be taken as a measure of difference in mortality, since, as according to the table, much of it is ascribable to difference in age-constitution. At the same time, where the range is very wide, as between the rates in Scandinavia and Australia, and those in southern and eastern Europe, the variation, to a great extent, cannot be accounted for otherwise than by difference in hygienic conditions, more especially in the light thrown by the figures of infantile mortality in the second part of the table. The variations from period to period in the same country are more instructive. They show that in the 35 years covered the death-rate has generally declined by over 20%. The exceptional cases are, first, Ireland and Norway, with their emigrating tendencies; then Spain, where the returns have probably to be discounted for improved registration, and France, where the population is all but stationary. In Finland the death-rate at the earlier period taken for the comparison was abnormally swollen by epidemic disease, and if it be set on one side the decline appears to have been in harmony with that in its Scandinavian neighbours. The decline in mortality has been much greater than that in the crude birth-rate everywhere except in France, Australia, and, of course, Ireland; and it is only in the two former that it has been exceeded by that in the fertility-rate. The standard mortality of each community is deduced from a life-table, representing a "generation" of people assumed to be born at the same moment and followed throughout their hypothetical life, in the light of the distribution by age ascertained

TABLE VII.

Country.	(A) Death per 1000 of Total Population.			(B) Deaths under one year per 1000 Births.		(C) Decline per cent.			[1]Probable Lifetime.
						1861–1870 to 1895–1904.		Fertility-rate.	
	1841–1850.	1861–1870.	1895–1904.	1874–1883.	1895–1904.	Death-rate.	Birth-rate.	1880–1882 to 1900–1902.	Years.
Sweden	20·6	20·2	15·8	128	98	21·7	15·0	8·2	52·3
Norway	18·2	18·0	15·1	104	90	10·5	3·9	3·5	52·2
Finland	23·5	32·6	18·7	164	134	42·6 [2]	7·2	—	42·8
Denmark	20·5	19·8	15·8	141	127	20·6	4·2	9·3	47·8
England	23·7	24·0	17·2	149	150	28·3	19·4	17·8	45·9
Scotland	—	21·8	17·3	122	126	20·6	14·7	12·5	46·2
Ireland	—	16·6	18·0	96	103	*+8·4*	11·1	*+2·1*	—
Holland	26·2	25·4	17·0	204	147	33·0	9·0	9·2	27·8
Belgium	24·4	23·8	17·8	148	156	25·2	9·8	19·8	45·1
Germany	26·8	26·9	20·8	208 [3]	198 [3]	22·6	4·6	8·4	40·7
Austria (W)	29·8	29·1	24·0	255	224	17·5	4·2	—	—
France	23·2	23·6	20·4	165	153	13·5	17·5	19·8	47·4
Italy	—	30·9	22·7	208	170	26·5	10·7	2·5	43·0
Spain	—	30·6	27·8	—	182	9·1	8·0	—	—
Hungary	—	33·0	27·4	—	216	17·0	6·2	—	40·1
Galicia	—	33·5	27·8	—	—	17·0	2·3	—	—
Servia	—	30·9	23·6	—	154	23·6	9·9	—	—
Russia (Eur.)	—	37·1	31·2	267	268	15·9	2·2	—	—
N. S. Wales	—	16·2	11·7	—	108	27·7	32·2	30·7	51·2
Victoria	—	16·7	13·3	—	105	20·4	37·2	24·1	—
New Zealand	—	13·2	9·8	117	79	25·7	35·1	24·5	55·4

[1] Mean after lifetime at birth. [2] Finland from 1850–1891, decrease 20·4. [3] Prussia only; Saxony, 284 and 272; Bavaria, 308 257.

through the census and the number of deaths at each age observed for as many years, generally from 10 to 20, as suffice to furnish a trustworthy average. The population thus dealt with is supposed to be stationary, that is, the loss by death at each age is at once made good by the addition of an equal number of the same age, whilst the survivors pass on to the age above. Of the many calculations set forth in these valuable tables there is only room here to refer to the "afterlifetime" for such countries as it is available, which is quoted in the last column of Table VII. It shows the average number of years which persons of a given age, or, as here, of all ages, will live, on the assumption that they are subject to the calculated probabilities of survival. It is sometimes known as the "expectation of life," a term, however, which involves a mathematical hypothesis now discarded.

The relation between the birth and the death rates has been the subject of much analysis and controversy. Observation has demonstrated that the two rates are generally found to move along parallel lines. A high birth-rate is accompanied by high mortality; conversely, when one is low, so is the other. A birth-rate continuously in excess of the death-rate tends to lower the latter through the supply it affords of people annually reaching the more healthy ages. If the supply be diminished, the narrower field open to the risks of infancy has the immediate effect of further decreasing the mortality. In course of time, however, under the same influence, those passing from their prime into the second period of danger acquire a numerical preponderance which throws its weight upon the general death-rate and tends to raise it. It is assumed that throughout the above course the hygienic conditions of life remain unchanged. If, however, they undergo marked improvement, the duration of life is extended and both birth and death-rates, being spread over a wider field of the living, tend to decrease. On the other hand, an accidental set-back to population, such as that caused by famine or a disastrous war, leaves room which an increasing birth-rate hastens to occupy. A similar result follows in a lesser degree a wave of emigration. Examples of all the above tendencies may be gleaned from the returns of the countries named in the table, though space does not admit of their exhibtion. In both France and Germany, for instance, the process of replenishment after a great war can be traced both early and late in the 19th century. In England, the decrease in "natality" is in itself enough to account for the decline in the death-rate, apart from any considerations of improved hygiene. In France, on the contrary, the low natality having been so long continued, has raised the death-rate, by reason of the balance of proportion having been shifted by it from youth and the prime of life to old age. It may be inferred from the above that a high birth-rate does not imply a high rate of increase of population, any more than does a decreasing mortality, but the two rates must be considered in their relations to each other. The death-rate, however, is often taken by itself as the measure of the relatively favourable conditions or otherwise of the different countries; but it indicates at best the maintaining power of the community, whereas the increasing power, as manifested in the birth-rate, has also to be taken into account. Here, again, it is not sufficient to rely upon the mere rate of natural growth, or the difference between the two rates, since this may be the same in a community where both the rates are very high as in one where they are relatively low, a distinction of considerable importance. It has been suggested by Dr Rubin of Copenhagen, that if the death rate (d) be squared and divided by the birth-rate (b), due influence is allowed to each rate respectively, as well as to the difference in the height of the rates in different countries (*Journ. R. Statist. Soc.*, London, 1897, p. 154). The quotient thus obtained decreases as the conditions are more favourable, and, on the whole, it seems to form a good index to the merit of the respective countries from the standpoint of vital forces. The first column of Table VIII. shows the order in which the countries mentioned are found to stand according to the above test.

TABLE VIII.

Country.	Serial order according to formula $\frac{d^2}{b}$.	Per 1000 of Population.					
		Annual excess of Births over Deaths.		Total annual increase.		Approximate loss by emigration.	
	1895–1904.	1861–1871.	1895–1904.	1861–1871.	1891–1901.	1861–1871.	1891–1901.
Sweden	7	11·2	10·9	7·7	7·1	3·7	3·7
Norway	4	12·9	14·6	7·9	11·3	5·1	2·7
Finland	10	2·1	13·5	1·3	11·1	1·0	2·3
Denmark	5	11·1	13·9	10·4	11·5	0·3	1·3
England	8	13·6	11·8	12·5	11·5	1·1	0·2
Scotland	9	13·0	11·9	9·3	10·6	3·6	1·2
Ireland	13	9·6	5·2	*−6·9*	*−5·4*	15·0	10·7
Holland	6	9·9	15·1	8·4	12·7	2·0	1·5
Belgium	11	7·8	10·7	7·4	9·8	1·1	0·1
Germany	12	10·3	14·7	7·8	13·2	2·5	0·7
Austria (W.)	16	7·9	10·2	5·6	0·5	0·8	0·5
France	18	2·7	1·3	2·8	1·6	*+ 0·2*	*+ 1·0*
Italy	15	6·5	10·8	6·0	6·2	0·9	4·6
Spain	19	7·7	7·0	5·1	4·9	2·1	0·4
Russia	20	12·7	17·5	11·7	13·5	0·7	1·6
Hungary	18	8·5	11·5	8·2	9·8	0·4	0·9
Servia	14	13·6	16·5	–	14·4	–	0·6
Galicia	17	10·9	15·6	10·9	10·4	0·1	4·1
New South Wales	2	24·8	16·1	36·9	18·4	*+12·1*	*+ 2·3*
Victoria	3	24·7	12·7	30·8	5·2	*+ 6·1*	7·5
New Zealand	1	27·0	16·3	63·0	19·0	*+36·0*	*+ 2·7*

The three Australasian states head the list in virtue of their remarkably low death-rate, which outweighs the relative paucity of their births. The next countries in order all belong to north-western Europe, and their index-quotients are all very close to each other. Sweden falls below its geographical neighbours owing to its low birth-rate, and Finland because of its higher mortality. England and Scotland, in spite of their higher birth-rates, are kept below Scandinavia by the higher death-rate, but their birth-rate places them above Belgium. Ireland and France are pulled down by their low natality. The latter, with the same mortality as Germany, stands far below it for the above reason, as Ireland is raised by its lower death-rate above the prolific countries of eastern Europe. The rate of natural growth is given in the second part of the table. In the case of two of the Australasian states, of Holland, Finland, Spain and Italy, the order is in accord with that given by the test applied above, and the difference between the two in Austria, Ireland and France is not large. The great difference between the serial rank occupied in the respective lists by Russia, Servia and Galicia, with remarkably high rates of natural growth, as well as that found in the case of most of the other countries in question, shows that this factor is by no means a trustworthy guide in the estimate of hygienic balance.

Migration.—Passing from the internal factors in the movement of population, the influence has to be taken into account of the interchange of population between different countries. The net results of such exchange can be roughly estimated by comparing the rate of natural growth with that of the total increase of the community between one census and another, as set forth in Table VIII., in the last section of which the approximate loss by emigration, as calculated by Dr Sundbärg, is given. It will be seen that the only European country which gains by the exchange is France, and there the accretion is almost insignificant. Between many of the countries there is a good deal of migration which is only seasonal or temporary, according to the demand for labour. From Russia, too, there is a stream of colonization across the Urals into western Siberia, and amongst the western Mediterranean populations there is constant migration to North Africa. The greatest drain from Europe, however, has been across the sea to the United States, Canada and Australasia, especially to the first-named. Dr Sundbärg's returns give about 28 millions as the number which left Europe by sea during the 19th century, of whom all but 4 millions emigrated during the last half of that period. Between 1821 and 1904, about 22 millions landed from Europe in the United States; about 2½ millions in Canada; 2 millions in Australia, besides a good number in Brazil, the Argentine and South Africa. The return of birthplace which usually forms part of the census inquiry, affords supplementary information on the subject of immigration. In Canada, for instance, those born abroad numbered 17 % of the population in 1871, and about 13 % thirty years later. In New South Wales, the corresponding figures were 41 and 28 %, and in Victoria 55 and 27. In New Zealand the consequences of the cessation of special encouragement to emigration were still more marked, the foreign-born declining in proportion from 63 to 33 %. On the other hand, in the United States, from 9·7 % in 1850 the proportion rose to 13·7 in 1900, and has since reached still higher figures, as has been the case recently in Canada also. Up to the early 'nineties the greater part of the immigrants into America were furnished by Germany, Ireland and Great Britain, but for the next fifteen years the place of those countries was taken by Italy and eastern Europe. The general results of the two movements in Europe have been thus summarised by Dr Sundbärg:—

Table IX.

	Annual rate per 1000 of population.							
	1801–1850.				1850–1900.			
	Births.	Deaths.	Births above Deaths.	Census Increase.	Births.	Deaths.	Births above Deaths.	Census Increase.
Europe, N.W.	35·4	26·5	8·9	8·1	34·4	23·4	11·0	8·6
„ S.W.	33·6	28·3	5·3	5·2	31·4	26·3	5·1	4·3
„ E.	45·9	38·1	7·8	7·7	46·2	34·7	11·5	10·6
Total Europe	38·6	31·2	7·4	7·1	38·0	28·4	9·6	8·2
United States	—	—	—	29·9	—	—	—	24·0
Canada	—	—	—	38·7	—	—	—	16·2
Australasia	—	—	—	85·9	—	—	—	48·2

Differences tend to be smoothened out, of course, in dealing with a population so large and varied as that of a continent, but the figures suffice to show the contrast between the early part of the century and the period following the great migratory movements to the new goldfields. In the countries receiving the stream of newcomers, the intercensal rate of increase was obviously very different from those of the older countries, though it seems to have largely spent itself or been counteracted by other influences. The latest rates, for instance, were only 18 per mille per annum in Australia; 11 in Canada and 19 in the United States.

Bibliography.—A very full bibliography up to 1899 is appended to von Fircke's *Bevölkerungslehre und Bevölkerungspolitik*. Reference may also be made to Matthews Duncan, *Fecundity, Fertility and Sterility* (ed. 1871); Newsholme, *Elements of Vital Statistics* (ed. 1899), and his paper on birth-rates, *Journ. R. Statist. Soc.* (1906); W. Farr, *Vital Statistics* (1885); Coghlan, *Report on Decline in Birth-rate, New South Wales* (1903), and report of Royal Commission on that decline (1904); Bonar, *Malthus and his Work* (1885); Bertillon, *Éléments de démographie*; Garnier, *Du Principe de population*; de Molinari, *Ralentissement du mouvement de la population*; Bertheau, *Essai sur les lois de la population*; Starkenburg, *Die Bevölkerungs-Wissenschaft*; Stieda, *Das sexual Verhältniss der Geborenen*; Rubin and Westergäard, *Statistik der Ehen*; Westergäard, *Die Lehre von der Mortalität und Morbilität*, and *Die Grundzüge der Theorie der Statistik*; Gonnard, *L'Émigration européenne*. (J. A. B.)

POPULONIUM (Etruscan *Pupluna*), an ancient seaport town of Etruria, Italy, at the north end of the peninsular of Monte Massoncello, at the south end of which is situated the town of Piombino (*q.v.*). The place, almost the only Etruscan town built directly on the sea, was situated on a lofty hill[1] now crowned by a conspicuous medieval castle and a poor modern village (Populonia). Considerable remains of its town walls, of large irregular, roughly rectangular blocks (the form is that of the natural splitting of the schistose sandstone), still exist, enclosing a circuit of about 1½ m. The remains existing within them are entirely Roman—a row of vaulted substructions, a water reservoir and a mosaic with representations of fishes. Strabo mentions the existence here of a look-out tower for the shoals of tunny-fish. There are some tombs outside the town, some of which, ranging from the Villanova period (9th century B.C.) to the middle of the 3rd century B.C., were explored in 1908. In one, a large circular tomb, were found three sepulchral couches in stone, carved in imitation of wood, and a fine statuette in bronze of Ajax committing suicide. Close by was found a horse collar with 14 bronze bells. The remains of a temple, devastated in ancient times (possibly by Dionysius of Syracuse in 384 B.C.), were also discovered, with fragments of Attic vases of the 5th century B.C., which had served as *ex votos* in it. Coins of the town have also been found in silver and copper. The iron mines of Elba, and the tin and copper of the mainland, were owned and smelted by the people of Populonia; hot springs too lay some 6 m. to the E. (Aquae Populaniae) on the high road—Via Aurelia—along the coast. At this point a road branched off to Saena (Siena). According to Virgil the town sent a contingent to the help of Aeneas, and it furnished Scipio with iron in 205 B.C. It offered considerable resistance to Sulla, who took it by siege; and from this dates its decline, which Strabo, who describes it well (v. 2, 6, p. 223), already notes as beginning, while four centuries later Rutilius describes it as in ruins. The harbour, however, continued to be of some importance, and the place was still an episcopal see in the time of Gregory the Great.

See G. Dennis, *Cities and Cemeteries of Etruria* (London, 1883, ii. 212 sqq.); I. Falchi in *Notizie degli Scavi* (1903–1904); L. A. Milani, ibid. (1908), 199 sqq.

PORBANDAR, a native state of India, in the Kathiawar political agency, Bombay, extending along the S.W. coast of the peninsula of Kathiawar. Area, 636 sq. m.; pop. (1901), 82,640, showing a decrease of 4 % in the decade. Estimated gross revenue, £65,000; tribute, £3,233. The chief, whose title is rana, is a Jethwa Rajput. Limestone is largely exported to Bombay. This limestone is used for buildings in Porbandar without mortar, and is said to coalesce into a solid block under the influence of moisture. The town of Porbandar is the maritime terminus of the Kathiawar railway system. Pop. (1901), 24,620. A large trade is conducted in native boats as far as the east coast of Africa.

PORCELAIN, the name of that kind of ceramic ware which is characterized by a translucent body, also loosely used for the finer kinds of ware generally, popularly known as "china" (see Ceramics). The French *porcelaine*, from which the word comes into English, is an adaptation of the Italian *porcellana*, a cowrie-shell, the beautifully polished surface of which caused the name to be applied to the ware. The Italian word is generally taken to be from *porcella*, diminutive of *porco*, pig, from a supposed resemblance of the shell to a pig's back.

PORCH (through the Fr. *porche*, from Lat. *porticus*; the Ital. equivalent is *portico*, corresponding to the Gr. *νάρθηξ*; Ger. *Vorhalle*), a covered erection forming a shelter to the entrance door of a large building. The earliest known are the two porches of the Tower of the Winds at Athens; there would seem to have been one in front of the entrance door of the villa of Diomede outside the gate at Pompeii; in Rome they were probably not allowed, but on either side of the entrance door of a mansion, porticoes set back behind the line of frontage were provided, according to F. Mazois, as shelters from sun and rain for those who paid early visits before the doors were opened. In front of the early Christian basilicas was a long arcaded porch called "narthex" (*q.v.*) In later times porches assume two forms—one the projecting erection covering the entrance at the west front of cathedrals, and divided into three or more doorways, &c., and the other a kind of covered chamber open at the ends, and having small windows at the sides as a protection from rain. These generally stand on the north or south sides of churches, though in Kent there are a few instances (as Snodland and Boxley) where they are at the west ends. Those of the Norman period generally have little projection, and are sometimes so flat as to be little more than outer dressings and hood-moulds to the inner door. They are often richly ornamented, and, as at Southwell in England and Kelso in Scotland, have rooms over, which have been erroneously called *parvises*. Early English porches are much longer, and in larger buildings frequently have rooms above; the gables are generally bold and high pitched. In larger buildings also, as at Wells, St Albans, &c., the interiors are as rich in design as the exteriors. Decorated and Perpendicular porches partake of much the same characteristics, the pitch of roof, mouldings, copings, battlements, &c., being, of course, influenced by the taste of the time. The later porches have rooms over them more frequently than in earlier times; these are often approached from the lower storey by small winding stairs, and sometimes have fire-places, and are supposed to have served as vestries; and sometimes there are the remains of a piscina, and relics of altars, as if they had been used as chantry chapels. It is probable there were wooden porches at all periods, particularly in those places where stone was scarce; but, as may be expected from their exposed position, the earliest have decayed. At Cobham, Surrey, there was one that had ranges of semicircular arches in oak at the sides, of strong Norman character. It is said there are several in which portions of Early English work are traceable, as at Chevington in Suffolk. In the Decorated and later periods, however, wooden porches are common, some plain, others with rich tracery and large boards; these frequently stand on a sort of half storey of stone work or *bahut*. The entrance porches at the west end of cathedrals are generally called *portals*, and where they assume the character of separate buildings, are designated *galilees*; *e.g.* the porticoes on the west side of the south transept of Lincoln Cathedral, and at the west end of the nave of Ely Cathedral, and the chapel at the west end of Durham Cathedral. The finest example in England of an open projected porch is that of Peterborough Cathedral, attached to the Early Norman nave.

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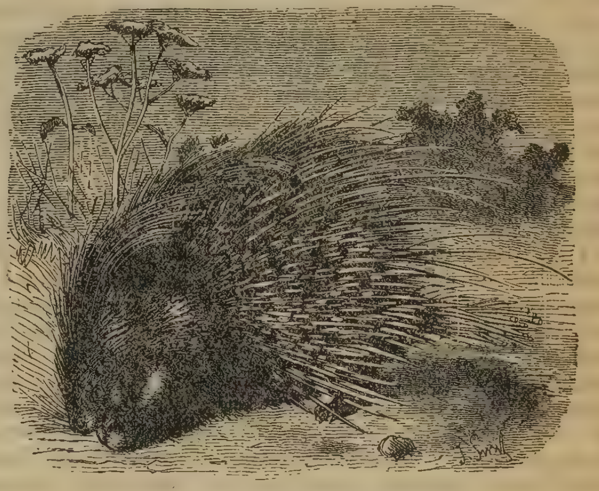
[1] It commands a fine view, and Corsica is sometimes visible, though not Sardinia, as Strabo (and following him, Lord Macaulay) erroneously state.

The term "porch" is also given to the magnificent portals of the French cathedrals, where the doors are so deeply recessed as to become porches, such as those of Reims, Amiens, Chartres, Troyes, Rouen, Bourges, Paris, and Beauvais cathedrals, St Ouen, Rouen, and earlier Romanesque churches, as in St Trophime, Arles and St Gilles. Many, however, have detached porches in front of the portals, as in Notre Dame at Avigon, Chartres (north and south), Noyon, Bourges (north and south), St Vincent at Rouen, Notre Dame de Louviers, the cathedrals of Albi and Le Puy, and in Germany those of Spires and Regensburg, and the churches of St Laurence and St Sebald at Nuremberg. (R. P. S.)

PORCUPINE (Fr., *porc-épic*, "spiny pig"), the name of the largest European representative of the terrestrial rodent mammals, distinguished by the spiny covering from which it takes its name. The European porcupine (*Hystrix cristata*) is the typical representative of a family of Old World rodents, the *Hystricidae*, all the members of which have the same protective covering. These rodents are characterized by the imperfectly rooted cheek-teeth, imperfect clavicles or collar-bones, cleft upper lip, rudimentary first front-toes, smooth soles, six teats and many cranial characters. They range over the south of Europe, the whole of Africa, India and the Malay Archipelago as far east as Borneo. They are all stout, heavily-built animals, with blunt rounded heads, fleshy mobile snouts, and coats of thick cylindrical or flattened spines, which form the whole covering of their body, and are not intermingled with ordinary hairs. Their habits are strictly terrestrial. Of the three genera *Hystrix* is characterized by the inflated skull, in which the nasal chamber is often considerably larger than the brain-case, and the short tail, tipped with numerous slender-stalked open quills, which make a loud rattling noise whenever the animal moves. The common porcupine (*H. cristata*), which occurs throughout the south of Europe and North and West Africa, is replaced in South Africa by *H. africaeaustralis* and in India by the hairy-nosed porcupine (*H. leucura*).



The Porcupine (*Hystrix cristata*).

Besides these large crested species, there are several smaller species without crests in north-east India, and the Malay region from Nepal to Borneo. The genus *Atherura* includes the brush-tailed porcupines which are much smaller animals, with long tails tipped with bundles of flattened spines. Two species are found in the Malay region and one in West Africa. *Trichys*, the last genus, contains two species, *T. fasciculata* of Borneo and *T. macrotis* of Sumatra, both externally very like *Atherura*, but differing from the members of that genus in many cranial characteristics. In the New World the porcupines are represented by the members of the family *Erethizontidae*, or *Coendidae*, which have rooted molars, complete collar-bones, entire upper lips, tuberculated soles, no trace of a first front-toe, and four teats. The spines are mixed with long soft hairs. They are less strictly nocturnal in their habits; and with one exception live entirely in trees, having in correspondence with this long and powerful prehensile tails. They include three genera, of which the first is represented by the Canadian porcupine (*Erethizon dorsatus*), a stout, heavily-built animal, with long hairs almost or quite hiding its spines, four front- and five hind-toes, and a short, stumpy tail. It is a native of the greater part of Canada and the United States, wherever there is any remnant of the original forest left. *Synetheres*, or *Coendu*, contains some eight or ten species, known as tree-porcupines, found throughout tropical South America, with one extending into Mexico. They are of a lighter build than the ground-porcupines, with short, close, many-coloured spines, often mixed with hairs, and prehensile tails. The hind-feet have only four toes, owing to the suppression of the first, in place of which they have a fleshy pad on the inner side of the foot, between which and the toes boughs and other objects can be firmly grasped as with a hand. *Chaetomys*, distinguished by the shape of its skull and the greater complexity of its teeth, contains *C. subspinosus*, a native of the hottest parts of Brazil. (W. H. F.; R. L.*)

PORDENONE, IL (1483–1539), an eminent painter of the Venetian school, whose correct name was Giovanni Antonio Licinio, or Licino. He was commonly named Il Pordenone from having been born in 1483 at Corticelli, a village near Pordenone (*q.v.*) in Italy. He ultimately dropped the name of Licinio, having quarrelled with his brothers, one of whom had wounded him in the hand; he then called himself Regillo, or De Regillo. His signature runs "Antonius Portunaensis," or "De Portunaonis." He was created a cavaliere by Charles V.

As a painter Licinio was a scholar of Pellegrino da S. Daniele, but the leading influence which governed his style was that of Giorgione; the popular story that he was a fellow-pupil with Titian under Giovanni Bellini is incorrect. The district about Pordenone had been somewhat fertile in capable painters; but Licinio excelled them all in invention and design, and more especially in the powers of a vigorous chiaroscurist and flesh painter. Indeed, so far as mere flesh-painting is concerned he was barely inferior to Titian in breadth, pulpiness and tone; and he was for a while the rival of that great painter in public regard. The two were open enemies, and Licinio would sometimes affect to wear arms while he was painting. He excelled Giorgione in light and shade and in the effect of relief, and was distinguished in perspective and in portraits; he was equally at home in fresco and in oil-colour. He executed many works in Pordenone and elsewhere in Friuli, and in Cremona and Venice; at one time he settled in Piacenza, where is one of his most celebrated church pictures, "St Catherine disputing with the Doctors in Alexandria"; the figure of St Paul in connexion with this picture is his own portrait. He was formally invited by Duke Hercules II. of Ferrara to that court; here soon afterwards, in 1539, he died, not without suspicion of poison. His latest works are comparatively careless and superficial; and generally he is better in male figures than in female—the latter being somewhat too sturdy—and the composition of his subject-pictures is scarcely on a level with their other merits. Pordenone appears to have been a vehement self-asserting man, to which his style as a painter corresponds, and his morals were not unexceptionable. Three of his principal scholars were Bernardino Licinio, named Il Sacchiense, his son-in-law Pomponio Amalteo, and Giovanni Maria Calderari.

The following may be named among Pordenone's works: the picture of "S Luigi Giustiniani and other Saints," originally in S Maria dell' Orto, Venice; a "Madonna and Saints" (both of these in the Venice academy); the "Woman taken in Adultery," in the Berlin museum; the "Annunciation," at Udine, regarded by Vasari as the artist's masterpiece, now damaged by restoration. In Hampton Court is a duplicate work, the "Painter and his Family"; and in Burghley House are two fine pictures now assigned to Pordenone—the "Finding of Moses" and the "Adoration of the Kings." These used to be attributed to Titian and to Bassano respectively.

PORDENONE, a town of the province of Udine, Venetia, Italy, 30 m. W. by S. of Udine on the railway to Treviso. Pop. (1901), 8425 (town); 12,409 (commune). It was the birthplace of the painter generally known as Il Pordenone (*q.v.*). Paintings from his brush adorn the cathedral (which has a fine brick campanile), and others are preserved in the gallery of the town hall. Cotton industries are active, and silk and pottery are manufactured.

PORE, a small opening or orifice, particularly used of the openings of the ducts of the sweat-glands in the skin or of the *stomata* in the epidermis of plants or those through which the pollen or seed are discharged from anthers or seed capsules. The word is an adaptation through the French from Lat. *porus*, Gr. *πόρος*, passage. In the sense of to look closely at, to read with persistent or close attention, "pore" is of obscure origin. It would seem to be connected with "peer," to look closely into, and would point to an O. Eng. *purian* or *pyrian*. There is no similar word in Old French.

PORFIRIUS, PUBLILIUS OPTATIANUS, Latin poet, possibly a native of Africa, flourished during the 4th century A.D. He has been identified with Publilius Optatianus, who was *praefectus urbi* (329 and 333), and is by some authorities included amongst the Christian poets. For some reason he had been banished, but having addressed a panegyric to the Emperor Constantine the Great, he was allowed to return. Twenty-eight poems are extant under his name, of which twenty were included in the panegyric. They have no value except as curiosities and specimens of perverted ingenuity. Some of them are squares (the number of letters in each line being equal), certain letters being rubricated so as to form a pattern or figure, and at the same time special verses or maxims; others represent various objects (a syrinx, an organ, an altar); others have special peculiarities in each line (number of words or letters); while the 28th poem (the *versus anacyclici*) may be read backwards without any effect upon sense or metre. A complimentary letter from the emperor and letter of thanks from the author are also extant. The best edition of the poem is by L. Müller (1877).

See also O. Seeck, "Das Leben des Dichters Porphyrius" in *Rheinisches Museum* (1908), lxiii. 267.

PORISM. The subject of porisms is perplexed by the multitude of different views which have been held by geometers as to what a porism really was and is. The treatise which has given rise to the controversies on this subject is the *Porisms* of Euclid, the author of the *Elements*. For as much as we know of this lost treatise we are indebted to the *Collection* of Pappus of Alexandria, who mentions it along with other geometrical treatises, and gives a number of lemmas necessary for understanding it. Pappus states that the porisms of Euclid are neither theorems nor problems, but are in some sort intermediate, so that they may be presented either as theorems or as problems; and they were regarded accordingly by many geometers, who looked merely at the form of the enunciation, as being actually theorems or problems, though the definitions given by the older writers showed that they better understood the distinction between the three classes of propositions. The older geometers regarded a theorem as directed to *proving* what is proposed, a problem as directed to *constructing* what is proposed, and finally a porism as directed to *finding* what is proposed (*εἰς πορισμὸν αὐτοῦ τοῦ προτεινομένου*). Pappus goes on to say that this last definition was changed by certain later geometers, who defined a porism on the ground of an accidental characteristic as *τὸ λεῖπον ὑποθέσει τοπικοῦ θεωρήματος*, that which falls short of a locus-theorem by a (or in its) hypothesis.

Proclus points out that the word was used in two senses. One sense is that of "corollary," as a result unsought, as it were, but seen to follow from a theorem. On the "porism" in the other sense he adds nothing to the definition of "the older geometers" except to say (what does not really help) that the finding of the center of a circle and the finding of the greatest common measure are porisms (Proclus, ed. Friedlein, p. 301).

Pappus gives a complete enunciation of a porism derived from Euclid, and an extension of it to a more general case. This porism, expressed in modern language, asserts that—given four straight lines of which three turn about the points in which they meet the fourth, if two of the points of intersection of these lines lie each on a fixed straight line, the remaining point of intersection will also lie on another straight line. The general enunciation applies to any number of straight lines, say $(n+1)$, of which n can turn about as many points fixed on the $(n+1)$th. These n straight lines cut, two and two, in $\frac{1}{2}n(n-1)$ points, $\frac{1}{2}n(n-1)$ being a triangular number whose side is $(n-1)$. If, then, they are made to turn about the n fixed points so that any $(n-1)$ of their $\frac{1}{2}n(n-1)$ points of intersection, chosen subject to a certain limitation, lie on $(n-1)$ given fixed straight lines, then each of the remaining points of intersection, $\frac{1}{2}(n-1)(n-2)$ in number, describes a straight line. Pappus gives also a complete enunciation of one porism of the first book of Euclid's treatise. This may be expressed thus: If about two fixed points P, Q we make turn two straight lines meeting on a given straight line L, and if one of them cut off a segment AM from a fixed straight line AX, given in position, we can determine another fixed straight line BY, and a point B fixed on it, such that the segment BM′ made by the second moving line on this second fixed line measured from B has a given ratio λ to the first segment AM. The rest of the enunciations given by Pappus are incomplete, and he merely says that he gives thirty-eight lemmas for the three books of porisms; and these include 171 theorems.

The lemmas which Pappus gives in connexion with the porisms are interesting historically, because he gives (1) the fundamental theorem that the cross or an harmonic ratio of a pencil of four straight lines meeting in a point is constant for all transversals; (2) the proof of the harmonic properties of a complete quadrilateral; (3) the theorem that, if the six vertices of a hexagon lie three and three on two straight lines, the three points of concourse of opposite sides lie on a straight line.

During the last three centuries this subject seems to have had great fascination for mathematicians, and many geometers have attempted to restore the lost porisms. Thus Albert Girard says in his *Traité de trigonométrie* (1626) that he hopes to publish a restoration. About the same time P. de Fermat wrote a short work under the title *Porismatum euclidaeorum renovata doctrina et sub forma isagoges recentioribus geometris exhibita* (see *Oeuvres de Fermat*, i., Paris, 1891); but two at least of the five examples of porisms which he gives do not fall within the classes indicated by Pappus. Robert Simson was the first to throw real light upón the subject. He first succeeded in explaining the only three propositions which Pappus indicates with any completeness. This explanation was published in the *Philosophical Transactions* in 1723. Later he investigated the subject of porisms generally in a work entitled *De porismatibus tractatus; quo doctrinam porismatum satis explicatam, et in posterum ab oblivione tutam fore sperat auctor*, and published after his death in a volume, *Roberti Simson opera quaedam reliqua* (Glasgow, 1776). Simson's treatise, *De porismatibus*, begins with definitions of theorem, problem, datum, porism and locus. Respecting the porism Simson says that Pappus's definition is too general, and therefore he will substitute for it the following: "Porisma est propositio in qua proponitur demonstrare rem aliquam vel plures datas esse, cui vel quibus, ut et cuilibet ex rebus innumeris non quidem datis, sed quae ad ea quae data sunt eandem habent relationem, convenire ostendendum est affectionem quandam communem in propositione descriptam. Porisma etiam in forma problematis enuntiari potest, si nimirum ex quibus data demonstranda sunt, invenienda proponantur." A locus (says Simson) is a species of porism. Then follows a Latin translation of Pappus's note on the porisms, and the propositions which form the bulk of the treatise. These are Pappus's thirty-eight lemmas relating to the porisms, ten cases of the proposition concerning four straight lines, twenty-nine porisms, two problems in illustration and some preliminary lemmas. John Playfair's memoir (*Trans. Roy. Soc. Edin.*, 1794, vol. iii.), a sort of sequel to Simson's treatise, had for its special object the inquiry into the probable origin of porisms—that is, into the steps which led the ancient geometers to the discovery of them. Playfair remarked that the careful investigation of all possible particular cases of a proposition would show that (1) under certain conditions a problem becomes impossible; (2) under certain other conditions, indeterminate or capable of an infinite number of solutions. These cases could be enunciated separately, were in a manner intermediate between theorems and problems, and were called "porisms." Playfair accordingly defined a porism thus: "A proposition affirming the possibility of finding such conditions as will render a certain problem indeterminate or capable of innumerable solutions." Though this definition of a porism appears to be most favoured in England, Simson's view has been most generally accepted abroad, and has the support of the great authority of Michael Chasles. However, in *Liouville's Journal de mathématiques pures et appliquées* (vol. xx., July, 1855), P. Breton published *Recherches nouvelles sur les porismes d'Euclide*, in which he gave a new translation of the text of Pappus, and sought to base thereon a view of the nature of a porism more closely conforming to the definitions in Pappus. This was followed in the same journal and in *La Science* by a controversy between Breton and A. J. H. Vincent, who disputed the interpretation given by the former of the text of Pappus, and declared himself in favour of the idea of Schooten, put forward in his *Mathematicae exercitationes* (1657), in which he gives the name of "porism" to one section. According to F. van Schooten, if the various relations between straight lines in a figure are written down in the form of equations or proportions, then the combination of these equations in all possible ways, and of new equations thus derived from them leads to the discovery of innumerable new properties of the figure, and here we have "porisms." The discussions, however, between Breton and Vincent, in which C. Housel also joined, did not carry forward the work of restoring Euclid's Porisms, which was left for Chasles. His work (*Les Trois livres de porismes d'Euclide*, Paris, 1860) makes full use of all the material found in Pappus. But we may doubt its being a successful reproduction of Euclid's actual work. Thus, in view of the ancillary relation in which Pappus's lemmas generally stand to the works to which they refer, it seems incredible that the first seven out of thirty-eight lemmas should be really equivalent (as Chasles makes them) to Euclid's first seven Porisms. Again, Chasles seems to have been wrong in making the ten cases of the four-line Porism begin the book, instead of the intercept-Porism fully enunciated by Pappus, to which the "lemma to the first Porism" relates intelligibly, being a particular case of it. An interesting hypothesis as to the *Porisms* was put forward by H. G. Zeuthen (*Die Lehre von den Kegelschnitten im Altertum*, 1886, ch. viii.). Observing, *e.g.*, that the intercept-Porism is still true if the two fixed points are points on a conic, and the straight lines drawn through them intersect on the conic instead of on a fixed straight line, Zeuthen conjectures that the *Porisms* were a by-product of a fully developed projective geometry of conics. It is a fact that Lemma 31 (though it makes no mention of a conic) corresponds exactly to Apollonius's method of determining the foci of a central conic (*Conics*, iii. 45–47 with 42).

The three porisms stated by Diophantus in his *Arithmetica* are propositions in the theory of numbers which can all be enunciated in the form "*we can find* numbers satisfying such and such conditions"; they are sufficiently analogous therefore to the geometrical porism as defined in Pappus and Proclus.

A valuable chapter on porisms (from a philological standpoint) is included in J. L. Heiberg's *Litterargeschichtliche Studien über Euklid* (Leipzig, 1882); and the following books or tracts may also be mentioned: Aug. Richter, *Porismen nach Simson bearbeitet* (Elbing, 1837); M. Cantor, "Ueber die Porismen des Euklid und deren Divinatoren," in *Schlömilch's Zeitsch. f. Math. u. Phy.* (1857), and *Literaturzeitung* (1861), p. 3 seq.; Th. Leidenfrost, *Die Porismen des Euklid* (Programm der Realschule zu Weimar, 1863); Fr. Buchbinder, *Euclids Porismen und Data* (Programm der kgl. Landesschule Pforta, 1866). (T. L. H.)

POROS, or Poro ("the Ford"), an island off the east coast of the Morea, separated at its western extremity by only a narrow channel from the mainland at Troezen, and consisting of a mass of limestone rock and of a mass of trachyte connected by a slight sandy isthmus. The town looks down on the beautiful harbour between the island and the mainland on the south.

The ancient Calauria, with which Poros is identified, was given, according to the myth, by Apollo to Poseidon in exchange for Delos; and it became in historic times famous for a temple of the sea-god, which formed the centre of an amphictyony of seven maritime states—Hermione, Epidaurus, Aegina, Athens, Prasiae, Nauplia, and Orchomenus. Here Demosthenes took sanctuary with "gracious Poseidon," and, when this threatened to fail him, sought death. The building was of Doric architecture and lay on a ridge of the hill commanding a fine view of Athens and the Saronic Gulf, near the middle of the limestone part of the island. The site was excavated in 1894, and traces of a sacred agora with porticoes and other buildings, as well as the temple, have been found. In the neighbourhood of Poros-Calauria are two small islands, the more westerly of which contains the ruins of a small temple, and is probably the ancient Sphaeria or Hiera mentioned by Pausanias as the seat of a temple of Athena Apaturia. The English, French, and Russian plenipotentiaries met at Poros in 1828 to discuss the basis of the Greek government.

See Chandler, *Travels*; Leake, *Morea*; Le Bas, *Voyage archéologique*; Curtius, *Peloponnesos*; Pouillon-Boblaye, *Recherches*; Bursian, *Geographie von Griechenland*; Rangabé "Ein Ausflug nach Poros," in *Deutsche Revue* (1883); and S. Wide, in *Mitteilungen d. deutsch. Inst. Athen.* (1895), vol. xx.

PORPHYRIO, POMPONIUS, Latin grammarian and commentator on Horace, possibly a native of Africa, flourished during the 2nd century A.D. (according to others, much later). His scholia on Horace, which are still extant, mainly consist of rhetorical and grammatical explanations. It is not probable that we possess the original work, which must have suffered from alterations and interpolations at the hands of the copyists of the middle ages, but on the whole the scholia form a valuable aid to the student of Horace.

Ed. W. Meyer (1874); A. Holder (1894); see also C. F. Urba, *Meletemata porphyrionea* (1885); E. Schweikert, *De Porphyrionis . . . scholiis Horatianis* (1865); F. Pauly, *Quaestiones criticae de . . . Porphyrionis commentariis Horatianis* (1858).

PORPHYRY (Πορφύριος) (A.D. 233–*c.* 304), Greek scholar, historian, and Neoplatonist, was born at Tyre, or Batanaea in Syria. He studied grammar and rhetoric under Cassius Longinus (*q.v.*). His original name was Malchus (king), which was changed by his tutor into Porphyrius (clad in purple), a jesting allusion to the colour of the imperial robes (cf. porphyrogenitus, born in the purple). In 262 he went to Rome attracted by the reputation of Plotinus, and for six years devoted himself to the study of Neoplatonism. Having injured his health by overwork, he went to live in Sicily for five years. On his return to Rome, he lectured on philosophy and endeavoured to render the obscure doctrines of Plotinus (who had died in the meantime) intelligible to the ordinary understanding. His most distinguished pupil was Iamblichus. When advanced in years he married Marcella, a widow with seven children and an enthusiastic student of philosophy. Nothing more is known of his life, and the date of his death is uncertain.

Of his numerous works on a great variety of subjects the following are extant: *Life of Plotinus* and an exposition of his teaching in the

Ἀφορμαὶ πρὸς τὰ νοητά (*Sententiae ad intelligibilia ducentes*, Aids to the study of the Intelligibles). The *Life of Pythagoras*, which is incomplete, probably formed part of a larger history of philosophy (φιλόσοφος ἱστορία, in four books) down to Plato. His work on Aristotle is represented by the *Introduction* (εἰσαγωγή) to and *Commentary* (ἐξήγησις, in the form of questions and answers) on the *Categories*. The first, translated into Latin by Boëtius, was extensively used in the middle ages as a compendium of Aristotelian logic; of the second only fragments have been preserved. His Χρονικά, a chronological work, extended from the taking of Troy down to A.D. 270; to it Eusebius is indebted for his list of the Macedonian kings. The treatise φιλόλογος ἱστορία is called an ἀκρόασις (lecture) by Eusebius, who in his *Praeparatio evangelica* (x. 3) has preserved a considerable extract from it, treating of plagiarism amongst the ancients. Other grammatical and literary works are Ὁμηρικὰ ζητήματα (*Quaestiones homericae*); and *De antro nympharum*, in which the description in the *Odyssey* (xiii. 102–112) is explained as an allegory of the universe. The Περὶ ἀποχῆς ἐμψύχων (*De abstinentia*), on abstinence from animal food, is especially valuable as having preserved numerous original statements of the old philosophers and the substance of Theophrastus's Περὶ εὐσεβείας (*On Piety*). It also contains a long fragment from the *Cretans* of Euripides. The Πρὸς Μαρκέλλαν is an exhortation to his wife Marcella to practise virtue and self-restraint and to study philosophy. The letter to the Egyptian priest Anebo, dealing with religious questions, was answered by a member of the school of Iamblichus, who called himself Abammon, in the *De mysteriis*. It is frequently referred to by Eusebius, Cyril and Augustine. Eusebius preserved fragments of the Περὶ τῆς ἐκ λογίων φιλοσοφίας (*De philosophia ex oraculis haurienda*), in which he expressed his belief in the responses of the oracles of various gods as confirming his theosophical views. Porphyry is well known as a violent opponent of Christianity and defender of Paganism; of his Κατὰ Χριστιανῶν (*Adversus Christianos*) in 15 books, perhaps the most important of all his works, only fragments remain. Counter-treatises were written by Eusebius of Caesarea, Apollinarius (or Apollinaris) of Laodicea, Methodius of Olympus, and Macarius of Magnesia, but all these are lost. Porphyry's view of the book of Daniel, that it was the work of a writer in the time of Antiochus Epiphanes, is given by Jerome. There is no proof of the assertion of Socrates, the ecclesiastical historian, and Augustine, that Porphyry was once a Christian.

There is no complete edition of the works of Porphyry. Separate editions: *Vita Plotini* in R. Volkmann's edition of the *Enneades* of Plotinus (1883); *Sententiae*, by B. Mommert (1907); *Vita Pythagorae, De antro nympharum, De abstinentia, Ad Marcellam*, by A. Nauck (1885); "Isagoge et in Aristotelis categorias commentarium," by A. Busse in *Commentaria in Aristotelem graeca* (1887), iv. 1, with the translation of Boëtius (ed. with introd., S. Brandt, 1906); fragments of the *Chronica* in C. W. Müller, *Frag. hist. graec.* (1849), iii. 688; *Quaestiones homericae*, by H. Schrader (1880, 1890); *Letter to Anebo* in W. Pharthey's edition of Iamblichus *De mysteriis* (1857); *De philosophia ex oraculis haurienda*, by G. Wolff (1856); fragments of the *Adversus Christianos* by A. Georgiades (Leipzig, 1891); English trans. of the *De abstinentia, De antro nympharum* and *Sententiae*, by Thomas Taylor (1823); of the *Sententiae* by T. Davidson in the *Journal of Speculative Philosophy*, iii. (1869); of the *De abstinentia* by S. Hibberd (1857), and of the *Ad Marcellam* by A. Zimmern (1896).

On Porphyry and his works generally see Fabricius, *Bibliotheca graeca* (ed. Harles), v. 725; Eunapius, *Vita philosophorum*; article in Suïdas; Lucas Holstenius, *De vita et scriptis Porphyrii* (Cambridge, 1655); J. E. Sandys, *Hist. of Classical Scholarship* (1906), i. 343; W. Christ, *Gesch. der griechischen Litteratur* (1898), § 621; M. N. Bouillet, *Porphyre, son rôle dans l'école néoplatonicienne* (1864); A. I. Kleffner, *Porphyrius der Neuplatoniker und Christenfeind* (Paderborn, 1896); on his philosophy, T. Whittaker, *The Neo-Platonists* (Cambridge, 1901), and NEOPLATONISM.

PORPHYRY (Gr. πορφύρεος, Lat. *purpureus*, purple), in petrology, a beautiful red volcanic rock which was much used by the Romans for ornamental purposes when cut and polished. The famous red porphyry (*porfido rosso antico*) came from Egypt, but its beauty and decorative value were first recognized by the Romans in the time of the emperor Claudius. It was obtained on the west coast of the Red Sea, where it forms a dike 80 or 90 ft. thick. For a long time the knowledge of its source was lost, but the original locality, marked by many ancient quarries, has been re-discovered at Jebel Dhokan, and the stone is again an article of commerce. In a dark red ground-mass it contains many small white or rose-red plagioclase felspars, black shining prisms of hornblende, and small plates of iron oxide. The red colour of the felspars and of the ground-mass is unusual in rocks of this group, and arises from the partial conversion of the plagioclase felspar into thulite and manganese-epidote. These minerals also occur in thin veins crossing the rock. Many specimens show effects of crushing and in extreme cases this has produced brecciation. Another famous porphyry, hardly less beautiful, is the *verde antique, porfido verde antico*, or *marmor lacedaemonium viride* of Pliny, which was obtained between Lebetsova and Marathonisi in Peloponnesus. It has the same structure as the red porphyry as it contains large white or green felspars in a fine ground-mass. The green colour arises from the abundant formation of chlorite and epidote in the large felspars and throughout the rock. In ancient times it was much used as an ornamental stone, these two varieties of porphyry making a fine contrast with one another. Green porphyries are not so rare as red. A similar rock is obtained at Lambay Island near Dublin. They are still used extensively, especially for small ornaments. Large pieces are difficult to obtain free from flaws, and marble is preferred for mural work, not only because of the greater variety of patterns but also because it is much softer and more easily cut and polished.

Many igneous rocks possess the structure which characterizes these porphyries (see PETROLOGY, Plate III.): the presence of scattered crystals of larger size in a fine-grained ground-mass. Most lavas, and many of the rocks which occur as dikes and sills, have porphyritic structure. These may be called porphyries and this term has consequently been applied to a great variety of rocks, *e.g.* diorite-porphyry, granite-porphyry, greenstone-porphyry, augite-porphyry, liebenerite-porphyry, &c. More recently the use of the term has been restricted to a series of rocks which are of intrusive origin and contain much porphyritic felspar (with or without quartz or nepheline). The porphyritic intrusive rocks with large crystals of augite, olivine, biotite, and hornblende are for the most part grouped under the lamprophyres; while the term porphyry is rarely now applied to any of the effusive rocks or lavas. Furthermore, it has become usual to subdivide the intrusive porphyries into two classes; in one of these the phenocrysts are mainly orthoclase, in the other mainly plagioclase felspar. The first series is known as the "porphyries," while the second group is called "porphyrites." There are porphyries which correspond chemically and mineralogically to granites, syenites, and nepheline-syenites; while the porphyrites form a parallel series to the diorites, norites and gabbros. In each case the porphyritic type occurs generally as dikes and thin sheets which consolidated beneath the surface but probably at no great depth (hypabyssal rocks); while granite, gabbro and the other holocrystalline non-porphyritic rocks belong to the plutonic or abyssal group which cooled very slowly at great depths and under enormous pressure.

The principal subdivisions of the group are the granite-porphyries, the syenite-porphyries and the elaeolite-porphyries. In all of them porphyritic orthoclase or alkali felspar is the characteristic mineral. The granite-porphyries and quartz-porphyries (*q.v.*) consist mainly of orthoclase, quartz and ferro-magnesian mineral, usually biotite but sometimes hornblende, augite or enstatite.

Granite-porphyries are exceedingly common in all regions where acid intrusive rocks occur. Many granite masses are surrounded by dikes of this kind, and in some cases the chilled margin of a granite consists of typical porphyry.

The syenite-porphyries, like the syenites, are less common than the granite-porphyries and granites. They are characterized by an abundance of orthoclase and a scarcity or absence of quartz. The phenocrysts are orthoclase (and oligoclase), biotite, hornblende or augite; the ground-mass is principally alkali felspar with sometimes a little quartz. In many specimens the felspars of the second generation form a mosaic of ill-shaped grains, in others they are little rectangular crystals which may have a fluxion arrangement (orthophyric type of ground-mass). Some of the rocks formerly known as orthoclase-porphyries belong to this group; others are ancient trachytic lavas (orthophyres). Closely related to the syenite-porphyries is the rhomben-porphyry of south Norway and West Africa. In these the large felspars have rhomb-shaped sections owing to their peculiar crystalline development. Olivine, augite and biotite occur in these rocks, but there is no quartz or soda-lime felspar. The porphyritic felspars contain both soda and potash and belong to anorthoclase. Rhomben-porphyries occur as dikes connected with the syenites (laurvikites of southern Norway), and many ice-borne boulders of these rocks have been found among the drift deposits of the east of England.

Elaeolite- and leucite- (syenite) porphyries form apophyses and dikes around nepheline- and leucite-syenite intrusions. The former contain porphyritic nepheline which is often weathered to soft, finely crystalline aggregates of white mica and other secondary products as in the well-known liebenerite-porphyry of Tirol and gieseckite-porphyry of Greenland. The felspars of these rocks are albite, orthoclase and anorthoclase and they often contain soda-augite and amphiboles. Elaeolite-porphyries occur along with nepheline-syenites in such districts as the Serra de Monchique, south Norway, Kola, Montreal. Allied to them are the tinguaites (so called from the Serra de Tingua, Rio de Janeiro, Brazil), which are pale green rocks with abundant alkali felspar nepheline, needles of green aegirine, and sometimes biotite and cancrinite. As a rule, however, these are not porphyritic. Some authors group the tinguaites with the aplites rather than the porphyries. Grorudites are quartz-tinguaites free from nepheline, and sölvsbergites are tinguaitic rocks in which neither quartz nor nepheline occur. The two last varieties have been described from the Christiania district in Norway, but tinguaites are known with nepheline-syenites in many parts of the world, *e.g.* Norway, Brazil, Portugal, Canada, Sweden, Greenland.

The following analyses of porphyries of different types will show the chemical composition of a few selected examples:—

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	K_2O	Na_2O	H_2O
I.	72·51	13·31	tr.	3·87	1·50	0·60	6·65	0·43	0·60
II.	67·18	16·65	0·55	2·15	1·54	2·35	2·91	4·03	0·75
III.	71·60	13·60	2·40	—	0·21	2·30	3·53	5·55	0·70
IV.	58·82	21·06	3·26	0·70	1·38	3·03	3·70	6·83	1·26
V.	45·18	23·31	6·11		1·45	4·62	11·16	5·94	1·14
VI.	54·46	19·96	2·34	3·33	0·61	2·12	8·68	2·76	5·20
VII.	75·20	12·65	1·53	0·28	0·26	0·60	4·14	5·67	0·12

I., Elvan or granite porphyry (with pinite after cordierite)—Prah sands, Cornwall. II., Granophyre—Armboth, Cumberland. III., Granophyre—Carrock Fell, Cumberland. IV., Rhomben-porphyry—Tönsterg, Norway. V., Elaeolite porphyry—Beemerville, New Jersey. VI., Tinguaite—Kola. VII., Grorudite—Assynt, Scotland.

Porphyrites.—The porphyrites as above mentioned are intrusive or hypabyssal rocks of porphyritic texture, with phenocrysts of plagioclase felspar and hornblende, biotite or augite (sometimes also quartz) in a fine ground-mass. The name has not always been used in this sense, but formerly signified rather decomposed andesitic and basaltic lavas of Carboniferous age and older. Both the red porphyry and the green porphyry of the ancients are more properly classified in this group than with the granite-porphyries, as their dominant felspar is plagioclase and they contain little or no primary quartz. Porphyrites occur as dikes which accompany masses of diorite, and are often called diorite-porphyrites; they differ from diorites in few respects except their porphyritic structure. The phenocrysts are plagioclase, often much zoned with central kernels of bytownite or labradorite and margins of oligoclase or even orthoclase. In a special group there are corroded blebs or porphyritic quartz: these rocks are called quartz-porphyrites, and are distinguished from the granite-porphyries by the scarcity or absence of orthoclase. The hornblende of the porphyrites is often green but sometimes brown, resembling that of the lamprophyres, a group from which the porphyrites are separated by their containing phenocrysts of felspar, which do not occur in normal lamprophyres. Augite, when present, is nearly always pale green; it is not so abundant as hornblende. Dark brown biotite is very common in large hexagonal plates. Muscovite and olivine are not represented in these rocks. The ground-mass is usually a crystalline aggregate of granular felspar in which plagioclase dominates, though orthoclase is rarely absent. The Alpine dike rocks known as ortlerites and suldenites are porphyrites containing much green or brown hornblende and augite; these, however, hardly require a distinctive designation. Diorite-porphyrites have almost as wide a distribution as granite-porphyries, and occur in all parts of the world where intrusions of granite and diorite have been injected; they are in fact among the commonest hypabyssal rocks.

To gabbros and norites certain types of porphyrite correspond which have the same mineral and chemical composition as the parent rocks but with a porphyritic instead of granitic structure. Gabbro-porphyrites are not numerous; or rather most of these rocks are described as porphyritic basalts and dolerites. The beerbachites are finely granular dike rocks resembling gabbros in all respects except in their being less coarsely crystalline. Norite-porphyrites have porphyritic plagioclase (labradorite usually) with hypersthene or bronzite, often altered to bastite. They accompany norite masses in Nahe (Prussia) and Tirol. They have vitreous forms which are described as andesitic-pitchstones or hypersthene-andesites.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O
I.	64·94	17·50	0·69	3·94	2·59	2·83	3·11	3·44	1·36
II.	61·58	18·84	4·68	—	6·59	2·04	1·49	4·27	1·61
III.	56·85	16·70	5·92	7·13	5·97	3·25	1·91	2·78	0·54

I, Quartz-porphyrite—Lippenhof, Schwarzwald. II., Porphyrite—Esterel, France. III., Norite-porphyrite—Klausen, Tirol.

(J. S. F.)

PORPOISE (sometimes spelled Porpus and Porpesse), a name derived from the O. Fr. *porpeis*, for *porc-peis*, *i.e.* pig-fish, Lat. *porcus*, pig, and *piscis*, fish; the mod. Fr. *marsouin* is borrowed from the Ger. *meerschwein*, although the word is commonly used by sailors to designate all the smaller cetaceans, especially those numerous species which naturalists call "dolphins," it is properly restricted to the common porpoise of the British seas (*Phocaena communis*, or *P. phocaena*).

The porpoise, when full grown, attains a length of 5 ft. or more; the dimensions of an adult female specimen from the English Channel being: length from nose to notch between the flukes of the tail, 62½ in.; from the nose to the front edge of the dorsal fin, 29 in.; height of dorsal fin, 4½ in.; length of base of dorsal fin, 8 in.; length of pectoral fin, 9¼ in.; breadth of pectoral fin, 3½ in.; breadth of tail flukes, 13 in. The head is rounded in front, and differs from that of dolphins in not having the snout produced into a distinct "beak" separated from the forehead by a groove. The under jaw projects about half an inch beyond the upper. The mouth is wide, bounded by stiff immobile lips, and curves slightly upwards at the hinder end. The eye is small, and the external ear represented by a minute aperture, scarcely larger than would be made by a pin, about 2 in. behind the eye. The dorsal fin, near the middle of the back, is low and triangular. The flippers are of moderate size, and slightly sickle-shaped. The upper-parts are dark grey or nearly black according to the light in which they are viewed and the state of moisture or otherwise of the skin; the under-parts pure white. The line of demarcation between these colours is not distinct, washes or splashes of grey encroaching upon the white on the sides, and varies somewhat in different individuals. Usually it passes from the throat (the anterior part of which, with the whole of the under jaw, is dark) above the origin of the flipper, along the middle of the flank, and descends again to the middle line before reaching the tail. Both sides of the flippers and flukes are black. The anterior edge of the dorsal fin is furnished with a row of small rounded horny spines or, rather, tubercles, of variable number. One of

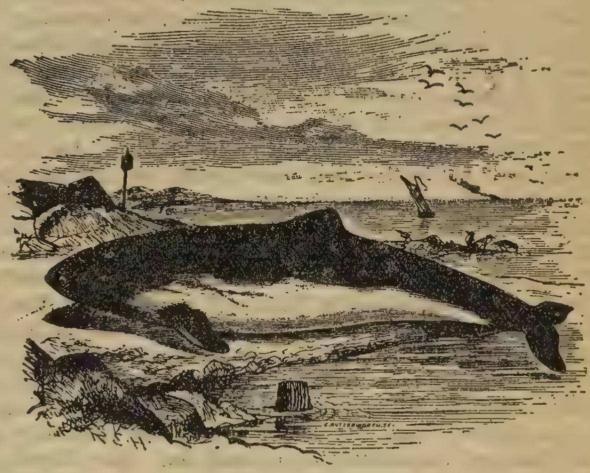


FIG. 1.—The Common Porpoise (*Phocaena communis*).

the most characteristic anatomical distinctions between the porpoise and other members of the *Delphinidae* is the form of the teeth (numbering twenty-three to twenty-six on each side of each jaw), which have expanded, flattened, spade-like crowns, with more or less marked vertical grooves, giving a tendency to a bilobed or often trilobed form (fig. 2).

The porpoise, which is sociable and gregarious, is usually seen in small herds, and frequents coasts, bays and estuaries rather than the open ocean. It is the commonest cetacean in the seas round the British Isles, and not infrequently ascends the Thames, having been seen as high as Richmond; it has also been observed in the Seine at Neuilly, near Paris. It frequents the Scandinavian coasts, entering the Baltic in the summer; and is found as far north as Baffin's Bay and as far west as the coasts of the United States. Southward its range is more limited than that of the dolphin, as, though common on the Atlantic coasts of France, it is not known to enter the Mediterranean.

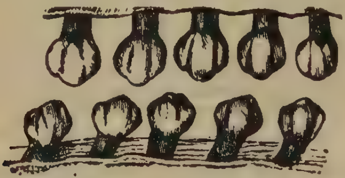


FIG. 2.—Teeth of Porpoise.

It feeds on mackerel, pilchards and herrings and, following the shoals, is often caught by fishermen in the nets along with its prey. In former times it was a common article of food in England and France, but is now rarely if ever eaten, being valuable only for the oil obtained from its blubber. Its skin is sometimes used for leather and boot-thongs, but the so-called "porpoise-hides" are generally obtained from the beluga. The Black Sea porpoise (*P. relicta*) is a distinct species. A third species, from the American coast of the North Pacific, has been described under the name of *Phocaena vomerina*, and another from the mouth of the Rio de la Plata as *P. spinipennis*. Nearly allied is *Neophocaena phocaenoides*, a small species from the Indian Ocean and Japan, with teeth of the same form as those of the porpoise, but fewer in number (eighteen to twenty on each side), of larger size, and more distinctly notched or lobed on the free edge. It is distinguished from the common porpoise externally by its black hue and the absence of a dorsal fin. (See CETACEA.) (R. L.*)

PORPORA, NICCOLA [or NICCOLÒ] **ANTONIO** (1686–1767), Italian operatic composer and teacher of singing, was born in Naples on the 19th of August 1686. He was educated at the Conservatorio di Santa Maria di Loreto. His first opera, *Basilio*, was produced at Naples; his second, *Berenice*, at Rome. Both were successful, and he followed them up by innumerable compositions of like character; but his fame rests chiefly upon his unequalled power of teaching singing. At the Conservatorio di Sant' Onofrio and the Poveri di Gesu Cristo he trained Farinelli, Caffarelli, Mingotti, Salimbeni, and other celebrated vocalists. Still his numerous engagements did not tempt him to forsake composition. In 1725 he visited Vienna, but the Emperor Charles VI. disliked his florid style, especially his constant use of the *trillo*, and refused to patronize him. After this rebuff he settled in Venice, teaching regularly in the schools of La Pietà and the Incurabili. In 1729 he was invited to London as a rival to Handel; but his visit was unfortunate. Little less disastrous was his second visit to England in 1734, when even the presence of his pupil, the great Farinelli, failed to save the dramatic company of Lincoln's Inn Fields theatre, known as the "Opera of the Nobility," from ruin. The sequence of dates and visits in Porpora's life are variously stated by different biographers. The electoral prince of Saxony and king of Poland had invited him to Dresden to become the singing master of the electoral princess, Maria Antonia, and in 1748 he is supposed to have been made Kapellmeister to the prince. Difficult relations, however, with Hasse and his wife resulted in his departure, of which the date is not known. From Dresden he is said to have gone to Vienna, where he gave lessons to Joseph Haydn (*q.v.*), and then to have returned in 1759 to Naples. From this time Porpora's career was a series of misfortunes. His last opera, *Camilla*, failed; and he became so poor that the expenses of his funeral were paid by subscription. Yet at the moment of his death in 1767 Farinelli and Caffarelli were living in splendour on fortunes for which they were largely indebted to the excellence of the old maestro's teaching. In George Sand's *Consuelo* much use is made of a romantic version of the life of young Haydn and his relations with the heroine, Porpora's pupil, and with Porpora himself. A good linguist and a man of considerable literary culture, Porpora was also celebrated for his power of repartee. His operas are, on the whole, tedious and conventional; but he produced some good work in the form of instrumental music and chamber-cantatas. A series of six Latin duets on the Passion (accessible in a modern edition published by Breitkopf and Haertel) is remarkable for dignity and beauty.

PORRIDGE (an altered form of "pottage," Fr. *potage*, soup, that which is cooked in a pot), a food made by stirring meal, especially oatmeal, in boiling water and cooking it slowly until the whole becomes soft. The dish and its name are particularly identified with Scotland; in Ireland it is commonly known as "stir-about." The former application to a broth made of vegetables or of meat and vegetables thickened with barley or other meal is obsolete, and the earlier "pottage" is the usual word employed. The form "porridge" apparently dates from the 16th century. In "porringer," a porridge-bowl, the *n* is inserted as in "passenger," "messenger."

PORSENA (or PORSENNA), **LARS**, king of Clusium in Etruria. He is said to have undertaken an expedition against Rome in order to restore the banished Tarquinius Superbus to the throne. He gained possession of the Janiculum, and was prevented from entering Rome only by the bravery of Horatius Cocles (*q.v.*). Porsena then laid siege to the city, but was so struck by the courage of Mucius Scaevola that he made peace on condition that the Romans restored the land they had taken from Veii and gave him twenty hostages. He subsequently returned both the land and the hostages (Livy, ii. 9–15; Dion. Halic., v. 21–34; Plutarch, *Poplicola*, p. 16–19). This story is probably an attempt to conceal a great disaster and to soothe the vanity of the Romans by accounts of legendary exploits. According to other authorities, the Romans were obliged to surrender the city, to acknowledge Porsena's supremacy by sending him a sceptre, a royal robe, and an ivory chair, to abandon their territory north of the Tiber, to give up their arms, and in future to use iron for agricultural purposes only. It is curious that, in spite of his military success, Porsena made no attempt to restore the Tarquinian dynasty. Hence it is suggested that the attack on Rome was merely an incident of the march of the Etruscans, driven southward by the invasion of upper Italy by the Celts, through Latium on their way to Campania. This would account for its transitory effects, and the speedy recovery of the Romans from the blow. With the departure of Porsena all traces of Etruscan sovereignty disappear and Rome is soon vigorously engaged in the prosecution of various wars (see Tacitus, *Hist.* iii. 72; Pliny, *Nat. Hist.* xxxiv. 39 [14]; Dion. Halic. v. 35, 36, vii. 5). The tomb at Chiusi described by Pliny (*Nat. Hist.* xxxvi. 19) as that of Porsena cannot have been his burial-place (see CLUSIUM).

For a critical examination of the story, see Schwegler, *Römische Geschichte*, bk. xxi. 18; Sir G. Cornewall Lewis, *Credibility of Early Roman History*, ch. xii. 5; W. Ihne, *Hist. of Rome*, vol. i.; E. Pais, *Storia di Roma*, i. ch. iv. (1898). Macaulay's *Lays of Ancient Rome* gives a dramatic version of the story.

PORSON, RICHARD (1759–1808), English classical scholar, was born on Christmas Day 1759 at East Ruston, near North Walsham, in Norfolk, the eldest son of Huggin Porson, parish clerk. His mother was the daughter of a shoemaker named Palmer, of the neighbouring village of Bacton. He was sent first to the village school at Bacton, kept by John Woodrow, and afterwards to that of Happisburgh kept by Mr Summers.

Here his extraordinary powers of memory and aptitude for arithmetic were soon discovered; his skill in penmanship, which attended him through life, was due to the care of Summers, who became early impressed with his abilities, and long afterwards stated that during fifty years of scholastic life he had never come across boys so clever as Porson and his two brothers. He was well grounded in Latin by Summers, remaining with him for three years. His father also took pains with his education, making him repeat at night the lessons he had learned in the day. He would frequently repeat without making a mistake a lesson which he had learned one or two years before and had never seen in the interval. For books he had only what his father's cottage supplied—a book or two of arithmetic, Greenwood's *England*, Jewell's *Apology*, and an odd volume of Chamber's *Cyclopaedia* picked up from a wrecked coaster, and eight or ten volumes of the *Universal Magazine*.

When Porson was eleven years old the Rev. T. Hewitt, the curate of East Ruston and two neighbouring villages, took charge of his education. Mr Hewitt taught him with his own boys, taking him through the ordinary Latin authors, Caesar, Terence, Ovid and Virgil; before this he had made such progress in mathematics as to be able to solve questions out of the *Ladies' Diary*. In addition to this Hewitt brought him under the notice of Mr Norris of Witton Park, who sent him to Cambridge and had him examined by Professor Lambert, the two tutors of Trinity, Postlethwaite and Collier, and the well-known mathematician Atwood, then assistant tutor; the result was so favourable a report of his knowledge and abilities that Mr Norris determined to provide for his education so as to fit him for the university. This was in 1773. It was found impossible to get him into Charterhouse, and he was entered on the foundation of Eton in August 1774.

Of his Eton life Porson had no very pleasant recollections, but he was popular among his schoolfellows; and two dramas he wrote for performance in the Long Chamber were remembered many years later. His marvellous memory was of course noticed; but at first he seems to have somewhat disappointed the expectations of his friends, as his composition was weak, and his ignorance of quantity kept him behind several of his inferiors. He went to Eton too late to have any chance of succeeding to a scholarship at King's College. In 1777 he suffered a great loss from the death of his patron Mr Norris; but contributions from Etonians to aid in the funds for his maintenance at the university were rapidly supplied, and he found a successor to Norris in Sir George Baker, the physician, at that time president of the college of physicians. Chiefly through his means Porson was entered at Trinity College, Cambridge, as a pensioner on the 28th of March 1778, matriculating in April. It is said that what first biassed his mind towards critical researches was the gift of a copy of Toup's *Longinus* by Dr Davies, the head master of Eton, for a good exercise; but it was Bentley and Richard Dawes to whom he looked as his immediate masters. His critical career was begun systematically while an undergraduate. He became a scholar of Trinity in 1780, won the Craven university scholarship in 1781, and took his degree of B.A. in 1782, as third senior optime, obtaining soon afterwards the first chancellor's medal for classical studies. The same year he was elected Fellow of Trinity, a very unusual thing for a junior bachelor of arts, as the junior bachelors were rarely allowed to be candidates for fellowships, a regulation which lasted from 1667 when Isaac Newton was elected till 1818 when Connop Thirlwall became a fellow. Porson graduated M.A. in 1785.

Having thus early secured his independence, he turned his thoughts to publication. The first occasion of his appearing in print was in a short notice of Schütz's *Aeschylus* in *Maty's Review*, written in 1783. This review contains several other essays by his hand; especially may be mentioned the reviews of R. F. Brunck's *Aristophanes* (containing an able summary of the poet's chief excellencies and defects), Weston's *Hermesianax*, and Huntingford's *Apology for the Monostrophics*. But it was to the tragedians, and especially to Aeschylus, that his mind was then chiefly directed. He began a correspondence with David Ruhnken, the veteran scholar of Leiden, requesting to be favoured with any fragments of Aeschylus that Ruhnken had come across in his collection of inedited lexicons and grammarians, and sending him, as a proof that he was not undertaking a task for which he was unequal, some specimens of his critical powers, and especially of his restoration of a very corrupt passage in the *Supplices* (673–677) by the help of a nearly equally corrupt passage of Plutarch's *Eroticus*. As the syndics of the Cambridge press were proposing to re-edit Thomas Stanley's *Aeschylus*, the editorship was offered to Porson; but he declined to undertake it on the conditions laid down, namely, of reprinting Stanley's corrupt text and incorporating all the variorum notes, however worthless. He was especially anxious that the Medicean MS. at Florence should be collated for the new edition, and offered to undertake the collation at an expense not greater than it would have cost if done by a person on the spot; but the syndics refused the offer, the vice-chancellor (Mr Torkington, master of Clare Hall) observing that Porson might *collect* his MSS. at home.

In 1786, a new edition of Hutchinson's *Anabasis* of Xenophon being called for, Porson was requested by the publisher to supply a few notes, which he did in conjunction with the Rev. W. Whiter, editor of the *Etymologicon universale*. These give the first specimen of that neat and terse style of Latin notes in which he was afterwards without a rival. They also show his intimate acquaintance with his two favourite authors, Plato and Athenaeus, and a familiarity with Eustathius's commentary on Homer.

In 1787 *the Notae breves ad Toupii emendationes in Suidam* were written, though they did not appear till 1790 in the new edition of Toup's book published at Oxford. These first made Porson's name known as a scholar of the first rank, and carried his fame beyond England. The letters he received from Christian G. Heyne and G. Hermann preserved in the library of Trinity College, and written before his *Euripides* was published, afford proof of this. In his notes he points out the errors of Toup and others; at the same time he speaks of Toup's book as "opus illud aureum," and states that his writing the notes at all is due to the admiration he had for it. They contain some brilliant emendations of various authors; but the necessity of having Toup's own notes with them has prevented their ever being reprinted in a separate form.

During this year, in the *Gentleman's Magazine*, he wrote the three letters on Hawkins's *Life of Johnson* which have been reprinted by Mr Kidd in his *Tracts and Criticisms of Porson*, and in a volume of Porson's *Correspondence*. They are admirable specimens of the dry humour so characteristic of the writer, and prove his intimate acquaintance with Shakespeare and the other English dramatists and poets. In the same periodical, in the course of 1788 and 1789, appeared the *Letters to Archdeacon Travis, on the spurious verse I John v. 7* (collected in 1790 into a volume), which must be considered to have settled the question. Gibbon's verdict on the book, that it was "the most acute and accurate piece of criticism since the days of Bentley," may be considered as somewhat partial, as it was in defence of him that Porson had entered the field against Travis. But in the masterly sketch of Gibbon's work and style in the preface Porson does not write in a merely flattering tone. It is to be wished that on such a subject the tone of levity had been modified. But Porson says in his preface that he could treat the subject in no other manner, if he treated it at all: "To peruse such a mass of falsehood and sophistry and to write remarks upon it, without sometimes giving way to laughter and sometimes to indignation, was, to me at least, impossible." Travis has no mercy shown him, but he certainly deserved none. One is equally struck with the thorough grasp Porson displays of his subject, the amount of his miscellaneous learning, and the humour that pervades the whole. But it was then the unpopular side: the publisher is said to have lost money by the book; and one of his early friends, Mrs Turner of Norwich, cut down a legacy she had left Porson to £30 on being told that he had written what was described to her as a book against Christianity.

During the years that followed he continued to contribute to the leading reviews, writing in the *Monthly Review* the articles on Robertson's *Parian Chronicle*, Edwards's *Plutarch*, and R. Payne Knight's *Essay on the Greek Alphabet*. He gave assistance to William Beloe in one or two articles in the *British Critick*, and probably wrote also in the *Analytical Review* and the *Critical Review*.

In 1792 his fellowship was no longer tenable by a layman; and, rather than undertake duties for which he felt himself unfit, and which involved subscription to the Articles (though he had no difficulty as to signing a statement as to his conformity with the liturgy of the Church of England when elected Greek professor), he determined not to take holy orders, which would have enabled him to remain a fellow, and thus deprived himself of his only means of subsistence. He might have been retained in the society by being appointed to a lay fellowship, one of the two permanent lay fellowships which the statutes then permitted falling vacant just in time. It is said that this had been promised him, and it was certainly the custom in the college always to appoint the senior among the existing laymen, who otherwise would vacate his fellowship. But the master (Dr Postlethwaite), who had the nomination, used his privilege to nominate a younger man (John Heys), a nephew of his own, and thus Porson was turned adrift without any means of support. A subscription was, however, got up among his friends to provide an annuity to keep him from actual want; Cracherode, Cleaver Banks, Burney and Parr took the lead, and enough was collected to produce about £100 a year. He accepted it only on the condition that he should receive the interest during his lifetime, and that the principal, placed in the hands of trustees, should be returned to the donors at his death. When this occurred they or their survivors refused to receive the money, and it was with part of this sum that, in 1816, the Porson prize was founded to perpetuate his name at Cambridge. The remainder was devoted to the foundation of the Porson scholarship in the same university. This scholarship was first awarded in 1855.

After the loss of his fellowship he continued chiefly to reside in London, having chambers in Essex Court, Temple—occasionally visiting his friends, such as Dr Goodall at Eton and Dr Samuel Parr at Hatton. It was at Dr Goodall's house that the *Letters to Travis* were written, and at one period of his life he spent a great deal of time at Hatton. While there he would generally spend his mornings in the library, and for the most part in silence; but in the evenings, especially if Parr were away, he would collect the young men of the house about him, and pour forth from memory torrents of every kind of literature. The charms of his society are described as being then irresistible.

In 1792 the Greek professorship at Cambridge became vacant by the resignation of Mr Cooke. To this Porson was elected without opposition, and he continued to hold it till his death. The duties then consisted in taking a part in the examinations for the university scholarships and classical medals. It was said he wished to give lectures; but lecturing was not in fashion in those days, and he did far more to advance the knowledge and study of the Greek language by his publications than he could have done by any amount of lecturing. It must be remembered that the emoluments of the professorship were only £40 a year. The authors on which his time was chiefly spent were the tragedians, Aristophanes, Athenaeus, and the lexicons of Suidas, Hesychius and Photius. This last he twice transcribed (the first transcript having been destroyed by a fire at Perry's house, which deprived the world of much valuable matter that he had written on the margins of his books) from the original among the Gale MSS. in the library of Trinity College. Of the brilliancy and accuracy of his emendations on Aristophanes, the fragments of the other comic poets, and the lexicographers he had a pleasing proof on one occasion when he found how often in Aristophanes he had been anticipated by Bentley, and on another when Schow's collation of the unique MS. of Hesychius appeared and proved him right in "an incredible number" of instances.

In 1795 there appeared from Foulis's press at Glasgow an edition of *Aeschylus* in folio, printed with the same types as the Glasgow *Homer*, without a word of preface or anything to give a clue to the editor. Many new readings were inserted in the text with an asterisk affixed, while an obelus was used to mark many others as corrupt. It was at once recognized as Porson's work; he had superintended the printing of a small edition in two vols. 8vo, but this was kept back by the printer and not issued till 1806, still without the editor's name. There are corrections of many more passages in this edition than in the folio; and, though the text cannot be considered as what would have gone forth if with his name and sanction, yet more is done for the text of Aeschylus than had been accomplished by any preceding editor. It has formed the substratum for all subsequent editions. It was printed from a copy of Pauw's edition corrected, which is preserved in the library of Trinity College.

Soon after this, in 1797, appeared the first instalment of what was intended to be a complete edition of Euripides—an edition of the *Hecuba*.

In the preface he pointed out the correct method of writing several words previously incorrectly written, and gave some specimens of his powers on the subject of Greek metres. The notes are very short, almost entirely critical; but so great a range of learning, combined with such felicity of emendation whenever a corrupt passage was encountered, is displayed that there was never any doubt as to the quarter whence the new edition had proceeded. He avoided the office of interpreter in his notes, which may well be wondered at on recollecting how admirably he did translate when he condescended to that branch of an editor's duties.

His work, however, did not escape attack; Gilbert Wakefield had already published a *Tragoediarum delectus*; and, conceiving himself to be slighted, as there was no mention of his labours in the new *Hecuba*, he wrote a "diatribe extemporalis" against it, a tract which for bad taste, bad Latin and bad criticism it would not be easy to match. Gottfried Hermann of Leipzig, then a very young man, who had also written a work on Greek metres, which Dr Elmsley has styled "a book of which too much ill cannot easily be said," issued an edition of the *Hecuba*, in which Porson's theories were openly attacked. Porson at first took no notice of either, but went on quietly with his Euripides, publishing the *Orestes* in 1798, the *Phoenissae* in 1799 and the *Medea* in 1801, the last printed at the Cambridge press, and with the editor's name on the title-page. But there are many allusions to his antagonists in the notes on such points as the final ν, the use of accents, &c.; and on v. 675 of the *Medea* he holds up Hermann by name to scorn in caustic and taunting language. And it is more than probable that to Hermann's attack we owe the most perfect of his works, the supplement to the preface to the *Hecuba*, prefixed to the second edition published at Cambridge in 1802. The metrical laws promulgated are laid down clearly, illustrated with an ample number of examples, and those that militate against them brought together and corrected, so that what had been beyond the reach of the ablest scholars of preceding times is made clear to the tyro. The laws of the iambic metre are fully explained, and the theory of the pause stated and proved, which had been only alluded to in the first edition. A third edition of the *Hecuba* appeared in 1808, and he left corrected copies of the other plays, of which new editions appeared soon after his death; but these four plays were all that was accomplished of the projected edition of the poet. Porson lived six years after the second edition of the *Hecuba* was published, but his natural indolence and procrastination led him to put off the work. He found time, however, to execute his collation of the Harleian MS. of the *Odyssey*, published in the Grenville *Homer* in 1801, and to present to the Society of Antiquaries his wonderful conjectural restoration of the Rosetta stone.

In 1806, when the London Institution was founded (then in the Old Jewry, since removed to Finsbury Circus), he was appointed principal librarian with a salary of £200 a year and a suite of rooms; and thus his latter years were made easy as far as money was concerned.

Among his most intimate friends was Perry, the editor of the *Morning Chronicle*; and this friendship was cemented by his marriage with Perry's sister, Mrs Lunan, in November 1796. The marriage was a happy one for the short time it lasted, as Porson became more attentive to times and seasons, and would have been weaned from his habits of drinking; but she sank in a decline a few months after her marriage (April 12, 1797), and he returned to his chambers in the Temple and his old habits. Perry's friendship was of great value to him in many ways; but it induced him to spend too much of his time in writing for the *Morning Chronicle*; indeed he was even accused of "giving up to Perry what was meant for mankind," and the existence of some of the papers he wrote there can be only deplored.

For some months before his death he had appeared to be failing: his memory was not what it had been, and he had some symptoms of intermittent fever; but on the 19th of September 1808 he was seized in the street with a fit of apoplexy, and after partially recovering sank in the 25th of that month at the age of forty-nine. He was buried in Trinity College, close to the statue of Newton, at the opposite end of the chapel to where rest the remains of Bentley.

In learning Porson was superior to Valckenaer, in accuracy to Bentley. It must be remembered that in his day the science of comparative philology had scarcely any existence; even the comparative value of MSS. was scarcely considered in editing an ancient author. With many editors MSS. were treated as of much the same value, whether they were really from the hand of a trustworthy scribe, or what Bentley calls "scrub manuscripts," or "scoundrel copies." Thus, if we are to find fault with Porson's way of editing, it is that he does not make sufficient difference between the MSS. he uses, or point out the relative value of the early copies whether in MS. or print. Thus he collates minutely Lascaris's edition of the *Medea*, mentioning even misprints in the text, rather from its rarity and costliness than from its intrinsic value. And his wonderful quickness at emendation has sometimes led him into error, which greater investigation into MSS. would have avoided; thus, in his note on Eur., *Phoem.* 1373 an error, perhaps a misprint (*κε* for *με*), in the first edition of the scholiast on Sophocles has led him into an emendation of v. 339 of the *Trachiniae* which clearly will not stand. But his most brilliant emendations, such as some of those on Athenaeus, on the *Supplices* of Aeschylus, or, to take one single instance, that on Eur. *Helen.* 751 (*οὐδ' Ἕλενος* for *οὐδέν γε*; see Maltby's *Thesaurus*, p. 299), are such as convince the reader of their absolute certainty; and this power was possessed by Porson to a degree no one else has ever attained. No doubt his mathematical training had something to do with this; frequently the process may be seen by which the truth has been reached.

A few words are called for on his general character. No one ever more loved truth for its own sake; few have sacrificed more rather than violate their consciences, and this at a time when a high standard in this respect was not common. In spite of his failings, few have had warmer friends; no one more willingly communicated his knowledge and gave help to others; scarcely a book appeared in his time or for some years after his death on the subjects to which he devoted his life without acknowledging assistance from him. And, if it be remembered that his life was a continued struggle against poverty and slight and ill-health, rather than complain that he did little, we should wonder how he accomplished so much.

His library was divided into two parts, one of which was sold by auction; the other, containing the transcript of the Gale Photius, his books with MS. notes, and some letters from foreign scholars, was bought by Trinity College for 1000 guineas. His notebooks were found to contain, in the words of Bishop Blomfield, "a rich treasure of criticism in every branch of classical literature—everything carefully and correctly written and sometimes rewritten—quite fit to meet the public eye, without any diminution or addition." They have been carefully rearranged, and illustrate among other things his extraordinary penmanship and power of minute and accurate writing. Much remains unpublished. J. H. Monk, his successor as Greek professor, and C. J. Blomfield (both afterwards bishops) edited the *Adversaria*, consisting of the notes on Athenaeus and the Greek poets, and his prelection on Euripides; P. P. Dobree, afterwards Greek professor, the notes on Aristophanes and the lexicon of Photius. Besides these, from other sources, Professor T. Gaisford edited his notes on Pausanias and Suidas, and Mr Kidd collected his scattered reviews. And, when Bishop Burgess attacked his literary character on the score of his *Letters to Travis*, Professor Turton (afterwards Bishop of Ely) came forward with a vindication.

The chief sources for Porson's life will be found in the memoirs in the *Gentleman's Magazine* for September and October 1808, and other periodicals of the time (mostly reprinted in Barker's *Porsoniana*, London, 1852); Dr Young's memoir in former editions of the *Ency. Brit.* (reprinted ibid. and in his works); Weston's (utterly worthless) *Short Account of the late Mr Richard Porson* (London, 1808; reissued with a new preface and title-page in 1814); Dr Clarke's narrative of his last illness and death (London, 1808; reprinted in the *Classical Journal*); Kidd's "Imperfect Outline of the Life of R.P.," prefixed to his collection of the *Tracts and Criticisms*; Beloe's *Sexagenarian* (not trustworthy), vol. i. (London, 1817); Barker's *Parriana*, vol. ii. (London, 1829); Maltby's "Porsoniana," published by Dyce in the volume of *Recollections of the Table-Talk of Samuel Rogers* (London, 1856); a life in the *Cambridge Essays* for 1857 by H. R. Luard; and a lengthy life by J. S. Watson (London, 1861). See also R. C. Jebb in *Dict. Nat. Biog.*, and J. E. Sandys, *History of Classical Scholarship*, ii. 424–430 (with copy of portrait by Hoppner; 1908).

The dates of Porson's published works are as follows: *Notae in Xenophontis anabasin* (1786); Appendix to Toup (1790); *Letters to Travis* (1790); *Aeschylus* (1795, 1806); *Euripides* (1797–1802); collation of the Harleian MS. of the *Odyssey* (1801); *Adversaria* (Monk and Blomfield, 1812); *Tracts and Criticisms* (Kidd, 1815); *Aristophanica* (Dobree, 1820); *Notae in Pausaniam* (Gaisford, 1820); *Photii lexicon* (Dobree, 1822); *Notae in Suidam* (Gaisford, 1834); *Correspondence* (Luard, edited for the Cambridge Antiquarian Society, 1867). Dr. Turton's vindication appeared in 1827.

(H. R. L.; J. E. S.*)

PORT. (1) (From the Lat. *portus*, harbour), a place to which ships may resort for the unloading or taking in of cargo, or for shelter, a harbour, also a town possessing such a harbour, a "seaport," or "seaport town," especially one where customhouse officers are stationed. As the name of a dark red Portuguese wine, the word is a shortened form of Oporto, *i.e.* the port, the chief centre of the wine-shipping trade of Portugal (see Wine). (2) (Through the Fr. *porte*, from Lat. *porta*, gate), an entrance or opening, not often used in the sense of gate, except in such compounds as "sallyport," cf. "portcullis," and in the derivative "porter," a keeper of a door or gate, especially of a public building, hotel, college, &c. The most general use of the word is for an opening for the admission of light and air in a ship's side, and formerly in ships of war for an embrasure for cannon, a "port-hole." For the application of the word to the left side of a ship, taking the place of the earlier "larboard," and its disputed origin, see Starboard and Larboard. (3) (Through the Fr. *porter*, from Lat. *portare*, to carry, bear), properly outward bearing or deportment, whence "portly," originally of dignified or majestic bearing, now chiefly used in the sense of stout or corpulent. The verb "to port" is only used as a military term "to port arms," *i.e.* to hold the rifle across and close to the body, the barrel being placed opposite to the left shoulder. Derivatives are "port-fire" (Fr. *porte-feu*), a fuse for firing rockets, &c., and formerly for the discharge of artillery, and "porter," *i.e.* one who carries a burden, particularly a servant of a railway company, hotel, &c., who carries passengers' luggage to and from a station, &c. The term "porter" has been applied, since the 18th century, to a particular form of beer, dark brown or almost black in colour (see Beer and Brewing). The finer kinds of this beer are generally now known as "stout." The name is almost certainly due to the fact that it was from the first a favourite drink among the London "porters," the street carriers of goods, luggage, &c., and in early uses the drink is called porter's ale, porter's beer, or porter-beer.

PORT ADELAIDE, a port of Adelaide county, South Australia, 7½ m. by rail N.W. of Adelaide. Pop. of the town and suburbs (1901), 20,089. It is situated on an estuary 9 m. from St Vincent Gulf and is the principal shipping port of South Australia. Its wharves, equipped with steam and travelling cranes, and tramways, are 2½ m. in extent; it has docks and a number of patent slips capable of taking up vessels of 300 to 1500 tons. There are also piers at Semaphore and Larg's Bay, on the other side of Lefevre's Peninsula some 2 m. distant, which are connected with Port Adelaide by rail. The industries comprise silver and copper smelting, brewing, sawmilling, ropemaking, flourmilling, sugar-refining and yacht-building. The harbour is protected by two forts known as the Fort Glanville batteries. The suburbs, which are connected with the town by tramways, are Alberton, Queenstown, Yatala, Rosewater and Kingston-on-the-Hill.

PORTADOWN, a market town of county Armagh, Ireland, on the river Bann and the Great Northern railway, 25 m. W.S.W. of Belfast. Pop. (1901), 10,092. It is a junction of lines from Dublin, Clones and Omagh. The Bann, which is connected with the Newry Canal and falls into Lough Neagh 5 m. north of the town, is navigable for vessels of 90 tons burden. It is crossed at Portadown by a stone bridge of seven arches, originally built in 1764, but since then re-erected. The manufacture of linen and cotton is carried on, and there is a considerable trade in pork, grain and farm produce. In the reign of Charles I. the manor was bestowed on John Obyns, who erected a mansion and a few houses, which were the beginning of the town. A grain-market was established in 1780. The town is governed by an urban district council.

PORTAELS, JEAN FRANÇOIS (1818–1895), Belgian painter, was born at Vilvorde (Brabant), in Belgium, on the 30th of April 1818. His father, a rich brewer, sent him to study in the Brussels Academy, and the director, François Navez, ere long received him as a pupil in his own studio. About 1841 Portaels went to Paris, where he was kindly received by Paul Delaroche. Having returned to Belgium, he carried off the Grand Prix de Rome in 1842. He then travelled through Italy, Greece, Morocco, Algeria, Egypt, the Lebanon, Judaea, Spain, Hungary and Norway. On his return to Belgium in 1847 Portaels succeeded H. Vanderhaert as director of the academy at Ghent. In 1849 he married the daughter of his first master, Navez, and in 1850 settled at Brussels; but as he failed in obtaining the post of director of the academy there, and wished, nevertheless, to carry on the educational work begun by his father-in-law, he opened a private studio-school, which became of great importance in the development of Belgian art. He again made several journeys, spending some time in Morocco; he came back to Brussels in 1874, and in 1878 obtained the directorship of the academy which had so long been the object of his ambition. Portaels executed a vast number of works. Decorative paintings in the church of St Jacques-sur-Caudenberg; biblical scenes, such as "The Daughter of Sion Reviled" (in the Brussels Gallery), "The Death of Judas," "The Magi travelling to Bethlehem," "Judith's Prayer," and "The Drought in Judaea"; genre pictures, among which are "A Box in the Theatre at Budapest" (Brussels Gallery), portraits of officials and of the fashionable world, Oriental scenes and, above all, pictures of fancy female figures and of exotic life. "His works are in general full of a facile grace, of which he is perhaps too lavish," wrote Théophile Gautier. Yet his pleasing and abundant productions as a painter do not constitute Portaels's crowning merit. The high place his name will fill in the history of contemporary Belgian art is due to his influence as a learned and clear-sighted instructor, who formed, among many others, the painters E. Wauters and E. Agneesens, the sculptor Ch. van der Stappen, and the architect Licot. He died at Brussels on the 8th of February 1895.

See E. L. de Taeye, *Peintres belges contemporains*; J. du Jardin, *L'Art flamand*. (F. K.*)

PORTAGE, a city and the county-seat of Columbia county, Wisconsin, U.S.A., on the Wisconsin river, about 85 m. N.W. of Milwaukee. Pop. (1890) 5143; (1900) 5459, of whom 1184 were foreign-born; (1910 U.S. census) 5440. It is served by the Chicago, Milwaukee & St Paul, and the Minneapolis, St Paul & Sault Ste Marie railways. The city is situated at the west end of the government ship canal connecting the Fox and Wisconsin rivers, and river steamboats ply during the open season between Portage and Green Bay and intermediate points in the Fox River Valley, Portage being the head of navigation on the Fox. Portage is in the midst of a fertile farming region, and has a trade in farm and dairy products and tobacco. Its manufactures include brick, tile, lumber, flour, pickles, knit goods, steel tanks and marine engines and launches, and there are several tobacco warehouses and grain elevators. As the Fox and Wisconsin rivers are here only 2 m. apart, these rivers were the early means of communication between Lake Michigan and the Mississippi river. The first Europeans known to have visited the site of the city were Radisson and Groseilliers, who crossed the portage in 1655. The portage was used by Marquette and Joliet on their way to the Mississippi in 1673, and a red granite monument commemorates their passage. About 1712 the Fox Indians disputed the passage of the portage, precipitating hostilities which continued intermittently until 1743. The first settler was Lawrence Barth, who engaged in the carrying trade here in 1793. Jacques Vieau established a trading post here in 1797, and by 1820 it was a thriving dépôt of the fur trade. During the Red Bird uprising (1827) a temporary military post was established by Major William Whistler of the U.S. army. Fort Winnebago was begun in the following year, was remodelled and completed by Lieut. Jefferson Davis in 1832, and was subsequently abandoned. It was from there in the same year that the final and successful campaign against Black Hawk was begun. After several failures the Fox-Wisconsin canal was completed in 1856, and in June of that year the "Aquila," a stern-wheeler, passed through the canal on its way from Pittsburg to Green Bay. The shifting channel of the Wisconsin has retarded navigation, and the canal has never been as important commercially as was expected.

PORTAGE LA PRAIRIE, a port of entry and the chief town of Portage la Prairie county, Manitoba, Canada, situated 50 m. W. of Winnipeg, on the Canadian Pacific and Canadian Northern railways, at an altitude of 854 ft. above the sea. Pop. (1901), 3901. It is in the midst of a fine agricultural district, into which several branch railways extend, and carries on a large export trade in grain and other farm produce.

PORTALEGRE, an episcopal city, capital of the district of Portalegre, Portugal; 8 m. N. of Portalegre station, on the Lisbon-Badajoz-Madrid railway. Pop. (1900), 11,820. Portalegre is the Roman *Amaea* or *Ammaia*, and numerous Roman and prehistoric remains have been discovered in the neighbourhood. The principal buildings are the cathedral, the ruined Moorish citadel and two more modern forts. The administrative district of Portalegre, in which the rearing of swine, the production of grain, wine and oil, and the manufacture of woollen and cotton goods and corks are the principal industries, coincides with the northern part of the ancient province of Alemtejo (*q.v.*). Pop. (1900), 124,443; area, 2405 sq. m.

PORTALIS, JEAN ÉTIENNE MARIE (1746–1807), French jurist, came of a bourgeois family, and was born at Bausset in Provence on the 1st of April 1746. He was educated by the Oratorians at their schools in Toulon and Marseilles, and then went to the university of Aix; while a student there he published his first two works, *Observations sur Émile* in 1763 and *Des Préjugés* in 1764. In 1765 he became an *avocat* at the parlement of Aix, and soon obtained so great a reputation that he was instructed by the duc de Choiseul in 1770 to draw up the decree authorizing the marriage of Protestants. From 1778 to 1781 he was one of the four assessors or administrators of Provence. In November 1793, after the republic had been proclaimed, he came to Paris and was thrown into prison, being the brother-in-law of Joseph Jérôme Siméon, the leader of the Federalists in Provence. He was soon removed through the influence of B. de V. Barère to a *maison de santé*, where he remained till the fall of Robespierre. On being released he practised as a lawyer in Paris; and in 1795 he was elected by the capital to the Conseil des Anciens, becoming a leader of the moderate party opposed to the directory. As a leader of the moderates he was proscribed at the *coup d'état* of Fructidor, but, unlike General Charles Pichegru and the marquis de Barbé-Marbois, he managed to escape to Switzerland, and did not return till Bonaparte became First Consul. Bonaparte made him a *conseiller d'état* in 1800, and then charged him, with F. D. Tronchet, Bigot de Préameneu, and Jacques de Maleville, to draw up the *Code Civil*. Of this commission he was the most industrious member, and many of the most important titles, notably those on marriage and heirship, are his work. In 1801 he was placed in charge of the department of *cultes* or public worship, and in that capacity had the chief share in drawing up the provisions of the Concordat. In 1803 he became a member of the Institute, in 1804 minister of public worship, and in 1805 a knight grand cross of the Legion of Honour. He soon after became totally blind; and after an operation he died at Paris on the 25th of August 1807.

The work of Portalis appears in the *Code Napoléon*, but see also Frederick Portalis's *Documents, rapports, et travaux inédits sur le Code Civil* (1844) and *Sur le Concordat* (1845); for his life, see the biography in the edition of his *Oeuvres* by F. Portalis (1823) and René Lavolée, *Portalis, sa vie et ses œuvres*, (Paris, 1869).

His son, JOSEPH MARIE PORTALIS (1778–1858), entered the diplomatic service, and obtaining the favour of Louis XVIII. filled many important offices. He was under-secretary of state for the ministry of justice, first president of the court of cassation, minister for foreign affairs, and in 1851 a member of the senate.

PORTARLINGTON, a market town situated partly in King's county but chiefly in Queen's county, Ireland, on both banks of the river Barrow, here the county boundary. Pop. (1901), 1943. The railway station, a mile south of the town, is an important junction, 42 m. west by south from Dublin, of the Great Southern & Western system, where the branch line to Athlone leaves the main line. Monthly fairs are held, and there is considerable local trade. After the revocation of the edict of Nantes a colony of French refugees was established here in the reign of William III., and the beautiful church of St Paul (rebuilt in 1857) was devoted to their use, services being conducted in the French language, for which reason the church is still spoken of as the "French Church." The former name of the town was Cooltetoodera, but on the property passing into the hands of Lord Arlington in the reign of Charles II. the name was changed. Emo Park, 5 m. south of the town, is the fine demesne of the earls of Portarlington, a title granted to the family of Dawson in 1785. An obelisk on Spire Hill near the town is one of the many famine relief works in Ireland. On the river, close to the town, there are picturesque remains of Lea Castle, originally built *c.* 1260. Portarlington was incorporated in 1667, and was a parliamentary borough both before the Union and after, its representation in the imperial parliament (by one member) being merged in that of the county by the Redistribution Act of 1885.

PORT ARTHUR (formerly Prince Arthur's Landing), a town and harbour in Thunder Bay District, Ontario, Canada, on Lake Superior, and the Canadian Pacific, Grand Trunk Pacific, and Canadian Northern railways, and the lake terminus of the two latter. Pop. (1901), 3214. The lake terminus of the Canadian Pacific, originally here, has been moved to Fort William, 4 m. distant. Lumber and minerals are shipped from the surrounding district, and vast quantities of grain from the farther west.

PORT ARTHUR (Chinese, *Lu-shun-k'ou*), a fortress situated at the extreme south of the peninsula of Liao-tung in the Chinese principality of Manchuria. It was formerly a Chinese naval arsenal and fortress, but was captured by the Japanese in 1894, who destroyed most of the defensive works. In 1898 it was leased to Russia with the neighbouring port of Talienwan, and was gradually converted into a Russian stronghold. In 1905 the lease was transferred to Japan. The port or harbour is a natural one, entirely landlocked except to the south. The basin inside is of limited extent. Barren and rocky hills rise from the water's edge all round. A railway 270 m. long connects the port with Mukden and the trans-Siberian line; there is also railway connexion with Pekin. The harbour is ice-free all the year round, a feature in which it contrasts favourably with Vladivostok.

The Liao-tung peninsula, separated from Korea by the Bay of Korea, and from the Chinese mainland by the Gulf of Liao-tung, runs in a south-westerly direction from the mainland of Manchuria, and is continued by a group of small islands which reach another peninsula projecting from the mainland of China in a north-easterly direction, and having at its north-eastern extremity the port of Wei-hai-wei. The Liao-tung peninsula is indented by several bays, two of which nearly meet, making an isthmus less than 2 m. wide, beyond which the peninsula slightly widens again, this part of it having the name of Kan-tun (regent's sword). Two wide bays open on the eastern shore of the latter: Lu-shun-k'ou (Port Arthur) and Talienwan. Both were leased to Russia. Lu-shun-k'ou Bay is nearly 4 m. long and 1¼ m. wide, the entrance being only 350 yds. wide. The Chinese deepened the bay artificially and erected quays. The roadstead is exposed to south-easterly winds, and in this respect the wider Bay of Talienwan is safer. Coal is found near to the port. The climate is very mild, and similar to that of south Crimea, only moister.

While in occupation by the Russians Port Arthur became Europeanized. The military port, Tairen, is a few miles to the north. During the Russo-Japanese war the Japanese assailed Port Arthur both by land and sea and, after repeated assaults, on the 1st of January 1905, General Stoessel surrendered the citadel into the hands of the Japanese.

PORTAS, or PORTUARY, a breviary (*q.v.*) of such convenient size that it could be carried on the person, whence its Latin name *portiforium* (*portare*, to carry, *foris*, out of doors, abroad). The English word was adapted from the Old French *portehors*, and took a large number of forms, *e.g. porthors*, *porteous*, *portes*, &c. In Scots law, the "porteous-roll" was the name given formerly to a list of criminals drawn up by the justice-clerk on information given by the local authorities, together with the names of witnesses, and charges made.

PORTATIVE ORGAN, a small medieval organ carried by the performer, who manipulated the bellows with one hand and fingered the keys with the other. This small instrument was necessarily made as simple as possible. On a small rectangular wind chest or reservoir, fed by means of a single bellows placed at the back, in front, or at the right side, were arranged the pipes —one, two or three to a note—supported by more or less ornamental uprights and an oblique bar. The most primitive style of keyboard consisted merely of sliders pushed in to make the note sound and restored to their normal position by a horn spring; the reverse action was also in use, the keys being furnished with knobs or handles.

Towards the middle of the 13th century the portatives represented in the miniatures of illuminated MSS. first show signs of a real keyboard with balanced keys, as in the 13th century Spanish MS., known as the Cantigas de Santa Maria,[1] containing four full pages of miniatures of instrumentalists, fifty-one in number. From the position of the performer's thumb it is evident that the keys are pressed down to make the notes sound. There are nine pipes and the same number of keys, sufficient for the diatonic octave of C major with the B flat added. The pipes put into these small organs were flue pipes, their intonation must have been very unstable owing to the irregularity of the wind supply fed by a single bellows, the pressure being at the mercy of the performer's hand. Increased pressure in pipes with fixed mouthpieces, such as organ pipes, produces a rise in pitch. These medieval portative organs, so extensively used during the 14th and 15th centuries, were revivals of those used by the Romans, of which a specimen excavated at Pompeii in 1876 is preserved in the Museum at Naples. The case measures 14½ in. by 9⅓ in. and contains nine pipes, of which the longest measures but 9¾ in.; six of the pipes have oblong holes at a short distance from the top similar to those made in *gamba* pipes of modern organs to give them their reedy quality, and also to those cut in the bamboo pipes of the Chinese Cheng, which is a primitive organ furnished with free reeds. From the description of these remains by C. F. Abdy Williams,[2] it would seem that a bronze plate 11½ in. by 2¾ in. having 18 rectangular slits arranged in three rows to form vandykes was found inside the case, with three little plates of bronze just wide enough to pass through the slits lying by it; this plate possibly formed part of the mechanism for the sliders of the keys. The small instrument often taken for a syrinx on a contorniate of Sallust in the Cabinet Impérial de France in Paris may be meant for a miniature portative. (K. S.)

PORT AUGUSTA, a seaport of Frome county, South Australia, on the east shore of Spencer Gulf, 259 m. by rail N.N.W. of Adelaide. Pop. about 2400. It has a fine natural deep and landlocked harbour, and the government wharves have berthing for large vessels. The chief exports are wool, wheat, flour, copper, hides and tallow. Port Augusta is the seat of a Roman Catholic bishop and has a cathedral, while its town-hall is the finest in the state, that of Adelaide excepted. It is also the starting point of the Great Northern railway. The largest ostrich farm in Australia lies 8 m. from the town. The neighbourhood is rich in minerals, copper, silver, iron and coal have been found, and in 1900 valuable gold quartz reefs were discovered at Tarcoola.

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[1] For a reproduction see J. F. Riaño, *Studies of Early Spanish Music*, pp. 119-127 (London, 1887).

[2] *Quarterly Musical Review* (August, 1893).

PORT AU PRINCE (originally *L'Hôpital*, and for brief periods *Port Henri* and *Port Républicain*), the capital of the republic of Haiti, West Indies, situated at the apex of the triangular bay which strikes inland for about 100 m. between the two great peninsulas of the west coast, with its upper recesses protected by the beautiful island of Gonaives (30 m. long by 2 broad). The city is admirably situated on ground that soon begins to rise rapidly towards the hills. It was originally laid out by the French on a regular plan with streets of good width running north and south and intersected by others at right angles. Everything has been allowed to fall into disorder and disrepair, and to this its public buildings form no exception. Every few years whole quarters of the town are burned down, but the people go on building the same slight wooden houses, with only here and there a more substantial warehouse in brick. In spite of the old French aqueduct the water-supply is defective. From June to September the heat is excessive, reaching 95° to 99° F. in the shade. The population, mostly negroes and mulattoes, is estimated at 61,000. Port au Prince was first laid out by M. de la Cuza in 1749. In 1751, and again in 1770, it was destroyed by earthquakes.

PORT BLAIR, the chief place in the convict settlement of the Andaman Islands in the Indian Ocean, situated on the south-east shore of the South Andaman Island, in 11° 42′ N., 93° E. It derives its name from Lieut. Blair, R.N., who first occupied it in 1789, as a station for the suppression of piracy and the protection of shipwrecked crews. Abandoned on account of sickness in 1796, it was not again occupied until 1856. It possesses one of the best harbours in Asia, while its central position in the Bay of Bengal gives it immense advantage as a place of naval rendezvous. (See ANDAMAN ISLANDS.)

PORT CHESTER, a village of Westchester county, New York, U.S.A., in the south-east part of the state, on Long Island Sound, and about 10 m. N.E. of New York City (26 m. from the Grand Central Station). Pop. (1900), 7440, of whom 2110 were foreign-born; (1910 census), 12,809. It is served by the New York, New Haven & Hartford railroad, and by daily steamers to and from New York City. The village is a summer resort as well as a suburban residential district for New York City. Among its public institutions are a library, a park and a hospital. The village has various manufactures, including bolts and nuts, motors for racing boats and automobiles; there are also large planing and wood-moulding mills. The earliest mention of Port Chester in any extant record is in the year 1732. Until 1837 it was known as Saw Pit, on account of a portion of the village, it is said, being used as a place for building boats. During the War of Independence the village was frequently occupied by detachments of American troops. Port Chester was incorporated as a village in 1868.

PORTCULLIS (from the Fr. *porte-coulisse*, *porte*, a gate, Lat. *porta*, and *coulisse*, a groove, used adjectivally for "sliding," from *couler*, to slide or glide, Lat. *colare*; the Fr. equivalents are *herse*, a harrow, and *coulisse*; Ger. *Fallgatter*; Ital. *saracinesca*), a strong-framed grating of oak, the lower points shod with iron, and sometimes entirely made of metal, hung so as to slide up and down in grooves with counterbalances, and intended to protect the gateways of castles, &c. The defenders having opened the gates and lowered the portcullis, could send arrows and darts through the gratings. A portcullis was in existence until modern times in a gateway at York. The Romans used the portcullis in the defence of gateways. It was called *cataracta* from the Gr. *καταρράκτης*, a waterfall (*καταρρήγνυσθαι*, to fall down). Vegetius (*De re milit.* iv. 4) speaks of it as an old means of defence, and it has been suggested that in Psalm xxiv. 7, 9, "Lift up your heads, oh ye gates," &c., there is an allusion to a similar contrivance. Remains of a *cataracta* are clearly seen in the gateway of Pompeii. The Italian name *saracinesca* originates from the crusades. (See GATE.)

PORTE, THE SUBLIME (Arab. *babi-'ali*, the high gate, through the French translation *la sublime porte*), in Turkey, the official name for the government, derived from the high gate giving access to the building where the offices of the principal state departments are situated.

PORT ELIZABETH, a seaport of the Cape province, South Africa, in Algoa Bay, by which name the port is often designated. It lies in 35° 57′ S., 25° 37′ E. on the east side of Cape Recife, being by sea 436 m. from Cape Town and 384 m. from Durban. In size and importance it is second only to Cape Town among the towns of the province. It is built partly along the seashore and partly on the slopes and top of the hills that rise some 200 ft. above the bay. The Baaken's River, usually a small stream, but subject (as in 1908) to disastrous floods, runs through the town, which consists of four divisions; the harbour and business quarter at the foot of the cliffs, the upper part, a flat table-land known as "The Hill"; "The Valley" formed by the Baaken's River; and "South Hill," east of the river.

The Town.—Jetty Street leads from the north jetty to the market square, in or around which are grouped the chief public buildings —the town-hall, court-house, post office, market buildings, public library, St Mary's church (Anglican) and St Augustine's (Roman Catholic). Several of these buildings are of considerable architectural merit and fine elevation. The library, of Elizabethan design, contains some 45,000 volumes. The market buildings, at the south-east corner of the square, and partly excavated from the sides of the cliff, contain large halls for the fruit, wool and feather markets and the museum. Feather-Market Hall, where are held the sales of ostrich feathers, seats 5000 persons. The museum has valuable ethnographical and zoological collections. Other public buildings include a synagogue and a Hindu temple. Leading west from Market Square is Main Street, in which are the principal business houses. Between Main Street and the sea is Strand Street, also a busy commercial thoroughfare. Behind the lower town streets rise in terraces to "The Hill," a residential district. Here is an open plot of ground, Donkin Reserve, containing the lighthouse and a stone pyramid with an inscription in memory of Elizabeth, wife of Sir Rufane Donkin, described as "one of the most perfect of human beings, who has given her name to the town below." A fountain, surmounted by the statue of a war-horse, erected by public subscription in 1905 commemorates "the services of the gallant animals which perished in the Anglo-Boer war, 1899–1902." Farther west is a large hospital, one of the finest institutions of its kind in South Africa. At the southern end of The Hill is St George's Park, which has some fine trees, in marked contrast to the general treeless, barren aspect of the town. Port Elizabeth indeed possesses few natural amenities, but its golf links are reputed the finest in South Africa. The town, apart from its transit trade and the industries connected therewith, has some manufactures—jam and confectionery works; oil, candle and explosive works; saw and flour mills; tanneries, &c. It has an excellent water supply.

The Harbour.—There is no enclosed basin, but the roadstead has excellent holding ground, protected from all winds except the south-east, the prevailing wind being westerly. No harbour or light dues are charged to vessels of any flag. The port has three jetties of wrought iron, respectively 1162, 1152 and 1462 ft. in length, extending to the four fathoms line. These jetties are provided with hydraulic cranes, &c., and railways connect them with the main line, so that goods can be sent direct from the jetties to every part of South Africa. In favourable weather vessels drawing up to 21 ft. can discharge cargo alongside the jetties. In unfavourable conditions and for larger steamers tugs and lighters are employed. Rough weather prevents discharge of cargo by lighters, on an average, seven days in the year. The customs-house and principal railway station are close to the north jetty. The port is state owned, and is under the administration of the harbour and railway board of the Union.

Trade.—Port Elizabeth has a large import trade, chiefly in textiles, machinery, hardware, apparel and provisions, supplying to a considerable extent the markets of Kimberley, Rhodesia, the Orange Free State and the Transvaal. The exports are mainly the products of the eastern part of the Cape province, the most important being ostrich feathers, wool and mohair. Skins, hides and maize are also exported. In 1855 the value of the imports was £376,000; in 1883 £2,364,000; in 1898 £6,248,000; in 1903 £10,137,000. Depression in trade brought down the imports in 1904 to £6,855,000. In 1906 they were £6,564,000 and in 1907 £6,004,000. The export trade has been of slower but more steady growth. It was valued at £584,000 in 1855, at £2,341,000 in 1883, £2,103,000 in 1898, £2,010,000 in 1903. Indicative of the fact that the agricultural community was little affected by the trade depression are the export figures for 1904 and 1906, which were £2,044,000 and £2,627,000 respectively. In 1907 goods valued at £3,150,000 were exported.

Population.—The population within the municipal area was at the 1904 census 32,959; that within the district of Port Elizabeth 46,626, of whom 23,782 were whites. Many of the inhabitants are of German origin and the Deutsche Liedertafel is one of the most popular clubs in the town.

History.—Algoa Bay was discovered by Bartholomew Diaz in 1488, and was by him named Bahia da Roca, probably with reference to the rocky islet in the bay, on which he is stated to have erected a cross (St Croix Island). After the middle of the 16th century the bay was called by the Portuguese Bahia da Lagoa, whence its modern designation. In 1754 the Dutch settlements at the Cape were extended eastwards as far as Algoa Bay. The convenience of reaching the eastern district by boat was then recognized and advantage taken of the roadstead sheltered by Cape Recife. In 1799, during the first occupation of Cape Colony by the British, Colonel (afterwards General Sir John) Vandeleur, to guard the roadstead, built a small fort on the hill west of the Baaken's River. It was named Fort Frederick in honour of the then duke of York, and is still preserved. A few houses grew up round the fort, and in 1820 besides the military there was a civilian population at Fort Frederick of about 35 persons. In April of that year arrived in the bay the first of some 4000 British immigrants, who settled in the eastern district of the colony (See CAPE COLONY: *History*). Under the supervision of Sir Rufane Donkin, acting governor of the Cape, a town was laid out at the base of the hills. In 1836 it was made a free warehousing port, and in 1837 the capital of a small adjacent district. To overcome the difficulty of landing from the roadstead a breakwater was built at the mouth of the Baakens River in 1856, but it had to be removed in 1869, as it caused a serious accumulation of sand. The prosperity which followed the construction of railways to the interior earned for the port the designation of "the Liverpool of South Africa." Railway work was begun in 1873 and Port Elizabeth is now in direct communication with all other parts of South Africa. At the same period (1873) the building of the existing jetties was undertaken. Port Elizabeth has possessed municipal government since 1836. Its predominant British character is shown by the fact that not until 1909 was the foundation stone laid of the first Dutch Reformed Church in the town.

PORTEOUS, JOHN (d. 1736), captain of the city guard of Edinburgh, whose name is associated with the celebrated riots of 1736, was the son of Stephen Porteous, an Edinburgh tailor. Having served in the army, he was employed in 1715 to drill the city guard for the defence of Edinburgh in anticipation of a Jacobite rising, and was promoted later to the command of the force. In 1736 a smuggler named Wilson, who had won popularity by helping a companion to escape from the Tolbooth prison, was hanged; and, some slight disturbance occurring at the execution, the city guard fired on the mob, killing a few and wounding a considerable number of persons. Porteous, who was said to have fired at the people with his own hand, was brought to trial and sentenced to death. The granting of a reprieve was hotly resented by the people of Edinburgh, and on the night of the 7th of September 1736 an armed body of men in disguise broke into the prison, seized Porteous, and hanged him on a signpost in the street. It was said that persons of high position were concerned in the crime; but although the government offered rewards for the apprehension of the perpetrators, and although General Moyle wrote to the duke of Newcastle that the criminals were "well-known by many of the inhabitants of the town," no one was ever convicted of participation in the murder. The sympathies of the people, and even, it is said, of the clergy, throughout Scotland, were so unmistakably on the side of the rioters that the original stringency of the bill introduced into parliament for the punishment of the city of Edinburgh had to be reduced to the levying of a fine of £2000 for Porteous's widow, and the disqualification of the provost for holding any public office. The incident of the Porteous riots was used by Sir Walter Scott in *The Heart of Midlothian*.

See Sir Daniel Wilson, *Memorials of Edinburgh in the Olden Time* (2 vols. Edinburgh, 1848): *State Trials*, vol. xvii.; William Coxe, *Memoirs of the Life of Sir R. Walpole* (4 vols. London, 1816); Alexander Carlyle, *Autobiography* (Edinburgh, 1860), which gives the account of an eye-witness of the execution of Wilson; pamphlets (2 vols. in British Museum) containing *The Life and Death of Captain John Porteous*, and other papers relating to the subject; W. E. H. Lecky, *History of England in the Eighteenth Century*, ii. 324, note (7 vols., London, 1892). See also Scott's notes to *The Heart of Midlothian*.

PORTER, BENJAMIN CURTIS (1843–), American artist, was born at Melrose, Massachusetts, on the 27th of August 1843. He was a pupil of A. H. Bicknell and of the Paris schools, and was elected an associate of the National Academy of Design, New York, in 1878, and a full academician in 1880. He is best known as a painter of portraits.

PORTER, DAVID (1780–1843), American naval officer, was born in Boston, Massachusetts, on the 1st of February 1780. His father, David, and his uncle, Samuel, commanded American ships in the War of Independence. In 1796 he accompanied his father to the West Indies; on a second and on a third voyage he was impressed on British vessels, from which, however, he escaped. He became a midshipman in the United States Navy in April 1798; served on the "Constellation" (Captain Thomas Truxton) and was midshipman of the foretop when the "Constellation" defeated the "Insurgente"; was promoted lieutenant in October 1799, and was in four successful actions with French ships in this year. In 1803, during the war with Tripoli, he was first lieutenant of the "Philadelphia" when that vessel grounded, was taken prisoner, and was not released until June 1805. He was commissioned master commandant in April 1806; in 1807–1810 served about New Orleans[1], where he captured several French privateers, and in 1812 was promoted captain. He commanded the frigate "Essex" in her famous voyage in 1812–1814. In the Atlantic he captured seven brigs, one ship, on the 13th of August 1812, the sloop "Alert," the first British war vessel taken in the War of 1812. Without orders from his superiors he then (February 1813) rounded Cape Horn, the harbours of the east coast of South America being closed to him. In the South Pacific he captured many British whalers (the British losses were estimated at £500,000), and on his own authority took formal possession (November 1813) of Nukahivah, the largest of the Marquesas Islands; the United States, however, never asserted any claim to the island, which in 1842, with the other Marquesas, was annexed by France. During most of February and March 1814 he was blockaded by the British frigates "Cherub" and "Phoebe" in the harbour of Valparaiso, and on the 28th of March was defeated by these vessels, which seem to have violated the neutrality of the port. He was released on parole, and sailed for New York on the "Essex, Jr.," a small vessel which he had captured from the British, and which accompanied the "Essex." At Sandy Hook he was detained by the captain of the British ship-of-war "Saturn" (who declared that Porter's parole was no longer effective), but escaped in a small boat. He was a member of the new board of naval commissioners from 1815 until 1823, when he commanded a squadron sent to the West Indies to suppress piracy. One of his officers, who landed at Fajardo (or Foxardo), Porto Rico, in pursuit of a pirate, was imprisoned by the Spanish authorities on the charge of piracy. Porter, without reporting the incident or awaiting instructions, forced the authorities to apologize. He was recalled (December 1824), was court-martialled, and was suspended for six months. In August 1826 he resigned his commission, and until 1829 was commander-in-chief of the Mexican navy, then fighting Spain; in payment for his services he received government land in Tehuantepec, where he hoped to promote an inter-oceanic canal. President Andrew Jackson appointed him consul-general to Algiers in 1830, and in 1831 created for him the post of chargé d'affaires at Constantinople, where in 1841 he became minister. He died in Pera on the 3rd of March 1843.

He wrote a *Journal of a Cruise made to the Pacific Ocean in the U.S. Frigate "Essex" in 1812–13–14* (2 vols., 1815; 2nd ed., 1822), and *Constantinople and its Environs* (2 vols., 1835), a valuable guide-book. See the *Memoir of Commodore David Porter* (Albany, New York, 1875), by his son, Admiral David D. Porter.

PORTER, DAVID DIXON (1813–1891), American naval officer, son of Captain David Porter, was born in Chester, Pennsylvania, on the 8th of June 1813. His first voyage, with his father in West Indian waters in 1823–1824, was terminated by the Fajardo affair (see Porter, David). In April 1826 he entered the Mexican navy, of which his father was commander-in-chief, and which he left in 1828, after the capture by the Spanish of the "Guerrero," on which he was serving under his cousin, David H. Porter (1804–1828), who was killed before the ship's surrender. He became a midshipman in the United States navy in 1829, and was in the coast survey in 1836–1842. In 1839 he married the daughter of Captain Daniel Tod Patterson (1786–1839), then commandant of the Washington navy-yard. Porter became a lieutenant in February 1841; served at the naval observatory in 1845–1846; in 1846 he was sent to the Dominican Republic to report on conditions there. During the Mexican War he served, from February to June 1847, as lieutenant and then as commanding officer of the "Spitfire," a paddle vessel built for use on the rivers, and took part in the bombardment of Vera Cruz and in the other naval operations under Commander M. C. Perry. From the close of the Mexican War to the beginning of the Civil War he had little but detail duty; in 1855 and again in 1856 he made trips to the Mediterranean to bring to the United States camels for army use in the south-west. In April 1861 he was assigned to the "Powhatan," and was sent under secret orders from the president for the relief of Fort Pickens, Pensacola, an expedition which he had urged. Porter was promoted commander on the 22nd of April, and on the 30th of May was sent to blockade the South-West Pass of the Mississippi. In August he left the gulf in a fruitless search for the Confederate cruiser "Sumter." Upon his return to New York in November he urged an expedition against New Orleans (*q.v.*), and recommended the appointment of Commander D. G. Farragut (*q.v.*), his foster-brother, to the chief command. In the expedition Porter himself commanded the mortar flotilla, which, when Farragut's fleet passed the forts on the early morning of the 24th of April 1862, covered its passage by a terrific bombardment that neutralized the fire of Fort Jackson. At Vicksburg Porter's bombardment assisted Farragut to run past the forts (June 28). On the 9th of July Porter was ordered, with ten mortar boats, to the James river, where McClellan's army was concentrated. On the 15th of October he took command of the gun-vessels which had been built on the upper waters of the Mississippi, and to which he made important additions at an improvised navy-yard at Mound City, Illinois. With this he took part in the capture of Arkansas Post on the 11th of January 1863. In the operations for the capture of Vicksburg in 1863 unsuccessful attempts were made in February and March by Porter's vessels to penetrate through connecting streams and bayous to the Yazoo river and reach the right rear of the Confederate defences on the bluffs. But in May the fleet ran past the Vicksburg batteries, mastered the Confederate forts at Grand Gulf, and made it possible for Grant's army to undertake the brilliant campaign which led to the fall of the place (see American Civil War and Vicksburg). Porter received the thanks of Congress for "opening the Mississippi River" and was promoted rear-admiral. He co-operated with Major-General N. P. Banks in the Red River expeditions in March-May 1864, in which his gun-boats, held above Alexandria by shallow water and rapids, narrowly escaped isolation, being enabled to return only by the help of a dam built by Lieut.-Colonel (Brigadier-General) Joseph Bailey (1827–1867). On the 12th of October 1864 he assumed command of the North Atlantic blockading squadron, then about to engage in a combined military and naval expedition against Fort Fisher, North Carolina. Porter claimed that his guns silenced Fort Fisher, but Major-General B. F. Butler, in command of the land forces, refused to assault, asserting that the fort was practically intact. After Butler's removal, Porter, co-operating with Major-General Alfred H. Terry, and commanding the largest fleet assembled at any one point during the war, took the fort on the 15th of January 1865; for this he again received the thanks of Congress. From 1865 to 1869 he was superintendent of the U.S. Naval Academy at Annapolis, which he greatly improved; his most notable change being the introduction of athletics. On the 25th of July he became vice-admiral. From the 9th of March to the 25th of June 1869, while Adolph E. Borie (1809–1880), of Pennsylvania, was secretary of the navy in President Grant's cabinet, Porter was virtually in charge of the navy department. In 1870 he succeeded Farragut in the grade of admiral, which lapsed after Porter's death until 1899, when it was re-established to reward Rear-Admiral George Dewey for his victory at Manila. Porter urged the reconstruction of the navy, which he saw begun in 1882. He died in Washington, D.C., on the 13th of February 1891.

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[1] While he was in New Orleans he adopted David Farragut, who later served with him on the "Essex."

Porter wrote a *Life of Commodore David Porter* (1875), gossipy *Incidents and Anecdotes of the Civil War* (1885), a none too accurate *History of the Navy during the War of the Rebellion* (1887), two novels, *Allan Dare and Robert le Diable* (1885; dramatized, 1887) and *Harry Marline* (1886), and a short "Romance of Gettysburg," published in *The Criterion* in 1903. See J. R. Soley, *Admiral Porter* (New York, 1903) in the "Great Commanders" Series.

Admiral Porter's three brothers were in the service of the United States: William David Porter (1809–1864) entered the navy in 1823, commanded the "Essex" on the Tennessee and the Mississippi in the Civil War, and became commodore in July 1862; Theodoric Henry Porter (1817–1846) was the first officer of the American army killed in the Mexican War; and Henry Ogden Porter (1823–1872) resigned from the United States navy in 1847, after seven years' service, fought under William Walker in Central America, returned to the American navy, was executive officer of the "Hatteras" when she was sunk by the "Alabama," and received wounds in the action from the effects of which he died several years later.

PORTER, ENDYMION (1587–1649), English royalist, descended from Sir William Porter, sergeant-at-arms to Henry VII., and son of Edmund Porter, of Aston-sub-Edge in Gloucestershire, by his cousin Angela, daughter of Giles Porter of Mickleton, in the same county, was brought up in Spain—where he had relatives—as page in the household of Olivares. He afterwards entered successively the service of Edward Villiers and of Buckingham, and through the latter's recommendation became groom of the bedchamber to Charles I. In October 1622 he was sent to negotiate concerning the affairs of the Palatinate and the marriage with the Infanta. He accompanied Charles and Buckingham on their foolhardy expedition in 1623, acted as their interpreter, and was included in the consequent attack made by Lord Bristol on Buckingham in 1626. In 1628 he was employed as envoy to Spain to negotiate for peace, and in 1634 on a mission to the Netherlands to the Infante Ferdinand. During the Civil War Porter remained a constant and faithful servant of the king. He was with him during the two Scottish campaigns, attended him again on the visit to Scotland in August 1641, and followed Charles on his last departure from London in 1642, receiving the nominal command of a regiment, and sitting in the Royalist parliament at Oxford in 1643. He had, however, little faith in the king's measures. "His Majesty's businesses," he writes in 1641, "run in their wonted channel—subtle designs of gaining the popular opinion and weak executions for the upholding of monarchy." His fidelity to Charles was of a personal, not of a political nature. "My duty and loyalty have taught me to follow my king," he declares, "and by the grace of God nothing shall divert me from it." This devotion to the king, the fact that he was the agent and protégé of Buckingham, and that his wife Olivia, daughter of John, Lord Boteler of Bramfield, and niece of Buckingham, was a zealous Roman Catholic, drew upon him the hostility of the opposite faction. As member of the Long Parliament, in which he sat as member for Droitwich, he was one of the minority of 59 who voted against Strafford's attainder, and was in consequence proclaimed a "betrayer of his country." On the 15th of February 1642 he was voted one of the dangerous counsellors, and specially excepted from pardon on the 4th of October and in the treaties of peace negotiated subsequently, while on the 10th of March 1643 he was excluded from parliament. Porter was also implicated in the army plot; he assisted Glamorgan in illegally putting the great seal to the commission to negotiate with the Irish in 1644; and was charged with having in the same manner affixed the great seal of Scotland, then temporarily in his keeping, to that of O'Neill in 1641, and of having incurred some responsibility for the Irish rebellion. Towards the end of 1645, when the king's cause was finally lost, Porter abandoned England, and resided successively in France, Brussels, where he was reduced to great poverty, and the Netherlands. The property which he had accumulated during the tenure of his various appointments, by successful commercial undertakings and by favours of the court, was now for the most part either confiscated or encumbered. He returned to England in 1649, after the king's death, and was allowed to compound for what remained of it. He died shortly afterwards, and was buried on the 20th of August 1649 at St Martin's-in-the-Fields, leaving as a special charge in his will to his sons and descendants to "observe and respect the family of my Lord Duke of Buckingham, deceased, to whom I owe all the happiness I had in the world." He left five sons, who all played conspicuous, if not all creditable, parts in the history of the time. According to Wood, Porter was "beloved by two kings: James I. for his admirable wit and Charles I. for his general bearing, brave style, sweet temper, great experience, travels and modern languages." During the period of his prosperity Porter had gained a great reputation in the world of art and letters. He wrote verses, was a generous patron of Davenant, who especially sings his praises, of Dekker, Warmstrey, May, Herrick and Robert Dover, and was included among the 84 "essentials" in Bolton's "Academy Royal." He was a judicious collector of pictures, and as the friend of Rubens, Van Dyck, Mytens and other painters, and as agent for Charles in his purchases abroad he had a considerable share in forming the king's magnificent collection. He was also instrumental in procuring the Arundel pictures from Spain. The authorship of Εἰκὼν πιστή, 1649, a vindication of the Εἰκὼν βασιλική, has been attributed with some reason to Porter.

AUTHORITIES.—*Life and Letters of Endymion Porter*, by D. Townshend (1897); article in the *Dict. of Nat. Biog.*, by C. H. Firth and authorities there cited; *Memoires*, by D. Lloyd (1668), p.657; Burton's *Hist. of Scotland* (1873), vi. 346–347; *Eng. Hist. Rev.* ii. 531, 692; Gardiner's *Hist. of England; Lives of the Lords Strangford* (1877), by E. B. de Fonblanque (Life and Letters); Wood, *Athenae Oxonienses;* Clarendon's *History of the Rebellion; State Papers and Calendar of State Papers*; *Calendar of State Papers: Dom.* and of *Committee for Compounding*; *The Chesters of Chichele*, by Waters, i. 144–149; *Eikon Basilike*, by Ed. Almack, p. 94. There are also various references, &c., to Endymion Porter in *Additional Charters*, British Museum, 6223, 1633, 6225; *Add. MSS.* 15,858; 33, 374; and *Egerton* 2550, 2533; in the *Hist. MSS. Comm. Series; MSS. of Duke of Portland, &c.*, and in *Notes and Queries*; also *Thomason Tracts*, Brit. Mus., E 118 (13).

PORTER, FITZ-JOHN (1822–1901), American soldier, was born at Portsmouth, New Hampshire, on the 31st of August 1822. He was the son of a naval officer, and nephew of David Porter of the frigate "Essex." He graduated at the United States Military Academy in 1845 and was assigned to the artillery. In the Mexican War he won two brevets for gallantry—that of captain for Molino del Rey and that of major for Chapultepec. He served at West Point as instructor and adjutant (1849–1855), and he took part in the Utah expedition. At the outbreak of the Civil War in 1861 he was employed on staff duties in the eastern states, and rendered great assistance in the organization of Pennsylvanian volunteers. In the absence of higher authority Porter sanctioned on his own responsibility the request of Missouri Unionists for permission to raise troops, a step which had an important influence upon the struggle for the possession of the state. He became colonel of a new regiment of regulars on the 14th of May, and soon afterwards brigadier-general of volunteers. Under McClellan he commanded a division of infantry in the Peninsular campaign, and directed the Union siege operations against Yorktown, and he was soon afterwards placed in command of the V. army corps. When the Seven Days' battle (*q.v.*) began Porter's corps had to sustain alone the full weight of the Confederate attack, and though defeated in the desperately fought battle of Gaines's Mill (June 27, 1862) the steadiness of his defence was so conspicuous that he was immediately promoted major-general of volunteers and brevet brigadier-general U.S.A. His corps, moreover, had the greatest share in the successful battles of Glendale and Malvern Hill. Soon afterwards, with other units of the Army of the Potomac, the V. corps was sent to reinforce Pope in central Virginia. Its inaction on the first day of the disastrous second battle of Bull Run (*q.v.*) led to the general's subsequent disgrace; but it made a splendid fight on the second day to save the army from complete rout, and subsequently shared in the Antietam campaign. On the same day on which McClellan was relieved from his command, Porter, his warm friend and supporter, was suspended. A few days later he was tried by court-martial on charges brought against him by Pope, and on the 21st of January 1863 was sentenced to be cashiered "and for ever disqualified from holding any office of trust under the government of the United States." After many years Porter's friends succeeded (1878) in procuring a revision of the case by a board of distinguished general officers. This board reported strongly in Porter's favour, but at the time the remission of the disqualifying penalty was all that was obtained in the way of redress. General Grant had now taken Porter's part, and wrote an article in vol. 135 of the *North American Review* entitled "An Undeserved Stigma." Against much opposition, partly political (1879–1886) and a veto on a legal point from President Arthur, a relief bill finally passed Congress, and Porter was on the 5th of August 1886 restored to the United States army as colonel and placed on the retired list, no provision, however, being made for compensation. After the Civil War General Porter was engaged in business in New York, and later held successively many important municipal offices. In 1869 he declined the offer made by the khedive of the chief command of the Egyptian army. He died on the 21st of May 1901, at Morristown, New Jersey.

See, besides General Grant's article, Cox, *The Second Battle of Bull Run as connected with the Porter Case* (Cincinnati, 1882); Lord, *A Summary of the Case of F. J. Porter* (1883), and papers in vol. ii. of the publications of the Military Historical Society of Massachusetts.

PORTER, HENRY (*fl.* 1596–1599), English dramatist, author of *The Two Angry Women of Abingdon*, may probably be identified with the Henry Porter who matriculated at Brasenose College, Oxford, on the 19th of June 1589, and is described as aged sixteen and the son of a gentleman of London. From 1596 to 1599 he was engaged in writing plays for Henslowe for the admiral's men, and his closest associate seems to have been Henry Chettle. The earlier entries in Henslowe's *Diary* are respectful in tone, and the considerable sums paid to "Mr Porter" prove that his plays were popular. Henslowe secured in February 1599 the sole rights of any play in which Porter had a hand, the consideration being an advance of forty shillings. As time goes on he is familiarly referred to as "Harry Porter"; his borrowings become more frequent, and the sums less, until on the 16th of April 1599 he obtained a loan of twelve pence in exchange for a bond to pay all he owed to Henslowe—twenty-five shillings—on pain of forfeiting ten pounds. Whether he paid or not does not appear, but his last loan is recorded on the 26th of May 1599, after which nothing further is known of him. It seems in the highest degree unlikely that he is the Henry Porter who took his degree as Mus. Bac. at Christ Church in 1600 after twelve years' study, and whose skill in sacred music is celebrated in an epigram by John Weever. The entries in Henslowe's *Diary* indicate that he wrote a play called *Love Prevented* (1598), *Hot Anger soon Cold*, with Chettle and Ben Jonson (1598), the second part of *The Two Angry Women of Abingdon* (1598), *The Four Merry Women of Abingdon* (1599), and *The Spencers* (1599), with Chettle. None of these are extant, unless, as has been suggested, *Love Prevented* is another name for *The Pleasant History of the two angry women of Abingdon. With the humorous mirth of Dick Coomes and Nicholas Proverbes, two serving men* (1599), the importance of which is well described by Professor Gayley: "As a comedy of unadulterated native flavour, breathing rural life and manners and the modern spirit, constructed with knowledge of the stage, and without affectation or constraint, it has no foregoing analogue except perhaps *The Pinner of Wakefield.* No play preceding or contemporary yields an easier conversational prose, not even the *Merry Wives*."

Alexander Dyce edited the *Angry Women* for the Percy Society in 1841; and it is included in W. C. Hazlitt's edition of Dodsley's *Old Plays* (1874). It was edited by Havelock Ellis in *Nero and other plays* (1888, "Mermaid Series,") and in *Representative English Comedies* (1903), with an introduction by the general editor, Professor C. M. Gayley.

PORTER, HORACE (1837–   ), American diplomatist and soldier, was born in Huntingdon, Pennsylvania, on the 15th of April 1837; son of David Rittenhouse Porter (1788–1867), governor of Pennsylvania in 1839–1845, and grandson of Andrew Porter (1743–1813), an officer in the Continental Army during the War of Independence, and surveyor-general of Pennsylvania from 1809 until his death. Horace Porter studied for a year (1854) at the Lawrence scientific school of Harvard University, and then entered the United States Military Academy, where he graduated in 1860, third in his class. During the Civil War he was chief of ordnance at the capture of Fort Pulaski; then served in the Army of the Potomac until after Antietam; was transferred to the west, where he took part in the battles of Chickamauga (for gallantry in which he received a congressional medal of honour in June 1902) and Chattanooga; and in April 1864 became aide-de-camp to General Grant, in which position he served until March 1869. He earned the brevet of captain at Fort Pulaski, that of major at the battle of the Wilderness, and that of lieutenant-colonel at New Market Heights, and in March 1865 was breveted colonel and brigadier-general. From August 1867 to January 1868, while General Grant was secretary of war *ad interim*, Porter was an assistant secretary, and from March 1869 to January 1873, when Grant was president, Porter was his executive secretary. He resigned from the army in December 1873, when he became vice-president of the Pullman Palace Car Company and held other business positions. From March 1897 to May 1905 he was United States ambassador to France. At his personal expense he conducted (1899–1905) a successful search for the body of John Paul Jones,[1] who had died in Paris in 1792. For this he received (May 9, 1906) a unanimous vote of thanks of both Houses of Congress, and the privileges of the floor for life. In 1907 he was a member of the American delegation to the Hague Peace Conference. General Porter became well-known as a public speaker, and delivered orations at the dedication of General Grant's tomb in New York, at the centennial of the founding of West Point, and at the re-interment of the body of John Paul Jones at Annapolis. His publications include *West Point Life* (1866) and *Campaigning with Grant* (1897).

PORTER, JANE (1776–1850), British novelist, daughter of an army surgeon, was born at Durham in 1776. Her life and reputation are closely linked with those of her sister, ANNA MARIA PORTER (1780–1832), novelist, and her brother, SIR ROBERT KER PORTER (1775–1842), painter and traveller. After their father's death, in 1779, the mother removed from Durham, their birthplace, to Edinburgh, where the children's love of romance was stimulated by their association with Flora Macdonald and the young Walter Scott. Mrs Porter moved to London, so that her son might study art, and the sisters subsequently resided at Thames Ditton and at Esher with their mother until her death in 1831. Anna Maria Porter published *Artless Tales* in 1793–1795, the first of a long series of works of which the more noteworthy are *Walsh Colville* (1797), *Octavia* (1798), *The Lake of Killarney* (1804), *A Sailor's Friendship and a Soldier's Love* (1805), *The Hungarian Brothers* (1807), *Don Sebastian* (1809), *Ballads, Romances and other Poems* (1811), *The Recluse of Norway* (1814), *The Knight of St John* (1817), *The Fast of St Magdalen* (1818), *The Village of Mariendorpt* (1821), *Roche Blanche* (1822), *Honor O'Hara* (1826) and *Barony* (1830). Jane Porter—whose intellectual power, though slower in development and in expression, was greater than her sister's—had in the meantime gained immediate popularity by her first work, *Thaddeus of Warsaw* (1803), which was translated into several languages and procured her election as canoness of the Teutonic order of St Joachim. In 1810, four years before the appearance of *Waverley*, she attempted national romance in her *Scottish Chiefs*. The story of Wallace had been a favourite one in her childhood, and she was probably well acquainted with the poem of Blind Harry (Henry the Minstrel). Although the book lacked historical accuracy, and the figure of Wallace is a sentimental conception of the least convincing kind, the picturesque power of narration displayed by Miss Porter has saved the story from the oblivion which has overtaken the works of most of Scott's predecessors in historical fiction. Her later works included *The Pastor's Fireside* (1815), *Duke Christian of Lüneburg* (1824), *Coming Out* (1828) and *The Field of Forty Footsteps* (1828). In conjunction with her sister she published in 1826 the *Tales round a Winter Hearth.* She also wrote some plays, and frequent contributions to current periodical literature. *Sir Edward Seaward's Diary* (1831) was asserted by Miss Porter to be founded on documents placed in her hands by the author's family, but is generally regarded as pure fiction. The claim of her eldest brother, Dr William Ogilvie Porter, to its authorship rests on a memorial inscription in Bristol Cathedral, written by Jane. On the 21st of September 1832 Anna Maria died, and for the next ten years Jane became "a wanderer" amongst her relations and friends.

Robert Ker Porter had in his own way been scarcely less successful than his sisters. After two years of study at the Royal Academy he had gained reputation as a painter of altar-pieces and battle-scenes of imposing magnitude. He went to Russia as historical painter to the emperor in 1804, travelled in Finland and Sweden, where he received knighthood from Gustavus IV. in 1806, and accompanied Sir John Moore to Spain in 1808. In 1811 he returned to Russia and married a Russian princess. He was knighted by the Prince Regent in 1813. In 1817 he travelled to Persia by way of St Petersburg and the Caucasus, returning through Bagdad and western Asia Minor. He examined the ruins of Persepolis, making many valuable drawings and copying cuneiform inscriptions. In 1826 he became British consul in Venezuela. His services there were recognized by a knight commandership of the Order of Hanover. Accounts of his wanderings are to be found in his *Travelling Sketches in Russia and Sweden* (1808), *Letters from Portugal and Spain* (1809), *Narrative of the late Campaign in Russia* (1813), and *Travels in Georgia, Persia, Armenia, Ancient Babylonia &c., during the years 1817–1820* (1821–1822). After leaving Venezuela (1841) he again visited St Petersburg, and died there suddenly on the 4th of May 1842. Jane Porter, who had joined him in Russia, then returned to England and took up her residence with her eldest brother at Bristol, where she died on the 24th of May 1850.

PORTER, MARY (d. 1765), English actress, was brought to the attention of Betterton by Mrs Barry, who had seen her play the Fairy Queen at Bartholomew Fair. In his company she made her first appearance in 1699, in tragedy, in which she was at her best, although she also played a long list of comedy parts. When her friends, Mrs Barry, Mrs Bracegirdle and Mrs Oldfield, had retired from the stage, she was left its undisputed queen. She died on the 24th of February 1765.

PORTER, NOAH (1811–1892), American educationalist and philosophical writer, was born in Farmington, Connecticut, on the 14th of December 1811. He graduated at Yale College, 1831, and laboured as a Congregational minister in Connecticut and Massachusetts, 1836–1846. He was elected professor of moral philosophy and metaphysics at Yale in 1846, and from 1871 to 1886 he was president of the college. He edited several editions of Noah Webster's English dictionary, and wrote on education, &c. His best-known work is *The Human Intellect, with an Introduction upon Psychology and the Human Soul* (1868), comprehending a general history of philosophy, and following in part the "common-sense" philosophy of the Scottish school, while accepting the Kantian doctrine of intuition, and declaring the notion of design to be a priori. He died in New Haven on the 4th of March 1892.

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[1] See JONES, JOHN PAUL, and an article by General Porter, "The Recovery of the Body of John Paul Jones," in the *Century Magazine*, (1905), lxx. 927 sqq.

PORTEUS, BEILBY (1731–1808), bishop of London, was born at York and educated at Christ's College, Cambridge, where he became fellow in 1752. He was ordained in 1757, and in 1762 was appointed domestic chaplain to the archbishop of Canterbury. In 1767 he became rector of Lambeth, and took his D.D. degree at Cambridge, preaching on that occasion a sermon which induced John Norris (1734–1777) to found the Norrisian professorship of divinity. About two years later he was appointed chaplain to the king and master of the hospital of St Cross, Winchester. In 1776 he became bishop of Chester, and in 1787 he was translated to London. He was a supporter of the Church Missionary and the British and Foreign Bible societies, and laboured for the abolition of slavery.

Of his published works the *Review of the Life and Character of Archbishop Secker* (London, 1770), and the *Summary of the principal Evidences for the Truth and Divine Origin of the Christian Revelation* (London, 1800), have passed through numerous editions.

PORTFOLIO (shortened form of *porto folio*, adapted from the Ital. *portafogli*, *portare*, to carry, and *fogli*, sheets or leaves of paper, Lat. *folium*, leaf), a case for keeping papers, documents, prints, maps, &c., usually a leather book-cover with a flexible back. As the official documents of a state department are in the hands of the minister of that department, the word "portfolio" is frequently used figuratively of the office itself, particularly on the continent of Europe, where the "portfolio" is the symbol of office, as, in English usage, the "seals" are for the secretaryships of state. The phrase "minister without portfolio" is applied to a member of a ministry to whom no special department is assigned.

PORT GLASGOW, a municipal and police burgh and seaport of Renfrewshire, Scotland, on the southern shore of the Firth of Clyde, 20¼ m. W.N.W. of Glasgow by the Caledonian railway. Pop. (1901), 16,857. The ground behind the town rises to a height of 700 ft. and is partly occupied by villas. Amongst the principal buildings are the town house (1815), with a tower and spire; the town hall (1873); the library (1887) founded by James Moffat, a merchant of the burgh, and the Carnegie Park Orphanage, also provided from the same bequest. Birkmyre Park was opened in 1894. The industries include shipbuilding and allied trades, engineering works, and iron and brass foundries. The area of the port (which has wet and graving docks) amounts to 16 acres, and there are 2000 yds. of quayage. The harbours are accessible at all stages of the tide. The district originally formed part of the parish of Kilmalcolm, the nucleus of the town being the village of Newark attached to the barony of that name. In 1668 it was purchased from Sir Patrick Maxwell of Newark by the Glasgow magistrates, who here constructed a harbour. In 1695 it was erected into a separate parish under the name of New Port Glasgow. In 1710 it became the chief custom-house port for the Clyde, until superseded by Greenock. The graving dock made in 1762 was the first dock of the kind in Scotland. In 1775 Port Glasgow was created a burgh of barony and since 1832 has formed one of the Kilmarnock parliamentary burghs (with Kilmarnock, Dumbarton, Renfrew and Rutherglen). It is governed by a council with provost and bailies. Adjoining the town on the east are the picturesque ruins of Newark Castle, a quadrangular building dating from the end of the 16th century. Formerly the property of the Dennistouns, it now belongs to the Shaw-Stewarts.

PORTHCAWL, a seaport and urban district in the mid-parliamentary division of Glamorganshire, South Wales, 30 m. by rail W. of Cardiff and 22 m. S.E. of Swansea. Pop. (1901) 1872. The urban district (formed in 1893) is conterminous with the civil parish of Newton Nottage, which, in addition to Porthcawl proper, built on the sea-front, comprises the ancient village of Nottage, 1 m. N., and the more modern village of Newton, 1 m. N.E. of Porthcawl. The natural harbour of Newton (as it used to be called) was improved by a breakwater, and was connected by a tramway with Maesteg, whence coal and iron were brought for shipment. The tramway was converted into a railway, and in 1865 opened for passenger traffic. In 1866 a dock (7½ acres) and tidal basin (2½ acres) were constructed, but since about 1902 they have fallen into disuse and the coal is diverged to other ports, chiefly Port Talbot. Porthcawl, however, has grown in popularity as a watering-place. Situated on a slightly elevated headland facing Swansea Bay and the Bristol Channel, it has fine sands, rocks and breezy commons, on one of which, near golf links resorted to from all parts of Glamorgan, is "The Rest," a convalescent home for the working classes, completed in 1891, with accommodation for eighty persons. The climate of Porthcawl is bracing, and the rainfall (averaging 25 in.) is about the lowest on the South Wales coast. The district is described by R. D. Blackmore in his tale *The Maid of Sker* (1872), based on a legend associated with Sker House, a fine Elizabethan building in the adjoining parish of Sker, which was formerly extra-parochial. The parish church (dedicated to St John the Baptist) has a pre-Reformation stone altar and an ancient carved stone pulpit, said to be the only relic of an earlier church now covered by the sea.

PORT HOPE, a town and port of entry of Durham county, Ontario, Canada, on the north shore of Lake Ontario, 63 m. N.E. of Toronto by the Grand Trunk railway, and connected with Charlotte, the port for Rochester, New York, by a daily steamboat service. The population, 5585 in 1881, shrunk in 1901 to 4188, but is increasing owing to the popularity of the town as a summer resort. It is picturesquely situated on the side and at the foot of hills overlooking the lake; and Smith's Creek, by which it is traversed, supplies abundant water-power. Trade is carried on in lumber, grain and flour. Trinity College School, a residential school under Anglican control, has a long and creditable history.

PORT HUDSON, a village in East Baton Rouge Parish, Louisiana, U.S.A., on the left bank of the Mississippi, about 135 m. above New Orleans. At the sharp turn of the Mississippi here the Confederates in 1862 built on the commanding bluffs powerful batteries covering a stretch of about 3 m., their strongest fortifications along the Mississippi between New Orleans and Vicksburg. On the night of the 14th of March 1863 Admiral Farragut, with seven vessels, attempted to run past the batteries, commanded by Brigadier-General William M. Gardner, but four of his vessels were disabled and forced to turn back, one, the "Mississippi" was destroyed, and only two, the "Hartford" and the "Albatross" got past. General N. P. Banks's land attack, on the 27th of May, was unsuccessful, the Union loss, nearly 2000, being six times that of the Confederates. A second attack on the 14th of June, entailed a further Union loss of about 1800 men. But on the 9th of July, two days after the news of the surrender of Vicksburg, after a siege of 45 days, General Gardner surrendered the position to General Banks with about 6400 men, 50 guns, 5000 small arms and ammunition, and two river steamers. The Union losses during the siege were probably more than 4000; the Confederate losses about 800. The capture of Vicksburg and Port Hudson secured to the Union the control of the Mississippi.

PORT HURON, a city and the county-seat of Saint Clair county, Michigan, U.S.A., at the confluence of the Saint Clair and Black rivers, and at the lower end of Lake Huron, about 60 m. N.N.E. of Detroit. Pop. (1900), 19,158 of whom 7142 were foreign-born; (1910 U.S. census) 18,863. It is served by the Grand Trunk and other railways, and by steamboat lines to Chicago and other ports. A railway tunnel, 6025 ft. long, under the Saint Clair, connects the city with Sarnia, Canada. The tunnel, which has an inside diameter of 20 ft., was constructed by the Grand Trunk railway in 1889–1891 at a cost of about $2,700,000, and was designed by Joseph Hobson (b. 1834). Port Huron is laid out with wide streets, on both sides of the Black river and along the shore of Lake Huron; it has attractive parks and mineral water springs, and is a summer resort. Among its buildings are the court house, the city hall, and a Modern Maccabee Temple—Port Huron being the headquarters of the Knights of the Modern Maccabees (1881), a fraternal society which, in 1910, had a membership of 107,737. Until 1908 Port Huron was the headquarters of the Knights of the Maccabees of the World (founded in 1883; 283,998 members in 1910). Port Huron has large shipping interests, and since 1866 has been the port of entry of the Huron customs district. In 1908 its exports were valued at $16,958,080 and its imports at $4,859,120. The city has shipyards, dry docks, large shops of the Grand Trunk railway, publishing houses, and manufactories of agricultural implements, steel ships, automobiles, foundry products, paper and pulp, and toys. In 1904 the city's factory products were valued at $4,789,589.

In 1686 the French established Fort St Joseph, a fortified trading post, which came into the possession of the British in 1761 and was occupied by American troops in 1814. The fort was renamed Fort Gratiot in honour of General Charles Gratiot (1788–1855), who was chief-engineer in General W. H. Harrison's army in 1813–1814, and was chief-engineer of the U.S. Army in 1828–1838. The settlement which grew up round the fort, and was organized as a village in 1840, was also known as Fort Gratiot, and was annexed to Port Huron in 1893. The fort was abandoned during 1837–1848, during 1852–1866, and, permanently, in 1879. The earliest permanent settlement, in what later became Port Huron, was made in 1790 by several French families. This settlement, distinct from that at the fort, was first called La Rivière De Lude, and, after 1828, Desmond. It was platted in 1835, incorporated as a village in 1840 (under its present name), and chartered as a city in 1857.

PORTICI, a town of Campania, Italy, in the province of Naples, 5 m. S.E. of Naples by rail, on the shores of the bay, and at the foot of Vesuvius. Pop. (1901), 14,239. The palace, erected in 1738, is traversed by the high road. It once contained the antiquities from Herculaneum, now removed to Naples, and since 1882 it has been a government school of agriculture. There is a small harbour. Just beyond Portici, on the south east, is Resina (pop, in 1901, 20,182), on the site of the ancient Herculaneum, with several fine modern villas. The inhabitants are engaged in fishing, silk-growing and silk-weaving. The town was completely destroyed by the eruption of Vesuvius in 1631.

PORTICO (Ital. for "porch," Lat. *porticus*), a term in architecture for the covered entrance porch to a building, which is carried by columns, and either constitutes the whole front of the building, as in the Greek and Roman temples, or forms an important feature, as the portico of the Pantheon at Rome attached to the rotunda. A circular projecting portico, such as those to the north and south transepts of St Paul's Cathedral, and that which forms the west entrance of St Mary le Strand, is known as cyclostyle. The term *porticus* is used to distinguish the entrance portico in an amphiprostylar or peripteral temple from that behind which is called the *posticum.*

PORTIÈRE, a hanging placed over a door, as its French name implies, or over the doorless entrance to a room. From the East, where doors are still rare, it came to Europe at a remote date—it is known to have been in use in the West in the 14th century, and was probably introduced much earlier. Like so many other domestic plenishings, it reached England by way of France, where it appears to have been originally called *rideau de porte.* It is still extensively used either as an ornament or as a means of mitigating draughts. It is usually of some heavy material, such as velvet, brocade, or plush, and is often fixed upon a brass arm, moving in a socket with the opening and closing of the door.

PORT JACKSON, or SYDNEY HARBOUR, a harbour of New South Wales, Australia. It is one of the safest and most beautiful harbours in the world; its area, including all its bays, is about 15 sq. m., with a shore line of 165 m.; it has deep water in every part, and is landlocked and secure in all weathers. The entrance, between two rocky promontories known as North and South Heads, is 2¼ m. wide between the outer heads, and narrows down to 1 m. 256 yds. The port is flanked on both sides by promontories, so that, in addition to a broad and deep central channel, there is a series of sheltered bays with good anchorage. Sydney lies on the southern shore about 4 m. from the Heads. Port Jackson is the chief naval dépôt of Australasia, the headquarters of the admiral's station, and is strongly fortified. The harbour has a number of islands, most of which are used for naval or government purposes—Shark Island is the quarantine station, Garden Island has naval foundries, hospital and stores, Goat Island is occupied by a powder magazine, Spectacle Island is used to store explosives, and on Cockatoo Island are important government docks. Port Jackson was discovered by Captain Phillip in 1788, though in 1770 Captain Cook, when coasting north, noticed what looked like an inlet, and named it after Sir George Jackson, one of the secretaries to the Admiralty. Captain Cook passed the harbour without recognizing its capacity; but the cliffs which guard the entrance are 300 ft. high, and no view of the basin can be seen from the masthead. Middle Head, which is opposite the entrance, closes it in, and it is necessary to enter, turn to the south, and then to the west before the best part of the harbour discloses itself.

PORT JERVIS, a city of Orange county, New York, U.S.A., on the Delaware river, at its junction with the Neversink, 88 m. N.W. of New York city by rail, and at the intersection of the boundary lines of the states of New York, New Jersey and Pennsylvania. Pop. (1900), 9385, of whom 895 were foreign-born; (1910 census), 9564. It is served by the Erie and the New York, Ontario & Western railways. The beauty of the scenery in its vicinity has made the city a summer resort. At Port Jervis are situated the extensive shops of the Erie railway. Among the manufactures are wearing apparel, silk, glass, and silver ware. The value of the factory products increased from $1,009,081 in 1900 to $1,635,215 in 1905, or 62%. Port Jervis was laid out in 1826, soon after work began on the Delaware & Hudson Canal; it owes its origin to that waterway (now abandoned), and was named in honour of John Bloomfield Jervis (1795–1885), the engineer who constructed the canal, who, in 1836, was in charge of the construction of the Croton Aqueduct, and wrote *Railway Property* (1859) and *The Construction and Management of Railways* (1861). Port Jervis was incorporated as a village in 1853, and was chartered as a city in 1907.

PORTLAND, EARL OF, an English title held by the family of Weston from 1633 to 1688, and by the family of Bentinck from 1689 to 1716, when it was merged in that of duke of Portland. Sir Richard Weston (1577–1635), according to Clarendon "a gentleman of very ancient extraction by father and mother," was the son and heir of Sir Jerome Weston (*c.* 1550–1603) of Skreens, in Roxwell, Essex, his grandfather being Richard Weston (d. 1572) justice of the common pleas. A member of parliament during the reigns of James I. and Charles I., Sir Richard was sent abroad by James on two occasions to negotiate on behalf of the elector palatine Frederick V.; after the murder of the duke of Buckingham, he became the principal counsellor of Charles I. In 1628 he was created Baron Weston of Neyland and in 1633 earl of Portland. Having in 1625 and 1626 had experience in the difficult task of obtaining money for the royal needs from the House of Commons, Weston was made lord high treasurer in 1628. His own inclinations and the obstacles in the way of raising money made him an advocate of a policy of peace and neutrality. His conduct was frequently attacked in parliament, but he retained both his office and the confidence of the king until his death on the 13th of March 1635. His son Jerome, the 2nd earl (1605–1663), was imprisoned for plotting in the interests of Charles I. in 1643, and was nominally president of Munster from 1644 to 1660. He sat in the convention parliament of 1660. He was succeeded by his son Charles (1639–1665), who was killed in a sea-fight with the Dutch off the Texel, and then by his brother Thomas (1609–1688), who died in poverty at Louvain, when the title became extinct. In 1689 it was revived by William III., who bestowed it upon his favourite William Bentinck (see below.)

Sir Richard Weston must be distinguished from a contemporary and namesake, Sir Richard Weston (*c.* 1579–1652), baron of the exchequer. Another Sir Richard Weston (*c.* 1466–1542) was a courtier and a diplomatist under Henry VIII.; his son was Sir Francis Weston (*c.* 1511–1536), who was beheaded for his alleged adultery with Anne Boleyn. This Sir Richard had a brother, Sir William Weston (d. 1540), who distinguished himself at the defence of Rhodes in 1522, and was afterwards prior of the Knights of St John in England. A third Sir Richard Weston (1591–1652), was mainly reponsible for introducing locks on the Wey and thus making this river navigable.

Another family of Weston produced Robert Weston (*c.* 1515–1573), lord chancellor of Ireland from 1566 until his death on the

20th of May 1573. Other famous Westons were Stephen Weston (1665–1742) bishop of Exeter from 1724 until his death, and his son Edward Weston (1703–1770) the writer.

Much of the earl of Portland's correspondence is in the Public Record Office, London. For his political career see S. R. Gardiner, *History of England* (1883–1884), and L. von Ranke, *Englische Geschichte* (Eng. trans., Oxford, 1875).

PORTLAND, WILLIAM BENTINCK, Earl of (*c.* 1645–1709), English statesman, was born, according to the Dutch historian, Groen van Prinsterer, in 1645, although most of the other authorities give the date as 1649. The son of Henry Bentinck of Diepenheim, he was descended from an ancient and noble family of Gelderland. He became page of honour and then gentleman of the bedchamber to William, prince of Orange. When, in 1675, the prince was attacked by small-pox, Bentinck nursed him assiduously, and this devotion secured for him the special and enduring friendship of William; henceforward, by his prudence and ability, he fully justified the confidence placed in him. In 1677 he was sent to England to solicit for the prince of Orange, the hand of Mary, daughter of James duke of York, afterwards James II., and he was again in England in 1683 and in 1685. When, in 1688, William was preparing for his invasion Bentinck went to some of the German princes to secure their support, or at least their neutrality, and he was also a medium of communication between his master and his English friends. He superintended the arrangements for the expedition and sailed to England with the prince.

The revolution accomplished, Bentinck was made groom of the stole, first gentleman of the bedchamber, and a privy councillor; and in April 1689 he was created Baron Cirencester, Viscount Woodstock and earl of Portland. He commanded some cavalry at the battle of the Boyne in 1690, and was present at the battle of Landen, where he was wounded, and at the siege of Namur. But his main work was of a diplomatic nature. Having thwarted the plot to murder the king in 1696, he helped to arrange the peace of Ryswick in 1697; in 1698 he was ambassador to Paris, where he opened negotiations with Louis XIV. for a partition of the Spanish monarchy, and as William's representative, he signed the two partition treaties. Portland had, however, become very jealous of the rising influence of Arnold van Keppel, earl of Albemarle, and, in 1699, he resigned all his offices in the royal household. But he did not forfeit the esteem of the king, who continued to trust and employ him. Portland had been loaded with gifts, and this, together with the jealousy felt for him as a foreigner, made him very unpopular in England. He received 135,000 acres of land in Ireland, and only the strong opposition of a united House of Commons prevented him obtaining a large gift of crown lands in North Wales. For his share in drawing up the partition treaties he was impeached in 1701, but the case against him was not proceeded with. He was occasionally employed on public business under Anne until his death at his residence, Bulstrode in Buckinghamshire, on the 23rd of November 1709. Portland's eldest son Henry (1680–1724) succeeded as 2nd earl. He was created marquess of Titchfield and duke of Portland in 1716.

See G. Burnet, *History of My Own Time* (Oxford, 1833); Lord Macaulay, *History of England* (1854); L. von Ranke, *Englische Geschichte* (Eng. trans., Oxford, 1875); and especially Onno Klopp, *Der Fall des Hauses Stuart* (Vienna, 1875–1888). See also Dr A. W. Ward's article in vol. iv. of the *Dict. Nat. Biog.*

PORTLAND, WILLIAM HENRY CAVENDISH BENTINCK, 3rd Duke of (1738–1809), prime minister of England, son of William, 2nd duke (1709–1762), and grandson of the 1st duke. His mother, Margaret, granddaughter and heiress of John Holles, duke of Newcastle, brought to her husband Welbeck Abbey and other estates in Nottinghamshire. He was born on the 14th of April 1738, and was educated at Oxford, where he graduated M.A. in 1757. In 1761, as marquess of Titchfield, he became M.P. for the borough of Weobly (Hereford), but in May 1762 he was called to the upper house on the death of his father. Under the marquess of Rockingham he was, from July 1765 to December 1766, lord chamberlain, and on the return of Rockingham to power in April 1782 he was made lord-lieutenant of Ireland. After the short ministry of Shelburne, succeeding the death of Rockingham, the duke of Portland was selected by Fox and North as a "convenient cipher" to become the head of the coalition ministry, to the formation of which the king was with great reluctance compelled to give his assent. The duke held the premiership from the 5th of April 1783 until the defeat of the bill for "the just and efficient government of British India" caused his dismissal from office on the 17th of December following. Under Pitt he was, from 1794 to 1801, secretary of state for the home department, after which he was, from 1801 to 1805, president of the council. In 1807 he was appointed a second time prime minister and first lord of the treasury. Ill health caused him to resign in October 1809, and he died on the 30th of that month. He owed his political influence chiefly to his rank, his mild disposition, and his personal integrity, for his talents were in no sense brilliant, and he was deficient in practical energy as well as in intellectual grasp.

He married in 1766 Lady Dorothy Cavendish (1750–1794), daughter of the 4th duke of Devonshire, and was succeeded as 4th duke by his son William Henry (1768–1854), who married a daughter of the famous gambler, General John Scott, and was brother-in-law to Canning. His son, the 5th duke, William John Cavendish Bentinck-Scott (1800–1879) died unmarried. He is notable for having constructed the underground halls at Welbeck Abbey, and for his retiring habits of life, which gave occasion for some singular stories.[1] He was succeeded by his cousin William John Arthur Charles James Cavendish-Bentinck (b. 1857) as 6th duke.

PORTLAND, a seaport of Normanby county, Victoria, Australia, 250 m. by rail S.W. of Melbourne. Pop. (1901), 2185. It stands on the western shore of a magnificent bay, 24 m. long and 12 m. broad, and is the outlet for a rich agricultural and pastoral tract.

PORTLAND, the largest city of Maine, U.S.A., the county-seat of Cumberland county, and a port of entry, on Casco Bay, about 115 m. by rail N.N.E. of Boston. Pop. (1890), 36,425; (1900), 50,145, of whom 34,918 were born in Maine, 3125 in the other New England states, 4476 in Canada, and 3273 in Ireland, and 291 were negroes; (1910 census) 58,571. Portland is served by the Maine Central, the Boston & Maine, and the Grand Trunk railways; by steamboat lines to New York, Boston, Bar Harbor, Saint John, N.B., and other coast ports, and, during the winter season, by the Allan and Dominion transatlantic lines. It is connected by ferry with South Portland.

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[1] Public interest centred for some years round the allegation that he lived a double life and was identical with Mr T. C. Druce, an upholsterer of Baker Street, London, who, in 1851, married Annie May. The "Druce case," involving a claim to the title and estates, by Mrs Druce (widow of W. T. Druce, son of T. C. Druce by Annie May) on behalf of her son, aroused much attention from 1897 to 1908. The duke of Portland was undoubtedly buried in Kensal Green cemetery in 1879. "Druce," on the other hand, was supposed to have died in 1864 and been interred in Highgate cemetery, his will bequeathing over £70,000 in personal estate. Mrs Druce's claims had two aspects, both as involving the revocation of probate of T. C. Druce's will, and also as identifying Druce with the duke of Portland. But her application to have the grave in Highgate opened (with the object of showing that the coffin there was empty), though granted by Dr Tristram, chancellor of the diocese of London, was thwarted by a *caveat* being entered on the part of the executor of T. C. Druce's will; and the case became the subject of constant proceedings in the law-courts without result. Meanwhile it was discovered that children of T. C. Druce by a former wife were living in Australia, and Mrs Druce's claims fell into the background, the case being taken up independently by Mr G. H. Druce as the representative of this family, from 1903 onwards. A company to finance his case was formed in 1905, and in the autumn of 1907 he instituted a charge of perjury against Mr Herbert Druce, T. C. Druce's younger son and executor, for having sworn that he had seen his father die in 1864. Sensational evidence of a mock burial was given by an American witness named Caldwell, and others; but eventually it was agreed that the grave at Highgate should be opened. This was done on December the 30th, and the body of Mr T. C. Druce was then found in the coffin. The charge of perjury at once collapsed and was withdrawn on January 6th, the opening of the grave definitely putting an end to the story of an identity between the two men.

The hilly peninsula, to which Portland was confined until the annexation of the town of Deering in 1899, is nearly 3 m. in length by about ¾ m. in average width; at its east end is Munjoy Hill, 160 ft. above the sea, and its west end Bramhall Hill, 15 ft. higher. Portland's total land area is about 21½ sq. m. The scenery in and about the city is noted for its picturesqueness, and this, with its delightful summer climate and historic interest, attracts a large number of visitors during the summer season. Munjoy Hill commands a fine view of Casco Bay, which is overlooked by other wooded heights. There is excellent yachting in the bay, which contains many beautiful islands, such as Peaks and Cushing's islands. Bramhall Hill commands an extensive view west and north-west of the bay, the mainland, and the White Mountains some 80 m. distant.

The city's park system includes the Western Promenade, on Bramhall Hill; the Eastern Promenade, on Munjoy Hill; Fort Allen Park, at the south extremity of the latter promenade; Fort Sumner, another small park farther west, on the same hill; Lincoln Park, containing 2½ acres of beautiful grounds near the centre of the city; Deering's Oaks (made famous by Longfellow), the principal park (50 acres) on the peninsula, with many fine old trees, pleasant drives, and an artificial pond used for boating; and Monument Square and Boothby Square. There are many pleasant drives along the shore of the bay or the banks of rivers, and some of these lead to popular resorts, such as Riverton Park, on the Presumpscot; Cape Cottage Park, at the mouth of the harbour; and Falmouth Foreside, bordering the inner bay.

The streets of Portland are generally well paved, are unusually clean, and, in the residence districts, where the fire of 1866 did not extend, they are profusely shaded by elms and other large trees—Portland has been called the "Forest City." Congress Street, the principal thoroughfare, extends along the middle of the peninsula north-east and south-west and from one end of it to the other, passing in the middle of its course through the shopping district.

In Portland's architecture, both public and private, there is much that is excellent; and there are a number of buildings of historic interest. The Post Office, at the corner of Exchange and Middle streets, is of white Vermont marble and has a Corinthian portico. The granite Customs House, extending from Fore Street to Commercial Street, is large and massive. The Public Library building is Romanesque and elaborately ornamented; the building was presented to the city by James P. Baxter; in the library is the statue, by Benjamin Paul Akers (1825–1861), of the dead pearl-diver, well known from Hawthorne's description in *The Marble Faun.* The Cumberland County Court House, of white Maine granite, occupies the block bounded by Federal, Pearl, Church and Newbury streets; immediately opposite (to the south-west) is the Federal Court building, also of Maine granite. The Portland Observatory, on Munjoy Hill, erected in 1807 to detect approaching vessels, rises 222 ft. above tide-water. In Monument Square, the site of a battery in 1775 is a soldiers' and sailors' monument (1889), a tall granite pedestal surmounted by a bronze female figure, by Franklin Simmons; at the corner of State Street is a statue of Henry W. Longfellow by the same sculptor; and where Congress Street crosses the Eastern Promenade, a monument to the first settlers, George Cleeve and Richard Tucker. On the Western Promenade there is a monument to Thomas Brackett Reed, who was a native and a resident of Portland. On Congress Street, below the Observatory, is the Eastern Cemetery, the oldest burying ground of the city; in it are the graves of Commodore Edward Preble, and of Captain Samuel Blythe (1784–1813) and Captain William Burroughs (1785–1813), who were killed in the engagement between the British brig "Boxer" and the American brig "Enterprise," their respective ships, off this coast on the 5th of September 1813. The cemetery also contains monuments to Alonzo P. Stinson, the first soldier from Portland killed in the Civil War, to the Portland soldiers in the War of Independence, and to Rear-Admiral James Alden (1810–1877), of the U.S. Navy, a native of Portland. Among the churches are the Cathedral of the Immaculate Conception (Roman Catholic), with a spire 236 ft. high, and St Luke's (Protestant Episcopal) Cathedral. In the Williston Church (Congregational), in Thomas Street, the Young People's Society of Christian Endeavor was founded in 1881 by the Rev. Francis E. Clark, then pastor of the church. The finest residence district is on Bramhall Hill. Many houses, especially in State, Danforth and Congress streets, are simple in style and old-fashioned in architecture. Of special interest to visitors is the Wadsworth-Longfellow House—the early home of Henry W. Longfellow—which was built in 1785–1786 by General Peleg Wadsworth (1748–1829), a soldier of the War of Independence, a representative in Congress from 1793 to 1807, and the grandfather of the poet; was given by Longfellow's sister, Mrs Anne Longfellow Pierce (1810–1901) to the Maine Historical Society; and contains interesting relics of the Wadsworth and Longfellow families, and especially of the poet himself. Behind the "Home" is the Library of the Maine Historical Society. The birthplace of Longfellow is now a tenement house at the corner of Fore and Hancock streets, near the Grand Trunk railway station.

In Portland, as in Bangor, the Maine Music Festival (begun in 1897) is held every year in October, three concerts being given by a chorus composed of local choruses trained in different cities of the state for the festival.

Among the institutions are: The Medical School of Maine, the medical department of Bowdoin College—instruction being given here during the last two years of the course; Westbrook Seminary (chartered in 1831, and empowered to grant degrees in 1863); the Public Library, containing (1910) 65,000 vols.; the Library of the Maine Historical Society (30,000 vols.); the Mechanics' Library, the Greenleaf Law Library, the Maine General Hospital, and the United States Marine Hospital. The Portland Society of Natural History, founded in 1843 and incorporated in 1850, has a building (1880) containing a library and natural history collections. The city is supplied with good water from Lake Sebago, 17 m. distant.

The harbour has an artificial breakwater and extensive modern fortifications (Fort Preble, on the Cape Shore; Fort Levett, on Cushing's Island; Fort Williams, at Portland Head; and Fort McKinley, on Great Diamond Island) among the best equipped in the United States. For a long period the city was noted for its commerce with the West Indies, which began to decline about 1876, but the coast trade and commerce with Great Britain are still considerable, especially in the winter, when Portland is the outlet of much of the trade from the Great Lakes that in the other seasons passes through Montreal. The principal exports are grain, live-stock and fruit. In 1908 the exports were valued at $11,353,339 and the imports at $1,189,964. The Grand Trunk Railroad Company has here two of the largest grain warehouses on the Atlantic Coast. In 1905 Portland was the first manufacturing city of the state, with a factory product valued at $9,132,801 (as against $8,527,649 for Lewiston, which outranked Portland in 1900); here are foundries and machine-shops, planing-mills, car and railway repair shops, packing and canning establishments—probably the first Indian corn canned in the United States was canned near Portland in 1840—potteries, and factories for making boots, shoes, clothing, matches, screens, sleighs, carriages, cosmetics, &c. Ship-building and fishing are important industries.

The first permanent settlement on the peninsula was established by George Cleeve and Richard Tucker at the foot of Munjoy Hill in 1633 immediately after they had been ejected from land which they had claimed at the mouth of the Spurwink. Soon the hill at the east end became the property of George Munjoy and that at the west end the property of George Bramhall. The Indian name of the peninsula was Machegonne, and the new settlement was during the next few years known by various names, such as Casco, Casco Neck, Cleeve's Neck, and Munjoy's Neck. In 1658 Massachusetts extended its jurisdiction over this part of Maine. The peninsula, with considerable neighbouring territory and Cape Elizabeth, was organized as a town in 1718 and was named Falmouth. The town suffered so severely from the Indians in 1676 that it was deserted until 1678. It was attacked in 1689, and in 1690 it was utterly destroyed by the French and Indians, and remained desolate until after the Treaty of Utrecht in 1713. When the port of Boston was closed by Great Britain in 1774 the bell of the old First Parish Church (Unitarian) of Portland (built 1740; the present building dates from 1825) was muffled and rung from morning till night, and in other ways the town showed its sympathy for the patriot cause. As a punishment, on the 18th of October 1775, the town was bombarded and burned by a British fleet. The peninsula portion of Falmouth was incorporated as a distinct town in 1786 and was named Portland. Portland was the capital of the state from 1820 to 1832 and in the latter year was chartered as a city. In 1886 a large central portion of the city, about 200 acres, was destroyed by a fire resulting from a Fourth of July celebration. Portland was the birthplace of Henry Wadsworth Longfellow, Thomas Brackett Reed, Edward Preble and his nephew George Henry Preble, Mrs Parton ("Fanny Fern"), Nathaniel Parker Willis, Seargent Smith Prentiss and Neal Dow, and it was the home of William Pitt Fessenden, Theophilus Parsons and Simon Greenleaf.

See W. Willis, *The History of Portland* (Portland, 1865), and William Goold, *Portland in the Past* (Portland, 1886).

PORTLAND, a city, port of entry and the county-seat of Multnomah county, Oregon, U.S.A., on the Willamette river, near its confluence with the Columbia, about 120 m. by water from the Pacific, 186 m. by rail S.S.W. of Seattle and about

772 m. N. of San Francisco. Pop. (1890), 46,385; (1900), 90,426, of whom 25,876 were foreign-born (6943 Chinese); (1910 census) 207,214. Portland is served by the Northern Pacific, the Southern Pacific, the Canadian Pacific, the Great Northern and other railways, by transpacific vessels to Hong-Kong and Yokohama, by coast-wise vessels to San Francisco, to ports on Puget Sound, in British Columbia, and in Alaska, and by river boats sailing 100 m. farther up the Willamette and up the Columbia and the Clearwater to Lewiston, Idaho. The city is built on both sides of the river (which is crossed by five bridges), and covers about 44 sq. m. On the western side the ground rises gradually for a distance of $\frac{3}{4}$ to $1\frac{1}{2}$ m., and then rises abruptly 500–1000 ft. to "Portland Heights" and "Council Crest," beyond the much-broken surface of which rises the Coast range; on the eastern side a slightly rolling surface extends to the foot-hills of the Cascade Mountains. From "Portland Heights" there are fine views of the Columbia and Willamette valleys, and, particularly, of the snow-clad summits of Mt Hood, Mt Jefferson, Mt St Helen's, Mt Adams and Mt Rainier (or Tacoma). In the residence districts (King's Hill, Nob Hill, Portland Heights, Willamette Heights, Hawthorne Avenue, &c.) are pleasantly shaded streets, and grounds decorated with shrubs, especially roses, which sometimes bloom as late as January—an annual "Rose Festival" is held here in June. The city has 205 acres in parks and numerous beautiful drives. It has a fine climate, the mean temperature during the winter months from 1874 to 1903 was 41° F.; the mean summer temperature for the same period 65° F. For the year ending the 31st of May 1900 the death-rate was reported to be only 9 per 1000, and in 1907 to be only 8·28 per 1000. The city's water is brought through a pipe 30 m. in length from Bull Run river, which is fed by Bull Run Lake at an elevation of more than 3000 ft. in the Cascade Mountains.

Among the prominent buildings are the Court House; the City Hall, containing the rooms of the Oregon Historical Society; the Customs House; the Protestant Episcopal Cathedral; the Public Library (with 75,000 volumes in 1908); several tall office buildings with frames of steel; and the Art Museum (1905). There are large grain elevators and miles of wharfs and docks. Among educational institutions are the law and medical departments of the University of Oregon, Hill Military Academy (1901) and Columbia University (Roman Catholic, 1901). The *Oregonian*, which was established here in 1850, is one of the most influential newspapers on the Pacific Slope.

The harbour is accessible for vessels of 26 ft. draught and the city's leading industry is the shipment by water and by rail of fish (especially salmon) and of the products (largely lumber, wheat and fruits) of the rich Willamette and Columbia valleys. It is also an important jobbing centre. The value of the exports in 1908 amounted to $16,652,850 and the value of the imports to $2,937,513; the foreign trade is chiefly with Great Britain and its possessions, and with the Orient, where wheat and flour are exchanged for raw silk, tea and manila and other fibres. Portland is the principal manufacturing city of the state. The total value of its factory product in 1905 was $28,651,321. The principal manufactures were lumber and timber products ($3,577,465) and flour and grist mill products ($2,712,735); other important manufactures were packed meat, planing-mill products, foundry and machine-shop products, railway cars (repaired), cordage and twine, and canned and preserved fish (salmon), oysters and fruits and vegetables.

Portland, named after Portland, Maine, was founded in 1845 by two real-estate men from New England, and was chartered as a city in 1851. Its early growth was promoted by the demand for provisions from California soon after the discovery of gold there, and although a considerable portion was swept by fire in 1873 the city had a population of nearly 20,000 before railway communication with the East was established by the Northern Pacific in 1883. East Portland and Albina were annexed to the city in July 1891. The Lewis and Clark Centennial and American Pacific Exposition and Oriental Fair was held in Portland in 1905 in commemoration of the expedition of Meriwether Lewis and William Clark to this region in 1805. The forestry building, 205 ft. long by 108 ft. wide and built of logs of Oregon fir 6 ft. or more in diameter and 54 ft. long, and a building devoted entirely to the subject of irrigation, were of unusual interest. The forestry building is now maintained as a museum chiefly for timber and timber products.

PORTLAND, ISLE OF, properly a peninsula of the coast of Dorsetshire, England, as a prolongation of a narrow ridge of shingle, Chesil Bank (*q.v.*), connects it with the mainland. Pop. (1901), 15,262. It is 4 m. long and nearly $1\frac{3}{4}$ in extreme breadth, with an area of about $4\frac{1}{2}$ sq. m. The shores are wild and precipitous, and Portland is inaccessible from the sea except towards the south. The highest point, close upon 500 ft., is the Verne hill in the north. Wave action is seen in the numerous caverns, and south-east of Portland Bill, the southern extremity of the isle, is a bank called the Shambles, between which and the land there flows a dangerous current called the Race of Portland. A raised beach is seen at Portland Bill. The substratum of the island is Kimeridge Clay, above which rests beds of sand and strata of Oolitic limestone, widely famed as a building stone. Extensive quarries, which are Crown property, have supplied the materials for St Paul's Cathedral and many other important public buildings. In the "dirt-bed" resting upon the Oolitic strata numerous specimens of petrified wood are found, some of great size. The soil, though shallow, is fertile, and mutton fed on the grass has a peculiar rich flavour. Quarrying, fishing and agriculture are the chief industries. Several curious local customs are retained by the inhabitants.

A joint railway of the Great Western and London & South Western companies runs south from Weymouth to Portland ($4\frac{3}{4}$ m.) and Easton ($8\frac{1}{2}$ m.) on the isle. The isle contains a convict prison with accommodation for about 1500 prisoners. Portland Castle, built by Henry VIII. in 1520, is generally occupied by the commander of the engineers or of the regiment stationed on the island. On a rock on the eastern side are remains of a more ancient fortress, Bow and Arrow Castle, ascribed to William Rufus.

A harbour of refuge, begun in 1847 under the direction of the Admiralty, was completed some fifteen years later. A breakwater stretching in a northerly direction from the north-east corner of the island partially enclosed a large area of water naturally sheltered on the south and west. An inner arm ran nearly east from the island and terminated in a masonry head and fort, and an outer detached arm bent to the north and terminated in a circular fort, a narrow entrance for shipping being left between the two. It was formed of a rubble mound quarried by convict labour at the summit of the island, and was lowered by a wire-rope incline to the sea. The harbour thus made was open on the north to Weymouth and the Channel, but the necessity for greater protection from torpedo attack made it advisable to complete the enclosure. Accordingly the Naval Works Acts of 1895 and subsequent years sanctioned works for closing the gap—about 2 m. long—between the end of the outer breakwater and the Bincleaves rocks near Weymouth, by two new breakwaters. One of these runs nearly east from the Bincleaves shore and is about 4642 ft. long, while from its extremity the other, about 4465 ft. long, stretches in a south-east direction towards the old outer breakwater, passages for navigation about 700 ft. wide separating it from its neighbours at each end. These new structures also consist of rubble mounds. The defensive harbour thus completely enclosed has an area of 2200 acres to the one-fathom line, of which 1500 acres have a depth of not less than 30 ft. at low water. There is no dockyard at Portland, but the watering and coaling arrangements for the supply of the fleet are of considerable importance. There is a coaling jetty and camber for the storage of both sea-borne and land-borne coal, with hydraulic appliances for handling it. The harbour and island are strongly fortified.

The isle of Portland is not mentioned in the time of the Romans. In 837 it was the scene of an action against the Danes, and in 1052 it was plundered by Earl Godwine. In 1643 the parliamentary party made themselves masters of the island and castle, but shortly afterwards these were regained by the Royalists through a clever stratagem, and not recovered again by the forces of the parliament till 1646.

PORTLANDIAN, in geology, a subdivision of the Upper Jurassic system that includes the strata lying between the Kimeridge Clay and the Purbeck beds. These rocks are well exposed on the isle of Portland, Dorsetshire, where they have been quarried for more than 200 years. J. Mitchell appears to have been the first to use the term "Portland lime" in geological literature (1788); T. Webster spoke of the "Portland Oolite" in 1812. In England the strata are very variable; the upper part consists principally of limestones, shelly, oolitic or compact, or in places very closely resembling chalk (Upway, Portisham, Brill, Chilmark). Nodules and layers of chert are well developed in some of the limestones of Dorsetshire and elsewhere; and a silicified oolite occurs near St Alban's Head. About Swindon, beds of sand are common in the Upper Portland beds with layers of calcareous sandstone (Swindon stone). Marly and sandy beds occur also at Shotover Hill. The lower portion is usually sandy and shows a gradual passage into the underlying Kimeridge Clay. W. H. Fitton in 1827 gave the name "Portland Sand" to this division. The Upper Portlandian in Dorsetshire is 130–170 ft. thick; the Lower Portlandian in the same district is 100–120 ft. These rocks crop out from South Dorsetshire into Wiltshire, Oxfordshire and Buckinghamshire, and possibly extend beneath younger rocks into Bedfordshire and Cambridgeshire. They have been proved by borings in Sussex and Kent, and in Yorkshire they are represented by part of the Speeton Clays, and in Lincolnshire by part of the Spilsby Sand. At Swindon and Aylesbury a conglomeratic layer with small pebbles of lydite and phosphatized fossils lies at the base of the Portland Stone.

The Upper Portlandian of England is characterized by the ammonite *Perisphinctes giganteus*, along with *Cytheria* (*Cyrena*) *rugosa*, *Trigonia gibbosa*, *Perisphinctes boloniensis* and *Trigonia incurva* as subzonal forms. *Olcostephanus gigas* is the zonal ammonite in the Lower Portlandian, associated with *Trigonia Pellati*, *Cyprina Brongniarti*, *Exogyra brantrutana* and *Astarte Saemanni* as subzonal indices. Other characteristic fossils are *Cerithium portlandicum*, the casts of which form the familiar "Portland screw," *Isastraea oblonga*, the Chelonian *Stegochelys*; the remains of saurians *Pliosaurus* and *Cimoliosaurus* and others are found; *Mesodon*, *Ischyodus* and other fishes occur in this formation. The Portland limestones have been much in demand for building purposes; at Portland the "Top Roach," the "Whit Bed" or top freestone, and the "Best Bed" (or Base Bed) are the best known. In the Vale of Wardour the lower Portlandian has been largely quarried; the stone from this neighbourhood is often described as Wardour, Tisbury or Chilmark stone. Swindon stone is a calcareous sandstone that occurs in the sands of the Upper Portland beds near Swindon.

Rocks of Portlandian age are well developed on the continent of Europe, but the grouping of the strata is different in some respects from that adopted by English geologists. In France the "Portlandian" is usually taken to include the Purbeckian as well as the equivalents of the English Portland beds, and some authors, *e.g.* E. Renevier, have included more or less of the Kimeridgian in this division. The Portlandian of north-west Germany includes the Eimbeckhäuser Plattenkalk and the Lower Portland Kalk. Oppel's "Tithonian" (tithonic) division, embracing Upper Kimeridge beds, Portlandian and Purbeckian beds in the Alpine district, is now recognized as a deeper water deposit of this time with many points of resemblance to the Russian development to which the name "Volgian" has been applied by S. Nikitin. The Portlandian beds of Yorkshire are more nearly related to the Volgian phase than to the beds of the same age in the south of England. The term Bononian (= Bolonian) was suggested by J. F. Blake in 1881 for a part of the Portlandian series, from their occurrence at Boulogne (Bononia) where they are similar to the beds of Dorset. He limited the name Portlandian to the Purbeckian and Upper Portlandian (Portland stone), while he placed the Portland Sands and upper part of the Kimeridge Clay in his Bolonian division: this scheme has not been accepted in England. See JURASSIC.

PORTLOCK, JOSEPH ELLISON (1794–1864), British geologist and soldier, the only son of Nathaniel Portlock, captain in the Royal Navy, was born at Gosport on the 30th of September 1794. Educated at the Royal Military Academy he entered the Royal Engineers in 1813. In 1814 he took part in the frontier operations in Canada. In 1824 he was selected by Colonel (afterwards Major-General) T. F. Colby (1784–1852) to take part in Ordnance Survey of Ireland. He was engaged for several years in the trigonometrical branch, and subsequently compiled information on the physical aspects, geology and economic products of Ireland. In 1837 he formed at Belfast a geological and statistical office, a museum for geological and zoological specimens, and a laboratory for the examination of soils. The work was then carried on by Portlock as the geological branch of the Ordnance Survey of Ireland, and the chief results were embodied in his *Report on the Geology of the County of Londonderry and of parts of Tyrone and Fermanagh* (1843), an elaborate and well-illustrated volume in which he was assisted by Thomas Oldham. After serving in Corfu and at Portsmouth he was, in 1849, appointed Commanding Royal Engineer at Cork, and from 1851–1856 he was Inspector of Studies at the Royal Military Academy, Woolwich. For a short time commanding officer at Dover, when the Council of Military Education was formed in 1857 he was selected as a member.

During these years of active service he contributed numerous geological papers to the scientific societies of Dublin and to the British Association. He published in 1848 a useful treatise on geology in Weale's "Rudimentary Series" (3rd. ed., 1853). He was president of the geological section of the British Association at Belfast (1852), and of the Geological Society of London (1856–1858). He wrote a *Memoir of the late Major-General Colby, with a Sketch of the Origin and Progress of the Trigonometrical Survey* (reprinted in 1869 from *Papers on Subjects connected with the Royal Engineers*, vols. iii.–v.). He also contributed several articles on military subjects to the 8th edition of the *Encyclopaedia Britannica*. He was elected a Fellow of the Royal Society in 1837. He died in Dublin on the 14th of February 1864.

PORT MAHON, or MAHON (Spanish *Puerto Mahón*), the capital and principal seaport of Minorca, in the Spanish province of the Balearic Islands. Pop. (1900), 17,144. Port Mahon is situated on the east coast, at the head of a deep inlet which extends inland for 3½ m. It is an important harbour (see MINORCA). The city occupies a conspicuous hill, and presents a fine appearance from the sea; it is solidly built of excellent stone. Many of the houses date from the British occupation, which has also left curious traces in the customs and speech of the people. The King's Island (Isla del Rey, so called as the landing-place of Alphonso III. of Aragon in 1287) contains a hospital built by the admiral of the British squadron in 1722; farther south-east on the shore is the village of Villa Carlos or George Town, with ruins of extensive British barracks; and at the mouth of the port, on the same side, are the remains of Forte San Felipe, originally erected by Charles V. and twice the scene of the capitulation of British troops. Opposite San Felipe is the easily defended peninsula of La Mola (256 ft. high), which is occupied by extensive Spanish fortifications. Mahon is one of the principal quarantine stations of Spain; the lazaretto, erected between 1798 and 1803, stands on a long tongue of land, separated from La Mola by the inlet of Cala Taulera. The principal modern buildings are the military and naval hospitals, the theatre, museum, library and schools. There are an arsenal and extensive quays. From its position on the route of vessels plying between Algeria and the south of France, the harbour is much frequented by French cargo-steamers; it is also a Spanish naval station. The principal exports are grain, live stock and fruit; cement, coal, iron, machinery, flour, raw cotton and hides are imported. Shoes and cotton and woollen goods are manufactured. About 250 vessels enter the port every year, and the annual value of the foreign trade is, approximately, £200,000 to £250,000.

Mahon is the ancient *Portus Magonis*, which under the Romans was a municipium (*Mun. flavium magontanum*), probably including the whole island under its authority. As the name suggests, it had previously been a Carthaginian settlement. The Moors, who occupied Minorca in the 8th century, were expelled by James I. of Aragon in 1232. Khair-ed-Din Barbarossa besieged and captured the city in 1535; and in 1558 it was sacked by a corsair called Piali. The British, who under James Stanhope, afterwards Earl Stanhope, seized the island in 1708, made Mahon a flourishing city, and in 1718 declared it a free port. In 1756 it fell into the hands of the French through the failure of Admiral Byng to relieve the garrison of St Philip's (San Felipe). Restored to the British in 1762, it was in 1782 heroically but unsuccessfully defended by General Murray. In 1802 it was finally ceded to Spain by the treaty of Amiens.

PORTMANTEAU, a leather case or trunk for carrying articles of personal use when travelling. The typical portmanteau of the present day has two compartments which, fastened at the back by hinges, close together like a book. The original portmanteau (adopted from Fr. *portemanteau, porter*, to carry, *manteau*, cloak, mantle) was a flexible round leather case to hold a cloak or other garment and of such a shape as could conveniently be carried on a rider's saddle. In French the word was also applied to a bracket or set of pegs on which to hang clothes. C. L. Dodgson ("Lewis Carroll") in *Through the Looking Glass* ("The Song of the Jabberwock") used the expression "portmanteau word" of an invented word composed of two words run together and supposed to convey humorously the combined meaning: thus "slithy" conveys slimy and lithe; "mimsy," flimsy and miserable.

PORTO ALEGRE, a city and port of Brazil, capital of the state of Rio Grande do Sul, at the northern extremity of Lagôa dos Patos on the eastern shore of an estuary called Rio Guahyba, about 160 m. from the port of Rio Grande do Sul at the entrance to the lake. The population which contains a large foreign element, chiefly German and Italian, was returned as 73,574 by the census of 1900, including some outlying districts not within urban limits. The *municipio* (commune), which has an area of 931 sq. m., had a population of nearly 100,000, including a large number of prosperous colonists. The railway from Porto Alegre to Novo Hamburgo and Taquara (55 m.) affords an outlet for some of the older German colonies. The railway from Porto Alegre to Uruguayana is completed from Margem da Taquary to Cacequy, 232 m. Its starting point, Margem da Taquary, is about 80 m. from the city, with which it is connected by river steamers. An extension of the railway is projected from Margem da Taquary to Neustadt on the Novo Hamburgo line, and will give the city direct railway connexion with the principal cities of western and southern Rio Grande do Sul. The Rio Guahyba, which is not a river, was once called "Viamão" because its outline is roughly that of the human hand, the rivers entering the estuary at its head corresponding to the fingers. The lower channels of these rivers (the Gravaty, Sinos, Cahy, Jacuhy and Taquary) are all navigable and bring considerable trade to the port. Its foreign trade is limited to light-draught steamers able to cross the bar at the entrance to the lake.

The city occupies a tongue of land projecting into the estuary, and extends along its shores and back to a low wooded hill. Its site, as seen from the water, is attractive, though its larger part is an almost level plain. There are pleasant suburbs along the shore and farther inland (Floresta, Gloria, Moinhos de Vento, *i.e.* "Windmills," Navigantes and Partenon). The climate is subtropical, cool and bracing in winter but insufferably hot in summer. The mean annual temperature is slightly under 69° F., the average maximum being a little over 82° and the average minimum 59°. The annual rainfall is about 30½ in. The city is regularly laid out with broad, straight, well-paved streets, in great part lined with shady trees. The waterside streets, however, follow the curve of the beach. There are several public squares and gardens, the more important being the Praça Harmonia, the Praça d'Alfandega, Praça da Independencia and the Parque, where an exposition was held in 1901. The public water supply is drawn from a range of hills 6 m. distant and is considered good. Porto Alegre, like many Brazilian cities, is in a transition stage, and handsome new structures of French and Italian styles rise from among the low, heavy and plain old buildings of Portuguese origin. Brick and broken stone are chiefly used in the walls, which are plastered outside and tinted. Tiles are used for roofing, and on modern edifices stucco ornamentation is lavishly employed. The most noteworthy public buildings are the Cathedral (Porto Alegre being the see of a Roman Catholic bishop), the handsome church of Nossa Senhora das Dores, the municipal palace, school of engineering, government palace, legislative halls, school of medicine, athenaeum, normal school and public library and military barracks. One of the hospitals—that of Caridade—is the largest in the state. The city is the chief commercial centre of the state and has shipyards for the construction of river and lake vessels. It manufactures cotton fabrics, boots and shoes, iron safes and stoves, carriages, furniture, butter and cheese, macaroni, preserves, candles, soap and paper.

Porto Alegre was founded in 1743 by immigrants from the Azores and was at first known as Porto dos Cazaes. Owing to the occupation of the southern part of the captaincy by the Spaniards, Governor Jose Marcellino de Figuereido selected this village in 1770 as his official residence and gave to it the name it now bears. It was made a *villa* in 1803, and in 1807, when Rio Grande do Sul was made a captaincy-general, the transfer of the capital from Rio Grande to Porto Alegre was officially recognized. In 1822 it was raised to the rank of a city, and in 1841, as a reward for its loyalty in revolutionary wars of that province, it was distinguished by the title of *leal e valorosa* (loyal and valorous). The first German immigrants to settle near Porto Alegre arrived in 1825, and much of its prosperity and commercial standing is due to the German element.

PORTOCARRERO, LUIS MANUEL FERNANDEZ DE (1635–1709), cardinal archbishop of Toledo, was a younger son of the marquis of Almenara and was born on the 8th of January 1635. He became dean of Toledo early, and was made cardinal on the 5th of August 1669. Till 1677 he lived at Rome as cardinal protector of the Spanish nation. In 1677 he was appointed interim viceroy of Sicily, counsellor of state and archbishop of Toledo. He ceased to be viceroy of Sicily in 1678. As archbishop of Toledo he exerted himself to protect the clergy from the obligation to pay the excises or *octroi* duties known as "the millions" and thereby helped to perpetuate the financial embarrassments of the government. His position rather than any personal qualities enabled him to play an important part in a great crisis of European politics. The decrepit King Charles II. was childless, and the disposal of his inheritance became a question of great interest to the European powers. Portocarrero was induced to become a supporter of the French party, which desired that the crown should be left to one of the family of Louis XIV., and not to a member of the king's own family, the Habsburgs. The great authority of Portocarrero as cardinal and primate of Spain was used to persuade, or rather to terrify the unhappy king into making a will in favour of the duke of Anjou, Philip V. He acted as regent till the new king reached Spain and hoped to be powerful under his rule. But the king's French advisers were aware that Spain required a thorough financial and administrative reform. Portocarrero could not see, and indeed had not either the intelligence or the honesty to see, the necessity. He was incapable, obstinate and perfectly selfish. The new rulers soon found that he must be removed and he was ordered to return to his diocese. When in 1706 the Austrian party appeared likely to gain the upper hand, Portocarrero was led by spite and vexation to go over to them. When fortune changed he returned to his allegiance to Philip V., and as the government was unwilling to offend the Church he escaped banishment. In 1709 when Louis XIV. made a pretence of withdrawing from the support of his grandson, the cardinal made a great display of loyalty. He died on the 14th of September and by his orders the words *Hic jacet pulvis, cinis, et nihil* were put on his tomb.

See Lord Stanhope, *History of the War of Succession in Spain* (London, 1832).

PORTO FARINA, a town of Tunisia about 20 m. E. of Bizerta, on the Ghar-el-Mela, a lagoon, also known as the Lake of Porto Farina, at the mouth of the Mejerda (the ancient Bagradas). Porto Farina was the naval arsenal of the piratical beys of Tunis and was bombarded by the English under Admiral Blake in 1655. The lagoon has become very shallow in consequence of the silt brought down by the Mejerda. The town has ceased to be important, and its inhabitants have dwindled to about 1500. The ruins 10 m. to the south-west, near the village of Bu Shater, are identified with the ancient Utica (*q.v.*).

PORTO MAURIZIO, a city of Liguria, Italy, the capital of the province of Porto Maurizio, on the coast of the Ligurian Sea, 46 m. by rail E. of Nice and 70 m. S.W. of Genoa, 115 ft. above sea-level. Pop. (1901), 7207. It consists of a picturesque old town on the heights and a modern town of villas on the lower slopes. The principal church, designed by Gaetano Cantone, is a large structure of 1780 with a dome rebuilt in 1821. A few remains of the old city walls may be seen. About 2 m. north-east of Porto Maurizio is the town of Oneglia, with a fine church, S. Giovanni Battista, designed by Gaetano Amoretti, a hospital (1785) and a large prison. It suffered considerably from the earthquake of 1887. Maurizio and Oneglia lie on the same bay and both have small but safe harbours, both are frequented for sea-bathing, and both are embowered amid olive groves; and the district is famous for the quality of its oil. The two towns together form one commune, called imperia, which had a population of 15,459 in 1907.

Porto Maurizio appears as *Portus Maurici* in the Maritime Itinerary. After being subject to the marquises of Turin (11th century) and of Clavesana, it was sold by Boniface of Clavesana in 1288 to Genoa in return for a yearly payment; in 1354 it became the seat of the Genoese vicar of the western Riviera, and remained in the possession of the republic till it was merged in the kingdom of Sardinia. Oneglia, formerly situated inland at the place called Castelvecchio (old castle), has occupied its present site from about 935. The bishops of Albenga sold it in 1298 to the Dorias of Genoa, who in their turn disposed of it in 1576 to Emanuel Philibert of Savoy. In the wars of the house of Savoy Oneglia often changed hands. In 1614 and 1649 the Spaniards and in 1623 and 1672 the Genoese obtained possession; in 1692 it had to repulse an attack by a French squadron; in 1744–1745 it was again occupied by the Spaniards, and in 1792 bombarded and burned by the French. Pellegrino Amoretti, assistant secretary to Charles V., and Andrea Doria, the famous admiral, were natives of Oneglia.

See G. Donaudi, *Storia di Porto Maurizio* (1889).

PORTO NOVO, a town of British India, on the Coromandel coast in the South Arcot district of Madras. Pop. (1901), 13,712. The English began trading here in 1683, when they found both the Danes and the Portuguese already established. The place is chiefly famous for the battle in July 1781, in which Sir Eyre Coote with 8000 men defeated Hyder Ali with 60,000 and saved the Madras presidency. In 1830 an attempt, finally unsuccessful mainly owing to the lack of fuel, was made to smelt iron from the ores found in the vicinity.

PORTO-RICHE, GEORGES DE (1849–), French dramatist, was born at Bordeaux. When he was twenty his pieces in verse began to be produced at the Parisian theatres; he also wrote some books of verse which met with a favourable reception, but these early works were not reprinted. In 1898 he published *Théâtre d'amour*, which contained four of his best pieces, *La Chance de Françoise*, *L'Infidèle*, *Amoureuse*, *Le Passé*. The title given to this collection indicates the difference between the plays of Porto-Riche and the political or sociological pieces of many of his contemporaries. In Germaine, the passionate and exacting heroine of *Amoureuse*, Mme Réjane found one of her best parts. In *Les Malefilâtres* (Odéon, 1904), also a drama of passion, the characters are drawn from the working classes.

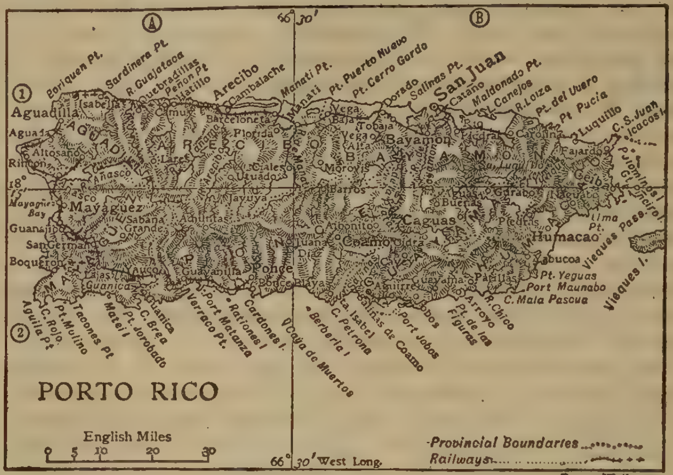
PORTO RICO, or PUERTO RICO ("Rich Harbour"), an island of the United States of America, the most easterly and the fourth in size of the Greater Antilles, situated between 17° 50′ and 18° 30′ N., and between 65° 30′ and 67° 15′ W., about 70 m. E. of Haiti, and 500 m. E. by S. of Cuba. It is about 100 m. long from east to west, 40 m. wide near the west end, and somewhat narrower towards the east end, and has an area of 3435 sq. m.

Physical Features.—A range of mountains, varying in height from 2000 ft. to about 3750 ft. on El Yunque Peak in the north-east corner, traverses the island from west to east and descends abruptly to the sea at each end. The south slope rises precipitously from the foothills; the north slope is more gradual, but it is much broken by rugged spurs and deep gorges. On the north there is little coastal plain except at the mouths of rivers, but on the south coast there is a plain of considerable extent broken only by the remains of eroded foothills. The water parting is about twice as far from the north coast as it is from the south coast, the rainfall is greater on the north slope, and the principal rivers—Rio Loiza, Rio de la Plata, Rio Manati and Rio Arecibo are on the north side. There are eight other rivers on the same side, seventeen on the south side, six at the east end and four at the west end, besides more than 1200 smaller streams, and the deep valleys cut by the streams add to the broken surface of the country. None of the rivers is navigable for more than a mile or two from the coast. The coast-line has few indentations sufficient to afford safe harbourage. Under the same jurisdiction as Porto Rico are the fertile island of Vieques (21 m. long and 6 m. wide) and the smaller and nearly barren island of Culebra off the east coast, the island of Mona, covered with deposits of guano, off the west coast, and numerous islets.

Fauna.—The native fauna is scanty. The agouti and the armadillo are practically extinct and the only other mammals are ground squirrels, rats, a few other small rodents, and some bats. A huge land-turtle is peculiar to the island. Reptiles are scarce, and venomous reptiles unknown. Noxious insects are less numerous than is usual in tropical countries. There are no large game birds, but song birds and doves are numerous on the mountains, and flamingoes and other water-birds frequent the coast. There are a few species of fresh-water fish, but food-fishes are scarce both in the rivers and along the coast.

Flora.—The flora is beautiful and varied. The more rugged districts and higher elevations are clad with such tropical forest trees as ebony, Spanish cedar, sandalwood, rosewood and mahogany. There are several species of palms, flowering trees, trees with beautifully coloured foliage, tree ferns, resinous trees and trees bearing tropical fruits. There are about thirty species of medicinal plants, twelve used for condiments, and twelve for dyes and tanning. In the semi-arid districts on the south slope of the mountains the flora consists chiefly of dry grasses, acacias, yuccas and cactuses.

Climate.—The climate is somewhat more healthy than that of the other West Indies. The temperature is moderated by the north-east trade winds, which, somewhat modified by local conditions, blow throughout the year, briskly during the day and more mildly during the night. It rarely reaches 100° F. or falls below 50°, and the mean annual temperature is about 80° (75·2° in January, 80·4° in August). The mean daily variation at San Juan is 11·5°; on the mountains the mean daily variation is 23°. The average annual rainfall on the north-east coast, at the foot of El Yunque Mountain, is 120 in. or more, while other districts are semi-arid or subject to severe droughts. At San Juan the average annual rainfall is about 55 in.; nearly two-thirds of this falls from June to November inclusive. Most of the rain is in showers, frequently heavy; and on the windward slope showers are an almost daily occurrence. The island is visited occasionally by hurricanes.



Soil.—Close to the coast the soil is for the most part a coral sand. Farther inland in the level districts and river bottoms it varies from a sandy to a clay loam containing much alluvium. On the foothills and in the less rugged mountain districts there is a thin but rich clay soil derived from coral limestone.

Industries.—A little more than one-fourth of the land is under cultivation and in 1899 more than three-fifths of the working population were engaged in agriculture. There were over 39,000 farms, nearly all of them small, and the average number of acres cultivated on each was not more than fifteen. Sugar on the lowlands, coffee on the upper, and tobacco on the lower mountain slopes are the principal crops. In 1909 there were 185,927 acres of sugar, yielding 244,257 tons for exportation, and valued at $18,432,446. The coffee plantations were greatly injured by a severe hurricane which visited the island on the 8th of August 1899, but the yield for export increased from 12,157,240 lb in 1901 to 38,756,750 lb, valued at $4,693,004, in 1907. The acreage, however, decreased from 178,155 acres in 1906 to 155,778 acres in 1909, and in the latter year the crop fell to 28,489,263 lb. Java coffee has been grown with success in Porto Rico. Tobacco of a superior quality is grown extensively on the lower northern slopes and much tobacco is now grown under cloth. The total acreage of tobacco increased from 12,871 acres in 1906 to 27,596 acres in 1909; the total value of the exported tobacco products increased from $681,642 in 1901 to $5,634,130 in 1909. Cotton, Indian corn, sweet potatoes, yams and rice are small crops. The culture of citrus fruits, principally oranges and grape-fruit, and of pineapples and coco-nuts has been rapidly extended. About 13,000 head of cattle were exported annually from 1901 to 1905, but much of the best grazing land has since been devoted to the cultivation of sugar-cane. A project for irrigating the district south of the mountains between Ponce and Patillas was adopted by the Porto Rican government in 1909. The Federal government has an agricultural experiment station at Mayaguez.

The mineral resources are very limited. Brick clay and limestone are abundant, and there are on the south coast a sand marl rich in phosphates and productive salt deposits. Iron ore, lignite, copper, mercury, molybdenite, nickel, platinum and other minerals have been found, but the quantity of each is too small, or the quality too poor, for them to be of commercial value. There are important mineral and thermal springs in various parts of the island.

The only manufacturing industries of much importance are the preparation of sugar, coffee and tobacco for market, and the manufacture of cigars, cigarettes, straw hats, soap, matches, vermicelli, sash, doors, ice, distilled liquors and some machinery.

Transport facilities are inadequate. The American Railroad of Porto Rico, about 190 m. long, connects the principal cities along the north and west coasts and those as far east as Ponce on the south coast; a railway between Ponce and Guayama, farther east, was virtually completed in 1910, and the Vega Alta railroad connects Vega Alta with Dorado on the north coast; but there are no inland railways and most of the products of the interior are carried to the coast in carts drawn by bullocks or on the backs of mules. The mileage of wagon roads was increased from about 170 m. in 1898 to 612 m. in 1909. The principal harbours are San Juan on the north and Ponce on the south coast; the former is accessible to vessels of about 30 ft. draught, and the latter has a natural channel which admits vessels of 25 ft. draught. Two lines of steamboats afford regular communication between San Juan and New York; one of them runs to Venezuelan ports and one to New Orleans; and there are lines to Cuba and direct to Spain.

The commerce of Porto Rico is principally with the United States. The value of its exports to the United States increased from $5,581,288 in the fiscal year ending on the 30th of June 1901 to $26,998,542 in 1909, and the value of its imports from the United States increased during this period from $7,413,502 to $25,163,678. In the meantime the value of its exports to foreign countries increased only from $3,002,679 to $4,565,598, and the value of its imports from foreign countries only from $1,952,728 to $3,054,318.

Population.—The population increased from 583,308 in 1860 to 798,565 in 1887, and to 953,243, or 277·5 per sq. m., in 1899. Of the total population in 1899, 589,426, or 61·8% were whites, 304,352 were of mixed blood, 59,390 were negroes and 75 were Chinese. In 1910 the census returned the population as 1,118,012. The proportion of whites is greater at the west end than at the east end, greater on the north side than on the south side, and greater in the interior than along the coast. Only 13,872, or about 1·5% of the total population of 1899, were foreign-born, and of these more than one-half were born in Spain. The married portion of the population was only 16.6% in 1899. The principal towns, with the population of each in 1910, are: San Juan, 48,716; Ponce, 35,027; Mayaguez, 16,591; Arecibo, 9612. The Roman Catholic is the predominant church and the bishopric of Porto Rico (1512) is one of the oldest in the New World.

Government.—The constitution of Porto Rico is contained in an act of the Congress of the United States (the Foraker Act) which came into operation in May 1900. The governor is appointed by the president of the United States with the advice and consent of the Senate for a term of four years, and associated with the governor is an executive council consisting of the secretary, treasurer, auditor, attorney-general, commissioner of the interior, commissioner of education, and five other members, all appointed in the same manner and for the same term as the governor. The constitution requires that at least five of the eleven members of the Executive Council shall be native inhabitants of Porto Rico; in practice the six members who are also heads of the administrative departments have been Americans while the other five have been Porto Ricans. The insular government, however, has created a seventh administrative department—that of health, charities and corrections—and requires that the head of this shall be chosen by the governor from among the five members of the Executive Council who are not heads of the other departments.

The Executive Council constitutes one branch of the legislative assembly; the House of Delegates the other. The House of Delegates consists of 35 members elected biennially, five from each of seven districts. The right to determine the electoral franchise is vested in the legislature itself and that body has conferred it upon practically all adult males. The governor has the right to veto any bill, and for passing a bill over his veto an affirmative vote of two-thirds of the members of each house is required. All laws enacted by the insular legislature must also be submitted to the Congress of the United States, which reserves the right to annul them. Railway, street railway, telegraph and telephone franchises can be granted only by the Executive Council with the approval of the governor, and none can be operative until it has been approved by the President of the United States. The governor and Executive Council have the exclusive right to grant all other franchises of a public or quasi-public nature and Congress reserves the right to annul or modify any such grant.

The administration of justice is vested in a United States district court and a supreme court, district courts, municipal courts and justice of the peace courts of Porto Rico. The judge of the United States district court and the chief justice and associate justices of the supreme court are appointed by the President with the consent of the Senate, and the judges of the district courts by the governor with the consent of the Executive Council.

The principal local government is that of the municipalities or municipal districts, but for the Spanish municipal government the insular legislature has substituted one resembling that of small towns in the United States, and it has reduced the number of districts from 66 to 47. Each municipal district elects biennially a mayor and a municipal council, the membership of which varies from five to nine according to the population of the district. The mayor appoints practically all municipal employés and may veto any ordinance of the council; his veto, however, may be overridden by two-thirds of the council. The police force of each municipality, or rather of each of 66 police districts, is maintained and controlled by the insular government; justice in each municipality is also administered by the insular government; the building, maintenance and repair of public roads are under the management of a board of three road supervisors in each of the seven insular election districts; and matters pertaining to education are for the most part under the insular commissioner of education and a school board of three members elected biennially in each municipality; nearly all other local affairs are within the jurisdiction of the mayor and municipal council.

Education.—In 1899 more than three-fourths of the inhabitants ten years of age or over were unable to read or write, and when in the following year the present system of government was established large powers were given to the commissioner of education. He controls the expenditure of public money for school purposes, the examination and the appointment of teachers, whose nominations by the municipal school boards are referred to the commissioner. The school system comprises preparatory schools, rural schools, graded schools, three high schools and the university of Porto Rico. The university at Rio Piedras was established by act of the insular legislature in 1903, but in 1910 only two departments had been organized—the insular normal school and the department of agriculture. Numerous scholarships have been established at government expense in Porto Rican schools and in colleges or universities of the United States. The average daily attendance in the public schools increased from 47,277 in 1906–1907 to 74,522 in 1908–1909. Each municipality is required to pay to its school board 25% of its receipts from the general property tax.

Finance.—Trade between Porto Rico and the United States is free, but upon imports to Porto Rico from foreign countries the Federal government collects custom duties and pays the net proceeds to the insular government. Other principal sources of income are excise taxes, a general property tax, an inheritance tax and a tax on insurance premiums. For the fiscal year ending June 1909 the net income of the insular government was $3,180,111·75 and the net bonded indebtedness was $3,759,231·22.

History.—On his second voyage Columbus sighted the island, to which he gave the name San Juan Bautista, and remained in its vicinity from the 17th to the 22nd of November 1493. In 1508 Nicolás de Ovando, governor of Hispaniola (Haiti) rewarded the services of Juan Ponce de Leon, one of Columbus's companions in 1493, by permitting him to explore the island, then called by the natives "Borinquen," and search for its reputed deposits of gold. Ponce's hospitable reception by the native chief, Aquebana or Guaybaná, and his fairly profitable search for the precious metal led King Ferdinand in 1509 to give him an appointment as temporary governor of the island, where his companions had already established the settlement of Caparra (Pueblo Viejo, near the present San Juan). In 1510 the king through Ovando's influence made this commission permanent. Meanwhile Ferdinand had also restored to Diego Columbus, son of the discoverer, the privileges of his father, including the control of the islands of Haiti and Porto Rico. The new admiral removed Ponce and appointed Juan Cerón to administer the affairs of Porto Rico. The quarrels between these two leaders disturbed the affairs of the island for the next two years, but in the end Ponce was forced to yield the political control to the representatives of Columbus. While Ponce was exploring Florida in 1513 the conquerors of Porto Rico had established their domination in the upper western portion of the island by a series of settlements. The ruthless methods by which the Spaniards forced the natives to labour for them caused a change in the attitude of the erstwhile friendly Borinqueños. Both Ponce and his rivals had introduced the system of repartimientos established by Columbus in Haiti. A preliminary distribution of 1060 natives in 1509–1510 was the direct precursor of the rebellion of the natives in 1511. For a time the Borinqueños, aided by Caribs from the neighbouring islands, threatened to destroy all vestiges of white occupation in Porto Rico, but in the end the Spaniards prevailed. Immediately after this rebellion a second distribution of more than 4000 natives foreshadowed the rapid disappearance of those unfortunates, despite the well-meaning regulations of the Council of the Indies. For some decades the inevitable extermination was postponed by the fact that the Spaniards were not numerous enough to occupy the southern and eastern portions of the island. Here a remnant of the Borinqueños, assisted by the Caribs, maintained a severe struggle with the conquerors, but in the end their Indian allies were subdued by English and French corsairs, and the unfortunate natives of Porto Rico were left alone to experience the full effect of forced labour, disastrous hurricanes, natural plagues and new diseases introduced by the conquerors. By 1520 philanthropic churchmen directed their attention to the miserable conditions of the natives; but remedial legislation was largely nullified by the rapacity of subordinate officials, and before the end of the 16th century the natives disappeared as a distinct race.

To replace the natives as a labour element and also to preserve them from extermination African slavery was early permitted, and by 1530 there were over 1500 negro slaves in Porto Rico. Although the extravagant prices paid at first almost ruined the planters, the traffic continued to flourish in hands of foreign concessionaires until 1820, when through English influence it was abandoned. At this period negroes were an important element of the population, but by no means the most numerous one.

At no period of its history has Porto Rico enjoyed great prosperity. Besides the causes already indicated the evil character of many of the white settlers conspired to retard its development. In 1515 its European population may have been 400. Until 1782 the island was divided into the eastern district of Puerto Rico and the western one of San Germán. In 1513 the arrival of its first bishop, who later also exercised the function of general inquisitor, added one more to the discordant elements ruling the island. About 1520 Caparra was abandoned for a more healthy site, and the city of San Juan de Puerto Rico was founded as the capital of the eastern district. In time Puerto Rico became the name of the whole island. In 1536 legislation for changing the method of general government and regulating common pasturages and public property caused extreme dissatisfaction, but for many years thereafter the form of control alternated between alcaldes selected by the inhabitants and annual governors appointed by the Council of the Indies.

To the difficulties caused by disaster, depopulation and maladministration there was added the danger of foreign invasion when war broke out in Europe between Francis I. of France and the emperor Charles V. In 1528 San Germán was plundered by a French corsair and twenty-six years later utterly destroyed. In 1533 the *fortaleza*, now the governor's palace, was begun at San Juan, and in 1539–1584 Morro Castle was erected at the entrance of the harbour. Possibly these slight fortifications preserved the capital from the destruction which overwhelmed all the other settlements; but these measures for defence were due more to the loyalty of the inhabitants than to the efforts of the home government, which at this time remained indifferent to appeals for help from the island.

In 1595 San Juan was unsuccessfully attacked by an English fleet under Sir Francis Drake; two years later another English force, led by Sir George Cumberland, occupied the city for some weeks. The city was attacked in 1625 by a Dutch fleet, which was easily repulsed. The buccaneers or filibusters, who during the 17th century were drawn to the West Indies by the prospect of plundering the possessions of decadent Spain, often invaded Porto Rico, but that island escaped the conquest which Haiti experienced. The English attacked the island in 1678, 1702, 1703 and 1743; and in 1797 an English force attempted to reduce San Juan, but was repulsed by the strong fortifications vigorously manned by resident volunteers. After this event the city was permitted to add the words "very noble and very loyal" to its coat of arms.

Porto Rico was comparatively unaffected by the great Spanish-American uprising of the early 19th century. During the struggle of Spain against Napoleon, the island, in common with the other American dominions, was represented in the Spanish Cortes and had its first legislative assembly. Trade with the United States was permitted in 1815, although only in Spanish ships. The island suffered from the reactionary policy of Ferdinand VII., but the few sporadic attempts at revolution between 1815 and 1820 were readily suppressed. Columbian insurgents made ineffectual attempts to invade the island during 1819–29. Governor Miguel de la Torre, who ruled the island with vice-regal powers during the second period of Ferdinand's absolutism, sternly repressed all attempts at liberalism, and made the island the resort for loyal refugees from the Spanish mainland. This policy, coupled with certain administrative and revenue reforms, and some private attempts in behalf of public education, made the last seven years of his rule, from 1827 to 1834, the most prosperous in the Spanish régime. The unsettled political condition of Spain during the next forty years was reflected in the disturbed political conditions of Porto Rico and Cuba. The suffrage was restricted, the Press was placed under a strict censorship, and the right of public assemblage was unknown. Economically the island in 1868 was in a much worse condition than thirty years before. The Revolution of 1868 in Spain promised such salutary changes for the Antilles as the introduction of political parties, the restoration of representation in the Spanish Cortes, and the enfranchisement of the slaves; but the imprudent "Insurrection of Lares," and other outbreaks of 1867–68, delayed these anticipated reforms. The reactionaries feared separation from the mother country. Under the short-lived republican government in Spain Porto Rico was in 1870–1874 a province with a provincial deputation, and in 1873 slavery was abolished. After the restoration of the monarchy under Alphonso XII. there was some improvement in the commerce of the island, but politically it displayed all the evils of an obsolete system of administration disturbed by a premature liberalism. In 1877 the provincial deputation was re-established, but it was not until 1895 that the home government attempted, far too late, to enact a series of adequate reform measures, and in November 1897 followed this by a grant of autonomy.

When in April 1898 war broke out between Spain and the United States the former strongly garrisoned the island, but the fortifications of the capital were largely of the massive stone construction that had repelled Abercrombie a century before, most of the artillery was of an obsolete pattern and the few cruisers in the harbour were antiquated in type. The American invasion of the island occurred in July. On the 25th of that month, while a few vessels made a demonstration before San Juan, the main American fleet was landing some 3400 troops under General Nelson A. Miles at Guánica, a small town on the southern shore, some 15 m. west of Ponce. Three days later the latter town surrendered, amid demonstrations of joy on the part of the inhabitants. The people seemed to regard the American flag as the harbinger of a new era. General Miles's policy in affording employment for the natives likewise served to make the new American régime acceptable.

Meanwhile the Spanish governor-general, Manuel Macías y

Casado, had ordered the forces under his command in the southern part of the island to fall back towards the ridge of mountains intersecting it from east to west, just north of the town of Coamo. Reinforcements were also brought up from San Juan and preparations made to resist an attack by the Americans, despite the current rumours of approaching peace. On their part the American forces, now numbering about 10,000 men, prepared to advance by separate routes across the island in four columns. Guayama, Mayagüez and Coamo were occupied; one portion of the army was within 20 m. of the northern coast and another had advanced along the main military road nearly to Aibonito, when the signing of the peace protocol on the 12th of August caused an immediate suspension of hostilities. The advance of the Americans had been rapid and decisive, with a small loss of life—three killed and forty wounded—due to the skill with which the military manœuvres were planned and executed and the cordial welcome given the invaders by the inhabitants. By November the Spaniards had evacuated the greater part of the island; after Captain General Macias embarked for Spain, General Ricardo Ortega was governor from the 16th to the 18th of October, when the island was turned over to the American forces. In the work of policing the island, in the accompanying tasks of sanitation, construction of highways and other public works, accounting for the expenditure of public funds, and in establishing a system of public education, the military control, which under the successive direction of Generals John R. Brooke, Guy V. Henry and George W. Davis, lasted until the 1st of May 1900, proved most effective in bridging over the period of transfer from the repressive control of Spain to the semi-paternal system under the American civil government. But it was hardly adapted to teach a people utterly without political experience the essential elements of self-government. To meet this problem the Congress of the United States passed the "Foraker Act," under which civil government was instituted, and which, with certain modifications is still in force (see ADMINISTRATION). Under this act the American element has exercised the controlling power, and this has proved distasteful to certain Porto Rican politicians.

On the 8th of August 1899 the island was visited by the most destructive cyclone in its history, causing a loss of about 3500 lives and a property damage amounting to 36,000,000 pesos, the coffee industry suffering most. This calamity afforded the American people an opportunity to display their generosity toward their new colony. Charles H. Allen became the first civil governor in May 1900; he was succeeded in August 1901 by William H. Hunt, who served until July 1904; Beekman Winthrop was governor in 1904–1907 and Régis H. Post from April 1907 until November 1909, when he was succeeded by George R. Colton. The island now has free trade with the United States, and receives into its general revenue fund all customs duties and internal taxes collected in the island. Its political leaders in the House of Delegates are restive under the control exercised by the Executive Council, but an attempt to hold up necessary appropriations resulted in the passage in July 1909 of an act continuing the appropriations of the previous year, whenever for any cause the lower house fails to pass the necessary financial legislation. In 1910 the coffee industry had not yet recovered from the effect of the cyclone of 1899 and the unfortunate mortgage system that prevailed under the Spanish régime. The fact that its product is shut out of its natural markets, without gaining that of the United States, is also a great handicap. The civic status of the people is still unsettled, but there has been under American rule a notable advance in the well-being of the island.

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PORTO TORRES (anc. *Turris Libisonis*, *q.v.*), a seaport on the north coast of Sardinia, 12½ m. N.W. of Sassari by rail. Pop. (1901), 3762 (town); 4225 (commune). It is only 10 ft. above sea-level, and is malarious, but is a seaport of some importance, having regular steam communication with Ajaccio, Leghorn and Cagliari, and with the north and west coasts of Sardinia. The church of S. Gavino, formerly the cathedral, probably dates from the 11th century. It is a Romanesque basilica with a nave and two aisles, divided by ancient columns; at each end of the nave is an apse. It has a 14th-century portal and two smaller doors at the sides added later in the Aragonese style. See D. Scano, *Storia dell' arte in Sardegna dal XI. al XIV. secolo* (Cagliari–Sassari, 1907), 91 sqq. To the N.N.W. is the island of Asniara, the principal quarantine station of Italy. Porto Torres was the seat of the *giudici* of the north-west portion of the island (the district was called Torres or Logudoro); it was plundered by the Genoese in 1166, but remained the seat of the *giudici* until 1272, when it was divided between various Genoese families, the Doria, Malaspina, &c., and the *giudici* of Arborea. It was also the seat of a bishopric until 1441, when the see was transferred to Sassari, Porto Torres being practically deserted, owing to its unhealthiness. It did not become an independent commune again until 1842.

PORTOVENERE (anc. *Portus Veneris*), a town and summer resort of Liguria, Italy, in the province of Genoa, at the southern extremity of the peninsula which protects the Gulf of Spezia on the west, 7 m. S. of Spezia by road. Pop. (1901), 1553 (town); 5754 (commune). The fortress and walls with which it was provided by the Genoese in the 9th or 10th century have been destroyed for military reasons. The restored church of St Peter, of black and white marble (1118; destroyed by the Aragonese in 1494), is reputed to occupy the site of a temple of Venus. The parish church dates from 1098. Yellow-veined black marble, known as Portoro, and building-stone are quarried here and in the fortified island of Palmaria to the east of Portovenere. In the Grotta dei Colombi objects of the Palaeolithic age have been found.

PORT PHILLIP, the harbour of Melbourne, Victoria, Australia. An almost circular, landlocked sheet of water, it is 31 m. long, 20 m. at its widest, with an area of 800 sq. m. A narrow channel flanked by bold cliffs forms its entrance, and when the tide recedes through it a strong current is encountered outside. The broken and somewhat dangerous sea thus caused is called "the Rip." Within the port on the eastern side are suburbs of Melbourne, such as Sorrento, Mornington, Frankston, Carrum, Mordialloc, Redcliff, Brighton and St Kilda. The wharves of Port Melbourne and Williamstown stand at the head of the port on an arm known as Hobson's Bay. On the western side the port of Geelong and the port and watering-place of Queenscliff are the only towns of importance. Port Phillip is well fortified with strong batteries at its entrance. The harbour was discovered in 1802 by Lieut. Murray, who named it in honour of Captain Phillip, first governor of New South Wales. The colony of Victoria was originally called the district of Port Phillip.

PORT PIRIE, a town of Victoria county, South Australia, on Germein Bay, an arm of Spencer Gulf, 168¾ m. by rail N. by W.

of Adelaide. It is a prosperous and well-equipped port, from which enormous quantities of wheat are annually shipped. Pop. (1901), 7983.

PORTRAITURE. The earliest attempts at individual portraiture (see also PAINTING) are found in the eidolon and mummy-cases of the ancient Egyptians; but their painting never went beyond conventional representation—mere outlines filled in with a flat tint of colour. In Greece portraiture probably had its origin in skiagraphy or shadow-painting. The story of the Greek maiden tracing the shadow of her departing lover on the wall points to this. The art developed rapidly. In 463 B.C., Polygnotus, one of the first Greek painters of distinction, introduced individual portraiture in the decoration of public buildings, and Apelles nearly a century later showed so much genius in rendering character and expression, that Alexander the Great appointed him "portrait painter in ordinary," and issued an edict forbidding any one else to produce pictorial representations of his majesty. Similar edicts were issued in favour of the sculptor Lysippus and Pyrgoteles the gem engraver. No works of the Greek painters survive, but the fate of two portraits by Apelles, which were in the possession of the emperor Claudius (A.D. 41–54), is known, the heads having been painted out to make room for the features of the divine Augustus!

After the time of Alexander (300 B.C.) Greek art rapidly deteriorated. There is, perhaps, nothing in the history of human intelligence to compare with the dazzling swiftness of its development or the rapidity of its decline. War was followed by pillage and devastation, and victorious Roman generals, mere depredators and plunderers, crowded Rome with the stolen treasures of Greece, with the result that Greek art and Greek influence soon made themselves felt in the imperial city, and for generations its artists were almost exclusively Greeks, chiefly portrait painters and decorators. The Romans possessed no innate aptitude for art, and rather despised it as a pursuit little becoming the dignity of a citizen. Although lacking in appreciation of the higher conditions of art, they had from early times decorated their atria with effigies—originally wax moulds—of the countenances of their ancestors. These primitive "wax-works" ultimately developed into portrait busts, often vivid and faithful, the only branch of art in which Rome achieved excellence.

With the invasion of the Northern barbarians and the fall of the empire Graeco-Roman art ended. In the following centuries Christianity gradually became the dominant religion, but its ascetic temper could not find expression in the old artistic forms. Instead of joy in the ideals of bodily perfection, came a loathing of the body and its beauty, and artists were classed among "persons of iniquitous occupations." Before the 5th century these prejudices had relaxed, and images and pictures again came into general favour for religious uses. In the 8th and 9th centuries, the iconoclasts commenced their systematic destruction, and it was not till the Renaissance in the 13th century that art began again to live. The great revival brought with it a closer observation of the facts of nature and a growing sense of beauty, and the works of Cimabue and Giotto prepared the way for those of Benozzo Gozzoli, Ghirlandaio and the long line of masters who raised Italian art to such a height in the 15th and 16th centuries. Although the works of the early painters of the Renaissance were mostly devoted to the expression of the dogmas of the Church, the growing love and study of nature led them, as opportunity afforded, to introduce portraits of living contemporaries into their sacred pictures. Gozzoli (1420–1498) and Ghirlandaio (1449–1494) began the practice, followed by nearly all the old and great painters, of introducing portraiture into their works; Ghirlandaio especially filling some of his great fresco compositions with the forms and features of the living men and women of Florence, members of the Tornabuoni, Medici and other great families. Acuteness of observation was innate in the race. By degrees it manifested itself in a marvellous subtlety in the rendering of individual character, in the portrayal of individual men and women, and a school of portraiture was developed of which Titian became the crowning glory. This great Venetian painter, by universal consent reckoned one of the masters of portraiture, has handed down to us the features of many of the greatest historical and literary personages of his time—emperor, pope, king, doge—all sat by turn to him and loaded him with honours. The names of Bellini, Raffaelle, Tintoret, Veronese and Moroni of Bergamo occur among those of the great Italian portrait painters of the 15th and 16th centuries. The last-named, some of whose finest works are now in England, was highly praised by Titian.

A love of ugliness characterizes the artists of the early German and Flemish schools, and most of the portraits produced by them previous to Holbein's time suffer from this cause. Schöngauer, Dürer and Lucas Cranach are never agreeable or pleasant, however interesting in other respects. Dürer, the typical German artist, the dreamer of dreams, the theorist, the thinker, the writer, was less fitted by nature for a portrait painter than Holbein, who, with a keen sense of nature's subtle beauty, was a far greater painter although a less powerful personality. He produced many fine works in other branches, but it is as a portrait painter that Holbein is chiefly known, and his highest claims to fame will rest on his marvellous achievements in that branch of art. He first came to England in 1526, bringing with him letters of introduction from Erasmus. Sir Thomas More received him as his guest, and during his stay he painted More's and Archbishop Warham's portraits. In 1532 he was again in London, where till his death in 1543 he spent much of his time. He was largely employed by the German merchants of the Steelyard and many Englishmen of note, and afterwards by Henry VIII., by whom he was taken into permanent service with a pension. As a portrait painter Holbein is remarkable not only for his keen insight into the character of his sitters, but for the beauty and delicacy of his drawing. As colourist he may be judged by an admirable example of his work, "The Ambassadors," in the National Gallery in London. Many of his drawings appear to have been made as preliminary studies for his portraits.

In Flanders Jan van Eyck (1390–1440), his brother Hubert, Quintin Matsys, Memlinc and other artists of the 15th century occasionally practised portraiture. The picture of Jean Arnolfini and his wife, in the National Gallery, London, is a remarkable sample of the first-named artist, and the small half-length of young Martin van Nieumenhoven, in the hospital of St John at Bruges, of the last-named. Nearly a century later the names of Antony Mor (or Moro), Rubens and Van Dyck appear. Rubens, although not primarily a painter of portraits, achieved no small distinction in that way, being much employed by royalty (Maria de Medici, Philip IV. and the English Charles I. among the number). His services were also in request as ambassador or diplomatist, and thrice at least he was sent on missions of that nature. His personal energy and industry were enormous, but a large proportion of the work attributed to him was painted by pupils, of whom Van Dyck was one of the most celebrated. Van Dyck (1599–1641) early acquired a high reputation as a portrait painter. In 1632 he was invited to England by Charles I., and settled there for the remainder of his life. He was knighted by Charles, and granted a pension of £200 a year, with the title of painter to his majesty. Many of Van Dyck's portraits, especially those of the early and middle periods, are unsurpassed in their freshness, force and vigour of handling. He is a master among masters. England possesses many of his works, especially of his later period. To Van Dyck we owe much of our knowledge of what Charles I. and those about him were like. A routine practice, luxurious living, failing health, and the employment of assistants told upon his work, which latterly lost much of its early charm.

In Holland in the 17th century portraiture reached a high standard. A reaction had set in against Italian influence, and extreme faithfulness and literal resemblance became the prevailing fashion. The large portrait pictures of the members of gilds and corporations, so frequently met with in Holland, are characteristically Dutch. The earliest works of the kind are generally rows of portraits ranged in double or single lines, without much attempt at grouping or composition. Later, in the hands of painters like Rembrandt, Frans Hals and Van der Helst, these pictures of civic guards, hospital regents and masters of gilds assumed a very different character, and are among the very finest works produced by the Dutch portrait painters of the 17th century. They may be termed "subscription portraits"—each member of the gild who desired a place on the canvas agreeing, before the commission was given, to pay, according to a graduated scale, his share of the cost. Among the most famous examples of this class of portraits are "The Anatomy Lesson," "The March-out of Captain Banning Kock and his Company" (erroneously called "The Night Watch"), and "The Five Syndics of the Cloth-Workers' Guild," by Rembrandt. The magnificent portrait groups at Haarlem by Hals—the next greatest portrait painter of Holland after Rembrandt—and the "Schuttersmaaltyd" by Van der Helst in the Amsterdam Museum, which Reynolds considered "perhaps the first picture of portraits in the world," must also be mentioned.

Of the pictorial art of Spain previous to the 15th century, little, if any, survives. Flemish example was long paramount and Flemish painters were patronized in high places. In the 16th century the names of native Spanish artists began to appear—Morales, Ribera, Zurbaran, a great though not a professed portrait painter; and in the last year of the century Velasquez was born, the greatest of Spain's artists, and one of the great portrait painters of the world. None, perhaps, has ever equalled him in keen insight into character, or in the swift magic of his brush. Philip IV., Olivarez and Innocent X. live for us on his canvases. His constantly varying, though generally extremely simple, methods, explain to some extent the interest and charm his works possess for artists. Depth of feeling and poetic imagination were, however, lacking, as may be seen in his prosaic treatment of such subjects as the "Coronation of the Virgin," the "Mars" and other kindred works in the Madrid Gallery. Velasquez must be classed with those whose career has been prematurely cut short. His works often show signs of haste and of the scanty leisure which the duties of his office of "Aposentador Mayor" left him—duties which ended in the fatal journey to the Isle of Rhé.

In France the most distinguished portrait painters of the 16th and 17th centuries were the Clouets, Cousin, Vouet, Philippe de Champaigne, Rigaud and Vanloo. French portraiture, long inflated and artificial, reached the height of pomposity in the reigns of Louis XIV. and XV., the epoch of which the towering wig is the symbol. In the 18th and early part of the 19th centuries occur the names of Boucher, Greuze, David, Gérard and Ingres; but somehow the portraits of the French masters seldom attract and captivate in the same way as those of the Dutch and Italian painters.

Foreign artists were engaged for almost every important work in painting in England down to the days of Sir Joshua Reynolds and Gainsborough. Henry VIII. employed Holbein; Queen Mary, Sir Antonio Moro; Elizabeth, Zucchero and Lucas de Heere; James I. van Somer, Cornelius Janssens and Daniel Mytens; Charles I. Rubens, Van Dyck, Mytens, Petitot, Honthorst and others; and Charles II., Lely and Kneller, although there were native artists of merit, among them Dobson, Walker and Jamesone, a Scottish painter. Puritan England and Presbyterian Scotland did little to encourage the portrait painter. The attitude of the latter towards it may be inferred from an entry in the diary of Sir Thomas Hope, the Scottish Lord Advocate in 1638. "This day, Friday, William Jamesone, painter (at the earnest desyr of my sone Mr Alexander) was sufferit to draw my pictur." He does not even give the painter's name correctly, although Jamesone at the time was a man of some note in Scotland. At the commencement of the reign of George I. art in England had sunk to about the lowest ebb. With the appearance of William Hogarth (1697–1764) the English school of painting may be said to have commenced, and in Reynolds and Gainsborough it produced two portrait painters whose works hold their own with those of the masters of the 16th and 17th centuries. Both Sir Joshua and Gainsborough are seen at their best in portraits of women and children.

George Romney (1734–1802) shared with Reynolds and Gainsborough the patronage of the wealthy and fashionable of his day. Many of his female portraits are of great beauty. For some unknown reason he never exhibited his works in the Royal Academy.

Sir Henry Raeburn (1756–1823) was a native of Edinburgh, and spent most of his life there. His portraits are broad and effective in treatment, masterly and swift in execution and often fine in colour. He painted nearly all the distinguished Scotsmen of his time—Walter Scott, Adam Smith, Braxfield, Robertson the historian, Dugald Stewart, Boswell, Jeffrey, Professor Wilson and many of the leading noblemen, lairds, clergy and their wives and daughters. For a considerable period his portraits were little known out of Scotland, but they are now much sought after, and fine examples appearing in London sale-rooms bring remarkable prices. Raeburn's immediate successor in Scotland, J. Watson Gordon (1788–1864), also painted many excellent portraits, chiefly of men. A very characteristic example of his art at its best may be seen in his "Provost of Peterhead" in the Scottish National Gallery.

Sir Thomas Lawrence (1769–1830) was the favourite English portrait painter of his time, and had an almost unrivalled career. He had an immense practice, and between the years 1787 and 1830 exhibited upwards of three hundred portraits in the Royal Academy alone. The Waterloo Gallery at Windsor contains some of his best work, chiefly painted in 1818–1819, including his portraits of the emperor Francis, Pope Pius VII. and Cardinal Gonsalvi. He was loaded with honours, and died President of the Royal Academy.

Sir J. E. Millais (1829–1896), although most widely known as a painter of figure subjects, achieved some of his greatest successes in portraiture, and no artist in recent years has approached him as a painter of children. His portraits of Gladstone, Sir James Paget, Sir Gilbert Greenall, Simon Fraser, J. C. Hook and Mrs. Bischoffsheim, to name only a few, are alone sufficient to give him a high place among British portrait painters.

Frank Holl (1845–1888) first came into note as a portrait painter in 1878, and during the subsequent nine years of his life he painted upwards of one hundred and ninety-eight portraits, an average of over twenty-two a year. The strain, however, proved too great for a naturally delicate constitution, and he died at the age of forty-three—another instance of a brilliant career prematurely cut short. To G. F. Watts (1820–1904) we are indebted for admirable portraits of many of the leading men of the Victorian era in politics, science, literature, theology and art. Among more recent artists, Sir W. Q. Orchardson (1835–1910), like Millais more widely known as a painter of figure subjects, but also admirable as a portrait painter; John Sargent (1856–), whose brilliant and vigorous characterization of his sitters leaves him without a rival; as well as Ouless, Shannon, Fildes, Herkomer and others, have worthily carried on the best traditions of the art.

In France contemporary portraiture is ably represented in the works of Carolus-Duran, Bonnat and Benjamin Constant, and in Germany by Lenbach, who has handed down to posterity with uncompromising faithfulness the form and features of Prince Bismarck.

Of portraiture in its other developments little need be said. Miniature painting, which grew out of the work of the illuminator, appears to have been always successfully practised in England. The works of Hilliard, Isaac and Peter Oliver, Samuel Cooper, Hoskins, Engleheart, Plimer and Cosway hold their own with the best of the kind; but this beautiful art, like that of the engraver, has been largely superseded by photography and the "processes" now in use.

It is unnecessary to refer to the many uses of portraiture, but one of its chiefest has been to transmit to posterity the form and features of those who have played a part, worthy or otherwise, in the past history of our race. Of its value to the biographer and historian, Carlyle, in a letter written in 1854, says, "In all my poor historical investigations it is one of the most primary wants to procure a bodily likeness of the personage inquired after; a good *portrait*, if such exists; failing that, even an indifferent, if sincere one; in short, *any* representation, made by a faithful human creature, of that face and figure which *he* saw with his eyes and which I can never see with mine. Often I have found the portrait superior in real instruction to half-a-dozen written biographies, or rather, I have found the portrait was as a small lighted *candle*, by which the biographies could for the first time be *read*, and some human interpretation be made of them." (G. Re.)

PORT RICHMOND, a part of the borough of Richmond in the city of New York, U.S.A., on the N. shore of Staten Island and on the Kill van Kull Channel. Before 1898 it was a separate village of Richmond county, New York, containing 6290 inhabitants in 1890. It is served by the Staten Island Rapid Transit railway, and by a ferry to Bergen Point, New Jersey, and has steam and electric railway connexions with the municipal ferry at St George, which furnishes easy access to the business districts on Manhattan Island. Among its places of historic interest are the Dutch Reformed Church, which is the direct successor of the church established on Staten Island in 1664 or 1665 by Waldenses and Huguenots; and the Danner Hotel, built soon after the War of Independence on the site of a temporary fort that had been erected by British troops, and used as a private dwelling until 1820. In this house Aaron Burr spent the last years of his life, dying there on the 14th of September 1836. Among the industrial establishments are a shipyard, dry dock and manufactories of flour, lumber, lead paint and builders' supplies. On the first of January 1898, when the act creating Greater New York came into effect, the village became a part of the third ward of Richmond borough.

PORT ROYAL, a celebrated Cistercian abbey, occupied a low and marshy site in the thickly wooded valley of the Yvette, at what is now known as Les Hameaux near Marly, a few miles south-west of Paris. It was founded in 1204 by Mahaut de Garlande, wife of Mathieu de Montmorenci-Marli in 1204; the church was built in 1229 from the designs of Robert de Luzarches. During its early years the convent received a number of papal privileges; the most important of these, granted by Honorius III. in 1223, authorized it to offer a retreat to women anxious to withdraw from the world without binding themselves by perpetual vows. Little is known of its history during the three succeeding centuries, except that its discipline became relaxed; reform was only attempted when Angélique Arnauld (*q.v.*) was appointed coadjutor to the elderly and invalid abbess in 1598. Angélique's reforming energy soon brought her into contact with Jean Duvergier (*q.v.*) abbot of Saint Cyran, and chief apostle in France of the Jansenist revival, and the later history of her convent is indissolubly connected with this movement.

In 1626 constant visitations of ague drove the nuns to Paris; they settled at Port Royal de Paris, at the end of the Faubourg Saint Jacques. The deserted buildings of Port Royal des Champs were presently occupied by "hermits," laymen, mostly relatives of the abbess, who wished for a semi-monastic existence, though without taking formal vows. In 1648, however, some of the nuns returned to the country, and the hermits retreated to buildings at a short distance from the abbey. Here they set up a "little school" for the sons of Jansenist parents; and here Jean Racine, the future poet, received his education. But in 1653 Innocent X. condemned the doctrines of Jansen. Three years later "the hermitage" and school were broken up, and the nuns were forbidden to receive new members into their community. These rigours were much increased when Louis XIV. took up the reins of government in 1660; between 1664 and 1669 the archbishop of Paris laid under an interdict those of the nuns who refused to subscribe the papal censure on Jansen. In 1669, however, came the so-called "Peace of Clement IX.," when the Jansenists generally were admitted to grace, and the interdict was removed from Port Royal, though the authorities broke up the convent into two distinct communities. The conformist nuns were gathered together at Port Royal de Paris, under an independent abbess; their Jansenist sisters were united at the original building in the country. Thereupon followed ten years of peace, for the nuns had a powerful protector in the king's cousin, Mme de Longueville. But in 1679 she died, and Louis at once ordered the nuns to send away their novices and boarders and to receive no others. Finally, in 1705, he got from Clement XI. a new condemnation of the Jansenists, which the few remaining nuns, all of whom were over sixty, refused to sign; and on the 29th of October 1709 they were forcibly removed from Port Royal by the police, and distributed among various conformist convents. In the following spring the buildings were pulled down; even the cemetery was not spared. The land on which the convent had stood was made over to Mme de Maintenon's college of St Cyr; in 1825 it was bought by some descendants of Jansenist families, who have done their best to restore the grounds to their original appearance, and have built a museum rich in Jansenist relics. Port Royal de Paris was secularized at the French Revolution, and is now a maternity hospital.

For a classified list of the chief books, ancient and modern, dealing with Port Royal, see the *Abrégé de l'histoire de Port Royal*, by Jean Racine, ed. E. Gazier (Paris, 1908). See also C. A. Sainte-Beuve, *Port Royal* (6 vols. and index, Paris, 1882); Charles Beard, *Port Royal* (2 vols., London, 1861); H. Reuchlin, *Geschichte von Port Royal* (2 vols., Hamburg, 1839–1844), and the books recommended under the articles Arnauld, Jansenism and Pascal.

PORT ROYAL, an island in Beaufort county, South Carolina, U.S.A., at the head of Port Royal Sound, about 16 m. from the Atlantic coast, and about 50 m. S.W. of Charleston. It is about 13 m. long (north and south) by about 7 m. wide. The surface is generally flat, and there is much marshland in its southern part, and along its north-eastern shore. The principal settlement is Beaufort, a port of entry, and the county-seat of Beaufort county, on the Beaufort river (here navigable for vessels drawing 18 ft.), about 11 m. from its mouth, and about 15 m. from the ocean. Pop. (1900) 4110 (3220 negroes); (1910) 2486. It is served by the Charleston & Western Carolina railway, has inland water communication with Savannah, Georgia, and its harbour, Port Royal Sound (between Bay Point on the north-east and Hilton Head on the south-west), is one of the largest and best on the coast of South Carolina. Beaufort's beautiful situation and delightful climate make it a winter resort. In the vicinity Sea Island cotton, rice, potatoes and other vegetables are raised—the truck industry having become very important; and there are groves of yellow pine and cypress. Large quantities of phosphate rock were formerly shipped from here. Among the manufactures are cotton goods, canned oysters, lumber and fertilizer. About 5 m. south of Beaufort is the town of Port Royal (pop. in 1910, 363), a terminus of the Charleston & Western Carolina railway. On the Beaufort River (eastern) shore of Paris Island, about 6 m. north of Bay Point, is a United States naval station, with a dry dock and repair shop.

Jean Ribaut (1520–1565), leading an expedition sent out by Admiral Gaspard de Coligny (1517–1572) to found a Huguenot colony in New France, sailed into the harbour, which he named Port Royal, on the 27th of May 1562, took possession of the region in the name of Charles IX., and established the first settlement (Fort Charles), probably on Paris Island. In June he sailed for France, leaving 26 volunteers under Captain Albert de la Pierria. Soon afterward the garrison killed Pierria (probably because of the severity of his discipline), and put to sea in an insufficiently equipped vessel, from which, after much suffering, they were rescued by an English ship, and taken to England. In 1670, a company under Colonel William Sayle (d. 1671) landed on Port Royal Island, but probably because this site exposed them to Spanish attacks, proceeded along the coast and founded the original Charles Town (see Charleston). In 1683, several families, chiefly Scotch, led by Henry Erskine, third Lord Cardross (1650–1693), established on the island a settlement named Stuart's Town (probably in honour of Cardross's family); but three years later most of the settlers were murdered by Spaniards from Florida and the remainder fled to Charleston. In 1710, after the lords proprietors had issued directions for "the building of a town to be called Beaufort Town," in honour of Henry Somerset, duke of Beaufort (1629–1700), the first permanent settlement was established on the island. The town was incorporated in 1803. In January 1779 about 200 British soldiers occupied the island by order of Colonel Augustine Prevost, but they were dislodged (Feb. 3) by about 300

Americans, mostly militiamen, under General William Moultrie. At the beginning of the Civil War the Confederates erected Fort Walker on Hilton Head, and Fort Beauregard on Bay Point. Captain (afterwards Admiral) Samuel F. Du Pont and General Thomas W. Sherman organized an expedition against these fortifications, which were reduced by a naval bombardment and were evacuated by the Confederates under General Thomas F. Drayton (d. 1891) on the 7th of November 1861. During the remainder of the war Port Royal Harbour was used as a coaling, repair and supply station by the Federal blockading squadron. Early in 1862 Port Royal Island and the neighbouring region became the scene of the so-called "Port Royal Experiment"—the successful effort of a group of northern people, chiefly from Boston, New York and Philadelphia, among whom Edward S. Philbrick (d. 1889) of Massachusetts was conspicuous, to take charge of the cotton plantations, deserted upon the occupation of the island by Union troops, and to employ the negroes under a system of paid labour. The volunteers organized as the Educational Commission for Freedmen (afterward the New England Freedmen's Aid Society), and the government granted them transportation, subsistence and quarters, and paid them small salaries.

See Edward McCrady's *History of South Carolina* (New York, 1897–1901); and, for an account of the Port Royal Experiment, *Letters from Port Royal* (Boston, 1906), edited by Elizabeth W Pearson.

PORTRUSH, a seaport and the most popular seaside resort of Co. Antrim, Ireland; the terminus of a branch of the Northern Counties (Midland) railway. Pop. (1901), 1941. It is very picturesquely situated on the basaltic peninsula of Ramore Head, with a deep bay on either side, and a harbour protected by the natural breakwater known as the Skerries. A fine hotel, owned by the railway company, and an excellent golf course are the chief features, together with a town-hall with public reading room, and the place is much frequented for golf and sea-bathing. It is also the centre for visitors to the Giants' Causeway, with which it is connected by an electric railway. Dunluce Castle, between Portrush and Bushmills, stands on a rock separated from the mainland by a chasm which is spanned by a bridge. The ruins, which are extensive, are of unknown date. Portrush has a thriving trade in salmon. It is governed by an urban district council.

PORT SAID, a seaport of Egypt, at the northern entrance of the Suez Canal, in 31° 15′ 35″ N., 32° 19′ 20″ E., and 145 m. by rail N.E. of Cairo. Pop. (1907), 49,884. It lies on the western side of the canal on the low, narrow, treeless and desolate strip of land which separates the Mediterranean from Lake Menzala, the land at this point being raised and its area increased by the draining of part of the lake and by the excavation of the inner harbour. The outer harbour is formed by two breakwaters which protect the entrance to the canal; altogether the harbour covers about 570 acres and accommodates ships drawing 28 ft. Originally besides the central basin of the inner harbour there were three docks; between 1903 and 1909 the harbour accommodation was doubled by the construction of new docks on the eastern side of the canal and by enlarging the western docks. The port possesses a floating dock 295 ft. long, 85 ft. broad and 18 ft. deep, capable of lifting 3500 tons, and a patent slip taking 300 tons and ships drawing 9 ft. 9 in. of water. On the western breakwater is a colossal statue of Ferdinand de Lesseps by E. Fremiet, unveiled in 1899, and a lighthouse 174 ft. high. Among the few buildings of note in the town are the offices of the Suez Canal Company and the British barracks, the last named having been built by Prince Henry of the Netherlands (d. 1879) as a dépôt for Dutch trade.

Port Said dates from 1859 and its situation was determined by the desire of the engineers of the Suez Canal to start the canal at the point on the Mediterranean coast of the isthmus of Suez nearest to deep water, and off the spot where Port Said now stands there was found a depth of 26 ft. at about 2 m. from the shore. For many years after its foundation it depended entirely upon the traffic of the canal, being the chief coaling station of all ships passing through and becoming the largest coaling station in the world. The population was of a very heterogeneous character, but mainly of an undesirable class of Levantines; this with the damp heat and the dirt and noise of the incessant coaling operations gave the town an unenviable reputation. In 1902, however, a new industry was added in the export of cotton from the eastern provinces of the Delta, the cotton being brought from Mataria by boat across Lake Menzala. In 1904 the opening of a standard gauge railway to Cairo placed Port Said in a position to compete with Alexandria for the external trade of Egypt generally, besides making it a tourist route to the capital from Europe. The result was to attract to the town a considerable commercial community and to raise its social status. A new suburb was created by reclaiming land on the north foreshore, and another suburb was created on the eastern side of the canal. The average annual value of the trade of the port for the five years 1902–1906 was £2,410,000. This figure includes the value of the coal used by vessels passing through the Suez Canal.

PORTSMOUTH, EARLS OF. In 1743 John Wallop (1690–1762) of Farley Wallop in Hampshire was created earl of Portsmouth. He belonged to an old Hampshire family and had been a lord of the treasury from 1717 to 1720, when he was created Baron Wallop. The earldom has since been held by his descendants, one of whom, Newton Wallop (b. 1856), became the 6th earl in 1891. This earl was a member of parliament from 1880 to 1891 and was under secretary of state for war from 1905 to 1908.

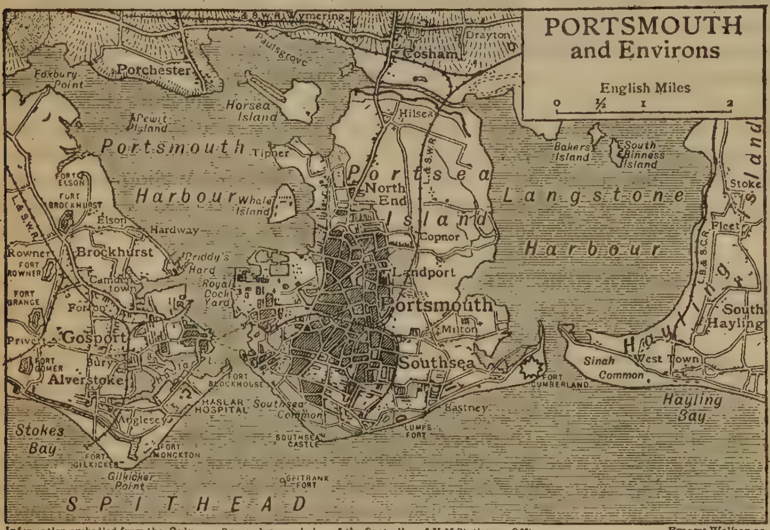
PORTSMOUTH, LOUISE DE KÉROUALLE, DUCHESS OF (1649–1734), mistress of the English king Charles II., was the daughter of Guillaume de Penancourt and his wife Marie de Plaeuc de Timeur. The name of Kéroualle was derived from an heiress whom her ancestor François de Penhoët had married in 1330. The family were nobles in Brittany, and their name was so spelt by themselves. But the form Querouailles was commonly used in England, where it was corrupted into Carwell or Carewell, perhaps with an ironic reference to the care which the duchess took to fill her pocket. In France it was variously spelt Queroul, Kéroual and Kéroël. The exact date of her birth is apparently unknown. Louise was placed early in life in the household of Henriette, duchess of Orleans, sister of Charles II. Saint-Simon asserts that her family threw her in the way of Louis XIV. in the hope that she would be promoted to the place of royal mistress. In 1670 she accompanied the duchess of Orleans on a visit to Charles II. at Dover. The sudden death of the duchess, attributed on dubious evidence to poison, left her unprovided for, but the king placed her among the ladies in waiting of his own queen. It was said in after times that she had been selected by the French court to fascinate the king of England, but for this there seems to be no evidence. Yet when there appeared a prospect that the king would show her favour, the intrigue was vigorously pushed by the French ambassador, Colbert de Croissy, aided by the secretary of state, Lord Arlington, and his wife. Louise, who concealed great cleverness and a strong will under an appearance of languor and a rather childish beauty (Evelyn the diarist speaks of her "baby face"), yielded only when she had already established a strong hold on the king's affections and character. Her son, ancestor of the dukes of Richmond, was born in 1672.

The support she received from the French envoy was given on the understanding that she should serve the interests of her native sovereign. The bargain was confirmed by gifts and honours from Louis XIV. and was loyally carried out by Louise. The hatred openly avowed for her in England was due as much to her own activity in the interest of France as to her notorious rapacity. The titles of Baroness Petersfield, countess of Fareham and duchess of Portsmouth were granted her for life on the 19th of August 1673. Her pensions and money allowances of various kinds were enormous. In 1677 alone she received £27,300. The French court gave her frequent presents, and in December 1673 conferred upon her the ducal fief of Aubigny at the request of Charles II. Her thorough understanding of the king's character enabled her to retain her hold on him to the end. She contrived to escape uninjured during the crisis of the Popish Plot in 1678. She was strong enough to maintain her position during a long illness in 1677, and a visit to France in 1682. In February 1685 she took measures to see that the king, who was secretly a Roman Catholic, did not die without confession and absolution. Soon after the king's death she retired to France, where, except for one short visit to England during the reign of James II., she remained. Her pensions and an outrageous grant on the Irish revenue given her by

Charles II. were lost either in the reign of James II. or at the Revolution of 1688. During her last years she lived at Aubigny, and was harassed by debt. The French king, Louis XIV., and after his death the regent Orleans, gave her a pension, and protected her against her creditors. She died at Paris on the 14th of November 1734.

See H. Forneron, *Louise de Kéroualle* (Paris, 1886); and Mrs Colquhoun Grant, *From Brittany to Whitehall* (London, 1909).

PORTSMOUTH, a municipal, county and parliamentary borough, and seaport of Hampshire, England, 74 m. S.W. from London, on the London & South-Western and the London, Brighton & South Coast railways. Pop. (1891), 159,278; (1901), 188,133. This great naval station and arsenal is an aggregate of four towns, Portsmouth, Portsea, Landport and Southsea, and occupies the south-western part of Portsea Island, which lies between Portsmouth Harbour and Langstone Harbour, two inlets of the English Channel. Portsmouth Harbour opens into Spithead, one of the arms of the Channel separating the Isle of Wight from the mainland. The harbour widens inwards in bottle form, Portsmouth lying on the east shore of the neck, with Gosport opposite to it on the west side. Portsmouth proper may be distinguished as the garrison town; Portsea as the naval station with the dockyards; Landport is occupied chiefly by the houses of artisans; and Southsea is a residential quarter and a favourite watering-place. Besides a number of handsome modern churches, among which is a Roman Catholic cathedral, Portsmouth possesses, in the church of St Thomas à Becket, a fine cruciform building dating from the second half of the 12th century, in which the chancel and transepts are original, but the nave and tower date from 1698, and the whole was extensively restored in 1904. The garrison chapel originally belonged to the hospital of St Nicholas, a foundation of the 13th century. Among other buildings worthy of mention (apart from those having naval or military connexion) the principal is the town-hall (1890), a fine classic building standing alone in a square, and surmounted by a handsome clock tower. Among educational institutions there are a large grammar school (1879), on a foundation of 1732, Roman Catholic schools adjoining the cathedral, schools for engineering students and dockyard apprentices, and seamen and marines' orphan school. Aria College in Portsea was opened in 1874 for the training of Jewish ministers. Victoria Park, in the heart of the town, contains a monument to Admiral Napier. There are recreation grounds for the naval and military forces in the vicinity. There is a railway station (Portsmouth Harbour) on the Hard, from which passenger steamers serve Ryde in the Isle of Wight. A ferry and a floating bridge connect with Gosport. The port has a considerable trade in coal, timber, fruits and agricultural produce. The parliamentary borough returns two members. The county borough was created in 1888. The municipal borough is under a mayor, 14 aldermen and 42 councillors. Area, 5010 acres.



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Emery Walker sc.

The dockyard seems to have been regularly established about 1540, but long before that date the town was of importance as a naval station and was used for the accommodation of the king's ships. In 1540 it covered 8 acres of ground, abutting on the harbour near the "King's Stairs." Cromwell added 2 acres in 1658, and Charles II. added 8 in 1663 and 10 more in 1667. By 1710 30 acres more had been reclaimed or bought, and by the end of the 18th century the total area was 90 acres. In 1848 a steam basin, covering 7 acres, and four new docks were opened, the dockyard ground being extended to 115 acres in all. In 1865 large extension works were decided upon, increasing the area to 293 acres. These included a tidal basin and, opening out of it, a deep dock and two locks, in themselves serving as large docks, which lead to three basins and four docks. An entrance was also formed between the new tidal basin and the steam basin of 1848, and large additions were made to the wharfage accommodation as well as to the storehouses and factories. Subsequent improvements included the formation of two new dry docks (1896) with a floor-length of 557 ft. and a depth of 33½ ft. over the sill at high water of spring tides; the construction of new jetties at the entrance to the tidal basin and at the north wall; the establishment of a coal wharf with hydraulic appliances; a torpedo range in the harbour; the erection of various buildings such as torpedo and gun-mounting stores, electrical shops and numerous subsidiary works; and extensive dredging of the harbour to increase the berthing accommodation for the fleet. Altogether the dockyard comprises 15 dry docks, 60 acres of enclosed basins, 18,400 ft. of wharfage and about 10 m. of railway. There is a gunnery establishment in the harbour on Whale Island, the area of which has been increased to nearly 90 acres by the accretion of material excavated from the dockyard extension works, and various barracks including those of the royal marine artillery at Eastney, beyond Southsea.

Portsmouth (*Portsmue, Portesmuth*) owes its origin to the retreat of the sea from Porchester, and its importance to its favourable position for a naval station. Though probably the site had long been recognized as a convenient landing-place, no town existed there until the 12th century, when the strategical advantage it offered induced Richard I. to build one. He granted a charter in 1194 declaring that he retained the borough in his hand, and granting a yearly fair and weekly market, freedom from certain tolls, from shire and hundred court and sheriffs' aids. In October 1200 King John repeated the grants, and Henry III. in 1229 gave the "men of Portsmouth" the town in fee farm and granted a merchant gild. Confirmations were made by successive kings, and a charter of incorporation was given by Elizabeth in 1599–1600. A new and enlarged charter was granted by Charles I. in 1627, by which the borough is now governed subject to changes by the municipal acts of the 19th century. Portsmouth has returned two members to parliament since 1295. A fair on the 1st of August and fourteen following days was granted by Richard I. The first day was afterwards changed to the 29th of June and later to the 11th of July. It was important as a trading fair for cutlery, earthenware, cloth and Dutch metal, and was abolished in 1846. The market, dating from 1194 and originally held on Thursday only, is now held on Tuesday and Saturday in addition. Portsmouth was important in the middle ages not only as a naval station but a trading centre. There was a considerable trade in wool and wine, and the building of the dockyards by Henry VII. further increased its prosperity.

See *Victoria County History: Hampshire*, iii. 172 seq.; R. East, *Extracts from the Portsmouth Records.*

PORTSMOUTH, a city, port of entry and one of the county-seats of Rockingham county, New Hampshire, U.S.A., on the Piscataqua river, about 3 m. from the Atlantic Ocean, about 45 m. E.S.E. of Concord, and about 54 m. N.N.E. of Boston. Pop. (1910 U.S. census) 11,269. Area, 17 sq. m. Portsmouth is served by the Boston & Maine railway, by electric lines to neighbouring towns, and in summer by a steamboat daily to the Isles of Shoals. The city is pleasantly situated, mainly on a peninsula, and has three public parks. Portsmouth attracts many visitors during the summer season. In Portsmouth are an Athenaeum (1817), with a valuable library; a public library (1881); a city hall; a county court house; a United States customs-house; a soldiers' and sailors' monument; an equestrian monument by James Edward Kelly to General Fitz John Porter; a cottage hospital (1886); a United States naval hospital (1891); a home for aged and indigent women (1877); and the Chase home for children (1877).

A United States navy yard, officially known as the Portsmouth Navy Yard, is on an island of the Piscataqua but within the township of Kittery, Maine. In 1800 Fernald's Island was purchased by the Federal government for a navy yard; it was the scene of considerable activity during the War of 1812, but was of much greater importance during the Civil War, when the famous "Kearsarge" and several other war vessels were built here.[1] In 1866 the yard was enlarged by connecting Seavey's Island with Fernald's; late in the 19th century it was equipped for building and repairing steel vessels. It now has a large stone dry dock. On Seavey's Island Admiral Cervera and other Spanish officers and sailors captured during the Spanish-American War were held prisoners in July—September 1898. Subsequently a large naval prison was erected. In 1905 the treaty ending the war between Japan and Russia was negotiated in what is known as the Peace Building in this yard.

In 1905 the city's factory products were valued at $2,602,056. During the summer season there is an important trade with the neighbouring watering-places; there is also a large transit trade in imported coal, but the foreign commerce, consisting wholly of imports, is small.

Portsmouth and Dover are the oldest permanent settlements in the state. David Thomson with a small company from Plymouth, England, in the spring or early summer of 1623 built and fortified a house at Little Harbor (now Odiorne's Point in the township of Rye) as a fishing and trading station. In 1630 there arrived another band of settlers sent over by the Laconia Company. They occupied Thomson's house and Great Island (New Castle) and built the "Great House" on what is now Water Street, Portsmouth. This settlement, with jurisdiction over all the territory now included in Portsmouth, New Castle and Greenland, and most of that in Rye, was known as "Strawberry Banke" until 1653, when it was incorporated (by the government of Massachusetts) under the name of Portsmouth. There was from the first much trouble between its Anglican settlers sent over by Mason and the Puritans from Massachusetts, and in 1641 Massachusetts extended her jurisdiction over this region. In 1679, however, New Hampshire was constituted a separate province, and Portsmouth was the capital until 1775. In 1693 New Castle (pop. 1900, 581), then including the greater part of the present township of Rye, was set apart from Portsmouth, and in 1703 Greenland (pop. 1900, 607) was likewise set apart. One of the first military exploits of the War of Independence occurred at New Castle, where there was then a fort called William and Mary. In December 1774 a copy of the order prohibiting the exportation of military stores to America was brought from Boston to Portsmouth by Paul Revere, whereupon the Portsmouth Committee of Safety organized militia companies, and captured the fort (Dec. 14). In 1849 Portsmouth was chartered as a city.

Portsmouth was the birthplace of Governor Benning Wentworth (1696–1770) and his nephew Governor John Wentworth (1737–1820); of Governor John Langdon (1739–1819); of Tobias Lear (1762–1816), the private secretary of General Washington from 1785 until Washington's death, consul-general at Santo Domingo in 1802–1804, and negotiator of a treaty with Tripoli in 1805; of Benjamin Penhallow Shillaber (1814–1890), humorist, who is best known by his *Life and Sayings of Mrs Partington* (1854); of James T. Fields, of Thomas Bailey Aldrich and of General Fitz John Porter. From 1807 to 1816 Portsmouth was the home of Daniel Webster.

PORTSMOUTH, a city and the county-seat of Scioto county, Ohio, U.S.A., picturesquely situated at the confluence of the Scioto and Ohio rivers, 95 m. S. of Columbus. Pop. (1910 U.S. census) 23,481. Portsmouth is served by the Baltimore & Ohio South-Western, the Chesapeake & Ohio and the Norfolk & Western railways, also by passenger and freight boats to Pittsburg, Cincinnati and intermediate ports. The city has a Carnegie library, a municipal hospital, an aged women's home and a children's home. Extending along the Ohio for 8 m. and arranged in three groups are works of the "Mound Builders." There are two small city parks, and a privately owned resort, Millbrook Park. The surrounding country is a fine farming region, which also abounds in coal, fire-clay and building stone. Natural gas is used for light, heat and power. In 1905 the city's factory products were valued at $7,970,674, of which $4,258,855 was the value of boots and shoes. The Norfolk & Western has division terminals here.

The first permanent settlement in the immediate vicinity was made in 1796. In 1799 Thomas Parker, of Alexandria, Virginia, laid out a village (which was named Alexandria) below the mouth of the Scioto, but as the ground was frequently flooded the village did not thrive, and about 1810 the inhabitants removed to Portsmouth. Portsmouth was laid out in 1803, incorporated as a town in 1815, and chartered as a city in 1851. The Ohio and Erie canal was opened from Cleveland to Portsmouth in 1832.

PORTSMOUTH, a city of Norfolk county, Virginia, U.S.A., on the Elizabeth river opposite Norfolk. Pop. (1910, census), 33,190. Portsmouth is served by the Atlantic Coast Line, the Seaboard Air Line, the Chesapeake & Ohio and the New York, Philadelphia & Norfolk (Pennsylvania system), the Southern, and the Norfolk & Western railways, by steamboat lines to Washington, Baltimore, New York, Providence and Boston, by ferries to Norfolk, and by electric lines to numerous suburbs. There is a 30-ft. channel to the ocean. Portsmouth is situated on level ground only a few feet above the sea; it has about 2½ m. of water-front, and adjoins one of the richest trucking districts in the Southern States. Among the principal buildings are the county court house, city hall, commercial building, United States naval hospital, post office building, high school and the Portsmouth orphan asylum, King's Daughters' hospital and the old Trinity Church (1762). In the southern part of the city is a United States navy yard and station, officially the Norfolk Yard (the second largest in the country), of about 450 acres, with three immense dry docks, machine shops, warehouses, travelling and water cranes, a training station, torpedo-boat headquarters, a powder plant (20 acres), a naval magazine, a naval hospital and the distribution headquarters of the United State Marine Corps. The total value of the city's factory products in 1905 was only $145,439. The city is a centre of the Virginia oyster "fisheries." Portsmouth and Norfolk form a customs district, Norfolk being the port of entry, whose exports in 1908 were valued at $11,326,817, and imports at $1,150,044.

Portsmouth was established by act of the Virginia assembly in 1752, incorporated as a town in 1852 and chartered as a city in 1858. Though situated in Norfolk county, the city has been since its incorporation administratively independent of it. Shortly before the War of Independence the British established a marine yard where the navy yard now is, but during the war it was confiscated by Virginia and in 1801 was sold to the United States. In April 1861 it was burned and abandoned by the Federals, and for a year afterwards was the chief navy yard of the Confederates. Here was constructed the iron-clad "Virginia" (the old "Merrimac"), which on the 9th of March 1862 fought in Hampton Roads (*q.v.*) the famous engagement with the "Monitor." Two months later, on the 9th of May, the Confederates abandoned the navy yard and evacuated Norfolk and Portsmouth, and the "Virginia" was destroyed by her commander, Josiah Tattnall.

PORT SUDAN, a town and harbour on the west coast of the Red Sea, in 19° 37′ N. 37° 12′ E., 700 m. by boat S. of Suez and 495 m. by rail N.E. of Khartum. Pop. (1906), 4289. It is the principal port of the Anglo-Egyptian Sudan and the headquarters of the customs administration. The coral reefs fringing the coast are here broken by a straight channel with deep water giving access to the harbour, which consists of a series of natural channels and basins. The largest basin is 900 yds. long by 500 broad and has a minimum depth of 6 fathoms. On the north side of the inlet are quays (completed 1909), fitted with electric cranes, &c. Here are the customs-house, coal sheds and goods station. The town proper lies on the south side of the inlet, connected with the quays by a railway bridge. Besides government offices the public buildings include hospitals, and a branch of the Gordon College of Khartum. Beyond the bridge in the upper waters of the inlet is a dry dock. The climate of Port Sudan is very hot and damp and fever is common. Adjacent to the town is an arid plain without vegetation other than mimosa thorns. Some 10 m. west is a line of hills parallel to the coast.

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[1] See Captain G. H. Preble, "Vessels of War built at Portsmouth, N. H. 1690–1868," in *New England Historical and Genealogical Register*, vol. xxii. (Boston, 1868); and W. E. Fentress, *Centennial History of the U.S. Navy Yard at Portsmouth, N. H.* (Portsmouth, 1876).

The port dates from 1905. It owes its existence to the desire of the Sudan administration to find a harbour more suitable than Suakin (*q.v.*) for the commerce of the country. Such a place was found in Mersa Sheikh Barghut (or Barud), 36 m. north of Suakin, a harbour so named from a saint whose tomb is prominent on the northern point of the entrance. When the building of the railway between the Nile and the Red Sea was begun, it was determined to create a port at this harbour—which was renamed Port Sudan (Bander es-Sudan). Up to the end of 1909 the total expenditure by the government alone on the town and harbour-works was £E914,320. The railway (which has termini both at Port Sudan and Suakin) was opened in January 1906 and the customs-house in the May following. Port Sudan immediately attracted a large trade, the value of goods passing through it in 1906 exceeding £470,000. In 1908 the imports and exports were valued at about £750,000. It is a regular port of call of British, German and Italian steamers. The imports are largely cotton goods, provisions, timber and cement; the exports gum, raw cotton, ivory, sesame, durra, senna, coffee (from Abyssinia), goat skins, &c. Forty miles north of Port Sudan is Mahommed Gul, the port for the mines of Gebet, worked by an English company.

The Foreign Office Report, *Trade of Port Sudan for the Year 1906*, by T. B. Hohler, gives a valuable account of the beginnings of the port. A chart of the harbour was issued by the British Admiralty in 1908. See also SUDAN: § *Anglo-Egyptian*.

PORT TOWNSEND, a city, port of entry and the county-seat of Jefferson county, Washington, U.S.A., on Quimper Peninsula, at the entrance to Puget Sound, about 40 m. N.N.W. of Seattle. Pop. (1905), 5300; (1910), 4181. The city is served by the Port Townsend Southern railway (controlled by the Northern Pacific, but operated independently) and by steamship lines to Victoria (British Columbia), San Francisco, Alaska and Oriental ports. The harbour is 7½ m. long and 3½ m. wide, and is deep, well sheltered and protected by three forts, of which Fort Worden is an excellently equipped modern fortification ranking with the forts at Portland (Maine), San Francisco, Boston and New York. The United States government has at Port Townsend a customs-house, a revenue cutter service, a marine hospital, a quarantine station and an immigration bureau. Port Townsend is the port of entry for the Puget Sound customs district. In 1908 its exports were valued at $37,547,553, much more than those of any other American port of entry on the Pacific; its imports were valued in 1908 at $21,876,361, being exceeded among the Pacific ports by those of San Francisco only. The city has a considerable trade in grain, lumber, fish, livestock, dairy products and oil; its manufactures include boilers, machinery and canned and pickled fish, especially salmon and herring. Port Townsend was settled in 1854, incorporated as a town in 1860 and chartered as a city in 1890.

PORTUGAL, a republic of western Europe, forming part of the Iberian Peninsula, and bounded on the N. and E. by Spain, and on the S. and W. by the Atlantic Ocean. Pop. (1900), 5,016,267; area, 34,254 sq. m. These totals do not include the inhabitants and area of the Azores and Madeira Islands, which are officially regarded as parts of continental Portugal. In shape the country resembles a roughly drawn parallelogram, with its greatest length (362 m.) from N. to S., and its greatest breadth (140 m.) from E. to W. For map, see SPAIN. The land frontiers are to some extent defined by the course of the four principal rivers, the Minho and Douro in the north, the Tagus and Guadiana in the south; elsewhere, and especially in the north, they are marked by mountain ranges; but in most parts their delimitation was originally based on political considerations. In no sense can the boundary-line be called either natural or scientific, apart from the fact that the adjacent districts on either side are poor, sparsely peopled, and therefore little liable to become a subject of dispute. The Portuguese seaboard is nearly 500 m. long, and of the six ancient provinces all are maritime except Traz-os-Montes. From the extreme north to Cape Mondego and thence onward to Cape Carvoeiro the outline of the coast is a long and gradual curve; farther south is the prominent mass of rock and mountain terminating westward in Capes Roca and Espichel; south of this, again, there is another wide curve, broken by the headland of Sines, and extending to Cape St Vincent, the south-eastern extremity of the country. The only other conspicuous promontory is Cape Santa Maria, on the south coast. The only deep indentations of the Portuguese littoral are the lagoon of Aveiro (*q.v.*) and the estuaries of the Minho, Douro, Mondego, Tagus, Sado and Guadiana, in which are the principal harbours. The only islands off the coast are the dangerous Farilhões and Berlings (Portuguese *Berlengas*) off Cape Carvoeiro.

Frontiers and Coasts.

Physical Features.—Few small countries contain so great a variety of scenery as Portugal. The bleak and desolate heights of the Serra da Estrella and the ranges of the northern frontier are almost alpine in character, although they nowhere reach the limit of perpetual snow. At a lower level there are wide tracts of moorland, covered in many cases with sweet-scented cistus and other wild flowers. The lagoon of Aveiro, the estuary of the Sado and the broad inland lake formed by the Tagus above Lisbon (*q.v.*), recall the waterways of Holland. The sand-dunes of the western coast and the Pinhal de Leiria (*q.v.*) resemble the French Landes. The Algarve and parts of Alemtejo might belong to North-West Africa rather than to Europe. The Paiz do Vinho, on the Douro, and the Tagus near Abrantes, with their terraced bush-vines grown up the steep banks of the rivers, are often compared with the Rhine and the Elbe. The harbours of Lisbon and Oporto are hardly inferior in beauty to those of Naples and Constantinople. Apart from this variety, and from the historic interest of such places as Braga, Bussaco, Cintra, Coimbra, or Torres Vedras, the attractiveness of the country is due to its colouring, and not to grandeur of form. Its landscapes are on a small scale; it has no vast plains, no inland seas, no mountain as high as 7000 ft. But its flora is the richest in Europe, and combines with the brilliant sunshine, the vivid but harmonious costumes of the peasantry, and the white or pale-tinted houses to compensate for any such deficiency. This wealth of colour gives to the scenery of Portugal a quite distinctive character and is the one feature common to all its varieties.

The orography of Portugal cannot be scientifically studied except in relation to that of Spain, for there is no dividing line between the principal Portuguese ranges and the highlands of Galicia, Leon and Spanish Estremadura. Three so-called Portuguese systems are sometimes distinguished: (1) the Transmontane, stretching between the Douro and the Minho; (2) the Beirene, between the Douro and the Tagus; (3) the Transtagine, south of the Tagus. The following ranges belong to the Transmontane system, which is the southern extension of the mountains of Galicia: Peneda (4728 ft.), forming the watershed between the river Lima and the lower Minho; the Serra do Gerez (4817 ft.), which rises like a gigantic wall between the Lima and the Homem, and sends off a spur known as the Amarella, Oural and Nora, south-westward between the Homem and the Cavado; La Raya Seca, a continuation of Gerez, which culminates in Larouco (4390 ft.) and contains the sources of the Cavado; Cabreira (4196 ft.), which contains the sources of the river Ave and separates the basin of the Tamega from that of the Cavado; Marão (4642 ft.), Villarelho (3547 ft.) and Padrella (3763 ft.), forming together a large *massif* between the rivers Tamega, Tua and Douro; and Nogueira (4331 ft.) and Bornes (3944 ft.), which divide the valley of the Tua from that of the Sabor. The Beirene system comprises two quite distinct mountain regions. North of the Mondego it includes Montemuro (4534 ft.), separating the Douro from the upper waters of its left-hand tributary the Paiva; Gralheira (3681 ft.) between the Paiva and the Vouga; the Serra do Caramullo

(3511 ft.), between the Vouga and the Dão; and the Serra da Lapa (3215 ft.), which gives rise to the Paiva, Tavora, Vouga and Dão. South of these ranges, but nominally included in the same system, is the Serra da Estrella, the loftiest ridge in Portugal (6532 ft.). The Estrella Mountains, which enclose the headwaters of the Mondego in a deep ravine, stretch from north-east to south-west and are continued in the same direction by the Serra de Lousã (3944 ft.). They form the last link in the chain of mountain ranges, known to Spanish geographers as the Carpetano-Vetonica, which extends across the centre of the Peninsula from east to west. The greater part of the Serra da Estrella constitutes the watershed between the Mondego and Zezere. Lesser ranges, which are included in the Beirene system and vary in height from 2000 to 4000 ft., are the Mesas, between the rivers Côa and Zezere; the Guardunha and Moradal, separating the Zezere from the Ponsul and Ocreza, tributaries of the Tagus; the Serra do Aire, and various ridges which stretch south-westward as far as the mountains of Cintra (*q.v.*). The Transtagine Mountains cannot rightly be described as a single system, as they consist for the most part of isolated ranges or *massifs.* The Serra da Arrabida (1637 ft.) rises between Cape Espichel and Setubal. São Mamede (3363 ft.), with the parallel and lower Serra de Portalegre, extends along part of the frontier of northern Alemtejo. Ossa (2129 ft.), Caixeiro (1483 ft.), Monfurado (1378 ft.) and Mendro (1332 ft.) form the high ground between the rivers Sado, Sorraia and Guadiana. East of the Guadiana the outliers of the Spanish Sierra Morena enter Portuguese territory. The Serra Grandola and Monte Cercal, two low ranges stretching from north to south, skirt the coast of southern Estremadura. In the extreme south the ranges are more closely massed together. They include Monchique, with the peak of Foya or Foia (2963 ft.), and various lower ranges. There are numerous large expanses of level country, the most notable of these being the plains (*campos*) of the Tagus valley, and of Aviz or Benavilla, Beja and Ourique, in Alemtejo; the high plateaux (*cimas*) of Mogadouro in Traz-os-Montes and Ourem between the Tagus and the upper Sorraia; the highly cultivated lowlands (*veigas*) of Chaves and Valença do Minho in the extreme north; and the marshy flats (*baixas*) along the coast of Alemtejo and the southern shore of the lower Tagus.

The three principal rivers which flow through Portugal to the sea—the Douro, Tagus and Guadiana—are described in separate articles. The chief Portuguese tributaries of the Douro are the Tamega, Tua and Sabor on the north, the Agueda, Côa and Paiva on the south; of the Tagus, the Ocreza, Ponsul and Zezere on the north, the Niza and Sorraia on the south, while into the Guadiana, on its right or Portuguese bank, flow the Caia, Degebe, Cobres, Oeiras and Vascão. The whole country drains into the Atlantic, to which all the main rivers flow in a westerly direction except the Guadiana, which turns south by east in the lower part of its course. The Minho (Spanish *Miño*) is the most northerly river of Portugal, and in size and importance is only inferior to the three great waterways already mentioned. It rises in the highlands of Galicia, and, after forming for some distance the boundary between that province and Entre-Minho-e-Douro, falls into the sea below the port of Caminha. Its length is 170 m. Small coasters can ascend the river as far as Salvatierra in Galicia (20 m.), but larger vessels are excluded by a sandy bar at the mouth. Between the Minho and Douro the chief rivers are the Lima (Spanish *Limia* or *Antela*), which also rises in Galicia, and reaches the sea at Vianna do Castello; the Cavado, which receives the Homem on the right, and forms the port of Espozende in its estuary; and the Ave, which rises in the Serra da Cabreira and issues at the port of Villa do Conde. Between the Douro and Tagus the Vouga rises in the Serra da Lapa and reaches the sea through the lagoon of Aveiro; the Mondego flows north-east through a long ravine in the Serra da Estrella, and then bends back so as to flow west-south-west. Its estuary contains the important harbour of Figueira da Foz; its chief tributaries are the Dão on the right, and the Alva, Ceira and Arunca on the left; its length is 125 m. of which 52 m. are navigable by small coasters. Several comparatively unimportant streams, chief among which are the Liz and Sizandro, enter the Atlantic between the mouths of the Mondego and Tagus. Between the Tagus and Cape St Vincent the principal rivers are the Sado, which is formed by the junction of several lesser streams and flows north-west to the port of Setubal; and the Mira, which takes a similar direction from its headwaters south of Monte Vigia to the port of Villa Nova de Milfontes. On the south coast the united waters of the Odelouca and Silves form the harbour of Villa Nova de Portimão, and the Algoz, Algibre or Quarteira, and the Asseca flow into the sea farther east. Portugal abounds in hot and medicinal springs, such as those of Caldas de Monchique, Caldas da Rainha and Vidago.

Geology.—By far the greater part of Portugal is occupied by ancient rocks of Archean and Palaeozoic age, and by eruptive masses which probably belong to various periods. All the higher mountains are formed of these rocks, and it is only near the coast and in the plain of the Tagus that later deposits are found. The Mesozoic beds form an irregular triangle extending from Lisbon and Torres Novas on the south to Oporto on the north. There are also a narrow strip along the southern shores of the Algarve and a few smaller patches along the western coast. The Tertiary deposits cover the plain of the Tagus and are found in other low-lying areas near the coast. Of the Lower Palaeozoic rocks the Ordovician appears to be the most widely-spread. Large areas have been referred to the Cambrian, but it is only at Villa Boim, about 6 m. W.S.W. of Elvas, that Cambrian fossils have been found. The Ordovician beds have yielded fossils in several places, Vallongo and Bussaco being amongst the best-known localities. The succession is similar to that of Brittany and Spain. Supposed Silurian beds have been described at Portalegre, and in the same neighbourhood Devonian fossils have been found. The Lower Carboniferous, which belongs to the "Culm" facies so widely spread in central Europe, occupies a wide area in southern Portugal; but the Upper Carboniferous is very restricted in extent, and occurs in small basins like those of the Central Plateau of France, resting unconformably upon the rocks below. The deposits in these basins consist largely of coarse sandstones and conglomerates, amongst which lie seams of coal. It is possible that some of these deposits may belong to the Permian or at least to the Perma-Carboniferous. Of the Mesozoic systems the Jurassic is the most widely-spread. Supposed Triassic beds are found, but they are confined chiefly to the eastern margin of the Mesozoic area north of Lisbon. The Jurassic deposits are partly marine and partly fresh-water or terrestrial, including beds of lignite. On the whole, excepting in eastern Algarve, the Upper Jurassic beds indicate the neighbourhood of a shore-line. The Cretaceous system is very limited in extent. Its most interesting feature is the occurrence near its summit, north of Cape Mondego, of sands and gravels containing plant remains. Here both Cretaceous and Tertiary forms are found, and the Mondego beds seem to represent the passage between the two systems. At the close of the Cretaceous period great eruptions of basalt and basaltic tuff took place, especially in the Lisbon area. The volcanic rocks then formed are followed by marine deposits of Oligocene and Miocene age. Towards the north these are associated with fresh-water limestones, indicating the presence of land in that direction. Marine Pliocene beds occur at the mouth of the Tagus. The contemporaneous beds inland are of fresh-water origin. Eruptive masses of various age are found in many localities. The Cintra granite sends veins into the base of the Upper Jurassic, and is very probably of Tertiary age. The Serra de Monchique is petrographically of great interest. It consists chiefly of elaeolite-syenite and other rocks derived from the same igneous magma.

Climate.—The climate of Portugal is equable and temperate. Lisbon, Coimbra, Evora and Oporto have mean temperatures between 60° and 61·5° F., and the daily variation nowhere exceeds 23°. This equability of temperature is partly caused by the very heavy rainfall precipitated on Portugal as one of the westernmost countries of Europe and the one most exposed to the Atlantic. The rainfall has been as heavy as 16 ft. in a year, and sometimes, as in the winter of 1909–1910, great damage is wrought by floods. Heavy fogs are also common along the coast, rendering it dangerous to ships. The rainfall is heaviest in the north and on the Serra da Estrella; it is least in Algarve. A fine climate and equability of temperature are not universal in Portugal; they are to be enjoyed mainly in Beira and Estremadura, especially at Cintra and Coimbra, and in the northern provinces. In the deep valleys where the mountains keep off the cool winds, it is excessively hot in summer; while on the summits of the mountains snow lies for many months. The meteorological station on the Serra da Estrella, with a mean annual temperature of 44·7° F., is the coldest spot in Portugal in which systematic observations are taken. Montalegre has a mean of 48·3° and Guarda of 50·3°. Even in Lisbon the yearly variation is not less than 50°. In Alemtejo the climate is very unfavourable, and, though the heat is not so great as in Algarve (where Lagos has a mean of 63°), the country has a more deserted appearance; while in winter when the Tagus overflows, unhealthy swamps are left. Notwithstanding that Algarve is hotter than Alemtejo, a profuse vegetation takes away much of the tropical effect. Portugal is very rarely visited by thunderstorms; but shocks of earthquake are frequently felt, and recall the great earthquake of Lisbon (*q.v.*) in 1755.

Fauna and Flora.—An account of the fauna of the Iberian Peninsula as a whole is given under SPAIN. Wolves are found in the wilder parts of the Serra da Estrella, and wild boars are preserved in some districts. As far as the constituents of its flora are concerned Portugal is not very dissimilar from Spain, but their distribution is peculiar. The vegetation of Spain is distributed in clearly marked zones; but over the whole of Portugal, except the hottest parts of Algarve and Alemtejo, the plants of northern Europe flourish side by side with cacti, palms, aloes and tree-ferns (see CINTRA). This is largely due to the fact that the moisture-laden winds from the Atlantic penetrate almost as far inland as the Portuguese frontier, but do not reach the interior of Spain. The soil is fertile, and the indigenous flora has been greatly enriched by the importation of such plants as the agave, the Mexican opuntia, the American maple, the Australian eucalyptus, the Scotch fir and the so-called Portuguese cypress (*Cupressus lusitanica*) from the Azores. There are many fine tracts of forest, among which may be mentioned the famous convent-wood of Bussaco (*q.v.*); cork trees are extensively cultivated, Barbary oaks (*Quercus ballota*, Port. *azinheira*) furnish edible acorns and excellent timber for charcoal, and carob-trees (*Ceratonia siliqua*, Port. *alfarrobeira*) also produce edible seed-pods somewhat resembling beans. Elms, limes and poplars are common north of the Tagus, ilexes, araucarias, myrtles, magnolias and a great variety of conifers in all parts. The Serra da Estrella has a rich alpine flora, and the lagoon of Aveiro contains a great number of aquatic plants.

Inhabitants.—The population of Portugal numbered 4,550,699 in 1878, 5,049,729 in 1890 and 5,423,132 in 1900. These totals include the inhabitants of the Azores and Madeira, which together amounted to 406,865 in 1900. Few immigrants enter the country, but the birth-rate is about 30 per 1000, while the mortality is only about 20 per 1000. Large bodies of emigrants, chiefly recruited from the sober, hardy and industrious peasantry of the northern provinces, annually leave Portugal to seek fortune in America. A few go to the Portuguese colonies, the great majority to Brazil. Many of these emigrants return with considerable savings and settle on the land. The mortality is highest among male children, and the normal excess of females is in the proportion of 109 to 100. Six-sevenths of the population of continental Portugal inhabit the provinces north of the Tagus. The density of population is greatest in Madeira (479·5 per sq. m. in 1900), Entre-Minho-e-Douro (419·5) and the Azores (277·9), nowhere else does it reach 200 per sq. m. In Alemtejo the percentage sinks to 45·1, and for the whole country, including the islands, it amounts only to 152·8.

The Portuguese people is composed of many racial elements. Its earliest known ancestors were the Iberians (*q.v.*). The peasantry, especially in the north, are closely akin to the Galician and Asturian Spaniards in character, physique and dialect; and these three ethnical groups—Portuguese of the north, Galicians, Asturians—may perhaps be regarded as the purest representatives of the Spanish stock. The first settlers with whom they intermarried were probably Carthaginians, who were followed in smaller numbers by Greeks; but the attempts which have sometimes been made to ascribe certain attributes of the Portuguese to the influence of these races are altogether fanciful. The Romans, whose supremacy was not seriously threatened for some six centuries after the Punic Wars, gave to Portugal its language and the foundation of its civilization; there is, however, no evidence that they seriously modified the physical type or character of its people. In these respects the Suevic and Visigothic conquests left a more permanent impression, especially in the northern provinces. After 711 came the long period of Moorish (*i.e.* Arab and Berber) predominance. The influence of the Moors was greatest south of the Tagus. In Alemtejo, and still more in Algarve, Arab and Berber types are common; and the influence of these races can everywhere be discerned in the architecture, handicrafts and speech of the peasantry. So complete was the intellectual triumph of the Moors that an intermediate "Mozarabic" population arose, Portuguese in blood, Christian in religion, but Arab in language and manners. Many of the Mozarabs even adopted the characteristic Mahommedan rite of circumcision. Under the tolerant rule of Islam the Portuguese Jews rose to a height of wealth and culture unparalleled in Europe; they intermarried with the Christians both at this period and after their forced conversion by King Emanuel I. (1495–1521). After 1450 yet another ethnical element was introduced into the nation, through the importation of African slaves in vast numbers. Negroid types are common throughout central and southern Portugal. No European race confronted with the problem of an immense coloured population has solved it more successfully than the Portuguese and their kinsmen in Brazil; in both countries intermarriage was freely resorted to, and the offspring of these mixed unions are superior in character and intelligence to most half-breeds.

National Characteristics.—The normal type evolved from this fusion of many races is dark-haired, sallow-skinned, brown-eyed and of low stature. The poorer classes, above all the fishermen and small farmers, are physically much finer than the well-to-do, who are prone to excessive stoutness owing to their more sedentary habits. The staple diet of the labouring classes and small farmers is fish, especially the dried codfish called *bacalhão*, rice, beans, maize bread and meal, olive oil, fruit and vegetables. Meat is rarely eaten except on festivals. In Alemtejo chestnuts and figs are important articles of diet. Drunkenness is extremely rare. There is no single national dress, but a great variety of picturesque costumes are worn. The sashes, broad-brimmed hats and copper-tipped quarterstaves of the men, and the brilliant cotton dresses and gold or silver filigree ornaments worn on holidays by the women are common throughout the country; but many classes have their own costumes, varying in detail according to the district or province. These costumes may be seen at their best at bull-fights and at such popular festivals as the *romarias* or pilgrimages, which combine religion with the attractions of a fair. The national sport of bull-fighting (*q.v.*) is conducted as humanely as possible, for the Portuguese are lovers of animals. The artistic sense of the nation is perhaps greatest among the peasantry, although Portugal has the most illiterate peasantry in western Europe. It is manifested in their poetry and music even more than in their admirable costumes and in the good taste which has preserved the Roman or Moorish forms of their domestic pottery. Even the men and women who till the soil are capable of improvizing verse of real merit, and sometimes excel in the ancient and difficult art of composing extempore amoebean rhymes. In this way, although the ancient ballads are not forgotten, new words are also fitted to the plaintive folk-tunes (*fados*) which every farm-hand knows and sings, accompanied sometimes by a rude clarinet or bagpipes, but more frequently by the so-called Portuguese guitar—an instrument which resembles a mandolin rather than the guitars of Italy and Spain. The native dances, slow but not ungraceful, and more restrained than those of Andalusia or the south of France, are obviously Moorish in origin, and depend for their main effects on the movement of the arms and body. Many curious superstitions survive in the country districts, including the beliefs in witches (*feitiçeiras*, *bruxas*) and werewolves (*lobishomens*); in sirens (*sereias*) which haunt the dangerous coast and lure fishermen to destruction; in fairies (*fadas*) and in many kinds of enchantment. It will be observed that the nomenclature of Portuguese folk-lore suggests that the popular superstitions are of the most diverse origin—Latin, Greek, Arabic, native: *lobishomem* is the Latin *lupus homo*, wolf-man, *sereia* is the Greek σειρήν, *bruxa* is Arabic, *feitiçeira* and *fada* Portuguese. Other beliefs can be traced to Jewish and African sources.

Chief Towns.—The chief towns of Portugal are Lisbon (pop. 1900, 356,009), the capital and principal seaport; Oporto (167,955), the capital of the northern provinces and, after Lisbon, the most important centre of trade; the seaports of Setubal (22,074), Ilhavo (12,617), Povoa de Varzim (12,623), Tavira (12,175), Faro (11,789), Ovar (10,462), Olhão (10,009) Vianna do Castello (10,000), Aveiro (9975), Lagos (8291), Leixões (7690) and Figueira da Foz (6221); and the inland cities or towns of Braga (24,202), Loulé (22,478), Coimbra (18,144), Evora (16,020), Covilhã (15,469), Elvas (13,981), Portalegre (11,820), Palmella (11,478), Torres Novas (10,746), Silves (9687), Lamego (9471), Guimarães (9104), Beja (8885), Santarem (8628), Vizeu (8057), Estremoz (7920), Monchique (7345), Castello Branco (7288), Abrantes (7255), Torres Vedras (6900), Thomar (6888), Villa Real (6716), Chaves (6388), Guarda (6124), Cintra (5914), Braganza (5535), Mafra (4769), Leiria (4459), Batalha (3858), Almeida (2330), Alcobaça (2309), Bussaco (1661). All these are described in separate articles.

Communications.—Up to 1851 there was practically no good carriage road in the country except the highway between Lisbon and Cintra. In 1853 the work of constructing a proper system of roads was undertaken, and by the end of the century all the larger towns were linked together by the main or "royal" highways to which the "district" and "municipal" roads were subsidiary. Each class of road was named after the authority responsible for its construction and upkeep. In some of the remoter rural districts there are only bridle-paths, or rough tracks, which become almost impassable in wet seasons, and are never suitable for vehicles less solid than the Portuguese ox-carts. The first railway was opened in 1853 to connect Lisbon with Badajoz. In 1910 1758 m. were completed, of which 672 m. were state lines. The Portuguese railways meet the Spanish at Valença do Minho on the northern frontier, at Barca d'Alva, at Villar Formoso, near Valencia de Alcantara, and near Badajoz on the eastern frontier. In some of the chief towns there are electric tramways. The most important internal waterways are the lower Tagus and the Douro between Oporto and the Paiz do Vinho. In 1908, 11,045 vessels of 19,354,967 tons entered Portuguese seaports, but a very large majority of these ships were foreign, and especially British. The postal and telegraphic services are adequate; telephone systems are installed in Lisbon, Oporto and other large towns; and the Eastern Telegraph Co. has an important cable station at Carcavellos near Lisbon (*q.v.*).

Land Tenure.—Four modes of land tenure are common in Portugal. The poor and thinly-peopled region of Alemtejo is divided into large estates, and cultivated by tenant farmers. Numerous estates in various provinces are held on the metayage system (*q.v.*). In the north, where the land is much subdivided, peasant proprietorship and a kind of emphyteusis (see Roman Law) are the most usual tenures. The Portuguese form of emphyteusis is called *aforamento*; the landlord parts with the user of his property in exchange for a quit-rent (*foro* or *canon*). He may evict his tenant should the rent be in arrear for five years, and may at any time distrain if it be overdue; but he cannot otherwise interfere with the holding, which the tenant may improve or neglect. Should the tenant sell or exchange his interest in the property, the right of pre-emption is vested in the landlord, and a corresponding right is enjoyed by the tenant should the quit-rent be for sale. As this tenure is very ancient, though modified in 1832 and 1867, the value of such holdings has been greatly enhanced with the improvement of the land and the decline in the purchasing power of currency.

Agriculture.—Many of the instruments and processes of Portuguese agriculture and viticulture were introduced by the Romans, and are such as Columella described in the 1st century A.D. The characteristic springless ox-cart which is used for heavy loads may be seen represented on Roman frescoes of even earlier date. One form of plough still used consists of a crooked bough, with an iron share attached. Oxen are employed for all field-work; those of the commonest breed are tawny, of great muscular power, very docile, and with horns measuring 5 or 6 ft. from tip to tip. The ox-yokes are often elaborately carved in a traditional pattern in which Gothic and Moorish designs are blended. The Moors introduced many improvements, especially in the system of irrigation; the characteristic Portuguese wells with their perpetual chains or buckets are of Moorish invention, and retain their Moorish name of *noras*. In all, rather more than 45% of the country is uncultivated, chiefly in Alemtejo, Traz-os-Montes and the Serra da Estrella. The principal grain-crops are maize, wheat and rye; rice is grown among the marshes of the coast. Gourds, pumpkins, cabbages and other vegetables are cultivated among the cereals. The large onions sold in Great Britain as Spanish are extensively produced in the northern provinces. Every district has its vineyards, the finest of which are in the Paiz do Vinho (see Oporto and Wine). The bush vines of this region are more exposed to the attacks of *Oidium Tuckeri*, which invaded the country in 1851, and of *Phylloxera vastatrix*, which followed in 1863, than the more deeply-rooted vines trained on trellises or trees. Both these pests have been successfully combated, largely by the use of sulphur and by grafting immune American vines upon native stocks. In addition to grapes the commoner fruits include quinces, apples, pears, cherries, limes, lemons and loquats (Port. *nespras*); Condeixa is famous for oranges, Amarante for peaches, Elvas for plums, the southern provinces for carobs and figs. Large quantities of olive oil are manufactured south of the Douro. Almost all cattle, except fighting-bulls, are stall-fed. The fighting-bulls are chiefly reared in the marshes and alluvial valleys; they are bred for strength and swiftness rather than size, and a good specimen should be sufficiently agile to leap over the inner barrier of the arena (about 68 in. high). Large herds of swine are fed in the oak and chestnut woods of Alemtejo; sheep and goats are reared in the mountains, where excellent cheeses are made from goats' milk.

Fisheries.—About 50,000 Portuguese are classed as hunters and fishermen. The majority of these are employed in the sardine and tunny fisheries. This industry is carried on in a fleet of more than 10,000 small vessels, including the whalers of the Azores and the cod-boats which operate outside Portuguese waters. The fishermen and fisherwomen form a quite distinct class of the people; both sexes are noted for their bodily strength, and the men for their bold and skilful seamanship. Tunny and sardines are cured and exported in large quantities, oysters are also exported, and many other sea fish, such as hake, sea-bream, whiting, conger and various flat-fish are consumed in the country. In the early years of the 20th century the competition of foreign steam trawlers inflicted much hardship on the fishermen. The average yearly value of the fish landed in Portugal (exclusive of cured fish from foreign countries) is about £800,000. Salmon, lampreys and eels are caught in some of the larger rivers; trout abound in the streams of the northern provinces; but many fresh-water fish common elsewhere in Europe, including pike, perch, tench and chub, are not found.

Mines.—It is usually stated that Portugal is rich in minerals, especially copper, but that want of capital and, especially in the south, of transport and labour, has retarded their exploitation. The mineral deposits of the country are very varied, but their extent is probably exaggerated. The average yearly output from 1901 to 1905 was worth less than £300,000. Copper is mined in southern Portugal. Common salt (chiefly from Alcacer do Sal near Setubal), gypsum, lime and marble are exported; marble and granite of fine quality abound in the southern provinces. Iron is obtained near Beja and Evora, tin in the district of Braganza. Lead, wolfram, antimony and auriferous quartz exist in the districts of Coimbra, Evora, Beja and Faro. Lignite occurs at many points around Coimbra, Leiria and Santarem; asphalt abounds near Alcobaça; phosphorite, asbestos and sulphur are common south of the Tagus. Petroleum has been found near Torres Vedras; pitchblende, arsenic, anthracite and zinc are also mined. Gold was washed from some of the Portuguese rivers before the Christian era, and among the Romans the auriferous sands of the Tagus were proverbially famous; it is, however, extremely improbable that large quantities of gold were ever obtained in this region, although small deposits of alluvial gold may still be found in the valleys of the Tagus and Mondego.

Manufactures.—The Methuen Treaty of 1703 prevented the establishment of some manufacturing industries in Portugal by securing a monopoly for British textiles, and it was only after 1892 that Portuguese cotton-spinning and weaving were fostered by heavy protective duties. In 20 years these industries became the most important in the country after agriculture, the wine and cork trades and the fisheries. In connexion with the wine trade there are many large cooperages; cork products are extensively manufactured for export. Lisbon is the headquarters of the ship-building trade. Here, and in other cities, tanning, distilling, various metallurgical industries, and manufactures of soap, flour, tobacco, &c., are carried on; the entire output is sold in Portugal or its colonies. There is a steady trade in natural mineral waters, which occur in many parts of continental Portugal and the Azores. From the 16th century to the 18th many artistic handicrafts were practised by the Portuguese in imitation of the fine pottery, cabinet-work, embroideries, &c., which they imported from India and Persia. Portuguese cabinet-work deteriorated in the 19th century; the glass-works and potteries of the Aveiro and Leiria districts have lost much of their ancient reputation; and even the exquisite lace of Peniche and Vianna do Castello is strangely neglected abroad. The finest Caldas da Rainha china-ware, with its fantastic representations of birds, beasts and fishes, still commands a fair price in foreign markets; but the blue and white ware originally copied from Delft and later modified under the influence of Persian pottery is now only manufactured in small quantities, of inferior quality. Skilful copies of Moorish metal-work may be purchased in the goldsmiths' and silversmiths' shops of Lisbon and Oporto; conspicuous among these are the filigree ornaments which are bought by the peasant women as investments and by foreign visitors as curiosities. In 1900 the total industrial population of Portugal was 455,296.

Commerce.—The annual value of the foreign trade of Portugal amounts approximately to £19,000,000. The following table shows the value for five years of the exports, and of all imports not re-exported (exclusive of coin and bullion):—

Years.	Exports.	Imports.
1901	£6,284,800	£12,849,622
1902	£6,318,888	£12,354,800
1903	£6,800,710	£13,068,000
1904	£6,824,692	£13,801,622
1905	£6,460,000	£13,486,666

In 1910 the principal exports, in order of value, were wine (chiefly port, common wines and Madeira), raw and manufactured cork, preserved fish, fruits and vegetables, cottons and yarn, copper ore, timber, olive oil, skins, grain and flour, tobacco and wool. The imports were raw and manufactured cotton, wool and silk, wheat and maize, coal, iron and machinery, dried codfish, sugar, rice, hides and skins, oils. The United Kingdom, which annually purchases wine to the value of about £900,000 and cork to the value of about £500,000, is the chief consumer of Portuguese goods, and the chief exporter to Portugal. Germany and the United States rank respectively second and third among the countries which export to Portugal; Spain, which buys bullocks and pigs, Brazil, which buys wine, and the Portuguese colonies, which buy textiles, are among the chief purchasers of Portuguese products. In addition to its direct foreign commerce Portugal derives much benefit from its share in the trade between South America and Europe. Large liners from Liverpool, Southampton, London, Hamburg, Havre and Antwerp call regularly for passengers or cargo at Leixões or Lisbon, or both ports, on their way to and from South America (especially Brazil). In connexion with this trade an important tourist traffic, chiefly from Great Britain and Germany, was developed towards the end of the 19th century.

Banks and Money.—In 1910 the Bank of Portugal, to which the treasury was deeply indebted, had a capital of £1,500,000, and a monopoly of note issue in continental Portugal, but the notes of the Ultramarine Bank circulated in the colonies. The notes of the Bank of Portugal in circulation amounted in value to about £14,000,000. For an account of the Monte Pio Geral, which is a combined bank, pawnbroking establishment and benefit society, see PAWNBROKING; the deposits in the Monte Pio and the State Savings Bank amounted in 1910 to some £5,228,000. There are also many private banks, including savings banks. Gold is the standard of value, but the actual currency is chiefly Bank of Portugal notes. The values of coin and notes are expressed in multiples of the *real* (plural *reis*), a monetary unit which does not actually exist. The milreis, 1000 reis of the par value of 4s. 5d. (or 4·5 milreis to the pound sterling) and the conto of reis (1000 milreis) are used for the calculation of large sums. Gold pieces of 10, 5, 2 and 1 milreis were coined up to 1891; 10, 5, and 2 testoon (*testão*) pieces, worth respectively 1000, 500 and 200 reis, are coined in silver; testoons of 100 reis and half testoons of 50 reis, in nickel; pieces of 20, 10 and 5 reis in bronze. The milreis fluctuates widely in value, the balance of exchange being usually adverse to Portugal; for the purposes of this article the milreis has been taken at par. The British sovereign is legal tender for 4500 reis, but in practice usually commands a premium. The metric system of weights and measures has been officially adopted, but many older standards are used, such as the *libra* (1·012 lb avoirdupois), *alqueire* (0·36 imperial bushel), *moio* (2·78 imp. bushels), *almude* of Lisbon (3·7 imp. gallons) and *almude* of Oporto (5·6 imp. gallons).

Finance.—For the five financial years, 1901–1902 to 1905–1906, the average revenue of Portugal was about £13,300,000 and the average expenditure £13,466,000. The chief sources of revenue were customs duties, taxes on land and industries, duties on tobacco and breadstuffs, the Lisbon octroi, receipts from national property, registration and stamps, &c. The heaviest expenditure (nearly £5,000,000) was incurred for the service of the consolidated debt; payments for the civil list, cortes, pensions, &c., amounted to more than £2,000,000, and the cost of public works to nearly as large a sum. The ministries of war and marine together spent about £2,500,000 each year. The practice of meeting deficits by loans, together with the great expenditure, after 1853, on public works, especially roads and railways, explains the rapid growth of the national debt in modern times. In 1853 the total public debt, internal and external, amounted to £2,082,680. It exceeded £90,000,000 in 1890, and in 1891–1892 the finances of the kingdom reached a crisis, from which there was no escape except by arranging for a reduction in the amount payable as interest (see *History*, below). By the law of the 26th of February 1892 30% was deducted from the internal debt payable in currency; by the law of the 20th of April 1893 $66\frac{2}{3}$% was deducted from the interest on the external debt, due in gold. A law of the 9th of August 1902 provided for the conversion of certain gold debts into three series of consolidated debt, at reduced interest. In 1909 the total outstanding debt amounted to £161,837,430, made up as follows: new external 3% converted in three series, £34,223,465; $4\frac{1}{2}$% tobacco loan £7,267,480; internal 3% (quoted in London) £113,132,979. Internal debt at 3, 4 and $4\frac{1}{2}$% was also outstanding to the amount of £7,213,506.

Constitution.—Up to October 1910 the government was an hereditary and constitutional monarchy, based on the constitutional charter which was granted by King Pedro IV. on the 29th of April 1826, and was afterwards several times modified; the most important changes were those effected by the acts of the 5th of July 1852, the 24th of July 1885, and the 28th of March and 25th of September 1895. The revolution of the 5th of October 1910 brought the monarchy to an end and substituted republican government for it. The monarchical constitution recognized four powers in the state—the executive, moderating, legislative and judicial. The two first of these were vested in the sovereign, who might be a woman, and who shared the legislative power with two chambers, the *Camara dos Pares* or House of Peers, and the *Camara dos Deputados* or House of Commons; these were collectively styled the *Cortes Geraes*, or more briefly the *Cortes*. The royal veto could not be imposed on legislation passed twice by both houses. The annual session lasted four months, and a general election was necessary at the end of every four years, or immediately after a dissolution. A committee representing both houses adjudicated upon all cases of conflict between Peers and Commons; should it fail to reach a decision, the dispute was referred to the sovereign, whose award was final. Up to 1885 some members sat in the House of Peers by hereditary right, while others were nominated for life. It was then decided that such rights should cease, except in the case of princes of royal blood and members then sitting, and that when all the hereditary peerages had lapsed the house should be composed of the princes of the royal blood, the archbishops and bishops of the continental dioceses, a hundred legislative peers appointed by the king for life, and fifty elected every new parliament by the Commons. In 1895 the number of nominated life peers was reduced to ninety and the elective branch was abolished. Subject to certain limitations and to a property qualification, any person over 40 years of age was eligible to a peerage. The titles and social position of the Portuguese aristocracy were not affected when its political privileges were abolished. In the nomination of life peers, and in certain administrative matters the sovereign was advised by a council of state, whose twelve members were nominated for life and were principally past or present ministers. The sovereign exercised his executive power through a cabinet which was responsible to the cortes, and consisted of seven members, representing the ministries of (1) the interior, (2) foreign affairs, (3) finance, (4) justice and worship, (5) war, (6) marine and colonies, (7) public works, industry and commerce. The House of Commons was composed of 148 members, representing the 26 electoral divisions of Portugal, the Azores and Madeira, which returned 113 elected members and 35 representatives of minorities, and of 7 members representing the colonies. Peers, naturalized foreigners and certain employees of the state were unable to sit in the House of Commons; members were required to be graduates of one of the highest, secondary or professional schools, or to possess an income of not less than 400 milreis (£88). All members might, in connexion with their official duties, travel free on railways and ships owned by the state; but since 1892 none had received any salary except the colonial members, who were paid 100 milreis (£22) per month during the session, and 50 milreis (£11) per month during the remainder of the year. All male citizens 21 years old who could read and write, or who paid taxes amounting to 500 reis yearly, had the parliamentary franchise, except convicts, beggars, undischarged bankrupts, domestic servants, workmen permanently employed by the state and soldiers or sailors below the rank of commissioned officer. (For changes made under republican rule, see *History*, § 8.)

Local Government.—Continental Portugal was formerly divided for administrative purposes into six provinces which corresponded to a great extent with the natural geographical divisions of the country and are described in separate articles; the names of these, which are still commonly used, are Entre-Minho-e-Douro (also called Entre-Douro-e-Minho or Minho), Traz-os-Montes, Beira, Estremadura, Alemtejo and Algarve. The province of Douro, another administrative division of less antiquity, comprised the present districts of Aveiro and Oporto, or part of Beira and Entre-Minho-e-Douro. The six ancient provinces were subdivided on the 28th of June 1833 into districts, each named after its chief town, as follows: Entre-Minho-e-Douro into Vianna do Castello, Braga, Oporto; Traz-os-Montes, into Villa Real, Braganza; Beira, into Aveiro, Vizeu, Coimbra, Guarda, Castello Branco; Estremadura, into Leiria, Santarem, Lisbon; Alemtejo, into Portalegre, Evora, Beja; Algarve was renamed Faro. In 1910 the Azores comprised three districts and Madeira formed one. Each district was governed by a commission composed of (1) the civil governor, who was nominated by the central authority and presided over the commission; (2) the administrative auditor; and (3) three members chosen by indirect suffrage. The districts were divided into communes (*concelhos*), each administered by an elected council, and a mayor nominated by the central authority. The mayor could not preside over the council, which appointed one of its own members to preside and to give effect to its decisions. The communes were subdivided into parishes (*freguesias*), which were administered by the elected council (*junta de parochia*) over which the parish priest (*presbitero*) presided, and by the *regedor*, an official who represented the mayor of the commune and was nominated by the civil governor. The central authority had almost complete control over local administration through its representatives, the civil governor, mayors and *regedores*.

Justice.—In 1910 Portugal was divided into 193 judicial districts (*comarcas*), in each of which there was a court of first instance. The three courts of appeal (*tribunaes de relação*) sat at Lisbon, Oporto and Ponta Delgada (Azores), and there was a Supreme Court in Lisbon.

Colonies.—At the beginning of the 19th century Portugal possessed a larger colonial empire than any European power except Great Britain and Spain. At the beginning of the 20th century its transmarine possessions had been greatly reduced in size by the loss of Brazil, but were still only surpassed in extent by those of three powers—Great Britain, France and Germany. Their total area was about 803,000 sq. m., of which 794,000 sq. m. are in Africa. They comprised, in Africa, the Cape Verde Islands, St Thomas and Prince's Islands, Portuguese Guinea, Angola and Portuguese East Africa, or Mozambique; in India, Goa, Damaun and Diu; in China, Macao; and in the Malay Archipelago part of Timor. All these are described in separate articles. In all the white population is in a minority; in most the climate is unsuitable for European colonization, nor is the commercial value of the colonies commensurate with their extent. Viewed as a whole, Portuguese administration has been carried on under difficulties which have rendered it costly and inefficient, the home government being compelled to contribute a large annual subsidy towards its maintenance. The amount paid in subsidies from 1870 to 1900 was about £15,000,000.

Religion.—Roman Catholicism was the state religion until 1910, but other creeds were tolerated, and the Church lost its temporal authority in 1834, when the monasteries were suppressed and their property confiscated for the first time. There are three ecclesiastical provinces—Braga, Lisbon and Evora, each under an archbishop. The archbishop of Braga, whose see is the most ancient, has the title of Primate; the archbishop of Lisbon has the honorary title of Patriarch, and is usually elected a cardinal. His province includes Madeira, the Azores and the West African colonies. There are fourteen dioceses, of which Oporto is the most important. The annual revenues of the upper hierarchy of the Church amounted, up to 1910, to about £65,000. In some of the larger towns the foreign residents have their own places of worship. (See further under *History.*)

Education.—Primary education is regulated by a law of 1844, under which children between the ages of 7 and 15 are bound to attend a school, should there be one within a mile, under penalty to the parents of a fine and deprivation of civil rights. This law has not been strictly enforced; primary education was never properly organized; and, according to census returns, the proportion of the population (including children) unable to read was 82·4% in 1878, 79·2 in 1890 and 78·6 in 1900. There were in 1910 5250 public and 1750 private primary schools. In the chief towns there are training schools for teachers. The system of secondary education was reorganized in 1894. In 1905 there were state lyceums in each district capital and in Guimarães, Lamego and Amarante; 5 municipal lyceums, at Celorico de Basto, Chaves, Ponte de Lima, Povoa de Varzim and Setubal; military and naval colleges; a secondary school for girls in Lisbon; numerous private secondary schools and ecclesiastical seminaries; industrial, commercial and technical schools; and pilot schools at Lisbon, Oporto, Faro and Ponta Delgada (Azores). Other important educational institutions are described under LISBON and OPORTO. The national university is at Coimbra (*q.v.*).

Defence.—Under the monarchy, the army was maintained at its normal strength partly by voluntary enlistment and conscription, the chief law regulating it being that of 1887, as variously modified in subsequent years. The cortes fixed the number of conscripts to be enrolled in each year: in 1905, 15,000 men for the army, 1000 for the navy, 500 for the municipal guards and 400 for the fiscal guards. The organization of the army was based on the acts of the 7th of September 1899 and the 24th of December 1901. With certain exceptions all men over 21 years of age were liable for service—3 years in the regular army, 5 years in the first reserve and 7 years in the second reserve; but exemption could always be purchased. In time of war, the municipal guards, numbering about 2200, and the fiscal guards, numbering about 5200, might be incorporated in the army. The total effective force of the active army on a peace footing was 1787 officers, 31,281 men, 6479 horses and mules and 100 guns. The total effective force on a war footing, inclusive of reservists, municipal guards and fiscal guards, was 4221 officers, 178,603 men, 19,600 horses and mules and 336 guns. Lisbon, Elvas and Angra in the Azores, were considered first-class fortresses, but only Lisbon had modern defences. The Portuguese navy in 1910 consisted of 1 armoured vessel, 5 protected cruisers, 2 third-class cruisers, 19 gunboats, 1 torpedo gunboat, 4 torpedo boats, 16 river gunboats, 4 transports and 3 training ships. Twelve other vessels, including 2 submarines, were under construction. The whole fleet was manned by about 5000 men.

BIBLIOGRAPHY.—Numerous official reports, chiefly statistical, are published periodically in Lisbon; a few are written in French, the majority in Portuguese. Read in conjunction with the British consular and diplomatic reports, they afford a comprehensive survey of the movement of population, the progress of trade, &c. The following state papers deserve special notice: *Caminhos de ferro* (1877, &c.), *Commercio e navigação* (annual, issued by the Ministry of Marine), *Le Portugal vinicole* (1900), *Le Portugal . . . . agricole* (1900), *Notas sobre Portugal* (2 vols., 1908). For geology, see the section of *Le Portugal . . . . agricole* written by P. Choffat and entitled "Aperçu de la geologie de Portugal," also "The Work of the Portuguese Geological Survey," by Philip Lake, in *Science Progress* (1896) v. 439–453; both these summaries refer to the most important original papers. Two illustrated volumes by Oswald Crawford, *Portugal Old and New* (London, 1880) and *Round the Calendar in Portugal* (London, 1890) contain much valuable information on agriculture, viticulture and peasant life in the northern provinces. *Through Portugal*, by Major Martin Hume (London, 1907) and *Lisbon and Cintra*, by A. A. Inchbold (London, 1908), describe the towns, &c., most frequently visited by tourists, and are illustrated in colours. *Le Portugal* (Paris, 1899), by 18 writers, is a brief but encyclopaedic description of continental Portugal. See also *Portugal: its Land and People*, by W. H. Koebel (London, 1909), and *Portuguese Architecture*, by W. C. Watson (London, 1908). The following books deal comprehensively with the Portuguese colonies; *As Colonias portuguezas*, by E. J. de Vasconcellos (2nd ed., Lisbon, 1903), *Les Colonies portugaises*, by A. de Almada Negreiros (Paris, 1908). (K. G. J.)

HISTORY

Throughout the centuries which witnessed the destruction of Carthaginian power by Rome, the establishment and decline of Latin civilization, the invasion by Alani, Suevi and other barbarian races, the resettlement under Visigothic rule and the overthrow of the Visigoths by Arab and Berber tribes from Africa, Portugal remained an undifferentiated part of Hispania, without sign of national consciousness. The Iberian Peninsula was one: and its common history is related under SPAIN. It is true that some Portuguese writers have sought to identify their race with the ancient Lusitani, and have claimed for it a separate and continuous existence dating from the 2nd century B.C. The revolt of Lusitania against the Romans has been regarded as an early manifestation of Portuguese love of liberty, Viriathus as a national hero. But this theory, which originated in the 15th century and was perpetuated in the title of *The Lusiads*, has no historical foundation. In 1095 Portugal was an obscure border fief of the kingdom of Leon. Its territories, far from the centres of European civilization and consisting largely of mountain, moorland and forest, were bounded on the north by the Minho, on the south by the Mondego. Its name (*Portucalia, Terra portucalensis*) was derived from the little seaport of Portus Cale or Villa Nova de Gaia, now a suburb of Oporto, at the mouth of the Douro. Its inhabitants, surrounded by Moorish or Spanish enemies and distracted by civil war, derived such rudiments of civilization as they possessed from Arabic or Leonese sources. But from these obscure beginnings Portugal rose in four centuries to be the greatest maritime, commercial and colonial power in Europe.

The history of the nation comprises eight periods. (1) Between 1095 and 1279 a Portuguese kingdom was established and extended until it reached its present continental limits. (2) Between 1279 and 1415 the monarchy was gradually consolidated in spite of resistance from the Church, the nobles and the rival kingdom of Castile. (3) In 1415 began a period of crusades and discoveries, culminating in the discovery of an ocean-route to India (1497–1499). (4) From 1499 to 1580 Portugal acquired an empire stretching from Brazil eastward to the Moluccas, reached the zenith of its prosperity and entered upon a period of swift decline. (5) Spanish kings ruled over Portugal from 1581 to 1640. (6) The chief event of the years 1640 to 1755 was the restoration of the Portuguese monarchy. (7) Between 1755 and 1826 the reforms of Pombal and the Peninsular War prepared the country for a change from absolutism to constitutional monarchy. (8) In 1826 the era of constitutional government began.

Count Henry.

1. *The Establishment of the Monarchy.*—The origin of Portugal, as a separate state, was an incident in the Christian reconquest of Spain. Towards the close of the 11th century crusading knights came from every part of Europe to aid the kings of northern and central Spain in driving out the Moors. Among these adventurers was Count Henry of Burgundy, an ambitious warrior who, in 1095, married Theresa, natural daughter of Alphonso VI., king of Leon. The county of Portugal, which had already been won back from the Moors (1055–1064), was included in Theresa's dowry. Count Henry ruled as a vassal of Alphonso VI., whose Galician marches were thus secured against any sudden Moorish raid. But in

1109 Alphonso VI. died, bequeathing all his territories to his legitimate daughter Urraca, and Count Henry at once invaded Leon, hoping to add to his own dominions at the expense of his suzerain. After three years of war against Urraca and other rival claimants to the throne of Leon, Count Henry himself died in 1112. He left Theresa to govern Portugal north of the Mondego during the minority of her infant son Affonso Henriques (Alphonso I.): south of the Mondego the Moors were still supreme.

Theresa, 1112–1128.

Theresa renewed the struggle against her half-sister and suzerain Urraca in 1116–1117, and again in 1120; in 1121 she was besieged in Lanhoso and captured. But a peace was negotiated by the archbishops Diogo Gelmires of Santiago de Compostela and Burdino of Braga, rival churchmen whose wealth and military resources enabled them to dictate terms. Bitter jealousy existed between the two prelates, each claiming to be primate of "all the Spains," and their antagonism had some historical importance in so far as it fostered the growth of separatist tendencies among the Portuguese. But the quarrel was temporarily suspended because both Gelmires and Burdino had reason to dread the extension of Urraca's authority. It was arranged that Theresa should be liberated and should continue to hold the county of Portugal as a fief (*honor*) of Leon. During the next five years she lavished wealth and titles upon her lover Fernando Peres, count of Trava, thus estranging her son, the archbishop of Braga and the nobles, most of whom were foreign crusaders. In 1128, after her power had been crushed in another unsuccessful conflict with Leon and Castile, she was deposed by her own rebellious subjects and exiled in company with Peres. She died in 1130.

Alphonso I., 1128–1185.

Alphonso, who became count of Portugal in 1128, was one of the warrior heroes of medieval romance; his exploits were sung by troubadours throughout south-western Europe, and even in Africa "ibn Errik"—the son of Henry—was known and feared. The annals of his reign have been encumbered with a mass of legends, among which must be included the account of a cortes held at Lamego in 1143; probably also the description of the Valdevez tournament, in which the Portuguese knights are said to have vanquished the champions of Leon and Castile. Alphonso was occupied in almost incessant border fighting against his Christian or Moorish neighbours. Twelve years of campaigning on the Galician frontier were concluded in 1143 by the peace of Zamora, in which Alphonso was recognized as independent of any Spanish sovereign, although he promised to be a faithful vassal of the pope and to pay him a yearly tribute of four ounces of gold. In 1167, however, the war was renewed. Alphonso succeeded in conquering part of Galicia, but in attempting to capture the frontier fortress of Badajoz he was wounded and forced to surrender to Ferdinand II. of Leon (1169). Ferdinand was his son-in-law, and was probably disposed to leniency by the imminence of a Moorish invasion in which Portugal could render useful assistance. Alphonso was therefore released under promise to abandon all his conquests in Galicia.

He had already won many victories over the Moors. At the beginning of his reign the religious fervour which had sustained the Almoravide dynasty was rapidly subsiding; in Portugal independent Moorish chiefs ruled over cities and petty states, ignoring the central government; in Africa the Almohades were destroying the remnants of the Almoravide power. Alphonso took advantage of these dissensions to invade Alemtejo, reinforced by the Templars and Hospitallers, whose respective headquarters were at Soure and Thomar. On the 25th of July 1139 he defeated the combined forces of the Moors on the plains of Ourique, in Alemtejo. Legend has magnified the victory into the rout of 200,000 Moslems under five kings; but so far was the battle from being decisive that in 1140 the Moors were able to seize the fortress of Leiria, built by Alphonso in 1135 as an outpost for the defence of Coimbra, his capital. In 1144 they defeated the Templars at Soure. But on the 15th of March 1147 Alphonso stormed the fortress of Santarem, and about the same time a band of crusaders on their way to Palestine landed at Oporto and volunteered for the impending siege of Lisbon. Among them were many Englishmen, Germans and Flemings, who were afterwards induced to settle in Portugal. Aided by these powerful allies, Alphonso captured Lisbon on the 24th of October 1147. This was the greatest military achievement of his reign. The Moorish garrisons of Palmella, Cintra and Almada soon capitulated, and in 1158 Alcacer do Sal, one of the chief centres of Moorish commerce, was taken by storm. At this time, however, the Almohades had triumphed in Africa and invaded the Peninsula, where they were able to check the Portuguese reconquest, although isolated bands of crusading adventurers succeeded in establishing themselves in various cities of Alemtejo. The most famous of these free-lances was Giraldo Sempavor ("Gerald the Fearless"), who captured Evora in 1166. In 1171 Alphonso concluded a seven years' truce with the Moors; weakened by his wound and by old age, he could no longer take the field, and when the war broke out afresh he delegated the chief command to his son Sancho. Between 1179 and 1184 the Moors retrieved many of their losses in Alemtejo, but were unable to retake Santarem and Lisbon. Alphonso died on the 6th of December 1185. He had secured for Portugal the status though not the name of an independent kingdom, and had extended its frontier southwards from the Mondego to the Tagus. He had laid the foundation of its navy and had strengthened, if he did not inaugurate, that system of co-operation between the Crown and the military orders which afterwards proved of incalculable service in the maritime and colonial development of the nation.

Sancho I., 1185–1211.

Sancho I. continued the war against the Moors with varying fortune. In 1189 he won Silves, then the capital of Algarve; in 1192 he lost not only Algarve but the greater part of Alemtejo, including Alcacer do Sal. A peace was then arranged, and for the next eight years Sancho was engaged in hostilities against Alphonso IX. of Leon. The motives and course of this indecisive struggle are equally obscure. It ended in 1201, and the last decade of Sancho's reign was a period of peaceful reform which earned for the king his popular name of *o Povoador*, the "maker of towns." He granted fresh charters to many cities, legalizing the system of self-government which the Romans had bequeathed to the Visigoths and the Moors had retained or improved. Lisbon had already (1179) received a charter from Alphonso I. Sancho also endeavoured to foster immigration and agriculture, by granting estates to the military orders and municipalities on condition that the occupiers should cultivate or colonize their lands. Towards the close of his reign he became embroiled in a dispute with Pope Innocent III. He had insisted that priests should accompany their flocks in battle, had made them amenable to secular jurisdiction, had withheld the tribute due to Rome and had even claimed the right of disposing of ecclesiastical domains. Finally he had quarrelled with Martinho Rodrigues, the unpopular bishop of Oporto, who was besieged for five months in his palace and then forced to seek redress in Rome (1209). As Sancho was in weak health and had no means of resisting Papal pressure, he made full submission (1210); and after bestowing large estates on his sons and daughters, he retired into the monastery of Alcobaça (*q.v.*), where he died in 1211.

Alphonso II., 1211–1223.

The reign of Alphonso II. ("the Fat") is noteworthy for the first meeting of the Portuguese cortes, to which the upper hierarchy of the Church and the nobles (*fidalgos* and *ricos homens*) were summoned by royal writ. The king was no warrior, but in 1212 a Portuguese contingent aided the Castilians to defeat the Moors at Las Navas de Tolosa, and in 1217 the ministers, bishops and captains of the realm, reinforced by foreign crusaders, retook Alcacer do Sal. Alfonso II. repudiated the will of his father, refused to surrender the estates left to his brothers, who went into exile, and only gave up the property bequeathed to his sisters after a prolonged civil war in which Alphonso IX. of Leon took part against them. Even then he compelled the heiresses to take the veil. His attempts to strengthen the monarchy and fill the treasury at the expense of the Church resulted in his excommunication by

Pope Honorius III., and Portugal remained under interdict until Alphonso II. died in 1223.

Sancho II., 1223–1248.

Sancho II. succeeded at the age of thirteen. To secure the removal of the interdict the leading statesmen who were identified with the policy of his father—Gonçalo Mendes the chancellor, Pedro Annes the lord chamberlain (*mordomo-môr*) and Vicente, dean of Lisbon—resigned their offices. Estevão Soares, archbishop of Braga, placed himself at the head of the nobles and churchmen who threatened to usurp the royal power during Sancho II.'s minority, and negotiated an alliance with Alphonso IX., by which it was arranged that the Portuguese should attack Elvas, the Spaniards Badajoz. Elvas was taken from the Moors in 1226, and in 1227 Sancho assumed control of the kingdom. He reinstated Pedro Annes, made Vicente chancellor, and appointed Martim Annes chief standard-bearer (*alferes môr*). He continued the crusade against the Moors, who were driven from their last strongholds in Alemtejo, and in 1239–1244, after a dispute with Rome which was once more ended by the imposition of an interdict and the submission of the Portuguese ruler, he won many successes in the Algarve. But his career of conquest was cut short by a revolution (1245), for which his marriage to a Castilian lady, D. Mecia Lopez de Haro, furnished a pretext. The legitimacy of the union has been questioned, on grounds which appear insufficient; but of its unpopularity there can be no doubt. The bishops, resenting the favour shown by Sancho to his father's anti-clerical ministers, took advantage of this unpopularity to organize the rebellion. They found a leader in Sancho's brother Alphonso, count of Boulogne, who owed his title to a marriage with Matilda, countess of Boulogne. The pope issued a bull of deposition in favour of Alphonso, who reached Lisbon in 1246; and after a civil war lasting two years Sancho II. retired to Toledo, where he died in January 1248.

Alphonso III., 1248–1279.

One of the first acts of the usurper, and one of the most important, was to abandon the semi-ecclesiastical titles of visitor (*visitador*) or defender (*curador*) of the realm, and to proclaim himself king (*rei*). Hitherto the position of the monarchy had been precarious; as in Aragon the nobles and the church had exercised a large measure of control over their nominal head, and though it would be pedantry to over-emphasize the importance of the royal title, its assumption by Alphonso III. does mark a definite stage in the evolution of a national monarchy and a centralized government. A second stage was reached shortly afterwards by the conquest of Algarve, the last remaining stronghold of the Moors. This drew down upon Portugal the anger of Alphonso X. of Leon and Castile, surnamed the Wise, who claimed suzerainty over Algarve. The war which followed was ended by Alphonso III. consenting to wed Donna Beatriz de Guzman, illegitimate daughter of Alphonso X., and to hold Algarve as a fief of Castile. The celebration of this marriage, while Matilda, countess of Boulogne and first wife of Alphonso III., was still alive, entailed the imposition of an interdict upon the kingdom. In 1254 Alphonso III. summoned a cortes at Leiria, in which the chief cities were represented, as well as the nobles and clergy. Fortified by their support the king refused to submit to Rome. At the cortes of Coimbra (1261), he further strengthened his position by conciliating the representatives of the cities, who denounced the issue of a debased coinage, and by recognizing that taxation could not be imposed without consent of the cortes. The clergy suffered more than the laity under a prolonged interdict, and in 1262 Pope Urban VI. legalized the disputed marriage and legitimized Dom Diniz, the king's eldest son. Thus ended the contest for supremacy between Church and Crown. The monarchy owed its triumph to its championship of national interests, to the support of the municipalities and military orders, and to the prestige gained by the royal armies in the Moorish and Castilian wars. In 1263 Alphonso X. renounced his claim to suzerainty over Algarve, and thus the kingdom of Portugal simultaneously reached its present European limits and attained its complete independence. Lisbon was henceforth recognized as the capital. Alphonso III. continued to reign until his death in 1279, but the peace of his later years was broken by the rebellion (1277–1279) of D. Diniz,[1] the heir-apparent.

2. *The Consolidation of the Monarchy: 1279–1415.*—The chief problems now confronting the monarchy were no longer military, but social, economic and constitutional. It is true that the reign of Diniz was not a period of uninterrupted peace. At the outset his legitimacy was disputed by his brother Alphonso, and a brief civil war ensued. Hostilities between Portugal and the reunited kingdoms of Leon and Castile were terminated in 1297 by a treaty of alliance, in accordance with which Ferdinand IV. of Leon and Castile married Constance, daughter of Diniz, while Alphonso, son of Diniz, married Beatrice of Castile, daughter of Ferdinand. A further outbreak of civil war, between the king and the heir-apparent, was averted in 1293 by the queen-consort Isabella of Portugal, who had married Diniz in 1281, and was canonized for her many virtues in the 16th century. She rode between the hostile camps, and succeeded in arranging an honourable peace between her husband and her son.

Diniz, 1279–1325.

These wars were too brief to interfere seriously with the social reconstruction to which the king devoted himself. At his accession the Portuguese people was far from homogeneous; it would be long before its component races—Moors and Mozarabs of the south, Galicians of the north, Jews and foreign crusaders—could be fused into one nationality. There were also urgent economic problems to be solved. The Moors had made Alemtejo the granary of Portugal, but war had undone their work, and large tracts of land were now barren and depopulated. Commerce and education had similarly been subordinated to the struggle for national existence. The machinery of administration was out of date and complicated by the authority of feudal and ecclesiastical courts. The supremacy of the Crown, though recognized, was still unstable. It was Diniz who initiated the needful reforms. He earned his title of the *rei lavrador* or "farmer king" by introducing improved methods of cultivation and founding agricultural schools. He encouraged maritime trade by negotiating a commercial treaty with England (1294) and forming a royal navy (1317) under the command of a Genoese admiral named Emmanuele di Pezagna (Manoel Pessanha). In 1290 he founded the university of Coimbra (*q.v.*). He was a poet and a patron of literature and music (see *Literature*, below). His chief administrative reforms were designed to secure centralized government and to limit the jurisdiction of feudal courts. He encouraged and nationalized the military orders. In 1290 the Portuguese knights of São Thiago (Santiago) were definitely separated from the parent Spanish order. The orders of Crato and of St Benedict of Aviz had already been established, the traditional dates of their incorporation being 1113 and 1162. After the condemnation of the Templars by Pope Clement V. (1312) an ecclesiastical commission investigated the charges against the Portuguese branch of the order, and found in its favour. As the Templars were rich, influential and loyal, Diniz took advantage of the death of Clement V. to maintain the order under a new name; the Order of Christ, as it was henceforth called, received the benediction of the pope in 1319 and subsequently played an important part in the colonial expansion of Portugal.

Alphonso IV., 1325–1357.

Alphonso IV. adhered to the matrimonial policy initiated by Diniz. He arranged that his daughter Maria should wed Alphonso XI. of Castile (1328), but the marriage precipitated the war it was intended to avert, and peace was only restored (1330) after Queen Isabella had again intervened. Pedro, the crown prince, afterwards married Constance, daughter of the duke of Peñafiel (near Valladolid), and Alphonso IV. brought a strong Portuguese army to aid the Castilians against the Moors of Granada and their African allies. In the victory won by the Christians on the banks of the river Salado, near Tarifa, he earned his title of Alphonso the Brave (1340). In 1347 he married his daughter Leonora

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[1] Throughout this article the abbreviation *D.* is used for the Portuguese title *Dom* and for its feminine form *Dona* (see DOMINUS).

Pedro I., 1357–1367.

(Lenor) to Pedro IV. of Aragon. The later years of his reign were darkened by the tragedy of Inez de Castro (*q.v.*). He died in 1357, and the first act of his successor, Pedro the Severe, was to take vengeance on the murderers of Inez. Throughout his reign he strengthened the central government at the expense of the aristocracy and the Church, by a stern enforcement of law and order. In 1361, at the cortes of Elvas, it was enacted that the privileges of the clergy should only be deemed valid in so far as they did not conflict with the royal prerogative. Pedro maintained friendly relations with England, where in 1352 Edward III. issued a proclamation in favour of Portuguese traders, and in 1353 the Portuguese envoy Affonso Martins Alho signed a covenant with the merchants of London, guaranteeing mutual good faith in all commercial dealings.

The foreign policy of Diniz, Alphonso IV. and Pedro I. had been, as a rule, successful in its main object, the preservation of peace with the Christian kingdoms of Spain; in consequence, the Portuguese had advanced in prosperity and culture. They had supported the monarchy because it was a national institution, hostile to the tyranny of nobles and clergy. During the reign of Ferdinand (1367–1383) and under the regency of Leonora the ruling dynasty ceased to represent the national will; the Portuguese people therefore made an end of the dynasty and chose its own ruler. The complex events which brought about this crisis may be briefly summarized.

Ferdinand and Leonora, 1367–1385.

Ferdinand, a weak but ambitious and unscrupulous king, claimed the thrones of Castile and Leon, left vacant by the death of Pedro I. of Castile (1369); he based his claim on the fact that his grandmother Beatrice belonged to the legitimate line of Castile. When the majority of the Castilian nobles refused to accept a Portuguese sovereign, and welcomed Henry of Trastamara (see SPAIN: *History*), as Henry II. of Castile, Ferdinand allied himself with the Moors and Aragonese; but in 1371 Pope Gregory XI. intervened, and it was decided that Ferdinand should renounce his claim and marry Leonora, the daughter of his successful rival. Ferdinand, however, preferred his Portuguese mistress, Leonora Telles de Menezes, whom he eventually married. To avenge this slight, Henry of Castile invaded Portugal and besieged Lisbon. Ferdinand appealed to John of Gaunt, who also claimed the throne of Castile, on behalf of his wife Constance, daughter of Pedro I. of Castile. An alliance between Portugal and England was concluded; and although Ferdinand made peace with Castile in 1374, he renewed his claim in 1380, after the death of Henry of Castile, and sent João Fernandes Andeiro, count of Ourem, to secure English aid. In 1381 Richard II. of England despatched a powerful force to Lisbon, and betrothed his cousin Prince Edward to Beatrice, only child of Ferdinand, who had been recognized as heiress to the throne by the cortes of Leiria (1376). In 1383, however, Ferdinand made peace with John I. of Castile at Salvaterra, deserting his English allies, who retaliated by ravaging part of his territory. By the treaty of Salvaterra it was agreed that Beatrice should marry John I. Six months later Ferdinand died, and in accordance with the terms of the treaty Leonora became regent until the eldest son of John I. and Beatrice should be of age.

The Rebellion of 1383.

Leonora had long carried on an intrigue with the count of Ourem, whose influence was resented by the leaders of the aristocracy, while her tyrannical rule also aroused bitter opposition. The malcontents chose D. John, grand-master of the knights of Aviz and illegitimate son of Pedro the Severe, as their leader, organized a revolt in Lisbon, and assassinated the count of Ourem within the royal palace (Dec. 6, 1383). Leonora fled to Santarem and summoned aid from Castile, while D. John was proclaimed defender of Portugal. In 1384 a Castilian army invested Lisbon, but encountered a heroic resistance, and after five months an outbreak of plague compelled them to raise the siege. John I. of Castile, discovering or alleging that Leonora had plotted to poison him, imprisoned her in a convent at Tordesillas, where she died in 1386. Before this, Nuno Alvares Pereira, constable of Portugal, had gained his popular title of "The Holy Constable" by twice defeating the invaders, at Atoleiro and Trancoso in the district of Guarda.

Cortes of Coimbra.

On the 16th of April 1385 the cortes assembled at Coimbra declared the crown of Portugal elective, and at the instance of João das Regras, the chancellor, D. John was chosen king. No event in the early constitutional history of Portugal is more important than this election, which definitely affirmed the national character of the monarchy. The choice of the grand-master of Aviz ratified the old alliance between the Crown and the military orders; his election by the whole cortes not only ratified the alliance between the Crown and the commons, but also included the nobles and the Church. The nation was unanimous.

John I., 1385–1433.

Ferdinand had been the last legitimate descendant of Count Henry of Burgundy. With John I. began the rule of a new dynasty, the House of Aviz. The most urgent matter which confronted the king—or the group of statesmen, led by João das Regras and the "Holy Constable" who inspired his policy—was the menace of Castilian aggression. But on the 14th of August 1385 the Portuguese army, aided by 500 English archers, utterly defeated the Castilians at Aljubarrota. By this victory the Portuguese showed themselves equal in military power to their strongest rivals in the Peninsula. In October the "Holy Constable" won another victory at Valverde; early in 1386 5000 English soldiers, under John of Gaunt, reinforced the Portuguese; and by the treaty of Windsor (May 9, 1386), the alliance between Portugal and England was confirmed and extended. Against such a combination the Castilians were powerless; a truce was arranged in 1387 and renewed at intervals until 1411, when peace was concluded. D. Diniz, eldest son of Inez de Castro, claimed the throne and invaded Portugal in 1398, but his supporters were easily crushed. The domestic and foreign policy pursued by John I. until his death in 1433 may be briefly described. At home he endeavoured to reform administration, to encourage agriculture and commerce, and to secure the loyalty of the nobles by grants of land and privileges so extensive that, towards the end of his reign, many nobles who exercised their full feudal rights had become almost independent princes. Abroad, he aimed at peace with Castile and close friendship with England. In 1387 he had married Philippa of Lancaster, daughter of John of Gaunt; Richard II. sent troops to aid in the expulsion of D. Diniz; Henry IV., Henry V. and Henry VI. of England successively ratified the treaty of Windsor; Henry IV. made his ally a knight of the Garter in 1400. The convent of Batalha (*q.v.*), founded to commemorate the victory of Aljubarrota, is architecturally a monument of the English influence prevalent at this time throughout Portugal.

The cortes of Coimbra, the battle of Aljubarrota and the treaty of Windsor mark the three final stages in the consolidation of the monarchy. A period of expansion oversea began in the same reign, with the capture of Ceuta in Morocco. The three eldest sons of King John and Queen Philippa—Edward, Pedro and Henry, afterwards celebrated as Prince Henry the Navigator—desired to win knighthood by service against the Moors, the historic enemies of their country and creed. In 1415 a Portuguese fleet, commanded by the king and the three princes, set sail for Ceuta. English men-at-arms were sent by Henry V. to take part in the expedition, which proved successful. The town was captured and garrisoned, and thus the first Portuguese outpost was established on the mainland of Africa.

3. *The Period of Discoveries: 1415–1499.*—Before describing in outline the course of the discoveries which were soon to render Portugal the foremost colonizing power in Europe it is necessary to indicate the main causes which contributed to that result. As the south-westernmost of the free peoples of Europe, the Portuguese were the natural inheritors of that work of exploration which had been carried on during the middle ages,

chiefly by the Arabs. They began where the Arabs left off, by penetrating far into the Atlantic. The long littoral of their country, with its fine harbours and rivers flowing westward to the ocean, had been the training-ground of a race of adventurous seamen. It was impossible, moreover, to expand or reach new markets except by sea: the interposition of Castile and Aragon, so often hostile, completely prevented any intercourse by land between Portugal and other European countries. Consequently the Portuguese merchants sent their goods by sea to England, Flanders, or the Hanse towns. The whole history of the nation had also inspired a desire for fresh conquests among its leaders. Portugal had won and now held its independence by the sword. The long struggle to expel the Moors, with the influence of foreign Crusaders and the military orders, had given a religious sanction to the desire for martial fame. Nowhere was the ancient crusading spirit so active a political force. To make war upon Islam seemed to the Portuguese their natural destiny and their duty as Christians.

Prince Henry the Navigator.

Exploration under Alphonso V. and John II.

It was the genius of Prince Henry the Navigator (*q.v.*) that co-ordinated and utilized all these tendencies towards expansion. Prince Henry placed at the disposal of his captains the vast resources of the Order of Christ, the best information and the most accurate instruments and maps which could be obtained. He sought to effect a junction with the half-fabulous Christian Empire of "Prester John" by way of the "Western Nile," *i.e.* the Senegal, and, in alliance with that potentate, to crush the Turks and liberate Palestine. The conception of an ocean route to India appears to have originated after his death. On land he again defeated the Moors, who attempted to re-take Ceuta in 1418; but in an expedition to Tangier, undertaken in 1436 by King Edward (1433–1438), the Portuguese army was defeated, and could only escape destruction by surrendering as a hostage Prince Ferdinand, the king's youngest brother. Ferdinand, known as "the Constant," from the fortitude with which he endured captivity, died unransomed in 1443. By sea Prince Henry's captains continued their exploration of Africa and the Atlantic. In 1433 Cape Bojador was doubled; in 1434 the first consignment of slaves was brought to Lisbon; and slave trading soon became one of the most profitable branches of Portuguese commerce. The Senegal was reached in 1445, Cape Verde was passed in the same year, and in 1446 Alvaro Fernandes pushed on almost as far as Sierra Leone. This was probably the farthest point reached before the Navigator died (1460). Meanwhile colonization progressed in the Azores and Madeira, where sugar and wine were produced; above all, the gold brought home from Guinea stimulated the commercial energy of the Portuguese. It had become clear that, apart from their religious and scientific aspects, these voyages of discovery were highly profitable. Under Alphonso V., surnamed the African (1443–1481), the Gulf of Guinea was explored as far as Cape St Catherine, and three expeditions (1458, 1461, 1471) were sent to Morocco; in 1471 Arzila (Asīla) and Tangier were captured from the Moors. Under John II. (1481–1495) the fortress of São Jorge da Mina, the modern Elmina (*q.v.*), was founded for the protection of the Guinea trade in 1481–1482; Diogo Cam (*q.v.*), or Cão, discovered the Congo in 1482 and reached Cape Cross in 1486; Bartholomeu Diaz (*q.v.*) doubled the Cape of Good Hope in 1488, thus proving that the Indian Ocean was accessible by sea. After 1492 the discovery of the West Indies by Columbus rendered desirable a delimitation of the Spanish and Portuguese spheres of exploration. This was accomplished by the treaty of Tordesillas (June 7, 1494) which modified the delimitation authorized by Pope Alexander VI. in two bulls issued on the 4th of May, 1493. The treaty gave to Portugal all lands which might be discovered east of a straight line drawn from the Arctic Pole to the Antarctic, at a distance of 370 leagues west of Cape Verde. Spain received the lands discovered west of this line. As, however, the known means of measuring longitude were so inexact that the line of demarcation could not in practice be determined (see J. de Andrade Corvo in *Journal das Sciencias Mathematicas*, xxxi. 147–176, Lisbon, 1881), the treaty was subject to very diverse interpretations. On its provisions were based both the Portuguese claim to Brazil and the Spanish claim to the Moluccas (see MALAY ARCHIPELAGO: *History*). The treaty was chiefly valuable to the Portuguese as a recognition of the prestige they had acquired. That prestige was enormously enhanced when, in 1497–1499, Vasco da Gama (*q.v.*) completed the voyage to India.

The Monarchy and the Nobles.

While the Crown was thus acquiring new possessions, its authority in Portugal was temporarily overshadowed by the growth of aristocratic privilege. At the cortes of Evora (1433) King Edward had obtained the enactment of a law[1] declaring that the estates granted by John I. to his adherents could only be inherited by the direct male descendants of the grantees, and failing such descendants, should revert to the Crown. After the death of Edward further attempts to curb the power of the nobles were made by his brother, D. Pedro, duke of Coimbra, who acted as regent during the minority of Alphonso V. (1438–1447). The head of the aristocratic opposition was the duke of Braganza, who contrived to secure the sympathy of the king and the dismissal of the regent. The quarrel led to civil war, and in May 1449 D. Pedro was defeated and killed. Thenceforward the grants made by John I. were renewed, and extended on so lavish a scale that the Braganza estates alone comprised about a third of the whole kingdom. An unwise foreign policy simultaneously injured the royal prestige, for Alphonso married his own niece, Joanna, daughter of Henry IV. of Castile, and claimed that kingdom in her name. At the battle of Toro, in 1476, he was defeated by Ferdinand and Isabella, and in 1478 he was compelled to sign the treaty of Alcantara, by which Joanna was relegated to a convent. His successor, John II. (1481–1495) reverted to the policy of matrimonial alliances with Castile and friendship with England. Finding, as he said, that the liberality of former kings had left the Crown "no estates except the high roads of Portugal," he determined to crush the feudal nobility and seize its territories. A cortes held at Evora (1481) empowered judges nominated by the Crown to administer justice in all feudal domains. The nobles resisted this infringement of their rights; but their leader, Ferdinand, duke of Braganza, was beheaded for high treason in 1483; in 1484 the king stabbed to death his own brother-in-law, Ferdinand, duke of Vizeu; and 80 other members of the aristocracy were afterwards executed. Thus John "the Perfect," as he was called, assured the supremacy of the Crown. He was succeeded in 1495 by Emanuel (Manoel) I., who was named "the Great" or "the Fortunate," because in his reign the sea route to India was discovered and a Portuguese Empire founded.

4. *The Portuguese Empire: 1499–1580.*—In 1500 King Emanuel assumed the title "Lord of the conquest, navigation and commerce of India, Ethiopia, Arabia and Persia," which was confirmed by Pope Alexander VI. in 1502. It was now upon schemes of conquest that the energy of the nation was to be concentrated, although the motives which called forth that energy were unchanged. "We come to seek Christians and spices," said the first of Vasco da Gama's sailors who landed in India: and the combination of missionary ardour with commercial enterprise which had led to the exploration of the Atlantic led also to the establishment of a Portuguese Empire. This expansion of national interests proceeded rapidly in almost every quarter of the known world. In the North Atlantic Gaspar and Miguel Corte-Real penetrated as far as Greenland (their "Labrador") in 1500–1501; but these voyages were politically and commercially unimportant. Equally barren was the intermittent fighting in Morocco, which was regarded as a crusade against the Moors. In the South Atlantic, however, the African coast was further explored, new settlements were founded, and a remarkable development of Portuguese-African civilization took place in the kingdom of Kongo (see ANGOLA).

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[1] Known as the *lei mental*, because it was supposed to fulfil the intention which John I. had in mind when the grants were made,

Pedro Alvares Cabral, sailing to India, but steering far westward to avoid the winds and currents of the Guinea coast, reached Brazil (1500) and claimed it for his sovereign. João da Nova discovered Ascension (1501) and St Helena (1502); Tristão da Cunha was the first to sight the archipelago still known by his name (1506). In East Africa the small Mahommedan states along the coast—Sofala, Mozambique, Kilwa, Brava, Mombasa, Malindi—either were destroyed or became subjects or allies of Portugal. Pedro de Covilham had reached Abyssinia (*q.v.*) as early as 1490; in 1520 a Portuguese embassy arrived at the court of "Prester John," and in 1541 a military force was sent to aid him in repelling a Mahommedan invasion. In the Indian Ocean and Arabian Sea, one of Cabral's ships discovered Madagascar (1501), which was partly explored by Tristão da Cunha (1507); Mauritius was discovered in 1507, Socotra occupied in 1506, and in the same year D. Lourenço d'Almeida visited Ceylon. In the Red Sea Massawa was the most northerly point frequented by the Portuguese until 1541, when a fleet under Estevão da Gama penetrated as far as Suez. Hormuz, in the Persian Gulf, was seized by Alphonso d'Albuquerque (1515), who also entered into diplomatic relations with Persia. On the Asiatic mainland the first trading-stations were established by Cabral at Cochin and Calicut (1501); more important, however, were the conquest of Goa (1510) and Malacca (1511) by Albuquerque, and the acquisition of Diu (1535) by Martim Affonso de Sousa. East of Malacca, Albuquerque sent Duarte Fernandes as envoy to Siam (1511), and despatched to the Moluccas two expeditions (1512, 1514), which founded the Portuguese dominion in the Malay Archipelago (*q.v.*). Fernão Pires de Andrade visited Canton in 1517 and opened up trade with China, where in 1557 the Portuguese were permitted to occupy Macao. Japan, accidentally discovered by three Portuguese traders in 1542, soon attracted large numbers of merchants and missionaries (see JAPAN, § viii.). In 1522 one of the ships of Ferdinand Magellan (*q.v.*)—a Portuguese sailor, though in the Spanish service—completed the first voyage round the world.

Almeida and Albuquerque.

Up to 1505 the Portuguese voyages to the East were little more than trading ventures or plundering raids, although a few "factories" for the exchange of goods were founded in Malabar. In theory, the objects of King Emanuel's policy were the establishment of friendly commercial relations with the Hindus (who were at first mistaken for Christians "not yet confirmed in the faith," as the king wrote to Alexander VI.) and the prosecution of a crusade against Islam. But Hindu and Mahommedan interests were found to be so closely interwoven that this policy became impracticable, and it was superseded when D. Francisco d'Almeida (*q.v.*) went to India as first Portuguese viceroy in 1505. Almeida sought to subordinate all else to sea power and commerce, to concentrate the whole naval and military force of the kingdom on the maintenance of maritime ascendancy; to annex no territory, to avoid risking troops ashore, and to leave the defence of such factories as might be necessary to friendly native powers, which would receive in return the support of the Portuguese fleet. Almeida's statesmanship was to a great extent sound. The Portuguese could never penetrate far inland; throughout the 16th century their settlements were confined to the coasts of Asia, Africa or America, and the area they were able effectively to occupy was far less than the area of their empire in the 20th century. A Chinese critic, quoted by Faria y Sousa, said of them that they were like fishes, "remove them from the water and they straightway die." It is thus absurd to speak of a "Portuguese conquest of India"; in a land campaign they would have been outnumbered and destroyed by the armies of any one of the greater Indian states. But their artillery and superior maritime science made them almost invulnerable at sea, and their principal military achievements consisted in the capture or defence of positions accessible from the sea, *e.g.* the defence of Cochin by Duarte Pacheco Pereira in 1504, the defence of Diu (*q.v.*) in 1538 and 1546.

Alphonso d'Albuquerque (*q.v.*), who succeeded Almeida in 1509, found it necessary to modify the policy formulated by his predecessor. Command of the sea could not be maintained—least of all in the monsoon months—while the Portuguese fleets were based on Lisbon, which could only be reached after a six months' voyage; and experience had proved that almost every Portuguese factory required a fortress for its defence when the fleets were absent. Portugal, like every great maritime trading community from Carthage to Venice, discovered that the ideal of "sea power and commerce" led directly to empire. In 1510 Albuquerque seized Goa, primarily as a naval base, and in so doing recognized the fact that his country was committed to a policy of territorial aggrandisement. Other seaports and islands were conquered or colonized in rapid succession, and by 1540 Portugal had acquired a line of scattered maritime possessions extending along the coasts of Brazil, East and West Africa, Malabar, Ceylon, Persia, Indo-China and the Malay Archipelago. The most important settlements in the East were Goa, Malacca and Hormuz.

To a superficial observer the prosperity of Portugal might well seem to have culminated during this period of expansion. Vast profits were derived from the import trade in the innumerable products of the tropics, of which Portugal was the sole purveyor in Europe. This influx of wealth furnished the economic basis for a sudden development of literary and artistic activity, inspired by contrast with the new world of the tropics. The 16th century was the golden age of Portuguese literature; humanists, such as Damião de Goes (*q.v.*), and scientists, such as the astronomer Pedro Nunes (Nonius), played conspicuous parts in the great intellectual movements of the time; a distinctive school of painters arose, chief among them being the so-called "Grão Vasco" (Vasco Fernandes of Vizeu); in architecture the name of King Emanuel was given to a new and composite style (the Manoeline or Manoellian), in which decorative forms from India and Africa were harmonized with Gothic and Renaissance designs; palaces, fortresses, cathedrals, monasteries, were built on a scale never before attempted in Portugal; and even in the minor arts and handicrafts—in goldsmith's work, for example, or in pottery—the influence of the East made itself felt. Oriental splendour and Renaissance culture combined to render social life in Lisbon hardly less brilliant than in Rome or Venice.

In order to understand the apparently sudden collapse of Portuguese power in 1578–1580 it is necessary to examine certain facts and tendencies which from the first rendered a catastrophe inevitable. Chief among these were the extent of the empire and its organization, the financial and commercial policy of its rulers, the hostility, often wantonly provoked, of the chief Oriental states, the depopulation of Portugal and the slave trade, the expulsion of the Jews, the growth of ecclesiastical influence in secular affairs, and the decadence of the monarchy.

Imperial Organization.

It is necessary to exclude Brazil from any survey of the Portuguese imperial system, because the colonization of Brazil (*q.v.*) was effected on distinctive lines. Otherwise the whole empire was governed on a more or less uniform system, although it included communities of the most diverse nature—protectorates such as Hormuz and Ternate in the Moluccas, colonies such as Goa and Madeira, captaincies under military rule such as Malacca, tributary states such as Kilwa, fortified factories as at Colombo and Cochin. West of the Cape the settlements in Africa and the Atlantic were governed, as a rule, by officials directly nominated by the king. East of the Cape the royal power was delegated to a viceroy or governor—the distinction was purely titular—whose legislative and executive authority was almost unlimited during his term of office. The viceroyalty was created in 1505, and from 1511 the Indian capital was Goa. Between 1505 and 1580 only four holders of the office—Almeida (1505–1509), Albuquerque (1509–1515), D. Vasco da Gama (1524) and D. João de Castro (1545–1548)—were men of marked ability and high character. All officials, including the viceroy and naval and military officers, were usually appointed for no more than three years. Although few large salaries were paid, the perquisites attached to official positions were enormous; at the beginning of the 17th century, for example, the captain of Malacca received not quite £300 yearly as his pay, but his annual profits from other sources were estimated at £20,000. Even judges were expected to live on their perquisites, in the shape of bribes. The competition for appointments was naturally very keen; Couto mentions the case of one grantee who received the reversion of a post to which 30 applicants had a prior claim.[1] Such reversions could be sold, bequeathed, or included in the dowries of married women; the right of trading with China might be part of the endowment of a school; a monastery or a hospital might purchase the command of a fortress. In 1538 the viceroy, D. Garcia de Noronha, publicly sold by auction every vacant appointment in Portuguese India—an example followed in 1614 by the king. Hardly less disastrous than the system by which officials were chosen and paid was the influence exercised by the Church. Simão Botelho, an able revenue officer, was denied absolution in 1543 because he had reorganized the Malacca customs-house without previously consulting the Dominicans in that city. In 1560 a supposed tooth of Buddha was brought to Goa; the raja of Pegu offered £100,000 for the relic, and as Portuguese India was virtually bankrupt the government wished to accept the offer; but the archbishop intervened and the relic was destroyed.

Finance.

The empire in the East was rarely solvent. Almeida and Albuquerque had hoped to meet the expense of administration mainly out of the fees extorted for safe-conducts at sea and trading-licences, with the tribute wrung from native states and the revenue from Crown lands in India. But the growth of expenditure—chiefly of an unremunerative kind, such as the cost of war and missions—soon rendered these resources inadequate; and after 1515 the empire became ever more dependent on the spoils of hostile states and on subsidies from the royal treasury in Lisbon. Systematic debasement of the coinage was practised both in India, where the monetary system was extremely complex,[2] and in Portugal; and owing to the bullionist policy adopted by Portuguese financiers little permanent benefit accrued to the mother country from its immense trade. Seeking for commercial profit, not in the exchange of commodities, but solely in the acquisition of actual gold and silver, and realizing that the home market could not absorb a tithe of the merchandise imported, the Lisbon capitalists sent their ships to discharge in Antwerp (where a Portuguese staple was established in 1503), or in some other port near the central markets of Europe. The raw materials purchased by Flemish, German or English traders were used in the establishment of productive industries, while Portugal received a vast influx of bullion, most of which was squandered on war, luxuries or the Church.

Commercial Policy.

In theory the most lucrative branches of commerce, such as the pepper trade, were monopolies vested in the Crown; the chartered companies and associations of merchant adventurers, which afterwards became the pioneers of British and Dutch colonial development, had no counterpart in Portuguese history, except in the few cases in which trading concessions were granted to military or monastic orders. But the Crown frequently farmed out its monopolies to individual merchants, or granted trading-licences by way of pension or reward. These were often of great value; *e.g.* in 1612 the right of sending a merchant ship to China was valued at £25,000. Great loss was necessarily inflicted on native traders by the monopolist system, which pressed most hardly on the Mahommedans, who had been the chief carriers in Indian waters. Two great powers, Egypt and Turkey, challenged the naval and commercial supremacy of the Portuguese, but an Egyptian armada was destroyed by Almeida in 1509, and though Ottoman fleets were on several occasions (as in 1517 and 1521) despatched from Suez or Basra, they failed to achieve any success, and the Portuguese were able to close the two principal trade routes between India and Europe. One of these trade routes passed up the Persian Gulf to Basra, and thence overland to Tripoli, for Mediterranean ports, and to Trebizond, for Constantinople. The other passed up the Red Sea to Suez, and thence to Alexandria, for Venice, Genoa and Ragusa. But by occupying Hormuz the Portuguese gained command of the Gulf route; and though they thrice failed to capture Aden (1513, 1517, 1547), and so entirely to close the Red Sea, they almost destroyed the traffic between India and Suez by occupying Socotra and sending fleets to cruise in the Strait of Bab el-Mandeb. In Malacca they possessed the connecting link between the trade-routes of the Far and Middle East, and thus they controlled the three sea-gates of the Indian Ocean and Arabian Sea—the Straits of Hormuz, Bab el-Mandeb and Malacca—and diverted the maritime trade with Europe to the Cape route.

Relations with Oriental States.

During the critical period in which their empire was being established (*c.* 1505–1550) the Portuguese were fortunate in escaping conflict with any Oriental power of the first rank except Egypt and Turkey; for the Bahmani sultanate of the Deccan had been already disintegrated before 1498, and the Mughals and Mahrattas were still far off. A coalition of the minor Mahommedan states was prevented by the great Hindu kingdom of Vijayanagar, which comprised the southern half of the Indian Peninsula. Vijayanagar gave the militant Mahommedanism of Northern India no opportunity for a combined attack on the Portuguese settlements. After 1565, when the power of Vijayanagar was broken at the battle of Talikot, a Mussulman coalition was at last formed, and the Portuguese were confronted by a line of hostile states stretching from Gujarat to Achin; but by this time they were strong enough to hold their own. It is characteristic of their native policy that they had not only refrained from aiding Vijayanagar in 1565, but had even been willing to despoil their Hindu allies. In 1543 Martim Affonso de Sousa, governor of India, organized an expedition to sack the Hindu temples at Conjeveram in Vijayanagar itself, and similar incidents are common in Indo-Portuguese history. Albuquerque was almost the only Portuguese statesman who strove to deal justly with both Hindus and Mahommedans, to respect native customs, and to establish friendly relations with the great powers of the East. Apart from the rigorous restrictions imposed by his successors upon trade, the sympathies of the natives were estranged by the harshness and venality of Portuguese administration, by such barbarities as the wholesale mutilation of non-combatants in war-time, and by religious persecution. After the arrival of the Franciscan missionaries, in 1517, Goa gradually became the headquarters of an immense proselytizing organization, which by 1561 had extended to East Africa, China, Japan and the Malay Archipelago (see GOA: *Ecclesiastical History*). Wherever the Portuguese were supreme they endeavoured to obtain converts by force. The widespread resentment thus aroused was a frequent cause of insurrection, and between 1515 and 1580 not a single year passed without war between the Portuguese and at least one African or Asiatic people.

Depopulation

Centuries of fighting against the Moors and Castilians had already left Portugal thinly populated; large tracts of land were uncultivated, especially in Alemtejo, and wolves were still common throughout the kingdom. It was impossible, from the first, to garrison the empire with trained men. As early as 1505 one of Almeida's ships contained a crew of rustics unable to distinguish between port and starboard; soon afterwards it became necessary to recruit convicts and slaves, and in 1538 a royal pardon was granted to all prisoners who would serve in India, except criminals under sentence for treason and canonical offences. Linschoten estimates that of all those who went to the East not one in ten returned. The heaviest losses were due to war, shipwreck and tropical diseases, but large numbers of the underpaid or unpaid soldiers deserted to the armies of native states. It is impossible to give more than approximately accurate statistics of the resultant depopulation of Portugal; but it seems probable that the inhabitants of the kingdom decreased from about 1,800,000 or 2,000,000 in 1500 to about 1,080,000 in 1586. The process of decay was hastened by frequent outbreaks of plague, sometimes followed by famine; a contemporary manuscript estimates that no fewer than 500 persons died daily in Lisbon alone during July, August and September 1569, and in some other years the joint effects of plague and famine were little less disastrous.

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[1] *Decadas*, XII. i. 10.

[2] See R. S. Whiteway, *Rise of the Portuguese Power*, &c. (London, 1898), pp. 67–72.

The Slave Trade.

While the country was being drained of its best citizens, hordes of slaves were imported to fill the vacancies, especially into the southern provinces.[1] Manual labour was thus discredited; the peasants sold their farms and emigrated or flocked to the towns; and small holdings were merged into vast estates, unscientifically cultivated by slaves and comparable with the *latifundia* which caused so many agrarian evils during the last two centuries of the Roman republic. The decadence of agriculture partly explains the prevalence of famine at a time when Portuguese maritime commerce was most prosperous. The Portuguese intermarried freely with their slaves, and this infusion of alien blood profoundly modified the character and physique of the nation. It may be said without exaggeration that the Portuguese of the "age of discoveries" and the Portuguese of the 17th and later centuries were two different races. Albuquerque, foreseeing the dangers that would arise from a shortage of population in his colonies, had encouraged his soldiers to marry captive Brahman and Mahommedan women, and to settle in India as farmers, shopkeepers or artisans. Under his rule the experiment was fairly successful, but the married colonists afterwards became a privileged caste, subsisting upon the labour of their slaves, and often disloyal to their rulers. Intermarriage led to the adoption, even by the rich, and especially by women (see Goa), of Asiatic dress, manners and modes of thought. Thus in the East, as in Europe, slavery reacted upon every class of the Portuguese.

The Persecution of the Jews.

The banishment, or forcible conversion, of the Jews deprived Portugal of its middle class and of its most scientific traders and financiers. Though the Jews had always been compelled to reside in separate quarters called *Juderías*, or Jewries, they had been protected by the earlier Portuguese kings. Before 1223 their courts had received autonomy in civil and criminal jurisdiction; their chief rabbi was appointed by the king and entitled to use the royal arms on his seal. Alphonso V. even permitted his Jewish subjects to live outside the Juderías, relieved them from the obligation to wear a distinctive costume (enforced in 1325), and nominated a Jew, Isaac Abrabanel (*q.v.*), as his minister of finance. In culture the Portuguese Jews surpassed their rulers. Many of them were well versed in Aristotelian and Arabic philosophy, in astronomy, mathematics, and especially in medicine. Three Hebrew printing-presses were established between 1487 and 1495; both John II. and Emanuel I. employed Jewish physicians; it was a Jew—Abraham Zacuto ben Samuel—who supplied Vasco da Gama with nautical instruments; and Jews were employed in the overland journeys by which the Portuguese court first endeavoured to obtain information on Far Eastern affairs. The Jews paid taxes on practically every business transaction, besides a special poll-tax of 30 *dinheiros* in memory of the 30 pieces of silver paid to Judas Iscariot; and for this reason they were protected by the Crown. For centuries they were also tolerated by the commons; but the other orders—ecclesiastics and nobles—resented their religious exclusiveness or envied their wealth, and gradually fostered the growth of popular prejudice against them. In 1449 the Lisbon Juderías were stormed and sacked, and between 1450 and 1481 the cortes four times petitioned the Crown to enforce the anti-Jewish provisions of the canon law. John II. gave asylum to 90,000 Jewish refugees from Castile, in return for a heavy poll-tax and on condition that they should leave the country within eight months, in ships furnished by himself. These ships were not provided in time, and the Jews who were thus unable to depart were enslaved, while their children were deported to the island of St Thomas, and there left to survive as best they might. In 1496 Emanuel I. desired to wed Isabella, daughter of Ferdinand and Isabella, but found that he was first required to purify his kingdom of the Jews, who were accordingly commanded to leave Portugal before the end of October 1497. But in order to avoid the economic dangers threatened by such an exodus, every Jew and Jewess between the ages of 4 and 24 was seized and forcibly baptized (19th March): "Christians" were not required to emigrate. In October 20,000 adults were treated in the same way. These "New Christians" or "Maranos," as they were called, were forbidden to leave the country between 1498 and 1507. In April 1506 most of those who resided in Lisbon were massacred during a riot, but throughout the rest of Emanuel's reign they were immune from violence, and were again permitted to emigrate—an opportunity of which the majority took advantage. Large numbers settled in Holland, where their commercial talent afterwards greatly assisted the Dutch in their rivalry with the Portuguese.

The Inquisition and the Jesuits.

The Reformation never reached Portugal, but even here the critical tendencies which elsewhere preceded Reform, were already at work. Their origin is to be sought not so much in the Revival of Learning as in the fact that the Portuguese had learned, on their voyages of discovery, to see and think for themselves. The true scientific spirit may be traced throughout the *Roteiros* of D. João de Castro (*q.v.*) and the *Colloquios* of Garcia de Orta—men who deserted books for experiment and manifested a new interest in the physical world. But orthodox churchmen feared that even in Portugal this appeal from authority to experience would lead to an attack upon religious doctrines previously regarded as beyond criticism. To check this dangerous movement of ideas, they demanded the introduction of the Inquisition into Portugal. The agents of the "New Christians" in Rome long contrived, by lavish bribery and with the support of many enlightened Portuguese, to delay the preliminary negotiations; but in 1536 the Holy Office was established in Lisbon, where the first *auto-da-fé* was held in 1540, and in 1560 its operations were extended to India. It seems probable that the influence of the tribunal upon Portuguese life and thought has been exaggerated. *Autos-da-fé* were rare events; their victims were not as a rule serious thinkers, but persons accused of sorcery or Judaizing, nor were they more numerous than the victims of the English laws relating to witchcraft and heresy. But the worst vices of the Inquisition were the widespread system of delation it encouraged by paying informers out of the property of the condemned, and its action as a trading and landholding association. Quite as serious, in their effects upon national life, were the severe censorship to which all printed matter was liable before publication and the control of education by the Jesuits. Poetry and imaginative literature usually escaped censure; but histories were mutilated and all original scientific and philosophical work was banned. Portuguese education centred in the national university of Coimbra, which had long shown itself ready to assimilate new ideas; between 1537 and 1547 John III. persuaded many eminent foreign teachers—among them the Scottish humanist George Buchanan (*q.v.*) and the French mathematician Élie Vinet—to lecture in its schools. But the discipline of the university needed reform, and the task was entrusted to the Jesuits. By 1555 they had secured control over Coimbra—a control which lasted for two centuries and extended to the whole educational system of the country. The effects of this change upon the national character were serious and permanent. Portugal sank back into the middle ages. The old initiative and self-reliance of the nation, already shaken by years of disaster, were now completely undermined, and the people submitted without show of resistance to a theocracy disguised as absolute monarchy.

Emanuel I. had been a fearless despot, such as Portugal needed if its scattered dependencies were to remain subject to the central government. During his reign (1495–1521) the Church was never permitted to encroach upon the royal

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[1] In the north, which had been relatively immune from wars agriculture was more prosperous and the peasants more tenacious of their land; hence the continuance of peasant proprietorship and the rarity of African types between the Douro and the Minho.

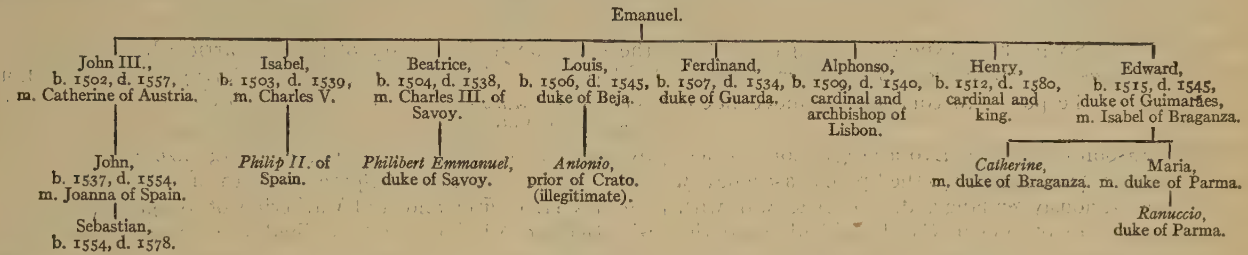
Decadence of the Monarchy.

prerogative. He even sent ambassadors to Rome to protest against ecclesiastical corruption, as well as to checkmate the Venetian diplomatists who threatened Europe with Ottoman vengeance if the Portuguese commercial monopoly were not relaxed. The Oriental magnificence of these embassies, notably that of 1514, and the fact that a king of Portugal dared openly to criticize the morals of the Vatican, temporarily enhanced the prestige of the monarchy. But Emanuel I. was the last great king of the Aviz dynasty. He had pursued the traditional policy of intermarriage with the royal families of Castile and Aragon, hoping to weld together the Spanish and Portuguese dominions into a single world-wide empire ruled by the house of Aviz. His ambition narrowly missed fulfilment, for Prince Miguel, his eldest son, was recognized (1498) as heir to the Spanish thrones. But Miguel died in infancy, and his inheritance passed to the Habsburgs. Frequent intermarriage, often so far within the prohibited degress as to require a papal dispensation, may possibly explain the weakened vitality of the Portuguese royal family, which was now subject to epilepsy, insanity and premature decay. The decadence of the monarchy as a national institution was reflected in the decadence of the cortes, which was rarely summoned between 1521 and 1580. John III. (1521–1557) was a ruler of fair ability, who became in his later years wholly subservient to his ecclesiastical advisers. He was succeeded by his grandson Sebastian (1557–1578), aged three years. Until the king came of age (1568), his grandmother, Queen Catherine, a fanatical daughter of Isabella the Catholic, and his great-uncle, Prince Henry, cardinal and inquisitor-general, governed as joint regents. Both were dominated by their Jesuit confessors, and a Jesuit, D. Luiz Gonçalves da Camara, became the tutor and, after 1568, the principal adviser of Sebastian.

The Disaster of Al Kasr.

The king was a strong-willed and weak-minded ascetic, who entrusted his empire to the Jesuits, refused to marry, although the dynasty was threatened with extinction, and spent years in preparing for a crusade against the Moors. The wisest act of John III. had been his withdrawal of all the Portuguese garrisons in Morocco except those at Ceuta, Arzila and Tangier. Sebastian reversed this policy. His first expedition to Africa (1574) was a mere reconnaissance, but four years later a favourable opportunity for invasion arrived. A dethroned sultan of Morocco, named Mulai Ahmad (Mahommed XI.), offered to acknowledge Portuguese suzerainty if he were restored to the throne by Portuguese arms, and Sebastian eagerly accepted these terms. The flower of his army was in Asia and his treasury was empty; but he contrived to extort funds from the "New Christians," and collected a force of some 18,000 men, chiefly untrained lads, worn-out veterans, and foreign free-lances. At Arzila, where he landed, he was joined by Mulai Ahmad, who could only muster 800 soldiers. Thence Sebastian sought to proceed overland to the seaport of El Araish, despite the advice of his ally and of others who knew the country. After a long desert march under an August sun, he took up an indefensible position in a valley near Al Kasr al Kebir (*q.v.*). On the morrow (Aug. 4, 1578) they were surrounded by the superior forces of Abd el Malek, the reigning sultan, and after a brave resistance Sebastian was killed and his army almost annihilated. So overwhelming was the disaster that the Portuguese people refused to believe the truth. It was rumoured that Sebastian still lived, and would sooner or later return and restore the past greatness of his country. "Sebastianism" became a religion; its votaries were numbered by thousands, and four impostors arose in succession, each claiming to be the *rei encuberto*, or "hidden king," whose advent was so ardently desired (see SEBASTIAN).

There was no surviving prince of the Aviz dynasty except the aged, feeble and almost insane Cardinal Prince Henry, who, as a younger son of Emanuel I., now became king. Henry died on the 31st of January 1580, and the throne was thus left vacant. There were five principal claimants—Philip II. of Spain; Philibert, duke of Savoy; Antonio, prior of Crato; Catherine, duchess of Braganza; and Ranuccio, duke of Parma—whose relationship to Emanuel I. is shown in the following table:—


Emanuel.
John III., b. 1502, d. 1557, m. Catherine of Austria.
Isabel, b. 1503, d. 1539, m. Charles V.
Beatrice, b. 1504, d. 1538, m. Charles III. of Savoy.
Louis, b. 1506, d. 1545, duke of Beja.
Ferdinand, b. 1507, d. 1534, duke of Guarda.
Alphonso, b. 1509, d. 1540, cardinal and archbishop of Lisbon.
Henry, b. 1512, d. 1580, cardinal and king.
Edward, b. 1515, d. 1545, duke of Guimarães, m. Isabel of Braganza.
John, b. 1537, d. 1554, m. Joanna of Spain.
Philip II. of Spain.
Philibert Emmanuel, duke of Savoy.
Antonio, prior of Crato. (illegitimate).
Catherine, m. duke of Braganza.
Maria, m. duke of Parma.
Sebastian, b. 1554, d. 1578.
Ranuccio, duke of Parma.

Tentative and hardly serious claims were also put forward by Pope Gregory XIII., as *ex officio* heir-general to a cardinal, and by Catherine de' Medici, as a descendant of Alphonso III. and Matilda of Boulogne.

5. *The "Sixty Years' Captivity": 1581–1640.*—The university of Coimbra declared in favour of Catherine, duchess of Braganza, but the prior of Crato was the only rival who offered any serious resistance to Philip II. D. Antonio proclaimed himself king and occupied Lisbon. The advocates of union with Spain, however, were numerous, influential, and ably led by their spokesmen in the cortes, Christovão de Moura and Antonio Pinheiro, bishop of Leiria. The duke of Braganza was won over to their side, chiefly by the promise that he should be king of Brazil if Philip II. became king of Portugal—a promise never fulfilled. Above all, the Church, including the Society of Jesus, naturally favoured the Habsburg claimant, who represented its two foremost champions, Spain and Austria. In 1581 a Spanish army, led by the duke of Alva, entered Portugal and easily defeated the levies of D. Antonio at Alcantara. The prior escaped to Paris and appealed to France and England for assistance. In 1582 a French fleet attempted to seize the Azores in his interest, but was defeated. In 1589 an English fleet was sent to aid the prior in a projected invasion of Portugal, but owing to a quarrel between its commanders, Sir Francis Drake and Sir John Norris, the expedition was abandoned. D. Antonio returned to Paris, where he died in 1594.

Meanwhile the victory of Alcantara left Philip II. supreme in Portugal, where he was soon afterwards crowned king. His constitutional position was defined at the Cortes of Thomar (1581). Portugal was not to be regarded as a conquered or annexed province, but as a separate kingdom, joined to Spain solely by a personal union similar to the union between Castile and Aragon under Ferdinand and Isabella. At Thomar Philip II. promised to maintain the rights and liberties conceded by his predecessors on the Portuguese throne, to summon the Cortes at frequent intervals, and to create a Portuguese privy council which should accompany the king everywhere and be consulted on all matters affecting Portuguese interests. Brazil and the settlements in Africa and Asia were still to belong to Portugal, not to Spain, and neither in Portugal nor in its colonies was any alien to be given lands, public office, or jurisdiction. On these terms the political union of the Iberian Peninsula was accomplished. It was the final stage in a process of accretion dating back to the beginnings of the Christian reconquest in the 8th century. Asturias had been united with Leon, Leon with Castile, Castile with Aragon. All these precedents seemed to indicate that Spain and Portugal would ultimately form one state; and despite the strong nationalism which their separate language and history had inspired among the Portuguese, the union of 1581 might have endured if the terms of the Thomar compact had been observed. But few of the promises made in 1581 were kept by the three Spanish kings who ruled over Portugal—Philip II. (1581–1598), Philip III. (1598–1621) and Philip IV. (1621–1640).[1] The cortes was only once summoned (1619), and the government of Portugal was entrusted by Philip III. chiefly to Francis duke of Lerma, by Philip IV. chiefly to Olivares (*q.v.*). The kingdom and its dependencies were also involved in the naval disasters which overtook Spain. Faro in Algarve was sacked in 1595 by the English, who ravaged the Azores in 1596; and in many parts of the world English, French and Dutch combined to harass Portuguese trade and seize Portuguese possessions. (See especially Brazil; India; Malay Archipelago.) Union with Spain had exposed Portugal to the hostility of the strongest naval powers of western Europe, and had deprived it of the power to conclude an independent peace.

The Rebellion of 1640.

Insurrections in Lisbon (1634) and Evora (1637) bore witness to the general discontent, but until 1640 the Spanish ascendancy was never seriously endangered. In 1640 war with France and a revolution in Catalonia had taxed the military resources of Spain to the utmost. The royal authority in Portugal was delegated to Margaret of Savoy, duchess of Mantua, whose train of Spanish and Italian courtiers aroused the jealousy of the Portuguese nobles, while the harsh rule of her secretary of state, Miguel de Vasconcellos de Brito, provoked the resentment of all classes. Even the Jesuits, whose influence in Portugal had steadily increased since 1555, were now prepared to act in the interests of Cardinal Richelieu, and therefore against Philip IV. A leader was found in John, 8th duke of Braganza, who as a grandson of the duchess Catherine was descended from Emanuel I. The duke, however, was naturally indolent, and it was with difficulty that his ambitious and energetic Castilian wife, D. Luiza de Guzman, obtained his assent to the proposed revolution. He refused to take any active part in it; but D. Luiza and her confidential adviser, João Pinto Ribeiro, recruited a powerful band of conspirators among the disaffected nobles. Their plans were carefully elaborated, and on the 1st of December 1640 various strategic points were seized, the few partisans of Spain who attempted resistance were overpowered, and a provisional government was formed under D. Rodrigo da Cunha, archbishop of Lisbon, who was appointed lieutenant-general of Portugal.

6. *The Restoration*: *1640–1755*.—On the 13th of December 1640 the duke of Braganza was crowned as John IV., and on the 19th of January 1641 the cortes formally accepted him as king. The whole country had already declared in his favour and expelled the Spanish garrisons, an example followed by all the Portuguese dependencies. Thus the "Sixty Years' Captivity" came to an end and the throne passed to the house of Braganza. But the Portuguese were well aware that they could hardly maintain their independence without foreign assistance, and ambassadors were at once sent to Great Britain, the Netherlands and France. The struggle between the Crown and the parliament prevented Charles I. from offering aid, but he immediately recognized John IV. as king. Richelieu and the states-general of the Netherlands despatched fleets to the Tagus; but commercial rivalry in Brazil and the East led soon afterwards to a colonial war with the Dutch, and Portugal was left without any ally except France.

War with Spain, 1640-1668.

The Portuguese armies were at first successful. D. Matheus d'Albuquerque defeated the Spaniards under the baron of Molingen at Montijo (May 26, 1644), and throughout the reign of John IV. (1640–1656) they suffered no serious reverse. But great anxiety was caused by a plot to restore Spanish rule, in which the duke of Caminha and the archbishop of Braga were implicated; and especially by the action of Mazarin, who had assumed control of French foreign policy in 1642. At the congress of Münster (1643) he refused to make the independence of Portugal a condition of peace between France and Spain; and in a letter dated the 4th of October 1647 he even offered the Portuguese Crown to the duke of Longueville—an offer which illustrates the weakness of John IV. and the dependence of Portugal upon France.

John IV. was succeeded by his second son, Alphonso VI. (1656–1683), who was then aged thirteen. During the king's minority the queen-mother, D. Luiza, acted as regent. She prosecuted the war with vigour, and on the 14th of January 1659 a Portuguese army commanded by D. Antonio Luiz de Menezes, count of Cantanhede, defeated the Spaniards under D. Luiz de Haro at Elvas. In March 1659, however, the war between France and Spain was ended by the treaty of the Pyrenees; and D. Luiz de Haro, acting as the Spanish plenipotentiary, obtained the inclusion in the treaty of a secret article by which France undertook to give no further aid to Portugal. Neither Louis XIV. nor Mazarin desired the aggrandisement of Spain at the expense of their own ally; they therefore evaded the secret article by sending Marshal Schomberg to reorganize the Portuguese army (1660), and by helping forward a marriage between Charles II. of England and Catherine of Braganza, the sister of Alphonso VI. This project had been already mooted by D. Luiza, who had foreseen the restoration of the Stuart monarchy, and had in 1650 welcomed the exiled princes Rupert and Maurice at the court of John IV. The dowry to be paid by Portugal was fixed at £500,000 and the cession to Great Britain of Bombay and Tangier. In May 1663 the marriage was celebrated, and thus Great Britain took the place of France as the active ally of Portugal.

Schomberg and Castello Melhor.

Meanwhile, on the 20th of June 1662, the regency had been terminated by a palace revolution. Alphonso VI. declared himself of age and seized the royal authority; D. Luiza retired to a convent. The king was feeble and vicious, but had wit enough to leave the conduct of affairs to stronger hands. D. Luiz de Sousa e Vasconcellos, count of Castello Melhor, directed the policy of the nation while Schomberg took charge of its defence. The army, reinforced by British troops under the earl of Inchiquin and by French and German volunteers or mercenaries, was led in the field by Portuguese generals, who successfully carried out the plans of Schomberg. On the 8th of June 1663 the count of Villa Flor utterly defeated D. John of Austria, and retook Evora, which had been captured by the invaders; on the 7th of July 1664 Pedro de Magalhães defeated the duke of Osuna at Ciudad Rodrigo; on the 17th of June 1665 the marquess of Marialva destroyed a Spanish army led by the marquess of Carraceña at the battle of Montes Claros, and Christovão de Brito Pereira followed up this victory with another at Villa Viçosa. The Spaniards failed to gain any compensating advantage, and on the 13th of February 1668 peace was concluded at Lisbon, Spain at last consenting to recognize the independence of the Portuguese kingdom.

The signature of the treaty of Lisbon had been preceded by another palace revolution. Castello Melhor, hoping to secure further French support for his country, had arranged a marriage between Alphonso VI. and Marie Françoise Elisabeth, daughter of Charles Amadeus of Nemours, and grand-daughter of Henry IV. of France. The marriage, celebrated in 1666, caused the downfall both of Castello Melhor and of the king. Queen Marie detested Alphonso and fell in love with his brother D. Pedro; and after four months of a hated union she left the palace and applied to the chapter of Lisbon cathedral to annul her marriage on the ground of non-consummation. D. Pedro imprisoned the king and assumed the regency; on the 1st of January 1668 his authority was recognized by the cortes; on the 24th of March the annulment of the queen's marriage was pronounced and confirmed by the pope; on the 2nd of April she married the regent. Castello Melhor was permitted to escape to France, while Alphonso VI. was banished to Terceira in the Azores. A conspiracy to restore him to the throne was discovered in 1674, and he was removed to Cintra, where he died in 1683.

Pedro II., who had acted as regent for fifteen years, now

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[1] Philip I., II. and III. of Portugal.

The Cortes and the Methuen Treaty.

became king. His reign (1683–1706) is a period of supreme importance in the economic and constitutional history of Portugal. The goldfields of Minas Geraes in Brazil, discovered about 1693, brought a vast revenue in royalties to the Crown, which was thus enabled to govern without summoning the cortes to vote supply. In 1697 the cortes met for the last time before the era of constitutional government. Even more important was the change effected when the Whig ministry of Great Britain sent John Methuen to Lisbon to negotiate a commercial agreement. The Methuen Treaty, signed on the 27th of December 1703, detached Portugal from the French alliance, and made her for more than 150 years a commercial and political satellite of Great Britain. Its most far-reaching provisions were those which admitted Portuguese wines to the British market at a lower rate of duty than was imposed upon French and German wines, in return for a corresponding preference to English textiles. The demand for "Port" and "Madeira" was thus artificially stimulated to such an extent that almost the whole productive energy of Portugal was concentrated upon the wine and cork trades. Other industries, including agriculture, were neglected, and even food-stuffs were imported from Great Britain. The disastrous economic results of the treaty were temporarily concealed by the influx of gold from Brazil, the check upon emigration from the wine-growing northern provinces, and the military advantages of alliance with Great Britain. Nor was the virtual abolition of the cortes seriously felt at first, owing to the excellent internal administration of Pedro II. and his minister the duke of Cadaval.

War of the Spanish Succession.

Pedro II. had at first wished to remain neutral in the impending struggle between Philip V. and the archduke Charles, rival claimants for the throne of Spain. But Queen Marie had died in 1683, and in 1687 Cadaval had induced the king to marry Maria Sophia de Neuberg, daughter of the elector-palatine. Louis XIV. of France, who had hoped through the influence of Queen Marie to secure Portuguese support for his own grandson Philip V., realized that this second marriage might thwart his policy, and strove to redress the balance by creating a strong party at the court of Lisbon. He so far succeeded that in 1700 Pedro II. recognized Philip V. as king of Spain and in 1701 protected a French fleet in the Tagus against the British. It was this incident that caused the despatch of the Methuen mission and the renewal of the Anglo-Portuguese alliance in 1703. On the 7th of March 1704 a British fleet under Sir George Rooke reached Lisbon, convoying the archduke Charles and 10,000 British troops, who were joined by a Portuguese army under D. João de Sousa, marquess das Minas, and at once invaded Spain. (For the campaigns of 1704–13, see Spanish Succession, War of the.) In 1705 Pedro II. was compelled by failing health to appoint a regent, and chose his sister, Catherine of Braganza, queen-dowager of England. On the death of the king (Dec. 9, 1706) Cadaval arranged a marriage between his successor John V. (1706–1750) and the archduchess Marianna, sister of the archduke Charles, thus binding Portugal more closely to the Anglo-Austrian cause. The strain of the war was acutely felt in Portugal, especially in 1711, when the French admiral Duguay-Trouin sacked Rio de Janeiro and cut off the Brazilian treasure-ships. At last, on the 6th of February 1715, nearly two years after the treaty of Utrecht, peace between Spain and Portugal was concluded at Madrid.

The Monarchy and the Church.

Never was the Portuguese Crown richer than in the years 1715–1755; rarely had the kingdom prospered less. The commercial and financial evils rife under the last kings of the Aviz dynasty were now repeated. More gold had been discovered in Matto Grosso, diamonds in Minas Geraes. As in the 16th century immense quantities of bullion were imported by the treasury, and were lavished upon war, luxury and the Church, while agriculture and manufactures continued to decline, and the countryside was depopulated by emigration to Brazil. John V. was a spendthrift and a bigot. He gave and lent enormous sums to successive popes, and at the bidding of Clement XI. he joined a "crusade" against the Turks in which his ships helped to win a naval action off Cape Matapan (1717). For these services he received the title of *Fidelissimus*, "Most Faithful"; "Majesty" had already been adopted by John IV. instead of the medieval "Highness," and the new style was intended to place the king of Portugal on an equality with his Most Christian Majesty of France and his Most Catholic Majesty of Spain. John V. was also empowered to create a multitude of new ecclesiastical dignities, and the archbishop of Lisbon was granted the rank and style of Patriarch *ex officio*. To the patriarchate was appended a Sacred College of 24 prelates, who were privileged to officiate in the scarlet robes of cardinals, while the patriarch wore the vestments of a second pope. Though regiments were disbanded, fleets put out of commission and fortresses dismantled to save the cost of their upkeep, the Crown paid nearly £100,000 yearly for the maintenance of this new hierarchy, and squandered untold wealth on the erection of churches and monasteries. In the church of São Roque in Lisbon, the decoration of a single chapel measuring 17 ft. by 12 ft. cost £225,000; the expenditure on the convent-palace of Mafra (*q.v.*) exceeded £4,000,000.

John V. was succeeded by his son Joseph (1750–1777). Five years afterwards Portugal was overtaken by the tremendous disaster of the Lisbon earthquake (see Lisbon), which, as Oliveira Martins justly observes, was "more than a cataclysm of nature; it was a moral revolution." It brought the Restoration period to an end (1755). Throughout that period the monarchy had occupied a precarious position, dependent until 1668 for its very existence, and after 1668 for its stability, on foreign support. Its policy had been moulded to suit France or Great Britain, while its internal administration had normally been directed by the Church. The cortes had grown obsolete; the feudal aristocracy were become courtiers. Once more, as in 1580, Portugal was governed by ecclesiastics in the name of an absolute monarch; once more, as in 1580, the chief strength of the ecclesiastical party was the Society of Jesus, which still controlled the conscience and mind of the nation and of its nominal rulers, through the confessional and the schools.

7. *The Reform of the Monarchy: 1755–1826.*—The unity of Portuguese history is hard to perceive in the years which witnessed the rise and fall of the Pombaline régime, the reign of the mad queen Maria, the Peninsular War and the subsequent chaos of revolutionary intrigue. At first sight it seems absurd to characterize this period of despotism ending in war, ruin and anarchy as a period of reform. Nevertheless, it is possible to trace through the apparent chaos an uninterrupted movement from absolutism to representative institutions. Pombal liberated the monarchy from clerical domination, and thus unwittingly opened the door to those "French principles," or democratic ideas, which spread rapidly after his downfall in 1777. The destruction of an obsolete political system, begun by Pombal, was completed by the Peninsular War; while French invaders and British governors together quickened among the Portuguese a new consciousness of their nationality, and a new desire for political rights, which rendered inevitable the change to constitutional monarchy.

Pombal, 1750–1777.

Two days after the accession of King Joseph, Sebastião José de Carvalho e Mello, better known as the marquess of Pombal (*q.v.*), was appointed secretary of state for foreign affairs and war. In a few months he gained an ascendancy over the king's mind which lasted until the end of the reign, and was strengthened by the courage and wisdom shown by Pombal at the time of the great earthquake. His policy was to strengthen the monarchy and to use it for the furtherance of a comprehensive scheme of reform. Beginning with finance and commerce, he reversed the bullionist policy of his predecessors and reorganized the entire system of taxation. He sought to undo the worst consequences of the Methuen treaty by the creation of national industries, establishing a gunpowder factory and a sugar refinery in 1751, a silk industry in 1752, wool, paper and glass factories after 1759. Colonial development was fostered, and the commercial dependence of Portugal upon

Great Britain was reduced, by the formation of chartered companies, the first of which (1753) was given control of the Algarve sardine and tunny fisheries. The Oldembourg Company (1754) received a monopoly of trade with the Portuguese colonies in the East; extensive monopolist rights were also conceded to the Pará and Maranhão Company (1755) and the Pernambuco and Parahyba Company (1759). In Lisbon a chamber of commerce (*Junta do commercio*) was organized in 1756 to replace an older association of merchants, the *Meza dos homens de negocio*, which had attacked the Pará Company; and in the same year the Alto Douro Company was formed to control the port-wine trade and to break the monopoly enjoyed by a syndicate of British wine merchants. This company met with strong opposition, culminating in a rising at Oporto (February 1757), which was savagely suppressed.

Both his commercial policy and his desire to strengthen the Crown brought Pombal into conflict with the Church and the aristocracy. In 1751 he had made all sentences passed by the Inquisition subject to revision by the Crown. The liberation of all slaves in Pará and Maranhão except negroes (1755), and the creation of the Pará Company, were prejudicial to the interests of the Jesuits, whose administrative authority over the Indians of Brazil was also curtailed. Various charges were brought against the Society by Pombal, and in September 1759, after five years of heated controversy (see Jesuits), he published a decree of expulsion against all its members in the Portuguese dominions. His power at court had previously been strengthened by the so-called Tavora plot. The marquess and marchioness of Tavora and their two sons, with the duke of Aveiro, the count of Atouguia and other noblemen, were accused of complicity in an attempt upon the life of King Joseph (September 1758). Pombal appointed a special tribunal to judge the case; many of the accused, including those already mentioned, were found guilty and executed; and an attempt was made to implicate the Jesuits. Pombal's enemies declared that he himself had organized the attack upon the king, in such a manner as to throw suspicion upon his political opponents and to gain credit for himself. This accusation was not proved, but the history of the Tavora plot remains extremely obscure. The expulsion of the Jesuits involved Portugal in a dispute with Pope Clement XIII.; in June 1760 the papal nuncio was ordered to leave Lisbon, and diplomatic relations with the Vatican were only resumed after the condemnation of the Jesuits by Clement XIV., in July 1773.

His victory over the Jesuits left Pombal free to develop his plans for reform. He devoted himself especially to education and defence. A school of commerce was founded in 1759; in 1760 the censorship of books was transferred from an ecclesiastical to a lay tribunal; in 1761 the former Jesuit college in Lisbon was converted into a college for the sons of noblemen; in 1768 a royal printing-press was established; in 1772 Pombal provided for a complete system of primary and secondary education, entailing the foundation of 837 schools. He founded a college of art in Mafra; he became visitor of Coimbra University, recast its statutes and introduced the teaching of natural science. Funds for these reforms were to a great extent provided out of the sequestrated property of the Jesuits; Pombal also effected great economies in internal administration. He abolished the distinction between Old and New Christians, and made all Portuguese subjects eligible to any office in the state. Far-reaching reforms were at the same time carried out in the army, navy and mercantile marine. In 1760 Admiral Boscawen had violated Portuguese neutrality by burning four French ships off Lagos; Pombal protested and the British government apologized, but not before the military weakness of Portugal had been demonstrated. Two years later, when the Family Compact involved Portugal in a war with Spain, Pombal called in Count William of Lippe-Bückeburg to reorganize the army, which was reinforced by a British contingent under Brigadier-General John Burgoyne, and was increased from 5000 to 50,000 men. The Spaniards were at first successful, and captured Braganza and Almeida; but they were subsequently defeated at Villa Velha and Valencia de Alcantara, and the Portuguese fully held their own up to the signature of peace at Fontainebleau, in February 1763. Towards the close of the reign, a long-standing controversy with Spain as to the frontier between Brazil and the Spanish colonies threatened a renewal of the war; but in this crisis Pombal was deprived of power by the death of King Joseph (Feb. 20, 1777) and the accession of his daughter Maria I.

Maria I., Pedro III. and D. John.

The queen was married to her uncle, who became king consort as Pedro III. Pombal's dismissal, brought about by the influence of the queen-mother Mariana Victoria, did not involve an immediate reversal of his policy. The controversy with Spain was amicably settled by the treaty of San Ildefonso (1777); and further industrial and educational reforms were inaugurated, chief among them being the foundation, in 1780, of the Royal Academy of Sciences. Queen Maria, who had previously shown signs of religious mania, became wholly insane after 1788, owing to the deaths of Pedro III. (May 1786), of the crown prince D. Joseph, and of her confessor, the inquisitor-general D. Ignacio de San Caetano. Her second son, D. John, assumed the conduct of affairs in 1792, although he did not take the title of regent until 1799. Meanwhile a two-fold reaction —on one side clericalist, on the other democratic—had set in against the reforms of Pombal. D. John told William Beckford in 1786 that "the kingdom belonged to the monks," and his consort Carlota Joaquina, daughter of Charles IV. of Spain, exercised a powerful influence in favour of the Church. But new ideas had been introduced with the new system of education, and the inevitable revolt against absolutism had resulted in the formation of a Radical party, which sympathized with the Revolution in France and carried on an active propaganda through the numerous masonic lodges which were in fact political clubs. D. John became alarmed, and the intendant of police in Lisbon, D. Diogo Ignacio de Pina Manique, organized an elaborate system of espionage which led to the imprisonment or exile of many harmless enthusiasts.

Relations with Spain, France and Great Britain, 1793–1806.

From similar motives, a treaty of alliance with Spain was signed at Aranjuez in March 1793; 5000 Portuguese troops were sent to assist in a Spanish invasion of France; a Portuguese squadron joined the British Mediterranean fleet. But in July 1795 Spain concluded a peace with the French republic from which Portugal, as the ally of Great Britain, was deliberately excluded. In 1796 Spain declared war upon Great Britain, and in 1797 a secret convention for the partition of Portugal was signed by the French ambassador in Madrid, General Pérignon, and by the Spanish minister Godoy. D. John appealed for help to Great Britain, which sent him 6000 men, under Sir Charles Stuart, and a subsidy of £200,000. Though Spain, through the influence of D. John's father-in-law Charles IV., still remained neutral, a state of war between Portugal and France existed until 1799. D. John then reopened negotiations with Napoleon, and Lucien Bonaparte was sent to dictate terms in Madrid. But D. John dared not consent to close the harbours of Portugal against British ships. England was the chief market for Portuguese wine and grain; and the long Portuguese littoral was at the mercy of the British navy. Compelled to choose between fighting on land and fighting at sea, D. John rejected the demands of Lucien Bonaparte, and on the 10th of February 1801 declared war upon Spain. His territories were at once invaded by a Franco-Spanish army, and on the 6th of June 1801 he was forced to conclude the peace of Badajoz, by which he ceded the frontier fortress of Olivenza to Spain, and undertook to pay 20,000,000 francs to Napoleon and to exclude British ships from Portuguese ports. Napoleon was dissatisfied with these terms, and although he ultimately ratified the treaty, he sent General Lannes to Lisbon as his ambassador, instructing him to humiliate the Portuguese and if possible to goad them into a renewal of the war. The same policy was continued by General Junot, who succeeded Lannes in 1804. Junot required D. John to declare war upon Great Britain, but this demand was not immediately pressed owing to the preoccupation of Napoleon with greater affairs, and in October 1805 Junot left Portugal.

By his Berlin decree of the 21st of November 1806 Napoleon required all continental states to close their ports to British ships. As Portugal again refused to obey, another secret Franco-Spanish treaty was signed at Fontainebleau on the 27th of October 1807, providing for the partition of Portugal. Entre-Minho-e-Douro was to be given to Louis II. of Etruria in exchange for his Italian kingdom; Algarve and Alemtejo were to form a separate principality for Godoy; the remaining provinces were to be garrisoned by French troops until a general peace should be concluded. To give effect to these terms, General Junot hastened westward across Spain, at the head of 30,000 French soldiers and a large body of Spanish auxiliaries. So rapid were his movements that there was no time to organize effective resistance. On the 29th of November D. John, acting on the advice of Sir Sidney Smith, British naval commander in the Tagus, appointed a council of regency and sailed for Brazil, convoyed by Sir Sidney Smith's squadron. For a detailed account of the subsequent military operations, see PENINSULAR WAR.

The Peninsular War.

Invasion by Junot, November 1807–August 1808.

Junot, who was everywhere well received by the Portuguese democrats, entered Lisbon at the end of November 1807. He assumed command of the Portuguese army, divided the kingdom into military governments, and, on the 1st of February 1808 announced that the Braganza dynasty had forfeited its right to the throne. He himself hoped to succeed D. John, and sought to conciliate the Portuguese by reducing the requisition demanded by Napoleon from 40,000,000 francs to 20,000,000. But the action of the French troops in occupying the fortresses of northern Spain provoked in May 1808 a general rising in that country, which soon spread to Portugal. The Spanish garrison in Oporto expelled the French governor and declared for the Braganzas, compelling Junot to march towards the north. He left Lisbon under the control of a regency, headed by the bishop of Oporto, who applied to Great Britain for help, promoted an insurrection against the French, and organized *juntas* (committees) of government in the larger towns. On the 1st of August 1808 Sir Arthur Wellesley, with 9000 British troops, landed at Figueira da Foz. He defeated a French division at Roliça (" Roleia ") on the 17th, and on the 21st won a victory over Junot at Vimeiro ("Vimiera"). Fearing an attack by Portuguese auxiliaries and the arrival of British reinforcements under Sir John Moore, Junot signed the convention of Cintra by which, on the 30th of August 1808, he agreed to evacuate Portugal (see WELLINGTON). The regency appointed by D. John was now reconstituted and in October Sir John Moore assumed command of all the allied troops in Portugal. From Lisbon Moore marched north-eastward with about 32,000 men to assist the Spanish armies against Napoleon; his subsequent retreat to join Sir David Baird in Galicia, in January 1809, diverted the pursuing army under Napoleon to the north-west, and temporarily saved Portugal from attack.

Invasion by Soult, March–May 1809.

In February Major-General William Carr Beresford was given command of the Portuguese army. Organized and disciplined by British officers, the native troops played a gallant part in the subsequent campaigns. In March 1809 the second invasion of Portugal began; Soult crossed the Galician frontier and captured Oporto, while an auxiliary force under General Lapisse advanced from Salamanca. On the 22nd of April, however, Wellesley, who had been recalled after the convention of Cintra, landed in Lisbon. On the 12th of May he forced the passage of the Douro, subsequently retaking Oporto and pursuing Soult into Spain. Valuable assistance had been rendered by the Portuguese generals Antonio da Silveira and Manoel de Brito Mousinho—the first a leader, the second an organizer.

Invasion by Masséna, June 1810–April 1811.

After the battle of Wagram (July 6, 1809) the French armies in the Peninsula received large reinforcements, and Marshal Masséna, with 120,000 men, was ordered to operate against Portugal. He crossed the frontier in June 1810 and besieged Almeida, which capitulated on the 27th of August. Wellesley, who had now become Viscount Wellington, opposed his march southwards, and won a victory at Bussaco on the 27th of September; but Masséna subsequently turned the position of the allied army on the Serra de Bussaco, and caused Wellington to fall back upon the fortified lines which he had already constructed at Torres Vedras. Here he stood upon the defensive until the invaders should be defeated by starvation. The Portuguese troops cut Masséna's communications; the peasants, under instructions from Wellington, had already laid waste their own farms, destroyed the roads and bridges by which Masséna might retreat, and burned their boats on the Tagus. On the 5th of March 1811, after a winter of terrible sufferings, Masséna's retreat began; he was harassed by the allied troops all the way to Sabugal, where the last rearguard action in Portugal took place on the 3rd of April. The invaders retired with a loss of nearly 30,000 men; Almeida was retaken on the 6th; and the remainder of the war was fought out on Spanish and French soil. The Portuguese troops remained under Wellington's command until 1814, and distinguished themselves in many actions, notably at Salamanca and on the Nivelle.

Results of the War.

At the congress of Vienna (1814–1815) Portugal was represented by three plenipotentiaries, who were instructed to press for the retrocession of Olivenza and to oppose the restoration of French Guiana, which the Brazilians had conquered in 1809. Neither object was attained; and this failure, which was attributed to the lack of British support, hastened the reaction against British influence which had already begun. Since 1808 Portugal had theoretically been governed by the regency representing D. John. But as the regency was corrupt and unable to co-operate with Wellington and Beresford, the British government had demanded that Sir Charles Stuart (son of the Sir Charles Stuart mentioned above) should be appointed one of its members. The real control of affairs soon afterwards passed into the strong hands of Stuart and Beresford; and while the war lasted the Portuguese acquiesced in what was in fact an autocracy exercised by foreigners. In 1815, however, they desired to resume their independence. A further cause of dissatisfaction was the mutual jealousy of Portugal and Brazil. The colony claimed as high a political status as the mother-country, and by a decree dated the 16th of January 1815 it was raised to the rank of a separate kingdom. Thenceforward, until 1822, the Portuguese sovereignty was styled the United Kingdom of Portugal, Brazil and the Algarves. The importance of this change became apparent when Queen Maria I. died (March 1816) and D. John succeeded to the united thrones as John VI. The king refused to leave Brazil, partly owing to the intrigues of Carlota Joaquina, who hoped to become queen of an independent Brazilian kingdom. Thus Portugal, which had been almost ruined by the war, was now humiliated by the failure of her diplomacy at Vienna and by her continued dependence upon Great Britain and Brazil. The resultant discontent found expression in the cry of " Portugal for the Portuguese " and in the demand for a constitution.

The Constitutional Movement, 1820–1826.

In 1817 a military revolt (*pronunciamento*) in Lisbon was crushed by Beresford, and the leader, General Gomes Freire de Andrade, was executed; but on the 16th of August 1820, after Beresford had sailed to Brazil to secure the return of John VI., a second rising took place in Oporto. It soon spread southward. A new council of regency was established in Lisbon, the British officers were expelled from the army; Beresford, on his return from Brazil, was not permitted to land; a constituent assembly was summoned. This body suppressed the Inquisition and drew up a highly democratic constitution, by which all citizens were declared equal before the law and eligible to any office; all class privileges were abolished, the liberty of the Press was guaranteed, and the government of the country was vested in a single chamber, subject only to the suspensive veto of the Crown. So extreme a change was disliked by most of the powers and by many Portuguese, especially those of the clerical party. Great Britain insisted on the return of John VI., who entrusted the government of Brazil to his elder son D. Pedro and landed in Portugal on the 3rd of July 1821. In 1822, on the advice of

D. Pedro, he swore to obey the constitution (thenceforward known as the "constitution of 1822"). But his younger son, D. Miguel, and the queen, Carlota Joaquina, refused to take the oath; and in December 1822 sentence of banishment was pronounced against them, though not enforced. They had many supporters at home and abroad. French troops had invaded Spain in the interests of Ferdinand VII. (1823), and the French government was prepared to countenance the absolutist party in Portugal in order to check British influence there. Another military revolt broke out in Traz-os-Montes on the 3rd of February 1823, its leader being the count of Amarante, who was opposed to the constitution. D. Miguel appealed to the army to "restore liberty to their king," and the army, incensed by the loss of Brazil (1822), gave him almost unanimous support. At this juncture John VI., vainly seeking for a compromise, abrogated the constitution of 1822, but appointed as his minister D. Pedro de Sousa Holstein, count (afterwards duke) of Palmella and leader of the "English" or constitutional party. These half-measures did not satisfy D. Miguel, whose soldiers seized the royal palace in Lisbon on the 30th of April 1824. Palmella was arrested, and John VI. forced to take refuge on the British flagship in the Tagus. But the united action of the foreign ministers restored the king and reinstated Palmella; the insurrection was crushed; D. Miguel submitted and went into exile (June 1824).

In Brazil also a revolution had taken place. The Brazilians demanded complete independence, and D. Pedro sided with them. The Portuguese garrison of Rio de Janeiro was overpowered; on the 7th of September 1822 D. Pedro declared the country independent, and on the 12th of October he was proclaimed constitutional emperor. He took no notice of the constituent assembly in Lisbon, which on the 19th of September had ordered him to return to Portugal on pain of forfeiting his right to inherit the Portuguese Crown. By the end of 1823 all Portuguese resistance to the new régime in Brazil had been overcome.

John VI. died on the 10th of March 1826, leaving (by will) his daughter D. Isabel Maria as regent for Pedro I. of Brazil, who now became Pedro IV. of Portugal. A crisis was evidently imminent, for Portugal would not tolerate an absentee sovereign who was far more Brazilian than Portuguese. The unsatisfied ambition of Carlota Joaquina and the hostility between absolutists and constitutionalists might at any moment precipitate a civil war. To conciliate the Portuguese, Pedro IV. drew up a charter (known as the "charter of 1826") which provided for moderate parliamentary government on the British model. To conciliate the Brazilians, he undertook (by decree dated May 2nd 1826) to surrender the Portuguese Crown to his daughter D. Maria da Gloria (then aged seven); but this abdication was made contingent upon her marriage with her uncle D. Miguel, who was first required to swear fidelity to the charter.

8. *Constitutional Government.*—The charter of 1826 forms the basis of the present Portuguese constitution and the starting-point of modern Portuguese history. That history comprises four periods: (*a*) From 1826 to 1834 the clerical and absolutist parties led by D. Miguel united every reactionary element throughout the kingdom in a last unsuccessful stand against constitutional government; (*b*) From 1834 to 1853 the main problem for Portuguese statesmen was whether the constitution, now accepted as inevitable, should embody the radical ideas of 1822 or the moderate ideas of 1826; (*c*) From 1853 to 1889 there was a period of transition marked by the rise of three new parties—Progressive, Regenerator, Republican; (*d*) From 1889 to 1908 the Progressives and Regenerators monopolized the control of public affairs, but the strength of Republicanism was not to be gauged by its representation in the cortes. At the beginning of the 20th century the question whether the monarchy should be replaced by a republic had become a living political issue, which was decided by the revolution of October 5, 1910.

The Absolutist Reaction.

The charter was brought to Lisbon by Sir Charles Stuart in July 1826. The absolutists had hoped that D. Pedro would abdicate unconditionally in favour of D. Miguel, and the council of regency at first refused to publish the charter. They were forced to do so (July 12) by a *pronunciamento* issued by D. João Carlos de Saldanha de Oliveira e Daun, count of Saldanha and commander of the army in Oporto. Saldanha, a prominent constitutionalist, threatened to march on Lisbon if the regency did not swear obedience to the charter by the 31st of July. Amid wild enthusiasm the charter was proclaimed on that day, and on the 3rd of August Saldanha became head of a Liberal ministry. An absolutist counter-revolution at once broke out in the north. It was organized by the marquess of Chaves, and supported openly by the Church and the Miguelite majority of the army; secret assistance was also given by Spain. As civil war appeared imminent, Canning despatched 5000 British troops under Sir William Clinton to restore order, and to disband the troops under Chaves. By March 1827 Clinton and Saldanha had secured the acceptance of the charter throughout Portugal.

In October 1826 D. Miguel also swore to obey the charter and was betrothed to his niece D. Maria da Gloria (Maria II.). Pedro IV. appointed him regent in July 1827 and in February 1828 he landed in Lisbon, where he was received with cries of "Viva D. Miguel I., rei absoluto!" In March he dissolved the parliament which had met in accordance with the charter. In April the Tory ministry under Wellington withdrew Clinton's division, which was the mainstay of the charter. In May D. Miguel summoned a cortes of the ancient type, which offered him the Crown; and on the 7th of July 1828 he took the oath as king. Saldanha, Palmella, the count of Villa Flor (afterwards duke of Terceira), and the other constitutionalist leaders were driven into exile, while scores of their adherents were executed and thousands imprisoned. Austria and Spain supported D. Miguel, who was able to dispose of the vast wealth of Carlota Joaquina; Great Britain and France remained neutral. Only the emperor D. Pedro and a handful of exiles upheld the cause of Maria II., who returned to Brazil in 1829.

The Miguelite Wars.

The Azores, although the majority of their inhabitants favoured absolutism, now became a centre of resistance to D. Miguel. In 1828 the garrison of Angra declared for Maria II., endured a siege lasting four months, and finally took refuge in the island of Terceira, where it was reinforced by volunteers from Brazil and constitutionalist refugees from England and France. In March 1829 Palmella established a regency on the island, on behalf of Maria II.; and D. Miguel's fleet was defeated in Praia Bay on the 12th of August. Fortune played into the hands of Palmella, Saldanha, Villa Flor and their followers in Terceira. In 1830 a Whig ministry came into office in Great Britain; the "July revolution" placed Louis Philippe on the throne of France; Carlota Joaquina, the power behind D. Miguel's throne, died on the 7th of January. The fanaticism of the clerical and absolutist parties in Portugal (collectively termed *apostolicos*) was enhanced by recrudescence of Sebastianism. Men saw in the brutal boor D. Miguel (*q.v.*) a personification of the hero-king Sebastian, whose second advent had been expected for two and a half centuries. In the orgy of persecution, outrages were committed on British and French subjects; and a French squadron retaliated by seizing D. Miguel's fleet in the Tagus (July 1831). In Brazil, D. Pedro abdicated (April 1831); he determined to return to Europe and conduct in person a campaign for the restoration of Maria II. He was received with enthusiasm by Louis Philippe. In Great Britain Palmella raised a loan of £2,000,000 and purchased a small fleet, of which Captain Sartorius, a retired British naval officer, was appointed admiral. In February 1832 the "Liberators," as they were styled, sailed from Belleisle to the Azores, with D. Pedro aboard the flagship. In July they reached Portugal and occupied Oporto, but the expected constitutionalist rising did not take place. The country was almost unanimous in its loyalty to D. Miguel, who had 80,000 troops against the 6500 (including 500 French and 300 British) of D. Pedro. But the Miguelites had no navy, and no competent general. They besieged D. Pedro in Oporto from July 1832 to July 1833, when the duke of Terceira and

Captain Charles Napier, who had succeeded Sartorius, effected a daring and successful diversion which resulted in the capture of Lisbon (July 24, 1833). Maria II. arrived from France in September. The war went in her favour, largely owing to the brilliant generalship of Saldanha and the financial straits to which D. Miguel was reduced. In April 1834 a Quadruple Alliance was concluded between France, Spain, Great Britain and the government of Maria II. The allied army defeated the Miguelites at Asseiceira on the 16th of May, and D. Miguel surrendered at Evora-Monte on the 24th. By the convention of Evora-Monte he was condemned to perpetual banishment from the Peninsula. On the 24th of September D. Pedro died. During the few months in which he acted as regent for his daughter, he had transformed Portugal from a semi-feudal into a modern state. Tithes, many hereditary privileges and all monopolies were abolished; every convent was closed and its property nationalized; the Jesuits, who had returned after the death of Pombal, were again expelled; the charter of 1826 was restored.

Maria II., 1834–1853.

Maria II. was fifteen years old at her accession. She was twice married—in December 1834 to Augustus, duke of Leuchtenberg, who died four months afterwards; and in April 1836 to Ferdinand of Saxe-Coburg, who received the title of king consort in September 1837. Both the queen and the king consort were strangers to Portugal, and could exercise little control over the turbulent factions whose intrigues and *pronunciamentos* made orderly government impossible. There were three political parties: the Miguelites, who were still strong enough to cause trouble; the Chartists, who advocated the principles of 1826; the Septembrists, who advocated those of 1822 and took their name from the successful *coup d'état* of the 9th–11th of September 1836. By this *coup d'état* the constitution of 1822 was substituted for the charter of 1826; and a Septembrist ministry under the Viscount Sá da Bandeira replaced the Chartist ministry under Saldanha, Terceira and Palmella. A counter-revolution, planned in the royal palace at Belem and hence known as the *Belemzada*, was frustrated in November 1836; and in 1837 a Chartist insurrection was crushed after severe fighting. This was known as the "War of the Marshals," from the rank of the two Chartist leaders, Saldanha and Terceira. In 1839 a moderate ministry took office, with Antonio Bermudo da Costa Cabral as its real, though not its ostensible, head. A *pronunciamento* by Costa Cabral led to the restoration of the charter on the 10th of February 1842, and a Cabral government was formed under the nominal leadership of Terceira. Costa Cabral, who became count of Thomar in 1845, ruled despotically, despite many insurrections, until May 1846, when a coalition of Miguelites, Septembrists and Chartist malcontents drove him into exile. On this occasion the rebellion—known as the "War of Maria da Fonte"—proved formidable. Oporto was held by a revolutionary *junta*, and Saldanha, who had become prime minister, persuaded the Quadruple Alliance to intervene. In June 1847 the Oporto *junta* surrendered, under promise of an amnesty, to a combined British and Spanish force, and the convention of Gramido (July 24, 1847) ended the war. Saldanha was rewarded with a dukedom, and retained office until June 1849. The dictatorial rule of his successor—the returned exile, Thomar—provoked another successful rising on the 7th of April 1851. Thomar again fled from the country; Saldanha again became prime minister, but at the head of a moderate coalition. He remained in power during five years of unbroken peace (1851–1856), and carried many useful reforms. The most important of these was the so-called Additional Act of the 5th of July 1852, which amended the charter of 1826 by providing for the direct election of deputies, the decentralization of the executive, the creation of representative municipal councils, and the abolition of capital punishment for political offences. Maria II. died on the 13th of November 1853, and was succeeded by her eldest son D. Pedro, during whose ministry the king consort D. Ferdinand acted as regent.

Pedro V. and Luiz.

Under the brothers Pedro V. (1853–1861) and Luiz (1861–1889) Portugal obtained a respite from civil strife. Both monarchs delegated the conduct of affairs to their ministers, who constructed new railways, reformed the educational system, and gradually improved the economic condition of the kingdom and its colonies. Pedro V. came of age and assumed the government on the 16th of November 1855, in 1857 he married Princess Stephanie of Hohenzollern. The only political disturbance which marred the peace of his reign arose out of the seizure of the "Charles et Georges," a French slave-trader which was captured off Mozambique. Napoleon III. sent a fleet to the Tagus and demanded an indemnity, which Portugal was compelled to pay. In 1860–1861 cholera ravaged the whole kingdom, and especially the capital. The king died of this disease on the 11th of November 1861, and two of his brothers, D. Ferdinand and D. John, died shortly afterwards. D. Luiz was absent at the time, and his father D. Ferdinand again became regent until his return, soon after which (1862) the new king married Maria Pia, daughter of Victor Emanuel II. of Italy. In 1869 slavery was abolished in every Portuguese colony. In 1870 the duke of Saldanha, the last survivor of the turbulent statesmen of Queen Maria's reign, threatened an appeal to arms if the king would not dismiss his minister, the duke of Loulé, an advanced Radical and freemason, whose influence, dating from the reign of Pedro V., was viewed with disfavour by Saldanha, as well as by more conservative politicians. The king yielded; and Saldanha himself became prime minister, retaining office until 1874, when, at the age of 80, he was sent as ambassador to London. He had been by far the most influential man in Portugal, and his death in 1876 was followed by a regrouping of political parties.

Political Parties.

The party of the Regenerators (*Regeneradores*), formed in 1852 out of a coalition of Septembrists and Chartists, had already been disintegrated. Its more radical elements, known at first as the Historic Left, were in 1877 reorganized as the Progressives (*Progressistas*). Its more conservative elements carried on the tradition and retained the name of the original Regenerators. Besides these two monarchist parties—the Regenerators or Conservative right and the Progressives or Constitutional left—a strong Republican party was formed in 1881. There were also the Miguelites, active but impotent intriguers; and the advocates of Iberian union, who became prominent in 1867, 1869, 1874, and especially in July 1872, when many well-known politicians were implicated in a fantastic conspiracy for the establishment of an Iberian republic. Portuguese nationalism was too strong for these advocates of union with Spain, whose propaganda was discredited as soon as any national interest was seriously endangered. This was the case in 1872, when Great Britain claimed the southern part of Delagoa Bay. The claim was submitted to the arbitration of M. Thiers, the French president, whose successor, Marshal Macmahon, delivered an award in favour of Portugal on the 19th of April 1875 (see Delagoa Bay).

Colonial Affairs: Relations with Great Britain.

King Luiz died on the 19th of October 1889, and was succeeded by his son D. Carlos (*q.v.*). Colonial affairs had for some time received close attention. In 1885 Portugal recognized the Congo Free State, and admitted its sovereignty over the north bank of the Lower Congo, although, in an unratified treaty of 1884, Great Britain had recognized both banks of the river as Portuguese territory. In 1886 Germany, France and Portugal defined by treaty the limits of their adjacent spheres of influence, and on the 26th of March 1887 Macao, hitherto leased to Portugal, was formally ceded by the Chinese government. In 1889 a resolution unanimously adopted by both chambers invited the ministry, of which José de Castro was president and Barros Gomes foreign minister, to press forward the territorial claims of Portugal in East and Central Africa. Shortly after the accession of King Carlos this active policy led to a dispute with Great Britain (see Africa, § 5). A Portuguese force under Major Serpa Pinto had invaded the

Shiré highlands in order to forestall their annexation by the British, and the British government demanded satisfaction. Public opinion rendered compliance difficult until a British squadron was despatched to the mouth of the Tagus, and the British minister presented an ultimatum (Jan. 11, 1890), requiring the withdrawal of all Portuguese forces from the Shiré. Barros Gomes was then able to yield under protest; but disturbances at once broke out in Lisbon and Oporto, and the ministry resigned. A coalition government took office on the 14th of January, with Serpa Pimentel as prime minister and J. Hintze-Ribeiro as foreign minister. The king, in a letter to Queen Victoria, declined for the time being to receive the Order of the Garter, which had just been offered him, and on the 6th of February the government addressed a circular letter to the powers, proposing to submit the issues in dispute to a European conference. Meanwhile a Republican rising was suppressed in Lisbon, and many suspected officers were degraded. On the 20th of August an Anglo-Portuguese agreement was negotiated in London, but the cortes refused to ratify it. The ministry therefore resigned, and on the 14th of October Abreu e Sousa formed a new cabinet, which arranged with Great Britain a *modus vivendi* for six months, pending the conclusion of another agreement. The British government was ready to make concessions, but more than one collision took place between Portuguese troops in Manica and the forces of the British South Africa Company. The defeat of the Portuguese was the chief cause of a serious military rising in Oporto, which broke out on the 30th of January 1891. The suppression of this rising so far enhanced the prestige of the cabinet that the cortes forthwith approved the convention with Great Britain; and the definitive treaty, by which Portugal abandoned all claim to a trans-African dominion, was ratified by the cortes on the 28th of May. Relations with Great Britain, however, remained far from cordial until the celebration of the fourth centenary of Vasco da Gama's voyage to India afforded the opportunity for a *rapprochement* in 1898.

Financial Crisis of 1892.

The extravagant management of the railways guaranteed by the state had entailed such heavy deficits that the payment of the coupon of the railway state loan, due on the 2nd of January 1892 had to be suspended. Thus arose a serious financial crisis, involving three changes of ministry. In May the Portuguese government committed a formal act of bankruptcy by issuing a decree reducing the amount then due to foreign bondholders by two-thirds. The bondholders' committees, supported by some of the powers concerned, protested against this illegal action. A compromise was at last arranged by Hintze-Ribeiro, who assumed office in February 1893 as head of a Progressive government. His cabinet promised only slightly better terms to the foreign bondholders, but it relieved the financial tension in some degree; and by coming to an agreement with Germany in East Africa and with Great Britain in South Africa as to the delimitation of frontiers, he minimized the risks of conflict with either country.

Portugal observed neutrality on the outbreak of the Anglo-Boer War, but the permission it conceded to the British consul at Lourenço Marques to search for contraband of war among goods imported there, and the free passage accorded to an armed force under General Carrington from Beira through Portuguese territory to Rhodesia, were vehemently attacked in the Press and at public meetings. The award of the Swiss arbitrators in the matter of the Delagoa Bay railway was given in 1900 (see Lourenço Marques). Portugal was condemned to pay 15,314,000 francs compensation; and this sum (less than was expected) was immediately raised by loan from the Portuguese Tobacco Company.

Constitutional Changes, 1885–1901.

A law of the 8th of August 1901 regulated the conditions of election to the lower house, thus ending a long series of parliamentary reforms. The most important of these had provided for the gradual extinction of the right of hereditary peers to sit in the upper house (July 24, 1885), had reduced the number of deputies and fixed the qualifications required for the exercise of the franchise (March 28, 1895); and had abolished the elective branch in the upper house (Sept. 25, 1895). These changes left untouched the most serious evil in Portuguese public life. The two great parties, Progressives and Regenerators, were largely composed of professional politicians whose votes were determined by their private interests. Skilful manipulation of the electoral returns enabled these two parties to hold office in fairly regular rotation; hence arose the popular nickname of *rotativos*, applied to Progressives and Regenerators alike. The same methods enabled them to obstruct the election of Republican and Independent candidates.

Republicanism and the Army.

Under such a system of government it was natural that economic issues should still dominate Portuguese politics at the beginning of the 20th century. Year by year the budget showed a deficit, and the indebtedness of the state increased. A large proportion of the expenditure was unproductive, corruption was rife in the public services, and the poverty of the overtaxed peasant and artisan classes gave rise to sporadic outbreaks of violence. In 1902 the students at Coimbra and Oporto organized an agitation against the proposed conversion of the gold debt; and anti-clerical riots, followed by a strike, rendered necessary the proclamation of martial law in Aveiro. In January 1903 an insurrection of peasants armed with scythes took place at Fundão; the imposition of a new market tax provoked riots at Coimbra in March; a serious strike of weavers took place at Oporto in June. In the same year the general distress was intensified by the failure of the Rural and Mortgage Bank of Brazil. In these circumstances Republicanism rapidly gained ground. Its real strength was masked by the system which enabled any ministry in power to control the election of candidates to the cortes. In April 1806, for example, only one Republican deputy was returned, although it was notorious that the Republican party could command a majority in many constituencies. Though the army as a whole was monarchist, certain regiments had become imbued with revolutionary ideals, which were fortified by the unwise employment of soldiers and sailors for the suppression of industrial disputes. During the weavers' strike the cruiser "Rainha D. Amelia" was converted into a temporary prison, and at Fundão, Aveiro and elsewhere troops had been ordered to fire on men with whom they sympathized. In November 1902, while King Carlos was in England, a military rising was organized in Oporto, but never took place. On the 23rd of April 1903 a body of cavalry and artillery mutinied in Lisbon and proclaimed a republic; but they were overpowered and ultimately transported to Mozambique. Such incidents, unimportant in themselves, were symptoms of a dangerous state of public opinion, which was debarred from expression in the cortes.

The Dictatorship, 1906–1908.

The constitution empowered the sovereign to veto any bill, to dissolve or prorogue the cortes, and to govern by means of ministerial decrees. The use of these extraordinary powers would be a breach of constitutional practice, but not of law. King Carlos had already been criticized for alleged excessive interferences in politics. An experiment in government by decree had been made in May—October 1894; it was repeated in September 1905, when the king consented to prorogue the cortes until January 1906 in order to postpone discussion of the terms upon which the tobacco monopoly was to be allocated. A general election, in February 1906, was followed by three changes of ministry, the last of which, on the 19th of May, inaugurated the régime known in Portugal as the *dictadura* or dictatorship. João Franco, the new prime minister, was conspicuous among Portuguese politicians for his integrity, energy and courage; he intended to reform the national finances and administration—by constitutional means, if possible. The cortes, opened on the 6th of June 1906, was dissolved on the 14th; another election took place, preceded by an official announcement that on this occasion all votes would be fairly counted; and the *Franquistas* or "New Regenerators" obtained a majority. When the cortes met, on the 29th of September, the opposition accused King Carlos of complicity in grave financial scandals. It was admitted that he had borrowed largely from the treasury, on the security of his civil list, and the Republican deputies accused him of endeavouring to assign the tobacco monopoly to one of his own foreign creditors, in settlement of the debt. Franco organized a coalition in defence of the Crown, but in January 1907 business in the cortes was brought to a standstill and many sittings ended in uproar. The attacks on the king were repeated at the trial of the poet Guerra Junqueiro, who was indicted for *lèse-majesté*. All parties believed that the ministry would fall, and the *rotativos* prepared once more to divide the spoils of office, when, on the 2nd of May 1907, João Franco reconstructed his cabinet, secured the dissolution of the cortes and announced that certain bills still under discussion would receive the force of law. His partisans in the press hailed the advent of a second Pombal, and their enthusiasm was shared by many enlightened Portuguese, who had previously held aloof from politics but now rallied to the support of an honest dictator. Backed by these forces, as well as by the king and the army, Franco effected some useful reforms. But his opponents included not only the Republicans, the professional politicians and those officials who feared inquiry, but also the magistracy, the district and municipal councils, and the large body of citizens who still believed in parliamentary government. The existing debt owed by D. Carlos to the nation was assessed at £154,000. This sum was ostensibly paid by the transference to the treasury of the royal yacht "Amelia" and certain palaces; but the cost and upkeep of the "Amelia" had been paid with public money, while the palaces had long been maintained as state property. These transactions, though perhaps necessary to save the credit of the sovereign at the least possible cost, infuriated the opposition. Newspapers and politicians openly advocated rebellion; Franco had recourse to coercion. Seditious journals were suppressed; gaols and fortresses were crowded with prisoners; the upper house, which was hostile to the dictator, was deprived of its judicial powers and reconstituted on a less democratic basis (as in 1826); the district and municipal councils were dissolved and replaced by administrative commissions nominated by the Crown (Jan. 1, 1908).

Assassination of King Carlos. Accession of Manoel.

The ministerial press from time to time announced the discovery of sensational plots against the king and the dictator. It is, however, uncertain whether the assassination of King Carlos and the crown prince (see CARLOS I.), on the 1st of February 1908, was part of a widely organized conspiracy; or whether it was the act of an isolated band of fanatics, unconnected with any political party. The republican press applauded the murder; the professional politicians benefited by it. But the regicide Buiça and his associates probably acted on their own initiative. The immediate results were the accession of Prince Manoel or Manuel (Emanuel II.) to the throne and the resignation of Franco, who sailed for Genoa. A coalition ministry, representing all the monarchist parties, was formed under the presidency of Admiral Ferreira do Amaral. The administrative commissions appointed by Franco were dissolved; the civil list was reduced; the upper house was reconstituted. A general election took place; in April the cortes met and the balance of power between Progressives and Regenerators was restored. On the 6th of May 1908 D. Manoel swore to uphold the constitution and was acclaimed king by the cortes. His uncle D. Affonso (b. 1865) took a similar oath as crown prince on the 22nd of March 1910.

The Revolution of 1910.

The failure of the dictatorship and the inability of the monarchists to agree upon any common policy had discredited the existing régime, and at the general election of August 1910 the Republican candidates in Lisbon and Oporto were returned by large majorities. On the 3rd of October the murder of a distinguished Republican physician, Dr Miguel Bombarda, precipitated the revolution which had been organized to take place in Lisbon ten days later. The Republican soldiers in Lisbon, aided by armed civilians and by the warships in the Tagus, attacked the loyal garrison and municipal guards, shelled the Necessidades Palace, and after severe street-fighting (Oct. 4th–6th) became masters of the capital. The king escaped to Ericeira, and thence, with the other members of the royal family, to Gibraltar. Soon afterwards they travelled undisturbed to England, where the king was received by the duke of Orleans. Throughout Portugal the proclamation of a republic was either welcomed or accepted without further resistance. A provisional government was formed under the presidency of Dr Theophilo Braga (b. 1843), a native of the Azores, who had since 1865 been prominent among Portuguese men of letters (see *Literature*, below). The new government undertook to carry out part of the Republican programme before summoning a constituent assembly to remodel the constitution. Among its most important acts were the expulsion of the religious congregations which had returned after 1834, the nationalization of their property, and the abolition, by decree, of the council of state, the upper house and all hereditary titles or privileges. The Republican programme also included the separation of Church and State, and the concession of local autonomy (on federal lines, if possible) to the provinces and colonies of Portugal.

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LITERATURE

The Portuguese language can be most conveniently described in relation to the other languages of the Peninsula (see SPAIN: *Language*). Portuguese literature is distinguished by the wealth and variety of its lyric poetry, by its primacy in bucolic verse and prose, by the number of its epics and historical books, by the relative slightness of the epistolary element, and by the almost complete absence of the memoir. Rich as its *romanceiro* is, its volume is far less than the Spanish, but the *cancioneiros* remain to prove that the early love songs of the whole Peninsula were written in Portuguese, while the primitive prose redaction of *Amadis*, the prototype of all romances of chivalry, was almost certainly made in Portugal, and a native of the same country produced in the *Diana* of Montemôr (Montemayor) the masterpiece of the pastoral novel. *The Lusiads* may be called at once the most successful epic cast in the classical mould, and the most national of poems, and the great historical monuments and books of travel of the 16th and 17th centuries are worthy of a nation of explorers who carried the banner of the Quinas to the ends of the earth. On the other hand Portugal gave birth to no considerable dramatist from the time of Gil Vicente, in the 16th century, until that of Garrett in the 19th, and it has failed to develop a national drama.

Its geographical position and history have rendered Portugal very dependent for intellectual stimulus and literary culture on foreign countries, and writers on Portuguese literature are wont to divide their subjects into periods corresponding to the literary currents from abroad which have modified its evolution. To summarize, the first literary activity of Portugal was derived from Provence, and Provençal taste ruled for more than a century; the poets of the 15th century imitated the Castilians, and the 16th saw the triumph of Italian or classical influence. Spain again imposed its literary standards and models in the 17th century, France in the 18th, while the Romantic movement reached Portugal by way of England and France; and those countries, and in less degree Germany, have done much to shape the literature of the 19th century. Yet as regards the Peninsula, the literatures of Portugal and Castile act and react on one another and if the latter gave much, she also received much, for nearly every Portuguese author of renown from 1450 until the 18th century, except Antonio Ferreira, wrote in Spanish, and some, like Jorge de Montemôr and Manoel de Mello, produced masterpieces in that language and are numbered as Spanish classics. Again, in no country was the victory of the Italian Renaissance and the classical revival so complete, so enduring.

But notwithstanding all its dependence on classical and foreign authors, Portuguese literature has a distinct individuality which appears in the romanceiro, in the songs named *cantares de amigo* of the cancioneiros, in the *Chronicles* of Fernão Lopes, in the *Historia tragico-maritima*, in the plays of Gil Vicente, in the bucolic verse and prose of the early 16th century, in the *Letters* of Marianna Alcoforado and, above all, in *The Lusiads*.

Poetry.

Early Period.—Though no literary documents belonging to the first century of Portuguese history have survived, there is evidence that an indigenous popular poetry both sacred and profane existed, and while Provençal influences moulded the manifestations of poetical talent for nearly two hundred years, they did not originate them. The close relations that prevailed between the reigning houses of Portugal, Provence and Aragon, cemented by intermarriages, introduced a knowledge of the *gay science*, but it reached Portugal by many other ways—by the crusaders who came to help in fighting the Moors, by the foreign prelates who occupied Peninsular sees, by the monastic and military orders who founded establishments in Portugal, by the visits of individual singers to court and baronial houses, but chiefly perhaps by the pilgrims who streamed from every country along the Frankish way to the far-famed shrine of Santiago de Compostela. Already by the end of the 12th century the lyric poetry of the troubadours had found cultivators in Portugal, and a few compositions which have come down to us bear a date slightly anterior to the year 1200. One of the earliest singers was D. Gil Sanches, an illegitimate son of Sancho I., and we possess a *cantar de amigo* in Galician-Portuguese, the first literary vehicle of the whole Peninsula, which appears to be the work of Sancho himself, and addressed to his concubine, A. Ribeirinha. The pre-Alphonsine period to which these men belong runs from 1200 to 1245 and produced little of moment, but in 1248 the accession of King Alphonso III., who had lived thirteen years in France, inaugurated a time of active and rich production which is illustrated in the *Cancioneiro da Ajuda*, the oldest collection of Peninsular verse. The apogee of palace-poetry dates from 1275 to 1280, when young King Diniz displayed his exceptional talents in a circle formed by the best troubadours of his father Alphonso III. and the veterans of his grandfather Alphonso II., whose song-book, *Cantigas de S. Maria*, contains the choicest religious verse of the age. Diniz, who had been educated by Amyeric of Cahors, proved himself the most fecund poet-king of his day, though the pleiad of *fidalgos* forming his court, and the *jograes* who flocked there from all parts, were fewer in number, less productive, and lacked the originality, vigour and brilliance of the singers who versified round Alphonso III.

The principal names of the Dionysian period (1284–1325) which is illustrated in the *Cancioneiro da Vaticana* are the king himself and his bastards D. Alphonso Sanches and D. Pedro, count of Barcellos. Of the two last, the former sings of love well and sincerely, while the latter is represented by love songs replete with false sentiment and by some rather gross songs of *maldizer*, a form which, if it rarely contains much poetical feeling or literary value, throws considerable light on the society of the time.

The verses of Diniz, essentially a love poet, are conventional in tone and form, but he can write pretty ballads and pastorals when he allows himself to be natural. The Portuguese troubadours belonged to all social classes, and even included a few priests, and though love was their favourite topic they used every kind of verse, and in satire they hold the palm. In other respects they are inferior to their Provençal masters. Speaking generally, the cancioneiros form monotonous reading owing to their poverty of ideas and conventionality of metrical forms and expression, but here and there men of talent who were poets by profession and better acquainted with Provençal literature endeavoured to lend their work variety by the use of difficult processes like the *lexaprem* and by introducing new forms like the *pastorela* and the *descort*. It is curious to note that no heroic songs are met with in the cancioneiros; they are all with one exception purely lyrical in form and tone. The death of King Diniz proved a severe blow to troubadour verse, and the reign of his successor Alphonso IV. witnessed a profound decadence of court poetry, while there is not a single poem by a Portuguese author in the last half of the 14th century, and only the names of a few authors have survived, among them the Galicians Vasco Pires de Camoens, an ancestor of Luiz de Camoens, and the typical lover Macias. The *romanceiro*, comprising romances of adventures, war and chivalry, together with religious and sea songs, forms a rich collection of ballad poetry which continued in process of elaboration throughout the whole of the middle ages, but unfortunately the oldest specimens have perished and scarcely any of those existing bear a date anterior to the 15th century.

Epic poetry in Portugal developed much later than lyric, but the signal victory of the united Christian hosts over the Moors at the battle of the Salado in 1340 gave occasion to an epic by Alphonso Giraldes of which some fragments remain.

Early Prose.

The first frankly literary prose documents appear in the 14th century, and consist of chronicles, lives of saints and genealogical treatises. The more important are the *Chronica breve do archivo nacional*, the *Chronicas de S. Cruz de Coimbra*, the *Chronica da conquista do Algarve* and the *Livros dos Linhagens*, aristocratic registers, portions of which, like the story of King Arthur, have considerable literary interest. All the above may be found in the *Portugaliae monumenta historica, scriptores*, while the Life of St Elizabeth of Portugal is included in the *Monarchia lusitana*; *Romania* has printed the following hagiographical texts belonging to the same century—the *Vida de Eufrosina*, the *Vida de Maria Egypcia* and the *Vida de Sancto Amaro*; the *Vida de Santo Eloy* has appeared in the *Instituto* and the *Vida dos Santos Barlaão e Josafate* has been issued by the Lisbon Academy of Sciences.

Romances of chivalry belonging to the various cycles must have penetrated into Portugal at an early date, and the *Nobiliario* of the Conde D. Pedro contains the genealogy of Arthur and the adventures of Lear and Merlin. There exists a mid-14th-century *Historia do Santo Graal*, and an unprinted *Josep* *ab Aramadia*, while, though the MS. is lost, we have abundant evidence of the existence of a primitive Portuguese prose redaction of *Amadis de Gaula* anterior to the present Spanish text. Furthermore, the *Livro de Esopo* published by Dr Leite de Vasconcellos also belongs to the period, and there are other works in MS.

Prose.

The 15th Century.—In the reign of John I. the court became an important literary centre, the king himself composed a *Livro de Montaria*, so far unedited, and his sons are rightly described as Camoens as "*inclyta geração, altos Infantes.*" King Edward (Duarte) collected a precious library composed of the ancient classics, some translated by his order, as well as medieval poems and histories, and he wrote a moral treatise *Leal comselheiro*, and hints on horsemanship, or *Livro da ensinança de bem cavalgar toda sella*. His brother D. Pedro also wrote a moral treatise *Da virtuosa Bemfeitoria*, and caused Vegetius's *De re militari* and Cicero's *De officiis* to be turned into Portuguese. This travelled prince brought back from Venice a MS. of Marco Polo, the gift of the Senate, and is still remembered by the people through the story *Livro das viagens do Infante D. Pedro o qual andou ás sete partidas do mundo*, reprinted almost yearly, of which he is the hero. All the monarchs of the 15th century were highly educated men and patrons of letters; indeed, even that typical medieval knight Alphonso V. confesses, in his correspondence with Azurara, that the sword avails nothing without the pen. The age is noted for its chronicles, beginning with the anonymous life of the Portuguese Cid, the Holy Constable Nuno Alvares Pereira, told in charming infantile prose, the translated *Chronica da fundição do moesteyro de Sam Vicente*, and the *Vida de D. Tello*. Fernão Lopes (*q.v.*), the father of Portuguese history and author of chronicles of King Pedro, King Ferdinand and King John I., has been called by Southey the best chronicler of any age or nation. Gomes Eannes de Azurara completed Lopes's chronicle of King John by describing the capture of Ceuta, and wrote a chronicle of D. Pedro de Menezes, governor of the town down to 1437, and a chronicle of D. Duarte de Menezes, captain of Alcacer, but his capital work is the chronicle of the conquest of Guinea (see AZURARA).

Though not a great chronicler or an artist like Lopes, Ruy de Pina (*q.v.*) is free from the rhetorical defects of Azurara, and his chronicles of King Edward and King Alphonso V. are characterized by unusual frankness, and meritorious both as history and literature. All these three writers combined the posts of keeper of the archives and royal chronicler, and were, in fact, the king's men, though Lopes at least seems rather the historian of a people than the oracle of a monarch. Garcia de Resende (*q.v.*) appropriated Pina's chronicle of King John II., and after adding a wealth of anecdote and gossip and casting the glamour of poetry over a somewhat dry record, he reissued it under his own name. The taste for romances of chivalry continued throughout the 15th century, but of all that were produced the only one that has come down to us is the *Estorea do Imperador Vespasiano*, an introduction to the Graal Cycle, based on the apocryphal gospel of Nicodemus.

Verse.

The Constable D. Pedro of Portugal, son of the prince of that name already referred to, has left some verses marked by elevation of thought and deep feeling, the *Satyra de felice e infelice vida*, and the death of his sister inspired his *Tragedia de la reiña Isabel*; but he is best remembered by his *Coplas del contempto del mundo* in the *Cancioneiro Geral*. Though he actually drafted the first in his native tongue, all these poems are in Castilian, and D. Pedro is one of the first representatives of those Spanish influences which set aside the Provençal manner and in its place adopted a taste for allegory and a reverence for classical antiquity, both imported from Italy. It was to the constable that the marquis de Santillana addressed his historic letter dealing with the origins of Peninsular verse. The court poetry of the reigns of King Alphonso V. and King John II., so far as it survives, is contained in the lyrical collection known as the *Cancioneiro Geral*, compiled by Garcia de Resende and printed in 1516. Nearly three hundred authors are there represented by pieces in Portuguese and Castilian, and they include D. João Manuel, D. João de Menezes, João Rodrigues de Sá e Menezes, Diogo Brandão, Duarte de Brito and Fernão da Silveira. The literary progenitors of the cancioneiro were the Spanish poets Juan de Mena, Jorge Manrique, Garci-Sanchez de Badajos and Rodriguez del Padron, and its main subjects are love, satire and epigram. The epic achievements of the Portuguese in that century, the discoveries and the wars in Africa, hardly find an echo, even in the verses of those who had taken part in them. Instead, an atmosphere of artificiality surrounds these productions, and the verses that reveal genuine poetical feeling are very few. They include a lament of Garcia de Resende on the death of Ignez de Castro which probably inspired the inimitable stanzas dedicated to the same subject in *The Lusiads*, the *Fingimento de Amores* by Diogo Brandão, the *Coplas* of D. Pedro already referred to, and a number of minor pieces. However, some names appeared in the *Cancioneiro Gerale* which were to be among the foremost in Portuguese literature, *e.g.* Bernardim Ribeiro, Christovam Falcão, Gil Vicente, and Sá de Miranda, who represent the transition between the Spanish school of the 15th and the Italian school of the 16th century, the members of which are called *Os Quinhentistas*. Ribeiro and Falcão, the introducers of the bucolic style, put new life into the old forms, and by their eclogues in *redondilhas*, breathing the deepest and most genuine feeling in verses of perfect harmony, they gave models which subsequent writers worked by but could never equal.

The Drama.—The history of the modern drama begins with religious plays, followed at a later period by moralities, and thence, by an easy transition, by the farce. This transition from the presentment of traditional types to the modern play can be traced in the works of Gil Vicente, the father of the Portuguese theatre. His first efforts belonged to the religious drama, and some of the more notable had edification for their object, *e.g.* the *Barca do Inferno*, but even in this class he soon introduces the comic element by way of relief, and in course of time he arrives at pure comedy and develops the study of character. For a detailed description and criticism of his work, see VICENTE.

Gil Vicente and the Eschola Velha.

In the various towns where he stayed and produced his plays, writers for the stage sprang up, and these formed the Eschola Velha or school of Gil Vicente. To name the best known, Evora, the city of culture, produced Affonso Alvarez, author of religious pieces, Antonio Ribeiro, nicknamed "the Chiado," an unfrocked friar with a strong satirical vein who wrote farces in the Bazochian style, and his brother Jeronimo Ribeiro. In Santarem appeared Antonio Prestes, a magistrate who drew from his judicial experience but evinced more knowledge of folk-lore than dramatic talent, while Camoens himself was so far influenced by Gil Vicente, whose plays he had perhaps seen performed in Lisbon, that in spite of his Coimbra training he never exchanged the old forms for those of the classical comedy. His *Amphitryons* is a free imitation of the Latin, yet thoroughly national in spirit and cast in the popular redondilha; the dialogue is spirited, the situations comic. *King Seleucus* derives from Plutarch and has a prose prologue of real interest for the history of the stage, while *Filodemo* is a clever tragi-comedy in verse with prose dialogues interspersed. Another poet of the same school is Balthazar Dias, the blind poet, whose simple religious *autos* are still performed in the villages, and are continually reprinted, the best liked being the *Auto of St Alexis*, and the *Auto of St Catherine*. He is purely medieval in subject and spirit, his lyrics are perfect in form and expression, his diction thoroughly popular. One of the last dramatists of the 16th century belonging to the old school was Simão Machado, who wrote the *Comedy of Diu* and the *Enchantments of Alfea*, two long plays almost entirely in Spanish, and full of digressions only made tolerable by the beauty of their lyrics.

Except Camoens, all these men, though disciples of Gil Vicente, are decidedly inferior to him in dramatic invention, fecundity and power of expression, and they were generally of humble social position. Moreover the favour of the court was withdrawn on the death of Gil Vicente, and this meant much, for there existed no educated middle class to support a national theatre. At the same time the old dramatists had to face the opposition of the classical school, which appealed to the cultured, and the hostility of the Inquisition, which early declared war on the popular plays on account of their grossness, and afterwards through the index prohibited altogether even the religious *autos*, as it had condemned the Italian comedies. The way was thus clear for the Jesuits, who, with their Latin tragi-comedies or dramatized allegories written to commemorate saints or for scholastic festivals, succeeded for a time in supplanting both the popular pieces of the old school and the plays modelled on the masterpieces of Greece and Rome. The old dramatists came to write for the lower classes only, and though the school lingered on, its productions were performed solely by travelling companies at country fairs. Though we know that much has perished, the four Indexes of the 16th century give some idea of the rich repertory of the popular theatre, and of the efforts necessary to destroy it; moreover, the Spanish Index of 1559, by forbidding *autos* of Gil Vicente and other Portuguese authors, is interesting evidence of the extent to which they were appreciated in the neighbouring country.

The Renaissance.—The movement commonly called the Renaissance reached Portugal both indirectly through Spain and directly from Italy, with which last country it maintained close literary relations throughout the 15th century. King Alphonso V. had been the pupil of Matthew of Pisa and summoned Justus Balduinus to his court to write the national history in Latin, while later King John II. corresponded with Politian, and early in his reign the first printing-press got to work. In the next century many famous humanists took up their abode in Portugal. Nicholas Cleynarts taught the Infant Henry, afterwards cardinal and king, and lectured on the classics at Braga and Evora, Vasaeus directed a school of Latin at Braga, and George Buchanan accompanied other foreign professors to Coimbra when King John III. reformed the university. Many distinguished Portuguese teachers returned from abroad to assist the king at the same time, among them Ayres Barbosa from Salamanca, André de Gouveia of the Parisian college of St Barbe, whom Montaigne dubbed "the greatest principal of France," Achilles Estaço and Diogo de Teive.

At home Portugal produced André de Resende (*q.v.*), author of the *Historia da antiguidade da cidade de Evora* and *De antiquitatibus Lusitaniae*, and Francisco de Hollanda, painter, architect, and author of, *inter alia*, the *Quatro dialogos da pintura antiga*. Moreover, women took a share in the intellectual movement of the time, and the sisters Luisa and Angela Sigêa, Joanna Vaz and Paula Vicente, daughter of Gil Vicente, constituted an informal female academy under the presidency of the Infanta D. Maria, daughter of King Manoel. Luisa Sigêa was both an orientalist and a Latin poetess, while Publia Hortensia de Castro, after a course of humanities, philosophy and theology, defended theses at Evora in her eighteenth year.

The Italian School or Os Quinhentistas.

The Italian school was founded by Sá de Miranda (*q.v.*), a man of noble character who, on his return in 1526 from a six years' stay in Italy, where he had foregathered with the leading writers of the day, initiated a reform of Portuguese literature which amounted to a revolution. He introduced and practised the forms of the sonnet, canzon, ode, epistle in *oitava rima* and in tercets, and the epigram, and raised the whole tone of poetry. At the same time he gave fresh life to the national redondilha metre (*medida velha*) by his *Cartas* or *Satiras* which with his *Eclogues*, some in Portuguese, others in Castilian, are his most successful compositions. His chief disciple, Antonio Ferreira (*q.v.*), a convinced classicist, went further, and dropping the use of Castilian, wrote sonnets much superior in form and style, though they lack the rustic atmosphere of those of his master, while his odes and epistles are too obviously reminiscent of Horace. D. Manoel de Portugal, Pero de Andrade Caminha, Diogo Bernardes, Frei Agostinho da Cruz and André Falcão de Resende continued the erudite school, which, after considerable opposition, definitely triumphed in the person of Luiz de Camoens. The *Lima* of Bernardes contains some beautiful eclogues as well as *cartas* in the bucolic style, while the odes, sonnets, and eclogues of Frei Agostinho are full of mystic charm. Camoens (*q.v.*) is, as Schlegel remarked, an entire literature in himself, and some critics rate him even higher as a lyric than as an epic poet. He unites and fuses the best elements of the Italian and the popular muse, using the forms of the one to express the spirit and traditions of the other, and when he employs the *medida velha*, it becomes in his hands a vehicle for thought, whereas before it had usually served merely to express emotions.

Epic Poetry.

His *Lusiads*, cast in the Virgilian mould, celebrates the combination of faith and patriotism which led to the discoveries and conquests of the Portuguese, and though the voyage of Vasco da Gama occasioned its composition and formed the skeleton round which it grew, its true subject is the *peito illustre lusitano*. Immediately on its appearance *The Lusiads* took rank as the national poem *par excellence*, and its success moved many writers to follow in the same path; of these the most successful was Jeronymo Corte Real (*q.v.*). All these poems, like the *Elegiada* of Luis Pereira Brandão on the disaster of Al Kasr, the *Primeiro cêrco de Diu* of the chronicler Francisco de Andrade, and even the *Affonso Africano* of Quevedo, for all its futile allegory, contain striking episodes and vigorous and well-coloured descriptive passages, but they cannot compare with *The Lusiads* in artistic value.

The Classical Comedy and Tragedy.

The return of Sá de Miranda from Italy operated to transform the drama as well as lyric poetry. He found the stage occupied mainly by religious plays in which there appeared no trace of the Greek or Roman theatre, and, admiring what he had seen in Italy, he and his followers protested against the name *auto*, restored that of *comedy*, and substituted prose for verse. They generally chose the plays of Terence as models, yet their life is conventional and their types are not Portuguese but Roman-Italian. The revived classical comedy was thus so bound down by respect for authority as to have little chance of development, while its language consisted of a latinized prose from which the emotions were almost absent. Though it secured the favour of the humanists and the nobility, and banished the old popular plays from both court and university soon after Gil Vicente's death, its victory was shortlived. Jorge Ferreira de Vasconcellos, who produced in the *Eufrosina* the first prose play, really belongs to the Spanish school, yet, though he wrote under the influence of the *Celestina*, which had a great vogue in Portugal, and of Roman models, his types, language and general characteristics are deeply national. However, even if they had stage qualities, the very length of this and his other plays, the *Ulisipo* and the *Aulegraphia*, would prevent their performance, but in fact they are novels in dialogue containing a treasury of popular lore and wise and witty sayings with a moral object. So decisive was the success of Jorge Ferreira's new invention, notwithstanding its anonymity, that it decided Sá de Miranda to attempt the prose comedy. He modelled himself on the Roman theatre as reflected by the plays of Ariosto, and he avowedly wrote the *Estrangeiros* to combat the school of Gil Vicente, while in it, as in *Os Vilhalpandos*, the action takes place in Italy. Antonio Ferreira, the chief dramatist of the classical school, knew both Greek and Latin as well as Miranda, but far surpassed him in style. He attempted both comedy and tragedy, and his success in the latter branch is due to the fact that he was not content to seek inspiration from Seneca, as were most of the tragedians of the 16th century, but went straight to the fountain heads, Sophocles and Euripides. His *Bristo* is but a youthful essay, but his second piece, *O Cioso*, is almost a comedy of character, though both are Italian even in the names of the personages. Ferreira's real claim to distinction, however, rests on *Ignez de Castro* (see FERREIRA).

The principal form taken by prose writing in the 16th century was historical, and a pleiad of distinguished writers arose to narrate the discoveries and conquests in Asia, Africa and the ocean. Many of them saw the achievements they relate and were inspired by patriotism to record them, so that their writings

16th-Century Prose: History.

lack that serene atmosphere of critical appreciation which is looked for if history is to take its place as a science. In the four decades of his *Asia*, João de Barros, the Livy of his country, tells in simple vigorous language the "deeds achieved by the Portuguese in the discovery and conquest of the seas and lands of the Orient." His first decade undoubtedly influenced Camoens, and together the two men fixed the Portuguese written tongue, the one by his prose, the other by his verse. The decades, which were continued by Diogo do Couto, a more critical writer and a clear and correct stylist, must be considered the noblest historical monument of the century (see Barros). Couto is also responsible for some acute observations on the causes of Portuguese decadence in the East, entitled *Soldado practico.*

The word encyclopaedist fits Damião de Goes, a diplomatist, traveller, humanist and bosom friend of Erasmus. One of the most critical spirits of the age, his chronicle of King Manoel, the Fortunate Monarch, which he introduced by one of Prince John, afterwards King John II., is worthy of the subject and the reign in which Portugal attained the apogee of its greatness. Goes (*q.v.*) wrote a number of other historical and descriptive works in Portuguese and Latin, some of which were printed during his residence in the Low Countries and contributed to his deserved fame. After twenty years of investigation at Goa, Fernão Lopes de Castanheda issued his *Historia do descobrimento e conquista da India pelos Portuguezes* (Lisbon, 1552–1554 and 1561), a book that ranks besides those of Barros and Couto. Antonio Galvão, who, after governing the Moluccas with rare success and integrity, had been offered the native throne of Ternate, went home in 1540, and died a pauper in a hospital, his famous treatise only appearing posthumously. The *Tratado dos diversos . . . caminhos por onde a pimenta e especiaria veyo da India . . . e assim de todos os descubrimentos . . . que são feitos em a era de 1560* has been universally recognized as of unique historical value. Like the preceding writers, Gaspar Correia or Corrêa lived long years in India and embodied his intimate knowledge of its manners and customs in the picturesque prose of the *Lendas da India*, which embraces the events of the years 1497 to 1550. Among other historical works dealing with the East are the *Commentarios de Affonso d'Albuquerque*, an account of the life of the great captain and administrator, by his natural son, and the *Tratado das cousas da China e de Ormuz*, by Frei Gaspar da Cruz.

Coming back to strictly Portuguese history, we have the uncritical *Chronica de D. João III.* by Francisco de Andrade, and the *Chronica de D. Sebastião* by Frei Bernardo da Cruz, who was with the king at Al Kasr al Kebir, while Miguel Leitão de Andrade, who was taken prisoner in that battle, related his experiences and preserved many popular traditions and customs in his *Miscellanea.* Bishop Osorio (*q.v.*), a scholar of European reputation, wrote chiefly in Latin, and his capital work, a chronicle of King Manoel, is in that tongue.

The books of travel of this century are unusually important because their authors were often the first Europeans to visit or at least to study the countries they refer to. They include, to quote the more noteworthy, the *Descobrimento de Frolida*, the *Itinerario* of Antonio Tenreiro, the *Verdadeira informacão das terras do Preste João* by Francisco Alvares and the *Ethiopia oriental* by Frei João dos Santos, both dealing with Abyssinia, the *Itinerario da terra santa* by Frei Pantaleão de Aveiro, and that much-translated classic, the *Historia da vida do padre Francisco Xavier* by Padre João de Lucena. Fernão Cardim in his *Narrativa epistolar* records a journey through Brazil, and Pedro Teixeira relates his experiences in Persia. But the work that holds the palm in its class is the *Peregrinação* which Fernão Mendes Pinto (*q.v.*), the famous adventurer, composed in his old age for his children's reading. While Mendes Pinto and his book are typically Portuguese of that age, the *Historia tragico-maritima*, sometimes designated the prose epic of *saudade*, is equally characteristic of the race of seamen which produced it. This collection of twelve stories of notable wrecks which befell Portuguese ships between 1552 and 1604 contains that of the galleon "St John" on the Natal coast, an event which inspired Corte-Real's epic poem as well as some poignant stanzas in *The Lusiads*, and the tales form a model of simple spontaneous popular writing.

Romances, &c.

The romance took many forms, and in two of them at least works appeared which exercised very considerable influence abroad. The *Menina e moça* of Bernardim Ribeiro, a tender pastoral story inspired by *saudade* for his lady-love, probably moved Montemôr or Montemayor (*q.v.*) to write his *Diana*, and may some fifty years later have suggested the *Lusitania transformada* to Fernão Alvares do Oriente, who, however, like Ribeiro, owes some debt to Sanazaro's *Arcadia.* To name the *Palmeirim d'Inglaterra* of Moraes (*q.v.*) is to mention a famous book from which, we are told, Burke quoted in the House of Commons, while Cervantes had long previously declared that it ought to be guarded as carefully as the works of Homer. Like most successful romances of chivalry, it had a numerous progeny, but its sequels, *D. Duardos* by Diogo Fernandes, and *D. Clarisel de Bretanha* by Gonçalves Lobato, are quite inferior. The historian Barros tried his youthful pen in a romance of chivalry, the *Chronica do Imperador Clarimundo*, while in another branch, and a popular one in Portugal, the Arthurian cycle, the dramatist Ferreira de Vasconcellos wrote *Sagramor* or *Memorial das proesas da segunda Tavola Redonda.* A book of quite a different order is the *Contos de proveito e exemplo* by Fernandes Trancoso, containing a series of twenty-nine tales derived from tradition or imitated from Boccaccio and others, which enjoyed deserved favour for more than a century.

Samuel Usque, a Lisbon Jew, deserves a place to himself for his *Consolaçam ás tribulações de Israel*, where he exposes the persecutions endured by his countrymen in every age down to his time; the book takes the dialogue form, and its diction is elegant and pure. The important part taken by Portuguese prelates and theologians at the Council of Trent stimulated religious writing, most of it in Latin, but Frei Bartholomeu dos Martyres, archbishop of Braga, wrote a *Cathecismo da doutrina Christã*, Frei Luiz de Granada a *Compendio de Doutrina Christã* and *Sermões*, all in Portuguese, and other notable pulpit orators include Diogo de Paiva de Andrade, Padre Luiz Alvares, Dom Antonio Pinheiro and Frei Miguel dos Santos, who preached at the obsequies of King Sebastian.

Among the moralists of the time three at least deserve the title of masters of prose style, Heitor Pinto for his *Imagens da vida Christã*, Bishop Arráez for his *Dialogos*, and Frei Thomé de Jesus for his noble devotional treatise *Trabalhos de Jesus*, while the maxims of Joanna da Gama, entitled *Ditos da Freira*, though lacking depth, form a curious psychological document. The ranks of scientists include the cosmographer Pedro Nunes (Nonius), a famous mathematician, and the botanist Garcia da Orta, whose *Colloquios dos simples e drogas* was the first book to be printed in the East (1563), while the form of Aristotelian scholastic philosophy known as *Philosophia conimbricensis* had a succession of learned exponents. As, however, their vehicle was Latin, a mere mention must suffice, and for the same reason only the title of a notable book by Francisco Sanches can be given, the *De nobili et prima universali scientia quod nihil scitur.*

In 1536 Fernão de Oliveira published the first Portuguese grammar, and three years later the historian Barros brought out his *Cartinha para aprender a ler*, and in 1540 his *Grammatica.* Magalhães Gandavo printed some rules on orthography in 1574. Nunes de Leão also produced a treatise on orthography in 1576 and a work on the origins of the language in 1605, and Jeronymo Cardoso gave his countrymen a Latin and Portuguese dictionary.

Os Seiscentistas. Lyric Poetry.

The 17th Century.—The gigantic efforts put forth in every department of activity during the 16th century led to the inevitable reaction. Energy was worn out, patriotic ardour declined into blind nationalist vanity, and rhetoric conquered style. From a literary as from a political point of view the 17th century found Portugal in a lamentable state of decadence which dated from the preceding age. In 1536 the Inquisition began its work, while between 1552 and 1555 the control of higher education passed into the hands of the Jesuits. Following the Inquisition and the Jesuits came two other obstacles to the cultivation of letters, the censorship of books and the Indexes, and, as if these plagues were not enough, the Spanish domination followed. Next the taint of Gongorism appeared, and the extent to which it affected the literature of Portugal may be seen in the five volumes of the *Fenix renascida*, where the very titles of the poems suffice to show the futilities which occupied the attention of some of the best talents. The prevailing European fashion of literary academies was not long in reaching Portugal, and 1647 saw the foundation of the *Academia dos Generosos* which included in its ranks the men most illustrious by learning and social position, and in 1663 the *Academia dos Singulares* came into being; but with all their pedantry, extravagances and bad taste, it must be confessed that these and similar corporations tended to promote the pursuit of good literature. In bucolics there arose a worthy disciple of Ribeiro in Francisco Rodrigues Lobo (*q.v.*), author of the lengthy pastoral romances *Corte na aldêa* and *Primavera*, the songs in which, with his eclogues, earned him the name of the Portuguese Theocritus. The foremost literary figure of the time was the encyclopaedic Francisco Manoel de Mello (*q.v.*), who, though himself a Spanish classic, strove hard and successfully to free himself from subservience to Spanish forms and style. Most of the remaining lyricists of the period were steeped in Gongorism or, writing in Spanish, have no place here. It suffices to mention Soror Violente do Céo, an exalted mystic called "the tenth muse," Bernarda Ferreira de Lacerda, author of the *Soledades de Bussaco*, the *Laura do Anfrizo* of Manoel Tagarro, the *Sylvia de Lizardo* of Frei Bernardo de Brito, and the poems of Frei Agostinho das Chagas, who, however, is better represented by his *Cartas espirituaes*. Satirical verse had two notable cultivators in D. Thomas de Noronha and Antonio Serrão de Castro, the first a natural and facile writer, the second the author of *Os Ratos da Inquisiçao*, a facetious poem composed during his incarceration in the dungeons of the Inquisition, while Diogo de Sousa Camacho showed abundant wit at the expense of the slaves of Gongorism and Marinism.

Epic Poetry.

The gallery of epic poets is a large one, but most of their productions are little more than rhymed chronicles and have almost passed into oblivion. The *Ulyssea* of Gabriel Pereira de Castro describes the foundation of Lisbon by Ulysses, but, notwithstanding its plagiarism of *The Lusiads* and faults of taste, these ten cantos contain some masterly descriptive passages, and the *ottava rima* shows a harmony and flexibility to which even Camoens rarely attained; but this praise cannot be extended to the tiresome *Ulyssipo* of Sousa de Macedo. The *Malaca conquistada* of Francisco de Sá de Menezes, having Alphonso d'Albuquerque for its hero, is prosaic in form, if correct in design. Rodriguez Lobo's twenty cantos in honour of the Holy Constable do him no credit, but the *Viriato tragico* by that travelled soldier Garcia de Mascarenhas has some vigorous descriptions, and critics reckon it the best epic of the second class.

History.

In point of style the historians of the period are laboured and rhetorical; they were mostly credulous friars who wrote in their cells, and no longer, as in the 16th century, travellers and men of action who described what they had seen.

Frei Bernardo de Brito began his ponderous *Monarchia Lusitana* with the creation of man and ended it where he should have begun, with the coming of Count Henry to the Peninsula. His contribution is a mass of legends destitute of foundation or critical sense, but both here and in the *Chronica de Cister* he writes a good prose. Of the four continuers of Brito's work, three are no better than their master, but Frei Antonio Brandão, who dealt with the period from King Alphonso Henriques to King John II., proved himself a man of high intelligence and a learned, conscientious historian.

Frei Luiz de Sousa, a typical monastic chronicler, although he had begun life as a soldier, worked up the materials collected by others, and after much *labor limae* produced the panegyrical *Vida de D. Frei Bartholemeu dos martyres*, the *Historia de S. Domingos*, and the *Annaes d'el rei D. João III*. His style is lucid and vivid, but he lacks the critical sense, and the speeches he puts into the mouths of his characters are imaginary. Manoel de Faria y Sousa (*q.v.*), a voluminous writer on Portuguese history and the arch-commentator of Camoens, wrote, by an irony of fate, in Spanish, and Mello's classic account of the Catalonian War is also in that language, while, by a still greater irony, Jacinto Freire de Andrade thought to picture and exalt the Cato-like viceroy of India by his grandiloquent *Vida de D. João de Castro*.

Other historical books of the period are the valuable *Discursos* of Severim de Faria, the *Portugal restaurado* of D. Luis de Menezes, conde de Ericeira, the ecclesiastical histories of Archbishop Rodrigo da Cunha, the *Agiologio lusitano* of Jorge Cardoso and the *Chronica da Companhia de Jesus* by Padre Balthazar Telles. The last also wrote an *Historia da Ethiopia*, and, though the travel literature of this century compares badly with that of the preceding, mention may be made of the *Itinerario da India por terra atê a ilha de Chipre* of Frei Gaspar de S. Bernardino, and the *Relação do novo caminho através da Arabia e Syria* of Padre Manoel Godinho.

Oratory.

In the 17th century the religious orders and especially the Jesuits absorbed even more of the activities and counted for more in the public affairs of Portugal than in the preceding age. The pulpit discharged some of the functions of the modern press, and men who combined the gifts of oratory and writing filled it and distinguished themselves, their order and their country. The Jesuit Antonio Vieira (*q.v.*), missionary, diplomat and voluminous writer, repeated the triumphs he had gained in Bahia and Lisbon in Rome, which proclaimed him the prince of Catholic orators. His 200 sermons are a mine of learning and experience, and they stand out from all others by their imaginative power, originality of view, variety of treatment and audacity of expression. His letters are in a simple conversational style, but they lack the popular locutions, humour and individuality of those of Mello. Vieira was a man of action, while the oratorian Manoel Bernardes lived as a recluse, hence his sermons and devotional works, especially *Luz e Calor* and the *Nova Floresta*, breathe a calm and sweetness alien to the other, while they are even richer treasures of pure Portuguese. Perhaps the truest and most feeling human documents of the century are the five epistles written by Marianna Alcoforado (*q.v.*) known to history as the *Letters of a Portuguese Nun*. Padre Ferreira de Almeida's translation of the Bible has considerable linguistic importance, and philological studies had an able exponent in Amaro de Roboredo.

The Drama.

The popular theatre lived on in the *Comedias de Cordel*, mostly anonymous and never printed its existence would hardly be known were it not for the pieces which were placed on the Index. The popular *autos* that have survived are mainly religious, and show the abuse of metaphor and the conceits which derive from Gongora. All through this century Portuguese dramatists, who aspired to be heard, wrote, like Jacintho Cordeiro and Mattos Fragoso, in Castilian, though a brilliant exception appeared in the person of Francisco Manoel de Mello (*q.v.*), whose witty *Auto do fidalgo aprendiz* in redondilhas is eminently national in language, subject and treatment. Until the Restoration of 1640 the stage remained spellbound by the Spaniards, and when a court once more came to Lisbon it preferred Italian opera, French plays, and *zarzuelas* to dramatic performances in the vernacular, with the result that both Portuguese authors and actors of repute disappeared.

The 18th Century.—The first part of the 18th century differs little from the preceding age except that both affectation and bad taste tended to increase, but gradually signs appeared of a literary revolution, which preceded the political and developed into the Romantic movement. Men of liberal ideas went abroad, chiefly to France, to escape the stupid tyranny that ruled in Church and state, and to their exhortation and example are largely due the reforms which were by degrees inaugurated in every branch of letters. Their names were among others Alexandre de Gusmão, the Cavalheiro de Oliveira, Ribeiro Sanches, Corrêa da Serra, Brotero and Nascimento. They had a forerunner in Luiz Antonio Verney, who poured sarcasm on the prevailing methods of education, and exposed to good effect the extraordinary literary and scientific decadence of Portugal in an epoch-making work, the *Verdadeiro methodo de estudar*.

Academy of History.

From time to time literary societies, variously called academies or arcadias, arose to co-operate in the work of reform. In 1720 King John V., an imitator of Louis XIV., established the academy of history. The fifteen volumes of its *Memorias*, published from 1721 to 1756, show the excellent work done by its members, among whom were Caetano de Sousa, author of the colossal *Historia da Casa Real portugueza*, Barbosa Machado, compiler of the invaluable *Bibliotheca Lusitana*, and Soares da Silva, chronicler of the reign of King John I.

Royal Academy of Sciences.

The Royal Academy of Sciences founded in 1780 by the 2nd duke of Lafões, uncle of Queen Maria I., still exists, though its output and influence are small. Its chief contributions to knowledge were the *Diccionario da lingua portugueza*, still unfinished, and the *Memorias* (1788–1795), and it included in its ranks nearly all the learned men of the last part of the 18th century. Among them were the ecclesiastical historian Frei Manoel do Cenaculo, bishop of Beja, the polygraph Ribeiro dos Santos, Caetano do Amaral, a patient investigator of the origins of Portugal, João Pedro Riberio, the founder of modern historical studies, D. Francisco Alexandre Lobo, bishop of Vizeu, whose essays on Camoens and other authors show sound critical sense and a correct style, Cardinal Saraiva, an expert on ancient and modern history and the voyages of his countrymen, and Frei Fortunato de S. Boaventura, a historical and literary critic.

Arcadias, Lyric Poetry, &c.

In 1756 Cruz e Silva (*q.v.*), with the aid of friends, established the *Arcadia Ulysiponense*, "to form a school of good sayings and good examples in eloquence and poetry." The most considered poets of the day joined the Arcadia and individually wrote much excellent verse, but they all lacked creative power. The principal Greek and Latin authors were the models they chose, and Garção, the most prominent Arcadian, composed the *Cantata de Dido*, a gem of ancient art, as well as some charming sonnets to friends and elegant odes and epistles. The bucolic verse of Quita, a hairdresser, has a tenderness and simplicity which challenge comparison with Bernardim Ribeiro, and the *Marilia* of Gonzaga contains a celebrated collection of bucolic-erotic verse. Their conventionality sets the lyrics of Cruz e Silva on a lower plane, but in the *Hyssope* he improves on the *Lutrin* of Boileau. After a chequered existence, internal dissensions caused the dissolution of the Arcadia in 1774. It had only gained a partial success because the despotic rule of Pombal, like the Inquisition before him, hindered freedom of fancy and discussion, and drove the Arcadians to waste themselves on flattering the powerful. In 1790 a New Arcadia came into being. Its two most distinguished members were the rival poets Bocage (*q.v.*) and Agostinho de Macedo (*q.v.*). The only other poet of the New Arcadia who ranks high is Curvo Semedo; but the Dissidents, a name bestowed on those who stood outside the Arcadias, included two distinguished men now to be cited, the second of whom became the herald of a poetical revolution. No Portuguese satirist possessed such a complete equipment for his office as Nicolao Tolentino, and though a dependent position depressed his muse, he painted the customs and follies of the time with almost photographic accuracy, and distributed his attacks or begged for favours in sparkling verse. The task of purifying and enriching the language and restoring the cult of the Quinhentistas was perseveringly carried out by Francisco Manoel de Nascimento (*q.v.*) in numerous compositions in prose and verse, both original and translated. Shortly before his death in Paris he became a convert to the Romantic movement, and he prepared the way for its definite triumph in the person of Almeida Garrett, who belonged to the *Filintistas*, or followers of Nascimento, in opposition to the *Elmanistas*, or disciples of Bocage.

The Drama.

Early in the 18th century the spirit of revolt against despotism led to an attempt at the restoration of the drama by authors sprung from the people, who wrote for spectators as coarse as they were ignorant of letters. Its centres were the theatres of the Bairro Alto and Mouraria, and the numerous pieces staged there belong to low comedy. The *Operas portuguezas* of Antonio José da Silva (*q.v.*), produced between 1733 and 1741, owe their name to the fact that *arias*, *minuets* and *modinhas* were interspersed with the prose dialogue, and if neither the plots, style, nor language are remarkable, they have a real comic force and a certain originality. Silva is the legitimate representative in the 18th century of the popular theatre inaugurated by Gil Vicente, and though born in Brazil, whence he brought the *modinha*, he is essentially a national writer. Like Silva's operas, the comedies of Nicolao Luiz contain a faithful picture of contemporary society and enjoyed considerable popularity. Luiz divided his attention between heroic comedies and comedies *de capa y espada*, but of the fifty-one ascribed to him, all in verse, only one bears his name, the rest appeared anonymously. His method was to choose some Spanish or Italian play, cut out the parts he disliked, and substitute scenes with dialogues in his own way, but he has neither ideals, taste nor education; and, except in *Os Maridos Peraltas*, his characters are lifeless and their conventional passions are expressed in inflated language. Notwithstanding their demerits, however, his comedies held the stage from 1760 until the end of the century.

Meanwhile the Arcadia also took up the task of raising the tone of the stage, but though the ancients and the classic writers of the 16th century were its ideals, it drew immediate inspiration from the contemporary French theatre. All its efforts failed, however, because its members lacked dramatic talents and, being out of touch with the people, could not create a national drama.

Garção (*q.v.*) led the way with the *Theatro Novo*, a bright little comedy in blank verse, and followed it up with another, *Assemblêa ou partida*; but he did not persevere. Figueiredo felt he had a mission to restore the drama, and wrote thirteen volumes of plays in prose and verse, but, though he chose national subjects, and could invent plots and draw characters, he could not make them live. Finally, the bucolic poet Quita produced the tragedies *Segunda Castro*, *Hermione* and two others, but these imitations from the French, for all the taste they show, were stillborn, and in the absence of court patronage, which was exclusively bestowed on the Lisbon opera, then the best equipped in Europe, Portugal remained without a drama of its own.

Sacred eloquence is represented by Fr. Alexandre Palhares, a student of Vieira, whose outspoken attack on vice in high places in a sermon preached before Queen Maria led to his exile from court. The art of letter-writing had cultivators in Abbade Costa, Ribeiro Sanches, physician of Catherine II. of Russia, Alexandre de Gusmão, and the celebrated Cavalheiro de Oliveira, also author of *Memorias politicas e literarias*, published at the Hague, whither he had fled to escape the Inquisition. Philological studies were pursued with ardour and many valuable publications have to be recorded, among them Bluteau's *Vocabulario Portuguez*, the *Reflexões sobre a lingoa portugueza* and an *Arte poetica* by Francisco José Freire, the *Exercicios* and *Espirito da lingoa e eloquencia* of Pereira de Figueiredo, translator of the Vulgate, and Viterbo's *Elucidario*, a dictionary of old terms and phrases which has not been superseded. Finally the best literary critic and one of the most correct prose writers of the period is Francisco Dias Gomes.

The 19th Century and After.—The 19th century witnessed a general revival of letters, beginning with the Romantic movement, of which the chief exponents were Garrett (*q.v.*) and Herculano (*q.v.*), both of whom had to leave Portugal on account of their political liberalism, and it was inaugurated in the

The Romantic Movement: Poetry.

field of poetry. Garrett read the masterpieces of contemporary foreign literature during his exiles in England and France, and, imbued with the national spirit, he produced in 1825 the poem *Camões*, wherein he broke with the established rules of composition in verse and destroyed the authority of the Arcadian rhymers. His poetry like that of his fellow *emigré*, the austere Herculano, is eminently sincere and natural, but while his short lyrics are personal in subject and his longer poems historical, the verse of Herculano is generally subjective and the motives religious or patriotic. The movement not only lost much of its virility and genuineness, but became ultra-Romantic with A. F. de Castilho (*q.v.*), whose most conspicuous followers were João de Lemos and the poets of the collection entitled *O Trovador*; Soares de Passos, a singer for the sad; the melodious Thomas Ribeiro, who drew his inspiration from Zorilla and voiced the opposition to a political union with Spain in the patriotic poem *D. Jayme*. Mendes Leal, a king in the heroic style, Gomes de Amorim and Bulhão Pato, belong more or less to the same school. On the other hand José Simões Dias broke with the Romantic tradition in which he had been educated, and successfully sought inspiration from popular sources, as his *Peninsulares* proves.

The Coimbra Question.

Recent Verse.

In 1865 there arose a serious and lengthy strife in the Portuguese Parnassus, which came to be known as the Coimbra question, from its origin in the university city. Its immediate cause was the preface which Castilho contributed to the poem *Moçidade* of Pinheiro Chagas, and it proclaimed the alliance of poetry with philosophy. The younger men of letters regarded Castilho as the self-elected pontiff of a mutual-praise school, who, ignorant of the literary movement abroad, claimed to direct them in the old paths, and would not tolerate criticism. The revolt against his primacy took the form of a fierce war of pamphlets, and led ultimately to the dethronement of the blind bard. The leaders in the movement were Anthero de Quental (*q.v.*) and Dr Theophilo Braga, the first a student of German philosophy and poetry, the second a disciple of Comte and author of an epic of humanity, *Visão dos tempos*, whose immense work in the spheres of poetry, criticism and literary history, marred by contradictions, but abounding in life, cannot be judged at present. In the issue literature gained considerably, and especially poetry, which entered on a period of active and rich production, still unchecked, in the persons of João de Deus (*q.v.*) and the Coimbrans and their disciples. The *Campo de flores* contains some of the most splendid short poems ever written in Portuguese, and an Italian critic has ventured to call João de Deus, to whom God and women were twin sources of inspiration, the greatest love poet of the 19th century. Simplicity, spontaneity and harmony distinguished his earlier verses, which are also his best, and their author belongs to no school but stands alone. A preponderance of reflection and foreign influences distinguish the poets now to be mentioned. Anthero de Quental, the chief of the Coimbrans, enshrined his metaphysical neo-Buddhistic ideas overshadowed by extreme pessimism, and marked the stages of his mental evolution, in a sequence of finely-wrought sonnets. These place him in the sacred circle near to Heine and Leopardi, and, though strongly individualistic, it is curious to note in them the influence of Germanism on the mind of a southerner and a descendant of the Catholic navigators of the 16th century. *Odes modernas*, written in youth, show "Santo Anthero," as his friends called him, in revolutionary, free-thinking and combative mood, and are ordinary enough, but the prose of his essays, *e.g. Considerations on the Philosophy of Portuguese Literary History*, has that peculiar refinement, clearness and conciseness which stamped the later work of this sensitive thinker. A subtle irony pervades the *Rimas* of João Penha, who links the Coimbrans with Guerra Junqueiro and the younger poets. Partly philosophical, partly naturalistic, Junqueiro began with the ironical composition, *A Morte de D. João*; in *Patria* he evoked in a series of dramatic scenes and lashed with satire the kings of the Braganza dynasty, and in *Os Simples* he interprets in sonorous stanzas the life of country-folk by the light of his powerful imagination and pantheistic tendencies. The *Claridades de Sul* of Gomes Leal, a militant anti-Christian, at times recall Baudelaire, and flashes of genius run through *Anti-Christo*, which is alive with the instinct of revolt. The *Só* of the invalidish Antonio Nobre is intensely Portuguese in subjects, atmosphere and rhythmic sweetness, and had a deep influence. Cesario Verde sought to interpret universal nature and human sorrow, and the Parnassian Gonçalves Crespo may be termed a deeper, richer Coppée. His *Miniaturas* and *Nocturnos* have been re-edited by his widow, D. Maria Amalia Vaz de Carvalho, a highly gifted critic and essayist whose personality and *cercle* call to mind the 18th-century poetess, the Marqueza de Alorna. The French symbolists found an enthusiastic adept in Eugenio de Castro. Antonio Feijo and José de Sousa Monteiro have written verse remarkable by its form, while perhaps the most considered of the later poets are Antonio Corrêa de Oliveira and Lopes Vieira. Many other genuine bards might be mentioned, because the Portuguese race can boast of an unceasing flow of lyric poetry.

The Drama.

Garrett took in hand the reform of the stage, moved by a desire to exile the translations on which the playhouses had long subsisted. He chose his subjects from the national history, and began with the *Auto de Gil Vicente*, in which he resuscitated the founder of the theatre, and followed this up with other prose plays, among which the *Alfageme de Santarem* takes the palm; finally he crowned his labours by *Frei Luiz de Sousa*, a tragedy of fatality and pathos and one of the really notable pieces of the century. The historical bent thus given to the drama was continued by the versatile Mendes Leal, by Gomes da Amorim and by Pinheiro Chagas, who all however succumbed more or less to the atmosphere and machinery of ultra-Romanticism, while the plays of Antonio Ennes deal with questions of the day in a spirit of combative liberalism. In the social drama, Ernesto Biester, and in comedy Fernando Caldeira, also no mean lyric poet, are two of the principal names, and the latter's pieces, *A Mantilha da Renda* and *A Madrugada*, have a delicacy and vivacity which justifies their success. The comedies of Gervasio Lobato are marked by an easy dialogue and a sparkling wit, and some of the most popular of them were written in collaboration with D. João de Camara, the leading dramatist of the day, one of whose pieces, *Os Velhos*, has been translated and staged abroad. To Henrique Lopes de Mendonça, scholar, critic and poet, we owe some strong historical plays as well as the piece *Zé Palonso*, written with Lobato, which made a big hit. The playwrights also include Julio Dantas, and Dr Marcellino Mesquita, author of *Leonor Telles* and other historical dramas, as well as of a powerful piece, *Dôr suprema*.

The Novel.

Herculano led the way in the historical romance by his *Lendas e narrativas* and *O Monasticon*, two somewhat laboured productions, whose progenitor was Walter Scott; they still find readers for their impeccable style. Their most popular successors have been *A Moçidade de D. João V.* and *A ultima corrida de touros reaes em Salvaterra* by Rebello da Silva, and *Um Anno na Corte* by the statesman, Andrade Corvo, the first and the last superior books. The novel shares with poetry the predominant place in the modern literature of Portugal, and Camillo Castello Branco (*q.v.*), Gomes Coelho and Eça de Queiroz are names which would stand very high in any country. The first, a wonderful impressionist though not perhaps a great novelist, describes to perfection the domestic and social life of Portugal in the early part of the 19th century. His remarkable works include *Amor de Perdição*, *Amor de Salvação*, *Retrato de Ricardina*, and the series entitled *Novellas do Minho*; moreover some of his essays in history and literary criticism, such as *Bohemia do Espirito*, rank only next to his romances. Gomes Coelho, better known as *Julio Diniz*, records his experiences of English society in Oporto in *A Familia ingleza*, and for his romantic idealism he has been dubbed British; Portuguese critics have accused him of imitating Dickens.

His stories, particularly *As Pupillas do Snr. Reitor*, depict country life and scenery with loving sympathy, and hold the reader by the charm of the characters, but Diniz is a rather subjective monotonous writer who lacks the power to analyse, and he is no psychologist. Eça de Queiroz (*q.v.*) founded the Naturalist school in Portugal by a powerful book written in 1871, but only published in 1875, under the title *The Crime of Father Amaro*; and two of his great romances, *Cousin Basil* and *Os Maias*, were written during his occupancy of consular posts in England. *The Relic* conveys the impressions of a journey in Palestine and in parts suggests his indebtedness to Flaubert, but its mysticism is entirely new and individual; while the versatility of his talent further appears in *The Correspondence of Fradique Mendes*, where acute observation is combined with brilliant satire or rich humour. The later portion of *The City and the Mountains*, for the truth and beauty of its descriptive passages, is highly praised, and many pages are already quoted as classic examples of Portuguese prose. Among other novelists are Oliveira Marreca, Pinheiro Chagas, Arnaldo Gama, Luis de Magalhães and Teixeira de Queiroz, the last of whom is almost as distinctly national a writer as Castello Branco himself.

History.

Years of persevering toil in archives and editions of old chronicles prepared Herculano for his *magnum opus*, the *Historia de Portugal*. The *Historia da Origem e Estabelecimento da Inquisição em Portugal* followed and confirmed the position of its author as the leading modern historian of the Peninsula, and he further initiated and edited the important series *Portugaliae Monumenta historica*. The Visconde de Santarem, and Judice Biker in geography and diplomatics, produced standard works; Luz Soriano compiled painstaking histories of the reign of King Joseph and of the Peninsular War; Silvestre Ribeiro printed a learned account of the scientific, literary and artistic establishments of Portugal, and Lieut.-Colonel Christovam Ayres was the author of a history of the Portuguese army. Rebello da Silva and the voluminous and brilliant publicists, Latino Coelho and Pinheiro Chagas, wrote at second hand and rank higher as stylists than as historians. Gama Barros and Costa Lobo followed closely in the footsteps of Herculano, the first by a *Historia da Administração publica em Portugal nos Seculos XII. a XV.*, positively packed with learning, the second by a *Historia da Sociedade em Portugal no Seculo XV.* Though he had no time for original research, Oliveira Martins (*q.v.*) possessed psychological imagination, a rare capacity for general ideas and the gift of picturesque narration; and in his philosophic *Historia de Portugal*, his sensational *Portugal contemporaneo*, *Os Filhos de D. João* and *Vida de Nun' Alvarez*, he painted an admirable series of portraits and, following his master Michelet, made the past live again. Furthermore the interesting volumes of his *Bibliotheca das Sciencias Sociaes* show extensive knowledge, freshness of views and critical independence and they have greatly contributed to the education of his countrymen.

Criticism.

Ramalho Ortigão, the art critic, will be remembered principally for the *Farpas*, a series of satirical and humorous sketches of Portuguese society which he wrote in collaboration with Queiroz. Julio Cesar Machado and Fialho de Almeida made their mark by many humorous publications, and, in the domain of pure literary criticism, mention must be made of Antonio Pedro Lopes de Mendonça, Rebello da Silva, Dr Joaquim de Vasconcellos, Mme Michaëlis de Vasconcellos, Silva Pinto, the favourite disciple of Castello Branco, and of Luciano Cordeiro, founder of the Lisbon Geographical Society, whose able monograph, *Soror Marianna*, vindicated the authenticity of the *Letters of a Portuguese Nun* and showed Marianna Alcoforado to be their authoress. Excellent critical work was also done by Moniz Barreto, whose early death was a serious loss to letters.

In scientific literature hardly a single department lacks a name of repute even outside Portugal. The press has accompanied the general progress, and ever since Herculano founded and wrote in the *Panorama*, the leading writers have almost without exception made both name and livelihood by writing for the papers, but as pure journalists none has excelled Antonio Rodriguez Sampaio, Antonio Augusto Teixeira de Vasconcellos and Emygdio Navarro.

Oratory.

The leading Portuguese orators of the 19th century, with the exception of Malhão, were not churchmen, as in the past, but politicians. The early days of parliamentary rule produced Manoel Fernandes Thomás and Manoel Borges Carneiro, but the most brilliant period was that of the first twenty-five years of constitutional government after 1834, and the historic names are those of Garrett, Manoel da Silva Passos, and the great tribune and apostle of liberty, José Estevão Coelho de Magalhães. The ill-fated Vieira de Castro excited the greatest admiration by his impassioned speeches in the Chamber of Deputies during the 'sixties; the nearest modern counterpart to these distinguished men is the orator Antonio Candido Ribeiro da Costa.

BIBLIOGRAPHY.—The corner-stones are the *Bibliotheca Lusitana* of Barbosa Machado and the *Diccionario bibliographico portuguez*, by Innocencio da Silva, with Brito Aranha's supplement; while the *Bibliotheca Hispana Nova* of Nicolao Antonio (1783–1788) may also be referred to. Subsidiary to these are the *Manual bibliographico portuguez* of Dr Pinto de Mattos, the admirable *Catalogo razonado de los Autores portugueses que escribieron en Castellano*, compiled by Garcia Peres (1890), and such publications as Figaniere's *Catalogo dos Manuscriptos portuguezes no Museu Britannico* (1853). The only full general history of the literature comes from the prolific pen of Dr Theophilo Braga (second and revised edition in 32 vols.). The volumes positively bulge with information and contain much acute criticism, but their value is diminished by frequent and needless digressions and by the fantastic theorizings of their author, a militant Positivist. Of one-volume books on the same subject, Dr Braga's *Curso da Historia da Litteratura portugueza* and his *Theoria da Historia da Litteratura portugueza* (3rd ed., 1881) may be recommended, though the plainer *Historia da Litteratura portugueza*, by Dr Mendes dos Remedios (3rd ed., 1908) has the considerable advantage for foreign students of including a large number of selected passages from the authors named. See also the *Chrestomathia archaica* of J. J. Nunes (1905). Among foreign studies the palm must be given to the "Geschichte der portugiesischen Litteratur" by the eminent scholar, Mme Michaëlis de Vasconcellos, in the *Grundriss der rom. Philologie* of Gröber (1893–1894). Among general critical studies are Costa e Silva's *Ensaio biographico-critico* and the masterly work of Menendez y Pelayo, *Historia de las ideas estaticas en España*.

Coming to special periods, the student may consult, for the cancioneiros, Mme Michaëlis de Vasconcellos, *op. cit.*, and her great edition of the *Cancioneiro da Ajuda* (1904); also H. R. Lang, *Das Liederbuch der Königs Denis von Portugal* (1894). Lopes de Mendonça treats of the literature of the 16th and 17th centuries in articles in the *Annaes das sciencias e letras*; and the *Memorias de litteratura portugueza* printed by the Lisbon Academy of Sciences (1792–1814) contain essays on the drama and the Arcadia, but the 19th century has naturally received most attention. For that period, see Lopes de Mendonça, *Memoiras da litteratura contemporanea* (1855); Romero Ortiz, *La Literatura portugueza en el siglo XIX.* (1869), containing much undigested information; and Maxime Formont, *Le Mouvement poétique contemporain en Portugal*, an able sketch; but the soundest review is due to Moniz Barreto, whose "Litteratura portugueza contemporanea" came out in the *Revista de Portugal* for July 1889. Students of the modern novel in Portugal should refer to the essays of J. Pereira de Sampaio ("Bruno") *A Geração Nova* (1886).

Portugal still lacks a collection equivalent to Rivadeneyra's *Biblioteca de autores españoles*, contenting itself with the *Parnasso lusitano* (6 vols., 1826) and a *Corpus illustrium poetarum lusitanorum qui latine scripserunt* (1745–1748), and though much has been accomplished to make the classics more available, even yet no correct, not to say critical, texts of many notable writers exist. The *Cancioneiro de Ajuda* by Mme Vasconcellos, is the perfection of editing, and there are diplomatic editions of other cancioneiros, *e.g. Il Canzoniere portoghese della Bibliotheca Vaticana*, by E. Monaci (1875), of which Dr Braga hurriedly prepared a critical edition; *Il Canzoniere portoghese Colocci-Brancuti* by E. Molteni (1880), and the *Cancioneiro Geral* (1846). The *Romanceiro portuguez* of V. E. Hardung is incomplete. (E. Pr.)

PORTUGUESE EAST AFRICA, or MOZAMBIQUE. This Portuguese possession, bounded E. by the Indian Ocean, N. by German East Africa, W. by the Nyasaland Protectorate, Rhodesia and the Transvaal, S. by Tongaland (Natal), has an area of 293,500 sq. m. It is divided in two by the river Zambezi. The northern portion, between the ocean and Lake Nyasa and the Shiré river, is a compact block of territory, squarish in shape, being about 400 m. long by 360 m. broad. South of the Zambezi the province consists of a strip of land along the coast varying from 50 to 200 m. in depth. Along the Zambezi itself Portuguese territory extends west as far as the Loangwa confluence, some 600 m. by river.

Physical Features.—The coast-line extends from 26° 52′ S. to 10° 40′ S., and from south to north makes a double curve with a general trend outward, *i.e.* to the east. It has a length of 1430 m. Some 40 m. north of the Natal (Tongoland) frontier is the deep indentation of Delagoa Bay (*q.v.*). The land then turns outward to Cape Corrientes, a little north of which is Inhambane Bay. Bending westward again and passing several small islands, of which the chief is Bazaruto, Sofala Bay is reached. Northward the Zambezi with a wide delta pours its waters into the ocean. From this point onward the coast is studded with small islands, mainly of coral formation. On one of these islands is Mozambique, and immediately north of that port is Conducia Bay. Somewhat farther north are two large bays—Fernao Veloso and Memba. There is a great difference in the character of the coast north and south of Mozambique. To the north the coast is much indented, abounds in rocky headlands and rugged cliffs while, as already stated, there is an almost continuous fringe of islands. South of Mozambique the coast-line is low, sandy and lined with mangrove swamps. Harbours are few and poor. The difference in character of these two regions arises from the fact that in the northern half the ocean current which flows south between Madagascar and the mainland is close to the coast, and scours out all the softer material, while at the same time the coral animalcules are building in deep waters. But south of Mozambique the ocean current forsakes the coast, allowing the accumulation of sand and alluvial matter. North of Fernao Veloso and Memba the largest bays are Pemba (where there is commodious anchorage for heavy draught vessels), Montepuesi and Tunghi, the last named having for its northern arm Cape Delgado, the limit of Portuguese territory.

Orographically the backbone of the province is the mountain chain which forms the eastern escarpment of the continental plateau. It does not present a uniformly abrupt descent to the plains, but in places—as in the lower Zambezi district—slopes gradually to the coast. The Lebombo Mountains, behind Delagoa Bay, nowhere exceed 2070 ft. in height; the Manica plateau, farther north, is higher. Mt Doe rises to 7875 ft. and Mt Panga to 7610 ft. The Gorongoza massif with Mt Miranga (6550 ft.), Enhatete (6050 ft.), and Gogogo (5900 ft.) lies north-east of the Manica plateau, and is, like it, of granitic formation. Gorongoza, rising isolated with precipitous outer slopes, has been likened in its aspect to a frowning citadel. The chief mountain range, however, lies north of the Zambezi, and east of Lake Chilwa, namely, the Namuli Mountains, in which Namuli Peak rises to 8860 ft., and Molisani, Mruli and Mresi attain altitudes of 6500 to 8000 ft. These mountains are covered with magnificent forests. Farther north the river basins are divided by well-marked ranges with heights of 3000 ft. and over. Near the south-east shore of Nyasa there is a high range (5000 to 6000 ft.) with an abrupt descent to the lake—some 3000 ft. in six miles. The country between Nyasa and Ibo is remarkable for the number of fantastically shaped granite peaks which rise from the plateau. The plateau lands west of the escarpment are of moderate elevation—perhaps averaging 2000 to 2500 ft. It is, however, only along the Zambezi and north of that river that Portuguese territory reaches to the continental plateau.

Besides the Zambezi (*q.v.*) the most considerable river in Portuguese East Africa is the Limpopo (*q.v.*) which enters the Indian Ocean about 100 m. north of Delagoa Bay. The Komati (*q.v.*), Sabi, Busi and Pungwe south of the Zambezi; the Lukugu, Lurio, Montepuesi (Mtepwesi) and Msalu, with the Rovuma (*q.v.*) and its affluent the Lujenda, to the north of it, are the other rivers of the province with considerable drainage areas. The Sabi rises in Mashonaland at an altitude of over 3000 ft., and after flowing south for over 200 m. turns east and pierces the mountains some 170 m. from the coast, being joined near the Anglo-Portuguese frontier by the Lundi. Cataracts entirely prevent navigation above this point. Below the Lundi confluence the bed of the Sabi becomes considerably broader, varying from half a mile to two miles. In the rainy season the Sabi is a large stream and even in the "dries" it can be navigated from its mouth by shallow draught steamers for over 150 m. Its general direction through Portuguese territory is east by north. At its mouth it forms a delta 60 m. in extent. The Busi (220 m.) and Pungwe (180 m.) are streams north of and similar in character to the Sabi. They both rise in the Manica plateau and enter the ocean in Pungwe Bay, their mouths but a mile or two apart. The lower reaches of both streams are navigable, the Busi for 25 m., the Pungwe for about 100 m. At the mouth of the Pungwe is the port of Beira. Of the north-Zambezi streams the Lukugu, rising in the hills south-east of Lake Chilwa, flows south and enters the ocean not far north of Quilimane. The Lurio, rising in the Namuli Mountains, flows north-east, having a course of some 200 m. The Montepuesi and the Msalu drain the country between the Lurio and Rovuma basins. Their banks are in general well defined and the wet season rise seems fairly constant.

Geology.—The central plateau consists of gneisses, granites and schists of the usual East African type which in part or in whole are to be referred to the Archaean system. The next oldest rocks belong to the Karroo period. Their principal occurrence is in the Zambezi basin, where at Tete they contain workable seams of coal, and have yielded plant remains indicating a Lower Karroo or Upper Carboniferous age. Sandstones and shales, possibly of Upper Karroo age, form a narrow belt at the edge of the foot-plateau. Upper Cretaceous rocks crop out from beneath the superficial deposits along the coast belt between Delagoa Bay and Mozambique. The Cenomanian period is represented in Conducia by the beds with *Puzosia* and *Acanthoceras*, and in Sofala and Busi by the beds with *Alectryonia ungulata* and *Exogyra columba.* The highest Cretaceous strata occur in Conducia, where they contain the huge ammonite *Pachydiscus conduciensis.* The Eocene formation is well represented in Gazaland by the nummulitic limestones which have been found to extend for a considerable distance inland. Basalts occur at several localities in the Zambezi basin. On the flanks of Mount Milanje there are two volcanic cones which would appear to be of comparatively recent date; but the most interesting igneous rocks are the rhyolitic lavas of the Lebombo range.

Climate.—The climate is unhealthy on the coast and along the banks of the Zambezi, where malaria is endemic. With moderate care, however, Europeans are able to enjoy tolerably good health. On the uplands and the plateaus the climate is temperate and healthy. At Tete, on the lower Zambezi, the annual mean temperature is 77·9° F., the hottest month being November, 83·3°, and the coldest July, 72·5°. At Quilimane, on the coast, the mean temperature is 85·1°, maximum 106·7° and minimum 49·1°. The cool season is from April to August. The rainy season lasts from December to March, and the dry season from May to the end of September. November is a month of light rains. During the monsoons the districts bordering the Mozambique Channel enjoy a fairly even mean temperature of 76·1°, maximum mean 88·7°, and minimum mean 65·3°.

Fauna.—The fauna is rich, game in immense variety being plentiful in most districts. The carnivora include the lion, both of the yellow and black-maned varieties, leopard, spotted hyena, jackal, serval, civet cat, genet, hunting dog (*Lycaon pictus*) in the Mozambique district, mongoose and spotted otter, the last-named rare. Of ungulata the elephant is plentiful, though large tuskers are not often shot. The black rhinoceros is also common, and south of the Zambezi are a few specimens of white rhinoceros (*R. simus*). The rivers and marshes are the home of numerous hippopotami, which have, however, deserted the lower Zambezi. The wart-hog and the smaller red hog are common. A species of zebra is plentiful, and herds of buffalo (*Bos caffer*) are numerous in the plains and in open woods. Of antelopes the finest are the eland and sable antelope. The kudu is rare. Waterbuck, hartebeeste (*Bubalis lichtensteini*), brindled gnu and tsesebe (south of the Zambezi, replaced north of that river by the lechwe and puku), reedbuck, bushbuck, impala, duiker, klipspringer and oribi are all common. The giraffe is not found within the province. Of edentata the scaly ant-eater and porcupine are numerous. Among rodentia hares and rabbits are abundant. There are several kinds of monkeys and lemuroids, but the anthropoids are absent. Crocodiles, lizards, chameleons, land and river tortoises are all very numerous, as are pythons (some 18 ft. long), cobras, puff-adders and vipers. Centipedes and scorpions and insects are innumerable. Among insects mosquitos, locusts, the tsetse fly, the hippo-fly, cockroaches, phylloxera, termites, soldier ants and flying ants are common plagues. As has been indicated, the Zambezi forms a dividing line not crossed by certain animals, so that the fauna north of that river presents some marked contrasts with that to the south.

Bird-life is abundant. Among the larger birds flamingoes are especially common in the Mozambique district. Cranes, herons, storks, pelicans and ibises are numerous, including the beautiful crested crane and the saddle-billed stork (*Mycteria senegalensis*), the last-named comparatively rare. The eagle, vulture, kite, buzzard and crow are well represented, though the crested eagle is not found. Of game birds the guinea fowl, partridge, bustard, quail, wild goose, teal, widgeon, mallard and other kinds of duck are all common. Other birds numerously represented are parrots (chiefly a smallish green bird—the grey parrot is not found), ravens, hornbills, buntings, finches, doves, a variety of cuckoo, small wagtails, a starling with a beautiful burnished bronze-green plumage, spur-winged plovers, stilt birds, ruffs and kingfishers.

Flora.—The flora is varied and abundant, though the custom of the natives to burn the grass during the dry season gives to large areas for nearly half the year a blackened, desolate appearance. Six varieties of palms are found—the coco-nut, raphia, wild date, borassus (or fan palm), hyphaene and *Phoenix spinosa.* The coco-nut is common in the coast regions and often attains 100 ft.; the date palm, found mostly in marshy ground and by the banks of small rivers, is seldom more than 20 ft. in height. Of the many timber trees a kind of cedar is found in the lower forests; ironwood and ebony are common, and other trees resemble satin and rosewood. The *Khaya senegalensis*, a very large tree found in ravines and by river banks, affords durable and easily-worked timber; there are several varieties of vitex and of ficus, notably the sycamore, which bears an edible fruit. Excellent hardwood is obtained from a species of grewia. Other characteristic trees are the mangrove (along the sea shore), sandal-wood, gum copal, baobab and bombax, and, in the lower plain, dracaenas (dragon trees), candalabra euphorbia, and many species of creepers and flowering shrubs. The thorny smilax and many other prickly creepers and shrubs are abundant. Acacias are numerous, including the gum-yielding variety, while landolphia rubber vines grow freely in the forests. Among plants of economic value the coffee, cotton, indigo and tobacco plants are found, as well as the castor oil and other oleaginous plants. Bananas, mangoes and pineapples grow in great profusion. Among flowers crinum lilies, lotus, gentians, gladioli, lobelias, violets (scentless), red and yellow immortelles (confined to the higher elevations) and yellow and blue amomums are common. Of grasses the bamboo is common. *Phragmites communis*, spear grass, with its waving, snowy plumes, grows 12 to 14 ft. and is abundant along the river banks and along the edges of the marshes. (For the flora of the Nyasa region see BRITISH CENTRAL AFRICA.)

Inhabitants.—Portuguese East Africa is sparsely inhabited, the estimated population (1909) being 3,120,000; 90% of the inhabitants belong to various Bantu tribes, from whose ranks most of the natives employed in the Transvaal gold mines are recruited. The most important in the northern half of the province are the Yaos (*q.v.*) and the Ma Kua (Makwa). The Makwa, notwithstanding the presence of Arabs, Banyans (Hindus) and Battias in all the coast districts, have preserved in a remarkable degree their purity of race, although their language has undergone considerable change (see BANTU LANGUAGES). Most of the country between the Rovuma and the Zambezi is populated by branches of this race, governed by numerous petty chiefs. The Makwa are divided into four families or groups—the Low Makwa, the Lomwe or Upper Makwa, the Maua and the Medo. Yao possess the country between the Msalu river and Nyasa. The dominant race between the Zambezi and the Mazoe are the Tavala, other tribes in the same region being the Maravi, Senga, Muzimba and Muzuzuro. They are mainly of Zulu origin. Between the Zambezi and the Pungwe are the Barue, Batoka, &c. In the district south of the Pungwe river, known as Gazaland, the ruling tribes are of Zulu origin, all other tribes of different stock being known as Tongas. For the most part these Tongas resemble the Basutos. They are of peaceful disposition. They occupy themselves with stock-raising and agriculture. The white inhabitants numbered about 9000 in 1909. They are chiefly Portuguese and British and nearly a half live in Lourenço Marques. There are many Portuguese half-castes.

Chief Towns.—The chief towns are Lourenço Marques, Mozambique, Quilimane, Inhambane, Beira, Chinde and Sofala, all separately noticed. The other European settlements are Chingune (see SOFALA), Angoxa and Ibo on the coast, and Sena, Tete and Zumbo on the Zambezi. Angoxa lies midway between Quilimane and Mozambique, dates from the 17th century, and is a small and little frequented port. Ibo, founded by the Portuguese at the beginning of the 17th century, is built on an island, likewise called Ibo, in 12° 20′ S., 40° 38′ E. off the northern arm of Montepuesi Bay, and 180 m. north of Mozambique. Ibo Island is one of a group known as the Querimba archipelago. The harbour is sheltered but shallow. The town attained considerable dimensions in the 17th century and was made the headquarters of the Cape Delgado district in the 18th century. The most prominent buildings are two forts, one disused. The other, called San João, is star-shaped and was built, according to an inscription over the gateway, in 1791. The Zambezi towns (Sena, Tete and Zumbo) mark the limits of penetration made by the Portuguese inland. Comparatively important places in the 17th and early part of the 18th centuries, with the decline of Portuguese power they fell into a ruinous condition. The opening up of Rhodesia and British Central Africa in the last quarter of the 19th century gave them renewed life. Sena, some 150 m. by river from Chinde, is built at the foot of a hill on the southern side of the Zambezi, from which it is now distant 2 m., though in the middle of the 16th century the river flowed by it. Sena possesses an 18th-century fort, a modern government house and a church dedicated to St Marcal.

Tete, founded about the same time as Sena, is also on the south bank of the Zambezi. It is about 140 m. by the river above Sena. Since 1894 there has been a regular service of steamers between Tete and Chinde. Of the ancient town little remains save the strongly-built fort and the church. The new town dates from about 1860, when there was a revival of the trade in gold dust and ivory. This trade, however, became practically extinct by 1903; the gold dust traffic through exhaustion of supplies, and the ivory trade through diversion to other routes. A transit trade to British possessions north and south of Tete has been developed, and in 1906 some gold mines in the neighbourhood began crushing ore. Zumbo is picturesquely situated just below the Loangwe confluence and commands large stretches of navigable water on the Loangwe and middle Zambezi. The 17th-century town was deserted in consequence of the hostility of the natives. In 1859 David Livingstone found on its site nothing but the ruins of a few houses. Since then a new settlement has been made, and Zumbo has acquired some transit trade with Rhodesia.

On the line of railway from Beira to Rhodesia the most important town is Massi Kessi (Portuguese Maçequece) in the centre of the Manica goldfields. It lies 2500 ft. above the sea, 194 m. north-west of Beira by rail, and is close to the British frontier. Along the railway from Lourenço Marques to the Transvaal frontier are stations marking the position of small settlements. The last Portuguese station is named Ressano Garcia; the first Transvaal station Komati Poort.

Communications.—The Zambezi is navigable by light draught steamers throughout its course in Portuguese territory with one break at the Kebrassa Rapids—400 m. from its mouth. By means of the Shiré affluent of the Zambezi there is direct steamer and railway connexion with British Central Africa. The navigability of the other rivers of the province has been indicated. From Lourenço Marques railways run to Swaziland and the Transvaal, and from Beira there is a railway to Rhodesia. These lines, built to foster trade with countries beyond Portuguese territory, link the ports named to the British railway systems in South and Central Africa. The route for a railway to connect Beira with Sena was surveyed in 1906–1907, a route from Quilimane to the Zambezi being also surveyed. A light railway (50 m. long) goes inland from Matamba, on Inhambane Bay, serving northern Gazaland. Native caravan routes traverse every part of the country, but these are mere tracks, and in general communication is difficult and slow.

Lourenço Marques, Beira, Mozambique and other ports are in telegraphic communication with Europe via South Africa and Zanzibar, and a cable connects Mozambique with Madagascar. Inland telegraph lines connect the ports with the adjacent British possessions. British, German and Portuguese steamship lines maintain regular communication between Lourenço Marques and other ports and Europe and India. In 1908 some 1700 vessels of 3,400,000 tons visited the ports of the province.

Agriculture and Other Industries.—The country from the Rovuma to the Zambezi is of great fertility, the richest portion being that between Angoxa and Quilimane. In the basin of the Zambezi the soil is fertilized by the inundations of the river. The low coast land of the Gaza country is almost equally fruitful. A great part of the country is suitable for the growth of the sugar-cane, rice, ground-nuts, coffee and tobacco. The two last named plants, as also cotton, vanilla, tea and cloves, are not a success in the Quilimane region, where coco-nuts and ground-nuts are the chief crops. Rubber vines are largely grown in the Mozambique district and the Mozambique Company has large plantations of coffee and sugar. There are numerous sugar factories and rice plantations in the Zambezi district. The natives devote their attention to the raising of oleaginous crops and of maize, cassava, beans, &c. Wheat and other cereals are grown in the valley of the Zambezi. Large herds of cattle are raised. The system prevails in many districts of dividing the land into *prazos* (large agricultural estates) in which the natives cultivate various crops for the benefit of the European leaseholder, who is also tax-collector for his district and can claim the tax either in labour or produce.

Fish are plentiful along the coast, and pearls are obtained off the Bazaruto Isles. Turtles are caught in the Querimba archipelago. Spirits, sugar, fibres and pottery are practically the only commodities manufactured. The hunting of game for ivory and skins affords employment to large numbers of people.

Mineral Resources.—There are immense deposits of coal in the neighbourhood of Tete and near Delagoa Bay, and adjoining the coalfields ironstone of the best quality is plentiful. Malachite and copper are found in the interior, north-west of Mozambique. The whole of the region north of Delagoa Bay to the Zambezi and inland to and beyond the Portuguese frontier is auriferous, and ancient gold workings abound. Many writers have sought to identify this region with the land of Ophir. In Manica several gold mines are worked. In 1906–1907 a rich formation similar to the American "placer" deposits was discovered in the Manica goldfields. Gold mines are also worked at Missale and Chifumbaze, to the north of Tete. The Missale mines are just south of the frontier of British Central Africa. Petroleum is found near Inhambane, as is also a curious elastic-like substance named inhangellite, resembling bitumen, chiefly derived from masses of a gelatinous alga (see *Kew Bulletin*, No. 5, 1907).

Commerce.—The chief exports are rubber, sugar, coal (from the Transvaal), beeswax, coco-nuts, copra and mangrove bark, ivory (including hippopotamus teeth and rhinoceros horns), skins and hides, ground-nuts, and oilseeds, monkey-nuts, mealies, cattle (to Madagascar), cotton, tobacco, gold and other minerals. The principal imports for consumption in the province are cotton goods, hardware and foodstuffs. The "Kaffir" trade is largely in cheap wines of a highly deleterious character, blankets, hats and shoes, brass wire and Venetian beads. Immense quantities of cheap wine are bought by the natives. There is at Lourenço Marques and at Beira a large transit trade to and from the Transvaal and Rhodesia respectively. The average annual value of the external trade of the province for the five years 1901–1905 was about £5,500,000. In 1909 the total trade of the province—including re-exports and goods in transit—exceeded £10,000,000. Fully 50% of this trade was in transit to or from the Transvaal. (See further LOURENÇO MARQUES; BEIRA, &c.) The trade of the province is chiefly with Great Britain, India, Germany and Portugal. The retail trade both at the seaports and in the settlements inland is largely in the hands of British Indians—Banyans, Battias and Parsees.

On the coast there are several native ports of call, between which and Madagascar a large surreptitious trade in slaves was carried on until 1877. With this island, and also with Zanzibar, there is a large general coasting trade.

Administration, Revenue, &c.—Formerly called Mozambique, the province since 1891 bears the official title of State of East Africa. It is under a governor-general, appointed for three years, and for administrative purposes is divided into several districts. There is a government council, instituted in 1907, composed partly of officials and partly of elected representatives of the commercial, industrial and agricultural communities. There is also a provincial council "with the attributions of an administrative and account tribunal." In each district is a subsidiary council. The governor-general resides at Lourenço Marques and has under his immediate direction the Delagoa Bay district. Gazaland (*q.v.*) and the district of Inhambane are also governed directly by Portuguese officials. The greater part of the country between the Sabi River and the Zambezi, including the Manica and Sofala regions, is administered, under a charter granting sovereign rights for 50 years from 1891, by the Companhia de Moçambique, which has its headquarters at Beira. The Quilimane, Chinde and Zambezi regions are administered by representatives of the governor-general, with headquarters at Mozambique. The Zambezi Company has large trading concessions over this district. North of the Quilimane district the coast region and adjacent islands go under the name of Angoxa. The territory between the Lurio and Rovuma rivers and Lake Nyasa is governed by the Companhia do Nyasa under a royal charter. Revenue is obtained largely from customs and a hut tax on natives. The annual revenue of the province is about £1,000,000. A military force, about 4000 strong, is maintained, including 1200 to 1400 Europeans. Education is chiefly in the hands of Roman Catholic missionaries.

History.—It is uncertain at what period the east coast of Africa south of Somaliland was first visited by the maritime races of the east. There is, however, no reason to doubt that by the 10th century A.D. the Arabs had occupied the seaboard as far south as Sofala, and that they carried on an active trade between East Africa and Arabia, the Persian Gulf and India. The Arabs built fine towns and exercised control over the coast peoples, but do not appear to have pushed their conquests far inland. They had extensive commercial dealings, chiefly in gold, ivory and slaves, with the Bantu potentates who ruled over the middle Zambezi valley and the country now known as Mashonaland. Until the close of the 15th century the Arab supremacy was unchallenged. But in 1498 Vasco da Gama entered the mouth of a river which he called Rio dos Bons Sinaes (River of Good Tokens), as there he first found himself in contact with the civilization of the East. This stream was the Quilimane River, taken by the Portuguese a little later to be the main mouth of the Zambezi. From this river da Gama continued his voyage, putting in at Mozambique and Mombasa on his way to India. Hostilities between the Arabs and Portuguese broke out almost immediately; da Gama, indeed, in his first voyage had some trouble with the sultan of Mozambique. In 1502 da Gama paid a visit to Sofala to make inquiries concerning the trade in gold carried on at that place, and the reports as to its wealth which reached Portugal led to the despatch in 1505 of a fleet of six ships under Pedro da Nhaya with instructions to establish Portuguese influence at Sofala. Da Nhaya was allowed to build a fort close to the Arab town. The fort, built in three months, was shortly afterwards attacked by a band of Bantus, who acted on the instigation of the Arabs. The attackers were driven off and the Arabs forced to acknowledge Portuguese rule. In 1509 a captain of Sofala and a factor, or chief trader, were sent out, and from this time the trade of the port fell to the Portuguese. Sofala, however, was not a suitable harbour for the refitting and provisioning of ships on the way to India, and to obtain such a port Mozambique was seized and fortified in 1507. By 1510 the Portuguese were masters of all the former Arab sultanates on the East African coast. The northern half of this region, from Kilwa to Mukdishu, has passed out of their possession; here it is only necessary to outline the history of the country still under the Portuguese Crown.

For forty years Sofala was their only station south of the Zambezi. Thence they traded with the monomotapa or chief of the "Mocaranga" (*i.e.* the Makalanga or Karanga) in whose territory were the mines whence the gold exported from Sofala was obtained. At that time this chief was a powerful potentate exercising authority over a wide area (see MONOMOTAPA). The efforts made by the Portuguese from Sofala to reach him were unsuccessful. It was probably the desire to penetrate to the "land of gold" by an easier route that led, in 1544, to the establishment of a station on the River of Good Tokens, a station from which grew the town of Quilimane. About the same time the Portuguese penetrated inland along the Zambezi, known then as the River of Sena, and founded the trading ports of Sena and Tete, or, perhaps, annexed already existing Arab towns of those names. It was at this period also that Lourenço Marques and a companion, sent out by the captain of Mozambique, entered Delagoa Bay and opened up trade with the natives. This was the most southerly point occupied by the Portuguese. For three centuries however the fine harbour was little used, and its ultimate development was due to the discovery of another "land of gold"—the Witwatersrand—beyond Portuguese territory. In the 16th century the Portuguese turned their energies towards the Zambezi valley. In 1569 their East African dominions, hitherto dependent on the viceroyalty of India, were made a separate government with headquarters at Mozambique.

Francisco Barreto, a former viceroy of India, appointed governor of the newly formed province, was instructed by King Sebastian to conquer the country of the gold mines. The route via the Zambezi, and not that by Sofala, was chosen by Barreto—in opposition to the desires of his council, but in accord with the advice of a Dominican friar named De Monclares. This advice proved fatal owing to the deadly climate of the Zambezi valley. Barreto's expedition, including over 1000 Europeans, started in November 1569, and from Sena marched south, an arrangement having been come to with the monomotapa by which the Portuguese were granted a right of way to the gold mines on condition of their attacking a rebel vassal of that chieftain. Barreto attacked and defeated this rebel, but received no help from the monomotapa, and his force was so greatly weakened by deaths and disease that he was obliged to return to Sena, whence he went to Mozambique to put down disorder among the Portuguese there. He returned to Sena in 1570, only to die a few days after his arrival. His successor Vasco Fernandes Homem, got together another expedition and made his way inland from Sofala to a region where he saw the ground being worked for gold. The comparative poorness of the mine filled him, it is stated, with disappointment, and he returned to Sofala. Thus these, the most important efforts made by the Portuguese to obtain possession of the interior, ended in failure.

Towards the end of the 16th century the Portuguese posts on the Zambezi were attacked by hordes of savages known as Muzimba, and Tete and Sena were destroyed. The captain-general of Mozambique—the province had been again attached to the Indian viceroyalty—was only able to make peace on promise not to interfere with matters which concerned only the native tribes. Thereafter the Portuguese often had to defend even the coast towns from attacks by the Bantus. Still they held one or two posts in the interior besides those on the Zambezi. Of these the chief appears to have been Masapa, on the river Mansovo, *i.e.* Mazoe, in what is now Mashonaland, and about 150 m. by road from Tete. Near Masapa dwelt the monomotapa, an insignificant chieftain, the power of the Makalanga having been broken by revolts of once subject tribes and by dissensions among the Makalanga themselves. In 1629 a treaty was concluded with a claimant to the chieftainship who embraced Christianity. This man, known as the Monomotapa Filippe, declared himself a vassal of Portugal, and with the help of Dominican friars and a number of half-breeds established his authority.

The Portuguese, however, failed to make any effective use of their East African possessions. Among the causes of their non-success in the years immediately following the period of conquest must be reckoned the "Sixty Years' Captivity" (1580–1640), when the Spanish and Portuguese crowns were united, and the neglect of Africa for the richer possessions in India and the Far East. A more important and permanent reason for the non-development of Mozambique province was its unhealthy and enervating climate, which prevented European colonization. The few thousands of Portuguese who went out were chiefly officials, and they and the small body of planters led in general a life of indolence and debauchery. Commerce too was hampered and good government rendered impossible through the system of farming out the administration to officials who were in return granted a monopoly of trade, and even when this system was abandoned trade was confined to Portuguese subjects.[1] But for many years the Jesuits and Dominicans were unceasing in their endeavours to win the native races to Christianity, the friars being the most energetic section of the white community. The first Jesuit missionaries began work in the province in the neighbourhood of Inhambane in 1560; in the same year another Jesuit, Gonçalo da Silveira, made his way to the zimbabwe (chief kraal) of the monomotapa, by whose orders he and his converts were strangled (March 16, 1561). Mission work was soon afterwards begun by the Dominicans and the two orders between them had agents spread over the greater part of the country from Mozambique southward. They gained thousands of at least nominal converts, notably the heir of one of the monomotapas, who was baptized in 1652 and who, renouncing his heirship, became vicar of the convent of Santa Barbara in Goa. But during the 18th century the zeal of the missionaries declined; in 1759 the Jesuits were expelled, and two years later the Dominicans were sent to Goa. At that time they had been, together with a few white, Goanese and half-caste traders, for fully a century practically the only representatives of Portugal in the interior (the towns on the Zambezi excepted). Portugal's influence was confined to helping one tribe in its quarrel with another, in return for favours received. The Portuguese were quite unable to take advantage of the disunion of the natives to establish their own supremacy. The exhaustion and enfeeblement of Portugal had, in short, its natural effect in Africa. In the early years of the 18th century the Arabs wrested from the Portuguese their African possessions north of Cape Delgado; the Dutch, French and British had been for some time menacing their trade and possessions in the south. In 1604, 1607 and again in 1662 the Dutch unsuccessfully attacked Mozambique, which was also attacked by the Arabs in 1670. The merchants of Sofala and Mozambique had, since the middle of the 17th century, found a new source of wealth in the export of slaves to Brazil, a trade due directly to the capture of the ports of Angola by the Dutch (1640–1648), but continued until nearly the middle of the 19th century.[2] Other trade declined steadily, the continual state of warfare among the tribes of the inland plateaus greatly reducing the production of gold.

In 1752 the government of the East African possessions was again separated from that of Goa, and twenty years later Francisco José Maria de Lacerda e Almeida, a man of high attainments, made governor of the province at his own request, endeavoured to reform the administration. Lacerda is chiefly remembered for his journey to the heart of Central Africa, where he died in October 1798. Lacerda had conceived the idea of establishing a chain of Portuguese posts across the continent from Mozambique to Angola, and his statesmanlike prescience was shown by his prediction that the seizure of Cape Town by the British would lead to the extension of British rule over Central Africa, thus isolating the Portuguese provinces on the east and west coasts. After Lacerda's death a state of apathy and decay was again manifest throughout Portuguese East Africa. During the greater part of the 19th century the country south of the Zambezi was devastated by hordes of savages of Zulu origin (see GAZALAND).

The discoveries of David Livingstone in the Zambezi basin in the period 1850–1865 attracted the attention of the British to those regions and led to the establishment of British settlements at the southern end of Lake Nyasa and in the Shiré highlands. These events aroused anxiety in Lisbon, which was increased when the British obtained a prepondering influence in Matabele, Mashona and Manica lands—the lands of the earlier monomotapas. With sudden energy the Portuguese engaged in the "scramble for Africa," and though the result was disappointing to the patriotic feelings of the people they secured from their powerful neighbours—Great Britain and Germany—much better terms than might have been anticipated, having regard to the extremely limited area over which they exercised any sort of jurisdiction. The story of the partition is set forth fully in AFRICA, § 5. Before the "scramble" began, Portugal had been fortunate in securing, in 1875, as the result of arbitration, complete possession of the fine harbour of Delagoa Bay, the southern half of which had been claimed by Great Britain in virtue of acts of annexation in 1823 and later years.

The pressure of political events and the commercial activity of her rivals induced Portugal to take steps to develop the agricultural and mineral resources of the territory secured to her by international agreements. Imitating the policy of Great Britain, charters conveying sovereign powers were granted to the Mozambique Company in 1891, and to the Nyasa Company in 1893. Both these companies, as well as the Zambezi Company (which lacks a charter), undertook to open up the territory committed to their care. In all of them British capital is largely engaged. The total decay of Sofala, the removal of the seat of government from Mozambique to Lourenço Marques, the rise of the last named port and of Beira (both largely dependent on the transit trade with British possessions), all served to mark the changed condition of affairs. An agreement concluded in 1909 between the Transvaal and Portugal gave Delagoa Bay from 50 to 55% of the import trade with the Transvaal, the Portuguese agreeing further to facilitate the recruitment of natives in the province for work on the Rand mines. The development, in the early years of the 20th century, of rubber, rice, sugar and other plantations also gave a new impetus to commerce.

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[1] Until 1853, when commerce was made free to all nations.

[2] Slavery was not abolished until 1878.

see W. B. Worsfold, *Portuguese Nyassaland* (London, 1899); Major J. Stevenson-Hamilton's paper in *Geog. Journ.* (Nov. 1909); V. A. d'Eça, "Esboço geographico-historico dos territorios portuguezes entre o Indico e o Nyassa" in *Bol. soc. geo. Lisboa* (1901). For geology consult A. A. F. de Andraada, "A Geological Reconnaissance of the Portuguese Territories between Lorenzo Marques and the Zambezi River," review in *Geol. Mag.* (1897); R. B. Newton, "Note on the Occurrence of Nummulitic Limestone in South-eastern Africa," *Geol. Mag.* (1896); Paul Choffat, *Crétacique de conducia, com. d. service géol. du Portugal* (1903). Ethnology and philology have received considerable attention. See M. M. Feio, *Indigènes de Moçambique* (Lisbon, 1900); J. V. do Sacramento, "Apontames sobre à lingua macúa" in *Bol. soc. geo. Lisboa*, 22nd and 23rd series (1904 and 1905); H. A. Junod, *Les Chants et les contes des Ba-Ronga de la baie de Delagoa* (Lausanne, 1897). For history see G. M'C. Theal's *Records of South-Eastern Africa* (9 vols., London, 1898–1903), containing texts of original documents and MSS., with translations in English; *History and Ethnography of South Africa to 1795* (3 vols., London, 1907–1910); and *The Portuguese in South Africa* (London, 1896); Père Courtois, *Notes chronologiques sur les anciennes missions catholiques au Zambezi* (Lisbon, 1889); João dos Santos, *Ethiopia oriental . . .* (Lisbon, 1609), an account of the travels of one of the early missionaries in Mozambique. A reprint, edited by M. D'Azevendo, was published at Lisbon in 1891. Valuable records of the state of the country in the last half of the 19th century are contained in the reports to the foreign office of the British consuls at Mozambique, notably those of Lieut. H. E. O'Neill, R.N., and Lyons McLeod. See also O'Neill's *The Mozambique and Nyassa Slave Trade* (London, 1885); McLeod's *Travels in Eastern Africa, with the Narrative of a Residence in Mozambique* (London, 1860); and *Travels . . .* [in] *Eastern and Central Africa* (London, 1879) from the journals of Captain J. F. Elton (consul at Mozambique), compiled by H. B. Cotterill. See further D. and C. Livingstone, *Narrative of an Expedition to the Zambesi and its Tributaries*, &c. (London, 1865), and the works cited under DELAGOA BAY and ZIMBABWE. Reference may also be made to the bibliography under BRITISH CENTRAL AFRICA. (F. R. C.)

PORTUGUESE GUINEA, a Portuguese colony in West Africa, extending along the Guinea coast from Cape Roxo in 12° 19′ N. to the Cogon estuary in 19° 50′ N. Inland it reaches to 13° 40′ W., being enclosed landward by French territory, the Casamance district of Senegal to the N., and French Guinea E. and S. (For map, see FRENCH WEST AFRICA.) The colony has an area of about 14,000 sq. m., and a population variously estimated at from 200,000 to 800,000. It consists largely of a low-lying deltaic region, together with an adjacent archipelago of small islands called the Bissagos.

The coast-line is deeply indented by estuaries into which flow numerous rivers whose sources are in the elevated region on the eastern border of the colony. The largest estuary, the Geba, receives the river of the same name, the Mancoa, a northern affluent, and the Rio Grande or Comba; the last a large stream rising in the highlands of Futa Jallon. North of the Geba estuary is the Rio Cacheo, while in the south is the Rio Cassini, in reality an arm of the sea. These rivers and estuaries are connected with one another and with many smaller rivers by a network of lagoons; and the Bissagos Islands, which lie off the Geba estuary, formed at one time part of the mainland. The Bissagos, protected seaward by dangerous breakers, consist of over thirty islands, besides many small reefs. The largest island, Orango, is the most southerly of the group and some 30 m. from the coast. Bulama and Bissao, islands of more importance, lie close to the mainland. The larger rivers can be ascended by vessels of considerable size for distances of 40 to 150 m., but navigation is rendered difficult by strong currents and the shifting nature of the channels as well as by hidden rocks and the great difference between high and low water. The climate is unhealthy, with a mean temperature of about 78° F. The rainfall is heavy, thunderstorms being frequent in the wet season, which lasts from May to October.

Flora and Fauna.—Large forest regions extend behind the mangrove-lined lagoons. Their characteristic trees are the oil and date palms, the baobab, the shea-butter tree, ebony, mahogany and calabash trees, and the acacia. Rubber vines are fairly abundant. Besides the forests, densest along the river valleys, there are extensive tracts of grassland and park-like country. Fruit trees include the papaw, with fruit the size of ostrich eggs, the guava, custard apple, mango, the banana, the orange and the citron. The tobacco, indigo and cotton plants grow wild, and the coffee plant is also found. Ground-nuts and kola nuts are cultivated, and rice and millet are the chief crops grown.

The elephant is found in the district between the Geba and Grande rivers, and hippopotamus are numerous. Other animals include the panther, wild boar, various antelopes, baboons, chimpanzees and large snakes. Crocodiles and sharks abound in the rivers. Birds include the pelican, heron, marabout, the trumpet bird and innumerable yellow parrots. Partridges and woodcock are also found. The hills of the termites are a notable feature in many parts of the country.

Inhabitants.—The people of the interior are mostly Mandingo (*q.v.*) and Fula (*q.v.*). The coast regions and the islands are inhabited by negro tribes which live side by side without mixing, each preserving their own customs, dress, language and type. They exhibit great attachment to the soil and are profoundly religious, being noted specially for their respect for family life and ancestral worship. Neither Christianity nor Mahommedanism has made much headway among them. Going from south to north the chief tribes are the Nalu, who dwell by the Cassini and are keen traders and lovers of peace; the Biafare or Biaffade, who occupy the region between the sea and the Rio Grande and jealously guard their country from strangers; the Bulam (Mankaie), living in the island of Bulama, and much given to adorning their bodies by long cuts formed into patterns; the Balanta, a piratical folk inhabiting the banks of the Geba; the Papel of the island of Bissao, formerly cannibals, an industrious agricultural tribe which furnishes the majority of the educated Africans employed by the Portuguese; the Manjak or Mandiago, and a branch of the Felup peoples, these last living near the Rio Cacheo in savage isolation and much given to waylaying and pillaging strangers. The Manjak inhabit the country between the Mancoa and the Cacheo, and the neighbouring islands. They are a hospitable and clever people, very adaptable, do not object to leaving their tribal lands, and are said to keep their word. Excellent seamen, good artisans and sharp traders, they maintain a sort of feudal system. Their houses are surrounded by walls, which are pierced with loopholes and provided with towers at the angles. The rooms are built round a courtyard. They examine the entrails of fowl to foretell good or evil events. The burial customs are elaborate. The body is smoked and, the skin having been removed, it is sewn up in a number of *pagns* (native cloths) and placed in a coffin fastened by gilded nails. Bright tissues are wrapped round the coffin, on which are hung little bells of copper and small brass mirrors. The seaward islands of the Bissagos are inhabited by an independent and warlike tribe of fishers and pirates called Bidiogos. Their women wear a short skirt made of palm leaves.

The natives who adopt Portuguese names and who form the bulk of the townsmen in the European settlements are called Gurmettes. They furnish the levies with which the authorities occasionally make war on the native tribes. The chief centres of trade are Bissao, on the island of the same name, which is surrounded by old fortifications; Cacheo, on the Rio Cacheo, also fortified; and Bulama (Boulam) on Bulama Island, the seat of the government. The European population consists of a few Portuguese officials, soldiers, traders and convicts, and a few traders of other nationalities.

History.—Bulama Island was discovered by Portuguese navigators in 1446, but was not formally claimed by Portugal until 1752, about which time she founded a station at Bissao, while in 1669 a post had been established on the Rio Grande. In 1870 a claim made by Great Britain to Bulama and a part of the mainland was disallowed by the arbitrator appointed (President Grant of the U.S.A.). The inland limits of the Portuguese sphere were fixed by a convention concluded with France in 1886, and the frontier was delimited during 1900–1903. Though so long settled in the district—the only part of the Guinea coast west of the Gabun left in her possession—Portugal has done little towards its development. With a fertile and well-watered soil, exceedingly rich in natural products, there is not much commerce, and such trade as exists, chiefly in non-Portuguese hands, is hampered by excessive customs duties and vexatious regulations. In 1905 the external trade of the colony was not more than £160,000 and was less than it had been twenty years previously. Ground-nuts, rubber, wax and ivory are the principal exports. Revenue and expenditure are about £50,000 a year. Portuguese authority does not in fact extend much beyond the few stations maintained, nor has the local government won the confidence of the natives. In 1908 Bissao and some European settlements on the mainland were besieged by the Papel and other tribes and troops had to be sent from Portugal before order could be restored. If however agriculture and commerce suffer, the ethnologist and zoologist find in this easily accessible little enclave a rich field for investigation, the almost nominal sovereignty of Portugal having left the country, practically uninfluenced by European culture, in much the same condition that it was in the 16th and 17th centuries.

See J. E. Giraud, "La Guinée portugaise" in *Bull. soc. géog. Marseille* (1905), vol. xxix.; A. L. de Fonseca, "Guiné" in *Bull. soc. geog. Lisboa* (1905), vol. xxiii.; R. Wagner, "Portugiesisch

Guinea: Land und Leute," in *Deutsche Rundschau.* (1905), vol. xxvii.; E. de Vasconcelles, *As Colonias portuguesas* (Lisbon, 1896–1897); and J. Machat, *Les Rivières du sud* (Paris, 1906), in which are cited many papers dealing with Portuguese Guinea.

PORTUNUS, or PORTUMNUS, in Roman mythology, originally the god of gates and doors (Lat. *porta*), and as such identified with Janus and represented with a key in his hand. Gradually he came to be recognized as a separate deity, who protected the harbours (*portus*) and ensured a safe return to seafarers. (Cicero, *Nat. deor.* ii. 26; Virgil, *Aen.* v. 241). With the introduction of the Greek gods, he became merged in Palaemon-Melicertes. He had a special priest (flamen portunalis) and temples on the Tiber near the Aemilian bridge and near Ostia, where a festival was celebrated in his honour on the 17th of August. Mommsen unhesitatingly identifies Portunus with the river-god Tiberinus, from the fact that the festival is also called Tiberinalia in the *fasti* of Philocalus; Marquardt regards him rather as the tutelary deity of warehouses.

See J. Marquardt, *Römische Staatsverwaltung* (1885), iii. 327, note 10.

PORTUS, an ancient harbour of Latium, Italy, on the right bank of the Tiber, at its mouth. For its origin see OSTIA. Claudius constructed the first harbour here, 2½ m. north of Ostia, enclosing an area of 170 acres, with two long curving moles projecting into the sea, and an artificial island, bearing a lighthouse, in the centre of the space between them; the harbour thus opened directly to the sea on the north-west and communicated with the Tiber by a channel on the south-east. The object was to obtain protection from the prevalent south-west wind, to which the river mouth was exposed. Though Claudius, in the inscription which he caused to be erected in A.D. 46, boasted that he had freed the city of Rome from the danger of inundation, his work was only partially successful. Nero gave the harbour the name of Portus Augusti. It was probably Claudius who constructed hither the direct road from Rome, the Via Portuensis (15 m.) which ran over the hills as far as the modern Ponte Galera, and then straight across the plain. An older road, the Via Campana, ran along the foot of the hills, following the right bank of the Tiber, and passing the grove of the Arval Brothers at the sixth mile, to the *Campus salinarum romanarum*, the saltmarsh on the right bank—from which indeed it derived its name (see *Notizie degli Scavi*, 1888, p. 228).

The site can still be fairly clearly traced in the low ground to the east of Fiumicino, and the lighthouse is represented in bas-reliefs. The harbour is generally supposed to have been protected by two moles with a breakwater in front, on which stood the lighthouse, with an entrance on each side of it. Trial soundings made in 1907 showed that the course of the right-hand mole is represented by a low sandhill, while the central breakwater was only some 190 yds. long, and probably divided from each of the two moles by a channel some 125 yds. wide. The existence of two entrances is, indeed, in accordance with the evidence of coins and literary tradition, though the position of that on the left is not certain, and it may have been closed in later times. The whole course of the left-hand mole has not yet been traced, but it seems to have protected not only the south-west but a considerable portion of the north-west side of the harbour. In A.D. 103 Trajan constructed another harbour farther inland—a hexagonal basin enclosing an area of 97 acres, and communicating by canals with the harbour of Claudius, with the Tiber direct, and with the sea, the last now forming the navigable arm of the Tiber (reopened for traffic by Gregory XIII. and again by Paul V.), and bearing the name Fossa trajana, though its origin is undoubtedly due to Claudius. The basin itself is still preserved, and is now a reedy lagoon. It was surrounded by extensive warehouses, remains of which may still be seen: the fineness of the brickwork of which they are built is remarkable. Farther to the east is a circular building in brick with niches; it is called the temple of Portumnus. To the east again is the so-called Arco di Nostra Donna, a gateway (possibly originally built by Trajan) in the fortifications which surround the port and are attributed to the time of Constantine. Many other remains of buildings exist; they were more easily traceable in the 16th century when Pirro Ligorio and Antonio Labacco made plans of the harbour. Considerable excavations were carried on in 1868, but unfortunately with the idea of recovering works of art and antiquities; and the plan and description given by R. Lanciani (*Annali del instituto*, 1868, 144 sqq.) were made under unfavourable circumstances. By means of these works Portus captured the main share of the harbour traffic of Rome, and though the importance of Ostia did not at once decrease we find Portus already an episcopal see in Constantine's time not very long (if at all) after Ostia, and as the only harbour in the time of the Gothic wars. Its abandonment dates from the partial silting up of the right arm of the Tiber in the middle ages, which restored to Ostia what little traffic was left. To the west of the harbour is the cathedral of S. Rufina (10th century, but modernized except for the campanile) and the episcopal palace, fortified in the middle ages, and containing a number of ancient inscriptions from the site. On the island (Isola Sacra) just opposite is the church of S. Ippolito, built on the site of a Roman building, with a picturesque medieval campanile (13th century ?); 2 m. to the west is the modern village of Fiumicino at the mouth of the right arm of the Tiber, which is 21 m. west-south-west by rail from Rome. It is a *frazione*, or portion of the commune of Rome. Three miles to the north is the pumping station by which the lowland (formerly called Stagno di Maccarese, now reclaimed and traversed by many drainage canals) between here and Maccarese is kept drained (Bonifica di Maccarese) (see TIBER).

See H. Dessau in *Corp. inscr. latin*, xiv. 1 sqq. (Berlin, 1887); J. Carcopino in *Notizie degli Scavi* (1907), p. 734. (T. As.)

PORT-VENDRES, a seaport of south-western France, in the department of Pyrénées-Orientales, in an inlet of the Mediterranean Sea, 19½ m. S.S.E. of Perpignan by rail. Pop. (1906), 2525. Port-Vendres, the ancient *Portus Veneris*, is fourth in importance of the French Mediterranean ports, and forms a good harbour of refuge. Its trade, which is with Spain, Greece and Algeria, is in cork, carobs, grain and wine, &c.

PORUS (4th century B.C.), an Indian prince, ruler of the country between the rivers Hydaspes and Acesines at the time of the invasion of Alexander the Great. In the battle on the banks of the Hydaspes he offered a desperate resistance, and Alexander, struck by his independent spirit, allowed him to retain his kingdom, which he increased by the addition of territory. From this time Porus was a loyal supporter of Alexander. He still held the position of a Macedonian satrap when assassinated some time between 321 and 315 B.C.

See Arrian v. 18, 19; Plutarch, *Alexander*, 60; Quintus Curtius viii. 14.

PORZIO, CAMILLO (1526–1580?), Italian historian, belonged to a wealthy and noble Neapolitan family, and was the son of the philosopher, Simone Porzio. He studied law, first at Bologna and later at Pisa, and after graduating *in utroque jure*, practised as a lawyer in Naples. He died in 1580. His chief literary work is *La Congiura dei baroni*, a history of the unsuccessful conspiracy of the Neapolitan barons against King Ferdinand I. of Naples in 1485; it is based on the authentic records of the state trials, but is prejudiced in favour of the royal power. It was first published by Manutius in Rome in 1565. Of Porzio's other works, the *Storia d'Italia* (from 1547 to 1552), of which only the first two books have survived, is the most important. The best edition of these two works is that edited by C. Monzani (Florence, 1855).

PORZIO, SIMONE (1497–1554), Italian philosopher, was born and died at Naples. Like his greater contemporary, Pomponazzi, he was a lecturer on medicine at Pisa (1546–1552), and in later life gave up purely scientific study for speculation on the nature of man. His philosophic theory was identical with that of Pomponazzi, whose *De immortalitate animi* he defended and amplified in a treatise *De mente humana*. There is told of him a story which illustrates the temper of the early humanistic revival in Italy. When he was beginning his first lecture at Pisa he opened the meteorological treatises of Aristotle. The audience, composed of students and townspeople, interrupted him with the cry Quid de anima? (We would hear about the soul), and Porzio was constrained to change the subject of his lecture. He professed the most open materialism, denied immortality in all forms and taught that the soul of man is homogeneous with the soul of animals and plants, material in origin and incapable of separate existence.

POSEIDON, in Greek mythology, god of the sea and of water generally, son of Cronus and Rhea, and brother of Zeus and Pluto. The connexion of his name with πόσις, πόντος, ποταμός, is generally accepted. When the three brothers deposed their father Cronus the kingdom of the sea fell by lot to Poseidon. His home was in a golden palace in the depths of the sea near Aegae in Achaea. In his hand he bore a trident, wherewith he lashed the sea into fury, split the rocks, and caused horses and fountains to spring from them. But, while he caused storms and shipwrecks, he could also send favouring winds; hence he was known as *Sotēr*, "the preserver." Another of his titles was *Gaeeochos*, "the supporter of earth," the sea being supposed to support the earth and keep it firmly in its place. He was the god of navigation and his temples stood especially on headlands and isthmuses. Every occupation connected with the sea was under his protection, and seafaring people, especially the Ionians, regarded themselves as his descendants. As god of the sea he disputed with other deities for the possession of the land. Earthquakes were thought to be produced by Poseidon shaking the earth—hence his epithet of *Enosichthon*, "Earth-shaker"—and hence he was worshipped even in inland places which had suffered from earthquakes. The seismic wave was also his work; the destruction of Helice in Achaea by such a wave (373 B.C.) was attributed to his wrath (Strabo viii. 384). The island of Delos was thought to have been raised by him, and about 198, when a new island appeared between Thera and Therasia, the Rhodians founded a temple of Poseidon on it (Strabo i. 57). Thessaly was said to have been a lake until he opened a way for the waters through the Vale of Tempe (Herodotus vii. 129). Poseidon was also the god of springs, which he produced by striking the rock with his trident, as he did on the acropolis of Athens when disputing with Athena for the sovereignty of Athens (Herodotus viii. 55; Apollodorus iii. 14). As such he was called *Nymphagetes*, the leader of the nymphs of springs and fountains, a god of fresh water, probably his original character, and in this connexion was φυτάλμιος (*phytalmius*), a god of vegetation, frequently associated with Demeter. In regard to the contest with Athena, it is probable that Poseidon is really Erechtheus, a local deity ousted by Athena and transformed into an agricultural hero. Dr Farnell, however, holds that Erechtheus and Poseidon were originally independent figures, and that both Erechtheus and Athena were prior to Poseidon, As he gave, so he could withhold, springs of water; thus the waterless neighbourhood of Argos was supposed to be the result of his anger. Black bulls, symbolical of the stormy sea, were sacrificed to him, and often thrown alive into rivers; in Ionia and Thessaly bull-fights took place in his honour; at a festival of his at Ephesus the cupbearers were called "bulls," and the god himself was surnamed "Bull Poseidon." The horse was especially associated with his worship; he was said to have produced the first horse by striking the ground in Thessaly with his trident (Virgil, *Georgics*, i. 12). At the fountain of Dīnē in Argolis horses bitted and bridled were sacrificed to him by being drowned (Pausanias viii. 7, 2), and similarly Sextus Pompeius sought to propitiate him by throwing horses into the sea (Dio Cassius xlviii. 48). He bore the surname of "Horse Neptune" (Ποσειδῶν ἵππιος), and was regarded as the tamer as well as the creator of the steed. In the deme of Colonus he was worshipped with Athena, the reputed inventor of the bridle. Various explanations of the title ἵππιος have been given: (1) that the horse represented the corn-spirit; (2) the resemblance of the crested waves to horses; (3) the impression of horses' hoofs near the god's sacred springs, and the shaking of the earth by them when galloping (see Farnell, *Cults of the Greek States*, iv. 20). Poseidon plays a considerable part in Greek legend. In the Trojan War he takes the side of the Greeks, because he had been cheated of his reward by Laomedon, king of Troy, for whom he had built the walls of the city. The binding of his son Polyphemus by Odysseus brings upon the hero the wrath of Poseidon, from which he is only protected by the united influence of the rest of the gods. He is famous for his numerous amours, especially with the nymphs of springs and fountains; his offspring were mostly wild and cruel, like the sea—the Laestrygones, Polyphemus, Antaeus, Procrustes and the like. He was worshipped as a national god by the Ionians, who took his worship over with them from Peloponnesus to Asia Minor. His chief sanctuary was at Mycale, where the Panionia, the national festival of the Ionians, was held. Other seats of his worship were in Thessaly, Boeotia and Peloponnesus. At Taenarum in Laconia he had a famous cave-like temple, with an asylum, and on the island of Tenos he was worshipped as the physician, probably in reference to the health-giving properties of the sea air. By far the most famous of his festivals was that celebrated every alternate year on the isthmus of Corinth, at which the "Isthmian games" were held. Here a colossal statue of him was set up in bronze by the Greeks after their victory over the Persians. The horse, the dolphin (the symbol of the calm sea) and the pine-tree, with wreaths of which the Isthmian victors were crowned, were sacred to him. Horses and black bulls, boars and rams were offered to him, sometimes human beings. His attributes are the trident and the dolphin (sometimes the tunny fish.)

As represented in art Poseidon resembles Zeus, but possesses less of his majestic calm, his muscles are more emphasized, and his hair is thicker and somewhat dishevelled. He is generally naked; his right leg rests on a rock or the prow of a ship; he carries a trident in his hand, and is gazing in front of him, apparently out to sea; sometimes he is standing on the water, swinging his trident, or riding in his chariot over the waves, accompanied by his wife Amphitrite, the Nereids and other inhabitants of the sea. It is in keeping with his restless character that he is rarely found sitting. He sometimes wears a long robe, sometimes a light scarf. Scopas, in a famous group, represented him surrounded by the denizens of the sea, escorting Achilles to the islands of the blest. In modern Greece St Nicholas has taken the place of Poseidon as patron of sailors. But the Zacynthians have a special seagod, half man, half fish, who dwells under the sea, rides on dolphins or in a car drawn by dolphins, and wields a trident. By the Romans Poseidon was identified with Neptune (*q.v.*).

See E. Gerhard, *Über Ursprung, Wesen und Geltung des Poseidon* (1851), with references to authorities in conveniently arranged notes; Preller-Robert, *Griechische Mythologie* (1894); O. Gruppe, *Griechische Mythologie* (1906), vol. ii.; and especially L. R. Farnell, *Cults of the Greek States* (1907), vol. iv., where special attention is drawn to the ethnological aspect of the cult of Poseidon.

POSEN, an eastern province of the kingdom of Prussia, in the German Empire, bounded N. by the Prussian province of West Prussia, E. by Russian Poland and S. and W. respectively by the Prussian provinces of Silesia and Brandenburg. Its area is 11,186 sq. m. and the population shows a density of 177·5 inhabitants to the square mile. Posen belongs to the north German plain, and consists of a low plateau intersected by the beds of the Netze, the Warthe and the Obra. These three rivers drain into the Oder, but part of the province falls within the basin of the Vistula, which forms the frontier for a short distance on the north-east. By means of the Bromberger canal the Netze is joined with the Brake and then through this river with the Vistula. The surface is dotted with small lakes and ponds, and there are many broad fens and marshes. The soil is light and sandy, but much of the land reclaimed in the boggy districts is very fertile. Upwards of 61% of the area is under tillage, 13% is occupied by pasture and meadows and 20% by forests, mostly fir. The principal crops are rye, the chief cereal grown, wheat, oats, barley, potatoes, beets and hops. The vine is cultivated to some extent in the south-west corner, and tobacco is also grown. The marshy tracts often afford excellent pasture and support large numbers of cattle, sheep and goats. The mineral resources of the province are practically restricted to lignite and salt. Besides brewing and distilling, the chief products are machinery, sugar, cloth, tobacco and bricks. Trade in timber and agricultural produce is facilitated by the network of railways, navigable rivers and canals, but both industry and trade are somewhat cramped by the duties imposed at the Russian frontier. The population of the province in 1905 was 1,986,637, including 1,347,958 Roman Catholics, 605,312 Protestants and 30,433 Jews. The Roman Catholics are mainly Poles, of whom there are upwards of 1,000,000 in Posen, while the great bulk of the 900,000 Germans are Protestants. About 57% of the population was returned in 1905 as "rural," in spite of the large number of so-called "towns," only five of which, however, have more than 20,000 inhabitants—Posen, Bromberg, Hohensalza, Gnesen and Schneidemühl. The province of Posen was long the worst-educated part of the German dominions, but of recent years this blemish has been removed. Thus while in 1882–1883 the ratio of illiterate recruits amounted to 9·75%, in 1901 less than one quarter per cent of the military drafts were without schooling. The province returns 15 members to the Reichstag, 29 to the Prussian Lower House of the Prussian Diet, and is represented in the Upper House by 19 members. It is divided into two districts, those of Bromberg and Posen.

History.—The history of Posen, comprehending some part of the old kingdom of Poland, including its most ancient capital, Gnesen, falls within the scope of the article POLAND. Its political connexion with Prussia began in 1772, when the districts to the north of the Netze fell to the share of that power in the first partition of Poland. The rest followed in 1793, and was united with the Netze district to form the province of South Prussia. In 1807, after the peace of Tilsit, Posen was incorporated with the grand duchy of Warsaw, but in 1815 it reverted to Prussia under the style of the grand duchy of Posen. In 1848 the Polish inhabitants of the province revolted and had to be put down by force, and, in spite of the efforts of the Prussian government, they remain in language and culture separated from their German compatriots.

The tide of German immigration into Posen began at an early period and flowed strongly in the 13th and following centuries. The industrious German settlers were welcomed by the Polish nobles and were the founders of most of the towns, in which they lived after their own customs and were governed by their own laws. They established manufactures, introduced the cultivation of hops, reclaimed the waste soil, and did much to improve agriculture. In the 16th century Protestantism was widely diffused by their means. A strong reaction set in in the following century, and persecution of the Protestants went hand in hand with the ravages of war in hastening the political, intellectual and agricultural decline of the district. By the 18th century the burghers had sunk to the level of "städtische Bauern," or peasants with municipal privileges, and poverty and misery were widely spread.

In the latter part of the 19th century, however, this state of things began to be greatly modified owing to the strong Polish national movement which threatened to drive back the boundaries of Germanism in the eastern provinces of Prussia, as they had already been driven back in Bohemia. Hitherto the most important class in Posen had been the Polish nobles, of whom many were very poor; but the economic development of the country and the break-up of the large estates into peasant holdings, which created a comparatively wealthy Polish middle class, threatened German ascendancy more seriously than had the traditional nationalism of the nobles. To combat this the Prussian government entered on a policy of the compulsory Germanization of the Polish population. In 1872 an administrative ordinance made German the medium of instruction in the schools "wherever possible," and the police commissaries who attended public meetings were instructed to close any meeting at which speeches were delivered in Polish. In April 1888 the Prussian parliament passed a law establishing a commission for the purpose of buying the land of the Poles in Posen and West Prussia, and letting it out to German colonists. The sum of 100,000,000 marks (£5,000,000) was voted for this work, to which in 1898 a like sum was added. In fifteen years an area of nearly 600 sq. m. of land was bought from the Poles, over one-half in Posen, and on this over 4000 families were settled. In spite of this policy, however, the Polish element continued to gain, this being partly due to immigration over the eastern border, partly to the repressive policy of the Prussian government, which converted what had been an aristocratic opposition into one that is popular and radical. In 1902 much scandal was caused by the revelation made in the Prussian parliament of the methods used in the attempt to Germanize the Poles; and Count Bülow had to confess that "corporal punishment was out of place in religious instruction"; Polish children having been beaten for refusing to say the Lord's Prayer in German (see *Ann. Reg.*, 1901, p. 278). In his speech of the 13th of January 1903, in which he made the above admission, Count Bülow also had to admit the failure of the Prussian policy. Fresh legislation was passed in May, devoting another 250,000,000 marks (£12,500,000) to the policy of German colonization, and forbidding the German colonists to sell their land to Poles.[1] The laws forbidding the use of the Polish language in the schools were retained, in spite of an agitation in Germany itself for their repeal. Yet, three years later, Baron von Rheinbaben, the Prussian minister of finance, complained that in fifteen years the German population of East Prussia had diminished by 630,000, while Polish immigrants had in five years numbered 300,000; at the same time he confessed that the Poles were vastly increasing their economic resources at the expense of the German element. As a result of this report a further sum of £100,000 was voted for "provincial colonization" and to prevent German emigration.

In 1906 the Prussian government was made somewhat ridiculous by the strike of some 100,000 Polish school children, who objected to being whipped for refusing to answer questions in German. The petition of the archbishop of Posen that the children should be allowed to receive religious instruction in Polish having been rejected by the Prussian minister of education, he issued on the 17th of October a pastoral allowing parents to confine religious instruction to home or priestly teaching. As a result parents were fined or imprisoned for withdrawing their children from religious instruction. The repressive efforts of the government, however, culminated in the bill, introduced in the session of 1907 by Prince Bülow, providing for the compulsory expropriation of Polish landowners in favour of Germans. This bill, which applied to "the districts in which the safety of the endangered German element could only be ensured by additional allotments to German settlers"—*i.e.* Posen and West Prussia—was passed, in spite of the strenuous opposition of some of the most conspicuous nobles in Prussia, in the session of 1908. At the same time under the Public Meetings Bill, introduced in 1907 and now passed, no language save German was to be used at any public meetings other than international congresses, &c.—save during actual parliamentary elections (*Ann. Reg.*, 1908, p. 290). How opposed to the general sentiment of Germany the Prussian policy in Posen was, was shown in February 1909, when it was condemned, though without effect, by a resolution of the German imperial parliament. In January 1910 the Prussian policy was again arraigned in the German parliament in connexion with the "Kattowitz incident," Herr von Delbrück justifying the removal of a number of minor officials, for voting for Polish candidates at a municipal election, on the ground that the officials of the empire deserted the ground on which the constitution of the empire rested if they failed to support Prussia in her struggle (*The Times*, January 13, 1910, 5 d.). Herr von Bethmann Hollweg expressed himself later in the Prussian parliament to the same effect (ibid. January 20 and 22).

For the history of Posen see Wuttke, *Städtebuch des Landes Posen* (Leipzig, 1864); C. Meyer, *Geschichte des Landes Posen* (Posen, 1887), and *Geschichte der Provinz Posen* (Gotha, 1891); Knoop, *Sagen und Erzählungen aus der Provinz Posen* (Posen, 1894); E. von Bergmann, *Zur Geschichte der Entwickelung deutscher, polnischer und jüdischer Bevölkerung in der Provinz Posen seit 1824* (Tübingen, 1883); E. Schmidt, *Geschichte des Deutschtums im Lande Posen unter polnischer Herrschaft* (Bromberg, 1904); Stumpfe, *Polenfrage und Ansiedelungskommission. Darstellung der staatlichen Kolonisation in Posen* (Berlin, 1902); Wegener, *Der wirtschaftliche Kampf der Deutschen mit den Polen um die Provinz Posen* (Posen, 1903); the *Handbuch für die Provinz Posen, Nachweisung der Behörden, Anstalten, Institute und Vereine* (Posen, 1905); and the publications of the *Historische Gesellschaft für die Provinz Posen* (Posen, 1882 seq.). See further the official work *Zwanzig Jahre deutscher Kulturarbeit 1886–1906* (Berlin, 1907). A good account of the Prussian policy in Posen, from an outside point of view, will be found in the *Annual Register*, passim.

POSEN (Polish *Poznan*), a city, archiepiscopal see and fortress of Germany, capital of the province of Posen, situated in a wide and sandy plain at the confluence of the Cybina and the Warthe, 150 m. E. from Berlin and 103 m. from Breslau. Pop. (1885), 68,315; (1895), 73,239; (1905), 136,808, of whom nearly one-half are Germans and about one-tenth Jews. Posen lies at the centre of a network of railways connecting it with Berlin, Breslau, Thorn, Kreuzburg, and Schneidemühl. The inner line of fortifications was removed in 1902 and the city has been completely modernized. The principal part of Posen, on the left bank of the Warthe, comprises the old town (Alstadt) and the modern quarter created by the Prussians after 1793. On the right bank lie Wallischei (a district inhabited by Poles) and some other suburbs. Posen has fifteen Roman Catholic and three Evangelical churches and several synagogues. The cathedral contains many interesting objects of art, but, with the exception of the Gothic Marienkirche of the 15th century, none of the churches is notable. The old town-hall is a quaint Slavonic adaptation of Romanesque forms. The royal castle, begun in 1905 and completed in 1910 at a cost of £250,000, is a pretentious building in what is officially called Romanesque style. It was intended as an effort to conciliate the Poles, and was opened by the emperor William II., with imposing ceremonies, on the 20th of August 1910. Posen possesses an "Emperor William" library with 200,000 volumes, and the Raczynski library with 50,000. Other principal buildings are the two theatres, the Emperor Frederick museum, founded in 1894, the Polish museum and the various public offices. Industries include the manufacture of agricultural machinery, spirits, furniture and sugar, also milling and brewing. There is an active trade, both by rail and river, in corn, cattle, wood, wool and potatoes. Posen is the headquarters of the V. army corps, and has a garrison of 6000 men.

Posen, one of the oldest towns in Poland and the residence of some of the early Polish princes, including Boleslaus I., became the seat of a Christian bishopric about the middle of the 10th century. The original settlement was on the right bank of the Warthe, but the new town, established on the opposite bank by German settlers about 1250, soon became the more important part of the double city. Posen became a great dépôt for the trade between Germany and western Europe on the one hand and Poland and Russia on the other. Many foreign merchants made the city their residence, and these included a colony of Scots, who exported produce to Edinburgh. The city attained the climax of its prosperity in the 16th century, when its population, according to one estimate, reached 80,000. The intolerance shown to the Protestants, the troubles of the Thirty Years' War, the plague and other causes, soon conspired to change this state of affairs, and in the 18th century the population sank to 12,000. New life was infused into the city after its annexation by Prussia at the second partition of Poland in 1793, and since this date its growth has been rapid.

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[1] *Annual Register* (1902), p. 280 seq.

See Lukaszewicz, *Historisch-statistisches Bild der Stadt Posen 968–1793* (Ger. trans., Posen, 1881); Ohlenschläger, *Kurzgefasste Geschichte und Beschreibung der Stadt Posen* (Posen, 1886); Warschauer, *Stadtbuch von Posen* (Posen, 1892); and *Führer durch Posen* (Posen, 1895).

POSIDIPPUS (3rd cent. B.C.), Greek dramatist, of Cassandrea in Macedonia, the last and one of the most distinguished of the writers of the new comedy. He began to write for the stage in 289 B.C., and, according to Suïdas, wrote 40 plays, of which 17 titles and some fragments have been preserved. He appears to have gone somewhat out of the beaten track in his choice of subjects, and it is evident that cooks held an important position in his list of characters. His comedies were frequently imitated by the Romans (Aulus Gellius ii. 23), and it is considered very probable that the *Menaechmi* (a comedy of errors) of Plautus is an adaptation either from the Ὅμοιοι, or from some unknown comedy of Posidippus, called Δίδυμοι, or perhaps Μέναιχμοι. His statue in the Vatican is considered a masterpiece of ancient art.

Fragments in A. Meineke, *Poetarum comicorum graecorum fragmenta* (1855).

Posidippus is also the name of a writer of epigrams (*c.* 270 B.C.), of which about 30 are preserved in the Greek Anthology.

See W. Christ, *Griechische Litteraturgeschichte* (1898).

POSIDONIUS (*c.* 130–50 B.C.), nicknamed "the Athlete," Stoic philosopher, the most learned man of his time (so Strabo τῶν καθ' ἡμᾶς φιλοσόφων πολυμαθέστατος, Galen ἐπιστημονικώτατος) and perhaps of all the school. A native of Apamea in Syria and a pupil of Panaetius, he spent after his teacher's death many years in travel and scientific researches in Spain (particularly at Gades), Africa, Italy, Gaul, Liguria, Sicily and on the eastern shores of the Adriatic. When he settled as a teacher at Rhodes (hence his surname "the Rhodian") his fame attracted numerous scholars; next to Panaetius he did most, by writings and personal intercourse, to spread Stoicism in the Roman world, and he became well known to many leading men, such as Marius, Rutilius Rufus, Pompey and Cicero. The last-named studied under him (78–77 B.C.), and speaks as his admirer and friend. He visited Rome, *e.g.* on an embassy in 86 B.C., but probably did not settle there as a teacher.

His works, now lost, were written in an attractive style and proved a mine of information to later writers. The titles and subjects of more than twenty of them are known. In common with other Stoics of the middle period, he displayed eclectic tendencies, following the older Stoics, Panaetius, Plato and Aristotle. His admiration for Plato led him to write a commentary on the *Timaeus*; in another way it is shown by important modifications which he made in psychological doctrine. Unquestionably more of a polymath than a philosopher, he appears uncritical and superficial. But at the time his spirit of inquiry provoked Strabo's criticism as something alien to the school (τὸ αἰτιολογικόν καὶ τὸ ἀριστοτέλιζον, ὅπερ ἐκκλίνουσιν οἱ ἡμέτεροι). In natural science, geography, natural history, mathematics and astronomy he took a genuine interest. He sought to determine the distance and magnitude of the sun, to calculate the diameter of the earth and the influence of the moon on the tides. His history of the period from 146 to 88 B.C., in fifty-two books, must have been a valuable storehouse of facts. Cicero, who submitted to his criticism the memoirs which he had written in Greek of his consulship, made use of writings of Posidonius in *De natura deorum*, bk. ii., and *De divinatione*, bk. i., and the author of the pseudo-Aristotelian treatise *De mundo* also borrowed from him.

See Zeller, *Philosophie der Griechen*, iii. 1, 570–584 (in Eng. trans., *Eclecticism*, 56–70); C. Müller, *Fragmenta historicorum graecorum*, iii. 245–296; J. Bake, *Posidonii Rhodii reliquiae* (Leiden, 1810), a valuable monograph; R. Scheppig, *De Posidonio rerum gentium terrarum scriptore* (Berlin, 1869); R. Hirzel, *Untersuchungen zu Ciceros philosophischen Schriften*, i. 191 seq., ii. 257 seq., 325 seq., 477–535, 756–789, iii. 342–378 (Leipzig, 1877); Thiaucourt, *Essai sur les traités philosophiques de Cicéron* (Paris, 1885); Schmekel, *Die Philosophie der mittlern Stoa* (1892); Arnold, *Untersuchungen über Theophanes von Mytilene und Posidonius von Apamea* (1882). (See also Stoics.)

POSITIVE (or Portable) **ORGAN,** a medieval chamber organ which could be carried from place to place without being taken to pieces, and when played was placed on a table or stool and required a blower for the bellows, as well as a performer. It was larger and more cumbersome than the portative (*q.v.*), with which it has often been confounded. The positive had usually but one kind of pipe, the open diapason of 2 ft. tone, and in the 16th century the best types had three registers by means of which each note could be sounded with its fifth and octave, or each by itself, or again in combinations of twos. The positive differed from the regal in having flue pipes, whereas the latter had beating reeds in tiny pipes, one or two inches long, concealed behind the keyboard. During the early middle ages most of the pneumatic organs belonged to this type.

A well-known instance of an early positive or portable organ of the 4th century occurs on the obelisk erected to the memory of Theodosius the Great, on his death in A.D. 395. Among the illuminated manuscripts of the British Museum miniatures abound representing interesting varieties of the portable organ of the middle ages; such as Add. MS. 29902 (fol. 6) and Add. MS. 27695b (fol. 13), Cotton MS. Tiberius A VII. fol. 104d., all of the 14th century, Add. MS. 28962, Add. MS. 17280, both of the 15th century. These little organs were to be found at every kind of function, civil and religious; they were used in the dwellings and chapels of the rich; at banquets and court functions; in choirs and music schools; and in the small orchestras of Peri and Monteverdi at the dawn of the musical drama or opera. (K. S.)

POSITIVISM (derived from *ponere*, whence *positus*, that which is laid down, certain), a philosophical term, applied somewhat loosely to any system which confines itself to the data of experience and declines to recognize a priori or metaphysical speculations. In this sense the term may be applied to empirical philosophers in general. Thus Hume is a positivist in the sense that he specifically restricts philosophy to the sphere of observation, and regards the causal relation as being nothing more than what we have been accustomed to expect. Similarly Mill, Spencer and physical scientists generally view the universe from the positivist standpoint. In its commonest acceptation, however, positivism is both narrower and wider than this. The term is specifically used of the philosophy of Auguste Comte, who applied the term to his system according to which knowledge is based exclusively on the methods and discoveries of the physical or "positive" sciences. According to Comte human thought passes through three stages—theological, metaphysical and positive. The final stage, positivism, is the understanding of the universe not as composed of a multitude of individuals each with volition, but as an ordered organism governed by necessary laws (see further Comte). The outcome of this positivism is the substitution for revealed religion of a religion of humanity—according to Huxley "Catholicism minus Christianity"—in which God is replaced by Humanity. This religion was to have its special priesthood, ritual and organization.

Positivism has, therefore, two distinct sides, the philosophical and the religious or mystical. Philosophical positivism has had distinguished representatives in France, Germany and England, and in the wider sense indicated above may be regarded as one of the two or three chief influences on modern philosophical development. Though the details of Comte's philosophic structure, *e.g.* the classification of the sciences, are without important significance, the positivistic tendency is prominent in all systems of thought which deny the supernatural and the metaphysical. Agnosticism, Phenomenalism, Rationalism, Materialism all manifest the positivist spirit, denying what may be succinctly described as the metempirical.

In France the Comtian tradition was maintained with important reservations and the abandonment of the religious aspect by Littré (*q.v.*), Taine and others. In Germany many of the followers of Kant have in greater or less degree maintained the view that all true knowledge depends upon the observation of objective phenomena. The distinctly religious aspect has been comparatively unimportant, except in so far as modern social evolutionist ethics may be regarded as religious in character. In England, however, a number of prominent Positivists have carried out Comte's original ideal of a Church of Humanity with ritual and organization. The chief building (in Chapel Street, Lamb's Conduit Street, London) is adorned with busts of the saints of humanity, and regular services are held. Positivist hymns are sung and addresses delivered. Among the leaders of this movement have been Frederic Harrison, Richard Congreve, E. S. Beesly and J. H. Bridges (d. 1906). Services are also held weekly in Essex Hall, London, and there are a few other centres in the provinces, including a prosperous church in Liverpool.

POSSE COMITATUS (Lat. "power of a county"), a summons to every male in the county, between the ages of fifteen and twenty, to be ready and apparelled, at the command of the sheriff and the cry of the county, to maintain peace and pursue felons. Ecclesiastical persons, peers and such as laboured under any infirmity were not compellable to attend. Owing to the establishment of county police, the sheriff does not now pursue felons, but by the Sheriffs Act (1887, sec. 8, sub-sec. 2) the calling out of the posse comitatus is expressly authorized if the sheriff finds any resistance in the execution of a writ. In view of the sheriff's duty to raise, if necessary, the posse comitatus it is no answer by him, for non-execution of a writ, to say that he was resisted.

See P. E. Mather, *Sheriff Law.*

POSSESSION (Lat. *possessio*, *possidere*, to possess), in law, a term derived from Roman law. The Roman conception of possession has been generally adopted, but not the Roman deductions from the conception. The subject of possession has become more difficult owing to the various senses in which the term has been interpreted. Thus it has been said to be either a right or a fact conferring a right, or both together. The latter is the view of Savigny, the leading authority upon the subject (*Recht des Besitzes*, translated by Sir Erskine Perry, 1848). Further, there is a want of agreement among legal writers as to the amount of right or rights that it confers. All that can be said with safety is that possession stands in a position intermediate between simple detention and absolute ownership, and that it implies two elements, physical detention and mental intention to hold the thing possessed as one's own. These difficulties being borne in mind, the definition of W. A. Hunter may be accepted: "Possession is the occupation of anything with the intention of exercising the rights of ownership in respect of it" (*Roman Law*, p. 209). Possession is inchoate or incomplete ownership; it is on its way to become ownership. In the case of the public domain of Rome (*ager publicus*) the possession was really the important matter, the *dominium* being practically of no value. Possession in Roman law was either *natural* or *civil.* The former was mere occupation, the latter such occupation as ripened by prescription into ownership. Possession exclusive against the world (including the true owner) was called "adverse possession." A servitude, such as a right of way, could not be held in true possession, but was said to be in "quasi-possession." The quasi-possessor, however, had possessory remedies. In Roman law a broad distinction was drawn between possession and ownership (*dominium*).[1] They were protected by different remedies—possession by interdict, ownership by action. This difference can only be explained by history. Here again, unfortunately, authorities differ. According to Savigny, a Roman citizen who had become a tenant of part of the *ager publicus* could not by any length of holding obtain more than a quasi-ownership, but one of which it would have been morally unjust to have deprived him. "The only legal remedies of which the tenants could avail themselves, if ejected or threatened with disturbance, were the possessory interdicts, summary processes of Roman law which were either expressly devised by the praetor for their protection, or else, according to another theory, had in older times been employed for the provisional maintenance of possessions pending the settlement of questions of legal right" (Maine, *Ancient Law*, ch. viii.). Savigny regards the protection of possession as an extension of the protection of the person. The same view was taken by the English court of exchequer in *Rogers* v. *Spence*, 13 M. & W. R. p. 581. According to Hunter (*Roman Law*, pp. 206, 221), Savigny overlooked the needs of aliens. It was the needs of aliens, incapable of the full proprietary rights of Roman citizens, that led to the invention by the praetor of a means of giving them equitable rights in the land, and protecting them in the enjoyment of these rights. Savigny attributes only two rights to possession in Roman law—acquisition of ownership by possession for a given time (*usucapio, longi temporis possessio*) and protection of possession from disturbance (*interdictum*). Others have included further rights—*inter alia*, the right to use force in defence of possession, and the right to have the burden of proof, in a contest as to the title, thrown upon the adversary: "In pari causa possessor potior haberi debet." The position of the possessor in Roman law was very strong. If a *bona fide* possessor, he could bring an action for *furtum* even against the owner, if a *mala fide* possessor of land, he was so far protected that he could not be ejected by force. A *mala fide* possessor of movables could, however, acquire no rights.[2]

It has been already stated that there is both a physical and a mental element in the conception of possession. This does not necessarily mean that corporal contact is in all cases requisite, or that the intention to hold the thing possessed as one's own may not be abandoned for a time. The control may be potential as well as actual. An estate may be possessed without the possessor going upon the land at all, and the possession of goods may be given by delivering the key of the warehouse in which they are stored. In international law the possession of part as giving a title to the whole has been of great importance (see INTERNATIONAL LAW). Where goods are pledged or bailed for a specific purpose the intention of the pledgor or bailor to hold them as his own is suspended during the existence of the limited right of the pledgee or bailee, to whom a fragment of the possession has passed. In Roman law the pledgor had *possessio ad usucapionem*, the pledgee *possessio ad interdicta.* The possession of the pledgee or bailee has been called "derivative possession." Possession may be exercised through another ("animo nostro, corpore alieno"), as through a servant, who has not true possession.[3] Possession so exercised has been called "representative possession." As soon as the representative determines to assume control on his own behalf or to submit to the control of another, the possession of the principal is gone. Possession may be transferred or lost. It is lost when either the *corpus* or the *animus* (to use the terms of Roman law) ceases to exist. It may be lost by the representatives in cases where the principal might have lost it.

In both Roman and English law the possessory tended to supersede the proprietary remedies from their greater convenience—that is to say, the plaintiff based his claim or the defendant his right upon possession rather than property. The English possessory action may have been directly suggested by the interdict. Bracton (103b) identifies the assise of novel disseisin, the most common form of possessory action, with the interdict *unde vi.* In England ejectment had practically superseded other real actions before the latter were (with the exception of dower, writ of dower and *quare impedit*) expressly abolished by the Real Property Limitation Act 1833, s. 36. The action for the recovery of land, introduced by the Judicature Acts, is the modern representative of the action of ejectment.

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[1] The distinction is very important, as it affects the contract of sale. The contract was not to transfer ownership, as in English law, but only *vacua possessio.*

[2] This does not agree with English law, where in certain cases a thief can give a good title to stolen goods, though he has no title himself.

[3] Much of the law of master and servant is based upon the Roman law of master and slave. The servant, like the slave, has not possession of his master's goods even though they are in his custody, unless, indeed, the circumstances are such that he ceases to be a servant and becomes a bailee.

The right of a party to recover possession is enforced by a writ of possession.

Possession gives in English law, speaking generally, much the same rights as in Roman law. Thus it serves to found a title (see Limitation, Statutes of; Prescription), and to throw the onus of proof upon the claimant. In an action for the recovery of land the defendant need only allege that he is in possession by himself or by his tenant, and (where such an allegation is necessary) that he had no notice to quit. The chief differences between Roman and English law, arising to some extent from the differences in the history of the two systems, are that the former did not give to derivative possessors (except in the case of pledge) the remedies of possessors, as does English law, and that Roman law is stricter than English in requiring that possession to found *usucapio* should (except in the case of *jus aquae ducendae*) be *ex justo titulo*, or under colour of right (see Prescription). There is one case of constructive possession which is peculiar to English law—that is, where possession is said to be given by a deed operating under the Statute of Uses (see "Orme's Case," *L. R.* 8, C. P. p. 281).

In English law the doctrine of possession becomes practically important in the following cases. (1) Possession serves as a convenient means of division of estates (see Real Property). One of the divisions of estates is into estates in possession and estates in reversion or remainder. It also serves as a division of personal property (*q.v.*). A close in action is said to be reduced into possession when the right of recovery by legal proceedings has become a right of enjoyment. (2) Possession gives a title against a wrongdoer. In the case of real property it is regarded as prima facie evidence of seisin.[1] In the case of personal property the mere possession of a finder is sufficient to enable him to maintain an action of trover against one who deprives him of the chattel[2] (see the leading case of *Armory* v. *Delamirie*, 1 Str. 504). (3) What is called "unity of possession" is one of the means whereby an easement is extinguished. Thus the owner of close A may have had a right of way over close B, while the latter belonged to a different owner. If the two closes come to be owned by the same person, the right of way is extinguished, but may under certain circumstances revive on the separation of the ownership. (4) Possession is very important as an element in determining the title to goods under 13 Eliz. c. 5, the Bills of Sale Act 1878 and the Bankruptcy Acts 1883 to 1890. It may be said that as a general rule retention of possession by the transferor or an absolute assignment or a colourable delivery of possession to the transferee is strong prima facie evidence of fraud. (5) Possession of goods or documents of title to goods is generally sufficient to enable agents and others to give a good title under the Factors' Acts (see Factor). (6) In criminal law the question of possession is important in founding the distinction between larceny and embezzlement. If the goods are in the possession of the master and he gives them to the custody of his servant for a specific purpose and the servant steals them, it is larceny; if they have never come into the master's possession, as if a clerk receives money on his master's behalf, it is embezzlement. Recent possession of stolen goods is always regarded as a presumption that the person in whose possession they are stole them or received them knowing them to have been stolen. In the case of a charge of receiving stolen goods evidence may be given that there was found in the possession of the accused other property stolen within the preceding period of twelve months, 34 & 35 Vict. c. 112, s. 19. (For possession in criminal law, see Stephen, *Digest of the Criminal Law*, note xi.) (7) Actions of possession of ships fall within the jurisdiction of the admiralty division. This jurisdiction in the case of British vessels depends upon the Admiralty Court Act 1861 (24 Vict. c. 10, s. 8), in the case of foreign vessels (in which the jurisdiction is rarely exercised) upon the general powers of the court as a maritime court.

The doctrines of adverse possession (in the old English sense, which was not identical with the Roman law, for the real owner must have actually or by fiction been disseised) and of *possessio fratris* are now of only antiquarian interest. The Statutes of Limitation have superseded the first. The only question now is, not whether possession has been adverse or not, but whether twelve years have elapsed since the right accrued. The maxim "possessio fratris de feodo simplici sororem facit esse haeredem" (Coke upon Littleton, 14b) has been altered by the rule of descent introduced by the Inheritance Act 1833, under which descent is traced from the purchaser. At one time possessory suits were occasionally maintained in England, and more frequently in Ireland, for the quieting of possession after proof of three years' possession before the filing of the bill. But such suits are now obsolete (see *Neill* v. *Duke of Devonshire*, 8 *A. C.* 146). There was one characteristic case in old English law in which possession was maintained by means of what was called "continual claim," made yearly in due form, where the person having the right was prevented by force or fear from exercising it (Coke upon Littleton, 253b). Continual claim was abolished by the Real Property Limitation Act 1833, s. 11.

Scotland.—In Scotland possessory actions still exist *eo nomine.* Actions of molestation, of removing, and of maills (payments) and duties are examples. A possessory judgment is one which entitles a person who has been in possession under a written title for seven years to continue his possession (Watson, *Law Dict.*, *s.v.* "Possessory Judgment").

United States.—Here the law in general agrees with that of England. Possessory rights are taxed in some of the states. Louisiana follows Roman law closely. Possession of incorporeal rights (to use the unscientific language of the Code) is called quasi-possession, and the division of possession into natural and civil is maintained (Civil Code, ss. 3389–3419).

In addition to the authorities cited may be mentioned Smith, *Dict. of Antiquities*, *s.v.* "Possessio"; Markby, *Elements of Law*; Holland, *Elements of Jurisprudence*; Holmes, *The Common Law* (lect. vi.); Pollock and Wright, *Possession in the Common Law.*

(J. W.)

POSSESSION, the term given to the supposed control of a human body and mind by an alien spirit, human or non-human; or the occupation by an alien spirit of some portion of a human body, causing sickness, pain, &c. The term *obsession* (Lat. for siege) is sometimes used as equivalent to possession; sometimes it denotes spirit control exercised from without, or it may mean no more than a maniacal monoideism. From an anthropological point of view possession may be conveniently classed as (*a*) inspirational, (*b*) demoniacal, (*c*) pathological, according to the view taken of the reason for or effect of the spiritual invasion of the possessed person.

a. In inspirational possession the oracle spirit is held to have entered the person in order to foretell the future or to proclaim the will of a god; the god himself may be regarded as speaking through the mouth of his devotee; among peoples in the lower stages of culture possession by spirits of the dead is inspirational, especially where there is any kind of ancestor worship in vogue. This kind of possession, so far as is known, does not appear among some of the lowest peoples, *e.g.* the Australians; but it is common in Africa, Polynesia and Asia, where European influence has not led to its decay. Many of the classical oracles were regarded as due to divine inspiration. The manifestations are often voluntarily induced and are provoked in many different ways; in classical times the eating of laurel leaves, the inhaling of fumes which ascended from a cleft in the rocks of Delphi, the drinking of intoxicating liquors, or of a more widely found means of inducing the phenomena—blood—were all in use. In the Malay Peninsula the medicine-man inhales incense which rises in clouds from a censer and hangs like a mist round his head; similar hypnotic effects are produced in Egypt in the case of divining boys by means of drugs. In Fiji the priest sat before a dish of scented oil and anointed himself with it, till in a few minutes he began to tremble and was finally strongly convulsed. In parts of India, draughts of blood from the neck of the newly decapitated victim were the means of rousing the priest to frenzy; while in Siberia, America and many parts of Africa drumming, contortions and orgiastic dancing are more commonly found. According to another account, the Fijian priest provoked the onset of the trance by a method in use in ordinary hypnotic practice; he sat amid dead silence before a whale's tooth, at which he gazed steadfastly.

The symptons of supposed possession by a god differ as widely as do those of the hypnotic trance. In Hawaii the god Oro gave his oracles by inspiring the priest, who ceased to speak or act as a voluntary agent, his frenzied utterances being interpreted by the attendant priests. In the Malay Peninsula the *pawang*, after censing himself, lies down on his back, with his head shrouded, and awaits the moment of inspiration. The tiger spirit which is the familiar of all Malay *pawangs* manifests its presence by a low lifelike growl and the *pawang* scratches at the mat, gives a series of catlike leaps and licks up from the floor the handfuls of rice scattered there. But his state seems to be far removed from the ecstasy of the Hawaiian priest, though it must be remembered that no test of bona fides is possible in either case. We meet with another stage in Tahiti in the lofty declamation of the possessed priests, who thus afford a parallel to the utterances of many modern mediums. Finally in Africa, where the frenzied form of possession is also common, we find at Sofala the manifestations of possession were confined to the simple dramatic imitation of the voice of the dead king, whose soul was believed to give counsel in this manner to his successor.

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[1] "Seisin" and "possession" are used sometimes as synonyms, as generally by Bracton; at other times they are distinguished: thus there can be possession of a term of years, but no seisin (Noy, *Maxims*, p. 2). It seems doubtful, however, how far in English law a tenant for years has true possession, for he is in law only a bailiff or servant of the landlord. But he certainly has possessory remedies, like the quasi-possessor in Roman law.

[2] Compare the *Code Napoléon*, art. 2279: "En fait de meubles la possession vaut titre."

b. Demoniacal possession is a widely spread explanation of such psychopathological conditions as epilepsy, somnambulism, hysteria, &c.; especially in the East Indian field lycanthropy (*q.v.*) and magical power (for evil) are commonly attributed to possession. Much of the evidence is that of native witnesses, and where European observers have succeeded in examining a case for themselves they have generally been guiltless of all knowledge of psychopathology and of the possibilities of suggestion; their statements are therefore to be accepted only with reserve. Demoniacal possession is familiar to us from the New Testament narratives; there seems to be no reason to suppose that the cases there recorded were due to anything but disease; but the view is still occasionally maintained by Christian apologists that real demon possession existed in Judaea. Demoniacs in the New Testament are stated to live among the tombs, to be deaf and dumb, or blind, to be possessed by a multitude of evil spirits or to suffer from high fever as a result of possession; the demons are said to pass into the bodies of animals or to reside in waterless places. No facts are recorded which are not explicable either as the ordinary symptoms of mental disease or as the result of suggestion (*q.v.*).

c. In the lower stages of culture all diseases are explained as due to the invasion of the body by disease spirits (see ANIMISM), but the effects are supposed to be physiological, not psychical as in demoniacal possession. The infringement of a totemic *tabu*, the wrath of an ancestor or other dead person or the malice of a disease spirit, such as the Malay *hantus*, or of any non-human spirit, may set up pathological conditions, according to animistic philosophy. Such cases, as well as those of demoniacal possession, which may be distinguished from the inspirational form by their invariably involuntary character, are dealt with by a variety of means such as spells, purifications, sacrifices to the possessing spirit, or coercion of various sorts (see EXORCISM).

We have few data as to the distribution of the phenomena here classified. Cases of inspirational or demoniacal possession were known in classical times; but the demon of Socrates must rather be classed as a case of sensory automatism. In our own day they are reported from the greater part of Asia, Africa and Polynesia, and they seem to occur in America, though our information is scanty. On the other hand in New Guinea and Australia they are practically unknown, though automatisms are put down to the agency of the dead.

From the psychological point of view the classification is again threefold: (*a*) as noted above, the majority of cases of so-called possession are simply psychopathological; (*b*) another class, the existence of which has only been recognized within recent times are the cases of secondary or multiple personality; the apparent independence and occasional conflict of primary and secondary selves has been explained by the theory of possession; but it has been possible in one of the most severe cases on record to unify the two personalities and memories after what the patient described as a struggle between them for supremacy, which would inevitably have suggested possession as the explanation, had not the issue of the case been the amalgamation of the two streams of consciousness. (*c*) The problem of the third class of cases, which may be termed mediumistic, is still unsolved. The medium (*q.v.*) or sensitive appears to have at command in the trance state a store of memories connected with the lives of deceased friends of a sitter (*i.e.* a person present at the séance), such memories being dealt with from the standpoint of the deceased person (who is termed the communicator); sometimes the memories are connected with the friends of a person not actually present or with articles placed in the hands of the medium, the owners being absent or dead. Mediumistic cases have undergone elaborate investigation at the hands of the Society for Psychical Research, and no serious attempt has been made to invalidate the facts set forward by the investigators; but so far no satisfactory explanation has been suggested. On the one hand thought transference or telepathy (*q.v.*) appears to be insufficient, unless we assume that the powers of a medium far transcend anything demonstrable in ordinary telepathic experiments; for the facts stated by or through the medium about the communicator seem in many cases to be known in their entirety to no single living person. If thought transference is the explanation, we must admit that the medium can (1) ransack all living brains for facts, (2) select those which are pertinent (*i.e.* known to the communicator) and (3) combine them in such a way as to suggest that the source of the information is the dead person. On the other hand, although, as we have seen, the communications show knowledge homologous to that of the deceased, they demonstrably do not include the whole of his knowledge; more than one attempt has been made to obtain from communicators the contents of sealed letters, written during their lifetime and kept from the knowledge of all other human beings till the seal was broken; but such attempts have so far failed, and the failure seems to form conclusive evidence both against possession and against other explanations based on the supposition that the dead are communicating.

BIBLIOGRAPHY.—For anthropological data see Bastian, *Der Mensch*; *Contemporary Review*, xxvii. 369; Ellis, *Tshi-speaking Peoples*; Naevius, *Demon Possession*; Radloff, *Das Schamanentum*; Skeat, *Malay Magic*; Stoll, *Suggestion und Hypnotismus*; Tylor, *Primitive Culture*; Verdun, *Le Diable dans les missions*; Maury, *La Magic*, p. 258 seq.; Chamberlain, *Things Japanese*, *s.v.* "Fox." For discussion of New Testament facts see W. M. Alexander, *Demoniacal Possession in the New Testament*; Conybeare, in *Jewish Quarterly Review*, viii. 576, ix. 59, 444, 581; Herzog's *Realencyclopädie*, *s.v.* "Dämonische." For patristic literature see Bingham, *Antiquities*, iii. For mediumistic possession see Myers, *Human Personality*; and the same author on "Pseudopossession" in *Proc. S.P.R.* xv. 384; *Proc. S.P.R.* vi. 436–450, viii. 1–167, xiii. 284–582, xvi. 1–536, xvii. 61–244, &c. For medical and psychological observations see Griesinger, *Mental Pathology*; James, *Principles of Psychology*; Janet, *Névroses et idées fixes*; Kraft-Ebbing, *Psychiatrie*; Sidis and S. P. Goodhart, *Multiple Personality*. (N. W. T.)

PÖSSNECK, a town of Germany, in the duchy of Saxe-Meiningen, 21 m. by rail S. of Jena, on the Kotschau. Pop. (1905), 12,702. It has a Gothic Evangelical church built about 1390, and a Gothic town-hall erected during the succeeding century. Its chief industries are the making of flannel, porcelain, furniture, machines, musical instruments and chocolate. The town has also tanneries, breweries, dyeworks and brickworks. Pössneck, which is of Slavonic origin, passed about 1300 to the landgrave of Thuringia. Later it belonged to Saxony and later still to the duchy of Saxe-Coburg-Saalfeld, passing to Saxe-Meiningen in 1826.

See E. Koch, *Aus Pössnecks Vergangenheit* (Pössneck, 1894–1895); the same writer, *Beiträge zur urkundlichen Geschichte der Stadt Pössneck* (Pössneck, 1896–1900); and the *Geschichte der Stadt Pössneck*, published by the *Pössnecker Zeitung* (Pössneck, 1902).

POST. 1. (An adaptation in O. Eng. of the Lat. *postis*, from *ponere*, to place), a stock, stake or stump, particularly an upright timber used as a support in building, as part of the framework of a door, as a boundary mark, &c., and formerly as a convenient object to which to attach public notices, &c., whence the verb "to post," to publish a notice, advertisement, &c., by affixing it in a conspicuous position, hence to make a statement with regard to an event or person, *e.g.* the "posting" of a defaulter, or of a ship as overdue or missing at Lloyd's.

2. (An adaptation of the Fr. *poste*, station, position, Ital. *posta* or *posto*, formed from the past participle *positus*, of Lat. *ponere*, to place), position, station, a position occupied by a soldier or body of soldiers, especially one specifically allotted to a soldier, such as the round of a sentry, hence a place of employment, an office. The sense of station has developed into the particular application of the word and its various derivatives, "postal," "postage," &c., to the service connected with the delivery of letters (see POST AND POSTAL SERVICE). From the earliest times as we see from the ἀγγαρεία of the Persian kings (*Herod.* viii. 98), the speedy despatch of messages, letters, &c., was attained by relays of men and horses stationed at regular intervals. This is paralleled by the *dispositi equites* of Roman times and by the elaborate system of the Great Khan which Marco Polo describes on the roads of China. The *New English Dictionary* finds the earliest use of the O. Fr. *poeste* and the Ital. *posta* for these stations of men and horses in Marco Polo's account. The Medieval Latin expression for the couriers was *caballarii postarum*, riders of the posts. From the stations or relays of horses the word was early applied to the riders themselves, and later to the mail carried by means of the "posts," and thence to the whole service. At the first establishment of

regular posts in the 16th century in England, they served two purposes, the carrying of the king's letters and the exclusive supply of horses for his couriers and for other travellers, the first being called the "posts of the pacquet," the second "the thorough posts." When, in 1780, the monopoly of supplying post-horses was taken away from the "postmasters," the term was retained for the "posting" establishments for travellers throughout the country, as well as in such words as "post-boy" and "post-chaise." The expression "post-haste," generally used adverbially in the sense of "with the utmost speed," was originally a superscription, "haste, post, haste," on letters that needed the greatest despatch, and was a command addressed to the "post," the bearer of the message. The peculiar use of "postmaster" as the name of the "scholars" of Merton College, Oxford, has not been explained. It occurs in the college records first as the name of a building (Postmasters' Hall) outside the college, in which the scholars (called *porcionistae* or *portionistae*) lived until about 1575. The suggestion that "postmaster" is a corruption of *portionista* is far-fetched, and there is nothing to support the theory that the scholars, as servitors to the masters, stood behind them at table and were thus called *post-magistri*.

POST, and POSTAL SERVICE. The germ of modern postal systems is to be looked for in the earliest organized establishment of a staff of government couriers. In the postal system of Spain and the German empire there is express record of permission to government couriers to carry letters for individuals in April 1544; and within fifteen or sixteen years that permission had grown into a legalized and regulated monopoly, whence the counts of Taxis drew part of their profits as postmasters-general. In Great Britain existing private letters of the 15th century—some, perhaps, of the 14th—bear endorsements which show that they were conveyed by relays of men and horses maintained under the control of the government, and primarily intended for its special service. In several states on the continent of Europe the universities had inland postal establishments of a rudimentary sort at an early date. The university of Paris organized a postal service almost at the beginning of the 13th century, and it lasted in a measure until 1719. In various parts of Europe mercantile gilds and brotherhoods were licensed to establish posts for commercial purposes. But everywhere—as far as the accessible evidence extends—foreign posts were under state control.

GREAT BRITAIN

Early History (c. 1533–1836).

Sixteenth Century.

As early as the middle of the 13th century entries occur in the wardrobe accounts of the kings of England of payments to royal messengers for the conveyance of letters. In the supervision of these royal messengers lies the germ of the office of postmaster-general. The first English postmaster of whom a distinct account can be given is Sir Brian Tuke, who is described (1533) in the records as "Magister Nunciorum, Cursorum, sive Postarum," "both in England and in other parts of the king's dominions beyond the seas." But long subsequent to this appointment of a postmaster-general the details of the service were frequently regulated by proclamations and by orders in council. Thus, among the royal proclamations in the library of the Society of Antiquaries, there is one of Philip and Mary (undated, but apparently of 1555) which regulates the supply of horses for the conveyance of letters to Dover. Again, in July 1556 the lords of the council ordered "that the postes betweene this and the Northe should eche of them keepe a booke, and make entrye of every lettre that he shall receive, the tyme of the deliverie thereof unto his hands, with the parties names that shall bring it unto him." Much of the business of the foreign postal service to and from England during the earlier years of Queen Elizabeth was managed by the incorporated "merchant strangers," who appointed a special postmaster. When that office fell vacant in 1568 they quarrelled about a successor; and the quarrel cost them their privilege.[1]

Under James I.

The accession of James I. to the English throne, by necessitating a more frequent communication between London and Scotland, led to improvements in the postal service. Special posts had already been established by the magistrates of certain Scottish towns to convey their despatches to and from the court. Thus in 1590 a messenger was appointed by the magistrates of Aberdeen with the title of "council-post."[2] The new royal orders of 1603 directed (1) that the postmasters at the various stages should enjoy the privilege of letting horses to "those riding in post (that is to say) with horn and guide," by commission or otherwise, and to that end they were charged to keep or have in readiness a sufficient number of post-horses; (2) that the lawful charge for the hire of each horse should be, for public messengers, at the rate of 2½d. a mile, "besides the guides' groats," private travellers being left to make their own agreements. Finally, it was directed that every postmaster should keep at least two horses for the express conveyance of government letters, and should forward such letters within a quarter of an hour of their receipt, and that the posts should travel at the rate of not less than 7 m. an hour in summer and 5 m. in winter.[3]

The De Questers.

In 1607 the king granted to John Stanhope, first Baron Stanhope of Harrington, and to his son Charles Stanhope, afterwards second Lord Stanhope, jointly and to the survivor of them, the postmastership of England under the title of "Master of the Posts and Messengers," with a fee of 100 marks a year, together with all "avails and profits" belonging to the office. In 1619 a separate office of "postmaster-general of England for foreign parts" was created in favour of Matthew de Quester[4] and Matthew de Quester the younger. The new office was regarded by the existing postmaster-general, Charles, Lord Stanhope, as an infringement of his own patent. A long dispute ensued in the king's bench and before the lords of the council.[5] In 1626 by an order in council liberty was granted to all companies of merchants, including the merchant adventurers, to send their letters and despatches by messengers of their own choosing. A year afterwards this liberty was revoked, except for the Company of Merchant Adventurers. Lord Stanhope, however, continued to carry letters abroad by his agents, and obtained a warrant prohibiting De Quester from interfering. It shows strikingly the confusion of postal affairs at this period to find a statement addressed to the privy council by the postmasters of England to the effect that they had received no payments "ever since the last day of November 1621 till this present time, June 1628"—the arrears amounting to £22,626.

The rights of the postmasters were also infringed by private individuals, as by one Samuel Jude in 1629 in the west of England.[6] In 1632 the foreign postmastership was assigned by De Quester, who had lost his son, to William Frizell and Thomas Witherings. Letters-patent were granted to them jointly, the 15th of March 1633.[1] Witherings took the labouring oar, and ranks as the first of many conspicuous postal reformers. ***Witherings.*** Under him one Richard Poole obtained a special postmastership for the service of the court. Among the earliest measures of improvement taken under the new patent was an acceleration of the continental mail service. For this purpose the patentees made a contract with the count of Thurn and Taxis, hereditary postmaster of the Empire and of Spain. At this time there was still but one mail weekly between London, Antwerp and Brussels, and the transit occupied from four to five days. By a subsequent contract with Count Thurn two mails weekly were secured and the transit made ordinarily in two days.[2] In June 1635 Witherings submitted to the king a proposal "for settling of staffets or pacquet-posts betwixt London and all parts of His Majesty's dominions, for the carrying and re-carrying of his subjects' letters," which contains curious notices of the state of internal communications. The net charge to the Crown of the existing posts is stated to be £3400 per annum. Letters, it is said, "being now carried by carriers or footposts 16 or 18 m. a day, it is full two months before any answer can be received from Scotland or Ireland to London. If any of His Majesty's subjects shall write to Madrid in Spain, he shall receive answer sooner and surer than he shall out of Scotland or Ireland." By the new plan it was proposed that all letters for the northern road should be put into one "portmantle," and directed to Edinburgh, with separate bags directed to such postmasters as lived upon the road near to any city or town corporate. The journey from London to Edinburgh was to be performed within three days. The scheme was approved on the 31st of July 1635, the proclamation establishing eight main postal lines—namely, the great northern road, to Ireland by Holyhead, to Ireland by Bristol, to the marches of Wales by Shrewsbury, to Plymouth, to Dover, to Harwich and to Yarmouth. The postage of a single letter was fixed at 2d. if under 80 m., 4d. if between 80 and 140 m., 6d. if above 140 m., 8d. if to Scotland. It was provided that no other messengers or footposts should carry letters to any places so provided, except common known carriers, or a particular messenger "sent on purpose with a letter by any man for his own occasions," or a letter by a friend, on pain of exemplary punishment.[3] In February 1638 another royal proclamation ratified an agreement between Witherings and De Noveau, postmaster to the French king, for the conveyance of the mails into France by Calais, Boulogne, Abbeville and Amiens.[4]

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[1] F. Windebank to Sir W. Cecil: "All the Italians were unwilling to give their voices to Raphael, . . . but inclined to favour Godfrey" (*Dom. Cor. Eliz.* xlviii. § 65, State Paper Dept., Rolls Office). Raphael was a German, Godfrey an Englishman.

[2] Kennedy, *Annals of Aberdeen*, i. 262.

[3] *Book of Proclamations*, p. 67 (S. P. O.; now in Rolls House); *Report from the Secret Committee on the Post Office*, (1844) appendix, pp. 38–40.

[4] Or "De l'Equester," as he is called in Latch's *Reports of King's Bench Cases*, p. 87.

[5] These disputes were much embittered by the growing jealousies of English against foreign merchants. The proofs of this in the state correspondence of Elizabeth's day are abundant, but there were many statesmen who took larger views. See, *e.g.* John Johnson's "Brief Declaration for the . . . erecting and maintaining of the Staple . . . in England" (June 1582), *Dom. Corresp. Eliz.* cliv. No. 30; and compare the same writer's "Discourse for the repairing the decayed State of the Merchants," &c. (July 22, 1577), ibid. cxiv. No. 39, with Leake's "Discourse," &c., of the same year (ibid. cxi. 1 seq.), and with John Hales's "Letter to Sir W. Cecil" (March 20, 1559), ibid. iii., where he describes the merchant strangers as being "spies for foreign princes," and with Cecil's "Reasons to move a Forbearing of the Restitution of the Intercourse to Antwerp" (1564), ibid. xxxv. No. 33 (in Rolls House).

[6] See *Analytical Index to the Remembrancia*, p. 418, as quoted by H. B. Wheatley in the *Academy* of the 27th of December 1879, p. 464.

But in 1640 the active postmaster was accused of divers abuses and misdemeanours, and his office sequestrated into the hands of Philip Burlamachi of London, merchant, who was to execute the same under the inspection of the principal secretary of state.[5] Witherings then assigned his patent to Robert Rich, earl of Warwick, and a long contest ensued in both houses of parliament. The sequestration was declared by a vote in parliament in 1642 to be illegal. Nevertheless the dispute gave repeated occupation to both houses during the period from 1641 to 1647, and was diversified by several affrays, in which violent hands were laid upon the mails. In 1643 the post office yielded only £5000 a year. In 1644 the Lords and Commons by a joint ordinance appointed Edmund Prideaux "to be master of the posts, messengers and couriers." In 1646 the opinion of the judges was taken on the validity of Witherings's patent (assigned to Lord Warwick), and they pronounced that "the clauses of restraint in the said patent are void and not good in law; that, notwithstanding these clauses be void, the patent is good for the rest."[6] It is evident, therefore, that any prohibition to carry letters must be by act of parliament to have force of law.

In 1650 an attempt was made by the common council of London to organize a new postal system on the great roads, to run twice a week. This scheme they temporarily carried into effect as respects Scotland. ***Under Cromwell.*** But Mr Attorney-General Prideaux urged on the council of state that, if the new enterprise were permitted, besides intrenching on the rights of the parliament, some other means would have to be devised for payment of the postmasters. Both houses resolved (1) that the offices of postmasters, inland and foreign, were, and ought to be, in the sole power and disposal of the parliament, and (2) that it should be referred to the council of state to take into consideration all existing claims in relation thereto. Of these there were five under the various patents which had been granted. Thereupon the Protector was advised that the management of the post office should be entrusted to John Thurloe by patent upon the expiration of John Manley's existing contract. Thurloe was to give security for payment of the existing rent of £10,000 a year. Ultimately the posts, both inland and foreign, were farmed to John Manley for £10,000 a year, by an agreement made in 1653. ***John Hill's Reforms.*** Meanwhile an attorney at York, named John Hill, placed relays of post-horses between that city and London, and undertook the conveyance of letters and parcels at half the former rates. He also formed local and limited partnerships in various parts of the kingdom for the extension of his plan, which aimed to establish eventually a general penny postage for England, a twopenny postage for Scotland and a fourpenny postage for Ireland. But the post office was looked upon by the government of the day as, first, a means of revenue, and secondly, a means of political espionage.[7] The new letter-carriers were "trampled down" by Cromwell's soldiery. The inventor had a narrow escape from severe punishment. He lived to publish (1659) the details of his plan, at the eve of the Restoration, in a pamphlet entitled *A Penny Post: or a Vindication of the Liberty and Birthright of every Englishman in carrying Merchants and other Man's letters, against any Restraint of Farmers*, &c. It is probable that this publication[8] helped to prepare the way for those measures of partial but far-reaching reform which were effected during the reign of Charles II. The rates of postage and the rights and duties of postmasters were settled under the Protectorate by an act of parliament of 1657, c. 30. In 1659 the item, "by postage of letters in farm, £14,000," appears in a report on the public revenue.[9]

The government of the Restoration continued to farm the post office upon conditions similar to those imposed by the act of 1657, but for a larger sum. ***Under Charles II.*** Henry Bishop, the first postmaster-general in the reign of Charles II., contracted to pay a yearly rent of £21,500, these new arrangements being embodied in the Act 12 Charles II. c. 35 (1660), entitled "An Act for Erecting and Establishing a Post Office." A clause proposing to frank all letters addressed to or sent by members of parliament during the session was rejected by the Lords. But the indenture enrolled with the letters-patent contained a proviso for the free carriage of all letters to or from the king, the great officers of state and also the single inland letters only of the members of that present parliament during that session. It also provided that the lessee should permit the secretaries of state, or either of them, to have the survey and inspection of all letters at their discretion. Bishop was succeeded by Daniel O'Neill[1] in 1662, on similar terms. In the consequent proclamation, issued on the 25th of May 1663, it was commanded that "no postmasters or other officers that shall be employed in the conveying of letters, or distributing of the same, or any other person or persons, . . . *except by the immediate warrant of our principal secretaries of state*, shall presume to open any letters or pacquets not directed unto themselves." In 1677 the general post office comprised in the chief office, under Henry Bennet, earl of Arlington, as postmaster-general, seventy-five persons, and its profits were farmed for £43,000 a year. There were then throughout England and Scotland 182 deputy postmasters, and in Ireland 18 officers at the Dublin office and 45 country postmasters. "The number of letters missive," says a writer of the same year, "is now prodigiously great. . . . A letter comprising one whole sheet of paper is conveyed 80 m. for twopence. Every twenty-four hours the post goes 120 m., and in five days an answer may be had from a place 300 m. distant."[2] By an act of the 15th Charles II. ("An Act for Settling the Profits of the Post Office on the duke of York, and his Heirs-Male"), and by a subsequent proclamation issued in August 1683, it was directed that the postmaster-general should "take effectual care for the conveyance of all bye-letters, by establishing correspondences . . . in all considerable market-towns with the next adjacent post-stage," and the rights of the postmasters as to hiring horses were again emphasized.

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[1] Minute in "House of Lords' Papers" (1633), *Fourth Report of Hist. MSS. Commission* (1874), app. The papers there calendared contain many proofs of Witherings's activity and ability. See also appendix to *Fifth Report* (1875), and "A proclamation concerning the Postmaster of England for Forraigne Parts" (July 19, 1632), in Rymer's *Foedera*, xix. 385.

[2] *Egerton MS.* (Brit. Mus.), No. 2543, fol. 5 seq.

[3] Rymer, *Foedera*, xix. 649. [4] Ibid. xx. 192. [5] Ibid. xx. 429.

[6] *Journals of the House of Commons*, ii. 81, 82, 95, 470, 493, 500, 501, 658 seq.; *Journals of the House of Lords*, v. 343, 387, 450, 469–473, 500 seq.; *Report from Secret Committee on the Post Office*, Appendix, pp. 60–69.

[7] Illustrations of this may be seen (in the state-paper department of the general record office) among the correspondence between Sir John Coke and Lord Conway, and also in many other state letters, as well after the outbreak of the great rebellion as before it. There is in the Bodleian Library (MS. Rawlinson, A. 477) a minute account of the methods alleged to have been pursued in the systematic and periodical examination of letters entrusted to the post office. The paper is not authenticated by any signature, and is undated. But it is an original document of the time of Charles II., addressed to Mr. Bridgman, clerk of the council, and drawn up to recommend the adoption of a like practice, but with greater dexterity than that used by Dr Dorislaus and Samuel Morland, who, according to this narrative, formed the Cromwellian board of examiners for post-office letters, and who read all that were addressed to foreign parts.

[8] There is a copy in the library of the British Museum, from which H. B. Wheatley has given the abstract quoted above.

[9] *Journals of the House of Commons*, vii. 627.

Dockwra's London Penny Post.

During the possession of the post-office profits by the duke of York a London penny post was established by the joint enterprise of William Dockwra, a searcher at the customs-house, and of Robert Murray, a clerk in the excise office. The working-out of the plan fell to the first-named, and in his hands it gave in April 1680—although but for a short time—far more extensive postal facilities to the Londoners than even those afforded 160 years later by the plans of Sir Rowland Hill. Dockwra carried, registered and *insured*, for a penny, both letters and parcels up to a pound in weight and £10 in value. He took what had been the mansion of Sir Robert Abdy in Lime Street as a chief office, established seven sorting and district offices, and between 400 and 500 receiving-houses and wall-boxes. He established hourly collections, with a maximum of ten deliveries daily for the central part of the city, and a minimum of six for the suburbs. Outlying villages, such as Hackney and Islington, had four daily deliveries; and his letter-carriers collected for each despatch of the general post office throughout the whole of the city and suburbs. Suits were laid against him in the court of king's bench for infringing on the duke of York's patent, and the jealousies of the farmers eventually prevailed. The penny post was made a branch of the general post. Dockwra, after the Revolution of 1688, obtained a pension of £500 a year (for a limited term) in compensation of his losses. In 1697 he was made comptroller of the London office. Eleven years later his improvements were outvied by Charles Povey, the author of schemes for improving coinage, and also of a curious volume, often wrongly ascribed to Defoe, entitled *The Visions of Sir Heister Ryley*. Povey took upon himself to set up a foot-post under the name of the "halfpenny carriage," appointed receiving-houses, and employed several persons to collect and deliver letters for hire within the cities of London and Westminster and borough of Southwark, "to the great prejudice of the revenue," as was represented by the postmaster-general to the lords of the treasury. Povey was compelled to desist.

Early Scottish Postal System.

At this period the postal system of Scotland was distinct from that of England. It had been reorganized early in the reign of Charles II., who in September 1662 had appointed Patrick Grahame of Inchbrakie to be postmaster-general of Scotland for life at a salary of £500 Scots. But it would seem from the proceedings of the Scottish privy council that the rights and duties of the office were ill defined; for immediately after the appointment of Grahame the council commissioned Robert Mein, merchant and keeper of the letter-office in Edinburgh, to establish posts between Scotland and Ireland, ordained that Linlithgow, Kilsyth, Glasgow, Kilmarnock, Dumboag, Ballantrae and Portpatrick should be stages on the route, and granted him the sum of £200 sterling to build a packet-boat to carry the mail from Portpatrick to Donaghadee.[3]

Early Colonial Posts.

Perhaps the earliest official notice of the colonial post is to be seen in the following paragraph from the records of the general court of Massachusetts in 1639. "It is ordered that notice be given that Richard Fairbanks his house in Boston is the place appointed for all letters which are brought from beyond the seas, or are to be sent thither to be left with him; and he is to take care that they are to be delivered or sent according to the directions; and he is allowed for every letter a penny, and must answer all miscarriages through his own neglect in this kind." The court in 1667 was petitioned to make better postal arrangements, the petitioners alleging the frequent "loss of letters whereby merchants, especially with their friends and employers in foreign parts, are greatly damnified; many times the letters are imputed (?) and thrown upon the exchange, so that those who will may take them up, no person, without some satisfaction, being willing to trouble their houses therewith." In Virginia the postal system was yet more primitive. The colonial law of 1657 required every planter to provide a messenger to convey the despatches as they arrived to the next plantation, and so on, on pain of forfeiting a hogshead of tobacco in default. The government of New York in 1672 established "a post to goe monthly from New York to Boston," advertising "those that bee disposed to send letters, to bring them to the secretary's office, where, in a lockt box, they shall be preserved till the messenger calls for them, all persons paying the post before the bagg be sealed up."[4] Thirty years later this monthly post had become a fortnightly one. The office of postmaster-general for America had been created in 1692.

Act of Consolidation.

The act of the 9th of Queen Anne which consolidated the posts of the empire into one establishment, and, as to organization, continued to be the great charter of the post office until the reforms of 1838–1850 mainly introduced by Sir Rowland Hill. The act of Anne largely increased the powers of the postmaster-general. It reorganized the chief letter-offices of Edinburgh, Dublin and New York, and settled new offices in the West Indies and elsewhere. It established three rates of single postage, viz. English, 3d. if under 80 m. and 4d. if above, and 6d. to Edinburgh or Dublin. It continued to the postmaster-general the sole privilege "to provide horses to persons riding post." And it gave, for the first time, parliamentary sanction to the power, formerly questionable, of the secretaries of state with respect to the opening of letters, by enacting that "from and after the first day of June 1711 no person or persons shall presume . . . to open, detain or delay . . . any letter or letters . . . after the same is or shall be delivered into the general or other post office, . . . and before delivery to the persons to whom they are directed, or for their use, *except by an express warrant in writing under the hand of one of the principal secretaries of state, for every such opening, detaining or delaying.*"

Cross-road Posts.

Nine years after the passing of the act of Anne the cross-posts were farmed to the well-known "humble" Ralph Allen—the lover of peace and of humanity.[5] Allen became the inventor of the cross-roads postal system, having made an agreement that the new profits so created should be his own during his lifetime. His improvements were so successful that he is said to have netted during forty-two years an average profit of nearly £12,000 a year.

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[1] The trusted friend but not always the trusted adviser of the duke of Ormonde. O'Neill's correspondence exists among the duke's papers, in part at Kilkenny Castle, in part (extensively) among the Carte MSS. in the Bodleian; and it abounds in incidental illustrations of postal administration in both England and Ireland.

[2] Quoted in *Gent. Mag.* (1815), xxxv. 309, 310.

[3] Lang, *Historical Summary of the Post Office in Scotland*, pp. 4, 5.

[4] Miles, "History of the Post Office," in the American *Banker's Magazine*, new series, vol. vii. p. 358 seq.

[5] "Is there a variance? enter but this door,
Balked are the courts; the contest is no more."
Pope's "humble Allen" was also the "Allworthy" of Fielding.

The postal revenue of Great Britain, meanwhile, stood thus:—

Gross and Net Income, 1724–1774.

	Gross Produce.			Net Revenue.		
	£	s.	d.	£	s.	d.
1724	178,071	16	9	96,339	7	5
1734	176,334	3	1	91,701	11	0
1744	194,461	8	7	85,114	9	4
1754	214,300	10	6	97,365	5	1
1764	225,326	5	8	116,182	8	5
1774	313,032	14	6	164,077	8	4

Permanent Pensions. The system of burdening the post-office revenue with pensions, nearly all of which had no public connexion with the postal service, and some of which were unconnected with any public service, was begun by Charles II., who granted to Barbara, duchess of Cleveland, £4700 a year, and to the earl of Rochester £4000 a year, out of that revenue. The example was followed until, in 1694, the pensions so chargeable amounted to £21,200. Queen Anne granted a pension of £5000 to the duke of Marlborough, charged in like manner. In March 1857 the existing pensions ceased to be payable by the post office, and became chargeable to the consolidated fund.

Palmer's Mail-coaches. In October 1782 the notice of the manager of the Bath theatre, John Palmer (1742–1818), was attracted to the postal service. So habitual were the robberies of the post that they came to be regarded as necessary evils. The officials urged the precaution of sending all bank-notes and bills of exchange in halves, and pointed the warning with a philosophical remark that "there are no other means of preventing robberies with effect." At this period the postal system was characterized by extreme irregularity in the departure of mails and delivery of letters by an average speed of about 3½ m. in the hour, and by a rapidly increasing diversion of correspondence into illicit channels. The net revenue, which had averaged £167,176 during the ten years ending with 1773, averaged but £159,625 during the ten years ending with 1783. Yet, when Palmer suggested that by building mail-coaches expressly adapted to run at a good speed, by furnishing a liberal supply of horses, and by attaching an armed guard to each coach the public would be greatly benefited, and the post-office revenue considerably increased, the officials maintained that the existing system was all but perfect. Lord Camden, however, brought the plan under the personal notice of Pitt, who insisted on its being tried. The experiment was made in August 1784, and its success exceeded all anticipation. The following table shows the rapid increase of revenue under the new arrangements:—

Gross and Net Income, 1784–1805.

Year.	Gross Income.			Net Revenue.		
	£	s.	d.	£	s.	d.
1784	420,101	1	8	196,513	16	7
1785	463,753	8	4	261,409	18	2
1790	533,198	1	9	331,179	18	8
1795	745,238	0	0	414,548	11	7
1800	1,083,950	0	0	720,981	17	1
1805	1,317,842	0	0	944,382	8	4

It had been at first proposed to reward Palmer by a grant for life of 2½% on a certain proportion of the increased net revenue, which would eventually have given him some £10,000 a year, but this proposition fell through. Pitt, however, appointed Palmer to be comptroller-general of postal revenues, an office which was soon made too hot for him to hold. He obtained a pension of £3000 a year, and ultimately, by the act 53 Geo. III. c. 157 (1813), after his case had received the sanction of five successive majorities against government, an additional sum of £50,000. Every sort of obstruction was placed in the way of his reward, although nearly a million had been added to the annual public revenue, and during a quarter of a century the mails had been conveyed over an aggregate of some seventy millions of miles without the occurrence of one serious mail robbery.[1]

Scottish and Irish Post Office, 1708–1801. Scotland shared in the advantages of the mail-coach system from the first. Shortly before its introduction the local penny post was set on foot in Edinburgh by Peter Williamson, the keeper of a coffee-room in the hall of Parliament House. He employed four letter-carriers, in uniform, appointed receivers in various parts of the city, and established hourly deliveries.[2] The officials of the post, when the success of the plan had become fully apparent, gave Williamson a pension, and absorbed his business, the acquisition of which was subsequently confirmed by the Act 34 Geo. III. c. 17 (1794). A dead-letter office was established in 1784. But in Ireland in 1801 only three public carriages conveyed mails. There were, indeed, few roads of any sort, and none on which coaches could travel faster than four miles an hour.[3] At this period the gross receipts of the Irish post office were £80,040; the charges of management and collection were £59,216, or at the rate of more than 70%; whilst in Scotland the receipts were £100,651, and the charges £16,896, or somewhat less than 17%.[4]

Franklin. In the American colonies postal improvements may be dated from the administration of Franklin, who was virtually the last colonial postmaster-general, as well as the best. In one shape or another he had forty years' experience of postal work, having been appointed postmaster at Philadelphia in October 1737. When he became postmaster-general in 1753 he visited all the chief post offices throughout Pennsylvania, New Jersey, New York and New England, looking at everything with his own eyes. His administration cannot be better summed up than we find it to be in a sentence or two which he wrote soon after his dismissal. Up to the date of his appointment, he says, "the American post office had never paid anything to that of Britain. We [*i.e.* himself and his assistant] were to have £600 a year between us, if we could make that sum out of the profits of the office. . . . In the first four years the office became above £900 in debt to us. But it soon after began to repay us; and before I was displaced by a freak of the minister's, we had brought it to yield three times as much clear revenue to the Crown as the post office of Ireland. Since that imprudent transaction they have received from it—not one farthing."

The interval between the development of Palmer's methods, and the reforms introduced twenty-seven years later by Sir Rowland Hill, is chiefly marked by the growth of the packet system, under the influence of steam navigation, and by the elaborate investigations of the revenue commissioners of 1826 and the following years. In some important particulars these mark out practical and most valuable reforms, but they contrasted unfavourably with the lucidity and reasoning of Rowland Hill's *Post Office Reform*.

Packet Services. As early as 1788 the cost of the packets employed by the post office attracted parliamentary attention. In that year the "commissioners of fees and gratuities" reported that in the preceding seventeen years the total cost of this branch had amounted to £1,038,133; and they naturally laid stress on the circumstance that many officers of the post office were owners of such packets, even down to the chamber-keeper. At this time part of the packet service was performed by hired vessels, and part by vessels which were the property of the Crown. The commissioners recommended that the latter should be sold, and the entire service be provided for by public and competitive tender. The subject was again inquired into by the finance committee of 1798, which reported that the recommendation of 1788 had not been fully acted upon, and expressed its concurrence in that recommendation. The plan was then to a considerable extent enforced. But the war rapidly increased the expenditure. The average (£61,000) of 1771–1787 had increased in 1797 to £78,439, in 1810 to £105,000, in 1814 to £160,603. In the succeeding years of peace the expense fell to an average of about £85,000. As early as 1818 the "Rob Roy" plied regularly between Greenock and Belfast; but no use was made of steam navigation for the postal service until 1821, when the postmaster-general established Crown packets. The expenditure under the new system, from that date to 1829 inclusive, was thus reported by the commissioners of revenue inquiry in 1830:—

Cost of Packet Service, 1820–1829.[5]

Year.	£	Year.	£
1820[6]	85,000	1825	110,838
1821[7]	134,868	1826	144,592
1822	115,429	1827	159,250
1823	93,725	1828	117,260
1824	116,602	1829	108,305

The general administration of postal affairs at this period was still characterized by repeated advances in the letter rates, and the twenty years previous to Rowland Hill's reforms by a stationary revenue. The following table will show the gross receipts, the charges of collection and management, and the net revenue (omitting fractions of a pound) of the post office of Great Britain. We give the figures for the year 1808 for the purpose of comparison.

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[1] *Debates of both Houses of Parliament in 1808 relative to the Agreement for the Reform and Improvement of the Post Office*, passim. See also H. Joyce, *The History of the Post Office* (1893).

[2] Lang, *Historical Summary of the Post Office in Scotland*, 15.

[3] *Minutes of Evidence before Select Committee on Taxation of Internal Communication* (1837), evidence of Sir Edward Lees, p. 397.

[4] *Report, &c., of Select Committee on Postage.*

[5] *Twenty-second Report of the Commissioners of Revenue Inquiry*, pp. 4–6.

[6] Last year of exclusive sailing packets.

[7] First year of steam-packets.

Year.	Gross Income.	Charges of Collection, &c.	Charges per cent. of Gross Income.	Net Revenue.	Population of United Kingdom.
	£	£		£	
1808	1,552,037	451,431	29	1,100,606	—
1815–16	2,193,741	594,045	27	1,599,696	19,552,000
1818–19	2,209,212	719,622	32½	1,489,590	—
1820–21	2,132,235	636,290	29	1,495,945	20,928,000
1824–25	2,255,239	655,914	29	1,599,325	22,362,000
1826–27	2,392,272	747.018	31	1,645,254	—
1836–37	2,206,736	609,220	27½	1,597,516	25,605,000
1838–39	2,346,278	686,768	29	1,659,510	—

Governmental Interference with Correspondence.

Before passing to the reform of 1839 we have to revert to that important feature in postal history—the interference with correspondence for judicial or political purposes. We have already seen (1) that this assumption had no parliamentary sanction until the enactment of the 9th of Queen Anne; (2) that the enactment differed from the royal proclamations in directing a special warrant for each opening or detention of correspondence. It is a significant gloss on the statute to find that for nearly a century (namely, until 1798 inclusive) it was not the practice to record such warrants regularly in any official book.[1] Of the use to which the power was applied the state trials afford some remarkable instances. At the trial of Bishop Atterbury, for example, in 1723 certain letters were offered in evidence which a clerk of the post office deposed on oath "to be true copies of the originals, which were stopped at the post office and copied, and sent forward as directed." Hereupon Atterbury asked this witness "if he had any express warrant under the hand of one of the principal secretaries of state for opening the said letters." But the lords shelved his objection on the grounds of public inexpediency. Twenty-nine peers recorded their protest against this decision.[2] But the practice thus sanctioned appears to have been pushed to such lengths as to elicit in April 1735 a strong protest and censure from the House of Commons. A committee of inquiry was appointed, and after receiving its report the house resolved that it was "an high infringement of the privileges of the . . . Commons of Great Britain in Parliament that letters of any member should be opened or delayed without a warrant of a principal secretary of state."

Sir Rowland Hill's Reforms (1836–1842).

Rowland Hill's pamphlet (*Post Office Reform*) of 1837 took for its starting-point the fact that, whereas the postal revenue showed for the past twenty years a positive though slight diminution, it ought to have showed an increase of £507,700 a year in order to have simply kept pace with the growth of population, and an increase of nearly four times that amount in order to have kept pace with the growth of the analogous though far less exorbitant duties imposed on stage-coaches. The stage-coach duties had produced, in 1815, £217,67-; in 1835 they produced £498,497. In 1837 there did not exist any precise account of the number of letters transmitted through the general post office. Hill, however, was able to prepare a sufficiently approximate estimate from the data of the London district post, and from the sums collected for postage. He thus calculated the number of chargeable letters at about 88,600,000, that of franked letters at 7,400,000, and that of newspapers at 30,000,000, giving a gross total of about 126,000,000. At this period the total cost of management and distribution was £696,569. In the finance accounts of the year (1837) deductions are made from the gross revenue for letters "refused, missent, redirected," and the like, which amount to about £122,000. An analysis of the component parts of this expenditure assigned £426,517 to cost of primary distribution and £270,052 to cost of secondary distribution and miscellaneous charges. A further analysis of the primary distribution expenditure gave £282,308 as the probable outgoings for receipt and delivery, and £144,209 as the probable outgoings for transit. In other words, the expenditure which hinged upon the *distance* the letters had to be conveyed was £144,000, and that which had nothing to do with distance was £282,000. Applying to these figures the estimated number of letters and newspapers (126,000,000) passing through the office, there resulted a probable average cost of $\frac{84}{100}$ of a penny for each, of which $\frac{28}{100}$ was cost of transit and $\frac{56}{100}$ cost of receipt, delivery, &c. Taking into account, however, the greater weight of newspapers and franked letters as compared with chargeable letters, the apparent average cost of *transit* became, by this estimate, but about $\frac{9}{100}$, or less than $\frac{1}{10}$ of a penny.

A detailed estimate of the cost of conveying a letter from London to Edinburgh, founded upon the average weight of the Edinburgh mail, gave a still lower proportion, since it reduced the apparent cost of transit, on the average, to the thirty-sixth part of one penny. Hill inferred that, if the charge for postage were to be made proportionate to the whole expense incurred in the receipt, transit and delivery of the letter, and in the collection of its postage, it must be made *uniformly* the same from every post-town to every other post-town in the United Kingdom, unless it could be shown how we are to collect so small a sum as the thirty-sixth part of a penny. And, inasmuch as it would take a ninefold weight to make the expense of transit amount to one farthing, he further inferred that, taxation apart, the charge ought to be precisely the same for every packet of moderate weight, without reference to the number of its enclosures.

At this period the rate of postage actually imposed (beyond the limits of the London district office) varied from 4d. to 1s. 8d. for a single letter, which was interpreted to mean a single piece of paper not exceeding an ounce in weight; a second piece of paper or any other enclosure, however small, constituted the packet a double letter. A single sheet of paper, if it at all exceeded an ounce in weight, was charged with fourfold postage. The average charge on inland general post letters was nearly 9d. for each. It was proposed that the charge for primary distribution—that is to say, the postage on all letters received in a post-town, and delivered in the same or in any other post-town in the British Isles— should be at the uniform rate of one penny for each half-ounce—all letters and other papers, whether single or multiple, forming one packet, and not weighing more than half an ounce, being charged one penny, and heavier packets, to any convenient limit, being charged an additional penny for each additional half-ounce. It was further proposed that stamped covers should be sold to the public at such a price as to include the postage, which would thus be collected in advance.[3]

Parliamentary Action.

By the public generally, and pre-eminently by the trading public, the plan was received with favour. By the functionaries of the post office it was denounced as ruinous and visionary. In 1838 petitions poured into the House of Commons. A select committee was appointed, which reported as follows:—

"The principal points which appear to your committee to have been established in evidence are the following: (1) the exceedingly slow advance and occasionally retrograde movement of the post office revenue during the . . . last twenty years; (2) the fact of the charge of postage exceeding the cost in a manifold proportion; (3) the fact of postage being evaded most extensively by all classes of society, and of correspondence being suppressed, more especially among the middle and working classes of the people, and this in consequence, as all the witnesses, including many of the post office authorities, think, of the excessively high scale of taxation; (4) the fact of very injurious effects resulting from this state of things to the commerce and industry of the country, and to the social habits and moral condition of the people; (5) the fact, as far as conclusions can be drawn from very imperfect data, that whenever on former occasions large reductions in the rates have been made, these reductions have been followed in short periods of time by an extension of correspondence proportionate to the contraction of the rates; (6) and, as matters of inference from fact and of opinion—(i.) that the only remedies for the evils above stated are a reduction of the rates, and the establishment of additional deliveries, and more frequent despatches of letters; (ii.) that owing to the rapid extension of railroads there is an urgent and daily increasing necessity for making such changes; (iii.) that any moderate reduction in the rates would occasion loss to the revenue, without in any material degree diminishing the present amount of letters irregularly conveyed, or giving rise to the growth of new correspondence; (iv.) that the principle of a low uniform rate is just in itself, and, when combined with prepayment and collection by means of a stamp, would be exceedingly convenient and highly satisfactory to the public."

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[1] *Report of Secret Committee on the Post Office* (1844), p. 9.

[2] *Lords' Journals*, xxii. 183–186; *State Trials*, xvi. 540 seq.

[3] *Post Office Reform*, 27 seq.

Nature of Reforms.

A bill to enable the treasury to establish uniform penny postage was carried in the House of Commons by a majority of 100, and became law on the 17th of August 1839. A temporary office was created to enable Rowland Hill to superintend the working out of his plan. The first step taken was to reduce, on the 5th of December 1839, the London district postage to 1d. and the general inland postage to 4d. the half-ounce (existing lower rates being continued). On the 10th of January 1840 the uniform penny rate came into operation throughout the United Kingdom—the scale of weight advancing from 1d. for each of the first two half-ounces, by gradations of 2d. for each additional ounce, or fraction of an ounce, up to 16 oz. The postage was to be prepaid, and if not to be charged at double rates. Parliamentary franking was abolished. Postage stamps were introduced in May following. The facilities of despatch were soon afterwards increased by the establishment of day mails.

Results.

But on the important point of simplification in the internal economy of the post office, with the object of reducing its cost without diminishing its working power, little was done. The plan had to work in the face of rooted mistrust on the part of the workers. Its author was (for a term of two years, afterwards prolonged to three) the officer, not of the post office, but of the treasury. He could only recommend measures the most indispensable through the chancellor of the exchequer. It happened, too, that the scheme had to be tried at a period of severe commercial depression. Nevertheless, the results actually attained in the first two years were briefly these: (1) the chargeable letters delivered in the United Kingdom, exclusive of that part of the government correspondence which theretofore passed free, had already increased from the rate of about 75,000,000 a year to that of 196,500,000; (2) the London district post letters had increased from about 13,000,000 to 23,000,000, or nearly in the ratio of the reduction of the rates; (3) the illicit conveyance of letters was substantially suppressed; (4) the gross revenue, exclusive of repayments, yielded about a million and a half per annum, which was about 63% of the amount of the gross revenue in 1839. These results at so early a stage, and in the face of so many obstructions, vindicated the new system.

Seven years later (1849) the 196,500,000 letters delivered throughout the United Kingdom in 1842 had increased to nearly 329,000,000. In addition, the following administrative improvements had been effected: (1) the time for posting letters at the London receiving-houses extended; (2) the limitation of weight abolished; (3) an additional daily despatch to London from the neighbouring (as yet independent) villages; (4) the postal arrangements of 120 of the largest cities and great towns revised; (5) unlimited writing on inland newspapers authorized on payment of an additional penny; (6) a summary process established for recovery of postage from the senders of unpaid letters when refused; (7) a book-post established; (8) registration reduced from one shilling to sixpence; (9) a third mail daily put on the railway (without additional charge) from the towns of the north-western district to London, and day mails extended within a radius of 20 m. round the metropolis; (10) a service of parliamentary returns, for private bills, provided for; (11) measures taken, against many obstacles, for the complete consolidation of the two heretofore distinct corps of letter-carriers—an improvement (on the whole) of detail, which led to other improvements thereafter.[1]

Later History (1842–1905).

When Sir R. Hill initiated his reform the postmaster-general was the earl of Lichfield, the thirty-first in succession to that office after Sir Brian Tuke. Under him the legislation of 1839 was carried out in 1840 and 1841. In September 1841 he was succeeded by Viscount Lowther.

Opening and Detention of Letters.

In the summer of 1844 the statement that the letters of Mazzini, then a political refugee, long resident in England, had been systematically opened, and their contents communicated to foreign governments, by Sir James Graham, secretary of state for the home department, aroused much indignation. The arrest of the brothers Bandiera,[2] largely in consequence of information derived from their correspondence with Mazzini, and their subsequent execution at Cosenza made a thorough investigation into the circumstances a public necessity. The consequent parliamentary inquiry of August 1844, after retracing the earlier events connected with the exercise of the discretional power of inspection which parliament had vested in the secretaries of state in 1710, elicited the fact that in 1806 Lord Spencer, then secretary for the home department, introduced for the first time the practice of recording in an official book all warrants issued for the detention and opening of letters, and also the additional fact that from 1822 onwards the warrants themselves had been preserved. The whole number of such warrants issued from 1806 to the middle of 1844 inclusive was stated to be 323, of which no less than 53 had been issued in the years 1841–1844 inclusive, a number exceeding that of any previous period of like extent.

The committee of 1844 proceeded to report that "the warrants issued during the present century may be divided into two classes —1st, those issued in furtherance of criminal justice . . . ; 2nd, those issued for the purpose of discovering the designs of persons known or suspected to be engaged in proceedings dangerous to the State, or (as in Mazzini's case) *deeply involving British interests*, and carried on in the United Kingdom or in British possessions beyond the seas. . . . Warrants of the second description originate with the home office. The principal secretary of state, of his own discretion, determines when to issue them, and gives instructions accordingly to the under-secretary, whose office is then purely ministerial. The mode of preparing them, and keeping record of them in a private book, is the same as in the case of criminal warrants. *There is no record kept of the grounds on which they are issued*, except so far as correspondence preserved at the home office may lead to infer them.[3] . . . The letters which have been detained and opened are, unless retained by special order, as sometimes happens in criminal cases, closed and resealed, without affixing any mark to indicate that they have been so detained and opened, and are forwarded by post according to their respective superscriptions."[4]

Almost forty years later a like question was again raised in the House of Commons (March 1882) by some Irish members, in relation to an alleged examination of correspondence at Dublin for political reasons. Sir William Harcourt on that occasion spoke thus: "This power is with the secretary of state in England. . . . In Ireland it belongs to the Irish government. . . . It is a power which is given for purposes of state, and the very essence of the power is that no account [of its exercise] can be rendered. To render an account would be to defeat the very object for which the power was granted. If the minister is not fit to exercise the power so entrusted, upon the responsibility cast upon him, he is not fit to occupy the post of secretary of state."[5] The House of Commons accepted this explanation; and in view of many grave incidents, both in Ireland and in America, it would be hard to justify any other conclusion.

Increase in Postal Business, 1839–1857.

The increase in the number of postal deliveries and in that of the receiving-houses and branch-offices, together with the numerous improvements introduced into the working economy of the post office, when Rowland Hill at length obtained the means of fully carrying out his reforms by his appointment as secretary, speedily gave a more vigorous impulse to the progress of the net revenue than had theretofore obtained. During the seven years 1845–1851 inclusive the average was but £810,951. During the six years 1852–1857 inclusive the average was £1,166,448—the average of the gross income during the same septennial period having been £2,681,835.

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[1] Hill, *History of Penny Postage* (1880), appendix A (*Life*, &c., ii. 438). Part of the strenuousness of the opposition to this measure arose, it must be owned, from the "high-handedness" which in Sir R. Hill's character somewhat marred very noble faculties. The change worked much harm to some humble but hardworking and meritorious functionaries.

[2] *Ricordi dei fratelli Bandiera e dei loro compagni di martirio in Cosenza*, p. 47 (Paris, 1844).

[3] *Report from the Secret Committee on the Post Office* (1844), p. 11.

[4] Ibid., pp. 14–17.

[5] Hansard, *Debates*, vol. cclxvii. cols. 294–296 (session of 1882).

Number of Letters: Gross and Net Income, 1838–1857.

Year ending	Estimated No. of Chargeable Letters.	Gross Income.	Cost of Management.	Net Revenue.	Postage charged on Government.
		£	£	£	£
Jan. 5, 1838	—	2,339,737	687,313	1,652,424	38,528
,, 1842	196,500,191	1,499,418	938,168	561,249	113,255
,, 1847	299,586,762	1,963,857	1,138,745	825,112	100,354
,, 1852	360,647,187	2,422,168	1,304,163	1,118,004	167,129
Dec. 31, 1857	504,421,000	3,035,713	1,720,815	1,314,898	135,517

Within a period of eighteen years under the penny rate the number of letters became more than sixfold what it was under the rates of 1838. When the change was first made the increase of letters was in the ratio of 122·25% during the year. The second year showed an increase on the first of about 16%. During the next fifteen years the average increase was at the rate of about 6% per annum. Although this enormous increase of business, coupled with the increasing preponderance of railway mail conveyance (invaluable, but costly), carried up the post office expenditure from £757,000 to £1,720,800, yet the net revenue of 1857 was within £350,000 of the net revenue of 1839. During the year 1857 the number of newspapers delivered in the United Kingdom was about 71 millions, and that of book-packets (the cheap carriage of which is one of the most serviceable and praiseworthy of modern postal improvements) about 6 millions.

Growth and Changes, 1858–1905.

Since 1858 the achievements of the period 1835–1857 have been eminently surpassed. This period includes the establishment of postal savings banks (1861) and the transfer to the state of the telegraphic service (1870). These improvements are dealt with in separate articles. The British postal business has grown at a more rapid rate than the population of the United Kingdom. Some of the causes of this development must be sought within the post office department, *e.g.* improved facilities, lower charges and the assumption of new functions; but others are to be found in the higher level of popular education, the increase of wealth, industry and commerce, and the rapid expansion of Greater Britain.

The following table shows the growth of letters delivered:—

United Kingdom.—Estimated inland delivery of letters, 1839–1905, with the increase per cent. per annum. Also the average number to each person, 00,000's omitted.

Inland Letter Rates,

The rates of inland letter postage have been altered as follows. From the 5th of October 1871 to the 1st of July 1885 the charges were: not exceeding 1 oz. one penny; over 1 oz. and not exceeding 2 oz. three halfpence, and an additional halfpenny for every 2 oz., so that the postage on a letter weighing between 10 and 12 oz. was 4d. On a letter weighing over 12 oz. and not exceeding 13 oz. the postage was 1s. 1d., and increased 1d. for each succeeding ounce. On the 1st of July 1885 the postage on letters over 12 oz. was reduced, and the gradation of charge beyond 2 oz. was made uniform, at the rate of one halfpenny for each additional ounce. Thus a letter weighing over 12 and not exceeding 14 oz. was charged 4½d., 14 to 16 oz. 5d., and so on. Notwithstanding this change, it was found as late as 1895 that 95% of the letters sent through the post weighed not more than 1 oz. each.

Among a number of postal and telegraphic concessions made to the public on the 22nd of June 1897, the sixtieth anniversary of Queen Victoria's accession to the throne, were new rates for letters as follows:—

	d.
Not exceeding 4 oz.	1
Over 4 oz. and not exceeding 6 oz.	1½
,, 6 ,, ,, ,, 8 ,,	2

with ½d. for each succeeding 2 oz.

This change, while it saved both the post office and the public the trouble of testing the weight of a large number of letters, had also the advantage of simplicity of calculation—one halfpenny is charged for each 2 oz., with a minimum charge of 1d.

Arrangements were at the same time made to ensure a delivery of letters by postmen at every house in the United Kingdom. It was estimated that 16 millions of letters, whose owners had previously to fetch them from the post office or from some point on a postman's walk, would thus be added to the official delivery. The estimate proved to be much under the mark, some 60 millions being added to the letters brought annually into the official delivery under this arrangement. Financial considerations have now been entirely disregarded for the benefit of these letters, and the cost of their delivery alone greatly exceeds the whole revenue derived from them.

In studying the statistics of letters delivered, it should be remembered that the figures for any particular year are affected by circumstances like a general election or a boom in trade, as well as by changes in the rates or condition of the post office services. The letters from foreign countries have been stimulated by lower charges, and those from the colonies by the imperial penny post, to which reference is made below.

Year ending 31st December until 1876, and thereafter the Financial Year ending 31st March.	Delivered in England and Wales.				Total in England and Wales.	Increase per cent. per annum.	Average number to each person.	Total in Scotland.	Increase per cent. per annum.	Average number to each person.	Total in Ireland.	Increase per cent. per annum.	Average number to each person.	Total in United Kingdom.	Increase per cent. per annum.	Average number to each person.
	By Country Offices.	Increase per cent. per annum.	In London District, including Local Letters.	Increase per cent. per annum.												
Estimated No. of Letters, 1839	—	—	—	—	60,0	—	4	8,0	—	3	8,0	—	1	76,0	—	3
,, ,, Franks. 1839	—	—	—	—	5,1	—		3	—		1,0	—		6,5	—	
,, ,, Letters, 1840	88,0	—	44,0	—	132,0	120·0	8	19,0	143·5	7	18,0	119·2	2	169,0	22·2	7
Average of 5 years, 1841–1845	122,0	10·7	57,0	9·0	179,0	10·2	11	24,0	9·2	9	24,0	9·5	3	227,0	10·0	8
,, ,, 1846–1850	180,0	5·5	79,0	5·5	259,0	5·2	15	34,0	4·2	12	34,0	5·0	4	327,0	5·0	12
,, ,, 1851–1855	233,0	6·5	97,0	5·0	330,0	6·0	13	41,0	5·2	14	39,0	3·5	6	410,0	5·7	15
,, ,, 1856–1860	302,0	4·2	125,0	5·5	427,0	4·5	22	51,0	3·2	16	45,0	3·0	7	523,0	4·2	18
,, ,, 1861–1865	373,0	5·7	161,0	5·7	534,0	5·7	29	61,0	0·5	20	53,0	3·2	9	648,0	5·5	22
,, ,, 1866–1870	472,0	4·2	192,0	3·2	664,0	4·0	31	76,0	4·7	24	60,0	3·2	11	800,0	4·0	26
Year 1871	501,0	0·5	220,0	7·0	721,0	2·5	32	80,0	1·2	24	66,0	3·0	13	867,0	2·3	27
,, 1875	580,0	4·8	266,7	6·5	846,8	5·3	35	90,9	0·9	26	70,5	0·8	13	1,008,3	4·6	31
,, 1880–1881	650,9	1·7	330,4	6·6	981,3	3·3	38	104,9	3·0	29	78,7	3·8	15	1,165,1	3·3	34
,, 1884–1885	757,2	2·7	391,1	4·1	1,148,3	3·2	42	122,9	2·6	32	89,1	1·6	18	1,360,3	2·9	38
,, 1890–1891	924,4	3·3	538,4	4·0	1,462,8	3·5	50	143,2	2·1	36	99,8	3·1	21	1,709,0	3·4	45
,, 1894–1895[1]	993,3	2·0	508,8	dec. 11·6	1,502,1	dec. 3·1	50	156,0	1·4	38	112,8	4·0	24	1,770,9	dec. 2·3	46
,, 1900–1901[2]	1,312,7	2·9	664,3	inc. 5·0	1,977,0	inc. 3·6	61	202,4	2·8	47	144,2	2·2	32	2,323,6	inc. 3·4	57
,, 1905–1906	1,559,9	3·2	753,4	3·6	2,313,3	3·3	68	238,1	3·7	51	155,8	0·1 dec.	36	2,707,2	3·1	62

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[1] It was discovered in the course of this year that the estimated figures for previous years had been swollen by an imperfect method of reckoning the London letters, &c. In 1883 as many as 2,770,000 valentines were sent through the post. The numbers gradually decreased until in 1890 only 320,000 were observed. Christmas cards have, however, considerably increased.

[2] Since the 22nd of June 1897, all packets over 2 oz., formerly counted as book packets, are reckoned as letters.

Letter and Post Cards. On the 12th of February 1892 letter cards bearing an imprinted penny stamp, and made to be fastened against inspection, were issued to the public at a charge of 1s. for 10 cards. The charge was reduced almost at once to 9d. for 8 cards. Similar cards have long been in use on the continent of Europe, but they do not enjoy much popularity in Great Britain either with the post office, which finds them inconvenient to handle in sorting and stamping, or with the public. The number issued annually is about 10 millions, not counting those of private manufacturers.

The following table gives the number of post cards:—

Estimated Number of Post Cards delivered in the United Kingdom, and the Increase per cent. per Annum.

Year.	England and Wales.		Scotland.		Ireland.		United Kingdom.	
	Number.	Inc. per cent. per annum.	Number.	Inc. per cent. per annum.	Number.	Inc. per cent. per annum.	Number.	Inc. per cent. per annum.
1872	64,000,000	—	8,000,000	—	4,000,000	—	76,000,000	—
1875	73,369,100	11·6	9,206,300	6·7	4,540,900	5·5	87,116,300	10·7
1881–1882	114,251,500	10·4	14,651,400	9·3	6,426,100	6·9	135,329,000	10·1
1884–1885	134,100,000	4·3	18,400,000	5·5	7,900,000	3·1	160,400,000	4·4
1889–1890	184,400,000	8·4	22,900,000	5·0	9,800,000	5·4	217,100,000	7·8
1893–1894	209,100,000	1·4	27,400,000	2·2	12,000,000	6·2	248,500,000	1·6
1894–1895*	271,600,000	29·9	28,700,000	4·7	12,500,000	4·2	312,800,000	25·9
		dec.						
1895–1896	268,300,000	1·2	32,200,000	12·2	14,000,000	12·0	314,500,000	0·6
		inc.						
1900–1901	359,400,000	4·9	41,600,000	2·0	18,000,000	6·5	419,000,000	4·7
1905–1906	676,500,000	9·6	91,000,000	5·0	32,800,000	6·8	800,300,000	9·0

*Private cards with adhesive stamps first allowed in this year.

Post cards were first introduced in Austria on the 1st of October 1869, and were first issued in Great Britain on the 1st of October 1870. Only one kind of card was employed, and this was sold for one halfpenny; but on the complaints of the stationers, a charge of ½d. per dozen for the material of the card was made in 1872, and permission was given for private persons to have their own cards stamped at Somerset House. In 1875 a stouter card was put on sale, and the charges were raised to 7d. per dozen for thin cards and 8d. per dozen for stout cards. In 1889 the charges were reduced, and they are now sold at 10 for 5½d. and 11 for 6d. respectively. On the 1st of September 1894, private post cards with an adhesive halfpenny stamp were allowed to pass by post, and the result has been greatly to diminish the number of cards purchased through the post office. It is estimated that 232 out of the 400 millions of cards delivered in 1899–1900 were private cards. The sizes of the official cards were again altered in January 1895 and November 1899. The regulations forbidding anything but the address to be written on the address side of a post card were made less stringent on the 1st of February 1897; and in 1898 unpaid post cards, which were previously charged as unpaid letters, were allowed to be delivered on payment of double the post card rate. These various changes, especially the use of the private card and the popularity of illustrated post cards, have contributed to the rapid increase in the number of post cards sent by post. Reply post cards were first issued on the 1st of October 1893. Their use has not been extensive. Only about 1½ million are issued yearly.

Book Packets and Samples.—The table at foot of page shows the estimated number of book packets, circulars and samples delivered in the United Kingdom, and the increase per cent. per annum. The rate of ½d. for 2 oz. for the book post has remained unaltered since the 1st of October 1870. Changes have been made in the regulations defining the articles which may be sent by book post, and prescribing the mode of packing them so as to admit of easy examination for the purpose of detecting letters, &c., sent by the halfpenny post. The book post received a great impetus in 1892 (May 28) by the permission to enclose book packets in unsealed envelopes. Complaint is, however, made that such envelopes form a dangerous trap for small letters, which are liable to slip inside the flaps of open envelopes. But as the rate of postage for articles weighing over 2 oz. is now the same for letters and for book packets, articles over that weight derive no advantage from being sent in open covers.

Sample Post.—The sample or pattern post, which was confined to bona-fide trade patterns and samples on the 1st of October 1870, was then assimilated to the book post (½d. for 2 oz.); but the restriction was difficult to enforce and irritating to the public, and the sample post was abolished on the 5th of October 1871, when the rates of letter postage were lowered. It was re-established on the 1st of October 1887 (1d. for 4 oz. or under, and ½d. for each succeeding 2 oz.); but when the Jubilee letter rates were introduced (June 22, 1897) it lost its *raison d'être*, and ceased to exist for inland purposes.

Newspapers.—The table on next page shows the estimated number of newspapers delivered in the United Kingdom, and the increase per cent. per annum.

The carriage of newspapers by the post office does not show the same elasticity as other post office business. This is due largely to the improved system of distribution adopted by newspaper managers and especially to the extension of the halfpenny press. The practice of posting a newspaper after reading it, under a co-operative arrangement, has practically ceased to exist. The carriage of newspapers by post is conducted by the post office at a loss.

Halfpenny Post Finance. It has been frequently stated on behalf of the post office that the halfpenny post is unremunerative. Representations are, however, made from time to time in favour of lower postage for literature of all kinds. It may therefore be of interest to mention that the postmaster-general of the United States has, in successive annual reports, deplored the effect on the post office service of the cheap rates for "second-class matter." The cost of carriage over so large a territory is heavier than in the United Kingdom; but the postmaster-general states that the low rates of postage "involve a sheer wanton waste of $20,000,000 or upwards a year." Facilities like the extension of free delivery are stifled, and the efficiency of the whole service cramped by the loss thus sustained. In the United Kingdom the rules respecting the halfpenny post were greatly simplified and brought into effect on the 1st of October 1906. The halfpenny post can be used only

Year.	England and Wales.		Scotland.		Ireland.		United Kingdom.	
	Number.	Inc. per cent. per annum.	Number.	Inc. per cent. per annum.	Number.	Inc. per cent. per annum.	Number.	Inc. per cent. per annum.
1872	90,000,000	—	13,000,000	—	11,000,000	—	114,000,000	—
1875	133,394,900	15·2	15,723,700	—	9,548,000	—	158,666,600	11·7
1881–1882	228,999,400	12·3	27,875,000	15·0	14,164,300	16·9	271,038,700	12·8
1884–1885	269,400,000	8·1	34,500,000	10·0	16,500,000	18·9	320,400,000	8·8
1889–1890	378,200,000	7·5	42,100,000	3·7	21,600,000	9·6	441,900,000	7·3
1894–1895	522,500,000	6·7	60,800,000	8·2	31,300,000	10·2	614,600,000	7·0
		dec.		dec.		dec.		dec.
1898–1899[1]	590,900,000	3·6	75,100,000	2·3	35,500,000	5·3	701,500,000	3·5
		inc.		inc.		inc.		inc.
1900–1901	619,300,000	4·0	77,800,000	3·7	35,300,000	8·6	732,400,000	4·2

[1] Book packets over 2 oz. transferred to the letter post as a result of the Jubilee changes.

for packets not exceeding 2 oz. in weight. The length of a packet must not exceed 2 ft., while 1 ft. is the limit in width or depth. Any printed or written matter not in the nature of a letter may be sent by the halfpenny post, but every packet must be posted either without a cover or in an unfastened envelope, or in a cover which can be easily removed. The number of halfpenny packets delivered in 1906–1907 was 933,200,000.

Year.	England and Wales.		Scotland.		Ireland.		United Kingdom.	
	Number.	Inc. per cent. per annum.	Number.	Inc. per cent. per annum.	Number.	Inc. per cent. per annum.	Number.	Inc. per cent. per annum.
1872 . .	87,000,000	—	12,000,000	—	10,000,000	—	109,000,000	—
1875 . .	93,345,600	2·3	13,819,100	4·5	13,884,700	10·2	121,049,400	3·4
1881–1882	108,651,700	5·7	15,477,300	2·4	16,660,100	4·7	140,789,100	5·2
1884–1885	110,700,000	·7	16,900,000	0·9	16,100,000	0·5	143,700,000	0·7
1889–1890	126,600,000	6·1 dec.	16,700,000	0·6 dec.	16,000,000	— dec.	159,300,000	4·9 dec.
1894–1895[1]	117,500,000	9·5 inc.	17,300,000	2·3 inc.	17,000,000	2·3 inc.	151,800,000	7·9 inc.
1899–1900	125,000,000	5·9	19,300,000	7·8	19,100,000	4·9	163,400,000	6·0
1900–1901	127,800,000	2·2	19,300,000	—	20,700,000	8·4	167,800,000	2·7

Inland Parcels.

The inland parcel post began on the 1st of August 1883. No parcel might exceed 7 ℔ in weight, 3½ ft. in length, of 6 ft. in length and girth combined. The rates were: not exceeding 1 ℔, 3d.; exceeding 1 ℔, but not exceeding 3℔, 6d.; exceeding 3 ℔, but not exceeding 5 ℔, 9d.; exceeding 5 ℔, but not exceeding 7 ℔, 1s. The following table shows the number of parcels delivered in the United Kingdom:—

Year ending 31st March.	Number of Parcels.
1884	14,000,000
1885	22,910,040
1890	42,852,600
1895	57,136,000
1900	75,448,000
1905	97,231,000

Arrangements were made with the railway companies, under which they receive 55% of the postage on each parcel sent by train. This arrangement, which was to hold good for 21 years, proved, however, an onerous one, and on the 1st of June 1887 the post office started a parcel coach between London and Brighton. The coach, replaced in 1905 by a motor van, travelled by night, and reached Brighton in time for the first delivery. The experiment proving successful, other coach and motor services were started at different dates between London and other places in the provinces, the mail services performed by motor vans amounting in 1906 to nearly forty. Nearly 11½ millions of parcels were conveyed by the post office in 1900–1901 without passing over a railway.

On the 1st of May 1896, the maximum weight was increased to 11 ℔, and the postage rates were reduced: not exceeding 1℔, 3d.; for each succeeding ℔, 1½d.; the charge for a parcel of 11 ℔ was thus 1s. 6d. New rates were subsequently introduced and the rates for parcels now are: not exceeding 1 ℔, 3d.; 2 ℔, 4d.; 3 ℔, 5d; 5 ℔, 6d.; 7 ℔, 7d.; for each succeeding ℔ up to 11 ℔, 1d. The length of a parcel must not exceed 3 ft. 6 in.; length and girth combined must not exceed 6 ft. By the Post Office (Literature for the Blind) Act 1906, the postage on packets of papers and books impressed for the use of the blind was greatly reduced, the rates being fixed at: not exceeding 2 oz., ½d.; exceeding 2 oz. and not exceeding 2 ℔, 1d.; not exceeding 5 ℔, 1½d.; not exceeding 6 ℔, 2½d.

Registered Letters.

The number of letters registered by the public in the United Kingdom in 1884–1885 amounted to 11,365,151. In the next ten years the numbers oscillated between 10,779,555 (1886–1887) and 12,132,144 (1892–1893); but since 1894–1895, when 11,958,264 letters were registered, the number steadily increased, until it stood at 19,029,114 for 1903–1904. It decreased, however, 2·8% in 1904–1905, inincreased ·7 in the following year, but declined again by ·8% in 1906–1907. It has been surmised[2] that the introduction of postal orders checked the growth of registered letters for some years after 1880. In 1886 a system of insurance for registered letters was adopted. The ordinary registration fee entitled the owner, in case of loss, to recover compensation from the post office up to a limit of £2. For an additional insurance fee of 1d. the limit was raised to £5, and for 2d. to £10. Various changes have since been made, and the separate insurance system has been abolished. At present a registration fee of 2d. entitles to compensation up to £5, 3d. £20, and each additional penny to a further £20, up to a maximum of £400. The system of registration has also been extended to parcels.

Railway Letters.

On the 1st of February 1891 the railway letter service came into operation. At passenger stations on the principal railways a letter not exceeding 4 oz. in weight may be handed in at the booking office for conveyance by the next train. A fee of 2d. is payable to the railway company as well as the ordinary postage of 1d. The letter may be addressed to a railway station to be called for. If it bears any other address it is posted on arrival at its proper station. The number of packets so sent is about 200,000 a year.

Express Letters.

The express delivery service dates from the 25th of March 1891. A private company formed for the purpose of supplying the public on demand with an express messenger to execute errands was found to be infringing the postmaster-general's monopoly both as regards the conveyance of letters and the transmission of communications by electricity. The services of the company were, however, much appreciated by the public. The government accordingly authorized the post office to license the existing company to continue its business, on the payment of royalties, till 1903,[3] and to start an express service of its own.

Messengers can be summoned from the post office by telephone, and arrangements can be made with the post office for the special delivery of all packets arriving by particular mails in advance of the ordinary postman. The sender of a packet may have it conveyed by express messenger all the way, or may direct that, after conveyance by ordinary post to the terminal post office, it shall then be delivered by special messenger. The fees, in addition to ordinary postage, were originally fixed at 2d. for the first mile, 3d. for the second mile, and 1s. a mile additional when the distance exceeded 2 m. and there was no public conveyance. Under the present regulations the fee is 3d. for each mile covered by special messenger before delivery. No charge is made for postage in respect of the special service, but if the packet is very weighty or the distance considerable, and no public conveyance is available, the sender must pay for a cab or other special conveyance.

Letters and parcels to or from a number of foreign countries and colonies may also be marked for express delivery after transmission by post; and residents in London, not having a delivery of ordinary letters on Sunday, may receive on that day express letters from home or abroad which have come to hand too late for express delivery on Saturday nights. The total number of express services in 1905–1906 was 1,578,746. In many cases one of these services included the delivery of batches of letters, so that in London alone 1,010,815 express services were performed, including 47,601 deliveries in advance of the postmen.

Returned Letters.

There are various central dépôts for dealing with "dead" or returned letters. The principal office is in London. In the year 1905–1906 10,868,272 letters were received at the various returned letter offices, of which 1,008,017 could neither be delivered to the addresses nor returned to the senders. Such of these as contain nothing of value are at once destroyed, and no record of them is kept. The others are recorded, and (if not previously claimed by the owners) their contents are sold by auction at intervals. If the owner applies after the sale, the proceeds are handed over to him. In addition to these 10 millions of letters, there were many others disposed of at head post offices, whence they were returned direct and unopened to the senders, whose names and addresses appeared on the outside of the letters. The total number of post cards received in the various offices as undelivered was 2,656,770; halfpenny packets, 12,439,377; newspapers, 473,346; and parcels, 248,526; 195,145 of these last were re-issued. Articles sent by the halfpenny post are destroyed at the head offices if they cannot be delivered; but the sender may have such articles returned if he writes a request to that effect on the outside of the packet, together with his name and address, and pays a second postage on the return of the packet. The number of registered letters and letters containing property sent through the post with insufficient addresses was 320,041. These letters contained £16,887 in cash and bank-notes, and £656,845 in bills, cheques, money orders, postal orders and stamps. The coin found loose in the post amounted to £1,380, as well as £12,272 in cheques and other forms of remittance.

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[1] See note to table of *Letters Delivered.*

[2] *Thirty-second Report of Postmaster-General.*

[3] Afterwards extended to the 31st of March 1922.

00's omitted.

Country or Colony.	Despatched from the United Kingdom.		Destined for the United Kingdom.	
	Letters and Post Cards.	Circulars, Book Packets, Patterns, News-papers.	Letters and Post Cards.	Circulars, Book Packets, Patterns, News-papers.
EUROPE.	℔	℔	℔	℔
Austria-Hungary	52,0	392,0	41,0	118,0
Belgium and Luxemburg	88,0	358,0	87,0	201,0
Denmark, Norway and Sweden	78,0	314,0	65,0	132,0
France (including Algeria and Tunis)	329,0	1,426,0	354,0	1,152,0
Germany	310,0	1,656,0	378,0	1,090,0
Gibraltar (including Tangier), Malta and Cyprus	46,0	413,0	64,0	44,0
Holland	140,0	302,0	90,0	450,0
Italy	73,0	613,0	66,0	172,0
Russia	49,0	325,0	35,0	92,0
Spain, Portugal and Azores	50,0	536,0	47,0	85,0
Switzerland	66,0	490,0	55,0	147,0
Turkey, Greece, Rumania and Balkan States	25,5	305,0	23,0	65,0
Totals	1,306,5	7,130,0	1,305,0	3,748,0
ASIA.	℔	℔	℔	℔
Asiatic Turkey and Persia	8,5	100,0	5,0	35,0
India (including Aden)	230,0	2,828,0	164,0	432,0
Ceylon, Straits Settlements and East Indies	56,0	755,0	40,0	90,0
China and Japan	54,0	762,0	55,0	84,0
Totals	348,5	4,445,0	264,0	641,0
AFRICA.	℔	℔	℔	℔
South African Colonies	323,0	2,671,0	237,0	530,0
East Coast of Africa (British and Portuguese Possessions), Mauritius, &c.	16,0	186,0	10,0	15,0
West Coast of Africa, Madeira, Canary Islands, Cape Verde, St Helena and Ascension	31,0	382,0	32,0	20,0
Egypt	40,0	398,0	28,0	64,0
Totals	410,0	3,637,0	307,0	629,0
AMERICA.	℔	℔	℔	℔
United States	397,0	2,850,0	431,0	2,488,0
Canada and Newfoundland	248,0	1,891,0	187,0	616,0
Mexico and Central American States	11,0	177,0	11,0	13,0
Brazil, Argentine Republic, Uruguay and Paraguay	39,0	621,0	35,0	78,0
Chile, Peru and Bolivia	15,0	195,0	17,0	34,0
Ecuador, Colombia and Venezuela	7,0	83,0	3,0	4,0
West Indies (British and Foreign)	49,0	449,0	31,0	47,0
Totals	766,0	6,266,0	715,0	3,280,0
AUSTRALASIA.	℔	℔	℔	℔
Commonwealth of Australia	122,0	1,600,0	80,0	534,0
New Zealand, Fiji, &c.	56,0	753,0	40,0	333,0
Totals	178,0	2,353,0	120,0	867,0
Grand totals	3,009,0	23,831,0	2,711,0	9,165,0

Foreign Mails.

The table in opposite column shows the estimated weight of the mails (excluding parcels) exchanged with the British colonies and foreign countries in 1905–1906. The number of letters and post cards may be roughly taken at 40 to the ℔.

During the same year 2,474,003 parcels were despatched out of the United Kingdom, and 1,431,035 were received from the British colonies and other countries. Germany, with 356,423, received the largest number of any one country, and easily heads the list of countries from which parcels were imported into the United Kingdom, with 474,669, France coming next with 254,490.

Foreign and Colonial Letter Rates.

On the 1st of January 1889 a weekly all-sea service to the Australasian colonies was opened. The rates were 4d. per ½ oz. for letters, and 2d. for post cards, as compared with 6d. and 3d. by the quicker route. In the Budget of 1890 provision was made for a lower and uniform rate of postage from the United Kingdom to India and the British colonies generally. The rates, which had hitherto varied from 2½d. to 4d., 5d., or 6d. per ½ oz., were fixed at 2½d. per ½ oz. The change took effect on the 1st of January 1891, and resulted at the outset in a loss of £100,000 a year. The fourth postal union congress, which met at Vienna in May and June 1891 (third congress at Lisbon, February and March 1885), took a further step in the direction of uniformity, and on the 1st of October 1891 the 2½d. rate was extended to foreign as well as colonial letters from the United Kingdom. The Australasian colonies gave their adhesion to the Union at this congress, and the Cape signified its adhesion at the next congress (Washington, May and June 1897), while British Bechuanaland and Rhodesia entered in 1900, and the whole of the British Empire is now included in the international union. Abyssinia, Afghanistan, Arabia, China and Morocco are the chief countries which remain outside. The rate was 2½d. the first oz., and 1½d. per oz. afterwards.

Imperial Penny Post.

Advantage was taken of the presence in England of special representatives of India and the principal British colonies to hold an imperial postal conference in London in June and July 1897, under the presidency of the duke of Norfolk, postmaster-general. Chiefly at the instance of Canada the duke announced that on and from Christmas Day 1898 an imperial penny post would be established with such of the British colonies as were prepared to reciprocate. The new rates (1d. per ½ oz.), which had long been advocated by Mr Henniker Heaton, were adopted then or shortly afterwards by the countries within the empire, with the exceptions of Australasia and the Cape, where the 2½d. rate remained unaltered. The Cape came afterwards into the scheme, and New Zealand joined in 1902. Australia did not see its way to make the necessary financial arrangements, but in 1905 agreed to receive without surcharge letters from other parts of the empire prepaid at 1d. per ½ oz. and reduced its outward postage to 2d. per ½ oz., raised to 1 oz. in 1907. In 1911 penny postage was adopted throughout the commonwealth and to the United Kingdom. Owing to the special relations existing between the governments of Egypt and the United Kingdom, penny postage for letters passing between the United Kingdom and Egypt and the Sudan was introduced in December 1905; and the Egyptian post office subsequently arranged for the adoption of this rate with many of the British colonies. On the 1st of October 1908 penny postage was established between Great Britain and the United States on the same lines as the imperial penny post.

At the 1897 conference it was proposed that the parcel rates with British possessions should be lowered and simplified by the adoption of a triple scale for parcels exchanged by sea, namely, 1s. up to 3 ℔, 2s. from 3 to 7 ℔, and 3s. from 7 to 11 ℔. This scale has been adopted by many of the British colonies. The parcel post has been gradually extended to nearly the whole civilized world, while the rates have in many cases been considerably reduced. The United States remained an exception, and in 1902 an agreement was concluded with the American Express Company for a parcel service. In April 1904 an official service was established with the United States post office, but the semi-official service is still maintained with the American Express Company. By the official service the limit of weight was 4 ℔ 6 oz., and the postage 2s. per parcel; by the semi-official service parcels up to 11 ℔ in weight may be sent, the rates ranging from 3s. to 6s. On the 1st of July 1908 the rates were revised. The limit of weight was increased to 11 ℔, the rate for a parcel being 1s. 6d. for a parcel up to 3 ℔ in weight, 2s. 6d. up to 7 ℔, 3s. 6d. up to 9 ℔ and 4s. 6d. for 11 ℔.

On the 1st of January 1885 the post office at Malta was transferred from the control of H.M. postmaster-general to that of the local administration, and a similar change was made as regards Gibraltar on the 1st of June 1896.

Foreign Mail Service.

Remarkable improvements have been effected in the speed and frequency of the mails sent abroad, and contracts are entered into from time to time with the various mail steamship companies for additional or improved services. The transit charges for special trains conveying mails through France and Italy for Egypt, India, Australia and the Far East have been successively reduced until they now stand at the ordinary Postal Union transit rates.

Army Post Office Corps.

Mention should be made of the Army post office, which is now an essential accompaniment of military operations. On the outbreak of hostilities in South Africa in 1899, the British post office supplied 10 officers and 392 men to deal with the mails of the forces, sell postage stamps, deal in postal orders, &c. Contingents were also sent by the Canadian, Australian, and Indian post offices. Including telegraphists and men of the army reserve, 3400 post office servants were sent to the front.

MONEY ORDER DEPARTMENT

Money Orders.

The money order branch of the post office dates from 1792.[1] It was begun with the special object of facilitating the safe conveyance of small sums to soldiers and sailors, the thefts of letters containing money being frequent. Two schemes were put forward, one similar to the present money order system. There were doubts whether the post office had power to adopt the system, and it was not officially taken up. Six officers of the post office, however, called the "clerks of the roads," who were already conducting a large newspaper business with profit to themselves, came forward with a plan, which was encouraged by the postmaster-general, who also bore the cost of advertising it, and even allowed the advices of the money orders to go free by post under the "frank" of the secretary to the post office. In 1798 the clerks of the roads gave up the scheme, and three post office clerks known as "Stow and Company" took it over. The death of Stow in 1836 left one sole proprietor who had a capital of £2000 embarked in the concern. In 1838 the government determined to take over the business and compensated the proprietor with an allowance of over £400 a year. The rates of commission fixed by the government were 1s. 6d. for sums exceeding £2 and under £5, and 6d. for all sums not exceeding £2. In 1840 these rates were reduced to 6d. and 3d. respectively. The number and aggregate amount of the orders issued (inland, colonial and foreign) in different periods from the reorganization until 1905 is as follows:—

Years.	Number.	Amount.
		£
1839	188,921	313,124
1849	4,248,891	8,152,643
1861–1865 (average)	8,055,227	16,624,503
1875	16,819,874	27,688,255
1880–1881	16,935,005	26,003,582
1885–1886	11,318,380	24,832,421
1890–1891	10,260,852	27,867,887
1895–1896	10,900,963	29,726,817
1900–1901	13,263,567	39,374,665
1905–1906	13,596,153	44,612,785

The decrease in the number of inland money orders till 1890–1891 was due to the competition of postal orders, and to the reduction (Jan. 1, 1878) of the charge for registering a letter from 4d. to 2d.[2]

In 1862 the issue of orders for larger sums was allowed: not exceeding £7, 9d.; not exceeding £10, 1s.

On the 1st of May 1871 a scale of charges was fixed as follows: orders not exceeding 10s., 1d.; not exceeding £1, 2d.; not exceeding £2, 3d.; and so on, an additional penny being charged per £. For sums of £10 the rate was 1s. It was found, however, that the low rate of 1d. for small orders did not provide a profit, and the rates were raised on the 1st of January 1878 to: orders not exceeding 10s., 2d.; not exceeding £2, 3d. On the 1st of September 1886 the rates were altered as follows: orders not exceeding £1, 2d.; not exceeding £2, 3d.; not exceeding £4, 4d.; not exceeding £7, 5 d.; not exceeding £10, 6d. On the 1st of February 1897 new rates were introduced; on orders not exceeding £3, 3d.; over £3 and not exceeding £10, 4d.

The cost of a money order transaction (at least 3d.) is very little affected by the amount of the remittance, and it was thought undesirable to continue the unremunerative business of sending small sums by money order at less than cost price at the expense of the senders of larger orders. The needs of smaller remitters appeared to be sufficiently met by postal orders and the registered letter post. It appeared, however, that the new charges fell with great severity upon mutual benefit societies, like the Hearts of Oak, which sent large numbers of small money orders every week, and on the 1st of May 1897 the 2d. rate was restored for orders not exceeding £1. This society and others now use postal orders instead of money orders. In 1905 the limit for money orders was extended to £40, and the rates are: sums over £10 and not exceeding £20, 6d.; sums over £20 and not exceeding £30, 8d.; sums over £30 and not exceeding £40, 10d.

Foreign and Colonial Money Orders.

Money orders may be sent to almost any country in the world. The rates are as follows: for sums not exceeding £1, 3d.; £2, 6d.; £4, 9d.; £6, 1s.; £8, 1s. 3d.; £10, 1s. 6d.; and for countries on which orders may be issued for higher amounts (limit £40), 3d. for every additional £2 or fraction of £2.

The money order system is largely used by the British government departments for the payment of pensions, separation allowances, remittance of bankruptcy dividends, &c.; and free orders may be obtained by the public, under certain conditions, for the purpose of remitting their taxes. The cost of management of the money order office was reduced by the substitution, since 1898, of a number of women clerks for men and boys.

Telegraph Money Orders.

On the 2nd of September 1889 the issue of telegraphic money orders between London and seventeen large towns was begun as an experiment, and on the 1st of March 1890 the system was extended to all head post offices, and branch offices in the United Kingdom. Two years later it was extended to every office which transacts both money order and telegraph business. The rates, which have been several times revised, are (1) a poundage at the ordinary rate for inland money orders, (2) a charge for the official telegram of advice to the office of payment at the ordinary rate for inland telegrams, the minimum being 6d., and (3) a supplementary fee of 2d. for each order. The sender of a telegraph money order may give instructions that, instead of being left at the post office to be called for, it should be delivered at the payee's residence, and that it should be crossed for payment through a bank. He may also, on paying for the extra words, send a short private message to his correspondent in the telegram of advice.

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[1] An historical outline is given in the *Forty-Second Report of Postmaster-General* (1896), p. 26.

[2] The total sums remitted did not fall off to the same extent, showing that the small orders alone were effected. The average amount for ordinary inland orders is now £2, 19s. 5d.

Telegraph money orders may also be sent to Algeria, Austria, Belgium, Bulgaria, Denmark, Egypt, Faeroe Islands, France, Germany, Holland, Hungary, Iceland, Italy, Luxemburg, Monaco, Norway, Rumania, Sweden and Switzerland. A fee of 2d. is required in addition to the usual money order commission and the cost of the telegram. The system is being rapidly extended to other countries.

The telegraph inland money orders in 1905–1906 amounted to 503,543, and the sums so remitted to £1,646,882, an average of £3, 1s. The number of telegraph money order transactions between the United Kingdom and foreign countries amounted to 18,787, representing £139,402.

Postal Orders. Postal orders were first issued on the 1st of January 1881. For some years before that date postmasters-general had considered the possibility of issuing orders for fixed amounts at a small commission to replace money orders for sums under 20s., which had failed to be remunerative. When the plan was submitted to a committee appointed by the treasury, it was objected that postal orders as remitting media would be less secure than money orders. This was met in part by giving a discretionary power to fill in the name of the post office and also of the payee. Another objection which was urged, namely, that they would prove to be an issue of government small notes under another name, was quickly disproved. Parliament sanctioned the scheme in 1880. The first series were:—

$$\text{Poundage}\quad \underbrace{\text{1s., 1s. 6d.}}_{\frac{1}{2}\text{d.}}\quad \underbrace{\text{2s. 6d., 5s., 7s. 6d.}}_{\text{1d.}}$$

$$\text{Poundage}\quad \underbrace{\text{10s., 12s. 6d., 15s., 17s. 6d., 20s.}}_{\text{2d.}}$$

In 1884 a new series was issued and a provision made that broken amounts might be made up by affixing postage stamps, to the value of 5d., to the orders. Postal orders have become increasingly popular as a means of remitting small amounts, especially since the introduction in 1903 of new denominations, rendering it possible to obtain a postal order for every complete sixpence from 6d. to 21s. From 6d. to 2s. 6d. the poundage is ½d., from 3s. to 15s., 1d., from 15s. 6d. up to 21s., 1½d. Postal orders are also furnished with counterfoils, as a means of keeping a record of the number and amount of each order posted. Orders for amounts of 10s. and upwards are printed in red ink. A system of interchange of postal orders between the United Kingdom and India and the British colonies, and also between one colony and another, has been instituted. British postal orders are obtainable also at post offices in Panama, Constantinople, Salonica and Smyrna, and on H.M. ships. The following table shows the number and value of postal orders issued from the beginning to the 31st of March 1907 (000's omitted):—

Year.	Number.	Value.
		£
1881–1882	4,462	2,006
1883–1884	12,286	5,028
1885–1886	25,790	10,788
1890–1891	48,841	19,178
1895–1896	64,076	23,896
1900–1901	85,390	29,881
1906–1907	101,658	40,484

It remains to be added that the various statutes relating to the post office, except those relating to telegraphs and the carriage of mails, were consolidated by the Post Office Act 1908. The act repealed and superseded 26 acts wholly and 10 acts in parts. Sections 1–11 deal with the duties of postage; §§ 12–19 with the conditions of transit of postal packets; §§ 20–22 with newspapers; §§ 23–25 with money orders; §§ 26–32 with ship letters; §§ 33–44 with the postmaster-general and officers; §§ 45–47 with the holding, &c., of land; §§ 48–49 with the extension of postal facilities and accommodation; §§ 50–69 with post office offences; §§ 70–78 with legal proceedings, and §§ 79–94 with regulations, definitions, &c.

SAVINGS BANKS.[1]

Savings Banks. The establishment of post office savings banks was practically suggested in the year 1860 by Charles William Sykes of Huddersfield, whose suggestion was cordially received by W. E. Gladstone, then chancellor of the exchequer, to whose conspicuous exertions in parliament the effectual working-out of the measure and also many and great improvements in its details are due. Half a century earlier (1807) it had been proposed to utilize the then existing and rudimentary money order branch of the post office for the collection and transmission of savings from all parts of the country to a central savings bank to be established in London. A bill to that effect was brought into the House of Commons by S. Whitbread, but it failed to receive adequate support, and was withdrawn. When Sykes revived the proposal of 1807 the number of savings banks managed by trustees was 638, but of these about 350 were open only for a few hours on a single day of the week. Only twenty throughout the kingdom were open daily. Twenty-four towns containing upwards of ten thousand inhabitants each were without any savings bank. Fourteen counties were without any. In the existing banks the average amount of a deposit was £4, 6s. 5d.

Gladstone's Bill, entitled "An Act to grant additional facilities for depositing small savings at interest, with the security of Government for the due repayment thereof," became law on the 17th of May 1861, and was brought into operation on the 16th of September following. The banks first opened were in places theretofore unprovided. In February 1862 the act was brought into operation in Scotland and in Ireland. Within two years nearly all the money order offices of the United Kingdom became savings banks, and the expansion of the business was continual. The growth of business is shown in the following table:—

Year ending 31st December.	Average Number of Accounts.	Average Amount of Deposits.	Average Balance in each Account.	Average Number of Offices.
			£ s d	
1863–1868 .	663,000	7,000,000	11 3 5	3,390
1869–1874 .	1,373,000	18,000,000	13 5 3	4,498
1875–1880 .	1,889,000	29,000,000	15 12 5	5,742
1881–1885 .	3,088,000	42,000,000	13 11 3	7,348
1886–1890 .	4,248,000	59,000,000	13 16 10	9,025
1891–1895 .	5,776,000	83,000,000	14 7 0	10,888

The code of the 1st of November 1888 did not enlarge the limits of deposits or make any great and conspicuous change in the general system, but the postmaster-general obtained power to offer certain facilities for the transfer of money from one account to another, for the easier disposal of the funds of deceased depositors by means of nominations, and in various ways for the convenience of the customers of the bank. Arrangements were made for reducing to 1s. the cost of certificates of births, deaths and marriages required for savings bank purposes. In July 1889 Local Loans 3% Stock was made available for purchase through the post office savings bank.

"In July 1891," says the report of the postmaster-general in 1897, "another Act of Parliament was passed by which the maximum amount which might be deposited was raised from £150 to £200, inclusive of interest. The annual limit remained at £30, but it was provided that, irrespective of that limit, depositors might replace in the bank the amount of any one withdrawal made in the same year. The object of this provision was to avoid curtailing the saving power of a person who might be driven by emergency to make an inroad upon his store, but who might nevertheless, when the emergency had passed, find himself none the poorer and able to replace the money withdrawn.

"The act provided also that where on any account the principal and interest together exceeded £200, interest should cease only on the amount in excess of £200, whereas previously interest ceased altogether when it had brought the balance of an account up to £200.

"The next striking development of the Savings Bank arose out of the Free Education Act, passed in September 1891. The government of the day desired that advantage should be taken of the opportunity to inculcate upon parents and children alike a lesson of thrift—that they should save the school pence which they were no longer bound to pay. The Education Department and the postmaster-general worked in concert to realize this end. School managers were urged to press the matter upon all concerned, special stamp slips were prepared and issued, managers were supplied on credit with stocks of stamps to be sold to the children, and clerks from the nearest post offices attended at schools to open accounts and receive deposits. The arrangement began in January 1892; about 1400 schools adopted the scheme at once, and three years later this number had risen to 3000. A sum of nearly £14,000 was estimated to have been deposited in schools in 5 months, and about £40,000 in the first year. Concurrently with the spread of the stamp-slip system in the schools, the extension of School Penny Banks, connected intimately with the Savings Bank, was a conspicuous result of the effort to turn into profitable channels the pence which no longer paid school fees.

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[1] For a succinct account of the history of the post office savings bank, "so far as depositors and the general public are concerned," see *Forty-third Report of Postmaster-General* (1897), pp. 32 seq.

"In December 1893 another Act of Parliament extended the annual limits of deposits from £30 to £50. The maximum of £200 remained unchanged, but it was provided that any accumulations accruing after that amount had been reached should be invested in government stock unless the depositor gave instructions to the contrary.

"In December 1893 arrangements were made for the use of the telegraph for the withdrawal of money from the savings bank. Postmasters-general had hesitated long before sanctioning this new departure. It was known that the system was in force abroad, and it was recognized that there might be, and doubtless were, cases in the United Kingdom where the possibility of withdrawing money without delay might be all-important, and might save a depositor from debt and distress. But, on the other hand, it was strongly held that the cause of thrift was sometimes served by interposing a delay between a sudden desire to spend and its realization; and it was also held to be essential to maintain a marked distinction between a bank of deposit for savings and a bank for keeping current accounts."

On the whole, the balance of opinion was in favour of the change, and two new methods of withdrawal were provided. A depositor might telegraph for his money and have his warrant sent to him by return of post, or he might telegraph for his money and have it paid to him in an hour or two on the authority of a telegram from the savings bank to the postmaster. The first method cost the depositor about 9d., the second cost him about 1s. 3d. for the transaction. On the 3rd of July 1905 a new system of withdrawal was instituted, under which a depositor, on presentation of his book at any post office open for savings bank business, can withdraw immediately any sum not exceeding £1. Depositors have availed themselves extensively of this system. During 1906, 4,758,440 withdrawals, considerably more than one-half of the total number of withdrawals, were made "on demand," and as a consequence the number of withdrawals made by telegraph fell to 122,802, against 168,036 in the previous year (during only half of which the "on demand" system was in force).

By an act which came into force on the 1st of January 1895 building societies, duly incorporated, were enabled to deposit at any one time a sum not exceeding £300, and to buy government stock up to £500 through the savings bank.

Savings Bank Finance.—The increase in the deposits lodged in the post office savings bank must be ascribed to a variety of causes. Numbers of trustee banks have been closed, and have transferred their accounts to the post office bank; greater facilities have been offered by the bank; the limits of deposit in one year, and of total deposit, have been raised; and, since October 1892, deposits may be made by cheque; while the long-continued fall in the rate of interest made the assured 2½% of the post office savings bank an increasing temptation to a class of investors previously accustomed to look elsewhere. The high price of consols, due in part to the magnitude of purchases on savings bank account, proved a serious embarrassment to the profitable working of the bank, which had shown a balance of earnings on each year's working until 1896, after paying its expenses and 2½% interest to its depositors. Economical working minimized, but did not remove the difficulty. The average cost of each transaction, originally nearly 7d., has been brought down to 5¾d. Down to the year 1896, £1,598,767 was paid into the exchequer under § 14 of the Act 40 Vict. c. 13, being the excess of interest which had accrued year by year. But since 1895 there have been deficits in each year, and in 1905, owing principally tc the reduced rate on consols, the expenditure exceeded the income by £88,094.

The central savings bank having outgrown its accommodation in Queen Victoria Street, London, a new site was purchased in 1898 for £45,000 at West Kensington, and the foundation-stone of a new building, costing £300,000, was laid by the prince of Wales on the 24th of June 1899. The entire removal of the business was carried out in 1903.

Under the Workmen's Compensation Act of 1897, sums awarded as compensation might be invested in the post office savings bank. This arrangement proved so convenient that an act of 1900 authorized a similar investment of money paid into an English county court in ordinary actions at common law, and ordered to be invested for the benefit of an infant or lunatic. In 1906 a committee was appointed to go into the question as to whether the post office should provide facilities for the insurance of employers in respect of liabilities under the Workmen's Compensation Acts, but no scheme was recommended involving post office action either as principal or agent. Post offices, however, exhibit notices drawing attention to the liabilities imposed by the act of 1906, and sub-postmasters are encouraged to accept agencies in their private capacity for insurance companies undertaking this class of insurance.

Inducements to Thrift.—By arrangement with the war office in July 1893, the deferred pay of soldiers leaving the army was invested on their behalf in the post office savings bank, but it was found that the majority of the soldiers draw out practically the whole amount at once, and the experiment was discontinued in 1901. At the request of large employers of labour, an officer of the savings bank attends at industrial establishments on days when wages are paid, and large numbers of workmen have thus been induced to become depositors. The advantages of the savings bank appear to be now thoroughly appreciated throughout the United Kingdom, as shown by the following table:—

	On the 31st of December 1900.					
	Number of Depositors.	Total Amount to Credit of Depositors.	Average Amount to Credit of each Depositor.			Proportion of Depositors to Population.
		£	£.	s.	d.	
England and Wales .	7,685,317	122,365,193	15	18	5	1 in 4
Scotland	372,801	5,126,299	13	15	0	1 in 12
Ireland	381,865	8,058,153	21	2	1	1 in 12
Totals . .	8,439,983	135,549,645	16	1	3	1 in 5
	On the 31st of December 1905.					
		£	£.	s.	d.	
England and Wales .	9,027,112	135,668,450	15	0	7	1 in 3·8
Scotland	451,627	6,205,339	13	14	10	1 in 10·4
Ireland	484,310	10,237,351	21	2	9	1 in 9·1
Totals . . .	9,963,049	152,111,140	15	5	4	1 in 4·3

Between the foundation of the bank and the end of 1899, upwards of £648,000,000, inclusive of interest, was credited to depositors, of which £474,000,000 was withdrawn. There were 232,634,596 deposits, 81,804,509 withdrawals, 27,071,556 accounts opened, and 18,631,573 accounts closed. The cross-entries, or instances where the account is operated upon at a different office from that at which it was opened, amounted to 33%. It is chiefly in respect of this facility that the post office savings bank enjoys its advantage over the trustee savings bank. In 1905, 16,320,204 deposits were made, amounting to £42,300,617. In the same year the withdrawals numbered 7,155,283, the total sum withdrawn being £42,096,037. The interest credited to depositors was £3,567,206, and the total sum standing to their credit on the 31st of December 1900 was £152,111,140.

A classification of accounts opened for 3 months in 1896, and assumed to be fairly typical, showed the following results:—

Occupation as stated by Depositors in opening Account.	Percentage to Total.
Professional	1·55
Official	2·81
Educational	1·01
Commercial	3·88
Agricultural and fishing	1·83
Industrial	18·43
Railway, shipping and transport	2·96
Tradesmen and their assistants	8·14
Domestic service	8·61
Miscellaneous	0·37
Married women, spinsters and children . . .	50·41
	100·00

Women and children of all ranks are believed to be 60·59 of the total number of depositors.

The accounts open at the end of 1895 showed the following division of deposits:—

		Per cent.
Balances not exceeding	£50	36·1
Exceeding £50 and not exceeding	100	24·5
„ 100 „ „ „	150	17·3
„ 150 „ „ „	200	14·8
„ 200		7·3
		100·0

The division according to number of accounts, in the same groups, was 90·8, 5·3, 2·2, 1·3 and 0·4 respectively.

Investments in Government Stock.—In September 1888 the minimum amount of government stock which might be purchased or sold through the post office savings bank was reduced from £10 to 1s., and it was also provided that any person who had purchased stock through the savings bank could, if he so desired, have it transferred to his own name in the books of the Bank of England. The act of 1893 raised the limit of stock to £200 in one year, and £500 in all; but any depositor might purchase stock, to replace stock previously sold, in one entire sum during that year. If a depositor exceeds the authorized limits of deposit in the post office savings bank, the excess is invested in stock by the post office on his behalf. The investments of depositors in government stock, however, have a tendency to decrease, and the sales, on the other hand, to increase, as will be seen from the following table:—

Year.	Investments.		Sales.		Average price of Consols.	No. of Depositors.	Total holding of Stock.
	No.	Amount.	No.	Amount.			
		£		£			£
1901	46,550	3,192,154	13,574	761,629	94¼	109,509	12,786,190
1902	40,893	2,694,447	17,221	1,054,193	94⅜	118,696	14,285,617
1903	47,726	3,131,172	17,742	1,085,578	90¾	131,343	16,165,548
1904	39,633	2,507,546	18,848	1,131,543	88¼	138,582	17,357,950
1905	32,301	2,212,285	22,824	1,507,219	89⅞	139,992	17,877,644

Annuities and Life Insurances.—The act of 1882, which came into operation on the 3rd of June 1884, utilized the machinery of the post office savings bank for annuities and life insurances, which had been effected through the post office at selected towns in England and Wales since the 17th of April 1865. Under the act of 1882 all payments were to be made by means of money deposited in the savings bank, and an order could be given by a depositor that any sum—even to 1d. a week—should be devoted to the purchase of an annuity or insurance so long as he retained a balance in the savings bank. In February 1896 new life insurance tables came into operation, with reduced annual rates, and with provision for payment of sums insured at various ages as desired. The following table shows the business done from 1901 to 1905:—

Year.	Annuities.											Life Insurances.					
	Immediate.					Deferred.											
	Contracts entered into.		Receipts.	Payments.		Contracts entered into.		Receipts.		Payments.		Contracts entered into.		Receipts.		Payments.	
	No.	Amount of Annuities.	Amount.	No.	Amount.	No.	Amount of Annuities.	No.	Amount.	No.	Amount.	No.	Amount of Insurances.	No.	Amount.	No.	Amount of claims on death and surrender.
		£	£		£		£		£		£		£		£		£
1901	1,764	42,268	562,159	33,269	527,371	142	3,066	1,365	23,630	1,075	14,175	920	44,296	21,972	22,647	380	12,992
1902	1,679	42,791	558,770	34,375	548,251	139	2,973	1,353	21,764	1,164	17,172	722	34,646	22,553	23,045	389	14,646
1903	1,763	43,973	557,981	35,463	571,904	157	3,424	1,366	24,489	1,210	14,689	592	31,413	22,672	23,063	387	13,126
1904	1,768	41,000	520,538	36,607	594,502	128	2,492	1,366	21,011	1,297	16,167	517	28,629	22,323	23,031	465	16,878
1905	1,840	45,488	573,205	37,686	614,406	158	3,204	1,386	24,287	1,347	16,965	741	37,011	21,836	23,376	449	15,593

Telegraphs and Telephones

Telegraphs. The history of the development of telegraphy and the early proposals for the transference to the state of the telegraph monopoly will be found in the article Telegraphy. On the 5th of February 1870 the Telegraph Act of the previous year took effect. The post office assumed control of telegraphic communication within the United Kingdom, and it became possible to send telegrams throughout the country at a uniform charge irrespective of locality or distance. In 1885 sixpenny telegrams were introduced. The charge for a written telegram which came into force in 1870 was one shilling for the first twenty words, and threepence for every additional five words, the addresses of sender and receiver being sent free. In 1885 the charge was reduced to a halfpenny a word throughout, including addresses (a system of abbreviated addresses, which could be registered on payment of a guinea a year, being introduced), with a minimum charge of sixpence. To obviate the damage and interruption resulting from storms large numbers of wires have been laid underground.

In 1891 the terms under which a new telegraph office was opened, on the request of a person or persons who undertook to guarantee the post office against loss, were reduced. In 1892 rural sanitary authorities were empowered to give such guarantees out of the rates. In 1897, as part of the Jubilee concessions, the government undertook to pay one-half of any deficiency under guarantees. During the six years ended in 1891 the average number of telegraph offices guaranteed each year was 77. From 1892 to 1897 the average rose to 167. In 1905 and 1906 it amounted to 152. The number of telegraph offices opened without guarantee has increased apace, and there are now 12,993 telegraph offices in all. As part of the Jubilee scheme the charges for porterage were reduced as follows: Up to 3 miles free; beyond 3 m., 3d. per m., reckoned from the post office; and arrangements were made for the free delivery at all hours of the day or night of any telegram within the metropolitan postal district. The cost of free delivery up to 3 m. was estimated at £52,000 a year.

Foreign Telegrams.—The sixth international telegraph conference, held at Berlin in 1884, effected a reduction in the charges to many countries. *E.g.* the rate per word was reduced for Russia from 9d. to 6½d., Spain 6d. to 4½d., Italy 5d. to 4½d., and India 4s. 7d. to 4s. The cost of repeating a message was reduced from one-half to one-fourth of the original charge for transmission. At the next conference (1890) held at Paris, further considerable reductions were effected. The rates to Austria-Hungary and Italy were reduced from 4½d. to 3d., Russia 6½d. to 5½d., Portugal 5½d. to 4½d., Sweden 5d. to 4d., Spain 4½d. to 4d., Canary Islands 1s. 7½d. to 1s., &c. The minimum charge for any foreign (European) telegram was fixed at 10d. The eighth conference (Budapest, 1896) succeeded in making the following reductions, among others, from the United Kingdom: China 7s. to 5s. 6d., Java 6s. to 5s., Japan 8s. to 6s. 2d., Mauritius 8s. 9d. to 5s., Persia 2s. 5d. to 1s. 9d. At this conference it was made incumbent upon every state adhering to the union to fix in its currency an equivalent approaching as nearly as possible the standard rate in gold, and to correct and declare the equivalent in case of any important fluctuation. The limit of letters in one word of plain language was raised from 10 to 15, and the number of figures from 3 to 5. The International Telegraph Bureau was also ordered to compile an enlarged official vocabulary of code words, which it is proposed to recognize as the sole authority for words which may be used in cypher telegrams sent by the public. (See Appendix to *Postmaster-General's Report*, 1897.) See further Telegraph.

Telephones. Ten years of state administration of the telegraphs had not passed before the postmaster-general was threatened with a formidable rival in the form of the telephone, which assumed a practical shape about the year 1878, the first exchange in the United Kingdom being established in the City of London in that year. The history of the telephone service and the growth of the industry are set out in the article TELEPHONE.

POST OFFICE STAFF

The staff of the post office on the 31st of March 1906 amounted to 195,432. Of these 41,081 were women, a proportion of over one-fifth of the staff. The postmasters numbered 875 (including 10 employed abroad), and the sub-postmasters 21,027. The total number of offices (including branch offices) was 22,088. The unestablished staff, not entitled to pension, made up chiefly of telegraph boys, and of persons who are employed for only part of the day on post office business, included 87,753 out of the grand total, and almost the whole of the sub-postmasters. The pay and prospects of almost all classes have been greatly improved since 1884, when the number stood at 91,184. The principal schemes of general revision of pay have been: 1881, Fawcett's scheme for sorting-clerks, sorters and telegraphists (additional cost £210,000 a year), and for postmen, 1882, £110,000: Raikes's various revisions, 1888, chief clerks and supervising officers, £6230; 1890, sorting-clerks, sorters and telegraphists, £179,600; 1890, supervising force, £65,000; 1890, London sorters, £20,700; 1891, London overseers, £9400; 1891, postmen, £125,650: Arnold Morley, 1884, London overseers, £1400, and rural auxiliaries, £20,000.

A committee was appointed in June 1895 with Lord Tweedmouth as chairman, to consider the pay and position of the post office staff, excluding the clerical force and those employed at headquarters. The committee reported on the 15th of December 1896 and its recommendations were adopted at an immediate increased expense of £139,000 a year, which has since risen to £500,000. In 1897 additional concessions were made at a cost of £100,000 a year.

In July 1890 a number of postmen in London went out on strike. Over 450 were dismissed in one morning, and the work of the post office was carried on without interruption. The men received no sympathy from the public, and most of them were ultimately successful in their plea to be reinstated. A quasi-political agitation was carried on during the general election of 1892 by some of the London sorters, who, under the plea of civil rights, claimed the right to influence candidates for parliament by exacting pledges for the promise of parliamentary support. The leaders were dismissed, and the post office has upheld the principle that its officers are to hold themselves free to serve either party in the State without putting themselves prominently forward as political partisans. Parliament has been repeatedly asked to sanction a parliamentary inquiry to reopen the settlement of the Tweedmouth Committee, and the telegraphists have been especially active in pressing for a further committee. The rates of pay at various dates since 1881 are set out with great fullness in the Parliamentary papers (*Postmen*, No. 237 of 1897; *Sorters, Telegraphists, &c.*, No. 230 of 1898, and *Report of the Select Committee on Post Office Servants*, 1907; this latter contains important recommendations for the removal of many grievances which the staff had been long agitating to have removed).

In November 1891 an important change was made in the method of recruiting postmen, with the object of encouraging military service, and providing situations for those who after serving in the army or navy are left without employment at a comparatively early age. In making appointments to the situation of postman, preference was given to army, navy and royal marine pensioners, and men of the army reserve. Due regard was paid to the legitimate claims of telegraph messengers or other persons who had prospects of succeeding to these situations. In August 1897 the government decided to reserve one-half of all suitable vacancies for ex-soldiers and sailors, as postmen, porters and labourers, and preference has been shown to them for employment as lift-attendants, caretakers, &c.

Finance.—The following table shows the financial working of the post office:—

Year.	Revenue.				Expenditure.									Net Revenue.
	Postal Receipts.	Extra Receipts.	Estimated Value of Services to other Departments.	Total.	Sites and Buildings.		Superannuations and other Non-effective Charges.	Salaries, Wages, &c.	Conveyance of Mails.	Packet Service.	Other Expenditure.		Total.	
					Purchase.	Erection.					Under P. O. Votes.	Under other Votes.		
	£	£	£	£	£	£	£	£	£	£	£	£	£	£
1884–1885	7,808,911	382,002	198,336	8,389,249	72,464	80,234	150,742	2,829,210	1,154,211	728,413	515,892	136,999	5,668,165	2,721,084
1889–1890	9,467,165	36,279	218,037	9,721,481	70,900	79,840	153,921	3,359,563	1,249,821	664,342	553,910	142,788	6,275,085	3,446,396
1894–1895	10,748,014	—	277,446	11,025,460	12,597	175,390	188,919	4,597,355	1,395,282	729,813	677,524	178,464	7,955,344	3,070,116
1899–1900	13,192,020	—	202,315	13,394,335	115,294	169,098	269,892	5,963,399	1,474,118	759,307	719,944	213,747	9,683,999	3,710,336
1900–1901	13,776,886	—	218,584	13,995,470	81,949	175,000	286,238	6,277,275	1,516,859	764,804	726,101	236,677	10,064,903	3,930,567
1905–1906	16,823,349	24,363	216,311	17,064,023	75,759	250,127	377,131	7,737,010	1,821,758	687,109	604,927	295,191	11,849,012	5,540,897

POSTAGE STAMPS

For all practical purposes the history of postage stamps begins in the United Kingdom. A post-paid envelope was in common use in Paris in the year 1653. Stamped postal letter-paper (*carta postale bollata*) was issued to the public by the government of the Sardinian States in November 1818, and stamped postal envelopes were issued by the same government from 1820 until 1836.[1] Stamped wrappers for newspapers were made experimentally in London by Charles Whiting, under the name of "go-frees," in 1830. Four years later (June 1834), and in ignorance of what Whiting had already done, Charles Knight, the well-known publisher, in a letter addressed to Lord Althorp, then chancellor of the exchequer, recommended similar wrappers for adoption. From this suggestion apparently Rowland Hill, who is justly regarded as the originator of postage stamps, got his idea. Meanwhile, however, the adhesive stamp was made experimentally by James Chalmers in his printing-office at Dundee in August 1834.[2] These experimental stamps were printed from ordinary type, and were made adhesive by a wash of gum. Chalmers had already won local distinction by his successful efforts in 1822, for the acceleration of the Scottish mails from London. Those efforts resulted in a saving of forty-eight hours on the double mail journey, and were highly appreciated in Scotland.

Rowland Hill brought the adhesive stamp under the notice of the commissioners of post office inquiry on the 13th of February 1837. Chalmers made no public mention of his stamp of 1834 until November 1837.

Rowland Hill's pamphlet led to the appointment of a committee of the House of Commons on the 22nd of November 1837, "to inquire into the rates and modes of charging postage, with a view to such a reduction thereof as may be made without injury to the revenue." This committee reported in favour of Hill's proposals; and an act was passed in 1839, authorizing the treasury to fix the rates of postage, and regulate the mode of their collection, whether by prepayment or otherwise. A premium of £200 was offered for the best, and £100 for the next best, proposal for bringing stamps into use, having regard to

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[1] *Stamp-Collector's Magazine*, v. 161 seq.; J. E. Gray, *Illustrated Catalogue of Postage Stamps*, 6th ed., 167.

[2] Patrick Chalmers, *Sir Rowland Hill and James Chalmers, Inventor of the Adhesive Stamp* (London, 1882), *passim*. See also the same writer's pamphlet, entitled *The Position of Sir Rowland Hill made plain* (1882), and his *The Adhesive Stamp: a Fresh Chapter in the History of Post-Office Reform* (1881). Compare Pearson Hill's tract, *A Paper on Postage Stamps*, in reply to Chalmers, reprinted from the *Philatelic Record* of November 1881. Pearson Hill has therein shown conclusively the priority of *publication* by Sir Rowland Hill. He has also given proof of James Chalmers's express acknowledgment of that priority. But he has not weakened the evidence of the priority of *invention* by Chalmers.

"(1) the convenience as regards the public use; (2) the security against forgery; (3) the facility of being checked and distinguished at the post office, which must of necessity be rapid; and (4) the expense of the production and circulation of the stamps." To this invitation 2600 replies were received, but no improvement was made upon Rowland Hill's suggestions. A further Minute, of the 26th of December 1839, announced that the treasury had decided to require that, as far as practicable, the postage of letters should be prepaid, and such prepayment effected by means of stamps. Stamped covers or wrappers, stamped envelopes, and adhesive stamps were to be issued by government. The stamps were engraved by Messrs Perkins, Bacon & Petch, of Fleet Street, from Hill's designs, and the Mulready envelopes and covers by Messrs Clowes & Son, of Blackfriars. The stamps were appointed to be brought into use on the 6th of May 1840, but they appear to have been issued to the public as early as the 1st of May. The penny stamp, bearing a profile of Queen Victoria, was coloured black, and the twopenny stamp blue, with check-letters in the lower angles (in all four angles from April 1858). Up to the 28th of January 1854 the stamps were not officially perforated, except in the session of 1851, when stamps, perforated by a Mr Archer, were issued at the House of Commons post office. In 1853 the government purchased Archer's patent for £4000. The stamps were first water-marked in April 1840.

The canton of Zürich was the first foreign state to adopt postage stamps, in 1843. The stamps reached America in the same year, being introduced by the government of Brazil. That of the United States did not adopt them until 1847; but a tentative issue was made by the post office of New York in 1845. An adhesive stamp was also issued at St Louis in the same year, and in Rhode Island in the next. In Europe the Swiss cantons of Geneva (1844) and of Basel (1845) soon followed the example set by Zürich. In the Russian Empire the use of postage stamps became general in 1848 (after preliminary issues at St Petersburg and in Finland in 1845). France issued them in 1849. The same year witnessed their introduction into Tuscany, Belgium and Bavaria, and also into New South Wales. Austria, Prussia, Saxony, Spain, Italy, followed in 1850. The use of postage stamps seems to have extended to the Hawaiian Islands (1851?) a year before it reached the Dutch Netherlands (1852). Within twenty-five years of the first issue of a postage stamp in London, the known varieties, issued in all parts of the world, amounted to 1391. Of these 841 were of European origin, 333 were American, 59 Asiatic, 55 African. The varieties of stamp issued in the several countries of Oceania were 103. Of the whole 1391 stamps no less than 811 were already obsolete in 1865, leaving 580 still in currency.

English Issues

(i.) *Line-engraved Stamps.*

Halfpenny Stamp.—First issue, October 1, 1870: size 18 mm. by 14 mm.; lake-red varying to rose-red.

One Penny Stamp.—First issue, 1st (for 6th) May 1840: the head executed by Frederick Heath, from a drawing by Henry Corbould of William Wyon's medal struck to commemorate her majesty's visit to the City of London on the 9th of November 1837: size 22½ mm. by 18¾ mm.; black, watermarked with a small crown; a few sheets in 1841 struck in red, two essays were made in April and October 1840 in blue and blue-back; imperforate. The *second issue*, January 20, 1841, differed only from the first issue as to colour—red instead of black. It is stated [1] that the colour, "though always officially referred to as 'red,' was really a red-brown, and this may be regarded as the normal colour; but considerable variations in tone and shade (brick-red, orange-red, lake-red) occurred from time to time, often accentuated by the blueing of the paper, though primarily due to a want of uniformity in the method employed for preparing the ink." The change of colour from black was made in order to render the obliteration (now in black instead of red ink) more distinct; imperforate. *Third issue*, February 1854: small crown watermark; perforated 16 (*i.e.* 16 holes to 2 centimetres). The *fourth issue*, January 1855, differed only from the third issue in being perforated 14. *Fifth issue*, February 1855: from a new die, with minute variations of engraving. In the second die the eyelid is more distinctly shaded, the nostril more curved, and the band round the hair has a thick dark line forming its lower edge. Small crown watermark; perforated 16 and 14. *Sixth issue*, July 1855: large crown watermark; perforated 14; a certain number 16. *Seventh issue*, January 1858: carmine-rose varying from pale to very deep. Large crown watermark; perforated, chiefly 14. *Eighth issue*, April 1, 1864: check-letters in all four corners instead of two only; large crown watermark; perforated 14.

In 1880 the line-engraved one penny stamps were superseded by the surface-printed one of similar value in venetian red, designed and printed by Messrs De la Rue & Co.

Three-halfpenny Stamp.—October 1, 1870: large crown watermark; lake-red; perforated 14. Superseded in October 1880 by De la Rue's surface-printed stamp.

Twopenny Stamp.—First issue, 1st (for 6th) May 1840: small crown watermark; light blue, dark blue; imperforate. *Second issue*, March 1841: small crown watermark; white line below "Postage" and above "Twopence"; dull to dark blue; imperforate. *Third issue*, February (?) 1854: small crown watermark; blue, dark blue; perforated 16. *Fourth issue*, March 1855: small crown watermark; blue, dark blue; perforated 14. *Fifth issue*, July 1855: large crown watermark; blue; perforated 16; blue, dark blue; perforated 14. *Sixth issue*, May (?) 1857: large crown watermark; white lines thinner, blue, dark blue; perforated 14; dark blue; perforated 16. *Seventh issue*, July 1858: large crown watermark; white lines as in fifth issue; deep to very deep blue; perforated 16. *Eighth issue*, April (?) 1869: large crown watermark; white lines thinner; dull blue, deep to very deep blue, violet blue; perforated 14. Superseded in December 1880 by De la Rue's surface-printed stamp.

(ii.) *Embossed Stamps.*

Produced by Dryden Brothers, of Lambeth, from designs submitted by Mr Ormond Hill of Somerset House, engraved after Wyon's medal.

Sixpence.—March 1, 1854: violet, reddish lilac, dark violet; imperforate. Superseded in October 1856 by De la Rue's surface-printed stamp.

Tenpence.—November 6, 1848: pale to very deep chestnut-brown; imperforate. Superseded by De la Rue's surface-printed stamp in 1867.

One Shilling.—September 11, 1847: emerald green, pure deep green, yellow-green; imperforate. Superseded in November 1856 by De la Rue's surface-printed stamp.

(iii.) *Surface-printed Stamps before 1880.*

Twopence-half-penny.—First issue, July 1, 1875: small anchor watermark; lilac-rose; perforated 14. *Second issue*, May 1876: orb watermark; lilac-rose, perforated 14. *Third issue*, February 5, 1880: orb watermark; cobalt, and some ultramarine; perforated 14. *Fourth issue*, March 23, 1881: large crown watermark; bright blue; perforated 14.

Threepence.—All perforated 14. *First issue*, May 1, 1862: heraldic emblems watermark; carmine (pale to deep). *Second issue*, March 1, 1865: same watermark as above; carmine-pink. *Third issue*, July 1867: watermarked with a spray of rose; carmine-pink, carmine-rose. *Fourth issue*, July 1873: watermark as third issue; carmine-rose. *Fifth issue*, January 1, 1881: watermark large crown; carmine-rose. *Sixth issue*, January 1, 1883; watermark as fifth issue; purple shades overprinted with value in deep pink.

Fourpence.—All perforated 14. *First issue*, July 31, 1855: watermark small garter; deep and dull carmine. *Second issue*, February 1856: watermark medium garter; pale carmine. *Third issue*, November 1, 1856: watermark medium garter; dull rose. *Fourth issue*, January 1857: watermark large garter; dull and pale to deep rose, pink. *Fifth issue*, January 15, 1862: watermark large garter; carmine-vermilion, vermilion-red. *Sixth issue*, July 1865: watermark large garter; pale to dark vermilion. *Seventh issue*, March 1, 1876: watermark large garter; pale vermilion. *Eighth issue*, February 27, 1877: watermark large garter; pale sage-green. *Ninth issue*, July 1880: watermark large garter; mouse-brown. *Tenth issue*, January 1, 1881: watermark large crown; mouse-brown.

Sixpence.—All perforated 14. *First issue*, October 21, 1856: no letters in angles; watermark heraldic emblems; dull lilac. *Second issue*, December 1, 1862: small white letters in angles; otherwise as first issue. *Third issue*, April 1, 1865: large white letters in angles; otherwise as first issue. *Fourth issue*, June 1867: watermark spray of rose; otherwise as third issue; some in bright lilac. *Fifth issue*, March 1869: as fourth issue; lilac, deep lilac, purple-lilac. *Sixth issue*, April 1, 1872: as fourth issue; bright chestnut-brown. *Seventh issue*, October 1872: as fourth issue; buff. *Eighth issue*, April 1873: as fourth issue; greenish grey. *Ninth issue*, April 1, 1874: watermarked as fourth issue; large coloured letters in angles; greenish grey. *Tenth issue*, January 1, 1881: large crown watermark; otherwise as ninth issue. *Eleventh issue*, January 1, 1883: as tenth issue; purple, overprinted with value in deep pink.

Eightpence.—September 11, 1876: watermark large garter; chrome-yellow, pale yellow; perforated 14.

Ninepence.—All perforated 14. *First issue*, January 15, 1862: watermark heraldic emblems; ochre-brown, bright bistre. *Second issue*, December 1, 1865: watermark as above; bistre-brown, straw. *Third issue*, October 1867: watermark spray of rose; straw.

Tenpence.—July 1, 1867: watermark spray of rose; red-brown; perforated 14.

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[1] Wright and Creeke, *History of the Adhesive Stamp of the British Isles available for Postal and Telegraph Purposes* (London, 1899).

One Shilling.—All perforated 14. *First issue*, November 1, 1856: watermark heraldic emblems; no letters in angles; dull green, pale to dark green. *Second issue*, December 1, 1862: as above; small white letters in angles; pale to dark green. *Third issue*, February 1865: as above; large white letters in angles; pale to dark green, bluish green. *Fourth issue*, August 1867: watermark spray of rose; otherwise as third issue; pale to dark green, bluish green. *Fifth issue*, September 1873: large coloured letters in angles; otherwise as fourth issue; light to dark green, bluish green. *Sixth issue*, October 14, 1880: as fifth issue; pale red-brown. *Seventh issue*, June 15, 1881: watermark large crown; otherwise as sixth issue; pale red-brown.

Two Shillings.—Watermark spray of rose; perforated 14. *First issue*, July 1, 1867: pale to full blue, very deep blue. *Second issue*, February 1880: light brown.

Five Shillings.—*First issue*, July 1, 1867: watermarked with a cross *paté*; pink, pale rose; perforated 15½ by 15. *Second issue*, November 1882: watermark large anchor; carmine-pink; perforated 14.

Ten Shillings.—*First issue*, September 26, 1878: watermark cross *paté*; green-grey; perforated 15½ by 15. *Second issue*, February 1883: watermark large anchor; green-grey; perforated 14.

One Pound.—*First issue*, September 26, 1878: watermark cross *paté*; brown-violet; perforated 15½ by 15. *Second issue*, December 1882: watermark large anchor; brown-violet; perforated 14.

(iv.) *After 1880.*

In 1880–1881 the halfpenny, penny, three-halfpenny and twopenny surface-printed stamps superseded the line-engraved stamps of the same value, and a new surface-printed stamp of fivepence was introduced. These stamps are distinguished from the stamps already described by the absence of plate-numbers and (except in the penny stamp) of check-letters in the corners; also by the coarser style of engraving necessary for printing by machines driven by steam-power.

One Halfpenny.—*First issue*, October 14, 1880: large crown watermark; pale green, bluish green, dark green; perforated 14. *Second issue*, April 1, 1884: slate-blue.

One Penny.—January 1, 1880: large crown watermark; venetian red; perforated 14.

Three-halfpence.—October 14, 1880: large crown watermark; venetian red; perforated 14.

Twopence.—December 8, 1880: large crown watermark; pale to very deep carmine red; perforated 14.

Fivepence.—March 15, 1881: large crown watermark; dark dull indigo, indigo-black; perforated 14.

The Customs and Inland Revenue Act which came into force on June 1, 1881, made it unnecessary to provide separate penny stamps for postal and fiscal purposes. By an act of 1882 (45 & 46 Vict. c. 72) it became unnecessary to provide separate stamps for postal and fiscal purposes up to and including stamps of the value of 2s. 6d. A new series was therefore issued:—

One Penny.—All perforated 14. *First issue*, July 12, 1881: large crown watermark; 14 pearls in each angle; purple-lilac, purple. *Second issue*, December 12, 1881: as first issue; 16 pearls in each angle; purple.

Three-halfpence.—April 1, 1884: large crown watermark; purple; perforated 14.

Twopence.—Ditto.

Twopence-halfpenny.—Ditto.

Threepence.—Ditto.

Fourpence.—Ditto, except in colour (sea-green).

Fivepence.—As fourpence.

Sixpence.—Ditto.

Ninepence.—Ditto.

One Shilling.—Ditto.

Two Shillings and Sixpence.—July 22, 1883: watermark large anchor; purple, dull lilac, dark purple; perforated 14.

Five Shillings.—April 1, 1884: ditto; pale to very deep carmine.

Ten Shillings.—Ditto; pale blue, cobalt, light to dull blue.

One Pound.—*First issue*, April 1, 1884: large crown watermark, 3 appearing in each stamp; brown-violet; perforated 14. *Second issue*, January 27, 1891: same watermark; bright green; perforated 14.

Five Pounds.—March 21, 1882: large anchor watermark; orange-vermilion, vermilion, bright vermilion; perforated 14.

Following upon the report of a committee of officials of the General Post Office and Somerset House, a series of new stamps, commonly known as the "Jubilee" issue, was introduced on January 1, 1887, all of which between one halfpenny and one shilling exclusive were printed either in two colours or on a coloured paper, so that each stamp was printed in part in one or other of the doubly fugitive inks—green and purple.

One Halfpenny.—January 1, 1887: large crown watermark; orange-vermilion to bright vermilion; perforated 14.

Three-halfpence.—January 1, 1887: as the halfpenny; green and purple.

Twopence.—Ditto: green and scarlet to carmine.

Twopence-halfpenny.—January 1, 1887: blue paper; watermark large crown; dark purple; perforated 14.

Threepence.—January 1, 1887: yellow paper; watermarked with a large crown; purple; perforated 14.

Fourpence.—January 1, 1887: watermark and perforation as in threepence; green and brown.

Fourpence-halfpenny.—September 15, 1892: as the fourpence; green and carmine.

Fivepence.—January 1, 1887: as the fourpence; purple and blue.

Sixpence.—January 1, 1887: pale red paper; watermarked with a large crown; purple; perforated 14.

Ninepence.—January 1, 1887: large crown watermark; purple and blue; perforated 14.

Tenpence.—February 24, 1890: as the ninepence; purple and carmine-red.

One Shilling.—January 1, 1887: as the ninepence; green.

The various fiscal stamps admitted to postage uses, the overprinted official stamps for use by government departments, and the stamps specially surcharged for use in the Ottoman Empire, do not call for detailed notice in this article.

The distinctive *telegraph stamps* are as follows:—

One Halfpenny.—April 1, 1880: shamrock watermark; orange vermilion; perforated 14.

One Penny.—February 1, 1876: as the halfpenny; reddish brown.

Threepence.—Perforated 14. *First issue*, February 1, 1876: watermark spray of rose; carmine. *Second issue*, August 1881: watermark large crown; carmine.

Fourpence.—March 1, 1877: watermark large garter; pale sage-green; perforated 14.

Sixpence.—Perforated 14. *First issue*, March 1, 1877: watermark spray of rose; greenish-grey. *Second issue*, July 1881: as first issue; watermark large crown.

One Shilling.—Perforated 14. *First issue*, February 1, 1876: watermark spray of rose; green. *Second issue*, October 1880: watermark spray of rose; pale red-brown. *Third issue*, February 1881: watermark large crown; pale red brown.

Three Shillings.—Perforated 14; slate blue. *First issue*, March 1, 1877: watermark spray of rose. *Second issue*, August 1881: watermark large crown.

Five Shillings.—*First issue*, February 1, 1876: watermark cross *paté*; dark to light rose; perforated 15 by 15½. *Second issue*, August 1881: watermark large anchor; carmine-rose; perforated 14.

Ten Shillings.—March 1, 1877; watermark cross *paté*; green-grey; perforated 15 by 15½.

One Pound.—March 1, 1877: watermark shamrock; brown-purple; perforated 14.

Five Pounds.—March 1, 1877: watermark shamrock; orange-vermilion: perforated 15½ by 15.

In addition to these, there were stamps specially prepared for the army telegraphs.

British Colonies and Dependencies

Australian Commonwealth.—In 1905 there were 6654 post offices open; 311,401,539 letters and cards, 171,844,868 newspapers, book-packets and circulars, 2,168,810 parcels, and 13,680,239 telegrams were received and despatched; the revenue was £2,738,146 and the expenditure £2,720,735.

New Zealand.—In 1905 there were 1937 post offices open; 74,767,288 letters and cards, 47,334,263 newspapers, book-packets and circulars, 392,017 parcels, and 5,640,219 telegrams were dealt with. The revenue from the post office was £410,968, and from telegraphs £273,911, while the expenditure on the post office was £302,146 and on telegraphs £276,581.

Dominion of Canada.—In 1905 there were 10,879 post offices open; 331,792,500 letters and cards, 60,405,000 newspapers, book-packets and circulars, and 58,338 parcels were received and despatched. The revenue from the post office amounted to £1,053,548, and from telegraphs £28,727, while the expenditure was, on the post office £952,652 and on telegraphs £78,934.

Cape of Good Hope.—The number of post offices open in 1905 was 1043; 7,596,600 letters and cards, 3,706,960 newspapers, book-packets and circulars, 536,800 parcels, and 6,045,228 telegrams were dealt with. The revenue from the post office was £423,056, and from telegraphs £206,842 the expenditure being, £456,171 on the post office and £272,863 on telegraphs.

British India.—In 1905 there were 16,033 post offices open; 597,707,867 letters and cards, 76,671,197 newspapers, book-packets and circulars, 4,541,367 parcels, and 9,098,345 telegrams were dealt with. The revenue from the post office was £1,566,704 and from telegraphs £733,193, while the expenditure was, on the post office, £1,199,557 and on telegraphs £546,914.

FRANCE

Early History.

The French postal system was founded by Louis XI. (June 19, 1464), was largely extended by Charles IX. (1565), and received considerable improvements at various periods under the respective governments of Henry IV. and Louis XIII. (1603, 1622, 1627 seq.).[1] In 1627 France originated a postal money-transmission system, a system of cheap registration for letters. The postmaster who thus anticipated modern improvements was Pierre d'Alméras, a man of high birth, who gave about £20,000 (of modern money) for the privilege of serving the public. The turmoils of the Fronde wrecked much that he had achieved. The first farm of postal income was made in 1672, and by farmers it was administered until June 1790. To increase the income postmasterships for a long time were not only sold but made hereditary. Many administrative improvements of detail were introduced, indeed, by Mazarin (1643), by Louvois (*c.* 1680 seq.), and by Cardinal de Fleury (1728); but many formidable abuses also continued. The revolutionary government transferred rather than removed them. Characteristically, it put a board of postmasters in room of a farming postmaster-general and a controlling one. Napoleon (during the consulate[2]) abolished the board, recommitted the business to a postmaster-general as it had been under Louis XIII., and greatly improved the details of the service; Napoleon's organization of 1802 is, in substance, that which now obtains, although, of course, large modifications and developments have been made from time to time.[3]

The university of Paris, as early as the 13th century, possessed a special postal system, for the abolition of which in the 18th it received a large compensation. But it continued to possess certain minor postal privileges until the Revolution.[4]

Mazarin's edict of the 3rd of December 1643 shows that France at that date had a parcel post as well as a letter post. That edict creates for each head post office throughout the kingdom three several officers styled respectively (1) comptroller, (2) weigher, (3) assessor; and, instead of remunerating them by salary, it directs the addition of one-fourth to the existing letter rate and parcel rate, and the division of the surcharge between the three. Fleury's edicts of 1728 make sub-postmasters directly responsible for the loss of letters or parcels; they also make it necessary that senders should post their letters at an office, and not give them to the carriers, and regulate the book-post by directing that book parcels (whether MS. or printed) shall be open at the ends.[5] In 1758, almost eighty years after Dockwra's establishment of a penny post in London, an historian of that city published an account of it, which in Paris came under the eye of Claude Piarron de Chamousset,[6] who obtained letters-patent to do the like, and, before setting to work or seeking profit for himself, issued a tract with the title, *Mémoire sur la petite-poste établie à Londres, sur la modèle de laquelle on pourrait en établir de semblables dans les plus grandes villes d'Europe.* The reform was successfully carried out.

By this time the general post office of France was producing a considerable and growing revenue. In 1676 the farmers had paid to the king £48,000 in the money of that day. A century later they paid a fixed rent of £352,000, and covenanted to pay in addition one-fifth of their net profits. In 1788—the date of the last letting to farm of the postal revenue—the fixed and the variable payments were commuted for one settled sum of £480,000 a year. The result of the devastations of the Revolution and of the wars of the empire together is shown strikingly by the fact that in 1814 the *gross* income of the post office was but little more than three-fifths of the *net* income in 1788. Six years of the peaceful government of Louis XVIII. raised the gross annual revenue to £928,000. On the eve of the Revolution of 1830 it reached £1,348,000. Towards the close of the next reign the post office yielded £2,100,000 (gross). Under the revolutionary government of 1848–1849 it declined again (falling in 1850 to £1,744,000); under that of Napoleon III. it rose steadily and uniformly with every year. In 1858 the gross revenue was £2,296,000, in 1868 £3,596,000.

Pigeon and Balloon Posts.

The ingenuity of the French postal authorities was severely tried by the exigencies of the German War of 1870–71. The first contrivance was to organize a pigeon service (see also PIGEON POST), carrying microscopic despatches prepared by the aid of photographic appliances.[7] The number of postal pigeons employed was 363, of which number fifty-seven returned with despatches. During the height of the siege the English postal authorities received letters for transmission by pigeon post into Paris by way of Tours, subject to the regulations that no information concerning the war was given, that the number of words did not exceed twenty, that the letters were delivered open, and that 5d. a word, with a registration fee of 6d.,[8] was prepaid as postage. At this rate the postage of the 200 letters on each folio was £40, that on the eighteen pellicles of sixteen folios each, carried by one pigeon, £11,520. Each despatch was repeated until its arrival had been acknowledged by balloon post; consequently many were sent off twenty and some even more than thirty times. The second step was to establish a regular system of postal balloons, fifty-one being employed for letter service and six for telegraphic service. To M. Durnouf belongs much of the honour of making the balloon service successful. On the basis of experiments carried out by him a decree of the 26th of September 1870 regulated the new postal system. Out of sixty-four several ascents, each costing on the average about £200, fifty-seven achieved their purpose, notwithstanding the building by Krupp of twenty guns, supplied with telescopic apparatus, for the destruction of the postal balloons. Only five were captured, and two others were lost at sea. The aggregate weight of the letters and newspapers thus aerially mailed by the French post office amounted to about eight tons and a half, including upwards of 3,000,000 letters; and, besides the aeronauts, ninety-one passengers were conveyed. The heroism displayed by the French balloon postmen was equalled by that of many of the ordinary letter-carriers in the conveyance of letters through the catacombs and quarries of Paris and its suburbs, and, under various disguises, often through the midst of the Prussian army. Several lost their lives in the discharge of their duty, in some cases saving their despatches by the sacrifice.[9] During the war the Marseilles route for the Anglo-Indian mails was abandoned. They were sent through Belgium and Germany, by the Brenner Pass to Brindisi, and thence by Italian packets to Alexandria. The French route was resumed in 1872.[10]

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[1] For the details, see *Ency. Brit.*, 8th ed., xviii. 420–424, and Maxime Du Camp, "L'Administration des Postes," in *Revue des deux mondes* (1865), 2nd series, vol. lxvii. 169 seq.

[2] 28 Pluviose, an XII. = the 18th of February 1804.

[3] Le Quien de la Neufville, *Usages des postes* (1730), pp. 59–67, 80, 121–123, 147–149, 286–291; Maxime du Camp, *op. cit. passim*; Pierre Clément, *Appréciation des conséquences de la réforme postale, passim*: Loret, *Gazette rimée* (Aug. 16, 1653); Furetière, *Le Roman Bourgeois* (in Du Camp, *ut supra*); "Die ersten Posteinrichtungen, u.s.w.," in *L'Union postale*, viii. 138; *Ordonnances des Rois de France*, as cited by A. de Rothschild, *Histoire de la poste-aux-lettres* (3rd ed., 1876), i. 171, 216, 269. We quote M. de Rothschild's clever book with some misgivings. It is eminently sparkling in style, and most readable; but its citations are so given that one is constantly in doubt lest they be given at second or even at third hand instead of from the sources. The essay of M. du Camp is, up to its date, far more trustworthy. He approaches his subject as a publicist, M. de Rothschild as a stamp-collector.

[4] There are several charters confirmatory of this original privilege. The earliest of these is of 1296 (Philip "the Fair").

[5] *Ordonnances*, &c., as above.

[6] There is an interesting biographical notice of Piarron de Chamousset in *Le Journal officiel* of July 5, 1875.

[7] The despatches carried by the pigeons were in the first instance photographed on a reduced scale on thin sheets of paper, the original writing being preserved, but after the ascent of the twenty-fifth balloon leaving the city an improved system was organized. The communications, whether public despatches, newspapers or private letters, were printed in ordinary type, and micro-photographed on to thin films of collodion. Each pellicle measured less than 2 in. by 1, and the reproduction of sixteen folio pages of type contained above 3000 private letters. These pellicles were so light that 50,000 despatches, weighing less than 1 gramme, were regarded as the weight for one pigeon. In order to ensure their safety during transit the films were rolled up tightly and placed in a small quill which was attached longitudinally to one of the tail feathers of the bird. On their arrival in Paris they were flattened out and thrown by means of the electric lantern on to a screen, copied by clerks, and despatched to their destination. This method was afterwards improved upon, sensitive paper being substituted for the screen, so that the letters were printed at once and distributed.

[8] *Seventeenth Report of the Postmaster-General*, p. 7.

[9] Boissay, "La Poste et la télégraphie pendant le siège de Paris," in *Journal des économistes*, 3rd series, vol. xxii. pp. 117–129 and pp. 273–282. Cf. *Postal Gazette* (1883), i. 7.

[10] *Sixteenth Report of the Postmaster-General*, p. 8.

The comparative postal statistics for all France during the years 1900 and 1905 stands thus:—

		1900.	1905.
		No.	No.
Letters		980,629,000	1,113,090,000
Post-cards		62,591,000	450,889,000
Newspapers, printed matter, samples, circulars, &c.		1,390,246,000	1,441,713,000
Value of money orders	French francs	1,422,736,000	1,834,360,000
	Internatl. ,,	56,210,000	73,229,000
Value of postal orders	,,	40,688,000	54,582,000
Receipts	,,	209,982,000	261,454,000
	£	8,399,000	10,458,000

The savings banks system of France, so far as it is connected with the postal service, dates only from 1875, and began then (at first) simply by the use of post offices as agencies and feeders for the pre-existing banks. Prior to the postal connexion the aggregate of the deposits stood at £22,920,000. In 1877 it reached £32,000,000. Postal savings banks, strictly so called, began only during the year 1881. At the close of 1882 they had 210,712 depositors, with an aggregate deposit of £1,872,938 sterling; in 1905 they had 12,134,523 depositors, with an aggregate deposit of £229,094,155.

The union of the telegraph with the post office dates only from 1878. The following table gives the figures for 1900 and 1905:—

		1900.	1905.
Length of line	kilometres	117,559	129,826
	miles	73,004	80,622
Length of wire	kilometres	388,814	418,331
	miles	241,453	259,784
Total gross receipts	francs	43,977,000	46,490,000
	£	1,759,000	1,860,000
Number of messages forwarded:			
Home service		36,723,000	39,433,000
International		3,374,000	3,686,000
Amount of International telegraphic money orders:			
From foreign countries to France	(Total francs)	6,145,455	10,239,546
From France to foreign countries	(Total francs)	6,124,913	4,754,960

The postal telephonic system began in 1879. The following table gives the figures for 1901 and 1905:—

		1901.	1905.
Length of line	kilometres	30,142	46,992
	miles	18,718	29,182
Length of wire	kilometres	453,287	498,389
	miles	281,491	309,500
Messages		175,340,000	232,727,645
Receipts	francs	17,518,000	23,495,000
	£	701,000	940,000

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AUSTRIA-HUNGARY

The Austrian postal system is among the oldest on record. Vienna possessed a local letter post and a parcel post, on the plan of prepayment, as early as May 1772, at which date no city in Germany possessed the like. This local post was established by a Frenchman (M. Hardy) and managed by a Dutchman (Schooten).[1] Thirteen years after its organization it became merged in the imperial post. The separate postal organizations of the empire (Austria) and of the kingdom (Hungary) date from 1867. In Austria the post office and the telegraph office are placed under the control of the minister of commerce, in Hungary under that of the minister of public works. The following table gives the figures for 1900 and 1904:—

Austria.

		1900.	1904.
Post offices	No.	6,895	8,327
Letters and post-cards	,,	1,193,418,000	1,421,107,000
Newspapers	,,	116,000,000	144,986,000
Packet post:			
Ordinary packets	kilogs.	37,521,000	44,624,000
Registered packets and letters	kronen	8,043,570,000	8,323,179,000
	£	335,148,000	346,799,000
Receipts	kronen	107,718,000	123,919,000
	£	4,488,000	5,163,000
Expenses	kronen	98,412,000	121,749,000
	£	4,100,000	5,073,000

Hungary.

		1900.	1904.
Post offices	No.	4,923	5,097
Letters, newspapers, &c.	,,	487,670,000	584,081,000
Packet post:			
Ordinary packets	,,	17,730,000	21,367,000
Packets with declared value and money letters	korona	6,256,900,000	4,936,403,000
	£	260,704,000	205,683,000
Reimbursements and money orders	korona	1,095,591,000	1,253,440,000
	£	45,649,000	52,226,000
Postal orders	korona	27,470,000	30,397,000
	£	1,145,000	1,266,000
Receipts	korona	47,103,000	57,067,000
	£	1,962,000	2,378,000
Expenses	korona	39,912,000	44,560,000
	£	1,663,000	1,857,000

GERMAN EMPIRE

The Prussian postal system developed mainly by the ability and energy of Dr Stephan, to whom the organization of the International Postal Union[2] was so largely indebted, into the admirably organized post and telegraph office of the empire—began with the Great Elector, and with the establishment in 1646 of a Government post from Cleves to Memel. Frederick II. largely extended it, and by his successor the laws relating to it were consolidated. In Strasburg a messenger code existed as early as 1443. A postal service was organized at Nuremberg in 1570. In 1803 the rights in the indemnity-lands (*Entschädigungsländer*) of the counts of Taxis as hereditary imperial postmasters were abolished. The first mail steam-packet was built in 1821; the first transmission of mails by railway was in 1847; the beginning of the postal administration of the telegraphs was in 1849; and, by the treaty of postal union with Austria, not only was the basis of the existing system of the posts and telegraphs of Germany fully laid, but the germ was virtually set of the International Postal Union. That treaty was made for ten years on the 6th of April 1850, and was immediately accepted by Bavaria. It came into full operation on the 1st of July following, and then included Saxony, Mecklenburg-Strelitz and Holstein. Other German states followed; and the treaty was renewed in August 1860.

The following table gives figures for 1900 and 1905:—

		1900.	1905.
Post offices	No.	32,135	33,105
Letters received	,,	2,893,555,000	3,855,369,000
Letters and parcels received (value declared)	,,	10,508,000	10,518,000
	1000 marks	15,984,425	16,215,800
Parcels received (value not declared)	No.	153,985,000	186,038,000
Postal orders received	,,	126,217,209	162,800,261
	1000 marks	7,868,860	9,807,934

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[1] Loeper, "Organisation des postes de ville," in *L'Union postale* vii. 1 seq.

[2] The International Postal Union was founded at Berne in 1874. All the countries of the world belong to it, with the exception of Afghanistan, Baluchistan, China, Abyssinia and Morocco. Congresses have been held at Paris (1878), Lisbon (1885), Vienna (1891), Washington (1897) and Rome (1906).

Telegraphs.[1]

		1900.	1905.
Length of line	kilometres	108,500	117,738
	miles	67,378	73,115
of which underground	kilometres	10,969	11,460
	miles	6,812	7,117
Length of wire	kilometres	424,500	469,801
	miles	263,614	291,746
of which underground	kilometres	49,934	52,014
	miles	31,009	32,301
Number of offices open to the public		20,768	26,912
Receipts	Marks	33,065,590	39,592,009
	£	1,625,724	1,946,607
Number of messages:			
Home service		28,643,849	30,275,833
International		12,356,840	15,300,309

[1] Exclusive of Württemburg and Bavaria.

Telephones.

	1901.	1905.
Length of line . . . miles	59,460	85,450
Length of wire . . . ,,	731,174	1,672,415
Number of messages	766,226,337	1,207,400,000

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ITALY

The origin of the Italian post office may be traced virtually to Venice and to the establishment of the "Corrieri di Venezia" early in the 16th century. As early as 1818 the Sardinian post office issued stamped letter-paper. The total number of letters, newspapers and book-packets conveyed in 1862 was but 111,733,319. In 1900 there were 7234 post offices; letters conveyed amounted to 180,349,449, post cards 82,544,547, newspapers, &c., 301,495,580, samples 9,117,526, official letters, franked, 46,302,121, postal packets 8,170,988, and registered letters of a declared value of £12,931,026. The receipts amounted to £2,429,000 and the expenses to £1,980,000.

UNITED STATES

The early history of the post office in the British colonies in North America has been referred to above. Benjamin Franklin was removed by the home department from his office of postmaster-general in America in 1774. On the 26th of July 1775 the American Congress assumed direction of the post offices, re-appointing Franklin to his former post. Shortly afterwards, when Franklin was sent as ambassador to France, his son-in-law, Richard Bache, was made postmaster-general in November 1775.

In 1789 the number of post offices was 75; in 1800, 903; in 1825, 5677; in 1875, 35,734; in 1885, 51,252; in 1890, 62,401; in 1895, 70,064; in 1900, 76,688; and in 1905, 68,131.

The following table gives the financial statements for a number of years:—

Year.	Extent of post routes in miles.	Revenue.	Expenditure.
1875	277,873	$26,791,360	$33,611,309
1880	343,888	33,315,479	36,542,804
1885	365,251	42,560,844	49,533,150
1890	427,991	60,882,097	65,930,717
1895	456,026	76,983,128	86,790,172
1900	500,982	102,354,579	107,740,268
1905	486,805	152,826,585	167,399,169

The revenue quoted does not include any allowance for the large quantity of official matter carried for other public departments, &c., indeed, the postmaster-general, in his *Report* for 1906, estimated that if the due allowance were made it would add approximately $20,000,000 to the revenue. The post office department is compelled to carry anything sent under a penalty frank, and franks are used by all the departments and their agents for the purpose of carrying everything they choose to send (*Report*, postmaster-general, 1893). The expenditure does not include the amounts certified to the Treasury for the transportation of mails over aided Pacific railways, or any allowance for the use of such buildings as are provided by the government.

Contrary to expectations repeatedly expressed, each year shows a deficit. This is partly explained by reductions in charges. The rate of postage on first-class matter was reduced from three cents to two cents on the 1st of October 1883, and the unit of weight was increased from half an ounce to one ounce on the 1st of July 1885. On the latter date, also, the postage on second-class matter was reduced from two cents to one cent per pound. This low rate has led to wholesale violation of the purpose of the law. In his report for 1899 Mr Emory Smith, postmaster-general, estimated that "fully one-half of all the matter mailed as second-class, and paid for at the pound rate, is not properly second-class within the intent of the law"; and that the cost of mere transportation of this wrongly classed matter exceeded the revenue derived from it by more than $12,000,000 for the year.

Until 1863 the rates of postage were based upon the distances over which the mails were conveyed. In 1846 these rates were—not exceeding 300 m., three cents; exceeding 300 m., ten cents. In 1851 the rates were reduced to three cents for distances not exceeding 3000 m. and ten cents for distances exceeding 3000 m. The use of adhesive postage stamps was first authorized by act of Congress, approved on the 3rd of March 1847, and on the 1st of June 1856 prepayment by stamps was made compulsory. In 1863 a uniform rate of postage without regard to distance was fixed at three cents, and on the 1st of October 1883, the rate was further reduced to two cents, the equivalent of the British penny postage.

All mail matter for distribution within the United States is divided into four classes. *First-class matter* includes letters, postal cards, post cards and anything sealed or closed against inspection. *Second-class matter* includes all newspapers and periodicals exclusively in print that have been "entered as second-class matter," and are regularly issued at stated intervals as frequently as four times a year from a known office of publication and mailed by publishers or newsagents to actual subscribers or to newsagents for sale, and newspapers and publications of this class mailed by persons other than publishers. The rates of postage to publishers are one cent a pound, and to other than publishers, one cent for each four ounces. *Third-class matter* includes printed books, pamphlets, engravings and circulars in print or reproduced by a copying process. The rate for third-class matter is one cent for each two ounces. *Fourth-class matter* is all mailable matter not included in the three preceding classes which is so prepared for mailing as to be easily withdrawn from the wrapper and examined. The rate is one cent for each ounce.

The franking privilege, which had grown to be an intolerable abuse, was temporarily abolished in 1873, but the post office now carries free under official "penalty" labels or envelopes (*i.e.* envelopes containing a notice of the legal penalty for their unauthorized use) matter which is of an official character, the privilege being extended to congressmen and government officials (see FRANKING). As late as 1860 the mails conveyed nothing but written and printed matter. They now admit nearly every known substance which does not exceed four pounds in weight (this restriction does not apply to single books), and which from its nature is not liable to injure the mails or the persons of postal employés.

A delivery system existed in a number of cities of the Union in 1862, the carriers remunerating themselves by the collection of a voluntary fee of from one to two cents on each piece of mail delivered. A uniform free delivery system was first authorized by law on the 3rd of March 1863, and was established on the succeeding 1st of July in forty-nine cities. The number of carriers employed the first year was 685. On the 1st of July 1884 there were 3890 letter-carriers in one hundred and fifty-nine "free delivery cities."

The free delivery service has grown rapidly. On the 1st of July 1901, 866 cities and towns were included in the scheme, and

16,389 letter-carriers were serving a population of 32,000,000. An extension to rural districts was started in 1896, and by December 1901, 4,000,000 of the rural population were within the scope of free delivery. Since the 1st of October 1885 a system has been in force for the immediate delivery by special messengers of letters, parcels, &c., for addresses within certain areas. A special ten-cent stamp (or its equivalent) is required in addition to the ordinary postage.

The registry system did not attain any degree of excellence until after 1860; and the money-order system was first established in 1864. The aggregate number of money orders, domestic and foreign, issued during the fiscal year 1906 was 61,497,861, of the value of $507,563,719. A step towards the popularization of the registry system was authorized in December 1899; letter-carriers in many city districts now accept and register letters at the door of the householder. Sea post offices for sorting mails during the Atlantic transit were established in December 1890 on the steamers of the North German Lloyd and Hamburg-American lines, and later on the vessels of the International Navigation Company. This plan effects a saving of from two to fourteen hours in the delivery of mails from Europe. The issue of "postal notes," commenced in 1883, was abandoned in 1894. The introduction of "postal checks" for small fixed amounts has been advocated. A new postal convention with Canada, removing the former restriction against sending merchandise, came into force on the 1st of March 1888. Uniformity of postage rates having been previously established, the United States and Canada became virtually one postal territory.

A convention for an exchange of parcels with Jamaica, admitting articles not exceeding 11 ℔, was agreed to in 1887; and since then conventions on similar lines have been concluded with other colonies and countries in America. The first arrangement of the kind with any European country was made with Germany, and came into operation on the 1st of October 1899. The postal laws, regulations and domestic conditions of the United States have been extended, by act of Congress, to Porto Rico and Hawaii. The "island possessions" (Guam, the Philippine Archipelago and Tutuila) have also been brought within the scope of the domestic conditions, including the rates of postage. The service introduced into Cuba, though modelled on the American plan, is practically autonomous.

Telegraphs.—The formation of a postal telegraph system has continued to be a subject of discussion by the postmasters-general. In his report for the year 1888 D. M. Dickinson proposed the appointment of an expert commission authorized to erect short experimental lines. His successor, John Wanamaker, for four years vigorously advocated a limited postal telegraph service. Under this proposal, contracting telegraph companies were to furnish lines, instruments and operators, and to transmit messages at rates fixed by the government; the department was to receive a small sum per message, to cover its expenses in collection and delivery. In 1894 Mr Bissell expressed the opinion that a government system would be unprofitable and inexpedient.

Savings Banks.—The establishment of postal savings banks was also recommended by Mr Wanamaker in his reports for the years 1889 to 1892, and by J. A. Gary in 1897. What is regarded as a step in this direction was taken in 1898, when the postal regulations were modified to allow money orders to be made payable at the office of issue,—a "mild and very convenient adaptation of the European savings bank system, without the payment of interest" (Mr Emory Smith). Finally in 1910 a system of postal savings banks was authorized by Congress.

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The various postal and telegraph rates and regulations of the United Kingdom appear in the quarterly *Post Office Guide* (price 6d.). For the United States, see the *U.S. Official Postal Guide.*(T. A. I.)

POST AND PAIR, a card game popular in the 16th and 17th centuries. A hand consisted of three cards, a pair royal ranking highest, or failing this, the highest pair. Another name of the game was Pink.

POSTER, a placard in the form either of letterpress or illustration, for posting up or otherwise exhibiting in public to attract attention to its contents. According to Brewer's *Dictionary of Phrase and Fable*, before the Fire of London the rails and posts which protected foot-passengers in the streets were used for affixing theatrical and other announcements, whence the name of posting-bills or posters; and in later times the name has come more generally into use for any fairly large separate sheet, illustrated or not, used to attract publicity, even though not actually posted up. In the article ADVERTISEMENTS the use of posters is discussed, and newspaper posters (or contents bills) under NEWSPAPERS. But the illustrated poster has come to represent a special form of artistic design.

The earliest examples of pictorial posters were adorned with rough woodcuts. When lithography became a common commercial process, wood-blocks ceased to be employed. The modern artistic poster made a definite beginning in France about 1836, with a design by Lalance to advertise a book entitled *Comment meurent les femmes*. His example was followed by C. Nanteuil, D. A. M. Raffet, Gavarni, Bertrand, Grandville, Tony Johannot, E. de Beaumont, T. H. Frère, Edouard Manet and other artists of high repute. Most of these early designs were printed in black on white or tinted paper. Between 1860 and 1866 crude attempts at printing posters in colours were made in both France and England. In 1866 Jules Chéret began what was destined to be the most noticeable series of pictorial placards in existence, a series containing over a thousand items. Chéret was originally employed in a lithographic establishment in England before he began to work for himself, and he used his knowledge there acquired to adapt all three primary colours, economically used, to astonishingly brilliant ends. For a considerable time he remained without a rival, though he had hosts of imitators. Eugène Grasset, a decorative designer of great versatility, produced the first of a small number of placards which, though inferior as advertisements to those of Chéret, were learned and beautiful decorations. Somewhat later a sensation was caused in Paris by the mordantly grotesque posters of Henri de Toulouse-Lautrec, in which the artist reduced detail to a minimum and obtained bold effects by the employment of large masses of flat colour. Important work, similar in character to Lautrec's, was produced by Ibels, Bonnard, T. A. Steinlen and others. A new and contrary direction was given to poster design by Mucha, a Hungarian resident in Paris, whose placards are marked by delicate colour and richness of detail. The following are amongst French artists who have designed posters of conspicuous merit: J. L. Forain, Willette, Paléologue, Sinet, Jossot, Roedel, Mayet, Cazals, Biais, De Feure, A. Guillaume, Ranft, Réalier-Dumas, F. Valloton and Metivet. Occasionally eminent French painters, such as Carrière, Boutet de Monvel, Aman-Jean, Schwabe, have made essays in poster-designing.

In England the first artists of repute to attempt the pictorial placard were Godfroy Durand and Walter Crane; but the first bill to attract widespread attention was one by Fred Walker to advertise a dramatized version of *The Woman in White* (1871). This was engraved on wood by W. H. Hooper. Shortly after this time pictures by Royal Academicians and others began to be reproduced as advertisements (the best-known case being that of Sir John Millais's "Bubbles"), but these have nothing directly to do with poster-designing. Stacy Marks, Hubert von Herkomer (the great poster for the *Magazine of Art*), Sir Edward Poynter and Sir James Linton are among popular painters who have made special drawings for reproduction as posters.

About 1894 the English poster began to improve. Designs by Aubrey Beardsley for the Avenue Theatre, by Dudley Hardy for various plays, and by Maurice Greiffenhagen for *The Pall Mall Budget*, were widely noticed by reason of their originality, simplicity and effectiveness. Simplicity was carried even farther by "the Beggarstaff Brothers" (James Pryde and William Nicholson), whose posters are perhaps the most original yet produced by Englishmen. Among other British designers the following have executed artistic and interesting placards: Frank Brangwyn, R. Anning Bell, John Hassall, Cecil Aldin, Phil May, Leonard Raven-Hill, Henry Harland, Robert Fowler, Wilson Steer, Charles R. Mackintosh, MacNair and MacDonald, Edgar Wilson, Charles I. Foulkes, Mabel Dearmer, Albert Morrow and C. Wilhelm.

Poster design on the continent of Europe has been largely influenced by French work, but designs of much originality have been made in Germany, Belgium, Italy and Spain. In Germany, among the most typical posters are those of Sattler, Otto Fischer, Gysis, T. T. Heine, Speyer, Max Klinger, Dasio, Hofmann and L. Zumbrusch. The principal Belgian designers include Privat Livemont, Rassenfosse, Berchmans, Meunier, Duyck and Crespin, V. Mignot, Donnay, Evenepoel, Cassiers and Toussaint. Of Italian designers those whose work is most characteristic are Mataloni and Hohenstein; while the best Spanish posters—those to advertise bull-fights and fairs—are mostly anonymous. The Spanish artists Utrillo and Casas have signed posters of more than ordinary merit. Curious if not very artistic bills have been produced in Russia; and in Austria good work has been done by Orlik, Schliessmann, Oliva and Hynais.

In the United States of America, however, with the exception of some designs by Matt Morgan, few posters of artistic interest were produced before 1889, in which year Louis J. Rhead commenced a notable series of decorative placards. Will H. Bradley began to produce his curious decorative grotesque posters a little later. If American artists are behind Europeans in the artistic designing of large posters they have no rivals in the production of small illustrated placards for publishers of books and magazines. Chief among those who have devoted themselves to this branch of poster design is Edward Penfield. Others who have achieved success in it include Maxfield Parrish, Ethel Reed, Will Carqueville, J. J. Gould, J. C. Leyendecker, Frank Hazenplug, Charles Dana Gibson, Will Denslow, Florence Lundbourg and Henry Mayer.

Exhibitions of artistic posters have been held in the chief cities of Europe and America, and the illustrated placard has already a literature of its own. In England a monthly magazine (*The Poster*) was for a time specially devoted to its interests, and collectors are numerous and enthusiastic.

See Ernest Maindron, *Les Affiches illustrées* (Paris, 1895); *Les Maîtres de l'affiche* (Paris); *Les Affiches étrangères illustrées* (Belgium, Austria, Great Britain, United States, Germany and Japan) (Paris, 1897); Charles Hiatt, *Picture Posters* (London, 1895); J. L. Spousel, *Das Moderne Plakat* (Dresden, 1897); Arsene Alexandre, M. H. Spielmann, H. C. Bunner and A. Jaccacci, *The Modern Poster* (New York, 1895). (C. Hi.)

POSTERN (from O. Fr. *posterne*, *posterle*, Late Lat. *posterula*, small back-door, *posterus*, behind), a small gateway in the enceinte of a castle, abbey, &c., from which to issue and enter unobserved. They are often called "sally ports." (See Gate.)

POSTHUMOUS, that which appears or is produced after the author or creator, and thus applied to a literary work or work of art published or produced after its author's death, or especially to a child born after the death of its father. The Latin *postumus*, latest, last, from which the word is derived, is formed from *post*, after, but it was in Late Latin connected with *humare*, to place in the ground (*humus*), to bury.

POSTICHE, a French term for a pretentious imitation, a counterfeit, particularly used of an inartistic addition to an otherwise perfect work of art. The French word was adapted from the Italian *posticcio*, from Latin *positus*, placed, added.

POSTIL, or Apostil, properly a gloss on a scriptural text, particularly on a gospel text, hence any explanatory note on other writings. The word is also applied to a general commentary, and also to a homily or discourse on the gospel or epistle appointed for the day. The word in Medieval Latin was *postilla*, and this has been taken to represent *post illa sc. verba textus*, *i.e.* "after these words of the text" (see Du Cange, *Glossarium*, *s.v. postillae*), but the form "apostil" may point to the Latin *appositum*, placed near or next to.

POSTILION (through the Fr. from the Ital. *postiglione*), a postboy, rider of a post-horse, hence any swift messenger, but more particularly the rider of the near horse of a vehicle drawn by two or more horses where there is no driver. The swift travelling postchaises of the 18th and early 19th centuries were usually driven by postilions.

POSTUMIA, VIA, an ancient highroad of northern Italy, constructed in 148 B.C. by the consul Spurius Postumius Albinus. It ran from the coast at Genua through the mountains to Dertona, Placentia (the termination of the Via Aemilia Lepidi) and Cremona, just east of the point where it crossed the Po. From Cremona the road ran eastward to Bedriacum, where it forked, one branch running to the left to Verona and thence to the Brenner, the other to the right to Mantua, Altinum and Aquileia. The military occupation of Liguria depended upon this road, and several of the more important towns owed their origin largely to it. Cremona was its central point, the distances being reckoned from it both eastwards and westwards. (T. As.)

POSY (a shortened form of *poesy*, Fr. *poésie*, poetry), a verse of poetry or a motto, either with a moral or religious sentiment or message of love, often inscribed in a ring or sent with a present, such as a bouquet of flowers, which may be the origin of the common use of the word for a nosegay or bouquet. It has been suggested that this use is due to the custom of the symbolic use of flowers. Skeat quotes the title of a tract (*Heber's MSS.* No. 1442), "A new yeare's guifte, or a posie made upon certen flowers," &c. "Posy rings," plain or engraved gold rings with a "posy" inscribed on the inside of the hoops, were very frequently in use as betrothal rings from the 16th to the 18th centuries. Common "posies" were such lines as "In thee my choice I do rejoice," "As God decreed so we agreed," and the like. There are several rings of this kind in the British Museum.

POTASHES, the crude potassium carbonate obtained by lixiviating wood ashes and evaporating the solution to dryness, an operation at one time carried out in iron pots—hence the name from "pot" and "ashes." The term potash or caustic potash is frequently used for potassium hydroxide, whilst such a phrase as sulphate of potash is now appropriately replaced by potassium sulphate. (See Potassium.)

POTASSIUM [symbol K (from *kalium*), atomic weight 39·114 $O=16$)], a metallic chemical element, belonging to the group termed the metals of the alkalis. Although never found free in nature, in combination the metal is abundantly and widely distributed. In the oceans alone there are estimated to be 1141×10^{12} tons of sulphate, K_2SO_4; but this inexhaustible store is not much drawn upon; and the "salt gardens" on the coast of France lost their industrial importance as potash-producers since the deposits at Stassfurt in Germany have come to be worked. These deposits, in addition to common salt, include the following minerals: sylvine, KCl; carnallite, $KCl\cdot MgCl_2\cdot 6H_2O$ (transparent, deliquescent crystals, often red with diffused oxide of iron); kainite, $K_2SO_4\cdot MgSO_4\cdot MgCl_2 6H_2O$ (hard crystalline masses, permanent in the air); kieserite $MgSO_4\cdot H_2O$ (only very slowly dissolved by water); besides polyhalite, $MgSO_4\cdot K_2SO_4\cdot 2CaSO_4\cdot 2H_2O$ anhydrite, $CaSO_4$; salt, $NaCl$, and some minor components. These potassium minerals are not confined to Stassfurt; larger quantities of sylvine and kainite are met with in the salt mines of Kalusz in the eastern Carpathian Mountains. The Stassfurt minerals owe their industrial importance to their solubility in water and consequent ready amenability to chemical operations. In point of absolute mass they are insignificant compared with the abundance and variety of potassiferous silicates, which occur everywhere in the earth's crust; orthoclase (potash felspar) and potash mica may be quoted as prominent examples. Such potassiferous silicates are found in almost all rocks, both as normal and as accessory components; and their disintegration furnishes the soluble potassium salts which are found in all fertile soils. These salts are sucked up by the roots of plants, and by taking part in the process of nutrition are partly converted into oxalate, tartrate, and other organic salts, which, when the plants are burned, are converted into the carbonate, K_2CO_3. It is a remarkable fact that, although in a given soil the soda-content may predominate largely over the potash salts, the plants growing in the soil take up the latter: in the ashes of most land plants the potash (calculated as K_2O) forms upwards of 90% of the total alkali. The proposition holds, in its general sense, for sea plants likewise. In ocean water the ratio of soda (Na_2O) to potash (K_2O) is 100 : 3·23 (Dittmar); in kelp it is, on the average, 100 : 5·26 (Richardson). Ashes particularly rich in potash are those of burning nettles, wormwood (*Artemisia absinthium*), tansy (*Tanacetum vulgare*), fumitory (*Fumaria officinalis*), and tobacco. In fact, the ashes of herbs generally are richer in potash than those of the trunks and branches of trees; yet, for obvious reasons, the latter are of greater industrial importance as sources of potassium carbonate. According to Liebig, potassium is the essential alkali of the animal body; and it may be noted that sheep excrete most of the potassium which they take from the land as sweat, one-third of the weight of raw merino consisting of potassium compounds.

To Sir Humphry Davy belongs the merit of isolating this element from potash, which itself had previously been considered an element. On placing a piece of potash on a platinum plate, connected to the negative of a powerful electric battery, and bringing a platinum wire, connected to the positive of the battery, to the surface of the potassium a vivid action was observed: gas was evolved at the upper surface of the fused globule of potash, whilst at the lower surface, adjacent to the platinum plate, minute metallic globules were formed, some of which immediately inflamed, whilst others merely tarnished. In 1808 Gay-Lussac and Thénard (*Ann. chim.* 65, p. 325) obtained the metal by passing melted potash down a clay tube containing iron turnings or wire heated to whiteness, and Caradau (ibid. 66, p. 97) effected the same decomposition with charcoal at a white heat. This last process was much improved by Brunner, Wöhler, and especially by F. M. L. Donny and J. D. B. Mareska (*Ann. chim. phys.*, 1852, (3), 35, p. 147). Brunner's process consisted in forming an intimate mixture of potassium carbonate and carbon by igniting crude tartar in covered iron crucibles, cooling the mass, and then distilling it at a white heat from iron bottles, the vaporized metal being condensed beneath the surface of paraffin or naphtha contained in a copper vessel. It was found, however, that if the cooling be not sufficiently rapid explosions occurred owing to the combination of the metal with carbon monoxide (produced in the oxidation of the charcoal) to form the potassium salt of hexaoxybenzene. In Mareska and Donny's process the condensation is effected in a shallow iron box, which has a large exposed surface, capable of being cooled by damped cloths. When the distillation is finished the iron box, after cooling, is unclamped and the product turned out beneath the surface of paraffin. It is purified by redistilling and condensing directly under paraffin. Electrolytic processes have also been devised. Linnemann (*Journ. Prak. Chem.*, 1858, 73, p. 413) obtained the metal on a small scale by electrolysing potassium cyanide between carbon electrodes; A. Matthiessen (*Journ. Chem. Soc.*, 1856, p. 30) electrolysed an equimolecular mixture of potassium and calcium chlorides (which melts at a lower temperature than potassium chloride) also between carbon electrodes; whilst Castner's process, in which caustic potash is electrolysed, is employed commercially. The metal, however, is not in great demand, for it is generally found that sodium (*q.v.*), which is cheaper, and, weight for weight, more reactive, will fulfil any purpose for which potassium may be desired.

Pure potassium is a silvery white metal tinged with blue; but on exposure to air it at once forms a film of oxide, and on prolonged exposure deliquesces into a solution of hydrate and carbonate. Perfectly dry oxygen, however, has no action upon it. At temperatures below 0° C. it is pretty hard and brittle; at the ordinary temperature it is so soft that it can be kneaded between the fingers and cut with a blunt knife. Its specific gravity is 0·865; hence it is the lightest metal known except lithium. It fuses at 62·5°C. (Bunsen) and boils at 667°, emitting an intensely green vapour. It may be obtained crystallized in quadratic octahedra of a greenish-blue colour, by melting in a sealed tube containing an inert gas, and inverting the tube when the metal has partially solidified. When heated in air it fuses and then takes fire, burning into a mixture of oxides. Most remarkable, and characteristic for the group it represents, is its action on water. A pellet of potassium when thrown on water at once bursts out into a violet flame and the burning metal fizzes about on the surface, its extremely high temperature precluding absolute contact with the liquid, except at the very end, when the last remnant, through loss of temperature, is wetted by the water and bursts with explosive violence. The reaction may be written $2K+2H_2O=2KOH+H_2$, and the flame is due to the combustion of the hydrogen, the violet colour being occasioned by the potassium vapour. The metal also reacts with alcohol to form potassium ethylate, while hydrogen escapes, this time without inflammation: $K+C_2H_5\cdot OH=C_2H_5\cdot OK+H$. When the oxide-free metal is heated gently in dry ammonia it is gradually transformed into a blue liquid, which on cooling freezes into a yellowish-brown or flesh-coloured solid, potassamide, KNH_2. When heated to redness the amide is decomposed into ammonia and potassium nitride, NK_3, which is an almost black solid. Both it and the amide decompose water readily with formation of ammonia and caustic potash. Potassium at temperatures from 200° to 400°C. occludes hydrogen gas, the highest degree of saturation corresponding approximately to the formula K_2H. In a vacuum or in sufficiently dilute hydrogen the compound from 200° upwards loses hydrogen, until the tension of the free gas has arrived at the maximum value characteristic of that temperature (Troost and Hautefeuille).

Compounds.

Oxides and Hydroxide.—Potassium forms two well-defined oxides, K_2O and K_2O_4, whilst several others, of less certain existence, have been described. The monoxide, K_2O, may be obtained by strongly heating the product or burning the metal in slightly moist air; by heating the hydroxide with the metal: $2KHO+2K=2K_2O+H_2$; or by passing pure and almost dry air over the molten metal (Kühnemann, *Chem. Centr.*, 1863, p. 491). It forms a grey brittle mass, having a conchoidal fracture; it is very deliquescent, combining very energetically with water to form caustic potash. According to Holt and Sims (*Journ. Chem. Soc.*, 1894, p. 438), the substance as obtained above always contains free potassium.

Potassium hydroxide or caustic potash, KOH, formerly considered to be an oxide but shown subsequently to be a hydroxide of potassium, may be obtained by dissolving the metal or monoxide in water, but is manufactured by double decomposition from potassium carbonate and slaked lime: $K_2CO_3+Ca(OH)_2=2KOH+CaCO_3$. A solution of one part of the carbonate in 12 parts of water is heated to boiling in a cast-iron vessel (industrially by means of steam-pipes) and the milk of lime added in instalments until a sample of the filtered mixture no longer effervesces with an excess of acid. The mixture is then allowed to settle in the iron vessel, access of air being prevented as much as practicable, and the clear liquor is syphoned off. The remaining mud of calcium carbonate and hydrate is washed, by decantation, with small instalments of hot water to recover at least part of the alkali diffused throughout it, but this process must not be continued too long or else some of the lime passes into solution. The liquors after a concentration in iron vessels are now evaporated in a silver dish, until the heavy vapour of the hydrate is seen to go off. The residual oily liquid is then poured out into a polished iron tray, or into an iron mould to produce the customary form of "sticks," and allowed to cool. The solid must be at once bottled, because it attracts the moisture and carbonic acid of the air with great avidity and deliquesces. According to Dittmar (*Journ. Soc. Chem. Ind.*, May 1884), nickel basins are far better adapted than iron basins for the preliminary concentration of potash ley. The latter begin to oxidize before the ley has come up to the traditional strength of specific gravity 1·333 when cold, while nickel is not attacked so long as the percentage of real KHO is short of 60. For the fusion of the dry hydrate nickel vessels cannot be used; in fact, even silver is perceptibly attacked as soon as all the excess of water is away; absolutely pure KHO can be produced only in gold vessels. Glass and (to a less extent) porcelain are attacked by caustic potash ley, slowly in the cold, more readily on boiling.

Solid caustic potash forms an opaque, white, stone-like mass of dense granular fracture; specific gravity 2·1. It fuses considerably below and is perceptibly volatile at a red heat. At a white heat the vapour breaks down into potassium, hydrogen and oxygen. It is extremely soluble in even cold water, and in any proportion of water on boiling. On crystallizing a solution, the hydrate $KOH\cdot 2H_2O$ is deposited; $2KOH\cdot 9H_2O$ and $2KOH\cdot 5H_2O$ have also been obtained. The solution is intensely "alkaline" to test-papers. It readily dissolves the epidermis of the skin and many other kinds of animal tissue—hence the former application of the "sticks" in surgery. A dilute potash readily emulsionizes fats, and on boiling saponifies them with formation of a soap and glycerin. All commercial caustic potash is contaminated with excess of water (over and above that in the KHO) and with potassium carbonate and chloride; sulphate, as a rule, is absent. A preparation sufficing for most purposes is obtained by digesting the commercial article in absolute alcohol, decanting and evaporating the solution to dryness and fusing in silver vessels.

The peroxide, K_2O_4, discovered by Gay-Lussac and Thénard, is obtained by heating the metal in an excess of slightly moist air or oxygen. Vernon Harcourt (*Journ. Chem. Soc.*, 1862, p. 267) recommends melting the metal in a flask filled with nitrogen and gradually displacing this gas by oxygen; the first formed grey film on the metal changes to a deep blue, and then the gas is rapidly absorbed, the film becoming white and afterwards yellow. It is a dark yellow powder, which fuses at a high temperature, the liquid on cooling depositing shining tabular crystals; at a white heat it loses oxygen and yields the monoxide. Exposed to moist air it loses oxygen, possibly giving the dioxide, K_2O_2; water reacts with it, evolving much heat and giving caustic potash, hydrogen peroxide and oxygen; whilst carbon monoxide gives potassium carbonate and oxygen at temperatures below 100°. A violent reaction ensues with phosphorus and sulphur, and many metals are oxidized by it, some with incandescence.

Halogen Compounds.—Potassium fluoride, KF, is a very deliquescent salt, crystallizing in cubes and having a sharp saline taste, which is formed by neutralizing potassium carbonate or hydroxide with hydrofluoric acid and concentrating in platinum vessels. It forms the acid fluoride KHF_2 when dissolved in aqueous hydrofluoric acid, a salt which at a red heat gives the normal fluoride and hydrofluoric acid. Other salts of composition $KF{\cdot}2HF$ and $KF{\cdot}3HF$, have been described by Moissan (*Compt. rend.*, 1888, 106, p. 547).

Potassium chloride, KCl, also known as muriate of potash, closely resembles ordinary salt. It is produced in immense quantities at Stassfurt from the so-called "Abraumsalze." For the purpose of the manufacturer of this salt these are assorted into a raw material containing approximately, in 100 parts, 55–65 of carnallite (representing 16 parts of potassium chloride), 20–25 of common salt, 15–20 of kieserite; 2–4 of tachhydrite ($CaCl_2{\cdot}2MgCl_2{\cdot}12H_2O$), and minor components. This mixture is now wrought mainly in two ways. (1) The salt is dissolved in water with the help of steam, and the solution is cooled down to from 60° to 70°, when a quantity of impure common salt crystallizes out, which is removed. The decanted ley deposits on standing a 70% potassium chloride, which is purified by washing with cold water. Common salt principally goes into solution, and the percentage may thus be brought up to from 80 to 95. The mother-liquor from the 70% chloride is evaporated, the common salt which separates out in the heat removed as it appears, and the sufficiently concentrated liquor allowed to crystallize, when almost pure carnallite separates out, which is easily decomposed into its components (see *infra*). (2) Ziervogel and Tuchen's method.—The crude salt is ground up and then heated in a concentrated solution of magnesium chloride with agitation. The carnallite principally dissolves and crystallizes out relatively pure on cooling. The mother-liquor is used for a subsequent extraction of fresh raw salt. The carnallite produced is dissolved in hot water and the solution allowed to cool, when it deposits a coarse granular potassium chloride containing up to 99% of the pure substance. The undissolved residue produced in either process consists chiefly of kieserite and common salt. It is worked up either for Epsom salt and common salt, or for sodium sulphate and magnesium chloride. The potassiferous by-products are utilized for the manufacture of manures.

Chemically pure chloride of potassium is most conveniently prepared from the pure perchlorate by heating it in a platinum basin at the lowest temperature and then fusing the residue in a well-covered platinum crucible. The fused product solidifies on cooling into a colourless glass.

When hydrochloric acid gas is passed into the solution the salt is completely precipitated as a fine powder. If the original solution contained the chlorides of magnesium or calcium or sulphate of potassium all impurities remain in the mother-liquor (the sulphur as $KHSO_4$), and can be removed by washing the precipitate with strong hydrochloric acid. The salt crystallizes in cubes of specific gravity 1.995; it melts at about 800° and volatilizes at a bright red heat. When melted in a current of hydrogen or electrolysed in the same condition, a dark blue mass is obtained of uncertain composition. It is extensively employed for the preparation of other potassium salts, but the largest quantity (especially of the impure product) is used in the production of artificial manures.

Potassium bromide, KBr, may be obtained by dissolving bromine in potash, whereupon bromide and bromate are first formed, evaporating and igniting the product in order to decompose the bromate: $6KHO + 3Br_2 = 5KBr + KBrO_3 + 3H_2O$; $2KBrO_3 = 2KBr + 3O_2$ (cf. CHLORATES); but it is manufactured by acting with bromine water on iron filings and decomposing the iron bromide thus formed with potassium carbonate. In appearance it closely resembles the chloride, forming colourless cubes which readily dissolve in water and melt at 722°. It combines with bromine to form an unstable tribromide, KBr_3 (see F. P. Worley, *Journ. Chem. Soc.*, 1905, 87, p. 1107).

Potassium iodide, KI, is obtained by dissolving iodine in potash, the deoxidation of the iodate being facilitated by the addition of charcoal before ignition, proceeding as with the bromide. The commercial salt usually has an alkaline reaction; it may be purified by dissolving in the minimum amount of water, and neutralizing with dilute sulphuric acid; alcohol is now added to precipitate the potassium sulphate, the solution filtered and crystallized. It forms colourless cubes which are readily soluble in water, melt at 685°, and yield a vapour of normal density. It is sparingly soluble in absolute alcohol. Both the iodide and bromide are used in photography. Iodine dissolves in an aqueous solution of the salt to form a dark brown liquid, which on evaporation over sulphuric acid gives black acicular crystals of the tri-iodide, KI_3. This salt is very deliquescent; it melts at 45°, and at 100° decomposes into iodine and potassium iodide. For the oxy-halogen salts see CHLORATE, CHLORINE, BROMINE and IODINE.

Potassium carbonate, K_2CO_3, popularly known as "potashes," was originally obtained in countries where wood was cheap by lixiviating wood ashes in wooden tubs, evaporating the solution to dryness in iron pots and calcining the residue; in more recent practice the calcination is carried out in reverberatory furnaces. This product, known as "crude potashes," contains, in addition to carbonate, varying amounts of sulphate and chloride and also insoluble matter. Crude potash is used for the manufacture of glass, and, after being causticized, for the making of soft soap. For many other purposes it must be refined, which is done by treating the crude product with the minimum of cold water required to dissolve the carbonate, removing the undissolved part (which consists chiefly of sulphate), and evaporating the clear liquor to dryness in an iron pan. The purified carbonate (which still contains most of the chloride of the raw material and other impurities) is known as "pearl ashes." Large quantities of carbonate used to be manufactured from the aqueous residue left in the distillation of beet-root spirit, *i.e.* indirectly from beet-root molasses. The liquors are evaporated to dryness and the residue is ignited to obtain a very impure carbonate, which is purified by methods founded on the different solubilities of the several components. Most of the carbonate which now occurs in commerce is made from the chloride of the Stassfurt beds by an adaptation of the "Leblanc process" for the conversion of common salt into soda ash (see ALKALI MANUFACTURE).

Chemically pure carbonate of potash is best prepared by igniting pure bicarbonate (see below) in iron or (better) in silver or platinum vessels, or else by calcining pure cream of tartar. The latter operation furnishes an intimate mixture of the carbonate with charcoal, from which the carbonate is extracted by lixiviation with water and filtration. The filtrate is evaporated to dryness (in iron or platinum vessels) and the residue fully dehydrated by gentle ignition. The salt is thus obtained as a white porous mass, fusible at a red heat (838° C., Carnelley) into a colourless liquid, which solidifies into a white opaque mass. The dry salt is very hygroscopic; it deliquesces into an oily solution ("oleum tartari") in ordinary air. The most saturated solution contains 205 parts of the salt to 100 of water and boils at 135°. On crystallizing a solution monoclinic crystals of $2K_2CO_3.3H_2O$ are deposited, which at 100° lose water and give a white powder of $K_2CO_3.H_2O$; this is completely dehydrated at 130°. The carbonate, being insoluble in strong alcohol (and many other liquid organic compounds), is much used for dehydration of the corresponding aqueous preparations. The pure carbonate is constantly used in the laboratory as a basic substance generally, for the disintegration of silicates, and as a precipitant. The industrial preparation serves for the making of flint glass, of potash soap (soft soap) and of caustic potash.

Potassium bicarbonate, $KHCO_3$, is obtained when carbonic acid is passed through a cold solution of the ordinary carbonate as long as it is absorbed. Any silicate present is also converted into bicarbonate with elimination of silica, which must be filtered off. The filtrate is evaporated at a temperature not exceeding 60° or at most 70° C.; after sufficient concentration it deposits on cooling anhydrous crystals of the salt, while the potassium chloride, which may be present as an impurity, remains mostly in the mother-liquor; the rest is easily removed by repeated recrystallization. If an absolutely pure preparation is wanted it is best to follow Wöhler and start with the "black flux" produced by the ignition of pure bitartrate. The flux is moistened with water and exposed to a current of carbonic acid, which, on account of the condensing action of the charcoal, is absorbed with great avidity. The bicarbonate forms large monoclinic prisms, permanent in the air. When the dry salt is heated to 190° it decomposes into normal carbonate, carbon dioxide and water.

Potassium sulphide, K_2S, was obtained by Berzelius in pale red crystals by passing hydrogen over potassium sulphate, and by Berthier as a flesh-coloured mass by heating the sulphate with carbon. It appears, however, that these products contain higher sulphides. On saturating a solution of caustic potash with sulphuretted hydrogen and adding a second equivalent of alkali, a solution is obtained which on evaporation in a vacuum deposits crystals of $K_2S.5H_2O$. The solution is strongly caustic. It turns yellow on exposure to air, absorbing oxygen and carbon dioxide and forming thiosulphate and potassium carbonate and liberating sulphuretted hydrogen, which decomposes into water and sulphur, the latter combining with the monosulphide to form higher salts. The solution also decomposes on boiling. The hydrosulphide, KHS, was obtained by Gay-Lussac on heating the metal in sulphuretted hydrogen, and by Berzelius on acting with sulphuretted hydrogen on potassium carbonate at a dull red heat. It forms a yellowish-white deliquescent mass, which melts on heating, and at a sufficiently high temperature it yields a dark red liquid. It is readily soluble in water, and on evaporation in a vacuum over caustic lime it deposits colourless, rhombohedral crystals of $2KHS.H_2O$. The solution is more easily prepared by saturating potash solution with sulphuretted hydrogen. The solution has a bitter taste, and on exposure to the air turns yellow, but on long exposure it recovers its original colourless appearance owing to the formation of thiosulphate. *Liver of sulphur* or *hepar sulphuris*, a medicine known to the alchemists, is a mixture of various polysulphides with the sulphate and thiosulphate, in variable proportions, obtained by gently heating the carbonate with sulphur in covered vessels. It forms a liver-coloured mass. In the pharmacopoeia it is designated *potassa sulphurata*.

Potassium sulphite, K_2SO_3, is prepared by saturating a potash solution with sulphur dioxide, adding a second equivalent of potash, and crystallizing in a vacuum, when the salt separates as small deliquescent, hexagonal crystals. The salt $K_2SO_3 \cdot H_2O$ may be obtained by crystallizing the metabisulphite, $K_2S_2O_5$ (from sulphur dioxide and a hot saturated solution of the carbonate, or from sulphur dioxide and a mixture of milk of lime and potassium sulphate) with an equivalent amount of potash. The salt $K_2SO_3 \cdot 2H_2O$ is obtained as oblique rhombic octahedra by crystallizing the solution over sulphuric acid. On the isomeric potassium sodium sulphites see SULPHUR.

Potassium sulphate, K_2SO_4, a salt known early in the 14th century, and studied by Glauber, Boyle and Tachenius, was styled in the 17th century *arcanum* or *sal duplicatum*, being regarded as a combination of an acid salt with an alkaline salt. It was obtained as a by-product in many chemical reactions, and subsequently used to be extracted from kainite, one of the Stassfurt minerals, but the process is now given up because the salt can be produced cheaply enough from the chloride by decomposing it with sulphuric acid and calcining the residue. To purify the crude product it is dissolved in hot water and the solution filtered and allowed to cool, when the bulk of the dissolved salt crystallizes out with characteristic promptitude. The very beautiful (anhydrous) crystals have the habit of a double six-sided pyramid, but really belong to the rhombic system. They are transparent, very hard and absolutely permanent in the air. They have a bitter, salty taste. The salt is soluble in water, but insoluble in caustic potash of sp. gr. 1·35, and in absolute alcohol. It fuses at 1078°. The crude salt is used occasionally in the manufacture of glass. The acid sulphate or bisulphate, $KHSO_4$, is readily produced by fusing thirteen parts of the powdered normal salt with eight parts of sulphuric acid. It forms rhombic pyramids, which melt at 197°. It dissolves in three parts of water of 0° C. The solution behaves pretty much as if its two congeners, K_2SO_4 and H_2SO_4, were present side by side of each other uncombined. An excess of alcohol, in fact, precipitates normal sulphate (with little bisulphate) and free acid remains in solution. Similar is the behaviour of the fused dry salt at a dull red heat; it acts on silicates, titanates, &c., as if it were sulphuric acid raised beyond its natural boiling point. Hence its frequent application in analysis as a disintegrating agent. For the salts of other sulphur acids, see SULPHUR.

Potassamide, NH_2K, discovered by Gay-Lussac and Thénard in 1871, is obtained as an olive green or brown mass by gently heating the metal in ammonia gas, or as a white, waxy, crystalline mass when the metal is heated in a silver boat. It decomposes in moist air, or with water, giving caustic potash and ammonia, in the latter case with considerable evolution of heat. On strong heating Tithesley (*Journ. Chem. Soc.*, 1894, p. 511) found that it decomposed into its elements. For the nitrite, see NITROGEN, for the nitrate see SALTPETRE and for the cyanide see PRUSSIC ACID; for other salts see the articles wherein the corresponding acid receives treatment.

Analysis, &c.—All volatile potassium compounds impart a violet coloration to the Bunsen flame, which is masked, however, if sodium be present. The emission spectrum shows two lines, $K\alpha$, a double line towards the infra-red, and $K\beta$ in the violet. The chief insoluble salts are the perchlorate, acid-tartrate and platinochloride. The atomic weight was determined by Stas and more recently by T. W. Richards and A. Stähler, who obtained the value 39·114 from analyses of the chloride, and by Richards and E. Meuller, who obtained the values 39·1135 and 39·1143 from analyses of the bromide (see *Abs. J. C. S.*, 1907, ii. 615).

Medicine.

Pharmacology.—Numerous salts and preparations of potassium are used in medicine; viz. *Potassii Carbonis* (salt of tartar), dose 5 to 20 grs., from which are made (*a*) *Potassii Bicarbonas*, dose 5 to 30 grs.; (*b*) *Potassa Caustica*, a powerful caustic not used internally. From caustic potash are made (1) *Potassii Permanganas*, dose 1 to 3 grs., used in preparing *Liquor Potassii Permanganatis*, a 1% solution, dose 2 to 4 drs. (2) *Potassii Iodidum*, dose 5 to 20 grs.; from this are made the *Linamentum Potassii Iodidi cum sapone*, strength 1 in 10, and the *Unguentum Potassii Iodidi*, strength 1 in 10. (3) *Potassii Bromidum*, dose 5 to 30 grs. (4) *Liquor Potassae*, strength 27 grs. of caustic potash to the oz. *Potassii Citras*, dose 10 to 40 grs. *Potassii Acetas*, dose 10 to 60 grs. *Potassii Chloras*, dose 5 to 15 grs., from which is made a lozenge, *Trochiscus Potassii Chloratis*, each containing 3 grs. *Potassii Tartras Acidus* (cream of tartar), dose 20 to 60 grs., which has a subpreparation *Potassii Tartras*, dose 30 to 60 grs. *Potassii Nitras* (saltpetre), dose 5 to 20 grs. *Potassii Sulphas*, dose 10 to 40 grs. *Potassii Bichromas*, dose $\frac{1}{10}$ to $\frac{1}{4}$ gr.

Toxicology.—Poisoning by caustic potash may take place or poisoning by pearl ash containing caustic potash. A caustic taste in the mouth is quickly followed by burning abdominal pain, vomiting and diarrhoea, with a feeble pulse and a cold clammy skin; the post-mortem appearances are those of acute gastro-intestinal irritation. The treatment is washing out the stomach or giving emetics followed by vinegar or lemon juice and later oil and white of egg.

Therapeutics.—Externally: Caustic potash is a most powerful irritant and caustic; it is used with lime in making Vienna paste, which is occasionally used to destroy morbid growths. Liquor potassae is also used in certain skin diseases. The permanganate of potash is an irritant if used pure. Its principal action is as an antiseptic and disinfectant. If wet it oxidizes the products of decomposition. It is used in the dressing of foul ulcers. The 1% solution is an antidote for snake-bite.

Internally: Dilute solutions of potash, like other alkalis, are used to neutralize the poisonous effects of strong acids. In the stomach potassium salts neutralize the gastric acid, and hence small doses are useful in hyperchloridia. Potassium salts are strongly diuretic, acting directly on the renal epithelium. They are quickly excreted in the urine, rendering it alkaline and thus more able to hold uric acid in solution. They also hinder the formation of uric acid calculi. The acetate and the citrate are valuable mild diuretics in Bright's disease and in feverish conditions, and by increasing the amount of urine diminish the pathological fluids in pleuritic effusion, ascites, &c. In tubal nephritis they aid the excretion of fatty casts. The tartrate and acid tartrate are also diuretic in their action and, as well as the sulphate, are valuable hydragogue saline purgatives. Potassium nitrate is chiefly used to make nitre paper, which on burning emits fumes useful in the treatment of the asthmatic paroxysm. Lozenges of potassium chlorate are used in stomatitis, tonsilitis and pharyngitis, it can also be used in a gargle, 10 grs. to 1 fl. oz. of water. Its therapeutic action is said to be due to nascent oxygen given off, so it is local in its action. In large doses it is a dangerous poison, converting the oxyhaemoglobin of the blood into methaemoglobin. Internally the permanganate is a valuable antidote in opium poisoning. The action of potassium bromide and potassium iodide has been treated under bromine and iodine (*q.v.*). All potassium salts if taken in large doses are cardiac depressants, they also depress the nervous system, especially the brain and spinal cord. Like all alkalis if given in quantities they increase metabolism.

POTATO (*Solanum tuberosum*), a well-known plant which owes its value to the peculiar habit of developing underground slender leafless shoots or branches which differ in character and office from the true roots, and gradually swelling at the free end produce the tubers (potatoes) which are the common vegetable food. The nature of these tubers is further rendered evident by the presence of "eyes" or leaf-buds, which in due time lengthen into shoots and form the haulm or stems of the plant. Such buds are not, under ordinary circumstances, formed on roots. The determining cause of the formation of the tubers is not certainly known, but Professor Bernard has suggested that it is the presence of a fungus, *Fusarium solani*, which, growing in the underground shoots, irritates them and causes the swelling; the result is that an efficient method of propagation is secured independently of the seed. Starch and other matters are stored up in the tubers, as in a seed, and are rendered available for the nutrition of the young shoots. When grown under natural circumstances the tubers are relatively small and close to the surface of the soil, or even lie upon it. In the latter case they become green and have an acrid taste, which renders them unpalatable to human beings, and as poisonous qualities are produced similar to those of many *Solanaceae* they are unwholesome. Hence the recommendation to keep the tubers in cellars or pits, not exposed to the light. Among the nine hundred species of *Solanum* less than a dozen have this property of forming tubers, but similar growths are formed at the ends of the shoots of the common bramble, of *Convolvulus sepium*, of *Helianthus tuberosus*, the so-called Jerusalem artichoke, of *Sagittaria*, and other plants. Tubers are also sometimes formed on aerial branches, as in some Aroids, Begonias, &c. The production of small green tubers on the haulm, in the axils of the leaves of the potato, is not very unfrequent, and affords an interesting proof of the true morphological nature of the underground shoots and tubers. This phenomenon follows injury to the phloem in the lower parts of the stem, preventing the downward flow of elaborated sap. The injury may be due to gnawing insects, and particularly to the fungus *Corticium vagum*, var. *Solani* (*Rhizoctonia*).

The so-called fir-cone potatoes, which are elongated and provided with scales at more or less regular intervals, show also very clearly that the tuber is only a thickened branch with "eyes" set in regular order, as in an ordinary shoot. The potato tuber consists mainly of a mass of cells filled with starch and encircled by a thin corky rind. A few vessels and woody fibres traverse the tubers.

The chief value of the potato as an article of diet consists in the starch it contains, and to a less extent in the potash and other salts. The quantity of nitrogen in its composition is small, and hence it should not be relied on to constitute the staple article of diet. Letheby gives the following as the average composition of the potato—

Nitrogenous matters	2·1	Saline matter	0·7
Starch, &c.	18·8	Water	75·0
Sugar	3·2		
Fat	0·2		100·0

—a result which approximates closely to the average of nineteen analyses cited in *How Crops Grow* from Grouven. In some analyses, however, the starch is put as low as 13·30, and the nitrogenous matter as 0·92 (Dehérain, *Cours de chimie agricole*, p. 159). Boussingault gives 25·2% of starch and 3% of nitrogenous matter. Warington states that the proportion of nitrogenous to non-nitrogenous matter in the digestible part of potatoes is as 1 to 10·6. The composition of the tubers evidently varies according to season, soils, manuring, the variety grown, &c., but the figures cited will give a sufficiently accurate idea of it. The "ash" contains on the average of thirty-one analyses as much as 59·8% of potash, and 19·1% of phosphoric acid, the other ingredients being in very minute proportion. Where, as in some parts of northern Germany, the potato is grown for the purpose of manufacturing spirit great attention is necessarily paid to the quantitative analysis of the starchy and saccharine matters, which are found to vary much in particular varieties, irrespective of the conditions under which they are grown.

It is to the Spaniards that we owe this valuable esculent. The Spaniards met with it in the neighbourhood of Quito, where it was cultivated by the natives. In the *Cronica de Peru* of Pedro Cieça (Seville, 1553), as well as in other Spanish books of about the same date, the potato is mentioned under the name "battata" or "papa." Hieronymus Cardan, a monk, is supposed to have been the first to introduce it from Peru into Spain, from which country it passed into Italy and thence into Belgium. Carl Sprengel, cited by Professor Edward Morren in his biographical sketch entitled *Charles de l'Escluse, sa vie et ses œuvres*, states that the potato was introduced from Santa Fé into England by John Hawkins in 1563 (*Garten Zeitung*, 1805, p. 346). If this be so, it is a question whether the English and not the Spaniards are not entitled to the credit of the first introduction; but, according to Sir Joseph Banks, the plant brought by Drake and Hawkins was not the common English potato but the sweet potato.

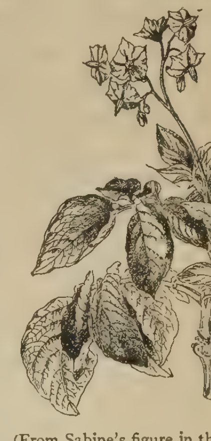
In 1587 or 1588 De l'Escluse (Clusius) received the plant from Philippe de Sivry, lord of Waldheim and governor of Mons, who in his turn received it from some member of the suite of the papal legate. At the discovery of America, we are told by Humboldt, the plant was cultivated in all the temperate parts of the continent from Chile to Colombia, but not in Mexico. In 1585 or 1586, potato tubers were brought from what is now North Carolina to Ireland on the return of the colonists sent out by Sir Walter Raleigh, and were first cultivated on Sir Walter's estate near Cork. The tubers introduced under the auspices of Raleigh were thus imported a few years later than those mentioned by Clusius in 1588, which must have been in cultivation in Italy and Spain for some years prior to that time. The earliest representation of the plant is to be found in Gerard's *Herbal*, published in 1597. The plant is mentioned under the name *Papus orbiculatus* in the first edition of the *Catalogus* of the same author, published in 1596, and again in the second edition, which was dedicated to Sir Walter Raleigh (1599). It is, however, in the *Herbal* that we find the first description of the potato, accompanied by a woodcut sufficiently correct to leave no doubt whatever as to the identity of the plant. In this work (p. 781) it is called "Battata virginiana sive Virginianorum, et Pappus, Potatoes of Virginia."

The "common potatoes" of which Gerard speaks are the tubers of *Ipomoea Batatas*, the sweet potato, which nowadays would not in Great Britain be spoken of as common. A second edition of the *Herbal* was published in 1636 by Thomas Johnson, with a different illustration from that given in the first edition, and one which in some respects, as in showing the true nature of the tuber, is superior to the first. The phenomenon of growing out or "super-tuberation" is shown in this cut.

Previous to this (in 1629) Parkinson, the friend and associate of Johnson, had published his *Paradisus*, in which (p. 517) he gives an indifferent figure of the potato under the name of *Papas seu Battatas Virginianorum*, and adds details as to the method of cooking the tubers which seem to indicate that they were still luxuries. Chabraeus, who wrote in 1666, tells us that the Peruvians made bread from the tubers, which they called "chunno." He further tells us that by the natives *Virginieae insulae* the plant was called "openauk," and that it is now known in European gardens, but he makes no mention of its use as an esculent vegetable, and, indeed, includes it among "plantae malignae et venenatae." Heriot (De Bry's *Collection of Voyages*), in his report on Virginia, describes a plant under the same name "with roots as large as a walnut and others much larger; they grow in damp soil, many hanging together as if fixed on ropes; they are good food either boiled or roasted." The plant (which is not a native of Virginia) was probably introduced there in consequence of the intercourse of the early settlers with the Spaniards. The cultivation of the potato in England made but little progress, even though it was strongly urged by the Royal Society in 1663; and not much more than a century has elapsed since its cultivation on a large scale became general.

Botanists are agreed that the only species in general cultivation in Great Britain is the one which Bauhin, in his *Phytopinax*, p. 89 (1596), called *Solanum tuberosum esculentum*, a name adopted by Linnaeus (omitting the last epithet), and employed by all botanical writers. This species is probably native in Chile, but it is very doubtful if it is truly wild farther north. Baker (*Journ. Linn. Soc.*, 1884, xx. 489), has reviewed the tuber-bearing species of *Solanum* from a systematic point of view as well as from that of geographical distribution. Out of twenty so-called species he considers six to be really distinct, while the others are merely synonymous or trifling variations. The six admitted tuber-bearing species are *S. tuberosum*, *S. Maglia*, *S. Commersoni*, *S. cardiophyllum*, *S. Jamesii* and *S. oxycarpum*.

S. tuberosum is, according to Mr Baker, a native not only of the Andes of Chile but also of those of Peru, Bolivia, Ecuador and Colombia, also of the mountains of Costa Rica, Mexico and the south-western United States. It seems most probable, however, that some at least of the plants mentioned in the northern part of America are the descendants of cultivated forms. *S. Maglia* is a native of the Chilean coast as far south as the Chonos Archipelago, and was cultivated in the garden of the Horticultural Society at Chiswick in 1822, being considered by Sabine, in his paper on the native country of the wild potato, to be the true *S. tuberosum* and the origin of the cultivated forms. This species was also found by Darwin in Chile, and was considered by him, as by Sabine before him, to be the wild potato. Baker refers to the plants figured by Sabine (*Trans. Hort. Soc. Lond.* v. 249) (fig. 1) as being without doubt *S. Maglia*, but A. de Candolle (*Origine des Plantes cultivées*, p. 40) is equally emphatic in the opinion that it is *S. tuberosum*. *S. Commersoni* occurs in Uruguay, Buenos Aires and the Argentine Republic, in rocky situations at a low level. Under the name of *S. Ohrondii* it has been introduced into western France, where it is not only hardy but produces abundance of tubers, which are palatable, but have a slightly acid taste. *S. cardiophyllum*, described by Lindley in the *Journ. Hort. Soc.* is a native of the mountains of central Mexico at elevations of 8000 to 9000 ft. *S. Jamesii* is a well-defined species occurring in the mountains of Colorado, New Mexico and Arizona, and also in Mexico. In a wild state the tubers are not larger than marbles. *S. oxycarpum* is a



(From Sabine's figure in the *Trans. Hort. Soc. Lond.*, 1824, vol. v. pl. ii. See text.)

FIG. 1.—Wild Potato-plant in bloom. (¼ nat. size.)

little known but very distinct tuberous species from central Mexico.[1]

A review of the localities in which the presence of *S. tuberosum* and its tuber-bearing allies has been ascertained shows that, broadly, these varieties may be divided into mountainous and littoral. In either case they would not be subjected, at least in their growing season, to the same extremes of heat, cold and drought as plants growing on inland plains. Again, those forms growing at a high elevation would probably start into growth later in the season than those near the coast. The significance of these facts from a cultural point of view is twofold: for, while a late variety is desirable for culture in Great Britain, as ensuring more or less immunity from spring frost, it is, on the other hand, undesirable, because late varieties are more liable to be attacked by the potato disease (*Phytophthora infestans*) which as a rule appears about the time when the earliest varieties are ready for lifting, but before the late varieties are matured.

In cultivation the potato varies very greatly not only as to the season of its growth but also as to productiveness, the vigour and luxuriance of its foliage, the presence or relative absence of hairs, the form of the leaves, the size and colour of the flowers, &c. The tubers vary greatly in size, form and colour; gardeners divide them into rounded forms and long forms or "kidneys," and there are of course varieties intermediate in form. The colour of the rind, yellowish, brown or purple, furnishes distinctions, as does the yellow or white colour of the flesh. The colour of the eyes and their prominence or depression are relatively very constant characteristics. These variations have arisen chiefly through cross-breeding, though not entirely so, there being a few cases upon record of the production of "sports" from tubers that have become the parents of new varieties, but authentic cases of the sporting of tubers are few and far between. If, on the other hand, the true seeds of any of our cultivated varieties are sown, the seedlings show very wide variations from one another and from the parents. In this connexion it is very interesting to observe that Messrs Sutton of Reading find that the seedlings of many of the varieties of potato that occur spontaneously in different parts of America come quite true to type from seed.

The potato thrives best in a rather light friable loam; and in thin sandy soils the produce, if not heavy, is generally of very good quality. Soils which are naturally wet and heavy, as well as those which are heavily manured, are not suitable. Indeed it is best, except when there is ample space, to grow only the earlier kinds in gardens. If the soil is of fair quality the less manure used upon it the better, unless it be soot or lime. Gypsum, bone-dust, superphosphate of lime and nitrate of soda may also be used, and wood ashes are advantageous if the soil contains much vegetable matter; but the best results are usually obtained when farmyard manure is supplemented by artificials, not by using artificials alone.

Potatoes are commonly propagated by planting whole tubers or by dividing the tubers, leaving to each segment or "set" one or two eyes or buds. The "sets" are then planted in rows at a distance varying from 15 in. to 3 ft., the distance being regulated by the height of the stems, and that between the sets varying from 6 to 12 in., 8 in. being a good average space for garden crops, with 2 ft. between the rows. The sets may be put in 6 in. deep. The planting of whole tubers instead of the cut sets usually gives a better return. The full-sized tubers are, however, preferable to smaller ones, as their larger buds tend to produce stronger shoots, ~~and~~ where cut sets are used the best returns are obtained from sets taken from the points of the tubers—not from their base. Thomas Dickson of Edinburgh long ago observed that the most healthy and productive crop was to be obtained by planting unripe tubers, and proposed this as a preventive of the disease called the "curl," which sometimes attacks the young stems, causing them and also the leaves to become crumpled, and few or no tubers to be produced; in this connexion it is interesting to note that Scottish and Irish seed potatoes give a larger yield than English, probably on account of their being less matured. It has also been noted that the sprouting of the eyes of the potato may be accelerated if, while still unripe, it is taken up and exposed for some weeks to the influence of a scorching sun. The best sets are those obtained from plants grown in elevated and open situations, and it is also beneficial to use sets grown on a different soil.

The earliest crops should, if possible, be planted in a light soil and in a warm situation, towards the end of February, or as early as possible in March. In some cases the tubers for early crops are sprouted on a hotbed, the plants being put out as soon as the leaves can bear exposure.

The main crop should be planted by the middle of March, sprouted sets being used; late planting is very undesirable. Those intended for storing should be dug up as soon as they are fairly ripe, unless they are attacked by the disease, in which case they must be taken up as soon as the murrain is observed; or if they are then sufficiently developed to be worth preserving, but not fully ripe, the haulms or shaws should be pulled out, to prevent the fungus passing down them into the tubers; this may be done without disturbing the tubers, which can be dug afterwards.

Forcing.—The earliest crop may be planted in December, and successional ones in January and February; the varieties specially suited for forcing being chosen. The mode of cultivation adopted by the London market gardeners is thus in substance explained by Cuthill: A long trench, 5 ft. wide and 2 ft. deep, is filled with hot dung, on which soil to the depth of 6 in. is put. The sets employed are middle-sized whole potatoes, which are placed close together over the bed, covered with 2 in. of mould, and then hooped and protected with mats and straw, under which conditions they will sprout in about a month. A bed of the requisite length (sometimes 100 yds.) is then prepared of about 2 ft. thickness of hot dung, soil is put on to the depth of 8 in., and the frames set over all. The potatoes are then carefully taken up from the striking bed, all the shoots being removed except the main one, and they are planted 4 in. deep, radishes being sown thinly over them and covered lightly with mould. When the haulm of the potato has grown to about 6 in. in height the points are nipped off, in order to give the radishes fair play; and, although this may stop growth for a few days, still the potato crop is always excellent. After planting nothing more is required but to keep up the temperature to about 70°, admitting air when practicable, and giving water as required. The crop is not dug up until it has come to maturity.

Potatoes are also grown largely in hooped beds on a warm border in the open ground. The sets after having been sprouted, as above, are planted out in January in trenches 2 ft. deep filled with hot dung, the sets being planted 5 in. deep, and over all radishes are sown. The ridges are then hooped over, allowing about 2 ft. of space in the middle, between the mould and the hoop, and are covered with mats and straw, but as soon as the radishes come up they are uncovered daily, and covered again every night as a protection against possible frosts. This is continued till the potatoes are ready for digging in May.

Potatoes are sometimes grown in pots in heat, sprouted sets being planted in 11-in. pots about two-thirds full of soil, and placed near the glass in any of the forcing-houses, where a temperature of from 65° to 70° is to be maintained. The plants are duly watered and earthed up as they advance in growth.

POTATO DISEASES

There are few agricultural subjects of greater importance than the culture of the potato and the losses entailed by potato disease. It is not unusual in bad seasons for a single grower to lose £30 per acre in one season. In extreme cases every tuber is lost, as the produce will not even pay the cost of lifting.

The best-known disease of potatoes is caused by the growth of a fungus named *Phytophihora infestans*, within the tissues of the host plant, and this fungus has the peculiar property of piercing and breaking up the cellular tissues and setting up putrescence in the course of its growth. The parasite, which has a somewhat restricted range of host plants, chiefly invades the potato, *Solanum tuberosum*; the bittersweet, *S. Dulcamara*, and other species of *Solanum*. It is also very destructive to the tomato, *Lycopersicum esculentum*, and to all or nearly all the other species of *Lycopersicum*. At times it attacks petunias and even scrophulariaceous plants, as *Anthocersis* and *Schizanthus*.

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[1] Although these six are the only species admitted as such by Baker, it is well to note some of the varieties. The *S. etuberosum* of Lindley, differing from the common *S. tuberosum* in not producing tubers, was found in Chile, and is probably not specifically distinct, although exceptional, for it is by no means very unusual to find even cultivated plants produce no tubers. *S. Fernandezianum* is, according to Baker, a form of *S. tuberosum*, but if so its habitat in the mountain woods of Juan Fernandez is climatically different from that in the dry mountains of central Chile, where the true *S. tuberosum* grows. *S. otites* was found more recently by André on the summit of Quindiu in Colombia, at a height of 11,483 ft. It produces tubers of the size of a nut. *S. Andreanum*, found by André at Cauca (6234 ft.), was considered by the traveller to be the true *S. tuberosum*, but this view is not shared by Baker, who named it after the discoverer. Its tubers, if it produces any, have not been seen. *S. immite* is probably only a slight variety of *S. tuberosum*, as are also the Venezuelan *S. colombianum*, *S. verrucosum*, *S. demissum* and *S. utile*. *S. Fendleri*, a native of the mountains of New Mexico and Arizona, was considered by Asa Gray to be likewise a form of *S. tuberosum*.

As a rule, although there are a few exceptions, the disease occurs wherever the potato is grown. It is known in South America in the home of the potato plant. In England the disease is generally first seen during the last ten days of July; its extension is greatly favoured by warm and showery weather. To the unaided eye the disease is seen as purplish brown or blackish blotches of various sizes, at first on the tips and edges of the leaves, and ultimately upon the leaf-stalks and the larger stems. On gathering the foliage for examination, especially in humid weather, these dark blotches are seen to be putrid, and when the disease takes a bad form the dying leaves give out a highly offensive odour. The fungus, which is chiefly within the leaves and stems, seldom emerges through the firm upper surface of the leaf; it commonly appears as a white bloom or mildew on the circumference of the disease-patches on the under surface. It grows within the tissues from central spots towards an ever-extending circumference, carrying putrescence in its course. As the patches extend in size by the growth of the fungus they at length become confluent, and so the leaves are destroyed and an end is put to one of the chief vital functions of the host plant. On the destruction of the leaves the fungus either descends the stem by the interior or the spores are washed by the rain to the tubers in the ground. In either case the tubers are reached by the fungus or its spores, and so become diseased. The fungus is very small in size, and under the microscope appears slightly whitish or colourless. The highest powers are required to see all parts of the parasite.

The accompanying illustration shows the habit and structure of the fungus. The letters A B show a vertical section through a fragment of a potato leaf, enlarged 100 diameters; A is the upper surface line, and B the lower; the lower surface of the leaf is shown at the top, the better to exhibit the nature of the fungus growths. Between A and B the loose cellular tissue of which the leaf is partly built up is seen in section, and at C the vertical palisade cells which give firmness to the upper surface of the leaf. Amongst the loose tissue of the leaf numerous transparent threads are shown; these are the mycelial threads or spawn of the fungus; wherever they touch the leaf-cells they pierce or break down the tissue, and so set up decomposition, as indicated by the darker shading. The lower surface of the potato leaf is furnished with numerous organs of transpiration or stomata, which are narrow orifices opening into the leaf and from which moisture is transpired in the form of vapour. Out of these small openings the fungus threads emerge, as shown at D, D, D. When the threads reach the air they branch in a tree-like manner, and each branch (sporangiophore) carries one or more ovate sporangia, as shown at E, E, E, which fall off and are carried by the wind. One is shown more highly magnified (400 diameters) at F; the contained protoplasm breaks up into a definite number of parts as at G, forming eight minute mobile bodies called "zoospores," each zoospore being furnished with two extremely attentuated vibrating hairs termed "cilia," as shown at H. These zoospores escape and swim about in any film of moisture, and on going to rest take a spherical form, germinate and produce threads of mycelium as at K. The sporangia may also germinate directly without undergoing division. The mycelium from the germinating sporangia or zoospores soon finds its way into the tissues of the potato leaf by the organs of transpiration, and the process of growth already described is repeated over and over again till the entire potato leaf, or indeed the whole plant, is reduced to putridity.

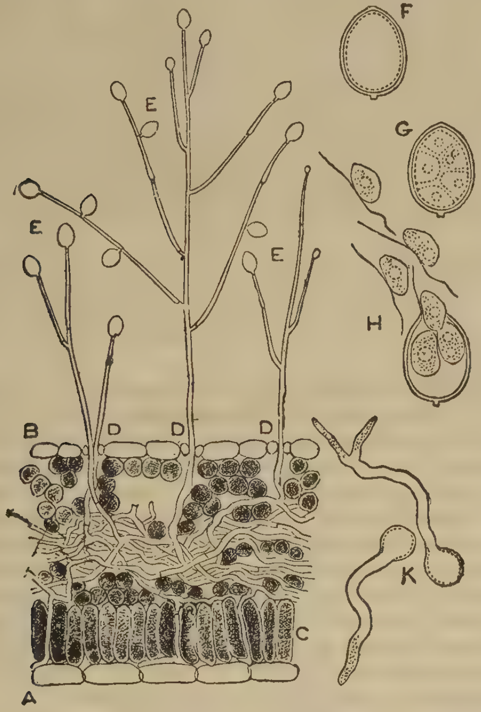


FIG. 2.—*Phytophthora infestans.* Fungus of Potato Disease.

The germinating spores are not only able to pierce the leaves and stems of the potato plant, and so gain an entry to its interior through the epidermis, but they are also able to pierce the skin of the tuber, especially in young examples. It is therefore obvious that, if the tubers are exposed to the air where they are liable to become slightly cracked by the sun, wind, hail and rain, and injured by small animals and insects, the spores from the leaves will drop on to the tubers, quickly germinate upon the slightly injured places, and cause the potatoes to become diseased. Earthing up therefore prevents these injuries, but where practised to an immoderate extent it materially reduces the produce of tubers. The labour entailed in repeated earthing up is also considered a serious objection to its general adoption.

The means of mitigating the damage done by this disease are (1) the selection of varieties found to resist its attacks; (2) the collection and destruction of diseased tubers so that none are left in the soil to become a menace to future crops; (3) care that no tubers showing traces of the disease are planted; (4) spraying with Bordeaux mixture at intervals from midsummer onwards. The last measure prevents the germination of the spores of the fungus on the leaves, and is a most useful mode of checking the spread of the disease; to be successful in its use, however, entails care in the preparation of the spray and thoroughness in its application. In spite of the many efforts in the direction of obtaining a resistant variety no great measure of success has been attained. The earlier varieties of potato appear to escape the disease almost entirely, as they are usually ready to be lifted before it becomes troublesome; while certain of the later varieties are much less prone to it than the majority. They do not appear, however, to maintain the same degree of immunity over a long period of years, but to become more and more open to the attack as the variety becomes older; nor do they always exhibit the same degree of immunity in different localities. Something may be done to mitigate the loss arising from the disease by selecting comparatively immune varieties from time to time.

Many ingenious attempts have been made to obtain a variety perfectly immune. Maule, thinking a hardier blood might be infused into the potato by crossing it with some of the native species, raised hybrids between it and the two common species of *Solanum* native in this country, *S. Dulcamara* and *S. nigrum*, but the hybrids proved as susceptible as the potato itself. Maule also tried the effect of grafting the potato on these two species and, though he succeeded, there is no record to show whether the product was any hardier than the parents. Dean (*Gard. Chron.*, Sept. 1876, p. 304) succeeded in grafting the potato on the tomato, and Messrs Sutton have carried out similar experiments on an extensive scale (*Journ. Roy. Hort. Soc.* 1899, xxiii. Proc. p. 20), but in no case have the variations produced proved disease-proof. Various experimenters, especially Fenn, have asserted that by engrafting an eye of one variety into the tuber of another, not only will adhesion take place but the new tubers will present great variety of character; this seems to be the case, but it can hardly be considered as established that the variations in question were the result of any commingling of the essences of the two varieties. The wound may simply have set up that variation in the buds the occasional existence of which has been already noted.

It is possible that the hybridizing of the potato with one or other of the wild types of tuberous *Solanums* may give rise to a variety which shall be immune, though unfortunately most are themselves liable to the attacks of the fungus, and one of the few crosses so made between the common potato and *Solanum Maglia* has exhibited the same undesirable trait. The form cultivated in England for some time under the name *Solanum tuberosum* (which, however, forms tubers and is probably not that known under this name by Lindley) seems so far to have escaped. In view of the fact that Biffen has proved that immunity from the attacks of a certain fungus in wheat is a transmissible recessive character reappearing in some of the individuals of the second generation, it would appear that there is great hope of securing an immune variety with the aid of this form. It is possible, too, that continued cultivation in the rich soil of gardens may induce that tendency to vary when seedlings are raised that is so marked a feature of the potato of commerce, in one or more of the other species of tuberous *Solanums*.

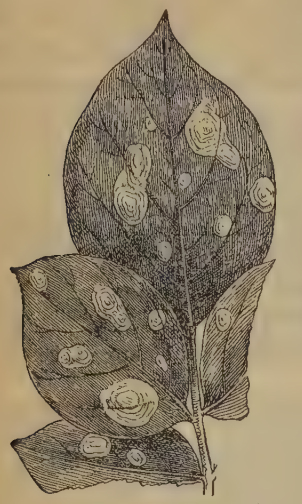
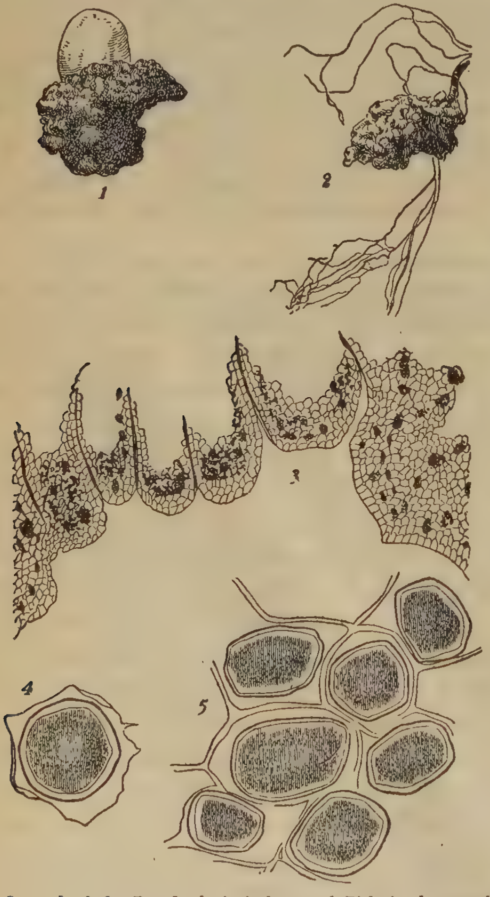


FIG. 3.—Portion of Leaf of Potato-Plant showing patches of a black mould, *Macrosporium Solani*, on the surface.

Another fungus attacking the leaves is *Macrosporium Solani* (fig. 3), but this attack usually comes earlier in the season than the foregoing. It is characterized by the curling of the leaves, which later show black spots due to the production of numerous dark spores in patches on the diseased leaves. The damage is often considerable, as the crop is greatly lessened by the interference with the functions of the leaf. The parasite may be held in check by spraying with Bordeaux mixture early in the season. The fungus passes the winter on pieces of leaf, &c., left on the ground. All such refuse should be cleared up and burned. A third fungus, *Cercospora concors*, also forms spots on the leaves and may be kept in check by the same means.

Wilting of the foliage followed by the discoloration of the stem and branches is characteristic of a disease of the potato known as "Blackleg." This disease is due to the presence of large numbers of *Bacillus solanacearum* in the tubes through which water is conveyed to the leaves from the roots. Their presence causes the appearance of blackish streaks in the stem and a dark ring some little distance below the surface in the tissues of the tuber. Tubers showing any trace of such a ring should not be used for seed, and rotation of crops should be observed as a means of preventing the infection of the crop with the germ. Biting and sucking insects have been found to carry the bacilli from one plant to another.



(From the *Journal of the Board of Agriculture and Fisheries*, by permission of the controller of H. M. Stationery Office.)

FIG. 4.—*Chrysophlyctis endobiotica* (*Oedomyces leproides*) in the Potato.

1 and 2, Tubers deformed by the fungus.
3, Section through diseased tissue showing dark masses of spores.
4 and 5, Tissue-cell, more highly magnified, showing enclosed spores.

The tubers frequently show scurfy or scab-like spots upon their surface, thus greatly depreciating their value for market purposes. The fungus, *Sorosporium scabies*, which is the cause of the scab, does not penetrate into the flesh of the tuber, nor detract from its edible properties. Excess of lime in the soil is said to favour the development of the fungus. Similar spots are produced on potatoes in America by the fungus *Oospora scabies*, and in both cases, if affected "seed" potatoes are steeped in a solution of ½ pint formalin in 15 gallons of water for two hours before planting, the attack on the resulting crop is materially lessened. The fungus, *Oedomyces leproides*, produces large, blackish, irregular warts which sometimes involve the whole surface of the tuber. This disease is of recent introduction into Great Britain, but bids fair to become very troublesome. The spores of the fungus pass the winter in the soil and the delicate mycelium attacks the young shoots in the summer. These become brown, finally blackish and greatly contorted until a large scab is formed on the developing tuber, whence the name by which the disease is known—"black scab." Diseased potatoes left in the soil and even slightly diseased "sets" are a source of infection of succeeding crops. Rotation must be observed and no diseased sets planted.

The rotting of tubers after lifting may be due to various causes, but the infection of the tubers by the *Phytophthora* already mentioned is a frequent source of this trouble, while "Winter Rot" is due to the fungus *Nectria Solani*. This fungus finds conditions suitable for growth when the potatoes are stored in a damp condition; rotting from this cause rarely occurs when they are dried before being placed in heaps. The first signs of this fungus is the appearance of small white tufts of mycelium bursting through the skin of the tuber, the spores of the fungus being carried at the tips of the threads forming these tufts. This form of fruit is succeeded by others which have received different names, and lastly by the mature *Nectria* which forms minute red flask-shaped perithecia on parts of the rotted potatoes that have dried up. The intermediate forms are known as *Monosporium*, *Fusarium* and *Cephalosporium*. The pieces of dried-up potato with the spores of *Nectria* upon them are a source of infection in the succeeding year, and care should be taken that diseased tubers are not planted. Flowers of sulphur plentifully sprinkled over the potatoes before storing has been found to check the spread of the rot in the heap.

POTATO RACE, a running contest, where the winner is the first who collects in a basket or other receptacle a number of potatoes, usually eight, placed, as a rule two yards apart, along a straight line, and then crosses a finish line five or ten yards farther on.

POTATO WAR (*Kartoffelkrieg*), the name given by the Prussians to the War of the Bavarian Succession in 1778–79. The Prussians and a Saxon contingent, commanded by Frederick the Great and his brother Prince Henry, were opposed to two Austrian armies under Loudon and Lacy. The operations consisted almost entirely of manœuvres which had for their object the obtaining or the denial to the enemy of food-supplies. The war thus acquired the name of *Kartoffelkrieg*. Its duration was from the 3rd of July 1778 to the assembly of the congress of Teschen on the 10th of March 1779, and its total cost £4,350,000 and 20,000 men to all parties. The war may be studied from the military point of view as an extreme example of what Clausewitz calls "war with a restricted aim."

POTAWATOMI (properly *Potewatmik*, fire-makers, in allusion to their secession from the Ojibway, and their establishment of a separate council-fire), a tribe of North-American Indians of Algonquian stock. When first known (about 1670), they lived around Green Bay, Wisconsin. They subsequently moved south and eventually settled in lower Michigan. They were allied with the French in their wars against the Iroquois and took part in the conspiracy of Pontiac (*q.v.*). In the War of Independence they fought for England, as also in that of 1812. In 1846 most of them were removed to a reservation in Kansas. Of these the majority have abandoned their tribal relations and become citizens. Others are in Wisconsin and the bulk in Oklahoma. They now number some 2500.

POTCHEFSTROOM, a town of the Transvaal, 88 m. S.W. of Johannesburg and 222 m. N.E. of Kimberley by rail. Pop. (1904), 9348, of whom 6014 were whites. The town stands 4100 ft. above the sea on the banks of the Mooi River, 15 m.

above its junction with the Vaal. The streets are lined with fine willow trees, and there are public grounds in which are nurseries and a showyard. Golf links add to the attractions of the place, which is one of the healthiest in the Transvaal. In the neighbourhood are gold-mines; the reef appearing to be a continuation of the Witwatersrand reefs. The Vaal river goldfields, of which Venterskroon is the centre, are 16 to 20 m. south-east of Potchefstroom.

Potchefstroom was founded in November 1838 by Hendrik Potgieter, and is the oldest town in and first capital of the Transvaal. In 1862 it was the scene of civil war between rival Boer factions. In 1880–81 the garrison camped outside the town was besieged by Boers under Commandant P. A. Cronje. The British troops (250 in number) were confined to a fort 25 yds. square and lost over a third of their strength in killed and wounded before they surrendered on the 21st of March, the investment having begun on the 18th of December 1880. Charges of treachery were brought against Cronje for failing to notify the besieged that an armistice had been agreed to by the Boer leaders. Of this armistice Colonel R. W. C. Winsloe, who was in command of the British, became aware before the surrender took place. On the suggestion of Commandant General Joubert the capitulation was considered as cancelled and a detachment of British troops reoccupied the town until the conclusion of peace. In the Anglo-Boer War of 1899–1902 Potchefstroom was occupied by the British without opposition. (See TRANSVAAL: *History*.)

POTEMKIN, GRIGORY ALEKSANDROVICH, PRINCE (1739–1791), Russian statesman, was born at Chizheva near Smolensk. He was educated at the Moscow University, and in 1755 entered the "Reiter" of the Horse Guards. His participation in the *coup d'état* of the 8th of July 1762 attracted the attention of the new empress, Catherine II., who made him a *Kammerjunker* and gave him a small estate. The biographical anecdotes relating to him during the next few years are obscure and mostly apocryphal. In 1768 he quitted the Guards and was attached to the court as a *Kammerherr*, but in 1769 he volunteered for the Turkish War and distinguished himself at Khotin, Focshani and Larga, besides routing the Turks at Olta. It was not till 1771 that he became Catherine's prime favourite. In that year he was made an adjutant-general, lieutenant-colonel of the Preobrazhensky Guards, a member of the council of state, and, in the words of a foreign contemporary diplomatist, "the most influential personage in Russia." Somewhat later he was created a count, and appointed commander-in-chief and governor-general of "New Russia," as the conquered provinces in the Ukraine were then called. In 1776, at Catherine's request, the emperor Joseph II. raised Potemkin to the rank of a prince of the Holy Roman Empire. In 1775 he was superseded in the empress's graces by Zavadovsky; but the relations between Catherine and her former lover continued to be most friendly, and his influence with her was never seriously disturbed by any of her subsequent favourites. A whole mass of facts testify to the enormous and extraordinary influence of Potemkin during the next ten years. His correspondence with the empress was uninterrupted. The most important state documents passed through his hands. Catherine loaded him with gifts. He was deeply interested in the question of the southern boundaries of Russia and consequently in the fate of the Turkish Empire. It was he who, in 1776, sketched the plan for the conquest of the Crimea which was subsequently realized; and about the same period he was busy with the so-called "Greek project," which aimed at restoring the Byzantine Empire under one of Catherine's grandsons. In many of the Balkan states he had well-informed agents. After he became field marshal, in 1784, he introduced many reforms into the army, and built a fleet in the Black Sea, which, though constructed of very bad materials, did excellent service in Catherine's second Turkish War (1787–92) His colonizing system was exposed to very severe criticism, yet it is impossible not to admire the results of his stupendous activity. The arsenal of Kherson, begun in 1778, the harbour of Sevastopol and the new fleet of fifteen liners and twenty-five smaller vessels, were monuments of his genius. But there was exaggeration in all he attempted. He spared neither men, money, nor himself in attempting to carry out his gigantic scheme for the colonization of the south Russian steppes; but he never calculated the cost, and more than three-quarters of the design had to be abandoned when but half finished. Catherine's famous expedition to the south in 1787 was a veritable triumph for Potemkin; for he contrived to conceal all the weak points of his administration and to present everything in a rose-coloured light. On this occasion he received the title of prince of Tauris. The same year the second Turkish War began, and the founder of New Russia took upon himself the responsibilities of commander-in-chief. But the army was ill-equipped and unprepared; and Potemkin in an hysterical fit of depression gave everything up for lost, and would have resigned but for the steady encouragement of the empress. Only after Suvarov had valiantly defended Kinburn did he take heart again, and besiege and capture Ochakov and Bender. In 1790 he conducted the military operations on the Dniester and held his court at Jassy with more than Asiatic pomp. In 1791 he returned to St Petersburg where, along with his friend Bezborodko (*q.v.*), he made vain efforts to overthrow the new favourite, Zubov, and in four months spent 850,000 roubles in banquets and entertainments, a sum subsequently reimbursed to him from the treasury. Then the empress grew impatient and compelled him (1791) to return to Jassy to conduct the peace negotiations as chief Russian plenipotentiary. On the 5th of October, while on his way to Nikolayev, he died in the open steppe, 40 m. from Jassy, in consequence of eating a whole goose while in a high state of fever.

Very various are the estimates of Potemkin. Neither during his life nor after his death did any two people agree about him. The German pamphlet: *Pansalim Fürst der Finsterniss und seine Geliebte*, published in 1794, is a fair specimen of the opinion of those who regarded him as the evil genius of Catherine and of Russia. But there were many, including the empress herself, who looked upon him as a man of manifold and commanding genius. He was indubitably the most extraordinary of all the Catherinian favourites. He was an able administrator, but wanting in self-control. Licentiousness, extravagance and an utter disregard for human life were his weak points, but he was loyal, generous and magnanimous. Nearly all the anecdotes related of him by Helbig, in the biography contributed by him to the journal *Minerva* (1797–1800), and freely utilized by later biographers, are absolutely worthless.

See V. A. Bilbasov, *Geschichte Katharinas II.* (Berlin, 1891–1893); C. de Larivière, *Catherine la Grande d'après sa correspondance* (Paris, 1895); Anonymous, *La Cour de Catherine II. Ses collaborateurs* (St Petersburg, 1899); A. V. Lopukhin, *Sketch of the Congress of Jassy, 1791* (Rus.; St Petersburg, 1893); *The Papers of Prince Potemkin, 1744–1793* (Rus.; St Petersburg, 1893–1895). (R. N. B.)

POTENTILLA (nat. order Rosaceae, *q.v.*), a border and rock-garden plant. Many of the species bear brilliantly coloured flowers and graceful foliage. A soil of a good loamy staple, enriched with rotten dung, will grow the potentilla to perfection. Potentillas may be increased, though not very freely, by parting them into as many pieces as there are crowns, the side growths being those which can usually be thus separated. This may be done in autumn or spring, and the plants will generally bloom the following season. The species and some of the varieties reproduce true from seed, and are readily increased by that means. The following are some of the best kinds: *aurea, atrosanguinea, davurica, formosa, nitida, n. atro-rubra, speciosa, tridentata* and *villosa*.

POTENTIOMETER, an instrument for the measurement of electromotive force and also of difference of electric potential between two points. The term potentiometer is usually applied to an instrument for the measurement of steady or continuous potential difference between two points in terms of the potential difference of the terminals of a standard voltaic cell of some kind, such as a Clark or Weston cell. The modern potentiometer has been developed out of an arrangement due to J. C. Poggendorff, employed also by J. Latimer Clark, but converted into its modern direct reading form by J. A. Fleming in 1885 (see *Industries*, 1886, i. 152). In principle the modern potentiometer consists of an arrangement by means of which any potential difference not exceeding a certain assigned value can be compared with that of a standard cell having a known electromotive force. In simplest form it consists of a long, straight, fine, uniform wire stretched over a divided scale. The ends of this wire are connected to one or more secondary cells of constant electromotive force, a variable resistance being interposed so as to regulate the current flowing through the fine wire. To one end of this fine wire is attached one terminal of a sensitive galvanometer. Sliding contacts can be moved along the fine wire into any position. Supposing that the scale under this wire is divided into 2000 parts and that we are in possession of a standard Clark cell, the electromotive force being known at various temperatures, and equal, say, to 1·434 volts at 15° C. The first process is to set the potentiometer. The slider is placed so as to touch the fine wire at division No. 1434 on the fine wire, and the Clark cell is connected in between the sliding contact and one terminal of the galvanometer, so that its negative pole is connected through the galvanometer with that end of the fine wire to which the negative pole of the working battery is attached. The resistance in circuit with the fine wire is then altered until the galvanometer shows no deflexion. We then know that the fall of potential down the 2000 divisions of the fine wire must be exactly 2 volts. If then we substitute for the standard cell any other source of electromotive force, we can move the slider into another position in which the galvanometer will show no deflection. The scale reading then indicates directly the electromotive force of this second source of potential. Thus, for instance, if an experiment were made with a Leclanché cell, and if the balancing-point were found to be at 1500 divisions on the scale, the electromotive force would be determined as 1·500 volts. Instead of adjusting in this manner the electromotive force of any form of cell, if we pass any constant current through a known resistance and bring wires from the extremities of that resistance into connexion with the slider and the galvanometer terminal, we can in the same way determine the fall of potential down the above resistance in terms of the electromotive force of the standard cell and thus measure the current flowing through the standard resistance.

In the practical form the potentiometer wire is partly replaced by a number of coils of wire, say 14 (see fig. 1), and the potentiometer wire itself has a resistance equal to one of these coils. One terminal of the galvanometer can then be shifted to the junction between any pair of consecutive coils and the slider shifted to any point on the potentiometer wire. By such an arrangement the potential difference can be measured of any amount from 0 to 1·5 volts. In some cases the potentiometer wire is wholly replaced by a series of coils divided into small subdivisions. We may employ such a potentiometer to measure large potential difference greater than the electromotive force of the working battery, as follows: The two points between which the potential difference is required are connected by high resistance, say of 100,000 ohms or more, and from the extremities of a known fraction of this resistance, say, 1/100 or 1/1000 or 1/10,000 wires are brought to the potentiometer and connected in between the slider and the corresponding galvanometer terminal. We can thus measure as described the drop in volts down a known fraction of the whole high resistance and therefore calculate the fall in potential down the whole of the high resistance, which is the potential difference required. The potentiometer and the divided resistance constitute a sort of electrical scaleyard by means of which any electromotive force or difference of potential can be compared with the electromotive force of a standard cell. Very convenient and practical forms of potentiometer have been devised by Crompton (fig. 2), Nalder, Elliot Bros., Fleming and others. An essential accompaniment therefore of the potentiometer is a series of standard low resistances, say of 0·1, 0·01, 0·001 ohm, and also a series of higher resistances divided into known fractions. In practical work, the low resistances take the form of certain strips of metal which have on them two pairs of terminals, one termed "current terminals," and the other "potential terminals." These resistance strips, as they are called, are carefully adjusted so that the resistance between the potential terminals has a known low value. In order to measure the value of a continuous electric current, and therefore to calibrate any amperemeter we proceed as follows: The amperemeter is placed in series with a suitable low resistance strip, say of 0·01 ohm. From the potential terminals of the strip, wires are brought to the potentiometer so as to determine their potential difference in terms of the electromotive force of the standard Clark cell. An observation is then taken of the reading of the amperemeter and of the fall of resistance down the low resistance when a certain steady current is passing through the strip and amperemeter. Supposing that the potential fall down the strip is found to be ·981 volt, the strip difference having a resistance of 0·1 ohm, it would be seen that the current passing through the strip was 98·1 amperes. If then the amperemeter scale reading was 100 it would show an error of that scale reading of minus 1·9 amperes or nearly 2%. In the same manner the potentiometer may be used to calibrate a voltmeter by the aid of a divided resistance of known value.

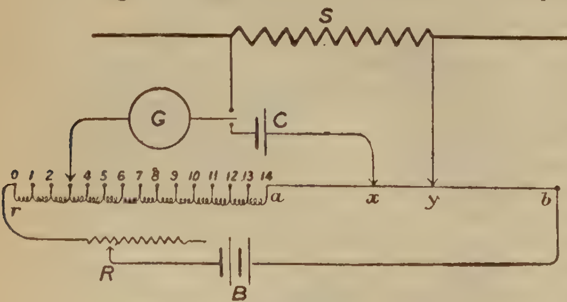


FIG. 1.

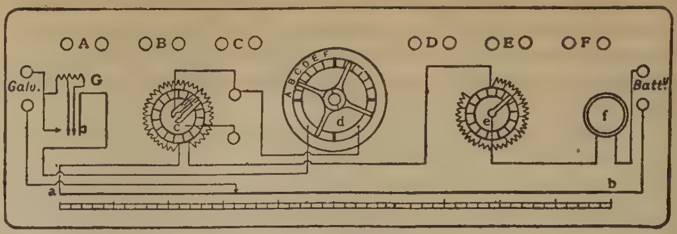


FIG. 2.—Diagram of the Internal Connexions of a Crompton Potentiometer.

a b, The scale wire.
c, The set of equal potentiometer coils in series with it.
d, The double pole switch connecting the 6 pairs of terminals A B C D E F in succession to the slide contacts.
e, The resistance coils.
f, The rheostat.
g, The galvanometer key.
A, B, C, D, E, F, Terminals to which standard cell or voltages to be tested are attached.

In electrical measurements connected with incandescent electric lamps the potentiometer is of great use, as it enables us to make accurately and nearly simultaneously two measurements, one of the current through the lamp and the other of the potential difference of the terminals. For this purpose a resistance, say, of one ohm, is placed in series with the lamp and a resistance of 100,000 ohms placed across the terminals of the lamp; the latter resistance is divided into two parts, one consisting of 1000 ohms and the other of 99,000 ohms. The potentiometer enables us to measure therefore the current through the lamp by measuring the drop in volts down a resistance in series with it and the potential difference of the terminals of the lamp by measuring the drop in volts down the 100th part of the high resistance of 100,000 ohms connected across the terminals of the lamp.

Standard Cells.—A necessary adjunct to the potentiometer is some form of standard cell to be used as a standard of electromotive force. In the case of the Clark standard cell above mentioned the elements are mercury and zinc separated by a paste of mercurous sulphate mixed with a saturated solution of zinc sulphate. Other voltaic standards of electromotive force are in use, such as the Weston cadmium cell, the Helmholtz calomel cell, and the standard Daniell cell. The Clark cell is made in two forms, the board of trade or tubular form, and the H form of cell devised by Lord Rayleigh. The German experts seem to favour the latter form; the specification issued by the Physikalisch-Technische Reichsanstalt of Berlin may be found in the *Electrician*, xxxi. 265–266. The electromotive force of the cell diminishes with rise of temperature, the board of trade value being 1·434 volts at 15° C.[1] and 1·434 (1 − 0·00077 (t − 15)) volts at t° C. A more exact expression is obtained if instead of 0·00077 the quantity 0·00078 + 0·000017 (t − 15) is used. In the Weston standard cell cadmium and cadmium sulphate are substituted for zinc and zinc sulphate; it has the advantage of a much smaller coefficient of temperature variation than the Clark cell. It is most conveniently made up in a glass vessel of H form, pure mercury and cadmium amalgam being the two elements (fig. 3), and when made as directed below it has at $t°$ C. an electromotive force E_t volts, such that

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[1] According to K. Kahle and W. Wien, the electromotive force of the H form of Clark cell is 1·4322 volts at 15° C.

$$E = 1{\cdot}0184 - 0{\cdot}0000406\,(t-20) - 0.00000095\,(t-20)^2 + 0{\cdot}00000001\,(t-20)^3.$$

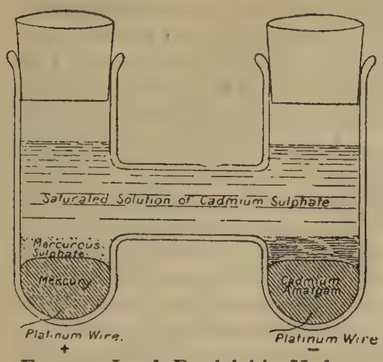

FIG. 3.—Lord Rayleigh's H form of Standard Voltaic Cell.

After the platinum wires have been sealed through the glass, a little aqua regia is placed in the cell legs until bubbles of gas arise from the platinum, when it is thrown out and replaced by a solution of mercurous nitrate. Then, by the use of another piece of platinum as anode, mercury is electrolytically deposited upon the platinum, which may also be amalgamated by making it white hot in a Bunsen flame and plunging it in mercury. To prepare the cadmium amalgam, one part of pure cadmium is dissolved in six parts of pure mercury, and the product while warm and fluid is placed in one limb of the cell and warmed, to ensure perfect contact with the platinum wire. The cadmium sulphate solution is prepared by digesting a saturated solution of cadmium sulphate with cadmium hydroxide to remove free acid, care being taken not to raise the temperature above 70° C., and then by digesting it still further with mercurous sulphate until no more precipitation occurs. The cadmium sulphate solution must be saturated and have free crystals of the salt in it. The mercurous sulphate must be free from acid, and made neutral by trituration with finely divided mercury. In making the paste, so much cadmium sulphate must be added that a saturated solution of that salt is formed and is present in the cell. The cell has the electromotive force above stated if the amalgam of cadmium has from 6 to 13 parts of mercury to 1 of cadmium. The German investigators seem to have a great preference for the H form of cell, but it is clear that a narrow tubular cell of the British board of trade form not only comes more quickly to the temperature of the water bath in which it is placed, but is more certain to be wholly at one temperature. In a modification of the H form devised by F. E. Smith, of the National Physical Laboratory (*Phil. Trans.*, A, 207, pp. 393–420), a contraction formed in the side of the vertical tube tends to hold the contents in place. Fig. 4 shows this cell, hermetically sealed, mounted in a brass case.

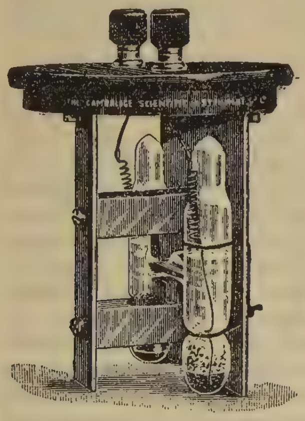

FIG. 4.—Method of mounting Weston Normal Cell. Brass case removed.

In cases when great accuracy is not required, a Daniell cell can be used as a standard of electromotive force. The form designed by J. A. Fleming (*Phil. Mag.*, 20, p. 126) consists of a U tube, one leg of which contains a rod of pure amalgamated zinc, and the other a rod of freshly electrotyped copper. The legs are filled with solutions of zinc sulphate and copper sulphate, the zinc rod being in the zinc sulphate and the copper rod in the copper sulphate. When so made, the cell has an electromotive force of 1·072 volts and no sensible temperature variation. The solutions are made by dissolving the purest recrystallized sulphate of copper and sulphate of zinc in distilled water. For the zinc solution, take 55·5 parts by weight of crystals of zinc sulphate ($ZnSO_47OH_2$) and dissolve in 44·5 parts by weight of distilled water; the resulting solution should have a specific gravity of 1·200 at about 20° C. For the sulphate of copper solution, take 16·5 parts by weight of pure crystals of copper sulphate ($CuSO_45OH_2$) and dissolve in 83·5 parts by weight of water; the resulting solution should have a specific gravity of 1.100 at 20° C. The solutions should be adjusted exactly to these densities and kept in stock bottles, from which the reservoirs of the cell should be filled up as required.

A form of potentiometer employing a vibration galvanometer and suitable for alternating current measurement by null methods has been devised by Dr Drysdale (see *Proc. Phys. Soc. Lond.* 1909, 21, 561.)

See J. A. Fleming, *Handbook for the Electrical Laboratory and Testing Room*, vol. i. (London, 1903)—vol. i contains on pp. 108–110 an extensive list of various original memoirs published on the Clark and Weston cells; G. D. Aspinall Parr, *Electrical Engineering Measuring Instruments* (London, 1903); W. C. Fisher, *The Potentiometer and its Adjuncts* (London, 1906).

POTENZA (anc. *Potentia*), a town and episcopal see of Basilicata, Italy, capital of the province of Potenza, 103 m. by rail E. by S. of Naples. Pop. (1901), 12,313 (town); 16,163 (commune). Situated 2700 ft. above sea-level on an isolated hill above the Basento (anc. *Casuentus*), it is much exposed to winds and has a far more northerly climate than its position (40° 40′ N.) implies, and is indeed one of the coldest places in Italy (mean temp. Jan 37·8°, July 70·9°, for whole year 53° F.). It has been almost entirely rebuilt since the earthquake of 1857. It has a school of the industrial arts and sciences, grows good wine, and makes bricks.

The ancient Potentia lay some 470 ft. lower, by the river. Its name shows that it was of Roman origin, and its importance was no doubt due to its position at the intersection of the road leading west to the Via Popillia and north-east to the Via Appia, with the Via Herculia. No remains are visible, but a considerable number of inscriptions have been found.

Potentia must be distinguished from Potentia in Picenum, on the Adriatic coast, near the modern Porto di Recanati, a colony founded in 184 B.C., the same year as Pisaurum, but of which little is known.

The abandonment of the old site and the erection of the new town probably date from the earthquake of 1273. By the Angevines Potenza was made a domain of the San Severino family; in the beginning of the 15th century it was held by Francesco Sforza, and in 1435 it passed to the Guevara family; the Loffredi, who succeeded by marriage, continued in possession till the abolition of the great fiefs. In 1694 there was a severe earthquake; and the more terrible earthquake which on the 16th and the 17th of December 1857 passed through southern Italy, and in Basilicata alone killed 32,475 persons, laid the greater part of Potenza in ruins. In 1860 it was the first town to rise against the Neapolitan government.

POTGIETER, EVERHARDES JOHANNES (1808–1875), Dutch prose writer and poet, was born at Zwolle, in Overyssel, on the 17th of June 1808. He started life in a merchant's office at Antwerp. In 1831 he made a journey to Sweden, described in two volumes, which appeared at Amsterdam in 1836–1840. Soon afterwards he settled in Amsterdam, engaged in commercial pursuits on his own account, but with more and more inclination towards literature. With Heije, the popular poet of Holland in those days, and Bakhuizen van den Brink, the rising historian (see also GROEN VAN PRINSTERER), Potgieter founded *De Muzen* (" The Muses," 1834–1836), a literary review, which was, however, soon superseded by *De Gids* (" The Guide "), a monthly, which became the leading magazine of Holland. In it he wrote, mostly under the initials of " W. D——g," a great number of articles and poems. The first collected edition of his poems (1832–1868) appeared in 2 vols. (Haarlem, 1868–1875), preceded by some of his contributions to *De Gids*, in 2 vols. also (Haarlem, 1864), and followed by 3 vols. of his *Studien en Schetsen* (" Studies and Sketches," Haarlem, 1879). Soon after his death (Feb. 3, 1875) a more comprehensive edition of Potgieter's *Verspreide en Nagelaten Werken* (" Miscellaneous and Posthumous Works ") was published in 8 vols. by his friend and literary executor, Johan C. Zimmerman (Haarlem, 1875–1877), who likewise supervised a more complete edition of Potgieter's writings which appeared at Haarlem in 1885–1890 in 19 vols. Of Potgieter's *Het Noorden in Omtrekken en Tafreelen* (" The North in Outlines and Pictures ") the third edition was issued in 1882, and an *édition de luxe* of his poems followed at Haarlem in 1893. Under the title of *Personen en Onderwerpen* (" Persons and Subjects ") many of Potgieter's criticisms had collectively appeared in 3 vols. at Haarlem in 1885, with an introduction by Busken-Huet.

Potgieter's favourite master among the Dutch classics was Hooft, whose peculiarities in style and language he admired and imitated. The same vein of altruistic, if often exaggerated and biased, abhorrence of the wonted conventionalities of literary life runs through all his writings, even through his private correspondence with Huet, parts of which have been published. Potgieter remained to his death the irreconcilable enemy of the Dutch " Jan Salie," as the Dutchman is nicknamed who does not believe in the regeneration of the Dutch people. Potgieter held up the Netherlanders of the golden age of the

16th and 17th centuries as models to be emulated. In these views he essentially differed from Huet. Yet the two friends worked harmoniously together; and when Potgieter reluctantly gave up *De Gids* in 1865, it was Huet whom he chose as his successor. Both then proceeded to Italy, and were present at the Dante festivities at Florence, which in Potgieter's case resulted in a poem in twenty stanzas, *Florence* (Haarlem, 1868). In Holland Potgieter's influence has been very marked and beneficial; but his own style, that of ultra-purist, was at times somewhat forced, stilted and not always easily understood. (H. Tr.)

POTHIER, ROBERT JOSEPH (1699–1772), French jurist, was born at Orleans on the 9th of January 1699. He studied law for the purpose of qualifying for the magistracy, and was appointed in 1720 judge of the presidial court of Orleans, thus following in the footsteps of his father and grandfather. This post he held for fifty-two years. He paid particular attention to the correction and co-ordination of the text of the *Pandects*, his *Pandectae Justinianae in novum ordinem digestae* (Paris and Chartres, 1748–1752) being a classic in the study of Roman law. In 1749 he was made professor of law in the university of Orleans. He wrote many learned monographs on French law, and much of his work was incorporated almost textually in the French Code Civil. He died at Orleans on the 2nd of March 1772. Of his numerous treatises the following may be specially mentioned: *Traité des obligations* (1761); *Du Contrat de vente* (1762); *Du Contrat de bail* (1764); *Du Contrat de société* (1765); *Des Contrats de prêt de consomption* (1766); *Du Contrat de depôt et de mandat* (1766); *Du Contrat de nantissement* (1767), &c. His works have several times been published in collected form (edited by Giffrein, 1820–1824; by Dupin, 1823–1825, and by Bugnet, 2nd ed. 11 vols. 1861–1862).

See Dupin, *Dissertation sur la vie et les ouvrages de Pothier* (Paris, 1825), and Frémont, *Vie de R. J. Pothier* (Orléans, 1850).

POTHOOK, an S-shaped metal hook for suspending a pot over a fire. While one extremity is hooked to the handle of the pot, the other is caught upon an iron crane moving on a pivot over the fire. Modern cooking-ranges have obviated the necessity for this arrangement, but it is still to be seen in great numbers of country cottages and farmhouse kitchens all over England, and in small artisans' houses in the west midlands and the north. In the elementary teaching of writing the "pothook" is a script of similar shape.

POTI, a seaport of Russian Transcaucasia, in the government of Kutais, at the mouth of the Rion on the coast of the Black Sea, 193 m. by rail W.N.W. of Tiflis and 35 m. by sea N. of Batum. Pop. (1882), 3112; (1897), 7666. The white walls of the fortress contrast with the green trees which surround them, and the lighthouse, 117 ft. high, is visible 17 m. Situated in a marshy delta not more than 2½ ft. above the level of the river, Poti is extremely unhealthy, fever and ague prevailing in summer and autumn. The Russians have improved the town and port, but the latter is still exposed to west and south-west gales. A new entrance was constructed in 1905, and a new inner harbour was at the same time under construction. The shipping trade amounts to £500,000 to £600,000 a year, almost entirely manganese ore, with some maize.

Poti represents the ancient Phasis, a commercial colony of the Greek city of Miletus. The present fortress was built in 1578 by Sultan Murad III. of Turkey at the time of a war with Persia. In 1640 it was destroyed by the Imeretians (Georgians), but it was restored and enlarged. The town was a great slave market. It was captured by the Russians in 1812 and 1829.

POTLATCH, a term, corrupted from a Nootka Indian word for "gift," for a ceremonial custom among some of the Indian tribes of north-west America, consisting in the distribution by an individual of his property among his friends and neighbours, who make equivalent gifts, with interest, in return.

POTOCKI, IGNATY (1741–1809), Polish statesman and writer, son of Eustachy Potocki, general of artillery of the army of Lithuania, was born at Podhajce. He was educated first at Warsaw beneath the eye of the pedagogic reformer Stanislaw Konarski (1700–1773), and subsequently in Italy, where he proposed to take orders. On returning home, however, he abandoned this idea, and as a member of the newly instituted commission of education rendered invaluable services to his country for the next sixteen years. He earnestly desired a reform of the constitution also, and was thus attracted to the party of the Czartoryscy. Elected deputy to every diet since 1778, he was a conspicuous member of the patriotic opposition. In matters of importance nothing was done without his advice, and he was esteemed as much for his character as for his talents. His influence was at its height during the Four Years' Diet, 1788–1792. He was appointed a member of the committee for the reform of the constitution, defended eloquently the right of the towns to the franchise, and was an advocate of an alliance with Prussia. Thus he was one of the creators of the constitution of the 3rd of May 1791, although his aristocratic antecedents prevented him from going the lengths of the more radical reformers. On the formation of the confederation of Targowica, Potocki emigrated to Dresden; but on the outbreak of the revolution of 1794 returned to Poland, was appointed a member of the national government, and entrusted with the conduct of foreign affairs. On the fall of Warsaw he surrendered to Suvarov and was sent to Russia, where he remained till 1796. On his return to Poland he retired to the village of Klimuntowo, where for the next thirteen years he devoted himself to literature. At the end of the war of 1809 he was commissioned to go to Vienna to present to Napoleon the petitions of the Galicians for the incorporation of their province with the grand duchy of Warsaw. He died at Vienna the same year. The most notable of Potocki's works is: *Vom Entstehen und Untergange der polnischen Konstitutionen vom 3ten May 1791* (Lemberg, 1793).

See August Sokolowski, *Illustrated History of Poland* (Pol.), vol. iv. (Vienna, 1901). (R. N. B.)

POTOCKI, STANISLAW FELIX (1752–1805), Polish politician, son of Franciszek Salezy Potocki, palatine of Kiev, of the Tulczyn line of the family, was born in 1752. He entered the public service, and owing to the influence of his relations became grand standard-bearer of the Crown at the age of twenty-two. In 1782 he was made palatine of Russia, in 1784 a lieutenant-general, and in 1789 he purchased the rank of a general of artillery from the Saxon minister, Brühl, for 20,000 ducats. Elected deputy for Braclaw at the famous Four Years' Diet, he began that career of treachery which was to terminate in the ruin of his country. Yet his previous career had awakened many hopes in him. A *grand seigneur* ruling patriarchally in his vast estates, liberal, enlightened, a generous master and a professed patriot, his popularity culminated in 1784 when he presented an infantry regiment of 400 men as a free gift to the republic. But he identified the public welfare with the welfare of the individual magnates. His scheme was the division of Poland into an oligarchy of autonomous grandees exercising the supreme power in rotation (in fact a perpetual interregnum), and in 1788 he won over to his views two other great lords, Xavier Branicki and Severin Rzewuski. The election of Malachowski (*q.v.*) and Kazimierz Sapieha as marshals of the diet still further alienated him from the Liberals; and, after strenuously but vainly opposing every project of reform, he retired to Vienna whence he continued to carry on an active propaganda against the new ideas. He protested against the constitution of the 3rd of May 1791, and after attempting fruitlessly to induce the emperor Leopold to take up arms "for the defence of the liberties of the republic," proceeded with his friends in March 1792 to St Petersburg, and subsequently with the connivance of the empress Catherine formed the confederation of Targowica for the maintenance of the ancient institutions of Poland (May 14, 1792), of which he was the marshal, or rather the dictator, directing its operations from his castle at Tulczyn. When the May constitution was overthrown and the Prussians were already in occupation of Great Poland, Potocki (March 1793) went on a diplomatic mission to St Petersburg; but, finding himself duped and set aside, retired to Vienna till 1797, when he settled down at Tulczyn and devoted himself for the remainder of his life to the improvement of his estates. He wrote *On the*

Polish Succession (Pol.) (Amsterdam, 1789); *Protest against the Succession to the Throne* (Pol.) (ibid. 1790); and other political works.

See Friedrich Schulz, *Poland in the year 1793* (Pol.) (Warsaw, 1899); Josef Zajaczek, *History of the Revolution of 1794* (Pol.) (Lemberg, 1881). (R. N. B.)

POTOMAC, a river in the east central part of the United States, having its source in the Alleghany Mountains and flowing S.E. into Chesapeake Bay. It is formed by the union of its north and south branches, about 15 m. S.E. of Cumberland, Maryland. The main stream has a length of about 450 m. and is navigable for large vessels for 113 m. above its mouth. The north branch, about 110 m. long, rises in the north-eastern part of West Virginia, pursues a north-easterly course, and forms part of the boundary between Maryland and West Virginia. The south branch has its sources in Highland county, Va., and in Pendleton county, W.Va., and flows north-east for about 140 m. until it joins the north branch. From the junction of these two streams until it reaches Harper's Ferry the Potomac river separates Maryland from West Virginia. At Harper's Ferry it receives the waters of the Shenandoah river and cuts through the Blue Ridge Mountains in a gorge noted for its scenic beauty. From this point to its mouth it forms the boundary between Virginia and Maryland. The stream crosses the Blue Ridge Mountains at an elevation of about 245 ft., and at Georgetown (Washington), 62 m. distant, it meets tidewater. Of this descent about 90 ft. occurs about 15 m. above Washington, at the Great Falls, a series of rapids about a mile long and including a cataract about 35 ft. high. Three and a half miles above Washington are the Little Falls, which mark the head of navigation. Large vessels, however, are prevented by a bridge from proceeding above Georgetown. At Washington there are two channels, with respective depths at mean low water of 18 and 21 ft. Large sums have been spent since 1870 on improving these channels. A few miles below the city the river broadens into a deep tidal estuary from 2½ to 7 m. wide; and channels 24 ft. deep and 200 ft. wide through all the shoals were secured by the project of 1899. The Anacostia river, or "East Branch," which flows into the Potomac just south of Washington, is navigable for large vessels for about 2 m. and for small scows and lighters as far as Bladensburg, Md., 8¾ m. above its mouth; its natural channel was narrow and tortuous, and about 18 ft. deep; in 1909 improvements (begun in 1902) had procured a channel 20 ft. deep at mean low water and 380 ft. wide. The Chesapeake & Ohio Canal, from Georgetown to Cumberland, Md., follows the Potomac closely on the Maryland side. The shipments over the Potomac above Washington in 1907 were valued at $7,596,494, and those below Washington at $21,093,800, the principal commodities being sand and gravel, ice, oils, naval ordnance and supplies, and building and paving materials. The shipments on the Anacostia river were of much the same character, and in 1907 were valued at $4,312,687.

POTOROO, or RAT KANGAROO, any member of the diprotodont marsupial sub-family *Potoroinae* (see MARSUPIALIA). None of them exceed a common rabbit in size. They inhabit Australia and Tasmania, are nocturnal, and feed on the leaves of grasses and other plants, as well as roots and bulbs, which they dig up with their forepaws; in this way some of them do considerable damage to cultivated crops. About ten species are known, presenting a considerable range of diversity in minor characters. The members of the type genus (*Potorous*) run, rather than leap, and do not use the hind feet for kicking. In the genus *Bettongia* the tail is prehensile, and with it they collect grass and twigs for making nests in their burrows.

POTOSÍ, a department of Bolivia occupying the south-western angle of that republic, bounded N. by Oruro, Cochabamba and Chuquisaca, E. by the two last departments and Tarija, S. by Argentina and W. by Chile and Oruro. Pop. (1900), 325,615, the larger part Indians; area, 48,801 sq. m. The eastern part of the department is traversed north to south by the eastern branch of the Andes, locally known as the Cordillera de los Frailes and the Sierras de Chichas. Spurs and broken ranges project eastward from these, between which are the headstreams of the Pilcomayo and Guapay, the first flowing south-east to the La Plata, and the second north-east to the Madeira and Amazon. The Pilcomayo itself rises in the department of Oruro, but several of its larger tributaries belong to Potosí—the San Juan, Cotagaita and Tumusla in the south, and Cachimayo in the north. The western part of the department belongs to the great Bolivian *altaplanicie*, or southern extension of the Titicaca basin. It is a barren, saline waste, almost uninhabitable. In the north, bordering on the transverse ridge of which the Cerro de Tahua (17,454 ft.) forms a part, is the depression known as the Pampa de Empeza, 12,080 ft. above sea-level, which is largely a region of morasses and saline plains. On and near the southern frontier is another transverse ridge, in part formed by the Sierra de Lipez, and in part by apparently detached groups of high peaks; it is a waterless desert like the Puna de Atacama.

Potosí is essentially a mining department, though agriculture and grazing occupy some attention in the eastern valleys. The western plateau is rich in minerals, especially silver and copper. The Huanchaca group of mines, situated on the slopes of the eastern Cordillera, overlooking the Pampa de Empeza, has the largest output of silver in Bolivia. The Pulacayo mine, belonging to this group, 15,153 ft. above sea-level, ranks next to the Broken Hill mine of Australia in production. Between 1873 and 1901 it yielded 4520 tons of silver, of an estimated value of £23,200,000. Farther south are the Portugalete mines, once very productive, and near the Argentine border are the Lipez mines. East of the Cordilleras are the famous "silver mountain" of Potosí, once the richest silver mine in the world; the snow-capped peak of Chorolque (18,452 ft.), which is claimed to have the highest mine in the world; Porco, a few miles south-west of Potosí; Guadalupe, Colquechaca and Aullagas. Besides silver, the Chorolque mines also yield tin, copper, bismuth, lead and wolfram. In 1907 the national government undertook railways from Potosí to Oruro, 205 m., and from Potosí to Tupiza, 155 m., to connect with the Central Northern line of Argentina, which was opened to Quiaca on the frontier on the 25th of May 1908. In western Potosí the department is traversed by the Antofagasta & Oruro railway (0·75 metre gauge). Besides Potosí, the capital of the department, the principal towns are Huanchaca (pop. about 10,000 in 1904), the seat of famous silver mines, 13,458 ft. elevation, and overlooking the Pampa de Empeza; Uyuni, 9 m. from Huanchaca, 12,100 ft. above sea-level, a small town but an important railway junction and commercial centre on the waterless plain, the shipping point and supply station for an extensive mining region; and Tupiza (pop. about 5000 in 1906), a prettily situated town near the Argentine frontier, on a small branch of the San Juan river, 9800 ft. above sea-level.

POTOSÍ, a city of Bolivia, capital of the department of Potosí, 47 m. (direct) S.W. of Sucré, or 88 m. by the post-road. Pop. (1906, estimate), 23,450. Potosí stands on a barren terrace on the northern slope of the Cerro Gordo de Potosí, 12,992 ft. above sea-level, and is one of the highest towns in the world. The famous *cerro* from which its name is taken rises above the town to a height of 15,381 ft., a barren, white-capped cone honeycombed with mining shafts. The town is regularly laid out with streets crossing each other at right angles. The smoke-begrimed buildings, many of which are unoccupied and in ruins, are commonly of adobe. A large plaza forms the conventional centre, around which are grouped various religious edifices, the government house, town hall, national college, the old "royal mint" dating from 1585, and the treasury. The city has a massive, plain cathedral, which in part dates from early colonial times, and in part from the closing years of Spanish rule. The water supply is derived from a costly system of reservoirs and aqueducts constructed by the Spanish government during the years of the city's greatest prosperity. There are 27 of these artificial lakes, and the aqueducts originally numbered 32, some of which are no longer serviceable. Rough mountain roads and pack animals are the only means of transportation to and from Potosí, but a railway from Oruro to Tupiza via Potosí, forming part of the projected Pan-American route, was contracted for in 1908. In 1611 the population of Potosí was reported to be 160,000, which probably included the whole mining district. A part of the diminution since then is explained by the fact that the great majority of the mines on the *cerro* have been abandoned.

The foundation of the city dates from 1547, two years after the first discovery of silver on the *cerro* by an Indian herder named Gualci. Charles V. conferred upon it the title of "villa imperial." From 1545 to 1800 the crown tax of one-fifth upon the mineral product amounted to £32,600,000, showing an acknowledged output of £163,000,000. The actual output, however, must have been much greater, as Spain was flooded with contraband silver, and there was a large trade in it at La Plata ports, whence it was taken to Brazil and Portugal. The total output to 1864 has been estimated at more than £400,000,000, but the annual output at the beginning of the 20th century barely exceeded 400,000 ozs. The struggle for independence began in Potosí on the 9th of November 1810, but the Spanish forces succeeded in retaining possession down to 1822.

POTOTAN, a town of the province of Iloilo, island of Panay, Philippine Islands, on the Jalaur river, about 17 m. N. of Iloilo. Pop. (1903), 37,373, including the population of Dingle (12,129) and Mina (4280), annexed after the census was taken. There is a fine church in the old town and a large stone church in Dingle; in the old town are several other buildings of masonry and some beautiful "fire" trees for shade. The principal industries are the cultivation of sugar-cane, Indian corn, rice, tobacco and hemp, and the raising of cattle, carabaos, sheep and horses.

POTSDAM, a town of Germany, the administrative capital of the Prussian province of Brandenburg, and one of the principal residences of the German Emperor, beautifully situated on the river Havel, 16 m. S.W. of Berlin, on the main line of railway to Magdeburg. Pop. (1905), 61,414. It is also connected with the capital by two local lines and by a steamboat service through the chain of lakes formed by the river. The greater part of the town lies on the right bank of the Havel and is connected with the Teltow suburb on the opposite bank by a long bridge (Lange Brücke). At the north end of this bridge rises the royal palace, a large quadrangular building of the 17th century, with a colonnade, chiefly interesting for the numerous relics it contains of Frederick the Great, who made it his favourite residence. At the south-eastern corner of the palace, close to the bridge, is the tree under which petitioners waited for the answer to their grievances, which Frederick the Great gave from an opposite window. It also contains reminiscences of Voltaire, who resided here for several years. The principal churches are the Nikolaikirche; the Church of the Holy Ghost, built in 1728; the garrison church, containing the remains of Frederick the Great and his father, Frederick William I.; and the Friedenskirche, or Church of Peace, erected by Frederick William IV. in 1845–1850. To the Friedenskirche is attached a mausoleum built after the model of a chapel at Innichen in Tirol, in which are buried Emperor Frederick III. and his consort, the Princess Royal of Great Britain, and two of their children who died in infancy. Among other conspicuous buildings are the large barracks and other military establishments; the town hall; and the Brandenburg gate, in the style of a Roman triumphal arch. The town has fine statues of several of the Prussian kings, including Frederick the Great. The Lustgarten, the Wilhelmsplatz and the Plantage are open spaces laid out as pleasure-grounds and adorned with statues and busts. In spite of its somewhat sleepy appearance, Potsdam has manufactures of silk goods, chemicals, furniture, chocolate, tobacco and optical instruments. Market-gardening affords occupation to many of the inhabitants, and the cultivation of winter violets is a specialty. The Havel is well stocked with fish. On a wooded eminence to the south of the town lies the observatory with extensive premises.

Potsdam is almost entirely surrounded by a fringe of royal palaces, parks and pleasure-grounds, which fairly substantiate its claim to the title of a "German Versailles." Immediately to the west is the park of Sans Souci, laid out by Frederick the Great, and largely extended by Frederick William IV. It is in the formal French style of the period, and is adorned with fountains, statuary and artificial ruins. Near the palace is the famous windmill; now royal property, which, according to a tradition now regarded as doubtful, its owner refused to sell to the king, meeting threatened violence by an appeal to the judges of Berlin. A little farther on is the Orangery, an extensive edifice in the Italian style, containing numerous pictures and other works of art. The park also includes the Charlottenhof, a reproduction of a Pompeian villa. At the west end of the park stands the New Palace, a huge brick edifice 375 ft. in length, erected by Frederick the Great at enormous expense in 1763–1769. It was occupied for a while by the emperor Frederick III., and was rechristened by him "Friedrichskron." On the accession of the emperor William II. its original name was restored. It is now the residence of the emperor. It contains reminiscences of Frederick and of Voltaire, a few pictures by ancient masters, a theatre, and a large hall decorated with shells and minerals. The spacious buildings at the back are devoted to the "Lehrbataillon," a battalion of infantry composed of drafts from different regiments trained here to ensure uniformity of drill throughout the army. To the north of Potsdam lies a small Russian village, Alexandrowka, built in 1826 to accommodate the Russian singers attached to the Prussian guards. A little to the east of it, on the Heiligersee, is the New Garden, containing the Marble Palace. The list of Potsdam palaces may be closed with two situated on the left bank of the Havel—one at Klein-Glienicke, formerly the country-seat of Prince Frederick Charles of Prussia (the "Red Prince"), and the other on the hill of Babelsberg. The latter, designed as a miniature copy of Windsor Castle, in the midst of a park in the English taste, was formerly the summer residence of the emperor William I.

Potsdam was originally a Slavonic fishing-village named Poztupimi, and is first mentioned in a document of 993. It became a town in the 14th century, but was unimportant until the great elector built a palace here between 1660 and 1682; and even at the close of his reign it only contained 3000 inhabitants. The elector Frederick William I. greatly enlarged Potsdam, and his stiff military tastes are reflected in the monotonous uniformity of the streets. Frederick the Great continued his father's work, and is the real creator of the modern splendour of the town, to which all his successors have contributed.

See H. C. P. Schmidt, *Geschichte und Topographie der Residenzstadt Potsdam* (Potsdam, 1825); G. Sello, *Potsdam und Sanssouci* (Breslau, 1888); Mügge, *Führer durch Potsdam und Umgebung* (Potsdam, 1896); Kopisch, *Die königlichen Schlösser und Gärten zu Potsdam* (Berlin, 1854); and Bethge, *Die Hohenzollernanlagen Potsdams* (Berlin, 1889).

POTSDAM, a village of St Lawrence county, New York, U.S.A., in the township of Potsdam, on the Raquette river, about 68 m. N.E. of Watertown. Pop. of the village (1905) 4162; (1910) 4036; of the township (1905) 8992; (1910) 8725. The village is served by the New York Central & Hudson River railway. It has a public library and is the seat of a state Normal School (1869), an outgrowth of St Lawrence Academy (founded in 1810 by Benjamin Raymond and maintained by him until 1816, when it was incorporated); of the Thomas S. Clarkson Memorial School of Technology (1896), founded by his sisters in honour of Thomas Streatfield Clarkson (1837–1894); and of the Crane Normal Institute of Music. The village has a considerable trade in dairy products. In the neighbourhood are extensive quarries of the well-known "Potsdam sandstone," the uppermost division of the Cambrian system, described as a "fine-grained sandstone cemented with silica," and very durable. The House of Parliament at Quebec, All Saints Cathedral at Albany, New York, and many other public edifices were built of this stone.

The "Ten Towns" of St Lawrence county, including the township of Potsdam, were sold by the state in 1787. The first settlement was made on the Raquette river, close to the present village, in 1803; the township was incorporated in 1806 and the village in 1831. Potsdam was named after Potsdam in Prussia because of the occurrence in each locality of reddish sandstone.

POTT, AUGUST FRIEDRICH (1802–1887), German philologist, was born at Nettelrede, Hanover, on the 14th of November 1802. He studied in Göttingen, and in 1825 became schoolmaster at Celle, Hanover; but after two years removed to Berlin, where he became *privatdozent* at the university. He studied comparative philology, and in 1883 was made professor at Halle, where he lived till his death on the 5th of July 1887. His *Etymologische Forschungen* (1834–1836) entitled him to rank as Bopp's foremost disciple in the Indo-Germanic science of language. Pott also devoted much attention to the origins of the gipsies.

POTT, PERCIVALL (1714–1788), English surgeon, was born in London on the 6th of January 1714. He served his apprenticeship with Edward Nourse, assistant surgeon to St Bartholomew's Hospital, and in 1736 was admitted to the Barbers'

Company and licensed to practise. He became assistant surgeon to St Bartholomew's in 1744 and full surgeon from 1749 till 1787. He died in London on the 22nd of December 1788. The first surgeon of his day in England, excelling even his pupil, John Hunter, on the practical side, he introduced various important innovations in procedure, doing much to abolish the extensive use of escharotics and the actual cautery that was prevalent when he began his career. A particular form of fracture of the ankle which he sustained through a fall from his horse in 1756 is still described as Pott's fracture, and his book, *Some few Remarks upon Fractures and Dislocations*, published in 1768 and translated into French and Italian, had a far-reaching influence in Great Britain and France. "Pott's disease" is a spinal affection of which he gave an excellent clinical description in his *Remarks on that kind of Palsy of the Lower Limbs which is frequently found to accompany a Curvature of the Spine* (1779). Among his other writings the most noteworthy are *A Treatise on Ruptures* (1756), *Observations on the Nature and Consequences of those Injuries to which the Head is liable from external violence* (1768), and *Chirurgical Observations* (1775). There are several editions of his collected works; that published by Sir James Earle in 1790 contains a sketch of his life.

POTTER, ALONZO (1800–1865), American bishop of the Protestant Episcopal Church, was born at Beekman (now La Grange), Dutchess county, New York, on the 6th of July 1800. His ancestors, English Friends, settled in Portsmouth, Rhode Island, between 1640 and 1660; his father was a farmer, a Quaker, and in 1798 and in 1814 was a member of the New York Assembly. The son graduated at Union College in 1818, and in 1821–1826 was professor of mathematics and natural philosophy there. In 1824 he was ordained priest, and married a daughter of President Eliphalet Nott of Union College; she died in 1839, and in 1841 he married her cousin. He was rector of St Paul's Boston, from 1826 to 1831, when he became professor of moral and intellectual philosophy and political economy at Union. In 1838 he refused the post of assistant bishop of the eastern diocese (Maine, New Hampshire, Massachusetts and Rhode Island). He was vice-president of Union College in 1838–1845. After the suspension of Henry Ustick Onderdonk (1789–1858) from the bishopric of Pennsylvania Potter was chosen to succeed him, and was consecrated on the 23rd of September 1845. Owing to his failing health he visited England and France in 1858, and in April 1864 sailed from New York for California, but died on board ship in San Francisco harbour on the 4th of July 1865.

In 1846 he established the western and north-eastern convocations of priests in his diocese; from 1850 to 1860, when its corner-stone was laid, he laboured for the "Hospital of the Protestant Episcopal Church in Philadelphia"; and in 1861 he established the Philadelphia Divinity School. In 1842 with George B. Emerson (1797–1871) he published *The School and the Schoolmaster*, which had a large circulation and great influence. In 1847, 1848, 1849 and 1853 he delivered five courses of lectures on the Lowell Institute foundation. He advocated temperance reform and frequently delivered a lecture on the *Drinking Usages of Society* (1852); he was an opponent of slavery and published a reply to the pro-slavery arguments of Bishop John Henry Hopkins (1792–1868) of Vermont. He edited many reprints and collections of sermons and lectures, and wrote: *Political Economy* (1840), *The Principles of Science applied to the Domestic and Mechanic Arts* (1841), *Handbook for Readers and Students* (1843), and *Religious Philosophy* (1870).

See M. A. de Wolfe Howe, *Memoirs of the Life and Services of the Right Reverend Alonzo Potter, D.D.* (Philadelphia, 1871).

His brother, HORATIO POTTER (1802–1887), was born in Beekman, New York, on the 9th of February 1802. He graduated at Union College in 1826, was ordained a priest of the Protestant Episcopal Church in 1828, was rector for several months in Saco, Maine, and in 1828–1833 was professor of mathematics and natural philosophy at Washington (now Trinity) College, Hartford, Connecticut. In 1833–1854 he was rector of St Peter's, Albany; in November 1854 he was elected provincial bishop of New York in place of Benjamin Tredwell Onderdonk (1791–1861), who had been suspended, and upon Onderdonk's death he became bishop. In 1868 his diocese was divided, the new dioceses of Albany, Central New York and Long Island being separated from it. Bishop Potter attended the Lambeth conferences of 1867 and 1868. His failing health put an end to his active service in 1883, when his nephew, H. C. Potter (*q.v.*), became his assistant. He died in New York City on the 2nd of January 1887.

POTTER, HENRY CODMAN (1835–1908), American Protestant Episcopal bishop, the son of Bishop Alonzo Potter, was born in Schenectady, New York, on the 25th of May 1835. He was educated in the Philadelphia Academy of the Protestant Episcopal Church and in the Theological Seminary of Virginia, where he graduated in 1857. He was ordained deacon in 1857 and priest in 1858; was rector of Christ Church, Greensburg, Pennsylvania, in 1858–1859, and of St John's Church, Troy, N. Y., in 1859–1866; refused the presidency of Kenyon College in 1863 and the bishopric of Iowa in 1875; was secretary of the House of Bishops in 1866–1883; and was assistant rector of Trinity Church, Boston, in 1866–1868, and rector of Grace Church, New York City, in 1868–1884. In October 1883 he was consecrated assistant to his uncle, Horatio Potter, bishop of New York, and in 1887 succeeded him. The Rev. David Hummell Greer (b. 1844) became his coadjutor in September 1903, and succeeded to the bishopric after the death of Bishop Potter in Cooperstown, N. Y., on the 21st of July 1908. During Bishop Potter's administration the corner-stone of the Cathedral of St John the Divine was laid (in 1892).

He was notable for his interest in social reform and in politics: as rector of Grace Church he worked to make it an "institutional church" with working-men's clubs, day nurseries, kindergartens, &c., and he took part in the summer work of the missions on the east side in New York City long after he was bishop; in 1900 he attacked the Tammany mayor (Robert A. Van Wyck) of New York City, accusing the city government of protecting vice, and was a leader in the reform movement which elected Seth Low mayor in the same year; he frequently assisted in settling labour disputes; he worked for the re-establishment of the army canteen and attempted to improve the saloon, which he called the "poor man's club"—notably by his taking part in the opening (August, 1904) of the unsuccessful Subway Tavern. He published: *Sisterhoods and Deaconesses at Home and Abroad* (1872); *The Gates of the East* (1876), a book of travels; *Sermons of the City* (1881); *Waymarks* (1892); *The Scholar and the State* (1897); *The East of To-day and To-morrow* (1902); *The Industrial Situation* (1902); *Law and Loyalty* (1903), and *Reminiscences of Bishops and Arch-Bishops* (1906).

See Harriett A. Kayser, *Bishop Potter, the People's Friend* (New York, 1910).

His brother, CLARKSON NOTT POTTER (1825–1882), was a civil engineer, then (1848–1868) a practising lawyer in New York City, and in 1869–1875 and in 1877–1881 a Democratic member of the National House of Representatives. Another brother, ROBERT BROWN POTTER (1829–1887), a lawyer and a soldier, commanded the 51st New York Volunteers at Cedar Mountain, Second Bull Run and Antietam, was wounded at Antietam and at Petersburg, was commissioned major-general of volunteers in September 1865, and was mustered out in 1866. A third brother, ELIPHALET NOTT POTTER (1836–1901), was rector of the Church of the Nativity, South Bethlehem, Pennsylvania, in 1862–1869, was professor of ethics in Lehigh University in 1869–1871, and was president of Union College in 1871–1884, of Hobart College in 1884–1897, and of Cosmopolitan University, a correspondence school, in 1897–1901.

POTTER, JOHN (*c.* 1674–1747), archbishop of Canterbury, was the son of a linen-draper at Wakefield, Yorkshire, and was born about 1674. At the age of fourteen he entered University College, Oxford, and in 1693 he published notes on Plutarch's *De audiendis poetis* and Basil's *Oratio ad juvenes*. In 1694 he was elected fellow of Lincoln College, and in 1697 his edition of Lycophron appeared. It was followed by his *Archaeologia graeca* (2 vols. 8vo, 1697–1798), the popularity of which endured till the advent of Dr William Smith's dictionaries. A reprint of his Lycophron in 1702 was dedicated to Graevius, and the *Antiquities* was afterwards published in Latin in the *Thesaurus* of Gronovius. Besides holding several livings he became in 1704 chaplain to Archbishop Tenison, and shortly afterwards was made chaplain-in-ordinary to Queen Anne. From 1708 he was regius professor of divinity and canon of Christ Church, Oxford; and from 1715 he was bishop of Oxford. In the latter year appeared his edition of Clement of Alexandria. In 1707 he published a *Discourse on Church Government*, and he took a prominent part in the controversy with Benjamin Hoadly, bishop of Bangor. In January 1737 Potter was unexpectedly appointed to succeed Wake in the see of Canterbury. He died on the 10th of October 1747. His *Theological Works*, consisting of sermons, charges, divinity lectures and the *Discourse on Church Government*, were published in 3 vols. 8vo, in 1753.

POTTER, PAUL (1625–1654), Dutch animal painter, was born at Enkhuizen, Holland. He was instructed in art by his father, Peter Potter, a landscape and figure painter of some merit, and by Nicolas Moeyaert, of Amsterdam. Other masters and influences are mentioned by various writers, but more than any other of his contemporaries he learnt through direct study from nature. By the time he had attained his fifteenth year his productions were already much esteemed. In 1646 he went to Delft, where he became a member of the gild of St Luke. At the age of twenty he settled at the Hague, and there married in 1650. He was patronized by Maurice, prince of Orange, for whom he painted the life-size picture of the "Young Bull," now one of the most celebrated works in the gallery of the Hague. In 1652 he was induced by Burgomaster Tulp of Amsterdam to remove to that city. His constitution seems to have been feeble, and his health suffered from the unremitting diligence with which he pursued his art. He died on the 15th of January 1654 at the age of twenty-nine.

His paintings are generally small; early in life, however, he attempted, but with ill success, to work on a monumental scale, as in the "Bear Hunt" at the Rijks Museum and the "Boar Hunt" of the Carstanjen collection, Berlin. Even the famous "Equestrian Portrait of Tulp" in the Six collection, Amsterdam, is awkward and stiff and hard in handling. His animals are designed with careful accuracy, while the landscape backgrounds are introduced with spirit and appropriateness. His colour is clear and transparent, his execution firm and finished without being laboured. His view of nature is purely objective and unemotional; he painted with the greatest directness and simplicity the things he saw before him, and his paintings of horses and cattle are so individualized that they become faithful portraits of the animals. The best among his small portraits of horses are in the Louvre and in the Schwerin Gallery; and certain of his studies are the most brilliant of all.

The earliest dated picture of importance is "Abraham Entering Into Canaan" (1642), at the Germanic Museum in Nuremberg, in which he makes the Scriptural subject an excuse for painting the patriarch's herds, just as in his "Orpheus" of 1650 (Rijks Museum, Amsterdam) he makes similar use of the Greek myth. Among his finest works on a small scale are a cattle piece (1653) in the Duc d'Arenberg's collection, and a similar, though earlier, picture in the Munich Pinakothek. In spite of his early death Paul Potter produced a great number of works. He worked with feverish application, as though he were aware of the short span of life that was granted him. He executed a series of some twenty etchings, mainly of animals, which are simple and direct in method and handling. Here, as in painting, his precocity was remarkable: his large plate of the "Herdsman," produced when he was only eighteen, and that of the "Shepherd," which dates from the following year, show him at his best as an accomplished master of the point.

Potter's works have been engraved by Bartolozzi, Danckerts, Visscher, Le Bas and others. Authentic paintings from his brush command very considerable prices. At the Stover sale in 1890 "The Dairy Farm" realized the record price of £6090. There are two of his paintings at the National Gallery, three in Buckingham Palace and a few in the duke of Westminster's collection. On the continent of Europe the most numerous and representative examples are to be found at the Rijks Museum in Amsterdam, the Hermitage in St Petersburg, and the Dresden Gallery.

See *Paulus Potter, sa vie et ses œuvres*, by T. van Westrheene (the Hague, 1867); *Eaux-fortes de Paul Potter*, by Georges Gratet Duplessis; and an old but interesting volume, *Paul Potter, peintre de l'école hollandaise*, by C. L. F. Lecarpentier (Rouen, 1818). (P. G. K.)

POTTER, PHILIP CIPRIANI HAMBLEY (1792–1871), English musician, was born in London, the son of a pianoforte teacher, and godson of a sister of G. B. Cipriani, the painter. He was educated for the musical profession under Attwood, Callcott, Crotch and Woelfl; later at Vienna, where he received encouragement from Beethoven. In 1816 an overture by him was performed at a Philharmonic concert, and he began a distinguished career as a pianist. In 1822 he became a professor, and in 1832 principal (resigning in 1859) of the Royal Academy of Music; in 1860 an exhibition was founded there in his honour. Cipriani Potter composed many works, now mostly forgotten, though important in their day. He died on the 28th of September 1871.

POTTERIES, THE, a name popularly applied to a district of north Staffordshire, the principal seat of the china and earthenware industry in England. It lies in the valley of the Trent a little south of its source, and extends into tributary valleys and up the hills flanking them. For a distance of 9 m. from south-east to north-west, and about 3 m. from north-east to south-west, the district resembles one great town, but the chief centres are Burslem, Hanley, Longton, Stoke-on-Trent, Fenton and Tunstall. Under the "Potteries federation" scheme (1908) these towns were amalgamated in 1910 as one municipal borough under the name of Stoke-on-Trent. Newcastle-under-Lyme, though not sharing in the staple industry, may also be reckoned in the district. Among the lesser manufacturing centres Etruria, ranking as a suburb of Hanley, is well known for its connexion with Josiah Wedgwood, who founded works here in 1769. The Wedgwoods and the Mintons are the two most famous family names connected with the china industry of the district. Coal and coarse clay are the only local natural products necessary to the industry; the finer clay and other ingredients are brought from Cornwall and elsewhere. Ironstone is raised in the district. The North Staffordshire and London & North-Western railways and the Grand Trunk canal are the principal means of communication.

POTTHAST, AUGUST (1824–1898), German historian, was born at Höxter on the 13th of August 1824, and was educated at Paderborn, Munster and Berlin. He assisted G. H. Pertz, the editor of the *Monumenta Germaniae historica*, and edited the *Regesta pontificum romanorum, 1198–1304* (Berlin, 1874–1875). From 1874 to 1894 he was librarian of the German Reichstag. Potthast is chiefly known through his monumental *Bibliotheca historica medii aevi* (1862), a guide to the sources of European history in the middle ages. The work, in the form of an index, gives particulars of practically all the historical writers of Europe and their work between 375 and 1500. A new and enlarged edition appeared at Berlin in 1896. Potthast died on the 13th of February 1898.

POTTINGER, ELDRED (1811–1843), Anglo-Indian soldier and diplomatist, entered the Bombay Artillery in 1827, and after some years of regimental duty was appointed to the political department under Colonel (afterwards Sir Henry) Pottinger. In 1837 he made a journey through Afghanistan in disguise. Arriving at Herat, he found it threatened by a Persian army (with which were some Russian officers) and immediately made himself known to the Afghan commander, offering his services. The attack which soon followed was conducted with the greatest vigour, but the defence, inspired by Pottinger, was invariably successful, and after a year the siege was raised. For this great service Pottinger was thanked by the governor-general, the earl of Auckland, made brevet-major, and also received the C.B. He was also appointed political officer at Herat. In 1841 he was political officer in Kohistan when the revolt against Shah Shuja broke out there. Taking refuge with the Gurkha garrison of Charikar, Major Pottinger stood a siege of fourteen days, and then made an adventurous retreat to Kabul. Less than a fortnight after his arrival Sir William Macnaghten was murdered, and Pottinger succeeded to his position as envoy to the Afghan court. The apathy of the military leaders made resistance hopeless, and it only remained to negotiate for the withdrawal of the British mission. Pottinger himself was one of the hostages handed over to Akbar Khan, and thus escaped the massacre in the Khyber Pass. Released, after many months' captivity, by Sir George Pollock's army, he returned to India, and a year later died while visiting Hong-Kong.

POTTO, the native name of the West African slow-lemurs, popularly miscalled "sloths," and scientifically known as *Perodicticus*, a name referring to the aborted condition of the index finger, which forms their most distinctive feature. The ordinary potto (*P. potto*) is about the size of a squirrel, but with large staring eyes, and a mere stump of a tail; its general colour is rufous brown. Bates's potto (*P. batesi*), of the Congo, is nearly allied; but the awantibo (*P.* [*Arctocebus*] *calabarensis*), of Old Calabar, differs by the complete loss of the tail (see PRIMATES).

POTTSTOWN, a borough of Montgomery county, Pennsylvania, U.S.A., on the Schuylkill river, 40 m. N.W. of Philadelphia. Pop. (1910 census) 15,599. Pottstown is served by the Pennsylvania and the Philadelphia & Reading railways, and by electric lines to neighbouring towns. In the borough is the Hill School (1851), an excellent secondary school for boys. There is trade with the surrounding country, which is devoted to farming and dairying and abounds in iron ore and limestone, but the principal industry is the manufacture of iron and steel, the first commercially important iron furnaces in Pennsylvania having been established near the site of Pottstown in 1716–1718. In 1905 the factory products were valued at $8,144,723 (10·7% more than in 1900). Three miles from Pottstown, in an amusement park, are the "ringing rocks," which cover about an acre, and have varying tones when struck, so that tunes may be played upon them. Pottstown was settled and laid out in 1752 and was named Pottsgrove in honour of its founder, John Potts (1710–1768); in 1815 it was incorporated as a borough and in 1829 the present name was adopted.

POTTSVILLE, a borough and the county-seat of Schuylkill county, Pennsylvania, U.S.A., at Schuylkill Gap through Sharp Mountain on the Schuylkill river, about 90 m. N.W. of Philadelphia. Pop. (1910 census) 20,236. It is served by the Pennsylvania, the Lehigh Valley and the Philadelphia & Reading railways, and by the Eastern Pennsylvania railway company to the borough of Minersville (pop., 1910, 7240), about 4½ m. N.N.E., and to the other boroughs in the immediate neighbourhood, for which Pottsville is a business and shipping centre. It is picturesquely situated in the famous Schuylkill coalfield and on the old Schuylkill canal and Tumbling Run, and has a considerable number of summer visitors. There are large repair shops of the Pennsylvania and of the Philadelphia & Reading railways at Pottsville. In 1905 the total value of the factory products was $5,805,788.

The first settlers here, a single family, were massacred by the Indians in August 1780; a second settlement was established about 1795, and an iron furnace was erected a few years later. In 1804 this furnace was purchased by John Pott (1759–1827), the founder of the borough; in 1807 coal was discovered; in 1816 the town was laid out; in 1828 it was incorporated as a borough; and in 1851 the borough became the county-seat. In 1854–1877 Pottsville was a centre of the Molly Maguire disturbances, and here a number of the leaders were tried and convicted in 1876–1877. In 1908 the borough of Yorkville (pop., 1900, 1125) was annexed to Pottsville.

POTWALLOPER, or POTWALLER, the name of a class of persons who were entitled in certain English boroughs to the parliamentary franchise. The word is usually taken to mean literally "one who boils a pot," from "wallop" or "gallop," which Skeat (*Etym. Dict.*, 1898) connects with the Old Low Ger. *wallen*, to boil, cf. "well," *i.e.* which springs or boils up. The "Potwalloper" was defined in *Curry's Case*, 1838 (*Falc* and *Fitz.*, p. 311) as "one, whether he be a householder or a lodger, who has the sole dominion over a room with a fireplace in it, and who furnishes and cooks his own diet at his own fireplace." The Representation of the People Act (1832) reserved these ancient franchise rights to their then holders only. In the *Return of Parliamentary Constituencies* (Electors, &c.), 1898, there was one "potwalloper" on the register.

POUCHED MOUSE, the colonial name for any member of the polyprotodont marsupial genus *Phascologale* (see MARSUPIALIA). There are over a dozen species, none larger, the most much smaller than a rat. The food of these animals is almost entirely insects, which some pursue among the branches of trees, while others are purely terrestrial. Pouched mice are found throughout Australia, where all the species have uniformly coloured fur, and also in New Guinea and the Aru and some of the adjacent islands, most of the Papuan forms being distinguished by striping on the back. In the view of Oldfield Thomas these marsupials fill the place held in Malaya by the tree-shrews, and in South America by the smaller opossums.

POUGHKEEPSIE, a city and the county-seat of Dutchess county, New York, U.S.A., and on the east bank of the Hudson river, 73 m. N. of New York City. Pop. (1910 census), 27,936. It is served by the New York Central & Hudson River, the New York, New Haven & Hartford, the West Shore, the Central New England, and the Poughkeepsie & Eastern (merged in the Central New England) railways, and by river steamboat lines on the Hudson. A cantilever railway bridge, 2260 ft. long (6767 ft., including approaches) and 200 ft. above the water, spans the Hudson at this point. The city is built partly on terraces rising 200 ft. above the river and partly on a level plateau above. On the Hudson here is the course for the intercollegiate boat-races in which the American college crews (save those of Yale and Harvard, which row on the Thames at New London) have rowed annually, beginning in 1895, except in 1896, when the race was rowed at Saratoga. In the north-eastern part of the city is College Hill Park, and in the centre is Eastman Park (11 acres, originally the home of Harvey Gridley Eastman). Vassar College (*q.v.*), one of the most famous women's colleges in America, occupies extensive grounds a short distance east of the city. Other educational institutions are the Lyndon Hall School (1848) for girls, Putnam Hall (for girls), St Faith's School (Protestant Episcopal; removed in 1904 from Saratoga Springs, where it was founded in 1890), Riverview Military Academy (1836), and Eastman Business College, one of the largest commercial schools in the country, founded in 1859 by Harvey Gridley Eastman (1832–1878). Immediately north of Poughkeepsie is the Hudson River State Hospital for the Insane (1871); in the city are the Vassar Brothers' Hospital (1878), with which a nurses' training school is connected; the Vassar Brothers' Home (1881) for aged and infirm men; the Poughkeepsie Orphan House and Home for the Friendless (1847); the Old Ladies' Home (1870); the Pringle Memorial Home (1899), for aged and indigent men, and the Adriance Memorial Library (45,000 volumes in 1909). The city is a manufacturing centre of considerable importance; the factory products in 1905 were valued at $7,206,914, an increase of 29·2% over 1900.

Poughkeepsie was settled by the Dutch about 1698, taking its name from an Indian word "Apokeepsing," or "Poughkepesingh," which seems to have been the name of a waterfall on the river front. The New York legislature met in Poughkeepsie in 1778, 1780, 1781, 1782, 1788 and 1795, and here in 1788 met the convention which ratified for New York the Federal constitution (July 28). Poughkeepsie was incorporated as a village in 1799 and was chartered as a city in 1854.

POULTICE, a mass of linseed-meal, bread or other substance, sometimes of medicinal herbs, mixed with boiling water and enclosed in muslin or linen and applied to the skin to reduce inflammation, to induce warmth, or when mixed with mustard, &c., as a counter-irritant. The word seems to have been taken from the plural *pultes* of the Lat. *puls*, pottage, pulse, Gr. πόλτος.

POULTRY AND POULTRY-FARMING. The term "poultry" (from "poult," Fr. *poulet*, dim. of *poule*, a fowl) is usually regarded as including the whole of the domesticated birds reclaimed by man for the sake of their flesh and their eggs. The most important is the common fowl, which is remarkable as having no distinctive English name; but the present article also deals with the poultry-farming side of the turkey, the guinea-fowl, the duck and the goose. For purely zoological details the separate articles referred to should be consulted.

Fowls.—The common fowl (see FOWL) belongs to the restricted genus *Gallus*, of which four wild species are known—the Bankiva jungle fowl (*G. ferrugineus*), the Sonnerat jungle fowl (*G. sonnerati*), the Ceylon jungle fowl (*G. stanleyi*), and the forked-tail jungle fowl (*G. furcatus*). The origin of the domesticated breeds is ascribed by Darwin, Blyth and other naturalists to the Bankiva fowl, much stress being laid on the comparative want of fertility in the hybrids produced between this species or the domesticated breeds and the other three forms of wild *Galli*, but it is probable that this want of fertility was due in great part to the unnatural conditions under which the parent and offspring were placed, as, if bred under more natural conditions, there is no difficulty in rearing these hybrids or in breeding from them with the domesticated varieties.

Breeds.—The number of poultry exhibitions has nowadays multiplied to such an extent that as many as twenty shows have been criticized in print in one week in Great Britain. Competition has increased the money value of prize fowls and created a large class—almost a profession—who have considerable pecuniary interests embarked in breeding and exhibiting such birds. This professionalism, and the interests at stake, have in turn naturally given rise to many proceedings of doubtful character, which it has been found needful to keep in check by an organization known as the Poultry Club. An enormous multiplication of varieties is another phase of this development, nearly all breeds having had their older subdivisions supplemented by new colours, produced through crossing and skilful selection, amidst which buff or orange, now bred in nearly all fowls, has had a curious popularity. While formerly the diminutive bantams were confined to a few well-marked varieties, all the large breeds of poultry have now been dwarfed into bantam size by the skill of breeders. To enter farther into this branch of the subject is beyond the scope of the present article, but it may be interesting to state that at a public auction in 1901 one prize fowl was sold for £150.

Game Fowls.—Game fowls differ less from the wild Bankiva than any other variety; they are, however, considerably larger, and carry the tail more erect than the wild birds. Game fowls in England were long cultivated not only as useful poultry, but on account of their combative tendencies for the cock-pit. The comb in the game is single, the beak massive, the spurs strong and very sharp. There is a tendency towards the assumption of the female plumage by the males, and distinct breeds of "henny" game are known. Game are highly esteemed for the table on account of their plumpness, the amount of the breast-meat, owing to the size of the pectoral muscles, being very great, from which cause, combined with their hardihood, they are most valuable for crossing with other breeds, as the Dorking. English-bred game have been reared of many varieties of colour, retaining in all cases their distinctive peculiarities of form. Game fowls have been reduced in size by selective breeding, and exceedingly minute game bantams have been produced with the distinguishing characters of the larger breed. But the long-legged and long-necked "stilty" game fowls, which resulted at one time from breeding for exhibition purposes, have been again superseded in favour of the old and genuine type.

Cochins.—This type, which must be regarded as including not only the birds generally so-called but also the Brahmas and Langshans, is of very large size, some of the males reaching the great weight of 16 or 17 lb. They are distinguished by a profusion of downy plumage, with small wings and tails; they are incapable of long flight, and the pectoral muscles are consequently but feebly developed. The Cochins originally imported from Shanghai were of several colours; some of the grey birds in America were crossed with the grey Chittagong, the Brahmas being the result of the cross, and they became established as a pure breed, faithfully reproducing their own type. The Langshans, a later importation, have fuller breasts and less abundant plumage. The exaggeration of fluff and leg-feather has removed all Cochins—it is to be feared permanently—from amongst popular and useful breeds, and in only less degree the Brahma, once the most popular breed of the day. On the other hand, new sub-breeds, based upon a cross from one or the other of the Asiatic races, have been multiplied and largely bred, these being all of smooth-legged type and somewhat less in size. A sub-variety of Cochin, raised in America, by crossing with a cuckoo-coloured breed long known as Dominiques, became fashionable under the name of Plymouth Rocks. They are cuckoo-coloured, viz. each feather is marked with transverse grey stripes on a lighter ground, and, as in all cuckoo-coloured breeds, the cocks are of the same colour as the hens; their legs are not feathered, and the plumage is not so loose as that of the more typical Cochins. To the original cuckoo-coloured Plymouth Rock have been added buff and white varieties; and by crossing Cochins and Brahmas with other fowls, American breeders produced another useful race of compact form with smooth yellow legs, and white feathers laced with black round the edges, called the silver-laced Wyandotte, to which were speedily added other colours and patterns of plumage. The feathered Langshan has given rise to the black Orpington with smooth legs; and a local cross of Cochin and Dorking prevalent in Lincolnshire, to a buff breed with smooth white legs, now called the buff Orpington, though quite unrelated to the former. All these are useful for table, and good layers.

Malayan Fowls.—The Malayan type has been long recognized as of Eastern origin. The birds are of large size, close and scant in plumage, with very long legs and necks. The *Gallus giganteus* of Temminck, which he regarded erroneously as a distinct species, belonged to this group, as did the Kulm fowl and the grey Chittagong of the United States. The Malays are of savage disposition. Several smaller breeds of a somewhat similar type are known as Indian Game; some of these, as the Aseels, are of indomitable courage. Until the arrival of the so-called Cochin breeds from the north of China, Malays were the largest fowls known in Europe and were employed to impart size to other varieties by crossing.

Spanish.—The Spanish or Mediterranean type is well marked. The birds are of moderate size, with large single erect combs and white ear-lobes. In the black Spanish the whiteness of the ear-lobe extends over the face, and its size has been so greatly developed by cultivation that in some specimens it is 6 or 7 in. in length and several in breadth. Closely related to the Spanish, differing only in colour of plumage and extent of white face and ear-lobe, are the white and brown Leghorns, the slaty-blue Andalusians, the black Minorcas, &c. All are non-incubators, the desire to sit having been lost in the tendency to the increased production of eggs, which has been developed by the persistent and long-continued selection of the most fertile layers. The white-faced black Spanish, once the most widely kept, has almost disappeared; but the allied red-faced Minorca and the blue Andalusian have achieved great popularity as free layers of large white eggs; and the yellow-legged Leghorns of similar type, though rather smaller, have spread on all sides with much multiplication of varieties, the latest of which, with mottled black and white plumage, is termed the Ancona.

Hamburghs.—The Hamburghs, erroneously so called from a name given them in the classification adopted at the early Birmingham shows, are chiefly breeds of English origin. They have double combs and small white ear-lobes. There are various sub-varieties. Those with a dark crescent-like mark on the end of each feather of the hen are termed Spangled Hamburghs. Others are of uniform black plumage. A somewhat similar breed of smaller size, with each feather of the hens marked with transverse bands of black on a white or bay ground, is termed Pencilled Hamburghs; they were formerly known as Dutch Everyday-layers. These breeds are all non-sitters and lay a remarkably large number of eggs. Hamburghs in England have been depressed in recent years by the complicated system of breeding separate strains for each sex; but there has been introduced from Europe the hardy Campine or Braekel, resembling the pencilled Hamburgh in plumage, but larger and with a single comb, and laying a large egg in great numbers.

Crested Fowls.—The crested breeds (non-incubating) have long been cultivated on the continent of Europe and are admirably delineated in the pictures by Hondekoeter and other early Dutch artists. In Great Britain they are erroneously termed Polish. The development of the feathered crest is accompanied by a great diminution in the size of the comb, which is sometimes entirely wanting. The wattles also are absent in some breeds, their place being occupied by a large tuft of feathers, forming what is termed the "beard." In all the crested breeds there is a remarkable alteration of the cranium, the anterior part of the skull forming a prominent hollow tuberosity which contains a very large part of the brain. This portion of the brain-case is rarely entirely ossified. There are numerous sub-varieties of crested fowls. The best-known breeds in England are the spangled, with a dark mark at the end of each feather. This mark often assumes a crescent shape, the horns of the crescent sometimes running up each margin of the feather so as to form a black border; feathers so marked are termed "laced" by poultry-fanciers. There are also white Polish and a buff variety. A very distinct sub-variety is the black breed with a white crest on the head and large pendent wattles. A variety with the arrangement of these colours reversed was formerly known, but it has now become extinct. Some of the larger breeds of the west of Europe are closely related to the Polish. The Crève-cœur is a crested breed of uniform black colour; it is of large size and of great value for the table and for egg-production.

The Houdan is a black and white breed of very similar character. In some breeds the form of the body and structure of bones of the face closely resemble those of the Polish, but there is an absence of the feathered crest, the crescent-shaped comb becoming more largely developed; such are those known as Guelders, Bredas, and La Flèche, the latter being the best French fowl for eating. A small white-crested variety, profusely feathered on the legs, was received about 1864 from Turkey; they are known as Sultans. The older French breeds are less kept than formerly, but a race originated in France by crossing Houdans with Dorkings and light Brahmas, and known as the Faverolles, is a tender and quick-growing table fowl, and even in the Houdan district itself is displacing the Houdan, one of its ancestors. The Faverolles have single upright combs, beards and whiskers, slightly feathered legs, and five toes on each foot; and the general colour of the hen is salmon or fawn, with an almost white breast.

Dorkings.—The Dorking type includes fowls that have for many generations been bred for the supply of the London markets. They are all fleshy on the breast and of fine quality. The Dorkings have an extra toe, a monstrosity which leads to disease of the feet. The Surrey and Sussex fowls are four-toed. The coloured Dorkings were greatly increased in size by crossing with an Indian breed of the Malay type. The birds of the Dorking type are fair layers and good sitters. They are rather delicate in constitution, and are chiefly bred in the south of England. Crossed with the game breed they furnish a hardy fowl, plumper than the Dorking and larger than the

Game, which is of unsurpassed excellence for the table. Mating a Dorking cock with large game hens is found to be the most advantageous.

Silk Fowls.—These constitute a singular variety, in which the barbs of the feathers are not connected by barbules and the entire plumage has a loose fibrous appearance; similar variations are found amongst other species of birds, but are soon lost in a wild state. The silk fowl best known is that in which the plumage is perfectly white, whilst the skin, cellular tissue between the muscles, and the periosteum covering the bones are a deep blue-black, the comb and wattles being a dark leaden blue. The birds are admirable sitters and mothers, and are much valued for rearing pheasants, being of somewhat small size. Though of remarkable appearance when cooked, they are of good quality. In crosses with other breeds the silky character of the plumage is generally lost, but the dark skin and intermuscular cellular tissue remain and greatly lessen the value of the birds in the market.

Frizzled Fowls are birds in which each feather curls outwards away from the body. They are common in India, but are not adapted to the climate of Britain, as the plumage offers an imperfect protection against wet.

Rumpless Fowls are those in which the coccygeal vertebrae are absent; there is consequently no tail. By crossing, rumpless breeds of any variety may be produced. They are not desirable to cultivate, as, from the structural peculiarities, the eggs are very apt to escape being fertilized.

Dumpies or *Creepers* are birds in which the bones of the legs are so short that their progression is considerably interfered with. The best known are the Scotch dumpies.

Long-tailed Fowls, under the various names of Yokohama or Phoenix fowls, or Shinotawaro fowls, are singular varieties recently introduced from Japan, in which the sickle-feathers of the tail are 6 or 7 ft. long. In Japan they are said to assume a much greater length. One bird in the museum at Tokio is stated to have sickle-feathers 17 ft. long. In other respects the fowls are not peculiar, resembling the birds of the Game type.

Bantam.—This term is applied to fowls of a diminutive size without any reference to the particular breed. By careful selection and crossing with small specimens any variety can be reduced to the desired size. The Chinese had in the Summer Palace at Peking small Cochins weighing not more than 1 ℔ each. The Japanese have long possessed a dwarf breed with enormous tail and comb, and with very short legs. One of the most artificial breeds is the Sebright bantam, named after its originator. This bird has the laced or marginal feather of the Polish combined with the absence of male plumage in the cocks, so that it may be described as a hen-feathered breed with laced plumage. When perfect in marking it is of singular beauty, but is not remarkable for fertility.

Most of the modern changes in breeds, broadly speaking, have been in the direction of replacing poultry with chiefly fancy points by really *useful* fowls, yet it is noteworthy that they have been carried out by fanciers, or breeders for exhibition, proving that there has not been that practical antagonism between the aims of these breeders and the production of food which some have alleged. But there has further been, since 1890 especially, a remarkable development of what has been termed "utility" poultry-breeding.

Feeding and Egg-production.—These aspects of poultry-culture are closely connected, and in both such advances have been made as almost amount to a revolution. The breeders of the United States have led the way, and, though it had first been taught in England, were the first to practise generally the systematic breeding, year after year, from the best layers only. It had always been known that some hens would lay from 150 to 200 eggs in a year whilst many did not exceed 100, and some laid much less. This was tested (on a better stock than the average) at the Maine experimental station in 1898–1899, 260 pullets being selected, of which 5 died and 19 were stolen. Of the remainder, 39 laid 160 eggs each or more, and 22 less than 100, the rest coming between these figures; the five best laid 200, 201, 204, 206 and 208 eggs in twelve months, and the three worst only 36, 37 and 38 in the same time. From such figures the money value of selective breeding is apparent. As a proof of what may be done by systematic breeding, one American breeder obtained an average of 196 eggs per annum from as many as 600 white Leghorns, and another 194 eggs from 140 Plymouth Rocks; greater numbers have been obtained from single birds or small pens of fowls, but these are results from considerable flocks.

It has been proved, however, that such averages as these cannot be obtained unless they are fed for as well as bred for. The most successful egg-farmers now feed their poultry on definite "rations," compounded so as to give what is termed a proper "nutritive ratio," or proportion of albuminoids to carbonaceous material. The basis of such feeding is analysis of foodstuffs, in some form which shows simply their percentages of albuminoids, fats or hydrocarbons, carbohydrates (starch, sugar, &c.), salts, crude husk or fibre, and water. Fats, being relatively much richer in carbon than the starch compounds, are generally multiplied by 2·25, and this product added instead to the carbohydrates; then the ratio of albuminoids or nitrogenous matter to this total of carbonaceous compounds is the "nutritive ratio." The following is a useful table of analyses made out in this way, taken from *The Book of Poultry*:—

Analyses of Poultry Foods.

Articles of Food.	Albuminoids or Flesh-formers.	Fats or Oils.	Fats × 2¼ = Value in Carbohydrates.	Carbohydrates.	Salts and Minerals.	Husk or Fibre.	Water.
Grains and Meals.							
Linseed meal	32·9	7·9	= 17·8	35·4	5·7	8·9	9·2
Beans and peas	24·0	1·5	= 3·4	48·0	2·5	10·0	14·0
Malt sprouts	23·2	1·7	= 3·8	48·5	5·7	10·7	10·2
Oatmeal	18·0	6·0	= 13·5	63·5	2·0	1·5	9·0
Middlings or Fine Sharps	16·0	4·0	= 9·0	57·0	4·5	4·5	14·0
Sunflower seed	16·0	21·5	= 48·4	21·4	2·6	29·0	9·5
Bran	15·5	4·0	= 9·0	44·0	6·0	16·5	14·0
Oats and ground oats	15·0	5·5	= 12·4	48·0	2·5	19·0	10·0
Wheat	12·0	1·8	= 4·0	70·1	1·8	2·3	12·0
Barley (and meal)	12·0	1·4	= 3·2	56·0	3·6	14·0	13·0
Millet seed	11·3	4·0	= 9·0	60·0	3·0	9·4	12·3
Maize	10·5	8·0	= 18·0	66·5	1·5	2·5	11·0
Rye	10·5	1·8	= 4·0	72·5	1·9	1·7	11·6
Buckwheat	10·0	2·2	= 5·0	62·2	2·0	11·0	12·6
Hempseed	10·0	21·0	= 47·2	45·0	2·0	14·0	8·0
Dari	9·5	4·5	= 10·1	68·7	1·5	3·3	12·5
White bread	8·8	1·8	= 4·0	56·4	0·5	0·0	32·5
Rice	6·6	0·4	= 0·9	80·0	0·0	0·0	13·0
Brewers' grains	5·4	1·6	= 3·6	12·5	1·0	3·8	75·7
Vegetables.							
Potatoes	6·5	0·0	= 0·0	41·0	2·0	0·0	50·5
Red clover	5·0	0·8	= 1·8	13·3	2·4	6·5	72·0
Meadow grass	3·5	1·0	= 2·2	13·5	2·0	4·7	75·3
Hay	8·4	2·6	= 5·8	41·0	6·2	27·2	14·6
Cabbage	2·4	0·4	= 0·9	3·8	1·4	1·5	90·5
Onions	1·5	0·2	= 0·5	4·8	0·5	2·0	91·0
Turnips	0·5	0·1	= 0·2	4·0	1·0	1·4	93·0
Animal Foods.							
Dry meat meal	71·2	13·7	= 30·8	0·3	4·1	0·0	10·7
Flesh of fowls	21·0	3·8	= 8·5	0·0	1·2	0·0	74·0
Horse-flesh	21·7	2·6	= 5·8	0·0	1·4	0·0	74·3
Lean of beef	20·5	3·5	= 7·9	0·0	1·6	0·0	74·4
Fresh-cut bone	20·2	26·1	= 58·7	0·0	24·0	0·0	29·7
Dried fish	48·4	11·6	= 26·1	0·0	29·2	0·0	10·8
Milk	4·0	3·5	= 7·9	4·8	0·7	0·0	87·0
Skim milk (separated)	3·1	0·3	= 0·7	5·3	0·7	0·0	90·6
Eggs (yolk only)	16·0	30·0	= 67·5	0·0	1·0	0·0	53·0
,, (white only)	12·0	2·0	= 4·5	0·0	1·2	0·0	84·8

Many writers have introduced unnecessary complication into a very simple matter. Some elaborately compute the amount of "dry matter," which is needless if our analyses show the proportion of water, as above. Others have calculated "digestibility," on the theory that food not rejected as excrement is "retained in the body." This theory has a basis in the case of animals which consume a large amount of hard indigestible fibre, excreted in such a form as horse manure; but fowls macerate all they eat in the crop, and grind it in the gizzard, and in their case the excreta represent very little undigested food, but mainly the final result of the vital processes, and of food usefully employed in carrying these on. We may be sure that we more than allow for any factor of indigestibility if we merely leave out any crude husk or fibre, giving that to the fowl for whatever it is worth, and calculate our ratio direct from the figures of the table.

Two extremely simple cases will suffice as examples of the modern method. Potatoes are often cheap, but on account of their starchy composition require a "balance," and the same may be said of maize: one method of balancing each will show what is meant and the simplicity of the calculation. We will take potatoes and bran first.

Ratio of Potatoes and Bran.

	Albuminoids.	Fat×2¼.	Carbohydrates.	Salts.
1 ℔ Potatoes . . .	6·5	0·0	41·0	2·0
1 ℔ Bran	15·5	9·0	44·0	6·0
	22·0	9·0	85·0 +9·0	8·0
			94·0	

Adding here the fats × 2¼ to the carbohydrates, we get the ratio of the mixture as 22 : 94, or about 1 : 4¼, which is very good. Coming next to the maize, let us suppose that it is desired to feed this as grain in the evening, and to "balance" it by an equal weight of "mash" or soft mixture in the morning. One way would be as follows:—

A Diei containing Maize.

	Albuminoids.	Fat×2¼.	Carbohydrates.	Salts.
3 ℔ Maize (× 3) . .	31·5	54·0	199·5	4·5
1 ℔ Horse-flesh . . .	21·7	5·8	0·0	1·0
2 ℔ Ground oats (×2).	30·0	24·8	96·0	5·0
	83·2	84·6	295·5 +84·6	10·5
			380·1	

This ration explains how in such a case we must multiply the figures for maize by 3, and those for oats by 2, being the proportions we are taking to one portion of horse-flesh. The ratio of this dietary comes out slightly lower than 1 : 4½.

The proper ratio for feeding fowls has received much discussion. Dietetic authorities mostly agree that about 1 : 5 is the best for maintenance of animal life generally, and more specifically that there should be of albuminoids about 18 parts in 100, of fats 7 and carbohydrates 75. That should suffice for growing chickens; but it is fairly obvious that fowls fattening may require more fat, while the constant production of eggs, whose high ratio is shown in the analyses, must require a larger amount of albuminoids. This fact is indicated by the hen herself, which when laying devours large earthworms, usually rejected with disgust at other times. She shows by this appetite how specially she needs albumen; and fowls on a wide range, though only fed with corn, may thus in summer "balance" a dietary for themselves by the worms and insects which they procure. When they cannot do this, more albumen must be supplied, and the general opinion of practical egg-farmers has tended towards a ratio of 1 : 4 or 1 : 4½ for hens in full lay. One successful American breeder feeds as high as 1 : 3, and states that his results have been best at that figure.

Passing from theory, the greatest practical advance in poultry-feeding has probably been the discovery of the benefit to be derived from dividing the extra supply of albumen between fresh bones cut up small in a mill (known amongst breeders as "cut bone") and such green food as clover or cabbage. The bones contain a good proportion of fat, and of mineral salts also, which careful experiments have shown to be of great importance both in egg-production and for growing stock. Green food had until recently been looked upon chiefly as a corrective, or necessity for health, though it was known that fowls on a pasture grazed largely. But the nutritive ratio of clover is as high as 1:3, and American poultry-farmers now use it largely as really albuminous food, to promote laying. Its use in this way also allows more animal food to be used without ill effect; and to this free use of clover and cut bone in conjunction the improved results upon American egg-farms are largely due. The following is the "mash" ration on a successful American egg-farm, and represents a high forcing diet: middlings or sharps 100 ℔, maize-meal 75 ℔, gluten-meal (a highly nitrogenous by-product of American flour-milling) 25 ℔, clover-meal 80 ℔, meat-meal 35 ℔, all weighed dry, mixed with boiling water in the evening, and kept covered all night.

The majority of poultry-farmers give their stock each day one feed of grain, and one of soft meal-food or "mash," but by no means agree as to the times for these meals. In England, morning mash and evening grain are almost universal, the latter giving more support during the long fast at night, and the former more rapid recuperation on cold mornings. But in America and Canada, where the climate compels confinement of the fowls for months together in enclosed sheds, health and eggs can only be secured by constant "scratching," to promote which the grain is scattered amongst loose litter spread several inches deep. Many, therefore, prefer to scatter the grain in the morning and feed the mash at night, alleging that a good breakfast of mash makes the fowls lazy, with bad results. Others state that this is avoided by a rather scantier morning feed of mash, with a slight sprinkle of grain in the litter afterwards. In 1890 a careful experiment was made by the Massachusetts Agricultural College, two similar lots of pullets being fed upon similar food, on the two plans, for two periods of several months each, in summer and winter seasons, and each lot receiving, besides the morning and evening feeds, a slight sprinkle of millet in the litter, to promote exercise. In egg-production there was scarcely any difference, what little there was being in favour of the morning mash; and the birds thus fed became also somewhat the heaviest. The most remarkable result was that the weight of manure voided in the night was nearly double in the case of the evening-mash birds, showing the rapid digestion of mash food.

Artificial Incubation and Rearing.—In the separate article on INCUBATOR, details are given concerning the appliances used in artificial hatching and rearing, and the subject may be only briefly treated here.

Even in England the eggs hatched in incubators now probably equal, or nearly equal, those hatched under hens: in America the wide practice of artificial incubation is difficult to realize. Of small-sized machines one Illinois maker sold 14,800 in 1899; and in regard to large sizes, in 1900 at least seven names and addresses were known of operators who each used from 55 to as many as 85 machines, every machine holding 300 or more eggs: somewhat smaller plants were of course far more numerous. Experience on such a vast scale has led to a practical advance of considerable importance. While in England it is still usual to effect empirical adjustment of ventilation and moisture, the better American incubators now dispense with direct moisture altogether. It was remembered that the hen hatches without moisture, and equally so the egg-ovens of Egypt; the absence of direct air-current, and consequently of any rapid evaporation, being the obvious explanation. The manufacturers therefore set themselves to slow the movement of the air; and when this object was effectually accomplished, it was found that there was no need for moisture, and that the chicks also hatched out stronger and in higher proportion. The general opinion in the United States, where many farmers tested both hens and machines on a large scale, whilst still undecided between them, is that the proceeds of artificial incubation are superior by about 10%, and this is based upon hatches of thousands annually.

Artificial hatching necessitates artificial brooding, and in this also great changes have taken place, any real success in rearing having been for some years far behind that in hatching. The method universally attempted at first might be called the "coverlet" system, nestling material such as strips of flannel or wool, warmed from above, being provided for the chicks to nestle under, as they do under the feathers of the hen. Many were reared in this way, but failures were also terribly general, and these were ultimately traced to confinement and pollution and heating and rebreathing of the air, caused by the nestling material. That system is now abandoned, warmed but open chambers being provided, which the chicks use at pleasure, but which have no coverlet to rest upon their bodies. In some, heated pipes traverse the upper part of the chamber, some inches above the chicks; in others a warm iron plate radiates heat in the same way; in others warmed air is brought in by flues or openings; in some small ones the lamp itself burns in the chamber of the brooder: but the principle is common to all of a warmed shelter, open above, and generally with an outer chamber also, sheltered but not heated, which breaks the transition to the open air outside. In America a very large proportion of the chickens reared are brought up till hardy in the large "brooder-houses" mentioned below.

Poultry-farming.—Poultry-farming in a practical sense is now carried on somewhat extensively in various ways, understanding that term to include any case where poultry-culture is carried on for substantial profit, or as an important interest of the holding, beyond the mere breeding of prize birds for exhibition. The difficulty never had been, as some have stated, in ground getting tainted or rent costing too much. It is now well understood that in the English climate 100 birds per acre must not be exceeded, though it is far better to confine them to one-half or one-third of the space, while some crop is got off the remainder when they go yearly to absolutely fresh ground. The mere rent of an acre is not much for 100 fowls, but the real difficulty was and is that a fowl is such a *small* unit, entailing constant liability to small losses and wastes, and necessity for labour and oversight out of proportion. Hence at a time when 100 eggs per annum was thought a fair return for each bird, and there was but a poor and uncertain market for them, this difficulty was insuperable. A very different average production would now be worked for; while, on the other hand, the greater crowding into cities, and growing appreciation of eggs as an article of diet, have caused a market for "new-laid" eggs at good prices which previously did not exist. It is these changes which have altered the conditions.

The chief development in England at the beginning of the 20th century was a very large increase in the poultry kept upon farms. Formerly very few were kept, looked after casually by the mistress or a boy, and only expected to provide for the household and occasionally a few shillings in cash, while any food expressly fed to them was grudged. It has now been taught all over the country, by lecturers under the county council technical instruction committees, that poultry pay best of any branch upon a farm. It has become generally known that, provided they can be run over the farm by using detached houses, and not huddled together, a dozen hens per acre can be kept upon a holding without interfering with any other stock; indeed, the curious fact is observed that horses and cattle prefer to graze over grass that might be thought soiled by the fowls. Where the statement was once derided, it is now a commonplace of county council lecturers, that the additional manure thus made is really worth to the farm from sixpence per bird per annum for small breeds to as much as one shilling for very large ones. Out of a large number of similar instances collected in 1900, one specimen may be given. In Worcestershire 210 fowls had the run of 100 acres, lots of 20 to 30 being kept in detached houses. From 20,000 to 25,000 eggs per annum were marketed, and 150 to 200 chickens, the food averaging about £40, and the cash return £90 to £100. The almost universal opinion is that the manure pays for the labour, and that the annual profit averages from 4s. to 5s. 6d. per head.

Poultry-farming on a larger scale than this is also carried on in connexion with the Sussex fattening industry, presently described. That was until recently a separate business, chickens being bought from neighbouring small rearers, or imported from Ireland, to go directly into fattening cages; and it has often been stated that rearing and fattening together were incompatible. This was so far true that the manure made by numbers of fattening poultry was very considerable, and had to be used upon a small holding kept in order to use it; such a holding, therefore, received as much as it could possibly bear, and was thereby "sickened" for live poultry running at large. But with an extra holding or larger holding this is not the case, and increasing competition and the desire for the two profits have led to a large amount of rearing and fattening combined. In 1894 one of the officers of the agricultural commission found 8000 chickens being reared and fattened annually on one farm of 200 acres, and this proved only a pioneer: in 1900 he found (amongst many such instances) 4000 reared upon 80 acres, 1500 upon 22 acres and 5000 upon an extra holding (taken for the purpose) of 40 acres. In most cases the main cereal crop was oats, to be fed to the fowls; and some cows were kept, the skim milk from which was used in the same way; but the poultry was the controlling interest of the whole.

On any such scale as this the manure becomes of great importance. About 1880 Dr Augustus Voelcker, chemist to the Royal Agricultural Society, made the following analysis of two samples, one moist or fresh dropped, the other freed from much moisture by storing under cover for four weeks:—

	Fresh Manure.	Partially Dried Manure.
Moisture	61·63	41·06
Organic matter and ammonia salts	20·19	38·19
Tribasic phosphate of lime	2·97	5·13
Magnesia, alkaline salts, &c.	2·63	3·13
Insoluble silicious matter (sand)	12·58	12·49
	100·00	100·00
Containing nitrogen	1·71	3·78
Equal to ammonia	2·09	4·59

Valued in the usual way, Dr Voelcker found that the moist manure was worth £2 per ton, and the drier stored manure £4 4s. per ton; but though the figures were indisputable, for many years such manure was practically unsaleable. Gradually in Sussex it became saleable at 6d. per bushel, and in 1900 some of the smaller fatters were selling it at prices varying from 4s. to 15s. per load; the larger men either used it themselves or obtained higher prices.

Really large poultry-farms are few in England, and to give quite recent facts would be to run the risk that they might prove ephemeral. It has been supposed that the common experience is failure after two years' trial, but this is unduly pessimistic. Even in 1901 two farms in Berkshire were selling eggs from over 2000 and 3000 laying hens; and there was one farm in the west of England, occupying 300 acres with the poultry (besides a shorthorn herd and other branches), which had a stock of 5000 pullets for laying, and had been in existence four years, a large capital amounting to thousands of pounds having been sunk in it. The owner explained that two years was the critical period, simply because for about that time there were practically no returns, and that in his case he had only "turned the corner" after three years. Though a practical man already, he had begun in a small way with one incubator and training one man; gradually extending, building up his own market, organizing his own selling agency, and building a mill to grind his own grain. Only such gradual extension by practical men can ever lead to success.

Besides the breeding of prize poultry, the changes mentioned in the early portion of this article have led to another class of breeding directed to the supply of pure races from good stock, but bred mainly for purposes of utility. The demand for such stock, at fair prices, though far below those for prize stock, is a good index of the development of the poultry industry. The establishments which supply it furnish eggs for hatching, or stock birds, or newly hatched chickens, which are now hatched in incubators and sold by thousands when only one day old, at which age they travel without needing food. Some of such establishments are quite large. One in Yorkshire occupies 43 acres solely devoted to this business.

Poultry-farming has reached its fullest development in the United States, owing no doubt to the apparently inexhaustible market; butcher's meat being far less eaten than in England, and poultry and eggs to a large extent replacing it as national food. More especially is there an enormous demand for small chickens, known as "broilers," weighing from 1½ ℔ to 2 ℔ only, destined to be split in half and broiled on a gridiron. These birds being unfattened, and ready at ten or twelve weeks, give a quick turnover with less expense and risk than older fatted birds; and this peculiar demand has largely dominated American poultry-farming, a great deal of which runs in the direction of great "broiler-plants" solely devoted to the hatching and rearing of these broilers, while large "brooder-houses," similar to those used in that business, are prevalent on more miscellaneous farms. The broiler business started at Hammonton in New Jersey about 1880–1885, when plant after plant was rapidly erected, some of which have since shut down; but many others have taken their place, and some of the originals are still running. The chicks are all hatched in incubators (many plants running from 20 to 40 machines), and then transferred to long "brooder-houses," built with a corridor all along one side, the rest being divided into successive pens for the chickens. These latter are moved along every few days to the next of the pens, which are arranged so as to give rather more space as the birds grow larger. Each pen has next the corridor a "hover" or brooding-shelter. These have no nestling material, but only a roof or cover somewhat to retain the heat, closed by a curtain cut into strips in front; and are warmed by hot-water pipes running along the building. Generally these pipes run some inches above the chicks reposing on the floor, and are set rather on a slant, so as to be higher for the bigger chicks in the larger pens; but in some cases they run under the floor, and warm the air which enters under the hovers. Every hover, with its inmates, can be reached from the corridor at the back of all. In many cases the chickens are confined in these small pens until large enough, the floors being littered and regularly cleaned; but some raisers have also small outside yards which they use in fine weather. The mortality in nearly all plants is great, as might be supposed. There are said to be some at Hammonton which only market 30% of the eggs incubated, yet pay a modest profit at that, which is allowed for. On the one hand, a broiler realizes about four times the cost of its own hatching and food; on the other hand, the labour is very heavy and the loss considerable: these factors obviously give a very wide margin of possibilities as regards success or failure.

The most remarkable establishment of this kind, embodying some novel features, was erected in Ohio at the end of 1896 by J. Loughlin. The plant cost over $60,000, and was designed to market 250 to 300 broilers per day regularly, weighing 1½ lb each, which were sold alive to one large dealer at $3 per dozen. Each day an average of 450 eggs were started, the chicks from which went into one pen. For the chicks, while small, there were 30 small pens, each with 5 by 10 ft. of floor space, or at the rate of six chickens per sq. foot; and there were 60 larger pens each 8 by 12 ft. with outer runs to each of 8 by 20 ft. Every day the chickens were marketed from the ninetieth pen, and all the rest moved one pen forward, leaving the first small pen vacant for the day's hatch: thus fully 22,000 birds were in the plant at one time.

In more general American poultry-farms the same system of "brooder-houses" largely prevails, and from many great numbers of broilers are sent to market; but as both heart and liver are perceptibly affected by such rearing, birds intended for stock are either taken out of doors early, or reared in detached brooders, as in England. Some establishments are mainly egg-farms, high averages being obtained by the system before described. Many breeders have a high reputation for their stock as layers, and derive large profit from selling stock or eggs to other farms. There are many immense duck-farms or "ranches," as mentioned below, which sell nothing except stock ducks or market ducklings. A great many combine the breeding and sale of exhibition poultry with some or all of these objects, fancy points being on the whole less distinct from useful qualities than in England, and the farmer and exhibitor far more commonly combined.

As a rule, American poultry-farmers employ long ranges of buildings divided into pens or houses, with enclosed yards in front; and the most remarkable fact is that interest can be paid upon the capital sunk in such buildings. The explanation in some cases is that much is put up by personal labour, while the cheapness of land and feed are also favourable. But the climatic conditions also differ. During the winter months the birds have to be confined in what are called "scratching-sheds," and American farmers have successfully reduced to a system the keeping of them healthy and in profit by scratching amongst litter in a small space. During this period the outer runs sweeten and recuperate; smaller runs therefore suffice, and the stock is kept closer and more compact. Another system is pursued, more especially about Rhode Island, called the "colony" plan; detached rough houses, holding forty or fifty hens each, being scattered over the farm: there may be a hundred houses, but there is no fencing. This is very economical in buildings, but expensive in the labour of feeding and collecting eggs, and the system is only possible near the sea or where there is little snow. In several cases it has been abandoned for the system of housing and scratching-sheds.

There are a few very large establishments indeed in the United States, combining almost every branch. At the Meadow Brook Farm in Pennsylvania, occupying 80 acres, the buildings total 112,000 sq. ft. under cover, and the farm has sent to market in one year 25,000 chickens and 20,000 ducklings, besides selling many stock birds, and an enormous number of eggs for hatching at an average price of $40 per 1000. Businesses like this are very exceptional; but farms on a more moderate scale are numerous, and intelligent American farmers reckon to make a profit of a dollar per annum for each head of their laying or breeding stock.

Table Poultry.—National taste governs the market for table poultry to a large extent. In England white meat, skin and legs are preferred, and at one time black legs or yellow skin were heavily discounted. More knowledge has largely removed that prejudice, but white has a market value still. In France exceedingly white and smooth skin is preferred, but buyers are indifferent to black legs. In America yellow skin and legs are actually preferred, such fowls being thought more juicy; but there has been some tendency towards white meat of late. Belgian feeders think the best result follows from crossing a yellow-skinned race upon a white-fleshed one. It is some confirmation of this idea that one of the best English table fowls is the produce of a cross between Dorkings and the yellow-skinned Indian game, while other similar instances might be cited. For some years past the quality of British table poultry has been shown by displays of plucked birds in connexion with the Christmas Smithfield Cattle Show. For many years France had a reputation for greatly surpassing British production; and as the best French fowls readily sell for £1 each and more in the Paris market, it would not be surprising if they were superior to such as have to be sold for 15s. per couple. French fatters appear to seek and obtain a smooth whiteness of fat under the skin—almost like that of a bladder of lard—which does not find favour in the British market; but the best judges have considered that the finest English specimens staged were equal to all comers, and some realized high prices. Foreign experts, equally with English, admit that England has now little to learn from any foreign feeders.

The chief supply of the best fowls for the London market has long come from the Sussex district whose centre is Heathfield: these are termed "Surrey" fowls, though Surrey now sends few in comparison. This local industry has been founded in a curious way upon the "ground oats" of the district, the whole grain being ground up, husk and all, nearly as fine as flour. This is done by a peculiar local dressing of the stones, which are "stitched" into little pits by a pointed pick, instead of being dressed into narrow grooves, as for flour-milling; and this meal is found specially suitable for feeding and fattening poultry. In early times cottagers crammed a few fowls with pellets of meal dipped in milk, but this method is now quite superseded by machine cramming, a rubber tube from the machine being introduced into the crop of each fowl, and a stroke of the foot on a pedal squeezing out a ration of thin, almost creamy, paste, composed of the ground oats, fat and sour skim-milk, a food which puts on flesh fast and makes it white and delicate. Great experience is required in this business. When killed and plucked, the fowls are placed in a trough whilst still warm, close side by side, and their backs and breasts pressed closer together by a board loaded with heavy weights. This combination of fattening and subsequent shaping constitutes the Sussex system, which is extending in some other parts of England; many excellent fowls, well fed, but unfattened, are also supplied from Lincolnshire (known as "Bostons") and other districts. The largest provincial towns have similar supplies in less degree.

In America larger fowls are called "roasters," to distinguish them from the broilers above described; and there has grown up in the eastern states a system of rearing these also in confinement. Hatching them begins in September, and the birds are at first reared in brooder-houses; but when large enough are placed about fifty together in small houses, with 6 by 8 ft. of floor, in small yards about 20 ft. square. One very successful raiser puts 200 birds into one pen 10 by 17 ft., in a warmed house, where they remain till killed at 7 lb or 8 lb weight. One firm had raised in this way, for seven years in succession, 2000 birds per annum upon half an acre of ground, but occasionally there is serious mortality in this kind of business, and as a rule only 60% are reared of those hatched, the loss of the rest being averaged and allowed for.

In western Europe there is some demand for chickens fattened quite young, weighing only 8 oz. to 12 oz. each, and known as *petits poussins*, or "milk chickens." In Belgium somewhat older ones, weighing up to 1½ lb, are sold as *poulets de grains*. The demand for such birds in England is small, and confined to the West End of London, the flesh being too excessively tender for average English palates. Birds of similar sizes have lately been finding a market in the United States, as "squab broilers," but are split and broiled, and not fattened, the difference being that a whole bird is served for one portion.

Turkeys.—The varieties of the turkey (*q.v.*) differ chiefly as to colour. The principal English breeds are the bronze or Cambridge, the black or Norfolk, the fawn and the white. Of these the first, especially when crossed with the American, is the largest and most desirable.

Turkey-breeding has been largely dominated by the magnificent American bronze breed, derived from wild blood, and distinguished for size and weight. There is some question whether it does not require more space and fresher ground than the older English strains, and may not be more delicate on small holdings. French birds come largely to the Christmas market in London, but, as compared with English, are small. The chicks, when hatched after twenty-eight days' incubation, should be left undisturbed for twenty-four or thirty hours, during which time they are digesting the yolk that is absorbed into the intestinal canal at birth. No attempt should be made to cram them; their first food should consist of sweet fresh meal, soft custard made with equal parts of egg and milk set by a gentle heat, and, above all, abundance of some bitter milky herb, as dandelion, or, much better, lettuce running to seed, on which they can be reared successfully with very little food of any other description. The young turkeys progress much better if the hen has the range of a small enclosure from the first than if she is confined to a coop; thus reared they are much hardier than when cooped and corn-fed, and not so susceptible to injury from slight showers; but a damp locality should be avoided. Turkey-hens are most persevering sitters, and are employed in France to hatch successions of sittings of hens' eggs. Turkeys can often be most advantageously reared by cottagers, as one or two hens only can be kept, one visit to the male being sufficient to fertilize the entire batch of eggs. The young turkeys find a larger proportion of their own food than fowls, and with a good free range cost but little until they are ready for fattening for the table. In places where the opportunity serves they may be allowed to roost in the trees with great advantage. Some wild flocks treated like pheasants are to be found in several of the large parks in Scotland as well as in England.

Guinea-fowls.—The guinea-fowl (*q.v.*) may be successfully reared in any dry locality provided it has a good range and trees in which to roost. The hen lays an abundance of eggs, which are generally hidden. The birds are useful as furnishing a supply of poultry for the table in the interval that ensues between the time when game are out of season and that before chickens arrive at maturity. On a dry, sandy and chalky soil and in a warm situation they are reared with ease, but are quite unsuited to damp, cold localities. The continued vociferation of the hen-birds renders their maintenance near a house very objectionable, as the cry is continued throughout great part of the night. Several variations of colour exist, but they do not require any detailed description.

Ducks.—All the varieties of the domesticated duck are descended from the common mallard or wild duck, *Anas boschas*, a species which, though timid in its wild state, is easily domesticated, and suffers changes of form and colour in a few generations. The most important breeds are: the Rouen, which, retaining the colour of the original species, grows to a large size; the Aylesbury, a large white breed with an expanded lemon-coloured bill; the Peking, a white breed with a pale yellowish tint in the plumage, and a very bright orange bill; two breeds which are entirely black. The smaller of these, which has been bred down to a very diminutive size, is remarkable for the extreme lustre of its feathers and the fact that its eggs are covered with a dark black pigment, which becomes less in quantity as each successive egg is deposited. It is known by the equally absurd names of East Indian, Labrador or Buenos Aires duck. The larger black variety, the Cayuga duck, has been introduced into England. Decoy or call ducks are small breeds of a very loquacious character, which were originally bred for the purpose of attracting the wild birds to the decoys. Some are of the natural colour, others are white. Amongst the less known breeds are the Duclair ducks of France, evidently the result of crossing white and coloured varieties. Among the breeds differing in structure may be mentioned the Indian Runner duck, formerly called Penguin duck from its erect attitude, the hook-billed and the tufted ducks, &c. During the last fifteen years of the 19th century the first of these became very popular in England as a hardy forager and good layer, many birds laying 150 to 180 eggs in a year. It is small in body but good in flavour, and is a great favourite in many districts.

Formerly the greater number of ducklings came to the London market from the Vale of Aylesbury. This trade still continues, but the adherence of the Aylesbury duckers to old-fashioned methods, and the increasing demand, has led to great competition in other districts, such as Norfolk, Lancashire, Kent, &c. Some of the new duck-farmers market 10,000 to 15,000 annually, mostly hatched in incubators, and never allowed in the water or out of the small rearing-pens. In America, however, this kind of rearing has found its fullest development, the number who raise 10,000 ducklings or more being considerable, and a few sending to market, as above indicated, very large numbers indeed, requiring 40 to 80 incubators to keep up the supply. It is remarkable that while in England the Aylesbury is generally preferred, in America the Peking duck is universally used, and has been made by selection both larger and a better layer. Some duck-farmers in England have, however, also adopted the Peking. By good feeding the ducks are caused to lay in the winter months, when the eggs are hatched under hens, the young ducklings being reared in artificially warmed buildings or in the labourers' cottages; they are fed most liberally on soft food, soaked grits, boiled rice with tallow-melters' greaves, and in ten or twelve weeks are fit for the market; if killed before moulting their quills, which they do when about twelve weeks old, they are heavier than afterwards and much better eating. When ducklings are required for the early spring markets the old birds must be fed most freely to cause the production of eggs in cold weather, corn being given in vessels of water, and the birds must be shut up at night, or the eggs will be laid in the water, where they sink and become putrid. Duck-rearing is a very profitable industry, very high prices being paid for ducklings in the early months of the year. The so-called Muscovy duck is a Brazilian species, *Cairina moschata*, which is not reared for the market, although the young birds are edible. The drake not unfrequently mates with the common duck, and large but sterile hybrids are the result.

Geese.—The domestic goose (*q.v.*) of Europe is undoubtedly the descendant of the migratory Graylag goose, *Anser cinereus*, from which it differs chiefly by its increased size. Although domesticated since the time of the Romans, it has not been subject to much variation. The most important breeds are the large grey variety known as the Toulouse, the white breed known as the Embden, and the common variety frequently marked with dark feathers on the back, and hence termed "saddlebacks." After the Crimean War a Russian variety was introduced into England in which the feathers are singularly elongated, and even curled and twisted; this breed, termed the Sebastopol, is of small size and more important as a fanciers' breed than from a practical point of view. In some countries a second species is domesticated; it is usually termed the Chinese, knob-fronted or swan goose, *Anser cygnoides*. Though perfectly distinct as a species, having a different number of vertebrae in the neck and a loud clanging voice, it breeds freely with the common goose, and the hybrids produced are perfectly fertile.

Geese in England are declining in relative popularity. In Germany they are consumed to an enormous extent, and the British consul-general at Berlin reports that even the large domestic supplies have to be supplemented by considerable imports from Russia, a special "goose-train" of fifteen to forty cars arriving daily from the Russian frontier at that city. In America there has been increased interest in goose-breeding, and in the Chinese goose especially, which has been largely bred (with some trifling peculiarities) under the name of the African goose, and crossed with the Embden and Toulouse. The produce of this African cross is considered very fertile and profitable to rear.

Geese are much more exclusively vegetable feeders than ducks, and can only be kept to profit where they can obtain a large proportion of their food by grazing. The old birds should not be killed off, as they continue fertile to a great age. Geese are readily fattened on oats thrown into water, and the young, when brought rapidly forward for the markets, afford a very good profit. The Chinese, if well fed, lay at a much earlier date than the common species, and, if their eggs are hatched under large Cochin hens, giving three or four to each bird, the young are ready for the table at a very early period. The nest, as in all cases of ground-nesting birds, should be made on the earth and not in boxes, which become too dry and over-heated. In breeding for the market or for the sake of profit, the very large exhibition birds should be avoided, as many are barren from over-fatness, and none are so prolific as birds of fair average size.

National Interests and Commerce.—The foreign importations of eggs into Great Britain increased rapidly during the later years of the 19th century. Taking only alternate years for brevity's sake, the following table shows the amount, value and average price per 120 between 1870 and 1900:—

Number, Value and Price of Imported Eggs.

Year.	Number of Eggs.	Value.	Average Price.	
		£	s.	d.
1870	430,842,240	1,102,080	6	1½
1872	531,591,720	1,762,000	7	11¼
1874	680,552,280	2,433,134	8	7
1876	753,026,040	2,620,396	8	4
1878	783,714,720	2,511,096	7	8¼
1880	747,408,600	2,235,451	7	2
1882	811,922,400	2,385,263	7	1
1884	993,608,760	2,910,493	7	0
1886	1,035,171,000	2,884,063	6	8
1888	1,126,793,000	3,083,167	6	6
1890	1,234,950,000	3,428,806	6	8
1892	1,336,730,000	3,794,718	6	10
1894	1,425,236,000	3,786,329	6	5
1896	1,589,401,000	4,184,656	6	4
1898	1,730,952,000	4,457,117	6	2
1900	2,025,820,560	5,406,141	6	5½

From such figures the conclusion might be drawn that foreign eggs were "ousting" British to a formidable extent; but such a conclusion is dispelled when we take into consideration questions of price and nationality. Imported eggs are of very different qualities and prices, France averaging for the year 1900, 7s. 7½d. per 120, Denmark 7s. 6¾d., Belgium 6s. 2d., Germany 5s. 9¼d. and Russia 5s. 6d., many of the latter being almost putrid when sold in England, and chiefly used in manufactures, for which, at a low price, they answer perfectly. Many eggs are sent from Russia to Germany, Belgium and even Denmark, so that some of these also come from her, at an original price with which no British producer could compete. A steady decline in imports of the higher priced French eggs, and an enormous increase of low-priced eggs, explain the drop in average price from 8s. 7d. per 120 in 1874 to 6s. 5½d. in 1900; and were this all, the inference would be simply that the selling price of eggs had fallen. But this is not so. While the higher priced *foreign* eggs have thus been largely displaced from the market, there has grown up a very large demand for British "new-laid" eggs, at prices much higher than any of the above. There is a wholesale market for such eggs in London. The lowest price (in May) for 1900 was 7s. 6d. to 8s. 6d., and the highest (in December) 19s. to 20s. per 120. The quantity of reputed "new-laid" British eggs now sold is enormous, and has grown up in the face of foreign imports, the native producer selling in spite of them, and at far better prices, many times more than he did, say, in 1875.

The following were the British imports of dead poultry and game for the last three years of the 19th century:—

Value of British Imports of Poultry and Game.

Year.	France.	Russia.	Belgium.	Other Countries.
	£	£	£	£
1898	217,703	164,498	127,923	127,368
1899	296,555	139,834	165,803	183,102
1900	333,148	199,282	213,603	264,327

The total for 1900 thus amounted to £1,010,360. The imports from France and Belgium are largely for the Christmas market. Those from Russia are chiefly very small fowls wrapped in paper and packed in cases of a hundred each, which come over frozen, to be sold at 1s. 2d. or 1s. 3d. each. Other sources include America, Canada and Australia, which have been sending smaller but increasing quantities of larger birds, packed in smaller numbers, and which realize 2s. 6d. to 3s. 6d. each, a few of the largest as much as 4s. each. Such supplies have somewhat affected the Sussex fattening industry, necessitating the production of a lower class of bird at a lower price and narrower margin; but they look rough and inferior in colour, and chiefly supply restaurant and hotel demand. The foreign birds being cold-storage goods, which must be consumed quickly when taken out, a fresh Sussex fowl of the same weight will always sell for considerably more.

There are no statistics of British poultry; in Ireland they are collected. The year 1851 closed a decade in which the number of holdings under ten acres had decreased enormously, and the number of poultry in Ireland was then returned as 7,470,694. In 1889 this number had doubled to 14,856,517, and in 1899 there were 18,233,520. The Irish Agricultural Organization Society is doing much to improve breeds and management, and the packing of eggs, of which Ireland is a considerable exporter to Great Britain. There is also now a considerable export of lean chickens for fattening to Sussex and other parts of England, and a smaller number have also been fattened in Ireland.

In Australia most of the federated states have a produce export department, which receives eggs and dead poultry into cold storage and ships to London, managing, if desired, the whole business. That of South Australia shipped a good many eggs to England in 1895, but the temperature was found too low for eggs, and this trade has so far not developed. Dead poultry come in a similar way from West Australia and Victoria to London. In New South Wales such arrangements have inaugurated a small export business which seems the most active of any, and more seems known about the poultry industry in this state than in others. The government statistician estimated the number kept in 1900 at 3,180,000 fowls, 320,000 ducks, 234,000 turkeys and 97,000 geese, the annual consumption being about three-fourths of this, and of eggs about 97,000,000.

In Canada the government makes considerable effort to encourage poultry. It has established several stations where systematic fattening of chickens in the English manner is taught, and official experiments are also made on the results of various feeding-rations and other matters. From these stations shipments of fatted chickens were first made to Liverpool and London, commencing an export trade which shows signs of growth.

The poultry industry in the United States is the most gigantic in the world. By the census of 1900, which tabulates returns from 5,096,252 out of the 5,739,657 farms in the States, the number of fowls over three months old on the 1st of June 1900 was returned as 233,598,085, with 6,599,367 turkeys, 5,676,863 geese, and 4,807,358 ducks, or 250,681,673 birds in all, valued at 85,794,996 dollars. This, however, would include very few of the chickens raised that year, which would not have reached the age stated, and mainly represents breeding and laying stock, which thus averages about 49 birds to every holding; it also of necessity omits many of the smaller city-lot raisers. The value of the poultry raised during the whole year 1899 is given as 136,891,877 dollars, and of the eggs produced (1,293,819,186 dozen) at 144,286,186 dollars; a total year's product of over £56,000,000. Adding only a very moderate amount for city-lot and other small producers not making return, the poultry industry in America exceeded in value either the wheat crop, or swine or cotton crop.

The importance of poultry in France has long been recognized, being due mainly to the prevalence of moderately small holdings and the national disposition to small rural industries. The eggs exported are collected from the farmers by such a well-organized system that eggs collected on Wednesday are in the London market the following Tuesday. The home consumption of eggs is also enormous, so that when prices for foreign eggs decreased in England, the Paris market paid better. In 1900 the Paris Municipal Council reported the consumption of eggs in that city alone in the previous year as 212 per head. Eggs are imported from Italy to some extent.

The conditions in Belgium are somewhat similar to those in France. Some eggs are imported from Italy, and much of the home production is from imported Italian hens, kept laying for a year and then killed: eggs are exported chiefly to France, Great Britain and Germany. There is a fattening industry somewhat similar to that in Sussex, lean chickens being bought for fattening in certain markets. The chief export of these is to Germany, but there is some to the London market, especially in December.

In the Netherlands the number of poultry increased considerably during the last decade of the 19th century, excepting turkeys, which diminished. Taking 1900 as a typical year, there were 4,083,312 fowls, 430,022 ducks, 36,307 geese, and 13,130 turkeys; and there were about 70 special establishments for poultry-rearing, which were rather on the increase, chiefly for local requirements. Of eggs there were exported to Belgium 656,898, England 370,418 and Germany 3,212,845 kilos; but the imports were in excess of this by 2,916,269 kilos, and came chiefly from Russia. Dead fowls and ducks also go to the countries above named.

In Denmark there were in 1900 about 9,000,000 fowls, mostly local and Italian. The eggs exported numbered 332,000,000, practically all to England; there were imported 35,600,000, practically all Russian, re-exported to England. The flourishing export trade is due to a good co-operative system.

Germany is a large consumer rather than a producer of poultry products, and chiefly a carrier of her nominal exports. She imports eggs from Italy and Austria-Hungary as well as from Russia.

Austria-Hungary has a large trade in poultry and eggs. In 1900 the dual monarchy imported poultry to the value of £268,240 and eggs to the value of £1,230,655. But the exports of poultry amounted to £977,051, and of eggs to no less than £3,750,078. This country is therefore a very large producer, most of the eggs going to Germany, and some of them through her on to England.

Italy sends live fowls, for laying, to northern Europe, and eggs to Belgium and France.

In Russia the growth of the poultry industry has been very great since 1890. In that year her British trade was small: in 1900 she bulked largest of all countries in eggs sent to England direct, and some nominally from others really came from her. Her exports of eggs (reckoned as £1 = 10 roubles) were valued in 1898 at £3,113,386, and of live poultry (chiefly geese) at £637,000; but this latter sum is now exceeded by geese alone sent to Germany, as above noticed.

Her vast southern provinces are, of course, the origin of this produce, which is collected by dealers from the farmers, the price realized by the latter for eggs being in summer sometimes less than a rouble per hundred. The government has shown considerable interest in this growing industry in several ways, and produce is carried at almost incredibly low rates on the State railways; but the vast distances involved must always confine Russian produce to the supply of the cheaper class of demand in western Europe. (L. Wr.)

POUNCE. (1) To drop upon and seize: properly said of a bird of prey seizing its victim in its claws. The substantive "pounce," from which the verb is formed, was the technical name in falconry for the claws on the three front toes of a hawk's claws, and so *The Book of St Albans* (1486) "Fryst the grete Clees behynde . . . ye shall call hom talons. . . . The Clees within the fote ye shall call of right her Pownces." (2) To decorate metal by driving or punching a design into it from the under or back part of the surface; also to decorate cloth or other fabrics by punching or "pinking" holes, scalloping the edges, &c. Both these words seem to be variants of "punch" (*q.v.*), which comes ultimately from the Latin *pungere*, *punctum*, to prick, pierce. From them must be distinguished (3) "pounce," a preparation of powdered cuttle-fish or sandarach, the resin of the sandarach-tree, formerly used for drying ink on the roughened surface of vellum, parchment or paper where an erasure had been made; later, the word was also given to the black sand used generally as a dusting-powder for drying ink before the invention of blotting-paper. The "pounce-box" or "pouncet-box" was a familiar object on all writing-tables till that time. A similar box with pierced lid for holding perfumes or aromatic vinegar also bore the name. This word is formed from the Lat. *pumex*, pumice-stone, which was employed for securing a smooth surface on vellum, parchment, &c. The term "pounce" is also applied to a finely powdered gum of the juniper or to pipe-clay darkened with charcoal used in transferring designs to fabrics, wall-surfaces, &c., through holes pricked in the original drawing.

POUND.[1] (1) An enclosure in which cattle or other animals are retained until redeemed by the owners, or when taken in distraint until replevised, such retention being in the nature of a pledge or security to compel satisfaction for debt or damage done. Animals may be seized and impounded when (1) distrained for rent; (2) damage *feasant*, *i.e.* doing harm on the land of the person seizing; (3) straying; (4) taken under legal process. A pound belongs to the township or village or manor where it is situated. The pound-keeper is obliged to receive everything offered to his custody and is not answerable if the thing offered be illegally impounded.

By a statute of 1554, no distress of cattle can be driven out of the hundred where taken unless to a pound in the same county, within three miles of the place of seizure. This statute also fixes 4d. as the fee for impounding a distress. Where cattle are impounded the impounder is bound to supply them with sufficient food and water (Cruelty to Animals Acts 1849 and 1854); any person, moreover, is authorized to enter a place where animals are impounded without food and water more than twelve hours and supply them; and the cost of such food is to be paid by the owner of the animal before it is removed. A statute of 1690 gives treble damages and costs against persons guilty of *pound breach*; and by statute of 1843 (Pound Breach) persons releasing or attempting to release cattle impounded or damaging any pound are liable to a fine not exceeding £5, awardable to the person on whose behalf the cattle were distrained, with imprisonment with hard labour in default. In the old law books varieties of pounds—as a common pound, an open pound and a close pound—are enumerated. By the Distress for Rent Act 1737 any person distraining for rent may turn any part of the premises into a pound *pro hac vice* for securing the distress. Pounds are not now much used. (F. Wa.)

Pound (2)—(*a*) a measure of weight; (*b*) an English money of account. (*a*) The English standard unit of weight is the *avoirdupois* pound of 7000 grains. The earliest weight in the English system was the Saxon pound, subsequently known as the Tower pound, from the old mint pound kept in the Tower of London. The Tower pound weighed 5400 grains and this weight of silver was coined into 240 pence or 20 shillings, hence pound in sense (2) (a pound weight of silver). The pound troy, probably introduced from France, was in use as early as 1415 and was adopted as the legal standard for gold and silver in 1527. The act which abolished the Tower pound (18 Hen. VIII.: the "pounde Troye which exceedeth the pounde Tower in weight iii quarters of the oz.") substituted a pound of 5760 grains, at which the pound troy still remains. There was in use together with the pound troy, the merchant's pound, weighing 6750 grains, which was established about 1270 for all commodities except gold, silver and medicines, but it was generally superseded by the pound avoirdupois about 1330. There was also in use for a short time another merchant's pound, introduced from France and Germany; this pound weighed 7200 grains. The pound avoirdupois has remained in use continuously since the 14th century, although it may have varied slightly at different periods—the Elizabethan standard was probably 7002 grains. The standard pound troy, placed together with the standard yard in the custody of the clerk of the House of Commons by a resolution of the House of the 2nd of June 1758, was destroyed at the burning of the houses of parliament in 1834. In 1838 a commission was appointed to consider the restoration of the standards, and in consequence of their report in 1841 the pound avoirdupois of 7000 grains was substituted for the pound troy as the standard. A new standard pound avoirdupois was made under the direction of a committee appointed in 1834 (which reported in 1854), by comparison with authenticated copies of the original standard (see *Phil. Trans.* 1856). This standard pound was legalized by an act of 1855 (18 & 19 Vict. c. 72). The standard avoirdupois pound is made of platinum, in the form of a cylinder nearly 1·35 in. high and 1·15 in. in diameter. It has a groove or channel round it to enable it to be lifted by means of an ivory fork (for illustration see Weights and Measures) and is marked "P.S. 1844. 1 lb." P.S. meaning Parliamentary Standard. It is preserved at the Standards Office, in the custody of the Board of Trade. Copies were also deposited at the Houses of Parliament, the Royal Mint, the Royal Observatory and with the Royal Society.

See the *Reports of the Standards Commission* (6 parts, 1868–1873), especially 3rd report (on the abolition of troy weight) and 5th report (on the business of the Standards Dept. and the condition of the official standards and apparatus; description of the reverification of the various official standards, with diagrams).

(*b*) The English monetary unit is the pound; it was originally a pound *weight* of silver (hence written £ for *libra*, Lat. pound weight), coined into twenty shillings, and is now represented by the gold sovereign (*q.v.*). The pound Scots was at one time of the same value as the English pound, but through gradual debasement of the coinage was reduced at the accession of James I. to about one-twelfth of the value of the English pound, and was divided into twenty shillings, each about the value of an English penny. The Egyptian pound, written £E, is a gold coin of 100 piastres, and was made the monetary unit of the country by a decree of the 14th of November 1885. Its weight is 8·544 grammes of gold 0·875 fine and its value in English standard gold is £1, 0s. $6\frac{1}{4}$d. The Turkish pound is written £T. The Turkish monetary system is dealt with at length under Turkey: *Monetary System.*

Valuable information from the historical point of view will be found in the *Reports* of the Standards Commission quoted above, and in H. W. Chisholm's *On the Science of Weighing and Measuring* (1877) and his *Seventh Annual Report* as warden of the standards;

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[1] Pound, in sense (1), is represented late in O.E. by the compounds *pund-fold* and *pund-breche* and by the derivative *pyndan*, to dam up, enclose, and *for-pyndan*, to shut out. The origin is unknown; "pen," an enclosure, is from a different root; "pond" a small pool of water, is a Middle English variant of "pound." In sense (2) the O.E. and M.E. *pund*, Du. *pond*, Ger. *Pfund*, are derivatives of the Lat. indeclinable substantive *pondo*—really an ablative singular as if from pondus (2nd declension)—a variant of *pondus*, *ponderis*, weight. The Lat. *pondo* is used as a shortened form of *libra pondo*, pound by weight. Finally is the verb "to pound," to crush by beating, to strike or beat; this in O.E. is *punian*, the *d* being excrescent as in "sound," noise. The word is rare outside English; cf. Mod. Du. *puin*, rubbish, broken stone.

R. Ruding, *Annals of the Coinage* (1819) and H. J. Chaney, *Our Weights and Measures* (1897). (T. A. I.)

POUSSIN, NICOLAS (1594–1665), French painter, was born at Les Andelys (Eure) in June 1594. Early sketches attracted the notice of Quentin Varin, a local painter, whose pupil Poussin became, till he went to Paris, where he entered the studio of Ferdinand Elle, a Fleming, and then of the Lorrainer L'Allemand. He found French art in a stage of transition: the old apprenticeship system was disturbed, and the academical schools destined to supplant it were not yet established; but, having met Courtois the mathematician, Poussin was fired by the study of his collection of engravings after Italian masters. After two abortive attempts to reach Rome, he fell in with the chevalier Marini at Lyons. Marini employed him on illustrations to his poems, took him into his household, and in 1624 enabled Poussin (who had been detained by commissions in Lyons and Paris) to rejoin him at Rome. There, his patron having died, Poussin fell into great distress. Falling ill he was received into the house of his compatriot Dughet and nursed by his daughter Anna Maria to whom in 1629, Poussin was married. Among his first patrons were Cardinal Barberini, for whom was painted the "Death of Germanicus" (Barberini Palace); Cardinal Omodei, for whom he produced, in 1630, the "Triumphs of Flora" (Louvre); Cardinal de Richelieu, who commissioned a Bacchanal (Louvre); Vicenzo Giustiniani, for whom was executed the "Massacre of the Innocents," of which there is a first sketch in the British Museum; Cassiano dal Pozzo, who became the owner of the first series of the "Seven Sacraments" (Belvoir Castle); and Fiéart de Chanteloup, with whom in 1640 Poussin, at the call of Sublet de Noyers, returned to France. Louis XIII. conferred on him the title of "first painter in ordinary," and in two years at Paris he produced several pictures for the royal chapels (the "Last Supper," painted for Versailles, now in the Louvre) and eight cartoons for the Gobelins, the series of the "Labours of Hercules" for the Louvre, the "Triumph of Truth" for Cardinal Richelieu (Louvre), and much minor work. In 1643, disgusted by the intrigues of Simon Vouët, Feuquières and the architect Lemercier, Poussin withdrew to Rome. There, in 1648, he finished for De Chanteloup the second series of the "Seven Sacraments" (Bridgewater Gallery), and also his noble landscape with Diogenes throwing away his Scoop (Louvre); in 1649 he painted the "Vision of St Paul" (Louvre) for the comic poet Scarron, and in 1651 the "Holy Family" (Louvre) for the duke of Créqui. Year by year he continued to produce an enormous variety of works, many of which are included in the list given by Félibien. He died on the 19th of November 1665 and was buried in the church of St Lawrence in Lucina, his wife having predeceased him.

The finest collection of Poussin's paintings as well as of his drawings is possessed by the Louvre; but, besides the pictures in the National Gallery and at Dulwich, England possesses several of his most considerable works: The "Triumph of Pan" is at Baisildon (Berkshire), and his great allegorical painting of the "Arts" at Knowsley. At Rome, in the Colonna and Valentini Palaces, are notable works by him, and one of the private apartments of Prince Doria is decorated by a great series of landscapes in distemper. Throughout his life he stood aloof from the popular movement of his native school. French art in his day was purely decorative, but in Poussin we find a survival of the impulses of the Renaissance coupled with conscious reference to classic work as the standard of excellence. In general we see his paintings at a great disadvantage, for the colour, even of the best preserved, has changed in parts, so that the keeping is disturbed; and the noble construction of his designs can be better seen in engravings than in the original. Amongst the many who have reproduced his works Audran, Claudine Stella, Picart and Pesne are the most successful.

Poussin left no children, but he adopted as his son Gaspar Dughet (Gasparo Duche), his wife's brother, who took the name of Poussin. Gaspar Poussin (1613–1675) devoted himself to landscape painting and rendered admirably the severer beauties of the Roman Campagna; a noteworthy series of works in tempera representing various sites near Rome is to be seen in the Colonna Palace; but one of his finest easel-pictures, the "Sacrifice of Abraham," formerly the property of the Colonna, is now, with other works by the same painter, in the National Gallery, London. The frescoes executed by Gaspar Poussin in S. Martino di Monti are in a bad state of preservation. The Louvre does not possess a single work by his hand. Gaspar died at Rome on the 27th of May 1675.

See Sandrart, *Acad. nob. art. pict.*; *Lettres de Nicolas Poussin* (Paris, 1824); Félibien, *Entretiens*; Gault de St Germain, *Vie de Nicolas Poussin* (1806); D'Argenville, *Abrégé de la vie des peintres*; Bouchitté, *Poussin et son œuvre* (1858); Emilia F. S. Pattison (Lady Dilke), *Documents inédits, Le Poussin*, in *L'Art* (1882).

POUT, also whiting-pout or bib (*Gadus luscus*), a fish of the family *Gadidae*. It is a small species abundant on the coasts of northern and western Europe, but less so in the Mediterranean. It is distinguished from other species of the genus *Gadus* by having a deep short body, with more or less distinct dark bars; a short and obtuse snout, not longer than the eye; the upper jaw the longer; and a long barbel at the chin. A black spot occupies the upper part of the base of the pectoral fin. Pout affect certain localities of limited extent, where a number may be caught with hook and line. They are excellent food, but must be eaten soon after capture. A pout of 5 lb is considered a very large specimen.

POUVILLON, ÉMILE (1840–1906), French novelist, was born at Montauban (Tarn et Garonne). He published in 1878 a collection of stories entitled *Nouvelles réalistes*. Making himself the chronicler of his native province of Quercy, he painted its scenery and its life with great clearness of outline and without exaggeration. His books include *Césette* (1881), the story of a peasant girl; *L'Innocent* (1884); *Jean-de-Jeanne* (1886); *Le Cheval bleu* (1888); *Le Vœu d'être chaste* (1900); *Chante-pleure* (1890); *Les Antibel* (1892); *Petites âmes* (1893); *Mademoiselle Clémence* (1896); *Pays et paysages* (1895); *Petites gens* (1905); *Bernadette de Lourdes* (1894), a mystery; and *Le Roi de Rome* (1898), a play. He died at Chambéry.

POVINDAH, a class of warrior nomadic traders in Afghanistan, who belong chiefly to the Nasir and Suliman Kuel tribes of Ghilzais. Their name, which designates their occupation, is derived from the same root as the Pushtu word for "to graze." They are almost wholly engaged in the carrying trade between India and Afghanistan and Central Asia. They assemble every autumn in the plains east of Ghazni, with their families, flocks, herds and long strings of camels and horses, laden with the goods of Bokhara and Kandahar; and forming caravans march through the Kakar and Waziri countries by the Zhob and Gomal passes of the Suliman hills. Entering Dera Ismail Khan district about October they leave their families and flocks, their arms and some two-thirds of their fighting men in the great grazing grounds which lie on either side of the Indus, and while some wander in search of employment, others pass on with their merchandise to the great cities of India, and even by rail as far as Calcutta, Karachi and Bombay. In the spring they again assemble, and return by the same route to their homes in the hills about Ghazni and Kalat-i-Ghilzai. When the hot season begins, the men, leaving their belongings behind them, move off again to Kandahar, Herat and Bokhara, with the Indian and European merchandise which they have brought from Hindustan. For generations the Waziris have carried on war to the knife with these merchant traders. To meet the opposition that awaited them on the road the Povindahs used to move heavily armed, in bodies of from 5000 to 10,000, and regular marches and encampments were observed under an elected khan or leader. But since the Gomal Pass was taken over by the British and opened up in 1889 there has been comparative security on the border. During the Second Afghan War the tribes on the Tank border were stirred up by emissaries from Kabul, and the Suliman Khel joined the Mahsud Waziris in their daring raid on the town of Tank in January 1879. Colonel Boisragon, who commanded at Dera Ismail Khan, moved out against the Povindah settlements in the mouth of the Gomal Pass and severely punished them. The Povindahs paid a fine of nearly Rs. 60,000 (£6000), and agreed that in future their migratory bands should be disarmed on their entry into British territory, their weapons to be deposited in a military arsenal, and returned to their owners when they again crossed the border.

POVOA DE VARZIM, a seaport of northern Portugal, in the district of Oporto; on a small and ill-sheltered bay, 18 m. N. of Oporto by the branch railway to Villa Nova de Familição. Pop. (1900), 12,623. In summer Povoa de Varzim is the most frequented sea-bathing resort in northern Portugal; it is also the headquarters of important sardine, hake, and sea-bream fisheries.

POWDER (through O. Fr. *puldre*, modern *poudre*, from Lat. *pulvis*, *pulveris*, dust), the small loose particles into which solid matter is disintegrated by such processes as grinding, crushing, pounding, &c., hence any preparation which takes the form of such loose uncompacted particles, the most familiar example of such preparation being that of gunpowder (*q.v.*). Many powders are found in medical uses, some of which have retained the name of their inventor, such as the compound powder of rhubarb, "Gregory powder," named after a Scottish doctor, James Gregory (1758–1822). Various preparations in form of powder are used for toilet purposes. During the period when the hair or wig was worn "powdered" or whitened, houses had a special room set apart for the process, known as the powdering-room or closet. In some birds, such as the herons, certain down-feathers or *plumulae* break off into a fine dust as fast as they are formed and form tracts defined in size and situation and known as "powder-down patches."

POWELL, FREDERICK YORK (1850–1904), English historian and scholar, was born in Bloomsbury, London, on the 14th of January 1850. Much of his childhood was spent in France and Spain, so that he early acquired a mastery of the language of both countries and an insight into the genius of the people. He was educated at Rugby School, and matriculated at Oxford as an unattached student, subsequently joining Christ Church, where he took a first-class in law and modern history in 1872. He was called to the bar at the Middle Temple in 1874, and married in the same year. He became law-lecturer and tutor of Christ Church, fellow of Oriel College, delegate of the Clarendon Press, and in 1894 he was made regius professor of modern history in succession to J. A. Froude. Although he never made any extensive contribution to history, he was a particularly stimulating teacher. He had been attracted in his school days to the study of Scandinavian history and literature, and he was closely allied with Professor Gudbrandr Vigfússon (d. 1889), whom he assisted in his *Icelandic Prose Reader* (1897), *Corpus poeticum boreale* (1887), *Origines islandicae* (1905), and in the editing of the Grimm Centenary papers (1886). He took a keen interest in the development of modern French poetry, and Verlaine, Mallarmé and Verhaeren all lectured at Oxford under his auspices. He was also a connoisseur in Japanese art. In politics his sympathies were with the oppressed of all nationalities; he had befriended refugees after the Commune, counting among his friends Jules Vallès[1] the author of *Les Réfractaires*; and he was also a friend of Stepniak and his circle. He died at Oxford on the 8th of May 1904.

See the *Life*, with letters and selections, by Oliver Elton (1906).

POWELL, GEORGE (*c.* 1658–1714), English actor and playwright, was the son of an actor of the same name (d. *c.* 1698), with whom, as the king of Bakam, he first appeared in 1687, as Emanuel in *The Island Princess*, Tate's version of Fletcher's play. He wrote or adapted *Alphonso, King of Naples* (1661), *Treacherous Brothers* (1676), and *Very Good Wife* (1693), and acted in them and in a long list of contemporary plays almost until his death. As a tragedian he succeeded to many of Betterton's parts, but not to his genius.

POWELL, JOHN WESLEY (1834–1902), American geologist and ethnologist, was born at Mount Morris, New York, on the 24th of March 1834. His parents were of English birth, but had moved to America in 1830, and he was educated at Illinois and Oberlin colleges. When the Civil War broke out he entered the Union Army as a private, and at the battle of Shiloh he lost his right arm. He continued, however, on active service and served as division chief of artillery before Vicksburg, reaching the rank of major of volunteers. In 1865 he was appointed professor of geology and curator of the museum in the Illinois Wesleyan University at Bloomington, and afterwards at the Normal University. In 1867 he commenced a series of expeditions to the Rocky Mountains and the canyons of the Green and Colorado rivers, during the course of which (1869) he made a daring boat-journey of three months, through the Grand Canyon, the river channel not having previously been explored. In these travels he gathered much valuable information on the geology, and he also made a special study of the Indians and their languages. His able work led to the establishment under the U.S. government of the geographical and geological survey of the Rocky Mountain region with which he was occupied in 1870–1879. This survey, with those of Ferdinand Hayden (1829–1887) and Captain George M. Wheeler (b. 1842) was incorporated with the United States Geological and Geographical Survey under Clarence King (1842–1901) in 1879, when Powell became director of the Bureau of Ethnology, a department he had assisted in founding. On King's resignation in 1881, Powell was appointed director also of the Geological Survey, a post which he occupied until 1894. To him the present thorough organization of the U.S. Geological Survey is largely due.

His principal publications were *Exploration of the Colorado River of the West and its Tributaries* (1875), *Report on the Geology of the Eastern Portion of the Uinta Mountains* (1876), *Report on the Lands of the Arid Region of the United States* (1879), *Introduction to the Study of Indian Languages* (1880), *Canyons of the Colorado* (1895), *Truth and Error* (1898). Especially important were his observations on what is now termed the "Uinta type" of mountain structure: a broad, flattened anticline, from which the strata descend steeply into bordering low grounds and quickly resume their horizontality—being sometimes faulted, and affording evidence of enormous denudation. He died in Haven, Maine, on the 23rd of September 1902.

See F. S. Dellenbaugh, *Romance of the Colorado River* (New York, 1903), and *Canyon Voyage: Second Powell Expedition* (New York, 1908).

POWELL, VAVASOR (1617–1670), Welsh Nonconformist, was by birth a Radnorshire man and was educated at Jesus College, Oxford. About 1639 he entered upon the career of an itinerant preacher, and for preaching in various parts of Wales he was twice arrested in 1640; however, he was not punished and during the Civil War he preached in and around London. In 1646, when the victory of the parliamentary cause was assured, Powell returned to Wales, having received a certificate of character from the Westminster Assembly, although he had refused to be ordained by the Presbyterians. With a salary granted to him by parliament he resumed his itinerant preaching in Wales. In 1650 parliament appointed a commission "for the better propagation and preaching of the gospel in Wales," and Powell acted as one of the principal advisers of this body. For three years he was actively employed in removing from their parishes those ministers whom he regarded as incompetent. In 1653 he returned to London, and having denounced Cromwell for accepting the office of Lord Protector he was imprisoned. At the Restoration in 1660 he was arrested for preaching, and after a short period of freedom he was again seized, and he remained in prison for seven years. He was set free in 1667, but in the following year he was again a prisoner, and he was in custody when he died on the 27th of October 1670. Powell wrote several treatises and also some hymns, but his chief gifts were those of a preacher.

See *The Life and Death of Mr Vavasor Powell* (1671), attributed to Edward Bagshaw the younger; *Vavasoris Examen et Purgamen* (1654), by E. Allen and others; D. Neal, *History of the Puritans* (1822); and T. Rees, *History of Protestant Nonconformity in Wales* (1861).

POWER [WILLIAM GRATTAN] TYRONE (1797–1841), Irish actor, was born near Kilmacthomas on the 2nd of November 1797. At the age of fourteen he joined a company of strolling players, eventually getting small parts in the London theatres. On the sudden death of Charles Connor he was given his parts and was immediately recognized as the best stage Irishman of his generation, becoming a popular favourite in London, Dublin and America. He was on board the ill-fated "President" when she foundered at sea in March 1841. Power wrote and performed several Irish plays, and published three novels and his *Impressions of America* (1836). He had married when twenty and left a widow and seven children, the oldest of whom, Sir William Tyrone Power, K.C.B. (b. 1819), became Commissary-general of the British army and was knighted in 1865.

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[1] (1833–1885), member of the Commune of 1871.

POWER OF ATTORNEY, or Letter of Attorney, is an authority under hand and seal empowering the person named therein to do some act on behalf of the principal, which otherwise could only be done by the principal himself. It is either general or special. A general power of attorney authorizes the agent to act for his principal in all matters, or in matters of a particular nature only, or in respect of a particular business. A special act of attorney authorizes the agent to represent his principal only in some particular specified act. It expires with death of the principal, and is revocable at his will, even by a verbal notice, unless it has been given for a valuable consideration. Moreover, the terms of the power are construed literally, and give such authority only as they confer expressly or by necessary implication. The Conveyancing Act of 1881 provides protection for any person making any payment or doing any act in good faith, in pursuance of a power of attorney, if before the time of the payment or act the donor of the power had died or become lunatic, of unsound mind, or bankrupt, or had revoked the power. The law relating to powers of attorney is a branch of the law of agency. (See Agent; Principal and Agent.)

POWERS, HIRAM (1805–1873), American sculptor, the son of a farmer, was born at Woodstock, Vermont, on the 29th of June 1805. In 1819 his father removed to Ohio, about six miles from Cincinnati, where the son attended school for about a year, staying meanwhile with his brother, a lawyer in Cincinnati. After leaving school he found employment in superintending a reading-room in connexion with the chief hotel of the town, but, being, in his own words, "forced at last to leave that place as his clothes and shoes were fast leaving him," he became a clerk in a general store. His second employer in this line of business having invested his capital in a clock and organ factory, Powers set himself to master the construction of the instruments, displaying an aptitude which in a short time enabled him to become the first mechanic in the factory. In 1826 he began to frequent the studio of Mr Eckstein, and at once conceived a strong passion for the art of sculpture. His proficiency in modelling secured him the situation of general assistant and artist of the Western Museum, kept by a Frenchman named Dorfeuille, where his ingenious representation of the infernal regions to illustrate the more striking scenes in the poem of Dante met with extraordinary success. After studying thoroughly the art of modelling and casting, at the end of 1834 he went to Washington, where his remarkable gifts soon awakened general attention. In 1837 he settled in Florence, where he remained till his death. While he found it profitable to devote the greater part of his time to busts, his best efforts were bestowed on ideal work. In 1839 his statue of "Eve" excited the warm admiration of Thorwaldsen, and in 1843 he produced his celebrated "Greek Slave," which at once gave him a place among the leading sculptors of his time. Among the best known of his other ideal statues are the "Fisher Boy," "Il Penseroso," "Proserpine," "California," "America" (modelled for the Crystal Palace, Sydenham), and the "Last of his Tribe." He died on the 27th of June 1873.

See an article by T. A. Trollope in *Lippincott's Magazine* for February 1875.

POWER TRANSMISSION. The appliances connected with installations for the utilization of natural sources of energy may be classified into three groups:—

1. Prime movers, by means of which the natural form of energy is transformed into mechanical energy. To this group belong all such appliances as water turbines, steam turbines, steam engines and boilers, gas producers, gas engines, oil engines, &c.

2. Machinery of any kind which is driven by energy made available by the prime mover. To this group belong all machine tools, textile machinery, pumping machinery, cranes—in fact every kind of machine which requires any considerable quantity of energy to drive it.

3. The appliances by means of which the energy made available by the prime mover is transmitted to the machine designed to utilise it. The term *power* is used to denote the rate at which energy is transmitted. The unit of power in common use is the horse power, and one horse power means a rate of transmission of 550 foot-pounds per second.

In many cases the prime mover is combined with the machine in such a way that the transmitting mechanism is not distinctly differentiated from either the prime mover or the machine, as in the case of the locomotive engine. In other cases the energy made available by the prime mover is distributed to a number of separate machines at a distance from the prime mover, as in the case of an engineer's workshop. In this case the transmitting mechanism by means of which the energy is distributed to the several machines has a distinct individuality. In other cases prime movers are located in places where the natural source of energy is abundant, namely, near waterfalls, or in the neighbourhood of coal-fields, and the energy made available is transmitted in bulk to factories, &c., at relatively great distances. In this case the method and mechanism of distribution become of paramount importance, since the distance between the prime mover and the places where the energy is to be utilized by machines is only limited by the efficiency of the mechanism of distribution.

Prime movers are considered in the articles Steam Engine; Gas Engine; Oil Engine, and Hydraulics, and machines in various special articles. The methods and mechanisms of distribution or transmission alone form the subjects of the present article, and the different methods in general use readily fall into four divisions:—

1. Mechanical.
2. Hydraulic.
3. Pneumatic.
4. Electrical.

I.—Mechanical

§ 1. *Methods.*—The mechanical transmission of power is effected in general by means of belts or ropes, by shafts or by wheel gearing and chains. Each individual method may be used separately or in combination. The problems involved in the design and arrangement of the mechanisms for the mechanical distribution of power are conveniently approached by the consideration of the way in which the mechanical energy made available by an engine is distributed to the several machines in the factory. By a belt on the fly-wheel of the prime mover the power is transmitted to the line shaft, and pulleys suitably placed along the line shaft by means of other belts transmit power, first, to small countershafts carrying fast and loose pulleys and striking gear for starting or stopping each engine at will, and then to the driving pulleys of the several machines. (See also Pulleys.)

§ 2. *Quantitative Estimation of the Power Transmitted.*—In dealing with the matter quantitatively the engine crank-shaft may be taken as the starting point of the transmission, and the first motion-shaft of the machine as the end of the transmission so far as that particular machine is concerned.

Let T be the mean torque or turning effort which the engine exerts continuously on the crank shaft when it is making N revolutions per second. It is more convenient to express the revolutions per second in terms of the angular velocity ω, that is, in radians per second. The relation between these quantities is $\omega=2\pi N$. Then the rate at which work is done by the engine crank shaft is $T\omega$ foot-pounds per second, equivalent to $T\omega/550$ horse power. This is now distributed to the several machines in varying proportions. Assuming for the sake of simplicity that the whole of the power is absorbed by one machine, let T_1 be the torque on the first motion-shaft of the machine, and let ω_1 be its angular velocity, then the rate at which the machine is absorbing energy is $T_1\omega_1$ foot-pounds per second. A certain quantity of energy is absorbed by the transmitting mechanism itself for the purpose of overcoming frictional and other resistances, otherwise the rate of absorption of energy by the machine would exactly equal the rate at which it was produced by the prime mover assuming steady conditions of working. Actually therefore $T_1\omega_1$ would be less than $T\omega$ so that

$$T_1\omega_1=\eta T\omega, \tag{1}$$

where η is called the efficiency of the transmission. Considering now the general problem of a multiple machine transmission, if $T_1, \omega_1, T_2, \omega_2, T_3, \omega_3, \ldots$ are the several torques and angular velocities of the respective first motion shafts of the machines,

$$(T_1\omega_1+T_2\omega_2+T_3\omega_3+\ldots)=\eta T\omega \qquad (2)$$

expresses the relations which must exist at any instant of steady motion. This is not quite a complete statement of the actual conditions because some of the provided energy is always in course of being stored and unstored from instant to instant as kinetic energy in the moving parts of the mechanism. Here, η is the over-all efficiency of the distributing mechanism. We now consider the separate parts of the transmitting mechanism.

§ 3. *Belts.*—Let a pulley A (fig. 1) drive a pulley B by means of a leather belt, and let the direction of motion be as indicated by the arrows on the pulleys. When the pulleys are revolving uniformly, A transmitting power to B, one side of the belt will be tight and the other side will be slack, but both sides will be in a state of tension. Let t and u be the respective tensions on the tight and slack side; then the torque exerted by the belt on the pulley B is $(t-u)r$, where r is the radius of the pulley in feet, and the rate at which the belt does work on the pulley is $(t-u)r\omega$ foot-pounds per second. If the horse-power required to drive the machine be represented by h.p., then

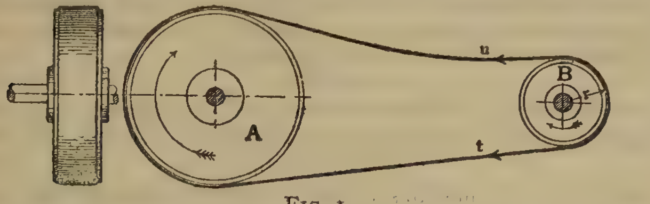


FIG. 1.

$$(t-u)r\omega=550 \text{ h.p.}, \qquad (3)$$

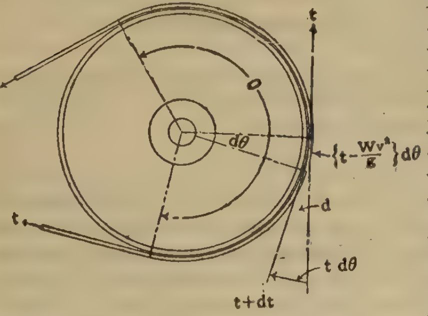


FIG. 2.

assuming the efficiency of the transmission to be unity. This equation contains two unknown tensions, and before either can be found another condition is necessary. This is supplied by the relation between the tensions, the arc of contact θ, in radians (fig. 2), the coefficient of friction μ between the belt and the pulley, the mass of the belt and the speed of the belt. Consider an element of the belt (fig. 2) subtending an angle $d\theta$ at the centre of the pulley, and let t be the tension on one side of the element and $(t+dt)$ the tension of the other side. The tension tending to cause the element to slide bodily round the surface of the pulley is dt. The normal pressure between the element and the face of the pulley due to the tensions is $t\,d\theta$, but this is diminished by the force necessary to constrain the element to move in the circular path determined by the curvature of the pulley. If W is the weight of the belt per foot, the constraining force required for this purpose is $Wv^2d\theta/g$, where v is the linear velocity of the belt in feet per second. Hence the frictional resistance of the element to sliding is $(t-Wv^2/g)\mu d\theta$, and this must be equal to the difference of tensions dt when the element is on the point of slipping, so that $(t-Wv^2/g)\mu d\theta=dt$. The solution of this equation is

$$\frac{t-Wv^2/g}{u-Wv^2/g}=e^{\mu\theta}, \qquad (4)$$

where t is now the maximum tension and u the minimum tension, and e is the base of the Napierian system of logarithms, 2·718. Equations (3) and (4) supply the condition from which the power transmitted by a given belt at a given speed can be found. For ordinary work the term involving v may be neglected, so that (4) becomes

$$t/u=e^{\mu\theta}. \qquad (5)$$

Equations (3) and (5) are ordinarily used for the preliminary design of a belt to calculate t, the maximum tension in the belt necessary to transmit a stated horse power at a stated speed, and then the cross section is proportioned so that the stress per square inch shall not exceed a certain safe limit determined from practice.

To facilitate the calculations in connexion with equation (5), tables are constructed giving the ratio t/u for various values of μ and θ. (See W. C. Unwin, *Machine Design*, 12th ed., p. 377.) The ratio should be calculated for the smaller pulley. If the belt is arranged as in fig. 1, that is, with the slack side uppermost, the drop of the belt tends to increase θ and hence the ratio t/u for both pulleys.

§ 4. *Example of Preliminary Design of a Belt.*—The following example illustrates the use of the equations for the design of a belt in the ordinary way. Find the width of a belt to transmit 20 h.p. from the flywheel of an engine to a shaft which runs at 180 revolutions per miunte (equal to 18·84 radians per second), the pulley on the shaft being 3 ft. diameter. Assume the engine flywheel to be of such diameter and at such a distance from the driven pulley that the arc of contact is 120°, equal to 2·094 radians, and further assume that the coefficient of friction $\mu=0{\cdot}3$. Then from equation (5) $t/u=e^{2.094\times0.3}=2{\cdot}718^{0.6282}$; that is $\log_e t/u=0{\cdot}6282$, from which $t/u=1{\cdot}87$, and $u=t/1{\cdot}87$. Using this in (3) we have $t(1-1/1{\cdot}87)\ 1{\cdot}5\times18{\cdot}84=550\times20$, from which $t=838$ ℔. Allowing a working strength of 300 ℔ per square inch, the area required is 2·8 sq. in., so that if the belt is $\frac{1}{4}$ in. thick its width would be 11·2 in., or if $\frac{3}{16}$ in. thick, 15 in. approximately.

The effect of the force constraining the circular motion in diminishing the horse power transmitted may now be ascertained by calculating the horse power which a belt of the size found will actually transmit when the maximum tension t is 838 ℔. A belt of the area found above would weigh about 1·4 ℔. per foot. The velocity of the belt, $v=\omega r=18{\cdot}84\times1{\cdot}5=28{\cdot}26$ ft. per second. The term Wv^2/g therefore has the numerical value 34·7. Hence equation (2) becomes $(t-34{\cdot}7)/(u-34{\cdot}7)=1{\cdot}87$, from which, inserting the value 838 for t, $u=464{\cdot}5$ ℔. Using this value of u in equation (1)

$$\text{H.P.}=\frac{(838-464{\cdot}5)\times18{\cdot}84\times1{\cdot}5}{550}=19{\cdot}15.$$

Thus with the comparatively low belt speed of 28 ft. per second the horse power is only diminished by about 5%. As the velocity increases the transmitted horse power increases, but the loss from this cause rapidly increases, and there will be one speed for every belt at which the horse power transmitted is a maximum. An increase of speed above this results in a diminution of transmitted horse power.

§ 5. *Belt Velocity for Maximum Horse Power.*—If the weight of a belt per foot is given, the speed at which the maximum horse power is transmitted for an assigned value of the maximum tension t can be calculated from equations (3) and (4) as follows:—

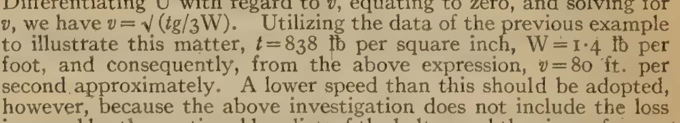
Let t be the given maximum tension with which a belt weighing W ℔ per foot may be worked. Then solving equation (4) for u, subtracting t from each side, and changing the signs all through: $t-u=(t-Wv^2/g)\ (1-e^{-\mu\theta})$. And the rate of working U, in foot-pounds per second, is

$$U=(t-u)v=(tv-Wv^3/g)(1-e^{-\mu\theta}).$$

Differentiating U with regard to v, equating to zero, and solving for v, we have $v=\sqrt{(tg/3W)}$. Utilizing the data of the previous example to illustrate this matter, $t=838$ ℔ per square inch, $W=1{\cdot}4$ ℔ per foot, and consequently, from the above expression, $v=80$ ft. per second approximately. A lower speed than this should be adopted, however, because the above investigation does not include the loss incurred by the continual bending of the belt round the circumference of the pulley. The loss from this cause increases with the velocity of the belt, and operates to make the velocity for maximum horse power considerably lower than that given above.

§ 6. *Flexibility.*—When a belt or rope is working power is absorbed in its continual bending round the pulleys, the amount depending upon the flexibility of the belt and the speed. If C is the couple required to bend the belt to the radius of the pulley, the rate at which work is done is $C\omega$ foot-pounds per second. The value of C for a given belt varies approximately inversely as the radius of the pulley, so that the loss of power from this cause will vary inversely as the radius of the pulley and directly as the speed of revolution. Hence thin flexible belts are to be preferred to thick stiff ones. Besides the loss of power in transmission due to this cause, the bending causes a stress in the belt which is to be added to the direct stress due to the tensions in the belt in order to find the maximum stress. In ordinary leather belts the bending stress is usually negligible; in ropes, however, especially wire rope, it assumes paramount importance, since it tends to overstrain the outermost strands and if these give way the life of the rope is soon determined.

§ 7. *Rope Driving.*—About 1856 James Combe, of Belfast, introduced the practice of transmitting power by means of ropes running in grooves turned circumferentially in the rim of the pulley (fig. 3). The ropes may be led off in groups to the different floors of the factory to pulleys keyed to the distributing shafting. A groove was adopted having an angle of about 45°,



(From Abram Combe, *Proc. Inst. Mech. Eng.*)

FIG. 3.—Rope driving; half-crossed rope drive, separate rope to each groove.

and this is the angle now used in the practice of Messrs Combe, Barbour and Combe, of Belfast. A section of the rim of a rope driving wheel showing the shape of the groove for a rope 1¾ in. diameter is shown in fig. 4, and a rope driving pulley designed for six 1¾in. ropes is shown in fig. 5. A rope is less flexible than a belt, and therefore care must be taken not to arrange rope drives with pulleys having too small a diameter relatively to the diameter of the rope. The principles of §§ 3, 4, 5 and 6, apply equally to ropes, but with the practical modification that the working stress in the rope is a much smaller fraction of the ultimate strength than in the case of belting and the ratio of the tensions is much greater. The following table, based upon the experience of Messrs Combe, presents the practical possibilities in a convenient form:—

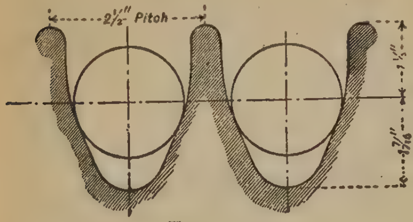


FIG. 4.

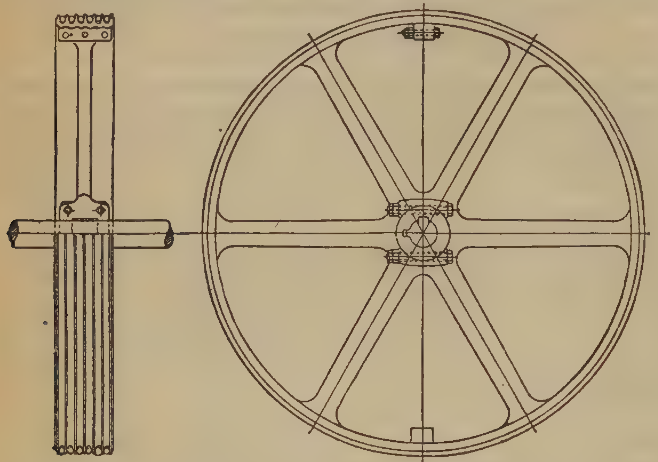


FIG. 5.—Rope Pulley, 10 ft. diam., 6 grooves, 2½ in. pitch, weight about 35 cwt. Constructed by Combe, Barbour & Combe, Ltd., Belfast.

Diameter of Rope.	Smallest diameter of Pulley, which should be used with the Rope.	H.P. per Rope for smallest Pulley at 100 revs. per minute.
in.	in.	
¾	14	⅝
1	21	1
1⅝	42	8
2⅛	66	16

The speed originally adopted for the rope was 55 ft. per second. This speed has been exceeded, but, as indicated above, for any particular case there is one speed at which the maximum horse power is transmitted, and this speed is chosen with due regard to the effect of centrifugal tension and the loss due to the continual bending of the rope round the pulley. Instead of using one rope for each groove, a single continuous rope may be used, driving from one common pulley several shafts at different speeds. For further information see Abram Combe, *Proc. Inst. Mech. Eng.* (July 1896). Experiments to compare the efficiencies of rope and belt driving were carried out at Lille in 1894 by the *Société Industrielle du Nord de la France*, for an account of which see D. S. Capper, *Proc. Inst. Mech. Eng.* (October 1896). Cotton ropes are used extensively for transmitting power in factories, and though more expensive than Manila ropes, are more durable when worked under suitable conditions.

§ 8. *Shafts.*—When a shaft transmits power from a prime mover to a machine, every section of it sustains a turning couple or torque T, and if ω is the angular velocity of rotation in radians per second, the rate of transmission is $T\omega$ foot-pounds per second, and the relation between the horse power, torque and angular velocity is

$$T\omega = 550 \text{ H.P.} \qquad (6)$$

The problem involved in the design of a shaft is so to proportion the size that the stress produced by the torque shall not exceed a certain limit, or that the relative angular displacement of two sections at right angles to the axis of the shaft at a given distance apart shall not exceed a certain angle, the particular features of the problem determining which condition shall operate in fixing the size. At a section of a solid round shaft where the diameter is D inches, the torque T inch-pounds, and the maximum shearing stress f pounds per square inch, the relation between the quantities is given by

$$T = \pi D^3 f/16, \qquad (7)$$

and the relation between the torque T, the diameter D, the relative angular displacement θ of two sections L inches apart by

$$T = C\theta\pi D^4/32L, \qquad (8)$$

where C is the modulus of rigidity for the material of the shaft. Observe that θ is here measured in radians. The ordinary problems of shaft transmission by solid round shafts subject to a uniform torque only can be solved by means of these equations.

Calculate the horse power which a shaft 4 in. diameter can transmit, revolving 120 times per minute (12·56 radians per second), when the maximum shearing stress f is limited to 11,000 ℔ per square inch. From equation (7) the maximum torque which may be applied to the shaft is T = 138,400 inch-pounds. From (6) $\text{H.P.} = \frac{138{,}400 \times 12{\cdot}56}{12 \times 550} = 264$. The example may be continued to find how much the shaft will twist in a length of 10 ft. Substituting the value of the torque in inch-pounds in equation (8), and taking 11,500,000 for the value of C,

$$\theta = \frac{138{,}400 \times 120 \times 32}{11{,}500{,}000 \times 3{\cdot}14 \times 256} = 0{\cdot}057 \text{ radians,}$$

and this is equivalent to 3·3°.

In the case of hollow round shafts where D is the external diameter and d the internal diameter equation (7) becomes

$$T = \pi f(D^4 - d^4)/16D, \qquad (9)$$

and equation (8) becomes

$$T = C\theta\pi(D^4 - d^4)/32L. \qquad (10)$$

The assumption tacitly made hitherto that the torque T remains constant is rarely true in practice; it usually varies from instant to instant, often in a periodic manner, and an appropriate value of f must be taken to suit any particular case. Again it rarely happens that a shaft sustains a torque only. There is usually a bending moment associated with it. For a discussion of the proper values of f, to suit cases where the stress is variable, and the way a bending moment of known amount may be combined with a known torque, see STRENGTH OF MATERIALS. It is sufficient to state here that if M is the bending moment in inch-pounds, and T the torque in inch-pounds, the magnitude of the greatest direct stress in the shaft due to the effect of the torque and twisting moment acting together is the same as would be produced by the application of a torque of

$$M + \sqrt{(T^2 + M^2)} \text{ inch-pounds.} \qquad (11)$$

It will be readily understood that in designing a shaft for the distribution of power to a factory where power is taken off at different places along the shaft, the diameter of the shaft near the engine must be proportioned to transmit the total power transmitted whilst the parts of the shaft more remote from the engine are made smaller, since the power transmitted there is smaller.

§ 9. *Gearing Pitch Chains.*—Gearing is used to transmit power from one shaft to another. The shafts may be parallel; or inclined to one another, so that if produced they would meet in a point; or inclined to one another so that if produced they would not meet in a point. In the first case the gear wheels are called spur wheels, sometimes cog wheels; in the second case bevel wheels, or, if the angle between the shafts is 90°, mitre wheels; and in the third case they are called skew bevels. In all cases the teeth should be so shaped that the velocity ratio between the shafts remains constant, although in very rare cases gearing is designed to work with a variable velocity ratio as part of some special machines. For the principles governing the shape of the teeth to fulfil the condition that the velocity ratio between the wheels shall be constant, see MECHANICS, § *Applied*. The size of the teeth is determined by the torque the gearing is required to transmit.

Pitch chains are closely allied to gearing; a familiar example is in the driving chain of a bicycle. Pitch chains are used to a limited extent as a substitute for belts, and the teeth of the chains and the teeth of the wheels with which they work are shaped on the same principles as those governing the design of the teeth of wheels.

If a pair of wheels is required to transmit a certain maximum horse power, the angular velocity of the shaft being ω, the pressure P which the teeth must be designed to sustain at the pitch circle is $550\ \text{H.P.}/\omega R$, where R is the radius of the pitch circle of the wheel, whose angular velocity is ω.

§ 10. *Velocity Ratio.*—In the case of transmission either by belts, ropes, shafts or gearing, the operating principle is that the rate of working is constant, assuming that the efficiency of the transmission is unity, and that the product $T\omega$ is therefore constant, whether the shafts are connected by ropes or gearing. Considering therefore two shafts, $T_1\omega_1 = T_2\omega_2$; that is $\omega_1/\omega_2 = T_2/T_1$; *i.e.* the angular velocity ratio is inversely as the torque ratio. Hence the higher the speed at which a shaft runs, the smaller the torque for the transmission of a given horse power, and the smaller the tension on the belts or ropes for the transmission of a given horse power.

§ 11. *Long Distance Transmission of Power.*—C. F. Hirn originated the transmission of power by means of wire ropes at Colmar in Alsace in 1850. Such a telodynamic transmission consists of a series of wire ropes running on wheels or pulleys supported on piers at spans varying from 300 to 500 ft. between the prime mover and the place where the power is utilized. The slack of the ropes is supported in some cases on guide pulleys distributed between the main piers. In this way 300 h.p. was transmitted over a distance of 6500 ft. at Freiberg by means of a series of wire ropes running at 62 ft. per second on pulleys 177 in. diameter. The individual ropes of the series, each transmitting 300 h.p., were each 1·08 in. diameter and contained 10 strands of 9 wires per strand, the wires being each 0·072 in. diameter. Similar installations existed at Schaffhausen, Oberursal, Bellegarde, Tortona and Zürich. For particulars of these transmissions with full details see W. C. Unwin's Howard Lectures on the "Development and Transmission of Power from Central Stations" (*Journ. Soc. Arts*, 1893, published in book form 1894). The system of telodynamic transmission would no doubt have developed to a much greater extent than it has done but for the advent of electrical transmission, which made practicable the transmission of power to distances utterly beyond the possibilities of any mechanical system.

See W. J. M. Rankine, *Treatise on Machinery and Millwork*; and W. C. Unwin, *Elements of Machine Design*; and for telodynamic transmission see F. Reuleaux, *Die Konstrukteur*. (W. E. D.)

II.—HYDRAULIC

The first proposal for a general transmission of hydraulic power was made by Bramah in 1802. In 1846 Lord Armstrong's hydraulic crane was erected at Newcastle, and was worked from the town water mains, but the pressure in such mains was too low and uncertain to secure satisfactory results. The invention of the accumulator in 1850 enabled much higher pressures to be used; since then 700 ℔ per square inch has been adopted in most private hydraulic power transmission plants. An attempt to give a public supply of hydraulic power was made in 1859, when a company was formed for laying mains in London along the river Thames between the Tower and Blackfriars, the engineer being Sir George Bruce; but though an act of parliament was obtained, the works were not carried out. The first public hydraulic supply station was established at Hull in 1877. In 1883 the General Hydraulic Power Works, Messrs Ellington and Woodall being the engineers, were started in London, and they now form the largest system of hydraulic power transmission in existence. Works of a similar character have since been established in several other towns. The general features of hydraulic power transmissions are: (1) a central station where the hydraulic pressure is created, usually by means of steam pumping engines; (2) a system of distribution mains; (3) machines for utilizing the pressure. In cases of public supplies there is the further important matter of registration.

When dealing with any practical problem of hydraulic power transmission it is of the first importance to determine the maximum demand for power, its duration and frequency. If the duration of the maximum demand is limited and the frequency restricted—for instance, when a swing bridge has to be opened and closed only a few times in the course of a day—a small pumping plant and a large accumulator will be desirable. If the maximum demand is more or less continuous, as when hydraulic pressure is used for working a pump in a mine or a hydraulic engine in a workshop, the central station pumping engine must be capable of supplying the maximum demand without the aid of an accumulator, which may or may not, according to circumstances, be provided to serve as a regulator. A hydraulic accumulator (fig. 1) ordinarily consists of a hydraulic cylinder and ram, the ram being loaded with sufficient weight to give the pressure required in the hydraulic mains. If a pressure of 700 ℔ per square inch is wanted, the weight of the ram and its load, neglecting friction, must be 700 ℔ for each square inch of its area, and if the cylinder is full, *i.e.* the ram elevated to its full extent, the accumulator is a reservoir of power, exactly as if it were a tank at the same cubical extent placed at an elevation of about 1600 ft. above the mains and connected with them. The function of accumulators in hydraulic power distribution is frequently misunderstood, and it has been urged that as in practice the size of the reservoirs of power that can be obtained by their use is small, they are of little value. An accumulator having a ram 20 in. diameter by 20 ft. stroke loaded to 700 ℔ is

Central Station.

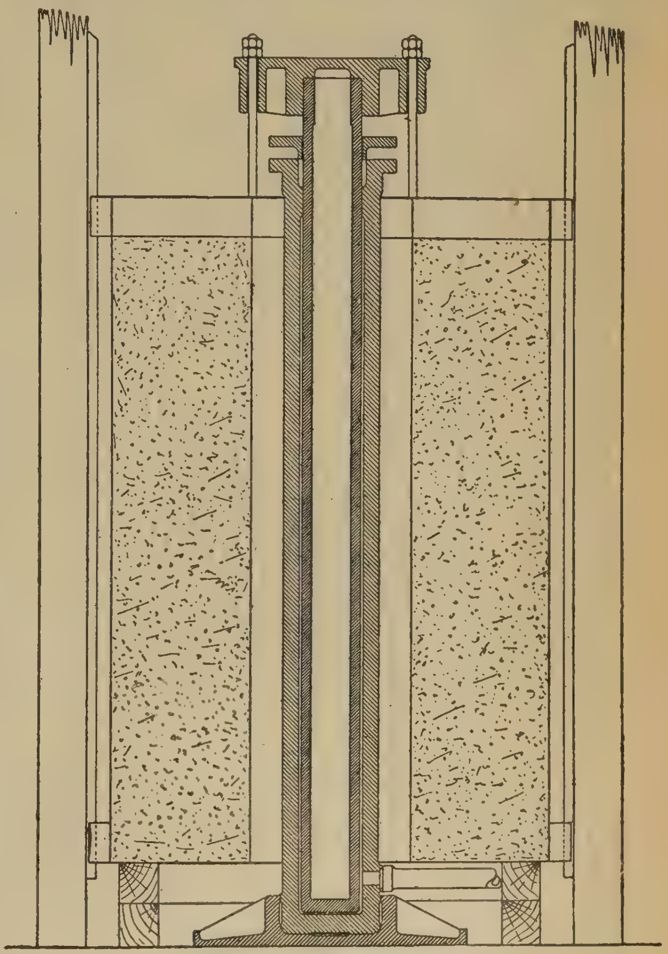


FIG. 1.

a fairly large one, but it contains only 439,740 foot-pounds of available energy. If the accumulator ram descended in one minute the horse power developed during that time would be 13·3, and until again pumped up its function would cease. Is so small a reservoir worth much? The correct answer to this question depends upon the surrounding circumstances. In the case of any general system of hydraulic power transmission it is certain that there will be very large and frequent variations in the combined demand for power, the periods of approximate maximum rarely exceeding in the aggregate 2 or 3 hours a day (see fig. 2). Where the area of supply is very extensive there are further subsidiary variations in small sections of the area. The main features of the combined load curves are fairly constant, but the local peaks are very erratic. Such conditions are favourable to the extensive use of accumulators.

When comparing the economy of hydraulic machinery which works intermittently, such as cranes and hoists, with other systems the effect of the hydraulic accumulator in reducing the maximum horse power required is often neglected. In consequence the comparison is vitiated, because the minimum cost of running a central station depends to a great extent upon the maximum demand, even though the maximum may be required only during a few minutes of the day. In the hydraulic system accumulators at the central stations perform the two distinct functions of reducing the maximum load on the pumps which supply the demand, and regulating automatically the speed of the pumps as the demand varies from minute to minute. In any large system where a number of pumping units are required they also allow a sufficient interval of time to start any additional units. Accumulators connected to the mains at a considerable distance from the central station reduce the variations of pressure, and the size of mains required for a given supply of power, and therefore have a most important influence on the economy of distribution. The mechanical efficiency of hydraulic accumulators is very high, being from 95% to 98%, and they are practically indestructible.

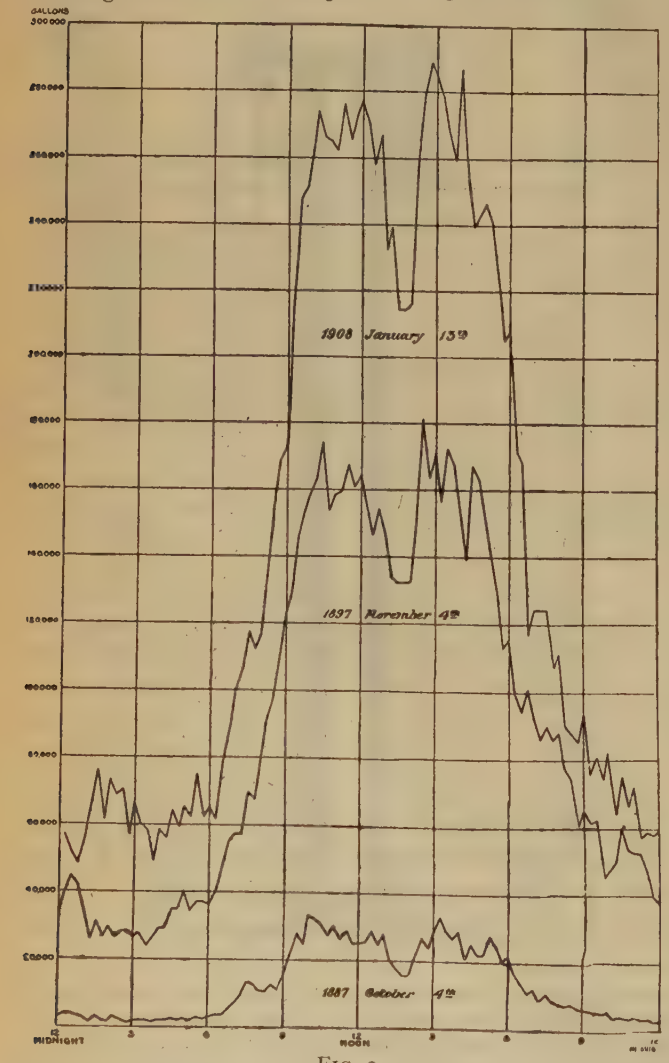


Fig. 2.

When designing central stations the aim should be to employ pumping engines of such capacity that they can be worked as nearly as possible continuously at about their maximum output; the same consideration should, in the main, determine the size of the pumping units in a station where more than a single unit is employed. With a number of units, each can be worked, when in use, at or near the most economical speed. Moreover, reserve plant is necessary if the supply of power is to be constant, and where the units are many the actual reserve required is less than where the units are few.

An effect of the multiplication of power units is to increase the capital outlay; indeed, it may be stated quite generally that economy in working and maintenance cannot be obtained without a larger capital outlay than would be required for a simpler and less economical plant. A high degree of economy estimated on financial data—the ultimate base on which these practical questions rest—can only be obtained in large installations where the averaging effect of the combination of a large number of comparatively small intermittent demands for power is greatest. The term *load-factor*, since it was first coined by Colonel R. E. Crompton in 1891, has come into common use as an expression of the relation between the average and the maximum output from any central source of supply. No argument is required to show that a given central station plant working continuously at its maximum speed day and night all the year round, say for 8760 hours in a year, should produce the power more cheaply per unit, not only as to the actual running cost, but also as to the capital or interest charges, than the same plant running on the average at the same speed for, say, one-third the time, or 2920 hours. In this case the load-factor 2920/8760 = ·333, or 33·370%. The saving on the whole expenditure per unit is not in direct proportion to an increase in the load-factor, and its effect on the various items of expenditure is extremely variable. The influence is greatest on the capital charges, and it has no influence at all, or may even have a detrimental effect, on some items; for instance, the cost of repairs per unit of output may be increased by a high load-factor. Its effect on the coal consumption depends very much on the kind and capacity of the boilers in use; on whether the engines are condensing or non-condensing; on the hours of work of the engine staff, &c. The economic value of the load-factor is of great importance in every installation, but its influence on the cost of supply varies at each central station, and must be separately determined. There is a load-factor peculiar to each use for which the power is supplied, and the whole load-factor can only be improved by the combination of different classes of demands, which differ in regard to the time of day or season at which they attain their maximum. It is in this respect that the great economy of a public distribution of power is most apparent, though there is also, of course, a direct economy due simply to the presumably large size of the central stations of a public supply. Demands for power of every kind have unfortunately a tendency to arise at the same time, so that in the absence of storage of power there seems no prospect of the load-factors for general supply of power in towns exceeding, in the most favourable conditions, 40%. The load-factor of most public hydraulic power supplies is considerably under 30%. It is questionable, however, whether a very high load-factor conduces to economy of working expenses as a whole in any general supply of energy. The more continuous the supply during the twenty-four hours of the day the greater is the difficulty of executing repairs, and the greater the amount of the reserve plant required.

In all central station work where fluctuating loads have to be dealt with it is most important that there should be ample boiler power. In a comprehensive system of power supply demand arises in a very sudden and erratic manner, and to meet this by forcing the boilers involves greater waste of coal than keeping steam up in sufficient reserve boilers. For this purpose boilers with large water capacity, such as the Lancashire, are preferable to the tubular type, if sufficient space is available. Superheated steam and also thermal storage are advantageous. Feed water heaters or economizers should always be used, all steam and feed pipes should be carefully protected from radiation, and the pipe flanges should be covered; in short, to secure good results in coal consumption every care must be taken to minimise the stand-by losses which are such serious items in central station economy when the load-factor is low. Though hydraulic power has the peculiar advantage, as regards coal consumption, that it is the speed of the engines which varies with an intermittent demand, nevertheless at the London stations it has been found that during a year's working only from 60 to 75% of the coal efficiency of trial runs of the engines can be obtained—*i.e.* at least 25% of the coal is wasted through the stand-by losses and through the pumping engines having to run at less than full power.

To determine the scale on which a central station plant should be designed is frequently a difficult matter. The rate of growth of the expected demand for the power is an important factor, but it has been clearly established that the reduction of working expenses resulting from the increase of size of an undertaking proceeds in a diminishing ratio. Increase in output is in fact sometimes accompanied by more than a proportionate increase of expenses. During recent years there have been causes at work which have raised considerably the price of labour, fuel, other items of expense, and the law of the "diminishing ratio" has been masked

On the diagram (fig. 3) of the costs of the London undertaking and the amount of power supplied, have been plotted points marking the total expenses of each year in relation to the output of power. These points for the years 1884–1899, and for output of from 50 to 700 million gallons followed approximately a straight line. Since 1899, however, though the output has increased from 708 millions to 1040 million gallons, the costs per unit of output have been always considerably above the preceding periods. The details of the London supply given in table 1 partly explain this by the relatively high price of fuel, but an equally important factor has been the rise in the local rates, which in the period 1899–1909 have risen from 2d. up to 3d. per 1000 gallons. If the cost of fuel, rates and wages had remained constant the plotting of expenses in relation to output would have been approximately along the extension of the line AB. This line cuts the vertical axis at A above the origin O, and the line OA indicates the minimum amount of the expenses, and by implication the initial size of the first central station erected in London. The curve in this diagram gives the cost per 1000 gallons.

Whether it is more economical to have several smaller stations in any particular system of power transmission, or a single centre of supply, is mainly governed by the cost of the mains and the facilities for laying them in the area served. No general rule can, however, be formulated, for it is a question of balance of advantages, and the solution must be obtained by consideration of the special circumstances of each case. It has been found desirable as the demand for the power and the area within which it is supplied has enlarged, not only to increase the number of central stations but also their capacity. The first pumping station erected was installed with 4 pumping engines of 200 h.p. each. The pumping capacity of this station has been increased to 7 units. The station at Rotherhithe completed in 1904 has 8 units together 1600 h.p., and the plant at the new station at Grosvenor Road has 8 units equalling 2400 h.p. The pumping stations are situated about 3 m. apart and concurrently with the increase in their size it has been found desirable to introduce a system of feeder mains (see below).

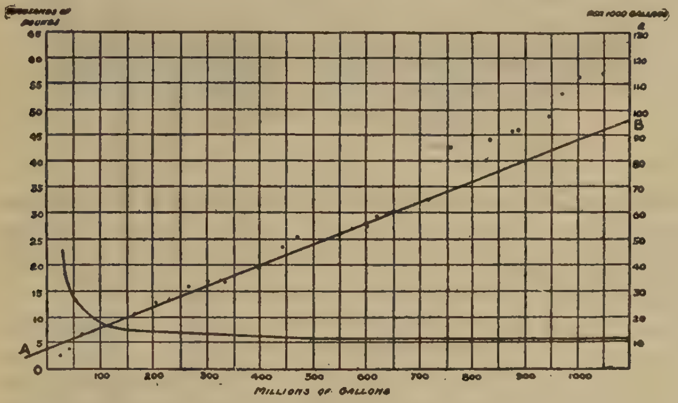


FIG. 3.

There are in all five central stations at work in connexion with the public supply of hydraulic power in London, having an aggregate of 7000 i.h.p. All the stations and mains are connected together and worked as one system. There are 14 accumulators with a total capacity of 4000 gallons, most of them having rams 20 in. diameter by 23 ft. stroke. The pumping engines are able together to deliver 11,000 gallons per minute. Details of the London supply are given in fig. 3 and in table 1.

TABLE I.

Year.	Gallons Pumped.	Annual Load-factors.	Maximum 24 hours Load-factors.	Cost of Fuel per 1000 gallons.	Price of Fuel per ton in Bunkers.	Number of Machines at work.	Miles of Mains.
				d.	s. d.		
1889	163,883,000	0·328	0·524	3·11	10 9	1022	38
1894	400,316,000	0·338	0·553	1·96	10 0	2204	73
1898	620,662,000	0·340	0·483	1·98	11 3	3515	109
1903	888,925,000	0·361	0·491	2·7	14 $3\frac{3}{4}$	5337	146
1909	1,027,147,000	0·354	0·495	2·78	15 1	6504	168

The load-factors are calculated on the actual recorded maximum output, and not on the estimated capacity of the plant running or installed. The daily periods of maximum output are shown in fig. 2. The table shows that the load-factors have not been much affected either by the increase of the area of supply or by the increased consumption of power. The coal used has been principally Durham small. The capital cost of the London undertaking has been about £950,000. In the central station at Wapping, erected in 1891, there are six sets of triple-expansion, surface-condensing vertical pumping engines of 200 i.h.p. each; six boilers with a working pressure of 150 ℔ per square inch, and two accumulators with rams 20 in. diameter by 23 ft. stroke loaded up to 800 ℔ per square inch. The engines run at a maximum piston speed of 250 ft. per minute, and the pumps are single-acting, driven directly from the piston rods. The supply given from this station in 1909 was approximately 6,800,000 gallons per week, and the cost for fuel, wages, superintendence, lighting, repairs and sundry station expenses 4·28d. per 1000 gallons, the value of the coal used being 14s. 11·3d. per ton in bunkers. The capital cost of the station, including the land, was £70,000. The load-factor at this station for 1909 was ·49, and the supply was maintained for 168 hours per week. The conditions are exceptionally favourable, and the figures represent the best result that has hitherto been obtained in hydraulic power central station work, having regard to the high price of fuel.

The installation in Hull differs little from the numerous private plants at work on the docks and railways of the United Kingdom. The value of the experiment was chiefly commercial, and the large public hydraulic power works established since are to be directly attributed to the Hull undertaking. In Birmingham gas engines are employed to drive the pumps. In Liverpool there are two central stations. The working pressure is 850 ℔ per square inch. There are 27 m. of mains, and about 1100 machines at work. In Manchester and Glasgow the pressure adopted is 1100 ℔ per square inch. In Manchester this pressure was selected principally in view of the large number of hydraulic packing presses used in the city, and the result has been altogether satisfactory. The works were established by the corporation in 1894, the central station being designed for 1200 i.h.p. Another station has since been built of equal capacity, and nearly 5 million gallons per week are being supplied to work about 2100 machines. Twenty-three miles of mains are laid.

In Antwerp a regular system of high-pressure hydraulic power transmission was established in 1894 specially to provide electric light for the city. The scheme was due to von Rysslеburgh, an electrical engineer of Ghent, who came to the conclusion that the most economical way of installing the electric light was to have a central hydraulic station, and from it transmit the power through pipes to various sub-stations in the town, where it could be converted by means of turbines and dynamos into electric energy. The coal cost of the electricity supplied—0·88d. per kw. hour—compares favourably with most central electric supply stations, although the efficiency of the turbines and dynamos used for the conversion does not exceed 40%. Von Rysslеburgh argued that hydraulic pumping engines would be more economical than steam-engines and dynamos, and that the loss in transmission from the central station to the consumer would be less with hydraulic converters than if the current were distributed directly. The loss in conversion, however, proved to be twice as great as had been anticipated, owing largely to defective apparatus and to under-estimation of the expense of maintaining the converting stations; and the net result was commercially unsatisfactory.

At Buenos Aires hydraulic mains are laid in the streets solely for drainage purposes. Each of the sumps, which are provided at intervals, contains two hydraulic pumps which automatically pump the sewage from a small section of the town into an outfall sewer at a higher level. The districts where this system is at work lie below the general drainage level of Buenos Aires. The average efficiency (pump h.p. to i.h.p.) is 41%, which is high, having regard to the low heads against which the pumps work. In this application all the conditions are favourable to hydraulic power transmission. The work is intermittent, there is direct action of the hydraulic pressure in the machines, and the load at each stroke of the pumps is constant. The same system has been adopted for the drainage of Woking and district, and a somewhat similar installation is in use at Margate.

Hydraulic power is supplied from the hydraulic mains on a sliding scale according to the quantity consumed. The minimum charge in London except for very large quantities is 1s. 6d. per 1000 gallons. In 1000 gallons at 750 ℔ per square inch there is an energy of $\frac{10{,}000\times1730}{33{,}000\times60}=8{\cdot}74$ h.p. hours; thus 1s. 6d. per 1000 gallons = 2d. per h.p. hour nearly. This amount is made up approximately of 9d. per 1000 gallons for the cost of generation, distribution and general expenses including rates and 9d. for capital charges. The average rate charged to consumers in 1908 was about 2s. 4d. per 1000 gallons. Even under the most favourable circumstances it does not appear probable that hydraulic power at 750 ℔ per square inch can be supplied from central stations in towns on a commercial basis over any considerable areas at less than 1s. per 1000 gallons. Allowing

75% as the efficiency of the motor through which the power is utilized, this rate would give 1·83d. per brake or effective h.p. hour. This cost seems high, and it is difficult to believe that it is the best hydraulic power transmission can accomplish having regard to the well-established fact that the mechanical efficiency of a steam pumping engine is greater than any other application of a steam-engine, and that the power can be conveyed through mains without any material loss for considerable distances. Still, no other system of power transmission except gas seems to be better off, and there is no method of transmission by which energy could, at the present time, be supplied retail in towns with commercial success at such an average rate when steam is employed as the prime mover. The average rate charged for hydraulic power in London and elsewhere is much the same as the average rate charged for the supply of electrical energy to the ordinary consumer. Gas is undoubtedly cheaper, but in a large number of cases is mechanically inconvenient in its application. Hydraulic pressure, electrical energy and compressed air (with reheating) can all be transmitted throughout towns with approximately the same losses and at the same cost, because the power is obtained in each system from coal, boilers, and steam-engines, and the actual loss in transmission can be kept down to a small percentage. The use of any particular system of power does not, however, primarily depend upon the cost of running the central station and distributing the power, but mainly upon the mechanical convenience of the system for the purpose to which it is applied. One form of energy is, in practice, found most useful for one purpose, another form for another and no one can command the whole field.

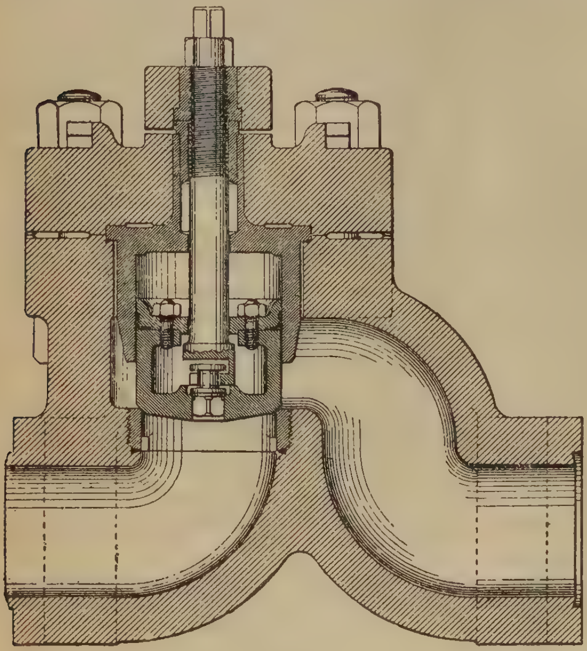


Fig. 4.

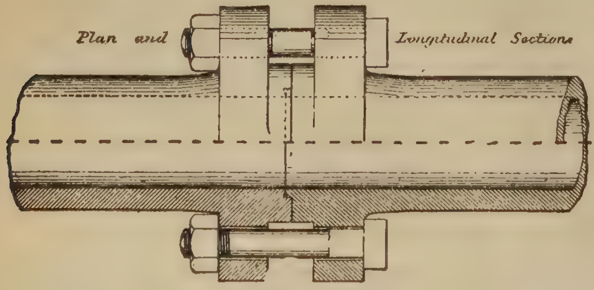


Fig. 5.

Precautions against Frost.

When water is employed as the fluid in hydraulic transmission the effects of frost must usually be provided against. In London and other towns, the water, before being pumped into the mains, is passed through the surface condensers of the engines, so as to raise its temperature. The mains are laid 3 ft. below the surface of the ground. Exposed pipes and cylinders are clothed, and means provided for draining them when out of use. When these simple precautions are adopted damage from frost is very rare. In special cases oil having a low freezing point is used, and in small plants good results have been obtained by mixing glycerin and methylated spirit with the water. A few gas jets judiciously distributed are of value where there is a difficulty in properly protecting the machinery by clothing.

Distribution.

From the central station the hydraulic power must be transmitted through a system of mains to the various points at which it is to be used. In laying out a network of mains it is first necessary to determine what velocity of flow can be allowed. Owing to the weight of water, the medium usually employed for hydraulic transmission, a low velocity is necessary in order to avoid shocks. The loss of pressure due to the velocity is independent of the actual pressure employed, and at moderate velocities of 3 to 4 ft. per second the loss per 1000 yds. is almost a negligible quantity at a pressure of 700 ℔ per square inch. For practical purposes Box's formula is sufficiently accurate—

$$\text{Loss of head} = \frac{\text{gallons}^2 \times \text{length in yards}}{(\text{diameter of pipes in inches} \times 3)^5}.$$

There is a further loss due to obstruction caused by valves and bends, but it has been found in London that a pressure of 750 ℔ at the central accumulators is sufficient to ensure a pressure of 700 ℔ throughout the system. The greatest distance the power is conveyed from the central stations in London is about 4 m. The higher the initial velocity the more variable the pressure; and in order to avoid this variation in any large system of mains it is usual to place additional accumulators at a

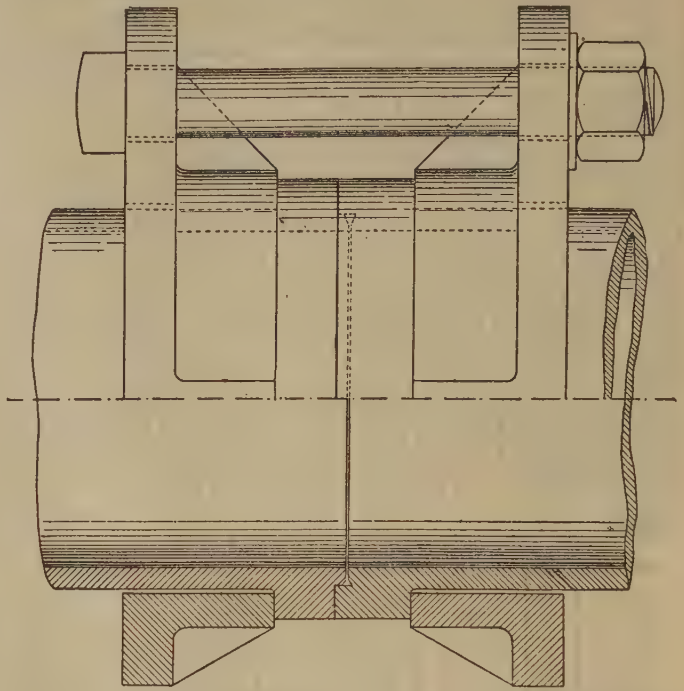


Fig. 6.—Half section and elevation at AB. Detail of 10″ steel pipe.

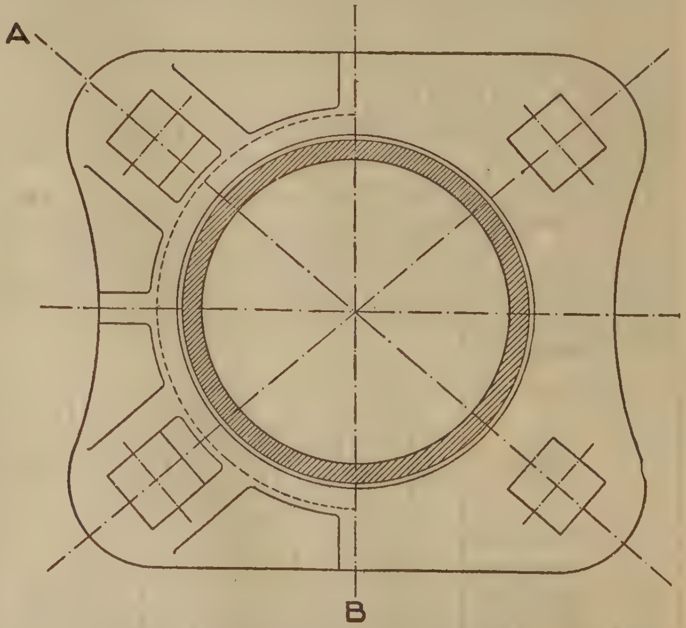


Fig. 6.—Half back elevation, half front elevation. Detail of 10″ steel pipe.

distance from the central station. They act in the same way as air-vessels. The mains should be laid in circuit, and valves placed at intervals, so that any section can be isolated for repairs or for making connexions without affecting the supply at other points. The main valves adopted in London are shown in fig. 4. Valves are also fixed to control all branch pipes, while relief valves, washouts and air valves are fixed as required.

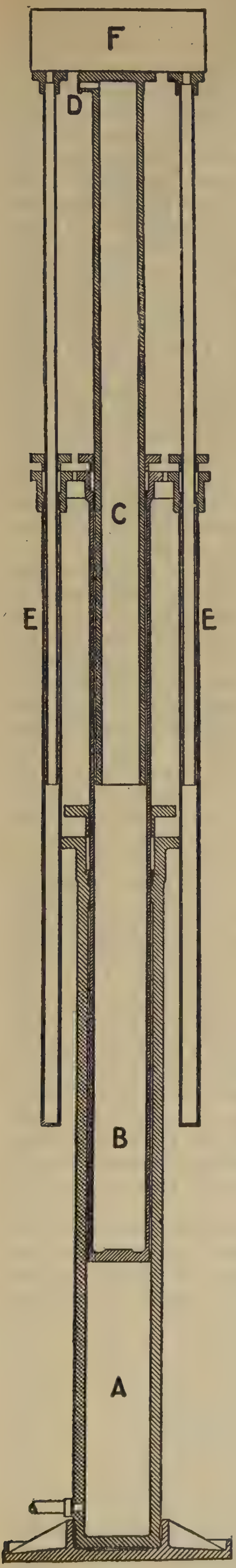


FIG. 7.

The largest pipes used in London are 10 in. internal diameter, and the smallest laid in the streets are 2 in. The pipes from 8 in. and below are usually made in cast iron, flanged and provided with spigots and faucets. The joint (fig. 5) is made with a gutta-percha ring, though sometimes asbestos and leather packing rings are used. Cast iron pipes for hydraulic power transmission have been standardized by the Engineering Standards Committee. Fig. 6 shows the 10 in. steel main as used in London. The main was laid in 1903 from the Rotherhithe Pumping Station of the London Hydraulic Power Company through the Tower Subway, and is used as a feeder main for supply to the City. It is the first instance of the use of feeder mains in hydraulic transmission. The velocity of flow is 6 ft. per second, and is automatically disconnected from the general system should the pressure in this main fall below that of accumulator pressure. Other mains, similarly controlled, are now in use. Ellington's system of hydraulic feeder mains has been developed by the laying of a 6-in. steel main from the Falcon Wharf Station at Blackfriars to the Strand, over Waterloo Bridge.

The Falcon Wharf Pumping Station at Blackfriars was the original central station in London, and the accumulators there are loaded to 750 ℔ per square inch. The other pumping stations are situated about 3 m. from Falcon Wharf and about the same distance from each other. The accumulator pressure at the outlying stations is during the busy time of the day maintained at about 800 ℔ per square inch. Consequently the smaller variations in demand for power throughout the system caused very intermittent running of the plant at Falcon Wharf, and the load-factor there is very low. The pumping plant has now been considerably increased, and part of the plant is constructed to pump into the feeder main at pressures of 800, 900, or 1000 ℔ per square inch according to the demand existing from hour to hour in the Strand district. By this means the output from Falcon Wharf has been doubled with a much improved load-factor. The accumulator in this system is of special construction (fig. 7). The pressure 750 ℔ per square inch is maintained in the cylinder A from the ordinary hydraulic supply main. The working ram B forms the cylinder for the fixed hollow ram C which is connected to the 6 in. bore feeder main D. The balancing rams E, E attached to the fixed head F serve the purpose of adjusting the pressure in the feeder main from 800 to 1000 ℔ per square inch according to the quantity of pressure water required to be transmitted through it. The higher pressure is required when the velocity in this main is 10 ft. per second. There is an automatic control valve at the junction of the feeder main with the service mains in the Strand, adjusted so that the same effect is produced as if a pumping station were in operation at that point of equal capacity to the maximum flow through the 6 in. main. The length of the feeder main in this case is 2000 yds., and at 10 ft. per second there is a loss of pressure of 240 ℔ per square inch, but the effect on the coal consumption is almost negligible, as the maximum flow is seldom needed. The engines are specially constructed to take the pressure overload. The feeder main is made of steel. The economical limit of the use of feeder mains is reached when the additional running expenses involved equal the annual value of the saving effected in the capital expenditure.

Registration.

In public supplies the power used is in all cases registered by meters, and since 1887 automatic instruments have been used at the central stations to record the amount supplied at each instant during the day and night. The ratio between the power registered at the consumers' machines and the power sent into the mains is the commercial efficiency of the whole system. The loss may be due to leakage from the mains or to defects in the meters; or if, as is often the case, the exhaust from the machines is registered, to waste on the consumers' premises. The automatic recorders give the maximum and minimum supplies during 24 hours every day, the maximum record showing the power required for a given number and capacity of machines, and the minimum giving an indication of the leakage. It has been found practicable to obtain an efficiency of 95% in most public power transmission plants over a series of years, but great care is required to produce so good a result. In some years 98% has been registered. Until 1888 no meters were available for registering a pressure of 700 ℔ per square inch, and all that could be done was to register the water after it had passed through the machines and lost its pressure. This method is still largely adopted; but now high-pressure meters give excellent results, exhaust registration is being superseded to a considerable extent by the more satisfactory arrangement of registering the power on its entry into the consumers' premises. In Manchester Kent's high-pressure meters are now used exclusively. Venturi meters have also been used with success for registering automatically the velocity of flow, and, by integration, the quantity in hydraulic power mains, and form a most useful check on the automatic recorders. The water after the pressure has been eliminated by passage through the machines, may run to a drain or be led back to the central station in return mains; the method adopted is a question of relative cost and convenience.

Machinery.

We proceed to the machines actuated by hydraulic power, and by a comparison of the useful work done by them with the work done by the engines and boilers at the central station the mechanical efficiency of the system as a whole can be gauged. At the central station and in the distribution there is no great difficulty in determining the efficiency within narrow limits; it should be 80% at the point of entry to the machine in which the pressure is used.

Where feeder mains are in use the efficiency of the system is necessarily reduced, owing to the higher velocities allowable in the feeder mains. Mechanical efficiency is then sacrificed for the sake of economy. The mechanical efficiency of the machines is a very uncertain quantity; the character of the machines and the nature of the conditions are so variable that a really accurate general statement is impossible. In most cases the losses in the machine are practically constant for a given size and speed of working; consequently the efficiency of a given machine may vary within very wide limits according to the work it has to do. For instance, a hydraulic pump of a given capacity, delivering the water to an elevation of 100 ft., will have an efficiency of 80%; but if the elevation of discharge is reduced to 15 ft., even though the hydraulic-pressure rams may be proportioned to the reduced head, the efficiency falls below 50%. The ultimate efficiency of the system, or $\frac{\text{pump h.p.}}{\text{i.h.p.}}$, in the one case is 64%, and in the other under 40%. In crane or lift work the efficiency varies with the size of the apparatus, with the load and with the speed. Efficiency in this sense is a most uncertain guide. Some of the most useful and successful applications of hydraulic power—as, for instance, hydraulic capstans for hauling wagons in railway goods yards—have a very low efficiency expressed on the ratio of work done to power expended. Hydraulic cranes for coal or grain hoisting have a high efficiency when well designed, but it is now very usual to employ grabs to save the labour of filling the buckets, and their use lowers the efficiency, expressed in tons of coal or grain raised, by 33% or even 50%. When hydraulic machines are fully loaded, 50% to 60% of the indicated power of the central station engine is often utilized in useful work done with a radius of 2 or 3 m. from the station. In very favourable circumstances the efficiency may rise to over 70% and in a great many cases in practice it no doubt falls below 25%. If, however, energy in any form can be obtained ready for use at a moderate rate, the actual efficiency of the machines (*i.e.* the ratio of the useful work done to the energy absorbed in the process) is not of very great importance where the use is intermittent.

Hydraulic pressure is more particularly advantageous in cases where the incompressibility of the fluid employed can be utilized, as in hydraulic lifts, cranes and presses. Hydraulic machines for these purposes have the peculiar and distinct advantage of direct action of the pressure on the moving rams, resulting in simplicity of construction, slow and steady movement of the working parts, absence of mechanical brakes and greatest safety in action. When the valve regulating the admission of the pressure to the hydraulic cylinder is closed, the water is shut in, and, as it is incompressible, the machine is locked. Thus all hydraulic machines possess an inherent brake; indeed, many of them are used solely as brakes.

Hydraulic power transmission does not possess the flexibility of electricity, its useful applications being comparatively limited, but the simplicity, efficiency, durability and reliability of typical hydraulic apparatus is such that it must continue to occupy an important position in industrial development.

Sometimes a much higher pressure than 700 ℔ or 1000 ℔ per square inch is desirable, more particularly for heavy presses and for machine tools such as are used for riveting, for punching, shearing, &c. The development of these applications has been largely due to the very complete machinery invented and perfected by R. H. Tweddell. One of the principal installations of this kind was erected in 1876 at Toulon dockyard, where the machines are all connected with a system of mains of 2½-in. bore and about 1700 yds. long, laid throughout the yard, and kept charged at a pressure of 1500 ℔ per square inch by engines of 100 h.p. with two large accumulators. Marc Berrier-Fontaine, the superintending engineer of the dockyard, stated that the economy of the system over the separately-driven geared machines formerly used is very great. But while pressures so high as 3 tons per square inch (as in the 12,000-ton Armstrong-Whitworth press) have been used for forging and other presses, it is not desirable, in the distribution of hydraulic power for general purposes, that 1000 ℔ per square inch should be much exceeded; otherwise the rams, which form the principal feature in nearly all hydraulic machines, if proportioned to the work required, will often become inconveniently small, and other mechanical difficulties will arise. The cost of the machinery also tends to become greater. In particular cases the working pressure can be increased to any desired extent by means of an intensifier (fig. 8).

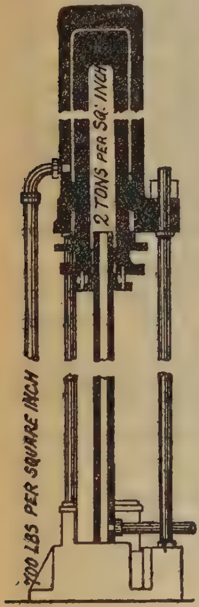


Fig. 8.

An important application of hydraulic power transmission is for ship work, the system being largely adopted both in H.M. navy and for merchant vessels. Hydraulic coal-discharging machinery was fitted by Armstrong as early as 1854 on board a small steamer, and in 1868 some hopper barges on the Tyne were supplied with hydraulic cranes. A. Betts Brown of Edinburgh applied hydraulic power to ship work in 1873, and in the same year the first use of this power for gunnery work was effected by G. M. Rendel on H.M.S. "Thunderer." The pressure usually employed in H.M. navy is 1000 ℔ per square inch. Accumulators are not used and the engines have to be fully equal to supply directly the whole demand. The distance through which the power has to be transmitted is, of course, very short, and the high velocity of 20 ft. per second is allowed in the main pipes. The maximum engine-power required under these conditions on the larger ships is very considerable. A recent development of hydraulic power on board ship is the Stone-Lloyd system of closing bulkhead doors. In hydraulic transmission of power it is usually the pressure which is employed, but there are one or two important cases in which the velocity of flow due to the pressure is utilized in the machine. Reference has already been made to the use of turbines working at 750 ℔ per square inch at Antwerp. The Pelton wheel has also been found to be adapted for use with such high pressures. Another useful application of the velocity due to the head in hydraulic transmission is in an adaptation of the well-known jet pump to fire hydrants. The value of the system of hydraulic transmission for the extinction of fire can hardly be overestimated where, as in London and most large towns, the ordinary pressure in the water mains is insufficient for the purpose.

Authorities.—Armstrong, *Proc. Inst. C.E.* (1850 and 1877), *Proc. Inst. Mech. E.* (1858 and 1868); Blaine, *Hydraulic Machinery* (1897); Davey, *Pumping Machinery* (1905); Dunkerley, *Hydraulics* (1907); Ellington, *Proc. Inst. C.E.* (1888 and 1893), *Proc. Inst. Mech. E.* (1882 and 1895), *Proc. Liverpool Eng. Sic.* (1880 and 1885); Greathead, *Proc. Inst. Mech. E.* (1879); Marks, "Hydraulic Power," *Engineering* (1905); Parsons, "Sanitary Works, Buenos Aires," *Proc. Inst. C.E.* (1896); Robinson, *Hydraulic Power and Hydraulic Machinery* (1887); Tweddell, *Proc. Inst. C.E.* (1883 and 1894), *Proc. Inst. Mech. E.* (1872 and 1874); Unwin, *Transmission of Power* (1894), *Treatise on Hydraulics* (1907). (E. B. E.)

III.—Pneumatic

Every wind that blows is an instance of the pneumatic transmission of power, and every windmill or sail that catches the breeze is a demonstration of it. The modern or technical use of the term, however, is confined to the compression of air at one point and its transmission to another point where it is used in motors to do work. The first recorded instance of this being done was by Denis Papin (b. 1647), who compressed air with power derived from a water-wheel and transmitted it through tubes to a distance. About 1800 George Medhurst (1759–1827) took out patents in England for compressing air. He compressed and transmitted air which worked motors, and he built a pneumatic automobile. William Mann in 1829 took out a patent in England for a compound air compressor. In his application he states: "The condensing pumps used in compressing I make of different capacities, according to the densities of the fluid to be compressed, those used to compress the higher densities being proportionately smaller than those previously used to compress it to the first or lower densities," &c. This is a very exact description of the best methods of compressing air to-day, omitting the very important inter-cooling. Baron Van Rathen in 1849 proposed to compress air in stages and to use inter-coolers between each stage to get 750 ℔ pressure for use in locomotives. For the next forty years inventors tried without success all manner of devices for cooling air during compression by water, either injected into the cylinder or circulated around it, and finally, with few exceptions, settled down to direct compression with no cooling worthy of mention. Only in the last ten years of the 19th century were the fundamental principles of economical air compression put into general practice, though all of them are contained in the patent of William Mann and the suggestion of Van Rathen.

The first successful application of compressed air to the transmission of power, as we know it, was at the Mont Cenis Tunnel in 1861. The form of compressor used was a system of water rams—several of them in succession—in which water was the piston, compressing the air upwards in the cylinder and forcing it out. Although the air came in contact with the water, it was not cooled, except slightly at the surface of the water and around the walls of the cylinders. The compressors were located near the tunnel, and the compressed air was transmitted through pipes to drilling machines working at the faces in the tunnel. Rotary drills were tried first, but were soon replaced by percussion drills adapted from drawings in the United States Patent Office, copied by a French and Italian commission from the patent of J. W. Fowle of Philadelphia. H. S. Drinker (*Tunneling, Explosive Compounds and Rock Drills*, New York, 1893) states positively that the first percussion drill ever made to work successfully was patented by J. J. Couch of Philadelphia in 1849. Shortly afterwards Fowle patented his drills, in which the direct stroke and self-rotating principle was used as we use it now. The first successful drill in the Hoosac Tunnel was patented in 1866 by W. Brooks, S. F. Gates and C. Burleigh, but after a few months was replaced by one made by Burleigh, who had bought Fowle's patent and improved it. Burleigh made a compressor, cooling the air during compression by an injected spray of water in the cylinders. The successful work in the Mont Cenis and Hoosac Tunnels with the percussion drilling machines caused the use of compressed air to spread rapidly, and it was soon found there were many other purposes for which it could be employed with advantage.

The larger tunnels and metal mines were naturally the earliest to adopt pneumatic transmission, often using it for pumping and hoisting as well as drilling. In Paris and Nantes, in Berne and in Birmingham (England), street tramways have been operated by pneumatic power, the transmission in these, however, being in tanks rather than pipes. Tanks on the cars are filled at the central loading stations with air at very high pressure, which is used in driving the motors, enough being taken to enable the car to make a trip and return to the loading station. Several attempts in pneumatic street traction were made in America, but failed owing to financial troubles and the successful introduction of electric traction. It is used very successfully, however, both in Europe and in America, in underground mine haulage, being especially adapted to coal mines, where electricity would be dangerous from its sparks. The copper smelting works at Anaconda, Montana, U.S.A., uses twelve large pneumatic locomotives for charging the furnaces, removing slag, &c. Many stone quarries have a central plant for compressing air, which is transmitted through pipes extending to all working points, and operates derricks, hoists, drills, stone cutters, &c., by means of motors. Every considerable ironworks, railroad shop or foundry has its pneumatic transmission plant. Also in the erection of the larger steel bridges or buildings a pneumatic transmission system is part of the contractor's outfit, and many railways have a portable compressing plant on a car ready to be moved to any point as needed.

Dr Julius G. Pohle, of Arizona, patented in 1886, and introduced extensively, the use of compressed air for lifting water directly, by admitting it into the water column. His plan is largely adopted in artesian wells that do not flow, or do not flow as much as desired, and is so arranged that the air supply has a back pressure of water equal to at least half the lift. If it is desired to lift the water 30 ft. the air is admitted to the water column at least 30 ft. below the standing water surface. The air admitted being so much lighter than the water it displaces, the column 60 ft. high becomes lighter than the column 30 ft. high and is constantly released and flows out at the top. The efficiency of this method is only 20 to 40%, depending on the lift, but its adaptation to artesian wells renders it valuable in many localities.

A remarkable pneumatic transmission system was installed in 1890 by Priestly in the Snake River Desert, Idaho, U.S.A. On the north side of the river is a cliff, nearly perpendicular, about 300 ft. high. One hundred and ninety feet above the river, for a considerable distance along the cliff, streams of water gush out from between the bottom of the great lava bed and the hardened clay of the old lake bottom. Priestly, without knowledge of Pohle's system, built a pipe line down the bluff and trained the water into it in such a way that it carried a very considerable quantity of air in the form of bubbles along with it down the pipe, compressing it on the way. The air was collected at the bottom in a covered reservoir, and taken up the cliff again to the lower part of an inverted siphon pipe, one side of which reached down from the water-supply about 60 ft. and the other side reached up and over the bluff. Allowing the water to fill both sides of the pipe to the level of the water-supply, he admitted his compressed air at about 75 ℔ pressure into the long side of the pipe near the bottom, and soon had water flowing upwards over the cliff and irrigating a large tract of rich lava land. He had made a power, a transmission and a motor plant without a moving part. A similar compressor was installed near Montreal, Canada, in 1896; another at Ainsworth, British Columbia, in 1898; and another at Norwich, Connecticut, U.S.A., in 1902. These are called hydraulic air compressors and show an efficiency of about 70%. They are particularly adapted to positions where there is a large flow of water with a slight fall or head.

The actual transmission of power by air from the compressor to the motor is simple and effective. The air admits of a velocity of 15 to 20 ft. per second through pipes, with very slight loss by friction, and consequently there is no necessity for an expensive pipe system in proportion to the power transmitted. It is found in practice that, allowing a velocity as given above, there is no noticeable difference in pressure between the compressor and the motor several miles away. Light butt-welded tubing is largely used for piping, and if properly put in there is very slight loss from leakage, which, moreover, can be easily detected and stopped. In practice, a sponge with soap-suds passed around a joint furnishes a detective agency, the escaping air blowing soap bubbles. In good practice there need not be more than 1% loss through leakage and 1% possibly through friction in the pneumatic transmission of power.

Air develops heat on compression and is cooled by expansion, and it expands with heat and contracts with cold. For the purpose of illustration suppose a cylinder 10 ft. long containing 10 cub. ft. of air at 60° F., with a frictionless piston at one end. If this piston be moved $7\frac{1}{2}$ ft. into the cylinder, so that the air is compressed to one-quarter of its volume, and none of the heat developed by compression be allowed to escape, the air will be under a pressure of 90 ℔ per square inch and at a temperature of 460° F. If this air be cooled down to 60° F. the pressure will be reduced to 45 ℔ per square inch, showing that the heat produced in the air itself during compression gives it an additional expansive force of 45 ℔ per square inch. The average force or pressure in compressing this air without loss of heat is 21 ℔ per square inch, whereas if all the heat developed during compression had been removed as rapidly as developed the average pressure on the piston would have been only 11 ℔ per square inch, showing that the heat developed in the air during compression, when not removed as fast as developed, caused in this case an extra force of 10 ℔ per square inch to be used on the piston. If this heated air could be transmitted and used without any loss of heat the extra force used in compressing it could be utilized; but in practice this is impossible, as the heat is lost in transmission. If the piston holding the $2\frac{1}{2}$ cub. ft. of air at 45 ℔ per square inch and at 60° F. were released the air expanding without receiving any heat would move it back within $3\frac{1}{3}$ ft. of the end only, and the temperature of the air would be lowered 170° F., or to 110° F. below zero. If the air were then warmed to 60° F. again it would move the piston the remaining $3\frac{1}{3}$ ft. to its starting point.

It is seen that the ideal air-compressing machine is one which will take all the heat from the air as rapidly as it is developed during compression. Such "isothermal compression" is never reached in practice, the best work yet done lacking 10% of it. It follows that the most inefficient compressing machine is one which takes away no heat during compression—that is, works by "adiabatic compression," which in practice has been much more nearly approached than the ideal. It also follows that the ideal motor for using compressed air is one which will supply heat to the air as required when it is expanding. Such "isothermal" expansion is often attained, and sometimes exceeded, in practice by supplying heat artificially. Finally, the most inefficient motor for using compressed air is one which supplies no heat to the air during its expansion, or works by adiabatic expansion, which was long very closely approached by most air motors. In practice isothermal compression is approached by compressing the air slightly, then cooling it, compressing it slightly again, and again cooling it until the desired compression is completed. This is called compression in stages or compound compression. Isothermal expansion is approximately accomplished by allowing the air to do part of its work (as expanding slightly in a cylinder) and then warming it, then allowing it to do a little more and then warming it again, and so continuing until expansion is complete. It will be seen that the air is carefully cooled during compression to prevent the heat it develops from working against compression, and even more carefully heated during expansion to prevent loss from cold developed during expansion. More stages of compression of course give a higher efficiency, but the cost of machinery and friction losses have to be considered. The reheating of air is often a disadvantage, especially in mining, where there are great objections to having any kind of combustion underground; but where reheating is possible, as W. C. Unwin says, "for the amount of heat supplied the economy realized in the weight of air used is surprising. The reason for this is, the heat supplied to the air is used nearly five times as efficiently as an equal amount of heat employed in generating steam." Practically there is a hot-air engine, using a medium much more effective than common air, in addition to a compressed-air engine, making the efficiency of the whole system extremely high. (A. De W. F.)

IV.—Electrical

Though the older methods of power transmission, such as wire ropes, compressed air and high-pressure water, are still worked on a comparatively small scale, the chief commercial burden has fallen upon the electric generator and motor linked by a transmission line. The efficiency of the conversion from mechanical power to electrical energy and back again is so high, and the facility of power distribution by electric motors is so great, as to leave little room for competition in any but very exceptional cases. The largest single department of electrical power transmission—that is, transmission for traction purposes—is at present almost wholly carried on by continuous currents. The usual voltage is 500 to 600, and the motors are almost universally series-wound constant-potential machines. The total amount of such transmission in daily use reaches probably a million and a half horse power. In long distance power transmission proper continuous currents are not used to any considerable extent, owing mainly to the difficulty of generating continuous currents at sufficient pressure to be available for such work, and the difficulty of reducing such pressure, even if it could be conveniently obtained, far enough to render it available for convenient distribution at the receiving end of the line. Single continuous current machines have seldom been built successfully for more than about 2000 to 3000 volts, if at the same time they were required to deliver any considerable amount of current. About 300 to 500 kilowatts per machine at this voltage appears to be the present limit, although it is by no means unlikely that the use of commutating poles and other improvements may considerably increase these figures. For distances at which more than this very moderate voltage is desirable one must either depend on alternating currents or use machines in series. In American practice the former alternative is universally taken. On the continent of Europe a very creditable degree of success has been achieved by adopting the latter, and many plants upon this system are in use, mostly in Switzerland. In these generators are worked at constant current, a sufficient number in series being employed to give the necessary electromotive force.

Power Transmission at Constant Current.—In this system, which has been developed chiefly by M. Thury, power is transmitted from constant current generators worked in series, and commonly coupled mechanically in pairs or larger groups driven by a single prime mover. The individual generators are wound for moderate currents, generally between 50 and 150 amperes, and deliver this ordinarily at a maximum voltage of 2000 to 3500, the output per armature seldom being above 300 kw. For the high voltages needed for long distance transmission as many generators as may be required are thrown in series. In the Moutiers-Lyons transmission of 110 m., the most considerable yet installed on this system, there are four groups, each consisting of four mechanically-coupled generators. The common current is 75 amp., and the maximum voltage per group is about 15,000 volts, giving nearly 60,000 volts as the transmission voltage at maximum load. In the St Maurice-Lausanne transmission of about 35 m. the constant current is 150 amp. and the voltage per armature is 2300, five pairs being put in series for the maximum load voltage of 23,000.

Regulation in such plants is accomplished either by varying the field strength through an automatic governor or by similarly varying the speed of the generators. Either method gives sufficiently good results. The transmission circuit is of the simplest character, and the power is received by motors, or for local distribution by motor generators, held to speed by centrifugal governors controlling field-varying mechanism. For large output the motors, like the generators, are in groups mechanically coupled and in series. In the Moutiers-Lyons transmission motor-generators are even designed to give a three-phase constant potential distribution, and in reverse to permit interchange of energy between the continuous current and several polyphase transmission systems.

The advantages of the system reside chiefly in easier line insulation than with alternating currents and in the abolition of the difficulties due to line inductance and capacity. It is probably as easy to insulate for 100,000 volts continuous current as for 50,000 volts alternating current. Part of the difference is due to the fact that in the latter case the crest of the E.M.F. wave reaches nearly 75,000 volts, and in addition static effects and minor resonant rise of voltage must be reckoned with. There is some possibility, therefore, of the advantageous use of continuous current in case very great distances, requiring enormous voltages, have to be covered. In addition, a constant current plant is at full voltage only at brief and rare periods of maximum load instead of all the time, which greatly increases the average factor of safety in insulation.

On the other hand, the constant current generators are relatively expensive and of inconveniently small individual output for large transmission work, and require very elaborate precautions in the matter of insulation. Their efficiency is a little less than that of large alternators, but the difference is partially off-set by the transformers used with the latter for any considerable voltage. A characteristic advantage of the constant current system is the extreme simplicity and cheapness of the switching arrangements as compared with the complication and cost of the ordinary switch-board for a polyphase station at high voltage. Comparing station with station as a whole it is at least an open question whether the polyphase system would have any material advantage in cost per kw. in an average case. The principal gains of the alternating systems appear in the relative simplicity of the distribution. In dealing with a few large power units the constant current system has the best of the argument in efficiency, but in the ordinary case of widespread distribution for varied purposes the advantage is quite the other way.

The high-voltage constant-current plant lends itself with especial ease to operation, at least in emergency, over a grounded circuit. In some recent plants, *e.g.* Moutiers-Lyons, provision is made at the sub-stations for grounding the central point of the system and either line in case of need, and in point of fact the voltage drop in working grounded is found to be within moderate and practicable limits.

The possibilities of improvement in the system have by no means been worked out, and although it has been overshadowed by the enormous growth of polyphase transmission it must still be considered seriously.

Transmission by Alternating Current.—The alternating current has conspicuous advantages. In the first place, whatever the voltage of transmission, the voltage of generation and that of distribution can be brought within moderate limits at a very high degree of efficiency by the use of transformers; and, in the second place, it is possible to build alternating-current generators of any required capacity, and for voltages high enough to permit the abolition of raising transformers except in unusual circumstances. At present such generators, giving 10,000 to 13,500 volts directly from the armature windings, are in common and highly successful use; and while the use of raising transformers is preferred by some engineers, experience shows that they cannot be considered essential, and are probably not desirable for the voltages in question, which are as great as at the present time seem necessary for the numerical majority of transmission plants. Polyphase generators, especially in large sizes, can be successfully wound up to more than double the figures just mentioned. The plant at Manojlovac, Dalmatia, has been equipped with four 30,000 volt three-phase generators, giving each about 5000 kw. at 42 ~ with 420 revolutions per minute, the full load efficiency being 94%. But for very large transmission work to considerable distances where much higher voltages are requisite such transformers cannot be dispensed with. Alternating currents are practically employed in the polyphase form, on account both of increased generator output in this type of apparatus and of the extremely valuable properties of the polyphase induction motors, which furnish a ready means for the distribution of power at the receiving end of the line. As between two- and three-phase apparatus the present practice is about equally divided; the transmission lines themselves, however, are, with rare exceptions, worked three-phase, on account of the saving of 25% in copper secured by the use of this system. Inasmuch as transformers can be freely combined vectorially to give resultant electromotive forces having any desired magnitudes and phase relations the passage from two-phase to three-phase, and back again, is made with the utmost ease, and the character of the generating and receiving apparatus thus becomes almost a matter of indifference. As regards such apparatus it is safe to say that honours are about even: sometimes one system proves more convenient, sometimes the other. The difficulty of obtaining proper single-phase motors for the varied purposes of general distribution has so far prevented any material use of single-phase transmission systems.

Generators for Power Transmission.—The generators are usually large two- or three-phase machines, and in the majority of instances they are driven by water-wheels. Power transmission on a large scale from steam plant has, up to the present, made no substantial progress, save as the networks of large electrical supply stations have in some cases grown to cover radii of many miles. The size of these generators varies from 100 or 200 kw. in small plants, up to 10,000 or more in the larger ones. Their efficiency ranges from 92% or thereabouts in the smaller sizes up to 96% or a fraction more in the largest, at full load. The voltage of these generators varies greatly. When raising transformers are used it is usually from 500 to 2500 volts; without them the generators are usually wound for 10,000 to 13,500 volts. Intermediate voltages have sometimes been employed, but are rather passing out of use, as they seem to fulfil no particularly useful purpose. The tendency at the present time, whatever the voltage, is towards the use of machines with stationary armatures and revolving field magnets, or towards a pure inductor type having all its windings stationary. At moderate voltages such an arrangement is merely a matter of convenience, but in high-voltage generators it is practically a necessity. Low-voltage machines are usually provided with polyodontal windings, these windings having several separate armature teeth per pole per phase, while the high-voltage machines are generally monodontal; in both classes the edges of the pole pieces are usually chamfered away in such form as to produce at least a close approximation to the sinusoidal form for the electromotive force. For this purpose, and to obtain a better inherent regulation under variations of load, the field magnets are, or should be, particularly powerful. In the best modern generators the variation of electromotive force from no load to full load, non-inductive, is less than 10% at constant field excitation. Closeness of inherent regulation is an important matter in generators for transmission work, inasmuch as there is as yet no entirely successful method of automatic voltage regulation on very large units; and the less hand regulation the better. Moreover, the design which secures this result also tends to secure stability of wave form in the electromotive force, a matter of even greater importance. There has been much discussion as to the best wave form for use on alternating circuits, it having been conclusively shown that for a given fundamental frequency the sinusoidal wave does not give the most economical use of iron in the transformers. For transmission work, however, particularly over long lines, this is a matter of inconceivably small importance compared with the stability and the freedom from troubles from higher harmonics that result from the use of a wave as nearly sinusoidal as can possibly be obtained. In every alternating circuit the odd harmonics are considerably in evidence in the electromotive force, either produced by the structure of the generator or introduced by the transformers and other apparatus. These are of no particular moment in work upon a small scale, but in transmission on a large scale to long distances, or especially through underground cables, they are, as will be seen in the consideration of the transmission line itself, a serious menace. Inasmuch as the periodicity of an alternating circuit must be maintained sensibly constant for successful operation, great care is usually exercised to secure such governing of the prime movers as will give constant speed at the generators. This can now be obtained, in all ordinary circumstances, by several forms of sensitive hydraulic governors which are now in use. The matter of absolute periodicity has not yet settled itself into any final form. American practice is based largely upon 60 cycles per second, which is probably as high a frequency as can be advantageously employed. Indeed, even this leads to some embarrassment in securing good motors of moderate rotative speed, and the tendency of the frequency is rather downward than upward. An inferior limit is set by the general desirability of operating incandescent lamps off the transmission circuits. For this purpose the frequency should be held above 30 cycles per second; below this point, flickering of the lamps becomes progressively more serious, especially with lamps having the very slender metallic filaments now commonly employed—so serious, indeed, as practically to prohibit their successful use—and plants installed for such low frequencies are generally confined to motor practice, or to the use of synchronous converters, which are somewhat easier to build in large units at low than at high periodicities. Occasional plants for railway and heavy motor service operate at as low as 15 ~, and more at 25 ~. Nearly all the general work of power transmission, however, is carried on between 30 and 60 ~. The inferior limit at which it is possible successfully to operate alternating arc lamps is about 40 ~; and if these are to be an important feature in transmission systems the indications are that practice will tend towards a periodicity above 40 ~, at which all the accessory apparatus can be successfully operated. European practice is based generally upon a frequency of 50 ~, which admirably meets average conditions of distribution.

Transmission Lines.—Power transmission lines differ from those used for general electric distribution principally in the use of higher voltage and in the precautions entailed thereby. The economic principles of design are precisely the same here as elsewhere, save that the conductors vary less in diameter and far more in length. Inasmuch as transmission systems are frequently installed prior to the existence of a well-developed distribution system the conditions of load and the market for the power transmitted can seldom be predicted accurately; consequently, the cases are very rare in which Kelvin's law can be applied with any advantage; and as it is at best confined to determining the most economical conditions at a particular epoch this law is probably of less use in power transmission than in any other branch of electric distribution. A superior limit is set to the permissible loss of energy in the line by the difficulty attending regulation for constant potential in case the line loss is considerable. The inferior limit is usually set by the undesirability of too large an investment in copper, and lines are usually laid out from the standpoint of regulation rather than from any other. In ordinary practice it seldom proves advantageous to allow more than 15% loss in the line even under extreme conditions, and the cases are few in which less than 5% loss is advisable. These few cases comprise those in which the demand for power notably overruns the supply as limited by the maximum power available at the generating station, and also the few cases in which a loss greater than 5% would indicate the use of a line wire too small from a mechanical standpoint. It is not advisable to attempt to construct long lines of wire smaller than No. 2 American wire-gauge (·257 in. diameter), although occasionally wire as small as No. 4 (·204 in. diameter) may safely be employed. Smaller diameter than this involves considerable added difficulty of insulation in lines operated at voltages in excess of about 50,000. The vast majority of transmission lines are composed of overhead conductors. In rare instances underground cables are used. In single-phase work these are preferably of concentric form, which, however, gets too complicated in the three-phase lines generally employed to secure economy in copper; for the latter, triplicate cables, lead sheathed, laid in glazed earthenware ducts, seem to give the best results. On account of the cost and the difficulty of repair of such lines they are not extensively used, and cables have not yet been produced for the extremely high voltages desirable in some very long circuits, although they are readily obtainable for voltages up to 30,000 or 40,000. As to the material of the conductors, copper is almost universally used. For very long spans, however, bronze wire of high tensile strength is occasionally employed as a substitute for copper wire, and more rarely steel wire; aluminium, too, is beginning to come into use for general line work. Bronze of high tensile strength (say 80,000 to 100,000 ℔ per square inch) has unfortunately less than half the conductivity of copper; and unless spans of many hundred feet are to be attempted it is better to use hard-drawn copper, which gives a tensile strength of from 60,000 to 65,000 ℔ to the square inch, with a reduction in conductivity of only 3 to 4%. As to aluminium, this metal has a tensile strength slightly less than that of annealed copper, a conductivity about 60% that of copper, and for equal conductivity is almost exactly one-half the weight. Mechanically, aluminium is somewhat inferior to copper, as its coefficient of expansion with temperature is 50% greater; and its elastic limit is very low, the metal tending to take a permanent set under comparatively light tension, and being seriously affected at less than half its ultimate tensile strength. Joints in aluminium wire are difficult to make, since the present methods of soldering are little better than cementing the metal with the flux; in practice the joints are purely mechanical, being usually made by means of tight-fitting sleeves forced into contact with the wire. With suitable caution in stringing, aluminium lines can be successfully used, and are likely to serve as a useful defence against increase in the price of copper. Whatever the material, most important lines are now built of stranded cable, sometimes with a hemp core to give added flexibility.

With respect to line construction the introduction of high voltages, say 40,000 and upwards, has made a radical change in the situation. The earlier transmission lines were for rather low voltages, seldom above 10,000. Insulation was extremely easy, and the transmission of any considerable amount of power implied heavy or numerous conductors. The line construction therefore followed rather closely the precedents set in telegraph and telephone construction and in low tension electric light service. In American practice the lines were usually of simple wooden poles set 40 to 50 to the mile, and carrying wooden cross-arms furnished with wooden pins carrying insulators of glass or porcelain. The poles were little larger than those used in telegraph lines, a favourite size being a 40-ft. pole about 8 in. in diameter at the top and 15 in. at the butt, set 6 to 7 ft. in the earth. Such poles commonly bore two cross-arms, the lower and longer carrying 4 pins, and the shorter upper arm 2 pins, so disposed that the upper pin on each side of the pole would form with the nearer pins below an equilateral triangle 18 to 24 in. on the side. The poles therefore carried two three-phase circuits one on either side, one or both circuits being spiralled. In European practice iron poles have been more frequently used, again following rather closely the model of telegraph practice, with similar spacing of poles, and with insulators, usually of porcelain, somewhat enlarged and improved over telegraph and electric light insulators, and spaced somewhat more widely. As between wooden and steel poles, the latter are of course the more durable and much the more costly. The difference in cost depends largely on the locality, and ultimately on the life of the wooden poles. This ranges from two or three up to ten or fifteen years, the latter figures only in favourable soils and when the lower ends of the poles have been thoroughly treated with some preservative. Under such conditions wood is often ultimately the cheaper material.

The use of very high voltages results in, for all moderate powers, the use of small and consequently light wires and in the necessity for heavy, large and costly insulators. For security against leakage and failure it becomes desirable to reduce the numer of insulation points, and with the resulting lengthening of span to design the line as a mechanical structure. A transmission line is subject to three sets of stresses. The most considerable are those due to the longitudinal pull of the catenary depending on the weight and tension of the wires. Under ordinary conditions these strains are balanced and come into play only when there is breakage of one or more wires and consequent unbalancing. It has been the common practice to give the poles sufficient strength to withstand this pull without failing. The maximum amount of the pull may be safely taken at the sum of the elastic limits of the wires, since it is unsafe so to design the spans as to be subject to larger stresses.

There is also lateral stress on a line due to wind acting upon the poles and wires, the latter amounting to little unless their diameter is increased by a coating of sleet, a condition which gives maximum stresses on the line. Wind then tends to push the line over, and it also increases the longitudinal stresses, being added geometrically to the catenary stress. The actual possibility of wind pressure is very generally over-estimated, and has resulted in much needlessly costly construction. In the first place, save for actual tornadoes, for which no estimates can be given, even the highest winds at the level of any ordinary transmission line are of modest actual velocity. It is probable that no transmission line save on mountain peaks at a very high elevation is ever exposed to an actual wind velocity of 75 m. per hour, and only at intervals of years is a velocity of even 60 m. reached near the ground level. Further, the maximum wind velocities are practically never reached at very low temperatures when the line is under its maximum catenary stress, and sleet formation, which takes place only within a very limited temperature range, is practically unknown under conditions of maximum wind. The relation of wind velocity to pressure in case of a suspended wire or cable may be approximately expressed by the equation $P=0\cdot0025V^2$, where P is the pressure per square foot of projected area of cable, and V is the actual wind velocity in miles per hour. Except for sleet conditions the wind pressure is, then, a matter of little concern. At times sleet may accumulate on bare wires to a thickness of half an inch to an inch. Even under these conditions the lateral stability of the line is a matter of less concern than the added component of stress in the catenary. The third element of line stress, the actual crushing stress of the wire load, is of no consequence in high voltage transmission work.

In scientific line design the best example has been set by the Italian engineers, who, realizing that the longitudinal strains, which are very severe in case of breakage of spans rigidly supported from pole to pole, are immediately relieved by a slight increase in catenary drop, have introduced the principle of longitudinal flexibility. The poles or towers of structural steel are so designed as to be fairly stiff against lateral pressure and are given secure foundation against overturning, but are deliberately designed to deflect lengthwise the line in the extreme case of breakage of wires so as at once to relieve the catenary tension without passing their elastic limit. In this way complete security is attained with a minimum of material and expense.

In recent construction both in America and Europe the tendency is to use steel poles or towers of ample height, 40 to 60 ft. and spans ranging from 300 to 600 ft., occasionally more. The catenary drop allowed is considerable, often 3 to 4% of the span length. Cross-arms and pins, when used, are commonly of iron or steel, and the interiors of the insulators are therefore fairly at earth potential. The insulators are of dense and hard-baked porcelain, built up of three or four shells cemented together to form a whole, with several deep petticoats to protect the inner surfaces from wetting. Such insulators may be 12 to 18 in. in diameter over all, and from top groove to base a little more. If well designed and made, insulators of this type can endure even under very heavy precipitation alternating voltages of 60,000 to 100,000 effective without flashing over, and double these figures when dry. For line voltages above 60,000 to 70,000 it is apparent that the insulating factor of safety would be seriously reduced, and some recent lines have been equipped with suspension insulators. These are in effect porcelain bells from 10 in. diameter upward strung together like a string of Japanese gongs. The bells are all the same size and are spaced about a foot apart, the suspensions being variously designed. These insulating groups can be as large as need be, and it is easy to push the aggregate insulation resistance, both dry and wet, far beyond the figures just mentioned. This suspension requires higher poles than the ordinary, but allows a considerable amount of longitudinal back lash, in case a wire burns off. Too extensive slip along the line is checked by guys fitted with strain insulators, like the suspension ones, at suitable intervals. The suspension insulator gives promise of successful use of voltages much higher than 100,000 volts. The wires on high voltage systems are generally widely spaced: very seldom less than 2 ft. between centres, and for the higher voltages something like 1 ft. for each 10,000 volts.

Voltage.—The most important factor in the economy of the conducting system is the actual voltage used for the transmission. This varies within very wide limits. For transmissions only a few miles in length the pressures employed may be from 2000 to 5000 volts, but for the serious work of power transmission less than 10,000 volts are now seldom used. This pressure, under all ordinary conditions and in all ordinary climates, can be and is used with complete success, and apparently without any greater difficulty than would be encountered at much lower voltage. It is regarded as the standard transmission voltage in American practice for short distances up to 10 or 15 m. Beyond this, and sometimes even on shorter lines, it is greatly increased; up to 20,000 volts there seems to be no material difficulty whatever in effecting and maintaining a sufficient insulation of the line. In the higher voltages there were in 1908 more than fifty plants in regular operation at 40,000 volts and above. Of these more than a score are operated at 60,000 volts and above. The highest working voltage employed in 1909 was 110,000 volts, which was successfully used in two American plants: that of the Grand Rapids—Muskegon (Michigan) system, and in the transmission work of the Central Colorado system. These both employ suspension insulators with five bells in series, and operate with no more trouble than falls to the lot of systems using ordinarily high voltages. The Rio de Janeiro transmission system, operates at 88,000 volts with large porcelain insulators, 17·5 in. in over-all diameter and 19·75 in height, carried on steel pins; the Kern River (California) plant at 75,000 volts with similar construction; the Missouri River Power Co. (Montana) at 70,000 volts, using glass insulators on wooden pins saturated with insulating material. There is no especial difficulty in building transformers for still higher pressures, the real problem lying in the insulation of the line. Taken as a whole these high voltage lines have given good service, those near the upper limit doing apparently as well as those near the lower, owing to more careful precautions in construction. Likewise the distances of transmission have steadily risen. There are, all told, nearly a score of power transmissions over 100 m. in length, the longest distance yet covered being from De Sabla to Sausalito (California), a distance of 232 m. This, like most other long American transmissions, is at 60∼, and it is interesting to note that even over such distances there seems to be very little evidence of trouble due to frequency. In point of fact, those who have had the most experience with long distance transmission are the last to worry about the difficulties of using alternating current. Some unusual phenomena turn up in high voltage work, but they are rather interesting than alarming. The lines become self-luminous from "coronal" discharge at a little above 20,000 volts, and at 40,000 or 50,000 volts the phenomenon, which is sometimes aggravated by *resonance*, becomes of a striking, not to say startling, character. At above 100,000 volts this coronal discharge must be given serious consideration.

Resonance, in substance, is due to synchronism of the periodic electromotive force, or a harmonic thereof, with the electro-magnetic time-constant of the system. The frequency of the currents actually employed in transmission work is so low that resonance with the fundamental frequency must be extremely rare; resonance with the harmonics is, however, common—much commoner than is generally supposed. In every electromotive force wave the odd harmonics are more or less in evidence, particularly the third, fifth and seventh. If the electromotive force wave departs notably from a sinusoidal form, traces of harmonics up to at least the 15th may generally be found; the third, seventh and the alternate higher harmonics are manifest in flattening the crest of the wave. Supposing, what is seldom quite true, that the harmonics are symmetrically disposed in phase with the fundamental, all the harmonics tend somewhat to elevate the shoulders of the wave; a wave, therefore, with peaked shoulders and a depression in the centre is certain to be affected by harmonics, while if it has a high central crest, there is evidence of great predominance of the fifth and higher harmonics. Generally the harmonics are slightly out of phase with the fundamental, so that the wave is both deformed and unsymmetrical. As to the amplitude of these harmonics, the third is usually the largest, and may sometimes in commercial machines amount to as much as 20% of the amplitude of the fundamental, and frequently 10%. In machines giving nearly sinusoidal waves it is of course much less, but it is not difficult to find even the seventh and higher harmonics producing variations as great as 5%. Since, other things being equal, the rise in electromotive force due to resonance is directly proportional to the magnitude of the harmonics, and the chance of getting it increases rapidly with the presence of those of the higher orders, the desirability of using the closest possible approximation to a sinusoidal wave is self-evident. The greater the inductance and capacity of the system and the less its ohmic resistance, the greater the chance of getting serious resonance. As regards the distributed capacity and inductance due to the line alone, the ordinary conditions are not at all formidable; the general effect of such distributed capacity and inductance is to produce in the system a series of static waves, their length varying inversely with the frequency. At commercial frequencies the wave length is very great, so great that even in the longest lines at present employed only a small fraction of a single wave length appears; the total length of the line is generally much less than one quarter the complete wave length, and the only notable effect is a moderate rise of potential along the line. The time-constant of the alternating circuit is $T=\cdot00629\sqrt{(LC)}$, where L is the absolute self-induction in henrys and C the capacity in microfarads; and if the frequency, or a marked harmonic thereof, coincide with this time-period, resonance may safely be looked for, and resonance of the harmonics may appear conspicuously in lines of ordinary lengths. The following table gives the values, both L and C, per mile of three-phase circuit, of the sizes (American wire-gauge) ordinarily employed for transmission circuits, the wires being assumed to be strung 48 in. apart and about the height already indicated:—

Size No.	Diameter.	L.	C.
	inch.		
0000	0·460	0·00312	0·0167
000	0·410	0·00322	0·0164
00	0·365	0·00328	0·0160
0	0·325	0·00336	0·0157
1	0·289	0·00338	0·0154
2	0·258	0·00347	0·0151
3	0·229	0·00351	0·0148
4	0·204	0·00358	0·0145

In cases where underground cables form a part of the system, the above values of C are very largely increased, and the probability of resonance is in proportion enhanced. A still further complication is introduced by the capacity and inductance of the apparatus used upon the system, which may often be far greater than that due to the entire line, even if the latter be of considerable length. In point of fact, it is altogether probable that resonance due to the distributed capacity and inductance of the overhead line alone is of rare occurrence and generally of trivial amount, while it is equally probable that resonance due to localized capacity and inductance other than that of the line conductors may, and often does, cause very serious disturbances upon the system. The subject has never been adequately investigated, but the tendency towards formidable sparking and arcing at various points on long-distance transmission systems is generally far greater than can be accounted for by consideration of the nominal voltages alone. The conditions may be still further complicated by the effect of earths or open circuits, which sometimes may produce, temporarily, appalling resonance phenomena, through bringing into action the capacity and inductance of the apparatus and introducing surges. In ordinary working the resonance of the harmonics is not very conspicuous, and the fact that it occurs not systematically, but only in special ways and under special conditions, indicates more strongly than anything else that the vital point is not the time-constant of the line alone, but those of the apparatus connected thereto. A definite and persistent tendency towards resonance may sometimes be effectively checked by the introduction of suitable inductance in the parts of the system most seriously affected, but the best general policy is to avoid as far as possible the presence of the higher harmonics, which are the chief sources of danger.

Closely allied to and connected with *resonance* is the phenomenon known as "surging," which is due to the discharge of the electromagnetic energy stored in a circuit containing inductance and capacity when that circuit is broken. This discharge is an oscillatory one, going on with decreasing amplitude until it is frittered away by resistance and other sources of loss. Its frequency is that of the system affected, and the surge may get reinforcement from resonance proper. It is sufficiently serious on its merits, however, since the resulting rise of voltage increases directly with the current and may produce terrific results when the break comes as the result of a short circuit. Minor surging occurs when there is a sudden and violent change in the conditions of the circuit even without an actual break. Such a change produces an impulsive redistribution of energy that may give a sharp rise in voltage. Every point of abrupt variation in the electrical constants on the system is liable to be affected by minor surges. Such disturbances when trivial are commonly referred to as "static." Surging, depending as it does on the current ruptured, may, and indeed often does, give particularly formidable effects on circuits of moderate voltage, while on high voltage transmission circuits the usually moderate current and the large margin of safety in the insulation are important ameliorating influences.

Maintenance.—Transmission lines are, when practicable, laid out through open country, and along roads which furnish easy access for inspection and repairs. The chief sources of danger in temperate climates are mechanical injury from the falling of branches of trees across the circuits, sleet and wind storms, and lightning. The first-mentioned difficulty may be avoided by keeping clear, so far as possible, of wooded country, and it should be remembered that, at the voltages customarily used for transmission, a twig the size of a lead-pencil falling across the wires may set up arcing, and it will end by burning the wires completely off—not directly by fusion, but by persistent arcing. A properly constructed overhead line is practically safe against all storms, save those of most extraordinary violence, and with care may be made secure even against these. As a matter of practice, interruptions of service upon transmission systems are very rarely due to trouble upon the main line itself, but are far more likely to occur in some part of the distributing system. The most dangerous combination of circumstances is a sleet storm sufficient to coat the wires with ice, followed by heavy winds; if the line, however, is constructed with proper factors of safety, bearing this particular danger in mind, there need be very little fear of serious results. Lightning is a much more formidable enemy. The lightning discharges observed upon electric circuits are of two general descriptions: first, a direct discharge of lightning upon the line, more or less severe, and always to be dreaded; and secondly, induced discharges due to lightning flashes which do not hit the line, or to static disturbances which may or may not produce actual lightning. Discharges of the former class are vastly more severe than those of the latter, and, fortunately, are somewhat rare. They may actually shatter the line, or may distribute themselves along it for a considerable distance, leaping from wire to pole, and thence to earth, without actually damaging the line to any marked degree. The induced discharges are felt principally in the apparatus, causing many of the burn-outs observed in transformers and generators. There is no complete protection against the effects of lightning upon the apparatus. Even the best lightning arresters are palliatives rather than preventives. If, however, a number of arresters are put in parallel, with reactance coils between them on the way towards the apparatus, the vast majority of lightning discharges, to whatever cause they may be due, will be deflected harmlessly to earth. Moreover, the apparatus itself has a considerable power of resistance, due to its high insulation. The ends of the line should be very thoroughly protected by such lightning arresters, and other points, such as prominent elevations along the line, should receive similar additional protection. In some cases a substantial steel-wire cable stretched along the tops of the poles several feet above the line wires and well grounded at frequent intervals has been found very advantageous. With the best protection at present available, lightning is not a serious menace to continuity of service, and the apparatus of the distributing system is far more difficult to protect than the main line and its apparatus.

Sub-stations.—In most long-distance transmission work the transmission line itself terminates in a sub-station, which bears to the general distribution system precisely the same relations which are borne by a central electric supply station to its distributing lines. Such a sub-station should be treated, in fact, as a central station, receiving its electric energy from a distance instead of employing local generators driven by prime movers. The design of the sub-station, however, is somewhat different from that of the ordinary central station. The transmission lines terminate generally in a bank of reducing transformers, bringing the voltage from the 10,000 or higher voltage employed upon the line to the 2000 or more generally used in the distribution. These transformers are usually large, and their magnitude should be determined by the same considerations which apply to determining the size of the units to be employed in a generating station. The general rule to be followed is that the separate units shall be of such size that one of them may be dispensed with without serious inconvenience. In the case of transformers, the unit in two- or three-phase working is the bank of transformers, which must be used together. In Continental practice three-phase reducing transformers are frequently made to include all three phases in a single structure; this practice is less frequently followed in American plants, separate transformers being more often used in each phase. In this case, two or three transformers, according as the two- or three-phase system is used, constitute a single transformer unit in the sense just mentioned. If a change is to be made from three-phase line to two-phase distribution, the change is made by the appropriate vector connexion of the transformers. The full-load efficiency of large sub-station transformers is commonly 97 to 98%. In any case, the sub-station is furnished with voltage regulating appliances, to enable the voltage upon the distribution lines to be held constant and uniform. These regulators are, in practice, transformers with a variable transformation ratio. This is obtained in divers ways—sometimes by changing the inductive relations of the primary and secondary coils, sometimes by changing the relative number of effective turns in primary and secondary. Sets of these inductive regulators enable the voltage to be controlled over a sufficiently wide range to secure uniform potential on the system, and with a degree of delicacy that obviates any undesirable changes in voltage. The regulation is usually manual, no automatic regulator yet having proved entirely satisfactory. In very large systems it is worth noting that the so-called "skin effect" in alternating current conductors may become conspicuous. In the transmission circuits themselves the wires are, in practice, never large enough to produce any sensible difference in conductivity for continuous and for alternating currents. In the heavy omnibus-bars of a large sub-station this immunity may not be continued, but in such cases flat strips are frequently employed. If these are not more than, say, a centimetre in thickness, the "skin effect" is practically insignificant for all frequencies used commercially. Not infrequently the sub-station also contains devices for the changing of alternating to continuous current, usually synchronous converters feeding either traction system or electric lighting mains. Beyond these converters the system becomes an ordinary continuous-current system, and is treated as such. When very close regulation is necessary, motor-generators are often preferred to synchronous converters. Series arc lighting from transmission circuits is a much more serious problem. At the present time two methods are in vogue: first, the operation of continuous-current series-arc machines by synchronous or induction motors driven from the transmission system; and, secondly, series alternating apparatus for feeding alternating arcs. This apparatus consists either of constant-current transformers with automatically moving secondaries, or of inductive regulators, also automatic in their action, supplemented by transformers to supply them with the necessarily rather high voltage employed for arc distribution. As between these two systems practice is at present divided; electrically, the alternating apparatus gives a rather higher real efficiency, but involves the use of alternating arcs, which are somewhat less efficient, watt for watt, as light producers than the continuous-current arcs. The apparatus, however, requires practically no care, while the arc machines, driven by motors, require the same amount of care as if they were driven by other power. Arc light transformers, however, are likely to have low power factors, hardly above 0·8 at full load, and rapidly falling off at lower loads. Synchronous rectifiers changing the alternating current into a unidirectional current, suitable for use with arc lights, have been employed with some success, but not to any considerable extent. They are satisfactory in avoiding the use of alternating currents in the arc, and consume but little energy in the transformation from one form of current to the other, but involve the use of static transformers automatically giving constant current, which are somewhat objectionable on the score of low-power factor. Mercury rectifiers are now used rather extensively and give excellent results, although they are as yet of somewhat uncertain life, and, like the synchronous rectifiers, require special transformers when worked at constant current. In Continental practice arc lights are almost universally worked off constant potential circuits, and hence the difficulties just considered are for the most part peculiar to American systems.

Distances of Transmission.—The ultimate determining factor in the distance to which power can be commercially transmitted is the economic side of the transmission, the maximum distance being the maximum distance at which the transmission will pay. As a mere engineering feat the transmission of power to a distance of many hundred miles is perfectly feasible, and, judging from the data available, the phenomena encountered in increasing the length of lines have not been of such character as to cause any hesitation in going still farther, provided the increase is commercially feasible. In American practice, it is within the truth to say that nearly all transmissions of reasonable size (say a few hundred kilowatts) to distances of twenty miles, or less, are pretty certain to pay. At distances up to fifty miles, in a large proportion of cases power can be delivered at prices which will enable it to compete with power locally generated by steam. From fifty to one hundred miles (on a large scale—several thousand kilowatts) the chances for commercial success are still good. The larger the amount of power transmitted, the better on the whole is the commercial outlook. The longest one yet operated has already been noted, and may be regarded as a commercial success. In certain localities where the cost of fuel is extremely high, transmissions of several hundred miles may prove successful from a commercial as well as an engineering standpoint, but the growth of industry, which indicates the necessity for such a transmission, may go on until, through improved facilities of transport, the cost of fuel may be greatly lowered and the economic conditions entirely changed. Such a modification of the conditions sometimes takes place much more quickly than would be anticipated at first sight, so that when very long distance transmissions are under consideration, the permanence of the conditions which will render them profitable should be a very serious subject of consideration. (L. Bl.)

POWIS, EARLS AND MARQUESSES OF. Before the Norman Conquest the Welsh principality of Powis, comprising the county of Montgomery and part of the counties of Brecknock, Radnor, Shropshire, Merioneth and Denbigh, was subject to the princes of North Wales. Early in the 12th century it was divided into upper and lower Powis. In 1283 Owen ap Griffin, prince of upper Powis, formally resigned his princely title (*nomen et circulum principatus*) and his lands to the English king Edward I. at Shrewsbury, and received the lands again as an English barony. (See *Montgomeryshire Collections*, 1868, vol. i.). This barony of Powis passed through female inheritance to the family of Cherleton and in 1421 to that of Grey. It fell into abeyance in 1551.

In 1587 Sir Edward Herbert (d. 1594), a younger son of William Herbert, earl of Pembroke, purchased some of the lands of the barony, including Red castle, afterwards Powis castle, near Welshpool, and in 1629 his son William (*c.* 1573–1656) was created Baron Powis. William's grandson, William, the 3rd baron (*c.* 1629–1696), was created earl of Powis in 1674 and Viscount Montgomery and marquess of Powis in 1687. The recognized head of the Roman Catholic aristocracy in England, Powis was suspected of complicity in some of the popish plots and was imprisoned in the Tower of London from 1678 to 1684. He followed James II. into exile and was created duke of Powis by the dethroned king. The English government deprived him of his estates, but these were restored to his son William, the 2nd marquess, in 1722. William, who had a somewhat chequered career as a Jacobite, died in October 1745, and when his son William, the 3rd marquess, died in 1748 the titles became extinct.

In 1748 Henry Arthur Herbert (d. 1772), who had been made Baron Herbert of Chirbury in 1743, was created Baron Powis and earl of Powis. He allied himself with the earlier holders of these titles, with which family he was distantly connected, by marrying Barbara, a niece of the 3rd marquess. The titles became extinct a second time when his son George Edward died in January 1801. George's sister and heiress, Henrietta Antonia (1758–1830), married Edward Clive (1754–1829), son and heir of the great Lord Clive. In 1794 he was made Baron Clive of Walcot, and in 1804, after serving as governor of Madras from 1798 to 1803, he was created Baron Powis and earl of Powis. His son Edward, the 2nd earl (1785–1848), took the name of Herbert in 1807 in lieu of that of Clive. He was a member of parliament from 1806 to 1839, and was elected in opposition to the Prince Consort, as chancellor of the university of Cambridge in 1847. His second son was Lieut.-General Sir Percy Egerton Herbert (1822–1876), who distinguished himself in the Crimean War, and Sir Percy's son, George Charles (b. 1862), became the 4th earl in 1891.

POWNALL, THOMAS (1722–1805), British colonial statesman and soldier, was born at Saltfleetby, Lincolnshire, England, in 1722. He was educated at Lincoln and at Trinity College, Cambridge, where he graduated in 1743. He entered the office of the lords commissioners of trade and plantations, of which his brother John was then secretary; and in 1753 he went to America as private secretary to Sir Danvers Osborn, just appointed governor of New York. Osborn committed suicide soon after reaching New York (Oct. 6), but Pownall remained in America, devoting himself to studying the condition of the American colonies. At the Albany Congress, in 1754, he met Benjamin Franklin, and a life-long friendship between the two resulted. In 1756 he returned to England, and presented to Pitt a plan for a campaign against the French in Canada, to begin with the investment of Quebec. In 1757 Pitt appointed him governor of Massachusetts,[1] in which office he heartily supported Pitt's policy during the Seven Years' War, and in 1758 encouraged the equipment of a force of 7000 men, to be recruited and armed in New England; but the French power in America once broken, Pownall came more directly under the influence of the lords of trade, and his unwillingness to carry out the repressive policies of that body caused his transfer to the governorship of South Carolina in February 1760. This office he held nominally for about a year; but he never went to South Carolina, and in June 1760 he returned to England. In 1762–1763 he was commissary-general of the British troops in Germany. As member of parliament for Tregony in 1768–1774 and for Minehead in 1774–1780, he at first sided with the Whigs in opposing all plans to tax the American colonists, but he supported North's administration after the outbreak of the War of Independence. He died at Bath on the 25th of February 1805. In 1764 he published (at first anonymously) his famous *Administration of the Colonies* (other editions appeared in 1765, 1766, 1768 and 1774), in which he advocated a union of all British possessions upon the basis of community of commercial interests.

For an extended account of Pownall's career and a bibliography of his publications see *Thomas Pownall, M.P., F.R.S.* (London, 1908), by Charles A. W. Pownall, a distant kinsman, who attempts to prove that Pownall was the "author behind the scenes" of the "Letters of Junius" and "that Francis was his subordinate."

POYET, GUILLAUME (1473–1548), French magistrate, was born at Angers. After practising successfully as a barrister at Angers and Paris, he was instructed by Louise of Savoy, mother of the king, Francis I., to uphold her rights against the constable de Bourbon in 1521. This was the beginning of his fortunes. Through the influence of the queen-mother he obtained the posts of advocate-general (1530) and president of the parlement of Paris (1534), and became chancellor of France in 1538. He was responsible for the legal reform contained in the ordinance of Villers-Cotterets (1539), the object of which was to shorten procedure. This ordered the keeping of registers of baptisms and deaths, and enjoined the exclusive use of the French language in legal procedure. With the constable de Montmorency he organized an intrigue to ruin Admiral Chabot, and procured his condemnation in 1541; but after the admiral was pardoned, Poyet was himself thrown into prison, deprived of his offices, and sentenced to a fine of 100,000 livres. He recovered his liberty in 1545, and died in April 1548.

See C. Porée, *Guillaume Poyet* (Angers, 1898).

POYNINGS, SIR EDWARD (1459–1521), lord deputy of Ireland, was the only son of Robert Poynings, second son of the 5th Baron Poynings. His mother was a daughter of Sir William Paston, and some of her correspondence is to be found in the

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[1] In September 1755 Pownall had been made lieutenant-governor of New Jersey, but he had little to do with the affairs of that province and resigned soon after his appointment to Massachusetts.

Paston Letters. Robert Poynings was implicated in Jack Cade's rebellion, and Edward was himself concerned in a Kentish rising against Richard III., which compelled him to escape to the Continent. He attached himself to Henry, earl of Richmond, afterwards King Henry VII., with whom he returned to England in 1485. By Henry VII. Poynings was employed in the wars on the Continent, and in 1493 he was made governor of Calais. In the following year he went to Ireland as lord deputy under the viceroyalty of Prince Henry, afterwards King Henry VIII. Poynings immediately set about Anglicizing the government of Ireland, which he thoroughly accomplished, after inflicting punishment on the powerful Irish clans who supported the imposture of Perkin Warbeck. He then summoned the celebrated parliament of Drogheda, which met in December 1494, and enacted the "Statutes of Drogheda," famous in Irish history as "Poynings's law" (see STATUTE: *Ireland*), which made the Irish legislature subordinate to, and completely dependent on, that of England, till its repeal in 1782. After defeating Perkin Warbeck at Waterford and driving him out of Ireland, Poynings returned to England in 1496, and was appointed warden of the Cinque Ports. He was employed both in military commands and in diplomatic missions abroad by Henry VII., and later by Henry VIII., his most important achievement being the successful negotiation of the "holy league" between England, Spain, the emperor, and the pope, in 1513. In 1520 he was present at the Field of the Cloth of Gold, in the arrangement of which he had taken an active part. He died in 1521. By his wife, Elizabeth Scot, Poynings left no surviving issue, and his estates passed through a collateral female line to the earl of Northumberland. He had several illegitimate children, one of whom, Thomas Poynings, was created Baron Poynings in 1545, but died in the same year without heirs.

See Sir Francis Bacon, *The History of the Reign of King Henry VII.* (London, 1641); Richard Bagwell, *Ireland under the Tudors* (2 vols., London, 1885); J. T. Gilbert, *History of the Viceroys of Ireland* (Dublin, 1865); J. A. Froude, *The English in Ireland* (3 vols., London, 1872–1874); Wilhelm Busch, *England under the Tudors*, ed. by James Gairdner (London, 1895).

POYNTER, SIR EDWARD JOHN, BART. (1836–), English painter, son of Ambrose Poynter, architect, was born in Paris on the 20th of March 1836. He pursued his art studies in England and in Paris (under Gleyre, 1856–1859), and exhibited his first picture at the Royal Academy in 1861. In 1869, after the exhibition of "Israel in Egypt" and "The Catapult," he was elected an Associate of the Royal Academy, and in 1876, the year of "Atalanta's Race," full Academician.

In the decorative arts he practised freely as a designer in fresco, mosaic, stained glass, pottery, tile-work and the like. While still quite a young man, he was encouraged by the architect William Burges, A.R.A., to design panels for his quaint Gothic cabinets; Messrs Powell obtained from him cartoons of designs for stained glass; for the decoration of Waltham Abbey church he was employed on a series of thirty important designs. Attracted by these, Dalziel Brothers commissioned a number of full-page drawings on wood for the illustration of their celebrated "Bible Gallery." The cartoons for "St George" and "St David," the mosaic panels now embellishing the outer lobby of the Palace of Westminster, were produced in 1870, and they were followed by the "Apelles" and "Phidias," in the same method of reproduction, in the Victoria and Albert Museum; by the important series of frescoes in St Stephen's, Dulwich—scenes from the life of the saint; by the decoration of the grill room at the Museum at South Kensington, with the tiles *en camaïeu*—an achievement strikingly successful and pregnant with results. Always a lover of water-colour drawing and of the art of landscape painting, he was elected to the Royal Society of Painters in Water Colours in 1883. In 1874 he designed the Ashantee medal; and in 1892, for the coinage of that year, the reverse of the shilling and florin, to the obverse of Mr Thomas Brock, R.A.

When the art teaching centre of South Kensington was assuming the importance it has since attained, Mr Poynter was appointed director for art in the Science and Art Department, and principal of the National Art Training Schools (now the Royal College of Art), and by virtue of his vigorous and successful administration he invested his office with a distinction which, after his resignation in 1881, it soon notoriously lacked. The directorship of the National Gallery became vacant in 1894, and Poynter, profoundly versed in the works of the Old Masters, especially of the Italian schools, was appointed to the post, which he held for ten years. Under his rule the National Gallery of British Art, at Millbank, presented by the late Sir Henry Tate, became a department of the National Gallery, and thither were removed many pictures formerly in the British rooms at Trafalgar Square, as well as the Chantrey Collection from South Kensington, &c. One of the most important services by the director was the editing of the great *Illustrated Catalogue of the National Gallery* (1889–1900), in which every picture in the collection is reproduced—an unprecedented achievement in the annals of art-publishing.

On the death of Sir John Millais in 1896, Poynter was elected to the presidency of the Royal Academy, and was knighted. He was made a baronet in 1902.

Paintings.—Among Sir Edward Poynter's most notable pictures have been the following: "Israel in Egypt" (1867); "The Catapult" (1868); "Perseus and Andromeda" (1872); "Atalanta's Race" (1876); "The Fortune-Teller" (1877); "Nausicaa and Her Maidens" (1879); "Visit to Aesculapius" (1880), now in the Chantrey Collection in the Tate Gallery; "The Ides of March" (1883); "Diadumenè" (1885), now destroyed; "On the Terrace" (1889); "The Meeting of Solomon and the Queen of Sheba" (1891); "Horae Serenae" and "Idle Fears" (1894), and numerous portraits and water-colour drawings.

Lectures.—In his series of Slade Lectures, delivered from 1875 to 1879, and first published in 1879 (republished, with additions, in 1897), Sir Edward Poynter deals with the whole subject of art education, considering in turn Decorative Art, Old and New Art, Systems of Art Education, Hints on the Formation of a Style, Training of Art Students, The Study of Nature, The Value of Things, Objects of Study, Professor Ruskin on Michelangelo (hotly controversial in tone), Influence of Art in Social Life, and Ancient Decorative Art.

See also Cosmo Monkhouse, "Sir E. J. Poynter, P.R.A.: His Life and Work," *Art Annual* (1897); M. H. Spielmann, "Sir E. J. Poynter, P.R.A., and his Studies," *The Magazine of Art* (1897).

POZHAREVATS (also written Passarowitz and Požarevac), a town in Servia, situated in the Morava valley, 4 m. E. of the Morava river and 8 m. S. of the Danube. The station for steamers, Dubravitsa, with its custom-house, standing on the banks of the Danube, forms practically the harbour of Pozharevats. The town has no special industry, but is the principal market of a very extensive and fruitful plain between the rivers Morava, Mlava and Danube. It is the capital of a department bearing the same name, and the seat of a prefecture, a tribunal of justice, a college and several national or normal schools. It has a large modern penitentiary, with a department for political offenders and a prison for women. Two miles to the west, towards Morava, is situated Lubichevo, a model farm and stud belonging to the government. The shady park and flower gardens are a popular resort of the people of Pozharevats. The town is known in the history of international treaties as the place at which the famous peace of Passarowitz between Austria and Turkey was concluded in 1718. Pop. (1900), 12,957.

Lignite is worked at Kostolats, 7 m. N. by E., and the hills between Pozharevats and Kostolats show many traces of Roman mines. A number of coins, sarcophagi and inscriptions found in the neighbourhood are also Roman.

POZOBLANCO, a town of southern Spain in the province of Cordova, near the head-waters of the Guadamatillas and of other small sub-tributaries of the Guadiana. Pop. (1900), 12,792. Pozoblanco is one of the chief towns in the lowlands of Los Pedroches, which lie between the Sierra de la Alcúdia on the north and the Sierra Morena on the south. Although there is no railway in the district, Pozoblanco has a thriving trade. Its fairs are famed for their exhibits of live stock and agricultural products. There are zinc and argentiferous lead mines in the neighbourhood, and manufactures of cloth and leather in the town itself.

POZZO DI BORGO, CARLO ANDREA, COUNT (1764–1842), Russian diplomatist, was born at Alata, near Ajaccio, of a noble Corsican family, on the 8th of March 1764, some four years before the cession of the island to France. He was educated at Pisa, and in early life was closely associated with Napoleon and Joseph Bonaparte, the two families being at that time closely allied in politics. Pozzo was one of the two delegates sent to the National Assembly in Paris to demand the political incorporation of Corsica in France, and was subsequently one of the Corsican deputies to the Legislative Assembly, where he sat on the benches of the right until the events of August 1792. On his safe return to Corsica he was warmly received by Paoli, but found himself in opposition to the Bonaparte brothers, who were now veering to the Jacobin party. Under the new constitution Pozzo was elected *procureur-général-syndic*, that is, chief of the civil government, while Paoli commanded the army. With Paoli he refused to obey a summons to the bar of the Convention, and the definite breach with the Bonaparte family, who actively supported the revolutionary authorities, dates from this time. Eventually Paoli and Pozzo accepted foreign help, and from 1794 to 1796, during the English protectorate of Corsica, Pozzo was president of the council of state under Sir Gilbert Elliot. When Napoleon sent troops to occupy the island he was excepted from the general amnesty, and took refuge in Rome, but the French authorities demanded his expulsion, and gave orders for his arrest in northern Italy. After a short stay in London he accompanied in 1798 Sir Gilbert Elliot (now become Lord Minto) on an embassy to Vienna, where he lived for six years and was well received in political circles. Hatred of Napoleon was his dominant passion, and even as an exile of no official standing he was recognized as a dangerous enemy. In 1804 through the influence of Prince Adam Czartoryski he entered the Russian diplomatic service, and was employed in 1805 as Russian commissioner with the Anglo-Neapolitan, and in 1806 with the Prussian army. He was entrusted with an important mission to Constantinople in 1807, but the conclusion of the alliance between Alexander I. and Napoleon at Tilsit in July interrupted his career, necessitating a temporary retirement after the completion of his business with the Porte. He returned to Vienna, but on the demand of Napoleon for his extradition Metternich desired him to leave the capital. In London, where he found safety from Napoleon, he renewed many old ties, and remained in England until 1812, when he was recalled by Alexander. He diligently sought to sow dissension in the Bonaparte household, and in a mission to Sweden he secured the co-operation of Bernadotte against Napoleon. On the entry of the allies into Paris he became commissary general to the provisional government. At the Bourbon restoration General Pozzo di Borgo became Russian ambassador at the Tuileries, and sought to secure a marriage between the duke of Berry and the Russian grandduchess Anna, Alexander's sister. He assisted at the Congress of Vienna, and during the Hundred Days he joined Louis XVIII. in Belgium, where he was also instructed to discuss the situation with Wellington. The tsar dreamed of allowing an appeal to the people of France on the subject of the government of France in accordance with his vague liberalizing tendencies, but Pozzo's suggestions in this direction were met by violent opposition, the duke refusing to make any concessions to what he regarded as rebellion; but in Petersburg, on the other hand, his attachment to the Bourbon dynasty was considered excessive. During the early years of his residence in Paris Pozzo laboured tirelessly to lessen the burdens laid on France by the allies and to shorten the period of foreign occupation. That his French sympathies were recognized in Paris is shown by the strange suggestion that he should enter the French ministry with the portfolio of foreign affairs. He consistently supported the moderate party at court, and stood by the ministry of the duc de Richelieu, thus earning the distrust and dislike of Metternich, who held him responsible for the revival of Liberal agitation in France. His influence at the Tuileries declined with the accession of Charles X., whose reactionary tendencies had always been distasteful to him; but at the revolution of 1830, when the Tsar Nicholas was reluctant to acknowledge Louis Philippe, he did good service in preventing difficulties with Russia. In 1832 he visited Petersburg; the next year he was in London renewing his relations with Wellington, and early in 1835 he was suddenly transferred to the London embassy in succession to Prince Lieven. Although he did not lose in official standing, Pozzo was aware that this change was due to suspicions long harboured in various quarters in St Petersburg that his diplomacy was too favourable to French interests. In London his health suffered, and he retired from the service in 1839 to spend the rest of his days in Paris, where he died on the 15th of February 1842. He had been made a count and peer of France in 1818.

See Ouvaroff, *Stein et Pozzo* (St Petersburg, 1846); *Correspondance diplomatique du comte Pozzo di Borgo et du comte de Nesselrode*, ed. by Charles Pozzo di Borgo (2 vols., Paris, 1890–1897); Vicomte A. Maggiolo, *Corse, France et Russie. Pozzo di Borgo, 1764–1842* (Paris, 1890); J.B.H.R. Capefigure, *Les Diplomates européens* (4 vols., 1843–1847).

POZZUOLI (anc. *Puteoli*, *q.v.*), a seaport and episcopal see of Campania, Italy, in the province of Naples, 7½ m. W. of it by rail. Pop. (1906), 17,017 (town); 22,838 (commune). It is situated on and at the base of a hill projecting into the bay at Pozzuoli, separated from the main portion of the Gulf of Naples by the promontory of Posilipo. Its mineral baths are frequented in summer; and the volcanic *pozzolana* earth (also found near Rome), used now as in Roman times for making cement and concrete, derives its name from the place. In the middle ages Pozzuoli was frequently sacked and also damaged by the natural convulsions of 1198 and 1538. To the north-east of the town is the Solfatura, a half extinct volcano crater, in which sulphurous gases are exhaled.

PRABHU, the writer caste of Western India, corresponding to the Kayasth of Bengal. Though numbering only 21,941 in Bombay in 1901, they occupy a very high position socially and in the professions. The first Indian to be appointed to the executive council at Bombay was a Prabhu, of the well-known Chaubal family.

PRADIER, JAMES (1792–1852), French sculptor, was born at Geneva. He was a member of the French Academy, and a popular sculptor of the pre-Romantic period, representing in France the drawing-room classicism which Canova illustrated at Rome. His chief works are the Niobe group (1822), "Atalanta" (1850), "Psyche" (1824), "Sappho" (1852) (all in the Louvre), "Prometheus" (Tuileries Gardens), a bas-relief on the triumphal arch of the Carrousel, the figures of "Fame" on the Arc de l'Étoile, and a statue of J. J. Rousseau for Geneva. Besides these mention should be made of his "Three Graces" (1821).

PRADILLA, FRANCISCO (1847–), Spanish painter, was born at Villanueva da Gallago (Saragossa). Having studied first at the Fernando Academy, and then at the Spanish Academy in Rome, of which he was afterwards director, he became the leading historical painter of modern Spain. In 1896 he was appointed director of the Madrid Museum. Though he is best known for such large historical compositions as "Joan the Mad" (gold medal, Paris, 1878), and "The Surrender of Granada" (gold medal, Munich, 1883), in which he discarded the heavy colouring of Laurens for a lighter and more atmospheric key, he has painted many excellent genre pictures in the manner of Fortuny, and some decorative compositions in which he follows the example of Tiepolo. The best of these are his decorations in the Murgo Palace in Madrid. Among his best known works are "Elopement," "Strand at Vigo," "Procession in Venice," "La Fiorella," "Reading on the Balcony," "Don Alfonso the Warrior," and "Don Alfonso the Scholar." He became member of the Berlin Academy in 1892.

PRAED, WINTHROP MACKWORTH (1802–1839), English poet, was born in London on the 26th of July 1802. The old family name was Mackworth, the additional name of Praed being derived from the marriage of the poet's great grandfather with a Cornish heiress. His father, William Mackworth Praed, was a serjeant-at-law. His mother belonged to the English branch of the New England family of Winthrop. In 1814 Praed was sent to Eton College. He there founded a manuscript periodical called *Apis matina.* This was succeeded in October 1820 by the *Etonian*, a paper projected and edited by Praed and Walter Blount, which appeared every month until July 1821, when the chief editor, who signed his contributions "Peregrine Courtenay," left Eton, and the paper died. Henry Nelson Coleridge, William Sidney Walker, and John Moultrie were the three best known of his coadjutors in this periodical, which was published by Charles Knight, and of which many interesting particulars are given in Knight's *Autobiography* and in Maxwell Lyte's *Eton College*. Before Praed left school he succeeded in establishing over a shop at Eton a "boys' library," the books of which are now amalgamated in the School Library. His career at Cambridge, where he matriculated at Trinity College, October 1821, was marked by exceptional brilliancy. He gained the Browne medal for Greek verse four times, and twice the chancellor's medal for English verse. He was bracketed third in the classical tripos in 1825, won a fellowship at his college in 1827, and three years later carried off the Seatonian prize. At the Union his speeches were only rivalled by those of Macaulay and of Charles Austin (1799–1874), who subsequently made a great reputation at the parliamentary bar. The character of Praed during his university life is described by Bulwer Lytton in the first volume of his *Life*. He began to study law, and in 1829 was called to the bar at the Middle Temple. He went the Norfolk circuit, where his prospects of advancement were bright, but the bias of his feelings inclined him towards politics, and after a year or two he devoted himself entirely to political life. Whilst at Cambridge he leaned to Whiggism, and even to the autumn of 1829 his feelings were bent towards the same side, but during the agitation for parliamentary reform his opinions changed, and when he was returned to parliament for St Germans (Dec. 17, 1830) his election was due to the Tory party. He sat for that borough until December 1832, and on its extinction contested the borough of St Ives, within the limits of which the Cornish estates of the Praeds were situated. The squibs which he wrote on this occasion were collected in a volume printed at Penzance in 1833 and entitled *Trash, dedicated without respect to James Halse, Esq., M.P.*, his successful competitor. Praed sat for Great Yarmouth from 1835 to 1837, and was secretary to the Board of Control during Sir Robert Peel's short administration. He sat for Aylesbury from 1837 until his death. During the progress of the Reform Bill he advocated the creation of three-cornered constituencies, in which each voter should have the power of giving two votes only, and maintained that freeholds within boroughs should confer votes for the boroughs and not for the county. Neither of these suggestions was then adopted, but the former ultimately formed part of the Reform Bill of 1866. He married in 1835 Helen Bogle. He died of consumption at Chester Square, London, on the 15th of July 1839.

Praed's lighter poetry was the perfection of ease. Mr Austin Dobson has justly praised his "sparkling wit, the clearness and finish of his style, and the flexibility and unflagging vivacity of his rhythm" (Ward's *English Poets*). It abounded in happy allusions to the characters and follies of the day. In his humorous effusions he found numerous imitators.

His poems were first edited by R. W. Griswold (New York, 1844); another American edition, by W. A. Whitmore, appeared in 1859; an authorized edition with a memoir by Derwent Coleridge appeared in 1864: *The Political and Occasional Poems of W. M. Praed* (1888), edited with notes by his nephew, Sir George Young, included many pieces collected from various newspapers and periodicals. Sir George Young separated from his work some poems, the work of his friend Edward Marlborough Fitzgerald, generally confused with his. Praed's essays, contributed to various magazines, were published in Morley's *Universal Library* in 1887.

PRAEFECT (*praefectus*), the title of various Roman officials, both civil and military. A praefect was not one of the magistrates proper; he was, strictly speaking, only the deputy or lieutenant of a superior magistrate or commander. The following were the most important.

1. The city praefect (*praefectus urbis*) acted at Rome as the deputy of the chief magistrate or magistrates during his or their absence from the city. Thus he represented in the earliest times the king and in later times the consul or consuls when he or they were absent on a campaign or on other public duties, such as the celebration of the annual Latin festival on the Alban Mount. The absence of the chief magistrate for more than a single day rendered the appointment of a praefect obligatory; but the obligation only arose when *all* the higher magistrates were absent. Hence so long as the consuls were the only higher magistrates their frequent absence often rendered the appointment of a praefect necessary, but after the institution of the praetorship (367 B.C.) the necessity only arose exceptionally, as it rarely happened that both the consuls and the praetor were absent simultaneously. But a praefect continued to be regularly appointed, even under the empire, during the enforced absence of all the higher magistrates at the Latin festival. The right and duty of appointing a praefect belonged to the magistrate (king, dictator or consul) whose deputy he was, but it seems to have been withdrawn from the consuls by the Licinian law (367), except that they still nominated praefects for the time of the festival. No formalities in the appointment and no legal qualifications on the part of the praefect were required. The praefect had all the powers of the magistrate whose deputy he was, except that he could not nominate a deputy to himself. His office expired on the return of his superior. There could only be one city praefect at a time, though the dictator Caesar broke the rule by appointing six or eight praefects simultaneously.

Praefectus Urbis Feriarum Latinarum.

Under the empire there was introduced a city prefecture which differed essentially from the above. Augustus occasionally appointed a city praefect to represent him in his absence from Italy, although the praetors, or even one of the consuls, remained in the capital. In the absence of Tiberius from Rome during the last eleven years of his reign (A.D. 26–37) the city prefecture, hitherto an exceptional and temporary office, became a regular and permanent magistracy; in all subsequent reigns the praefect held office even during the presence of the emperor in Rome. He was always chosen by the emperor and usually from men who had held the consulship; his office was regarded, like the censorship under the republic, as the crowning honour of a long political career. It was not conferred for any definite length of time, but might be held for years or for life. As under the republic, the praefect was not allowed to quit the city for more than a day at a time. His duty was the preservation of peace in the capital; he was, in fact, the chief of the police, being charged with the superintendence of the streets, markets and public buildings. He was further entrusted by Augustus with a summary criminal jurisdiction over slaves and rioters, which was, however, gradually extended till in the time of Severus or even earlier it embraced all offences by whomsoever committed. Further, he had the power of dealing with civil cases where his interference seemed requisite in the interests of the public safety, but such occasions were naturally few. By the beginning of the 3rd century, and perhaps earlier, appeals to the emperor in civil cases were handed over by him to be dealt with by the praefect. Except where special restrictions interfered, an appeal lay from the praefect to the emperor. Though not a military officer, the praefect commanded the city cohorts (*cohortes urbanae*), which formed part of the garrison of Rome and ranked above the line regiments, though below the guards (see PRAETORIANS). The military power thus placed in the hands of the chief of the police was one of the most sorely-felt innovations of the empire. The constitutional changes of Diocletian and Constantine extended still further the power of the praefect, in whom, after the disbanding of the guards and the removal from Rome of the highest officials, the whole military, administrative and judicial powers were centred.

2. Under the republic judicial praefects (*praefecti jure dicendo*) were sent annually from Rome as deputies of the praetors to administer justice in certain towns of the Italian allies. These towns were called prefectures (*praefecturae*). After the Social War (90–89 B.C.), when all Italy had received the Roman

franchise, such prefectures ceased to exist in fact, though the name was sometimes retained.

3. Under the empire the praetorians or imperial guards were commanded by one, two, or even three praefects (*praefecti praetorio*), who were chosen by the emperor from among the knights and held office at his pleasure. From the time of Alexander Severus the post was open to senators also, and if a knight was appointed he was at the same time raised to the senate. Down to the time of Constantine, who deprived the office of its military character, the prefecture of the guards was regularly held by tried soldiers, often by men who had fought their way up from the ranks. In course of time the command seems to have been enlarged so as to include all the troops in Italy except the corps commanded by the city praefect (*cohortes urbanae*). Further, the praetorian praefect acquired, in addition to his military functions, a criminal jurisdiction, which he exercised not as the delegate but as the representative of the emperor, and hence it was decreed by Constantine (331) that from the sentence of the praetorian praefect there should be no appeal. A similar jurisdiction in civil cases was acquired by him not later than the time of Severus. Hence a knowledge of law became a qualification for the post, which under Marcus Antoninus and Commodus, but especially from the time of Severus, was held by the first jurists of the age, (*e.g.* Papinian, Ulpian and Paullus), while the military qualification fell more and more into the background. Under Constantine the institution of the *magistri militum* deprived the praetorian prefecture altogether of its military character, but left it the highest civil office of the empire.

The title of "praefect" was borne by various other Roman officials, of whom we may mention the following:—

4. *Praefectus Socium* (*sociorum*).—Under the republic the contingents furnished to the Roman armies by the Italian allies were commanded by Roman officers called *praefecti socium* (*sociorum*), who were nominated by the consuls and corresponded to the tribunes in the legions.

5. *Praefectus Classium.*—Down to near the close of the republic a naval command was never held independently but only in connexion with the command of an army, and, when the general appointed an officer to command the fleet in his room, this lieutenant was styled "praefect of the fleet" (*praefectus classium*). When in 311 B.C. the people took the appointment of these lieutenants into their own hands the title was changed from "praefects" to *duo viri navales*, or "two naval men"; but under the empire the admirals went by their old name of praefects.

6. *Praefectus Fabrum.*—The colonel of the engineer and artillery corps (*fabri*) in a Roman army was called a praefect; he did not belong to the legion, but was directly subordinate to the general in command.

7. *Praefectus Annonae.*—The important duty of provisioning Rome was committed by Augustus (between A.D. 8 and 14) to a praefect, who was appointed by the emperor from among the knights and held office at the imperial pleasure.

8. *Praefectus Aegypti* (afterwards *Praefectus augustalis*).—Under the empire the government of Egypt was entrusted to a viceroy with the title of "praefect," who was selected from the knights, and was surrounded by royal pomp instead of the usual insignia of a Roman magistrate. He stood under the immediate orders of the emperor. The exceptional position thus accorded to Egypt was due to a regard on the part of the emperors to the peculiar character of the population, the strategic strength of the country, and its political importance as the granary of Rome. (J. G. Fr.)

9. *Praefectus Castrorum*, from the time of Augustus to Severus the title of the commander of the fixed camps of the legions in different parts of the empire. He was a purely military man appointed by the emperor, usually a centurion whose term of service was completed. From the time of Domitian, when each legion had a separate camp, the name of the legion was added to the title, *e.g.* praefectus castrorum legionis xiii. gem. (*C.I.L.* iii. 454). The duties of this officer included: the arrangement of the camp and medical service, the transport of the baggage, the construction of roads, bridges and fortifications, the supply of ammunition and engines of war.

10. *Praefectus Vigilum*, the commander of the seven *cohortes vigilum*, a night police force instituted by Augustus (A.D. 6). To each cohort, consisting of about 1000 men (chiefly freedmen), was entrusted the care of two of the fourteen city districts; one of its chief duties was that of a fire brigade. The policing of the city had formerly been one of the duties of the aediles, but was now transferred to the praefectus vigilum, appointed by the emperor from the equites. He exercised criminal jurisdiction in cases of incendiarism and offences committed against the law during the night, and in later times this jurisdiction was considerably extended.

The different kinds of praefects are fully discussed in Mommsen, *Römisches Staatsrecht* (1887) vols. ii., iii.; see also T. M. Taylor, *Constitutional and Political History of Rome* (1899). There is an excellent monograph on the *Praefectura urbis* by P. E. Vigneaux (1896). Mommsen deals very cursorily with the *praefectus castrorum*, but there is a special article by G. Wilmanns, in *Ephemeris epigraphica* (1872), vol. i., "De praefecto castrorum et praefecto legionis."

For the French *préfet* see PREFECT. (X.)

PRAEMUNIRE (Lat. *praemonere*, to pre-admonish or forewarn), in English law an offence so called from the introductory words of the writ of summons issued to the defendant to answer the charge, "Praemunire facias A.B.," &c., *i.e.* "cause A.B. to be forewarned." From this the word came to be used to denote the offences, usually ecclesiastical, prosecuted by means of such a writ, and also the penalties they incurred. The statute of Richard II., Purchasing bulls from Rome (1392), is usually designated *the* Statute of Praemunire, but it is only one of numerous stringent measures (some still unrepealed, and, as a body, of the most confused character) passed for the purpose of putting restraint on the papal usurpation of authority in England. From the beginning of the 14th century papal aggression had been particularly active, more especially in two forms. The one, the disposal of ecclesiastical benefices, before the same became vacant, to men of the pope's own choosing; the other, the encouragement of resort to himself and his curia rather than to the courts of the country. The Statute of Provisors 1306, passed in the reign of Edward I., was, according to Coke, the foundation of all subsequent statutes of praemunire. This statute enacted "that no tax imposed by any religious persons should be sent out of the country whether under the name of a rent, tallage, tribute or any kind of imposition." A much greater check on the freedom of action of the popes was imposed by the Statute of Provisors (1350–1351) and the Statute of Praemunire passed in the reign of Edward III. The former of these, after premising "that the Pope of Rome, accroaching to him the seignories of possession and benefices of the holy Church of the realm of England doth give and grant the same benefices to aliens which did never dwell in England, and to cardinals, which might not dwell here, and to others as well aliens as denizens, as if he had been patron or advowee of the said dignities and benefices, as he was not of right by the laws of England . . . ," ordained the free election of all dignities and benefices elective in the manner as they were granted by the king's progenitors. The Statute of Praemunire (the first statute so called) 1353, though expressly levelled at the pretensions of the Roman curia, excludes any direct reference to it in actual words. By it, the king "at the grievous and clamorous complaints of the great men and commons of the realm of England" enacts "that all the people of the king's ligeance of what condition that they be, which shall draw any out of the realm in plea" or any matter of which the cognizance properly belongs to the king's court shall be allowed two months in which to answer for their contempt of the king's rights in transferring their pleas abroad. The penalties which were attached to the offence under this statute involved the loss of all civil rights, forfeiture of lands, goods and chattels, and imprisonment during the royal pleasure.

Many other statutes followed that of 1353, but that passed in the sixteenth year of Richard II.'s reign is, as mentioned before, usually referred to as *the* Statute of Praemunire. This statute, after first stating "that the right of recovering the presentments to churches, prebends, and other benefices . . . belongeth only to the king's court of the old right of his crown, used and approved in the time of all his progenitors kings of England," proceeds to condemn the practice of papal translation, and after rehearsing the promise of the three estates of the realm to stand with the king in all cases touching his crown and his regalty, enacts "that if any purchase or pursue, or cause to be purchased or pursued in the court of Rome, or elsewhere, any such translations, processes, and sentences of excommunications, bulls, instruments or any other things whatsoever . . . he and his notaries, abettors and counsellors" shall be put out of the king's protection, and their lands tenements, goods and chattels forfeit to the king, and they shall be attached by their bodies or process made against them by *praemunire facias*. This statute, says Stubbs, was one of the strongest defensive measures taken during the middle ages against Rome and was called for by the conduct of the pope, who had forbidden the bishops to execute the sentences of the royal courts in suits connected with ecclesiastical patronage. The last ancient statute concerning praemunire, until the Reformation, was an extension in the reign of Henry IV. (1400) of the Statute of Provisors, by which all persons who accepted any provision from the pope to be exempt from canonical obedience to their proper ordinary were subjected to the penalties prescribed. The range and description of offences subject to the penalties of praemunire were greatly widened after the Reformation, so that acts of a very miscellaneous character were from time to time brought within the scope of enactments passed for a very different purpose. For instance, the penalties of praemunire were incurred, under an act of Queen Elizabeth (1571), for denying the Queen's title; and under an act of James I. the Statute of Monopolies (1623), for obtaining any stay of proceedings (other than by arrest of judgment or a writ of error) in any suit for a monopoly; under an act of Charles I. (1640) the attempting to restrain the importation or making of gunpowder was a praemunire; in the reign of Charles II. an act of 1661 made the asserting maliciously and advisedly, by speaking or writing, that both or either house of parliament has a legislative authority without the king, a praemunire. In the same reign, the Habeas Corpus Act 1679 made the committing of any man to prison out of the realm a praemunire, unpardonable even by the king. It thus appears that while the Crown by its prerogative might at any time remit the whole or any part of the punishment incurred by a praemunire, an exception was made in transgressions of the Statute of Habeas Corpus.[1] An act of William III. (1695) made serjeants, counsellors, proctors, attorneys, and all officers of courts practising without having taken the proper oaths guilty of a praemunire. By the Succession to the Crown Act 1707, *verbally* to assert the rights of a person to the Crown contrary to the Acts of Settlement and Union is praemunire (to do so by writing or printing is treason). The Royal Marriages Act 1772 is the last statute which subjects anyone to the penalties of a praemunire. A peer charged with praemunire is not entitled to trial by his peers, but is to be tried by a jury. The most famous historical instance of a prosecution of the Statute of Praemunire was that of Cardinal Wolsey in 1529.

AUTHORITIES.—*Statutes of the Realm*; Coke, *Institutes*; Collier, *Ecclesiastical History*; Hallam, *Middle Ages*; Reeves' *History of English Law*; Stephen's *Commentaries on the Laws of England*; Sir J. Stephen's *History of Criminal Law*; Sir T. E. Tomlin's *Law Dictionary*; Stubbs, *Constitutional History*. (T. A. I.)

PRAENESTE (mod. Palestrina), a very ancient city of Latium, lies 23 m. E. of Rome by the Via Praenestina (see below), on a spur of the Apennines facing the Alban Hills. To the natural strength of the place and its commanding situation Praeneste owed in large measure its historical importance. There are various legends as to its foundation. Objects in metal and ivory discovered in the earliest graves prove that as early as the 8th or 7th century B.C. Praeneste had reached a considerable degree of civilization and stood in commercial relations not only with Etruria but with the East. At this time the city was probably under the hegemony of Alba Longa, then the head of the Latin League. In 499 B.C., according to Livy, Praeneste withdrew from the Latin League, in the list of whose members given by Dionysius (v. 61) it occurs, and formed an alliance with Rome. After Rome had been weakened by the Gallic invasion (390) Praeneste joined its foes in a long struggle with Rome. The struggle culminated in the great Latin War (340–38), in which the Romans were victorious, and Praeneste was punished for its share in the war by the loss of part of its territory. It was not, however, like most other Latin cities, embodied in the Roman state, but continued in the position of a city in alliance with Rome down to the Social War, when it received the Roman franchise (in 90 B.C., probably as one of those cities which had not rebelled or had laid down their arms at once), which in 215 B.C. some of its citizens—who had bravely held Casilinum against Hannibal, and only surrendered when pressed by hunger —had refused to accept.

As an allied city it furnished contingents to the Roman army and possessed the right of exile (*jus exilii*), *i.e.* persons banished from Rome were allowed to reside at Praeneste. To judge from the works of art and inscriptions of this period (338 to 90 B.C.), it must have been for the place a time of prosperity, and even luxury. The nuts of Praeneste were famous and its roses were amongst the finest in Italy. The Latin spoken at Praeneste was somewhat peculiar,[2] and was ridiculed to some extent by the Romans. In the civil wars of Sulla the younger Marius was blockaded in the town by the Sullans (82 B.C.); and on its capture Marius slew himself, the male inhabitants were massacred in cold blood, and a military colony was settled on part of its territory, though, possibly owing to the extravagance of the new *coloni*, we find that in 63 B.C. this was already in the possession of large proprietors. It was probably in 82 B.C. that the city was removed from the hill-side to the lower ground at the Madonna dell' Aquila, and that the temple of Fortune was enlarged so as to include much of the space occupied by the ancient city. From an inscription found in 1907 it appears that Sulla delegated the foundation of the new colony to M. Terentius Varro Lucullus, who was consul in 73 B.C. Under the empire Praeneste, from its elevated situation and cool salubrious air, became a favourite summer resort of the wealthy Romans, whose villas studded the neighbourhood. Horace ranked it with Tibur and Baiae, though as a fact it never became so fashionable a residence as Tibur or the Alban Hills. Still, Augustus resorted thither; here Tiberius recovered from a dangerous illness, and here Hadrian probably built himself a villa. Marcus Aurelius also had a villa here. Amongst private persons who owned villas at Praeneste were Pliny the younger and Symmachus. Inscriptions show that the inhabitants of Praeneste were especially fond of gladiatorial shows.

But Praeneste was chiefly famed for its great temple of Fortune and for its oracle, in connexion with the temple, known as the "Praenestine lots" (*sortes praenestinae*). The oldest portion of the sanctuary was, however, that situated on the lowest terrace but one. Here is a grotto in the natural rock, containing a beautiful coloured mosaic pavement, representing a sea-scene—a temple of Poseidon on the shore, with various fish swimming in the sea. To the east of this is a large space, now open, but once very possibly roofed, and forming a basilica in two storeys, built against the rock on the north side, and there decorated with pilasters also; and to the east again is an apsidal hall, often identified with the temple itself, in which the famous mosaic with scenes from the Nile, now in the Palazzo Barberini on the uppermost terrace, was found. Under this hall is a chamber, which, as an inscription on its walls shows, served as a treasury in the 2nd century B.C. In front of this temple an obelisk was erected in the reign of Claudius, fragments of which still exist. The modern cathedral, just below the level of this temple, occupies the civil basilica of the town, upon the façade of which was a sun-dial, described by Varro (traces of which may still be seen). In the modern piazza the steps leading up to this latter basilica and the base of a large monument were found in 1907; so that only a part of the piazza represents the ancient forum. As extended by Sulla the sanctuary of Fortune occupied a series of five vast terraces, which, resting on gigantic substructions of masonry and connected with each other by grand staircases, rose one above the other on the hill in the form of the side of a pyramid, crowned on the highest terrace by the round temple of Fortune. This immense edifice, probably by far the largest sanctuary in Italy, must have presented a most imposing aspect, visible as it was from a great part of Latium, from Rome, and even from the sea. The ground at the foot of the lowest terrace is 1476 ft. above sea-level; here is a cistern, divided into ten large chambers, in brick-faced concrete. The goddess Fortuna here went by the name of Primigenia (First-Born, but perhaps in an active sense First-Bearer); she was represented suckling two babes, said to be Jupiter and Juno, and she was especially worshipped by matrons. The oracle continued to be consulted down to Christian times, until Constantine, and again later Theodosius, forbade the practice and closed the temple. A bishop of Praeneste is first mentioned in A.D. 313. In 1297 the Colonna family, who then owned Praeneste (Palestrina), revolted from the pope, but in the following year the town was taken and razed to the ground. In 1437 the city, which had been rebuilt, was captured by the papal general Cardinal Vitelleschi and once more utterly destroyed. It was rebuilt and fortified by Stefano Colonna in 1448. In 1630 it passed by purchase into the Barberini family. Praeneste was the native town of Aelian, and in modern times of the great composer (Giovanni) Pierluigi da Palestrina.

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[1] Sir T. E. Tomlins says that there is only one instance of a prosecution on a praemunire to be found in the state trials, in which case the penalties were inflicted upon some persons for refusing to take the oath of allegiance to Charles II.

[2] Thus the Praenestines shortened some words: they said *conia* for *ciconia*, *tammodo* for *tantummodo* (Plaut. *Truc.* iii. 2, 23; Id. *Trinum.* iii. 1, 8; cf. Comment. on Festus, p. 731, ed. Lindemann), and inscriptions exhibit the forms *Acmemeno* and *Tondrus* for *Agamemno* and *Tyndarus*. They said *nefrones* for *nefrendes* in the sense of *testiculi* and *tongitio* for *notio* (Festus, *s.v.* "nefrendes" and "tongere"). Cf. Quintilian, *Instit.* i. 5, 56.

The modern town of Palestrina, a collection of narrow and filthy alleys, stands on the terraces once occupied by the temple of Fortune. On the summit of the hill (2471 ft.), nearly a mile from the town, stood the ancient citadel, the site of which is now occupied by a few poor houses (Castel San Pietro) and a ruined medieval castle of the Colonna. The magnificent view embraces Soracte, Rome, the Alban Hills and the Campagna as far as the sea. Considerable portions of the southern wall of the ancient citadel, built in very massive Cyclopean masonry of blocks of limestone, are still to be seen; and the two walls, also polygonal, which formerly united the citadel with the town, can still be traced. The ruins of the villa attributed to Hadrian stand in the plain near the church of S. Maria della Villa, about three-quarters of a mile from the town. Here was discovered the Braschi Antinoüs, now in the Vatican. The calendar, which, as Suetonius tells us, was set up by the grammarian, M. Verrius Flaccus in the forum of Praeneste (the reference being to the forum of the imperial period, at the Madonna dell' Aquila), was discovered in the ruins of the church of S. Agapitus in 1771, where it has been used as building material (C. Hülsen in *Corp. inscr. lat.* 2nd ed. i. 230). Excavations made, especially since 1855, in the ancient necropolis, which lay on a plateau surrounded by valleys at the foot of the hill, and of the town, have yielded important results for the history of the art and manufactures of Praeneste. Of the objects found in the oldest graves, and supposed to date from about the 7th century B.C., the cups of silver and silver-gilt and most of the gold and amber jewelry are Phoenician (possibly Carthaginian), or at least made on Phoenician models; but the bronzes and some of the ivory articles seem to be Etruscan. No objects have been discovered belonging to the period intermediate between the 7th and 3rd centuries B.C.; but "from about 250 B.C. onwards we have a series of Praenestine graves surmounted by the characteristic 'pine-apple' of local stone, containing stone coffins with rich bronze, ivory and gold ornaments beside the skeleton. From these come the bronze *cistae* and *specula* with partly (but far from wholly) Etruscan inscriptions, for which Praeneste is renowned" (Conway, *Ital. Dial.*). Among these is the famous Ficoroni casket, engraved with pictures of the arrival of the Argonauts in Bithynia and the victory of Pollux over Amycus. It was found in 1738. "The caskets are unique in Italy, but a large number of mirrors of precisely similar style have been discovered in Etruria and are published in full by the German Archaeological School at Rome: *Etruskische Spiegeln*, vol. v. sqq. (Berlin, 1884). Hence, although a priori it would be reasonable to conjecture that objects with Etruscan characteristics came from Etruria, the evidence, positive and negative, points decisively to an Etruscan factory in or near Praeneste itself" (Conway, ibid.). Most of the objects discovered in the necropolis are preserved in the Roman collections, especially in the Kircherian Museum (which possesses the Ficoroni casket) and the Barberini library.

See E. Fernique, *Préneste* (Bibliothèque des Écoles Françaises, *fasc.* 17, Paris, 1880); H. Dessau in *Corp. inscr. lat.* xiv. 288 sqq., *Corp. inscr. etrusc.* vol. ii.; O. Marucchi, *Guida archeologica dell' antica Preneste* (Rome, 1885), and in *Bullettino comunale* (1904), 233 sqq.; R. S. Conway, *Italic Dialects*, i. 311 sqq. (Cambridge, 1897); T. Ashby in *Papers of the British School at Rome*, i. 132 sqq.; R. Delbrück, *Hellenistische Bauten in Latium*, p. 47 sqq. (Berlin, 1907); *Notizie degli Scavi*, *passim*; and especially D. Vaglieri (1907), p. 132, &c.; R. van Deman Magoffin, *Topography and Municipal History of Praeneste* (Johns Hopkins University Studies, xxvi. 9, 10); (Baltimore, 1908). (J. G. Fr.; R. S. C.; T. As.)

PRAENESTINA, VIA, an ancient road of Italy, leading from Rome E. by S. to Praeneste, a distance of 23 m., Gabii being situated almost exactly half-way. At the ninth mile the road crosses a ravine by the well-preserved and lofty Ponte di Nona, with seven arches, the finest ancient bridge in the neighbourhood of Rome. The line of the road is, considering the difficulty of the country beyond Gabii, very straight. In the stretch beyond Gabii it is only used as a track, and well preserved. Half-way between Gabii and Praeneste is the well-preserved single-arched bridge, known as Ponte Amato.

See T. Ashby in *Papers of the British School at Rome*, i. 149 sqq. (T. As.)

PRAETOR (Lat. *prae-itor*, "he who goes before," "a leader"), originally a military title, was in classical times the designation of the highest magistrates in the Latin towns. The Roman consuls were at first called praetors; in the early code of the Twelve Tables (450 B.C.) they appear to have had no other title. By the Licinian law of 367, which abolished the military tribunes with consular power and enacted that the supreme executive should henceforward be in the hands of the two consuls, a new magistrate was at the same time created who was to be a colleague of the consuls, though with lower rank and lesser powers. This new magistrate was entrusted with the exclusive jurisdiction in civil cases; in other respects his powers resembled those of the consuls. His distinctive title was the city praetor (*praetor urbanus*), and in aftertime, when the number of praetors was increased, the city praetor always ranked first. To this new magistrate the title of "praetor" was thenceforward properly restricted.[1] About 242 the increase of a foreign population in Rome necessitated the creation of a second praetor for the decision of suits between foreigners (*peregrini*) or between citizens and foreigners. This praetor was known at a later time as the "foreign praetor" (*praetor peregrinus*).[2] About 227 two more praetors were added to administer the recently acquired provinces of Sicily and Sardinia. The conquest of Spain occasioned the appointment of two more in 197, of whom one governed Hither and the other Further Spain. The number of praetors, thus augmented to six, remained stationary till Sulla's time (82). But in the interval their duties vastly multiplied. On the one hand, five new provinces were added to the Roman dominions—Macedonia and Achaia in 146, Africa in the same year, Asia in 134, Gallia Narbonensis in 118, Cilicia probably in 102. On the other hand, new and permanent jury courts (*quaestiones perpetuae*) were instituted at Rome, over which the praetors were called on to preside. To meet this increase of business the tenure of office of the praetors and also of the consuls was practically prolonged from one to two years, with the distinction that in their second year of office they bore the titles of propraetor and proconsul instead of praetor and consul. The prolongation of office, together with the participation of the proconsuls in duties which properly fell to the praetors, formed the basis of Sulla's arrangements. He increased the number of the praetors from six to eight, and ordained that henceforward all the eight should in their first year administer justice at Rome and in their second should as propraetors undertake the government of provinces. The courts over which the praetors presided, in addition to those of the city praetor and the foreign praetor, dealt with the following offences: oppression of the provincials by governors (*repetundarum*), bribery (*ambitus*), embezzlement (*peculatus*), treason (*majestatis*), murder (*de sicariis et veneficis*), and probably forgery (*falsi*). A tenth province

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[1] Some writers, following Livy vi. 42, assert that at first the praetorship was open to patricians only, but Mommsen (*Röm. Staatsrecht* ii. 195 [204] shows that this is probably a mistake. The election of a plebeian to the office for the first time in 337 was certainly opposed by the consul who presided at the election, but there appears to have been no legal obstacle to it.

[2] [His official title in republican times was *Praetor qui inter peregrinos jus dicit*, under the empire *Praetor qui inter cives peregrinos jus dicit*, until the time of Vespasian, when the abbreviated title *praetor peregrinus* came into use.]

(Gallia cisalpina) was added to the previous nine, and thus the number of judicial and provincial departments corresponded to the annual number of praetors, propraetors and proconsuls. The proportion, however, was not long maintained: new provinces were added to the empire—Bithynia in 74, Cyrene about the same time, Crete in 67, Syria in 64—and one or more new law courts were instituted. To keep pace with the increase of duties Julius Caesar increased the number of praetors successively to ten, fourteen and sixteen; after his time the number varied from eight to eighteen.

The praetors were elected, like the consuls, by the people assembled in the *comitia centuriata* and with the same formalities.[1] They regularly held office for a year; only in the transition period between the republic and the empire was their tenure of office sometimes limited to a few months.[2] The insignia of the praetor were those common to the higher Roman magistrates—the purple-edged robe (*toga praetexta*) and the ivory chair (*sella curulis*); in Rome he was attended by two lictors, in the provinces by six. The praetors elect cast lots to determine the department which each of them should administer. A praetor was essentially a civil judge, and as such he was accustomed at or before his entry on office to publish an edict setting forth the rules of law and procedure by which he intended to be guided in his decisions. As these rules were often accepted by his successors, the praetor thus acquired an almost legislatorial power, and his edicts, thus continued, corrected and amplified from year to year, became, under the title of the "perpetual" edicts, one of the most important factors in moulding Roman law. Their tendency was to smooth away the occasional harshness and anomalies of the civil law by substituting rules of equity for the letter of the law, and in this respect the Roman praetor has been compared to the English chancellor. His functions were considerably modified by the introduction of the standing jury courts (*quaestiones perpetuae*). Hitherto the praetor had conducted the preliminary inquiry as to whether an action would lie, and had appointed for the actual trial of the case a deputy, whom he instructed in the law applicable to the case and whose decisions he enforced. The proceedings before the praetor were technically known as *jus* in distinction from *judicium*, which was the actual trial before the deputy judge. But in the standing jury courts (of which the first—that for *repetundae*—was instituted in 149), or rather in the most important of them, the praetors themselves presided and tried the cases. These new courts, though formally civil, were substantially criminal courts; and thus a criminal jurisdiction was added to the original civil jurisdiction of the praetors. Under the empire various special functions were assigned to certain praetors, such as the two treasury praetors (*praetores aerarii*),[3] appointed by Augustus in 23; the spear praetor (*praetor hastarius*), who presided over the court of the Hundred Men, which dealt especially with cases of inheritance; the two trust praetors (*praetores fideicommissarii*), appointed by Claudius to look after cases of trust estates, but reduced by Titus to one; the ward praetor (*praetor tutelaris*), appointed by Marcus Aurelius to deal with the affairs of minors; and the liberation praetor (*praetor de liberalibus causis*), who tried cases turning on the liberation of slaves.[4] There is no evidence that the praetors continued to preside over the standing courts after the beginning of the 3rd century A.D., and the foreign praetorship disappears about this time.[5] Even the jurisdiction of the city praetor seems not to have survived the reforms of Diocletian, though the office itself continued to exist. But of the praetorships with special jurisdiction (especially the ward praetorship and the liberation praetorship) some lasted into the 4th century and were copied in the constitution of Constantinople.

Besides their judicial functions, the praetors, as colleagues of the consuls, possessed, though in a less degree, all the consular powers, which they regularly exercised in the absence of the consuls; but in the presence of a consul they exercised them only at the special command either of the consul or, more usually, of the senate. Thus the praetor possessed military power (*imperium*); even the city praetor, though attached by his office to Rome, could not only levy troops but also in certain circumstances take the command in person. As provincial governors the praetors had frequent occasion to exercise their military powers, and they were often accorded a triumph. The city praetor presided over popular assemblies for the election of certain inferior magistrates, but all the praetors officiating in Rome had the right to summon assemblies for the purpose of legislation. In the absence of the consuls the city praetor, and in default of him the other praetors, were empowered to call meetings of the senate. Public religious duties, such as the fulfilment of state vows, the celebration of sacrifices and games, and the fixing of the dates of movable feasts, probably only fell to the praetors in the absence of the consuls. But since in the early times the consuls as a rule spent only the first months of their year of office in Rome, it is probable that a considerable share of religious business devolved on the city praetor; this was certainly the case with the Festival of the Cross-roads (*compitalia*), and he directed the games in honour of Apollo from their institution in 212. Augustus in 22 placed the direction of all the popular festivals in the hands of the praetors, and it is not without significance that the praetors continued thus to minister to the pleasures of the Roman mob for centuries after they had ceased almost entirely to transact the business of the state. (For the praetor as provincial governor see PROVINCE.) (J. G. FR.; X.)

A full account of the praetorship will be found in Mommsen, *Römisches Staatsrecht* (1887), vol. ii. and P. Willems, *Le Droit public romain* (1883); T. M. Taylor's *Constitutional and Political History of Rome* (1899) will also be found useful. There is a monograph by E. Labatut, *Histoire de la préture* (1868).

PRAETORIANS. In the early Roman republic, *praetor* (*q.v.*) meant commander of the army: in the later republic *praetor* and *propraetor* were the usual titles for provincial governors with military powers. Accordingly, the general's quarters in a camp came to be called *praetorium*,[6] and one of the gates *porta praetoria*, and the general's bodyguard *cohors praetoria*, or, if large enough to include several cohorts, *cohortes praetoriae*. Under the empire the nomenclature continued with some changes. In particular *cohortes praetoriae* now designated the imperial bodyguard. This, as founded by Augustus, consisted of nine cohorts, each 1000 strong, some part of which was always with the emperor, whether in Rome or elsewhere. In A.D. 23 his successor Tiberius concentrated this force on the eastern edge of Rome in fortified barracks: hence one cohort in turn, clad in civilian garb, was sent to the emperor's house on the Palatine, and large detachments could be despatched to foreign wars. The men were recruited voluntarily, in Italy or in Italianized districts, and enjoyed better pay and shorter service than the regular army: they were under *praefecti praetorio* (usually two; later, sometimes three, rarely only one), who during most of the empire might not be senators. This force was the only body of troops in Rome (save a few *cohortes urbanae*, a fire brigade, and some non-Roman personal guards of the emperor), or, indeed, anywhere near the capital. Accordingly it could make or unmake emperors in crises—at the accession of Claudius in A.D. 41, in 68–69, and again late in the second century. But its normal influence was less than is often asserted. Moreover, its prefects, since they were two and liable to be disunited, and since they could not be senators, neither combined with the senators to restore an oligarchy nor themselves aspired as pretenders to the throne. These prefects were at first soldiers, but later mostly lawyers who relieved the emperors of various civil and criminal jurisdiction. In the second century the praetorian cohorts became ten in number, and at the end of it Septimius Severus reorganized them so that they consisted practically of barbarian soldiers and held constant conflict with the people of Rome. At the end of the third century the *praefecti praetorio* were reconstituted as four officers, each ruling one quarter of the now divided empire. In 312 the Praetorian Guard was suppressed by Constantine. Their barracks at Rome covering a rectangle of 39 acres (1210 by 1410 ft.), were included by Aurelian in the walls of Rome, and three sides of the enceinte can still be seen near the Porta Pia, with brickwork as old as Tiberius: the interior (now barracks for the Italian army) is archaeologically less interesting.

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[1] [Until the time of Tiberius, when their election was transferred to the Senate.]

[2] [The age for the office was forty under the republic, thirty under the empire.]

[3] [They took the place of the quaestors; this arrangement continued till the time of Claudius.]

[4] [The fiscal praetor (*praetor fiscalis*) was appointed by Nerva to hear claims preferred against the imperial fiscus.]

[5] Marquardt conjectures with much probability that when Caracalla extended the Roman franchise to the whole empire he at the same time abolished the foreign praetorship.

[6] In permanent forts and fortresses, *praetorium* probably denoted strictly a residence: the official headquarters building (though commonly styled *praetorium* by moderns) was the *principia*. On the other hand praetorium could denote any lord's residence, even on a civilian's estate.

PRAETORIUS, MICHAEL (1571–1621), German musical historian, theorist and composer, was born at Kreuzberg, in Thuringia, on the 15th of February 1571. His father's name was Michael Schultheis.[1] While he was still quite young he visited the university of Frankfort on the Oder for three years. Here he studied philosophy, and on the death of his brother, on whose support he relied, he was given a post as organist in the town. He acted as kapellmeister at Lüneburg early in life, was engaged first as organist and later as kapellmeister and secretary to the duke of Brunswick-Wolfenbüttel, and was eventually rewarded for his long services with the priory of Ringelheim, near Goslar. He died at Wolfenbüttel on the 15th of February 1621. Of his very numerous compositions copies are now very scarce. The most important are: *Polyhymnia* (15 vols.), *Musae Sioniae* (16 vols.), and *Musa Aonia* (9 vols.), all written partly to Latin and partly to German words. But more precious than all these is the *Syntagma musicum* (3 vols. and a *cahier* of plates, 4to, Wittenberg and Wolfenbüttel, 1615–1620). In the original prospectus of the work four volumes were promised, but it is certain that no more than three were ever published. The fourth volume mentioned in Forkel's catalogue is clearly nothing but the *cahier* of plates attached to vol. ii.

The chief value of this very remarkable work lies in the information it gives concerning the condition of instrumental music in the early years of the 17th century. The plates include excellent representations of all the musical instruments in use at the time they were published, together with many forms even then treated only as antique curiosities. The work thus throws a light upon the earlier forms of instrumental music which to the historian is invaluable. In fact, without the information bequeathed to us by Praetorius it would be impossible to reconstruct in theory the orchestra of the earlier half of the 17th century, during which the opera and the oratorio both sprang into existence, or even to understand the descriptions left us by other less careful writers.

PRAETUTTII (also called Πραιτεττιοί), a tribe of ancient Italy inhabiting the south of Picenum. Their territory lay between the rivers Vomanum and Tessinnus (Pliny iii. § 110), and therefore included Castrum Novum, Interamnia and the Truentus, as well as probably the original of Hadria. From this name was derived the medieval form *Aprutium* (quoted by Kiepert in his *Alte Geographie*), and hence the modern Abruzzo (more commonly in the plural *gli Abruzzi*), denoting the whole central mountain land of Italy. We have no evidence, except their name, and that throws no light on their language, for separating them from the other inhabitants of Picenum (*q.v.*).
(R. S. C.)

PRAGMATIC SANCTION (Lat. *pragmatica sanctio*, from the Gr. πρᾶγμα, business), originally a term of the later Roman law. It is found in the Theodosian and Justinian codes, together with such variants as a *pragmaticum*, *pragmatica jussio*, command; *annotatio*, an imperial rescript; *constitutio*, a regulation; and *pragmaticum rescriptum*. It was a decision of the state dealing with some interest greater than a question in dispute between private persons, and was given for some community (*universitas hominum*) and for a public cause. In more recent times it was adopted by those countries which followed the Roman law, and in particular by despotically governed countries where the rulers had a natural tendency to approve of the maxims and to adopt the language of the imperial Roman lawyers. A pragmatic sanction, as the term was used by them, was an expression of the will of the sovereign or "the prince," defining the limits of his own power, or regulating the succession. Justinian regulated the government of Italy after it had been reconquered from the Ostrogoths by pragmatic sanctions. In after ages the king of France, Charles VII., imposed limits on the claims of the popes to exercise jurisdiction in his dominions by the pragmatic sanction of Bourges in 1438. The emperor Charles VI. settled the law of succession for the dominions of the house of Habsburg by pragmatic sanction first published on the 19th of April 1713, and thereby prepared the way for the great war which ensued upon his death. Philip V., the first of the Bourbon kings of Spain, introduced the Salic law by a pragmatic sanction, and his descendant, Ferdinand VII., revoked it by another. The term was not used in England even for such things as the will by which Henry VIII. regulated the succession to the throne, which would have been a pragmatic sanction in a country of the Roman law. The term and the thing signified by it have become obsolete owing to the spread of constitutional government in modern Europe.

PRAGMATISM, in philosophy, etymologically a theory or method of dealing with real things (Gr. πράγματα: cf. πραγματικός, versed in affairs). "Pragmatic," as here employed is not used in the common colloquial sense of "pragmatical," *i.e.* "fussy and positive," nor in the historical sense, as in "Pragmatic Sanction," of "relating to affairs of state," but in the sense of practical or efficient.[2] Pragmatism, as a general philosophic doctrine or mental attitude, can only be understood as part of a reaction against the intellectualistic speculation which has characterized most of modern metaphysics. It arises from a general awakening to the fact that the growth of our psychological and biological knowledge must profoundly transform the traditional epistemology. It follows that "pragmatic" lines of thought may originate from a multiplicity of considerations and in a variety of contexts. These, however, may be conveniently classified under four main heads—psychological, logical, ethical and religious—and the history of the subject shows that all these have contributed to the development of pragmatism.

1. Psychologically, pragmatism starts from the efficacy and all-pervasiveness of mental activity, and points out that interest, attention, selection, purpose, bias, desire, emotion, satisfaction, &c., colour and control all our cognitive processes. It insists that all thought is personal and purposive and that "pure" thought is a figment. A judgment which is not prompted by motives and inspired by interest, which has not for its aim the satisfaction of a cognitive purpose, is psychologically impossible, and it is, therefore, mistaken to construct a logic which abstracts from all these facts. Nor is the presence of such non-intellectual factors in thinking necessarily deleterious: at any rate they are ineradicable. Truths are always on one side matters of belief, and beliefs are ultimately rules for action. The whole functioning of our mental apparatus is directed upon yielding the right response to the stimulations of the environment, and is valuable if and in so far as it does this. The "psychologism" thus introduced into logic amounts to a systematic protest against the notion of a dehumanized thought and the study of logic in abstraction from actual psychic process.

2. In its logical aspect pragmatism originates in a criticism of fundamental conceptions like "truth," "error," "fact"

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[1] German *Schultz* or *Schultze* (*Schultheiss*), meaning the head-man of a township, latinized into praetor or praetorius. Many other members of the family of Praetorius were eminent as musicians.

[2] *The New English Dictionary* quotes for nine distinct senses of the word, of which the philosophic is the eighth. The seven earlier ones are all more or less obsolescent, and their very number shows that the meaning of the word was very vague.

and "reality," the current accounts of which it finds untenable or unmeaning. "Truth," for example, cannot be defined as the agreement or correspondence of thought with "reality," for how can thought determine whether it correctly "copies" what transcends it? Nor can our truth be a copy of a transcendent and absolute truth (Dewey). If it be asked, therefore, what such phrases mean, it is found that their meaning is really defined by their use. The real difference between two conceptions lies in their application, in the different consequences for the purposes of life which their acceptance carries. When no such "practical" difference can be found, conceptions are identical; when they will not "work," *i.e.* when they thwart the purpose which demanded them, they are false; when they are inapplicable they are unmeaning (A. Sidgwick). Hence the "principle of Peirce" may be formulated as being that "every truth has practical consequences, and these are the test of its truth." It is clear that this (1) implicitly considers truth as a value, and so connects it with the conception of good, and (2) openly raises the question—What is truth, and how is it to be distinguished from error? This accordingly becomes the central problem of pragmatism. This same issue also arises independently out of the breakdown or rationalistic theories of knowledge (F. H. Bradley, H. H. Joachim). Logical analysis, after assuming that truth is independent and not of our making, has to confess that all logical operations involve an apparently arbitrary interference with their data (Bradley). Again, it assumes an ideal of truth which turns out to be humanly unattainable and incompatible with the existence of error, and an ideal of science which no human science can be conceived as attaining. The obvious way of avoiding the scepticism into which rationalism is thus driven is to revise the assumptions about the nature and postulates of truth which lead to it.

3. The ethical affinities of pragmatism spring from the perception that all knowing is referred to a purpose. This at once renders it "useful," *i.e.* a means to an end or "good." Completely "useless" knowledge becomes impossible, though the uses of knowledge may still vary greatly in character, in directness, and in the extent and force of their appeal to different minds. This relation to a "good" must not, however, be construed as a doctrine of ethics in the narrower sense; nor is its "utilitarianism" to be confused with the hedonism of the British associationists. "Useful" means "good for an (any) end," and the "good" which the "true" claims must be understood as cognitive. But cognitive "good" and moral "good" are brought into close connexion, as species of teleological "good" and contributory to "the Good." Thus only the generic, not the specific, difference between them is abolished. The "true" becomes a sort of *value*, like the beautiful and the (moral) good. Moreover, since the "real" is the object of the "true," and can be distinguished from the "unreal" only by developing superior value in the process of cognition which arrives at it, the notions of "reality" and "fact" also turn out to be disguised forms of value. Thus the dualism between judgments of fact and judgments of value disappears: whatever "facts" we recognize are seen to be relative to the complex of human purposes to which they are revealed. It should further be noted that pragmatism conceives "practice" very widely: it includes everything related to the control of experience. The dualism, therefore, between "practice" and "theory" also vanishes; a "theory" unrelated to practice (however indirectly) is simply an illusion. Lastly it may be pointed out that, as asserting the efficacy of thought and the reality of choice, pragmatism involves a real, though determinable, indetermination in the course of events.

4. Pragmatism has very distinctly a connexion with religion, because it explains, and to some extent justifies, the faith-attitude or will to believe, and those who study the psychology of religion cannot but be impressed with the pragmatic nature of this attitude. If the whole of a man's personality goes to the making of the truth he accepts, it is clear that his beliefs are not matters of "pure reason," and that his passional and volitional nature must contribute to them and cannot validly be excluded. His religion also is ultimately a vital attitude which rests on his interests and on his choices between alternatives which are real for him. It is not however asserted that his mere willing to believe is a proof of the truth of what he wishes to believe, any more than a will to disbelieve justifies disbelief. His will to believe merely recognizes that choice is necessary and implies risk, and puts him in a position to obtain verification (or disproof). The pragmatic claim for religion, therefore, is that to those who will take the first step and will to believe an encouraging amount of the appropriate verifications accrues. It is further pointed out that this procedure is quite consonant with the practice of science with regard to its axioms. Originally these are always postulates which have to be assumed before they can be proved, and thus in a way "make" the evidence which confirms them. Scientific and religious verification therefore, though superficially distinct, are alike in kind.

The *pragmatic doctrine of truth*, which it is now possible to outline, results from a convergence of the above lines of argument. Because truth is a value and vitally valuable, and all meaning depends on its context and its relation to us, there cannot be any abstract "absolute" truth disconnected from all human purposes. Because all truth is primarily a claim which may turn out to be false, it has to be tested. To test it is to try to distinguish between truth and falsity, and to answer the question—What renders the claim of a judgment to be true, really true? Now such testing, though it varies greatly in different departments of knowledge, is always effected by the consequences to which the claim leads when acted on. Only if they are "good" is the claim validated and the reasoning judged to be "right": only if they are tested does the theory of truth become intelligible and that of error explicable. If, therefore, a logic fails to employ the pragmatic test, it is doomed to remain purely formal, and the possibility of applying its doctrines to actual knowing, and their real validity, remain in doubt. By applying the pragmatic test on the other hand, it is possible to describe how truths are developed and errors corrected, and how in general old truths are adjusted to new situations. This "making of truth" is conceived as making for greater satisfaction and greater control of experience. It renders the truth of any time relative to the knowledge of the time, and precludes the notion of any rigid, static or incorrigible truth. Thus truth is continually being made and re-made. If the new truth seems to be such that our cognitive purposes would have been better served by it than they were by the truth we had at the time, it is antedated and said to have been "true all along." If an old truth is improved upon, it is revalued as "false." To this double process there is no actual end, but ideally an "absolute" truth (or system of truths) would be a truth which would be adequate to every purpose.

Extensions of pragmatism in a variety of directions readily suggest themselves, and indeed only the doctrine of truth in the above sketch can be treated as strictly indispensable. If however the logical method of pragmatism is critically applied to all the sciences, many doctrines will be cut out which have little or no "pragmatic value." This all-round application of the pragmatic method has received the name of "humanism." It expressly refers itself to the maxim of Protagoras that "man is the measure of all things," and is best conceived as a protest against the assumption that logic can treat thought in abstraction from its psychological context and the personality of the knower, *i.e.* that knowledge can be dehumanized. To arbitrary and unverifiable metaphysical speculation, and to forms of "absolutism" which have lost touch with human interests, this humanism is particularly destructive. It emphasizes still more than pragmatism the personal aspect of all knowing and its contribution to the "making of reality" which necessarily accompanies the making of truth. But it also goes on to raise the question whether the making of reality for our knowledge does not, in view of the essentially practical nature of knowledge, imply also a real making of reality by us, and so throw light upon the whole genesis of reality. In this direction pragmatism may ultimately lead to a number of metaphysics, each of which will represent a personal guess at a final synthesis of experience, while remaining essentially undogmatic and improvable. The great variety and impermanence of metaphysical systems in the past thus find their explanation: they were all along what they are now recognized as being, viz. personal efflorescences provoked by a totality of experiences which differed in each case.

As regards the history and bibliography of pragmatism, the term was first invented by C. S. Peirce in discussions with William James at Harvard University, and its meaning was expounded by him in an article on "How to make our Ideas clear" in the *Popular Science Monthly* for January 1878. The pragmatic test of truth was referred to by James in his *Will to Believe* (1896, p. 124, in a paper first published in 1881). The validity of the argument from consequences and the connexion of truth with what "works" was asserted à propos of A. J. Balfour's *Foundations of Belief* by A. Seth Pringle-Pattison in his *Man's Place in Cosmos* (1897, p. 307). But the word "pragmatism" itself first occurs in print in 1898, in James's pamphlet on *Theoretical Conceptions and Practical Results*, and again in his *Varieties of Religious Experience* (1902, p. 444). It was rapidly taken up, first by W. Caldwell in *Mind* (1900, new series, No. 36), and by F. C. S. Schiller in *Personal Idealism* (1902). James himself at first developed chiefly the psychological and ethical aspects of the doctrine in his epoch-making *Principles of Psychology* (1890) and his *Will to Believe*. The application to logic, therefore, was mainly made by his followers, John Dewey and his pupils, in the *Chicago Decennial Publications* and especially in their *Studies in Logical Theory* (1903), where, however, the term used is "instrumentalism," and by F. C. S. Schiller, in "Axioms as Postulates" (in *Personal Idealism*, ed. H. Sturt, 1902), in *Humanism* (1903), in which that term was proposed for the extensions of pragmatism, in *Studies in Humanism* (1907), and in *Plato or Protagoras* (1908). All these logical and philosophic developments were popularly expounded by James in his *Pragmatism* (1907), followed by *A Pluralistic Universe* (1908) and *The Meaning of Truth* (1909). H. H. Bawden's *The Principles of Pragmatism* (1910) is a popular sketch. Alfred Sidgwick's logical writings, especially his *Distinction* (1892) and *The Use of Words in Argument* (1901), represent an independent development. For the religious applications see G. Tyrrell (*Lex orandi*, 1903, *Lex credendi*, 1906). Among critical writers on the pragmatic side may be mentioned H. Sturt (*Idola theatri*, 1906), and H. V. Knox (*Mind*, new series, No. 54). There is already a large controversial literature in the philosophic journals, and two critical works appeared in 1909: J. B. Pratt, *What is Pragmatism?* (1909), and A. Schinz, *Anti-Pragmatism*(1909). Outside the English-writing world, identical or kindred tendencies are represented in France by Leroy, Poincaré, Bergson, Milhaud, Blondel, Duhem, Wilbois, Pradines; in Germany by Mach, Ostwald, Simmel, Jerusalem, Goldscheid, Jacoby; in Italy by Papini, Prezzolini, Vailati, Troiano. In addition there are numbers of partial pragmatists, *e.g.* G. Santayana (*The Life of Reason*, 1905). Various anticipations of pragmatism in the history of philosophy are noted in Schiller's *Plato or Protagoras ?* (1908). (F. C. S. S.)

PRAGUE (Ger. *Prag*; Bohemian *Praha*), the ancient capital of the Bohemian kingdom, residence of an archbishop and an Imperial governor, and the meeting-place of the Bohemian Diet. The population of the town, including the suburbs that have not yet been incorporated with it, was 460,849 in 1906. Somewhat under a fifth of the population are Germans, the rest belong to the Bohemian (Czech) nationality. Prague is situated on both banks of the river Vltava (Ger. Moldau) in 50°5′ N., 14°25′ E., 150 m. N.W. of Vienna and 75 S.S.E. of Dresden. The city is divided into eight districts, which are numbered thus: I. Staré město (the old town), II. Nové město (the new town); III. Malá strana (the small side "quarter"); IV. Hradčany; V. Josefské město (Joseph's, formerly the Jewish, town); VI. Vyšehrad; VII. Holesovic-Bubna; VIII. the suburbs Karlin (Ger. Karolinenthal), Vinohrady and Smichov are not yet incorporated with the city. Prague was by its geographical situation naturally destined to become the capital of Bohemia, as it lies in the centre of the country. The origin of Prague goes back to a very early date, though, as is the case with most very ancient cities, the tales connected with its origin are no doubt legendary. The earliest inhabited spot within the precincts of the present city was the hill named Vyšehrad (higher castle, acropolis) on the right bank of the Vltava. Here the semi-mythical prince Krok, his daughter Libusa, and her husband the peasant Přemysl are stated to have resided. To Libusa is attributed also the foundation of a settlement on the opposite bank of the Vltava on the Hradčany hill. The ancient Bohemian chronicler Cosmas of Prague gives a very picturesque account of this semi-mythical occurrence.

It is probable that at an early period buildings sprang up in those parts of the present Staré město and Malá strana that are situated nearest to the banks of the river. These banks were from a very remote period connected by a bridge. This bridge was probably situated very near the spot where Charles IV. afterwards built the famed "bridge of Prague." It is probable that independently of the Hradčany and Vyšehrad settlements a certain number of buildings existed as early as 993 on the site of the present Poříč Street (near the station of the state railway). The city continued to increase, and during the reign of King Vratislav (1061–1092) many Germans were attracted to Prague.

In 1235 King Wenceslaus I. surrounded the old town—that is to say, the buildings on the right bank of the Vltava—with a wall and ditch. These fortifications, starting from the river, followed the line of the present Elisabeth Street, the Příkopy or Graben—which therefrom derives its name, signifying ditch or trench—and then that of the Ovocna and Ferdinandova Streets. The Jewish quarter was included in the fortifications, but it was divided by gates and a wall from the old town. King Ottakar II. also contributed greatly to the enlargement of Prague. The still extant fortified towers of the Hradčany belong to his reign. The sovereign, however, to whom Prague is most indebted is the emperor Charles IV. (Charles I., as king of Bohemia). He has rightly been called the second founder of Prague. He founded the university, one of the oldest on the Continent. It immediately became famous all over Europe and students flocked to it from all countries. The town soon became too small, and it is probably in consequence of this that Charles determined to found the "new town." This, which includes the greater part of the modern city, was surrounded by walls, which starting from the foot of the Vyšehrad included the small already-existing settlement of Poříč and then adjoined the borders of the old town from the beginning of the present Příkopy Street up to the river. During the Hussite wars Prague suffered greatly. Two of the greatest battles of the Hussite wars, that of the Žižkov and that of the Vyšehrad (both 1420), were fought on the outskirts of Prague, and after the last-named battle the ancient Vyšehrad castle was entirely destroyed. The Bohemian nobles in alliance with the citizens of the old town attacked and conquered the new town, which for a time lost its privileges and became subject to the old town. Prague gradually recovered during the reign of King George of Poděbrad, and became yet more prosperous during that of King Vladislav.

During the reign of Ferdinand I. of Habsburg (1526–1564) Prague played a considerable part in the opposition to that prince caused in Bohemia by his endeavour to reduce both the political and religious liberty of the country. When the antagonism between the Romanist dynasty and the Bohemian Protestants culminated in the troubles of 1546 and 1547 and the Bohemians, after a weak and unsuccessful attempt to assert their liberties, were obliged to submit unconditionally to the house of Habsburg, Prague was deprived of many of its liberties and privileges. The burgomaster of the old town was one of those who were decapitated in the Hradčany Square (Aug. 20, 1547). Ferdinand had summoned a meeting of the estates on that day at the adjoining Hradčany palace, and it became known as the "bloody diet" (*Krvavy sněm*).

The importance of the city of Prague greatly increased during the reign of Rudolph II. That sovereign chose Prague as his permanent residence and it thus became—as Rudolph, besides being king of Bohemia, was also German emperor, king of Hungary and ruler of the hereditary Habsburg lands—the centre of his vast domains. It was in Prague that the Thirty Years' War broke out. On the 23rd of May 1618 the Protestant nobles of Bohemia threw from the windows of the council chamber of the Hradčany palace two of the Imperial councillors who were accused of having influenced in a manner unfavourable to the Bohemians the emperor Matthias, who was also king of Bohemia. War broke out and continued when in 1619 Matthias was succeeded by Ferdinand. In the same year the Bohemians elected as their king Frederick of the Palatinate, and both he and his wife Elizabeth of England were crowned in St Vitus's Cathedral. On the 8th of November 1620 the Bohemian forces were decisively defeated by the Imperialists on the White Mountain at the outskirts of Prague. The town submitted on the following day and the whole country was quickly subdued by the Imperialist armies. On the 21st of June 1621 the principal leaders of the rising against the house of Habsburg were beheaded in the market of the old town near the town hall. In 1631 Prague was occupied for a short time by the Saxon allies of Gustavus Adolphus, king of Sweden, but the Imperial army led by Wallenstein soon obliged them to retire. In 1648 a Swedish army stormed the Malá strana and Hradčany. The citizens, now entirely Romanists, bravely defended the bridge, and the Swedes were unable to obtain possession of the part of Prague situated on the right bank of the Vltava. In November the news of the conclusion of the peace of Westphalia reached Prague and put a stop to hostilities.

Henceforth the history of Prague continues uneventful for a considerable period. During the Austrian War of Succession it again became the scene of important events. On the 26th of November 1741 Prague was stormed by an army consisting of Bavarians, French and Saxons which upheld the cause of Charles, elector of Bavaria, who claimed the succession to the Bohemian throne and to the other domains of the house of Habsburg. A large part of the Bohemian nobility did homage to Charles, and he was crowned king of Bohemia in St Vitus's Cathedral on the 17th of December 1741. The rule of the Bavarian prince lasted, however, but a very short time. On the 27th of June 1742 the armies of the empress Maria Theresa began to besiege the French army of Marshal Belle-Isle in Prague, and the French commander was obliged to evacuate the city in December 1742. In the spring of the following year Maria Theresa arrived at Prague and was crowned there, but in 1744 the city was again the scene of warfare. In that year Frederick the Great of Prussia invaded Bohemia and obtained possession of Prague after a severe and prolonged bombardment, in the course of which a large part of the town was destroyed. The Prussian occupation was, however, of short duration. At the beginning of the Seven Years' War Prague was—in 1757—again besieged by Frederick the Great after he had defeated the Austrians in a battle between the Žižkov and Počernic (commonly called the battle of Prague, see SEVEN YEARS' WAR). In June of the same year the Austrian victory at Kolin obliged the Prussians to raise the siege. Prague, which had suffered even more during the second bombardment, now enjoyed a long period of quiet.

In the beginning of the 19th century Prague, which had become almost a German city, became the centre of a movement that endeavoured to revive the almost extinct Bohemian nationality. This movement was greatly aided by the foundation of the "Society of the Bohemian Museum" in 1822. Several patriotic Bohemian noblemen founded this association. The collections belonging to it and its library were at first housed in the Malá strana, then in a somewhat larger building in the Příkopy. They are now in a large handsome building at the top of the Václavské Náměsti. In connexion with the Bohemian museum a society named *Matice* (treasury) was founded, which published editions of the ancient Bohemian works, as well as writings of modern Bohemian authors.

This movement was at first purely literary, and only in 1848 assumed a political character. It was determined to hold at Prague a "Slavic congress" at which all Slavic countries were to be represented. During the sittings of the congress troubles broke out which originated in an insignificant conflict between students and soldiers of the garrison. Barricades were erected and the town finally surrendered unconditionally after a severe bombardment (June 1848). In 1866 the Prussians, who had invaded Bohemia, occupied Prague (July 8) without encountering any resistance. At the "Blue Star" hotel in Prague also was signed the treaty which ended the war between Austria and Prussia (Aug. 23).

In the years of peace that followed, the development of Prague was constant and vast. The removal of the fortifications greatly assisted this development. The communities of Vyšehrad (1883), Holesovic-Bubna (1884) and Libeň (1901) were consecutively included in the city. Occasional riots, such as in 1897, when the Bohemians were exasperated by the action of the Vienna government which restricted the use of the national language in the law courts; and in 1905, when the people demanded an extension of the suffrage, have not interfered with the increasing prosperity of the city, and their importance has been greatly exaggerated.

Though numerous ancient monuments at Prague have been destroyed in consequence of intestine strife and foreign warfare, the city still contains many of great value and may be considered one of the most interesting cities of central Europe. The natural situation of the town has also at all periods been greatly admired. The centre of the old town and indeed of the entire community of Prague is the town hall (*staroměstská radnice*), which is surrounded by the market-place, the scene of the execution of the Bohemian patriots in 1621. The buildings of the town hall date from various periods. Its oldest parts are the tower and the chapel of St Lawrence, built in 1381. The adjoining ancient council chamber dates from the reign of King Vladislav (1471–1516). The modern hall that is now used for the meetings of the town council is decorated by two paintings of the Bohemian artist Wenceslaus Brozik, which represent Hus before the council of Constance, and the election of George of Poděbrad as king of Bohemia. In the market-place opposite the town hall is situated the ancient Týn church, memorable as having been the religious centre of the Hussite movement. A chapel connected with the so-called Týn or market-place of the German traders stood here from the earliest times, but the present building was begun in the 14th century, and completed in the 15th during the reign of George of Poděbrad. The fine façade built by that king was formerly adorned with a statue of King George, who was represented as holding a sword pointing upward to a representation of the chalice, the emblem of the Hussite Church. Both statue and chalice were removed by the Jesuits in 1623. In the interior of the church the tomb of the astronomer Tycho Brahe is notable, as is the very ancient pulpit from which the Hussite archbishop John of Rokycan preached. In earlier days the Church reformers Milič and Hus also preached here. Close to the town hall is the Joseph-Stadt, the ancient ghetto of Prague. The synagogue is one of the oldest in Europe, and the adjoining cemetery—part of which has unfortunately been destroyed in the course of the modern sanitary improvement of this part of Prague—has great historical interest. The university founded by Charles IV. in 1348 played a great part in the history of Bohemia during the Hussite wars. The lecture-rooms and other institutions connected with the two universities—in 1881 and 1882 a Bohemian university was founded though the German one continued to exist—are now housed in two vast buildings known as the Carolinum and the Clementinum. The Carolinum, first built about the year 1383 but frequently altered, has a closer connexion with Hus and the Hussite movement than any other building at Prague. It was the scene of many religious discussions, and it was here also that the Bohemian nobles met before the uprising of 1618. The large part of the lecture-rooms, the observatory and the very valuable library are in the Clementinum. This building was formerly a college of the Jesuits, who established themselves in Prague in 1556 and erected these extensive buildings at various periods between 1578 and 1715. The Celetna ulice, which leads from the town hall to the limits of the old town contains at its extremity the so-called powder tower (*prašna brána*). It occupies the spot where one of the old town gates was situated, and was built by King Vladislav in that elaborate style of architecture which is known as the style of Vladislav. The building was very skilfully restored in 1880–1883. The powder tower stands at the corner of the Příkopy (in Ger. *Graben*) which with its continuations, the Ovocná ulice and the Ferdinandová ulice, is the most animated part of modern Prague. At the extreme end of the Ferdinandová ulice is the modern Bohemian national theatre.

The "new town" of Prague, though not equal in interest to the "old town," is also well worth notice. At the extremity of the place of Wenceslaus (Václavské Náměsti) is situated the handsome building that contains the collections and library of the Bohemian museum. The museum was opened by the Archduke Charles Louis of Austria on the 18th of May 1891. Of the many interesting churches in the "new town" the Karlov deserves special mention. It was built by Charles IV. in 1350 in the Gothic style, but was restored in the 18th century. The monastery that formerly adjoined this church has been suppressed and its buildings are now used as a hospital. Near the Karlov church is the Karlovo Náměsti (place of Charles), in which is situated the former town hall of the "new town," from the windows of which the councillors were thrown at the beginning of the Hussite wars. The Vyšehrad, now a part of Prague, adjoins the "new town." It has preserved but slight traces of its ancient splendour. It contains, however, the

Romanesque chapel of S Martin, the Church of SS Peter and Paul, and the adjoining cemetery where many of the leaders of the Bohemian national movement are buried.

The districts of Prague situated on the left bank of the Vltava are connected with the other parts of the city by bridges, of which the oldest is the *Karlovo most* (bridge of Charles). The present structure was begun by Charles IV. in 1357, but in consequence of frequent storms and inundations it was only completed in 1503. The statues on the bridge are of an even later date. Not far from the bridge in the centre of the Malá strana is the monument to Radetzky, erected in 1858 out of captured Piedmontese cannon. Near here are the palaces of the governor of Bohemia and that in which the Bohemian diet (*sněm*) now meets. At the extreme end of the Malá strana is the extensive Strahov monastery, from the terraces of which the finest view of the city of Prague can be obtained. The monastery possesses one of the most valuable libraries in Prague and a small picture gallery. The church of the monastery contains the tomb of the famous General Pappenheim. In the Malá strana and the adjoining Hradčany are situated the winter residences of the wealthy Bohemian nobility. Of the many palaces, the Waldstein, Schwarzenberg—formerly Rosenberg—palaces, the two palaces of the counts Thun and that of Prince Lobkowitz are the most interesting. On the summit of the Hradčany is the vast palace of the ancient kings of Bohemia, which also contains the hall where the estates of Bohemia formerly met. During the Hussite wars most of the buildings on the Hradčany hill were destroyed, and a large part of the castle still known as the halls of Vladislav was rebuilt by the kings of that name. The handsome halls known as the Spanish and German halls were erected by Ferdinand I., and additions were made by other sovereigns also. The Hradčany was for a time the residence of Rudolph, crown prince of Austria, and it is also occupied by the emperor of Austria during his visits to Prague. Adjoining the Hradčany palace is the famed Cathedral of St Vitus, where the kings of Bohemia were crowned. The earliest church on this spot was built by St Wenceslaus, and the present building was begun by Charles IV. and has as yet remained unfinished. The cathedral contains the chapel of St Wenceslaus, where the insignia of the Bohemian kings are preserved, the tomb of St John of Nepomuk, and a monument to the Bohemian sovereigns who are buried here, the work of Colin of Malines. On the slope of the Hradčany hill are the ancient towers named Mikulka, Daliborka, the white tower and the black tower, which formed part of the fortified works erected by Ottakar II. (1253–1278).

The suburbs of Prague contain few objects of interest, but they are centres of the rapidly increasing trade and industry of Prague.

See Count Lützow, *Prague*, in "Mediaeval Towns" Series (London, 1902); Tomek, *Dějepis Města Prahy* (History of the town of Prague), the standard work on Prague, which the author only continued up to the year 1608. (L.)

PRAGUERIE, THE, a revolt of the French nobility against King Charles VII. in 1440. It was so named because a similar rising had recently taken place in Prague, Bohemia, at that time closely associated with France through the house of Luxemburg, kings of Bohemia, and it was caused by the reforms of Charles VII. at the close of the Hundred Years' War, by which he sought to lessen the anarchy in France. The attempt to reduce the brigand-soldiery, and especially the ordinances passed by the estates of Languedoïl at Orleans in 1439, which not only gave the king an aid of 100,000 francs (an act which was later used by the king as though it were a perpetual grant and so freed him from that parliamentary control of the purse so important in England), but demanded as well royal nominations to officerships in the army, marked a gain in the royal prerogative which the nobility resolved to challenge. The main instigator was Charles I., duke of Bourbon, who three years before had attempted a similar rising, and had been forced to ask pardon of the king. He and his bastard brother, Alexander, were joined by the former favourite, Georges de la Trémoille, John V., duke of Brittany, who allied himself with the English, the duke of Alençon, the count of Vendôme, and captains of mercenaries like Antoine de Chabannes, or Jean de la Roche. The duke of Bourbon gained over to their side the dauphin Louis—afterwards Louis XI.—then sixteen years old, and proposed to set aside the king in his favour, making him regent. Louis was readily induced to rebel; but the country was saved from a serious civil war by the energy of the king's officers and the solid loyalty of his "good cities." The constable de Richemont marched with the king's troops into Poitou, his old battleground with Georges de la Trémoille, and in two months he had subdued the country. The royal artillery battered down the feudal strongholds. The dauphin and the duke of Alençon failed to bring about any sympathetic rising in Auvergne, and the Praguerie was over, except for some final pillaging and plundering in Saintonge and Poitou, which the royal army failed to prevent. Charles VII. then attempted to ensure the loyalty of the duke of Bourbon by the gift of a large pension, forgave all the rebellious gentry, and installed his son in Dauphiné (see Louis XI.). The ordinance of Orleans was enforced.

PRAHRAN, a city of Bourke county, Victoria, Australia, 3½ m. by rail S.E. of Melbourne and suburban to it. Pop. (1901), 41,161. It is connected with Melbourne by cable tram over a fine iron girder bridge across the Yarra. Many of its streets are planted with trees and it has numerous handsome shops and villas. Prahran was proclaimed a city in 1879.

PRAIRIE (adopted from the Fr. *prairie*, a meadow-tract, Late Lat. *prataria*, Lat. *pratum*, meadow), a level tract of grassy and treeless country, generally restricted to tracts so characterized in the central parts of North America. In the United States the prairies may be taken to extend from southern Michigan and western Ohio over Illinois (especially designated the Prairie State), Indiana, Missouri, Iowa, Wisconsin and Minnesota, and west of the Missouri to the foothills of the Rocky Mountains (see articles on the several states, and United States). In Canada they extend from the same mountains to a line somewhat to the east of Winnipeg. The word prairie is used in a large number of compounds referring to natural and other features, flora, fauna, &c., characteristic of the prairies. Examples are: *prairie-chicken* or *prairie-hen*, a name for the pinnated grouse (*Cupidonia* or *Tympanucus cupido*), also applied to *Pedioecetes phasinellus*, the sharp-tailed grouse; *prairie-dog*, a rodent of the squirrel family, genus *Cynomys*, a gregarious burrowing animal, and other animals noticed below; *prairie-schooner*, a name for the covered wagons in which emigrants used to cross the plains; *prairie-grass*, &c.

PRAIRIE DU CHIEN, a city and the county-seat of Crawford county, Wisconsin, U.S.A., on the east bank of the Mississippi river about 3 m. above the mouth of the Wisconsin, about 98 m. W. of Madison. Pop. (1890) 3131; (1900) 3232; (1905) 3179; (1910) 3149. It is served by the Chicago, Milwaukee & St Paul, and the Chicago, Burlington & Quincy railways. The city has a fine location, its natural attractiveness and mineral springs in the vicinity combining to make it a summer and health resort. It has an excellent artesian water-supply. Among its buildings are the Crawford county court-house, the city hospital and a sanatorium. It is the seat of St Mary's Academy (1872; R.C.) for young women, and the College of the Sacred Heart (1880; R.C.) for men. Among the manufactures are beer, wagons, wool, and pearl buttons, and the city is a centre of the fresh-water pearl fisheries along the Mississippi. Prairie du Chien is one of the most interesting places, historically, in Wisconsin. The first white man known to have visited the site was Father Hennepin in 1680; later in the same year the trader Du Lhut (or Duluth) was here. In 1685 Nicholas Perrot, the French commandant in the West, built Fort St Nicholas near the site of the present city. After the close of the French and Indian War, British authorities assumed possession, but no garrison was regularly maintained. In 1779–1780 Prairie du Chien was the scene of plots and counterplots of American and British sympathizers and of the activities of Godefrey Linctot, the agent of George Rogers Clark. About 1780–1781 a permanent settlement began to grow up around the post. Prairie du Chien was formally surrendered in 1796 to the United States authorities under the Jay treaty, and by them Fort Shelby was erected. On the 17th of July 1814 a force of British, Canadians and Indians under Major William McKay captured the fort, and renamed it Fort McKay, but abandoned it in May 1815. In 1816 Fort Crawford was erected—it was rebuilt on a different site in 1829—and in 1820 one of the principal dépôts of the American Fur Company was established here. Here in 1823 Judge James Duane Doty (1799–1865) opened the first United States court in what is now the state of Wisconsin. At the time of the Red Bird rising in 1827, Governor Lewis Cass of Michigan

Territory made Prairie du Chien his temporary headquarters. During the Black Hawk War (1832) Zachary Taylor, then a lieutenant-colonel, was in command of Fort Crawford, and to him Black Hawk was entrusted after his capture. The Chicago, Milwaukee & St Paul railroad was completed to Prairie du Chien in 1857. The city was chartered in 1872.

PRAIRIE-MARMOT, a zoological emendation for the American name "prairie-dog," applied to a small North American rodent allied to the squirrels and marmots, and technically known as *Cynomys ludovicianus* (see MARMOT). In a great degree prairie-marmots, of which there are several species in North America, ranging as far south as Mexico, are intermediate between marmots and sousliks (see SOUSLIK), having the cheek-pouches much smaller than in the latter, and the first front-toe, which is rudimentary in marmots and sousliks, well developed. The cheek-teeth are more complex than those of marmots, and the two series converge behind. In their slender build and small size, prairie-marmots are much more like sousliks than marmots. In habits these rodents are very like marmots, the typical species inhabiting the open prairies, while the others are found in mountains. The prairie species (*C. ludovicianus*) makes a raised, funnel-shaped entrance to its burrow. All feed on the roots of grass; and when disturbed, like marmots, utter a whistling cry. Rattlesnakes, owls and weasels are commonly found in the burrows; but their presence is no indication of the existence of a kind of "happy family" arrangement, the snakes, at any rate, preying on the young marmots. The hibernation of these rodents is only partial, and confined to seasons of intense cold. (See RODENTIA.)

PRAKRIT (*prākṛta*, natural), a term applied to the vernacular languages of India as opposed to the literary Sanskrit (*saṁskṛta*, purified). The place which the Prakrits occupy in regard to the Indo-European languages (*q.v.*), ancient and modern, is treated under that head. There were two main groups of ancient Indo-Aryan dialects, or Primary Prakrits, viz. the language of the Midland or *Āryāvarta*, and that of what is called the Outer Band. The language of the Midland became the language of literature, and was crystallized in the shape of literary Sanskrit about 300 B.C. Beside it all the Primary Prakrits continued to develop under the usual laws of phonetics, and, as vernaculars, reached a secondary stage marked by a tendency to simplify harsh combinations of consonants and the broader diphthongs, the synthetic processes of declension and conjugation remaining as a whole unaltered. The process of development closely resembles that of old Italian from the Italic dialects of Latin times. It should be noted that although the literary dialect of the Midland became fixed, the vernacular of the same tract continued to develop along with the other Primary Prakrits, but owing to the existence of a literary standard by its side its development was to a certain extent retarded, so that it was left somewhat behind by its fellows in the race.

The Secondary Prakrits, in their turn, received literary culture. In their earliest stage one of them became the sacred language of Buddhism, and under the name of Pali (*q.v.*) has been widely studied. In a still later stage several Secondary Prakrits became generally employed for a new literature, both sacred and profane. Not only were three of them used for the propagation of the Jaina religion (see JAINS), but they were also dealt with as vehicles for independent secular works, besides being largely employed in the Indian drama. In the last-named Brahmans, heroes and people of high rank spoke in Sanskrit, while the other characters expressed themselves in some Secondary Prakrit according to nationality or profession. This later stage of the Secondary Prakrits is known as the Prakrit *par excellence*, and forms the main subject of the present article. A still further stage of development will also be discussed, that of the *Apabhraṁśa*, or "corrupt language." The Prakrit *par excellence*, which will throughout the rest of this article be called simply "Prakrit," underwent the common fate of all Indian literary languages. In its turn it was fixed by grammarians, and as a literary language ceased to grow, while as a vernacular it went on in its own course. From the point of view of grammarians this further development was looked upon as corruption, and its result hence received the name of *Apabhraṁśa*. Again in their turn the *Apabhraṁśas* received literary cultivation and a stereotyped form, while as vernaculars they went on into the stage of the Tertiary Prakrits and become the modern Indo-Aryan languages.

In the Prakrit stage of the Secondary Prakrits we see the same grouping as before—a Midland language, and the dialects of the Outer Band. The Prakrit of the Midland was known as Śaurasēnī, from Śūrasēna, the name of the country round Mathurā (Muttra). It was the language of the territories having the Gangetic Doab for their centre. To the west it probably extended as far as the modern Lahore and to the east as far as the confluence of the Jumna and the Ganges. Conquests carried the language much further afield, so that it occupied not only Rajputana, but also Gujarat. As stated above, the development of Śaurasēnī was retarded by the influence of its great neighbour Sanskrit. Moreover, both being sprung from the same original—the Primary Prakrit of the Midland—its vocabulary, making allowances for phonetic changes, is the same as in that language.

The Prakrits of the Outer Band, all more closely connected with each other than any one of them was to Śaurasēnī, were Māgadhī, Ardhamāgadhī, Māhārāṣṭrī, and an unknown Prakrit of the North-west. Māgadhī was spoken in the eastern half of the Gangetic plain. Its proper home was Māgadha, the modern South Bihar, but it extended far beyond these limits at very early times. Judging from the modern vernaculars, its western limit must have been about the longitude of the city of Benares. Between it and Śaurasēnī (*i.e.* in the modern Oudh and the country to its south) lay Ardhamāgadhī or "half-Māgadhī." Māhārāṣṭrī was the language of Māhārāṣṭra, the great kingdom extending southwards from the river Nerbudda to the Kistna and sometimes including the southern part of the modern Bombay Presidency and Hyderabad. Its language therefore lay south of Śaurasēnī. West of Śaurasēnī, in the Western Punjab, there must have been another Prakrit of which we have no record, although we know a little about its later *Apabhraṁśa* form. Here there were also speakers of Paiśācī (see INDO-ARYAN LANGUAGES), and the local Prakrit, if we are to judge from the modern Tertiary vernacular, was a mixed form of speech. We have a detailed description of only one *Apabhraṁśa*—the Nāgara—the *Apabhraṁśa* of the Śaurasēnī spoken in the neighbourhood of Gujarat, and therefore somewhat mixed with Māhārāṣṭrī. We may, however, conclude that there was an *Apabhraṁśa* corresponding to each Prakrit, so that we have, in addition to Śaurasēna, a Māgadha, an Ardhamāgadha and a Māhārāṣṭra *Apabhraṁśa*. Native writers describe more than one local *Apabhraṁśa*, of which we may mention Vrācaḍa, the ancient dialect of Sind. There were numerous Prakrit subdialects to which it is not necessary to refer.

Of all these Prakrits, Māhārāṣṭrī is that which is best known to us. It early obtained literary pre-eminence, and not only was the subject of long treatises by native grammarians, but became the language of lyric poetry and of the formal epic (*kāvya*). Dramatic works have been written in it, and it was also the vehicle of many later scriptures of the Jaina religion. We also know a good deal about Ardhamāgadhī, in which the older Jaina writings were composed. With Māgadhī we have, unfortunately, only a partial acquaintance, derived from brief accounts by native grammarians and from short sentences scattered through the plays. We know something more about Śaurasēnī, for it is the usual prose dialect of the plays, and is also employed for the sacred writings of one of the Jaina sects.

Language.

The materials extant for the study of the Prakrit are either native grammars or else literary works written in accord with the rules laid down therein. Originally real vernaculars with tendencies towards certain phonetic changes, the dialects were taken in hand by grammatical systematizers, who pruned down what they thought was over-luxuriant growth, trained errant shoots in the way they thought they ought to have gone, and too often generalized tendencies into universal rules. Subsequent writers followed these rules and not the living speech, even though they were writing in what was meant to be a vernacular. Moreover, at an early date, the Prakrits, *qua* literary languages, began to lose their characteristics as local forms of speech. A writer composed in Māhārāṣṭrī, not because it was his native language, but because it was the particular Prakrit employed for lyrics and in formal epics. In the same way, in dramatic literature, Saurasēnī and Māgadhī were put into the mouths of characters in particular walks in life, whatever the nationality of the dramatist might have been. There was thus a tendency for these literary Prakrits to adopt forms from the vernacular dialects of those who wrote them, and, *en revanche*, for the very popular lyric poetry of Māhārāṣṭrī to influence the local dialects of the most distant parts of India. On the other hand, although to a certain extent artificial, the literary Prakrits are all *based* on local vernaculars, a fact entirely borne out by a comparison with the modern Indian languages, which closely agree with them in their mutual points of difference. We now proceed to consider the general points in which the Prakrits differ from Sanskrit and from each other. The reader is throughout assumed to be familiar with the general outline of the article SANSKRIT.

[Contractions: Skr. = Sanskrit. Pr. = Prakrit. S. = Saurasēnī. Mg. = Māgadhī. AMg. = Ardhamāgadhī. M. = Māhārāṣṭrī. Ap. = Nāgara Apabhraṁśa.]

Vocabulary.—The vocabulary of Ś. is to all intents and purposes the same as that of Skr. In the languages of the Outer Band there are numerous provincial words (*dēśī* or *dēśya*), the originals of which belonged to Primary Prakrits other than those of the Midland. In the Outer Band there is also a rich variety of grammatical forms, many of which are found in the Veda and not in classical Sanskrit, and some (*e.g.* Pr. *-hi*, Pali *-dhi*, Greek *-θι*) which cannot be traced to any known Primary Prakrit form, but which must have existed in that stage and beyond it, back into Indo-European times.

Phonetics.—The Skr. diphthongs *ē* and *ō* are treated in Pr. as pure vowels, and may each be either long or short. *Āi* and *āu* become either *ē̆* and *ō̆* or *aï* and *aü* respectively. The vowel *r̥* becomes *a*, *i*, or, under the influence of a neighbouring labial, *u*. Before two consonants an original long vowel becomes short, and *i* and *u* are (according to the grammarians) changed to *e* and *o* respectively. The last rule is an instance of grammarians' over-generalization, and is not universally true. Examples, Skr. *mārga-*, Pr. *magga-*; Skr. *sindura-*, Pr. *sendura-*; Skr. *pustaka-*, Pr. *potthaa-*. Conversely, a short vowel before two consonants is lengthened on one of them being elided. Thus, Skr. *īsvara-*, Pr. *issara-* or *īsara-*; Skr. *jihvā*, Pr. *jīhā*. In Ap. the quantity of vowels is very loosely observed.

In all dialects *n* becomes *ṇ* unless it is followed by a dental mute, but in Jaina works *nn* and initial *n* remain unchanged. Judging from modern vernaculars, the latter seems to have been the real state of affairs. In Mg. *j* becomes *y* and *r* becomes *l*. Here also *s* and *s* become *ś*, a peculiarity still preserved by the modern Bengali. Elsewhere *ś* and *s* usually become *s*, but the change of a sibilant to *h* is not uncommon in the Outer Prakrits (even in Mg.), though rare in the more archaic Ś.

Initial *y* becomes *j* except in Mg., in which, on the contrary, *j* becomes *y*. Subject to the foregoing general rules, all other initial consonants usually remain unchanged. As regards medial single consonants:—

1. *K*, *g*, *c*, *j*, *t*, *d* and *y* are usually elided. As a hiatus is caused by the elision, a faintly sounded *y* (or in some cases *v*) is substituted for the elided consonant, though only written in Jaina MSS. Examples: Skr. *lōka-*, Pr. *lō(y)a-*; Pr. *maa* = Skr. *mata-*, *maḍa-*, *maya-*, *mr̥ga* or *mr̥ta-*. The latter example illustrates the extraordinary confusion which results from the strict application of this rule of elision of medial consonants. Such a Prakrit would have failed in the main object of a language—the connotation of distinct ideas by distinct sounds. To the present writer it seems impossible that such a language could ever have existed, and he is persuaded that the rule just given is merely another instance of grammarians' over-generalization. A rule has been made out of a tendency, and this tendency was evidently, first, to soften a hard letter, and then (but not necessarily) to elide it. We see this well illustrated by *Apabhraṁśa*, in which *k*, *t* and *p* are usually preserved under the forms *g*, *d* and *b*. In the Outer Prakrits also *k* often becomes *g*, as in Skr. *śrāvaka-*, Jaina M. and AMg. *sāvaga-*, Mg. *śāvaga-*. Ś. and Mg. always preserve a medial *t*, changing it to *d*; thus, Skr. *gata-*, S. Mg. *gada-*, elsewhere *ga(y)a-*.

2. *Kh*, *gh*, *th*, *dh*, *ph* and *bh* similarly become *h*. Also, as above, Ś. and Mg. change *th* to *dh*. *Ṭh* becomes *ḍh*, and *ph* may become *bh*. The other aspirates (*ch*, *jh*, *ḍh*), and also sometimes *bh*, remain unchanged. In Ap., as before, *kh*, *th* and *ph* are usually preserved in *gh*, *dh* and *bh* respectively.

3. *Ṭ* becomes *ḍ*, *ḍ* becomes *ḷ* (often written *l*), which when doubled becomes dentalized to *ll*, as in the case of the Jaina *nn*. *P* and *b* usually become *v*. The Outer languages often cerebralize dental sounds and change *ṭ* to *l*.

4. *N*, *m*, *l* and *h* remain unchanged. *V* disappears before *u*, but otherwise generally remains unchanged. In Ap. *m* may become a *v* nasalized by *anunāsika*; thus, Skr. *bhramara-*, Ap. *bhā̃vara-*.

Final consonants usually disappear altogether, except nasals, which become *anusvāra*. Thus, Skr. *samantāt*, *phalam*, Pr. *samantā*, *phalaṁ*.

The following rules will be found to include the great majority of possible cases of compound consonants. They show clearly the character of all changes from Primary to Secondary Prakrit, viz. the substitution, mainly by a process of assimilation, of a slurred for a distinct pronunciation:—

1. In Pr. a conjunct consonant cannot consist of more than two elements, and, except in Mg. and Ap., can only be a double consonant or a consonant preceded by a nasal, a consonant followed by *r*, or one of the following: *ṇh*, *nh*, *mh*, *lh*. The consonants *r* and *h* cannot be doubled.

2. In Pr. the only conjuncts which can begin a word are *ṇh*, *nh*, *mh*, and *lh*. If any other conjunct consonant be initial, the first member of the Pr. form of it is dropped. Thus, in Pr. *kr* becomes *kk*, and the Skr. *ākramati* becomes Pr. *akkamaï*. If we omit the initial preposition *ā-* (Pr. *a-*), the *kk* becomes initial, and we have *kamaï*, not **kkamai*. Similarly, Skr. *sthira-* becomes Pr. *thira-* for **tthira-*.

3. *L* and *v* are elided when they stand first or last in a compound, and the remaining letter is doubled, if it admits of doubling. Thus, Skr. *ulkā*, Pr. *ukkā*; Skr. *pakva*, Pr. *pakka-*. The same rule is followed regarding *r*, but when it follows a consonant it is sometimes, especially in Ap., retained even when initial. Thus, Skr. *arka-*, Pr. *akka*; Skr. *priya-*, Pr. *pia-* or (Ap.) *pria-*.

4. *M*, *n* and *y* are elided when standing last in a compound, and the remaining letter is doubled; thus, Skr. *raśmi-*, Pr. *rassi-*.

5. *K*, *g*, *ṭ*, *ḍ*, *t*, *d*, *p*, *ś*, *ṣ* and *s* are elided when standing first in a compound, and the remaining letter is doubled as before; thus, Skr. *bhakta-*, Pr. *bhatta-*; Skr. *skhalita-*, Pr. *khalia-* for **kkhalia-* (see rule 2).

6. The above rules hold in the order given above; that is to say, rule 3 holds in preference to rules 4 and 5, and rule 4 in preference to rule 5. Thus, in the Skr. compound *kr*, the *r* is elided under rule 3, and not the *k* under rule 5, so that the Pr. form is *kk*.

7. *Special Rules for Mg.*—In this form of Pr. there are several peculiar changes. *Dy*, *rj*, *ry*, all become *yy*; *ṇy*, *ny*, *jñ*, *ñj* become *ññ*; medial *cch* becomes *śc*; *ṭṭ*, *ṣṭ*, *ṣṭh* become *sṭ*; and *rth*, *sth* become *st*. Other changes also occur, besides dialectic variations of those given above.

Declension.—Pr. has preserved the three genders of Skr., but has lost the dual number. As a rule, the gender of a noun follows that of the Skr. original, though in AMg. there is already a tendency to substitute the masculine for the neuter, and in Ap. these two genders are frequently confused, if the distinction is not altogether neglected. In the formation of cases, the phonetic rules just given are fully applied, but there are also other deviations from the Skr. original. The consonantal stems which form an important part of Skr. declension are frequently given vocalic endings, and there is a general tendency to assimilate their declension to that of *a*-bases, corresponding to the first and second declensions in Latin. This tendency is strongly helped by the free use of pleonastic suffixes ending in *a*, which are added to the base without affecting its meaning. Of these the most common are *-ka-*, *-ḍa-*, and *-alla-*, *-illa-* or *-ulla-*. The first of these was also very common in Skr., but its use became much extended in Pr. In accordance with the general rule, the *k* is liable to elision; thus, Skr. *ghōṭa-ka-*, Pr. *ghōḍa-a-*. It may even be doubled, as in Skr. *bahu-*, much, Pr. *bahu-a-a-*, for *bahu-ka-ka-*. *-Ḍa-* is confined to Ap., and may be used alone or together with the other two, as in Skr *bāhubala-*, strength of arm, Ap. *bāhubaḷ-ulla-ḍa-(k)a-*. *Illa-* is most common in the Outer languages, and especially so in AMg. and M.; thus, Skr. *pura-*, M. *pur-illa-*.

All the Skr. cases are preserved except the dative, which has altogether disappeared in the Midland, but has survived in the singular number in the Outer languages. Everywhere the genitive can be employed in its place. Most of the case-forms are derived from Sanskrit according to the phonetic rules, but Ap. has a number of dialectic forms which cannot be referred to that language (cf. the remarks above about *-hi* = *θι*). It also rarely distinguishes between the nominative and the accusative. As an example, we may give the commoner forms of the declension of the Skr. *putra*, Pr. *putta-*, a son (see next page). It should be understood that numerous other forms were also in use, but the ones given here are selected because they are both common and typical.

The declension of neuter *a*-bases closely resembles the above, differing only in the nominative and accusative singular and plural. Ap. has almost lost the neuter termination in the singular. Feminine *a*-stems are declined on the same lines, but the cases have run more into each other, the instrumental, genitive and locative singular being identical in form. Very similarly are declined the bases ending in other vowels. The few still ending in consonants and which have not become merged in the *a*-declension, present numerous apparent irregularities, due to the inevitable phonetic changes, which must be learned from the textbooks.

	Skr.	Ś.	Ap.	M.	AMg.	Mg.
Singular:						
Nom.	*putras*	*puttō*	*puttu*	*puttē*	*puttē*	*puttē*
Acc.	*putram*	*puttaṁ*	*puttu*	*puttaṁ*	*puttaṁ*	*puttaṁ*
Instr.	*putrēṇa*	*puttēṇa*	*puttē̃*	*puttēṇa(ṁ)*	*puttēna(ṁ)*	*puttēṇa*
Dat.	*putrāya*	—	—	*puttāa*	*puttāē*	*puttāa*
Abl.	*putrāt*	*puttādō*	*puttahu*	*puttāō*	*puttāō*	*puttādō*
Gen.	*putrasya*	*puttassa*	*puttaho,* *puttaha*	*puttassa*	*puttassa,*	*puttaśśa* *puttāha*
Loc.	*putrē* **putrasmin*	*puttē*	*putti,* *puttahĩ*	*puttē,* *puttammi*	*puttē,* *puttammi*	*puttē,* *puttammi,* *puttāhiṁ*
Plural:						
Nom.	*putrās*	*puttā*	*putta*	*putta*	*puttā*	*puttā*
Acc.	*putrān*	*puttē*	*puttē* *putta*	*puttē* *puttā*	*puttē,* *puttā*	*puttē*
Instr.	**putrēbhis*	*puttēhiṁ*	*puttahĩ*	*puttēhiṁ'*	*puttēhiṁ*	*puttēhiṁ*
Abl.	*putrēbhyas*	*puttāhiṁ-tō*	*puttahũ*	*puttāhiṁ-tō*	*puttēhiṁ-tō*	*puttāhiṁ-tō*
Gen.	*putrāṇām*	*puttāṇaṁ*	*puttahã*	*puttāṇaṁ*	*puttāṇaṁ*	*puttāṇaṁ,* *puttāhã*
Loc.	*putrēsu*	*puttēsu(ṁ)*	*puttahĩ*	*puttēsu*	*puttēsu*	*puttēśu(ṁ)*

All the Skr. pronouns appear in Pr., but often in extremely abraded shapes. It would, for instance, be difficult to recognize the Skr. *tvām* in the Ap. *paï*. There is also a most luxuriant growth of by-forms, the genitive plural of the pronoun of the second person being, *e.g.*, represented by no less than twenty-five different words in M. alone. We also find forms which have no original in classical Skr. Thus, in that language, the pronoun *sa-*, he, is only used in the nominative singular of two genders, but occurs also in other cases in Pr.

Conjugation.—The Pr. verb shows even more decay than does the noun. With a few isolated exceptions, all trace of the second, or consonantal, conjugation of Skr. has disappeared, and (much as has happened in the case of nouns) all verbs are now conjugated after the analogy of the *a*-conjugation. This *a*-conjugation, on the other hand, falls into two classes, the first being the *a*-conjugation proper, and the second the *ē*-conjugation, in which the *ē* represents the *aya* of the Skr. 10th class and of causal and denominative verbs. The *ātmanēpada* voice of Skr. has practically disappeared in the Midland, and even in the Outer languages it is not common. The present participle is the only form which has everywhere survived. The other forms are supplied by the *parasmaipada*. All the past tenses (imperfect, perfect and aorists) have fallen into disuse, leaving only a few sporadic remains, their place being supplied, as in the case of the tertiary vernaculars, by the participles, with or without auxiliary verbs. The present tense of the verb substantive has survived from Skr., but it is usual to employ *atthi* (=Skr. *asti*) for both numbers and all persons of the present, and *āsī* (=*āsīt*) for both numbers and all persons of the past. It is interesting to note that the latter has survived in the modern Panjabi *sī*, was, in which language it is universally, but wrongly, described as a feminine. Another verb substantive (Skr. √ *bhū*) has also survived, generally in the form *hōi* or *huvaï* for *bhavati*. In AMg. and M. we also have *bhavaï* pretty frequently, and the same form also occurs, but less often, in Ś. and Mg. Its usual past participle is *hūa-* or Mg. *hūda-*, Ś. *bhūda-*. The forms are given here as they are important when the history of the Tertiary Prakrits comes under consideration. These two verbs substantive make periphrastic tenses with other participles, and, in the case of the past participles and gerundives of transitive verbs (both of which are passive in signification), the agent or subject is put into the instrumental case, the participle being used either personally or impersonally, as in the tertiary languages. Thus, *tēṇa girivarō diṭṭhō*, by him a mountain was seen, *i.e.* he saw a mountain; *tēṇa paḍivannaṁ*, it was acknowledged by him, he acknowledged. The gerundive, or future passive participle, is also used impersonally in the case of intransitive verbs, as in *dūraṁ gantavvaṁ*, it is to be gone far, we must go far.

Besides the participles, the infinitive and the indeclinable participle (gerund) have also survived. So also the passive voice, conjugated in the same tenses as the active, and generally with *parasmaipada* terminations. The causal has been already mentioned. There are also numerous denominative verbs (many of them onomatopoeic), and a good supply of examples of frequentative and desiderative bases, mostly formed, with the necessary phonetic modifications, as in Skr. The present participle in the *parasmaipada* ends in *-anta-* (*-enta-*), declined according to the *a*-declension, and in the *ātmanēpada* in *-māna-*. The termination *-(i)ta-* of the Skr. past participle passive has survived under the form *-ia-*. Many direct representatives of Skr. participles in *-ta-* (without the *i*) and *-na-* also appear. Thus, Skr. *dṛṣṭa-*, Pr. *diṭṭha-*, seen; Skr. *lagna-*, Pr. *lagga-*, attached. As usual there is a tendency to simplification, and the termination *ia* is commonly added to the Pr. present base, instead of following Skr. analogy. Thus, not only have we *tatta-* formed directly from the Skr. *tapta-*, but we have also *tavia-* from the Pr. present stem *tav-aï* (=Skr. *tapati*), he is hot. All the three forms of the future passive participle or gerundive, in *-tavya-*, *-anīya-* and *-ya-*, have survived. The infinitive has survived, not only with the form corresponding to the classical Sanskrit termination *-tum*, but also with several old Vedic forms. The same is the case with the gerund, in which both the classical forms in *-tvā* and *-(t)ya* have survived, but with the loss of the distinctive use which obtained in Sanskrit. Besides these there are also survivals of Vedic forms, and even of Primary Prakrit forms not found in the Veda. The passive is generally formed by adding *-jja* or, in Ś. and Mg., *-īa-*, to the root or, more often, to the present stem. Thus, M. *pucchĩjjaĩ* or Ś. *pucchīadi*, he is being asked.

The following are therefore the only tenses which are fully conjugated in Pr.: the present, the imperative, the future and the optative. Except in Ap., the personal terminations in general correspond to the Skr. ones, but in Ap. there are some forms which probably go back to unrecorded Primary Prakrits and have not as yet been explained. As an example we take the conjugation of the base *puccha-*, ask (Skr. *pṛcchati*), in the present tense.

	Skr.	Ś.	Ap.	M.	AMg.	Mg.
Sing.						
1.	*pṛcchāmi*	*pucchāmi*	*pucchaũ*	*pucchāmi*	*pucchāmi*	*puscāmi*
2.	*pṛcchasi*	*pucchasi*	*pucchasi* or *-hi*	*pucchasi*	*pucchasi*	*puścasi*
3.	*pṛcchati*	*pucchadi*	*pucchaï*	*pucchaï*	*pucchaï*	*puścadi*
Plur.						
1.	*pṛcchāmas*	*pucchāmō*	*pucchahũ*	*pucchāmō*	*pucchāmō*	*puścāmō*
2.	*pṛcchatha*	*pucchadha*	*pucchahu*	*pucchaha*	*pucchaha*	*puścadha*
3.	*pṛcchanti*	*pucchanti*	*pucchahĩ*	*pucchanti*	*pucchanti*	*puścanti*

The imperative similarly follows the Skr. imperative. The Ś. second person singular is generally *puccha*, while the Outer languages often have a form corresponding to *pucchēhi*. The base of the optative is generally formed by adding *-ejja-* in the Outer languages and *-ēa-* in Ś.; thus, Ś. *pucchēaṁ*, others *pucchejjāmi*, &c., may I ask. The Skr. future termination *-isya-* is represented by *-issa-* or *-ihi-*; thus, *pucchissāmi* or *pucchihimi*, I shall ask.

Literature.

Prakrit Literature.—The great mass of Prakrit literature is devoted to the Jaina religion, and, so far as it is known, is described under the head of Jains. Here it is sufficient to state that the oldest Jaina *sūtras* were in Ardhamāgadhī, while the non-canonical books of the Švētāmbara sect were in a form of Māhārāṣṭrī, and the canon of the Digambaras appears to have been in a form of Śaurasēnī. Besides these religious works, Prakrit also appears in secular literature. In artificial lyric poetry it is pre-eminent. The most admired work is the *Sattasaī* (*Saptaśaptikā*), compiled at some time between the 3rd and 7th centuries A.D. by Hāla. The grace and poetry of this collection, in which art most happily succeeds in concealing art, has rarely been exceeded in literature of its kind. It has had numerous imitators, both in Sanskrit and in the modern vernaculars, the most famous of which is the Satsaī of Bihārī Lāl (17th century A.D.). Hāla's work is important, not only on its own account, but also as showing the existence of a large Prakrit literature at the time when it was compiled. Most of this is now lost. There are some scholars (including the present writer) who believe that Sanskrit literature owes more than is generally admitted to works in the vernacular, and that even the Mahābhārata first took its form as a folk-epic in an early Prakrit, and was subsequently translated into Sanskrit, in which language it was further manipulated, added to, and received its final shape. In literary Prakrit we have two important specimens of formal epic poetry—the *Rāvaṇavaha* or *Sētubandha* (attributed to Pravarasēna, before A.D. 700), dealing with the subject of the *Rāmāyaṇa*, and the *Gaüḍavaha* of Vākpati (7th–8th century A.D.), celebrating the conquest of Bengal by Yaśōvarman, king of Kanauj. Reference must also be made to the *Kumārapāla-carita*, the title of the last eight cantos of the huge *Dvyāśraya Mahākāvya* of Hēmacandra (A.D. 1150). The whole work was written to serve as a series of illustrations to the author's Sanskrit and Prakrit grammar, the *Siddha-hēmacandra*. The last eight cantos are in Prakrit, and illustrate the rules of the corresponding portion of his work. Its hero is Kumāra-pāla of Aṇhilvāḍā. Dramatic literature has also an admired example in the *Karpūra-mañjarī* ("Camphor-cluster," the name of the heroine) by Rāja-śēkhara (A.D. 900), an amusing comedy of intrigue. An important source of our knowledge of Prakrit, and especially of dialectic Prakrit, is the Sanskrit drama. It has already been pointed out that in works of this class many of the characters speak in Prakrit, different dialects being employed for different purposes. Generally speaking, Śaurasēnī is employed for prose and Māhārāṣṭrī (the language of lyric poetry) for the songs, but special characters also speak special dialects according to their supposed nationality or profession. In India there is nothing extraordinary in such a polyglot medley. It is paralleled by the conditions of any large house in Bengal at the present day, in which there are people from every part of India, each of whom speaks his own language and is understood by the others, though none of them attempts to speak what is not his mother tongue. The result is that in the Sanskrit drama we have a valuable reflection of the local dialects. It is somewhat distorted, for the authors wrote according to the rules laid down by technical handbooks, and the dialects which they employed were, in the case of the later writers, as dead as Sanskrit. But nevertheless, if not an absolutely true representation, it is founded on the truth, and it is almost our only source of information as to the condition of the Indian vernaculars in the first five centuries A.D. The drama which gives the best examples of these dialects is the *Mr̥cchakaṭikā*. For further particulars regarding the Sanskrit drama, reference should be made to the article SANSKRIT.

AUTHORITIES.—The father of Prakrit philology was Ch. Lassen, the author of the *Institutiones linguae pracriticae* (Bonn, 1837). This famous work, a wonderful product of the learning of the time, is now out of date, and has been definitely superseded by R. Pischel's *Grammatik der Prākritsprachen* (Strasburg, 1900). As an introduction to the study of the language, the best work is H. Jacobi's *Ausgewählte Erzählungen in Mâhârâshṭrî zur Einführung in das Studium des Prâkṛit, Grammatik, Text, Wörterbuch* (Leipzig, 1886). The best editions of the native grammars are E. B. Cowell's of Vararuci's *Prākr̥ta-prakāśa* (London, 1868), R. Pischel's of Hēmacandra (Halle, 1877, 1889) [see above], and E. Hultzsch's of Śiṁharāja's *Prākr̥tarūpāvatāra* (London, 1909). For *Dēśya* words, see Pischel's *The Deśînâmamâlâ of Hemachandra* (Bombay, 1880). For *Apabhraṁśa*, in addition to his edition of Hēmacandra's grammar, see the same author's *Materialen zur Kenntnis des Apabhraṁśa* (Berlin, 1902). For the mutual relationship of the various Prakrits, see S. Konow, "Mâhârâshṭrî and Mârâthî," in the *Indian Antiquary*, (1903), xxxii., 189 sqq. For Jaina Prakrit, see under JAINS. As regards the secular texts mentioned above the following are the best editions: A. Weber, *Das Saptataçatakam des Hāla* (Leipzig, 1881); another edition by Durgāprasād and Kāśīnāth Pāṇḍurang Parab under the title of *The Gâthasapataśatî of Śâtavâhana* (Bombay, 1889) [a good commentary]; S. Goldschmidt, *Rāvaṇavaha oder Setubandha* (Strasburg. 1880–1883) [text and translation]; Śivadatta and Parab, *The Setubandha of Pravarasena* (Bombay, 1895); Shaṅkar Pāṇḍurang Paṇḍit, *The Gaüḍavaho, a Historical Poem in Prâkrit, by Vâkpati* (Bombay, 1887); the same editor, *The Kumârapâla-charita* (Bombay, 1900); *Rajaçekhara's Karpūramañjarī*, edited by S. Konow, translated by C. R. Lanman (Cambridge, Mass., 1901).

The literature of the Sanskrit drama is given under SANSKRIT.

(G. A. GR.)

PRAM (Du. *praam*), the name of a flat-bottomed boat or barge used as a "lighter" for discharging and loading cargo in the ports of the Baltic and North Sea. The word, which is common in various forms to all the languages bordering on those seas, is originally Slavonic; its ultimate etymology connects it with the words found in all Indo-European languages which are to be traced to the root *par-*, to go through, travel; cf. "fare," "ferry," "far," Gr. *πόρος*, way, Lat. *portare*, carry, &c.

PRANTL, KARL VON (1820–1888), German philosopher, was born at Landsberg on the Lech on the 28th of January 1820, and died on the 14th of September 1888 at Oberstdorf. In 1843 he became doctor of philosophy at Munich Observatory, where he was made professor in 1859. He was also a member of the Academies of Berlin and Munich. Strongly in agreement with the Hegelian tradition, he defended and amplified it in *Die gegenwärtige Aufgabe der Philosophie* (1852) and *Verstehen und Beurteilen* (1877). In these works he emphasized the identity of the subjective and the objective for consciousness, and the fact that the perception of this unity is peculiar to man. He is more important, however, as a commentator and scholar, and made valuable contributions to the study of Aristotle. He published *Aristoteles über die Farben* (1849), *Aristoteles' acht Bücher der Physik* (1857), and numerous minor articles on smaller points, such as the authenticity of the thirty-eight books of the *Problems*. The work by which he is best known is the *Geschichte der Logik im Abendland* (Leipzig, 1855–1870). Chr. Sigwart, in the preface to the first edition of his *Logic*, makes "special mention" of the assistance he obtained from this book.

PRATI, GIOVANNI (1815–1884), Italian poet, was born at Dasindo and educated in law at Padua. Adopting a literary career, he was inspired by anti-Austrian feeling and devotion to the royal house of Savoy, and in early life his combination of a sympathy for national independence with monarchical sentiments brought him into trouble in both quarters, Guerrazzi expelling him from Tuscany in 1849 for his praise of Carlo Alberto. In 1862 he was elected a deputy to the Italian parliament, and in 1876 a senator. He died at Rome on the 9th of May 1884. Prati was a prolific poet, his volumes of verse ranging from his romantic narrative *Ermenegarda* (1841) to the lyrics collected in *Psiche* (1875) and *Iside* (1878). His *Opere varie* were published in five volumes in 1875, and a selection in one volume in 1892.

PRATINAS (the quantity of the second vowel is doubtful), one of the oldest tragic poets of Athens, was a native of Phlius in Peloponnesus. About 500 B.C. he competed with Choerilus and Aeschylus, when the latter made his first appearance as a writer for the stage. Pratinas was also the introducer of satyric dramas as a species of entertainment distinct from tragedy, in which the rustic merry-makings and the extravagant dances of the satyrs were retained. The associations of his home, not far from Corinth, where Arion was said to have established the cyclic choruses of satyrs, may account for his preference for this kind of drama. Pratinas was also a writer of dithyrambs and the choral odes called *hyporchemata* (a considerable fragment of one of these is preserved in Athenaeus xiv. 617). It is related that, during the performance of one of his plays, the scaffolding of the wooden stage gave way, in consequence of which the Athenians built a theatre of stone; but recent excavations make it doubtful whether a stone theatre existed in Athens at so early a date. A monument was erected by the inhabitants of Phlius in honour of Pratinas's son Aristias, who, with his father, enjoyed the reputation of excelling all, with the exception of Aeschylus, in the composition of satyric dramas, one of which was called *Cyclops*.

See Pausanias ii. 13; Suidas *q.v.*; fragments in T. Bergk, *Poetae lyrici graeci*, vol. iii.

PRATINCOLE, a word apparently invented by J. Latham (*Synopsis*, v. 222), being the English rendering of *Pratincola*, applied in 1756 by P. Kramer (*Elenchus*, p. 381) to a bird which had hitherto received no definite name, though it had long before been described and even recognizably figured by Aldrovandus (*Ornithologia*, xvii. 9) under the vague designation of "*hirundo marina*." It is the *Glareola pratincola* of modern ornithologists, forming the type of a genus *Glareola*, founded by M. J. Brisson in 1760, belonging to the group *Limicolae*, and constituting together with the coursers (*Cursorius*) a separate family, *Glareolidae*. The pratincoles, of which some eight or nine species have been described, are all small birds, slenderly built and mostly delicately coloured, with a short stout bill, a wide gape, long pointed wings, and a tail more or less forked. In some of their habits they are thoroughly plover-like, running very swiftly and breeding on the ground, but on the wing they have much the appearance of swallows, and, like them, feed, at least partly, while flying.[1] The ordinary pratincole of Europe, *G. pratincola*, breeds abundantly in many parts of Spain, Barbary and Sicily, along the valley of the Danube, and in southern Russia, while owing to its great powers of flight it frequently wanders far from its home, and more than a score of examples have been recorded as occurring in the British Islands. In the south-east of Europe a second and closely-allied species, *G. nordmanni* or *G. melanoptera*, which has black instead of chestnut inner wing-coverts, accompanies or, farther to the eastward, replaces it; and in its turn it is replaced in India, China and Australia by *G. orientalis*. Australia also possesses another species, *G. grallaria*, remarkable for the great length of its wings and much longer legs, while its tail is scarcely forked—peculiarities that have led to its being considered the type of a distinct genus or sub-genus *Stiltia*. Two species, *G. lactea* and *G. cinerea*, from India and Africa respectively, seem by their pale coloration to be desert forms, and they are the smallest of this curious little group. The species whose mode of nidification is known lay either two or three eggs, stone-coloured, blotched, spotted, and streaked with black or brownish-grey. The young when hatched are clothed in down and are able to run at once—just as are young plovers. (A. N.)

PRATO, a town and episcopal see of Tuscany, Italy, in the province of Florence, 11 m. by rail N.W. of Florence, 207 ft. above sea-level. Pop. (1906), 20,197 (town); 55,298 (commune). It is situated on the Bisenzio, and is dominated by a medieval castle and surrounded by walls of the 11th and 14th centuries. The cathedral of St Stephen was begun in the 12th century in the Tuscan Romanesque style; to this period belongs the narrow nave with its wide arches; the raised transepts and the chapels were added by Giovanni Pisano in 1317–1320; the campanile dates from 1340 (it is a much smaller and less elaborate version of Giotto's campanile at Florence), while the façade, also of alternate white sandstone and green serpentine, belongs to 1413. It has a fine doorway with a bas-relief by Andrea della Robbia over it; but the most striking external feature is the lovely open-air pulpit at an angle of the building, erected by Donatello and Michelozzo for displaying to the people without risk the Virgin's girdle, brought from the Holy Land by a knight of Prato in 1130. The pulpit itself has beautiful reliefs of dancing children; beneath it is a splendid bronze capital. The contract was given out in 1428, but the work was seriously begun only in 1434 and finished in 1438. The Chapel of the Girdle has good frescoes by Agnolo Gaddi (1365), a statue of the Virgin by Giovanni Pisano, and a handsome bronze open-work screen. The frescoes in the choir, with scenes from the life of St John the Baptist and St Stephen, are by Fra Filippo Lippi (1456–1466) and are his best work; the dance of Salome and the lying in state of St Stephen are the finest of the series. Among other works of art may be mentioned the clay statue of the Madonna dell' Ulivo by Benedetto da Maiano. The massive old Palazzo Pretorio (13th century) has been somewhat modified in details; the adjacent Palazzo Comunale contains a small picture gallery with works by Filippo and Filippino Lippi. A beautiful Madonna by the latter (1497) is in a small street shrine at the corner of the Via S. Margherita. The Church of S. Domenico is a Gothic edifice of 1281; that of S. Francesco has an almost Renaissance façade, fine cloisters with a good 15th-century tomb, and a chapter-house with Giottesque frescoes. The Madonna del Buon Consiglio has some good reliefs by Andrea della Robbia, by whom is also the beautiful frieze in the Madonna delle Carceri. This church, by Giuliano da Sangallo (1485–1491), is a Greek cross, with barrel vaults over the arms, and a dome; it is a fine work, and the decoration of the exterior in marble of different colours (unfinished) is of a noble simplicity. Some remains exist of the 13th-century fortress, and the large Piazza Mercatale is picturesque. The works of art visible in Prato are due, as will be seen, entirely to Florentine artists. As a whole the town has a somewhat modern aspect. The industries of Prato embrace the manufacture of woollens (the most important), straw-plaiting, biscuits, hats, macaroni, candles, silk, olive oil, clothing and furniture, also copper and iron works, and printing.

Prato is said to be first mentioned by name in 1107, but the cathedral appears as early as 1048 as the parish church of Borgo Cornio or Santo Stefano. It was subject to the Alberti until 1180, and was then under the Imperial supremacy. It appears to have freed itself from this at the end of the 13th century. In 1313 the town acknowledged the authority of Robert, king of Naples, and in 1350 Niccola Acciajoli, seneschal of Joanna, sold it to the Florentines for 17,500 florins of gold. In 1512 it was sacked by the Spaniards under General Cardona. In 1653 it obtained the rank of city.

See E. Corradini, *Prato* (Bergamo, 1905).

PRATT, ORSON (1811–1881), Mormon apostle, was born of humble parents at Hartford, New York. In 1830 he joined the Mormon Church, becoming a member of its council of twelve in 1834 and one of its twelve apostles in 1835. Pratt was also a mathematician of some note. He was professor of mathematics in the university of Deseret and wrote several books on this subject, these including *Cubic and Biquadratic Equations* (1866). He was a member, and several times speaker, of the Utah House of Representatives. Among his writings may be mentioned *Key to the Universe* (1866), and *The Bible and Polygamy* (1870).

PRAWN, the name of an edible large shrimp-like crustacean in Great Britain usually applied to *Leander serratus* (see Shrimp). The word is in M. Eng. *prayne* or *prane*, and no cognate forms are found in any other languages. It has been often referred to the Lat. *perna*, a ham-shaped shellfish, but this is due to Florio, who by a mistake glosses *parnocchie*, prawne-fishes or shrimps. The O. Ital. *perna* and *pernocchia* meant a shellfish which yielded "nacre" or mother-of-pearl.

PRAXIAS and **ANDROSTHENES,** Greek sculptors, who are said by Pausanias (x. 19, 4) to have executed the pediments of the temple of Apollo at Delphi. Both were Athenians; Praxias a pupil of Calamis. The statement raises historic difficulties, as, according to the leaders of the recent French excavations at Delphi, the temple of Apollo was destroyed about 373 B.C. and rebuilt by 339 B.C., a date which seems too late for the lifetime of a pupil of Calamis. In any case no fragments of the pediments of this later temple have been found, and it has been suggested that they were removed bodily to Rome.

PRAXILLA, of Sicyon, Greek lyric poetess, one of the so-called nine "lyric" Muses, flourished about 450 B.C. According to Athenaeus (xv. 694), she was famous as a composer of scolia (short lyrical poems sung after dinner), which were considered equal to those of Alcaeus and Anacreon. She also wrote dithyrambs and hymns, chiefly on mystic and mythological subjects, genealogies, and the love-stories of the gods and heroes. A dactylic metre was also called by her name.

Fragments in T. Bergk, *Poetae lyrici graeci*, vol. iii.; see also C. F. Neue, *De Praxillae Sicyoniae reliquiis* (progr. Dorpat, 1844).

PRAXITELES, of Athens, the son of Cephissodotus, the greatest of the Attic sculptors of the 4th century B.C., who has left an imperishable mark on the history of art. It has been maintained by some writers that there were two sculptors of the name, one a contemporary of Pheidias, the other, more celebrated, of two generations later. This duplication is defended in Furtwängler's *Masterpieces of Greek Sculpture* (pp. 99, 102, seq.) but on insufficient grounds. There is, however, no reason why the great Praxiteles should not have had a grandfather of the same name: all that we can say is that at present we have no certain evidence that this was the case.

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[1] This combination of characters for many years led systematizers astray, though some of them were from the first correct in their notions as to the Pratincole's position. Linnaeus, even in his latest publication, placed it in the genus *Hirundo*; but the interleaved and annotated copies of his *Systema naturae* in the Linnean Society's library show the species marked for separation and insertion in the Order *Grallae*—*Pratincola trachelia* being the name by which he had meant to designate it in any future edition. He seems to have been induced to this change of view mainly through a specimen of the bird sent to him by John White, the brother of Gilbert White; but the opinion published in 1769 by Scopoli (*Ann. I. hist. naturalis*, p. 110) had doubtless contributed thereto, though the earlier judgment to the same effect of Brisson, as mentioned above, had been disregarded. Different erroneous assignments of the form have been made even by recent authors, who neglected the clear evidence afforded by the internal structure of the Pratincole. For instance, Sundevall in 1873 (*Tentamen*, p. 86) placed *Glareola* among the *Caprimulgidae*, a position which osteology shows cannot be maintained for a moment.

Though Praxiteles may be considered as in some ways well known to us, yet we have no means for fixing his date accurately. It seems clear that he was no longer working in the time of Alexander the Great, or that king would have employed him. Pliny's date, 364 B.C., is probably that of one of his most noted works.

Our knowledge of Praxiteles has received a great addition, and has been placed on a satisfactory basis, by the discovery at Olympia in 1877 of his statue of Hermes bearing the infant Dionysus, a statue which has become famous throughout the world (Greek Art, fig. 43 and Plate VI. fig. 82). Hermes is represented as in the act of carrying the child Dionysus to the nymphs who were charged with his rearing. He pauses on the way, and holds out to the child a bunch of grapes to excite his desire. The young child can hardly be regarded as a success; he is not really childlike. But the figure of the Hermes, full and solid without being fleshy, at once strong and active, is a masterpiece, and the play of surface is astonishing. In the head we have a remarkably rounded and intelligent shape, and the face expresses the perfection of health and enjoyment.

This statue must for the future be our best evidence for the style of Praxiteles. It altogether confirms and interprets the statements as to Praxiteles made by Pliny and other ancient critics. Gracefulness in repose, and an indefinable charm are also the attributes of works in our museums which appear to be copies of statues by Praxiteles. Perhaps the most notable of these are the Apollo Sauroctonus, or the lizard-slayer, a youth leaning against a tree and idly striking with an arrow at a lizard, and the Aphrodite at the bath (Greek Art, Plate V., fig. 71) of the Vatican, which is a copy of the statue made by Praxiteles for the people of Cnidus, and by them valued so highly that they refused to sell it to King Nicomedes, who was willing in return to discharge the whole debt of the city, which, says Pliny, was enormous.

The Satyr of the Capitol at Rome has commonly been regarded as a copy of one of the Satyrs of Praxiteles; but we cannot identify it in the list of his works. Moreover, the style is hard and poor; a far superior replica exists in a torso in the Louvre. The attitude and character of the work are certainly of Praxitelean school.

Excavations at Mantineia in Arcadia have brought to light the basis of a group of Leto Apollo and Artemis by Praxiteles. This basis was doubtless not the work of the great sculptor himself, but of one of his assistants. Nevertheless it is pleasing and historically valuable. Pausanias (viii. 9, 1) thus describes the base, "on the base which supports the statues there are sculptured the Muses and Marsyas playing the flutes." Three slabs which have survived represent Apollo, Marsyas, a slave, and six of the Muses, the slab which held the other three having disappeared.

A head of Aphrodite at Petworth in England, and a head of Hermes in the British Museum (Aberdeen Hermes), have lately been claimed by competent authorities as actual works of Praxiteles. Both are charming works, but rather by the successors of Praxiteles than by himself.

Besides these works, connected with Praxiteles on definite evidence, there are in our museums works without number of the Roman age, statues of Hermes, of Dionysus, of Aphrodite, of Satyrs and Nymphs and the like, in which a varied amount of Praxitelean style may be discerned. Four points of composition may be mentioned, which appear to be in origin Praxitelean: (1) a very flexible line divides the figures if drawn down the midst from top to bottom; they all tend to lounging; (2) they are adapted to front and back view rather than to being seen from one side or the other; (3) trees, drapery and the like are used for supports to the marble figures, and included in the design, instead of being extraneous to it; (4) the faces are presented in three-quarter view.

The subjects chosen by Praxiteles were either human beings or the less elderly and dignified deities. It is Apollo, Hermes and Aphrodite who attract him rather than Zeus, Poseidon or Athena. And in his hands the deities sink to the human level, or, indeed, sometimes almost below it. They have grace and charm in a supreme degree, but the element of awe and reverence is wanting.

Praxiteles and his school worked almost entirely in marble. At the time the marble quarries of Paros were at their best; nor could any marble be finer for the purposes of the sculptor than that of which the Hermes is made. Some of the statues of Praxiteles were coloured by the painter Nicias, and in the opinion of the sculptor they gained greatly by this treatment.

(P. G.)

PRAYER (from Lat. *precari*, entreat; Ital. *pregaria*, Fr. *prière*), a term used generally for any humble petition, but more technically, in religion, for that mode of addressing a divine or sacred power in which there predominates the mood and intention of reverent entreaty.

Prayer and its Congeners.—Prayer in the latter sense is a characteristic feature of the higher religions, and we might even say that Christianity or Mahommedanism, ritually viewed, is in its inmost essence a service of prayer. At all stages of religious development, however, and more especially in the case of the more primitive types of cult, prayer as thus understood occurs together with, and shades off into, other varieties of observance that bear obvious marks of belonging to the same family.

Confining ourselves for the moment to forms of explicit address, we may group these under three categories according as the power addressed is conceived by the applicant to be on a higher, or on much the same, or on a lower plane of dignity and authority as compared with himself. (1) Only if the deity be regarded as altogether superior is there room for prayer proper, that is, reverent entreaty. Of this we may perhaps roughly distinguish a higher and a lower type, according as there is either complete confidence in the divine benevolence and justice, or a disposition to suppose a certain arbitrariness or at any rate conditionality to attach to the granting of requests. In the first case prayer will be accompanied with disinterested homage, praise and thankgiving, and will in fact tend to lose its distinctive character of entreaty or petition, passing into a mystic communing or converse with God. In the second case it will be supported by pleading, involving on the one hand self-abasement, with confession of sins and promises of repentance and reform, or on the other hand self-justification, in the shape of the expression of faith and recitation of past services, together with reminders of previous favour shown. (2) If, however, the worshipper place his god on a level with himself, so far at any rate as to make him to some extent dependent on the service man contracts to render him, then genuine prayer tends to be replaced by a mere bargaining, often conjoined with flattery and with insincere promises. This spirit of *do ut des* will be found to go closely with the gift-theory of sacrifice, and to be especially characteristic of those religions of middle grade that are given over to sacrificial worship as conducted in temples and by means of organized priesthoods. Not but what, when the high gods are kind for a consideration, the lower deities will likewise be found addicted to such commerce; thus in India the hedge-priest and his familiar will bandy conditions in spirited dialogue audible to the multitude (cf. W. Crooke, *Things Indian, s.v.* "Demonology," pp. 132, 134). (3) Lastly, the degree of dependency on human goodwill attributed to the power addressed may be so great that, instead of diplomatic politeness, there is positive hectoring, with dictation, threats and abuse. Even the Italian peasant is said occasionally to offer both abuse and physical violence to the image of a recalcitrant saint; and antiquity wondered at the bullying manner of the Egyptians towards their gods (cf. Iamblichus, *De mysteriis*, vi. 5–7). This frame of mind, however, is mainly symptomatic of the lower levels of cult. Thus the Zulu says to the ancestral ghost, "Help me or you will feed on nettles"; whilst the still more primitive Australian exclaims to the "dead hand" that he carries about with him as a kind of divining-rod, "Guide me aright, or I throw you to the dogs."

So far we have dealt with forms of address explicitly directed towards a power that, one might naturally conclude, has personality, since it is apparently expected to hear and answer. At the primitive stage, however, the degree of personification is, probably, often far slighter than the words used would seem to suggest. The verbal employment of vocatives and of the second person may have little or no personifying force, serving primarily but to make the speaker's wish and idea intelligible to himself. When the rustic talks in the vernacular to his horse he is not much concerned to know whether he is heard and understood; still less when he mutters threats against an absent rival, or kicks the stool that has tripped him up with a vicious "Take that!"

These considerations may help towards the understanding of a second class of cases, namely forms of implicit address shading off into unaddressed formulas. Wishings, blessings, cursings, oaths, vows, exorcisms, and so on, are uttered aloud, doubtless partly that they may be heard by the human parties to the rite, but likewise in many cases that they may be heard, or at least overheard, by a consentient deity, perhaps represented visibly by an idol or other cult-object. The ease with which explicit invocations attach themselves to many of these apparently self-contained forms proves that there is not necessarily any perceived difference of kind, and that implicit address as towards a "something not-ourselves" is often the true designation of the latter. On the other hand, there is reason to believe that the magical spell proper is a self-contained and self-sufficient form of utterance, and that it lies at the root of much that has become address, and even prayer in the fullest sense.

From Spell to Prayer.—Of course to address and entreat a fellow-being is a faculty as old as that of speech, and, as soon as it occurred to man to treat sacred powers as fellow-beings, assuredly there was a beginning of prayer. We do not know, and are not likely to know, how religion first arose, and the probability is that many springs went to feed that immense river. Thus care for the dead may well have been one amongst such separate sources. It is natural for sorrow to cry to the newly dead "Come back!" and for bereavement to add "Come back and help!" Another source is mythologic fancy, which, in answer to childlike questions; "Who made the world?" "Who made our laws?" and so on, creates "magnified non-natural men," who presently made their appearance in ritual (for to think a thing the savage must dance it); whereupon personal intercourse becomes possible between such a being and the tribesmen, the more so because the supporters of law and order, the elders, will wish to associate themselves as closely as possible with the supreme law-giver. From Australia, where we have the best chance of studying rudimentary religion in some bulk, comes a certain amount of evidence showing that in the two ways just mentioned some inchoate prayer is being evolved. On the other hand, it is remarkable how conspicuous, on the whole, is the absence of prayer from the magico-religious ritual of the Australians. Uttered formulas abound; yet they are not forms of address, but rather the self-sufficient pronouncements of the magician's *fiat*. Viewed analytically in its developed nature, magic is a wonder-working recognized as such, the core of the mystery consisting in the supposed transformation of suggested idea into accomplished fact by means of that suggestion itself. To the magician, endowed in the opinion of his fellows (and doubtless of himself) with this wonderful power of effective suggestion, the output of such power naturally represents itself as a kind of unconditional willing. When he cries "Rain, rain," or otherwise makes vivid to himself and his hearers the idea of rain, expecting that the rain will thereby be forced to come, it is as if he had said "Rain, now you must come," or simply "Rain, come!" and we find as a fact that magical formulas mostly assume the tone of an actual or virtual imperative, "As I do this, so let the like happen," "I do this in order that the like may happen," and so on. Now it is easy to "call spirits from the vasty deep," but disappointed experience shows that they will not always come. Hence such imperatives have a tendency to dwindle into optatives. "Let the demon of small-pox depart!" is replaced by the more humble "Grandfather Smallpox, go away!" where the affectionate appellative (employed, however, in all likelihood merely to cajole) signalizes an approach to the genuine spirit of prayer. Again, the magician conscious of his limitations will seek to supplement his influence —his *mana*, as it is termed in the Pacific—by tapping, so to speak, whatever sources of similar power lie round about him; and these the "magomorphism" of primitive society perceives on every hand. A notable method of borrowing power from another magic-wielding agency is simply to breathe its name in connexion with the spell that stands in need of reinforcement; as the name suggests its owner, so it comes to stand for his real presence. It is noticeable that even the more highly developed forms of liturgical prayer tend, in the recitation of divine titles, attributes and the like, to present a survival of this magical use of potent names.

Prayer as a Part of Ritual.—An exactly converse process must now be glanced at, whereby, instead of growing out of it, prayer actually generates spell. In advanced religion, indeed, prayer is the chosen vehicle of the free spirit of worship. Its mechanism is not unduly rigid, and it is largely autonomous, being rid of subservience to other ritual factors. In more primitive ritual, however, set forms of prayer are the rule, and their function is mainly to accompany and support a ceremony the nerve of which consists in action rather than speech. Hence, suppose genuine prayer to have come into being, it is exceedingly apt to degenerate into a mere piece of formalism; and yet, whereas its intrinsic meaning is dulled by repetition according to a well-known pyschological law, its virtue is thereby hardly lessened for the undeveloped religious consciousness, which holds the saving grace to lie mainly in the repetition itself. But a formula that depends for its efficacy on being uttered rather than on being heard is virtually indistinguishable from the self-sufficient spell of the magician, though its origin is different. A good example of a degenerated prayer-ritual comes from the Todas (see W. H. R. Rivers, *The Todas*, ch. x.). The prayer itself tends to be slurred over, or even omitted. On the other hand, great stress is laid on a preliminary citation of names of power followed by the word *idith*. This at one time seems to have meant "for the sake of," carrying with it some idea of supplication; but it has now lost this connotation, seeing that it can be used not merely after the name of a god, but after that of any sacred object or incident held capable of imparting magic efficacy to the formula. Even the higher religions have to fight against the tendency to "vain repetitions" (often embodying a certain sacred number, *e.g.* three), as well as to the use of prayers as amulets, medicinal charms, and so on. Thus, Buddhism offers the striking case of the praying-wheel. It remains to add that throughout we must carefully distinguish in theory, however hard this may be to do in practice, between legitimate ritual understood as such, whether integral to prayer, such as its verbal forms, or accessory, such as gestures, postures, incense, oil or what not, and the formalism of religious decay, such as generally betrays itself by its meaninglessness, by its gibberish phrases, sing-song intonation and so forth.

Silent Prayer.—A small point in the history of prayer, but one that has an interesting bearing on the subject of its relation to magic, is concerned with the custom of praying silently. Charms and words of power being supposed to possess efficacy in themselves are guarded with great secrecy by their owners, and hence, in so far as prayer verges on spell, there will be a disposition to mutter or otherwise conceal the sacred formula. Thus the prayers of the Todas already alluded to are in all cases uttered "in the throat," although these are public prayers, each village having a form of its own. At a later stage, when the distinction between magic and religion is more clearly recognized and an anti-social character assigned to the former on the ground that it subserves the sinister interests of individuals, the overt and as it were congregational nature of the praying comes to be insisted on as a guarantee that no magic is being employed (cf. Apuleius, *Apol.* 54, "tacitas preces in templo dis allegasti: igitur magus es"), a notion that suffers easy translation into the view that there are more or less disreputable gods with whom private trafficking may be done on the sly (cf. Horace, *Ep.* I. xvi. 60, "labra movet metuens audiri, Pulchra Laverna, da mihi fallere"). Thus it is quite in accordance with the outlook of the classical period that Plato in his *Laws* (909–910) should prohibit all possession of private shrines or performance of private rites; "let a man go to a temple to pray, and let any one who pleases join with him in the prayer." Nevertheless, instances are not wanting amongst the Greeks of private prayers of the loftiest and most disinterested tone (cf. L. R. Farnell, *The Evolution of Religion*, p. 202 seq.). Finally we may note in this connexion that in advanced religion, at the point at which prayer is coming to be conceived as communion, silent adoration is sometimes thought to bring man nearest to God.

The Moralization of Prayer.—When we come to consider the moral quality of the act of prayer, this contrast between the spirit of public and private religion is fundamental for all but the most advanced forms of cult. In its public rites the community becomes conscious of common ends and a common edification. We may observe how even a very primitive people such as the Arunta of Australia behaves with the greatest solemnity at its ceremonies, and professes to be made "glad" and "strong" thereby; whilst of his countrymen, whom he would not trust to pray in private, Plato testifies that in the temples during the sacrificial prayers "they show an intense earnestness and with eager interest talk to the Gods and beseech them" (*Laws*, 887). We may therefore assume that, in acts of public worship at any rate, prayer and its magico-religious congeners are at all stages resorted to as a "means of grace," even though such grace do not constitute the expressed object of petition. Poverty of expression is apt to cloak the real spirit of primitive prayer, and the formula under which its aspirations may be summed up, namely, "Blessings come, evils go," covers all sorts of confused notions about a grace to be acquired and an impurity to be wiped away, which, as far back as our clues take us, invite interpretations of a decidedly spiritualistic and ethical order. To explicate, however, and purge the meaning of that "strong heart" and "clean" which the savage after his fashion can wish and ask for, remained the task of the higher and more self-conscious types of religion. A favourite contrast for which there is more to be said is that drawn between the magico-religious spell-ritual, that says in effect, "My will be done," and the spirit of "Thy will be done" that breathes through the highest forms of worship. Such resignation in the face of the divine will and providence is, however, not altogether beyond the horizon of primitive faith, as witness the following prayer of the Khonds of Orissa: "We are ignorant of what it is good to ask for. You know what is good for us. Give it to us." (Tylor, *Prim. Culture*, 4. 369.) At this point prayer by a supreme paradox virtually extinguishes itself, since in becoming an end in itself, a means of contemplative devotion and of mystic communing with God, it ceases to have logical need for the petitionary form. Thus on the face of it there is something like a return to the self-sufficient utterance of antique religion; but, in reality, there is all the difference in the world between a suggestion directed outwardly in the fruitless attempt to conjure nature without first obeying her, and one directed towards the inner man so as to establish the peace of God within the heart.

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PRAYER, BOOK OF COMMON, the title of the official service book of the Church of England. One of the most important steps taken at the Reformation was the compilation and provision of a comprehensive service book for general and compulsory use in public worship in all cathedral and parish churches throughout the Church of England.

Apart from alterations in detail, both as to doctrine and ritual, which will be referred to later, the following main advantages were achieved from the very first and apply to all editions of the Prayer Book equally.

1. The substitution of the English language for the Latin language, which had hitherto been in universal and almost complete use, and in which all the old service books were written.

2. Unification and simplification. The number of books required for the performance of divine service in pre-Reformation days was very large; the most important being the Missal for the service of Holy Communion or the Mass; the Breviary for the daily service or performance of the divine office; the Manual for the minor sacramental offices usually performed by the parish priest; and the Pontifical, containing such services as were exclusively reserved for performance by the bishop. Many of the contents of these larger volumes were published in separate volumes known by a great variety—over one hundred—different names. The Prayer Book represents in a much condensed and abbreviated form the four chief ancient service books, viz.: the Missal, Breviary, Manual and Pontifical.

In addition to a multiplicity of books there was much variety of use. Although the Sarum Use prevailed far the most widely, yet there were separate Uses of York and Hereford, and also to a less degree of Lincoln, Bangor, Exeter, Wells, St Paul's, and probably of other dioceses and cathedral churches as well. Cranmer's preface "Concerning the Service of the Church" expressly mentions the abolition of this variety as one of the things to be achieved by a Book of Common Prayer. It says: "And whereas heretofore there hath been great diversity in saying and singing in Churches within this Realm; some following Salisbury Use, some Hereford Use, and some the Use of Bangor, some of York, some of Lincoln; now from henceforth all the whole Realm shall have but one Use."

We will next enumerate the sources from which the Prayer Book was compiled. 1. It has been already indicated that the older pre-Reformation service books formed the main quarry, especially those according to the Use of Sarum. Morning and Evening Prayer, including the psalter and the lessons, were taken from the Breviary, Matins being compiled out of Nocturns (or Matins); Lauds and Prime; and Evensong out of Vespers and Compline. The Order of Holy Communion, including the collects, epistles and gospels, was taken from the Missal. The sacramental and other offices which occupy a position in the Prayer Book between the Order of Holy Communion and the Psalms were taken from the Manual; and the services for consecration or ordering of bishops, priests and deacons were taken from the Pontifical; but in all cases not only with a change of Latin into English, but with numerous alterations, omissions and additions.

2. The reformed Latin Breviary of Cardinal Quignon, Francis de Quiñones, a Spaniard, a Franciscan and cardinal of the Holy Cross, brought out a reformed Latin breviary with papal sanction in 1535. A second and revised edition appeared in 1537. It met with considerable favour, and was adopted into use in many places, without, however, winning universal acceptance, and in 1558 papal

sanction was withdrawn and it ceased to be printed. From this reformed breviary the compilers of the Prayer Book borrowed the following. (*a*) Many passages—almost verbatim—in the preface "Concerning the Service of the Church." It would occupy too much space to print them in parallel columns here. (*b*) Making the Sunday and Holy-day services identical in structure with the week-day services. (*c*) The removal of all antiphons and responds. This refers to Quignon's first edition only. (*d*) The increased amount of Holy Scripture read. Quignon provided a first lesson from the Old Testament; a second lesson from the New Testament; and on Saints' Days a third lesson from the Lives of the Saints, though this lesson was also occasionally taken from Holy Scripture. (*e*) The prefixing to every service a form of confession and absolution. The idea, not the actual language, is borrowed by the Prayer Book. (*f*) The substitution of the Athanasian Creed for the Apostles' Creed on certain days instead of the former being an addition to the latter. So in the Prayer Book, when used, the Athanasian Creed is substituted for, not added to, the shorter creed. (*g*) The uniform assignment of three Psalms to each hour suggests the average number and arrangement of the Psalms in the Prayer Book at Matins and Evensong.

3. The Mozarabic Missal. (*a*) The four short prayers preceding the prayer for the consecration of the water in the office for the public baptism of infants are adapted from the benediction of the font in the Mozarabic Liturgy (Migne, *Pat. Lat.* tom. lxxxv. col. 465). The evidence for this borrowing is still plainer in the larger form of prayer for this purpose provided in the first book of Edward VI. The Mozarabic Liturgy was printed and published under Cardinal Ximenes in 1500, and may well have been in Cranmer's hands; whereas the *Missale gallicanum*, a Gallican Sacramentary, containing the same prayers with slight variations, was first published by Cardinal Thomesius in 1680 and must have been unknown to Cranmer. (*b*) According to F. Procter and W. H. Frere (*A New History of the Book of Common Prayer*, p. 375: London, 1902), the use of the plural number instead of the singular in the form of the opening versicles of Morning and Evening prayer is a following of Mozarabic usage. But we have been unable to verify this statement. (*c*) Many of the new collects introduced into the Prayer Book, though not transferred bodily from any Mozarabic service book, are modelled upon a Mozarabic pattern, and preserve some Mozarabic ideas and phrases, *e.g.* the references to the Second Advent in the collects for the first and third Sundays in Advent take their tone from the Mozarabic Advent services. The collect for Christmas Day is based on a collect for Christmas Day Lauds in the Mozarabic Breviary (Migne, *Pat. Lat.* tom. lxxxvi., col. 122). The collect for the first Sunday in Lent is based on a preface (Inlatio) in the Mass for the Wednesday after the fifth Sunday in Lent (ibid., tom. lxxxv., col. 382). The collect for the first Sunday after Easter is based upon an "Alia Oratio" (ibid., col. 517), and an "Oratio ad pacem" (col. 518) for the Saturday in Easter week. The collect for St Andrew's Day is based on a Missa in the Mozarabic Mass for the same festival (ibid., col. 159). Other examples might be given, but this is hardly the place for complete details. (*d*) The many addresses, beginning with "Dearly beloved brethren" ("the Scripture moveth us," &c.), introduced into most of the services in the Prayer Book, correspond to the addresses which, under the title of "Missa," and generally addressed to "fratres dilectissimi" or "carissimi," form part of every Mozarabic Mass. (*e*) The prayer of consecration in the Order of Holy Communion, especially as regards the recital of the words of institution commencing "Who in the same night," &c., follows a Mozarabic rather than the Sarum or Roman model in several respects, but the same features are found in the consecration prayer in the Brandenburg-Nürnberg agenda of 1533, and it is doubtful whether the Anglican borrowing is from a Mozarabic or a Lutheran source. Possibly both the Anglican and Lutheran formulae are derived independently from the Mozarabic; because, as we have seen, a Mozarabic missal was certainly in Cranmer's hands and studied by him.

4. Eastern Liturgies. These were certainly known to Cranmer, but it is remarkable how little he borrowed from them. (*a*) The prayer which was placed at the end of the Litany in 1549, and now stands as the last prayer but one at the end of Matins and Evensong, as well as of the Litany, was undoubtedly borrowed from the Liturgy of St Chrysostom, where, as likewise in the Liturgy of St Basil, it forms the prayer of the third antiphon after the Deacon's Litany in the Mass of the Catechumens. (*b*) The concluding prayer of Matins and Evensong, "The Grace of our Lord," &c., which was added in 1662, may have been taken from Greek liturgies. It is the opening salutation in the Mass of the Catechumens in the Clementine Liturgy, where it occurs again, as it does in the Greek Liturgies before the "Sursum corda"; though there is no evidence to prove that it was not taken directly from Holy Scripture (2 Cor. xiii. 14). (*c*) The Epiklesis or invocation of the Holy Spirit upon the elements, must have been copied from an Eastern Liturgy. It occurs in the 1549 Prayer Book, but has been omitted in all subsequent editions. It runs thus: "Hear us, O merciful Father, we beseech Thee, and with Thy holy Spirit and word vouchsafe to bl†ess and sanc†tify these Thy gifts and creatures of bread and wine, that they may be unto us the body and blood of Thy most dearly beloved Son Jesus Christ." This is not an exact translation of any known *epiklesis*, and Cranmer altered its position from after to immediately before the words of institution. (*d*) Four petitions in the Litany. "That it may please Thee to illuminate all Bishops, Priests and Deacons," &c. (altered in 1661 from all Bishops, pastors and ministers) and "That it may please Thee to give to all nations unity, peace and concord," and "That it may please Thee to succour, help and comfort all that are in danger, necessity and tribulation," and "That it may please Thee to preserve all that travel by land or by water, all women labouring of child, all sick persons, and young children, and to show Thy pity upon all prisoners and captives!" are almost certainly modelled on corresponding petitions in the Deacon's Litany in the Liturgy of St Chrysostom (ed. F. E. Brightman, p. 362, i. 35, and p. 363, lines 4, 17, 15). At least, they resemble far more closely the Greek petitions than they do any corresponding Latin petitions in the Old Sarum Litany.

5. Lutheran and other continental Protestant service books. The most considerable quantity of the new material which was imported into the Prayer Book was drawn from Lutheran and Genevan service books. The Litany, for example, in the Prayer Book is based upon the medieval Latin Litany, but great variation both in substance and language and by way of addition and omission, are made in it. These variations are largely borrowed from and closely follow the language of various Lutheran litanies, especially that given in the consultation of Archbishop Hermann of Cologne issued in 1543. Lutheran influence can likewise be traced in way of variation introduced into the baptismal and other sacramental or occasional offices. So in the Communion service the most striking departures from ancient precedent have a Protestant origin. The introduction of the Ten Commandments in 1553 seems to be derived from the order of service published by Valerandus Pollanus (Pullain) in 1551; and that of the Comfortable Words in 1549 is borrowed, though all the texts chosen are not identical, from the Consultation of Hermann. It is impossible to pursue this subject here further in detail.

6. Original compositions of the compilers of the Prayer Book, not traceable to ancient or 16th-century originals. These are not numerous. They include most of the collects on Saints' Days, for which, though no direct evidence of authorship is as yet forthcoming, Cranmer is probably responsible, and certain other collects, such as that for the Royal Family (Archbishop Whitgift); that for the high court of parliament (Archbishop Laud); that for all conditions of men (Bishop Gunning), &c.

We proceed to describe next the various stages through which the Book of Common Prayer has passed and the leading features of each revision. Of changes preceding the first Prayer Book it will only be necessary to mention here: (*a*) The compiling and publishing of the Litany in English by Cranmer in 1544. (*b*) Royal injunctions in August 1547 ordering the Epistle and Gospel to be read in English at High Mass. (*c*) A royal proclamation, dated the 8th of March 1548, imposing for use at the coming Easter *The Order of the Communion*. This was an order or form of service in English for the communion of the people in both kinds. It was to be inserted into the service after the communion of the priest, without making any other alteration in the Latin Mass. It comprised the long exhortation or notice to be given on Sunday, or on some other day, previous to the Communion, the longer exhortation, and the shorter invitation, the confession, absolution, comfortable words, prayer of humble access, formulae of administration and the concluding peace, all as they exist at present, though with variations of some importance.

The first complete vernacular Book of Common Prayer was issued in 1549. It was carried through both houses of parliament by the 21st of January 1549, by an Act of Uniformity which made its use compulsory on and after the following Whit-Sunday. The exact date of the giving of the royal assent, and the question whether this Book received the assent of Convocation, are historical points of difficulty and uncertainty which cannot be treated at length here.

Some of the chief points of difference between this and subsequent Prayer Books were the following: Matins and Evensong began with the Lord's Prayer, and ended with the third collect; there were no alternative Psalm-canticles for Benedictus, Magnificat and Nunc Dimittis; the Athanasian Creed was introduced after the Benedictus on six festivals only, and in addition to the Apostles' Creed; the Litany was placed after the Communion service, for which an alternative title was given, viz.: "commonly called the Mass." Introits were provided for use on every Sunday and Holy-Day; after the offertory intending communicants were directed to "tarry still in the quire or in some convenient place nigh the quire"; in the prayer "for the whole state of Christ's church," the blessed Virgin Mary was commemorated by name among departed saints; prayer for the departed was explicitly retained; also an invocation of the Holy Spirit before the words of institution, the prayer of oblation immediately following them. The mixed chalice was ordered to be used, and the Agnus Dei to be sung during the Communion of the people. A large selection of short scriptural post-Communions was provided. Unleavened bread was to be used and placed not in the hand but in the mouth of the communicant. The sign of the cross was to be made not only in the eucharistic consecration prayer, but also in Baptism, Confirmation, Holy Matrimony and the Visitation of the Sick. Reservation for the sick and unction of the sick were retained; and exorcism, unction, trine immersion and the chrisom were included in the baptismal service. The prayer in the burial service, as in the Communion service, contained distinct intercessions for the departed; and a form of Holy Communion was provided for use at funerals with proper introit, collect, epistle and gospel.

As to vestments, in the choir offices, the surplice only was to be used; the hood being added in cathedrals and colleges; and by all graduates when preaching, everywhere.

At Holy Communion the officiating priest was to wear "a white Albe plain with a vestment or Cope," and the assistant clergy were to wear "Albes with tunicles." Whenever a bishop was celebrant he was to wear, "beside his rochette, a surplice or albe, and a cope or vestment," and also to carry "his pastoral staff in his hand, or else borne or holden by his chaplain." The mitre was not mentioned.

The ordinal was not attached to this Prayer Book at its first appearance, but it was added under another act of parliament in the following year, 1550. It was very similar to the present ordinal except that the words "for the office and work of a Priest in the Church of God, now committed unto thee by the Imposition of our hands" were wanting, and the chalice or cup with the bread were delivered, as well as a Bible, to each newly-ordained priest.

We pass on to 1552 when a new and revised edition of the Prayer Book was introduced by an act of parliament which ordered that it should come into use on All Saints' Day (Nov. 1). The alterations made in it were many and important, and as they represent the furthest point ever reached by the Prayer Book in a Protestant direction, they deserve special mention and attention.

1. The introductory sentences, exhortation, confession and absolution were prefixed to the Order for Morning Prayer daily throughout the year and ordered to be read before Evening Prayer as well. Alternative Psalms were provided for Benedictus, Magnificat and Nunc Dimittis.

2. Numerous and most important alterations were made in the Order for Holy Communion, in the title of which the words "commonly called the Mass" were left out. (*a*) The Introits were omitted. (*b*) Gloria in excelsis was transferred from near the beginning to near the end of the service. (*c*) The ten commandments with an expanded tenfold Kyrie eleison were introduced. (*d*) The long new English canon of 1549 was split up into three parts: the first part becoming the prayer for the church militant; the second part becoming the prayer of consecration, the third part, or prayer of oblation, becoming the first post-Communion collect; the epiklesis or invocation of the Holy Ghost upon the elements was entirely omitted. (*e*) The mixed chalice, the use of the sign of the cross in the consecration prayer; the commemoration of the blessed Virgin Mary and of various classes of saints were omitted. (*f*) The Agnus Dei and the post-Communion anthems were omitted. (*g*) The words of administration in the 1549 book were abolished, viz.: "The body of our Lord Jesus Christ which was given for thee, preserve thy body and soul unto everlasting life," and "The blood of our Lord Jesus Christ which was shed for thee preserve thy body and soul unto everlasting life," and the following words were substituted: "Take and eat this in remembrance that Christ died for thee, and feed on him in thy heart by faith, with thanksgiving," and "Drink this in remembrance that Christ's blood was shed for thee, and be thankful." (*h*) A long rubric was added at the end of the service explanatory of the attitude of kneeling at the reception of Holy Communion, in which it was stated that "it is not meant hereby that any adoration is done, or ought to be done, either unto the sacramental bread and wine there bodily received, or to any real and essential presence there being of Christ's natural flesh and blood," &c. (*i*) Exorcism, unction, trine immersion and the chrisom were omitted from the baptismal service. (*k*) Unction and communion with the reserved sacrament were removed from the services for the visitation and the communion of the sick. (*l*) Prayers for the dead and provision for a celebration of Holy Communion at a funeral were removed from the burial service. (*m*) The vestments retained and ordered under the Prayer Book of 1549 were abolished by a new rubric which directed that both at the time of Communion and at all other times of ministration a bishop should wear a rochet and that a priest or deacon should have and wear a surplice only; (*n*) on the other hand, the directions as to daily service were extended to all clergy and made much stricter, (*o*) and the number of days on which the Athanasian Creed was to be used was raised from six to thirteen.

The main objects of these drastic alterations have been thought to have been two-fold.

1. To abolish all ritual for which there was not scriptural warrant. If this was their object it was not consistently or completely carried out. No scriptural warrant can be found for the use of the surplice, or for the use of the sign of the cross in baptism, both of which were retained.

2. To make the services as unlike the pre-Reformation services as possible. This object too was not fully attained; no liturgical precedent can be found for the violent dislocation of certain parts of the Order for Holy Communion, especially in the case of the prayer of oblation and of the Gloria in Excelsis; but the orders for Morning and Evening Prayer and the Holy Communion retained features of the Breviary and Missal services, the bulk of their component material being still drawn from them. While the alterations, therefore, were violent enough to alarm and offend the Catholic party, they were not violent enough to satisfy the extreme Puritan party, who would no doubt have agitated for and would probably have obtained still further reformation and revision. But this Prayer Book only lived for eight months. It came into use on All Saints' Day (Nov. 1) 1552, and on the 6th of July 1553 Edward VI. died and was succeeded by his sister Mary, under whom the Prayer Book was abolished and the old Latin services and service books resumed their place.

On the death of Queen Mary and the accession of her sister Elizabeth (Nov. 17, 1558) all was reversed, and the Book of Common Prayer was restored into use again.

The Act of Uniformity, which obtained final parliamentary authority on the 28th of April 1559, ordered that the Prayer Book should come again into use on St John the Baptist's Day (June 24, 1559). This was the second Prayer Book of King Edward VI., with the following few but important alterations, which, like all the alterations introduced at subsequent dates into the Prayer Book, were in a Catholic rather than in a Protestant direction.

1. Morning and Evening Prayer were directed to be "used in the accustomed place of the church, chapel or chancel, instead of "in such place as the people may best hear."

2. The rubric ordering the use of the rochet only by the bishop and of surplice only by a priest or deacon was abolished. The eucharistic vestments ordered in the first Prayer Book of Edward VI. were brought back by a new rubric which directed that "the minister at the time of the communion and at all other times in his ministration, shall use such vestments in the church as were in use by authority of parliament in the second year of the reign of King Edward the VI. according to the act of parliament set in the beginning of this book.

3. In the Litany the following petition found in both the

Edwardian Prayer Books was omitted "from the tyranny of the bishop of Rome and all his detestable enormities, good Lord deliver us."

4. In the Communion service the two clauses of administration found in the first and second Prayer Books of King Edward's reign were combined.

5. The rubric explanatory of "kneeling for reception," commonly known as "the Black Rubric" was omitted.

6. In the Ordinal in the rubric before the oath of the queen's sovereignty the words "against the power and authority of all foreign potentates" were substituted for "against the usurped power and authority of the Bishop of Rome," and in the oath itself four references to the bishop of Rome, by name, were omitted.

There were a few more minor alterations, without doctrinal or political significance which need not be described in detail here.

The only further addition or alteration made in Queen Elizabeth's reign was in 1561, when all the present black letter Holy Days were added to the Kalendar except St George (April 23) Lammas (Aug. 1), St Laurence (Aug. 10) and St Clement (Nov. 22), which already existed, and except St Enurchus (Sept. 7), added in 1604, and the Venerable Bede (May 27) and St Alban (June 17) added in 1662.

A smouldering and growing Puritan discontent with the Prayer Book, suppressed with a firm hand under Queen Elizabeth, burst out into a flame on the accession of King James I. in 1603. A petition called the millenary petition, because signed by no less than one thousand ministers, was soon presented to him, asking, among other things, for various alterations in the Prayer Book and specifying the alterations desired. As a result the king summoned a conference of leading Puritan divines, and of bishops and other leading Anglican divines, which met under his presidency at Hampton Court in January 1604. After both sides had been heard, certain alterations were determined upon and were ordered by royal authority, with the general assent of Convocation. These alterations were not very numerous nor of great importance, but such as they were they all went in the direction of catholicizing rather than of puritanizing the Prayer Book; the one exception being the substitution of some chapters of the canonical scriptures for some chapters of the Apocrypha, especially of the book of Tobit. Other changes were:—

1. The addition of one more black letter Saint's Day, viz.: Enurchus (by error for Evurtius) on the 7th of September. This was a small but a very extraordinary and an inexplicable change to make. The only explanation offered, which is a pure guess and seems barely possible, is that it was desired to place some mark of dignity upon a day which during the late reign had been kept with great festivity as the birthday of Queen Elizabeth.

2. The words, "The absolution to be pronounced by the minister alone" at Morning and Evening Prayer, were altered to "The Absolution, or Remission of Sins, to be pronounced by the priest alone, standing; the people still kneeling."

3. A prayer for the royal family was added after the prayer for the king, and a petition was added in the Litany to the same effect, both exhibiting slight verbal differences from the prayer and petition as used to-day.

4. Thanksgiving prayers were added for rain, for fair weather, for plenty, for peace and victory.

5. Important alterations were introduced into the service for the private baptism of children in houses, with the object of doing away with lay baptism and securing the administration by the minister of the parish, or some other lawful minister.

6. The confirmation service was entitled and explained thus: "The Order of Confirmation, or Laying on of Hands upon Children Baptized, and able to render an account of their faith according to the Catechism following."

7. The concluding portion of the Catechism, consisting of eleven questions on the sacraments, was now added.

There were other slight changes of a verbal kind, involving no doctrinal or political significance and which therefore need not be described here.

The next important stage in the history of the Prayer Book was its total suppression in 1645 for a period of fifteen years, "the Directory for the Public Worship of God in the Three Kingdoms" being established in its place. The restoration of King Charles II. in 1660 brought with it toleration at once, and soon afterwards complete restoration of the Prayer Book, but not exactly in the same form which it had before. Nonconformists pressed upon the king, either that the Prayer Book should not be re-introduced, or that if it were re-introduced, features which they objected to might be removed. The result was that a conference was held in 1661, known from its place of meeting as the Savoy Conference, the church being represented by twelve bishops and the Nonconformists by twelve eminent Presbyterian divines, each side accompanied by nine coadjutors.

The objections raised from the Nonconformist point of view were numerous and varied, but they were thoroughly discussed between the first meeting on the 15th of April and the last on the 24th of July 1661; the bishops agreeing to meet the Puritan wishes on a few minor points but on none of fundamental importance. Later in the year, between the 20th of November and the 20th of December, Convocation assembled and undertook the revision of the Prayer Book. In the earlier part of the following year the book so revised came before parliament. No amendment was made in it in either house and it finally received the royal assent on the 19th of May 1662, being annexed to an Act of Uniformity which provided for its coming into general and compulsory use on St Bartholomew's Day (Aug. 24).

The alterations thus introduced were very numerous, amounting to many hundreds, and many of them were more important than any which had been introduced into the Prayer Book since 1552. Their general tendency was distinctly in a Catholic as opposed to a Puritan direction, and the two thousand Puritan incumbents who vacated their benefices on St Bartholomew's Day rather than accept the altered Prayer Book bear eloquent testimony to that fact.

It is impossible to give here an exhaustive list of the alterations: but the following were some of the principal changes made in 1662. (*a*) The preface "It hath been the wisdom of the Church of England," &c., composed by Sanderson, bishop of Lincoln, was prefixed to the Prayer Book. (*b*) The authorized version of the Bible of 1611 was taken into use, except in the case of the Psalms, where the great Bible of 1539–1540 was retained as much smoother for singing, and in parts of the Communion service. (*c*) The rubric preceding the absolution in Morning and Evening Prayer, viz.: "The absolution to be pronounced by the minister alone," was altered into "The Absolution, or Remission of Sins, to be pronounced by the priest alone, standing; the people still kneeling." (*d*) In the Litany the phrase "Bishops, Pastors and Ministers of the Church," was altered into "Bishops, Priests and Deacons," and in the clause commencing "From all sedition and privy conspiracy," &c., the words "rebellion" and "schism" were added. (*e*) Among the "Prayers and Thanksgivings upon several occasions," were added the two Ember week prayers, the prayer for the high court of parliament, the collect or prayer for all conditions of men, the general thanksgiving, and that "For restoring Public Peace at Home." (*f*) In the Communion service two rubrics were prefixed to the prayer "for the whole state of Christ's Church militant here in earth" ordering the humble presentation and placing of the alms upon the Holy Table, and the placing thereon then of so much Bread and Wine as the priest shall think sufficient; and (*g*) the commemoration of the departed was added to the prayer itself. (*h*) The rubric explanatory of the posture of kneeling for reception, known as the Black Rubric, which had been added in 1562, but omitted in 1559 and 1604, was re-introduced; but the words "to any real and essential presence there being of Christ's natural flesh and blood" were altered to "unto any Corporal Presence of Christ's natural Flesh and Blood"—a very important and significant alteration which affected the meaning of the whole rubric. (*i*) Rubrics were also added ordering the manual acts by the priest in the prayer of consecration, and the covering of the remainder of the consecrated elements after Communion with a fair linen cloth. (*k*) A new office was added for the Ministration of Baptism to such as are of riper years. (*l*) A rubric was prefixed to the Order for the Burial of the Dead, forbidding that order to be used "for any that die unbaptized, or excommunicate, or have laid violent hands upon themselves." (*m*) In the "Ordering of Priests," and "the Consecration of Bishops," in the formula for ordination, after the words, "Receive the Holy Ghost," these words were added "for the Office and Work of a Priest (or Bishop) in the Church of God, now committed unto thee by the Imposition of our hands." (*n*) The ornaments rubric, regulating the vesture of the clergy was thrown into its present shape, referring back not to 1604 or 1559 or 1552, but to the first Prayer Book of Edward VI. in 1549 for the rule to be followed.

The above are the important alterations, among numerous others of minor significance, introduced into the Prayer Book in 1662. Their general trend is obvious. It is not in the Puritan direction, but intended to emphasize and to make more clear church doctrine and discipline, which in recent years had become obscured or decayed. No substantial alteration has been made in the Prayer Book since 1662, but two alterations must be chronicled as having obtained the sanction of the Convocations of Canterbury and York, and also legal force by act of parliament. In 1871 a new Lectionary was substituted for the previously existing one, into the merits and demerits of which it is not possible to enter here; and in 1872, by the Act of Uniformity Amendment Act, a shortened form of service was provided instead of the present form of Morning and Evening Prayer for optional use in other than cathedral churches on all days except Sunday, Christmas Day, Ash Wednesday, Good Friday and Ascension Day; provision was also statutably made for the separation of services, and for additional services, to be taken, however, except so far as anthems and hymns are concerned, entirely out of the Bible and the Book of Common Prayer.

In the year 1907 letters of business were issued by the Crown to the Convocations inviting and enabling them to make alterations in the Prayer Book (afterwards to be embodied in an act of parliament). These letters were issued in compliance with the second recommendation (1906) of the Royal Commission on Ecclesiastical Discipline, viz.: that "Letters of business should be issued to the Convocations with instructions: (*a*) to consider the preparation of a new rubric regulating the ornaments (that is to say, the vesture) of the ministers of the church, at the times of their ministrations, with a view to its enactment by parliament; and (*b*) to frame, with a view to their enactment of parliament, such modifications in the existing law relating to the conduct of Divine Service, and to the ornaments and fittings of churches as may tend to secure the greater elasticity which a reasonable recognition of the comprehensiveness of the Church of England and of its present needs seems to demand."

A few words are added in conclusion about the state services. Until the year 1859 they were four in number.

1. A Form of Prayer with Thanksgiving to be used yearly upon the Fifth Day of November, to commemorate the happy deliverance of King James I. and the Three Estates of England from the Gunpowder Plot in 1604.
2. A Form of Prayer with Fasting to be used yearly on the Thirtieth Day of January, to commemorate the Martyrdom of the Blessed King Charles the First in 1649.
3. A Form of Prayer with Thanksgiving to be used yearly on the Twenty-ninth Day of May, to commemorate the Restoration to the throne of King Charles the Second in 1660.
4. A Form of Prayer with Thanksgiving to be used yearly on the Day of the Accession of the reigning Monarch.

The first three of these services were abolished in 1859 by royal warrant—that is to say by the exercise of the same authority which had instituted them. The fourth form of service was retained in its old shape till 1901, when a new form, or rather new forms of service, having been prepared by Convocation, were authorized by royal warrant on the 9th of November. (F. E. W.)

PRAYERS FOR THE DEAD. Wherever there is a belief in the continued existence of man's personality through and after death, religion naturally concerns itself with the relations between the living and the dead. And where the idea of a future judgment obtains, prayers are often offered on their behalf to the Higher Powers. Prayers for the dead are mentioned in 2 Maccabees xii. 43–45, where the writer is uncertain whether to regard the sacrifice offered by Judas as a propitiatory sin-offering or as a memorial thank-offering, a distinction of great importance in the later history of the practice. Prayers for the dead form part of the authorized Jewish services. The form in use in England contains the following passage: "Have mercy upon him; pardon all his transgressions . . . Shelter his soul in the shadow of Thy wings. Make known to him the path of life." The only passage in the New Testament which is held to bear directly on the subject is 2 Tim. i. 18, where, however, it is not certain that Onesiphorus, for whom St Paul prayed, was dead. Outside the Bible the proof of the early use of prayers for the dead has been carried a step farther by Professor Ramsay's discoveries, for it is now impossible to doubt the genuineness of the copy (contained in the spurious acts of the saint) of the inscription on the tomb of Abercius of Hieropolis in Phrygia (see Lightfoot, *Apostolic Fathers*, pt. ii. vol. i. p. 492 sqq.). The 19th line of the inscription runs thus: "Let every friend who observeth this pray for me," *i.e.* Abercius, who throughout speaks in the first person: he died in the latter part of the 2nd century. The inscriptions in the Roman catacombs bear similar witness to the practice, by the occurrence of such phrases as "Mayst thou live among the saints" (3rd century); "May God refresh the soul of . . ."; "Peace be with them." Among Church writers Tertullian is the first to mention prayers for the dead, and that not as a concession to natural sentiment, but as a duty: "The widow who does not pray for her dead husband has as good as divorced him." This passage occurs in one of his later Montanistic writings, dating from the beginning of the 3rd century. Subsequent writers similarly make incidental mention of the practice as prevalent, but not as unlawful or even disputed (until Aerius challenged it towards the end of the 4th century). The most famous instance is St Augustine's prayer for his mother, Monica, at the end of the 9th book of his *Confessions*.

An important element in the liturgies of the various Churches consisted of the diptychs or lists of names of living and dead who were to be commemorated at the Eucharist. To be inserted in these lists was an honour, and out of the practice grew the canonization of saints; on the other hand, to be excluded was a condemnation. In the middle of the 3rd century we find Cyprian enjoining that there should be no oblation or public prayer made for a deceased layman who had broken a Church rule by appointing a cleric trustee under his will: "He ought not to be named in the priests' prayer who has done his best to detain the clergy from the altar." Although it is not possible, as a rule, to name dates for the exact words used in the ancient liturgies, yet the universal occurrence of these diptychs and of definite prayers for the dead in all parts of the Church in the 4th and 5th centuries tends to show how primitive such prayers were. The language used in the prayers for the departed is very reserved, and contains no suggestion of a place or state of pain. We may cite the following from the so-called liturgy of St James:—

> "Remember, O Lord, the God of Spirits and of all Flesh, those whom we have remembered and those whom we have not remembered, men of the true faith, from righteous Abel unto to-day; do thou thyself give them rest there in the land of the living, in thy kingdom, in the delight of Paradise, in the bosom of Abraham, Isaac and Jacob, our holy fathers, from whence pain and sorrow and sighing have fled away, where the light of thy countenance visiteth them and always shineth upon them."

Public prayers were only offered for those who were believed to have died as faithful members of Christ. But Perpetua, who was martyred in 202, believed herself to have been encouraged by a vision to pray for her brother, who had died in his eighth year, almost certainly unbaptized; and a later vision assured her that her prayer had been answered and he translated from punishment. St Augustine thought it needful to point out that the narrative was not canonical Scripture, and contended that the child had perhaps been baptized. Similarly, a medieval legend relates that Gregory the Great was so struck with the justice of the emperor Trajan, that he prayed for him, and in consequence he was admitted to Paradise (cf. Dante, *Purg.* x., *Parad.* xx.).

As time went on, further developments took place. Petitions to God that he would hear the intercessions of the departed became direct requests to them to pray (*Ora pro nobis*); and, finally, the saints were asked themselves to grant grace and help. Again, men felt difficulty in supposing that one who repented at the close of a wicked life could at once enjoy the fellowship of the saints in Paradise (St Luke xxiii. 43), and it seemed unfair that they should be made equal with those who had borne the burden and heat of the day (St Matt. xx. 12). And so the simple severance between good and bad indicated in St Luke vi. 26, became the threefold division made familiar by Dante. These speculations were further fixed by the growth of the theory of satisfaction and of Indulgences: each forgiven soul was supposed to have to endure an amount of suffering in proportion to the guilt of its sins, and the prayers and pious acts of the living availed to shorten this penance time in Purgatory (see INDULGENCES). It thus came about that prayers for the dead were regarded only as aiming at the deliverance of souls from purgatorial fires; and that application of the Eucharist seems to have overshadowed all others. The Council of Trent attempted certain reforms in the matter, with more or less success; but, broadly speaking, the system still remains in the Roman Catholic Church, and masses for the dead are a very important part of its acts of worship.

The Reformation took its rise in a righteous protest against the sale of Indulgences; and by a natural reaction the Protestants, in rejecting the Roman doctrine of Purgatory, were inclined to disuse all prayers for the dead. Important changes have been made, in the successive revisions of the Prayer Book, in the commemorations of the dead at the Eucharist and in the Burial Service.

In the Communion Service of 1549, after praise and thanks were offered for all the saints, chiefly the Blessed Virgin, came the following: "We commend into thy mercy all other thy servants, which are departed hence from us with the sign of faith and now do rest in the sleep of peace: grant unto them, we beseech thee, thy mercy and everlasting peace." The Burial Service of the same date contained explicit prayers for the deceased, and introit, collect, epistle and gospel were provided for "the Celebration of the Holy Communion when there is a Burial of the Dead." In 1552, under the influence of Bucer, all mention of the dead, whether commemorative or intercessory, was cut out of the Eucharist; the prayers in the Burial Service were brought into their present form; and the provision for Holy Communion at a Burial was omitted. The thankful commemoration of the dead in the Eucharist was restored in 1661, but prayers for them remained, if they remained at all, veiled in ambiguous phrases.

The Church of England has never forbidden prayers for the dead, however little she has used them in her public services. It was proposed in 1552 to condemn the scholastic doctrine *De precatione pro defunctis* in what is now the 22nd of the Thirty-Nine Articles, but the proposal was rejected. And these intercessions have been used in private by a long list of English divines, among whom Andrewes, Cosin, Ken, Wesley and Keble form an almost complete chain down to the present day. On the tomb of Bishop Barrow (1680) stands a request to passers-by to pray for their fellow-servant. And in a suit (1838) as to the lawfulness of an inscription, "Pray for the soul of . . .," the Court decided that "no authority or canon has been pointed out by which the practice of praying for the dead has been expressly prohibited." As Jeremy Taylor put it (*Dissuasive from Popery*, I. i. iv.), "General prayers for the dead the Church of England never did condemn by any express articles, but left it in the middle."

H. M. Luckock, *After Death* (1st ed., London, 1879); E. H. Plumptre, *The Spirits in Prison* (London, 1884). (W. O. B.)

PRAYING WHEEL, a mechanical apparatus used by the Lamaist Buddhists in Tibet and elsewhere for offering prayers. Strips of paper bearing a manifold repetition of the words "The Jewel in the Lotus, Amen," are wrapped round cylinders of all sizes—from hand-mills to wind- or water-mills. As the wheel revolves these uncoil and the prayer is considered to be offered.

PREACHING (Fr. *prêcher*, from Lat. *praedicare*, to proclaim), the proclamation of a Divine message both to those who have not heard it, and to those who, having heard it, have not accepted it, and the regular instruction of the converted in the doctrines and duties of the faith, is a distinctive though not a peculiar feature of the Christian religion. The Mahommedans exercise it freely, and it is not unknown among the Buddhists. The history of Christian preaching with which alone this article is concerned has its roots (1) in the activity of the Hebrew prophets and scribes, the former representing the broader appeal, the latter the edification of the faithful, (2) in the ministry of Jesus Christ and His apostles, where again we have both the evangelical invitation and the teaching of truth and duty. Whichever element is emphasized in preaching, the preacher is one who believes himself to be the ambassador of God, charged with a message which it is his duty to deliver.

1. *The Patristic Age, to the Death of St Augustine,* A.D. 430.—Of the first two centuries we have very little information. From the Acts of the Apostles we gather something as to the methods adopted by St Peter and St Paul, and these we may believe were more or less general. The Apostles who had known the Lord would naturally recall the facts of His life, and the story of His words and works would form a great deal of their preaching. After they had passed away and before the Christian Scriptures were canonically sifted and collected there was a gap which for us is only slenderly filled by such productions as the so-called *2nd Epistle of Clement*, really a rambling homily on repentance and confession (see CLEMENTINE LITERATURE), and by what we can imagine was the practice of men like Ignatius and, on the other hand, the Apologists. Most of these were primarily writers, but Justin Martyr has left a reputation for speaking, especially in debate, as well. Some of the writings of Tertullian (*c.* 200), *e.g.* those on *Patience* and *Penitence*, read as though they had been spoken, and it is hard to believe that this brilliant rhetorician did not consecrate his powers of address to his new faith. Cyprian (d. 258), too, was a finished speaker; his *Epistle to Donatus* emphasizes the need of a simple and undecorated style in the proclamation of the gospel. None of his sermons, however, unless we regard his book on the Lord's Prayer as a homily, has come down to us.

By this time the canon of New Testament Scripture was fairly settled, and with Origen (d. 254) we find the beginning of preaching as an explanation and application of definite texts. Origen was pre-eminently a teacher, and the didactic side of preaching is thus more conspicuous in his work. When we allow for his excessive use of the allegorical method, there is still left a great deal of power and suggestiveness. In his hands, as may be seen from the 19 homilies on Jeremiah that have been preserved in the Greek (and others in the Latin of Rufinus), the crude homily of his predecessors began to take a more dignified, orderly and impressive form. Alongside Origen we may rank Hippolytus of Rome on the strength of the one sermon of his which is extant, a panegyric on baptism based on the theophany which marked the baptism of Jesus.

The 4th century marks the culmination of early Christian preaching. The imperial patronage had made education and social distinctions a greater possibility for the preacher, and the decline of political eloquence furnished an opening for pulpit oratory. The didactic element was no longer in sole possession of the field, for the inrush of multitudes to the Christian faith and the building of large churches necessitated a return to the evangelical or proclamatory type of sermon. It was the age of doctrinal controversy, and the intellectual presentation of the Christian position was thus sharpened and developed. The Antiochene school had set a worthy example of careful exegesis of scripture. It was in the East especially that preaching flourished: Eusebius of Caesarea, Eusebius of Emesa, Athanasius, Macarius, Cyril of Jerusalem, Ephraem Syrus among the orthodox; and of the Arians, Arius himself and Ulfilas the great Gothic missionary, are all of high quality; but above even these stand out the three Cappadocians, Basil (*q.v.*) of Caesarea, cultured, devout and practical; his brother Gregory (*q.v.*) of Nyssa, more inclined to the speculative and metaphysical, and Gregory (*q.v.*) of Nazianzus, richly endowed with poetic and oratorial gifts, the finest preacher of the three. At the apex of the pyramid stands John of Antioch, Chrysostom (*q.v.*), who in 387, at the age of 40, began his 12 years' ministry in his native city and in 399, the six memorable years in Constantinople, where he loved the poor, withstood tyranny and preached with amazing power. His sermons, says Dr E. C. Dargan, "show the native oratorical instinct highly trained by study and practice, a careful and sensible (not greatly allegorical) interpretation of Scripture, a deep concern for the spiritual welfare of his charge, and a thorough consecration to his work. His style is impetuous, rich, torrential at times; his thought is practical and imaginative rather than deeply philosophical. His knowledge of human nature is keen and ample, and his sermons are a remarkable reflection of the manners and customs of his age. His ethical appeal is constant and stimulating."

In the West the allegorical method of Alexander had more influence than the historical exegesis of Antioch. This is seen in Ambrose of Milan, with whom may be named Hilary of Poitiers and Gaudentius of Brescia, the friend of Chrysostom, and a link between him and Ambrose. But the only name of first rank in preaching is that of Augustine, and even he is curiously unequal. His fondness for the allegorical and his manifest carelessness of preparation disappoint as often as his profundity, his devout mysticisms, his practical application attract and satisfy. Augustine's *De doctrina Christiana*, bk. iv., is the first attempt to formulate the principles of homiletics.

2. *The Early Middle Ages, 430–1100.*—After the days of Chrysostom and Augustine there was a great decline of preaching. With the poor exceptions of one or two names like those of Theodore of Mopsuestia and John of Damascus, the Eastern Church produced no preachers of distinction. The causes of the ebb were both internal and external. Within the Church there was a departure from the great experimental truths of the Gospel, their place being taken by the preaching of nature and morality on a theistic basis. To this we may add a fantastic and absurd allegorization, the indiscriminate laudation of saints and martyrs, polemical strife, the hardening of the doctrine into dogma, the development of a narrow ecclesiasticism, and the failure of the missionary spirit in the orthodox section of the Eastern Church (as contrasted with the marvellous evangelistic activity of the Nestorians (*q.v.*). Outside the Church the break-up of old civilizations, the confused beginnings of medieval kingdoms, with the attendant war and rapine, the inroads of the Saracens and the rise of Islam, were all effective silencers of the pulpit. Yet the night was not without its stars; at Rome Leo the Great and Gregory the Great could preach, and the missionaries Patrick, Columba, Columbanus, Augustine, Wilfrid, Willibrord, Gall and Boniface are known by their fruits. The homilies of Beda are marked by a tender devoutness, and here and there rise to glowing eloquence. In the 8th century Charlemagne, through the *Capitularies*, tried in vain to galvanize preaching; such specimens as we have show the sermons of the times to be marked by superstition, ignorance, formality and plagiarism. It was the age when the papacy was growing out of the ruins of the old Roman Empire, and the best talents were devoted to the organization of ecclesiasticism rather than to the preaching of the Word. Liturgies were taking shape, penance was deemed of more importance than repentance, and there was more insistence on discipline than on Christian morality. Towards the end of the period we note the beginnings of the triple division of medieval preaching into cloistral, parochial and missionary or popular preaching, a division based at first on audiences rather than on subject-matter, the general character of which—legends and popular stories rather than exposition of Scripture—was much the same everywhere. About this time, no doubt, some preachers began to use the vernacular, though no examples of such a practice have been preserved. There are few great names in the 9th, 10th and 11th centuries: Anselm was a great Churchman, but no great preacher; perhaps the most worthy of mention is Anskar, the missionary to the Scandinavians. Rabanus Maurus published an adaptation of Augustine's *De doctrina Christiana*, bk. iv. But certain forces were at work which were destined to bring about a great revival, viz. the rise of the scholastic theology, the reforms of Pope Hildebrand, and the preaching of the First Crusade by Pope Urban II. (d. 1099) and Peter the Hermit.

3. *The Later Medieval Age, 1100–1500.*—In the 12th century the significant feature is the growing use of the various national languages in competition with the hitherto universal Latin. The most eminent preacher of the century was Bernard of Clairvaux (1091–1153), esteemed alike by gentle and simple, and summing up the popular scholastic and mystical types of preaching. His homilies, though tediously minute, still breathe a charm and power (see Bernard, St).

Alongside Bernard may be placed the two mystics of St Victor, Hugo and Richard, and a little later Peter Waldo of Lyons, who, like Henry of Lausanne, preached a plain message to the poor and lowly. The 13th century saw the culmination of medieval preaching, especially in the rise of the two great mendicant orders of Francis and Dominic. Representative Franciscan names are Antony of Padua (d. 1231), who travelled and preached through southern Europe; Berthold of Regensburg (d. 1272), who, with his wit and pathos, imagination and insight, drew huge crowds all over Germany, as in homeliest vernacular he denounced sin with all the severity of a John the Baptist; and Francis Bonaventura, the schoolman and mystic, who wrote a little book on *The Art of Preaching*. Of the Dominicans Thomas Aquinas (d. 1274), the theologian, was perhaps also the greatest preacher. With the 14th century a new note, that of reformation, is struck; but on the whole there was a drop from the high level of the 13th. In Italy Bernardino of Siena on the scholastic side, Robert of Lecce and Gabriel Barletta on the popular, are the chief names; in Germany these phases are represented by John Gritsch and John Geiler of Kaiserburg respectively. Among the popular preachers vigour was often blended with coarseness and vulgarity. Mysticism is represented by Suso, Meister Eckhart, above all Johann Tauler (*q.v.*) of Strassburg (d. 1461), a true prophet in an age of degeneration. Towards the close of the century comes John Wycliffe (*q.v.*) and his English travelling preachers, who passed the torch to Hus and the Bohemians, and in the next age Savonarola, who was to Florence what Jeremiah had been to Jerusalem.

4. *The Reformation Period, 1500–1700.*—It is here that the story of modern preaching may be said to begin. The Reformers gave the sermon a higher place in the ordinary service than it had previously held, and they laid special stress upon the interpretation and application of Scripture. The controversy with Rome, and the appeal to the reason and conscience of the individual, together with the spread of the New Learning, gave preaching a new force and influence which reacted upon the old faith, as John Wild (d. 1554), one of the best Roman Catholic preachers of the day, a man noted for his "emphasis on Scripture, his grasp of evangelical truth, his earnest piety, amiable character and sustained power in the pulpit," fully admitted. Other famous preachers on the same side were the Spaniards Luiz of Granada and Thomas of Villanova, the Italians Cornelio Musso, Egidio of Viterbo and Carlo Borromeo, and the German Peter Canisius. Among the Reformers were, of course, Martin Luther and most of his German collaborators; the Swiss Zwingli, Bullinger, Farel and Calvin; the English Latimer, John Bradford, John Jewel; the Scot John Knox. Nor can even so cursory a sketch omit to mention Bernardino Ochino and the Anabaptist Hübmaier. In all these cases fuller details will be found in the articles bearing their names. Most of the Reformation preachers read their sermons, in contrast to the practice of earlier ages. The English Book of Homilies was compiled because competent preachers were comparatively rare.

The 17th-century preaching was, generally speaking, a continuation of that of the 16th century, the pattern having been set by the Council of Trent and by the principles and practice of the Reformers. In Spain and Germany, however, there was a decline of power, in marked contrast to the vigour manifested in France and England. In France, indeed, the Catholic pulpit now came to its perfection, stimulated, no doubt, by the toleration accorded to the Huguenots up to 1685 and by the patronage of Louis XIV. The names of Bossuet, Fléchier, Bourdaloue, Fénelon and Massillon, all supreme preachers, despite a certain artificial pompousness, belong here, and on the reformed side are Jean Claude (d. 1687), author of the *Essay on the Sermon*, and Jacques Saurin (d. 1730). In England the rivalry was not between Catholic and Reformer, but between Anglican and Nonconformist, or, if we may use the wide but less correct term, Puritan. On the one hand are Andrewes, Hall, Chillingworth, Jeremy Taylor, Barrow and South; on the other Baxter, Calamy, the Goodwins, Howe, Owen, Bunyan, in each case but a few names out of many. The sermons of these men were largely scriptural, the cardinal evangelical truths being emphasized with reality and vigour, but with a tendency to abstract theology rather than concrete religion. The danger was felt by the university of Cambridge, which in 1674 passed a statute forbidding its preachers to read their sermons.

Germany, harassed by the Thirty Years' War and deadened by a rigid Lutheranism, can show little besides Andrea and Johann Arndt until the coming of the Pietists (see PIETISM), A. H. Francke and Philipp Spencer, with Paul Gerhardt and his cousin Johann. The early years of the 18th century were a time of deadness as regards preaching. The Illumination in Germany and Deism in England were largely responsible for this, though the names of J. A. Bengel (better known as a commentator), Zinzendorf, Butler and the Erskines helped to redeem the time from the reproach of being the dark age of Protestantism. In the Roman Catholic Church the greatest force was Bridaine in France, a popular preacher of high worth. But, generally speaking, there was no heart in preaching, sermons were unimpassioned, stilted and formal presentations of ethics and apologetics, seldom delivered extempore.

5. *The Modern Period* may be said to begin in 1738, the year in which John Wesley began his memorable work. Preaching once more was based on the Bible, which was expounded with force and earnestness, and though throughout the century there remained a good many pulpiteers who produced nothing but solemn fudge, the example and stimulus given by Wesley and Whitefield were almost immeasurably productive. Whitefield was the greater orator, Wesley the better thinker; but, diverse in temperament as they were, they alike laid emphasis on open-air preaching. In their train came the great field preachers of Wales, like John Elias and Christmas Evans, and later the Primitive Methodists, who by their camp meetings and itinerancies kept religious enthusiasm alive when Wesleyan Methodism was in peril of hardening. Meanwhile, in America the Puritan tradition, adapted to the new conditions, is represented by Cotton Mather, and later by Jonathan Edwards, the greatest preacher of his time and country. Whitefield's visits raised a band of pioneer preachers, cultured and uncultured, men who knew their Bibles but often interpreted them awry.

In the early 19th century the pulpit had a great power, especially in Wales, where it was the vehicle of almost every kind of knowledge. And it may be doubted whether, all in all, preaching has ever reached so uniformly high a level or been so powerful a force as during the 19th century, and this in spite of other forces similarly making for enlightenment and morality. It shared to the full in all the quickening that transformed so many departments of civilization during that epoch, and has been specially influenced by the missionary enterprise, the discoveries of science, the fuller knowledge of the Bible, the awakened zeal for social service. Modern preaching, like ancient preaching, has been so varied, depending, as it so largely does, on the personality of the preacher, that it is not possible to speak of its characteristics. Nor can one do more than enumerate a few outstanding modern names, exclusive of living preachers. In the Roman Catholic Church are the Italians Ventura and Curci, the Germans Diepenbrock and Foerster, the French Lacordaire, Dupanloup, Loyson (Père Hyacinthe) and Henri Didon. Of Protestants, Germany produced Schleiermacher, Claus Harms, Tholuck and F. W. Krummacher; France, Vinet and the Monods. In England representative Anglican preachers were Newman (whose best preaching preceded his obedience to Rome), T. Arnold, F. W. Robertson, Liddon, Farrar, Magee; of Free Churchmen, T. Binney, Thomas Jones, R. W. Dale and Joseph Parker (Congregationalist); Robert Hall, C. H. Spurgeon and Alexander Maclaren (Baptists); W. M. Punshon, Hugh Price Hughes and Peter Mackenzie (Wesleyan); James Martineau (Unitarian). The Scottish Churches gave Edward Irving, Thos. Chalmers, R. S. Candlish, R. M. McCheyne and John Caird. In America, honoured names are those of W. E. Channing, Henry Ward Beecher, Horace Bushnell, Phillips Brooks, to mention only a few.

See J. M. Neale, *Medieval Preachers and Preaching* (1857); R. Rothe, *Geschichte der Predigt vom Anfang bis auf Schleiermacher* (1881); J. P. Mahaffy, *Decay of Modern Preaching* (1882); E. C. Durgan, *A History of Preaching* (1906), and preface to *The Pulpit Encyclopaedia*, vol. i. (1909); and the various volumes of the Yale Lectures on Preaching. Also SERMON. (A. J. G.)

PREAMBLE (Med. Lat. *praeambulum*, from *praeambulare*, to walk before), an introductory statement, a preliminary explanation. The term is particularly applied to the opening paragraph of a statute which summarizes the intention of the legislature in passing the measure; thus the preamble of the statute, of which the title is the Children Act 1908, is as follows: "An Act to consolidate and amend the Law relating to the Protection of Children and Young Persons, Reformatory and Industrial Schools and Juvenile Offenders, and otherwise to amend the Law with respect to Children and Young Persons." The procedure in the British parliament differs in regard to the preambles of public and private bills. The second reading of a public bill affirms the principle, and therefore in committee the preamble stands postponed till after the consideration of the clauses, when it is considered in reference to those clauses as amended and altered if need be (Standing Order 35). On the other hand, the preamble of a private bill, if opposed, is considered first in committee, and counsel for the bill deals with the expediency of the bill, calls witnesses for the allegation in the preamble, and petitions against the bill are then heard; if the preamble is negatived the bill is dropped, if affirmed it is gone through clause by clause. On unopposed private bills the preamble has also to be proved, more especially with regard to whether the clauses required by the standing orders are inserted (see May, *Parliamentary Practice*, 1906, pp. 483, 808 seq.).

PREANGER, a residency of the island of Java, Dutch East Indies, bounded S. by the Indian Ocean, W. by Bantam, N. by Batavia and Krawang, and N.E. and E. by Cheribon and Banyumas. It is officially termed the Preanger Regencies, of which there are five, covering the several administrative divisions. It also includes the small island of Nusa Were. The natives are Sudanese. The whole residency is mountainous, but there are two main parallel ranges of peaks along the northern boundary and through the middle. Among these are to be found a singularly large number of both active and inactive volcanoes, including the well-known Salak and Gede in the north, and bunched together at the eastern end the Chikorai, Papandayan, Wayang, Malabar, Guntur, &c., ranging from 6000 to 10,000 ft. in height. The rivers of the province belong to the basins of the Indian Ocean and the Java Sea respectively, the water-parting being formed by the western and eastern ends respectively of the northern and southern lines of mountain peaks. The two which drain the largest basin are the Chi Manuk and the Chi Tarum, both rising in the eastern end of the province and flowing north-east and north-west respectively to the Java Sea. The Chi Tandui, also rising here, flows south-east to the Indian Ocean, and alone of all the rivers in this province is navigable. Large stretches of marsh occur on each side of this river, as well as here and there among the hills where inland lakes formerly existed, as, for instance, near Bandung. Crater lakes are Telaga (lake) Budas, in the crater of the volcano of the same name in the south-east, and Telaga Warna, on the slopes of the Gede, famous for its beautiful tinting. On the same side of the Gede is the health resort of Sindanglaya (founded 1850–1860), with a mineral spring containing salt, and close by is the country residence of Chipanas, belonging to the governor-general.

Numerous warm springs are scattered about this volcanic region. Petroleum and coal have been worked, and there is a rich yield of chalk, while a good quality of bricks is made from the red clay. The soil is in general very fertile, the principal products being rice, maize and pulse (*kachang*) in the lower grounds, and cinchona, coffee and tea, as well as cocoa, tobacco and fibrous plants in the hills. The coffee cultivation has, however, considerably diminished. Forest culture, mat-making, weaving and fish-breeding are also practised, the last-named in the marshes after the rice harvest. The plantations are almost entirely owned by the government and Europeans, but the rice mills are in the hands of Chinese. Irrigation works have been carried out in various parts. The principal towns are Bandung, the capital of the residency, Sukabumi, Chianjar, Sumedang, Chichalengka, Garut, Tasik Malaya and Manon Jaya, all with the exception of Sumedang connected by railway.

PREBENDARY (Lat. *praebendo* = give or grant, through Low Lat. *praebenda*), one who holds a prebend, namely an endowment in land, or pension in money, given to a cathedral or conventual church *in praebendam*—that is, for the maintenance of a secular priest or regular canon. In the early Church the title had a more general signification. The word *praebenda* originally signified the daily rations given to soldiers, whence it passed to indicate daily distributions of food and drink to monks, canons, &c. It became a frequent custom to grant such a prebend from the resources of a monastery to certain poor people or to the founder. Such persons were, literally, *prebendaries*. At a later date, when the custom in collegiate churches of living in common had become less general, a certain amount of the church revenue was divided among the clergy serving such a church, and each portion (no longer of meat or drink only) was called a *prebend*. The clergy of such churches were generally canons, and the titles *canon* and *prebendary* were, and are, sometimes used as synonymous. A member of such a college is a canon in virtue of the spiritual duties which he has to perform, and the assignation to him of a stall in choir and a place in chapter; he is a prebendary in virtue of his benefice. In the Roman Catholic Church the duties of a prebendary as such generally consist in his attendance at choral office in his church. In the Anglican Church he usually bears his part in the conducting of the ordinary church services, except when he has a vicar, as in the old cathedral foundations (see CATHEDRAL). A prebendary may be either simple or a dignitary. In the former case he has no cure and no more than his revenue for his support; in the latter he has always a jurisdiction annexed. In the Anglican Church the bishop is of common right patron of all prebends, and if a prebend is in the gift of a lay patron he must present his candidate to the bishop who institutes as to other benefices. No person may hold more than one prebend in the same church; therefore, if a prebendary accepts a deanery in his church his prebend becomes void by cession. A prebend is practically a sinecure, and the holder has no cure of souls as such. He may, and often does, accept a parochial office or chaplaincy in addition.

In the middle ages there were many less regular kinds of prebends: *e.g. praebenda doctoralis*, with which teaching duties were connected, *praebenda lectoralis*, *praebenda missae*, to which the duty of saying a certain number of masses was attached, *praebenda mortuaria*, founded for the saying of masses for the dead. Chantries belonged to this class. All these prebends were generally assigned to special holders, but there were also *praebendae currentes*, which were not held by any persons in particular. Sometimes prebends were held by boys who sang in choir, *praebendae pueriles*. Occasionally the name of prebendary was applied to those servants in a monastery who attended to the food. In England the word *prebendary* was sometimes used as synonymous with *prebend*, as *prebend* was occasionally used for *prebendary*.

Du Cange, *Glossarium mediae et infimae latinitatis*, ed. L. Favre (Niort, 1883, &c.); Migne, *Encyclopédie théologique*, 1st series, vol. x. (s. Droit Canon); Sir R. J. Phillimore, *Ecclesiastical Law of the Church of England* (2nd ed., 1895). (E. O'N.)

PRE-CAMBRIAN, in geology, the enormously long and indistinctly defined period of time anterior to the Cambrian period. In the restricted sense in which it is now often employed it embraces a period or group of periods subsequent to the Archean (*q.v.*) and anterior to the Cambrian, although some writers still prefer to include the former. The superior limit of pre-Cambrian rocks is fixed by the *Olenellus* fauna at the base of the Cambrian (some geologists speak of certain pre-Olenellus beds as *eo-Cambrian*); the lower limit has ~~not~~ yet been generally established, though it is sufficiently clear in certain regions. The rocks of this period are much more obviously of sedimentary origin than those of the Archean; they include conglomerates, sandstones, greywackes, quartzites, slates, limestones and dolomites, which appear to have been formed under conditions similar to those which obtained in later epochs. Although the sediments prevail, they are often very highly metamorphosed and distorted by crustal movements; igneous rocks occur in great bulk in some regions. Fossils are usually extremely rare and very ill-preserved; but indications of protozoa, coelenterates, echinoderms, molluscoids, mollusca, worms and arthropods have been distinguished. The name pre-Cambrian is the equivalent of the "Algonkian" of the United States Geological Survey, and of the "Proterozoic" of other American authorities; the terms eozoic, archaeozoic, agnotozoic, cryptozoic, eparchaic and others have also been applied to the same period.

Three or more great stratigraphical breaks have been recognized within the system of pre-Cambrian rocks; but how far these breaks synchronize in widely separated regions where they are found is difficult to determine in the absence of good palaeontological evidence.

The most striking development of pre-Cambrian rocks in Great Britain is the Torridonian (*q.v.*) group of the north-west highlands of Scotland, which lies with strong unconformability between the Lewisian gneiss and the basal quartzite of the Cambrian. The Eastern or Dalradian (*q.v.*) schists of Scotland and their equivalents in Ireland and Anglesey may be, in part at least, of the same age. In Shropshire, in the neighbourhood of the Welsh border, is the remnant of an ancient ridge now forming the Longmynd and the smaller hills to the west, Caer Caradoc, the Wrekin, and the Cardington Hills. The latter are built mainly of much altered porphyries and tuffs which C. Callaway named the Uriconian series; this series is clearly of pre-Cambrian age. The great mass of grits, flags and slates forming the Longmynd cannot yet be definitely assigned to this period, though they may be provisionally retained here under Callaway's name, Londmyndian. Probably contemporaneous with the Uriconian are the volcanic series of Barnt Green, Licky Hill and Caldecote. The micaceous schists of Rushton (Salop) may be placed here. In the Charnwood Forest a group of crystalline rocks, named Charnian by W. W. Watts, rises up in the form of small hills amid the surrounding Trias; they are classed as follows in descending order: The Brand series, including the slates of Swithland and Groby, quartzite and conglomerate and purple and green beds; the Maplewell series, including the olive hornstones of Bradgate, the Woodhouse beds, the slate-agglomerate of Roecliffe, the Beacon Hill hornstones and a felspathic agglomerate; and the Blackbrook series of grits and hornstones. The ancient volcanic rocks of St Davids, Pembrokeshire, were formerly regarded by H. Hicks as of pre-Cambrian age, in which he recognized a lower, "Dimetian," a middle, "Arvonian," and an upper, "Pebidian," series. The pre-Cambrian age of these rocks was for a long time disputed, but J. F. N. Green (*Q. J. Geol. Soc.*, 1908, 64, p. 363) made it clear that there is an Upper Pebidian (Rhyolitic group), and a Lower Pebidian (Trachytic group), and that Hicks's "Dimetian," the St Davids granophyre, is a laccolitic mass intrusive in the Pebidian. Both the Pebidian volcanic rocks and the intruded granophyre are separated from the Cambrian by an unconformity.

In Finno-Scandinavia pre-Cambrian rocks are well developed. In the Scandinavian mountain ranges are the Seve and Sparagmite formations; the latter, a coarse-grained felspathic sandstone, is very similar to the Torridonian of Scotland; it occurs also in Enontekis in Finland. Next in descending order come the Jotnian sandstones (2000 metres), which retain ripple-marks; they are associated with conglomerates and slates and intrusive diabase and the Rapakiwi granite. The Jotnian group rests unconformably upon the Jatulian quartzites and schists, with slates, dolomite and carbonaceous beds (north of Lake Onega is a bed of anthracite 2 metres thick). Outflows of diabase and gabbro occur in this series, which is from 1600 to 2000 metres in thickness. Below the Jatulian is another group of schistose sediments, the Kalevian, more strongly folded than the former and separated from the groups above and below by unconformable junctions. These rocks are regarded by J. J. Sederholm as older than the Huronian of North America (possibly analogous to the Keewatin formation), and yet several groups of sediments in this region (Botnian schists, &c.) lie between the Kalevian series and the granitic (Archean) complex.

Pre-Cambrian rocks occupy large areas and attain an enormous thickness in North America; all types of sediment are represented in various stages of metamorphism, and with these are igneous rocks, often developed upon a vast scale. They have been subdivided into the following groups or formations: an upper Keweenawan and a lower Huronian group; the latter is subdivided into an upper Animikean (north-east Minnesota) or Penokean (north-west Wisconsin); a middle and a lower division. Each of these four groups is separated by marked unconformity from the rocks above and below. Huronian rocks are well developed in the following districts: the Marquette region of northern Michigan, comprising quartzites, slates and conglomerates, with important iron-bearing slates and schists and ferruginous cherts; in the Menominee district of Michigan and Wisconsin similar rocks occur; the Penokee-Gogebic district of Wisconsin and Michigan comprises quartzites, shales and limestones, with beds and dikes of diabase and olivine-gabbro; the same rocks occur in the Crystal Falls, north Michigan; the Mesabi and Vermilion districts, Minnesota, and north of Lake Michigan rock groups of this age take an important place. The valuable iron ores of Mesabi, Penokee-Gogebic and Menominee belong mainly to the Animikean group; in the Penokee rocks of this age vast thicknesses of igneous rocks constitute the greater part of the formation. The Keweenawan rocks are said to attain the enormous thickness of 50,000 ft.; the higher beds are mainly sandy sediments and conglomerates; in the lower portions are great igneous masses, gabbros, diabase and porphyries; thus in the St Croix valley, north-west Wisconsin and Minnesota, no fewer than 65 lava flows and 5 conglomeratic beds have been counted, which together aggregate some 20,000 ft. in thickness. Some of these lava flows appear to have been due to fissure eruptions. The native copper deposits of this age in north Michigan are the most extensive known.

Pre-Cambrian rocks occupy large areas and reach great thicknesses in the eastern provinces of Canada; in Newfoundland 10,000 ft. of strata lie between the Archean and Cambrian (the Terranovian series of South Hunt; Avalon group of others); similar rocks occur also north of the Great Lakes and in the Hudson Bay region. They are found also in great force in the Colorado Canyon, in the Adirondack Mountains, and Black Hills of S. Dakota and elsewhere.

Turning to Europe, we find pre-Cambrian rocks in Brittany, the "phyllades de Saint Lô," or Briovérian of Chas. Barrois; and along the western border of France and south-west of the central *massif*. In the Fichtelgebirge, the Silesian mountains and east Thuringia similar rocks occur; the Przibramer Schiefer of Lipold and rocks in J. Barrande's stage A are of this age. Probably the metamorphosed eruptive rocks on the southern border of the Hunsrück and Taunus are pre-Cambrian. Large tracts of metamorphic sedimentary rocks that may be classed here are found in Shantung and north China, and probably also in Brazil, India and Australia. In South Africa the gold-bearing Witwatersrand beds of the Transvaal and the overlying Ventersdorp and Potchefstroom systems; the Griqualand system and Cango and Ibeques systems of Cape Colony, all occur above Archean rocks and below those of Devonian age; they cannot as yet, therefore, be classed as pre-Cambrian and their age is still uncertain.

Little can be said of the climatic conditions of this remote period, the fossil evidence being so poor; but it is of interest to note that in certain regions, viz. in the Lake Huron region, in the Gaisa series of Varanger Fjord, Norway, and in the Yangtse district in China, conglomerate beds are found in which many of the boulders are scratched like those of the Dwyka beds of South Africa, and thus suggest the possibility of glacial conditions at some stages of the period.

For literature see *Geological Literature added to the Geological Society's Library* (annual). (J. A. H.)

PRECARIOUS, literally, held on the good-will of another, or on entreaty (Lat. *prex*, *precis*, prayer) to another. The word is used, in law, of a tenure of land, office, &c., held at the pleasure of another. In general usage it has the significance of something uncertain, dangerous or risky.

PRECEDENCE (from Lat. *praecedere*, to go before, precede). This word in the sense in which it is here employed means priority of place, or superiority of rank, in the conventional system of arrangement under which the more eminent and dignified orders of the community are classified on occasions of public ceremony and in the intercourse of private life. In the United Kingdom there is no complete and comprehensive code whereby the scheme of social gradation has been defined and settled, once and for all, on a sure and lasting foundation. The principles and rules at present controlling it have been formulated at different periods and have been derived from various sources. The Crown is the fountain of honour, and it is its undoubted prerogative to confer on any of its subjects, in any part of its dominions, such titles and distinctions and such rank and place as to it may seem meet and convenient. Its discretion in this respect is altogether unbounded at common law, and is limited in those cases only wherein it has been submitted to restraint by act of parliament. In the old time all questions of precedence came in the ordinary course of things within the jurisdiction of the court of chivalry, in which the lord high constable and earl marshal presided as judges, and of which the kings of arms, heralds and pursuivants were the assessors and executive officers. When, however, points of unusual moment and magnitude happened to be brought into controversy, they were occasionally considered and decided by the sovereign in person, or by a special commission, or by the privy council, or even by the parliament itself. But it was not until towards the middle of the 16th century that precedence was made the subject of any legislation in the proper meaning of the term.[1]

In 1539 an act "for the placing of the Lords in Parliament" (31 Hen. VIII. c. 10) was passed at the instance of the king, and by it the relative rank of the members of the royal family, of the great officers of state and the household, and of the hierarchy and the peerage was definitely and definitively ascertained. In 1563 an act "for declaring the authority of the Lord Keeper of the Great Seal and the Lord Chancellor to be the same" (5 Eliz. c. 18) also declared their precedence to be the same. Questions concerning the precedence of peers are mentioned in the Lords Journals 4 & 5 Ph. and M. and 39 Eliz., but in the reign of James I. such questions were often referred to the commissioners for executing the office of earl marshal. In the reign of Charles I. the House of Lords considered several questions of precedency and objected in the earl of Banbury's case to warrants overruling the statute of 31 Hen. VIII. In 1689 an act "for enabling Lords Commissioners of the Great Seal to execute the office of Lord Chancellor or Lord Keeper" (1 Will. and Mary c. 21) gave to the commissioners not being peers of the realm place next to the speaker of the House of Commons and to the speaker place next to the peers of the realm. In 1707 the Act of Union with Scotland (6 Anne c. 11) provided that all peers of Scotland should be peers of Great Britain[2] and should have rank immediately after the peers of the like degrees in England at the time of the union and before all peers of Great Britain of the like degrees created after the union. In 1800 the Act of Union with Ireland (39 & 40 Geo. III. c. 67) provided that the lords spiritual of Ireland should have rank immediately after the lords spiritual of the same degree in Great Britain, and that the lords temporal of Ireland should have rank immediately after the lords temporal of the same degree in Great Britain at the time of the union, and further that "peerages of Ireland created after the union should have precedence with peerages of the United Kingdom created after the union according to the dates of their creation." At different times too during the current century several statutes have been passed for the reform and extension of the judicial organization which have very materially affected the precedence of the judges, more especially the Judicature Act of 1873 (36 & 37 Vict. c. 66), under which the lords justices of appeal and the justices of the High Court now receive their appointments. But the statute of Henry VIII. "for the placing of the Lords" still remains the only legislative measure in which it has been attempted to deal directly and systematically with any large and important section of the scale of general precedence; and the law, so far as it relates to the ranking of the sovereign's immediate kindred whether lineal or collateral, the principal ministers of the Crown and court, and both the spiritual and temporal members of the House of Lords, is to all practical intents and purposes what it was made by that statute nearly 350 years ago. Where no act of parliament applies precedence is determined either by the will and pleasure of the sovereign or by what is accepted as "ancient usage and established custom." Of the sovereign's will and pleasure the appropriate method of announcement is by warrant under the sign-manual, or letters patent under the great seal. But, although the Crown has at all periods very frequently conceded special privileges of rank and place to particular persons, its interference with the scale of general precedence has been rare and exceptional. In 1540 it was provided by warrant from Henry VIII. that certain officers of the household therein named should precede the secretaries of state when and if they were under the degree of barons.[1] In 1612 James I. directed by letters patent, not without long and elaborate argument in the Star Chamber, that baronets, then newly created, should be ranked after the younger sons of viscounts and barons, and that a number of political and judicial functionaries should be ranked between knights of the Garter and such knights bannerets as should be made by the sovereign in person "under his standard displayed in an army royal in open war."[2] Four years later he further directed, also by letters patent, that the sons of baronets and their wives and the daughters of baronets should be placed before the sons of knights and their wives and the daughters of knights "of what degree or order soever."[3] And again in 1620 the same king commanded by warrant "after solemn argument before his majesty" that the younger sons of earls should precede knights of the privy council and knights of the Garter not being "barons or of a higher degree."[4] If we add to these ordinances the provisions relating to precedence contained in the statutes of several of the orders of knighthood which since then have been instituted or reconstructed, we shall nearly, if not quite, exhaust the catalogue of the interpositions of the sovereign with regard to the rank and place of classes as distinguished from individuals. Of "ancient usage and established custom" the records of the College of Arms furnish the fullest and most trustworthy evidence. Among them in particular there is a collection of early tables of precedence which were published by authority at intervals from the end of the 14th to the end of the 15th century, and to which peculiar weight has been attached by many successive generations of heralds. On them, indeed, as illustrative of and supplementary to the action of parliament and the Crown, all subsequent tables of precedence have been in great measure founded. The oldest is the "Order of All Estates of Nobles and Gentry," prepared apparently for the coronation of Henry IV. in 1399, under the supervision of Ralph Nevill, earl of Westmorland and earl marshal; and the next is the "Order of All States of Worship and Gentry," prepared, as announced in the heading, for the coronation of Henry VI. in 1429, under the supervision of the lord protector Humphrey, duke of Gloucester, and the earl marshal, John Mowbray, duke of Norfolk. Two more are of the reign of Edward IV., and were severally issued by John Tiptoft, earl of Worcester and lord high constable, in 1467, and by Anthony Widvile, Earl Rivers and lord high constable, in 1479. The latest is commonly and shortly known as the "Series Ordinum," and was drawn up by a special commission presided over by Jasper Tudor, duke of Bedford, it is presumed for observance at the marriage of Henry VII. and Elizabeth of York in 1486. To these may be added the "Order for the Placing of Lords and Ladies," taken at a grand entertainment given by command of Henry VIII. at the king's manor-house of Richmond in 1520 by Charles Somerset, earl of Worcester, lord chamberlain of the household, to the French ambassador, Olivier de la Vernade, seigneur de la Bâtie; the "Precedency of All Estates," arranged in 1594 by the commissioners for executing the office of earl marshal; and the "Roll of the King's Majesty's most Royal Proceeding through London" from the Tower to Whitehall on the eve of the coronation of James I., also arranged by the commissioners for executing the office of earl marshal. On many isolated points, too, of more or less importance, special declaratory decisions have been from time to time propounded by the earls marshal, their substitutes and deputies; for example, in 1594, when the younger sons of dukes were placed before viscounts; in 1625, when the rank of knights of the Bath and their wives was fixed; and in 1615 and 1677, when the eldest sons of the younger sons of peers were placed before the eldest sons of knights and of baronets. It is from these miscellaneous sources that the precedence among others of all peeresses, the eldest sons and their wives and the daughters of all peers, and the younger sons and their wives of all dukes, marquesses and earls is ascertained and established. And further, for the purpose of proving continuity of practice and disposing of minor questions not otherwise and more conclusively set at rest, the official programmes and accounts preserved by the heralds of different public solemnities and processions, such as coronations, royal marriages, state funerals, national thanksgivings and so on, have always been considered to be of great historical and technical value.[5]

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[1] Ample materials for the satisfaction of the curiosity of those who are desirous of investigating the history of precedence under its wider and more remote aspects will be found in such writers as Selden or Mackenzie, together with the authorities quoted or referred to by them: Selden, *Titles of Honor*, pt. ii. p. 740 seq. (London, 1672); Mackenzie, *Observations upon The Laws and Customs of Nations as to Precedency* (Edinburgh, 1680; and also reprinted in Guillim, *Display of Heraldry*, 6th ed., London, 1724).

[2] For the parliamentary rights of Scottish peers see article PEERAGE.

1.—*General Precedence of Men.*

The sovereign; (1) prince of Wales; (2) younger sons of the sovereign; (3) grandsons of the sovereign; (4) brothers of the sovereign; (5) uncles of the sovereign; (6) nephews of the sovereign;[6] (7) ambassadors; (8) archbishop of Canterbury, primate of all England; (9) lord high chancellor of Great Britain or lord keeper of the great seal; (10) archbishop of York, primate of England;[7] (11) prime minister; (12) lord high treasurer of Great

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[1] Quoted by Sir Charles Young from *State Papers: published by Authority* (4to, 1830), p. 623, in *Privy Councillors and their Precedence* (1850), p. 15.

[2] *Patent Rolls*, 10th Jac., pt. x. mem. 8. It is commonly stated that the bannerets here referred to could be made by the prince of Wales as well as by the king. But the privilege was conferred by James I. on Henry, the then prince of Wales, only (Selden, *Titles of Honor*, pt. ii. p. 750).

[3] Ibid., 14th Jac., part ii. mem. 24; Selden, *Titles of Honor*, part ii. p. 752.

[4] Cited by Sir Charles Young, *Order of Precedence, with Authorities and Remarks*, p. 27 (London, 1851).

[5] Selden, *Titles of Honor*, pt. ii. p. 753.

[6] The precedence of the members of the royal family depends on their relationship to the reigning sovereign and not on their relationship to any of the predecessors of the reigning sovereign. It is provided by 31 Hen. VIII. c. 10 that no person, "except only the King's children," shall have place "at the side of the Cloth of Estate in the Parliament Chamber," and that "the King's Son, the King's Brother, the King's Nephew, or the King's Brother's or Sister's Sons," shall have place before all prelates, great officers of state and peers. Lord Chief Justice Coke was of opinion that the king's nephew meant the king's grandson or *nepos* (*Institutes*, vol. iv. ch. 77). But, as Mr Justice Blackstone says, "under the description of the King's children his grandsons are held to be included without having recourse to Sir Edward Coke's interpretation of nephew" (*Commentaries*, vol. i. ch. 4). Besides, if grandson is to be understood by nephew, the king's grandson would be placed after the king's brother. The prince of Wales is not specifically mentioned in the statute "for the placing of the Lords"; but, as he is always, whether the son or the grandson of the sovereign, the heir-apparent to the Crown, he is ranked next to the sovereign or the queen-consort. With the exception of the prince of Wales, all the male relations of the sovereign are ranked first in the order of their degrees of consanguinity with him or her, and secondly, in the order of their proximity to the succession to the Crown; thus the members of the several groups into which the royal family is divided take precedence according to their own seniority and the seniority of their fathers or mothers, the sons of the sons or brothers of the sovereign being preferred to the sons of the daughters or sisters of the sovereign among the sovereign's grandsons and nephews.

[7] By 31 Hen. VIII. c. 10, the king's vicegerent "for good and due ministration of justice in all causes and cases touching the ecclesiastical jurisdiction" is placed immediately before the archbishop of Canterbury. The office of vicegerent or vicar-general was then held by Thomas, Lord Cromwell, afterwards earl of Essex, together with that of lord privy seal, and it was never conferred on any other person. By the Act of Union with Ireland the archbishops of Ireland had place next to the archbishops of England, and if consecrated before and not after the disestablishment of the Church in Ireland they retain this position under the Irish Church Act of 1869. At the coronation of William IV. the lord chancellor of Ireland walked next after the lord chancellor of Great Britain and before the lord president of the council and lord privy seal. In Ireland, if he is a peer he has precedence between the archbishops of Armagh and Dublin, and if he is not a peer after the archbishop of Dublin. But, except in the House of Lords, the precedence of the lord chancellor of Great Britain or the lord keeper of the great seal is the same whether he is a peer or a commoner. The lord keeper has the same precedence as the lord chancellor under 5 Eliz. c. 18. But the last appointment to the lord keepership was that of Sir Robert Henley, afterwards Lord Henley, lord chancellor, and earl of Northington, in 1757, and the office is not likely to be revived.

Britain; (13) lord president of the privy council; (14) lord keeper of the privy seal;[1] (15) lord great chamberlain of England; (16) lord high constable of England; (17) earl marshal; (18) lord high admiral; (19) lord steward of the household; (20) lord chamberlain of the household;[2] above peers of their own degree; (21) dukes;[3] (22) marquesses; (23) dukes' eldest sons;[4] (24) earls; (25) marquesses' eldest sons; (26) dukes' younger sons; (27) viscounts; (28) earls' eldest sons; (29) marquesses' younger sons; (30) bishops; (31) barons;[5] (32) speaker of the House of Commons; (33) commissioners of the great seal;[6] (34) treasurer of the household; (35) comptroller of the household; (36) master of the horse; (37) vice-chamberlain of the household; (38) secretaries of state;[7] (39) viscounts' eldest sons; (40) earls' younger sons; (41) barons' eldest sons; (42) knights of the Garter;[8] (43) privy councillors;[9] (44) chancellor of the exchequer; (45) chancellor of the duchy of Lancaster; (46) lord chief justice of England; (47) master of the rolls; (48) lords justices of appeal;[1] (49) judges of the High Court of Justice;[2] (50) knights bannerets made by the sovereign in person; (51) viscounts' younger sons; (52) barons' younger sons; (53) sons of lords of appeal;[3] (54) baronets;[4] (55) knights bannerets not made by the sovereign in person; (56) knights of the first class of the Bath, the Star of India, St Michael and St George;[5] (57) the Indian Empire, the Royal Victorian Order; (58) knights of the second class of the Bath, the Star of India, and St Michael and St George;[6] other orders K.C.I.E., &c.; (59) knights bachelors;[7] (60) sons of commanders of the Royal Victorian Order; (61) judges of county courts;[8] (62) eldest sons of the younger sons of peers; (63) baronets' eldest sons; (64) knights' eldest sons; (65) baronets' younger sons; (66) knights' younger sons;[9] (67) companions of the Bath, the Star of India, St Michael and St George and the Indian Empire;[10] (68) members of the 4th class of the Royal Victorian Order; (69) companions of the Distinguished Service Order; (70) members of the 5th class of the Royal Victorian Order; (71) esquires;[11] (72) gentlemen.[12]

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[1] The lord president of the council and the lord privy seal, if they are peers, are placed by 31 Hen. VIII. c. 10 before all dukes except dukes related to the sovereign in one or other of the degrees of consanguinity specified in the act. And, since the holders of these offices have been and are always peers, their proper precedence if they are commoners has never been determined.

[2] It is provided by 31 Hen. VIII. c. 10 that "the Great Chamberlain, the Constable, the Marshal, the Lord Admiral, the Grand Master or Lord Steward, and the King's Chamberlain shall sit and be placed after the Lord Privy Seal in manner and form following: that is to say, every one of them shall sit and be placed above all other personages being of the same estates or degrees that they shall happen to be of, that is to say the Great Chamberlain first, the Constable next, the Marshal third, the Lord Admiral the fourth, the Grand Master or Lord Steward the fifth, and the King's Chamberlain the sixth." The office of lord high steward of England, then under attainder, is not mentioned in the act for the placing of the Lords, "because it was intended," Lord Chief Justice Coke says, "that when the use of him should be necessary he should not endure longer than *hac vice*" (*Inst.* iv. 77). But it may be noted that, when his office is called out of abeyance for coronations or trials by the House of Lords, the lord high steward is the greatest of all the great officers of state in England. The office of lord great chamberlain of England is hereditary in the coheirs of the last duke of Ancaster, who inherited it from the De Veres, earls of Oxford, in whose line it had descended from the reign of Henry I. The office of lord high constable of England, also under attainder, is called out of abeyance for and pending coronations only. The office of earl marshal is hereditary in the Howards, dukes of Norfolk, premier dukes and, as earls of Arundel, premier earls of England, under a grant in special tail male from Charles II. in 1672. The office of lord high admiral, like the office of lord high treasurer, is practically extinct as a dignity. Since the reign of Queen Anne there has been only one lord high admiral, namely, William, duke of Clarence, afterwards William IV., for a few months in the Canning administration of 1827. The lord steward and the lord chamberlain of the household are always peers, and have seldom been under the degree of earls. We may here remark that both the Scottish and Irish Acts of Union make no reference to the precedence of the great officers of state of Scotland and Ireland. Not to mention the prince of Wales, who is by birth steward of Scotland, the earl of Shrewsbury is hereditary great seneschal of Ireland; the duke of Argyll is hereditary master of the household; the earl of Errol is hereditary lord high constable of Scotland; but what places they are entitled to in the scale of general precedence is altogether doubtful and uncertain. In Ireland the great seneschal ranks after the lord chancellor if he is a commoner, and after the archbishop of Dublin if the lord chancellor is a peer, and in both cases before dukes ("Order of precedence," *Dublin Gazette*, June 3, 1843). Again, on George IV.'s visit to Edinburgh in 1821, the lord high constable had place as the first subject in Scotland immediately after the members of the royal family. At every coronation from that of George III. to that of Queen Victoria, the lord high constable of Scotland has been placed next to the earl marshal of England, and, although no rank has been assigned on these occasions to the hereditary great seneschal of Ireland, the lord high constable of Ireland appointed for the ceremony has been at all or most of them placed next to the lord high constable of Scotland. It is worthy of notice, however, that Sir George Mackenzie, writing when lord advocate of Scotland in the reign of Charles II., says that "the Constable and Marischal take not place as Officers of the Crown but according to their creation as Earls," and he moreover expresses the opinion that "it seems very strange that these who ride upon the King's right and left hand when he returns from his Parliaments and who guard the Parliament itself, and the Honours, should have no precedency by their offices" (*Observations*, &c., p. 25, in Guillim's *Display of Heraldry*, p. 461 seq.; but see also Wood-Douglas, *Peerage of Scotland*, i. 557).

[3] Both Sir Charles Young and Sir Bernard Burke place "Dukes of the Blood Royal" before dukes, their eldest sons before marquesses, and their younger sons before marquesses' eldest sons. In the "Ancient Tables of Precedence," which we have already cited, dukes of the blood royal are always ranked before other dukes, and in most of them their eldest sons and in some of them their younger sons are placed in a corresponding order of precedence. But in this connexion the words of the act for the placing of the Lords are perfectly plain and unambiguous: "All Dukes not aforementioned," *i.e.* all except only such as shall happen to be the king's son, the king's brother, the king's uncle, the king's nephew, or the king's brother's or sister's son, "Marquesses, Earls, Viscounts and Barons, not having any of the offices aforesaid, shall sit and be placed after their anciety as it hath been accustomed." As Lord Chief Justice Coke and Mr Justice Blackstone observe, the degrees of consanguinity with the sovereign to which precedence is given by 31 Hen. VIII. c. 10 are the same as those within which it was made high treason by 28 Hen. VIII. c. 18 for any man to contract marriage without the consent of the king. Queen Victoria, by letters patent under the great seal in 1865, ordained that, "besides the children of Sovereigns of these realms, the children of the sons of any of the Sovereigns of Great Britain and Ireland shall have and at all times hold and enjoy the style or attribute of 'Royal Highness' with their titular dignity of Prince or Princess prefixed to their respective Christian names, or with their other titles of honour." But, notwithstanding this, their rank and place are still governed by the act for the placing of the Lords. The duke of Cumberland has no precedence as a cousin of the king, being the grandson of a son of George III. and would not be a "Royal Highness" at all if his father had not been, like his grandfather, king of Hanover. In *Garter's Roll of the Lords Spiritual and Temporal*, the official list of the House of Lords, the duke of Cumberland is entered in the precedence of his dukedom after the duke of Northumberland. Under the combined operation of the act for the placing of the Lords and the Acts of Union with Scotland (art. 23) and with Ireland (art. 4), peers of the same degrees, as dukes, marquesses, earls, viscounts and barons, severally, have precedence according to priority in the creation of their respective peerages. But peerages of England created before 1707 precede peerages of Scotland created before 1707, peerages of Great Britain created between 1707 and 1801 precede peerages of Ireland created before 1801, and peerages of Ireland created before 1801 precede peerages of the United Kingdom and of Ireland created after 1801, which take precedence in common. The relative precedence of the members of the House of Lords, including the representative peers of Scotland and Ireland, is officially set forth in *Garter's roll*, which is prepared by the Garter king of arms at the commencement of each session of parliament, that of the Scottish peers generally in the *Union Roll*, and that of the Irish peers generally in *Ulster's Roll*, a record which is under the charge of and is periodically corrected by the Ulster king of arms. The *Union Roll* is founded on the "Decreet of Ranking" pronounced and promulgated by a royal commission in 1606, which, in the words of an eminent authority in such matters, "was adopted at once as the roll of the peers in Parliament, convention and all public meetings, and continued to be called uninterruptedly with such alterations upon it as judgments of the Court of Session upon appeal in modification of the precedency of certain peers rendered necessary, with the omission of such dignities as became extinct and with the addition from time to time of newly created peerages—down to the last sitting of the Scottish Parliament on the 1st of May 1707" (*The Earldom of Mar*, &c., by the earl of Crawford (25th) and Balcarres (8th), ii. 16).

[4] Eldest sons of peers of any given degree are of the same rank as, but are to be placed immediately after, peers of the first degree under that of their fathers; and the younger sons of peers of any given degree are of the same rank, but are to be placed after peers of the second degree and the eldest sons of peers of the first degree under that of their fathers.

[5] Secretaries of state, if they are barons, precede all other barons under 31 Hen. VIII. c. 10. But if they are of any higher degree their rank is not influenced by their official position.

[6] Under 1 Will. and Mary, c. 21, being the only commissioners for the execution of any office who have precedence assigned to them.

[7] The officers of the household who, under Henry VIII.'s warrant of 1540, precede the secretaries of state have been for a long time always peers or the sons of peers, with personal rank higher, and usually far higher, than their official rank. The practical result is, seeing also that the great seal is only very rarely indeed in commission, that the secretaries of state, when they are commoners whose personal precedence is below a baron's, have official precedence immediately after the speaker of the House of Commons. The principal secretaries, for so they are all designated, are officially equal to one another in dignity, and are placed among themselves according to seniority of appointment.

[8] During more than two centuries only one commoner has been indebted for his precedence to his election into the order, and that was Sir Robert Walpole, the minister, who at the coronation of George II. in 1727 was placed as a knight of the Garter immediately before privy councillors. The proper precedence of both knights of the Thistle and knights of St Patrick is undecided.

[9] Privy councillors of Great Britain and of Ireland take precedence in common according to priority of admission. The chancellors of the exchequer and of the duchy of Lancaster, the lord chief justice

2.—*General Precedence of Women*

The Queen;[13] (1) queen dowager; (2) princess of Wales; (3) daughters of the sovereign; (4) wives of the sovereign's younger sons; (5) granddaughters of the sovereign; (6) wives of the sovereign's grandsons; (7) sisters of the sovereign; (8) wives of the sovereign's brothers; (9) aunts of the sovereign; (10) wives of the sovereign's uncles; (11) nieces of the sovereign;

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of England, the master of the rolls, and the lords justices of appeal are always members of the privy council, and have rank and place as privy councillors, if they are not also peers.

[1] The lords justices of appeal have precedence among themselves according to seniority of appointment. Until recently they were preceded by the lord chief justice of the common pleas and the lord chief baron of the exchequer (divisions of the High Court of Justice). But under existing arrangements these offices have fallen into abeyance, although they have not been formally abolished. The vice-chancellors used to follow the lords justices of appeal; but, in spite of the fact that there is still one vice-chancellor remaining, the office of vice-chancellor is extinct and will altogether disappear on his decease. In Ireland all these offices are in existence, but they have no precedence allotted to them in England; as the judges holding them are invariably privy councillors, however, they are ranked accordingly. And it is the same with regard to the lord justice-general and the lord justice-clerk in Scotland.

[2] The judges of all the divisions of the High Court of Justice are ranked together according to seniority of appointment. Neither the senators of the College of Justice in Scotland nor the judges of the various divisions of the High Court in Ireland have any precedence in England. The precedence of the Scottish judges among themselves is settled by a royal warrant of Nisbet in his *System of Heraldry*. The precedence of the Irish judges among themselves is the same as the precedence of the English judges among themselves used to be before the offices of chief justice of the common pleas and chief baron of the exchequer were suspended.

[3] By warrants of the 30th of March 1898, although lords of appeal rank with hereditary barons in order of creation, their sons stand in a class by themselves.

[4] It is a question whether baronets ought or ought not to have precedence, like peers, according as they are of England, Scotland, Great Britain, Ireland or the United Kingdom. Baronets are not referred to in either the Scottish or the Irish Act of Union; and Sir Bernard Burke contends that, since the Acts of Union are silent with regard to them, they are still entitled to whatever precedence was originally conferred on them. He therefore places the whole body of the baronets together in the order merely of the dates of their several creations, and in this he appears to us to have both law and reason on his side.

[5] These knights consist of grand crosses of the first, grand commanders of the second, and grand crosses of the third order, and have precedence in their respective orders according to seniority of creation. By the statutes of the order of the Bath, as revised in 1847, it is ordained that the knights grand crosses are to be placed "next to and immediately after baronets," thus superseding knights bannerets not created by the sovereign in person.

[6] Knights commanders of all three orders are placed in each order according to seniority of creation.

[7] Knights bachelors are ranked together according to seniority of creation, whether they are made by the sovereign or the lord lieutenant of Ireland.

[8] Royal x. Warrant of 1884.

[9] The sons of all persons, when any specified rank is assigned to them, are placed in the precedence of their fathers. Eldest sons of the younger sons of peers were ranked before the eldest sons of knights by order of the earl marshal, the 18th of March 1615, and before the eldest sons of baronets by order of the earl marshal, the 6th of April 1677. But no precedence has been given to the younger sons of the younger sons of peers, although precedence is given to the younger as well as the eldest sons of baronets and knights by James I.'s decree of 1616. Moreover, no precedence has been given to either the eldest or the younger sons of the eldest sons of peers. But in practice this omission is generally disregarded, and the children of the eldest sons of dukes, marquesses and earls, at all events, are accorded the same rank and titles which they would have if their fathers were actual instead of *quasi* peers of the degree next under that of their grandfathers. Sir Charles Young says that "by decision (Chap. Coll. Arms of 1680) if the eldest son of an earl died in his father's lifetime leaving a son and heir, such son and heir during the life of the earl his grandfather is entitled to the same place and precedence as was due to his father: so had the father been summoned to parliament as the eldest son of a peer the grandson would succeed to the dignity even during the grandfather's lifetime" (*Order of Precedence*, p. 27). And, of course, what applies to the grandson and heir of an earl applies equally to the grandsons and heirs of dukes and marquesses. But the grandsons and heirs of viscounts and barons are differently situated, and have neither honorary additions to their names nor any ascertained place and precedence even by the etiquette of society.

[10] Companions are members of the third class of the first three orders and the only members of the fourth order, except the sovereign and the grand master. Sir Charles Young and Sir Bernard Burke concur in placing the companions of these orders before the eldest sons of the younger sons of peers, on the ground that under their statutes they are entitled to precede "all Esquires of the Realm." But the sons of peers themselves—the eldest as well as the younger—are merely esquires, and are ranked before, and not among, other esquires because they have a particular precedence of their own assigned to them. Similarly the eldest sons of the younger sons of peers and the eldest sons of baronets and of knights who are also esquires, and likewise the younger sons of baronets and of knights who are not esquires, have a particular precedence of their own assigned to them. All of them are placed before esquires as a specific grade in the scale of general precedence, and it seems clear enough that it is before esquires, considered as a specific grade, that the companions of the orders ought to be placed and not before any other persons who, whether they are or are not esquires, have a definite and settled rank which is superior to that specific grade in the scale of general precedence.

[11] It appears to be admitted on all hands that the following persons are esquires and ought to be so described in all legal documents and processes: first, the eldest sons of peers in the lifetime of their fathers, and the younger sons of peers both in and after the lifetime of their fathers; secondly, the eldest sons of the younger sons of peers and their eldest sons in perpetual succession, and the eldest sons of baronets and knights; thirdly, esquires created with or without the grant of armorial bearings by the sovereign; fourthly, justices of the peace, barristers-at-law and mayors of corporations; and fifthly, those who are styled esquires in patents, commissions or appointments to offices under the Crown in the state, the household, the army or navy and elsewhere. Sir Bernard Burke accords precedence to serjeants-at-law and masters in lunacy, not only before esquires as such, but also before the companions of the orders of knighthood. It is, however, enough to observe with regard to the first, since no more of them are to be created, that, in spite of the extravagant pretensions which have been frequently urged by them and on their behalf, "they have not in the general scale," as Sir Charles Young says, "any precedence, and when under the degree of a Knight rank only as Esquires"; and with regard to the second, that the statute 8 & 9 Vict. c. 100, on which the Ulster king of arms bases their claims, simply provides that they "shall take the same rank and precedence as the masters in ordinary of the High Court of Chancery," who are now extinct, "apparently," to recur to Sir Charles Young, "assuming the rank of the masters without defining it." "The masters, however," he adds, "as such have not a settled place in the order of general precedency emanating from any authority by statute or otherwise" (*Order of Precedence*, p. 71). Sir William Blackstone says that before esquires "the Heralds rank all Colonels, Serjeants-at-Law and Doctors in the three learned professions" (*Commentaries*, vol. i. ch. 12). But the only foundation for this statement seems to be a passage in Guillim, which is obviously without any authority.

[12] The heralds and lawyers are agreed that gentlemen are those who, by inheritance or grant from the Crown, are entitled to bear coat armour (see Coke, *Inst.* iv. ch. 77; Blackstone, *Comm.* i. ch. 12; Selden, *Titles of Honor*, pt. ii. ch. 8; Guillim, *Display of Heraldry*, pt. ii. ch. 26).

[13] The queen-consort is the second personage in the realm, and has precedence of the queen-dowager. But the husband of a reigning queen has no rank or place except such as is specially accorded to him by the sovereign.

(12) wives of the sovereign's nephews;[1] (13) wives of dukes of the blood royal; (14) duchesses;[2] (15) wives of eldest sons of dukes of the blood royal; (16) marchionesses; (17) wives of the eldest sons of dukes; (18) dukes' daughters;[3] (19) countesses; (20) wives of younger sons of dukes of the blood royal; (21) wives of the eldest sons of marquesses; (22) marquesses' daughters; (23) wives of the younger sons of dukes; (24) viscountesses; (25) wives of the eldest sons of earls; (26) earls' daughters, (27) wives of the younger sons of marquesses; (28) baronesses; (29) wives of the eldest sons of viscounts; (30) viscounts' daughters; (31) wives of the younger sons of earls; (32) wives of the eldest sons of barons; (33) barons' daughters; (34) maids of honour to the queen;[4] (35) wives of knights of the Garter; (36) wives of knights bannerets made by the sovereign in person; (37) wives of the younger sons of viscounts; (38) wives of the younger sons of barons; (39) baronets' wives; (40) wives of knights bannerets not made by the sovereign in person; (41) wives of knights of the Thistle; (42) wives of knights of St Patrick; (43) wives of knights grand crosses of the Bath, grand commanders of the Star of India, and grand crosses of St Michael and St George; (44) wives of knights commanders of the Bath, the Star of India, and St Michael and St George; (45) knights bachelors' wives; (46) wives of the eldest sons of the younger sons of peers; (47) daughters of the younger sons of peers; (48) wives of the eldest sons of baronets; (49) baronets' daughters; (50) wives of the eldest sons of knights; (51) knights' daughters; (52) wives of the younger sons of baronets; (53) wives of the younger sons of knights;[5] (54) wives of commanders of the Royal Victorian Order, companions of the Bath, the Star of India, St Michael and St George, and the Indian Empire; (55) wives of members of the 4th class Royal Victorian Order; (56) wives of esquires;[6] (57) gentlewomen;[7]

A special table of precedence in Scotland is regulated by a royal warrant dated the 16th of March 1905, and a special table of precedence in Ireland was set forth by authority of the Lord Lieutenant (Jan. 2, 1895). Both contain errors and will probably be revised.

Attention to the foregoing tables will show that general precedence is of different kinds as well as of several degrees. It is first either personal or official, and secondly either substantive or derivative. Personal precedence belongs to the royal family, the peerage and certain specified classes of the commonalty. Official precedence belongs to such of the dignitaries of the Church and such of the ministers of state and the household as have had rank and place accorded to them by parliament or the Crown, to the speaker of the House of Commons and to the members of the privy council and the judicature. Substantive precedence, which may be either personal or official, belongs to all those whose rank and place are enjoyed by them independently of their connexion with anybody else, as by the archbishop of Canterbury, the lord high chancellor or the lord great chamberlain, peers and peeresses, baronets, knights and some esquires. Derivative precedence, which can only be personal, belongs to all those whose rank and place are determined by their consanguinity with or affinity to somebody else, as the lineal and collateral relations of the sovereign, the sons, daughters and daughters-in-law of peers and peeresses in their own right, and the wives, sons, daughters and daughters-in-law of baronets, knights and some esquires. It is to be observed, however, that the precedence of the sovereign is at once official and personal, and that the precedence of peeresses by marriage is at once derivative and substantive. In the case of the sovereign it is his or her actual tenure of the office of king or queen which regulates the rank and place of the various members of the royal family, and in the case of peeresses by marriage, although their rank and place are derivative in origin, yet they are substantive in continuance, since during coverture and widowhood peeresses by marriage are as much peeresses as peeresses in their own right, and their legal and political status is precisely the same as if they had acquired it by creation or inheritance.

Bearing the above definitions and explanations in mind, the following canons or rules may be found practically useful:—

1. Anybody who is entitled to both personal and official precedence is to be placed according to that which implies the higher rank. If, for example, a baron and a baronet are both privy councillors, the precedence of the first is that of a baron and the precedence of the second is that of a privy councillor. And similarly, except as hereafter stated, with respect to the holders of two or more personal or two or more official dignities.

2. Save in the case of the sovereign, official rank can never supply the foundation for derivative rank. Hence the official precedence of a husband or father affords no indication of the personal precedence of his wife or children. The wives and children, for example, of the archbishop of Canterbury, the lord high chancellor or the speaker of the House of Commons do not participate in their official rank but only in their personal rank, whatever it may be.

3. Among subjects men alone can convey derivative rank, except in the case of the daughters and sisters of the sovereign, or of peeresses in their own right. But no man can acquire any rank or place by marriage. The sons-in-law or brothers-in-law of the sovereign and the husbands of peeresses in their own right have as such no precedence whatever. And the daughter and heiress of the premier duke of England, unless she happens to be also a peeress in her own right, does not transmit any rank or place to her children.

4. Within the limits of the peerage derivative rank is as a rule always merged in personal, as distinguished from official, substantive rank. If, for example, the younger son of a duke is created a baron or inherits a barony, his precedence ceases to be that of a duke's younger son and becomes that of a baron. But where the eldest son of a duke, a marquess or an earl is summoned to the House of Lords in a barony of his father's, or succeeds as or is created a baron, he is still, as before, "commonly called" by some superior title of peerage, as marquess, earl or viscount, and retains his derivative precedence on all occasions, except in parliament or at ceremonies which he attends in his character as a peer. The younger sons of all peers, however, who are created or who inherit peerages—which they often do under special limitations—are everywhere placed according to their substantive rank, no matter how inferior it may be to their derivative rank. But if the son of a duke or a

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[1] There is no act of parliament or ordinance of the Crown regulating the precedence of the female members of the royal family. But the above is the gradation which appears to have become established among them, and follows the analogy supplied by the act for the placing of the lords in the case of their husbands and brothers.

[2] Peeresses in their own right and peeresses by marriage are ranked together, the first in their own precedence and the second in the precedence of their husbands.

[3] Among the daughters of peers there is no distinction between the eldest and the younger as there is among the sons of peers. Their precedence is immediately after the wives of their eldest brothers, and several degrees above the wives of their younger brothers. They are placed among themselves in the precedence of their fathers. But the daughter of the premier duke or baron ranks after the wife of the eldest son of the junior duke or baron.

[4] Maids of honour to the queen are the only women who have any official precedence. They have the style or title of honourable, and are placed immediately after barons' daughters by Sir Bernard Burke, the rank which is accorded to them by the etiquette of society. But Sir Charles Young does not assign any precedence to them, and we do not know on what authority the Ulster king of arms does so, although he is by no means singular in the course he has taken.

[5] The wives of baronets and knights, the wives of the eldest sons and the daughters of the younger sons of peers, and the wives of the sons and the daughters of baronets and knights are all placed severally in the precedence of their respective husbands, husbands' fathers and fathers.

[6] "Esquire" and "gentleman" are not names of "dignity" but names of "worship," and esquires and gentlemen do not, in strictness, convey or transmit any precedence to their wives or children (see Coke, *Inst.* ii., "Of Additions," p. 667).

[7] "And *generosus* and *generosa* are good additions: and if a gentlewoman be named Spinster in any original writ, *i.e.* appeal or indictment, she may abate and quash the same, for she hath as good right to that addition as Baroness, Viscountess, Marchioness or Duchess have to theirs" (Coke, *Inst.* ii., "Of Additions," p. 668).

marquess, whether eldest or younger, or the eldest son of an earl is consecrated a bishop his derivative rank is not merged in his substantive rank, because it is official, and his derivative and personal rank implies the higher precedence. Again, the daughters of dukes, marquesses and earls who become peeresses by marriage or creation, or who inherit as peeresses, are placed according to their substantive and not according to their derivative rank, although they may thereby be assigned a far lower precedence than that to which their birth entitles them.

5. The widows of peers and baronets have precedence immediately before the wives or widows of the next successors in their husbands' dignities. But the sons and daughters of peers and baronets have precedence immediately before the sons and daughters of the holders of the dignities to whom their fathers succeeded. The reason of this is that the first are senior in the dignities and the second are nearer in the line of succession to them.

6. The widows of peers who marry again either share the precedence of their second husbands or resume the precedence belonging to them independently of their marriage with their first husbands. Thus, if the daughter of a duke or an esquire marries first an earl and secondly a baron, although she remains a peeress, she is placed as a baroness instead of a countess. But if either of them should marry a commoner as her second husband, whatever may be his rank or degree, she ceases to be a peeress. While, however, the duke's daughter, if her second husband were not the eldest son of a duke, would resume her precedence as the daughter of a duke, the esquire's daughter would share the precedence of her second husband, whether he were a peer's son, a baronet, a knight or an esquire. The widows of peers have long kept their former rank in society, but they have no such right unless by permission of the sovereign, which permission has on several recent occasions been refused.

7. The widows of the eldest and younger sons of dukes and marquesses and of the eldest sons of earls, and also the widows of baronets and knights who marry again, are permitted by the etiquette of society to keep the titles and rank acquired by their first marriage if their second marriage is with a commoner whose precedence is considerably lower. But the widows of the younger sons of earls and of the eldest and younger sons of viscounts and barons, although their precedence is higher than that of the widows of baronets and knights, are not allowed to retain it, under any circumstances, after a second marriage.

8. Marriage does not affect the precedence of peeresses in their own right unless their husbands are peers whose peerages are of a higher degree, or, being of the same degree, are of more ancient creation than their own. If, for example, a baroness in her own right marries a viscount she is placed and described as a viscountess, or if she marries a baron whose barony is older than hers she is placed in his precedence and described by his title. But if she marries a baron whose barony is junior to hers she keeps her own precedence and title.

9. The daughters of peers, of sons of peers, baronets and knights retain after marriage the precedence they derive from their fathers, unless they marry peers of any rank or commoners of higher rank than their own. Hence, for example, the daughter of a duke who marries the eldest son of a marquess is placed as a duke's daughter, not as the wife of a marquess's eldest son, and the daughter of a baronet who marries the younger son of a knight is placed as a baronet's daughter and not as the wife of a knight's younger son.

10. What are termed "titles of courtesy" are borne by all the sons and daughters of peers and peeresses in their own right, who in this connexion stand on exactly the same footing. The eldest sons of dukes, marquesses and earls are designated by the names of one or other of the inferior peerages of their fathers, usually a marquessate or an earldom in the first, an earldom or a viscounty in the second and a viscounty or barony in the third case. The rule applicable in former times, still adhered to by the older English dignities, was that a duke's eldest son was styled earl, the son of a marquess, viscount, the son of an earl, baron. No such rule obtained in Scotland. But, whatever it may be, it is altogether without effect on the rank and place of the bearer, which are those belonging to him as the eldest son of his father. The younger sons of dukes and marquesses are styled "lords," followed by both their Christian names and surnames. The younger sons of earls and both the eldest and the younger sons of viscounts and barons are described as "honourable" before both their Christian names and surnames. The daughters of dukes, marquesses and earls are styled "ladies" before both their Christian names and surnames. The daughters of viscounts and barons are described as "honourable" before both their Christian names and surnames. If the eldest son of a marquess or an earl marries a woman of rank equal or inferior to his own, she takes his title and precedence; but if she is of superior rank she retains, with her own precedence, the prefix "lady" before her Christian name followed by the name of her husband's title of courtesy. Again, if the younger son of a duke or a marquess marries a woman of rank equal or inferior to his own, she is called "lady," with his Christian and surname following, and is placed in his precedence, but, if she is of superior rank, she retains, with her own precedence, the prefix "lady" before her Christian name and his surname. If the daughter of a duke, a marquess or an earl marries the younger son of an earl, the eldest or younger son of a viscount or baron, a baronet, a knight or an esquire, &c., she retains, with her own precedence, the prefix "lady" before her Christian name and her husband's surname. If the daughter of a viscount marries the younger son of an earl or anybody of inferior rank to him, or the daughter of a baron marries the younger son of a viscount or anybody of inferior rank to him, she retains her own precedence with the prefix "honourable" before the addition "Mrs" and his surname or Christian name and surname. But, if her husband is a baronet or a knight, she is called the Honourable Lady Smith or the Honourable Lady Jones, as the case may be. The wives of the younger sons of earls and of the eldest and younger sons of viscounts and barons, if they are of inferior rank to their husbands, take their precedence and are described as the Honourable Mrs, with the surnames or Christian names and surnames of their husbands following. The judges were placed by James I. before the younger sons of viscounts and barons and accorded the title of "honourable" (*q.v.*). But in this addition their wives do not participate, since it is merely an official distinction.

It is manifest on even a cursory examination of the tables we have given that, although they embody the only scheme of general precedence, whether for men or for women, which is authoritatively sanctioned or recognized, they are in many respects very imperfectly fitted to meet the circumstances and requirements of the present day.[1] In both of them the limits prescribed to the royal family are pedantically and inconveniently narrow, and stand out in striking contrast to the wide and ample bounds through which the operation of the Royal Marriage Act (12 Geo. III. c. 11) extends the disabilities but not the privileges of the sovereign's kindred. Otherwise the scale of general precedence for women compares favourably enough with the scale of general precedence for men. If, indeed, it includes the queen's maids of honour and the wives of the companions of the knightly orders, there certainly does not seems to be any good reason why it should omit the mistress of the robes and the ladies of the bedchamber, or the ladies of the royal order of Victoria and Albert and the imperial order of the Crown of India. But these are trifling matters in themselves, and concern only a minute fraction of the community. The scale of general precedence for men is now in substantially the same condition as that in which it has been for between two and three centuries, and the political, to say nothing of the social, arrangements to which it was framed to apply have in the interval undergone an almost complete transformation. The consequence is that a good deal of it has come down to us in the shape of a survival, and has ceased to be of any practical use for the purpose it was originally designed to effect. While it comprises several official and personal dignities which are virtually obsolete and extinguished, it entirely omits the great majority of the members of Government in its existing form, and whole sections of society on a less exalted level, to whom it is universally felt that some rank and place at all events are both in public and in private justly due. And, when it does confess the presence of any of the sovereign's principal ministers, it commonly places them in positions which are out of all keeping with their actual eminence and importance. It ranks the lord president of the council and the lord privy seal before dukes, while it places the chancellor of the exchequer after the younger sons of earls and the eldest sons of barons, and the secretaries of state after the master of the horse and the vice-chamberlain of the household. The lord chancellor still has precedence as the first of the great officers of state, which was allotted to him not as what he is, the head of the judicature, but as what he once was, the prime minister of the sovereign; and the lord chief justice, who is next to him in regular judicial rank, as presiding over the common law courts, as he presides over the courts of equity, is placed after the chancellors of the exchequer and of the duchy of Lancaster, who still have the precedence which was allotted to them not as ministers, which they are, but as judges, which they are no longer. Neither the lord-lieutenant of Ireland, the viceroy of India, nor the governor-general of Canada has any rank or place at St James's, where, as well as at Westminster, the lord steward or the lord chamberlain of the household is a much greater and more splendid personage. Again, in the scale of general precedence there are no clergymen except bishops, no lawyers except judges, and no officers of either the army or the navy from field marshals and admirals of the fleet downwards. Nor, of course, are any colonial governors or lieutenant-governors entered on it. It contains no mention of under-secretaries of state, chairmen or commissioners of administrative boards, comptrollers or secretaries of government departments, lord-lieutenants or sheriffs of counties, deputy lieutenants or justices of the peace, members of the House of Commons or graduates of the universities. It is true that among some of these classes definite systems of subordination are established by either authority or usage, which are carefully observed and enforced in the particular areas and spheres to which they have reference. But we have seldom any means of determining the relative value of a given term in one series as compared with a given term in another series, or of connecting the different steps in the scales of local, professional or academical precedence with the different steps in the scale of general precedence, to which such scales of special precedence ought to be contributory and supplementary. We know, for example, that major-generals and rear-admirals are of equal rank, that with them are placed commissaries-general and inspectors-general of hospitals and fleets, that in India along with civilians of thirty-one years' standing they immediately follow the vice-chancellors of the Indian universities, and that in relation to the consular service they immediately precede agents-general and consuls-general. But there is nothing to aid us in determining whether in England they should be ranked with, before or after deans, king's counsel or doctors in divinity, who are as destitute as they are themselves of any recognized general precedence, and who, as matters now stand, would certainly have to give place to the younger sons of baronets and knights and the companions of the knightly orders.

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[1] "There are no doubt certain public ceremonials of State, such as Coronations, Royal Public Funerals and Processions of the Sovereign to Parliament, &c., wherein various public functionaries walk and have for the occasion certain places assigned to them, but which they may not at all times find the same, as it by no means follows that they are always entitled to the same place for having been there once: there is to a certain extent a precedent furnished thereby, and in some cases the uniformity of precedence in regard to one class over another has in such cases become established. This applies, for instance, to the places of the Gentlemen of the Privy Chamber, Law Officers of the Crown and Masters and Six Clerks in Chancery, who have no definite or fixed place in the tables of precedency regulating the general orders of society, though in reference to State ceremonials they have certain places assigned in the order of procession in right of their offices, which, however, give them no general rank. Upon such occasions, nevertheless, the legal rank and precedence which they hold in the Courts of Law is observed, and so far establishes among themselves, and in respect to their several classes, their precedency" (Sir Charles Young, *Order of Precedence*, &c., pp. 59-61).

No foreigner has any legal precedence in Great Britain,[1] but it is suggested that it being proper courtesy to accord to guests the precedence due to the rank they bear in their own countries, they should rank in society with and immediately before those of the relative rank in England. It should, however, be remembered that the younger sons of counts and other nobles bear the title of count with the addition of the Christian name, and they should be ranked with younger sons of British earls, &c., whatever title they bear. The eldest son of a duke for example is sometimes called prince, but the place accorded to him by the above rule would be next after a British marquess. Some persons of authority consider, however, that a foreigner should be given precedence over every native whatever the rank may be.

It has now become usual to recognize ecclesiastical rank derived from the pope, even when held by subjects of the king. Cardinals, therefore, rank by international usage above archbishops, as princes of the blood royal, and in Ireland, Roman Catholic and Protestant bishops rank as such by authority of the warrants there in force.

An order respecting precedence was sent by the secretary of state for the colonies to the governor-general of Canada (July 24, 1868). Precedence in India is regulated by a Royal Warrant dated the 6th of May 1871, a copy of which is subjoined.

VICTORIA, by the Grace of God, of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith.

To all to whom these presents shall come, greeting.

Whereas it hath been represented unto Us that it is advisable to regulate the Rank and Precedence of persons holding appointments in the East Indies. In order to fix the same, and prevent all disputes, We do hereby declare that it is Our will and pleasure that the following Table be observed with respect to the Rank and Precedence of the persons hereinafter named, viz.:—

Governor-General and Viceroy of India. Governor of Madras. Governor of Bombay. President of the Council of the Governor-General. Lieutenant-Governor of Bengal. Lieutenant-Governor of North-West Provinces. Lieutenant-Governor of the Punjaub. Commander-in-Chief in India, when a Member of Council. Chief Justice of Bengal. Bishop of Calcutta, Metropolitan of India. Chief Justices of Madras, Bombay and North-Western Provinces. Commanders-in-Chief in Madras and Bombay, when also Members of Council. Ordinary Members of the Council of the Governor-General. Bishops of Madras and Bombay. Ordinary Members of Council in Madras and Bombay.

Commander-in-Chief in India, when not a Member of Council. Puisne Judges of the High Courts of Calcutta, Madras, Bombay and North-Western Provinces. Commanders-in-Chief, Madras and Bombay, when not Members of Council. Chief Commissioners and Resident at Hyderabad. Military Officers above rank of Major-General. Additional Members of the Council of the Governor-General when assembled to make laws, &c. Commodore commanding Her Majesty's Naval Forces in India. Judge Advocate General of India. Secretaries to the Government of India. Additional Members of the Councils of the Governors of Madras and Bombay when assembled to make laws, &c. Members of the Legislative Council of the Lieutenant-Governor of Bengal. Agents to the Governor-General in Rajpootana and Central India. Commissioner in Sind. Judges of the Chief Court, Punjaub. Chief Secretaries to the Governments of Madras and Bombay.

FIRST CLASS

Civilians of 28 years' standing to rank with Major-Generals.

Advocate General, Calcutta. Residents at Foreign Courts and Residents at Aden, the Persian Gulf and Bagdad. Recorders of Moulmein and Rangoon. Advocates-General, Madras and Bombay. Members of the Boards of Revenue, Bengal, Madras, North-West Provinces. Secretaries to Local Governments. Chief Engineer, 1st Class. Comptroller-General of Accounts in India. Directors-General, Post Office, Telegraphs and Irrigation. Judicial Commissioners, Oude, Central Provinces, Mysore and Sind. Financial Commissioners in the Punjaub, Oude and Central Provinces. Archdeacon of Calcutta. Secretary to Council of Governor-General for making Laws, &c. Officers Commanding Brigades.

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[1] This subject was considered by the House of Lords in February 1628, on the proposition of a committee that no foreign nobility has right of precedence within this realm before any peer of this kingdom.

Second Class

Civilians of 20 years' standing ranking with Colonels.

Commissioners of Divisions. Directors of Public Instruction under Governments. Private Secretary to Viceroy. Military Secretary to Viceroy. Archdeacons of Madras and Bombay. Surveyor-General of India. Superintendent, Great Trigonometrical Survey. Sanitary Commissioner with Government of India. Superintendent of the Geological Survey in India. Inspector-General of Forests in India.

Inspector-General of Police.
Registrars-General. } Under Local Governments.

Standing Counsel to Government of India. Remembrancers of Legal Affairs, and Legal Advisers to the Government in the North-West Provinces and the Punjaub. Commissioners of Revenue Survey and Settlement. Chief Engineers, 2nd and 3rd Class, and Superintendents of Irrigation.

Third Class

Civilians of 12 years' standing ranking with Lieutenant-Colonels.

Political Agents. Under-Secretaries to Government of India. Inspector-General of Education, Central Provinces, and Directors-General of Education, Oude, British Burmah, Berer and Mysore. Officers, 1st Grade, Education Department. Officers, 1st Grade, Financial Department. Private Secretaries to Governors. Military Secretaries to Governors. First Judges of Presidency Courts of Small Causes. Chief Magistrates of Presidency Towns. Administrator-General, Calcutta. Administrators-General, Madras and Bombay.

Inspectors-General of Jails.
Sanitary Commissioners. } Under Local Governments.
Conservators of Forests.

Superintending Engineers, 1st Class. Deputy Directors of Post Office and Telegraphs and Directors of Traffic and Construction. Postmasters-General. Senior Chaplains. Officers, 1st Grade, Geological Survey. Officers, 2nd Grade, Education Department. Officers, 2nd Grade, Financial Department. Superintendents, 1st Grade, Telegraph Department.

Fourth Class

Civilians of 8 years' standing ranking with Majors.

Assistant Political Agents. Officers, 2nd Grade, Geological Survey. Officers, 3rd Grade, Education Department. Officers, 3rd Grade, Financial Department. Superintendents, 2nd Grade, Telegraph Department. Government Solicitors.

Fifth Class

Civilians of 4 years' standing ranking with Captains.

Junior Chaplains. Officers, 4th Grade, Education Department.

Sixth Class

Civilians of less than 4 years' standing to rank with Subalterns.

Note 1.—Commissioners of Divisions within their own Divisions, and Residents and Political Agents within the limits of their respective charges, to take precedence immediately before Civilians of the 1st Class.

Note 2.—Collectors and Magistrates of Districts, and Deputy Commissioners of Districts, and the Chief Officer of each Presidency Municipality, to take precedence within their respective charges before the 3rd Class and Lieutenant-Colonels in the Army.

Sheriffs to rank within their charges immediately after Lieutenant-Colonels in the Army.

All Officers not mentioned in the above table, whose rank is regulated by comparison with rank in the Army, to have the same rank with reference to Civil Servants as is enjoyed by Military Officers of equal grades.

All other persons who may not be mentioned in this table to take rank according to general usage, which is to be explained and determined by the Governor-General in Council in case any question shall arise.

Nothing in the foregoing rules to disturb the existing practice relating to precedence at Native Courts, or on occasions of intercourse with Natives, and the Governor-General in Council to be empowered to make rules for such occasions in case any dispute shall arise.

All ladies to take place according to the rank herein assigned to their respective husbands, with the exception of wives of Peers, and of ladies having precedence in England, independently of their husbands, and who are not in rank below the daughters of Barons; such ladies to take place according to their several ranks, with reference to such precedence in England, immediately after the wives of Members of Council at the Presidencies in India.

Given at Our Court at Windsor, this sixth day of May, in the year of our Lord one thousand eight hundred and seventy-one, and in the thirty-fourth year of our Reign.

By Her Majesty's Command.

(Signed) ARGYLL.

(F. DR.; W. A. L.)

PRECENTOR (Late Lat. *praecentor*, from *praecinere*, to sing before, lead in singing), the title of the principal director of the singing or musical portions of the service in a cathedral or cathedral church. In the English Church in cathedrals of the "Old Foundation" the precentor is a member of the cathedral chapter and officially ranks next to the dean. His musical duties are usually performed by the "succentor," one of the vicars choral. In cathedrals of the "New Foundation" the "precentor" is not a member of the chapter, but is one of the minor canons.

PRECEPT (Lat. *praeceptum*, a rule, from *praecipere*, literally to take beforehand, to give rules, instructions or orders), a command or rule, especially one with regard to conduct or action, a moral rule or injunction, a maxim. Apart from this general use, the word was used, in law, of many orders in writing issuing from a court or other legal authority; it is now chiefly used of an order demanding the payment of money under a rate by poor law or other local authorities (see RATE). The Latin form *praecipe, i.e.* enjoin, command, is used of the note of instructions delivered by a plaintiff or his solicitor to be filed by the officer of the court, giving the names of the plaintiff and defendant, the nature of the writ, &c. For the obsolete writ of *praecipe quod reddat* see WRIT.

PRECEPTOR, a teacher or instructor, the classical meaning of the Latin *praeceptor*, from *praecipere*, literally to take in advance, hence to give rules or "precepts," advise, teach. As an educational term in English the word is familiar through the College of Preceptors, a chartered society chiefly composed of private teachers; it was incorporated in 1849 and was one of the first professional bodies to institute regular courses of pedagogic lectures and to award after examination the titles of licentiate and associate to teachers. It also holds examinations for pupils. In post-classical Latin *praeceptor* meant a commander, *praecipere*, to order, enjoin, and the term was adopted by the Knights Templars for the heads of the provincial communities of knights established on their estates. These communities and the estates themselves were known as "preceptories," and answered to the "commanderies" of the Hospitallers.

PRECESSION OF THE EQUINOXES, in astronomy, the term assigned to the progressive motion of the equinox, because it takes place in a direction from east towards west, opposite to that in which planets move, and in which longitudes are measured. The equinox being defined as the point of intersection of the equator and ecliptic, its motion arises from the fact that both of these great circles are in continuous though slow motion. The motion of the ecliptic is due to the action of the planets on the earth, which produces a slow progressive change in the position of the plane of the earth's orbit, and therefore of the ecliptic. This motion takes place round a diameter of the celestial sphere as an axis or nodal line, which intersects the sphere in two points, which are at present in longitudes about 173° and 353°. The direction of the motion around this axis is such that from the limits 353° through 0° to 173°, which includes the vernal equinox, the motion is towards the south, while, in the remainder of the circle, it is towards the north. At the present time the rate of the motion is 46.7″ per century. In consequence of the smallness of the angle, 7°, which the axis of motion makes with the line of the equinoxes, its effect on the precession is quite small, now amounting to only 0.14″ per annum. Owing to its cause this small part of the precession is called "planetary."

The motion of the equator is due to the combined action of the sun and moon on the equatorial protuberance of the earth (see ASTRONOMY). Owing to its cause this largest part of the precession is called "luni-solar." Its fundamental law is that the mean celestial pole at each instant (see NUTATION) moves at right angles to the circle joining it to the pole of the ecliptic as that instant. Hence if the pole of the ecliptic were fixed, the celestial pole would revolve around it in a circle at a constant distance equal to the obliquity of the ecliptic. Owing, however, to the slow change in the position of the pole of the ecliptic, the motion is only approximately in a circle, and the obliquity varies slowly from century to century. At the present time the rate of motion measured on a great circle is about 20″ per year; that is to say both the pole and the plane of the equator move through this angle annually. But when measured around the pole of the ecliptic as a centre the motion is about 2·5 times this or, at present, 50·37″ annually. This is the present amount of the luni-solar precession which, if it remained constant, would carry the pole completely round in a period of 25,730 years. But the exact period varies slightly, owing to the motion of the pole of the ecliptic. The combined effect of the luni-solar and planetary precession or the total motion of the equinox is called the general precession. Its annual amount during our time is $50{\cdot}2564+0{\cdot}02220''\,T$, T being the time reckoned from 1900 in centuries.

PRECINCT (from Lat. *praecingere*, to encircle, enclose, surround, *prae* and *cingere*, to gird), an enclosure, a space within the boundaries, marked by walls or fences or by an imaginary line, of a building or group of buildings, especially used of such a space belonging to a cathedral or other religious building. The word is frequently used, indefinitely, of the neighbourhood or environs of a place or building. In the United States of America it is applied to various minor territorial divisions or districts, for electoral or judicial purposes. In some of the states they correspond to the "township" as the principal subdivision of the "county."

PRECIOUS (O. Fr. *precios*, mod. *précieux*, Lat. *pretiosus*, of high value or price, *pretium*), costly or of high value, particularly used in political economy of those metals which are "valuable enough to be used as a standard of value and abundant enough for coinage" (*The Century Dictionary*). The term is thus practically confined to gold and silver. Platinum in theory may be included as it was used for coinage in Russia in 1828; the fluctuations in the value of the metal caused its discontinuance in 1845 (see GOLD, SILVER and MONEY). "Precious stones" include those gems which are valued for ornament and jewelry. "Strictly speaking the only *precious stones* are the diamond, ruby, sapphire and emerald, though the term is often extended to the opal, notwithstanding its lack of hardness, and to the pearl . . . strictly an animal product," G. F. Kunz, *Gems and Precious Stones of North America* (1890) (see GEM, and LAPIDARY AND GEM-CUTTING). A particular use of "precious" as meaning fastidious, over-refined, is taken from the French *précieux*, familiar in the appellation of *Les Précieuses*, given to the social and literary circle of ladies which centred round the Hôtel de Rambouillet in the 17th century (see RAMBOUILLET; CATHERINE DE VIVONNE, MARQUISE DE).

PRECONIZATION (Late Lat. *praeconizatio*, from *praeconizare*, to proclaim, Lat. *praeco*, a public crier), a public proclamation or announcement. In this sense it is practically obsolete; but the word is still technically used of the solemn proclamation of new bishops, and of the sees to which they are appointed, made by the pope in the consistory of cardinals (see BISHOP). In the English ecclesiastical courts "praeconize" is also still used in the sense of "to summon by name."

PREDELLA, the Italian word for a footstool or kneeling-stool, hence applied to the step or platform on which an altar rests, and to a shelf raised above the altar at the back, a super-altar or *gradino*. The face both of the step and shelf are frequently decorated with sculpture or painting, and the term "predella" is frequently given to the sculpture or painting so used, and, further, to any painting that is a pendant to a larger work.

PREDESTINATION (from Late Lat. *praedestinare*, to determine beforehand; from the root *sta*, as in *stare*, stand), a theological term used in three senses: (1) God's unchangeable decision from eternity of all that is to be; (2) God's destination of men to everlasting happiness or misery; (3) God's appointment unto life or "election" (the appointment unto death being called "reprobation," and the term "foreordination" being preferred to "predestination" in regard to it). In the first sense the conception is similar to that of fate; this assumes a moral character as *nemesis*, or the inevitable penalty of transgression. Sophocles represents man's life as woven with a "shuttle of adamant" (*Antigone*, 622–624). Stoicism formulated a doctrine of providence or necessity. Epicurus denies a divine superintendence of human affairs. A powerful influence in Scandinavian religion was exercised by the belief in "the *nornir*, or Fates, usually thought of as three sisters." In Brahminic thought *Karma*, the consequences of action, necessitates rebirth in a lower or higher mode of existence, according to guilt or merit. With some modifications this conception is taken over by Buddhism. The Chinese *tao*, the order of heaven, which should be the order for earth as well, may also be compared. According to Josephus (*Antiq.* xviii. 1, 3, 4; xiii. 5, 9) the Sadducees denied fate altogether, and placed good and evil wholly in man's choice; the Pharisees, while recognizing man's freedom, laid emphasis on fate; the Essenes insisted on an absolute fate. This statement is exposed to the suspicion of attempting to assimilate the Jewish sects to the Greek schools. In Islam the orthodox theology teaches an absolute predestination, and yet some teachers hold men responsible for the moral character of their acts. The freethinking school of the Mo'tazilites insisted that the righteousness of God in rewarding or punishing men for their actions could be vindicated only by the recognition of human freedom.

The question of the relation of divine and human will has been the subject of two controversies in the Christian church, the Augustinian-Pelagian and the Calvinistic-Arminian. Pelagius maintained the free-will of man, and held that man's conduct, character, destiny are in his own hand. Grace, by enlightening, forgiving sin and strengthening his moral powers, helps man to fulfil this purpose. While grace is meant for all, men make themselves worthy of it by striving after virtue. This doctrine as minimizing grace was repugnant to Augustine. He regarded mankind as sinful, guilty, ruined, incapable of any good. God alone can save. His grace is effectual and irresistible. As what God has done He has eternally willed to do, grace involves predestination. God has from eternity chosen those whom He wills to save ("election"), and consequently He has also passed over those whom He leaves to perish ("praeterition"). As all deserve damnation, there is no injustice in leaving them to their deserts. The "reprobation" of the wicked is not the cause of their sin; God's foreknowledge does not make the sin necessary; how reprobation and foreknowledge are related is not made plain.

The doctrine of Augustine was revived in the 9th century by Gottschalk, who taught that God's passing over the lost meant their predestination to punishment. Hincmar of Reims persecuted him for not distinguishing the two positions. This dispute would have little interest now, had not Hincmar appealed to John Scotus Erigena, who attempted to solve the theological problem by philosophical conceptions. He denied that foreknowledge or predestination as temporal relations could be properly predicated of God as eternal; he described sin and its consequences as negations, neither caused by nor known to God; he maintained that as evil is only a stage in the development of good, there will ultimately be a universal return to God. Thus the doctrine of reprobation was emptied of meaning. This defence of orthodoxy was condemned as heretical. The controversy was kept up during the scholastic period. Thomas Aquinas followed Augustine. Duns Scotus leaned toward Semi-Pelagianism, which rejected the doctrine of predestination, and maintained a co-operation of freedom and grace. While Aquinas affirmed the positions of Augustine, he deduced them from his Aristotelian conception of God as "first mover, itself unmoved." His original contribution to the subject was his theory of divine concurrence. He distinguishes secondary causes as natural and necessary, and as voluntary and contingent; though both are set in motion by God, yet as the natural remain natural, so do the voluntary remain voluntary. But this is clearly only a verbal solution.

At the Reformation the Augustinian position was accepted by both Luther and Calvin. Melanchthon modified his earlier view in the direction of synergism, the theory of a co-operation of divine grace and human freedom. The later Lutheran doctrine is "that man, unable as he is to will any good thing, can yet use the means of grace, and that these means of grace, carrying in themselves a divine power, produce a saving effect on all who do not voluntarily oppose their influence. Baptism, *e.g.* confers grace, which if not resisted is saving. And God, foreseeing who will and who will not, resist the grace offered, predestinates to life all who are foreseen as believers." Calvin's view is the same as Augustine's. He held the *sublapsarian* view that the fall was decreed, but not the *supralapsarian* view that it "was decreed as a means towards carrying out a previous decree to save some and leave others to perish." The latter view was held by Beza and other Calvinists, and, it is said, repelled Arminius from

Calvinism, and led him to formulate the doctrine that as repentance and faith are the divinely decreed conditions of eternal life, God has determined to give that life to all whom He foresees as fulfilling these conditions. According to Calvinism God's election unto salvation is absolute, determined by His own inscrutable will; according to Arminianism it is conditional, dependent on man's use of grace. The Synod of Dort (1618–1619) which affirmed the sublapsarian without excluding the supralapsarian form of Calvinism, condemned the views of Arminius and his followers, who were known as Remonstrants from the remonstrance "which in four articles repudiates supralapsarianism and infralapsarianism (which regarded the Fall as foreseen, but not decreed), and the doctrines of irresistibility of grace, and of the impossibility of the elect finally falling away from it, and boldly asserts the universality of grace." In the Church of Rome the Dominicans favoured Augustinianism, the Jesuits Semi-Pelagianism; the work of Molina on the agreement of free-will with the gifts of grace provoked a controversy, which the pope silenced without deciding; but which broke out again a generation later when Jansen tried to revive the decaying Augustinianism. The church of England has passed through several disputes regarding the question whether the Thirty-Nine Articles are Calvinistic or not; while there is some ambiguity in the language, it seems to favour Calvinism. At the Evangelical Revival the old questions came up, as Wesley favoured Arminianism and George Whitefield Calvinism. In Scotland Calvinism was repudiated by James Morison, the founder of the Evangelical Union, who declared the three universalities, God's love for all, Christ's death for all, the Holy Spirit's working for all.

While retained in the creeds of several denominations, in the public teaching of the churches the doctrine of predestination has lost its place and power. While the doctrine of election magnified God's grace, and so encouraged humility in man, it minimized man's freedom, and so produced either an over-confidence in those who believed themselves elect, or despair in those who could not reach the assurance. Now it is recognized that God's sovereignty must be conceived as consistent with man's liberty. While God fulfils His all-embracing purpose, that fulfilment leaves room for the exercise of individual freedom; the freedom God has bestowed on man He can so restrain and direct as to overrule even its abuse for His own gracious ends. That God desires that all should be saved, and that the salvation of each depends on his own choice—these are the general convictions of modern theology. The problem now is the reconciliation of human freedom with divine foreknowledge. Martineau accepts Dugald Stewart's solution. "There is no absurdity in supposing that the deity may, for wise purposes, have chosen to open a source of contingency in the voluntary actions of his creatures, to which no prescience can possibly extend." Others hold the problem to be insoluble, and not needing to be solved.
(A. E. G.*)

PREDICABLES (Lat. *praedicabilis*, that which may be stated or affirmed), in scholastic logic, a term applied to a classification of the possible relations in which a predicate may stand to its subject. The list given by the schoolmen and generally adopted by modern logicians is based on the original fivefold classification given by Aristotle (*Topics*, *a* iv. 101 b. 17–25): definition (*ὅρος*), genus (*γένος*), differentia (*διαφορά*), property (*ἴδιον*), accident (*συμβεβηκός*).[1] The scholastic classification, obtained from Böetius's Latin version of Porphyry's *Eisagoge*, modified Aristotle's by substituting species (*εἶδος*) for definition. Both classifications are of universals, concepts or general terms, proper names of course being excluded. There is, however, a radical difference between the two systems. The standpoint of the Aristotelian classification is the predication of one universal concerning another. The Porphyrian, by introducing species, deals with the predication of universals concerning individuals (for species is necessarily predicated of the individual), and thus created difficulties from which the Aristotelian is free (see below).

The Aristotelian classification may be briefly explained: (1) The *Definition* of anything is the statement of its essence (Arist. *τὸ τί ἦν εἶναι*), *i.e.* that which makes it what it is: *e.g.* "a triangle is a three-sided rectilineal figure." (2) *Genus* is that part of the essence which is also predicable of other things different from them in kind. A triangle is a rectilineal figure; *i.e.* in fixing the genus of a thing, we subsume it under a higher universal, of which it is a species. (3) *Differentia* is that part of the essence which distinguishes one species from another. As compared with quadrilaterals, hexagons, &c., all of which are rectilineal figures, a triangle is "differentiated" as having three sides. (4) A *Property* is an attribute which is common to all the members of a class, but is not part of its essence (*i.e.* need not be given in its definition). The fact that the interior angles of all triangles are equal to two right angles is not part of the definition, but is universally true. (5) An *Accident* is an attribute which may or may not belong to a subject. The colour of the human hair is an accident, for it belongs in no way to the *essence* of humanity.

This classification, though it is of high value in the clearing up of our conceptions of the essential contrasted with the accidental, the relation of genus, differentia and definition and so forth, is of more significance in connexion with abstract sciences, especially mathematics, than for the physical sciences. It is superior on the whole to the Porphyrian scheme, which has grave defects. As has been said it classifies universals as predicates of individuals and thus involves the difficulties which gave rise to the controversy between realism and nominalism (*q.v.*). How are we to distinguish species from genus? Napoleon was a Frenchman, a man, an animal. In the second place how do we distinguish property and accident? Many so-called accidents are predicable *necessarily* of any *particular* persons. This difficulty gave rise to the distinction of separable and inseparable accidents, which is one of considerable difficulty.

See the modern logic textbooks.

PREDICAMENT, now used only in the sense of a dangerous or unpleasant position or situation. It meant properly that which is "predicated" or affirmed (Lat. *praedicare*) of anything, in logic, one of the ten Aristotelian categories (see CATEGORY), and so any definite state or condition. The use of "predicament" in the sense of "bad predicament," without the limiting adjective, is paralleled by "plight," for "bad plight," "success" for "good success."

PREDICATION (from Lat. *praedicare*, to state, assert), in logic, the term which denotes the joining of a predicate to a subject in a judgment or proposition. The statement "all men are mortal" is to predicate mortality of all men. In other words a judgment is made up of a subject and a predicate joined by a copula. Since the true unit of thought is the judgment, since all concepts or universals exist only in continuous thinking (judging), the theory of predication is a fundamental part of logic. The true relation of subject and predicate has not been determined with unanimity, various logicians emphasizing different aspects of the process (see LOGIC). The logical use of "predicate" is to be distinguished from the grammatical, which includes the verb, whether it be the verb "to be" in its various forms, or another verb. The simple grammatical sentence "he strokes the dog" the first word is the subject, while "strokes the dog" is the predicate, including verb and object. In logic every proposition is reducible to the form "A is B," "B" being the predicate. Thus the logical form of "he strokes the dog" would be "he is stroking the dog" or some other periphrasis which liberates and determines the logical predicate. The true significance of the logical copula is difficult. It cannot be described simply as a third (*i.e.* separate part) of the judgment, because until two terms are enjoined by it they are not subject and predicate. Much discussion has raged round the question whether the use of the verb "to be" as the copula implies that *existence* is predicated by the subject. It may be taken as generally agreed that this is not the case (see further LOGIC, and the textbooks).

PRE-EXISTENCE, DOCTRINE OF, in theology, the doctrine that Jesus Christ had a human soul which existed before the creation of the world—the first and most perfect of created things—and subsisted, prior to His human birth, in union with the Second Person of the Godhead. It was this human soul which suffered the pain and sorrow described in the Gospels. The chief exposition of this doctrine is that of Dr Watts (*Works*, v. 274, &c.); it has received little support. In a wider form the doctrine has been applied to men in general—namely, that in the beginning of Creation God created the souls of all men, which were subsequently as a punishment for ill-doing incarnated in physical bodies till discipline should render them fit for spiritual existence. Supporters of this doctrine, the Pre-existants or Pre-existiani, are found as early as the 2nd century, among them being Justin Martyr and Origen (*q.v.*), and the idea not only belongs to metempsychosis and mysticism generally, but is widely prevalent in Oriental thought. It was condemned by the Council of Constantinople in 540, but has frequently reappeared in modern thought (cf. Wordsworth's *Intimations of Immortality*) being in fact the natural correlative of a belief in immortality.

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[1] Strictly Aristotle's classification is into four as *διαφορὰ* really belongs to *γένος*.

PREFACE (Med. Lat. *prefatia*, for classical *praefatio*, *praefari*, to speak beforehand), an introduction to a book, also any preliminary or introductory statement. In liturgical use the term is applied to that portion of the Eucharistic service which immediately precedes the canon or central portion; the preface, which begins at the words *Vere dignum*, "It is very meet, right, &c.," is ushered in, in all liturgies, with the *Sursum Corda*, "Lift up your hearts," and ends with the *Sanctus*, "Holy, Holy, Holy, &c." In the Western liturgies proper prefaces are appointed for particular occasions (see LITURGY).

PREFECT (*préfet*), in France, the title of a high official. The prefects of the department were created by a law of the 28th Pluviose in the year VIII. (Feb. 17, 1800). They were intended to be the chief organs of internal administration, and have, in fact, discharged this function, especially under the First and Second Empire, surviving, though with diminished importance, under the other forms of government which modern France has seen. In comparison with other French officials, they are well paid (the salary nowadays ranges from 39,000 to 18,000 francs according to the class).

In the administration of the *ancien régime* the term "prefect" was not employed; practically the only case in which it occurs was in the organization of the establishment of institutions opened by the religious orders, in which there was generally a "prefect of the studies" (*préfet des études*). In the year VIII., in the discussion of the law of the 28th Pluviose, no reason was stated for the choice of this term. But like the "Tribunes" and "Consuls" of the constitution of the year VIII., it was taken from the Roman institutions which were then so fashionable (see PRAEFECT); it may also be recalled that Voltaire had used the term "prefecture" in speaking of the authority of Louis XIV. over the free towns of Alsace.

The prefect has to a certain extent a double character and two series of functions. Firstly he is the general representative of the government, whose duty it is to ensure execution of the government's decisions, the exercise of the law, and the regular working of all branches of the public service in the department. In so far the rôle of the prefect is essentially political; he guarantees the direct and legal action of the government in his department. He has the supervision of all the state services in his department, which procures the necessary uniformity in the working of the services, each of which is specialized within a narrow sphere. He serves as a local source of information to the government, and transmits to it complaints or representations from those under his administration. In the name of the state he exercises a certain administrative control over the local authorities, such as the *conseil général*, the mayors and the municipal councils. This control, though considerably restricted by the law of the 10th of August 1871, on the *conseils généraux*, and that of the 5th of April 1884, on municipal organization, still holds good in some important respects. The prefect can still annul certain decisions of the *conseil général*. He can suspend for a month a municipal council, mayor or deputy-mayor; certain decisions of the municipal councils require his approval; and he may annul such of their regulations as are *extra vires*. He can annul or suspend the *maire's* decrees and he has also considerable control over public institutions, charitable and otherwise. He may make regulations (*règlements*) both on special points, in virtue of various laws, and for the general administration of the police.

When the prefects were created in the year VIII. the intendants of provinces of the *ancien régime* were taken as a model, and there is a great resemblance between their respective functions. The prefect, however, is no more than an intendant in miniature, being only at the head of a department, whereas the intendant was over a *généralité*, which was a much larger district. In the same way the *sous-préfets* correspond to the *subdélégués* of the intendants, with the difference that they are actual officials subordinate to the prefects, while the *subdélégués* were merely the representatives with whom the intendants provided themselves, and to whom they gave powers.

Secondly, the prefect is not only the general representative of the government, but the representative of the department in the management of its local interests. But his unfettered powers in this respect have been reduced under the third Republic. This has chiefly been the effect of the law of the 10th of August 1871, which has led to decentralization, by increasing the powers of the *conseils généraux*. The law created a departmental committee (*commission départementale*), elected by the *conseil général* which, in the interval of the sessions of the latter, takes part in matters concerning the administration of the departmental interests, either in virtue of the law, or by a delegation of powers from the *conseil général*.

The *sous-préfets*, having very limited powers of deciding questions, serve above all as intermediaries between the prefect and the persons under his administration. This function was most useful in the year VIII., when communications were difficult, even within a department, but nowadays it only leads to complications. As a matter of fact their chief service to the administration lies in keeping up good relations with the *maires* of the communes in their *arrondissement*, and thus acquiring a certain amount of influence over them. The National Assembly, which passed the law of the 10th of August 1871, had also decided to suppress the *sous-préfets*, but M. Thiers, who was then president of the Republic, persuaded them to reconsider this decision. Since then the Chamber of Deputies has on several occasions taken advantage of the budget to attempt the suppression of the *sous-préfets* by refusing to vote the amount necessary for the payment of their salaries. But the government has always opposed this unconstitutional measure, holding that the suppression could only be effected by an organic law, and that it would necessarily involve a remodelling of the administrative organization. So far their view has prevailed in the Chambers. (J. P. E.)

PREHNITE, a mineral consisting of calcium hydrogen orthosilicate, $H_2Ca_2Al_2(SiO_4)_3$. It crystallizes in the hemimorphic class of the orthorhombic system, but the hemimorphic character is usually obscured by twinning. Crystals are generally platy in habit, but they rarely occur singly and distinctly shaped; almost invariably they are closely aggregated together to form barrel-shaped or globular groups with a crystalline surface. This form, together with the pale oil-green colour, gives the mineral a very characteristic appearance. It is translucent and has a vitreous lustre. The hardness is rather over 6 and the spec. grav. 2·80–2·95. Crystals are pyro-electric. Prehnite is sometimes classed with the zeolites, since it occurs under the same conditions as these minerals and often in association with them: the small amount of water (4·4%) is, however, expelled only at a red heat and is therefore not water of crystallization.

Prehnite occurs as a mineral of secondary origin in the amygdaloidal cavities of basic igneous rocks, such as basalt and diabase, and less often, in veins in granite and gneiss. Fine specimens are found with zeolites in the volcanic rocks of several places in the south of Scotland, *e.g.* Old Kilpatrick in Dumbartonshire, Bishopton in Renfrewshire, Campsie Hills in Stirlingshire and in the neighbourhood of Edinburgh; also at Paterson and Bergen Hill in New Jersey, and with native copper in the trap-rocks of the Lake Superior region. In the French (at Le Bourg d'Oisans) and Tyrolese Alps it occurs with axinite, epidote, felspar, &c., lining crevices in gneiss. Large masses have been found at Cradock in Cape Colony, from which locality it was brought in the 18th century by Colonel Prehn, the governor of the colony; hence the names "Cape chrysolite" and prehnite (of A. G. Werner, 1789). Prehnite is sometimes cut and polished for small ornaments; it then somewhat resembles chrysoprase in appearance.

PREJUDICE (Lat. *praejudicium*), literally judgment or decision beforehand, which in classical usage meant a precedent, a preceding judgment, also a special form of judicial examination precedent to a trial, especially in matters relating to *status*. The transferred sense, of injury or damage inflicted by decisions or judgments disregarding interests affected, does not appear till post-classical times in Latin. This last use of damage appears in English in relation to legal matters, especially in the phrase "without prejudice," *i.e.* without detriment to rights or claims. When two parties are negotiating for the settlement of a dispute, statements or admissions made by or on behalf of either, with a stipulation, expressed or implied, that the statements are made "without prejudice" to the party's claims in the dispute, cannot be put in evidence in litigation to settle the dispute (see EVIDENCE). The general meaning of the word is that of opinion, favourable or hostile, based on prepossessions, and therefore biassed or unreasonable.

PREL, KARL, FREIHERR VON (1839–1899), German philosopher, was born at Landshut on the 3rd of April 1839. After studying at the university of Munich he served in the Bavarian army from 1859 to 1872, when he retired with the rank of captain. He then gave himself up to philosophical work, especially in connexion with the phenomena of hypnotism and occultism from the modern psychological standpoint. He attempted to deduce the existence of spirit, apart from, and yet entering from time to time into connexion with, the phenomena of the senses, by an examination of the relation between the ego of thought and the age of sensible experience as understood by Kant. In 1868 he received the degree of doctor from the university of Tübingen in recognition of a treatise on the psychology of Dreams (*Oneirokritikon. Der Traum vom Standpunkt des transcendentalen Idealismus*).

Subsequently, he published numerous works on various psychological and scientific subjects, of which the more important are: *Der gesunde Menschenverstand vor den Problemen der Wissenschaft* (1872); *Der Kampf ums Dasein am Himmel* (1874), republished in 1882 under the title *Entwickelungsgeschichte des Weltalls*; *Die Planetenbewohner und die Nebularhypothese* (1880); *Die Philosophie der Mystik* (1885); *Justinus Kerner und die Seherin von Prevorst* (1886); *Die monistische Seelenlehre* (1888); *Die Mystik der alten Griechen* (1888); *Kants mystische Weltanschauung* (1889); *Studien aus dem Gebiete der Geheimwissenschaften* (1890); *Der Spiritismus* (1893); *Die Entdeckung der Seele durch die Geheimwissenschaften* (1894–1895). In *Der Kampf ums Dasein am Himmel* von Prel endeavoured to apply the Darwinian doctrine of organic evolution not only to the sphere of consciousness but also even more widely as the philosophical principle of the world. He was one of a large number of German thinkers who during the latter half of the 19th century endeavoured to treat the mind as a mechanism. He died on the 4th of August 1899.

See Evolution; *in Philosophy*.

PRELATE (Lat. *praelatus*, set above, from *praefero*, prefer), an ecclesiastical dignitary of high rank. In the early middle ages the title *prelate* was applied to secular persons in high positions and thence it passed to persons having ecclesiastical authority. The *De prelatis* of Valerian is concerned with secular princes, and even as late as the 14th century the title was occasionally applied to secular magistrates. In medieval ecclesiastical usage the term might be applied to almost any person having ecclesiastical authority; it was very commonly given to the more dignified clergy of a cathedral church, but often also to ordinary priests charged with the cure of souls and, in the early days of monasticism, to monastic superiors, even to superiors of convents of women. The term occurs very frequently in the Rule of St Benedict and other early monastic rules.

In more modern usage in the Roman Catholic Church prelates, properly so-called, are those who have jurisdiction *in foro externo*, but a liberal interpretation has given the title a more general significance. Prelacy is defined by the canonists as "pre-eminence with jurisdiction" (*praeeminentia cum jurisdictione*), and the idea supposes an episcopal or quasi-episcopal jurisdiction. But gradually the title was extended to ecclesiastical persons having a prominent office even without jurisdiction, and later still it has come to be applied to ecclesiastical persons marked by some special honour though without any definite office or jurisdiction.

We may therefore distinguish "true" from "titular" prelates. The true prelacy is composed of the persons who constitute the ecclesiastical hierarchy; jurisdiction is inherent in their office and gives pre-eminence, as with patriarchs, archbishops and bishops. A good example of the dependence of prelacy on jurisdiction is found in those religious orders, such as the Dominicans, where authority is strictly elective and temporary. Thus a Dominican prior ranks *ipso facto* as a prelate during his three years of office, but, if not re-elected, loses this dignity with his jurisdiction.

The true, no less than the titular, prelates have their various ranks, differing as regards title, precedence, clothing and other insignia. The distinguishing colour of a prelate's clothing is violet; the form, like the greater or less use of violet, depends on the rank of the prelate. Four classes may be distinguished: (1) Great prelates, *e.g.* cardinals, archbishops and bishops. (2) Exempt prelates (*praelati nullius dioeceseos, praelati nullius*), *i.e.* abbots and religious superiors, who are withdrawn from the ordinary diocesan jurisdiction and themselves possess episcopal jurisdiction (*jurisdictio quasi episcopalis*). (3) Roman prelates, (*a*) active and (*b*) honorary. The title is applied to numerous ecclesiastics attached by some dignity, active or honorary, to the Roman court (see Curia Romana). In the list of these prelates are protonotaries apostolic, domestic prelates, private chamberlains, *participanti* and supernumerary. Of these last there are two kinds, honorary and honorary *extra urbem*. Only protonotaries and domestic prelates are for life; the others lose their dignity at the death of the pope who appointed them. A special class of Roman prelatures exist at Rome, endowed as a kind of ecclesiastical majority to which those members of certain families who are destined for the clerical life naturally succeed.

In the reformed churches the title was retained in England, Sweden, Denmark and Germany. The cathedral chapter of Brandenburg consists of two prelates, the dean and the senior, besides eight other members. The chapter of Merseburg contains five prelates, viz. the dean, senior, provost, custos and scholasticus. In Baden the general synod is presided over by the prelate (*prelat*), *i.e.* the principal "superintendent." In the Church of England the term prelate has been since the Reformation applied only to archbishops and bishops. The word "prelacy," meaning no more originally than the office and dignity of a prelate, came to be applied in Presbyterian Scotland and Puritan England—especially during the 17th century—to the episcopal form of church government, being used in a derogatory sense.

See Du Cange, *Glossarium mediae et infimae latinitatis* (new ed., by L. Favre, Niort, 1883); Paul Hinschius, *Kirchenrecht* (Berlin, 1869); F. H. Vering, professor of law at Prague, *Lehrbuch des katholischen, orientalischen und protestantischen Kirchenrechts* (1893).

(E. O'N.)

PRELLER, FRIEDRICH (1804–1878), German landscape-painter, was born at Eisenach on the 25th of April 1804. After studying drawing at Weimar, he went in 1821, on Goethe's advice, to Dresden, where in 1824 he was invited to accompany the grand duke of Weimar to Belgium. He became a pupil in the academy at Antwerp. From 1827 to 1831 he studied in Italy, and in 1831 received an appointment in the Weimar school of art. In 1834–1836 he executed in tempera six pictures on subjects taken from the *Odyssey* in the "Roman House" at Leipzig, in 1836–1837 the landscapes with scenes from *Oberon* in the Wieland room in the grand-ducal palace at Weimar, and in 1836–1848 six frescoes on Thuringian subjects commissioned by the grand duchess. In 1840 he visited Norway and produced a number of easel works, some of which are preserved at Weimar. In 1859 he revisited Italy, and on his return in 1861 he completed for the grand-ducal museum the frescoes illustrative of the *Odyssey*, which are held to constitute his chief claim to fame. Preller, who was also a successful etcher, died at Weimar on the 23rd of April 1878.

PRELLER, LUDWIG (1809–1861), German philologist and antiquarian, was born at Hamburg on the 15th of September 1809. After having studied at Leipzig, Berlin and Göttingen, in 1838 he was appointed to the professorship of philology at Dorpat, which, however, he resigned in 1843. He afterwards spent some time in Italy, but settled in Jena in 1844, where he became professor in 1846. In the same year he removed as head librarian to Weimar, where he died on the 21st of June 1861. His chief works are: *Demeter u. Persephone* (1837); *Griechische Mythologie* (1854–1855; 4th ed., by C. Robert, 1887 seq.); and *Römische Mythologie* (1858; 3rd ed. by H. Jordan, 1881–1883). He also co-operated with H. Ritter in the preparation of the most useful *Historia philosophiae graecae et romanae ex fontium locis contexta* (1838; ed. E. Wellmann, 1898). He contributed extensively to Ersch and Gruber's *Allgemeine Encyklopädie* and Pauly's *Realencyklopädie der classischen Altertumswissenschaft*. A complete list of his works will be found in *Ausgewählte Aufsätze aus dem Gebiete der klassischen Altertumswissenschaft* (ed. R. Köhler, 1864).

See G. T. Stichling, *Ludwig Preller. Eine Gedächtnissrede* (Weimar, 1863); C. Bursian, *Geschichte der classischen Philologie in Deutschland* (1883).

PREMIUM (Lat. *praemium*, profit, reward, *prae+emere*, to buy), in general, a reward or prize; a consideration. In the law of insurance, the sum of money or consideration (either annual or in a lump sum) which the insured pays the insurers in order to gain a certain amount in the event of some specific loss happening is termed a premium. The word is applied to the fee paid in consideration of being taught a trade or profession. It is also used in the sense of "bonus," as something beyond or additional, as in the phrases, "premium bonus system," "premium system," where a bonus or sum is given in addition to wages in proportion to the value of the work done. On the stock exchange, when a security has not yet been fully paid up, it is customary to quote its price at par, or so much *premium* or discount. Par represents the amount actually paid up on it, while if it is above the level it is said to be at a premium of so much, or if below at a discount.

PREMONITION (from Lat. *prae*, before, *monere*, to advise or warn), an impression relating to a future event. Strictly the word should mean a warning proceeding from an external source. Its modern extension to all forms of impression supposed to convey information as to the future is justified on the assumption that such intimations commonly originate in the subliminal consciousness of the percipient and are thence transferred to the ordinary consciousness. In modern times the best attested premonitions are those relating to events about to occur in the subject's own organism. It was observed by the animal magnetists at the beginning of the 19th century in France and Germany, that certain of their subjects, when in the "magnetic" trance, could foretell accurately the course of their diseases, the date of the occurrence of a crisis and the length of time needed to effect a cure. Similar observations were subsequently recorded in Great Britain and in America (see, for instance, the case of Anna Winsor, 1860–1863, reported by Dr Ira Barrows). The power of prediction possessed by the subject in such cases may be explained in two ways: (1) As due to an abnormal power of perception possessed by certain persons, when in the hypnotic trance, of the working of their own pathological processes; or (2) more probably, as the result of self-suggestion; the organism is "set" to explode at a given date in a crisis, or to develop the fore-ordained symptoms.

Apart from these cases there are two types of alleged premonitions. (1) The future event may be foreshadowed by a symbol. Amongst the best known of these symbolic impressions are banshees, corpse lights, phantom funeral processions, ominous animals or sounds and symbolic dreams (*e.g.* of teeth falling out). Of all such cases it is enough to say that it is impossible for the serious inquirer to establish any causal connexion between the omen and the event which it is presumed to foreshadow. (2) There are many instances, recorded by educated witnesses, of dreams, visions, warning voices, &c., giving precise information as to coming events. In some of these cases, where the dream, &c., has been put on record before its "fulfilment" is known, chance is sufficient to explain the coincidence, as in the recorded cases of dreams foretelling the winner of the Derby or the death of a crowned head. In cases where such an explanation is precluded by the nature of the details foreshadowed, the evidence is found to be defective, generally from the absence of contemporary documents. The persistent belief on the part of the narrators in the genuineness of their previsions indicates that in some cases there may be a hallucination of memory, analogous to the well known feeling of "false recognition." Prof. Josiah Royce has suggested for this supposed form of hallucination the term "pseudo-presentiment."

Bibliography.—See Puységur, *Du Magnétisme animal* (1807); Alexandre Bertrand, *Traité du somnambulisme* (1823); Mrs H. Sidgwick, *Proceedings S.P.R.*, vol. v.; F. W. H. Myers, *Proceedings S.P.R.*, vol. xi.; F. W. H. Myers, *Human Personality* (1903); F. Podmore, *Studies in Psychical Research* (1897); *Proceedings American Society for Psychical Research* (1889, Report on Phantasms and Presentiments); *Annales des sciences psychiques* (Jan.–Feb., 1889, Article on Premonitions by G. B. Ermacora). (F. P.)

PREMONSTRATENSIANS, also called Norbertines, and in England White Canons, from the colour of the habit: an order of Augustinian Canons founded in 1120 by St Norbert, afterwards archbishop of Magdeburg. He had made various efforts to introduce a strict form of canonical life in various communities of canons in Germany; in 1120 he was working in the diocese of Laon, and there in a desert place, called Prémontré, in Aisne, he and thirteen companions established a monastery to be the cradle of a new order. They were canons regular and followed the so-called Rule of St Augustine (see Augustinians), but with supplementary statutes that made the life one of great austerity. St Norbert was a friend of St Bernard of Clairvaux—and he was largely influenced by the Cistercian ideals as to both the manner of life and the government of his order. But as the Premonstratensians were not monks but canons regular, their work was preaching and the exercise of the pastoral office, and they served a large number of parishes incorporated in their monasteries. The order was founded in 1120; in 1126, when it received papal approbation, there were nine houses; and others were established in quick succession throughout western Europe, so that at the middle of the 14th century there are said to have been over 1300 monasteries of men and 400 of women. The Premonstratensians played a predominant part in the conversion of the Wends and the Christianizing and civilizing of the territories about the Elbe and the Oder. In time mitigations and relaxations crept in, and these gave rise to reforms and semi-independent congregations within the order. The Premonstratensians came into England (*c.* 1143) first at Newhouse in Lincoln, and before the dissolution under Henry VIII. there were 35 houses. At the beginning of the 19th century the order had been almost exterminated, only eight houses surviving, all in the Austrian dominions. There are now some 20 monasteries and 1000 canons, who serve numerous parishes; and there are two or three small houses in England. The strength of the order now lies in Belgium, where at Tongerloo is a great Premonstratensian abbey that still maintains a semblance of its medieval state.

Helyot, *Histoire des ordres réligieux* (1714), ii. chs. 23–26; Max Heimbucher, *Orden u. Kongregationen* (1907), ii. § 56; articles in Wetzer u. Welte *Kirchenlexicon* (2nd ed.) and Herzog *Realencyklopädie* (3rd ed.). The best special study is F. Winter, *Die Prämonstratenser des 12. Jahrh. und ihre Bedeutung für das nordöstliche Deutschland* (1865). (E. C. B.)

PŘEMYSL, the reputed ancestor of the line of dukes and kings which ruled in Bohemia from 873 or earlier until the murder of Wenceslaus III. in 1306, and which was known as the Přemyslide dynasty. According to legend Přemysl was a peasant of Staditz who attracted the notice of Libussa, daughter of a certain Krok, who ruled over a large part of Bohemia, and is said to have been descended from Samo. Přemysl married Libussa, the traditional foundress of Prague, and during the 8th century became prince of the Bohemian Čechs. His family became extinct when Wenceslaus III. died, but through females the title to Bohemia passed from the Přemyslides to the house of Luxemburg and later to the house of Habsburg.

See F. Palacky, *Geschichte von Böhmen*, Bd. I. (Prague, 1844).

PRENZLAU, or Prenzlow, a town of Germany, in the Prussian province of Brandenburg. It lies on the lower Ucker See, 30 m. W. by S. of Stettin by rail. Pop. (1905), 20,929. The Gothic church of St Mary (Evangelical), dating from 1340, is one of the finest churches in the district, and the remains of the town gates, walls and towers are also interesting. The industries include wool-spinning, iron-founding, brewing and sugar-refining. Tobacco is grown in the neighbourhood, and cigars are manufactured in the town.

Prenzlau is first mentioned in a document of the close of the 12th century, and received its municipal charter in 1235. As the capital of the old Uckermark it was a frequent object of dispute between Pomerania and Brandenburg until incorporated with the latter about 1480. At Prenzlau Prince Hohenlohe, with his corps of 12,000 men, surrendered to Murat on the retreat after the battle of Jena in October 1806.

See I. Ziegler, *Prenzlau, die ehemalige Hauptstadt der Uckermark* (Prenzlau, 1886).

PRERAU (Czech, *Přerov*), a town of Austria, in Moravia, 56 m. E.N.E. of Brünn by rail. Pop. (1900), 16,738, chiefly

Czěch. It is one of the oldest towns in Moravia, and possesses a Gothic town-hall and an old castle, once occupied by Matthias Corvinus. It has an important cloth industry, and manufactures of sugar, ropes, machinery and agricultural implements. Prerau was at one time the chief seat of the Moravian Brethren.

PREROGATIVE, in law, an exclusive privilege of the Crown. The word, originally an adjective, is derived from the *centuria praerogativa*, or century which voted first on a proposed law (*rogatio*) in the Roman *comitia centuriata*. In English law, Blackstone says, "by the word prerogative we are to understand the character and power which the sovereign hath over and above all other persons, in right of his regal dignity; and which, though part of the common law of the country, is out of its ordinary course. This is expressed in its very name, for it signifies, in its etymology, something that is required or demanded *before*, or in preference to, all others" (Stephen's *Comm.* vol. ii. bk. iv. pt. i. ch. vi.). The prerogative is sometimes called *jura regalia* or *regalia*, the *regalia* being either *majora*, the regal dignity and power, or *minora*, the revenue of the Crown.

The theory of English law as to the prerogative of the king seems to be not quite consistent. On the one hand, he is a perfect and irresponsible being, holding his office by divine right; George V., "*by the Grace of God* of Great Britain and Ireland King,"[1] is still the heading of every writ. On the other hand, his powers are defined and limited by law. This is laid down as early as the 13th century (Bracton, 5b). A consequence of this position is that the prerogative may be confined or extended by the supreme legislative authority, and that the courts have jurisdiction to decide whether or not any alleged right falls within the prerogative. The prerogative of the Crown, still of great extent, has been gradually limited by a long series of enactments, the most worthy of notice being *Magna carta*, *Confirmatio cartarum*, *Prerogativa regis*, the Petition of Right, the Habeas Corpus Act, the Bill of Rights and the Act of Settlement. The most important of the obsolete prerogatives which have been at one time claimed and exercised are the following: (1) the right to impose a tax upon the subject without the consent of parliament. (2) The right to dispense with the obligation of statutes, by the insertion in a grant of the clause *non obstante statuto* (see DISPENSATION). (3) The right of purveyance and pre-emption—that is, of buying up provisions at a valuation without the consent of the owner—and the right of impressing carriages and horses (see PURVEYANCE). (4) The authority to erect tribunals not proceeding according to the ordinary course of justice was declared illegal by 16 Car. I. c. 10 (the act dissolving the Star Chamber, the court of the marches of Wales, and the court of the president and council of the north). (5) The revenue from first-fruits and tenths (see ANNATES). (6) The right of corody—that is, of sending one of the royal chaplains to be maintained by a bishop until the bishop promotes him to a benefice—has become obsolete by disuse. (7) The right by forfeiture to the property of a convict upon his conviction for treason or felony was abolished by the Felony Act 1870. (8) The immunity of the Crown from payment of costs has been taken away in almost all cases. (9) The right to alienate crown lands by grant at pleasure was taken away by 1 Anne c. 8. In very few cases has the prerogative been extended by statute; the Regulation of the Forces Act was an example of such extension. By that act the jurisdiction of lords-lieutenant of counties over the auxiliary forces was revested in the Crown.

The prerogative may be exercised in person or by delegation. The prerogative of conferring honours is generally (though not necessarily) exercised by the king in person, as in the case of investment with knighthood and military or civil decorations. The delegation of the prerogative often takes place by commission, issued with or without a joint address from both houses of parliament. Parts of the prerogative—generally in the nature of profit, and so in derogation of the revenue of the Crown—may be conferred upon subjects by grant in letters patent, which will be presumed after enjoyment by the subject for a certain time. What in the king is a prerogative becomes a franchise in the subject, *e.g.* chases, warrens, wrecks, treasure-trove, courts-leet.

The existing prerogatives may be divided, with Blackstone, into such as are direct and such as are by way of exception; or perhaps better, with Chief Baron Comyns, into those affecting external relations and those affecting internal relations. Under the first class would fall the power of making war and concluding peace. As incidents to this power the king has the right of sending and receiving ambassadors, of concluding treaties, and of granting passports, safe-conducts, letters of marque and reprisals. These rights may be limited by international agreement; thus the Declaration of Paris, 1856, abolished privateering as far as the assenting nations (of whom Great Britain was one) were concerned.

The prerogatives affecting internal relations may be conveniently, if not scientifically, classified as personal, political, judicial, ecclesiastical and fiscal.

Personal.—In order that there may always be an existing head of the state the king is regarded as a corporation. He cannot die; there can only be a demise of the Crown—that is, a transfer of the royal authority to a different person. On the same principle the king cannot be under age, though in cases where the king has been of tender years a protector or regent has usually been appointed for administrative purposes. The king is personally irresponsible for crime or tort, it being an ancient common law maxim that the king can do no wrong, and that any injury suffered by a subject at the hands of the king is to be attributed to the mistake of his advisers. A curious consequence of this irresponsibility is that the king is apparently the only person in the realm who cannot under any circumstances arrest a suspected felon, for no action for false imprisonment would lie against him, and in the event of the arrest of an innocent person there would be a wrong without a remedy. He cannot be guilty of laches, or negligence. The maxim of the common law is "Nullum tempus occurrit regi." This is still the law in criminal matters. With a very few exceptions, such as prosecutions for treason and offences against the customs, no lapse of time will in England (though it is otherwise in Scotland) bar the right of the Crown to prosecute. The king is exempt from taxation on the ground that, as the revenue of the realm is his prerogative, it is useless for him to tax himself. But lands purchased by the privy purse are liable to taxation (39 & 40 Geo. III. c. 88, s. 6). He is also exempt from tolls (which can only exist as a franchise granted by him), and from the poor-rate, as he is not mentioned in the Poor Law Acts. His person cannot be arrested or his goods distrained or taken in execution. The privilege of exemption from taxation applies to his palaces and to the public buildings of the state. No kind of judicial process can be executed in a palace as long as it continues to be a royal residence. The privilege does not attach to palaces which the king has ceased to use as a dwelling, such as Hampton Court. The king has also several personal privileges of minor importance, such as the title of "majesty," the right to a royal salute, to the use of the royal standard and of special liveries, &c.

Political.—The king is the supreme executive and co-ordinate legislative authority. As such authority he has the attribute of sovereignty[2] or pre-eminence, and the right to the allegiance of his subjects. All land is mediately or immediately held of him. Land derelict suddenly by the sea, land newly discovered by subjects and islands arising in the sea are his. As paramount authority in parliament he can dissolve or prorogue it at pleasure, but cannot prolong it beyond seven years. In theory parliament only exists at his will, for it is summoned by his writ, and the vote for a member of parliament is only a franchise, not a right existing independently of his grant. He can refuse his assent to a bill passed by the houses of parliament. This right has, however, not been exercised since 1707, when Queen Anne refused the royal assent to a Scottish Militia Bill. The king has power to issue proclamations and (with the assent of the privy council) orders in council, in some cases as part of the ancient prerogative, in others under the provisions of an act of parliament. Proclamations are only binding so far as they are founded upon and enforce the laws of the realm. They cannot alter the common law or create a new offence. The king is the fountain of honour; as such he has the valuable power of granting peerages at will, so far as he is not restrained by any act of parliament, and so far as he keeps within certain constitutional limits, *e.g.* he cannot insert a shifting clause in a patent of peerage. He also confers all other titles of honour, whether hereditary or not, and grants precedence and armorial bearings. The great officers of state are appointed by the king. The only restriction upon the creation of offices is that he cannot create new offices with new fees attached to them, or annex new fees to old offices, for this would be to impose a tax upon the subject without an act of parliament. The king, as head of the state, is in supreme command of the army and navy for the defence of the realm. This right, contested by the Long Parliament, was finally declared by 13 Car. II. c. 6 to be in the king alone. The right of command carries with it as an incident the right to build forts and defences, to impress seamen in case of necessity, and to prohibit the importation of munitions of war (39 & 40 Vict. c. 36, s. 43), also the right to the soil of the foreshore and of estuaries of rivers, and the jurisdiction over territorial waters. Other rights which fall under the political branch of the prerogative may be called the commercial rights, including the coining of money, the regulating of weights and measures, the establishing of markets and fairs, and the erecting of beacons, lighthouses and sea-marks. As *parens patriae* he is *ex officio* guardian of infants, idiots and lunatics. It is scarcely necessary to point out that all these prerogatives (except the conferring of honours and such prerogatives as are purely personal) are exercised through responsible ministers, practically in these days members of the party to which the majority of the House of Commons belongs. Thus the jurisdiction over infants, &c., is exercised in England by the lord chancellor, and over beacons, &c., by the Trinity House, under the general superintendence of the Board of Trade.

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[1] There is no difference in the prerogative as exercised by a king or a queen regnant, so that the word "king" in its constitutional sense includes queen. That the queen regnant has the same rights as a king was declared by 1 Mary sess. 3, c. 1.

[2] The word "sovereign" is frequently applied to the king in legal works. It should be borne in mind at the same time that the king is not a sovereign in the strict sense in which the term is used by Austin.

Judicial.—The king is the fountain of justice, and the supreme conservator of the peace of the realm. As supreme judge the king has the appointment of all judicial officers (other than those in certain local courts), who act as his deputies. He may constitute legal courts for the administration of the general law of the land, but he cannot erect tribunals not proceeding according to the known and established law of the realm, such as the Star Chamber or the commissions of martial law forbidden by the Petition of Right. Nor can he add to the jurisdiction of courts; thus he cannot give a spiritual court temporal powers. The king was in theory supposed to be present in court. Actions in the king's bench were until modern times said to be *coram rege ipso*, and the king could not be non-suited, for a non-suit implied the non-appearance of the plaintiff in court. The king enforces judgment by means of the sheriff, who represents the executive authority. As supreme conservator of the peace, the king, through the lord-lieutenant in counties, and through the lord chancellor in cities and boroughs, appoints justices of the peace. In the same capacity he is the prosecutor of crimes. All indictments still conclude with the words "against the peace of our lord the king, his crown and dignity." As it is the king's peace that is broken by the commission of a crime, the king has, as the offended party, the power of remission. The king cannot be sued by ordinary action. He may sue by ordinary action, but he has the advantage of being able to use prerogative process (see below). He has the right of intervention in all litigation where his rights are concerned, or in the interests of public justice, as where collusion is alleged between the decree nisi and the decree absolute in divorce. Crown debts have priority in administration and bankruptcy.

Ecclesiastical.—The king is recognized as "supreme governor" of the Church by 26 Hen. VIII. c. 1, and 1 Eliz. c. 1. By this prerogative he convenes and dissolves convocation and nominates to vacant bishoprics and other ecclesiastical preferments. The dean and chapter of a cathedral cannot proceed to the election of a bishop without the king's permission to elect (see CONGÉ D'ÉLIRE). When any benefice is vacant by the promotion of the incumbent to a bishopric other than a colonial bishopric the king has the patronage *pro hac vice*. The king cannot create new ecclesiastical jurisdiction in England or in colonies other than crown colonies. Where a new bishopric is created it is under the powers of an act of parliament.

Fiscal.—The theory of the constitution is that the king, being entrusted with the defence of the realm and the administration of justice, must have sufficient means given him for the purpose. The bulk of the revenue of the Norman and Plantagenet kings was derived from crown lands and feudal dues. At the present day the rents of crown lands form a very small part of the revenue, and the feudal dues do not exist except in the pecuniarily unimportant cases of escheat, royal fish, wrecks, treasure trove, waifs and strays, &c. Of the revenue a comparatively small part (the civil list) is paid to the king in person, the rest (the consolidated fund) is applied to public purposes.

Prerogative Process.—This is the name given to certain methods of procedure which the Crown alone has the right of using; such are inquest of office (an inquiry by jury concerning the right of the Crown to land or goods), extent (a mode of execution), *scire facias* (for the resumption of a grant), and information (by which proceedings are commenced in the name of the attorney-general for a public wrong or for injury to crown property).

Prerogative Writs.—Certain writs are called "prerogative writs," as distinguished from writs of right, because it is within the prerogative to issue or reissue them (see WRIT).

Besides the authorities cited, see Allen, *Inquiry into the Rise and Growth of the Royal Prerogative in England*; Chitty, *The Prerogative of the Crown*; Staunforde, *Exposition of the King's Prerogative*; Comyns, *Digest*, art. "Praerogative"; Broom, *Constitutional Law*; and the works of W. Bagehot, S. Low, A. V. Dicey and Sir W. Anson, on the Constitution.

PREROGATIVE COURTS, the name given to the English provincial courts of Canterbury and York, as far as regarded their jurisdiction over the estates of deceased persons.

They had jurisdiction to grant probate or administration where the diocesan courts could not entertain the case owing to the deceased having died possessed of goods above the value of £5 (*bona notabilia*) in each of two or more dioceses. The jurisdiction of the prerogative courts was transferred to the Court of Probate in 1857 by the Probate Court Act, and is now vested in the Probate, Divorce and Admiralty Division of the High Court of Justice by the Judicature Act 1875. In the state of New Jersey, United States, the court having jurisdiction over probate matters is called the Prerogative Court.

PRESBYTER (Gr. *πρεσβύτερος*, elder, the comparative of *πρέσβυς*, an old man), the title borne from very early times by certain officers or ministers of the Christian Church intermediate between "bishops" and "deacons." The specialized use of the word as implying not only age, but consequently wisdom and authority, is analogous to that of "senate" (from senior), of "gerousia" (from *γέρων*), and of "elder." It is the original form of priest (*q.v.*). The word is not found in pre-Christian writings except in the Septuagint, though as Deissmann has shown it is found on the Papyri as an official title for the village magistrates of Egypt and the members of the *γερουσία*, or senate, of many towns in Asia Minor. The office is, however, closely analogous to, and perhaps founded on, a similar office in the Jewish synagogue organization among the officials of which were the *zekenim*, or elders, sometimes identified with the archisynagogues. In the New Testament the Greek word is used both for the ancient Jewish official and for the Christian elder. On Jewish tombstones of the Hellenistic period the title is frequently found, sometimes applied to women. The head official of the English Jews prior to their expulsion bore the title of *Presbyter judaeorum*; opinions differ as to whether this officer was ecclesiastical or had merely the secular duty of supervising the exchequer of the Jews (see further *The Jewish Encyclopedia*, 1905, x. 190, 191).

The history of presbyteral government as opposed to episcopacy and pure congregationalism is not known in detail. After the Reformation, however, it was adopted by Calvin and his followers, who created that system which has ever since been known as Presbyterianism (*q.v.*). There are many theories as to the origin of the office of presbyter in the Christian Church. (1) Some connect it with the appointment of the seven recorded in Acts vi. This is the view taken by Boehmer,[1] Ritschl[2] and Lindsay.[3] It is urged that the traditional view which regards the seven as deacons is untenable because the term "deacon" is never used in the narrative, and there is no reference to the office in the Acts. On the other hand the officials of the Jerusalem church are always called "elders" and when they are first introduced (Acts xi. 30) appear to be discharging the functions for which "the seven" were specially set apart. (2) The view adopted by the majority of English scholars is, while refusing to accept the connexion between the presbyters and the seven, to regard the office as distinctly primitive and say that it was taken over by the earliest Christian community at Jerusalem from the Jewish synagogue.[4] (3) Harnack and a few other modern scholars[5] maintain that the office of presbyter did not come into existence till the 2nd century. During the last quarter of the 1st century, a three-fold organization is found in the Church: (*a*) a spiritual organization composed of "apostles, prophets and teachers who had been awakened by the spirit and by the spirit endowed"; (*b*) an administrative organization, "For the care of the poor, for worship, for correspondence, the congregation needed controlling officials. These were the bishop and the deacons, the former for higher, the latter for inferior services"; (*c*) a patriarchal organization based upon the natural deference of the younger to the older members of the Church. The senior members of the community, by virtue of their age and experience, watched over the conduct and guided the action of the younger and less experienced portion of the Church, though they held no official position and were not appointed for any particular work like the bishops and deacons. In the 2nd century the patriarchal element in the organization was merged in the administrative, and the presbyters became a definite order in the ministry. The time at which the change occurred cannot be definitely fixed. "In some congregations," as Harnack says, "it may have been long before the elders were *chosen*, in others this may have come very soon; in some the sphere of the competency of the presbyters and patrons may have been quite indefinite and in others more precise." Harnack's theory is based upon the following arguments: (*a*) The silence of the genuine Epistles of St Paul and the Epistle to the Hebrews. In I Cor. xii. 28 Paul says that God has given to the Church apostles, prophets, teachers, miracles, gifts of healing, helps, governments; but of presbyters he has not a word to say. Even from passages where he is speaking of the jurisdiction of the congregation, as for example in I Cor. v., vi., the presbyters are absent, while in Phil. i. I it is the bishops and deacons that he mentions. (*b*) The documents in which presbyters are mentioned in an official sense, viz. the Epistle of James, the first Epistle of Peter, the Acts of the Apostles and the Pastoral Epistles belong to a later age and reflect the customs of their own day rather than those of the primitive Church. (*c*) Even Clement of Rome does not say that the apostles had appointed presbyters in the congregation, he speaks only of bishops and deacons. For this reason the statement in Acts xiv. 23 is to be looked upon with suspicion. These arguments, however, are not absolutely decisive. It is true that presbyters are not mentioned in the genuine Epistles of St Paul, but there are hints that similar officers existed in some of the churches founded by the apostle. There is a reference in I Thess. v. 12 to "those who rule over you" (*προϊστάμενοι*), and the same word occurs in Rom. xii. 8.[1] The term "governments" (*κυβερνήσεις*) in I Cor. xiv. 28 obviously refers to men who discharged the same functions as presbyters. If too, as seems most probable, bishops and presbyters were practically identical, there is of course a specific reference to them in Phil. i. I. The "leaders" who are mentioned three times in Hebrews xiii. were also probably "presbyters" under another name. Harnack's second argument depends for its validity upon certain conclusions with regard to the date of James and I Peter, which are not universally accepted. Few English scholars, for instance, would accept as late a date as 120–140 for James, and I Peter may be as early as 65, as Harnack himself admits, though he prefers a date in the reign of Domitian. If this possibility in regard to I Peter is granted, it is fatal to the theory, because at the time when the epistle was written official presbyters were so well established that abuse and degeneration had already begun to creep in and some of the elders were already guilty of "lording it over their heritage" and making a profit out of their office (I Pet. v. I–4). With regard to the testimony of Acts, the only question, since Harnack admits the Lucan authorship,[2] is whether Luke is describing the organization of the Church as it existed at the time of the events recorded or reflecting the arrangements which prevailed at the time when the book was written. It is difficult to see how Luke can have been wrong with regard to the "Ephesian elders" who came to meet Paul at Miletus since he was present on the occasion (xx. 15–17). The only mistake that seems possible is that he may have conferred a later title upon the emissaries of the Church of Ephesus. This is not likely, but, at all events, it would only prove that the office under another name existed at Ephesus, for otherwise Luke could not possibly have put into the mouth of Paul the address which follows. Neither is there prima facie ground for objecting to the statements with regard to the presbyters of Jerusalem. If the Church at Jerusalem had any officials, it is highly probable that those officials bore the name and took over the functions of the elders of the synagogue. The statement in Acts xiv. 23, that Paul and Barnabas appointed elders in the churches of South Galatia, is more open to objection perhaps, owing to the silence of the Epistle to the Galatians. With regard to the evidence of the Epistle of Clement, Harnack seems to be incorrect in his conclusions. Scholars of such opposite schools of thought as Schmiedel[3] and Lindsay[4] maintain that the epistle contains the most explicit references to presbyters of the official type. The crucial passage (xliv. 4–6) seems to bear out their contention. "It will be no light sin for us if we thrust out of the oversight (*ἐπισκοπή*) those who have offered the gifts unblameably and holily. Blessed are those *presbyters* who have gone before . . . for they have no fear lest any one should remove them from their appointed place" (*ἀπὸ τοῦ ἱδρυμένου τόπου*). There is an equally specific reference in liv. 2: "Only let the flock of Christ keep peace with its duly-appointed presbyters" (*μετὰ τῶν καθισταμένων πρεσβυτέρων*).

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[1] *Diss. jur. eccl.* p. 373.

[2] *Entstehung der altkatholischen Kirche*, 2nd ed. p. 355.

[3] *The Church and the Ministry*, p. 116; cf. also Brown, *Apostolical Succession*, p. 144.

[4] Lightfoot, *Ep. to the Philippians*, p. 192.

[5] *E.g.* Sohm, *Kirchenrecht*, 92; Weizsäcker, *Apostolic Age* (Eng. trans. ii. 330); Allen, *Christian Institutions*, p. 38; A. C. McGiffert, *Apostolic Age*, p. 663 (1897).

The conclusions which we seem to reach are as follows: (I) In the earliest stage (between 30 and 60) there is no uniform organization in the Christian Church. Presbyters are found in Jerusalem from primitive times. In the Pauline churches the name is not found except at Ephesus and possibly in south Galatia, though there are traces of the office, at any rate in germ, under different titles in other churches. (2) In the second stage (between 60 and 100) there is an increasing tendency towards uniformity. The office is found definitely mentioned in connexion with the churches of Asia Minor (I Pet. i. I), Corinth (Epistle of Clement) and Crete (Titus). The officials were called by two names, "elders" and "bishops," the former denoting the office, the latter the function (exercising the oversight). The substantial identity of the two titles cannot be doubted in the light of such passages as Acts xx. 17, 28; I Pet. v. I, 2; I Tim. iii. I–7, v. 17–19 and Titus i. 5–7.

There is far less controversy with regard to the later history of the presbyters. The third stage of the development of the office is marked by the rise of the single *episcopus* as the head of the individual church (see BISHOP; EPISCOPACY). The first trace of this is to be found in the Epistles of Ignatius which prove that by the year 115 "the three orders" as they were afterwards called—bishop, presbyters and deacons—already existed, not indeed universally, but in a large proportion of the churches. The presbyters occupied an intermediate position between the bishop and the deacons. They constituted "the council of the bishop." It was some time before the threefold ministry became universal. The *Didache* knows nothing of the presbyters; bishops and deacons are mentioned, but there is no reference to the second order. The *Shepherd of Hermas* knows nothing of the single bishop; the churches are under the control of a body of presbyter-bishops. Before the close of the 2nd century however the three orders were established almost everywhere. The sources of the Apostolic Canons (which date between 140–180) lay down the rule that even the smallest community of Christians, though it contain only twelve members, must have its bishop and its presbyters. The original equality of bishops and presbyters was still however theoretically maintained. The Canons of Hippolytus which belong to the end of the 2nd century distinctly lay it down that "at the ordination of a presbyter everything is to be done as in the case of a bishop, save that he does not seat himself upon the throne. The same prayer shall also be said as for a bishop, the name of the bishop only being left out. The presbyter shall in all things be equal with the bishop, save in the matter of presiding and ordaining, for the power to ordain is not given him." The presbyters formed the governing body of the church. It was their duty to maintain order, exercise discipline, and superintend the affairs of the Church. At the beginning of the 3rd century, if we are to believe Tertullian, they had no spiritual authority of their own, at any rate as far as the sacraments are concerned. The right to baptize and celebrate the communion was delegated to them by the bishop.[5]

In the fourth stage we find the presbyters, like the bishops, becoming endowed with special sacerdotal powers and functions. Up to the end of the 2nd century the universal priesthood of all believers was the accepted doctrine of the Church. It was not till the middle of the 3rd century that the priesthood was restricted to the clergy. Cyprian is largely responsible for the change, though traces of it are found during the previous half century. Cyprian bestows the highest sacerdotal terms upon the bishops of course, but his references to the priestly character of the office of presbyter are also most definite.[6] Henceforth presbyters are recognized as the *secundum sacerdotium* in the Church.

With the rise of the diocesan bishops the position of the presbyters became more important. The charge of the individual church was entrusted to them and gradually they took the place of the local bishops of earlier days, so that in the 5th and 6th centuries an organization was reached which approximated in general outline to the system which prevails in the Anglican Church to-day.

See Hatch, *Organization of the Early Christian Churches* (2nd ed., 1882), and Harnack's "*excursus*" in the German edition of this work (1883); Harnack, *Die Lehre der zwölf Apostel* (1884); Loening, *Die Gemeindeverfassung des Urchristentums* (1889); Sohm, *Kirchenrecht* (1892); an article by Loofs, in *Studien und Kritiken*, for 1890 (pp. 619-658); Lindsay, *The Church and the Ministry in the Early Centuries* (1902); Schmiedel, article "Ministry," in *Enc. Bib.* (H. T. A.)

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[1] Hort translates *προϊστάμενοι* "those who care for you," but I Tim. iii. 12 and v. 17 seem to be against this. In Justin Martyr, *Apol.* i. 67, *προεστώς* evidently refers to "the president of the church," and in a recently discovered papyrus which Ramsay dates 303 a certain bishop is described as *λαοῦ προϊστάμενον*, *Studies in Roman Provinces*, pp. 125–126.

[2] *Lukas der Arzt* (1906), cap. I.

[3] *Ency. Bib.* p. 3134 sqq.

[4] *The Church and the Ministry*, p. 160. Cf. also Loening, *Die Gemeindeverfassung des Urchristentums*, p. 58.

[5] Tertull. *De bapt*, 17: "Baptismi dandi habet jus summus sacerdos qui est episcopus; dehinc presbyteri . . . . non tamen sine episcopi auctoritate."

[6] Cf. Ep. 58: "Presbyteri cum episcopo sacerdotali honore conjuncti."

PRESBYTERIANISM, a highly organized form of church government in which presbyters or elders occupy a prominent place. As one of the three principal systems of ecclesiastical polity known to the Christian Church, Presbyterianism occupies an intermediate position between episcopacy and congregationalism. A brief comparison with these will indicate its salient features. In episcopacy the supreme authority is a diocesan bishop; in congregationalism it is the members of the congregation assembled in church meeting; in Presbyterianism it is a church council composed of representative presbyters. In episcopacy the control of church affairs is almost entirely withdrawn from the people; in congregationalism it is almost entirely exercised by the people; in Presbyterianism it rests with a council composed of duly appointed office-bearers chosen by the people. The ecclesiastical unit in episcopacy is a diocese, comprising many churches and ruled by a prelate; in congregationalism it is a single church, self-governed and entirely independent of all others; in Presbyterianism it is a presbytery or council composed of ministers and elders representing all the churches within a specified district. It may be said broadly, therefore, that in episcopacy the government is monarchical; in congregationalism, democratic; and in Presbyterianism, aristocratic or representative.

I.—THE SYSTEM DESCRIBED

One Order.

As compared with the Church of England (Episcopal) in which there are three orders of clergy—bishops, priests and deacons, the Presbyterian Church recognizes but one spiritual order, viz. presbyters. These are ecclesiastically of equal rank, though differentiated, according to their duties, as ministers who preach and administer the sacraments, and as elders who are associated with the ministers in the oversight of the people. There are deacons in Presbyterianism inferior in rank to presbyters, their duties being regarded as non-spiritual.

Membership.

The membership of a Presbyterian Church consists of all who are enrolled as communicants, together with their children. Others who worship regularly without becoming communicants are called adherents. Only communicants exercise the rights of membership. They elect the minister and other office-bearers. But, in contrast with Congregationalism, when they elect and "call" a minister their action has to be sustained by the presbytery, which judges of his fitness for that particular sphere, of the measure of the congregation's unanimity, and of the adequacy of financial support. When satisfied, the presbytery proceeds with the ordination and induction. The ordination and induction of ministers is always the act of a presbytery. The ordination and induction of elders in some branches of the Church is the act of the kirk-session; in others it is the act of the presbytery.

Kirk-Session.

The kirk-session is the first of a series of councils or church courts which are an essential feature of Presbyterianism. It consists of the ministers and ruling elders. The minister is *ex officio* president or moderator. Without his presence or the presence of his duly-appointed deputy the meeting would not be in order nor its proceedings valid. The moderator has not a deliberative, but only a casting vote. (This is true of the moderator in all the church courts.) Neither the session nor the congregation has jurisdiction over the minister. He holds his office *ad vitam aut culpam*; he cannot demit it or be deprived of it without consent of the presbytery. In this way his independence among the people to whom he ministers is to a large extent secured. The kirk-session has oversight of the congregation in regard to such matters as the hours of public worship, the arrangements for administration of the sacraments, the admission of new members and the exercise of church discipline. New members are either catechumens or members transferred from other churches. The former are received after special instruction and profession of faith; the latter on presenting a certificate of church membership from the church which they have left. Though the admission of new members is, strictly speaking, the act of the session, this duty usually devolves upon the minister, who reports his procedure to the session for approval and confirmation. Matters about which there is any doubt or difficulty, or division of opinion in the session, may be carried for settlement to the next higher court, the presbytery.

The Presbytery.

The presbytery consists of all the ministers and a selection of the ruling elders from the congregations within a prescribed area. The presbytery chooses its moderator periodically from among its ministerial members. His duty is to see that business is transacted according to Presbyterian principle and procedure. The moderator has no special power or supremacy over his brethren, but is honoured and obeyed as *primus inter pares*. The work of the presbytery is episcopal. It has oversight of all the congregations within its bounds; hears references from kirk-sessions or appeals from individual members; sanctions the formation of new congregations; superintends the education of students for the ministry; stimulates and guides pastoral and evangelistic work; and exercises discipline over all within its bounds, including the ministers. Three members, two of whom must be ministers, form a quorum; a small number compared with the important business they may have to transact, but the right of appeal to a higher court is perhaps sufficient safeguard against abuse. Presbytery meetings are either ordinary or occasional. The former are held at prearranged intervals. Occasional meetings are either *in hunc effectum* or *pro re nata*. The presbytery fixes the former for specific business; the latter is summoned by the moderator, either on his own initiative or on the requisition of two or more members of presbytery, for the transaction of business which has suddenly emerged. The first question considered at a *pro re nata* meeting is the action of the moderator in calling the meeting. If this is approved the meeting proceeds; if not, the meeting is dissolved. Appeals and complaints may be taken from the presbytery to the synod.

The Synod.

The synod is a provincial council which consists of the ministers and representative elders from all the congregations within a specified number of presbyteries, in the same way as the presbytery is representative of a specified number of congregations. Though higher in rank and larger than most presbyteries it is practically of less importance, not being, like the presbytery, a court of first instance, nor yet, like the general assembly, a court of final appeal. The synod at its first meeting chooses a minister as its moderator whose duties, though somewhat more restricted, are similar to those of presbyterial moderators. The synod hears appeals and references from presbyteries; and by its discussions and decisions business of various kinds, if not settled, is ripened for consideration and final settlement by the general assembly, the supreme court of the Church.

The General Assembly.

The general assembly is representative of the whole Church, either, as in the Irish General Assembly, by a minister and elder sent direct to it from every congregation, or, as in the Scottish General Assemblies, by a proportion of delegates, ministers and elders from every presbytery. The general assembly annually at its first meeting chooses one of its ministerial members as moderator. He takes precedence, *primus inter pares*, of all the members, and is recognized as the official head of the Church during his term of office. His position is one of great honour and influence, but he remains a simple presbyter, without any special rule or jurisdiction. The general assembly reviews all the work of the Church; settles controversies; makes administrative laws; directs and stimulates missionary and other spiritual work; appoints professors of theology; admits to the ministry applicants from other churches; hears and decides complaints, references and appeals which have come up through the inferior courts; and takes cognizance of all matters connected with the Church's interests or with the general welfare of the people. As a judicatory it is the final court of appeal; and by it alone can the graver censures of church discipline be reviewed and removed. The general assembly meets once a year at the time and place agreed upon and appointed by its predecessor.

Conciliar Courts.

By means of this series of conciliar courts the unity of the Church is secured and made manifest; the combined, simultaneous effort of the whole is made possible; and disputes, instead of being fought out where they arise, are carried for settlement to a larger and higher judicatory, free from local feeling and prejudice. As access to the church courts is the right of all, and involves but slight expense, the liberty of even the humblest member of the Church is safeguarded, and local oppression or injustice is rendered difficult.

The weak point in the system is that episcopal superintendence being exercised in every case by a plurality of individuals there is no one, moderator or senior member, whose special duty it is to take initial action when the unpleasant work of judicial investigation or ecclesiastical discipline becomes necessary. This has led in some quarters to a desire that the moderator should be clothed with greater responsibility and have his period of office prolonged; should be made, in fact, more of a bishop in the Anglican sense of the word.

Though the *jus divinum* of presbytery is not now insisted upon as in some former times, Presbyterians claim that it is the church polity set forth in the New Testament. The case is usually stated somewhat as follows. With the sanction and under the

New Testament Authority.

guidance of the Apostles, officers called elders and deacons were appointed in every newly-formed church.[1] They were elected by the people, and ordained or set apart for their sacred work by the Apostles.[2] The elders were appointed to teach and rule;[3] the deacons to minister to the poor.[4] There were elders in the church at Jerusalem,[5] and in the church at Ephesus;[6] Paul and Barnabas appointed elders in the cities of Lycaonia and Pisidia;[7] Paul left Titus in Crete to appoint elders in every city;[8] the elders amongst the strangers scattered throughout Pontus, Galatia, Cappadocia, Asia and Bithynia received a special exhortation by Peter.[9] These elders were rulers, and the only rulers in the New Testament Church. Just as in the synagogue there was a plurality of rulers called elders, so there was in every Christian church a plurality of elders. The elders were different from the deacons, but there is no indication that any one elder was of higher rank than the others. The elder was not an officer inferior and subordinate to the bishop. The elder was a bishop. The two titles are applied to the same persons. See Acts xx. 17, 28; " he sent and called for the *elders* of the church. . . . Take heed to all the flock over which the Holy Ghost hath made you bishops." See also Titus i. 5, 6: " ordain *elders* . . . for a *bishop* must be blameless." This is now admitted by modern expositors.[10] The elders were chosen by the people. This is not expressly stated in the New Testament but is regarded as a necessary inference. When an apostle was about to be chosen as successor to Judas, the people were invited to take part in the election;[11] and when deacons were about to be appointed the Apostles asked the people to make the choice.[12] It is inferred that elders were similarly chosen. It is worthy of notice that there is no account at all of the first appointment of elders as there is of deacons. Probably the recognition and appointment of elders was simply the transfer from the synagogue to the Church of a usage which was regarded as essential among Jews; and the Gentile churches naturally followed the example of the Jewish Christians.[13] The elders thus chosen by the people and inducted to their office by the Apostles acted as a church court. Only thus could a plurality of rulers of equal rank act in an efficient and orderly way. They would discharge their pastoral duties as individuals, but when a solemn ecclesiastical act, like ordination, was performed, it would be done, as in the case of Timothy, by " the laying on of the hands of the presbytery ";[14] and when an authoritative decision had to be reached, as in regard to circumcision, a synod or court was called together for the purpose.[15] The action of Paul and Barnabas at Antioch[16] seems to accord with Presbyterian rather than Congregational polity. The latter would have required that the question should have been settled by the church at Antioch instead of being referred to Jerusalem. And the decision of the council at Jerusalem was evidently more than advisory; it was authoritative and meant to be binding on all the churches.[17] The principle of ministerial parity which is fundamental in Presbyterianism is founded not merely on apostolic example but on the words of Christ Himself: " Ye know that the princes of the Gentiles exercise dominion over them, and they that are great exercise authority upon them. But it shall not be so among you."[18]

Alternative Definitions.

From the foregoing outline it will be seen that Presbyterianism may be said to consist in the government of the Church by representative assemblies composed of the two classes of presbyters, ministers and elders, and so arranged as to manifest and realize the visible unity of the whole Church. Or it may be described as denying (1) that the apostolic office is perpetual and should still exist in the Christian Church; (2) that all church power should be vested in the clergy; (3) that each congregation should be independent of all the rest; and as asserting (1) that the people ought to have a substantial part in the government of the Church; (2) that presbyters, *i.e.* elders or bishops, are the highest permanent officers in the Church and are of equal rank; (3) that an outward and visible Church is one in the sense that a smaller part is controlled by a larger and all the parts by the whole.[19]

Divergent Views.

Though Presbyterians are unanimous in adopting the general system of church polity as here outlined, and in claiming New Testament authority for it, there are certain differences of view in regard to details which may be noticed. There is no doubt that considerable indefiniteness in regard to the precise *status* and rank of the ruling elder is commonly prevalent. When ministers and elders are associated in the membership of a church court their equality is admitted; no such idea as voting by orders is ever entertained. Yet even in a church court inequality, generally speaking, is visible to the extent that an elder is not usually eligible for the moderator's chair. In some other respects also a certain disparity is apparent between a minister and his elders. Practically the minister is regarded as of higher standing. The duty of teaching and of administering the sacraments and of always presiding in church courts being strictly reserved to him invests his office with a dignity and influence greater than that of the elder. It was inevitable, therefore, that this question as to the exact *status* of the ruling elder should claim attention in the discussions of the Pan-Presbyterian Alliance. At its meeting in Belfast in 1884 a report was submitted by a " committee on the eldership " which had been previously appointed. According to this committee there are prevalent three distinct theories in regard to the office and function of ruling elders:—

Theories of the Ruling Elder.

I. That while the New Testament recognizes but one order of presbyters there are in this order two degrees or classes, known as teaching elders and ruling elders. In teaching, in dispensing the sacraments, in presiding over public worship, and in the private functions by which he ministers to the comfort, the instruction and the improvement of the people committed to his care, a pastor acts within his parish (or congregation) according to his own discretion; and for the discharge of all the duties of the pastoral office he is accountable only to the presbytery from whom he received the charge of the parish (or congregation). But in everything which concerns what is called discipline—the exercise of that jurisdiction over the people with which the office-bearers of the church are conceived to be invested, he is assisted by lay-elders. They are laymen in that they have no right to teach or to dispense the sacraments, and on this account they fill an office in the Presbyterian Church inferior in rank and power to that of the pastors. Their peculiar business is expressed by the term " ruling elders." [20]

II. A second theory is contended for by Principal Campbell in his treatise on the eldership, and by others also, that there is no warrant in Scripture for the eldership as it exists in the Presbyterian Church; that the ruling elder is not, and is not designed to be, a counterpart of the New Testament elder; in other words, that he is not a presbyter, but only a layman chosen to represent the laity in the church courts and permitted to assist in the government of the church.

III. A third theory, advanced by Professor Witherow and others, is that the modern elder is intended to be, and should be, recognized as a copy of the scriptural presbyter. Those who take this view hold that " in everything except training and the consequences of training the elder is the very same as the minister," and they base their opinion on the fact that the terms " overseer " or " bishop," " presbyter " and " elder," are used interchangeably throughout the New Testament. It is consistent with this view to argue the absolute parity of ministers and elders, conceding to all presbyters " equal right to teach, to rule, to administer the sacraments, to take part in the ordination of ministers, and to preside in church courts."

Present-day Practice.

The practice of the Presbyterian churches of the present day is in accord with the first-named theory. Where attempts are made to reduce the third theory to practice the result is not satisfactory. Nor is the first-named theory less in harmony with Scripture teaching than the third. In the initial stages of the Apostolic Church it was no doubt sufficient to have a plurality of presbyters with absolutely similar duties and powers. At first, indeed, this may have been the only possible course. But apparently it soon became desirable and perhaps necessary to specialize the work of teaching by setting apart for that duty one presbyter who should withdraw from secular occupation and devote his whole time to the work of the ministry. There seems to be evidence of this in the later writings of the New Testament.[21] It is now held by all Presbyterian churches that one presbyter in every congregation should have specially committed to him the work of teaching, administering the sacraments, visiting the flock pastorally, and taking oversight, with his fellow elders, of all the interests of the church. To share with the minister such general oversight is not regarded by intelligent and influential laymen as an incongruous or unworthy office; but to identify the duties of the eldership, even in theory, with those of the minister is a sure way of deterring from accepting office many whose counsel and influence in the eldership would be invaluable.[1]

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[1] Phil. i. 1.

[2] Acts vi. 2–6.

[3] 1 Tim. v. 17; Titus i. 9.

[4] Acts vi. 1, 2.

[5] Acts xi. 29, xv. 2, 4, 6, xvi. 4.

[6] Acts xx. 17.

[7] Acts xiv. 23.

[8] Titus i. 5.

[9] 1 Peter v. 1.

[10] See Bishop Lightfoot's exhaustive essay in his volume on the Epistle to the Philippians.

[11] Acts i. 15–26.

[12] Acts vi. 2–6.

[13] Acts xiv. 23.

[14] 1 Timothy iv. 14.

[15] Acts xv. 6–20.

[16] Acts xv. 2.

[17] Acts xvi. 4.

[18] Matt. xx. 25, 26; Luke xxii. 25, 26.

[19] *Proceedings of Seventh General Council of the Alliance of Reformed Churches holding the Presbyterian System* (Washington, 1899).

[20] Hill's *View of the Constitution of the Church of Scotland*, pp. 37, 38.

[21] 1 Tim. iv. 15, v. 17; Col. iv. 17.

Another subject upon which there is a difference of opinion in the Presbyterian churches is the question of Church Establishments. The view, originally held by all Presbyterian churches in Great Britain and on the Continent, that union with and support by the civil government are not only lawful but also desirable, is now held only by a minority, and is practically exemplified among English-speaking Presbyterians only in the Church of Scotland (see SCOTLAND, CHURCH OF). The lawfulness of Church Establishments with due qualifications is perhaps generally recognized in theory, but there is a growing tendency to regard connexion with the state as inexpedient, if not actually contrary to sound Presbyterian principle. That this tendency exists cannot be doubted, and there is reason to fear that its influence, by identifying Presbyterianism with dissent in England and Scotland, is unfavourable to the general tone and character of the Presbyterian Church.

Spiritual Independence.

Those who favour state connexion and those who oppose it agree in claiming spiritual independence as a fundamental principle of Presbyterianism. That principle is equally opposed to Erastianism and to Papacy, to the civil power dominating the Church, and to the ecclesiastical power dominating the state. All Presbyterians admit the supremacy of the state in things secular, and they claim supremacy for the Church in things spiritual. Those who favour a Church Establishment hold that Church and state should each be supreme in its own sphere, and that on these terms a union between them is not only lawful but is the highest exemplification of Christian statesmanship. So long as these two spheres are at all points clearly distinct, and so long as there is a desire on the part of each to recognize the supremacy of the other, there is little danger of friction or collision. But when spiritual and secular interests come into unfriendly contact and entanglement; when controversy in regard to them becomes inevitable; from which sphere, the spiritual or the civil, is the final decision to come? Before the Reformation the Church would have had the last word; since that event the right and the duty of the civil power have been generally recognized.

Origin.

The origin of Presbyterianism is a question of historical interest. By some it is said to have begun at the Reformation; by some it is traced back to the days of Israel in Egypt;[2] by most, however, it is regarded as of later Jewish origin, and as having come into existence in its present form simultaneously with the formation of the Christian Church. The last is Bishop Lightfoot's view. He connects the Christian ministry, not with the worship of the Temple, in which were priests and sacrificial ritual, but with that of the synagogue, which was a local institution providing spiritual edification by the reading and exposition of Scripture.[3] The first Christians were regarded, even by themselves, as a Jewish sect. They were spoken of as "the way."[4] They took with them, into the new communities which they formed, the Jewish polity or rule and oversight by elders. The appointment of these would be regarded as a matter of course, and would not seem to call for any special notice in such a narrative as the Acts of the Apostles.

Historic Episcopacy.

But Presbyterianism was associated in the 2nd century with a kind of episcopacy. This episcopacy was at first rather congregational than diocesan; but the tendency of its growth was undoubtedly towards the latter. Hence for proof that their church polity is apostolic Presbyterians are accustomed to appeal to the New Testament and to the time when the apostles were still living; and for proof of the apostolicity of prelacy Episcopalians appeal rather to the early Church fathers and to a time when the last of the Apostles had just passed away.[5] It is generally admitted that distinct traces of Presbyterian polity are to be found in unexpected quarters (*e.g.* Ireland, Iona, the Culdees, &c.) from the early centuries of church history and throughout the medieval ages down to the Reformation of the 16th century. Only in a very modified sense, therefore, can it be correctly said to date from the Reformation.

The Reformers.

At the Reformation the Bible was for the great mass of both priests and people a new discovery. The study of it shed floods of light upon all church questions. The leaders of the Reformation searched the New Testament not only for doctrinal truth but also to ascertain the polity of the primitive Church. This was specially true of the Reformers in Switzerland, France, Scotland, Holland and in some parts of Germany. Luther gave little attention to New Testament polity, though he believed in and clung passionately to the universal priesthood of all true Christians, and rejected the idea of a sacerdotal caste. He had no dream or vision of the Church's spiritual independence and prerogative. He was content that ecclesiastical supremacy should be with the civil power, and he believed that the work of the Reformation would in that way be best preserved and furthered. In no sense can his "consistorial" system of church government be regarded as Presbyterian.

Leaders of the Reformed Church.

It was different with the Reformers outside Germany. While Luther studied the Scriptures in search of true doctrine and Christian life and was indifferent to forms of church polity, they studied the New Testament not only in search of primitive church doctrine but also of primitive church polity. One is struck by the unanimity with which, working individually and often in lands far apart, they reached the same conclusions. They did not get their ideas of church polity from one another, but drew it directly from the New Testament. For example, John Row, one of the five commissioners appointed by the Scottish Privy Council to draw up what is now known as the *First Book of Discipline*, distinctly says that "they took not their example from any kirk in the world; no, not from Geneva"; but they drew their plan from the sacred Scriptures.[6] This was true of them all. They were unanimous in rejecting the episcopacy of the Church of Rome, the sanctity of celibacy, the sacerdotal character of the ministry, the confessional, the propitiatory nature of the mass. They were unanimous in adopting the idea of a church in which all the members were priests under the Lord Jesus, the One High Priest and Ruler; the officers of which were not mediators between men and God, but preachers of One Mediator, Christ Jesus; not lords over God's heritage, but ensamples to the flock and ministers to render service. They were unanimous in regarding ministerial service as mainly pastoral; preaching, administering the sacraments and visiting from house to house; and, further, in perceiving that Christian ministers must be also spiritual rulers, not in virtue of any magical influence transmitted from the Apostles, but in virtue of their election by the Church and of their appointment in the name of the Lord Jesus. When the conclusions thus reached by many independent investigators were at length reduced to a system by Calvin, in his famous *Institutio*, it became the definite ideal of church government for all the Reformed, in contradistinction to the Lutheran, churches.

Early Hindrances.

Yet we do not find that the leaders of the Reformed Church succeeded in establishing at once a fully-developed Presbyterian polity. Powerful influences hindered them from realizing their ideal. We notice two. In the first place, the people generally dreaded the recurrence of ecclesiastical tyranny. So dreadful had been the yoke of Rome, which they had shaken off, that they feared to submit to anything similar even under Protestant auspices. When their ministers, moved by an intense desire to keep the Church pure by means of the exercise of scriptural discipline, claimed special spiritual rule over the people, it was not wonderful that the latter should have been reluctant to submit to a new spiritual despotism. So strong was this feeling in some places that it was contended that the discipline of excommunication, if exercised at all, should be exercised only by the secular power. A second powerful influence was of a different kind, viz. municipal jealousy of church power. The municipal authority in those times claimed the right to exercise a censorship over the citizens' private life. Any attempt on the part of the Church to exercise discipline was resented as an intrusion. It has been a common mistake to think of Calvin and contemporary Reformers as introducing a discipline of stern repression which made the innocent gaieties of life impossible, and produced a dull uniformity of straitlaced manners and hypocritical morals. The discipline was there before the Reformers. There were civil laws which regulated clothing, food and social festivity. Hence friction, at times, between the Reformers and civic authorities friendly to the Reformation; not as to whether there should be "discipline" (that was never doubted) but as to whether it should be ecclesiastical or municipal. Even, therefore, where people desired the Reformation there were powerful influences opposed to the setting up of church government and to the exercise of church discipline after the manner of the apostolic Church; and one ceases to wonder at the absence of complete Presbyterianism in the countries which were forward to embrace and adopt the Reformation. Indeed the more favourable the secular authorities were to the Reformation the less need was there to discriminate between civil and ecclesiastical power, and to define strictly how the latter should be exercised. We look in vain, therefore, for much more than the germs and principles of Presbyterianism in the churches of the first Reformers. Its evolution and the thorough application of its principles to actual church life came later, not in Saxony or Switzerland, but in France and Scotland; and through Scotland it has passed to all English-speaking lands.

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[1] *Report of Proceedings*, Third General Council of the Alliance of Reformed Churches, &c. (1884), pp. 373 seq. and App. p. 131.

[2] Exodus iii. 16; iv. 29.

[3] St Luke iv. 16 seq.

[4] Acts ix. 2.

[5] See Lightfoot's *Essay in Commentary on the Epistle to the Philippians.*

[6] Knox, Winran, Spotswood and Douglas—all of them John—were the other commissioners.

Theology.

The doctrines of Presbyterianism are those generally known as evangelical and Calvinistic. The supreme standard of belief is the Word of God in the original languages. The subordinate standards have been numerous, though marked by striking agreement in the main body of Christian doctrine which they set forth. Much has been done of late years to make these subordinate standards of reformed doctrine more generally known. The following list is fairly complete:—

Switzerland.—*First Helvetic Confession* (1536). *Geneva Confession* (1536). *Geneva Catechism* (1545).

England.—*Forty-two Articles* (1553). *Thirty-eight Articles* (1563). *Thirty-nine Articles* (1571). *Lambeth Articles* (1595). *Irish Articles* (1615). *Westminster Confession* (1644–1647). *Larger and Shorter Catechisms* (1647).

France.—*Confessio gallicana* (1559).

Scotland.—*Scottish Confession* (1560). *Westminster Confession* (1647). *Larger and Shorter Catechisms* (1647).

Netherlands.—*Frisian Confession* (1528). *Confessio belgica* (1561). *Netherlands Confession* (1566).

Hungary.—*Hungarian Confession* (1562).

Bohemia.—*Bohemian Confession* (1609).

Presbyterian Worship.

The form of worship associated with Presbyterianism has been marked by extreme simplicity. It consists of reading of Holy Scripture, psalmody, non-liturgical prayer and preaching. There is nothing in the standards of the Presbyterian Church against liturgical worship. In some of the early books of order a few forms of prayer were given, but their use was not compulsory. On the whole, the preponderating preference has always been in favour of so-called extemporaneous, or free prayer; and the Westminster *Directory of Public Worship* has to a large extent stereotyped the form and order of the service in most Presbyterian churches. Within certain broad outlines much, perhaps too much, is left to the choice of individual congregations. It used to be customary among Presbyterians to stand during public prayer, and to remain seated during the acts of praise, but this peculiarity is no longer maintained. The psalms rendered into metre were formerly the only vehicle of the Church's public praise, but hymns are now also used in most Presbyterian churches.[1] Organs used to be regarded as contrary to New Testament example, but their use is now all but universal. The public praise used to be led by an individual called the "precentor," who occupied a box in front of, and a little lower than, the pulpit. Choirs of male and female voices now lead the church praise.

Sacraments.

Presbyterianism has two sacraments, baptism and the Lord's Supper. Baptism is administered both to infants and adults by pouring or sprinkling, but the mode is considered immaterial. The Lord's Supper, as generally observed throughout the various Presbyterian churches, is a close imitation of the New Testament practice; and where it is not marred by undue prolixity commends itself to most Christian people as a solemn and impressive service. The old plan of coming out and taking one's place at the communion table in the body of the church is unhappily seen no more; communicants now receive the sacred elements seated in their pews. The dispensing of this rite is strictly reserved to an ordained minister, who is assisted by elders in handing the bread and the cup to the people. The administration of private communion to the sick and dying is extremely rare in Presbyterian churches, but there is less objection to it than formerly, and in some churches it is even encouraged.

Discipline.

Presbyterian discipline is now entirely confined to exclusion from membership or from office. Though it is the duty of a minister to warn against irreverent or profane participation in the Lord's Supper, he himself has no right to exclude any one from communion; that can only be done as the act of himself and the elders duly assembled in session. A code of instructions for the guidance of church courts when engaged in cases of discipline is in general use, and bears witness to the extreme care taken not only to have things done decently and in order, but also to prevent hasty, impulsive and illogical procedure in the investigation of charges of heresy or immorality. Cases of discipline are now comparatively rare, and, when they do occur, are not characterized by the bigoted severity which prevailed in former times and was rightly denounced as unchristian.

General Statistics.

The extent to which the Presbyterian form of church government prevails throughout the world has been made more manifest in recent years by the formation of a "General Council of the Alliance of Reformed Churches holding the Presbyterian System." At a representative conference in London in 1875 the constitution of the council was agreed upon. The first council met in Edinburgh in 1877. Since then it has met in Philadelphia, Belfast, London, Toronto, Glasgow, Washington and Liverpool. Churches which are organized on Presbyterian principles and hold doctrines in harmony with the reformed confessions are eligible for admission to the alliance. The object is not to form one great Presbyterian organization, but to promote unity and fellowship among the numerous branches of Presbyterianism throughout the world. On the roll of the general council held at Washington in 1899 there were sixty-four churches. The statistics of these and of sixteen others not formally in the alliance were 29,476 congregations, 26,251 ministers, 126,607 elders and 4,852,096 communicants. Of these eighty churches, twelve were in the United Kingdom, twenty on the continent of Europe, sixteen in North America, three in South America, ten in Asia, nine in Africa, six in Australia, two in New Zealand, one in Jamaica and one in Melanesia. The desire for union which led to the formation of the alliance has, since 1875, borne remarkable fruit. In England in 1876 two churches united to form the Presbyterian Church of England; in the Netherlands two churches became one in 1892; in South Africa a union of the different branches of the Presbyterian Church took place in 1897; in Scotland the Free Church and the United Presbyterian became one in 1900 under the designation of the United Free Church; in Australia and Tasmania six churches united in 1901 to form the Presbyterian Church of Australia; and a few months later the two churches in New Zealand which represented respectively the North and South Islands united to form the Presbyterian Church of New Zealand. "In no portion of the empire," it has been said, "does the British flag now fly over a divided Presbyterianism, except in the British Isles themselves."

II.—History in Different Countries

From this general outline of Presbyterianism we now turn to consider its evolution and history in some of the countries with which it is or has been specially associated. We omit, however, one of the most important, viz. Scotland, as the history is fully covered under the separate headings of SCOTLAND, CHURCH OF, and allied articles.

Switzerland.

The Swiss, owing to their peculiar geographical position and to certain political circumstances, early manifested independence in ecclesiastical matters, and became accustomed to the

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[1] Principal Rous's version is the best known and most widely used. It is an English work. Somewhat reluctantly it was accepted by Scottish Presbyterianism as a substitute for an older version with a greater variety of metre and music. "Old Hundred" and "Old 124th" mean the 100th and 124th Psalms in that *old* book.

Calvin.

management of their church affairs. The work of Zwingli as a Reformer, important and thorough though it was, did not concern itself mainly with church polity. Ecclesiastical affairs were, as a matter of course, wholly under the management of the cantonal and municipal authorities, and Zwingli was content that it should be so. The work of Farel, previous to his coming to Geneva, was almost entirely evangelistic, and his first work in Geneva was of a similar character. It was the town council which made arrangements for religious disputations, and provided for the housing and maintenance of the preachers. When Calvin, at Farel's invitation, settled in Geneva (1536) the work of reformation became more constructive. "The need of the hour was organization and familiar instruction, and Calvin set himself to work at once." The first reforms he wished to see introduced concerned the Lord's Supper, church praise, religious instruction of youth and the regulation of marriage. In connexion with the first he desired that the *discipline de l'excommunication* should be exercised. His plan was partly Presbyterian and partly consistorial. Owing to certain circumstances in its past history, Geneva was notoriously immoral. "The rule of dissolute bishops, and the example of a turbulent and immoral clergy, had poisoned the morals of the city. Even the nuns of Geneva were notorious for their conduct."[1] Calvin suggested that men of known worth should be appointed in different quarters of the city to report to the ministers those persons in their district who lived in open sin; that the ministers should then warn such persons not to come to the communion; and that, if their warnings were unheeded, discipline should be enforced. It was on this subject of keeping pure the Lord's Table that the controversy arose between the ministers and the town councillors which ended in the banishment of Calvin, Farel and Conrad from Geneva. In 1538 the ministers took upon themselves to refuse to administer the Lord's Supper in Geneva because the city, as represented by its council, declined to submit to church discipline. The storm then broke out, and the ministers were banished (1538).

It may be convenient at this point to consider Calvin's ideal church polity, as set forth in his famous *Christianae religionis institutio*, the first edition of which was published in 1536. Briefly it was as follows:—

A separate ministry is an ordinance of God (*Inst.* iv. 3, i. 3).

Ministers duly called and ordained may alone preach and administer the sacraments (iv. 3, 10).

A legitimate ministry is one appointed with the consent and approbation of the people under the presidency of other pastors by whom the final act of ordination (with laying on of hands) shall be performed (iv. 3, 15).

Governors or persons of advanced years selected from the people and associated with the ministers in admonishing and exercising discipline (iv. 3, 8). This discipline is all-important, and is the special business of the governors.

His system, while preserving the democratic theory by recognizing the congregation as holding the church power, was in practice strictly aristocratic inasmuch as the congregation is never allowed any direct use of power, which is invested in the whole body of elders. His great object was discipline. With regard to the relations between the Church and the civil power, Calvin was opposed to the Zwinglian theory whereby all ecclesiastical power was handed over to the state. Calvin's refusal to administer the sacrament, for which he was banished from Geneva, is important as a matter of ecclesiastical history, because it is the essence of the whole system which he subsequently introduced. It rests on the principles that the Church has the right to exclude those who are unworthy, and that she is in no way subject to the civil power in spiritual matters. During the three years of his banishment Calvin was at Strassburg, where he had been carrying out his ideas. His recall was greatly to his honour. The town had become a prey to anarchy. One party threatened to return to Romanism; another threatened to sacrifice the independence of Geneva and submit to Berne. It was felt to be a *political* necessity that he should return, and in 1541, somewhat reluctantly, he returned on his own terms. These were the recognition of the Church's spiritual independence, the division of the town into parishes, and the appointment (by the municipal authority) of a consistory or council of elders in each parish for the exercise of discipline.

These terms were embodied in the famous *Ordonnances ecclésiastiques de l'église de Genève* (1541). The four orders mentioned in the *Institutio* are recognized: pastors, doctors, elders and deacons. The pastors were to preach, administer the sacraments, and in conjunction with the elders to exercise discipline. In their totality they form the *vénérable compagnie*. A newly-made pastor was to be settled in a fixed charge by the magistrate with the consent of the congregation, after having been approved as to knowledge and manner of life by the pastors already in office. By them he was to be ordained, after vowing to be true in office, faithful to the church system, obedient to the laws and to the civil government, and ready to exercise discipline without fear or favour. The doctors were to teach the faithful in sound learning, to guard purity of doctrine, and to be amenable to discipline. The elders (*Anciens, commis, ou deputez par la seigneurie ou consistoire*) were regarded as the essential part of the system. They were the bond of union between Church and state. Their business was to supervise daily life, to warn the disorderly, and to give notice to the consistory of cases requiring discipline. To form the consistory all the elders with the ministers were to meet every Sunday under the presidency of one of the syndics or magistrates. This court could award censures up to exclusion from the sacrament.

Manifestly the arrangement was a compromise. The state retained control of the ecclesiastical organization, and Calvin secured his much-needed system of discipline. Fourteen years of friction and struggle followed, and if there came after them a period of comparative triumph and repose for the great reformer it must still be remembered that he was never able to have his ideal ecclesiastical organization fully realized in the city of his adoption.

The early Presbyterianism of Switzerland was defective in the following respects: (1) It started from a wrong definition of the Church, which, instead of being conceived as an organized community of believers in the Lord Jesus Christ, was made to depend upon the preaching of the gospel and the administration of the sacraments. As these implied a duly appointed minister, the existence of the Church was made to depend upon an organized ministry rather than an organized membership. It calls to mind the Romish formula: "*Ubi episcopus ibi ecclesia.*" (2) It did not maintain the scriptural right of the people to choose their minister and other office-bearers. (3) Its independence of civil control was very imperfect. (4) And it did not by means of church courts provide for the manifestation of the Church's unity and for the concentration of the Church's influence.

"Calvin," says Principal Lindsay, "did three things for Geneva all of which went far beyond its walls. He gave its Church a trained ministry, its homes an educated people who could give a reason for their faith, and the whole city an heroic soul which enabled the little town to stand forth as the citadel and city of refuge for the oppressed Protestants of Europe."[2]

France.

Calvin's Influence.

It is pathetic and yet inspiring to study the development of Presbyterianism in France; pathetic because it was in a time of fierce persecution that the French Protestants organized themselves into churches, and inspiring, because it showed the power which scriptural organization gave them to withstand incessant, unrelenting hostility. It would be difficult to exaggerate the influence of Calvin upon French Protestantism. His *Christianae religionis institutio* became a standard round which his countrymen rallied in the work and battle of the Reformation. Though under thirty years of age, he became all over Europe, and in an exceptional degree in France, the leader, organizer and consolidator of the Reformation. The work which the young Frenchman did for his countrymen was immense.[3]

French Protestantism.

The year 1555 may be taken as the date when French Protestantism began to be organized. A few churches had been organized earlier, at Meaux in 1546 and at Nîmes in 1547, but their members had been dispersed by persecution. Prior to 1555 the Protestants of France had been for the most part solitary Bible students or little companies meeting together for worship without any organization. But in that year the following incident was the beginning of a great movement. A small company had been accustomed to meet in the lodging of the sieur de la Ferrière in Paris near the Pré-aux-Clercs. At one of the meetings the father of a newly-born child explained that he could not go outside France to seek a pure baptism and that his conscience would not permit his child to be baptized according to the rites of the Romish Church. After prayer the company constituted themselves into a church: chose Jean le Maçon to be their minister, and others of their number to be elders and deacons. It seemed as if all France had been waiting for this event as a signal, for organized churches began to spring up everywhere immediately afterwards. Within two years Meaux, Poitiers, Angers, les Îles de Saintonge, Agen, Bourges, Issoudun, Aubigny, Blois, Tours, Lyon, Orléans and Rouen were organized. Thirty-six more were completely organized by 1560.[1] According to Beza there were about this time 2150 organized churches. A few years later Cardinal St Croix reckoned that the Huguenots were one half of the population. One hundred and twenty-seven pastors had been sent to France from Geneva before 1567.

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[1] Lindsay, *Hist. of the Reform.* ii. 90.

[2] *Hist. of the Reform.* ii. 31.

[3] Ibid. ii. 158.

First General Synod.

In 1558 a further stage in the development of Presbyterian church polity was reached. Some doctrinal differences having arisen in the church at Poitiers, Antoine de Chandieu, minister at Paris, went to compose them, and, as the result of a conference, a synod was convened to meet in Paris the following year (1559). It was the first general synod of the French Protestant Church, and consisted of representatives from, some say sixty-six, others, twelve churches. It adopted a confession of faith and a book of order or discipline. The confession consisted of forty articles. It was based on a short confession drafted by Calvin in 1557, and may still be regarded, though once or twice revised, as the confession of the French Protestant Church. The book of order, *Discipline ecclesiastique des églises réformées de France*, regulated the organization and procedure of the churches. It contains this fundamental statement of Presbyterian parity, " Aucune église ne pourra prétendre primaute ni domination sur l'autre; ni pareillement, les ministres d'une église les uns sur les autres; ni les anciens ou diacres, les uns sur les autres." The various church courts, familiar to us now as Presbyterian, are explained. The *consistoire* or session consisted of the minister, elders and deacons (the latter without a vote), and was over the congregation. The *colloque* or presbytery was composed of representative ministers and elders (*anciens*) from a group of congregations. Next in order was the provincial synod which consisted of a minister and an elder or deacon from each church in the province. Over all was the general or national synod. Some of the arrangements are worthy of notice. When a church was first formed the office bearers were elected by the people, but there the power of the congregation ceased. Future vacancies in the eldership were filled up by the office-bearers. The eldership was not for life, but there was always a tendency to make it so. When the ministry of a church became vacant the choice of a successor rested with the *colloque* or with the provincial synod. The people, however, might object, and if their objection was considered valid redress was given. Later the synod of Nîmes (1572) decreed that no minister might be imposed upon an unwilling people. Deacons, in addition to having charge of the poor and sick, might catechize, and occasionally offer public prayer or read a written sermon. The president or moderator of each church court was *primus inter pares*. The remarkable feature of French church polity was its aristocratic nature, which it owed to the system of co-optation; and the exclusion of the congregation from direct and frequent interference in spiritual matters prevented many evils which result from too much intermeddling on the part of the laity. Up to 1565 the national synod consisted of a minister with one or two elders or deacons from every church; after that date, to avoid overcrowding, its numbers were restricted to representatives from each provincial synod. On questions of discipline elders and deacons might vote; on doctrinal questions only as many of these as there were ministers.

" It is interesting to see how in a country whose civil rule was becoming gradually more absolutist, this 'Church under the cross' framed for itself a government which reconciled, more thoroughly perhaps than has ever been done since, the two principles of popular rights and supreme control. Its constitution has spread to Holland, Scotland (Ireland, England), and to the great American (and Colonial) churches. Their ecclesiastical polity came much more from Paris than from Geneva."[2]

To trace the history of Presbyterianism in France for the next thirty years would be to write the history of France itself during that period. We should have to tell of the great and rapid increase of the Church; of its powerful influence among the nobles and the *bourgeoisie*; of its direful persecutions; of its St Bartholomew massacre with 70,000 victims; of its regrettable though perhaps inevitable entanglements in politics and war; and finally of its attaining not only tolerance but also honourable recognition and protection when Henry IV. in 1598 signed the famous edict of Nantes. This secured complete liberty of conscience everywhere within the realm and the free right of public worship in all places in which it existed during the years 1596 and 1597, or where it had been granted by the edict of Poitiers (1577) interpreted by the convention of Nérac (1578) and the treaty of Fleix (1580)—in all some two hundred towns; in two places in every *bailliage* and *sénéchaussée*; in the castles of Protestant *seigneurs hauts justiciers* (some three thousand); and in the houses of lesser nobles, provided the audience did not consist of more than thirty persons over and above relations of the family. Protestants were granted full civil rights and protection, and were permitted to hold their ecclesiastical assemblies—consistories, colloquies and synods, national and provincial. Under the protection of the edict the Huguenot Church of France flourished. Theological colleges were established at Sedan, Montauban and Saumur, and French theology became a counterpoise to the narrow Reformed scholastic of Switzerland and Holland.[3]

The history of the Church from the passing of the edict of Nantes till its revocation in 1685 cannot be given here. That event was the climax of a long series of horrors. Under the persecution, a large number were killed, and between four and five millions of Protestants left the country. Early in the 18th century Antoine Court made marvellous efforts to restore Presbyterianism. In momentary peril of death for fifteen years, he restored in the Vivarais and the Cévennes Presbyterian church polity in all its integrity. In 1715 he assembled his first *colloque*. Synods were held in 1718, 1723, 1726 and 1727; and in a remote spot in Bas Languedoc in 1744 a national synod assembled—the first since 1660—which consisted of representatives from every province formerly Protestant.

From 1760 owing to the gradual spread of the sceptical spirit and the teaching of Voltaire more tolerant views prevailed. In 1787 the Edict of Tolerance was published. In 1789 all citizens were made equal before the law, and the position of Presbyterianism improved till 1791. In 1801 and 1802 Napoleon took into his own hands the independence of both Catholic and Protestant Churches, the national synod was abolished, and all active religious propaganda was rigorously forbidden. In 1848 an assembly representative of the *églises consistoriales* met at Paris. When it refused to discuss points of doctrine a secession took place under the name of the *Union des églises évangéliques de France*. This society held a synod at which a confession of faith and a book of order were drawn up. Meanwhile the national Protestant Church set itself to the work of reconstruction on the basis of universal suffrage, with restrictions, but no result was arrived at. In 1852 a change took place in its constitution. The *églises consistoriales* were abolished, and in each parish a presbyterial council was appointed, the minister being president, with four to seven elders chosen by the people. In the large towns there were consistories composed of all the ministers and of delegates from the various parishes. Over all was the central provincial council consisting of the two senior ministers and fifteen members nominated by the state in the first instance. In 1858 there were 617 pastors and the *Union des églises évangéliques* numbered 27 churches.

The Netherlands.

From the geographical position of the Netherlands, Presbyterianism there took its tone from France. In 1562 the *Confessio belgica* was publicly acknowledged, and in 1563 the church order was arranged. In 1574 the first provincial synod of Holland and Zealand was held, but William of Orange would not allow any action to be taken independently of the state. The Reformed churches had established themselves in independence of the state when that state was Catholic; when the government became Protestant the Church had protection and at the same time became dependent. It was a state church. By the union of Utrecht the communes and provinces had each the regulation of its own religion; hence constant conflict. In most cases it was insisted on as necessary that church discipline should remain with the civil authority. In 1576 William, with the support of Holland, Zeeland and their allies, put forth forty articles, by which doctors, elders and deacons were recognized, and church discipline given to the elders, subject to appeal to the magistrate and by which the Church was placed in absolute dependence on the state. These articles, however, never came into operation; and the decisions of the synod of Dort in 1578, which made the Church independent were equally fruitless. In 1581 the Middelburg Synod divided the Church, created provincial synods and presbyteries, but could not shake off the civil power in connexion with the choice of church officers. Thus, although the congregations were Presbyterian, the civil government retained overwhelming influence. The Leiden magistrates said in 1581: " If we accept everything determined upon in the synod, we shall end by being vassals of the synod. We will not open to churchmen a door for a new mastership over government and subjects, wife and child." From 1618 a modified Presbyterian polity predominated. As a rule elders held office for only two years. The " kerk-raad " (kirk-session) met weekly, the magistrate being a member *ex officio*. The *colloque* consisted of one minister and one elder from each congregation. At the annual provincial synod, held by consent of the states, two ministers and one elder attended from each *colloque*. Every congregation was visited by ministers appointed by the provincial synod. In 1795, of course, everything was upset, and it was not until after the restoration of the Netherland States that a new organization was formed in 1816. Its main features were strictly Presbyterian, but the minister was greatly superior to the elder, and the state had wide powers especially in the nomination of higher officers. In 1851 the system now in force was adopted. The congregation chooses all the officers, and these form a church council.

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[1] Lindsay, *Hist. of the Reform.* ii. 166.

[2] Ibid. ii. 169.

[3] Ibid. ii. 222, 223.

England.

Presbyterian principles and ideas were entertained by many of the leading ecclesiastics in England during the reign of Edward VI. Even the archbishop of Canterbury favoured a modification of episcopacy, and an approach to Presbyterian polity and dicipline; but attention was mainly directed to the settlement of doctrine and worship. Cranmer wrote that bishops and priests were not different but the same in the beginning of Christ's religion. Thirteen bishops subscribed this proposition: that in the New Testament there is no mention made of any distinctions or degrees in orders but only deacons and priests or bishops. Cranmer held that the consecration of a bishop was an unnecessary rite, and not required by Scripture; that election and appointment to office were sufficient. The bishop of St Davids was of the same opinion. Latimer and Hooper maintained that Bishops and presbyters were identical; and Pilkington, bishop of Durham, and Bishop Jewel were of the same mind. The latter, about the time of Elizabeth's succession, expressed his hope that the bishops would become pastors, labourers and watchmen; and that the great riches of bishoprics would be diminished and reduced to mediocrity; that, being delivered from courtly and regal pomp, the bishops might take care of the flock of Christ. During the reign of Edward, the title of superintendent was often adopted instead of bishop, and it will be recollected that John Knox was an honoured worker in England with the title of superintendent during this reign. As an indication of sympathy with Presbyterianism, it may be noted that Cranmer favoured a proposal for the formation of a council of presbyters in each diocese, and for provincial synods.

Presbytery of Wandsworth.

During 1567 and 1568 the persecutions in France and Holland drove thousands of Protestants, mostly Presbyterians, to England. In 1570 Presbyterian views found a distinguished exponent in Dr Thomas Cartwright at Cambridge; and the temper of parliament was shown by the act of 1571, for the reform of disorders in the Church, in which, while all mention of doctrine is omitted, the doctrinal articles alone being sanctioned, ordination without a bishop is implicitly recognized. In 1572 a formal manifesto was published, entitled an *Admonition to Parliament*, the leading ideas in which were: parity of ministers, appointment of elders and deacons; election of ministers by the congregation; objection to prescribed prayer and antiphonal chanting; preaching, the chief duty of a minister; and the power of the magistrates to root out superstition and idolatry. On the 20th of November 1572 the authors of the "Admonition" set up at Wandsworth what has been called the first presbytery in England. They adopted a purely Presbyterian system which was published as the *Orders of Wandsworth*. Similar associations or presbyteries were formed in London and in the midland and eastern counties; but the privy council was hostile. Only in Jersey and Guernsey, whither large numbers of Huguenots had fled after the St Bartholomew massacre, was Presbyterianism fully permitted. Cartwright and Edmund Snape were ministers there; and from 1576 to 1625 a completely appointed Presbyterian Church existed, under the rule of synods, and authorized by the governor. The action of the Commons in 1584, stimulated by the opposition of the Lords, showed that the principles of Presbyterianism were strongly held. Bills were introduced to reduce the position of a bishop to well-nigh that of *primus inter pares*; to place the power of veto in the congregation; to abolish the canon law and to establish a presbytery in every parish. These proposals were rendered abortive by the unflinching use of the queen's prerogative.

The Westminster Assembly.

In 1640 Henderson, Baillie, Blair and Gillespie came to London as commissioners from the General Assembly in Scotland, in response to a request from ministers in London who desired to see the Church of England more closely modelled after the Reformed type. They were able men, whose preaching drew great crowds, and increased the desire for the establishment of Presbyterianism. In 1642 the Long Parliament abolished Episcopacy (the act to come into force on the 5th of November 1643); and summoned an assembly of divines to meet at Westminster in June 1643 to advise parliament as to the new form of Church government. The Westminster Assembly, through its *Confession, Directory* and *Catechisms*, has become so associated with the Presbyterian Church that it is difficult to realize that it was not a church court at all, much less a creation of Presbyterianism.

It was a council created by parliament to give advice in church matters at a great crisis in the nation's history; but its acts, though from the high character and great learning of its members worthy of deepest respect, did not *per se* bind parliament or indeed anyone. It was, in a very real sense, representative of the whole country, as two members were chosen by parliament from each county. The number summoned was 151, viz. ten lords, twenty members of the House of Commons, and one hundred and twenty-one ministers. The ministers were mostly Puritans; by their ordination, &c., Episcopalian; and for the most part strongly impressed with the desirability of nearer agreement with the Church of Scotland, and other branches of the Reformed Church on the Continent. About one-half of the members attended regularly. Those who were out-and-out Episcopalians did not attend at all. Apart from these, there were three well-defined parties: (1) those with Presbyterian ideas and sympathies, a great majority; (2) Erastians, ably represented and led by Selden, Lightfoot and Coleman; (3) Independents, ten or eleven in number, led by Philip Nye, and assured of Cromwell's support. Then there were the Scottish commissioners who, though without votes, took a leading part in the proceedings. Judged by the objects for which it was summoned the Westminster Assembly was a failure, a remarkable failure. Episcopacy, Erastianism and Independency, though of little account in the assembly, were to bulk largely in England's future; while the church polity which the assembly favoured and recommended was to be almost unknown. Judged in other ways, however, the influence of the assembly's labours has been very great. *The Confession of Faith* and the *Larger* and *Shorter Catechisms* are recognized and venerated standards in all the lands where British Presbyterianism, with its sturdy characteristics, has taken root. And the *Directory of Public Worship* has shaped and coloured, perhaps too thoroughly, the ritual and atmosphere of every group of Protestant Anglo-Saxon worshippers throughout the world, except Episcopalians.

Synod of London.

In June 1646 the ordinance establishing presbyteries was ratified by both houses of parliament, and a few days afterwards it was ordered to be put into execution. Twelve presbyteries were erected in London; Shropshire and Lancashire were organized; and Bolton was so vigorous in the cause as to gain the name of the Geneva of Lancashire. But the system never took root. Not only were there well-known adverse influences, but the soil seems to have been uncongenial. As compared with Scotland, English Presbyterianism had more of the lay element. In every *classis* or presbytery there were two elders to each minister. The Synod of London met half-yearly from 1647 till 1655. Synods also were held in the north. But during the Commonwealth Independency gained ground. Then with the Restoration came Episcopacy, and the persecution of all who were not Episcopalians; and the dream and vision of a truly Reformed English Church practically passed away.

Decadence.

After the Revolution and during the reign of William and Mary the hatred of the Church of England to the Presbyterians and other dissenters had been obliged to lie dormant. With the accession of Anne, however, began an attempt apparently to make up for lost time. From the beginning of the 18th century the greater number of the Presbyterian congregations became practically independent in polity and Unitarian in doctrine. Indigenous Presbyterianism became almost unknown. The Presbyterianism now visible in England is of Scottish origin and Scottish type, and beyond the fact of embracing a few congregations which date from, or before, the Act of Uniformity and the Five Mile Act, has little in common with the Presbyterianism which was for a brief period by law established.

Union in 1876.

In 1876 the union of the Presbyterian Church in England with the English congregations of the United Presbyterian Church of Scotland gathered all English Presbyterians (with some exceptions) into one church, "The Presbyterian Church of England." "What kept these bodies apart was their separate historic origin and development, but especially the alienation caused by the 'Voluntary Controversy' which had its roots in the difficult problems of civil law in its relation to religion, and the stumbling-block of the civil magistrate's authority in relation to the Christian conscience."[1] Since the union the growth of the Church has been considerable. Presbyterianism is comparatively strong in three districts of England, namely Northumberland, Lancashire and London. Elsewhere it is either weak or nonexistent. Even where it is comparatively strong it is largely exotic. The membership is mainly Scottish, and the ministers have been imported principally from Scotland. To English people, therefore, the Presbyterian is still the "Scotch Church," and they are as a whole slow to connect themselves with it. Efforts have been made to counteract this feeling by making the Church more distinctly English. The danger in this direction is that when Presbyterianism has been modified far enough to suit the English taste it may be found less acceptable to its more stalwart supporters from beyond the Tweed. Following the lead of the Independents, who set up Mansfield College at Oxford, the Presbyterian Church has founded Westminster College at Cambridge as a substitute for its Theological Hall in London. It was opened in 1899 with the view of securing a home-bred ministry more conversant with English academic life and thought.

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[1] Drysdale, *History of the Presbyterians in England*, p. 625.

In common with the general Presbyterianism of the British Isles, the Presbyterian Church of England has in recent years been readjusting its relation to the Westminster Confession of Faith. Without setting aside the Confession as the church's standard, twenty-four "Articles of the Faith" have been adopted. In these no change, it is alleged, has been made in regard to the substance of the Westminster doctrine, but there is an alteration of emphasis and proportion.

There are in England fourteen congregations in connexion with the Church of Scotland, six of them in London and the remainder in Berwick, Northumberland, Carlisle and Lancashire.

Many Unitarians in England still call themselves Presbyterians. This, except historically, is a misnomer, for, though descended from the old English Presbyterians, they retain nothing of their distinctive doctrine or polity—nothing of Presbyterianism, indeed, but the name.

Ireland.

Presbyterianism in Ireland, in modern times at least, dates from the plantation of Ulster in the reign of James I. The infusion of a considerable Scottish element into the population necessitated the formation of a congenial church. The immigrants from England took with them, in like manner, their attachment to the Episcopal Church. But these two sections of Protestantism, in their common exile and in presence of the preponderating Roman Catholicism of the country, seemed at first inclined to draw closer together than had been thought possible in Great Britain. A confession of faith, drawn up by Archbishop Usher at the convocation of 1615, implicitly admitted the validity of Presbyterian ordination, and denied the distinction between bishop and presbyter. Within the Episcopal Church and supported by its endowments, Robert Blair, John Livingstone and other ministers maintained a Scottish Presbyterian communion.

The First Presbytery.

From 1625 to 1638 the history of Irish Presbyterians is one of bare existence. Their ministers, silenced by Wentworth, after an ineffectual attempt to reach New England, fled to Scotland, and there took a leading part in the great movement of 1638. After the Irish rebellion of 1641 the Protestant interest for a time was ruined. A majority of the Ulster Protestants were Presbyterians, and in a great religious revival which took place the ministers of the Scottish regiments stationed in Ireland took a leading part. Kirk-sessions were formed in four regiments, and the first regular presbytery was held at Carrickfergus on the 10th of June 1642, attended by five ministers and by ruling elders from the regimental sessions. This presbytery supplied ministers to as many congregations as possible; and for the remainder ministers were sent from Scotland. By the end of 1643 the Ulster Church was fairly established. Notwithstanding intervening reverses there were by 1647 nearly thirty ordained ministers in fixed charges in Ulster besides the chaplains of the Scottish regiments.

At the Restoration, in which they heartily co-operated, there were in Ulster seventy ministers in fixed charges, with nearly eighty parishes or congregations containing one hundred thousand persons. There were five presbyteries holding monthly meetings and annual visitations of all the congregations within their bounds, and coming together in general synod four times a year. Entire conformity with the Scottish Church was maintained, and strict discipline was enforced by pastoral visitations, kirk-sessions and presbyteries.

After the Restoration the determination of the government to put down Presbyterianism was speedily felt in Ireland. In 1661 the lords justices forbade all unlawful assemblies, and in these they included meetings of presbytery as exercising ecclesiastical jurisdiction not warranted by the law. Bishop Jeremy Taylor was forward in this work of persecution. The ministers refused to take the Oath of Supremacy without the qualification suggested by Usher. Their parishes were declared vacant, and episcopal clergy appointed to them. The ejected ministers were forbidden to preach or administer the sacraments. In Ulster sixty-one ministers were ejected. Of seventy only seven conformed. Under Ormonde, in 1665, ministers were again permitted to revive Presbyterian worship and discipline, and for several years the Church prospered not only in Ulster but also in the south and west. In 1672 she received a yearly grant from Charles II. of £600 (*regium donum*), and under William III. the amount was considerably increased. It was continued till 1869.

In 1679 the rising in Scotland which ended in the battle of Bothwell Bridge brought trouble on the Irish Presbyterians in spite of their loyal addresses disowning it. It was not, however, till 1682 that they again lost the privilege of public ministry, and suffered severe oppression. They were opposed to James II., though they had benefited by his Declaration of Indulgence, and they were the first to congratulate the Prince of Orange on his arrival in England. The heroic defence of Londonderry owed much to them, as they were a majority of the population, and some of their ministers rendered conspicuous service. There were then in Ireland about a hundred congregations, seventy-five with settled ministers, under five presbyteries. Their preponderance in Ulster and their consciousness of their great service to England led them first of all to hope that Presbyterianism might be substituted for Episcopacy in Ulster, and afterwards, that it might be placed on an equal footing with the latter.

During the 18th century Irish Presbyterianism became infected with Arianism. Under the leadership of Dr Henry Cooke, a minister of rare ability and eloquence, the evangelical party triumphed in the church courts, and the Unitarians seceded and became a separate denomination. In 1840 the Synod of Ulster and the Secession Synod united to form the General Assembly of the Presbyterian Church in Ireland.

The Presbyterian Church in Ireland is the most conservative of the great Presbyterian churches in the United Kingdom. Her attitude is one of sturdy adherence to the old paths of evangelical doctrine and Presbyterian polity. She has been a zealous supporter of Irish national education, which is theoretically "united secular and separate religious instruction." The Church Act of 1869 which disestablished and disendowed the Irish Episcopal Church took away the Presbyterian *regium donum.* The ministers with all but absolute unanimity decided to commute their life-interest and form therewith a great fund for the support of the Church. The commutation fund thus formed is a permanent memorial of a generous and disinterested act on the part of her ministry. It amounted in 1902 to £588,028. The interest accruing from it is added to the yearly sustentation contributions, and forms a central fund for ministerial support. Since the state endowment ceased the average income of ministers from their congregations has considerably increased.

The Irish Presbyterian Church has set an example to all her sister churches by her forwardness to care for the poor. Her "Presbyterian Orphan Society" undertakes the support of every poor orphan child throughout the Church. No Presbyterian orphan child now needs to seek workhouse relief. The orphans are boarded in the homes of respectable poor people, who thus also benefit by the society. A scheme of pensions for her aged poor has been instituted.

Three small communities of Presbyterians maintain a separate autonomy in Ireland, viz. the Reformed Presbyterian Church, with thirty-six; the Eastern Reformed, with six; and the Secession Church, with ten congregations.

Wales.

The Presbyterian Church of Wales, commonly known as the "Calvinistic Methodist," had its origin in the great evangelical revival of the 18th century. Its polity has been of gradual growth, and still retains some features peculiar to itself. In 1811 its preachers were first presbyterially ordained and authorized to administer the sacraments. In 1823 a Confession of Faith was adopted. In 1864 the two associations or synods of North and South Wales were united in a general assembly. Great attention is given to the education of the ministry, a considerable number of whom, in recent years, have taken arts degrees at Oxford and Cambridge. As far as the difference in language will permit, there is cordial fellowship and co-operation with the Presbyterian Church of England. The appetite of the Welsh people for sermons is enormous, and the preachers are characterized by an exceptionally high order of pulpit power.

(W. Y.)

United States.

Presbyterianism in the United States is a reproduction and further development of Presbyterianism in Europe. The history of the American Presbyterian churches, excluding the two "Reformed" Churches (see Reformed Church in the United States for the German body, and Reformed Church in America for the Dutch body), may be divided into three periods.

1. *The Colonial Period.*—The earliest Presbyterian emigration consisted of French Huguenots under the auspices of Admiral Coligny, led to Port Royal, South Carolina, by Jean Ribaut in 1562, and to Florida (near the present St Augustine) by René de Laudonnière in 1564, and by Ribaut in 1565. The former enterprise was soon abandoned, and the colonists of the latter were massacred by the Spaniards. Under Pierre de Guast, sieur de Monts, Huguenots settled in Nova Scotia in 1604 but did not remain after 1607. Huguenot churches were formed on Staten Island, New York, in 1665; in New York City in 1683; at Charleston, South Carolina, in 1686; at Boston, Massachusetts, in 1687; at New Rochelle, New York, in 1688; and at other places. The Charleston church alone of these early churches maintains its independence of any American denomination.

English Puritans emigrated under the auspices of the Virginia Company to the Bermudas in 1612; and in 1617 a Presbyterian Church, governed by ministers and four elders, was established there by Lewis Hughes, who used the liturgy of the isles of Guernsey and Jersey. Beginning with 1620, New England was colonized by English Presbyterians of the two types which developed from the discussions of the Westminster Assembly (1643–1648) into Presbyterianism and Congregationalism. The Plymouth colony was rather of the Congregational type, and the Massachusetts Bay colony rather of the Presbyterian. These types co-operated as in Old England in the county associations; and a mixed system was produced, called by Henry M. Dexter "a Congregationalized Presbyterianism or a Presbyterianized Congregationalism." Presbyterianism was stronger in Connecticut than in Massachusetts. Thence it crossed into the Dutch settlements on the Hudson and the Delaware, and mingled with other elements in Virginia, Maryland and the Carolinas. Nine of these Puritan Presbyterian churches were established on Long Island between 1640 and 1670—one at Southampton and one at Southold (originally of the Congregational type) in 1640, one at Hempstead about 1644, one at Jamaica in 1662, and churches at Newtown and Setauket in the next half century; and three Puritan Presbyterian churches were established in Westchester county, New York, between 1677 and 1685. In New York City, Francis Doughty preached to Puritan Presbyterians in 1643; in 1650 he was succeeded by Richard Denton (1586–1662). Doughty preached in Virginia and Maryland in 1650–1659, and was the father of British Presbyterianism in the Middle Colonies. His work in Virginia and Maryland was carried on twenty-five years later by Francis Makemie (d. 1708).

Irish Presbyterianism was carried to America by an unknown Irish minister in 1668. Its foremost representative was Francis Makemie, already mentioned, who, in 1683, as an ordained minister of the presbytery of Laggan, was invited to minister to the Maryland and Virginia Presbyterians. In 1684 he acted as pastor of an Irish church at Elizabeth River, Virginia; in 1699 received permission from the colonial authorities to preach at Pocomoke and Onancock on the eastern shore of Virginia, and about 1700 organized a church at Snow Hill in Worcester county, Maryland; in 1704 he returned to America from a trip to Great Britain in which he had interested the Presbyterians of London, Dublin and Glasgow in the American churches, and brought back with him two ordained missionaries, John Hampton (d. *c.* 1721) and George McNish (1660–1723); in 1707 was imprisoned in New York City for preaching without licence, but was acquitted in 1708.

To the banks of the Delaware the clergy of New England sent missionaries: Benjamin Woodbridge went to Philadelphia in 1698 and was followed almost immediately by Jedediah Andrews (1674–1746), who was ordained in 1701, and under whom the first Presbyterian church in Philadelphia was organized; in 1698 John Wilson (d. 1712) became pastor of a Presbyterian Church at New Castle, Delaware; Samuel Davis (d. 1725) seems to have preached as early as 1692 at Lewes, Delaware, and Nathaniel Taylor (d. 1710) was another of the New England missionaries along the Delaware river and bay. About 1695 Thomas Bridge, with Presbyterians from Fairfield county, Connecticut, settled at Cohansey, in West Jersey. These New England ministers in the Delaware valley, with Francis Makemie as moderator, organized in 1706 the first American presbytery, the presbytery of Philadelphia. In 1716 this presbytery became a synod by dividing itself into four "subordinate meetings or presbyteries," after the Irish model. The synod increased the number of its churches by a large accession from New York and from New Jersey, where there had been large Presbyterian settlements. The synod seems to have remained without a constitution and without subscription until 1729, when it adopted the Westminster standards. In 1732 the presbytery of "Dunagall" (Donegal) was established in Lancaster county, Pennsylvania.

Two parties had developed with the growth of the Church. The stricter party urged the adoption of the Westminster standards and conformity thereto; the broader party were unwilling to sacrifice their liberty. The former followed the model of the Church of Scotland; the liberal party sympathized with the London and Dublin Presbyterians. The two parties united under the act of 1729, which adopted the Westminster symbols "as being, in all the essential and necessary articles, good forms of sound words and systems of Christian doctrine." This adopting act allowed scruples as to "articles not essential and necessary in doctrine, worship or government"—the presbytery being judge in the case and not the subscriber. In 1730–1732 the stricter party in the presbyteries of New Castle and Donegal insisted on full subscription, and in 1736, in a minority synod, interpreted the adopting act according to their own views. The liberals put themselves on guard against the plotting of the other side. Friction was increased by a contest between Gilbert Tennent and his friends, who favoured Whitefield and his revival measures, and Robert Cross (1689–1766), pastor at Jamaica in 1723–1758, and his friends. The Tennents erected the Log College (on the Neshaminy, about 20 m. north of Philadelphia) to educate candidates for the ministry; and the synod in 1738 passed an act, aimed at the Log College, providing that all students not educated in the colleges of New England or Great Britain should be examined by a committee of synod, thus depriving the presbyteries of the right of determining in the case. The presbytery of New Brunswick declined to yield (1739). The Cross party charged the Tennents with heresy and disorder; the Tennents charged their opponents with ungodliness and tyranny. When the synod met in 1741 the moderate men remained away; and thus the synod broke in two. The New York presbytery declined at first to unite with either party, worked in vain for reconciliation, and finally joined with the Tennents in establishing the synod of New York (1745) which was called the New Side, in contradistinction to the synod of Philadelphia, the Old Side.

During the separation the New Side established the college of New Jersey at Elizabethtown (now Elizabeth) in 1747, and the Log College of the Tennents was merged into it. It was removed to Princeton in 1755, funds for its aid being received from England, Ireland and Scotland. The Old Side adopted the academy at New London, Chester county, Pennsylvania, which had been organized by Francis Alison in 1741, as their own; but the New London school broke up when Alison became a professor in the Philadelphia Academy (afterwards the university of Pennsylvania). During the separation the synod of Philadelphia decreased from twenty-six to twenty-two ministers, but the synod of New York grew from twenty to seventy-two ministers, and the New Side reaped all the fruits of the Great Awakening under Whitefield and his successors. Different views on subscription and discipline, and the arbitrary act of excision were the barriers to union, but these were removed; in 1758 the adopting act was re-established in its original breadth, the "Synod of New York and Philadelphia" was formed, and the reunion was signalized by the formation of the presbytery of Hanover in Virginia. Under John Witherspoon the college of New Jersey was the favoured school of the reunited church. The union was not perfect; the presbytery of Donegal was for three years in revolt against the synod; and in 1762 a second presbytery of Philadelphia was formed; but the strength of the synod increased rapidly and at the outbreak of the War of Independence it had 11 presbyteries and 132 ministers.

Presbyterianism had an independent development in the Carolinas, whither there was a considerable Scotch migration in 1684–1687. William Dunlop (*c.* 1650–1700) ministered to them until 1688, when he became principal of the university of Glasgow. At Charleston a mixed congregation of Scotch Presbyterians and English Puritans was organized in 1690. What is now Dorchester county, South Carolina, was settled in 1695 by members of a church established in Dorchester, Massachusetts. In 1710 there were five churches in the Carolinas; in 1722-1723 they formed the presbytery of James Island, which (after 1727) went through the same struggle as the synod of Philadelphia in reference to subscription; and in 1731 the parties separated into subscribers and non-subscribers.

From New England, as has been seen, Puritan settlers established Presbyterian churches (or churches which immediately became Presbyterian) in Long Island, on New Jersey, and in South Carolina; but the Puritans who remained in New England usually established Congregational churches. But there were exceptions: Irish Presbyterians from Ulster formed a church at Londonderry, New Hampshire, which, about 1729, grew into a presbytery; the Boston presbytery, organized in 1745, became in 1774 the synod of New England with three presbyteries and sixteen ministers; and there were two independent presbyteries, that of "the Eastward" organized at Boothbay, Maine, in 1771, and that of Grafton, in New Hampshire, founded by Eleazar Wheelock and other ministers interested in Dartmouth College.

The Presbyterians from the Scotch Established Church combined with the American Presbyterian Church, but the separating churches of Scotland organized independent bodies. The Reformed Presbyterian Church (Covenanters) sent John Cuthbertson in 1751; he was joined in 1773 by Matthew Lind and Alexander Dobbin from the Reformed Presbytery of Ireland, and they organized in March 1774 the Reformed Presbytery of America. The Anti-Burgher Synod sent Alexander Gellatly and Andrew Arnot in 1752, and two years later they organized the Associate Presbytery of Pennsylvania; they were joined in 1757 by the Scotch Church in New York City, which had split off because of objections to the growing use of Watts's Psalms; they had grown to two presbyteries and thirteen ministers in 1776. The Burgher Synod in 1764 sent Thomas Clarke of Ballybay, Ireland, who settled at Salem, Washington county, New York, and in 1776 sent David Telfair, of Monteith, Scotland, who preached in Philadelphia; they united with the Associate Presbytery of Pennsylvania; in 1771 the Scotch Synod ordered the presbytery to annul its union with the Burghers, and although Dr Clarke of Salem remained in the Associate Presbytery, the Burgher ministers who immigrated later joined the Associate Reformed Church. In 1769–1774 there was a futile attempt to secure the union of the Associate Presbytery with the main American Church.

2. *From the War of Independence to the Civil War.*—During the War of Independence the Presbyterian churches suffered severely. Ministers and people with few exceptions—the most notable being the Scotch Highlanders who had settled in the valley of the Mohawk in New York and on Cape Fear river in North Carolina—sided with the patriot or Whig party: John Witherspoon was the only clergyman in the Continental Congress of 1776, and was otherwise a prominent leader; John Murray of the Presbytery of the Eastward was an eloquent leader in New England; and in the South the Scotch-Irish were the backbone of the American partisan forces, two of whose leaders, Daniel Morgan and Andrew Pickens, were Presbyterian elders.

At the close of the War the Presbyterian bodies began at once to reconstruct themselves. In 1782 the presbyteries of the Associate and Reformed churches united, forming the Associate and Reformed Synod of North America; but as there were a few dissenters in both bodies the older Associate and Reformed Presbyteries remained as separate units—the Associate Presbytery continued to exist under the same name until 1801, when it became the Associate Synod of North America; in 1818 it ceased to be subordinate to the Scotch General Synod. The Associate Reformed Synod added in 1794 a fourth presbytery, that of Londonderry, containing most of the New England churches, but in 1801 "disclaimed" this presbytery because it did not take a sufficiently strict view of the question of psalm-singing. The Reformed Presbytery of North America was reconstituted by two ministers from Ireland in 1798; it became a synod of three presbyteries in 1809 and a general synod in 1823; in the first decade of the century the presbytery required all members to free their slaves. The synod of New York and Philadelphia, which in 1781 had organized the presbytery of Redstone, the first of western Pennsylvania, in 1788 resolved itself into a General Assembly, which first met in Philadelphia in 1789, and after revising the chapters on Church and state, adopted the Westminster symbols as to their constitution, "as containing the system of doctrine taught in the Holy Scriptures," and they made them unalterable without the consent of two-thirds of the presbyteries and the General Assembly. In 1801 a "plan of union" proposed by the General Association (Congregational) of Connecticut was accepted by the General Assembly, and the work of home missions in the western section of the country was prosecuted jointly. The result was mixed churches in western New York and the new states west of the Alleghany Mountains, which grew into presbyteries and synods having peculiar features midway between Presbyterianism and Congregationalism.

The general strictness of the church in its requirements for ministerial education occasioned it great loss in this period when the territory beyond the Appalachians was being settled so largely by Scotch-Irish and Presbyterians. The revivals in Kentucky brought about differences which resulted in the high-handed exclusion of the revivalists. These formed themselves into the presbytery of Cumberland, on the 4th of February 1810, which grew in three years into a synod of three presbyteries and became the "Cumberland Presbyterian Church." In 1813 they revised the Westminster Confession and excluded, as they claimed, fatalism and infant damnation. If they had appealed to the General Assembly they might have received justice, or possibly the separation might have been on a larger scale. In 1822, under the influence of John Mitchell Mason (1770–1829), the Associate Reformed Synod combined with the General Assembly of the Presbyterian Church, but the majority was too slender to make the union thorough. The greater part of the ministers decided to remain separate, and accordingly organized three independent synods—New York, Scioto and the Carolinas. In 1858 the associate synods of the north and west united with the Associate Synod as the United Presbyterian Church. In 1833 the Reformed Presbyterian Church divided into New Lights and Old Lights in a dispute as to the propriety of Covenanters exercising the rights of citizenship under the constitution of the United States.

A great and widespread revival marked the opening years of the century, resulting in marvellous increase of zeal and numbers. New measures were adopted, doctrines were adapted to the times, and ancient disputes were revived between the conservative and progressive forces. Theological seminaries had been organized: the Theological Seminary of the Presbyterian Church at Princeton, N.J., founded in 1812 by the General Assembly; the Auburn Theological Seminary at Auburn, N.Y., founded in 1819 by the synod of Geneva, and afterwards associated with the New School; a school at Hampden Sidney, Virginia, founded by the synod of Virginia in 1824, named Union Theological Seminary in Virginia after 1826, supported after 1828 by the synods of Virginia and North Carolina, and in 1898 removed to Richmond, Va.; the Western Theological Seminary, founded at Allegheny (Pittsburg), Pa., in 1827 by the General Assembly; the Presbyterian Theological Seminary at Columbia, South Carolina, founded in 1828 by the synod of South Carolina; Lane Theological Seminary, founded independently in 1829 by the New School at Cincinnati, Ohio; and Union Theological Seminary, founded in 1836 by independent action of New School men, in New York City. Differences in doctrine as well as polity and discipline became more and more prominent. The doctrinal differences came to a head in the trials of George Duffield (1832), Lyman Beecher (1835) and Albert Barnes (1836) which, however, resulted in the acquittal of the accused, but which increased friction and ill feeling. The differences developed were chiefly between general atonement and atonement for the elect only and between mediate imputation and immediate imputation.

The agitation with reference to African slavery threw the bulk of the Southern Presbyterians on the Old Side, which was further strengthened by the accession of the Associate Reformed. The ancient differences between Old and New Side were revived, and once more it was urged that there should be (1) strict subscription, (2) exclusion of the Congregationalized churches, and strict Presbyterian polity and discipline, and (3) the condemnation and exclusion of the new divinity and the maintenance of scholastic orthodoxy. In 1834 a convention of the Old Side was held in Philadelphia, and the "Act and Testimony" was adopted charging doctrinal unsoundness and neglect of discipline upon the New Side, and urging that these should be excluded from the Church. The moderate men on both sides opposed this action and strove for peace or an amicable separation, but in vain. In 1837 the Old Side obtained the majority in the General Assembly for the second time only in seven years; they seized their opportunity and abrogated the "Plan of Union of 1801 with the Connecticut Congregationalists," cut off the synod of Western Reserve and then the synods of Utica, Geneva and Genesee, without a trial, and dissolved the third presbytery of Philadelphia without providing for the standing of its ministers. The New Side men met in convention at Auburn, N.Y., in August 1837, and adopted measures for resisting the wrong, but in the General Assembly of 1838 the moderator refused to recognize their commissioners. On an appeal to the assembly the moderator's decision was reversed, a new moderator was chosen, and the assembly adjourned to another place of meeting. The Old Side remained after the adjournment and organized themselves, claiming the historic succession. Having the moderator and clerks from the assembly of 1837, they retained the books and papers. Thus two General Assemblies were organized, the Old and the New School. An appeal was made to the civil courts, which decided (1839) in favour of the New School; but this decision was overruled and a new trial ordered. It was deemed best, however, to cease litigation and to leave matters as they were.

Several years of confusion followed. In 1840 we have the first safe basis for comparison of strength.

	Ministers.	Churches.	Communicants.
Old School . .	1308	1898	126,583
New School . .	1234	1375	102,060

The "sides" remained separate throughout the remainder of this period. The North was especially agitated by the slavery question.[1] In 1847 the synod of the Free Presbyterian Church was formed by the anti-slavery secession of the presbytery of Ripley, O. (New School), and a part of the presbytery of Mahoning, Pa., (Old School); this synod, then numbering five presbyteries with 43 ministers, joined the New School Assembly during the Civil War. In 1850 the New School Assembly declared slave-holding, unless excusable for some special reason, a cause for discipline; in 1853 it asked the Southern presbyteries to report what action they had taken to put themselves in accord with the resolution of 1850;

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[1] The separation of the southern part of the Associate Reformed Church from the northern in 1821, and the establishment of the Associate Reformed Synod of the South had not been due to slavery, but was for convenience in administration.

in 1858, 6 synods, 21 presbyteries and about 15,000 communicants withdrew and organized the United Synod. Just before the outbreak of the Civil War in 1861 these churches numbered:—

	Synods.	Presbyteries.	Ministers.	Churches.	Communicants.
Old School .	33	171	2656	3531	292,927 (1860)
New School.	22	104	1523	1482	134,933 (1860)
United Synod	4	15	113	197	10,205 (1858)
Cumberland Presbyterian	23	96	890	1189	82,008 (1859)

3. *Since the beginning of the Civil War.*—The Southern presbyteries of the Old School Assembly withdrew in 1861, and delegates from ten southern synods (47 presbyteries) met in Augusta, Georgia, in December, and organized as the General Assembly of the Presbyterian Church in the Confederate States of America, which included 700 ministers, 1000 churches and 75,000 communicants. Its strength was increased by the addition: in 1863 of the small Independent Presbyterian Church of South Carolina; in 1865 of the United Synod (New School), which at that time had 120 ministers, 190 churches, and 12,000 communicants; in 1867 of the presbytery of Patapsco; in 1869 of the synod of Kentucky; and in 1874 of the synod of Missouri. At the close of the Civil War this Southern Church adopted the name of the General Assembly of the Presbyterian Church in the United States.

In 1867 there was an unsuccessful attempt to combine all the Presbyterian bodies of the North. In 1869 the Old and New Schools in the North combined on the basis of the common standards; to commemorate the union a memorial fund was raised which amounted in 1871 to $7,607,492. Between 1870 and 1881 three presbyteries of the Reformed Presbyterian General Synod (New School) joined the northern General Assembly. In 1906 the greater part of the Cumberland Presbyterian Church (then having 195,770 members) united with the northern General Assembly. Although the differences between the Old School and the New School were much less in 1869 than in 1837—during the separation the New School was conservative, the Old School liberal, in tendency—there were serious dissensions in the northern church after the union. The first of these was due to the adoption by certain teachers in theological seminaries of the methods and results of the "higher criticism," and two famous heresy cases followed. Charles Augustus Briggs, tried for heresy for his inaugural address in 1891 as professor of biblical theology at Union Seminary (in which he attacked the inerrancy of the Bible, held the composite character of the Hexateuch and of the Book of Isaiah and taught that sanctification is not complete at death), was acquitted by the presbytery of New York, but was declared guilty and was suspended from its ministry by the General Assembly of 1893. Henry Preserved Smith, professor of Hebrew and Old Testament exegesis in Lane Seminary, for a pamphlet published in 1891 denying the inerrancy but affirming the inspiration of the Scriptures, was suspended in 1892 by the presbytery of Cincinnati, and was unsuccessful in his appeal to the synod and to the General Assembly. Dr Briggs remained a member of the Union Seminary faculty but left the Presbyterian Church to enter the Protestant Episcopal. Dr Smith resigned his chair at Lane Seminary, and entered the Congregational ministry. In 1892–1893 there was an open break between the General Assembly and Union Seminary, which repudiated the agreement of 1870[1] between the seminaries and the assembly; the assembly disclaimed responsibility for the Seminary's teachings and withheld financial aid from its students. In 1896 McCormick Theological Seminary (which in 1858 as New Albany Theological Seminary had come under the control of the assembly) and Auburn Seminary refused to make the changes desired by the General Assembly; a satisfactory arrangement with McCormick was made. Lane and Auburn remained practically independent.

But although the conservative party was successful in inducing successive general assemblies to lay repeatedly stronger stress on the verbal inerrancy of Holy Scripture and to make belief in such inerrancy a requisite of teachers in theological seminaries and of candidates for the ministry, there was in other matters an increasing liberal tendency. In 1902 the General Assembly adopted a Brief Statement of the Reformed Faith, not as a legal standard but as an interpretation of the confession; it repudiated the doctrine of infant damnation, insisted on the consistency of predestination with God's universal love, and incorporated new chapters on the Holy Spirit, the love of God, and missions. The Assembly of 1906 authorized (but did not make mandatory) the use of a book of common worship; the question of a liturgy had been opened in 1855 by C. W. Baird's *Eutaxia*; in 1864 Charles W. Shields (1825–1904), who afterwards entered the Protestant Episcopal Church, republished and urged the adoption of the Book of Common Prayer as amended by the Westminster Divines in the royal commission of 1661; and Henry Van Dyke was prominent in the latter stage of the movement for a liturgy.

The northern General Assembly and the Cumberland Church, which united with it in 1906, are the only Presbyterian bodies in America that have done anything tangible for Christian union in the last fifty years: the southern Assembly is much more conservative than the northern—in 1866 it suspended James Woodrow (1828–1907), professor of natural science in connexion with revealed religion, for holding evolutionary views, and it declared that Adam's body was "directly fashioned by Almighty God, without any natural animal parentage of any kind, out of matter previously created out of nothing"; and in 1897 it ordered that women were not to speak in promiscuous meetings—and its attitude toward the negro, insisting in separate church organizations for blacks and whites, makes union with the northern bodies difficult; the United Presbyterian Church in North America in 1890 refused to join the union of Presbyterian and Reformed missions in India, and its opposition to instrumental music and to the use of any songs but the psalms of the Old Testament, although this is decreasing in strength, are bars to union; the synod of the Reformed Presbyterian Church of North America in 1888 refused to unite with the United Presbyterian Church because the latter did not object to the secular character of the constitution of the United States; and with the general synod of the Reformed Presbyterian Church the synod could not unite in 1890 because the general synod allowed and the synod did not allow its members to "incorporate" themselves with the political system of the United States. A loose union, called the "Federal Council of the Reformed Churches in America," was formed in 1894 by the churches mentioned (excepting the Southern Assembly) and the Dutch and German Reformed churches.

More or less closely connected with the Northern Church are the theological seminaries at Princeton, Auburn, Pittsburg (formerly Allegheny—the Western Seminary), Cincinnati (Lane), New York (Union) and Chicago (McCormick), already named, and San Francisco Seminary (1871) since 1892 at San Anselmo, Cal., a theological seminary (1891) at Omaha, Nebraska, a German theological seminary (1869) at Bloomfield, New Jersey, the German Presbyterian Theological School of the North-west (1852) at Dubuque, Iowa, and the Presbyterian Theological Seminary of Kentucky, which is under the control and supervision of the northern and southern churches. Seminaries of the Southern Church are the Union Theological Seminary at Richmond, Virginia, and the Columbia Theological Seminary at Columbia, South Carolina, already mentioned, the Austin Presbyterian Theological Seminary (1902) at Austin, Texas, the theological department in the South-western Presbyterian University at Clarksville, Tennessee, and, for negroes, Stillman Institute (1877), at Tuscaloosa, Alabama. The United Presbyterian Church has two seminaries, one at Xenia, Ohio, and one at Allegheny (Pittsburg). Of the Covenanter bodies the synod of the Reformed Presbyterian Church has a theological seminary in Allegheny (Pittsburg), established in 1856, and the general synod in 1887 organized a college at Cedarville, Ohio. The Associate Reformed Synod of the South has the Erskine Theological Seminary (1837) in Due West, South Carolina.

The foreign missionary work of the General Assembly had been carried on after 1812 through the (Congregational) American Board of Commissioners for Foreign Missions (organized in 1810) until the separation of 1837, when the Old School Assembly established its own board of foreign missions; the New School continued to work through the American board; after the union of 1869 the separate board was perpetuated and the American board transferred to it, with the contributions made to the American board by the New School churches, the missions in Africa (1833), in Syria (1822), and in Persia (1835). The Church now has, besides these missions, others in India (1834), Siam (1840), China (1846), Colombia (1856), Brazil (1859), Japan (1859), Laos (1867), Mexico (transferred in 1872 by the American and Foreign Christian Union), Chile (transferred in 1873 by the same Union; first established in 1845), Guatemala (1882), Korea (1884) and the Philippine Islands (1899). A board of home missions was organized in 1816; a board of education in 1819; a woman's board of foreign missions in 1869; a women's executive committee for home mission work (which takes particular interest in the work for the freedmen) in 1878; a board of publication in 1838 (after 1887 called the board of Publication and Sunday School Work); a board of aid for colleges

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[1] This agreement, proposed to the General Assembly in 1870 by the directors of Princeton and of Union, gave the Assembly a veto on the election and removal of professors.

(1883); a board of church erection in 1844; a board of work for freedmen; and a board of ministerial relief, after the union of 1869 the Board of Home Missions was removed from Philadelphia to New York City.

The Southern Church, unlike the Northern, is not working through "boards," but through executive committees, which were formerly more loosely organized, and which left to the presbyteries the more direct control of their activities, but which now differ little from the boards of the northern Church. It has: an executive committee on foreign missions (first definitely organized by the Assembly in 1877), which has missions in China (1867), Brazil (1869), Mexico (1874), Japan (1885), Congo Free State (1891), Korea (1896) and Cuba (1899); and executive committees of home missions (1865), of publication and sabbath school work, of ministerial education and relief, of schools and colleges and of colored evangelization (formed in 1891). Permanent committees on the "sabbath and family religion," the "Bible cause" and "evangelistic work" report to the General Assembly annually.

The United Presbyterian Church has a board of foreign missions (reorganized in 1859) with missions in Egypt (1853), now a synod with four presbyteries (in 1909, 71 congregations, 70 ministers and 10,341 members), in the Punjab (1854), now a synod with four presbyteries (in 1909, 35 congregations, 51 ministers and 17,321 members), and in the Sudan (1901); and boards of home missions (reorganized, 1859), church extension (1859), publication (1859), education (1859), ministerial relief (1862), and missions to the freedmen (1863).

Presbyterians of different churches in the United States in 1906 numbered 1,830,555; of this total 322,542 were in Pennsylvania, where there were 248,335 members of the Presbyterian Church in the United States of America (the Northern Church), being more than one-fifth of its total membership; 56,587 members of the United Presbyterian Church of North America, being more than two-fifths of its total membership; 2709 members of the Synod of the Reformed Presbyterian Church of North America, three-tenths of its total membership; the entire membership of the Reformed Presbyterian Church in the United States and Canada (440), 3150 members of the Welsh Calvinistic Methodist Church, nearly one-fourth of its total membership; and 2065 members of the Reformed Presbyterian Church in North America, general synod, about five-ninths of its total membership. The strength of the Church in Pennsylvania is largely due to the Scotch-Irish settlements in that state. Philadelphia is the home of the boards of publication and of Sunday schools of the Northern Church; and in Allegheny (Pittsburg) are the principal theological seminary of the United Presbyterian body and its publishing house. In New York state there were 199,923 Presbyterians, of whom 186,278 were members of the Northern Church and 10,115 of the United Presbyterian Church of North America. In Ohio there were 138,768 Presbyterians, 114,772 being of the Northern and 18,336 of the United Presbyterian Church. The other states with a large Presbyterian population were Illinois (115,602; 86,251 of the Northern Church; 17,208 of the Cumberland Church; 9555 of the United Presbyterian Church); New Jersey (79,912; 78,490 of the Northern Church); Tennessee (79,337; 42,464 being Cumberland Presbyterians, more than one-fifth of the total membership; 6640 of the Colored Cumberland Church, more than one-third of its membership; 21,390 of the Southern Church; and 6786 of the Northern Church); Missouri (71,599; 28,637 of the Cumberland Church; 25,991 of the Northern Church; 14,713 of the Southern Church); Texas (62,090; 31,598 of the Cumberland Church; 23,934 of the Southern Church; 4118 of the Northern Church; and 2091 of the Colored Cumberland Church); Iowa (60,081; 48,326 of the Northern Church; 8890 of the United Presbyterian Church); and North Carolina (55,837; 41,322 of the Southern and 10,696 of the Northern Church). The Northern Church had a total membership of 1,179,566. The Southern Church had a total membership of 266,345. The Cumberland Presbyterian Church had (in 1906, when it became a part of the Northern Church) 195,770 members. The Colored Cumberland Church had a membership of 18,066. The United Presbyterian Church of North America had a total membership of 130,342. The Welsh Calvinistic Methodist Church had a total membership of 13,280. The Associate Reformed Synod of the South had a membership of 13,201. The Synod of the Reformed Presbyterian Church in North America had in 1906 a membership of 9122. The "Reformed Presbyterian Church in North America, General Synod," had a membership of 3620. The Associate Presbyterian Church, or Associated Synod of North America had a membership of 786. The Reformed Presbyterian Church in the United States and Canada had a membership in the United States of 440.

On American Presbyterianism, see Charles Hodge, *Constitutional History of the Presbyterian Church in the United States of America, 1706–1788* (2 vols., Philadelphia, 1839–1840); *Records of the Presbyterian Church in the United States of America from 1706 to 1788* (ibid., 1841); Richard Webster, *History of the Presbyterian Church in America* (ibid., 1858); E. H. Gillett, *History of the Presbyterian Church in the United States of America* (2nd ed., ibid., 1873); C. A. Briggs, *American Presbyterianism* (New York, 1885). There is a good bibliography on pp. xi–xxxi of R. E. Thompson's *History of the Presbyterian Churches in the United States* (ibid., 1895), vol. vi. of the American Church History Series; in the same series in vol. xi. are sketches of "The United Presbyterians," by J. B. Scouller, "The Cumberland Presbyterians," by R. N. Foster, and "The Southern Presbyterians," by Thomas C. Johnson. Other works on the separate churches are: E. B. Crisman, *Origin and Doctrines of the Cumberland Presbyterian Church* (St Louis, 1877) and W. M. Glasgow, *History of the Reformed Presbyterian Church in America* (Baltimore, 1888).

PRESBYTERY, in architecture, that portion of the choir of a church in which the high altar is placed, and which is generally raised by a few steps above the rest of the church. It is reserved for the priests, and in that respect differs from the choir, the stalls in which are occasionally occupied by the laity. In Westminster Abbey the space east of the transept is the presbytery, and the same arrangement is found in Canterbury Cathedral. In San Clemente at Rome the presbytery is enclosed with a marble balustrade or screen. For the use of the word in Church government see PRESBYTER and PRESBYTERIANISM.

PRESCOT, a market town and urban district in the Ormskirk parliamentary division of Lancashire, England, 8 m. E. of Liverpool by the London & North Western railway. Pop. (1901), 7855. It is of considerable antiquity, and received a grant for a market and fair in the 7th year of Edward III. A church existed in the 13th century. The present church of St Mary is in various styles, with a lofty tower and spire and carved timber roof. The chief industry is the making of watches, and the town has long been celebrated for the production of watch movements and tools. The industry was first introduced in 1730 by John Miller from Yorkshire. There is also a manufacture of electric cables. John Philip Kemble, the actor, was born at Prescot in 1757. To the north of the town is Knowsley Park, the demesne of the earls of Derby, with a mansion of various dates from the 15th century onward, containing a fine collection of pictures. Prescot was formerly of greater importance in relation to the now populous district of south-west Lancashire; it was also a postal centre, and it is curious to notice that such addresses as "Liverpool, near Prescot" were necessary.

PRESCOTT, WILLIAM HICKLING (1796–1859), American historian, was born in Salem, Massachusetts, on the 4th of May 1796. His grandfather was Colonel William Prescott (1726–1795), who commanded at the battle of Bunker Hill; and his father was a well-known lawyer. He received his earlier education in his native city, until the removal of his family in 1808 to Boston. He entered Harvard College in the autumn of 1811, but almost at the outset his career was interrupted by an accident which affected the subsequent course of his life. A hard piece of bread, flung at random in the Commons Hall, struck his left eye and destroyed the sight. After graduating honourably in 1814 he entered his father's office as a student of law; but in January 1815 the uninjured eye showed dangerous symptoms of inflammation. When at last in the autumn he was in condition to travel, it was determined that he should pass the winter at St Michael's and in the spring obtain medical advice in Europe. His visit to the Azores, which was constantly broken by confinement to a darkened room, is chiefly noteworthy from the fact that he there began the mental discipline which enabled him to compose and retain in memory long passages for subsequent dictation; and, apart from the gain in culture, his journey to England, France, and Italy (April 1816 to July 1817) was scarcely satisfactory. The verdict of the physicians was that the injured eye was hopelessly paralysed, and that the preservation of the sight of the other depended upon the maintenance of his general health. His further pursuit of the legal profession seemed to be out of the question, and on his return to Boston he remained quietly at home. On 4th May 1820 he was married to Miss Susan Amory. Prior to his marriage he had made a few experiments in composition, but he now finally decided to devote his life to literature. A review of Byron's *Letters on Pope* in 1821 constituted his first contribution to the *North American Review*, to which he continued for many years to send the results of his slighter researches. He next turned to French literature, and to the early English drama and ballad literature. Of the direction and quality of his thought at this time he has left indications in his papers on *Essay-Writing* (1822) and on *French and English Tragedy* (1823). In pursuance of his method of successive studies he began in 1823 the study of Italian literature, passing over German as demanding more labour than he could afford. In the following year he made his first acquaintance with the literature of Spain under the influence of his friend and biographer, Ticknor; and, while its attractiveness proved greater than he had at the outset anticipated, the comparative novelty of the subject as a field for research served as an additional stimulus.

In the meantime his aims had been gradually concentrating. History had always been a favourite study with him, and Mably's *Observations sur l'histoire* appears to have had considerable influence in determining him to the choice of some special period for historic research. The selection, however, was not finally made without prolonged hesitation. It was not till the 19th of January 1826 that he recorded in the private memoranda begun by him in 1820 his decision "to embrace the gift of the Spanish subject." The choice was certainly a bold one. He could only use the eye which remained to him for brief and intermittent periods, and as travelling affected his sight prejudicially he could not anticipate any personal research amongst unpublished records and historic scenes. He was happy, however, in the possession of ample means and admirable friends; and he sketched with no undue restriction or hesitancy the plan of the *History of the reign of Ferdinand and Isabella*—his first great work. Mr English, one of his secretaries, has furnished a picture of him at this period seated in a study lined on two sides with books and darkened by green screens and curtains of blue muslin, which required readjustment with almost every cloud that passed across the sky. His writing apparatus—a noctograph—lay before him, and he kept his ivory style in his hand to jot down notes as the reading progressed. In accordance with his general method these notes were in turn read over to him until he had completely mastered them, when they were worked up in his memory to their final shape. So proficient did he become that he was able to retain the equivalent of sixty pages of printed matter in his memory, turning and returning them as he walked or drove. The rate of progress was necessarily slow, apart from any liability to interruption by other undertakings and failures in bodily health. He still continued his yearly experimental contributions to the *North American Review*, elaborating them with a view as much to ultimate historical proficiency as to immediate literary effect, the essays on *Scottish Song* (1826), *Novel-Writing* (1827), *Molière* (1828), and Irving's *Granada* (1829) belonging to this preparatory period. On the 6th of October 1829 he began the actual work of composition, which was continued without more serious interruptions than those occasioned by the essays on *Asylums for the Blind* (1830), *Poetry and Romance of the Italians* (1831), and *English Literature of the 19th Century* (1832), until the 25th of June 1836, when the concluding note was written. Another year, during which his essay on *Cervantes* appeared, was spent in the final revision of the *History* for the press. Its success upon its publication in Boston was immediate. Arrangements were speedily made for its publication in England, and there its success was not less marked. From the position of an obscure reviewer Prescott suddenly found himself elevated to the first rank of contemporary historians.

After coquetting for a short time with the project of a life of Molière he decided to follow in the track of his first work with a *History of the Conquest of Mexico*. Washington Irving, who had already made preparations to occupy the same field, generously withdrew in his favour. The work was completed in August 1843, the five years' labour having been broken by the composition of reviews of Lockhart's *Life of Scott* (1838), Kenyon's *Poems* (1839), *Chateaubriand* (1839), Bancroft's *United States* (1841), Mariotti's *Italy* (1842), and Madame Calderon's *Life in Mexico* (1843), and by the preparation of an abridgment of his *Ferdinand and Isabella* in anticipation of its threatened abridgment by another hand. On the 6th of December 1843 the *Conquest of Mexico* was published with a success proportionate to a wide reputation won by his previous work. The careful methods of work which he had adopted from the outset had borne admirable fruit. While the consultation of authorities had been no less thorough, his style had become more free and less self-conscious; and the epic qualities of the theme were such as to call forth in the highest degree his powers of picturesque narration.

It was only a step from the conquest of Mexico to that of Peru, and scarcely three months elapsed before he began to break ground on the latter subject. In February 1845 he received the announcement of his election as corresponding member of the French Institute in place of the Spanish historian Navarrete, and also of the Royal Society of Berlin. The winter found him arranging for the publication in England of the selection from his articles and reviews which appeared in 1845, under the title of *Critical and Historical Essays*, and was issued almost contemporaneously at New York under the title of *Biographical and Critical Miscellanies*. The *Conquest of Peru* was completed in November 1846 and published in March following. His misgivings as to its reception were at once set at rest, and it was speedily issued in translations into French, Spanish, German and Dutch, in addition to the English editions of New York, London and Paris.

He was now over fifty and his sight showed serious symptoms of enfeeblement. Although during the composition of the *Ferdinand and Isabella* it had been of very intermittent service to him, it had so far improved that he could read with a certain amount of regularity during the writing of the *Conquest of Mexico*, and also, though in a less degree, during the years devoted to the *Conquest of Peru*. Now, however, the use of his remaining eye had been reduced to an hour a day, divided into portions at wide intervals, and he was driven to the conclusion that whatever plans he made must be formed on the same calculations as those of a blind man. He had been for many years collecting materials for a history of Philip II., but he hesitated for some time to attempt a work of such magnitude, occupying himself in the meantime with the slighter labours of a memoir of John Pickering for the Massachusetts Historical Society and the revision of Ticknor's *History of Spanish Literature*. But in March 1848 he set himself with characteristic courage to the accomplishment of the larger project. He had been fortunate in obtaining the aid of Don Pascual de Gayangos, then professor of Arabic literature at Madrid, by whose offices he was enabled to obtain material not only from the public archives of Spain but from the muniment rooms of the great Spanish families. With an exceptional range of information thus afforded him, he wrote the opening of his history in July 1849; but, finding himself still unsettled in his work, he decided in the spring of the following year to carry out a long projected visit to England. The idea of writing memoirs was dismissed in favour of the more elaborate form, and in November 1855 the first two volumes of his uncompleted *History of Philip II.* were issued from the press, their sale eclipsing that of any of his earlier books. This was his last great undertaking; but as Robertson's *Charles V.*, in the light of new sources of information, was inadequate to take its place as a link in the series, he republished it in an improved and extended form in December 1856. A slight attack of apoplexy on the 4th of February 1858 foretold the end, though he persevered with the preparation of the third volume of *Philip II.* for the press, and with the emendation and annotation of his *Conquest of Mexico.* On the morning of the 27th of January 1859 a second attack occurred, and he died in the afternoon of the same day in his sixty-third year.

As an historian Prescott stands in the direct line of literary descent from Robertson, whose influence is clearly discernible both in his method and style. But, while Robertson was in some measure the initiator of a movement, Prescott came to his task when the range of information was incomparably wider and when progress in sociologic theory had thrown innumerable convergent lights upon the progress of events. He worked, therefore, upon more assured ground; his sifting of authorities was more thorough and his method less restricted. At the same time he cannot be classed as in the highest sense a philosophic historian. His power lies chiefly in the clear grasp of fact, in selection and synthesis, in the vivid narration of incident. For extended analysis he had small liking and faculty; his critical insight is limited in range, and he confines himself almost wholly to the concrete elements of history. When he does venture upon more abstract criticism his standards are often commonplace and superficial, and the world scheme to which he relates events is less profound than the thought of his time altogether warranted. Moreover, the authorities on whom he relied have had to be corrected since in many points of detail in the light of later archaeological research. If these things, however, indicate Prescott's deficiencies from the point of view of ideal history, few historians have had in a higher degree that artistic feeling in the broad arrangement of materials which ensures popular interest. The course of his narrative is unperplexed by doubtful or insoluble problems. The painting is filled in with primary colours and with a free hand; and any sense of crudity which may be awakened by close inspection is compensated by the vigour and massive effectiveness of the whole.

Prescott's works in 16 vols. were edited by J. F. Kirk in 1870–1874. His *Life* was written by George Ticknor (1864; revised 1875). There are later lives by R. Ogden (1904) and H. T. Peck (1905).

PRESCRIPTION, in the broadest sense, the acquisition or extinction of rights by lapse of time. The term is derived from the *praescriptio* of Roman law, originally a matter of procedure, a clause inserted before the *formula* on behalf of either the plaintiff or, in early times, the defendant, limiting the question at issue. It was so called from its preceding the *formula.*[1] One of the defendant's *praescriptiones* was *longi temporis* or *longae possessionis praescriptio* (afterwards superseded by the *exceptio*), limiting the question to the fact of possession without interruption by the defendant for a certain time. It seems to have been introduced by the praetor to meet cases affecting aliens or lands out of Italy where the *usucapio* of the civil law (the original means of curing a defect of title by lapse of time) could not apply. The time of acquisition by *usucapio* was fixed by the Twelve Tables at one year for movables and two years for immovables. *Praescriptio* thus constituted a kind of praetorian *usucapio.* In the time of Justinian *usucapio* and *praescriptio* (called also *longi temporis possessio*), as far as they affected the acquisition of ownership, differed only in name, *usucapio* being looked at from the point of view of property, *praescriptio* from the point of view of pleading. By the legislation of Justinian movables were acquired by three years' possession, immovables by ten years' possession where the parties had their domicile in the same province (*inter praesentes*), twenty years' possession where they were domiciled in different provinces (*inter absentes*). Servitudes could not be acquired by *usucapio* proper, but were said to be acquired by *quasi usucapio*, probably in the same time as sufficed to give a title to immovables. There was also a *longissimi temporis possessio* of thirty years, applicable to both movables and immovables, and requiring nothing but *bona fides* on the part of the possessor. Where the right sought to be established was claimed against the Church, a still longer period of forty years (at one time a hundred) was necessary. Immemorial prescription was required in a few cases of a public character, as roads.[2] *Praescriptio* was also the term applied to lapse of time as barring actions upon contracts or torts under various provisions corresponding to the English Statutes of Limitation. The prescription of Roman law (and of modern systems based upon it) is thus both acquisitive and extinctive. It looks either to the length of time during which the defendant has been in possession, or to the length of time during which the plaintiff has been out of possession. In English law the latter kind of prescription is called limitation. The tendency of law is to substitute a definite for an indefinite period of prescription.

In English law prescription is used in a comparatively narrow sense. It is acquisitive only, and is very limited in its application. A title by prescription can be made only to incorporeal hereditaments—that is, in legal language, hereditaments that are or have been appendant or appurtenant to corporeal hereditaments—and to certain exemptions and privileges.[3] The rights claimable by prescription for the most part consist of rights *in alieno solo.* The most important are advowsons, tithes, commons, ways, watercourses, lights, offices, dignities, franchises, pensions, annuities and rents. Land or movables cannot be claimed by prescription. The foundation of prescription is the presumption of law that a person found in undisturbed enjoyment of a right did not come into possession by an unlawful act (see Williams, *Rights of Common,* 3). In the English courts this presumption was, perhaps still is, based upon the fiction of a lost grant, viz. that there had been a grant of the hereditament by a person capable of granting it to a person capable of taking it, and that the grant had been lost. The jury were instructed to find the loss of a once existing grant in whose existence no one really believed. The enjoyment of the right must have been from a time whereof the memory of man runneth not to the contrary. The period of legal memory was after a time necessarily fixed for purposes of convenience at a certain date. The date adopted varied at first with the time during which the demandant in a writ of right must have proved seisin in himself or his ancestors. After one or two previous enactments the date was finally fixed by the Statute of Westminster the First (3 Edw. I. c. 39) at the reign of Richard I., which was interpreted to mean the first year of the reign of Richard I. (1189). The inconvenience of this remote date, as time went on, led to the gradual growth of a rule of evidence that proof of enjoyment for twenty years was prima facie evidence of enjoyment from time immemorial. But evidence of the beginning of the enjoyment at however remote a date, if subsequent to 1 Richard I., was sufficient to destroy the claim. This is still the law with respect to claims not falling within the Prescription Act, mostly rights in gross—that is, where there is no dominant or servient tenement, *e.g.* a right to a pew or to a several fishery in gross. The twenty years' rule was of comparatively late introduction; it does not seem to have been known in the time of Elizabeth, and was perhaps introduced in analogy to the Statute of Limitations, 21 Jac. I. c. 16. With respect to claims of profits *à prendre* and easements a change was made by the Prescription Act 1832 (extended to Ireland by an act of 1858, but not to Scotland). By that act claims to rights of common and other profits *à prendre* are not to be defeated after thirty years' enjoyment by any person claiming right thereto without interruption for thirty years by showing only the commencement of the right, and after sixty years' enjoyment the right is absolute and indefeasible unless had by consent or agreement by deed or writing (§ 1). In claims of rights of way or other easements the periods are twenty years and forty years respectively (§ 2). The before-mentioned periods are to be deemed those next before suits, and nothing is to be deemed to be an interruption unless acquiesced in for one year (§ 4). In pleading, the enjoyment as of right may be alleged during the period mentioned in the act, and without claiming in the name or right of the owner of the fee (§ 5). No presumption is to be made in favour of a right exercised for a less period (§ 6). The time during which a person otherwise capable of resisting a claim is an infant, idiot, *non compos mentis, feme covert,* or tenant for life, or during which an action or suit has been pending until abated by the death of a party, is to be excluded in the computation of the periods unless where the right or claim is declared to be absolute and indefeasible (§ 7). An act to define the period of prescription for a *modus decimandi,* or an exemption from tithes by composition, was passed the same year. The Prescription Act is only supplemented to the common law, so that a claim may be based upon the act or, in the alternative, upon the common law. Nor does the act alter the conditions necessary at common law for a good claim by prescription. The claim under the statute must be one which may be lawfully made at common law. The principal rules upon the subject are these. (1) The title is founded upon actual usage. The amount of actual usage and the evidence necessary to prove it vary according to the kind of claim. (2) The enjoyment must (except in the case of light) be as of right—that is to say, peaceable, openly used, and not by licence. (3) The prescription must be certain and reasonable. Inhabitants cannot, however, claim by prescription, as they are an uncertain and fluctuating body, unless under a grant from the Crown, which constitutes them a corporation for the purposes of the grant. (4) The prescription must be alleged in a *que estate* or in a man and his ancestors. Prescription in a

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[1] "Praescriptiones autem appellatas esse ab eo quod ante formula praescribuntur" (Gaius iv. § 132).

[2] "Viae vicinales, quarum memoria non extat" (*Dig.* xliii. 7, 3).

[3] Prescription seems at one time to have borne a wider meaning. A claim by prescription to land is mentioned in 32 Hen. VIII. c. 2. And it seems that tenants in common may still make title to land by prescription (Littleton's *Tenures,* § 310).

que estate lies at common law by reason of continuous and immemorial enjoyment by the claimant, a person seised in fee, and all those whose estate he had (*toux ceux que estate il ad*). The Prescription Act fixes a definite period and does away with the necessity which existed at common law of prescribing in the name of the person seised in fee. Prescription in a man and his ancestors is not of ordinary occurrence in practice. Corporations, however, occasionally claim by a prescription analogous to this, viz. in the corporation and its predecessors. Such claims by either a person or a corporation are not within the Prescription Act, which applies only where there are dominant and servient tenements. By 32 Hen. VIII. c. 2 (1540) no person can make any prescription by the seisin or possession of his ancestor unless such seisen or possession had been within threescore years next before such prescription made. (5) A prescription cannot lie for a thing which cannot be granted, as it rests upon the presumption of a lost grant. Thus a lord of a manor cannot prescribe to raise a tax or toll upon strangers, for such a claim could never have been good by any grant.

Prescription and Custom.—Prescription must be carefully distinguished from custom. Prescription, as has been said, is either in a *que estate* or in a man and his ancestors—that is to say, it is a personal claim; custom is purely local—that is to say, it is a usage obtaining the force of law within a particular district. In the time of Littleton the difference between prescription and custom was not fully recognized (see Littleton's *Tenures*, § 170), but the law as it exists at present had become established by the time of Sir Edward Coke. A custom must be certain, reasonable and exercised as of right. Like prescription at common law, it must have existed from time immemorial. On this ground a custom to erect stalls at statute sessions for hiring servants was held to be bad, because such sessions were introduced by the Statute of Labourers, 23 Edw. III. st. 1 (*Simpson* v. *Wells*, L.R., 7 Q.B., 214). Some rights may be claimed by custom which cannot be claimed by prescription, *e.g.* a right of inhabitants to dance on a village green, for such a right is not connected with the enjoyment of land. On the other hand, profits *à prendre* can be claimed by prescription but not by custom, unless in two or three exceptional cases, such as rights of copyholders to common in the lord's demesne, or to dig sand within their tenements, rights to estovers in royal forests, and rights of tinbounders in Cornwall.

United States.—The Law of the United States (except in Louisiana) is based upon that of England, but the period of enjoyment necessary to found a title by prescription varies in the different states. An easement or profit *à prendre* is acquired by twenty years' enjoyment in most states, following the English common law rule. In Louisiana the period varies according to the subject from three to thirty years, and property other than incorporeal hereditaments may be claimed by prescription as in Roman law (see *Kent's Comm.* iii. 442).

International Law uses the term "prescription" in its wider or Roman sense. "The general consent of mankind has established the principle that long and uninterrupted possession by one nation excludes the claim of every other" (Wheaton, *Int. Law*, § 165). Historic instances of rights which were at one time claimed and exercised by prescription as against other nations are the sovereignty of Venice over the Adriatic and of Great Britain over the Narrow Seas, and the right to the Sound dues long exacted by Denmark. But such claims were rejected by the highest authorities on international law (*e.g.* Grotius), on the ground that they were defective both in *justus titulus* and in *de facto* possession. There is no special period fixed, as in municipal law, for the acquirement of international rights by lapse of time. In private international law prescription is treated as part of the *lex fori* or law of procedure. (J. W.)

Scotland.—In the law of Scotland "prescription" is a term of wider meaning than in England, being used as including both *prescription* and *limitation* of English law. In its most general sense it may be described as the effect which the law attaches to the lapse of time, and it involves the idea of possession held by one person adverse to the rights of another. Though having its basis in the common law, its operation was early defined by statute, and it is now in all respects statutory. Prescription in Scots law may be regarded (1) as a mode of acquiring rights—the positive prescription; (2) as a mode of extinguishing rights—the negative prescription; (3) as a mode of limiting rights of action—the shorter prescriptions. It must, however, be observed with reference to this division that the distinction between (1) and (2) is rather an accidental (due to a loose interpretation of the language of the act of 1617, c. 12) than a logically accurate one. It is, moreover, strictly confined to heritable rights, having no application in the case of movable property. But, though the distinction has been complained of by the highest authority as tending to create embarrassment in the law (see opinion of Lord Chancellor St Leonards in *Dougall* v. *Dundee Harbour Trustees*, 1852, 24 *Jurist*, 385), it is now too well settled to be departed from.

1. *Positive Prescription.*—The positive prescription was introduced by the act of 1617, c. 12. After setting forth in the preamble the inconvenience resulting from the loss of titles and the danger of forgery after the means of improbation are lost by the lapse of time, it enacts that whatever heritages the lieges, their predecessors or authors have possessed by themselves or others in their names peaceably, in virtue of infeftments for the space of forty years, continually and together, from the date of their said infeftments, and without any lawful interruption during the said space, they shall not be disturbed therein, provided they produce a written title on which their possession has proceeded. Such written title must be either a charter and sasine preceding the forty years, or, when no charter is extant, instruments of sasine proceeding upon retours or precepts of *clare constat*. Though the statute in its literal construction only applied to such heritable subjects as had been conveyed by charter and sasine, it was at an early date interpreted so as to include other heritable rights, as servitudes, tacks, public rights of way, &c., where no charter could be supposed to exist. The act of 1617 was so well framed that it continued to regulate the prescription of land rights till 1874. By the Conveyancing Act of that year (37 & 38 Vict. c. 94, § 34) the period of prescription was shortened from forty years to twenty. It was provided that possessions for twenty years upon "an *ex facie* valid irredeemable title recorded in the appropriate register of sasines" should in future give the same right as forty years' possessions upon charter and sasine under the earlier law. The act of 1874 does not, however, apply to all the cases which fell under the act of 1617. Thus it has been decided that twenty years' possession on a charter of adjudication followed by sasine and a declarator of expiry of the legal is insufficient to give an unchallengeable right, an adjudication not being an "*ex facie* irredeemable title" (*Hinton* v. *Connel's Trustees*, 1883, 10 Rettie's *Reports*, p. 1110). It is further specially provided by the act of 1874 that the twenty years' prescription is not to apply to servitudes, rights of way, and public rights generally. The following rules apply to the positive prescription. (*a*) The possession which is required for it must be peaceable, continuous ("continually and together," as the act of 1617 has it), and uninterrupted. (*b*) The prescription runs *de momento in momentum.* (*c*) The person against whom the prescription runs must be major and *sui juris*—a rule which, as regards minority, was specially provided for by the act of 1617, and as regards other cases of incapacity by the application of the principles of the common law. Under the Conveyancing Act, however, it is provided that in all cases where the twenty years' prescription applies, the lapse of thirty years is to exclude any plea on the ground of minority or want of capacity.

2. *Negative Prescription.*—This prescription was introduced by the act of 1469, c. 28, and substantially re-enacted by the act of 1474, c. 55. At first restricted to personal claims of debt, it was gradually extended in practice and ultimately made applicable to heritable bonds and other heritable rights by the above-mentioned act of 1617. By the act of 1469 it is declared that the person having interest in an obligation must follow the same within the space of forty years and take document thereupon, otherwise it shall be prescribed. The negative prescription accordingly extinguishes *in toto* the right to demand performance of an obligation after forty years, the years being reckoned from the day on which fulfilment of the obligation can be first demanded. The lapse of this period of time creates a conclusive presumption—one incapable of being redargued—that the debt or obligation has been paid or fulfilled. But it must be kept in view that the negative prescription does not *per se*—without the operation of the positive—establish a right to heritable property (Erskine, *Inst.* b. iii. tit. 7, § 8). As regards the character of the prescription, it is requisite, in the same way as in the case of the positive, that the years shall have run continuously and without interruption, *i.e.* without any act done on the part of the creditor which indicates his intention to keep alive the right. Such interruption may, for instance, take place by the payment of interest on the debt, or citation of the debtor in an action for the debt, or by a claim being lodged in the debtor's sequestration. In the same way as in the positive, the currency of the negative prescription is suspended by the debtor being minor or *non valens agere.*

3. *Shorter Prescriptions.*—There are certain short prescriptions recognized by Scots law—corresponding to the limitations of English law—which operate not as extinguishing rights but as excluding the ordinary means of proving them. The following require to be noticed. (*a*) Vicennial prescription protecting a person who has been served as heir for twenty years against action by any other person claiming to be heir. (*b*) Decennial prescription requiring all actions by minors against their tutors and curators, and vice versa, to be prosecuted within ten years from the expiration of the guardianship. (*c*) Septennial prescription providing that no person bind himself, under certain exceptions, for and with another, conjunctly and severally, in any bond or contract for sums of money shall be bound for more than seven years after the date of the obligation. There are also other shorter prescriptions limiting rights of action in different matters as the sexennial, quinquennial and triennial.

PRESENT, an adjective, adverb and substantive meaning that which is at hand or before one in place or in time. Also another substantive meaning a gift, and a verb meaning to bring into the presence of, to offer, to deliver. The verb is pronounced *presént*; the others *prèsent.* The first group is due to the Latin *praesens*, the present participle of *praeesse*, to be before one or at hand; from this participle was formed the verb *praesentare*, to bring before one, exhibit, show. The sense of "gift" is due to the O. Fr. phrase *mettre en présent à quelqu'un*, to bring something into the presence of a person, to offer, give. The legal formal phrase "these presents" is common, especially in the form "know all men by these presents," as an opening to a deed, more particularly to a deed-poll which cannot be referred to as an "indenture." The phrase "these present words, documents, writings," &c. is an adaptation of a similar phrase in O.Fr. *ces presentes* (*sc. lettres*). As ecclesiastical terms "to present" or "presentation" are used of the "presenting" or nomination by the patron to the bishop of the person chosen by him to fill a vacant benefice. When the bishop is patron he does not "present," but "collates." "Presentiment," foreboding, the feeling of something impending, must be distinguished in etymology; it is derived from the Lat. *praesentire*, to perceive beforehand.

PRESENTATIONISM (from Lat. *prae-esse*, *praesens*, present), a philosophical term used in various senses deriving from the general sense of the term "presentation." According to G. F. Stout (cf. *Manual of Psychology*, i. 57), presentations are "whatever constituents or our total experience at any moment directly determine the nature of the object as it is perceived or thought of at that moment." In Baldwin's *Dictionary of Philosophy*, vol. ii., a presentation is "an object in the special form under which it is cognized at any given moment of perceptual or ideational process." This, the widest definition of the term, due largely to Professor James Ward, thus includes both perceptual and ideational processes. The term has, indeed, been narrowed so as to include ideation, the correlative "representation" being utilized for ideal presentation, but in general the wider use is preferred. When the mind is cognizing an object, the object "presents" itself to the senses or to thought in one of a number of different forms (*e.g.* a picture is a work of art, a saleable commodity, a representation of a house, &c.). Presentation is thus essentially a cognitive process. Hence the most important use of the term "presentationism," which is defined by Ward, in *Mind*, N.S. (1893), ii. 58, as "a doctrine the gist of which is that all the elements of psychical life are primarily and ultimately cognitive elements." This use takes precedence of two others: (1) that of Hamilton, for presentative as opposed to representative theories of knowledge, and (2) that of some later writers who took it as equivalent to phenomenon (*q.v.*). Ward traces the doctrine in his sense to Hume, to whom the mind is a "kind of theatre" in which perceptions appear and vanish continually (see Green and Grose edition of the *Treatise*, i. 534). The main problem is as to whether psychic activity is "presented" or not. Ward holds that it is not presented or presentable save indirectly.

For the problems connected with Presentation and Presentationism see especially the article PSYCHOLOGY and authorities there quoted.

PRESIDENCY, an administrative unit of the Indian empire. The word is derived from the title of president or chief of the council of a principal factory under the early East India Company —a title which lasted until governors were appointed under act of parliament in 1784. It thence came to be applied to the three original provinces of Bengal, Madras, and Bombay. It is now restricted to Madras and Bombay, in distinction to the lieutenant-governorships. In Anglo-Indian usage, "presidency" was also applied to the capital city as opposed to the country beyond, termed the "mofussil"; and this usage lingers in such phrases as "presidency town," "presidency magistrate," and "presidency college."

PRESIDENT (Fr. *president*, from Lat. *praesidens*, post-Augustan Lat. for *praeses*, director, ruler, from *praesidere*, to sit in front of, preside), a style or title of various connotation, but always conveying the sense of one who presides. In classical Latin the title *praeses*, or president, was given to all governors of provinces, but was confined in the time of Diocletian to the procurators who, as lieutenants of the emperor, governed the smaller provinces. In this sense it survived in the middle ages. Du Cange gives instances from the capitularies of Charlemagne of the style *praeses provinciae* as applied to the count; and later examples of *praeses*, or *praesidens*, as used of royal seneschals and other officials having jurisdiction under the Crown.

In England the word survived late in this sense of royal lieutenant. Thus, John Cowell, in his *Interpreter of Words* (1607) defines "President" as "used in Common Law for the King's lieutenant in any province or function; as President of Wales, of York, of Berwick. President of the King's Council." In some of the British North American colonies (New Hampshire, Pennsylvania, South Carolina) there was a president of the council, usually elected by the council; and when Pennsylvania and New Hampshire became states, one member of the Executive Council was called president. The chief (and single) executive head in Delaware, South Carolina and New Hampshire (1784–1792) was called president.

During the revolutionary struggle in America from 1774 onwards, the presiding officer of the Continental Congress was styled "President" and when the present constitution of the United States was framed in 1787 (in effect 1789) the title of President was transferred to the head of the Federal government. "President" thus became the accepted style for the elected chief of a modern republic, the example of the United States being followed by the South American republics, by France in 1849, and by Switzerland.

In the simple sense of "one who presides" the word "president" preserved its meaning alongside the technical use implying royal delegation. In this sense the *New English Dictionary* quotes its use by Chaucer (*Troylus*, iv. 185) in 1374. In ecclesiastical terminology *praesidens* was sometimes used for the head of cathedral chapters, instead of dean or provost; and it was sometimes the title given to the principal visitor of monasteries, notably in the reformed congregation of Cluny (Du Cange). In the United Kingdom the heads of many colleges are styled "president," the title being of considerable antiquity in the case of one college at Cambridge (Queens', founded in 1448) and four at Oxford (St John's, Magdalen, Corpus Christi, Trinity). At five Cambridge colleges (Pembroke, Gonville and Caius, St Catherine's, St John's, Magdalene) the title "president" is borne by the *second* in authority, being the equivalent of "vice-master." In the United States "president" is the usual style of the head of a college and also of a university wherever this has developed out of a single college. "President" is also the style of persons elected to preside over the meetings of learned, scientific, literary and artistic academies and societies, *e.g.* the president of the Royal Academy (P.R.A.) in London; the title of the president of the Royal Society (P.R.S.) dates from its foundation in 1660. In the United States the style "president" is also given to the person who presides over the proceedings of financial, commercial and industrial corporations (banks, railways, &c.), in Great Britain usually styled "chairman," but in the case of the Bank of England and certain other banks "governor."

In Great Britain the title "president" is also borne by certain ministers of the Crown and certain judges, and preserves some of the ancient connotation of a royal lieutenancy explained above. Thus the style of "president" applied to the heads of the board of agriculture, local government board, board of education, board of trade, &c., which are all committees of the privy council, is derived from that of the lord president of the council, the representative of the king. The presidents of the court of session in Scotland, and of the probate and divorce division, &c. in England, also bear this style ultimately as representatives of the Crown.

In France, besides the president of the republic, there are presidents of the senate and of the chamber of deputies. In Germany the word *Präsident* is used in most of the English senses of "president," *e.g.* of a corporation, society, assembly or political body. As a judicial title *Präsident* is confined to the head of any one of the corporations (*Kollegien*) on the basis of which the judicial system of the empire is organized (*Landgericht, Oberlandesgericht, Reichsgericht*), and must be distinguished from that of *Vorsitzender* (literally also *praesidens*), *i.e.* the judge (who may or may not be the *Präsident*) selected to preside over a division of the court appointed to try particular cases.

In Prussia *Präsident* also retains its old sense of "governor," *Oberpräsident* being the title of the chief of the administration of a province, *Präsident* that of the head of a government district (*Regierungsbezirk*). The consistories of the established Protestant Church are also presided over by a *Präsident*, who is a royal official.

PRESS (through Fr. *presse* from Lat. *pressare*, frequentative of *premere*, to crush, squeeze, press), a word which appears in English in the 13th and 14th centuries with three particular

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[1] The style "president" was in every case exchanged for that of "governor" within a few years of the proclamation of the independence of the United States. The title "president" is no longer used for any governor under the British Crown, but relics of past usage survive in the "presidencies" of Madras and Bombay.

meanings, viz. (1) crowd or throng, often used of the *mêlée* in a battle, (2) a shelved cupboard for books or clothes, and (3) an apparatus for exerting pressure on various substances, and for various purposes. The first meaning is still current, though usually it has a literary air; a specific use is the nautical one of "press of sail," *i.e.* as much sail as the wind will allow; cf. the similar use of "crowd." The second use has given way to other words, but is still the technical term in use in libraries, where the books bear "press-marks" specifying the case or shelf where they may be found. As a term for a machine or apparatus for exerting pressure, there are innumerable examples, usually with a qualifying word giving the purpose for which the pressure is applied, either for attaining compression into a small space, or a required shape, or for extracting juices or liquids, or the methods adopted for exerting the pressure. The printing-press has given rise to obvious transferred uses of the word "press": thus it is applied to an establishment for printing, *e.g.* the Clarendon Press, at Oxford, or the Pitt Press, at Cambridge, to a printing-house and to the staff which conduct the business, to the issue of printed matter and especially to its daily or periodical issue, hence newspapers and periodicals generally. According to the *New English Dictionary* this use originated in phrases such as "the liberty of the press," "to write for the press," &c. The earliest quotation given is from the first number of the Dublin *Press*, 1797. For the history of the liberty or freedom of the press see Press Laws; also Newspapers and Periodicals. For the punishment of "pressing" see Peine Forte et Dure. It is now recognized that "press" in "press gang," "to press," *i.e.* to force or compulsorily enlist men for naval or military service, is a word distinct from the above. It stands for the earlier "prest," and is ultimately due to French *prêter*, to lend (see Impressment).

PRESSBURG (Hung. *Pozsony*, Lat. *Posonium*), a town of Hungary, capital of the county of the same name, 133 m. N.W. of Budapest by rail. Pop. (1900), 61,537, about half of whom are Germans. Pressburg is picturesquely situated on the left bank of the Danube, at the base of the outlying spurs of the Little Carpathians, in a position of strategical importance near the *Porta Hungarica*. Pressburg was the capital of Hungary from 1541 until 1784, while the Hungarian parliament held its sittings here till 1848. One of the most conspicuous buildings of the town is the royal palace, situated on the Schlossberg, a plateau 270 ft. above the Danube, which was destroyed by fire in 1811 and has since been in ruins. Other noteworthy buildings are the cathedral, a Gothic edifice of the 13th century, restored in 1861–1880, in which many of the Hungarian kings were crowned; the town hall, also a 13th-century building, several times restored, and containing an interesting museum; the Franciscan church, dating from 1272; and the law-courts, erected in 1783, where the sittings of parliament were held from 1802 to 1848. The Grassalkowitch palace is now the residence of an archduke, and there is an archiepiscopal palace. Educational establishments include an academy of jurisprudence, a military academy, a Roman Catholic and a Protestant seminary, a training school for female teachers, and several secondary and technical schools. A large business is carried on in wooden furniture, tobacco and cigars, paper, ribbons, leather wares, chemicals, liqueurs, confectionery and biscuits. There is, besides, a dynamite factory, which produces over 2,000,000 ℔ of explosives annually, a large cloth factory and several flour-mills. Trade in grain and wine is active. Besides the extensive traffic on the Danube, the town is also an important railway junction. The first railway line in Hungary was that from Pressburg to Tyrnau through the valley of the Waag. The town has many points of interest in its environs. About twenty-five minutes by steamer down the Danube, the extensive ruins of the castle of Theben (Hung. *Dévény*), the former gate of Hungary, are situated at the point where the March, which forms the boundary between Austria and Hungary, falls into the Danube. Opposite on the left bank is Hainburg, the gateway of Hungary from the Austrian side. Eastward and southward of Pressburg stretches a long and fertile plain, known as the Upper or Little Hungarian plain. It has an area of 2825 sq. m., of which two-thirds lay on the right bank of the Danube, and the whole is bounded by the rivers Neutra and Raab. In the extreme south-west of this plain is situated the lake of Fertö-Tava (Ger. *Neusiedler See*), which has an area of about 100 sq. m., but it is of varying size, and sometimes dries up in part. Eastward it is united with the extensive marsh called the Hanság, through which it is in communication with the river Raab and with the Danube. In the Roman period it was known as *Peïso* or *Pelso*. In several places of the dry bed traces of prehistoric lake-dwellings have been discovered. In conjunction with the regulation of the river Raab, and the drainage of the Hanság marsh, plans for the drainage of the lake have been proposed.

Little is known of the early history of Pressburg, which was founded about 1000. It was soon strongly fortified, though it was captured by the king of Bohemia, Ottakar II., in 1271. It received many privileges from the Hungarian kings, especially from the emperor Sigismund, and its strategic situation made it an important fortress. Sigismund held Imperial diets in the town. After the battle of Mohacs in 1526 and the capture of Buda by the Turks, Pressburg became the capital of Hungary. Here in 1608 the Austrian and Hungarian malcontents concluded a treaty with the archduke Matthias, afterwards emperor, against their lawful sovereign, the emperor Rudolf II. In 1619 the town was taken by Bethlen Gabor, but it was recovered by the Imperialists in 1621. In 1687 it was the scene of the session of the estates of Hungary during which the Hungarians renounced their right of choosing their own king and accepted the hereditary succession of the Habsburgs. Here also was held the diet of 1741 when the members swore to assist their sovereign, Maria Theresa, against Frederick the Great. In 1784 Buda took the place of Pressburg as the capital of Hungary, but the latter town continued to be the seat of the parliament until 1848. On the 26th of December 1805 peace was signed here between Napoleon and the emperor Francis I., and in 1809 the town was bombarded by the French.

See J. Kiraly, *Geschichte des Donau-Mauth- und Urfahr-Rechts der Freistadt Pressburg* (Pressburg, 1890); T. Ortvay, *Geschichte der Stadt Pressburg* (Pressburg, 1892), and *Pressburgs Strassen und Plätze* (Pressburg, 1905).

PRESSENSÉ, EDMOND DEHAULT DE (1824–1891), French Protestant divine, was born at Paris on the 7th of January 1824. He studied at Lausanne under Alexander Vinet, and at Halle and Berlin under F. A. G. Tholuck and J. A. W. Neander, and in 1847 became pastor in the Evangelical Free Church at the chapel of Taitbout in Paris. He was a powerful preacher and a good political speaker; from 1871 he was a member of the National Assembly, and from 1883 a senator. In 1890 he was elected a member of the Academy of Sciences. Pressensé laboured for the revival of biblical studies. He contended that the Evangelical Church ought to be independent of the power of the state. He died on the 8th of April 1891.

He founded in 1854 the *Revue chrétienne*, and in 1866 the *Bulletin théologique*. His works include: *Histoire des trois premiers siècles de l'église chrétienne* (6 vols. 1856–1877; new ed. 1887–1889), *L'Église et la révolution française* (1864; 3rd ed., 1889), *Jésus-Christ, son temps, sa vie, son œuvre* (against E. Renan, 1866; 7th ed. 1884), *Les Origines, le problème de la connaissance; le problème cosmologique* (1883; 2nd ed. 1887). See T. Roussel, *Notice sur la vie et les œuvres de Pressensé* (1894).

PRESS GANG, the popular name for the companies of officers and men who were commissioned to execute the warrants for the impressment of seamen in Great Britain (see Impressment). These bodies consisted of a captain, one or more lieutenants, and a band of trustworthy men. They were sent to seaports, or occasionally to inland towns where sailors were likely to be met when going from one coast to another. A "rendezvous" was opened, volunteers were enlisted, deserters arrested, and such "able bodied persons" as were liable to be pressed for service in the fleet were seized, and sent to the *guard ships* (*q.v.*).

PRESS LAWS, the laws concerning the licensing of books and the liberty of expression in all products of the printing-press, especially newspapers. The liberty of the press has always been regarded by modern political writers as of supreme importance. "Give me liberty to know, to utter, and to argue freely according to conscience, above all other liberties," says Milton in the *Areopagitica.*

At the present day the liberty of the press in English-speaking countries is a matter of merely historical importance. But this liberty was a plant of slow growth. Before the invention of printing the Church assumed the right to control the expression of all opinion distasteful to her. When the printing-press was invented German printers established themselves at various important centres of western Europe, where already numbers of copyists were employed in multiplying manuscripts. In 1473 Louis XI. granted letters patent (giving the right of printing and selling books) to "Uldaric Quéring" (Ulrich Gering), who three years earlier had set up a press in the Sorbonne (the theological faculty of the university at Paris), and before long Paris had more than fifty presses at work. The Church and universities soon found the output of books beyond their control. In 1496 Pope Alexander VI. began to be restive, and in 1501 he issued a bull against unlicensed printing, which introduced the principle of censorship.[1] Between 1524 and 1548 the Imperial Diet in Germany drew up various stringent regulations; and in 1535 Francis I., in France, prohibited by edict, under penalty of death, the printing of books. This was too severe, however, and shortly afterwards the Sorbonne was given the right of deciding, a system which lasted to the Revolution.

In England the authority of parliament was invoked to aid the ecclesiastical authority. There is an ordinance as early as 1382, 5 Ric. II. st. 2, c. 5 (not assented to by the Commons, but appearing upon the parliament roll), directed against unlicensed preachers. After the invention of printing the ecclesiastical censorship was still asserted, but only as collateral with the censorial rights of the Crown, claimed by virtue of its general prerogative. After the Reformation the greater part of the rights of censorship passed to the Crown, which at the same time assumed the power of granting by letters patent the right of printing or selling books as a monopoly. The grant, if made to the author himself, was an equivalent of copyright; if made to a person other than the author, it seems to have always been subject to the author's copyright as it existed at common law.

Censorship was either restrictive or corrective, *i.e.* it interfered to restrict or prevent publication, or it enforced penalties after publication. Repression of free discussion was regarded as so necessary a part of government that Sir Thomas More in his *Utopia* makes it punishable with death for a private individual to criticize the conduct of the ruling power. Under Mary printing was confined to members of the Stationers' Company, founded by royal charter in 1556. Under Elizabeth the Star Chamber assumed the right to confine printing to London, Oxford and Cambridge, to limit the number of printers and presses, to prohibit all publications issued without proper licence, and to enter houses to search for unlicensed presses and publications (Order of 1585, Strype's *Whitgift*, app. 94). The search for unlicensed presses or publications was entrusted to an officer called the "messenger of the press." In 1637 was issued an order of the Star Chamber forbidding the importation of books printed abroad to the scandal of religion or the Church or the government, and the printing of any book not first lawfully licensed. Law books were to be licensed by one of the chief justices or the chief baron, books of history and state affairs by one of the secretaries of state, of heraldry by the earl marshal, of divinity, philosophy, poetry and other subjects by the archbishop of Canterbury or the bishop of London, or the chancellors or vice-chancellors of the universities. There were to be only twenty master printers and four letter-founders. The punishment was at the discretion of the court (Rushworth, *Historical Collections*, vol. iii. app. 306). The same principle of press restriction was carried out by the Long Parliament after the abolition of the Star Chamber, and it was an ordinance of that body issued in 1643 that called forth Milton's *Areopagitica, a Speech for the Liberty of Unlicensed Printing*, itself an unlicensed book. The parliament appointed committees for printing, who appointed licensers, but the licensing was really left in a great measure to the wardens of the Stationers' Company. At the Restoration Sir John Birkenhead acted as licenser, appointed apparently under the general prerogative. It was, no doubt, too, under the general prerogative that Charles II., by a proclamation in 1660, called in and suppressed Milton's *Defensio pro populo anglicano.* Then followed the Licensing Act of 1662 (13 & 14 Car. II. c. 33), limited to two years. The provisions as to importation of books, the appointment of licensers, and the number of printers and founders were practically re-enactments of the similar provisions in the Star Chamber order of 1637. Printing presses were not to be set up without notice to the Stationers' Company. A king's messenger had power by warrant of the king or a secretary of state to enter and search for unlicensed presses and printing. Severe penalties by fine and imprisonment were denounced against offenders. The act was successively renewed up to 1679. Under the powers of the act Sir Roger L'Estrange was appointed licenser, and the effect of the supervision was that practically the newspaper press was reduced to the *London Gazette.* The objections made to lines 594-599 of the first book of *Paradise Lost* by the archbishop of Canterbury's chaplain, acting as licenser, are well known. The act expired in 1679, and for the remainder of the reign of Charles II., as in the reign of George III., the restrictions on the press took the form of prosecutions for libel. In 1685 the Licensing Act was renewed for seven years (1 Jac. II. c. 8, § 15). No mention of the liberty of the press was made in the Bill of Rights. On the expiration of the Licensing Act in 1692 it was continued till the end of the existing session of parliament (4 & 5 Will. and Mary, c. 24, § 14). In 1695 the Commons refused to renew it. The immediate effect of this was to lay authors open to the attacks of literary piracy, and in 1709 the first Copyright Act (8 Anne, c. 19) was enacted for their protection. The power of a secretary of state to issue a warrant, whether general or special, for the purpose of searching for and seizing the author of a libel or the libellous papers themselves—a power exercised by the Star Chamber and confirmed by the Licensing Act—was still asserted, and was not finally declared illegal until the case of *Entick* v. *Carrington* in 1765 (*St. Tr.* xix. 1030). In 1776 the House of Commons came to a resolution in accordance with this decision. The compulsory stamp duty on newspapers was abandoned in 1855 (18 Vict. c. 27), the duty on paper in 1861 (24 Vict. c. 20), the optional duty on newspapers in 1870 (33 & 34 Vict. c. 38). From that time the English press may be said to date its complete freedom, which rests rather upon a constitutional than a legal foundation. It is not confirmed by any provision of the supreme legislative authority, as is the case in many countries. A declaration in favour of the liberty of the press is usually a prominent feature in the written constitutions of foreign states.

The few existing restrictions on the liberty of the press are presumed to be imposed for the public benefit. They are in some cases of great historical interest. The rights of private persons are in general sufficiently protected in one direction by the law of Libel (*q.v.*), in another by the law of Copyright (*q.v.*), while the criminal law provides for the cases of press offences against morality, public justice, &c. Thus the courts have power to punish summarily as a contempt the publication of comments upon proceedings *sub judice* or reflections upon the conduct of judicial officers. (See CONTEMPT OF COURT.) The last relic of the censorship before publication is to be found in the licensing of stage plays. By 6 & 7 Vict. c. 68 no new plays or additions to old plays can be acted for hire at any theatre in Great Britain until they have been submitted to the lord chamberlain, who may forbid any play or any part of a play. The penalty for acting a play before it has been allowed or after it has been disallowed is a sum not exceeding £50 for every offence and the forfeiture of the licence of the theatre in which the offence occurred. This jurisdiction is exercised by an official of the lord chamberlain's department called the "examiner of stage plays." The last relic of the monopoly of printing formerly granted to licensees of the Crown is found in the exclusive right of the king's printer and the universities of Oxford and Cambridge to print the Bible[1] and the Book of Common Prayer, and of the king's printer to print acts of parliament and other state documents. The privileges of the universities are confirmed by 13 Eliz. c. 29. The rights of the king's printer are protected by severe penalties. A maximum term of seven years' penal servitude is incurred by any person who prints any act of parliament or other government document, falsely purporting to be printed by the king's printer or under the authority of His Majesty's stationery office (8 & 9 Vict. c. 113; 45 Vict. c. 9). The rights of the printers of the journals of either house of parliament are protected by 8 & 9 Vict. c. 113. The publication of parliamentary debates in any form by any other persons than the printers of the journals of the two houses is still in theory a breach of privilege, but in practice they have been fully reported since 1771. The other restrictions upon the press are to a great extent those imposed for police purposes. By 32 & 33 Vict. c. 24 (confirming in part previous enactments applying to Great Britain) the printer of any paper or book for profit is required under penalties to print thereon his name and address or the name of a university press, and is to keep a copy of everything printed, with a few exceptions. Penalties must be sued for within three months, and no proceeding for penalties can be begun unless in the name of the attorney-general or solicitor-general of England or the lord advocate of Scotland. By the Newspaper Libel and Registration Act 1881 (44 & 45 Vict. c. 60), which applies to England and Ireland, but not to Scotland, newspaper proprietors are, except in the case of joint-stock companies, to be registered and to make annual returns of the title of the newspaper and the names of all the proprietors, with their occupations, places of business and places of residence. By the Corrupt Practices Prevention Acts 1883 and 1884 (46 & 47 Vict. c. 51, § 18, and 47 & 48 Vict. c. 70, § 14), the name and address of the printer must be printed on all bills, placards, &c., referring to a parliamentary or municipal election. By 6 & 7 Vict. c. 68, § 7, the name and place of abode of a manager of a theatre are to be printed on every play-bill announcing a representation at such theatre. Offences against decency by the press are provided for by 20 & 21 Vict. c. 83; 25 & 26 Vict. c. 101, § 251 (for Scotland), and 2 & 3 Vict. c. 47, § 54 (for the metropolis). The importation of obscene literature into the United Kingdom is forbidden by 39 & 40 Vict. c. 36, § 42. By the Larceny Act 1861, any person who prints or publishes an advertisement offering a reward for the return of stolen goods without questions asked is subject to a penalty (24 & 25 Vict. c. 96, § 102). This penalty cannot, however, be sued for without the sanction of the attorney-general or solicitor-general of England or Ireland (33 & 34 Vict. c. 65). The advertisement in the United Kingdom of foreign or illegal lotteries is prohibited by 6 & 7 Will. IV. c. 66, betting advertisements by 16 & 17 Vict. c. 119, § 7, and 37 Vict. c. 15.

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[1] The principle of the censorship is still uncompromisingly maintained by the Roman Catholic Church; and this, though in general binding only in *foro conscientiae*, has necessarily had considerable importance in states which recognize the papacy as an independent power relations with which are established by concordat. Thus in Italy, under the Sardinian constitution of 1848, Bibles, catechisms and liturgical words had to be licensed by the bishop. The principle of the censorship, consecrated anew in Pope Pius IX.'s *Syllabus* of 1864, was reaffirmed in the apostolic constitution *Officiorum* of Leo XIII. and in 1907 in the encyclical *Pascendi* of Pius X. This last expresses "the highest esteem for this institution of censors" and orders censors to be appointed in all episcopal curias for the revision of books intended for publication, at the same time directing that their names shall not be made known to the authors of the books condemned. (See also INDEX LIBRORUM PROHIBITORUM.)

The right of an author or publisher to the full profits of his undertaking was at one time restricted by the Copyright Act of Anne (8 Anne, c. 19, § 4), by which the archbishop of Canterbury and other authorities were empowered to lower the price of a book upon complaint that the price was unreasonable. The only restriction of the kind now existing is the obligation of delivering (without request) to the British Museum a copy of any work published within the United Kingdom, and of delivering (on request) copies for the use of the university libraries at Oxford and Cambridge, the library of the faculty of advocates at Edinburgh, and the library of Trinity College, Dublin (5 & 6 Vict. c. 45, §§ 6–10).

Scotland.—Printing became, as in England, a royal monopoly. The exclusive right of printing was granted by James IV. to Walter Chepman, who printed the first book in Scotland. The monopoly of printing acts of the Scottish parliament was granted by James V. to the printer chosen by the clerk register and specially licensed by the king (1540, c. 127). Printers are forbidden by 1551, c. 27, to print, whether in Latin or English, without licence from ordinaries deputed in that behalf by the Crown. No book treating of religion or of the kirk was to be printed without a licence from the general assembly (1646, c. 164), or of the kingdom without a licence from one of the judges or the secretary (c. 165). The council were empowered to prohibit presses at their discretion by the order of the 30th of March 1655. The importation of "famous" books and libels in defence of the pope was prohibited by 1581, c. 106. Press offences were treated with the utmost severity. By 1585, c. 1, the author of a libellous writing against the king was punishable with death. It is scarcely necessary to say that since the union the press of Scotland has enjoyed no less liberty than that of England.

In the case of Bibles, Old and New Testaments, Psalm Books, the Book of Common Prayer, the Confession of Faith, and the Larger and Shorter Catechisms a licence for printing is still required. The licensing authority is the lord advocate, but all proposed publications are submitted for approval to the body officially known as "His Majesty's sole and only Master Printers in Scotland," consisting of the lord advocate, the solicitor-general, the moderator of the general assembly, and four other members. A licence is also required for printing acts of parliament; but a general licence granted in 1848 to a firm of printers in Edinburgh is still operative, and their publications are not submitted for approval. As its work is practically confined to Bibles and the other religious publications enumerated, the above-mentioned body commonly receives the name of the Bible Board.

Ireland.—By the Prevention of Crime Act 1882 (45 & 46 Vict. c. 25), the lord-lieutenant was empowered to order the seizure of any newspaper appearing to contain matter inciting to the commission of treason or of any act of violence or intimidation (§ 13). He may also by warrant direct the search for and seizure of any papers or documents suspected to be used or to be intended to be used for the purpose of or in connexion with any secret society existing for criminal purposes (§ 14).

The British Dominions.—In the British colonies the press is as free as it is in England. Each colony has its special legislation on the subject for police and revenue purposes. Where there is a government printer, his monopoly is protected by the Documentary Evidence Act 1868 (31 & 32 Vict. c. 37), which imposes a maximum penalty of five years' penal servitude upon any person printing a copy of any proclamation, order, or regulation which falsely purports to have been printed by the government printer, or to be printed under the authority of the legislature of any British colony or possession. The act is, however, subject to any law made by the colonial legislature.

India.—During the governor-generalship of Lord Lytton was passed the "Act for the better control of publications in Oriental languages," Act ix. of 1878. (1) By this act copies of newspapers published out of British India were liable to forfeiture and seizure by warrant throughout the whole of British India if the papers contained any words, signs or visible representations likely to excite disaffection to the government established by law in British India, or antipathy between any persons of different races, castes, religions or sects in British India. The governor-general might by notification in the *Gazette of India*, exclude newspapers, books, &c., from British India. (2) In places to which the act was extended by order of the governor-general in council a magistrate might require the printer and publisher of a newspaper to enter into a bond, with a deposit, not to publish a newspaper containing "any words, signs," &c. (as in 1), or to use or attempt to use it for the purpose of extortion or threat. The consequences of offending were forfeiture of the deposit, papers, press, &c. Books used for the illegal purposes above mentioned were subject to forfeiture, but no bond or deposit was required previous to publication of books, as in the case of newspapers.

This act, which remained in force until 1910, was found, owing principally to the restriction of its operation to newspapers published in the vernacular, to be ineffective in coping with the spread of news sheets exciting disaffection amongst the natives towards the government of India. It was consequently repealed and replaced by an act of February 1910, which applies to all newspapers published after the act. The deposit requiring to be made is now obligatory on all new printing-presses, whether issuing a newspaper or not, and independently of the deposit on the newspaper. The requirement of a formal bond has been abolished. There are provisions for forfeiture of the deposit and confiscation of the press on repetition of the offence. The 1910 act gives power to the authorities to open postal packets, other than letters, suspected of containing seditious matter, and requires the printer of a newspaper to deposit with the government two copies of each issue at the time of publication. It includes a long list of offences incitement to which is punishable under the act, and in giving power to stop a seditious newspaper after conviction, and in fixing responsibility on the actual printers of seditious matter, has considerably strengthened the power of the law.

Egypt.—The press is subject to a special law (The Press Law of 1881) and to certain articles of the penal code which define press offences and prescribe penalties (both fine and imprisonment) for them. Owing to the capitulations, which are in force in Egypt as part of the Ottoman Empire, the penal code cannot be applied to foreign subjects, and its application had not (up to 1910) been found sufficient to repress abuses. The probable result of strengthening the law would be that conductors of native papers desirous of indulging in violent language or sedition would engage a foreign subject as nominal proprietor or editor and thereby escape local jurisdiction. The Press Law of 1881 is a more powerful instrument than the penal code, inasmuch as there are decisions of the mixed tribunals that that law is, in principle, applicable to foreigners. By this law registration of newspapers is obligatory, and the government has power of control, defined in art. 13 as follows: "In the interests of public order, of religion or of morality, every newspaper or periodical can be suspended or suppressed by order of the minister of the interior after two warnings, or, without previous warning, by a decision of the council of ministers. Each warning may be accompanied by a fine of from £E5 to £E20." If a newspaper or periodical which has been suppressed continues to appear, the responsible parties can be fined, and the printing-press which issues the suppressed publication can be closed by order of the minister of the interior. The closure or seizure of the printing-press would, however, in the case of a foreigner require the co-operation of his consul.

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[1] The monopoly of the king's printer does not extend to any translation other than the Authorized Version, and not to that if it be accompanied by new notes or marginal readings.

This law was from about 1900 allowed to fall into disuse. Owing to the excesses of the Arabic newspapers the law was revived in the early part of 1909, but was applied with great moderation. During the year two native papers were warned and one was suppressed. The tribunals remained alone competent to inflict any penalty (apart from suppression and seizure of the printing-press) more severe than a fine of £E20, and in 1909 under the penal code the editor of one native paper was sentenced to a year's imprisonment and the editor of another to three months' imprisonment. (See Sir Eldon Gorst's reports on Egypt for 1908 and 1909, specially *Egypt No. 1, 1909*, pp. 3-5.)

The United States.—The first constitutions of Pennsylvania, Delaware, Maryland and North Carolina, enacted in 1776, are interesting as containing the earliest declarations of any legislative authority in favour of the liberty of the press. The same principle was afterwards adopted in the constitution of the United States. The acts of Congress dealing with the press are not numerous, as each state has for the most part its own legislation on the subject, dealing generally with, among other matters, the registration of newspapers, the monopoly of the state printer, and the right of giving the truth in evidence in defence to proceedings for libel. The act of the 18th of August 1856 forbids diplomatic or consular officers of the United States to correspond with any foreign newspaper in regard to the affairs of a foreign state. The act of the 3rd of March 1873 prohibits the printing and circulation of obscene literature. Legislation by Congress has provided that all printing (unless otherwise ordered by law) for the Senate and House of Representatives and the executive and judicial departments, shall be done by the government printer.

Austria-Hungary.—In the Austrian Empire, which from 1804 to 1867 embraced Hungary also, the press laws under Metternich's régime were extremely severe. By the penal code of 1808 all printing had to be licensed, under heavy penalties, and in 1810 two censors were appointed. In short, the press had no shadow of liberty. During the revolution of 1848-1849 the principle of the freedom of the press was established, but the censorship was restored in 1852 and not abolished until 1863. The actual press laws of Austria are based on the press law of the 17th of December 1862 as modified by later supplementary enactments. In principle the freedom of the press was secured by art. 13 of the constitution of the 21st of December 1867. In practice, however, it was still restricted by the obligation on newspaper proprietors to deposit "caution money" (*Kautionszwang*) with the authorities, and the retention of the government stamp on newspapers. The caution money was abolished by a press law of the 9th of July 1894, and the stamp by that of the 27th of December 1899. The police, however, still have the right, either on their own initiative or under the instructions of the public prosecutor (*Staatsanwalt*), "provisionally" to confiscate printed matter which in their opinion offends against the terms of the press law or is contrary to the public interest. The public prosecutor has, within eight days, to justify this action in court, either by proceeding against those responsible for the publication, or by proving the published matter is offensive and ought to be suppressed. This latter "objective" procedure (*objektives Verfahren*) is peculiar to Austria and obviously places vast powers of control in the hands of the authorities. In 1902 the government introduced a bill greatly modifying these and other provisions of the press law in a liberal sense, but the bill was postponed to more urgent matters.

In Hungary the liberty of the press was secured by art. 18 of the constitution of 1848, which was restored in 1867. Under this the censorship was abolished; but, in addition to provision for the cases of libel, incitement to violence and crime, &c., the law also provided penalties for certain political press offences (§§ 6-8), *i.e.* attacks on the king or members of his family, incitements to (*a*) the dissolution of the territorial unity of the state or of the dynastic link with Austria; (*b*) the forcible alteration of the constitution; (*c*) disobedience to lawful authorities; (*d*) commission of crime. Press offences are tried by special jury courts. Under the Criminal Code of 1878 (§§ 170-174) further offences were made subject to penalty, including "direct incitement of one class of the population, one nationality or religious denomination to hatred of another," instigation against the constitution and parliament, and glorification of any one who has suffered punishment for such offences. "Direct incitement" (§ 172), was subsequently interpreted by the curia to mean "any spoken or written word . . . which is capable of producing in another hatred against a nationality, &c."

The result of these provisions has been that liberty of the press has existed in practice only for the Magyars, constant prosecutions having been directed against the editors and proprietors of publications giving voice to the grievances of the other Hungarian races, conviction being all but inevitable owing to the special juries (due to the high property qualification) being almost exclusively composed of members of the dominant race.

In Transylvania, where the old stringent Austrian press law of 1852 is still in force, the public prosecutor has discretionary powers to confiscate obnoxious literature, powers freely used against the Rumanian press. (See R. W. Seton Watson, *Racial Problems in Hungary*, London, 1908, pp. 293 sqq.)

Belgium.—It was the prosecution of political writers by the Dutch government that directly led to the independence of Belgium in 1830. By the Belgian constitution of the 7th of February 1831, art. 18, it is declared that the press is free, that censorship shall never again be established, that sureties cannot be exacted from writers, editors or printers, and that when the author is known and domiciled in Belgium the printer or bookseller cannot be prosecuted. By art. 98 press offences are to be tried by jury. The penal law of the press is contained in the decree of the 20th of July 1831, made perpetual in 1833. By this law it is made an offence, apart from the penal code, (1) to incite to the commission of a crime by placards or printed writings in a public meeting; (2) to attack the obligatory force of the laws, or to incite to disobedience of them; (3) to attack the constitutional authority or inviolability of the king, the constitutional authority of the dynasty, or the authority and rights of the chambers. Every copy of a journal must bear the name of the printer and the indication of his domicile in Belgium. Proceedings for offences against the law must be taken in some cases within three months, in others within a year.

Denmark.—Press offences were at one time punished with great severity. By the code of Christian V. (1683) libel was punished with infamy and hard labour for life, and, if against a magistrate, with death. Censorship was abolished and the press declared free by art. 86 of the constitution granted by Frederick VII. on the 5th of June 1849 and confirmed by Christian IX. in 1866. Art. 81 forbids the search for or seizure of printed matter in a dwelling-house, unless after judicial proceedings.

France.—The government began early to impose stringent restrictions upon printing. An edict of Henry II. in 1559 made it punishable with death to print without authority. The university of Paris originally claimed the right of licensing new theological works, a jurisdiction vested in the Crown by an ordinance of 1566. Offences against religion were severely punished by the secular authorities. Thus the parliament of Toulouse sent Vanini to the stake in 1619 for the crime of publishing a heretical work. A few years later, in 1626, Cardinal Richelieu declared it a capital offence to publish a work against religion or the state. In 1723 appeared a regulation forbidding any but licensed booksellers to deal in books. Many later regulations were directed against unlicensed presses, the employment of more than a certain number of workmen, &c. At the Revolution all these restrictions were abolished, and the Assembly declared it to be the right of every citizen to print and publish his opinions. This new liberty quickly needed a check, which was attempted as early as 1791, but no effectual restraint was imposed until the law of the 5th of February 1810 established a direction of the press. The charter of Louis XVIII. in 1814 gave liberty to the press in express terms, but restrictions soon followed. In 1819 a system of sureties (*cautionnements*) replaced the censorship. The Revolution of 1830 was caused by, *inter alia*, one of the ordinances of St Cloud (July 25, 1830) for suspension of the liberty of the press. Restrictions on the liberty were removed for the time in 1830 and 1852, only to be succeeded as usual by the press laws of 1835 and 1852. During the Second Empire government prosecutions for libel were used as a powerful engine against the press. The proceedings against Montalembert in 1858 are a well-known instance. Between 1858 and 1866 many newspapers were suppressed by proclamation. With the republic liberty of the press was completely re-established. A decree of the 27th of October 1870 submitted press offences to trial by jury.[1] The law of the 29th of July 1881, by which the French press is now regulated, begins by asserting the liberty of the press and of bookselling. The principal limitations of this liberty are the prohibition to publish criminal proceedings before hearing in public, or lists of subscriptions for indemnifying an accused person, and the power of forbidding the entrance of foreign newspapers under certain circumstances. The order of responsibility for printed matter is (1) the manager or editor, (2) the author, (3) the printer, (4) the vender or distributor. The printer and the vender, however, can only be punished for acts not falling within their proper functions. Proceedings for breaches of the law must be taken within three months. As to taxation, the decree of the 5th of September 1870 abolished the stamp duty upon newspapers, but it is still imposed upon public notices (*affiches*) other than those of public authorities. None but the notices of public authorities may be printed on white paper.

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[1] See Dalloz, *Jurisprudence générale*, s.v. "Presse"; ibid. *Titles alphabétiques* (1845-1877), s.v. "Presse."

Germany.—Censorship was introduced by the diet of Spires in 1529. From that time till 1848 there were numerous restrictions on the liberty of the press. One of the most important was a resolution of the diet of the German confederation, passed on the 20th of September 1819 as a sequel to the Carlsbad decrees (*q.v.*), by which newspapers were subject to licence and police supervision in each state. Liberty dates, as in Austria and Italy, from 1848. Soon after that year, however, it became necessary to establish press laws in most of the German states, as in Bavaria in 1850, Prussia and Baden in 1851. Since the establishment of the new empire censorship has disappeared. By art. 74 of the constitution of the empire (1871) every one attacking the empire or its officers through the press is liable to punishment in his own state. By art. 4 the laws relating to the press are under imperial and not local control. The press law of the 7th of May 1874 is therefore in force throughout the whole empire. At its beginning it affirms the liberty of the press. Its main provisions are these: The name and address of the printer must appear on all printed matter. Newspapers and periodicals must in addition bear the name of some one person, domiciled in the empire, as responsible editor, and a copy of every number must be deposited with the police authorities of the district in which it is published. Foreign periodicals may be excluded by proclamation of the Imperial chancellor for two years, if twice within the year they have been guilty of certain offences against the penal code. Criminal proceedings are not to be reported while still *sub judice.* The order of responsibility for offences is the same as in France. Proceedings must be taken within six months. In certain cases printed matter may be seized without the order of a court. This may take place where (1) the publication does not bear the name of printer or editor, (2) military secrets are revealed in time of war, (3) justice would be defeated by the publication not being immediately seized. A judicial tribunal is to decide at once upon the legality of the seizure. The press law is not to affect regulations made in time of war or internal disturbance. A temporary law passed in 1878 gave the police large powers in the case of socialistic publications. Only offences involving heavy penalties are tried by jury. The proposal of the Reichstag that all press offences should be so tried was rejected by the governments, except as regards those states (Bavaria, Württemberg, Baden, Oldenburg) where this principle was already in force.

Greece.—Under King Otto censorship was exercised up to 1844. By the constitution of the 18th of March 1844 every one may publish his thoughts by means of the press, observing the laws of the state. The press is free, and censorship (λογοκρισία) is not permitted. Responsible editors, publishers and printers of newspapers are not required to deposit money on the ground of surety. Publishers of newspapers must be Greek citizens (art. 10). The legislature may exclude reporters from its sittings in certain cases (art. 48). Press offences are to be tried by jury, except when they deal only with private life (art. 93).

Holland.—The press has been free since the existence of the present kingdom of the Netherlands, which dates from 1815. Liberty of the press is expressly secured by art. 8 of the constitution of 1848. By art. 286 of the penal code seditious books and newspapers may be seized. By art. 283 of the same code and by a royal decree of the 25th of January 1814 the name of the printer must appear upon newspapers. Press offences are not tried by jury.

Italy.—By art. 27 of the political code of Sardinia, granted by Charles Albert on the 4th of March 1848, and still in force, the press is free, but abuses of the liberty are restrained by law. The present press law of Italy is contained in the law of the 26th of March 1848, as altered by later enactments. Everything printed in typographical characters, or by lithography or any similar means, must indicate the place and the date of printing and the name of the printer. A copy of everything printed must be deposited with certain officials and at certain libraries. Before the publication of any newspaper or periodical, notice of the intended publication must be given at the office of the secretary of state for internal affairs. The notice must contain (1) a declaration of the legal qualification of the person intending to publish, whether as proprietor or editor, (2) the nature of the publication, and (3) the name and residence of the responsible editor. Every newspaper is bound to insert gratuitously a contradiction or explanation of any charge made against a person in its columns. For contravention of these and other regulations there is a statutory penalty not exceeding 1000 lire (£40). The publication of a newspaper may be suspended until the payment of a fine. The publication of parliamentary debates is permitted. Press offences are tried by a jury of twelve. By a law of the 11th of May 1877 it is forbidden to publish any indication of the way in which individual judges or jurors voted in their deliberations.

Norway.—The liberty of the press is secured by art. 100 of the constitution of 1814. No one can be punished for any writing unless he, or some one by his instigation, offend against the state, law, religion or decency, or make infamous accusations against any one. Criticism of the government is expressly permitted.

Ottoman Empire.—By art. 12 of the constitution of the 23rd of December 1876 the press was recognized as free, subject to the limits imposed by law. The constitution was, however, "suspended," and a rigorous censorship was enforced, under the direction of Sultan Abd-ul-Hamid II., until the revolution of 1908.

Portugal.—It is stated by Braga and others that a free press existed up to the establishment of the Inquisition, and that Gil Vicente (d. 1536) was the last writer who dared to express his thoughts freely. At a later period Bocage was imprisoned for writings displeasing to the authorities. Boards of censorship under the names of the "Real mesa censoria," or the "Mesa do desembargo do paço," assumed to license publications. Liberty of the press was, however, finally secured, and censorship limited, by art. 7 of the constitution granted by John VI. in 1821. By art. 8 a special tribunal was constituted in both Portugal and Brazil to protect the liberty of printing. The censorship was confined to that exercised by the bishops over theological or dogmatic works. The debates in the legislature and proceedings in the courts of justice are not generally reported.

Rumania.—By the constitution of the 30th of June 1866, art. 5, Rumanians enjoy liberty of the press. By art. 24 the constitution guarantees to all the liberty of communicating and publishing ideas through the press, every one being liable for abuse in cases determined by the penal code. Press offences are to be tried by jury. Censorship is abolished, and is never to be re-established. No previous authorization is necessary for the publication of newspapers. No sureties are to be demanded from journalists, writers, editors or printers. The press is not to be subjected to regulation of advertisements. No newspaper or publication is to be suspended or suppressed. Every author is responsible for his writings; in default of the author, the manager or editor is responsible. Every newspaper must have a responsible manager in the possession of civil and political rights.

Russia.—The position of the Russian press generally was, previously to the revolution of 1905, regulated by a law of the 6th of April 1865. The effect of that law was to exempt from preventive censorship (if published in St Petersburg or Moscow) all newspapers, periodicals and original works and translations not exceeding a certain number of pages, and (wherever published) all government publications, matter printed by academies, universities and scientific bodies, and maps, plans, and charts. Everything printed and published that did not fall within any of these categories had, before issue to the public, to be submitted for the approval of government censors stationed in different parts of the empire. The minister of the interior had power to dispense with the preventive censorship in the case of provincial newspapers and periodicals. In St Petersburg and Moscow the periodical press was subject to corrective censorship for infringement of the numerous restrictive regulations contained in the code, and supplemented at times by secret instructions from the minister of the interior to editors and publishers. Apart from the code, the sustained display of a spirit hostile to the government rendered the publisher of a periodical liable to punishment. The penalties established by the law of 1865 for offences against the press regulations consisted in the infliction of a series of warnings published in the *Official Gazette.* A first warning merely enjoined more care for the future; a second was followed by suspension for a certain period, sometimes by a prohibition to insert advertisements; a third by suppression, and perhaps prosecution of the offending conductor. By Imperial ukaz of the 2nd of June 1872 the jurisdiction of the judicial tribunals over press offences was practically transferred to the minister of the interior, except in the case of violation of private rights, as by libel. The law of 1865 was modified in 1874 by a regulation to the effect that all publications appearing at longer intervals than one week should be submitted to the central board of censors. This applied to all periodicals that had been formerly published without preventive censorship. By a ukaz issued in 1881 a committee of four members was entrusted with the decision of all matters relating to the press submitted to it by the minister of the interior. The strictest supervision was exercised over the foreign press, periodical and otherwise. None but a few privileged individuals, such as members of the royal family, foreign diplomatists, and editors of newspapers in the capital, might receive foreign publications free of censorship. The censorship consisted in blackening out, and sometimes in the excision, of whole columns and sheets of publications that might be deemed pernicious. Only such periodicals as were placed on a list approved by the board of censors were allowed to be received through the post office by non-privileged persons. Telegraphic messages to newspapers were subject to strict censorship. The Russian telegraphic press agency is under official management.

Full liberty of the press was guaranteed by the Imperial ukaz of the 17th of October 1905, and though no special legislation followed the censorship was for a time *de facto* abolished. With the progress of the reaction, however, the old conditions were to a certain extent re-established. In St Petersburg, for instance, the newspapers were in 1909 again under the absolute jurisdiction of chief of police and were forbidden to publish any reference to members of the Imperial family or to the affairs of Poland (except official notices). In 1908 as many as 73 newspapers and periodicals were suppressed, of which 28 were in St Petersburg alone.

Spain.—There was probably no country where restrictions on the liberty of the press were at one time more stringent than in Spain. From the first use of printing up to 1521 censorship was exercised by the Crown; after that date the Inquisition began to assume the right, and continued to do so up to its suppression in 1808. In 1558 Philip II. denounced the penalty of death against even the possessor of a book upon the *Index expurgatorius* of the Inquisition. Some of the greatest names in Spanish literature were sufferers: Castillejo, Mendoza, Mariana and Quevedo incurred the displeasure of the Inquisition; Luis Ponce de Leon was imprisoned for his translation of the Song of Solomon. The last *Index* appeared in 1790.[1] In 1812 the constitution promulgated by the regency in the name of Ferdinand VII. provided by art. 371 that all Spaniards should have liberty to write, print and publish their political ideas without any necessity for licence, examination or approbation previous to publication, subject to the restrictions imposed by law. Art. 13 of the constitution of the 30th of June 1876, promulgated on the accession of Alphonso XII., practically re-enacts this provision.

Sweden.—The press law of the 16th of July 1812 is one of the fundamental laws of Sweden. It is an expansion of art. 86 of the constitution of the 6th of June 1809. Liberty of the press is declared to be the privilege of every Swede, subject to prosecution for libellous writing. Privileges of individuals as to publication are abolished. The title and place of publication of every newspaper or periodical must be registered, and every publication must bear the name of the printer and the place of printing. Press offences are tried by a jury of nine, chosen respectively by the prosecutor, the prisoner, and the court. The verdict of two-thirds of the jury is final.

Switzerland.—Liberty of the press is secured by art. 45 of the constitution of 1848, re-enacted by art. 55 of the constitution of the 29th of May 1874. Each canton has its own laws for the repression of abuse of the liberty, subject to the approbation of the federal council. The confederation can impose penalties on libels directed against itself or its officers.

PRESTEIGN, a market town, urban district, and assize and county town of Radnorshire, Wales, situated on the Lug amidst beautiful scenery. Pop. (1901), 1245. Presteign is the terminus of a branch of the Great Western railway running north from Titley Junction in Herefordshire. The old-fashioned town contains the fine parish church of St Andrew, dating chiefly from the 15th century, and an interesting old inn, the "Radnorshire Arms," once the residence of the Bradshaw family in the 17th century. To the west rises the Wardon, a wooded hill laid out as a public park. Presteign is the most easterly spot on the Welsh border, a circumstance that is noted in the Cymric expression to mark the extreme breadth of the Principality—*o Tyddewi i Llanandras* ("from St Davids to Presteign").

Although the Welsh name of Llanandras is said to denote a foundation by St Andras ap Rhun ap Brychan in the 5th century, the place seems to have been an obscure hamlet in the lordship of Moelynaidd until the 14th century, when Bishop David Martyn of St Davids (1290–1328) conferred valuable market privileges upon this his native place, which on doubtful authority is said to derive its English name from this priest. In 1542 Presteign was named as the meeting-place of the county sessions for Radnorshire in conjunction with New Radnor, and it has ever since ranked as the county town. Although an ancient borough by prescription, Presteign was not included in the Radnor parliamentary district until the 19th century, and of this privilege it was deprived by the Redistribution Act of 1885.

PRESTER JOHN, a fabulous medieval Christian monarch of Asia. The history of Prester John no doubt originally gathered round some nucleus of fact, though what that was is extremely difficult to determine. But the name and the figure which it suggested occupied so prominent a place in the mind of Europe for two or three centuries that a real history could hardly have a stronger claim to exposition. Before Prester John appears upon the scene we find the way prepared for his appearance by a kindred fable, which entwined itself with the legends about him. This is the story of the appearance at Rome (1122), in the pontificate of Calixtus II., of a certain Oriental ecclesiastic, whom one account styles "John, the patriarch of the Indians," and another "an archbishop of India." This ecclesiastic related wonderful stories of the shrine of St Thomas in India, and of the miracles wrought there by the body of the apostle, including the distribution of the sacramental wafer by his hand. We cannot regard the appearance at Rome of the personage who related these marvels in presence of the pope as a mere popular fiction: it rests on two authorities apparently independent (one of them a letter from Odo of Reims, abbot of St Remy from 1118 to 1151), for their discrepancies show that one was not copied from the other, though in the principal facts they agree.

Nearly a quarter of a century later Prester John appears upon the scene, in the character of a Christian conqueror and potentate who combined the characters of priest and king, and ruled over vast dominions in the Far East. This idea was universal in Europe from about the middle of the 12th century to the end of the 13th or beginning of the 14th. The Asiatic story then died away, but the name remained, and the royal presbyter was now assigned a locus in Ethiopia. Indeed, it is not improbable that from a very early date the title was assigned to the Abyssinian king, though for a time this identification was overshadowed by the prevalence of the Asiatic legend. At the bottom of the double allocation there was, no doubt, that confusion of Ethiopia with India which is as old as Virgil and perhaps older.

The first mention of Prester John occurs in the chronicle of Otto, bishop of Freisingen. This writer states that when at the papal court in 1145 he met with the bishop of Gabala (Jibal in Syria), who related how "not many years before one John, king and priest (*rex et sacerdos*), who dwelt in the extreme Orient beyond Persia and Armenia, and was, with his people, a Christian but a Nestorian, had made war against the brother kings of the Persians and Medes, who were called Samiards (or Sanjards), and captured Ecbatana their capital. After this victory *Presbyter John*—for so he was wont to be styled—advanced to fight for the Church at Jerusalem; but when he arrived at the Tigris and found no means of transport for his army, he turned northward, as he had heard that the river in that quarter was frozen over in winter-time. After halting on its banks for some years in expectation of a frost he was obliged to return home. This personage was said to be of the ancient race of the Magi mentioned in the Gospel, to rule the same nations that they ruled, and to have such wealth that he used a sceptre of solid emerald. Whatever impression was made by this report, or by other rumours of the event on which it was founded, was far exceeded, about 1165, by the circulation of a letter purporting to be addressed by Prester John to the emperor Manuel. This letter, professing to come from "Presbyter Joannes, by the power and virtue of God and of the Lord Jesus Christ, Lord of Lords," claimed that he was the greatest monarch under heaven, as well as a devout Christian. The letter dealt at length with the wonders of his empire. It was his desire to visit the Holy Sepulchre with a great host, and to subdue the enemies of the Cross. Seventy-two kings, reigning over as many kingdoms, were his tributaries. His empire extended over the three Indies, including that Farther India, where lay the body of St Thomas, to the sun-rising, and back again down the slope to the ruins of Babylon and the tower of Babel. All the wild beasts and monstrous creatures commemorated in current legend were to be found in his dominions, as well as all the wild and eccentric races of men of whom strange stories were told, including those unclean nations whom Alexander Magnus walled up among the mountains of the north, and who were to come forth at the latter day—and so were the Amazons and the Bragmans. His dominions contained the monstrous ants that dug gold and the fish that gave the purple; they produced all manner of precious stones and all the famous aromatics. Within them was found the Fountain of Youth; the pebbles which give light, restore sight, and render the possessor invisible; the Sea of Sand was there, stored with fish of wondrous savour; and the River of Stones was there also; besides a subterranean stream whose sands were of gems. His territory produced the worm called "salamander," which lived in fire, and which wrought itself an incombustible envelope from which were manufactured robes for the presbyter, which were washed in flaming fire. When the king went forth to war thirteen great crosses made of gold and jewels were carried in wagons before him as his standards, and each was followed by 10,000 knights and 100,000 footmen. There were no poor in his dominions, no thief or robber, no flatterer or miser, no dissensions, no lies, and no vices. His palace was built after the plan of that which St Thomas erected for the Indian king Gondopharus. Of the splendour of this details are given. Before it was a marvellous mirror erected on a many-storeyed pedestal (described in detail); in this speculum he could discern everything that went on throughout his dominions, and detect conspiracies. He was waited on by 7 kings at a time, by 60 dukes and 365 counts; 12 archbishops sat on his right hand, and 20 bishops on his left, besides the patriarch of St Thomas's, the protopope of the Sarmagantians (Samarkand?), and the archprotopope of Susa, where the royal residence was. There was another palace of still more wonderful character, built by the presbyter's father in obedience to a heavenly command, in the city of Bribric. Should it be asked why, with all this power and splendour, he calls himself merely "presbyter," this is because of his humility, and because it was not fitting for one whose sewer was a primate and king, whose butler an archbishop and king, whose chamberlain a bishop and king, whose master of the horse an archimandrite and king, whose chief cook an abbot and king, to be called by such titles as these.

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[1] See Ticknor, *Hist. of Span. Lit.* i. 422 seq., iii. 366

How great was the popularity and diffusion of this letter may be judged in some degree from the fact that Zarncke in his treatise on Prester John gives a list of close on 100 MSS. of it. Of these there are 8 in the British Museum, 10 at Vienna, 13 in the great Paris library, 15 at Munich. There are also several renderings in old German verse. Many circumstances of the time tended to render such a letter acceptable. Christendom would welcome gladly the intelligence of a counterpoise arising so unexpectedly to the Mahommedan power; while the statements of the letter itself combined a reference to and corroboration of all the romantic figments concerning Asia which already fed the curiosity of Europe, which figured in the world-maps, and filled that fabulous history of Alexander which for nearly a thousand years supplanted the real history of the Macedonian throughout Europe and western Asia.

The only other surviving document of the 12th century bearing on this subject is a letter of which MS. copies are preserved in the Cambridge and Paris libraries, and which is also embedded in the chronicles of several English annalists, including Benedict of Peterborough, Roger Hovedon and Matthew Paris. It purports to have been indited from the Rialto at Venice by Pope Alexander III. on the 5th day before the calends of October (Sept. 27), data which fix the year as 1177. The pope addresses it, *carissimo in Christo filio Johanni, illustro et magnifico indorum regi* [Hovedon's copy here inserts *sacerdoti sanctissimo*]. He recites how he had heard of the monarch's Christian profession, diligence in good works and piety, by manifold narrators and common report, but also more particularly from his (the pope's) physician and confidant (*medicus et familiaris noster*), Master Philip, who had received information from honourable persons of the monarch's kingdom, with whom he had intercourse in those (Eastern) parts. Philip had also reported the king's anxiety for instruction in Catholic discipline and for reconciliation with the apostolic see in regard to all discrepancies, and his desire to have a church in Rome and an altar at Jerusalem. The pope goes on to say that he found it too difficult, on account of the length and obstructions of the way, to send any one (of ecclesiastical position?) *a latere*, but he would despatch Philip to communicate instruction to him. And on accepting Philip's communications the king should send back honourable persons bearing letters sealed with his seal, in which his wishes should be fully set forth. "The more nobly and magnanimously thou conductest thyself, and *the less thou vauntest of thy wealth and power*, the more readily shall we regard thy wishes both as to the concession of a church in the city and of altars in the church of SS. Peter and Paul, and in the church of the Lord's Sepulchre at Jerusalem, and as to other reasonable requests."

There is no express mention of the title "Prester John" in what seem the more genuine copies of this letter. But the address and the expression in the italicized passage just quoted (which evidently alludes to the vaunting epistle of 1165) hardly leave room for doubt that the pope supposed himself to be addressing the author of that letter. We do not know how far the imaginations about Prester John retained their vitality in 1221, forty-four years after the letter of Pope Alexander, for we know of no mention of Prester John in the interval. But in that year again a rumour came out of the East that a great Christian conqueror was taking the hated Moslems in reverse and sweeping away their power. Prophecies current among the Christians in Syria of the destruction of Mahomet's sect after six centuries of duration added to the excitement attending these rumours. The name ascribed to the conqueror was David, and some called him the son or the grandson of Prester John of India. He whose conquests and slaughters now revived the legend was in fact no Christian or King David but the famous Jenghiz Khan. The delusion was dissipated slowly, and even after the great Tatar invasion and devastation of eastern Europe its effects still influenced the mind of Christendom and caused popes and kings to send missions to the Tatar hordes with a lingering feeling that their khans, if not already Christians, were at least always on the verge of conversion.

Before proceeding further we must go back to the bishop of Gabala's story. M. d'Avezac first showed to whom the story must apply. The only conqueror whose career suits in time and approximates in circumstances is the founder of Kara-Khitai, which existed as a great empire in Central Asia during the latter two-thirds of the 13th century. This personage was a prince of the Khitai or Khitaian dynasty of Liao, which had reigned over northern China and the regions beyond the Wall during a great part of the 10th and 11th centuries, and from which came the name Khitai (Cathay), by which China was once known in Europe and still is known in Russia. On the overthrow of the dynasty about 1125 this prince, who is called by the Chinese Yeliu Tashi, and had gone through a complete Chinese education, escaped westward with a body of followers. Being well received by the Uighurs and other tribes west of the desert, subjects of his family, he gathered an army and commenced a course of conquest which eventually extended over eastern and western Turkestan. He took the title of Gur Khan or Kor Khan, said to mean "universal" or "supreme" khan, and fixed at Balasaghun, north of the T'ian Shan range, the capital of his empire, which became known as that of Kara-Khitai (Black Cathay). In 1141 the assistance of this Khitaian prince was invoked by the shah of Kharezm against Sanjar, the Seljuk sovereign of Persia, who had expelled the shah from his kingdom and killed his son. The Gur Khan came with a vast army of Turks, Khitaians, and others, and defeated Sanjar near Samarkand (Sept. 1141) in a battle which the historian Ibn al-Athir calls the greatest defeat that Islam had ever undergone in those regions. Though the Gur Khan himself is not described as having extended his conquests into Persia, the shah of Kharezm followed up the victory by invading Khorasan and plundering the cities and treasuries of Sanjar. In this event—the defeat of Sanjar, whose brother's son, Mas'ud, reigned over western Persia—occurring four years before the story of the Eastern conqueror was told at Rome to Bishop Otto, we seem to have the destruction of the *Samiardi fratres* or Sanjar brothers, which was the germ of the story of Prester John.

There is no evidence of any profession of Christianity on the part of the Gur Khan, though the daughter of the last of his race is recorded to have been a Christian. The hosts of the Gur Khan are called by Moslem historians *Al-Turk-al-Kuffar*, the kafir or infidel Turks; and in later days the use of this term "kafir" led to misapprehensions, as when Vasco da Gama's people were led to take for Christians the Banyan traders on the African coast, and to describe as Christian sovereigns so many princes of the Farther East of whom they heard at Calicut. How the name John arose is one of the obscure points. Oppert supposes the title "Gur Khan" to have been confounded with Yukhanan or Johannes; and it is probable that even in the Levant the stories of "John the patriarch of the Indies," repeated in the early part of this article, may have already mingled with the rumours from the East.

The failure in the history of the Gur Khan to meet all points in the story of the bishop of Gabala led Professor Bruun of Odessa to bring forward another candidate for identity with the original Prester John, in the person of the Georgian prince John Orbelian, the "sbasalar," or generalissimo under several kings of Georgia in that age. He shows instances, in documents of the 15th century, of the association of Prester John with the Caucasus. In one at least of these the title is applied to the king of Abassia, *i.e.* of the Abhasians of Caucasus. Some confusion between Abash (Abyssinia) and Abhas seems to be possibly at the bottom of the imbroglio. An abstract of Professor Bruun's argument will be found in the 2nd edition of Sir H. Yule's *Marco Polo*, ii. 539–542. As regards any real foundation for the title of "Presbyter" we may observe that nothing worth mentioning has been alleged on behalf of any candidate.

When the Mongol conquests threw Asia open to Frank travellers in the middle of the 13th century their minds were full of Prester John; they sought in vain for an adequate representative, nor was it in the nature of things that they should not find some representative. In fact they found several. Apparently no real tradition existed among the Eastern Christians of such a personage; the myth had taken shape from the clouds of rumour as they rolled westward from Asia. But the persistent demand produced a supply; and the honour of identification with Prester John, after hovering over one head and another, settled for a long time upon that of the king of the Nestorian tribe of Kerait, famous in the histories of Jenghiz under the name of Ung or Awang Khan.

In Carpini's (1248) single mention of Prester John as the king of the Christians of India the Greater, who defeats the Tatars by an elaborate stratagem, Oppert recognizes Jalaluddin of Kharezm and his brief success over the Mongols in Afghanistan. In the Armenian prince Sempad's account (1248), on the other hand, this Christian king of India *is aided* by the Tatars to defeat and harass the Saracens, and becomes the vassal of the Mongols. In the narrative of William Rubruquis (1253), though distinct reference is made to the conquering Gur Khan under the name of Coir Cham of Caracatay, the title of "King John" is assigned to Kushluk, king of the Naimans, who had married the daughter of the last lineal representative of the gur khans.[1] And from the remarks which Rubruquis makes in connexion with this King John, on the habit of the Nestorians to spin wonderful stories out of nothing, and of the great tales that went forth about King John, it is evident that the intelligent traveller supposed this king of the Naimans to be the original of the widely spread legend. He mentions, however, a brother of this John called Unc who ruled over the Crit and Merkit (or Kerait and Mekrit, two of the great tribes of Mongolia), whose history he associates with that of Jenghiz Khan. Unc Khan reappears in Marco Polo, who tells much about him as "a great prince, the same that we call Prester John, him in fact about whose great dominion all the world talks." This Unc was in fact the prince of the Kerait, called by the Chinese Tuli, and by the Persian historians of the Mongols Toghral, on whom the Kin emperor of north China had conferred the title of "wang" or king, whence his coming to be known as Awang or Ung Khan. He was long the ally of Jenghiz, but a breach occurred between them, and they were mortal enemies till the death of Ung Khan in 1203. In the narrative of Marco Polo "Unc Can," alias Prester John, is the liege lord of the Tatars, to whom they paid tribute until Jenghiz arose. And this is substantially the story repeated by other European writers of the end of the 13th century, such as Ricold of Montecroce and the sieur de Joinville, as well as by one Asiatic, the famous Christian writer, Gregory Abulfaraj. We can find no Oriental corroboration of the claims of Ung Khan to supremacy over the Mongols. But that his power and dignity were considerable appears from the term "Padshah," which is applied to him by the historian Rashiduddin.

We find Prester John in one more phase before he vanishes from Asiatic history, real or mythical. Marco Polo in the latter part of the 13th century, and Friar John of Montecorvino, afterwards archbishop of Cambaluc, in the beginning of the 14th, speak of the descendants of Prester John as holding territory under the great khan in a locality which can be identified with the plain of Kuku-Khotan, north of the great bend of the Yellow river and about 280 m. north-west of Peking. The prince reigning in the time of these two writers was named King George, and was the "6th in descent from Prester John," *i.e.* no doubt from Awang Khan. Friar Odoric, about 1326, visited the country still ruled by the prince whom he calls Prester John; "but," he says, "as regards him, not one-hundredth part is true that is told of him." With this mention Prester John ceases to have any pretension to historical existence in Asia (for we need not turn aside to Mandeville's fabulous revival of old stories or to the barefaced fictions of his contemporary, John of Hese, which bring in the old tales of the miraculous body of St Thomas), and his connexion with that quarter of the world gradually died out of the memory of Europe.[2]

When next we begin to hear his name it is as an African, not as an Asiatic prince; and the personage so styled is in fact the Christian king of Abyssinia. Ludolf has asserted that this application was an invention of the Portuguese and arose only in the 15th century. But this is a mistake; for in fact the application had begun much earlier, and probably long before the name had ceased to be attached by writers on Asia to the descendants of the king of the Kerait. It is true that the Florentine Simone Sigoli, who visited Cairo in 1384, in his *Viaggio al Monte Sinai* still speaks of "Presto Giovanni" as a monarch dwelling in India; but it is the India which is conterminous with the dominions of the soldan of Egypt, and whose lord is master of the Nile, to close or open its discharge upon Egypt. Thirty years earlier (*c.* 1352) the Franciscan Giovanni de' Marignolli, apostolic legate in Asia, speaks in his *Chronica* of Ethiopia where the Negroes are, and which is called the land of Prester John.[3] Going back still further, Friar Jordanus "Catalani," who returned from the East before 1328, speaks of the emperor of the Ethiopians "quem vos vocatis *Prestre Johan*."

But, indeed, we shall have strong probability on our side if we go back much further still, and say that, however vague may have been the ideas of Pope Alexander III. respecting the geographical position of the potentate whom he addressed from Venice in 1177, the only real person to whom the letter can have been sent was the king of Abyssinia. Let it be observed that the "honourable persons of the monarch's kingdom" whom the leech Philip had met with in the East must have been the representatives of some real power, and not of a phantom. It must have been a real king who professed to desire reconciliation with the Catholic Church and the assignation of a church at Rome and of an altar at Jerusalem. Moreover, we know that the Ethiopic Church did long possess a chapel and altar in the Church of the Holy Sepulchre, and, though we have been unable to find travellers' testimony to this older than about 1497, it is quite possible that the appropriation may have originated much earlier.[4] We know from Marco Polo that about a century after the date of Pope Alexander's epistle a mission was sent by the king of Abyssinia to Jerusalem to make offerings on his part at the Church of the Sepulchre. It must be remembered that at the time of the pope's letter Jerusalem, which had been taken from the Moslem in 1099, was still in Christian possession. Abyssinia had been going through a long period of vicissitude and distraction. In the 10th century the royal line had been superseded by a dynasty of Falasha Jews, followed by other Christian families; but weakness and disorder continued till the restoration of the "House of Solomon" (*c.* 1268). Nothing is more likely than that the princes of the "Christian families" who had got possession of the throne of northern Abyssinia should have wished to strengthen themselves by a connexion with European Christendom, and to establish relations with Jerusalem, then in Christian hands. We do not know whether the leech Philip ever reached his destination, or whether a reply ever came back to the Lateran.[5]

Baronius, who takes the view for which we have been arguing, supposes it possible that the church in Rome possessed in his own time by the Abyssinians (St Stephen's in the Vatican) might have been granted on this occasion. But we may be sure that this was a modern concession during the attempts to master the Ethiopian Church early in the 16th century. Ludolf intimates that its occupancy had been taken from them in his own time after it had been held "for more than a century."

In the legendary history of the *Translation of the three Blessed Kings* by John of Hildesheim (*c.* 1370), of which an account and extracts are given by Zarncke (*Abhandl.* ii. 154 seq.), we have an evident jumble in the writer's mind between the Asiatic and the African location of Prester John; among other matters it is stated that Prester John and the Nubians dug a chapel out of the rock under Calvary in honour of the three kings: "et vocatur illa capella in partibus illis capella Nubiyanorum ad reges in praesentem diem, sed Sarracini . . . ob invidiam obstruxerunt" (p. 158).

From the 14th century onwards Prester John had found his seat in Abyssinia. It is there that Fra Mauro's great map (1459) presents a fine city with the rubric, "Qui il Preste Janni fa residentia principal." When, nearer the end of the century (1481–1495), King

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[1] It has been pointed out by Alexander Wylie that Kushluk was son of a powerful king of the Naimans, whose name Ta-Yang-Khan is precisely "Great King John" as nearly as that could be expressed in Chinese.

[2] The stories of Khitai as a Christian empire, which led the Jesuits at the court of Akbar to despatch Benedict Goes in search of it (1601), did, however, suggest to Jerome Xavier, their chief, that the country in question "was the Cathay of Marco Polo, and its Christian king the representative of the famous Prester John"—a jumble of inaccuracy.

[3] In a Spanish work of about the same date, by an anonymous Franciscan, we are told that the emperor called "Abdeselib, which means 'servant of the Cross,' is a protector of *Preste Juan*, who is the patriarch of Nubia and Ethiopia, and is lord of many great lands, and many cities of Christians, though they be black as pitch, and brand themselves with the sign of the cross in token of their baptism" (*Libro del conocimiento de todos reynos, &c.*, printed at Madrid, 1877).

[4] Indeed, we can carry the date back half a century further by the evidence of a letter translated in Ludolf (*Comment.* p. 303). This is addressed from Shoa by the king Zara Jacob in the eighth year of his reign (1442) to the Abyssinian monks, dwellers at Jerusalem. The king desires them to light certain lamps in the Church of the Sepulchre, including "three in our chapel." In the *Pilgerfahrt des Ritters Arnold von Harff* (1496–1499: Cologne, 1860, p. 175), we find it stated that the Abyssinians had their chapel, &c., to the left of the Holy Sepulchre, between two pillars of the Temple, whilst the Armenian chapel was over theirs, reached by a stone staircase alongside of the Indians (or Abyssinians). This exactly corresponds with the plan and reference given in Sandys's *Travels* (1615), p. 162, which show the different chapels. The first on the south, *i.e.* the left looking from the body of the church, is "No. 35.—The chappell of the Abisines, over which the chappell of the Armenians." A reference to Jerusalem, which we procured through the kindness of Mr Walter Besant, shows that the Abyssinians no longer have a chapel or privileges in the Church of the Sepulchre. Between the Armenians and the Copts they have been deprived of these, and even of the keys of their convent. The resentment of King Theodore at the loss of these privileges was one of the indirect causes which led to the war between him and England in 1867–68.

[5] Matthew Paris gives a letter from Philip, prior of the Dominicans in Palestine, which reached the pope in 1237, and which speaks of a prelate from whom he had received several letters, "qui praeest omnibus quos Nestoriana haeresis ab ecclesia separavit (cujus praelatio per Indiam Majorem, et per regnum sacerdotis Johannis, et per regna magis proxima Orienti dilatatur)." We have little doubt that Abyssinia was the "regnum" here indicated, though it was a mistake to identify the Abyssinian Church with the Nestorians.

John II. of Portugal was prosecuting inquiries regarding access to India his first object was to open communication with "Prester John of the Indies," who was understood to be a Christian potentate in Africa. And when Vasco da Gama went on his voyage from Mozambique northwards he began to hear of "Preste Joham" as reigning in the interior—or rather, probably, by the light of his preconceptions of the existence of that personage in East Africa he thus interpreted what was told him. More than twenty years later, when the first book on Abyssinia was composed—that of Alvarez—the title designating the king of Abyssinia is "Prester John," or simply "the Preste."

On the whole subject in its older aspects, see Ludolf's *Historia Aethiopica* and its *Commentary*, passim. The excellent remarks of M. d'Avezac, comprising a conspectus of almost the whole essence of the subject, are in the *Recueil de voyages et de mémoires* published by the Société de Géographie, iv. 547–564 (Paris, 1839). Two German works of importance which have been used in this article are the interesting and suggestive *Der Presbyter Johannes in Sage und Geschichte*, by Dr Gustav Oppert (2nd ed., Berlin, 1870), and, most important of all in its learned, careful and critical collection and discussion of all the passages bearing on the subject, *Der Priester Johannes*, by Friedrich Zarncke of Leipzig (1876–1879). See also Sir H. Yule's *Cathay and the Way Thither*, p. 173 seq., and in *Marco Polo* (2nd ed.), i. 229–233, ii. 539–543. (H. Y.)

PRESTIDIGITATION (from Lat. *praesto*, ready, and *digitus*, finger), the art of conjuring by nimble-fingered dexterity, particularly as opposed to the use of mechanical devices (see CONJURING). The Latin *praestigium*, illusion, *praestigiae* tricks, and *praestigiator*, juggler (from *prae*, before, and *stingere*, to prick), cover the same meaning though differently derived.

PRESTIGE, influence and authority exercised by reason of high reputation. It is one of the few words which have gained a meaning superior to that of original usage. The word in French, from which it has been borrowed by English, as in Latin *praestigium* or *praestigiae*, meant jugglers' tricks, deceit, imposture, and so is found in the 16th century. The Latin stands for *praestrigium*, from *praestringere*, to bind or fasten tight, hence to blindfold; others derive from *praestinguere*, to darken, obscure, deceive. The word was at first generally used as foreign and italicized; thus the *New English Dictionary* quotes Sir Walter Scott (*Paul's Letters to his Kinsfolk*, 1815) for the earliest example in English of the modern usage, "Napoleon needed the dazzling blaze of decisive victory to renew the charm or *prestige* . . . once attached to his name and fortunes." Other words derived from *praestigium* through the French retain the original meaning of juggling or conjuring (see PRESTIDIGITATION).

PRESTON, JOHN (1587–1628), English Puritan divine, was born at Heyford in Northamptonshire and was educated at Queens' College, Cambridge (fellow 1609). He took orders, and on becoming dean of his college drew large crowds to hear his preaching. On the duke of Buckingham's advice he was appointed chaplain to Prince Charles in 1620; in 1622 he became preacher at Lincoln's Inn and master of Emmanuel College, Cambridge. After the accession of Charles I. he worked hard on behalf of the Puritan cause, but could accomplish little or nothing against Archbishop Laud. In theology he was a stanch Calvinist and his writings had considerable popularity.

PRESTON, a municipal, county, and parliamentary borough and port, of Lancashire, England, on the river Ribble, 209 m. N.W. by N. from London by the London & North-Western railway, served also by the Lancashire & Yorkshire railway. Pop. (1891), 107,573; (1901), 112,989; at the beginning of the 19th century it was about 17,000. The nucleus of its site consists of a ridge rising sharply from the north bank of the river, while the surrounding country, especially to the west about the estuary, is flat. Among the numerous parish churches that of St John, built in Decorated style in 1855, occupies a site which has carried a church from early times. Among several Roman Catholic churches, that of St Walpurgis (1854) is a handsome building of Early Decorated character. Of public buildings the most noteworthy is the large town hall, with lofty tower and spire, in Early English style, built in 1867 from designs by Sir Gilbert Scott.

The free public library and museum were established in 1879 by the trustees of E. R. Harris, a prominent citizen. A new building was opened in 1893. Here is placed Dr Shepherd's library founded in 1761, of nearly 9000 volumes, as well as a collection of pictures, &c., valued at £40,000, bequeathed by the late R. Newsham. The Harris Institute, endowed by the above-named trustees with £40,000, is established in a building of classical style erected in 1849, wherein are held science and art classes, and a chemical laboratory is maintained. For the grammar school, founded in 1550, a building in the Tudor style was erected in 1841 by private shareholders, but in 1860 they sold it to the corporation, who now have the management of the school. The blue-coat school, founded in 1701, was in 1817 amalgamated with the national schools. A Victoria Jubilee technical school was established under a grant from the Harris trustees in 1897. There is also a deaf and dumb school. Preston is well supplied with public recreation grounds, including Avenham Park, the Miller Park, with a statue of the 14th earl of Derby (d. 1869), the Moor Park, the Marsh, and the Deepdale grounds, with an observatory. Preston is one of the principal seats of the cotton manufacture in Lancashire. There are also iron and brass foundries, engineering works, cotton machinery works, and boiler works, and some shipbuilding is carried on. In 1826 Preston became a creek of Lancaster, in 1839 it was included in the new port of Fleetwood, and in 1843 it was created an independent port. The trade of the port was insignificant until the construction of spacious docks, in conjunction with the deepening of the river from the quays of Preston to its outfall in the Irish Sea, a distance of 16 m., was begun in 1884, and was carried out at a cost of over one million sterling. The main wet dock, opened in 1892, is 3240 ft. long and 600 ft. wide. The total quayage is over 8500 lineal feet. The channel of the river has been made straighter, and from docks to sea deepened, so that the dock is accessible for vessels of 17 ft. draught on ordinary spring tides. A canal connects Preston with Lancaster.

The parliamentary borough, which returns two members, falls between the Blackpool and Darwen divisions of the county. The corporation consists of a mayor, 12 aldermen and 36 councillors. Area of municipal borough, 3971 acres.

Preston, otherwise Prestune, was near the minor Roman station at Walton-le-Dale and the great Roman road running from Warrington passed through it. It is mentioned in Domesday Book as one of Earl Tostig's possessions which had fallen to Roger of Poictou, and on his defection it was forfeited to the Crown.[1] Henry II. about the year 1179 granted the burgesses a charter by which he confirmed to them the privileges he had granted to Newcastle-under-Lyme, the chief of which were a free borough and a gild merchant. This is the first of fourteen royal charters which have been granted to Preston, the chief of which are as follows: John in 1199 confirmed to Preston all the rights granted by Henry II.'s charter and also "their fair of eight days" from the Assumption (Aug. 15) and a three days' fair from the eve of Saints Simon and Jude (Oct. 28). Henry III. in 1217 confirmed the summer fair, but for five days only, and granted a weekly market on Wednesday. Edward III. (1328), Richard II. (1379), Henry IV. (1401), Henry V. (1414), Henry VI. (1425) and Philip and Mary (1557) confirmed the previous charters. The weekly market, though granted for Wednesday, was held as early as 1292 on Saturday. Elizabeth in 1566 granted the town its great charter which ratified and extended all previous grants, including the gild merchant, the weekly market on Saturday and the two annual fairs, in August for eight days and in October for seven days. Charles II. in 1662 and 1685 granted charters, by the latter of which an additional weekly market on Wednesday was conceded and a three days' fair beginning on the 16th of March. The most important industry used to be woollen weaving. Elizabeth's charter granted to the corporation all fees received from the sealing of cloth within the borough, and in 1571 the mayor reported that the cloths usually made near Preston were "narrow white kearses." Other early industries were glove-making and linen cloth. The first cotton-spinning mill was built in 1777 in Moor Lane, and in 1791 John Horrocks built the Yellow Factory. In 1835 there were forty factories, chiefly spinning, yielding 70,000 ℔ of cotton yarn weekly. A gild existed perhaps in Saxon times, but the grant of a gild merchant dates from Henry II.'s charter, about 1179. The first gild of which there was any record was celebrated in 1328, at which it was decided to hold a gild every twenty years. Up to 1542, however, they do not appear to have been very regularly celebrated, but since that year they have been and still are held at intervals of twenty years. A special gild mayor is appointed on each occasion. The first mention of a procession at the gild is in 1500. One of the most important items of business was the enrolling of freemen, and the gild rolls are records of the population. In 1397 the gild roll contained the names of over 200 in-burgesses and 100 foreign burgesses; in 1415 the number of in-burgesses was 188, which in 1459 had declined to 72. In 1582 there were over 500 in-burgesses and 340 out-burgesses. There is no evidence for, but rather against, the common statement that Preston was burnt or razed to the ground during the Scottish invasion of 1322. The town suffered severely from the Black Death in 1349–1350, when as many as 3000 persons are said to have died, and again in the year November 1630 to November 1631, 1100 died of pestilence. During the Civil War Preston sided with the king and became the headquarters of the Royalists in Lancashire. In February 1643 Sir John Seaton with a Parliamentary force marched from Manchester and successfully assaulted it. A strong Parliamentary garrison was established here and its fortifications repaired, but in March the earl of Derby recaptured the town. The Royalists did not garrison it, but after demolishing the greater part of the works left it unfortified. After the battle of Marston Moor Prince Rupert marched through Preston in September 1644 and carried the mayor and bailiffs prisoners to Skipton Castle, where they were confined for twelve months. On the 17th of August 1648 the Royalist forces under the duke of Hamilton and General Langdale were defeated at Preston by Cromwell with a loss of 1000 killed and 4000 taken prisoners. During the Rebellion of 1715 the rebel forces entered Preston on the 9th of November, and after proclaiming the Chevalier de St George king at the cross in the market-place, remained here for some days, during which the government forces advanced. The town was assaulted, and on the 14th of November General Forster surrendered his army of about 1400 men to the king's forces. In 1745 Prince Charles Edward marched through on the way south and north, but the town took no part in the rebellion. The borough returned two members from 1295 to 1331, then ceased to exercise the privilege on account of poverty till 1529, but since that date (except in 1653) it has always sent two representatives to parliament. The curious institution of the mock mayor and corporation of Walton, which was at its foundation in 1701 a Jacobite association, ceased after 1766 to be of any political significance and lapsed in 1800. There was probably a church here in Saxon times and it is believed to be one of the three churches in Amounderness mentioned in Domesday Book. In 1094 it is named in a charter of Roger de Poictou. The early dedication was to St Wilfrid, but probably about 1531, when it was rebuilt, it was re-dedicated to St John. At the time of the Reformation, many, especially among the neighbouring gentry, clung to the old faith, and there is still a large Roman Catholic population. There were two monastic foundations here: a hospital dedicated to St Mary Magdalene, which stood on the Maudlands, and a Franciscan convent of Grey Friars situated to the west of Friargate. In the 18th century Preston had a high reputation as a centre of fashionable society, and earned the epithet still familiarly associated with it, "proud."

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[1] The Court leet was held twice a year up to 1835.

See H. Fishwick, *History of the Parish of Preston* (1900).

PRESTONPANS, a police burgh and watering-place of Haddingtonshire, Scotland, on the Firth of Forth, 9½ m. E. of Edinburgh by the North British railway. Pop. (1901), 2614. A mile to the east of the village is the site of the battle of the 21st of September 1745, in which Prince Charles Edward and his highlanders gained a complete victory over the royal forces under Sir John Cope. Colonel James Gardiner was mortally wounded after an heroic stand, and an obelisk in the grounds of his house at Bankton, close to the battlefield, commemorates his valour, while the ballad of Adam Skirving (1719–1803), "Hey, Johnnie Cope!" has immortalized the rout of Cope.

Until the beginning of the 19th century, the salt trade was prosecuted with great success, the pans having been laid down as long ago as 1185, but the industry has declined. There are manufactures of fire-bricks, tiles and pottery, besides brewing and soap-making. In the vicinity there is an extensive coal-field. Fisheries are still of importance, although the bed of Pandore oysters (an esteemed variety) has lost something of its former fertility. There are harbours at Morrison's Haven to the west and at Cockenzie and Port Seton to the north-east, which practically form one village, with a population of 1687. The cross of the barony of Preston dates from 1617. Schaw's Hospital Trust, at one time intended for the education and maintenance of the children of poor parents, has been modified, and the bequest is used to provide free education and bursaries, while the building has been leased by the trustees of Miss Mary Murray, who bequeathed £20,000 (afterwards increased to £30,000) for the training of poor children as domestic servants.

PRESTWICH, SIR JOSEPH (1812–1896), English geologist, was born at Clapham, Surrey, on the 12th of March, 1812. He was educated in Paris, Reading and at University College, London, where under Dr D. Lardner and Edward Turner, he paid special attention to natural philosophy and chemistry, and gained some knowledge of mineralogy and geology. Circumstances compelled him to enter into commercial life, and until he was sixty years of age he was busily engaged in the City as a wine merchant. He devoted all his leisure to geology. His business journeys enabled him to see and learn much of the general geology of England, Scotland and France, and this so effectively that at the time of his death he ranked as the most eminent of British geologists. As early as 1831 he commenced, during holiday visits, to make a study of the coal-field of Coalbrookdale in Shropshire, and the results of his observations were communicated to the Geological Society of London in 1834 and 1836, and embodied in a memoir published in 1838. His name is, however, especially known in connexion with his researches on the Eocene strata of the London and Hampshire Basins (1846–1857): he defined the Thanet Sands and the Woolwich and Reading Beds, and studied the sequence of deposits and of organic remains and the method of formation of these and the succeeding strata of London clay and Bagshot Beds. So highly appreciated were his essays on the subject that in 1849 he was awarded the Wollaston Medal by the Geological Society of London; and in 1853 he was elected F.R.S. In the course of his observations he was led to study questions of water supply and published in 1851 *A Geological Inquiry respecting the Water-bearing Strata of the Country around London*, a work that at once became a standard authority; and his extensive knowledge in that respect procured him a seat on the Royal Commission on Water Supply, appointed in 1866. From 1858 the question of the antiquity of man engaged his attention. On various occasions statements had been made as to the association of flint implements formed by man with the bones of extinct mammals which belonged to more remote periods than those generally assigned for the appearance of the human race on this earth, but the evidence adduced had usually been disregarded by geologists as not affording sufficient proof of the point. Prestwich, together with Dr Hugh Falconer and Sir John Evans, saw the desirability of a closer examination of the facts, particularly in regard to the implements discovered by Boucher de Perthes in the gravels of the Somme valley; and their investigations in France and England yielded evidence which proved that man existed contemporaneously with the Pleistocene mammalia (*Phil. Trans.* 1861 and 1864). In 1865 a Royal Medal was awarded to Prestwich by the Royal Society. In 1866 he was chosen one of the commissioners appointed to inquire into the several matters relating to coal in the United Kingdom; and he subsequently contributed an important *Report on the Quantities of Coal, wrought and unwrought, in the Coalfields of Somersetshire and part of Gloucestershire*, and another *Report on the Probabilities of finding Coal in the South of England* (1871). His researches on the Crag Beds of Suffolk and Norfolk, his report on Brixham Cave, his papers on the Channel Tunnel and the Chesil Bank, among others published during the years 1868–1875, may be mentioned.

In 1870 he married Grace Anne McCall (née Milne), niece of Dr H. Falconer, and author of the *Harbour Bar* and other works (see *Essays Descriptive and Biographical*, by Grace, Lady

Prestwich; edited by L. E. Milne, 1901). Prestwich retired from business in 1872, and two years later he was invited to take the chair of geology at Oxford, vacant through the death of John Phillips. This post he occupied until 1887. During his professorship he wrote his great work entitled *Geology: Chemical, Physical and Stratigraphical* (vol. i., 1886; vol. ii., 1888).

On leaving Oxford Prestwich spent his remaining years in his country house, Darent-Hulme, Shoreham, Kent, erected by him in 1869. There, although seventy-six years of age, he maintained marvellous activity in geological research, devoting his attention to the superficial deposits of the Darent valley, to the occurrence of palaeolithic flint implements in the valleys and of an earlier type since called eolithic, on the chalk plateau of Kent; he likewise dealt generally with the raised beaches and rubble-drift of the south of England and their relation to recent changes of level. His latest publications were *Collected Papers on some Controverted Questions of Geology*, and *On Certain Phenomena belonging to the Close of the Last Geological Period and on their Bearing upon the Tradition of the Flood* (1895). He was knighted in 1896, and died on the 23rd of June in the same year, at Shoreham in Kent.

See *Life and Letters of Sir Joseph Prestwich*, edited by his wife (1899).

PRESTWICH, an urban district in the Prestwich parliamentary division of Lancashire, England, 5 m. N.N.W. of Manchester on the Lancashire & Yorkshire railway. Pop. (1901), 12,839. It possesses cotton manufactures, but consists chiefly of handsome mansions and villas inhabited by Manchester merchants.

PRETORIA, the administrative capital of the Union of South Africa and of the province of the Transvaal, 46 m. by rail N. by E. of Johannesburg. Pop. (1904) 36,839, of whom 21,114 were whites. Pretoria is situated on the banken veld or northern slopes of the high veld, on both banks of the Aapies tributary of the Limpopo, and is 4470 ft. above the sea, being 1300 ft. lower than Johannesburg. Built in a hollow surrounded by hills, the aspect of the town with the river flowing through it and its broad streets lined with willows is picturesque. In summer the heat and moisture are excessive, and the Aapies (which is spanned by four bridges) is liable to floods.

The town is regularly laid out in rectangular blocks of uniform width. The older part lies on the west side of the Aapies River and between it and a smaller stream known as the Spruit. In the centre of this part of Pretoria is Church Square, so named from the Dutch Reformed Church which stood in it, but was demolished in 1905. Government buildings on the south side of the square contain the chambers of the Provincial Council and other public offices. They were erected in 1892 and are a handsome block in Renaissance style, three-storied, with a central tower surmounted by a statue of Liberty. On the north side of the square are the law courts, on the west side the Post Office. The chief banking offices are also in the square.

Running east and west from Church Square is Church Street, the chief business thoroughfare. A little east of Church Square this street opens on to Market Square, with commodious market buildings. The former Presidency, the residence of Paul Kruger, is at the western end of the street near the Spruit. Opposite it is the Dopper Church, in which Kruger used occasionally to preach. Other churches in the heart of the town include the Anglican cathedral, dedicated to St Alban, and the Presbyterian Church, both in Schoemans Street, the Roman Catholic Church in Koch Street with schools, convent buildings and extensive grounds, and the new Dutch Reformed Church in Vermeulen Street. In the north of the town is the National Museum and adjacent are the Zoological Gardens. Other public buildings are the government library, the University College and the opera house. East of the Aapies and on the slopes of the hills are the residential districts of Arcadia, Sunnyside and Muckleneuk. Bryntirion, a suburb on the northern slopes of the hills, contains the residences of the chief officials, including Government House. Here is Meintjes Kop, with a broad natural shelf midway below the summit. This shelf was chosen in 1909 as the site of the public offices of the Union. The designs of Mr Herbert Baker were accepted for two large blocks of identical design connected by a semicircular colonnade (passing behind the narrow kloof which bisects the shelf). Besides other open spaces there is Burger's park, originally planned, during the first British occupation, as a botanical garden. It is beautifully wooded and through it runs the Spruit. A park and sports ground at the western end of the town contains the pedestal for a statue of President Kruger. The statue itself remained for years at Lourenço Marques and appears to have been lost. Adjoining this park on the north is the cemetery. Among those buried there are Kruger and many of the British who fell during the war of 1899–1902. Signal Hill, which rises 400 ft. above the plain, is west of the park. The plateau at its foot was the site of the English laager during the war of 1880–81, and is now occupied by the central railway station and workshops. North of the cemetery is the prison, a building which replaces a notoriously insanitary gaol used during the republican régime.

The water supply of Pretoria is drawn from the source of the Aapies River, where rise magnificent springs. The Fountains, as they are called, are 3 m. west of Pretoria. Some 3 m. north of the town is the *Wonderboom*, an enormous wild fig-tree, the only one of its kind in the district. At West Fort, 7 m. from the town, is a leper asylum; at Waterval, 15 m. north, the British prisoners captured by the Boers up to the fall of Pretoria were confined. Thirty miles east by north of Pretoria is the Premier Diamond mine. Bronkhorst Spruit, where in December 1880 a detachment of British soldiers was ambushed by the Boers, lies about 30 m. east by south of the town.

History.—Pretoria was founded in 1855, the ground on which it stands being purchased by the Boer government from Marthinus Pretorius. It was made the centre of a new district created at the same time, both town and district being named in honour of Andries Pretorius. By treaty between the South African Republic (then comprising the districts of Potchefstroom, Rustenburg, Pretoria and Zoutpansberg) and the republic of Lydenburg, concluded at Pretoria in 1860, the two republics were united and Pretoria chosen as the capital of the whole state, and in September of that year the Volksraad held its first meeting in the new capital. Until 1864, however, when the civil war in the Transvaal ended, Potchefstroom remained the virtual capital of the country. From that year the seat of government has always been at Pretoria. There in 1877 Sir Theophilus Shepstone proclaimed the annexation of the Transvaal to Great Britain. In December 1880 it was invested by the Boers, but held out until the conclusion of peace. In 1881 the convention restoring self-government to the Transvaal was signed at Pretoria. From that time until 1900 the dominating figure in the town was that of the president—Paul Kruger. As revenue flowed in from the gold-mines on the Rand many fine buildings were erected in the capital, which was placed in railway communication with Cape Town in 1893 and with Lourenço Marques and Durban in 1895. To Pretoria Dr Jameson and his troopers were brought prisoners (January 1896) after the fight at Doornkop (to be handed over in a few days to the British government), and thither also were brought the Reform Committee prisoners from Johannesburg. In May 1900 Kruger fled from the town, which on the 5th of June surrendered without resistance to Lord Roberts, despite its formidable encircling forts, which however were never effectively armed. On the 31st of May 1902 the articles of peace whereby the Boer leaders recognized British sovereignty were signed at Pretoria, and five years later there assembled in the capital the first parliament of the Transvaal as a self-governing state of the British Empire. On the establishment of the Union of South Africa in 1910 Pretoria became its administrative capital, the seat of the legislature being however at Cape Town. The Transvaal parliament was replaced by a Provincial Council (see TRANSVAAL: § *History*).

The town is governed by a municipality, which since 1903 has acquired control of the sanitary service, water supply, electric lighting and tramways. In 1909 the proportional representation system was adopted for the election of town councillors.

PRETORIUS, the family name of two of the early leaders of the "Trek" Boers—Andries Wilhelmus Jacobus Pretorius and Marthinus Wessels Pretorius, father and son.

1. ANDRIES PRETORIUS (1799–1853), a Dutch farmer of Graaff-Reinet, Cape Colony, and a descendant from one of the earliest Dutch settlers in South Africa, left his home in the Great

Trek, and by way of what is now the Orange Free State crossed the Drakensberg into Natal, where he arrived in November 1838, at a time when the emigrants there were without a recognized leader. Pretorius was at once chosen commandant-general and speedily collected a force to avenge the massacre of Piet Retief and his party, who had been treacherously killed by the Zulu king Dingaan the previous February. Pretorius's force was attacked on the 16th of December ("Dingaan's Day") by over 10,000 Zulus, who were beaten off with a loss of 3000 men. In January 1840 Pretorius with a commando of 400 burghers helped Mpande in his revolt against his brother Dingaan and was the leader of the Natal Boers in their opposition to the British. In 1842 he besieged the small British garrison at Durban, but retreated to Maritzburg on the arrival of reinforcements under Colonel (subsequently Sir) Josias Cloete and afterwards exerted his influence with the Boers in favour of coming to terms with the British. He remained in Natal as a British subject, and in 1847 was chosen by the Dutch farmers there to lay before the governor of Cape Colony the grievances under which they laboured owing to the constant immigration of natives, to whom locations were assigned to the detriment of Boer claims. Pretorius went to Grahams Town, where Sir Henry Pottinger (the governor) then was; but Sir Henry refused to see him or receive any communication from him. Pretorius returned to Natal determined to abandon his farm and once more trek beyond the British dominions. With a considerable following he was preparing to cross the Drakensberg when Sir Harry Smith, newly appointed governor of the Cape, reached the emigrants' camp on the Tugela (Jan. 1848). Sir Harry promised the farmers protection from the natives and persuaded many of the party to remain, but Pretorius departed, and on the proclamation of British sovereignty up to the Vaal fixed his residence in the Magalisberg, north of that river. He was chosen by the burghers living on both banks of the Vaal as their commandant-general. At the request of the Boers at Winburg Pretorius crossed the Vaal in July and led the anti-British party in their "war of freedom," occupying Bloemfontein on the 20th of the same month. In August he was defeated at Boomplaats by Sir Harry Smith and thereupon retreated north of the Vaal, where he became leader of one of the largest of the parties into which the trans-Vaal Boers were divided, and commandant-general of Potchefstroom and Rustenburg, his principal rival being Commandant-General A. H. Potgieter. In 1851 he was asked by the Boer malcontents in the Orange River Sovereignty and by the Basuto chief Moshesh to come to their aid, and he announced his intention of crossing the Vaal to "restore order" in the Sovereignty. His object, however, was rather to obtain from the British an acknowledgment of the independence of the Transvaal Boers. The British cabinet having decided on a policy of abandonment, the proposal of Pretorius was entertained. A reward of £2000 which had been offered for his apprehension after the Boomplaats fight, was withdrawn, Pretorius met the British commissioners at a farm near the Sand River, and with them concluded the convention (Jan. 17, 1852) by which the independence of the Transvaal Boers was recognized by Great Britain. Pretorius recrossed the Vaal and at Rustenburg on the 16th of March was reconciled to Potgieter, the followers of both leaders approving the convention, though the Potgieter party was not represented at the Sand River. In the same year Pretorius paid a visit to Durban with the object of opening up trade between Natal and the new republic. He also in 1852 attempted to close the road to the interior through Bechuanaland and sent a commando to the western border against Sechele. During this expedition David Livingstone's house at Kolobeng was looted. Pretorius died at his home at Magalisberg on the 23rd of July 1853. He is described by Theal as "the ablest leader and most perfect representative of the Emigrant Farmers." In 1855 a new district and a new town were formed out of the Potchefstroom and Rustenburg districts and named Pretoria in honour of the late commandant-general.

2. MARTHINIUS PRETORIUS (1819–1901), the eldest son of Andries, was appointed in August 1853 to succeed his father as commandant-general of Potchefstroom and Rustenburg, two of the districts into which the Transvaal was then divided. In 1854 he led his burghers against a chief named Makapan, who had murdered a party of twenty-three Boers, including ten women and children. The natives were blockaded in a great cave in the Zoutpansberg and about 3000 were starved to death or shot as they attempted to escape. Having thus chastised Makapan's clan, Pretorius turned his energies to the creation of a strong central government, and from 1856 onward his dominating idea appears to have been the formation of one Boer state to include the Orange River burghers. In December 1856 representatives of the districts of Potchefstroom, Rustenburg and Pretoria met and drew up a constitution and on the 6th of January the "South African Republic" was formally constituted Pretorius having been elected president on the previous day. Though the Boers of the Lydenburg, Utrecht and Zoutpansberg districts refused to acknowledge the new republic, Pretorius, with the active co-operation of Commandant Paul Kruger (afterwards President Kruger), endeavoured (1857) to bring about the union of the Orange Free State and the Transvaal, and a commando crossed the Vaal to support Pretorius. The attempt at coercion failed, but in December 1859 the partisans of Pretorius in the Free State secured his election as president of that republic. Pretorius had just effected a reconciliation of the Lydenburg Boers with those of the other districts of the Transvaal, and hoping to complete his work of unification he accepted the presidency of the Free State, assuming office at Bloemfontein in February 1860. But the condition of anarchy into which the Transvaal fell shortly afterwards effectually weaned the Free State burghers from any thought of immediate amalgamation with their northern neighbours. Pretorius however continued to intervene in the affairs of the Transvaal and at length (April 15, 1863) resigned his Free State presidency. Acting as mediator between the various Transvaal parties Pretorius in January 1864 succeeded in putting an end to the civil strife and in May following once more became president of the South African Republic—now for the first time a united community. Conciliation was a marked feature of his character and to Pretorius more than any other man was due the welding of the Transvaal Boers into one nation. Pretorius shared the ideas of his father and the Emigrant Farmers generally concerning the title of the state to indefinite expansion north, east and west. Although he had much difficulty in maintaining the authority of the republic over the natives within its recognized borders, yet in April 1868, on the report of gold discoveries at Tati, he issued a proclamation annexing to the Transvaal on the west the whole of Bechuanaland and on the east territory up to and including part of Delagoa Bay. As to Delagoa Bay Portugal at once protested and in 1869 its right to the bay was acknowledged by Pretorius, who in the same year was re-elected president. The right of the Boers to the whole of Bechuanaland was not pressed by Pretorius in the face of British opposition, but in 1870, when the discovery of diamonds along the lower Vaal had led to the establishment of many diggers' camps, an attempt was made to enforce the claims of the Transvaal to that district. Pretorius aroused the hostility of the diggers by granting an exclusive concession to one firm. Realizing his mistake, the concession was cancelled and in September 1870 he issued a proclamation notable as offering to the diggers very large powers of self-government. Pretorius went to the western frontier and in repeated conferences with the Bechuana chiefs attempted to get them to acknowledge the Boer contention and by joining the Transvaal to "save" their territory from the British. His diplomacy failed, and finally, without consulting his colleagues, he agreed to refer the question of the boundary to the arbitration of Mr R. W. Keate, then lieutenant-governor of Natal. The award, given on the 17th of October 1871, was against the Boer claims. Pretorius loyally accepted the decision, but it aroused a storm of indignation in the Transvaal. The Volksraad refused to ratify the award and Pretorius resigned the presidency (November 1871).

From this time Pretorius took little further part in public affairs until after the first annexation of the state by Great Britain. In 1878 he acted as chairman of the committee of Boer leaders who were seeking the restoration of the independence of their country, and for his action in that capacity he was arrested in January 1880 by order of Sir Garnet Wolseley on a charge of treason. (See the BLUE BOOK [C. 2584] of 1880 for details of this charge.) He was admitted to bail and shortly afterwards urged by Wolseley to accept a seat on the executive council. This offer Pretorius declined, but he consented to tour the country with a proclamation by Wolseley counselling the Boers to submit, and promising them self-government. In December of the same year he was appointed, with Paul Kruger and P. Joubert, to carry on the government on the part of the insurgent Boers. He was one of the signatories to the Pretoria Convention and continued to act as a member of the Triumvirate until the election of Kruger as president in May 1883. He then withdrew from public life; but lived to see the country re-annexed to Great Britain, dying at Potchefstroom on the 19th of May 1901. He is stated to have disapproved the later developments of Krugerism, and within four months of his death visited Louis Botha and Schalk Burger, on behalf of Lord Kitchener, with the object of bringing the war to an end.

For the elder Pretorius see G. M. Theal, *Compendium of the History and Geography of South Africa*, 3rd ed. (London, 1878), and *History of South Africa*, vol. iv. [1834–1854] (London, 1893). For the younger Pretorius see vol. v. of the same series.

PRETTY, a word usually applied in the sense of pleasing in appearance, without connoting those qualities which are described as beautiful or handsome. In Old English *praettig* meant tricky, cunning or wily, and is thus used to translate the Latin *sagax*, *astutus*, *callidus*, in a vocabulary of about 1000. *Praett* meant a trick, and this word is seen in many forms in Dutch, cf. the words *prettig*, sportive, *part*, trick. A connexion has been suggested with the Greek πρακτικός, πράττειν, to do, make, through Latin *practica*, practice, performance; but the *New English Dictionary* rejects these, as also Celtic sources, as unfounded. From "cunning" to skilful, and thence to its use as a term of general appreciation as is so often used by Pepys, the development is easy.

PREVARICATION, a divergence from the truth, equivocation, quibbling, a want of plain-dealing or straightforwardness, especially a deliberate misrepresentation by evasive answers, often used as a less offensive synonym for a lie. The Latin *praevaricatio* was specifically applied to the conduct in an action at law in which an advocate (*praevaricator*) in collusion with his opponent put up a bad case of defence. *Praevaricare* meant literally to walk with the legs very wide apart, to straddle, hence to walk crookedly, to stray from the direct road, *varicus*, straddling, being derived from *varus*, bow-legged, a word which has been connected etymologically with German *quer*, transverse, across, and English "queer."

PREVEZA, or PREVESA, a seaport of Albania, European Turkey, in the vilayet of Iannina; at the entrance to the Gulf of Arta, an inlet of the Ionian Sea. Pop. (1905), 6500, of whom about four-fifths are Christian Albanians or Greeks, and one-fifth Moslems. The town is surrounded by dense olive groves, and most of its houses stand in their own gardens. The harbour is small, and closed to large vessels by a bar of sand; but it is a port of call for the Austrian Lloyd steamers, and annually accommodates about 1500 small vessels, the majority of which are engaged in the coasting trade. Preveza exports dairy produce, valonia, hides and wool, olives and olive oil. The yearly value of its trade varies from about £70,000 to £80,000. About 3 m. north are the ruins of Nicopolis (*q.v.*).

PRÉVOST, ANTOINE FRANÇOIS (1697–1763), French author and novelist, was born at Hesdin, Artois, on the 1st of April 1697. He first appears with the full name of Prévost d'Exiles in a letter to the booksellers of Amsterdam in 1731. His father, Liévin Prévost, was a lawyer, and several members of the family had embraced the ecclesiastical estate. Prévost was educated at the Jesuit school of Hesdin, and in 1713 became a novice of the order in Paris, pursuing his studies at the same time at the college of La Flèche. At the end of 1716 he left the Jesuits to join the army, but he soon tired of life in barracks, and returned to Paris in 1719 with the idea, apparently, of resuming his novitiate. He is said to have travelled in Holland about this time; in any case he returned to the army, this time with a commission. Some of his biographers have assumed that he suffered some of the misfortunes assigned to his hero Des Grieux. However that may be, he joined in 1719–1720 the learned community of the Benedictines of St Maur, with whom he found refuge, he himself says, after the unlucky termination of a love affair. He took the vows at Jumièges in 1721 after a year's novitiate, and received in 1726 priest's orders at St Germer de Flaix. He resided for seven years in various houses of the order, teaching, preaching and studying. In 1728 he was at the abbey of St Germain-des-Prés, Paris, where he was engaged on the *Gallia christiana*, the learned work undertaken by the monks in continuation of the works of Denys de Sainte-Marthe, who had been a member of their order. His restless spirit made him seek from the Pope a transfer to the easier rule of Cluny; but without waiting for the brief, he left the abbey without leave (1728), and, learning that his superiors had obtained a *lettre de cachet* against him, fled to England.

In London he acquired considerable knowledge of English history and literature, traceable throughout his writings. Before leaving the Benedictines Prévost had begun his most famous romance, *Mémoires et avantures d'un homme de qualité qui s'est retiré du monde*, the first four volumes of which were published in Paris in 1728, and two years later at Amsterdam. In 1729 he left England for Holland, where he began to publish (Utrecht, 1730) a romance, the material of which, at least, had been gathered in London—*Le Philosophe anglois, ou Histoire de Monsieur Cleveland, fils naturel de Cromwell, écrite par lui-mesme, et traduite de l'anglois* (Paris 1731–1739, 8 vols., but most of the existing sets are partly Paris and partly Utrecht). A spurious fifth volume (Utrecht, 1734) contained attacks on the Jesuits, and an English translation of the whole appeared in 1734. Meanwhile, during his residence at the Hague, he engaged on a translation of the *Historia* of De Thou, and, relying on the popularity of his first book, published at Amsterdam a *Suite* in three volumes, forming volumes v., vi., and vii. of the original *Mémoires et avantures d'un homme de qualité*. The seventh volume contained the famous *Manon Lescaut*, separately published in Paris in 1731 as *Les Aventures du chevalier des Grieux et de Manon Lescaut, par Monsieur D*.... The book was eagerly read, chiefly in pirated copies, as it was forbidden in France. In 1733 he left the Hague for London in company with a lady whose character, as given by Prévost's enemies, was far from desirable. In London he edited a weekly gazette on the model of Addison's *Spectator*, *Le Pour et contre*, which he continued to produce, with short intervals, until 1740.

In the autumn of 1734 Prévost was reconciled with the Benedictines, and, returning to France, was received in the Benedictine monastery of La Croix-Saint-Leufroy in the diocese of Evreux to pass through a new, though brief, novitiate. In 1735 he was dispensed from residence in a monastery by becoming almoner to the prince de Conti, and in 1754 obtained the priory of St Georges de Gesnes. He continued to produce novels and translations from the English, and, with the exception of a brief exile (1741–1742) spent in Brussels and Frankfort, he resided for the most part at Chantilly until his death, which took place suddenly while he was walking in the neighbouring woods on the 23rd of December 1763. Hideous particulars have been added, but the cause of his death, the rupture of an aneurism, has been definitely established. Stories of crime and disaster were related of Prévost by his enemies, and diligently repeated, but they have proved to be as apocryphal as the details given of his death.

Manon Lescaut, one of the greatest novels of the century, is very short; it is entirely free from improbable incident, it is penetrated by the truest and most cunningly managed feeling; and almost every one of its characters is a triumph of that analytic portraiture which is the secret of the modern novel. The chevalier des Grieux, the hero, is probably the most perfect example of the carrying out of the sentiment "All for love and the world well lost" that exists in fiction, at least where the circumstances are those of ordinary and probable life. Tiberge, his friend, is hardly inferior in the difficult part of mentor and reasonable man. Lescaut, the heroine's brother, has vigorous touches as a bully and Bohemian; but the triumph of the book is Manon herself. Animated by a real affection for her lover, and false to him only because her love of splendour, comfort and luxury prevents her from welcoming privation with him or for him, though in effect she prefers him to all others, perfectly natural and even amiable in her degradation, and yet showing the moral of that degradation most vividly, Manon is one of the most remarkable heroines in all fiction. She had no literary ancestress; she seems to have sprung entirely from the imagination, or perhaps the sympathetic observation, of the wandering scholar who drew her. Only the *Princesse de Clèves* can challenge comparison with her before or near to her own date, and in *Manon Lescaut* the plot is much more complete and interesting, the sentiments less artificial, and the whole story nearer to actual life than in Madame de la Fayette's masterpiece. Prevost's other works include: *Le Doyen de Killérine, histoire morale, composée sur les mémoires d'une illustre famille d'Ireland* (Paris, 1735; 2nd part, the Hague, 1739, 3rd, 4th and 5th parts, 1740); *Tout pour l'amour* (1735), a translation of Dryden's tragedy; *Histoire d'une Grecque moderne* (Amsterdam [Paris] 2 vols., 1740); *Histoire de Marguerite d'Anjou* (Amsterdam [Paris] 2 vols., 1740); *Mémoires pour servir a l'histoire de Malte* (Amsterdam, 1741); *Campagnes philosophiques, ou mémoires . . . contenant l'histoire de la guerre d'Irelande* (Amsterdam, 1741); *Histoire de Guillaume le Conquérant* (Paris, 1742); *Histoire générale des voyages* (15 vols., Paris, 1746–1759), continued by other writers; translations from Samuel Richardson, *Pamela* (4 vols., 1742), *Lettres anglaises ou Histoire de Miss Clarisse Harlowe* (6 vols., London, 1741); *Nouvelles lettres anglaises, ou Histoire du chevalier Grandisson* (Amsterdam, 3 vols., 1755); *Mémoires pour servir a l'histoire de la vertu* (Cologne, 4 vols., 1762), from Mrs Sheridan's *Mémoires of Miss Sidney Bidulph*; *Histoire de la maison de Stuart* (3 vols., 1740) from Hume's *History of England to 1688*; *Le Monde morale, ou Mémoires pour servir a l'histoire du cœur humain* (2 vols., Geneva, 1760), &c.

For the bibliography of Prevost's works, which presents many complications, and for documentary evidence of the facts of his life see H. Harrisse, *L'Abbé Prevost* (1896); also a thesis (1898) by V. Schroeder.

PRÉVOST, CONSTANT (1787–1856), French geologist, was born in Paris on the 4th of June 1787, and was son of Louis Prévost, receiver of the rentes of that city. He was educated at the Central Schools, where, inspired by the lectures of G. Cuvier, Alexandre Brongniart and A. Duméril, he determined to devote himself to natural science. He took his degree in Letters and Sciences in 1811, and for a time pursued the study of medicine and anatomy. Mainly through the influence of Brongniart he turned his attention to geology, and during the years 1816–1819 made a special study of the Vienna Basin where he pointed out for the first time the presence of Tertiary strata like those of the Paris Basin, but including a series of later date. His next work (1821) was an essay on the geology of parts of Normandy, with special reference to the Secondary strata, which he compared with those of England. From 1821–1829 he was professor of geology at the Athenaeum at Paris, and he took a leading part with Ami Boué, G. P. Deshayes and Jules Desnoyers in the founding of the Geological Society of France (1830). In 1831 he became assistant professor and afterwards honorary professor of geology to the faculty of sciences. Having studied the volcanoes of Italy and Auvergne, he opposed the views of von Buch regarding craters of elevation, maintaining that the cones were due to the material successively errupted. Like Lyell he advocated a study of the causes or forces now in action in order to illustrate the past. One of his more important memoirs was *De la Chronologie des terrains et du synchronisme des formations* (1845). He died in Paris on the 17th of August 1856.

Memoir with portrait, by J. Gosselet, *Ann. soc. géol. du nord*, tome xxv. 1896.

PRÉVOST, EUGÈNE MARCEL (1862–   ), French novelist, was born in Paris on the 1st of May 1862. He was educated at Jesuit schools in Bordeaux and Paris, entering the École Polytechnique in 1882. He published a story in the *Clairon* as early as 1881, but for some years after the completion of his studies he applied his technical knowledge to the manufacture of tobacco. He published in succession, *Le Scorpion* (1887), *Chonchette* (1888), *Mademoiselle Jauffre* (1889), *Cousine Laura* (1890), *La Confession d'un amant* (1891), *Lettres de femmes* (1892), *L'Automne d'une femme* (1893), and in 1894 he made a great sensation by an exaggerated and revolting study of the results of Parisian education and Parisian society on young girls, *Les Demi-vierges*, which was dramatized and produced with great success at the Gymnase on the 21st of May 1895. *Le Jardin secret* appeared in 1897; and in 1900 *Les Vierges fortes*, and a study of the question of women's education and independence in two novels *Frédérique* and *Léa*. *L'Heureux ménage* (1901), *Les Lettres à Françoise* (1902), *La Princesse d'Erminge* (1904), and *L'Accordeur aveugle* (1905) are among his later novels. An amusing picture of modern German manners is given in his *Monsieur et Madame Moloch* (1906). He had a great success in 1904 with a four act play *La Plus faible*, produced at the Comédie Française. In 1909 he was elected to the Academy.

PRÉVOST, PIERRE (1751–1839), Swiss philosopher and physicist, son of a Protestant clergyman in Geneva, was born in that city on the 3rd of March 1751, and was educated for a clerical career. But he forsook it for law, and this too he quickly deserted to devote himself to education and to travelling. He became intimate with J. J. Rousseau, and, a little later, with Dugald Stewart, having previously distinguished himself as a translator of and commentator on Euripides. Frederick II. of Prussia secured him in 1780 as professor of philosophy, and made him member of the Akadémie der Wissenschaften in Berlin. He there became acquainted with Lagrange, and was thus led to turn his attention to physical science. After some years spent on political economy and on the principles of the fine arts (in connexion with which he wrote, for the *Berlin Memoirs*, a remarkable dissertation on poetry) he returned to Geneva and began his work on magnetism and on heat. Interrupted occasionally in his studies by political duties, in which he was often called to the front, he remained professor of philosophy at Geneva till he was called in 1810 to the chair of physics. He died at Geneva on the 8th of April 1839.

Prévost published much on philology, philosophy, and political economy; but he will be remembered mainly for having published, with additions of his own, the *Traité de physique* of G. L. Le Sage, and for his enunciation of the law of exchange in radiation. His scientific publications included *De l'Origine des forces magnétiques* (1788), *Recherches physico-mécaniques sur la chaleur* (1792), and *Essai sur le calorique rayonnant* (1809).

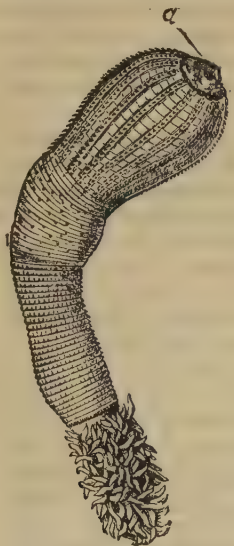
PRÉVOST-PARADOL, LUCIEN ANATOLE (1829–1870), French man of letters, was born in Paris on the 8th of August 1829. He was educated at the College Bourbon and entered the École Normale. In 1855 he was appointed professor of French literature at Aix. He held the post, however, barely a year, resigning it to become a leader-writer on the *Journal des débats*. He also wrote in the *Courrier du dimanche*, and for a very short time in the *Presse*. His chief works are *Essais de politique et de littérature* (three series, 1859–1866), and *Essais sur les moralistes français* (1864). He was, however, rather a journalist than a writer of books, and was one of the chief opponents of the empire on the side of moderate liberalism. He underwent the usual difficulties of a journalist under that régime, and was once imprisoned. In 1865 he was elected an Academician. The accession of Émile Ollivier to power was fatal to Prévost-Paradol, who apparently believed in the possibility of a liberal empire, and consequently accepted the appointment of envoy to the United States. This was the signal for the most unmeasured attacks on him from the republican party. He had scarcely installed himself in his post before the outbreak of war between France and Prussia occurred. He shot himself at Washington on the 11th of July 1870, and died on the 20th.

PREY (O. Fr. *preie*, mod. *proie*, Lat. *praeda*, booty, from *prae* and the root *hed*—seen in *prehendere*, *prendere*, to grasp), booty, spoil, plunder taken in war, by robbery, or other violent means; particularly the quarry, the animal killed for food by a carnivorous animal; a beast or bird of prey. A particular usage for that which is saved from any trial of strength or battle is familiar from the Bible (Jer. xxi. 9) "his life shall be unto him for a prey."

PRIAM (Gr. Πρίαμος), in Greek legend, the last king of Troy, son of Laomedon and brother of Tithonus. Little is known of him before the Trojan War, which broke out when he was advanced in years. According to Homer (*Iliad*, iii. 184) in his youth he fought on the side of the Phrygians against the Amazons. He had fifty sons and fifty daughters, and possessed immense wealth. He appears only twice on the scene of action during the war—to make arrangements for the duel between Paris and Menelaus, and to beg the body of Hector for burial from Achilles, whom he visits in his tent by night. He was said to have been slain by Neoptolemus, son of Achilles, during the sack of Troy (Virgil, *Aeneid*, ii. 512). See under Troy, on the legends.

PRIAPEIA, a collection of poems (about eighty in number) in various metres on the subject of Priāpus. It was compiled from literary works and inscriptions on images of the god by an unknown editor, who composed the introductory epigram. From their style and versification it is evident that the poems belong to the best period of Latin literature. Some, however, may be interpolations of a later period. They will be found in F. Bücheler's *Petronius* (1904), L. Müller's *Catullus* (1870), and E. Bährens, *Poetae latini minores*, i. (1879).

PRIAPULOIDEA, a small group of vermiform marine creatures; they have been usually placed in the neighbourhood of the Gephyrea, but their position is uncertain and it is doubtful if they are to be regarded as coelomate animals. They are cylindrical worm-like animals, with a median anterior mouth quite devoid of any armature or tentacles. The body is ringed, and often has circles of spines, which are continued into the slightly protrusible pharynx. The alimentary canal is straight, the anus terminal, though in *Priapulus* one or two hollow ventral diverticula of the body-wall stretch out behind it. The nervous system, composed of a ring and a ventral cord, retains its primitive connexion with the ectoderm. There are no specialized sense-organs or vascular or respiratory systems. There is a wide body-cavity, but as this has no connexion with the renal or reproductive organs it cannot be regarded as a coelom, but probably is a blood-space or haemocoel.



Priapulus caudatus Lam. (Nat. size.) *a*, Mouth, surrounded by spines.

The Priapuloidea are dioecious, and their male and female organs, which are one with the excretory organs, consist of a pair of branching tufts, each of which opens to the exterior on one side of the anus. The tips of these tufts enclose a flame-cell similar to those found in Platyhelminths, &c., and these probably function as excretory organs. As the animals become adult, diverticula arise on the tubes of these organs, which develop either spermatozoa or ova. These pass out through the ducts. Nothing is known of the development. There are three genera: (i.) *Priapulus*, with the species *P. caudatus*, Lam., of the Arctic and Antarctic and neighbouring cold seas, and *P. bicaudatus*, Dan., of the north Atlantic and Arctic seas; (ii.) *Priapuloides australis*, de Guerne, of the southern circumpolar waters; and (iii.) *Halicryptus*, with the species *H. spinulosus*, v. Sieb., of northern seas. They live in the mud, which they eat, in comparatively shallow waters up to 50 fathoms.

Authorities.—Apel, *Zeitschr. wiss. Zool.* (1885), vol xlii.; Scharff, *Quart. Journ. Mic. Sci.* (1885), vol. xxv.; Ehlers *Zeitschr. wiss. Zool.* (1861), vol. xi.; Schauinsland, *Zool. Anz.* (1886), vol. ix.; De Guerne, *Mission scientifique du Cap Horn* (1891), vol vi.; Michaelsen, *Jahrb. Hamburg-Aust.* (1888), vol. vi. (A. E. S.)

PRIĀPUS, in Greek mythology, son of Dionysus (or Adonis or Hermes) and Aphrodite (or Chione). He is unknown to Homer and Hesiod. The chief seat of his worship was the coast of the Hellespont, especially at Lampsacus, which claimed to be his birthplace. Thence his cult extended to Lydia, and by way of the islands of Lesbos and Thasos to the whole of Greece (especially Argolis), whence it made its way to Italy, together with that of Aphrodite. Priapus is the personification of the fruitfulness of nature. Sailors invoked him in distress and fishermen prayed to him for success. He gradually came to be regarded as the god of sensuality. His symbol was the phallus, an emblem of productivity and a protection against the evil eye. The first fruits of the gardens and fields, goats, milk and honey, and occasionally asses, were offered to him. He was sometimes represented as an old man, with a long beard and large genitals, wearing a long Oriental robe and a turban or garland of vine-leaves, with fruit and bunches of grapes in his lap. Amongst the Romans, rough wooden images, after the manner of the hermae, with phallus stained with vermilion, were set up in gardens. His image was placed on tombs, as symbolizing the doctrine of regeneration and a future life, and his name occurs on sepulchral inscriptions. In his hand he carried a bill-hook or club, while a reed on his head, shaking backwards and forwards in the wind, acted as a scarecrow.

PRIBILOF ISLANDS (often called the Fur Seal Islands, Russian equivalent, "Kotovi"), a group of four islands, part of Alaska, lying in Bering Sea in about 56° 50′ N. and 170° W., about 200 m. N. of Unalaska and 200 m. S. of Cape Newenham, the nearest point on the mainland. The principal islands are St Paul (about 35 sq. m.; 13 m. long, from N.E. to S.W.; maximum width about 6 m.; named from St Peter and St Paul's Day, on which it was discovered) and St George (about 27 sq.m.; 10 m. long, maximum width, 4 m.; probably named after Pribilof's ship) about 30 m. S.E.; Otter and Walrus islets, the former covering about 4 sq. m., and the latter merely a reef covering about 64 acres, are near St Paul. In 1907 the native population was 263—170 on St Paul and 93 on St George. Only agents of the United States or employés of the lessees are permitted as residents on the islands. The islands are hilly and volcanic—Bogoslof, a crater on St Paul, is 600 ft. high—without harbours, and have a mean annual temperature of about 35·7° F., and a rainfall of about 35 in. There are only two seasons—rainy summers lasting from May to October, and dry winters from November to April. The flora is restricted to ferns, mosses and grasses, though there are some creeping willows and small shrubs. The largest seal rookery, containing about 80 % of the seals in the Pribilofs, is on St Paul. The seals found here are a distinct variety (*Callorhinus alascanus*) with much better fur than that of any other variety. Besides the fur seal there are blue and grey foxes (more on St George than on St Paul), and on St George Island and on the Walrus reef there are great bird rookeries—the breeding places of immense numbers of gulls, sea-parrots, auks, cormorants and arries (*Lomvia arra*).

The islands were first sighted in 1767 by Joan Synd, and were visited in 1786 by Gerasim Pribiloff, who discovered the fur seal rookeries for which they became famous. From Russia the islands passed with Alaska to the United States in 1867. From 1870 to 1890 the United States government leased the islands to the Alaska Commercial Company. In 1890–1910 the North American Commercial Company held the monopoly. But the industry shrank considerably owing to pelagic sealing. The season during which land hunting is allowed on the islands includes June, July, September and October. (See also Seal and Bering Sea Arbitration.)

PŘIBRAM, a town of Bohemia, Austria, 39 m. S.W. of Prague by rail. Pop. (1900), 13,576, together with the adjoining township of Birkenberg, 19,119, almost exclusively Czech. It lies in a valley between the hills of Birkenberg and Heiliger Berg, and in its neighbourhood are the lead and silver mines which belong to the Austrian government and are worked in nine shafts, two of which, the Adalbert shaft (3637 ft.) and the Maria shaft, (3575 ft.) are the deepest in the world. The mines have been worked for several centuries, but their actual prosperity dates from 1770, when the sinking of the Adalbert shaft began. They yield yearly an average of 80,000 ℔ of silver and 1900 tons of lead. At the top of the Heiliger Berg (1889 ft.) is a church with a wonder-working image of the Virgin, which is the chief place of pilgrimage in Bohemia.

PRICE, BARTHOLOMEW (1818–1898), English mathematician and educationist, was born at Coln St Denis, Gloucestershire, in 1818. He was educated at Pembroke College, Oxford, of which college (after taking a first class in mathematics in 1840 and gaining the university mathematical scholarship in 1842) he became fellow in 1844 and tutor and mathematical lecturer in 1845. He at once took a leading position in the mathematical teaching of the university, and published treatises on the *Differential calculus* (in 1848) and the *Infinitesimal calculus* (4 vols., 1852–1860), which for long were the recognized textbooks there. This latter work included the differential and integral calculus, the calculus of variations, the theory of attractions, and analytical mechanics. In 1853 he was appointed Sedleian professor of natural philosophy, resigning it in June 1898. His chief public activity at Oxford was in connexion with the hebdomadal council, and with the Clarendon Press, of which he was for many years secretary. He was also a curator of the Bodleian Library, an honorary fellow of Queen's College, a governor of Winchester College and a visitor of Greenwich Observatory. In 1891 he was elected Master of Pembroke College, which dignity carried with it a canonry of Gloucester Cathedral. He died on the 29th of December 1898. See *Monthly Notices of the Royal Astronomical Society* (1899).

PRICE, BONAMY (1807–1888), English political economist, was born at St Peter Port, Guernsey, on the 22nd of May 1807. He entered at Worcester College, Oxford, in 1825, where he took a double first in 1829. From 1830 to 1850 he was an assistant master at Rugby school. He then lived for some years in London, being engaged in business and literary work, and was appointed to serve on various royal commissions. He married in 1864. In 1868 he was elected Drummond professor of political economy at Oxford, and was thrice re-elected to the post, which he held till his death. In 1883 he was elected an honorary fellow of his college. In addition to his professorial work, he was in much request as a popular lecturer on political economy. He died in London on the 8th of January 1888. His principal publications, exclusive of pamphlets, were: *The Principles of Currency* (1869), *Currency and Banking* (1876), *Chapters on Practical Political Economy* (1878).

PRICE, RICHARD (1723–1791), English moral and political philosopher, son of a dissenting minister, was born on the 23rd of February 1723, at Tynton, Glamorganshire. He was educated privately and at a dissenting academy in London, and became chaplain and companion to a Mr Streatfield at Stoke Newington. By the death of Mr Streatfield and of an uncle in 1756 his circumstances were considerably improved, and in 1757 he married a Miss Sarah Blundell, originally of Belgrave in Leicestershire.

In 1767 he published a volume of sermons, which gained him the acquaintance of Lord Shelburne, an event which had much influence in raising his reputation and determining the character of his subsequent pursuits. It was, however, as a writer on financial and political questions that Price became widely known. In 1769, in a letter to Dr Franklin, he wrote some observations on the expectation of lives, the increase of mankind, and the population of London, which were published in the *Philosophical Transactions* of that year; in May 1770 he communicated to the Royal Society a paper on the proper method of calculating the values of contingent reversions. The publication of these papers is said to have exercised a beneficial influence in drawing attention to the inadequate calculations on which many insurance and benefit societies had recently been formed. In 1769 Price received the degree of D.D. from the university of Glasgow. In 1771 he published his *Appeal to the Public on the Subject of the National Debt* (ed. 1772 and 1774). This pamphlet excited considerable controversy, and is supposed to have influenced Pitt in re-establishing the sinking fund for the extinction of the national debt, which had been created by Walpole in 1716 and abolished in 1733. The means, however, which Price proposed for the extinction of the debt are described by Lord Overstone[1] as "a sort of hocus-pocus machinery," supposed to work "without loss to any one," and consequently unsound.

Price then turned his attention to the question of the American colonies. He had from the first been strongly opposed to the war, and in 1776 he published a pamphlet entitled *Observations on Civil Liberty and the Justice and Policy of the War with America.* Several thousand copies of this work were sold within a few days; a cheap edition was soon issued; the pamphlet was extolled by one set of politicians and abused by another; amongst its critics were Dr Markham, archbishop of York, John Wesley, and Edmund Burke; and Price rapidly became one of the best-known men in England. He was presented with the freedom of the city of London, and it is said that his pamphlet had no inconsiderable share in determining the Americans to declare their independence. A second pamphlet on the war with America, the debts of Great Britain, and kindred topics followed in the spring of 1777. His name thus became identified with the cause of American independence. He was the intimate friend of Franklin; he corresponded with Turgot; and in the winter of 1778 he was invited by Congress to go to America and assist in the financial administration of the states. This offer he refused from unwillingness to quit his own country and his family connexions. In 1781 he received the degree of D.D. from Yale College.

One of Price's most intimate friends was Dr Priestley, in spite of the fact that they took the most opposite views on morals and metaphysics. In 1778 appeared a published correspondence between these two liberal theologians on the subjects of materialism and necessity, wherein Price maintains, in opposition to Priestley, the free agency of man and the unity and immateriality of the human soul. Both Price and Priestley were what would now vaguely be called "Unitarians," though they occupied respectively the extreme right and the extreme left position of that school. Indeed, Price's opinions would seem to have been rather Arian than Socinian.

The pamphlets on the American War made Price famous. He preached to crowded congregations, and, when Lord Shelburne acceded to power, not only was he offered the post of private secretary to the premier, but it is said that one of the paragraphs in the king's speech was suggested by him and even inserted in his words. In 1786 Mrs Price died. There were no children by the marriage, his own health was failing, and the remainder of his life appears to have been clouded by solitude and dejection. The progress of the French Revolution alone cheered him. On the 19th of April 1791 he died, worn out with suffering and disease.

Ethical Theory.

The philosophical importance of Price is entirely in the region of ethics. The *Review of the Principal Questions in Morals* (1757, 3rd ed. revised 1787) contains his whole theory. It is divided into ten chapters, the first of which, though a small part of the whole, completes his demonstration of ethical theory. The remaining chapters investigate details of minor importance, and are especially interesting as showing his relation to Butler and Kant (ch. iii. and ch. vii.). The work is professedly a refutation of Hutcheson, but is rather constructive than polemical. The theory he propounds is closely allied to that of Cudworth, but is interesting mainly in comparison with the subsequent theories of Kant.

I. Right and wrong belong to actions *in themselves.* By this he means, not that the ethical value of actions is independent of their motive and end (see ch. vi), but rather that it is unaffected by consequences, and that it is more or less invariable for intelligent beings. II. This ethical value is perceived by reason or understanding (which, unlike Kant, he does not distinguish), which intuitively recognizes fitness or congruity between actions, agents and total circumstances. Arguing that ethical judgment is an act of discrimination, he endeavours to invalidate the doctrine of the moral sense (see SHAFTESBURY and HUTCHESON). Yet, in denying the importance of the emotions in moral judgment, he is driven back to the admission that right actions must be "grateful" to us; that, in fact, moral approbation includes both an act of the understanding and an emotion of the heart. Still it remains true that reason alone, in its highest development, would be a sufficient guide. In this conclusion he is in close agreement with Kant; reason is the arbiter, and right is (1) not a matter of the emotions and (2) not relative to imperfect human nature. Price's main point of difference with Cudworth is that while Cudworth regards the moral criterion as a *νόημα* or modification of the mind, existing in germ and developed by circumstances, Price regards it as acquired from the contemplation of actions, but acquired necessarily, immediately, intuitively. In his view of disinterested action (ch. iii.) he adds nothing to Butler. III. Happiness he regards as the *only* end, conceivable by us, of divine Providence, but it is a happiness wholly dependent upon rectitude. Virtue tends always to happiness, and in the end must produce it in its perfect form.

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[1] Lord Overstone reprinted in 1857, for private circulation, Price's and other rare tracts on the national debt and the sinking fund.

Works.—Besides the above-mentioned, Price wrote an *Essay on the Population of England* (2nd ed., 1780); two Fast-day Sermons, published respectively in 1779 and 1781; and *Observations on the importance of the American Revolution and the means of rendering it a benefit to the World* (1784). A complete list of his works is given as an appendix to Dr Priestley's *Funeral Sermon*. His views on the French Revolution are denounced by Burke in his *Reflections on the Revolution in France*. Notices of Price's ethical system occur in Mackintosh's *Progress of Ethical Philosophy*, Jouffroy's *Introduction to Ethics*, Whewell's *History of Moral Philosophy in England*; Bain's *Mental and Moral Sciences*. See also ETHICS, and T. Fowler's monograph on Shaftesbury and Hutcheson. For Price's life see memoir by his nephew, William Morgan. (J. M. M.)

PRICE, the equivalent in money for which a commodity is sold or purchased, the value of anything expressed in terms of a medium of exchange (see VALUE and WEALTH). The word is a doublet of "praise," commendation, eulogy, Lat. *laus*, and "prize," a reward of victory, the ultimate source of which is the Lat. *pretium*; the Aryan root *par-*, to buy, is seen in Skr. *pana*, wages, reward, Gr. *πιπράσκειν*, to sell, &c. The O. Fr. *pris*, mod. *prix*, was taken from a Late Latin form *precium*, and had the various meanings of the English, "price," "prize," and "praise"; it was adapted in English as *pris* or *prise* and was gradually differentiated in form for the different meanings; thus "praise" was developed from an earlier verbal form *preise* or *preyse* in the 15th century; the original meaning survives in "appraise," to set a value to anything, cf. the current meaning of "to prize," to value highly. "Prize," reward, does not appear as a separate form till the 16th century. In "prize-fight," a boxing contest for money, the idea of reward seems clear, but the word appears earlier than the form "prize" in this sense and means a contest or match, and may be a different word altogether; the *New English Dictionary* compares the Greek use of *ἆθλον*, literally reward, hence contest. "Prize" in the sense of that which is captured in war, especially at sea, is a distinct word. It comes through the Fr. *prise*, early Romanic *presa* for *prensa*, from Lat. *praehendere*, to seize, capture. For the international law on the subject see PRIZE.

PRICHARD, JAMES COWLES (1786–1848), English physician and ethnologist, was born on the 11th of February 1786 at Ross in Herefordshire. His parents were of the Society of Friends, and he was educated at home, especially in modern languages and general literature. He adopted medicine as a profession mainly because of the facilities it offered for anthropological investigations. He took his M.D. at Edinburgh, afterwards reading for a year at Trinity College, Cambridge, whence, joining the Church of England, he migrated to St John's College, Oxford, afterwards entering as a gentleman commoner at Trinity College, Oxford, but taking no degree in either university. In 1810 he settled at Bristol as a physician, and in 1813 published his *Researches into the Physical History of Man*, in 2 vols., afterwards extended to 5 vols. The central principle of the book is the primitive unity of the human species, acted upon by causes which have since divided it into permanent varieties or races. The work is dedicated to Blumenbach, whose five races of man are adopted. But where Prichard excelled Blumenbach and all his other predecessors was in his grasp of the principle that people should be studied by combining all available characters. One investigation begun in this work requires special mention, the bringing into view of the fact, neglected or contradicted by philologists, that the Celtic nations are allied by language with the Slavonian, German and Pelasgian (Greek and Latin), thus forming a fourth European branch of the Asiatic stock (which would now be called Indo-European or Aryan). His special treatise containing Celtic compared with Sanskrit words appeared in 1831 under the title *Eastern Origin of the Celtic nations*. It is remarkable that the essay by Adolphe Pictet, *De l'Affinité des langues celtiques avec le sanscrit*, which was crowned by the French Academy and made its author's reputation, should have been published in 1837 in evident ignorance of the earlier and in some respects stricter investigations of Prichard.

In 1843 Prichard published his *Natural History of Man*, in which he reiterated his belief in the specific unity of man, pointing out that "the same inward and mental nature is to be recognized in all the races." Prichard may fairly be honoured with the title of the founder of the English branch of the sciences of anthropology and ethnology. In 1811 he was appointed physician to St Peter's hospital, Bristol, and in 1814 to the Bristol infirmary. In 1822 he published *Treatise on Diseases of the Nervous System* (pt. i.), and in 1835 a *Treatise on Insanity and other Disorders affecting the Mind*, in which he advanced the theory of the existence of a distinct mental disease, "moral insanity." In 1842, following up this suggestion, he published *On the different forms of Insanity in relation to Jurisprudence designed for the use of Persons concerned in Legal Questions regarding Unsoundness of Mind*. In 1845 he was made a commissioner in lunacy, and removed to London. He died there three years later, on the 23rd of December, of rheumatic fever. At the time of his death he was president of the Ethnological Society and a fellow of the Royal Society. Among his less important works were: *A Review of the Doctrine of a Vital Principle* (1829); *On the Treatment of Hemiplegia* (1831); *On the Extinction of some Varieties of the Human Race* (1839); *Analysis of Egyptian Mythology* (1819).

See Memoir by Dr Thomas Hodgkin (1798–1866) in the *Journal of the Ethnological Society* (Feb. 1849); Memoir read before the Bath and Bristol branch of the Provincial Medical and Surgical Association (March 1849) by Dr J. A. Symonds (*Journ. Eth. Soc.*, (1850); *Prichard and Symonds in Special Relation to Mental Science*, by Dr Hack Tuke (1891).

PRICK POSTS, an old architectural name given sometimes to the queen posts of a roof, and sometimes to the filling in quarters in framing. (See POST and PANE.)

PRIDE, THOMAS (d. 1658), parliamentarian general in the English Civil War, is stated to have been brought up by the parish of St Bride's, London. Subsequently he was a drayman and a brewer. At the beginning of the Civil War he served as a captain under the earl of Essex, and was gradually promoted to the rank of colonel. He distinguished himself at the battle of Preston, and with his regiment took part in the military occupation of London in December 1648, which was the first step towards bringing the king to trial. The second was the expulsion of the Presbyterian and Royalist elements in the House of Commons, for which Pride is chiefly remembered. This, resolved by the army council and ordered by the lord general, Fairfax, was carried out by Colonel Pride's regiment. Taking his stand at the entrance of the House of Commons with a written list in his hand, he caused the arrest or exclusion of the obnoxious members, who were pointed out to him. After about a hundred members had been thus dealt with ("Pride's Purge"), the mutilated House of Commons proceeded to bring the king to trial. Pride was one of the judges of the king and signed his death-warrant, appending to his signature a seal showing a coat of arms. He commanded an infantry brigade under Cromwell at Dunbar and Worcester. He took no conspicuous part in Commonwealth politics, except in opposing the proposal to confer the kingly dignity on Cromwell. He was knighted by the Protector in 1656, and was also chosen a member of the new House of Lords. He died at Nonsuch House, an estate which he had bought in Surrey, on the 23rd of October 1658. After the Restoration his body was ordered to be dug up and suspended on the gallows at Tyburn along with those of Cromwell, Ireton and Bradshaw, though it is said that the execution of this sentence was evaded.

Noble, *Lives of the Regicides*; Bate, *Lives of the Prime Actors and Principal Contrivers of the Murder of Charles I.*; Carlyle, *Cromwell's Letters and Speeches*.

PRIDEAUX, HUMPHREY (1648–1724), English divine and Oriental scholar, was born of good family at Place, in Cornwall, on the 3rd of May 1648, and received his early education at the grammar schools of Liskeard and Bodmin. In 1665 he was placed at Westminster under Busby, and in 1668 went on to

Christ Church, Oxford, where he took his degrees in the following order: B.A., 1672; M.A., 1675; B.D., 1682; and D.D., 1686. His account of the famous Arundel marbles just given to the university appeared in 1676. In 1679 he was appointed to the rectory of St Clement's, Oxford, and Hebrew lecturer at Christ Church, where he continued until February 1686, holding for the last three years the rectory of Bladon with Woodstock. In 1686 he exchanged for the benefice of Saham in Norfolk. The sympathies of Prideaux inclined to Low Churchism in religion and to Whiggism in politics, and he took an active part in the controversies of the day, publishing the following pamphlets: "The Validity of the Orders of the Church of England" (1688), "Letter to a Friend on the Present Convocation" (1690), "The Case of Clandestine Marriages stated" (1691). Prideaux was promoted to the archdeaconry of Suffolk in December 1688, and to the deanery of Norwich (he had long been one of the canons) in June 1702. In 1694 he was obliged, through ill health, to resign the rectory of Saham, and after having held the vicarage of Trowse for fourteen years (1696–1710) he found himself incapacitated from further parochial duty. He died at Norwich on the 1st of November 1724.

Many of the dean's writings were of considerable value. His *Life of Mahomet* (1697) was really a polemical tract against the deists and has now no biographical value. Both it and his *Directions to Churchwardens* (1701) passed through several editions. Even greater success attended *The Old and New Testament connected in the History of the Jews* (1716), a work which not only displayed but stimulated research. Biographical details of his numerous publications and of his manuscripts are given in the *Bibliotheca Cornubiensis*, ii. 527–533, and iii. 1319. A volume of his letters to John Ellis, some time under-secretary of state, was edited by E. M. Thompson for the Camden Society in 1875; they contain a vivid picture of Oxford life after the Restoration. An anonymous life (probably by Thomas Birch) appeared in 1748; it was mainly compiled from information furnished by Prideaux's son Edmund.

PRIE, JEANNE AGNES BERTHELOT DE PLÉNEUF, MARQUISE DE (1698–1727), French adventuress, was the daughter of a rich but unscrupulous father and an immoral mother. At the age of fifteen she was married to Louis, marquis de Prie, and went with him to the court of Savoy at Turin, where he was ambassador. She was twenty-one when she returned to France, and was soon the declared mistress of Louis Henri, duc de Bourbon. During his ministry (1723–1725) she was in several respects the real ruler of France, her most notable triumph being the marriage of Louis XV. to Marie Leszczynska instead of to Mlle de Vermandois. But when, in 1725, she sought to have Bourbon's rival Fleury exiled, her ascendancy came to an end. After Fleury's recall and the banishment of Bourbon to Chantilly Mme de Prie was exiled to Courbépine, where she committed suicide the next year.

See M. H. Thirion, *Madame de Prie* (Paris, 1905).

PRIE-DIEU, literally "pray God," strictly a prayer desk, primarily intended for private use, but often found in churches of the European continent. It is a small ornamental wooden desk furnished with a sloping shelf for books, and a cushioned kneeling piece. It appears not to have received its present name until the early part of the 17th century. At that period in France a small room or oratory was sometimes known by the same name. A similar form of chair, in domestic furniture, is called prie-dieu by analogy.

PRIEGO DE CORDOBA, a town of southern Spain in the extreme S.E. of the province of Cordova, near the headwaters of the river Guadajoz, and on the northern slope of the Sierra de Priego. Pop. (1900), 16,902. The district abounds in cattle and mules and agricultural products, especially wine and oil. The local industries also include tanning and manufactures of esparto fabrics, rugs and cotton goods. The oldest church was built in the 13th century and subsequently restored; it has a fine chapel. There are ruins of an old castle—Priego having been a fortified city of the Moors which was captured by the Christians in 1226, lost again, and finally retaken in 1407.

PRIENE (mod. *Samsun kale*), an ancient city of Ionia on the foot-hills of Mycale, about 6 m. N. of the Maeander. It was formerly on the sea coast, but now lies some miles inland. It is said to have been founded by Ionians under Aegyptus, a son of Neleus. Sacked by Ardys of Lydia, it revived and attained great prosperity under its "sage," Bias, in the middle of the 6th century. Cyrus captured it in 545; but it was able to send twelve ships to join the Ionian revolt (500–494). Disputes with Samos, and the troubles after Alexander's death, brought Priene low, and Rome had to save it from the kings of Pergamum and Cappadocia in 155. Orophernes, the rebellious brother of the Cappadocian king, who had deposited a treasure there and recovered it by Roman intervention, restored the temple of Athena as a thankoffering. Under Roman and Byzantine dominion Priene had a prosperous history. It passed into Moslem hands late in the 13th century. The ruins, which lie on successive terraces, were the object of missions sent out by the English Society of Dilettanti in 1765 and 1868, and have been thoroughly laid open by Dr Th. Wiegand (1895–1899) for the Berlin Museum. The city, as rebuilt in the 4th and 3rd centuries, was laid out on a rectangular scheme. It faced south, its acropolis rising nearly 700 ft. behind it. The whole area was enclosed by a wall 7 ft. thick with towers at intervals and three principal gates. On the lower slopes of the acropolis was a shrine of Demeter. The town had six main streets, about 20 ft. wide, running east and west and fifteen streets about 10 ft. wide crossing at right angles, all being evenly spaced; and it was thus divided into about 80 *insulae*. Private houses were apportioned four to an *insula*. The systems of water-supply and drainage can easily be discerned. The houses present many analogies with the earliest Pompeian. In the western half of the city, on a high terrace north of the main street and approached by a fine stairway, was the temple of Athena Polias, a hexastyle peripterial Ionic structure built by Pythias, the architect of the Mausoleum. Under the basis of the statue of Athena were found in 1870 silver tetradrachms of Orophernes, and some jewelry, probably deposited at the time of the Cappadocian restoration. Fronting the main street is a series of halls, and on the other side is the fine market place. The municipal buildings, Roman gymnasium, and well preserved theatre lie to the north, but, like all the other public structures, in the centre of the plan. Temples of Isis and Asclepius have been laid bare. At the lowest point on the south, within the walls, was the large stadium, connected with a gymnasium of Hellenistic times.

See Society of Dilettanti, *Ionian Antiquities* (1821), vol. ii.; Th. Wiegand and H. Schrader, *Priene* (1904); on inscriptions (360) see Hiller von Gärtringen, *Inschriften von Priene* (Berlin, 1907), with collection of ancient references to the city. (D. G. H.)

PRIEST (Ger. *Priester*, Fr. *prêtre*), the contracted form of "presbyter" (*πρεσβύτερος*, "elder"; see PRESBYTER), a name of office in the early Christian Church, already mentioned in the New Testament. But in the English Bible the presbyters of the New Testament are called "elders," not "priests"; the latter name is reserved for ministers of pre-Christian religions, the Semitic כֹּהֲנִים (*kōhănīm*, sing. *kōhēn*) and כְּמָרִים (*kemārīm*), or the Greek *ἱερεῖς*. The reason of this will appear more clearly in the sequel; it is enough to observe at present that, before our English word was formed, the original idea of a presbyter had been overlaid with others derived from pre-Christian priesthoods, so that it is from these and not from the etymological force of the word that we must start in considering historically what a priest is. The theologians of the Greek and Latin churches expressly found the conception of a Christian priesthood on the hierarchy of the Jewish temple, while the names by which the sacerdotal character is expressed—*ἱερεύς*, *sacerdos*—originally designated the ministers of sacred things in Greek and Roman heathenism, and then came to be used as translations into Greek and Latin of the Hebrew *kōhēn*. *Kōhēn*, *ἱερεύς*, *sacerdos*, are, in fact, fair translations of one another; they all denote a minister whose stated business was to perform, on behalf of the community, certain public ritual acts, particularly sacrifices, directed godwards. Such ministers or priests existed in all the great religions of ancient civilization. The term 'priest" is sometimes taken to include "sorcerer," but this use is open to criticism and may produce confusion.

The close inter-relation which existed in primitive society between magic, priesthood and kingship has been indicated by Frazer in his *Early History of the Kingship*. His remarks throw some light on the early character of priesthood as well as kingship. "When once a special class of sorcerers has been segregated from the community and entrusted by it with the discharge of duties on which the public safety and welfare are believed to depend, these men gradually rise to wealth and power till their leaders blossom out into sacred kings." According to Frazer's view, "as time goes on the fallacy of magic becomes more and more apparent and is slowly displaced by religion; in other words the magician gives way to the priest. Hence the king starting as a magician tends gradually to exchange the practice of magic for the functions of prayer and sacrifice." We are not concerned here with the debatable question whether magic preceded religion. Probably magic was always accompanied by some primitive form of *animism* whether the Melanesian *mana* or fetishism (see Dr Haddon's *Magic and Fetishism*, pp. 58-62, 64-90).

The investigations which have been carried on in recent years by King, Tallquist and Zimmern, as well as by Brünnow and Craig, on the magic and ritual of Babylonia and Assyria have been fruitful of results. The question, however, remains to be settled how far the officials and their functions, which in the much more highly developed civilization of Babylonia came to be differentiated and specialized, can be strictly included under the functions of priesthood. The answer to this question will be in many cases negative or affirmative according to our strict adherence or the reverse to the definition of the priest set forth above as "a minister whose stated business it was to perform on behalf of the community certain ritual acts, in some cases sacrifices (or the recitation of prayers), *directed Godwards*." On the other hand the seer, diviner and prophet is a minister whose function it is to communicate God's will or word *to man*. This is not a distinction which governs Zimmern and other writers. Our chief source of information is Zimmern's *Beiträge zur Kenntniss der Babylon: Religion*, pp. 81-95, from which Lagrange in his *Études sur les religions sémitiques*^{2} has chiefly derived his materials (ch. vi. p. 222 sqq.) respecting Babylonia and Assyria. Zimmern's results are summarized in *K.A.T*^{3}. p. 589 sqq. Here we find magic and soothsaying closely intertwined with priestly functions as, we shall see, was the case in early Hebrew pre-exilian days with the Kōhēn. It must be borne in mind that primitive humanity is not governed by logical distinctions. Among the Babylonians and Assyrians the *barû* (from *barû* to see, inspect) was a soothsaying priest who was consulted whenever any important undertaking was proposed, and addressed his inquiries to Samaš the sun god (or Adad) as *bêl biri* or lord of the oracle (accompanied by the sacrifice of lambs). The signs were usually obtained from the inspection of the liver (according to Johns, that of the lamb that was sacrificed); or it took place through birds; hence the name in this case given to the *barû* of *dagil iṣṣurê* "bird inspector." Johns, however, is disposed to regard him as a distinct functionary. Sometimes divination took place through vessels filled with water and oil (see OMEN and DIVINATION).

As contrasted with the *barû* or soothsaying priest, as he is called by Zimmern, we have the *ašipu*, who was the priest-magician who dealt in conjurations (*šiptu*), whereby diseases were removed, spells broken, or in expiations whereby sins were expiated. Tallquist's edition of the *Maklû* series of incantations and his explanations of the ritual, and also the publications by Zimmern of the *Šurpu* series of tablets in his *Beiträge* have rendered us familiar with the functions of the *ašipu*. See article "Magic" in Hastings's *Dict. Bible*, where examples are given of incantations with magical by-play. Also compare Jastrow's *Religion of Babylonia* (1898), ch. xvi., "The Magical Texts," where a fuller treatment will be found. Now, as the conjurations were addressed to the deity, *ašipu*, according to the definition given above, comes more reasonably under the category of priest. But the priest belongs to the realm of religion proper, which involves a relation of dependence on the superior power, whereas the *ašipu* belongs to the realm of magic, which is coercive and seeks "to *constrain* the hostile power to give way" (Lagrange).

There was also a third kind of priest called the *zammaru*, whose function it was to sing hymns.

In the earlier period of the Assyrian monarchy we find the king holding the office of *pa-te-si* or *išakku* or (more definitely) the *šangu, i.e. priest* of Ašur, the patron-deity of Assyria. This high-priestly office towards the tutelary deity of the nation appears to have belonged to the king by virtue of his royal rank. In Babylonia under the last empire (except in the case of Nebuchadrezzar, who calls himself *patesi ṣîri*, "exalted priest," *K.I.B.* iii. p. 60) no such high-priestly function attached to the king, for in Babylonia the priesthoods were endowed with great wealth and power, and even the king stood in awe of them (see Johns, *Babylonian and Assyrian Laws, Contracts and Letters*, p. 212 sqq). These powerfully-organized priesthoods, as well as the elaborate nature of their ritual and apparatus of worship, must have deeply and permanently impressed the exiled Jewish community. Thus arose the more developed system of Ezekiel's scheme (xl.-xlviii.) and of the Priestercodex and the high dignity which became attached to the person of the High Priest (reflected in the narrative of Uzziah's leprosy in 2 Chron. xxvi. 16-20). Other parallels to the sacerdotal system of the Priestercodex may here be noted. (1) According to Zimmern the *barû* and the *ašipu* formed close gilds and the office passed from father to son. This is certainly true of the *šangûtu* or priesthood, which was connected with a special family attached to a particular temple and its worship. (2) Johns also points out the existence of the *rab-barû*, chief soothsayer, and the *rab-mašmašu* or chief magician. (3) Bodily defects (as squinting, lack of teeth, maimed finger) was disqualifications for priesthood (cf. Lev. xxi. 17 sqq.). (4) In the ritual tablets for the *ašipu* published in Zimmern's *Beiträge*, No. 26, col. iii. 19 sqq., we read "that the *mašmašu* (priest's magician) is to pass forth to the gateway, sacrifice a sheep in the palace portal, and to smear the threshold and posts of the palace gateway right and left with the blood of the lamb." We are reminded of Exod. xii. 7 (P). (5) The Babylonian term *kuppuru* (infin. Pael) is used of the magician-priest or *ašipu* and means "wipe out." This confirms the view that the Hebrew *kipper*, which appears to be a late word (specially employed in Ezek, and P.), originally had the meaning which belongs to the Aramaic viz. "wipe off" and not "cover" as in Arabic. Zimmern thinks that the meaning "atone" "expiate," which belongs to the Pael form of the root k-p-r in both Aramaic and Arabic was borrowed from the Babylonian (cf. Driver's note in "Deuteronomy," *Int. Commentary*, p. 425 sqq, and especially his article "Propitiation" in Hastings's *Dict. Bible*).

The Rev. C. H. W. Johns, to whom reference has already been made, demurs (in a communication to the writer) to the fusion of the priest and the magician, and to the custom of "calling every unknown official a priest or a eunuch." "If a Babylonian said *šangu* he meant one thing, by *iššipu* another, and by *ramku* another. I do not deny that the same man might unite all three functions in one person. Thus a *šangu* had a definite share in the offerings, a *mašmašu* a different share. It seems to me that the priests belonged to the old families who were descended from the original tribe or clan, &c., that founded the city, and they could not admit outsiders save by adoption into the family. If a new god had a temple set up he had a new set of priests, but this priesthood descended in its line, *e.g.* a Šamaš priest did not beget a man who became a priest of Nabû. Further 'priest' implied a peculiar relation to the god. A soothsayer was a general practitioner in his art, not attached to any one god or temple. Anyone could be a *ramku* who actually poured out libations; that a priest usually did it was no exception to that rule. The priest was only a sort of specialist in the practice. The priest also offered prayer, interceded, &c. I cannot see that he taught. An oracle of the god came through him. If the *modus operandi* was akin to soothsaying it was only because that special form of soothsaying was peculiar to the particular cult of that god, and even this as a secondary development. I do not think that early priests received oracles save in dreams, &c. That magic early invaded religion is possible, but there are many traces of its being a foreign element. This is not usually pointed out."

Among the *ancient Egyptians* the local god was the protector and lord of the district. Consequently it was the interest and duty of the inhabitants to maintain the cultus of the patron-deity of their city who dwelt in their midst. Moreover, in the earlier times we find the prince of the nome acting as the High Priest of the local god, but in course of time the state, represented by the king, began to an ever-increasing degree to take oversight over the more important local cults. Thus we find that the Egyptian monarch was empowered to exercise priestly functions before all the gods. We constantly see him in the wall-paintings portrayed as a priest in the conventional attitudes before the images of the gods. In the chief sanctuaries the chief priests possessed special privileges, and it is probable that those in the immediate entourage of the king were elected to these positions. The highest nobility in the nome sought the honour of priesthood in the service of the local deity. One special class called *kher heb* were charged with reciting the divine formulae, which were popularly held to possess magical virtue. In the middle empire (VIIth to XIIth Dynasties) the lay element maintains its position in religious cultus despite its complexity. But under the new empire (Dynasties XVIIIth and following) the professional priest had attained to ominous power. The temples possessed larger estates and became more wealthy. Priests increased in number and were divided into ranks, and we find them occupying state offices, just as in Babylonia the priest acts as judge or inspector of canals (Johns, *Babyl. and Assyr. Laws*, &c., p. 213).

We now turn to the priesthood as we find it in ancient Greece and Italy. Homer knows special priests who preside over ritual acts in the temples to which they are attached; but his kings also do sacrifice on behalf of their people. The king, in fact, both in Greece and in Rome, was the acting head of the state religion, and when the regal power came to an end his sacred functions were not transferred to the ordinary priests, but either they were distributed among high officers of state, as archons and prytanes, or the title of "king" was still preserved as that of a religious functionary, as in the case of the *rex sacrorum* at Rome and the *archon basileus* at Athens. In the domestic circle the union of priesthood and natural headship was never disturbed; the Roman paterfamilias sacrificed for the whole family. On the other hand, *gentes* and *phratriae*, which had no natural head, had special priests chosen from their members; for every circle of ancient society, from the family up to the state, was a religious as well as a civil unity, and had its own gods and sacred rites. The lines of religious and civil society were identical, and, so long as they remained so, no antagonism could arise between the spiritual and the temporal power. In point of fact, in Greece and Rome the priest never attained to any considerable independent importance; we cannot speak of priestly power and hardly even of a distinct priestly class. In Greece the priest, so far as he is an independent functionary and not one of the magistrates, is simply the elected or hereditary minister of a temple charged with "those things which are ordained to be done towards the gods" (see Aristotle, *Pol.* vi. 8), and remunerated from the revenues of the temple, or by the gifts of worshippers and sacrificial dues. The position was often lucrative and always honourable, and the priests were under the special protection of the gods they served. But their purely ritual functions gave them no means of establishing a considerable influence on the minds of men, and the technical knowledge which they possessed as to the way in which the gods could be acceptably approached was neither so intricate nor so mysterious as to give the class a special importance. The funds of the temples were not in their control, but were treated as public moneys. Above all, where, as at Athens, the decision of questions of sacred law fell not to the priests but to the college of *ἐξηγηταί*, one great source of priestly power was wholly lacking. There remains, indeed, one other sacred function of great importance in the ancient world in which the Greek priests had a share. As man approached the gods in sacrifice and prayers, so too the gods declared themselves to men by divers signs and tokens, which it was possible to read by the art of Divination (*q.v.*). In many nations divination and priesthood have always gone hand in hand; at Rome, for example, the augurs and the *XV viri sacrorum*, who interpreted the Sibylline books, were priestly colleges. In Greece, on the other hand, divination was not generally a priestly function, but it did belong to the priests of the Oracles (see ORACLE). The great oracles, however, were of Panhellenic celebrity and did not serve each a particular state, and so in this direction also the risk of an independent priestly power within the state was avoided.[1]

In Rome, again, where the functions of the priesthood were politically much more weighty, where the technicalities of religion were more complicated, where priests interpreted the will of the gods, and where the pontiffs had a most important jurisdiction in sacred things, the state was much too strong to suffer these powers to escape from its own immediate control: the old monarchy of the king in sacred things descended to the inheritors of his temporal power; the highest civil and religious functions met in the same persons (cf. Cic. *De dom.* i. 1); and every priest was subject to the state exactly as the magistrates were, referring all weighty matters to state decision and then executing what the one supreme power decreed. And it is instructive to observe that when the plebeians extorted their full share of political power they also demanded and obtained admission to every priestly college of political importance, to those, namely, of the pontiffs, the augurs, and the *XV viri sacrorum.* The Romans, it need hardly be said, had no hereditary priests.[2]

We can only glance briefly at the ancient religions of India (Aryan). "In historical times the priesthood is rigidly confined to members of the Brahman caste, who are regarded as the representatives of God on earth. But there are indications that at an earlier date the Kshatriya or warrior caste often became priests. The power of the priesthood began with the delegation by the king of his sacrificial duties to a 'president' (*purohita*). This power grew with the growing importance of the sacrifice and the complication of its ceremonial. In the post-Vedic period 'right' or 'wrong' simply means the exact performance or the neglect, whether intentional or unintentional—of all the details of a prescribed ritual, the centre of which was the sacrifice. At this period the priestly caste gained its unbounded power over the minds of men" (Professor Rapson). For further details as to the development of the priestly caste and wisdom in India the reader must refer to BRAHMINISM; here it is enough to observe that among a religious people a priesthood which forms a close and still more an hereditary corporation, and the assistance of which is indispensable in all religious acts, must rise to practical supremacy in society except under the strongest form of despotism, where the sovereign is head of the Church as well as of the state.

Among the Zoroastrian Iranians, as among the Indian Aryans, the aid of a priest to recite the sacrificial liturgy was necessary at every offering (Herod. i. 132), and the Iranian priests (âthravans, later *Magi*) claimed, like the Brahmans, to be the highest order of society; but a variety of conditions were lacking to give them the full place of their Indian brethren. Zoroastrianism is not a nature religion, but the result of a reform which never, under the old empire, thoroughly penetrated the masses; and the priesthood, as it was not based on family tradition, did not form a strict hereditary caste. It was open to any one to obtain entrance into the priesthood, while on the other hand it was only as a priest that he could exercise sacerdotal functions, for these were strictly reserved to priests. Accordingly the clergy formed a compact hierarchy not inferior in influence to the clergy of the Christian middle ages, had great power in the state, and were often irksome even to the great king.

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[1] For the Greek priests, see, besides Schömann and other works on Greek antiquities, Newton, *Essays on Art and Archaeology*, p. 136 seq. (from epigraphic material). See also for Greek as well as Roman priest, art. "Sacerdos" (*Sacerdotium*) in Warre Cornish's *Concise Dict. of Greek and Roman Antiquities.*

[2] On the Roman priests, see in general Marquardt, *Römische Staatsverwaltung*, vol. iii., and for the pontiffs in particular the art. "Sacerdos" in Warre Cornish's *Concise Dict.*, also *Pontifex.*

But the best established hierarchy is not so powerful as a caste, and the monarchs had one strong hold on the clergy by retaining the patronage of great ecclesiastical places, and another in the fact that the Semitic provinces on the Tigris, where the capital lay, were mainly inhabited by men of other faith.[1]

The duties of the priests were not restricted to the services of the temple, but they also took part in the household cults. The ritual had a mechanical character and was by no means attractive. It is impossible to enter into the manifold details of the fire cultus which forms the main part of the worship in the Avesta. They belong to an earlier period than the Zoroastrian, nor was this fire cultus restricted to the temples. Portable fire altars were carried about and the worship could be celebrated in any spot. It may be noted that in all the ceremonies in the religion of the Avesta, incantations, prayers and confessions play a very large part. The prevailing element in the incantations consists in the exorcism of devils. In fact, the Persian religion throughout all its multitude of purifications, observances and expiations was a constant warfare against impurity, death and the devil. Amid all the ceremonialism of its priesthood there were also high ideals set forth in Zoroastrian religion of what a priest should be. Thus we read in Vendidâd xviii., "Many there be, noble Zarathustra, who bear the mouth bandage, who have yet not girded their loins with the law. If such a one says 'I am an Athravan' he lies; call him not Athravan, noble Zarathustra, said Ahura Mazda, but thou shouldst call him priest, noble Zarathustra, who sits awake the whole night through and yearns for holy wisdom that enables man to stand on death's bridge fearless and with happy heart, the wisdom whereby he attains the holy and glorious world of paradise."

In this rapid glance at some of the chief priesthoods of antiquity we have hitherto passed over the pure Semites, whose priesthoods call for closer examination because of the profound influence which one of them—that of the Jews—has exercised on Christianity, and so on the whole history of the modern world. But before we proceed to this it may be well to note one or two things that come out by comparison of the systems already before us. Priestly acts—that is, acts done by one and accepted by the gods on behalf of many—are common to all antique religions, and cannot be lacking where the primary subject of religion is not the individual but the natural community. But the origin of a separate priestly class, distinct from the natural heads of the community, cannot be explained by any such broad general principle; in some cases, as in Greece, it is little more than a matter of convenience that part of the religious duties of the state should be confided to special ministers charged with the care of particular temples, while in others the intervention of a special priesthood is indispensable to the validity of every religious act, so that the priest ultimately becomes a mediator and the vehicle of all divine grace. This position, we see, can be reached by various paths: the priest may become indispensable through the growth of ritual observances and precautions too complicated for a layman to master, or he may lay claim to special nearness to the gods on the ground, it may be, of his race, or, it may be, of habitual practices of purity and asceticism which cannot be combined with the duties of ordinary life, as, for example, celibacy was required of priestesses of Vesta at Rome. But the highest developments of priestly influence are hardly separable from something of magical superstition, the *opus operatum* of the priest has the power of a sorcerer's spell. The strength of the priesthood in Chaldaea and in Egypt stands plainly in the closest connexion with the survival of a magical element in the state religion, and Rome, in like manner, is more priestly than Greece, because it is more superstitious. In most cases, however, where an ancient civilization shows us a strong priestly system we are unable to make out in any detail the steps by which that system was elaborated; the clearest case perhaps is the priesthood of the Jews, which is not less interesting from its origin and growth than from the influence exerted by the system long after the priests were dispersed and their sanctuary laid in ruins.

Among the nomadic Semites, to whom the Hebrews belonged before they settled in Canaan, there has never been any developed priesthood. The acts of religion partake of the general simplicity of desert life; apart from the private worship of household gods and the oblations and salutations offered at the graves of departed kinsmen, the ritual observances of the ancient Arabs were visits to the tribal sanctuary to salute the god with a gift of milk, first-fruits or the like, the sacrifice of firstlings and vows (see NAZARITE and PASSOVER), and an occasional pilgrimage to discharge a vow at the annual feast and fair of one of the more distant holy places (see MECCA). These acts required no priestly aid; each man slew his own victim and divided the sacrifice in his own circle; the share of the god was the blood which was smeared upon or poured out beside stone (*noṣb*, *ghabghab*) set up as an altar or perhaps as a symbol of the deity. It does not appear that any portion of the sacrifice was burned on the altar, or that any part of the victim was the due of the sanctuary. We find therefore no trace of a sacrificial priesthood, but each temple had one or more doorkeepers (*sādin*, *ḥājib*), whose office was usually hereditary in a certain family and who had the charge of the temple and its treasures. The sacrifices and offerings were acknowledgments of divine bounty and means used to insure its continuance; the Arab was the "slave" of his god and paid him tribute, as slaves used to do to their masters, or subjects to their lords; and the free Bedouin, trained in the solitude of the desert to habits of absolute self-reliance, knew no master except his god, and acknowledged no other will before which his own should bend. The voice of the god might be uttered in omens which the skilled could read, or conveyed in the inspired rhymes of soothsayers, but frequently it was sought in the oracle of the sanctuary, where the sacred lot was administered for a fee by the *sādin*. The sanctuary thus became a seat of judgment, and here, too, compacts were sealed by oaths and sacrificial ceremonies. These institutions, though known to us only from sources belonging to an age when the old faith was falling to pieces, are certainly very ancient. The fundamental type of the Arabic sanctuary can be traced through all the Semitic lands, and so appears to be older than the Semitic dispersion; even the technical terms are mainly the same, so that we may justly assume that the more developed ritual and priesthoods of the settled Semites sprang from a state of things not very remote from what we find among the heathen Arabs. Now among the Arabs, as we have seen, ritual service is the affair of the individual, or of a mass of individuals gathered in a great feast, but still doing worship each for himself and his own private circle; the only public aspect of religion is found in connexion with divination and the oracle to which the affairs of the community are submitted. In Greece and Rome the public sacrifices were the chief function of religion, and in them the priesthood represented the ancient kings. But in the desert there is no king and no sovereignty save that of the divine oracle, and therefore it is from the soothsayers or ministers of the oracle that a public ministry of religion can most naturally spring. With the beginning of a settled state the sanctuaries must rise in importance and all the functions of revelation will gather round them. A sacrificial priesthood will arise as the worship becomes more complex (especially as sacrifice in antiquity is a common preliminary to the consultation of an oracle), but the public ritual will still remain closely associated with oracle or divination, and the priest will still be, above all things, a revealer. That this was what actually happened may be inferred from the fact that the Canaanite and Phoenician name for a priest (*kōhēn*) is identical with the Arabic *kāhin*, a "soothsayer." Soothsaying was no modern importation in Arabia; its characteristic form—a monotonous croon of short rhyming clauses—is the same as was practised by the Hebrew "wizards who peeped and muttered" in the days of Isaiah, and that this form was native in Arabia is clear from its having a technical name (*saj'*), which in Hebrew survives only in derivative words with modified sense.[2] The *kāhin*, therefore, is not a degraded priest but such a soothsayer as is found in most primitive societies, and the Canaanite priests grew out of these early revealers. In point of fact some form of revelation or oracle appears to have existed in every great shrine of Canaan and Syria,[3] and the importance of this element in the cultus may be measured from the fact that at Hierapolis it was the charge of the chief priest, just as in the Levitical legislation. But the use of "kāhin" for "priest" in the Canaanite area points to more than this: it is connected with the orgiastic character of Canaanite religion. The soothsayer differs from the priest of an oracle by giving his revelation under excitement and often in a frenzy allied to madness. In natural soothsaying this frenzy is the necessary physical accompaniment of an afflatus which, though it seems supernatural to a rude people, is really akin to poetic inspiration.

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[1] Cf. especially Nöldeke's *Tabari*, p. 450 seq.

[2] Měshuggā', 2 Kings ix. 11, Jer. xxix. 26—a term of contempt applied to prophets. (See HEBREW RELIGION.)

[3] For examples, see PALMYRA and PHILISTINES; see further, Lucian, *De dea syria*, 36, for Hierapolis; Zosimus i. 58, for Aphaca; Pliny, *H. N.* xxxvii. 58 (compared with Lucian, *ut supra*, and Movers, *Phoenizier*, i. 655), for the temple of Melkart at Tyre.

But it is soon learned that a similar physical state can be produced artificially, and at the Canaanite sanctuaries this was done on a large scale. We see from 1 Kings xviii., 2 Kings x., that great Baal temples had two classes of ministers, *kōhănīm* and *nĕbhīīm*, "priests" and "prophets," and as the former bear a name which primarily denotes a soothsayer, so the latter are also a kind of priests who do sacrificial service with a wild ritual of their own How deeply the orgiastic character was stamped on the priesthoods of north Semitic nature-worship is clear from Greek and Roman accounts, such as that of Appuleius (*Metam.* bk. viii.).

The Hebrews, who made the language of Canaan their own, took also the Canaanite name for a priest. But the earliest forms of Hebrew priesthood are not Canaanite in character; the priest, as he appears in the older records of the time of the Judges, Eli at Shiloh, Jonathan in the private temple of Micah and at Dan, is much liker the *sādin* than the *kāhin*.[1] The whole structure of Hebrew society at the time of the conquest was almost precisely that of a federation of Arab tribes, and the religious ordinances are scarcely distinguishable from those of Arabia, save only that the great deliverance of the Exodus and the period when Moses, sitting in judgment at the sanctuary of Kadesh, had for a whole generation impressed the sovereignty of Jehovah on all the tribes, had created an idea of unity between the scattered settlements in Canaan such as the Arabs before Mahomet never had. But neither in civil nor in religious life was this ideal unity expressed in fixed institutions, the old individualism of the Semitic nomad still held its ground. Thus the firstlings, first-fruits and vows are still the free gift of the individual which no human authority exacts, and which every householder presents and consumes with his circle in a sacrificial feast without priestly aid. As in Arabia, the ordinary sanctuary is still a sacred stone (מַצֵּבָה = *noṣb*) set up under the open heaven, and here the blood of the victim is poured out as an offering to God (see especially 1 Sam. xiv. 34, and cf. 2 Sam. xxiii. 16, 17). The priest has no place in this ritual; he is not the minister of an altar,[2] but the guardian of a temple, such as was already found here and there in the land for the custody of sacred images and palladia or other consecrated things (the ark at Shiloh, 1 Sam. iii. 3; images in Micah's temple, Judges xvii. 5.; Goliath's sword lying behind the "ephod" or plated image at Nob, 1 Sam. xxi. 9; no doubt also money, as in the Canaanite temple at Shechem, Judges ix. 4). Such treasures required a guardian; but, above all, wherever there was a temple there was an oracle, a kind of sacred lot, just as in Arabia (1 Sam. xiv. 41, Sept.), which could only be drawn where there was an "ephod" and a priest (1 Sam. xiv. 18, Sept., and xxiii. 6 seq.). The Hebrews had already possessed a tent-temple and oracle of this kind in the wilderness (Exod. xxxiii. 7 seq.), of which Moses was the priest and Joshua the aedituus, and ever since that time the judgment of God through the priest at the sanctuary had a greater weight than the word of a seer, and was the ultimate solution of every controversy and claim (1 Sam. ii. 25; Exod. xxi. 6, xxii. 8, 9, where for "judge," "judges," of A.V. read "God" with R.V.). The temple at Shiloh, where the ark was preserved, was the lineal descendant of the Mosaic sanctuary —for it was not the place but the palladium and its oracle that were the essential thing—and its priests claimed kin with Moses himself. In the divided state of the nation, indeed, this sanctuary was hardly visited from beyond Mt Ephraim; and every man or tribe that cared to provide the necessary apparatus (ephod, teraphim, &c.) and hire a priest might have a temple and oracle of his own at which to consult Jehovah (Judges xvii., xviii.); but there was hardly another sanctuary of equal dignity. The priest of Shiloh is a much greater person than Micah's priest Jonathan; at the great feasts he sits enthroned by the doorway, preserving decorum among the worshippers; he has certain legal dues, and, if he is disposed to exact more, no one ventures to resist (1 Sam. ii. 12 seq., where the text needs a slight correction). The priestly position of the family survived the fall of Shiloh and the capture of the ark, and it was members of this house who consulted Jehovah for the early kings until Solomon deposed Abiathar. Indeed, though priesthood was not yet tied to one family, so that Micah's son, or Eleazar of Kirjath-jearim (1 Sam. vii. 1), or David's sons (2 Sam. viii. 18) could all be priests, a Levite—that is, a man of Moses' tribe—was already preferred for the office elsewhere than at Shiloh (Judges xvii. 13), and such a priest naturally handed down his place to his posterity (Judges xviii. 30).

Ultimately, indeed, as sanctuaries were multiplied and the priests all over the land came to form one well-marked class, "Levite" and legitimate priest became equivalent expressions, as is explained in the article LEVITES. But between the priesthood of Eli at Shiloh or of Jonathan at Dan and the priesthood of the Levites as described in Deut. xxxiii. 8 seq. there lies a period of the inner history of which we know almost nothing. It is plain that the various priestly colleges regarded themselves as one order, that they had common traditions of law and ritual which were traced back to Moses, and common interests which had not been vindicated without a struggle (Deut., *ut supra*). The kingship had not deprived them of their functions as fountains of divine judgment (cf. Deut. xvii. 8 seq.); on the contrary, the decisions of the sanctuary had grown up into a body of sacred law, which the priests administered according to a traditional precedent. According to Semitic ideas the declaration of law is quite a distinct function from the enforcing of it, and the royal executive came into no collision with the purely declaratory functions of the priests. The latter, on the contrary, must have grown in importance with the unification and progress of the nation, and in all probability the consolidation of the priesthood into one class went hand in hand with a consolidation of legal tradition. And this work must have been well done, for, though the general corruption of society at the beginning of the Assyrian period was nowhere more conspicuous than at the sanctuaries and among the priesthood, the invective of Hos. iv. equally with the eulogium of Deut. xxxiii. proves that the position which the later priests abused had been won by ancestors who earned the respect of the nation as worthy representatives of a divine Torah.

The ritual functions of the priesthood still appear in Deut. xxxiii. as secondary to that of declaring the sentence of God, but they were no longer insignificant. With the prosperity of the nation, and especially through the absorption of the Canaanites and of their holy places, ritual had become much more elaborate, and in royal sanctuaries at least there were regular public offerings maintained by the king and presented by the priests (cf. 2 Kings xvi. 15). Private sacrifices, too, could hardly be offered without some priestly aid now that ritual was more complex; the provision of Deut. xviii. as to the priestly dues is certainly ancient, and shows that besides the tribute of first-fruits and the like the priests had a fee in kind for each sacrifice, as we find to have been the case among the Phoenicians according to the sacrificial tablet of Marseilles. Their judicial functions also brought profit to the priests, fines being exacted for certain offences and paid to them (2 Kings xii. 16; Hos. iv. 8; Amos ii. 8). The greater priestly offices were therefore in every respect very important places, and the priests of the royal sanctuaries were among the grandees of the realm (2 Sam. viii. 18; 2 Kings x. 11, xii. 2); minor offices in the sanctuaries were in the patronage of the great priests and were often miserable enough,[3] the petty priest depending largely on what "customers" he could find (2 Kings xii. 7 [8]; Deut. xviii. 8). That at least the greater offices were hereditary—as in the case of the sons of Zadok, who succeeded to the royal priesthood in Jerusalem after the fall of Abiathar—was almost a matter of course as society was then constituted, but there is not the slightest trace of an hereditary hierarchy officiating by divine right, such as existed after the exile. The sons of Zadok, the priests of the royal chapel, were the king's servants as absolutely as any other great officers of state; they owed their place to the fiat of King Solomon, and the royal will was supreme in all matters of cultus (2 Kings xii., xvi. 10 seq.); indeed the monarchs of Judah, like those of other nations, did sacrifice in person when they chose down to the time of the captivity (1 Kings ix. 25; 2 Kings xvi. 12 seq.; Jer. xxx. 21). And as the sons of Zadok had no divine right as against the kings, so too they had no claim to be more legitimate than the priests of the local sanctuaries, who also were reckoned to the tribe which in the 7th century B.C. was recognized as having been divinely set apart as Jehovah's ministers in the days of Moses (Deut. x. 8, xviii. 1 seq.).

The steps which prepared the way for the post-exile hierarchy, the destruction of the northern sanctuaries and priesthoods by the Assyrians, the polemic of the spiritual prophets against the corruptions of popular worship, which issued in the reformation of Josiah, the suppression of the provincial shrines of Judah and the transference of their ministers to Jerusalem, the successful resistance of the sons of Zadok to the proposal to share the sanctuary on equal terms with these new-comers, and the theoretical justification of the degradation of the latter to the position of mere servants in the Temple supplied by Ezekiel soon after the captivity, need not here be dealt with. Further details respecting priestly offices and hereditary priesthoods and the relation of Aaronids to Zadokids will be found briefly discussed in *Ency. Bib.* vol. iii. cols. 3843–3845. Cf. Hastings's *Dict. Bible*, iv. 72–75; *Camb. Bib. Essays* (1909), pp. 100 seq., 112 seq.

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[1] This appears even in the words used as synonyms for "priest" משרת, שמר הסף, which exactly corresponds to *sādin* and *ḥājib*. That the name of כהן was borrowed from the Canaanites appears certain, for that out of the multiplicity of words for soothsayers and the like common to Hebrew and Arabic (either formed from a common root or expressing exactly the same idea—יִדְּעֹנִי, ʻarrāf; חֹבֵר, ḥabīr; חֹזֶה, רֹאֶה, ḥāzi; קֹסֵם, cf. istiḳsām) the two nations should have chosen the same one independently to mean a priest is, in view of the great difference in character between old Hebrew and Canaanite priesthoods, inconceivable. Besides כהן Hebrew has the word כמר (pl. כמרים), which, however, is not applied to priests of the national religion. This, in fact, is the old Aramaic word for a priest (with suffixed article, *kumrā*). Its origin is obscure. In the Aramaic papyri discovered near Assouan (Syene) כמר is priest of the gods (Cowley and Sayce, Pap. E. line 15), presumably Khnum and Set; and in Sachau's Pap. I. line 5, כמריא definitely mean the priests of the god Ḥnûb. This coincides with the Hebrew use of the term as *idolatrous* priests, Hos. x. 5; Zeph. i. 4; 2 Kings xxiii. 5.

[2] It is not clear from 1 Sam. ii. 15 whether even at Shiloh the priest had anything to do with sacrifice, whether those who burned the fat were the worshippers themselves or some subordinate ministers of the Temple. Certainly it was not the "priest" who did so, for he in this narrative is always in the singular. Hophni and Phinehas are not called priests, though they bore the ark and so were priests in the sense of Josh. iii.

[3] See 1 Sam. ii. 36, a passage written after the hereditary dignity of the sons of Zadok at Jerusalem was well established.

It is instructive to observe how differently the prophets of the 8th century speak of the judicial or "teaching" functions of the priests and of the ritual of the great sanctuaries. For the latter they have nothing but condemnation, but the former they acknowledge as part of the divine order of the state, while they complain that the priests have prostituted their office for lucre. In point of fact the one rested on old Hebrew tradition, the other had taken shape mainly under Canaanite influence, and in most of its features was little more than the crassest nature-worship. In this respect there was no distinction between the Temple of Zion and other shrines, or rather it was just in the greatest sanctuary with the most stately ritual that foreign influences had most play, as we see alike in the original institutions of Solomon and in the innovations of Ahaz (2 Kings xvi. 10 seq., xxiii. 11 seq.). The Canaanite influence on the later organization of the Temple is clearly seen in the association of Temple prophets with the Temple priests under the control of the chief priest, which is often referred to by Jeremiah; even the viler ministers of sensual worship, the male and female prostitutes of the Phoenician temples, had found a place on Mt Zion and were only removed by Josiah's reformation.[1] All this necessarily tended to make the ritual ministry of the priests more important than it had been in old times; but it was in the reign of Manasseh, when the sense of divine wrath lay heavy on the people, when the old ways of seeking Jehovah's favour had failed and new and more powerful means of atonement were eagerly sought for (Micah vi. 6 seq.; 2 Kings xxi.; and cf. MOLOCH), that sacrificial functions reached their full importance. In the time of Josiah altar service and not the function of "teaching" has become the essential thing in priesthood (Deut. x. 8, xviii. 7); the latter, indeed, is not forgotten (Jer. ii. 8, xviii. 18), but by the time of Ezekiel it also has mainly to do with ritual, with the distinction between holy and profane, clean and unclean, with the statutory observances at festivals and the like (Ezek. xliv. 23 seq.). What the priestly Torah was at the time of the exile can be seen from the collection of laws in Lev. xvii.–xxvi., which includes many moral precepts, but regards them equally with ritual precepts from the point of view of the maintenance of national holiness. The holiness of Israel centres in the sanctuary, and round the sanctuary stand the priests, who alone can approach the most holy things without profanation, and who are the guardians of Israel's sanctity, partly by protecting the one meeting-place of God and man from profane contact, and partly as the mediators of the continual atoning rites by which breaches of holiness are expiated.

The bases of priestly power under this system are the unity of the altar, its inaccessibility to laymen and to the inferior ministers of the sanctuary, and the specific atoning functions of the blood of priestly sacrifices. All these things were unknown in old Israel. So fundamental a change as lies between Hosea and the Priestly Code was only possible in the general dissolution of the old life of Israel produced by the Assyrians and by the prophets; and indeed the new order did not take shape as a system till the exile had made a great change in old institutions. It was meant also to give expression to the demands of the prophets for spiritual service and national holiness, but this it did not accomplish so successfully; the ideas of the prophets could not be realized under any ritual system, but only in a new dispensation (Jer. xxxi. 31 seq.), when priestly Torah and priestly atonement should be no longer required. Nevertheless, the concentration of all ritual at a single point, and the practical exclusion of laymen from active participation in it—for the old sacrificial feast had now shrunk into entire insignificance in comparison with the stated priestly holocausts and atoning rites[2]—lent powerful assistance to the growth of a new and higher type of personal religion, the religion which found its social expression not in material acts of oblation, but in the language of the Psalms. In the best times of the old kingdom the priests had shared the place of the prophets as the religious leaders of the nation; under the second Temple they represented the unprogressive traditional side of religion, and the leaders of thought were the psalmists and the scribes, who spoke much more directly to the piety of the nation.

But, on the other hand, the material influence of the priests was greater than it had ever been before; the Temple was the only visible centre of national life in the ages of servitude to foreign power, and the priests were the only great national functionaries, who drew to themselves all the sacred dues as a matter of right and even appropriated the tithes paid of old to the king. When the High Priest stood at the altar in all his princely state, when he poured out the libation amidst the blare of trumpets, and the singers lifted up their voice and all the people fell prostrate in prayer till he descended and raised his hands in blessing, the slaves of the Greek or the Persian forgot for a moment their bondage and knew that the day of their redemption was near (Ecclus. l.). The High Priest at such a moment seemed to embody all the glory of the nation, as the kings had done of old, and when the time came to strike a successful blow for freedom it was a priestly house that led the nation to the victory which united in one person the functions of High Priest and prince. From the foundation of the Hasmonean state to the time of Herod the history of the high-priesthood merges in the political history of the nation; from Herod onward the priestly aristocracy of the Sadducees lost its chief hold over the nation and expired in vain controversy with the Pharisees.

The influence of the Hebrew priesthood on the thought and organization of Christendom was the influence not of a living institution, for it hardly began till after the fall of the Temple, but of the theory embodied in the later parts of the Pentateuch. Two points in this theory were laid hold of—the doctrine of priestly mediation and the system of priestly hierarchy. The first forms the text of the principal argument in the Epistle to the Hebrews, in which the author easily demonstrates the inadequacy of the mediation and atoning rites of the Old Testament, and builds upon this demonstration the doctrine of the effectual high-priesthood of Christ, who, in his sacrifice of himself, truly "led His people to God," not leaving them outside as He entered the heavenly sanctuary, but taking them with Him into spiritual nearness to the throne of grace. This argument leaves no room for a special priesthood in the Christian Church, and in fact nothing of the kind is found in the oldest organization of the new communities of faith. The idea that presbyters and bishops are priests and the successors of the Old Testament priesthood first appears in full force in the writings of Cyprian, and here it is not the notion of priestly mediation but that of priestly power which is insisted on. Church office is a copy of the old hierarchy. Now among the Jews, as we have seen, the hierarchy proper has for its necessary condition the destruction of the state and the bondage of Israel to a foreign prince, so that spiritual power is the only basis left for a national aristocracy. The same conditions have produced similar spiritual aristocracies again and again in the East in more modern times, and even in antiquity more than one Oriental priesthood took a line of development similar to that which we have traced in Judaea. Thus the hereditary priests of Ḳozaḥ (Κοζέ) were the chief dignitaries in Idumaea at the time of the Jewish conquest of the country (Jos. *Ant.* xv. 7, 9), and the High Priest of Hierapolis wore the princely purple and crown like the High Priest of the Jews (*De dea syria*, 42). The kingly insignia of the High Priest of the sun at Emesa are described by Herodian (v. 3, 3), in connexion with the history of Elagabalus, whose elevation to the Roman purple was mainly due to the extraordinary local influence of his sacerdotal place. Other examples of priestly princes are given by Strabo in speaking of Pessinus (p. 567) and Olbe (p. 672). As no such hierarchy existed in the West, it is plain that if the idea of Christian priesthood was influenced by living institutions as well as by the Old Testament that influence must be sought in the East (cf. Lightfoot, *Philippians*, p. 261). The further development of the notion of Christian priesthood was connected with the view that the Eucharist (*q.v.*) is a propitiatory sacrifice which only a consecrated priest can perform. It is sufficient to remark here that the presentation of the sacrifice of the mass came to be viewed as the essential priestly office, so that the Christian presbyter really was a *sacerdos* in the antique sense. Protestants, in rejecting the sacrifice of the mass, deny also that there is a Christian priesthood "like the Levitical," and have either dropped the name of "priest" or use it in a quite emasculated sense. For further details as to the history and doctrine of priesthood in Christendom the reader is referred to the article, "Priestertum: Priesterweihe in der Christlichen Kirche," in *P.R.E.*, 3rd ed., Bd. xvi. p. 47 sqq.

There is probably no nature religion among races above mere savagery which has not had a priesthood; but an examination of other examples would scarcely bring out any important feature that has not been already illustrated. Among higher religions orthodox Islam has never had real priests, doing religious acts on behalf of others, though it has, like Protestant churches, leaders of public devotion (imāms) and an important class of privileged religious teachers (ʽulemā). But a distinction of grades of holiness gained by ascetic life has never been entirely foreign to the Eastern mind, and in the popular faith of Mahommedan peoples something very like priesthood has crept in by this channel. For where holiness is associated with ascetic practices the masses can never attain to a perfect life, and naturally tend to lean on the professors of special sanctity as the mediators of their religious welfare. The best example, however, of a full-blown priestly system with a monastic hierarchy grafted in this way on a religion originally not priestly is found in Tibetan Buddhism (see LAMAISM), and similar causes undoubtedly had their share in the development of sacerdotalism in the Christian Church. The idea of priestly asceticism expressed in the celibacy of the clergy belongs also to certain types of heathen and especially Semitic priesthood, to those above all in which the priestly service is held to have a magical or theurgic quality.

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[1] 2 Kings xxiii. 7; cf. Deut. xxiii. 18, where "dogs" = the later Galli; cf. *Corp. insc. sem.* i. 93 seq.

[2] Cf. the impression which the ritual produced on the Greeks, Bernays's *Theophrastus*, pp. 85, 111 seq

(W. R. S.; O. C. W.)

PRIESTLEY, JOSEPH (1733–1804), English chemist and Nonconformist minister, was born on the 13th of March 1733 at Fieldhead, a hamlet near Birstal in the West Riding of Yorkshire. He was the eldest of a family of six. His father, Jonas Priestley, a woollen-cloth dresser of moderate means, was the son of a member of the Established Church, but both he and his wife, the only daughter of a farmer named Swift, were Nonconformists. Three years after the death of Mrs Priestley in 1739, Joseph's father's sister, Mrs Keighley, took him to live with her, and sent him at the age of twelve to a neighbouring grammar school. In his holidays he learned Hebrew from Mr Kirkby, a dissenting minister at Heckmondwike, who subsequently took entire charge of his education. From the age of sixteen to nearly twenty his health was so unsatisfactory that he attended neither school nor college, but worked at Chaldee and Syriac, began to read Arabic, and mastered 'S Gravesande's *Natural Philosophy*, together with various textbooks of logic and metaphysics. An uncle having promised him a place in a counting-house at Lisbon, he also learned French, German and Italian to fit himself for the post. But his aunt was anxious for him to be a minister, as he himself desired, and therefore in 1752, when his health had improved, he went to Daventry to attend the Nonconformist academy formerly carried on by Dr P. Doddridge at Northampton. There he stayed three years, exchanging his early Calvinism for a system of "necessarianism" under the influence of D. Hartley's *Observations on Man* and A. Collins's *Philosophical Enquiry concerning Human Liberty*. In 1755 he was appointed to a small congregation at Needham Market, in Suffolk, where he was not very successful. In 1758 he obtained a more congenial congregation at Nantwich, where he opened a school at which the elementary lessons were varied with experiments in natural philosophy. Three years later he removed to Warrington as classical tutor in a new academy, and there he attended lectures on chemistry by Dr Matthew Turner of Liverpool and pursued those studies in electricity which gained him the fellowship of the Royal Society in 1766 and supplied him with material for his *History of Electricity*. In 1762 he had married the daughter of Isaac Wilkinson, a Wrexham ironmaster. In 1767 he was appointed to the charge of Mill Hill Chapel at Leeds, where he again changed his religious opinions from a loose Arianism to definite Socinianism and wrote many political tracts hostile to the attitude of the government towards the American colonies. He also began his researches into "different kinds of airs," getting a plentiful supply of "fixed air" from a brewery next door to his house. By the end of 1771 his scientific reputation was such that he was suggested for the post of "astronomer" to Captain Cook's second expedition to the South Seas, but his unorthodox opinions were objectionable to certain members of the board of longitude and the appointment was not ratified. In 1772, the year in which he was chosen a foreign associate of the French Academy of Sciences, he accepted the position of librarian and literary companion to Lord Shelburne (afterwards 1st Marquess of Landsdowne) at Calne, with a salary of £250 a year and a house. With that nobleman he travelled on the Continent; the month of October 1774 he spent in Paris, and meeting Lavoisier and his friends, gave them an account of the experiment by which on the previous 1st of August he had prepared "dephlogisticated air" (oxygen). In 1780 he parted company with his patron, who allowed him an annuity of £150 for life, and settling at Birmingham was appointed junior minister of the New Meeting Society. There he continued his literary and scientific labours, enjoying congenial intercourse with such men as Matthew Boulton, James Keir, James Watt and Erasmus Darwin at the periodical dinners of the Lunar Society. On the 14th of July 1791 the Constitutional Society of Birmingham arranged a dinner to celebrate the anniversary of the fall of the Bastille. Priestley, according to his own account, "had little to do with it" But his predilections in favour of the revolutionists were notorious, and the mob seized the occasion to burn his chapel and sack his house at Fairhill. He and his family escaped, but his material possessions were destroyed and the labour of years annihilated. He retreated to London, where he felt safe, though he continued to be an object of "troublesome attention," and even the fellows of the Royal Society shunned him. But he received an invitation to become morning preacher at Gravel Pit Chapel, Hackney. This he accepted, and performed the duties of the charge till 1794, when he determined to follow his three sons, who had emigrated to America in the previous year. On the 7th of April he embarked with his wife at Gravesend and reached New York on the 4th of June. Finally settling at Northumberland, Pennsylvania, he lived there for nearly ten years, until on the 6th of February 1804, after clearly and audibly dictating a few changes he wished made in some of his writings, he quietly expired.

Priestley was a most voluminous writer, and his works (excluding his scientific writings) as collected and edited by his friend J. T. Rutt in 1817–1832 fill 25 octavo volumes. (The first volume, containing his life and correspondence, was issued separately in two parts, 1831–1832.) His first appearance as an author was in 1761, when he published the *Scripture Doctrine of Remission* and the *Rudiments of English Grammar*. His chief theological and philosophical works were *Institutes of Natural and Revealed Religion* (3 vols., 1772–1774); *History of the Corruption of Christianity* (2 vols., 1782); *General History of the Christian Church to the Fall of the Western Empire*, vols. i. and ii. (1790), vols. iii. and iv. (1802–1803); *Disquisitions relating to Matter and Spirit* (1777), and various essays and letters on necessarianism. But his theological writings are forgotten, and he is chiefly remembered as a scientific investigator who contributed especially to the chemistry of gases. Yet judged by modern standards he had an inadequate conception of the meaning of ordered research. In reference to his preparation of oxygen he says, "It provides a striking illustration of a remark I have more than once made in my philosophical writings and which can hardly be too often repeated, viz. that more is owing to what we call chance—that is, philosophically speaking, to the observation of events arising from unknown causes—than to any proper design or preconceived theory in this business." If in this sentence he scarcely does justice to the powers of logical inference and inductive reasoning displayed in much of his work, it remains true that blind experiment—heating a substance, or treating it with some reagent, to see what would happen—was his characteristic method of inquiry. Thus by heating spirits of salt he obtained "marine acid air" (hydrochloric acid gas), and he was able to collect it because he happened to use mercury, instead of water, in his pneumatic trough. Then he treated oil of vitriol in the same way, but got nothing until by accident he dropped some mercury into the liquid, when "vitriolic acid air" (sulphur dioxide) was evolved. Again he heated fluorspar with oil of vitriol, as K. W. Scheele had done, and because he was employing a glass vessel he got "fluor acid air" (silicon fluoride). Heating spirits of hartshorn, he was able to collect "alkaline air" (gaseous ammonia), again because he was using mercury in his pneumatic trough; then, trying what would happen if he passed electric sparks through the gas, he decomposed it into nitrogen and hydrogen, and "having a notion" that mixed with hydrochloric acid gas it would produce a "neutral air," perhaps much the same as common air, he synthesized sal ammoniac. Dephlogisticated air (oxygen) he prepared in August 1774 by heating red oxide of mercury with a burning-glass, and he found that in it a candle burnt with a remarkably vigorous flame and mice lived well. He concluded that it was not common air, but the substance, "in much greater perfection," that rendered common air respirable and a supporter of combustion. Of the analogy between combustion and respiration—both true phlogistic processes in his view—he had convinced himself three years before, and his paper, "On Different Kinds of Air" (*Phil. Trans.*, 1772) described experiments which showed that growing plants are able to "restore" air which has been vitiated, whether by being breathed or by having candles burnt in it. Priestley displayed much ingenuity in devising apparatus suited to his requirements and in carrying out and varying his experiments; it was in the interpretation of results that he was deficient. Had this not been the case he could scarcely have remained a firm believer in the phlogistic doctrine. At one time, indeed, he found Lavoisier's views so specious that he was much inclined to accept them, but he overcame this wavering, and so late as 1800 he wrote to the Rev. Theophilus Lindsey (1723–1808), "I have well considered all that my opponents have advanced and feel perfectly confident of the ground I stand upon. . . . Though nearly alone I am under no apprehension of defeat."

His chief books on chemistry were six volumes of *Experiments and Observations on different Kinds of Air*, published between 1774 and 1786; *Experiments on the Generation of Air from Water* (1793); *Experiments and Observations relating to the Analysis of Atmospheric Air*, and *Considerations on the Doctrine of Phlogiston established and that of the Composition of Water refuted* (1800). He also published (1767) a treatise on the *History and Present State of Electricity*, which embodies some original work, and (1772) a *History of Discoveries relating to Vision, Light and Colours*, which is a mere compilation.

PRIEUR, PIERRE (*c.* 1626–*c.* 1676), French enamel painter. He married Marie (1610–1677), sister of Jean Petitot, as her second husband. In 1669 he was in England, painting a miniature of Charles II. and another of Lady Castlemaine, both after Cooper, for the king of Denmark. In 1670 he was in Poland, painting for the Danish monarch a portrait of King Michael, and in the following year was in Denmark executing a remarkable series of portraits of the children of Frederick III. All these, with some beautiful enamel badges for the Order of the Elephant, are in the Danish royal collection. By Christian V. he is said to have been sent to Spain and Russia, where several examples of his work, dated 1676, are to be seen in the Hermitage. In the following year he died in Denmark. He was a Huguenot, and was said to possess secret colours in enamel, especially a blue, which were not known to his Petitot relations. His work in England is of great rarity, Lord Dartrey possessing the finest example, and there are two remarkable works in the Pierpont Morgan collection and one at Windsor Castle. Two in the Propert collection have been lost sight of. (G. C. W.)

PRIEUR DE LA MARNE [PIERRE LOUIS PRIEUR] (1756–1827), French politician, was born at Sommesous (Marne) on the 1st of August 1756. He practised as a lawyer at Châlons-sur-Marne until 1789, when he was elected to the states-general. He became secretary to the Assembly, and the violence of his attacks on the *ancien régime* won him the nickname of "Crieur de la Marne." In 1791 he became vice-president of the criminal tribunal of Paris. Re-elected to the Convention, he was sent to Normandy, where he directed bitter reprisals against the Federalists. He voted for the death of Louis XVI., and as a member of the committees of national defence and of public safety he was despatched in October 1793 to Brittany, where he established the Terror. In May 1794 he became president of the Convention. The counter-revolutionaries drove him into hiding from May 1795 until the amnesty proclaimed in the autumn of that year. He took no part in public affairs under the directory, the consulate or the empire, and in 1816 was banished as a regicide. He died in Brussels on the 31st of May 1827.

See Pierre Bliard, *Le Conventionnel Prieur de la Marne en mission dans l'ouest 1793–1794 d'après des documents inédits* (1906).

PRIEUR-DUVERNOIS, CLAUDE ANTOINE, COMTE (1763–1832), French politician, was born at Auxonne on the 2nd of December 1763, and was commonly known as Prieur de la Côte d'Or, after his native department. As an officer of engineers he presented to the National Assembly in 1790 a *Mémoire* on the standardization of weights and measures. In 1791 he was returned by the Côte d'Or to the Legislative Assembly, and in 1792 to the Convention. After the revolution of the 10th of August 1792 he was sent on a mission to the army of the Rhine to announce the deposition of Louis XVI., for whose death he voted in the Convention. In 1793 he was employed in breaking up the Federalist movement in Normandy, but he was arrested by the Federalist authorities of Caen, and only released in July 1793 after the defeat of their forces at Vernon. On the 14th of August 1793 he became a member of the committee of public safety, where he allied himself closely with Lazare Carnot in the organization of national defence, being especially charged with the provision of the munitions of war. Under the Directory he sat in the Council of the Five Hundred, retiring after the *coup d'état* of 18 Brumaire (November 9, 1799). In 1808 he was created a count of the empire, and in 1811 he retired from the army with the grade of *chef de brigade*. He was one of the founders of the École Polytechnique, and shared in the establishment of the Institute of France; the adoption of the metric system and the foundation of the bureau of longitude were also due to his efforts. Prieur died at Dijon on the 11th of August 1832.

See J. Gros, *Le Comité de salut public* (1893); and E. Charavay, *Correspondance de Carnot*, vol. i., which includes some documents drawn up by Prieur.

PRIM, JUAN, MARQUIS DE LOS CASTILLEJOS, COUNT DE REUS (1814–1870), Spanish soldier and statesman, was the son of Lieut.-Colonel Pablo Prim, and was born at Reus in Catalonia on the 12th of December 1814. He entered the free corps known as the volunteers of Isabella II. in 1834, and in the course of the Carlist War he rose to the rank of lieutenant-colonel and had two orders of knighthood conferred upon him. After the pacification of 1839, as a progressist opposed to the dictatorship of Espartero, he was sent into exile. However, in 1843 he was elected deputy for Tarragona, and after defeating Espartero at Bruch he entered Madrid in triumph with Serrano. The regent Maria Christina promoted him major-general, and made him count of Reus. Narvaez, the prime minister, failed to understand what constitutional freedom meant, and Prim, on showing signs of opposition, was sentenced to six years' imprisonment in the Philippine Islands. The sentence was not carried out, and Prim remained an exile in England and France until the amnesty of 1847. He then returned to Spain, and was first employed as captain-general of Porto Rico and afterwards as military representative with the sultan during the Crimean War. In 1854 he was elected to the cortes, and gave his support to O'Donnell, who promoted him lieutenant-general in 1856. In the war with Morocco he did such good service at Los Castillejos or Marabout, Cabo Negro, Guad al Gelu and Campamento in 1860 that he was made marquis de los Castillejos and a grandee of Spain. He commanded the Spanish army in Mexico when he refused to consent to the ambitious schemes of Napoleon III. On his return to Spain he joined the opposition, heading pronunciamentos in Catalonia against Narvaez and O'Donnell. All his attempts failed until the death of Narvaez in April 1868, after which Queen Isabella fell more and more under the influence of the Jesuits, and became increasingly tyrannical, until at last even Serrano was exiled. In September 1868 Serrano and Prim returned, and Admiral Topete, commanding the fleet, raised the standard of revolt at Cadiz (see SPAIN). In July 1869 Serrano was elected regent, and Prim became president of the council and was made a marshal. On the 16th of November 1870 Amadeo, duke of Aosta, was elected king of Spain, but Prim, on leaving the chamber of the cortes on the 28th of December, was shot by unknown assassins and died two days later. The cortes took his children as wards of the country; three days afterwards King Amadeo I. swore in the presence of the corpse to observe the new Spanish constitution.

Two biographies of Prim down to 1860 were published in that year by Gimenez y Guited and Gonzalez Llanos. See also L. Blairet, *Le Général Prim et la situation actuelle de l'Espagne* (Paris, 1867); Guillaumot, *Juan Prim et l'Espagne* (Paris, 1870); and *Prim*, by H. Leonardon (in French, 1901), which contains a useful bibliography.

PRIMAGE (adopted from the Fr. *primage*, from *prime*, recompense, Lat. *praemium*, reward), a commercial term signifying originally a small customary payment over and above the freight made to the master of the ship for his care and trouble. It is now generally included in the freight, as an additional percentage. It varies according to the usages of different ports and particular trades.

PRIMATE (from Low Lat. *primas*=one who held the first place, *primas partes*). During the 4th and 5th centuries A.D. the title was applied to both secular and ecclesiastical officials. The Theodosian Code mentions primates of towns, districts and fortified places (*Primates urbium, vicorum, castellorum*). The Pragmatic Sanction of Justinian also mentions primates governing a district, *primates regionis*; and in this sense the title survived, under Turkish rule, in Greece until the 19th century. An official called "primate of the palace" is mentioned in the laws of the Visigoths. Primas also seems to have been used loosely during the middle ages for "head" or "chief." Du Cange cites *primas castri*. The title, however, has been more generally used to denote a bishop with special privileges and powers. It was first employed almost synonymously with *metropolitan* to denote the chief bishop of a province having his see in the capital and certain rights of superintendence over the whole province. At the Council of Nicaea (A.D. 325) the metropolitan constitution was assumed as universal, and after this the terms "metropolitan," and "primate," to denote the chief bishop of a province, came into general use. The title of primate was used more generally in Africa, while elsewhere metropolitan was more generally employed. The primates in Africa differed from those elsewhere in that the title always belonged to the longest ordained bishop in a province, who had not necessarily his see in the capital, except in the case of the bishop of Carthage, who was head also of the other five African provinces. There were also three sorts of honorary primates: (1) *primates aevo*, the oldest bishop in a province next to the primate, on whom power devolved when the primate was disabled or disqualified; (2) titular metropolitans, the bishops of certain cities which had the name and title of civil metropoles bestowed on them by some emperor; (3) the bishops of some mother-churches which were honoured by ancient custom but were subject to the ordinary metropolitan, *e.g.* the bishop of Jerusalem, who was subject to his metropolitan at Caesarea.

At a later date "primate" became the official title of certain metropolitans who obtained from the pope a position of episcopal authority over several other metropolitans and who were, at the same time, appointed vicars of the Holy See. This was done in the case of the bishops of Arles and Thessalonica as early as the 5th century. Such primates were sometimes also called patriarchs, *primates diocesearum* (political, not episcopal dioceses), *primates provinciae, summi primates, praesules omnium sacerdotum in partibus suis*. In this sense the Western primate was considered the equivalent of the Eastern patriarch. The archbishop of Reims received the title of *primas inter primates*. By the False Decretals an attempt was made to establish such a primacy as a permanent institution, but the attempt was not successful and the dignity of primate became more or less honorary. The overlapping of the title is illustrated by the case of England, where the archbishop of York still bears the title of primate of England and the archbishop of Canterbury that of primate of all England. A less general use of the title is its application in medieval usage to the head of a cathedral school or college (*primas scholarum*) and to the dignitaries of a cathedral church. The abbot of Fulda received from the pope the title of *primas inter abbates*. In the Episcopal Church of Scotland the senior bishop is styled the *primas*.

Du Cange, *Glossarium*; Hinschius, *Kirchenrecht* (Berlin, 1869); Moeller, *History of the Christian Church*, translated from the German by Andrew Rutherford, B.D. (London, 1902); Bingham, *Origines ecclesiasticae* (1840).

PRIMATES (Lat. *primus*, first), the name given by Linnaeus to the highest order of mammals (see MAMMALIA), which was taken by him to include not only man, apes, monkeys and lemurs, but likewise bats. The latter group is now separated as a distinct order (see CHIROPTERA). It has also been proposed to remove from the Primates the lemurs, constituting the group *Prosimiae*, or *Lemuroidea*, to form an order by themselves; but general opinion is now against this view, and they are accordingly here regarded as representing a sub-order of Primates, all the other members of which are included in a second subordinal group—the *Anthropoidea*, or *Simiae*. Support to the view that lemurs should be included in the order is afforded by the discovery in Madagascar of an extinct species (*Nesopithecus*) presenting certain characters connecting it with monkeys on the one hand and with lemurs on the other.

In this broader sense the Primates may briefly be defined as follows. All the members of the order are plantigrade mammals, normally with five fingers and five toes, which are generally armed with broad flattened nails, although these are rarely replaced on single digits, or on all the digits, by claws or claw-like nails. The dental formula is $i.\frac{2}{2}$, $c.\frac{1}{1}$, $d.\ \frac{2}{2}\ (\frac{3}{3})$, $m.\frac{3}{3}\ (\frac{2}{2})$; all the teeth in advance of the molars being normally preceded by milk-teeth. The molars are three-, four- or five-cusped, but the cusps may in some cases coalesce into transverse ridges. The thumb and great toe are, as a rule, opposable to the other digits. The clavicles (collar-bones) are complete; there is nearly always a free centrale bone in the wrist, or carpus, in which the scaphoid and lunar are likewise generally separate. The orbits (and the eyes) are directed more or less forwards, and generally surrounded by bone (fig. 1), while the lower jaw has a vertical movement on the upper. With a few exceptions the stomach is simple; and a duodeno-jejunal flexure of the intestine and a caecum are present. The diet is generally vegetable, but may be mixed, or, rarely, consisting of insects. The uterus may be either bicornuate or simple; and the placenta either discoidal and deciduate, or diffuse and non-deciduate, with a great development of the allantois. The clitoris may or may not be perforate; the penis is pendent; and the testes are extra-abdominal, situate either in a scrotum behind the penis or in a similarly situated fold of the integument. At most the teats are four in number, but generally only two situated on the breast, although occasionally abdominal or even inguinal. As a rule only a single offspring is produced at a birth, such offspring being always born in a completely helpless condition.

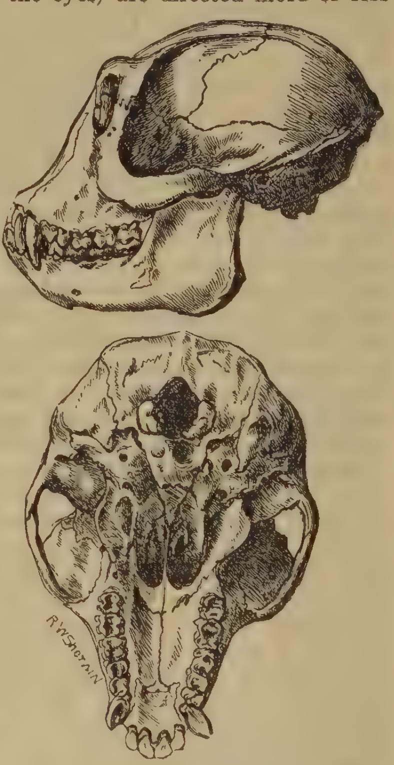


FIG. 1.—Lateral and lower views of the Skull of a Langur Monkey (*Semnopithecus*), to show the forward direction and complete closure of the orbits, and the characters of the dentition of the Old World Catarhini.

With the exception of man, who has adapted himself to exist in all climates, the Primates are essentially a tropical and subtropical group, although some of the monkeys inhabit districts where the winter climate is severe. The great majority—in fact nearly all—of the members of the order are arboreal in their habits. In size there is great variation, the extremes in this respect being represented by man and the gorilla on the one side, and the marmosets and tarsiers, which are no larger than squirrels, on the other.

As regards the proper meaning of the popular names "monkey," "baboon" and "ape," it appears that these are in the main general terms which, with the exception of the second, may be applied indifferently to all the members of the first sub-order. "Baboon" appears to be properly applicable to the dog-faced African species, and may therefore be conveniently restricted to the members of the genus *Papio* and their immediate relatives. "Ape," on the other hand, may be specially used for the tailless man-like representatives of the order; while the term "monkey" may be employed for all the rest, other than lemurs; monkeys being, however, divisible into sub-groups, such as macaques, langurs, guerezas, mangabeys, &c. This usage cannot, however, be universally employed, and the term "monkeys" may be employed for the entire group.

Anthropoidea.—The Primates, as already mentioned, are divisible into two main groups, or sub-orders, of which the first includes man, apes, baboons and monkeys. For this group Professor Max Weber employs the name Simiae (in contradistinction to Prosimiae for the lemurs). Since, however, to take as the title for a group which includes man himself the designation of creatures so much lower in the scale is likely to be repugnant, it seems preferable to employ the designation Anthropoidea for the higher division of the order.

As the essential features distinguishing the Anthropoidea from the second sub-order may best be indicated under the heading of the latter, reference may at once be made to some of the more striking characters of the members of the former group. The proportions of the body as regards the relative lengths of the two pairs of limbs to one another and to that of the trunk vary considerably. Both pairs may be much elongated, as in *Ateles* and *Hylobates*, and either sub-equally, as in the first of these, or with the arms greatly in excess, as in the second. The legs may be excessively short, and the arms, at the same time, excessively long, as in the orang-utan. Both pairs may be short and sub-equal, as in many of the baboons (*Papio*). Only in *Nyctipithecus* and the *Hapalidae* does the excess in length of the lower limbs over the upper exceed or equal that which is found in man. The length of the tail presents some noteworthy points. It is found at its greatest absolute length, and also greatly developed relatively, being about twice the length of the trunk, in such monkeys as the Indian langurs; but its greatest relative length is attained in the spider-monkeys (*Ateles*), where it reaches three times the length of the trunk. The constancy of the degree of its development varies much in different groups. In the greater number of genera it is long in all the species, and in some (*Simia*, *Anthropopithecus* and *Hylobates*) it is absent in all. In others it may be long or short, or completely absent, as in macaques (*Macacus*).

The form of the head presents great differences—it may be rounded, as in *Ateles*; produced vertically, as in *Simia*; drawn out posteriorly to an extreme degree, as in *Chrysothrix*; or anteriorly, as in the baboons. A production of the muzzle, necessitated by the presence of large teeth, exists in the chimpanzee (*Anthropopithecus*), but in the baboons, not only is this prolongation carried farther, but the terminal position of the nostrils gives a dog-like aspect to the face.

The eyes may be small compared with the size of the head, as in the baboons; but they may, on the contrary, attain a relatively enormous size, as in *Nyctipithecus*. They are always forwardly directed, and never much more separated one from another than in man; they may, however, be more closely approximated, as in the squirrel-monkeys (*Chrysothrix*) of South America.

The ears are always well developed, and very generally have their postero-superior angle pointed. They may be large and small in the same genus, as in *Anthropopithecus* (chimpanzee and gorilla); but only in the gorilla do we find, even in a rudimentary condition, that soft depending portion of the human ear termed the "lobule." The nose has scarcely ever more than a slight prominence, and yet an enormous development is to be met with in the proboscis-monkey (*Nasalis*); while in the snub-nosed monkeys (*Rhinopithecus*) we find a sharply prominent, though smaller and extremely upturned nose. The hoolock gibbon also possesses a prominent but slightly aquiline nose. The terminal position of the nostrils in the baboons has already been mentioned. These apertures may be closely approximated, as in all the man-like apes (*Simiidae* and *Hylobatidae*), or they may be separated one from the other by a broad septum, as in the *Cebidae*, its breadth, however, varying somewhat in different genera, as in *Ateles* and *Eriodes*, and *Callithrix* and *Nyctipithecus*. The lips are generally thin, but may be very extensile, as in the orang-utan.

The hands are generally provided with thumbs, though these organs (as in the African guerezas, *Colobus*, and the American spider-monkeys, *Ateles*) may be represented only by small nailless tubercles. The thumb is more human in its proportions in the chimpanzee than in any other of the higher apes. As compared with the length of the hand, it is most man-like in the lowest American monkeys, such as *Chrysothrix* and *Hapale*. In spite of greater relative length it may, however, little merit the name of thumb, as it is but slightly opposable to the other digits in any of the American monkeys, and is not at all so in the *Hapalidae*. The "great toe" is never rudimentary and, except in man, in place of being the longest digit of the foot, is constantly the shortest. As compared with the entire length of the foot, it is most man-like in the chimpanzee and some gibbons, and smallest of all in the orang-utan, and next smallest in *Hapale*. Every digit is provided with a nail, except the great toe of the orang-utan and the rudimentary tubercle representing the thumb in *Ateles* and *Colobus*. The nail of the great toe is flat in every species, but the other nails are never so flat as are the nails of man. The lateral compression of the nails becomes more strongly marked in some *Cebidae*, e.g. *Eriodes*, but attains its extreme in the *Hapalidae*, where every nail, except that of the great toe, assumes the form of a long, curved and sharply pointed claw.

With the single exception of man, the body is almost entirely clothed with copious hair, and never has the back naked. In the gibbons, the langurs, the macaques and the baboons, naked spaces (*ischiatic callosities*) are present on that part of the body which is the main support in the sitting posture. These naked spaces are subject to swelling at the season of sexual excitement. Such naked spaces are never found in any of the American monkeys. No ape or monkey has so exclusive and preponderating a development of hair on the head and face as exists in man. As to the head, long hair is found thereon in *Hapale oedipus* and in some of the langurs and guerezas, whilst certain macaques, like the Chinese bonnet-monkey (*Macacus sinicus*), have the hair of the head long and radiating in all directions from a central point on the crown. A beard is developed in the male orang-utan; and the Diana monkey (*Cercopithecus diana*) has long hair on the cheeks and chin. The wanderoo (*Macacus silenus*) has the face encircled by a kind of mane of long hairs; and many of the marmosets have a long tuft of hairs on each side of the head. American monkeys exhibit some extremes respecting hair-development. Thus in some of the howlers (as in some of the guerezas of the Old World) the hair of the flanks is greatly elongated. Some also have an elongated beard, but the latter structure attains its maximum of development in the couxio (*Pithecia satanas*). Some of the species of the American genus *Pithecia* have the hair of the body and tail very long, others have the head of the female furnished with elongated hair; while the allied *Uacaria calva* has the head bald. Long hair may be developed from the shoulders as in *Papio hamadryas* and *Theropithecus gelada*. Very long hair is also developed on the back of the snub-nosed monkeys (*Rhinopithecus*) in winter. The direction of the hair may sometimes vary in nearly allied forms, the hairs on the arm and fore-arm respectively being often so directed that the tips converge towards the elbow. Such is the case in most of the higher apes, yet in *Hylobates agilis* all the hair of both these segments is directed towards the wrist. The hair presents generally no remarkable character as to its structure. It may, however, be silky, as in *Hapale rosalia*, or assume the character of wool, as in the woolly spider-monkeys (*Eriodes*) and *Macacus tibetanus*, which inhabits Tibet.

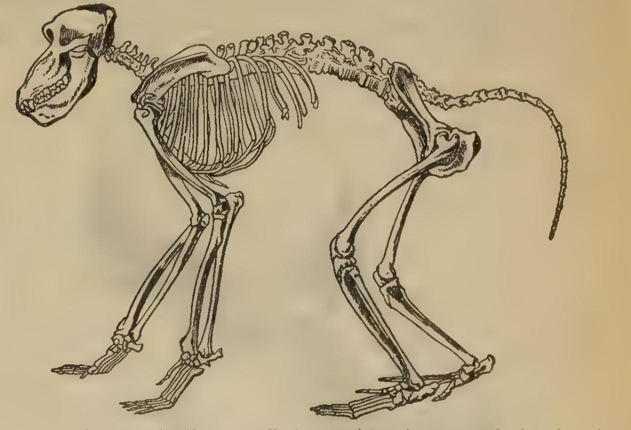


FIG. 2.—Skeleton of Chacma Baboon (*Papio porcarius*), showing the great relative length of the facial part of the Skull.

Great brilliance of colour is sometimes found in the naked parts of the body, particularly in the baboons and some of the other *Cercopithecidae*, and especially in the regions of the face and sexual organs. Among these latter rose, turquoise-blue, green, golden-yellow and vermilion appear, in various combinations, in one or other or both of these regions, and become especially brilliant at the period of sexual excitement.

The skeleton, more especially in the higher forms, is in the main similar to that of man, so that only a brief notice is necessary. In the skull considerable variation in regard to the proportionate length of the face to that of the brain-case (cranial portion) exists in the two sexes, owing to the general development of large tusks in the males (other than in man, who is not now under consideration). Generally speaking, the elongation of the facial portion, as compared to the cranial, increases as we pass from the higher to the lower forms. The increase does not, however, occur regularly, being greater in the orang-utan and chimpanzee than in some of the langurs (*Semnopithecus*, fig. 1); the maximum development of this feature occurs in the dog-faced baboons (*Papio*, fig. 2). In American monkeys, with the exception of the howlers (*Alouata*, fig. 3), the facial part is relatively smaller than in Old World monkeys and apes; while in the squirrel-monkeys (*Chrysothrix*) it is even smaller than in man himself.

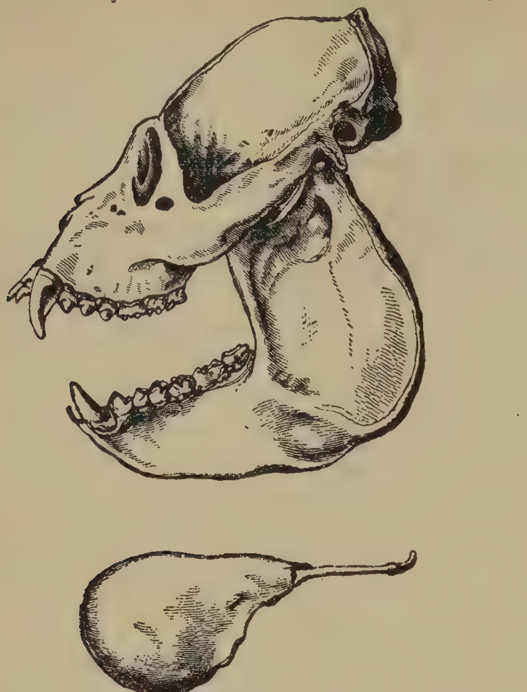


Fig. 3.—Skull and Hyoid-bone of a Howler-Monkey (*Alouata*). In nature the hyoid-bone, which is bladder-like, is placed between the two branches of the lower jaw.

In none of the Old World group does the forehead present that rounded and elevated contour characteristic of man, although the height of this region is great in the orang-utan (fig. 4). Curiously enough, American monkeys, especially those included in *Pithecia*, are the most man-like in this respect. The skull of the male gorilla is characterized by the great development of the crests for muscular attachment, one of these (superciliary) overhanging the orbits, a second (sagittal) traversing the middle line of the upper surface, while a third (lambdoid) forms an inverted V on the occiput, and affords attachment for the muscles of the neck.

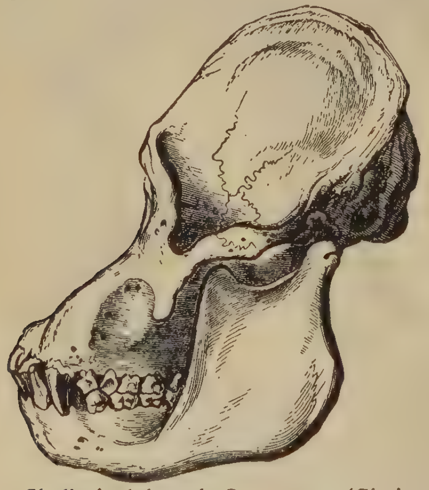


Fig. 4.—Skull of adult male Orang-utan (*Simia satyrus*).

In the gorilla the orbits are much as in man, but in the orang-utan they are more rounded. They become very large in *Hylobates*, but attain an enormous size in the American *Nyctipithecus*. The extent to which each orbit opens into the adjacent temporal fossa, *i.e.* the size and shape of the sphenomaxillary fissure, varies considerably; this is narrow and much elongated in the gorilla and the baboons, but short in the langurs and spider-monkeys. It is most closed in the howlers, where it sometimes all but disappears entirely. The mastoid process never attains the large relative size it has in man; but it is prominent in the baboons and larger macaques, as well as in the chimpanzee and gorilla, its development bearing relation to the size and weight of the head. As the mastoid diminishes, the under surface of the petrosal assumes a swollen or bladder-like condition.

The plane of the foramen magnum, as compared with the basicranial axis, varies with the projection of the occiput; it generally forms a less open angle with that axis than in man, but in *Chrysothrix* the angle is yet more open than in the human skull. The cheek, or zygomatic, arches bend outwards and upwards in the gorilla and some baboons, but decrease in relative as well as absolute size in the smaller forms—notably in *Chrysothrix*. No long slender styloid process is normally attached to the skull, though such may be the case in the baboons. An external bony auditory meatus (or tube) is present in Old World but absent in New World monkeys. In all apes and monkeys the premaxillae have a distinctness of development and a relative size not found in man; the sutures separating them from the maxillae remaining visible, except in the chimpanzee, after the adult dentition has been attained. The maxillae develop great swollen tuberosities in the baboons and the black ape of Celebes. The nasal bones are small, and generally flatter than in man; being in the orang-utan quite flat. They are convex in some langurs and all baboons; but the proboscis-monkey has its nasals no more developed than those of other species. The nasals seem to attain their maximum of relative size in the howlers. The lower jaw, or mandible, is always in one piece in adults; and is most man-like in the siamang, which alone has a slight chin. On the other hand, in other gibbons the angle is produced downwards and backwards, as also in marmosets. Its maximum of relative size is attained in the howlers (fig. 3), where the broad ascending part serves to protect and shelter the enormously developed body of the hyoid.

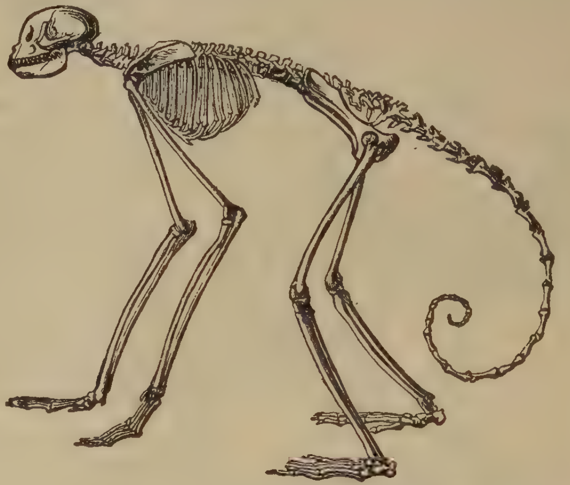


Fig. 5.—Skeleton of South American Spider-Monkey (*Ateles*), to illustrate the length of the limbs and tail, and the slenderness of the former.

Air-cells may be developed, as in the gorilla, in the parts adjacent to the mastoid. Frontal sinuses are generally absent in the Old World group, being replaced by coarse cellular bone. In old age the sutures of the skull become obliterated, the one between the two nasals disappearing at an early age in Old World monkeys. In the spider-monkeys and howlers the tentorium, or membrane dividing the hemispheres of the brain from the cerebellum, becomes bony.

The spinal column of apes and monkeys always lacks the S-like curvature of that of man, the nearest approach to this occurring in the baboons (fig. 2). The number of dorsal vertebrae varies from eleven in some species of *Cercopithecus* and *Macacus* to fourteen in certain gibbons or fifteen in the American night-apes (*Nyctipithecus*). In the American *Cebidae* the number seldom falls below thirteen; in the orang-utan it is twelve, as in man, but thirteen in the chimpanzee and gorilla. In most cases the dorsal and lumbar regions are about equal in length, but the lumbar region is the shorter in the man-like group, and less than half the length of the dorsal in the gorilla. The lumbar spinous processes are vertical, or project backwards in the man-like apes, gibbons and spider-monkeys; in the others they project forwards, especially in *Cebidae*. The lumbar transverse processes project outwards, more or less at right angles to the axis of the spine, or else forwards. The sacrum attains its greatest absolute length in the gorilla, but is relatively longer than in man in all the man-like group. *Hylobates* has the relatively longest sacrum. The number of vertebrae included in the sacrum varies more or less with age; with the exception of the *Simiidae* and *Hylobatidae*, there are generally only two or three; but in *Ateles*, *Hylobates*, and *Uacaria* there may be four; while in the *Simiidae* there are always five, and sometimes six. In most apes the sacrum and lumbar vertebrae lie in one slightly curved line, the gorilla and champanzee presenting in this respect a great contrast to the human structure. In the orang-utan the sacro-vertebral angle is rather more marked; but in some baboons it is so much so as almost to rival that of man.

With the exception of the man-like apes and gibbons and the Barbary ape (*Macacus inuus*), the caudal vertebrae of monkeys exceed four in number; but the mandril, *Papio* (*Maimon*) *maimon*, has sometimes only five. The short-tailed macaques and uakaris have from about fifteen to seventeen, the shortness of the tail being occasioned rather by a diminution in the size of the component vertebrae than by a decrease in number. In the other forms the number varies between twenty and thirty-three, the latter being the number attained in the spider-monkeys (fig. 5). The proportion borne by this region of the spine to the more anterior parts is greatest in the spider-monkeys of the genus *Ateles*, almost three to one; in the other longest-tailed genera it is rarely so large as two to one. The absolute length of the tail is greatest in the langurs and guerezas, where also the individual caudal vertebrae attain their greatest length, namely two inches. The caudal vertebrae generally increase in length from the sacrum till about the seventh, eighth or ninth, which, with the tenth and eleventh, are the longest in most long-tailed forms. In *Ateles* the eleventh, twelfth, thirteenth and fourteenth vertebrae are the longest. In most members of the sub-order the breast-bone, or sternum, is narrow, and consists of a more or less enlarged upper portion, or manubrium, followed by a chain of sub-equal elongated bones from three to six in number. In man, man-like apes and gibbons there is, however, a broad sternum; or one consisting of a manubrium, followed by one bone only, as in *Hylobates*. In the orang-utan the breast-bone long remains made up of ossifications arranged in pairs, side by side, successively. The true ribs are seven in number on each side in the highest forms, but in *Hylobates* there are sometimes eight; in *Ateles* there are sometimes nine pairs; in *Hapale* the number varies from six to eight, and from seven to eight in the other genera. The "angles" of the ribs are never so marked as in man; most so in *Hylobates*. *Pithecia* is distinguished by the greater relative breadth of the ribs. In no ape or monkey is the thorax half as broad again as it is deep from back to breast. Nevertheless, in the *Simiidae* and *Hylobatidae*, its transverse diameter exceeds its depth by from about one-fourth to a little under one-third of the latter. In *Ateles* (and sometimes also in *Alouata*) the thorax is wider than deep, but in the rest it is deeper than wide.

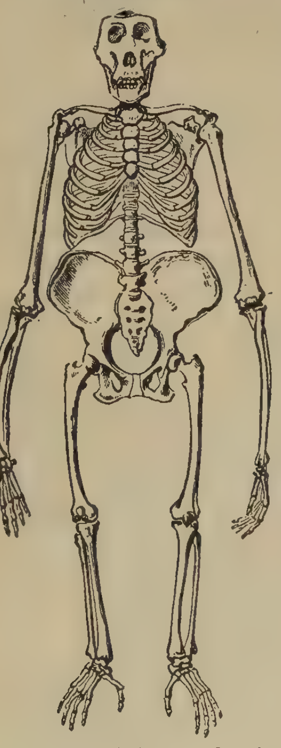


FIG. 6.—Skeleton of the Gorilla (*Anthropopithecus gorilla*), to exhibit the flattened sternum, the broad and shallow thorax, and the great length of the fore-limbs.

The greatest absolute length of the fore-limb occurs in the gorilla (fig. 6) and the orang-utan. The humerus never has a perforation (entepicondylar) on the inner side of its lower extremity. Except in the man-like apes, the ulna articulates with the wrist (carpus). The hand is capable of pronation and supination on the fore-arm; and except in man, the chimpanzee and the gorilla there is a centrale in the carpus. The phalanges are the same in number in apes and monkeys as in man, except that in *Ateles* and *Colobus* the thumb may have but one small nodular phalange or none. The phalanges are generally more curved than in man, and, except in the *Hapalidae*, the terminal ones are flattened from back to front. In the *Hapalidae* they are laterally compressed, curved, and pointed to support the claws characteristic of that family. The length of the thumb with its metacarpal bears a much greater proportion to that of the spine in *Hylobates* and *Simia* than in man. With the exception of *Ateles* and *Colobus*, the shortest thumb, thus estimated, is found in *Nyctipithecus* and *Chrysothrix*.

The hind-limb, measured from the summit of the femur to the tip of the longest digit, is absolutely greatest in the gorilla, and then in the orang-utan and the chimpanzee. If the foot be removed, the leg of the chimpanzee is longer than that of the orang-utan. The ankle, or tarsus, consists of the same seven bones as in man, and these bones are so arranged, or bound together by ligaments, as to form a transverse and an antero-posterior arch. In no ape or monkey, however, do the lower ends of the inner metatarsals form the anterior point of support of the antero-posterior arch, as in man. The calcaneum, except in the gorilla, is shorter compared with the spine than in man. The phalanges of the foot are the same in number as in man, except that the great toe of the orang-utan has often but one. They are very like their representatives in the hand, and are convex above, concave and flattened below. Only in the *Hapalidae* are the terminal phalanges laterally compressed instead of flattened. The toes are never nearly so short relatively in apes and monkeys as in man; yet the proportion borne by the great toe, with its metatarsal, to the spine closely approximates in the gorilla to the proportion existing in man, and this proportion is exceeded in *Hylobates* and *Ateles*.

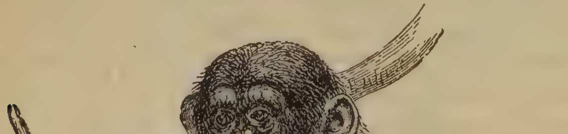
Omitting all reference to the muscles, we find that in apes and monkeys the absolute size of the brain never approaches that of man; the cranial capacity being never less than 55 cub. in. in any normal human subject, while in the orang-utan and chimpanzee it is but 26 and 27½ cub. in. respectively. The relative size of the brain varies inversely with the size of the whole body, as is the case in warm-blooded vertebrates generally. The hemispheres of the brain are almost always so much developed as to cover over the cerebellum, the only exceptions being the howlers and the siamang (*Hylobates syndactylus*). In the latter the cerebellum is slightly uncovered, but it is considerably so in the former. In *Chrysothrix* the posterior lobes are more largely developed relatively than in man. As in mammals generally, much convoluted hemispheres are correlated with a considerable absolute bulk of body. Thus in *Hapale* (and here only) we find the hemispheres quite smooth, the only groove being that which represents the Sylvian fissure. In *Simia* and *Anthropopithecus*, on the contrary, they are richly convoluted. A *hippocampus minor* is present in all apes and monkeys, and in some *Cebidae* is larger relatively than in man, and absolutely larger than the *hippocampus major*. Of all apes and monkeys the orang-utan has a brain most like that of man; indeed it may be said to be like man's in all respects save that it is much inferior in size and weight, and that the hemispheres are more symmetrically convoluted and less complicated by minor foldings. The human brain, as known by European specimens, has been supposed to differ from that of apes and monkeys by the absence of the so-called simian fold (*Affenspalte*) on the posterior portion of the main hemispheres. On studying a large series of Egyptian and Sudani brains, Professor G. Elliot Smith finds, however, that this simian fold, or sulcus, can be distinctly recognized. "It is easy," he writes, "to select examples from the series of Egyptian and Sudanese brains in my possession, in which the pattern formed by the occipital sulci on the lateral surface of the hemisphere in individual anthropoid apes is so exactly reproduced that the identity of every sulcus is placed beyond reasonable doubt. . . . And if we take individual examples of gorilla-brains, it becomes still easier to match the occipital pattern of each of them to numerous human brains. . . . It is easy to appreciate the difficulties which have beset investigators of European types of brain, and to understand the reasons for the common belief in the absence of the supposed distinctly simian sulci in the lateral aspect of the occipital region of the human brain."

In no ape or monkey does the series of teeth form so perfect an arch as in man, the opposite series of cheek-teeth tending to become more parallel. None has the teeth placed in one uninterrupted series in each jaw, as is the case in the human species; but there is always a small gap between the upper canine and the adjacent incisor, and between the lower canine and the adjacent premolar. This condition is due to the excessive size of the canines, the interspaces giving passage to the tips of these teeth. This prolongation of the canines into tusk-like weapons of offence and defence (especially developed in the males) makes a great difference between the aspect of the dentition in apes and man. The number of the teeth is the same as in man in all Old World Primates. The New World *Cebidae* have an additional premolar on each side of each jaw, while the *Hapalidae* have a molar the less. The incisors are nearly vertical, save in *Pithecia* and its allies, where their tips project forward. The canines are considerably longer than the incisors, except in *Hapale*, where the lower incisors equal them in length. The premolars differ structurally from the molars much as in man, except that the first lower one may be modified in shape to give passage to the upper canine, as in the baboons. The grinding surface of the molars consists generally of two incomplete transverse ridges, the end of each ridge projecting more than the intermediate part, indicating the position of the four original tubercles. In the man-like apes there is, however, in the upper molars a ridge running obliquely from the front inner tubercle, or cusp, outwards and backwards to the hind outer tubercle. In the *Cercopithecidae* this ridge is wanting, but it reappears in *Ateles* and *Alouata* amongst the *Cebidae*. In the *Hapalidae* the tubercles of the molars are more produced and sharp-pointed, in harmony with the insectivorous habits of the marmosets. The last lower molar may be reduced or much enlarged as compared with the others. Thus in *Cercopithecus talapoin* it has but three tubercles, while in the macaques and baboons it is very large, and has five well-developed cusps. The number of milk-teeth is as in man, except that American monkeys have an additional one. In general the canines are the last teeth to be cut of the permanent dentition, their cutting sometimes causing such constitutional disturbance as to produce convulsions and death. In the gibbons, however, the canines accompany, if they do not precede, the appearance of the hindmost molar, while in the orang-utan they at least sometimes make their appearance before the latter.

The stomach is simple in all apes and monkeys except langurs, guerezas, and their allies. It is especially human in shape in *Hylobates*, except that the pylorus is somewhat more elongated and distinct. It is of a rounded form in *Pithecia*, and in *Hapale* the cardiac orifice is exceptionally near the pylorus. In the langur group it is sacculated, especially at the cardiac end, being, in fact, very like a colon spirally coiled. The intestine is devoid of *valvulae conniventes*, but provided with a well-developed caecum, which is, however, short and conical in the baboons. Only in the man-like apes is there a vermiform appendix. The colon may be much longer relatively than in man, as in the man-like apes; it may be greatly sacculated, as in *Hylobates*; or devoid of sacculations, as in *Cebus*. The liver may be very like man's, especially in gibbons, the orang-utan, and the chimpanzee; but in the gorilla both the right and left lobes are cleft by a fissure almost as much as in the baboons. In the langur group the liver is much divided, and placed obliquely to accommodate the sacculated stomach. The lateral lobes in *Hapale* are much larger than the central lobe. The caudate lobe is very large in *Cebidae*, especially in *Ateles*, and above all in *Pithecia*. There is always a gall-bladder.

The larynx in many members of the sub-order is furnished with sac-like appendages, varying in different species as regards number, size and situation. They may be dilatations of the laryngeal ventricle (opening into the larynx below the false vocal chords), as in the man-like apes; or they may open above the false vocal chords so as to be extensions of the thyro-hyoid membrane, as in gibbons. There may be but a single median opening in the front part of that membrane at the base of the epiglottis, as in *Cercopithecidae*, or there may be a single median opening at the back of the trachea, just below the cricoid cartilage, as in spider-monkeys; and while there is in some instances only a single sac, in other instances, as in the howlers, there may be five. These may be enormous, meeting in the middle line in front, and extending down to the axillae, as in the gorilla and orang-utan. Finally a sac may occupy the cavity of the expanded body of the hyoid-bone, as in howlers (fig. 3). The hyoid has its basilar part generally somewhat more convex and enlarged than in man; but in howlers it becomes greatly enlarged and deeply excavated, so as to form a great bony bladder-like structure (fig. 3). The cornua of the hyoid are never entirely absent, but the anterior or lesser cornua may be so, as in the howlers. The anterior cornua never exceed the posterior cornua in length; but they may be (*Cercopithecus*) more developed relatively than in man, and may even be jointed, as in *Lagothrix*.

The lungs are generally similar to those of man, although, as in gibbons, the right one may be four-lobed. In the man-like apes the great arteries are likewise of the human type; but in the *Hylobatidae* and *Cercopithecidae* the left carotid may arise from the innominate. The discoidal and deciduate placenta is generally two-lobed, although single in the howlers; in the marmosets it is unusually thick. American monkeys differ from their Old World cousins in having two umbilical veins in place of a single one. In the *Cercopithecidae* gestation lasts about seven months, but in the marmosets is reduced to three. The young, which are generally carried on the breast, are suckled for about six months in most monkeys.



(From a sketch by Wolf from life.)

FIG. 7.—An Immature Chimpanzee (*Anthropopithecus troglodytes*).

Man-like Apes.—In common with man, the apes and monkeys of the Old World form a section—Catarrhina—of the sub-order Anthropoidea, characterized by the following features: There are only two pairs of premolar teeth, so that the complete dental formula is $i. \frac{2}{2}, c. \frac{1}{1}, p. \frac{2}{2}, m. \frac{3}{3}$. The tympanum has an external bony tube, or meatus; but there is no tympanic bulla. A squamoso-frontal suture causes the frontal and the alisphenoid bones to enter largely into the formation of the orbital plate; and the orbito-temporal foramen is small. Cheek-pouches and callosities on the buttocks are frequently present. The nails are flat or rounded, the descending colon of the intestine has an S-like (sigmoid) flexure; the caecum is simple, and there may be a vermiform appendix. The inter-nasal septum is thin, and the nostrils are directed outwards. The tail, which may be rudimentary, is never prehensile. The ethmoturbinal bones of the nasal chamber are typically united. Laryngeal sacs are commonly developed. In addition to the primary discoidal placenta, a secondary, and sometimes temporary one is developed.

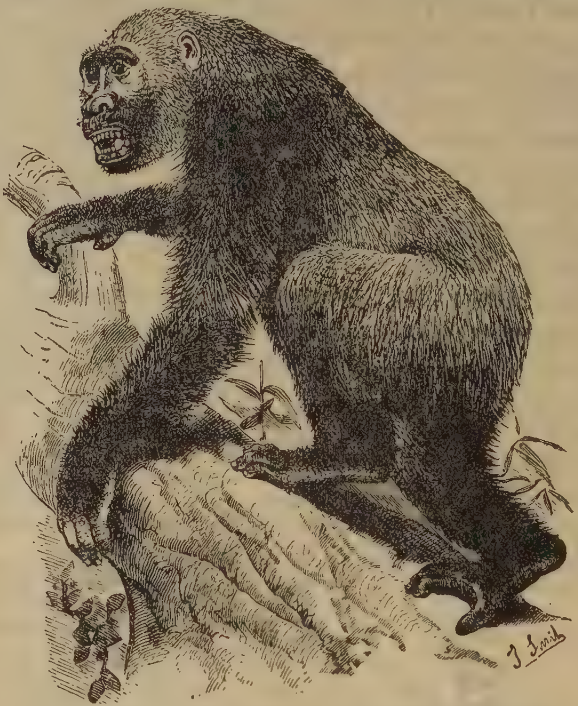


FIG. 8.—Adult Male Gorilla (*Anthropopithecus gorilla*).

It does not come within the province of this article to treat of man (see ANTHROPOLOGY); but it may be mentioned that the distinctive characteristics of the family *Hominidae* (including the single genus *Homo*), as compared with those of the *Simiidae*, or man-like apes, are chiefly relative. These are shown by the greater size of the brain and brain-case as compared with the facial portion of the skull, smaller development of the canine teeth of the males, more complete adaptation of the structure of the vertebral column to the vertical position, greater length of the lower as compared with the upper extremities, and the greater length of the great toe, with almost complete absence of the power of bringing it in opposition to the other four toes. The last and the small size of the canine teeth are perhaps the most marked and easily defined distinctions that can be drawn between the two groups, so far as purely zoological characters are concerned. The regular arch formed by the series of teeth is, however, as already mentioned, another feature distinguishing man from the man-like apes.

In common with the gibbons (*Hylobatidae*) the man-like apes, or *Simiidae*, are distinguished from the lower representatives of the present sub-order by the following features: The sternum is short and broad, and the thorax wide and shallow (fig. 6), while the pelvis, as shown in the same figure, is more or less laterally expanded, and hollow on its inner-surface; and the number of dorso-lumbar vertebrae ranges from sixteen to eighteen. The arm is longer than the leg; and while the hair on the fore-arm is directed upwards, that of the upper-arm slopes downwards to meet it at the elbow. Cheek-pouches are absent. The cusps of the molars are separate; and five in number above and four below. The caecum has a vermiform appendix; and the secondary placenta merely forms a temporary fold. The *Simiidae* are specially characterized by the absence of callosities on the buttocks; the presence of sixteen or seventeen dorso-lumbar vertebrae, and of twelve or thirteen pairs of ribs; the wrinkling of the enamel of the cheek-teeth; the great expansion and concavity of the iliac bones of the pelvis; and the application of only the edge of the sole of the foot to the ground in walking.

The existing members of the family are referable to at least two genera, the one African and the other Asiatic. The first genus, *Anthropopithecus*,[1] is typified by the West African chimpanzee, *A. troglodytes* (fig. 7), and is characterized by the absence of excessive elevation in the skull, by the fore limb not reaching more than half-way down the shin, the presence of thirteen pairs of ribs, the well-developed great toe, the absence of a centrale in the carpus, and the black or grey hair. There is a well-developed laryngeal sinus, which may extend downwards to the axilla. Chimpanzees are characterized by the large size of the ears, and typically by the small development of the supra-orbital ridges. The latter are, however, more developed in the Central African *A. tchego* (of which the kulu-kamba is a local phase); this form—whether regarded as a species or a race—being thus more gorilla-like (see Chimpanzee).

The gorilla (*Anthropopithecus gorilla*, fig. 8), of which there are likewise several local forms, ranging from the West Coast through the forest-tract to East Central Africa, and apparently best regarded as sub-species, is frequently made the type of a second genus—*Gorilla*; but is extremely close to the chimpanzee, from which it is perhaps best distinguished by its much smaller ears. It is the largest of the apes, although the females are greatly inferior in stature and bulk to the males. The gorilla is also a much less completely arboreal ape than the chimpanzee, in consequence of which more of the sole of the foot is applied to the ground in walking. The enormous supra-orbital ridges of the skull of the male, and likewise the large and powerful tusks in that sex are very characteristic. A full-grown gorilla will stand considerably over six feet in height. According to Dr A. Keith, in addition to its smaller and flatter ears, the gorilla may be best distinguished from the chimpanzee by the presence of a nasal fold running to the margin of the upper lip; by the large size and peculiar characters of the tusks and cheek-teeth; by its broad, short, thick hands and feet, of which the fingers and toes are partially webbed; by the long heel; and by the relative length of the upper half of the arm as compared with the fore-arm. An important distinctive feature of the skull of the gorilla is the great length of the nasal bones. Finally, in adult life the gorilla is sharply differentiated from the chimpanzee by its sullen, untameable, ferocious disposition.

As regards the relationship existing between the gorilla and the chimpanzee, Dr Keith observes: "An examination of all the structural systems of the African anthropoids leads to the inference that the gorilla is the more primitive of the two forms, and approaches the common parent stock more nearly than does the chimpanzee. The teeth of the gorilla, individually and collectively, form a complete dentition, a dentition at the very highest point of development; the teeth of the chimpanzee show marked signs of retrogression in development both in size and structure. The muscular development and the consequent bony crests for muscular attachment of the gorilla far surpass those of the chimpanzee. The muscular development of the adult chimpanzee represents that of the adolescent gorilla. Some of the bodily organs of the gorilla belong to a simpler and earlier type than those of the chimpanzee. But in one point the chimpanzee evidently represents more nearly the parent form—its limbs and body are more adapted for arboreal locomotion; of the two, the gorilla shows the nearer approach to the human mode of locomotion. On the whole the evidence at our disposal points to the conclusion that the chimpanzee is a derivative from the gorilla stock, in which, with a progressive brain development, there have been retrograde changes in most of the other parts of the body. The various races of chimpanzee differ according to the degree to which these changes have been carried." (See Gorilla.)

From both the chimpanzee and the gorilla the orang-utan, or mias (*Simia satyrus*), of Borneo and Sumatra is broadly distinguished by the extreme elevation of the skull (fig. 4), the excessive length of the fore limbs, which reach to the ankle, the presence of only twelve pairs of ribs and of a centrale in the carpus, the short and rudimentary great toe, and the bright-red colour of the hair. Adult males are furnished with a longish beard on the chin, and they may also develop a large warty prominence, consisting of fibro-cellular tissue, on each side of the face, which thus assumes an extraordinary wide and flattened form. There is no vestige of a tail. The hands are very long; but the thumb is short, not reaching the end of the metacarpal bone of the index-finger. The feet have exceedingly long toes, except the great toe, which only reaches to the middle of the first joint of the adjacent toe, and is often destitute not only of a nail, but of the second phalange also. It nevertheless possesses an *opponens* muscle. The brain has the hemispheres greatly convoluted, and is altogether more like the brain of man than is that of any other ape. A prolongation is developed from each ventricle of the larynx, and these processes in the adult become enormous, uniting together in front over the windpipe and forming one great sac which extends down between the muscles to the axilla. The canine teeth of adult males are very large. In Borneo the orang-utan displays great variability, and has accordingly been divided into a number of local races, in some of which the males apparently lack the lateral expansion of the face. Whether the Sumatran orang-utan should be regarded as a distinct species, with two local races, may be left an open question. (See Orang-Utan).

Gibbons.—The comparatively small, long-armed and tailless Asiatic apes known as gibbons have been very generally included in the same family as the man-like apes; but since they differ in several important features—to say nothing of their smaller bodily size—it has recently been proposed to refer them to a family apart, the *Hylobatidae*. The distinctive features of this family include the presence of small naked callosities on the buttocks, the possession of eighteen dorso-lumbar vertebrae and thirteen pairs of ribs, the absence of foldings in the enamel of the molar teeth, the slight lateral expansion and concavity of the iliac bones of the pelvis, and the application of the whole sole of the foot to the ground in walking. The vertebral column presents no trace of the sigmoid flexure which is developed partially in the *Simiidae* and completely in the *Hominidae*. None of the gibbons have any rudiment of a tail; and the canines are elongated and tusk-like. When the body is erect, the arms are so long that they reach the ground. The great toe is well developed, reaching to the middle or end of the first joint of the adjacent toe; but the thumb only attains to, or reaches a little beyond, the upper end of the first joint of the index-finger. There is a centrale in the carpus. The laryngeal sacs are no longer prolongations of the laryngeal ventricles, but open into the larynx above the false vocal chords. The group is distributed throughout the forest-regions of south-eastern Asia, eastwards and southwards from Assam, and is represented by a considerable number of species. Among these, the siamang, *Hylobates syndactylus*, of Sumatra and the Malay Peninsula, differs from all the rest by the union of the index and third fingers up to the base of their terminal joints, in consequence of which this species is regarded as representing a sub-genus (*Symphalangus*) by itself, while all the others belong to *Hylobates* proper. The general colour of gibbons is either pale fawn or black, with or without a white band across the forehead. In a female from Hainan in the menagerie of the Zoological Society of London, the colour of the coat changed from black to fawn about the time full maturity was attained. Apparently no such change takes place in the male. According to Dr W. Volz, the two banks of the Lematang River in the Palembang district of Sumatra are respectively inhabited by two different species of gibbons—on the west bank is found the siamang (*Hylobates syndactylus*), while the country to the east of the river is the home of the agile gibbon, or waw-waw (*H. agilis*). It is not necessary to capture, or even to see, specimens of the two species in order to satisfy oneself as to their limitations, for they may be readily distinguished by their cries: the siamang calling in a single note, whereas the cry of the waw-waw forms two notes. The remarkable thing about their distribution in Palembang is that the two species are found in company throughout the rest of Sumatra; and even in Palembang itself they inhabit the mountain districts, where the river is so narrow that they could easily leap over it, and yet they keep to the opposite banks. Gibbons are perhaps the most agile of all the Old World monkeys, rivalling in this respect the American spider-monkeys, despite their lack of the prehensile tails of the latter (see Gibbon).

Langur Group.—The well-known long-tailed langur monkeys of India and the adjacent regions are the first representatives of the third family of apes and monkeys, which includes all the remaining members of the sub-order now under consideration. In the *Cercopithecidae*, as the family is called, the following features are distinctive: The sternum, or breast-bone, is narrow and elongated, and the thorax compressed and wedge-shaped, while the iliac bones of the pelvis are narrow, with the inner surface flat; the dorso-lumbar vertebrae are nineteen or twenty in number. The front limbs are shorter than the hind pair; the whole sole of the foot is applied to the ground in walking; and the hair on the arm is directed downwards from the shoulder to the hand. There are always bare callosities on the buttocks, and very generally cheek-pouches. The caecum is conical. Transverse ridges connect the cusps of the molars. The secondary placenta is fully developed.

The first group of the family is represented by the langurs and their allies, collectively forming the sub-family *Semnopithecinae*, in which the tail and hind limbs are very long, and the body is slender; there are no cheek-pouches, but, on the other hand, the stomach is complicated by sacculations or pouches, and the last lower molar has a posterior heel, thus carrying five cusps. The thumb is small or absent, the callosities on the buttocks are also small, and the nails are narrow and pointed. The laryngeal sac (or throat-sac) opens in the middle line of the front of the larynx, and is formed by an extension of the thyro-hyoid membrane. The true langurs, of the genus *Semnopithecus*, in which a small thumb is retained, form a large group confined to south-eastern Asia, where it ranges from India and the Himalaya to Borneo and Sumatra by way of Burma, Cochin China and the Malay Peninsula. A well-known representative is the sacred hanuman monkey (*S. entellus*) of India, which, like the larger Himalayan *S. schistaceus*, is slate-coloured; the Bornean *S. hosei*, on the other hand, is wholly maroon-red. Other species, like the Indian *S. johni*, have the head crested. The allied genus *Rhinopithecus*, as typified by the orange snub-nosed monkey, *R. roxellanae* (fig. 9), of eastern Tibet and Szechuen, is characterized by the curiously short and upturned nose and the long silky hair of the back, especially in the winter coat. In the typical species the predominating colour is orange, tending to yellowish-olive on the back; but in *R. bieti* of the mountains bordering the valley of the Mekon and *R. brelichi* of Central China it is slaty-grey. The third Asiatic genus is represented by the proboscis monkey (*Nasalis larvatus*) of Borneo, in which the nose is extraordinarily elongated. The nose of the adult male is commonly represented as projecting straight out from the face, but it really bends down to overhang the upper lip; it is much shorter in the female, and quite small and bent upwards in the young. (See LANGUR and PROBOSCIS MONKEY.)

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[1] It has been proposed to transfer the name *Simia* to the chimpanzee, on the ground that it was originally given to that animal.

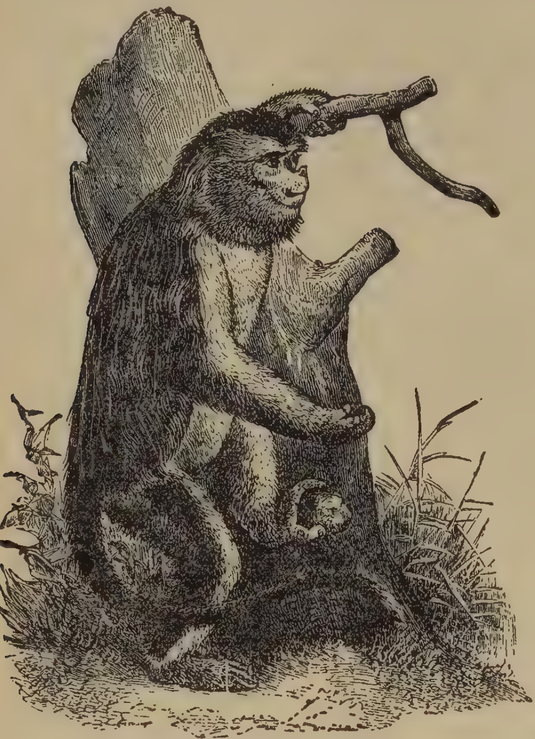
(From Milne-Edwards.)

FIG. 9.—The Orange Snub-nosed Monkey (*Rhinopithecus roxellanae*).

The African guerezas, forming the genus *Colobus*, differ from their Asiatic cousins by the total loss of the thumb. Some of these monkeys, like *Colobus satanas* of West Africa, are wholly black; but in others, such as *C. guereza* (or *abyssinicus*), *C. sharpei* and *C. caudatus* of North-east and East Africa, forming the sub-genus *Guereza*, there is much long white hair, which in the species last-named forms a mantle on the sides of the body and an elongated fringe to the tail, thus assimilating the appearance of the animal to the long lichens hanging from the boughs of the trees in which it dwells. Most or all of the *Semnopithecinae* feed on leaves; a circumstance doubtless correlated with the complex structure of their stomach.

Cercopitheques, Mangabeys, Macaques and Baboons.—The whole of the remaining members of the family *Cercopithecidae* are included in the sub-family *Cercopithecinae*, which presents the following characteristics: The hind limbs are not longer than the front pair; the tail may be either long, short or practically absent; cheek-pouches are present; the stomach is simple; the callosities on the buttocks are often very large; the last lower molar may or may not have a posterior heel; and the thumb is well developed. Whereas all the *Semnopithecinae* are completely arboreal, many of the *Cercopithesinae*, and more especially the baboons, are to a great extent or entirely terrestrial. The typical representatives of the group are the African monkeys, forming the genus *Cercopithecus*, which includes a very large number of species with the following characters in common: the tail, although shorter than in the *Semnopithecinae*, is long, as are the hind limbs, while the general form is slender. The jaw and muzzle are short and the cheek-pouches large; while the nose is not prominent, with the nostrils approximated; whiskers and a beard of variable length are usually developed. The fingers of the long hands are united by webs at the base; the thumb is small in comparison with the great toe. The callosities are of moderate size; and the hairs of the thick and soft fur are in most cases marked by differently-coloured rings. For convenience of description the numerous species of this genus may be arranged in a number of groups or sub-genera. The first of these groups includes the spot-nosed forms (*Rhinostictus*), characterized by the presence of a spot of white, red or blue on the nose; well-known species, being the lesser white-nosed guenon (*C. petaurista*) of West Africa and the hocheur, *C. nictitans*, which is also West African. In the typical group, as represented by the malbrouck monkey (*C. cynosurus*) of the West Coast, and the Abyssinian grivet (*C. sabaeus*), the fur of the back is of a more or less olive-green hue, while the under surface and whiskers are white and the limbs grey. The large patas monkey (*C. patas*) of West Africa and the red-backed monkey (*C. pyrrhonotus*) of Kordofan typify a third section (*Erythrocebus*), characterized by the red upper and white lower surface of the body. A fourth section (*Mona*) includes the mona (*C. mona*) of Western, and Sykes's monkey (*C. albigularis*) of Eastern Africa, with a number of allied species, characterized by the presence of a black band running from the outer angle of the eye to the ear, and the black or dark-grey limbs. The bearded monkey (*C. pogonias*) of Fernando Po and Guinea, with two sub-species, typifies a small section (*Otopithecus*), characterized by large rufous or yellowish ear-tufts and the presence of three black stripes on the forehead. *Pogonocebus* is another small section, including the well-known Diana monkey (*C. diana*) of Western, and De Brazza's monkey (*C. neglectus*) of Eastern Africa, easily recognized by the long (generally white) beard and frontal crest. Finally, the little talapoin (*C. talapoin*) of the Gaboon alone represents a group (*Miopithecus*) broadly distinguished by having three, in place of four, cusps on the crowns of the lower molars.

The next group is that of the African mangabeys (*Cercocebus*), the more typical species of which are easily recognized by their bare flesh-coloured eyelids, and the absence of rings of different colours on the hair, or at least on that of the back. In these monkeys the general form is intermediate between that of the cercopitheques and the macaques, to be next mentioned, the head being more oval and the muzzle more produced than in the former, but less so than in the latter. The limbs are longer and the body is more slender than in the macaques, and the callosities are also smaller. On the other hand, the thumb is smaller than in the guenons, and the tail is carried curled over the back instead of straight; while these monkeys differ from the former in having a posterior heel to the last lower molar, which is thus five-cusped, as in the macaques. The laryngeal air sacs of the latter are, however, wanting. Well-known representatives of the typical section of the group are the sooty mangabey (*C. fuliginosus*) and the white-collared mangabey (*C. collaris*) of West Africa, the latter easily recognized by the bright red crown of the head. A second group of the genus, *Lophocebus* (or *Semnocebus*) is typified by the white-cheeked mangabey (*C. albigena*) of the equatorial forest-region, in which the head is crested and the eyelids lack bare flesh-coloured rims. The rhesus monkey (*Macacus rhesus*) of India is the typical representative of the macaques, which may be regarded as the Asiatic representatives of the mangabeys. From that group the macaques differ by their heavier and stouter build (fig. 10), thicker limbs, the presence of large laryngeal sacs, the larger size of the callosities, and the more produced muzzle, while many of them have the tail (which may be absent) much shorter. The nostrils are not terminal, and the hairs are generally ringed. In habits the macaques are much more terrestrial than the mangabeys, some of them being completely so. In the typical group, which, in addition to the rhesus, includes the Himalayan macaque (*M. assamensis*), the brown macaque (*M. arctoides*) of Burma and Tibet (fig. 10), the tail may be about equal to half the length of the body or less; but in the Barbary ape, *M.* (*Inuus*) *inuus*, of North Africa and Gibraltar, this appendage is wanting. In a third group (*Nemestrinus*), represented by the pig-tailed macaque (*M. nemestrinus*), ranging from Burma to Borneo, and the lion-macaque (*M. leoninus*) of Siam, the tail, which is carried erect, is about one-third the length of the body. The lion-tailed macaque (*M. silenus*) of southern India, often miscalled the wanderoo, represents a group by itself (*Vetulus*) characterized by

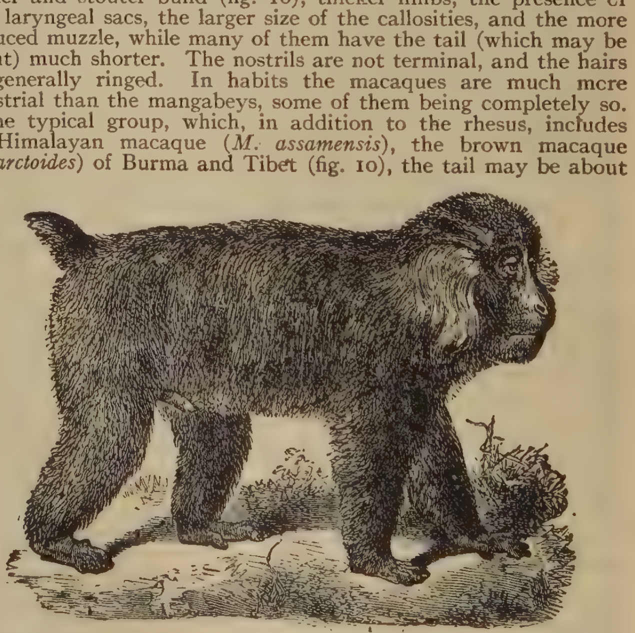
(From Milne-Edwards.)

FIG. 10.—The Tibet Macaque (*Macacus arctoides tibetanus*).

the long hair fringing the face and meeting under the chin, and the tufted lion-like tail, which is from one-half to three-quarters the length of the body. The last group (*Cynomolgus*), now often regarded as a distinct genus, is typified by the widely-spread crab-eating macaque (*M. cynomolgus*), characterized by its produced muzzle, short and stout limbs, and basally-swollen tail, which is nearly as long as the body. It also includes the South Indian bonnet-macaque (*M. sinicus*) and the Ceylon toque-macaque (*M. pileatus*), taking their names from the elongated hair on the crown, which are nearly allied, and with the first-named species approach the baboons in their elongated muzzles (see MACAQUE).

A still nearer approach to the baboons is made by the black ape (*Cynopithecus niger*) of Celebes and the neighbouring islands, which is represented by several sub-species, among them the so-called Moor-macaque (*Macacus maurus*). Some difference of opinion exists as to the proper serial position of this species, which is included in *Macacus* by several zoologists who separate *Cynomolgus* as a genus. It is characterized by the marked elongation of the muzzle, which, like the neck, hands and feet, is naked. The nostrils are, however, directed outwards and downwards, as in the macaques; but, on the other hand, there are baboon-like ridges on the sides of the muzzle and heavy supra-orbital ridges. There are large cheek-pouches; and the tail is a mere stump. The colour is sooty-black. The weird-looking gelada baboon (*Theropithecus gelada*) of southern, and the allied *T. obscurus* of eastern Abyssinia represent a genus which is essentially baboon-like in general characteristics, but has the nostrils of the macaque-type, while the facial portion of the skull is shorter than the cranial. The preorbital portion of the face is concave with the ridges rounded, and the tusks are very long. The long tail is tufted at the tip, and the hair is long and bushy, developing into a mantle-like mane on the forequarters of old males, leaving the chest bare. The general colour is dark-brown. The last representatives of the *Cercopithecidae* are the baboons, or dog-faced baboons, of Africa and Arabia, forming the genus *Papio*. These are for the most part large monkeys, associating in herds under the leadership of an old male, and dwelling chiefly among rocks, although they ascend trees in search of gum. They are easily recognized by their long dog-like faces (fig. 11), in which the nostrils open at the extremity of the greatly elongated muzzle. On the sides of the muzzle are prominent longitudinal ridges covered with bare skin which may be brilliantly coloured. The callosities, which are also generally bright-coloured, are large; and the tail is of moderate length or short. The hairs are ringed with different colours, and the general colour is olive-yellow, grey or brownish. The typical, and at the same time the smallest representative of the group is the yellow baboon (*P. cynocephalus* or *P. babuin*) (fig. 11), ranging from Abyssinia to Angola and Mozambique, and distinguished by its rather short and grooved muzzle and longish tail, which is nearly as long as the body. The majority of the species, such as the widely spread *P. anubis* (with several local races), *P. sphinx* of West Africa, and the chacma (*P. porcarius*) of South Africa, are included in the sub-genus *Chaeropithecus*, and have the muzzle longer and undivided and the tail shorter, in most the colour is golden-olive with very distinct rings, but in the chacma it is darker. The hamadryad baboon, *P. hamadryas*, of north-east Africa and Arabia, and the closely allied *P. arabicus* of southern Arabia, represent a sub-genus (*Hamadryas*) characterized by the ashy-grey colour and the profuse mantle-like mane of the adult males; the tail being slightly shorter than the body. Lastly, the West African mandrill (*P. maimon*) and drill (*P. leucophaeus*) form the sub-genus *Maimon*, distinguished by the extremely short tail, and the great development of the facial ridges, which are strongly fluted. In the mandrill, which is the most brilliantly coloured of all mammals, the ridges are vermilion and cobalt, while the callosities on the buttocks are of equal brilliance; but in the drill, which has white ear-tufts, the colouring is more sombre (see BABOON and MANDRILL).

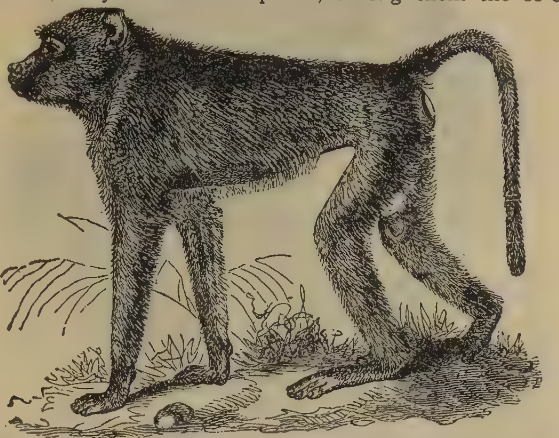

FIG. 11.—The Yellow Baboon (*Papio cynocephalus*).

American Monkeys and Marmosets.—The monkeys and marmosets of tropical America constitute the Platyrrhina, or second section of the Anthropoidea, and are characterized as follows: An additional premolar is present in both jaws, bringing up the number of these teeth to three pairs. The tympanum is ring-like, with no external bony-tube, or meatus; and a tympanic bulla exists. A parieto-zygomatic suture causes the jugal bone to be included in the orbital plate; and the orbito-temporal foramen is large. Cheek-pouches and callosities on the buttocks are wanting. The descending colon does not form a sigmoid flexure; and the caecum is generally bent in a hook-like form, with, at most, very slight narrowing of its terminal extremity. The cartilage forming the inter-nasal septum is broad, and the nostrils are directed obliquely outwards. The tail, which never has fewer than fourteen vertebrae, is generally as long as the body, and frequently prehensile. The ethmoturbinals are originally separate; and the laryngeal sac, when present, is of peculiar type. Usually there is only a simple primary discoid placenta, but rudiments of a secondary one have been recently described.

The first family, or *Cebidae*, includes the American monkeys, as distinct from marmosets, which present the following characteristics: The ears are more or less naked externally. The terminal joints of the fingers and toes carry flat or curved nails; and the thumb, when present, is opposable to the other fingers. Except in the uakaris, the tail is long, generally short-haired, and frequently with a terminal bare surface for prehension. Dentition $i.\ \frac{2}{2}$, $c.\ \frac{1}{1}$, $p.\ \frac{3}{3}$, $m,\ \frac{3}{3}$. Generally a foramen (entepicondylar) in the inner side of the lower end of the humerus. As a rule, only a single offspring is produced at a birth. Ranging over tropical America, the *Cebidae* have their headquarters in the vast Brazilian forests, where so many of the animals are more or less arboreal in their habits. These monkeys are completely arboreal, more so, indeed, than the gibbons among the Catarrhina.

The first sub-family, *Alouatinae*, is represented only by the howlers, *Alouata* (or *Mycetes*), characterized by the long prehensile tail with the extremity naked below, the well-developed thumb, and the extension of the hyoid-bone into an enormous bladder-like chamber contained between the two branches of the lower jaw (fig. 3). In this bony cup is received one of the three or five laryngeal sacs. There are about half a dozen species, with several sub-species; three of the best known being *A. seniculus*, *A. belzebul* and *A. ursina*. Several are brilliantly coloured, with bright or golden hair on the flanks; but in the Amazonian *A. nigra* the male is black and the female straw-coloured. The muzzle is longer than in other *Cebidae* (see HOWLER).

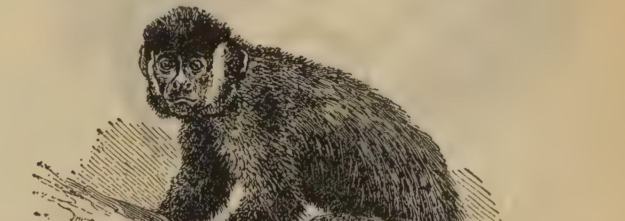

FIG. 12.—The White-cheeked Capuchin (*Cebus lunatus*).

The *Cebinae* include the typical members of the family, characterized by the large brain, of which the elongated hemispheres cover the cerebellum; the brain-case of the skull being, of course, elongated in proportion. The lumbar vertebrae are short, with upright comb-like processes, instead of the rhomboidal ones of the howlers. The lower jaw and hyoid are of normal form. In the first section of the sub-family the tail is evenly haired throughout, the thumb well developed, the limbs of medium length, with the front not longer than the hind pair, the nails curved, and the humerus with an entepicondylar foramen. The typical genus *Cebus* includes the numerous species of capuchins, many of which are so commonly seen in captivity. They are stouter in build and smaller in size than the spider-monkeys, and their tails are only prehensile to a small extent, but are commonly carried spirally rolled. The conical upper canines project below the upper lip, and the molars have blunt low cusps. Well-known species are the white-cheeked capuchin, *C. lunatus* (fig. 12), of south Brazil; the true capuchin, *C. capucinus*, ranging from Guiana to Brazil; and the brown capuchin, *C. fatuellus*, of Guiana; all of these showing the black crown from which these monkeys take their popular name. The most northern representative of the group is the white-throated *C. hypoleucus*, which ranges to Costa Rica. The squirrel-monkeys, *Chrysothrix* (or *Saimiris*), of which *C. sciureus* is the most familiar representative, are not unfrequently placed in the *Nyctipithecinae*, although their true position seems to be here. They differ from *Cebus* by their smaller size and more delicate build, by the tail being scarcely at all prehensile, by the smaller canines, smaller and more sharply cusped molars, and the large and closely-approximated orbits, whose inner walls are partly membranous (see CAPUCHIN and SQUIRREL-MONKEY).

The second section of the sub-family includes the spider-monkeys (fig. 13), and is characterized by the completely prehensile tail, with the inner surface of the tip naked, the rudimentary condition or absence of the thumb, the laterally compressed and more or less pointed nails, and the absence of an entepicondylar foramen to the humerus. The limbs, too, are very long and slender, with the front pair of greater length than the hind ones. The caecum approximates to that of the Catarrhina, having its terminal extremity pointed. The true spider-monkeys (*Ateles*) lack the thumb, and have the nails but slightly compressed and pointed, the limbs very long, the nasal septum of ordinary width, and the fur not woolly. Nearly all have the hair on the head, except that of the forehead, directed forwards. There are nearly a dozen species. In these monkeys so powerful is the grasp of the tail that the whole body can be sustained by this organ alone. It even serves as a fifth hand, as detached objects, otherwise out of reach, can be grasped by it, and brought towards the hand or mouth. Their prehension is in other respects exceptionally defective, owing to the loss of the thumb. Spider-monkeys are very gentle in disposition; and, by this and their long limbs and fitness for tree-life, seem to represent the gibbons of the Old World. Nevertheless, in spite of their admirable adaptation for arboreal life, their comparatively slow progression offers a marked contrast to the vigorous agility of the gibbons (see SPIDER-MONKEY). The brown spider-monkey (*Brachyteles arachnoides*) of south Brazil alone represents a genus connecting the preceding in some degree with the next, a rudimentary thumb being present, while the fur is woolly, the nails are much compressed, and the nostrils more approximated than usual. In the woolly spider-monkeys of the genus *Lagothrix* (fig. 14) not only is the fur woolly, but the thumb is fairly well developed; the nails are like those of *Brachyteles*, but the nostrils are normal. Humboldt's spider-monkey, *L. humboldti* (or *L. lagotrica*) and the dusky spider-monkey, *L. infumata*, both of which occur in Brazil and Amazonia, alone represent this genus.

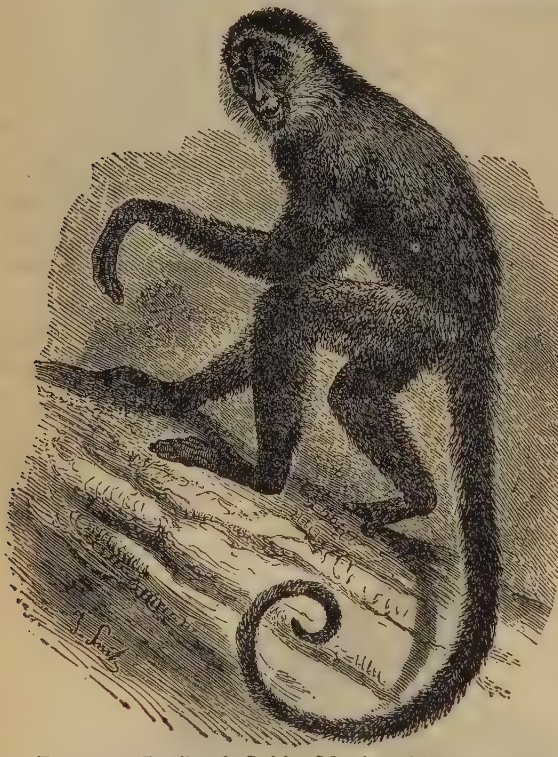

FIG. 13.—Geoffroy's Spider-Monkey (*Ateles geoffroyi*).

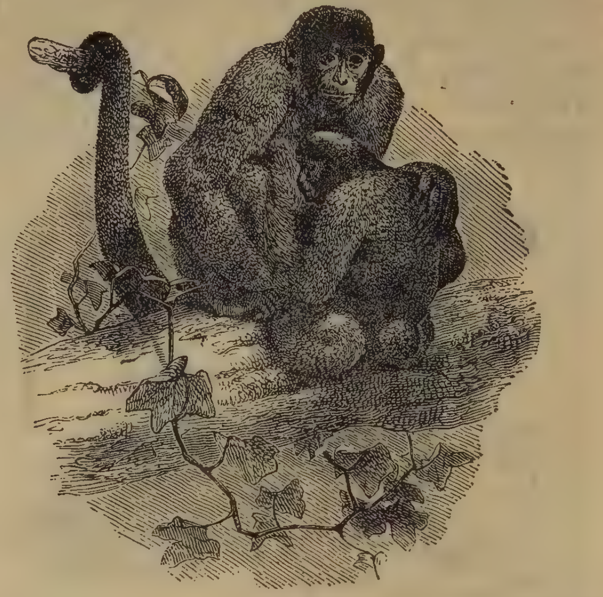

FIG. 14.—Humboldt's Woolly Spider-Monkey (*Lagothrix humboldti*).

Some half-dozen species of the monkeys known as sakis (*Pithecia*) form the typical representatives of the sub-family *Pithecinae*, in which the tail, even when long, is non-prehensile, while the lower incisors are slender and inclined forwards in a peculiar manner, with a gap on each side separating them from the long canine. The hemispheres of the brain cover the cerebellum, the brain-case is elongated, and, despite the absence of a laryngeal sac, the lower jaw is deep with a large angle, thus recalling that of the howlers. There is no caecum. In all cases the thumb is well developed. The arrangement of the hair is very variable. From the other members of the group the sakis are sufficiently distinguished by the long and bushy tail; while they are further characterized by having a large head. In some cases the hair on the crown of the head is divided by a transverse parting, so as to overhang the upper part of the face. *P. satanas* of Pará and *P. chiropotes* of Guiana are well-known species. The uakaris (*Uacaria* or *Cothurus*) of Amazonia are broadly distinguished from all other *Cebidae* by their short or rudimentary tails; *Ua. calva* being remarkable for its brilliant red jaw and pale chestnut hair (see UAKARI).

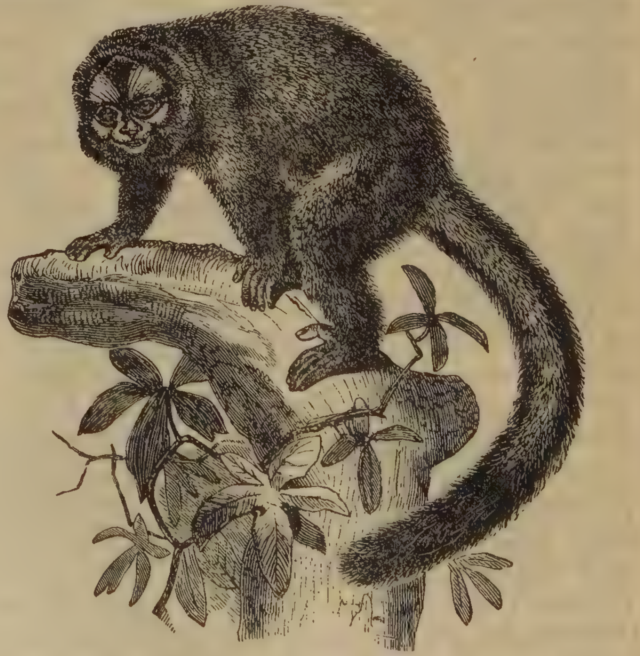

FIG. 15.—Lemur-like Douroucouli (*Nyctipithecus felinus*).

The last and lowest representatives of the *Cebidae* constitute the sub-family *Nyctipithecinae*, the members of which are cat-like monkeys, with woolly or bushy hair, short, conical muzzles, non-prehensile tails and well-developed thumbs. The brain-case of the skull is not elongated, and the hemispheres of the brain do not cover the cerebellum. The lumbar vertebrae are elongated, with long, sharp, backwardly directed spinal processes; the hinder part of the lower jaw is tall; and there is no laryngeal sac. The long and hooked caecum has its terminal portion constricted. In accordance with their nocturnal habits, the douroucoulis (*Nyctipithecus*) are easily recognized by their large and closely approximated eyes, which are, however, separated by a complete septum, the comparatively narrow nasal septum, small ears buried in the woolly fur, and long bushy tail. Well-known species are the lemur-like douroucouli (*N. felinus*, fig. 15) of Amazonia, Peru and Ecuador, and *N. vociferans*, with a nearly similar distribution. The titis, *Callithrix* (or *Callicebus*[1]), are smaller monkeys (fig. 16), with more forwardly directed eyes, which are not surrounded by a radiating fringe of hair and a wider nasal septum. The titis are represented by about ten species, of which *C. moloch* is represented in fig. 16. Most of them are confined to Amazonia, but a few among them *C. moloch*, reach the east coast. Like the marmosets, they feed largely upon insects and grubs.

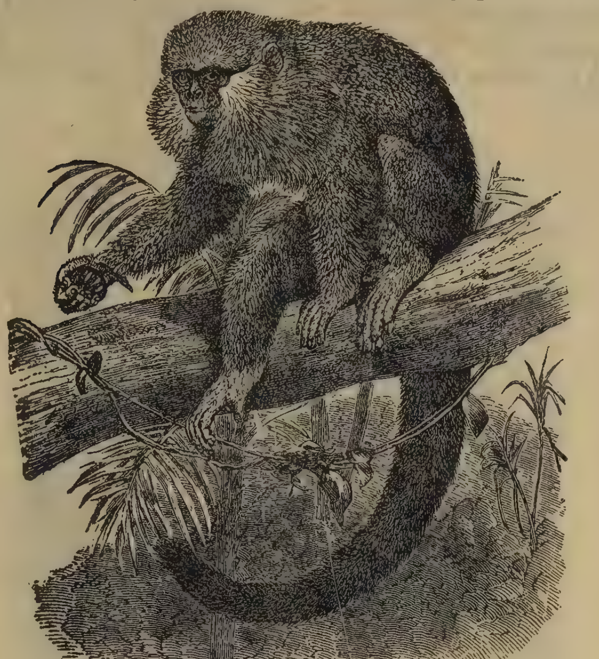

FIG. 16.—The Moloch Titi (*Callithrix moloch*).

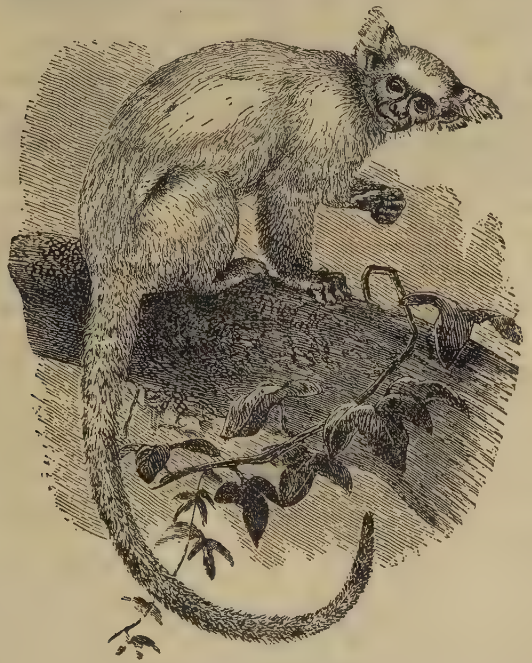

FIG. 17.—The Golden Marmoset (*Hapale chrysoleuca*).

The second and last family of the Platyrrhina is represented by the marmosets or oustitis (*Hapalidae*), all of which are small monkeys, with the ears hairy externally, and the nails, except that of the great toe, claw-like, the thumb non-opposable, the tail long, bushy and non-prehensile, and only two molars in each jaw, the dental formula thus being *i.* $\frac{2}{2}$, *c.* $\frac{1}{1}$, *p.* $\frac{3}{3}$, *m.* $\frac{2}{2}$. The humerus has no entepicondylar foramen. Three young are produced at a birth. Marmosets are divided into two genera, those in which the lower canines are not markedly larger than the incisors constituting the typical *Hapale*, while such as have the lower canines taller than the teeth between them form the genus *Midas*. These squirrel-like little monkeys, in which the great toe can be opposed to the other toes, range as far north as 15° N., where they are represented by *Midas geoffroyi*, and as far in the opposite direction as the southern tropic, where *M. chrysopygus* and *M. rosalia* occur. The colour and the length of the hair are very variable, some species having long silky pale-chestnut hair (fig. 17) and tufted ears, while in others the hair is comparatively short and black, or black with brown bars, while the ears are not tufted (see MARMOSET).

Lemurs, Prosimiae.—Although the likeness generally takes the form of a more or less grotesque caricature, the faces of all monkeys and apes present, in greater or less degree, some resemblance to the human countenance. In the lower group of Primates, commonly known as lemurs, or lemuroids, this resemblance is wholly lost, and the face assumes an elongated and fox-like form, totally devoid of that "expression" which is so characteristic of man and the higher apes and monkeys.

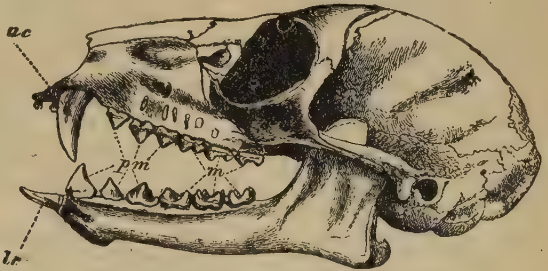

FIG. 18.—Skull of Ring-tailed Lemur (*Lemur catta*).
uc, Upper canine. *pm*, Premolars.
lc, Lower canine. *m*, True molars.

Lemurs, Prosimiae or Lemuroidea, which form a group confined to the tropical regions of the Old World and more numerously represented in Madagascar than elsewhere, are arboreal and for the most part crepuscular or nocturnal Primates, feeding on insects or fruits, or both together and collectively characterized as follows. The tail, which is generally long and thickly haired, is never prehensile. As a rule, there is a single pair of pectoral teats, but an additional abdominal or even inguinal pair may be present. The thumb and great toe are opposable to the other digits, the former being provided with a flat nail, while the second toe is always furnished with a claw; the fourth toe is longer than all the rest, and the second, or index, finger is small or rudimentary. In the skull (fig. 18) the orbital ring is formed by the frontal and jugal bones, and, except in the *Tarsiidae*, there is a free communication between the orbit and the temporal fossa; the lachrymal foramen is situated outside the orbit (fig. 18); the tympanic either forms a free semicircle in the auditory bulla or enters into the formation of the latter; and the foramen rotundum is generally fused into the sphenoidal fissure. Interparietal bones are frequently developed, and the two halves of the lower jaw are generally welded together in front. Except in the genus *Perodicticus*, the humerus is furnished with an entepicondylar foramen at the lower end; the centrale of the carpus is generally free; and the femur is usually provided with a third trochanter. The cerebellum is only partially covered by the hemispheres of the brain, which in the medium-sized and larger species conform to the general type of the same parts in monkeys and apes. The normal dental formula is *i.* $\frac{2}{2}$, *c.* $\frac{1}{1}$, *p.* $\frac{3}{3}$, *m.* $\frac{3}{3}$, or the same as in American monkeys; but the upper incisors are small and separated from each other, while the lower ones are large and approximated to the incisor-like canine; the molars have three or four cusps. In all cases the stomach is simple and a caecum present. The testicles are contained in a scrotum, the penis has a bone, the uterus is bicornuate and the urethra perforates the clitoris. The placenta may be either diffuse, with a large allantoic portion, and non-deciduate, or discoidal and deciduate. As a rule, only a single offspring is produced at a birth. Very noteworthy is the occurrence in the females of the Asiatic lorisis of what appears to be the vestige of a marsupial apparatus, attached to the front of the pelvis. *Lemur catta* also possesses the rudiment of a marsupial fold; while in both sexes of the aye-aye occurs a skin-muscle corresponding to the *sphincter marsupii* of marsupials.

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[1] Apparently the name *Callithrix* was originally given to the marmosets, and if transferred to that group should be replaced by *Callicebus*.

The distribution of existing lemurs is very peculiar, the majority of the species inhabiting Madagascar, where they for the most part dwell in small patches of forest, and form about one-half the entire mammalian fauna of the island. The remaining species inhabit Africa south of the Sahara and the Indo-Malay countries.

Tarsier.—The tiny little large-eyed Malay lemuroid known as the tarsier, *Tarsius spectrum* (or *T. tarsius*), of the Malay Peninsula and islands, together with its Celebean and Philippine representatives, alone constitutes the section Tarsiina (and the family *Tarsiidae*), which has the following distinctive characteristics: The lower incisor is vertical and the canine of normal form, while the upper incisors are in contact; the orbit is cut off from the temporal fossa by a bony plate, leaving only a small orbital fissure; the tympanum enters into the formation of the auditory meatus, through which passes the canal for the internal carotid artery; the tibia and fibula in the hind-leg are fused together, and the calcaneum and navicular of the tarsus elongated. The tarsier seems to be a primitive form which makes a certain approximation to the Anthropoidea, and differs from other lemuroids in the structure of its placenta. The dental formula is *i.* $\frac{2}{1}$, *c.* $\frac{1}{1}$, *p.* $\frac{3}{3}$, m. $\frac{3}{3}$, total 34. Tarsiers have enormous eyes, occupying the whole front of the orbital region, and are purely nocturnal in their habits, living in trees on the branches of which they move by hopping, a power they possess owing to the elongation of the tarsal bones (see Tarsier).

Malagasy Lemurs.—All the other Prosimiae may be grouped in a second section, the Lemurina, characterized as follows: The lower incisors and the canine are similar in form and inclined forwards (fig. 18); the upper incisors are small and separated by an interval in the middle line; the orbits communicate largely with the temporal fossae; the internal carotid artery enters the skull in advance of the auditory meatus through the foramen lacerum anterius; and the tibia and fibula are separate. The Malagasy lemurs are now all included in the single family *Lemuridae*, which is confined to Madagascar and the Comoro Islands, and characterized by the tympanic ring lying free in the auditory bulla. The typical sub-family *Lemurinae*, which includes the majority of the family group, is characterized by all the fingers except the index having flat nails, the elongation of the facial portion of the skull, the large hemispheres of the brain not covering the cerebellum, the occasional presence of two inguinal in addition to the normal pectoral teats, the dental formula *i.* $\frac{2}{2}$, *c.* $\frac{1}{1}$, *p.* $\frac{3}{3}$, *m.* $\frac{3}{3}$, with the first upper incisor generally small and sometimes wanting, and the hinder cusps of the upper molars smaller than the front ones. These lemurs are woolly-haired animals, often nearly as large as cats, with the legs longer than the arms, the tail long and bushy, and the spinal processes of the last dorsal and the lumbar vertebrae inclined. In the typical genus *Lemur* (fig. 19), the tarsus is of normal length, the tail at least half as long as the body, the ears are tufted, there are no inguinal teats, the last premolar is not markedly broader than the others, and the upper molars have a conspicuous cingulum. These lemurs have long fox-like faces, and habitually walk on the ground or on the branches of trees on all fours, although they can also jump with marvellous agility. They are gregarious, living in small troops, are diurnal in their habits, but most active towards evening, when they make the woods resound with their loud cries, and feed, not only on fruits and buds, but also on eggs, young birds and insects. When at rest or sleeping, they generally coil their long, bushy tails around their bodies, apparently for the sake of the warmth it affords. They have usually a single young one at a birth, which is at first nearly naked, and is carried about, hanging close to and almost concealed by the hair of the mother's belly. After a while the young lemur changes its position and mounts upon the mother's back, where it is carried about until able to climb and leap by itself. One of the most beautiful species is the ring-tailed lemur (*L. catta*, fig. 19), of a delicate grey colour, and with a long tail marked with alternating rings of black and white. This is said by G. A. Shaw to be an exception to other lemurs in not being arboreal, but living chiefly among rocks ~~and~~ bushes. Pollen, however, says that it inhabits the forests of the south-west parts of Madagascar, living, like its congeners, in considerable troops, and not differing from them in its habits. He adds that it is extremely gentle, and active and graceful in its movements, and utters at intervals a little plaintive cry like that of a cat. All the others have the tail of uniform colour. The largest is *L. varius*, the ruffed lemur, sometimes black and white, and sometimes reddish-brown, the variation apparently not depending on sex or age, but on the individual. In *L. macaco* the male is black and the female red *L. mongoz*, *L. fulvus* and *L. rubriventer* are other well-known species.

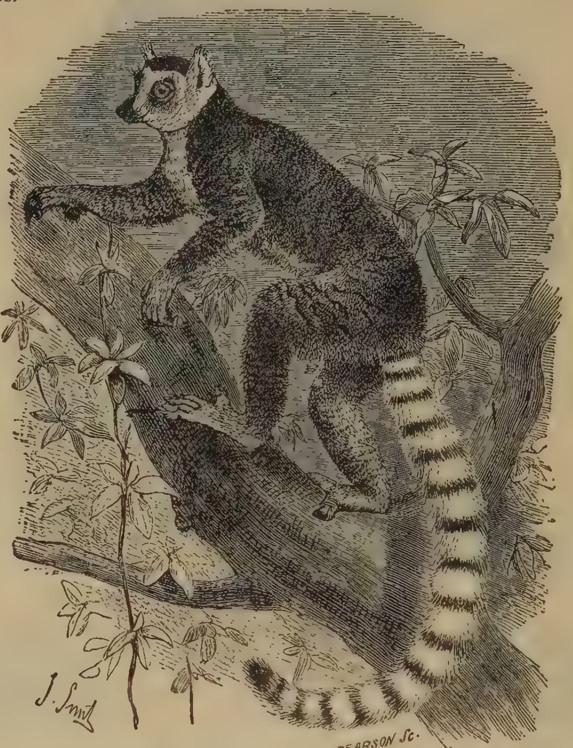


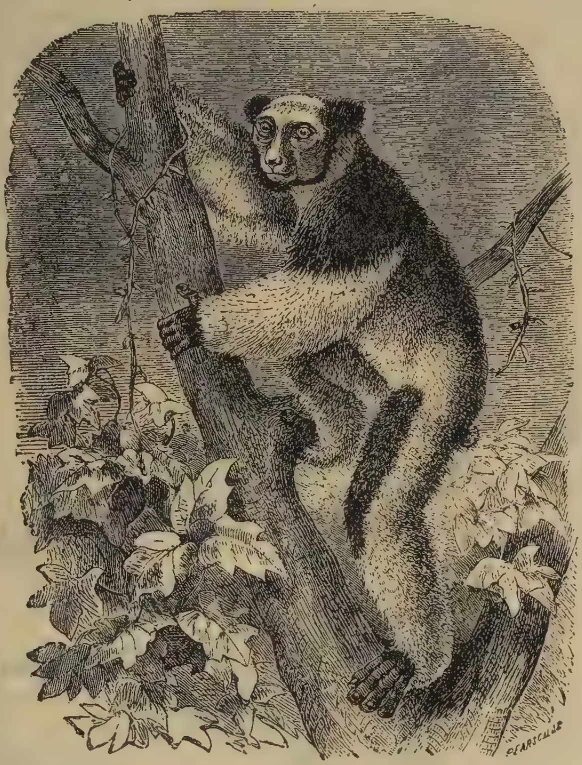
Fig. 19.—The Ring-tailed Lemur (*Lemur catta*).

In all these lemurs the small upper incisors are not in contact with one another or with the canine, in front of which they are both placed. In the species of *Hapalemur*, on the other hand, the upper incisors are very small, sub-equal and separated widely in the middle line; those of each side in contact with each other and with the canine, the posterior one being placed on the inside, and not in front of the latter. Muzzle very short and truncated. Two inguinal teats, in addition to the normal pectoral pair, are present. The last premolar is broader than those in front, and the upper molars lack a distinct cingulum. The typical *H. griseus* is smaller than any of the true lemurs, of a dark-grey colour, with round face and short ears. It is quite nocturnal, and lives chiefly among bamboos, subsisting on the young shoots. The second species has been named *H. simus*. In *Hapalemur* there is no free centrale to the carpus, and the same is the case with the six or seven species of *Lepidolemur* (*Lepilemur*), in which the first upper incisor is rudimentary or wanting, while the second may also be wanting in the adult. There are small lemurs, with small premaxillae, short snouts, tails shorter than the body, bladder-like mastoid processes, and the upper molars with an inconspicuous cingulum and the hind-cusps of the last two rudimentary; the fourth upper premolar being relatively broad. *Mixocebus caniceps* is an allied generic type (see Lemur)

The small Malagasy lemurs of the genera *Chirogale*, *Microcebus* and *Opolemur* differ from the preceding in the elongation of the calcaneum and navicular of the tarsus, on which grounds they have been affiliated to the African galagos. The difference in the structure of the tympanum in the two groups indicates, however, that the elongation of the tarsus has been independently developed in each group. These lemurs have short, rounded skulls, large eyes, long hind limbs and tail, large ears, the first upper incisor larger than the second, the last upper premolar much smaller than the first molar and furnished with only one outer cusp, and the mastoid not bladder-like. Some are less than a rat in size, and all are nocturnal. One of the largest, *Microcebus furcifer*, is reddish-grey, and distinguished by a dark median stripe on its back which divides on the top of the head into two branches, one of which passes forwards above each eye. The most interesting peculiarity of these lemurs is that certain species (*Opolemur samati*, *Chirogale milii*, &c.) during the dry season coil themselves up in holes of trees, and pass into a state of torpidity, like that of the hibernating animals in the winter of northern climates. Before this takes place an immense deposit of fat accumulates upon certain parts of the body, especially the basal portion of the tail. The smallest species, *M. pusillus*, lives among the slender branches on the tops of the highest trees, feeding on fruit and insects, and making nests like those of birds.

In the sub-family *Indrisinae* the dentition of the adult consists of thirty teeth, usually expressed by the formula *i.* $\frac{2}{1}$, *c.* $\frac{1}{1}$, *p.* $\frac{2}{2}$, *m.* $\frac{3}{3}$; but possibly *i.* $\frac{2}{2}$, *c.* $\frac{1}{0}$, *p.* $\frac{2}{2}$, *m.* $\frac{3}{3}$. In the milk-dentition there are twenty-two teeth, the two additional teeth in the fore part of the lower jaw having no successors in the permanent series. Hind limbs greatly developed, but the tarsus normal, the great toe of large size, and very opposable; the other toes united at their base by a fold of skin, which extends as far as the end of the first phalange. The thumb is but slightly opposable; and all the fingers and toes are hairy. The length of the tail is variable. Two pectoral teats. Caecum very large, and colon extremely long and spirally coiled. The brain is large and the thorax wide.

The animals of this group are essentially arboreal, and feed exclusively on fruit, leaves, buds and flowers. When they descend to the ground, which is but seldom, they sit upright on their hind legs, and move from one clump of trees to another by a series of short jumps, holding their arms above them in the air. Among them are the largest members of the order. The genus *Indris* has the upper incisors sub-equal in size; upper canine larger than the first premolar, muzzle moderately long, ears exserted. Carpus without an os centrale. Tail rudimentary. Vertebrae: C.7, D.12, L.9, S.4, Ca.9. The indri (*I. brevicaudatus*, fig. 20), discovered by Sonnerat in 1780, is the largest of the group, and has long woolly hair, partly brown and partly white. In the sifakas, *Propithecus*, of which there appear to be three species, with numerous local races, the second upper incisor is much smaller than the first. Upper canine larger than the first premolar. Muzzle rather short. Ears short, concealed by the fur. An os centrale in the carpus. Tail long. Vertebrae: C.7, D.12, L.8, S.3, Ca.28. In *Avahis*, represented only by *A. laniger*, the second upper incisor is larger than the first. Upper canine scarcely larger than the first premolar. Muzzle very short. Ears very small and hidden in the fur, which is very short and woolly. Carpus without os centrale. Tail long. Vertebræ: C.7, D.11, L.9, S.3, Ca.23 (see INDRI and SIFAKA).



(From Milne-Edwards and Grandidier.)

FIG. 20.—The Indri (*Indris brevicaudatus*).

The last sub-family, *Chiromyinae* (formerly regarded as a family), is represented only by the aye-aye, *Chiromys* (or *Daubentonia*) *madagascariensis*, and has the following characteristics: Dentition of adult, *i.* $\frac{1}{1}$, *c.* $\frac{0}{0}$, *p.* $\frac{1}{0}$, *m.* $\frac{3}{3}$, total 18. Incisors (fig. 21) very large, compressed, curved, with persistent pulps and enamel only in front, as in rodents. Teeth of cheek-series with flat indistinctly tuberculated crowns. In the young, the first set of teeth more resemble those of normal lemurs, being *i.* $\frac{2}{2}$, *c.* $\frac{1}{0}$, *m.* $\frac{2}{2}$, all very small. Four teats, inguinal in position, a feature peculiar to this species. All the digits of both feet with pointed, rather compressed claws, except the great toe, which has a flattened nail; middle digit of the hand excessively attenuated. Vertebrae: C.7, D.12, L.6, S.3, Ca.27 (see AYE-AYE).

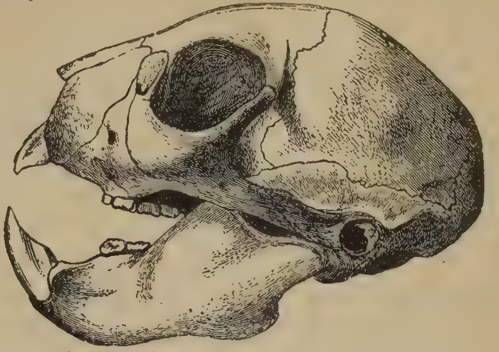


FIG. 21.—Skull of the Aye-aye (*Chiromys madagascariensis*).

Galagos and Lorises.—The lemurs of Africa and the Indo-Malay countries—commonly miscalled sloths—differ from the *Lemuridae* in that the tympanic enters into the formation of the auditory meatus, in consequence of which they are referred to a family by themselves, the *Nycticebidae*, which is in turn divided into two sub-families, *Galaginae* and *Nycticebinae*. The African galagos or *Galaginae*, which have the same dental formula as the *Lemuridae*, are distinguished by the elongation of the calcaneum and navicular of the tarsus. In the single genus *Galago*, with the sub-genera *Otolemur* and *Hemigalago*, the last upper premolar, which is nearly as large as the first molar, has two large external cusps. Vertebrae: C.7, D.13, L.6, S.3, Ca.22–26. Tail long, and generally bushy. Ears large, rounded, naked and capable of being folded at the will of the animal. Teats four, two pectoral and two inguinal (see GALAGO). The lorises, *Nycticebinae* (*Lorisinae*), are distinguished as follows: Index-finger very short, sometimes rudimentary and nailless. Fore and hind limbs nearly equal in length. Tarsus not specially elongated. Thumb and great toe diverging widely from the other digits, the latter especially being habitually directed backwards. Tail short or rudimentary. Teats two or four. Lorises and pottos (as the African representatives of the group are called) are essentially nocturnal, and remarkable for the slowness of their movements. They are completely arboreal, their limbs being formed only for climbing and clinging to branches, not for jumping or running. They have rounded heads, very large eyes, short ears and thick, short, soft fur. They feed, not only on vegetable substances, but, like many of the *Lemuridae*, also on insects, eggs and birds, which they steal upon while roosting at night. One of the greatest anatomical peculiarities of these animals is the breaking up of the large arterial trunks of the limbs into numerous small parallel branches, constituting a *rete mirabile*, which is found also in the sloths, with which the lorises are sometimes confounded on account of the slowness of their movements. The Asiatic lorises, which are divided into two genera, are characterized by the retention of the normal number of phalanges in the small index-finger, and the presence of a pair of minute abdominal teats (the existence of which has only recently been discovered by Messrs Annandale and Willey). In the slow lorises, forming the genus *Nycticebus* (fig. 22), the first upper incisor is larger than the second, which is often early deciduous. Inner margin of the orbits separated from each other by a narrow flat space. Nasal and

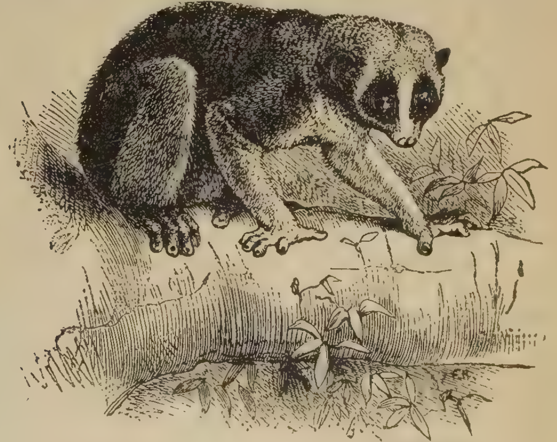

(From A. Milne-Edwards.)

FIG. 22.—The Slow Loris (*Nycticebus tardigradus*).

premaxillary bones projecting but very slightly in front of the maxillae. Body and limbs stout. No tail. Vertebrae: C.7, D.17, L.6, S.3, Ca.12. The single species *N. tardigradus*, with several races, inhabits eastern Bengal, the Malay countries, Sumatra, Borneo, Java, Siam and Cochin China. These lorises lead solitary lives in the recesses of large forests, chiefly in mountainous districts, where they sleep during the day in holes or fissures of large trees, rolled up into a ball, with the head between the hind legs. On the approach of evening they awake, and during the night ramble among the branches of trees slowly, in search of food, which consists of leaves and fruit, small birds, insects and mice. When in quest of living prey they move noiselessly till quite close, and then suddenly seize it with one of their hands. The female produces but one young at a time. In the second genus, represented only by the slender loris (*Loris gracilis*) of southern India and Ceylon, the upper incisors are very small and equal. Orbits very large, and only separated in the middle line above by a thin vertical plate of bone. Nasals and premaxillae produced forwards considerably beyond the anterior limits of the maxillae, and supporting a pointed nose. Body and limbs slender. No external tail. Vertebrae: C.7, D.14, L.9, S.3, Ca.6. The slender loris is about the size of a squirrel, of a yellowish-brown colour, with large, prominent eyes, pointed nose, long thin body, long, angularly bent, slender limbs and no tail. Its habits are like those of the rest of the group. The Indian and Ceylon races are distinct (see LORIS).

The African pottos, *Perodicticus*, differ by the reduction of the index-finger to a mere nailless tubercle, and apparently by the absence of abdominal teats. In the typical section of the genus there is a short tail, about a third of the length of the trunk. Two or three of the anterior dorsal vertebrae have very long slender spinous processes which in the living animal project beyond the general level of the skin forming distinct conical prominences, covered only by an exceedingly thin and naked integument. *P. potto*, the potto, is one of the oldest known members of the lemuroids having been described in 1705 by Bosman, who met with it in his voyage to Guinea. It was, however, lost sight of until 1835, when it was rediscovered in Sierra Leone. It is also found in the Gaboon and the Congo, and is strictly nocturnal and slower in its movements even than *Nycticebus tardigradus*, which otherwise it much resembles in its habits. A second species, *P. batesi*, inhabits the Congo district. A third species, the awantibo (*P. calabarensis*), rather smaller and more delicately made, with smaller hands and feet and rudimentary tail, constitutes the sub-genus *Arctocebus*. It is found at Old Calabar, and is very rare. Vertebrae: C.7, D.15, L.7, S.3, Ca.9.

Extinct Primates

The most interesting of all the extinct representatives of the order is *Pithecanthropus erectus* (*q.v.*), which is represented by the imperfect roof of a skull, two molars and a femur, discovered in a bed of volcanic ash in Java. The forehead is extremely low, with beetling brow-ridges, and the whole calvarium presents a curiously gibbon-like aspect. The capacity of the brain-case is estimated to have equalled two-thirds that of an average modern man. The creature is regarded as transitional between the higher apes, more especially the *Hylobatidae* and the lowest representatives of the genus *Homo*, such as the Neanderthal men. From the Lower Pliocene of India has been obtained the palate of a chimpanzee-like ape, which by some is referred to the existing *Anthropopithecus*, while by others it is considered to represent a genus by itself—*Palaeopithecus*. The same formation has yielded the canine tooth of a large ape, apparently referable to the existing Asiatic genus *Simia*. From the Miocene of Europe has been described the genus *Dryopithecus*, typified by *D. fontani*, a generalized ape of the size of a chimpanzee, related, perhaps, both to the *Simiidae* and the *Hylobatidae*. The Lower Pliocene of Germany has yielded other remains referred to a distinct genus under the name of *Paidopithex rhenanus*. From the Miocene of the Vienna basin Dr O. Abel has described certain ape-remains under the name of *Griphopithecus suessi*, as well as others regarded as representing a species of *Dryopithecus* with the name *D. darwini*. As regards the first, all that can be said is that it indicates a member of the group to which *Dryopithecus* belongs. It has been suggested that the latter genus is closely related to man, but this idea is discountenanced by the great relative length of the muzzle and the small space for the tongue. Teeth of another man-like ape from the Tertiary of Swabia, described under the preoccupied name *Anthropodus*, have been re-named *Neopithecus*. The genus *Anthropodus* is represented by remains of an ape of doubtful position from the French Pliocene. *Pliopithecus* from the French Miocene is certainly a gibbon, perhaps not distinguishable from *Hylobates*.

Oreopithecus, from the Miocene of Tuscany, is perhaps intermediate between gibbons and baboons (*Papio*), the latter of which, as well as *Macacus*, are represented in the Indian Pliocene. *Mesopithecus*, of the Grecian Lower Pliocene, presents some characters connecting it with *Semnopithecus* and others with *Macacus*. An allied type from the Lower Pliocene of France is *Dolichopithecus*, taking its name from the elongated skull; while *Macacus* occurs in the Upper Pliocene and Pleistocene of several parts of Europe. *Cryptopithecus*, from the Swiss Oligocene, appears to be the oldest known Old World monkey. From the Miocene of Patagonia are known certain monkeys described as *Homunculus*, *Anthropops*, &c., apparently more akin to the *Cebidae* but perhaps representing an extinct family.

Passing on to the lemurs, it may be mentioned in the first place that G. Grandidier has described an extinct lemur from the Tertiary of France, which he believes to be nearly related to the slow lorises, and has accordingly named *Pronycticebus gaudryi*. If the determination be correct the discovery is of interest as tending to link the modern faunas of southern India and West Africa (which possess many features in common) with the Tertiary fauna of Europe. Certain remarkable extinct lemuroids of large size have been discovered in the superficial deposits of Madagascar, in one of which (*Megaladapis*) the upper cheek-teeth are of a tritubercular type (fig. 23), while in the second and smaller form (*Nesopithecus*) the dentition makes a notable approximation to that of the *Cercopithecidae*. Each of these genera, which probably survived till a very late date, is generally regarded as typifying a family group. In *Megaladapis* the skull is distinguished by its elongation and the small size of the eye-sockets, the tritubercular upper molars presenting considerable resemblance to those of the living *Lepidolemur*. The brain is of a remarkably low type. In one species the approximate length of the skull is 250, and in the second 330 millimetres. Even more interesting are the two large species of *Nesopithecus*, one of which was at first described as *Globilemur*. They show a very complicated type of brain, and were at first regarded as indicating Malagasy representatives of the Anthropoidea. In regard to the character of the tympanic region of the skull this genus shows several features characteristic of the more typical Malagasy lemuroids; and the eye-sockets are open behind, while the dentition is numerically the same as in some of the latter. On the other hand, in several features *Nesopithecus* resembles the Anthropoidea; the upper incisors are not separated in the middle line, and the upper molars

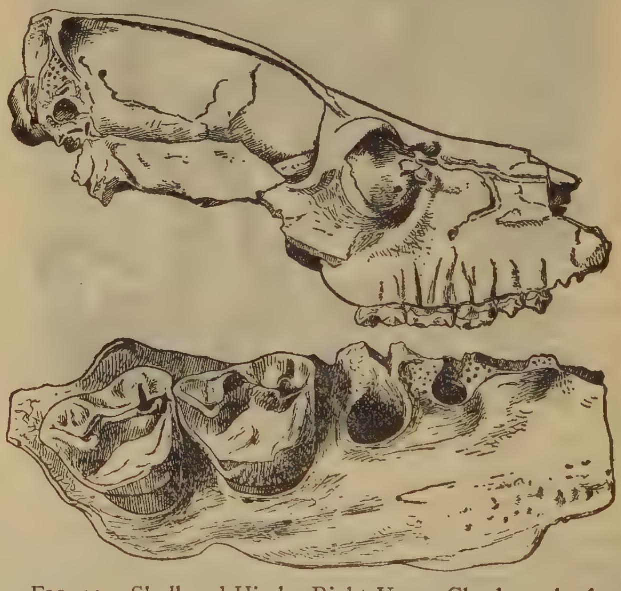


FIG. 23.—Skull and Hinder Right Upper Cheek-teeth of *Megaladapis madagascariensis*.

present the pattern found in the *Cercopithecidae*, while in one species the lachrymal bone and foramen are within the orbit. The resemblances to apes are not confined to the skull, but are found in almost all the bones. Probably the genus may be regarded as a specialized lemuroid. The Oligocene and Eocene formations of Europe and North America have yielded remains of a number of primitive lemuroids, grouped together under the name of *Mesodonta* or *Pseudolemures*, and divided into families severally typified by the genera *Hyopsodus*, *Notharctus*, *Anaptomorphus and Microchoerus* (*Necrolemur*), of which the last two are European and the others American. To particularize the characteristics of the different families would occupy too much space, and only the following features of the group can be mentioned. The dental formula is $i.\frac{3}{3}$, $c.\frac{1}{1}$, $p.\frac{4}{4}$ or $\frac{2}{2}$, $m.\frac{3}{3}$. The canines are often large; the upper molars carry from three to six cusps, while the lower ones are of the tuberculo-sectorial type with either four or five cusps. The lachrymal foramen may be either within or without the orbit, which is in free communication with the temporal fossa, with or without a complete bony ring. The humerus has an entepicondylar foramen. It is specially noteworthy that *Adapis* resembles the *Lemuridae* in the form and relations of the tympanic ring. *Anaptomorphus* has large orbits and tritubercular molars. Certain Middle and Lower Eocene North American genera, such as *Mixodectes* and *Pelycodus*, together with the European *Plesiadapis* and *Protoadapis*, which have been regarded as lemuroids, are now frequently referred to the RODENTIA (*q.v.*). On the other hand, *Metachiromys*, of the Bridger Eocene of America, originally described as a relative of *Chiromys*, has been stated to be an armadillo.

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PRIME, PRIMER AND **PRIMING.** These three words are to be referred to Lat. *primus*, first, "prime," in O. Eng. *prim*, occurs first in the ecclesiastical sense of the Latin *prima hora*, the first hour, one of the lesser canonical hours of the Roman Church (see BREVIARY). Hence the word "primer" (Med. Lat. *primarius*), *i.e.* a book of hours. This was a book for the use of the laity and not strictly a service book. These books originally contained parts of the offices for the canonical hours, the penitential and other psalms, the Litany, devotional prayers and other matter. There were several "Primers" printed in the reign of Henry VIII.; the *King's Primer* of 1545 contained the Calendar, the Commandments, Creed, Lord's Prayer, the penitential psalms, Litany and prayers for special occasions. The primer of William Marshall, the printer and reformer, 1534, is entitled *The Prymer in Englyshe, with certeyn prayers and godly meditations, very necessary for all people that understande not the Latyne Tongue.* Later these primers contained the Catechism, graces before and after meals, and the A. B. C. They were published for children, like the earlier Sarum Primer (1537), and became educational in purpose, as reading books. The earlier primers were also used in this way, as is shown by the "litel child" of Chaucer's *Prioress's Tale*, who sitting "at his prymer, redemptorie herde synge." Thus "primer" or "primmer" became the regular name for an elementary book for learners. For the type known as "great primer" and "long primer," see TYPOGRAPHY.

Apart from the use of "prime" as the period of greatest vigour of life, the first of the guards in fencing, and for those numbers which have no divisors except themselves and unity (see ARITHMETIC), the principal use is that of the verb, in the sense of to insert in the pan of an old-fashioned small arm, the "primer," containing powder which, on explosion by percussion, fires the charge. This use seems to be due to "priming" being the first stage in the discharge of the weapon. Finally "priming" is the first coat of size or colour laid on a surface as a preparation for the body colour.

PRIME MINISTER, or PREMIER, in England, the first minister of the Crown. Until 1905 the office of prime minister was unknown to the law,[1] but by a royal warrant of the 2nd of December of that year the holder of the office, as such, was given precedence next after the archbishop of York. The prime minister is the medium of intercourse between the cabinet and the sovereign; he has to be cognizant of all matters of real importance that take place in the different departments so as to exercise a controlling influence in the cabinet; he is virtually responsible for the disposal of the entire patronage of the Crown; he selects his colleagues, and by his resignation of office dissolves the ministry. Yet he was until 1905, in theory at least, but the equal of the colleagues he appointed. The prime minister is nominated by the sovereign. "I offered," said Sir Robert Peel on his resignation of office, "no opinion as to the choice of a successor. That is almost the only act which is the personal act of the sovereign; it is for the sovereign to determine in whom her confidence shall be placed." Yet this selection by the Crown is practically limited. No prime minister could carry on the government of the country for any length of time who did not possess the confidence of the House of Commons. The prime minister has no salary as prime minister, but he usually holds the premiership in connexion with the first lordship of the treasury, the chancellorship of the exchequer, a secretaryship of state or the privy seal. Sir Robert Walpole must be regarded as the first prime minister—that is, a minister who imposed harmonious action upon his colleagues in the cabinet. This was brought about partly by the capacity of the man himself, partly by the lack of interest of George I. and II. in English home affairs. This creation, as it were, of a superior minister was so gradually and silently effected that it is difficult to realize its full importance. In previous ministries there was no prime minister except so far as one member of the administration dominated over his colleagues by the force of character and intelligence. In the reign of George III. even North and Addington were universally acknowledged by the title of prime minister, though they had little claim to the independence of action of a Walpole or a Pitt.

British Prime Ministers.

Sir R. Walpole . . .	1721–1742
John, Lord Carteret (afterwards Earl Granville) . . .	1742–1744
Henry Pelham . .	1744–1754
Duke of Newcastle .	1754–1756
William Pitt and Duke of Newcastle	1756–1762
Earl of Bute . . .	1762–1763
George Grenville . .	1763–1765
Marquess of Rockingham . . .	1765–1766
W. Pitt, Earl of Chatham . . .	1766–1767
Duke of Grafton .	1767–1770
Lord North . . .	1770–1782
Marquess of Rockingham . . .	1782
Earl of Shelburne (afterwards Marquess of Lansdowne) . . .	1782–1783
Lord North (afterwards Earl of Guilford	1783
W. Pitt	1783–1801
H. Addington (afterwards Viscount Sidmouth) . .	1801–1804
W. Pitt	1804–1806
Lord Grenville . .	1806–1807
Duke of Portland .	1807–1809
Spencer Perceval .	1809–1812
Earl of Liverpool .	1812–1827
G. Canning . . .	1827

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[1] The first formal mention in a public document appears to be in 1878, where, in the opening clause of the treaty of Berlin, the earl of Beaconsfield is referred to as "First Lord of Her Majesty's Treasury, Prime Minister of England."

Viscount Goderich (afterwards Earl of Ripon)	1827–1828
Duke of Wellington	1828–1830
Earl Grey	1830–1834
Viscount Melbourne	1834
Sir R. Peel	1834–1835
Viscount Melbourne	1835–1841
Sir R. Peel	1841–1846
Lord John Russell (afterwards Earl Russell)	1846–1852
Earl of Derby	1852
Earl of Aberdeen	1852–1855
Viscount Palmerston	1855–1858
Earl of Derby	1858–1859
Viscount Palmerston	1859–1865
Earl Russell	1865–1866
Earl of Derby	1866–1868
B. Disraeli (afterwards Earl of Beaconsfield)	1868
W. E. Gladstone	1868–1874
B. Disraeli (Beaconsfield)	1874–1880
W. E. Gladstone	1880–1885
Marquess of Salisbury	1885–1886
W. E. Gladstone	1886
Marquess of Salisbury	1886–1892
W. E. Gladstone	1892–1894
Earl of Rosebery	1894–1895
Marquess of Salisbury	1895–1902
A. J. Balfour	1902–1905
Sir H. Campbell-Bannerman	1905–1908
H. H. Asquith	1908–

PRIMERO (Span. first), a card game of Spanish origin, which Strutt calls "the oldest game of cards played in England." It is described as having a close resmblance to *Ombre* (*q.v.*), by which it had been superseded. In both games the spadillo or ace of spades was the best card, but Primero was played with six cards and *Ombre* with nine. The exact method of play is uncertain.

PRIME VERTICAL, in astronomy, the vertical circle passing east and west through the zenith, and intersecting the horizon in its east and west points (see ASTRONOMY).

PRIMITIVE METHODIST CHURCH, THE, a community of nonconformists, which owes its origin to the fact that Methodism as founded by the Wesleys tended, after the first generation, to depart from the enthusiasm that had marked its inception and to settle down to the task of self-organization. There were, however, some ardent spirits who continued to work along the old lines and whose watchword was revivalism, and out of their efforts came the Bible Christian, the Independent Methodist and the Primitive Methodist denominations. These enthusiastic evangelists esteemed zeal a higher virtue than discipline and decorum, and put small emphasis on church systems as compared with conversions. One of the men to whom Primitive Methodism owes its existence was Hugh Bourne (1772–1852), a millwright of Stoke-upon-Trent. He joined a Methodist society at Burslem, but business taking him at the close of 1800 to the colliery district of Harrisehead and Kidsgrove, he was so impressed by the prevailing ignorance and debasement that he began a religious revival of the district. His open-air preaching was accompanied by prayer and singing, a departure from Wesley's practice and the forerunner of the well-known "Camp Meeting." A chapel was built at Harrisehead, and a second revival occurred in September 1804, largely the result of a meeting held at Congleton by some enthusiasts from Southport. One of the after-fruits of this revival was the conversion (Jan. 1805) of the joint founder of Primitive Methodism, William Clowes (1780–1851), a native of Burslem, who had come to Tunstall. Clowes was a man of fine appearance and open disposition, with a compelling personality that found expression in a steady glance and a thrilling voice. He was a potter by trade, and had a national reputation as a dancer. He joined a Methodist class, threw his house open for love-feasts and prayer-meetings, and did a great deal of itinerant evangelization among the cottages of the countryside. Lorenzo Dow (1777–1834), an eccentric American Methodist revivalist, visited North Staffordshire and spoke of the camp-meetings held in America, with the result that on the 31st of May 1807 the first real English gathering of the kind was held on Mow Cop, since regarded as the Mecca of Primitive Methodism. It lasted from 6 a.m. to 8 p.m., and Bourne and his friends determined to continue the experiment as a counterblast to the parish wakes of the time, which were little better than local saturnalia. Opposition from a master potter of the district, who threatened to put the Conventicle Act in force, was overcome, but more serious difficulties were presented by the antagonism of the Wesleyan Methodist circuit authorities. But Bourne and his friends persisted against both Conference and the local superintendent, who issued bills declaring that no camp-meeting would be held at Norton in August 1807. The meeting was held and ten months later Bourne was expelled by the Burslem Quarterly Meeting, ostensibly for non-attendance at class (he had been away from home, evangelizing), really, as the Wesleyan superintendent told him "because you have a tendency to set up other than the ordinary worship" which was precisely the reason why, fifty years earlier, the Anglican Church had declined to sanction the methods of John Wesley. The camp-meetings went steadily on, and their influence is reflected in the writings of George Eliot, George Borrow and William Howitt. The societies which Bourne formed were for a time allowed to go under (Wesleyan) Methodist protection, but the crisis came in 1810, when the Stanley class of ten members declined to wash their hands of the Camp-Meeting Methodists, and so were refused admission. About this time, too (1809), Bourne appointed James Crawfoot, a Wesleyan local preacher who had been removed from the list for assisting the Independent Methodists, as a travelling preacher at 10s. a week, instructing him to give his whole time to evangelization and to get his converts to join the denominations to which they were most inclined. Clowes, who, in spite of his revivalist sympathies, was more attached to Methodism than Bourne, was cut off from his church for taking part in camp-meetings at Ramsor in 1808 and 1810. His personality drew a number of strong men after him, and a society meeting held in a kitchen and then in a warehouse became the nucleus of a circuit, a chapel being built at Tunstall in July 1811, two months after the fusion of the Bourne and Clowes forces. Clowes, like Crawfoot, was set apart as a preacher to "live by the gospel," and in February 1812 the name "Primitive Methodist" was formally adopted, although for nearly a generation the name "Clowesites" survived in local use.

The first distinct period in the history of Primitive Methodism proper is 1811–1843. It was a time of rapid expansion, marked by great missionary fervour, and may be called the Circuit Period, for even after the circuits were grouped into districts in 1821 they did not lose their privilege of missionary initiative. The line of geographical progress first followed the valley of the Trent. The original circuit at Tunstall no sooner felt its feet than it favoured consolidation rather than extension. But irrepressibles like John Benton broke through the "non-mission law," and pressed forward through the "Adam Bede" country to Derby (which became the 2nd circuit in 1816); Nottingham, where a great camp-meeting on Whit Sunday 1816 was attended by 12,000 people; Leicestershire, where Loughborough became the 3rd circuit, with extensions into Rutland, Lincolnshire and Norfolk; and ultimately to Hull, which became the 4th circuit, and where a meeting which deserves to be called the First Conference was held in June 1819. The Hull circuit during the next five years, through its Yorkshire, Western, North-Western and Northern Missions, carried on a vigorous campaign with great success, especially among the then semi-savage colliers of Durham and Northumberland. During the five years 1819–1824 there had been made from Hull 17 circuits with a membership of 7600, and Hull itself had 3700 more.

Simultaneously with this work in the north, Tunstall circuit, having thrown off its lethargy at the Wrine Hill camp-meeting on the 23rd of May 1819, was carrying on an aggressive evangelism. In the Black Country, Darlaston circuit was formed in 1820, and John Wedgewood's Cheshire Mission, begun in 1819, led to work in Liverpool on the one hand and in Salop on the other. From Macclesfield a descent was made on Manchester; from Oakengates in South Shropshire came extensions to Herefordshire, Glamorganshire and Wiltshire, where the famous Brinkworth circuit was established. The succeeding years, however, 1825–1828, showed a serious set-back, due to the lack of discipline. But drastic measures were taken, and in one year thirty preachers were struck off the list. Thenceforward, while the Oxford Movement was awakening one section of the people of England the Primitive Methodists were making themselves felt among other classes of the population. John Oxtoby, who evangelized Filey and became known as "Praying Johnny," was known to spend six hours at a time in intercession. Robert Key at Saham Tony in 1832 won over a young woman who converted her brother, Robert Eaglen, who, eighteen years later at Colchester, proved so decisive a factor in the life of Charles Haddon Spurgeon.

The Times of the 27th of December 1830, referring to the disaffected state of the southern counties, said: "The present population must be provided for in body and spirit on more liberal and Christian principles, or the whole mass of labourers will start into legions of banditti—banditti less criminal than those who have made them so, and who by a just and fearful retribution will soon become their victims." These were the classes the Primitive Methodists tried to reach, and in doing so they found themselves between two fires. On the one hand there was the mob violence that often amounted to sheer ruffianism, especially in Wessex and the home-counties. On the other hand there was legal persecution all over the country, and the preachers suffered many things from the hands of rural clergy and county magistrates. There are a score of cases of serious imprisonment, and a countless number of arrests and temporary detention. Local preachers received notice to quit their holdings, labourers were discharged, those who opened their cottages for meetings were evicted, and to show any hospitality to a travelling preacher was to risk the loss of home and employment. But the spirit of the evangelists was unquenchable.

At the Conference of 1842 both Clowes and Bourne became supernumeraries with a pension of £25 a year each. Clowes, indeed, had been free from circuit work since 1827, and he continued to pray and preach as he was able till his death in March 1851. Bourne, who worked at his trade more or less all through life, spent his last ten years in advocating the temperance cause; he died in October 1852. The years 1842–1853 mark a transition period in the history of Primitive Methodism. It was John Flesher who chiefly guided the movement from a loosely jointed Home Missionary Organization on to the lines of a real Connexionalism. One of the first steps was to move the Book Room and the meeting place of the executive committee from Bemersley to London. Soon after came the gradual process by which the circuits handed over their mission-work to a central Connexional Committee. The removal to London was proof that the leaders were alive to the necessity of grappling with the rapid growth of towns and cities, and that the Connexion, at first mainly a rural movement, had also urban work to accomplish. The famous Hull circuit long retained a number of powerful branches, a survival of the first period, but by 1853 it had come into line with what was by that time regarded as the normal organization.

The period 1853–1885 (where typical names are W. and S. Antliff, Thomas Bateman and Henry Hodge) finds Primitive Methodism as a connexion of federated districts, a unity which may be described as mechanical rather than organic. The districts between 1853 and 1873 were ten in number, Tunstall, Nottingham, Hull, Sunderland, Norwich, Manchester, Brinkworth, Leeds, Bristol and London. Conference—the supreme assembly—was a very jealously guarded preserve, being attainable only to preachers who had travelled 18 and superintended 12 years, and to laymen who had been members 12 and officials 10 years. This exclusiveness naturally strengthened the popularity and power of the districts, where energy and talent found a scope elsewhere denied. Thus Hull district inaugurated a bold policy of chapel-buildings; Norwich that of a foreign mission; Sunderland and Manchester the ideal of a better-educated ministry, Sunderland institute being opened in 1868; Nottingham district founded a middle-class school; Leeds promoted a union of Sunday-schools, and the placing of chapel property on a better financial footing. The period as a whole had some anxious moments; emigration to the gold-fields and the strife which afflicted Wesleyan Methodism brought loss and confusion between 1853 and 1860. Yet when Conference met at Tunstall in the latter year to celebrate its jubilee it could report 675 ministers and 11,384 local preachers, 132,114 members, 2267 chapels, 167,533 scholars and 30,988 teachers. Over-seas, too, there was much activity and success. Work begun in Australia and New Zealand prospered, and the former country finally contributed over 11,000 members to the formation of the United Methodist Church of Australia, New Zealand with its 2600 members preferring to remain connected with the home country. In the United States there had been a quiet but steady growth since the first agents went out in 1829 and Hugh Bourne's advisory visit in 1844. There are now three Conferences—the Eastern, Pennsylvania and Western, with about 70 ministers, 100 churches and 7000 members. The Canadian churches had a good record, consummated in 1884 when they contributed 8000 members and 100 ministers to the United Methodist Church of the Dominion. In January 1870 the first piece of real foreign missionary work was begun at Fernando Po, followed in December of the same year by the mission at Aliwal North on the Orange River in South Africa. This station is the centre of a polyglot circuit or district 150 m. by 50 m., and there is a membership of 1731 and an efficient institution for training teachers, evangelists and artisans. In 1899 another South African mission was started, ultimately locating itself at Mashukulumbwe, and a few years later work was begun in Southern Nigeria.

Since 1885 Primitive Methodism has been developing from a "Connexion" into a "Church," the designation employed since 1902. At home a Union for Social Service was formed in 1906, the natural outcome of Thomas Jackson's efforts for the hungry and distressed in Clapton and Whitechapel, and of similar work at St George's Hall, Southwark. Other significant episodes have been the Unification of the Funds, the Equalization of Districts and the reconstruction of Conference on a broader basis, the Ministers' Sustentation Fund and the Church Extension Fund, and the enlargement and reorganization of the college at Manchester. This undertaking owes much to the liberality of Sir William P. Hartley, whose name the college, which is a school of the Victoria University, now bears. The Christian Endeavour movement in Great Britain derives, perhaps, its greatest force from its Primitive Methodist members; and the appointment of central missions, connexional evangelists and mission-vans, which tour the more sparsely populated rural districts, witness to a continuance of the original spirit of the denomination, while the more cultured side is fostered by the Hartley lecture. In celebration of the centenary of the Church, a fund of £250,000 was launched in 1907, and this was brought to a successful issue. Statistics for 1909 show 1178 ministers, 16,158 local preachers, 212,168 members, 4484 chapels, 465,531 Sunday scholars, 59,557 teachers. In the United States there were, in 1906, 101 church edifices and a total membership of 7558.

See H. B. Kendall, *The Origin and History of the Primitive Methodist Church* (2 vols., 1906); and *What hath God Wrought? A Centenary Memorial of the P.M. Church* (1908). (A. J. G.)

PRIMOGENITURE (Lat. *primus*, first, and *genitus*, born, from *gignere*, to bring forth), a term used to signify the preference in inheritance which is given by law, custom or usage, to the eldest son and his issue, or in exceptional cases to the line of the eldest daughter. The practice is almost entirely confined to the United Kingdom, having been abolished by the various civil codes of the European states, and having been rejected in the United States as contrary to the spirit of the constitution. The history of primogeniture is given in the article Succession, while the existing English law will be found in the articles Heir; Inheritance; Will, &c. But it may be briefly said here that the English law provided that in ordinary cases of inheritance to land of intestates the rule of primogeniture shall prevail among the male children of the person from whom descent is to be traced, but not among the females; and this principle is applied throughout all the degrees of relationship. There are exceptions to this rule, as in the cases of "gavelkind" and "borough-English," and in the copyhold lands of a great number of manors, where customs analogous to those of gavelkind and borough-English have existed from time immemorial. In another class of exceptions the rule of primogeniture is applied to the inheritance of females, who usually take equal shares in each degree. The necessity for a sole succession has, for example, introduced succession by primogeniture among females in the case of the inheritance of the Crown, and a similar necessity led to the maxim of the feudal law that certain dignities and offices, castles acquired for the defence of the realm, and other inheritances under "the law of the sword," should not be divided, but should go to the eldest of the co-heiresses (Bracton, *De Legibus*, ii. c. 76; Co. Litt., 165*a*). There are also many other special customs by which the ordinary rule of primogeniture is varied. It may be remarked that the English law of inheritance of land creates a double preference, subject to certain exceptions and customs, in favour of the male over the female and of the first-born among the males. This necessitates the rule of representation by which the issue of children are regarded as standing in the places of their parents, called "representative primogeniture." The rule appears to have been firmly established in England during the reign of Henry III., though its application was favoured as early as the 12th century throughout the numerous contests between brothers claiming by proximity of blood and their nephews claiming by representation, as in the case of King John and his nephew Prince Arthur (Glanvill, vii. c. 3; Bracton, *De Legibus*, ii. c. 30).

See Pollock and Maitland, *History of English Law*; K. E. Digby, *History of the Law of Real Property*; Sir H. Maine, *Ancient Law and Early History of Institutions*; C. S. Kenny, *Law of Primogeniture in England*.

PRIMROSE.[1] The genus *Primula* contains numerous species distributed throughout the cooler parts of Europe and Asia, and found also on the mountains of Abyssinia and Java; a few are American. They are herbaceous perennials, with a permanent stock from which are emitted tufts of leaves and flower-stems which die down in winter; the new growths formed in autumn remains in a bud-like condition ready to develop in spring. They form the typical genus of Primulaceae (*q.v.*), the floral conformation of which is very interesting on several accounts independently of the beauty of the flowers. The variation in the length of the stamens and of the style in the flowers of *Primula* has attracted much attention since Charles Darwin pointed out the true significance of these varied arrangements. Briefly it may be said that some of the flowers have short stamens and a long style, while others have long stamens, or stamens inserted so high up that the anthers protrude beyond the corolla tube, and a short style. Gardeners and florists had for centuries been familiar with these variations, calling the flowers from which the anthers protruded "thrum-eyed" and those in which the stigma appeared in the mouth of the tube "pin-eyed." Darwin showed by experiment that the most perfect degree of fertility, as shown by the greatest number of seeds and the healthiest seedlings, was attained when the pollen from a short-stamened flower was transferred to the stigma of a short-styled flower, or when the pollen from the long stamens was applied to the long style. As in any given flower the stamens are short (or low down in the flower-tube) and the style long, or conversely, it follows that to ensure a high degree of fertility cross fertilization must occur, and this is effected by the transfer of the pollen from one flower to another by insects. Incomplete fertility arises when the stigma is impregnated by the pollen from the same flower. The size of the pollen-grains and the texture of the stigma are different in the two forms of flower (see figure under PRIMULACEAE). The discovery of the physiological significance of these variations in structure, which had long been noticed, was made by Darwin, and formed the first of a series of similar observations and experiments by himself and subsequent observers (see Darwin, *Different Forms of Flowers*, &c.). Among British species may be mentioned the Common Primrose (*P. vulgaris*); the cowslip (*P. veris*); the true Oxlip (*P. elatior*), a rare plant only found in the eastern counties; and the common oxlip, the flowers of which recall those of the common primrose, but are provided with a supporting stem, as in the cowslip; it is, in fact, a hybrid between the cowslip and the primrose. In addition to these two other species occur in Britain, namely, *P. farinosa*, found in Wales, the north of England and southern Scotland, and *P. scotica*, which occurs in Orkney and Caithness. These two species are found also in high Arctic latitudes, and *P. farinosa*, or a very closely allied form, exists in Fuegia.

The *Auricula* (*q.v.*) of the gardens is derived from *P. Auricula*, a yellow-flowered species, a native of the Swiss mountains. The *Polyanthus* (*q.v.*), a well-known garden race, is probably derived from a cross between the primrose and cowslip. The Himalayas are rich in species of primrose, often very difficult of determination or limitation, certain forms being peculiar to particular valleys. Of these *P. denticulata*, *Stuartii*, *sikkimmensis*, *nivalis*, *floribunda*, may be mentioned as frequently cultivated, as well as the lovely rose-coloured species *P. rosea*.

The Royal Cowslip (*P. imperialis*) resembles *P. japonica*, but has leaves measuring 18 in. long by 5 in. wide. It grows at an elevation of 9000 ft. in Java, and has deep yellow or orange flowers.

The primrose is to be had in cultivation in a considerable variety of shades of colour, ranging from the palest yellow to deep crimson and blue. As the varieties do not reproduce quite true from seed, it is necessary to increase special kinds by division. The primrose is at its best in heavy soils in slight shade, and with plenty of moisture during the summer.

One of the most popular of winter and early spring decorative plants is the Chinese primrose, *Primula sinensis*, of which some superb strains have been obtained. For ordinary purposes young plants are raised annually from seeds, sown about the beginning of March, and again for succession in April and, if needed, in May. The seed should be sown in well-drained pots or pans, in a compost of three parts light loam, one part well-rotted leaf-mould, and one part clean gritty sand, as it does not germinate freely if the soil contains stagnant moisture, afterwards placing a sheet of glass over the pans to prevent evaporation of moisture. When the seeds germinate, remove the glass and place the pans in a well-lighted position near the glass, shading them from the sun with thin white paper, and giving water moderately as required. When the seedlings are large enough to handle, prick them out in pans or shallow boxes, and, as soon as they have made leaves an inch long, pot them singly in 3-in. pots, using in the soil a little rotten dung. They should then be placed in a light frame near the glass in an open situation, facing the north. When their pots are filled with roots they should be moved into 6-in. or 7-in. pots. The soil should now consist of three parts good loam broken with the hand, one part rotten dung and leaf-mould, and as much sand as will keep the whole open. They should be potted firmly, and kept in frames close up to the glass till September, excess in watering being carefully avoided. In the autumn they should be transferred to a light house and placed near the glass, the atmosphere being kept dry by the occasional use of fire-heat. The night temperature should be kept about 45°. When the flowering stems are growing up, manure water once or twice a week will be beneficial. The semi-double varieties are increased from seeds, but the fully-double ones, and any particular sort, can only be increased by cuttings. *Primula japonica*, a bold-growing and very beautiful Japanese plant, is hardy in sheltered positions in England. *P. cortusoides*, var. *Sieboldii* (Japan), of which there are many lovely forms, is suitable for outdoor culture and under glass. There are several small-growing hardy species which should be accommodated on the best positions on rockeries where they are secure from excessive dampness during winter; excess of moisture at that season is the worst enemy of the choice Alpine varieties. They are propagated by seed and by division of the crowns after flowering. *P. Forrestii* is a quite new orange-yellow flowered species from China; as is also *P. Bulleyi*. They are probably hardy—at least in favoured spots.

Evening primrose belongs to the genus *Oenothera* (natural order Onagraceae), natives of temperate North and South America. The common evening primrose, *Oe. biennis*, has become naturalized in Britain and elsewhere in Europe; the form or species known as var. *grandiflora* or *Oe. Lamarckiana* is a very showy plant with larger flowers than in the common form. Other species known in gardens are *Oe. missouriensis* (*macrocarpa*), 6 to 12 in., which has stout trailing branches, lance-shaped leaves and large yellow blossoms; *Oe. taraxacifolia*, 6 to 12 in., which has a stout crown from which the trailing branches spring out, and these bear very large white flowers changing to delicate rose; this perishes in cold soils, and should therefore be raised from seed annually. Of erect habit are *Oe. speciosa*, 1 to 2 ft., with large white flowers: *Oe. fruticosa*, 2 to 3 ft., with abundant yellow flowers.

The name of Cape Primrose has been given by some to the hybrid forms of *Streptocarpus*, a South African genus belonging to the natural order Gesneraceae.

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[1] Lat. *primula*; Ital. and Span. *primavera*; Fr. *primevère*, or in some provinces *primerole*. Strangely enough, the word was applied, according to Dr Prior, in the middle ages to the daisy (*Bellis perennis*), the present usage being of comparatively recent origin.

PRIMROSE LEAGUE, THE, an organization for spreading Conservative principles amongst the British democracy. The primrose is associated with the name of Lord Beaconsfield (*q.v.*), as being preferred by him to other flowers. On a card affixed to the wreath of primroses sent by Queen Victoria to be placed upon his coffin was written in Her Majesty's own handwriting: "His favourite flowers: from Osborne: a tribute of affectionate regard from Queen Victoria." On the day of the unveiling of Lord Beaconsfield's statue all the members of the Conservative party in the House of Commons were decorated with the primrose. A small group had for some time discussed the means for obtaining for Conservative principles the support of the people. Sir H. D. Wolff therefore said to Lord Randolph Churchill, "Let us found a primrose league." The idea was accepted by several gentlemen in the habit of working together, and a meeting was held at the Carlton Club shortly afterwards, consisting Lord Randolph Churchill, Sir H. Drummond Wolff, Mr (afterwards Sir John) Gorst, Mr Percy Mitford, Colonel Fred Burnaby and some others, to whom were subsequently added Mr Satchell Hopkins, Mr J. B. Stone, Mr Rowlands and some Birmingham supporters of Colonel Fred Burnaby, who also wished to return Lord Randolph Churchill as a Conservative member for that city. These gentlemen were of great service in remodelling the original statutes first drawn up by Sir H. Drummond Wolff. The latter had for some years perceived the influence exercised in benefit societies by badges and titular appellations, and he further endeavoured to devise some quaint phraseology which would be attractive to the working classes. The title of Knight Harbinger was taken from an office no longer existing in the Royal Household, and a regular gradation was instituted for the honorific titles and decorations assigned to members. This idea, though at first ridiculed, has been greatly developed since the foundation of the order; and new distinctions and decorations have been founded, also contributing to the attractions of the league. The League was partially copied from the organization of the Orange Society in Ireland. In lieu of calling the different subsidiary associations by the ordinary term "Lodges," the name was given of "Habitations," which could be constituted with thirteen members. These were intended as a substitute for the paid canvassers, about to be abolished by Mr Gladstone's Reform Bill. The principles of the League are best explained in the declaration which every member is asked to sign: "I declare on my honour and faith that I will devote my best ability to the maintenance of religion, of the estates of the realm, and of the imperial ascendancy of the British Empire; and that, consistently with my allegiance to the sovereign of these realms, I will promote with discretion and fidelity the above objects, being those of the Primrose League." The motto was "Imperium et libertas"; the seal, three primroses; and the badge, a monogram containing the letters PL, surrounded by primroses. Many other badges and various articles of jewellery have since been designed, with this flower as an emblem.

A small office was first taken on a second floor in Essex Street, Strand; but this had soon to be abandoned, as the dimensions of the League rapidly increased. Ladies were generally included in the first organization of the League, but subsequently a separate Ladies' Branch and Grand Council were formed. The founder of the Ladies' Grand Council was Lady Borthwick (afterwards Lady Glenesk), and the first meeting of the committee took place at her house in Piccadilly on the 2nd of March 1885. The ladies who formed the first committee were: Lady Borthwick, the dowager-duchess of Marlborough (first lady president), Lady Wimborne, Lady Randolph Churchill, Lady Charles Beresford, the dowager-marchioness of Waterford, Julia marchioness of Tweeddale, Julia countess of Jersey, Mrs (subsequently Lady) Hardman, Lady Dorothy Nevill, the Honourable Lady Campbell (later Lady Blythswood), the Honourable Mrs Armitage, Mrs Bischoffsheim, Miss Meresia Nevill (the first secretary of the Ladies' Council).

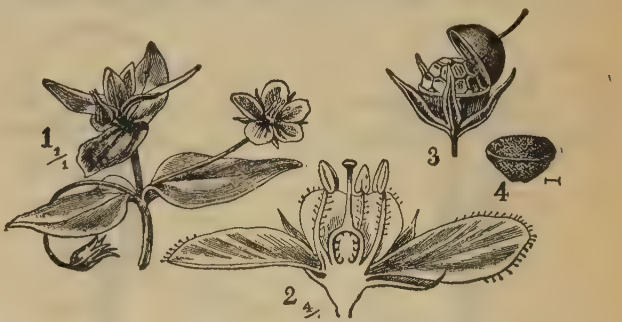
When the League had become a success, it was joined by Lord Salisbury and Sir Stafford Northcote, who were elected Grand Masters. Its numbers gradually increased to a marvellous extent, as may be seen by the following figures:—

Year.	Knights.	Dames.	Associates.	Total.	Habitations.
1884	747	153	57	957	46
1885	8071	1381	1914	11,366	169
1886	32,645	23,381	181,257	237,283	1200
1887	50,258	39,215	476,388	565,861	1724
1888	54,580	42,791	575,235	672,606	1877
1889	58,180	46,216	705,832	810,228	1986
1890	60,795	48,796	801,261	910,852	2081
1891	63,251	50,973	887,068	1,001,292	2143
1901	75,260	64,906	1,416,473	1,556,639	2392
1910	87,235	80,038	1,885,746	2,053,019	2645

See an article in the *Albemarle* of January 1892, written by Miss Meresia Nevill; and the *Primrose League Manual*, published at the offices at Westminster. The latter publication is interesting as a history of the organization. (H. D. W.)

PRIMULACEAE, in botany, an order of Gamopetalous Dicotyledons belonging to the series Primulales and containing 28 genera with about 350 species. It is cosmopolitan in distribution, but the majority of the species are confined to the temperate and colder parts of the northern hemisphere and many are arctic or alpine. Eight genera are represented in the British flora.

The plants are herbs, sometimes annual as in pimpernel (*Anagallis arvensis*) (fig. 1), but generally perennial as in *Primula*, where the plant persists by means of a sympodial rhizome, or in *Cyclamen* by means of a tuber formed from the swollen hypocotyl. The leaves form a radical rosette as in *Primula* (primrose, cowslip, &c.), or there is a well-developed aerial stem which is erect, as in species of *Lysimachia*, or creeping, as in *Lysimachia Nummularia* (creeping jenny or money-wort). *Hottonia* (water violet) is a floating water plant with submerged leaves cut into fine linear segments. The leaves are generally simple, often with a toothed margin; their arrangement is alternate, opposite or whorled, all three forms occurring in one and the same genus *Lysimachia*. The flowers are solitary in the leaf-axils as in pimpernel, money-wort, &c., or umbelled as in primrose, where the umbel is sessile, and cowslip, where it is stalked, or in racemes or spikes as in species of *Lysimachia*. Each flower is subtended by a bract, but there are no bracteoles, and corresponding with the absence of the latter the two first developed sepals stand right and left (fig. 2). The flowers are hermaphrodite and regular with parts in fives (pentamerous) throughout, though exceptions from the pentamerous arrangement occur. The sepals are leafy and persistent; the corolla is generally divided into a longer or shorter tube and a limb which is spreading, as in primrose, or reflexed, as in *Cyclamen*; in *Soldanella* it is bell-shaped; in *Lysimachia* the tube is often very short, the petals appearing almost free; in *Glaux* the petals are absent. The five stamens spring from the corolla-tube and are



(After Wossidlo. From Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.)

FIG. 1.—*Anagallis arvensis* (pimpernel).

1, Flowering branch.
2, A flower cut through longitudinally, showing the central placenta.
3, Capsule.
4, Seed.
2, 3, 4, Enlarged.

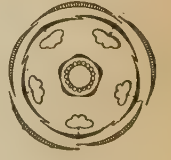


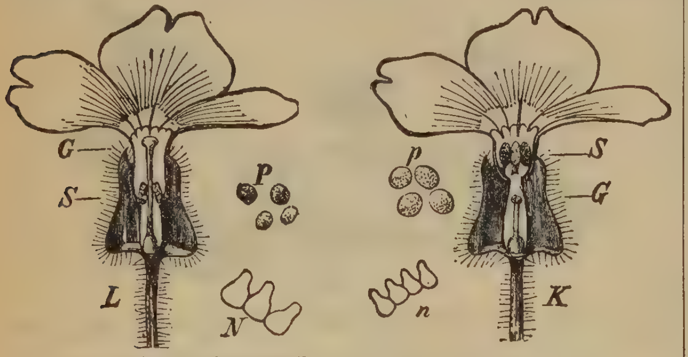
FIG. 2.

Diagram of a typical flower of Primulaceae.

opposite to its lobes; this anomalous position is generally explained by assuming that an outer whorl of stamens opposite the sepals has disappeared, though sometimes represented by scales as in *Samolus* and *Soldanella*. Another explanation is based on the late appearance of the petals in the floral development and their origin from the backs of the primordia of the stamens; it is then assumed that three alternating whorls only are present, namely, sepals, stamens bearing petal-like dorsal outgrowths, and carpels. The superior ovary—half-inferior in *Samolus*—bears a simple style ending in a capitate entire stigma, and contains a free-central placenta bearing generally a large number of ovules, which are exceptional in the group Gamopetalae in having two integuments. The fruit is a capsule dehiscing by 5 sometimes 10 teeth or valves, or sometimes transversely (a pyxidium) as in *Anagallis*.

Cross pollination is often favoured by dimorphism of the flower, as shown in species of *Primula* (fig. 3). The two forms have long and short styles repectively, the stamens occupying corresponding positions half-way down or at the mouth of the corolla-tube; the long-styled flowers have smaller pollen-grains, which correspond with smaller stigmatic papillae on the short styles.

The order is divided into five tribes by characters based on differences in position of the ovules—which are generally semi-anatropous so that the seed is peltate with the hilum in the centre on one side (or ventral), but sometimes, as in *Hottonia* and *Samolus*, anatropous with the hilum basal—together with the method of dehiscence of the capsule and the relative position of the ovary. The chief British genera are *Primula*, including *P. vulgaris*, primrose, *P. veris*, cowslip, *P. elatior*, oxlip, and the small alpine species *P. farinosa*, with mealy leaves; *Lysimachia*, loose strife, including *L. Nummularia*, money-wort; *Anagallis*, pimpernel; and *Hottonia*, water violet.

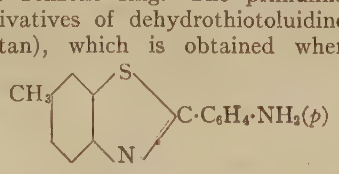


(From Strasburger's *Lehrbuch der Botanik.*)

FIG. 3.—*Primula sinensis*.

L, Long-styled flowers.
K, Short-styled flowers.
G, Style.
S, Anthers.
P, Pollen grains, and *N*, stigmatic papillae of long-styled form.
p, *n*, Ditto of short-styled form. (*P*, *N*, *p*, *n*.)

PRIMULINE, a dye-stuff containing the thiazole ring system conjointly with a benzene ring. The primulines are to be considered as derivatives of dehydrothiotoluidine (aminobenzenyltoluylmercaptan), which is obtained when para-toluidine is heated with sulphur for eighteen hours at 180–190° C. and then for a further six hours at 200–220° C. (P. Jacobson, *Ber.*, 1889, 22, p. 333; L. Gattermann, ibid. p. 1084). Dehydrothiotoluidine is not itself a dye-stuff, but if the heating be carried out at a higher temperature in the presence of more sulphur, then a base is formed, which gives primuline-yellow on sulphonation (A. G. Green, *Journ. Soc. Chem. Ind.*, 1888, 1, p. 194). Primuline-yellow is a mixture of sodium salts and probably contains in the molecule at least three thiazole rings in combination. It is a substantive cotton-dye of rather fugitive shade, but can be diazotized on the fibre and then developed with other components, so yielding a series of ingrain colours.



Primuline.

Thioflavine T is obtained by the methylation of dehydrothiotoluidine with methyl alcohol in the presence of hydrochloric acid [German Patent 51738 (1888)]. Thioflavine S results from the methylation of dehydrothiotoluidine sulphonic acid. This sulphonic acid on oxidation with bleaching powder or with lead peroxide, in alkaline solution yields *chloramine yellow*, which dyes cotton a beautiful yellow.

PRIMUS, MARCUS ANTONIUS, Roman general, was born at Tolosa in Gaul about A.D. 30–35. During the reign of Nero he was resident in Rome and a member of the senate, from which he was expelled for forgery in connexion with a will and was banished from the city. He was subsequently reinstated by Galba, and placed in command of the 7th legion in Pannonia. During the civil war he was one of Vespasian's strongest supporters. Advancing into Italy, he gained a decisive victory over the Vitellians at Bedriacum (or Betriacum) in October 69, and on the same day stormed and set fire to Cremona. He then crossed the Apennines, and made his way to Rome, into which he forced an entrance after considerable opposition. Vitellius was seized and put to death. For a few days Primus was virtually ruler of Rome, and the senate bestowed upon him the rank and insignia of a consul. But on the arrival of Licinius Mucianus he was not only obliged to surrender his authority, but was treated with such ignominy that he left Rome. Primus must have been alive during the reign of Domitian, since four epigrams of Martial are addressed to him. Tacitus describes him as brave in action, ready of speech, clever at bringing others into odium, powerful in times of civil war and rebellion, greedy, extravagant, in peace a bad citizen, in war an ally not to be despised.

See Tacitus, *Histories*, ii., iii., iv.; Dio Cassius lxv. 9–21.

PRINA, GIUSEPPE (1768–1814), Italian statesman. He gave early proofs of rare talent, and after studying at the university of Pavia he passed as doctor of law in 1789. He was a firm adherent of Napoleon Bonaparte, and when Eugène Beauharnais became viceroy of Italy, was appointed minister of finance. Genial in private life, he was harsh and unyielding in his official capacity, and his singular skill in devising fresh taxes to meet the enormous demands of Napoleon's government made him the best-hated man in Lombardy, the more so that, being a Piedmontese, he was regarded as a foreigner. The news of the emperor's forced abdication on the 11th of April 1814 reached Milan on the 16th, and roused hopes of independence. The senate assembled on the 19th and Prina's party moved that delegates should be despatched to Vienna to request that Eugène Beauharnais should be raised to the throne of a free Italian kingdom. In spite of precautions this fact became public and provoked the formidable riot styled "The battle of the umbrellas" that broke out the next day. A furious mob burst into the senate, pillaged its halls and sought everywhere for the execrated Prina. Not finding him there, the rioters rushed to his house, which they wrecked, and seizing the doomed minister, who was discovered in a remote chamber donning a disguise, during four hours dragged him about the town, until wounded, mutilated, almost torn to pieces, he received his death-blow. The mob then insulted his miserable remains, stuffing stamped-paper into his mouth. These horrors were enacted by day, in a thoroughfare crowded with "respectable" citizens sheltered from the rain by umbrellas. The authorities were passive, and although some courageous persons actually rescued the victim at an early stage and concealed him in a friendly house, the bloodthirsty mob soon discovered his refuge and were about to force an entrance, when the dying man surrendered to save his deliverer's property. The riots directly contributed to the re-establishment of Austrian rule in Milan.

See M. Fabi, *Milano ed il ministro Prina* (Novara, 1860); F. Lemmi, *La Restaurazione austriaca a Milano nel* 1814 (Bologna, 1902); Ugo Foscolo, *Alcune parole intorno alla fine del regno d'Italia.* The story of the murder of Prina forms the subject of a play by G. Rovetta, entitled *Principio di secolo.*

PRINCE (Lat. *princeps*, from *primus capio*, "I am the first to take"; Ital. *principe*, Fr. *prince*), a title implying either political power or social rank. The Latin word *princeps* originally signified "the first" either in place or action (cf. Ger. *Fürst;* O.H.G. *foristo*=English "first"). As an honorary title it was applied in the Roman republic to the *princeps senatus*, *i.e.* the senator who stood first on the censor's list, and the *princeps juventutis*, *i.e.* the first on the roll of the equestrian order. The assumption of the style of *princeps senatus* by Augustus (*q.v.*) first associated the word with the idea of sovereignty and dominion, but throughout the period of the empire it is still used as a title of certain civil or military officials (*e.g. princeps officii*, for the chief official of a provincial governor, in the Theodosian code, leg. I., *De offic. rect. prov.* i. 7; *princeps militiae*, *i.e.* the commander of a cohort or legion); while in the middle ages the term is still applied vaguely in charters to the magnates of the state or the high officials of the palace, *principes* being treated as the equivalent of *proceres*, *optimates* or *seniores*. Yet the idea of sovereignty as implied in the word *princeps*, used as a title rather than as a designation, survived strongly. In the Visigothic and Lombard codes *princeps* is the equivalent of *rex* or *imperator*; and when, after the overthrow of the Lombard kingdom by the Franks, Arichis II. (d. 787) of Beneventum wished to assert his independent sovereignty, he had himself anointed and crowned, and exchanged his style of duke for that of prince.

France.

From Italy the use of the title spread—first, with the Crusaders, to the Holy Land, where Bohemund, son of Tancred, took the style of prince of Antioch; next, with the Latin conquerors, into the East Roman Empire, where in 1205 William de Champlette, a cadet of the house of Champagne, founded the principality of Achaea and the Morea. This example was followed by lesser magnates, who styled themselves loosely, or were so styled by the chroniclers, "princes," even though they had little claim to independent sovereignty. From the East the fashion was carried back to France; but there the erection of certain fiefs into "principalities," which became common in the 15th and 16th centuries, certainly implied no concession of independent sovereignty, and the title of "prince" thus bestowed ranked below that of "duke," being sometimes borne by cadet branches of ducal houses, *e.g.* the princes of Léon and of Soubise, cadets of the house of Rohan. On the other hand, the title of "prince" was borne from the time of Charles VII. or Louis XI. by the sons of the royal house, so-called "princes of the blood" (*princes du sang*), who took precedence in due order after the king. To these were added, from the time of Louis XIV., the *princes légitimés*, recognized bastards of the sovereign, who ranked next after the princes of the blood. Thus, *e.g.* the princes of Condé, Conti and Lamballe owed their exalted precedence, not to their principalities, but to their royal descent.

Germany.

In Germany, Austria and other countries formerly embraced in the Holy Roman Empire the title of "prince" has had a somewhat different history. During the first period of the empire, the "princes" were the whole body of the *optimates* who took rank next to the emperor. In the 11th century, with the growth of feudalism, all feudatories holding in chief of the Crown ranked as "princes," from dukes to simple counts, together with archbishops, bishops and the abbots of monasteries held directly of the emperor. Towards the end of the 12th century, however, the order of princes (*Fürstenstand*) was narrowed to the more important spiritual and temporal feudatories who had a right to a seat in the diet of the empire in the "college of princes" (*Fürstenbank*). Finally, in the 13th century, seven of the most powerful of these separated themselves into a college which obtained the sole right of electing the emperor. These were called "prince electors" (*Kurfürsten*), and formed the highest rank of the German princes (see ELECTOR). The formal designation of "prince" (*Fürst*) was, however, extremely rare in Germany in the middle ages. Examples are the princes of Mecklenburg (Prilislav I., prince of the Holy Roman Empire in 1170) and Rügen, the latter title now belonging to the kings of Prussia. In the 17th century some half-dozen more principalities were created, of which that of Schwarzburg-Sondershausen (1697) survives as a sovereign house. The 18th century increased their number, and of the princely houses of this period those of Schwarzburg-Rudolstadt (1710), Waldeck (1712) and Reuss, elder branch (1778), have preserved their sovereignty. Of the other sovereign "princes" in Germany, Reuss, cadet branch, obtained the title in 1806, Schaumburg-Lippe in 1807. Outside the German Empire the prince of Liechtenstein, whose title dates from 1608, still remains sovereign.

Thus, in Germany, with the decay of the empire the title "prince" received a sovereign connotation, though it ranks, as in France, below that of "duke." There are, however, in the countries formerly embraced in the Holy Roman Empire other classes of "princes." Some of these inherit titles, sovereign under the old empire, but "mediatized" during the years of its collapse at the beginning of the 19th century, *e.g.* Thurn and Taxis (1695), Hohenlohe (1764), Leiningen (1779); others received the title of "prince" immediately before or after the end of the empire as "compensation" for ceded territories, *e.g.* Metternich-Winneburg (1803). Besides these mediatized princes, who transmit their titles and their privilege of "royal" blood to all their legitimate descendants, there are also in Austria and Germany "princes," created by the various German sovereigns, and some dating from the period of the old empire, who take a lower rank, as not being "princes of the Holy Roman Empire" nor entitled to any royal privileges. Some of these titles have been bestowed to give a recognized rank to the morganatic wives and children of royal princes, *e.g.*, the princes of Battenberg, or the title of "princess" of Hohenberg borne by the consort of the Archduke Francis Ferdinand d'Este; others as a reward for distinguished service, *e.g.* Hardenberg, Blücher, Bismarck. In this latter case the rule of primogeniture has been usual, the younger sons taking the title of "count" (*Graf*). These non-royal princes are ranked in the *Almanach de Gotha* with British and French dukes and Italian princes. All these various classes of princes are styled *Fürst* and have the predicate "Serene Highness" (*Durchlaucht*). The word *Prinz*, actually synonymous with *Fürst*, is reserved as the title of the non-reigning members of sovereign houses and, with certain exceptions (*e.g.* Bavaria), for the cadets of mediatized ducal and princely families. The heir to a throne is "crown prince" (*Kronprinz*), "hereditary grand duke" (*Erbgrossherzog*) or "hereditary prince" (*Erbprinz*). The heir to the crown of Prussia, when not the son of the monarch has the title of "prince of Prussia" (*Prinz von Preussen*).[1]

Italy.

In Italy the title "prince" (*principe*) is also of very unequal value. In Naples, following the precedent set by Arichis II., "much affecting the glory of a greater name than duke," it ranked above that of duke. In other parts of Italy the heads of great families sometimes bear the title of "prince," *e.g.* Prince Corsini, duke of Casigliano; sometimes that of "duke," *e.g.* the Caetani, princes of Teano, whose chief is styled "duke of Sermoneta," the title of "prince of Teano" being borne by his eldest son. The title of "prince of Naples" is attached to the eldest son of the king of Italy. The excessive multiplication of the title has tended to deprive it of much social value in itself, and under the democratic constitution of Italy it confers neither power nor precedence.

Russia.

"Prince" is also the translation of the Russian title *knyaz*, though *veliky knyaz*, the style of the Imperial princes, is rendered "grand duke." Some of the Russian, or Polish-Russian, princely families are of great importance—*e.g.* the Czartoryskis, the Swiatopolk-Czetwertynskis, or the Russian branch of the Lubomirskis. But, in general, though the title "prince" implies descent from one or other of the ruling dynasties of Russia, it is in itself of little account, being exceedingly common owing to its being borne by every member of the family. The predicate of "Serene Highness," though borne by certain magnates who were princes before they became Russians—as in the case of the families mentioned above—is not attached to the Russian title of "prince." In some cases, however, it is conferred with the title by imperial warrant (*e.g.* Lieven, 1826).

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[1] Fürst may or may not be a sovereign or territorial title, but it is only borne by the head of the family, *e.g.* Heinrich XIV., *regierender Fürst* (reigning prince) von Reuss or *Fürst* Bismarck. *Prinz* always implies cadetship, *e.g. Prinz* Heinrich XLV. Reuss. The title *Prinz von Preussen*, therefore, excludes any idea of territorial sovereignty, whereas the correct German rendering of that of prince of Wales, which originally at least implied such sovereignty, would be *Fürst von Wales.*

Turkey.

Monaco.

The title of "prince" is also borne by the descendants of those Greek Phanariot families (see PHANARIOTS), *e.g.* Mavrocordato, Ypsilanti, Soutzo, who formerly supplied hospodars to the Turkish principalities on the Danube. In the Ottoman Empire the rulers appointed to the quasi-independent Christian communities subject to it have usually been designated "prince," and the title has thus come to signify in connexion with the Eastern Question a sovereignty more or less subordinate. As such it was rejected on behalf of the Bavarian prince Otho, when he accepted the throne of Greece, in favour of that of "king." On the other hand, the substitution, in 1852, in Montenegro of the title of "prince and lord" (*knyaz i gospodar*) for the ancient title of *vladika* (archbishop) certainly implied no such subordination. The only other instance in Europe of "prince" as a completely sovereign title is that of the prince of Monaco, the formal style having been adopted by the Grimaldi lords in 1641.

Great Britain.

Prince of Wales.

In Great Britain "prince" and "princess" as titles are confined to members of the royal family, though non-royal dukes are so described in their formal style (see DUKE). Nor is this use of great antiquity; the custom of giving the courtesy title of "prince" to all male descendants of the sovereign to the third and fourth generation being of modern growth and quite foreign to English traditions. It was not till the reign of Henry VII. that the king's sons began to be styled "princes"; and as late as the time of Charles II., the daughters of the duke of York, both of whom became queens regnant, were called simply the Lady Mary and the Lady Anne. The title of "princess royal," bestowed on the eldest daughter of the sovereign was borrowed by King George II. from Prussia. Until recent years the title "prince" was never conferred on anybody except the heir-apparent to the Crown, and his principality is a peerage. Since the reign of Edward III. the eldest sons of the kings and queens of England have always been dukes of Cornwall by birth, and, with a few exceptions, princes of Wales by creation. Before that Edward I. had conferred the principality on his eldest son, afterwards Edward II., who was summoned to and sat in parliament as prince of Wales. But Edward the Black Prince was the original grantee of the principality as well as of the dukedom, under the special limitations which have continued in force to the present day. The entail of the former was "to him and his heirs the kings of England" and of the latter "to him and his heirs the first-begotten sons of the kings of England." Hence when a prince of Wales and duke of Cornwall succeeds to the throne the principality in all cases merges at once in the Crown, and can have no separate existence again except under a fresh creation, while the dukedom, if he has a son, descends immediately to him, or remains in abeyance until he has a son if one is not already born. If, however, a prince of Wales and duke of Cornwall should die in the lifetime of the sovereign, leaving a son and heir, both dignities are extinguished, because his son, although he is his heir, is neither a king of England nor the first-begotten son of a king of England. But, if instead of a son he should leave a brother his heir, then—as was decided in the reign of James I. on the death of Henry, prince of Wales, whose heir was his brother Charles, duke of York—the dukedom of Cornwall would pass to him as the first-begotten son of the king of England then alive, the principality of Wales alone becoming merged in the Crown. It has thus occasionally happened that the dukes of Cornwall have not been princes of Wales, as Henry VI. and Edward VI., and that the princes of Wales have not been dukes of Cornwall, as Richard II. and George III.

But even now the cadets of the reigning family can only by royal intervention legally be saved from merging, as of old, in the general untitled mass of the people. The children of the sovereign other than his eldest son, though by courtesy "princes" and "princesses," need a royal warrant to raise them *de jure* above the common herd; and even then, though they be dubbed "Royal Highness" in their cradles, they remain "commoners" till raised to the peerage. In 1905 King Edward VII. established what appears to be a new precedent, by conferring the titles of "princess" and "highness" upon the daughters of the princess Louise, duchess of Fife, created "princess royal."

This use of the word "prince"—which has in England so lofty a connotation—to translate foreign titles of such varying importance and significance naturally leads to a good deal of confusion in the public mind. It is not uncommon in English society to see, *e.g.* a Russian prince, who may be only the cadet of a family not included in the *Almanach de Gotha*, given precedence as such over the untitled members of a great English ducal family, and treated with some of that exaggerated deference paid to "royalty." On the other hand, the insular complacency of many Englishmen is apt to regard all German princes with a certain contempt, whereas the title is in Germany sometimes associated with sovereign power, sometimes with vast territorial possessions, and always with high social position.

See, Du Cange, *Glossarium*, *s.v.* "Princeps," ed. G. A. L. Henschal (Niort, 1883); John Selden, *Titles of Honour* (London, 1672); *Almanach de Gotha* (1906); H. Schulze, *Die Hausgesetze der regierenden deutschen Fürstenhäuser* (3 vols., Jena, 1862–1883); H. Rehm, *Modernes Fürstenrecht* (Munich, 1904). (W. A. P.)

PRINCE EDWARD ISLAND, a province of the Dominion of Canada, lies between 45° 58′ and 47° 7′ N. and 62° and 64° 27′ W. The underlying geological formation is Permian, though outliers of Triassic rock occur. The coal seams supposed to underlie the Permian formation are apparently too deep down to be of practical value. The rocks consist of soft red micaceous sandstone and shales, with interstratified but irregular beds of brownish-red conglomerates containing pebbles of white quartz and other rocks. There are also beds of hard dark-red sandstone with the shales. Bands of moderately hard reddish-brown conglomerate, the pebbles being of red shale and containing white calcite, are seen at many points; and then greenish-grey irregular patches occur in the red beds, due to the bleaching out of the red colours by the action of the organic matter of plants. Fossil plants are abundant at many places. Beds of peat, dunes of drifted sand, alluvial clays and mussel mud occur in and near the creeks and bays.

Physical Features.—The island lies in a great semi-circular bay of the Gulf of St Lawrence, which extends from Point Miscou in New Brunswick to Cape North in Cape Breton. From the mainland it is separated by Northumberland Strait, which varies from 9 to 30 miles in width. It is extremely irregular in shape, and deep inlets and tidal streams almost divide it into three approximately equal parts; from the head of Hillsborough river on the south to Savage Harbour on the north is only one and a half miles, while at high tide the distance between the heads of the streams which fall into Bedeque and Richmond Bays is even less. North of Summerside the land nowhere rises more than 175 ft. above sea-level; but between Summerside and Charlottetown, especially near north Wiltshire, is a ridge of hills, running from north to south and rising to a height of nearly 500 ft. From Charlottetown eastwards the land is low and level. The north shore, facing the gulf, is a long series of beaches of fine sand, and is a favourite resort in summer. On the south, low cliffs of crumbling red sandstone face the strait. The climate is healthy, and though bracing, milder than that of the neighbouring mainland. Fogs are much less common than in either New Brunswick or Nova Scotia.

Area and Population.—The greatest length of the island is 145 m., its greatest breadth 34 m., its total area 2184 sq. m.

The population in 1901 was 103,259, having sunk from 109,078 in 1891. It is thus much the most densely populated province in Canada, there being nearly fifty-two persons to the sq. m. Though very large families are not so common as in the province of Quebec, the agricultural character of the population makes the average number of persons to a family greater (5·51) than in any other province. As in all the maritime provinces, there is a steady immigration to the Canadian West and to the United States. The population is mainly of British descent, but also comprises descendants of the French Acadians and of the American loyalists. About 200 Indians of the Mic-Mac tribe remain, and have slightly increased in numbers since 1891. In 1901 the origin of the people was: Scots, 41,753; English, 24,043; Irish, 21,992; French, 13,867; all other nationalities, 1604. The principal religious denominations and the number of their adherents were as follows: Church of Rome, 45,796; Presbyterians, 30,750; Methodists, 13,402; Anglican, 5976; Baptists, 5905. The Irish and French are almost entirely Roman Catholic, the Scots about two-thirds Presbyterian and one third Roman Catholic. Jurisdiction over the Catholics is held by the bishop of Charlottetown, and over the Anglicans by the bishop of Nova Scotia. The Presbyterians form part of the synod of the Maritime Provinces.

Administration, &c.—Five members of the House of Commons and four senators are sent to the federal legislature. At its entry into federation in 1873, the number of members was six, and the reduction to five in 1901 was bitterly denounced. The local government now consists of a lieutenant-governor and of a legislative assembly. This conducts not only the general affairs of the province, but most of those of the towns and villages; legal provision has, however, been made for the establishment of a municipal system, and Charlottetown and Summerside are incorporated municipalities, though with powers of self-government much more limited than those of any other incorporated Canadian towns. The provincial revenues, which tend to prove inadequate, are largely made up of the subsidy paid by the federal government, though there are numerous taxes, which bear heavily on the small industrial population. But for the increase in 1907 of the federal subsidy, financial exigencies might have forced the adoption of direct taxation, in spite of its unpopularity among the farmers.

Education.—Primary education in the province has been given free since 1852. Since 1877 it has been under the control of a minister of education with a seat in the provincial cabinet. At Charlottetown is the Prince of Wales College, really a rather advanced secondary school, with which is affiliated the Normal School. St Dunstan's College, another advanced high school in Charlottetown, is under Roman Catholic control. Advanced university education is not given in the province. Attendance at the primary schools is by law compulsory, but the exigencies of a farming population and the lack of adequate means of enforcement render the law inoperative. The salaries of the teachers are, as a rule, low, and the school buildings cheerless and ill-maintained.

Agriculture.—The soil, an open sandy loam, deep red in colour, which was slightly exhausted at the beginning of the century by repeated crops of cereals, has been renewed by the application of mussel mud dredged from the bays and tidal streams. All the staple crops are grown—especially oats, potatoes and turnips. Wheat is raised only for local consumption. Cattle and hogs flourish. In the last years of the 19th century the introduction of co-operation gave a great impetus to the manufacture of butter and cheese. The first cheese factory was opened in 1892, and the first creamery in 1894. Of over 15,000 farmers all, save about 900, own their own farms, and are in nearly all cases well-to-do. Large quantities of animal and vegetable food, amounting to about one-half of the total product, are exported, chiefly to Cape Breton, Newfoundland, and the New England states. Fruit is raised less extensively than in Nova Scotia, but enough is grown to supply the local market, and apples of good quality are exported.

Fisheries.—Though smaller in value than those of any other sea-board province, the fisheries of Prince Edward Island are, in proportion to the total population, extremely productive. Of the catch of about £200,000, lobsters, most of which are canned, are worth about £90,000, and oysters £20,000, in the latter case about half the total value of the catch of the Dominion, which is compelled to import largely from the United States. There are signs of the approaching exhaustion of the oyster beds, but no adequate remedy or new source of supply has been found. Herring, cod, mackerel and smelts are also caught in large quantities in the coast waters.

Other Industries.—About one-third of the province is covered with birch, beech, maple, pine, spruce, cedar and other woods, but though a little lumber is exported, the industry is declining. The building of wooden ships, a flourishing trade till about 1886, is now almost extinct. The packing of pork and of lobsters is actively pursued near Charlottetown, and small factories have been established for the manufacture of boots and shoes, tobacco, condensed milk, &c., but the great bulk of the manufactured goods used are imported from the other provinces.

Communications.—The Prince Edward Island branch of the Intercolonial railway, owned and worked by the federal government, runs from Souris in the east to Tignish in the north-west, with branches to Georgetown, Murray Harbour, Charlottetown and Cape Traverse. Good wagon roads intersect each other everywhere, and nearly all the villages and country districts are connected by telephone. During spring, summer and autumn Charlottetown has daily communication with Pictou in Nova Scotia and Shediac in New Brunswick, and a frequent service to other ports in Nova Scotia, Newfoundland and Massachusetts. The harbour of Charlottetown and the Northumberland Straits are closed by ice from about the middle of December to the beginning of April, after which there is a service by specially constructed ice-breaking boats between Georgetown and Pictou. The ice is often too thick to make a regular service possible, and the island has long agitated for federal construction of a railway tunnel between Cape Traverse in Prince Edward Island and the neighbouring shore of New Brunswick, 9 m. distant.

History.—Jacques Cartier sighted Prince Edward Island on his first voyage in June 1534, but mistook it for part of the mainland. Succeeding voyagers discovered his mistake, and toward the end of the 16th century it was called Isle St Jean, which name it retained till 1798, when it was given its present name out of compliment to the duke of Kent, at that time commanding the British forces in North America. In 1603 Champlain took possession of it for France, and in 1663 it was granted by the company of New France to Captain Doublet, an officer in the navy whose failure to make permanent settlements soon brought about the loss of his grant. Little attention was paid to the island until after the Peace of Utrecht, when the French made efforts to colonize it. In 1719 it was granted, *en franc alleu noble*, to the count of St Pierre, who tried to establish fisheries and a trading company. He spent large sums on his enterprise, but the scheme proved unsuccessful and his grant was revoked. In 1758, soon after the capture of Louisbourg, Isle St Jean was occupied by a British force under Lord Rollo (see *Annual Register*, 1758). Its population at this time numbered about 4000, under a military governor with his headquarters at Port la Joie (Charlottetown). After its final cession to Great Britain in 1763 it was placed under the administration of Nova Scotia, but later was made a separate government, its first parliament meeting in 1773.

In 1764–1765 it was surveyed, and most of the present names given; in 1767 it was divided into townships of about 20,000 acres each, grants of which were made to individuals with claims on the government. They were to pay a small sum as quit rents, and the conditions imposed provided for the establishment of churches and wharves and bona-fide settlement. On these terms practically the whole island was granted away in a single day. The grantees were in most cases mere speculators, and the lands fell into the hands of a large number of non-residents. A continual agitation against the absentees was kept up by the settlers, who rapidly increased in numbers. During the early

19th century many Scottish immigrants settled in the island. A commission appointed in 1860 advised the compulsory purchase of the lands, and their sale in smaller holdings to genuine settlers, but a bill passed with this intent was disallowed by the imperial authorities.

In 1864 a conference to consider the question of maritime union met at Charlottetown. The visit of delegates from Canada widened it into a general conference on federation, from which sprang the Dominion of Canada. Prince Edward Island's local patriotism forced its representatives to withdraw from the later conferences, but the abrogation in 1866 by the United States of the Reciprocity Treaty of 1854, financial difficulties connected with the building of an island railway, and the offer of better terms by the Dominion government, brought it into federation in 1873. A bill on the lines of that formerly disallowed was soon afterwards passed, and the land difficulty was finally settled. Since then the main political issues have been the quarrel with the federal government over the construction of a tunnel and the control of the liquor traffic, which has been prohibited but by no means suppressed.

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PRINCES' ISLANDS (anc. *Demonesi*; Byzantine, *Papadonisia*; Turkish, *Kizil Adalar*, or "Red Islands," from the ruddy colour of the rocks), a cluster of nine islands in the Sea of Marmora, forming a caza of the prefecture of Constantinople. They figure in Byzantine history chiefly as places of banishment. A convent in Prinkipo (now a mass of ruins at the spot called Kamares) was a place of exile for the empresses Irene, Euphrosyne, Zoe and Anna Dalassena. Antigone was the prison of the patriarch Methodius, and its chapel is said to have been built by the empress Theodora. In Khalki the monastery of the Theotokos (originally of St John), which since 1831 has been a Greek commercial school, was probably founded by John VI. or VII. Palaeologus, was rebuilt about 1680, and again in the 18th century by Alexander Ypsilanti, hospodar of Moldavia. Close beside it is the tomb of Edward Barton, second English ambassador to the Porte. Hagia Trias (a school of theology since 1844) was rebuilt by the patriarch Metrophanes. On Prote were the monasteries to which Bardanes (Philippicus), Michael I. Rhangabes, Romanus I., Lecapenus and Romanus IV. Diogenes were banished. The islands are a favourite summer resort; four are inhabited and noted for the mildness and salubrity of their climate. Prinkipo (*Pityusa*), altitude 655 ft.; Khalki (*Chalcitis*; Turkish *Heibeli*), 445 ft.; Prote (Turkish *Kinali*), 375 ft.; and Antigone (*Panormus*; Turkish *Burgaz Adasi*), 500 ft. The buildings on all the islands were injured by the earthquake of 1894, especially the naval college, and monastery of St George on Khalki, and the monastery of Christ on Prinkipo. The population is about 10,500, half being Greek. Khalki contains an Ottoman naval school and Greek theological and commercial colleges.

See G. Schlumberger, *Les Îles des Princes* (Paris, 1884); A. Grisebach, *Rumelien und Brussa* (Göttingen, 1839).

PRINCETON, a city and the county-seat of Gibson county, Indiana, U.S.A., about 27 m. N. of Evansville. Pop. (1900), 6041, 628 being of negro descent and 198 foreign-born; (1910) 6443. It is served by the Evansville & Terre Haute and the Southern railways (the latter of which has shops here), and by the Evansville & Southern Indiana traction line (electric). It has a considerable trade in oil and coal and in the agricultural products of the surrounding region, and has various manufactures. Princeton was first settled in 1814, and was chartered as a city in 1884.

PRINCETON, a borough of Mercer county, New Jersey, on Stony Brook, and the Delaware & Raritan canal, 49 m. S.W. of New York City. Pop. (1905) 6029; (1910) 5136. Princeton is served by the Pennsylvania railroad, and by two electric lines to Trenton (10 m.), passing through Lawrenceville (in Lawrence township; until 1816 called Maidenhead; pop., 2522 in 1910), the seat of the Lawrenceville school (1882), for boys, which was endowed by the residuary legatees of John Cleve Green (1800–1875), and is probably the first endowed secondary school for boys in the Middle States.

Princeton is situated 210 ft. above sea-level, and the county to the east, north and west is rocky and hilly. The borough is the seat of Princeton University (*q.v.*), and of "The Theological Seminary of the Presbyterian Church in the United States of America," commonly known as Princeton Theological Seminary, which was opened in 1812, and was chartered in 1824. The seminary was for one year under the sole care of Archibald Alexander (*q.v.*), and among its teachers and representative theologians have been Samuel Miller (1769–1850), who was professor of ecclesiastical history and church government here (1813–1849), Charles Hodge, Joseph Addison Alexander and James Waddel Alexander, William Henry Green, Archibald Alexander Hodge, Francis L. Patton, who became president in 1902 and Benjamin B. Warfield (b. 1851), professor of didactic and polemic theology from 1887. Under such leaders Princeton theology has been distinctly conservative, supporting the old standards of the Westminster Confession and Catechisms. The seminary is well endowed, so that there is no charge for tuition or room rent; among its principal benefactors were James Lenox (1800–1880), Robert Leighton Stuart (1806–1882), his widow and his brother Alexander (1810–1879), John Cleve Green, mentioned above, and Mrs Mary J. Winthrop (d. 1902). It has a fine campus south-west of the business centre of the borough; in the Lenox Library and the Lenox Reference Library, built in 1843 and 1879 respectively, and gifts of James Lenox, there were 82,200 bound volumes and 31,500 pamphlets in 1909; Stuart Hall (1876) contains lecture-rooms; Miller Chapel is the place of worship; and the three dormitories are Alexander Hall (the "Old Seminary"), first used for this purpose in 1817, Brown Hall, built in 1864–1865, and Hodge Hall (1893). In 1908–1909 the faculty numbered 16 and the students 153, of whom 8 were fellows and 17 graduate students.

Princeton became in 1897 the home of Grover Cleveland, who died there; and from 1898 until his death it was the residence of Laurence Hutton (1843–1904), a well-known writer on the history of the stage. Besides its fine residences and buildings of the seminary and of the university, the only notable buildings are the handsome Princeton Inn, about midway between the campus of the university and that of the seminary, and "Morven," the homestead of the Stocktons, built in the first decade of the 18th century. In the Princeton Cemetery are buried presidents and professors of the university.

The first settlers were the companions of Richard Stockton, the grandfather of Richard Stockton, signer of the Declaration of Independence. The removal hither in 1756 from Newark of the College of New Jersey, later Princeton University, gave the place its first educational prominence. At the time of the War of Independence town and gown were both strongly patriotic. The first state legislature of New Jersey met here on the 27th of August 1776; and in Nassau Hall, the first of the college buildings, erected in 1754–1756, which was then the largest edifice in the colonies, the Continental Congress sat from the 30th of June to the 4th of November 1783, and on the 31st of October Congress received the news of the signature of the definitive treaty of peace with Great Britain. After the battle of Trenton Cornwallis's troops were hurried to that place, three regiments and three companies of light-horse being left at Princeton when the main body, on the 2nd of January 1777, passed through. Washington, unable to retreat or to meet the British attack, turned Cornwallis's left flank and advanced on the weak garrison at Princeton. On the 3rd a force under Gen. Hugh Mercer (*c.* 1720–1777), ordered to destroy the Stony Brook bridge, and so cut off escape to Trenton, met two of the three regiments, led by Lieut.-Colonel Charles Mawhood, near the bridge, and, though doing great execution with its rifles at a distance, was unable, being unequipped with bayonets, to hold its ground in hand-to-hand fighting, and fled through an orchard, leaving Mercer there mortally wounded; he died on the 12th in a farm-house (still standing) on the battlefield. Washington's main army now came to the assistance of the retreating Americans, and forced the retreat of the other British regiments (the 55th and 40th) to Princeton, where they either surrendered or fled towards New Brunswick. The British losses were heavy and the Americans lost many officers. The bridge was destroyed by the American troops just before the approach of General Alexander Leslie (*c.* 1740–1794) with reinforcements from Cornwallis. Washington's flank movement at Trenton and his engagement with the British at Princeton made necessary the withdrawal of the British from West Jersey. In the autumn of 1783 Washington, summoned to Princeton by Congress, then in session there, made his headquarters at Rocky Hill, about 4 m. north of Princeton in Montgomery township, Somerset county, whence on the 2nd of November he issued his farewell address to the army; his headquarters is preserved as a museum. A battle monument in Princeton, designed by MacMonnies and paid for by the Federal Congress, the state of New Jersey and the borough of Princeton, has been projected.

See J. R. Williams, *Handbook of Princeton* (New York, 1905); J. F. Hageman, *History of Princeton and its Institutions* (2 vols., Philadelphia, 1879); W. S. Stryker, *The Battles of Trenton and Princeton* (Boston, 1898); and V. L. Collins, *The Continental Congress at Princeton* (Princeton, 1908).

PRINCETON UNIVERSITY, an American institution of higher learning in Princeton, New Jersey, until 1896 called officially the college of New Jersey. Its campus consists of 539 acres comprised in three tracts of ground adjoining each other. The main campus, one of the most beautiful in the country, is on the south side of Nassau Street, the old country road between Philadelphia and New York, and is principally contained in a block of about 225 acres, which on its west side has an almost continuous row of English collegiate Gothic buildings: Blair Hall, Stafford Little Hall and the gymnasium.

Nassau Hall, which was built in 1756, nearly destroyed by fire in 1802, rebuilt in 1804, and damaged by fire in 1855, is a squarely built edifice in the Georgian style. Originally housing the whole college, it is familiarly known as North College, in a quadrangle arrangement of which West College, built in 1836, is the only other remainder; the south side having been occupied since 1838 by Clio Hall and Whig Hall, the homes of the two literary societies, founded respectively in 1765 and 1769, and since 1893 housed in white marble buildings of classical type; and East College, having given place to the main building of the University Library (1897), in Oxford Gothic of Longmeadow stone, the gift of Mrs Percy Rivington Pyne. Besides West College, the dormitories are Reunion Hall (1870), commemorating the reconciliation of the Old and New schools of the Presbyterian Church; University Hall (1876), formerly an hotel and now housing on its lower floors the university dining halls for all freshmen and sophomores; Witherspoon Hall (1877), in Victorian Gothic of grey stone trimmed with brown; Edwards Hall (1880), a brown stone Gothic building; Albert B. Dod Hall (1890), a granite limestone-trimmed Italian building; David Brown Hall (1891), granite and Pompeian brick, in Florentine Renaissance; the Pyne Buildings (1896) in half-timbered Chester style; Blair Hall (1897), built in English Collegiate Gothic of white Germantown stone, on the south-western margin of the campus; the Stafford Little Hall (1899 and 1901), in the same style as Blair Hall, and joining it on the south; Seventy-nine Hall (1904), the gift of the class of 1879, another Tudor Gothic building of red brick trimmed with Indiana limestone; and Patton Hall (1906); Campbell Hall (1909), the gift of the class of 1877; and a new group of buildings, chiefly dormitories, occupying the entire north-west corner of the main campus, fronting on Nassau and University Place, three sections of which (two being the gift of Mrs Russell Sage) were completed in 1910. These buildings are in the same architectural style and of the same materials as Blair and Little Halls. There is accommodation for about 90% of the undergraduates of the university in the campus dormitories, including the new buildings.

The recitation halls are: Dickinson (1870; remodelled in 1876) and McCosh Hall (1907), for the academic department; and the school of science building (1873), a gift of John C. Green, on the north-east corner of the main block of the campus. The Halsted Observatory (1869) and the Observatory of Instruction (1878) are well known for the work done in them by the astronomer Charles Augustus Young (1834–1908); among the laboratories are the biological (1887), the chemical (1891), the civil engineering (1904), the Palmer physical (1908), and, for natural science, Guyot Hall (1909), which also houses the natural science museum, including valuable fossils. There is a museum of historic art (1887) which includes the finds of the Princeton archaeological expedition to Syria, and in Nassau Hall there is a psychological laboratory. There are two auditoriums, the Marquand chapel (1881), the gift of Henry G. Marquand, and Alexander Hall (1892), used for commencement exercises. Also on the campus are the dean's house (1756), until 1878 the president's residence; Prospect (1849), bought by the college in 1878, which is the president's residence; the university offices (1803); and Dodge Hall (1900) and Murray Hall (1879), which are the home of the college Y.M.C.A., the Philadelphian Society, founded in 1825.

The university library is housed in a large building already described, built (1896) on to the Chancellor Green library building (1872), given by John C. Green in memory of his brother Henry Woodhull Green, chancellor of the state of New Jersey, and now the reading room and reference library. In 1910 the library had a collection of 257,800 volumes and about 58,000 unbound pamphlets. There are two athletic fields: one, the university, two blocks east of the main campus, and the other, the Brokaw field, in the south-west corner of the main campus; immediately north of the latter are the Brokaw Memorial gateway and building (1892), with a swimming pool, and the university gymnasium (1903). South-east of the Campus is Lake Carnegie, an artificial widening of Millstone River, the gift of Andrew Carnegie; it is used for boating.

A notable feature of the university is its upper-class club-houses. The upper-class clubs have in the social life of Princeton somewhat the place of the Greek letter societies elsewhere. There are no fraternities at Princeton: each entering student pledges himself to "have no connexion whatever with any secret society, nor be present at the meetings of any secret society" so long as he is a member of the university, "it being understood that this promise has no reference to the American Whig and Cliosophic Societies." These two societies, the object of which is particularly to cultivate skill in debate and public speaking, are affiliated with the English department of the faculty.

A peculiarity of the university is its system of student government, which is most markedly developed in the Princeton "honour system" in examinations and written recitations, under which every student signs a pledge on his paper that he has "neither given nor received assistance," and there is no faculty or monitorial watch over students in examinations; the system is administered by a student committee, to which any dishonesty in examinations is to be reported, and which then investigates the charge, and if it finds it true reports the offender to the faculty for dismissal.

The university in 1910 included an academic department, leading to the degree of A.B., or Litt. B.; the John C. Green school of science (1873), offering courses leading to the degree of B.S. and C.E.; a school of electrical engineering; and a graduate department (1877), with courses leading to master's and doctor's degrees. Entrance requirements are largely in accordance with the recommendations of the National Education Association and the college entrance examination board; students entering the academic department must offer Greek if they are candidates for the degree of A.B.; students (not offering Greek for entrance) who concentrate in mathematics or science in junior and senior year are candidates for the B.S. degree, and those who concentrate in other departments during those years, for the Litt. B. degree. The entrance requirements for the B.S. and Litt. B. degree are the same, and they differ from those for the A.B. degree (and agree with those for the C.E. degree) in including more mathematics, *i.e.* solid geometry and plane trigonometry. The school of electrical engineering is graduate and professional in its scope. The graduate school (1871) is only slightly developed, and this development has been almost entirely since 1900; a bequest of more than $300,000 in 1906 provided for the John R. Thomson Graduate College; and the estate of Isaac Chauncey Wyman (d. 1910), of the class of 1848, valued at about

$3,000,000, was left to the university for the establishment of the graduate school.

A notable feature of the scheme of instruction is the preceptorial (or tutorial) system, introduced in 1905; it somewhat resembles Jowett's method at Balliol College, Oxford; the preceptors, usually young men (many of them domiciled in the dormitories), have "conferences" each with a certain number of students on prescribed reading, especially in the departments of philosophy, history and politics, art and archaeology, and the languages. The preceptorial system has been a great success, and seems to have given the university a greater intellectual vitality. In 1909–1910 the university faculty numbered 169, of whom 51 were preceptors. In the same year there were 1400 students of whom 134 were in the graduate school, 13 in the school of electrical engineering, 521 in the A.B. course, 440 in the Litt.B. and B.S. courses, 203 in the C.E. course, and 89 not in regular courses.

The corporate title of the university is "The Trustees of Princeton University," and the university is governed by the trustees, of whom the governor of the state of New Jersey is *ex officio* president. The president of the university is president of the board in the absence of the governor. The Board consists of twenty-five "life trustees," a self-perpetuating body, two *ex officio* trustees, and (since 1900) five alumni trustees, elected by the graduates of the university for a five-year term, one each year.

The tuition fee is $160 a year in all undergraduate courses. There are many scholarships and prizes, a fund for the remission of tuition to students of insufficient means, and funds for the assistance of students for the ministry. In July 1909 the assets of the university were $4,749,482, of which $4,168,900 was invested for endowment; of the endowment $3,410,907 was special, $330,445 general, $60,000 historical, $122,643 was for scholarships and $244,905 was for professorships; and in this fiscal year the gifts for current expenses and special purposes amounted to $199,294 and the gifts for endowment to $1,508,283.

The university owes its origin to a movement set on foot by the Synod of Philadelphia in 1739 to establish in the Middle Colonies a college to rank with Harvard and Yale in New England and William and Mary in Virginia. Owing to dissension in the Church, no progress was made until 1746, when the plan was again broached by the synod of New York, recently formed by the secession of the presbytery of New York and the presbytery of New Brunswick, radical (New School) presbyteries of the Synod of Philadelphia. The synod of New York was led by Ebenezer Pemberton (1704–1779), a graduate of Harvard (1721), and Jonathan Dickinson (1688–1747), a graduate of Yale (1706). Together they had attempted to make peace between the conservatism of the presbytery of Philadelphia and the radicalism of the presbytery of New Brunswick. Most of the leaders of the presbytery of New Brunswick had been educated at the Log College, a school with restricted curriculum, situated about 20 m. N.N.E. of Philadelphia, but recently closed. The students of the Log College were almost without exception preparing for the Presbyterian ministry, and on the closing of the Log College, the opportunity was taken by the synod of New York to found a larger and better institution of higher learning, broader in scope and training, and to transfer to the new project the Log College interests. On October 22nd 1746, John Hamilton, acting governor of New Jersey, granted a charter for erecting a college in New Jersey. The college of New Jersey was opened in May 1747 at Elizabeth, New Jersey, with the Rev. Jonathan Dickinson as president. Little was accomplished until 1748, when, on the 14th of September, a second charter was granted to the "trustees of the College of New Jersey," thirteen in number. The college under the administration of Jonathan Dickinson, held its exercises from the last of May 1747 to the 7th of October 1747, when Dickinson died. Upon the succession of Aaron Burr to the presidency, the school removed to Newark, where the first commencement was held in 1748 and where Burr began the work of organizing the college and its curriculum; but the situation was unsuitable, and in 1752 the trustees voted to remove the college to Princeton, where land was given for the Campus by Nathaniel Fitz Randolph. While funds were being collected in Great Britain, work was begun in Princeton in 1754 on the first college building, which, at Governor Belcher's request, was named Nassau Hall, in honour of King William. A year after the completion of this single college building and the removal of the students to Princeton, Burr died and was succeeded by his father-in-law, Jonathan Edwards, who died after five weeks in office (1758). He was succeeded (1759–1761) by Samuel Davies, and Davies (in 1761–1766) by Samuel Finley (1715–1766). John Witherspoon (*q.v.*) was president from 1768 until his death in 1794, and more than any of his predecessors influenced the college. The presidents immediately succeeding Witherspoon were: his son-in-law, Samuel Stanhope Smith (1750–1819), who resigned in 1812; Ashbel Green (1762–1848), who resigned in 1822; James Carnahan (1775–1859), who held office for thirty-one years (1823–1854), and in whose presidency there was, in 1846–1852, a department of law in the college; and John Maclean (1800–1886), who was president from 1854 to 1868. Up to the outbreak of the Civil War, the college was largely attended by Southerners, and the Civil War thus dealt it a doubly heavy blow, from which it began to recover under the long presidency (1868–1888) of James McCosh, who, like his successor, Francis Landey Patton (*q.v.*), president from 1888 to 1902, greatly advanced the material welfare of the college. Fourteen new buildings were erected during Dr McCosh's administration, and the John C. Green School of Science was established in 1873 by the gift of John Cleve Green; and during Dr Patton's administration the enrolment of students more than doubled, as did the number of members of the faculty. In October 1896, on the 150th anniversary of its founding, the official name of the College of New Jersey, long popularly displaced by Princeton, was dropped, and the corporation became "The Trustees of Princeton University," although the institution did not become, in the usual American use of the term, a university, having no professional schools whatever, and only a small post graduate department. On Dr Patton's resignation in 1902 he was succeeded by Woodrow Wilson (*q.v.*), the first layman to become president, who introduced the preceptorial system already described.

PRINCIPAL, a person or thing first, or chief in rank or importance, or, more widely, prominent, leading. The Lat. adj. *principalis*, first, chief, original, also princely, is formed from *princeps*, the first, chief, prince, from *primus*, first, and *capere* to hold. In Late Lat. *principalis* was used as a substitute for an overseer or superintendent, and also for the chief magistrate of a municipality (Symmachus, *Ep.* 9, 1). It is a common title for the head of educational institutions, universities, colleges and schools. It is thus used of the director, of some of the heads of newer universities in England, *e.g.* London and Birmingham, always so in Scotland, and frequently combined with the vice-chancellorship. At the university of Oxford the name occurs twice as the title of the head of a college, viz. of Brasenose and Jesus. It was always used of the heads of halls, of which St Edmund Hall alone remains. It is also the designation used of the head of the newer theological or denominational colleges, and also of the women's colleges. At Cambridge it does not occur. In law, it is used in distinction from "accessory," for the person who actually commits the crime, "principal in the first degree," or who is present, aiding and abetting at the commission of the crime," principal in the second degree;" and also for the person for whom another acts by his authority (see PRINCIPAL AND AGENT below). Finally as a shortened form of "principal sum," "principal money," &c., the term is used of the original sum lent or invested upon which interest is paid, and so, widely of any capital sum, as opposed to interest or income derived from it.

PRINCIPAL AND AGENT. In law an agent is a person authorized to do some act or acts in the name of another, who is called his principal. The law regulating the relations of principal and agent has its origin in the law of mandate among the Romans, and in England the spirit of that system of jurisprudence pervades this branch of the law. The law of agency is thus almost alike throughout the whole British Empire, and a branch of the British commercial code, in which it is of great importance that different nations should understand each other's system, differs only slightly from the law of the rest of Europe.

In a general view of the law of agency it is necessary to have regard to the rights and duties of the principal, the agent, and the public. The agent should not do what he has no authority for; yet if he be seen to have authority, those with whom he deals should not be injured by secret and unusual conditions. The employer is bound by what his agent does in his name, but the public are not entitled to take advantage of obligations which are known to be unauthorized and unusual. The agent is entitled to demand performance by the principal of the obligations undertaken by him within the bounds of his commission, but he is not entitled to pledge him with a recklessness which he would certainly avoid in the management of his own affairs. It is in the regulation of these powers and corresponding checks in such a manner that the legal principle shall apply to daily practice, that the niceties of this branch of the law consist.

Agents are of different kinds, according to their stipulated or consuetudinary powers. The main restraint in the possible powers of an agent is in the old maxim, *delegatus non potest delegare*, designed to check the complexity that might be created by inquiries into repeatedly-deputed responsibility. The agent cannot delegate his commission or put another in his place; but in practice this principle is sometimes modified, for it so may arise from the nature of his office that he is to employ other persons for the accomplishment of certain objects. Thus, there is nothing to prevent a commercial agent from sending a portion of the goods entrusted by him to his own agent for disposal.

In the general case agency is constituted by the acceptance of the mandate or authority to act for the principal, and the evidence of this may be either verbal or in writing. The English statute of frauds requires an agent to have authority in writing for the purposes of its 1st, 2nd and 3rd clauses relating to leases. "And it is a general rule, that an agent who has to execute a deed, or to take or give livery or seisin, must be appointed by deed for that purpose. Moreover, as a corporation aggregate can in general act only by deed, its agent must be so appointed, though it would seem that some trifling agencies, even for corporations, may be appointed without one." (Smith's *Mercantile Law*, B. I. ch. iv.). It is a general rule that those obligations which can only be undertaken by solemn formalities cannot be entered on by a delegate who has not received his authority in writing. But it is often constituted, at the same time that its extent is defined, by mere appointment to some known and recognised function—as where one is appointed agent for a banking establishment, factor for a merchant, broker, supercargo, traveller, or attorney. In these cases, usage defines the powers granted to the agent; and the employer will not readily be subjected to obligations going beyond the usual functions of the office; nor will the public dealing with the agent be bound by private instructions inconsistent with its usual character. While, however, the public, ignorant of such secret limitations, are not bound to respect them, the agent himself is liable for the consequences of transgressing them. Agency may also be either created or enlarged by *implication*. What the agent has done with his principal's consent the public are justified in believing him authorized to continue doing. Thus, as a familiar instance, the servant who has continued to purchase goods for his master at a particular shop on credit is presumed to retain authority and trust, and pledges his master's credit in further purchases, though he should, without the knowledge of the shopkeeper, apply the articles to his own uses. The law is ever jealous in admitting as accessories of a general appointment to any particular agency the power to borrow money in the principal's name, to give his name to bill transactions, and to pledge him to guaranties; but all these acts may be authorized by implication, or by being the continuation of a series of transactions, of the same kind and in the same line of business, to which the principal has given his sanction. Thus an employer may, by the previous sanction of such operations, be liable for the bills or notes drawn, indorsed and accepted by his clerk or other mandatary; nay, may be responsible for the obligations thus incurred after the mandatary's dismissal, if the party dealing with him knew that he was countenanced in such transactions, and had no reason to suppose that he was dismissed. In questions of this kind the distinction between a general and a special agent is important. A general agent is employed to transact all his principal's business of a particular kind, at a certain place—as a factor to buy and sell; a broker to negotiate contracts of a particular kind; an attorney to transact his legal business; a shipmaster to do all things relating to the employment of a ship. Such an agent's power to do everything usual in the line of business in which he is employed is not limited by any private restriction or order unknown to the party with whom he is dealing. On the contrary, it is incumbent on the party dealing with a particular agent, *i.e.* one specially employed in a single transaction, to ascertain the extent of his authority. The law applicable to a mercantile agent's power to pledge or otherwise dispose of the goods entrusted to him being in an unsatisfactory state, a statutory remedy was applied to it by an act of 1825 (6 Geo. IV. c. 94), amended in 1842 (5 & 6 Vict. c. 39) and replaced by the Factors Act 1889.

The obligations of the principal are: to pay the agent's remuneration, or, as it is often called, *commission*, the amount of which is fixed by contract or the usage of trade; to pay all advances made by the agent in the regular course of his employment; and to honour the obligations lawfully undertaken for him. The agent is responsible for the possession of the proper skill and means for carrying out the functions which he undertakes. He must devote to the interests of his employer such care and attention as a man of ordinary prudence bestows on his own—a duty capable of no more certain definition, the application of it as a fixed rule being the function of a jury. He is bound to observe the strictest good faith; and the law even interposes to remove him from temptation to sacrifice his employer's interests to his own (see COMMISSION: *Secret*). Thus, when he is employed to buy, he must not be the seller. When an agent is employed to sell, he must not be the purchaser. He ought only to deal with persons in good credit, but he is not responsible for their absolute solvency unless he guarantee them. A mercantile agent guaranteeing the payments he treats for is said to hold a *del credere* commission.

See also AUCTIONS AND AUCTIONEERS; BROKER; FACTOR; GUARANTEE, &c.; also Smith's *Mercantile Law* (11th ed., 1905); Bowstead, *On Agency* (4th ed., 1909).

PRINGLE, SIR JOHN (1707–1782), British physician, was the younger son of Sir John Pringle, of Stitchel, Roxburghshire, and was born on the 10th of April 1707. He was educated at St Andrews, at Edinburgh, and at Leiden. He took the degree of doctor of physic at the last-named university, where he was an intimate friend of G. van Swieten and A. von Haller. He settled in Edinburgh at first as a physician, but after 1734 also acted as professor of moral philosophy in the university. In 1742 he became physician to the earl of Stair, then commanding the British army in Flanders, and in 1744 was appointed by the duke of Cumberland physician-general to the forces in the Low Countries. In 1749, having settled in London, he was made physician in ordinary to the duke of Cumberland; and in 1752 he married a daughter of Dr William Oliver (1695–1764) of Bath, the inventor of "Bath Oliver" biscuits. Subsequently he received other court appointments as physician, and in 1766 was made a baronet. His first book, *Observations on the Nature and Cure of Hospital and Jayl Fevers*, was published in 1750, and in the same year he contributed to the *Philosophical Transactions* of the Royal Society three papers on "Experiments on Septic and Antiseptic Substances," which gained him the Copley medal. Two years later he published his important work, *Observations on the Diseases of the Army in Camp and Garrison*, which entitles him to be regarded as the founder of modern military medicine. In November 1772 he was elected president of the Royal Society. In this capacity he delivered six "discourses," which were afterwards collected into a single volume (1783). After passing his seventieth year he resigned his presidency and removed to Edinburgh in 1780, but returned to London in September 1781, and died on the 18th of January following. There is a monument to him in Westminster Abbey, executed by Nollekens.

A *Life* of Pringle by Andrew Kippis is prefixed to the volume containing the *Six Discourses*. The library of the College of Physicians of Edinburgh possesses ten folio volumes of his unedited MSS. including an essay "On Air, Climate, Diet and Exercise." There are *Éloges* on him by Vicq d'Azyr and Condorcet.

PRINGSHEIM, NATHANAEL (1823–1894), German botanist, was born at Wziesko in Silesia, on the 30th of November 1823. He studied at the universities of Breslau, Leipzig, and Berlin successively. He graduated in 1848 as doctor of philosophy with the thesis *De forma et incremento stratorum crassiorum in plantarum cellula*, and rapidly became a leader in the great botanical renaissance of the 19th century. His contributions to scientific algology were of striking interest. Pringsheim was among the very first to demonstrate the occurrence of a sexual process in this class of plants, and he drew from his observations weighty conclusions as to the nature of sexuality. Together with the French investigators G. Thuret and E. Bornet, Pringsheim ranks as the founder of our scientific knowledge of the algae. Among his researches in this field may be mentioned those on *Vaucheria* (1855), the Oedogoniaceae (1855–1858), the Coleochaeteae (1860), *Hydrodictyon* (1861), and *Pandorina* (1869); the last-mentioned memoir bore the title *Beobachtungen über die Paarung de Zoosporen*. This was a discovery of fundamental importance; the conjugation of zoospores was regarded by Pringsheim, with good reason, as the primitive form of sexual reproduction. A work on the course of morphological differentiation in the Sphacelariaceae (1873), a family of marine algae, is of great interest, inasmuch as it treats of evolutionary questions; the author's point of view is that of Naegeli rather than Darwin. Closely connected with Pringsheim's algological work was his long-continued investigation of the Saprolegniaceae, a family of algoid fungi, some of which have become notorious as the causes of disease in fish. Among his contributions to our knowledge of the higher plants, his exhaustive monograph on the curious genus of water-ferns, *Savinia*, deserves special mention. His career as a morphologist culminated in 1876 with the publication of a memoir on the alternation of generations in thallophytes and mosses. From 1874 to the close of his life Pringsheim's activity was chiefly directed to physiological questions: he published, in a long series of memoirs, a theory of the carbon-assimilation of green plants, the central point of which is the conception of the chlorophyll-pigment as a screen, with the main function of protecting the protoplasm from light-rays which would neutralize its assimilative activity by stimulating too active respiration. This view has not been accepted as offering an adequate explanation of the phenomena. Pringsheim founded in 1858, and edited till his death, the classical *Jahrbuch für wissenschaftliche Botanik*, which still bears his name. He was also founder, in 1882, and first president, of the German Botanical Society. His work was for the most part carried on in his private laboratory in Berlin; he only held a teaching post of importance for four years, 1864–1868, when he was professor at Jena. In early life he was a keen politician on the Liberal side. He died in Berlin on the 6th of October 1894.

A fuller account of Pringsheim's career will be found in *Nature*, (1895) vol. li., and in the *Berichte der deutschen botanischen Gesellschaft*, (1895) vol. xiii. The latter is by his friend and colleague, Ferdinand Cohn. (D. H. S.)

PRINSEP, JAMES (1799–1840), Anglo-Indian scholar and antiquary, was born on the 20th of August 1799. In 1819 he was given an appointment in the Calcutta mint, where he ultimately became assay-master, succeeding H. H. Wilson, whom he likewise succeeded as secretary of the Asiatic Society. Apart from architectural work (chiefly at Benares), his leisure was devoted to Indian inscriptions and numismatics, and he is remembered as the first to decipher and translate the rock edicts of Asoka. Returning to England in 1838 in broken health, he died in London on the 22nd of April 1840. Prinsep's Ghat, an archway on the bank of the Hugli, was erected to his memory by the citizens of Calcutta.

PRINSEP, VALENTINE CAMERON (1838–1904), English artist, was born on the 4th of February 1838. His father, Henry Thoby Prinsep, who was for sixteen years a member of the Council of India, had settled at Little Holland House, which became a centre of artistic society. Henry Prinsep was an intimate friend of G. F. Watts, under whom his son first studied. Val Prinsep also worked in Paris in the *atelier* Gleyre; and "Taffy" in his friend Du Maurier's novel *Trilby*, is said to have been sketched from him. He was an intimate friend of Millais and of Burne-Jones, with whom he travelled in Italy. He had a share with Rossetti and others in the decoration of the hall of the Oxford Union. He first exhibited at the Royal Academy in 1862 with his "Bianca Capella," his first picture, which attracted marked notice, being a portrait (1866) of General Gordon in Chinese costume; the best of his later exhibits were "À Versailles," "The Emperor Theophilus chooses his Wife," "The Broken Idol" and "The Goose Girl." He was elected A.R.A. in 1879 and R.A. in 1894. In 1877 he went to India and painted a huge picture of the Delhi durbar, exhibited in 1880, and afterwards hung at Buckingham Palace. He married in 1884 Florence, daughter of the well-known collector, Frederick Leyland. Prinsep wrote two plays, *Cousin Dick* and *Monsieur le Duc*, produced at the Court and the St James's theatres respectively; two novels; and *Imperial India: an Artist's Journal* (1879). He was an enthusiastic volunteer, and one of the founders of the Artists' Corps. He died on the 11th of November 1904.

PRINT, the colloquial abbreviation used to describe printed cloths generally, though it is most commonly applied to the staple kinds of cotton goods. The word must be distinguished from "printer," which refers to the regular kinds of cotton cloths intended for printing. (See TEXTILE PRINTING.)

PRINTING (from Lat. *imprimere*, O. Fr. *empreindre*), the art or practice of transferring by pressure, letters, characters or designs upon paper or other impressible surfaces, usually by means of ink or oily pigment. As thus defined, it includes three entirely different processes: copperplate printing, lithographic or chemical stone-printing, and letterpress printing. The difference between the three lies in the nature or conformation of the surface which is covered with the pigment and afterwards gives a reproduction in reverse on the material impressed. For the nature and method of preparing these surfaces see respectively ENGRAVING (and allied articles), LITHOGRAPHY and TYPOGRAPHY. In copperplate printing the whole of the plate is first inked, the flat surface is then cleaned, leaving ink in the incisions or trenches cut by the engraver, so that, when dampened paper is laid over the plate and pressure is brought to bear, the paper sinks into the incisions and takes up the ink, which makes an impression in line or lines on the paper. In lithographic printing the surface of the stone, which is practically level, is protected by dampening against taking the ink except where the design requires. In letterpress printing the printing surface is in relief, and alone receives the ink, the remainder being protected by its lower level. Before the invention of typography, pages of books, or anything of a broadside nature, were printed from woodcuts, *i.e.* blocks cut with a knife on wood *plankwise*, as distinct from wood engravings which are cut with a burin on the *end* grain, a more modern innovation. These woodcuts, like the lithographic or engraved surface, served one definite purpose only, but in typography the types can be distributed and used again in other combinations.

The term "printing" is often used to include all the various processes that go to make the finished product; but in this article it is properly confined to "press-work," *i.e.* to the work of the printing-press, by which the book, newspaper, or other printed article, when set up in type and ready as a surface to be actually impressed on the paper, is finally converted into the shape in which it is to be issued or published.

History of Printing-press.

Before dealing with modern machinery it will be necessary to consider the historical evolution of the printing-press, especially since the middle of the 19th century, from which point printing machinery has developed in a most remarkable manner.

It is not clear how the first printers struck off their copies, but without doubt Gutenberg did use at an early period in his career a mechanical press of some kind, which was constructed of wood. In fact he could not have produced his famous forty-two line Bible without such aid.

Wooden Hand-presses. The earliest picture of a press shows roughly the construction to have been that of an upright frame, the power exerted by a movable handle, placed in a screw which was tightened up to secure the requisite impression, and was loosened again after the impression was obtained. The type pages were placed on a flat bed of solid wood or stone, and it was quite a labour to run this bed into its proper position under the hanging but fixed horizontal plane, called the *platen*, which gave the necessary impress when screwed down by the aid of the movable bar. This labour had to be repeated in order to release the printed sheet and before another copy could be struck off. This same press, with a few modifications, was apparently still in general use till the early part of the 17th century, when Willem Janszon Blaeu (1571–1638) of Amsterdam, who was appointed map maker to the Dutch Republic in 1633, made some substantial improvements in it. Our first authority on printing, Joseph Moxon, in his *Mechanick Exercises, as Applied to the Art of Printing* (vol. i., 1683), says, " There are two sorts of presses in use, viz. the old fashion and the new fashion," and he gives credit to Blaeu for the invention of the new and decidedly improved press (fig. 1).

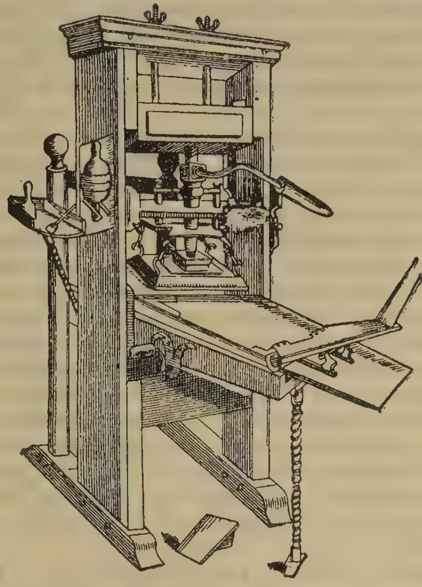
FIG. 1.—Blaeu's Wooden Hand-press.

Blaeu's improvement consisted of putting the spindle of the screw through a square block which was guided in the wooden frame, and from this block the platen was suspended by wires or cords. This block gave a more rigid platen, and at the same time ensured a more equal motion to the screw when actuated by the bar-handle. He also invented a device which allowed the bed on which the type pages were placed to run in and out more readily, thus reducing the great labour involved in that part of the work of the older form of press, and he also used a new kind of iron lever or handle to turn the screw which applied the necessary pressure. The value of these various improvements, which were in details rather than in principles, was speedily recognized, and the press was introduced into England and became known as the " new fashion."

From this it will be observed that in a general way there had only been two kinds of wooden presses in use for a period of no less than three hundred and fifty years, and when the work of some of the early printers is studied, it is marvellous how often good results were obtained from such crude appliances.

Iron Hand-presses. The iron press (fig. 2) invented by Charles, 3rd earl Stanhope (1753–1816), at the end of the 18th century was a decided advance on those made of wood. Greater power was obtained at a smaller expenditure of labour, and it allowed of larger and heavier surfaces being printed. The chief points of the iron press consisted of an improved application of the power to the spindle. The main part of it was the upright frame or staple, of iron; the feet of this staple rested upon two pieces of substantial timber dovetailed into a cross, which formed a base or foundation for the complete press to stand upon. The staple was united at the top and bottom, but the neck and body were left open, the former for the mechanism and the latter for the platen and the bed when run in preparatory to taking the impression. The upper part of the staple, called the nut, answered the same purpose as the head in the older kind of wooden press, and was in fact a box with a female screw in which the screw of the spindle worked. The lower portion of the neck was occupied by a piston and cup, in and on which the toe of the spindle worked. On the near side of the staple was a vertical pillar, termed the arbor, the lower end of which was inserted into the staple at the top of the shoulder—the upper end passing through a top-plate, which being screwed on to the upper part of the staple held it firmly. The extreme upper end of the arbor, which was hexagonal, received a head, which was really a lever of some length; this head was connected by a coupling-bar to a similar lever or head, into which the upper end of the spindle was inserted. The bar by which the power was applied by the pressman was fixed into the arbor, and not into the spindle, so that the lever was the whole width of the press, instead of half, as in Blaeu's wooden press, and it was better placed for the application of the worker's strength. There was also another lever to the arbor head in addition to that of the spindle head; and lastly, the screw itself was so enlarged that it greatly increased the power. The platen was screwed on to the under surface of the spindle; the table or bed had slides underneath which moved in, and not on, ribs as in the older form of press, and was run in and out by means of strips of webbing fastened to each end and passed round a drum or wheel. As the platen was very heavy the operator was assisted in raising it from the type-forme by a balance weight suspended upon a hooked lever at the back of the press. This somewhat counterbalanced the weight of the platen, raised it after the impression had been taken, and brought the bar-handle back again to its original position, ready for another pull.

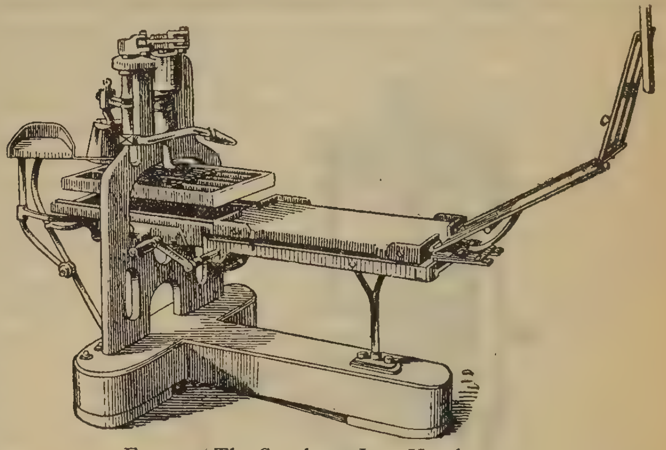
FIG. 2.—The Stanhope Iron Hand-press.

The Stanhope press, which is still in use, was soon followed by other hand-presses made of iron, with varying changes of details. The most successful of these were the Albion and Columbian presses, the former of English manufacture, and the latter invented (1816) by an American, George Clymer (1754–1834), of Philadelphia.

The Albion press (fig. 3), which was designed by Richard Whittaker Cope, was afterwards much improved upon by John Hopkinson (1849–1898). It is still used where hand printing prevails, and it was this form of press which was employed by William Morris at his famous, but short-lived, Kelmscott Press, in the production of many sumptuous books, the most celebrated of which was the *Chaucer*, a large folio volume, illustrated by Sir Edward Burne-Jones. The chief characteristics of the Albion are its lightness of build and its ease in running; the pull is short, the power great, and the means whereby it is attained so simple that the press does not readily get out of order. It is easily taken to pieces for cleaning, and readily re-erected. The power is obtained by pulling the bar-handle across, which causes an inclined piece of wedge-shaped steel, called the chill, to become perpendicular; in so doing the platen is forced down, and the impression takes place at the moment the chill is brought into a vertical position. On the return of the bar the platen is raised by a spiral spring, placed in a box and fixed at the head of the press. The larger sizes of these presses usually print a sheet of double crown, measuring 30×20 in.

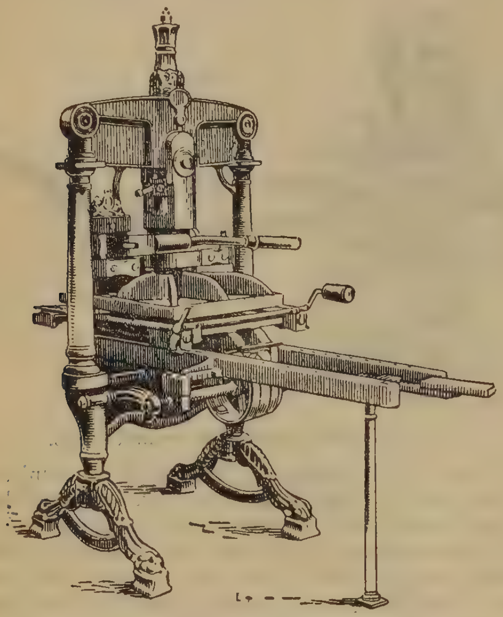

Fig. 3.—Payne & Sons' Albion Hand-press.

Although the Columbian is not so much in demand as the Albion, it is still employed for heavy hand-work because of its greater stability and power. This power is acquired by a very massive lever, moving on a pivot bolt in the top of the near side of the staple, and passing across the press to the further side of the frame, at which end the power is applied through the coupling-bar by a bar-handle working from the near side. The platen is attached to the centre of the lever by a square bar of iron, and its vertical descent is assured by two projecting guides, one from each cheek; it is then raised from the type-forme, and the iron bar carried back by two levers—the one attached to and above the head and weighted with the eagle; the other behind the press, attached to the arm to which the coupling-bar is fixed, and which also has a weight at the end. The great power of this press adapts it to the working of large and solid formes in printing, but it is somewhat slower in action than the Albion press, which is both lighter in construction and quicker in working.

The average output of the modern hand-press, when all is made ready for running, is about two hundred and fifty impressions per hour. This number, it should be said, is the product of two men who work together as "partners." One inks the type-forme and keeps a sharp look-out for any inequality of inking, and sees generally that the work is being turned out in a workmanlike manner. The other lays on the sheet to certain marks, runs the carriage in under the platen, and pulls the bar-handle across to give the necessary impression. He then runs back the carriage and takes out the printed sheet, which he replaces by another sheet, and repeats the different operations for the next impression. During the interval between taking off the printed sheet and laying on the next one his partner inks the type surface with a roller which carries just sufficient ink properly distributed to preserve uniformity of "colour."

Having dealt with hand-presses, we must now go back to the end of the 18th century, when the first experiments were made to devise some mechanical means of producing larger printed sheets, and at a quicker rate. In England the broad distinction between "presses" and "machines" is generally considered to rest in the fact that the former are worked by hand, and the latter by steam, gas or electricity; and the men who work by these two methods are called respectively "pressmen" and "machine minders" or "machine managers." But in America the terms "presses" and "pressmen" are universally applied to machines and the men who operate them. For the purposes of this article presses and machines are used as synonymous terms.

The First Cylinder Machine.

Various schemes had been propounded with a view of increasing the output of the hand-press, and in 1790 William Nicholson (1753–1815) evolved his ideas on the subject, which were suggestions rather than definite inventions. Nicholson was not a printer, but, as he was an author and editor, it is presumed that he had some knowledge of printing. His proposals were to print from type placed either on a flat bed or a cylinder, and the impression was to be given by another cylinder covered with some suitable material, the paper being fed in between the type and the impression cylinder, and the ink applied by rollers covered with cloth or leather, or both. While Nicholson's schemes did not bear any practical result they certainly helped others later on. His suggestion to print from type made wedge-shaped (that is, smaller at the foot and wider at the top) to allow of its being so fixed on a cylinder that it would radiate from the centre and thus present an even printing surface, was adopted later by Applegath and others, and really was the first conception of printing on the rotary principle which has now been brought to such perfection.

It was left to Friedrich König (1774–1833), a German, to produce the first really practical printing machine. His invention was to print type placed on a flat bed, the impression being given by a large cylinder, under which the type passed, but his inking appliances were not satisfactory. He induced the proprietor of *The Times* (London) to take two of these machines, and in 1814 that newspaper was printed with steam power at the rate of 1100 impressions per hour, a great advance on the number produced up to that time. Both Nicholson's and König's machines printed only one side at a time—the second or backing printing being a separate and distinct operation—but they really embodied the general principles on which all other machines have been constructed or modelled.

It will be understood that Nicholson's theories were to print both from the flat and from type arranged in circular or cylinder form. These two principles are defined as *reciprocating*, for the flat bed which travels backwards and forwards; and *rotary*, for that which continuously revolves or rotates. König's invention was a reciprocating one.

Double Platen Machine.

Two other classes of presses of somewhat different design were largely in operation in the middle of the 19th century—the "double platen," which still printed only one side at each impression from each end, and the "perfecting machine," which was made with two large cylinders and printed from two type-formes placed on separate beds. Although the latter machine turned out sheets printed on both sides before it delivered them (hence its name), the second impression was still a distinct operation. The double platen press was somewhat analogous to the hand-press, both the type beds and impressions being flat. A machine of this kind, if it printed a sheet of double demy, which measures 35×22½ in., was about 13 ft. in length, and the platen itself, of very massive construction, was placed in the centre. This platen had a perpendicular motion, being guided in grooves and worked by a connecting rod fixed to a cross beam and crank, which acquired its motion from the main shaft. There were two type beds and two inking tables, which travelled backwards and forwards, and one platen only, situated in the middle of the machine, which in turn gave the needful impression as the type-formes passed underneath. The sheets were laid or fed to certain marks between the frisket and tympan, and when these were closed together the carriage was propelled under the platen and the impression was given to that portion of the machine, while at the other end another sheet was being fed in ready to receive its impression in due course.

It was once thought that the finest work could not be produced by a cylinder impressing a surface in the progress of its reciprocating motion, but that it was likely to give a slurred or blurred impression. This is why machines of flat construction were so long employed for the best class of work. But cylinder presses are now made so truly turned, and geared to such nicety, that this idea no longer prevails. The cylinder press is able to produce generally quite as good work as the double platen, its speed is much greater, and it requires a smaller amount of power to drive it.

Perfecting Machine.

The perfecting machine has had a great vogue, and has been much improved from time to time, especially in America, though the two-revolution machine in recent years superseded it, whether temporarily or not being still uncertain. We shall deal with it more fully below in relation to the modern and more complicated class of machinery; and this also applies to the ordinary stop or single cylinder, and small platen machines, both of which have been in use many years, and are still in demand.

Type Revolving Machines.

Before the general introduction of rotary machines which print from curved stereotype plates from an endless web or reel of paper (see below), several other presses of a revolving character were made, to some extent based on Nicholson's ideas. The first printing surface used was ordinary type, because the difficulty of curving the stereotype plates had not been surmounted. This type was fixed, both in vertical and in perpendicular positions, upon a cylinder, round which rotated other cylinders, which held and compressed the sheets against the larger one, which also revolved and carried the printing surface. These machines were made to print several sheets at a time, and were called four-, six-, eight- or ten-feeders, according to the number of sheets fed in and printed. They necessitated a great deal of labour, because each feed required a separate layer-on and taker-off besides the superintending printer, and other hands to carry away the sheets as fast as they accumulated at the different taking-off boards. Besides, these sheets all had to be folded by hand. In this class of machine various improvements were made from time to time by different manufacturers, each profiting by the experiences of the others, and two kinds of such revolving presses may now be given as examples.

After many experiments Augustus Applegath (1789–1871) in 1848 constructed for *The Times* (London), a machine which was an eight-feeder, built entirely on the cylindrical principle, the cylinders placed not in a horizontal but in a vertical position. The type was fixed on a large cylinder, and instead of the printing surface presenting a complete circle, the different columns were each arranged so as to form a polygon. Around this large type cylinder were eight smaller ones, all upright, for taking the impression for each of the eight sheets fed in separately, and rollers were so arranged as to apply the ink to the type as it passed alternately from one impression cylinder to the other. The sheets were laid in from eight different feed-boards, placed horizontally, and they passed through tapes, when they were seized by another series of tapes and then turned sideways between their corresponding impression and type cylinder, thus obtaining sheets printed on one side only. The impression cylinder then delivered the sheets separately (still in a vertical position) into the hands of the boys employed as takers-off. The results from this press were, at the time, considered fairly satisfactory, the number of copies (about 8000) printed per hour from one type-forme having been materially increased by the employing of the eight different stations to feed the sheets in, all of which in turn were printed from the same single type surface.

About 1845 Robert Hoe & Co. of New York, and subsequently of London, had constructed, to meet the increased demands of newspapers, the "Hoe Type Revolving Machine," one good point of which was an apparatus for securely fastening in the type on a large central cylinder fixed horizontally. This was accomplished by the construction of cast-iron beds, one for each separate page (not column, as in Applegath's machine). The column rules were made tapering towards the feet of the type, and the type was securely locked in on these beds so that it could be held firmly in the required position to form a complete circle, thus allowing the cylinder to revolve at a greater speed than Applegath's, which was polygonal. Around the large type cylinders were placed the smaller impression cylinders, the number of these being governed by the output required. Hoe's first presses were four-feeders, but as many as ten feeds were supplied, as in the case of the two presses built to replace the Applegath machine for *The Times*, each of which produced about 2000 impressions from each feed, making a total of 20,000 per hour, printed on one side, or from two machines 20,000 sheets printed on both sides. As will be observed, the only differences in principle between these two type revolving machines were in the positions of the respective cylinders, and the fixing of the type to form a printing surface.

It was Sir Rowland Hill who first suggested the possibilities of a press which should print both sides at once, from a roll or reel of paper. This was about 1825, but it was William A. Bullock (1813–1867) of Philadelphia who in 1865 invented the first machine to print from a continuous web of paper. This machine had two pairs of cylinders, that is, two type or stereotype cylinders, and two others which gave the impression as the web passed between. The second impression cylinder was made somewhat larger so as to give a greater tympan surface, to lessen the off-set from the side first printed. In his machine the stereotype plates were not made to fill the whole periphery of the forme cylinders so as to allow of the sheets being cut before printing, a difficulty which the first machines did not satisfactorily overcome. The sheets were severed by knives placed on the cylinders, and when cut were carried by grippers and tapes; and delivery was made by means of automatic metal fingers fixed upon endless belts at such distances apart as to seize each sheet in succession as it left the last printing cylinder. These presses were not at first reliable in working, especially in the cutting and delivery of the sheets after printing, but were finally so far improved that the Bullock press came into quite general use. The inventor was killed by being caught in the driving belt of one of his own presses.

Modern Presses.

Classification of Modern Presses and Machines.

The machines invented during the second half of the 19th century and still in general use, are best classified as follows:—

1. *The iron hand-press*, such as the Albion or the Columbian, used for the pulling of proofs, or for the printing of limited *éditions de luxe*.

2. *Small platen machines* (worked by foot or power) used for the printing of cards, circulars and small jobbing or commercial work.

3. *Single cylinder machines* (in England generally called "Wharfedales"), usually built on the "stop" cylinder principle, and printing one side of the sheet only.

4. *Perfecting machines*, usually with two cylinders, and printing or "perfecting" both sides of a sheet before it leaves the machine, but with two distinct operations.

5. *Two-revolution machines*, which, although with but one cylinder, have largely superseded perfecting machines, as their output has been increased and the quality of their work compares favourably with that of the average two-cylinder.

6. *Two-colour machines*, usually made with one feed, that is, with only one cylinder, but with two printing surfaces, and two sets of inking apparatus one at each end of the machine. Occasionally these machines are made with two cylinders.

7. *Rotary machines*, printing from an endless web of paper from curved stereotype or electrotype plates, principally used

for newspaper or periodical work. They are made to print upon a single reel, or upon two, four, six or even eight reels, in both single or double widths, *i.e.* two or four pages wide.

The hand-press has already been sufficiently described, and we may proceed to deal with the other classes.

Platen Jobbing Machines.

The small but useful platen machine (fig. 4) is very largely employed in those printing-houses that make commercial work a speciality. The smaller machines can be worked with the foot, but if the establishment is equipped with power it is customary to gear them for driving. The larger machines require power. As its name implies, the type bed and impression platen are both flat surfaces as in the hand-press, but as they are self-inking and are easily driven, the average output is about 1000 copies per hour, and but one operator is required, whereas two men at a hand-press can produce only 250 copies in the same time. In design these platen presses usually consist of a square frame with a driving shaft fixed horizontally across the centre of it. This shaft is attached to a large fly-wheel which gives impetus to the press when started and assists in carrying over the impression when the platen is in contact with the printing surface. The type-forme is usually fixed in an almost vertical and stationary position, and it is the platen on which the sheet is laid which rises from the horizontal position to the vertical in order to give the necessary impact to produce a printed impression from the type-forme. Practically this platen is, as it were, hinged at the off side, nearest the type bed, and its rise and fall is effected by the use of two arms, one on each side of the platen, which derive an eccentric motion from cams geared in connexion with the shaft. When the sheet is printed and the platen falls back to the horizontal the operator removes it with one hand and with the other lays on a fresh sheet. Generally the larger of these machines will print a sheet up to 21 × 16 in.

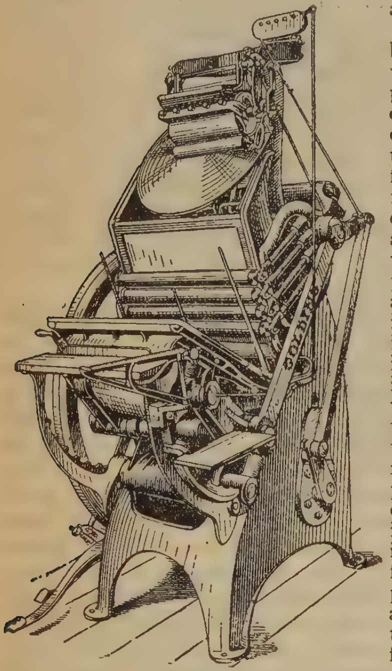

Fig. 4.—The Golding Jobber Platen Machine.

"Wharfedale" Machines.

The modern single or "stop" cylinder, quite different in construction from the old single cylinder machines, largely succeeded the double platen machine. The principle of the stop cylinder was really a French invention, but it has been more commonly adopted in Great Britain, where the machines are known as "Wharfedales" (fig. 5). They are much used for the printing of books and commercial work. The average production is about 1000 copies per hour. The type bed travels with a reciprocating motion upon rollers or runners made of steel, the bed being driven by a simple crank motion, starting and stopping without much noise or vibration. All the running parts are made of hard steel. The cylinder is "stopped" by a cam motion while the bed is travelling backward, and during this interval the sheet to be printed is laid against the "marks," and the gripper closes on it before the cylinder is released, thus ensuring great accuracy of lay, and consequent good register. After the impression is made the sheet is seized by another set of fingers and is transferred to a second and smaller cylinder over the larger one, and this smaller cylinder or drum delivers the sheet to the "flyer," or delivery apparatus, which in turn deposits it upon the table. The inking arrangements are usually very good, for, by a system of racks and cogs which may be regulated to a nicety, the necessary distribution of ink and rolling of the printing surface runs in gear with the travelling type bed or coffin. All the accessories for inking are placed at the end of the machine, the ink itself being supplied from a ductor, which can be so regulated by the keys attached to it as to let out the precise amount of pigment required. The ink passes to a small solid metal roller, and is then conveyed by a vibrating roller made of composition to a larger and hollow metal cylinder or drum which distributes the ink for the first time. This revolves with the run of the machine and at the same time has a slight reciprocating action which helps the distribution. A second vibrating composition roller conveys the ink from this drum to the distributing table or ink slab, on which other rollers, called distributors, still further thin out the ink. As the type bed travels, larger composition rollers, called inkers, placed near the cylinder, adjusted to the requisite pressure on the type, pick up the necessary amount of ink for each impression and convey it to the type as it passes under them. Usually three or four such rollers are required to ink the forme.

Perfecting Machines.

The perfecting machine is so named because it produces sheets printed on both sides or, in technical language, "perfected." This operation is performed by two distinct printings. This class of machine has been in use a great many years, although both the stop-cylinder and the two-revolution press have to some extent superseded it. It is perhaps best adapted for the printing of newspapers or magazines having circulations that do not require rotary machines intended for long runs. Although some perfecting machines have been made with one cylinder only, which reverses itself on the old "tumbler" principle, they now are made with two cylinders, and it is with this class that we are particularly concerned. There are various makes of perfecting machines of which the Dryden & Foord is shown in fig. 6; among the best recent typed is the Huber Perfecter.

Although the two-type beds have a reciprocating motion, as in the ordinary one-sided press, the two cylinders rotate towards each other. The frame of the machine, owing to the fact that it contains two carriages and a double inking apparatus, is long, the exact size depending on the size of the sheet to be printed. Close to the large cylinders are the inking rollers, which take the necessary amount of ink, each set from its own slab as it passes under, and these rollers convey the requisite ink to the printing surface as the forme-carriage runs under its own cylinder. The distinctive feature is the ingenious manner in which the sheets are printed first on one side, and then on the other. This is performed by carrying them over a series of smaller cylinders or drums by means of tapes. The pile of sheets

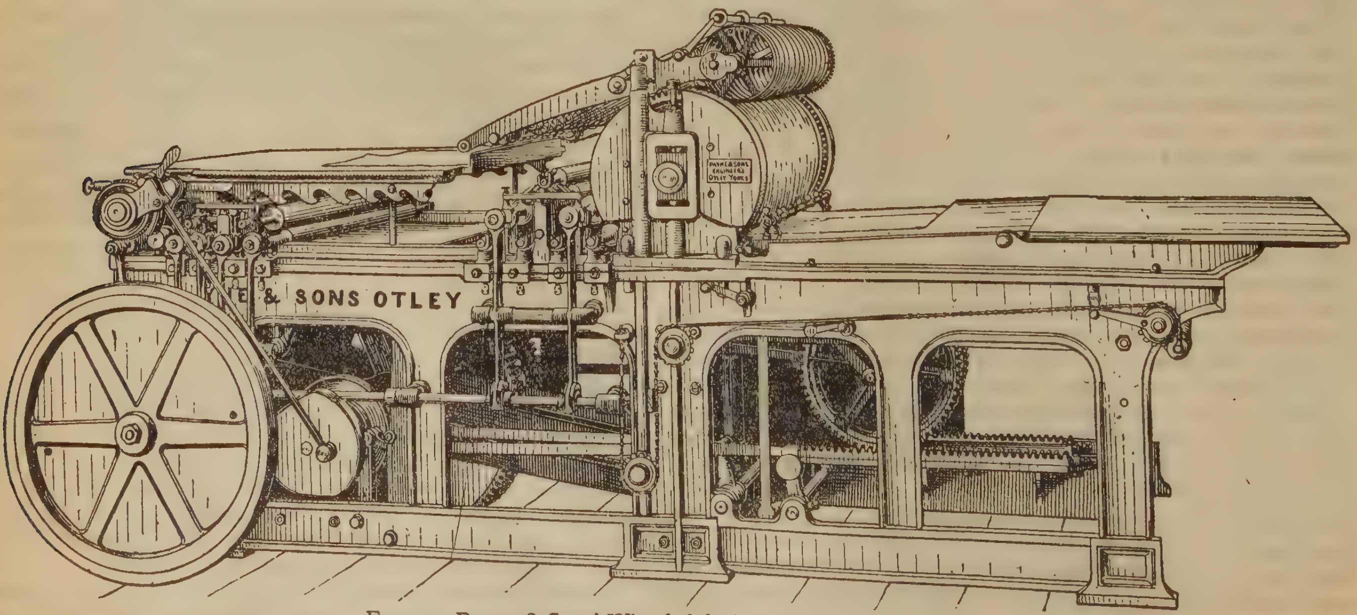

Fig. 5.—Payne & Sons' Wharfedale Stop-Cylinder Machine.

to be fed in stands on a high board at one end. The sheet is laid to its mark and is conveyed round an entry drum; thence it is carried round the first impression cylinder, and under this, moving at the same speed as the cylinder, is the type bed containing the inner forme already inked. The paper then receives its impression on the first side. In the older type of machine it is next led up to the right-hand one of the two reversing drums, which are placed above the large printing cylinders, and over which it passes with the printed side downwards. It is then brought under the second or left-hand drum, and so on to the other large impression cylinder, with the blank side of the sheet exposed to the type of the outer forme on the table underneath. Thus it will be seen that the sheet is reversed in its travel between the first and second large cylinders which give the impression. The sheet is then finally run out and delivered in the space between the two large cylinders, and laid on the delivery board—usually with the aid of flyers. In the more recent type of perfecting machines the sheet is fed directly into grippers, change taking place when grippers on each cylinder meet, the outer forme grippers taking the sheet from the inner forme grippers.

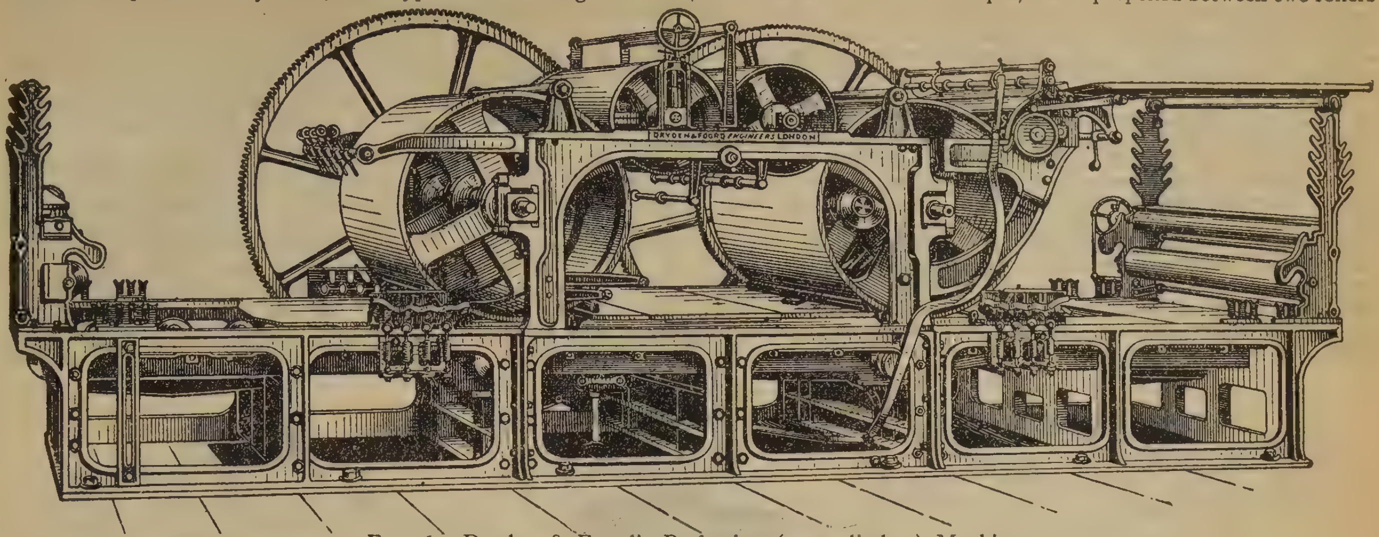

Fig. 6.—Dryden & Foord's Perfecting (two-cylinders) Machine.

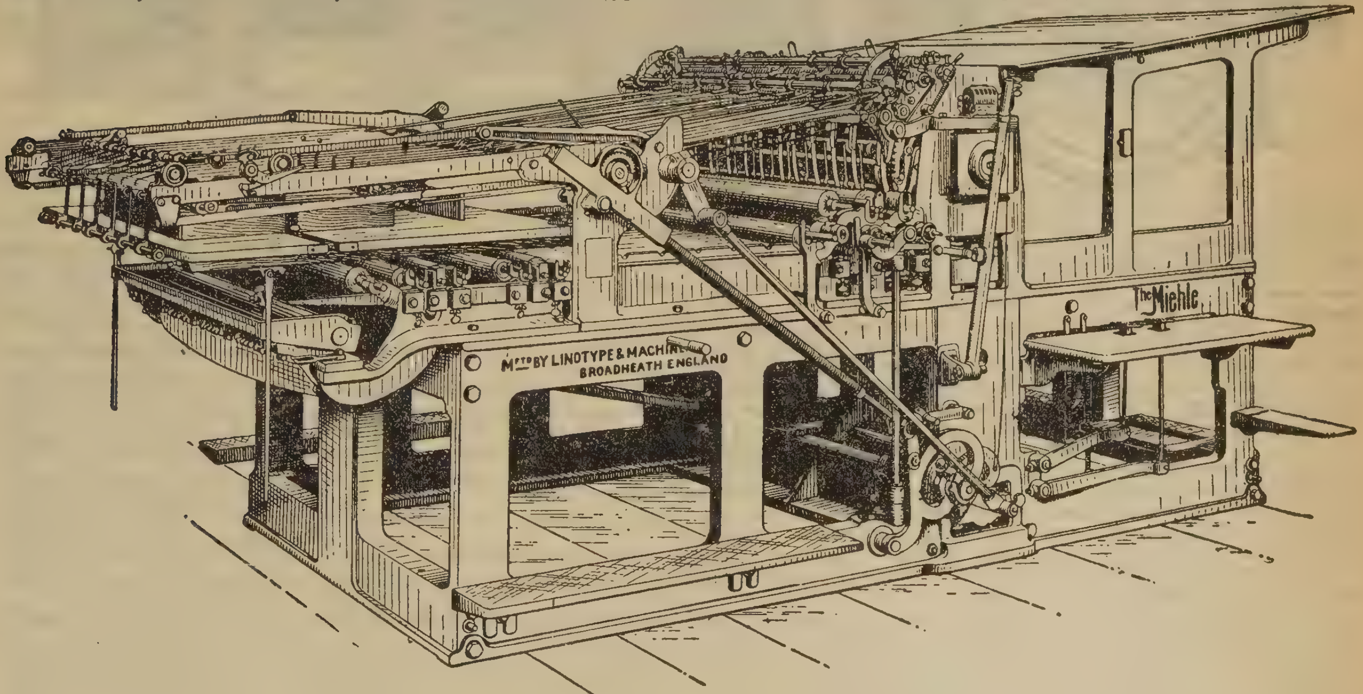

Fig. 7.—The Miehle Two-revolution Cylinder Machine.

This is a general description of the principles on which these machines are built, but, as in other classes, there are many variations in details. For example, there are the drop-bar, the web and the gripper methods of feeding these presses. In the first case a bar descends upon the paper after it is laid to point marks, and this bar, having a rotary motion, runs the sheet between a roller and a small drum into the machine. The web arrangement consists of a series of broad tapes which lie on the laying-on board and are fastened to a small drum underneath it. This drum has a series of small cogs which move the web or tapes in the same direction. The sheet is laid to a back mark on the tapes, and is propelled between two rollers direct into the machine. Another variety employs grippers somewhat after the manner of the ordinary single cylinder. The Anglo-French perfecting machine is one of that class. As a rule most double-cylinder presses produce on an average about 1000 copies per hour, printed both sides.

Two-Revolution Machines.

The two-revolution machine is another one-cylinder machine built on the reciprocating principle. Its speed is greater than the stop cylinder (it may be geared to produce from 1500 to 2000 copies per hour, printed one side only). The Miehle (fig. 7), which is of American design but now made also in Great Britain, is a good example of this kind of machine and is much used, especially for illustrated work. It has the high over-feedboard, and the taking-off apparatus is automatic but on a different plan from that of the ordinary Wharfedale, the sheets being carried over tapes with the freshly-printed side uppermost, thus preventing smearing; they are then carried on to the heap or pile by the frame or long arms placed at the end of the machine. A recent feature of this machine is the tandem equipment, whereby two, three or even four machines may be coupled together for colour work. Only one layer-on is required and register is obtained automatically throughout.

The principle of the two-revolution press is that the cylinder always rotates in the same direction, and twice for each copy given, once for the actual impression, and again to allow of the return of the forme-carriage in its reciprocating action. This also allows time for the feeding in of the next sheet to be printed. Among other advantages claimed for this press one is that the movement which governs the action of the type bed in reversing is so arranged that the strain which sometimes occurs in other reciprocating machines is considerably reduced; another is that the registering or correct backing of the pages on the second side in printing is uncommonly good; but this depends much upon the layer-on. In many of the old kinds of two-revolution machines, owing to the cylinder being geared separately from the type bed, it was apt to be occasionally thrown out, but in the Miehle, for instance, it is only out of gear in reversing, and in gear while printing. Great strength is imparted to the frame, and the type bed is particularly rigid. These points, together with a truly turned and polished cylinder, with carefully planned means of adjustment, much simplify the preparation of making-ready of any kind of type-forme or blocks for printing, which is carried out much in the same way as on the ordinary single cylinder, but in a more convenient manner. Many of these machines are made to print four double crowns, 60 × 40 in., or even larger.

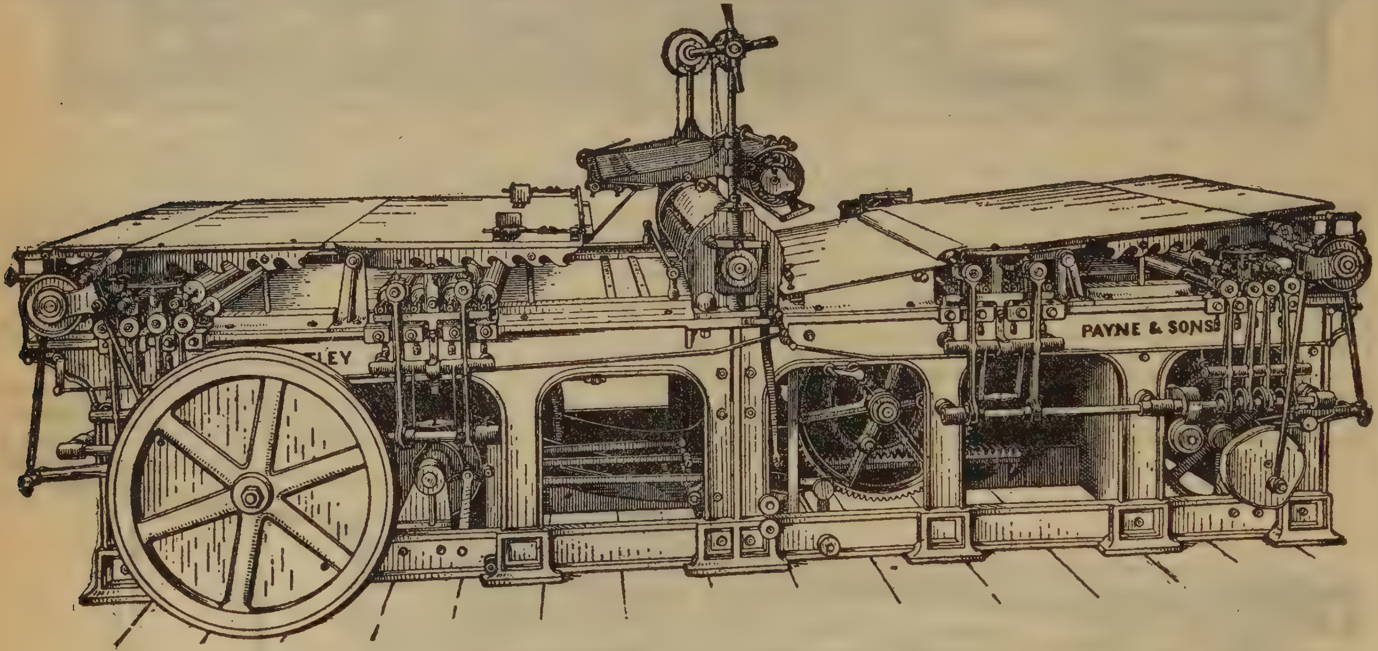

Fig. 8.—Payne & Sons' Two-colour Single Cylinder Machine.

Two-Colour Machines. The two-colour machine is generally a single cylinder (fig. 8) with one feed only, and the bed motion reciprocating. The two colours are printed each at one revolution from the two type-formes as they pass under the cylinder, which rotates twice in its travel. A double inking apparatus is of course necessary, and the inking arrangements are placed at the two extreme ends of the machine. In comparison with the ordinary single cylinder the two-colour machine is built with a longer frame, as is necessary to allow the two type-formes to pass under the cylinder, both in its travel forward and on its return. This cylinder on its return is stationary, in fact it might be called a double or rather an alternative stop-cylinder machine, with the inking facilities arranged somewhat on the same plan as on either a two-feeder or a perfecting machine. These two-colour presses are intended only for long runs, short runs may be worked to advantage separately on the ordinary single-colour machine. Generally, with the exception just mentioned, the machine is much the same as the ordinary stop or Wharfedale.

Before leaving the subject of printing with the reciprocating bed-motion, it may be mentioned that although in all modern machines of that kind the printed sheet is self-delivered, the imprinted paper has generally been fed in by hand, and for some classes of work this is still done. But many automatic feeders have been invented from time to time, which for the many purposes for which they are suitable must be reckoned part of a modern printing establishment.

Rotary Machines. As distinct from flat bed printing with a reciprocating motion, printing on rotary principles is a most interesting study, and it is this department of printing mechanics which has developed so very much in recent years. It seems almost as though this branch had reached its limit, and as though any further developments can only be a question of duplication of the existing facilities so as to print from a greater number of cylinders than, say, an octuple machine. This would be merely a matter of building a higher machine so as to take a larger number of reels arranged in decks. As the name implies, these presses are so constructed that both printing surfaces and paper continuously rotate, the web of paper travelling in and out, in a serpentine manner, between various cylinders of two characters—one (the type cylinders) carrying the surface to be impressed, usually curved stereotype plates, and the other (the impression cylinders) giving the desired impression. Such a press, if driven by electric power, is set in motion by merely pushing a button or small switch, a bell first giving warning of the press being about to move. The number of duplicate sets of stereotype plates to be worked from by these presses is determined by the size and number of the pages to be printed, and this in turn is regulated by the capacity of the machine.

As already explained, the forerunners of the rotary presses of the present day were the type-revolving printing-machines, and, whilst they were still being used, experiments were being made to cast curved stereotype plates which would facilitate and simplify the work of producing newspapers. This was successfully accomplished by the use of flexible paper matrices, from which metal plates could be cast in shaped moulds to any desired curve. These plates were then fixed on the beds of the Hoe type revolving machine, which were adapted to receive them instead of the movable type-formes previously used. This new method enabled the printers to duplicate the type pages and to run several machines at the same time, thus producing copies with far greater rapidity. In some large offices as many as five machines were in constant use. About this period the English stamp duty on printed matter was repealed, and this materially aided the development of the newspaper press.

Subsequently the proprietors of *The Times* made various experiments with a view to making a rotary perfecting press, and as a result started the first one about 1868. It was somewhat similar in design to the Bullock press, so far as the printing apparatus was concerned, except that the cylinders were all of one size and placed one above the other. The sheets were severed after printing, brought up by tapes, and carried down to a sheet flyer, which moved backwards and forwards, and the sheets were alternately "flown" into the hands of two boys seated opposite each other on either side of the flyers. Hippolyte Marinoni (1823–1904), of Paris, also devised a machine on a somewhat similar principle, making the impression and type cylinders of one size and placing them one over the other. About 1870 an English rotary machine called the "Victory" was invented by Messrs Duncan & Wilson. It printed from the web, and had a folder attached. An improved form of this machine is still in use. This machine had separate fly-boards for the delivery of the sheets. In 1871 Messrs Hoe & Co. again turned their attention to the construction of a rotary perfecting press to print from the reel or continuous web of paper, and from stereotype plates fastened to the cylinder.

The rotary presses in use at the present time are indeed wonderful specimens of mechanical ingenuity, all the various operations of damping (when necessary), feeding, printing (both sides), cutting, folding, pasting, wrapping (when required) and counting being purely automatic. These machines are of various kinds, and are specially made to order so as to cope with the particular class of work in view. They may be built on the "deck" principle of two, three, four, or even more reels of paper, and either in single width (two pages wide), or double width (four pages wide). Single and two-reel machines are generally constructed on the "straight line" principle, *i.e.* arranged with the paper at one end of the machine, and passing through the cylinders to the folder at the other end where the copies are delivered. Three- and four-reel machines have also been constructed on the same principle, but the more usual arrangement of the four-reel press is to place two reels at either end, with the folders and delivery boards in the centre. This makes it possible to operate them as independent machines, or to run in combination with each other.

When presses are made in double width a two-reel machine is known as a quadruple, a three-reel as a sextuple, and a four-reel as an octuple machine. Double sextuple and double octuple machines are made, having six and eight reels respectively. The quadruple machine is a favourite one and is perhaps most in demand for newspaper work. This press prints from two reels of the double width. The first reel is placed to the right of the machine near the floor, and the second at the back of the machine and at right angles to it. A quadruple machine will produce 48,000 copies per hour of four, six or eight pages; and proportionately less of a greater number of pages; all folded, counted and pasted if required. The four cylinders, which are on the right-hand side of the press, are respectively the printing and impression cylinders—the two inside ones being those giving the impression, and the two outer ones bearing the printing surfaces. The inking arrangements are placed at the two extreme ends of these four drums or cylinders, thus being near the type surfaces in each case. As the paper is unwound from the reel below it travels between the first two cylinders when it is printed on the first side; it then passes to the third and fourth cylinders, which give it the second backing side, thus "perfecting" the printed sheet. From this point the long sheet is carried overhead to the left-hand side of the machine, where it is cut longitudinally and divided, and then associated with the other web similarly printed by the other half of the press. They then descend into the two different folders, where they are folded and cut—the copies being discharged on to the delivery boards situated at the two sides of the left-hand portion of the machine, and each quire is counted or told off by being jogged forward. This description applies to one half of the machine only, for while this is in operation the same thing is being repeated by the other half situated at the back.

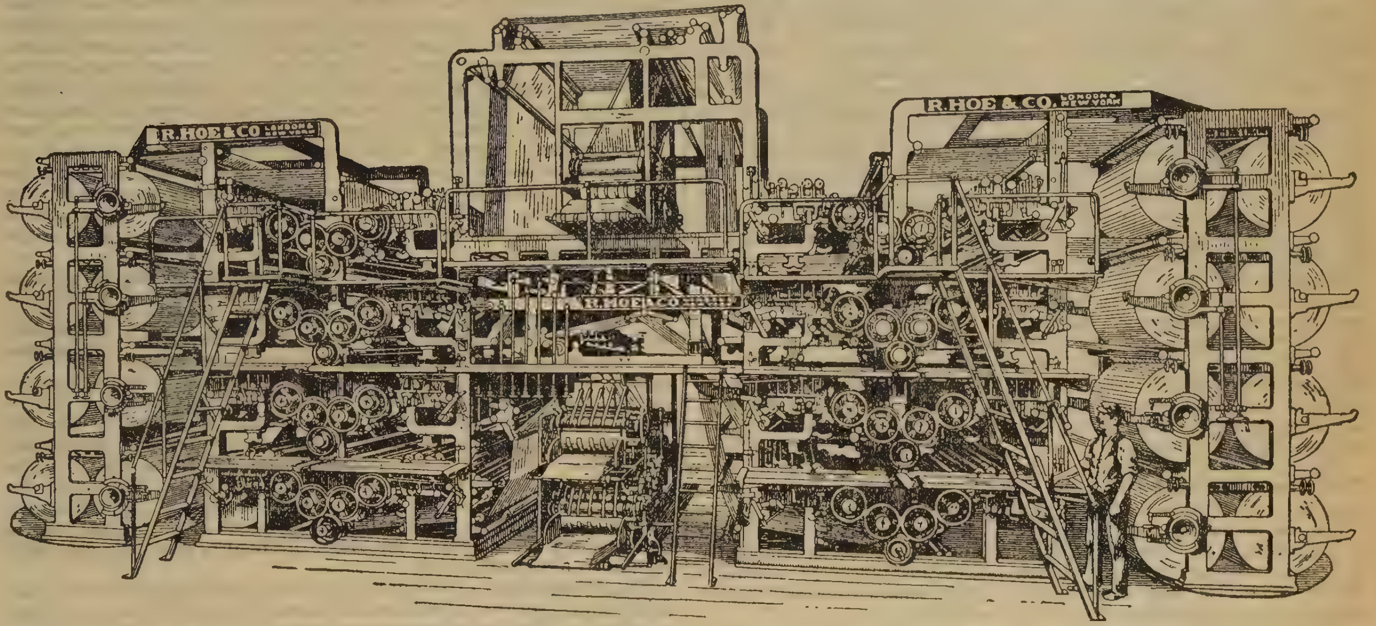
R.HOE & CO.
R.HOE & CO.
R.HOE & CO.

FIG. 9.—Hoe's Double Octuple Rotary Machine.

Another machine, somewhat complex but quite complete in itself, is that constructed by Messrs Robert Hoe & Co. in London from drawings and patterns sent over from New York, for weekly papers of large circulation. Double sets of plates are placed on the main machine, which is capable of taking twenty-four pages, but by using narrower rolls the number of pages may be reduced to either sixteen or twenty if a smaller paper is desired. In addition to the body of the paper it prints a cover, and is capable of producing 24,000 complete copies per hour, folded, insetted, cut, pasted and covered. That portion of the machine which prints the cover is fed from a narrower reel of a different colour of paper from that used for the inside pages. The printing surface for one side of the cover is placed at one end of the cylinder and the reverse side is placed at the other end. This ingenious combination results in the printing of one cover for every copy of the paper.

Octuple Rotary Machines.

The double octuple machines (fig. 9) erected by the same firm for the printing of *Lloyd's Weekly News* were probably, in 1908, the latest development in rotary printing. These presses print from eight different reels of the double width, four placed at each end of the machine, the delivery being in the centre, and from eight sets of plates, four pages on each type cylinder, making a total of thirty-two pages in all. Each press produces of that number of pages 50,000 copies per hour, printed both sides, cut, folded and counted off in quires complete; by increasing the sets of stereotype pages the same machine will produce 100,000 copies per hour of sixteen pages, and by duplicating the folding and delivery apparatus, 200,000 copies of eight pages of the same size. This mammoth press measures 54 ft. in length, 19 ft. in height and 12 ft. across; its dead weight is about 110 tons, and roughly 100,000 different pieces of metal were used in its construction. The rough cost of such a machine is probably about £18,000. Such a press requires two 55 h.p. motors, one at each end, to drive it. The press is practically four quadruple machines built together, each of which can be worked independently of the other. The paper is fed from reels placed at the two ends in decks, one above the other, each reel containing about five miles of paper, and weighing about fourteen hundredweight. The process of unwinding these long reels of paper in the course of printing takes only half an hour; they are arranged on a revolving stand so that directly they are spent the stand is turned half way round, and four other full reels already in position are presented ready to be run into the press. This ingenious arrangement, whereby the reels can be changed in about three minutes, obviates the loss of time previously incurred by the press being kept standing while the empty spindles were removed and replaced with four full reels.

The Preparation or Making-ready for Printing.

Having described some representative types of the different classes of printing-presses in use, we may now treat of the methods employed by the workmen in securing the best results in printing. The real art of printing, as far as presswork is concerned, lies in the careful preparation of the printing surface for printing before running off any number of impressions. This preparation is technically called "making-ready," and is an operation requiring much time and care, especially in the case of illustrated work, where artistic appreciation and skill on the part of the workman is of great assistance in obtaining satisfactory and delicate results. Theoretically, if both type and press were new, little or no preparation should be necessary, but practical experience proves that this need of preparation has not yet been entirely obviated and still remains an important factor. Single proofs of type, stereotype, electrotype or blocks of any description can often be struck off without making-ready with fairly good results, but if precision of "colour" (that is, inking) and uniformity of impression throughout a volume are desired, it is necessary to put the forme, whether type or blocks or both, into a proper condition before starting the printing of an edition, whatever its number. And this applies to all good work produced from whatever presses or machines other than those built on the rotary principle. In these, even if time permitted, little can be done in the way of making-ready; nor is it really necessary for newspapers, printed and read one day, and then generally thrown away the next. But for finely printed works this preparation is essential; the actual results vary with the operator, both as regards quality and, what is very important to the employer, in the length of time taken. Some men labour more at it than others, and it is considered that a press is only really paying while it is actually running.

The system of making-ready employed now is quite different from that in use when it was necessary to dampen paper before it could be satisfactorily printed. It was then customary to print with a good deal of packing, usually consisting of a thick blanket together with several thicknesses of paper, all of which intervened between the printing and the impression surface, whether the latter was flat or cylindrical. There was much in favour of this system, because a good firm impression could be obtained, and the "nutmeg-grater" effect on the reverse, when the impression was too heavy, could, after the sheets were dry, be removed by cold-pressing in a hydraulic press. It is still the best method for obtaining first-rate results in fine work, where hand-made or other rough paper is used. But the demand for cheap literature required quicker means of production, and the introduction of process blocks, especially those made by the half-tone process, necessitated the use of smooth paper and a faster drying ink, both of which are to be deplored, because to calender the paper to the degree requisite for this kind of printing practically means destroying its natural surface, and in rendering the ink quicker in drying the pigment undoubtedly suffers. On the other hand, there has been a compensating advantage in the fact that improved machinery has been demanded for this class of work, and the British manufacturer has been stimulated by the American manufacturers, who have taken the initiative in the change of methods in printing. Cylinders are now turned so truly and ground to such a nicety that very little packing is required between type and sheet to be impressed, so that a new system of making-ready, termed "hard-packing," has been resorted to. The fact that the iron impression cylinder was nearer the type forbade the large amount of soft-packing formerly used, besides which process blocks, whether line or half-tone, could not be rendered properly by a soft impression. Although less packing is necessary, greater care is required in preparing type or blocks for printing by this new method.

The method in making-ready ordinary plain formes is as follows. The type-forme is placed on the coffin or bed of the press and fixed into its proper position—the precise position being regulated by the exact size of the sheet of paper on which the work is to be printed. The cylinder is first dressed with a fine and thin calico drawn tightly over and fastened securely, which serves as a base on which to fasten sheets. A sheet of some hard paper, such as manila, is then placed over it to form, as it were, a foundation.

The printer next proceeds to pull a sheet, without ink, to test the impression. We take it that the machine has already been regulated by means of the impression screws at the respective ends of the cylinder for all-round or average work, and that any inequality of impression can be remedied by adding or taking away from the sheets on the cylinder. Now, supposing the forme to be dealt with consists of thirty-two pages to be printed on quad crown paper, measuring 40×30 in., on a suitable size of single cylinder machine of the Wharfedale class, it would be found, although both the machine and type were fairly new (that is, not much worn), that there was some amount of inequality in the impression given to the whole sheet. This is easily detected by examining the sheet the reversed side in a strong side-light. Although the greater part may be fairly even, some pages, or portions of pages, would show up too strongly, the impress almost cutting through the paper, while in other portions the impression would be so faint that it could hardly be seen. These differences of impression are called respectively "high" and "low." All these difficulties have to be rectified by the printer either overlaying or cutting away pieces in this first trial sheet. If the "set" of the cylinder is about correct, and the impression sheet has been taken with neither too many nor too few sheets on the cylinder, it will be a matter rather of overlaying, or "patching up," than of cutting away from this trial sheet. As soon as this first sheet has been levelled up it is fixed on to the cylinder to its exact position, so that it will register or correspond with the type when the press is running, and another trial sheet is struck off, which is treated precisely in the same manner, and is then fastened up on the cylinder on top of the first sheet. It may even be necessary for fine printing to repeat this a third time, especially if the forme includes blocks of any kind. When this preparation is completed, the whole is covered up by a somewhat stouter sheet, which forms a protection to the whole making-ready, but which can easily be lifted should it be necessary to give any finishing touches to it before beginning to run.

If the forme to be printed consists of both type and blocks mixed, a somewhat different treatment has to be employed in order to put the blocks into a relative position with the type for printing. This is done by the usual trial impression sheet, and, as blocks are found to vary much in height and are generally low as compared with type, this deficiency has to be remedied by underlaying the blocks so that they are brought to the height of the type, or a shade higher. This is usually done by pasting layers of thickish paper, or even thin cards, underneath the blocks. This must be carefully done so as to make them stand squarely and firmly on their base, in order that they may not rock and give a slur in printing. After underlaying, and to emphasize the respective degrees of light and shade in the illustrations, a separate and careful overlaying is required for the blocks before anything is done to the main forme. This is particularly necessary if the blocks are woodcuts, or electrotypes of woodcuts, which require a different cutting of perhaps three different thicknesses, all on thin hard paper, to give their full effect. But with half-tone process illustrations very little overlaying is required, provided the blocks have been brought up to the proper height by underlaying in the first instance—the various tones being already in the block itself—and it is little more than a matter of sharp, hard impression to give full effect to these, if both paper and ink are suitable. For line process blocks a still different treatment in making-ready is desirable, so as to get rid of the hard edges which are nearly always found in this kind of block. Here too it is essential that the preliminary underlaying be done with extreme care if good work is desired. The originals and the engraver's proofs are of great assistance to the workman in bringing out the details of an illustration when he is preparing it for printing. In rotary printing from the curved stereotype plate and from the endless web of paper much can be done to assist the printer if good stereotype plates are supplied to him, and, if the forme contains any illustrations, both the artist and the engraver can help him if they keep in mind the particular character of illustration which they are preparing for the press. The artist can accentuate the high lights or solids in the original drawing or photograph, and the stereotyper can emphasize points in the picture by thickening the plate in the parts necessary to stand out.

Recent Developments.

The past generation has seen many improvements in printing machinery, all tending to an increased production, and generally to the betterment of the work turned out. This is particularly true of three-colour printing (see PROCESS), which for commercial purposes has been brought to a high degree of perfection. Only what may be fairly considered as representative presses have been dealt with in this article, but there are many others, some of which have been most ingeniously constructed for special purposes. Process engraving has practically superseded wood engraving, and the new processes have brought new conditions, requiring a different making-ready, paper and ink. Some of these altered conditions are to be regretted. For instance, it is unfortunate that the quality and surface of papers have to be sacrificed to the demands for cheap literature, and this especially applies to illustrated work.

The introduction of the autoplate is of great advantage to those using rotary presses, because it allows the production of a large number of duplicate stereotype plates of satisfactory quality speedily. This is all important in a newspaper office, where the margin of time between the caseroom and machine department is usually so limited, for it permits several machines being quickly equipped with duplicate sets of the same pages.

Power is another matter that is changing fast. Electricity is supplanting both steam and gas, and is being installed in most large printing-houses, including newspaper offices. Suction gas is being tried in some offices as a supplanter of electricity and is said to be much cheaper as a power producer. The independent system of motors is generally adopted, because it is found more economical and better for driving purposes, besides dispensing with the overhead shafting and belting, always unsightly, and dangerous to the work-people. Speeds can be regulated to a nicety for each separate machine, and any machine can be set in motion by pressing a button.

The Management of a Printing-house.

A printing-house of average size, which makes book printing a speciality, consists of many departments under the supreme control of a general manager. His deputy may be said to be the works manager, who is responsible for all work being produced in a proper manner by the different departments. The progress of the work is as follows. The MS., or "copy" as it is called, is handed, with all instructions, to the overseer of the caseroom, who gives it out to the compositors in instalments as they finish the work already in hand. Formerly the greater bulk of composition was done on the piece-work system, but as machine composition has largely superseded hand labour for the more ordinary class of work, piece-work is declining, and there is a greater tendency to have the work done on "establishment" ("'stab"), *i.e.* fixed weekly wages. When the copy is in type a proof is struck off and sent to the reading closet, where the corrector of the press (see PROOF-READING), with the aid of a reading-boy, will compare it with the original MS. or copy, and mark all errors on the proof, so that they may be amended by the compositor at his own cost before it is despatched to the author or customer, who in turn revises or corrects it for the general improvement of the work. The proof is then returned to the printer, and if these corrections are at all heavy, another proof, called the "revise," is submitted, together with the first marked one, so that the author may see that his emendations have been made. This may even be repeated, but when finally corrected the proof is marked "press" and is sent to the printer with the necessary instructions as to printing. After another reading or revision in the reading closet it is sent to the compositors, who make the final corrections in the type and hand the forme to the printing department to deal with. It is this department which contributes most to the success of any printing firm, and it requires a really good man at its head. He must be a thoroughly practical printer familiar with the different kinds of printing machinery. To make the department pay, the machines must be kept fully employed with the many classes of work that a large concern has to deal with; the wheels must be kept running as much as possible, and the time for making-ready curtailed as far as is consistent with the proper preparation of the forme. Here again it is most important that a sharp eye be kept on the materials used. Ink forms a large item in the total expenses of this department, besides which there are: oil for lubricating, turpentine and other solvents for cleaning, paper for proofs and making-ready, &c. When the work is printed it is handed to the warehousemen, who are responsible both for unprinted and printed paper. Lastly, the counting-house deals with all accounts, both departments' and customers'.

Bibliography.—The following books and periodicals may be specially referred to: *Books*—J. Southward (and subsequently A. Powell), *Practical Printing*, a handbook of the art of typography (2 vols. 8vo, London, 1900); J. Southward, *Modern Printing*, a treatise on the principles and practice of typography, &c. (large 8vo, London, 1900); C. T. Jacobi, *Printing*, a practical treatise on the art of printing, &c. (8vo, 4th ed., London, 1908); W. J. Kelly, *Presswork*, a practical handbook for the use of pressmen and their apprentices (8vo, 2nd ed., Chicago, 1902); C. T. Jacobi, *The Printer's Handbook of Trade Recipes*, &c. (8vo, 3rd ed., London, 1905); F. J. F. Wilson and D. Grey, *Modern Printing Machinery and Letterpress Printing* (large 8vo, London, 1888); Robert Hoe, *A Short History of the Printing Press* (4to, New York, 1902); T. L. de Vinne, *The Invention of Printing* (New York, 1876). *Periodicals*—*The British and Colonial Printer and Stationer* (London, bi-weekly); *The British Printer* (Leicester, alternate months); *The Printer's Register* (London, monthly); *The Printing World* (London, monthly); *The Caxton Magazine* (London, monthly); *The Printing Art* (Cambridge, Mass., U.S.A., monthly); *The Inland Printer* (Chicago, monthly); *The American Printer* (New York, monthly); *The International Printer* (Philadelphia, monthly). See also the bibliography attached to the article Typography. (C. T. J.)

PRIOR, MATTHEW (1664–1721), English poet and diplomatist, was the son of a Nonconformist joiner at Wimborne-Minster, East Dorset, and was born on the 21st of July 1664. His father moved to London, and sent him to Westminster, under Dr Busby. At his father's death he left school, and fell to the care of his uncle, a vintner in Channel Row. Here Lord Dorset found him reading Horace, and set him to translate an ode. He acquitted himself so well that the earl offered to contribute to the continuance of his education at Westminster. One of his schoolfellows and friends was Charles Montagu, afterwards earl of Halifax. It was to avoid being separated from Montagu and his brother James that Prior accepted, against his patron's wish, a scholarship recently founded at St John's College. He took his B.A. degree in 1686, and two years later became a fellow. In collaboration with Montagu he wrote in 1687 the *City Mouse and Country Mouse*, in ridicule of Dryden's *Hind and Panther*. It was an age when satirists were in request, and sure of patronage and promotion. The joint production made the fortune of both authors. Montagu was promoted at once, and Prior three years later was gazetted secretary to the embassy at the Hague. After four years of this employment he was appointed one of the gentlemen of the king's bedchamber. Apparently, also, he acted as one of the king's secretaries, and in 1697 he was secretary to the plenipotentiaries who concluded the peace of Ryswick. Prior's talent for affairs was doubted by Pope, who had no special means of judging, but it is not likely that King William would have employed in this important business a man who had not given proof of diplomatic skill and grasp of details. The poet's knowledge of French is specially mentioned among his qualifications, and this was recognized by his being sent in the following year to Paris in attendance on the English ambassador. At this period Prior could say with good reason that "he had commonly business enough upon his hands, and was only a poet by accident." To verse, however, which had laid the foundation of his fortunes, he still occasionally trusted as a means of maintaining his position. His occasional poems during this period include an elegy on Queen Mary in 1695; a satirical version of Boileau's *Ode sur le prise de Namur* (1695); some lines on William's escape from assassination in 1696; and a brief piece called *The Secretary*. After his return from France Prior became under-secretary of state and succeeded Locke as a commissioner of trade. In 1701 he sat in parliament for East Grinstead. He had certainly been in William's confidence with regard to the Partition Treaty; but when Somers, Orford and Halifax were impeached for their share in it he voted on the Tory side, and immediately on Anne's accession he definitely allied himself with Harley and St John. Perhaps in consequence of this for nine years there is no mention of his name in connexion with any public transaction. But when the Tories came into power in 1710 Prior's diplomatic abilities were again called into action, and till the death of Anne he held a prominent place in all negotiations with the French court, sometimes as secret agent, sometimes in an equivocal position as ambassador's companion, sometimes as fully accredited but very unpunctually paid ambassador. His share in negotiating the treaty of Utrecht, of which he is said to have disapproved, personally led to its popular nickname of "Matt's Peace." When the queen died and the Whigs regained power he was impeached by Sir Robert Walpole and kept in close custody for two years (1715–1717). In 1709 he had already published a collection of verse. During this imprisonment, maintaining his cheerful philosophy, he wrote his longest humorous poem, *Alma; or, The Progress of the Mind*. This, along with his most ambitious work, *Solomon*, and other *Poems on several Occasions*, was published by subscription in 1718. The sum received for this volume (4000 guineas), with a present of £4000 from Lord Harley, enabled him to live in comfort; but he did not long survive his enforced retirement from public life, although he bore his ups and downs with rare equanimity. He died at Wimpole, Cambridgeshire, a seat of the earl of Oxford, on the 18th of September 1721, and was buried in Westminster Abbey, where his monument may be seen in Poet's Corner. *A History of his Own Time* was issued by J. Bancks in 1740. The book pretended to be derived from Prior's papers, but it is doubtful how far it should be regarded as authentic.

Prior had very much the same easy, pleasure-loving disposition as Chaucer (with whose career his life offers a certain parallelism), combined with a similar capacity for solid work. His poems show considerable variety, a pleasant scholarship and great executive skill. The most ambitious, *i.e. Solomon*, and the paraphrase of the *Nut-Brown Maid*, are the least successful. But *Alma*, an admitted imitation of Butler, is a delightful piece of wayward easy humour, full of witty turns and well-remembered allusions, and Prior's mastery of the octo-syllabic couplet is greater than that of Swift or Pope. His tales in rhyme, though often objectionable in their themes, are excellent specimens of narrative skill; and as an epigrammatist he is unrivalled in English. The majority of his love songs are frigid and academic, mere wax-flowers of Parnassus; but in familiar or playful efforts, of which the type are the admirable lines *To a Child of Quality*, he has still no rival. "Prior's"—says Thackeray, himself no mean proficient in this kind—"seem to me amongst the easiest, the richest, the most charmingly humorous of English lyrical poems. Horace is always in his mind, and his song and his philosophy, his good sense, his happy easy turns and melody, his loves and his Epicurianism, bear a great resemblance to that most delightful and accomplished master."

The largest collection of Prior's verses is that by R. Brimley Johnson in the "Aldine Poets" (2 vols., 1892). There is also a selection in the "Parchment Library," with introduction and notes by Austin Dobson (1889). (A. D.)

PRIOR (from Lat. *prior*—former, and hence superior, through O. Fr. *priour*), a title applied generally to certain monastic superiors, but also in the middle ages to other persons in authority. Under the Roman Empire the word *prior* is found signifying "ancestor." In the early middle ages it was commonly applied to secular officials and magistrates, and it remained all though the middle ages as the title of certain officials in the

Italian city states. Noteworthy among these were the famous *priores artis* at Florence. These were appointed governors of the Florentine republic when the Companies of the Arts seized the government in 1282.

The term *prior* was most commonly used to denote the superiors in a monastery, at first with an indefinite significance, but later, as monastic institutions crystallized, describing certain definite officials. In the Rule of St Benedict and other early rules the titles *praepositus* and *praelatus* (see PRELATE) are generally used, but *prior* is also found signifying in a general way the superiors and elders in a monastery. When used by St Benedict in the singular number it seems (according to the commentator Ménard) to denote the abbot himself. At a later date in the order of St Benedict the title was applied to the monk next in authority to the abbot, though this usage was not adopted technically until the 13th century. In some monasteries several priors were to be found and generally at least two. Thus we find the terms *prior*, *sub-prior*, *tertius prior*, *quartus prior*, *quintus prior*. The first prior was sometimes called *prior major*, sometimes *prior claustralis*. Occasionally both titles are found in one house, the latter ranking below the former. The first prior acted as vicar in all matters in the absence of the abbot, and was generally charged with the details of the discipline of the monastery. With the foundation of the order of Cluny in the 10th century there appeared the *conventual prior* who ruled as head of a monastery, but was subject in some degree to the *archiabbas* of the mother-house of Cluny. The Regular Canons later gave this title of prior to the heads of their houses, as did also the Carthusians and the Dominicans. It was in houses of these orders that the sub-prior became a regular official. Among the Dominicans the head of a province is known as the "prior provincial." In the order of St John of Jerusalem (*q.v.*) a priory was a group of commanderies ruled by a "grand prior."

The term prior was applied also in the middle ages in a very general manner. Thus there was the *prior scholae* or leader of the choir, *prior scriniariorum*, &c.

See Du Cange, *Glossarium mediae et infimae latinitatis*, new edition by L. Favre (Niort, 1883, &c.); Sir William Smith and S. Cheetham, edd. *Dictionary of Christian Antiquities* (1875–1880). (E. O'N.)

PRISCIAN [PRISCIANUS CAESARIENSIS], the celebrated Latin grammarian, lived about A.D. 500, *i.e.* somewhat before Justinian. This is shown by the facts that he addressed to Anastasius, emperor of the East (491–518), a laudatory poem, and that the MSS. of his *Institutiones grammaticae* contain a subscription to the effect that the work was copied (526, 527) by Flavius Theodorus, a clerk in the imperial secretariat. Three minor treatises are dedicated to Symmachus (the father-in-law of Boëtius). Cassiodorus, writing in the ninety-third year of his age (560? 573?), heads some extracts from Priscian with the statement that he taught at Constantinople in his (Cassiodorus's) time (Keil, *Gr. Lat.* vii. 207). His title *Caesariensis* points, according to Niebuhr and others, to Caesarea in Mauretania. Priscian's teacher was Theoctistus, who also wrote an *Institutio artis grammaticae.* Priscian was quoted by several writers in Britain of the 8th century—Aldhelm, Bede, Alcuin—and was abridged or largely used in the next century by Hrabanus Maurus of Fulda and Servatus Lupus of Ferrières. There is hardly a library in Europe that did not and does not contain a copy of his great work, and there are about a thousand MSS. of it. The greater part of these contain only books i.–xvi. (sometimes called *Priscianus major*); a few contain (with the three books *Ad Symmachum*) books xvii., xviii. (*Priscianus minor*); and a few contain both parts. The earliest MSS. are of the 9th century, though a few fragments are somewhat earlier. All are ultimately derived from the copy made by Theodorus. The first printed edition was in 1470 at Venice.

The *Institutiones grammaticae* is a systematic exposition of Latin grammar, dedicated to Julian, consul and patrician, whom some have identified with the author of a well-known epitome of Justinian's *Novellae*, but the lawyer appears to be somewhat later than Priscian. It is divided into eighteen books, of which the first sixteen deal mainly with sounds, word-formation and inflexions; the last two, which form from a fourth to a third of the whole work, deal with syntax. Priscian informs us in his preface that he has translated into Latin such precepts of the Greeks Herodian and Apollonius as seemed suitable, and added to them from Latin grammarians. He has preserved to us numerous fragments which would otherwise have been lost, *e.g.* from Ennius, Pacuvius, Accius, Lucilius, Cato and Varro. But the authors whom he quotes most frequently are Virgil, and, next to him, Terence, Cicero, Plautus; then Lucan, Horace, Juvenal, Sallust, Statius, Ovid, Livy and Persius. His industry in collecting forms and examples is both great and methodical. His style is somewhat heavy, but sensible and clear; it is free, not of course from usages of Late Latin, but from anything that can be called barbarism. Its defects may be referred in the main to four heads. (1) Priscian avowedly treats Greek writers on (Greek) grammar as his supreme authorities; and bears too little in mind that each has a history of its own and is a law to itself. (2) There had been no scientific study of phonetics, and consequently the changes and combinations of languages are treated in a mechanical way: *e.g.* *i* passes into *a*, as *genus*, *generis*, *generatum*; into *o*, as *saxi*, *saxosus*; *q* passes into *s*, as *torqueo*, *torsi*, &c. (3) The resolution of a word into root or stem and inflexional or derivative affixes was an idea wholly unknown, and the rules of formation are often based on unimportant phenomena; *e.g.* *Venus*, like other names ending in *us*, ought to have genitive *Veni*, but, as this might be taken for a verb, it has *Veneris*. *Ador* has no genitive because two rules conflict; for neuters in *or* have a short penult (*e.g.* *aequor*, *aequoris*), and *adoro*, from which it is derived, has a long penult. (4) The practical meaning of the inflexions is not realized, and syntactical usages are treated as if they were arbitrary or accidental associations. Thus, after laying down as a general rule for declinable words that, when they refer to one and the same person, they must have the same case, gender and number, Priscian adds that when there are transitive words we may use different numbers, as *doceo discipulos*, *docemus discipulum*. He often states a rule too broadly or narrowly, and then, as it were, gropes after restrictions and extensions.

His etymologies are of course sometimes very wild: *e.g.* *caelebs* from *caelestium vitam ducens*, *b* being put for consonantal *u* because a consonant cannot be put before another consonant; *deterior* from the verb *detero*, *deteris*; *potior* (adj.) from *potior*, *potiris*; *arbor* from *robur*; *verbum* from *verberatus aeris*, &c. Nor is he always right in Greek usages.

Priscian's three short treatises dedicated to Symmachus are on weights and measures, the metres of Terence, and some rhetorical elements (exercises translated from the Προγυμνάσματα of Hermogenes). He also wrote *De nomine, pronomine, et verbo* (an abridgment of part of his *Institutiones*), and an interesting specimen of the school teaching of grammar in the shape of complete parsing by question and answer of the first twelve lines of the *Aeneid* (*Partitiones xii. versuum Aeneidos principalium*). The metre is discussed first, each verse is scanned, and each word thoroughly and instructively examined. A treatise on accents is ascribed to Priscian, but is rejected by modern writers on the ground of matter and language. He also wrote two poems, not in any way remarkable, viz. a panegyric on Anastasius in 312 hexameters with a short iambic introduction, and a faithful translation into 1087 hexameters of Dionysius's *Periegesis* or geographical survey of the world.

The best edition of the grammatical works is by Hertz and Keil, in Keil's *Grammatici latini*, vols. ii., iii.; poems in E. Bährens' *Poetae latini minores*, the "Periegesis" also, in C. W. Müller, *Geographi graeci minores*, vol. ii. See J. E. Sandys, *History of Classical Scholarship* (ed. 1906), pp. 272 sqq.

PRISCILLIAN (d. 385), Spanish theologian and the founder of a party which, in spite of severe persecution for heresy, continued to subsist in Spain and in Gaul until after the middle of the 6th century. He was a wealthy layman who had devoted his life to a study of the occult sciences and the deeper problems of philosophy. He was largely a mystic and regarded the Christian life as continual intercourse with God. His favourite idea is that which St Paul had expressed in the words "Know ye not that ye are the temple of God?" and he argued that to make himself a fit habitation for the divine a man must, besides holding the Catholic faith and doing works of love, renounce marriage and earthly honour, and practise a hard asceticism. It was on the question of continence in, if not renunciation of, marriage, that he came into conflict with the authorities. Priscillian and his sympathizers, who were organized into bands of *spiritales* and *abstinentes*, like the Cathari of later days, indignantly refused the compromise which by this time the Church had established in the matter (see MARRIAGE: *Canon Law*). This explains the charge of Manichaeism levelled against Priscillian (Jerome, for his talk of the *Sordes nuptiarum*, had been similarly accused, and to escape popular indignation had retired to Bethlehem),[1] and to this was added the accusation of magic and licentious orgies. Among the more prominent of Priscillian's friends were two bishops, named Instantius and Salvianus, and Hyginus of Cordova also joined the party; but, through the exertions of Idacius of Emerita, the leading Priscillianists, who had failed to appear before the synod of Spanish and Aquitanian bishops to which they had been summoned, were excommunicated at Saragossa in October 380. Meanwhile, however, Priscillian was made bishop of Avila, and the orthodox party found it necessary to appeal to the emperor (Gratian), who issued an edict threatening the sectarian leaders with banishment. Priscillian, Instantius and Salvianus succeeded, however, in procuring the withdrawal of Gratian's edict, and the attempted arrest of Ithacius of Ossonuba. On the murder of Gratian and accession of Maximus (383) Ithacius fled to Treves, and in consequence of his representations a synod was held (384) at Bordeaux, where Instantius was deposed. Priscillian appealed to the emperor, with the unexpected result that with six of his companions he was burned alive at Treves in 385. The first instance of the application of the Theodosian law against heretics had the approval of the synod which met at Treves in the same year, but Ambrose of Milan and Martin of Tours can claim the glory of having in some measure stayed the hand of persecution. The heresy, notwithstanding the severe measures taken against it, continued to spread in France as well as in Spain; in 412 Lazarus, bishop of Aix in Provence, and Herod, bishop of Arles, were expelled from their sees on a charge of Manichaeism. Proculus, the metropolitan of Marseilles, and the metropolitans of Vienne and Narbonensis Secunda were also followers of the rigorous tradition for which Priscillian had died. Something was done for its repression by a synod held by Turibius of Astorga in 446, and by that of Toledo in 447; as an openly professed creed it wholly disappeared after the second synod of Braga in 563. "The official church," says F. C. Conybeare, "had to respect the ascetic spirit to the extent of enjoining celibacy upon its priests, and of recognizing, or rather immuring, such of the laity as desired to live out the old ascetic ideal. But the official teaching of Rome would not allow it to be the ideal and duty of every Christian. Priscillian perished for insisting that it was such; and seven centuries later the Church began to burn the Cathari by thousands because they took a similar view of the Christian life."

The long prevalent estimation of Priscillian as a heretic and Manichaean rested upon Augustine, Turibius of Astorga, Leo the Great and Orosius, although at the Council of Toledo in 400, fifteen years after Priscillian's death, when his case was reviewed, the most serious charge that could be brought was the error of language involved in rendering ἀγένητος by *innascibilis*. It was long thought that all the writings of the "heretic" himself had perished, but in 1885, G. Schepss discovered at Würzburg eleven genuine tracts, since published in the Vienna *Corpus*. "They contain nothing that is not orthodox and commonplace, nothing that Jerome might not have written," and go far to justify the description of Priscillian as "the first martyr burned by a Spanish Inquisition."

See E. Ch. Babut, *Priscillian et le Priscillianisme* (Paris, 1909). (A. J. G.)

PRISCUS, of Panium in Thrace, Greek sophist and historian, lived during the 5th century A.D. He accompanied Maximin, the ambassador of Theodosius the Younger, to the court of Attila (448). During the reign of Marcian (450–457) he also took part in missions to Arabia and the Egyptian Thebaïd. Priscus was the author of an historical work in eight books (Βυζαντινικὴ Ἱστορία), probably from the accession of Attila to that of Zeno (433–474). Only fragments of the work remain, but the description of Attila and his court and the account of the reception of the Roman ambassadors is a most valuable piece of contemporary history. Priscus's style is pure, and his impartiality and trustworthiness entitle him to an honourable place among the writers of his time.

Fragments and life in C. W. Müller, *Fragmenta historicorum graecorum*, iv. 69–110; v. 24–26, ed. B. G. Niebuhr in Bonn, *Corpus scriptorum hist. byzantinae* (1829), vol. vi., and L. Dindorf in *Historici graeci minores* (1870), vol. i. For the embassy to Attila see Gibbon, *Decline and Fall*, ch. 34.

PRISCUS, a Greek Neoplatonist philosopher, of the school of Iamblichus and Aedesius. He died about the year 398 at the age of ninety. The emperor Julian frequently invited him to court on the strength of his reputation in connexion with theurgy. Eunapius says that he was a man of dignified and austere habit. Unlike Maximus, he used his influence over Julian with great moderation. He died during the Gothic invasion of Greece (A.D. 396–98). He is important partly as maintaining the best traditions of philosophy during a period when Neoplatonism as a whole was a parasite of imperial power, and partly as being a connecting link between Iamblichus and Plutarch of Athens.

See Zeller's *Hist. of Greek Phil.*

PRISHTINA, PRICHTINA, or PRISTINA, the chief town of a sanjak in the vilayet of Kossovo, Albania, European Turkey; on a small tributary of the river Sitnítza, an affluent of the Ibar, and 3 m. E. of the Prishtina station on the Salonica-Mitrovitza railway. Pop. (1905), about 11,000. Prishtina is the seat of a governor-general and of a general of division, and possesses many mosques, a military hospital and a higher class school. The trade is considerable, the exports including chrome, wheat, maize, barley, skins, wine and timber from the magnificent beech forests in the sanjak. The plain of Kossovo (*Kossovopolye*, "Field of Blackbirds"), to the west, was the scene of the battle in which the Servian empire was destroyed by the Turks in 1389. To the south-east lies the partly ruined monastery of Grachanitza founded by King Milutin of Servia (1275–1321). Among the frescoes are a remarkable head of Christ in the dome, and portraits of the founder and his queen Simonida, daughter of Andronicus II. Palaeologus.

See G. M. M. Mackenzie and A. P. Irby, *Travels in the Slavonic Provinces of Turkey* (1877).

PRISM (Gr. πρίσμα, properly a thing sawn, πρίζειν, to saw), in geometry a solid enclosed by plane surfaces, two of which, termed the ends, are parallel, equal, similar and similarly situated polygons, and the faces connecting the ends are parallelograms, equal in number to the sides of the polygon. If the faces be perpendicular to the ends the prism is a "right prism," and the faces are rectangles; otherwise the prism is "oblique." The *axis* is the line joining the centres of the ends. It may be generated by moving a plane (corresponding to an end or base) parallel to itself. A prismoid differs from a prism in having for its ends two dissimilar parallel figures. For illustrations see CRYSTALLOGRAPHY, and for the mensuration see that article. In optics the word denotes a triangular prism, *i.e.* one having a triangle for base, used to decompose white light. (See REFRACTION and DISPERSION.)

PRISON (derived through the Fr. from the Lat. *prehensio*, seizure), a place for the confinement or compulsory restraint of persons after arrest or sentence by arbitrary authority or process of law.

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[1] Cf. the outbreak at Rome in 384 against the *gymnosophists*, emaciated monks who walked the streets and vehemently denounced marriage. The epistles of Pope Siricius (who wished to stand well with the people) are full of scorn for these ascetics, and the Leonine sacramentary contains prayers which severely denounce them.

Early Penalties.

The earliest object sought in imprisonment was to secure the person of the accused to ensure his appearance before his judges for trial, and after conviction to produce him to take his punishment. They were applied to other uses less justifiable or defensible; they served to execute the will of the despotic master upon all who set themselves in opposition to his authority, or were decreed, more or less wisely but still arbitrarily, by a government in the best interests of society, organized for the general good. Coercion and intimidation slowly came to be leading ideas, the infliction of a lesser penalty than the capital. The deprivation of liberty under irksome circumstances, rough lodging, hard fare and perpetual labour was after all a milder measure than death, although long years elapsed before the prison was so used. Penal codes depended rather upon shorter and more cruel methods; the scaffold was in constant use, with all manner of physical pain, torture before and after sentence, shameful exposure, hideous mutilation, exile, selling into bondage as slaves. Incarceration was no doubt practised by irresponsible masters, regardless of personal rights, callous to the sufferings of their victims, to which death by starvation or horrible neglect was a welcome relief. But consignment to a prison for lengthened periods was, as a penalty, of more recent introduction, and of still later date is the recognition of the duties incumbent upon the authority to use its powers mercifully by humane endeavours to reform and improve those on whom it laid hands.

Howard's Reforms in England.

The progress made can only be realized by considering what prisons once were. The shocking picture drawn by John Howard of the state of prisons at the latter end of the 18th century will last for all time. They were for the most part pestiferous dens, overcrowded, dark, foully dirty, not only ill ventilated, but deprived altogether of fresh air. The wretched inmates were dependent for food upon the caprice of their gaolers or the charity of the benevolent; water was denied them except in the scantiest proportions; their only bedding was putrid straw. Every one in durance, whether tried or untried, was heavily ironed. All alike were subject to the rapacity of their gaolers and the extortions of their fellows. Gaol fees were levied ruthlessly—"garnish" also, the tax or contribution paid by each individual to a common fund to be spent by the whole body, generally in drink. Idleness, drunkenness, vicious intercourse, sickness, starvation, squalor, cruelty, chains, awful oppression and everywhere culpable neglect—in these words may be summed up the state of the gaols at the time of Howard's visitation.

At this time prisons were primarily places of detention, not of punishment, peopled by accused persons, still innocent in the eyes of the law, and debtors guilty only of breaches of the financial rules of a commercial country, framed chiefly in the interest of the creditor. Freedom from arrest was guaranteed by Magna Carta, save on a criminal charge, yet thousands were committed to gaol on legal fictions and retained indefinitely for costs far in excess of the original debt. The impecunious were locked up and deprived of all hope of earning means to obtain enlargement; while their families and persons dependent on them shared their imprisonment and added to the overcrowding. The prisons were always full. Gaol deliveries were of rare occurrence, even when tardy trial ended in acquittal release was delayed until illegal charges in the way of fees had been satisfied.

In the article DEPORTATION it is shown how the discoveries in the southern seas led to the adoption of penal exile in preference to other suggested improvements in the English prison systems. The penitentiary scheme proposed by Howard was not, however, abandoned. It was revised and kept alive by Jeremy Bentham in his fanatical scheme for a "panopticon or inspection house," described as "a circular building, an iron cage, glazed, a glass lantern as large as Ranelagh, with the cells on the outer circumference." His plan was to keep every inmate of every cell under constant close observation, and all were to be reformed by solitude and seclusion while constantly employed in remunerative labour, in the profits of which they were to share. The scheme hung fire, owing, it was alleged, to the personal hostility of George III. to Bentham as an advanced radical. Lands were, however, purchased which were eventually taken over by the government and utilized for the erection of Millbank penitentiary, begun in 1813 and partially completed in 1816. It was now fully recognized that the reformation of prisoners could best be attempted by seclusion, "employment and religious instruction." Millbank, as a new and most enlightened undertaking in prison affairs, was opened with much éclat. It was to be governed by a specially appointed committee of distinguished personages, the chairman being the Speaker of the House of Commons. The sum total expended upon the buildings amounted to half a million of money, and the yearly charges of the establishment were a heavy burden on the exchequer.

The erection of Millbank was a step in the right direction. The energy with which it was undertaken was the more remarkable because elsewhere throughout the United Kingdom the prisons, with few exceptions, remained deplorably bad. J. Neild, who in 1812 followed in the footsteps of John Howard, found that the old conditions remained unchanged. "The great reformation produced by Howard," to use Neild's own words, "was merely temporary . . . prisons were relapsing into their former horrid state of privation, filthiness, severity and neglect." Yet the legislature was alive to the need for prison reform. Besides the building of Millbank it had promulgated many acts for the amelioration of prisoners. Gaol fees were once more distinctly abolished; the appointment of chaplains was insisted upon, and the erection of improved prison buildings was rendered imperative upon local authorities. But these, with other and much older acts, remained in abeyance. Thus an act which provided for the classification of prisoners had remained a dead letter; even the separation of the males from the females was not a universal rule. Roused by these crying evils, a small band of earnest men formed themselves into an association for the improvement of prison discipline. They perambulated the country inspecting the prisons; they issued lengthy interrogatories to prison officials; they published periodical reports giving the result of their inquiries, with their views on the true principles of prison management, and much sound advice, accompanied by elaborate plans on the subject of prison construction. The labours of this society brought out into strong relief the naked deformity of the bulk of the British gaols. Speaking of St Albans from his personal observation Mr (afterwards Sir T. F.) Buxton, a most active member of the society, said: "All were in ill health; almost all were in rags; almost all were filthy in the extreme. The state of the prison, the desperation of the prisoners, broadly hinted in their conversation and plainly expressed in their conduct, the uproar of oaths, complaints and obscenity, the indescribable stench, presented together a concentration of the utmost misery and the utmost guilt." The reports of the society laid bare the existence of similar horrors in numbers of other gaols. Yet this was in 1818, when the legislature was setting a praiseworthy example—when half a million had been spent in providing large airy cells for a thousand prisoners. Even in London itself, within easy reach of the palatial Millbank penitentiary, the chief prison of the city, Newgate, was in a disgraceful condition. This had been exposed by a parliamentary inquiry as far back as 1814, but nothing had been done to remedy the evils laid bare. The state of the female side had already attracted the attention of that devoted woman, Mrs Fry, whose ministrations and wonderful success no doubt encouraged, if they did not bring about, the formation of the Prison Society. Mrs Fry went first to Newgate in 1813, but only as a casual visitor. It was not until 1817 that she entered upon the noble work with which her name will ever be associated. She worked a miracle there in an incredibly short space of time. The ward into which she penetrated was like a den of wild beasts; it was filled with women unsexed, fighting, swearing, dancing, gaming, yelling and justly deserved its name of "hell above ground." Within a month it was transformed.

and presented, says an eyewitness, "a scene where stillness and propriety reigned." The wild beasts were tamed. Movements similar to that which Mrs Fry headed were soon set on foot both in England and on the Continent, and public attention was generally directed to the urgent necessity for prison reform.

Stimulated by the success achieved by Mrs Fry, the Prison Discipline Society continued its labours. Hostile critics were not wanting; many voices were raised in protest against the ultra-humanitarianism which sought to make gaols too comfortable and tended to pamper criminals. But the society pursued its objects, undeterred by sarcasm. Many of these are now accepted as axioms in prison treatment; for instance, that female officers only should have charge of female prisoners, that prisoners of both sexes should be kept apart and constantly employed. Yet these principles were unacknowledged at that time and were first enunciated in acts such as the 4 Geo. IV. c. 65 and the 5 Geo. IV. c. 85 (1823–1824), the passing of which were mainly due to the strenuous exertions of the Prison Discipline Society. It was laid down in these that over and above safe custody it was essential to preserve health, improve morals, and enforce hard labour on all prisoners sentenced to it. Irons were strictly forbidden except in cases of "urgent and absolute necessity," and it was ruled that every prisoner should have a bed to himself—if possible a separate cell, the last being the first formal statement of a principle upon which all future prison discipline was to be based.

The importance of these acts cannot be over-estimated as supplying a legal standard of efficiency by which all prisons could be measured. Still the progress of improvement was extremely slow, and the managers of gaols still evaded or ignored the acts. Many local authorities grudged the money to rebuild or enlarge their gaols; others varied much in their interpretation of the rules as to hard labour and the hours of employment. One great drawback to general reform was that a large number of small prisons lay beyond the reach of the law. Those under small jurisdictions in the boroughs and under the petty corporate bodies continued open to the strongest reprobation, and thus remained until they were swept away by the measure which brought about the reform of the municipal corporations in 1835. But by this time a still more determined effort had been made to establish some uniform and improved system of prison discipline. In 1831 a select committee of the House of Commons went into the whole subject of secondary punishment and reported that, as the difficulties in the way of an effective classification of prisoners were insurmountable, they were strongly in favour of the confinement of prisoners in separate cells, recommending that the whole of the prisons should be altered accordingly and the expense borne by the public exchequer. There can be little doubt that this committee was greatly struck by the superior methods of prison discipline pursued in the United States. The best American prisons had recently been visited by two eminent Frenchmen, J. A. de Beaumont and A. de Tocqueville, who spoke of them in terms of the highest praise. It was with the object of appropriating what was best in the American system that Mr W. Crawford was despatched across the Atlantic on a special mission of inquiry. His exhaustive report, published in 1834, was a valuable contribution to the whole question of penal discipline. Another select committee, this time of the House of Lords, returned to the subject in 1835, and after a long investigation re-enunciated the theory that all prisoners should be kept separate from one another. It also urged in strong terms the necessity for one uniform system of treatment, more especially as regarded dietaries, labour and education, and strongly recommended the appointment of official inspectors to enforce obedience to the acts. These recommendations were eventually adopted and formed the basis of a new departure.

American Progress.

For fifty years transportation (see DEPORTATION) had been in England the principal form of secondary punishment for crime. Primary or capital punishment still existed, but to a greatly modified extent. The pious Quakers of Pennsylvania at the end of the 18th century had realized a deeper duty towards the offenders than their extinction, and sought to amend and reform the living. The note struck first in the Walnut Street penitentiary began a new era in prison treatment, and the methods adopted were destined to extend over the whole world. This was the germ of the nearly universal principle of individual confinement, and the origin of what some advanced thinkers have denounced as the greatest crime of the present age, the invention of the separate cell. It was and still is held by many that the criminal may be best and most effectually weaned from his evil ways by shutting him up for lengthy periods between four walls, and subjecting him, when most susceptible, to curative processes, to constant exhortation and searching introspection, changing his nature and restoring him to society a reformed man.

It must be at once admitted that the system of isolation has produced no remarkable results. Solitary confinement has neither conquered nor appreciably diminished crime, even where it has been applied with extreme care, as in Belgium, and more recently in France, where it obtains strict and unbroken for long terms of years. Cloistered seclusion is an artificial condition quite at variance with human instincts and habits, and the treatment, long continued, has proved injurious to health, inducing mental breakdown. A slow death may be defended indeed on moral grounds if regeneration has been compassed, but it is only another form of capital punishment. Still the measures introduced in the United States and the action taken upon them fill a large page in prison history and must be recorded here.

Several states in the Union followed the lead of Pennsylvania. That of New York built the great Auburn penitentiary in 1816 to carry out the new principles. There every prisoner was kept continuously in complete isolation. He saw no one, spoke to no one, and did no work. Within a short period very deplorable results began to show themselves. Many prisoners became insane; health was generally impaired and life greatly endangered. Mr Crawford, whose mission to the United States has been already referred to, was in favour of solitary confinement, but he could not deny that several cases of suicide followed this isolation. Some relaxation of the disastrous severity seemed desirable, and out of this grew the second great system, which was presently introduced at Auburn and afterwards at the no less renowned prison of Sing Sing. It was called the silent system. While the prisoners were still separated at night or meals, they were suffered to labour in association, but under a rule of silence ruthlessly and rigorously maintained. The latter, entrusted to irresponsible subordinates, degenerated into a despotism which brought the system into great discredit. All discipline officers were permitted to wield the whip summarily and without the slightest check. Under such a system the most frightful excesses were possible and many cases of brutal cruelty were laid bare. Reviewing the merits and demerits of each system, Mr Crawford gave his adhesion to that of unvarying solitude as pursued in the Eastern penitentiary in Pennsylvania.

Cellular Separation.

Mr Crawford came back from the United States an ardent champion of the solitary system. He saw, however, great difficulties in making this the universal rule, chief among which was the enormous expense of providing suitable prisons. Some modification of the rule of unbroken solitude would be inevitable; but he strongly urged its adoption for certain classes, and he was equally convinced of the imperative necessity for giving every prisoner a separate sleeping cell. It is clear that the government endorsed Mr Crawford's views. Where it was possible they gave effect to them at once. At Millbank, with its spacious solitary cells, the rule of seclusion was more and more strictly enforced. Ere long permissive legislation strove to disseminate the new principles. In 1830 Lord John Russell had given it as his opinion that cellular separation was desirable in all prisons. But it was not until 1839 that an act was passed which laid it down that individuals might be confined separately in single cells. Even now the executive did not insist upon the construction of prisons on a new plan. It only set a good example by undertaking the erection of one which should serve as a model for the whole country. In 1840 the first stone of Pentonville prison was laid, and after three years of considerable outlay, its cells, 520 in number, were occupied on the solitary, or more exactly the separate system—the latter being somewhat less rigorous and irksome in its restraints. To the credit of many local jurisdictions, they speedily followed the lead of the central authority. Within half a dozen years no fewer than fifty-four new prisons were built on the Pentonville plan, which now began to serve generally as a "model" for imitation, not in England alone, but all over the world. Sir Joshua Jebb, who presided over its erection, may fairly claim indeed to be the author and originator of modern prison architecture.

The building of Pentonville was epoch-making. The modern prison dates from it. The penal discipline of to-day, much modified and varied it is true, may be largely traced to it. The "cell" scheme of individual separation holds the ground, and countries which can afford the outlay have built or are building cellular prisons. France has made steady progress in this respect. Great additions have been made to La Santé prison in Paris, and a new prison on gigantic lines has been opened at Fresnes les Rungis, on the outskirt of the metropolis, to replace the obsolete Mazas, and to give cellular accommodation to the large numbers always on hand in Paris. Germany has embarked on penitentiary reforms with the provision of several new prisons; it is the same with the United States, Austria, Holland, Spain, Portugal, Denmark, Norway, Sweden. In Italy a comprehensive scheme has been drawn up so that cellular imprisonment may become a general rule. In Belgium, where penal administration has received the closest attention for a number of years, the régime of cellular imprisonment has been long carried to its farthest limits, and solitary confinement ranging over ten years and in some cases much more has been strictly enforced. Of late years however a new school has arisen in Belgium which expresses strong doubts of the wisdom or efficacy of prolonged cellular confinement. In England, moreover, which, if not the first to adopt separation in principle, certainly gave the largest effect to it in practice, continuous cellular confinement for short terms is ceasing to be the inevitable rule; and although it has been retained in cases of penal servitude for the first six months, it was in 1899 practically abandoned for lesser sentences, and all prisoners after the first month work together in association under surveillance. In July 1910 the home secretary announced his intention to reduce it to one month in all cases, except those of recidivists (see RECIDIVISM). The bias of modern practice, in short, is towards milder methods, not only in treatment, but in those anticipatory processes which may render imprisonment unnecessary.

The Modern British System.

To understand the existing British prison system it is necessary to consider its gradual growth and the steps taken to establish it. Its foundations were laid by Sir George Grey, home secretary, when transportation ended rather abruptly by the refusal of the chief colonies to continue to be the dumping ground for British convicts. Sir George Grey sought to deal with the difficulty as a whole, and to provide for all classes of criminals, the most heinous deserving severe correction and the minor offenders in the earliest stages of misconduct. For the first there was some urgency, the latter was still the business of the local jurisdictions. The system now introduced consisted of three principal parts: (1) of a limited period of separate confinement in a home prison or penitentiary, accompanied by industrial employment and moral training; (2) of hard labour at some public works prison either at home or abroad; and (3) of exile to a colony with a conditional pardon or ticket-of-leave (*q.v.*). No pains were spared to give effect to this plan. Pentonville was available for the first phase; Millbank was also pressed into the service and accommodation was hired in some of the best provincial prisons, as at Wakefield and Leicester. Few facilities existed for carrying out the second stage, but they were speedily improvised. Although the hulks at home had been condemned, convict establishments in which these floating prisons still formed the principal part were organized at Bermuda and Gibraltar. Neither of these was a conspicuous success; they were too remote for effective supervision; and although they lingered on for some years they were finally abolished. The chief efforts of the authorities were directed to the formation of public works prisons at home, and here the most satisfactory results were soon obtained. The construction of a harbour of refuge at Portland had been recommended in 1845; in 1847 an act was passed to facilitate the purchase of land there, and a sum of money was taken in the estimates for the erection of a prison which was begun next year. At another point, Dartmoor, a prison already stood available, although it had not been occupied since the last war, when ten thousand French and American prisoners had been incarcerated in it. A little reconstruction made Dartmoor into a modern gaol, and in the waste lands around there was ample labour for any number of convict hands. Dartmoor was opened in 1850; two years later a convict prison was established at Portsmouth in connexion with the dockyard, and another of the same class at Chatham in 1856. The third stage in Sir George Grey's scheme contemplated the enforced emigration of released convicts, whom the discipline of separation and public works was supposed to have purged and purified, and who would have better hopes of entering on a new career of honest industry in a new country than when thrown back among vicious associations at home. The theory was good, the practice impossible. No colony would receive these ticket-of-leave men. Van Diemen's Land positively refused to do so, even though this denial cut off the supply of labour, now urgently needed. The appearance of a convict ship at the Cape of Good Hope nearly produced a revolt. Although Earl Grey addressed a circular letter to all colonial governments offering them the questionable boon of transportation, only one, the comparatively new colony of Western Australia, accepted. But this single receptacle could not absorb a tithe of the whole number of convicts awaiting exile. It became necessary therefore to find some other means for their disposal. Accordingly, in 1853 the first Penal Servitude Act was passed, substituting certain shorter sentences of penal servitude for transportation. It was only just to abbreviate the terms; under the old sentence the transportee knew that if well conducted he would spend the greater part of it in comparative freedom. But although sentences were shortened it was not thought safe to surrender all control over the released convict; and he was only granted a ticket-of-leave for the unexpired portion of his original sentence. No effective supervision was maintained over these convicts at large. They speedily relapsed into crime; their numbers, as the years passed, became so great and their depredations so serious, especially in garrotte robberies, that a cry of indignation was raised against the system, which led to its arraignment before a select committee of the House of Commons in 1863.

Meanwhile prison discipline in the elementary stage, as inflicted on lesser offenders, was continually discussed. The subject was referred to many committees for inquiry, and it was shown that there was a lamentable want of uniformity in the enforcement of legal penalties. The processes and treatment varied with the localities. Dietaries differed, here too ample, there meagre to starvation. The amount of exercise allowed varied greatly; there was no universal rule as to employment. In some prisons hard labour was insisted upon, and embraced tread-wheels or the newly-invented cranks; in some it did not exist at all. The cells inhabited by prisoners (and separate cellular confinement was now very general) were of different dimensions—variously lighted, warmed and ventilated. The time spent in these cells was not invariably the same, and as yet no authoritative decision had been made between the solitary and silent systems. The first named had been tried at Pentonville, but the period had been greatly reduced. The duration had been at first fixed at eighteen months, but it was proved that the prisoners' minds had become enfeebled by this long isolation, and the period was limited to nine months. In many jurisdictions however the silent system, or that of associated labour in silence, was still preferred; and there might be prisons within a short distance of each other at which two entirely different systems of discipline were in force. In 1849 Mr Charles Pearson, M.P., moved for a select committee to report upon the best means of securing some uniform system which should be at once punitive, reformatory and self-supporting. He urged that all existing plans were inefficacious, and he advocated a new scheme by which the labour of all prisoners should be applied to agriculture in district prisons. The result of a full inquiry was the reiteration of views already accepted in theory but not yet generally adopted in practice. Thirteen more years elapsed and still no such steps had been taken. A new committee sat in 1863, and in its report again remarked in no measured terms upon the many and wide differences that still existed in the gaols of Great Britain as regards construction, diet, labour and general discipline, "leading to an inequality, uncertainty and inefficiency of punishment productive of the most prejudicial results." Matters could only be mended by the exercise of legislative authority, and this came in the Prison Act of 1865, an act which consolidated all previous statutes on the subject of prison discipline, many of its provisions being still in force. Yet the years passed and uniformity was still far from secured; it was impossible indeed while prison administration was still left to a number of local authorities, no two of which were often of the same mind. The legislature had tried its best, but had failed. It had exercised some supervision through its inspectors, had forbidden cells to be used until duly certified as fit, and had threatened to withhold exchequer contributions from prisons of which unfavourable reports were received. Such penalties had exercised no sufficient terrors. It began to be understood, moreover, that the prisons under local jurisdictions were not always conveniently and economically situated. Crime, with the many facilities offered for rapid locomotion to those who committed it, had ceased to be merely local, and the whole state rather than individual communities ought to be taxed; prison charges should be borne by the public exchequer and not by local rates. These considerations gained strength and led at length to the introduction of the Prison Bill which became law in 1877, by which the control of all gaols was vested in a body of prison commissioners appointed by and responsible to the home secretary. These commissioners had power to consolidate by closing superfluous prisons, to establish one system of discipline, and generally by watchful supervision, aided by the experience of specialists, to maintain that much-desired uniformity which had been so long and unsuccessfully sought. At the same time the co-operation of the local magistrates was invited so far as advice and assistance were concerned; but all real power and control has passed from their hands into that of the commissioners of prisons. The system established by the act of 1877 is that now in force.

As for penal servitude, the punishment reserved for the gravest offences, great changes had been introduced. We left this branch of the subject at a parliamentary inquiry. The verdict given was in the main satisfactory; but doubts were expressed as to the severity of the discipline inflicted, the principal features of which were moderate labour, ample diet and substantial gratuities. The first was far less than the work free men did for a livelihood, the second larger, the third excessive, so that convicts often left prisons with thirty, forty, even eighty pounds in their pockets. Penal servitude, to use the words of the lord chief justice Sir Alexander Cockburn, one of the members of the committee, "was hardly calculated to produce on the mind of the criminal that salutary dread of the recurrence of the punishment which may be the means of deterring him and, through his example, others from the commission of crime." The chief recommendation put forward to mend the system comprised lengthening of all sentences, a diminution in the dietaries, the abolition of large gratuities, and, speaking broadly, a general tightening of the reins. The most notable change however was in regard to labour, the quantity and value of which was to be regulated in future by the so-called "mark-system." This plan had originated with Captain Maconochie, at one time superintendent in Norfolk Island, who had recommended that the punishment inflicted upon criminals should be measured, not by time, but by the amount of labour actually performed. In support of his theory he devised an ingenious system of recording the convicts' daily industry by marks, which on reaching a given total would entitle them to their release. This mark system had already been tried with good results in Ireland, where the Irish system, as it was called, introduced by Sir Walter Crofton, had attracted widespread attention. There had been a very marked diminution in crime, attributable it was supposed to this system, which was in almost all respects the same as the English, although the Irish authorities had invented an "intermediate stage" in which convicts worked in a state of semi-freedom and thus practised the self-reliance which in many produced reform. As a matter of fact the diminution in crime was traceable to general causes, such as a general exodus by emigration, the introduction of a poor law and an increase in the facilities for earning an honest livelihood. It may be added here that judged by later experience the Irish system had no transcendent merits, and it is now extinct. But we owe something to the Irish practice which first popularized the idea of maintaining a strict supervision over convicts in a state of conditional release, and it reconciled us to a system which was long wrongfully stigmatized as espionage. The mark system, as recommended by the committee of 1863 and as subsequently introduced, had however little in common with either Maconochie's or the Irish plan. It was similar in principle and that was all. According to the committee, every convict should have it in his power to earn a remission—in other words, to shorten his sentence by his industry. This industry was to be measured by marks earned by hard labour at the public works, after a short probational term of close "separate" confinement. But the remission gained did not mean absolute release. All males were to be sent, during the latter part of their sentence, "without disguise to a thinly peopled colony," to work out their time and their own rehabilitation. The committee still clung to the old theory of transportation, and this in spite of the lively protests of some of its members. The one outlet remaining, however, that of Western Australia, was soon afterwards (1867) closed to convict emigrants; and this part of the committee's recommendations became a dead letter. Not so the mark system, or the plan of earning remission by steady industry. This was carried out on a broad and intelligent basis by officials prompt to avail themselves of the advantages it offered. Thus in 1877–1878 efforts were made to minimize contamination by segregating the worst criminals and restricting conversation at exercise. A special class was formed in 1880, in which all convicts "not versed in crime," first offenders and comparatively innocent men, are now kept apart from the older and more hardened criminals. The committee last quoted gave it as their opinion that "penal servitude as at present administered is on the whole satisfactory; it is effective as a punishment and free from serious abuses . . . . a sentence of penal servitude is now generally an object of dread to the criminal population." Since then, steps have been taken in the classification of convicts when undergoing sentence with a view to dealing more effectually with habitual criminals.

Latest Measures for Enforcing Penal Discipline in England.

Having thus traced the history of secondary punishments and prison discipline in England, it will be well to describe the system now actually in force. This will be best understood if we follow those who break the law through all the stages from that of arrest, through conviction, to release, conditional or complete.

After a short detention in a police cell, an offender, unless disposed of summarily, passes into one of His Majesty's prisons, there to await his trial at sessions or assizes. The period thus spent in the provinces will never exceed three months; in London, with the frequent sitting at Clerkenwell and of the Central Criminal Court, it is seldom more than one month. While awaiting trial the prisoner may wear his own clothes, provide his own food, see and communicate with his friends and legal adviser so as to prepare fully for his defence. His fate after conviction depends on his sentence. If this be "imprisonment," so called to distinguish it from "penal servitude," although both mean deprivation of liberty and are closely akin, it is undergone in one of the "local" prisons—the prisons till 1878 under local jurisdiction, but now entirely controlled by the state through the home secretary and the commissioners of prisons. The régime undergone is cellular; able-bodied prisoners are kept in strict separation for at least a month, and during that time subjected to severe labour; although the term of first-class hard labour and of purely penal character no longer exists. The tread-wheel has also been abolished. A system of progressive stages based on the mark system has been adopted in the local prisons, and the prisoner's progress through each depends on his own industry and good conduct. During the first month he sleeps on a plank bed, a wooden frame raised from the floor, with bedding but without mattress. When he has earned the proper number of marks, which at the earliest cannot be until one month has elapsed, he passes into the second stage and is allowed better diet and a mattress twice a week. The third stage, at the end of the third month, gives him further privileges as regards diet and bed. The fourth stage concedes to the prisoner a mattress every night, and the privilege, if well conducted, to communicate by letter or through visits with his friends outside. These stages are applicable to females except as regards the plank bed; youths under sixteen and old men above sixty are also allowed mattresses. A small gratuity may be earned during the second and three following stages, amounting in the aggregate to ten shillings. The labour, too, may be industrial, and include instruction in tailoring, shoemaking, basket-making, bookbinding, printing, and many more handicrafts. Throughout the sentence the prisoner has the advantage of religious and moral instruction; he attends divine service regularly, and whatever his creed is visited by a chaplain professing it, and receives educational assistance according to his needs. His physical welfare is watched over by competent medical men; close attention is paid to the sanitary condition of prisons; strict rules govern the size of cells, with their lighting, warming and ventilation. Dietaries are everywhere the same; they are calculated with great nicety according to the time of durance, and afford variety and ample nutrition without running into excess. In a word, as regards discipline, labour, treatment, exactly the same system obtains in the "local" prisons throughout the United Kingdom.

Where the sentence passes beyond two years it ceases to be styled imprisonment and becomes penal servitude, which may be inflicted for any period from three years to life. The prisoner becomes a convict and undergoes his penalty in one or more of the convict prisons. These are entirely under state management. A sentence of penal servitude as now administered consists of three distinct periods or stages: (1) that of probation endured in separate confinement at a so-called "close" prison; (2) a period of labour in association at a public works prison; and (3) conditional release for the unexpired portion of the sentence upon licence or ticket-of-leave.

1. In the first stage, which was limited to six months, but which it is proposed to reduce to one month, the convict passes his whole time in his cell apart from other prisoners, engaged at some industrial employment. He exercises and goes to chapel daily in the society of others, but holds no communication with them; his only intercourse with his fellow-creatures is when he is visited by the governor, chaplain, schoolmaster or trade instructor. This period of almost unbroken solitude is of a painful character, and its duration has therefore been wisely limited.

2. The second is a longer stage and endures for the whole or a greater part of the remainder of the sentence, its duration being governed by the power a convict holds in his own hands to earn a remission. It is now passed at a public works prison; either at Aylesbury (females), Borstal, Dartmoor, Parkhurst or Portland. While cellular separation, except at work, at prayers or exercise, is strictly maintained,—labour is in association under the close and constant supervision of officials. Intercommunication no doubt takes place; men working together in quarry, brickfield or barrow-run, and out of earshot of their guardians, may and do converse at times. But the work is too arduous to allow of long and desultory conversation; the chance of contamination is now minimized by the careful separation of the less hardened from the old offenders. There is no reason to suppose that any great evils arise from this association, and without it the execution of the many important national public works which now attest its value would have been impossible. Among these may be mentioned the following: the quarrying of stone for the great Portland breakwater, nearly 2 m. in length and between 50 and 60 ft. deep in the sea, with the defensive works on the Verne, batteries, casements and barracks intended to render the island of Portland impregnable, and the enlargement and extension of the dockyards at Chatham and Portsmouth. At Borstal a line of forts intended to protect Chatham on the south and west have been erected by convicts; they have also built magazines at Chattenden on the left bank of the Medway. Besides this, convict labour has been usefully employed in the erection of prison buildings at new points or in extension of those at the old. In all cases the bricks have been made, the stone quarried and dressed, the timber sawn, the iron cast, forged and wrought by the prisoners. The great merit of this system is the skill acquired in handicrafts by so many otherwise idle and useless hands. Convict mechanics are rarely found ready made. It is a fact that a large percentage of the total number employed at trades learnt them in prison. These results are no doubt greatly aided by the judicious stimulus given to the highest effort of the mark system. The chief objection to enforced labour has been the difficulty in ensuring this; but the convict nowadays eagerly tries his best, because only thus can he win privileges while in prison and an earlier release from it. Every day's work is gauged and marks recorded according to its value; upon the total earned depends his passage through the stages or classes which regulate his diet and general treatment, and more especially his interviews and communications with his relations and friends. Yet more; steady willing labour continuously performed will earn a remission of a fourth of the sentence. It must be borne in mind that the marks thus earned may be forfeited at any time by misconduct, but affect remission to this extent only. The full remission in a five years' sentence is one year and ninety-one days; in seven years, one year two hundred and seventy-three days; in fourteen, three years one hundred and ninety-seven days; in twenty, four years one hundred and ninety days. "Lifers" cannot claim any remission, but their cases are brought forward at the end of twenty years and then considered on their merits.

3. Having earned his remission the convict enters upon the third stage of his punishment. He is released, but only conditionally, on licence or ticket-of-leave. This permission to be at large may easily be forfeited by fresh breaches of the law. Stringent conditions are endorsed upon the licence and well known to every licence holder (see Ticket-of-Leave).

Further modifications have been introduced from time to time in the British penal system, tending mostly to milder discipline, more intelligent classification of prisoners and a certain amelioration of their lot. In its general outlines the system as set forth above has been maintained, but the departmental committee appointed in 1895 made some important recommendations which were presently adopted in part. The committee was dissatisfied with the moral results achieved and thought that more attention should be paid to reformatory processes. They believed that "few inmates left prison better than when they came in." Recommittals were frequent and recidivism on the increase. Imprisonment was not sufficiently deterrent to the habitual criminal class, and small attention was paid to the reclamation of less hardened offenders. The views of this committee were embodied in a Penal Servitude bill which was long debated, but became law in 1898. It emphasized the excellence of the system devised in 1879 for the segregation of the comparatively innocent from convicts hardened in crime. The system of the "star" class as originally established provided that the prisoner never previously convicted should be kept absolutely apart, at chapel, labour, exercise and in quarters, from his less fortunate fellows who had already been imprisoned. The rule was strictly enforced and with the most conspicuous results, so that little more than 1% of "stars" have been re-convicted when once more at large. The privilege of the "star" is only accorded after careful inquiry and reasonable proof that the individual has never before been sent to prison. Reference is made to the police at the time of conviction, and the duty of looking into previous and present character is very strictly performed. The inquiry is continuous and may be prolonged into the sentence; then, if necessary, correction is applied. But as a matter of fact very few mistakes are made. It is obvious that wrongful admission into the "star" class might be fraught with mischievous consequences, and it is well known that a first sentence does not necessarily mean absolute unacquaintance with crime. For administrative convenience the "stars"—whose name comes from the scrap of crimson cloth worn on cap and jacket sleeve—have been generally concentrated at Portland, and employed in labours specially allotted to them, for the most part demanding a higher rate of intelligence than the general average shown by convicts. Moulders, blacksmiths, carpenters, tinsmiths, stonemasons, bookbinders, painters and various other trades and handicrafts are the peculiar province of the "stars."

The Prison Act of 1898 made some marked changes in penal discipline. One was the strict limitation of corporal punishment to offences of mutiny and gross personal violence to officers, where previously it might be inflicted for many forms of misconduct, and it can only now be adjudged under great restrictions. It was feared that the removal of this powerful deterrent would adversely affect discipline, but on the contrary, the yearly average of prison offences has diminished from 147 to 131 per thousand prisoners, and it has been felt by the authorities that the limitation was salutary and wise. Another change was the power given to courts of law to differentiate between offenders by ordering them one of three classes of treatment ranging from severe to less rigorous. The first of these divisions was akin to that of former first-class misdemeanants; the second division was allotted to persons guilty of trivial offences not amounting to moral depravity, the third division was apportioned to serious crime calling for severe repression, involving strict separation for the first twenty-eight days with "hard labour" (now an obsolete expression, since all prison labour is nowadays accounted "hard"). The scheme was judicious, but courts have been slow to make use of its provisions. Yet a third improvement was permission conceded to prisoners locked up in default of payment of fine, to obtain a reduction of time proportionate to part payment of the fine. The numbers under both categories are considerable, and taken together show a steady increase in the ten years from 1892 (when the acts first came into effect) to 1902, the figures being 33,802 in 1892 and 51,302 in 1902.

Imprisonment, albeit somewhat modified and diluted, continues to be used as the chief penalty and most trusted panacea for all crime. The medicine is so simple in application and so easily available that it is served out almost automatically and indifferently to every law-breaker; the pickpocket and the burglar are locked up next door to the clergyman at variance with his bishop; the weak-kneed and self-indulgent drunkard rubs shoulders with the political zealot who has endangered the peace of nations. There is an enormous mass of so-called crime in England which is not crime at all, and still is perpetually penalized by an infliction of imprisonment for such short periods as to be perfectly futile. The bulk of the offences for which it is meted out are trivial and unimportant. Eighty-three per cent of the annual convictions, summarily and on indictment, followed by committal to gaol, are for misconduct that is distinctly non-criminal, such as breaches of municipal by-laws and police regulations, drunkenness, gaming and offences under the vagrancy acts. The leniency of the sentences indicates the comparatively trifling character of the wrongdoing. Forty per cent. of the males and 39% of the females were sent to prison for periods of a week or less; on the other hand, no more than 4% were sentenced to six months and under, only 2% were imprisoned for terms between six months and one year; and ·75% to more than one year. The question will arise some day whether it is really necessary to maintain fifty-six local prisons, with all their elaborate paraphernalia, their imposing buildings and expensive staff, to maintain discipline in daily life and insist upon the proper observance of customs and usages, many of them of purely modern invention. Of course there is in most cases the alternative of a fine, the non-payment of which entails the imprisonment; yet a penalty imposed on the pocket is so clearly the proper retribution for such misdeeds that better methods should be devised for the collection of fines.

The chief aim of penal legislation should indeed be either to keep gaols empty or to use them only where distinct reduction in the number of offenders, whether by regeneration or by continuous withdrawal from noxious activity, can be obtained. An axiom based upon this view has been formulated, and although paradoxical it may well be quoted here. The great aim and object of all penal processes, it has been said, should be the recognition of the general principle of dividing all offenders into two categories: (1) those who ought never to enter a gaol, and (2) those who ought never to be allowed to leave it. Praiseworthy efforts to compass the first end have been made in recent legislation. The First Offenders Act in 1887 had the effect of postponing sentence and sparing these offenders from incarceration subject to their good conduct. An average of about 4500 thus escaped imprisonment in the five years between 1893 and 1897, and an average of 5500 the five following years. The gain in this was great, seeing that no more than 6 to 8% were actually sent to gaol after the commission of a second offence, and that there was therefore a very distinct saving in expense of maintenance of prisoners incarcerated. The value of this act is to be seen in its wide adoption. It is in force in some of the states of the American Union. It was adopted in France by the Berenger law of 1891, and in Belgium, where 14% of sentences of imprisonment in one year and a-half were postponed. In some countries the concession has been accompanied by admonition. The Summary Jurisdiction Acts, by which large numbers of minor offenders were discharged on bail, or subjected to fines or very brief terms of imprisonment, have also tended to diminish the prison population enormously. The number annually discharged increased from 33,000 in 1893 to 51,302 in 1902. This excellent system has commended itself to many countries and it is now adopted by the bulk of governments and jurisdictions owing allegiance to the British Crown.

Two new systems of applying imprisonment have commended themselves to English administrators, and both have been effected by the Prevention of Crime Act 1908. The first is a new method for educating and reforming young offenders, already on the frontiers of habitual crime, no longer children, but at an age still susceptible of permanent improvement; the second is the legal acceptance of the principle of indefinite detention, the willingness to inflict an indeterminate sentence on those who have already forfeited the right to be at large.

Both these measures originated in the United States. The Borstal scheme of a juvenile-adult reformatory has been to some extent planned on the institutions of Elmira reformatory in the state of New York and of Concord in Massachusetts (see JUVENILE OFFENDERS). Side by side with the new processes introduced, the idea of the indeterminate sentence was started and put in practice, by which release was made to depend upon reasonable hope of amendment and sentences were prolonged until it was more or less certain that the treatment had resulted in cure.

Other measures are set forth in the new classification of convicts, prescribed by the secretary of state in the rules submitted by him to the House of Commons in 1904. All convicts are classed in three categories, viz. (A) the Ordinary division; (B) the Habitual Offenders' division; and (C) the Long Sentence division.

The " A " or Ordinary division comprises all ordinary convicts under old rules who are still separated into the three classes of " star," intermediate and recidivist, as provided by the act of 1898. The qualifications for each class are clearly laid down. Only those never previously convicted, or known as of not habitually criminal or corrupt habits, are eligible for the " star " class. The intermediate class takes those not previously convicted but deemed unsuitable as " stars " from antecedents and generally unsatisfactory character. The recidivist class is for those previously sentenced to penal servitude or whose record shows them to have been guilty of grave and persistent crime.

These three classes begin with cellular confinement, but for varying periods; the first for three months, the second six months and the third for nine months, in all cases subject to a medical report upon mental and physical condition. Female convicts pass the first three months of their sentence in separate cells.

The " B " division indicates the worst penalties to be inflicted upon habitual criminals. There is no recognition whatever of the principle of the indeterminate sentence. The law merely prescribes the forfeiture of all remission. The convict is not eligible for release or licence, but when the time of conditional liberation would have formerly arrived the case is submitted to the authorities and dealt with on its merits. Early release depends upon the reports on industry and conduct, and the prospect of his keeping straight if set free. He may have to " do " his whole time but not an hour beyond it.

Certain privileges are conceded to the " B " division to compensate those in it for the loss of remission. They wear a special dress, a band of blue cloth on the left arm; they may earn an extra gratuity and spend a part of it in buying extra food or articles of comfort and relaxation; they may take their meals in association, converse at them or at exercise, but not at labour.

The " C " division has been designed for convicts serving long sentences, who have gained all possible privileges in the early years of sentence and have little or nothing to expect further until the last year of their sentence, when they may earn an additional gratuity. But after ten years they may enter the " C " division, earn a special gratuity therein, and enjoy the various privileges accorded to the " B " or habitual criminals' division with the additional advantage that there is no interference with their remission.

Still milder and more humanitarian prison treatment was that put forward by the home secretary in 1910 in his speech already referred to. In it he suggested that the following reforms should be carried out, some by administrative order and some by future legislation: (1) time for the payment of fines inflicted for minor offences; (2) disciplinary treatment outside prison for all offenders under 21 years of age; (3) punishment of those guilty of offences not involving moral turpitude to be relieved of all degrading features; (4) the reduction of the period of solitary confinement to a maximum of one month; (5) and the abolition of the ticket-of-leave system. It was also proposed to give four lectures or concerts a year in convict prisons.

Prisons in other Countries.—The general progress made in prison treatment will be best realized by a brief survey of penal institutions in the principal countries of the world. It will be convenient to take them alphabetically.

1. *Austria-Hungary.*—The régime of cellular confinement has not been universally adopted; only six prisons are built on that principle and no more than 15% of the whole number of prisoners can be subjected to the system. Cellular separation is not inflicted for long periods, the minimum being six months and the maximum three years. The bulk of the prisoners live and labour in common. A great feature has been the execution of public works by prisoners in a state of semi-liberty beyond prison walls—the practical adoption of the so-called " Irish " or intermediate prison—and good results are seen in road-making and the improvement of river courses.

2. *Belgium.*—This country has spared neither pains nor money in carrying out penal processes, and the Belgian prisons are examples of the cellular system prolonged to the utmost limits of human endurance. There is a minimum of ten years, but the individual may elect to continue in separation, or be transferred to partial association. A new school of Belgian criminologists has been headed by M. Prins, the chief of the prison department, who has protested that to hope the vicious, hardened offender, after a long detention, " surrounded with every attention, soaked with good counsel, will leave his cell regenerated," is a Utopian dream.

3. *British Dominions beyond the Sea.*—The principle of cellular separation was accepted as far back as 1836 and the model prison of Pentonville, opened in 1842, has since been copied throughout the civilized world. The cellular system has been adopted in all British colonies with various modifications, and prisons built on modern principles are to be found in Canada, Australia, New Zealand and the Cape of Good Hope. India retains association as the system most suitable for its criminal classes, with other methods generally abandoned in Great Britain, such as the employment of well-conducted prisoners as auxiliaries in prison discipline and service; deportation is still the penalty for the worst offences and is carried out on a large scale and with satisfactory results in the Andaman Islands. In Egypt since the establishment of British control a very marked change has been introduced in prison affairs.

4. *Denmark.*—In Denmark all convicted prisoners pass through several stages, from cellular treatment to the intermediate prison and conditional liberty. Two new prisons on the latest model have been erected at Copenhagen, one for males and the other for females. The smaller gaols for short terms are mostly on the cellular plan.

5. *France.*—France has devoted very considerable attention to prison matters and is now practising the two extremes of treatment, the strict cellular isolation of the Belgian system and the penal exile or transportation which was long the English rule.

6. *Germany.*—The unified German Empire has not as yet adopted one system of prison treatment, and its various component kingdoms still retain independence in views and practice.

Baden has a well-known cellular prison at Bruchsal, but separation is not imposed for more than four years and associated labour is carried out in another quarter of the prison.

Bavaria has four cellular prisons, the chief being at Munich and Nuremberg, but the collective system also obtains.

Prussia having declared for the cellular system constructed the well-known Moabit prison in Berlin, also those of Ratibor in Silesia and of Herford in Westphalia, while those of Graudenz, Breslau, Werden and Cologne have been added since. The total number of separate cells to-day is 11,041 against 3247 in 1869. Two new cellular prisons, Luttringhausen and Saarbruck, have recently been added. Frankfurt has a good prison on the Pentonville (London) plan; so has Hamburg; and new buildings have been erected at Wohlan, Siegburg, Breslau and Munster. Separate cells in Prussia had increased in 1896 from 3247 to 6573. The cellular régime is applicable to prisoners between 18 and 30, and to first offenders of 50 years of age, the term being fixed by the governor of the gaol, but never exceeding three years.

Saxony established a penitentiary at Zwickau in 1850 and in its earlier management exhibited exaggerated kindness to its inmates. Both the cellular and the associated systems obtain.

Württemberg has accepted the cellular system. There are prisons for females at Heilbronn, and for males at Ludwigsburg and Stuttgart; in Württemberg itself the régime is collective.

7. *Holland* has followed her nearest neighbour Belgium and has now at command separate cells sufficient to receive the whole number of her prison population. The system of unbroken seclusion, prolonged to five years, is maintained with strictness.

8. *Italy.*—Although accepting the principle of cellular imprisonment, Italy has not adopted it largely, partly from want of funds and not a little because the current of thought has set against it. The really penal establishments are 77 in number, the great *ergastolo* of San Stefano being one. Agricultural labour for convicts has been tried in colonies of *coatti* (or those provisionally released) planted out in the islands of the Italian archipelago.

9. *Norway.*—The separation of Norway, as an independent state, from Sweden has produced no great change in its prison institutions, which still follow the lines of the neighbouring country.

10. *Portugal.*—There are three or more cellular prisons at Lisbon, Coimbra and Santarem, and the system of strict separation when first adopted in 1884 was expected both to amend and deter.

11. *Sweden.*—Prince Oscar of Sweden was one of the earliest adherents of cellular imprisonment, and at his urgent representation penitentiary reform was warmly espoused in 1841. His influence is still felt, and the system in force in Norway and Sweden is progressive from strict separation to working outside the cell. Sweden, which adopted the cellular system in 1842, has now cells sufficient for prisoners sentenced to two years and less. There are three principal central prisons, one at Langholm near Stockholm, a second at Malmo and a third at Mya Varfet near Gothenburg.

12. *United States.*—The penal system of the United States varies between being the most advanced and the most backward in the civilized world. At one end of the scale are the numerous bad

county gaols and the horrors of the convict lease system in the southern states, now nearly extinct; at the other such modern and well-equipped reformatories as Elmira and Concord (see Juvenile Offenders). The worst feature is the indiscriminate association sometimes seen of all inmates, bond and free, the convicted and accused; even witnesses against whom there is no shadow of a charge are sometimes imprisoned among felons. Nor is it only in distant corners of the great continent that this criticism applies, though constant improvements are removing the grounds for it. It is only a short time since the local gaol in the city of New York, "the Tombs," a house of detention for prisoners awaiting trial, was described in an official report to the state legislature as "a disgrace. . . . It is defective in every modern appliance. It is dark, damp and ill-ventilated . . . worst of all is the hideous system of keeping two or three men in a cell; . . . a means of indescribable torture to a decent man and a prolific source of vice and crime to a criminal. Such treatment of dogs would be gross cruelty." This building has, however, now been pulled down, and a new and better one has taken its place. The administration of prisons rests mainly with the various state authorities, and there is no federal or general system which would introduce uniformity of treatment. The federal government has no influence or control except for offences against the federal laws, regulating coinage, postal service, the revenue and so forth. Prison management is essentially a local concern, but some general features are common to all states, such as the rule that while petty offenders and prisoners awaiting trial are under county and city jurisdiction, the state takes charge of all persons convicted of serious crimes. The state prisons receive by far the largest proportion of the criminal population, more than half the general total being imprisoned therein. Some of them are models of cleanliness and good order, built on the best and most imposing lines with large comfortable cells and an abundance of light and air. The earnest desire of most prison administration is to develop industrial training and trade profits side by side with mildness of treatment. The latter sometimes lapses into methods which are not usually thought compatible with prison discipline, such as the permission to play on musical instruments, the holding of concerts, the privilege of smoking and chewing tobacco, of receiving baskets of provisions, novels and newspapers from friends outside.

It is worthy of note that prison architecture in the United States misses many of the gloomy features common to such constructions. The newest prisons are generally lighter, more roomy, better ventilated and on the whole more comfortable than even the best British prisons. In 1900 Sir E. Ruggles Brise, the English expert on prisons, declared that "the purity of the air and the cleanliness of the American prisons are admirable, and under a very elaborate system of warming by hot air, a regular and uniform temperature is sustained throughout the year, which, considering the varying nature of the climate from extreme heat to cold many points below zero, is a considerable engineering triumph."

Prison Industries.—It is an axiom in prison science that enforced labour cannot easily be made productive. No doubt the problem has been in a measure solved in England by that useful incentive to industry, the mark system. But the more substantial returns cannot always be expected with the sedentary employments and single-handed effort inseparable from the régime of cellular imprisonment. England for many years past, in adopting the principle of Public Works Prisons after a certain short period spent in separation, has pronounced in favour of open-air employment in association. Although the system still has many hostile critics its value cannot be contested. It has been said by a trustworthy authority,[1] "We are convinced also that severe labour on public works is most beneficial in teaching criminals habits of industry and training them to such employments as digging, road-making and brick-making—work of a kind which cannot be carried on in separate confinement." A good proof of the value of the system as remunerative and healthful, morally and physically, is seen in the growing desire of other countries to follow our lead. Very similar operations have been carried out in Austria-Hungary, where large tracts of land have been brought into cultivation, and watercourses have been diverted successfully despite serious difficulties, climatic and physical; in Russia convict labour has been largely used in the construction of the Trans-siberian railway; the military operations in the Sudan were greatly aided by convict labourers engaged in useful work at the base and all along the line; Italy passed a law in 1904 enacting outdoor labour for the reclamation and draining of waste lands by prisoners under long sentence; and France, although much wedded to cellular imprisonment, is beginning to favour extra-mural employment of prisoners under strict regulations. The subject was discussed at the Penitentiary Congress at Budapest in 1905, and a resolution passed recommending extra-mural employment for prisoners of rural origin, vagrants and drunkards, and those subject to tuberculous disease, "so largely the concomitant of cellular confinement."

Prison industries continue to be largely sedentary in character; they cover a wide range, although the conditions of life are for the most part artificial. Most trades and handicrafts are practised, such as shoemaking, tailoring, carpentry, the work of white- and blacksmiths; skilful and intelligent workmen, such as the French and Japanese, find a wide outlet for their versatile and artistic talent. The well-known products, styled *articles de Paris*, prison-made, find a large sale, and many objects of high art, fine paintings, cloisonné enamels and gold lacquer are among the beautiful products from Japanese prisoners. The indoor manufactures followed in British prisons are not so varied as the foregoing and have been limited by the protests and objections raised by free or outside labour against alleged unfair competition. Accordingly, the production of goods has been largely curtailed for the open market and prison labour is restricted nowadays to supplying articles required for current use by public departments—such as the navy, army, post office and, of course, all prison establishments. Prison labour has found an outlet, therefore, in such work as service blanket making, hammock making, mail-bag making, the manufacture of cartridge cases, flags, chopping firewood for barracks and so on, having been diverted almost entirely from mat-making, once an exclusive prison trade originally invented indeed by prison task-masters. The total annual value of the labour applied in English prisons has varied. In 1896–1897 the total accruing from manufactures, farm operations and the ordinary service of the prison was £213,812, the prison population in local and convict prisons being 17,614; in 1903–1904 the total amounted to £244,518, the prison population on the 31st of March 1904 being 21,117. The gross expenditure was £524,289 for 1896–1897, as against £615,656 for 1903–1904. Figures are not available for any exact comparison of outlay and return in other countries, but the earnings in European countries generally run to about half the expenditure. In the United States the policy varies between the two extremes of making prisoners self-supporting and of leaving them in idleness so that the whole weight of expense falls upon the state. In some states economic considerations have carried the day; in others the stringency of labour laws under the pressure of labour associations has paralysed all prison industry. In the first mentioned, the contract system, by which a contractor hires the prisoner's labour from the state, has proved very profitable, but at the sacrifice of discipline and neglect of reformatory processes upon the individual. This leasing-out system has been carried further in some of the southern states, and has produced the convict camps, which have been much criticized and condemned from the harshness of the discipline enforced, the many abuses that exist and the meagre results other than monetary that have been obtained.

The modern movement in favour of industrial employment combined with humane and intelligent considerations has swept away the more or less barbaric method of enforcing labour by automatic machinery such as the treadmill, crank and shot drill (see Treadmill).

Authorities.—John Howard, *State of Prisons in England and Wales* (1784); Cesare Lombroso, *L'Uomo delinquente*, &c. (1899); Beaumont and A. de Tocqueville, *Système pénitentiaire aux États-Unis* (1837); Crawford, *Report on Penitentiaries* (U.S.A., 1838); Maconochie, *Prison Discipline* (1856); Dr Guillaume, *Progress of Prison Discipline in Switzerland* (1872); Arthur Griffiths, *Memorials of Millbank* (1873), *Chronicles of Newgate* (1882); Armingol y Cornet, *Prisons and Prison Discipline in Spain* (1874); Stevens, *Régime des établissements pénitentiaires en Belgique* (1875); F. V. Holtzendorf and von Jagemann, *Handbuch des Gefängniswesens* (1877); Scaglia Beltrani, *Reforma penitenzaria in Italia* (1879); Sir Edmund F. Du Cane, *Punishment and Prevention of Crime* (1885); Braco, *Estudos penitenciarios e criminaes* (Lisbon, 1888); Garofalo, *Studio sul delitto, sulle sui cause e sui mezzi di repressione* (1890); Adolphe Guillot, *Les Prisons de Paris* (1890); Tallack, *Preventive and Penological Principles* (1896); Salillas, *Vida penal en España* (Madrid).

(A. G.)

PRISONERS' BASE (Prisoners' Bars), an ancient game much affected by children. The players are divided into two sides, each standing within a base or home marked off at some distance apart. After preliminary songs and war-like challenges, a player on one side runs out and is pursued by one of "the enemy"; if touched he becomes a prisoner of the side to which his captor belongs. If another player from the side of the pursued runs between him and his pursuer, the latter has to follow *him*, but the last to leave his base is privileged to touch any one of the enemy who left his base before him. The rules of the game are, however, traditional, and necessarily somewhat elastic. The end comes, of course, when all of one side have been captured by the other.

PRITCHARD, CHARLES (1808–1893), British astronomer, was born at Alberbury, Shropshire, on the 29th of February 1808. At the age of eighteen he was enrolled as a sizar at St John's College, Cambridge, whence he graduated in 1830 as fourth wrangler. In 1832 he was elected fellow of his college, and in the following year he was ordained, and became head master of a private school at Stockwell. From 1834 to 1862 he was headmaster of Clapham grammar school. He then retired to Freshwater, in the Isle of Wight, and took an active interest in the affairs of the Royal Astronomical Society, of which he became honorary secretary in 1862 and president in 1866. His career as a professional astronomer began in 1870, when he was elected Savilian professor of astronomy at Oxford. At his request the university determined to erect a fine equatorial telescope for the instruction of his class and for purposes of research, a scheme which, in consequence of Warren de la Rue's munificent gift of instruments from his private observatory at Cranford, expanded into the establishment of the new university observatory. By De la Rue's advice, Pritchard began his career there with a determination of the physical libration of the moon, or the nutation of its axis. In 1882 Pritchard commenced a systematic study of stellar photometry. For this purpose he employed an instrument known as the "wedge photometer" (see PHOTOMETRY, CELESTIAL, and *Mem. R.A.S.* xlvii. 353), with which he measured the relative brightness of 2784 stars between the North Pole and about −10° declination. The results were published in 1885 in his *Uranometria Nova Oxoniensis*, and their importance was recognized by the bestowal in 1886 upon him, conjointly with Professor Pickering, of the Royal Astronomical Society's gold medal. He now resolved to try the experiment of applying photography to the determination of stellar parallax. With the object of testing the capabilities of the method, he took for his first essay the well-known star 61 Cygni, and his results agreed so well with those previously attained that he undertook the systematic measurement of the parallaxes of second-magnitude stars, and published the outcome in the third and fourth volumes of the Publications of the Oxford University Observatory. Although some lurking errors impaired the authority of the concluded parallaxes this work ranks as a valuable contribution to astronomy, since it showed the possibility of employing photography in such delicate investigations. When the great scheme of an international survey of the heavens was projected, the zone between 25° and 31° north declination was allotted to him, and at the time of his death some progress had been made in recording its included stars. Pritchard became a fellow of New College, Oxford, in 1883, and an honorary fellow of St John's College, Cambridge, in 1886. He was elected a fellow of the Royal Society in 1840, and in 1892 was awarded one of the royal medals for his work on photometry and stellar parallax. He died on the 28th of May 1893.

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[1] *Report of the Royal Commission on Penal Servitude* (1878–1879).

See *Proc. Roy. Soc.* liv. 3; *Month. Notices, Roy. Astr. Soc.* liv. 198; W. E. Plummer, *Observatory*, xvi. 256 (portrait); *Astr. and Astrophysics*, xii. 592; J. Foster, *Oxford Men and their Colleges*, p. 206; *Hist. Register of the Univ. of Oxford*, p. 95; *The Times* (May 30, 1893); C. J. Robinson's *Register of Merchant Taylors' School*, ii. 210; *Charles Pritchard, D.D., Memoirs of his Life*, by Ada Pritchard (London, 1897).

PRITCHARD, HANNAH (1711–1768), English actress, whose name before her early marriage—to an actor—was Vaughan, first attracted attention as a singer at Bartholomew's Fair in 1733. She was soon playing a wide variety of parts, mostly comedy, at the Haymarket, Drury Lane and Covent Garden. When Garrick became patentee of Drury Lane in 1747 she joined his company and played with him for twenty years, her last appearance being as Lady Macbeth—one of her greatest rôles—in April 1768, a few months before her death. Her talents were highly thought of by the critics of the day. Her daughter, who had studied under Garrick, and whose beauty created a sensation when she made her début (as "Miss Pritchard") in October 1756, did not live up to the expectations then raised. She married in 1762 the actor John Palmer, retired from the stage at the same time as her mother, and after her husband's death married a political writer named Lloyd.

PRITTLEWELL, a residential parish in the borough of Southend-on-Sea, and in the S.E. parliamentary division of Essex, England; lying 1½ m. inland (N.N.W.) from Southend, with a station on the Southend branch of the Great Eastern railway. The church of St Mary the Virgin has fine Perpendicular work and traces of Norman work. There are fragments of a Cluniac priory of the 12th century. Pop. (1901), 27,245.

PRIVAS, a town of south-eastern France, capital of the department of Ardèche, 95 m. S. by W. of Lyons on a branch line of the railway from that city to Nîmes. Pop. (1906), town, 3495; commune, 7000. Privas is situated near the Ouvèze, here joined by the Mezayon and Chazalon. The town is the seat of a prefecture, a court of assizes and a tribunal of first instance. Other institutions are training colleges for both sexes, a communal college and a lunatic asylum for the departments of Ardèche and Drôme. Silk-milling is carried on. The rearing of silk-worms and the cultivation of the mulberry are widespread industries. There are mines of iron ore in the vicinity. Trade is in silk, tanned leather, game, chestnuts and fruit preserves.

Privas is first heard of in the 12th century, as a possession of the counts of Valentinois, and subsequently became the seat of a separate barony. One of the strongholds of the Reformed Faith, it suffered terribly during the Wars of Religion. Ineffectually besieged by the royal troops in 1574, it passed in 1619, by the marriage of the heiress of the barony, Paule de Chambaud, into the possession of the vicomte de Lestrange, a Roman Catholic noble. A general rising followed, and in 1629 it was besieged and taken by Louis XIII. It was reduced to ruins, and the king decreed that it should not be again inhabited; but in 1632, some of the townspeople having fought against Lestrange, who had joined Montmorency's rebellion, the inhabitants were allowed to return. Some ancient houses, which escaped the general destruction, are still standing.

PRIVATEER, an armed vessel belonging to a private owner, commissioned by a belligerent state to carry on operations of war. The commission is known as *letters of marque*. Acceptance of such a commission by a British subject is forbidden by the Foreign Enlistment Act 1870. Privateering is now a matter of much less importance than it formerly was, owing to the terms of art. 1 of the Declaration of Paris, April 16, 1856, "Privateering is and remains abolished." The declaration binds only the powers who are signatories or who afterwards assented, and those only when engaged in war with one another. The United States and Spain have not acceded to it, but though it did not hold as between them in the war of 1898, they both observed it. Privateers stand in a position between that of a public ship of war and a merchant vessel, and the raising of merchant vessels to the status of warships has in recent wars given rise to so much difficulty in distinguishing between volunteer war-ships and privateers that the subject was made one of those for settlement by the Second Hague Conference (1907). The rules adopted are as follows:—

1. A merchant-ship converted into a war-ship cannot have the rights and duties appertaining to vessels having that status unless it is placed under the direct authority, immediate control and responsibility of the power the flag of which it flies.
2. Merchant-ships converted into war-ships must bear the external marks which distinguish the war-ships of their nationality.
3. The commander must be in the service of the state and duly commissioned by the proper authorities. His name must figure on the list of the officers of the fighting fleet.
4. The crew must be subject to military discipline.
5. Every merchant-ship converted into a war-ship is bound to observe in its operations the laws and customs of war.
6. A belligerent who converts a merchant-ship into a war-ship must, as soon as possible, announce such conversion in the list of its war-ships.

In connexion with the conversion of the "Peterburg" and "Smolensk" on the high seas during the Russo-Japanese War, and the ruse by which they came through the Bosporus and the Dardanelles, it was agreed, after a vain attempt to solve the question in a way satisfactory to all parties, that the subject of whether the conversion may take place upon the high seas should remain outside the scope of the convention. (T. BA.)

PRIVET, in botany, the vernacular name of *Ligustrum*,[1] a genus of Oleaceae, containing about thirty-five species, natives of temperate and tropical Asia; only the common privet is a native of Europe. They are shrubs or low trees with evergreen or nearly evergreen opposite entire leaves, and dense clusters of small, white, tubular four-parted flowers, enclosing two stamens and succeeded by small, globular, usually black berries, each with a single pendulous seed. The best-known species is the common European privet, *L. vulgare*, which makes good hedges; *L. ovalifolium* (a native of Japan) thrives by the seaside and even in towns; there is a yellow-leaved variety (var. *variegatum*), the leaves becoming white as they get older. *L. lucidum* (China) is taller and handsomer. There are numerous varieties of *L. vulgare* in cultivation; var. *buxifolium* has broader and more persistent leaves; var. *fructu-luteum* has bright yellow fruit; var. *pendulum* has long weeping branches; and var. *variegatum* has the leaves variegated with bright yellow. *L. japonicum*, *L. Massalongianum* (Khassia Hills) and other species are also cultivated. Mock-privet is *Phillyrea*, a member of the same order and a small genus of ornamental hardy evergreen shrubs, natives of the Mediterranean region and Asia Minor.

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[1] Other vernacular names for the common species are prim, primprint, primwort and primrose.

PRIVILEGE, in law, an immunity or exemption conferred by special grant in derogation of common right. The term is derived from *privilegium*, a law specially passed in favour of or against a particular person. In Roman law the latter sense was the more common; in modern law the word bears only the former sense. Privilege in English law is either *personal* or *real*—that is to say, it is granted to a person, as a peer, or to a place, as a university. The most important instances at present existing in England are the privilege of parliament (see PARLIAMENT), which protects certain communications from being regarded as libellous (see LIBEL AND SLANDER), and certain privileges enjoyed by the clergy and others, by which they are to some extent exempt from public duties, such as serving on juries. Privileged copyholds are those held by the custom of the manor and not by the will of the lord. There are certain debts in England, Scotland and the United States which are said to be privileged—that is, such debts as the executor must first apply the personal estate of the deceased, in payment, for example, of funeral expenses or servants' wages. In English law the term "preferred" rather than "privileged" is generally applied to such debts. There are certain deeds and summonses which are privileged in Scots law, the former because they require less solemnity than ordinary deeds, the latter because the ordinary *induciae* are shortened in their case (see Watson, *Law Dict.*, *s.v.* "Privilege").

In the United States the term privilege is of considerable political importance. By art. iv. § 2 of the constitution, "the citizens of each state shall be entitled to all privileges and immunities of citizens in the several states." By art. xiv. § 1 of the amendments to the constitution (enacted July 28, 1868), "no state shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States." It will be noticed that the former applies to citizens of the states, the latter to citizens of the United States. "The intention of this clause (art. iv.) was to confer on the citizens of each state, if one may so say, a general citizenship, and to communicate all the privileges and immunities which the citizens of the same state would have been entitled to under the like circumstances" (Story, *Constitution of the United States*, § 1806). The clauses have several times been the subject of judicial decision in the Supreme Court. With regard to art. iv., it was held that a state licence tax discriminating against commodities the production of other states was void as abridging the privileges and immunities of the citizens of such other states (*Ward* v. *State of Maryland*, 12 Wallace's Reports, 418). With regard to art. xiv. 1, it was held that its main purpose was to protect from the hostile legislation of the states the privileges and immunities of citizens of the United States, looking more especially to the then recent admission of negroes to political rights. Accordingly it was held that a grant of exclusive right or privilege of maintaining slaughter-houses for twenty-one years, imposing at the same time the duty of providing ample conveniences, was not unconstitutional, as it was only a police regulation for the health of the people (*The Slaughter-House Cases*, 16 Wallace, 36). The same has been held of a refusal by a state to grant to a woman a licence to practise law (*Bradwell* v. *The State*, 16 Wallace, 130), of a state law confining the rights of suffrage to males (*Minor* v. *Happersett*, 21 Wallace, 162), and of a state law regulating the sale of intoxicating liquors (*Bartemeyer* v. *Iowa*, 18 Wallace, 129). Suits to redress the deprivation of privilege secured by the constitution of the United States must be brought in a United States court. It is a crime to conspire to prevent the free exercise and enjoyment of any privilege, or to conspire to deprive any person of equal privileges and immunities, or under colour of law to subject any inhabitant of a state or territory to the deprivation of any privileges or immunities (*Revised Statutes of United States*, §§ 5507, 5510, 5519).

PRIVY COUNCIL. The origin of the privy council dates back substantially to the Norman period of English history. The *commune concilium*, the assembly, in theory, of all the tenants-in-chief of the Crown, had attached to and included in it a group of officers of state and of the royal household, who with a staff of clerks and secretaries carried on the executive, judicial and financial business of government. This group, of necessity permanent, it is suggested, formed the *curia regis*; and appears to have consisted of the chancellor, the chief justiciary (so long as the office lasted), the treasurer, the steward, the chamberlain, the marshal and the constable, together with the two archbishops and any other persons the king might choose to appoint. Their duties were to advise the king in matters of legislation and administration, to see justice done and generally to execute the royal will. Such a blend of advisory, executive and judicial power could exist only in a simple condition of affairs, and therefore it was to be expected that as government became more settled, and so more complicated, a separation of powers would inevitably follow. The change came quickly. Quite early finance was dealt with by a small section of the court convened at the exchequer chamber; this soon developed into a separate department controlled by the treasurer, managing the revenue and deciding all suits connected with its administration. A little later the court of king's bench and the court of common pleas grew into being, and by the end of the reign of John these two courts were finally separated from one another and from the *curia*. The establishment of separate courts of justice, although relieving the *curia* of much of its work, did not deprive it of all judicial power. The king was the fountain of justice, and where redress could not be obtained in the ordinary way, either from the greatness of the disputants, through private oppression, or because no other means existed, resort still remained to the Crown, either in the first instance or when all other courses had failed the petitioner. Relieved of financial detail and the bulk of its judicial work, the *curia* continued to develop on the lines of an advisory and administrative council. Becoming prominent as a council of regency during the minority of Henry III., it quickly assumed definite form as the *concilium regis*. Under Edward I. "its members take an oath; they are sworn of the council—swearing to give good advice, to protect the king's interests, to do justice honestly, to take no gifts" (Maitland, *Const. Hist.* p. 91). At this period in addition to the great officers of state the judges and a number of bishops appear among the members. One of the most important duties of the council was to advise the Crown in matters of legislation. During the fourteenth and fifteenth centuries, ordinances in subordinate matters appear to have been made regularly by the king in council and accepted as legal by parliament and by the judges. In early parliamentary days it was also part of the council's duty to put into legislative form the petitions sent up by the Commons. Frequently the statute in its final form did not correspond with the petition, and the Commons were continually complaining of the council's unwarrantable interference. Eventually by the reign of Henry VII. the council had ceased to interfere, the petitions being drawn in the form of a bill, and enacted without alteration.

During the 14th century the *concilium regis* had become definitely distinct as well from parliament as from the courts of law. Under Henry IV. in 1404 the council numbered nineteen—three bishops, nine peers and seven commoners. The members held office at the king's pleasure, they are sworn to give their best advice and are well paid for their work. They meet continually, though the king is often absent, but their proceedings are committed to writing. Maitland (*Const. Hist.* p. 199) sums up the work as follows: "The function of the Council is to advise the King upon every exercise of the royal power. Every sort of ordinance, licence, pardon, that the King can issue is brought before the Council. Sometimes Parliament trusts it with extraordinary powers of legislation and taxation; to raise loans and the like. It is to the advice of the Council that the King looks in all his financial difficulties." The powers of the council naturally varied with the character of the king. Quiescent and obedient under a strong king, its influence was re-asserted under a weak one; and when infant kings sat on the throne, for all practical purposes it became the ruler of the land.

In spite of the existence of regular courts of law the council continually interfered with affairs of justice. Many attempts were made by it to set aside or to disregard the judgments of the ordinary courts, but by the beginning of the 15th century parliament had forcibly intervened, and the council gave in. Repeatedly statutes were passed during the reign of Edward III. with a view to checking the council's original jurisdiction in criminal matters, but without effect, as in the reigns of Henry IV. and his son the Commons are found still petitioning against the practice. Yet during the period under review parliament is continually enacting that certain offenders are to be punished by and at the discretion of the council. Evidently such a tribunal, quickly and informally constituted, bound by no legal rules and maxims, proved a useful engine for sharp and speedy punishment. In 1487 was passed an act (3 Hen. VII. c. 1) which is accounted the creator of the Court of Star Chamber. Perjury, riot, bribery of jurors and misconduct of officials had grown rife, and the act authorizes certain members of the council to call offenders before it, to examine them, and if satisfied of their guilt, to punish them. In later years a committee of the council appear to have sat and exercised a widely extended criminal jurisdiction, inflicting every kind of punishment short of the death penalty. This body became known as the Court of Star Chamber and remained in existence until its abolition by act of parliament in 1641.

During the 14th century many petitions relating to civil disputes were presented to the council and were frequently taken into consideration by it on the ground that extraordinary remedies were required, either from lack of legal form or owing to influential private oppression. Eventually where the courts could decide, it became the practice of the council not to interfere, but where no relief could be obtained the council passed the petition on to the chancellor. In course of time the petitions went direct to the chancellor, and in this manner the equity jurisdiction of the court of chancery was established. The act of 1641, which abolished the Court of Star Chamber, also formally forbade the council to meddle with civil causes.

During the Tudor period the council grew in importance; it became useful to the Crown as a vehicle for straining prerogative to the utmost. By the act 31 Hen. VIII. the king's proclamation acquired the force of law, and for a short period the king in council had concurrent legislative power with parliament. Henry's statute was repealed by 1 Edw. VI. c. 12 and the legislative supremacy of parliament re-established. In 1553 the council numbered forty members—four bishops, fourteen peers and the rest commoners. The increase in the number of its members, the direct and often independent communication between the Crown and its secretaries, and the strong personality of the Tudor sovereigns quickly reacted on the work of the council. It had become too large for consultative purposes and the sovereign began a practice, which quickly grew, of consulting only its important members. In this way, within the council itself, there appears a small inner ring—a true privy council—the parent of the cabinet of later days.

The struggle of James I. and Charles I. for absolute power and finally the Rebellion, ended by leaving the council for the time being impotent. The act of 1641 had not only abolished its special criminal jurisdiction but forbade its interference in civil cases, while the growth of the Secretariat had gradually removed the bulk of its administrative powers. In the end there was little left for it but occasional meetings to give legal sanction to orders it had no concern with, and on the judicial side to act as a court of final resort in Admiralty matters and for all civil and criminal appeals from the courts of the Crown's dominions beyond the seas.

In the reign of Charles II. an attempt was made to revive the usefulness of the council. A scheme was prepared by Sir William Temple in 1679 and accepted by the king. A representative council of thirty members came into being and attempted to carry out the new scheme, but the king, after a short trial, held to his old opinion that the numbers of the council made it "unfit for the secrecy and despatch which are necessary in many great affairs." Once more the king returned to his confidential committee, his cabal, out of which the cabinet of the future grew. Under William III. faction flourished and made general agreement at the council board impossible. George I., ignorant of the English language, never appeared at its meetings, with the result that the direction of affairs passed into the hands of a committee of ministers—the cabinet.

Although the true privy council is the cabinet, the name is to-day given collectively to a large number of eminent people whose membership and position are titular only. All members of the cabinet if not already privy councillors become so on appointment to cabinet office. Occasionally, subordinate members of the ministry and some of its private supporters are made privy councillors as a special distinction. The lord chancellor, the lords of appeal in ordinary, the president of the probate division, the lord president of the court of session in Scotland, the lord justice clerk and the lord advocate of Scotland are always privy councillors, as are the archbishops of Canterbury and York and the bishop of London. In 1897 all the premiers of the self-governing colonies were made privy councillors. Of recent years, retired ambassadors, judges, retired civil servants and persons distinguished in science, letters and arts have been appointed. The custom seems also to be growing of using the honour of privy councillor to reward political supporters who do not wish for hereditary titles. The collective title of the council is "the Lords and others of His Majesty's Most Honourable Privy Council." The members are addressed as "Right Honourable" and wear a state uniform. The appointment is informal, the new privy councillor simply being invited by the king to take his seat at the board. He is then sworn in, and his name placed on the list. Office lasts for the life of the sovereign and six months after, but it is the modern custom for the new sovereign to renew the appointment.

Meetings of the whole council are held at the beginning of a new reign or when the reigning sovereign announces his or her marriage. The lord mayor of London is then summoned to attend. The whole council might also be summoned on other occasions of state and ceremony.

The formal meetings of the council are attended by the few councillors concerned with the orders to be issued. These are generally ministers or officials. The chief officer of the council is the lord president, now a cabinet minister of the highest rank, but without departmental duties. The office of clerk of the council dates from 1540 and his signature is necessary to authenticate all orders.

The administrative work of the council has always been done through committees, and during the last two centuries in spite of changed conditions this rule has been preserved in theory. The board of trade, the local government board, the education department and the board of agriculture were all committees of the council. Now, of course, these so-called committees are state departments presided over by ministers responsible to parliament. The existing jurisdiction of the council is both administrative and judicial.

Administrative.—This jurisdiction depends chiefly upon statutory authority, which practically makes of the privy council a subordinate legislature. It is found impossible for parliament to enact long and intricate measures dealing with departmental detail, hence a general measure is passed and the privy council is authorized under the act to draw up orders in council which of course have the full force of law. This power is exercised usually by committees to which matters are referred by the Crown in council, the departments of state concerned settling the details. Other examples of administrative work are the universities committee, with temporary powers under the Universities Act (1877), and the committee of council for the consideration of charters of incorporation under the Municipal Corporations Act (1882), the latter a work of considerable difficulty and delicacy and usually carried out in close consultation with the local government board. Cases affecting the constitutional rights of the Channel Islands are referred to a committee for the affairs of Jersey and Guernsey. The committees report to the Crown in council, and their report is adopted and enforced by an order in council published in the *Gazette*. Among other acts conferring administrative powers on the privy council are the Pharmacy Act (1852), as amended by 31 & 32 Vict. c. 121, the Medical Act (1858), the Foreign Enlistment Act (1870), the Destructive Insects Act (1877), the Contagious Diseases (Animals) Act (1878), the Dentists Act (1878) the Veterinary Surgeons Act (1881).

Judicial.—By the 3 & 4 Will. IV. c. 41 a judicial committee of the council was constituted. It consists of all the members of the council holding or having held the office of lord president or lord chancellor or certain high judicial offices enumerated in the act. By the Appellate Jurisdiction Acts of 1876 and 1887 other high judicial offices are included. All the lords of appeal in ordinary are members of the committee. Under the act of 1833 the king may also appoint any other two persons, being councillors. By the acts of 1833 and 1887 two persons having been Indian or Colonial judges may be appointed, and such appointments carry an annual salary of £400. By an act of 1895 any of the chief justices of certain colonies who are also privy councillors may be appointed to the committee, but not more than five such appointments may be made. Under this act certain colonial chief justices now sit. In appeals under the Clergy Discipline Acts three bishops sit as assessors. In colonial Admiralty appeals two nautical assessors attend. These assessors are merely technical advisers, and have no part in any decision. Appeals also lie from consular courts and prize courts. The decisions of ecclesiastical courts are subject to review by the committee, the sovereign being the "supreme governor" of the Church, but no appeal is competent where the case is one for the exercise of the bishop's discretion. In these ecclesiastical cases the committee does not profess to expound and settle doctrine with ecclesiastical authority: it merely interprets the laws of the Church. In matters relating to ritual history and precedents are taken into account. Appeals also lie from vice-admiralty courts abroad, the Channel Islands, the Isle of Man, India and all the colonies. As a rule they lie as of right when the value of the matter at issue is of a certain amount (the amount varying according to the appeal rules of the different foreign possessions) and in a few other cases. Recent legislation, at the instance of the colonies, has to some extent further restricted the right to appeal. Appeals lie at the discretion of the committee on leave being obtained by petition for special leave to appeal. All proceedings are by petition (see PETITION) which is addressed to the Crown in council in the first instance. The judicial proceedings of the council are in reality conducted like an ordinary case in the courts of law. Counsel are heard, and the ordinary rules of law and legal practice followed, and costs taxed. Judgment is given by motion which takes the form of advice to the Crown, and whatever may have taken place privately in discussion between the members, outwardly the committee is unanimous. Within recent years it has been suggested that the appellate jurisdiction of the House of Lords and the privy council should be coalesced, and thus constitute one final court of appeal for the whole empire. Besides the appellate there exists in the sovereign in council an original jurisdiction in questions concerning boundaries between dependencies, the extent of charters and the like. Until recently the council dealt with the petitions to extend the time patents were protected, but this work has now been given by statute to the controller-general of patents.

Ireland has its own privy council. The lord-lieutenant takes the place of the Crown. There is little real work and the distinction of membership is titular as in England. Scotland has had no privy council since the Act of Union which provided for one council for Great Britain. British colonies with parliamentary government have cabinets or committees of ministers, borrowed from the English model, but no privy council. In France, before the Revolution, the king had a council which bore some resemblance to the English type (see FRANCE: *Law and Institutions*). In Germany a "privy council" (*Geheimes Rats-Kollegium, Geheimes Conseil, Staatsrat*), which under the prince formed the supreme organ of government, formerly existed in the various states of the empire, and out of this the ministries developed in the 17th century. These were originally committees of the council (*Geheime Konferenz, Geheimes Kabinett, &c.*) which, as in England, gradually absorbed its functions. In some of the German states, however, it still survives as the "council of state" (*Staatsrat*) and in Württemberg as "privy council" (*Geheimer Rat*). The title *Wirklicher Geheimer Rat* (real privy councillor), with the predicate *Excellenz* is given to the highest officials. That of *Geheimer Rat* simply is very generally, *e.g.* in Prussia, given to high officials, usually with the addition of the branch of the service to which they belong, *e.g. Geheimer Finanzrat, Geheimer Justizrat.* The title is also sometimes purely honorary, *e.g.* that of *Geheimer Commerzienrat*, bestowed on eminent men of business. (G. E.*)

PRIVY PURSE, is the amount set apart in the civil list (*q.v.*) for the private and personal use of the sovereign in England. During the reign of Queen Victoria it was £60,000 a year, but on the accession of Edward VII. the amount was fixed at £110,000 a year, which was the amount paid to the last sovereign (William IV.) who had a queen consort. The official who is charged with all payments made by the sovereign for his private expenses or charities is termed the keeper of the privy purse. The department of the keeper of the privy purse to the sovereign, assumed its existing shape in the earlier part of the last century. Under Queen Victoria the offices of keeper of the privy purse and private secretary were combined. As now organized these branches of the royal household consist of the private secretary and the keeper of the privy purse, two assistant private secretaries and keepers of the privy purse, and a secretary, assistant secretary and several clerks of the privy purse. These officials, though of the royal household, are not in the department of the lord steward or the lord chamberlain, but are of the king's *personal staff.*

PRIVY SEAL, a seal of the United Kingdom, next in importance to the great seal, and occupying an intermediate position between it and the signet. The authority of the privy seal was principally of a two-fold nature. It was a warrant to the lord chancellor to affix the great seal to such patents, charters, &c., as must necessarily pass the great seal (more particularly letters patent (*q.v.*). It was also the authority required for the issue of money from the exchequer, and was appended to documents of minor importance which did not require the great seal. Previous to the Great Seal Act 1884, all letters patent conferring any dignity, office, monopoly, franchise or other privilege were always passed under the privy seal before passing under the great seal.

Lord Privy Seal is the title of the officer who had the custody of the privy seal. He was originally known as the "keeper of the privy seal." The importance of the office was due to the desire of the privy council and the parliament in the 14th and 15th centuries to place some check on the issue of public money, as well as to prevent the use of the great seal by the sovereign without any intermediary except the lord chancellor. The lord privy seal first appears as a minister of state in the reign of Edward III. Until 1537 he was always an ecclesiastic, but is now more usually a temporal lord. He is the fifth great officer of state, and takes rank next after the president of the council and before all dukes.

See Anson, *Law and Custom of the Constitution* (1896).

PRIZE, or PRIZE OF WAR (Fr. *prise*, from *prendre*, to take), a vessel or cargo captured by a belligerent on the high seas; also the act of capture. Under BLOCKADE, CONTRABAND, and NEUTRALITY will be found details of existing practice as regards infringements of international law which expose neutrality vessels and cargoes to capture and trial in a prize court. Under WAR will be found the application of international law in relation to the private property of subjects and citizens of belligerent states as between them. We treat here of the manner of dealing with prizes after they have been brought into the jurisdiction of the prize court.

Under the law in force at the beginning of 1910 the subject was governed by the following English acts: the Naval Prize Act 1864 (27 & 28 Vict. c. 25); the Colonial Courts of Admiralty Act 1890 (53 & 54 Vict. c. 27); the Supreme Court of Judicature Act 1891 (54 & 55 Vict. c. 53, s. 4), and the Prize Courts Act 1894 (57 & 58 Vict c. 39). A new Naval Prize Act was, however, already in contemplation, repealing the acts of 1864 and 1894, consolidating and re-enacting their main provisions and making such statutory provisions as will permit of the ratification of a convention adopted at the second Hague Conference (1907) for the establishment of an International Prize Court.

The Convention referred to above contains an elaborate scheme of 50 articles setting out the constitution and procedure of the court. It begins with the following declaration of its objects:—

> Animated by the desire to settle in an equitable manner the differences which sometimes arise in the course of a naval war in connexion with the decisions of national prize courts:
>
> Considering that, if these courts are to continue to exercise their functions in the manner determined by national legislation, it is desirable that in certain cases an appeal should be provided under conditions conciliating, as far as possible, the public and private interests involved in matters of prize:
>
> Whereas, moreover, the institution of an international court, whose jurisdiction and procedure would be carefully defined, has seemed to be the best method of attaining this object:
>
> Convinced, finally, that in this manner the hardships consequent on naval war would be mitigated; that, in particular, good relations will be more easily maintained between belligerents and neutrals, and peace better assured. . . . .

It prescribes that the court shall be composed of fifteen members out of the whole panel (art. 14). Of these Great Britain, France, Germany, Austria-Hungary, Russia, Italy, the United States and Japan each appoint one (art. 15). A schedule of the other powers is appended to the Convention, under which they take their turn to sit to the number of seven, making up together the prescribed fifteen. As composed under the first year's distribution, the other judges would be appointed by Argentina, Colombia, Spain, Greece, Norway, Holland and Turkey.

There are also full provisions as to the procedure and conduct of the proceedings in the court, but the only provisions of concern to general readers are those relating to international law, which are as follows:—

> 1. The validity of the capture of a merchant-ship or its cargo is decided before a prize court in accordance with the present convention when neutral or enemy property is involved.
>
> 2. Jurisdiction in matters of prize is exercised in the first instance by the prize courts of the belligerent captor.
>
> The judgments of these courts are pronounced in public or are officially notified to parties concerned who are neutrals or enemies.
>
> 3. The judgments of national prize courts may be brought before the international prize court:—
>
> i. When the judgment of the national prize courts affects the property of a neutral power or individual;
>
> ii. When the judgment affects enemy property and relates to:—
>
> (*a*) Cargo on board a neutral ship;
>
> (*b*) An enemy ship captured in the territorial waters of a neutral power, when that power has not made the capture the subject of a diplomatic claim;
>
> (*c*) A claim based upon the allegation that the seizure has been effected in violation, either of the provisions of a convention in force between the belligerent powers, or of an enactment issued by the belligerent captor.
>
> The appeal against the judgment of the national court can be based on the ground that the judgment was wrong either in fact or in law.
>
> 4. An appeal may be brought:—
>
> i. By a neutral power, if the judgment of the national tribunals injuriously affects its property or the property of its nationals (art. 3 [(i.)]), or if the capture of an enemy vessel is alleged to have taken place in the territorial waters of that power (art. 3 (ii.) (*b*));
>
> ii. By a neutral individual, if the judgment of the National Court injuriously affects his property (art. 3 (i.)), subject, however, to the reservation that the power to which he belongs may forbid him to bring the case before the court, or may itself undertake the proceedings in his place;
>
> iii. By an individual subject or citizen of an enemy power, if the judgment of the national court injuriously affects his property in the cases referred to in art. 3 (ii.), except that mentioned in paragraph (*b*).
>
> 5. An appeal may also be brought on the same conditions as in the preceding article, by persons belonging either to neutral states or to the enemy, deriving their rights from and entitled to represent an individual qualified to appeal, and who have taken part in the proceedings before the national court. Persons so entitled may appeal separately to the extent of their interest.
>
> The same rule applies in the case of persons belonging either to neutral states or to the enemy who derive their rights from and are entitled to represent a neutral power whose property was the subject of the decision.
>
> 6. When, in accordance with the above art. 3, the international court has jurisdiction, the national courts cannot deal with a case in more than two instances. The municipal law of the belligerent captor shall decide whether the case may be brought before the international court after judgment has been given in first instance or only after an appeal.
>
> If the national courts fail to give judgment within two years from the date of capture, the case may be carried direct to the international court.
>
> 7. If a question of law to be decided is covered by a treaty in force between the belligerent captor and a power which is itself or whose subject or citizen is a party to the proceedings, the court is governed by the provisions of the said treaty.
>
> In the absence of such provisions, the court shall apply the rules of international law. If no generally recognized rule exists, the court shall give judgment in accordance with the general principles of justice and equity.
>
> The above provisions apply equally to questions relating to the order and mode of proof.
>
> If, in accordance with art. 3 (ii.) (*c*), the ground of appeal is the violation of an enactment issued by the belligerent captor, the court shall enforce the enactment.
>
> The court may disregard failure to comply with the procedure laid down in the legislation of the belligerent captor, when it is of opinion that the consequences of complying therewith are unjust and inequitable.
>
> 8. If the court pronounces the capture of the vessel or cargo to be valid, they shall be disposed of in accordance with the laws of the belligerent captor.
>
> If it pronounces the capture to be null, the court shall order restitution of the vessel or cargo, and shall fix, if there is occasion, the amount of the damages. If the vessel or cargo have been sold or destroyed, the court shall determine the compensation to be given to the owner on this account.
>
> If the national prize court pronounced the capture to be null, the court can only be asked to decide as to the damages.
>
> 9. The contracting powers undertake to submit in good faith to the decisions of the international prize court, and to carry them out with the least possible delay.

The British delegates, in their report on the work of the Conference, wrote that it was to them a subject of satisfaction that they had been able to accomplish the task thus laid upon them, " not, indeed, in the form of an adaptation of the machinery of the existing court, but in the form of a new institution" ; and that the convention drawn appeared to them to be " a very noteworthy step in the history of law as the first attempt to constitute a really international court, and as the first device to produce uniformity in any branch of international law." Here, however, the delegates overstated the scope of the work done, and in order to obtain that uniformity a further conference was held in London (Dec. 1908–Feb. 1909) " to arrive at an agreement as to what are the generally recognized rules of international law within the meaning of art. 7 " of the Convention. The London Conference drew up a series of rules which it declared " correspond in substance with the generally recognized principles of international law " on Blockade (*q.v.*), Contraband of War (*q.v.*), Unneutral service, Destruction of Neutral Prizes, Transfer to a Neutral Flag, Enemy Character, Convoy (*q.v.*), Resistance to Search and Compensation. These rules, if ratified, will bind the international court.

The proposal to submit captures in war to a special international jurisdiction has often been made, and in fact it suggests itself whenever there are two opinions concerning the justice of a prize court's decision.

The Institute of International Law in 1887, after adopting a very full code of prize law, consisting of no fewer than 122 articles and covering every branch of the subject, forwarded them to the different European governments, with the expression of a wish that " in the future reform might take a still more complete shape by the institution of an international tribunal for trial of prize cases. "

The subject was brought up at the session in 1905 at Christiania of the International Law Association. The discussion showed that there was much to be said on both sides. Mr Justice Phillimore *inter alios* seemed favourable to the institution of an independent court of appeal only.

This was the position of the discussion at the opening of the second Hague Conference in June 1907, when the British and German delegates announced that they had been instructed to present schemes for the establishment of an international court of appeal in matters of naval prize. Two projects were simultaneously presented on behalf of Great Britain and Germany.

The original English idea was to "secure the adaptation" of the machinery of the existing Hague Court to the purposes of an "International Tribunal of Appeal" from decisions of belligerent prize courts. The official instructions, published in the correspondence respecting the Second Conference[1] observed, in reference to the proposal, that the "judgments of the tribunal in such cases would probably prove the most rapid and efficient means which can, under existing conditions, be devised for giving form and authority to the canons of international law in matters of prize." The instructions continue that the advantages would far outweigh any difficulty which might arise from the fact that some alterations in the municipal laws of this country, and probably also of other states, would be required, and that "H.M. Government considered that if the Hague Conference accomplished no other object than the constitution of such a tribunal, it would render an inestimable service to civilization and mankind."

The objection to the existing system is that the judge is appointed by the belligerent state whose interest it is to condemn the capture; that his bias, if any, is against the neutral interest. But will there be no room in an international prize court for bias against the belligerent? "Representing as we do," said Mr Choate at the sitting of the 11th of July, "a widely extended maritime nation, and a nation which hopes *and confidently expects always in the future to be a neutral nation*, we deem the establishment of an international court of prize by this Conference to be a matter of supreme importance." The converse may obviously be as important for a nation which, with its vast dependencies, cannot with equal confidence expect to remain a mere spectator among the rivalries of expanding states in different quarters of the globe. The interests of the civilized world in time of war are divisible into three groups, namely, the respective interests of the two belligerents, and the interest of the neutrals. In practice the interest of the neutrals is against the making of captures. Under the system hitherto prevailing it is the judge appointed by the captor who decides whether the capture was a legitimate one or not. It may be contended, however, that he hears the cause and gives his judgment in the face of the whole neutral world, at all times the larger part of civilized mankind, and one which has now infinitely greater facilities for making its voice heard than it had a century earlier, when a powerful belligerent maritime state was, out of all proportion to any neutral combination, able to enforce its views as regards neutral property. (T. Ba.)

PRIZREN (also written *Prisren*, *Prisrend*, *Prizrendi*, *Prezdra* and *Perzerin*), the capital of the sanjak of Prizren, in the vilayet of Kossovo, Albania, European Turkey; 65 m. E. by N. of Scutari, on the river Bistritza, a left-hand tributary of the White Drin. Pop. (1905), about 30,000, chiefly Mahommedan Albanians, with a minority of Roman Catholic Albanians, Serbs and Greeks. Prizren is beautifully situated 1424 ft. above sea-level, among the northern outliers of the Shar Planina. To the north-west a fertile and undulating plain, watered by the White Drin, extends as far as Ipek (42 m.). A good road connects Prizren with the Ferisovich station on the Salonica-Mitrovitza railway (37 m.). The city is the seat of a Roman Catholic archbishop, a Greek bishop, and a Servian theological seminary. Its chief buildings are the citadel and many mosques, one of which is an ancient Byzantine basilica, originally a Servian cathedral. In its bazaars an active trade in agricultural produce, glass, pottery, saddlery, and copper and iron ware is carried on; but the manufacture of fire-arms, for which Prizren was long famous throughout European Turkey, has suffered greatly from foreign competition.

Prizren has sometimes, though on doubtful evidence, been identified with the ancient Tharendus or Theranda. In the 12th century it was the residence of the kings of Servia, and the sanjak of Prizren forms part of the region still called Old Servia (*Stara Srbiya*) by the Slavs. From the 13th century to the 16th Prizren had a flourishing export trade with Ragusa, and it has always been one of the principal centres of commerce and industry in Albania.

PRJEVALSKY [Przhevalsky], **NIKOLAI MIKHAILOVICH** (1839–1888), Russian traveller, born at Kimbory, in the government of Smolensk, on the 31st of March 1839, was descended from a noble Cossack family. He was educated at the Smolensk gymnasium, and in 1855 entered an infantry regiment as a subaltern. In November 1856 he became an officer, and four years later he entered the academy of the general staff. From 1864 to 1866 he taught geography at the military school at Warsaw, and in 1867 he was admitted to the general staff and sent to Irkutsk, where he started to explore the highlands on the banks of the Usuri, the great southern tributary of the Amur. This occupied him until 1869, when he published a book on the Usuri region, partly ethnographical in character. Between November 1870 and September 1873, accompanied by only three men and with ridiculously small pecuniary resources, he crossed the Gobi desert, reached Peking, and, pushing westwards and south-westwards, explored the Ordos and the Ala-shan, as well as the upper part of the Yangtsze-kiang. He also penetrated into Tibet, reaching the banks of the Di Chu river. By this remarkable journey he proved that, for resolute and enduring men, travelling in the Central Asian plateaus was easier than had been supposed. The Russian Geographical Society presented him with the great Constantine medal, and from all parts of Europe he received medals and honorary diplomas. The work in which he embodied his researches was immediately translated into all civilized languages, the English version, *Mongolia, the Tangut Country, and the Solitudes of Northern Tibet* (1876), being edited by Sir Henry Yule. On his second journey in 1877, while endeavouring to reach Lhasa through east Turkestan, he re-discovered the great lake Lop-nor (*q.v.*), which had not been visited by any European since Marco Polo. On his third expedition in 1879–1880 he penetrated, by Hami, the Tsai-dam and the great valley of the Tibetan river Kara-su, to Napchu, 170 m. from Lhasa, when he was turned back by order of the Dalai Lama. In 1883–1885 he undertook a fourth journey of exploration in the wild mountain regions between Mongolia and Tibet. On these four expeditions he made collections of plants and animals of inestimable value, including nearly twenty thousand zoological and sixteen thousand botanical specimens. Among other remarkable discoveries were those of the wild camel, ancestor of the domesticated species, and of the early type of horse, now known by his name (*Equus prjewalskii*). Prjevalsky's account of his second journey, *From Kulja, across the Tian-Shan, to Lop-nor*, was translated into English in 1879. In September 1888 he started on a fifth expedition, intending to reach Lhasa, but on the 1st of November he died at Karakol on Lake Issyk-kul. A monument was erected to his memory on the shores of the lake, and the Russian government changed the name of the town of Karakol to Przhevalsk (*q.v.*) in his honour.

PROA (Malay, *prau*), the general term in the Malay language for all vessels, from the *sampan* or canoe to the square-rigged *kapal*, but in western usage confined to the swift-sailing craft that the pirates of the Indian Ocean made familiar to sailors in eastern waters. The chief points which characterize these vessels are that while the weather-side is rounded the lee-side is flat from stem to stern, that both stem and stern are exactly similar in shape, and that there is a small similarly shaped hull swung out from the side of the main hull on poles, which acts as an outrigger and prevents the vessel heeling over. The main hull carries the mast rigging and an enormous triangular-shaped sail.

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[1] Prince von Bülow was credited with suggesting in his correspondence on the question of the *Bundesrath* that a tribunal of arbitration should be instituted to deal with all questions of capture. At any rate, on the 19th of January 1900 he wrote that the German government had proposed that all the points then in dispute should be submitted to arbitration. The British government declared their concurrence in the institution of a tribunal to arbitrate upon claims for compensation.

PROBABILISM (from Lat. *probare*, to test, approve), a term used both in theology and in philosophy with the general implication that in the absence of certainty probability is the best criterion. Thus it is applied in connexion with casuistry for the view that the layman in difficult matters of conscience may safely follow a doctrine inculcated by a recognized doctor of the church. This view was originated by the monk Molina (1528–1581), and has been widely employed by the Jesuits. In philosophy the term is applied to that practical doctrine which gives assistance in ordinary matters to one who is sceptical in respect of the possibility of real knowledge: it supposes that though knowledge is impossible a man may rely on strong beliefs in practical affairs. This view was held by the sceptics of the New Academy (see SCEPTICISM and CARNEADES). Opposed to "probabilism" is "probabiliorism" (Lat. *probabilior*, more likely), which holds that when there is a preponderance of evidence on one side of a controversy that side is presumably right.

PROBABILITY (Lat. *probabilis*, probable or credible), a term which in general implies credibility short of certainty.

Description and Division of the Subject.

The mathematical theory of probabilities deals with certain phenomena which are employed to measure credibility. This measurement is well exemplified by games of chance. If a pack of cards is shuffled and a card dealt, the probability that the card will belong to a particular suit is measured by—we may say, is—the ratio 1:4, or $\frac{1}{4}$; there being four suits to any one of them the card might have belonged. So the probability that an ace will be drawn is $\frac{4}{52}$, as out of the 52 cards in the pack 4 are aces. So the probability that ace will turn up when a die is thrown is $\frac{1}{6}$. The probability that one or other of the two events, ace or deuce, will occur is $\frac{1}{3}$. If simultaneously a die is thrown and a card is dealt from a pack which has been shuffled, the probability that the double event will consist of two aces is 1×4 divided by 6×52, as the total number of double events formed by combining a face of a die with a face of a card is 6×52, and out of these 1×4 consist of two aces.

The data of probabilities are often prima facie at least of a type different from that which has been described. For example, the probability that a child about to be born will be a boy is about 0·51. This statement is founded solely on the observed fact that about 51% of children born (alive, in European countries) prove to be boys. The probability is not, as in the instance of dice and cards, measured by the proportion between a number of cases favourable to the event and a total number of possible cases. Those instances indeed also admit of the measurement based on observed frequency. Thus the number of times that a die turns up ace is found by observation to be about 16·6% of the number of throws; and similar statements are true of cards and coins.[1] The probabilities with which the calculus deals admit generally of being measured by the number of times that the event is found by experience to occur, in proportion to the number of times that it might possibly occur.

The idea of a probable or expected number is not confined to the number of times that an event occurs; if the occurrence of the event is associated with a certain amount of money or any other measurable article there will be a probable or expected amount of that article. For instance, if a person throwing dice is to receive two shillings every time that six turns up, he may expect in a hundred throws to win about $2\times16{\cdot}6$ (about 33·3) shillings. If he is to receive two shillings for every *six* and one shilling for every *ace*, his expectation will be $2\times16{\cdot}6+1\times16{\cdot}6$ (50) shillings. The expectation of lifetime is calculated on this principle. Of 1000 males aged ten say the probable number who will die in their next year is 490, in the following year 397, and so on; if we (roughly) estimate that those who die in the first year will have enjoyed one year of life after ten, those who die in the next year will have enjoyed two years of life, and so on; then the total number of years which the 1000 males[2] aged ten may be expected to live is

$$1 \times 1000 + 2 \times (1000-490) + 3\,(1000-490-397) + \dots$$

Space as well as time may be the subject of expectation. If drops of rain fall in the long run with equal frequency on one point—or rather on one small interval, say of a centimetre or two—on a band of finite length and negligible breadth, the distance which is to be expected between a point of impact in the upper half of the line and a point of impact in the lower half has a definite proportion to the length of the given line.[3]

Expectation in the general sense may be considered as a kind of average.[4] The doctrine of averages and of the deviations therefrom technically called "errors" is distinguished from the other portion of the calculus by the peculiar difficulty of its method. The paths struck out by Laplace and Gauss have hardly yet been completed and made quite secure. The doctrine is also distinguished by the importance of its applications. The theory of errors enables the physicist so to combine discrepant observations as to obtain the best measurement. It may abridge the labour of the statistician by the use of samples.[5] It may assist the statistician in testing the validity of inductions.[6] It promises to be of special service to him in perfecting the logical method of concomitant variations; especially in investigating the laws of heredity. For instance the correlation between the height of parents and that of children is such that if we take a number of men all of the same height and observe the average height of their adult sons, the deviation of the latter average from the general average of adult males bears a definite proportion—about a half—to the similarly measured deviation of the height common to the fathers. The same kind and amount of correlation between parents and children with respect to many other attributes besides stature has been ascertained by Professor Karl Pearson and his collaborators.[7] The kinetics of free molecules (gases) forms another important branch of science which involves the theory of errors.

The description of the subject which has been given will explain the division which it is proposed to adopt. In Part I. probability and expectation will be considered apart from the peculiar difficulties incident to errors or deviation from averages. The *first* section of the first part will be devoted to a preliminary inquiry into the evidence of the primary data and axioms of the science. Freed from philosophical difficulties the mathematical calculation of probabilities will proceed in the *second* section. The analogous calculation of expectation will follow in the *third* section. The contents of the first three sections will be illustrated in the *fourth* by a class of examples dealing with space measurements—the so-called "local" or "geometrical" probabilities. Part II. is devoted to averages and the deviations therefrom, or more generally that grouping of statistics which may be called a law of frequency. Part II. is divided into two sections distinguished by differences in character and extent between the principal generalizations respecting laws of frequency.

PART I.—PROBABILITY AND EXPECTATION

Section I.—*First Principles.*

1. As in other mathematical sciences, so in probabilities, or even more so, the philosophical foundations are less clear than the calculations based thereon. On this obscure and controversial topic absolute uniformity is not to be expected. But it is hoped that the following summary in which diverse authoritative judgments are balanced may minimize dissent.

2. (1) *How the Measure of Probability is Ascertained.*—The first question which arises under this head is: on what evidence are the facts obtained which are employed to measure probability? A very generally accepted view is that which Laplace has thus expressed:

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[1] Cf. note to par. 5 below.

[2] It is more usual to speak of the *mean* expectation, the average number of years *per head*.

[3] Below, par. 88.

[4] For more exact definition see below, par. 95.

[5] See Bowley's Address to Section F. of the British Association (1906).

[6] Edgeworth, "Methods of Statistics," *Journal of the Statistical Society* (Jubilee volume, 1885).

[7] See *Biometrika*, vol. iii. "Inheritance of Mental Characters."

"The probability of an event is the ratio of the number of cases which favour it to the number of all the possible cases, when nothing leads us to believe that one of these cases ought to occur rather than the others; which renders them, for us, equally possible."[1] Against this view it is urged that merely psychological facts can at best afford a measure of belief, not of credibility. Accordingly, the ground of probability is sought in the observed fact of a class or "series"[2] such that if we take a great many members of the class, or terms of the series, the members thereof which belong to a certain assigned species compared with the total number taken tends to a certain fraction as a limit. Thus the series which consists of heads and tails obtained by tossing up a well-made coin is such that out of a large number of throws the proportion giving heads is nearly *half*.

3. These views are not so diametrically opposed as may at first appear. On the one hand, those who follow Laplace would of course admit that the presumption afforded by the "number of favourable cases" with respect to the probability of throwing either *five* or *six* with a die must be modified in accordance with actual experience such as that below cited[3] respecting particular dice that they turn up *five* or *six* rather oftener than once in three times. On the other hand, the series which is regarded as the empirical basis of probability is not a simple matter of fact. There are implied conditions which are not satisfied by the sort of uniformity which ordinarily characterizes scientific laws; which would not be satisfied for instance by the proportionate frequency of any one digit, *e.g.* 8, in the expansion of any vulgar fraction, though the expression may consist of a circulating decimal with a very long period.[4]

4. The type of the series is rather the frequency of the several digits in the expansion of an incommensurable constant such as $\sqrt{2}$, log 11, π, &c.[5] The observed fact that the digits occur with equal frequency is fortified by the absence of a reason why one digit should occur oftener than another.[6]

5. The most perfect types of probability appear to present the two aspects: proportion of favourable cases given a priori and frequency of occurrence observed a posteriori. When one of these attributes is not manifested it is often legitimate to infer its existence from the presence of the other. Given numerous batches of balls, each batch numbering say 100 and consisting partly of white and partly of black balls; if the percentages of white balls presented by the set of batches averaged, and, as it were, hovered about some particular percentage, *e.g.* 50, though we knew as an independent datum, or by inspection of the given percentages, that the series was not obtained by simply extracting a hundred balls from a jar containing a *mélange* of white and black balls, we might still be justified in concluding that the observed phenomenon resulted from a system equivalent to a number of jars of various constitution, compounded in some complicated fashion. So Laplace may be justified in postulating behind frequencies embodied in vital statistics the existence of a "constitution" analogous to games of chance, "possibilities" or favourable cases which might conceivably be "developed" or discussed.[7] On the other hand, it is often legitimate to infer from the known proportion of favourable cases a corresponding frequency of occurrence. The cogency of the inference will vary according to the degree of experience. That one face of a die or a coin will turn up nearly as often as another might be affirmed with perfect confidence of the particular dice which Weldon threw some thousands of times,[8] or the coins with which Professor Pearson similarly operated.[9] It may be affirmed with much confidence of ordinary coins and dice without specific experience, and generally, where fairplay is presumed, of games of chance. This confidence is based not only on experiments like those tried by Buffon, Jevons and many others,[10] but also on a continuous, extensive, almost unconsciously registered experience *in pari materia*. It is this sort of experience which justifies our expectation that commonly in mathematical tables one digit will occur as often as another, that in a shower about as many drops will fall on one element of area as upon a neighbouring spot of equal size. Doubtless the presumption must be extended with caution to phenomena with which we are less familiar. For example, is a meteor equally likely to hit one square mile as another of the earth's surface? We seem to descend in the scale of credibility from absolute certainty that alternative events occur with about equal frequency to absolute ignorance whether one occurs more frequently than the other. The empirical basis of probability may appear to become evanescent in a case like the following, which has been discussed by many writers on Probabilities.[11] What is the probability of drawing a white ball from a box of which we only know that it contains balls both black and white and none of any other colour? In this case, unlike the case of an urn containing a mixture of white and black balls in equal proportions, we have no reason to expect that if we go on drawing balls from the urn, replacing each ball after it has been drawn, that the series so presented will consist of black and white in about equal numbers. But there is ground for believing that in the long course of experiences *in pari materia*—other urns of similar constitution, other cases in which there is no reason to expect one alternative more than another—an event of one kind will occur about as often as one of another kind. A "cross-series"[12] is thus formed which seems to rest on as extensive if not so definite an empirical basis as the series which we began by considering. Thus the so-called "intellectual probability"[13] which it has been sought to separate from the material probability verified by frequency of occurrence, may still rest on a similar though less obvious ground of experience. This type of probability not verified by specific experience is presented in two particularly important classes.

6. *Unverified Probabilities.*—In applying the theory of errors to the art of measurement it is usual to assume that prior to observation one value of the quantity under measurement is as likely as another. "When the probability is unknown," says Laplace,[14] "we may equally suppose it to have any value between zero and unit." The assumption is fundamentally similar whether the quantum is a ratio to be determined by the theorem of Bayes,[15] or an absolute quantity to be determined by the more general theory of error. Of this first principle it is well observed by Professor Karl Pearson[16]: "There is an element of human experience at the bottom of Laplace's assumption." Professor Pearson quotes with approbation[16] the following account of the matter: "The assumption that any probability-constant about which we know nothing in particular is as likely to have one value as another is grounded upon the rough but solid experience that such constants do as a matter of fact as often have one value as another."

7. It may be objected, no doubt, that one value (of the object under measurement) is often known beforehand *not* to be as likely as another. The barometric height for instance is *not* equally likely to be 29 in. or to be 2 in. The reply is that the postulate is only required with respect to a small tract in a certain neighbourhood, some 2 in. above and below 29½ in. in the case of barometric pressure.

8. It is further objected that the assumption in question involves inconsistencies in cases like the following. Suppose observations are made on the length of a pendulum together with the time of its oscillation. As the time is proportional to the square root of the length, it follows that if the values of the length occur with equal frequency those of the time cannot do so; and, inversely, if the proposition is true of the times it cannot be true of the lengths.[18] One reply to this objection is afforded by the reply to the former one. For where we are concerned only with a small tract of values it will often happen that *both* the square and the square root and any ordinary function of a quantity which assumes equivalent values with equal probability will each present an approximately equal distribution of probabilities.[19] It may further be replied that in general the reasoning does not require the a priori probabilities of the different values to be very nearly equal; it suffices that they should not be very unequal;[20] and this much seems to be given by experience.

9. Whenever we can justify Laplace's first principle[21] that "probability is the ratio of the number of favourable cases to the number of all possible cases" no additional difficulty is involved in his second

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[1] Laplace, *Théorie analytique des probabilités*, liv. II. ch. i. No. 1. Cf. Introduction, *IIe principe*.

[2] The term employed by Venn in his important *Logic of Chance*.

[3] Below, par. 119.

[4] *E.g.* $\frac{1}{1861}$, in the expansion of which the digit 8 occurs once in ten times in seemingly random fashion (see *Mess. of Maths.* 1864, vol. 2, pp. 1 and 39).

[5] The type shows that the phenomena which are the object of probabilities do not constitute a distinct class of things. Occurrences which perfectly conform to laws of nature and are capable of exact prediction yet in certain aspects present the appearance of chance. Cf. Edgeworth, "Law of Error," *Cam. Phil. Trans.*, 1905, p. 128.

[6] Cf. Venn. *op. cit.* ch. v. § 14; and v. Kries on the "Prinzip des mangelnden Grundes" in his *Wahrscheinlichkeitsrechnung*, ch. i. § 4, *et passim*.

[7] In a passage criticized unfavourably by Dr Venn, *Logic of Chance*, ch. iv. § 14.

[8] Below, par. 115.

[9] *Chances of Death*, i. 44.

[10] A summary of such experiments, comprising above 100,000 trials, is given by Professor Karl Pearson in his *Chances of Death*, i. 48.

[11] *E.g.* J. S. Mill, *Logic*, bk. III., ch. xviii. § 2.

[12] Cf. Venn, *Logic of Chance*, ch. vi. § 24.

[13] Boole, *Trans. Roy. Soc.* (1862), ix. 251.

[14] *Op. cit.* Introduction.

[15] Below, par. 130.

[16] *Grammar of Science*, ed. 2, p. 146.

[17] From the article by the present writer on the "Philosophy of Chance" in *Mind*, No. ix., in which some of the views here indicated are stated at greater length than is here possible.

[18] Cf. v. Kries, *op. cit.* ch. ii.

[19] On the principle of Taylor's theorem; cf. Edgeworth, *Phil. Mag.* (1892), xxxiv. 431 seq.

[20] Cf. J. S. Mill, in the passage referred to below, par. 13, on the use that may be made of an "antecedent probability," though "it would be impossible to estimate that probability with anything like numerical precision."

[21] *Op. cit.* Introduction.

principle, of which the following may be taken as an equivalent. If we distribute the favourable cases into several groups the probability of the event will be sum of the probabilities pertaining to each group.[1]

10. Another important instance of unverified probabilities occurs when it is assumed without specific experience that one phenomenon is independent of another in such wise that the probability of a double event is equal to the product of the one event multiplied by the probability of the other—as in the instance already given of two aces occurring. The assumption has been verified with respect to "runs" in some games of chance;[2] but it is legitimately applied far beyond those instances. The proposition that very long runs of particular digits, *e.g.* of 7, may be expected in the development of a constant like π—*e.g.* a run of six consecutive *sevens* if the expansion of the constant was carried to a million places of decimals—may be given as an instance in which our conviction greatly transcends specific verification. In the calculation of probable, and improbable, errors, it[3] has to be assumed without specific verification that the observations on which the calculation is based are independent of each other in the sense now under consideration. With these explanations we may accept Laplace's third principle "If the events are independent of each other the probability of their concurrence (*l'existence de leur ensemble*) is the product of their separate probabilities."[4]

11. *Interdependent Probabilities.*—Among the principles of probabilities it is usual to enunciate, after Laplace, several other propositions.[5] But these may here be rapidly passed over as they do not seem to involve any additional philosophical difficulty.

12. It has been shown that when two events are independent of each other the product of their separate probabilities forms the probability of their concurrence. It follows that the probability of the double event divided by the probability of either, say the first, component gives the probability of the other, the second component event. The quotient, we might say, is the probability that when the first event has occurred, the second will occur. The proposition in this form is true also of events which are not independent of one another. Laplace exemplifies the composition of such interdependent probabilities by the instance of three urns, A,B,C, about which it is known that two contain only white balls and one only black balls.[6] The probability of drawing a white ball from an assigned urn, say C, is $\frac{2}{3}$. The probability that, a white ball having been drawn from C, a ball drawn from B will be white, is $\frac{1}{2}$. Therefore the probability of the double event drawing a white ball from C and also from B is $\frac{2}{3}\times\frac{1}{2}$, or $\frac{1}{3}$. The question now arises. Supposing we know only the probability of the double event, which probability we will call [BC], and the probability of one of them, say [C] (but not, as in the case instanced, the mechanism of their interdependence); what can we infer about the probability [B] of the other event (an event such as in the above instance drawing a white ball from the urn B)—the separate probability irrespective of what has happened as to the urn C? We cannot in general say that [B]=[BC] divided by [C] but rather that quotient $\times k$, where k is an unknown coefficient which may be either positive or negative. It might, however, be improper to treat k as zero on the ground that it is equally likely (in the long run of similar data) to be positive or negative. For given values of [BC] and [C], k has not this equiprobable character, since its positive and negative ranges are not in general equal; as appears from considering that [B] cannot be less than [BC], nor greater than unity.[7]

13. *Probability of Causes and Future Effects.*—The first principles which have been established afford an adequate ground for the reasoning which is described as deducing the probability of a cause from an observed event.[8] If with the poet[9] we may represent a perfect mixture by the waters of the Po in which the "two Doras" and other tributaries are indiscriminately commingled, there is no great difference in respect of definition and deduction between the probability that a certain particle of water should have emanated from a particular source, or should be discharged through a particular mouth of the river. "This principle," we may say with De Morgan, "of the retrospective or 'inverse' probability is not essentially different from the one first stated (Principle I.)."[10] Nor is a new first principle necessarily involved when after ascending from an effect to a cause we descend to a collateral effect.[11] It is true that in the investigation of causes it is often necessary to have recourse to the unverified species of probability. An intance has already been given of several approximately equiprobable causes, the several values of a quantity under measurement, from one of which the observed phenomena, the given set of observations, must have, so to speak, emanated. A simpler instance of two alternative causes occurs in the investigation which J. S. Mill[12] has illustrated—whether an event, such as a succession of aces, has been produced by a particular cause, such as loading of the die, or by that mass of "fleeting causes" called chance. It is sufficient for the argument that the "a priori" probabilities of the alternatives should not be very unequal.[13]

14. (2) *Whether Credibility is Measurable.*—The domain of probabilities according to some authorities does not extend much, if at all, beyond the objective phenomena which have been described in the preceding paragraphs. The claims of the science to measure the subjective quantity, degree of belief, are disallowed or minimized. Belief, it is objected, depends upon a complex of perceptions and emotions not amenable[14] to calculus. Moreover, belief is not credibility; even if we do believe with more or less confidence in exact conformity with the measure of probability afforded by the calculus, *ought* we so to believe? In reply it must be admitted that many of the beliefs on which we have to act are not of the kind for which the calculus prescribes. It was absurd of Craig[15] to attempt to evaluate the credibility of the Christian religion by mathematical calculation. But there seem to be a number of simpler cases of which we may say with De Morgan[16] "that in the universal opinion of those who examine the subject, the state of mind to which a person *ought* to be able to bring himself" is in accordance with the regulation measure of probability. If in the ordeal to which Portia's suitors were subjected there had been a picture of her not in one only, but in two of the caskets, then—though the judgment of the principal parties might be distorted by emotion—the impartial spectator would normally expect with greater confidence than before that at any particular trial a casket containing the likeness of the lady would be chosen. So the indications of a thermometer may not correspond to the sensations of a fevered patient, but they serve to regulate the temperature of a public library so as to secure the comfort of the majority. This view does not commit us to the quantitative precision of De Morgan that in a case such as above supposed we ought to "look three times as confidently upon the arrival as upon the non-arrival" of the event.[17] Two or three roughly distinguished degrees of credibility—very probable, as probable as not, very improbable, practically impossible—suffice for the more important applications of the calculus. Such is the character of the judgments which the calculus enables us to form with respect to the occurrence of a certain difference between the real value of any quantity under measurement and the value assigned to it by the measurement. The confidence that the constants which we have determined are accurate within certain limits is a subjective feeling which cannot be dislodged from an important part of probabilities.[18] This sphere of subjective probability is widened by the latest developments of the science[19] so far as they add to the number of constants for which it is important to determine the probable—and improbable—error. For instance, a measure of the deviation of observations from an average or mean value was required by the older writers only as subordinate to the determination of the mean, but now this "standard deviation" (below, par. 98) is often treated as an entity for which it is important to discover the limits of error.[20] Some of the newer methods may also serve to countenance the measurement of subjective quantity, in so far as they successfully apply the calculus to quantities not admitting of a precise unit, such as colour

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[1] Bertrand on "Probabilités composées," *op. cit.* art. 23.

[2] In some of the experiences referred to at par. 5.

[3] See below, pars. 132, 159.

[4] *Op. cit.* Introduction.

[5] There is a good statement of them in Boole's *Laws of Thought*, ch. xvi. § 7. Cf. De Morgan "Theory of Probabilities" (*Encyc. Metrop.*), §§ 12 seq.

[6] Laplace, *op. cit.* Introduction, *IV^e Principe*; cf. *V^e Principe* and liv., II. ch. i. § 1.

[7] In such a case there seems to be a propriety in expressing the indeterminate element in our data, not as above, but as proposed by Boole in his remarkable *Laws of Thought*, ch. xvii., ch. xviii., § 1 (cf. *Trans. Edin. Roy. Soc.*, (1857), vol. xxi.; and *Trans. Roy. Soc.*, 1862, vol. ix., vol. clii. pt. i. p. 251); the undetermined constant now representing the probability that if the event C does not occur the event B will. The values of *this* constant—in the absence of specific data, and where independence is not presumable—are, it should seem, equally distributed between the values 0 and 1. Cf. as to Boole's Calculus, *Mind, loc. cit.*, ix. 230 seq.

[8] Laplace's *Sixth* Principle. [9] Manzoni.

[10] De Morgan, *Theory of Probabilities*, § 19; cf. Venn, *Logic of Chance*, ch. vii. § 9; Edgeworth, "On the Probable Errors of Frequency Constants," *Journ. Stat. Soc.* (1908), p. 653. The essential symmetry of the inverse and the direct methods is shown by an elegant proof which Professor Cook Wilson has given for the received rules of inverse probability (*Nature*, 1900, Dec. 13).

[11] Laplace's *Seventh* Principle.

[12] *Logic*, book III., ch. xviii. § 6.

[13] Cf. above, par. 8; below, par. 46.

[14] Cf. Venn, *Logic of Chance*, p. 126.

[15] See the reference to Craig in Todhunter, *History . . . of Probability.*

[16] *Formal Logic*, p. 173.

[17] Ibid. Cf. "Theory of Probabilities" (*Encyc. Metrop.*), note to § 5, "Wherever the term greater or less can be applied there twice, thrice, &c., can be conceived, though not perhaps measured by us."

[18] It is well remarked by Professor Irving Fisher (*Capital and Income*, 1907, ch. xvi.), that Bernoulli's theorem involves a "subjective" element a "psychological magnitude." The remark is applicable to the general theory of error of which the theorem of Bernoulli is a particular case (see below, pars. 103, 104).

[19] In the hands of Professor Karl Pearson, Mr Sheppard and Mr Yule. Cf. par. 149, below.

[20] Cf. Edgeworth, *Journ. Stat. Soc.* (Dec. 1908).

of eye or curliness of hair.[1] A closer analogy is supplied by the older writers who boldly handle "moral" or subjective advantage, as will be shown under the next head.

15. (3) *Axioms of Expectation.*—Expectation so far as it involves probability presents the same philosophical questions. They occur chiefly in connexion with two principles analogous to and deducible from propositions which have been stated with respect to probability.[2] (i.) The expectation of the sum of two quantities subject to risk is the sum of the expectations of each. (ii.) The expectation of the product of two quantities subject to risk is the product of the expectations of each; provided that the risks are independent. For example, let one of the fortuitously fluctuating quantities be the winnings of a player at a game in which he takes the amount A if he throws ace with a die (and nothing if he throws another face). Then the expectation of that quantity is $\frac{1}{6}$A; or, in n trials (n being large), the player may expect to win about $n\frac{1}{6}$A. Let the other fortuitously fluctuating quantity be winnings of a player at a game in which he takes the amount B when an ace of any suit is dealt from an ordinary pack of cards. The expectation of this quantity is $\frac{1}{13}$B; or in n trials the player may expect to win about $n\frac{1}{13}$B. Now suppose a compound trial at which one simultaneously throws a die and deals a card; and let his winning at a compound trial be the sum of the amounts which he would have received for the die and the card respectively at a simple trial. In n such compound trials he may expect to win about $n\frac{1}{6}\mathrm{A}+n\frac{1}{13}\mathrm{B}$, or the expectation of the winning at a compound trial is the sum of the separate expectations. Next suppose the winning at a compound trial to be the product of the two amounts which he would have received for the die and the card if played at a simple trial. It is zero unless the player obtains two aces. It is A×B when this double event occurs. But this double event occurs in the long run only once in 78 times. Accordingly the expectation of the winning at a compound trial at which the winning is the product of the winnings at two simple trials is the product of the separate expectations. What has been shown for two expectations of the simplest type, where α is the probability of an event which has been associated with a quantity a, may easily be extended to several expectations each of the type

$$\mathrm{a}_1\alpha_1+\mathrm{a}_2\alpha_2+\mathrm{a}_3\alpha_3+\ \ .\ \ .\ \ .$$

where $\mathrm{a}_r\alpha_r$ is an expectation of the simplest type, above exemplified, or of the type $\mathrm{a}_1\alpha_1\times\mathrm{a}_2\alpha_2\times\mathrm{a}_3\alpha_3\times\ldots$ or a mixture of these types. For by the law which has been exemplified the sum of r expectations can always be reduced to the sum of $r-1$, and then the $r-1$ to $r-2$, and so on; and the like is true of products.

16. It should be remarked that the proviso as to the *independence* of the probabilities involved is required only by the *second* of the two fundamental propositions. It may be dispensed with by the first. Thus in the example of interdependent probabilities given by Laplace[3]—three urns about which it is known that two contain only black balls and one only white—if a person drawing a ball first from C and then from B is to receive x shillings every time he draws a white ball, from one or other of the urns, he may expect if he performs the compound operation n times to receive $n\times2\times\frac{2}{3}x$ shillings. But the expectation of the *product* of the number of shillings won by drawing a white ball from C and the number of shillings won by afterwards drawing a white ball from B is not $n(\frac{2}{3})^2x^2$, but $n\frac{1}{3}x^2$.

17. The first of the two principles is largely employed in the practical applications of probabilities. The second principle is largely employed in the higher generalizations of the science[4] (the laws of error demonstrated in Part II.); the requisite independence of the involved probabilities being mostly of the unverified[5] species.

18. *Expectation of Utility.*—A philosophical difficulty peculiar to expectation[6] arises when the quantity expected has not the objective character usually presupposed in the applications of mathematics. The most signal instance occurs when the expectation relates to an advantage, and that advantage is estimated subjectively by the amount of utility or satisfaction afforded to the possessor. Mathematicians have commonly adopted the assumption made by Daniel Bernoulli that a small increase in a person's material means or "physical fortune" causes an increase of satisfaction or "moral fortune," inversely proportional to the physical fortune; and accordingly that the moral fortune is equateable to the logarithm of the physical fortune.[7] The spirit in which this assumption should be employed is well expressed by Laplace when he says[8] that the expectation of subjective advantage (*l'espérance morale*) "depends on a thousand variable circumstances which it is almost always impossible to define and still more to submit to calculation." "One cannot give a general rule for appreciating this relative value," yet the principle above stated in "applying to the commonest cases leads to results which are often useful."

19. In this spirit we may regard the logarithm in Bernoulli's (as in Malthus's) theory as representative of a more general relation. Thus generalized the principle has been accepted by economists and utilitarian philosophers whose judgment on the relation between material goods and utility or satisfaction carries weight. Thus Professor Alfred Marshall writes:[9] "In accordance with a suggestion made by Daniel Bernoulli, we may perhaps suppose that the satisfaction which a person derives from his income may be regarded as beginning when he has enough to support life and afterwards as increasing by equal amounts with every equal successive percentage that is added to his income; and vice versa for loss of income."[10] The general principle is embodied in Bentham's utilitarian reasoning which has been widely accepted.[11] The possibility of formulating the relation between feeling and its external cause is further supported by Fechner's investigations. This branch of Probabilities also obtains support from another part of the science, the calculation sanctioned by Laplace, of the disutility incident to error of measurement.[12] Altogether it seems impossible to deny that some simple mathematical operations prescribed by the calculus of probabilities are sometimes serviceably employed to estimate prospective benefit in the subjective sense of desirable feeling.

20. *Single Cases and "Series."*—Analogous to the question regarding the standard of belief which arose under a former head, a question regarding the standard of action arises under the head of expectation. The former question, it may be observed, arises chiefly with respect to events which are considered as singular, not forming part of a series. There is no doubt, there is a full belief, that if we go on tossing (unloaded) dice the event which consists of obtaining either a *five* or a *six* will occur in approximately 33·3% of the trials. The important question is what is or should be our state of mind with regard to the result of a trial which is *sui generis* and not to be repeated, like the choice of a casket in the *Merchant of Venice*.[13] A similar difficulty is presented by singular events, with respect to volition. Is the chance of one to a thousand of the prize £1000 at a lottery approximately equivalent to £1 in the eyes of a person who for once, and once only, has the offer of such a stake? The question is separable from one with which it is often confounded, the one discussed in the last paragraph what is the "moral" value of the prize? The person might be a millionaire for whom £1 and £1000 both belong to the category of small change. The stake and the prize might both be "moral." The better opinion seems that apart from a system of transactions like that in which an insurance company undertakes, or at least a "cross-series"[14] of the kind which seem largely to operate in ordinary life, expectations in which the risks are very different are no longer equateable. So De Morgan with regard to the "single case" (the solitary transaction in question) declares that the "mathematical expectation is not a sufficient approximation to the actual phenomenon of the mind when benefits depend upon very small probabilities; even when the fortune of the player forms no part of the consideration"[15] [without making allowance for the difference between "moral" and mathematical probabilities]. So Condorcet, "If one considers a single man and a single event there can be no kind of equality"[16] (between expectations with very different risks). It is only for the long run—*lorsqu'on embrasse la suite indéfinie des évènements*—that the rule is valid: To the same effect at greater length the logicians Dr Venn[17] and von Kries.[18] Some of the mathematical writers have much to learn from their logical critics[19] on this and other questions relating to first principles.

Section II.—*Calculation of Probability.*

21. *Object of the Section.*—In the following calculations the principal object is to ascertain the number of cases favourable to an event in proportion to the total number of possible cases.[20]

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[1] Below, par. 152.

[2] Consider the equivalent of Laplace's second principle given at par 9, above, and his third principle quoted at par. 10.

[3] Above, par. 12.

[4] In the more familiar form; that (of two independently fluctuating quantities) the mean of the product is the product of the means (cf. Czuber, *Theorie der Beobachtungsfehler*, p. 133).

[5] Above, par. 6.

[6] These peculiarities afford some justification for Laplace's restriction of the term expectation to "goods." As to the wider definition here adopted see below, par. 94 and par. 95, note.

[7] Each fortune referred to is divided by a proper parameter. See below, par. 69

[8] *Op. cit.* liv. II. ch. xiii. No. 41. Cf. liv. II. ch. i. No. 2.

[9] *Principles of Economics*, book III., ch. vi. § 6, p. 209, ed. 4.

[10] Cf. below, par. 71.

[11] Some further references bearing on the subject are given in a paper by the present writer on the "Pure Theory of Taxation," No. III. *Economic Journ.* (1897), vii. 550–551.

[12] Below, par. 131.

[13] Above, par. 14.

[14] Above, par. 5.

[15] Article on "Probabilities" (*Encyc. Metrop.*), § 40.

[16] *Essai* (1785), pp. 142 et seq.

[17] *Logic of Chance*, ch. vi. §§ 24–28.

[18] *Wahrscheinlichkeitsrechnung*, pp. 184 seq.

[19] The relations of recent logicians to the older mathematical writers on Probabilities may be illustrated by the relations of modern "historical" economists to their more abstract predecessors.

[20] Of the two properties which have been found to characterize probability (above, par. 5)—proportionate (1) number of (equally) favourable cases and (2) frequency of observed occurrence—the former especially pertain to the data and *quaesita* of this section.

"The difficulty consists in the enumeration of the cases," as Lagrange says. Sometimes summation is the only mathematical operation employed; but very commonly it is necessary to apply the theory of permutations and combinations involving multiplication.[1]

22. *Fundamental Theorem.*—One of the simplest problems of this sort is one of the most important. Given a *mélange* of things consisting of two species, if n things are taken at random what is the probability that s out of these n things will be of a certain species? For example, the *mélange* might be a well-shuffled pack of cards, and the species black and red; the *quaesitum*, what is the probability that if n cards are dealt, s of them will be black? There are two varieties of the problem: either after each card is dealt it is returned to the pack, which is reshuffled, or all the n cards are dealt (as in ordinary games of cards) without replacement. The first variety of the problem deserves its place as being not only the simpler, but also the more important, of the two.

23. At the first deal there are 26 cases favourable to black, 26 to red. When two deals have been made (in the manner prescribed), out of 52^2 cases formed by combinations between a card turned up at the first deal and a card turned up at the second, 26×26 cases are combinations of two blacks, 26×26 are combinations of two reds, and the remainder $2(26 \times 26)$ are made up of combinations between one black and one red; 26×26 cases of black at the first deal and red at the second, and 26×26 cases of red at the first and black at the second deal. The number of cases favourable to each alternative is evidently given by the several terms in the expansion of $(26+26)^2$. The corresponding probabilities are given by dividing each term by the total number of cases, viz. 52^2. Similarly, when we go on to a third deal, the respective probabilities of the three possible cases, three blacks, two blacks and one red, two reds and one black, three blacks, are given by the successive terms in the binomial expansion of $(26+26)^3$, and so on. The reasoning is quite general. Thus for the event which consists of dealing either clubs or spades (black) we might substitute an event of which the probability at a single trial is not $\frac{1}{2}$, *e.g.* dealing hearts. Generally, if p and $1-p$ are the respective probabilities of the event occurring or not occurring at a single trial, the respective probabilities that in n trials the event will occur n times, $n-1$ times . . . twice, once or not at all, are given by the successive terms in the expansion of $[p+(1-p)]^n$; of which expansion the general term is $\frac{n!}{s!(n-s)!} p^s(1-p)^{n-s}$.

24. The probability may also be calculated as follows. Taking for example the case in which the event consists of dealing hearts; consider any particular arrangement of the n cards, of which s are hearts, *e.g.* the arrangement in which the s cards first dealt are hearts and the following $n-s$ all belong to other suits. The probability of the first s cards being all hearts is $(\frac{1}{4})^s$; the probability that none of the last $(n-s)$ cards are hearts is $(\frac{3}{4})^{n-s}$. Hence the probability of that particular arrangement occurring is $(\frac{1}{4})^s(\frac{3}{4})^{n-s}$. But this arrangement is but one of many, *e.g.* that in which the s hearts are the last dealt, which are equally likely to occur. There are as many different arrangements of this type as there are combinations of n things taken together s times, that is $n!/s!(n-s)!$ The probability thus calculated agrees with the preceding result.

25. It follows from the law of expansion for $[p+(1-p)]^n$ that as n is increased, the value of the fractions which form the terms at either extremity diminishes. When n becomes very large, the terms which are in the neighbourhood of the greatest term of the expansion overbalance the sum total of the remaining terms.[2] Thus in the example above given, if we go on and on dealing cards (with replacement) the ratio of the red cards dealt to all the cards dealt tends to become more and more nearly approximate to the limit $\frac{1}{2}$. These statements are comprised in the theorem known as James Bernoulli's. Stated in its simplest form—that "in the long run all events will tend to occur with a relative frequency proportional to their objective probabilities"[3]—this theorem has been regarded as tautological or circular. Yet the proofs of the theorem which have been given by great mathematicians may deserve attention as at least showing the consistency of first principles.[4] Moreover, as usually stated, James Bernoulli's imports something more than the first axiom of probabilities.[5]

26. The generalization of the Binomial Theorem which is called the "Multinomial Theorem"[6] gives the rule when there are more than two alternatives at each trial. For instance, if there are three alternatives, hearts, diamonds or a card belonging to a black suit, the probability that if n cards are dealt there will occur s hearts, t diamonds, and $n-s-t$ cards which are either clubs or spades is

$$\frac{n!}{s!t!(n-s-t)!}\left(\frac{1}{4}\right)^s\left(\frac{1}{4}\right)^t\left(\frac{1}{2}\right)^{n-s-t}$$

27. *Applications of Fundamental Theorem.*—The peculiar interest of the problem which is here placed first is that its solution represents a law of almost universal application: the law assigning the frequency with which different values assumed by a quantity, like most of the quantities with which statistics has to do, depends upon several independent agencies. It is remarkable that the problem in probabilities which historically was almost the first belongs to the kind which is first in interest. Of this character is a question which occupied Galileo and before him Cardan, and an even earlier writer: what are the chances that, when two or three dice are thrown, the sum of the points or pips turned up should amount to a certain number? A particular case of this problem is presented by the old game of "passedix": what is the probability that if three dice are thrown the sum of the pips should exceed ten?[7] The answer is obtained by considering the number of combinations that are favourable to each of the different alternatives, 18 pips, 17, 16 . . . . 11 pips, which make up the event in question. Thus out of the total of 216 (6^3) combinations, *one* is favourable to 18, *three* to 17, and so on. There are twenty-five chances, as we may call the permutations, in favour of 12, twenty-seven in favour of 11.[8] The sum of all these being 108, we have for the event in question 108/216, an even chance. More generally it may be inquired: what is the probability that, if n dice are thrown, the number of points turned up will be exactly s? By an extension of the reasoning which was employed in the first problem it is seen that the required probability is that of which the index is s in the expansion of the expression

$$\left[\left(\frac{1}{6}\right)^1+\left(\frac{1}{6}\right)^2+\left(\frac{1}{6}\right)^3+\left(\frac{1}{6}\right)^4+\left(\frac{1}{6}\right)^5+\left(\frac{1}{6}\right)^6\right]^n$$

The calculation may be simplified by writing this expression in the form

$$\left(\frac{1}{6}\right)^n\left[1-\left(\frac{1}{6}\right)^6\right]^n \left[1-\frac{1}{6}\right]^{-n}.$$

The successive terms of the expansion give the respective probabilities that the number in question should be n, $n+1$ . . . $6n$ comprising all the possible numbers among which s is presumably included (otherwise the answer is *zero*). Of course we are not limited to six alternatives; instead of a die we may have a teetotum with any number of sides. The series expressing the probabilities of the different sums can be written out in general terms, as Laplace and others have done; but it seems to be of less interest than the approximate formula which will be given later.[9]

28. *Variant of the Fundamental Theorem.*—The second variety of our first problem may next be considered. Suppose that after each trial the card dealt (ball drawn, &c.) is not replaced *in statu quo ante*. For instance, if r cards are dealt in the ordinary way from a shuffled pack, what is the probability that s of them will be hearts ($s<13$)? Consider any particular arrangement of the r cards, whereof s are hearts, *e.g.* that in which the s cards first dealt are all hearts, the remaining $r-s$ belonging to other suits. The probability of the first card being a heart is $\frac{13}{52}$; the probability that, the first having been a heart, the second should be a heart is $\frac{12}{51}$ (since a heart having been removed there are now 12 favourable cases out of a total of 51 cases). And so on. Likewise the probability of the $(s+1)$th card being not a heart, all the preceding s having been hearts, is $39/(52-s)$, the probability of the $(s+2)$th card being not a heart is similarly reckoned. And thus the probability of the particular arrangement considered is found to be

$$\frac{13 \cdot 12 \cdot \cdots \{13-(s-1)\{ \cdot 39 \cdot 38 \cdot \cdots (39-r-s-1)}{52 \cdot 51 \cdot \cdots \{52-(s-1)\} \cdot \{52-s\}\{52-(s+1)\} \cdots \{52-(r-1)\}}.$$

Now consider any other arrangement of the r cards, *e.g.* t of the s hearts to occur first and the remaining $s-t$ last. The denominator in the above expression will remain the same; and in the numerator only the order of the factors will be altered. The probability of the second arrangement is therefore the same as that of the first; and the probability that some one or other of the arrangements will occur is given by multiplying the probability of any one arrangement and the number of different arrangements, which, as in the simpler case of the problem,[10] is the same as the number of combinations formed by r things taken together s times, that is $r!/s!\,(r-s)!$. The formula thus obtained may be generalized by substituting n for

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[1] Cf. Bertrand's distinction between "Probabilités totales," and "Probabilités composées," *Calcul des probabilités*, ch. ii. arts. 23, 24.

[2] Cf. Todhunter, *History . . . of Probability*, p. 360, and other statements of James Bernoulli's Theorem, referred to in the index.

[3] Venn, *op. cit.* p. 91.

[4] Some of these proofs are adduced, and a new and elegant one added by Bertrand, *op. cit.* ch. v.

[5] When the degree in which a certain range of central terms tends to preponderate over the residue of the series is formulated with precision, as in the statement given by Todhunter (*op. cit.* p. 548) when he is interpreting Laplace, then James Bernoulli's theorem presents a particular case of the law of error—the case considered below in par. 103.

[6] See Chrystal, *Algebra*, ch. xxiii. § 12; or other textbook of algebra.

[7] See Todhunter, *History . . . of Probability*, art. 8; Bertrand, *Calcul des probabilités*, p. vii., or the original documents.

[8] As Galileo discerned. A friend of his had observed that 11 occurred 1080 times to 1000 times of 12.

[9] The law of error given below, par. 104.

[10] Above, par. 24.

52, pn for 13, qn for 39 (where $p+q=1$; pn and qn are integers). A formula thus generalized is proposed by Professor Karl Pearson[1] as proper to represent the frequency with which different values are assumed by a quantity depending on causes which are *not* independent.

29. *Miscellaneous Examples: Games of Chance.*—The majority of the problems under this heading cannot, like the preceding two, be regarded as conducing directly to statistical methods which are required in investigating some parts of nature. They are at best elegant exercises in a kind of mathematical reasoning which is required in most of such methods. Games of chance present some of the best examples. We may begin with one of the oldest, the problem which the Chevalier de Méré put to Pascal when he questioned: How many times must a pair of dice be thrown in order that it may be an even chance that double *six*—the event called *sonnez*—may occur at least once?[2] The answer may be obtained by finding a general expression for the probability that the event will occur at least once in n trials; and then determining n so that this expression $=\frac{1}{2}$. The probability of the event occurring is the difference between unity and the probability of its failing. Now the probability of "sonnez" failing at a single throw (of two dice) is $\frac{35}{36}$. Therefore the probability of its failing in n throws is $\left(\frac{35}{36}\right)^n$. Whence we obtain, to determine n, the equation $1-\left(\frac{35}{36}\right)^n=\frac{1}{2}$, which gives $n=24{\cdot}605$ nearly.

30. In the preceding problem the *quaesitum* was (unity *minus*) the probability that out of all the possible events an assigned one ("sonnez") should fail to occur in the course of n trials. In the following problem the *quaesitum* is the probability that out of all the possible events one or other should fail—that they should not all be represented in the course of n trials. A die being thrown n times, what is the probability that all three of the following events will not be represented (that one or other of the three will not occur at least once); viz. (a) either ace or deuce turning up, (b) either 3 or 4, (c) either 5 or 6. The number of cases in which one at least of these events fails to occur is equal to the number of cases in which (a) fails, *plus* the number in which (b) fails, *plus* the number in which (c) fails, *minus* the number of cases in which two of the events fail concurrently (which cases without this subtraction would be counted twice).[3] Now the number of cases in which (a) fails to occur in the course of the n trials is $\left(\frac{2}{3}\right)^n$ of all the possible cases numbering 3^n. Like propositions are true of (b) and (c). The number of cases in which both (a) and (b) fail is $\left(\frac{1}{3}\right)^n$ of the total;[4] and the like is true of the cases in which both (a) and (c) fail and the cases in which both (b) and (c) fail. Accordingly the probability that one at least of the events will fail to occur in the course of n trials is

$$3\left(\frac{2}{3}\right)^n-3\left(\frac{1}{3}\right)^n.$$

31. One more step is required by the following problem: If n cards are dealt from a pack, each card after it has been dealt being returned to the pack, which is then reshuffled, what is the probability that one or other of the four suits will not be represented? The probability that hearts will fail to occur in the course of the n deals is $\left(\frac{3}{4}\right)^n$; and the like is true of the three other suits. From the sum of these probabilities is to be subtracted the sum of the probabilities that there will be concurrent failures of any two suits; but from this subtrahend are to be subtracted the proportional number of cases in which there are concurrent failures of any three suits (otherwise cases such as that in which *e.g.* hearts, diamonds and clubs concurrently failed[5] would not be represented at all). Now the probability of any assigned two suits failing is $\left(\frac{2}{4}\right)^n$; the probability of any assigned three suits failing is $\left(\frac{1}{4}\right)^n$. Accordingly the required probability is

$$4\left(\frac{3}{4}\right)^n-6\left(\frac{2}{4}\right)^n+4\left(\frac{1}{4}\right)^n.$$

The analogy of the Binomial Theorem supplies the clue to the solution of the general problem of which the following is an example. If a die is thrown n times the probability that every face will have turned up at least once is[6]

$$1-6\left(\frac{5}{6}\right)^n+15\left(\frac{4}{6}\right)^n-20\left(\frac{3}{6}\right)^n+15\left(\frac{2}{5}\right)^n-6\left(\frac{1}{6}\right)^n.$$

32. If in the (first) problem stated in paragraph 31 the cards are dealt in the ordinary way (without replacement), we must substitute for $\left(\frac{3}{4}\right)^n$, the continued product $\frac{39}{52}\cdot\frac{38}{51}\cdots\frac{39-(n-1)}{52-(n-1)}$; for $\left(\frac{2}{4}\right)^n$ the continued product $\frac{26}{52}\cdot\frac{25}{51}\cdots\frac{26-(n-1)}{52-(n-1)}$, and so on.

33. Still considering miscellaneous examples relating to games of chance let us inquire what is the probability that at whist each of the two parties should have two honours?[7] If the turned-up card is an honour, the probability that of the three other honours an assigned one is among the twenty-five which are in the hands of the dealer or his partner, while the remaining two honours are in the hands of the other party, is $\frac{25}{51}, \frac{26}{50}, \frac{25}{49}$. But the assigned card may with equal probability be any one of three honours; and accordingly the above written probability is to be multiplied by 3. If the turned-up card is not an honour then the probability that an assigned pair of honours is in the hands of the dealer or his partner, while the remaining two honours are in the hands of their adversaries, is $\frac{25}{51}\cdot\frac{24}{50}\cdot\frac{26}{49}\cdot\frac{25}{48}$; this probability is to be multiplied by *six*, as the assigned pair may be any of the six binary combinations formed by the four honours. Now the probability of the alternative first considered—the turned-up card being an honour—is $\frac{4}{13}$; and the probability of the second alternative, $\frac{9}{13}$. Accordingly the required probability is

$$\frac{4}{13}\cdot3\cdot\frac{25}{51}\cdot\frac{26}{50}\cdot\frac{25}{49}+\frac{9}{13}\cdot6\cdot\frac{25}{51}\cdot\frac{24}{50}\cdot\frac{26}{49}\cdot\frac{25}{48}=\frac{325}{833}.$$

34. The probability that each of the four players should have an honour may be calculated thus.[8] If the card turned up is an honour then *ipso facto* the dealer has one honour and the probability that the remaining players have each an assigned one of the three remaining honours, is $\frac{13}{51}\cdot\frac{13}{50}\cdot\frac{13}{49}$. Which probability is to be multiplied by 3!, as there are that number of ways in which the three cards may be assigned. If the card turned up is not an honour the probability that each player has an assigned honour is $\frac{13}{51}\cdot\frac{13}{50}\cdot\frac{13}{49}\cdot\frac{12}{48}$. Which probability is to be multiplied by 4!. Accordingly the required probability is

$$\frac{4}{13}\cdot3!\frac{13^3}{51.50.49}+\frac{9}{13}\cdot4!\frac{12.13^3}{48.51.50.49}=\frac{6.13^3}{51.50.49}$$

(the chance not being affected by the character of the card turned up).

35. The probability of all the trumps being held by the dealer is $\frac{12}{51}\cdot\frac{11}{50}\cdots\frac{2}{41}\cdot\frac{1}{40}$ or $\frac{12!\,39!}{52!}$, which being calculated by means of tables for (logarithms of) factorials[9] or directly,[10] is 158,753,389,900.

36. There is a set of dominoes which goes from double blank to double nine (each domino presenting either a combination—which occurs only once—of two digits, or a repetition of the same digit). What is the probability that a domino drawn from the set will prove to be one assigned beforehand? The probability is the reciprocal of the number of dominoes: which is $10\times9/2$ (the number of combinations of different digits) $+10$ (the number of doubles) $=55$.

37. *Choice and Chance.*—When we leave the sphere of games of chance and frame questions relating to ordinary life there is a danger of assuming distributions of probability which are far from probable. For example, let this be the question. The House of Commons formerly consisting of 489 English members, 60 Scottish and 103 Irish, what was the probability that a committee of three members should represent the three nationalities? An assumption of indifference where it does not exist is involved in the answer that the required probability is the ratio of the number of favourable triplets, viz. $489\times60\times103$ to the total number of triplets, viz. $652\times651\times650\times3!$ A similar absence of selection is postulated by the ordinary treatment of a question like the following. There being s candidates

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[1] *Trans. Roy. Soc.* (1895). See below, par. 165.

[2] Todhunter, *History . . . of Probability*, and Bertrand, *Calcul des probabilités*, p. 9.

[3] *All three* events cannot fail.

[4] (c) occurring n times.

[5] The reasoning may be illustrated by using the area of a circle to represent the frequency with which hearts fail, another (equal) circle for diamonds; for the case in which both hearts and diamonds fail the area common to the circles interlapping, and so on.

[6] See Whitworth, *Exercises in Choice and Chance*, No. 502 (p. 125); referring to prop. xiv. of the same author's *Choice and Chance*.

[7] Cf. Whitworth, *Choice and Chance*, question 143, p. 183, ed. 4.

[8] Ibid.

[9] There is such a table at the end of De Morgan's article in the Calculus of Probabilities in the *Ency. Brit.* "Pure Sciences," vol. ii.

[10] Cancelling factors common to the numerator and denominator.

at an examination and r optional subjects from which each candidate chooses one ($r>s$), what is the probability that no two candidates should choose the same subject? If the candidates be arranged in any order, the probability that the second candidate should not choose the same subject as the first candidate is $(n-1)/n$. The probability that the third candidate will not choose either of the two subjects taken by the aforesaid candidates is $(n-2)/n$, and so on. Thus the required probability is

$$n(n-1)\;(n-2)\ldots\{n-(s-1)\}/n^s.$$

38. When as in these cases the interest of the problem lies chiefly in the application of the theory of combinations, or permutations, there is a propriety in Whitworth's enunciation of the questions under the head of *choice* rather than *chance*. It comes to the same whether we say that there are x ways in which an event may happen, or that the probability of its happening in an assigned one of those ways is $1/x$. For example, suppose that there are n couples waltzing at a ball; if the names of the men are arranged in alphabetical order, what is the probability that the names of their partners will also be in alphabetical order? The probability that the man who is first in alphabetical order should have for partner the lady who is first in that order is $1/n$. The probability that the man who is second alphabetical order should have for partner the lady who is second in that order is $1/(n-1)$, and so on. Therefore the required probability is $1/n!$. Or it may be easier to say that the number of ways, each consisting of a set of couples in which the party can be arranged, is $n!$; of which only one is favourable.

39. The same principle governs the following question. For how many days can a family of 10 continue to sit down to dinner in a different order each day; it not being indifferent who sits at the head of the table—what is the absolute, as well as the relative, position of the members? The number of permutations, viz. 10!, is the answer. If we are to attend to the relative position only—as would be natural if the question related to 10 children turning round a fly-pole—the number of different arrangements would be only 9!

40. *Method of Equations in Finite Differences.*—The last question may serve to introduce a method which Laplace has applied with great *éclat* to problems in probabilities. Let y_n be the number of ways in which n men can take their places at a round table, without respect to their *absolute* position; and consider how the number will be increased by introducing an additional man. From every particular arrangement of the original n men can now be obtained n different arrangements of the $n+1$ men (since the additional man may sit between any two of the party of n). Hence $y_{n+1}=ny_n$, an *equation of differences* of which the solution is C $(n-1)!$ The constant may be determined by considering the case in which n is 2.

41. The following example is not quite so simple. If a coin is thrown n times, what is the chance that head occurs at least twice running? Calling each sequence of n throws a "case," consider the number of cases in which head never occurs twice running; let u_n be this number, then 2^n-u_n must be the number of cases when head occurs at least twice successively. Consider the value of u_{n+2}; if the last or $(n+2)$th throw be tail, u_{n+2} includes all the cases (u_{n+1}) of the $n+1$ preceding throws which gave no succession of heads; and if the last be head the last but one must be tail, and these two may be preceded by any one of the u_n favourable cases for the first n throws. Consequently,

$$u_{n+2}=u_{n+1}+u_n.$$

If α, β are the roots of the quadratic $x^2-x-1=0$, this equation gives[1]

$$u_n=\mathrm{A}\alpha^n+\mathrm{B}\beta^n.$$

Here A and B are easily found from the conditions $u_1=2$, $u_2=3$; viz.

$$\mathrm{A}=\frac{\alpha^2}{\alpha-\beta},\ \mathrm{B}=\frac{\beta^2}{\beta-\alpha},$$

whence $$u_n=\frac{n+2}{2^{n+1}}\left\{1+\frac{(n+1)n}{1\cdot2\cdot3}\,5+\&\mathrm{c.}\right\}.$$

The probability that head never turns up twice running is found by dividing this by 2^n, the whole number of cases. This probability, of course, becomes smaller and smaller as the number of trials (n) is increased. This is a particular case of a more general problem solved by Laplace[2] as to the occurrence i times running of an event of which the probability at one trial is p.

42. In such problems where we now employ the calculus of finite difference Laplace employed his method of generating functions. A distinguished instance is afforded by the problem of points which was put by the Chevalier de Méré to Pascal and has exercised generations of mathematicians. It is thus stated by Laplace.[3] Two players of equal skill have staked equal sums; the stakes to belong to the player who shall have won a certain number of games. Suppose they agree to leave off playing when one player, A, wants x "points" (games to be won) in order to complete the assigned number, while the second player wants x' points: how ought they to divide the stakes? This is a question in *Expectation*, but its difficulty consists in determining the probability that one of the players, say A, shall win the stakes. Let that probability be $y_{x,x'}$. Then, after the next game, if A has won, the probability of his winning the stakes will be $y_{x-1,x'}$. But if A loses, B winning, the probability will be $y_{x,x'-1}$. But these alternatives are equally likely. Accordingly the probability of A winning the stakes may be written

$$\tfrac{1}{2}y_{x-1,\,x'}+\tfrac{1}{2}y_{x,\,x'-1}.$$

This is the same probability as that which was before written $y_{x,x'}$. Equating the two expressions we have, for the function y, an equation of finite difference involving two variables, of which the solution is[4]

$$y=\frac{1}{2^x}\left\{1+\frac{x}{1}\,\frac{1}{2}+\frac{x(x+1)}{1\cdot2}\,\frac{1}{2^2}+\ldots\ldots+\frac{x(x+1)\cdots(x+x'-2)}{1\cdot2\cdots(x'-1)}\,\frac{1}{2^{x'-1}}\right\}.$$

43. The problem of points is to be distinguished from another classical problem, relating to a contest in which the winner has not simply to win a certain number of games, but to win a certain number of counters from his opponent.[5] Space does not admit even the enunciation of other complicated problems to which Laplace has applied the method of generating functions.

44. *Probability of Causes Deduced from Observed Events.*—Problems relating to the probability of alternative causes, deduced from observed effects, are usually placed in the separate category of "inverse" probability, though, as above remarked,[6] they do not necessarily involve different principles. The difference principally consists in the need of evidence, other than that which is afforded by the observed event, as to the probability of the alternative causes existing and operating. The following is an example free from the difficulty incident to unverified a priori probabilities, which commonly besets this kind of problem. A digit having been taken at random from mathematical tables (or the expansion of an endless constant such as π); a *second* digit is obtained by taking from a random succession of digits one that added to the first digit makes a sum greater than 9. Given a result thus formed, what are the respective probabilities that the second digit should have been 0, 1, 2, . . . 8 or 9? In the long run the first digit assumes with equal frequency the values 0, 1, 2 . . . 8, 9. Accordingly the second digit can never be 0. There is only one chance of its being 1, namely when the first digit is 9 If the second digit is 2, and the first either 8 or 9, the observed effect will be produced. And so on. If the second digit is 9, the effect may occur in nine ways. Accordingly in the long run of pairs thus formed it will occur that the cases or causes which are defined by the circumstances that the second digit is 0, 1, 2, . . . 8, 9, respectively, will occur with frequencies in the following ratios 0 : 1 : 2 . . . 8 : 9. The probability of the observed event having been caused by a particular (second) digit, *e.g.* 7, is $7/(0+1+2+\ldots+9)=7/45$.

45. The following example taken from Laplace[7] is of a more familiar type. An urn is known to contain three balls made up of white and black balls in some unknown proportion. From this urn a ball is extracted m times (being each time replaced after extraction). If a white ball is drawn every time, what are the respective probabilities that the number of white balls in the urn are 3, 2, 1 or 0? By parity of reasoning it appears that in the first case the result is certain, its probability 1, in the second case the probability of the observed event occurring is $(\frac{2}{3})^m$, in the third case that probability is $(\frac{1}{3})^m$, in the fourth case *zero*. Accordingly the respective inverse probabilities are in the ratios

$$1:(\tfrac{2}{3})^m:(\tfrac{1}{3})^m:0;$$

provided that (as in the preceding example, with respect to the second digits) the alternative causes, the four possible constitutions of the urn, are (a priori) equally probable. This is rather a bold assumption with respect to the contents of concrete urns[8] and similar groupings; but with regard to things in general may perhaps be justified on the principle of *cross-series.*[9]

46. Often in the investigation of causes we are not thrown back on unverified a priori probabilities. We have some specific evidence though of a very rough character. An example has been cited from Mill in a preceding paragraph.[10] Against the improbabilities calculated by the methods of the present section there has often to be balanced an improbability evidenced by common sense, which does not admit of mathematical calculation. Bertrand[11] puts the following case. The manager of a gambling house has purchased a roulette table which is found to give *red* 5300 times, *black* 4700 times, out of 10,000 trials. The purchaser claims an indemnity from the maker. What can the calculus tell us as to the justice of the claim? Nothing

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[1] Cf. Boole's *Finite Differences*, ch. vii. § 5.

[2] *Op. cit.* liv. II. ch. ii., No. 12.

[3] *Op. cit.* liv. II. ch. ii., No. 8.

[4] A clear and corrected version of Laplace's reasoning is given by Todhunter, *History. . . of Probability*, art. 973, p. 528, with reference to the more general cases in which the "skills" of each party—their chances of winning a single game—are not equal but respectively p and q ($p+q=1$). See also Czuber, *Wahrscheinlichkeitstheorie*, pp. 30 seq.

[5] See Todhunter, *op. cit.* art. 107, and other articles referring to duration of play. See also Boole, *Finite Differences*, ch. xiv., art. 7, ex. 6.

[6] Above, par. 13.

[7] *Op. cit.* liv. II. ch. i. No. 1.

[8] Cf. Bertrand, *op. cit.* § 118.

[9] Above, par. 5.

[10] Par. 13.

[11] *Op. cit.* § 134.

precise, yet something worth knowing. The a priori improbability of the maker's inaccuracy must be very great to overcome the improbability of such an event occurring by chance if the machine is accurately made (accuracy being defined, say, by the condition that the ratio of red to [red + white] would prove to be in the indefinitely long run of trials between 0·499 and 0·501). The odds against the so defined event occurring are found to be some millions to one.[1]

47. The difficulty recurs in more practical problems: for instance, certain symptoms having been observed, to find the probability that they are produced by a particular disease. Such concrete applications of probabilities are often open to the sort of objections which have been urged against the classical use of the calculus to determine the probability that witnesses are true, or judges just.

48. *Probability of Testimony.*—The application of probabilities to testimony proceeds upon two assumptions: (1) that to each witness there pertains a coefficient of probability representing the average frequency with which he speaks the truth or untruth, (2) that the statements of witnesses are *independent* in the sense proper to probabilities. Thus if two witnesses concur in making a statement which must be either true or false, their agreement is a circumstance which is only to be accounted for by one of two alternatives: either that they are both speaking the truth, or both false. If the average truthfulness—the credibility—of one witness is p, that of the other p', then the probabilities of the two alternative explanations are to each other in the ratio pp': $(1-p)\ (1-p')$; the probability that the statement is true is $pp'/\{pp'+(1-p)\ (1-p')\}$. So far no account is taken of the a priori probability of the statement. This evidence may be treated as an independent witness. Thus, if a person whose credibility is p asserts that he has seen at whist a hand consisting entirely of trumps dealt from a well-shuffled pack of cards, there are two alternative explanations of his assertion, with probabilities in the ratio

$$p \times 0{\cdot}000{,}000{,}000{,}0063 : (1-p) \times 0{\cdot}999{,}999{,}999{,}993.$$

The truthfulness of the witness must be very great to outweigh the a priori improbability of the fact.[2] These formulae are easily extended to the case of three or more witnesses. The probability of a statement made by three witnesses of respective credibilities p, p', p'' is

$$pp'p''/\{pp'p''+(1-p)\ (1-p')\ (1-p'')\}.$$

For r witnesses we have

$$p_1 p_2 \ldots p_r/\{p_1 p_2 \ldots p_r+(1-p_1)\ (1-p_2) \ldots (1-p_r)\}.$$

Dividing both the numerator and the denominator by $p_1 p_2 \ldots p_r$, we see that the probability of the statement increases with the number of the witnesses, provided that for every witness $(1-p)/p$ is a proper fraction, and accordingly $p > \frac{1}{2}$. As an example of several witnesses, let us inquire how many witnesses to a fact such as a hand at whist consisting entirely of trumps would be required in order to make it an even chance that the fact occurred, supposing the credibility of each witness to be $\frac{9}{10}$.[3] Let x be the required number of witnesses. We have the $1/(1+(\frac{1}{9})^x\, 0{\cdot}000{,}000{,}000{,}006)=\frac{1}{2}$, or $x \log 9 = 12{\cdot}2$. Whence, if x is 13, it is more than an even chance that the statement is true.

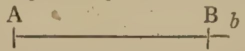
49. When an event may occur in two or more ways equally probable a priori, the formulae show that the probability of the statement will depend on the credibility of the witnesses; and accordingly the explicit consideration of a priori probabilities may, as in our first instance, be omitted. One who reports the number of a ticket obtained at a lottery ordinarily makes a statement against which there is no a priori improbability; but if the number is one which had been predicted, there is an a priori improbability $\frac{1}{n}$ that an assigned ticket should be drawn out of a *mélange* of n tickets. Similar reasoning is applicable to the probability that the decisions of judgments, the verdict of juries, is right.

50. The assumptions upon which all this reasoning is based are open to serious criticisms. The postulated *independence* of witnesses and judges is frequently not realized. The revolutionary tribunal which condemned Condorcet was affected by an identity of illusions and passions which that mathematician had not taken into account when he calculated "that the probability of a decision being conformable to truth will increase indefinitely as the number of voters is increased."[4]

51. The use of coefficients based on the average truthfulness or justice of each witness and judge involves the neglect of particulars which ought to influence our estimate of probability, such as the consistency of a witness's statements and the relation of the case to the interests, prejudices and capacities of the witness or the judge.[5] Thus even in so simple a case as the alleged occurrence of an extraordinary hand at whist, the "truthfulness" of the witness in the general sense of the term may not adequately represent his liability to have made a mistake about the shuffling.[6] A neglect of particulars, however, is sometimes practised with success in the applications of statistics (insurance, for instance). Perhaps there are broad results and general rules to which the mathematical theory may be applicable. Perhaps the laborious researches of Poisson on the "probability of judgments" are not, as they have been called by an eminent mathematician, *absolument rien*.[7] More than mathematical interest may attach to Laplace's investigation of a rule appropriate to cases like the following. An event (suppose the death of a certain person) must have proceeded from one of n causes A, B, C, &c., and a tribunal has to pronounce on which is the most probable. Professor Morgan Crofton's original proof of Laplace's rule is here reproduced.[8]

52. Let each member of the tribunal arrange the causes in the order of their probability according to his judgment, after weighing the evidence. To compare the presumption thus afforded by any one judge in favour of a specified cause with that afforded by the other judges, we must assign a value to the probability of the cause derived solely from its being, say, the rth on his list. As he is supposed to be unable to pronounce any closer to the truth than to say (suppose) H is more likely than D, D more likely than L, &c., the probability of any cause will be the average value of all those which that probability can have, given simply that it always occupies the same place on the list of the probabilities arranged in order of magnitude. As the sum of the n probabilities is always 1, the question reduces to this:—

Any whole (such as the number 1) is divided at random into n parts, and the parts are arranged in the order of their magnitude—least, second, third, . . . greatest; this is repeated for the same whole a great number of times; required the mean value of the least, of the second, &c., parts, up to that of the greatest.



Let the whole in question be represented by a line AB $= a$, and let it be divided at random into n parts by taking $n-1$ points indiscriminately on it. Let the required mean values be

$$\lambda_1 a,\ \lambda_2 a,\ \lambda_3 a \ldots \lambda_n a,$$

where $\lambda_1, \lambda_2, \lambda_3 \ldots$ must be constant fractions. As a great number of positions is taken in AB for each of the n points, we may take a as representing that number; and the whole number N of cases will be

$$N = a^{n-1}.$$

The sum of the *least* parts, in every case, will be

$$S_1 = N\lambda_1 a = \lambda_1 a^n.$$

Let a small increment, B$b = \delta a$, be added on to the line AB at the end B; the increase in this sum is $\delta S_1 = n\lambda_1 a^{n-1}\delta a$. But, in dividing the new line Ab, either the $n-1$ points all fall on AB as before, or $n-2$ fall on AB and 1 on Bb (the cases where 2 or more fall on Bb are so few we may neglect them). If all fall on AB, the least part is always the same as before except when it is the last, at the end B of the line, and then it is greater than before by δa; as it falls last in n^{-1} of the whole number of trials, the increase in S_1 is $n^{-1}a^{n-1}\delta a$. But if one point of division falls on Bb, the number of new cases introduced is $(n-1)a^{n-2}\,\delta a$; but, the least part being now an infinitesimal, the sum S_1 is not affected; we have therefore

$$\delta S_1 = n\lambda_1 a^{n-1}\delta a = n^{-1}a^{n-1}\delta a;$$
$$\therefore \lambda_1 = n^{-2}.$$

To find λ_2, reasoning exactly in the same way, we find that where one point falls on Bb and $n-2$ on AB, as the least part is infinitesimal, the *second least* part is the *least* of the $n-1$ parts made by the $n-2$ points; consequently, if we put λ_1' for the value of λ_1 when there are $n-1$ parts only, instead of n,

$$\delta S_2 = n\lambda_2 a^{n-1}\delta a = n^{-1}\ a^{n-1}\delta a + (n-1)a^{n-2}\lambda_1' a\delta a,$$
$$\therefore n\lambda_2 = n^{-1} + (n-1)\lambda_1';\ \text{but}\ \lambda'_1 = (n-1)^{-2};$$
$$\therefore n\lambda_2 = n^{-1} + (n-1)^{-1}.$$

In the same way we can show generally that

$$n\lambda_r = n^{-1} + (n-1)\lambda'_{r-1};$$

and thus the required mean value of the rth part is

$$\lambda_r a = an^{-1}\{n^{-1} + (n-1)^{-1} + (n-2)^{-1} + \ .\ .\ .\ (n-r+1)^{-1}\}.$$

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[1] By a calculation based on the fundamental theorem (above, par. 23; cf. below, par. 103).

[2] But see below, par. 51.

[3] Morgan Crofton, *loc. cit.* p. 778, par. 1.

[4] *Essai*, p. 6 (there is postulated a proviso analogous to that which has been stated in par. 49 above, with reference to witnesses: that the probability of any one voter being right is $> \frac{1}{2}$).

[5] See Mill's forcible remarks on this use of probabilities, which he places among the "misapplications of the calculus which have made it the real opprobrium of mathematics" (*Logic*, Book III, ch. xviii. § 3). Cf. Bertrand, *Calcul des probabilités*; Venn, *Logic of Chance*, ch. xvi. § 5–7; v. Kries, *Principien der Wahrscheinlichkeitsrechnung*, ch. ix., preface, § v., and ch. xiii. §§ 12, 13; Laplace's general reflections on this matter seem more valuable than his calculations: "Tant de passions et d'intérêts particuliers y mêlent si souvent leur influence qu'il est impossible de soumettre au calcul cette probabilité," *op. cit.* Introduction (*Des Choix et décisions des assemblées*).

[6] As to the possibility of mistake in this respect, see Proctor, *How to play Whist*, p. 121.

[7] Bertrand, *loc. cit.*

[8] *Loc. cit.* § 43.

Thus each judge implicitly assigns the probabilities

$$\frac{1}{n^2}, \frac{1}{n}\left(\frac{1}{n}+\frac{1}{n-1}\right), \frac{1}{n}\left(\frac{1}{n}+\frac{1}{n-1}+\frac{1}{n-2}\right);$$

to the causes as they stand on his list, beginning from the lowest. The values assigned for the probability of each alternative cause may be treated as so many equally authoritative observations representing a quantity which it is required to determine. According to a general rule given below [1] the observations are to be added and divided by their number; but here if we are concerned only with the relative magnitudes of the probabilities in favour of each alternative it suffices to compare the sums of the observations. We thus arrive at Laplace's rule. Add the numbers found on the different lists for the cause A, for the cause B, and so on; that cause which has the greatest sum is the most probable.

53. *Probability of Future Effects deduced from Causes.*—Another class of problems which it is usual to place in a separate category are those which require that, having ascended from an observed event to probable causes, we should descend to the probability of collateral effects. But no new principle is involved in such problems. The reason may be illustrated by the following modification of the problem about digits which was above set [2] to illustrate the method of deducing the probability of alternative causes. What is the probability that if to the *second* digit which contributed to the effect there described there is added a *third* digit taken at random, the sum of the second and third will be greater than 10 (or any other assigned figure)? The probabilities—the a posteriori probabilities derived from the observed event (that the sum of the first and second digit exceeds 9)—each multiplied by 45, of the alternatives constituted by the different values 0, 1, 2, . . . 8, 9 of the second figure are written in the first of the subjoined rows.

0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	4	5	6	7	8
0	0	2	6	12	20	30	42	56	72

Below each of these probabilities is written the probability, × 10 that if the corresponding cause existed the effect under consideration would result. The product of the two probabilities pertaining to each alternative way of producing the event gives the probability of the event occurring in that way. The sum of these products which are written in the third row divided by 45×10, viz. $\frac{240}{450}=\frac{8}{15}$, is the required probability. It may be expected that actual trial would verify this result.

54. "*Rule of Succession.*"—One case of inferred future effects, sometimes called the "rule of succession," claims special notice as having been thought to furnish a test for the cogency of induction. A white ball has been extracted (with replacement after extraction) n times from an immense number of black and white balls mixed in some unknown proportion; what is the probability that at the $(n+1)$th trial a white ball will be drawn? It is assumed that each constitution of the *mélange* [3] formed by the proportion of white balls (the probability of drawing a white ball), say p, is a priori as likely to have any one value as another of the series

$$\Delta p, 2\Delta p, 3\Delta p, \ldots 1-2\Delta p, 1-\Delta p, 1.$$

Whence a posteriori the probability of any particular value of p as the cause of the observed recurrence is $p^n/\Sigma p^n$, where p in the denominator receives every value from Δp to 1. The probability that this cause, if it exists, will produce the effect in question, the extraction of a white ball at the $(n+1)$th trial, is p. The probability of the event, obtained by summing the probabilities of all the different ways in which it may occur, is accordingly $\Sigma p^{n+1}/\Sigma p^n$, where p both in the numerator and the denominator is to receive all possible values between Δp and 1. In the limit we have

$$\int_0^1 p^{n+1}dp\Big/\int_0^1 p^n dp=(n+1)\big/(n+2).$$

In particular if $n=1$, the probability that an event which has been observed once will recur on a second trial is $\frac{2}{3}$. These results are perhaps not so absurd as they have seemed to some critics, when the principle of "cross-series" [4] is taken into account. Among authorities who seem to attach importance to the rule of succession, in addition to the classical writers on Probabilities, may be mentioned Lotze [5] and Karl Pearson.[6]

Section III.—*Calculation of Expectation.*

55. *Analogues of Preceding Problems.*—This section presents problems analogous to the preceding. If n balls are extracted from an urn containing black and white balls mixed up in the proportions $p : (1-p)$, each ball being replaced after extraction, the expected number of white balls in the set of n is by definition np.[7] It may be instructive to verify the consistency of first principles by *demonstrating* this axiomatic proposition.[8] Consider the respective probabilities that in the series of n trials there will occur no white balls, exactly one white ball, exactly two white balls, and so on, as shown in the following scheme:—

No. of white balls	0,	1,	2,	. . . n
Corresponding probability.	$(1-p)^n$,	$\frac{n!}{(n-1)!1}(1-p)^{n-1}p$,	$\frac{n!}{(n-2)!2!}(1-p)^{n-2}p^2$	. . . p^n

To calculate the expectation of white balls it is proper to multiply 1 by the probability that exactly one white ball will occur, 2 by the probability of two white balls, and so on. We have thus for the required expectation

$$\frac{n!}{(n-1)!}(1-p)^{n-1}p+\frac{n!}{(n-2)!}(1-p)^{n-2}p^2+\ldots$$
$$+\frac{n!}{(n-r)!(r-1)!}(1-p)^{n-r}p^r+\ldots+np^n$$
$$=np\,[(1-p)^{n-1}+(n-1)(1-p)^{n-2}p+\ldots$$
$$+\frac{(n-1)!}{(n-r)!(r-1)!}(1-p)^{n-r}p^{r-1}+\ldots+p^{n-1}]$$
$$=np[(1-p)+p]^{n-1}=np.$$

The expectation in the case where the balls are not replaced—not similarly axiomatic—may be found by approximative formulae.[9]

56. *Games of Chance.*—With reference to the topic which occurred next under the head of probabilities, a distinction must be drawn between the number of trials which make it an even chance that all the faces of a die will not have turned up at least once, and the number of trials which are made on an average before that event occurs. We may pass from the probability to expectation in such cases by means of the following theorem. If s is the number of trials in which on an average success (such as turning up every face of a die at least once) is obtained, then $s=1+f_1+f_2+\ldots$; where f_r denotes the probability of failing in the first r trials. For the required expectation is equal to 1×probability of succeeding at the first trial + 2 × probability of succeeding at the second trial+&c. Now the probability of succeeding at the first trial is $1-f_1$; the probability of succeeding at the second trial (after failing at the first) is $f_1(1-f_2)$; the probability of succeeding at the third trial is similarly $f_2(1-f_3)$; and so on. Substituting these values for the expression for the expectation, we have the proposition which was to be proved. In the proposed problem

$$f_n=6\left(\frac{5}{6}\right)^n-15\left(\frac{4}{6}\right)^n\times 20\left(\frac{3}{6}\right)^n-15\left(\frac{2}{6}\right)^n+6\left(\frac{1^n}{6}\right)$$

Assigning to n in each of these terms, every value from 1 to ∞ we have $6\cdot\frac{5}{6}/(1-\frac{5}{6}), =30$, for the sum of the first set, with corresponding expressions for the sets formed from the following terms. Whence $s=1+30-30+20-\frac{15}{2}+\frac{6}{5}=14\cdot7$. By parity of reasoning it is proved that on an average $7\frac{419}{630}$ cards[10] must be dealt before at least one card of every suit has turned up.[11]

57. Dominoes are taken at random (with replacement after each extraction) from the set of the kind described in a preceding paragraph.[12] What is the difference (irrespective of *sign*) to be expected between the two numbers on each domino? The digit 9, according as it is combined with itself, or any smaller digit, gives the sum of differences

$$0+1+2+\ldots+9.$$

The digit 8 combined with itself or any smaller digit gives the sum of differences $0+1+2+\ldots+8$ and so on. The sum of the differences is $\Sigma\frac{1}{2}r.\ r+1$, where r has every integer value from 1 to 9 inclusive, $=\frac{9(9+1)(9+2)}{2\cdot3}$, $=165$. And the number of the differences is $10+9+8+\ .\ .\ .+2+1=55$. Therefore the required expectation is $165/55=3$.

58. *Digits taken at Random.*—The last question is to be distinguished from the following. What is the difference (irrespective of *sign*) between two digits, taken at random from mathematical tables, or the expansion of an endless constant like π? The combinations of different digits will now occur twice as often as the repetitions of the same digit. The sum of the differences may now be obtained from the consideration that the sum of the *positive* differences must be equal to sum of the *negative* differences when the *null* differences are distributed equally between the positive and the negative set. The sum of the positive set is, as before,

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[1] Below, pars. 135, 136. A difficulty raised by Cournot with respect to the determination of several quantities which are connected by an equation does not here arise. The system of values determined for the several causes fulfils by construction the condition that the sum of the values should be equal to unity.

[2] Above, par. 44.

[3] It comes to the same to suppose the total number of balls in the mixture to be N; and to assume that the number of white balls is a priori equally likely to have any one of the values 1, 2, . . . N−1, N.

[4] Above, par. 5.

[5] *Logic*, bk. ii. ch. ix. § 5.

[6] *Grammar of Science*, ch. iv. § 16. Cf. the article in *Mind* above referred to, ix. 234.

[7] See the introductory remarks headed "Description and Division of the Subject."

[8] Cf. above, par. 25.

[9] See Pearson, *Phil. Trans.* (1895), A.

[10] Whitworth, *Exercises*, No. 502.

[11] Ibid. No. 504, cf. above, par. 29.

[12] Ibid. par. 36.

165. But the denominator of this numerator is not the same as before, but less by half the number of null differences, that is 5. We thus obtain for the required expectation 165/50=3·3.

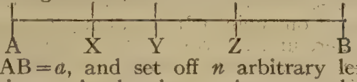
59. A simple verification of this prediction may thus be obtained. In a table of logarithms note any two digits so situated as to afford no presumption of close correlation; for instance, in the last place of the logarithm of 10009 the digit 7 and in the last place of the logarithm of 10019 the digit 4, and take the difference between these two, viz. 3, irrespective of sign. Proceed similarly with the similarly situated pair which form the last places of the logarithms of 10029 and 10039; for which the difference is 1, and so on. The mean of the differences thus found ought to be approximately 3·3. Experimenting thus on the last digits of logarithms, in Hutton's tables extending to seven places, from the logarithm of 10009 to the logarithm of 10909, the writer has found for the mean of 250 differences, 3·2.

60. *Points taken at Random.*—By parity of reasoning it may be shown that if two different milestones are taken at random on a road n miles long (there being a stone at the starting-point) their average distance apart is $\frac{1}{3}(n+2)$.

61. If instead of finite differences as in the last two problems the intervals between the numbers or degrees which may be selected are indefinitely small, we have the theorem that the mean distance between two points taken at random on a finite straight line is a third of the length of that straight line.

Rules for Voting at Elections.

62. The fortuitous division of a straight line is happily employed by Professor Morgan Crofton to exhibit Laplace's method of determining the worth of several candidates by combining the votes of electors. There is a close relation between this method and the method above given for determining the probabilities of several alternatives by combining the judgments of different judges.[1] But there is this difference—that the several estimates of worth, unlike those of probability, are not subject to the condition that their sum should be equal to a constant quantity (unity). The *quaesita* are now expectations, not probabilities. Professor Morgan Crofton's version [2] of the argument is as follows. Suppose there are n candidates for an office; each elector is to arrange them in what he believes to be the order of merit; and we have first to find the numerical value of the merit he thus implicitly attributes to each candidate. Fixing on some limit a as the maximum of merit, n arbitrary values less than a are taken and then arranged in order of magnitude—least, second, third, . . . greatest; to find the mean value of each.



Take a line $AB=a$, and set off n arbitrary lengths AX, AY, AZ . . . beginning at A; that is, n points are taken at random in AB. Now the mean values of AZ, XY, YZ, . . . are all equal; for if a new point P be taken at random, it is equally likely to be 1st, 2nd, 3rd, &c., in order beginning from A, because out of $n+1$ points the chance of an assigned one being 1st is $(n+1)^{-1}$; of its being 2nd $(n+1)^{-1}$; and so on. But the chance of P being 1st is equal to the mean value of AX divided by AB; of its being 2nd $M(XY)\div AB$; and so on. Hence the mean value of AX is $AB\ (n+1)^{-1}$; that of AY is $2AB\ (n+1)^{-1}$; and so on. Thus the mean merit assigned to the several candidates is

$$a(n+1)^{-1},\ 2a(n+1)^{-1},\ 3a(n+1)^{-1}\ldots na(n+1)^{-1}.$$

Thus the relative merits may be estimated by writing under the names of the candidates the numbers 1, 2, 3, . . . n. The same being done by each elector, the probability will be in favour of the candidate who has the greatest sum.

Practically it is to be feared that this plan would not succeed, because, as Laplace observes, not only are electors swayed by many considerations independent of the merit of the candidates, but they would often place low down in their list any candidate whom they judged a formidable competitor to the one they preferred, thus giving an unfair advantage to candidates of mediocre merit.

63. This objection is less appropriate to competitive examinations, to which the method may seem applicable. But there is a more fundamental objection in this case, if not indeed in every case, to the reasoning on which the method rests: viz. that there is supposed an a priori distribution of values which is in general not supposable; viz. that the several estimates of worth, the marks given to different candidates by the same examiner, are likely to cover evenly the whole of the tract between the minimum and maximum, *e.g.* between 0 and 100. Experience, fortified by theory, shows that very generally such estimates are not thus indifferently disposed, but rather in an order which will presently be described as the normal law of error.[3] The theorem governing the case would therefore seem to be not that which is applied by Laplace and Morgan Crofton, but that which has been investigated by Karl Pearson,[4] a theorem which does not lend itself so readily to the purpose in hand.[5]

64. *Expectation of Advantage.*—The general examples of expectation which have been given may be supplemented by some appropriate to that special use of the term which Laplace has sanctioned when he considers the subject of expectation as a "good"; in particular money, or that for the sake of which money is desired, "moral" advantage, in more modern phrase utility or satisfaction.

65. *Pecuniary Advantage.*—The most important calculations of pecuniary expectation relate to annuities and insurance; based largely on life tables from which the expectation of life itself, as well as of money value at the end, or at any period, of life is predicted. The reader is referred to these heads for practical exemplifications of the calculus. It must suffice here to point out how the calculations are facilitated by the adoption of a law of frequency, the Gompertz or the Gompertz-Makeham law, which on the one hand can hardly be ranked with hypotheses resting on a *vera causa*, yet on the other hand is not purely empirical, but is recommended, as germane to the subject-matter, by colourable suppositions.[6]

66. There is space here only for one or two simple examples of money as the subject of expectation. Two persons A and B throw a die alternately, A beginning, with the understanding that the one who first throws an ace is to receive a prize of £1. What are their respective expectations?[7] The chance that the prize should be won at the first throw is $\frac{1}{6}$, the chance that it should be won at the second throw is $\frac{5}{6}\ \frac{1}{6}$; at the third throw $(\frac{5}{6})^2\frac{1}{6}$, at the fourth throw $(\frac{5}{6})^3\ \frac{1}{6}$, and so on. Accordingly the expectation of A

$$=£1\times\tfrac{1}{6}\ \{1+(\tfrac{5}{6})^2+(\tfrac{5}{6})^4+\ .\ .\ .\};$$

expectation of B

$$=£1\times\tfrac{1}{6}\cdot\tfrac{5}{6}\ \{1+(\tfrac{5}{6})^2+(\tfrac{5}{6})^4+\ .\ .\ .\}.$$

Thus A's expectation is to B's as $1:\frac{5}{6}$. But their expectations must together amount to £1. Therefore A's expectation is $\frac{6}{11}$ of a pound, B's $\frac{5}{11}$.

67. There are n tickets in a bag, numbered 1, 2, 3, . . . n. A man draws two tickets at once, and is to receive a number of sovereigns equal to the product of the numbers drawn. What is his expectation?[8] It is the number of pounds divided by an improper fraction of which the denominator is the number of possible products, $\frac{1}{2}n(n-1)$, and the numerator is the sum of all possible products $=\frac{1}{2}\{(1+2+3\ .\ .\ .\ +n)^2-(1^2+2^2+\ .\ .\ .\ +n\}$. Whence the required number (of pounds) is found to be $\frac{1}{12}(n+1)(3n+2)$. The result may be contrasted with what it would be if the two tickets were not to be drawn at once, but the second after replacement of the first. On this supposition the expectation in respect of one of the tickets separately is $\frac{1}{2}(n+1)$. Therefore, as the two events are now *independent*, the expectation of the product,[9] being the product of the expectations, is $\{\frac{1}{2}(n+1)\}^2$.

68. Peter throws three coins, Paul two. The one who obtains the greater number of heads wins £1. If the number of heads are equal, they play again, and so on, until one or other obtains a greater number of heads. What are their respective expectations?[10] At the first trial there are three alternatives: (α) Peter obtains more heads than Paul, (β) an equal number, (γ) fewer. The cases in favour of α are (1) Peter obtains three heads, (2) Peter, two heads, while Paul one or none, (3) Peter one head, Paul none. The cases in favour of β are (1) two heads for both, or (2) one head, or (3) none, for both. The remaining case favours γ. The probability of α is $\frac{1}{8}+\frac{3}{8}\frac{3}{4}+\frac{3}{8}\frac{1}{4}=\frac{1}{2}$. The probability of β is $\frac{3}{8}\frac{1}{4}+\frac{3}{8}\frac{1}{2}+\frac{1}{8}\frac{1}{4}=\frac{5}{16}$. The probability of γ is $1-\frac{13}{16}=\frac{3}{16}$. Alternative β is to be split up into three α', β', γ', of which the probabilities (when β has occurred) are as before, $\frac{8}{16}$, $\frac{5}{16}$, $\frac{3}{16}$. β' is similarly split up, and so on. Thus Peter's expectation is $\frac{8}{16}\{1+\frac{5}{16}+(\frac{5}{16})^2+\ .\ .\ .\ \}£1=\frac{8}{11}£1$. Paul's expectation is $\frac{3}{11}£1$.

An urn contains m balls marked 1, 2, 3, . . . m. Paul extracts successively the m balls, under an agreement to give Peter a shilling every time that a ball comes out in its proper order. What is Peter's expectation? The expectation with respect to any one ball is $\frac{1}{m}$, and therefore the expectation with respect to all is 1 (shilling).[11]

69. *Advantage subjectively estimated.*—Elaborate calculations are paradoxically employed by Laplace and other mathematicians to determine the expectation of subjective advantage in various cases of risk. The calculation is based on Daniel Bernoulli's formula which may be written thus: If x denote a man's *physical* fortune, and y the corresponding *moral* fortune

$$y=k\log(x/h),$$

k, h being constants, x and y are always positive, and $x>h$; for every man must possess some fortune, or its equivalent, in order to live. To estimate now the value of a *moral expectation.* Suppose a person whose fortune is a to have the chance p of obtaining a sum α, q of obtaining β, r of obtaining γ, &c., and let

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[1] Above, par. 52.

[2] *Loc. cit.* § 45.

[3] See Edgeworth, "Elements of Chance in Examinations," *Journ. Stat. Soc.* (1890). Cf. below, par. 124.

[4] *Biometrika*, i. 390.

[5] Moore, of Columbia University, New York, has attempted to trace Karl Pearson's theory in the statistics relating to the efficiency of wages (*Economic Journal*, Dec. 1907; and *Journ. Stat. Soc.*, Dec. 1907).

[6] Cf. below, par. 169.

[7] Whitworth, *Choice and Chance*, question 126.

[8] Whitworth, *Exercises*, No. 567.

[9] According to the principle above enounced, par. 15.

[10] Bertrand, id. § 44, prob. xlvii.

[11] Bertrand, id. § 39, prob. xliii. It is not to be objected that the probabilities on which the several expectations are calculated are not independent (above, par. 16).

$$p+q+r+ \ldots =1,$$

only one of the events being possible. Now his moral expectation from the first chance—that is, the increment of his moral fortune multiplied by the chance—is

$$pk\left\{\log \frac{a+\alpha}{h}-\log \frac{a}{h}\right\}=pk \log (a+\alpha)-pk \log a.$$

Hence his whole moral expectation is[1]

$$\mathrm{E}=kp \log (a+\alpha)+kq \log(a+\beta)+kr \log(a+\gamma)+\ldots -k \log a;$$

and, if Y stands for his moral fortune including this expectation, that is, $k \log (a/h) + \mathrm{E}$, we have

$$\mathrm{Y}=kp \log(a+\alpha)+kq \log(a+\beta)+\ldots -k \log h.$$

To find X, the physical fortune corresponding to this moral one, we have $\mathrm{Y}=k \log \mathrm{X}-k \log h.$

Hence $\mathrm{X}=(a+\alpha)^p(a+\beta)^q(a+\gamma)^r,$

and $\mathrm{X}-a$ will be the actual or physical increase of fortune which is of the same value to him as his expectation, and which he may reasonably accept in lieu of it. The mathematical value of the same expectation is[2]

$$p\alpha+q\beta+r\gamma+\ldots$$

70. *Gambling and Insurance.*—These formulae are employed, often with the aid of refined mathematical theorems, to demonstrate received propositions of great practical importance: that in general gambling is disadvantageous, insurance beneficial, and that in speculative operations it is better to subdivide risks—not to "have all your eggs in one basket."

71. These propositions may be deduced by the use of a formula which perhaps keeps closer to the facts: viz. that utility or satisfaction is a function of material goods not definitely ascertainable, defined only by the conditions that the function continually increases with the increase of the variable, but at a continually decreasing rate (and some additional postulate as to the lower limit of the variable), say $y=\psi(x)$ (if x as before denotes physical fortune, and y the corresponding utility or satisfaction); where all that is known in general of ψ is that $\psi'(x)$ is positive, $\psi''(x)$ is negative; and $\psi(x)$ is never less, x is always greater than zero. Suppose a gambler whose (physical) fortune is a, to have the chance p of obtaining a sum α and the chance $q(=1-p)$ of losing the sum β. If the game is fair in the usual sense of the term $p\alpha=q\beta$. Accordingly the prospective psychical advantage of the party is $p\psi(\mathrm{a}+\alpha)+q\psi(\mathrm{a}-\beta)=p\psi(\mathrm{a}+\alpha)+q\psi\{\mathrm{a}-(p/q)\alpha\}$, say y_α. When α is zero the expression reduces to the first state of the man, $\psi(\mathrm{a})$, say y_0. To compare this state with what it becomes by the gambling transaction, let α receive continually small increments of $\Delta\alpha$. When α is zero the first differential coefficient of $(y_\alpha-y_0)$, viz. $p\psi'(\mathrm{a})-p\psi'(\mathrm{a}),=0$. Also the second differential coefficient, viz. $p\psi''(\mathrm{a})+\frac{p^2}{q}\psi''(\mathrm{a})$, is negative, since by hypothesis ψ'' is continually negative. And as α continues to increase from zero, the second differential coefficient of $(y_\alpha-y_0)$, viz. $p\psi''(\mathrm{a}+\alpha)+\frac{p^2}{q}\psi''(\mathrm{a}+\frac{p}{q}\alpha)$, continues to be negative. Therefore the increments received by the first differential coefficient of $(y_\alpha-y_0)$ are continually negative; and therefore $(y_\alpha-y_0)$ is continually negative; $y_\alpha<y_0$[3] for finite values of α (not exceeding $q\mathrm{a}/p$).[4]

72. To show the advantage of insurance, let us suppose with Morgan Crofton[5] that a merchant, whose fortune is represented by 1, will realize a sum ϵ if a certain vessel arrives safely. Let the probability of this be p. To make up exactly for the risk run by the insurance company, he should pay them a sum $(1-p)\epsilon$. If he does, his moral fortune becomes, according to the formula now proposed $\psi(1+p\epsilon)$, since his physical fortune is increased by the secured sum ϵ, minus the payment $(1-p)\epsilon$; while if he does not insure it will be $p\psi(1+\epsilon)+(1-p)\psi(1)$. We have then to compare $\psi(1+p\epsilon)$, say y_1, with $p\psi(1+\epsilon)+(1-p)\psi(1)$, say y_2. By reasoning analogous to that of the preceding paragraph it appears that (y_2-y_1) is zero when $\epsilon=0$ and continually diminishes as ϵ increases up to any assigned finite (admissible) value. Similarly it may be shown that it is better to expose one's fortune in a number of separate sums to risks independent of each other than to expose the whole to the same danger. Suppose a merchant, having a fortune, has besides a sum ϵ which he must receive if a ship arrives in safety. Then, if the chance of the ship arriving $=p$, and $q=1-p$, his prospective advantage is $p\psi(1+\epsilon)+q\psi(1)$. Now instead of exposing the lump sum ϵ to a single risk, let him subdivide ϵ into n equal parts, each exposed to an independent equal risk (q) of being lost. As n is made larger[6] it becomes more and more nearly a certainty that he will realize $p\epsilon$ out of the total ϵ exposed to risk. Therefore his condition (in respect of the sort of advantage which is under consideration) will be approximately $\psi(1+p\epsilon)$. Then we have to compare $\psi(1+p\epsilon)$, say y_1, with $p\psi(1+\epsilon)+q\psi(1)$, say y_2. By reasoning analogous to that which has been above employed—observing that $(p-p^2)\psi''(1)$ is negative for all possible values of p—we conclude that $y_2<y_1$.

73. *The Petersburg Problem.*—The doctrine of "moral fortune" was first formulated by Daniel Bernoulli[7] with reference to their celebrated "Petersburg Problem," which is thus stated by Todhunter[8]: "A throws a coin in the air: if head appears at the first throw he is to receive a shilling from B, if head does not appear until the second throw he is to receive 2s., if head does not appear until the third throw he is to receive 4s., and so on, required the expectation of A." So many lessons are presented by this problem that there has been room for disputing what is *the* lesson. Laplace and other high authorities follow Daniel Bernoulli. Poisson finds the explanation in the fact that B could not be expected to pay up so large a sum. Whitworth, who regards the disadvantage of gambling as consisting mainly in the danger of becoming "cleaned out,"[9] finds this moral in the Petersburg problem. All have not noticed what some regard as the principal lesson to be obtained from the paradox: viz. that a transaction which cannot be regarded as one of a series—at least a "cross-series"[10]—is not subject to the general rule for expectations of advantage whether material or moral.[11]

Section IV.—*Geometrical Applications.*

74. Under this head occur some interesting illustrations of principles employed in the preceding sections; in particular of a priori probabilities and of the relation between probability and expectation.

75. *Illustrations of a priori Probabilities.*—The assumption which has been made under preceding heads that the probability of certain alternatives is approximately equal appears to rest on evidence of much the same character as the assumption which is made under this head that one point in a line, plane or volume is as likely to occur as another, under certain circumstances. Thus consider the proposition: if a given area S is included within a given area A, the chance of a point P, taken at random on A, falling on S is S/A. In a great variety of circumstances such a size can be assigned to the spaces, and "taking at random" can be so defined that the proposition is more or less directly based on experience. The fact that the points of incidence are equally distributed in space is observed, or connected by inference with observation, in many cases, *e.g.* raindrops and molecules. There is a solid substratum of evidence for the premiss employed in the solution of problems like the following: On a chess-board, on which the side of every square is a, there is thrown a coin of diameter $b(b<a)$ so as to be entirely on the board, which may be supposed to have no border. What is the probability that the coin is entirely on one square?[12] The area on which the coin can fall is $(8a-b)^2$. The portion of the area which is favourable to the event is $64(a-b)^2$. Therefore the required probability is $(a-b)^2/(a-\frac{1}{8}b)^2$.

76. *Random Lines.*—Speculative difficulties recur when we have to define a straight line taken at random in a plane; for instance, in the following problem proposed by Buffon.[13]

A floor is ruled with equidistant parallel lines; a rod, shorter than the distance between each pair, being thrown at random on the floor, to find the chance of its falling on one of the lines. The problem is usually solved as follows:—

Let x be the distance of the centre of the rod from the nearest line, θ the inclination of the rod to a perpendicular to the parallels, $2a$ the common distance of the parallels, $2c$ the length of rod; then, as all values of x and θ between their extreme limits are equally probable, the whole number of cases will be represented by

$$\int_0^a\int_{-\pi/2}^{\pi/2}dx\,d\theta=\pi a.$$

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[1] It is important to remark that we should be wrong in thus adding the expectations if the events were not mutually exclusive. For the mathematical expectations it is not so.

[2] This paragraph is taken from Morgan Crofton's article on "Probability," in the 9th edition of the *Ency. Brit.*

[3] Cf. Marshall, *Principles of Economics*, Mathematical Appendix, note ix.

[4] Or should we rather say, not exceeding the limit at which $\psi(\mathrm{a}-p\alpha/q)$ becomes 0? (The value of $\psi(0)$ may be regarded as $-\infty$.) Neither of the proposed limitations materially affects the validity of the theorem.

[5] *Loc. cit.* par. 25.

[6] See above, par. 25 (James Bernoulli's theorem).

[7] *Specimen theoriae novae de mensura sortis* (16), translated (into German) with notes by Pringsheim (1906).

[8] *Op. cit.* art. 389.

[9] *Choice and Chance*, pp. 211, 232. The danger of a party to a game of chance being "ruined" (by losing more than his whole fortune), which forms a separate chapter in some treatises, is readily deducible from the theory of deviations from an average which will be stated in pt. ii.

[10] Above, par. 5.

[11] Above, par. 20.

[12] Whitworth, *Exercises*, No. 500.

[13] Cf. Morgan Crofton, *loc. cit.*

Now if the rod crosses one of the lines we must have $c > x/\cos\theta$; so that the favourable cases will be measured by

$$\int_{\pi/2}^{\pi/2} d\theta \int_{0}^{c\cos\theta} dx = 2c.$$

Thus the probability required is $p = 2c/\pi a$.

It may be asked—why should we take the centre of the rod as the point where distance from the nearest line has all its values equally probable? Why not one extremity of the line, or some other point suited to the circumstances of projection? Fortunately it makes no difference in the result to what point in the rod we assign this pre-eminence.

77. The legitimacy of the assumption obtains some verification from the success of a test suggested by Laplace. If a rod is actually thrown, as supposed in the problem, a great number of times, and the frequency with which it falls on one of the parallels is observed, that proportionate number thus found, say p, furnishes a value for the constant π. For π ought to equal $2c/pa$. The experiment has been made by Professor Wolf of Frankfort. Having thrown a needle of length 36 mm. on a plane ruled with parallel lines at a distance from each other of 45 mm. 5000 times, he observed that the needle crossed a parallel 2532 times. Whence the value of π is deduced 3·1596, with a probable error[1] ± ·05.

78. More hesitation may be felt when we have to define a random chord of a circle,[2] for instance, with reference to the question, what is the probability that a chord taken at random will be greater than the side of an equilateral triangle? For some purposes it would no doubt be proper to assume that the chord is constructed by taking any point on the circumference and joining it to another point on the circumference, the points from which one is taken at random being distributed at equal intervals around the circumference. On this understanding the probability in question would be $\frac{1}{3}$. But in other connexions, for instance, if the chord is obtained by the intersection with the circle of a rod thrown in random fashion, it seems preferable to consider the chord as a case of a straight line falling at random on a plane. Morgan Crofton[3] himself gives the following definition of such a line: If an infinite number of straight lines be drawn at random in a plane, there will be as many parallel to any given direction as to any other, all directions being equally probable; also those having any given direction will be disposed with equal frequency all over the plane. Hence, if a line be determined by the co-ordinates p, ω, the perpendicular on it from a fixed origin O, and the inclination of that perpendicular to a fixed axis, then, if p, ω be made to vary by equal infinitesimal increments, the series of lines so given will represent the entire series of random straight lines. Thus the number of lines for which p falls between p and $p+dp$, and ω between ω and $\omega+d\omega$, will be measured by $dpd\omega$, and the integral $\iint dpd\omega$, between any limits, measures the number of lines within those limits.

79. Authoritative and useful as this definition is, it is not entirely free from difficulty. It amounts to this, that if we write the equation of the random line

$$x\cos\alpha + y\sin\alpha - p = 0,$$

we ought to take α and p as those variables, of which the equicrescent values are equally probable—the equiprobable variables, as we may say. But might we not also write the equation in either of the following forms

(1) $x/a + y/b - 1 = 0$,

(2) $ax + by - 1 = 0$,

and take a and b in either system as the equiprobable variables? To be sure, if the equal distribution of probabilities is extended to infinity we shall be landed in the absurdity that of the random lines passing through any point on the axis of y a proportion differing infinitesimally from unity—100%—are either (1) parallel or (2) perpendicular to the axis of x. But the admission of infinite values will render *any* scheme for the equal distribution of probabilities absurd. If Professor Crofton's constant p, for example, becomes infinite, the origin being thus placed at an infinite distance, all the random chords intersecting a finite circle would be parallel!

80. However this may be, Professor Crofton's conception has the distinction of leading to a series of interesting propositions, of which specimens are here subjoined.[4] The number of random lines which meet any closed convex contour of length L is measured by L. For, taking O inside the contour, and integrating first for p, from 0 to p, the perpendicular on the tangent to the contour, we have $\int pd\omega$; taking this through four right angles for ω, we have by Legendre's theorem on rectification, N being the measure of the number of lines,

$$N = \int_{0}^{2\pi} pd\omega = L.^{5}$$

Thus, if a random line meet a given contour, of length L, the chance of its meeting another convex contour, of length l, internal to the former is $p = l/L$. If the given contour be not convex, or not closed, N will evidently be the length of an endless string, drawn tight around the contour.

81. If a random line meet a closed convex contour of length L, the chance of it meeting another such contour, external to the former, is $p = (X-Y)/L$, where X is the length of an endless band enveloping both contours, and crossing between them, and Y that of a band also enveloping both, but not crossing. This may be shown by means of Legendre's integral above; or as follows:—

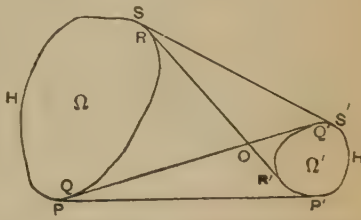

FIG. 1.

Call, for shortness, N(A) the number of lines meeting an area A; N(A, A′) the number which meet both A and A′; then (fig. 1)

$$N(SROQPH) + N(S'Q'OR'P'H') = N(SROQPH + S'Q'OR'P'H') + N(SROQPH,\ S'Q'OR'P'H'),$$

since in the first member each line meeting both areas is counted twice. But the number of lines meeting the non-convex figure consisting of OQPHSR and OQ′S′H′P′R′ is equal to the band Y, and the number meeting both these areas is identical with that of those meeting the given areas Ω, Ω′; hence X = Y + N(Ω, Ω′). Thus the number meeting both the given areas is measured by X − Y. Hence the theorem follows.

82. Two random chords cross a given convex boundary, of length L, and area Ω; to find the chance that their intersection falls inside the boundary.

Consider the first chord in any position; let C be its length; considering it as a closed area, the chance of the second chord meeting it is 2C/L; and the whole chance of its coordinates falling in dp, $d\omega$ and of the second chord meeting it in that position is

$$\frac{2C}{L}\frac{dpd\omega}{\iint dpd\omega} = \frac{2}{L^2}Cdpd\omega.$$

But the whole chance is the sum of these chances for all its positions;

$$\therefore \text{prob.} = 2L^{-2}\iint Cdpd\omega.$$

Now, for a given value of ω, the value of $\int Cdp$ is evidently the area Ω; then, taking ω from π to 0, we have

$$\text{required probability} = 2\pi\Omega L^{-2}.$$

The mean value of a chord drawn at random across the boundary is

$$M = \frac{\iint Cdpd\omega}{\iint dpd\omega} = \frac{\pi\Omega}{L}.$$

83. A straight band of breadth c being traced on a floor, and a circle of radius r thrown on it at random; to find the mean area of the band which is covered by the circle. (The cases are omitted where the circle falls outside the band.)[6]

If S be the space covered, the chance of a random point on the circle falling on the band is $p = M(S)/\pi r^2$, this is the same as if the circle were fixed, and the band thrown on it at random. Now let A (fig. 2) be a position of the random point; the favourable cases are when HK, *the bisector of the band*, meets a circle, centre A, radius $\frac{1}{2}c$; and the whole number are when HK meets a circle, centre O, radius $r+\frac{1}{2}c$; hence the probability is

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[1] As recorded by Czuber, *Geometrische Wahrscheinlichkeiten*, p. 90.

[2] Cf. Bertrand, *Calcul des probabilités*, pp. 4 seq. The matter has been much discussed in the *Educational Times*. See *Mathematical Questions . . . from the Educational Times* [a reprint], xxix. 17–20, containing references to earlier discussions, *e.g.* x. 33 (by Woolhouse).

[3] *Loc. cit.* § 75.

[4] The whole of p. 787 of Morgan Crofton's article is often referred to, and parts of pp. 786, 788 are transferred here.

[5] This result also follows by considering that, if an infinite plane be covered by an infinity of lines drawn at random, it is evident that the number of these which meet a given finite straight line is proportional to its length, and is the same whatever be its position. Hence, if we take l the length of the line as the measure of this number, the number of random lines which cut any element ds of the contour is measured by ds, and the number which meet the contour is therefore measured by $\frac{1}{2}$L, half the length of the boundary. If we take $2l$ as the measure for the line, the measure for the contour will be L, as above. Of course we have to remember that each line must meet the contour twice. It would be possible to rectify any closed curve by means of this principle. Suppose it traced on the surface of a circular disk, of circumference L, and the disk thrown a great number of times on a system of parallel lines, whose distance asunder equals the diameter, if we count the number of cases in which the closed curve meets one of the parallels, the ratio of this number to the whole number of trials will be ultimately the ratio of the circumference of the curve to that of the circle. [Morgan Crofton's note.]

[6] Or the floor may be supposed painted with parallel bands, at a distance asunder equal to the diameter; so that the circle must fall on one.

$$p=\frac{2\pi\cdot\frac{1}{2}c}{2\pi(r+\frac{1}{2}c)}=\frac{c}{2r+c}.$$

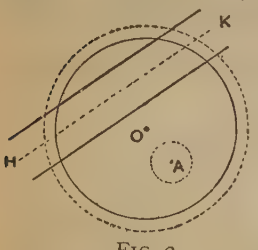

FIG. 2.

This is constant for all positions of A; hence, equating these two values of p, the mean value required is $M(S)=c(2r+c)^{-1}\pi r^2$.

The mean value of the portion of the *circumference* which falls on the band is the same fraction $c/(2r+c)$ of the whole circumference.

If *any convex area* whose surface is Ω and circumference L be thrown on the band, instead of a circle, the mean area covered is

$$M(S)=\pi c(L+\pi c)^{-1}\Omega.$$

For as before, fixing the random point at A, the chance of a random point in Ω falling on the band is $p=2\pi.\frac{1}{2}c/L'$, where L' is the perimeter of a *parallel* curve to L, at a normal distance $\frac{1}{2}c$ from it. Now

$$L'=L+2\pi.\tfrac{1}{2}c.$$

$$\therefore\frac{M(S)}{\Omega}=\frac{\pi c}{L+\pi c}.$$

84. Buffon's problem may be easily deduced in a similar manner. Thus, if $2r$ = length of line, a = distance between the parallels, and we conceive a circle (fig. 3) of diameter a with its centre at the middle O of the line,[1] rigidly attached to the latter, and thrown with it on the parallels, this circle must meet one of the parallels; if it be thrown an infinite number of times we shall thus have an infinite number of chords crossing it at random. Their number is measured by $2\pi.\frac{1}{2}a$, and the number which meet $2r$ is measured by $4r$. Hence the chance that the line $2r$ meets one of the parallels is $p=4r/\pi a$.

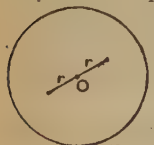

FIG. 3.

85. To investigate the probability that the inclination of the line joining any two points in a given convex area Ω shall lie within given limits. We give here a method of reducing this question to calculation, for the sake of an integral to which it leads, and which is not easy to deduce otherwise.

First let one of the points A (fig. 4) be fixed; draw through it a chord PQ = C, at an inclination θ to some fixed line; put $AP=r$, $AQ=r'$; then the number of cases for which the direction of the line joining A and B lies between θ and $\theta+d\theta$ is measured by $\frac{1}{2}(r^2+r'^2)d\theta$.

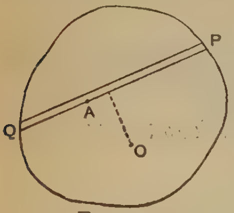

FIG. 4.

Now let A range over the space between PQ and a parallel chord distant dp from it, the number of cases for which A lies in this space and the direction of AB from θ to $\theta+d\theta$ is (first considering A to lie in the element $drdp$)

$$\tfrac{1}{2}dpd\theta\int_{O}^{C}(r^2+r'^2)dr=\tfrac{1}{3}C^3dpd\theta.$$

Let p be the perpendicular on C from a given origin O, and let ω be the inclination of p (we may put $d\omega$ for $d\theta$), C will be a given function of p, ω; and, integrating first for ω constant, the whole number of cases for which ω falls between given limits ω', ω'' is

$$\tfrac{1}{3}\int_{\omega''}^{\omega'}d\omega\int C^3dp;$$

the integral $\int C^3dp$ being taken for all positions of C between two tangents to the boundary parallel to PQ. The question is thus reduced to the evaluation of this double integral, which, of course, is generally difficult enough; we may, however, deduce from it a remarkable result; for, if the integral $\frac{1}{3}\iint C^3dpd\omega$ be extended to all possible positions of C, it gives the whole number of pairs of positions of the points A, B which lie inside the area; but this number is Ω^2; hence

$$\iint C^3dpd\omega=3\Omega^2,$$

the integration extending to all possible positions of the chord C,—its length being a given function of its co-ordinates p, ω.[2]

COR. Hence if L, Ω be the perimeter and area of any closed convex contour, the mean value of the cube of a chord drawn across it at random is $3\Omega^2/L$.

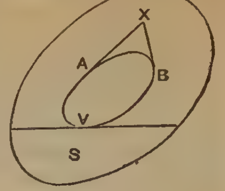

FIG. 5.

86. Let there be any two convex boundaries (fig. 5) so related that a tangent at any point V to the inner cuts off a constant segment S from the outer (*e.g.* two concentric similar ellipses); let the annular area between them be called A; from a point X taken at random on this annulus draw tangents XA, XB to the inner. The mean value of the arc AB, $M(AB)=LS/A$, L being the whole length of the inner curve ABV.

The following lemma will first be proved:—

If there be any convex arc AB (fig. 6), and if N_1 be (the measure of) the number of random lines which meet it once, N_2 the number which meet it twice,

$$2\text{ arc }AB=N_1+2N_2.$$

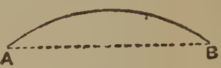

FIG. 6.

For draw the chord AB; the number of lines meeting the convex figure so formed is N_1+N_2 = arc + chord (the perimeter); but N_1 = number of lines meeting the chord = 2 chord;

$$\therefore 2\text{ arc}+N_1=2N_2+2N_2,\quad\therefore 2\text{ arc}=N_1+2N_2.$$

Now fix the point X, in fig. 5, and draw XA, XB. If a random line cross the boundary L, and p_1 be the probability that it meets the arc AB once, p_2 that it does so twice,

$$2AB/L=p_1+2p_2;$$

and if the point X range all over the annulus, and p_1, p_2 are the same probabilities for all positions of X,

$$2M(AB)/L=p_1+2p_2.$$

Let now IK (fig. 7) be any position of the random line; drawing tangents at I, K, it is easy to see that it will cut the arc AB twice when X is in the space marked α, and once when X is in either space marked β; hence, for this position of the line, $p_1+2p_2=2(\alpha+\beta)/A=2S/A$, which is constant; hence $M(AB)/L=S/A$.

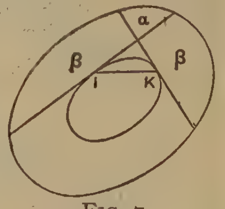

FIG. 7.

Hence the mean value of the arc is the same fraction of the perimeter that the constant area S is of the annulus.

If L be not related as above to the outer boundary, $M(AB)/L=M(S)/A$, M(S) being the mean area of the segment cut off by a tangent at a random point on the perimeter L.

The above result may be expressed as an integral. If s be the arc AB included by tangents from any point (x, y) on the annulus,

$$\iint sdxdy=LS.$$

It has been shown (*Phil. Trans.*, 1868, p. 191) that, if θ be the angle between the tangents XA, XB,

$$\iint\theta dxdy=\pi(A-2S).$$

The mean value of the tangent XA or XB may be shown to be $M(XA)=SP/2A$, where P = perimeter of locus of centre of gravity of the segment S.

87. When we go on to species of three dimensions further speculative difficulties occur. How is a random line through a given point to be defined? Since it is usual to define a vector by two angles (viz. ϕ the angle made with the axis X by a vector r in the plane XY, and θ (or $\frac{1}{2}\pi-\theta$) the angle made by the vector ρ with r in the plane containing both ρ and r and the axis Z) it seems natural to treat the angles ϕ and θ as the equiprobable variables. In other words, if we take at random any meridian on the celestial globe and combine it with any right ascension the vector joining the centre to the point thus assigned is a random line.[3] It is possible that for some purposes this conception may be appropriate. For many purposes surely it is proper to assume a more symmetrical distribution of the terminal points on the surface of a sphere, a distribution such that each element of the surface shall contain an approximately equal number of points. Such an assumption is usually made in the kinetic theory of molecules with respect to the direction of the line joining the centres of two colliding spheres in a "molecular chaos."[4] It is safe to say with Czuber, "No discussion can remove indeterminateness." Let us hope with him that "though this branch of probability can for the present claim only a theoretic interest, in the future it will perhaps also lead to practical results."[5]

88. *Illustrations of probability and expectation.*—The close relation between probability and expectation is well illustrated by geometrical examples. As above stated, when a given space S is included within a given space A, if p is the probability that a point

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[1] The line might be anywhere within the circle without altering the question.

[2] This integral was given by Morgan Crofton in the *Comptes rendus* (1869), p. 1469. An analytical proof was given by Serret, *Annales scient. de l'école normale* (1869), p. 177.

[3] Cf. Bertrand, *op. cit.* § 135.

[4] See *e.g.* Watson, *Kinetic Theory of Gases*, p. 2; Tait, *Trans. Roy. Soc., Edin.* (1888), xxxiii. 68.

[5] *Wahrscheinlichkeitstheorie*, p. 64.

P, taken at random on A, falling on S, $p=\mathrm{S}/\mathrm{A}$. If now the space S be variable, and M(S) be its mean value

$$p=\mathrm{M}(\mathrm{S})/\mathrm{A}.$$

For, if we suppose S to have n equally probable values S_1, S_2, S_3 . . ., the chance of any one S_1 being taken, and of P falling on S_1, is

$$p_1=n^{-1}\mathrm{S}_1/\mathrm{A};$$

now the whole probability $p=p_1+p_2+p_3+$ . . . ., which leads at once to the above expression. The chance of two points falling on S is, in the same way,

$$p=\mathrm{M}(\mathrm{S}^2)/\mathrm{A}^2,$$

and so on.

In such a case, if the probability be known, the mean value follows, and vice versa. Thus, we might find the mean value of the nth power of the distance XY between two points taken at random in a line of length l, by considering the chance that, if n more points are so taken, they shall all fall between X and Y. This chance is

$$\mathrm{M}(\mathrm{XY})^n/l^n=2(n+1)^{-1}(n+2)^{-1};$$

for the chance that X shall be one of the extreme points, out of the whole $(n+2)$, is $2(n+2)^{-1}$; and, if it is, the chance that the other extreme point is Y is $(n+1)^{-1}$. Therefore

$$\mathrm{M}(\mathrm{XY})^n=2l^n(n+1)^{-1}(n+2)^{-1}.$$

A line l is divided into n segments by $n-1$ points taken at random; to find the mean value of the product of the n segments. Let a, b, c, . . . be the segments in one particular case. If n new points are taken at random in the line, the chance that one falls on each segment is

$$1.2.3 \ldots\ldots nabc \ldots\ldots /l^n;$$

hence the chance that this occurs, however the line is divided, is

$$n!l^{-n}\mathrm{M}(abc \ldots\ldots).$$

Now the whole number of different orders in which the whole $2n-1$ points may occur is $(2n-1)!$; out of these the number in which one of the first series falls between every two of the second is easily found by the theory of permutations to be $n!(n-1)!$. Hence the required mean value of the product is

$$\mathrm{M}(abc \ldots\ldots)=\frac{(n-1)!}{(2n-1)!}l^n.$$

89. Additional examples of the relation between probability and expectation appear in the following series of propositions: (1) If M be the mean value of any quantity depending on the positions of two points (*e.g.* their distance) which are taken, one in a space A, the other in a space B (external to A); and if M′ be the same mean when both points are taken indiscriminately in the whole space A+B; M_a, M_b the same mean when both points are taken in A and both in B respectively; then

$$(\mathrm{A}+\mathrm{B})^2\mathrm{M}'=2\mathrm{ABM}+\mathrm{A}^2\mathrm{M}_a+\mathrm{B}^2\mathrm{M}_b.$$

If the space A=B, $4\mathrm{M}'=2\mathrm{M}+\mathrm{M}_a+\mathrm{M}_b$; if, also, $\mathrm{M}_a=\mathrm{M}_b$, then $2\mathrm{M}'=\mathrm{M}+\mathrm{M}_a$.

(2) The mean distance of a point P within a given area from a fixed straight line (which does not meet the area) is evidently the distance of the centre of gravity G of the area from the line. Thus, if A, B are two fixed points on a line outside the area, the mean value of the area of the triangle APB = the triangle AGB. From this it will follow that, if X, Y, Z are three points taken at random in three given spaces on a plane (such that they cannot all be cut by any straight line), the mean value of the area of the triangle XYZ is the triangle GG′G″, determined by the three centres of gravity of the spaces.

(3) This proposition is of use in the solution of the following problem:—

Two points X, Y are taken at random within a triangle. What is the mean area M of the triangle XYC, formed by joining them with one of the angles of the triangle?

Bisect the triangle by the line CD; let M_1 be the mean value when both points fall in the triangle ACD, and M_2 the value when one falls in ACD and the other in BCD; then $2\mathrm{M}=\mathrm{M}_1+\mathrm{M}_2$. But $\mathrm{M}_1=\frac{1}{2}\mathrm{M}$; and $\mathrm{M}_2=\mathrm{GG'C}$, where G, G′ are the centres of gravity of ACD, BCD; hence $\mathrm{M}_2=\frac{2}{9}\mathrm{ABC}$, and $\mathrm{M}=\frac{4}{27}\mathrm{ABC}$.

(4) From this mean value we pass to probabilities. The chance that a new point Z falls on the triangle XYC is $\frac{4}{27}$; and the chance that three points X, Y, Z taken at random form, with a vertex C, a re-entrant quadrilateral, is $\frac{4}{9}$.

90. The calculation of geometrical probability and expectation is much facilitated by the following general principle: If M be a mean value depending on the positions of n points falling on a space A; and if this space receive a small increment α, and M′ be the same mean when the n points are taken on $\mathrm{A}+\alpha$, and M the same mean when one point falls on α and the remaining $n-1$ on A; then, the sum of all the cases being $\mathrm{M}'(\mathrm{A}+\alpha)^n$, and this sum consisting of the cases (1) when all the points are on A, (2) when one is on α the others on A (as we may neglect all where two or more fall on α), we have

$$\mathrm{M}'(\mathrm{A}+\alpha)^n=\mathrm{MA}^n+n\mathrm{M}_1\alpha^{n-1};$$
$$\therefore (\mathrm{M}'-\mathrm{M})\mathrm{A}=n\mathrm{A}(\mathrm{M}_1-\mathrm{M}),$$

as M′ nearly = M. For example, suppose two points X, Y are taken in a line of length l, to find the mean value M of $(\mathrm{XY})^n$. If l receives an increment dl, $ld\mathrm{M}=2dl(\mathrm{M}_1-\mathrm{M})$. Now M_1 here = the mean nth power of the distance of a single point taken at random in l from one extremity of l; and this is $l^n(n+1)^{\ 1}$ (as is shown by finding the chance of n other points falling on that distance); hence

$$ld\mathrm{M}=2dl\{l^n(n+1)^{-1}-\mathrm{M}\};$$
$$\therefore ld\mathrm{M}+2\mathrm{M}dl=2(n+1)^{-1}l^ndl,$$

or

$$l^{-1}.d.\mathrm{M}l^2=2(n+1)^{-1}l^ndl:$$
$$\therefore \mathrm{M}l^2=2(n+1)^{-1}\int l^{n+1}dl=2l^{n+2}/(n+1)(n+2)+\mathrm{C};$$
$$\therefore \mathrm{N}=2l^n/(n+1)\ (n+2),$$

C being evidently 0.

91. The corresponding principle for probabilities may thus be stated: If p is the probability of a certain condition being satisfied by the n points within A in art. 90, p' the same probability when they fall on the space $\mathrm{A}+\alpha$, and p' the same when one point falls on α and the rest on A, then, since the numbers of favourable cases are respectively $p'(\mathrm{A}+\alpha)^n$, $p\mathrm{A}^n$, $np_1\alpha\mathrm{A}^{n-1}$, we find

$$(p'-p)\mathrm{A}=n\alpha(p^1-p).$$

Hence if $p'=p$ then $p_1=p$. For example, if we have to find the chance of three points within a circle forming an acute-angled triangle, by adding an infinitesimal concentric ring to the circle, we have evidently $p'=p$; hence the required chance is unaltered by assuming one of the three points taken on the circumference. Again, in finding the chance that four points within a triangle shall form a convex quadrilateral, if we add to the triangle a small band between the base and a line parallel to it, the chance is clearly unaltered. Therefore we may take one of the points at random on the base (fig. 8), the others X, Y, Z within the triangle. Now the four lines from the vertex B to the four points are as likely to occur in any specified order as any other. Hence it is an even chance that X, Y, Z fall on one of the triangles ABW, CBW, or that two fall on one of these triangles and the remaining one on the other. Hence the probability of a re-entrant quadrilateral is

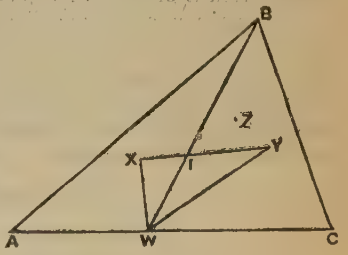

FIG. 8.

$$\tfrac{1}{2}p_1+\tfrac{1}{2}p_2,$$

where p_1 = prob. (WXYZ re-entrant), X, Y, Z in one triangle;
p_2 = do., X in one triangle, Y in the other, Z in either.

But $p_1=\frac{4}{9}$. Now to find p_2; the chance of Z falling within the triangle WXY is the mean area of WXY divided by ABC. Now by par. 89, for any particular position of W, M(WXY) = WGG′, where G, G′ are the centres of gravity of ABW, CBW. It is easy to see that $\mathrm{WGG'}=\frac{1}{9}\mathrm{ABC}=\frac{1}{9}$, putting ABC = 1. Now if Z falls in CBW, the chance of WXYZ re-entrant is 2M(IYW); for Y is as likely to fall in WXZ as Z to fall in WXY; also if Z falls in ABW the chance of WXYZ re-entrant is 2M(IXW). Thus the whole chance is $p_2=2\mathrm{M}(\mathrm{IYW}+\mathrm{IXW})=\frac{2}{9}$. Hence the probability of a re-entrant quadrilateral is

$$\tfrac{1}{2}\ \tfrac{4}{9}+\tfrac{1}{2}\cdot\tfrac{2}{9}=\tfrac{1}{3}.$$

That of its being convex is $\frac{2}{3}$.

92. From this probability we may pass to the mean value of the area XYZ, if M be this mean, and A the given area, the chance of a fourth point falling on the triangle is M/A; and the chance of a re-entrant quadrilateral is four times this, or 4M/A. This chance has just been shown to be $\frac{1}{3}$; and accordingly $\mathrm{M}=\frac{1}{12}\mathrm{A}$.

93. The preceding problem is a particular case of a more general problem investigated by Sylvester. For another instance, let the given area A be a circle; within such three points are taken at random; and let M be the mean value of the triangle thus formed. Adding a concentric ring α, we have since M′: M as the areas of the circles, $\mathrm{M}'=\mathrm{M}(\mathrm{A}+\alpha)/\mathrm{A}$.

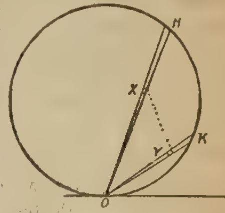

FIG. 9.

$$\mathrm{AM}\alpha/\mathrm{A}=3\alpha(\mathrm{M}_1-\mathrm{M});\quad \therefore \mathrm{M}=\tfrac{3}{4}\mathrm{M}_1,$$

where M_1 is the value of M when one of the points is on the circumference. Take O fixed; we have to find the mean value of OXY (fig. 9). Taking $(\rho,\theta)(\rho',\theta')$ as co-ordinates of X, Y,

$$\mathrm{M}_1=(\pi a^2)^{-2}\iint\rho d\rho d\theta\iint\rho' d\rho' d\theta.\ (\mathrm{OXY}).$$
$$\because \mathrm{M}_1=(\pi^4a^2)^{-1}\iiiint\tfrac{1}{2}\rho\rho'\sin(\theta-\theta')\rho\rho' d\rho d\rho' d\theta d\theta'$$
$$=(\pi^2a^4)^{-1}.\tfrac{1}{2}\iint\tfrac{1}{9}r^3r'^3.\sin(\theta-\theta')d\theta d\theta',$$

putting $r = \mathrm{OH}$, $r' = \mathrm{OK}$; as $r = 2a \sin \theta$, $r' = 2a \sin \theta'$,

$$\mathrm{M}_1 = \frac{1}{\pi^2 a^4} \cdot \frac{(2a)^6}{9} \int_0^\pi \int_0^\theta \sin^3\theta \sin^3\theta' \sin (\theta - \theta') d\theta d\theta'.$$

Professor Sylvester has remarked that this double integral, by means of the theorem

$$\int_0^a \int_0^x f(x, y) dx dy = \int_0^a \int_0^x f(a-y, a-x) dx dy,$$

is easily shown to be identical with

$$2\int_0^\pi \int_0^\theta \sin^4\theta \sin^3\theta' \cos \theta' d\theta d\theta' = \tfrac{1}{2} \int_0^\pi \sin^8\theta d\theta = \tfrac{1}{2} \frac{1 \cdot 3 \cdot 5 \cdot 7}{2 \cdot 4 \cdot 6 \cdot 8} \pi.$$

$$\because \mathrm{M}_1 = \frac{35 a^2}{36\pi}; \quad \because \mathrm{M} = \frac{35}{48\pi^2} \pi a^2.$$

From this mean value we pass to the probability that four points within a circle shall form a re-entrant figure, viz.

$$p = \frac{35}{12\pi^2}.$$

94. The function of expectation in this class of problem appears to afford an additional justification of the position here assigned to this conception[1] as distinguished from an average in the more general sense which is proper to the following Part.

PART II.—AVERAGES AND LAWS OF ERROR

95. *Averages.*—An average may be defined as a quantity derived from a given set of quantities by a process such that, if the constituents become all equal, the average will coincide with the constituents, and the constituents not being equal, the average is greater than the least and less than the greatest of the constituents. For example, if $x_1, x_2, \ldots x_n$ are the constituents, the following expressions form averages (called respectively the arithmetic, geometric and harmonic means):—

$$\frac{x_1 + x_2 + \ldots + x_n}{n}.$$

$$(x_1 \times x_2 \times \ldots \times x_n)^{\frac{1}{n}}.$$

$$1 \Big/ \frac{1}{n}\left(\frac{1}{x_1} + \frac{1}{x_2} + \ldots + \frac{1}{x_n}\right).$$

The conditions of an average are likewise satisfied by innumerable other symmetrical functions, for example:—

$$\left(\frac{x_1^2 + x_2^2 + \ldots + x_n^2}{n}\right)^{\frac{1}{2}}.$$

The conception may be extended from symmetrical to unsymmetrical functions by supposing any one or more of the constituents in the former to be repeated several times. Thus if in the first of the averages above instanced (the arithmetic mean) the constituent x_r, occurs l times, the expression is to be modified by putting lx_r for x_r in the numerator, and in the denominator, for n, $n+r-1$. The definition of an average covers a still wider field. The process employed need not be a *function.*[2] One of the most important averages is formed by arranging the constituents in the order of magnitude and taking for the average a value which has as many constituents above it as below it, the median. The designation is also extended to that value about which the greatest number of the constituents cluster most closely, the "centre of greatest density," or (with reference to the geometrical representation of the grouping of the constituents) the greatest ordinate, or, as recurring most frequently, the mode.[3] But to comply with the definition there must be added the condition that the mode does not occur at either extremity of the range between the greatest and the least of the constituents. There should be also in general added a definition of the process by which the mode is derived from the given constituents.[4] Perhaps this specification may be dispensed with when the number of the constituents is indefinitely large. For then it may be presumed that *any* method of determining the mode will lead to the same result. This presumption presupposes that the constituents are quantities of the kind which form the sort of "series" which is proper to Probabilities.[5] A similar presupposition is to be made with respect to the constituents of the other averages, so far as they are objects of probabilities.

96. *The Law of Error.*—Of the propositions respecting average with which Probabilities is concerned the most important are those which deal with the relation of the average to its constituents, and are commonly called "laws of error." Error is defined in popular dictionaries as "deviation from truth"; and since truth commonly lies in a mean, while measurements are some too large and some too small, the term in scientific diction is extended to deviations of statistics from their average, even when that average—like the mean of human or barometric heights—does not stand for any real objective thing. A "law of error" is a relation between the extent of a deviation and the frequency with which it occurs: for instance, the proposition that if a digit is taken at random from mathematical tables, the difference between that figure and the mean of the whole series (indefinitely prolonged) of figures so obtained, namely, 4·5, will in the long run prove to be equally often ±0·5, ±1·5, ±2·5, ±3·5, ±4·5.[6] The assignment of frequency to *discrete* values—as 0, 1, 2, &c., in the preceding example—is often replaced by a continuous curve with a corresponding equation. The distinction of being *the* law of error is bestowed on a function which is applicable not merely to one sort of statistics—such as the digits above instanced—but to the great variety of miscellaneous groups, generally at least, if not universally. What form is most deserving of this distinction is not decided by uniform usage; different authorities do not attach the same weight to the different grounds on which the claim is based, namely the extent of cases to which the law may be applicable, the closeness of the application, and the presumption prior to specific experience in favour of the law. The term "the law of error" is here employed to denote (1) a species to which the title belongs by universal usage, (2) a wider class in favour of which there is the same sort of a priori presumption as that which is held to justify the more familiar species. The law of error thus understood forms the subject of the first section below.

97. *Laws of Frequency.*—What other laws of error may require notice are included in the wider genus "laws of frequency," which forms the subject of the second section. Laws of frequency, so far as they belong to the domain of Probabilities, relate much to the same sort of grouped statistics as laws of error, but do not, like them, connote an explicit reference to an average. Thus the sequence of random digits above instanced as affording a law of error, considered without reference to the mean value, presents the law of frequency that one digit occurs as often as another (in the long run). Every law of error is a law of frequency; but the converse is not true. For example, it is a law of frequency—discovered by Professor Pareto[7]—that the number of incomes of different size (above a certain size) is approximately represented by the equation $y = \mathrm{A}/x^a$, where x denotes the size of an income, y the number of incomes of that size. But whether this generalization can be construed as a law of error(in the sense here defined) depends on the nice inquiry whether the point from which the frequency diminishes as the income x increases can be regarded as a "mode," y diminishing as x decreases from that point.

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[1] See introductory remarks and note to par. 95.

[2] A great variety of (functional) averages, including those which are best known, are comprehended in the following general form $\phi^{-1}\{\mathrm{M}[\phi(x_1), \phi(x_2), \ldots \phi(x_n)]\}$; where ϕ is an arbitrary function, ϕ^{-1} is inverse (such that $\phi^{-1}(\phi(x)) \equiv x$), M is any (functional) mean. When M denotes the arithmetic mean; if $\phi(x) \equiv \log x$ $(\phi^{-1}(x) \equiv e^x)$ we have the geometric mean; if $\phi(x) \equiv 1/x$, we have the harmonic mean. Of this whole class of averages it is true that the average of several averages is equal to the average of all their constituents.

[3] This convenient term was introduced by Karl Pearson.

[4] *E.g.* some specified method of *smoothing* the given statistics.

[5] See above, pt. i., pars. 3 and 4. Accordingly the *expected* value of the sum of n (similar) constituents $(x_1 + x_2 + \ldots + x_n)$ may be regarded as an average, the average value of nx_r where x_r is any one of the constituents.

[6] See as to the fact and the evidence for it, Venn, *Logic of Chance*, 3rd ed., pp. 111, 114. Cf. *Ency. Brit.*, 8th ed., art "Probability," p. 592; Bertrand, *op. cit.*, preface § ii.; above, par. 59.

[7] See his *Cours d'économie politique*, ii. 306. Cf. Bowley, Evidence before the Select Committee on Income Tax (1906, No. 365, Question 1163 seq.); Benini, *Metodologica statistica*, p. 324, referred to in the *Journ. Stat. Soc.* (March, 1909).

Section I.—*The Law of Error.*

98. (1) *The Normal Law of Error.*—The simplest and best recognized statement of the law of error, often called the "normal law," is the equation

$$z=\frac{1}{\sqrt{\pi}c}e^{-(x-a)^2/c^2},$$

more conveniently written $(1/\sqrt{\pi}c)\ \exp-(x-a)^2/c^2$, where x is the magnitude of an observation or "statistic," z is the proportional frequency of observations measuring x, a is the arithmetic mean of the group (supposed indefinitely[1] multiplied) of similar statistics: c is a constant sometimes called the "modulus"[2] proper to the group; and the equation signifies that if any large number N of such a group is taken at random, the number of observations between x and $x+\Delta x$ is (approximately) equal to the right-hand side of the equation multiplied by $N\Delta x$. A graphical representation of the corresponding curve—sometimes called the "probability-curve"—is here given (fig. 10), showing the general shape of the curve, and how its dimensions vary with the magnitude of the modulus c. The area being constant (viz. unity), the curve is furled up when c is small, spread out when c is large. There is added a table of integrals, corresponding to areas subtended by the curve; in a form suited for calculations of probability, the variable, τ, being the length of the abscissa referred to (divided by) the modulus.[3] It may be noted that the points of inflexion in the figure are each at a distance from the origin of $1/\sqrt{2}$ modulus, a distance equal to the square foot of the mean square of error—often called the "standard deviation." Another notable value of the abscissa is that which divides the area on either side of the origin into two equal parts; commonly called the "probable error." The value of τ which corresponds to this point is 0·4769. . . .

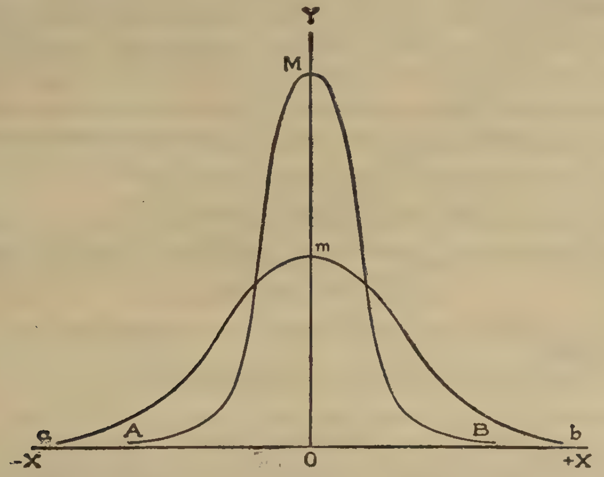

FIG. 10.

A priori proof.

99. An a priori proof of this law was given by Herschel[4] as follows: "The probability of an error depends solely on its magnitude and not on its direction;" positive and negative errors are equally probable. "Suppose a ball dropped from a given height with the intention that it should fall on a given mark," errors in all directions are equally probable, and errors in perpendicular directions are independent. Accordingly the required law, "*which must necessarily be general and apply alike in all cases, since the causes of error are supposed alike unknown*,"[5] is for one dimension of the form $\phi(x^2)$, for two dimensions $\phi(x^2+y^2)$; and $\phi(x^2+y^2)\equiv\phi(x^2)\times\phi(y^2)$; a functional equation of which the solution is the function above written. A reason which satisfied Herschel is entitled to attention, especially if it is endorsed by Thomson and Tait.[6] But it must be confessed that the claim to universality is not, without some strain of interpretation,[7] to be reconciled with common experience.

Table of the Values of the Integral $I=\frac{2}{\sqrt{\pi}}\int_0^\tau e^{-x^2}dx$.

τ	I	τ	I	τ	I	τ	I
0·00	0·00000	·2	·22270	1·3	·93401	2·4	·99931
·01	·01128	·3	·32863	1·4	·95229	2·5	·99959
·02	·02256	·4	·42839	1·5	·96611	2·6	·99976
·03	·03384	·5	·52050	1·6	·97635	2·7	·99986
·04	·04511	·6	·60386	1·7	·98379	2·8	·99992
·05	·05637	·7	·67780	1·8	·98909	2·9	·99996
·06	·06762	·8	·74210	1·9	·99279	3·0	·99998
·07	·07886	·9	·79691	2·0	·99532	∞	1·00000
·08	·09008	1·0	·84270	2·1	·99702		
·09	·10128	1 1	·88020	2·2	·99814		
·1	·11246	1·2	·91031	2·3	·99886		

100. There is, however, one class of phenomena to which Herschel's reasoning applies without reservation. In a "molecular chaos," such as the received kinetic theory of gases postulates, if a molecule be placed at rest at a given point and the distance which it travels from that point in a given time, driven hither and thither by colliding molecules, is regarded as an "error," it may be presumed that errors in all directions are equally probable and errors in perpendicular directions are independent. It is remarkable that a similar presumption with respect to the *velocities* of the molecules was employed by Clerk Maxwell, in his first approach to the theory of molecular motion, to establish the law of error in that region.

101. *The Laplace-Quetelet Hypothesis.*—That presumption has, indeed, not received general assent; and the law of error appears to be better rested on a proof which was originated by Laplace. According to this view, the normal law of error is a first approximation to the frequency with which different values are apt to be assumed by a variable magnitude dependent on a great number of independent variables, each of which assumes different values in random fashion over a limited range, according to *a* law of error, not in general *the* law, nor in general the same for each variable. The normal law prevails in nature because it often happens—in the world of atoms, in organic and in social life—that things depend on a number of independent agencies. Laplace, indeed, appears to have applied the mathematical principle on which this explanation depends only to examples (of the law of error) artificially generated by the process of taking averages. The merit of accounting for the prevalence of the law *in rerum natura* belongs rather to Quetelet. He, however, employed too simple a formula[8] for the action of the causes. The hypothesis seems first to have been stated in all its generality both of mathematical theory and statistical exemplification by Glaisher.[9]

(A) Deduction from Hypothetical Conditions.

102. The validity of the explanation may best be tested by first (A) deducing the law of error from the condition of numerous independent causes; and (B) showing that the law is adequately fulfilled in a variety of concrete cases, in which the condition is probably present. The condition may be supposed to be perfectly fulfilled in *games of chance*, or, more generally, *sortitions*, characterized by the circumstance that we have a knowledge prior to specific experience of the proportion of what Laplace calls favourable cases[10] to all cases—a category which includes, for instance, the distribution of digits obtained by random extracts from mathematical tables, as well as the distribution of the numbers of points on dominoes.

Games of Chance.

103. The genesis of the law of error is most clearly illustrated by the simplest sort of "game," that in which the sortition is between two alternatives, heads or tails, hearts or not-hearts, or, generally, a success or failure, the probability of a success being p and that of a failure q, where $p+q=1$. The number of such successes in the course of n trials may be considered as an aggregate made up of n independently varying elements, each of which assumes the values 0 or 1 with respective frequency q and p. The frequency of each value of the

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[1] On this conception see below, par. 122.

[2] *E.g.* in the article on "Probability" in the 9th ed. of the *Ency. Brit.*; also by Airy and other authorities. Bravais, in his article *Sur la probabilité des erreurs.* . . . "Mémoires présentés par divers savants" (1846), p. 257, takes as the "modulus or parameter" the inverse square of our c. Doubtless different parameters are suited to different purposes and contexts; c when we consult the common tables, and in connexion with the operator, as below, par. 160; $k(=\frac{1}{2}c^2)$ when we investigate the formation of the probability-curve out of independent elements (below, par. 104); $h(=1/c^2)$ when we are concerned with weights or precisions (below, par. 134). If one form of the coefficient must be uniformly adhered to, probably, $\sigma(=c/\sqrt{2})$, for which Professor Pearson expresses a preference, appears the best. It is called by him the "standard deviation."

[3] Fuller tables are to be found in many accessible treatises. Burgess's tables in the *Trans. of the Edin. Roy. Soc.* for 1900 are carried to a high degree of accuracy. Thorndike, in his *Mental and Social Measurements*, gives, among other useful tables, one referred to the standard deviation as the argument. New tables of the probability integral are given by W. F. Sheppard, *Biometrics*, ii. 174 seq.

[4] *Edinburgh Review* (1850), xcii. 19.

[5] The italics are in the original. The passage continues: "And it is on this ignorance, and not on any peculiarity in cases, that the idea of probability in the abstract is formed." Cf. above, par. 6.

[6] *Natural Philosophy*, pt. i. art. 391. For other a priori proofs see Czuber, *Theorie der Beobachtungsfehler*, th. i.

[7] Cf. note to par. 127.

[8] He considered the effect as the sum of causes each of which obeys the simplest law of frequency, the symmetrical binomial.

[9] *Memoirs of Astronomical Society* (1878), p. 105. Cf. Morgan Crofton, "On the Law of Errors of Observation," *Trans. Roy. Soc.* (1870), vol. clx. pt. i. p. 178.

[10] Above, par. 2.

aggregate is given by a corresponding term in the expansion of $(q+p)$, and by a well-known theorem[1] this term is approximately equal to $\frac{1}{\sqrt{\pi 2npq}}e^{-\nu^2/2npq}$; where ν is the number of integers by which the term is distant from np (or an integer close to np); provided that ν is of (or $<$) the order $\sqrt{n}$. Graphically, let the sortition made for each element be represented by the taking or not taking with respective frequency p and q a step of length i. If a body starting from zero takes successively n such steps, the point at which it will most probably come to a stop is at npi (measured from zero); the probability of its stopping at any neighbouring point within a range of $\pm\sqrt{n}i$ is given by the above-written law of frequency, νi being the distance of the stopping-point from npi. Put $\nu i=x$ and $2npqi^2=c^2$; then the probability may be written $(1/\sqrt{\pi}\,c)\exp -x^2/c^2$.

104. It is a short step, but a difficult one, from this case, in which the element is *binomial*—heads or tails—to the general case, in which the element has several values, according to the law of frequency—consists, for instance, of the number of points presented by a randomly-thrown die. According to the general theorem, if Q is the sum[2] of numerous elements, each of which assumes different magnitudes according to a law of frequency, $z=f_r(x)$, the function f being in general different for different elements, the number of times that Q assumes magnitudes between x and $x+\Delta x$ in the course of N trials is $\mathrm{N}z\Delta x$, if $z=(1/\sqrt{2\pi k})\exp -(x-a)^2/2k$; where a is the sum of the arithmetic means of all the elements, any one of which $a_r=\left[\int xf_r(x)dx\right]$, the square brackets denoting that the integrations extend between the extreme limits of the element's range, if the frequency-locus for each element is continuous, it being understood that $\left[\int f_r(x)dx\right]=1$; and k is the sum of the mean squares of error for each element, $=\Sigma\left[\int \xi^2 f_r(a_r+\xi)d\xi\right]$, if the frequency-locus for each element is continuous, where a_r is the arithmetic mean of one of the elements, and ξ the deviation of any value assumed by that element from a_r, Σ denoting summation over all the elements. When the frequency-locus for the element is not continuous, the *integrations* which give the arithmetic mean and mean square of error for the element must be replaced by *summations*. For example, in the case of the dice above instanced, the law of frequency for each element is that it assumes equally often each of the values 1, 2, 3, 4, 5, 6. Thus the arithmetic mean for each element is 3·5, and the mean square of error $\{(3\cdot5-1)^2+(3\cdot5-2)^2+\&\text{c.}\}/6=2\cdot916$. Accordingly, the sum of the points obtained by tossing a large number, n, of dice at random will assume a particular value x with a frequency which is approximately assigned by the equation

$$z=(1/\sqrt{\pi 5\cdot8\tfrac{1}{3}n})\exp -(x-3\cdot5)^2/5\cdot8\tfrac{1}{3}n.$$

The rule equally applies to the case in which the elements are not similar; one might be the number of points on a die, another the number of points on a domino, and so on. Graphically, each element is no longer represented by a step which is either null or i, but by a step which may be, with an assigned probability, one or other of several degrees between those limits, the law of frequency and the range of i being different for the different elements.

105. *Variant Proofs.*—The evidence of these statements can only be indicated here. All the proofs which have been offered involve some postulate as to the deviation of the elements from their respective centres of gravity, their "errors." If these errors extended to infinity, it might well happen that the law of error would not be fulfilled by a sum of such elements.[3] The necessary and sufficient postulate appears to be that the mean powers of deviation for the elements, the second (above written) and the similarly formed third, fourth, &c., powers (up to some assigned power), should be finite.[4]

106. (1) The proof which seems to flow most directly from this postulate proceeds thus. It is deduced that the mean powers of deviation for the proposed representative curve, the law of error (up to a certain power), differ from the corresponding powers of the actual locus by quantities which are negligible when the number of the elements is large.[5] But loci which have their mean powers of deviation (up to some certain power) approximately equal may be considered as approximately coincident.[6]

107. (2) The earliest and best-known proof is that which was originated by Laplace and generalized by Poisson.[7] Some idea of this celebrated theory may be obtained from the following free version, applied to a simple case. The case is that in which all the elements have one and the same locus of frequency, and that locus is symmetrical about the centre of gravity. Let the locus be represented by the equation $\eta=\phi(\xi)$, where the centre of gravity is the origin, and $\phi(+\xi)=\phi(-\xi)$; the construction signifying that the probability of the element having a value ξ (between say $\xi-\frac{1}{2}\Delta\xi$ and $\xi+\frac{1}{2}\Delta\xi$) is $\phi(\xi)\Delta\xi$. Square brackets denoting summation between extreme limits, put $\chi(\alpha)$ for $[\mathrm{S}\phi(\xi)e^{\sqrt{-1}\alpha\xi}\Delta\xi]$ where ξ is an integer multiple of $\Delta\xi$ (or Δx) $=\rho\Delta x$, say. Form the mth power of $\chi(\alpha)$. The coefficient of $e^{\sqrt{-1}\alpha r\Delta x}$ in $(\chi(\alpha))^m$ is the probability that the sum of the values of the m elements should be equal to $r\Delta x$; a probability which is equal to Δxy_r, where y is the ordinate of the locus representing the frequency of the compound quantity (formed by the sum of the elements). Owing to the symmetry of the function ϕ the value of y_r, will not be altered if we substitute for $e^{\sqrt{-1}\alpha r\Delta x}$, $e^{-\sqrt{-1}\alpha r\Delta x}$, nor if we substitute $\frac{1}{2}(e^{+\sqrt{-1}\alpha r\Delta x}+e^{-\sqrt{-1}\alpha r\Delta x})$, that is $\cos\alpha r\Delta x$. Thus $(\chi(\alpha))^m$ becomes a sum of terms of the form $\Delta xy_r\cos\alpha r\Delta x$, where $y_{-r}=y_{+r}$. Now multiply $(\chi(\alpha))^m$ thus expressed by $\cos t\Delta x\alpha$, where, t being an integer, $t\Delta x=x$, the abscissa of the "error" the probability of whose occurrence is to be determined. The product will consist of a sum of terms of the form $\Delta xy_r\,\frac{1}{2}(\cos\alpha(r+t)\Delta x+\cos\alpha(r-t)\Delta x)$. As every value of $r-t$ (except zero) is matched by a value equal in absolute magnitude, $-r+t$, and likewise every value of $r+t$ is matched by value $-r-t$, the series takes the form $\Delta xy_r\Sigma\cos q\alpha\Delta x+\Delta xy_t$, where q has all possible integer values from 1 to the largest value of $|r|$[8] increased by $|t|$; and the term free from circular functions is the equivalent of $\Delta xy_r\cos\alpha(r+t)\Delta x$, when $r=-t$, together with $\Delta xy_r\cos\alpha(r-t)\Delta x$, when $r=+t$. Now substitute for $\alpha\Delta x$ a new symbol β; and integrate with respect to β, the thus transformed $(\chi(\alpha))^m\cos t\Delta x\alpha$ between the limits $\beta=0$ and $\beta=\pi$. The integrals of all the terms which are of the form $\Delta xy_r\cos q\beta$ will vanish, and there will be left surviving only $\pi\Delta xy_t$. We thus obtain, as equal to $\pi\Delta xy_t$, $\int_0^\pi\{\chi(\beta/\Delta x)\}^m\cos t\beta d\beta$. Now change the independent variable to α; then as $d\beta=d\alpha\Delta x$,

$$\Delta xy_t=\Delta x\frac{1}{\pi}\int_0^{\pi/\Delta x}d\alpha(\chi(\alpha))^m\cos t\Delta x\alpha.$$

Replacing $t\Delta x$ by x, and dividing both sides by Δx, we have

$$y_x=\int_0^{\pi/\Delta x}\delta\alpha(\chi(\alpha))^m\cos\alpha x.$$

Now expanding the $\cos\alpha x$ which enters into the expression for $\chi(\alpha)$, we obtain

$$\chi(\alpha)=[\mathrm{S}\phi(\alpha)]-\frac{1}{2!}[\mathrm{S}\phi(\alpha)\alpha^2]x^2+\frac{1}{4!}[\mathrm{S}\phi(\alpha)\alpha^4]x^4\ .\ .\ .$$

Performing the summations indicated, we express $\chi(\alpha)$ in terms of the mean powers of deviation for an element. Whence $\chi(\alpha)^m$ is expressible in terms of the mean powers of the compound locus. First and chief is the mean second power of deviation for the compound, which is the sum of the mean second powers of deviation for the elements, say k. It is found that the sought probability may be equated to

$$\int_0^{\pi/\Delta x}dxe^{-\frac{1}{2}\alpha^2k}\cos\alpha x+\frac{1}{4!}k_2\int_0^{\pi/\Delta x}dx\alpha^4e^{-\frac{1}{2}\alpha^2k}\cos\alpha x-\ .\ .\ .,$$

where k_2 is the coefficient defined below.[9] Here $\pi/\Delta x$ may be replaced by ∞, since the finite difference Δx is small with respect to unity when the number of the elements is large;[10] and thus the integrals involved become equateable to known definite integrals. If it were allowable to neglect all the terms of the series but the first the expression would reduce to $\frac{1}{\sqrt{(2\pi k)}}e^{-u^2/k}$, the normal law of error. But it is allowable to neglect the terms after the first, in a first approximation, for values of x not exceeding a certain range, the number of the elements being large, and if the postulate above enunciated is satisfied.[11] With these reservations it is proved that the sum of a number of similar and symmetrical elements conforms to the normal law of error. The proof is by parity extended to the case in which the elements have different but still symmetrical frequency functions; and, by a bolder use of imaginary quantities, to the case of unsymmetrical functions.

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[1] By the use of Stirling's and Bernoulli's theorems, Todhunter, *History . . . of Probability*.

[2] The statement includes the case of a linear function, since an element multiplied by a constant is still an element.

[3] *E.g.* if the frequency-locus of each element were $1/\pi(1+x^2)$, extending to infinity in both directions. But extension to infinity would not be fatal, if the form of the element's locus were *normal*.

[4] For a fuller exposition and a justification of many of the statements which follow, see the writer's paper on "The Law of Error" in the *Camb. Phil. Trans.* (1905).

[5] *Loc. cit.* pt. i. § 1.

[6] On this criterion of coincidence see Karl Pearson's paper "On the Systematic Fitting of Curves," *Biometrika*, vols. i. and ii.

[7] Laplace, *Théorie analytique des probabilités*, bk. ii. ch. iv.; Poisson, *Recherches sur la probabilité des jugements*. Good restatements of this proof are given by Todhunter, *History . . . of Probability* art. 1004, and by Czuber, *Theorie der Beobachtungsfehler*, art. 38 and Th. 2, § 4.

[8] The symbol $||$ is used to denote absolute magnitude, abstraction being made of *sign*.

[9] Below, pars. 159, 160.

[10] *Loc. cit.* app. I.

[11] *Loc. cit.* p. 53 and context.

108. (3) De Forest[1] has given a proof unencumbered by imaginaries of what is the fundamental proposition in Laplace's theory that, if a polynomial of the form

$$A_0+A_1z+A_2z^2+\ldots+A_mz^m$$

be raised to the nth power and expanded in the form

$$B_0+B_1z+B_2z^2+\ldots+B_{mn}z^{mn},$$

then the magnitudes of the B's in the neighbourhood of their maximum (say B_1) will be disposed in accordance with a "probability-curve," or normal law of error.

109. (4) Professor Morgan Crofton's original proof of the law of error is based on a datum obtained by observing the effect which the introduction of a new element produces on the frequency-locus for the aggregate of elements. It seems to be assumed, very properly, that the sought function involves as constants some at least of the mean powers of the aggregate, in particular the mean second power, say k. We may without loss of generality refer each of the elements (and accordingly the aggregate) to its respective centre of gravity. Then if $y, =f(x)$, is the ordinate of the frequency-locus for the aggregate before taking in a new element, and $y=\partial y$ the ordinate after that operation, by a well-known principle,[2] $y+\partial y=[S\phi_m(\xi)f(x-\xi)\Delta\xi]$, where $\eta, =\phi_m(\xi)$, is the frequency-locus for the new element, and the square brackets indicate that the summation is to extend over the whole range of values assumed by that element. Expanding in ascending powers of (each value of) ξ and neglecting powers above the second, as is found to be legitimate under the conditions specified, we have (since the first mean power of the element vanishes)

$$\partial y=\tfrac{1}{2}[S\xi^2\phi^m(\xi)\Delta\xi]\frac{d^2f}{dx^2}.$$

From the fundamental proposition that the mean square for the aggregate equals the sum of mean squares for the elements it follows that $[S\xi^2\phi_m(\xi)\Delta\xi]$ the mean second power of deviation for the mth element is equal to ∂k, the addition to k the mean second power of deviation for the aggregate. There is thus obtained a partial differential equation of the second order

$$\frac{dy}{dk}=\tfrac{1}{2}\frac{d^2y}{dk^2}. \qquad (1)$$

A subsidiary equation is (in effect) obtained by Professor Crofton from the property that if the unit according to which the axis of x is graduated is altered in any assigned ratio, there must be a corresponding alteration both of the ordinate expressing the frequency of the aggregate and of the mean square of deviation for the aggregation. By supposing the alteration indefinitely small he obtains a second partial differential equation, viz. (in the notation here adopted)

$$y+x\frac{dy}{dx}+2k\frac{dy}{dk}=0. \qquad (2)$$

From these two equations, regard being had to certian other conditions of the problem,[3] it is deducible that $y=Ce^{-x^2/2k}$, where C is a constant of which the value is determined by the condition that

$$\int_{-\infty}^{\infty}ydx=1.$$

110. (5) The condition on which Professor Crofton's proof is based may be called differential, as obtained from the introduction of a single new element. There is also an integral condition obtained from the introduction of a whole set of new elements. For let A be the sum of m_1 elements, fluctuating according to the sought law of error. Let B be the sum of another set of elements m_2 in number (m_1 and m_2 both large). Then Q a quantity formed by adding together each pair of concurrent values presented by A and B must also conform to the law of error, since Q is the sum of m_1+m_2 elements. The general form which satisfies this condition of *reproductivity* is limited by other conditions to the normal law of error.[4]

111. The list of variant proofs is not yet exhausted,[5] but enough has been said to establish the proposition that a sum of numerous elements of the kind described will fluctuate approximately according to the normal law of error.

Varieties of Linear Function.

112. As the number of elements is increased, the constant above designated k continually increases; so that the curve representing the frequency of the compound magnitude spreads out from its centre. It is otherwise if instead of the simple sum we consider the linear function formed by adding the m elements each multiplied by $1/m$. The "spread" of the average thus constituted will continually diminish as the number of the elements is increased; the sides closing in as the vertex rises up. The change in "spread" produced by the accession of new elements is illustrated by the transition from the high to the low curve, in fig. 10, in the case of a *sum*; in the case of an *average* (arithmetic mean) by the reverse relation.

Extension to Non-linear Functions.

113. The proposition which has been proved for linear functions may be extended to any other function of numerous variables, each representing the value assumed by an independently fluctuating element; if the function may be expanded in ascending powers of the variables, according to Taylor's theorem, and all the powers after the first may be neglected. The matter is not so simple as it is often represented, when the variable elements may assume large, perhaps infinite, values; but with the aid of the postulate above enunciated the difficulty can be overcome.[6]

Extension to two or more Dimensions.

114. All the proofs which have been noticed have been extended to errors in two (or more) dimensions.[7] Let Q be the sum of a number of elements, each of which, being a function of two variables, x and y, assumes different pairs of values according to a law of frequency $z_r=f_r(x, y)$, the functions being in general different for different elements. The frequency with which Q assumes values of the variables between x and $+\Delta x$ and between y and $y+\Delta y$ is $z\Delta x\Delta y$, if

$$z=\frac{1}{2\pi\sqrt{km-l^2}}\exp-\frac{m(x-a)^2-2l(x-a)(q-b)+k(y-b)^2}{2(km-l^2)};$$

where, as in the simpler case, $a=\Sigma a_r$, a_r being the arithmetic mean of the values of x assumed in the long run by one of the elements, b is the corresponding sum for values of y, and

$$k=\Sigma\left[\iint(x-a_r)^2f_r(x, y)dxdy\right]$$
$$m=\Sigma\left[\iint(y-b_r)^2f_r(x, y)dxdy\right]$$
$$l=\Sigma\left[\iint(x-a_r)(y-b_r)f_r(x, y)dxdy\right];$$

the summation extending over all the elements, and the integration between the extreme limits of each; supposing that the law of frequency for each element is continuous, otherwise summation is to be substituted for integration. For example, let each element be constituted as follows: Three coins having been tossed, the number of heads presented by the first and second coins together is put for x, the number of heads presented by the second and third coins together is put for y. The law of frequency for the element is represented in fig. 11, the integers outside denoting the values of x or y, the fractions inside probabilites of particular values of x and y concurring.

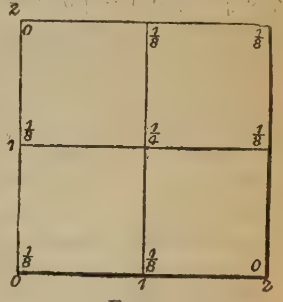

FIG. 11.

If i is the distance from 0 to 1 and from 1 to 2 on the abscissa, and i' the corresponding distance on the ordinate, the mean of the values of x for the element—Δa, as we may say,—is i, and the corresponding mean square of horizontal deviations is $\frac{1}{2}i^2$. Likewise $\Delta b=i'$; $\Delta m=\frac{1}{2}i'^2$; and $\Delta l=\frac{1}{8}(+i\times+i'-i\times-i')$ $=\frac{1}{4}ii'$. Accordingly, if n such elements are put together (if n *steps* of the kind which the diagram represents are taken), the frequency with which a particular pair of aggregates x and y will concur, with which a particular point on the plane of xy, namely, $x=ri$ and $y=ri$, will be reached, is given by the equation

$$z=\frac{1}{2\pi}\sqrt{\frac{16}{3n}}\exp-\frac{8}{3n}\left[(r-n)^2i^2-(r-n)(r'-n)ii'+(r'-u)i'^2\right]^8.$$

115. A verification is afforded by a set of statistics obtained with dice by Weldon, and here reproduced by his permission. A *success* is in this experiment defined, not by obtaining a head when a coin is tossed, but by obtaining a face with more than three points on it when a die is tossed; the probabilities of the two events are the same, or rather would be if coins and dice were perfectly symmetrical.[9] Professor Weldon virtually took six *steps* of the sort above described when, six painted dice having been thrown, he added the number of successes in that painted batch to the number of successes in another batch of six to form his x, and to the number of successes in a *third* batch of six to form his y. The result is represented in the annexed table, where each degree on the axis of x and y respectively corresponds to the i and i' of the preceding paragraphs, and $i=i'$. The observed frequencies being represented by numerals, a general correspondence between the facts and the formula is apparent.

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[1] The *Analyst* (Iowa), vols. v., vi., vii. *passim*; and especially vi. 142 seq., vii. 172 seq.

[2] Morgan Crofton, *loc. cit.* p. 781, col. *a.* The principle has been used by the present writer in the *Phil. Mag.* (1883), xvi. 301.

[3] For a criticism and extension of Crofton's proof see the already cited paper on "The Law of Error," *Camb. Phil. Trans.* (1905), pt. i. § 2. Space does not permit the reproduction of Crofton's proof as given in the 9th ed. of the *Ency. Brit.* (art. "Probability," § 48).

[4] *Loc. cit.* pt. I. § 4; and app. 6.

[5] *Loc. cit.* p. 122 seq.

[6] *Loc. cit.* pt. ii. § 7.

[7] The second by Burbury, in *Phil. Mag.* (1894), xxxvii. 145; the third by its author in the *Analyst* for 1881; and the remainder by the present writer in *Phil. Mag.* (1896), xii. 247; and *Camb. Phil. Trans.* (1905), *loc. cit.*

[8] Compare the formula for the simple case above, § 4.

[9] On the irregularity of the dice with which Weldon experimented, see Pearson, *Phil. Mag.* (1900), p. 167.

The maximum frequency is, as it ought to be, at the point $x=6i$, $y=6i'$. The density is particularly great along a line through that point, making 45° with the axis of x; particularly small in the complementary direction. This also is as it ought to be. For if the centre is made the origin by substituting x for $(x-a)$ and y for $(y-b)$, and then new co-ordinates X and Y are taken, making an angle θ with x and y respectively, the curve which is traced on the plane of zX by its intersection with the surface is of the form

$$z=\mathrm{J}\exp-\mathrm{X}^2[k\sin^2\theta-2l\cos\theta\sin\theta+m\cos^2\theta]/2(km-l^2),$$

a probability-curve which will be more or less spread out according as the factor $k\sin^2\theta-2l\cos\theta\sin\theta+m\cos^2\theta$ is less or greater. Now this expression has a minimum or maximum when $(k-m)\sin\theta-2l\cos 2\theta=0$; a minimum when $(k-m)\cos 2\theta+2l\sin 2\theta$ is positive, and a maximum when that criterion is negative; that is, in the present case, where $k=m$, a minimum when $\theta=\frac{1}{4}\pi$ and a maximum when $\theta=\frac{3}{4}\pi$.

	0	1	2	3	4	5	6	7	8	9	10	11	12
12													
11							1	1	5	1		1	
10						2	6	28	27	19	2		
9				1	2	11	43	76	57	54	15	4	
8				6	18	49	116	138	118	59	25	5	
7				12	47	109	208	213	118	71	23	1	
6			9	29	77	199	244	198	121	32	3		
5		3	12	51	119	181	200	129	69	18	3		
4		2	16	55	100	117	91	46	19	3			
3		2	14	28	53	43	34	17	1				
2			7	12	13	18	4	1	1				
1			2	4	1	2	1						
0													

116. *Characteristics of the Law of Error.*[1]—As may be presumed from the examples just given, in order that there should be some approximation to the normal law the number of elements need not be very great. A very tolerable imitation of the probability-curve has been obtained by superposing *three* elements, each obeying a law of frequency quite different from the normal one,[2] namely, that simple law according to which one value of a variable occurs as frequently as another between the limits within which the variation is confined ($y=1/2a$, between limits $x=+a$, $x=-a$). If the component elements obey unsymmetrical laws of frequency, the compound will indeed be to some extent unsymmetrical, unlike the "normal" probability-curve. But, as the number of the elements is increased, the portion of the compound curve in the neighbourhood of its centre of gravity tends to be rounded off into the normal shape. The portion of the compound curve which is sensibly identical with a curve of the "normal" family becomes greater the greater the number of independent elements; *caeteris paribus*, and granted certain conditions as to the equality and the range of the elements. It will readily be granted that if one component predominates, it may unduly impress its own character on the compound. But it should be pointed out that the characteristic with which we are now concerned is not average magnitude, but deviation from the average. The component elements may be very unequal in their contributions to the average magnitude of the compound without prejudice to its "normal" character, provided that the fluctuation of all or many of the elements is of one and the same order. The proof of the law requires that the contribution made by each element to the mean square of deviation for the compound, k, should be small, capable of being treated as differential with respect to k. It is not necessary that all these small quantities should be of the same order, but only that they should admit of being rearranged, by massing together those of a smaller order, as a numerous set of independent elements in which no two or three stand out as *sui generis* in respect of the magnitude of their fluctuation. For example, if one element consist of the number of points on a domino (the sum of two digits taken at random), and other elements, each of either 1 or 0 according as heads or tails turn up when a coin is cast, the first element, having a mean square of deviation 16·5, will not be of the same order as the others, each having 0·25 for its mean square of deviation. But *sixty-six* of the latter taken together would constitute an independent element of the same order as the first one; and accordingly if there are several times sixty-six elements of the latter sort, along with one or two of the former sort, the conditions for the generation of the normal distribution will be satisfied. These propositions would evidently be unaffected by altering the average magnitude, without altering the deviation from the average, for any element, that is, by adding a greater or less *fixed* magnitude to each element. The propositions are adapted to the case in which the elements fluctuate according to a law of frequency other than the normal. For if they are already normal, the aforesaid conditions are unnecessary. The normal law will be obeyed by the sum of elements which each obey it, even though they are not numerous and not independent and not of the same order in respect of the extent of fluctuation. A similar distinction is to be drawn with respect to some further conditions which the reasoning requires. A limitation as to the range of the elements is not necessary when they are already normal, or even have a certain affinity to the normal curve. Very large values of the element are not excluded, provided they are sufficiently rare. What has been said of curves with special reference to one dimension is of course to be extended to the case of surfaces and many dimensions. In all cases the theorem that under the conditions stated the normal law of error will be generated is to be distinguished from the hypothesis that the conditions are fairly well fulfilled in ordinary experience.

(B) Verification of the Normal Law.

117. Having deduced the genesis of the law of error from ideal conditions such as are attributed to perfectly fair games of chance, we have next to inquire how far these conditions are realized and the law fulfilled in common experience.

Errors proper.

118. Among important concrete cases errors of observation occupy a leading place. The theory is brought to bear on this case by the hypothesis that an error is the algebraic sum of numerous elements, each varying according to a law of frequency special to itself. This hypothesis involves two assumptions: (1) that an error is dependent on numerous independent causes; (2) that the function expressing that dependence can be treated as a linear function, by expanding in terms of ascending powers (of the elements) according to Taylor's theorem and neglecting higher powers, or otherwise. The first assumption seems, in Dr Glaisher's words, "most natural and true. In any observation where great care is taken, so that no large error can occur, we can see that its accuracy is influenced by a great number of circumstances which ultimately depend on independent causes: the state of the observer's eye and his physiological condition in general, the state of the atmosphere, of the different parts of the instrument, &c., evidently depend on a great number of causes, while each contributes to the actual error."[3] The second assumption seems to be frequently realized in nature. But the assumption is not always safe. For example, where the velocities of molecules are distributed according to the normal law of error, with zero as centre, the *energies* must be distributed according to a quite different law. This rationale is applicable not only to the fallible perceptions of the senses, but also to impressions into which a large ingredient of inference enters, such as estimates of a man's height or weight from his appearance,[4] and even higher acts of judgment.[5] Aiming at an object is an act similar to measuring an object, misses are produced by much the same variety of causes as mistakes; and, accordingly, it is found that shots aimed at the same bull's-eye are apt to be distributed according to the normal law, whether in two dimensions on a target or according to their horizontal deviations, as exhibited below (par. 156).

Miscellaneous Statistics.

A residual class comprises miscellaneous statistics, physical as well as social, in which the normal law of error makes its appearance, presumably in consequence of the action of numerous independent influences. Well-known instances are afforded by human heights and other bodily measurements, as tabulated by Quetelet[6] and others.[7] Professor Pearson has found that "the normal curve suffices to describe within the limits of random sampling the distribution of the chief characters in man."[8] The tendency of social phenomena to conform to the normal law of frequency is well exemplified by A. L. Bowley's grouping of the wages paid to different classes.[1]

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[1] Experiments *in pari materia* performed by A. D. Darbishire afford additional illustrations. See "Some Tables for illustrating Statistical Correlation," *Mem.* and *Proc. Man. Lit., and Phil. Soc.*, vol. li. pt. iii.

[2] *Journ. Stat. Soc.* (March 1900), p. 73, referring to Burton, *Phil. Mag.* (1883), xvi. 301.

[3] *Memoirs of Astronomical Society* (1878), p. 105.

[4] *Journ. Stat. Soc.* (1890), p. 462 seq.

[5] *E.g.* the marking of the same work by different examiners. Ibid.

[6] *Lettres sur la théorie des probabilités* and *Physique sociale*.

[7] *E.g.* the measurements of Italian recruits, adduced in the *Atlante statistico*, published under the direction of the Ministero de Agricultura (Rome, 1882); and Weldon's measurements of crabs, *Proc. Roy. Soc.* liv. 321; discussed by Pearson in the *Trans. Roy. Soc.* (1894), vol. clxxxv. A.

[8] *Biometrika*, iii. 395. Cf. ibid. p. 141.

A Variant Classification.

119. The division of concrete errors which has been proposed is not to be confounded with another twofold classification, namely, observations which stand for a real objective thing, and such statistics as are not thus representative of something outside themselves, groups of which the mean is called "subjective." This division would be neither clear nor useful. On the one hand so-called real means are often only approximately equal to objective quantities. Thus the proportional frequency with which one face of a die—the *six* suppose—turns up is only approximately given by the objective fact that the *six* is one face of a nearly perfect cube. For a set of dice with which Weldon experimented, the average frequency of a throw, presenting either five or six points, proved to be not ·3, but 0·3377.[2] The difference of this result from the regulation 0·3 is as unpredictable from objective data, prior to experiment, as any of the means called subjective or fictitious. So the mean of errors of observation often differs from the thing observed by a so-called "constant error." So shots may be constantly deflected from the bull's-eye by a steady wind or "drift."

120. On the other hand, statistics, not purporting to represent a real object, have more or less close relations to magnitudes which cannot be described as fictitious. Where the items averaged are ratios, *e.g.* the proportion of births or deaths to the total population in several districts or other sections, it sometimes happens that the distribution of the ratios exactly corresponds to that which is obtained in the simplest games of chance—"combinational" distribution in the phrase of Lexis.[3] There is unmistakably suggested a *sortition* of the simplest type, with a real ascertainable relation between the number of "favourable cases" and the total number of cases. The most remarkable example of this property is presented by the proportion of male to female (or to total) births. Some other instances are given by Lexis[4] and Westergaard.[5] A similar correspondence between the actual and the "combinational" distribution has been found by Bortkevitch[6] in the case of very small probabilities (in which case the law of error is no longer "normal"). And it is likely that some ratios—such as general death-rates—not presenting combinational distribution, might be broken up into subdivisions—such as death-rates for different occupations or age-periods—each distributed in that simple fashion.

121. Another sort of averages which it is difficult to class as subjective rather than objective occurs in some social statistics, under the designation of index-numbers. The percentage which represents the change in the value of money between two epochs is seldom regarded as the mere average change in the price of several articles taken at random, but rather as the measure of something, *e.g.* the variation in the price of a given amount of commodities, or of a unit of commodity.[7] So something substantive appears to be designated by the *volume of trade*, or that of the *consumption of the working classes*, of which the growth is measured by appropriate *index-numbers*,[8] the former due to Bourne and Sir Robert Giffen,[9] the latter to George Wood.[10]

122. But apart from these peculiarities, any set of statistics may be related to a certain *quaesitum*, very much as measurements are related to the object measured. That *quaesitum* is the limiting or ultimate mean to which the series of statistics, if indefinitely prolonged, would converge, the mean of the complete group; this conception of a limit applying to any *frequency-constant*, to "*c*," for instance, as well as "*a*" in the case of the normal curve.[11] The given statistics may be treated as samples from which to reason up to the true constant by that principle of the calculus which determines the comparative probability of different causes from which an observed event may have emanated.[12]

123. Thus it appears that there is a characteristic more essential to the statistician than the existence of an objective *quaesitum*, namely, the use of that method which is primarily, but not exclusively, proper to that sort of *quaesitum*—*inverse probability*.[13] Without that delicate instrument the doctrine of error can seldom be fully utilized; but some of its uses may be indicated before the introduction of technical difficulties.

Applications of the Normal Law.

124. Having established the prevalence of the law of error,[14] we go on to its applications. The mere presumption that wherever three or four independent causes co-operate, the law of error tends to be set up, has a certain speculative interest.[15] The assumption of the law as a hypothesis is legitimate. When the presumption is confirmed by specific experience this knowledge is apt to be turned to account. It is usefully applied to the practice of gunnery,[16] to determine the proportion of shots which under assigned conditions may be expected to hit a zone of given size. The expenditure of ammunition required to hit an object can thence be inferred. Also the comparison between practice under different conditions is facilitated. In many kinds of examination it is found that the total marks given to different candidates for answers to the same set of questions range approximately in conformity with the law of error. It is understood that the civil service commissioners have founded on this fact some practical directions to examiners. Apart from such direct applications, it is a useful addition to our knowledge of a class that the measurable attributes of its members range in conformity with this general law. Something is added to the truth that "the days of a man are threescore and ten," if we may regard that epoch, or more exactly for England, 72, as "Nature's aim, the length of life for which she builds a man, the dispersion on each side of this point being . . . nearly normal."[17] So Herschel says: "An [a mere] average gives us no assurance that the future will be like the past. A [normal] mean may be reckoned on with the most complete confidence."[18] The existence of independent causes,[19] inferred from the fulfilment of the normal law, may be some guarantee of stability. In natural history especially have the conceptions supplied by the law of error been fruitful. Investigators are already on the track of this inquiry: if those members of a species whose size or other measurable attributes are above (or below) the average are preferred—by "natural" or some other kind of selection—as parents, how will the law of frequency as regards that attribute be modified in the next generation?

Normal Distribution of Molecular Velocities.

125. A particularly perfect application of the normal law of error in more than one dimension is afforded by the movements of the molecules in a homogeneous gas. A general idea of the rôle played by probabilities in the explanation of these movements may be obtained without entering into the more complicated and controverted parts of the subject, without going beyond the initial very abstract supposition of perfectly elastic equal spheres. For convenience of enunciation we may confine ourselves to two dimensions. Let us imagine, then, an enormous billiard-table with perfectly elastic cushions and a frictionless cloth on which millions of perfectly elastic balls rush hither and thither at random—colliding with each other—a homogeneous chaos, with that sort of uniformity in the midst of diversity which is characteristic of probabilities. Upon this hypothesis, if we fix attention on any n balls taken at random—they need not be, according to some they ought not to be, contiguous—if n is very large, the average properties will be approximately the same as those of the total mixture. In particular the average energy of the n balls may be equated to the average energy of the total number of balls, say T/N, if T is the total energy and N the total number of the balls. Now if we watch any one of the n specimen balls long enough for it to undergo a great number of collisions, we observe that either of its velocity-components, say that in the direction of x, viz. u, receives accessions from an immense number of independent causes in random fashion. We may presume, therefore, that these will be distributed (among the n balls) according to the law of error. The law will not be of the type which was first supposed, where the "spread" continually increases as the number of the elements is increased.[20] Nor will it be of the type which was afterwards mentioned[21] where the spread diminishes as the number of the elements is increased. The linear function by which the elements are aggregated is here of an intermediate type; such that the mean square of deviation corresponding to the velocity remains constant. The method of composition might be illustrated by the process of taking r digits at random from mathematical tables adding the differences between each digit and 4·5 the mean value of digits, and dividing the sum by $\sqrt{r}$. Here are some figures obtained by taking at random batches of sixteen digits from the expansion of π, subtracting $16 \times 4{\cdot}5$ from the sum of each batch, and dividing the remainder by $\sqrt{16}$:—

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[1] *Wages in the United Kingdom in the Nineteenth Century*; and art. "Wages" in the *Ency. Brit.*, 10th ed., vol. xxxiii.

[2] *Phil. Mag.* (1900), p. 168.

[3] Cf. *Journ. Stat. Soc.*, Jubilee No., p. 192.

[4] *Massenerscheinungen.*

[5] *Grundzüge der Statistik.* Cf. Bowley, *Elements of Statistics*, p. 302.

[6] *Das Gesetz der kleinen Zahlen.*

[7] See for other definitions *Report of the British Association* (1889), pp. 136 and 161, and compare Walsh's exhaustive *Measurement of General Exchange-Value.*

[8] Cf. Bowley, *Elements of Statistics*, ch. ix.

[9] *Journ. Stat. Soc.* (1874 and later). Parly. Papers [C. 2247] and [C. 3079].

[10] "Working-Class Progress since 1860," *Journ. Stat. Soc.* (1899), p. 639.

[11] On this conception compare Venn, *Logic of Chance*, chs. iii. and iv., and Sheppard, *Proc. Lond. Math. Soc.*, p. 363 seq.

[12] Laplace's 6th principle, *Théorie analytique*, intro. x.

[13] See above, pars. 13 and 14.

[14] Cf. above, par. 102.

[15] Cf. Galton's enthusiasm, *Natural Inheritance*, p. 66.

[16] A lucid statement of the methods and results of probabilities applied to gunnery is given in the *Official Text-book of Gunnery* (1902).

[17] Venn, *Journ. Stat. Soc.* (1891), p. 443.

[18] *Ed. Rev.* (1850), xcii. 23.

[19] Cf. Galton, *Phil. Mag.* (1875), xlix. 44.

[20] Above, par. 112.

[21] Ibid.

+1·25, +0·75, −1, −1, +5·5, −2·75, +0·75, −2,
+1·75, +3·25, +0·25, −2·75, −2·25, −0·5, +4·75, +0·25.

If, instead of sixteen, a million digits went to each batch, the general character of the series would be much the same; the aggregate figures would continue to hover about zero with a standard deviation of 8·25, a probable error of nearly 2. Here for instance are seven aggregates formed by recombining 252 out of the 256 digits above utilized into batches of 36 according to the prescribed rule: viz. subtracting 36×4·5 from the sum of each batch of 36 and dividing the remainder by √36:—

−0·5, +3·3, +2·6, −0·6, +1·5, −2, +1.

The illustration brings into view the circumstance that though the system of molecules may start with a distribution of velocities other than the normal, yet by repeated collisions the normal distribution will be superinduced. If both the velocities u and v are distributed according to the law of error for one dimension, we may presume that the joint values of u and v conform to the normal surface. Or we may reason directly that as the pair of velocities u and v is made up of a great number of elementary pairs (the co-ordinates in each of which need not, initially at least, be supposed uncorrelated) the law of frequency for concurrent values of u and v must be of the normal form which may be written [1]

$$z = \frac{1}{2\sqrt{(km\,.\,1-r^2)}}\exp-\left[\frac{x^2}{k}-2r\frac{xy}{\sqrt{km}}+\frac{y^2}{m}\right]/2(1-r^2).$$

It may be presumed that r, the coefficient of correlation, is zero, for, owing to the symmetry of the influences by which the molecular chaos is brought about, it is not to be supposed that there is any connexion or repugnance between one direction of u, say south to north, and one direction of v, say west to east. For a like reason k must be supposed equal to m. Thus the average velocity $=2k$; which multiplied by m, the mass of a sphere, is to be equated to the average energy T/N. The reasoning may be extended with confidence to three dimensions, and with caution to contiguous molecules.

Normal Correlation in Biology.

126. Correlation cannot be ignored in another application of the many-dimensioned law of error, its use in biological inquiries to investigate the relations between different generations. It was found by Galton that the heights and other measurable attributes of children of the same parents range about a mean which is not that of the parental heights, but nearer the average of the general population. The amount of this "regression" is simply proportional to the distance of the "mid-parent's" height from the general average. This is a case of very general law which governs the relations not only between members of the same family, but also between members of the same organism, and generally between two (or more) coexistent or in any way co-ordinated observations, each belonging to a normal group. Let x and y be the measurements of a pair thus constituted. Then [2] it may be expected that the conjunction of particular values for x and y will approximately obey the two-dimensioned normal law which has been already exhibited (see par. 114).

127. *Regression-lines.*—In the expression above given, put $l/\sqrt{km}=r$, and the equation for the frequency of pairs having values of the attribute under measurement becomes

$$z=\frac{1}{2\pi\sqrt{km}\sqrt{1-r^2}}\exp\left[\frac{(x-a)^2}{k}-2r\frac{(x-a)(y-b)}{\sqrt{k}\;\sqrt{m}}+\frac{(y-b)^2}{m}\right]/2(1-r^2).$$

This formula is of very general application.[3] If two sets of measurements were made on the height, or other measurable feature, of the proverbial "Goodwin Sands" and "Tenterden Steeple," and the first measurement of one set was coupled with the first of the other set, the second with the second, and so on, the pairs of magnitudes thus presented would doubtless vary according to the above-written law, only in that case r would presumably be zero; the expression for z would reduce to the product of the two *independent* probabilities that particular values of x and y should concur. But slight interdependences between things supposed to be totally unconnected would often be discovered by this law of error in two or more dimensions.[4] It may be put in a more convenient form by substituting ξ for $(x-a)/\sqrt{k}$ and η for $(y-b)/\sqrt{m}$. The equation of the surface then becomes $z = (1/2\pi\sqrt{1-r^2})\exp-[\xi^2-2r\xi\eta+\eta^2]/2(1-r^2)$. If the frequency of observations in the vicinity of a point is represented by the number of dots in a small increment of area, when $r=0$ the dots will be distributed uniformly about the origin, the *curves of equal probability* will be circles. When r is different from zero the dots will be distributed so that the majority will be massed in two quadrants: in those for which ξ and η are both positive or both negative when r is positive, in those for which ξ and η have opposite signs when r is negative. In the limiting case, when $r=1$ the whole host will be massed along the line $\eta=\xi$, every deviation ξ being attended with an equal deviation η. In general, to any deviation of one of the variables ξ' there corresponds a set or "array" (Pearson) of values of the other variable; for which the frequency is given by substituting ξ' for ξ in the general equation. The section thus obtained proves to be a normal probability-curve with standard deviation $\sqrt{(1-r^2)}$. The most probable value of η corresponding to the assigned value of ξ is $r\xi'$. The equation $\eta-r\xi$, or rather what it becomes when translated back to our original co-ordinates $(y-b)/\sigma_2=r(x-a)\sigma_1$, where σ_1, σ_2 are our $\sqrt{k}$, $\sqrt{m}$ respectively,[5] is often called a *regression-equation.* A verification is to hand in the above-cited statistics, which Weldon obtained by casting batches of dice. If the dice were perfect, r $(=l/\sqrt{km})$ would equal $\frac{1}{2}$, and as the dice proved not to be very imperfect, the coefficient is doubtless approximately $=\frac{1}{2}$. Accordingly, we may expect that, if axes x and y are drawn through the point of maximum-frequency at the centre of the compartment containing 244 observations, corresponding to any value of x, say $2\nu i$ (where i is the side of each square compartment), the most probable value of y should be νi, and corresponding to $y=2\nu i$ the most probable value of x should be νi. And in fact these regression-equations are fairly well fulfilled for the *integer* values of ν (more than which could not be expected from *discrete* observations): *e.g.* when $x=+4i$, the value of y, for which the frequency (25) is a maximum, is as it ought to be $+2i$; when $x=-2i$ the maximum (119) is at $y=-i$; when $x=-4i$ the maximum (16) is at $y=-2i$; when y is $+2i$ the maximum (138) is at $x=+i$; when y is $-2i$ the maximum (117) at $x=-i$, and in the two cases ($x=+2i$ and $y=+4i$), where the fulfilment is not exact, the failure is not very serious.

128. Analogous statements hold good for the case of three or more dimensions of error.[6] The normal law of error for any number of variables, x_1 x_2 x_3, may be put in the form $z=(1(2\pi)n/2\sqrt{\Delta})\exp-[R_{11}x_1^2+R_{22}x_2^2+\&c.+2R_{12}x_1x_2+\&c.]/2\Delta$ where Δ is the determinant:—

$$\begin{array}{ccc} 1 & r_{12} & r_{13}\,\cdot\cdot \\ r_{21} & 1 & r_{23}\,\cdot\cdot \\ r_{31} & r_{32} & 1\;\cdot\cdot \\ : & : & :: \end{array}$$

each r, *e.g.* r_{23} $(=r_{32})$, is the coefficient of correlation between two of the variables, *e.g.* x_2, x_3; R_{11} is the first minor of the determinant formed by omitting the first row and first column; R_{22} is the first minor formed by omitting the second row and the second column, and so on; R_{12} $(=R_{21})$ is the first minor formed by omitting the first column and second row (or vice versa). The principle of correlation plays an important rôle in natural history. It has replaced the notion that there is a simple proportion between the size of organs by the appropriate conception that there are simple proportions existing between the *deviation* from the average of one organ and the *most probable* value for the coexistent deviation of the other organ from its average.[7] Attributes favoured by "natural" or other selection are found to be *correlated* with other attributes which are not directly selected. The extent to which the attributes of an individual depend upon those of his ancestors as measured by correlation.[8] The principle is instrumental to most of the important "mathematical contributions" which Professor Pearson has made to the theory of evolution.[9] In social inquiries, also, the principle promises a rich harvest. Where numerous fluctuating causes go to produce a result like pauperism or immunity from small-pox, the ideal method of eliminating chance would be to construct "regression-equations" of the following type: "Change % in pauperism [in the decade 1871–1881] in rural districts = −27·07 %, +0·299 (change % out-relief ratio), +0·271 (change % on proportion of old), + ·064 (change % in population)."[10]

Determination of Constants by the Inverse Method.

129. In order to determine the best values of the coefficients involved in the law of error, and to test the worth of the results obtained by using any values, recourse must be had to *inverse probability.*

130. The simplest problem under this head is where the *quaesitum* is a single real object and the data consist of a large number of observations, $x_1, x_2, \ldots x_n$, such that if the number were indefinitely increased, the completed series would form a normal probability-curve with the true point as its centre, and having a given modulus c. It is as if we had observed the position of the dints made by the fragments

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[1] Above, par. 114, and below, par. 127.

[2] Some plurality of independent causes is presumable.

[3] Herschel's a priori proposition concerning the law of error in two dimensions (above, par. 99) might still be defended either as *generally* true, so many phenomena showing no trace of interdependence, or on the principle which justifies our putting $\frac{1}{2}$ for a probability that is unknown (above, par. 6), or 5 for a decimal place that is neglected; correlation being equally likely to be positive or negative. The latter sort of explanation may be offered for the less serious contrast between the a priori and the empirical proof of the law of error in one dimension (below, par. 158).

[4] Cf. above, par. 115.

[5] Cf. note to par. 98, above.

[6] *Phil. Mag.* (1892), p. 200 seq.; 1896, p. 211; Pearson, *Trans. Roy. Soc.* (1896), 187, p. 302; Burbury, *Phil. Mag.* (1894), p. 145.

[7] Pearson, "On the Reconstruction of Prehistoric Races," *Trans. Roy. Soc.* (1898), A, p. 174 seq.; *Proc. Roy. Soc.* (1898), p. 418.

[8] Pearson, "The Law of Ancestral Heredity," *Trans. Roy. Soc.*; *Proc. Roy. Soc.* (1898).

[9] Papers in the Royal Society since 1895.

[10] An example instructively discussed by Yule, *Journn. Stat. Soc.* (1899).

of an exploding shell so far as to know the distance of each mark measured (from an origin) along a right line, say the line of an extended fortification, and it was known that the shell was fired perpendicular to the fortification from a distant ridge parallel to the fortification, and that the shell was of a kind of which the fragments are scattered according to a normal law[1] with a known coefficient of dispersion; the question is at what position on the distant ridge was the enemy's gun probably placed? By received principles the probability, say P, that the given set of observations should have resulted from measuring (or aiming at) an object of which the real position was between x and $x + \Delta x$ is

$$\Delta x \ \mathrm{J} \exp - [(x - x_1)^2 + (x - x_2)^2 + \&c.]/c^2;$$

where J is a constant obtained by equating to unity $\int_{-\infty}^{+\infty} \mathrm{P}dx$ (since the given set of observations must have resulted from some position on the axis of x). The value of x, from which the given set of observations *most probably* resulted, is obtained by making P a *maximum*. Putting $d\mathrm{P}/dx = 0$, we have for the maximum ($d^2\mathrm{P}/dx^2$ being negative for this value) the arithmetic mean of the given observations. The accuracy of the determination is measured by a probability-curve with modulus $c/\sqrt{n}$. This in the course of a very long siege if every case in which the given group of shell-marks $x_1, x_2, \ldots x_n$ was presented could be investigated, it would be found that the enemy's cannon was fired from the position x', the (point right opposite to the) arithmetic mean of x_1, x_2, &c., x_n, with a frequency assigned by the equation

$$z = (\sqrt{n}/\sqrt{\pi c}) \exp - n(x - x')^2/c^2.$$

The reasoning is applicable without material modification to the case in which the data and the *quaesitum* are not absolute quantities, but proportions; for instance, given the percentage of white balls in several large batches drawn at random from an immense urn containing black and white balls, to find the percentage of white balls in the urn—the inverse problem associated with the name of Bayes.

131. Simple as this solution is, it is not the one which has most recommended itself to Laplace. He envisages the *quaesitum* not so much as that point which is *most probably* the real one, as that point which may *most advantageously* be put for the real one. In our illustration it is as if it were required to discover from a number of shot-marks not the point[2] which in the course of a long siege would be most frequently the position of the cannon which had scattered the observed fragments but the point which it would be best to treat as that position—to fire at, say, with a view of silencing the enemy's gun—having regard not so much to the frequency with which the direction adopted is right, as to the extent to which it is wrong in the long run. As the measure of the detriment of error, Laplace[3] takes "la valeur moyenne de l'erreur à craindre," the mean first power of the errors taken positively on each side of the real point. The mean spare of errors is proposed by Gauss as the criterion.[4] *Any* mean power indeed. the integral of any function which increases in absolute magnitude with the increase of its variable, taken as the measure of the detriment, will lead to the same conclusion, if the normal law prevails.[5]

132. Yet another speculative difficulty occurs in the simplest, and recurs in the more complicated inverse problem. In putting P as the probability, deduced from the observations that the real point for which they stand is x (between x and $x + \Delta x$), it is tacitly assumed that prior to observation one value of x is as probable as another. In our illustration it must be assumed that the enemy's gun was as likely to be at one point as another of (a certain tract of) the ridge from which it was fired. If, apart from the evidence of the shell-marks, there was any reason for thinking that the gun was situated at one point rather than another, the formula would require to be modified. This a priori probability is sometimes grounded on our *ignorance*; according to another view, the procedure is justified by a rough general knowledge that over a tract of x for which P is sensible one value of x occurs about as often as another.[6]

133. Subject to similar speculative difficulties, the solution which has been obtained may be extended to the analogous problem in which the *quaesitum* is not the real value of an observed magnitude, but the mean to which a series of statistics indefinitely prolonged converges.[7]

134. Next, let the modulus, still supposed given, not be the same for all the observations, but c_1 for x_1, c_2 for x_2, &c. Then P becomes proportional to

$$\exp - [(x - x_1)^2/c_1^2 + (x - x_2)^2/c_2^2 + \&c.].$$

And the value of x which is both the most probable and the "most advantageous" is $(x_1/c_1^2 + x_2/c_2^2 + \&c.)/(1/c_1^2 + 1/c_2^2 + \&c.)$; each observation being weighted with the inverse mean square of observations made under similar conditions.[8] This is the rule prescribed by the "method of least squares"; but as the rule in this case has been deduced by genuine inverse probability, the problem does not exemplify what is most characteristic in that method, namely, that a rule deducible from the hypothesis that the errors of observations obey the normal law of error is employed in cases where the normal law is not known, or even is known not, to hold good. For example, let the curve of error for each observation be of the form of

$$z = [1/\sqrt{(\pi c)}] \times \exp[- x^2/c^2 - 2j(x/c - 2x^3/3c^3)],$$

where j is a small fraction, so that z may equally well be equated to $(1/\sqrt{\pi c})[1 - 2j(x/c - 2x^3/3c^3)] \exp - x^2/c^2$, a law which is actually very prevalent. Then, according to the genuine inverse method, the most probable value of x is given by the quadratic equation $\frac{d}{dx}\log \mathrm{P} = 0$, where $\log \mathrm{P} = \text{const.} - \Sigma(x - x_r)^2/c_r^2 - \Sigma 2j[(x - x_r)^3/c_r^3 - 2(x - x_r)^3/3c_r^3]$, Σ denoting summation over all the observations. According to the "method of least squares," the solution is the weighted arithmetic mean of the observations, the weight of any observation being inversely proportional to the corresponding mean square, *i.e.* $c_r^2/2$ (the terms of the integral which involve j vanishing), which would be the solution if the j's are all zero. We put for the solution of the given case what is known to be the solution of an essentially different case. How can this paradox be justified?

Method of least Squares.

135. Many of the answers which have been given to this question seem to come to this. When the data are unmanageable, it is legitimate to attend to a part thereof, and to determine the most probable (or the "most advantageous") value of the *quaesitum*, and the degree of its accuracy, from the selected portion of the data as if it formed the whole. This throwing overboard of part of the data in order to utilize the remainder has often to be resorted to in the rough course of applied probabilities. Thus an insurance office only takes account of the age and some other simple attributes of its customers, though a better bargain might be made in particular cases by taking into account all available details. The nature of the method is particularly clear in the case where the given set of observations consists of several batches, the observations in any batch ranging under the same law of frequency with mean x'_r and mean square of error k_r, the function and the constants different for different batches; then if we confine our attention to those parts of the data which are of the type x'_r and k_r—ignoring what else may be given as to the laws of error—we may treat the x'_r's as so many observations, each ranging under the normal law of error with its coefficient of dispersion; and apply the rules proper to the normal law. Those rules applied to the data, considered as a set of derivative observations each formed by a batch of the original observations) averaged, give as the most probable (and also the most advantageous combination of the observations the arithmetic mean weighted according to the inverse mean square pertaining to each observation, and for the law of the error to which the determination is liable the normal law with standard deviation[9] $\sqrt{(\Sigma k/n)}$—the very rules that are prescribed by the method of least squares.

136. The principle involved might be illustrated by the proposal to make the economy of datum a little less rigid: to utilize, not indeed all, but a little more of our materials—not only the mean square of error for each batch, but also the mean cube of error. To begin with the simple case of a single homogeneous batch: suppose that in our example the fragments of the shell are no longer scattered according to the normal law. By the method of least squares it would still be proper to put the arithmetic mean to the given observations for the true point required, and to measure the accuracy of that determination by a probability-curve of which the modulus is $\sqrt{(2k)}$, where k is the mean square of deviation (of fragments from their mean). If it is thought desirable to utilize more of the data there is available, the proposition that the arithmetic mean of a

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[1] If normally in any direction indifferently according to the two- or three-dimensioned law of error, then normally in one dimension when collected and distributed in *belts* perpendicular to a horizontal right line, as in the example cited below, par. 155.

[2] Or small interval (cf. preceding section).

[3] "Toute erreur soit positive soit négative doit être considerée comme un désavantage ou une perte réelle à un jeu quelconque," *Théorie analytique*, art. 20 seq., especially art. 25. As to which it is acutely remarked by Bravais (*op. cit.* p. 258), "Cette règle simple laisse à désirer une démonstration rigoureuse, car l'analogue du cas actuel avec celui des jeux de hasard est loin d'être complète."

[4] *Theoria combinationis*, pt. i. § 6. Simon Newcomb is conspicuous by walking in the way of Laplace and Gauss in his preference of the *most advantageous* to the *most probable* determinations. With Gauss he postulates that "the evil of an error is proportioned to the square of its magnitude" (*American Journal of Mathematics*, vol. viii. No. 4).

[5] As argued by the present writer, *Camb. Phil. Trans.* (1885), vol. xiv. pt. ii. p. 161. Cf. Glaisher, *Mem. Astronom. Soc.* xxxix. 108.

[6] The view taken by the present writer on the "Philosophy of Chance," in *Mind* (1880; approved by Professor Pearson, *Grammar of Science*, 2nd ed. p. 146). See also "A priori Probabilities," *Phil. Mag.* (Sept. 1884), and *Camb. Phil. Trans.* (1885), vol. xiv. pt. ii. p. 147 seq.

[7] Above, pars. 6, 7.

[8] The mean square $\int_{-\infty}^{+\infty} (x^2/\sqrt{\pi c}) \exp - x^2/c^2 dx = c^2/2$.

[9] The standard deviation pertaining to a set of (n/r) composite observations, each derived from the original n observations by averaging a batch thereof numbering r, is $\sqrt{(k/r)}/\sqrt{(n/r)} = \sqrt{(k/n)}$, when the given observations are all of the same weight; *mutatis mutandis* when the weights differ.

numerous set of observations, say $x, x_2, \dots x_n$ (taken as a sample from an indefinitely large group obeying any the same law of frequency) varies from set to set approximately according to the following law (to be established later)

$$z = \frac{n}{\sqrt{\pi}c} \exp - \left[\frac{nx^2}{c^2} + 2nj\left(\frac{x}{c} - \frac{2x^3}{3c^3}\right) \right] = f(x), \text{ say;}$$

where $c^2/2$ the mean square of deviation, and j = the mean cube of deviation, and j/c_3, say j, is small. Then, by abstraction analogous to that which has just been attributed to the method of least squares, we may regard the datum as a single observation, the arithmetic mean (of a sample batch of observations) subject to the law of error $z=f(x)$. The most probable value of the *quaesitum* is therefore given by the equation $f'(x-x') = 0$, where x' is the arithmetic mean of the given observations. From the resulting quadratic equation, putting $x = x' + \epsilon$, and recollecting that ϵ is small we have $\epsilon = \mathrm{j}c$. That is the correction due to the utilization of the mean cube of error. The *most advantageous* solution cannot now be determined,[1] $f(x)$ being unsymmetrical, without assuming a particular form for the function of detriment. This method of least squares *plus* cubes may easily be extended to the case of several batches.

137. This application of probabilities not to the actual data but to a selected part thereof, this economy of the inverse method, is widely practised in miscellaneous statistics, where the object is to determine whether the discrepancy between two sets of observation is accidental or significant of a real difference.[2] For instance, let the data be ages at death of individuals of two classes (*e.g.* temperate or not so, urban or rural, &c.) who have been under observation, since the age of, say, 20. Granted that the ages at death conform to Gompertz's law; the determination of the *modal* age at death, that age at which the proportion of the total observed dying (per unit of time) is a maximum for each class, would most perfectly be effected by the genuine inverse method. That method will also enable us to determine the probability that the two modes should have differed to the observed extent by mere accident.[3] According to the abridged method it suffices to proceed as *if* our data consisted of two observations x' and y', the average ages at death of the two classes, each average obeying the normal law of error, with respective moduli $c_1 = \sqrt{[(x'-x_1)^2 + (x'-x_2)^2 + \&c.]2/n}$, $c_2 = \sqrt{[(y'-y_1)^2 + (y'-y_2)^2 + \&c.]2/n}$, where x_1, x_2, &c., $y_1\ y_2$, &c., are the respective sets of observed ages at death; as follows from the law of error, whatever the law of distribution of the given observations. According to a well-known property of the normal law, the difference between the averages of n and n' observations respectively will range under a probability-curve with modulus $\sqrt{c_1^2 + c_2^2}$, say c. Whence for the probability that a difference as great as the observed one, say e, should have occurred by chance we have $\frac{1}{2}[1-\theta(\tau)]$, where $\tau = e/c$, and $\theta(x)$ is the integral $2/\sqrt{\pi}\int_0^z(\exp = x_2)dx$, given in many treatises.

Abridged Methods.

138. This sort of abridgment may be extended to other kinds of average besides the arithmetic, in particular the *median* (that point which has as many of the given observations above as below it). By simple induction we know that the median of a large sample of observations is a probable value for the *true* median; how probable is determined as follows from a selection of our data. First suppose that all the observations are of the same weight. If x' were the true median, the probability that as many as $\frac{1}{2}n + \mathrm{r}$ of the observations should fall on either side of that point is given by the normal law for which the *exponent* is $-2\mathrm{r}^2/n$.[4] This probability that the observed median will differ from the true one by a certain number of observations is connected with the probability that they will differ by a certain extent of the abscissa, by the proposition that the number of observations contained between the true and apparent median is equal to the small difference between them multiplied by the density of observations at the median—in the case of normal and generally symmetrical curves the greatest ordinate. This is the second datum we require to select. In the case of the normal curve it may be calculated from the modulus itself, determined by induction from a selection of data. If the observations are not all of the same worth, weight may be assigned by counting one observation as if it occurred oftener than another. This is the essence of Laplace's Method of Situation.[5]

139. In its simplest form, where all the given observations are of equal weight, this method is of wide applicability. Compared with the genuine inverse method, it is always more convenient, seldom much less accurate, sometimes even more accurate. If the given observations obey the normal law, the precision of the median is less than the precision of the arithmetic mean by only some 25%—a discrepancy not very serious where only a rough estimate of the worth of an average is required. If the observations do not obey the normal law—especially if the extremities are abnormally divergent—the precision of the median may be greater than that of the arithmetic mean.[6]

Determination of Frequency-Constants.

140. Yet another instance of the contrast between genuine and abridged inversion is afforded by the problem to determine the modulus as well as the mean for a set of observations known to obey the normal law; what the first problem[7] becomes when the coefficient of dispersion is not given. By inverse probability we ought in that case, in addition to the equation $d\mathrm{P}/dx = 0$, to put $d\mathrm{P}/d\mathrm{c} = 0$. Whence $\mathrm{c}^2 = 2[(x'-x_1)^2 + (x'-x_2)^2 + \&c. + (x'-x_n)^2]/n$, and $x' = (x_1 + x_2 + \&c. + x^n)/n$. This solution differs from that which is often given in the textbooks[8] in that there, in the expression for c^2, $(n-1)$ occurs in the denominator instead of n. The difference is explained by the fact that the authorities referred to determine c, not by genuine inversion, but by ordinary induction, by a condition which certainly would be fulfilled in the long run, but does not express the whole of our data; a condition in this respect like the equation of c to $\sqrt{\pi}(\Sigma\mathrm{e})/n$, where e is the difference (taken positively, without regard to its sign) between any observation and the arithmetic mean of all the observations.[9]

141. Of course the determination of the most probable value is subject to the speculative difficulties proper to a priori probability: which are particularly striking in this case, as it appears equally natural to take as that constant, of which the values are a priori equally probable, $k(=\mathrm{c}^2/2)$, or even[10] $h(=1/\mathrm{c}^2)$, the measure of weight, as in fact Laplace has done;[11] yet no two of these assumptions can be exactly true.[12]

142. A more convenient determination is obtained from simple induction by equating the modulus to some datum of the observed group to which it would be equal if the group were complete—in particular to the distance from the median of some percentile (or point which marks off a certain percentage, *e.g* 25 of the given observations) multiplied by a factor corresponding to the percentile obtainable from a familiar table. Mr Sheppard has given an interesting proof[13] that we cannot by way of percentiles obtain such good[14] results for the frequency-constants as by the use of "the average and average square" [the method prescribed by inverse probability].

Entangled Measurements.

143. The same philosophical subtleties, with greater mathematical complications, meet us when we pass on to the case of two or more *quaesita*. The problem under this head which mainly exercised the older writers was to determine a number of unknown quantities, given a larger number, n, of equations involving them.

144. Supposing the true values approximately known, by substituting the approximate values in the given equations and expanding according to Taylor's theorem, there will be obtained for the *corrections*, say $x, y \dots, n$ linear equations of the form

$$a_1x + b_1y \cdots = f_1$$
$$a_2x + b_2y \cdots = f_2,$$

where each a and b is a known coefficient, and each f is a fallible observation. Suppose that the error to which each is liable obeys the normal law, and that the modulus pertaining to each observation is the same—which latter condition can be secured by multiplying each equation by a proper factor—then if x' and y' are the true values of the *quaesita*, the frequency with which $(a_1x' + b_1y' - f_1)$ assumes different values is given by the equation $z = 1/(\sqrt{\pi}\mathrm{c}') \exp - [a_1x + b_1y - f_1]^2/\mathrm{c}_1^2$, where c_1 is a constant which, if not known beforehand, may be inferred, as in the simpler case, from a set of observations. Similar statements holding for the other equations, the probability that the given set of observations f_1, f_2, &c., should have resulted from a particular system of values for x, y . . is J exp $[(a_1x+b_1y-f_1)^2/c_1^2+(a_2x+b_2y-f_2)^2/c_2^2+\&c.]$, where J is a constant determined on the same principle as in the analogous simpler cases.[1] The condition that P should be a maximum gives as many linear equations for the determination of x' y' . . . as there are unknown quantities.

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[1] The use of the cubes is also contrasted with that of the squares (only) in this respect: that it is no longer a matter of indifference *how many* of the original observations we assign to the batch of which the mean constitutes the single (compound) observation.

[2] The object of the writer's paper on "Methods of Statistics" in the Jubilee number of the *Journ. Stat. Soc.* (1885).

[3] See on the use of the inverse method to determine the mode of a group, the present writer's paper on "Probable Errors" in the *Journ. Stat. Soc.* (Sept. 1908).

[4] Above, par. 103.

[5] *Théorie analytique*, 2nd supp. p. 164. *Mécanique céleste*, bk. iii. art. 40; on which see the note in Bowdich's translation. The method may be extended to other percentiles. See Czuber, *Beobachtungsfehler*, § 58. Cf. *Phil. Mag.* (1886), p. 375; and Sheppard, *Trans. Roy. Soc.* (1889), 192, p. 135, *ante*, where the error incident to this kind of determination is ascertained with much precision.

[6] Cf. *Phil. Mag.* (1887), xxiv. 269 seq., where the median is prescribed in case of "discordant" (heterogeneous) observations. If the more drastic remedy of rejecting part of the data is resorted to Sheppard's method of performing that operation may be recommended (*Proc. Lond. Math. Soc.* vol. 31). He prescribes for cases to which the median may not be appropriate, namely, the determination of other frequency-constants besides the mean of the observations.

[7] Above, par. 134.

[8] *E.g.* Airy, *Theory of Errors*, art. 60.

[9] It is a nice point that the expression for c^2, which has $(n-1)$ instead of n for denominator, though not the more *probable*, may yet be the more *advantageous* (supposing that there were any sensible difference between the two). Cf. *Camb. Phil. Trans.* (1885), vol. xiv. pt. ii. p. 165; and "Probable Errors," *Journ. Stat. Soc.* (June 1908).

[10] Above, par. 96, note.

[11] *Théorie analytique*, 2nd supp. ed. 1847, p. 578.

[12] See the matter discussed in *Camb. Phil. Trans.*, *loc. cit.*

[13] *Trans. Roy. Soc.* (1899), A, cxcii. 135.

[14] Good as tested by a comparison of the mean squares of errors in the frequency-constant determined by the compared methods.

145. The solution proper to the case where the observations are known to arrange according to the normal law may be extended to numerous observations ranging under any law, on the principles which justify the use of the Method of Least Squares in the case of a single *quaesitum.*

146. As in that simple case, the principle of economy will now justify the use of the *median*, *e.g.* in the case of two *quaesita*, putting for the true values of x and y that point for which the sum of the perpendiculars let fall from it on each of a set of lines representing the given equations (properly weighted) is a minimum.[2]

Normal Correlation.

147. The older writers have expressed the error in the determination of one of the variables without reference to the error in the other. But the error of one variable may be regarded as *correlated* with that of another; that is, if the system x', y' . . . forms the solution of the given equations, while $x'+\xi$, $y'+\eta$ . . . is the real system, the (small) values of ξ, η. . . . which will concur in the long run of systems from which the given set of observations result are normally correlated. From this point of view Bravais, in 1846, was led to several theorems which are applicable to the now more important case of correlation in which ξ and η are given (not in general small) deviations from the means of two or more correlated members (organs or attributes) forming a normal group.

148. To determine the frequency-constants of such a group it is proper to proceed on the analogy of the simple case of one-dimensioned error. In the case of two dimensions, for instance, the probability p_1 that a given pair of observations (x_1, y_1) should have resulted from a normal group of which the means are x' y' respectively, the standard deviations σ_1 and σ_2 and the coefficient of correlation r, may be written—

$$\Delta x\Delta y\Delta\sigma_1\Delta\sigma_2\Delta r(1/2\pi)\sqrt{\sigma_1\sigma_2(1-r^2)}\ \exp-\tfrac{1}{2}E^2,$$

where $E^2=(x'-x_1)^2/\sigma_1^2-2r(x'-x_1)(y'-y_1)/\sigma_1\sigma_2+(y'-y_1)^2/\sigma_2^2$. A similar statement holds for each other pair of observations (x_2y_2), (x_3y_3). . .; with analogous expressions for p_2, p_3. . . Whence, as in the simpler case, we have $p_1\times p_2\times\&c.\times p_n/J$ (a constant) for P, the a posteriori probability that the given observations should have resulted from an assigned system of the frequency-constants. The most probable system is determined by making P a maximum, and accordingly equating to zero each of the following expressions—

$$\frac{dP}{dx},\ \frac{dP}{dy},\ \frac{dP}{d\sigma_1},\ \frac{dP}{d\sigma_2},\ \frac{dP}{dr}.$$

The values of the arithmetic mean and of the standard deviation for each variable are what have been obtained in the simple case of one dimension. The value of r is $\Sigma(x'-x_r)(y'-y_r)/\sigma_1\sigma_2$.[3] The probable error of the determination is assigned on the assumption that the errors to which it is liable are small.[4] Such coefficients have already been calculated for a great number of interesting cases. For instance, the coefficient of correlation between the human stature and femur is 0·8, between the right and left femur is 0·96, between the statures of husbands and wives is 0·28.[5]

149. This application of inverse probability to determine correlation-coefficients and the error to which the determination is liable has been largely employed by Professor Pearson[6] and other recent writers. The use of the normal formula to measure the probable—and improbable—errors incident to such determinations is justified by reasoning akin to that which has been employed in the general proof of the law of error.[7] Professor Pearson has pointed out a circumstance which seems to be of great importance in the theory of evolution: that the errors incident to the determination of different frequency-coefficients are apt to be mutually correlated. Thus if a random selection be made from a certain population, the correlation-coefficient which fits the organs of that set is apt to differ from the coefficient proper to the complete group in the same sense as some other frequency-coefficients.

150. The last remark applies also to the determination of the coefficients, in particular those of correlation, by abridged methods, on principles explained with reference to the simple case; for instance by the formula $r=\Sigma\eta/\Sigma\xi$, where $\Sigma\xi$ is the sum of (some or all) the positive (or the negative) deviations of the values for one organ or attribute measured by the modulus pertaining to that member, and $\Sigma\eta$ is the sum of the values of the other member, which are associated with the constituents of $\Sigma\xi$. This variety of this method is certainly much less troublesome, and is perhaps not much less accurate, than the method prescribed by genuine inversion.

151. A method of rejecting data analogous to the use of percentiles in one dimension is practised when, given the frequency of observations for each increment of area, *e.g.* each Δx Δy, we utilize only the frequency for *integral* areas. Mr Sheppard has given an elegant solution of the problem: to find the correlation between two attributes, given the medians L, and M, of a normal group for each attribute and the distribution of the total group, as thus.[8]

	Below L,	*Above L,*
Below M,	*P*	*R*
Above M,	*R*	*P*

FIG. 12.

If cos D is put for r, the coefficient of correlation, it is found that $D=\pi R/(P+R)$. For example, let the group of statistics relating to dice already [9]cited from Professor Weldon be arranged in four quadrants by a horizontal and a vertical line, each of which separates the total groups into two halves: lines of which equations prove to be respectively $y=6{\cdot}11$ and $x=6{\cdot}156$. For R we have 1360·5, and for P 687·5 roughly. Whence $D=\pi\times0{\cdot}66$; $r=\cos 0{\cdot}66\times\pi=-\frac{1}{2}$ nearly, as it ought; the negative sign being required by the circumstance that the lower part of Mr Sheppard's diagram shown in fig. 12 corresponds to the upper part of Professor Weldon's diagram shown in par. 115.

152. Necessity rather than convenience is sometimes the motive for resort to percentiles. Professor Pearson has applied the median method to determine the correlation between husbands and wives in respect of the darkness of eye-colour, a character which does not admit of exact graduation: "our numbers merely refer to certain groupings, arranged, it is true, in increasing darkness of colour, but in no way corresponding to equal increases in colour-intensity."[10] From data of this sort, having ascertained the number of husbands with eye-colours above the median tint who marry wives with eye-colour above the median tint, Professor Pearson finds for r the coefficient of correlation +0·1. A general method for determining the frequency-constants when the data are, or are taken to be, of the integral sort has been given by Professor Pearson.[11] Attention should also be called to Mr Yule's treatment of the problem by a sort of logical calculus on the lines of Boole and Jevons.[12]

Abnormal Correlation.

153. In the cases of correlation which have been so far considered, it has been presupposed that the things correlated range according to the normal law of error. But now, suppose the law of distribution to be no longer normal: for instance, that the dots on the plane of xy,[13] representing each a pair of members, are no longer grouped in elliptic (or circular) rings of equal frequency, that the locus of the maximum y deviation, corresponding to an assigned x deviation, is no longer a right line. How is the interdependence of these deviations to be formulated? It is submitted that such data may be treated as if they were normal: by an extension of the *Method of Least Squares,* in two or more dimensions.[14] Thus when the amount of pauperism together with the amount of outdoor relief is plotted in several unions there is obtained a distribution far from normal. Nevertheless if the average pauperism and average outdoor relief are taken for *aggregates*—say quintettes or decades—of unions taken at random, it may be expected that these means will conform to the normal law, with coefficients obtained from the original data, according to the rule which is proper to the case of the normal law.[15] By obtaining averages conforming to the normal law, as by the simple application of the method of least squares, we should not indeed have utilized the whole of our data, but we shall put a part of it in a very useful

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[1] Above, par. 130.

[2] See *Phil. Mag.* (1888), "On a New Method of Reducing Observations"; where a comparison in respect of convenience and accuracy with the received method is attempted.

[3] Corresponding to the $k/\sqrt{lm}$ of pars. 14, 127 above.

[4] Pearson, *Trans. Roy. Soc.*, A, 191, p. 234.

[5] Pearson, *Grammar of Science*, 2nd ed. p. 402, 431.

[6] *Trans. Roy. Soc.* (1898), A, vol. 191; *Biometrika*, ii. 273.

[7] Above, par. 107. Compare the proof of the "Subsidiary Law of Error," as the law in this connexion may be called, in the paper on "Probable Errors," *Journ. Stat. Soc.* (June 1908).

[8] *Trans. Roy. Soc.* (1899), A, 192, p. 141.

[9] Above, par. 115.

[10] *Grammar of Science*, p. 432.

[11] *Trans. Roy. Soc.*, A, vol. 195. In this connexion reference should also be made to Pearson's theory of "Contingency" in his thirteenth contribution to the "Mathematical Theory of Evolution" (*Drapers' Company Research Memoirs*).

[12] *Trans. Roy. Soc.* (1900), A, 194, p. 257; (1901), A, 197, p. 91.

[13] Above, par. 127.

[14] Above, par. 116.

[15] If from the given set of n observations (each corresponding to a point on the plane xy) there is derived a set of n/s observations each obtained by averaging a batch numbering s of the original observation; the coefficient of correlation for the derived system is the same as that which pertains to the original system. As to the standard deviation for the new system see note to par. 135.

shape. Although the regression-equations obtained would not accurately fit the original material, yet they would have a certain correspondence thereto. What sort of correspondence may be illustrated by an example in games of chance, which Professor Weldon kindly supplied. Three half-dozen of dice having been thrown, the number of dice with more than three points in that dozen which is made up of the first and the second half-dozen is taken for y, the number of sixes in the dozen made up to the first and the third half-dozen, is taken for x. Thus each twofold observation (xy) is the sum of six twofold elements, each of which is subject to a law of frequency represented in fig. 13; where [1] the figures outside denote the number of successes of each kind, for the ordinate the number of dice with more than three points (out of a cast of two dice), for the co-ordinate the number of sixes (out of a cast of two dice, one of which is common to the aforesaid cast); and the figures inside denote the comparative probabilities of each twofold value (*e.g.* the probability of obtaining in the first two cast dice each with more than three points, and in the second cast two sixes, is 1/72). Treating this law of frequency according to the rule which is proper to the normal law, we have (for the element) if the sides of the compartments each $=i$

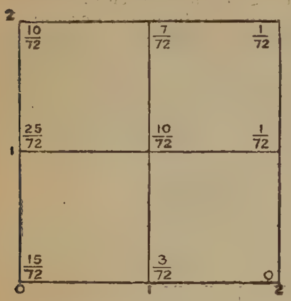

FIG. 13.

$$\sigma_1=i\sqrt{5/18};\ \sigma_2=i/\sqrt{2};\ \mathrm{r}=1/\sqrt{20}.$$

Whence for the regression-equation which gives the value of the ordinate most probably associated with an assigned value of the abscissa we have $y=x\times \mathrm{r}\sigma_2/\sigma_1=0{\cdot}3x$; and for the other regression-equation, $x=y/6$. Accordingly, in Professor Weldon's statistics, which are reproduced in the annexed diagram, when $x=3$ the most probable value of y ought to be 1. And in fact this expectation is verified, x and y being measured along lines drawn through the centre of the compartment, which *ought* to have the maximum of content, representing the concurrence of one dozen with *two* sixes and another dozen with *six* dice having each more than three points, the compartment which in fact contains 254 (*almost* the maximum content). In the absence of observations at $x=-3i$ or $y=\pm 6i$, the regression-equations cannot be further verified. At least they have begun to be verified by batches composed of six elements, whereas they are not verifiable at all for the simple elements. The normal formula describes the given statistics as they behave, not when by themselves, but when massed in crowds: the regression-equation does not tell us that if x' is the magnitude of one member the most probable magnitude of the other member associated therewith is rx', but that if x' is the average of several samples of the first member, then rx' is the most probable average for the specimens of the other member associated with those samples. Mr Yule's proposal to construct regression-equations according to the normal rule "without troubling to investigate the normality of the distribution" [2] admits of this among other explanations.[3] Mr Yule's own view of the subject is well worthy of attention.

	0	1	2	3	4	5	6	7	8	9	10	11	12
12					1								
11		4	3	3	3	1							
10	3	17	15	13	10	4	3	1					
9	12	51	59	61	36	14	5	3					
8	36	135	154	150	64	21	5	2	1				
7	74	195	260	179	112	35	5	1					
6	90	248	254	170	75	26	3						
5	93	220	230	124	51	8	2						
4	86	162	127	75	19	4	1						
3	37	86	56	17	6	2							
2	14	23	23	4	3								
1	2	4											
0													

Sheppard's Corrections.

154. In the determination of the standard-deviation proper to the law of error (and other constants proper to other laws of frequency) it commonly happens that besides the inaccuracy, which has been estimated, due to the paucity of the data, there is an inaccuracy due to their *discrete* character: the circumstance that measurement, *e.g.* of human heights, are given in comparatively large units, *e.g.* inches, while the real objects are more perfectly graduated. Mr Sheppard has prescribed a remedy for this imperfection. For the standard deviation let μ_2 be the rough value obtained on the supposition that the observations are massed at intervals of unit length (not spread out continuously, as ideal measurements would be); then the proper value, the mean *integral* of deviation squared, say $(\mu_2)=\mu_2-\frac{1}{12}h^2$, where h is the size of a unit, *e.g.* an inch. It is not to be objected to this correction that it becomes nugatory when it is less than the probable error to which the measurement is liable on account of the paucity of observations. For, as the correction is always in one direction, that of subtraction, it tends in the long run to be advantageous even though masked in particular instances by larger fluctuating errors.[4]

Pearson's Criterion of Empirical Verification.

155. Professor Pearson has given a beautiful application of the theory of correlation to test the empirical evidence that a given group conforms to a proposed formula, *e.g.* the normal law of error.[5]

Supposing the constants of the proposed function to be known—in the case of the normal law the arithmetic mean and modulus—we could determine the position of any percentile, *e.g.* the median, say a. Now the probability that if any sample numbering n were taken at random from the complete group, the median of the sample, a', would lie at such a distance from a that there should be r observations between

$$a \text{ and } a' \text{ is } \int_r^\infty \sqrt{2/\pi n}\ \exp -2\mathrm{r}^2/n.^{6}$$

If, then, any observed set has an excess which makes the above written integral very small, the set has probably not been formed by a random selection from the supposed given complete group. To extend this method to the case of two, or generally n, percentiles, forming $(n+1)$ compartments, it must be observed that the excesses say e and e′, are not independent but correlated. To measure the probability of obtaining a pair of excesses respectively as large as e and e′, we have now (corresponding to the extremity of the probability-curve in the simple case) the solid content of a certain probability-surface outside the curve of equal probability which passes through the points on the plane xy assigned by e, e′ (and the other data). This double, or in general multiple, integral, say P, is expressed by Professor Pearson with great elegance in terms of the quadratic factor, called by him χ^2, which forms the exponent of the expression for the probability that a particular system of the values of the correlated e, e′, &c., should concur—

$$\mathrm{P}=\sqrt{2/\pi}\int_\chi^\infty e^{-\frac{1}{2}\chi^2}d\chi+\sqrt{\frac{2}{\pi}}e^{-\frac{1}{2}\chi^2}\left[\frac{\chi}{1}+\frac{\chi^3}{1\cdot 3}+\cdots+\frac{\chi^{n-2}}{1\cdot 3\cdots(n-2)}\right]$$

when n is odd; with an expression different in form, but nearly coincident in result, when n is even. The practical rule derived from this general theorem may thus be stated. Find from the given observations the probable values of the coefficients pertaining to the formula which is supposed to represent the observations. Calculate from the coefficients a certain number, say n, of percentiles; thereby dividing the given set into $n+1$ sections, any of which, according to calculation, ought to contain say m of the observations, while in fact it contains m'. Put e for $m'-m$; then $\chi^2=\Sigma e^2/m$. Professor Pearson has given in an appended table the values of P corresponding to values of $n+1$ up to 20, and values of χ^2 up to 70. He does not conceal that there is some laxity involved in the circumstance that the coefficients employed are not known exactly, only inferred with probability.[7]

156. Here is one of Professor Pearson's illustrations. The table on next page gives the distribution of 1000 shots fired at a line in a target, the hits being arranged in belts drawn on the target parallel to the line. The "normal distribution" is obtained from a normal curve, of which the coefficients are determined from the observations. From the value of χ^2, viz. 45·8, and of $(n+1)$, viz. 11, we deduce, with sufficient accuracy from Professor Pearson's table, or more exactly from the formula on which the table is based, that P=·000,001,5. "In other words, if shots are distributed on a target according to the normal law, then such a distribution as that cited could only be expected to occur on an average some 15 or 16 times in 10,000,000 times."

The Criterion Criticized.

157. "Such a distribution" in this argument must be interpreted as a distribution for which it is claimed that the observations are all independent of each other. Suppose that there were only 500 independent observations, the remainder being merely duplicates of these 500. Then in the above

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[1] Cf. above, par. 115.
[2] *Proc. Roy. Soc.*, vol. 60, p. 477.
[3] Below, par. 168.

[4] Just as the removal of a tax tends to be in the long run beneficial to the consumer, though the benefit on any particular occasion may be masked by fluctuations of price due to other causes.
[5] *Phil. Mag.* (July, 1900).
[6] As shown above, par. 103.
[7] *Loc. cit.* p. 166.

table the columns for the normal distribution and for the discrepancy e should each be halved; and accordingly the column for e^2/m should be halved. Thus e^2/m being reduced to 22·9, P as found from Professor Pearson's table is between 995 and 629. That is, such a distribution might be expected to occur once on an average some once or twice in a hundred times. If actual duplication of this sort is not common in statistics,[1] yet in all such applications of the Pearsonian criterion—and in other calculations involving the number of observations, in particular the determinations of probable error—a good margin is to be left for the possibility that the n observations are not perfectly *independent*: *e.g.* the accidents of wind or nerve which affected one shot may have affected other shots immediately before or after.

Belt.	Observed Frequency.	Normal Distribution.	e.	e^2/m.
1	1	1	0	0
2	4	6	− 2	0·667
3	10	27	−17	10·704
4	89	67	+22	7·224
5	190	162	+28	4·839
6	212	242	−30	3·719
7	204	240	−36	5·400
8	193	157	+36	8·255
9	79	70	+ 9	1·157
10	16	26	−10	3·846
11	2	2	0	0
	1000	1000	—	45·811

158. (2) *The Generalized Law of Error.*—That the normal law of error should not be exactly fulfilled is not disconcerting to those who ground the law upon the plurality of independent causes. On that view the normal law would only be exact when the numbers of elements from which it is generated is very great. In general, when that number is large, but not indefinitely great,[2] there is required a correction owing to one or other of the following imperfections: that the elements do not fluctuate according to the normal law of frequency; that their fluctuations are not independent of each other; that the function whereby they are aggregated is not linear. The correction is formed by a series of terms descending in the order of magnitude.

Second and Third Approximations.

159. The first term of this series may be written

$$-2(k/c^3)[x/c-2x^3/3c^3];$$

where $c^2/2$ is the mean square of deviation for the compound and also the sum of the mean squares of deviations for the component elements, k_1 is the mean cube of deviations for the compound and the sum of the mean cubes for the components, and the elements are supposed to be such and so numerous that k_1/c^3 is of the order $1/\sqrt{n}$. This second approximation, first given by Poisson, was rediscovered by De Forest.[3] The present writer has obtained it[4] by a variety of methods. By a further extension of these methods a *third* and further approximations may be found. The corrected normal law is then of the form[5]

$$z=\frac{1}{\sqrt{\pi}c}\left(\exp-\frac{x^2}{c^2}\right)\left[1-2\mathrm{k}\left(\frac{x}{c}-\frac{2x^3}{3c^3}\right)+\mathrm{k}^2\left(-\frac{5}{3}+10\frac{x^2}{c^2}\right.\right.$$
$$\left.\left.-\frac{20}{3}\frac{x^4}{c^4}+\frac{8}{9}\frac{x^6}{c^6}\right)+\mathrm{k}_2\left(\tfrac{1}{2}-2\frac{x^2}{c^2}+\frac{2}{3}\frac{x^4}{c^4}\right)\right];$$

where $\mathrm{k} = k_1/c^3$, $\mathrm{k}_2=k_2/c^4$, k_1 and c are defined as above, k_2 is the sum of the respective differences for each element between its mean fourth power of error and thrice its mean square of error,[6] and also the corresponding difference for the compound. The formula may be verified by the case of the *binomial*, considered as a simple case of the law of great numbers. Here

$$c^2 = 2npq,\ k_1 = npq\ (q-p),\ k_2 = npq\ (1 - 6pq).^7$$

These values being substituted for the coefficients in the general formula, there results an expression which may be obtained directly by continuing[8] to expand the expression for a term of the binomial. In virtue of the second approximation a set of observations is not to be excluded from the affinity to the normal curve because, like the curve of barometric heights,[9] it is slightly asymmetrical. In virtue of the third approximation it is not excluded because, like the group of shot-marks above examined, it is, though almost perfectly symmetrical, in other respects apparently somewhat abnormal.

Higher Approximations.

160. If the third approximation is not satisfactory there is still available a fourth, or a still higher degree of approximation.[10] The general expression for y which (multiplied by Δx) represents the probability that an error will occur at a particular point (within a particular small interval) may be written

$$e^{-k_1\frac{1}{3!}\left(\frac{d}{dx}\right)^3+k_4\frac{1}{4!}\left(\frac{d}{dx}\right)^4-\ldots+(-1)^t k_t\frac{1}{(t+2)!}\left(\frac{d}{dx}\right)^{t+2}\ldots}y_0,$$

where y_0 is (the normal error-function) $\frac{1}{\sqrt{(2k\pi)}}e^{-x^2/2k}$, k is the mean square of deviation; $k_1, k_2, \ldots$, &c., are coefficients formed from the mean powers of deviation according to the rule that k_t is the difference between the tth mean power as it actually is and what it would be if the $(t-1)$th approximation were perfectly correct. Thus k_1 is the difference between the actual mean third power and what the third power would be if the first approximation, the normal law, were perfectly correct, that is, the difference between the actual mean third power, often written μ_3, and zero, that is μ_3. Similarly k_2 is the difference between the actual mean fourth power of deviation, say μ_4, and what that mean power would be if the second approximation were perfectly correct, viz. $3k^2$. Thus $k_2=\mu_3-3k^2$. The series k_1, k_3, k_5, &c., k, k_2, k_4, &c., form each a succession of terms descending in the order of magnitude, when each k, *e.g.* k_t has been divided by the corresponding power, *i.e.* the power $(t+2)$ of the parameter or modulus $c=\sqrt{(2k)}$, which division is secured by the successive differentiations of y_0, with which each k is associated, *e.g.* k_t with $\left(\frac{d}{dx}\right)^{t+2}$. Moreover, the first term of the odd series of k's when divided by the proper power of the parameter, viz. c^3 is small in comparison with the first term of the even series, viz. k, properly referred—divided by c^2 ($=2k$).

Character of the Approximation.

161. Whatever the degree of approximation employed, it is to be remembered that the law in general is only applicable to a certain range of the compound magnitude here represented by the abscissa x.[11] The curve of error, even when generalized as here proposed, coincides only with the central portion—the body, as distinguished from the extremities—of the actual locus; a greater or less proportion.

Extension to Two or More Dimensions.

162. The law thus generalized may be extended, with similar reservations, to two or more dimensions. For example, the second approximation in two dimensions may be written

$$z_0-\frac{1}{3!}\left({}_{3,0}\mathrm{k}\frac{d^3z_0}{dx^3}+3{}_{2,1}\mathrm{k}\frac{d^3z_0}{dx^2dy}+3{}_{1,2}\mathrm{k}\frac{d^3z_0}{dxdy^2}+{}_{0,3}\mathrm{k}\frac{d^3z_0}{dy_0}\right);$$

where z_0 is (the normal error-function)

$$\frac{1}{\pi(1-1^2)}\exp.-\frac{(x^2-2rxy+y^2)}{(1-r^2)},$$

x and y are (as before) co-ordinates measured from the centre of gravity of the group as origin, each referred to (divided by) its proper modulus; r is the ordinary coefficient of regression; ${}_{3,0}\mathrm{k}$ is the mean value of the cubes x^3, ${}_{2,1}\mathrm{k}$ is the mean value of the products x^2y, and so on; all these k's being quantities of an order less than unity. This form lends itself readily to the determination of a second approximation to the regression-curve, which is the locus of that y, which is the most probable value of the ordinate corresponding to an assigned value of x. Form the logarithm of the above-written expression (for the frequency-surface); and differentiate that logarithm with respect to x. The required locus is given by equating this differential to zero (the second differential being always negative). The resulting equation is of the form

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[1] It is frequent in the statistics of wages.

[2] See on this subject, in addition to the paper on the "Law of Error" already cited (*Camb. Phil. Trans.*, 1905), another paper by the present writer, on "The Generalized Law of Error," in the *Journ. Stat. Soc.* (September, 1906).

[3] *The Analyst* (Iowa), vol. ix.

[4] *Phil. Mag* (Feb., 1896) and *Camb. Phil. Trans.* (1905).

[5] The part of the third approximation affected with k^2 may be found by proceeding to another step in the method described (*Phil. Mag.*, 1896, p. 96). The remaining part of the third approximation is found by the same method (or the variant on p. 97) from the new partial differential equation $\frac{dy}{di}=\frac{1}{24}\frac{d^4y}{dx^4}$, where k_2, is the difference between the actual mean fourth power of deviation and what it would be if the normal law held good. Further approximations may be obtained on the same principle.

[6] $\mu_4-3\mu_2^2$ in the notation which Professor Pearson has made familiar.

[7] Cf. Pearson, *Trans. Roy. Soc.* (1895), A, clxxxvi. 347.

[8] Above, § 103, referring to Todhunter, *History*, art. 993. The third (or second additional term of) approximation for the binomial, given explicitly by Professor Pearson, *Trans. Roy. Soc.* (1895), A, footnote of p. 347, will be found to agree with the general formula above given, when it is observed that the correction affecting the *absolute term*, his y_0, disappears in his formula by division.

[9] *Journ. Stat. Soc.* (1899), p. 550, referring to Pearson, *Trans. Roy. Soc.* (1898), A.

[10] Practically no doubt the law is not available beyond the third or fourth approximation, for a reason given by Pearson, with reference to his generalized probability-curve, that the probable error incident to the determination of the higher moments becomes very great.

[11] This consideration does not present the determination of the true *moments* from the complete set of observations if homogeneous, according as the system of elements fulfils more or less perfectly certain conditions.

$$y-rx-T-\alpha x^2-2\beta xy-\gamma y^2=0,$$

where T, α, β, γ are all small, linear functions of the k's. As y is nearly equal to r x, it is legitimate to substitute r x for y, when y is multiplied by a small coefficient. The curve of regression thus reduces to a *parabola* with equation of the form

$$y-T=rx-qx^2;$$

where q is a linear function of the third mean powers and moments of the given group.

163. *Dissection of certain Heterogeneous Groups.*—Under the head of law of error may be placed the case in which statistics relating to two (or more) different types, each separately conforming to the normal law, are mixed together; for instance, the measurements of human heights in a country comprising two distinct races.

In this case the *quaesita* are the constants in a curve of the form:

$$y=\alpha(1/\sqrt{\pi}c_1)\ \exp-(x-a)^2/c_1{}^2+\beta(1/\sqrt{\pi}c_2)\ \exp-(x-b)^2/c_2{}^2,$$

where α and β are the proportionate sizes of the two groups ($\alpha+\beta=1$); *a* and *b* are the respective centres of gravity; and c_1, c_2 the respective moduli. The data are measurements each of which relates to *one or other* of these component curves. A splendid solution of this difficult problem has been given by Professor Pearson. The five unknown quantities are connected by him with the centre of gravity of the given observations, and the mean second, third, fourth and fifth powers of their deviations from that centre of gravity, by certain rational algebraic equations, which reduce to an equation in one variable of the *ninth* dimension. In an example worked by Professor Pearson this fundamental equation had three possible roots, two of which gave very fair solutions of the problem, while the third suggested that there might be a *negative* solution, importing that the given system would be obtained by *subtracting* one of the normal groups from the other; but the coefficients for the negative solution proved to be imaginary. "In the case of crabs' foreheads, therefore, we cannot represent the frequency curve for their forehead length as the difference of two normal curves." In another case, which primâ facie seemed normal, Professor Pearson found that "all nine roots of the fundamental nonic lead to imaginary solutions of the problem. The best and most accurate representation is the normal curve."

164. This laborious method of separation seems best suited to cases in which it is known beforehand that the statistics are a mixture of two normal groups, or at least this is strongly suggested by the two-headed character of the given group. Otherwise the less troublesome generalized law of error may be preferable, as it is appropriate both to the mixture of two—not very widely different—normal groups, and also the other cases of composition. Even when a group of statistics can be broken up into two or three frequency curves of the normal—or not very abnormal—type, the group may yet be adequately represented by a single curve of the "generalized" type, provided that the heterogeneity is not very great, not great enough to prevent the constants k_1, k_2, k_3, &c., from being small. Thus, suppose the given group to consist of two normal curves each having the same modulus *c*, and that the distance between the centres is considerable, so considerable as just to cause the central portion of the total group to become saddle-backed. This phenomenon sets in when the distance between the centre of gravity of the system and the centre of either component $=\sqrt{\tfrac{1}{2}}c$.[1] Even in this case k_2 is only $-0{\cdot}125$; k_4 is $0{\cdot}25$ (the odd k's are zero).

Section II.—*Laws of Frequency.*

The "Generalized Probability Curve."

165. A formula much more comprehensive than the corrected normal law is proposed by Professor Pearson under the designation of the "generalized probability-curve." The ground and scope of the new law cannot be better stated than in the words of the author: "The slope of the normal curve is given by a relation the form

$$\frac{1}{y}\frac{dy}{dx}=-\frac{x}{c_1}.$$

The slope of the curve correlated to the skew binomial, as the normal curve to the symmetrical binomial, is given by a relation of the form

$$\frac{1}{y}\frac{dy}{dx}=-\frac{x}{c_1+c_2x}.$$

Finally, the slope of the curve correlated to the hypergeometrical series (which expresses a probability distribution in which the contributory causes are not independent, and not equally likely to give equal deviations in excess and defect), as the above curves to their respective binomials, is given by a relation of the form

$$\frac{1}{y}\frac{dy}{dx}=-\frac{x}{c_1+c_2x+c_3x^2}.$$

This latter curve comprises the two others as special cases, and, so far as my investigations have yet gone, practically covers all *homogeneous* statistics that I have had to deal with. Something still more general may be conceivable, but I have found no necessity for it."[2] The "hypergeometrical series," it should be explained, had appeared as representative of the distribution of black balls,[3] in the following case. "Take *n* balls in a bag, of which *pn* are black and *qn* are white, and let r balls be drawn and the number of black be recorded. If $r>pn$, the range of black balls will lie between 0 and *pn*; the resulting frequency-polygon is given by a hypergeometrical series."

Further reasons in favour of his construction are given by Professor Pearson in a later paper.[4] "The immense majority, if not the totality, of frequency distributions in homogeneous material show, when the frequency is indefinitely increased, a tendency to give a smooth curve characterized by the following properties. (i.) The frequency starts from zero, increases slowly or rapidly to a maximum and then falls again to zero—probably at a quite different rate—as the character for which the frequency is measured is steadily increased. This is the almost universal unimodal distribution of the frequency of homogeneous series . . (ii.) In the next place there is generally contact of the frequency-curve at the extremities of the range. These characteristics at once suggest the following of frequency curve, if $y\delta x$ measure the frequency falling between x and $x+\delta x$:—

$$\frac{dy}{dx}=\frac{y(x+a)}{F(x)}\ \ldots$$

Now let us assume that $F(x)$ can be expanded by Maclaurin's theorem. Then our differential equation to the frequency will be

$$\frac{1}{y}\frac{dy}{dx}=\frac{x+a}{b_0+b_1x+b_2x^2+\ldots}$$

Experience shows that the form (x) ["keeping b_0, b_1, b_2, only"] suffices for certainly the great bulk of frequency distributions."[5]

166. The "generalized probability-curve" presents two main forms[6]·—

$$y=y_0(1+x/a_1)^{\nu a_1})\ 1-x/a_2)^{\nu a_2},$$

$$\text{and } y=y_0\frac{1}{(1+x^2/a^2)^m}e^{-\nu\tan^{-1}x/a}.$$

When a_1, a_2, ν are all finite and positive, the *first* form represents, in general, a skew curve, with limited range in both directions; in the particular case, when $a_1=a_2$, a symmetrical curve, with range limited in both directions. If $a_2=\infty$, the curve reduces to

$$y=y_0(2+x/a_1{}^{\nu a_1}1e^{-\nu x});$$

representing an asymmetrical binomial with $\nu=2\mu_2/\mu_3$, and $2_1=2\mu_2{}^2/\mu_3-a\mu_3/\mu_2$, μ_2 and μ_3, being respectively the mean second and mean third power of deviation measured from the centre of gravity. In the particular case, when μ_3 is small, this form reduces to what is above called the "quasi-normal" curve; and when μ_3 is zero, a_1 becoming infinite, to the simple normal curve. The pregnant general form yields two less familiar shapes apt to represent curves of the character shown in figs. 14 and 15—the one occurring in a good number of instances, such as infant deaths, the values of houses, the number of petals in certain flowers; the other less familiarly illustrated by *Consumptivity* and *Cloudiness*.[7] The *second* solution represents a skew curve with unlimited range in both directions.[8] Professor Pearson has successfully applied these formulae to a number of beautiful specimens culled in the most diverse fields of statistics. The flexibility with which the generalized probability-curve adapts itself to every variety of existing groups no doubt gives it a great advantage over the normal curve, even in its extended form. It is only in respect of a priori evidence that the latter can claim precedence.[9]

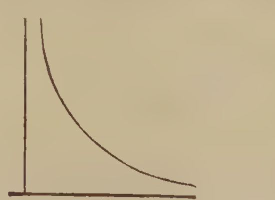
FIG. 14.

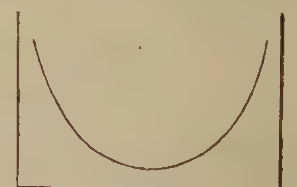
FIG. 15.

167. *Skew Correlation.*—Professor Pearson has extended his

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[1] Cf. *Journ. Stat. Soc.* (1899), lxii. 131. A similar substitution of the generalized law of error may be recommended in preference to the method of *translating* a normal law of error (putting $x=f(x)$, where x obeys the normal law of error) suggested by the present writer (*Journ. Stat. Soc.*, 1898), and independently by Professor J. C. Kapteyn (*Skew Frequency Curves*, 1903).

[2] *Trans. Roy. Soc.* (1895), A, p. 381.

[3] Ibid. p. 360.

[4] "Mathematical Contributions to the Theory of Evolution" (*Drapers' Company Research Memoirs, Biometric Series II.*), xiv. 4.

[5] p. 7, *loc. cit.*

[6] Ibid. p. 367.

[7] Pearson, *loc. cit.*, p. 364, and *Proc. Roy. Soc.*

[8] A lucid exposition of Professor Pearson's various methods is given by W. Palin Elderton in *Frequency-curves and Correlation* (1906).

[9] *Journ. Stat. Soc.* (1895), p. 506.

method to frequency-loci of two dimensions;[1] constructing for the curve of regression (as a substitute for the normal right line), in the case of "skew correlation," a parabola,[2] with constants based on the higher moments of the given group.

168. In this connexion reference may again be made to Mr Yule's method of treating skew surfaces as if they were normal. It is certainly remarkable that the correlation should be so well represented by a line—the property of a normal surface—in cases of which normality cannot be predicated: for instance, the statistics of the number of husbands (or wives) living at each age who have wives (or husbands) living at different ages.[3] It may be suggested that though in this case there is one dominant cause, the continual decrease of the population, inconsistent with the plurality of causes postulated for the law of error, yet there is a sufficient degree of accidental variation to realize one property at least of the normal locus.

Relations between Frequency and Probability.

169. There is possibly an extensive class of phenomena of which frequency depends largely on fortuitous causes, yet not so completely as to present the genuine law of error.[4] This mixed class of phenomena might be amenable to a kind of law of frequency that would be different from, yet have some affinity to, the law of error. The double character may be taken as the definition of the laws proper to the present section. The definition of the class is more distinct than its extent. Consider for example the statistics which represent the numbers out of a million born that die in each year of age after thirty of forty—the latter part of the column in a life-table. These are well represented by a species of Professor Pearson's "generalized probability-curve,"[5] his type iii. of the form

$$y = yo\,(1 + x/a)^{\gamma a} e^{-\gamma x}.$$

The statistics also lend themselves to the Gompertz-Makeham formula for the number living at the age

$$l_x = \mathrm{S}^x g^{x/c}.$$

The former law, the simplest species of the "generalized probability-curve," may well be attributed in part to the operation of a plexus of causes such as that which is apt to generate the law of error. In fact, a high authority, Professor Lexis, has seen in these statistics—or continental statistics *in pari materia*—a fulfilment of the normal law of error.[6] They at least fulfil tolerably the generalized law of error above described. But the Gompertz-Makeham formula is not thus to be accounted for; at least it is not thus that it was regarded by its discoverers. Gompertz justifies his law[7] by a "hypothetical deduction congruous with many natural effects," such as the exhaustion of air by a pump; and Makeham follows[8] in the same track of explanation by way of natural laws. Of course it is not denied that mortality is subject to accident. But the Gompertz-Makeham law purports to be fulfilled in spite of, not by reason of, fortuitous agencies. The formula is accounted for not by the interaction of fleeting causes which is characteristic of probability, but by causes of that ordinary kind of which the investigation constitutes the greater part of natural science. Laws of frequency thus conceived do not belong to the theory of Probabilities.

Authorities.—As a comprehensive and masterly treatment of the subject as a whole, in its philosophical as well as mathematical character, there is nothing similar or second to Laplace's *Théorie analytique des probabilités*. But this "ne plus ultra of mathematical skill and power" as it is called by Herschel (*Edinburgh Review*, 1850) is not easy reading. Much of its difficulty is connected with the use of a mathematical method which is now almost superseded, "Generating Functions." Not all parts of the book are as rewarding as the Introduction (published separately as *Essai philosophique des probabilités*) and the fourth and subsequent chapters of the second book. Among numerous general treatises E. Çzuber's *Wahrscheinlichkeitstheorie* (1899) may be noticed as terse, lucid and abounding in references. Other authorities may be mentioned in relation to the different parts of the subject as above divided. First principles are discussed with remarkable acumen by J. Venn in *Logic of Chance* (1st ed., 1876, 3rd ed., 1888) and by J. v. Kries in *Principien der Wahrscheinlichkeitsrechnung* (1886). As a repertory of neat problems involving the calculation of probability and expectation W. A. Whitworth's *Choice and Chance* (5th ed., 1901), and *DCC. Exercises . . . in Choice and Chance* (1897) deserve mention. But this advantage is afforded in nearly as great perfection by more comprehensive works. Bertrand's *Calcul des probabilités* (1889) abounds in choice examples, while it excels in almost every other branch of the subject. Special mention is also deserved by H. Poincaré's *Calcul des probabilités* (*leçons professes*, 1893–1894). On local or geometrical probability Professor Morgan Crofton is one of the highest authorities. His paper on "Local Probability" in *Phil. Trans.* (1868), and on "Geometrical Theorems," *Proc. Lond. Math. Soc.* (1887), viii., should be read in connexion with the section on "Local Probability" in his article on "Probability" in the 9th edition of the *Ency. Brit.*, from which section several paragraphs have been transferred *en bloc* to the section on Geometrical Applications in the present article. The topic is treated exhaustively by Czuber in *Geometrische Wahrscheinlichkeiten und Mittelworten* (1884). Czuber is also to be mentioned as the author of *Theorie der Beobachtungsfehler*, in which he has reproduced, often with improvement, or referred to, almost everything of importance in the work of his predecessors. A. L. Bowley's *Elements of Statistics*, pt. 2 (2nd ed., 1902), forms an introduction to the law of error which leads the beginner easily, yet far. References to other writers are given in Section I. of Part II. above. A list of writings on the cognate topic, the method of least squares, has been given by Merriman (*Connecticut Trans.* vol. iv.). On laws of frequency, as above defined, Professor Karl Pearson is the highest authority. His "Contributions to the Mathematical Theory of Evolution," of which twelve have appeared in the *Trans. Roy. Soc.* (1894–1903) and others are being published by the Drapers' Company, teem with new theories in Probabilities. (F. Y. E.[9])

PROBATE, in English law, the "proving" (Lat. *probatio*) of a will. The early jurisdiction of the English ecclesiastical courts over the probate of wills of personality is discussed under Will. The Court of Probate Act 1857 transferred the jurisdiction both voluntary and contentious of all ecclesiastical, royal peculiar, peculiar and manorial courts to the court of probate thereby constituted, created a judge and registrars of that court, abolished the old exclusive rights in testamentary matters of the advocates of Doctors' Commons, and laid down rules of procedure. Contentious jurisdiction was given to county courts when the personal estate of the deceased was under £200 in value. The Judicature Act 1873 merged the old court of probate in the probate divorce and admiralty division of the High Court of Justice. The division now consists of the president and one other judge. The practice of the division is mainly regulated by the rules of the Supreme Court 1883. Appeals lie to the court of appeal and thence to the House of Lords. Probate may be taken out either in *common* or *solemn* form. In the former case, which is adopted when there is no dispute as to the validity of the will, the court simply recognizes the will propounded as the last will of the deceased. This formality is necessary to enable the executor to administer the estate of his testator. Probate in this form is granted simply as a ministerial act if the attestation clause declares that the formalities of the Wills Act have been complied with, or if other evidence to that effect is produced. Such grant is liable to revocation, but it is provided that any person dealing with an executor on the faith of a grant of probate in common form, shall not be prejudiced by its revocation. The executor may within thirty years be called upon to prove in solemn form, or a person who doubts the validity of the will propounded may enter a caveat which prevents the executor proving for six months and the caveat may be renewed each six months. The executor may however take out a summons to get the caveat "subducted" or withdrawn, but if an appearance to the summons is entered within six days to the summons the executor is then compelled to prove in solemn form. Probate in *solemn* form is a judgment of the court in favour of the will propounded, and is only revocable by the discovery of a later will. In order, therefore, to obtain such grant proceedings have to be taken by action, and witnesses produced in support of the will, and the action proceeds in the usual way.

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[1] "Contributions," No. xiv. (above cited).

[2] Not the same parabola as that proposed at par. 162.

[3] *Census of England and Wales General Report* (cod. 2174), p. 226. Cf. p. 70, as to the rationale of the phenomenon.

[4] A good example of the suggested blend between law and chance is presented by an hypothesis which Benine (in a passage referred to above, par. 97) has proposed to account for Pareto's income-curve.

[5] "Contributions," No. ii., *Phil. Trans.* (1895), vol. 186, A.

[6] Lexis, *Massenerscheinungen*, § 46. Cf. Venn, cited above, par. 124.

[7] *Phil. Trans.* (1–25).

[8] *Assurance Magazine* (1866), xi. 315.

[9] These initials do not apply to certain passages in the above article, namely, the greater part of paragraphs 41, 52, 62 and 72, and almost the whole of the 4th section of Part. I. (pars. 76–93), which have been adopted from the article "Probability" in the 9th edition of the *Ency. Brit.*, written by Professor Morgan Crofton.

The principal rules now obtaining as to probate are these. Probate, which since the Land Transfer Act 1897 must be taken out for wills of realty as well as wills of personalty, may be granted either in the principal or in a district registry, and should be obtained within six months after the testator's death. When no executor is named the will is not now invalid, as was once the case, but administration *cum testamento annexo* is granted. The same course is pursued where the executor renounces or dies intestate before administering the estate of the deceased. After probate, the probate itself (as the official copy of the will is called) becomes evidence, the original will being deposited in the principal registry at Somerset House, London. On grant of probate, estate duty, denoted by a stamp on the affidavit sworn for that purpose, is payable. It varies according to the amount at which the estate of the deceased is fixed by the oath of the executor (see ESTATE DUTY). The act of 1881 enables any officer of inland revenue to grant probate where the personal estate does not exceed £300.

Ireland.—In 1867 an act on lines similar to the English act was passed for Ireland and under the Irish Judicature Act of 1877 the then existing court of probate was merged in the High Court of Justice.

Scotland.—*Confirmation* includes both the probate and letters of administration of English procedure. Without confirmation by the court interference by the executor becomes a vitious intromission. Originally confirmation of testaments of movables fell, as in England, under the cognizance of the church courts. Such jurisdiction certainly existed at the time of *regiam majestatem.* This ecclesiastical right continued through the commissary court at Edinburgh (constituted by Queen Mary in 1563), and the local commissaries, until modern times when the jurisdiction of the courts was at first transferred and then abolished by a series of enactments from the Commissary Courts Act 1823 to the Sheriff Courts Act 1876. The act of 1823 placed the commissary jurisdiction in the sheriff courts; by the act of 1876 the sheriffs sit as sheriffs in testamentary matters, no longer as commissaries. Confirmation of wills where the whole estate is under £300 is regulated by the Customs and Inland Revenue Act 1881 and other acts. An eik is an addition to a confirmation made on discovery of additional effects of the deceased after confirmation.

United States.—Probate is granted in some states by the ordinary chancery or common law courts, but more frequently by courts of special jurisdiction, such as the prerogative court in New Jersey, the surrogates' court in New York, the orphans' court in Pennsylvania.

"In a great majority of the states the original equitable jurisdiction over administrations is in all ordinary cases—without any special circumstances such as fraud, or without any other equitable feature such as trust—either expressly or practically abrogated. The courts of equity, in the absence of such special circumstances or distinctively equitable features, either do not possess or will not exercise the jurisdiction, but leave the whole matter of administrations to the special probate tribunals" . . . . so that "unless the case involves some special feature or exceptional circumstances of themselves warranting the interference of equity, such as fraud, waste, and the like, or unless it is of such an essential nature that a probate court is incompetent to give adequate relief, or is one of which the probate court having taken cognizance has completely miscarried and failed to do justice by its decree, the courts of equity will refuse to interpose and to exercise whatever dormant powers they may possess, but will leave the subject matter and the parties to the statutory forum which the legislature plainly regarded as sufficient and intended to be practically exclusive" (Rice's *Probate Law*, pp. 4 and 5).

Probate courts are in most if not all the states courts of record, having a public seal and a clerk (or the judge has authority to act as clerk); they issue process and execute their decrees by appropriate officers in the same manner as the common law and chancery courts. They sit at stated terms. They have power to punish for contempt, and to compel obedience to their orders and decrees, and their judgments upon matters within their jurisdiction are enforced usually by the same means as common law and chancery courts (Noemen's *Law of Administration*, § 145).

Jurisdiction as to wills and their probate as such is neither included in nor excepted out of the grant of judicial power to the courts of the United States (*i.e.* the *Federal* as distinguished from the state courts). So far as it is *ex parte* and merely administrative it is not conferred, and it cannot be exercised by them at all until in a case at law or in equity its exercise becomes necessary to settle a controversy by reason of the (diverse) citizenship of the parties. An action to set aside the probate of a will of real estate may be maintained in a Federal court when the parties on one side are citizens of a different state from the parties on the other side (*Ellis* v. *Davis*, 109 U.S. Reports, 485). Probate in solemn form, *i.e.* after due notice to all parties in interest is the almost universal form in use in the United States. One reason for this no doubt is that all documents affecting title to real estate must be recorded and probate in solemn form concludes all parties to the proceeding and thus tends to establish the title to all real estate passing under the will.

In the United States wills of real property must be separately proven in the proper probate court in each state in which the real property is situated, unless statute dispenses with separate probate (each state being "foreign" to every other for this purpose). Copies of such will and probate should be filed also in the office of the register of deeds of each county in the state in which any real property belonging to the testator is situated.

In the state of *New Jersey* it has been held that an unprobated will is capable of conveying an interest in the property devised, and when a conveyance is made under a power in the will before probate a subsequent probate validates the conveyance (1906, *Mackey* v. *Mackey*, 63 Atl. Rep. 984).

In *Illinois* a court of equity has no *inherent* power to entertain a bill to contest a will (1906; *O'Brien* v. *Bonfield*, 220 Ill. Rep. 219).

In *Missouri* a foreign (New York) will of real estate in Missouri, probate of which was duly recorded in Missouri, cannot be *collaterally* attacked, and cannot be set aside by direct proceeding after being filed for record more than five years in Missouri (1907; *Cohen* v. *Herbert*, 104 So. W. Rep. 84).

PROBATION. The probation system, in penology, is an attempt to reform a prisoner outside prison, a special kind of warder—the probation officer—supervising the prisoner in the prisoner's own home. The state of Massachusetts in America was the first to attempt "probation," and at first (1878) in a tentative manner. As success crowned the efforts of the reformers the system was developed and applied to an increasing number of cases; and gradually other American states followed with some variations in their plans. The probation officers attend the court and the judge officially gives up the prisoner to the officer chosen to supervise him, generally explaining to the prisoner that, if he is not obedient to all the rules made for him by the officer, he will be returned to court and prison will be his fate. An officer generally has from sixty to eighty cases under his care. Women officers are in charge of women and boys and girls under eighteen. A probation officer has a special area of the town allotted to him and usually gets all prisoners from that area. He acquires an intimate knowledge of the physical, economic and social surroundings in which his prisoner lives. He is therefore well fitted to watch him and to help him to become once more a decent citizen. He gradually gives him back his liberty and removes restrictions until he is capable of living a decent life alone. The powers of the probation officer are necessarily very great. The prisoner continues his work as before, but the officer visits his factory or workshop and arranges to receive his wages each week, passing over the greater part of them to the wife to keep up the home, giving a very small sum to the prisoner for personal expenses, and retaining a small sum, which is paid back to the prisoner when he becomes a free man.

The advantages claimed for the probation system are these, that a number of independent well-paid probation officers, chosen for their knowledge of human nature and their skill in reforming it, can give personal attention to individual cases; the stigma of prison is avoided, and while great care is taken that the prisoner shall be strictly controlled and effectively restrained, his self-respect is carefully developed; the family benefits, the home is not broken up, the wages still come in, and if the prisoner is a mother and a wife, it is, of course, most important that she should retain her place in the home; the prisoner does not "lose his job" nor his mechanical skill if he is a skilled workman. Lastly, the system is far cheaper than imprisonment. The prisoner keeps himself and his family, and one officer can attend to from 60 to 80 prisoners.

In the United Kingdom the probation system has been applied to young offenders by the Prevention of Crime Act 1908. That act empowered the prison commissioners to place offenders on licence from the Borstal Institution (see JUVENILE OFFENDERS) at any time after six months (in the case of a female, three months), if satisfied that there was a reasonable probability of their abstaining from crime and leading a useful and industrious life. The condition of their release is that they be placed under the supervision or authority of some society or person (named in the licence) willing to take charge of the case. This is, of course, only a limited application of the system of probation, for those detained in a Borstal Institution are offenders between the ages of sixteen and twenty-one who have been convicted of an indictable offence. It does not apply to those of full age, nor to those under twenty-one years of age who have been committed to prison for minor offences. It has been long held by English prison reformers that young persons under the age of twenty-one should not be committed to prison, unless for serious offences, but that they should be put under some system of probation. Legislation to this effect was foreshadowed by the home secretary in his speech on prison reform in the House of Commons on the 20th of July 1910.

PROBOSCIDEA (animals "with a proboscis"), the scientific name of the group of mammals represented at the present day only by the two species of elephant. Although here regarded as a sub-order of UNGULATA (*q.v.*), the group is sometimes accorded the rank of an order by itself.[1] The existing elephants are widely sundered from all other living mammals, and for a long time palaeontology afforded but little clue as to their ancestry. Discoveries made during the first few years of the 20th century in the Lower Tertiary deposits of the Fayum district of Egypt have, however, brought to light the existence of several kinds of primitive proboscideans which serve to link the group with other ungulates, and likewise apparently indicate affinity with the *Sirenia*.

The following are some of the leading characteristics of existing elephants. The combined upper lips and nose are produced into a long muscular, flexible and prehensile proboscis, or trunk, with the nostrils at its tip. The teeth consist of a pair of large upper permanently growing incisors or tusks; and a set of cheek-teeth having their crowns composed of a series of tall transverse vertical plates gradually increasing in number from the first to the last of the series; and only portions of two of these teeth being in use at any one time. There are no clavicles; and the limbs are stout, with their component segments placed nearly in a vertical line, and the upper segment, especially in the hind-limb, the longest; the radius and ulna are distinct, the latter articulating extensively with the carpus; the fibula and tibia also distinct; the astragalus very flat on both surfaces; and both front and hind feet short, broad and massive, with five toes (though the outer pair may be more or less rudimentary), all encased in a common integument, though with distinct, broad, short hoofs; third digit the largest. Two anterior venae cavae entering the right auricle. Stomach simple. A capacious caecum. Testes permanently abdominal. Uterus bicornuate. Placenta deciduate and zonary. Teats two, pectoral.

Dentition.

In order to understand the peculiar nature of the dentition, it is necessary to discuss to some extent those of the immediate ancestors of the true elephants, such as the mastodons (see MASTODON). As regards the incisors, or tusks, which project largely out of the mouth, and are of an elongated conical form and generally curved, these are composed mainly of solid dentine, the fine elastic quality and large mass of which renders it invaluable as "ivory" for commerce and the arts. A peculiarity of the dentine of the Proboscidea is that it shows, in transverse fractures or sections, fine lines proceeding in the arc of a circle from the centre to the circumference in opposite directions, and forming by their decussations curvilinear lozenges, as in the "engine-turning" of the case of a watch. The enamel-covering in existing species is confined to the extreme apex, and very soon wears off, but in some extinct species it forms persistent longitudinal bands of limited breadth. The tusks have small milk-predecessors, shed at an early age.

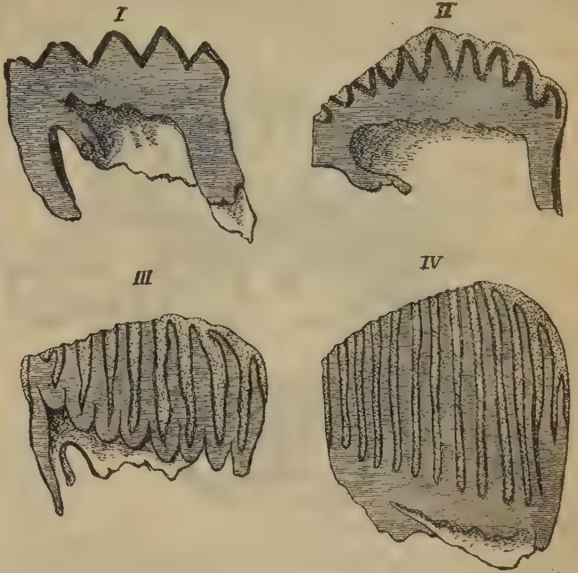

FIG. 1.—Longitudinal Sections of the Crowns of Molar Teeth of various Proboscideans, showing stages in the gradual modification from the simple to the complex form. The dentine is indicated by transverse lines, the cement by a dotted surface, and the enamel is black.

I, *Mastodon americanus*; III, *Elephas africanus*;
II, *Elephas* (*Stegodon*) *insignis*; IV, *Elephas primigenius.*

As regards the cheek-teeth, these are composed in the mastodons of a variable number of enamel-covered transverse ridges, often divided into inner and outer columns, which may partially alternate, and complicated by smaller additional columns; but in the unworn tooth they stand out freely on the surface of the crown, with deep valleys between (fig. 1, I). In the elephants the ridges are increased in number, and consequently become narrower from before backwards, while they are greatly extended in vertical height. In order to give solidity to what would otherwise be a comb-like tooth, the whole structure is enveloped and united in a large mass of cement, which completely fills the valleys, and gives a general smooth appearance to the unworn tooth; but as the wear consequent upon the masticating process proceeds, the alternate layers of tissue of different hardness—cement, dentine and enamel—which are disclosed upon the surface form a fine and efficient grinding instrument. The intermediate stages between the molar of a modern elephant and that of a mastodon are so fully known that it is not possible to draw a definite line between the two types of tooth-structure (see fig. I, II, III, IV).

As regards the mode of succession, that of modern elephants is very peculiar. During the complete lifetime of the animal there are but six cheek-teeth, which it will be convenient to allude to as molars, on each side of each jaw, with occasionally a rudimentary one in front, completing the typical number of seven. The last three represent the molars of ordinary mammals, those in front are milk-molars, which are never replaced by permanent successors, the whole series gradually moving forwards in the jaw, and the teeth becoming worn away and their remnants cast out in front, while development of others proceeds behind. The individual teeth are so large, and the processes of growth and destruction by wear take place so slowly, that not more than one, or portions of two, teeth are ever in place and in use on each side of each jaw at one time, and the whole series of changes coincides with the usual duration of the animal's life. On the other hand, the earlier representations of the proboscidean series referred to below have the whole of the cheek-teeth in place and use at one time, and the milk-molars vertically displaced by premolars in the ordinary fashion. Among mastodons transitional forms occur in the mode of succession as well as in structure, many species showing a vertical displacement of one or more of the milk-molars, and the same has been observed in one extinct species of true elephant (*Elephas planifrons*) as regards some of these teeth.

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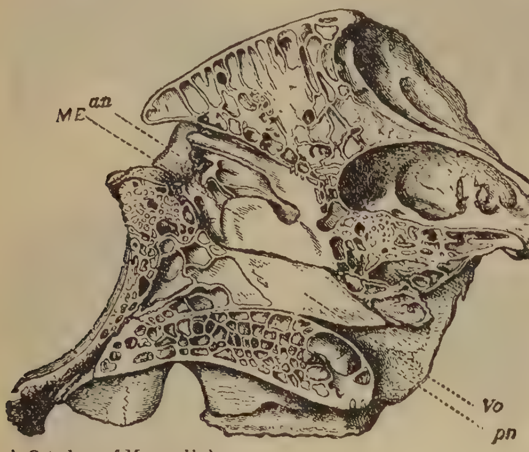
[1] Cuvier's order Pachydermata (Gr. παχύς, thick and δέρμα, skin), containing the elephants, hippopotami, rhinoceros, swine, tapirs, hyraxes, &c., is now abandoned, its members now forming the orders Proboscidea and Hyracoidea and the sub-order Perissodactyla. A few Artiodactyla are also included.

Physical Characteristics.

Most proboscideans are animals of large dimensions, and some are the most colossal of land mammals. The head is of great proportionate size; and, as the brain-case increases but little in bulk during growth, while the exterior wall of the skull is required to be of great superficial extent to support the trunk and the ponderous tusks, and to afford space for the attachment of muscles of sufficient size and strength to wield the skull thus heavily weighted, an extraordinary development of air-cells takes place in the cancellous tissue of nearly all the bones of the cranium. These cells are not only formed in the walls of the cranium proper, but are also largely developed in the nasal bones and upper part of the premaxillae and maxillae, the bones forming the palate and the basi-cranial axis, and even extend into the interior of the ossified mesethmoid and vomer. Where two originally distinct bones come into contact, the cells pass freely from one to the other, and almost all the sutures become obliterated in old animals. The intercellular lamellae in the great mass which surrounds the brain-cavity superiorly and laterally mostly radiate from the inner to the outer table, but in the other bones their direction is more irregular. Like the similar but less developed air-cells in the skulls of many other mammals, they all communicate with the nasal passages, and they are entirely secondary to the original growth of the bones, their development having scarcely commenced in the new-born animal, and gradually enlarge as the growth of the creature proceeds. The nasal bones are very short, and the anterior nasal aperture situated high in the face. The zygomatic arch is slender and straight, the jugal bone being small, and forming only the middle part of the arch, the anterior part of which (unlike that of true Ungulates) is formed only by the maxilla. The maxillo-turbinals are rudimentary, the elongated proboscis supplying their place functionally in warming and clearing from dust the inspired air.



(Flower's *Osteology of Mammalia.*)

FIG. 2.—Section of the Skull of the African Elephant (*Elephas africanus*) taken to the left of the middle line, and including the vomer (*Vo*) and the mesethmoid (*ME*).

an, Anterior, *pn*, Posterior nasal aperture.

The neck is very short. The limbs, as already mentioned, are long and stout, and remarkable for the great length of the upper segment (especially the femur) as compared with the lower segment, as represented by the foot. It is owing to this and the vertical position of the femur that the knee-joint in the hind-leg is placed much lower, and is more conspicuous externally than in most quadrupedal mammals; and this having been erroneously compared with the hock-joint or ankle of the more ordinary ungulates, gave rise to the popular fallacy that the joints of the elephant's leg bend in a contrary direction to that of other mammals. There is no round ligament in the hip-joint, or third trochanter to the femur. The radius and ulna are distinct, though fixed in a crossed or prone position; and the fibula also is quite separated from the tibia. The feet are short and broad, the carpal and tarsal bones being very square, with flattened surfaces for articulation; the astragalus especially differs from that of the more typical ungulates in its flatness, in the absence of distinct pulley-like articular surface at either extremity, and in having no articular facet for the cuboid. The fibula articulates with the calcaneum, as in the artiodactyle sub-order of Ungulata. Of the five toes present on each foot, the middle one is somewhat the largest, while the lateral ones are the smallest, and generally lack (especially in the hind-foot) the complete number of phalanges. The terminal phalanges are all small, irregular in form, and late in ossification. The whole are encased in a common integument, with a flat, subcircular, truncated sole, the only external indication of the toes being the broad oval nails or hoofs arranged in a semicircle around the front edge of the sole. The hind foot is smaller and narrower ~~than~~ the front. The liver is small and simple, and there is no gall-bladder. In form the brain resembles that of the lower orders of mammals in that the cerebellum is entirely behind and uncovered by the cerebrum, but the hemispheres of the latter are richly convoluted.

Elephants are exclusively vegetable-feeders, living chiefly on leaves and young branches of forest trees and various kinds of herbage, or roots, which they gather and convey to their mouth by a very mobile proboscis, an organ which combines in a marvellous manner strength with dexterity of application, and is a necessary compensation for the shortness and inflexibility of the neck, as it is by this that many of the functions of the lips of other animals are performed. By its means elephants are enabled to drink without bending the head or limbs. The end of the trunk being dipped, for instance, into a stream or pool, a forcible inspiration fills the two capacious air-passages in its interior with water, which, on the tip of the trunk being turned upwards and inserted into the mouth, is ejected by a blowing action, and swallowed. Or if the animal wishes to refresh and cool its skin, it can throw the water in a copious stream over any part of its surface. Elephants can also throw dust and sand over their bodies by the same means and for the same purpose, and they have frequently been observed fanning themselves with boughs held in the trunk.

The following are the distinctive features of the genus *Elephas*, the type of the family Elephantidae: Dentition: *i.* $\frac{1}{0}$, *c.* $\frac{0}{0}$, *m.* $\frac{6}{6}=26$. The incisors variable, but usually of very large size, especially in the male sex, directed somewhat outwards, and curved upwards, without enamel except on the apex before it is worn; preceded by small milk-incisors. The molars succeed each other by horizontal replacement from before backwards, never more than one or part of two being in use on each side of each jaw at the same time; each composed of numerous flattened enamel-covered plates or ridges of dentine, projecting from a common many-rooted base, surrounded and united together by cement. The number of plates increases from the anterior to the posterior molar in regular succession, varying in the different species, but the third and fourth (or the last milk-molar and the first true molar), and these only, have the same number of ridges, which always exceeds five. Skull of adult very high and globular. Lower jaw ending in front in a deflected, spout-like symphysis. Vertebrae: C. 7, D. 19–21, L. 3–4, S. 4, C. 26–33.

The two existing species of elephant are the Indian or Asiatic (*Elephas maximus*), and the African (*E. africanus*), the distinctive characteristics of which are given under ELEPHANT. See also MAMMOTH and MASTODON.

EXTINCT PROBOSCIDEA

Elephas.—The extinct representatives of the Proboscidea are of the greatest importance and interest, since they serve to connect the modern elephants with ungulates of more ordinary type. The MAMMOTH (*Elephas primigenius*) is treated in a separate article. Nearly allied is *E. armeniacus* of Asia Minor; but *E. antiquus*, of which the remains are abundant in many of the superficial formations of England and Europe generally, approximates in the structure of its molar teeth to the African elephant. It is represented in the Pleistocene of India by the closely allied or identical *E. namadicus*. Affinity with the African species is strongly marked in the case of the dwarf elephants of Malta (*E. melitensis*) and Cyprus (*E. cypriotes*); and the gigantic *E. meridionalis*, of the "forest-bed" of the east coast of England and the Upper Pliocene of the Val D'Arno, has likewise molars showing the broad lozenges of enamel-bordered dentine characteristic of the African type. These and other species indicate, however, that, so far as dental characters are concerned, generic separation of the African from the Asiatic elephant is impossible. In North America the mammoth occurs in the far north, *E. columbi*, more akin to *E. antiquus* chiefly in the Central United States, and *E. imperator* (allied to *E. meridionalis*) in the south. The oldest representatives of this group are *E. hysudricus* and *E. planifrons* of the Lower Pliocene of Northern India; the latter of which developed premolars vertically replacing the anterior teeth of the molar series.

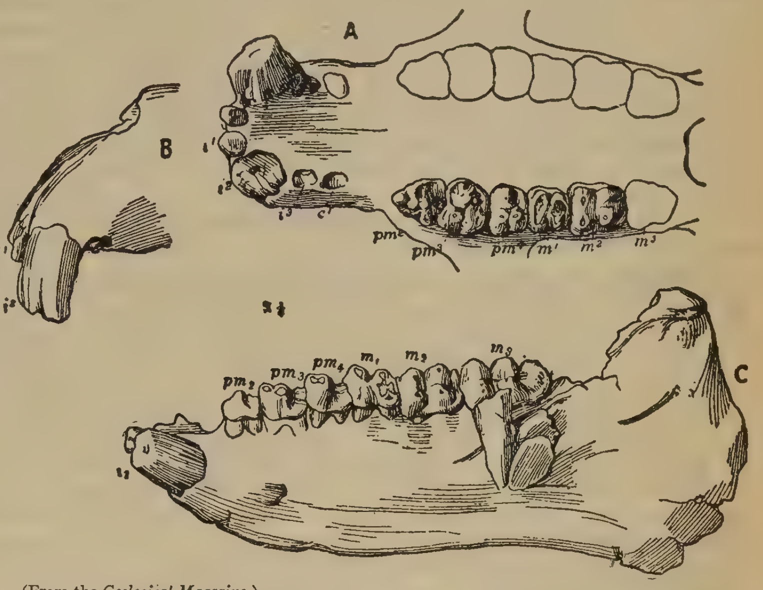
From *E. planifrons* there is an almost complete transition to the ridge-toothed elephants, such as *E. ganesa*, *E. insignis*, *E. bombifrons* and *E. clifti*, typically from the Lower Pliocene of India and Burma, but some of which extend eastwards to Java, Borneo, China and Japan. These constitute the group (or genus) *Stegodon*, and are characterized by the lowness of the crowns of the molar teeth, in which the tall plates of the more typical elephants are reduced to low ridges with more or less completely open valleys between them; the number of ridges in each tooth is always much lower than in the corresponding teeth of the typical elephants. Premolars, vertically replacing the anterior molars, were often developed. These stegodont elephants appear to have been confined to India and the countries farther east, and exhibit an almost complete transition, so far as dental characters are concerned, to the mastodons of the same region.

Mastodon.—The connexion between the stegodont elephants and the mastodons (see MASTODON) is formed by the Indian and Burmese *Mastodon latidens* and *M. cautleyi.* In fact the main distinction between these animals and the stegodont elephants is the smaller number of ridges in the third, fourth and fifth molars, which is usually four, and never exceeds five, whereas in the stegodonts it is at least six and the numbers are not the same in each of the three teeth. In the two species named the transverse ridges are more or less continuous. Many other species, such as the European *M. arvernensis* (see fig. 2 in art. MASTODON) and the Indian *M. sivalensis*, have, however, the ridges broken up into columns, or cones, more or less alternately arranged, and thus blocking the intermediate valleys. In these species, which are of Pliocene age, there are four ridges in molars 3, 4 and 5; but in the Pleistocene North American *M. americanus* (as well as in many other species) these are reduced to three in each of the aforesaid teeth. The lower jaw of the latter species frequently shows small tusks, which are, however, generally shed in mature age. Premolars, which vertically replace some of the anterior molars (milk-molars), are developed in many species, although not in *M. americanus.* Species of the genus are found over the greater part of the world, inclusive of Europe, Asia and North and South America; *M. humboldti* being the best known South American species. A single tooth referable to this or the next genus has been obtained from South Africa.

Tetrabelodon.—The more primitive mastodons constitute the genus *Tetrabelodon*, and are characterized by the presence of a pair of short chisel-shaped tusks in the lower jaw, which is prolonged into a trough-like chin for their support; tusks being also present in the upper jaw. These animals were provided with a snout-like muzzle instead of a trunk (see MASTODON). Their birthplace was Africa; the Miocene European *M. angustidens* having been discovered in Egypt in strata overlying those from which were obtained the remains of the under-mentioned more primitive genera. Tetrabelodont mastodons were, however, by no means confided to the Miocene, *Tetrabelodon longirostris* occurring in the Lower Pliocene of Europe, and *T. pandionis* in that of India. Most of these four-tusked mastodons were smaller animals than modern elephants.

Palaeomastodon.—No proboscidean earlier than *Tetrabelodon* occurs in Europe, but the group is represented in the Upper Eocene of Egypt by a smaller and more primitive type known as *Palaeomastodon.* This genus resembles *Tetrabelodon* in having four pairs of tusks, but differs in the less elephant-like skull, and the simpler character of the molar teeth, of which five pairs were in use at one time, whereas in *Tetrabelodon* and *Mastodon* there were never more than two pairs and a portion of a third in simultaneous wear.

Moeritherium.—The earliest representative of the proboscidean stock at present known is *Moeritherium*, from the Middle Eocene of Egypt, which includes still smaller animals, whose relationship to *Elephas* would scarcely be realized were it not for the intermediate links. All six pairs of cheek-teeth (*pm.* 2–*m.* 3, fig. 3) were in use at once, and there was a comparatively full series of teeth in the front of the jaws; while the premolars were preceded by milk-molars in the normal manner. Very significant is the enlargement of the second pair of incisors in each jaw, thereby foreshadowing the tusks of *Tetrabelodon.* There was, however, no lengthening of the chin, so that the muzzle was probably of normal proportions. This animal was not larger than a tapir.



(From the *Geological Magazine.*)

FIG. 3.—Dentition of *Moeritherium lyonsi.*
A, Upper teeth.
B, Front of snout, showing the tusk-like second incisors.
C, Left ramus of mandible from outer side.

Dinotherium.—The huge proboscidean from the Lower Pliocene and Middle Miocene strata of Europe and India, known as *Dinotherium*, indicates a type off the line of descent of the elephants. Upper tusks were apparently wanting, but the lower jaws carried a pair of large tusks bent downwards in a peculiar manner (fig. 4). The cheek-teeth formed five pairs, all in use at one time, and premolars vertically replacing milk-molars in the ordinary fashion. The ridge-formula of the permanent teeth of the cheek series was 2.2.3.2.2.

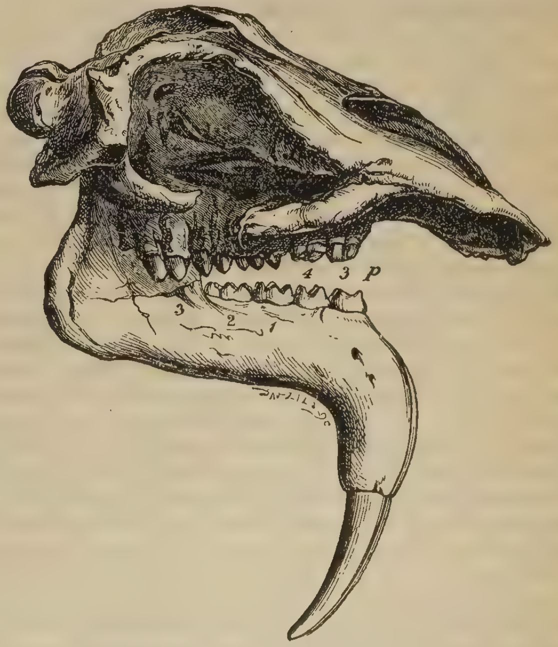


FIG. 4.—Skull of *Dinotherium giganteum* (Lower Pliocene. Eppelsheim, Hesse-Darmstadt).

Barytherium and Pyrotherium.—Very problematical are the affinities of *Barytherium* of the Egyptian Eocene and *Pyrotherium* of the Lower Tertiaries of Patagonia; although it is possible that they may both be offshoots from the primitive proboscidean stock. *Pyrotherium* had a pair of upwardly directed tusks in the lower jaw. The cheek-teeth are five in number and carry transverse ridges similar to those on the molars of *Dinotherium*, although there are only two to each tooth. If really related to the Proboscidea, *Pyrotherium* may be derived from the African ancestral stock of that group which reached South America by way of a former land-connexion between that continent and Africa. So far as can be determined, *Barytherium* approximates in many respects to *Dinotherium*, but in others seems to approach *Uintatherium* of the North American Tertiaries (see AMBLYPODA).

See C. W. Andrews, *Descriptive Catalogue of the Tertiary Vertebrata of the Fayum*, British Museum, 1906. (R. L.*)

PROBOSCIS, the trunk of an elephant (Gr. προβοσκίς, πρό, before, βόσκειν, to feed), the long flexible snout of the order of Mammalia called *Proboscidea* (*q.v.*), which embraces the elephant and its extinct allies the mammoths and mastodons. The term is also applied to the snout of the tapir and of the "kahan" or proboscis-monkey (*Nasalis larvatus*), and more particularly to the elongated parts of the mouth of various insects, such as the *rostrum* or beak of a rhynchophorus beetle, the antlia of *Lepidoptera*, the sucking mouth of the house-fly, &c. Various worms possess a tubular structure which can be extended at the anterior portion of the body, and some gastropods a sucking tongue, to both of which the name "proboscis" is applied.

PROBOSCIS-MONKEY, a large, long-tailed, red Bornean species characterized by the extraordinary prolongation of the nose of the adult male, which hangs, however, down in front of the upper lip and does not stand straight out from the face in the manner commonly represented in pictures. From this feature the species, which is the only representative of its genus, derives its name of *Nasalis larvatus*. In females and young the nose is much less developed, with a tendency to turn upwards in the latter. This monkey is a leaf-eater, nearly allied to the langurs, as typified by the sacred ape of India. (See PRIMATES.)

PROBUS, MARCUS AURELIUS, Roman emperor A.D. 276 to 282, was a native of Sirmium in Pannonia. At an early age he entered the army, where he distinguished himself under the emperors Valerian, Claudius and Aurelian. He was appointed governor of the East by the emperor Tacitus, at whose death he was immediately proclaimed his successor by the soldiers. Florianus, who had claimed to succeed his brother, was put to death by his own troops, and the senate eagerly ratified the choice of the army. The reign of Probus was mainly spent in successful wars by which he re-established the security of all the frontiers, the most important of these operations being directed to clearing Gaul of the Germans. Probus had also put down three usurpers, Saturninus, Proculus and Bonosus. One of his principles was never to allow the soldiers to be idle, and to employ them in time of peace on useful works, such as the planting of vineyards in Gaul, Pannonia and other districts. This increase of duties was naturally unpopular, and while the emperor was urging on the draining of the marshes of his native place he was attacked and slain by his own soldiers. Scarcely any emperor has left behind him so good a reputation; his death was mourned alike by senate and people, and even the soldiers repented and raised a monument in his honour.

Life by Vopiscus; Zosimus i. 64; Zonaras xii. 29; Aurelius Victor, *Caes.* and *Epit.* 37; H. Schiller, *Geschichte der römischen Kaiserzeit* (1883), vol. i.; E. Lépaulle, *Étude historique sur M. A. Probus d'après la numismatique* (1885); Pauly-Wissowa, *Realencyclopädie*, ii. 2516 (Henze).

PROBUS, MARCUS VALERIUS, of Berytus, Roman grammarian and critic, flourished during the reign of Nero. He was a student rather than a teacher, and devoted himself to the criticism and elucidation of the texts of classical authors (especially the most important Roman poets) by means of marginal notes or by signs, after the manner of the Alexandrine grammarians. In this way he treated Horace, Lucretius, Terence and Persius, the biography of the last-named being probably taken from Probus's introduction to his edition of the poet. With the exception of these texts, he published little, but his lectures were preserved in the notes taken by his pupils. Some of his criticisms on Virgil may be preserved in the commentary on the *Bucolics* and *Georgics* which goes under his name. We possess by him part of a treatise *De notis*, probably an excerpt from a larger work. It contains a list of abbreviations used in official and historical writings (especially proper names), in laws, legal pleadings and edicts.

The following works have been wrongly attributed to him. (1) *Catholica Probi*, on the declension of nouns, the conjugation of verbs, and the rhythmic endings of sentences. This is now generally regarded as the work of the grammarian Marius Plotius Sacerdos (3rd century). (2) *Instituta artium*, on the eight parts of speech, also called *Ars vaticana* from its having been found in a Vatican MS. As mention is made in it of the baths of Diocletian, it cannot be earlier than the 4th century. It is possibly by a later Probus, whose existence is, however, problematical. (3) *Appendix Probi*, treating of the noun, the use of cases, rules of orthography (valuable in reference to the pronunciation of Latin at the time), and a table of *Differentiae*. As the author has evidently used the *Instituta*, it also must be assigned to a late date. (4) *De nomine excerpta*, a compilation from various grammatical works.

See J. Steup, *De Probis grammaticis* (1871); Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans.), 301.

PROCEDURE (Fr. *procédure*, from Lat. *procedere*, to go forward), in general, a method or course of action. In law, procedure may be defined as the mode in which the successive steps in litigation are taken. As a term in English law it dates only from the passing of the Common Law Procedure Acts 1852–1860; it is usually coupled with, or more often replaced by, the word "practice." The procedure of the High Court of Justice in England is governed by the rules of the supreme court, which are published in the *Annual Practice*. Procedure has been defined (per Lush, L.J., *Poyser* v. *Minors*, L. R. 7 Q.B.D. 329), as "the mode of proceeding by which a legal right is enforced as distinguished from the law which gives or defines the right, and which by means of the proceeding the court is to administer; the machinery as distinguished from the product." T. E. Holland (*Elements of Jurisprudence*, 1906, p. 86) describes procedure, or "adjective" law, as that part of law which provides a method of aiding and protecting rights.

See the articles on the various branches of law, as ADMIRALTY JURISDICTION, CRIMINAL LAW, DIVORCE, &c.; also ACTION, APPEAL, EVIDENCE, PLEADING, SUMMONS, TRIAL, &c.

PROCESS, a general term now technically employed for the photo-mechanical processes by which illustrations are reproduced in printing. Until the last quarter of the 19th century reproductive processes, save as regards line reproduction, can hardly be said to have had an existence. Paintings, drawings, and engravings, which it was desired to put into form which by means of the printing-press could be multiplied indefinitely had to go through a process of interpretation by an engraver or draughtsman, who, on a metal plate, a block of wood or stone, gave a rendering of the original subject. The means at his disposal were lines and dots, which, varying in their thickness and proximity, expressed dark or light passages in the scheme of light and shade of the original. It will readily be understood how such interpretations would vary. An engraver with fine art instincts would produce a result as distinct in character as an engraving as was the original as a painting or drawing, and engravings were sought after as works of art, and treasured for their artistic qualities. But engraving of this kind took time. Years were devoted to the production of one steel- or copper-plate, while wood engravers who were artists could only work on a block when in the mood; and for that mood the publisher had to wait, and he grew impatient and was willing to accept rapid interpretation of originals by men who could produce them under other than artistic conditions. But the pain of the artist at the bad rendering of his original was often great, so that he, not less than the publisher, though for another reason, hailed the attempts that were being made to reproduce his work mechanically without the intervention of the translator or interpreter. The ideal of an artist would naturally be a reproduction of his work in facsimile, which retained all, or as many as possible of, the individual characteristics of his work; and to give him this was the aim of the school of wood engravers which originated in the United States and made a last stand to maintain the position of their art in the field of book illustration. By a system of extremely fine work the American wood engravers were able to keep much closer to the tones of an original than had previously been possible; but the result was obtained at the sacrifice of the artistic rendering of the best old engravings, and was so mechanical in its character that when it had to compete with a real mechanical process the engraving could not hold its ground, the enormous difference in the cost of production being a factor of sufficient importance in itself to make it impossible for the engraving to retain the field. A similar development had been going on in the other branches of engraving. The line engraver and the etcher, to whom had been entrusted the interpreting of works of art first produced in other forms, found themselves faced by mechanical reproductions in plate form which, while preserving more of the character of the original work, were produced in much less time and at a greatly reduced cost. It has thus come about that the last quarter of the 19th century witnessed the dispossession of the hand engraver from the field of interpretative engraving, and the occupation of his position by the chemist and the mechanician.

The term "process," which has come to be applied to all photo-mechanical reproductions, is a somewhat unfortunate one, inasmuch as it is descriptive of nothing. From time to time various names have been given to its varying forms, indicative either of the name of the inventor or of some peculiarity of method. Zincography, gillotype, photogravure, heliogravure, heliotype, phototype, albertype, are illustrations of the kind of name given often to very slightly varying applications of the same principle, but usage has come to apply the term "process" to any printing surface that is produced by chemical and mechanical means. The whole of these processes may be arranged under three heads: (1) relief; (2) intaglio; (3) planographic.

1. *Relief Processes.*—An engraving in relief is one in which the printing surface stands up above the surrounding ground. The history of the development of relief processes is really the history of photography (*q.v.*); for whilst attempts were made to obtain results without the aid of photography, by drawing upon plates with prepared chalk or ink, "rolling them up" with printer's ink and etching away the ground with acid, as in the case of zincography, the real progress of all process has been upon the lines of photography; and to Niepce and Daguerre may be attributed the origin of the modern mechanical and chemical processes.

Speaking broadly, all the modern "processes" are the outcome of a discovery by Mungo Ponton that a preparation of albumen or other colloid substance and bichromate of potash could be hardened and rendered insoluble and nonabsorbent in water by exposure to light, and that as a photographic negative permitted the passage through it of light in varying degrees of intensity, so a film of the preparation placed under a negative was liable to be hardened and rendered insoluble in degrees varying with the intensity of the light affecting it. This discovery governs the production of process blocks or plates of all kinds.

Line Blocks.

The methods of reproduction of pure line work differ greatly from those for the reproduction of originals in tone. As the first necessity in securing a good result is the suitability of the original to be reproduced, it is desirable to make clear the character of a good original. This should be of one tone or degree of colour all through. It may be all grey; it is better that it be all black. It may not be black in parts only and grey in others. The lines of an original may be of any variety of thickness. It is necessary, therefore, for the draughtsman to see that he works with a good black ink, or ink that will tell as black when it is exposed to the photographic plate. Inks of a warm tone—that is, inclining to red or orange—yield better results than cold inks which incline to blue.

Most prepared liquid inks have a tendency to lose their blackness by exposure to the atmosphere on the removal of the cork from the bottle. The ideal ink is one freshly ground from a dry cake of colour when beginning work. Indian ink is good if well ground and kept sufficiently thick to assure the necessary blackness. It has the advantage of not washing up when colour in washes is passed over it, but it must be used freshly ground. The addition of a little Indian yellow, burnt sienna or sepia, gives a warmth of tone to it and renders it photographically more active. Bourgeois ink, prepared by Bourgeois of Paris, appears to be prepared with the admixture of some warm colour with the black base. It is a good ink for the purpose, and is prepared both in solid and liquid form. Lampblack gives good black lines; so does ivory black, which is warmer in tone than lampblack. Higgins' Indian ink or American drawing ink is an American ink made in liquid form which has the reputation of not fading by exposure. Stephens's Ebony Stain is a fine black medium which does not clog the pen; if it thickens and dries, it cracks off and does not corrode the pen.

Besides the pen a brush brought to a fine point is much preferred by some artists, as it yields a line less monotonous than that given by a pen, though the brush cannot be used so freely. The paper used should be smooth and as white as possible. A paper is made with a surface coating of white chalk, which admits of the use of a scraper to remove lines or to break them up.

It is not possible to lay down a rule for the amount of reduction to be made when photographing for the reproduction; the finer the drawing the less should be the reduction made; but experience is the only guide. Sometimes, where the lines are very fine and the drawing minute in character, an enlargement is desirable. Where drawings are reduced too much, there is a tendency for the spaces between the lines to fill up, and to give a coarse, heavy result. Faulty drawing is not lessened by reduction. On the contrary, the fault becomes more evident, so it is desirable to make all necessary corrections in the drawing.

The original drawing which has to be reproduced is photographed to the size of the required block. The negative taken is absolutely dense except where the lines of the drawing have affected it, and these are absolutely clear, admitting the unrestricted passage of light through them. A piece of planished copper or zinc is prepared or made sensitive to light by a preparation of albumen or gelatin and bichromate of potash spread upon its surface. The negative is laid upon the sensitized metal and placed in the light in the way an ordinary photograph is printed. The light passes through the transparent lines of the negative and hardens the bichromated film beneath them. Both negative and plate are then taken into a darkened room, where the metal plate is rolled with an inked roller, placed in a bath of cold water and allowed to soak until the albumen and bichromate becomes so softened everywhere, except where the light has hardened them, that they all wash away, and nothing is left but the hardened lines. The lines are dusted with asphalt, which by heat is melted on to them, and makes a ground which resists the action of acid. A coat of varnish is put over the back and edges of the plate, to protect them from the acid also, and only the spaces between the lines on the surface are left free to its action. The plate is then placed in a bath of dilute nitric acid, which eats away the metal wherever it is exposed; but it leaves the lines of the drawing, which are protected by the hardened film standing up above the eaten or etched surface; and these lines, which correspond to those of a wood engraving, are the printing surface of the plate. The plate is mounted on a wood or metal block, made type-high, and it can then be used along with type in the printing-press.

Various devices have been resorted to that effects of tone may be obtained by means of the simple line process. Grained papers with a surface of chalk, upon which are printed close-ruled lines crossing at right angles, or rows of dots give the papers a heavy, flat, "tone," upon which a drawing can be made in pencil, chalk or ink, and gradations of tone introduced by means of scrapers, which remove partially or entirely the black ruled lines or dots, leaving, if desired, high lights of pure white. A drawing on such paper consists of lines or dots, a combination of the original lines or dots of the paper and those of the drawing itself, the scraper splitting up lines into dots or removing them altogether. The result is quite easily reproduced by the line process. Another method is by the use of what are known as Day's "shades," or shading mediums. They are transparent films of gelatin which have upon them lines or dots in varying combination in relief, so that they can be inked up by a roller. When placed over a drawing, their transparency enables the operator to see exactly what passage he is dealing with, and he can by means of a burnisher impress the lines or dots of the shade upon any passage of the drawing; these lines or dots then become part of the drawing; and are reproduced in the usual way.

Swelled Gelatin Process.

Pencil or chalk drawings upon simple white-grained paper, where the pencil or chalk passing over the ruts or hollows in the paper makes a mark on the top of the grain only, are also reproducible by the line process, but such drawings are apt to be unequal in colour and difficult to deal with. The difficulty led to the invention of a process by Henry Matheson, who, not having the capital to work it, joined the late Mr Dawson, senior, whose sons continued to work the process with Matheson under the name of the Swelled Gelatin Process. It is based upon the fact that gelatin, sensitized with bichromate of potash, swells when placed in water, and swells in proportion to the amount of light to which it has been exposed. A negative taken from a drawing which varies in tone, not being thoroughly black all through, varies in the quality of its transparent lines and dots; and when a piece of paper or glass coated with sensitized gelatin is exposed to the action of such a negative it is affected according to the amount of light the negative allows to pass. After making a print on such paper or glass, it is placed in a dish of water and the surface allowed to swell, which it does in varying degrees, the portion unaffected by the light absorbing most water and swelling most, the hardened lines of the drawing not swelling at all. This swelled print is then placed in a frame, and a preparation of plaster is poured upon it to make a mould of its surface. When this has set and the gelatin has been removed, this mould is filled with a preparation of wax, which sets in a few minutes sufficiently for it to be released from its plaster mould. Additional wax is built up when necessary upon the "whites," as they are technically called—that is, the passages which represent what will be the hollows in the block—so that these may be as deep as possible; and this wax mould is electrotyped in copper. The lines and dots of this copper block, which when finished is backed up with metal and mounted, vary slightly in height, the result being that the slightly lower dots do not come so closely in contact with the inking roller or with the paper, and so produce when printed a grey impression corresponding to the greyness of the original drawing.

The drawback to the use of the process is that it is about three times as costly as the ordinary process. It is a method much used for the reproduction of line and stipple engravings, where fine dots and lines are apt to be printed in delicate tones. The finest results by this method are producible, however, by omitting the plaster mould and wax-cast stages, and by coating the sensitized gelatin with plumbago or other impalpable metal preparation which will enable it to receive a copper deposit to qualify it to take its place in the electrotyper's bath, and so to get the needed thin coating of copper from the surface of the gelatin itself; but this needs to be done with the greatest care, and is still more costly.

Typographic Etching.

A non-photographic process of obtaining line blocks in relief has been for a long time successfully worked by Messrs Dawson. A brass plate is coated with a film or ground of wax upon which a tracing of the drawing to be reproduced may be rubbed down. By means of an etching needle the lines of the drawings are incised upon the thin wax ground down to the surface of the brass plate. A pencil of wax and a pencil of hot metal are then used to produce a flow of melted wax which drops from the wax pencil upon the ridges of wax between the lines and builds them up until they are of sufficient height. The risk that this wax may run into the incised lines has to be carefully guarded against, but skilful treatment manages so that it stops at the edges and does not run over. In maps and diagrams where lettering or figures are necessary, type is impressed into the wax with a very neat and precise result. By this means a mould is formed, an electrotype from which gives a really good relief block which may be printed with type.

Half-tone Processes.

The invention of line processes only stimulated the efforts to find out some means whereby tones might be reproduced on blocks or plates that could be printed along with type in the ordinary rapid printing-press. It is only possible to approximate to the printing of a flat or graduated tone by producing a broken or granulated surface which shall present a series of lines or dots that, when inked and impressed upon paper, shall by the variations of proximity and size give the impression of an unbroken tone. This necessitates the lines or dots being so small that the eye shall not at a glance appreciate the broken-up character of the surface of the block. Many efforts resulted in the production of what is known as the *screen*, which itself was only made possible by the invention of ruling machines of a delicacy previously unknown.

A screen is made by coating a sheet of glass—which must be flawless both as to body and surface—with a composition analogous to the ground used by an etcher to coat his plate before drawing upon it with his needle. The glass so coated is placed in an automatic ruling machine, of which the ruling point is a diamond, and which can be adjusted so as to rule any number of lines from 50 to 300 to the inch. The lines are ruled diagonally on the glass, and at mathematically equal distances from each other. The sheet of glass, after ruling, is treated with hydrofluoric acid, and the lines where the ground is cleared away by the diamond point are etched or bitten into it. The plate is cleaned up and an opaque dark pigment rubbed into the lines. Two such ruled sheets of glass are sealed together face to face with Canada balsam, with the diagonally ruled lines crossing each other at right angles, the result being a grating or screen containing innumerable little squares of clear glass through which the light can pass, which it cannot do through the ruled lines, which are filled by the opaque pigment.

To produce a half-tone block from a picture, a black and white drawing in tone, or a photograph, a negative is exposed in the camera in the usual way, with this screen quite close to it but not in contact; and the subject is photographed on to the negative through the screen, and what is termed a "screen negative" is the result. It is a photograph of so much of the original as could affect the negative through the little clear squares of the screen, and represents the tones of it by innumerable dots and lines, the size and proximity of which are regulated by the fineness or coarseness of the screen used.

In the early days zinc was the metal used for these half-tone blocks; but experience showed that though more difficult to etch to the necessary depth, the closer, denser texture of copper rendered plates of this metal much more suitable for the production of the best blocks, and zinc now is used only for inferior blocks. Whichever metal may be used, a sheet of it, most carefully planished, is sensitized with a coating of gelatin or fish-glue and bichromate of potash, dried and exposed under the screen negative to the action of light, as in the ordinary method of photographic printing. The action of the light hardens the gelatin film, the portion not so hardened being soluble by water. The plate with the gelatin picture in lines and dots is exposed to heat and the image is burnt in on the surface of the metal like an enamel, which enables the photographic picture to resist the subsequent etching. The plate is placed in a bath of iron perchloride and etched until sufficient depth is obtained. Wherever the surface of the plate is free from the lines and dots, it is bitten away by the perchloride, and the lines and dots are left in relief. This first biting in the bath produces a rather flat general impression of the original, and is termed "rough etching." To produce finer results, and to bring out the contrasts of black and white necessary to a good reproduction, the block has to go through processes of stopping out and rebiting similar to those of etching an intaglio plate. This "fine etching" calls for the artistic taste and judgment of the craftsman; and with a good photograph to work from the final quality of a block will depend largely upon its treatment by the fine etcher. A substitute for the acid bath has been found in an acid blast. The acid is driven in the form of a spray with some force on to the surface of the prepared plate, which it etches more rapidly and more effectively than the bath.

One risk to be guarded against is the underbiting of the lines and dots which form the printing surface. As soon as the acid has eaten its way downwards past the protecting surface film, it will attack the sides of the upstanding dots as well as the ground that supports them, with the result that they become weakened and rendered liable to break off in the process of printing, as well as to make the obtaining of electrotypes from the blocks a matter of extreme difficulty, the underbitten points breaking or tearing away in the mould. To avoid this underbiting a fatty ground is laid over the surface of the block each time it is etched; by exposure to heat this ground is sufficiently melted to permit of its running down the sides of the upstanding points, and so giving them the required protection. The acid blast is less liable than the bath process to eat away the sides of the dots.

This method of making tone relief blocks is most generally known as the "Meisenbach" process, from Meisenbach, of Munich, who was the first to make it commercially successful, but the history of its development is somewhat obscure. Fox Talbot as early as 1852 took out a patent for using a screen of crape or muslin; he also suggested dusting glass with a fine powder to produce a grain screen. All the early ruled screens were single line, and the credit is due of suggesting the shifting of the single line screen during the operation and, by reversing it, producing the effect of the double line, to Sir Joseph Swan, who patented the process in 1879. Meisenbach's patent for a similar method is dated 1882. The development of the screen was the important factor in the development of the process. The early screens were photographs of ruled plates and the great advance was made by Max Levy of Philadelphia, who made it possible by his ruling machines to produce screens of a fineness and clearness not previously practicable. It was F. E. Ives who, in 1886, introduced ruled screens placed face to face and sealed up so as to produce cross-lined screens.

The chief objection to this process is its inability to reproduce the extremes of expression employed by the artist in black and white; actual white is impossible, and delicate tones, such as are characteristic of skies, are destroyed by the cross-bar lines of the screen, which cover down all light passages and rob the reproduction of that brilliancy which characterized wood engraving. It is true that the addition of hand engraving can be resorted to in the case of the process block, and lights and other varieties of tone and form introduced, but this can only be done on blocks of very fine texture, and the cost of reproduction is greatly increased by the introduction of such handwork by the engraver.

Three Colour Blocks.

The most important development of the half-tone process is in the direction of the reproduction of works in colour by means of relief blocks. The theories of colour (*q.v.*) in light and in pigments enter largely into this development. White or solar light is composed of rays of light of three distinct colours, red, green and violet, which are called the primary or fundamental colours because by their combination in various proportions all other tones of colour are produced, but they cannot themselves be produced by any combination of other coloured rays. The theory of pigmental colour differs from this in that the primary or foundation colours from which all others are produced, while being themselves unproducible by any admixture, are blue, red and yellow, and while the combination of the red, green and violet of the scientist produces white, the combination of the primaries of pigments in their full strength produces black.

Colour is the result of the absorption and reflection of the rays of light which strike upon a body. The rays which are reflected are those which affect the vision and produce the sense of colour. Should the object absorb all the rays it appears black, should it absorb none but reflect all it is white, and between these two extremes lie an infinite variety of tones. Filters have been made which absorb and refuse passage to certain coloured rays, while permitting the passage of others, *e.g.* a photographic filter of a certain colour will absorb and stop the passage of red and green rays, while permitting the passage through it of the violet. It will then be perceived how, when a picture or other coloured object is placed before a camera, with one of these filters between it and the exposed negative, the rays of light of the colour which can pass through the filter to the negative will be the only ones which can affect it, and that it is possible in this way to secure on three separate negatives a record of the green, red and violet rays which are reflected from its coloured surface by any object placed before the camera.

These records are coloured photographs; they are simply ordinary negatives, records of colour values which may be translated into colour by the use of coloured inks. The principle governing the process is analysis or separation followed by recombination. Positives are made from these colour records, from which by means of the rule screens already described half-tone process blocks are made which, when printed one over the other in coloured inks, combine again the colours which were separated by the filtering process and give approximately a reproduction of the original in its true colours. The colour used with each block must have a relation to the filter used in its production. It must represent a combination of the two colours stopped out by the filter when making the negative from which the block was made, that is to say, the colour used must be complementary to the colours stopped out. Certain subjects which are amenable to long exposures can be dealt with by what is known as the "direct process," whereby the screen negative and the colour record are made by one operation on the same plate. By this means six of the fifteen otherwise necessary operations are saved, but the method is not always practicable.

As far back as 1861 the suggestion was made at the Royal Institution by Clerk Maxwell to reproduce objects in their natural colours by superimposing the three primary colours. Later Baron Ransomut, of Vienna, Mr Collen, a gentleman who taught drawing to Queen Victoria, and two Frenchmen, MM. Chas. Cros and Ducos du Hauron, carried on the idea and made experiments with the aid of photography, which were still further developed in Germany by Professor Husnik, of Prague, Dr Vogel, of Berlin, and others; but it was in America that the first three-colour blocks for letterpress printing were made, F. E. Ives, at Philadelphia, being their maker in 1881.

This three-colour relief process has made great advances in recent years. The first great practical difficulty which had to be overcome was to produce three screen blocks which could be printed one over the other. Were the screens of each block used at the same angle, the lines and dots would print on the top of one another; but a great deal of the colour result depends upon a considerable proportion of each colour being on the white paper. Artists know well that much purer and more brilliant results are produced by placing touches of colour side by side than one over another; small patches of red and blue, placed side by side, yield to the eye a purple of much greater purity and beauty than the same touches of colour worked one over the other. Consequently it was found necessary to turn the screen at a different angle for each block, so that the lines should not fall on each other but should cross each other; but the risk of this is that, used at certain angles, the crossing of the screen lines will produce what is known as the *moiré antique* result. Vogel took out a patent in Great Britain for the process, and he therein stated that the screens should be used at certain stated angles. He also proposed to use single-line screens, similar to those used by F. E. Ives at Philadelphia, instead of cross-line; but it has since been found that the cross- or double-line screens can be used successfully; and that the angle at which they can be used is not a fixed one.

Colour Filters.

Filters are made in a dry or wet form. The dry filter is made by spreading a film of gelatin or collodion, tinted by an aniline colour, upon a piece of glass. The wet filter is a cell or trough made of two sheets of glass, sealed all round and filled with water tinted with an aniline dye or colour. The accuracy of the tint of the colour-filter may be tested by the spectroscope, or by an instrument invented by Sir William Abney, and known as the Abney colour sensitometer. This is a theoretical test. The practical test is by photographing through them patches of blue, red, and yellow. If, for example, the filter for blue records the full strength of blue with the full strength of the colour of the negative, while giving slight or no record at all of the red and yellow, it is practically a true filter. It is possible to treat the negatives themselves so as to render them more sensitive to the special colour they are intended to record. Indeed Dr Albert, of Munich, has produced a collodion emulsion which is so sensitized that the various colour sensations are directly obtained without the interposition of a colour filter. Different makes of plates demand different colour-filters. (For colour-filter making see Ives, *Photographic Journal*, vol. xx. No. 11). The preparation of these colour-filters calls for great perfection of quality in the materials employed, and great accuracy in the using of them. The glass, whether for the dry or wet filter, must be absolutely flat as to its surface, and its two sides must be absolutely parallel. In the wet filter the glasses forming the sides of the cell or trough must be parallel to each other.

Coloured glass is sometimes used in combination with the tinted collodion, but there is no particular advantage in this, because two glasses are always used in the making of a filter, and each one may, if desired, be coated with different dyes and afterwards cemented together with Canada balsam.

The following dyes or their equivalents form a basis for nearly all three-colour filters:—

For the red printing negative	Brilliant green. Brilliant yellow.
„ blue „ „	Cochineal red. Brilliant yellow.
„ yellow „ „	Methyl violet. Naphthol green.

The first dye named is the base colour in each case, the second is employed in small proportions to produce the required modification of tint.

Need of Careful Printing.

The theory of the three-colour process is that the same three colours shall be used for the printing of every subject; and there is no doubt that if the filtration were perfect and the printing inks absolutely pure, the theory would work out fairly correctly in practice; but there is room for improvement in both these matters, and it is therefore often found desirable to print special subjects with special pigments, which makes it difficult to print several subjects together. Special care is called for on the part of the printer. There must be the most perfect register of the three subjects, otherwise a blurred effect results; there must be constant watchfulness to see that there is no excess of ink of any one colour, or the whole scheme of colour will be destroyed. This three-colour process has been a rather long time in establishing itself and nothing has so tended to retard it as bad printing. Good blocks have been obtainable, but in the hands of ordinary printers they have yielded but indifferent results. It is hardly to be expected that the untrained eye of the ordinary printer should be successful where the work requires the cultivated judgment of an artist. There is one other necessity for success in all tone relief work, and that is the use of the right quality of paper and ink. The blocks are so delicate they soon fill up if an excess of ink is used. Ink of a good quality can be used in much less quantity than common kinds, but it must be impressed upon paper that is sympathetic and will "bear out" the ink.

The best results can be obtained only with the use of what is known as "coated" paper. It is a paper which, after manufacture, is passed through a bath of a preparation of china clay, which by means of brushes is rubbed into the surface of the paper. When dry the surface takes a high polish, and is sensitive to the smallest amount of ink. The polish of this coated paper is objectionable to many readers of illustrated books, and the clay adds considerably to the weight. Paper makers are, however, supplying a dull-surfaced highly calendered rag paper which is very good for artistic and scientific illustrations and obviates both the glossy surface and the supposed lack of permanency of chromo paper.

2. *Intaglio Processes.*—An intaglio engraving is one in which the printing surface is sunk below the surrounding portions of the plate; the lines or dots—pressed, cut or bitten into the surface—holding the ink which is to be impressed upon the paper when the original surface of the plate is wiped clean. The old-fashioned steel engraving may be taken as the type of an intaglio plate, in which the lines which printed were cut into the surface of the plate, instead of being left standing up in relief, as in the case of a wood engraving.

"Photogravure" is the name by which the many processes are generally known by means of which intaglio engravings are made mechanically, "heliogravure" being another name for the process, or special application of it. Photogravure reproduces the tones of photographs or drawings, and gives the nearest approach to a facsimile reproduction that has yet been arrived at. Gelatin bichromatized is the medium by means of which the photogravure plate is produced; but as the screen is not used in ordinary work, it is necessary to produce an ink-holding grain in some way upon the plate. This is done by allowing a cloud of bitumen dust, raised inside a box, to settle upon the surface of a copper plate; it is fixed by heat, which, though insufficient to melt it, is enough to attach the fine grains to the plate. Over this prepared surface is laid the film of bichromatized gelatin, upon which is printed the subject through a glass positive; the usual hardening process takes place by the action of light, followed by a washing out of the unhardened portions of the gelatin. The plate is exposed to the action of ferric chloride, which attacks it most strongly in the least exposed parts, but which cannot eat it away in broad flat masses of dark, even in the non-exposed portions, owing to the existence of the bitumen granulation, which ensures the keeping of a grained surface even in the darkest passages.

Photogravure is a costly process to employ for illustration. The plates have to be printed slowly, with much hand work, as in the case of etchings. It is the printing that makes its use expensive, rather than the making of the plates; and as each plate must be printed separately and on special paper, it cannot be employed with type, like relief blocks.

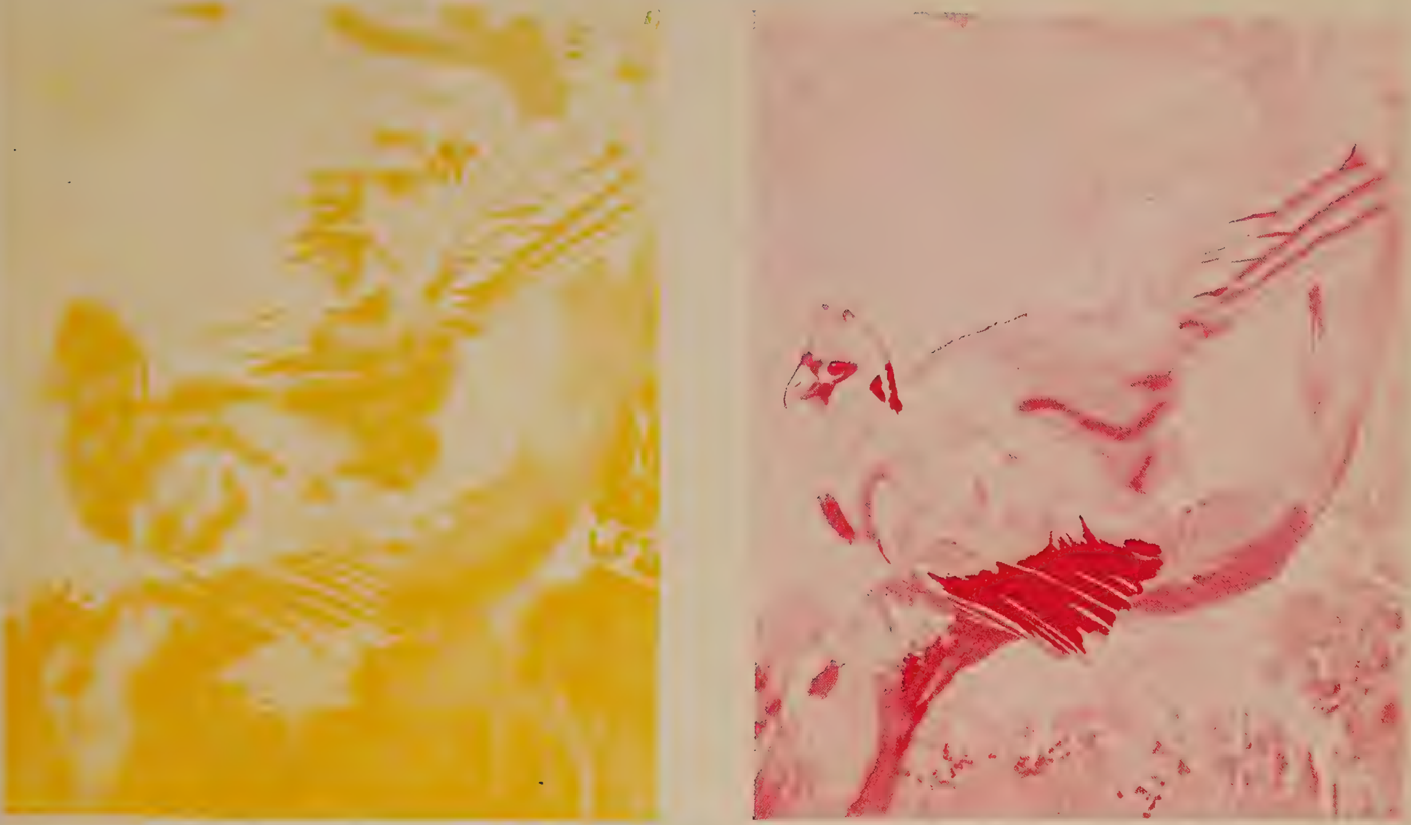
There is much uncertainty about the production of plates by the photogravure method; and although great improvements have been made in the process, it is often necessary to produce several plates before a satisfactory one is obtained. In all these reproductive processes the more artistic the workman the better the result; this is especially true of photogravure, in which the aim is to come very much nearer to the original work of the artist designer than in the less perfect processes.

The method of Rousillon, which was adopted by Goupil in the production of photogravure plates in the early days of the process, was to prepare the surface of the plate with a secret preparation of certain salts, which crystallized under the action of light, so that when exposed under the negative the surface was broken up by this crystallization more or less, according to the amount of light the negative permitted to reach it. The plate with its crystallized surface was then electrotyped, and the electrotype was the plate used for printing. It was a deposit process, as opposed to an etching process.

Rembrandt Intaglio Process.

Photogravure plates are made also by the use of the grain screen, in which the reticulations of the screen take the place of the bitumen powder in producing a grain; it is the inversion of the method by means of which points and lines are produced in the relief block. It has not, however, come much into favour, probably owing to the greater coarseness of the grain and the consequent loss of softness in the tones. An application of this method has, however, been made in the development known as the Rembrandt intaglio process. It is a secret process; but the secret lies more in the press by which the plates are printed than in the plates themselves, which are intaglio plates made with a very fine screen and bent to a cylinder. The attempt to print photogravure plates by machinery was given up because the plates were so shallow they would not stand the wear and tear, and their life was too short and the results too indifferent; but the use of the grain screen renders possible stronger, deeper plates, that will stand harder wear. There is little doubt that the machine used is some form of the machine used to print wall-papers, in which there is a central cylinder engraved with the design, inked by rollers with which it comes in contact. The ink not only fills up the intaglio or sunk portion which has to print the design, but covers as well the whole surface of the plate. To clean this surface, leaving ink only in the sunk dots and lines, another metal cylinder is employed, ground and grooved somewhat like the shaft of the common steel of the dinner table used to sharpen knives, the grooved surface of which, passing over the engraved cylinder, scrapes clean its inked surface, leaving ink only in the sunk portions, which will, as the cylinder comes in contact with the paper, deposit itself and print the picture. The results produced by the Rembrandt intaglio process are softer and smoother than those given by photogravure, and they are free from the gritty qualities which occasionally characterize photogravure; but they lack the brilliancy and depth of the latter. The process on the whole is less costly to use, mainly because the printing is so much more rapid, and is turned out by a machine instead of by hand.

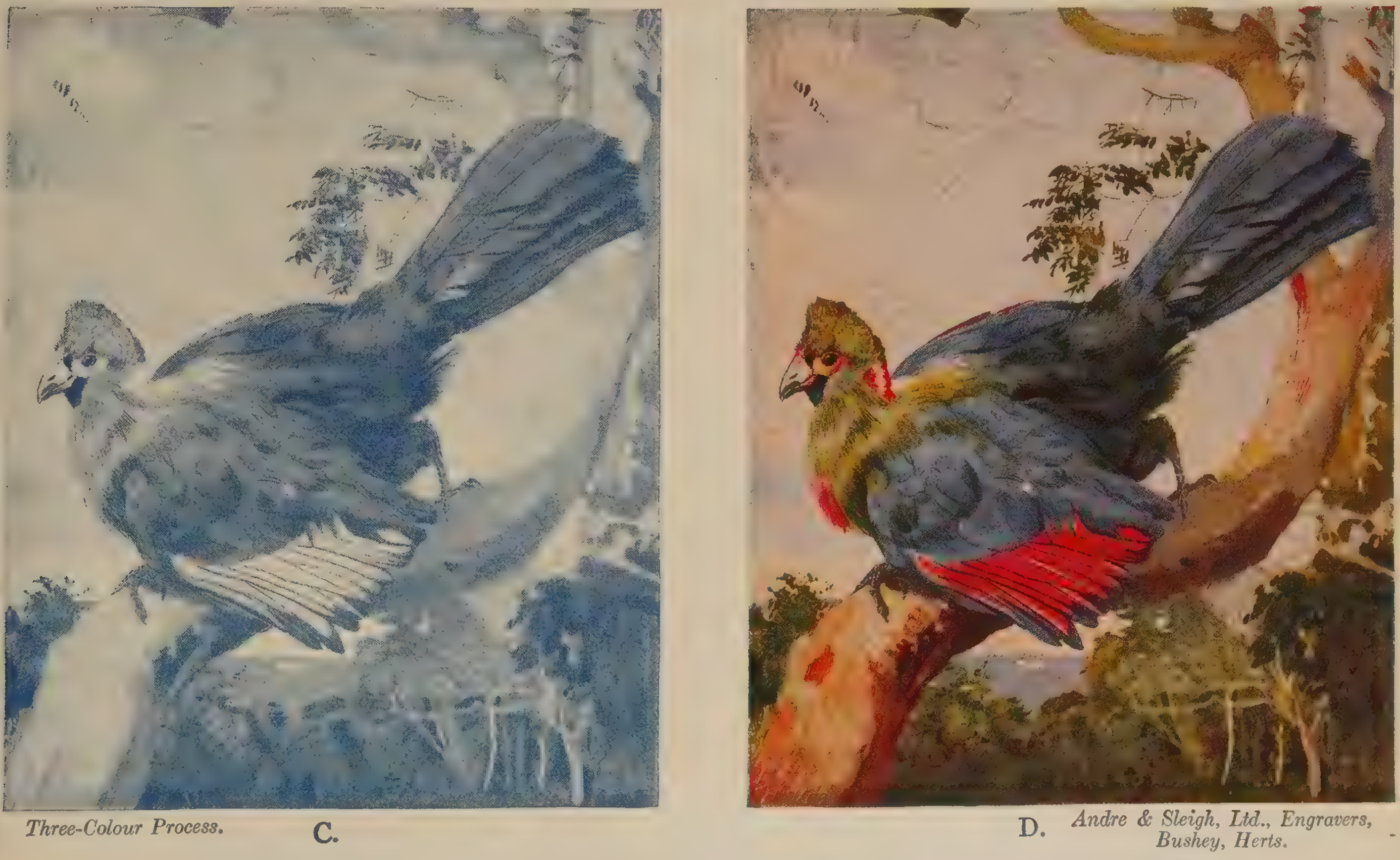
A method of printing intaglio plates made from a screen



A. GALLIREX JOHNSTONI. B.

The Turaco of Ruwenzori.

From a Drawing by Sir Harry Johnston, from "The Uganda Protectorate," by Permission of Hutchinson & Co.



Three-Colour Process. C.

D. *Andre & Sleigh, Ltd., Engravers, Bushey, Herts.*

SHOWING THE SEPARATE COLOURS EMPLOYED IN PHOTO-REPRODUCTION BY THE THREE-COLOUR PROCESS

The three primary colours are separated out by photography, each colour sensation is etched on copper, and when the Blocks representing Yellow (A), Red (B), and Blue (C), as illustrated above, are superimposed in the printing press. the result (D) is a reproduction of the original in all its combinations of colour.

negative by the lithographic press was introduced and patented by Sir Joseph Swan and his son, Donald Cameron-Swan. The sunk surfaces are rendered receptive of lithographic ink while the surface of the plate itself is kept damp with water or glycerin and water, and remains clean and free from ink when the plate is rolled.

Monotype.

The monotype is not a new, but a revival of a somewhat old, method of reproducing on paper a painting by an artist. The design is executed on a plate by means of brushes, fingers or other tools, with paint or printer's ink. On the completion of the painting, paper is laid upon it, and plate and paper are together passed through a press, when the ink or colour is transferred to the paper. One impression only is possible, hence the name of the process. A method has been devised by Sir Hubert von Herkomer for dusting the painting while still wet with a fine metallic powder, which gives a tooth to and renders the surface sympathetic to a copper deposit when it is placed in the galvanic bath, by which means an electrotype of the painting, with its varying relief surfaces, is obtained, and forms a plate from which numerous impressions can be taken.

Electrotypes.

The very large number of impressions it is often required to get from the etched surface of a block has made it necessary to devise means for preserving the original block, and to prepare and work from duplicates, which can be renewed when necessary. For this process the original is coated with a film of the finest plumbago (black lead) powder before being placed face to face with a bed of soft fine wax, into which it is pressed. The plumbago prevents adhesion and facilitates the withdrawal of the block after contact with the wax. The wax mould which is thus obtained is suspended in a galvanic bath of sulphate of copper. On passing a current of electricity through the liquid to the mould, the copper at once begins to deposit itself in metallic form over the face of the wax mould, and in a short time the deposit becomes thick enough, either by itself or when backed up with other metal, to be used as a block in the place of the original. The very fine nature of process blocks, and the necessity of obtaining perfect impressions from them, has led to the introduction of gutta-percha instead of wax as the medium for making a mould. It is melted and poured in a liquid state upon the block, and when cold can be removed without the risk attending the use of wax, which is apt to give way in the course of the separation of the block from the mould. Gutta-percha is much more tenacious, and being somewhat flexible, does not break and tear, as wax is liable to do. The whole process requires the greatest care in its manipulation.

Steel-facing.

Steel-facing is resorted to where long numbers have to be printed from photogravure plates. The finest film of steel is deposited by an electric battery over the whole face of the plate, which it hardens and protects. This steel face in time begins to wear, through the constant pressure and rubbing incidental to the process of printing, and the copper begins to show through it. As soon as this happens the plate is placed in an acid bath, in which the steel film disappears. The plate itself being still intact, can be re-steeled for further work.

Changes in Machinery.

The changes which have taken place in the form of illustrations have necessarily been accompanied by changes in the machinery by which they are printed. Almost all the changes and improvements have been initiated in the United States of America. The vital change made in the interest of process block-printing is what is technically known as "hard packing." Before the introduction of process blocks the "blanket" played an important part in all printing machines. It was a soft woollen sheet, which came between the plate or cylinder and the type and blocks, and modified the force of the contact between them. Owing to the increased fineness of the texture of the process block as compared with the wood engraving, it was found that the blanket was too coarse and soft a material, and that it interfered with the clearness and fineness of the printed result. Blankets of finer material were tried, with improved results; but at last the blanket was entirely superseded by a glazed board, the machinery was more accurately constructed, and the hard, finely-polished steel cylinder, without any intervening substance save the thin glazed board and the sheet of paper to be printed, was brought in contact with the type and blocks. The old soft blanket kept the cylinder or the flat press in contact with the type, in spite of the weak construction of much printing machinery. The new method of work made no allowance for such construction; and the new machinery, to meet the new conditions, had to be very perfect in manufacture. About the old machines there was a lack of solidity, which allowed vibration. Modern work demands absolute rigidity in the machine; and a chief characteristic of the best modern printing machinery is strength and solidity, admitting of precision of impression. Another change has been in the nature and treatment of the printing paper. Most elaborate methods were adopted for the moistening of the substance of paper before use. Most paper was printed on whilst damp, but damp paper had to disappear with the soft blanket, and a clay-surfaced or highly-calendered paper was introduced with a glazed face in harmony with the polished steel cylinder which pressed it against the type and blocks. It is essential to this paper that it be dry when used; to ensure the best results with it the paper should be kept some weeks or months before use, so that it may be absolutely dry, or seasoned. If printed on too soon, the clay surface tears away when in contact with the "tacky" ink; and instead of the ink being deposited on the paper, bits of the paper surface are left on the forme, and white spots appear in the impression. The bits of paper surface so deposited on the forme get inked as they pass under the rollers, and impress black spots on the sheets that come after. New and unseasoned paper accounts for much bad printing, and this form of badness is due to the change in material due to the necessities of modern process work.

3. *Planographic processes* are such as are printed from a flat surface neither raised above the surrounding ground like a wood engraving or type letter, nor sunk below the ground like an etching or steel engraving. Lithography (*q.v.*) with its flat stone or plate may be taken as the type.

Woodbury type is a development rather than an invention by Walter Woodbury. By an old nature-printing process leaves and other things which lent themselves to the treatment were by extreme pressure forced into a flat surface of soft metal, and the mould so formed was used as a printing surface to reproduce the forms of the impressed object. Woodbury found that a film of bichromated gelatin exposed to the action of light under a negative and the unaffected parts washed away gave him a relief image which was so hardened by the action of light aided by other hardening agents, that it could with no injury to the film itself—which could be used many times to make fresh moulds—be forced by hydraulic pressure into a thin flat plate of lead or type metal, and that the mould so formed could be used in a similar way to the mould formed in the old nature printing process. But a Woodbury type print is rather a cast from the shallow mould than a print in the true sense. It is obtained by filling the mould with a warm solution of coloured gelatin and pressing on it a piece of hard surfaced paper. The pressure forces the solution away from the highest parts of this mould which come in actual contact with the paper, so that none of it is left between them and the surface of the paper which in these parts remains uncoloured. These are the high lights of the print. The pressure forces the colouring matter into the hollows of the mould, and this amount is graduated according to the depth of the hollows. The coloured gelatin gradually cools and hardens and adheres to the paper which on its removal from the mould retains a delicate cast of the impressed subject. The variety of light and shade is the result of the varying depth of the hollows and the consequent variation of the amount of colouring matter taken up by the impressed paper. The white paper is an important element in the result, the light reflected from it through this coloured gelatin varying according to the thickness of the gelatin film. A drawback to the use of the Woodbury type for book illustration is that every print has to be trimmed and mounted, and of course it cannot be printed with type.

Stannotype is a variation upon Woodbury type. It is an attempt to do away with the need of the hydraulic press for the making of the mould. A film of bichromated gelatin is exposed to the action of light under a positive instead of a negative and the unaffected parts washed away, by which means a mould is obtained corresponding exactly to that obtained in metal by pressure from a film exposed to light under a negative. This mould was covered by a coating of tin foil to give it the necessary metal surface, and good results were obtained from it, but for some reason it has never come much into use.

Collotype or *phototype* is a process in which the film of isinglass, gelatin or gum, treated with bichromate of potash with the addition of alum or some other hardening substance, becomes an actual printing surface inked with an ordinary roller and printed by an ordinary machine. A strong tough film made up of a first coating of a simple gelatinous nature covered by a second film of the sensitive bichromated gelatin is spread upon glass and allowed to dry. Exposed to light under a reversed negative the unprotected parts are hardened in proportion to the amount of protection they receive from the negative. After exposure under the negative the back of the film is exposed to the action of sunlight through the glass at its back, so that the whole film may be rendered as hard and tough and durable as possible to stand the wear and tear of the process of printing. When in its place in the printing press the film must be kept moistened. The soft parts unacted upon by the light, but from which the bichromate has been since washed, will absorb moisture in proportion to the action the light has exercised upon it, the absolutely hard parts refusing moisture altogether. The film may now be inked with an ordinary inking roller, the ink being freely taken up by the hard and unmoistened passages and by the partly hardened in proportion to the amount of moisture they are capable of absorbing; as in lithography, the constant moistening of the printing surface is a necessity. Collotype is largely used for postcards. It may be printed in a lithographic or ordinary vertical press of the letterpress printer. Admirable colour results are obtained by this process.

Heliotype is a variation of the method of producing the film which is first spread as described upon waxed glass and then stripped from the glass when dry. After hardening the back of the film it is laid down upon a metal plate and firmly secured to it by the use of an india-rubber cement. It is remarkable the admirable results that are obtainable by so delicate a process. The films have not a long life; a few hundreds only can be printed from each, but the renewal of the film is a simple matter. The result is very like a photograph. The use of heliotype is, however, practically obsolete.

Photolithography.—Zinc or aluminium plates are now frequently used instead of the more cumbrous stones for all so called lithographic printing. These plates have the same affinity for fat ink as stone, the method of dealing with them being practically the same as with stones, and the description may be taken as applying to both. The stone itself may be rendered sensitive by coating it with a thin film of bichromated gelatin, exposing it under a reversed negative of the required subject and treating the hardened film as it is treated in the case of collotype. A better plan is to render sensitive a sheet of unsized or transfer paper which is exposed under a negative, moistened, and rolled with transfer ink, which is of a specially fatty nature, and adheres only to the parts hardened by exposure which are unaffected by the moistening and remain dry. This inked sheet is laid upon the stone and the two together are subjected to great pressure, passing through a lithographic press. After further moistening the sheet of transfer paper is peeled off, the stone leaving the inked drawing behind it. The usual methods of lithography are then followed, the stone is treated with a preparation of acid and gum, kept moist and printed from in the ordinary lithographic method. Lithography of all kinds can only deal with lines or solid blocks. Tints present difficulties which are best dealt with by other methods of reproduction, but attempts have been made to obtain tints lithographically by breaking up the solid surfaces of the gelatin print with a grain before rolling it with ink and transferring it to the stone.

One of the most successful of such attempts is known as the *Ink Photo* process, which is more or less of a secret process worked by Messrs Sprague. None of them, however, yield so sound a result as a good drawing made in line, as the grain has a tendency to fill up. Transfers may also be made on to zinc plates which will take the lithographic ink equally well with stones. The plates may be etched—as the inked surfaces resist the action of acid—and by this means a relief plate made, which when mounted on a block, type-high, may be printed typographically. It is known in this form as zincography.

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(E. BA.)

PROCESS, in law, in the widest sense of the word, any means by which a court of justice gives effect to its authority. In the old practice of the English common law courts process was either original or judicial. Original process was a means of compelling a defendant to compliance with an original writ (see WRIT). Judicial process was any compulsory proceeding rendered necessary after the appearance of the defendant. Process was also divided in civil matters into original, mesne and final. Original process in this sense was any means taken to compel the appearance of the defendant. A writ of summons is now the universal means in the High Court of Justice. Mesne process was either any proceeding against the defendant taken between the beginning and the end of the action, such as to compel him to give bail, or was directed to persons not parties to the action, such as jurors or witnesses. Arrest on mesne process was abolished in England by the Debtors Act 1869. Final process is practically coexistent with execution. In criminal matters process only applies where the defendant does not appear upon summons or otherwise. A warrant is now the usual form of such process.

Stet processus was a technical term used in old common law practice. It consisted of an entry on the record by consent of the parties for a stay of proceedings. Since the Judicature Acts there has been no record, and the *stet processus* has disappeared with it.

In Scots law process is used in a much wider sense, almost equivalent to practice or procedure in English law. Where papers forming steps of a process are borrowed and not returned, the return of the borrowed process may be enforced by caption (attachment). The Scottish process is very much akin to the French *dossier*.

In the United States process is governed by numerous statutes, both of Congress and of the state legislatures. The law is founded upon the English common law.

PROCESSION[1] (M. Eng., *processioun*, Fr., *procession*, Lat., *processio*, from *procedere*, to go forth, advance, proceed), in general, an organized body of people advancing in a formal or ceremonial manner. This definition covers a wide variety of such progresses: the medieval pageants, of which the Lord

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[1] In classical Latin the word generally used for a procession was *pompa*, a formal march or progress of persons to some particular spot, to celebrate some event, or for some public or religious purpose. *Processio* is used by Cicero in the sense of "a marching forward, an advance," any public progress, such as the formal entrance of the consul upon his office (Du Cange, *s.v. Processio*), or the public appearance of the emperor. In Late Latin *processio* is generally used of a religious procession, the word having come to be used of the body of persons advancing or proceeding.

Mayor's show in London is the most conspicuous survival; the processions connected with royal coronations and with court ceremonies generally; the processions of friendly societies, so popular in Great Britain and America; processions organized as a demonstration of political or other opinions; processions forming part of the ceremonies of public worship. In a narrower sense of "going forth, proceeding," the term is used in the technical language of theology in the phrase "Procession of the Holy Ghost," expressing the relation of the Third Person in the Triune Godhead to the Father and the Son.

Greek and Roman Processions.

Processions have in all peoples and at all times been a natural form of public celebration, as forming an orderly and impressive way in which a number of persons can take part in some ceremony. They are included in the celebrations of many religions, and in many countries, both in the East and West, they accompany such events as weddings and funerals. Religious and triumphal processions are abundantly illustrated by ancient monuments, *e.g.* the religious processions of Egypt, those illustrated by the rock-carvings of Boghaz-Keui (see PTERIA), the many representations of processions in Greek art, culminating in the great Panathenaic procession of the Parthenon frieze, and Roman triumphal reliefs, such as those of the arch of Titus.

Processions played a prominent part in the great festivals of Greece, where they were always religious in character. The games were either opened or accompanied by more or less elaborate processions and sacrifices, while processions from the earliest times formed part of the worship of the old nature gods (*e.g.* those connected with the cult of Dionysus, &c.), and later formed an essential part of the celebration of the great religious festivals (*e.g.* the processions of the Thesmophoria, and that of the Great Dionysia), and of the mysteries (*e.g.* the great procession from Athens to Eleusis, in connexion with the Eleusinia).

Of the Roman processions, the most prominent was that of the Triumph, which had its origin in the return of the victorious army headed by the general, who proceeded in great pomp from the Campus to the Capitol to offer sacrifice, accompanied by the army, captives, spoils, the chief magistrate, priests bearing the images of the gods, amidst strewing of flowers, burning of incense and the like (Ovid, *Trist.* iv. 2, 3 and 6). Connected with the triumph was the *pompa circensis*, or solemn procession which preceded the games in the circus; it first came into use at the *ludi romani*, when the games were preceded by a great procession from the Capitol to the Circus. The praetor or consul who appeared in the *pompa circensis* wore the robes of a triumphing general (see Mommsen, *Staatsrecht I.* 397 for the connexion of the triumph with the *ludi*). Thus, when it became customary for the consul to celebrate games at the opening of the consular year, he came, under the empire, to appear in triumphal robes in the *processus consularis*, or procession of the consul to the Capitol to sacrifice to Jupiter. After the establishment of Christianity, the consular processions in Constantinople retained their religious character, now proceeding to St Sophia, where prayers and offerings were made; but in Rome, where Christianity was not so widely spread among the upper classes, the tendency was to convert the procession into a purely civil function, omitting the pagan rites and prayers, without substituting Christian ones (Dahremberg and Saglio, *s.v.* "Consul"). Besides these public processions, there were others connected with the primitive worship of the country people, which remained unchanged, and were later to influence the worship of the Christian Church. Such were those of the Ambarvalia, Robigalia, &c., which were essentially rustic festivals, lustrations of the fields, consisting in a procession round the spot to be purified, leading the sacrificial victims with prayers, hymns and ceremonies, in order to protect the young crops from evil influences. (See Preller, *Röm. Mythologie*, pp. 370–372.)

Processions in the Christian Church.

As to the antiquity of processions as part of the ritual of the Christian Church, there is no absolute proof of their existence before the 4th century, but as we know that in the catacombs stations were held at the tombs of the martyrs on the anniversary of their death, for the celebration of the eucharist, it is quite probable that the faithful proceeded to the appointed spot in some kind of procession, though there is no satisfactory evidence that this was the case. There are, indeed, early instances of the use of the word *processio* by Christian writers, but it does not in any case appear to have the modern meaning "procession." Tertullian (2nd century) uses *processio* and *procedere* in the sense of "to go out, appear in public,"[1] and, as applied to a church function, *processio* was first used in the same way as *collecta*, as the equivalent of the Greek *σύναξις*, *i.e.* for the assembly of the people in the church (Du Cange, *s.v.*). In this sense it appears to be used by Pope Leo I. (*Ep. IX. ad Diosc. episc.* c. 445: "qui nostris processionibus et ordinationibus frequenter interfuit"), while in the version by Dionysius Exiguus of the 17th canon of the Council of Laodicaea *συνάξεσι*, is translated by *processionibus* (Smith, *Dic. of Chr. Antiq. s.v.* "Procession").

For the processions that formed part of the ritual of the eucharist, those of the introit, the gospel and the oblation, the earliest records date from the 6th century and even later (see Duchesne, *Origines*, 2nd ed., pp. 77, 154, 181; 78, 194), but they evidently were established at a much earlier date. As to public processions, these seem to have come into rapid vogue after the recognition of Christianity as the religion of the empire. Those at Jerusalem would seem to have been long established when described by the authoress of the *Peregrinatio Silviae* towards the end of the 4th century (see PALM SUNDAY, for the procession of palms).

Litanies or Rogations.

Very early were the processions accompanied by hymns and prayers, known as *litaniae* (Gr. λιτανεῖα, from λιτή, prayer), *rogationes* or *supplicationes* (see LITANY). It is to such a procession that reference appears to be made in a letter[2] of St Basil (*c.* 375), which would thus be the first recorded mention of a public Christian procession. The first mention for the Western Church occurs in St Ambrose (*c.* 388, Ep. 40 § 16, *Ad Theodos.* "monachos . . . qui . . . psalmos canentes ex consuetudine usuque veteri pergebant ad celebritatem Machabaeorum martyrum"). In both these cases the litanies are stated to have been long in use. There is also mention of a procession accompanied by hymns, organized at Constantinople by St John Chrysostom (*c.* 390–400) in opposition to a procession of Arians, in Sozomen, *Hist. eccl.* viii. 8.[3] In times of calamity litanies were held, in which the people walked in robes of penitence, fasting, barefooted, and, in later times, frequently dressed in black (*litaniae nigrae*). The cross was carried at the head of the procession and often the gospel and the relics of the saint were carried. Gregory of Tours gives numerous instances of such litanies in time of calamity; thus he describes (*Vita S. Remig.* I.) a procession of the clergy and people round the city, in which relics of St Remigius were carried and litanies chanted in order to avert the plague. So, too, Gregory the Great (*Ep.* xi. 57) writes to the Sicilian bishops to hold processions in order to prevent a threatened invasion of Sicily. A famous instance of these penitential litanies is the *litania septiformis* ordered by Gregory the Great in the year 590, when Rome had been inundated and pestilence had followed.

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[1] See *De praescr. adv. haer.* C. xliii., "Ubi metus in Deum, ibi gravitas honesta . . . et subjectio religiosa, et apparitio devota, et *processio modesta*, et Ecclesia unita et Dei omnia," where it would seem to mean "a modest bearing in public;" also *De cultu foem.* ii., xi., "Vobis autem nulla procedendi caussa tetrica; aut imbecillus aliquis ex fratribus visitandus, aut sacrificium offertur, aut Dei verbum administratur," which shows that *procedere* was not used *only* of going to church. The passage *ad uxorem*, ii. 4, which is sometimes quoted to prove the existence of processions at this date, appears to use *procedere* in the same way as the above passages; ". . . si procedendum erit, nunquam magis familiae occupatio obveniat. Quis enim sinat conjugem suam visitandorum fratrum gratia vicatim aliena ac quidem pauperiora quaeque tuguria circuire? . . . quis denique solemnibus Paschae abnoctantem securus sustinebit?"

[2] Ep. 207 *ad Neocaes*: *'Αλλ' οὐκ ἦν, φητὶ, ταῦτα ἐπὶ τοῦ μεγάλου Γρεγορίου. 'Αλλ' οὐδὲ αἱ Λιτανεῖαι, ἅς ὑμεῖς νῦν ἐπιδεύετε κ. τ. λ.*

[3] Brawls having arisen with the Catholics, who began singing their hymns in opposition, the emperor prohibited the Arian meetings.

In this litany seven processions, of clergy, laymen, monks, nuns, matrons, the poor, and children respectively, starting from seven different churches, proceeding to hear mass at Sta Maria Maggiore (see Greg. of Tours, *Hist. Fr.* x.1, and Johann. Diac. *Vita Greg. Magn.* i. 42). This litany has often been confused with the *litania major*, introduced at Rome in 598 (*vide supra*), but is quite distinct from it.[1]

Funeral processions, accompanied with singing and the carrying of lighted tapers, were very early customary (see Lights, Ceremonial Use of), and akin to these, also very early, were the processions connected with the translation of the relics of martyrs from their original burying place to the church where they were to be enshrined (see *e.g.* St Ambrose, *Ep.* 29 and St Augustine, *De civitate Dei*, xxii. 8 and *Conf.* viii. 7, for the finding and translation of the relics of Saints Gervasius and Protasius). From the time of the emperor Constantine I. these processions were of great magnificence.[2]

Origin of Christian Processions.

Some liturgists maintain that the early Church in its processions followed Old Testament precedents, quoting such cases as the procession of the ark round the walls of Jericho (Josh. vi.), the procession of David with the ark (2 Sam. vi.), the processions of thanksgiving on the return from captivity, &c. The liturgy of the early Church as Duchesne shows (*Origines*, ch. i.) was influenced by that of the Jewish synagogue, but the theory that the Church adopted the Old Testament ritual is of quite late growth. What is certain is that certain festivals involving processions were adopted by the Christian Church from the pagan calendar of Rome. Here we need only mention the *litaniae majores et minores*, which are stated by Usener ("Alte Bittgänge," in Zeller, *Philosophische Aufsätze*, p. 278 seq.) to have been first instituted by Pope Liberius (352–366). It is generally acknowledged that they are the equivalent of the Christian Church of the Roman lustrations of the crops in spring, the *Ambarvalia*, &c. The *litania major*, or great procession on St Mark's day (April 25) is shown to coincide both in date and ritual with the Roman Robigalia, which took place *a.d. vii. Kal. Mai.*, and consisted in a procession leaving Rome by the Flaminian gate, and proceeding by way of the Milvian bridge to a sanctuary at the 5th milestone of the Via Claudia, where the *flamen quirinalis* sacrificed a dog and a sheep to avert blight (*robigo*) from the crops (*Fasti praenestini*, C.T.L.T., p. 317). The *litania major* followed the same route as far as the Milvian bridge, when it turned off and returned to St Peter's, where mass was celebrated. This was already established as an annual festival by 598, as is shown by a document of Gregory the Great (*Regist.* ii.) which inculcates the duty of celebrating *litaniam, quae major ab omnibus appellatur*. The *litaniae minores* or rogations, held on the three days preceding Ascension Day, were first introduced into Gaul by Bishop Mamertus of Vienne (*c.* 470), and made binding for all Gaul by the 1st Council of Orleans (511). The *litaniae minores* were also adopted for these three days in Rome by Leo III. (*c.* 800). A description of the institution and character of the Ascensiontide rogations is given by Sidonius Apollinaris (*Ep.* v. 14). "The solemnity of these," he says, "was first established by Mamertus. Hitherto they had been erratic, lukewarm and poorly attended (*vagae, tepentes, infrequentesque*); those which he instituted were characterized by fasting, prayers, psalms and tears." In the Ambrosian rite the rogations take place after Ascensiontide, and in the Spanish on the Thursday to Saturday after Whitsuntide, and in November (Synod of Girona, 517).

Processions in the modern Roman Catholic Church.

It is impossible to describe in detail the vast development of processions during the middle ages. The most important and characteristic of these still have a place in the ritual of the Roman Catholic Church. The rules governing them are laid down in the *Rituale Romanum* (Tit. ix.), and they are classified in the following way:—

(1) *Processiones generales*, in which the whole body of the clergy takes part. (2) *Processiones ordinariae*, on yearly festivals, such as the feast of the Purification of the Virgin (Candlemass, *q.v.*), the procession on Palm Sunday (*q.v.*), the *Litaniae majores* and *minores*, the feast of Corpus Christi (*q.v.*), and on other days, according to the custom of the churches. (3) *Processiones extraordinariae*, or processions ordered on special occasions, *e.g.* to pray for rain or fine weather, in time of storm, famine, plague, war, or, *in quacunque tribulatione*, processions of thanksgiving, translation of relics, the dedication of a church or cemetery. There are also processions of honour, for instance to meet a royal personage, or the bishop on his first entry into his diocese (*Pontif. rom.* iii.). Those taking part in processions are to walk bare-headed (weather permitting), two and two, in decent costume, and with reverent mien; clergy and laity, men and women, are to walk separately. The cross is carried at the head of the procession, and banners embroidered with sacred pictures in places where this is customary; these banners must not be of military or triangular shape. Violet is the colour prescribed for processions, except on the Feast of Corpus Christi, or on a day when some other colour is prescribed. The officiating priest wears a cope, or at least a surplice with a violet stole, the other priests and clergy wear surplices.

Where the host is carried in procession it is covered always by a canopy, and accompanied by lights. At the *litaniae majores* and *minores* and other penitential processions, joyful hymns are not allowed, but the litanies are sung, and, if the length of the procession requires, the penitential and gradual psalms.

As to the discipline regarding processions the bishop, according to the Council of Trent (*Sess.* 25 *de reg. cap.* 6), appoints and regulates processions and public prayers outside the churches.

The observance or variation of the discipline belongs to the Congregation of Rites; in pontifical processions, which are regulated by the masters of the ceremonies (*magistri ceremoniarum pontificalium*), these points are decided by the chief cardinal deacon. As to processions within the churches, some difference of opinion having arisen as to the regulating authority, the Congregation of Rites has decided that the bishop must ask, though not necessarily follow, the advice of the chapter in their regulation.

Reformed Churches.—The Reformation abolished in all Protestant countries those processions associated with the doctrine of transubstantiation (Corpus Christi); "the Sacrament of the Lord's Supper," according to the 28th Article of Religion of the Church of England "was not by Christ's ordinance reserved, carried about, lifted up, or worshipped." It also abolished those associated with the cult of the Blessed Virgin and the saints. The stern simplicity of Calvinism, indeed, would not tolerate religious processions of any kind, and from the "Reformed" Churches they vanished altogether. The more conservative temper of the Anglican and Lutheran communions, however, suffered the retention of such processions as did not conflict with the reformed doctrines, though even in these Churches they met with opposition and tended after a while to fall into disuse.

Lutheran Church.

The Lutheran practice has varied at different times and in different countries. Thus, according to the Württemberg *Kirchenordnung* of 1553, a funeral procession was prescribed, the bier being followed by the congregation singing hymns; the Brandenburg *Kirchenordnung* (1540) directed a cross-bearer to precede the procession and lighted candles to be carried, and this was prescribed also by the Waldeck *Kirchenordnung* of 1556. At present funeral processions survive in general only in the country districts; the processional cross or crucifix is still carried. In some provinces also the Lutheran Church has retained the ancient rogation processions in the week before Whitsuntide and, in some cases, in the month of May or on special occasions (*e.g.* days of humiliation, *Busstage*), processions about the fields to ask a blessing on the crops. On these occasions the ancient litanies are still used.

In England "the perambulations of the circuits of the parishes . . . used heretofore in the days of rogations" were ordered to be observed by the *Injunctions* of Queen Elizabeth in 1559; and for these processions certain "psalms, prayers and homilies"

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[1] Litanies, owing to the fact that they were sung in procession were in England sometimes themselves called "processions." Thus we read in the "Order of making Knights of the Bath for the coronation of Queen Elizabeth": "the parson of the said church knelynge said the procession in Englysche and all that were there answered the parson" (B. M. Add. MSS. 4712, p. 51, printed in Anstis's *Observations*, p. 53).

[2] See Martigny, *Dict. des antiquités chr.* *s.v.* "Processions," "Stations," "Translations" for details of processions under Constantine, and Du Cange, *s.v. Processio* for various processions in the middle ages.

Church of England.

were prescribed. The Puritans, who aimed at setting up the Genevan model, objected; and the visitation articles of the bishops in Charles I.'s time make frequent inquisition into the neglect of the clergy to obey the law in this matter. With "the profane, ungodly, presumptuous multitude" (to quote Baxter's *Saint's Rest*, 1650, pp. 344, 345), however, these "processions and perambulations" appear to have been very popular, though "only the traditions of their fathers." However this may be, the Commonwealth made an end of them, and they seem never to have been revived; Sparrow, in his *Rationale upon the Book of Common Prayer* (London, 1668), speaks of "the service *formerly* appointed in the Rogation days of Procession."

Among the processions that survived the Reformation in the English Church was that of the sovereign and the Knights of the Garter on St George's day. This was until Charles II.'s time a regular rogation, the choristers in surplices, the gentlemen of the royal chapel in copes, and the canons and other clergy in copes preceding the knights and singing the litany. In 1661, after the Restoration, by order of the sovereign and knights companions in chapter "that supplicational procession" was "converted into a hymn of thanksgiving." Akin to this procession also are the others connected with royal functions; coronations, funerals. These retained, and retain, many pre-Reformation features elsewhere fallen obsolete. Thus at the funeral of George II. (1760) the body was received at the door of the Abbey by the dean and prebendaries in their copes, attended by the choir, all carrying lighted tapers, who preceded it up the church, singing.

The only procession formerly prescribed in the Book of Common Prayer is that in the order of the burial of the dead, where the rubric directs that "the priest and clerks meeting the corpse at the entrance of the churchyard, and going before it, either into the church, or towards the grave, shall say, or sing" certain verses of Scripture. Tapers seem to have been carried, not only at royal funerals, until well into the 18th century (see LIGHTS, CEREMONIAL). Processions, with singing of the litany or of hymns, appear also to have been always usual on such occasions as the consecration of churches and churchyards and the solemn reception of a visiting bishop. Under the influence of the Catholic revival, associated with the Oxford Tractarians, processions have become increasingly popular in the English Church, pre-Reformation usages having in some churches been revived without any legal sanction. The most common forms, however, are the processional litanies, and the solemn entry of clergy and choir into the church, which on festivals is accompanied by the singing of a processional hymn, their exit being similarly accompanied by the chanting of the *Nunc Dimittis*. In this connexion the use of the processional cross, banners and lights has been largely revived.

See the article "Bittgänge," by M. Herold, in Herzog-Hauck, *Realencyklopädie*, iii. 248 (3rd ed., Leipzig, 1897); Wetzer und Welte, *Kirchenlexikon*, *s.v.* "Prozession, Bittgänge Litanei" and Smith's *Dictionary of Christian Antiquities s.v.* "Procession." For the early ritual see Duchesne, *Origines du culte chrétien* (3rd ed., Paris, 1903). See also G. Catalani, *Rituale romanum perpetuis commentariis exornatum* (1760); N. Serarius, *Sacri peripatetici de sacris ecclesiae catholicae processionibus* (2 vols., Cologne, 1607); Jac. Gretser, *De ecclesiae romanae processionibus* (2 vols., Ingolstadt, 1606); Jac. Eveillon, *De processionibus ecclesiae* (Paris, 1641); Edw. Martène, *De antiquis ecclesiae ritibus* (3 vols., Antwerp, 1763), &c. For the past usage of the Church of England, *Hierurgia anglicana*, ed. Vernon Staley, p. ii pp. 3–22 (London, 1903).

PROCESSION PATH (Lat. *ambitus templi*), the route taken by processions on solemn days in large churches—up the north aisle, round behind the high altar, down the south aisle, and then up the centre of the nave.

PROCÈS-VERBAL (Fr. *procès*, process, Late Lat. *verbalis*, from *verbum*, word), in French law, a detailed authenticated account drawn up by a magistrate, police officer, or other person having authority of acts or proceedings done in the exercise of his duty. In a criminal charge, a procès-verbal is a statement of the facts of the case. The term is also sometimes applied to the written minutes of a meeting or assembly.

PROCIDA (Gr. Προχύτη, Lat. *Prochyta*), an island off the coast of Campania, Italy, 2 m. S.W. of Capo Miseno, and 2 m. N.E. of Ischia on the west side of the Gulf of Naples, and about 12 m. S.W. of Naples. Pop. (1901), of the town, 2520; of the whole island, one commune, 14,440. It is about 2 m. in length and of varying width, and, reckoning in the adjacent island of Vivara, is made up of four extinct craters, parts of the margins of all of which have been destroyed by the sea. The highest point of it is only 250 ft. above sea-level. It is very fertile, and the population is engaged in the cultivation of vines and fruit and in fishing. Procida, the only town, lies on the east side; its castle is now a prison. It also contains a royal palace. Classical authors explained the name of Procida either as an allusion to its having been detached from Ischia, or as being that of the nurse of Aeneas.

PROCLAMATION (Lat. *proclamare*, to make public by announcement), in English law, a formal announcement (royal proclamation), made under the great seal, of some matter which the king in council desires to make known to his subjects: *e.g.* the declaration of war, the statement of neutrality, the summoning or dissolution of parliament, or the bringing into operation of the provisions of some statute the enforcement of which the legislature has left to the discretion of the king in council. Royal proclamations of this character, made in furtherance of the *executive* power of the Crown, are binding on the subject, "where they do not either contradict the old laws or tend to establish new ones, but only confine the execution of such laws as are already in being in such manner as the sovereign shall judge necessary" (Blackstone's *Commentaries*, ed. Stephen, ii. 528; Stephen's *Commentaries*, 14th ed. 1903, ii. 506, 507; Dicey, *Law of the Constitution*, 6th ed., 51). Royal proclamations, which, although not made in pursuance of the executive powers of the Crown, either call upon the subject to *fulfil* some duty which he is by law bound to perform, or to abstain from any acts or conduct already prohibited by law, are lawful and right, and disobedience to them (while not of itself a misdemeanour) is an aggravation of the offence (see charge of Chief Justice Cockburn to the grand jury in *R.* v. *Eyre* (1867) and Case of Proclamations 1610, 12 Co. Rep. 74). The Crown has from time to time *legislated* by proclamation; and the Statute of Proclamations 1539 provided that proclamations made by the king with the assent of the council should have the force of statute law if they were not prejudicial to "any person's inheritance, offices, liberties, goods, chattels or life." But this enactment was repealed by an act of 1547; and it is certain that a proclamation purporting to be made in the exercise of legislative power by which the sovereign imposes a duty to which the subject is not by law liable, or prohibits under penalties what is not an offence at law, or adds fresh penalties to any offence, is of no effect unless itself issued in virtue of statutory authority (see also ORDER IN COUNCIL). The Crown has power to legislate by proclamation for a newly conquered country (Jenkyns, *British Rule and Jurisdiction beyond the Seas*); and this power was freely exercised in the Transvaal Colony during the Boer War of 1899–1902. In the British colonies, ordinances are frequently brought into force by proclamation; certain imperial acts do not take effect in a colony until there proclaimed (*e.g.* the Foreign Enlistment Act 1870); and proclamations are constantly issued in furtherance of executive acts. In many British protectorates the high commissioner or administrator is empowered to legislate by proclamation.

In the old system of real property law in England, fines, levied with "proclamations," *i.e.* with successive public announcements of the transaction in open court, barred the rights of strangers, as well as parties, in case they had not made claim to the property conveyed within five years thereafter (acts 1483–1484 and 1488–1489). These proclamations were originally made sixteen times, four times in the term in which the fine was levied, and four times in each of the three succeeding terms. Afterwards the number of proclamations was reduced to one in each of the four terms. The proclamations were endorsed on the back of the record. The system was abolished by the Fines and Recoveries Act 1833. (A. W. R.)

PROCLUS, or PROCULUS (A.D. 410–485), the chief representative of the later Neoplatonists, was born at Constantinople, but brought up at Xanthus in Lycia. Having studied grammar under Orion and philosophy under Olympiodorus the Peripatetic, at Alexandria, he proceeded to Athens. There he attended the lectures of the Neoplatonists Plutarch and Syrianus, and about 450 succeeded the latter in the chair of philosophy (hence his surname Diadochus, which, however, is referred by others to his being the "successor" of Plato). As an ardent upholder of the old pagan religion Proclus incurred the hatred of the Christians, and was obliged to take refuge in Asia Minor. After a year's absence he returned to Athens, where he remained until his death. His epitaph, written by himself, is to be found in *Anthologia palatina*, vii. 451. Although possessed of ample means, Proclus led a most temperate, even ascetic life, and employed his wealth in generous relief of the poor. He was supposed to hold communion with the gods, who endowed him with miraculous powers. He acted up to his famous saying that "the philosopher should be the hierophant of the whole world" by celebrating Egyptian and Chaldaean as well as Greek festivals, and on certain days performing sacred rites in honour of all the dead.

His great literary activity was chiefly devoted to the elucidation of the writings of Plato. There are still extant commentaries on the *First Alcibiades*, *Parmenides*, *Republic*, *Timaeus* and *Cratylus*. His views are more fully expounded in the *Περὶ τῆς κατὰ Πλάτωνα θεολογίας* (*In Platonis theologiam*). The *Στοιχείωσις θεολογική* (*Institutio theologica*) contains a compendious account of the principles of Neoplatonism and the modifications introduced in it by Proclus himself. The pseudo-Aristotelian *De causis* is an Arabic extract from this work, ascribed to Alfarabius (d. 950), circulated in the west by means of a Latin translation (ed. O. Bardenhewer, Freiburg, 1882). It was answered by the Christian rhetorician Procopius of Gaza in a treatise which was deliberately appropriated without acknowledgment by Nicolaus of Methone, a Byzantine theologian of the 12th century (see W. Christ, *Gesch. der griechischen Litteratur*, 1898, § 692). Other philosophical works by Proclus are *Στοιχείωσις φυσικὴ ἢ Περὶ κινήσεως* (*Institutio physica sive De motu*, a compendium of the last five books of Aristotle's *Περὶ φυσικῆς ἀκροάσεως*, *De physica auscultatione*), and *De providentia et fato*, *Decem dubitationes circa providentiam*, *De malorum subsistentia*, known only by the Latin translation of William of Moerbeke (archbishop of Corinth, 1277–1281), who also translated the *Στοιχείωσις θεολογική* into Latin. In addition to the epitaph already mentioned, Proclus was the author of hymns, seven of which have been preserved (to Helios, Aphrodite, the Muses, the Gods, the Lycian Aphrodite, Hecate and Janus, and Athena), and of an epigram in the Greek Anthology (*Anthol. pal.* iii. 3, 166 in Didot edition.) His astronomical and mathematical writings include *Ὑποτύπωσις τῶν ἀστρονομικῶν ὑποθέσεων* (*Hypotyposis astronomicarum positionum*, ed. C. Manitius, Leipzig, 1909); *Περὶ σφαίρας* (*De sphaera*); *Παράφρασις εἰς τὴν Πτολεμαίου τετράβιβλον*, a paraphrase of the difficult passages in Ptolemy's astrological work *Tetrabiblus*; *Εἰς τὸ πρῶτον τῶν Εὐκλείδου στοιχείων*, a commentary on the first book of Euclid's *Elements*; a short treatise on the effect of eclipses (*De effectibus eclipsium*, only in a Latin translation).

His grammatical works are: a commentary on the *Works and Days* of Hesiod (incomplete); some scholia on Homer; an elementary treatise on the epistolary style, *Περὶ ἐπιστολιμαίου χαρακτῆρος* (*Characteres epistolici*), attributed in some MSS. to Libanius. The *Χρηστομαθία γραμματική* by a Proclus, who is identified by Suïdas with the Neoplatonist, is probably the work of a grammarian of the 2nd or 3rd century, though Wilamowitz-Möllendorff (*Philolog. Untersuch.* vii.; supported by O. Immisch in *Festschrift Th. Gomperz*, pp. 237–274) agrees with Suïdas. According to Suïdas, he was also the author of *Ἐπιχειρήματα ιή κατὰ Χριστιανῶν* (*Animadversiones duodeviginti in christianos*). This work, identified by W. Christ with the *Institutio theologica*, was answered by Joannes Philoponus (7th century) in his *De aeternitate mundi*. Some of his commentary on the Chaldaean oracles (*Λόγια Χαλδαϊκά*) has been discovered in modern times.

There is no complete edition of the works ~~of~~ Proclus. The selection of V. Cousin (Paris, 1864) contains the treatises *De providentia et fato*, *Decem dubitationes*, and *De malorum subsistentia*, the commentaries on the *Alcibiades* and *Parmenides*. The *Institutio theologica* has been edited by G. F. Creuzer in the Didot edition of Plotinus (Paris, 1855); the *In Platonis theologiam* has not been reprinted since 1618, when it was published by Aemilius Portus with a Latin translation. Most recent editions of individual works are: Commentaries on the *Parmenides*, French translation with notes by A. E. Chaignet (1900–1903); *Republic*, by W. Kroll (1899–1901); *Timaeus*, by E. Diehl (1903–); *Hymns*, by E. Abel (1883) and A. Ludwich (1895); commentary on Euclid by G. Friedlein (1873); Λόγια Χαλδαϊκά, by A. Jahn (1891); *Characteres epistolici*, by A. Westermann (1856), Scholia to Hesiod in E. Vollbehr's edition (1844). Thomas Taylor, the "Platonist," translated the commentaries on the *Timaeus* and Euclid, *The Theology of Plato*, the *Elements of Theology*, and the three Latin treatises.

On Proclus generally and his works see article in Suïdas; Marinus, *Vita Procli*; J. A. Fabricius, *Bibliotheca graeca* (ed. Harles), ix. 363–445; W. Christ, *Geschichte der griechischen Litteratur* (1898), § 623; J. E. Sandys, *Hist. of Classical Scholarship* (1906), i. 372; J. B. Bury, *Later Roman Empire* (1889), i. 13, where Proclus is styled the "Hegel of Neoplatonism"; on his philosophy, T. Whittaker, *The Neo-Platonists* (1901), and NEOPLATONISM.

Extracts from the Χρηστομαθία are preserved in Photius (*Cod.* 239), almost the only source of information regarding the epic cycle; on the question of authorship, see Christ § 637, and Sandys, p. 379; also D. B. Monro's appendix to his ed. of Homer's *Odyssey*, xiii.–xxiv. (1901).

PROCOPIUS, Byzantine historian, was born at Caesarea in Palestine towards the end of the 5th century A.D. He became a lawyer, probably at Constantinople, and was in 527 appointed secretary and legal adviser to Belisarius, who was proceeding to command the imperial army in the war against the Persians (*De bello persico* i. 12). When the Persian War was suspended and Belisarius was despatched against the Vandals of Africa in 533, Procopius again accompanied him, as he subsequently did in the war against the Ostrogoths of Italy, which began in 535. After the capture of Ravenna in 540 Procopius seems to have returned to Constantinople, since he minutely describes the great plague of 542 (*op. cit.* ii. 22). It does not appear whether he was with the Roman armies in the later stages of the Gothic War, when Belisarius and afterwards Narses fought against Totila in Italy; his narrative of these years is much less full and minute than that of the earlier warfare. Of his subsequent fortunes we know nothing, except that he was living in 559. Whether he was the Procopius who was prefect of Constantinople in 562 (Theophanes, *Chronographia*, 201, 202), and was removed from office in the year following, cannot be determined. As the historian was evidently a person of note, who had obtained the rank of *illustrius* (Suïdas), and from a passage in the *Anecdota* (12) seems to have risen to be a senator, there is no improbability in his having been raised to the high office of prefect.

Procopius's writings fall into three divisions: the *Histories* (Persian, Vandal and Gothic Wars), in eight books; the treatise on the *Buildings of Justinian* (*De aedificiis*), in six books; and the *Unpublished Memoirs* (*Ἀνέκδοτα*, *Historia arcana*), so called because they were not published during the lifetime of the author.

The *Histories* are called by the author himself the *Books about the Wars* (*οἱ ὑπὲρ τῶν πολέμων λόγοι*). They consist of: (1) the Persian Wars, in two books, giving a narrative of the long struggle of the emperors Justin and Justinian against the Persian kings Kavadh and Chosroes Anushirvan down to 550; (2) the Vandal War, in two books, describing the conquest of the Vandal kingdom in Africa and the subsequent events there from 532 down to 546 (with a few words on later occurrences); (3) the Gothic War, in three books, narrating the war against the Ostrogoths in Sicily and Italy from 536 till 552. The eighth book contains a further summary of events down to 554. These eight books of *Histories*, although mainly occupied with military matters, contain notices of some of the more important domestic events, such as the Nika insurrection at Constantinople in 532, the plague in 542, the conspiracy of Artabenes in 548. They tell us, however, comparatively little about the civil administration of the empire, and nothing about legislation. On the other hand they are rich in geographical and ethnographical information.

As an historian Procopius is of quite unusual merit, when the generally low literary level of his age is considered. He is industrious in collecting facts, careful and impartial in stating them; his judgment is sound, his reflections generally acute, his conceptions of the general march and movement of things not unworthy of the great events he has recorded. His descriptions, particularly of military operations, are clear, and his especial fondness for this part of the subject seldom leads him into unnecessary minuteness. The style, although marked by mannerisms, by occasional affectations and rhetorical devices, is on the whole direct and businesslike, nor is the Greek bad for the period in which he wrote. His models are Thucydides and Herodotus. The former he imitates in the maxims (γνῶμαι) he throws in and the speeches which he puts into the mouth of the chief actors; the latter in his frequent geographical digressions, in the personal anecdotes, in the tendency to collect and attach some credence to marvellous tales. The speeches are obviously composed by Procopius himself, rarely showing any dramatic variety in their language, but they seem sometimes to convey the substance of what was said; and even when this is not the case they frequently serve to bring out the points of a critical situation. Procopius is almost as much a geographer as an historian, and his descriptions of the people and places he himself visited are generally careful and thorough. Although a warmly patriotic Roman, he does full justice to the merits of the barbarian enemies of the empire, particularly the Ostrogoths; although the subject of a despotic prince, he criticizes the civil and military administration of Justinian and his dealings with foreign peoples with a freedom which gives a favourable impression of the tolerance of the emperor. His chief defects are a somewhat pretentious and at the same time monotonous style, and a want of sympathy and intensity.

The *De aedificiis* contains an account of the chief public works executed during the reign of Justinian down to 558 (in which year it seems to have been composed), particularly churches, palaces, hospitals, fortresses, roads, bridges and other river works throughout the empire. All these are of course ascribed to the personal action of the monarch. If not written at the command of Justinian (as some have supposed), it is evidently grounded on official information, and is full of gross flattery of the emperor and of the (then deceased) empress. In point of style it is greatly inferior to the *Histories*—florid, pompous and affected, and at the same time tedious. Its chief value lies in the geographical notices which it contains.

The *Anecdota* ("Secret History") purports to be a supplement to the *Histories*, containing explanations and additions which the author could not insert in the latter work for fear of Justinian and Theodora. It is a furious invective against these sovereigns, their characters, personal conduct and government, with attacks on Belisarius and his wife Antonina, and on other noted officials in the civil and military services of the empire. Owing to the ferocity and brutality of the attacks upon Justinian, the authenticity of the *Anecdota* has often been called in question, but the claims of Procopius to the authorship are now generally recognized. In point of style, the *Anecdota* is inferior to the *Histories*, and has the air of being unfinished, or at least unrevised. Its merit lies in the furious earnestness with which it is written, which gives it a force and reality sometimes wanting in the more elaborate books written for publication. The history of Philip of Macedon by Theopompus probably furnished the author with a model.

The best complete edition of Procopius is by J. Haury (Teubner Series, 1905); the *Gothic War* has been edited by D. Comparetti (1895–1898), with an Italian translation. There are English translations of the *History of the Wars*, by H. Holcroft (1653); of the *Anecdota* (1674, anonymous); of the *Buildings*, by Aubrey Stewart (1888, in Palestine Pilgrims' Text Society). Chief authorities: F. Dahn, *Procopius von Cäsarea* (1865); W. S. Teuffel in *Studien und Charakteristiken* (2nd ed., 1889); L. Ranke, *Weltgeschichte* (1883), iv. 2. On the genuineness of the *Anecdota* cf. J. B. Bury (who agrees with Ranke in rejecting the authorship of Procopius) *A History of the Later Roman Empire* (1889), vol. i., and introd. to vol. i. (p. 57) and app. to vol. iv. of his edition of Gibbon's *Decline and Fall*. For the literature of the subject generally, see C. Krumbacher, *Geschichte der byzantinischen Litteratur* (2nd ed., 1897).

PROCOPIUS OF GAZA (*c.* 465–528 A.D.), Christian sophist and rhetorician, one of the most important representatives of the famous school of his native place. Here he spent nearly the whole of his life teaching and writing, and took no part in the theological movements of his time. The little that is known of him is to be found in his letters and the encomium by his pupil and successor Choricius. He was the author of numerous rhetorical and theological works. Of the former, his panegyric on the emperor Anastasius alone is extant; the description of the church of St Sophia and the monody on its partial destruction by an earthquake are spurious. His letters (162 in number), addressed to persons of rank, friends, and literary opponents, throw valuable light upon the condition of the sophistical rhetoric of the period and the character of the writer. The fragment of a polemical treatise against the Neoplatonist Proclus is now assigned to Nicolaus, archbishop of Methone in Peloponnesus (*fl.* 12th century). Procopius's theological writings consist of commentaries on the Octateuch, the books of Kings and Chronicles, Isaiah, the Proverbs, the Song of Songs and Ecclesiastes. They are amongst the earliest examples of the "catenic" (*catena*, chain) form of commentary, consisting of a series of extracts from the fathers, arranged, with independent additions, to elucidate the portions of Scripture concerned. Photius (*cod.* 206), while blaming the diffuseness of these commentaries, praises the writer's learning and style, which, however, he considers too ornate for the purpose.

Complete editions of the works of Procopius in Migne, *Patrologia graeca*, lxxxvii; the letters also in *Epistolographi graeci*, ed. R. Hercher (1873); see also K. Seitz, *Die Schule von Gaza* (1892); D. Russos, Τρεῖς Γαζαῖοι (Constantinople, 1893); L. Eisenhofer, *Procopius von Gaza* (1897); further bibliographical notices in C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897), and article by G. Krüger in Herzog-Hauck's *Realencyclopädie für protestantische Theologie* (1905).

PROCRUSTES (Gr. for "the stretcher"), also called Polypemon or Damastes, in Greek legend, a robber dwelling in the neighbourhood of Eleusis, who was slain by Theseus. He had two bedsteads (according to some, only one), the one very long, the other very short. When a stranger claimed his hospitality, Procrustes compelled him, if he was tall, to lie down on the short bed, and then cut off his extremities to make him fit. If on the other hand he was short, he was placed on the long bedstead and his limbs pulled out until he died from exhaustion. The "bed of Procrustes" has become proverbial.

Diod. Sic. iv. 59; Hyginus, *fab.* 38; Plutarch, *Theseus*, 11; Pausanias i. 38, 5.

PROCTER, BRYAN WALLER (1787–1874), English poet, was born at Leeds on the 21st of November 1787. He was educated at Harrow, where he had for contemporaries Lord Byron and Sir Robert Peel. On leaving school he was placed in the office of a solicitor at Calne, Wiltshire, remaining there until about 1807, when he returned to London to study law. By the death of his father in 1816 he became possessed of a small property, and soon after entered into partnership with a solicitor; but in 1820 the partnership was dissolved, and he began to write under the pseudonym of "Barry Cornwall." After his marriage in 1824 to Miss Skepper, a daughter of Mrs Basil Montague, he returned to his professional work as conveyancer, and was called to the bar in 1831. In the following year he was appointed, metropolitan commissioner of lunacy—an appointment annually renewed until his election to the permanent commission constituted by the act of 1842. He resigned office in 1861. He died on the 5th of October 1874. Most of his verse was composed between 1815, when he began to contribute to the *Literary Gazette*, and 1823, or at latest 1832.

His principal poetical works were: *Dramatic Scenes and other Poems* (1819), *A Sicilian Story* (1820), *Mirandola*, a tragedy performed at Covent Garden with Macready, Charles Kemble and Miss Foote in the leading parts (1821), *The Flood of Thessaly* (1823), and *English Songs* (1832). He was also the author of

Effigies poetica (1824), *Life of Edmund Kean* (1835), *Essays and Tales in Prose* (1851), *Charles Lamb; a Memoir* (1866), and of memoirs of Ben Jonson and Shakespeare for editions of their works. A posthumous autobiographical fragment with notes of his literary friends, of whom he had a wide range from Bowles to Browning, was published in 1877, with some additions by Coventry Patmore. Charles Lamb gave the highest possible praise to his friend's *Dramatic Sketches* when he said that had he found them as anonymous manuscript in the Garrick collection he would have had no hesitation about including them in his *Dramatic Specimens*. He was perhaps not an impartial critic. "Barry Cornwall's" genius cannot be said to have been entirely mimetic, but his works are full of subdued echoes. His songs have caught some notes from the Elizabethan and Cavalier lyrics, and blended them with others from the leading poets of his own time; and his dramatic fragments show a similar infusion of the early Victorian spirit into pre-Restoration forms and cadences. The results are somewhat heterogeneous, and lack the impress of a pervading and dominant personality to give them unity, but they abound in pleasant touches, with here and there the flash of a higher, though casual, inspiration.

His daughter, ADELAIDE ANNE PROCTER (1825–1864), also a poet, was born on the 30th of October 1825. She began to contribute to *Household Words* in 1853. She adopted the name of "Mary Berwick," so that the editor, Charles Dickens, should not be prejudiced by his friendship for the Procters. Her principal work is *Legends and Lyrics*, of which a first series, published in 1858, ran through nine editions in seven years, while a second series issued in 1860 met with a similar success. Her unambitious verses dealing with simple emotional themes in a simple manner have a charm which is scarcely explicable on the ground of high literary merit, but which is due rather to the fact that they are the cultured expression of an earnest and beneficent life. Among the best known of her poems are *The Angel's Story*, *The Legend of Bregenz* and *The Legend of Provence*. Many of her songs and hymns are very popular. Latterly she became a convert to Roman Catholicism, and her philanthropic zeal appears to have hastened her death, which took place on the 2nd of February 1864.

PROCTOR, ALEXANDER PHIMISTER (1862–), American sculptor and painter, was born in Ontario, Canada, on the 27th of September 1862. As a youth he lived at Denver, Colorado, spending much of his time in the Rocky Mountains, and his familiarity with the ways and habits of wild animals was supplemented later by study in the Jardin des Plantes, Paris. He was a pupil at the National Academy of Design and later in the Art Students' League, in New York, and first attracted attention by his statues of wild animals at the Columbian Exposition, Chicago. In 1896 he won the Rinehart Scholarship, which enabled him to spend five years in Paris, where he studied under Puech and J. A. Injalbert. Among his works of sculpture are: "Indian Warrior" (a small bronze); "Panthers," Prospect Park, Brooklyn, New York; "Quadriga," for United States Pavilion, Paris Exhibition (1900), and groups in the City Park, Denver, and Zoological Park, New York. His pictures of wild animals, mainly in water colours, are also characteristic. He became a member of the Society of American Artists (1895), of the National Academy of Design (1904), of the American Water Color Society, and of the Architectural League, New York.

PROCTOR, RICHARD ANTHONY (1837–1888), British astronomer, was born at Chelsea on the 23rd of March 1837. He was a delicate child, and, his father dying in 1850, his mother attended herself to his education. On his health improving he was sent to King's College, London, from which he obtained a scholarship at St John's College, Cambridge. He graduated in 1860 as 23rd wrangler. His marriage while still an undergraduate probably accounted for his low place in the tripos. He then read for the bar, but turned to astronomy and authorship instead, and in 1865 published an article on the "Colours of Double Stars" in the *Cornhill Magazine*. His first book—*Saturn and his System*—was published in the same year, at his own expense. This work contains an elaborate account of the phenomena presented by the planet; but although favourably received by astronomers, it had no great sale. He intended to follow it up with similar treatises on Mars, Jupiter, sun, moon, comets and meteors, stars, and nebulae, and had in fact commenced a monograph on Mars, when the failure of a New Zealand bank deprived him of an independence which would have enabled him to carry out his scheme without anxiety as to its commercial success or failure. Being thus obliged to depend upon his writings for the support of his family, and having learned by the fate of his *Saturn* that the general public are not attracted by works requiring arduous study, he cultivated a more popular style. He wrote for a number of periodicals; and although he has stated that he would at this time willingly have "turned to stone-breaking on the roads, or any other form of hard and honest but unscientific labour, if a modest competence had been offered" him in any such direction, he attained a high degree of popularity, and his numerous works had a wide influence in familiarizing the public with the main facts of astronomy. His earlier efforts were, however, not always successful. His *Handbook of the Stars* (1866) was refused by Messrs Longmans and Messrs Macmillan, but being privately printed, it sold fairly well. For his *Half-Hours with the Telescope* (1868), which eventually reached a 20th edition, he received originally £25 from Messrs Hardwick. Although teaching was uncongenial to him he took pupils in mathematics, and held for a time the position of mathematical coach for Woolwich and Sandhurst.

His literary standing meantime improved, and he became a regular contributor to *The Intellectual Observer*, *Chambers's Journal* and the *Popular Science Review*. In 1870 appeared his *Other Worlds than Ours*, in which he discussed the question of the plurality of worlds in the light of new facts. This was followed by a long series of popular treatises in rapid succession, amongst the more important of which are *Light Science for Leisure Hours* and *The Sun* (1871); *The Orbs around Us* and *Essays on Astronomy* (1872); *The Expanse of Heaven*, *The Moon* and *The Borderland of Science* (1873); *The Universe and the Coming Transits* and *Transits of Venus* (1874); *Our Place among Infinities* (1875); *Myths and Marvels of Astronomy* (1877); *The Universe of Stars* (1878); *Flowers of the Sky* (1879); *The Peotry of Astronomy* (1880); *Easy Star Lessons* and *Familiar Science Studies* (1882); *Mysteries of Time and Space* and *The Great Pyramid* (1883); *The Universe of Suns* (1884); *The Seasons* (1885); *Other Suns than Ours* and *Half-Hours with the Stars* (1887). In 1881 he founded *Knowledge*, a popular weekly magazine of science (converted into a monthly in 1885), which had a considerable circulation. In it he wrote on a great variety of subjects, including chess and whist. He was also the author of the articles on astronomy in the *American Cyclopaedia* and the ninth edition of the *Encyclopaedia Britannica*, and was well known as a popular lecturer on astronomy in England, America and Australia. Elected a fellow of the Royal Astronomical Society in 1866, he became honorary secretary in 1872, and contributed eighty-three separate papers to its *Monthly Notices*. Of these the more noteworthy dealt with the distribution of stars, star-clusters and nebulae, and the construction of the sidereal universe. He was an expert in all that related to map-drawing, and published two star-atlases. A chart on an isographic projection, exhibiting all the stars contained in the *Bonn Durchmusterung*, was designed to show the laws according to which the stars down to the 9–10th magnitude are distributed over the northern heavens. His "Theoretical Considerations respecting the Corona" (*Monthly Notices*, xxxi. 184, 254) also deserve mention, as well as his discussions of the rotation of Mars, by which he deduced its period with a probable error of $0^s{\cdot}005$. He also vigorously criticized the official arrangements for observing the transits of Venus of 1874 and 1882. His largest and most ambitious work, *Old and New Astronomy*, unfortunately left unfinished at his death, was completed by A. Cowper Ranyard and published in 1892. He settled in America some time after his second marriage in 1881, and died at New York on the 12th of September 1888.

See *Monthly Notices*, xlix. 164; *Observatory*, xi. 366; *The Times*, (Sept. 14, 1888); *Knowledge* (Oct. 1888, p. 265); Appleton's *Annual Cyclopaedia*, xiii. 707; Autobiographical Notes in *New Science Review*, i. 393.

PROCTOR, an English variant of the word procurator (*q.v.*); strictly, a person who takes charge or acts for another, and so approaching very nearly in meaning to "agent" (*q.v.*). The title is used in England in three principal senses.

1. A practitioner in the ecclesiastical and admiralty courts. A proctor in this sense is also a qualified person licensed by the archbishop of Canterbury to undertake duties such as are performed in other courts by solicitors, but this matter is now only of historical interest, since by the Judicature Acts 1873 and 1875 all the business formerly confined to proctors may be conducted by solicitors. The king's proctor is the proctor or solicitor representing the Crown in the courts of probate and divorce. In petitions of divorce or for declaration of nullity of marriage the king's proctor may, under direction of the attorney-general, and by leave of the court, intervene in the suit for the purpose of proving collusion between the parties. His power of intervening is limited, by the Matrimonial Causes Act 1860, to cases of *collusion* only, but he may also, as one of the public, show cause against a decree *nisi* being made absolute (see DIVORCE). In the admiralty court a proctor or procurator was an officer who, in conjunction with the king's proctor, acted as the attorney or solicitor in all causes concerning the lord high admiral's affairs in the high court of admiralty and other courts. The king's proctor so acted in all causes concerning the king.

2. A representative of the clergy in convocation. A proctor in this sense represents either the chapter of a cathedral or the beneficed clergy of a diocese. In the province of Canterbury two proctors represent the clergy of each diocese; in that of York there are two for each archdeaconry. In both alike each chapter is represented by one.

3. The name of certain important university officials. At Oxford the proctors (*procuratores*), under the statutes, supervise the transaction of university business and appoint delegates to look after any particular affairs wherever these are not otherwise provided for by statute. They are *ex officio* members of all the important delegacies, except that of the University Press. They also act as the assessors of the chancellor or his commissary in particular matters dealt with in the university. They supervise the voting at public meetings of the university and announce the results. They also have, according to the ancient statutes, the power of veto in convocation and congregation: no proposal can be passed into a statute or decree if twice vetoed by them. They are *ex officio* members of the hebdomadal council, the governing council of the university, and they are the assessors of the vice-chancellor when he confers degrees. When a degree is to be granted they walk down the hall in which the ceremony is performed, nominally to ask for the approval of the masters, and it was formerly the custom for any tradesman, or any other person, who had a claim of debt against the postulant for a degree, to pluck the gown of the proctor as he passed and request settlement of the debt before the degree was granted. The proctors are also responsible for the good order of the university, and they are charged with the duty of inquiring into and reporting on any breaches of its statutes, customs or privileges. They are empowered to punish undergraduates, or graduates under the degree of Bachelor of Civil Law and Master of Arts, by fine or by confinement to their colleges or lodgings (familiarly known as "gating"). They have to draw up the list of candidates for examination, and have to be present at all examinations, to see that they are properly conducted. They are responsible for the good order of the streets at night, so far as members of the university are concerned. For this purpose more especially each of them is empowered, immediately on his election, to nominate two masters of at least three years' standing as pro-proctors. The proctors and pro-proctors take it in turn to perambulate the streets nightly, accompanied by two sworn constables, familiarly known as "bulldogs." The proctors are elected by the heads, fellows and resident members of convocation of each college in rotation. They are presented to the vice-chancellor with much ceremony, part of which consists in taking over the insignia of their office—a copy of the statutes and a bunch of keys—from their predecessors.

At Cambridge the proctors are nominated annually by the colleges in rotation and elected (a formal proceeding) by the senate. They must have been three years members of the senate and have resided two years at the university. The two pro-proctors are not, as at Oxford, nominated by the proctors, but are also elected by the senate on the nomination of the colleges, each college having the right to nominate a pro-proctor the year next before that in which it nominates the proctor (Grace of February 26, 1863). Two additional pro-proctors are also elected by the senate each year, on the nomination of the vice-chancellor and proctors, to assist the latter in the maintenance of discipline (Grace of June 6, 1878).

The early history of the office at Cambridge is obscure, but it seems that the proctors have always represented the colleges in university proceedings. At present their functions are twofold (1) as taking part in all university ceremonials, (2) as enforcing discipline in the case of members of the university who are *in statu pupillari* (*i.e.* undergraduates and Bachelors of Arts and Law). (1) The proctors are not (as at Oxford) *ex officio* members of the council of the senate or of other boards or syndicates, except those with which their duties are specially connected. But their presence is essential at all congregations of the senate, at which the senior proctor reads all the "graces" (already approved by the council of the senate). If any grace is opposed by any member of the senate saying *non placet* the proctors take the votes of those present and announce the result. Graces are offered not only for making changes in university statutes and ordinances and for appointing examiners and the like, but also for granting degrees. When a degree is to be taken the college of the candidate presents a *supplicat* or petition for the degree, this petition is approved by the council of the senate, when they have satisfied themselves that the candidate has fulfilled the conditions, and is read at the congregation by the senior proctor: these *supplicats* are practically never opposed, but graces for new statutes and ordinances are frequently opposed, and on very important occasions many hundreds of non-resident members of the senate come up to record their votes. (2) The proctors' powers as to discipline have a very long history. As far as concerns members of the university they have authority to impose certain fines for minor offences, such as not wearing academical dress on occasions when it is ordered, and also to order a man not to be out of his college after a certain hour for a certain number of days ("gating"). In the case of more serious offences the proctor generally reports the matter to the authorities of the offender's college to be dealt with by them, or as an ultimate resort brings the offender before the university court of discipline, which has power to rusticate or expel. The power of the proctors over persons who are not members of the university dated from charters granted by Elizabeth and James I., which empowered the university authorities to search for undesirable characters, men and women, rogues, vagabonds, and other *personas de malo suspectas*, and punish them by imprisonment or banishment. In recent times this power was regularly exercised with respect to women of bad character. The proctors promenaded the streets attended by their servants (the bulldogs), who are always sworn in as special constables. If occasion arose the proctor could arrest a suspected woman and have her taken to the Spinning House (for which Hobson the carrier had left an endowment); the next day the woman was brought before the vice-chancellor, who had power to commit her to the Spinning House; as a general rule the sentence was not for a longer perior than three weeks. For this purpose the vice-chancellor sat *in camera* and the jurisdiction had nothing to do with that of the vice-chancellor's court. In 1898 attention was called to this procedure by the case of a girl named Daisy Hopkins, who was arrested and committed to the Spinning House. Application was made on her behalf to the Queen's Bench Division for a writ of habeas corpus, and when the application came on it appeared that there had been a technical irregularity (the prisoner not having been formally charged when brought before the vice-chancellor); so the writ was granted and the prisoner released. She afterwards brought an action against the proctor, which failed. It was now decided to abolish the practice of hearing these cases *in camera*. The whole practice was, however, objected to by the authorities of the town, and after conference an agreement was arrived at, the proctorial jurisdiction over persons not members of the university being abolished (1904).

PROCURATION (Lat. *procurare*, to take care of), the action of taking care of, hence management, stewardship, agency. The word is applied to the authority or power delegated to a procurator, or agent, as well as to the exercise of such authority expressed frequently "by procuration" (*per procurationem*), or shortly *per pro.*, or simply *p.p.* In ecclesiastical law, procuration is the providing necessaries for bishops and archdeacons during their visitations of parochial churches in their dioceses. Procuration at first took the form of meat, drink, provender, and other accommodation, but it was gradually compounded for a certain sum of money. Procuration is merely an ecclesiastical due, and is suable only in a spiritual court. In those dioceses where the bishop's estates have vested in the ecclesiastical commissioners procurations are payable to the commissioners who, however, have abandoned their collection (Phillimore, *Ecc. Law*, 2nd ed., 1895, pp. 1051, 1060). Procuration is also used specifically for the negotiation of a loan by an agent for his client, whether by mortgage or otherwise, and the sum of money or commission paid for negotiating it is frequently termed *procuration fee*.

The English criminal law makes the provision or attempted provision of any girl or woman under twenty-one years of age for the purpose of illicit intercourse an offence, known as procuration. (See PROSTITUTION.)

PROCURATOR (Lat. *procurare*, to take care of), generally one who acts for another. With the Romans it was applied to a person who maintained or defended an action on behalf of another, thus performing the functions of a modern attorney. Roman families of importance employed an official corresponding to the modern steward and frequently called the *procurator*. Later the name was applied especially to certain imperial officials in the provinces of the Roman Empire. With the establishment of the imperial power under Augustus, the emperor took under his direct government those of which the condition or situation rendered a large military force necessary. Here certain officials, known as the *procuratores Caesaris*, took the place occupied by the *quaestor* in the senatorial provinces. They were either equites or freedmen of the Caesar and their office was concerned with the interests of the *fiscus* (the public property of the Caesar). They looked after the taxes and paid the troops. There were also officials bearing this title of *procuratores Caesaris* in the senatorial provinces. They collected certain dues of the *fiscus* which were independent of those paid to the *aerarium* (the property of the senate). This organization lasted with some modifications until the 3rd century. The *procurator* was an important official in the reorganized empire of Diocletian.

The title remained all through the middle ages to describe very various officials. Thus it was sometimes applied to a regent acting for a king during his minority or absence; sometimes it appears as an alternative title to *seneschal* or *dapifer*. It preserved its legal significance in the title of *procurator animarum*, who acted as solicitor or proxy in the ecclesiastical courts, and was so called because these courts dealt with matters affecting the spiritual interests of the persons concerned. The economical significance remained in such titles as *procurator anniversariorum*, the exactor of dues for the celebration of anniversaries; this office was assigned to laymen. The *procurator draperii* was entrusted with the administration of matters pertaining to the art of cloth-making. The *procurator duplarum* was the collector of fines in certain churches from absent canons, &c. The officials entrusted with the administration of the goods of a church were called variously *procurator ecclesiae*, *procurator parcitatis*, *procurator universitatis*. Bishops and bishops-elect frequently described themselves by the title of *procuratores ecclesiarum*. The prior of a dependent religious house was sometimes styled *procurator obedientiae*. The official who represented the public interests in the courts of the inquisition was known as the *procurator fidei*. The administrator of the affairs of a large community was sometimes called the *procurator syndicus*, the administrator of goods left to the poor, *procurator pauperum*. In monasteries the *economus* was, and is, sometimes described as *procurator*. Thus the procurator has still the administration of material affairs in every Dominican priory. *Procurator di San Marco* was a title of honour in the republic of Venice. There were nine official procurators and numerous distinguished persons bearing the honorary title.

The term procurator (Fr. *procureur*) is used in those countries whose codes are based on the Roman civil law for certain officials, having a representative character, in the courts of law. Thus under the *ancien régime* in France the *procureurs du roi* were the representative of the Crown in all causes (see FRANCE: *Law and Institutions*); and now the *procureurs généraux*, and under them the *procureurs substituts*, *procureurs de la république* and *procureurs* still represent the *ministère public* in the courts. In Scotland the procurator is a law agent who practises in an inferior court. A procurator in Scotland has been, since the Law Agents Acts 1873, exactly in the same legal position as other law agents. The procurator-fiscal is a local officer charged with the prosecution of crimes. He is appointed by the sheriff. He also performs the duties of an English coroner by holding inquiries into the circumstances of suspicious deaths. A common English form of procurator is proctor (*q.v.*).

See Sir William Smith, *Dictionary of Greek and Roman Antiquities* (3rd ed., 1890–1891), and Du Cange, *Glossarium mediae et infimae latinitatis* (new ed. by L. Favre, Niort, 1883). (E. O'N.)

PRODICUS OF CEOS (b. *c.* 465 or 450 B.C.), a Greek humanist of the first period of the Sophistical movement, known as the "precursor of Socrates." He was still living in 399 B.C. He came to Athens as ambassador from Ceos, and became known as a speaker and a teacher. Like Protagoras, he professed to train his pupils for domestic and civic affairs; but it would appear that, while Protagoras's chief instruments of education were rhetoric and style, Prodicus made ethics prominent in his curriculum. In ethics he was a pessimist. Though he discharged his civic duties in spite of a frail physique, he emphasized the sorrows of life; and yet he advocated no hopeless resignation, but rather the remedy of work, and took as his model Heracles, the embodiment of virile activity. The influence of his views may be recognized as late as the *Shepherd of Hermas*. His views on the origin of the belief in the gods is strikingly modern. First came those great powers which benefit mankind (comparing the worship of the Nile), and after these the deified men who have rendered services to humanity. But he was no atheist, for the pantheist Zeno spoke highly of him. Of his natural philosophy we know only the titles of his treatises *On Nature* and *On the Nature of Man*. His chief interest is that he sought to give precision to the use of words. Two of his discourses were specially famous; one, "On Propriety of Language," is repeatedly alluded to by Plato; the other, entitled Ὧραι, contained the celebrated apologue of the Choice of Heracles, of which the Xenophontean Socrates (*Mem.* ii. 1, 21 seq.) gives a summary. Theramenes, Euripides and Isocrates are said to have been pupils or hearers of Prodicus. By his immediate successors he was variously estimated: Plato satirizes him in the early dialogues; Aristophanes in the Ταγηνισταὶ calls him "a babbling brook"; Aeschines the Socratic condemns him as a sophist.

See Spengel, *Artium scriptores*, pp. 45 sqq.; Welcker, "Prodikos der Vorgänger des Sokrates," in *Rheinisches Museum* (1833), and in *Kleine Schriften*, ii. 393; Hummel, *De Prodico Sophista* (Leiden, 1846); Cougny, *De Prodico Ceio* (Paris, 1858).

PRODIGY, an extraordinary or wonderful thing, person, event, &c.; something which excites amazement and astonishment. The term has been particularly applied to children who display a precocious genius, especially in music. The German expression *Wunderkind* has of late been often adopted by those who have found the name "infant prodigy" too reminiscent of the "infant phenomenon" familiar to readers of Dickens. The Lat. *prodigium*, an omen, portent, and abnormal or monstrous event, is probably not to be derived from *pro* and *dicere*, to foretell, prophesy, but rather, on the analogy of *adagium*, adage, aphorism, from *pro* (*prot* before a vowel), and the root of *aio*, I say.

PRODUCTION (Lat. *productionem*, from *producere*, to produce), in general, the act of producing, or bringing forth. Production, in contrast with distribution and consumption, is one of the great divisions which all treatises on economics make in dealing with the subject, and as such it is defined in every textbook and its elements and processes dealt with at length. J. R. McCulloch's definition may be given as one difficult to improve on: "by production, in the science of political economy, we are not to understand the production of matter, for that is the exclusive attribute of Omnipotence, but the production of utility, and consequently of exchangeable value, by appropriating and modifying matter already in existence, so as to fit it to satisfy our wants, and to contribute to our enjoyments." W. S. Jevons says, "production is one of the very few happily chosen terms which the economist possesses. Etymologically the term implies that we draw wealth forth, and this is the correct idea of production." Though the mere definition of "production" as the creation of utilities is apparently simple enough, the treatment of the subject has varied from time to time in proportion to the changes which economic science has itself undergone; it has been said that the theory of production is based on unalterable natural facts, but even this cannot be too absolutely stated, for the organization of production changes with social growth. Much discussion has, during the growth of the science of economics, centred round what is and what is not productive or unproductive, and as to the relative importance of the functions of production and distribution.

See E. Canaan's *History of the Theories of Production and Distribution* (1893), and the standard treatises on economics. Also the articles, CAPITAL; VALUE; WEALTH.

PROFANITY, irreverent or blasphemous language, swearing, by the use of words casting derision on sacred or divine things, especially the taking of the name of God in vain (see BLASPHEMY; and SWEARING). The word "profane," derived from Lat. *profanum*, outside the temple (*fanum*), hence opposed to *sacrum* or *religiosum*, in the sense of not sacred, common, is used in English not only as meaning irreverent, or blasphemous, but also in the senses of the original Latin, not initiated into sacred mysteries, hence, lay, secular, or as referring to subjects not connected with sacred or biblical matters, *e.g.* profane literature, history, &c.

PROFESSOR (the Latin noun formed from the verb *profiteri*, to declare publicly, to acknowledge, profess), a term now properly confined to a teacher of a special grade at a university. Its former significance of one who has made "profession" or open acknowledgment of religious belief, or, in particular, has made a promise binding the maker to a religious order, is now obsolete. The educational use is found in post-Augustan Latin, and *profiteri* is used by Pliny (*Ep.* ii. 18, 3, iv. 11, 14), absolutely, in the sense of "to be a teacher," an extension of the classical use in the sense of to practise, profess a science or art, *e.g. profiteri jus, medicinam, philosophiam*, &c. In the universities of the middle ages the conferring of a degree in any faculty or branch of learning meant the right or qualification to teach in that faculty, whence the terms *magister*, "master," and *doctor* for those on whom the degree had been granted. To these names must be added that of "professor." The "three titles of Master, Doctor, Professor, were in the middle ages absolutely synonymous" (H. Rashdall, *The Universities of Europe in the Middle Ages*, 1895, i. 21). At Paris in the faculties of theology, medicine and arts *professor* is more frequently used than *doctor* but less so than *magister*; at Bologna the teachers of law are known as *professores* or *doctores* (id.). From this position to that of the holder of an endowed "chair," the occupant of which is the principal public teacher of the particular faculty, the evolution was gradual. The first endowed professorship at Oxford was that of divinity, founded by the mother of Henry VII. in 1497 (?1502) and named after her the "Margaret Professorship." The foundation of the regius professorship by Henry VIII., in 1546 no doubt, as the *New English Dictionary* points out, tended to the general modern use of the word. Subordinate public teachers in faculties or in subjects to which a professorial "chair" is attached, are known as "readers" or "lecturers," and these titles are also used for the principal public teachers in subjects which have not reached professorial rank.

PROFILE, an outline or contour drawing, particularly the drawing of the outline of the human face as seen from the side, or in architecture the contour of a part of a building, of a moulding, &c., as shown by a vertical section. In fortification the "profile" of an earthwork is an outline of a transverse section and gives the relative thickness; so a work is said to be "of strong" or "of weak" profile. The Fr. *profil*, formerly *porfil, pourfil*, Ital. *profilo, proffilo*, are formed from Lat. *pro*, and *filare*, to draw a line, *filum*, thread.

The French *pourfil* also gave English "purfle," to embroider the edge of a fabric with gold or other thread; this was further corrupted to "purl," now often wrongly spelt "pearl," an inverted stitch in knitting.

PROFIT-SHARING (*i.e.* between employer and employed), a method of remunerating labour, under which the employees receive, in addition to ordinary wages, a share of the profit which the business realizes. The term is not infrequently used loosely to include many forms of addition to ordinary wages, such as bonus on output or quality, gain-sharing and product-bearing. Yet strictly, where an employee or a group works for a share of the product, or is paid so much in addition to ordinary wages in proportion as the product exceeds a certain quantity, or the quality exceeds a certain standard, in neither of these cases have we profit-sharing, for the net result of the business may be a large profit or a small one or a loss, and the employee's claim is unaffected. In the same way if a workman is employed on the basis that if in doing a particular job he saves something out of a stipulated time of labour, or a stipulated amount of materials, he shall receive in addition to ordinary wages a proportion of the value so saved, that is technically gain-sharing, not profit-sharing. Even where the bonus depends strictly on profit, it is not reckoned as profit-sharing, if it is confined to the leading employees.

An agreement is of the essence of the matter. It is not profit-sharing where an employer takes something from his profits at his own will and pleasure, and gives it to his employees. Strictly such gifts in cash are gratuities, while, when they take other forms, such as better houses, libraries, recreation rooms, provision for sickness and old age, all given at the will of the employer, we have paternalism. Such benefits thus taken expressly from profits and varying more or less with the amount of profit certainly approach true profit-sharing: they are sometimes called "indeterminate" profit-sharing. Though many of the above methods of remunerating, or benefiting, the employed are from time to time included under profit-sharing even by writers of repute, the strict sense of the term was defined by the international congress on profit-sharing in 1889 as "an agreement freely entered into by which the employed receives a share of profits determined in advance." It does not follow that the agreement must be actually enforceable at law; some employers to protect themselves from litigation stipulate that it shall not be.

Profit-sharing, in the loose sense, must be of untold antiquity; the first great example of profit-sharing in the strict sense is that of the Parisian house-painter, Edme-Jean Leclaire, "The Father of Profit-Sharing." In 1842 he was employing 300 men on day wages. By greater zeal and intelligence and less waste, not necessarily by harder work, he reckoned they could save £3000 a year; and he made it their interest to do so by arranging that they should receive the greater part of the saving themselves. This arrangement proved a very great success; the material gain to the men and the improvement in their morale were marked; and Leclaire, who began life with nothing and died worth £48,000, always maintained that, without the zeal drawn out in his men by profit-sharing, he never could have made so large a business or gained so much wealth. In 1908 the system was still in active operation in the firm. Its main features are as follows: after paying 5% interest on the capital, and small sums as wages of superintendence to the two managing partners, the remaining profit is divided into four parts, one of which goes to the managing partners, one to the Mutual Aid Society, and the remaining half to the employees as a dividend on their ordinary wages, exclusive of piece-work and overtime, on which no dividend is paid. The Mutual Aid Society is a registered body, and is a limited partner in the firm, the liability of the two managing partners being unlimited and the control resting entirely in their hands. The benefits of the Mutual Aid Society, and of the profit-sharing generally, are enjoyed in the main by all the employees of the business, but certain advantages are confined to a limited number of permanent employees.

Leclaire's system attracted the marked interest of John Stuart Mill and other English economists, and in 1865–1867 a number of experiments in profit-sharing, or as it was then called, industrial partnership, were made in England, the most noted being that of Henry Briggs, Son & Co., at their collieries in Yorkshire. The main object in this case was to detach the workmen from the trade union and attach them to the firm. In other ways the experiment was very successful, and £40,000 was divided as bonus on wages in nine years, but the main object was not attained; and when the price of coal fell heavily after the inflation of 1873 Briggs's men joined the strike to resist a reduction of wages, and the experiment came to an end.

The present extent of profit-sharing, though in itself considerable, is but small in comparison with the vast extent of the world's commerce and industry, and except in one of its developments, co-partnership, it can hardly be said to be making progress. In 1906 there were in the United Kingdom and its colonies 65 ordinary firms practising profit-sharing in its strictest sense, and 17 others known to have adopted and not known to have discontinued it, making 82 in all as against 92 in 1901, and 101 in 1894. On the other hand the number of employees had grown from 28,000 in 1894 to 48,000 in 1906. In addition about one-fourth of the workmen's co-operative societies in Great Britain (see CO-OPERATION) practise profit-sharing with perhaps 30,000 employees.

In 1894 it was found that there were more profit-sharing firms in the British Empire than in any other country, and this is probably still true. The only rival is France, where, however, the term "participation aux bénéfices" is used in a wider sense. There are also important examples in Germany, the United States, Switzerland (where the state once applied the system in the postal service, and still does in the telegraphs), in Holland, in the socialist co-operative societies of Belgium, and elsewhere.

Profit-sharing has been quickly abandoned in many instances, for various reasons; there were no profits to divide; the small bonus given seemed to have no effect; the hope of detaching the men from their union, or contenting them with lower wages, was not realized; or the business passed into unsympathetic hands. On the other hand, one lasting success in such a matter proves more than many short experiments which failed; and profit-sharing has been splendidly successful where some high-minded man has breathed into it the spirit of partnership. Often it has been a step to actual partnership; the workman has not only received a share of profit, as added remuneration of his labour, but been led on to invest in the capital of the business, and as a shareholder, to take his share of the profits paid on capital, as well as of responsibility, of loss if any, and of control. This system of profit-sharing plus shareholding is now known as co-partnership (see CO-OPERATION), and is making undoubted progress. It is exemplified in nearly all profit-sharing co-operative societies, and in a growing number of businesses of non-co-operative origin which accumulate part or the whole of labour's profit in shares. In 1908, in the Familistère of Guise the whole capital of £200,000 belonged to the workers and a few retired workers, in Leclaire's old business the Mutual Aid Fund owned half, in the Laroche-Joubert paper-works the employees owned more than two-thirds. In the South Metropolitan Gas Co. the employees owned £327,000 and elected three of the nine directors. It would seem to be in this direction, as a step to full partnership, that profit-sharing has a great future before it.

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(A. WI.*)

PROGNATHISM (Gr. *πρό*, forward, and *γνάθος*, jaw), the term applied by ethnologists, with its opposite *Orthognathism* (*ὀρθός*, straight), to describe the varying degrees of projection of the upper jaw, which itself is determined by the angle made by the whole face with the brain-cap. *Eurygnathism* (*εὐρύς*, wide), is the lateral projection of jawbones so characteristic of the Mongolic races. (See CRANIOMETRY.)

PROGNOSIS (Gr. *πρόγνωσις*, knowledge of recognition beforehand, from *προγιγνώσκειν*, to know beforehand, cf. "prognostication," prediction), a term used in modern medicine, as it was in Greek, for an opinion, forecast or decision as to the probable course, duration and termination of a case of disease. It is to be distinguished from "diagnosis" (Gr. *διάγνωσις*, *διαγιγνώσκειν* to distinguish), the determination or identification of a disease in a particular case from an investigation of its history and symptoms.

PROGRAMME, or PROGRAM, in its original use, following that of Gr. *πρόγραμμα*, a public notice (*προγράφειν*, to make public by writing), now chiefly in the sense of a printed notice containing the items of a musical concert, with the names of the pieces to be performed, the composers and the performers, or of a theatrical performance, with the characters, actors, scenes, &c. In a wider sense the word is used of a syllabus or scheme of study, order of proceedings or the like, or of a catalogue or schedule containing the chief points in a course of action, and so, politically, in the sense of a list of the principal objects on which a party proposes to base its legislative course of action, as in the "Newcastle Programme" of 1891, drawn up by the Liberal Federation. The spelling "program," now general in America, was that first in use in England, and so continued till the French form "programme" was adopted at the beginning of the 19th century. The *New English Dictionary* considers the earlier and modern American spelling preferable, on the analogy of "diagram," "telegram," "cryptogram" and the like. Scott and Carlyle always used "program."

PROGRAMME MUSIC, a musical nickname which has passed into academic currency, denoting instrumental music without words but descriptive of non-musical ideas. Musical sounds lend themselves to descriptive purposes with an ease which is often uncontrollable. A chromatic scale may suggest the whistling of the wind or the cries of cats; reiterated staccato notes may suggest many things, from raindrops to the cackling of hens. Again, though music cannot directly imitate anything in nature except sounds, it has a range of contrast and a power of climax that is profoundly emotional in effect; and the emotions it calls up may resemble those of some dramatic story, or those produced by the contemplation of nature. But chromatic scales, reiterated notes, emotional contrasts and climaxes, are also perfectly normal musical means of expression; and the attempts to read non-musical meanings into them are often merely annoying to composers who have thought only of the music. Some distinguished writers on music have found a difficulty in admitting the possibility of emotional contrasts and climaxes in an art without an external subject-matter. But it is impossible to study the history of music without coming to the conclusion that in all mature periods music has been self-sufficient to this extent, that, whatever stimulus it may receive from external ideas, and however much of these ideas it may have embodied in its structure, nothing has survived as a permanently intelligible classic that has not been musically coherent to a degree which seems to drive the subject-matter into the background, even in cases where that subject-matter is naturally present, as in songs, choral works and operas. In short, since sound as it occurs in nature is not sufficiently highly organized to form the raw material for art, there is no natural tendency in music to include, as a "subject," any item conceivable apart from its artistic embodiment. Explicit programme music has thus never been a thing of cardinal importance, either in the transitional periods in which it has been most prominent, or in the permanent musical classics.

At the same time, artistic creation is not a thing that can be governed by any a priori metaphysical theory; and no great artist has been so ascetic as always to resist the inclination to act on the external ideas that impress him. No composer writes important music for the voice without words; for speech is too ancient a function of the human voice to be ousted by any a priori theory of art; and no really artistic composer, handling a living art-form, has failed to be influenced, sooner or later, by the words which he sets. It matters little if these words be in themselves very poor, for even false sentiment must make some appeal to true experience, and the great composers are quicker to seize the truth than to criticize its verbal presentation or to suspect insincerity. The earliest mature musical art was, then, inevitably descriptive, since it was vocal. So incessant is the minute onomatopoeia of 16th-century music, both in the genuine form of sound-painting (*Tonmalerei*) and in the spurious forms to which composers were led by the appearance of notes on paper (*e.g.* quick notes representing "darkness" because they are printed black!) that there is hardly a page in the productions of the "golden age" of music which has not its literary aspect. Programme music, then, may be expected to derive many of its characteristics from ancient times; but it cannot properly be said to exist until the rise of instrumental music, for not until then could music be based upon external ideas that did not arise inevitably from the use of words or dramatic action.

The resources of the modern orchestra have enabled recent composers to attain a realism which makes that of earlier descriptive music appear ridiculous; but there is little to choose between classics and moderns in the intellectual childishness of such realism. Thunderstorms, bird-songs and pastoral effects galore have been imitated by musicians great and small from the days of the Fitzwilliam Virginal Book to those of the episode of the flock of sheep in Strauss's *Don Quixote.* And, while the progress in realism has been so immense that the only step which remains is to drive a real flock of sheep across the concert-platform, the musical progress implied thereby has been that from inexpensive to expensive rubbish. What is really important, in the programme music of Strauss no less than that of the classics, is the representation of characters and feelings. In this respect the classical record is of high interest, though the greatest composers have contributed but little to it. Thus the *Bible Sonatas* of J. Kuhnau (published in 1700) and Bach's early *Capriccio on the Departure of a Beloved Brother*, which is closely modelled on Kuhnau's programme music, show very markedly the tendency on the one hand to illustrate characters and feelings, and on the other hand to extract from their programmes every occasion for something that would be a piece of incidental music if the stories were presented as dramas. Thus, though Kuhnau in his naïve explanatory preface to his first Bible sonata seems to be trying, like a child, to frighten himself into a fit by describing the size and appearance of Goliath, in the music it is only *le bravate* of Goliath that are portrayed. Thus the best movement in the Goliath sonata is a figured chorale (*Aus tiefer Noth schrei' ich zu Dir*) representing the terror and prayers of the Israelites. And thus the subjects of the other sonatas (*Saul cured by David's music*; *The Marriage of Jacob*; *Hezekiah*; *Gideon*; and *The Funeral of Jacob*) are in various quaint ways musical because ethical; though Kuhnau's conceptions are far better than his execution. In the same way Bach makes his *Capriccio* descriptive of the feelings of the anxious and sorrowing friends of the departing brother, and his utmost realism takes the form of a lively fugue, very much in Kuhnau's best style, on the themes of the postilion's coachhorn and cracking whip. Even Buxtehude's musical illustrations of the "nature and characters of the planets" are probably not the absurdities they have been hastily taken for by writers to whom their title seems nonsensical; for Buxtehude would, of course, take an astrological rather than an astronomical view of the subject, and so the planets would represent temperaments, and their motions the music of the spheres.

Nearly all the harpsichord pieces of Couperin have fantastic titles, and a few of them are descriptive music. His greater contemporary and survivor, Rameau, was an opera composer of real importance, whose harpsichord music contains much that is ingeniously descriptive. *La Poule*, with its theme inscribed "co-co-co-co-co-co-cocodai," is one of the best harpsichord pieces outside Bach, and is also one of the most minutely realistic compositions ever written. French music has always been remarkably dependent on external stimulus, and nearly all its classics are either programme music or operas. And the extent to which Rameau's jokes may be regarded as typically French is indicated by the fact that Haydn apologized for his imitation of frogs in *The Seasons*, saying that this "französische Quark" had been forced on him by a friend. But throughout the growth of the sonata style, not excepting Haydn's own early work, the tendency towards gratuitously descriptive music is very prominent; and the symphonies of Dittersdorf on the *Metamorphoses* of Ovid are excellent examples of the way in which external ideas may suggest much that is valuable to a musician who struggles with new forms, while at the same time they may serve to distract attention from points in which his designs break down. (See SYMPHONIC POEM.) Strict accuracy would forbid us to include in our survey such descriptive music as comes in operatic overtures or other pieces in which the programme is really necessitated by the conditions of the art; but the line cannot be so drawn without cutting off much that is essential. From the time of Gluck onwards there was a natural and steady growth in the descriptive powers of operatic music, which could not fail to react upon purely instrumental music; but of programme music for its own sake we may say there is no first-rate classic on a large scale before Beethoven, though Beethoven himself could no more surpass Haydn in illustrating an oratorio text (as in the magnificent opening of *The Creation*) than Haydn could surpass Handel.

Mozart's *Musikalischer Spass* is a solitary example of a special branch of descriptive music; a burlesque of incompetent performers and incompetent composers. The lifelike absurdity of the themes with their caricature of classical formulas; the inevitable processes by which the "howlers" in composition seem to arrive as by natural laws further complicated by the equally natural laws of the howlers in performance; and the unfailing atmosphere of good nature with which Mozart satirizes, among other things, his own style; all combine to make this work very interesting on paper. The effect in performance is astonishing; so exactly, or rather so ideally, is the squalid effect of bad structure and performance kept at a constant level of comic interest. (In the Leipzig edition of the parts of this work the modern editor has added a new and worthy act to Mozart's glorious farce by correcting and questioning many of the mistakes!) Mozart's burlesque has remained unapproached, even in dramatic music. Compared with it, Wagner's portrait of Beckmesser in *Die Meistersinger* seems embittered in conception and disappointing in comic effect. Mendelssohn is said to have had a splendid faculty for extemporizing similar musical jokes. His Funeral March of Pyramus and Thisbe in the *Midsummer Night's Dream*, and Cornelius's operatic trio in which three persons conjugate the verb *Ich sterbe den Tod des Verräters*, are among the few examples of a burlesque in which there is enough musical sense to keep the joke alive. Such burlesques have their bearing on programme music, in so far as they involve the musical portrayal of character and give opportunity for masterly studies of the psychology of failure. Their special resources thus play a large part in the recent development of the symphonic poem by Richard Strauss, whose instrumental works avowedly illustrate his cheerfully pessimistic views on art and life. But into the main classics of programme music this kind of characterization hardly enters at all.

Beethoven was three times moved to ascribe some of his profoundest music to an external source. In the first instance, that of the *Eroica Symphony*, he did not really produce anything that can fairly be called programme music. Napoleon, before he became emperor, was his ideal hero; and a triumphant symphony, on a gigantic scale and covering the widest range of emotion expressible by music, seemed to him a tribute due to the liberator of Europe; until the liberator became the tyrant. That the slow movement should be a funeral march was, in relation to the heroic tone of the work, as natural as that a symphony should have a slow movement at all. There is no reason in music why the idea of heroic death and mourning should be the end of the representation of heroic ideals. Hence it is unnecessary, though plausible, to hear, in the lively whispering opening of the scherzo, the babel of the fickle crowd that soon forgets its hero; and the criticism which regards the finale as "an inappropriate concession to sonata form" may be dismissed as merely unmusical without therefore being literary. Beethoven's next work inspired from without was the *Pastoral Symphony:* and there he records his theory of programme music on the title-page, by calling it "rather the expression of feeling than tone-painting." There is not a bar of the *Pastoral Symphony* that would be otherwise if its "programme" had never been thought of either by Beethoven or by earlier composers. The nightingale, cuckoo and quail have exactly the same function in the coda of the slow movement as dozens of similar non-thematic episodes at the close of other slow movements (*e.g.* in the violin sonata Op. 24, and the pianoforte sonata in D minor). The "merry meeting of country folk" is a subject that lends itself admirably to Beethoven's form of *scherzo* (*q.v.*); and the thunderstorm, which interrupts the last repetition of this scherzo, and forms an introduction to the finale, is none the less purely musical for being, like several of Beethoven's inventions, without any formal parallel in other works. Beethoven's *Battle Symphony* is a clever pot-boiler, which, like most musical representations of such noisy things as battles, may be disregarded in the study of serious programme music. His third great example is the sonata *Les Adieux, l'absence et le retour.* Here, again, we have a monument of pure sonata form; and, whatever light may be thrown upon the musical interpretation of the work by a knowledge of the relation between Beethoven and his friend and patron the Archduke Rudolph and the circumstances of the archduke's departure from Vienna during the Napoleonic wars, far more light may be thrown upon Beethoven's feelings by the study of the music in itself. This ought obviously to be true of all successful programme music; the music ought to illustrate the programme, but we ought not to need to learn or guess at quantities of extraneous information in order to understand the music. No doubt much ingenuity may be spent in tracing external details (the end of the first movement of *Les Adieux* has been compared to the departure of a coach), but the real emotional basis is of a universal and musical kind. The same observations apply to the overtures to *Coriolan*, *Egmont* and *Leonora*; works in which the origin as music for the stage is so far from distracting Beethoven's attention from musical form that the overture which was at first most inseparably associated with the stage and most irregular in form (*Leonora* No. 2) took final shape as the most gigantic formal design ever embodied in a single movement (*Leonora* No. 3), and so proved to be too large for the final version of the opera for which it was first conceived. Beethoven's numerous recorded assertions, whether as to the "picture" he had in his mind whenever he composed, or as to the "meaning" of any particular composition, are not things on which it is safe to rely. Many of his friends, especially his first biographer, Schindler, irritated him into putting them off with any nonsense that came into his head. Composers who have much to express cannot spare time for expressing it in other terms than those of their own art.

Modern programme music shows many divergent tendencies, the least significant of which is the common habit of giving fantastic titles to pieces of instrumental music after they have been composed, as was the case with many of Schumann's pianoforte lyrics. Such a habit may conduce to the immediate popularity of the works, though it is apt to impose on their interpretation limits which might not quite satisfy the composer himself. But there is plenty of genuine programme music in Schumann's case, though, as with Beethoven, the musical sense throws far more light on the programme than the programme throws upon the music. Musical people may profitably study E. T. A. Hoffmann and Jean Paul Richter in the light of Schumann's *Novellettes* and *Kreisleriana*; but if they do not already understand Schumann's music, Jean Paul and Hoffmann will help them only to talk about it. The popular love of fantastic titles for music affected even the most abstract and academic composers during the romantic period. No one wrote more programme music than Spohr; and, strange to say, while Spohr's programme constantly interfered with the externals of his form and ruined the latter part of his symphony *Die Weihe der Töne*, it did not in any way help to broaden his style. Mendelssohn's *Scotch* and *Italian* symphonies, and his *Hebrides Overture*, are cases rather of what may be called local colour than of programme music. His *Reformation Symphony*, which he himself regarded as a failure, and which was not published until after his death, is a composite production, artistically more successful, though less popular, than Spohr's *Weihe der Töne*. The overture to the *Midsummer Night's Dream* is a marvellous musical epitome of Shakespeare's play; and the one point which invites criticism, namely, the comparative slightness and conventionality of its second subject, may be defended as closely corresponding with Shakespeare's equally defensible treatment of the two pairs of lovers.

The one composer of the mid-nineteenth century who really lived on programme music was Berlioz, but he shows a characteristic inability to make up his mind as to what he is doing at any given moment. Externals appeal to him with such overwhelming force that, with all the genuine power of his rhetoric, he often loses grasp of the situation he thinks he is portraying. The moonshine and the sentiment of the *Scène d'amour*, in his *Romeo and Juliet* symphony, is charming; and the agitated sighing episodes which occasionally interrupt its flow, though not musically convincing, are dramatically plain enough to anyone who has once read the balcony scene: but when Berlioz thinks of the nurse knocking or calling at the door his mind is so possessed with the mere incident of the moment that he makes a realistic noise without interrupting the amorous duet. No idea of the emotional tension of the two lovers, of Juliet's artifices for gaining time, and of her agitation at the interruptions of the nurse, seems here to enter into Berlioz's head. Again, if the whole thing is to be expressed in instrumental music, why do we have, before the scene begins, *real* voices of persons in various degrees of conviviality returning home from the ball? The whole design is notoriously full of similar incongruities, of which these are the more significant for being the most plausible. There is hardly a single work of Berlioz, except the *Harold* symphony and the *Symphonie fantastique*, in which the determination to write programme music does not frequently yield to the impulse to make singers get up and explain in words what it is all about. The climax of absurdity is in the *Symphonie funèbre et triomphale*, written for the inauguration of the Bastille Column, and scored for an enormous military band and chorus. The first movement is a funeral march, and is not only one of Berlioz's finest pieces, but probably the greatest work ever written for a military band. The *Apothéose* chorus is in the form of a triumphal march. Because the occasion was one on which there would be plenty of real speeches, Berlioz must needs write a connecting link called *Oraison funèbre*, consisting of a sermon delivered by a solo trombone; presumably for use in later performances. His naïve Gasconade genius prefers this to the use of the chorus!

Current modern criticism demands plausibility, though it cares little for intellectual soundness: and while practically the whole of Liszt's work is professedly programme music (where it is not actually vocal) and, though there is much in it which is incomplete without external explanation, Liszt is far too "modern" to betray himself into obvious confusion between different planes of musical realism. With all his unreality of style, Liszt's symphonic poems are remarkable steps towards the attainment of a kind of instrumental music which, whether its form is dictated by a programme or not, is at any rate not that of the classical symphony. The programmes of Liszt's works have not always, perhaps not often, produced a living musical form; a form, that is, in which the rhythms and proportions are neither stiff nor nebulous. Both in breadth of design and in organization and flow, the works of Richard Strauss are as great an advance on Liszt as they are more complex in musical, realistic and autobiographical content. Being, with the exception of the latest French orchestral developments, incomparably the most important works illustrating the present state of musical transition, they have given rise to endless discussions as to the legitimacy of programme music. Such discussions are mere windmill-tilting unless it is constantly borne in mind that no artist who has anything of his own to say will ever be prevented from saying it, in the best art-forms attainable in his day, by any scruples as to whether the antecedents of his art-forms are legitimate or not. There is only one thing that is artistically legitimate, and that is a perfect work of art. And the only thing demonstrably prejudicial to such legitimacy in a piece of programme music is that even the most cultured of musicians generally understand music better than they understand anything else, while the greatest musicians know more of their art than is dreamt of in general culture. (D. F. T.)

PROHIBITION (Lat. *prohibere*, to prevent), a term meaning the action of forbidding or preventing by an order, decree, &c. The word is particularly applied to the forbidding by law of the sale and manufacture of intoxicating liquors (see LIQUOR LAWS and TEMPERANCE). In law, as defined by Blackstone, prohibition is "a writ directed to the judge and parties of a suit in any inferior court, commanding them to cease from the prosecution thereof, upon a surmise either that the cause originally or some collateral matter arising therein does not belong to that jurisdiction, but to the cognizance of some other court." A writ of prohibition is a prerogative writ—that is to say, it does not issue as of course, but is granted only on proper grounds being shown. Before the Judicature Acts prohibition was granted by one of the superior courts at Westminster; it also issued in certain cases from the court of chancery. It is now granted by the High Court of Justice. Up to 1875 the high court of admiralty was for the purposes of prohibition an inferior court. But now by the Judicature Act 1873, s. 24, it is provided that no proceeding in the High Court of Justice or the court of appeal is to be restrained by prohibition, a stay of proceedings taking its place where necessary. The admiralty division being now one of the divisions of the High Court can therefore no longer be restrained by prohibition. The courts to which it has most frequently issued are the ecclesiastical courts, and county and other local courts, such as the lord mayor's court of London, the court of passage of the city of Liverpool and the court of record of the hundred of Salford. In the case of courts of quarter sessions, the same result is generally obtained by *certiorari* (see WRIT). The extent to which the ecclesiastical courts were restrainable by prohibition led to continual disputes for centuries between the civil and the ecclesiastical authorities. Attempts were made at different times to define the scope of the writ, the most conspicuous instances being the statute *Circumspecte Agatis*, 13 Edw. I. st. 4; the *Articuli cleri*, 9 Edw. II. st. 1; and the later *Articuli cleri* of 3 Jac. I., consisting of the claims asserted by Archbishop Bancroft and the reply of the judges. The law seems to be undoubted that the spiritual court acting in spiritual matters *pro salute animae* cannot be restrained. The difficulties arise in the application of the principle to individual cases.

Prohibition lies either before or after judgment. In order that proceedings should be restrained after judgment it is necessary that want of jurisdiction in the inferior court should appear upon the face of the proceedings, that the party seeking the prohibition should have taken his objection in the inferior court, or that he was in ignorance of a material fact. A prohibition goes either for excess of jurisdiction, as if an ecclesiastical court were to try a claim by prescription to a pew, or for transgression of clear laws of procedure, as if such a court were to require two witnesses to prove a payment of tithes. It will not as a rule be awarded on a matter of practice. The remedy in such a case is appeal. Nor will it go, unless in exceptional cases, at the instance of a stranger to the suit. The procedure in prohibition is partly common law, partly statutory. Application for a prohibition is usually made *ex parte* to a judge in chambers on affidavit. The application may be granted or refused. If granted, a rule to show cause why a writ of prohibition should not issue goes to the inferior judge and the other party. In prohibition to courts other than county courts pleadings in prohibition may be ordered. These pleadings are as far as possible assimilated to pleadings in actions. They are rare in practice, and are only ordered in cases of great difficulty and importance.

Much learning on the subject of prohibition will be found in the opinion of Mr Justice Wills delivered to the House of Lords in *The Mayor and Aldermen of London* v. *Cox* (1867, L.R. 2 Eng. and Ir. Appeals, 239).

In Scots law prohibition is not used in the English sense. The same result is obtained by suspension or reduction. In the United States the Supreme Court has power to issue a prohibition to the district courts when proceeding as courts of admiralty and maritime jurisdiction. Most of the states have also their own law upon the subject, generally giving power to the supreme judicial authority in the state to prohibit courts of inferior jurisdiction.

PROJECTION, in mathematics. If from a fixed point S in space lines or rays be drawn to different points A, B, C, . . . in space, and if these rays are cut by a plane in points A′, B′, C′, . . . the latter are called the projections of the given points on the plane. Instead of the plane another surface may be taken, and then the points are projected to that surface instead of to a plane. In this manner any figure, plane or in space of three dimensions, may be projected to any surface from any point which is called the centre of projection. If the figure projected is in three dimensions then this projection is the same as that used in what is generally known as *perspective* (*q.v.*).

In modern mathematics the word *projection* is often taken with a slightly different meaning, supposing that plane figures are projected into plane figures, but three-dimensional ones into three-dimensional figures. Projection in this sense, when treated by co-ordinate geometry, leads in its algebraical aspect to the theory of linear substitution and hence to the theory of invariants and co-variants (see ALGEBRAIC FORMS).

In this article projection will be treated from a purely geometrical point of view. References like (G. § 87) relate to the article GEOMETRY, § *Projective*, in vol. xi.

§ 1. *Projection of Plane Figures.*—Let us suppose we have in space two planes π and π'. In the plane π a figure is given having known properties; then we have the problem to find its projection from some centre S to the plane π', and to deduce from the known properties of the given figure the properties of the new one.

If a point A is given in the plane π we have to join it to the centre S and find the point A′ where this ray SA cuts the plane π'; it is the projection of A. On the other hand if A′ is given in the plane π', then A will be its projection in π. Hence *if one figure in π' is the projection of another in π, then conversely the latter is also the projection of the former.*

A point and its projection are therefore also called corresponding points, and similarly we speak of corresponding lines and curves, &c.

§ 2. We at once get the following properties:—

The projection of a point is a point, and one point only.

The projection of a line (*straight line*) *is a line*; for all points in a line are projected by rays which lie in the plane determined by S and the line, and this plane cuts the plane π' in a line which is the projection of the given line.

If a point lies in a line its projection lies in the projection of the line.

The projection of the line joining two points A, B *is the line which joins the projections* A′, B′ *of the points* A, B. For the projecting plane of the line AB contains the rays SA, SB which project the points A, B.

The projection of the point of intersection of two lines a, b is the point of intersection of the projections a', b' of those lines.

Similarly we get—

The projection of a curve is a curve.

The projections of the points of intersection of two curves are the points of intersection of the projections of the given curves.

If a line cuts a curve in n points, then the projection of the line cuts the projection of the curve in n points. Or—

The order of a curve remains unaltered by projection.

The projection of a tangent to a curve is a tangent to the projection of the curve. For the tangent is a line which has two coincident points in common with a curve.

The number of tangents that can be drawn from a point to a curve remains unaltered by projection. Or—

The class of a curve remains unaltered by projection.

§ 3. Two figures of which one is a projection of the other obtained in the manner described may be moved out of the position in which they are obtained. They are then still said to be one the projection of the other, or to be projective or homographic. But when they are in the position originally considered they are said to be in *perspective position*, or (shorter) to be *perspective*.

All the properties stated in §§ 1, 2 hold for figures which are projective, whether they are perspective or not. There are others which hold only for projective figures when they are in perspective position, which we shall now consider.

If two planes π and π' are perspective, then their line of intersection is called the *axis of projection*. Any point in this line coincides with its projection. Hence—

All points in the axis are their own projections. Hence also—

Every line meets its projection on the axis.

§ 4. The property that the lines joining corresponding points all pass through a common point, that any pair of corresponding points and the centre are in a line, is also expressed by saying that the figures are co-linear or co-polar; and the fact that both figures have a line, the axis, in common on which corresponding lines meet is expressed by saying that the figures are co-axal.

The connexion between these properties has to be investigated.

For this purpose we consider in the plane π a triangle ABC, and let the lines BC, CA, AB be denoted by a, b, c. The projection will consist of three points A′, B′, C′ and three lines a', b', c'. These have such a position that the lines AA′, BB′, CC′ meet in a point, viz. at S, and the points of intersection of a and a', b and b', c and c' lie on the axis (by § 2). The two triangles therefore are said to be both co-linear and co-axal. Of these properties either is a consequence of the other, as will now be proved.

If two triangles, whether in the same plane or not, are co-linear they are co-axal. Or—

If the lines AA′, BB′, CC′ *joining the vertices of two triangles meet in a point, then the intersections of the sides* BC *and* B′C′, CA *and* C′A′, AB *and* A′B′ *are three points in a line.* Conversely—

If two triangles are co-axal they are co-linear. Or—

If the intersection of the sides of two triangles ABC *and* A′B′C′, *viz. of* BC *and* B′C′, *of* CA *and* C′A′, *and of* AB *and* A′B′, *lie in a line, then the lines* AA′, BB′, *and* CC′ *meet in a point.*

Proof.—Let us first suppose the triangles to be in different places. By supposition the lines AA′, BB′, CC′ (fig. 1) meet in a point S. But three intersecting lines determine three planes, SCB, SCA and SAB. In the first lie the points B, C and also B′, C′. Hence the lines BC and B′C′ will intersect at some point P, because any two lines in the same plane intersect. Similarly CA and C′A′ will intersect at some point Q, and AB and A′B′ at some point R. These points P, Q, R lie in the plane of the triangle ABC because they are points on the sides of this triangle, and similarly in the plane of the triangle A′B′C′. Hence they lie in the intersection of two planes—that is, in a line. This line (PQR in fig. 1) is called the axis of perspective or homology, and the intersection of AA′, BB′, CC′, *i.e.* S in the figure, the centre of perspective.

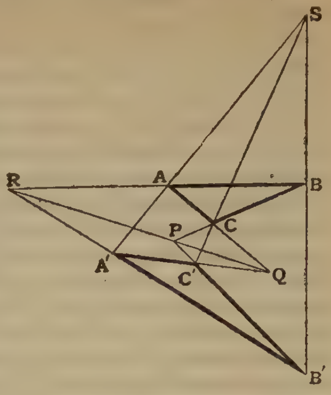

FIG. 1.

Secondly, if the triangles ABC and A′B′C′ lie both in the same plane the above proof does not hold. In this case we may consider the plane figure as the projection of the figure in space of which we have just proved the theorem. Let ABC, A′B′C′ be the co-linear triangles with S as centre, so that AA′, BB′, CC′ meet at S. Take now any point in space, say your eye E, and from it draw the rays projecting the figure. In the line ES take any point S_1, and in EA, EB, EC take points A_1, B_1, C_1 respectively, but so that S_1, A_1, B_1, C_1 are not in a plane. In the plane ESA which projects the line S_1A_1 lie then the line S_1A_1 and also EA′; these will therefore meet in a point A_1', of which A′ will be the projection. Similarly points B_1', C_1' are found. Hence we have now in space two triangles $A_1B_1C_1$ and $A_1'B_1'C_1'$ which are co-linear. They are therefore co-axal, that is, the points P_1, Q_1, R_1, where A_1B_1, &c., meet will lie in a line. Their projections therefore lie in a line. But these are the points P, Q, R, which were to be proved to lie in a line.

This proves the first part of the theorem. The second part or converse theorem is proved in exactly the same way. For another proof see (G. § 37).

§ 5. By aid of this theorem we can now prove a fundamental property of two projective planes.

Let s be the axis, S the centre, and let A, A′ and B, B′ be two pairs of corresponding points which we suppose fixed, and C, C′ any other pair of corresponding points. Then the triangles ABC and A′B′C′ are co-axal, and they will remain co-axal if the one plane π' be turned relative to the other about the axis. They will therefore, by Desargue's theorem, remain co-linear, and the centre will be the point S′, where AA′ meets BB′. Hence the line joining any pair of corresponding points C, C′ will pass through the centre S′. The figures are therefore perspective. This will remain true if the planes are turned till they coincide, because Desargue's theorem remains true.

If two planes are perspective, then if the one plane be turned about the axis through any angle, especially if the one plane be turned till it coincides with the other, the two planes will remain perspective; corresponding lines will still meet on a line called the axis, and the lines joining corresponding points will still pass through a common centre S *situated in the plane.*

Whilst the one plane is turned this point S *will move in a circle whose centre lies in the plane π, which is kept fixed, and whose plane is perpendicular to the axis.*

The last part will be proved presently. As the plane π' may be turned about the axis in one or the opposite sense, there will be two perspective positions possible when the planes coincide.

§ 6. Let (fig. 2) π, π' be the planes intersecting in the axis s whilst S is the centre of projection. To project a point A in π we join A to S and see where this line cuts π'. This gives the point A′. But if we draw through S any line parallel to π, then this line will cut π' in some point I′, and if all lines through S be drawn which are parallel to π these will form a plane parallel to π which will cut the plane π' in a line i' parallel to the axis s. If we say that a line parallel to a plane cuts the latter at an infinite distance, we may say that all points at an infinite distance in π are projected into points which lie in a straight line i', and conversely all points in the line are projected to an infinite distance in π, whilst all other points are projected to finite points. We say therefore that all points in the plane π at an infinite distance may be considered as lying in a straight line, because their projections lie in a line. Thus we are again led to consider points at infinity in a plane as lying in a line (cf. G. §§ 2–4).

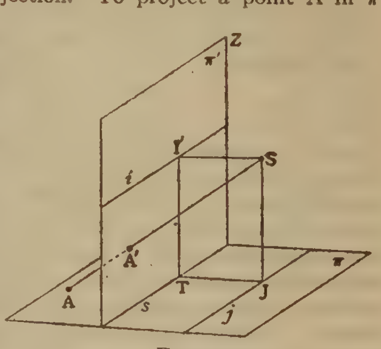

FIG. 2.

Similarly there is a line j in π which is projected to infinity in π'; this projection will be denoted by j' so that i and j' are lines at infinity.

§ 7. If we suppose through S a plane drawn perpendicular to the axis s cutting it at T, and in this plane the two lines SI′ parallel to π and SJ parallel to π'; then the lines through I′ and J parallel to the axis will be the lines i' and j. At the same time a parallelogram SJTI′S has been formed. If now the plane π' be turned about the axis, then the points I′ and J will not move in their planes; hence the lengths TJ and TI′, and therefore also SI′ and SJ, will not change. If the plane π is kept fixed in space the point J will remain fixed, and S describes a circle about J as centre and with SJ as radius. This proves the last part of the theorem in § 5.

§ 8. The plane π' may be turned either in the sense indicated by the arrow at Z or in the opposite sense till π' falls into π. In the first case we get a figure like fig. 3; i' and j will be on the same side of the axis, and on this side will also lie the centre S; and

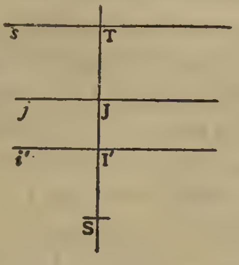

FIG. 3.

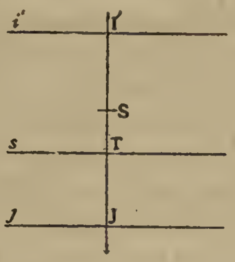

FIG. 4.

then ST = SJ + SI′ or SI′ = JT, SJ = I′T. In the second case (fig. 4) i' and j will be on opposite sides of the axis, and the centre S will lie between them in such a position that I′S = TJ and I′T = SJ. If I′S = SJ, the point S will lie on the axis.

It follows that any one of the four points S, T, J, I′ is completely determined by the other three: if the axis, the centre, and one of the lines i' or j are given the other is determined; the three lines s, i', j determine the centre; the centre and the lines i', j determine the axis.

§ 9. We shall now suppose that the two projective planes π, π' are perspective and have been made to coincide.

If the centre, the axis, and either one pair of corresponding points on a line through the centre or one pair of corresponding lines meeting on the axis are given, then the whole projection is determined.

Proof.—If A and A′ (fig. 1) are given corresponding points, it has to be shown that we can find to every other point B the corresponding point B′. Join AB to cut the axis in R. Join RA′; then B′ must lie on this line. But it must also lie on the line SB. Where both meet is B′. That the figures thus obtained are really projective can be seen by aid of the theorem of § 4. For, if for any point C the corresponding point C′ be found, then the triangles ABC and A′B′C′ are, by construction, co-linear, hence co-axal; and s will be the axis, because AB and AC meet their corresponding lines A′B′ and A′C′ on it. BC and B′C′ therefore also meet on s.

If on the other hand a, a' are given corresponding lines, then any line through S will cut them in corresponding points A, A′ which may be used as above.

§ 10. Rows and pencils which are projective or perspective have been considered in the article GEOMETRY (G. §§ 12–40). All that has been said there holds, of course, here for any pair of corresponding rows or pencils. The centre of perspective for any pair of corresponding rows is at the centre of projection S, whilst the axis contains coincident corresponding elements. Corresponding pencils on the other hand have their axis of perspective on the axis of projection whilst the coincident rays pass through the centre.

We mention here a few of those properties which are independent of the perspective position:—

The correspondence between two projective rows or pencils is completely determined if to three elements in one the corresponding ones in the other are given. If for instance in two projective rows three pairs of corresponding points are given, then we can find to every other point in either the corresponding point (G. §§ 29–36).

If A, B, C, D *are four points in a row and* A′, B′, C′, D′ *the corresponding points, then their cross-ratios are equal* (AB, CD) = (A′B′, C′D′)—where (AB, CD) = AC/CB : AD/DB.

If in particular the point D be at infinity we have (AB, CD) = −AC/CB = AC/BC. If therefore the points D and D′ are both at infinity we have AC/BC = AD/BD, and the rows are similar (G. § 39). This can only happen in special cases. For the line joining corresponding points passes through the centre; the latter must therefore lie at infinity if D, D′ are different points at infinity. But if D and D′ coincide they must lie on the axis, that is, at the point at infinity of the axis unless the axis is altogether at infinity. Hence—

In two perspective planes every row which is parallel to the axis is similar to its corresponding row, and in general no other row has this property.

But if the centre or the axis is at infinity then every row is similar to its corresponding row.

In either of these two cases the metrical properties are particularly simple. If the axis is at infinity the ratio of similitude is the same for all rows and the figures are similar. If the centre is at infinity we get parallel projection; and the ratio of similitude changes from row to row (see §§ 16, 17).

In both cases the mid-points of corresponding segments will be corresponding points.

§ 11. *Involution.*—If the planes of two projective figures coincide, then every point in their common plane has to be counted twice, once as a point A in the figure π, once as a point B′ in the figure π'. The points A′ and B corresponding to them will in general be different points; but it may happen that they coincide. Here a theorem holds similar to that about rows (G. §§ 76 seq.).

If two projective planes coincide, and if to one point in their common plane the same point corresponds, whether we consider the point as belonging to the first or to the second plane, then the same will happen for every other point—that is to say, to every point will correspond the same point in the first as in the second plane.

In this case the figures are said to be in *involution.*

Proof.—Let (fig. 5) S be the centre, s the axis of projection, and let a point denoted by A in the first plane and by B′ in the second have the property that the points A′ and B corresponding to them again coincide. Let C and D′ be the names which some other point has in the two planes. If the line AC cuts the axis in X, then the point where the line XA′ cuts SC will be the point C′ corresponding to C (§ 9). The line B′D′ also cuts the axis in X, and therefore the point D corresponding to D′ is the point where XB cuts SD′. But this is the same point as C′. This point C′ might also be got by drawing CB and joining its intersection Y with the axis to B′. Then C′ must be the point where B′Y meets SC. This figure, which now forms a complete quadrilateral, shows that in order to get involution the corresponding points A and A′ have to be harmonic conjugates with regard to S and the point T where AA′ cuts the axis.

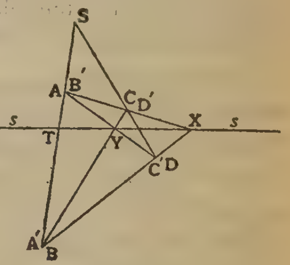

FIG. 5.

If two perspective figures be in involution, two corresponding points are harmonic conjugates with regard to the centre and the point where the line joining them cuts the axis. Similarly—

Any two corresponding lines are harmonic conjugates with regard to the axis and the line from their point of intersection to the centre. Conversely—

If in two perspective planes one pair of corresponding points be harmonic conjugates with regard to the centre and the point where the line joining them cuts the axis, then every pair of corresponding points has this property and the planes are in involution.

§ 12. *Projective Planes which are not in perspective position.*—We return to the case that two planes π and π' are projective but not in perspective position, and state in some of the more important cases the conditions which determine the correspondence between them. Here it is of great advantage to start with another definition which, though at first it may seem to be of far greater generality, is in reality equivalent to the one given before.

We call two planes projective if to every point in one corresponds a point in the other, to every line a line, and to a point in a line a point in the corresponding line, in such a manner that the cross-ratio of four points in a line, or of four rays in a pencil, is equal to the cross-ratio of the corresponding points or rays.

The last part about the equality of cross-ratios can be proved to be a consequence of the first. As space does not allow us to give an exact proof for this we include it in the definition.

If one plane is actually projected to another we get a correspondence which has the properties required in the new definition. This shows that a correspondence between two planes conform to this definition is possible. That it is also definite we have to show. It follows at once that—

Corresponding rows, and likewise corresponding pencils, are projective in the old sense (G. §§ 25, 30). Further—

If two planes are projective to a third they are projective to each other.

The correspondence between two projective planes π and π' is determined if we have given either two rows u, v in π and the corresponding rows u', v' in π', the point where u and v meet corresponding to the points where u' and v' meet, or two pencils U, V *in π and the corresponding pencils* U′, V′ *in π', the ray* UV *joining the centres of the pencils in π corresponding to the ray* U′V′.

It is sufficient to prove the first part. Let any line a cut u, v in the points A and B. To these will correspond points A′ and B′ in u' and v' which are known. To the line a corresponds then the line A′B′. Thus to every line in the one plane the corresponding line in the other can be found, hence also to every point the corresponding point.

§ 13. *If the planes of two projective figures coincide, and if either four points, of which no three lie in a line, or else four lines, of which no three pass through a point, in the one coincide with their corresponding points, or lines, in the other, then every point and every line coincides with its corresponding point or line so that the figures are identical.*

If the four points A, B, C, D coincide with their corresponding points, then every line joining two of these points will coincide with its corresponding line. Thus the lines AB and CD, and therefore also their point of intersection E, will coincide with their corresponding elements. The row AB has thus three points A, B, E coincident with their corresponding points, and is therefore identical with it (§ 10). As there are six lines which join two and two of the four points A, B, C, D, there are six lines such that each point in either coincides with its corresponding point. Every other line will thus have the six points in which it cuts these, and therefore all points, coincident with their corresponding points. The proof of the second part is exactly the same. It follows—

§ 14. *If two projective figures, which are not identical, lie in the same plane, then not more than three points which are not in a line, or three lines which do not pass through a point, can be coincident with their corresponding points or lines.*

If the figures are in perspective position, then they have in common one line, the axis, with all points in it, and one point, the centre, with all lines through it. No other point or line can therefore coincide with its corresponding point or line without the figures becoming identical.

It follows also that—

The correspondence between two projective planes is completely determined if there are given—either to four points in the one the corresponding four points in the other provided that no three of them lie in a line, or to any four lines the corresponding lines provided that no three of them pass through a point.

To show this we observe first that two planes π, π' may be made projective in such a manner that four given points A, B, C, D in the one correspond to four given points A', B', C', D' in the other; for to the lines AB, CD will correspond the lines $A'B'$ and $C'D'$, and to the intersection E of the former the point E' where the latter meet. The correspondence between these rows is therefore determined, as we know three pairs of corresponding points. But this determines a correspondence (by § 12). To prove that in this case and also in the case of § 12 there is but one correspondence possible, let us suppose there were two, or that we could have in the plane π' two figures which are each projective to the figure in π and which have each the points $A'B'C'D'$ corresponding to the points ABCD in π. Then these two figures will themselves be projective and have four corresponding points coincident. They are therefore identical by § 13.

Two projective planes will be in perspective if one row coincides with its corresponding row. The line containing these rows will be the axis of projection.

As in this case every point on s coincides with its corresponding point, it follows that every row a meets its corresponding row a' on s where corresponding points are united. The two rows a, a' are therefore perspective (G. § 30), and the lines joining corresponding points will meet in a point S. If r be any one of these lines cutting a, a' in the points A and A' and the line s at K, then to the line AK corresponds $A'K$, or the ray r corresponds to itself. The points B, B' in which r cuts another pair b, b' of corresponding rows must therefore be corresponding points. Hence the lines joining corresponding points in b and b' also pass through S. Similarly all lines joining corresponding points in the two planes π and π' meet in S; hence the planes are perspective.

The following proposition is proved in a similar way:—

Two projective planes will be in perspective position if one pencil coincides with its corresponding one. The centre of these pencils will be the centre of perspective.

In this case the two planes must of course coincide, whilst in the first case this is not necessary.

§ 15. We shall now show that two planes which are projective according to definition (§ 12) can be brought into perspective position, hence that the new definition is really equivalent to the old. We use the following property: If two coincident planes π and π' are perspective with S as centre, then any two corresponding rows are also perspective with S as centre. This therefore is true for the row j and j' and for i and i', of which i and j' are the lines at infinity in the two planes. If now the plane π' be made to slide on π so that each line moves parallel to itself, then the point at infinity in each line, and hence the whole line at infinity in π', remains fixed. So does the point at infinity on j, which thus remains coincident with its corresponding point on j', and therefore the rows j and j' remain perspective, that is to say the rays joining corresponding points in them meet at some point T. Similarly the lines joining corresponding points in i and i' will meet in some point T'. These two points T and T' originally coincided with each other and with S.

Conversely, if two projective planes are placed one on the other, then as soon as the lines j and i' are parallel the two points T and T' can be found by joining corresponding points in j and j', and also in i and i'. If now a point at infinity is called A as a point in π and B' as a point in π', then the point A' will lie on i' and B on j, so that the line AA' passes through T' and BB' through T. These two lines are parallel. If then the plane π' be moved parallel to itself till T' comes to T, then these two lines will coincide with each other, and with them will coincide the lines AB and $A'B'$. This line and similarly every line through T will thus now coincide with its corresponding line. The two planes are therefore according to the last theorem in § 14 in perspective position.

It will be noticed that the plane π' may be placed on π in two different ways, viz. if we have placed π' on π we may take it off and turn it over in space before we bring it back to π, so that what was its upper becomes now its lower face. For each of these positions we get one pair of centres T, T', and only one pair, because the above process must give every perspective position. It follows—

In two projective planes there are in general two and only two pencils in either such that angles in one are equal to their corresponding angles in the other. If one of these pencils is made coincident with its corresponding one, then the planes will be perspective.

This agrees with the fact that two perspective planes in space can be made coincident by turning one about their axis in two different ways (§ 8).

In the reasoning employed it is essential that the lines j and i' are finite. If one lies at infinity, say j, then i and j coincide, hence their corresponding lines i' and j' will coincide; that is, i' also lies at infinity, so that the lines at infinity in the two planes are corresponding lines. If the planes are now made coincident and perspective, then it may happen that the lines at infinity correspond point for point, or can be made to do so by turning the one plane in itself. In this case the line at infinity is the axis, whilst the centre may be a finite point. This gives similar figures (see § 16). In the other case the line at infinity corresponds to itself without being the axis; the lines joining corresponding points therefore all coincide with it, and the centre S lies on it at infinity. The axis will be some finite line. This gives parallel projection (see § 17). For want of space we do not show how to find in these cases the perspective position, but only remark that in the first case any pair of corresponding points in π and π' may be taken as the points T and T', whilst in the other case there is a pencil of parallels in π such that any one line of these can be made to coincide point for point with its corresponding line in π', and thus serve as the axis of projection. It will therefore be possible to get the planes in perspective position by first placing any point A' on its corresponding point A and then turning π' about this point till lines joining corresponding points are parallel.

§ 16. *Similar Figures.*—If the axis is at infinity every line is parallel to its corresponding line. Corresponding angles are therefore equal. The figures are similar, and (§ 10) the ratio of similitude of any two corresponding rows is constant.

If similar figures are in perspective position they are said to be similarly situated, and the centre of projection is called the centre of similitude. To place two similar figures in this position, we observe that their lines at infinity will coincide as soon as both figures are put in the same plane, but the rows on them are not necessarily identical. They are projective, and hence in general not more than two points on one will coincide with their corresponding points in the other (G. § 34). To make them identical it is either sufficient to turn one figure in its plane till three lines in one are parallel to their corresponding lines in the other, or it is necessary before this can be done to turn the one plane over in space. It can be shown that in the former case all lines are, or no line is, parallel to its corresponding line, whilst in the second case there are two directions, at right angles to each other, which have the property that each line in either direction is parallel to its corresponding line. We also see that—

If in two similar figures three lines, of which no two are parallel, are parallel respectively to their corresponding lines, then every line has this property and the two figures are similarly situated; or

Two similar figures are similarly situated as soon as two corresponding triangles are so situated.

If two similar figures are perspective without being in the same plane, their planes must be parallel as the axis is at infinity. Hence—

Any plane figure is projected from any centre to a parallel plane into a similar figure.

If two similar figures are similarly situated, then corresponding points may either be on the same or on different sides of the centre. If, besides, the ratio of similitude is unity, then corresponding points will be equidistant from the centre. In the first case therefore the two figures will be identical. In the second case they will be identically equal but not coincident. They can be made to coincide by turning one in its plane through two right angles about the centre of similitude S. The figures are in involution, as is seen at once, and they are said to be *symmetrical with regard to the point* S *as centre*. If the two figures be considered as part of one, then this is said to have a centre. Thus regular polygons of an even number of sides and parallelograms have each a centre, which is a centre of symmetry.

§ 17. *Parallel Projection.*—If, instead of the axis, the centre be moved to infinity, all the projecting rays will be parallel, and we get what is called *parallel projection*. In this case the line at infinity passes through the centre and therefore corresponds to itself—but not point for point as in the case of similar figures. To any point I at infinity corresponds therefore a point I' also at infinity but different from the first. Hence to parallel lines meeting at I correspond parallel lines of another direction meeting at I'. Further, in any two corresponding rows the two points at infinity are corresponding points; hence the rows are similar. This gives the principal properties of parallel projection:—

To parallel lines correspond parallel lines; or

To a parallelogram corresponds a parallelogram.

The correspondence of parallel projection is completely determined as soon as for any parallelogram in the one figure the corresponding parallelogram in the other has been selected, as follows from the general case in § 14. [*Corresponding rows are similar* (§ 10).]

The ratio of similitude for these rows changes with the direction: *If a row is parallel to the axis, its corresponding row, which is also parallel to the axis, will be equal to it,* because any two pairs AA′ and BB′ of corresponding points will form a parallelogram.

Another important property is the following:—

The areas of corresponding figures have a constant ratio.

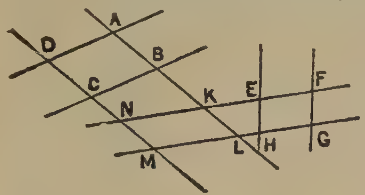

FIG. 6.

We prove this first for parallelograms. Let ABCD and EFGH be any two parallelograms in π, A′B′C′D′ and E′F′G′H′ the corresponding parallelograms in π'. Then to the parallelogram KLMN which lies (fig. 6) between the lines AB, CD and EF, GH will correspond a parallelogram K′L′M′N′ formed in exactly the same manner. As ABCD and KLMN are between the same parallels their areas are as the bases. Hence—

$$\frac{ABCD}{KLMN}=\frac{AB}{KL}, \text{ and similarly } \frac{A'B'C'D'}{K'L'M'N'}=\frac{A'B'}{K'L'}.$$

But AB/KL = A′B′/K′L′, as the rows AB and A′B′ are similar. Hence

$$\frac{ABCD}{A'B'C'D'}=\frac{KLMN}{K'L'M'N'} \text{ and similarly } \frac{EFGH}{E'F'G'H'}=\frac{KLMN}{K'L'M'N'}.$$

Hence also

$$\frac{ABCD}{A'B'C'D'}=\frac{EFGH}{E'F'G'H'}.$$

This proves the theorem for parallelograms and also for their halves, that is, for any triangles. As polygons can be divided into triangles the truth of the theorem follows at once for them, and is extended (by the method of exhaustion) to areas bounded by curves by inscribing polygons in, and circumscribing polygons about, the curves.

Just as (G. § 8) a segment of a line is given a sense, so a sense may be given to an area. This is done as follows. If we go round the boundary of an area, the latter is either to the right or to the left. If we turn round and go in the opposite sense, then the area will be to the left if it was first to the right, and vice versa. If we give the boundary a definite sense, and go round in this sense, then the *area is said to be either of the one or of the other sense according as the area is to the right or to the left.* The area is generally said to be positive if it is to the left. The sense of the boundary is indicated either by an arrowhead or by the order of the letters which denote points in the boundary. Thus, if A, B, C be the vertices of a triangle, then ABC shall denote the area in magnitude and sense, the sense being fixed by going round the triangle in the order from A to B to C. It will then be seen that ABC and ACB denote the same area but with opposite sense, and generally ABC = BCA = CAB = − ACB = − BAC = − CBA; that is, an interchange of two letters changes the sense. Also, if A and A′ are two points on opposite sides of, and equidistant from, the line BC, then ABC = −A′BC.

Taking account of the sense, we may make the following statement:—

If A, A′ are two corresponding points, if the line AA′ cuts the axis in B, and if C is any other point in the axis, then the triangles ABC and A′BC are corresponding, and

$$\frac{ABC}{A'BC}=\frac{AB}{A'B}=-\frac{AB}{BA'};$$

or *The constant ratio of corresponding areas is equal and opposite to the ratio in which the axis divides the segment joining two corresponding points.*

§ 18. Several special cases of parallel projection are of interest.

Orthographic Projection.—If the two planes π and π' have a definite position in space, and if a figure in π is projected to π' by rays perpendicular to this plane, then the projection is said to be orthographic. If in this case the plane π be turned till it coincides with π' so that the figures remain perspective, then *the projecting rays will be perpendicular to the axis of projection,* because any one of these rays is, and remains during the turning, perpendicular to the axis.

The constant ratio of the area of the projection to that of the original figure is, in this case, the cosine of the angle between the two planes π *and* π', as will be seen by projecting a rectangle which has its base in the axis.

Orthographic projection is of constant use in geometrical drawing.

Shear.—If the centre of projection be taken at infinity on the axis, then the projecting rays are parallel to the axis; hence corresponding points will be equidistant from the axis. In this case, therefore, *areas of corresponding figures will be equal.*

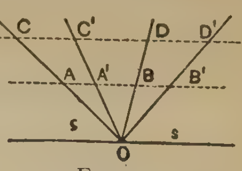

FIG. 7.

If A, A′ and B, B′ (fig. 7) are two pairs of corresponding points on the same line, parallel to the axis, then, as corresponding segments parallel to the axis are equal, it follows that AB = A′B′, hence also AA′ = BB′. If these points be joined to any point O on the axis, then AO and A′O will be corresponding lines; they will therefore be cut by any line parallel to the axis in corresponding points. In the figure therefore C, C′ and also D, D′ will be pairs of corresponding points and CC′ = DD′. As the ratio CC′/AA′ equals the ratio of the distances of C and A from the axis, therefore—

Two corresponding figures may be got one out of the other by moving all points in the one parallel to a fixed line, the axis, through distances which are proportional to their own distances from the axis. Points in a line remain hereby in a line.

Such a transformation of a plane figure is produced by a shearing stress in any section of a homogeneous elastic solid. For this reason Lord Kelvin gave it the name of shear.

A shear of a plane figure is determined if we are given the axis and the distance through which one point has been moved; for in this case the axis, the centre, and a pair of corresponding points are given.

§ 19. *Symmetry and Skew-Symmetry.*—If the centre is not on the axis, and if corresponding points are at equal distances from it, they must be on opposite sides of it. The figures will be in involution (§ 11). In this case the direction of the projecting rays is said to be *conjugate to the axis.*

The conjugate direction may be perpendicular to the axis. If the line joining two corresponding points A, A′ cuts the axis in B, then AB = BA′. Therefore, if the plane be folded over along the axis, A will fall on A′. Hence by this folding over every point will coincide with its corresponding point. The figures therefore are identically equal or congruent, and in their original position they are *symmetrical* with regard to the axis, which itself is called *an axis of symmetry.* If the two figures are considered as one this one is said to be symmetrical with regard to an axis, and is said to have an axis of symmetry or simply an axis. Every diameter of a circle is thus an axis; also the median line of an isosceles triangle and the diagonals of a rhombus are axes of the figures to which they belong.

In the more general case where the projecting rays are not perpendicular to the axis we have a kind of twisted symmetry which may be called *skew-symmetry.* It can be got from symmetry by giving the whole figure a shear. It will also be easily seen that we get skew-symmetry if we first form a shear to a given figure and then separate it from its shear by folding it over along the axis of the shear, which thereby becomes an axis of skew-symmetry.

Skew-symmetrical and therefore also symmetrical figures have the following properties:—

Corresponding areas are equal, but of opposite sense.

Any two corresponding lines are harmonic conjugates with regard to the axis and a line in the conjugate direction.

If the two figures be again considered as one whole, this is said to be skew-symmetrical and to have an axis of skew-symmetry. Thus the median line of any triangle is an axis of skew-symmetry, the side on which it stands having the conjugate direction, the other sides being conjugate lines. From this it follows, for instance, that the three median lines of a triangle meet in a point. For two median lines will be corresponding lines with regard to the third as axis, and must therefore meet on the axis.

An axis of skew-symmetry is generally called a *diameter.* Thus every diameter of a conic is an axis of skew-symmetry, the conjugate direction being the direction of the chords which it bisects.

§ 20. We state a few properties of these figures useful in mechanics, but we omit the easy proofs:—

If a plane area has an axis of skew-symmetry, then the mass-centre (centre of mean distances or centre of inertia) *lies on it.*

If a figure undergoes a shear, the mass-centre of its area remains the mass-centre; and generally—

In parallel projection the mass-centres of corresponding areas (*or of groups of points, but not of curves*) *are corresponding points.*

The moment of inertia of a plane figure does not change if the figure undergoes a shear in the direction of the axis with regard to which the moment has been taken.

If a figure has an axis of skew-symmetry, then this axis and the conjugate direction are conjugate diameters of the momental ellipse for every point in the axis.

If a figure has an axis of symmetry, then this is an axis of the momental ellipse for every point in it.

The truth of the last propositions follows at once from the fact that the product of inertia for the lines in question vanishes.

It is of interest to notice how a great many propositions of Euclid are only special cases of projection. The theorems Euc. I. 35–41 about parallelograms or triangles on equal bases and between the same parallels are examples of shear, whilst I. 43 gives a case of skew-symmetry, hence of involution. Figures which are identically equal are of course projective, and they are perspective when placed so that they have an axis or a centre of symmetry (cf. Henrici, *Elementary Geometry, Congruent Figures*). In this case again the relation is that of involution. The importance of treating similar figures when in perspective position has long been recognized; we need only mention the well-known proposition about the centres of similitude of circles.

Applications to Conics.

§ 21. *Any conic can be projected into any other conic. This may be done in such a manner that three points on one conic and the tangents at two of them are projected to three arbitrarily selected points and the tangents at two of them on the other.*

If u and u' are any two conics, then we have to prove that we can project u in such a manner that five points on it will be projected to points on u'. As the projection is determined as soon as the projections of any four points or four lines are selected, we cannot project any five points of u to any five arbitrarily selected points on u'. But if A, B, C be any three points on u, and if the tangents at B and C meet at D, if further A′, B′, C′ are any three points on u', and if the tangents at B′ and C′ meet at D′, then the plane of u may be projected to the plane of u' in such a manner that the points A, B, C, D are projected to A′, B′, C′, D′. This determines the correspondence (§ 14). The conic u will be projected into a conic, the points A, B, C and the tangents BD and CD to the points A′, B′, C′ and the lines B′D′ and C′D′, which are tangents to u' at B′ and C′. The projection of u must therefore (G. § 52) coincide with u', because it is a conic which has three points and the tangents at two of them in common with u'.

Similarly we might have taken *three tangents and the points of contact of two of them as corresponding to similar elements on the other.*

If the one conic be a circle which cuts the line j, the projection will cut the line at infinity in two points; hence it will be a hyperbola. Similarly, if the circle touches j, the projection will be a parabola; and, if the circle has no point in common with j, the projection will be an ellipse. These curves appear thus as sections of a circular cone, for in case that the two planes of projection are separated the rays projecting the circle form such a cone.

Any conic may be projected into itself.

If we take any point S in the plane of a conic as centre, the polar of this point as axis of projection, and any two points in which a line through S cuts the conic as corresponding points, then these will be harmonic conjugates with regard to the centre and the axis. We therefore have involution (§ 11), and every point is projected into its harmonic conjugate with regard to the centre and the axis—hence every point A on the conic into that point A′ on the conic in which the line SA′ cuts the conic again, as follows from the harmonic properties of pole and polar (G. § 62 seq.).

Two conics which cut the line at infinity in the same two points are similar figures and similarly situated—the centre of similitude being in general some finite point.

To prove this, we take the line at infinity and the asymptotes of one as corresponding to the line at infinity and the asymptotes of the other, and besides a tangent to the first as corresponding to a parallel tangent to the other. The line at infinity will then correspond to itself point for point; hence the figures will be similar and similarly situated.

§ 22. *Areas of Parabolic Segments.*—One parabola may always be considered as a parallel projection of another in such a manner that any two points A, B on the one correspond to any two points A′, B′ on the other; that is, the points A, B and the point at infinity on the one may be made to correspond respectively to the points A′, B′ and the point at infinity on the other, whilst the tangents at A and at infinity of the one correspond to the tangents at B′ and at infinity of the other. This completely determines the correspondence, and it is parallel projection because the line at infinity corresponds to the line at infinity. Let the tangents at A and B meet at C, and those at A′, B′ at C′; then C, C′ will correspond, and so will the triangles ABC and A′B′C′ as well as the parabolic segments cut off by the chords AB and A′B′. If (AB) denotes the area of the segment cut off by the chord AB we have therefore

$$(\mathrm{AB})/\mathrm{ABC} = (\mathrm{A'B'})/\mathrm{A'B'C'}; \text{ or}$$

The area of a segment of a parabola stands in a constant ratio to the area of the triangle formed by the chord of the segment and the tangents at the end points of the chord.

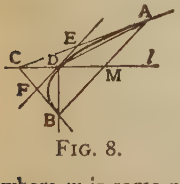

FIG. 8.

If then (fig. 8) we join the point C to the mid-point M of AB, then this line l will be bisected at D by the parabola (G. § 74), and the tangent at D will be parallel to AB. Let this tangent cut AC in E and CB in F, then by the last theorem

$$\frac{(\mathrm{AB})}{\mathrm{ABC}} = \frac{(\mathrm{AD})}{\mathrm{ADE}} = \frac{(\mathrm{BD})}{\mathrm{BFD}} = m,$$

where m is some number to be determined. The figure gives

$$(\mathrm{AB}) = \mathrm{ABD} + (\mathrm{AD}) + (\mathrm{BD}).$$

Combining both equations, we have

$$\mathrm{ABD} = m\,(\mathrm{ABC} - \mathrm{ADE} - \mathrm{BFD}).$$

But we have also $\mathrm{ABD} = \frac{1}{2}\,\mathrm{ABC}$, and $\mathrm{ADE} = \mathrm{BFD} = \frac{1}{8}\,\mathrm{ABC}$; hence

$$\tfrac{1}{2}\,\mathrm{ABC} = m\,(1 - \tfrac{1}{8} - \tfrac{1}{8})\,\mathrm{ABC}, \text{ or } m = \tfrac{2}{3}.$$

The area of a parabolic segment equals two-thirds of the area of the triangle formed by the chord and the tangents at the end points of the chord.

§ 23. *Elliptic Areas.*—To consider one ellipse a parallel projection of another we may establish the correspondence as follows. If AC, BD are any pair of conjugate diameters of the one and A′C′, B′D′ any pair of conjugate diameters of the other, then these may be made to correspond to each other, and the correspondence will be completely determined if the parallelogram formed by the tangents at A, B, C, D is made to correspond to that formed by the tangents at A′, B′, C′, D′ (§§ 17 and 21). As the projection of the first conic has the four points A′, B′, C′, D′ and the tangents at these points in common with the second, the two ellipses are projected one into the other. Their areas will correspond, and so do those of the parallelograms ABCD and A′B′C′D′. Hence—

The area of an ellipse has a constant ratio to the area of any inscribed parallelogram whose diagonals are conjugate diameters, and also to every circumscribed parallelogram whose sides are parallel to conjugate diameters.

It follows at once that—

All parallelograms inscribed in an ellipse whose diagonals are conjugate diameters are equal in area; and

All parallelograms circumscribed about an ellipse whose sides are parallel to conjugate diameters are equal in area.

If a, b are the length of the semi-axes of the ellipse, then the area of the circumscribed parallelogram will be $4ab$ and of the inscribed one $2ab$.

For the circle of radius r the inscribed parallelogram becomes the square of area $2r^2$ and the circle has the area $r^2\pi$; the constant ratio of an ellipse to the inscribed parallelogram has therefore also the value $\frac{1}{2}\pi$. Hence—

The area of an ellipse equals $ab\pi$.

§ 24. *Projective Properties.*—The properties of the projection of a figure depend partly on the relative position of the planes of the figures and the centre of projection, but principally on the properties of the given figure. Points in a line are projected into points in a line, harmonic points into harmonic points, a conic into a conic; but parallel lines are not projected into parallel lines nor right angles into right angles, neither are the projections of equal segments or angles again equal. There are then some properties which remain unaltered by projection, whilst others change. The former are called projective or descriptive, the latter metrical properties of figures, because the latter all depend on measurement.

To a triangle and its median lines correspond a triangle and three lines which meet in a point, but which as a rule are not median lines.

In this case, if we take the triangle together with the line at infinity, we get as the projection a triangle ABC, and some other line j which cuts the sides a, b, c of the triangle in the points A_1, B_1, C_1. If we now take on BC the harmonic conjugate A_2 to A_1 and similarly on CA and AB the harmonic conjugates to B_1 and C_1 respectively, then the lines AA_2, BB_2, CC_2 will be the projections of the median lines in the given figure. Hence these lines must meet in a point.

As the triangle and the fourth line we may take any four given lines, because any four lines may be projected into any four given lines (§ 14). This gives a theorem:—

If each vertex of a triangle be joined to that point in the opposite side which is, with regard to the vertices, the harmonic conjugate of the point in which the side is cut by a given line, then the three lines thus obtained meet in a point.

We get thus out of the special theorem about the median lines of a triangle a more general one. But before this could be done we had to add the line at infinity to the lines in the given figure.

In a similar manner a great many theorems relating to metrical properties can be generalized by taking the line at infinity or points at infinity as forming part of the original figure. Conversely special cases relating to measurement are obtained by projecting some line in a figure of known properties to infinity. This is true for all properties relating to parallel lines or to bisection of segments, but not immediately for angles. It is, however, possible to establish for every metrical relation the corresponding projective property. To do this it is necessary to consider imaginary elements. These have originally been introduced into geometry by aid of co-ordinate geometry, where imaginary quantities constantly occur as roots of equations.

Their introduction into pure geometry is due principally to Poncelet, who by the publication of his great work *Traité des Propriétés Projectives des Figures* became the founder of projective geometry in its widest sense. Monge had considered parallel projection and had already distinguished between permanent and accidental properties of figures, the latter being those which depended merely on the accidental position of one part to another. Thus in projecting two circles which lie in different planes it depends on the accidental position of the centre of projection whether the projections be two conics which do or do not meet. Poncelet introduced the principle of continuity in order to make theorems general and independent of those accidental positions which depend analytically on the fact that the equations used have real or imaginary roots. But the correctness of this principle remained without a proof. Von Staudt has, however, shown how it is possible to introduce imaginary elements by purely geometrical reasoning, and we shall now try to give the reader some idea of his theory.

§ 25. *Imaginary Elements.*—If a line cuts a curve and if the line be moved, turned for instance about a point in it, it may happen that two of the points of intersection approach each other till they coincide. The line then becomes a tangent. If the line is still further moved in the same manner it separates from the curve and two points of intersection are lost. Thus in considering the relation of a line to a conic we have to distinguish three cases—the line cuts the conic in two points, touches it, or has no point in common with it. This is quite analogous to the fact that a quadratic equation with one unknown quantity has either two, one, or no roots. But in algebra it has long been found convenient to express this differently by saying a quadratic equation has always two roots, but these may be either both real and different, or equal, or they may be imaginary. In geometry a similar mode of expressing the fact above stated is not less convenient.

We say therefore a line has always two points in common with a conic, but these are either distinct, or coincident, or invisible. The word imaginary is generally used instead of invisible; but, as the points have nothing to do with imagination, we prefer the word "invisible" recommended originally by Clifford.

Invisible points occur in pairs of conjugate points, for a line loses always two visible points of intersection with a curve simultaneously. This is analogous to the fact that an algebraical equation with real coefficients has imaginary roots in pairs. *Only one real line can be drawn through an invisible point*, for two real lines meet in a real or visible point. *The real line through an invisible point contains also its conjugate.*

Similarly there are invisible lines—tangents, for instance, from a point within a conic—which occur in pairs of conjugates, two conjugates having a real point in common.

The introduction of invisible points would be nothing but a play upon words unless there is a real geometrical property indicated which can be used in geometrical constructions—that it has a definite meaning, for instance, to say that two conics cut a line in the same two invisible points, or that we can draw one conic through three real points and the two invisible ones which another conic has in common with a line that does not actually cut it. We have in fact to give a geometrical definition of invisible points. This is done by aid of the theory of involution (G. § 76 seq.).

An involution of points on a line has (according to G. § 77 [2]) either two or one or no foci. Instead of this we now say it has always two foci which may be distinct, coincident or invisible. These foci are determined by the involution, but they also determine the involution. If the foci are real this follows from the fact that conjugate points are harmonic conjugates with regard to the foci. That it is also the case for invisible foci will presently appear. If we take this at present for granted we may replace a pair of real, coincident or invisible points by the involution of which they are the foci.

Now any two pairs of conjugate points determine an involution (G. § 77 [6]).

Hence any point-pair, whether real or invisible, is completely determined by any two pairs of conjugate points of the involution which has given the point-pair as foci and may therefore be replaced by them.

Two pairs of invisible points are thus said to be identical if, and only if, they are the foci of the same involution.

We know (G. § 82) that a conic determines on every line an involution in which conjugate points are conjugate poles with regard to the conic—that is, that either lies on the polar of the other. This holds whether the line cuts the conic or not. Furthermore, in the former case the points common to the line and the conic are the foci of the involution. Hence we now say that this is always the case, and that the *invisible* points common to a line and a conic are the *invisible* foci of the involution in question. If then we state the problem of drawing a conic which passes through two points given as the intersection of a conic and a line as that of drawing a conic which determines a given involution on the line, we have it in a form in which it is independent of the accidental circumstance of the intersections being real or invisible. So is the solution of the problem, as we shall now show.

§ 26. We have seen (§ 21) that a conic may always be projected into itself by taking any point S as centre and its polar *s* as axis of projection, corresponding points being those in which a line through S cuts the conic. If then (fig. 9) A, A′ and B, B′ are pairs of corresponding points so that the lines AA′ and BB′ pass through S, then the lines AB and A′B′, as corresponding lines, will meet at a point R on the axis, and the lines AB′ and A′B will meet at another point R′ on the axis. These points R, R′ are conjugate points in the involution which the conic determines on the line *s*, because the triangle RSR′ is a polar triangle (G. § 62), so that R′ lies on the polar of R.

This gives a simple means of determining for any point Q on the line *s* its conjugate point Q′. We take any two points A, A′ on the conic which lie on a line through S, join Q to A by a line cutting the conic again in C, and join C to A′. This line will cut *s* in the point Q′ required.

To draw some conic which shall determine on a line s a given involution.

We have here to reconstruct the fig. 9, having given on the line *s* an involution. Let Q, Q′ and R, R′ (fig. 9) be two pairs of conjugate points in this involution. We take any point B and join it to R and R′, and another point C to Q and Q′. Let BR and CQ meet at A, and BR′ and CQ′ at A′. If now a point P be moved along *s* its conjugate point P′ will also move and the two points will describe projective rows The two rays AP and A′P′ will therefore describe projective pencils, and the intersection of corresponding rays will lie on a conic which passes through A, A′, B and C. This conic determines on *s* the given involution.

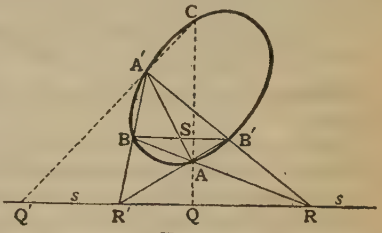

Fig. 9.

Of these four points not only B and C but also the point A may be taken arbitrarily, for if A, B, C are given, the line AB will cut *s* in some point R. As the involution is supposed known, we can find the point R′ conjugate to R, which we join to B. In the same way the line CA will cut *s* in some point Q. Its conjugate point Q′ we join to C. The line CQ′ will cut BR′ in a point A′, and then AA′ will pass through the pole S (cf. fig. 9). We may now interchange A and B and find the point B′. Then BB′ will also pass through S, which is thus found. At the same time five points A, B, C, A′, B′ on the conic have been found, so that the conic is completely known which determines on the line *s* the given involution. Hence—

Through three points we can always draw one conic, and only one, which determines on a given line a given involution, all the same whether the involution has real, coincident or invisible foci.

In the last case the theorem may now also be stated thus:—

It is always possible to draw a conic which passes through three given real points and through two invisible points which any other conic has in common with a line.

§ 27. The above theory of invisible points gives rise to a great number of interesting consequences, of which we state a few.

The theorem at the end of § 21 may now be stated:—

Any two conics are similar and similarly situated if they cut the line at infinity in the same two points—real, coincident or invisible.

It follows that

Any two parabolas are similar; and they are similarly situated as soon as their axes are parallel.

The involution which a circle determines at its centre is circular (G. § 79); that is, every line is perpendicular to its conjugate line. This will be cut by the line at infinity in an involution which has the following property: The lines which join any finite point to two conjugate points in the involution are at right angles to each other. Hence all circular involutions in a plane determine the same involution on the line at infinity. The latter is therefore called *the circular involution on the line at infinity*; and the involution which a circle determines at its centre is called *the circular involution at that point.* All circles determine thus on the line at infinity the same involution; in other words, they have the same two invisible points in common with the line at infinity.

All circles may be considered as passing through the same two points at infinity.

These points are called the *circular points* at infinity, and by Professor Cayley the *absolute* in the plane. They are the foci of the circular involution in the line at infinity.

Conversely—*Every conic which passes through the circular points is a circle*; because the involution at its centre is circular, hence conjugate diameters are at right angles, and this property only circles possess.

We now see why we can draw always one and only one circle through any three points; these three points together with the circular points at infinity are five points through which one conic only can be drawn.

Any two circles are similar and similarly situated because they have the same points at infinity (§ 21).

Any two concentric circles may be considered as having double contact at infinity, because the lines joining the common centre to the circular points at infinity are tangents to both circles at the circular points, as the line at infinity is the polar of the centre.

Any two lines at right angles to one another are harmonic conjugates with regard to the rays joining their intersection to the circular points, because these rays are the focal rays of the circular involution at the intersection of the given lines.

To bisect an angle with the vertex A means (G. § 23) to find two rays through A which are harmonic conjugates with regard to the limits of the angle and perpendicular to each other. These rays are therefore harmonic with regard to the limits of the given angle and with regard to the rays through the circular points. Thus perpendicularity and bisection of an angle have been stated in a projective form.

It must not be forgotten that the circular points do not exist at all; but to introduce them gives us a short way of making a statement which would otherwise be long and cumbrous.

We can now generalize any theorem relating to metrical properties. For instance, the simple fact that the chord of a circle is touched by a concentric circle at its *mid point* proves the theorem:—

If two conics have double contact, then the points where any tangent to one of them cuts the other are harmonic with regard to the point of contact and the point where the tangent cuts the chord of contact.

(O. H.)

PROKOP, the name of two of the most prominent Hussite generals

1. Prokop, surnamed "Veliky" (the great) or "Holy" (the bald), was a married utraquist priest who belonged to an eminent family of citizens of Prague. Though a priest and continuing to officiate as such, he became the most prominent leader of the advanced Hussite or Taborite forces during the latter part of the Hussite wars. He was not indeed the immediate successor of Žižka as leader of the Taborites, as has been frequently stated, but he commanded the forces of Tabor when they obtained their great victories over the Germans and Romanists at Usti nad Labam (Aussig) in 1426 and Domažlice (Tauss) in 1431. He also acted as leader of the Taborites during their frequent incursions into Hungary and Germany, particularly when in 1429 a vast Bohemian army invaded Saxony and the territory of Nuremberg. The Hussites, however, made no attempt permanently to conquer German territory, and on the 6th of February 1430 Prokop concluded at Kulmbach a treaty with Frederick of Brandenburg, burgrave of Nuremberg, by which the Hussites engaged themselves to leave Germany. When the Bohemians entered into negotiations with Sigismund and the Council of Basel and, after prolonged discussions, resolved to send an embassy to the council, Prokop the Great was the most prominent member of this embassy, which reached Basel on the 4th of January 1433. When the negotiations there for a time proved resultless Prokop with the other envoys returned to Bohemia, where new internal troubles broke out. A Taborite army led by Prokop the Great besieged Plzeň, which was then in the hands of the Romanists. The discipline in the Hussite camp had, however, slackened in the course of prolonged warfare, and the Taborites encamped before Plzeň revolted against Prokop, who therefore returned to Prague. Probably encouraged by these dissensions among the men of Tabor, the Bohemian nobility, both Romanist and utraquist, formed a league for the purpose of opposing democracy, which through the victories of Tabor had acquired great strength in the Bohemian towns. The struggle began at Prague. Aided by the nobles, the citizens of the old town took possession of the more democratic new town, which Prokop unsuccessfully attempted to defend. Prokop now called to his aid Prokop "the Lesser," who had succeeded him in the command of the Taborite army before Plzeň. They jointly retreated eastward from Prague, and their forces, known as the army of the towns, met at Lipan, between Kourim and Kolin, the army of the nobles (May 30, 1434). The Taborites were decisively defeated, and Prokop the Great perished in this battle.

2. Prokop "the Lesser," or Prokupek (the Bohemian diminutive of the word Prokop), was one of the greatest Hussite generals. Little is known of his early life. He took part in all the later campaigns of Prokop the Great in Germany, and succeeded him as commander of the Taborite army that besieged Plzeň. After the formation of the confederacy of the nobles he was recalled by Prokop the Great, with whom he shared the command of the army of the towns at the fateful battle of Lipan, in which he also perished.

See Count Lutzow, *Bohemia: A Historical Sketch*; Palacky, *History of Bohemia*; Toman, *Husitske Valečnictvi* (Hussite Warfare).

PROKOPOVICH, THEOFAN (1681–1736), Russian archbishop and statesman, one of the ablest coadjutors of Peter the Great, was sprung from a merchant family. He brilliantly distinguished himself at the Orthodox academy of Kiev, subsequently completing his education in Poland (for which purpose he turned Uniate), and at Rome in the College of the Propaganda. Primed with all the knowledge of the West, he returned home to seek his fortune, and, as the Orthodox monk, became one of the professors at, and subsequently rector of, the academy of Kiev. He entirely reformed the teaching of theology there, substituting the historical method of the German theologians for the antiquated Orthodox scholastic system. In 1709 Peter the Great, while passing through Kiev, was struck by the eloquence of Prokopovich in a sermon on "the most glorious victory," *i.e.* Poltava, and in 1716 summoned him to Petersburg. From henceforth it was Theofan's duty and pleasure to explain the new ideas and justify the most alarming innovations from the pulpit. So invaluable, indeed, did he become to the civil power, that, despite the determined opposition of the Russian clergy, who regarded "the Light of Kiev" as an interloper and semi-heretic, he was rapidly promoted, becoming, in 1718, bishop of Pskov, and finally, in 1724, archbishop of Novgorod. As the author of "the spiritual regulation" for the reform of the Russian Church, Theofan must, indeed, be regarded as the creator of "the spiritual department" superseding the patriarchate, and better known by its later name of "the holy synod," of which he was made the vice-president. Penetrated by the conviction that ignorance was the worst of the inveterate evils of old Russia, a pitiless enemy of superstition of every sort, a reformer by nature, overflowing with energy and resource, and with a singularly lucid mind armed at all points by a far-reaching erudition, Prokopovich was the soul of the reforming party after the death of Peter the Great. To him also belongs the great merit of liberating Russian preaching from the fetters of Polish turgidity and affectation by introducing popular themes and a simple style into Orthodox pulpit eloquence.

See I. Chistovitch, *Theofan Prokopovich and his Times* (Rus.; Petersburg, 1868); P. Morozov, *Theophan Prokopovich as a Writer* (Rus.; Petersburg, 1880). (R. N. B.)

PROLEGOMENON (Gr. for "that which is said beforehand," προλέγειν, to speak, say before), a preface or introduction to a book, especially a preliminary introductory essay to a learned work, or a treatise which serves as a general survey or introduction to the study of some subject or as a special survey of the subject. The word is more often used in the plural.

PROLETARIAT, or Proletariate, a term borrowed from the French and used collectively of those classes of a political community who depend for their livelihood on their daily labour, the wage-earning, operative class as opposed to the capital-owning class. It is of frequent use by those social reformers who base their theories on the supposed antagonism of capital and labour. The Latin *proletarius*, from which the word was formed, was the name given to the body of citizens possessed of no property and who therefore served the state with their children (*proles*, offspring). This division of the members of the state was traditionally ascribed to Servius Tullius.

PROLOCUTOR, one who speaks for others (Lat. *pro*, for, and *loqui*, to speak); specifically the chairman of the lower house of convocation in the two provinces of the Church of England, who presides in that house and acts as representative and spokesman in the upper house. He is elected by the lower house, subject to the approval of the metropolitan. (See Convocation.)

PROLOGUE (from Gr. πρό, before, and λόγος, a word), a prefatory piece of writing, usually composed to introduce a drama. The Greeks use a word πρόλογος, which included the modern meaning of the prologue, but was of wider significance, embracing any kind of preface, like the Latin *praefatio*. In Attic Greek drama, a character in the play, very often a deity, stood forward or appeared from a machine before the action of the play began, and made from the empty stage such statements as it was necessary that the audience should hear, in order that they might appreciate the ensuing drama. It was the early Greek custom to dilate in great detail on everything that had led up to the play, the latter being itself, as a rule, merely the catastrophe which had inevitably to ensue on the facts related in the prologue. The importance, therefore, of the prologue in Greek drama was very great; it sometimes almost took the place of a romance, to which, or to an episode in which, the play itself succeeded. It is believed that the prologue in this form was practically the invention of Euripides, and with him, as has been said, it takes the place of "an explanatory first act." This may help to modify the objection which criticism has often brought against the Greek prologue, as an impertinence, a useless growth prefixed to the play, and standing as a barrier between us and our enjoyment of it. The point precisely is that, to an Athenian audience, it was useful and pertinent, as supplying just what they needed to make the succeeding scenes intelligible. But it is difficult to accept the view that Euripides invented the plan of producing a god out of a machine to justify the action of deity upon man, because it is plain that he himself disliked this interference of the supernatural and did not believe in it. He seems, in such a typical prologue as that to the *Hippolytus*, to be accepting a conventional formula, and employing it, almost perversely, as a medium for his ironic rationalism. Many of the existing Greek prologues may be later in date than the plays they illustrate, or may contain large interpolations. On the Latin stage the prologue was often more elaborate than it was in Athens, and in the careful composition of the poems which Plautus prefixes to his plays we see what importance he gave to this portion of the entertainment; sometimes, as in the preface to the *Rudens*, Plautus rises to the height of his genius in his adroit and romantic prologues, usually placed in the mouths of persons who make no appearance in the play itself. Molière revived the Plautian prologue in the introduction to his *Amphitryon*. Racine introduced Piety as the speaker of a prologue which opened his choral tragedy of *Esther*. The tradition of the ancients vividly affected our own early dramatists. Not only were the mystery plays and miracles of the middle ages begun by a homily, but when the drama in its modern sense was inaugurated in the reign of Elizabeth, the prologue came with it, directly adapted from the practice of Euripides and Terence. Sackville, Lord Buckhurst, prepared a sort of prologue in dumb show for his *Gorbuduc* of 1562; and he also wrote a famous *Induction*, which is, practically, a prologue, to a miscellany of short romantic epics by diverse hands. In the Elizabethan drama the prologue was very far from being universally employed. In the plays of Shakespeare, for instance, it is an artifice which the poet very rarely introduced, although we find it in *Henry V.* and *Romeo and Juliet*. Sometimes the Elizabethan prologue was a highly elaborated poem; in 1603 a harbinger recited a sonnet on the stage, to prepare the audience for Heywood's *A Woman Kill'd with Kindness*. Often the prologue was a piece of blank verse, so obscure and complicated that it is difficult to know how its hearers contrived to follow it; such are the prologues of Chapman. Among Elizabethan prologues the most ingenious and interesting are those of Ben Jonson, who varied the form on every occasion. For instance, in *The Poetaster* (1602), Envy comes in "as Prologue," and speaks a long copy of heroics, only to be turned off the stage by an armed figure, who states that he is the real prologue, and proceeds to spout more verses. Jonson's introductions were often recited by the "stage-keeper," or manager. Beaumont and Fletcher seem to have almost wholly dispensed with prologues, and the form was far from being universal, until the Restoration, when it became *de rigueur*. The prologues of the last thirty years of the 17th century were always written in rhymed verse, and were generally spoken by a principal actor or actress in the ensuing piece. They were often, in the hands of competent poets, highly finished essays on social or literary topics. For instance, the famous prologue to Dryden's *Aurengzebe* (1675) is really a brief treatise on fashions in versification. Throughout the 18th century the prologue continued to flourish, but went out of vogue in the early part of the 19th.

See also EPILOGUE. (E. G.)

PROME, a district in the Pegu division of Lower Burma, with an area of 2915 sq. m. and a population (1901) of 365,804. It occupies the whole breadth of the valley of the Irrawaddy, between Thayetmyo district on the north and Henzada and Tharrawaddy districts on the south, and originally extended as far as the frontier of Independent Burma, but in 1870 Thayetmyo was formed into an independent jurisdiction. There are two mountain ranges in Prome, which form respectively the eastern and western boundaries. The Arakan Yomas extends along the whole of the western side, and that portion of the district lying on the right bank of the Irrawaddy is broken up by thickly wooded spurs running in a south-easterly direction, the space for cultivation being but limited and confined to the parts adjacent to the river. On the eastern side lies the Pegu Yomas, and north and north-east of the district its forest-covered spurs form numerous valleys and ravines, the torrents from which unite in one large stream called the Na-weng River. The most important of the plains lie in the south and south-west portions of Prome, and extend along the whole length of the railway that runs between the towns of Paungdē and Prome; they are mostly under cultivation, and those in the south are watered by a series of streams forming the Myit-ma-kha or upper portion of the Hlaing. There are in addition large tracts of land covered by tree-jungle which are available for cultivation. The principal river is the Irrawaddy, which intersects the district from north to south; next in importance are the Tha-ni and its tributaries and the Na-weng system of rivers. In the hills near the capital the soil is of Tertiary formation, and in the plains it is an alluvial deposit. The climate is much drier than other districts in Lower Burma, the annual rainfall being about 48 in. The temperature ranges from about 100° in June to 60° in January. The staple crop is rice, but some cotton and tobacco are grown, while the custard apples are famous. Sericulture is extensively carried on by a special class. The forests yield teak and cutch, cotton and silk-weaving are important industries; there are also manufactures of ornamental boxes, coarse brown sugar and cutch.

The early history of the once flourishing kingdom of Prome, like that of the other states which now form portions of Burma, is veiled in obscurity. After the conquest of Pegu in 1758 by Alompra, the founder of the last dynasty of Ava kings, Prome remained a portion of the Burman kingdom till the close of the second Burmese War in 1853, when the province of Pegu was annexed to British territory.

PROME, the chief town of the district, is situated on the left bank of the Irrawaddy, 161 m. N. of Rangoon, population (1901), 27,375.

To the south and south-east the town is closed in by low pagoda-topped hills, on one of which stands the conspicuous gilded Shwe Tsan-daw. The town was taken by the British in 1825 and again in 1852, on both occasions with hardly any opposition. In 1862 it was almost entirely destroyed by fire, and was afterwards relaid out in straight and broad streets. It was erected into a municipality in 1874, and since then great improvements have been made, including waterworks. Its principal manufactures are silk cloths and lacquer ware. It is the terminus of a railway from Rangoon, which runs through the district. The other chief towns in the district are Shwedaung (pop. 10,787) and Paungde (pop. 11,105).

PROMENADE, a walk taken for exercise or more especially for social amusement, hence a road, drive or other public place laid out for the purpose, a parade. The French word *promenade* was formerly *pourmenade*, and came from *pourmener*, *promener*, to take for a walk, Late Latin *prominare*, to drive an animal out to pasture, from *pro*, forward, *minare*, to drive on with cries and threats (*minae*). "Promenade concerts," so called from the fact that the audience are free to walk about or "promenade," were first introduced from Paris to London in 1838 under the name of "promenade concerts à la Musard," after the concerts given by the French musician and conductor, Philippe Musard (1793–1859). They were given at the Lyceum Theatre (English Opera House).

PROMETHEUS, son of the Titan Iapetus by the sea nymph Clymene, the chief "culture hero," and, in some accounts, the

Demiurge of Greek mythical legend. As a culture-hero or inventor and teacher of the arts of life, he belongs to a wide and well-known category of imaginary beings. Thus Qat, Quahteaht, Pundjel, Maui, Ioskeha, Cagn, Wainamoinen and an endless array of others represent the ideal and heroic first teachers of Melanesians, Ahts, Australians, Maoris, Algonkins, Bushmen and Finns. Among the lowest races the culture-hero commonly wears a bestial guise, is a spider (Melanesia), an eagle hawk (in some myths and south-east Australia), a coyote (north-west America), a dog or raven (Thlinkeet), a mantis insect (Bushman), and so forth, yet is endowed with human or even super-human qualities, and often shades off into a permanent and practically deathless god. Prometheus, on the other hand, is purely anthropomorphic. He is the friend and benefactor of mankind. He defends them against Zeus, who, in accordance with a widely diffused mythical theory, desires to destroy the human race and supplant them by a new and better species, or who simply revenges a trick in which men get the better of him. The pedigree and early exploits of Prometheus are given by Hesiod (*Theog.* 510-616). On a certain occasion gods and men met at Mecone. The business of the assembly was to decide what portions of slain animals the gods should receive in sacrifice. On one side Prometheus arranged the best parts of the ox covered with offal, on the other the bones covered with fat, as the meat was covered in Homeric sacrifices. Zeus was invited to make his choice, chose the fat, and found only bones beneath. A similar fable of an original choice, in which the chooser is beguiled by appearances, recurs in Africa and North America (see the caskets in the *Merchant of Venice*). The native tribes adapt the myth to explain the different modes of life among themselves and white men. In wrath at this trick, according to Hesiod, or in other versions for the purpose of exterminating the remnants of people who escaped the deluge of Deucalion, Zeus never bestowed, or later withdrew, the gift of fire. In his "philanthropic fashion," Prometheus stole fire, concealed in a hollow fennel stalk (Hesiod, *Op. et Di.*), and a fennel stalk is still used in the Greek islands as a means of carrying a light (cf. Pliny xiii. 22). According to some legends he gained the fire by holding a rod close to the sun. Probably the hollow fennel stalk in which fire was carried got its place in myth from the very fact of its common use.

We thus find Prometheus in the position of the fire-bringer, or fire-stealer, and so connected with a very wide cycle of similar mythical benefactors. Among the Murri of Gippsland, to begin with a backward people, the fire-stealer was a man, but he became a bird. *Tow-e-ra*, or fire, was in the possession of two women who hated the blacks. A man who loved men cajoled the women, stole fire when their backs were turned, and was metamorphosed into "a little bird with a red mark on its tail, which is the mark of fire." The fire-bringer in Brittany is the golden or fire-crested wren. Myths like this kill two birds with one stone, and at once account for the possession of fire by men and for the marking of certain animals regarded as fire-bringers.[1] In another Australian legend fire was stolen by the hawk from the bandicoot, and given to men. In yet another a man held his spear to the sun, and so got a light. A bird is fire-bringer in an Andaman island tale, and a ghost in another myth of the same island.[2] In New Zealand, Maui stole fire from Mauika, the lord of fire. He used a bird's intervention. Among the Ahts, in North America,[3] fire was stolen by animals from the cuttle-fish. Among the Thlinkeets, Yehl, the raven god, was the fire-stealer. Among the Cahrocs, the coyote steals fire from "two old women." Among the Aryans of India, Soma is stolen by birds, as water is among the Thlinkeets, and mead in the Edda.[4] Fire concealed himself, in the Veda, was dragged from his hiding place by Mataricvan, and was given to the priestly clan of Bhrigu. We also hear that Mataricvan "brought fire from afar" (*R. V.* iii. 9, 5), and that Bhrigu found fire lurking in the water (*R. V.* x. 46, 2).[5]

In considering the whole question, one must beware of the hasty analogical method of reasoning too common among mythologists. For example, when a bird is spoken of as the fire-bringer we need not necessarily conclude that, in each case, the bird means lightning. On the other hand, the myth often exists to explain the cause of the markings of certain actual species of birds. Again, because a hero is said to have stolen or brought fire, we need not regard that hero as the personification of fire, and explain all his myth as a fire-myth. The legend of Prometheus has too often been treated in this fashion, though he is really a culture hero, of whose exploits, such as making men of clay, fire-stealing is no more than a single example. This tendency to evolve the whole myth of Prometheus from a belief that he is personified fire, or the fire-god, has been intensified by Kuhn's ingenious and plausible etymology of the name Προμηθεύς. The Greeks derived it from *προμηθής*, provident, and connected it with other such words as *προμηθοῦμαι*, *προμήθεια*. They had also the proper name Ἐπιμηθεύς for the slow-witted brother of Prometheus who turned all the hero's wisdom to foolishness. Against these very natural etymologies the philologists support a theory that Prometheus is really a Greek form of *pramantha* (Skt.), the fire-stick of the Hindus. The process of etymological change, as given by Steinthal, was this. The boring of the Perpendicular in the horizontal fire-stick, whereby fire was kindled, was called *manthana*, from *math*, "I shake." The preposition *pra* was prefixed, and you get *pramantha*. But Mataricvan was feigned to have brought Agni, fire, and "the fetching of the god was designated by the same verb *mathnāmi* as the proper earthly boring" of the fire-stick. "Now this verb, especially when compounded with the preposition *pra*, gained the signification to tear off, snatch to oneself, rob."[6] Steinthal goes on: "Thus the fetching of Agni became a robbery of the fire, and the *pramātha* (fire-stick) a robber. The gods had intended, for some reason or other, to withhold fire from men; a benefactor of mankind stole it from the gods. This robbery was called *pramātha*; *pramāthyu-s* is 'he who loves boring or robbery, a borer or robber.' From the latter words, according to the peculiarities of Greek phonology, is formed Προμηθεύ-ς, Prometheus. He is therefore a fire-god," &c. Few things more ingenious than this have ever been done by philologists. It will be observed that "forgetfulness of the meaning of words" is made to account for the Greek belief that fire was *stolen* from the gods. To recapitulate the doctrine more succinctly, men originally said, in Sanskrit (or some Aryan speech more ancient still), "fire is got by rubbing or boring;" nothing could have been more scientific and straightforward. They also said, "fire is brought by Mataricvan;" nothing could have been more in accordance with the mythopoeic mode of thought. Then the word which means "fetched" is confused with the word which means "bored," and gains the sense of "robbed." Lastly, fire is said (owing to this confusion) to have been stolen, and the term which meant the common savage fire-stick is by a process of delusion conceived to represent, not a stick, but a person, Prometheus, who stole fire. Thus then, according to the philologists, arose the myth that fire was stolen, a myth which, we presume, would not otherwise have occurred to Greeks. Now we have not to decide whether the Greeks were right in thinking that Prometheus only meant "the fore-sighted wise man," or whether the Germans know better, and are correct when they say the name merely meant "fire-stick." But we may, at least, point out that the myth of the stealing of fire and of the fire-stealer is current among races who are not Aryan, and never heard the word *pramantha*. We have shown that Thlinkeets, Ahts, Andaman Islanders, Australians, Maoris, South Sea Islanders, Cahrocs and others all believe fire was originally stolen. Is it credible that, in all their languages, the name of the fire-stick should have caused a confusion of thought which ultimately led to the belief that fire was obtained originally by larceny? If such a coincidence appears incredible, we may doubt whether the belief that is common to Greeks and Cahrocs and Ahts was produced, in Greek minds by an etymological confusion, in Australia, America and so forth by some other cause. What, then, is the origin of the widely-diffused myth that fire was stolen? We offer a purely conjectural suggestion. No race is found without fire, but even some civilized races have found the artificial reproduction of fire very tedious. Thus we read (*Od.* v. 488-493), "As when a man hath hidden away a brand in the black embers at an upland farm, one that hath no neighbour nigh, and so saveth the seed of fire that he may not have to seek a light otherwhere, even so did Odysseus cover him with the leaves." If, in the Homeric age, men found it so hard to get the seed of fire, what must the difficulty have been in the earliest dawn of the art of fire-making? Suppose, then, that the human groups of early savages are hostile. One group lets its fire go out, the next thing to do would be to borrow a light from the neighbour, perhaps several miles off. But if the neighbours are hostile the unlucky group is cut off from fire, *igni interdicitur.* The only way to get fire in such a case is to steal it. Men accustomed to such a precarious condition might readily believe that the first possessors of fire, wherever they were, set a high value on it, and refused to communicate it to others. Hence the belief that fire was originally stolen. This hypothesis at least explains all myths of fire-stealing by the natural needs, passions, and characters of men, "a jealous race," whereas the philological theory explains the Greek myth by an exceptional accident of changing language, and leaves the other widely diffused myths of fire-stealing in the dark. It would occupy too much space to discuss, in the ethnological method, the rest of the legend of Prometheus. Like the Australian Pundjel, and the Maori Tiki, he made men of clay. He it was who, when Zeus had changed his wife into a fly, and swallowed her, broke open the god's head and let out his daughter Athena. He aided Zeus in the struggle with the Titans. He was punished by him on some desolate hill (usually styled Caucasus) for fire-stealing, and was finally released by Heracles.

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[1] For these see Brough Smith with Howitt, *Native Tribes of South-east Australia*, *Aborigines of Victoria*; Kuhn, on bird fire-bringer in Isle of Man, *Die Herabkunft des Feuers*, p. 109; Van Gennep, *Mythes et légendes d'Australie*.

[2] *Journ. Anthrop. Inst.* (Nov. 1884).

[3] Sproat, *Savage Life*.

[4] Bancroft, iii. 100; *Aitareya brahmana*, ii. 93, 203; Kuhn, *op. cit.*, 144.

[5] Cf. Bergaigne, *La Religion védique*, i. 52–56, and Kuhn's *Herabkunft*; and see the essays by Steinthal in appendix to English version of Goldziher's *Mythology among the Hebrews*.

[6] Cf. Kuhn, *op. cit.* pp. 16, 17.

His career may be studied in Hesiod; in the splendid *Prometheus vinctus* of Aeschylus, with the *scholia*; in Heyne's *Apollodorus*; in the excursus (I) of Schüzius to the Aeschylean drama, and in the frequently quoted work of Kuhn. The essay of Steinthal may also be examined (Goldziher, *Myth. Hebr.*, Eng. trans., p. 363-392), where the amused student will discover that "Moses is a Pramanthas," with much else that is as learned and convincing. See also Tylor's *Early History of Man*; Nesfield in *Calcutta Review* (January, April, 1884); and the article FIRE. (A. L.)

PROMOTER, one who promotes (Lat. *promovere,* to move forward), advances or forwards any scheme, project or undertaking. The most general specific sense in which the word is now used is that of a person who takes the steps necessary to the incorporation of a joint-stock company (see COMPANY) or to the passing of a private or local act of parliament. In legal history, a promoter was one who prosecuted offenders, originally as an officer of the Crown, later as a common informer; the term is still used thus of the prosecutor in a suit in an ecclesiastical court.

PRONGBUCK, PRONGHORN, or (in America) simply ANTELOPE, the sole existing representative of a family (*Antilocapridae*) of hollow-horned ruminants in which the horn-sheaths are forked and annually shed and renewed. Standing about 3 ft. high at the shoulder and slightly more at the croup, the male prongbuck has the black horns rising vertically upwards immediately above the eyes. The general colour is bright sandy fawn, with much white on the face, three white bars on the throat and white under parts and buttocks. The white throat-bands are evidently protective; and the long white hair on the buttocks can be erected and expanded into large chrysanthemum-like bunches as in Japanese deer; these being guides to the members of the herd when in flight. The tail is short; lateral hoofs are wanting; and the teeth are tall-crowned. Female prongbuck produce one or two young at a birth, and are either hornless or furnished with small and more or less rudimentary horns.

Prongbuck, of which two races, the typical *Antilocapra americana* and *A. mexicana,* are recognized by American naturalists, inhabit the open plains of the temperate districts of western North America, where they were formerly very abundant. Nowadays their numbers have become greatly diminished and small and isolated bands represent the great herds of former years. Young prongbuck are very liable to be attacked by wolves; to protect them from these marauders the females first clear an area in the middle of a patch of cactus, by jumping on the plants with their sharp hoofs, and bring forth their offspring in the protected space. Certain extinct American ruminants, namely *Cosoryx, Blastomeryx* and *Merycodus* are believed to be in some way related to the prongbuck; but they have frontal appendages more like antlers than horns. In view of this presumed relationship it seems preferable to retain the family *Antilocapridae* rather than relegate it to the rank of a sub-family of *Bovidae.* (See PECORA.) (R. L.*)

PRONUNCIATION (Lat. *pronuntiatio,* from *pronuntiare,* proclaim, announce, pronounce), the action of pronouncing, the manner of uttering an articulate vocal sound (see PHONETICS and VOICE). The original sense of the Latin, a public declaration, is preserved in Spanish *pronunciamiento,* a manifesto or proclamation, especially as issued by a party of insurrection or revolution.

PRONY, GASPARD CLAIR FRANÇOIS MARIE RICHE DE (1755–1839), French engineer, was born at Chamelet, in the department of the Rhone, on the 22nd of July 1755, and was educated at the École des Ponts et Chaussées. His *Mémoire sur la poussée des voûtes* published in 1783, in defence of the principles of bridge construction introduced by his master J. R. Perronnet, attracted special attention. The laborious enterprise of drawing up the famous *Tables du Cadastre* was entrusted to his direction in 1792, and in 1794 he was appointed professor of the mathematical sciences at the École Polytechnique, becoming director at the École des Ponts et Chaussées four years later. He was employed by Napoleon to superintend the engineering operations for protecting the province of Ferrara against the inundations of the Po and for draining and improving the Pontine Marshes. After the Restoration he was likewise engaged in regulating the course of the Rhone, and in several other important works. He was made a baron in 1828, and a peer in 1835. He died at Asnières (Seine) on the 29th of July 1839. For the "Prony Brake" see DYNAMOMETER.

PROOF (in M. Eng. *preove, proeve, preve, &c.,* from O. Fr. *prueve, proeve,* &c., mod. *preuve,* Late. Lat. *proba, probare,* to prove, to test the goodness of anything, *probus,* good), a word of which the two main branches are derived from those of "to prove," viz. to show to be true, to test, to try. Of the first division the chief meanings are: that which establishes the truth of a fact or the belief in the truth, demonstration, for the nature of which see LOGIC. In law "proof" is the general term for the establishment of the material facts in issue in a particular case by proper legal means to the satisfaction of the court (see EVIDENCE); specifically, documents so attested as to form legal evidence, written copies of what a witness is prepared to support on oath, and the evidence of any case in the court records are all termed "proofs." In Scots law the term is used of a trial before a judge alone as opposed to trial by jury. From the general sense of examination, trial or assay derived from "to prove," to test the quality of anything, "proof" is used of that which has succeeded in standing a trial or test; the commonest form in which this use appears is as a compound adjective, thus materials are said to be "waterproof," "armour-" "bullet-proof," and the like. The principal other uses are for a standard of strength for spirit (see ALCOHOL and SPIRITS) for a trial impression, in printing, on which corrections and additions can be made (see article PROOF-READING) and, in engraving and etching, for one of a limited number of impressions made before the ordinary issue is printed. In the earlier history of engraving a "proof" was an impression during the process of printing made for the artist's inspection, approval or correction, whence its name. In the modern use of the term, where the impression has been taken before the inscription has been added to the plate, it is called a "proof before letter."

In bookbinding, some of the shorter or narrower leaves are left with rough edges, "uncropped," to show that the book has not been "cut," these are styled "proofs."

PROOF-READING, the art or business of correcting for the press the printed "proofs" of articles or books set in type before publication. The special business of a proof-reader, attached to a printing house, is to correct these proofs before they are shown to the author; he is an intermediary between the compositor and the author, and as such his functions may vary according to his capacities. Proof-reading as a distinct department in the work of a printing office does not date from the very earliest days of "the art preservative of all arts." The first products of the printing-press show abundant evidences of the non-existence of any one specially charged with the duty of correcting the compositors' mistakes. How much conjectural emendation and consequent controversy would have been avoided if the First Folio Shakespeare had been more typographically correct! Sir Theodore Martin said that the typographical errors alone of that work had been computed to number nearly 20,000, which amounts to 2·25% of the total number of words in the volume. It was a usual practice in the 17th and 18th centuries for authors to send the proofs of their works round amongst their personal friends for correction; and in the universities and colleges sheets of works passing through the press were frequently hung up in the quadrangles for public inspection and correction. With the growth of printing gradually came a demand for systematic proof-reading, and the leading printers engaged scholars and men of letters to read proofs for them. Among these may be mentioned Cruden, of *Concordance* fame ("Alexander the Corrector"), and William Julius Mickle, poet, and translator of Luiz de Camoens's *Lusiads*, who was a reader at the Clarendon Press. Goldsmith and Dr Johnson also are credited with having wielded the proof-reader's pen. Times, however, have changed since, as the elder D'Israeli wrote, "it became the glory of the learned to be correctors of the press to eminent printers," and to-day in every printing office the proof-reader is found—an unobtrusive functionary, known to publishers, authors, editors and journalists, but for the most part unknown to the general reading public; a functionary who yet does useful, often valuable, and always indispensable work. The influence of good proof-reading upon the character of book, newspaper and general printing is too often underrated. The celebrated old printing offices and the foremost of the modern ones owe their reputation for good workmanship largely to the excellence and thoroughness of the work done in their reading-rooms, for no perfection of paper, ink, machining or binding can atone for bad or slipshod typography.

The nature of the proof-reader's work, frequently monotonous and uninteresting, will be made clear by what follows. After the compositor (see TYPOGRAPHY) has set up, by hand or type-setting machine, the "copy" supplied to him, a slip or page proof is pulled and sent with the manuscript to the proof-reader. The manuscript is then read aloud by a copy-holder, while the proof-reader carefully follows the text before him letter by letter, marking on the margin of the proof all the misspellings, turned letters, "wrong fonts" (letters differing in size or style of face from those in the immediate context) and other errors, and seeing that the punctuation clearly defines the author's meaning. The copy-holder reads rapidly—indeed, an ordinary listener would imagine it to be impossible for the proof-reader to understand him—and as the reader is obliged to keep pace, he goes through the proof again, without the aid of the copy-holder, in order to mark any errors that may have escaped him in the first rapid reading. The proof, called the "first proof," is then sent to the compositor to be corrected. When this has been done, a further proof is submitted to the reader, who, upon satisfying himself by careful revision that it is free from typographical mistakes, passes it as "clean." If the reader, when dealing with the first proof, notices any slips in grammar or errors of fact on the part of the writer, or is in doubt whether any particular word in the manuscript has been correctly deciphered, he underlines the word or passage, and places "Qy." (query) in the margin. The proof is then despatched to the author or editor. On the return of the proof, after the writer's corrections and alterations have been carried out, the type is made up into pages and sheets and another proof pulled. This passes into the hands of the press reader (as distinguished from the "first proof-reader"), who checks the headlines, page numbers, and sequence of chapters or sections, and observes that the pages are of uniform length and that a sufficient amount of margin is allowed, before finally reading through the text. When the press-reader's corrections have been effected, the work is ready for the printing machine or the stereotyping foundry.

The cost of proof-reading may be said to range from about 7½ to 20% of the cost of composition, varying, of course, with the nature of the work.

Many prominent authors have expressed in warm terms their gratitude to the proof-reader for valuable assistance rendered by apt queries and pertinent suggestions. Two of these expressions of opinion may be given as typical, one from a novelist and one from a poet. Charles Dickens said: "I know from some slight practical experience what the duties of correctors of the press are, and how these duties are usually discharged. And I can testify, and do testify here, that they are not mechanical—that they are not mere matters of manipulation and routine; but that they require from those who perform them much natural intelligence, much superadded cultivation, considerable readiness of reference, quickness of resource, an excellent memory and a clear understanding. And I must gratefully acknowledge that I have never gone through the sheets of any book I have written without having had presented to me by the corrector of the press something I had overlooked—some slight inconsistency into which I had fallen—some little lapse I had made—in short, without having set down in black and white some unquestionable indication that I had been closely followed in my work by a patient and trained mind, and not merely by a skilful eye. In this declaration I have not the slightest doubt that the great body of my brother and sister writers would, as a plain act of justice, heartily concur." Robert Browning thus corroborated Dickens: "I have had every opportunity of becoming acquainted with, and gratefully acknowledging, the extreme service rendered to me; and, if mine be no exceptional case, the qualifications of readers and correctors are important indeed." P. Larousse spoke of French proof-readers as his "collaborateurs les plus chers," and Hugo referred to them as those "modestes savants" so well able "lustrer les plumes du génie"; while the Académie Française consulted them on points arising in the revision of the Academy's dictionary.

Though much good work is done by readers who have not been practical printers, yet the technical knowledge gained by working as a compositor is essential to the best proof-reading. The reader must possess a quick eye, alert to note every error or mechanical imperfection in the type, and must scrutinize closely every letter of every word, clause and sentence, while keeping a grasp of the sense of the matter he is dealing with. The more varied his information and the wider his knowledge, the better. Though his strict duty is merely to see that the author's copy is properly reproduced, he is always glad to give the author the benefit of the experience and knowledge he has acquired, and, as a consequence, he is constantly crossing the line which separates proof-reading from sub-editorial duties. From this last consideration has arisen the plea for the reader, on the daily press especially, being placed under the control of, and made responsible to, the editorial department rather than the head of the composing-room.

Proof-readers in Great Britain have a trade union, and many of them retain membership of the unions to which they belonged when working as compositors; and in some states of the American Union as well as in Scotland the compositors insist upon readers being also members of their society. The oldest English organization devoted entirely to the interests of proof-readers is the Association of Correctors of the Press, founded in 1854. The chief aim of the association is to give its members information as to vacant situations, so as to keep them in full employment; but it also assists members in distress from its benevolent fund, and provides pensions, as well as a sum of money at death. There is in France the *Société des correcteurs des imprimeries de Paris*. There are also proof-readers' societies in several American cities, many of whose members are women, for in the United States women bulk largely in the rank of proof-readers. There are very few women proof-readers in London. In Edinburgh, however, women form a considerable proportion of the proof-readers. (J. A. BL.; J. R.*)

PROPAGATION, the multiplication of a species by natural processes of reproduction (*q.v.*). The Latin *propagare* meant to fasten down (*pro-* and *pangere*, to fasten) layers, shoots or slips (*propagines*) of plants for the purpose of reproduction, hence to generate, reproduce and generally to extend or increase. It is in this sense that "propagation" is used of the spreading or dissemination of doctrines, ideas, opinions, &c. The term "propaganda," often wrongly used as a plural word, means properly an organization or association for the spreading of particular beliefs or opinions, and is an adaptation of the name of that committee of cardinals in the Roman curia which supervises foreign missions, the full title being *Congregatio de propaganda fide.*

PROPELLANTS, a generic name for explosives used for propelling projectiles from guns and other firearms, in order to distinguish them from the more violent explosives used in shells, mines, &c., to produce a blasting effect. Some explosive substances can be used both as propellants and as bursters, as for example gunpowder, and some of the ingredients of a propellant may be similar, though differently proportioned and combined, to those of a "high explosive." (For details see EXPLOSIVES; GUNPOWDER; CORDITE, &C.)

PROPERTIUS, SEXTUS (*fl.* 30–15 B.C.), the greatest of the elegiac poets of Rome, was born of a well-to-do Umbrian family at or near Asisium (Assisi), the birthplace also of the famous St Francis. We learn from Ovid that Propertius was his senior, but also his friend and companion; and that he was third in the sequence of elegiac poets, following Gallus, who was born in 69 B.C., and Tibullus, and immediately preceding Ovid himself, who was born in 43 B.C. We shall not then be far wrong in supposing that he was born about 50 B.C. His early life was full of misfortune. He lost his father prematurely; and after the battle of Philippi and the return of Octavian to Rome, Propertius, like Virgil and Horace, was deprived of his estate to provide land for the veterans, but, unlike them, he had no patrons at court, and he was reduced from opulence to comparative indigence. The widespread discontent which the confiscations caused provoked the insurrection generally known as the *bellum perusinum* from its only important incident, the fierce and fatal resistance of Perugia, which deprived the poet of another of his relations, who was killed by brigands while making his escape from the lines of Octavian. The loss of his patrimony, however, thanks no doubt to his mother's providence, did not prevent Propertius from receiving a superior education. After, or it may be, during its completion he and she left Umbria for Rome; and there, about the year 34 B.C., he assumed the garb of manly freedom. He was urged to take up a pleader's profession; but, like Ovid, he found in letters and gallantry a more congenial pursuit. Soon afterwards he made the acquaintance of Lycinna, about whom we know little beyond the fact that she subsequently excited the jealousy of Cynthia, and was subjected to all her powers of persecution (*vexandi*). This passing fancy was succeeded by a serious attachment, the object of which was the famous "Cynthia." Her real name was Hostia, and she was a native of Tibur. She was a courtesan of the superior class, somewhat older than Propertius, but, as it seems, a woman of singular beauty and varied accomplishments. Her own predilections led her to literature; and in her society Propertius found the intellectual sympathy and encouragement which were essential for the development of his powers. Her character, as depicted in the poems, is not an attractive one; but she seems to have entertained a genuine affection for her lover. The intimacy began in 28 and lasted till 23 B.C. These six years must not, however, be supposed to have been a period of unbroken felicity. Apart from minor disagreements an infidelity on Propertius's part excited the deepest resentment in Cynthia; and he was banished for a year. The quarrel was made up about the beginning of 25 B.C.; and soon after Propertius published his first book of poems and inscribed it with the name of his mistress. Its publication placed him in the first rank of contemporary poets, and amongst other things procured him admission to the literary circle of Maecenas. The intimacy was renewed; but the old enchantment was lost. Neither Cynthia nor Propertius was faithful to the other. The mutual ardour gradually cooled; motives of prudence and decorum urged the discontinuance of the connexion; and disillusion changed insensibly to disgust. Although this separation might have been expected to be final, it is not certain that it was so. It is true that Cynthia, whose health appears to have been weak, does not seem to have survived the separation long. But a careful study of the seventh poem of the last book, in which Propertius gives an account of a dream of her which he had after her death, leads us to the belief that they were once more reconciled, and that in her last illness Cynthia left to her former lover the duty of carrying out her wishes with regard to the disposal of her effects and the arrangements of her funeral. Almost nothing is known of the subsequent history of the poet. He was alive in 16 B.C., as some allusions in the last book testify. And two passages in the letters of the younger Pliny mention a descendant of the poet, one Passennus Paullus. Now in 18 B.C. Augustus carried the *Leges Juliae*, which offered inducements to marriage and imposed disabilities upon the celibate. Propertius then may have been one of the first to comply with the new enactments. He would thus have married and had at least one child, from whom the contemporary of Pliny was descended.

Propertius had a large number of friends and acquaintances, chiefly literary, belonging to the circle of Maecenas. Amongst these may be mentioned Virgil, the epic poet Ponticus, Bassus (probably the iambic poet of the name), and at a later period Ovid. We hear nothing of Tibullus, nor of Horace, who also never mentions Propertius. This reciprocal silence is probably significant. In person Propertius was pale and thin, as was to be expected in one of a delicate and even sickly constitution. He was very careful about his personal appearance, and paid an almost foppish attention to dress and gait. He was of a somewhat voluptuous and self-indulgent temperament, which shrank from danger and active exertion. He was anxiously sensitive about the opinion of others, eager for their sympathy and regard, and, in general, impressionable to their influence. His over-emotional nature passed rapidly from one phase of feeling to another; but the more melancholy moods predominated. A vein of sadness runs through his poems, sometimes breaking out into querulous exclamation, but more frequently venting itself in gloomy reflections and prognostications. He had fits of superstition which in healthier moments he despised.

The poems of Propertius, as they have come down to us, consist of four books containing 4046 lines of elegiac verse. The first book, or *Cynthia*, was published separately and early in the poet's literary life. It may be assigned to 25 B.C. The dates of the publication of the rest are uncertain, but none of them was published before 24 B.C., and the last not before 16 B.C. The unusual length of the second one (1402 lines) has led Lachmann and other critics to suppose that it originally consisted of two books, and they have placed the beginning of the third book at ii. 10, a poem addressed to Augustus, thus making five books, and this arrangement has been accepted by several editors.

The subjects of the poems are threefold: (1) amatory and personal, mostly regarding Cynthia—seventy-two (sixty Cynthia elegies), of which the last book contains three; (2) political and social, on events of the day—thirteen, including three in the last book; (3) historical and antiquarian—six, of which five are in the last book.

The writings of Propertius are noted for their difficulty and their disorder. The workmanship is unequal, curtness alternating with redundance, and carelessness with elaboration. A desultory sequence of ideas, an excessive vagueness and indirectness of expression, a peculiar and abnormal latinity, a constant tendency to exaggeration, and an immoderate indulgence in learned and literary allusions—all these are obstacles lying in the way of a study of Propertius. But those who have the will and the patience to surmount them will find their trouble well repaid. For power and range of imagination, for freshness and vividness of conception, for truth and originality of presentation, few Roman poets can compare with him when he is at his best. And this is when he is carried out of himself, when the discordant qualities of his genius are, so to say, fused together by the electric spark of an immediate inspiration. His vanity and egotism are undeniable, but they are redeemed by his fancy and his humour.

Two of his merits seem to have impressed the ancients themselves. The first is most obvious in the scenes of quiet description and emotion in whose presentation he particularly excels. Softness of outline, warmth of colouring, a fine and almost voluptuous feeling for beauty of every kind, and a pleading and melancholy tenderness—such were the elements of the spell which he threw round the sympathies of his reader, and which his compatriots expressed by the vague but expressive word *blanditia*. His poetic *facundia*, or command of striking and appropriate language, is more noticeable still. Not only is his vocabulary very extensive, but his employment of it extraordinarily bold and unconventional. New settings of use, idiom and construction continually surprise us, and, in spite of occasional harshness, secure for his style an unusual freshness and freedom. His handling of the elegiac couplet, and especially of its second line, deserves especial recognition. It is vigorous, varied and even picturesque. In the matter of the rhythms, caesuras and elisions which it allows, the metrical treatment is much more severe than that of Catullus, whose elegiacs are comparatively rude and barbarous; but it is not bound hand and foot, like the Ovidian distich, in a formal and conventional system. An elaborate symmetry is observable in the construction of many of his elegies, and this has tempted critics to divide a number of them into strophes.

Propertius's poems bear evident marks of the study of his predecessors, both Greek and Latin, and of the influence of his contemporaries. He tells us himself that Callimachus and Philetas were his masters (iii. 1, seq.), and that it was his ambition to be the Roman Callimachus (iv. 1, 64). But, as Teuffel has said, his debt to these writers is chiefly a formal one. Even into his mythological learning he breathes a life to which these dry scholars are strangers. We can trace obligations to Meleager, Theocritus, Apollonius Rhodius and other Alexandrines, and amongst earlier writers to Homer, Pindar, Aeschylus and others. Propertius's influence upon his successors was considerable. There is hardly a page of Ovid which does not show obligations to his poems, while other writers made a more sparing use of his stories.

A just appreciation of the genius and the writings of Propertius is made sensibly more difficult by the condition in which his works have come down to us. Some poems have been lost; others are fragmentary; and many are more or less disfigured by corruption and disarrangement. The manuscripts on which we have to rely are both late and deeply interpolated. Thus the restoration and interpretation of the poems is one of peculiar delicacy and difficulty.

On the Propertii see Mommsen in *Hermes*, iv. 370; Haupt, *Opusc.* i. 282. Inscriptions of Propertii have been found at Assisi. Propertius's family was not "noble," ii. 34, 55, 6, and ii. 24, 37 seq. Apart from the question of reading in iv. 1, 125 (MSS. Asis.), "the climbing walls of his town" (scandentes arces, scandens murus, iv. 1, 65 and *loc. cit.*), its nearness to Perugia, and its position close above the plain (i. 22, 9, 10) are decisive for Asisium as the birthplace of Propertius. Ovid thus assigns Propertius his place: successor fuit hic (Tibullus), tibi, Galle: *Propertius illi* (Tibullo): Quartus ab his serie temporis ipse fui (*Tr.* iv. 10, 53, 54) (cf. ib., ii. 467). For Ovid's friendship with Propertius see below—iv. i, 121 seq. is the chief authority for the earlier events of his life, 127 seq.: "Ossaque legisti non illa aetate legenda Patris et in tenues cogeris ipse Lares. Nam tibi cum multi versarent rura iuvenci Abstulit excultas pertica tristis opes." Elsewhere he says that he is "non ita dives" ii. 24, *loc. cit.*) and that he had "nulla domi fortuna relicta," ii. 34, *loc. cit.* His living on the Esquiline, iii. 23, 24, points to a competence. For the death of his kinsman, generally supposed to be the Gallus of i. 21, see i. 22, 5–8. Propertius's mother is mentioned more than once, in very affectionate terms in i., ii. 21. She was dead when iii. 13 (11) was written, *i.e.* six months after the publication of the first book. For the quality of Propertius's education, the poems themselves are the only, but a sufficient, testimony. For Lycinna see iii. 15, 3–10, 43. Cynthia (Hostia) was a native of Tibur (iv. 7, 85), and probably a grand-daughter (iii. 20, 8) of L. Hostius, who wrote a poem on the Illyrian War of 178 B.C., of which some fragments are preserved. She was older than Propertius (ii. 18, 20). That she was a *meretrix* is clear from many indications—her special accomplishments, her house in the Subura, the occurrence of scenes like those in i. 3, ii. 29, the fact that Propertius could not marry her, &c. For references to her beauty see ii. 2, 5 sqq. and 3, 9 sqq.; ii. 13, 23, 24; to her poetry, ii. 3, 21; to other accomplishments, i. 2, 27 seq.; iii. 20, 7 seq. She was fickle (i. 15, ii. 6, &c.), avaricious (ii. 16, 11, 12), fond of finery (ii. 3, 15, 16), violent of temper (iii. 8; i. 4, 18 seq.). For the five years see iii. 25, 3, "quinque tibi potui servire fideliter annos"; and for the year of estrangement, iii. 16, 9, "peccaram semel, et totum sum pulsus in annum." The second separation is vouched for by the two last elegies of book iii. For the evidence which iv. 7 furnishes in favour of a reconciliation see Postgate (*Prop.* Introd. p. xxv. seq.); iv. 6 commemorates the celebration of the *ludi quinquennales*, in 16 B.C., and iv. 11, 66 alludes to the consulship of P. Scipio in the same year. For Passennus Paullus (or as an Assisi inscription calls him C. Passennus Sergius Paullus Propertius Blaesus), see Pliny (*Ep.* vi. 15), "municeps Properti atque etiam inter maiores Propertium numerat"; (9, 22), "in litteris veteres aemulatur exprimit reddit: Propertium in primis a quo genus ducit, vera suboles eoque simillima illi in quo ille praecipuus, si elegos eius in manum sumpseris, leges opus tersum molle iucundum et plane in Properti domo scriptum." ii. 1 and iii. 9 are addressed to Maecenas, ii. 10 to Augustus. Virgil is spoken of in the highest terms in ii. 34, 61 seq. Other poems are addressed to Ponticus (i. 7, 9), Bassus (i. 4), Lynceus, a tragic poet (i. 19, ii. 34). In *Ep.* ii. 2, 87 seq., Horace has been thought to make a direct attack on Propertius. On Propertius's personal appearance, see i. 1, 22, 5, 21. A likeness of him has possibly been preserved in a double Hermes in the Villa Albani and the Vatican, which represents a young beardless Roman, of a nervous and somewhat sickly appearance, together with a Greek poet (Visconti, *Iconograph. romana*, pl. 14, 3, 4). Ill health is proved by i. 15 and the frequent references to death and burial—i. 19, ii. 1, 71 sqq., ii. 13, 17 sqq. For his care about dress and the like see ii. 4, 5, seq. For want of courage and energy see ii. 7, 14, ii. 19, 17–24; and for superstitious leanings, ii. 27, ii. 4, 15, iv. 5, 9 seq. The four-book numbering is now the current one and is adopted in this article though there is little doubt that there were originally four books besides the *Cynthia*. Few of the poems can be dated with certainty, but those that can, with the exception of iv. 6 and 11, fall between the years 28 and 23 B.C. For ancient references to Propertius as a writer see Quint. x. 1, 93 (where it is stated that some (not Quintilian) preferred him to Tibullus), Ov. *A. A.* iii. 333; *Tr.* iii. 465, v. 1, 17; Mart. xiv. 189, viii. 73; Pliny, *loc. cit.* above, Stat. *Silv.* i. 2, 253.

There is no existing MS. of Propertius older than the 12th century. Up till the publication of Bährens's edition (1880), the oldest one, Neapolitanus (N., now at Wolfenbüttel), was universally regarded as the best, and even now critics are found to maintain its paramount claims. But the more judicious admit the value of the four MSS. collated by Bährens. Vossianus, *c.* 1300 (A); Laurentianus, end of 14th century (F); Ottoboniano-Vaticanus, 15th century (V); Daventriensis, 15th century (D), to which has to be added the Holkhamicus, 1421 (L), collated by Postgate, *Cambridge Philological Transactions* (1894) vol. iv.

The *editio princeps* of Propertius is that of 1472 (Venice). Among later editions we may mention the following, those with explanatory or critical notes being marked with an asterisk: *Scaliger (1577, &c.), *Broukhusius (2nd ed., 1577), *Passeratius (1608, with *index verborum*), *Vulpius (1755, with *index verborum*), *P. Burmann (and Santen) (1780), *Lachmann (1816), *Hertzberg (1843–1845), L. Müller (1870), Haupt-Vahlen (last ed., 1904), *Bährens (1880), *A. Palmer (1880), *Postgate (1881), selections with introduction (text with critical notes in the *Corpus poetarum latinorum*, 1894, also issued separately), *Rothstein (1898), *H. E. Butler (1905), *index verborum* (to his own text), J. S. Phillimore (1906), A. E. Housman (without publishing an edition) has done much to improve and explain the poems. For further information we may refer to F. Plessis, *Études critiques sur Properce et ses élégies* (1886), and the sections on the poet in Teuffel's and Schanz's *Histories of Roman Literature*.

The following translations into English verse are known: G. F. Nott (1782), bk. i.; C. A. Alton, selections in his *Specimens of the Classic Poets* (1814), ii. 215 seq.; C. R. Moore (1870); J. Cranstoun (1875); F. A. Paley (1866), verse translations from bk. v. with notes; also a few translations by the poet Gray, vol. i. (Gosse, 1884); S. G. Tremenheere (1899), bk. i. Prose translations: P. J. F. Gantillon (with Nott's and Elton's versions, Bohn, 1848); J. S. Phillimore (1906). (J. P. P.)

PROPERTY, that which is peculiarly one's own, that which belongs to or is characteristic of an individual. The Latin *proprietas* (formed from *proprius*, one's own, possibly derived from *prope*, near) in post-Augustan times was extended to ownership and rights of possession. It is thus, in law, the generic term for rights of ownership and for things subject to the rights of ownership. It is "the most comprehensive of all terms which can be used, inasmuch as it is indicative and descriptive of every possible interest which the party can have" (see Langdale, M. R., in *Jones* v. *Skinner*, 1835, 5 L. J. Ch. 90).

In Roman law and in modern systems of law based on it, property is divided into "movables" and "immovables"; in English law, on the other hand, the division is into personal property, including chattels real, and real property (see PERSONAL PROPERTY and REAL PROPERTY). Theatrical usage has given a specific meaning to the word, that of any article used on the stage during the performance of a play.

PROPHET (προφήτης), a word taken from the vocabulary of ancient Greek religion,[1] which passed into the language of Christianity, and so into the modern tongues of Europe, because it was adopted by the Hellenistic Jews as the rendering of the Hebrew נביא (*nābhī*^{a} pl., *nebhīīm*). The word therefore as we use it is meant to convey an idea which belongs to Hebrew and not to Hellenic belief.

That the word *nābhī*^{a}, "prophet," originally signified one who speaks or announces the divine will, is rendered highly probable by a comparison of the Assyrian *nabū*, meaning (*a*) to "call" or "name," (*b*) "announce" (see Delitzsch, *Handwörterbuch sub voce*). The Babylonian deity *Nabū* (in Old Testament Nebo) is a contraction from *Na-bi-u*, which thus corresponds closely with the Hebrew *nābhī*^{a} and originally signified the speaker or proclaimer of destiny. He was represented as the writer of the tablets of destiny, and was therefore regarded as the interpreter of oracles (see Zimmern, *K. A. T.*^{3} pp. 400, 404). Accordingly this derivation is preferable to that suggested by earlier Semitists from Gesenius to (in recent times) Kautzsch ("Religion of Israel," Hastings's *Dict. Bible*, extra vol., p. 652 footnote), and Cheyne (*Ency. Bibl.* col. 3853), which connects it with another verbal root *naba*, "bubble" or "gush." This Davidson ("Prophecy and Prophets," Hastings's *Dict. Bible*, p. 108 footnote) rightly rejects. While he connects it with the Arabic root *naba'a*, "come into prominence" (conj. II. "announce,") he ends by ascribing to it an ultimate Babylonian origin. Zimmern (*K.A.T.*^{3} p. 590) gives the name of a priest-official *munambū* (lit. "howler"), which is derived from a Piel of *nabū*, viz. *nubbū* (= *numbū*), "bawl" or "howl." A brief sketch will be given (1) of the history of Hebrew prophecy (in supplement to what has been already said in the article HEBREW RELIGION or is to be found in the articles devoted to individual prophets), and (2) of prophecy in the early Christian Church.

The Seer.

1. *The Prophets of the Old Testament.*—The author of 1 Sam. ix. 9 tells us that "beforetime in Israel, when a man went to inquire of God, thus he spake, Come and let us go to the seer; for he that is now called a prophet (*nābhī*^{a}) was beforetime called a seer." This remark is probably a later gloss. Samuel was a "seer" (ver. 11), or, as he is also called (ver. 6 seq.), a "man of God," that is one who stood in closer relations to God than ordinary men; "all that he said was sure to come to pass," so that he could be consulted with advantage even in private matters like the loss of the asses of Kish. The narrative of 1 Sam. ix. belongs, as Budde has demonstrated, to the older stratum of the narrative (called J) which includes ix., x. 1-16, xi. 1-11, 15, xiii., xiv. 1-16 in which Samuel is a priest-seer of a provincial town, without the high functions of government as *Shōphēt*. We must not suppose that the word "prophet" had merely become more common in his time and supplanted an older synonym. This is clearly shown a few verses farther down, where we see that there were already in Samuel's time people known as *nebhīīm*, but that they were not seers. The seer (*rōeh*) appears individually, and his function was probably not so much one of speech as of the routine of close observation of the entrails of slaughtered victims, like the Assyrian *barū* (see PRIEST). It is in this way that the function of the seer is closely connected (as in the case of Balaam) with sacrifices. With the prophets it is quite otherwise; they appear not individually but in bands; their prophesying is a united exercise accompanied by music, and seemingly dance-music; it is marked by strong excitement, which sometimes acts contagiously, and may be so powerful that he who is seized by it is unable to stand,[2] and, though this condition is regarded as produced by a divine afflatus, it is matter of ironical comment when a prominent man like Saul is found to be thus affected. Samuel in his later days appears presiding over the exercises of a group of *nebhīīm* at Ramah, where they seem to have had a sort of coenobium (Naioth), but he was not himself a *nābhī*^{a}—that name is never applied to him except in 1 Sam. iii. 21, where it is plainly used in the later sense for the idea which in Samuel's own time was expressed by "seer."

The Dervish.

But again this special type of *nebhīīm* seems to have been a new thing in Israel in the days of Samuel. Seers there had been of old as in other primitive nations; of the two Hebrew words literally corresponding to our seer, *rōeh* and *ḥōzeh*, the second is found also in Arabic, and seems to belong to the primitive Semitic vocabulary.[3] But the enthusiastic bands of prophets are nowhere mentioned before the time of Samuel; and in the whole previous history the word prophet occurs very rarely, never in the very oldest narratives, and always in that sense which we know to be later than the age of Samuel, so that the use of the term is due to writers of the age of the kings, who spoke of ancient things in the language of their own day. The appearance of the *nebhīīm* in the time of Samuel was, it would seem, as is explained in the article HEBREW RELIGION, one manifestation of the deep pulse of suppressed indignant patriotism which began to beat in the hearts of the nation in the age of Philistine oppression, and this fact explains the influence of the movement on Saul and the interest taken in it by Samuel.

It was perhaps only in time of war, when Israel felt himself to be fighting the battles of Yahweh, that the Hebrew was stirred to the depths of his nature by emotions of a religious colour. Thus the deeper feelings of religion were embodied in warlike patriotism, and these feelings the Philistine oppression had raised to extreme tension among all who loved liberty, while yet the want of a captain to lead forth the armies of Yahweh against his foemen deprived them of their natural outlet.

In its external features the new phenomenon was exceedingly like what is still seen in the East in every *zikr* of dervishes—the enthusiasm of the prophets expressed itself in no artificial form, but in a way natural to the Oriental temperament. Processions with pipe and hand-drum, such as that described in 1 Sam. x., were indeed a customary part of ordinary religious feasts; but there they were an outlet for natural merriment, here they have changed their character to express an emotion more sombre and more intense, by which the prophets, and often mere chance spectators too, were so overpowered that they seemed to lose their old personality and to be swayed by a supernatural influence. More than this hardly lies in the expression "a divine spirit" (רוח אלהים), which is used not only of the prophetic afflatus but of the evil frenzy that afflicted Saul's later days. The Hebrews had a less narrow conception of the spiritual than we are apt to read into their records.

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[1] According to Plato (*Timaeus*, p. 72) the name προφήτης ought properly to be confined to the interpreters employed to put an intelligible sense on the dreams, visions, or enigmatic utterances of the frenzied μάντις. But in ordinary Greek usage the prophet of any god is in general any human instrument through whom the god declares himself; and the tendency was "to reserve the name for unconscious interpreters of the divine thought, and for the ministers of the oracles in general" (Bouché-Leclercq, *Hist. de la divination*, 1880, ii. 11). This probably facilitated the adoption of the term by the Hellenists of Alexandria, for, when Philo distinguishes the prophet from the spurious diviner by saying that the latter applies his own inferences to omens and the like while the true prophet, rapt in ecstasy, speaks nothing of his own, but simply repeats what is given to him by a revelation in which his reason has no part (ed. Mangey, ii. 321 seq., 343; cf. i. 510 seq.), he follows the prevalent notion of the later Jews, at least in so far as he makes the function of the prophet that of purely mechanical reproduction; cf. John xi. 51, and the whole view of revelation presupposed in the Apocalyptic literature. But in any case the Greek language hardly offered another word for an organ of revelation so colourless as προφήτης, while the condition of etymology among the ancients made it possible to interpret it as having a special reference to prediction (so Eusebius, *Dem. Ev.* v., deriving it from προφαίνω).

[2] 1 Sam. x. 5 seq., xix. 20 seq. In the latter passage read "they saw the fervour of the prophets as they prophesied, &c." (see Hoffmann in Stade's *Zeitschr.* 1883, p. 89), after the Syriac.

[3] Hoffmann, *ut supra*, p. 92 seq. *Rōeh*, however, occurs very rarely in early, *i.e.* pre-exilian, Hebrew, viz. in 1 Sam. ix. 9, Isa. xxx. 10. We have several in the late literature of Chronicles. Accordingly we lack the materials for determining the distinction which probably existed between the *rōeh*, the *ḥōzeh* and the *ḳōsēm*. Cheyne, art. "Prophetic Literature" in *Ency. Bib.*, col. 3858, appears to identify them.

Canaanite Prophets.

To give a name to this new phenomenon the Israelites, it would seem, had to borrow a word from their Canaanite neighbours. At all events the word *nābhī*^{a} is neither part of the old Semitic vocabulary (in Arabic it is a late loan word) nor has it any etymology in Hebrew, the cognate words "to prophesy" and the like being derived from the noun in its technical sense. But we know that there were *nebhīīm* among the Canaanites; the "prophets" of Baal appear in the history of Elijah as men who sought to attract their god by wild orgiastic rites. In fact the presence of an orgiastic character is as marked a feature in Canaanite religion as the absence of it is in the oldest religion of Israel; but the new Hebrew enthusiasts had at least an external resemblance to the devotees of the Canaanite sanctuaries and this would be enough to determine the choice of a name which in the first instance seems hardly to have been a name of honour. In admitting[1] that the name was borrowed, we are not by any means shut up to suppose that the Hebrew *nebhīīm* simply copied their Canaanite neighbours. The phenomenon is perfectly intelligible without any such hypothesis. A wave of intense religious feeling passes over the land and finds its expression, according to the ordinary law of oriental life, in the formation of a sort of enthusiastic religious order. The Nazarites and the Rechabites are parallel phenomena, though of vastly inferior historical importance.

It may be assumed that the name *nābhī*^{a}, while it originated from Babylonian sources, reached Israel through Canaanite channels (cf. Kautzsch, "Religion of Israel," in Hastings's *Dict. Bible* extra vol., p. 653). Some support is given to this view by (*a*) the statement in 1 Kings xviii. 19 that four hundred prophets of Baal and Ashērah sat at Jezebel's table; (*b*) the fact that Deborah, Samuel, Elijah, Elisha, Micaiah ben Imlah, the most notable of the earlier representatives of prophecy, belong to northern Israel, which was more subject to Canaanite-Phoenician influence.

It is certainly probable that the *nābhī*^{a} emerged by a process of continued development, of which the intermediate stages are lost, from the older *rōeh*, as the explanatory gloss in 1 Sam. ix. 9 evidently intimates. Samuel himself is called a *rōeh*. We may assume that like the practice of the soothsaying priest (the earlier type of priest) and of the *ḳōsēm* (diviner), so the procedure of the *rōeh* was mechanical and magical in character. Clear indications of a primitive magical *modus operandi* appear as survivals in the narratives of the pre-exilian prophets. The wonder-working staff of Elisha (2 Kings iv. 29, 31) is one of these indications. There are likewise traces of survival in the examples of "sympathetic magic" transformed into the acted *parable of prophecy*. Students of Tallquist's *Maklū* series of incantation or of the *šurpu* series edited by Zimmern (in his *Beiträge zur Kenntniss der Babylonischen Religion*) will recollect the images over which the priest sorcerer recites his formulae. The accompanying actions (tying knots, &c.) which he performs are assumed to work themselves out on the enemy whose evil eye or sorcery is blasting the happiness of the suppliant (see Hastings's *Dict. Bible*, "Magic," p. 209, where examples are cited). The signs or symbolic acts of the prophet probably originated in the actions of sympathetic magic. Thus in the vivid scene of 1 Kings xxii. 11 the iron horns of Zedeḳiah ben Kena'nah, and in 2 Kings xiii. 15–19 the magic of the arrow shot eastward and of the thrice stricken floor, are evident survivals of an older practice. The magical act passes into sign or symbol, not however without the accompanying conception that underlies it still persisting that a mysterious effectuating potency belongs to the symbolic act. The mystic power of a significant name *Maḥēr shālāl ḥash baz* inscribed on a tablet and bestowed on a child (Isa. viii. 1–4, cf. xx. 2 sqq.), of the "thongs and bars" of Jer. xxvii. (in which contending prophets confront one another in a contest of symbols), of the linen girdle of ch. xiii. 1 sqq., and of the potter's vessel of xix. 1 sqq., are further illustrations of survivals from the old world of magic. The symbol gradually passes into mere metaphor, and we already begin to see this when we compare Ezekiel's oracles and those of the Deutero-Isaiah with the records of the words and deeds of earlier prophets.

Prophetic Societies or Gilds.

Nathan.

Elijah.

The peculiar methods of the prophetic exercises described in 1 Sam. were of little consequence for the future development of prophecy. The heat of a first enthusiasm necessarily cooled when the political conditions that produced it passed away; and, if the prophetic associations had done no more than organize a new form of spiritual excitement, they would have only added one to the many mechanical types of hysterical religion which are found all over the East. Their real importance was that they embodied an intenser vein of feeling than was expressed in the ordinary feasts and sacrifices, and that the greater intensity was not artificial, but due to a revival of national sentiment. The worship of the local sanctuaries did nothing to promote the sense of the religious unity of Israel; Yahweh in the age of the Judges ran no small risk of being divided into a number of local Baals, givers of natural good things each to his own locality. The struggle for freedom called forth a deeper sense of the unity of the people of the one Yahweh, and in so doing raised religion to a loftier plane; for a faith which unites a nation is necessarily a higher moral force than one which only unites a township or a clan. The local worships, which subsisted unchanged during the greater part of the Hebrew kingship, gave no expression to this rise in the religious consciousness of the nation; on the contrary, we see from the prophetic books of the 8th century that they lagged more and more behind the progress of religious thought. But the prophetic societies were in their origin one symptom of that upheaval of national life of which the institution of the human sovereign reigning under the divine King was the chief fruit; they preserved the traditions of that great movement; they were, in however imperfect a way, an organ of national religious feeling, and could move forward with the movement of national life. And so, though we cannot follow the steps of the process, we are not surprised to learn that they soon had an established footing in Israel, and that the prophets came to be recognized as a standing sacred element in society. What was their precise place in Hebrew life we hardly know but they formed at least a religious class which in all its traditions represented the new national and not the old communal and particularistic life. One characteristic point which appears very early is that they felt themselves called upon to vindicate the laws of divine righteousness in national matters, and especially in the conduct of the kings, who were not answerable to human authority. The cases of Nathan and David in the matter of Uriah, of Elijah and Ahab after the judicial murder of Naboth, will occur to everyone, and from the Hebrew standpoint the action of Gad in the matter of the census taken by David belongs to the same category. Such interventions with an Eastern king demanded great moral courage, for, though to some extent protected by their sacred character, the persons of the prophets were by no means legally inviolable (1 Kings xix. 2, xxii. 27; 2 Kings vi. 31). It is far from easy to determine how far the development of the class of prophets meant the absorption into it of the old seers. Probably both coexisted for some time. At all events we know from Isa. iii. 2, 3, that in Isaiah's time the *ḳōsēm* still held an important place in society as well as the prophet and the magician. The functions of *rōeh* and *nābhī*^{a} may indeed at first have been mingled. The great prophecy of Nathan (2 Sam. vii.) is of too disputed a date to be cited in evidence,[1] but already in David's time we find that Gad the *nābhīᵃ* is also the king's seer (2 Sam. xxiv. 11; cf. 1 Sam. xxii. 5), and by-and-by it comes to be clearly understood that the prophets are the appointed organ of Yahweh's communications with His people or His king. The rise of this function of the prophets is plainly parallel with the change which took place under the kings in the position of the priestly oracle; the Torah of the priests now dealt rather with permanent sacred ordinances than with the giving of new divine counsel for special occasions. Yahweh's ever-present kingship in Israel, which was the chief religious idea brought into prominence by the national revival, demanded a more continuous manifestation of His revealing spirit than was given either by the priestly lot or by the rise of occasional seers; and where could this be sought except among the prophets? It does not, of course, follow that everyone who had shared in the divine afflatus of prophetic enthusiasm gave forth oracles; but the prophets as a class stood nearer than other men to the mysterious workings of Yahweh, and it was in their circle that revelation seemed to have its natural home. A most instructive passage in this respect is 1 Kings xxii., where we find some four hundred prophets gathered together round the king, and where it is clear that Jehoshaphat was equally convinced, on the one hand, that the word of Yahweh could be found among the prophets, and on the other that it was very probable that some, or even the mass of them, might be no better than liars. And here it is to be observed that Micaiah, who proved the true prophet, does not accuse the others of conscious imposture; he admits that they speak under the influence of a spirit proceeding from Yahweh, but it is a lying spirit sent to deceive. The sublime and solitary figure of Elijah, whom we are apt to take as the typical figure of a prophet in the old kingdom, has little in common with the picture even of the true prophet which we derive from 1 Kings xxii.; and when his history is carefully and critically read it is found to give no reason to think that he stood in any close relation to the prophetic societies of his time. He is a man of God, like Moses and Samuel, a man admitted to a strange and awful intimacy with the Most High, and like them he combines functions which in later times were distributed between prophet and priest. The fundamental idea that Yahweh guides His people by the word of revelation is older than the separation of special classes of theocratic organs; Moses, indeed, is not only prophet and priest, but judge and ruler. But, as the history goes on, the prophet stands out more and more as the typical organ of revelation, the type of the man who is Yahweh's intimate, sharing His secrets (Amos iii. 7; Jer. xxiii. 22), and ministering to Israel the gracious guidance which distinguishes it from all other nations (Amos ii. 11; Hosea xii. 10, 13), and also the sentences of awful judgment by which Yahweh rebukes rebellion (Hos. vi. 5). The full development of this view seems to lie between the time of Elijah and that of Amos and Hosea—under the dynasty of Jehu, when prophecy, as represented by Elisha and Jonah, stood in the fullest harmony with the patriotic efforts of the age. This growth in the conception of the prophetic function is reflected in parts of the Pentateuch, which may be dated with probability as belonging to the period just named; the name of *nābhīᵃ* is extended to the patriarchs as Yahweh's intimates (Gen. xx. 7), and Moses begins to be chiefly looked at as the greatest of prophets (Num. xi., xii.; Deut. xxxiv. 10), while Aaron and Miriam are also placed in the same class (Exod. xv. 20; Num. xii.), because they too are among the divinely favoured leaders of Israel (cf. Micah vi. 4).[2]

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[1] If this account of the origin of the *nebhīīm* is correct (cf. Kuenen, *Prophets*, Eng. trans., p. 554 seq.), the etymological sense of the word נביא is comparatively unimportant. The root seems to mean "to start up," "to rise into prominence," and so "to become audible." This is based on the Arabic *naba'a*; see the remarks at the beginning of this article.

Elisha.

Elisha, the successor of Elijah, stood in much closer relations to the prophetic societies than his great master had done. As a man of practical aims he required a circle through which to work, and he found this among the prophets, or, as they are now called, the sons of the prophets. According to Semitic idiom "sons of the prophets" most naturally means "members of a prophetic corporation,"[3] which may imply that under the headship of Elisha and the favour of the dynasty of Jehu, which owed much to Elisha and his party, the prophetic societies took a more regular form than before. The accounts we have certainly point in this direction, and it is characteristic that in 2 Kings iv. 42 first-fruits are paid to Elisha. But to an institution like prophecy national recognition, royal favour and fixed organization are dangerous gifts. It has always been the evil fate of the Hebrews to destroy their own highest ideals by attempting to translate them into set forms, and the ideal of a prophetic guidance of the nation of Yahweh could not have been more effectually neutralized than by committing its realization to the kind of state Church of professional prophets, "eating bread" by their trade (Amos vii. 12),[4] which claimed to inherit the traditions of Elijah and Elisha. The sons of the prophets appear to have been grouped round the leading sanctuaries, Gilgal, Bethel, and the like (cf. Hos. ix. 8), and to have stood in pretty close relation to the priesthood (Hos. iv. 5), though this comes out more clearly for the southern kingdom, where, down to the last days of Hebrew independence, the official prophets of Jerusalem were connected with the Temple and were under the authority of the chief priest (Jer. xxix. 26). Since the absorption of the aborigines in Israel Canaanite ideas had exercised great influence over the sanctuaries—so much so that the reforming prophets of the 8th century regarded the national religion as having become wholly heathenish; and this influence the ordinary prophets, whom a man like Micah regards as mere diviners, had certainly not escaped. They too were, at the beginning of the Assyrian period, not much more different from prophets of Baal than the priests were from priests of Baal. Their God had another name, but it was almost forgotten that He had a different character.

Amos and his Successors.

The rise and progress of the new school of prophecy, beginning with Amos and continued in the succession of canonical prophets, which broke through this religious stagnation, is discussed in the article HEBREW RELIGION; for from Amos, and still more from Isaiah downwards, the prophets and their work made up the chief interest of Hebrew history. From this time, moreover, the prophets appear as authors; and their books, preserved in the Old Testament, form the subject of special articles (AMOS, HOSEA, &c.). A few observations of a general character will therefore suffice in this place.

Amos disclaimed all connexion with the mere professional prophets, and in this he was followed by his successors. Formerly the prophets of Yahweh had been all on the same side; their opponents were the prophets of Baal. But henceforth there were two parties among the prophets of Yahweh themselves, the new prophets accusing the old of imposture and disloyalty to Yahweh, and these retaliating with charge of disloyalty to Israel. We have learned to call the prophets of the new school "true" prophets and their adversaries "false"; and this is perfectly just if we take the appellations to mean that the true prophets maintained a higher, and therefore a truer, view of

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[1] Budde (*Bücher Samuelis*, p. 233) assigns Nathan's speech (2 Sam. vii.) to a late E. writer in the 7th century. Perhaps we might assign it and Jer. xxiii. 5, 6, to the earlier part of Josiah's reign.

[2] None of these passages belong to the very oldest thread of Pentateuchal story, and similarly Deborah is called prophetess only in the later account (Judg. iv. 4), not in the song (Judg. v.). It is characteristic that in Num. xi. the elders who receive a share in Moses' task also receive a share of his prophetic spirit (cf. the parallel 2 Kings ii. 9 seq.). In the older account (Exod. xviii.) this is not so. Again, Moses differs from all other prophets in that Yahweh speaks to him face to face, and he sees the similitude of Yahweh. This is in fact the difference between him and Elijah (cf. Exod. xxxiii. 8–11 with 1 Kings xix. 13), but not between him and the great prophets of the 8th century (Isa. vi. 5). That prophecy was generally given in visions, dreams and obscure sentences is true only of an early period. Amos still has frequent visions of a more or less enigmatic character, as Micaiah had, but there is little trace of this in the great prophets after him. On the psychological reasons for this see W. R. Smith, *Prophets of Israel* (1882), p. 221 seq.

[3] See G. Hoffmann, *Kirchenversammlung zu Ephesus* (1873), p. 89.

[4] Those who consulted the old seers were expected to make a present, 1 Sam. ix. 7 (Arabic *ḥolwānu-'l-kāhin*; cf. Bokhari iv. 219). Similar presents were brought to the older prophets (1 Kings xiv. 3), and first-fruits were sometimes paid to a man of God; but the successors of Amos share his contempt for those who traded on their oracles (*Mic.* iii. 5 seq.).

Yahweh's character, purpose and relation to His people. But the false prophets were by no means mere common impostors; they were the accredited exponents of the common orthodoxy of their day, for the prophets who opposed Jeremiah took their stand on the ground of the prophetic traditions of Isaiah, whose doctrine of the inviolability of Yahweh's seat on Zion was the starting-point of their opposition to Jeremiah's predictions of captivity. No doubt there were many conscious hypocrites and impostors among the professional prophets, as there always will be among the professional representatives of a religious standpoint which is intrinsically untenable, and yet has on its side the prestige of tradition and popular acceptance. But on the whole the false prophets deserve that name, not for their conscious impostures, but because they were content to handle religious formulas, which they had learned by rote, as if they were intuitive principles, the fruit of direct spiritual experience, to enforce a conventional morality, shutting their eyes to glaring national sins, after the manner of professional orthodoxy, and, in brief, to treat the religious *status quo* as if it could be accepted without question as fully embodying the unchanging principles of all religion. The popular faith was full of heathenish superstition strangely blended with the higher ideas which were the inheritance left to Israel by men like Moses and Elijah; but the common prophets accepted all alike, and combined heathen arts of divination and practices of mere physical enthusiasm with a not altogether insincere pretension that through their professional oracles the ideal was being maintained of a continuous divine guidance of the people of Yahweh.

Amos and his successors accepted the old ideal of prophecy if they disowned the class which pretended to embody it. "The Lord Yahweh will do nothing, but He revealeth His secret to His servants the prophets." "By a prophet Yahweh brought Israel out of Egypt, and by a prophet" in each successive age Israel had been watched over and preserved. But in point of fact the function of the new prophecy was not to preserve but to destroy Israel, if Israel still meant the actual Hebrew nation, with its traditional national life. Till Amos (with the solitary exception of Micaiah ben Imlah, in 1 Kings xxii.) prophecy was optimist—even Elijah, if he denounced the destruction of a dynasty and the annihilation of all who had bowed the knee to Baal, never doubted of the future of the nation when only the faithful remained; but the new prophecy is pessimist—it knows that Israel is rotten to the core, and that the whole fabric of society must be dissolved before reconstruction is possible. And this it knows, not by a mere ethical judgment on the visible state of society, but because it has read Yahweh's secret written in the signs of the times and knows that He has condemned His people. To the mass these signs are unintelligible, because they deem it impossible that Yahweh should utterly cast off His chosen nation; but to those who know His absolute righteousness, and confront it with the people's sin, the impending approach of the Assyrian can have only one meaning and can point to only one issue, viz. the total ruin of the nation which has denied its divine head. It is sometimes proposed to view the canonical prophets as simple preachers of righteousness; their predictions of woe, we are told, are conditional, and tell what Israel must suffer if it does not repent. But this is an incomplete view; the peculiarity of their position is that they know that Israel as it exists is beyond repentance. Only, while they are hopeless about their nation they have absolute faith in Yahweh and His purpose. That cannot be frustrated, and, as it includes the choice of Israel as His people, it is certain that, though the present commonwealth must perish, a new and better Israel will rise from its grave. Not the reformation but the resurrection of Israel is the goal of the prophets' hope (Hos. vi. 1 seq.).

This of course is only the broadest possible statement of a position which undergoes many modifications in the hands of individual seers, but on the whole governs all prophecy from Amos to Jeremiah. The position has, we see, two sides: on the one side the prophets are heralds of an inexorable judgment based on the demands of absolute righteousness; on the other they represent an assured conviction of Yahweh's invincible and gracious love. The current theological formula for this two-sided position is that the prophets are at once preachers of the law and forerunners of the gospel; and, as it is generally assumed that they found the law already written, their originality and real importance is made to lie wholly in their evangelical function. But in reality as has been shown in the article on Hebrew Religion, the prophets are older than the law, and the part of their work which was really epoch-making for Israel is just the part which is usually passed over as unimportant. By emphasizing the purely moral character of Yahweh's demands from Israel, by teaching that the mere payment of service and worship at Yahweh's shrines did not entitle Israel's sins to be treated one whit more lightly than the sins of other nations, and by enforcing these doctrines through the conception that the approach of the all-destroying empire, before which Israel must fall equally with all its neighbours, was the proof of Yahweh's impartial righteousness, they gave for the first time a really broad and fruitful conception of the moral government of the whole earth by the one true God.[1]

It is impossible to read the books of the older prophets, and especially of their protagonist Amos, without seeing that the new thing which they are compelled to speak is not Yahweh's grace but His inexorable and righteous wrath. That that wrath must be followed by fresh mercies is not in itself a new thought, but only the necessary expression of the inherited conviction that Yahweh whom they preach as the judge of all the earth, is nevertheless, as past history has proved, the God who has chosen Israel as His people. That this is so appears most clearly in the fact that with Amos the prophecy of restoration appears only in a few verses at the end of his book, and in the still more instructive fact that neither he nor Hosea attempts to explain how the restoration which they accept as a postulate of faith is to be historically realized.[2] Recent critics, however, viz. Wellhausen, Nowack, Marti and Harper, as well as others, have denied the genuineness of the concluding verses in Amos, viz. ix. 8–15. To Hosea, at least in his later prophecies, the fate of Judah does not appear separable from that of the northern realm—when Israel and Ephraim fall by their iniquity Judah must fall with them (Hos. v. 5). Thus even on this side there is no real bridge over the chasm that separates the total ruin impending over the Israel of the present from the glorious restoration of the Israel of the future. There is a unity in the divine purpose, of which judgment and mercy are the two poles, but there is as yet no conception of an historical continuity in the execution of that purpose, and therefore no foundation laid for the maintenance of a continuous community of faith in the impending fall of the nation.

From this we can see the enormous importance of the work of Isaiah as it has been exhibited in the article Hebrew Religion; his doctrine of the remnant, never lost to the nation in the worst times, never destroyed by the most fiery judgments, supplies the lacking element of continuity between the Israel of the present and of the future. Yahweh's kingdom cannot perish even for a time; nay, Isaiah argues that it must remain visible, and visible not merely in the circle of the like-minded whom he had gathered round him and who formed the first germ of the notion of the church, but in the political form of a kingdom also. Zion at least, the sacred hearth of Yahweh, the visible centre of His kingdom, must remain inviolable; it can never be delivered into the hands of the Assyrian. Thus, with Isaiah in the days of Sennacherib's invasion, the prophetic word became again, as it had been in the days of the Syrian wars, "the chariots and horsemen of Israel," the stay and strength of all patriotic hope.

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[1] It must not be supposed that this conception necessarily came into force as soon as it was recognized that Yahweh was the creator of the universe. That the national or tribal god is the creator is an idea often found in very low religions. To us God's sovereignty over nature often seems the hardest thing to conceive; but to primitive peoples who know nothing of laws of nature, His moral sovereignty is a much more difficult conception. In the older literature of the Hebrews, the nearest approach to the thought of Amos and Hosea is not Gen. ii., iii., but Gen. xviii. 25.

[2] Hosea ii. 14 seq., xi. 10 seq. are not solutions of this difficulty, as appears from their metaphorical form. They tell us that Yahweh will call His people and that they will answer; but this is only putting in another form the axiom that the gifts and calling of God are without repentance.

Yet even at this crisis the resemblance between Isaiah and Elisha, between the new prophecy and the old, is more apparent than real. Elisha still stands firmly planted on the old national conception of the religion of Yahweh; his ideals are such as do not lie beyond the range of practical politics. In doing battle against the Tyrian Baal he is content with a reformation for which the whole nation can be heartily won, because it makes no radical change in their inherited faith and practices of worship. And in stimulating resistance to Syria he is still the prophet of the old "God of the hosts of Israel"—a God who works deliverance by the thews and sinews of His earthly warriors. But Isaiah's ideal of religion was one for which he himself demands as a preliminary condition an outpouring of Yahweh's spirit on king (Isa. xi. 2) and people (Isa. xxxii. 15), working an entire moral regeneration. And so too it is not through the material organization of the Judaean kingdom that Isaiah looks for deliverance from Assyria. He sees with absolute clearness the powerlessness of the little realm against that great empire: the Assyrian must fall, and fall before Jerusalem, that Yahweh alone may appear to all the earth as the one true God, while all the idols appear as vain to help their worshippers. These conceptions break through the old particularistic idea of Yahweh and His religion at every point. Zion is now not the centre of a mere national cult, but the centre of all true religion for the whole world; and more than once the prophet indicates not obscurely that the necessary issue of the great conflict between Yahweh and the gods of the heathen must be the conversion of all nations, the disappearance of every other religion before the faith of the God of Israel. The pre-exilian origin of Isa. ii. 2–4 which announces that all foreign nations shall stream towards the exalted mountain of Yahweh's temple is maintained by Duhm but is denied by many recent critics including Cornill. But this all-conquering religion is not the popular Yahweh worship; why then can the prophet still hold that the one true God is yet the God of Israel, and that the vindication of His Godhead involves the preservation of Israel? Not because His providence is confined to Israel—it embraces all nations; not because He shows any favouritism to Israel—He judges all nations by the same strict rule. If Israel alone among nations can meet the Assyrian with the boast "with us is God," the reason is that in Zion the true God is known[1]—not indeed to the mass, but to the prophet, and that the "holy seed"[2] or "remnant" (contained in the name *Shear yāshūbh*) which forms the salt of the nation. The interpretation which Isaiah puts on this fact depends on the circumstance that at that date religion had never been conceived as a relation between God and individuals, or as a relation between God and a purely spiritual society, but always as a relation between a deity and some natural social group—a stock, a tribe, a nation. It was therefore only as the God of Israel that the true God could be known within Israel; and so on the one hand the little society of faith—which had not in reality the least tinge of political coherence—is thought of as yet forming the true kernel of the nation *qua* nation, while on the other hand the state of Judah profits by the prophetic religion inasmuch as the nation must be saved from destruction in order that the prophetic faith—which is still bound up with the idea of the nation—may not be dissolved. This connexion of ideas was not of course explicitly before the prophet's mind, for the distinctive features of a national religion could not be formulated so long as no other kind of religion had ever been heard of. When we put down in black and white the explicit details of what is involved in Isaiah's conclusion of faith we see that it has no absolute validity. True religion can exist without having a particular nation as its subject as soon as the idea of a spiritual community of faith has been realized. But till this was realized Isaiah was right in teaching that the law of continuity demanded that the nation within which Yahweh had made Himself known to His spiritual prophets must be maintained as a nation for the sake of the glory of God and the preservation of the "remnant."

The withdrawal of Sennacherib's army, in which the doctrine of the inviolability of Zion received the most striking practical confirmation, was welcomed by Isaiah and his disciples as an earnest of the speedy inbringing of the new spiritual era. But these hopes were not fulfilled. The prophetic teaching had indeed produced a profound effect; to the party of reaction, as the persecution under Manasseh shows, it seemed to threaten to subvert all society; and we can still measure the range and depth of its influence in the literary remains of the period from Isaiah to the captivity, which include Micah vi. 1–8, and that noble essay to build a complete national code on the principle of love to God, righteousness, and humanity—the legislation of Deuteronomy. Nay more, the reception of the book of Deuteronomy by king and people in the eighteenth year of Josiah shows what a hold the prophetic teaching had on the popular conscience. It was no small triumph that there was even a passing attempt to introduce such a code as the law of the land. But it was one thing to touch the conscience of the nation and another to change its heart and renew its whole life. That no code could do, and, as every practical government must adapt itself to actualities and not to a purely ideal standard, it must have appeared at once that the attempt to govern by prophetic ideas was only sewing a new piece on an old garment. The immediate result of Josiah's reformation was the complete dissolution of anything that could be called a political party of prophetic ideas; the priests and the ordinary prophets were satisfied with what had been accomplished; the old abuses began again, but the nation had received a reformed constitution and there was nothing more to be said.

Thus it was that, though beyond question there had been a real advance in the average ethical and spiritual ideas of the people since the time of Isaiah, Jeremiah found himself more isolated than Isaiah had ever been. Even in that earliest part of his book which is mainly a recapitulation of his experiences and work in the reign of Josiah, his tone is one of absolute hopelessness as to the future of the nation. But we should quite misunderstand this pessimism if we held it to mean that Jeremiah saw no signs of private morality and individual spiritual convictions among his people. To him as a prophet the question was whether Israel as a nation could be saved. In Isaiah's days the answer had been affirmative; there appeared to be at least a potentiality of national regeneration in the holy seed when once it should be cleansed from the chaff by a work of judgment. But, now a century of respite had been granted, the Chaldaeans were at the gates, and there was no sign of valid national repentance. The harvest was past, the season of ripe fruits was over, and still Israel was not saved (Jer. viii. 20). The time of respite had been wasted, all attempts at national reformation had failed; how should Yahweh spare a nation which had shown no tokens of fitness to discharge the vocation of Yahweh's people? The question was not whether there was still a faithful remnant, but whether that remnant was able to save the state as a state, and this Jeremiah was forced to deny. Nay, every attempt at genuine amendment was frustrated by the dead weight of a powerful opposition, and when the first captivity came it was precisely the best elements of Judah that went into captivity and were scattered among the nations (xxiv. 5, xxiii. 2 seq.). And so the prophet was compelled to teach that the immediate future of Israel was a blank, that the state as a state was doomed. He did not even dare to intercede for such a nation (vii. 16); though Moses and Samuel stood pleading for it before Yahweh, He could not but cast it out of His sight (xv. 1). It was the death-struggle of the idea of a national religion (vi. 8);

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[1] We should be apt to say "the true idea of God," but that is a way of putting it which does not correspond with prophetic thought. To the prophets knowledge of God is concrete knowledge of the divine character as shown in acts—knowledge of a person, not of an idea.

[2] The last clause of Isa. vi. 13, "a holy seed is its stock," is rejected by many critics (Duhm, Cheyne, Marti and others) as a later insertion. It is omitted in the Septuagint.

the continuity of true faith refused to be longer bound up with the continuity of the nation. Still indeed the New-Testament idea of a purely spiritual kingdom of God, in this world but not of it, is beyond the prophet's horizon, and he can think of no other vindication of the divine purpose than that the true Israel shall be gathered again from its dispersion. But the condition of this restoration is now changed. To gather the dispersed implies a call of God to individuals, and in the restored Israel the covenant of Yahweh shall not be merely with the nation but with man one by one, and "they shall no more teach everyone his neighbour saying, Know the Lord, for all shall know Me from the least of them even to the greatest of them" (xxxi. 33 seq.). In a word, when the nation is dissolved into its individual elements the continuity and ultimate victory of true faith depends on the relation of Yahweh to individual souls, out of which the new state shall be built up (Jer iii. 14).

Thus, for the first time in the world's history, the ultimate problem of faith is based on the relation of God to the individual believer; and this problem Jeremiah is compelled to face mainly in relation to his own personality, to assure himself that his own faith is a true possession and lifts him above all the calamities that assail him, in spite of the hopeless ruin of his nation. The struggle is a sore one; his very life is bitter to him; and yet he emerges victorious. To know that God is with him is enough though all else fail him. Now as soon as the relation of God to a single soul has thus been set free from all earthly conditions the work of prophecy is really complete, for what God has done for one soul He can do for all, but only by speaking to each believer as directly as He does to Jeremiah. Henceforth revelation is not a word to the nation spoken through an individual, but a word spoken to one which is equally valid for every one who receives it with like faith. The New Testament joins on not to the post-exile prophets, who are only faint echoes of earlier seers, but to Jeremiah's great idea of the new covenant in which God's law is written on the individual heart, and the community of faith is the fellowship of all to whom He has thus spoken. The prophets of the restoration are only the last waves beating on the shore after the storm which destroyed the old nation, but created in its room a fellowship of spiritual religion, had passed over; they resemble the old prophets in the same imperfect way in which the restored community of Jerusalem resembled a real nation. It was only in so far as the community of faith still possessed certain external features of nationality that post-exile prophecy was possible at all, and very soon the care of the national or quasi-national aspects of religion passed altogether out of their hands into those of the scribes, of whom Ezekiel was the first father, and whose Torah was not the living word of prophecy but the Pentateuchal code. From the time of Jeremiah downwards the perennial interest of Old-Testament thought lies in the working out of the problems of personal religion and of the idea of a spiritual fellowship of faith transcending all national limitation; and these are the motives not only of the lyrics of the Psalter but of the greater theodiceas of Isa. xl.–lxvi. and of the book of Job. The theodicea of the prophets is national; they see Yahweh's righteousness working itself out with unmistakable clearness in the present, and know that all that He brings upon Israel is manifestly just; but from the days of Jeremiah[1] the fortunes of Israel as a nation are no longer the one thing which religion has to explain; the greater question arises of a theory of the divine purpose which shall justify the ways of God with individual men or with His "righteous servant"—that is, with the ideal community of true faith as distinct from the natural Israel.

It will be evident even from this rapid sketch, necessarily confined to a few of the most cardinal points, that Hebrew prophecy is not a thing that can be defined and reduced to a formula, but was a living institution which can only be understood by studying its growth and observing its connexion with the historical movements with which its various manifestations were bound up. Throughout the great age of prophecy the most obvious formal character that distinguished it was that the prophet did not speak in his own name but in the name of Yahweh. But the claim to speak in the name of God is one which has often been made—and made sincerely—by others than the prophets of Israel, and which is susceptible of a great variety of meanings, according to the idea of God and His relation to man which is presupposed. Every early religion seeks to realize such an intercourse with the object of worship as shall be two-sided; when the worshipper approaches the deity he desires to have an answer assuring him of acceptance and divine aid. The revelation thus looked for may be found in natural omens, in the priestly lot or some similar sacral oracle, or, finally, in the words of a seer who is held to be in closer contact with the deity than common men. Broadly speaking these methods of revelation are found in all ancient religions, but no other religion presents anything precisely analogous to prophecy. It is true that the prophets absorbed the old seers, and that the Israelites, as we see in the case of the asses of Kish, went to their seers on the same kind of occasions as sent heathen nations to seers or diviners. There is sufficient evidence that down to the last age of the Judaean monarchy practices not essentially different from divination were current in all classes of society, and were often in the hands of men who claimed to speak as prophets in the name of Yahweh. But the great prophets disallowed this claim, and the distinction which they draw between true prophecy and divination is recognized not only in the prophetical law of Deuteronomy but in earlier parts of the Pentateuch and historical books. "There is no augury in Jacob and no divination in Israel; in due time it is told to Jacob and to Israel what God doth work" (Num. xxiii. 23). The seer, in the sense in which all antiquity believed in seers, is simply a man who sees what others cannot see, no matter whether the thing seen be of public or of mere private interest; but the prophet is an organ of Yahweh's kingship over His people—he sees and tells so much of the secret purpose of Yahweh as is needful for His people to know. We have already seen how Amos and Hosea put this (*supra*, p. 2011), and it does not appear that they were introducing a conception of prophecy formally novel—the new thing was their conception of Yahweh's purpose. And so too with the following great prophets; the important thing in their work was not their moral earnestness and not their specific predictions of future events, but the clearness of spiritual insight with which they read the spiritual significance of the signs of the time and interpreted the movements of history as proofs of Yahweh's actual moral sovereignty exercised over Israel. So long as the great problems of religion could be envisaged as problems of the relation of Yahweh to Israel as a nation the prophets continued to speak and to bring forth new truths; but the ultimate result was that it became apparent that the idea of moral government involved the destruction of Israel, and then the function of prophecy was gone because it was essentially national in its objects. But meantime the relation of God to the prophet had acquired an independent significance; the inner life of Isaiah during the long years when his teaching seemed lost, or of Jeremiah through the whole course of his seemingly fruitless ministry, was rich in experiences of faith triumphing over temptations and trials, of personal converse with God sustaining the soul in the face of difficulties hopeless to the eye of sense, which formed the pattern of a new and higher stage of religion in which the relation of the individual soul to God should be set free from those limitations which had been imposed by the conception that the primary subject of religion is the nation. But the religion of the Old Testament did not become merely individualistic in becoming individual, and now the problem was to realize a new conception of the society of faith, the true Israel, the collective servant of Yahweh —in a word to form the idea of a spiritual commonwealth and to show how it was possible for faith to hold fast, in spite of all seeming contradiction, to the truth that Yahweh had chosen for himself a spiritual people, every member of which was in truth the object of His saving and unfailing love, and which should ultimately in very deed inherit that glory of which the carnal Israel was unworthy. This is the post-prophetic problem which occupies the more profound of the later Old-Testament books, but first received its true solution in the gospel, when the last shreds of the old nationalism disappeared and the spiritual kingdom found its centre in the person of Christ.

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[1] One might say from the days of Habakkuk.

Old-Testament prophecy therefore forms only one stage in a larger development, and its true significance and value can only be realized when it is looked at in this light. In this as in all other matters of transcendental truth "wisdom is justified of her children"; the conclusive vindication of the prophets as true messengers of God is that their work forms an integral part in the progress of spiritual religion, and there are many things in their teaching the profundity and importance of which are much clearer to us than they could possibly have been to their contemporaries, because they are mere flashes of spiritual insight lighting up for a moment some corner of a region on which the steady sun of the gospel had not yet risen.

A less complete but yet most powerful vindication of the spiritual prophets was furnished by the course and event of Israel's history. After the captivity it was no longer a question that the prophetic conception of Yahweh was the only possible one. Thenceforth the religion of Yahweh and the religion of the prophets are synonymous; no other reading of Israel's past was possible, and in fact the whole history of the Hebrews in Canaan, as it was finally shaped in the exile, is written from this point of view, and has come down to us, along with the remains of actual prophetic books, under the collective title of "The Prophets."

To some extent this historical vindication of the prophetic insight went on during the activity of the prophets themselves. From the time of Amos downwards the prophets spoke mainly at great historical crises, when events were moving fast and a few years were often sufficient to show that they were right and their opponents wrong in their reading of the signs of the times. And here the controversy did not turn on the exact fulfilment of detailed predictions; detailed prediction occupies a very secondary place in the writings of the prophets.

The prophets themselves required no historical verification of their word to assure them that it was indeed the word of God, nor do they for a moment admit that their contemporaries are entitled to treat its authority as unproved till such verification is offered. The word of God carries its own evidence with it in its searching force and fire: "Is not my word like as a fire, saith Yahweh, and like a hammer that breaketh the rock in pieces?" (Jer. xxiii. 29). To the prophet himself it comes with imperious force: it constrains him to speak (Amos iii. 8), seizes him with a strong hand (Isa. viii. 11), burns like a fire within his bones till it finds utterance (Jer. xx. 9); and it is this force of moral conviction which ought also to commend it to the conscience of his hearers. The word is true because it is worthy of the true God. When Deut. xviii. 21, 22 seeks the legal criterion of true prophecy in the fulfilment of prediction, the writer is no doubt guided by the remembrance of the remarkable confirmation which the doctrines of spiritual prophecy had received in history then recent, but his criterion would have appeared inadequate to the prophets themselves, and indeed this passage is one of the most striking proofs that to formulate the principles of prophetic religion in a legal code was an impossible task.

The mass of the nation, of course, was always much more struck by the "signs" and predictions of the prophets than by their spiritual ideas; we see how the idea of supernatural insight and power in everyday matters dominates the popular conception of Elijah and Elisha in the books of Kings. At a very early date the great prophets became a kind of saints or *welis*, and the respect paid to the tombs of the prophets, which ultimately took in almost every particular the place of the old local shrines (Matt. xxiii. 29; Jerome, *Epit. Paulae*, § 13; see OBADIAH), can be traced back to the time before the exile.[1]

The Hebrew prophet stands alone among divinely appointed and inspired men of any religion, though analogies in other religions present themselves. Ethical and religious teachers arose among other nations of antiquity whose precepts may well be compared with those of Hebrew prophecy. We might cite the maxims of Ani in the Egyptian papyrus Prisse (XIIth dynasty). But these teachers did not succeed in accomplishing a task parallel to what the Hebrew prophets achieved, namely, the complete renewal and elevation of the Hebrew religion from a local and national into a universal and ethical religion. Yet instructive parallels may be found in ancient literatures. Thus the Vedic hymns are reputed to have no human authors. The names attached to them are those of the seers who "saw" them, to whom they were revealed. They are therefore merely the channels through which the divine word is communicated to man (Professor Rapson). The Rev. C. H. W. Johns (*Interpreter*, April 1906, "The Prophets of Babylonia") thinks that longer discourses moral, and predictive, fully equal to those of the Hebrew prophets, existed in Babylonia as early as the 3rd millennium B.C. but were curtailed into the brief sentences of the omen tablets. "The so-called 'tablet of warning to kings against injustice' gives a fair specimen of connected discourse, *e.g.* 'If a king hearken not to law, his people shall grow feeble and his land be ravaged. If he attend not to the justice of his land, Ea, the king of fates, shall distort his lot, &c.'" Further illustrations of ethical teaching may be found in the litany or confession of a penitent cited by Mr Johns in the same paper (p. 303).

It may be here stated that Winckler's conception of the Hebrew prophet Isaiah as the mouthpiece of the Assyrian court (*K.A.T.*^{3} p. 172 sqq.) can be easily refuted by a reference to the Isaianic oracles. A theory that Jeremiah was similarly influenced from Babylonia might seem more plausible, though equally baseless.

After the extinction of the prophetic voice, an ever-increasing weight was not unnaturally laid on the predictive element in their writings. Their creative religious ideas had become the common property of religious-minded Jews, at least in the somewhat imperfect shape in which they were embodied in the law, and their work on this side was carried on by the great religious poets. But the restored community which was still making a sort of faint attempt to be a religious nation as well as a Church felt very painfully the want of a direct message from God in critical times such as the prophets of old had been wont to bring. And in this need men began to look at the prophetic books, mainly in the hope that there might be found in them predictions which still awaited fulfilment, and might be taken as referring to the latter days of Persian or Greek oppression. By ignoring the free poetical form of prophecy, and still more by ignoring the fact that the prophetic pictures of the ideal future of Israel could not be literally fulfilled after the fall of the ancient state had entirely changed the sphere in which the problems of true religion had to be worked out, it was possible to find a great mass of unfulfilled prophecy which might form the basis of eschatological constructions. All this was quite in the vein of later Judaism, and so at length the unfulfilled predictions of the prophets served as the raw material for the elaborate eschatology of the apocalypses (see APOCALYPTIC LITERATURE). In spite of superficial resemblances, mainly due to the unavoidable influence of current exegetical methods, the conception of prophecy as fulfilled in Christ is fundamentally different from the Jewish apocalyptic view of unfulfilled prophecy. Not external details but the spiritual ideas of the prophets find their fulfilment in the new dispensation, and they do so under forms entirely diverse from those of the old national kingdom of Yahweh.

LITERATURE.—In the ancient and medieval Church and in the dogmatic period of Protestantism there was little or no attempt at historical study of prophecy, and the prophetical books were found instructive only through the application of allegorical or typical exegesis. For details the reader may refer to Diestel, *Geschichte des Alten Testaments* (Jena 1869), and for the final form of orthodox Protestant views to Witsius, *De prophetis et prophetia*. The growing sense of the insufficiency of this treatment towards the close of the period of dogmatism showed itself in various ways. On the one hand we have the revival of apocalyptic exegesis by Cocceius and his school, which has continued to influence certain circles down to the present day, and has led to the most varied attempts to find in prophecy a history written before the event of all the chief vicissitudes of the Christian Church down to the end of the world. On the other hand Lowth's *Lectures on Hebrew Poetry*, and the same author's *Commentary on Isaiah* (1778), show the beginnings of a tendency to look mainly at the aesthetic aspects of the prophetical books, and to view the prophets as enlightened religious poets. This tendency culminates in Eichhorn, *Die hebräischen Propheten* (1816). Neither of these methods could do much for the historical understanding of the phenomena of prophecy as a whole, and the more liberal students of the Old Testament were long blinded by the moralizing unhistorical rationalism which succeeded the old orthodoxy. The first requisite of real progress, after dogmatic prejudices had been broken through, was to get a living conception of the history in which the prophets moved; and this again called for a revision of all traditional notions as to the age of the various parts of Hebrew literature—criticism of the sources of the history, among which the prophetical books themselves take the first place. In recent times therefore advance in the understanding of the prophets has moved on *pari passu* with the higher criticism, especially the criticism of the Pentateuch, and with the general study of Hebrew history; and most works on the subject prior to Ewald must be regarded as quite antiquated except for the light they cast on detailed points of exegesis. On the prophets and their works the reader would still do well to consult Ewald's *Propheten des alten Bundes* (1st ed., 1840–1841, 2nd ed., 1867–1868, Eng. trans., 1876–1877). The subject is treated in all works on Old Testament introduction (among which Kuenen's *Onderzoek*, vol. ii., claims the first place), and on Old-Testament theology (see especially Vatke, *Religion des A.T.*, 1835). On the theology of the prophets there is a separate work by Duhm (Bonn, 1875), and Knobel's *Prophetismus der Hebräer* (1837), is a separate introduction to the prophetical books. Kuenen's *Prophets and Prophecy in Israel* (1875, Eng. trans. 1877) is in form mainly a criticism of the traditional view of prophecy, and should therefore be compared with his *Onderzoek* and *Godsdienst van Israel*. Most English books on the subject are more theological than historical, but a sketch of Hebrew prophecy in connexion with the history down to the close of the 8th century is given by W. R. Smith, *The Prophets of Israel* (Edinburgh, 1882). The literature of the theological questions connected with prophecy is much too copious to be cited here; lists will be found in several of the books already referred to. Among more recent works and articles should be mentioned Briggs, *Messianic Prophecy*; Giesebrecht, *Die Berufsbegabung der alttestamentlichen Propheten*; Volz, *Die vorexilische Jahwe-Prophetie u. der Messias*; Hühn, *Die messianischen Weissagungen*; R. Kittel, *Prophetie u. Weissagung*; Professor Kennett, *Pre-exilic Prophets*; W. H. Bennett, *Post-exilic Prophets* (T. and T. Clark); A. B. Davidson, "Prophecy and Prophets," in Hastings's *Dict. Bible*; also "Prophetic Literature," by Cheyne and others in *Ency. Bibl.* (W. R. S.; O. C. W.)

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[1] See 2 Kings xxiii. 21, and also Deut. xxxiv. 6. So too all the old national heroes and heroines ultimately became prophets; in the case of Deborah there is even a fusion in local tradition between an old heroine and an historical seer.

II. *Prophets in the Primitive Church.*—The appearance of prophets in the first Christian communities is one proof of the strength of faith and hope by which these bodies were animated. An old prophecy (Joel iii. 1) has foretold that in the Messianic age the Spirit of God would be poured out on every member of the religious community, and in point of fact it was the universal conviction of those who believed in Christ that they all possessed the Spirit of God. This Spirit, manifesting His presence in a variety of ways and through a variety of gifts, was to be the only ruling authority in the Church. He raised up for Himself particular individuals, into whose mouths He put the word of God, and these were at first regarded as the true leaders of the congregations. We find accordingly that there were prophets in the oldest church, that of Jerusalem (Acts. xi. 27, xv. 32), and again that there were "prophets and teachers" in the church at Antioch (Acts xiii. 1). These were not office-bearers chosen by the congregation, but preachers raised up by the Spirit and conferred as gifts on the Church. When Paul says (1 Cor. xii. 28; cf. Eph. iv. 11), "God hath set some in the Church, first apostles, secondarily prophets, thirdly teachers," he points to a state of things which in his time prevailed in all the churches both of Jewish and heathen origin. We here learn from Paul that the prophets occupied the second position in point of dignity; and we see from another passage (1 Cor. xiv.) that they were distinguished from the teachers by their speaking under the influence of inspiration—not, however, like the "speakers in tongues," in unintelligible ejaculations and disconnected words, but in articulate, rational edifying speech. Until recently it was impossible to form any distinct idea of the Christian prophets in the post-apostolic age, not so much from want of materials as because what evidence existed was not sufficiently clear and connected. It was understood, indeed, that they had maintained their place in the churches till the end of the 2nd century, and that the great conflict with what is known as Montanism had first proved fatal to them; but a clear conception of their position and influence in the churches was not to be had. But the discovery, by Bryennios in 1873, of the ancient Christian work called Διδαχὴ τῶν δώδεκα ἀποστόλων (published in 1883), has immensely extended the range of our knowledge, and has at the same time thrown a clear light on many notices in other sources which for want of proper interpretation had been previously neglected or incorrectly understood.

The most important facts known at present about the manner of life, the influence, and the history of the early Christian prophets are the following: (1) Until late in the 2nd century the prophets (or prophetesses) were regarded as an essential element in a Church possessing the Holy Ghost. Their existence was believed in, and they did actually exist, not only in the catholic congregations—if the expression may be used—but also in the Marcionite Church and the Gnostic societies. Not a few Christian prophets are known to us by name: as Agabus, Judas, and Silas in Jerusalem; Barnabas, Simon Niger, &c., in Antioch; in Asia Minor, the daughters of Philip, Quadratus, Ammia, Polycarp, Melito, Montanus, Maximilla and Priscilla; in Rome, Hermas; among the followers of Basilides, Barkabbas and Barkoph; in the community of Apelles, Philumene, &c. Lucian tells us that the impostor Peregrinus Proteus, in the time of Antoninus Pius, figured as a prophet in the Christian churches of Syria. (2) Till the middle of the 2nd century the prophets were the regular preachers of the churches, without being attached to any particular congregation. While the "apostles" (*i.e.* itinerating missionaries) were obliged to preach from place to place, the prophets were at liberty either, like the teachers, to settle in a certain church or to travel from one to another. (3) In the time of Paul the form of prophecy was reasoned exhortation in a state of inspiration; but very frequently the inspiration took the form of ecstasy—the prophet lost control of himself, so that he did not remember afterwards what he had said. In the Gentile-Christian churches, under the influence of pagan associations, ecstasy was the rule. (4) With regard to the matter of prophecy, it might embrace anything that was necessary or for the edification of the Church. The prophets not only consoled and exhorted by the recital of what God had done and by predictions of the future, but they uttered extempore thanksgivings in the congregational assemblies, and delivered special directions, which might extend to the most minute details, as, for example, the disposal of the church funds. (5) It was the duty of the prophets to follow in all respects the example of the Lord (ἔχειν τοὺς τρόπους τοῦ Κυρίου), and to put in practice what they preached. But an ascetic life was expected of them only when, like the apostles, they went about as missionaries, in which case the rules in Matt. x. applied to them. Whenever, on the contrary, they settled in a place they had a claim to a liberal maintenance at the hands of the congregation. The author of the Διδαχὴ even compares them to the High Priests of the Old Testament, and considers them entitled to the first-fruits of the Levitical law. In reality, they might justly be compared to the priests in so far as they were the mouthpieces of the congregation in public thanksgiving. (6) Since prophets were regarded as a gift of God and as moved by the Holy Spirit, the individual congregation had no right of control over them. When anyone was approved as a prophet and exhibited the "conversation of the Lord," no one was permitted to put him to the test or to criticize him. The author of the Διδαχὴ goes so far as to assert that whoever does this is guilty of the sin against the Holy Ghost. (7) This unique position of the prophets could only be maintained so long as the original enthusiasm remained fresh and vigorous. From three quarters primitive Christian prophecy was exposed to danger—first, from the permanent officials of the congregation, who, in the interests of order, peace and security could not but look with suspicion on the activity of excited prophets; second, from the prophets themselves, in so far as an increasing number of dishonest characters was found amongst them, whose object was to levy contributions on the churches;[1] third, from those prophets who were filled with the stern spirit of primitive Christianity and imposed on churches, now becoming assimilated to the world, obligations which these were neither able nor willing to fulfil. It is from this point of view that we must seek to understand the so-called Montanistic crisis. Even the author of the Διδαχή finds it necessary to defend the prophets who practised celibacy and strict asceticism against the depreciatory criticism of church members. In Asia Minor there was already in the year 160 a party, called by Epiphanius "Alogi," who rejected all Christian prophecy. On the other hand, it was also in Asia Minor that there appeared along with Montanus those energetic prophetesses who charged the churches and their bishops and deacons with becoming secularized, and endeavoured to prevent Christianity from being naturalized in the world, and to bring the churches once more under the exclusive guidance of the Spirit and His charismata. The critical situation thus arising spread in the course of a few decades over most of the provincial churches. The necessity of resisting the inexorable demands of the prophets led to the introduction of new rules for distinguishing true and false prophets. No prophet, it was declared, could speak in ecstasy, that was devilish; further, only false prophets accepted gifts. Both canons were innovations, designed to strike a fatal blow at prophecy and the church organization re-established by the prophets in Asia—the bishops not being quite prepared to declare boldly that the Church had no further need of prophets. But the prophets would not have been suppressed by their new methods of judging them alone. A much more important circumstance was the rise of a new theory, according to which all divine revelations were summed up in the apostles or in their writings. It was now taught that prophecy in general was a peculiarity of the Old Testament ("lex et prophetae usque ad Johannem"); that in the new covenant God had spoken only through apostles; that the whole word of God so far as binding on the Church was contained in the apostolic record—the New Testament;[2] and that, consequently, the Church neither required nor could acknowledge new revelations, or even instructions, through prophets. The revolution which this theory gradually brought about is shown in the transformation of the religious, enthusiastic organization of the Church into a legal and political constitution. A great many things had to be sacrificed to this, and amongst others the old prophets. The strictly enforced episcopal constitution, the creation of a clerical order, and the formation of the New Testament canon accomplished the overthrow of the prophets. Instead of the old formula, "God continually confers on the church apostles, prophets, and teachers," the word now was: "The Church is founded in the (written) word of the prophets (*i.e.* the Old Testament prophets) and the apostles (viz. the twelve and Paul)." After the beginning of the 3rd century there were still no doubt men under the control of the hierarchy who experienced the prophetic ecstasy, or clerics like Cyprian who professed to have received special directions from God; but prophets by vocation no longer existed and these sporadic utterances were in no sense placed on a level with the contents of the sacred Scriptures.

See Hilgenfeld, *Die Glossolalie in der alten Kirche* (1850); Bückmann, "Über die Wunderkräfte bei den ersten Christen und ihr Erlöschen," in the *Ztschr. f. d. Ges. luther. Theol. u. Kirche* (1878), pp. 216–255 (learned but utterly uncritical); Bonwetsch, "Die Prophetie im apostol. und nachapostol. Zeitalter," in the *Ztschr. f. kirchl. Wissensch. u. kirchl. Leben* (1884), pt. 8, p. 408 seq , pt. 9, p. 460 seq.; Harnack, *Die Lehre der zwölf Apostel* (1884), pp. 93–137; Haller, "Die Propheten der nachapostolischen Kirche," in the *Theol. Studien aus Württemberg* (1888), p. 36 seq.; Nardin, "Essai sur les prophètes de l'église primitive," Thesis, (Paris, 1888); Weinel, "Die Wirkungen des Geistes und der Geister im nachapostolischen Zeitalter bis auf Irenaeus," (1899); Selwyn, "The Christian Prophets and the Prophetic Apocalypse" (1900); Bénazech, "Le Prophétisme chrétienne depuis les origines jusqu'au pasteur d'Hermas," Thesis, (Paris, 1901). (A. Ha.; A. C. McG.)

PROPIOLIC ACID, $CH{:}C\cdot CO_2H$, acetylene mono-carboxylic acid, an unsaturated organic acid prepared by boiling acetylene dicarboxylic acid (obtained by the action of alcoholic potash on dibromsuccinic acid) or its acid potassium salt with water (E. v. Bandrowski, *Ber.*, 1880, 13, p. 2340). It forms silky crystals which melt at 6° C., and boil at about 144° C. with decomposition. It is soluble in water and possesses an odour resembling that of acetic acid. Exposure to sunlight converts it into trimesic acid (benzene-1.3.5-tricarboxylic acid). Bromine converts it into dibromacrylic acid, and it gives with hydrochloric acid β-chloracrylic acid. It forms a characteristic explosive silver salt on the addition of ammoniacal silver nitrate to its aqueous solution, and an amorphous precipitate which explodes on warming with ammoniacal cuprous chloride. Its ethyl ester condenses with hydrazine to form pyrazolone (R. v. Rothenburg, *Ber.*, 1893, 26, p. 1722). *Phenylpropiolic acid*, $C_6H_5C{:}C\cdot CO_2H$, formed by the action of alcoholic potash on cinnamic acid dibromide, $C_6H_5CHBr\cdot CHBr\cdot CO_2H$, crystallizes in long needles or prisms which melt at 136–137° C. When heated with water to 120° C. it yields phenyl acetylene $C_6H_5\cdot C{:}CH$. Chromic acid oxidizes it to benzoic acid; zinc and acetic acid reduce it to cinnamic acid, $C_6H_5\cdot CH{:}CH\cdot CO_2H$, whilst sodium amalgam reduces it to hydrocinnamic acid, $C_6H_5\cdot CH_2\cdot CO_2H$. *Ortho-nitrophenylpropiolic acid*, $NO_2\cdot C_6H_4\cdot C{:}C\cdot CO_2H$, prepared by the action of alcoholic potash on ortho-nitrocinnamic acid dibromide (A. v. Baeyer, *Ber.*, 1880, 13, p. 2258), crystallizes in needles which decompose when heated to 155–156° C. It is readily converted into indigo (*q.v.*).

PROPYLAEA (Πρόπυλον, Προπύλαια), the name given to a porch or gate-house, at the entrance of a sacred or other enclosure in Greece; such propylaea usually consisted, in their simplest form, of a porch supported by columns both without and within the actual gate. The name is especially given to the great entrance hall of the Acropolis at Athens, which was begun in 437 B.C. by Pericles, to take the place of an earlier gateway. Owing probably to political difficulties and to the outbreak of the Peloponnesian War, the building was never completed according to the original plans; but the portion that was built was among the chief glories of Athens, and afforded a model to many subsequent imitators. The architect was Mnesicles; the material Pentelic marble, with Eleusinian blackstone for dados and other details. The plan of the Propylaea consists of a large square hall, from which five steps lead up to a wall pierced by five gateways of graduated sizes, the central one giving passage to a road suitable for beasts or possibly for vehicles. On the inner side towards the Acropolis, this wall is faced with a portico of six Doric columns. At the other end of the great hall is a similar portico facing outwards; and between this and the doors the hall is divided into three aisles by rows of Ionic columns. The western or outer front is flanked on each side by a projecting wing, with a row of three smaller Doric columns between Antae at right angles to the main portico. The north wing is completed by a square chamber which served as a picture gallery; but the south wing contains no corresponding chamber, and its plan has evidently been curtailed; its front projected beyond its covered area, and it is finished in what was evidently a provisional way on the side of the bastion before the little temple of Victory (Νίκη). From this and other indications Professor Dorpfeld has inferred that the original plan of Mnesicles was to complete the south wing on a plan symmetrical with that of the north wing, but opening by a portico on to the bastion to the west; and to add on the inner side of the Propylaea two great halls, faced by porticoes almost in a line with the main portico, but with smaller columns. It is probable that this larger plan had to be given up, because it would have interfered with sacred objects such as the precinct of Artemis Brauronia and the altar of Nike, and religious conservatism prevailed over the waning influence of Pericles. In addition to this, the unfinished surface of the walls and the rough bosses left on many of the blocks show that the building was never completed. The Propylaea were approached in Greek times by a zig-zag path, terraced along the rock; this was superseded in Roman times by a broad flight of steps. In medieval times the Propylaea served as the palace of the dukes of Athens; they were much damaged by the explosion of a powder magazine in 1656. The tower, of Frankish or Turkish date, that stood on the south wing, was pulled down in 1874.

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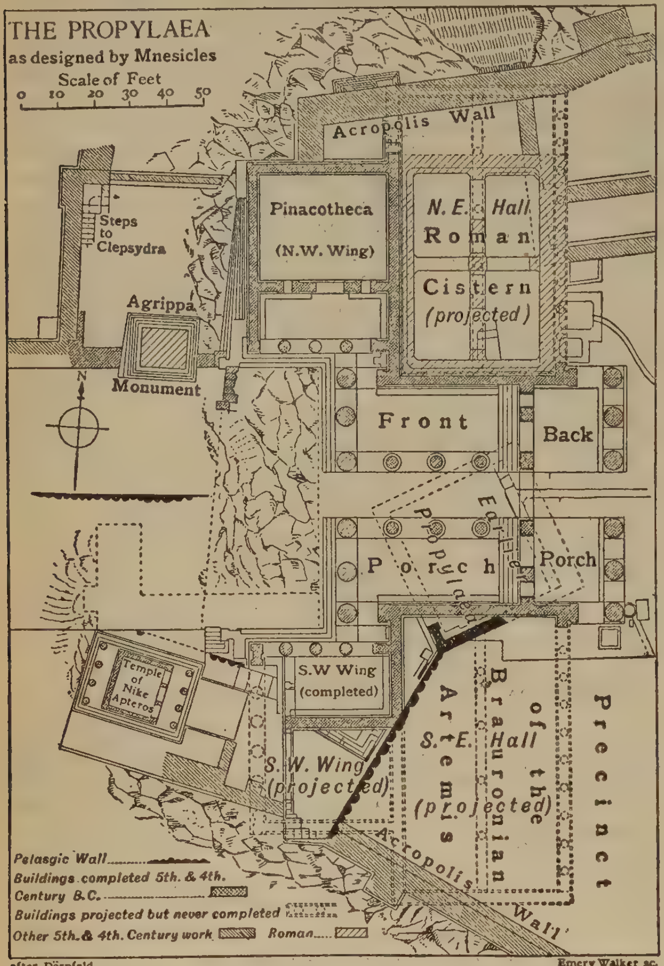
[1] See Lucian's story about Peregrinus, and that chapter of the Διδαχή where the author labours to establish criteria for distinguishing false prophets from true.

[2] The Apocalypse of John was received into it, not as the work of a prophet but as that of an apostle.



after Dörpfeld

Emery Walker sc.

(Redrawn from the *Athenische Mitteilungen* by permission of the Kaiserliches Archaeologisches Institut.)

See R. Böhn, *Die Propylaeen der Akropolis zu Athen* (Berlin, 1882); W. Dörpfeld, articles in *Mittheilungen d. d. Inst. Athen.* (1885) vol. x. (E. Gr.)

PROPYL ALCOHOLS (C_3H_7OH). Two compounds of this formula exist as explained in the article Alcohols. *Normal propyl alcohol*, $CH_3 \cdot CH_2 \cdot CH_2 \cdot OH$, was obtained in 1853 by G. C. B. Chancel, by submitting fusel oil to fractional distillation. It may be prepared by any of the methods applicable to primary alcohols. It is an agreeable-smelling liquid, boiling at 97·4° C., and miscible with water in all proportions. It cannot be separated from water by fractional distillation, since it forms a mixture of constant boiling point (see Distillation). Oxidation converts it into propionic acid. It is distinguished from ethyl alcohol by its insolubility in a cold saturated calcium chloride solution.

Iso-propyl alcohol $(CH_3)_2CHOH$, was obtained by M. P. E. Berthelot in 1855 by heating the addition compound of propylene and sulphuric acid with water, and in 1862 by C. Friedel by the reduction of acetone. It is a colourless liquid boiling at 82·7° C.

PROROGATION, a postponement, specifically the termination without dissolution of a session of parliament by discontinuing the meetings until the next session. The Lat. *prorogatio* (from *prorogare*, to ask publicly) meant a prolongation or continuance of office or command, *cf.* *prorogatio imperii* (Liv. viii. 26), or a putting off or deferring of an appointed time, *cf.* *dies ad solvendum prorogare* (Cic. *Phil.* ii. 10, 24). A prorogation of parliament affects both houses, and thus differs from an "adjournment," which does not terminate the session and is effected by each house separately by resolution. Further, at a prorogation, a bill which has not passed all of its stages must begin again *ab initio* in the next session, and all proceedings, except impeachments and appeals before the House of Lords, are quashed. A prorogation is effected by the sovereign in person, or by commission. If, at the demise of the Crown, parliament stands prorogued or adjourned, it is by 6 Anne c. 7 to sit and act at once; similarly the Crown must by proclamation order parliament to sit, if prorogued, when the militia is embodied or the reserves are called out.

PROSCENIUM (Gr. *προσκήνιον*), that part of the stage in the ancient Greek theatre which lies in front of the *σκηνή*, *scena*, the back wall; the word appears to embrace the whole stage between the *ὀρχήστρα* and the *σκηνή*. In the modern theatre the word is applied to that part of the stage which is in front of the curtain and the orchestra, and sometimes to the whole front of the stage, including the curtain and the arch containing it, which separates the stage from the auditorium.

PROSE, a word supposed to be derived from the Lat. *prorsus*, direct or straight, and signifying the plain speech of mankind, when written, or rhetorically composed, without reference to the rules of verse. It has been usual to distinguish prose very definitely from poetry (*q.v.*), and this was an early opinion. Ronsard said that his training as a poet had proved to him that prose and poetry were "mortal enemies." But "poetry" is a more or less metaphysical term, which cannot be used without danger as a distinctive one in this sense. For instance, an ill-inspired work in rhyme, or even a well-written metrical composition of a satirical or didactic kind, cannot be said to be poetry, and yet most certainly is not prose; it is a specimen of verse. On the other hand, a work of highly wrought and elaborately sustained non-metrical writing is often called a prose-poem. The fact that this phrase can be employed shows that the antithesis between prose and poetry is not complete, for no one, even in jest or hyperbole, speaks of a prose-verse.

Prose, therefore, is most safely defined as comprising all forms of careful literary expression which are not metrically versified, and hence the definition from *prorsus*, the notion being that all verse is in its nature so far artificial that it is subjected to definite and recognized rules, by which it is diverted out of the perfectly direct modes of speech. Prose, on the other hand, is straight and plain, not an artistic product, but used for stating precisely that which is true in reason or fact. The Latins called prose *sermo pedestris*, and later *oratio soluta*, thus showing their consciousness that it was not poetry, which soars on wings, and not verse, which is bound by the rules of prosodical confinement.

Prose, however, is not everything that is loosely said. It has its rules and requirements. In the earliest ages, no doubt, conversation did not exist. The rudest fragments of speech were sufficient to indicate the needs of the savage, and these blunt babblings were not prose. Later on some orator, dowered with a native persuasiveness, and desirous of making an effect upon his comrades, would link together some broken sentences, and in his heat produce with them something more coherent than a chain of ejaculations. So far as this was lucid and dignified, this would be the beginning of prose. It cannot be too often said that prose is the result of conversation, but it must at the same time be insisted upon that conversation itself is not necessarily, nor often, prose. Prose is not the negation of all laws of speech; it rejects merely those laws which depend upon metre. What the laws are upon which it does depend are not easy to enumerate or define. But this much is plain; as prose depends on the linking of successive sentences, the first requirement of it is that these sentences should be so arranged as to ensure lucidity and directness. In prose, that the meaning should be given is the primal necessity. But as it is found that a dull and clumsy, and especially a monotonous arrangement, of sentences is fatal to the attention of the listener or reader, it is needful that to plainness should be added various attractions and ornaments. The sentences must be built up in a manner which displays variety and flexibility. It is highly desirable that there should be a harmony, and even a rhythm, in the progress of style, care being always taken that this rhythm and this harmony are not those of verse, or recognizably metrical. Again, the colour and form of adjectives, and their sufficient yet not excessive recurrence, is an important factor in the construction of prose. The omission of certain faults, too, is essential. In every language grammatical correctness is obligatory. Here we see a distinction between mere conversation, which is loose, fragmentary and often, even in the lips of highly educated persons, slightly ungrammatical; and prose, which is bound to weed away whatever is slovenly and incorrect, and to watch very closely lest merely colloquial expressions, which cannot be defended, should slip into careful speech. What is required in good prose is a moderate and reasonable elevation without bombast or bathos. Not everything that is loosely said or vaguely thought is prose, and the celebrated phrase of M. Jourdain in Molière's *Bourgeois gentilhomme*: "Par ma foi, il y a plus de quarante ans que je dis de la prose, sans que j'en susse rien," is not exactly true, although it is an amusing illustration of the truth, for all the little loose phrases which M. Jourdain had used in his life, though they were certainly not verse, were not prose either, whatever the schoolmaster might say. On the other hand, it seems that Earle goes too enthusiastically in the contrary direction when he says, "Poetry, which is the organ of Imagination, is futile without the support of Reason; Prose, which is the organ of Reason, has no vivacity or beauty or artistic value but with the favour and sympathy of the Imagination." It is better to hold to the simpler view that prose is literary expression not subjected to any species of metrical law.

Greece.—The beginnings of ancient Greek prose are very obscure. It is highly probable that they took the form of inscriptions in temples and upon monuments, and gradually developed into historical and topographical records, preserving local memories, and giving form to local legends. It seems that it was in Ionia that the art of prose was first cultivated, and a history of Miletus, composed by the half-mythical Cadmus, is appealed to as the earliest monument of Greek prose. This, however, is lost, and so are all the other *horoi* of earliest times. We come down to something definite when we reach Hecataeus, the first geographer, and Herodorus, the first natural philosopher, of the Greeks; and, although the writings of these men have disappeared, we know enough about them to see that by the 4th century B.C. the use of prose in its set modern sense had been established on a permanent basis. We even know what the character of the style of Hecataeus was, and that it was admired for its clearness, its grammatical purity, its agreeable individuality—qualities which have been valued in prose ever since. These writers were promptly succeeded by Hellanicus of Lesbos, who wrote many historical books which are lost, and by Herodotus of Halicarnassus, whose noble storehouse of chronicle and legend is the earliest monument of European prose which has come down to us. When once non-metrical language could be used with the mastery and freedom of Herodotus, it was plain that all departments of human knowledge were open to its exercise. But it is still in Ionia and the Asiatic islands that we find it cultivated by philosophers, critics and men of science. The earliest of these great masters of prose survive, not in their works, but in much later records of their opinions; in philosophy the actual writings of Thales, Anaximander, Pythagoras and Empedocles are lost, and it is more than possible that their cosmological rhapsodies were partly metrical, a mingling of ode with prose apophthegm. We come into clearer air when we cross the Aegean and reach the Athenian historians: Thucydides, whose priceless story of the Peloponnesian War has most fortunately come down to us; and Xenophon, who continued that chronicle in the spirit and under the influence of Thucydides, and who carried Greek prose to a great height of easy distinction. But it is with the practice of philosophy that prose in ancient Greece rises to its acme of ingenuity, flexibility and variety, proving itself a vehicle for the finest human thought such as no later ingenuity of language has contrived to excel. The death of Socrates (399 B.C.) has been taken by scholars as the date when the philosophical writings of the Athenians reached their highest pitch of perfection in the art of Plato, who is the greatest prose writer of Greece, and, in the view of many who are well qualified to judge, of the world. In his celebrated dialogues—*Crito*, *Gorgias*, *Phaedo*, *Phaedrus*, the *Symposium*, most of all perhaps in the *Republic*—we see what splendour, what elasticity, what exactitude, this means of expression had in so short a time developed; how little there was for future prose-writers in any age to learn about their business. The rhetoricians were even more highly admired by the critics of antiquity than the philosophers, and it is probable that ancient opinion would have set Demosthenes higher than Plato as a composer of prose. But modern readers are no longer so much interested in the technique of rhetoric, and, although no less an authority than Professor Gilbert Murray has declared the essay-writing of the school of Isocrates to form "the final perfection of ancient prose," the works of the orators cease to move us with great enthusiasm. In Aristotle we see the conscious art of prose-writing already subordinated to the preservation and explanation of facts, and after Aristotle's day there is little to record in a hasty outline of the progress of Greek prose.

Latin.—In spite of having the experience of the Greeks to guide them, the Romans obeyed the universal law of literary history by cultivating verse long before they essayed the writing of prose. But that the example of later Greece was closely followed in Rome is proved by the fact that the earliest prose historians of whom we have definite knowledge, Q. F. Pictor and L. C. Alimentus, actually wrote in Greek. The earliest annalist who wrote in Latin was L. C. Hemina; the works of all these early historians are lost. A great deal of primitive Roman prose was occupied with jurisprudence and political oratory. By universal consent the first master of Latin prose was Cato, the loss of whose speeches and "Origines" is extremely to be deplored; we possess from his pen one practical treatise on agriculture. In the next generation we are told that the literary perfection of oratory was carried to the highest point by Marcus Antonius and Lucius Licinius Crassus—"by a happy chance their styles were exactly complementary to one another, and to hear both in one day was the highest intellectual entertainment which Rome afforded." Unfortunately none but inconsiderable fragments survive to display to us the qualities of Roman prose in its golden age. Happily, however, those qualities were concentrated in a man of the highest genius, whose best writings have come down to us; this is Cicero, whose prose exhibits the Latin language to no less advantage than Plato's does the Greek. From 70 to 60 B.C. Cicero's literary work lay mainly in the field of rhetoric; after his exile the splendour of his oratory declined, but he was occupied upon two treatises of extreme importance, the *De oratore* and the *De republica*, composed in 55 and 54-57 B.C. respectively; of the latter certain magnificent passages have been preserved. The beautiful essays of Cicero's old age are more completely known to us, and they comprise two of the masterpieces of the prose of the world, the *De amicitia* and *De senectute* (45 B.C.). It is to the collection of the wonderful private letters of Cicero, published some years after his death by Atticus and Tiro, that we owe our intimate knowledge of the age in which he lived, and these have ever since and in every language been held the models of epistolary prose. Of Cicero's greatest contemporary, Julius Caesar, much less has been preserved, and this is unfortunate because Roman critical opinion placed Caesar at the head of those who wrote Latin prose with purity and perfection. His letters, his grammars, his works of science, his speeches are lost, but we retain his famous *Commentaries on the War in Gaul*. Sallust followed Caesar as an historian, and Thucydides as a master of style. His use of prose, as we trace it in the *Jugurtha* and the *Catilina*, is hard, clear and polished. The chroniclers who succeeded Sallust neglected these qualities, and Latin prose, as the Augustan age began, became more diffuse and more rhetorical.

But it was wielded in that age by one writer of the highest genius, the historian Titus Livius. He greatly enriched the tissue of Latin prose with ornament which hitherto had been confined to poetry; this enables him, in the course of his vast annals, "to advance without flagging through the long and intricate narrative where a simpler diction must necessarily have grown monotonous" (Mackail). The periodic structure of Latin prose, which had been developed by Cicero, was carried by Livy "to an even greater complexity." The style of Pollio, who wrote a *History of the Civil Laws*, was much admired, and the loss of this work must be deplored. A different species of prose, the *plebius sermo*, or colloquial speech of the poor, is partly preserved in the invaluable fragments of a Neronian writer, Petronius Arbiter. Of the Latin prose-writers of the silver age, the elder Pliny, Quintilian and Tacitus, who adorned the last years before the decay of classical Latin, nothing need here be said.

English.—It was long supposed that the conscious use of prose in the English language was a comparatively recent thing, dating back at farthest to the middle of the 16th century, and due directly to French influences. Earle was the first to show that this was not the case, and to assert that we "possess a longer pedigree of prose literature than any other country in Europe." Though this may be held to be a somewhat violent statement, the independence of English prose is a fact which rests on a firm basis. "The Code of Laws of King's Inn" dates from the 7th century, and there are various other legal documents which may be hardly literature in themselves, but which are worded in a way that seems to denote the existence of a literary tradition. After the Danish invasion, Latin ceased to be the universal language of the educated, and translations into the vernacular began to be required. In 887, Alfred, who had collected the principal scholars of England around him, wrote with their help, in English, his *Hand-Book*; this, probably the earliest specimen of finished English prose, is unhappily lost. Alfred's preface to the English version of the *Cura pastoralis* was in Latin; this translation was probably completed in 890. Later still Alfred produced various translations from Bede, Orosius, Boethius and other classics of the latest Latin, and, in 900, closing a translation from St Augustine, we read "Here end the sayings of King Alfred." The prose of Alfred is simple, straightforward and clear, without any pretension to elegance. He had no direct followers until the time of the monastic revival, when the first name of eminence which we encounter is that of Ælfric, who, about 997, began to translate, or rather to paraphrase, certain portions of the Bible. The prose of Ælfric, however, though extremely interesting historically, has the fault that it presents too close a resemblance, in structure and movement, to the alliterative verse of the age. This is particularly true of his *Homilies*. A little later vigorous prose was put forth by Wulfstan, archbishop of York, who died in 1023. At the Norman Conquest, the progress of English prose was violently checked, and, as has been acutely said, it "was just kept alive, but only like a man in catalepsy." The *Annals* of Winchester, Worcester and Peterborough were carried on in English until 1154, when they were resumed in Latin; the chronicle which thus came to an end was the most important document in English prose written before the Norman Conquest. Except in a few remote monasteries, English now ceased to be used, even for religious purposes, and the literature became exclusively Latin or French. There was nothing in prose that was analogous to the revival of verse in the *Ormulum* or the metrical chronicles. All the pre-Norman practice in prose belongs to what used to be distinguished as Anglo-Saxon literature. The distinction has fallen into desuetude, as it has become more clearly perceived that there is no real break between the earlier and the later language. The Norman check, however, makes it fair to say that modern English prose begins with the *Testament of Love* of Thomas Usk, an imitation of the *De consolatione* of Boethius, which a certain London Lollard wrote in prison about 1584. About the same time were written a number of translations, *The Tale of Melibee* and *The Parson's Sermon* by Chaucer; the treatises of John of Trevisa, whose style in the *Polychronicon* has a good deal of vigour; and the three versions of the *Travels* of Jean à Barbe, formerly attributed to a fabulous "Sir John Mandeville." The composite text of these last-mentioned versions really forms the earliest specimen of purely secular prose which can be said to possess genuine literary value, but again the fact, which has only lately been ascertained, that "Sir John Mandeville" was not an original English writer robs it of much of its value. The anonymous compiler-translator can no longer be styled "the father of English prose." That name seems more properly to belong to John Wyclif, who, in the course of his fierce career as a controversialist, more and more completely abandoned Latin for English as the vehicle of his tracts. The earliest English Bible was begun by Nicholas Hereford, who had carried it up to Baruch, when he abruptly dropped it in June 1382. The completion of this great work is usually attributed, but on insufficient grounds, to Wyclif himself. A new version was almost immediately started by John Purvey, another Wyclifite, who completed it in 1388. We are still among translators, but towards the middle of the 14th century Englishmen began, somewhat timidly, to use prose as the vehicle for original work. Capgrave, an Augustinian friar, wrote a chronicle of English history down to 1417; Sir John Fortescue, the eminent constitutional jurist, produced about 1475 a book on *The Governance of England*; and Reginald Pecock, bishop of Chichester, attacked the Lollards in his *Repressor of Over Much Blaming of the Clergy* (1455), which was so caustic and scandalous that it cost him his diocese. The prose of Pecock is sometimes strangely modern, and to judge what the ordinary English prose familiarly in use in the 15th century was it is more useful to turn to *The Paston Letters*. The introduction of printing into England is coeval with a sudden development of English prose, a marvellous example of which is to be seen in Caxton's 1485 edition of Sir Thomas Malory's *Morte d'Arthur*, a compilation from French sources, in which the capacities of the English language for melody and noble sweetness were for the first time displayed, although much was yet lacking in strength and conciseness. Caxton himself, Lord Berners and Lord Rivers, added an element of literary merit to their useful translations. The earliest modern historian was Robert Fabyan, whose posthumous *Chronicles* were printed in 1515. Edward Hall was a better writer, whose *Noble Families of Lancaster and York* had the honour of being studied by Shakespeare. With the advent of the Renaissance to England, prose was heightened and made more colloquial. Sir Thomas More's *Richard III.* was a work of considerable importance; his finer *Utopia* (1516) was unfortunately composed in Latin, which still held its own as a dangerous rival to the vernacular in prose. In his *Governor* (1531) Sir Thomas Elyot added moral philosophy to the gradually widening range of subjects which were thought proper for English prose. In the same year Tyndale began his famous version of the Bible, the story of which forms one of the most romantic episodes in the chronicles of literature; at Tyndale's death in 1536 the work was taken up by Miles Coverdale. The *Sermons* of Latimer (1549) introduced elements of humour, dash and vigour which had before been foreign to the stately but sluggish prose of England. The earliest biography, a book in many ways marvellously modern, was the *Life of Cardinal Wolsey*, by George Cavendish, written about 1557, but not printed (even in part) until 1641. In the closing scenes of this memorable book, which describe what Cavendish had personally experienced, we may say that the perfection of easy English style is reached for the first time. The prose of the middle of the 16th century—as we see it exemplified in the earliest English critic, Sir Thomas Wilson; the earliest English pedagogue, Roger Ascham; the distinguished humanist, Sir John Cheke—is clear, unadorned and firm, these Englishmen holding themselves bound to resist the influences coming to them from Italy and Spain, influences which were in favour of elaborate verbiage and tortured construction. Equal simplicity marked such writers as Foxe, Stow and Holinshed, who had definite information to purvey, and wished a straightforward prose in which to present it. But Hoby and North, who translated Guevara, Castiglione and Amyot, brought with them not a few of the ingenious exotic graces of those originals, and prepared the way for the startling innovations of Lyly in his famous didactic romance of *Euphues* (1579). The extravagances and eccentricities of Lyly outdid those of his continental prototypes, and euphuism became a disturbing influence which, it may be, English prose has not, even to the present hour, entirely succeeded in throwing off. In spite of its overwhelming popularity, it was opposed in its own day, not merely by the stately sobriety of Hooker, in whom we see Latin models predominant, but by the sweetness of Sir Philip Sidney in his *Arcadia*. Raleigh wrote English prose that was perhaps more majestic than any which preceded it, but he revelled in length of sentence and in ponderosity of phrase, so that it is probable that the vast prestige of *The History of the World* on the whole delayed the emancipation of English prose more than it furthered it. The direct influence of the euphuistic eccentricity was seen for some time in the work of poets like Lodge and Greene, and divines like Lancelot Andrewes; its indirect influence in the floweriness and violence of most careful prose down to the Restoration. Bacon, whose contempt of the vernacular is with difficulty to be excused, despaired too early of our national writing. Donne cultivated a rolling and sonorous majesty of style; and Burton could use English with humour and vivacity when he gave himself the chance, but his text is a prototype of the vicious abuse of quotation which was a crowning fault of prose in the early 17th century. In spite of the skill with which, during the civil wars and the Commonwealth, certain authors (such as Jeremy Taylor, Howell, Fuller, Milton, Izaak Walton) manipulated prose, and in spite of the extraordinary magnificence of the Ciceronian periods of Sir Thomas Browne, it was not until shortly before the Restoration that English prose reached its perfection. According to Dr Johnson, Sir William Temple (1628–1699) "was the first writer who gave cadence to English prose; before his time they were careless of arrangement, and did not mind whether a sentence ended with an important word or an insignificant word, or with what part of speech it concluded." The tendency was all in favour of brevity and crispness, and in particular of shorter sentences and easier constructions. Not a little of the majesty of the earlier age was lost; but for practical purposes, and in the hands of ordinary men, prose became a far more useful and businesslike implement than it had hitherto been. The short treatises of Halifax, if we compare them with similar writings of a generation earlier, display the complete change of style; or we may contrast the clear and sarcastic sentences of South with the undulating quaintness of Joseph Hall. The range of English speech was first comprehended perhaps by Dryden, who combined dignity and even pomp of movement with an ease and laxity at occasion which gave variety to prose, removed from it its stilted and too prelatical elevation at inappropriate moments, and approximated it to the ordinary speech of cultivated persons. This then may be called the foundation of modern English prose, which has extended into no departments not recognized, at least in essence, by Bunyan, Dryden and Temple. The ensuing varieties of prose have been mainly matters of style. In the 18th century, for instance, there was a constant alternation between a quiet, rather cold elegance and precision of prose-writing, which was called the Addisonian manner, and a swelling, latinized style, full of large words and weighty periods, in which Johnson was the most famous but Gibbon perhaps the most characteristic proficient. But as far as grammatical arrangement and the rules of syntax are concerned, it cannot be said that English prose has altered essentially since about 1680. It is, however, to be noted that in the course of the 19th century the use of short sentences, and the habit of neglecting to group them into paragraphs, introduced a heresy not known before; and that, on the other hand, there has been a successful attempt made to restore the beauty and variety of early 17th-century diction, which had suffered a long decline from the Restoration onwards.

Icelandic.—The independent invention of prose by the exiled aristocrats in the Heroic Age of Iceland is one of the most singular facts in literary history. It resulted from the fact that story-telling grew to be a recognized form of amusement in the isolated and refined life of an Icelandic household from the 9th to the 11th century. Something of the same kind had existed in the courts of Norway before the exodus, but it was in Iceland that it was reduced to an art and reached perfection. It is remarkable how suddenly the saga, as a composition, became a finished work; it was written in a prose which immediately presented, in the best examples, "a considerable choice of words, a richness of alliteration and a delicate use of syntax" (Vigfusson). The deliberate composition of sagas began about the year 1030, and it is supposed that they began to be written down soon after 1100. It is distinctly recorded that Ari Fródi (1067–1148) was the first man in Iceland who wrote down stories in the Norse tongue. Many of Ari's books are lost, but enough survive to show what Icelandic prose was in the hands of its earliest artificer, and the impress of his rich and simple style is felt on all the succeeding masterpieces of the great age of Icelandic history and biography. But the Greater Sagas, as they are called, the anonymous stories which followed the work of Ari and were completed in the 13th century, exhibit prose style in its most enchanting fullness, whether in the majesty of *Njala*, in the romantic art of *Laxdaela*, or in the hurrying garrulity of *Eyrbyggia*. There followed a vast abundance of sagas and saga-writers. The great historian, Sturla (1214–1284), is the latest of these classic writers of Iceland, and after his death there was a very rapid decline in the purity and dignity of the national prose. By the opening of the 14th century the art of writing in the old noble language had become entirely lost, and it was not until the 17th century that it began to revive as an archaeological curiosity and a plaything for scholars. "For an Icelander of the present day to write modern history in saga style is a ludicrous absurdity," and the splendid living prose of the 12th century remains unrelated, a strange and unparalleled portent in the history of European literature. Of its beneficial effect on later Scandinavian, English and even Teutonic style there can be no question.

Spain.—In Castilian Spanish, as in the other languages of Europe, verse is already far advanced before we meet with any distinct traces of prose. A didactic treatise for use in the confessional is attributed to a monk of Navarre, writing in the 13th century. Between 1220 and 1250 a chronicle of Toledo was indited. But the earliest prose-writer of whom Spain can really boast is King Alphonso the Learned (1226–1284), in whose encyclopaedic treatises "Castilian makes its first great stride in the direction of exactitude and clearness" (Fitzmaurice-Kelly). Almost all the creditable prose of the end of the 13th century is attributed to Alphonso, who was helped by a sort of committee of subsidiary authors. The king's nephew, Juan Manuel (1282–1347), author of the admirable *Conde Lucanor*, carried prose to a further point in delicacy and precision. The poet Ayala (1332–1407) was another gifted artificer of Spanish prose, which suffered a setback in the hands of his successors, Santillana and Mena. It rose once more in *The Sea of Histories* of Pérez de Guzmán (1378–1460), who has been compared to Plutarch and St Simon, and in whom the lucid and energetic purity of Castilian prose is for the first time seen in its perfection. In the 15th century the shapeless novel of chivalry was predominant, while in the age of Charles V. poetry altogether overshadowed prose. The next great writer of prose whom we meet with is Guevara, who died in 1545, and whose *Dial of Princes* exercised an influence which was not confined to Spanish, and even extended to English prose (in North's well-known version). The historians of this period, prolix and discursive, were of less value. The earliest picaroon novel, *Lazarillo de Tormes* (1554), the authorship of which is unknown, introduced a new form and exhibited Castilian prose style in a much lighter aspect than it had hitherto worn. Still greater elegance is met with in the mystical and critical writings of Juan de Valdés and in those of Luis de León; of the latter Mr Fitzmaurice-Kelly says that "his concise eloquence and his classical purity of expression rank him among the best masters of Castilian prose." The instrument, accordingly, was polished and sharpened for the finest uses, and was ready to the hand of the supreme magician Cervantes, whose *Don Quixote* was begun a few years (about 1591) after *Los Nombres de Cristo* of Luis de León had been published (1583); these dates are significant in the history of Spanish prose. The prose of Lope de Vega is stately and clear, but of course has little importance in comparison with the verse of his huge theatre. Quevedo's style had the faults which were now invading all European writing, of violent antithesis and obscure ingenuity; but his *Visions* (1627) occupy a prominent place in the history of Castilian prose. The latest struggles of a decadent critical conscience, battling against tortuousness and affectation, are seen in Gracián (1601–1658) and in Molinos (1627–1697), who vainly endeavoured to save classic prose out of the intellectual shipwreck of the 18th century. When Spanish prose revived in the 19th century, in the person of Larra (1809–1837), the influence of French models was found to have deprived it of distinctly national character, while giving it a fresh fluidity and grace.

French.—There had long been a flourishing versified literature in the vernacular of France, before anyone thought of writing French prose. It was the desire to be exact in giving information, together with a reduced sense of the value of rhyme and rhythm, which led to a partial divergence from metre. The translator of the fabulous *Chronicle of Turpin* mentions that he writes in prose "because rhyme entails the addition of words which are not in the Latin." Thus about the year 1200 verse began to be abandoned by chroniclers who had some definite statements to impart, and who had no natural gifts as poets. They ceased to sing; they wrote, more or less easily, as those around them spoke. The earliest French prose was translated from the Latin, but Baldwin VI., who died in 1205, is said to have commissioned several scribes to compile in the vulgar tongue a history of the world. If this was ever written it is lost, but we possess a *Book of Stories* written about 1225 by a clerk at Lille, which may fairly be said to be the start-word of French prose history. When once, however, a taste for prose was admitted, the superiority of that medium over verse as material for exact history could not but be perceived, and prose soon became frequent. The earliest French prose-writer of genius was Geoffroy (or Jofroi) de Villehardouin, who put down memoirs of his life between 1198 and 1207; he left his book, which is known as *The Conquest of Constantinople*, incomplete when he died in 1213. In the history of prose, Villehardouin takes an eminent place. In his admirable style are seen many of the most precious elements of French prose, its lucidity, its force, its sobriety and its charm of address. He had been trained as an orator, and it was his merit that, as M. Langlois has said, he was content to write as he had learned to speak. Villehardouin was closely followed by other admirable writers of memoirs, by Robert of Clari, by Henri of Valenciennes, by the anonymous chronicler of Béthune, to whom we owe the famous description of the battle of Bouvines, and by the Minstrel of Reims. The last-named finished his *Récits* in 1260. These works in the new easy manner of writing were found to be as elegant and as vivacious as any preserved by the old rhetorical art of verse. They led the way directly to the eminent writer who was the earliest historian of modern Europe, to Jean de Joinville, who finished his *Histoire de St Louis* in 1309. A century later Froissart left his famous *Chroniques* unfinished in 1404, and again a hundred years passed before Philippe de Commines dropped the thread of his *Mémoires* in 1511. These are the three most illustrious names in the chronicle of French medieval prose, in whom the various characteristics of the nation are separately developed. It must be noted that these three are simply the most eminent figures in a great cloud of prose-writers, who preserved with more or less vivacity the features of French life in the later middle ages, and helped to facilitate the use of the central national language. In the 15th century, moreover, Antoine de la Salle deserves mention as practically the earliest of French novelists, and one whose skill in the manipulation of language was long in waiting for a rival among his successors. But with the Renaissance came the infusion into France of the spirit of antiquity, and in Rabelais there was revealed an author of the very highest genius who at once defended the integrity of French syntax and enriched its vocabulary with an infinite multitude of forms. The year 1532, in which the first brief sketch of *Gargantua* appeared, was critical in French literature; for more than twenty years afterwards the structure of the great Pantagruelist romance was still being builded. Meanwhile in 1549 had appeared the *Défense et illustration de la langue française* of Joachim du Bellay, in which the foundations of the learned and brilliant literary criticism of France were firmly laid. The liberation of the language proceeded simultaneously in all directions. In 1539 it was officially decreed that all judicial acts were thenceforward to be written in vernacular prose, "en langage maternal français et non autrement." Calvin led the theologians, and his precise, transparent and sober prose, curiously deficient in colour, gave the model to a long line of sober rhetoricians. It is in the pages of Calvin that we meet for the first time with a simple French prose style, which is easily intelligible by the reader of to-day. There is some affectation of an ornamented pedantry in St François de Sales, some return to the form and spirit of medieval French in Montaigne; so that the prose of these great writers may easily seem to us more antiquated than that of Calvin. Yet the *Institution* belongs at latest to 1560, and the immortal *Essais* at earliest to 1580. We are approaching the moment when there should be nothing left for French prose to learn, and when development should merely take forms of personal brilliancy and initiative of enterprise on lines already clearly laid down. But we pause at Brantôme, in whom the broad practice of French as Froissart and the medieval chroniclers had used it was combined with the modern passion for minute detail and the close observation of the picturesque. Here the habit of memoir-writing in French prose first becomes a passion. With the beginning of the 17th century there sprang up almost an infatuation for making prose uniformly dignified and noble, for draping it in solemn robes, for avoiding all turns of speech which could remind the reader of the "barbarous" origins of the language; the earliest examples of this subjection of eloquence to purely aristocratic forms have been traced back to the *Servitude volontaire* of Montaigne's friend, La Boétie (1530–1563). In the pursuit of this dignity of speech the prose writers of the 16th century ventured to borrow not words merely but grammatical terms and peculiarities of syntax from the ancient literatures of Greece and Rome. The genius of France, however, and the necessity of remaining intelligible checked excess in this tendency, and after a few wild experiments the general result was discovered to be the widening of the capacities of the language, but at the temporary expense of some of the idiomatic richness of the old French form. In the 17th century a great stimulus was given to easy prose by the writers of romances, led by d'Urfé, and by the writers of letters, led by Balzac. In the hands of these authors French prose lost its heaviness and its solemnity; it became an instrument fit to record the sentiments of social life in an elegant balance of phrases; here was first discovered what Voltaire calls the *nombre et harmonie de la prose*. French style became capable of more than this, it achieved the noblest and the subtlest expressions of human and divine philosophy, when it was used by Descartes and by Pascal to interpret their majestic thoughts to the world. At this moment of national development, in 1637, the French Academy was founded, for the distinct purpose of purifying, embellishing and enlarging the French language; and in process of time, out of the midst of the academy, and as a primary result of its labours, arose the extremely important *Remarques* (1647) of Vaugelas, a work of grave authority, which was the earliest elaborate treatise on the science of prose in any language. Antiquated as the method of Vaugelas now seems, and little regarded in detail by modern writers, it may be said that his famous book is still the basis of all authority on the subject of French prose. In common with his colleagues of the hour, Vaugelas strove to lay down laws by which harmony of structure, a graceful sobriety, lucidity and exactitude of expression, could be secured to every practised French writer. He was not accepted as an infallible lawgiver, even in his own age; he was immediately exposed to the searching criticism of La Mothe le Vayer, who, however, was radically at one with him regarding the basis of his definition. The great demerit of the early academicians was that they knew little and cared less about the forms of medieval French. They thrust everything aside which they regarded as barbarous, and the work of the 19th century was to recover from a past behind Rabelais elements of great value which the 17th had arbitrarily rejected as "incorrect." In the succeeding centuries there has been a vast extension of the practice of French prose into every conceivable department of experience and observation, but in spite of all neologisms, and in spite of the waves of preciosity which have periodically swept over the French language in the three hundred years which divide the age of Somaize from that of Mallarmé, the treatise of Vaugelas remains the final code in which the laws that govern French prose are preserved.

Italy.—The case of prose in the Italian language has this unique feature that, instead of gathering form obscurely and slowly, it came into sudden existence at the will of one of the greatest of writers. Latin had almost universally been used in Italy until the close of the 13th century, when Dante created a vernacular prose in the non-metrical part of his famous *Vita Nuova*, written about 1293. For a long time the prose of Dante stood practically alone, and Petrarch actually affected to despise the works which his great predecessor had written in the vulgar tongue. But about 1348 Boccaccio started the composition of his *Decameron*, which gave classic form to the prose romance of Italy. There had been stories in the vernacular before, and Boccaccio himself had written the *Filocopo* and the *Amato*, but the *Decameron* marked the lines upon which easy and graceful Italian prose was to move for the future. It should have been greatly to the advantage of Italy over the other countries of Europe, that in the hands of Dante and Boccaccio prose was born full-grown, and had not to pass through the tedious periods of uncertain development which awaited it in England, France and Spain. After this brilliant beginning, however, there was a decline in the 15th century, the writers of the next age lacking the courage to be independent of antiquity. There was a return to Latin phraseology which made many works almost macaronic in character; the famous *Hypnerotomachia* of Colonna is an instance of this. Something of the purity of Italian prose as Boccaccio had left it was recovered by Sannazaro in his *Arcadia* (1489) a pseudo-classical pastoral romance, the form of which was widely imitated throughout Europe; even Sannazaro, however, did not see how needful it was to cast off Latin constructions. At length a pair of historians, Machiavelli and Guicciardini, succeeded in releasing prose from the yoke of Rome, and in writing undiluted Tuscan. In the 16th century the prose writers of Italy became extremely prolific, with Pietro Bembo at their head. The novelists were now prominent, but, although they take a foremost place in the history of Italian literature, there was little art in their employment of language. Many of them were born out of Tuscany, and, like Bandello, never learned the exact rules of pure Italian prose. Since the 16th century Italian would seem to have undergone no radical changes as a language, and its prose has been stationary in form. At the close of the 19th century a new school of writers, with Gabriele d'Annunzio at its head, created a demand for a new prose, but it is significant that the remedy suggested by these innovators was neither more nor less than a return to the procedure of Boccaccio and Machiavelli, who remain the types of ease and dignity in Italian prose.

German.—The earliest coherent attempts at the creation of German prose belong to the age of Charlemagne, and the first example usually quoted is the *Strassburger Eidschwüre* of 842. For all literary purposes, however, metrical language was used exclusively during the *mittelhochdeutsch* period, which lasted until the end of the 13th century. What little prose there was, was limited to jurisprudence and theology. David of Augsburg, who died in 1272, is named as the earliest preacher in the vernacular, but only one of his sermons has come down to us. More important was Berthold "the Sweet" (1220–1272), whose sermons were discovered by Neander and published in 1824. Historical prose began with the Saxon Chronicle of 1248. There was little to record in the next two centuries, until prose was revived by Geiler von Kaisersburg (1445–1510) in his sermons. About the same time translations were made of the *Decameron* and of other Italian collections of novels. The development of prose in Germany is, however, negligible until we reach the Reformation, and it is Luther's Bible (New Testament, 1522), on which all classic German prose is based. This movement is due to Luther alone, since the other protagonists of reform wrote mainly in Latin. Johann Fischart composed important secular books in the vernacular, in particular the *Bienenkorb* (1579) and an imitation of *Gargantua* (1575), which is the earliest German novel. But nearly a century passes before we reach another prose work of real importance in the German vernacular, this being the curious picaresque romance of *Simplicissimus* (1669) of Grimmelshausen. But the neglect of prose by the German nation was still general, and is exemplified in the way by which men of the stamp of Leibnitz wrote in Latin and even in French, rather than in their own "barbarous" tongue. What Luther had done at the beginning of the 16th century was, however, completed and confirmed in the middle of the 18th by Lessing, who must be considered as the creator of modern German prose. The critical period in this revival was 1764 to 1768, which saw the production of *Laocoon* and the *Hamburgische Dramaturgie*. We pass on presently to Jean Paul Richter, and so to Goethe, in whose majestic hands German prose became the organ of thought and eloquence which it has been ever since.

AUTHORITIES.—John Earle, *English Prose* (London, 1890); C. Favre de Vaugelas, *Remarques sur la langue française* (Paris, 1647). *Nouvelles remarques* (Paris, 1690); T. Mundt, *Kunst der deutschen Prosa* (Berlin, 1837); J. W. Mackail, *Latin Literature* (London, 1895); James Fitzmaurice-Kelly, *History of Spanish Literature* (London, 1898); G. Vigfusson, various Prolegomena. (E. G.)

PROSECUTION, the procedure by which the law is put in motion to bring an accused person to trial (see CRIMINAL LAW; INDICTMENT; SUMMARY JURISDICTION, and TRIAL). In theory in the United Kingdom the king is in all criminal offences the prosecutor, because such offences are said to be against his peace, his crown and dignity, but in practice such prosecutions are ordinarily undertaken by the individuals who have suffered from the crime. This is a different procedure from that prevailing in Scotland, European continental countries and the United States, in all of which a public department or officer undertakes the prosecution of offences. A step towards public prosecution was taken in England by the Prosecution of Offences Act (1879), under which an officer called the "Director of Public Prosecutions" was appointed; in 1884 the Prosecution of Offences Act of that year revoked the appointment made under the act of 1879, and constituted the solicitor to the Treasury Director of Public Prosecutions. The Prosecution of Offences Act (1908) separated the two offices again, making the public prosecutor independent of the treasury, but putting him under the control of the Home Office. The duty of the public prosecutor is to institute, undertake or carry on criminal proceedings in any court and to give advice and assistance to persons concerned in such proceedings. The appointment of such an officer, according to the act of 1908, does not preclude any person from instituting or carrying on criminal proceedings, but the public prosecutor may at any stage undertake the conduct of these proceedings if he thinks fit (s. 2, par. 3).

A person to be qualified for the post of public prosecutor must be a barrister or solicitor of not less than ten years' standing, and an assistant public prosecutor, who may be appointed under the act of 1908 and who is empowered to do any act or thing which the public prosecutor is required or authorized to do, must be a barrister or solicitor of not less than seven years' standing. See also LORD ADVOCATE.

PROSELYTE (Gr. προσήλυτος), strictly one that has arrived (=Lat. *advena*), a stranger or sojourner, a term now practically restricted to converts from one religion to another. It was originally so used of converts to Judaism, but any one who sets out to convert others to his own opinions is said to "proselytize." The word is commonly used in the Alexandrian Greek translation of the Old Testament (Septuagint) for the Hebrew word (*ger*) which is derived from a root (gur) denoting to sojourn. The English versions often render the word by "stranger;" but though distinguished from the home-born 'ezrah (=one rising from the soil), the person denominated *ger* became the equal of the native Israelite, and, when the meaning of *ger* passed from a mainly civil to a religious connotation, enjoyed many rights. Like the Arabic *jar* (which is philologically cognate to *ger*), the *ger* attached himself as a client to an individual or as a protected settler to the community. He shared in the Sabbath rest (Exod. xx. 10), and was liable to the same duties and privileges as Israel (see references in Oxford *Gesenius*, p. 158). The Hebrew word later came to mean what we now understand by proselyte, a term which appears in the sense of convert to Judaism in the New Testament (Matt. xxiii. 15; Acts ii. 10).

The Rabbinic law recognized two classes: (*a*) the full proselyte, the stranger of righteousness (*ger sedeq*), who was admitted after circumcision, baptism and the offering of a sacrifice (after the destruction of the Temple the first two ceremonies were alone possible); and (*b*) the limited proselyte, the resident alien (*ger toshab*) or proselyte of the gate (*ger ha-sha'ar*), who, without accepting Judaism, renounced idolatry and accepted Jewish jurisdiction, thereby acquiring limited citizenship in Palestine. Some authorities think that the "God-fearers" of some of the Psalms and of the New Testament were these limited proselytes. The Hebrew and Greek terms, however, lost the connotation of a change of residence, and both *ger* and "proselyte" came to apply to a convert without regard to his nationality.

At various periods there were proselytes to Judaism. The Maccabaeans used compulsion in some cases, but Judaism in the Diaspora was a missionary religion in the less militant sense. Heathens felt in the religion of Israel an escape from their growing scepticism, and a solution to the problem of life. Josephus testifies that there was much proselytism in Rome (Against Apion, ii. 39), and several Latin writers confirm this (Cicero, *Pro Flacco*, § 28; Juvenal xiv. 96; cf. Reinach, *Textes d'auteurs grecs et romains relatifs au Judaïsme* (1895). The well-known reference in Matt. xxv. 15 supports the view that proselytes were actively sought by the Pharisees, and the famous *Didachē* was probably in the first instance a manual for instructing proselytes in the principles of Judaism. There were, however, varying opinions as to the value to the Jewish body of these accessions. Some rabbis interpreted Israel's dispersion as divinely designed for the very purpose of proselytizing (*Pesahim* 87*b*.). In the Diaspora admission of converts may have been made easy, circumcision being sometimes omitted, but the conditions became gradually more severe, until they reached their present form. It is thought that the Hadrianic persecution led to this change. The Jews seem to have suffered during the war from the treachery of half-hearted friends. Again, many who had become converts to Judaism afterwards joined the new Christian communities. Moreover, in the middle ages, it was not lawful for the Jews to admit proselytes. Various church councils prohibited it, and the Code of Alfonso X. (1261) made conversion to the synagogue a capital crime. (In 1222 a Christian deacon was executed at Oxford for his apostasy to Judaism: Matthew Paris, ed. Luard, iii. 71.) Again, the pragmatic theory of Judaism, enunciated in Talmudic times, and raised almost to the dignity of a dogma by Maimonides (*On Repentance*, iii. 5, &c.), was that Judaism was not necessary for salvation, for "the pious of all nations have a share in the world to come" (*Tosephta*, Sanh. xiii. 2). If to these causes be added a certain exclusiveness, which refused to meet a would-be convert more than half-way, we find no difficulty in accounting for the reluctance which the medieval and modern synagogue has felt on the subject. Yet willing proselytes to Judaism are still freely received, provided that their bona fides are proven. In some reformed congregations in America proselytes are admitted without circumcision, and a similar policy is proposed (not yet adopted) by the Jewish Religious Union in London, though the male children of proselytes are to be required to undergo the rite. In 1896 the central conference of American Rabbis formulated as a proselyte Confession of faith these five principles: (1) God the Only One; (2) Man His Image; (3) Immortality of the Soul; (4) Retribution; and (5) Israel's Mission. Most cases of conversion to Judaism at the present time are for purposes of marriage, and female proselytes are more numerous than male. Female proselytes are admitted after the total immersion in a ritual bath, though in some Reformed congregations this rite is omitted. Proselytes are still not allowed, in Orthodox circles, to become the wives of reputed descendants of the priestly families, but otherwise marriage with proselytes is altogether equal to marriage between born Jews.

See Schürer, *Geschichte des jüdischen Volkes*, ed. 3, iii. 102–135, Bertholet, *Die Stellung der Israeliten und der Juden zu den Fremden*, 179–349; articles in *Ency. Bib.*, Hastings's *Dict. Bib.* and the *Jewish Ency.* For the Jewish law of the admission of proselytes, see *Shulḥan 'Aruch*, Yore Deah, § 268. (I. A.)

PROSERPINE (*Proserpina*), the Latin form of Persephone,[1] a Greek goddess, daughter of Zeus and the earth-goddess Demeter. In Greek mythology Demeter and Proserpine were closely associated, being known together as the two goddesses, the venerable or august goddesses, sometimes as the great goddesses. Proserpine herself was commonly known as the daughter (Core), sometimes as the first-born. As she was gathering flowers with her playmates in a meadow, the earth opened and Pluto, god of the dead, appeared and carried her off to be his queen in the world below.[2] This legend was localized in various places, as at Eleusis, Lerna, and "that fair field of Enna" in Sicily. Torch in hand, her sorrowing mother sought her through the wide world, and finding her not she forbade the earth to put forth its increase. So all that year not a blade of corn grew on the earth, and men would have died of hunger if Zeus had not persuaded Pluto to let Proserpine go. But before he let her go Pluto made her eat the seed of a pomegranate, and thus she could not stay away from him for ever.[3] So it was arranged that she should spend two-thirds (according to later authors, one-half) of every year with her mother and the heavenly gods, and should pass the rest of the year with Pluto beneath the earth.[4] There can be little doubt that this is a mythological expression for the growth of vegetation in spring and its disappearance in autumn. According to Theopompus there was a Western people who actually called the spring Proserpine. As wife of Pluto, she sent spectres, ruled the ghosts, and carried into effect the curses of men. The lake of Avernus, as an entrance to the infernal regions, was sacred to her. From the head of a dying person Proserpine was supposed to cut a lock of hair which had been kept sacred and unshorn through life.[5] She was sometimes identified with Hecate. On the other hand in her character of goddess of the spring she was honoured with flower-festivals in Sicily and at Hipponium in Italy. Sicily was a favourite haunt of the two goddesses, and ancient tradition affirmed that the whole island was sacred to them. The Sicilians claimed to be the first on whom Demeter had bestowed the gift of corn, and hence they honoured the two goddesses with many festivals. They celebrated the festival of Demeter when the corn began to shoot, and the descent of Proserpine when it was ripe. At Cyare, a fountain near Syracuse which Pluto made to spring up when he carried off his bride, the Syracusans held an annual festival in the course of which bulls were sacrificed by being drowned in the water. At Cyzicus also, in Asia Minor, bulls were sacrificed to Proserpine. Demeter and Proserpine were worshipped together by the Athenians at the greater and less Eleusinian festivals, held in autumn and spring respectively. In the Eleusinian mysteries Proserpine no doubt played an important part. One Greek writer, Achemachus, identified Proserpine with the Egyptian Isis.[1] At Rome Proserpine was associated with Ceres (the Roman representative of Demeter) in the festival of the Cerealia (April 12 to 19), she was represented as the wife of Dis Pater (the Roman Pluto), and was sometimes identified with the native Latin goddess Libera. The pomegranate was Proserpine's symbol, and the pigeon and cock were sacred to her. Her votaries abstained from the flesh of domestic fowls, fish, beans, pomegranates and apples. In works of art she appears with a cornucopia or with ears of corn and a cock.[2] The regular form of her name in Greek was Persephone, but various other forms occur: Phersephone, Persephassa, Phersephassa, Pherrephatta, &c., to explain which different etymologies were invented. Corresponding to Proserpine as goddess of the dead is the old Norse goddess *Hel* (Gothic *Halja*), whom Saxo Grammaticus calls Proserpine.

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[1] Some, however, regard *Proserpina* as a native Latin form, not borrowed from the Greek, and connected with *proserpere*, meaning the goddess who aided the germination of the seed.

[2] The story is reminiscent of the old form of marriage by capture.

[3] The idea that persons who have made their way to the abode of the dead can return to the upper world if they have not tasted the food of the dead appears elsewhere, as in New Zealand (R. Taylor, *New Zealand*, pp. 233, 271).

[4] Hymn to Demeter; Ovid, *Fasti*, iv. 419; *Metam.* v. 385.

[5] *Aen.*, iv. 698 seq. It appears to have been a Greek custom to cut a lock of hair from a dead man's head, and hang it outside of the house door, in token that there was a corpse in the house. At least this seems a fair inference from Eurip. *Alc.*, 75, 76, 101–104. The lock so cut may have been that which was kept sacred to the gods and unshorn (*Etym. Mag.*, *s.v.* ἀπεσκολυμμένος). For examples of hair dedicated to gods, see *Il.* xxiii. 141 seq.; Plut., *Thes.* 5; Paus. viii. 20, 3. In Tibet a lama (priest) is called in to cut off some hairs from the head of a dying person, in order that his soul may escape through the top of his head, which is deemed an essential condition of a good transmigration (Horace de la Penna, in Bogle and Manning's *Travels in Tibet*, ed. C. R. Markham, 1876). We can hardly doubt that the intention of the Graeco-Roman custom was similar. In modern Greece the god of death, Charos, is supposed to draw the soul out of the body, and if a man resists the Arachobites believe that Charos slits open his breast (B. Schmidt, *Volksleben der Neugriechen*, 1871, p. 228). There are other instances of incisions made in the body of a dying person to allow his soul to escape (cf. A. Bastian, *Der Mensch in der Geschichte*, 1860, ii. 342). The custom probably dates from the times when death in battle was the usual death. In the legend of Nisus and Scylla there is a trace of the custom which was still observed in classical times in the sacrifice of animals. The practice of cutting off the hair of the dead prevailed in India, though it does not appear in the Vedas (Monier-Williams, *Religious Thought and Life in India*, p. 281). We are reminded of the practice of the Pawnees and other North-American Indians, who shaved the head with the exception of one lock (the scalp-lock), which was removed by a victorious enemy (Catlin, *North American Indians*, ii. 24). The Sandwich Islanders also cut a lock from a slain foe (W. Ellis, *Polynesian Researches*, 1834, iv. 159).

See L. Preller, *Demeter und Persephone* (1837); R. Foerster, *Der Raub und die Rückkehr der Persephone* (1874); A. Zimmermann, *De Proserpinae raptu et reditu* (1882); J. A. Overbeck, "Demeter and Kore" in *Griechische Kunstmythologie*, ii. (1878). (J. G. Fr.; X.)

PROSKUROV, or Ploskurov, a town of Russia, in the government of Podolia, situated on the railway from Odessa to Lemberg, 62 m. N.W. of Zhmerinka junction. Pop. (1897), 22,915, more than one-half being Jews. It is poorly built, mostly of wood, on a low marshy plain surrounded by hills, at the confluence of the Ploskaya with the Bug. Its old castle has been destroyed, the site being occupied by a Roman Catholic church. The Orthodox Greek cathedral (1839) contains a very ancient and highly venerated image of the Virgin. The manufactures include oil-works and potteries; the Jewish merchants carry on an active export trade in corn and sugar, while the imports consist of salt and manufactured wares. Agriculture and market-gardening are the chief occupations of the Little-Russian inhabitants.

PROSODY (Gr. προσῳδία), the art of versification (see Verse), including as its three divisions accent, breathing and quantity. Prosody is the mode in which the discipline is determined by which successive syllables are so arranged as to form verse. The Latin name for it was *accentus*.

PROSPECTUS (Lat. for view, look-out, prospect, from *prospicere*, to look forward), a written or printed preliminary announcement of some undertaking, giving the scheme or plan, the principal features, &c. In law, the term is specifically applied to the invitation issued to the public by a company to subscribe for shares in the enterprise for which the company is formed (see Company).

PROSPER OF AQUITAINE, or Prosper Tiro (*c.* 390–*c.* 465), Christian writer and disciple of St Augustine, was a native of Aquitaine, and seems to have been educated at Marseilles. In 431 he appeared in Rome to interview Pope Celestine regarding the teachings of St Augustine and then all traces of him are lost until 440, the first year of the pontificate of Leo I., who had been in Gaul and thus probably had met Prosper. In any case Prosper was soon in Rome, attached to the pope in some secretarial or notarial capacity. Gennadius (*De script. eccl.* 85) mentions a rumour that Prosper dictated the famous letters of Leo I. against Eutyches. The date of his death is not known, but his chronicle goes as far as 455, and the fact that Ammianus Marcellinus mentions him under the year 463 seems to indicate that his death was shortly after that date. Prosper was a layman, but he threw himself with ardour into the religious controversies of his day, defending Augustine and propagating orthodoxy. The Pelagians were attacked in a glowing polemical poem of about 1000 lines, *Adversus ingratos*, written about 430. The theme, *dogma quod . . . pestifero vomuit coluber sermone Britannus*, is relieved by a treatment not lacking in liveliness and in classical measures. After Augustine's death he wrote three series of Augustinian defences, especially against Vincent of Lerins (*Pro Augustino responsiones*). His chief work was against Cassian's *Collatio*, his *De gratia dei ut libero arbitrio* (432). He also induced Pope Celestine to publish an *Epistola ad episcopos Gallorum* against Cassian. He had earlier opened a correspondence with Augustine, along with his friends Tyro and Hilarius, and although he did not meet him personally his enthusiasm for the great theologian led him to make an abridgment of his commentary on the Psalms, as well as a collection of sentences from his works—probably the first dogmatic compilation of that class in which Peter Lombard's *Liber sententiarum* is the best-known example. He also put into elegiac metre, in 106 epigrams, some of Augustine's theological dicta.

Far more important historically than these is Prosper's *Epitoma chronicon*. It is a careless compilation from St Jerome in the earlier part, and from other writers in the later, but the lack of other sources makes it very valuable for the period from 425 to 455, which is drawn from Prosper's personal experience. There were five different editions, the last of them dating from 455, after the death of Valentinian. For a long time the *Chronicon imperiale* was also attributed to Prosper Tiro, but without the slightest justification. It is entirely independent of the real Prosper, and in parts even shows Pelagian tendencies and sympathies.

The *Chronicon* has been edited by T. Mommsen in the *Chronica minora* of the *Monumenta Germaniae historica* (1892). The complete works are in Migne's *Patrologia latina*. Tome 51. See L. Valentine, *St. Prosper d'Aquitaine* (Paris, 1900), where a complete list of previous writings on Prosper is to be found; also A. Potthast, *Bibliotheca historica* (1896).

PROSSNITZ (Czech *Prostějov*), a town of Austria, in Moravia, 50 m. N.E. of Brünn by rail. Pop. (1900), 24,054, mostly Czech. It is situated in the fertile plain of the Hanna, and is the principal commercial centre for the sale of the various produce of the region. It has important textile, malt and sugar industries, distilling, brewing and milling, manufactures of agricultural implements and lucifer matches. Prossnitz is a town of ancient origin, and in the 16th century was one of the chief seats of the Moravian Brethren.

PROSTITUTION (from Lat. *prostituere*, to expose publicly), a word which may best be defined as promiscuous unchastity for gain. In German law it is described as *Gewerbsmässige Unzucht*. It has always been distinguished in law and custom from concubinage, which is an inferior state of marriage, and from adultery and other irregular sexual relations, in which the motive is passion. Prostitution has existed in all civilized countries from the earliest times, and has always been subject to regulation by law or by custom. In Christian countries attempts have repeatedly been made to suppress it, but without success. Its ultimate basis lies in the two most elementary attributes of living things, namely, the will to live and the instinct of reproduction. The one represents the interest of the individual, the other that of the race; and the essential character of prostitution is that it utilizes the latter to satisfy the former, whereas in true sexual passion, as Schopenhauer has pointed out, the advantage of the individual is subordinated to the needs of the race. In practical language, prostitution offers, through abuse of the sexual instinct, a means of livelihood which a certain proportion of women prefer to other means. It is often assumed by philanthropic moralists that no other means are open to them. That may be so in cases in which deception or constraint has been used, and adverse circumstances—such as lack of friends and a harsh social code—close the door to other occupations; but to suppose that such cases account for prostitution is to misapprehend the problem. The detailed investigations of various observers and the experience of rescue societies prove that the great majority of prostitutes prefer that means of livelihood to others entailing regular work, discipline and self-control. When they really cease to prefer the life, they leave it voluntarily.[1] Otherwise there is extreme difficulty in reclaiming even the few who will consent to try, and permanent success is only attained with a small proportion of them. The earliest attempt at reclamation met with the same result. It was carried out by the Roman empress Theodora, wife of Justinian, herself a prostitute in early life. She established a home for 500 women on the Bosporus, but after a time they could not bear the restraint; some threw themselves into the sea, and eventually the scheme was abandoned. The preference is due to several causes, of which indolence is the chief. Prostitutes are drawn mainly from the lower classes; the life offers them an escape from the toil which would otherwise be their lot. Women who present themselves to the police for inscription on the continent of Europe frequently give as their reason for embracing the life, that they do not intend to work any more. Other causes are love of excitement and dislike of restraint. The same qualities make the criminal and the wastrel. In addition, a large proportion have the sexual appetite developed in an abnormal degree. Of 3505 women interrogated by M. Buls in Brussels, 1118 admitted *le goût pour l'homme.* The foregoing are primary causes. External conditions which foster any of these tendencies, or destroy the self-respect and sense of modesty which are their natural antidotes, are secondary causes of prostitution. The more important are: (1) difficulty of finding employment; (2) excessively laborious and ill-paid work; (3) harsh treatment of girls at home; (4) promiscuous and indecent mode of living among the overcrowded poor; (5) the aggregation of people together in large communities and factories, whereby the young are brought into constant contact with demoralized companions; (6) the example of luxury, self-indulgence and loose manners set by the wealthier classes; (7) demoralizing literature and amusements; (8) the arts of profligate men and their agents. Alcohol is often an aid to prostitution, but it can hardly be called a cause, for the practice flourishes even more in the most abstemious than in the most drunken countries. These observations apply to the West. In Oriental countries girls are commonly born into or brought up to the trade, and in that case have no choice.

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[1] Others regarded her as originally a moon-goddess.

[2] As the wife of Hades she was represented with the insignia of royalty and a torch.

History.

Among the ancient nations of the East, with the exception of the Jews, prostitution appears to have been connected with religious worship, and to have been not merely tolerated but encouraged. From the Mosaic ordinances and the narrative of the Old Testament it is clear that the separation of the Jews as the chosen people, and the maintenance of their faith, were always felt by Moses and by the later prophets to be chiefly endangered by the vicious attractions of the religious rites practised around them. The code of sexual morality laid down in the Book of Leviticus is prefaced by the injunction not to do after the doings of the land of Egypt, nor after the doings of the land of Canaan, where all the abominations forbidden to the Jews were practised; and whenever the Israelites lapsed from their faith and "went a-whoring after strange gods," the transgression was always associated with licentious conduct. In Egypt, Phoenicia, Assyria, Chaldea, Canaan and Persia, the worship of Isis, Moloch, Baal, Astarte, Mylitta and other deities consisted of the most extravagant sensual orgies, and the temples were merely centres of vice. In Babylon some degree of prostitution appears to have been even compulsory and imposed upon all women in honour of the goddess Mylitta. In India the ancient connexion between religion and prostitution still survives; but that is not the case in China, a most licentious country, and, considering the antiquity of its civilization, and its conservatism, we may perhaps conclude that it formed an exception in this respect among the ancient nations. Among the Jews, who stood apart from the surrounding peoples, the object of the Mosaic law was clearly to preserve the purity of the race and the religion. Prostitution in itself was not forbidden, but it was to be confined to foreign women. Jewish fathers were forbidden to turn their daughters into prostitutes (Lev. xix. 29), and the daughters of Israel were forbidden to become prostitutes (Deut. xxiii. 17), but no penalty was attached to disobedience, except in the case of a priest's daughter, who was to be burnt (Lev. xxi. 9). This distinction is significant of the attitude of Moses, because the heathen "priestesses" were nothing but prostitutes. Similarly, he forbade groves, a common adjunct of heathen temples and a convenient cover for debauchery. Again, his purpose is shown by the severe penalties imposed on adultery (death) and on unchastity in a betrothed damsel (death by stoning), as contrasted with the mild prohibition of prostitution. So long as it did not touch the race or the religion, he tolerated it; and even this degree of disapproval was not maintained, for Jephthah was the son of a harlot[2] (Judg. xi. 1). There is abundant evidence in the Old Testament that prostitution prevailed extensively in Palestine, even in the earlier and more puritan days. The women were forbidden Jerusalem and places of worship; they infested the waysides, and there is some evidence of a distinctive dress or bearing, which was a marked feature of the trade among the Greeks and Romans. In the later period of aggrandisement that increase of licentious indulgence which Moses had foreseen took place, associated with infidelity. The people plunged into debauchery, the invariable sign of national decadence, which has always accompanied over-prosperity and security, and has always heralded national destruction. Before leaving the Jews, it may be noted as an interesting fact that the remarkable series of ordinances laid down by Moses in the interest of public health contains unmistakable recognition of venereal disease and its contagious character (Lev. xv.).

Passing on to the ancient Greeks, we find prostitution treated at Athens on a new principle. The regulations of Solon were designed to preserve public order and decency. He established houses of prostitution (*dicteria*), which were a state monopoly and confined to certain quarters. The *dicteriades* were forbidden the superior parts of the town, and were placed under various disabilities. They were compelled to wear a distinctive dress, and, so far from being connected with religion, they were not allowed to take part in religious services. These laws do not seem to have been carried out at all effectually, and were presently relaxed. After the Persian wars more stringent regulations were again introduced. The *dicteriades* were placed under police control, and were liable to prosecution for various offences, such as ruining youths, committing sacrilege and treason against the state. It is clear, however, that as time went on the Athenian authorities experienced the difficulties encountered by modern administrations in carrying out state regulation. There were grades of prostitution, socially though not legally recognized, and women of a superior order were too powerful for the law, which failed to maintain the ban against them. The Greek *hetaerae*, who were prostitutes, not "mistresses," and the most gifted and brilliant members of their class known to history, wielded great and open influence. The test case of Phryne, in which the stern attitude previously maintained by the Areopagus broke down, established their triumph over the law, deprived virtuous women of their sole advantage, and opened the door to general laxity. In later times any one could set up a *dicterion* on payment of the tax. In other Greek cities extreme licence prevailed. At Corinth, which was famous for sensual practices, a temple, with a huge staff of common prostitutes for attendants, was established in honour of Aphrodite and for the accommodation of the sailors frequenting the port. The worship of this goddess became generally debased into an excuse for sexual excesses.

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[1] The number of those who do so is considerable. In Copenhagen, from 1871 to 1896, 33% of the registered prostitutes were removed from the register by marriage and by returning to their friends. Many women resort to prostitution occasionally in alternation with work.

[2] Neither "harlot" nor "whore" is the Anglo-Saxon for a prostitute, for which the word is *miltestre* (so in Matt. xxi. 31). "Whore" came into English from Scandinavian sources. It was not spelled with the initial *w* till the beginning of the 16th century. The earlier forms are *hore* or *hoore*. The word appears in many Teutonic languages, Dan. *hore*, Swed. *hora*, Du. *hoer*, Ger. *Hure*. The ultimate origin has been taken to be the root meaning "to love," seen in Lat. *carus*, dear. In its earliest usages the word means "adulterer" or "adulteress." It is frequent in the early version of the Bible in the sense of prostitute. "Harlot," possibly, as the *New English Dictionary* points out, as a less offensive word, is frequent in 16th-century versions.

The word "harlot" first appears without its present application and usually of men, in the sense of rogue, vagabond, sometimes even with no evil significance at all, much as we use "fellow." Thus in the prologue to the *Canterbury Tales*, 647, where the "Somonour" is called a "gentil harlot and a kynde." The word came from Fr. *arlot*, masculine, *arlotte*, feminine. Du Cange (*Glossarium*) defines med. Lat. *arlotus*, as *Helluo, ventri deditus*, and gives the Fr. *arlot* as an equivalent, with the meaning *homo nihili, fripon, coquin.* The *Catholicon anglicum* (1483) defines "harlott" as *joculator, joculatrix, histrio, histrix*, connecting the word with the wandering players, actors, jugglers, of the day. The ultimate origin of the Romanic word is unknown. Skeat connects it with the Teutonic word, which appears in Ger. *kerl*, Eng. "churl," which means "man," "fellow." Like "bigot" (*q.v.*), the word has been fancifully derived from the name of a person, viz. Arletta or Arlotta, the mother of William the Conqueror (William Lambarde, 1536–1601, *Perambulation of Kent*, pub. 1576).

The Romans united the Jewish pride of race with the Greek regard for public decency, and in addition upheld a standard of austerity all their own. In early days female virtue was highly honoured and strenuously maintained among them, of which the institution of the vestal virgins was a visible sign. Their attitude towards prostitution differed, accordingly, from that of other ancient nations. Among them, alone, it was considered disgraceful to a man to frequent the company of prostitutes; and this traditional standard of social conduct, which markedly distinguished them from the Greeks, retained sufficient force down to the later days of the Republic to furnish Cicero with a weapon of rhetorical attack against his political opponents, whom he denounced as *scortatores*. Prostitution was more severely regulated by them than by any other ancient race. They introduced the system of police registration, which is the leading feature of administration in most European countries to-day. From the earliest days of the Republic prostitutes were required to register at the aediles' office, where licences were issued to them on payment of a tax. They were placed under stringent control, had to wear a distinctive dress, dye their hair or wear yellow wigs, and were subject to various civil disabilities; but the severest feature of the system was that, once registered, their names were never erased, and consequently remained for ever under an indelible stain. As in our times, registration became ineffective, and neither law nor tradition could check the demoralizing influence of ease and luxury when once external conquest left the Romans free to devote their energies to the pursuit of pleasure. An attempt was made, by the enactment of severer laws against prostitution, to stem the rising tide of immorality, which threatened to taint the best blood in Rome with the basest elements in the later days of the Republic. Citizens were prohibited from marrying the descendants or relatives of prostitutes, daughters of equestrians were forbidden to become prostitutes, and married women who did so were liable to penalties. More stringent regulations were also imposed on prostitutes themselves, in addition to the old disabilities and police system, which remained in force. If these laws had any effect at all, it was to promote the general prevalence of immorality; they certainly did not diminish prostitution. The profligacy of imperial Rome has never been surpassed for gross and obscene sensuality.

The greatest change introduced by Christianity with regard to prostitution was the adoption of a more charitable attitude towards these social and legal outcasts. The Roman state tax, which had descended to the emperors and had been further regulated under Caligula, was partly given up in the 4th century by Theodosius, on the representations of Florentius, a wealthy patrician, who offered to make good the loss of revenue out of his own pocket. It was fully and finally abolished by Anastasius I. in the next century, and the old registers were destroyed. Then some of the civil disabilities of prostitutes were removed by Justinian in the 6th century. Gibbon, who never gave credit for a good motive when a base one could be found, attributes Justinian's action solely to his desire to marry Theodora, whose life had been notorious; and no doubt she influenced him in the matter, but it is permissible to assume a good motive. Even Gibbon is constrained to admit her virtue after marriage, and to give her credit for "the most benevolent institution" of Justinian's reign, the rescue home for fallen women in Constantinople, which was at any rate disinterested. Though it did not succeed, it marks a turning-point in the treatment of a class which had never met with public sympathy before. At the same time procuration and connivance were severely punished, which is in keeping with the Christian attitude. The early Christian Church laid great stress on chastity, which probably suggested to its Roman persecutors the horrible punishment of forcibly prostituting Christian maidens. Such malignity enhanced the glory of martyrdom without shaking the constancy of its victims; and the triumph of purity in an age of unbounded licence was conspicuously recognized by Alaric, the Gothic conqueror, who gave strict orders in the sack of Rome that the virtue of Christian women was to be respected. The church, however, was not severe upon prostitutes, to whom the altar was open upon repentance, and some of the fathers explicity recognized their trade as a necessary evil. Among them was St Augustine, a man of the world, who saw that its suppression would stimulate more destructive forms of immorality. Gradually charity degenerated into patronage. Rome, conquered spiritually by Christianity and materially by the northern barbarians, sapped the virtue of both. Before the middle ages the institutions and ministers of the Church became a by-word for vice. Charlemagne made an effort to suppress the prevailing disorder, but his private life was licentious, and his capitularies, which ordained the scourging of prostitutes and panders, were not inspired by any regard for morality. A period of reform followed. The rise of chivalry, with its lofty idealization of women, and the wave of Christian fervour connected with the Crusades, inspired a vigorous and high-minded campaign against an all-prevalent evil. The Church became exceedingly active in prevention and rescue work, and was assisted by a devout and zealous laity. Rescue missions were organized, convents were founded everywhere for the reception of penitents, and dowries were subscribed to procure them husbands. Fulke de Neuilly was a conspicuous figure in this work. He held missions, preached, and collected large sums for marriage dowries. Pope Innocent III. (1198–1216) pronounced it a praiseworthy act to marry a prostitute; and Gregory IX., a few years later, wrote to Germany that brothel-keepers were not to prevent prostitutes from attending missions, and that clergy and laity who drew profit from prostitution were banned. "Urge bachelors," he wrote, "to marry repentant girls, or induce the latter to enter the cloister." In spite of such efforts, and of occasional spasms of severity by individual rulers, prostitution flourished everywhere throughout the middle ages. It was not merely tolerated, but licensed and regulated by law. In London there was a row of "bordells" (brothels) or "stews" in the Borough near London Bridge. They were originally licensed by the bishops of Winchester, according to John Noorthouck, and subsequently sanctioned by parliament. Stow quotes the regulations enacted in the year 1161, during the reign of Henry II. These were rather protective than repressive, as they settled the rent which women had to pay for the rooms, and forbade their compulsory detention. The act was afterwards confirmed in the reigns of Edward III. and Richard II. In 1383 the bordells belonged to William Walworth, lord mayor of London, who farmed them out, probably on behalf of the Corporation, according to analogy in other parts of Europe. They were closed in 1506, but reopened until 1546, when they were abolished by Henry VIII. In London we get the earliest known regulations directed against the spread of venereal disease. The act of 1161 forbade the bordell-keepers to have women suffering from the "perilous infirmity of burning"; and by an order of 1430 they were forbidden to admit men suffering from an *infirmitas nefanda*. Probably it was by virtue of this order that in 1439 two keepers were condemned to eleven days' imprisonment and banishment from the city. In 1473, again, it is recorded that bawds and strumpets were severely handled by Lord Mayor Hampton.

Elsewhere in Europe much the same state of things prevailed during the same period. Prostitution was both protected and regulated, and in many places it constituted a source of public revenue. In France prostitutes were distinguished by a badge, and forbidden to wear jewels and fine stuffs and to frequent certain parts of the town. Public brothels on a large scale were established at Toulouse, Avignon and Montpellier. At Toulouse the profits were shared between the city and the university; at Montpellier and Avignon the trade was a municipal monopoly, and farmed out to individuals; at Avignon, where the establishment was kept up during the whole period of the popes' residence, the inmates were subjected to a weekly examination. In 1254 Louis IX. issued an edict exiling prostitutes and brothel-keepers; but it was repealed two years later, though in this and the succeeding century procuration was punished with extreme severity. In some parts of France prostitutes paid a tax to the seigneur. In Germany, according to Fiducin, the public protection of *Lust-Dirnen* was a regular thing in all the large towns during the middle ages. "Frauenhäuser," similar to those in London and in France, existed in many places. They are mentioned in Hamburg in 1292; and from later records it appears that they were built by the corporation, which farmed them. So also in Ulm, where special regulations were issued in 1430. We find them existing at Regensburg in 1306, at Zürich in 1314, at Basel in 1356 and Vienna in 1384. According to Henne-am-Rhyn, admission to these houses was forbidden to married men, clergy and Jews, and on Sundays and saints' days they were closed. The laws of the emperor Frederick II. in the 13th century contain some curious provisions. Any one convicted of a criminal assault on a prostitute against her will was liable to be beheaded; if she made a false accusation she was subject to the same penalty. Any one not going to the assistance of a woman calling for help was liable to a heavy fine. In these ordinances the influence of chivalry may be detected. At the same time prostitutes were forbidden to live among respectable women or go to the baths with them. Hospitality to important guests included placing the public Frauenhäuser at their disposal. So King (afterwards Emperor) Sigismund was treated at Bern in 1414 and at Ulm in 1434, so much to his satisfaction that he publicly complimented his hosts on it. Besides the municipal Frauenhäuser, there were "Winkelhäuser," which were regarded as irregular competitors. In 1492 the licensed women of Nuremberg complained to the mayor of this unfair competition, and in 1508 they received his permission to storm the obnoxious Winkelhaus, which they actually did. In Italy and Spain the system appears to have been very much the same. At Bologna prostitutes had to wear a distinctive dress, in Venice they were forbidden to frequent the wine-shop, and in Ravenna they were compelled to leave a neighbourhood on the complaint of other residents. At Naples a court of prostitutes was established, having jurisdiction over everything connected with prostitution. It led to great abuses, was reformed in 1589, and abolished about a century later.

Such was the state of things in the middle ages. In the 15th and 16th centuries a great change took place. It was due to two very different causes: (1) fear of disease; (2) the Reformation. With regard to the first, there can be little doubt that both the slighter and graver forms of venereal disease existed in very remote times, but until the 15th century they attracted comparatively little attention. The constitutional character of syphilis was certainly not understood—which is by no means surprising, since its pathology has only recently been elucidated (see VENEREAL DISEASES)—but one would still have expected to find more notice taken of it by historical, moral and medical writers in classical and medieval times. Nor is it possible to explain their reticence by prudery, in view of the unbounded literary licence permitted in those ages. One can only conclude that the evil was less widely spread or less virulent than it afterwards became. At the end of the 15th century it attracted so much notice that it was supposed to have originated then *de novo*, or to have been brought from the West Indies by Columbus—both untenable hypotheses; and, as usual, each country accused some other of bringing the contagion within its borders. To speculate on the cause of this increased prevalence would be idle; it is enough to note the fact and its consequences. It was immediately followed by the Reformation, and the two together led to a general campaign against the system of licensed prostitution. The last Frauenhaus was closed in Ulm in 1531, in Basel in 1534 and in Nuremberg in 1562. In London, as already noted, the bordells were abolished in 1546. In Paris an ordinance was issued in 1560 prohibiting these establishments, and later all prostitutes were required to leave the city within twenty-four hours. These instances will suffice to show the general character of the movement. Nor were municipal brothels ever tolerated again. It is observed by Henne-am-Rhyn—no friend of toleration—that their suppression was followed by the appearance of the crime of infanticide, by the establishment of hospitals for foundlings and for syphilis. This suggests an indictment against humanity which is hardly justified by the facts. Infanticide was no new thing, and foundling hospitals date from the beginning of the 13th century. Their marked increase and the establishment of syphilitic hospitals came a century later than the Reformation campaign against the Frauenhäuser. The suppression of the latter did not affect the prevalence of prostitution. In the 17th century another spasm of severity occurred. In 1635 an edict was issued in Paris condemning men concerned in the traffic to the galleys for life; women and girls to be whipped, shaved and banished for life, without formal trial. These ordinances were modified by Louis XIV. in 1684. The Puritan enactments in England were equally savage. Fornication was punishable by three months' imprisonment, followed by bail for good behaviour. Bawds were condemned to be whipped, pilloried, branded and imprisoned for three years; the punishment for a second offence was death. In Hamburg all brothels were pulled down and the women expelled from the town. If these measures had any effect, it was speedily lost in a greater reaction; but they have some historical interest, as the present system was gradually evolved from them.

It would be tedious and unprofitable to follow all the steps, the shifts and turns of policy, adopted in different countries during the 18th century for the suppression or control of an incurable evil. They involve no new principle, and merely represent phases in the evolution of the more settled and more systematic procedure in force at the present time. Its chief feature, as compared with the past, is the establishment of an organized police force, to which the control of prostitution is entrusted, coupled with a general determination to put the subject out of sight and ignore it as far as possible. The procedure on the continent of Europe is virtually a return to the old Roman system of registration and supervision, except that there is no state tax, and names can be removed from the register. The objects are the same, namely, public order and decency, with one important addition, which has given rise to much controversy. This is the protection of health. From what has gone before, the reader will have gathered that it is not, as frequently supposed, a new thing. Already in the middle ages the question occupied the attention of parliament in England, and a weekly examination of public women by the barber (the surgeon of that time) was instituted at Avignon. The practice was adopted in Spain from about 1500, and later in many other places. But the abolition of licensed brothels, and the consequent growth of private prostitution, rendered it a dead letter. To meet the difficulty, registration was devised. It was first suggested in France in 1765, but was not adopted until 1778. The present regulations in France are based on the ordinances of that year and of 1780 which in their turn were borrowed from those of the 16th and 17th centuries, previously mentioned. The *theory* of the modern attitude towards prostitution is clearly laid down by successive ordinances issued in Berlin. Those of 1700 stated that "this traffic is not permitted, but merely tolerated"; the more precise ones of 1792 pronounced the toleration of prostitution a necessary evil, "to avoid greater disorders which are not to be restrained by any law or authority, and which take their rise from an inextinguishable natural appetite"; and the regulations of 1850 and 1876 are headed: "Polizeiliche Vorschriften zur Sicherung der Gesundheit, der öffentlichen Ordnung und des öffentlichen Anstandes." This embraces the whole theory of present administration, and if *Gesundheit* be omitted, is not less applicable to the United Kingdom than to the continent. The last attempt to suppress prostitution in Germany is worth noting, as it occurred so late as 1845. Registration was stopped and the tolerated houses were closed in Berlin, Halle and Cologne. The attempt was a complete failure, and it was abandoned in 1851 in favour of the previous system.

We proceed to state the present condition of the law in France, Germany, Austria and the United Kingdom.

Present laws.

France.—The French criminal law takes no cognizance of prostitution. The subject was omitted from the penal code drawn up by the first Republic, and was never restored, although many attempts were made to introduce legislation, on account of the great disorder which arose. Procuration is to a certain extent a criminal offence. Paragraph 334 of the code forbids the exciting, favouring or facilitating habitually the debauch of girls or boys under twenty-one years of age; the penalty is imprisonment for six months to two years, and a fine of 50 to 500 francs. If the offence is committed by parents, guardians or other persons in a tutelary position, imprisonment is from two to five years, and the fine 300 to 1000 francs. The regulation of prostitution rests on the law of 1790, which entrusted the preservation of public tranquillity to the administrative authorities; these are in Paris the prefect of police, and in other communes the mayor. The Parisian regulations have been built up by the decrees of successive prefects. They are based on those of 1778, which fell into abeyance at the Revolution, were reintroduced in 1816, amended in 1823, and made more complete in 1830 and 1841. Those adopted in other towns do not differ in any essential particular. The more important points are: (1) registration of prostitutes, which is either voluntary, or compulsory after repeated arrest; (2) recognized brothels, which are of two classes—*maisons de tolérance* (residential) and *maisons de passe* (houses of call); (3) medical examination, which is weekly at the *maisons de tolérance*, while other registered prostitutes must present themselves fortnightly at the dispensary; (4) hospital treatment of those found diseased; (5) rules with regard to solicitation, the frequenting of public places, &c. A small fee is paid for examination. The penalty for infraction of regulations is imprisonment; offences are divided into two classes: (1) slight, (2) grave, and the term of imprisonment varies accordingly from fourteen days to one year. Names may be erased from the register on the following grounds: (1) marriage, (2) organic disease such as to render the calling impossible, (3) return to relations and proof of good behaviour. The whole procedure appears to rest on grounds of doubtful legality. Prostitution never comes before the courts which alone can try offences and pronounce sentence. The police have no power to do so, yet they both try and sentence these women. That is to say, the whole system depends on their doing, by some verbal quibble, what they have no power to do. The question came before the court of Reims in 1876, in the case of two women who refused to submit to medical examination, and the judge decided in their favour. He was dismissed in consequence, which does not make the situation more satisfactory.

Germany.—The German law is more explicit and more logical. Prostitution is not forbidden, but by paragraph 361 of the Imperial Code women are liable to arrest for practising prostitution without being under police control, and for contravening regulations after they have been placed under such control. This brings the traffic completely under the police, and gives legal sanction to their regulations. These vary to some extent in different places, but their general tenor is the same. They include compulsory registration and weekly or semi-weekly medical examination, together with rules, for the most part extremely strict, with regard to public demeanour and conditions of life. In Hamburg, for instance, prostitutes are confined to certain streets or houses, forbidden to share lodgings with persons not registered, to have female servants under twenty-five years of age, to keep children after school age, to admit young men under twenty, to make a noise or quarrel, to attract attention in any way, to go out between two and five in summer, to frequent certain parts of the town, or public balls, or superior seats in the theatre, to remain out after 11 p.m. (Regulations of 1886). On proved reclamation, supervision may be relaxed or names struck off the register. Generally, the women are compelled to contribute a fixed sum to a sick fund, for defraying the cost of medical examination; and in some places also to a journey fund, which is applied to sending strangers to their homes. Brothels are absolutely illegal throughout Germany. Paragraph 180 of the Imperial Code (1876) made *Kuppelei* a penal offence. *Kuppelei* is defined as promoting prostitution, either by procuration or by providing facilities of any kind. There is (1) ordinary *Kuppelei*, or simply assisting prostitution for gain, and (2) aggravated *Kuppelei*, which includes false pretences and procuration by parents, guardians, teachers, &c. The penalty for the former is a short term of imprisonment and police supervision; for the latter, penal servitude up to five years. It is obvious that if this law were strictly enforced, it would amount to suppression, for every householder or houseowner who harboured a prostitute would be liable to prosecution. Its actual interpretation, however, is very elastic. A law passed in Prussia in 1900 has for its object the reclamation of the young. Girls under eighteen may be placed under control until they are twenty-one.

Austria.—The Austrian law goes farther than the German, and is still more inconsistent with the existing practice. By paragraph 5 of the Criminal Act of 1885 prostitution is actually forbidden, but permission is given to the police to tolerate it under conditions, and to prescribe regulations according to circumstances. Power to punish is also given to the police. Only certain cases of prostitution are liable to criminal prosecution, namely, when continued after police punishment, with disregard of regulations, when practised by persons suffering from venereal disease, and when accompanied by public scandal. Seduction of the young is punishable by imprisonment, eight days to six months; living on the prostitution of others, by eight days to three months. *Kuppelei* is a penal offence. Simple *Kuppelei* include (1) harbouring prostitutes for the purpose of pursuing their trade, (2) procuration, (3) having any connexion with the traffic—penalty, three to six months' imprisonment; qualified *Kuppelei* is (1) procuration of innocent persons (equivalent to use of false pretences), (2) procuration by parents, guardians, &c.—penalty, one to five years. The police regulations and procedure are similar to those in Germany, but less strict. In all these countries a special service of police is employed.

Great Britain.—The English law differs markedly from the foregoing. It regards prostitution solely as a public nuisance, and dates from the middle of the 18th century. The principal act (25 Geo. II.) was passed in 1755, making perpetual a previous act of 1752. It is entitled "An act for encouraging prosecutions against persons keeping bawdy-houses," and provides that two ratepayers, on giving notice to a constable, may go with him before a justice and obtain an order for proceeding against the persons in question. A further act was passed in 1763, fixing the penalties, and a third in 1818 (58 Geo. III.), enabling the overseers of the parish to take the requisite proceedings. Thus machinery was provided for dealing with brothels, but it was left to the public to put it in motion. The Vagrancy Act of 1824 enables the police to proceed against "common prostitutes for behaving in a riotous or indecent manner," and also forbids indecent literature. This was strengthened by a special act (1839) applying to London only, for the prevention of "loitering for the purpose of prostitution or solicitation, to the annoyance of passengers or inhabitants." Other large towns have since obtained private acts for the same purpose. The penalties are fines and short terms of imprisonment. In 1847 an act was passed making it an offence for publicans to allow "common prostitutes to assemble and continue" in licensed premises. The Licensing Act of 1872 contains a provision to the same effect. The previous law for dealing with brothels by indictment was strengthened by the Criminal Law Amendment Act of 1885, which renders "any person who keeps, manages or acts or assists in the management of a brothel," and any owner or occupier who knowingly permits the same, liable to summary conviction under the Summary Jurisdiction Act; penalties for first offence, a fine up to £20, or imprisonment up to three months, increased for second offence to £40 and four months respectively. The same act also strengthened the law, which had previously been very weak, for the protection of the young and the prevention of procuration. It makes the procuration or attempted procuration of any girl or woman "to become a common prostitute" a misdemeanour punishable by two years' imprisonment, and places the following offences on the same footing: procuring defilement by threats, fraud or drugs; compulsory detention for defilement or in a brothel; procuring the defilement of girls under twenty-one; inducing them to leave the kingdom or to leave home and go to a brothel, with intent. The defilement of girls under sixteen and over thirteen years of age is also a misdemeanour, and subject to the same penalty; the defilement of girls under thirteen is felony, punishable by penal servitude from five years up to a life-sentence. Owners or occupiers of premises conniving at these offences are equally liable.

No account of the law in the United Kingdom would be complete without some reference to the partial adoption of the system of examination as employed elsewhere in Europe in 1864–1883. In 1864 a Contagious Diseases Prevention Act was passed providing for the compulsory medical examination of prostitutes, and detention in hospital of those found diseased, in the following garrison towns: Portsmouth, Plymouth, Woolwich, Chatham, Sheerness, Aldershot, Colchester, Shorncliffe, the Curragh, Cork and Queenstown. The legal machinery was a justices' order granted on sworn information that the woman named was a common prostitute. "The Act having proved very inefficacious" (judge advocate-general in House of Commons, April 1883), it was amended in 1866 and extended to Windsor. Two years later an important memorial was drawn up by the royal colleges of physicians and surgeons in favour of the acts and their extended application, and in 1869 they were further amended and applied to Canterbury, Dover, Gravesend, Maidstone, Southampton and Winchester—eighteen places in all. A popular agitation, based on humanitarian and moral grounds, and continuously carried on against the measure led to the appointment of a royal commission in 1871 and a select committee in 1879. The direct evidence was strongly in favour of the acts, alike with regard to the diminution of disease among the troops in the protected towns, the absence of complaints and the good effect on public order, to which clergymen and other residents testified. The majority of the committee reported accordingly after three years' inquiry; but in 1883 the House of Commons passed a resolution, by 182 to 110 votes, condemning the compulsory examination of women. As this would have entailed refusal to vote the money required to carry on the system, it was immediately dropped, and the officers of the metropolitan police to whom its execution had been entrusted were recalled. In 1886 the C. D. Acts were repealed.

In *India* the system was introduced for military cantonments in 1865, partially suspended at the end of 1884, and stopped in 1888 on account of the action of the House of Commons. A new Cantonment Act was applied in 1889, and an amending act in 1893, by which the compulsory or periodical examination of women was prohibited. In consequence of the enormous increase of syphilis which followed, a new order was made in 1897, which gave power (1) to call on persons suffering from a contagious disease to attend the dispensary, (2) to remove brothels, (3) to prevent the residence or loitering of prostitutes near cantonments.

The foregoing summary of existing laws and regulations sufficiently indicates the present methods of dealing with prostitution. All Western nations broadly follow one or other of the systems described, though the local regulations may vary somewhat in minor details.

Conditions actually existing.

The French system of recognized houses, with registration, *police des mœurs*, &c., obtains in Belgium, Russia, Hungary, Spain and Portugal; Italy adopted it in 1855, but abandoned it in 1888 for a modified system; in the Dutch towns *maisons de tolérance* are permitted with or without a *service des mœurs;* Norway has abandoned registration, except in Bergen and Trondhjem, but otherwise Scandinavia rather follows the German principle of non-recognition, with more or less vigorous policing; of the Swiss cantons, some have the French, others the German system; while the United States and the British self-governing colonies incline more to the English model of comparative freedom, without a moral police or one possessing arbitrary executive powers independent of the courts of justice. All the systems have their defects; all fail to fulfil their purpose in the great cities. The most modest aim is to preserve public order and propriety. This object is better secured on the continent of Europe than elsewhere, but at the cost of submitting to an arbitrary police rule, intolerable to a free people. There appears to be less prostitution, both visible and actual, in Italy than in other countries. Under the English system the streets can be, and sometimes are, kept orderly in provincial towns by an energetic police; but in London the mass of prostitution is so great that the police seem totally unable to cope with it. Important thoroughfares and centres are frequented by large numbers of prostitutes in broad daylight, and choked by them at night. The law with regard to loitering is a dead letter, for these women do nothing but loiter. Flagrant solicitation is to some extent repressed, but for the most part the police content themselves with preventing positive tumults, and do not always succeed in that. On the other hand the less obvious but more pernicious nuisance of the brothel prevails to a far greater extent on the continent of Europe. Under the French system it is, of course, encouraged, in preference to "surreptitious" prostitution; but under the German it is forbidden. The facts here afford a proof of the impotence of the law no less striking than the condition of the London streets. By the German and Austrian criminal law, quoted above, brothels are prohibited, yet they abound in both countries. In Austria they are recognized, and perhaps the logic of the law is saved by permissive police clauses. In Germany it is not so. Paragraph 180 absolutely disposes of the question, and in Berlin it is acted on. Elsewhere brothels not only existed, but were recognized by authority for years after the passing of the laws against *Kuppelei.* It was not until 1886 and 1889 that they were nominally abolished in Hamburg and Saxony respectively. Yet they still exist in most or all of the large towns, with the knowledge and consent, if not with the permission, of the police. In some they are even authorized. Berlin, which is more severely policed than any town outside Russia, is an exception. There brothels are not openly winked at, but the police have to deal annually with 16,000 or 17,000 charges of *Kuppelei*, and the number remains very constant, from which it may be inferred that the law, even when logically and energetically carried out, is quite ineffective. The European system of registration is still more delusive. In Russia, where the authorities have the means of knowing the movements and habits of every individual, it may be possible to compel the registration of the majority of prostitutes, but in other countries it is impossible. The police everywhere complain of the amount of "clandestine" prostitution, which they cannot control, and which tends always to increase, under the system, while the roll of inscribed women dwindles. The numbers alone are sufficient to prove the failure of the procedure; for instance, 311 and 270 in Dresden and Munich respectively (Zehnder 1891), both capital towns and cities of pleasure containing over 300,000 inhabitants. Cologne, with only half the population, had double the number on the register at the same time. In Paris, which may be called the headquarters of Western vice, the disproportion between registered and clandestine prostitution has reduced the whole system to an absurdity. The number of women on the roll is not a tenth of the estimated number of prostitutes; nor is Berlin, with about 3000 on the register, any better off. In Bordeaux, Brest, Lille, Lyons and Marseilles the same process is going on (Reuss). It follows that the protection of health, which is the object aimed at by registration, is delusive in an equal degree. There are no means of ascertaining the amount of venereal disease existing in any town or country, except in Norway, and consequently, no data for comparing one period or one place with another; but we know that all forms of such disease are still very prevalent in all large European towns, in spite of the system. The only exact figures available are the military returns, which are of some value. It is in garrison towns of moderate size that compulsory registration is likely to be most efficiently carried out and to produce the most decided results, because the women with whom soldiers consort are by their character and habits least able to elude the vigilance of the police. The following table gives the proportion of admissions to hospital from all forms of venereal disease in the German, French, Austrian and British forces for twenty years from 1876. It may be added that the proportion in the Russian army is almost identical with the French, while the Italian figures are slightly higher than the Austrian. It is therefore unnecessary to give them:—

Admissions per 1000 in European Armies.

Year.	German.	French.	Austrian.	British (Home).	British (India).
1876	28·8	57·0	65·8	146·5	203·5
1877	30·0	57·8	66·9	153·2	224·4
1878	36·0	59·7	75·4	175·5	291·6
1879	38·5	63·7	81·4	179·5	253·3
1880	34·9	65·8	75·7	245·9	249·0
1881	39·2	60·6	79·0	245·5	259·6
1882	41·0	62·0	73·7	246·0	265·5
1883	38·2	58·9	73·3	260·0	271·3
1884	34·5	52·1	73·5	270·7	293·5
1885	32·6	50·7	69·0	275·4	342·6
1886	29·7	49·6	65·8	267·1	385·8
1887	28·6	51·6	64·4	252·9	361·4
1888	26·3	46·7	65·4	224·5	372·2
1889	26·7	45·8	65·3	212·1	481·5
1890	26·7	43·8	65·4	212·4	503·6
1891	27·2	43·7	63·7	197·4	400·7
1892	27·9	44·0	61·6	201·2	409·9
1893	—	42·8	64·5	194·6	466·0
1894	—	40·9	64·8	182·4	511·4
1895	—	—	—	173·8	522·3

The most striking thing in this table is the enormous difference between the continental and the British figures. To make the comparison more complete, we will add the following, which gives the average admissions per 1000 for the three years 1890–1892:—

German.	French.	Russian.	Austrian.	Italian.	U.S.A.	British (Home).	British (India).	Dutch (Indies).
27·2	43·6	43·0	63·5	71·3	77·4	203·6	438·0	455·6

It is clear at once that troops in the East stand upon an entirely different footing from those in the West, the Dutch figures being even higher than the British; we may therefore put them aside for the moment. Comparing the rest, we notice that not only are the British figures enormously higher than the other European, but the latter also show very large discrepancies; and since all the foreign troops are under the same protective system, we may conclude that other factors must be taken into account. The discipline maintained, the character of the soldiers themselves, and the procedure with regard to admission into hospital, no doubt all affect the returns. Further, a sort of epidemic rise and fall is to be noted. All the returns given in the first table show a simultaneous rise for several years, beginning with 1876; and having reached a maximum, each shows a progressive fall, likewise lasting over several years. This points to another disturbing factor. It is convincingly shown by the figures for the protected districts in the United Kingdom before, during, and after the period of protection. In 1864—that is, just before the first Contagious Diseases Act came into operation—the proportional figure was 260; ten years later it had fallen to 126; but in 1883 it had risen again to 234, in spite of the protection. Then, protection being removed, it rose to 276, but afterwards fell again progressively to 191 in 1895, without any protection. It is therefore evident that in interpreting the statistics allowance must be made for large fluctuations due to causes quite independent of the protective system. The margin of difference, however, between the British and European returns is so large that, when all allowances have been made, it is impossible to doubt that a considerable degree of real protection is afforded to soldiers by the system. This conclusion is confirmed by the comparatively high returns for the army of the United States, and still more by the Indian statistics. They rose gradually, it is true, during the cantonment system, but when that was dropped disease increased with shocking rapidity. Between 1887 and 1895 the admissions for primary syphilis rose from 75·5 to 174·1 per 1000, and those for secondary syphilis from 29·4 to 84·9.

The broad conclusion is that under special conditions, and when rigidly enforced, registration and medical examination do to a considerable extent fulfil the purpose of protecting health. Their failure to do so among the population at large and under the ordinary conditions of life is not surprising when we regard the amount of venereal disease which still occurs even among soldiers protected by the most rigorous measures and under the most favourable conditions.

A general view of the whole subject suggests no pleasant or hopeful conclusions. Prostitution appears to be inseparable from human society in large communities. In different countries and ages it has in turn been patronized and prohibited, ignored and recognized, tolerated and condemned, regulated and let alone, flaunted and concealed. Christianity, the greatest moral force in the history of mankind, has repeatedly and systematically attacked it with a scourge in one hand and balm in the other; but the effect has been trifling or transient. Nor have all the social and administrative resources of modern civilization availed to exercise an effective control. The elementary laws on which prostitution rests are stronger than the artificial codes imposed by moral teaching, conventional standards or legislatures; and attempts at repression only lead to a change of form, not of substance. It survives all treatment; and though it may coexist with national vigour, its extravagant development is one of the signs of a rotten and decaying civilization. In Western communities the traffic is not carried on so openly as in the East, nor is it exploited for purposes of public revenue, as among the ancients and in the middle ages; a veil of reticence and secrecy, for the most part of a transparently flimsy character, is thrown over it; but whatever is gained in public decency is counterbalanced by other attendant evils. Two, in particular, are fostered by the policing of prostitutes. One is the system of blackmail levied by the executive. The scandal has been most notorious in the United States, but it exists everywhere, and is a constant source of profound corruption. The other is the growth of the most degraded class that ever disgraced the name of man—the creatures who live upon the earnings of individual prostitutes, with whom they cohabit. They are called *souteneurs* in France, *louis* in Germany, *cadets* in New York, and by various slang names in Great Britain. They are all criminals. They flourish chiefly on the continent of Europe, where they exist in large and ever-increasing numbers; but they find their way everywhere, and are a dangerous menace to society. They are not altogether new. The Elizabethan drama is full of references to men who took toll of prostitutes in return for protective services in the old days of persecution; but they have been greatly fostered by the modern system, under which women find it necessary or convenient to have the cover of a man, who can pass for a husband and baffle the police. Thus the law is evaded on the one hand by the corruption of those who administer it, and on the other by the appearance of a class of criminal idlers more degraded than any other—both greater evils than the traffic which the law is intended, but fails, to control. There are no data for comparing the extent of profligacy at present existing in Western communities with that in other countries or in former times, but the unmentionable facts which come constantly to the knowledge of the *police des mœurs*, and less frequently to the ears of doctors, and lawyers, leave no doubt that in intensity of vice the great centres of modern civilization have nothing whatever to learn from Corinth, imperial Rome, ancient Egypt or modern China. The classical obscenities dug up and relegated to museums are far surpassed by the photographic abominations prepared to-day in Paris or in Amsterdam. The gross perversion and abuse of the sexual instinct implied by these excesses may be a passing phase, but it is a phase which has always marked the decadence of great nations. It is undoubtedly accompanied by a general tendency towards increase of the volume of prostitution. Improvement in the conditions of life among the poor ought to tend in the opposite direction, by removing one of the most potent causes of the traffic, but it is more than counterbalanced by the rising standard of luxury and comfort which accompanies it, by the aggregation of the people more and more into great cities, and by their craving for amusement. The growth of prostitution has already left its marks on the marriage- and birth-rates of the most highly civilized Western communities.

In 1900 the Prussian Government made an attempt, with the co-operation of the medical corporations, to ascertain the amount of venereal disease prevalent in the kingdom. Circular questions were addressed to all members of the medical profession requesting them to report the number of patients suffering from those disorders in their practice at the date of the 1st of April. Answers were sent in by 63%, and the aggregate number of patients was 40,902. From this datum it is calculated that the number of persons attacked in the course of a year is at the very least 500,000 in Prussia alone (vide *Hygienische Rundschau*, April 1902).

Authorities.—W. F. Amos, *State Regulation of Vice*; Committee of Fifteen (New York), *The Social Evil* (1902); Conférence Internationale (Brussels, 1899), *Comptes rendus*; Fiaux, *La Prostitution en Belgique*; Gibbon, *Decline and Fall of the Roman Empire*; Henne-am-Rhyn, *Die Gebrechen der Sitten-polizei*; Parent-Duchâtelet, *De la prostitution dans la ville de Paris*; Reuss, *La Prostitution*; Von Raumer, *Geschichte der Hohenstaufen*; Sanger, *History of Prostitution*; Schlegel, *Histoire de la prostitution en Chine*; Schrank, *Die Prostitution in Wien*; Stürmer, *Die Prostitution in Russland*; Tarnowsky, *La Prostitution*; Zehnder, *Die Gefahren der Prostitution*. (A. Sl.)

PROSTYLE (Gr. *πρό*, before, and *στῦλος*, a column), in architecture, a portico in which the columns project from the building to which it is attached.

PROTAGORAS (*c.* 481–411 B.C.), Greek philosopher, was born at Abdera. He is known as the first of the Sophists (*q.v.*), *i.e.* he was the first to teach for payment. It is said that he received nearly £400 from a single pupil. He learned philosophy in the Ionian school, and was perhaps a pupil of Democritus, though this is doubtful on chronological grounds. He was an older contemporary of Socrates. He was so highly esteemed by Pericles that he was entrusted with the task of framing laws for the new colony of Thurii (Plut. *Pericles*, 36). At the age of seventy, having been accused by Pythodorus, and convicted of atheism, Protagoras fled from Athens, and on his way to Sicily was lost at sea. According to Plato (*Prot.*, 318 E), he endeavoured to communicate "prudence" (*εὐβουλία*) to his pupils, "which should fit them to manage their households, and to take part by word and deed in civic affairs." The education which he provided consisted of rhetoric, grammar, style and the interpretation of the poets. His formal lectures were supplemented by discussions amongst his pupils. He left behind him several treatises, of which only a few fragments have survived. In *Truth*, by way of justifying his rejection of philosophy or science, he maintained that "man is the measure of all things—of what is, that it is, and of what is not, that it is not." Besides *Truth*, and the book *Of the Gods* which caused his condemnation at Athens, Diogenes Laërtius attributes to him treatises on political, ethical, educational and rhetorical subjects. Protagoras was the first to systematize grammar, distinguishing the parts of speech, the tenses and the moods.

Authorities.—Diog. Laërt., ix. 8, &c.; the very different representations in Plato's *Protagoras* and *Theaetetus*; the fragments in Johannes Frei, *Quaestiones Protagoreae* (Bonn, 1845), and A. J. Vitringa, *Disquisitio de Protagorae vita et Philosophia* (Gröningen, 1852); for the Thurian legislation, M. H. E. Meier, *Opuscula*, i. 222, and Gomperz in Franz Hoffmann's *Beiträge zur Gesch. des griech. und röm. Rechts* (1870). On Protagoras' philosophy see the histories of philosophy, *e.g.* Gomperz, *Greek Thinkers* (Eng. trans., 1901) i. 438–475 and 586–592, Zeller, Ueberweg, Erdmann, and works quoted under Sophists.

PROTECTION, in economics a system of commercial policy and a body of doctrine, which in their modern forms are the outgrowth of the commercial and industrial development of the 19th century. The common definition of protection as a policy is the attempt to develop a manufacturing industry by a system of discriminating duties upon manufactured goods imported from foreign countries. But this is far too narrow a definition to suit the modern use of the term, though the notion of discriminating tariffs is common and, we may say, basal to all definitions. Protection as a policy includes not only discriminating tariffs, but also a large number of other features supplementary to this fundamental one and designed to emphasize its purpose. Thus a scheme of bounties and premiums, of rebates and drawbacks, is everywhere considered an essential element of the protective system. Nor is it any longer limited to the encouragement of manufactures, but includes as well the protection of agriculture, forestry, mining, fishing, shipping, &c. In short, one cannot give a comprehensive and satisfactory definition of protection to-day without giving it a much wider scope than that of a system of protective duties upon manufacturing industry.

National Policy.

Many of its advocates claim, and with some show of reason, that the term protection, as now used to describe the commercial policy of a nation, should be so defined as to include all the means by which a country undertakes to secure through the positive efforts of the government the complete industrial and commercial development of all its resources and of all its parts. As its object is thus comprehensive, its justification is to be found in a series of arguments based upon political, economic, and social considerations. From this point of view the protective policy embraces not merely the system of discriminating import duties in favour of home products—industrial, agricultural and mining, with which the policy began in the United States, for example—but also the system of bounties offered for the introduction and establishment of new industries; the policy of restricted immigration of the less desirable classes of labourers, combined with the positive inducements to the skilled labour of other countries to transfer itself to the one in question; the system of discriminating or prohibitive tonnage duties, known as Navigation Acts; the system of developing foreign markets by an active policy directed towards securing advantages for home products in foreign countries—in a word, all those pecuniary or other sacrifices which a country may make in order to develop its material resources and establish, develop and foster industry and commerce. In this wide sense the comprehensive policy adopted by the United States, for example, includes the making of a careful geological and botanical survey of the whole country in order to discover and open up the vast natural wealth of its domain in its mines, forests and fields; the establishment of experiment stations to test the usefulness of new crops or means of making old crops more valuable; the stocking of its rivers with fish and the afforesting of its mountains; the introduction of new or more valuable breeds of livestock; the building of railways and canals, and the offering of inducements to private parties to undertake similar enterprises; the deepening of its rivers and harbours, &c.; and, finally, the development, at public expense, of a scheme of technical and commercial education—lower and higher—adapted to discover and train all the talent in the community available for developing the industry and commerce of the country.

If such an account of the features of a protective policy is objected to on the ground that free trade countries like Great Britain have also adopted some of them, it may be replied that in so far as they have done so they have adopted the principle of protection, namely, that government shall adopt a positive policy looking towards the development, by government aid if necessary, of new branches of commerce and industry and the firmer establishment of old branches. It may further be pointed out that the countries which have adopted the protective policy most fully—the United States, France, Germany and Russia—have most consistently followed out the policy here indicated and in all these countries it has been the so-called protectionist party which has identified itself most fully with the comprehensive policy here suggested.

Economic Doctrine.

As a doctrine, protection is the set of principles by which this policy of government aid to industry is justified, and these principles have been elaborated hand in hand with the development of the so-called protective policy sometimes outrunning its actual application and advocating its further extension, more often lagging behind and seeking for means of explaining and defending what had already been done. The present development of the system and theory of protection is a result of the growing predominance of capitalism in modern society, combined with the tendency of modern politics towards the organization and development of great national states, with the resulting desire to secure their industrial as well as their political independence. It has been further favoured in certain ways by the fact that the financial needs of modern states require a resort to indirect taxation, thus making it easier for the capitalistic forces to exploit the tax system for their own benefit; while the wars of the 19th century have favoured in many ways the tendency towards the adoption of special means, like high discriminating duties, to accomplish this end. Hand in hand with this has gone a steady tendency to see in the state a powerful means of promoting the development of trade and industry, and a growing disbelief in the more extreme forms of the free trade doctrine, such as the type known as the Manchester School, the theory of the *laissez faire, laissez passer* school of economics and politics.

Protection, both as a doctrine and policy, can be best understood by examining the course of its development in those countries adopting it most consistently. Germany and the United States offer the two striking examples of great modern nations adopting a system of protection and developing under its influence. They may in a certain sense serve as types of the kind of state which in the 19th century accepted and defended, in its politics at any rate, the so-called protective system. In both cases the high protective system was associated with the development of nationality, of industry, of capitalism, and of a financial system which favoured the growth of certain elements of the protective policy.

United States.

The protective system in the United States began with the adoption of the Constitution in 1789, and found its first formal defence in the celebrated report of Alexander Hamilton on manufactures. The argument and the movement were largely academic. As there was no strong manufacturing interest in existence, so there was no organized capitalistic effort to secure manipulation of the tariff duties in the interest of special industries. There was general agreement, however, that it would be desirable to develop a manufacturing industry in the colonies if it were practicable. A high degree of natural protection was already afforded by the cost of transportation. It was felt, therefore, that a small duty on manufactures would probably serve the purpose, since the development of the manufactures would favour the production of raw material, which would therefore need no special encouragement. It was also felt that a small duty, continued for a few years, would result in the establishment of the industry on such a firm basis that all duties might be abolished. The introduction of this form of protection, *i.e.* discriminating duties upon imported goods, was greatly assisted, if not originally caused, by the fact that the new government needed money which could most easily be obtained by customs duties. Thus all those parties which were opposed to direct taxes joined their efforts with those interested in securing protective duties, in order to commit the government to the policy of basing its revenue system on a tariff on imports. To these considerations must be added the further one that the country had just thrown off political dependence on Europe, and felt that it must now become industrially independent also, if it were to be a great nation. These influences, then, namely, firstly, the desire of the statesmen of the time to create a revenue system for the Federal government which would make it absolutely independent of the states; secondly, the wish to develop an industry which would serve the needs of the new country while it promoted its complete independence of the Old World, conspired to commit the Federal government from the beginning to a policy of protection based upon a system of discriminating duties. At the same time a system of discriminating tonnage dues and prohibitory regulations relating to foreign shipping in the coasting trade was adopted to promote and foster the shipping interest.

Industry and commerce began to thrive as never before, largely because of the absolute free trade which the Constitution had secured among the states of the Union. The long struggle between France and Great Britain, extending from 1806 to 1812, for the possession of the commerce and the trade of the world, combined with the retaliatory measures of the American government itself, practically destroyed American commerce for a time, and finally led to the British-American War of 1812, which closed in 1815. The financial system of the Federal government during this war was based on getting the largest returns from the customs, so that the duties were screwed up still higher. The ten years period of non-intercourse, while it had seriously injured American commerce, had fostered the growth of American manufacturing; and when the close of the War of 1812 brought with it an enormous influx of foreign goods, particularly from the plethoric warehouses and factories of England, it looked for a time as though the new American industries were destined to vanish as rapidly as they had grown up. And now for the first time appeared a strong, well-developed, capitalistic party, which was, in spite of some drawbacks, destined to grow until it became one of the most characteristic features of the politics of the republic.

The manufacturers of the country determined the tariff policy of the country, and with few reverses pursued a steadily advancing course of victory down to the close of the 19th century. They secured the maintenance of high duties at the close of the war of 1812, and managed to increase them steadily until the reaction of 1830–1833, when they were forced to content themselves with a lower rate, which continued, with a slight interruption in 1842–1846, until the outbreak of the Civil War in 1861. This was an opportunity which they knew how to utilize to the greatest advantage. During the war, when the government was forced to exploit every possible source of revenue, the protectionist party knew how to turn the necessities of the government to its advantage. The rate of duties was pressed ever higher; and when the war closed, and the taxes could again be lowered, the protectionist managers knew how to lower or remit altogether the non-protective duties, and thus keep high, and even advance to a still higher point, the duties which protected them from foreign competition.

In the meantime the country was turning from agriculture to manufactures at an unprecedented rate. The manufacturing party was becoming ever stronger and more aggressive. As it had also been the national party, it profited by the enormous development of the nationalist sentiment during and after the war. It now became patriotic to favour the development of a national industry. It was treason to advocate free trade—that had been the policy of the slave-holders' party, and the Slave-holders' Rebellion, as the Civil War was called, had drawn its strength largely from the free-trade sentiment. The policy of the protectionist party had expanded with the growth of the country and the necessity of coming to terms with the antagonistic elements. Thus at first the platform of the protectionists had been one of reasonably low duties on manufactured commodities, low duties on half-manufactured and no duties at all on raw material. But as the country advanced, and it was seen how the interests of manufacturing had been quickened by the policy of discrimination, those engaged in producing raw materials and half-manufactured commodities demanded that they too should be considered. As this concession had to be made by the manufacturers, they were compelled to justify it by other arguments than those used at first. The infant-industry argument gave place to the proposition, that as long as the prices of raw materials and labour were higher in America than abroad, it would be necessary to maintain countervailing duties at least equal to this difference, in order to protect American industry. One branch after another of manufacturing or agriculture was included and given the benefit of protection. In order to have satisfactory theoretical basis for such a policy, the theory was advanced that foreign trade was a necessary evil, to be diminished as much as possible. The ideas were advanced and spread throughout the country: that the home market should be reserved for home products; that the labourers should be protected against the influx of foreign cheap labour (Chinese Exclusion Acts; restrictive immigration laws); that prices should be kept high, so as to enable employers to pay high wages; that shipping should be encouraged by subsidies, the sugar industries by bounties; that the nation should become ever more independent of foreign nations for all its industrial products, and capable of holding its own against the world in industry as well as in arms.

The protective party has been the national party during a time when the greatest question before the American people was whether it was to be one nation, or two, or twenty, and it naturally profited by the inevitable victory of nationalism; it has always stood for honest payment of national and state debts, if not in the standard according to which they were contracted, in a still better one, and it has profited naturally by this attitude in a country where the development of trade and industry was rapidly and steadily towards a capitalistic state of society in which such policy is favoured; it has stood for a vigorous and active independence in the field of world politics, and it has naturally profited by this fact in a country which was rapidly forging ahead to take its place among the greatest of existing nations, and with an ever-increasing self-consciousness was ready to assert itself among the nations of the world; it has stood for free labour against slave labour, and consequently profited here again in a country whose greatest conflict turned upon the question whether the system of slave labour should be extended or not; it has stood for high wages for American labourers, and in words at any rate has advocated a policy directed to protecting them against competition with the "pauper labour" of the Old World. It has stood for government activity in the direction of developing railways and canals; of establishing education upon national lines, making it free, in all grades from the kindergarten to the university, to all citizens of the republic, and it has profited by this association in a country where all influences were telling in favour of this tendency. In short, whatever one may think of the wisdom or folly of trying to develop national industry by a system of discriminating duties, the protective party as such in the United States has been on the progressive side of so many of the deep questions of national importance that it has obtained and kept the allegiance of thousands of men who would have been glad to see a change, or indeed a reversal, in the tariff policy of the party.

Germany.

The history of the tariff policy in Germany had been very similar to that of the United States. Beginning with the establishment of absolute free trade among the various German states in the earlier customs union, it extended this policy, by the establishment of the North German Confederation and the new German Empire, to all the states now included in the federation. The long-wished-for political union meant political independence, and when political independence was once achieved, industrial and commercial independence were next desired. Within the empire itself it was necessary, if the new organization were to be strong and vigorous, that the central government should become independent of the individual states; and this could be best effected by giving it a revenue system based upon import duties, which in the long run has enabled the central government to subsidize the state governments, and thus bring them still further under its influence. To develop this system the political support of some strong party was needed. This party was found in the protectionist elements, which have thus again become the national party in a state which was being rapidly nationalized; the industrial party in a society which was rapidly passing from the agricultural to the industrial condition; the capitalistic party in a society which was rapidly becoming capitalistic in all its tendencies. It stood for industrial and commercial, as well as political, independence of other countries, and thus satisfied the longing for national unity and independence of a people which had suffered for centuries from disunion and dependence.

These two examples may serve to explain how the two most powerful industrial nations next to Great Britain became and remained highly protectionist in sentiment and in action, and how they both opened the 20th century with a more openly declared and a more fully developed system of protection than ever before.

Modern Advocates and Critics.

Protection as a theory or doctrine is to a certain extent an outgrowth or modification of the old doctrines of mercantilism. In its modern form, however, it dates really from the celebrated report on manufactures made by Alexander Hamilton when secretary of the U.S. Treasury in the year 1791. The views there advanced have been further developed by Friedrich List and Henry C. Carey, and have in later years been carried along somewhat different lines to their logical conclusions by Simon N. Patten and George Gunton. Starting from an argument in favour of temporary duties on manufactured goods imported from abroad until such time as the infant industry might take firm root, the development proceeded through List, who favoured the maintenance of such duties until the country had passed into the manufacturing stage as a whole, and then through Carey to Patten and Gunton, who maintain that a protective policy, extended to cover agriculture, trade and mining, should be preserved as the permanent policy of the country until the entire world is one nation, or all nations have reached the same level of political, economic and social efficiency. The protective policy, which a century ago was to be, in the view of its advocates, temporary and partial, has become to-day, in the arguments of its apologists, permanent and comprehensive. We must content ourselves here with a brief statement of the arguments of the leading and most successful defenders of modern protectionism.

Hamilton.

Alexander Hamilton, at that time secretary of the treasury, submitted his celebrated report on manufactures to the Congress of the United States on the 5th of December 1791. It is in a certain sense the first formulation of the modern doctrine of protection, and all later developments start from it as a basis. It is a positive argument directed to proving that the existence of manufacturing is necessary to the highest development of a nation, and that it may be wisely promoted by various means, of which the most important is a system of discriminating duties upon foreign imports. Among the objects to be attained by the development of a flourishing manufacturing industry are mentioned: (1) Independence of foreign nations for military and other essential supplies. (2) A positive augmentation of the produce and revenue of society, growing out of (*a*) division of labour, (*b*) extensive use of machinery, (*c*) additional employment to classes of the community not ordinarily engaged in business. (3) An increase in the immigration of skilled labourers from foreign countries. (4) A greater scope for the diversity of talents and dispositions which discriminate men from each other. (5) A more ample and various field for enterprise. (6) In many cases a new, and in all a more certain and steady demand for the surplus produce of the soil. (7) A more lucrative and prosperous trade than if the country were solely agricultural. Among the feasible means of promoting the development of such an industry he mentions the following: (1) Protective duties, or duties on foreign articles which are the rivals of the domestic ones, to be encouraged. (2) Prohibition of rival articles or duties equivalent to prohibition. (3) Prohibition of the exportation of the materials of manufactures. (4) Pecuniary bounties. (5) Premiums. (6) Exemption of the materials of manufactures from duty. (7) Drawbacks of the duties which are imposed on the materials of manufactures. (8) The encouragement of new inventions and discoveries at home, and the introduction into the United States of such as may have been made in other countries; particularly those which relate to machinery. (9) Judicious regulations for the inspection of manufactured commodities. (10) The facilitating of the pecuniary remittances from place to place.

The above suggestions contain the outline of a comprehensive scheme for developing the manufacturing resources of the country, and the United States has subsequently adopted, in one form or another, almost all of these propositions. Hamilton considered that the duties, &c., would not have to be very high or very long continued in order to accomplish their legitimate ends, after which they would become unnecessary, and would naturally be abolished. He conceded that, generally speaking, import duties were taxes on the customer, and therefore burdens—but burdens which might well be temporarily borne for the sake of the ultimate advantage arising from cheaper goods and diversified industries. He emphasized also the advantage of a home market for agricultural products, and seemed to think that the United States had to pay the cost of transportation both on the agricultural products it exported and the manufactured goods it imported. This report remained the armoury from which the protectionists drew their weapons of offence and defence for two generations, and it has not yet ceased to be the centre around which the theoretical contest is waged even to-day in Germany and France as well as in the United States.

List.

The next great theorist in this field was the German, Friedrich List, who, while an exile in the United States, became imbued with protectionist ideas, and after doing substantial service for them in the country of his adoption, returned to Germany to do battle for them there. He published his *National System of Political Economy* in Germany in the year 1841. It had great and immediate success, and has exercised a wide influence in Europe on theoretical discussion as well as on practical politics. List, like Hamilton, looked on protection as a temporary system designed to facilitate the passage of a country from an agricultural to a manufacturing state. He accepted free trade as generally and permanently true, but suited for actual adoption only in that cosmopolitan era towards which the world is progressing. But in order to prepare for this cosmopolitan period it is first necessary for each nation to develop its own resources in a complete and harmonious manner. A comprehensive group of national economies is the fundamental condition of a desirable world economy; otherwise there would be a predominance of one or of a few nations, which would of itself constitute an imperfect civilization. Protection is a means of educating a nation, of advancing it from a lower to a higher state. He admits that it may involve a loss, but only in the sense that money expended for an education or an educational system is a loss, or that money spent for seed corn is a loss. To the cosmopolitan system of Adam Smith, List opposes the national system as a preliminary and necessary stage. He favours the imposition of duties as the most efficient means of effecting the protection which he has in mind. Agriculture will be sufficiently protected by the constant demand for its products. The essence of his larger work is contained in a pamphlet published in Philadelphia in 1827, entitled *Outlines of American Political Economy*. It is, in fact, a series of letters advocating the further development of the protective system already adopted in the United States.

Carey; Patten.

The third great name in the history of protection is that of Henry C. Carey, an American, in some ways the most distinguished and most influential of the followers of Hamilton and List. He was at first a strong free trader, then a protectionist who believed in protection as a preparation for free trade, and finally an uncompromising advocate of protection in all circumstances and for all nations. In him and in Simon M. Patten, the last, and in many respects the ablest, of the apologists for protection, we have the theoretical development corresponding to the practical outcome of protection as a comprehensive all-embracing scheme extending protection to all branches of industry alike—agriculture, manufacturing and mining—and aiming to be permanent in its form and policy. As Patten expresses it: "Protection now changes from a temporary expedient to gain specific ends (such as the establishment of manufactures), to a consistent endeavour to keep society dynamic and progressive. Protection has become part of a fixed national policy to increase the value of labour with the increase of productive power, and to aid in the spread of knowledge and skill, and in the adjustment of a people to its environment." The object of protection has now become, in the view of the theoretical American protectionist, not an approximation to European industrial conditions, but as great a differentiation from them as possible. Carey's works were translated into the leading European languages, and contributed doubtless to the spread of protectionist ideas, though the extreme form in which his views were expressed, and the rambling illogical method of exposition, repelled many who might otherwise have been attracted by the course of his thought.

Economists of other schools, with the exception of the more rigid British free traders, have allowed a relative validity to the doctrines of List; and even among older British economists, Mill and some of his disciples conceded the logical possibility of quickening the development of an industry by import duties in such a way as to result in more good than harm, though they have hardly been willing to acknowledge that it is practically possible. The modern historical school of political economists have generally admitted the reasonableness of protective policies at certain times and places, though usually finding the justification in political and social considerations rather than in economic. And while the British objections to protectionism in any form have been widely upheld by the more conservative economists in England, the new political school of "tariff-reform and colonial preference" has found strong support at the hands of such British authorities on economics as Professors Cunningham, Ashley and Hewins, or the authors of *Compatriots' Club Essays* 1906 (J. L. Garvin and others), whose advocacy of a national policy recalls the work of Hamilton and List. (E. J. J.)

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PROTECTOR, a Latin word (formed from *protegere*, to cover in front) adopted into English. In post-classical Latin the *protectores* were the body-guards of the emperors, and of the Praetorian prefects until, under Constantine the Great (306–337), they ceased to exercise military functions. The *protectores*, with the *domestici*, continued to form the body-guard and household troops of the emperor. They were veterans selected from the legions, and were capable of being appointed to high commands. In the Roman curia the *protectores regnorum* are cardinals who take charge of the affairs of the "province" to which they are named which come before the Sacred College, and to present them for consideration. In England "protector" was used first for the regent during a minority (*e.g.* the Protector Somerset, and then by Oliver Cromwell when he assumed the government in 1653). The name thus acquired a revolutionary significance, and has not since been officially used in England. In Spanish America the bishops were officially protectors of the Indians. The title is convenient for a ruler who wishes to exercise control outside the limits of his direct sovereignty. Thus Napoleon called himself protector of the Confederation of the Rhine. The kings of France, and the governments which have arisen out of the Revolution, were protectors of the Latin Christians in the Turkish Empire, while the tsars of Russia have claimed the same position towards the Orthodox Christians.

See App. B. to vol. ii. of Bury's edition of the *Decline and Fall* (London, 1896); Du Cange, *Glossarium lat.*; Sorel, *L'Europe et la révolution française*, vol. vii. (Paris, 1904).

PROTECTORATE, in international law, now a common term to describe the relation between two states, one of which exercises control, great or small, direct or indirect, over the other. It is significant of the rare use of the term until recent times that the word does not occur in Sir G. C. Lewis's book on *The Government of Dependencies*. Yet the relation is very ancient. There have always been states which dominated their neighbours, but which did not think fit to annex them formally. It has always been politic for powerful states to facilitate and hide schemes of aggrandizement under euphemistic expressions; to cloak subjection or dependence by describing it in words inoffensive or strictly applicable to other relations. A common problem has been how to reduce a state to submission or subordination while ostensibly preserving its independence or existence; to obtain power while escaping responsibility and the expenditure attending the establishment of a regular administration. Engelhardt (*Les Protectorats anciens et modernes*) and other writers on the subject have collected a large number of instances in antiquity in which a true protectorate existed, even though the name was not used. Thus the Hegemony of Athens as it existed about 467 B.C., was a form of protectorate; though the subject states were termed allies, the so-called "allies" in all important legal matters had to resort to Athens (Meyer, *Geschichte des Alterthums*, vol. iii. § 274).

In dealing with dependent nations Rome used terms which veiled subjection (Gairal, *Les Protectorats internationaux*, p. 26). Thus the relationship of subject or dependent cities to the dominant power was described as that of *clientes* to the *patronus* (Marquardt, *Römische Staatsverwaltung*, 2nd ed., vol. i. p. 80). Such cities might also be described as *civitates foederatae* or *civitates liberae*. Another expression of the same fact was that certain communities had come under the power of the Roman people; *in deditionem* or *in fidem populi romani venire* (Marquardt, *Römische Staatsverwaltung*, i. 73, 81). The kingdoms of Numidia, Macedonia, Syria and Pergamum were examples of protected states, their rulers being termed *inservientes*. The Romans drew a distinction between *foedera aequa* and *foedera iniqua*. The latter created a form of protectorate. But the protected state remained free. This is explained in a passage of the Digest 49. 15. 7: "Liber autem populus est is, qui nullius alterius populi potestati est subjectus, sive is foederatus est; item sive aequo foedere in amicitiam venit, sive foedere comprehensum est, ut is populus alterius populi majestatem comiter conservaret. Hoc enim adjicitur, ut intelligatur alterum populum superiorem esse: non ut intelligatur alterum non esse liberum" (Marquardt, *Römische Staatsverwaltung*, 2nd ed., vol. i. p. 46, Mommsen, *Römisches Staatsrecht*, vol. iii. pt. 1, p. 645, and the instances collected by Pufendorf, 8 c. 9. 4).

In medieval times this relation existed, and the term "protection" was in use. But the relation of subordination of one state to another was generally expressed in terms of feudal law. One state was deemed the vassal of another; the ruler of one did homage to the ruler of another. In his book *De la République* Bodin treats of *ceux qui sont en protection* (1. c. 7), or, as the Latin text has it, *de patrocinio et clientela*. In Bodin's view such states retain their sovereignty (1. c. 8). Discussing the question whether a prince who becomes a *cliens* of another loses his *majestas*, he concludes that, unlike the true vassal, the *cliens* is not deprived of sovereignty: "Nihilominus in foederibus et pacis actionibus, quae inter principes aut populos societate et amicitia conjunctissimos sancientur; eam vim habet ut nec alter alteri pareat, nec imperet: sed ut alter alterius majestatem observare, sine ulla majestatis minutione teneatur. Itaque jus illud clientelare seu protectionis omnium maximum ac pulcherrimum inter principes censetur" (1 c. 7). Elsewhere Bodin remarks, "le mot de protection est special et n'emporte aucune subjection de celuy qui est en protection." He distinguishes the relation of *seigneur* and vassal from that of *protecteur* and *adherent*. As to whether the protected state or prince is sovereign, he remarks, "je tiens qu'il demeure soverain, et n'est point subject." He makes clear this conception of protection by adding "l'advoué ou adherent doit estre exempte de la puissance du protecteur s'il contrevient aux traictes de protection. Voila donc la plus grande seureté de la protection, c'est empescher s'il est possible que les protecteurs ne soyent saisis des fortresses" &c. (p. 549, ed. 1580). Sometimes letters of protection were granted by a prince to a weak state, as *e.g.* by Louis XIII. in 1641 to the prince of Monaco (Gairal, p. 81).

Reverting to the distinction in Roman law, Grotius and Pufendorf, with many others, treat protection as an instance of unequal treaties; that is, "when either the promises are unequal, or when either of the parties is obliged to harder conditions" (*De jure belli et pacis*, 1 c. 13. 21; *De jure naturae*, 8. c. 9).

Definitions of Protectorate.

The following are some definitions of "protectorate": "Principis privilegium, quo ne alicui vis inferatur, cavetur, eumque *in protectionem* suscipit." Du Cange: "La situation d'un état à l'egard d'un autre moins puissant auquel il a promis son appui d'une manière permanent" (Gairal, p. 52); a definition applicable only to certain simple forms of this relation. "Pour le protégé, une condition de mi-souveraineté substituée à la pleine indépendance que comporte le régime de simple protection" (p. 58). "La situation respective de deux états de puissance inégale, dont l'un contracte l'obligation permanente de défendre l'autre, et en outre de le diriger" (p. 62). "Unter einem Protektorat versteht man ein Schutzverhältniss zwischen zwei Staaten des Inhalts dass der eine Staat, der Oberstaat oder schutzherrliche Staat, zum dauernden Schutze des anderen Staates—des Schutzstaates oder Unterstaates—verpflichtet ist; wofür ihm ein mehr oder weniger weitgehender Einfluss auf die auswärtigen Angelegenheiten desselben und theilweise auch auf dessen innere Verhältnisse eingeraümt ist" (von Stengel, *Die deutschen Schutzgebiete*, 11). "Das Verhältniss von zwei (oder mehreren) Staaten, das in materieller Beziehung auf dem dauernden Bedurfniss des Schutzes eines schwächeren Staates durch einen stärkeren beruht" (Ullmann, s. 26).

"The one common element in Protectorates is the prohibition of all foreign relations except those permitted by the protecting state. What the idea of a protectorate excludes, and the idea of annexation, on the other hand, would include, is that absolute ownership which was signified by the word dominium in Roman law, and which, though not quite satisfactorily, is sometimes described as 'territorial sovereignty.' The protected country remains, in regard to the protecting state, a foreign country; and this being so, the inhabitants of the protectorate, whether native-born or immigrant settlers, do not by virtue of the relationship between the protecting and the protected state become subjects of the protecting state" (Lord Justice Kennedy, *Rex* v. *Crewe*, 1910, 79, *L.J.*, p. 802). "The mark of a protected state or people, whether civilized or uncivilized, is that it cannot maintain political intercourse with foreign powers except through or by permission of the protecting state" (Hall, *Foreign Jurisdiction of the British Crown*, p. 218). "A British protectorate is a country which is not within British dominions, but as regards its foreign relations is under the exclusive control of the King, so that its government cannot hold direct communication with any other foreign power, nor a foreign power with that Government" (Jenkyns, *British Rule and Jurisdiction beyond the Seas*, p. 165; Reinsch, *Colonial Government*, p. 109; Payne, *Colonies and Colonial Federations*, p. 194).

The term is used very loosely. Often it designates a relation which it is deemed politic to leave indefinite: a state desires to obtain the reality of conquest without the responsibilities attaching thereto. Protectorate may mean no more than what it says: "One state agrees to protect or guarantee the safety of another." The term is also employed to describe any relation of a political superior to an inferior state. It is also used as the equivalent of suzerainty. As appears from the article SUZERAINTY, the terms are distinguishable. But both imply a desire to carry out changes without friction and not to break up ancient forms; both proceed on the plan of securing to the stronger state the substance of power while allowing the weaker state a semblance of its old constitution. It is a form of empire or state building which appears when a powerful, expanding state comes in contact with feebler political organizations, or when a state falls into decay, and disintegration sets in. The creation of a protectorate is convenient for the superior and the inferior; it relieves the former from the full responsibilities incident to annexation; it spares to some extent the feelings of the latter.

Certain protectorates originate in treaties; others have been imposed by force. Some are accompanied by occupation, in which case it is difficult to distinguish them from annexation. Thus the treaty of May 1881, art. 2, between France and Tunis, provides for the occupation of strategical points by the protecting state (A. Devaulx, *Les Protectorats de la France*, p. 21).

The establishment of a protectorate may be akin to a guarantee. Generally, however, the former implies a closer relation than a guarantee; and the two relations may be widely different, as may be seen by comparing treaties of guarantee with the treaty establishing the protectorate of Tunis.

Strictly speaking, a protectorate cannot exist over a domain uninhabited or ruled by no organized state; in such cases the elements of the true protectorates are wanting. But the distinction is not adhered to. The difficulty of defining the relations between the protected and the protecting states is greater, because a protectorate may imply a condition of transition: a contractual or limited relation of state to state, more or less rapidly changing into true union.

Indian Protectorates.

It has been the policy of the British government in India to establish on the frontiers, as elsewhere, protectorates. The political advantages of the system are pointed out in Sir A. Lyall's *Rise and Expansion of the British Dominion in India*. It is a system "whereby the great conquering or commercial peoples masked, so to speak, their irresistible advance"; it was much practised by the Romans in Africa and Asia; it has been chiefly applied in modern times in India (p. 326). The Indian states are sometimes described as "Feudatory States," sometimes "Independent and Protected States" (Twiss), sometimes "Mediatized States" (Chesney), sometimes "Half-Sovereign," sometimes as in a position of "subordinate alliance" (Lord Salisbury, *Parliamentary Papers*, 1897 [c. 8700]. § 27). The Interpretation Act, 1889 (52 & 53 Vic. c. 63, s. 18), refers to the Indian native princes as under the "suzerainty" of the British Crown. These states are really *sui generis*, and their precise position can be understood only by a private examination of the treaties affecting them. The following are the chief points as to which Indian states are subject to English law: (1) the governor-general is empowered to make laws for servants of the British government and European and native Indian subjects of his majesty; (2) British laws are in force in certain parts of the native states *e.g.* in cantonments; (3) native princes have adopted certain British laws, *e.g.* the Indian Penal Code; (4) they have no external relations with foreign states; (5) the king is the donor of honours; (6) acts of parliament affect them indirectly by directly affecting the British agent; (7) they receive advice, which may be akin to commands. (See also Ilbert's *Government of India*, 2nd ed. p. 140).

Among the chief British protectorates are: The African groups, consisting of the western group—Gambia; Sierra Leone; Ashanti (northern territory); Northern Nigeria; Southern Nigeria (with which is amalgamated Lagos). The southern group—Bechuanaland; Southern Rhodesia; Swaziland. The central group—North-east Rhodesia and North-west Rhodesia; Nyasaland. The eastern group—British East Africa; Uganda; Zanzibar and Pemba (sometimes described as "a sphere of influence"); Somaliland; and the Sudan.

Existing Protectorates.

There is a group of protectorates near Aden, including the island of Sokotra. There are also the Bahrein Islands in the Persian Gulf. Jurisdiction over these protectorates is, generally speaking, exercised under orders in council made under the Foreign Jurisdiction Act 1890 (Burge's *Colonial and Foreign Law*, 2nd ed., p. 320). There is also the Malay group, consisting of the Malay States in the Borneo peninsula and in Borneo, the protectorates of North Borneo, Brunei and Sarawak. Protectorates also exist in the Western Pacific group of islands (including the Friendly Islands, the Ellice and Gilbert group, and the British Solomon Islands).

There is the interesting case of Papua (formerly British New Guinea), over which a protectorate was established in 1884, but which became in 1906 a territory of the Australian Commonwealth. There are also dependencies, or protectorates, attached to India, Baluchistan, Sikkim and Andaman Islands.

France possesses several protectorates, of which the chief are Tunis, Annam and Tongking. Her policy has been until lately to transform them into French territory. Such change has taken place as to Tahiti and Madagascar, and such in effect is the position of the Indo-China protectorates (Devaulx, *Les Protectorats de la France*; Report by Mr Lister, *Parl. Papers* 1908, Cd. 3883).

The chief German protectorates are South-west Africa, Togoland and Cameroon, German East Africa, Kaiser Wilhelm Land, Bismarck Archipelago, Solomon Islands, and Kiaochow—under lease from China—(*Zeitschrift für Kolonialrecht*, 1907, p. 311). Russia has the protectorates of Khiva and Bokhara; and China exercises or claims rights as protector of certain dependencies.

There are two principal classes of protectorates; the first being those exercised generally by treaty over civilized countries. Of the first, the chief are: (*a*) that of Cracow, which was recognized by the Treaty of Vienna as an independent state, and placed under the protection of Russia: it was incorporated with Austria in 1846; (*b*) Andorra, protected by Spain and France as successors of the counts of Foix (See ANDORRA); (*c*) the Ionian Islands, placed under the protection of Great Britain by the Treaty of Paris of 1815.

The second class of protectorates consists of those exercised by one civilized state over an uncivilized people, sometimes called a "Colonial Protectorate" or "pseudo-protectorate," and usually the preparatory step to annexation. These have become common, especially in Africa, since 1878. The second class may be subdivided into two groups: (*a*) protectorates exercised over countries with organized governments and under recognized sovereigns, such as the Malay States; and (*b*) those exercised over countries possessing no stable or definite governments and rulers. The territories of chartered companies, when not within the dominion of the protecting state, may also for some purposes be regarded as protectorates.

Rights and Duties of Protecting and Protected States.

Attempts have been made to define the reciprocal rights and duties of protecting and protected states. Sometimes the treaty creating the relation defines the obligations. Thus in the treaty with respect to Sarawak the latter is described as an "independent state under the protection of Great Britain." "Such protection shall confer no right on his Majesty's government to interfere with the internal administration of that state further than is herein provided." The British consular officers are to receive exequaturs in the name of the government of Sarawak. Foreign relations are to be conducted by that government, and the raja cannot cede or alienate any part of the territory without the consent of the British government (Hertslet, 18. 227). In the treaty creating a protectorate over the territories of the king and chief of Opopo (Hertslet, 17. 130) the sovereign undertakes to extend to them, and to the territory under their authority and jurisdiction, his favour and protection. They promise not to enter into "any correspondence, agreement or treaty with any foreign nation or power, except with the knowledge and sanction of his Majesty's government." Some treaties establishing protectorates provide for direct interference with internal affairs; for example, the treaty of 1847 creating a French protectorate over Tahiti, and that of 1883 as to Tunis. Sometimes the *Oberstaat*—to use a convenient expression—is content to insist upon the presence of a resident, who guides the policy of the native ruler. In the case of protectorates over uncivilized countries it is usual to stipulate against alienation of territory without consent of the *Oberstaat.*

Protectorates and International Law.

The legal position of protectorates is still somewhat undetermined; there are an old view and also a new view of their nature. The relation may be one of international law, two states having entered into obligations by treaty. Or the relation may be one of public law; one of two states has become subordinate to, and incorporated with, the other. The general rule is that the protected state does not cease to be a sovereign state, if such was its previous status. Its head is still entitled to the immunities and dignity of a sovereign ruler. Further, the establishment of a protectorate does not necessarily rescind treaties made between the protected state and other states, at all events when it is not in reality conquest or cession, or when any modification would be to the injury of third parties (*Parl. Papers*, Madagascar, 1897 [c. 8700]; Trione, 187). Nor does the new relation make any change as to the nationality of the subjects of the two states, though in some countries facilities are afforded to the subjects of the *Unterstaat* to transfer their allegiance; and they owe a certain ill-defined degree of obedience to the protecting state. Nor, speaking generally, does the territory of the protected state become part of the territory of the *Oberstaat*; in this respect is it unlike a colony, which may be regarded as an extension or outlying province of the country. At the same time, the question whether a particular protectorate forms part of the "dominion" or "territory" of the Crown for any purposes or within the meaning of any statute cannot be regarded as wholly free from doubt; its terms and intention must be examined. In *Rex* v. *Crewe* (1910, 79, L. J. 874) the Court of Appeal decided that the Bechuanaland Protectorate was not part of the dominion of the Crown, but was foreign territory. Several writers propose this distinction—the protected country is to be considered a part of the territory as to certain important sovereign rights, and as to other matters not. In one view, for the purpose of municipal law, the territory of a protectorate is not, but for the purposes of international law is, within the territory of the protecting state. In another view, such territory is foreign only in the sense that it is not within the purview of the majority of statutes (see Hall's *International Law*, 6th ed., 126, Heilborn, 535; Tupper's *Indian Protectorates*, 336; Laband, 2, § 70).

The older view of the position of a protectorate according to international law is contained in the decision of Dr Lushington in the case of the "Leucade" (8 S.T., N.S., 432), to the effect that, the declaration of war by Great Britain against Russia notwithstanding, the Ionian Islands, which were then under the protectorate of Great Britain, remained neutral. The king of Great Britain had the right of declaring peace and war. "Such a right is inseparable from protection." But the Ionian states did not become necessarily enemies of the state with which Great Britain was at war. According to one view, the protected state is implicated in the wars to which the protecting state is a party only when the latter has acquired a right of military occupation over the territory of the former. "Cette solution a été reconnue par la France en 1870, à propos de la guerre contre l'Allemagne pour les îles Taiti alors soumises à notre protectorat; elle s'imposerait pour la Tunisie, l'Annam et Tonkin, et pour le Cambodge, où les traités nous confèrent le droit d'occupation militaire" (M. Despagnet). In the event of hostilities between the protecting and protected states, such hostilities would be regarded not as of the nature of an insurrection, but as a regular war (Trione, 149).

By the General Act of the Berlin Conference it was agreed that the acquisition of a protectorate should be notified to the signatories to the agreement (art. 34), and it has been the practice to give such notice. It was proposed by some of the powers represented that effective occupation should be a condition to the creation of a protectorate on the coast of Africa. But this was opposed by England, and was not adopted (Laband, ii. 680).

Many writers adhere to the doctrine that there is no impairment of sovereignty of the weaker state by the establishment of a protectorate. They also allege that it is *res inter alios acta*, an arrangement which concerns only parties to it. But the trend of recent policy and purport of much recent legislation are against this view. The distinct tendency, especially as to protectorates over uncivilized countries, is to treat, for purposes of international law, the territory of a protectorate as if it belonged to the protecting state. If France, for example, permitted in Tunis or other protectorates operations of an unfriendly character to any power, the injured power would no doubt look to France for redress. This view would probably be strongly pressed in the case of protectorates over countries having no well-defined or stable government. The probability is that in such cases governments and courts applying international law would probably be guided not by technical facts—such, to take the case of British possessions, as the fact that an order in council permitted appeals to the Judicial Committee—but would look to the facts of the case. "Any state which undertakes to protect another assumes towards the rest of the world responsibility for its good behaviour—the more complete protection the more extensive the responsibility—and this responsibility involves a duty to interfere if need be" (Coolidge, *United States as a World Power,*" p. 167; and to the same effect Liszt, *Völkerrecht*, p. 31; and Zorn, *Völkerrecht*, p. 45). The tendency is for protecting states to assert jurisdiction over foreigners within the territories of the protected states (Westlake, 187; Jenkyns, p. 176; Ilbert, 2nd ed., 393, 434). Mr Hall remarks (*International Law*, 6th ed., p. 126 n.) that "all the states represented at the Berlin Conference of 1884–1885, with the exception of Great Britain, maintained that the normal jurisdiction of a protectorate includes the right of administering justice over the subjects of other civilized states." The General Act contemplated measures which are scarcely compatible with the exemption of European traders and adventurers from the local civilized jurisdiction. He points out that Great Britain—which until lately took the view that a protected state possesses only delegated powers, and that an Eastern state cannot grant jurisdiction over persons who are neither its own subjects nor subjects of the country to which the powers are delegated—had by the Pacific Order in Council of 1893 and the South African Orders in Council of 1891–1894 asserted jurisdiction over natives and foreign subjects. "The Orders show a gradual increase of the assumption of internal sovereignty" (Jenkyns, 193). A similar process is observable in the German protectorates, which are treated for some purposes as "inland," and not foreign territory (*Der koloniale Inlands- und Auslands-begriff, Zeitschrift für Kolonialrecht*, 1907, p. 311). The fact is that in the case of protectorates over uncivilized or semi-civilized countries a development is inevitable: control quickly hardens into conquest, and international law more and more takes note of this fact.

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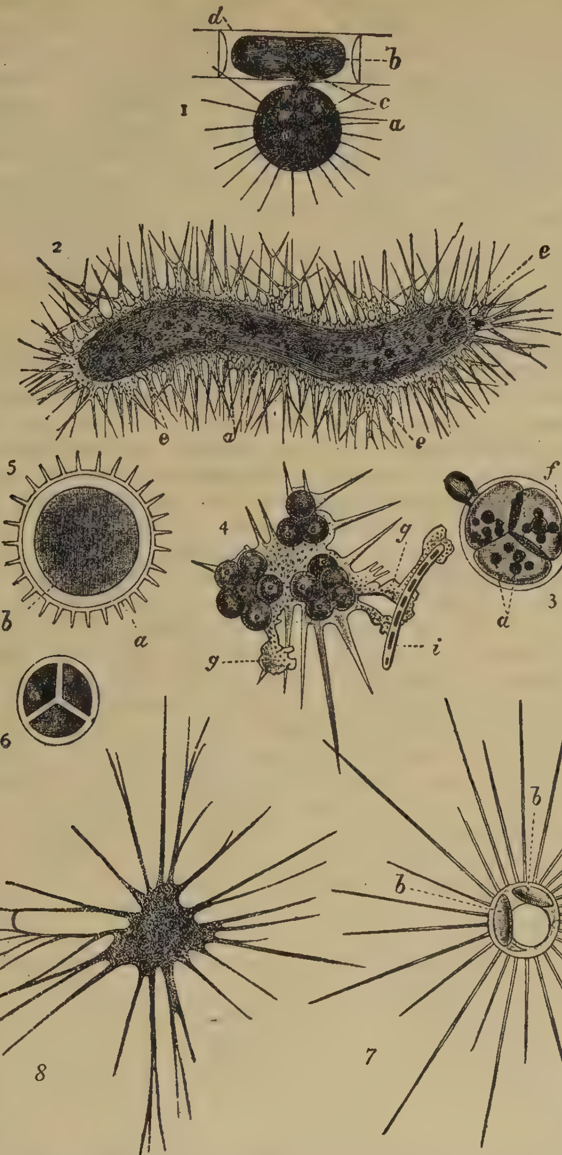
PROTEOMYXA, a name given by E. Ray Lankester (*Ency. Brit.*, 9th ed., 1885, art. "Protozoa,") to a group of Protozoa Sarcodina. The group was really recognized as distinct by Cienkowski and by Zopf, receiving the name of Monadinea from the former; but as this name had been usually applied to Flagellates and even the zoospores are not always provided with flagella, Lankester's name has become more suitable, and has been adopted by Delage and Hérouard (1896) and by Hartog (1906). The group entered to a considerable extent into the "Monera" of Haeckel, supposed (erroneously in most if not all species adequately studied) to possess no nucleus in the protoplasm. The following are the characteristics of the group. Pseudopods usually granular, fine flexible, tapering generally, not freely branching; reproducing sometimes by simple fission, but more frequently by multiple fission in a brood-cyst whose walls may be multiple. Plasmodium formation occasional, but never leading to the formation of a massive fructification: other syngamic processes unknown, and probably non-existent. Encystment, or at least a resting stage at full growth, is very characteristic, and frequently an excretion of granules takes place into the first-formed cyst, whereupon a second inner cyst is formed which may be followed by a third. These brood-cysts, in which multiple fission takes place, may be of two kinds, ordinary and resting, the latter being distinguished by a firm, and usually ornamented and cuticularized cell-wall, and only producing its zoospores after an interval. Besides, an individual at any age may under unfavourable conditions surround itself with a "hypnocyst," to pass the time until matters are more suitable to active life, when it emerges unchanged.



1, *Vampyrella spirogyrae*, Cienk., amoeba phase penetrating a cell of Spirogyra *b*, by a process of its protoplasm *c*, and taking up the substance of the Spirogyra cell, some of which is seen within the *Vampyrella a*.

2, Large individual of *Vampyrella*, showing pseudopodia *e*, and food particles *a*. The nucleus (though present) is not shown in this drawing.

3, Cyst phase of *Vampyrella*. The contents of the cyst have divided into four equal parts, of which three are visible. One is commencing to break its way through the cyst-wall *f*; *a*, food particles.

4, *Archerina boltoni*, Lankester, showing lobose and filamentous protoplasm, and three groups of chlorophyll corpuscles. The protoplasm *g* is engulphing a Bacterium *i*.

5, Cyst phase of *Archerina: a*, spinous cyst-wall; *b*, green-coloured contents.

6, Chlorophyll corpuscle of *Archerina* showing tetraschistic division.

7. Actinophryd form of *Archerina: b*, chlorophyll corpuscles.

8, *Protogenes primordialis*, Haeckel (*Amoeba porrecta*, M. Schultze), from Schultze's figure.

From the initial character of the brood-cell on leaving the sporocyst the dividing character of the two orders is taken.

1. Zoosporeae, Zopf. The brood-cells leave the cyst as "Monads" (with one or two flagella). Genera: *Pseudospora*, Cienk.; *Protomonas*, Cienk.; *Diplophysalis*, Zopf.; *Gymnococcus*, Z.; *Aphelidium*, Z.; *Pseudosporidium*, Z.; *Plasmodiophora*, Woronin; *Tetramyxa*, Goebel.

2. Azoosporeae, Zopf. Genera: *Endyonema*, Z.; *Vampyrella*, Cienk. (figs. 1, 2, 3); *Leptophrys*, Hertw. and Less.; *Bursulla*, Sorokin; *Protogenes*, Haeck. (fig. 8); *Archerina*, Lank. (figs. 4–7); *Serosporidium*, L. Pfeiffer; *Lymphosporidium*, Calkins.

Many of the species are endoparasites in living cells, mostly of Algae or Fungi, but not exclusively. At least two species of *Pseudospora* have been taken for reproductive stages in the life history of their hosts—whence indeed the generic name. *Plasmodiophora brassicae* gives rise to the disease known as "Hanburies" or "fingers and toes" in Cruciferae; *Lymphosporidium* causes a virulent epidemic among the American brook-trout, *Salvelinus fontinalis*. *Archerina boltoni* is remarkable for containing a pair of chlorophyll corpuscles in each cell; no nucleus has been made out, but the chlorophyll bodies divide previous to fission. It is a fresh-water form. The cells of this species form loose aggregates or filoplasmodia, like those of *Mikrogromia* (Foraminifera, *q.v.*) or *Leydenia* (Labyrinthuloidea, *q.v.*), &c.

Vampyrella (figs. 1–3) and *Enteromyxa* also form a compact plasmodium which separates into 1-nucleate cells, which then encyst and divide into a brood of four.

Bibliography.—F. Cienkowski in *Archiv für mikroskopische Anatomie* (1865); Haeckel, "Die Moneren," in *Jenaische Zeitschr.* (1868), vol. iv.; W. Zopf, "Die Monadineen," in Schenk's *Handbuch der Botanik* (1887), vol. iii. pt. ii., and *Beiträge zur Physiologie und Morphologie niederer Organismen* (1890); Delage and E. Hérouard, *Traité de zoologie concrète*, vol. i.; *La Cellule et les protozoaires* (1896); Marcus Hartog, *Cambridge Natural History* (1906), vol. i.

(M. Ha.)

PROTESILAUS, in Greek legend, son of Iphiclus, and husband of Laodameia. In command of the Greek contingent from Phylace in Thessaly, he was the first to spring ashore on Trojan soil, although he knew it meant instant death. His wife besought the gods below that he might be permitted to return to earth for the space of three hours. Her prayer was granted, and on the expiration of the time allotted she returned with him to the nether world. According to Hyginus (*Fab.* 103, 104), Laodameia made a waxen image of her husband. A slave, having detected her in the act of embracing it and supposing it to be a lover, informed her father, who ordered her to burn the image; whereupon she threw herself with it into the flames. In another account (Conon, *Narrationes*, 13) Protesilaus survived the fall of Troy and carried off Aethilla, the sister of Priam. During a halt on the peninsula of Pallene, Aethilla and the other captive women set fire to the ships. Protesilaus, unable to continue his voyage, remained and built the city of Scione. His tomb and temple were to be seen near Eleus in the Thracian Chersonese. Nymphs had planted elm-trees, facing towards Troy, which withered away as soon as they had grown high enough to see the captured city. Protesilaus was the subject of a tragedy by Euripides, of which some fragments remain.

Iliad, ii. 698; Lucian, *Dial mort.* xxiii. 1; Ovid, *Heroides*, xiii.; Philostratus, *Heroica*, iii.

PROTESTANT, the generic name for an adherent of those Churches which base their teaching on the principles of the Reformation (*q.v.*). The name is derived from the formal *Protestatio* handed in by the evangelical states of the empire, including some of the more important princes and 14 imperial cities, against the *recess* of the diet of Spires (1529), which decreed that the religious *status quo* was to be preserved, that no innovations were to be introduced in those states which had not hitherto made them, and that the mass was everywhere to be tolerated. The name Protestant seems to have been first applied to the protesting princes by their opponents, and it soon came to be used indiscriminately of all the adherents of the reformed religion. Its use appears to have spread more rapidly outside Germany than in Germany itself, one cause of its popularity being that it was negative and colourless, and could thus be applied by adherents of the "old religion" to those of the "new religion," without giving offence, on occasions when it was expedient to avoid abusive language. The designation was moreover grateful to the Reformers as connoting a certain boldness of attitude; and Professor Kattenbusch (Herzog-Hauck, *Realencyklopädie*, 3rd ed., xvi. p. 136, 15) points out with great truth how, from this point of view, the name "Protestantism" has survived as embodying for many the conception of liberty, of the right of private judgment, of toleration for every progressive idea in religion, as opposed to the Roman Catholic principles of authority and tradition; so that many even of those who do not "profess and call themselves Christians" yet glory in the name of "Protestant."

As the designation of a Church, "Protestant" was unknown during the Reformation period and for a long while after. In Germany the Reformers called themselves usually *evangelici*, and avoided special designations for their communities, which they conceived only as part of the true Catholic Church; "Calvinists," "Lutherans," "Zwinglians" were, in the main, terms of abuse intended to stamp them as followers of one or other heretical leader, like Arians or Hussites. It was not until the period of the Thirty Years' War that the two main schools of the reformed or evangelical Churches marked their definitive separation: the Calvinists describing themselves as the "Reformed Church," the Lutherans as the "Lutheran Church." In France, in England, in Holland the evangelicals continued to describe their churches as *ecclesiae reformatae*, without the *arrière pensée* which in Germany had confined the designation "Reformed" to the followers of a particular church order and doctrine. As to the word "Protestant," it was never applied to the Church of England or to any other, save unofficially and in the wide sense above indicated, until the style "Protestant Episcopal Church" (see below) was assumed by the Anglican communion in the United States. Even in the Bill of Rights the phrase "Protestant religion" occurs, but not "Protestant Church," and it was reserved for the Liberal government, in the original draft (afterwards changed) of the Accession Declaration Bill introduced in 1910, to suggest "Protestant Reformed Church of England" as a new title for the Established Church.

The style "Protestant" had, however, during the 19th century assumed a variety of new shades of meaning which necessarily made its particular application a somewhat hazardous proceeding. In Germany it had, for a while, been assumed by the Lutherans as against the Calvinists, and when in 1817 King Frederick William III. of Prussia forcibly amalgamated the Lutheran and Reformed Churches in the new "Evangelical Church" its public use was forbidden in the Prussian dominions. It survived, however, in spite of royal decrees, but in an altered sense. It became—to quote Professor Kattenbusch—the "secular" designation of the adherents of the Reformation, the shibboleth of the "liberal" ecclesiastical and theological tendencies. Finally, in opposition to the ultramontane movement in the Roman Catholic Church, it came once more into fashion in something of its original sense among the evangelicals.

In the Church of England, on the other hand, the name "Protestant" has, under the influence of the High Church reaction, been repudiated by an increasingly large number of the clergy and laity, and is even sometimes used by them in a derogatory sense as applied to their fellow-churchmen who still uphold in their integrity the principles of the Reformation. Among the latter, on the other hand, "Protestantism" is used as exclusive of a good many of the doctrines and practices which in the Lutheran Church were at one time "Protestant" as opposed to "Reformed," *e.g.* the doctrine of the real Presence, auricular confession, the use of ceremonial lights and vestments. By many churchmen, too, the name of "Protestant" is accepted in what they take to be the old sense as implying repudiation of the claims of Rome, but as not necessarily involving a denial of "Catholic" doctrine or any confusion of the Church of England with non-episcopal churches at home or abroad.

In contradistinction to all these somewhat refined meanings, the term "Protestant" is in common parlance applied to all Christians who do not belong to the Roman Catholic Church, or to one or other of the ancient Churches of the East.

PROTESTANTENVEREIN is the name of a society in Germany the general object of which is to promote the union (*Verein*) and progress of the various established Protestant Churches of the country in harmony with the advance of culture and on the basis of Christianity. It was founded at Frankfort-on-the-Main in 1863 by a number of distinguished clergymen and laymen of liberal tendencies, representing the freer parties of the Lutheran and Reformed Churches of the various German states, amongst whom were the statesmen Bluntschli and Von Bennigsen and the professors R. Rothe, H. Ewald, D. Schenkel, A. Hilgenfeld and F. Hitzig. The more special objects of the association are the following: the development of the Churches on the basis of a representative parochial and synodal system of government in which the laity shall enjoy their full rights; the promotion of a federation of all the Churches in one national Church; resistance to all hierarchical tendencies both within and without the Protestant Churches; the promotion of Christian toleration and mutual respect amongst the various confessions; the rousing and nurture of the Christian life and of all Christian works necessary for the moral strength and prosperity of the nation. These objects include opposition to the claims of Rome and to autocratic interference with the Church on the part of either political or ecclesiastical authorities, efforts to induce the laity to claim and exercise their privileges as members of the Church, the assertion of the right of the clergy, laity and both lay and clerical professors to search for and proclaim freely the truth in independence of the creeds and the letter of Scripture. Membership in the association is open to all Germans who are Protestants and declare their willingness to co-operate in promoting its objects. The means used to promote these objects are mainly (1) the formation of local branch associations throughout the country, the duty of which is by lectures, meetings and the distribution of suitable literature to make known and advocate its principles, and (2) the holding of great annual or biennial meetings of the whole association, at which its objects and principles are expounded and applied to the circumstances of the Church at the moment. The "theses" accepted by the general meetings of the association as the result of the discussions on the papers read indicate the theological position of its members. The following may serve as illustrations:—

> The creeds of the Protestant Church shut the doors on the past only, but open them for advance in the future; it is immoral and contrary to true Protestantism to require subscription to them. The limits of the freedom of teaching are not prescribed by the letter of Scripture, but a fundamental requirement of Protestantism is free inquiry in and about the Scriptures. The attempt to limit the freedom of theological inquiry and teaching in the universities is a violation of the vital principle of Protestantism. Only such conceptions of the person of Jesus can satisfy the religious necessities of this age as fully recognize the idea of his humanity and place in history. The higher reason only has unconditional authority, and the Bible must justify itself before its tribunal; we find the history of divine revelation and its fulfilment in the Bible alone, and reason bids us regard the Bible as the only authority and canon in matters of religious belief.

The formation of the association at once provoked fierce and determined opposition on the part of the orthodox sections of the Church, particularly in Berlin. Attempts more or less successful have been made from the first to exclude clergymen and professors identified with it from the pulpits and chairs of Berlin and elsewhere, though membership in it involves no legal disqualification for either. One of the objects of the association was to some extent obtained by their organization of the Prussian Church when Dr Falk was cultus minister, on the basis of parochial and synodal representation, which came into full operation in 1879. But the election for the general synod turned out very unfavourable to the liberal party, and the large orthodox majority endeavoured to use their power against the principles and the members of the association. In 1882 the position of the association was rendered still more difficult by the agitation in Berlin of Dr Kalthoff and other members of it in favour of a "people's church" on purely dissenting and extremely advanced theological principles. This difficulty has continued, and the extreme rationalist position taken up by some leaders has alienated the sympathy not only of the obscurantists but of those who were prepared to go some distance in the direction of a liberal theology. There are now about 25,000 members in the 20 branches of the Verein.

See D. Schenkel, *Der deutsche Protestantenverein und seine Bedeutung für die Gegenwart* (Wiesbaden, 1868, 2nd ed. 1871); *Der deutsche Protestantenverein in seinen Statuten und den Thesen seiner Hauptversammlungen 1865–1882* (Berlin, 1883); P. Wehlhorn in Herzog-Hauck's *Realencyk. für prot. Theol. u. Kirche*; H. Weinel, "Religious Life and Thought in Germany To-day," *Hibbert Journal* (July 1909).

PROTESTANT EPISCOPAL CHURCH, in the United States, a part of the Anglican Communion, organized after the War of Independence by the scattered parishes of the Church of England which survived the war. It inherits from the Church of England, with which it is in communion, its liturgy, polity and spiritual traditions, though it has entire independence in legislation. While the clergy of both Churches are cordially received in their respective countries, there is no formal connexion between them except in fellowship and in advisory council as at the Lambeth Conference. The Church in the United States is therefore an independent national Church which has adapted itself to the conditions of American life.

With many likenesses, the Protestant Episcopal Church is different from the Church of England in its organization and representative form of government. It has the three orders of bishops, priests and deacons, and uses an almost identical liturgy; but it is a democratic institution in which the laity have practically as much power as the clergy, and they are represented in all legislative bodies. The constitution of the Church follows in many particulars the constitution of the United States. As the separate states of the Union are made up of different townships, so the diocese is composed of separate parishes; and as the nation is a union of the states, so the Church is a union of the dioceses. The American plan of representative government is consistently adhered to. The Church in America is thus a part of the Catholic Church of Christ, with its roots deep in the past and yet a living body with a life of its own, standing for the truth of the Christian religion in the great Republic. It is now firmly established in every state and Territory of the United States, and in all the dependencies, with also vigorous missions in foreign lands.

History.

Services of the Church of England were held by the chaplains of exploring expeditions in various parts of North America before a settlement was established: on Hudson Bay, in 1578, and on the shores of the Pacific with Drake in 1579; but the first permanent foothold of the Church was in Jamestown, Virginia, in 1607, when a colony was founded and a church built. This fact is recognized in the proposed preamble to the constitution, in which it is stated that this American Church was "first planted in Virginia in the year of Our Lord 1607, by representatives of the ancient Church of England." Parishes were later founded in Maryland in 1676; in Massachusetts in 1686; in New York about 1693; in Connecticut in 1706; and in the other colonies during the 17th and 18th centuries. The growth of these colonial churches was largely promoted by the Society for the Propagation of the Gospel in Foreign Parts, founded in 1701, through the efforts of the Rev. Thomas Bray, a missionary in Maryland. These churches scattered throughout the different colonies up to the American War of Independence were missions of the Church of England. They were under the jurisdiction of the Bishop of London, there being no bishop in America. The Bishop of London superintended these distant parishes by means of commissaries. Many of the clergy came from England; and when young men in America desired to be ordained, it was necessary for them to go to England for this purpose. The Church during the colonial period was incomplete in organization, and without the power of expansion. It was confined principally to the more settled parts of the country, though it had extended itself into all the colonies. During this period a few educational institutions were founded: the College of William and Mary in 1693, in Virginia; the Public Academy of Philadelphia, in 1749, now the university of Pennsylvania; and King's College, in 1754, in New York, now Columbia University. The clergy also frequently taught in parochial schools, and trained boys and girls in their homes.

When the war broke out and independence was declared, a number of the clergy went back to England, leaving their parishes vacant, but many, especially in the southern states, remained and upheld the American cause. A large majority of the laymen were patriots. Two-thirds of the signers of the Declaration of Independence were Episcopalians. The churches, having their support largely withdrawn by the Venerable Society, became very weak. In Massachusetts during the war only two churches were kept open.

After the war it was very soon recognized that if the Church was to survive, there must be organization and co-operation among the fragments left. Rev. William White (1748-1836) of Philadelphia, who had been chaplain of the Continental Congress, was a leader in the plan of organization. Rev. Samuel Seabury (1729–1796) of Connecticut was also an important factor in continuing the life of the Church. He was elected bishop by the clergy of Connecticut, and after being refused in England, was consecrated bishop of Connecticut by the Scotch non-juror bishops in Aberdeen on the 14th of November 1784. Later, William White of Pennsylvania and Samuel Provoost (1742–1815) of New York were consecrated bishops in the chapel at Lambeth Palace on the 4th of February 1787, by the archbishops of Canterbury and York and others. Rev. James Madison (1749–1812) of Virginia was also consecrated bishop in England, on the 19th of September 1790. An important meeting or general convention of laymen, clergy and bishops was held in 1784, and another in 1789, for the purpose of consolidating and uniting the Church. Certain fundamental principles were adopted which were the basis of organization: that the Episcopal Church be independent of all foreign authority; that it have full and exclusive power to regulate the concerns of its own communion; that the doctrines be maintained as in the Church of England; that bishops, priests and deacons be required; that the canons and laws be made by a more representative body of clergy and laity conjointly. At the general convention of 1789 a constitution and canons were finally adopted, and the book of Common Prayer was set forth.

The Church thus being fully organized, it was prepared to develop and extend. There was a long period, however, when little was done save retain what had already been gained. Owing in a measure to the popular prejudice against anything that savoured of England, and to the difficulty of adapting the newly formed institution to the conditions of American life, the Church hardly held its own from 1789 to 1811. The general convention of 1811 was attended by only five clergymen and four laymen more than that of 1789. The Church in Virginia especially suffered a decline, but in the North it maintained itself. After 1811 a new spirit manifested itself in the consecration of three important men to the episcopate. John Henry Hobart, a man of great zeal and devotion, became bishop of New York in 1811; Alexander Viets Griswold (1766–1843), a man of piety and force, became bishop of the eastern diocese of New England in 1811; and Richard Channing Moore (1762–1841), a strong preacher and vigorous personality, was consecrated bishop of Virginia in 1814. Both Hobart and Moore became interested in theological education; and their efforts to train clergymen resulted in the establishment of the General Theological Seminary in New York in 1819, and the Theological Seminary in Virginia, opened in Alexandria in 1824. The *Churchman's Magazine* was started. Another evidence of expansion was the consecration in 1819 of Philander Chase (1775–1852), who became pioneer bishop of the West, first in Ohio where he laid the foundations (1824) of the "Theological Seminary of the Protestant Episcopal Church in the Diocese of Ohio," afterward called Kenyon College, at Gambier, and then in Illinois where he organized a church and founded Jubilee College. The Domestic and Foreign Missionary Society was started in 1821. This centralized the mission work, and became the great agency in the growth and extension of the Church. Bishop Jackson Kemper (1789–1870) in the North-west, and Bishop James Hervey Otey (1800–1863) in the South-west, did important pioneer work.

The period between 1835 and 1865 was characterized by further expansion of the episcopate and the formation of new dioceses. Bishop William Ingraham Kip (1811–1893) went to the miners of California in 1853. The dioceses of Oregon and Iowa were founded in 1854; and Bishop Henry Benjamin Whipple (1822–1901) was sent to Minnesota in 1859. The Church found its way into Indiana, Texas, Arkansas, Florida, Nebraska and Colorado. In 1835 there were 763 clergymen; in 1850 the number had increased to 1558; and even in 1865 there were 2450. The number of communicants also grew from 1835, when there were 36,000; to 1850, when there were 80,000; and to 1865, when there were 150,000. During this period some beautiful church buildings were erected, notably Trinity church and Grace church, New York. The services were richer; stained glass was used; stalls for the clergy and choir were introduced, and the lectern was substituted for the old-time reading-desk. Other educational institutions were founded: Nashotah, Wisconsin, in 1842; Bexley Hall at Gambier in 1839; Racine College, at Racine, Wisconsin; and Griswold College in Iowa.

When the Civil War broke out in 1861 the Church in the South met and formed a separate organization called "The Protestant Episcopal Church in the Confederate States," but the Church in the North did not recognize the secession; at the meeting of the general convention in New York in 1862, the roll of the Southern dioceses was called, and though absent, they were still considered a part of the Church in the United States. This brotherliness was an important factor in bringing about a complete union between the Northern and Southern Churches after the Civil War; so the Church in the Confederate States had but a temporary existence.

Since the Civil War the Church has grown with the expansion of national life. It has become strong in great centres, and has reached out into every part of the United States and its dependencies, and has maintained missionary stations in foreign lands. There are bishops and missionary dioceses in Alaska, Hawaii, the Philippine Islands, Porto Rico and Cuba; two bishops in China and two in Japan; and bishops in Liberia, Haiti, and Brazil.

Institutions of learning, schools, colleges and theological seminaries, have been founded. Prominent among the schools are St Paul's, at Concord, New Hampshire; St Mark's, at Southboro, Massachusetts; Groton School, at Groton, Massachusetts; St Mary's, at Garden City, Long Island; St Agnes's, at Albany, New York; St Mary's, at Burlington, New Jersey; the Cathedral School, at Washington D.C.; and St. George's School, at Newport, Rhode Island. In addition to the colleges already referred to, there should be included: Trinity College, at Hartford, Connecticut; St Stephen's, at Annandale, New York; the University of the South, at Sewanee, Tennessee; and Hobart College, at Geneva, New York. The theological seminaries, besides the general seminary in New York and the Virginia Seminary, are: the Divinity School, in Philadelphia; the Berkeley Divinity School, at Middletown, Connecticut; the Seabury Divinity School, at Faribault, Minnesota; Western Theological Seminary, in Chicago; Nashotah House, at Nashotah, Wisconsin; Bexley Hall, Gambier, Ohio; the Church Divinity School of the Pacific, San Mateo, California; and the Episcopal Theological School in Cambridge, Massachusetts.

Cathedrals have been built or were in process of construction in 1910 in many cities. Among them are: All Saints Cathedral, Milwaukee; the Cathedral of All Saints, Albany; the Cathedral of the Incarnation, Garden City, Long Island; the Cathedral Church of St Luke, Portland, Maine; St John the Divine, New York; and also those in Dallas, Texas, Washington, D.C., Davenport, Iowa, and Cleveland, Ohio.

The institutional life of the Church is constantly increasing. Among the numerous organizations founded for distinct purposes are: the Woman's Auxiliary to the Board of Missions; the American Church Building Fund Commission; the American Church Missionary Society; the General Clergy Relief Fund; the Assyrian Mission Committee; the American Church Institute for Negroes; the Brotherhood of St Andrew; the Girls' Friendly Society; the Church Students' Missionary Association; the Church Laymen's Union; the Seabury Society of New York; the Church Mission to Deaf Mutes; the Conference of Church Workers among the Colored People; the Society for the Increase of the Ministry; the Church Association for the Advancement of the Interests of Labor; the Church Temperance Society; the Church Unity Society; the Confraternity of the Blessed Sacrament; the Guild of the Holy Cross; the Guild of St Barnabas for Nurses; the Church Congress in the United States. In addition there are Sunday School commissions and institutes in almost every diocese. Among the religious orders may be mentioned the Society of Mission Priests of St John the Evangelist; the Order of the Holy Cross; the Community of St Mary; the Sisterhood of St Margaret; the All Saints Sisters of the Poor; the Sisterhood of St John Baptist; and others. There are also training schools for deaconesses, including the New York Training School for Deaconesses; and the Church Training and Deaconess House of the Diocese of Pennsylvania.

Government.

The Protestant Episcopal Church in the United States is governed according to the constitutions and canons adopted in 1789, and from time to time amended by the General Convention, which meets every three years. The General Convention consists of the House of Bishops, having as members all the bishops of the Church, and a House of Deputies, composed of four presbyters and four laymen elected by each diocese in union with the Convention; also one clerical and one lay deputy from each missionary district within the boundaries of the United States, and one clerical and one lay deputy chosen by the Convocation of the American Churches in Europe. The voting is by both houses acting separately and concurring. In the House of Deputies the vote is taken by orders, the clerical and lay deputies voting separately; and they must concur for a resolution to pass. This representative body legislates for the whole Church. Each diocese also has its own constitution and canons, by which it regulates its internal affairs, having also an annual diocesan convention, in which the clergy and laity are represented. A bishop is elected by the diocese, subject to confirmation by a majority of the bishops and standing committees of the different dioceses. Missionary bishops are elected by the House of Bishops and confirmed by the House of Deputies if the General Convention is in session; if not in session, by a majority of the standing committees. The presiding bishop of the Church was the senior bishop in order of consecration, until 1910, when an amendment to the constitution was adopted providing for his election by the General Convention. A special feature of the government of the Church is the power given to the laymen. In the parishes they elect their own clergyman; and they have votes in the diocesan convention and in the General Convention, and are thus an integral part of the legislative machinery of the Church.

The worship of the Church is conducted in accordance with the Book of Common Prayer, set forth in 1789, but changed from time to time as need has arisen. The preface states that "this Church is far from intending to depart from the Church of England in any essential part of doctrine, discipline or worship, or further than local circumstances require." This principle guided the Church in the early days, and continues in force. However, changes have been made in the direction of omission and addition. The Athanasian Creed is omitted, as well as all reference to the king and royal family. The Commination Service has been dropped. In the *Te Deum*, in place of "Thou didst not abhor the Virgin's womb," is substituted "Thou didst humble Thyself to be born of a Virgin." Many verbal changes have been made. "Our Father which art in Heaven" is changed to "Who art in Heaven"; "Them that trespass" is changed to "Those who trespass." The Ornaments Rubric and the Black Rubric are omitted. The Communion Office is more like the Scottish office, having the Oblation and Invocation. Instead of the Commandments may be said our Lord's summary of the law. Special prayers and thanksgiving have been added, to be used upon several occasions. A form of the consecration of a church has been introduced, as well as an office for the institution of a minister and an office for the visitation of prisoners. The last revision of the American Prayer Book was in 1892; gospels for the Festival of the Transfiguration and for the early celebration of the Holy Communion on Christmas Day and Easter Day were added; and a greater flexibility in the use of the Prayer Book was permitted.

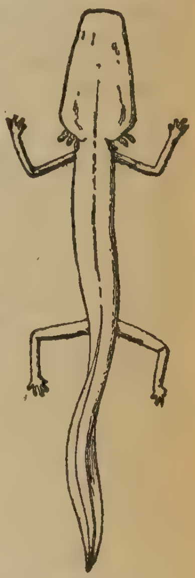
The statistics as reported by the General Convention of 1907 are as follows: the whole number of clergy, 5329; deacons ordained, 483; priests ordained, 471; candidates for holy orders, 469; postulants, 323; lay readers, 2464; baptisms, 197,203; persons confirmed, 158,931; communicants, 871,862; Sunday School officers and teachers, 47,871; pupils, 446,367; parishes and missions, 7615; church edifices, 7028; rectories, 2530; church hospitals, 72; orphan asylums, 57; homes, 84; academic institutions, 22; collegiate, 17; theological, 23; other institutions, 79; total contributions for all purposes, $52,257,519; episcopal fund, $3,499,838; hospitals and other institutions, $17,509,085.

AUTHORITIES.—J. S. M. Anderson, *History of the Church of England in the Colonies* (3 vols., 2nd ed., London, 1856); Leighton Coleman, *The Church in America* (New York, 1895); A. L. Cross, *The Anglican Episcopate and the American Colonies* (New York, 1902); H. W. Foote, *Annals of King's Chapel* (2 vols., Boston, 1882–1887); George Hodges, *Three Hundred Years of the Episcopal Church in America* (Philadelphia, 1906); W. S. Perry, *History of the American Episcopal Church, 1587–1883, with Monographs* (2 vols., Boston, 1885); W. S. Perry, *Historical Collections Relating to the Episcopal Colonial Church, covering Virginia, Pennsylvania, Massachusetts, Maryland and Delaware* (4 vols., Hartford, 1870); S. D. McConnell, *History of the American Episcopal Church* (New York, 1890); D. D. Addison, *The Episcopalians* (New York, 1902); C. C. Tiffany, *A History of the Protestant Episcopal Church* (New York, 1905). (D. D. A.)

PROTEUS, in Greek mythology, a prophetic old man of the sea. According to Homer, his resting-place was the island of Pharos, near the mouth of the Nile; in Virgil his home is the island of Carpathus, between Crete and Rhodes. He knew all things past, present and future, but was loth to tell what he knew. Those who would consult him had first to surprise and bind him during his noonday slumber in a cave by the sea, where he was wont to pass the heat of the day surrounded by his seals. Even when caught he would try to escape by assuming all sorts of shapes: now he was a lion, now a serpent, a leopard, a boar, a tree, fire, water. But if his captor held him fast the god at last returned to his proper shape, gave the wished-for answer, and then plunged into the sea. He was subject to Poseidon, and acted as shepherd to his "flocks." In post-Homeric times the story ran that Proteus was the son of Poseidon and a king of Egypt, to whose court Helen was taken by Hermes after she had been carried off, Paris being accompanied to Troy by a phantom substituted for her. This is the story followed by Herodotus (ii. 112, 118), who got it from Egyptian priests, and by Euripides in the *Helena*. From his power of assuming whatever shape he pleased Proteus came to be regarded, especially by the Orphic mystics, as a symbol of the original matter from which the world was created. Rather he is typical of the ever-changing aspect of the sea (Homer, *Odyssey*, iv. 351; Virgil, *Georgics*, iv. 386).

PROTEUS (*Proteus anguinus*), in zoology, a blind perennibranchiate tailed Batrachian, inhabiting the subterranean waters of the limestone caves to the east of the Adriatic from Carniola to Herzegovina. It was long supposed to be the sole representative of the Batrachians in the cave fauna, but other examples have been added in recent years. It is a small eel-like animal, with minute limbs, the anterior of which are tridactyle, the posterior didactyle, with a strongly compressed tail, a narrow head, with flat truncate snout, minute rudimentary eyes hidden under the skin, which is usually colourless, or rather flesh-coloured, with the short, plume-like external gills blood-red; the jaws and palate are toothed. This extraordinary Batrachian has been found in a great number of different caves, but rather sporadically, and it is believed that its real home is in deeper subterranean waters, whence it is expelled at times of floods. It is often kept in aquariums, where it may turn almost black, and has bred in captivity. *Proteus* forms with *Necturus* (*Menobranchus*) the family Proteidae. The second genus, which is widely distributed in eastern North America, is more generalized in its structure, having better developed limbs, with four digits, and is adapted to live in the light. But the two are closely allied, and *Necturus* gives us a very exact idea of what sort of a type *Proteus* must be derived from.

In 1896 a Proteus-like Batrachian was discovered in Texas during the operation of boring an artesian well 188 ft. deep, when it was shot out with a number of remarkable and unknown Crustaceans. *Typhlomolge rathbuni* (see fig.), as this creature was called, agrees with *Proteus* in the shape of the head, in the absence of functional eyes, in the presence of external gills, and in the unpigmented skin. It differs in the very short body and the long slender limbs with four to five digits. It was first placed in the same family as *Proteus*, but the anatomical investigations of Ellen J. Emerson have led this author to believe that the real affinities are with the larval form of the lungless salamander *Spelerpes*, not with *Necturus* and *Proteus*. Whilst *Proteus* has lungs in addition to the gills, *Typhlomolge* lacks the lungs, and with them the trachea and larnyx. It is therefore probable that *Typhlomolge* is a permanent larva derived from *Spelerpes*, whilst we are quite unable to assign any direct ancestor to *Necturus*.



Typhlomolge rathbuni.

Another blind Urodele has recently been described as *Typhlotriton spelaeus*, from caves in the Mississippi Valley. It has neither gills nor lungs in the adult, and is found under rocks in or out of the water. It is not allied to *Proteus*. The eyes are apparently normal in the larva, but in the adult they have undergone marked degeneration.

See P. Configliachi and M. Rusconi, *Del Proteo anguino* (Pavia, 1819), 4; J. de Bedriaga, *Lurchfauna Europas* (1897), ii. 28; E. Zeller, *Über die Fortpflanzung des Proteus anguinus., Jahresb. ver. Nat. Württemb.* (1889), p. 131; L. Steineger, "New Genus and Species of Blind Cave Salamanders from North America," *P.U.S. Nat. Mus.* (1892), xv. 115; idem, "New Genus and Species of Blind, Tailed Batrachians from the Subterranean Waters of Texas," *op. cit.* (1896), xviii. 619; Ellen J. Emerson, "General Anatomy of *Typhlomolge rathbuni*," *P. Boston Soc. N.H.* (1905), xxxii. 43.

PROTHESIS (Gr. πρόθεσις, a setting forth, from προτιθέναι, to set forward or before), in the liturgy of the Orthodox Eastern Church, the name given to the act of "setting forth" the oblation, *i.e.* the arranging of the bread on the paten, the signing of the cross (σφραγίζειν) on the bread with the sacred spear, the mixing of the chalice, and the veiling of the paten and chalice (see F. E. Brightman, *Liturgies Eastern and Western*, 1896). The term is also used, architecturally, for the place in which this ceremony takes place, a chamber on the north side of the central apse in a Greek church, with a small table. During the reign of Justin II. (565–574) this chamber was located in an apse, and another apse was added on the south side for the diaconicon (*q.v.*), so that from his time the Greek church was triapsal. In the churches in central Syria the ritual was apparently not the same, as both prothesis and diaconica are generally rectangular, and the former, according to De Vogüé, constituted a chamber for the deposit of offerings by the faithful. Consequently it is sometimes placed on the south side, if when so placed it was more accessible to the pilgrims. There is always a much wider doorway to the prothesis than to the diaconicon, and there are cases where a side doorway from the central apse leads direct to the diaconicon, but never to the prothesis.

PROTISTA, a name invented by Ernst Haeckel (*Generelle Morphologie der Organismen*, 1866) to denote a group of organisms supposed to be intermediate between the animal and vegetable kingdoms. As knowledge advanced the precise limits of the group shifted, and Haeckel himself, in successive publications, placed different sets of organisms within it, at one time proposing to include all unicellular animals and plants, making it a third kingdom equivalent to the animal and vegetable kingdoms. Partly because the term represented an interpretation rather than an objective set of facts, the word Protista has not been generally accepted for use in classification, and, whilst recognizing that the limits of the animal and plant kingdoms are not sharply defined, modern systematists refrain from associating these doubtfully placed organisms simply because of the dubiety of their position. (See PROTOZOA.)

PROTOCOL (Fr. *protocole*, Late Lat. *protocollum*, from Gr. πρῶτος, first, and κολλᾶν, to glue, *i.e.* originally the first sheet of a papyrus roll), in diplomacy, the name given to a variety of written instruments. The *protocollum* was under the late Roman Empire a volume of leaves, bound together with glue, in which public acts were recorded, so as to guard against fraud or error on the part of those responsible for preparing them; and in later usage it came to be applied to the original drafts of such acts. Thus, too, the word *prothocollare* was devised for the process of drawing up public acts in authentic form (Du Cange, *Glossarium lat.* s.v. *Protocollum*). The use of the word *protocollum* for the introductory and other formulae in the medieval diploma (see DIPLOMATIC) thus explains itself as implying a recorded usage in such matters.

In the language of modern diplomacy the name of "protocol" is given to the minutes (*procès-verbaux*) of the several sittings of a conference or congress; these, though signed by the plenipotentiaries present, have only the force of verbal engagements (see CONGRESS). The name of "protocols" is also given to certain diplomatic instruments in which, without the form of a treaty or convention being adopted, are recorded the principles or the matters of detail on which an agreement has been reached, *e.g.* making special arrangements for carrying out the objects of previous treaties, defining these objects more clearly, interpreting the exact sense of a doubtful clause in a treaty (*protocoles interpretatifs*) and the like. Thus the famous Troppau protocol, which annunciated the right and duty of the European powers to intervene in the internal affairs of a state threatened with revolution, was from the point of view of its signatories merely a logical application of the principles contained in the treaty of the 20th of November 1815 (see TROPPAU). Occasionally also an agreement between two or more powers takes the form of a protocol, rather than a treaty, when the intention is to proclaim a community of views or aims without binding them to eventual common action in support of those views or aims; thus the settlement of the question of the Danish succession was recognized by the powers in conference at London, by the protocol of 1852 (see SCHLESWIG-HOLSTEIN QUESTION).

Finally, "the protocol" (*protocole diplomatique, protocole de chancellerie*) is the body of ceremonial rules to be observed in all written or personal official intercourse between the heads of different states or their ministers. Thus the protocol lays down in great detail the styles and titles to be given to states, their heads, and their public ministers, and the honours to be paid to them; it also indicates the forms and customary courtesies to be observed in all international acts. "It is," says M. Pradier-Fodéré, "the code of international politeness."

See P. Pradier-Fodéré, *Cours de droit diplomatique* (Paris, 1899), ii. 499.

PROTOGENES, a Greek painter, born in Caunus, on the coast of Caria, but resident in Rhodes during the latter half of the 4th century B.C. He was celebrated for the minute and laborious finish which he bestowed on his pictures, both in drawing and in colour. Apelles, his great rival, standing astonished in presence of one of these works, could only console himself by saying that it was wanting in charm. On one picture, the "Ialysus," he spent seven years; on another, the "Satyr," he worked continuously during the siege of Rhodes by Demetrius Poliorcetes (305–304 B.C.) notwithstanding that the garden in which he painted was in the middle of the enemy's camp. Demetrius, unsolicited, took measures for his safety; more than that, when told that the "Ialysus" just mentioned was in a part of the town exposed to assault, Demetrius changed his plan of operations. Ialysus was a local hero, the founder of the town of the same name in the island of Rhodes, and probably he was represented as a huntsman. This picture was still in Rhodes in the time of Cicero, but was afterwards removed to Rome, where it perished in the burning of the Temple of Peace. The picture painted during the siege of Rhodes consisted of a satyr leaning idly against a pillar on which was a figure of a partridge, so life-like that ordinary spectators saw nothing but it. Enraged on this account, the painter wiped out the partridge. The "Satyr" must have been one of his last works. He would then be about seventy years of age, and had enjoyed for about twenty years a reputation next only to that of Apelles, his friend and benefactor. Both were finished colourists so far as the fresco-painting of their day permitted, and both were laborious in the practice of drawing, doubtless with the view to obtaining bold effects of perspective as well as fineness of outline. It was an illustration of this practice when Apelles, finding in the house of Protogenes a large panel ready prepared for a picture, drew upon it with a brush a very fine line which he said would tell sufficiently who had called. Protogenes on his return home took a brush with a different colour and drew a still finer line along that of Apelles dividing it in two. Apelles called again; and, thus challenged, drew with a third colour another line within that of Protogenes, who then admitted himself surpassed. This panel was seen by Pliny (*N.H.* xxxv. 83) in Rome, where it was much admired, and where it perished by fire. In the gallery of the Propylaea at Athens was to be seen a panel by Protogenes. The subject consisted of two figures representing personifications of the coast of Attica, Paralus and Hammonias. For the council chamber at Athens he painted figures of the Thesmothetae, but in what form or character is not known. Probably these works were executed in Athens, and it may have been then that he met Aristotle, who recommended him to take for subjects the deeds of Alexander the Great. In his "Alexander and Pan" he may have followed that advice in the idealizing spirit to which he was accustomed. To this spirit must be traced also his "Cydippe" and "Tlepolemus," legendary personages of Rhodes. Among his portraits are mentioned those of the mother of Aristotle, Philiscus the tragic poet, and King Antigonus. But Protogenes was also a sculptor to some extent, and made several bronze statues of athletes, armed figures, huntsmen and persons in the act of offering sacrifices.

PROTOGENES (E. Haeckel), a little-known genus of Foraminifera (*q.v.*), marine organisms, forming a naked flat disk with numerous long radiating pseudopodia: nucleus and contractile vacuole not seen, and reproduction unknown.

PROTOMYXA (E. Haeckel), a genus of Foraminifera (*q.v.*), marine organisms, of orange colour, naked and reproducing in a broad-cyst which liberates 1-flagellate zoospores.

PROTOPLASM, the name given in modern biology to a substance composing, wholly or in part, all living cells, tissues or organisms of any kind, and hence regarded as the primary living substance, the physical and material basis of life. The term "protoplasma," from πρῶτος, first, and πλάσμα, formed substance, was coined by the botanist Hugo von Mohl, in 1846, for the "tough, slimy, granular, semi-fluid" constituent of plant cells, which he distinguished from the cell-wall, nucleus and cell-sap. This was not, however, the first recognition of the true living substance as such, since this step had been achieved in 1835 by the French naturalist F. Dujardin, who in his studies on Foraminifera had proposed the term "*sarcode*" for the living material of their bodies in the following words: "Je propose de nommer ainsi ce que d'autres observateurs ont appelé une gelée vivante, cette substance glutineuse, diaphane, insoluble dans l'eau, se contractant en masses globuleuses, s'attachant aux aiguilles de dissection, et se laissant étirer comme du mucus, enfin se trouvant dans tous les animaux inférieurs interposée aux autres éléments de structure." To the French naturalist belongs, therefore, the real credit of the discovery of protoplasm, or rather, to be more accurate, of the first recognition of its true nature as the material basis of vital phenomena. Neither Dujardin nor von Mohl, however, had any conception of the universal occurrence and fundamental similarity of protoplasm in all living things, whether animal or vegetable, and it was not till 1861 that the identity of animal sarcode and vegetable protoplasm was proclaimed by Max Schultze, whose name stands out as the framer, if not the founder, of the modern notions concerning the nature of the living substance. From this time onwards the term "protoplasm" was used for the living substance of all classes of organisms, although it would have been more in accordance with the custom of priority in nomenclature to have made use of Dujardin's term "sarcode."

A living organism, of any kind whatsoever, may be regarded as composed of (1) protoplasm, (2) substances or structures produced by the protoplasm, either by differentiation or modification of the protoplasm itself, or by the excretory or secretory activity of the living substance. The protoplasm of a given organism may be in a single individual mass, or may be aggregated into a number of masses or units, discontinuous but not disconnected, termed *cells* (see CYTOLOGY). Thus living organisms may be distinguished, in a general way, as unicellular or multicellular. An instance of a unicellular organism is well seen in an *Amoeba*, or in one of the Foraminifera, classic examples for the study of undifferentiated protoplasm, which here composes the greater part of the body, while products of the formative activity of the protoplasm are seen in the external shell and in various internal granules and structures. As an example of a multicellular organism we may take the human body, built up of an immense number of living cells which produce, singly or in co-operation, a variety of substances and structures, each contributing to the functions of the body. This, without attempting to enter into details, the horny epidermis covering the body, the hairs, nails, teeth, skeleton, connective tissue, &c., are all of them products formed by the metabolic activity of the living substance and existing in intimate connexion with it, though not themselves to be regarded as living. In addition to metabolic products of this kind, special modifications of the living substance itself are connected with specializations or exaggerations, as it were, of a particular vital function; such are the contractile substance of muscular tissue, and the various mechanisms seen in nervous and sensory tissue. It is necessary, therefore, in a living body of any kind, to distinguish clearly between simple protoplasm, its differentiations and its products.

Protoplasm from whatever source, whether studied in a cell of the human body, in an *Amoeba* or Foraminifer, or in a vegetable organism, is essentially uniform and similar in appearance and properties. Its appearance, graphically described by Dujardin in the passage quoted above, is that of a greyish, viscid, slimy, semi-transparent and semi-fluid substance. Its properties are those of living things generally, and the most salient and obvious manifestation of life is the power of automatic movement exhibited by living protoplasm. When free and not limited by firm envelopes, the movements take the character known generally as amoeboid, well shown in the common *Amoeba* or in the white corpuscles of the blood. When confined by rigid envelopes, as in plant-cells, the protoplasm exhibits streaming movements of various kinds. Even more essentially characteristic of the living matter than the power of movement is the property of metabolism—that is to say, the capacity of assimilating substances different from itself, of building them up into its own substance (anabolism), and of again decomposing these complex molecules into simpler ones (katabolism) with production of energy in the form of heat, movement and electrical phenomena. An important part of the metabolic process is respiration, *i.e.* the absorption of oxygen from the surrounding medium and oxidation of carbon atoms to form carbonic acid gas and other simple chemical compounds; in ordinary plant and animal protoplasm the process of respiration seems to be of universal occurrence, but some Bacteria constitute apparently an exception to the rule. Metabolism results not only in the generation of energy, but also, if anabolism be in excess of katabolism, in increase of bulk, and consequent growth and reproduction.

Living protoplasm is, therefore, considered from a chemical standpoint, in a state of continual flux and instability, and it follows that if protoplasm be a definite chemical substance or mixture of substances (see below), a given sample of protoplasm cannot be pure, or at least cannot remain so for any length of time so long as its power of metabolism is being exerted, but will contain particles either about to be built up by anabolism into its substance, or resulting from katabolic disintegration of its complex molecules. Hence it is convenient to distinguish the living substance from its *metaplastic products* of anabolism and katabolism. Such products are to be recognized invariably in protoplasm and take the form generally of *granules* and *vacuoles*. Granules vary in size from very minute to relatively large, coarse grains of matter, usually of a firm and solid nature. To the presence of innumerable granules is due the greyish, semi-transparent appearance of protoplasm, which in parts free from granules appears hyaline and transparent. Different samples of protoplasm may vary greatly in the number and coarseness of the granulations. Vacuoles are fluid drops of more watery consistence, which, when relatively small, assume a spherical form, as the result of surface tension acting upon a drop of fluid suspended in another fluid. When vacuoles are numerous and large, however, they may assume various forms from mutual pressure, like air-bubbles in a foam. A good example of frothy protoplasm, due to the presence of numerous vacuoles, is seen in the common "sun-animalcule" (*Actinosphaerium*). Or when the cell is confined by an envelope, and becomes very vacuolated, the vacuoles may become confluent to form a cell-sap contained in a protoplasmic lining or "primordial utricle," and traversed by strands of protoplasm, as in the ordinary cells of plant-tissues. In many unicellular organisms, so-called contractile vacuoles are continually being formed as an act of excretion and expelled from the body when they reach a certain size.

While the majority of protoplasmic granules are probably to be regarded as metaplastic in nature, there is one class of granulations of which this is certainly not true, namely the grains of *chromatin*, so named from their peculiar affinity for certain dyes, such as carmine, logwood and various aniline stains. These grains may occur as *chromidia*, scattered through the protoplasm, or they may be concentrated at one or more spots to form a definite *nucleus* or nuclei, which may or may not be limited from the remaining protoplasm by a definite membrane, and may undergo further differentiations of structure which cannot be considered further here (see CYTOLOGY). The protoplasm of an ordinary cell is thus specialized into nucleus and cytoplasm. It was formerly thought that the most primitive forms of life, the Monera of E. Haeckel, consisted of pure protoplasm without a nucleus. It must be borne in mind, however, that chromatin can be present without being concentrated to form a definite nucleus, and that with imperfect technique the chromatin may easily escape observation. It seems justifiable at present to believe, until the contrary has been proved, that all organisms, however primitive, contain chromatin in some form: first, because this substance has always been found when suitable methods for its detection have been employed; secondly, because it has been shown experimentally, by cutting up small organisms, such as *Amoeba*, that enucleated fragments of protoplasm are unable to maintain their continued existence as living bodies; and, thirdly, because modern research has shown the chromatin to be of very great, perhaps fundamental, importance in regulating the vital processes of the cell and so determining the specific characters of the organism, a property which enables the chromatin to act as the vehicle of heredity and to transmit the characters of parent to offspring. In the present state of our knowledge, therefore, the peculiar chromatin-granules must be regarded as an integral part, perhaps even the most essentially and primarily important portion, of the living substance. At the same time it must be borne in mind that the term "chromatin" does not denote a definite chemical substance, to be recognized universally by hard and fast chemical tests. The chromatin of different organisms or cells may behave quite differently in relation to stains or other reactions; and if it be true that it is the chromatin which determines the nature and activities of the cell, it follows that no two cells which differ from one another in any way can have their chromatin exactly similar. The conception of chromatin is one based upon its relations to the vital activities and life cycle, as a whole, of the organism or cell, and not upon any definable material, that is chemical and physical, properties.

The importance of protoplasm, as the physical and material basis of life, has caused it to be the subject in recent years of much minute and laborious research. It seems obvious that matter so peculiarly endowed must possess a complexity of structure and organization far exceeding that which at first sight meets the eye. Some biologists have attacked the problem of the ultimate constitution of protoplasm from a purely theoretical standpoint, and have framed hypotheses of an ultramicroscopic constitution sufficient, in their opinion, to explain, or at least to throw light upon, the vital activities of the living substance. Others, proceeding by more empirical methods, have attempted to lay bare the structure of protoplasm by means of the refinements of modern microscopical technique, or to solve the question of its constitution by means of chemical and physiological investigation. Hence a convenient distinction, not always easy, however, to maintain in practice, is drawn between *speculative* and *empirical* theories of protoplasm.

1. *Speculative theories* have come with the greatest frequency from those who have attempted to find a material explanation for the phenomena of heredity (*q.v.*). As instances may be mentioned more particularly the "gemmules" of Darwin, the "pangenes" of de Vries, the "plastidules" of Haeckel, and the "biophores" of Weismann. These theories have been ably brought together and discussed by Delage, who has included them all under the term "micromerism," since they agree in the assumption that the living substance contains, or consists of, a vast number of excessively minute particles—*i.e.* aggregates or combinations of molecules, which give to the protoplasm its specific properties and tendencies ("idioplasm" of Nägeli). In other cases the assumption of invisible protoplasmic units has been inspired by a desire either to explain the general vital and assimilative powers of protoplasm, as, for example, the "micellae" of Nägeli and the "plasomes" of Wiesner, or to elucidate the mechanism of some one function, such as the "inotagmas" of Engelmann, assumed to be the agents of contractility. In general, it may be said of all these speculations either that they can only be extended to all vital phenomena by the help of so many subordinate hypotheses and assumptions that they become unworkable and unintelligible, or that they only carry the difficulties a step further back, and really explain nothing. Thus it is postulated for Wiesner's hypothetical plasomes that they possess the power of assimilation, growth and reproduction by division; in other words, that they are endowed with just those properties which constitute the unexplained mystery of living matter.

2. *Empirical theories of protoplasm* differ according as their authors seek to find one universal type of structure or constitution common to all conditions or differentiations of the living substance, or, on the contrary, are of opinion that it may vary fundamentally in different places or at different times. From these two points of view protoplasm may be regarded either as *monomorphic* or *polymorphic* (Fischer). The microscopical investigation of protoplasm reveals at the first glance a viscid, slimy or mucilaginous substance, in which is embedded an immense number of granules, for the most part very tiny. Very rarely are these granules absent, and then only from a portion of the protoplasm, and only temporarily. Hence many authorities have regarded the minute granules—the "microsomes" of Hanstein—as themselves the ultimate living units of protoplasm, in opposition to those who would regard them merely as "metaplastic" substances, *i.e.* as the heterogeneous by-products of metabolism and vital activity. The *granular theory*, as this conception of the living substance is called, has received its extreme elaboration at the hands of Altmann, whose standpoint may be taken as typical of this class of theories. After demonstrating the universal occurrence of granules in protoplasm, Altmann has compared each individual granule to a free-living bacterium, and thus regards a cell as a colony of minute organisms, namely the granules or *bioblasts*, as he has termed them, living embedded in a common matrix, like a zoogloea colony of bacteria. Of this theory it may be remarked, firstly, that it brings us no nearer to an explanation of vital phenomena than do the plasomes of Wiesner; secondly, that to consider bacteria as equivalent, not to cells, but to cell granules, is to assume for this class of organisms a position with regard to the cell theory which is, to say the least, doubtful; and, thirdly, that the observations of the vast majority of competent microscopists furnish abundant support for the statement that granules of protoplasm do not lie free in a structureless matrix, but are embedded in the substance of a minute and delicate framework or *morphoplasm*, which in its turn is bathed by a watery fluid or *enchylema* permeating the whole substance. The upholders of the granular theory deny the existence of the framework, or explain it as due to an arrangement of the granules, or as an optical effect produced by the matrix between the granules. Amongst those, on the other hand, who assert the existence of a framework distinct from granules and enchylema, the utmost diversity of opinion prevails with regard to the true structural relations of these three parts and the rôle played by each in the exercise of vital functions. Some have regarded the framework as made up of a tangle of separate fibrillae (*filar theory*)—a view more especially connected with the name of Flemming—but most are agreed that it represents the appearance of a *reticulum* or network with excessively fine meshes, usually from ½ to 1 μ in diameter. The reticulum carries the granules at its nodal points, and is bathed everywhere by the enchylema. Even with so much in common, however, opinions are still greatly at variance. In the first place, the majority of observers interpret the reticulum as the expression of an actual spongy framework, a network of minute fibrillae ramifying in all planes. While, however, Heitzmann, following the speculations of Brücke, considered the framework itself to be actively contractile and the seat of all protoplasmic movement, an opposite point of view is represented by the writings of Leydig, Schäfer and others, who regard the reticulum merely as a kind of supporting framework or *spongioplasm*, in which is lodged the enchylema or *hyaloplasm*, considered to be itself the primary motile and living substance. Bütschli, on the other hand, has pointed out the grave difficulties that attend the interpretation of the reticulum as a fibrillar framework, in view of the distinctly fluid consistence of, at any rate, most samples of protoplasm. For if the substance of the framework be assumed to be of a firm, solid nature, then the protoplasm as a whole could not behave as a fluid, any more than could a sponge soaked in water. On the other hand, the hypothesis of a fluid fibrillar framework leads to a physical impossibility, since one liquid cannot be permanently suspended in another in the form of a network. Bütschli therefore interprets the universally present reticulum as a meshwork of minute lamellae, forming a honeycombed or *alveolar* structure, similar to the arrangement of fluid lamellae in a fine foam or lather, in which the interstices are filled, not with air but with another fluid; in other words, the structure of protoplasm is that of an exceedingly fine emulsion of two liquids not miscible with one another.

It may be claimed for the *alveolar theory* of Bütschli that it throws light upon many known facts relating to protoplasm. It interprets the reticulum as the optical section of a minute foam-like structure, and permits the formation of protoplasmic striations and of apparent fibrillae as the result of linear or radiating dispositions of the alveolar framework; it reconciles with the laws of physics the combination of a framework with a fluid or semi-fluid aggregate condition, while variations in the fluidity of the framework are compatible with a stiffening of the protoplasm almost to the pitch of rigidity, as seen, for example, in nervous tissue; and, finally, it explains many characteristic structural peculiarities of protoplasm, such as the superficial layer of radiately arranged alveoli, the spherical form of vacuoles, the continuous wall or pellicle which limits both the vacuoles and the protoplasm as a whole, and many other points not intelligible on the theory of a sponge-like structure. Bütschli has succeeded, moreover, in producing artificial foams of minute structure, which not only mimic the appearance of protoplasm, but can be made to exhibit streaming and amoeboid movements very similar to those of simple protoplasmic organisms. Incidentally these experiments have shown that many of the apparent granulations and "microsomes" are an optical effect produced by the nodes of the minute framework. In his most recent works Bütschli has extended his theory of alveolar structure to many other substances, and has tried to prove that it is a universal characteristic of colloid bodies, a view strongly combated, however, by Fischer. While it cannot be claimed that Bütschli's theory furnishes in any way a complete explanation of life, leaving untouched, as it does, the fundamental question of assimilation and metabolism, he at least draws attention to a very important class of facts, which, if demonstrated to be of universal occurrence, must be reckoned with in future treatment of the protoplasm question, and would form an indispensable preliminary to all speculations upon the mechanism of the living substance.

In opposition to the above-mentioned monomorphic theories of protoplasm, all of which agree in assuming the existence of some fundamental type of structure in all living substance, attempts have been made at various times to show that the structural appearances seen in protoplasm are in reality artificial products, due to precipitation or coagulation caused by reagents used in the study or preparation of living objects. These views have been developed by Fischer, who by experimenting upon various proteids with histological fixatives, has shown that it is possible to produce in them a granular, reticular or alveolar structure, according to treatment, and, further, that granules so produced may be differentially stained according to their size and absorptive powers. Fischer therefore suggests that many structural appearances seen in protoplasm may be purely artificial, but does not extend this view to all such structures, which would indeed be impossible, in view of the frequency with which reticular or alveolar structures have been observed during life. He suggests, however, that such structures may be temporary results of *vital precipitation* of proteids within the organism, and that protoplasm may have at different times a granular reticular or alveolar structure, or may be homogeneous. Fischer's conception of living protoplasm is therefore that of a polymorphic substance, and a similar view is held at the present time by Flemming, Wilson and others. Strassburger also regards protoplasm as composed of two portions: a motile *kinoplasm* which is fibrillar, and a nutritive *trophoplasm* which is alveolar, in structure.

The chemical investigation of protoplasm labours at the outset under the disadvantage that it cannot deal with the living substance as a whole, since no analysis can be performed upon it without destroying the life. Protoplasm consists, to the extent of about 60% of its total mass, of a mixture of various *nucleo-proteids*—that is to say, of those substances which, in molecular structure and chemical composition, are the most complex bodies known. In association with them are always found varying amounts of fats, carbohydrates, and other bodies, and such compounds are always present in the living substance to a greater or less degree as products of both upward and downward metabolism. Protoplasm also contains a large but variable percentage of water, the amount of which present in any given case affects largely its fluid or viscid aggregate condition. Especial interest attaches to the remarkable class of bodies known as ferments or *enzymes*, which when prepared and isolated from the living body are capable of effecting in other substances chemical changes of a kind regarded as specifically vital. It is from their study, and from that of the complex proteids found in the living body, that the greatest advances towards an explanation of the properties of living matter may be expected at the present time.

The question may be raised how far it is probable that there is one universal living substance which could conceivably be isolated or prepared in a pure state, and which would then exhibit the phenomena characteristic of vital activity. It is sufficiently obvious, in the first place, that protoplasm, as we know it, exhibits infinite diversity of character, and that no two samples of protoplasm are absolutely similar in all respects. Chemical differences must be assumed to exist not only between the vital fabrics of allied species of organisms, but even between those of individuals of the same species. Kassowitz regards this variability as compatible with the assumption of a gigantic protoplasmic molecule in which endless variations arise by changes in the combinations of a vast number of atoms and atom complexes. It is difficult to conceive, however, of any single substance, however complex in its chemical constitution, which could perform all the functions of life. To postulate a universal living substance is to proceed along a path which leads inevitably to the assumption of biophores, plastidules or other similar units, since the ultimate living particles must then be imagined as endowed at the outset with many, if not all, of the fundamental properties and characteristic actions of living bodies. Such a conception has as its logical result a vitalistic standpoint, which may or may not embody the correct mental attitude with regard to the study of life, but which at any rate tends to check any further advance towards an explanation or analysis of elementary vital phenomena. We may rather, with Kölliker, Verworn and others, ascribe the activities of protoplasm to the mutual interaction of many substances, no single one of which can be considered as living in itself, but only in so far as it forms an indispensable constituent of a living body. From this point of view life is to be regarded, not as the property of a single definite substance, but as the expression of the ever-changing relations existing between the many substances which make up the complex and variable congeries known to us as protoplasm.

AUTHORITIES.—For exhaustive historical summaries of the protoplasm question, with full bibliographical references, the reader may be referred to the following works, especially the first five: Bütschli, *Investigations on Microscopic Foams and Protoplasm* (London, 1894); *Untersuchungen über Strukturen* (Leipzig, 1898); "Meine Ansicht über die Struktur des Protoplasmas und einige ihrer Kritiker," *Arch. f. Entwickelungsmechanik d. Org.* (1901); xi. 499–584, pl. xx.; Delage, *La Structure du protoplasme et les théories sur l hérédité* (Paris, 1895); Wilson, *The Cell* (2nd ed., London, 1900); Fischer, *Fixirung, Färbung, und Bau des Protoplasmas* (Leipzig, 1899); Kassowitz, *Allgemeine Biologie* (Vienna, 1899); G. Mann, *Protoplasm, its Definition, Chemistry and Structure* (Oxford, 1906), p. 59.

(E. A. M.)

PROTOZOA (Gr. πρῶτος, first, and ζῷον, living thing), the name given by modern zoologists to the animalcules, for the most part microscopic, which were termed by the older naturalists Infusoria, from the manner in which they appear in infusions containing decaying animal and vegetable matter. The name Infusoria is now, however, restricted to one of the four classes which comprise the Protozoa proper. The name Protozoa was coined as far back as 1820 as an equivalent for the German word *Urthiere*, meaning animals of primitive or archaic nature, the forms of animal life which may be supposed to have been the first that appeared upon our globe. The great naturalist C. T. von Siebold was, however, the first to give a scientific definition to the group. Von Siebold pointed out that in the Protozoa the individual was always a single vital unit or *cell*, in contrast with the higher division of the animal kingdom, the Metazoa, in which the body is generally, though not universally, regarded as composed of many such units. To put the matter briefly and somewhat technically: the Protozoa are unicellular animals, the Metazoa multicellular animals; in the Protozoa the cell is complete in itself, both morphologically and physiologically, and is capable of maintaining a separate and independent existence in suitable surroundings, like any other organism; in the Metazoa the cells are differentiated for the performance of distinct functions and combined together to form the various tissues of which the body is built up, and the individual cells of the Metazoan body are not capable of maintaining a separate existence apart from their fellows. This is the sense in which the term Protozoa is used by zoologists, whereby certain forms of animal life, which were formerly ranked as Protozoa, such as sponges and rotifers, are now definitely excluded from the group and classed as Metazoa.

The animal kingdom may be divided, therefore, into two sub-kingdoms, the Protozoa and the Metazoa, the first-named characterized by their essentially unicellular nature. This is a criterion by which it is easy to define the Protozoa from a purely zoological standpoint, but which becomes less satisfactory when we take into consideration the whole range of microscopic unicellular organisms. Besides the true Protozoa, which, *ex hypothesi*, are organisms of animal nature, there are many other organisms of equally simple organization, including the Bacteria and the unicellular plants. The Bacteria stand sharply apart from the other forms of life, not only, in many cases, by their divergent methods of metabolism, but by morphological characteristics, such as the definite body-form limited by a distinct envelope, the absence of organs for locomotion other than the peculiar flagella, and, above all, by the lack of any differentiation of the body-protoplasm into nucleus and cytoplasm, as in all true cells of either animal or vegetable nature. On the other hand, to separate by hard-and-fast definitions the unicellular plants from the unicellular animals is not only difficult but practically impossible. The essential difference between plant and animal is a physiological one, a difference in the method of nutrition. A typical green plant is able to live independently of other organisms and to build up its substance from simple gases in the air and inorganic salts in the soil or water, provided that certain conditions of light and moisture be present in its environment; this is the so-called holophytic method of nutrition. A typical animal, on the other hand, while practically independent of sunlight, is not able to exist apart from other living organisms, since it is not able to build up its substance from simple chemical constituents like a plant, but must be supplied with ready-made proteids in its food, for which it requires other organisms, either plants or animals; this is the so-called holozoic method of nutrition. Intermediate between these two habits of life is the so-called saprophytic habit, exemplified by the fungi amongst plants; in this method of nutrition the organism cannot build up its substance entirely from inorganic substances, but absorbs the organic substances present in solutions containing organic salts or decaying animal or vegetable matter.

If we regard the organisms termed collectively Protozoa from the point of view of their methods of nutrition (considering for the present only free-living, non-parasitic forms), we find in one class, the Flagellata, examples of the three methods mentioned above, the holozoic, holophytic and saprophytic habit of life, not only in species closely allied to each other, but even combined in one and the same species at different periods of its life or in different surroundings. An individual of a given species may contain chlorophyll, with which it decomposes carbonic acid gas in the sunlight, like a plant, while possessing a definite mouth-aperture, by means of which it can ingest solid food, like an animal. Such instances show clearly that in the simplest forms of life the difference between plant and animal is but a difference of habit and of mode of nutrition, to which the organism is not at first irrevocably committed, and which are not at first accompanied by distinctive morphological characteristics. Only when the organism becomes specialized for one or the other mode of life exclusively does it acquire such definite morphological characters that the difference between plant and animal can be used for the purpose of a natural classification, as in the higher forms of life. In the lowest forms it is not possible to base natural subdivisions on their vegetable or animal nature. For this reason it has been proposed by E. Haeckel to unite all the primitive forms of life in which the body is morphologically equivalent to a single cell into one group, the Protista, irrespective of their animal or vegetable nature. In this method of dealing with the problem the Protista are regarded as a distinct kingdom (*Reich*), more or less intermediate between, but distinct from, the animal and vegetable kingdoms, and representing the ancestral stock from which both animals and plants have sprung. Many authorities have followed Haeckel's lead in the matter, and the science of Protistology or *Protistenkunde* has already a special journal devoted to the publication of researches upon it. But though it may be more scientific, from a theoretical point of view, to group all these primitive organisms together in the way suggested by Haeckel, in practice it is inconvenient, on account of the vast number of forms of life to be comprised as Protista, their diversity in habit of life and organization, ~~and~~, above all, the difference in the technical methods required for their study, which becomes too complicated for a single worker. Hence Protistology becomes split up in practice by its own mass into three sciences: the Bacteria are the objects of the science of bacteriology; botanists deal with the unicellular plants; and the zoologists with those Protista which are more distinctly animal in their characters.

Hence the Protozoa are to be regarded as a convenient rather than a natural group, and may be characterized generally as follows: Organisms in which the individual is a single cell, that is to say, consists of a single undivided mass of protoplasm which is capable of independent existence in a suitable environment; if many such individuals be combined together to form a colony, as frequently occurs, there is no differentiation of the individuals except for reproductive purposes, and never for tissue-formation as in the Metazoa. The body always contains chromatin or nuclear substance, which may be disposed in various ways, but usually forms one or more concentrated masses termed nuclei, which can be distinguished sharply from the general body-protoplasm or cytoplasm. The protoplasmic body may be naked at the surface, or may be limited and enclosed by a distinct envelope or cell-membrane, which is not usually of the nature of cellulose, except in holophytic forms. Organs serving for locomotion and for the capture and assimilation of solid food are usually present, but may be wanting altogether when the mode of nutrition is other than holozoic; chlorophyll, on the other hand, is only found as a constituent of the body-substance in the holophytic Flagellata.[1] To these characters it may be added that reproduction is effected by some form of fission, or division of the body into smaller portions, and that in the vast majority of Protozoa, if not in all, a process of conjugation or *syngamy* occurs at some period in the life-cycle, the essential feature of the process being fusion of nuclear matter from distinct individuals. The foregoing definition does not distinguish the Protozoa sharply from the primitive forms of plant-life, with which, as stated above, they are connected by many transitions; but the differentiation of the body-substance into nucleus and cytoplasm separates them at once from the Bacteria, in which the chromatin is distributed evenly through the body-protoplasm.

Protozoa and Disease.—The study of the Protozoa has acquired great practical importance from the fact that many of them live as parasites of other animals, and as such may be the cause of dangerous diseases and epidemics in the higher forms of animal life and in man (see PARASITIC DISEASES). Examples of parasitic forms are to be found in all the four classes into which, as will be stated below, the Protozoa are divided, and one class, the Sporozoa, is composed entirely of endoparasitic forms. Hence Protozoology, as it is termed, is rapidly assuming an importance in medical and veterinary science almost equal to that of bacteriology, although the recognition of Protozoa as agents in the production of disease is hardly older than a decade. The most striking instances of Protozoa well established as pathogenic agents are the malarial parasites, the species of *Piroplasma* causing haemoglobinuria of cattle and other animals, the trypanosomes causing tsetse-fly disease, surra, sleeping sickness, and other maladies, the species of *Leishmania* causing kala azar and oriental sore, and the *Amoeba* responsible for the so-called amoebic dysentery. Other diseases referred, but as yet doubtfully, to the agency of Protozoa are syphilis, small-pox, hydrophobia, yellow fever, and even cancer.

It is only possible here to discuss briefly in a general way the relations of these parasites to their hosts. When two organisms stand habitually in the relation of host and parasite, an equilibrium tends to become established gradually between them, so that a condition is brought about in which, after many generations, the host becomes "tolerant" of the parasite, and the parasite is not lethal to the host, though perhaps capable of setting up considerable disturbance in its vital functions. Many animals are found to contain almost constantly certain internal parasites without being, apparently, in the least affected by them; and it should be borne in mind that in most cases it is not to the interest of the parasite to destroy the host or to overtax its resources. But when the parasite is transferred naturally or artificially to a species or race of host which does not ordinarily harbour it, and which therefore has not acquired powers of resisting its attacks, the parasites may be most deadly in their effects. Thus the white traveller in the tropics is exposed to far greater dangers from the indigenous disease-producing organisms than are the natives of those climes.

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[1] Many Protozoa contain symbiotic green organisms, so-called zoochlorellae or zooxanthellae, in their body-protoplasm; for instance, Radiolaria, and Ciliata such as *Paramecium bursaria*, &c. This condition must be carefully distinguished from chlorophyll occurring as a cell-constituent.

In some cases two organisms have become mutually adapted to each other as host and parasite to such an extent that the parasite is not capable of flourishing in any other host. An instance of this is *Trypanosoma lewisi* of the rat, which cannot live in any other species of animal but a rat, and which is not as a rule lethal to a rat, at least not to one otherwise healthy. Contrasting in an instructive manner with this species is *Trypanosoma brucii*, which occurs as a natural parasite of buffaloes and other big game in Africa, and is, apparently, harmless to them, but which is capable of being transferred to other animals by inoculation. The transference may take place naturally, by the bite of a tsetse-fly, or may be effected artificially; in either case *T. brucii* is extremely lethal to certain animals, such as imported cattle, horses and dogs, or to rats and guinea-pigs. Other animals, however, may be quite "repellent"[1] to this parasite, that is to say, if it be inoculated into their blood it dies out without producing ill effects, just as *T. lewisi* does when injected into an animal other than a rat. Thus it is seen that *T. brucii*, when introduced into the blood of an animal which is specifically or racially distinct from its natural hosts in the region where it is indigenous, is either unable to maintain itself in its new host, or flourishes in it to such an extent as to be the cause of its death.

We may assume, therefore, at least as a working hypothesis, that a lethal parasite is one that is new to its host, and that a harmless parasite is one long established. Since all parasites must have been new to their proper hosts at some period, recent or remote, in the history of the species, it would follow that the first commencement of parasitism would be in almost all cases a life and death struggle, as it were, between the two organisms concerned, and it is quite conceivable that the host might succumb in the struggle and so be exterminated. Ray Lankester has suggested that the extinction of many species of animals in the past may have been due, in some cases, to their having been attacked by a species of parasite to which they did not succeed in becoming adapted, and by which they became, in consequence, exterminated entirely.

Organization of the Protozoa.—The body-form may be constant or inconstant in the Protozoa, according as the body-substance is or is not limited at the surface by a firm envelope or cuticle. When the surface of the protoplasm is naked, as in the common amoeba and allied organisms, the movements of the animal bring about continual changes of form. The protoplasm flows out at any point into processes termed *pseudopodia*, which are being continually retracted and formed anew. Such movements are known as amoeboid, and may be seen in the cells of Metazoa as well as in Protozoa. The pseudopodia serve both for locomotion and for the capture of food. If equally developed on all sides of the body, the animal as a whole remains stationary, but if formed more on one side than the other, the mass of the body shifts its position in that direction, but the movement of translation is generally slow. If the animal remains perfectly quiescent and inactive, the laws of surface-tension acting upon the semi-fluid protoplasmic body cause it to assume a simple spherical form, which is also the type of body-form generally characteristic of Protozoa of floating habit (Radiolaria, Heliozoa, &c.).

In the majority of Protozoa, however, the protoplasm is limited at the surface by a firm membrane or cuticle, and in consequence the body has a definite form, which varies greatly in different species, according to the habit of life. As a general rule those forms that are fixed and sedentary in habit tend towards a radially symmetrical structure; those that are free-swimming approach to an ovoid form, with the longest axis of the body placed in the direction of movement; and those that creep upon a firm substratum have the lower side of the body flattened, so that dorsal and ventral surfaces can be distinguished; it is very rare, however, to find a bilaterally symmetrical type of body-structure amongst these organisms. In some cases the cuticle may be too thin to check completely the changes of form due to the movements of the underlying protoplasm; instances of this are seen amongst the so-called "metabolic" Flagellata, in which the body exhibits continually changes of form, termed by Lankester "euglenoid" movements, due to the activity of the superficial contractile layer of the body manifesting itself in ring-like contractions passing down the body in a manner similar to the peristaltic movements of the intestine.

The body-substance of the Protozoa is protoplasm, or, as it was originally termed by Dujardin, sarcode, which is finely alveolar in structure, the diameter of the alveoli varying generally between $\frac{1}{2}$ and $1\ \mu$. At the surface of the body the alveoli may take on a definite honeycomb-like arrangement, forming a special "alveolar layer" which in optical section appears radially striated. Besides the minute protoplasmic alveoli, the protoplasm often shows a coarse vacuolation throughout the whole or a part of its substance, giving the body a frothy structure. When such vacuoles are present they must be carefully distinguished from the contractile vacuoles and food-vacuoles described below; from the former they differ by their non-contractile nature, and from the latter by not containing food-substances.

In many Protozoa and especially in those forms in which there is no cuticle, the body may be supported by a skeleton. The material of the skeleton differs greatly in different cases, and may be wholly of an organic nature, or may be impregnated with, or almost entirely composed of, inorganic mineral salts, in which case the skeletal substance is usually either silica or carbonate of lime. From the morphological point of view the skeletons of Protozoa may be divided into two principal classes, according as they are formed internal to, or external to, the body in each case. Instances of internal skeletons are best seen in the spherical floating forms comprised in the orders Radiolaria and Heliozoa; such skeletons usually take the form of spicules, radiating from the centre to the circumference, and often further strengthened by the formation of tangential bars, producing by their union a lattice-work, which in species of relatively large size may be formed periodically at the surface as the animal grows so that the entire skeleton takes the form of concentric hollow spheres held together by radiating beams. The architectural types of these skeletons show, however, an almost infinite diversity, and cannot be summarized briefly. External skeletons have usually the form of a shell or house, into which the body can be retracted for protection, and from which the protoplasm can issue forth during the animal's phases of activity. Shells of this kind, which must be carefully distinguished from cuticles or other membranes that invest the body closely, are well seen in the order Foraminifera; in the simplest cases they are monaxon in architecture, that is to say, with one principal axis round which the shell is radially symmetrical, and at one pole is a large aperture through which the protoplasm can creep out. In addition to the principal aperture, the shell may or may not be pierced all over by numerous fine pores, through which also the protoplasm can pass out. For further details concerning these shells and their very numerous varieties of structure the reader is referred to the article FORAMINIFERA.

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[1] The use of the terms "tolerant" and "repellent" is taken from the excellent article on "Sleeping Sickness," by E. Ray Lankester, in the *Quarterly Review* (July 1904), No. 399, pp. 113–138.

The protoplasmic body of the Protozoa is frequently differentiated into two zones or regions: a more external, termed the ectoplasm or ectosarc, and a more internal, termed the endoplasm or endosarc. The ectosarc is distinguished by being more clear and hyaline in appearance, and more tough and viscid in consistence; the endoplasm, on the other hand, is more granular and opaque, and of a more fluid nature. The ectoplasm is the protective layer of the body, and is also the portion most concerned in movement, in excretion, and perhaps also in sensation and in functions similar to those performed by the nervous systems of higher animals. The endoplasm, on the other hand, is the chief seat of digestive and reproductive functions.

As the protective layer of the body, the ectoplasm forms the envelopes or membranes which invest the surface of the body, and which are differentiations of the outermost layer of the ectoplasm. Thus in most Flagellata the ectoplasm is represented only by the more or less firm outer covering or *periplast*. Even when such envelopes are absent, however, the ectoplasm can still be seen to exert a protective function; as, for instance, in those Myxosporidia which are parasitic in the gall-bladders or urinary bladders of their hosts, and which can resist the action of the juices in which they live so long as the ectoplasm is intact, but succumb to the action of the medium if the ectoplasm be injured. In many Infusoria the ectoplasm contains special organs of offence termed trichocysts, each a minute ovoid body from which, on stimulation, a thread is shot out, in a manner similar to the nematocysts of Coelenterata. Similar organs are seen also in the spores of Myxosporidia, as the so-called polar capsules; but in this case the organs are not specially ectoplasmic, and appear to serve for adhesion and attachment, rather than for offence.

The connexion of the ectoplasm with movement is seen in the simplest forms, such as *Amoeba*, by the fact that all pseudopodia arise from it in the first instance. In forms with a definite cuticle, on the other hand, the ectoplasm usually contains contractile fibres or myonemes, forming, as it were, the muscular system of the organism. The dependence of the motility of the animal upon the development of the ectoplasm is well seen in Gregarines, in which other organs of locomotion are absent; in forms endowed with active powers of locomotion a distinct ectoplasmic layer is present below the cuticle; in those Gregarines incapable of active movement, on the other hand, the ectoplasm is absent or scarcely recognizable.

From the ectoplasm arise the special organs of locomotion, which, when present, take the form of pseudopodia, flagella or cilia. Pseudopodia, as already explained, are temporary protoplasmic organs which can be extruded or retracted at any point; they fall naturally into two principal types, between which, however, transitions are to be found: first, slender, filamentous or *filose* pseudopodia, composed of ectoplasm alone, which may remain separate from one another, or may anastomose to form networks, and are then termed *reticulose*; secondly, thick, blunt, so-called *lobose* pseudopodia, which are composed of ectoplasm with a core of endoplasm, and never form networks. In forms showing active locomotor powers the pseudopodia are usually more lobose in type; filose pseudopodia, on the other hand, are more adapted for the function of capturing food.

Flagella are long, slender, vibratile filaments, generally few in number when present, and usually placed at the pole of the body which is anterior in progression. Each flagellum performs peculiar lashing movements which cause the body, if free, to be dragged along after the flagellum in jerks or leaps; if, however, the body be fixed, the action of the flagellum or flagella causes a current towards it, by which means the animal obtains its food-supply. A flagellum which is anterior in movement has been distinguished by Lankester by the convenient term *tractellum*; sometimes, however, the flagellum is posterior in movement and acts as a propeller, like the tail of a fish; for this type Lankester has proposed the term *pulsellum*. The flagellum appears to arise in all cases from a distinct basal granule, and in some cases, as in the genus *Trypanosoma*, there is a portion of the nuclear apparatus set apart as a distinct kinetic nucleus, with the function, apparently, of governing the activities of the flagellum.

Cilia are minute, hair-like extensions of the ectoplasm, which pierce the cuticle and form typically a furry covering to the body. Though perhaps primitively derived from flagella, cilia, in their usual form, are distinguished from flagella by being of smaller size, by being present, as a rule, in much greater numbers, and above all by the character of their movements. In the place of the complicated lashing movements of the flagella, each cilium performs a simple stroke in one direction, becoming first bowed on one side, by an act of contraction, and then straightened out again when relaxed. The movements of the cilia are coordinated and they act in concert, though not absolutely in unison, each one contracting just before or after its neighbour, so that waves of movement pass over a ciliated surface in a given direction, similar to what may be seen in a cornfield when the wind is blowing over it. Primitively coating the whole surface of the body evenly, the cilia may become modified and specialized in various ways, which cannot be described in detail here (see INFUSORIA).

Besides the organs of locomotion already mentioned, there may be present so-called undulating membranes, in the form of thin sheets of ectoplasm which are capable of performing sinuous, undulating movements by their inherent contractility. In some cases distinct contractile threads or myonemes have been described in these membranes. Undulating membranes appear to be formed either by the fusion together of a row of cilia, side by side, or by the attachment of a flagellum to the body by means of an ectoplasmic web, in which case the flagellum forms the free edge of the membrane, as in the genus *Trypanosoma*.

Returning to the ectoplasm, the excretory function exerted by this layer is seen by the formation in it of the peculiar contractile vacuoles found in most free-living Protozoa. A contractile vacuole is a spherical drop of watery fluid which makes its appearance periodically at some particular spot near the surface of the animal's body, or, if more than one such vacuole is present, at several definite and constant places. Each vacuole grows to a certain size, and when it has reached the limit of its growth it discharges its contents to the exterior by a sudden and rapid contraction. There is, apparently, in most if not in all cases, a definite pore through which the contractile vacuole empties itself to the exterior. On account of the relatively large size which the contractile vacuole attains it bulges inwards beyond the limits of the ectoplasm and comes to lie chiefly in the endoplasm, to which it is sometimes, but erroneously, ascribed. In the most highly differentiated Protozoa, for instance, the Ciliata, the ectoplasm contains an apparatus of excretory channels, situated in its deeper layers, and forming as it were a drainage-system, from which the contractile vacuoles are fed. The fluid discharged by the contractile vacuoles appears to be chiefly water which has been absorbed at the surface of the protoplasmic body, and which has filtered through the protoplasm, taking up the soluble waste nitrogenous products of the metabolism and the gaseous products of respiration; hence the contractile vacuoles may be compared in a general way to the urinary and respiratory organs of the Metazoa.

One of the first consequences of the parasitic habit of life is the disappearance of the contractile vacuoles, which are hardly ever found in truly parasitic Protozoa, that is to say, in forms which live in the interior of other animals and nourish themselves at their expense. They are also very frequently absent in marine forms.

Mechanisms of a nervous nature are very seldom found in Protozoa, but in some Ciliata special tactile bristles are found, and it is possible that flagella, and perhaps even pseudopodia, may be sometimes tactile rather than locomotor in function. Pigment-spots, apparently sensitive to light, may also occur in some Flagellata.

The endoplasm, as already stated, is the chief seat of nutritive and reproductive processes. In many Flagellata the ectoplasm is represented only by the thin envelope or periplast, so that the whole body is practically endoplasm. When the two layers are well differentiated the endoplasm is more fluid and coarsely granular, and contains various organs, chief amongst them in importance being the nucleus, which must be considered specially and may be put aside for the present.

In considering the functions of ingestion and assimilation of food a distinction must be drawn between those Protozoa which absorb solid food-particles, that is to say, which are holozoic in habit, and those which, being holophytic, saprophytic or parasitic in habit, absorb their nourishment in a state of solution. Only in holozoic forms is a special apparatus found for ingestion or digestion of food; in all other forms nutriment is absorbed by osmosis through the body-wall, presumably at any point of the surface. In holozoic forms we must distinguish further those in which the protoplasm is naked at the surface from those in which the body is clothed by a firm cuticle or cell-membrane. In naked forms food-particles are taken in at any point of the body-surface, either by means of the pseudopodia, or by the action of flagella causing them to impinge upon the surface of the body. In either case the food is absorbed by the protoplasm simply flowing round it and engulfing it, and the food passes into the interior of the body in a tiny droplet of water forming what is termed a food-vacuole. Into the food-vacuole the surrounding protoplasm secretes digestive enzymes, so that each such vacuole represents a minute digestive cavity, in which the food is slowly digested, rendered soluble, and absorbed by the surrounding protoplasm. The insoluble residue of the food is finally rejected by expelling the food-vacuole and its contents from the surface of the body at any convenient point.

The simple process of food-absorption described above for the more primitive naked forms is necessarily modified in detail, though not in principle, in corticate Protozoa, that is to say, in forms provided with a cuticle. In the first place, it becomes necessary to have a special aperture for the ingestion of food, a cell-mouth or *cytostome*. Primitively the cytostome is a simple pore or interruption of the cuticle, but in forms more highly evolved the aperture is prolonged inwards in the form of a tube lined by ectosarc and cuticle, forming a gullet or oesophagus which ends in the endoplasm. Food-particles are forced by the action of cilia or flagella down the oesophagus and collect at the bottom of it in a droplet of water which, after reaching a certain size, passes into the endoplasm as a food-vacuole in which the food is digested. For rejection of the insoluble residue of the food-vacuoles, a special pore or cell-anus (*cytopyge*) may be present. In the Ciliata there is often a distinct anal tube visible at all times, but as a rule the anus is only visible at the moment that faecal matter is being ejected from it, though fine sections show that the pore is a constant one. In the higher Flagellata, on the other hand, the oesophageal ingrowth forms commonly a sort of cloacal cavity, into which the contractile vacuole or vacuoles discharge themselves, and into which also the food-vacuoles evacuate their residues.

Besides the food-vacuoles already described, and the nuclear apparatus presently to be dealt with, the endoplasm may contain various metaplastic products, that is to say, bodies to be regarded as stages in the upward or downward metabolism of the protoplasmic substance. Such substances may take the form of coarse granules of various kinds, crystals, vacuoles or droplets of fatty or oily nature, pigment-grains, and other bodies. In the holophytic Flagellata the endoplasm contains also various organs proper to the vegetable cell, such as chlorophyll-bodies (chromatophores), pyrenoids, grains of a starchy nature (paramylum), and so forth, which need not be described here in detail.

The nucleus in Protozoa is usually a compact, fairly conspicuous structure, composed of chromatin combined in various ways with an achromatic substance or substances. Sometimes the chromatin is distributed in smaller masses through the nucleus, producing a granular type of nucleus; more often the chromatin is more or less concentrated in a central mass forming a so-called karyosome, consisting of an achromatic plastinoid substance impregnated with chromatin. If the karyosome is large and there is very little chromatin between it and the nuclear membrane, the nucleus is of the type termed vesicular. A nuclear membrane is not, however, always present, and true nucleoli, of the type found in the nuclei of metazoan cells, are not found in Protozoa.

A given individual may have more than one nucleus, and the number present may amount to many thousands, as in the plasmodia of Mycetozoa. In such cases the nuclei may be all of one kind, that is to say, not markedly different in size, structure or function, so far as can be seen; or there may be a pronounced morphological differentiation of the nuclei correlated with a difference of function. Thus in the class Infusoria two nuclei are found in each individual; a macronucleus which is somatic in function, that is to say, which regulates the metabolism and vital processes of the body generally, and the micronucleus, which is generative in function, that is to say, which remains in reserve during the ordinary, "vegetative" life of the organism and becomes active during the act of syngamy, after which the effete macronucleus is absorbed or cast out and a new somatic nucleus is formed from portions of the micronuclei which have undergone fusion in the sexual act. Thus the micronucleus of the Infusoria can be compared in a general way with the germ-plasm of the Metazoa, like which it remains inactive until the sexual union. On the other hand, in some Flagellata a differentiation of the nucleus of quite a different type is seen, a smaller, kinetic nucleus being separated off from the larger, trophic or principal nucleus. The kinetic nucleus has the function, apparently, of controlling the locomotor apparatus, so that the specialization of these two nuclei is of a kind quite different from that seen in the Infusoria.

Besides the nuclear substance which is concentrated to form the principal nucleus or nuclei, there may be present also extranuclear granules of chromatin, so-called chromidia, scattered throughout the whole or some part of the protoplasmic body. Chromidia may be normally present in addition to the principal nucleus, or may be formed from the principal nucleus during certain phases of the life-cycle. In some cases the entire nucleus may become resolved temporarily into chromidia, from which a new nucleus may be formed again later by condensation and concentration of the scattered granules. When the chromidia are numerous and closely packed they may form a so-called chromidial network (*Chromidial-Netz*). Recent observations on the reproduction of some Sarcodina have shown that the chromidia may possess great importance in the life-cycle as representing generative chromatin which, like the micronucleus of the Infusoria mentioned above, remains in reserve until, by the process of syngamy, the nuclear apparatus is renewed; while the principal nuclei represent, like the macronuclei, somatic or vegetative chromatin which becomes effete and is cast off or absorbed when syngamy takes place. These questions will be discussed further below.

It was formerly supposed that the lowest Protozoa were entirely without a nucleus, and on this supposition E. Haeckel attempted to establish a class named by him Monera, defined as Protozoa consisting of protoplasm alone, in which a nucleus was not differentiated. To this class were referred various organisms whose alleged archaic nature was expressed by such names as *Protogenes primordialis*, organisms which, like so many other of the primitive forms of animal life described by Haeckel, have been seen by that naturalist alone up to the present. In all Protozoa that have been examined by modern methods a nucleus in some form has been demonstrated to exist, and it must be supposed, until proof to the contrary be forthcoming, that in the case of the so-called Monera either the nucleus was overlooked owing to defective technique, or it had been temporarily resolved into chromidia.

The nuclear apparatus may be supplemented by other bodies of which the nature is not always clear. Such is the so-called "Nebenkern" of *Paramoeba eilhardi*, apparently of the nature of a centrosome. Sometimes the karyosome acts like a centrosome during the division of the nucleus, and sometimes true centrosomes are present. Flagella also commonly arise from basal granules of a centrosomic nature, blepharoplasts in the correct sense of the term;[1] these blepharoplasts are always in connexion with the nucleus, or with the kinetic nucleus if there is one distinct from the trophic nucleus, as in the genus *Trypanosoma* and allied forms.

Reproduction of the Protozoa.—The mode of reproduction in these organisms is the same as that of the cell generally, and takes always the form of fission of some kind; that is to say, of division of the body into smaller portions, each of which represents a young individual. The division of the body is preceded by that of the nucleus, if single, or of each nucleus in the cases where there are two different nuclei; if, however, more than one nucleus of the same kind be present, the nuclei may be simply shared amongst the daughter-individuals, this mode of division being known as plasmotomy. Other organs of the body may either, like the nucleus, undergo fission, or may be formed afresh in the daughter-individuals.

The division of the nucleus in Protozoa may take place by the direct method or by means of mitosis. Direct division, without mitosis, is of very common occurrence; the division may be simple or multiple, that is to say, into only two parts, or into a number of fragments formed simultaneously. An extreme case of multiple fission is seen in the formation of the microgametes of *Coccidium schubergi*, where the nucleus breaks up into a great number of chromidia, which become concentrated in patches to form the several daughter-nuclei. In some cases, on the other hand, multiple daughter-nuclei are formed by rapidly repeated simple division of the parent nucleus. The mode of division may be different in different nuclei of the same individual; thus in the Infusoria the macronucleus divides by direct division, the micronucleus by mitosis.

The mitosis of the Protozoa is far from being of the uniform stereotyped pattern seen in the Metazoa, but, as might have been expected, often shows a much simpler and more primitive condition. Centrosomes are often absent, and their place may be taken, as stated above, by other bodies. The nuclear membrane may be retained throughout the mitosis. Definite chromosomes can, as a rule, be made out, but the chromosomes are often very numerous and minute, without definite form, and divide irregularly. Much remains to be done in studying the mitosis of the Protozoa, but it is probable that wider knowledge will show many conditions intermediate between direct division and perfect mitosis.

The simplest method of fission in Protozoa is that termed binary, where the body divides into two halves, which may be equal and similar, so that the result is two sister-individuals impossible to distinguish as parent and offspring. In many cases of binary fission, however, the resulting daughter-individuals may be markedly unequal in size, so that one may be distinguished as the parent, the other as the offspring. If the daughter-individual be relatively very small, and formed in a more or less imperfect condition at first, the process is termed gemmation or budding. The buds formed in this way may be either external, formed on the surface of the body, or internal, that is, formed in special internal cavities, from which the offspring are later set free, as in many Acinetaria. Gemmation may be correlated with multiple nuclear fission in such a way that buds are formed over the whole body surface of the organism, which thereby undergoes a process of simultaneous multiple fission into numerous daughter-individuals. Rapid multiple fission of this kind is termed sporulation, and is a form of reproduction which is of common occurrence, especially in parasitic forms. Usually the central portion of the parent body remains over as a residual body (*Restkörper*), but sometimes the parent organism is entirely resolved into the daughter-individuals, which are termed spores in a general way, but can be given special names in special cases (see Gregarines, Coccidia, &c.).

Life-cycles of the Protozoa.—It is probable that in all Protozoa, as in the Metazoa, the life-history takes its course in a series of recurrent cycles of greater or less extent, a fixed point, as it were, in the cycle being marked by the act of syngamy or conjugation, which represents, apparently, a process for recuperation of the waning vital powers of the organism. It is true that in many types of Protozoa syngamy is not known as yet to occur, but in all species which have been thoroughly investigated syngamy in some form has been observed, and there is nothing to lead to the belief that the sexual process is not of universal occurrence in the Protozoa.

The life-cycle of a given species may be very simple or it may be extremely complex, the organism occurring under many different forms at different phases or periods of its development. The polymorphism of the Protozoa is best considered under three categories, according to the three main causes to which it is due, namely, first, polymorphism due to adaptation to different conditions of existence; secondly, polymorphism due to differences of size and structure during growth; thirdly, polymorphism due to the differentiation of individuals in connexion with the process of syngamy or sexual conjugation.

1. *Polymorphism in Relation to Life-conditions.*—As a protection against unfavourable conditions, or for other reasons, most Protozoa have the power of passing into a resting condition, during which the vital functions may be wholly or in part suspended. In the resting phase the animal usually becomes enveloped in a resistant membrane or *cyst* secreted by it, and is then said to be encysted. The formation of a cyst may be a response to conditions of various kinds. Very commonly it is formed to protect the organism against a change of medium, as in the case of freshwater forms liable to desiccation, or of parasites about to pass out of the bodies of their hosts. In other cases the organism passes into the resting state in order to absorb ingested nutriment or in order to enter upon reproductive phases.

As a preparation for encystment, organs of locomotion, if present, are retracted or cast off; contractile vacuoles cease to be formed; and the food-vacuoles disappear, usually by digestion of their contents and rejection of the waste residue. The body becomes rounded off and more or less spherical in form, and the protoplasm becomes denser, that is, less fluid and more opaque, but at the same time of diminished specific gravity, by loss of water. The cyst is then secreted at the surface as a layer of varying thickness and toughness. In the encysted condition many Protozoa are capable of being transported by the wind, a fact which explains their appearance in infusions and liquids exposed to the air. In favourable conditions the cysts germinate, that is to say, the envelope is dissolved and the contained organism or organisms are set free to enter upon the strenuous life once more.

In the Mycetozoa, organisms adapted to a semi-terrestrial life in moist surroundings, the protoplasm is capable, when desiccated, of passing into a tough condition resembling sealing-wax, which, when moistened, assumes again its normal appearance and active condition.

Resting phases, analogous to encystment, are seen in the spores of various forms, especially those of parasitic habit, which are commonly enclosed in tough, resistant envelopes or sporocysts, and enveloped as a protection against change of medium or of host. Within the sporocyst multiplication of the sporoplasm may take place to form more or fewer sporozoites. The sporocysts usually show definite symmetry and structure, infinitely variable in different species. In a suitable medium the spores germinate by rupture of the sporocysts and escape of the contents.

2. *Polymorphism in Relation to Growth and Development.*—In many species of Protozoa there is hardly any difference to be observed between different individuals during their active phases except in size. Those individuals about to multiply by fission are slightly above the normal in dimensions; on the

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[1] The kinetic nucleus of *Trypanosoma* is sometimes, but in the writer's opinion wrongly, named centrosome or blepharoplast; the bodies to which cytologists give these names are achromatic bodies; the kinetic nucleus is a true chromatic nucleus. The question of the centrosome in Protozoa is discussed by R. Goldschmidt and M. Popoff.

other hand, those resulting from recent fission will be smaller than the average; and such differences are, it need hardly be said, more pronounced when the fission is of the unequal binary type, or in cases of gemmation or multiple fission. In cases also where a given strain of a species is becoming senile, it is sometimes observed that the individuals are markedly undersized on the average.

On the other hand, it is often the case that the young individuals resulting from a recent act of multiplication may differ from adult individuals of the species, not merely in size, but in structural characters, to such an extent that their relationship to the adult forms could not be determined by simple inspection without other evidence. This is especially true of those species in which multiplication by sporulation occurs, giving rise to numerous small spores which may at first be in a resting condition, enveloped in protective sporocysts, but which sooner or later become free, motile individuals known technically as swarm-spores. Thus in many Sarcodina the adult is a large amoeboid organism which produces by sporulation a great number of relatively minute swarm-spores. These may be either, as in the common *Amoeba proteus*, amoeboid organisms, so-called amoebulae or pseudopodiospores, or, as in the Foraminifera and Radiolaria, flagellated organisms, so-called flagellulae or flagellispores. Sometimes, as in many Mycetozoa, amoeboid and flagellated phases may succeed each other rapidly in the development of the swarm-spores. The familiar *Noctiluca miliaris* is another instance of a species which produces by sporulation numerous tiny swarm-spores quite different from the parent form in their characters. Such instances could be multiplied indefinitely amongst the Protozoa.

When the young individuals differ greatly from the adults in structure and appearance they may be regarded as larval forms, and it is interesting to note that such forms appear to be just as much recapitulative, in the phylogenetic sense, as are the larvae of many Metazoa. A striking instance is that of the Acinetaria, in which the swarm-spores produced by gemmation are ciliated, and thus betray affinities with the Ciliata which could hardly be suspected from a study of the adult forms alone. Similarly, in the genus *Trypanosoma*, the young forms often show a *Herpetomonas*-like structure which is probably of phyletic significance. The swarm-spores of Sarcodina and of *Noctiluca* mentioned above can, perhaps, be regarded in the same light. On the other hand, many larval forms cannot be considered as exhibiting recapitulative characters, but merely as adaptations to environment or other special life-conditions. This is especially true, as in Metazoa, of parasitic forms, subject as they are to great vicissitudes, to cope with which the most finely adjusted adaptations are necessary on the part of the organism.

3. *Polymorphism in Relation to Sex.*—In all Protozoa of which the life-cycle has been made known in its entire course, a process of syngamy or sexual union has been found to occur. There are still many forms in which syngamy remains to be discovered: this is true even of some groups of considerable extent. It is quite possible, therefore, that Protozoa exist in which syngamy does not occur. In view, however, of the widespread occurrence of sexual processes amongst unicellular organisms, both of animal and vegetable nature, and the fact that extended observation continually brings to light new instances of this kind, it is safer, in cases amongst the Protozoa in which syngamy is not known to occur, to explain its apparent absence by the imperfections of the present state of our knowledge, than to suppose that in such forms sexual phenomena are entirely lacking in the life-cycle.[1]

The process of syngamy, though greatly diversified in different forms, consists essentially of one and the same process in all cases; namely, the fusion of nuclear matter from two distinct individuals. *Plus ça change, plus c'est la même chose!* Hence true syngamy may be distinguished as karyogamy from the process of plastogamy, or fusion of the protoplasmic bodies, of frequent occurrence in many forms of Protozoa. The individuals whose nuclei undergo fusion are termed *gametes*. They may be in no way different from each other or from ordinary individuals of the species, or, on the other hand, they may be highly differentiated in size, form and structure. The two gametes may undergo complete fusion into one body, thus giving rise to an individual termed generally a zygote or copula, but which may bear special names in special cases (*e.g.* vermicule or oökinete of the malarial parasites, &c.); such a process is termed sometimes copulation. On the other hand, the bodies of the two gametes may remain distinct, and portions of the nucleus of each be exchanged between them; to this condition the term conjugation is sometimes specially applied. The act of syngamy may be performed in the free condition, or in the resting state, within a cyst.

The significance of syngamy has been much discussed, and it is very difficult to make positive statements upon this point. By comparing the life-cycles of different forms it is found that syngamy sometimes precedes, sometimes follows, a period of great reproductive activity on the part of the organism. Thus in such a form as *Noctiluca*, syngamy between two full-grown individuals is followed by rapid sporulation and the production of a swarm of young individuals; on the other hand, in Foraminifera and Radiolaria, rapid sporulation of adult individuals produces a numerous progeny of young forms which may go through the process of syngamy and produce zygotes that simply grow into the adult form. Comparing these two types of development, instances of which might be greatly multiplied, it is seen that in one case syngamy follows a period of growth and precedes a period of proliferation in the life-cycle, and that in the other case exactly the reverse is true. Hence it follows that syngamy must not be regarded as in any way specially connected with reproduction, but must be considered in its relation to the life-cycle as a whole, and in those instances in which syngamy is followed by increased reproductive activity the explanation must be sought in the general physiological effects of the sexual process upon the vital powers of the organism.

In the Metazoa the sexual process is always related to the production of a new individual, that is to say, of a multicellular organism for which there is no analogy amongst the Protozoa, although an approach to the Metazoan condition is seen in colony-forming Flagellata, such as *Volvox* and its allies. The reproduction of Protozoa is analogous to the ordinary process of cell-division and multiplication which is going on at all times in the bodies of the Metazoa, and which can be observed in the production of the gametes; that is to say, in the period of the life-cycle immediately preceding the sexual process in the Metazoa, just as much as in the developmental phases which follow syngamy and result in the building up of a new Metazoan individual. Hence, so far as the Protozoa are concerned, the phrase "sexual reproduction" is an incongruous combination of words; reproduction and sex are two distinct things, not necessarily related or in any direct causal connexion; and in order to arrive at any theory of sex it is necessary first of all to clear away all misconceptions or preconceived notions arising from analogies with the multicellular Metazoan individual.

Many observations indicate that the vital powers of the Protozoa become gradually weakened, and the individual tends to become senile and effete, unless the process of syngamy intervenes. The immediate result of the sexual union is a renewal of the vitality, a rejuvenescence, which manifests itself in enhanced powers of metabolism, growth and reproduction. These facts have been most studied in the Ciliata. It is observed that if these organisms be prevented from conjugating with others of their kind they become senile and finally die off. It has been found by G. N. Calkins, however, that if the senile individuals be given a change of medium and nourishment, their vigour may be renewed and their life prolonged for a time, though not indefinitely; there comes a period when artificial methods fail and only the natural process of syngamy can enable them to prolong their existence. The results obtained by Calkins are of great interest, as indicating that under special conditions of the environment the necessity for the sexual process may be diminished and the event may be deferred for a long time, if not indefinitely. Hence it is quite possible that in many Protozoa the process of syngamy may be in abeyance, just as there are plants which can be propagated indefinitely by suckers or cuttings without ever setting seed; and it is possible that the inoculative or artificial transmission of parasitic Protozoa from one host to another, as in the case of pathogenic trypanosomes, without any apparent diminution in their vital powers, is an instance of this kind.

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[1] It will be shown below, however, that in some species syngamy may perhaps be *secondarily* in abeyance.

As a general rule, in order that syngamy may be attended by beneficial results to the organism, it is necessary that the two conjugating individuals should be from different strains, that is to say, they should not be nearly related by descent and parentage. Thus F. Schaudinn found that in order to observe the sexual union of the gametes of Foraminifera it was necessary to bring together gametes of distinct parentage. On the other hand it has been observed that in many Protozoa, especially in parasitic forms, syngamy takes place between individuals of common parentage. Thus in *Amoeba coli*, according to F. Schaudinn, a single individual becomes encysted and its nucleus divides into two; after each nucleus has undergone certain maturative changes they give rise to pronuclei which conjugate and initiate a new developmental cycle. Syngamy between sister individuals, or autogamy, as it has been termed, is not, however, confined to parasitic Protozoa; it has been observed in *Actinosphaerium* by R. Hertwig. The benefit to the organism, if any, arising from autogamy can only be supposed to result from the rearrangement and reconstitution of the nuclear apparatus. The frequent occurrence of autogamy suggests that in many Protozoa the nature of the environment diminishes the importance of the sexual process, at least so far as the mixture of nuclear material from distinct sources is concerned; and, since autogamy is most common in parasitic forms, this result may, in the light of G. N. Calkins's experiments, be ascribed in great part to the frequent changes of environment and nutrition to which parasitic forms, above all, are subject.

True syngamy consists, as has been said, of nuclear fusion or karyogamy. It rarely, if ever, happens, however, that such fusion takes place without the conjugating nuclei having undergone some process of reduction by elimination of a portion of the nuclear substance, in a manner analogous to the maturation of the germ-cells in the Metazoa. The chromatin thus eliminated may be cast out from the body of the organism as one or more so-called polar bodies; or may be absorbed in the cytoplasm; or may remain in the cytoplasm and be left over in the residual protoplasm in cases where syngamy is followed by a process of rapid multiplication by sporulation; but in all cases the chromatin removed from the nucleus is rejected in some way or other and plays no part in the subsequent development of the organism. The nuclei of the gametes which have completed this process of *épuration nucléaire* are then ripe for syngamic fusion and are termed pronuclei; the union of two pronuclei produces a single nucleus termed a synkaryon.

It is certain that in many, if not in all, cases the nuclear substance that is rejected as a preliminary to syngamy consists of somatic or vegetative chromatin; that is to say, of chromatin that has been functional in regulating the ordinary vital functions, metabolism, growth, reproduction, &c., during previous generations, and has become effete; while on the other hand the chromatin that persists to form the pronuclei is generative chromatin which has remained in reserve for the sexual act and has retained its peculiar powers and properties unimpaired. The truth of this explanation is extremely obvious in such forms as the Infusoria, where somatic and generative chromatin are concentrated into two distinct and entirely separate nuclei. In some Rhizopoda also the body contains one or more principal nuclei and a mass of chromidia, and it has been observed that as a preparation for syngamy the principal nuclei are eliminated and the pronuclei are formed from the chromidia; in such cases, therefore, it is reasonable to regard the principal nuclei as representing somatic chromatin, the chromidia as generative chromatin. In other cases, however, for example *Actinosphaerium*, the chromidia must be interpreted, from their behaviour, as somatic chromatin, and the principal nuclei as generative chromatin; hence R. Goldschmidt has proposed the special term *sporetia* for those chromidia which represent reserve generative chromatin. In the majority of Protozoa, however, the nuclear substance is not differentiated in such a way that it can be distinguished by any visible peculiarities into somatic and generative chromatin.

The process of reduction is not limited, apparently, to the elimination of somatic chromatin, but a portion of the generative chromatin is also cast off. Thus in the Infusoria not only the somatic macronucleus, but also a considerable portion of the generative micronucleus, is absorbed at each act of conjugation. The elimination of generative chromatin is perhaps of importance as a factor in heredity and the production of variations, or possibly for sex determination, as will be discussed below; it is difficult to suggest any other explanations for it, unless it be supposed that during the exercise of ordinary vital functions a portion of the generative chromatin be rendered effete as well as the somatic chromatin.

From the considerations set forth in the foregoing paragraphs it must be supposed that the synkaryon, the fusion-product of the two pronuclei in syngamy, consists at first purely of generative chromatin, which must speedily become differentiated into the regulative somatic chromatin of the ensuing generations and the generative chromatin held in reserve for the next act of syngamy. Such a differentiation can be actually observed in the Infusoria, where immediately after conjugation the synkaryon divides into one or more pairs of nuclei, each pair becoming the two unequally sized nuclei of an ordinary individual, sometimes with, even at this stage, an apparently wanton elimination of nuclear substance. Thus the somatic and generative chromatin of the Protozoa offer a certain analogy with the soma and germ-plasm of Metazoa; but in making such comparisons the distinction between a physiological analogy and a morphological homology should be borne clearly in mind.

It has been stated above that the two gametes of a given species of Protozoa may be perfectly similar and indistinguishable, or may be very different one from the other. The condition with similar gametes is termed isogamy, that with differentiated gametes anisogamy. Every transition can be found from complete isogamy and pronounced anisogamy in the Protozoa; in tracing, however, the evolution of specialized gametes it must be remembered that we are dealing only with visible morphological differences mainly of an adaptive nature, without prejudice to the question of the possible existence of a fundamental sexual antithesis in all gametes, present even when not perceptible. The sex philosopher O. Weininger has urged that sex is a fundamental attribute of living things, and that the living substance, protoplasm, consists of arrhenoplasm and thelyplasm united in varying proportions. Certain observations of F. Schaudinn tend to support this view; in *Trypanosoma noctuae*, for example, Schaudinn found that the process of reduction in one gamete took an opposite course to that which it took in the other gamete. In one gamete certain portions of the nucleus were retained and certain other portions rejected; in the maturation of the other gamete the portions rejected and the portions retained were the reverse. Hence Schaudinn was led to regard the indifferent individuals as essentially hermaphrodite in nature, and therefore capable of giving rise to gametes of either order by elimination of one or the other set of sexual elements; a theory which throws further light on the elimination of generative chromatin mentioned above. It is possible, therefore, that the gametes of Protozoa may possess sexual characters intrinsically different even when perfectly similar so far as can be perceived. It is very probable, for instance, that the isogamy in Gregarines is a state of things derived secondarily from a primitive condition of anisogamy (see GREGARINES).

The simplest possible condition of the gametes is seen in the free-swimming Ciliata, forms which in other respects are the most highly organized of Protozoa; here the individuals which conjugate are only distinguished from ordinary individuals of the species by the fact that their nuclei have undergone very complicated processes of reduction and nuclear elimination. In these forms there is also no difference between young and adult individuals, beyond scarcely perceptible differences of size between individuals about to divide and those that are the products of recent division, so that these species are practically monomorphic in the active condition. In forms, however, which, like *Vorticella*, are of sessile habit, small free-swimming individuals are liberated which seek out and conjugate with the ordinary sessile individuals. Here we have an instance of a morphological differentiation of the gametes which is clearly adaptive to the life-conditions of the species. In other Protozoa there may be, as already stated, differences, more or less pronounced, between young and adult individuals, and syngamy may take place either between young individuals (microgamy) or between adults (macrogamy); the gametes may be in either case ordinary individuals of the species, not specially differentiated in any way, or on the other hand they may be differentiated from ordinary individuals, while still similar and isogamic amongst themselves; or, finally, they may be anisogamic; that is to say, differentiated into two distinct types. Thus in the Radiolaria, for example, an adult individual breaks up by a process of sporulation into numerous minute flagellated swarm-spores; these may be all of one kind, termed isospores, which develop directly without undergoing syngamy; or they may be of two kinds, termed anisospores, both different in their character from the isospores, and incapable of development without syngamy.

When the gametes are differentiated the divergence between them almost always follows parallel paths. One gamete is distinguished by its smaller size, its greater activity, and its comparative poverty in granules of reserve food-material; hence it is termed the microgamete. The other gamete is distinguished by its greater bulk, its pronounced sluggishness and inertness, and its tendency to form and store up in the cytoplasm reserve nutriment of one kind or another; hence it is termed the macrogamete, or, as some prefer to write it, the megagamete (better megadogamete). When these differences are very pronounced, as, for instance, in the Coccidia and other Sporozoa, a condition is reached which is practically indistinguishable from that seen in the sperm and ova of the Metazoa. Hence the microgamete is generally regarded as male, the macrogamete as female; and these terms may be conveniently used, although they do not in themselves imply more than would the words positive and negative, or any other pair of terms expressive of a fundamental contrast. The microgamete may become reduced to a mere thread of chromatin, which may possess one or two flagella for purposes of locomotion, as in Coccidia, &c., or may move by serpentine movements of the whole body, which resembles in its entirety a flagellum, and is often wrongly so termed. In contrast with the microgamete, its correlative, the macrogamete, tends to become a bulky, inert body, often with great resemblance to an ovum, its cytoplasm dense and granular, packed with reserve food-materials as an egg contains yolk, and without organs of locomotion or capacity for movement of any kind. Hence the macrogamete is the passive element in syngamy, which requires to be sought out and "fertilized" by the active microgamete, a division of labour perfectly analogous to that seen in the male and female gametes of Metazoa. In those cases where syngamy takes place by interchange of nuclear substance between two gametes which remain separate from one another, as in the Infusoria, each gamete forms two pronuclei, which are distinguished by their behaviour as the active and passive pronuclei respectively. The active pronucleus of each gamete passes over into the body of the other and fuses with its passive pronucleus to form a synkaryon. A similar method of procedure occurs also in *Amoeba coli*, according to F. Schaudinn.

When gametes are not very highly specialized they may still retain the power of multiplication by division possessed by ordinary individuals, so long as they have not undergone the process of nuclear reduction preliminary to syngamy. If, however, the gametes are highly specialized they may forfeit the power of multiplication. In this respect the microgametes are worse off than the other sex; on account of the great reduction of the body-protoplasm, and the entire absence of any reserve materials, they must either fulfil their destiny as gametes or die off. The macrogametes, on the other hand, with their great reserves of cytoplasm and nutriment, are more hardy than any other forms of the species, and are able to maintain their existence in periods of famine and starvation when all other forms are killed off. Moreover they may regain the power of multiplication by a process of parthenogenesis, a term originally applied in the Metazoa to cases where a germ-cell of definitely female character, that is to say an ovum, acquires the power of reproduction without fertilization by syngamy. A macrogamete multiplying by parthenogenesis first goes through certain nuclear changes whereby it is set back, as it were, from the female to the indifferent condition, and it is then able to multiply by fission like any ordinary, non-sexual individual of the species. Parthenogenesis has been described by F. Schaudinn in the malarial parasites and in *Trypanosoma noctuae*. In both cases the female forms are able to persist under adverse conditions after all other forms have perished, and then by parthenogenesis they may multiply when conditions are more favourable, overrun the host again, and cause a relapse of the disease of which they are the cause. S. v. Prowazek has described in *Herpetomonas muscae-domesticae* an analogous process of multiplication on the part of male individuals, and has coined the term etheogenesis for this process, but the statement needs confirmation, and as a general rule the microgamete is quite incapable of independent reproduction under any circumstances.

It is often found that not only are the gametes differentiated, but that their immediate progenitors may also exhibit characters which mark them off from the ordinary or indifferent individuals of the species. In such cases the parent-forms of the gametes are termed gametocytes, and they may differ amongst themselves in characters which render it possible to distinguish those destined to produce microgametes from those which will produce the other sex. The parent-individuals of the microgametes, or microgametocytes, are distinguished as a general rule by clearer protoplasm, free from coarse granulations, and a larger nucleus, more rich in chromatin. The macrogametocytes, on the other hand, usually have coarsely granular cytoplasm, rich in reserve food-stuffs, and a relatively small nucleus. The gametocytes produce the gametes by methods that vary according to the degree of specialization of the gametes. In isogamous forms, of which good examples are furnished by many Gregarines (*q.v.*), the gametes are produced by a process of sporulation on the part of the gametocytes, a certain amount of residual protoplasm being left over. In forms with pronounced anisogamy, for instance, Coccidia or Haemosporidia, the microgametes are produced by sporulation in which almost the whole mass of the body of the gametocyte may be left over as residual protoplasm, together with some portion of the nucleus; in the other sex, however, the process of sporulation may be altogether in abeyance, and the macrogametocyte becomes simply converted into the macrogamete after going through a process of nuclear reduction.

The gametocytes may, however, possess the power of multiplication without change of character for many generations; or, to put the matter in other words, the sexual differentiation may be apparent not merely in the generation immediately preceding the gametes, but in many generations prior to this. Thus a given species may consist of three different types of adult individuals, male, female and indifferent, each multiplying in its own line. Complicated alternations of generations are the result, and if at the same time there is a well-marked difference between young and adult forms of the species the height of polymorphism is reached. Very commonly a double series of generations occurs, the non-sexual or indifferent forms multiplying apart from the sexually differentiated individuals and the generations immediately descended from them; in such cases the series of non-sexual generations is termed schizogony, the series of sexual generations gametogony or sporogony. Schizogony and sporogony usually occur as adaptations to, or at least in relation with, distinct conditions of life. Thus in parasitic forms, as well illustrated by the Coccidia, the organisms multiply by schizogony when overrunning the host, that is to say, when nutriment is abundant; sporogony begins as a preparation for passing into the outer world, in order to infect new hosts. In the Haemosporidia, in which transmission from one vertebrate host to another is effected by means of blood-sucking ectoparasites (Diptera, ticks, leeches, &c.), the schizogony goes on in the vertebrate host, the sporogony in the invertebrate host. In free-living, non-parasitic forms, schizogony may go on under ordinary conditions, while sporogony supervenes as a preparation for a marked change in the life-conditions; for instance, a change of medium, or at the approach of winter. It is interesting to note that, as a general rule, the differentiation of sexual forms seems to be a preliminary to the production of more resistant forms capable of braving adverse conditions or violent changes in the conditions of life; a phenomenon which is in support of the hypothesis that syngamy has a strengthening effect on the vitality of the species.

Classification of the Protozoa.

Various attempts have been made to separate the Protozoa into two primary subdivisions. E. Ray Lankester divided them into two main groups, the Gymnomyxa, with naked protoplasm and indefinite form, and the Corticata, with the protoplasm limited by a firm membrane, and consequently with a definite body-form. In many of the corticate groups, however, there must be placed amoeboid, non-corticate forms, such as *Mastigamoeba* amongst the Flagellata, or the malarial parasites amongst the Sporozoa. Hence if Lankester's classification be used, it must be without a hard and fast verbal definition. F. Doflein, on the other hand, has divided the Protozoa into Plasmodroma, with organs of locomotion derived from protoplasmic processes, *i.e.* pseudopodia or flagella, and Ciliophora, with locomotion by cilia. It may be doubted, however, if the distinction between flagella and cilia is so fundamental and sharply defined as this mode of classification would imply. W. H. Jackson has proposed to unite the forms bearing flagella and cilia into one section, Plegepoda, and distinguishes two other sections, Rhizopoda (=Sarcodina) and Endoparasita (=Sporozoa).

Four main groups of Protozoa, of the rank of classes, are universally recognized, however they may be combined into larger categories; these are the Sarcodina, Mastigophora, Sporozoa and Infusoria.

The Sarcodina are characterized by the body being composed of naked protoplasm, not covered by any limiting cuticle, although in many cases a house or shell is secreted into which the protoplasm can be partly or entirely withdrawn. No special organs of locomotion, either flagella or cilia, are ever present in the adult, and locomotion and capture of food are effected in the manner named *amoeboid,* by more or less temporary extrusions or outflow of the protoplasm which are termed pseudopodia, as in *Amoeba.*

The Mastigophora are so named because organs of locomotion are always present in the adult in the form of one or more flagella, each flagellum (Gr. μάστιξ, whip) a delicate, thread-like extension of the protoplasm, endowed with a special contractility which enables it to perform lashing, whip-like movements. The body protoplasm is sometimes naked, in which case it may be amoeboid, but is more usually limited by a cuticle, varying in thickness in different types.

The Sporozoa, with the exception of a few forms of dubious position, are exclusively internal parasites of Metazoa, absorbing their food from the internal juices and secretions of their hosts, and never exhibiting in their trophic phases any organs of locomotion or for the ingestion and digestion of solid food. The body-protoplasm may be naked and amoeboid or limited by a cuticle. The reproduction is specialized in correlation with the parasitic habit, and results typically in the formation of a number of minute germs or spores, by which the infection of fresh hosts is effected. It must not be supposed, however, that spore-formation is confined to this class of Protozoa.

The Infusoria, a name originally of much wider application, is now restricted to denote those Protozoa in which locomotion or capture of food is effected by means of special organs termed *cilia,* minute hair-like contractile extensions of the protoplasm differing from flagella not only in their usually smaller size and greater number, but also in the mode of contraction and movement. The cilia may be present throughout life or only in an early stage of the individual. The body is always limited by a cuticle and the nucleus seems to be invariably double, being divided into two parts specialized in function and differing in size, termed respectively macronucleus and micronucleus.

Comparing these four subdivisions with one another, it may be said at once that the Sporozoa and Infusoria are highly specialized classes, each well marked off from the other subdivisions. The Sarcodina and Mastigophora, on the other hand, include the most primitive types of Protozoa and are delimited from one another by a somewhat arbitrary character, the presence or absence of a flagellum in the adult. Thus Mastigamoeba is a form which unites the characters of the Sarcodina and Mastigophora, having an amoeboid body which bears a flagellum, and it is classed among the Mastigophora merely because the flagellum is retained throughout life; if the flagellum were absent in the adult condition it would be placed among the Sarcodina, many of which have flagella in their young stages but lack them when adult. Hence Bütschli considered the Rhizomastigina (*i.e. Mastigamoeba* and its allies) as the most primitive group of Protozoa, representing the common ancestral form of all the classes; and on this view the flagellated young stages of many Sarcodina would represent recapitulative larval stages.

Bütschli's theory of Protozoan phylogeny implies that a flagellum is an organ of most primitive nature, possessed perhaps by the earliest forms of life; and it must be remembered that flagella are borne by many Bacteria. On the other hand, one would imagine, from general considerations, that living beings possessing a flagellum would have been preceded in evolution by others that did not bear so definite an organ. The flagellum itself is generally regarded as a vibratile process or extension of the protoplasm, comparable in its nature to a slender pseudopodium endowed with peculiar powers of movement. More knowledge with regard to the nature and formation of the flagellum is needed in order to decide this point, and particularly with regard to the question whether the flagella of Bacteria are of the same nature as those of Protozoa.

It has been much debated whether the earliest forms of life were of the nature of plants or animals. Many authors consider the question settled beyond all debate by a process of trenchant deductive reasoning. It is argued that animals require other organisms for their nutriment, and that plants, that is to say green plants, do not; therefore plants must have preceded animals. On the other hand, the morphologist will urge that green plants derive their peculiar powers of metabolism from the possession of very definite cell-organs, namely chromatophores containing chlorophyll; and will argue that living things without such organs must have preceded in evolution those possessing them. The whole dispute is based on the assumption that plant and animal represent the two fundamental modes of metabolism; whereas the study of the Bacteria shows the possibility of many other modes of life. Many Bacteria exhibit processes of metabolism totally different from those generally laid down in textbooks as characteristic of living matter; some are killed by free oxygen; others can absorb free nitrogen, and various other "abnormal" properties are manifested by them. Hence the primitive organisms may have been neither plant nor animal in their nature, but may have possessed, like the Bacteria at present, many different methods of metabolism from which plant and animal are two divergent paths of evolution.

The origin of life is veiled in a mist which biological knowledge in its present state is unable to dispel; and speculations with regard to the nature of the earliest form of life are as yet premature and futile.

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PROUDHON, PIERRE JOSEPH (1809–1865), French socialist and political writer, was born on the 15th of January 1809 at Besançon, France, the native place also of the socialist Fourier. His origin was of the humblest, his father being a brewer's cooper; and the boy herded cows and followed other simple pursuits of a like nature. But he was not entirely self-educated; at sixteen he entered the college of his native place, though his family was so poor that he could not procure the necessary books, and had to borrow them from his mates in order to copy the lessons. At nineteen he became a working compositor; afterwards he rose to be a corrector for the press, reading proofs of ecclesiastical works, and thereby acquiring a very competent knowledge of theology. In this way also he came to learn Hebrew, and to compare it with Greek, Latin and French; and it was the first proof of his intellectual audacity that on the strength of this he wrote an *Essai de grammaire générale*. As Proudhon knew nothing whatever of the true principles of philology, his treatise was of no value. In 1838 he obtained the *pension Suard*, a bursary of 1500 francs a year for three years, for the encouragement of young men of promise, which was in the gift of the academy of Besançon.

In 1839 he wrote a treatise *L'Utilité de la célébration du dimanche* which contained the germs of his revolutionary ideas. About this time he went to Paris, where he lived a poor, ascetic and studious life—making acquaintance, however, with the socialistic ideas which were then fomenting in the capital. In 1840 he published his first work *Qu'est-ce que la propriété?* His famous answer to this question, " La propriété, c'est le vol " (property is theft), naturally did not please the academy of Besançon, and there was some talk of withdrawing his *pension*; but he held it for the regular period. For his third memoir on property, which took the shape of a letter to the Fourierist, M. Considérant, he was tried at Besançon but was acquitted. In 1846 he published his greatest work, the *Système des contradictions économiques ou philosophie de la misère*. For some time Proudhon carried on a small printing establishment at Besançon, but without success; afterwards he became connected as a kind of manager with a commercial firm at Lyons. In 1847 he left this employment, and finally settled in Paris, where he was now becoming celebrated as a leader of innovation. He regretted the sudden outbreak of the revolution of February (1848), because it found the social reformers unprepared. But he threw himself with ardour into the conflict of opinion, and soon gained a national notoriety. He was the moving spirit of the *Représentant du peuple* and other journals, in which the most advanced theories were advocated in the strongest language; and as member of assembly for the Seine department he brought forward his celebrated proposal of exacting an impost of one-third on interest and rent, which of course was rejected. His attempt to found a bank which should operate by granting gratuitous credit was also a complete failure; of the five million francs which he required only seventeen thousand were offered. The violence of his utterances led to an imprisonment at Paris for three years, during which he married a young working woman. As Proudhon aimed at economic rather than political innovation, he had no special quarrel with the second empire, and he lived in comparative quiet under it till the publication of his work, *De la Justice dans la révolution et dans l'église*, (1858) in which he attacked the Church and other existing institutions with unusual fury. This time he fled to Brussels to escape imprisonment. On his return to France his health broke down, though he continued to write. He died at Passy on the 16th of January 1865.

Personally Proudhon was one of the most remarkable figures of modern France. His life was marked by the severest simplicity and even Puritanism; he was affectionate in his domestic relations, a most loyal friend, and strictly upright in conduct. He was strongly opposed to the prevailing French socialism of his time because of its utopianism and immorality; and, though he uttered all manner of wild paradox and vehement invective against the dominant ideas and institutions, he was remarkably free from feelings of personal hate. In all that he said and did he was the son of the people, who had not been broken to the usual social and academic discipline; hence his roughness, his one-sidedness, and his exaggerations; but he is always vigorous, and often brilliant and original.

It would of course be impossible to reduce the ideas of such an irregular thinker to systematic form. In later years Proudhon himself confessed that " the great part of his publications formed only a work of dissection and ventilation, so to speak, by means of which he slowly makes his way towards a superior conception of political and economic laws." Yet the groundwork of his teaching is clear and firm; no one could insist with greater emphasis on the demonstrative character of economic principles as understood by himself. He strongly believed in the absolute truth of a few moral ideas, with which it was the aim of his teaching to mould and suffuse political economy. Of these fundamental ideas, justice, liberty and equality were the chief. What he desiderated, for instance, in an ideal society was the most perfect equality of remuneration. It was his principle that service pays service, that a day's labour balances a day's labour—in other words, that the duration of labour is the just measure of value. He did not shrink from any of the consequences of this theory, for he would give the same remuneration to the worst mason as to a Phidias; but he looks forward also to a period in human development when the present inequality in the talent and capacity of men would be reduced to an inappreciable minimum. From the great principle of service as the equivalent of service is derived his axiom that property is the right of *aubaine*. The *aubain* was a stranger not naturalized; and the right of *aubaine* was the right in virtue of which the sovereign, from the earliest monarchy, claimed the goods of such a stranger who had died in his territory.[1] Property is a right of the same nature, with a like power of appropriation in the form of rent, interest, &c. It reaps without labour, consumes without producing, and enjoys without exertion. Proudhon's aim, therefore, was to realize a science of society resting on principles of justice, liberty and equality thus understood; " a science absolute, rigorous, based on the nature of man and of his faculties, and on their mutual relations; a science which we have not to invent, but to discover." But he saw clearly that such ideas with their necessary accompaniments could only be realized through a long and laborious process of social transformation. He strongly detested the prurient immorality of the schools of Saint-Simon and Fourier. He attacked them not less bitterly for thinking that society could be changed off-hand by a ready-made and complete scheme of reform. It was "the most accursed lie," he said, "that could be offered to mankind." In social change he distinguishes between the transition and the perfection or achievement. With regard to the transition he advocated the progressive abolition of the right of *aubaine*, by reducing interest, rent, &c. For the goal he professed only to give the general principles; he had no ready-made scheme, no utopia. The positive organization of the new society in its details was a labour that would require fifty Montesquieus. The organization he desired was one on collective principles, a free association which would take account of the division of labour, and which would maintain the personality both of the man and the citizen. With his strong and fervid feeling for human dignity and liberty, Proudhon could not have tolerated any theory of social change that did not give full scope for the free development of man. Connected with this was his famous paradox of *anarchy*, as the goal of the free development of society, by which he meant that through the ethical progress of men government should become unnecessary. "Government of man by man in every form," he says, "is oppression. The highest perfection of society is found in the union of order and *anarchy*." Proudhon, indeed, was the first to use the word *anarchy*, not in its revolutionary sense, as we understand it now, but as he himself says, to express the highest perfection of social organization.

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[1] The *droit d'aubaine* was abolished in 1790, revived by Napoleon, and ended in 1819.

Proudhon's theory of property as the right of *aubaine* is substantially the same as the theory of capital held by Marx and most of the later socialists. Marx, however, always greatly detested Proudhon and his doctrines, and attacked him violently in his *Misère de la philosophie*. Property and capital are defined and treated by Proudhon as the power of exploiting the labour of other men, of claiming the results of labour without giving an equivalent. Proudhon's famous paradox, "La propriété, c'est le vol," is merely a trenchant expression of this general principle. As slavery is assassination inasmuch as it destroys all that is valuable and desirable in human personality, so property is theft inasmuch as it appropriates the value produced by the labour of others without rendering an equivalent. For property Proudhon would substitute individual possession, the right of occupation being equal for all men.

A complete edition of Proudhon's works, including his posthumous writings, was published at Paris (1875). See also *P. J. Proudhon, sa vie et sa correspondance*, by Sainte-Beuve (Paris, 1875); Beauchéry, *Économie sociale de P. J. Proudhon* (Lille, 1867); Spoll, *P. J. Proudhon; étude biographique* (Paris, 1867); Marchegay, *Silhouette de Proudhon* (Paris, 1868); Putlitz, *P. J. Proudhon, sein Leben und seine positiven Ideen* (Berlin, 1881); Diehl, *P. J. Proudhon, seine Lehre und sein Leben* (Jena, 1888–1889); Mülberger, *Studien über Proudhon* (Stuttgart, 1891); Desjardins, *P. J. Proudhon, sa vie, ses œuvres et sa doctrine* (Paris, 1896); Mülberger, *P. J. Proudhon* (Stuttgart, 1899).

PROUST, ANTONIN (1832–1905), French journalist and politician, was born at Niort on the 15th of March 1832. He founded in 1864 an anti-imperial journal, *La Semaine hebdomadaire* which appeared at Brussels. He was war correspondent to *Le Temps* in the early days of the Franco-German War, but after Sedan he returned to Paris, where he became secretary to Gambetta and superintended the refugees in Paris. He entered the Chamber as deputy for his native town in 1876, taking his seat on the left. In Gambetta's cabinet (1881–1882) he was minister of the fine arts, and in the Chamber of Deputies he was regularly commissioned to draw up the budget for the fine arts, after the separate department had ceased to exist. Prosecuted in connexion with the Panama scandals, he was acquitted in 1893. From this time he lived in the closest retirement. On the 20th of March 1905 he shot himself in the head, dying of the wound two days later.

PROUST, JOSEPH LOUIS (1754–1826), French chemist, was born on the 26th of September 1754 at Angers, where his father was an apothecary. After beginning the study of chemistry in his father's shop he came to Paris and gained the appointment of apothecary in chief to the Salpetrière, also lecturing on chemistry at the *musée* of the aeronaut J. F. Pilâtre de Rozier, whom he accompanied in a balloon ascent in 1784. Next, at the instance of Charles IV., he went to Spain, where he taught chemistry first at the artillery school of Segovia, and then at Salamanca, finally becoming in 1789 director of the royal laboratory at Madrid. In 1808 he lost both his position and his money by the fall of his patron, and retired first to Craon in Mayenne and then to Angers, where he died on the 5th of July 1826. His name is best known in connexion with a long controversy with C. L. Berthollet. The latter chemist was led by his doctrine of mass-action to deny that substances always combine in constant and definite proportions. Proust, on the other hand, maintained that compounds always contain definite quantities of their constituent elements, and that in cases where two or more elements unite to form more than one compound, the proportions in which they are present vary *per saltum*, not gradually. In 1799 he proved that carbonate of copper, whether natural or artificial, always has the same composition, and later he showed that the two oxides of tin and the two sulphides of iron always contain the same relative weights of their components and that no intermediate indeterminate compounds exist. His analytical skill enabled him to demonstrate the inaccuracy of the researches by which Berthollet attempted to support the opposite view, and to show among other things that some of the compounds which Berthollet treated as oxides were in reality hydrates containing chemically combined water, and the upshot was that by 1808 he had fully vindicated his position. Proust also investigated the varieties of sugar that occur in sweet vegetable juices, distinguishing three kinds, and he showed that the sugar in grapes, of which he announced the existence to his classes at Madrid in 1799, is identical with that obtained from honey by the Russian chemist J. T. Lowitz (1757–1804).

Besides papers in scientific periodicals he published *Indagaciones sobre el estañada de cobre, la vajilla de estaño y el vidriado* (1803); *Mémoire sur le sucre de raisins* (1808); *Recueil des mémoires relatifs á la poudre à canon* (1815); and *Essai sur une des causes qui peuvent amener la formation du calcul* (1824).

PROUSTITE, a mineral consisting of silver sulpharsenite, Ag_3AsS_3, known also as light red silver ore, and an important source of the metal. It is closely allied to the corresponding sulphantimonite, pyrargyrite, from which it was distinguished by the chemical analyses of J. L. Proust in 1804, after whom the mineral received its name. Many of the characters being so similar to those of pyrargyrite (*q.v.*) they are mentioned under that species. The prismatic crystals are often terminated by the scalenohedron $\{20\bar{1}\}$ and the obtuse rhombohedron $\{110\}$, thus resembling calcite (dog-tooth-spar) in habit. The colour is scarlet-vermilion and the lustre adamantine; crystals are transparent and very brilliant, but on exposure to light they soon become dull black and opaque. The streak is scarlet, the hardness $2\frac{1}{2}$, and the specific gravity 5·57. The mode of occurrence is the same as that of pyrargyrite, and the two minerals are sometimes found together. Magnificent groups of large crystals have been found at Chañarcillo in Chile; other localities which have yielded fine specimens are Freiberg and Marienberg in Saxony, Joachimsthal in Bohemia and Markirch in Alsace. (L. J. S.)

PROUT, SAMUEL (1783–1852), English water-colour painter, was born at Plymouth on the 17th of September 1783. He spent whole summer days, in company with the ill-fated Haydon, in drawing the quiet cottages, rustic bridges and romantic water-mills of the beautiful valleys of Devon. He even made a journey through Cornwall to try his hand in furnishing sketches for Britton's *Beauties of England*. On his removal in 1803 to London, which became his headquarters after 1812, a new scene of activity opened up before Prout. He now endeavoured to correct and improve his style by the study of the works of the rising school of landscape. To gain a living he painted marine pieces for Palser the printseller, received pupils, and published many drawing books for learners. He was likewise one of the first who turned to account in his profession the newly-invented art of lithography. It was not however until about 1818 that Prout discovered his proper sphere. Happening at that time to make his first visit to the Continent, and to study the quaint streets and market-places of continental cities, he suddenly found himself in a new and enchanting province of art. All his faculties, having found their congenial element, sprung into unwonted power and activity. His eye readily caught the picturesque features of the architecture, and his hand recorded them with unsurpassed felicity and fine selection of line. The composition of his drawings was exquisitely natural; their colour exhibited "the truest and happiest association in sun and shade"; the picturesque remnants of ancient architecture were rendered with the happiest breadth and largeness, with the heartiest perception and enjoyment of their time-worn ruggedness; and the solemnity of great cathedrals was brought out with striking effect. At the time of his death, on the 10th of February 1852, there was scarcely a nook in France, Germany, Italy and the Netherlands where his quiet, benevolent, observant face had not been seen searching for antique gables and sculptured pieces of stone. In Venice especially there was hardly a pillar which his eye had not lovingly studied and his pencil had not dexterously copied.

See a memoir of Prout, by John Ruskin, in *Art Journal* for 1849, and the same author's *Notes on the Fine Art Society's Loan Collection of Drawings by Samuel Prout and William Hunt* (1879–1880).

PROUT, WILLIAM (1785–1850), English chemist and physician, was born at Horton, Gloucestershire, on the 15th of January 1785, and died in London on the 9th of April 1850. His life was spent as a practising physician in London, but he also occupied himself with chemical research. He was an active worker in physiological chemistry, and carried out many analyses of the products of living organisms, among them being one of the gastric juice which, at the end of 1823, resulted in the notable discovery that the acid contents of the stomach contain hydrochloric acid which is separable by distillation. In 1815 he published anonymously in the *Annals of Philosophy* a paper "On the relation between the specific gravities of bodies in their gaseous state and the weights of their atoms," in which he calculated that the atomic weights of a number of the elements are multiples of that of hydrogen; and in a second paper published in the same periodical the following year he suggested that the πρώτη ὕλη of the ancients is realized in hydrogen, from which the other elements are formed by some process of condensation or grouping. This view, generally known as "Prout's hypothesis," at least had the merit of stimulating inquiry, and many of the most careful determinations of atomic weights undertaken since its promulgation have been provoked by the desire to test its validity.

PROVENÇAL LANGUAGE. The name Provençal is used to comprehend all the varieties of Romanic speech formerly spoken and written, and still generally used by country people in the south of France. The geographical limits of this infinitely varied idiom cannot be defined with precision, because it is conterminous on the north, south and east with idioms of the same family, with which almost at every point it blends by insensible gradations. Roughly speaking it may be said to be contained between the Atlantic on the west, the Pyrenees and Mediterranean on the south, and the Alps on the east, and to be bounded on the north by a line proceeding from the Gironde to the Alps, and passing through the departments of Gironde, Dordogne, Haute Vienne, Creuse, Allier, Loire, Rhone, Isère and Savoie. These limits are to some extent conventional. True, they are fixed in accordance with the mean of linguistic characters; but it is self-evident that according to the importance attached to one character or another they may be determined differently.

1. *Different Names.*—Though the name Provençal is generally adopted to designate the Romanic idiom of this region, it must not be supposed that this name has been imposed by general consensus, or that it rests upon any very firm historical basis. In the southern part of Gaul, Romanic developed itself, so to say, in the natural state of language. Contrary to what took place in other Romanic countries, no local variety here raised itself to the rank of the literary idiom *par excellence.* While in Italy the Florentine, in France the French dialect proper (that is to say, the dialect of the Île de France), succeeded little by little in monopolizing literary use, to the exclusion of the other dialects, we do not find that either the Marseillais or the Toulousain idiom was ever spoken or written outside of Marseilles or Toulouse. In consequence of this circumstance, no name originally designating the language of a town or of a small district came to be employed to designate the language of the whole of southern France; and on the other hand the geographical region described above, having never had any special name, was not able to give one to the idiom.

In the middle ages the idiom was spoken of under various appellations: *Romans* or *lenga romana* was that most generally used. The name was employed by the authors of the *Leys d'amors*, a treatise on grammar, poetry and rhetoric, composed at Toulouse in the 14th century. But while it is capable of being applied and in fact, has been applied, to each of the Romanic languages individually, the term is too general to be retained in a particular case; though it was revived in the beginning of the 19th century by Raynouard, the author of the *Lexique roman. Roman* or *langue romane* is no longer in use among scholars to design the Romanic language of the south of France. In the 13th century a poet born in Catalonia, on the southern slope of the Pyrenees, Raimon Vidal of Besalù, introduced the name of *Limousin* language, probably on account of the great reputation of some Limousin troubadours; but he took care to define the expression, which he extended beyond its original meaning, by saying that in speaking of *Limousin* he must be understood to include Saintonge, Quercy, Auvergne, &c. (*Rasos de trobar*, ed. Stengel, p. 70). This expression found favour in Spain, and especially in Catalonia, where the little treatise of Raimon Vidal was extensively read. The most ancient lyric poetry of the Catalans (13th and 14th centuries), composed on the model of the poetry of the troubadours, was often styled in Spain *poesía lemosina*, and in the same country *lengua lemosina*, long designated at once the Provençal and the old literary Catalan.

The name Provençal as applied to language is hardly met with in the middle ages, except in the restricted sense of the language of Provence proper, *i.e.* of the region lying south of Dauphiné on the eastern side of the Rhone. Raimon Feraut, who composed about 1300, a versified life of St Honorat, uses it, but he was himself a native of Provence. We can also cite the title of a grammar, the *Donatz proensals*, by Hugh Faidit (about 1250); but this work was composed in north Italy, and we may conceive that the Italians living next to Provence employed the name Provençal somewhat vaguely without inquiring into the geographical limits of the idiom so called. In fact, the name Provençal became traditional in Italy, and in the beginning of the 16th century Bembo could write, "Era per tutto il Ponente la favella *Provenzale*, ne tempi ne quali ella fiori, in prezzo et in istima molta, et tra tutti gli altri idiomi di quelle parti, di gran lunga primiera. Conciosiacosa che ciascuno, o Francese, o Fiamingo, o Guascone, o Borgognone, o altramente di quelle nationi che egli si fosse, il quale bene scrivere e specialmente verseggiar volesse, quantunque egli Provenzale non fosse, lo faceva Provenzalmente" (*Prose*, ed. 1529, fol. viii.).[1] This passage, in which the primacy of the Provençal tongue is manifestly exaggerated, is interesting as showing the name Provençal employed, though with little precision, in the sense in which we now apply it.

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[1] "The Provençal speech in the times in which it flourished was prized and held in great esteem all over the West, and among all the other idioms of that region was by far the foremost; so that every one, whether Frenchman, Fleming, Gascon, Burgundian, or of what nation soever, who wished to write and versify well, although he was not a Provençal, did it in the Provençal language."

Another designation, which is supported by the great authority of Dante, is that of *lingua d'oco* (*langue d'oc*). In his treatise, *De vulgari eloquio* (bk. i. chs. viii. and ix.), Dante divides the languages of Latin origin into three idioms, which he characterizes by the affirmative particles used in each, *oc. oïl, si*; "nam alii *oc*, alii *oïl*, alii *si*, affirmando loquuntur, ut puta Hispani, Franci, et Latini." As is seen, he attributes the affirmation *oc* to the Spaniards, which is of course erroneous; but there is no doubt that to the Spaniards he joined more correctly the inhabitants of southern France, for in the *Vita nuova*, ch. xxv., and in the *Convivio*, I. x., he speaks of the *lingua d'oco* as having been long celebrated for its poets, which can apply only to the language of the troubadours. The name *langue d'oc* occurs also as early as the end of the 13th century, in public acts, but with a different sense, that of the province of Languedoc, as constituted after the union of the county of Toulouse to the French king's dominion in 1271. In the royal acts of the end of the 13th and of the 14th century *partes linguae occitanae* or *pays de langue d'oc* designates the union of the five seneschalates of Périgueux, Carcassone, Beaucaire, Toulouse and Rodez; that is to say, the province of Languedoc, such as it existed till 1790. Some scholars, following the example of Dante, still actually use the term *langue d'oc* in opposition to *langue d'oui*; but these names have the inconvenience that they take such a secondary fact as the form of the affirmative particle as an essential character. Moreover, it can hardly help to distinguish the other Romanic languages, as *langue de si* would cause a confusion between Italian and Spanish. Provençal, without being entirely satisfactory, since in principle it applies solely to the language of Provence, is, notwithstanding, the least objectionable name that can be adopted. In addition to its being in some sort consecrated by the use made of it by the Italians, who were the first after the Renaissance to study the works of the troubadours, it must not be forgotten that, just as the Roman *provincia*, in which the name originated, extended across the south of Gaul from the Alps to Toulouse and the Pyrenees, so still in the middle ages *provincia, provinciales*, were understood in a very wide sense to designate not only Provence strictly so called, *i.e.* the present departments of Alpes Maritimes, Basses Alpes, Var, Bouches du Rhône, but also a very considerable part of Languedoc and the adjacent countries. Thus in the 12th century the chronicler Albert of Aix-la-Chapelle (Albertus Aquensis) places the town of Puy (Haute Loire) *in Provincia*.

2. *General Characters of the Language in its Ancient State.*—The Provençal language, within the limits above indicated, cannot be said to have any general characters really peculiar to it. Such of its characters as are found in all the varieties of the language are met with also in neighbouring idioms; such as are not found elsewhere are not general characters, that is to say, are manifested only in certain varieties of Provençal. In reality "Provençal language" does not designate, properly speaking, a linguistic unity; it is merely a geographical expression.

Tonic or Accented Vowels.—Latin *a* is preserved in an open syllable amāre, *amar*, amātum, *amat*, as well as in a closed syllable carnem, *carn*. This character is common also to the Romanic of Spain and Italy; but it is one of the best distinguishing marks between Provençal and French, for, to the north, this *a*, when in an open syllable, does not pass beyond a line which would run approximately through Blaye, Coutras (Gironde), Riberac, Nontron (Dordogne), Bellac (Haute Vienne), Boussac (Creuse), Montluçon, Gannat (Allier), Montbrison (Loire). Starting eastward from Lyons or thereabouts, there appears a notable linguistic fact which is observable in varied proportions in the departments of Ain, Isère and Savoie, and in Romanic Switzerland. This is, that accented Latin *a* in an open syllable, when preceded by a *mouillure* or palatalization (whatever the origin of this), becomes *e*; on the contrary, when there is no *mouillure*, it remains *a*. Thus we find in the *Meditations* of Marguerite d'Oingt (Lyons, *c.* 1300) *ensennier, deleitier*, as against *desirrar, recontar, regardar*. Of these two endings, the former, *-ier*, is that which is found regularly in French, the second that which is regular in Pr. Pure Pr. would have *-ar* in both cases (*ensenhar, deleitar, desirrar.* &c.); Fr. would have *-ier* (*enseignier, delitier*) and *-er* (*desirer*). G. I. Ascoli has given the name of *Franco-provençal* (*franco-provenzale*) to the varieties of Romanic in which we find this duality of treatment in Latin *a*, according as it was or was not preceded by a palatalized sound. Lat. ē, ĭ become close *e* (Ital. *e chiuso*; Fr. *é*): habēre, *aver*, crēdit, ~~cre~~, mē(n)sem, *mes*, fĭdem, *fe*, pĭlum, *pel*. This character is not only common to Italian and Spanish, but also extends over the French domain on its western side as far as Britanny. Certain exceptions noticed in French do not occur in Pr.: thus mercēdem, cēra, pr(eh)e(n)sum, venēnum, which give in Fr. *merci, cire, pris, venin*, where we should have expected *mercei, ceire, preis, venein*, give regularly in Pr. *merce, cera, pres, vere*. Lat. *ĕ* preserves, as in Italy, the sound of open *e* (Ital. *e aperto*): pĕdem, *pe*, lĕvat, *leva*, lĕporem, *lebre*. In certain determinate cases, this *e*, from about the 13th century onwards, may diphthongize to *ie*: ĕgo, *eu*, then *ieu*, hĕri, *er, ier*, fĕrio, *fer, fier*. Lat. *ī* is preserved, as in all the Romanic languages: amīcum, *ami*, rīpa, *riba*. Lat. *ĭ* is treated like *ĭ* long when it precedes (with hiatus) another vowel: pĭum, pĭa, *piu, pia*, vĭa, *via*, ligat, *lia*. Lat. *ō, ŭ* result in one and the same sound, that of Ital. *u*, Fr. *ou* (Eng *oo*). The same phenomenon takes place in the north of Italy and in the Romanic of Switzerland. This sound, which is styled by the *Donat Proensal* the *o estreit* (close *o*), is usually symbolized in the early texts by simple *o*, and is thus confounded in spelling, though not in pronunciation, with the open *o* (*o larc* of the *Donat Proensal*), which comes from Lat. *ŏ*. Lat. *ū* becomes *ü* (*i.e.* Fr. *u*), as all over France, and also in part of north Italy: mūrum, *mur* (=mür), dūrum, *dur* (=dür). Lat. *au* is rigorously preserved over the whole extent of the Pr. domain: aurum, *aur*, alauda, *alauza*, pauperem, *paubre*. At present the preservation of Lat. *au* does not extend much outside the Prov. domain; it is, however, found in certain parts of the Ladina zone in Switzerland (upper Rhine valley), and in Friuli, and it is to be supposed to have been once general over the whole of that zone. It is attested as late as the 16th century in the Vaudois valleys of Piedmont, and there are also examples of it in old Catalan. Elsewhere the diphthong has regularly become open *o* (aurum, Ital. and Span, *oro*. Fr. *or*, &c.).

Atonic Vowels.—The atonic vowels (*i.e.* vowels of the unaccented syllables) which precede the accented syllable present no very characteristic phenomenon; but it is otherwise with those that follow the accented syllable, the *post-tonic* vowels. The Pr. is one of the Romanic idioms which, like the French, but unlike the Castilian and many dialects of Italy, admit of only one syllable after the accent. But the rules are not quite the same as in French, and in some exceptional cases real proparoxytones seem to have been preserved by ancient documents. In French the only vowel which can stand after the accented syllable is "*e* feminine," otherwise called "*e* mute." In Prov. *a* and *e* are the most frequent vowels in this position, but *i* and *o* also occur. In French the first of the two post-tonic vowels of a Latin proparoxytone always disappears; in Prov. it tends to be preserved, when followed by one of the consonants *n, r, l, d*: te·rminum, *te·rmen*, ho·minem, *o·men*, a·ngelum, *a·ngel*, se·calem, *se·guel*, cre·scere, *crei·sser*, te·pidum, *te·be*. We have some instances of two syllables being retained after the tonic in the extreme south and south-east: *dime·negue* (dies dominica), *cano·negue* (canonicus), *mo·negue, mo·nega* (monacus, monaca), *ma·nega* (manica, a handle), *ca·nebe* (cannabis), later *dimergue, canorgue, morgue, morga, marga, carbe*; however, when such apparently proparoxytonic forms appear in poetry, the ending *-egue, -ega, -ebe* counts only as one syllable, from which it appears that the copyist, not the author, is responsible for them. Again, names of places ending in *-anicus, -onicus*, as *Colonicus, De-Athatianicus, Dominitianicus*, &c., now *Colorgues, Dassargues, Domessargues*, in department Gard, appear in the 12th and 13th centuries as *Colonegues, Dazanegues, Domensanegues*. Moreover Prov. presents in certain words coming from Latin proparoxytones the trace of forms which (like Italian) admitted two atonic vowels after the accented syllable: thus we have *porte·que* and *po·rgue* (po·rticum), *Fabre·ga*, a place name, and *fa·rga* (fa·brica), *perte·ga* and *pe·rga* (pe·rtica), *feme·na* and *fe·mna* (fe·mina). We have also *lagre·ma* (la·cryma), but a form accented like Fr. *larme* does not exist. There seems to be no doubt that these forms, in which a displacement of the Latin accent is observed, were at an earlier period pronounced as proparoxytones (*po·rtegue, fa.brega, pe.rtega e·mena, la·grema*).

Consonants.—The boundary usually recognized between Prov. and French is founded upon linguistic characters furnished by the vowels, especially *a*; if it had been determined by characters furnished by the consonants, the line of demarcation would have to be drawn farther south, because the consonantal system which is regarded as proper to French really extends in its main features over the northern zone of the Provençal region as defined above. As with the vowels, only a few of the salient facts can here be indicated. *C* initial, or second consonant of a group, before *a* (caballum, mercātum), preserves its Latin sound (=*k*) in the greater part of the Prov. region. But in the northern zone it takes the sound of *tch* (Eng. *ch* in *chin*) as in Old French, and this sound is still pretty well preserved, although there is here and there a tendency to the present sound of *ch* in Fr. (=*sh* Eng.). The place names Castellum, Castanētum, Casale give *Chastel. Chastanet, Chazal*, in Dordogne, Haute Vienne, Corrèze, Puy de Dôme, Cantal, Haute Loire, the north of Lozère, of Ardêche, of

Drome, of Isère, and of Hautes Alpes, and *Castel*, *Castanet*, *Cazal*, farther to the south. Analogously, *g* initial, or second consonant of a group, followed by *a*, becomes *j* (*i.e. dzh*=O. Fr. and Eng. *j* in *jam*) in the same zone; Garrīca is *Jarrija*, *Jarria* in Dordogne, Corrèze, Cantal, Haute Loire, Isère, and *Garriga* farther south. Between two vowels *t* becomes *d*; *edat*, *emperador*, *nadal*, *amada* aetatem, imperatōrem, natāle, amāta). This was also the case in O. Fr. until about the 10th or 11th century (*honurede*, *emperedur*, *lavadures*, &c., in the *Life of St Alexis*). But in the northern zone this *d*, representing a Latin *t*, fell away as early as in French. In an 11th-century text from the environs of Valence we read *muraor*, *coroaa* (*muratōrem, corrogāta), Fr. *corvée* (P. Meyer, *Recueil d'anciens textes*, Provençal section, No. 40). In the south, Latin *d* between two vowels was preserved almost everywhere until about the middle of the 12th century, when it became *z* (as in Fr. and Eng. *zero*): *cruzel*, *azorar*, *auzir*, *vezer* (crudēlem, adorāre, audīre, vidēre). In the 14th and 15th centuries this *z*, like every *z* or *s* soft of whatever origin, was liable to become *r* (lingual, not uvular): *aurir*, *veren* (audire, videntem). In Béarn and Gascony *d* remained; but in the northern zone Latin *d*, instead of changing into *z*, *r*, disappeared as in French and quite as early. The poem of Boethius, of which the MS. is of the 11th century, shows in this respect great hesitation: *e.g. d* preserved in *chaden*, *credet*, *tradar*, *veder* (cadentem, *credĕ·dit, *tradāre, videre); *d* fallen away in *creessen*, *feeltat*, *traazo*, *veüt*, *fiar* (*credessent, fidelitātem, *tradatiōnem, *vidutum, p. ple. of vidére, fidāre). One of the most general facts in Pr. is the habit of rejecting Latin final *t*, of which examples to any number are presented by the verbs. In French this *t* was formerly retained when it followed a vowel which remained, *aimet*, *entret* (amat, intrat), and still remains (in writing at least) when, in Latin, it follows a consonant, *aiment*, *fait*, *vit* (amant, facit, *fact, vivit, *vivt); but in Pr. the *t* is dropped in all cases, even in the most ancient texts: *aman*, *fai*, *viu*. Yet in the northern zone we find the *t* retained in the 3rd per. pl. of verbs, *-ant*, *-ont* (Lat. -ant, -unt). *H* has gone completely (or at least only appears through orthographic tradition, and very intermittently, (*h*)*erba*, (*h*)*onor*, (*h*)*umil*, &c.), not only in words of Latin origin, which is the case in Old French, but even in Teutonic words (*anta*, *ardit*, *arenc*, *ausberc*, *elm*, Fr. *honte*, *hardi*, *hareng*, *haubert*, *heaume*, with *h* aspirated). By this feature, the northern limits of which are not yet well determined, the Provençal attaches itself to the Romanic of the southern countries. *N* final, or standing in Latin between two vowels of which the second is to be dropped, disappears in the whole central part of the Pr. domain: *gran gra*, *ben be*, *en e*, *ven ve*, *fin fi*, *un u* (granum, bene, in, venit, finem, unum). The forms with *n* belong to the eastern part (left of the Rhone), the western part (Gascony, but not Béarn), and the region of the Pyrenees. It is possible that this loss of *n* went along with a lengthening of final vowel; at least, in Béarnese when the *n* falls away the vowel is doubled: *caperaa*, *besii*, *boo* (capellānum, vicīnum, bonum), &c.

These are the most important characteristics of the consonants in relation to the extent of space over which they prevail. Others, which appear only within a more limited area, are perhaps more curious on account of their strangeness. It will suffice to mention a few which belong to the district bounded on the west and south by the Atlantic, the Basque provinces and the Pyrenees, and which extends northward and eastward towards the Garonne and its affluents, as far as the Gironde. (This includes Béarn, Bigorre and Gascony.) Here the sound *v* no longer exists, being replaced generally by *b*; between two vowels, in Gascony, by *u* with the sound of English *w*. Initial *r* assumes a prosthetic *a*: *arram*, *arre*, *Arrobert* (rāmum, rem, Robertum). *Ll* between two vowels becomes *r*: *aperar*, *caperan*, or (Béarn) *caperaa*, *bera*, *era* (apellare, capellanum, bella, illa). On the contrary, at the end of words (viz. in Romanic) *ll* becomes *g* or *t*, *d*; the former change seems to belong rather to Hautes and Basses Pyrénées, Landes, the latter to Gironde, Lot et Garonne, Gers: *eg*, *ed*, *et* (ille), *arrasteg*, *-ed*, *-et* (rastellum), *casteg*, *-ed*, *-et* (castellum), *capdeg*, *-ed*, *-et* (capitellum), whence Fr. *cadet* (in 16th century *capdet*, originally a Gascon word). For further details upon the consonants in this region of south-west France see *Romania*, iii. 435–438, v. 368–369.

Flexion.—Old Provençal has, like Old French, a declension consisting of two cases for each number, derived from the Latin nominative and accusative. In certain respects this declension is more in conformity with etymology in Provençal than in Old French, having been less influenced by analogy. The following are the types of this declension, taking them in the order of the Latin declensions. (1) Words in *-a* coming from Latin 1st decl., increased by certain words coming from Latin neuter plurals treated in Prov. as feminine singulars; one form only for each number: sing. *causa*, pl. *causas*. (2) Words of the Latin 2nd decl., with a few from the 4th; two forms for each number: sing. subject *cavals* (caballus), object *caval* (caballum); pl. subject *caval* (caballi), object *cavals* (caballos. (3) Words of Latin 3rd decl. Here there are three Latin types to be considered. The first type presents the same theme and the same accentuation in all the cases, *e.g.* canis. The second presents the same accentuation in the nominative singular and in the other cases, but the theme differs: co·mes, co·mitem. In the third type the accentuation changes: pecca·tor, peccatō·rem. The first type is naturally confounded with nouns of the 2nd decl.: sing. subj. *cans* or *cas*, obj. *can* or *ca*. The second and third types are sometimes followed in their original variety; thus *coms* answers to co·mes, and *co·mte* to co·mitem. But it has often happened that already in vulgar Latin the theme of the nominative singular had been refashioned after the theme of the oblique cases. They said in the nom. sing. heredis, parentis, principis, for heres, parens, princeps. Consequently the difference both of theme and of accentuation which existed in Latin between nominative and accusative has disappeared in Pr. This reconstruction of the nominative singular after the theme of the other cases takes place in all Latin words in *-as* (except *abbas*), in those in *-io*, in the greater part of those in *-or*, at least in all those which have an abstract meaning. Thus we obtain *bontatz* (bonitatis for bonitas) and *bontat* (bonitatem), *ciutatz* (civitatis for civitas) and *ciutat* (civitatem), *amors* (amoris for amor) and *amor* (amorem). All present participles in the subject case singular are formed in this way upon refashioned Latin nominatives: *amans* (amantis for amans), *amant* (amantem). It is to be remarked that in regard to feminine nouns Pr. is more etymological than French. In the latter feminine nouns have generally only one form for each number: *bonté* for the subj. as well as for the obj. case, and not *bontés* and *bonté*; in Pr. on the contrary *bontatz* and *bontat*. Still, in a large number of nouns the original difference of accentuation between the nominative singular and the other cases has been maintained, whence there result two very distinct forms for the subjunctive and objective cases. Of these words it is impossible to give a full list here; we confine ourselves to the exhibition of a few types, remarking that these words are above all such as designate persons: *a·bas aba·t*, *pa·stre pasto·r*, *sor soro·r*, *cantai·re cantado·r* (cantātor, -ōrem), *emperai·re emperad·or*, *bar baro·*, *compa·nh companho·*, *lai·re lairo·* (latro, -ōnem). To this class belong various proper names: *E·ble Eblo·*, *Gui Guio·*, *Uc Ugo·*. A few have even come from the 2nd decl., thus *Pei·res Peiro·*, *Pons Ponso·*, *Ca·rles*, *Carlo*, the vulgar Latin types being Petrus, -ōnem, Pontius, -ōnem, Carolus, -ōnem. (On this peculiarity of the vulgar Latin declension, see Philipon, in *Romania*, xxxi. 213–228.) We may mention also geographical adjectives, such as *Bret Breto·*, *Bergo·nhz Bergonho·*, *Gasc Gasco·*, &c. The plural of the 3rd decl. is like that of the second: subj. *aba·t*, *soro·r*, *cantado·r*, *emperado·r*, *baro·*, *companho·*, *lairo·*; obj. *aba·tz*, *soro·rs*, *cantado·rs*, *emperado·rs*, *baro·s*, *companho·s*, *lairo·s*, as if the Latin nominative pl. had been abbāti, sorōri, cantatōri, &c. It is barely possible that such forms actually existed in vulgar Latin; no trace of them, however, is found in the texts, save in the glosses of Cassel (8th century), sapienti for sapientes, and in a great many ancient charters parentorum, which implies a nominative parenti. The words of the 4th and 5th declensions present no points requiring mention here.

This declension of two cases is a notable character of the whole Romanic of Gaul, north as well as south, *i.e.* French as well as Provençal. It must be noted, however, that in the south-west it existed only in a very restricted measure. In the old texts of Gascony it is no longer general in the 13th century. In Béarn it appears to have been completely unknown, the nouns and adjectives having only one form, usually that of the objective case. In Catalan poetry its application is often laid down in the 13th century, but as the charters and documents free from literary influence show no trace of it, its introduction into the poetry of this country may be assumed to be an artificial fact. In the region where it is best observed, *i.e.* in the centre and north of the Provençal territory, it tends to disappear from ordinary use already in the 13th century. The poet-grammarian Raimon Vidal of Besalù, who flourished about the middle of the century, points out in various troubadours transgressions of the rules of declension, and recognizes that in colloquial speech they are no longer observed. The general tendency was to retain only a single form, that of the objective case. For certain words, however, it was the subjunctive form which survived. Thus in modern Pr. the words in the ending *-ai·re* (answering to Lat. -ator) are as frequent as those in *-adou·* (repr. -atōrem). But there is a slight difference of meaning between these two suffixes.

Adjectives, generally speaking, agree in flexion with the nouns. But there is one fact particular to adjectives and past participles which is observed with more or less regularity in certain 12th and 13th-century texts. There is a tendency to mark more clearly than in the substantives the flexion of the subj. pl., chiefly when the adjective or participle is employed predicatively. This is marked by the addition of an *i*, placed, according to the district, either after the final consonant, or else after the last vowel so as to form a diphthong with it. The following are examples from an ancient translation of the New Testament (MS. in library of the Palais Saint-Pierre, Lyons, end of 13th century): " Dic a vos que no siatz *consirosi* " (ne solliciti sitis, Matt. vi. 25); " que siatz *visti* d'els " (ut videamini ab eis, Matt. vi. 1); " e davant los reis els princeps seretz *menadi* " (et ad praesides et ad reges ducemini, Matt. x. 18). In charters of the 12th and 13th centuries we find in the subj. case pl., and especially in this predicative use, *pagaig*, *certifiaih*, *acossailhaih*, representing pagati, certificati, adconsiliati.

A similar peculiarity is noticeable also in masculine substantives, but appears only in a very limited number of texts; so *auzil*, *auzelh* [Lat. avicelli] (see A. Thomas, in *Romania*, xxxiv. 353).

It is in the verbs that the individuality of the different Romanic idioms manifests itself most distinctly. At a very early date the etymological data were crossed, in various directions and divers manners according to the country, by analogical tendencies. The local varieties became little by little so numerous in the Romanic conjugation that it is not easy to discover any very characteristic features observed over a territory so vast as that of which the limits have been indicated at the commencement of this article. The following are, however, a few.

The infinitives are in *-ar*, *-ér*, *-re*, *-ir*, corresponding to the Lat. -āre, -ēre, -ĕre, -īre, respectively; as in the whole Romanic domain, the conjugation in *-ar* is the most numerous. The table of verbs, which forms part of the Pr. grammar called the *Donatz Proensals* (13th century), contains 473 verbs in *-ar*, 101 in *-ér* and *-re*, 115 in *-ir*. In the *-ar* conjugation we remark one verb from another conjugation: *far* (cf. Ital. *fare*) from facere. The conjugations in *-ér* and *-re* encroach each upon the territory of the other. The three Lat. verbs cadĕre, capĕre, sapĕre have become *-ér* verbs (*caze·r*, *cabe·r*, *sabe·r*) as in Fr. *cheoir*, *-cevoir* (*recevoir*), *savoir*; and several other verbs waver between the two: *crede·r*, *creer*, and *crei·re* (cre·dĕre), *quere·r* and *que·rre* (quaerĕre). This fluctuation is most frequent in the case of verbs which belonged originally to the *-ēre* conjugation: *arde·r* and *a·rdre*, *plaze·r* and *plai·re*, *taze·r* and *tai·re* (ardēre, placēre, tacēre). Next to the *-ar* conjugation, that in *-ir* is the one which has preserved most formative power. As in the other Romanic languages, it has welcomed a large number of German verbs, and has attracted several verbs which etymologically ought to have belonged to the conjugations in *-ér* and *-re*: *emplir* im-plēre), *jauzir* (gaudēre), *cosir* (consuēre), *erebir* (eri-pĕre), *fugir* (fugĕre), *seguir* (*sequĕre=sequi) also *segre*.

Except in the *-ar* conjugation, the ending of the infinitive does not determine in a regular manner the mode of forming the different tenses. The present participles are divided into two series: those in *-an* (obj. sing.) for the first conj., those in *-en* for the others. In this the Pr. distinguishes itself very clearly from the French, in which all present participles have *-ant*. There is also in Pr. a participial form or verbal adjective which is not met with in any other Romanic language, except Rumanian, where, moreover, it is employed in a different sense; this is a form in *-do·r*, *-doi·ra*, which supposes a Latin type -tōrius, or -tŭrius; the sense is that of a future participle, active for the intransitive verbs, passive for the transitive: *endevenido·r*, *-doi·ra*, "that is to happen"; *fazedo·r*, *-doi·ra*, "that is to be done"; *punido·r*, *-doi·ra*, "to be punished." In conjugation properly so called we may remark the almost complete disappearance of the Lat. preterite in *-āvi*, of which traces are found only in texts written in the neighbourhood of the French-speaking region, and in Béarn. In return, a preterite which seems to have been suggested by the Latin dĕdi, stĕti, has increased and become the type of the tense almost everywhere in the *-ar* conjugation, and in many verbs in *-ér* and *-re*: *amei·*, *ame·st*, *ame·t*, *ame·m*, *ame·tz*, *ame·ron*. In French there is a form like this, or at least having the same origin, only in a small number of verbs, none of which belong to the first conjugation, and in these only in the 3rd pers. sing. and pl. (*perdiét*, *perdierent*; *entendiét*, *entendierent*, &c.). It is well known that reduplicated preterites had greatly multiplied in vulgar Latin: there have been recovered such forms as ascendiderat, ostendedit, pandiderunt, adtendedit incendiderat, &c. (see Schuchardt, *Vokalismus des Vulgarlateins*, i. 35, iii. 10; cf. *Romania*, ii. 477). But, in order to explain the Pr. form *-ei*, *-est*, *-et* (with open *è*), we must suppose a termination not in -ĭdi or -ēdi, but in -ĕ·di. In the western region the 3rd pers. sing. is generally in *-ec*, probably by analogy with preterites like *bec*, *crec*, *dec*, *sec*, formed after the Latin type in -ui. Another notable peculiarity, of which Old French shows only rare traces, in texts of a very remote period, is the preservation of a preterite in *-ara* or *-era*, derived from the Latin pluperfect, *ama·ra* or *ame·ra*, "I loved." The former, which is rare, comes directly from Lat. amâram, the latter has been influenced by the ordinary preterite in *-ei*. This preterite is used with the sense of a simple past, not of a pluperfect, and consequently is an exact doublet of the ordinary preterite, which explains how it was at length eliminated almost everywhere by the latter, of which it was a mere synonym. But it remained in general use with the sense of a past conditional: *ama·ra* or *ame·ra*, "I should have loved," *fora*, "I should have been."

3. *Modern Provençal.*—In consequence of political circumstances the Provençal ceased to be used for administrative as well as literary purposes about the 15th century, in some places a little sooner, in others later (notably in Béarn, where it continued to be written as the language of ordinary use till the 17th, and even in some places till the 18th century). The poems in local dialect composed and printed in the 16th century, and on to our own day, have no link with the literature of the preceding period. Reduced to the condition of a *patois*, or popular dialect simply, the idiom experienced somewhat rapid modifications. Any one who should compare the poems of Goudelin of Toulouse (1579–1649) with those of a Toulousain troubadour of the 13th century would be astonished at the changes which the language has undergone. Yet this impression would probably be exaggerated. In order to make a rigorously accurate comparison of the language at the two epochs, it would have to be written in the two cases with the same orthographic system, which it is not. The first writers of Provençal, about the 10th and 11th century, applied to the language the Latin orthography, preserving to each letter, as far as possible, the value given to it in the contemporary pronunciation of Latin. To express certain sounds which did not exist in Latin, or which were not there clearly enough noted, there were introduced little by little, and without regular system, various conventional symbolizations such as *lh* and *nh* to symbolize the sound of *l* and *n mouillées*. From this method of proceeding there resulted an orthographic system somewhat wanting in fixity, but which from its very instability lent itself fairly well to the variations which the pronunciation underwent in time and locality. But, the tradition having been interrupted about the 15th century, those who afterwards by way of pastime attempted composition in the *patois* formed, each for himself apart, an orthography of which many elements were borrowed from French usage. It is evident that differences already considerable must be exaggerated by the use of two very distinct orthographical systems. Nevertheless, even if we get quit of the illusion which makes us at first sight suppose differences of sound where there are merely different ways of spelling the same sound, we find that between the 14th and 16th centuries the language underwent everywhere, Béarn excepted, great modifications both in vocabulary and grammar. The Provençal literature having gradually died out during the 14th century, the vocabulary lost rapidly the greater part of the terms expressing general ideas or abstract conceptions. To supply the place of these, the authors who have written in the *patois* of the south during the last few centuries have been obliged to borrow from French, modifying at the same time their form, a multitude of vocables which naturally have remained for the most part unintelligible to people who know only the *patois*. In this case the adoption of foreign words was excusable; but it did not stop here. Little by little, as primary instruction (now compulsory) was diffused, and introduced, first in the towns and afterwards in the villages, certain knowledge of French, words purely French, have been introduced into use in place of the corresponding dialect words. Thus, one hears constantly in Provence *pè·ro*, *mè·ro*, *frè·ro*, forms adapted from French, instead of *paire*, *maire*, *fraire*, *cacha* (*catsha·* = Fr. *cacher*) instead of *escoundre*, &c.

In the phonology, the modifications are of the natural order, and so have nothing revolutionary. The language has developed locally tendencies which certainly already existed during the flourishing period, although the ancient orthography did not recognize them. Of the vowels, *a* tonic is generally preserved; *an* in an open syllable becomes *ò* (open) in part of the departments of Aveyron, Lot, Dordogne, Corrèze, Cantal and south of Haute Loire: *gro* (granum), *mo* (manum), *po* (panem). This nasalized *a* must have had a particular sound already in O. Pr., for it is qualified in the *Donatz Proensals* (ed. Stengel, p. 49) as *a estreit* (= close or narrow *a*). A feature almost general is the passage of post-tonic *a* into *o*: *terro*, *amavo*, *amado* (terra, amabat, amata). In many places, particularly in the east, examples of this change occur as early as the end of the 15th century. But even yet there are a few cantons, notably Montpellier and its neighbourhood, and also Nice, where the ancient post-tonic *a* is preserved. It is remarkable that the Latin diphthong *au*, which had become simple *o* in almost all Romanic lands at the date of the most ancient texts, is to this day preserved with a very distinct diphthongal sound everywhere in the south of France.

In the morphology, the leading feature of modern Provençal is the ever greater simplification of grammatical forms. Not only have the two forms (nominative and objective) in each number, in nouns and adjectives, been reduced to one—this reduction manifested itself in ordinary use already in the 14th century—but in many places there no longer remains any distinction between the singular and the plural. In a great part of the south *ieu* (e g o) does duty as an objective, *me* or *mi* being very restricted in use. In part of Drôme it is the other way, *mi* being substituted in the nominative for *ieu*, which it has completely displaced. It is perhaps in conjugation that the greatest changes from the older form of the language are seen. Analogy, basing itself upon one or another much used form, has acted with immense force, tending to make general in the whole conjugation, without any regard to the original classes to which the various verbs belonged, certain terminations, chiefly those which were accented, and thus appeared to the popular instinct to have more significance. The result, if the tendency were carried the full length, would be the reduction of all the three conjugations to one. Perhaps before this point is reached the *patois* of the south will themselves have disappeared. As the endless modifications which the language undergoes, in vocabulary and grammar alike, develop themselves in different directions, and each over an area differently circumscribed, the general aspect of the language becomes more and more confused, without the possibility of grouping the endless varieties within dialectal divisions, there being hardly any case in which a certain number of phonetic or morphological facts present themselves within the same geographical limits. The custom has been adopted of roughly designating these varieties by the name of the ancient provinces in which they appear. *Limousin* (divided into *High* and *Low Limousin*), *Marchese*, *Auvergnese*, *Gascon*, *Béarnese*, *Rouergat*, *Languedocian*, *Provençal*, &c.; but these divisions, though convenient in use, correspond to no actualities. Nîmes and Montpellier are in Languedoc, and Arles and Tarascon are in Provence; nevertheless the dialect of Nîmes resembles that of Arles and Tarascon more than that of Montpellier.

Texts.—For the history of the Provençal in all its varieties there are many more materials than for any other Romanic language, not excepting even Italian or French. The literary texts go back to the 10th or 11th century (see below). For phonetic purposes many of these texts are of secondary value, because the MSS. in which they have reached us, and several of which, especially for the poetry of the troubadours, are of Italian origin, have altered the original forms to an extent which it is not easy to determine; but we possess a countless number of charters, *coutumes*, regulations, accounts, registers of taxation, which are worthy of absolute confidence—first, because these documents are in most cases original, and, secondly, because, none of the dialectical varieties having raised itself to the rank of the literary language, as happened in France with the central (Parisian) variety and in Italy with the Florentine, writers never had the temptation to abandon their own idiom for another. For a selection of that kind of documents see P. Meyer, *Documents linguistiques du midi de la France* (vol. i., 1909, in 8vo, containing the documents of Ain, Basses Alpes, Hautes Alpes, Alpes Maritimes). It is proper to add that Provençal possesses two ancient grammars of the 13th century (the earliest compiled for any Romanic idiom)—the *Donatz proensals* and *Razos de trobar* (see below, PROVENÇAL LITERATURE). Although very short, especially the second, which is a collection of detached observations, they furnish valuable data. The 14th-century *Leys d'amors* presents the language in a somewhat artificial state—the written rather than the spoken language.

BIBLIOGRAPHY: 1. *Ancient Condition.*—There does not exist any comprehensive work upon the Provençal whence to obtain a precise idea of the history of the language at its different epochs. Diez's *Grammatik der romanischen Sprachen* is still the groundwork. It gives, especially in the 3rd ed. (1869–1872), the last revised by the author, the results of extensive researches conveniently arranged. But Diez had only a slender knowledge of the language in its present state, and in his time phonology had made little progress. The French translation of MM. G. Paris, A. Brachet and Morel-Fatio (Paris, 1873–1876) was to be completed by a supplementary volume, but this expedient had to be abandoned, it having been recognized that what was wanted was not a supplement but a general recast. Meyer-Lübke's *Grammatik der romanischen Sprachen* (Leipzig, 1890–1899; Fr. trans., with indexes, 1890–1906), though representing a more advanced state of Romance philology, is marred by an unusual number of inaccuracies, and is of little use for the study of Provençal. The "Recherches philologiques sur la langue romane," and "Résumé de la grammaire romane," published by Raynouard at the beginning of vol. i. of his *Lexique roman* (1838), are entirely out of date. The "Tableau sommaire des flexions provençales," published by K. Bartsch, in the *Chrestomathie provençale*, though much improved in later editions, is incomplete and often erroneous. Better is the *introduzione grammaticale* to V. Crescini's *Manualetto provenzale* (2nd ed., 1905). Grandgent's *Outline of the Phonology and Morphology of Old Provençal* (Boston, 1905) is also to be recommended. But the actual state of our knowledge of ancient Provençal must be sought in a great number of scattered dissertations or monographs, which will be found especially in the *Romania*, the *Revue de la société pour l'étude des langues romanes*, and other periodicals, to which may be added some academic dissertations published mainly in Germany, and the special studies upon the language of particular texts prefixed to editions of these. As to dictionaries, the *Lexique roman, ou dictionnaire de la langue des troubadours*, by Raynouard (6 vols. 8vo, Paris, 1836–1844), can always be used with advantage. It has been largely supplemented by Professor E. Levy in his *Provenzalisches Supplement-Wörterbuch* (5 vols., Leipzig, 1892–1910, stops actually at letter P). The numerous special vocabularies appended by editors to texts published by them cannot be neglected. These yield a considerable number of words, either wanting or wrongly explained in the *Lexique roman.*

2. *Modern Form.*—The most useful grammatical works (all done with insufficient knowledge of phonology, and under the preconceived idea that there exist dialects with definite circumscription) are J. B. Andrews, *Essai de grammaire du dialecte mentonais* [Mentone] (Nice, 1878), see also his "Phonétique mentonaise," in *Romania*, xii. 394; Cantagrel, "Notes sur l'orthographie et la prononciation languedocienne," prefixed to *La Canson de la Lauseto*, by A. Mir (Montpellier, 1876); Chabaneau, *Grammaire limousine* (Paris, 1876), referring especially to the variety of Nontron, in the north of Périgord (Dordogne); Constans, *Essai sur l'histoire du sous-dialecte du Rouergue* (Montpellier and Paris, 1880); Lespy, *Grammaire béarnaise* (2nd ed., Paris, 1880); A. Luchaire, *Études sur les idiomes pyrénéens de la région française* (Paris, 1879); Moutier, *Grammaire dauphinoise, dialecte de la vallée de la Drôme* (Montelimar, 1882); Ruben, "Étude sur le patois du Haut Limousin," prefixed to *Poems* by J. Foucaud, in the Limousin *patois* (Limoges, 1866). Far superior in every respect are Alfred Dauzat's essays on the language of North Auvergne: *Phonétique historique du patois de Vinzelles* (Paris, 1897), *Morphologie du patois de Vinzelles* (Paris, 1900), *Géographie phonétique d'une région de la Basse Auvergne* (Paris, 1906). As to dictionaries, we may mention, among others, Andrews, *Vocabulaire français-mentonais* (Nice, 1877); Azais, *Dictionnaire des idiomes romans du midi de la France* (3 vols. 8vo, Montpellier, 1877), taking for its basis the dialect of Béziers; Chabrand and De Rochas d'Aiglun, *Patois des Alpes Cottiennes et en particulier du Queyras* (Grenoble and Paris, 1877); Couzinié, *Dictionnaire de la langue romane-castraise* (Castres, 1850); Garcin, *Nouveau dictionnaire provençal-français* (2 vols., Draguignan, 1841); Honnorat, *Dictionnaire provençal-française* (2 vols. 4to, Digne, 1846–1847), De Sauvages, *Dictionnaire languedocien-français* (new ed., 2 vols., Alais, 1820); Vayssier, *Dictionnaire patois-français du département de l'Aveyron* (Rodez, 1879). F. Mistral's *Tresor dou Felibrige, ou dictionnaire provençal-français* (2 vols. 4to, 1880–1888) is the most complete of all. This dictionary takes as its basis the variety of Maillane (in the north of Bouches-du-Rhône), the author's native district, but gives, as far as possible, all the forms used in the south of France. It is by far the best of all the dictionaries of the southern dialects which have yet been published, and, to a great extent, will enable the student to dispense with all the others. (P. M.)

PROVENÇAL LITERATURE. Provençal literature is much more easily defined than the language in which it is expressed. Starting in the 11th and 12th centuries in several centres it thence gradually spread out, first over the greater portion, though not the whole of southern France, and then into the north of Italy and Spain. It never felt the influence of the neighbouring literatures. At the time of its highest development (12th century) the art of composing in the vulgar tongue did not exist, or was only beginning to exist, to the south of the Alps and the Pyrenees. In the north, in the country of French speech, vernacular poetry was in full bloom; but between the districts in which it had developed—Champagne, Île de France, Picardy and Normandy—and the region in which Provençal literature had sprung up, there seems to have been an intermediate zone formed by Burgundy, Bourbonnais, Berry, Touraine and Anjou which, far on in the middle ages, appears to have remained almost barren of vernacular literature. In its rise Provençal literature stands completely by itself, and in its development it long continued to be absolutely original. It presents at several points genuine analogies with the sister-literature of northern France; but these analogies are due principally to certain primary elements common to both and only in a slight degree to mutual reaction.

It must be inquired, however, what amount of originality could belong to any, even the most original, Romantic literature in the middle ages. In all Romanic countries compositions in the vernacular began to appear while the custom of writing in Latin was still preserved by uninterrupted tradition. Even during the most barbarous periods, when intellectual life was at its lowest, it was in Latin that sermons, lives of saints more or less apocryphal, accounts of miracles designed to attract pilgrims to certain shrines, monastic annals, legal documents, and contracts of all kinds were composed. When learning began to revive, as was the case in northern and central France under the influence of Charlemagne and later in the 11th century, it was Latin literature which naturally received increased attention, and the Latin language was more then ever employed in writing. Slowly and gradually the Romanic languages, especially those of France, came to occupy part of the ground formerly occupied by Latin, but even after the middle ages had passed away the parent tongue retained no small portions of its original empire. Consequently Romanic literatures in general (and this is especially true of Provençal, as it does not extend beyond the medieval period) afford only an incomplete representation of the intellectual development of each country. Those literatures even which are most truly national, as having been subjected to no external influence, are only to a limited extent capable of teaching us what the nation was. They were, in short, created in the interests of the illiterate part of the people, and to a considerable degree by men themselves almost devoid of literary learning. But that does not make them less interesting.

Origin.—It was in the 11th century, and at several places in the extensive territory whose limits have been described in the foregoing account of the Provençal language, that Provençal literature first made its appearance. It took poetic form; and its oldest monuments show a relative perfection and a variety from which it may be concluded that poetry had already received a considerable development. The oldest poetic text, of which the date and origin are not surely determined, is said to be a Provençal burden (Fr. *refrain*) attached to a Latin poem which has been published (*Zeitschrift für deutsche Philologie*, 1881, p. 335) from a Vatican MS., written, it is asserted, in the 10th century. But it is useless to linger over these few words, the text of which seems corrupt, or at least has not yet been satisfactorily interpreted. The honour of being the oldest literary monument of the Provençal language must be assigned to a fragment of two hundred and fifty-seven decasyllabic verses preserved in an Orleans MS. and frequently edited and annotated since it was first printed by Raynouard in 1817 in his *Choix des poésies originales des troubadours*. The writing of the MS. is of the first half of the 11th century. The peculiarities of the language point to the north of the Provençal region, probably Limousin or Marche. It is the beginning of a poem in which the unknown author, taking Boethius's treatise *De consolatione philosophiae* as the groundwork of his composition, adopts and develops its ideas and gives them a Christian colouring of which there is no trace in the original. Thus from some verses in which Boethius contrasts his happy youth with his afflicted old age he draws a lengthy homily on the necessity of laying up from early years a treasure of good works. The poem is consequently a didactic piece composed by a "clerk" knowing Latin. He doubtless preferred the poetic form to prose because his illiterate contemporaries were accustomed to poetry in the vulgar tongue, and because this form was better adapted to recitation; and thus his work, while a product of erudition in as far as it was an adaptation of a Latin treatise, shows that at the time when it was composed a vernacular poetry was in existence. A little later, at the close of the same century, we have the poems of William IX., count of Poitiers, duke of Guienne. They consist of eleven very diverse strophic pieces, and were consequently meant to be sung. Several are love songs; one relates a *bonne fortune* in very gross terms; and the most important of all—the only one which can be approximately dated, being composed at the time when William was setting out for Spain to fight the Saracens (about 1119) —expresses in touching and often noble words the writer's regret for the frivolity of his past life and the apprehensions which oppressed him as he bade farewell, perhaps for ever, to his country and his young son. We also know from Ordericus Vitalis that William IX. had composed various poems on the incidents of his ill-fated expedition to the Holy Land in 1101. And it must further be mentioned that in one of his pieces (*Ben voil que sapchon li plusor*) he makes a very clear allusion to a kind of poetry which we know only by the specimens of later date, the *partimen*, or, as it is called in France, the *jeu parti*. William IX. was born in 1071 and died in 1127. There is no doubt that the most prolific period of his literary activity was his youth. On the other hand there is no reason to believe that he created the type of poetry of which he is to us the oldest representative. It is easy to understand how his high social rank saved some of his productions from oblivion whilst the poems of his predecessors and contemporaries disappeared with the generations who heard and sang them; and in the contrast in form and subject between the Boethius poem and the stanzas of William IX. we find evidence that by the 11 century Provençal poetry was being rapidly developed in various directions. Whence came this poetry? How and by whose work was it formed? That it has no connexion whatever with Latin poetry is generally admitted. There is absolutely nothing in common either in form or ideas between the last productions of classical Latinity, as they appear in Sidonius Apollinaris or Fortunatus, and the first poetic compositions in Romanic. The view which seems to meet with general acceptance, though it has not been distinctly formulated by any one, is that Romanic poetry sprang out of a popular poetry quietly holding its place from the Roman times, no specimen of which has survived—just as the Romanic languages are only continuations with local modifications of vulgar Latin. There are both truth and error in this opinion. The question is really a very complex one. First as to the form Romanic versification, as it appears in the Boethius poem and the verses of William IX., and a little farther north in the poem of the *Passion* and the *Life of St Leger* (10th or 11th century), has with all its variety some general and permanent characteristics; it is rhymed, and it is composed of a definite number of syllables certain of which have the syllabic accent. This form has evident affinity with the rhythmic Latin versification, of which specimens exist from the close of the Roman Empire in ecclesiastical poetry. The exact type of Romanic verse is not found, however, in this ecclesiastical Latin poetry; the latter was not popular. However, it may be assumed that there was a popular variety of rhythmic poetry from which Romanic verse is derived.

Again, as regards the substance, the poetic material, we find nothing in the earliest Provençal which is strictly popular. The extremely personal compositions of William IX. have nothing in common with folk-lore. They are subjective poetry addressed to a very limited and probably rather aristocratic audience. The same may be said of the Boethius poem, though it belongs to the quite different species of edifying literature; at any rate it is not popular poetry. Vernacular compositions seem to have been at first produced for the amusement, or in the case of religious poetry, for the edification, of that part of lay society which had leisure and lands, and reckoned intellectual pastime among the good things of life. Gradually this class, intelligent, but with no Latin education, enlarged the circle of its ideas. In the 12th century, and still more in the 13th, historical works and popular treatises on contemporary science were composed for its use in the only language it understood; and vernacular literature continued gradually to develop partly on original lines and partly by borrowing from the literature of the "clerks." But in the 11th century vernacular poetry was still rather limited, and has hardly any higher object than the amusement or the edification of the upper classes. An aristocratic poetry, such as it appears in the oldest Provençal compositions, cannot be the production of shepherds and husbandmen; and there is no probability that it was invented or even very notably improved by William IX.

From what class of persons then did it proceed? Latin chroniclers of the middle ages mention as *joculares*, *joculatores*, men of a class not very highly esteemed whose profession consisted in amusing their audience either by what we still call jugglers' tricks, by exhibiting performing animals, or by recitation and song. They are called *joglars* in Provençal, *jouglers* or *jougleors* in French. A certain Barnaldus, styled *joglarius*, appears as witness in 1058 to a charter of the chartulary of St Victor at Marseilles. In 1106 the act of foundation of a *salva terra* in Rouergue specifies that neither knight nor man-at-arms nor *joculator* is to reside in the village about to be created. These individuals—successors of the *mimi* and the *thymelici* of antiquity, who were professional amusers of the public—were the first authors of poetry in the vernacular both in the south and in the north of France. To the upper classes who welcomed them to their castles they supplied that sort of entertainment now sought at the theatre or in books of light literature. There were certain of them who, leaving buffoonery to the ruder and less intelligent members of the profession, devoted themselves to the composition of pieces intended for singing, and consequently in verse. In the north, where manners were not so refined and where the taste for warlike adventure prevailed, the jongleurs produced *chansons de geste* full of tales of battle and combat. In the courts of the southern nobles, where wealth was more abundant and a life of ease and pleasure was consequently indulged in, they produced love songs. There is probably a large amount of truth in the remark made by Dante in ch. xxv. of his *Vita nuova*, that the first to compose in the vulgar tongue did so because he wished to be understood by a lady who would have found it difficult to follow Latin verses.[1] And in fact there are love songs among the pieces by William of Poitiers; and the same type preponderates among the compositions of the troubadours who came immediately after him. But it is worthy of note that in all this vast body of love poetry there is no epithalamium nor any address to a marriageable lady. The social conditions of the south of France in the feudal period explain in great measure the powerful development of this kind of poetry, and also its peculiar characteristics—the profound respect, the extreme deference of the poet towards the lady whom he addresses. Rich heiresses were married young, often when hardly out of their girlhood, and most frequently without their fancy being consulted. But they seem after marriage to have enjoyed great liberty. Eager for pleasure and greedy of praise, the fair ladies of the castle became the natural patronesses of the *mesnie* or household of men-at-arms and jongleurs whom their husbands maintained in their castles. Songs of love addressed to them soon became an accepted and almost conventional form of literature; and, as in social position the authors were generally far below those to whom they directed their amorous plaints, this kind of poetry was always distinguished by great reserve and an essentially respectful style. From the beginning the sentiments, real or assumed, of the poets are expressed in such a refined and guarded style that some historians, over-estimating the virtue of the ladies of that time, have been misled to the belief that the love of the troubadour for the mistress of his thoughts was generally platonic and conventional.

The conditions under which Romanic poetry arose in the south of France being thus determined as accurately as the scarcity of documents allows, we now proceed to give a survey of the various forms of Provençal literature, chronological order being followed in each division. By this arrangement the wealth of each form will be better displayed; and, as it is rare in the south of France for the same person to distinguish himself in more than one of them, there will be generally no occasion to introduce the same author in different sections.

Poetry of the Troubadours.—Though he was certainly not the creator of the lyric poetry of southern France, William, count of Poitiers, by personally cultivating it gave it a position of honour, and indirectly contributed in a very powerful degree to ensure its development and preservation. Shortly after him centres of poetic activity make their appearance in various places—first in Limousin and Gascony. In the former province lived a viscount of Ventadour, Eble, who during the second part of William of Poitiers's life seems to have been brought into relation with him, and according to a contemporary historian, Geffrei, prior of Vigeois, *erat valde gratiosus in cantilenis.* We possess none of his compositions; but under his influence Bernart of Ventadour was trained to poetry, who, though only the son of one of the serving-men of the castle, managed to gain the love of the lady of Ventadour, and when on the discovery of their amour he had to depart elsewhere, received a gracious welcome from Eleanor of Guienne, consort (from 1152) of Henry II. of England. Of Bernart's compositions we possess about fifty songs of elegant simplicity, some of which may be taken as the most perfect specimens of love poetry Provençal literature has ever produced. Bernart must therefore have been in repute before the middle of the 12th century; and his poetic career extended well on towards its close. At the same period, or probably a little earlier, flourished Cercamon, a poet certainly inferior to Bernart, to judge by the few pieces he has left us, but nevertheless of genuine importance among the troubadours both because of his early date and because definite information regarding him has been preserved. He was a Gascon, and composed, says his old biographer, "pastorals" according to the ancient custom (*pastorelas a la uzansa antiga*). This is the record of the appearance in the south of France of a poetic form which ultimately acquired large development. The period at which Cercamon lived is determined by a piece where he alludes very clearly to the approaching marriage of the king of France, Louis VII., with Eleanor of Guienne (1137). Among the earliest troubadours may also be reckoned Marcabrun, a pupil of Cercamon's, from whose pen we have about forty pieces, those which can be approximately dated ranging from 1135 to 1148 or thereabout. This poet has great originality of thought and style. His songs, several of which are historical, are free from the commonplaces of their class, and contain curious strictures on the corruptions of the time.

We cannot here do more than enumerate the leading troubadours and briefly indicate in what conditions their poetry was developed and through what circumstances it fell into decay and finally disappeared: Peter of Auvergne (Peire d'Alvernha), who in certain respects must be classed with Marcabrun; Arnaut Daniel, remarkable for his complicated versification, the inventor of the *sestina*, a poetic form for which Dante and Petrarch express an admiration difficult for us to understand; Arnaut of Mareuil, who, while less famous than Arnaut Daniel, certainly surpasses him in elegant simplicity of form and delicacy of sentiment; Bertran de Born, now the most generally known of all the troubadours on account of the part he is said to have played both by his sword and his *sirventescs* in the struggle between Henry II. of England and his rebel sons, though the importance of his part in the events of the time seems to have been greatly exaggerated; Peire Vidal of Toulouse, a poet of varied inspiration who grew rich with gifts bestowed on him by the greatest nobles of his time; Guiraut de Borneil, *lo maestre dels trobadors*, and at any rate master in the art of the so-called "close" style (*trobar clus*), though he has also left us some songs of charming simplicity; Gaucelm Faidit, from whom we have a touching lament (*planh*) on the death of Richard Cœur de Lion; Folquet of Marseilles, the most powerful thinker among the poets of the south, who from being a troubadour became first a monk, then an abbot, and finally bishop of Toulouse (d. 1231).

It is not without interest to discover from what class of society the troubadours came. Many of them, there is no doubt, had a very humble origin. Bernart of Ventadour's father was a servant, Peire Vidal's a maker of furred garments, Perdigon's a fisher. Others belonged to the bourgeoisie: Peire d'Alvernha, for example, Peire Raimon of Toulouse, Elias Fonsalada. More rarely we see traders' sons becoming troubadours; this was the case with Folquet of Marseilles and Aimeric de Pegulhan. A great many were clerics, or at least studied for the Church, for instance, Arnaut of Mareuil, Hugh of Saint Circq (Uc de Saint Circ), Aimeric de Belenoi, Hugh Brunet, Peire Cardinal; some had even taken orders: the monk of Montaudon, the monk Gaubert of Puicibot. Ecclesiastical authority did not always tolerate this breach of discipline. Gui d'Uissel, canon and troubadour, was obliged by the injunction of the pontifical legate to give up his song-making. One point is particularly striking, the number of nobles (usually poor knights whose incomes were insufficient to support their rank) who became troubadours, or even, by an inferior descent, jongleurs: Raimon de Miraval, Pons de Capdoill, Guillem Azemar, Cadenet, Peirol, Raimbaut de Vacqueiras, and many more.

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[1] "E lo primo che comenciò a dire sicome poeta volgare si mosse peròche volle fare intendere le sue parole a donna alla quale era malagevole ad intendere i versi latini."

There is no doubt they betook themselves to poetry not merely for their own pleasure, but for the sake of the gifts to be obtained from the nobles whose courts they frequented. A very different position was occupied by such important persons as William of Poitiers, Raimbaut of Orange, the viscount of Saint Antonin, William of Berga and Blacatz, who made poetry for their own amusement, but contributed not a little, by thus becoming troubadours, to raise the profession.

The profession itself was entirely dependent on the existence and prosperity of the feudal courts. The troubadours could hardly expect to obtain a livelihood from any other quarter than the generosity of the great. It will consequently be well to mention the more important at least of those princes who are known to have been patrons and some of them practisers of the poetic art. They are arranged approximately in geographical order, and after each are inserted the names of those troubadours with whom they were connected.

France.—Eleanor of Guienne, Bernart de Ventadour (Ventadorn); Henry Curtmantle, son of Henry II. of England, Bertran de Born (?); Richard Cœur de Lion, Arnaut Daniel, Peire Vidal, Folquet of Marseilles, Gaucelm Faidit; Ermengarde of Narbonne (1143–1192), Bernart de Ventadour, Peire Rogier, Peire d'Alvernha; Raimon V., count of Toulouse (1143–1194), Bernart de Ventadour, Peire Rogier, Peire Raimon, Hugh Brunet, Peire Vidal, Folquet of Marseilles, Bernart de Durfort; Raimon VI., count of Toulouse (1194–1222), Raimon de Miraval, Aimeric de Pegulhan, Aimeric de Belenoi, Ademar lo Negre; Alphonse II., count of Provence (1185–1209), Elias de Barjols; Raimon Berenger IV., count of Provence (1209–1245), Sordel; Barral, viscount of Marseilles (d. *c.* 1192), Peire Vidal, Folquet de Marseilles; William VIII., lord of Montpellier (1172–1204), Peire Raimon, Arnaut de Mareuil, Folquet de Marseilles, Guiraut de Calanson, Aimeric de Sarlat; Robert, dauphin of Auvergne (1169–1234), Peirol, Perdigon, Pierre de Maensac, Gaucelm Faidit; Guillaume du Baus, prince of Orange (1182–1218), Raimbaut de Vacqueiras, Perdigon; Savaric de Mauléon (1200–1230), Gaucelm de Puicibot, Hugh de Saint Circq; Blacatz, a Provençal noble (1200?–1236), Cadenet, Joan d'Aubusson, Sordel, Guillem Figueira; Henry I., count of Rodez (1208–1222?), Hugh de Saint Circq; perhaps Hugh IV., count of Rodez (1222?–1274) and Henry II., count of Rodez (1274–1302), Guiraut Riquier, Folquet de Lunel, Serveri de Girone, Bertran Carbonel; Nunyo Sanchez, count of Roussillon (d. 1241), Aimeric de Belenoi; Bernard IV., count of Astarac (1249–1291), Guiraut Riquier, Amanieu de Sescas.

Spain.—Alphonse II., king of Aragon (1162–1196), Peire Rogier, Peire Raimon, Peire Vidal, Cadenet, Guiraut de Cabreira, Elias de Barjols, the monk of Montaudon, Hugh Brunet; Peter II., king of Aragon (1196–1213), Raimon de Miraval, Aimeric de Pegulhan, Perdigon, Ademar lo Negre, Hugh of Saint Circq; James I., king of Aragon (1213–1276), Peire Cardinal, Bernart Sicart de Maruejols, Guiraut Riquier, At de Mons; Peter III., king of Aragon (1276–1285), Paulet of Marseilles, Guiraut Riquier, Serveri de Girone; Alphonso IX., king of Leon (1138–1214), Peire Rogier, Guiraut de Borneil, Aimeric de Pegulhan, Hugh de Saint Circq; Alphonso X., king of Castile (1252–1284), Bertran de Lamanon, Bonifaci Calvo, Guiraut Riquier, Folquet de Lunel, Arnaut Plages, Bertran Carbonel.

Italy.—Boniface II, marquis of Montferrat (1192–1207), Peire Vidal, Raimbaut de Vacqueiras, Elias Cairel, Gaucelm Faidit (?); Frederick II., emperor (1215–1250), Jean d'Aubusson, Aimeric de Pegulhan, Guillem Figueira; Azzo VI., marquis of Este (1196–1212), Aimeric de Pegulhan, Rambertin de Buvalelli; Azzo VIII., marquis of Este (1215–1264), Aimeric de Pegulhan.

The first thing that strikes one in this list is that, while the troubadours find protectors in Spain and Italy, they do not seem to have been welcomed in French-speaking countries. This, however, must not be taken too absolutely. Provençal poetry was appreciated in the north of France. There is reason to believe that when Constance, daughter of one of the counts of Arles, was married in 998 to Robert, king of France, she brought along with her Provençal jongleurs. Poems by troubadours are quoted in the French romances of the beginning of the 13th century; some of them are transcribed in the old collections of French songs, and the preacher Robert de Sorbon informs us in a curious passage that one day a jongleur sang a poem by Folquet of Marseilles at the court of the king of France. But in any case it is easy to understand that, the countries of the *langue d'oui* having a full developed literature of their own suited to the taste of the people, the troubadours generally preferred to go to regions where they had less to fear in the way of competition.

The decline and fall of troubadour poetry was mainly due to political causes. When about the beginning of the 13th century the Albigensian War had ruined a large number of the nobles and reduced to lasting poverty a part of the south of France, the profession of troubadour ceased to be lucrative. It was then that many of those poets went to spend their last days in the north of Spain and Italy, where Provençal poetry had for more than one generation been highly esteemed. Following their example, other poets who were not natives of the south of France began to compose in Provençal, and this fashion continued till, about the middle of the 13th century, they gradually abandoned the foreign tongue in northern Italy, and somewhat later in Catalonia, and took to singing the same airs in the local dialects. About the same time in the Provençal region the flame of poetry had died out save in a few places—Narbonne, Rodez, Foix and Astarac—where it kept burning feebly for a little longer. In the 14th century composition in the language of the country was still practised; but the productions of this period are mainly works for instruction and edification, translations from Latin or sometimes even from French, with an occasional romance. As for the poetry of the troubadours, it was dead for ever.

Form.—Originally the poems of the troubadours were intended to be sung. The poet usually composed the music as well as the words; and in several cases he owed his fame more to his musical than to his literary ability. Two manuscripts preserve specimens of the music of the troubadours, but, though the subject has been recently investigated, we are hardly able to form a clear opinion of the originality and of the merits of these musical compositions. The following are the principal poetic forms which the troubadours employed. The oldest and most usual generic term is *vers*, by which is understood any composition intended to be sung, no matter what the subject. At the close of the 12th century it became customary to call all verse treating of love *canso*—the name *vers* being then more generally reserved for poems on other themes. The *sirventesc* differs from the *vers* and the *canso* only by its subject, being for the most part devoted to moral and political topics. Peire Cardinal is celebrated for the *sirventescs* he composed against the clergy of his time. The political poems of Bertran de Born are *sirventescs*. There is reason to believe that originally this word meant simply a poem composed by a *sirvent* (Lat. *serviens*) or man-at-arms. The *sirventesc* is very frequently composed in the form, sometimes even with rhymes, of a love song having acquired some popularity, so that it might be sung to the same air. The *tenson* is a debate between two interlocutors, each of whom has a stanza in turn. The *partimen* (Fr. *jeu parti*) is also a poetic debate, but it differs from the tension in so far that the range of debate is limited. In the first stanza one of the partners proposes two alternatives; the other partner chooses one of them and defends it, the opposite side remaining to be defended by the original propounder. Often in a final couplet a judge or arbiter is appointed to decide between the parties. This poetic game is mentioned by William, count of Poitiers, at the end of the 11th century. The *pastoreta*, afterwards *pastorela*, is in general an account of the love adventures of a knight with a shepherdess. All these classes have one form capable of endless variations: five or more stanzas and one or two envois. The *dansa* and *balada*, intended to mark the time in dancing, are pieces with a refrain. The *alba*, which has also a refrain, is, as the name indicates, a waking or morning song at the dawning of the day. All those classes are in stanzas. The *descort* is not thus divided, and consequently it must be set to music right through. Its name is derived from the fact that, its component parts not being equal, there is a kind of "discord" between them. It is generally reserved for themes of love. Other kinds of lyric poems, sometimes with nothing new about them except the name, were developed in the south of France; but those here mentioned are the more important.

Narrative Poetry.—Although the strictly lyric poetry of the troubadours forms the most original part of Provençal literature, it must not be supposed that the remainder is of trifling importance. Narrative poetry, especially, received in the south of France a great development, and, thanks to recent discoveries, a considerable body of it has already become known. Several classes must be distinguished: the *chanson de geste*, legendary or apparently historical, the romance of adventure and the novel. Northern France remains emphatically the native country of the *chanson de geste*; but, although in the south different social conditions, a more delicate taste, and a higher state of civilization prevented a similar profusion of tales of war and heroic deeds, Provençal literature has some highly important specimens of this class. The first place belongs to *Girart de Roussillon*, a poem of ten thousand verses, which relates the struggles of Charles Martel with his powerful vassal the Burgundian Gerard of Roussillon. It is a literary production of rare excellence and of exceptional interest for the history of civilization in the 11th and 12th centuries. *Girart de Roussillon* belongs only within certain limits to the literature of southern France. The recension which we possess appears to have been made on the borders of Limousin and Poitou; but it is clearly no more than a recast of an older poem no longer extant, probably either of French or at least Burgundian origin. To Limousin also seems to belong the poem of *Aigar and Maurin* (end of the 12th century), of which we have unfortunately only a fragment so short that the subject cannot be clearly made out. Of less heroic character is the poem of *Daurel and Beton* (first half of the 13th century), connected with the cycle of Charlemagne, but by the romantic character of the events more like a regular romance of adventure. We cannot, however, form a complete judgment in regard to it, as the only MS. in which it has been preserved is defective at the close, and that to an amount there is no means of ascertaining. Midway between legend and history may be classified the Provençal *Chanson of Antioch*, a mere fragment of which, 700 verses in extent, has been recovered in Madrid and published in *Archives de l'Orient latin*, vol. ii. This poem, which seems to have been composed by a certain Gregoire Bechada, mentioned in a 12th-century chronicle and written in Limousin (see G. Paris, in *Romania*, xxii. 358), is one of the sources of the Spanish compilation *La gran conquista de Ultramar*. To history proper belongs the Chanson of the crusade against the Albigensians, which, in its present state, is composed of two poems one tacked to the other: the first, containing the events from the beginning of the crusade till 1213, is the work of a cleric named William of Tudela, a moderate supporter of the crusaders; the second, from 1213 to 1218, is by a vehement opponent of the enterprise. The language and style of the two parts are no less different than the opinions. Finally, about 1280, Guillaume Anelier, a native of Toulouse, composed, in the *chanson de geste* form, a poem on the war carried on in Navarre by the French in 1276 and 1277. It is an historical work of little literary merit. All these poems are in the form of *chansons de geste*, viz. in stanzas of indefinite length, with a single rhyme. *Gerard of Roussillon*, *Aigar and Maurin* and *Daurel and Beton* are in verses of ten, the others in verses of twelve syllables. The peculiarity of the versification in *Gerard* is that the pause in the line occurs after the sixth syllable, and not, as is usual, after the fourth.

Like the *chanson de geste*, the romance of adventure is but slightly represented in the south; but it is to be borne in mind that many works of this class must have perished, as is rendered evident by the mere fact that, with few exceptions, the narrative poems which have come down to us are each known by a single manuscript only. We possess but three Provençal romances of adventure: *Jaufré* (composed in the middle of the 13th century and dedicated to a king of Aragon, possibly James I.), *Blandin of Cornwall* and *Guillem de la Barra*. The first two are connected with the Arthurian cycle: *Jaufré* is an elegant and ingenious work; *Blandin of Cornwall* the dullest and most insipid one can well imagine. The romance of *Guillem de la Barra* tells a strange story also found in Boccaccio's *Decameron* (2nd Day, viii.). It is rather a poor poem; but as a contribution to literary history it has the advantage of being dated. It was finished in 1318, and is dedicated to a noble of Languedoc called Sicart de Montaut. Connected with the romance of adventure is the novel (in Provençal *novas*, always in the plural), which is originally an account of an event "newly" happened. The novel must have been at first in the south what, as we see by the *Decameron*, it was in Italy, a society pastime—the wits in turn relating anecdotes, true or imaginary, which they think likely to amuse their auditors. But before long this kind of production was treated in verse, the form adopted being that of the romances of adventure—octosyllabic verses rhyming in pairs. Some of those novels which have come down to us may be ranked with the most graceful works in Provençal literature; two are from the pen of the Catalan author Raimon Vidal de Besalú. One, the *Castia-gilos* (the Chastisement of the Jealous Man), is a treatment, not easily matched for elegance, of a frequently-handled theme—the story of the husband who, in order to entrap his wife, takes the disguise of the lover whom she is expecting and receives with satisfaction blows intended, as he thinks, for him whose part he is playing; the other, *The Judgment of Love*, is the recital of a question of the law of love, departing considerably from the subjects usually treated in the novels. Mention may also be made of the novel of *The Parrot* by Arnaut de Carcassonne, in which the principal character is a parrot of great eloquence and ability, who succeeds marvellously in securing the success of the amorous enterprises of his master. Novels came to be extended to the proportions of a long romance. *Flamenca*, which belongs to the novel type, has still over eight thousand verses, though the only MS. of it has lost some leaves both at the beginning and at the end. This poem, composed in all probability in 1234, is the story of a lady who by very ingenious devices, not unlike those employed in the *Miles gloriosus* of Plautus, succeeds in eluding the vigilance of her jealous husband. No analysis can be given here of a work the action of which is highly complicated; suffice it to remark that there is no book in medieval literature which betokens so much quickness of intellect and is so instructive in regard to the manners and usages of polite society in the 13th century. We know that novels were in great favour in the south of France, although the specimens preserved are not very numerous. Statements made by Francesco da Barberino (early part of 14th century), and recently brought to light, give us a glimpse of several works of this class which have been lost. From the south of France the novel spread into Catalonia, where we find in the 14th century a number of novels in verse very similar to the Provençal ones, and into Italy, where in general the prose form has been adopted.

Didactic and Religious Poetry.—Compositions intended for instruction, correction and edification were very numerous in the south of France as well as elsewhere, and, in spite of the enormous losses sustained by Provençal literature, much of this kind still remains. But it is seldom that such works have much originality or literary value. Originality was naturally absent, as the aim of the writers was mainly to bring the teachings contained in Latin works within the reach of lay hearers or readers. Literary value was not of course excluded by the lack of originality, but by an unfortunate chance the greater part of those who sought to instruct or edify, and attempted to substitute moral works for secular productions in favour with the people, were, with a few exceptions, persons of limited ability. It would be out of question to enumerate here all the didactic treatises, all the lives of saints, all the treatises of popular theology and morals, all the books of devotion, all the pious canticles, composed in Provençal verse during the middle ages; still some of these poems may be singled out. Daude de Prades (early 13th century), a canon of Maguelone, and at the same time a troubadour, has left a poem, the *Auzels cassadors*, which is one of the best sources for the study of falconry. Raimon d'Avignon, otherwise unknown, translated in verses, about the year 1200, Rogier of Parme's "Surgery" (*Romania*, x. 63 and 496). We may mention also a poem on astrology by a certain G. (Guilhem?), and another, anonymous, on geomancy, both written about the end of the 13th century (*Romania*, xxvi. 825). As to moral compositions, we have to recall the Boethius poem (unfortunately a mere fragment) already mentioned as one of the oldest documents of the language, and really a remarkable work; and to notice an early (12th century?) metrical translation of the famous *Disticha de moribus* of Dionysius Cato (*Romania*, xxv. 98, and xxix. 445). More original are some compositions of an educational character known under the name of *ensenhamenz*, and, in some respects, comparable to the English nurture-books. The most interesting are those of Garin le Brun (12th century), Arnaut de Mareuil, Arnaut Guilhem de Marsan, Amanieu de Sescas. Their general object is the education of ladies of rank. Of metrical lives of saints we possess about a dozen (see *Histoire littéraire de la France*, vol. xxxii.), among which two or three deserve a particular attention: the Life of Sancta Fides, recently discovered and printed *Romania*, xxxi.), written early in the 12th century; the Life of St Enimia (13th century), by Bertran of Marseilles, and that of St Honorat of Lerins by Raimon Feraud (about 1300), which is distinguished by variety and elegance of versification, but it is almost entirely a translation from Latin. Lives of saints (St Andrew, St Thomas the Apostle, St John the Evangelist) form a part of a poem, strictly didactic, which stands out by reason of its great extent (nearly thirty-five thousand verses) and the somewhat original conception of its scheme—the *Breviari d'amor*, a vast encyclopaedia, on a theological basis, composed by the Minorite friar Matfre Ermengaud of Béziers between 1288 and 1300 or thereabout.

Drama.—The dramatic literature of southern France belongs entirely to the religious class, and shows little originality. It consists of mysteries and miracle plays seldom exceeding two or three thousand lines, which never developed into the enormous dramas of northern France, whose acting required several consecutive days. Comic plays, so plentiful in medieval French literature (*farces, sotties*), do not seem to have found favour in the south. Specimens which we possess of Provençal drama are comparatively few; but researches in local archives, especially in old account books, have brought to light a considerable number of entries concerning the acting, at public expense, of religious plays, called, in Latin documents, *ludus, historia, moralitas*, most of which seem to be irretrievably lost. As all the Provençal plays, sometimes mere fragments, which have escaped destruction, are preserved in about a dozen manuscripts, unearthed within the last forty or fifty years, there is hope that new texts of that sort may some day be published. Generally those plays belong to the 15th century or to the 16th. Still, a few are more ancient and may be ascribed to the 14th century or even to the end of the 13th. The oldest appears to be the *Mystery of St Agnes* (edited by Bartsch, 1869), written in Arles. Somewhat more recent, but not later than the beginning of the 14th century, is a Passion of Christ (not yet printed) and a mystery of the Marriage of the Virgin, which is partly adapted from a French poem of the 13th century, (see *Romania* xvi. 71). A manuscript, discovered in private archives (printed by Jeanroy and Teulié, 1893), contains not less than sixteen short mysteries, three founded on the Old Testament, thirteen on the New. They were written in Rouergue and are partly imitated from French mysteries. At Manosque (Basses Alpes) was found a fragment of a *Ludus sancti Jacobi*, inserted in a register of notarial deeds (printed by C. Arnaud.

Marseilles, 1858). The region comprised between the Rhone and the Var seems to have been particularly fond of representations of this sort, to judge by the entries in the local records (see *Romania* xxvii. 400). At the close of the 15th and the beginning of the 16th centuries many mysteries were played in that part of Dauphiné which corresponds to the present department of Hautes-Alpes. Five mysteries of this district, composed and played somewhere about 1500 (the mysteries of St Eustace, of St Andrew, of St Pons, of SS Peter and Paul and of St Anthony of Vienne), have come down to us, and have been edited by Abbé Fazy (1883), the four others by Canon P. Guillaume (1883–1888). The influence of the contemporary French sacred drama may to some extent be traced in them.

Prose.—Prose composition in the south of France belongs to a comparatively late stage of literary development; and the same remark applies to the other Romanic countries, particularly to northern France, where prose hardly comes into fashion till the beginning of the 13th century, the prose of the preceding century being little else than translations of the books of the Bible (especially the Psalter).

As early as the 12th century we find in Languedoc sermons, whose importance is more linguistic than literary (*Sermons du XII^e siècle en vieux provençal*, ed. by F. Armitage, Heilbronn, 1884). About the same time, in Limousin, were translated chapters xiii.–xvii. of St John's Gospel (Bartsch, *Chrestomathie provençale*). Various translations of the New Testament and of some parts of the Old have been done in Languedoc and Provence during the 13th and 14th centuries (see S. Berger, "Les Bibles provençales et vaudoises," *Romania* xviii. 353; and "Nouvelles recherches sur les Bibles provençales et catalanes," ibid. xix. 505). The Provençal prose rendering of some lives of saints made in the early part of the 13th century (*Revue des langues romanes*, 1890) is more interesting from a purely linguistic than from a literary point of view. To the 13th century belong certain lives of the troubadours intended to be prefixed to, and to explain, their poems. Many of them were written before 1250, when the first anthologies of troubadour poetry were compiled; and some are the work of the troubadour Hugh of Saint Circq. Some were composed in the north of Italy, at a time when the troubadours found more favour east of the Alps, than in their own country. Considered as historical documents these biographies are of a very doubtful value. Most of them are mere works of fiction, written by men who had no data except such informations as they derived from the songs they had to explain and which they often misunderstood. To the same period must be assigned *Las Razos de trobar* of the troubadour Raimon Vidal de Besalú (an elegant little treatise touching on various points of grammar and the poetic art), and also the *Donatz proensals* of Hugh Faidit, a writer otherwise unknown, who drew up his purely grammatical work at the request of two natives of northern Italy. A remarkable work, both in style and thought, is the *Life of St Douceline*, who died in 1274, near Marseilles, and founded an order of Beguines. In the 14th century compositions in prose grew more numerous. Some rare local chronicles may be mentioned, the most interesting being that of Mascaro, which contains the annals of the town of Béziers from 1338 to 1390. Theological treatises and pious legends translated from Latin and French also increase in number. The leading prose-work of this period is the treatise on grammar, poetry and rhetoric known by the name of *Leys d'amors*. It was composed in Toulouse, shortly before 1350, by a group of scholars, and was intended to fix the rules of the language with a view to the promotion of a poetical renaissance. For this purpose an academy was founded which awarded prizes in the shape of flowers to the best compositions in verse. We still possess the collection of the pieces crowned by this academy during the 14th century, and a large part of the 15th (*Flors del gay saber*). Unfortunately they are rather academic than poetic. The *Leys d'amors*, which was to be the starting-point and rule of the new poetry, is the best production of this abortive renaissance. The decay of Provençal literature, caused by political circumstances, arrived too soon to allow of a full development of prose. This accounts, in some measure for the complete absence of historical compositions. There is nothing to compare with Villehardouin or Joinville in northern France, or with Ramon Muntaner in Catalonia. The 14th and 15th centuries were in no respect a prosperous period for literature in the south of France. In the 15th century people began to write French both in verse and prose; and from that time Provençal literature became a thing of the past. From the 16th century such poetry as is written in the vernacular of southern France (Auger Gaillard, La Bellaudiera, Goudelin, d'Astros, &c.), is entirely dependent on French influence. The connexion with ancient Provençal literature is entirely broken.

Bibliography.—Fauriel, *Histoire de la poésie provençale* (Paris, 1846, 3 vols. 8vo), is quite antiquated. Not only are three-fourths of the works in Provençal poetry ignored, but the very idea of the book is vitiated by the author's system (now abandoned), based on the supposition that in the south of France there was an immense epic literature. The articles on the troubadours in the *Histoire littéraire de la France*, by Ginguené, E. David, &c., must be consulted with extreme caution. F. Diez's *Die Poesie der Troubadours* (Zwickau, 1827, 8vo; new ed by Bartsch, 1883) and his *Leben und Werke der Troubadours* (Zwickau, 1829, 8vo; new ed. by Bartsch, 1882) are of great excellence for the time at which they appeared. A. Restori's *Letteratura provenzale* (Milan, Hoepli, 1891), though very short and not free from oversights, gives a generally correct view of the subject. For the history of Provençal literature in Spain, see Milà y Fontanals, *De los Trovadores en España* (Barcelona, 1861, 8vo); for Italy, Cavedoni, *Ricerche storiche intorno ai trovatori provenzali* (Modena, 1844, 8vo); A. Thomas, *Francesco Barberino et la littérature provençale en Italie* (Paris, 1883, 8vo); O. Schultz, "Die Lebensverhältnisse der italienischen Trobadors," in *Zeits. für romanische Philologie* (1883). For the bibliography consult especially Bartsch, *Grundriss zur Geschichte der provenzalischen Literatur* (Elberfeld, 1872, 8vo). For texts the reader may be referred to Raynouard, *Choix de poésies originales des Troubadours* (1816–1821, 6 vols. 8vo), and *Lexique roman, ou dict. de la langue des troubadours*, of which vol. i. (1838) is entirely taken up with texts; and Rochegude, *Parnasse occitanien* (Toulouse, 1819, 8vo). All the pieces published by Raynouard and Rochegude have been reprinted without amendment by Mahn, *Die Werke der Troubadours in provenz. Sprache* (Berlin, 8vo, vol. i. 1846, ii. 1855–1864, iii. 1880; vol. iv. contains an edition of the troubadour Guiraut Riquier, 1853). The same editor's *Gedichte der Troubadours* (Berlin, 1856–1873) is a collection conspicuous for its want of order and of accuracy (see *Romania* iii. 303). Among editions of individual troubadours may be mentioned: *Peire Vidal's Lieder*, by Karl Bartsch (Berlin, 1857, 12mo.); *Les Derniers troubadours de la Provence*, by Paul Meyer (Paris, 1871, 8vo); *Der Troubadour Jaufre Rudel, sein Leben und seine Werke*, by A. Stimming (Kiel, 1873, 8vo); *Bertran de Born, sein Leben und seine Werke*, by A. Stimming (Halle, 1879, 8vo; revised and abridged edition, Halle, 1892); another edition, by A. Thomas (Toulouse, 1888, 8vo); *Guilhem Figueira, ein provenzalischer Troubadour*, by E. Levy (Berlin, 1880, 8vo); *Das Leben und die Lieder des Troubadours Peire Rogier*, by Carl Appel (Berlin, 1882, 8vo); *La vita e le opere del trovatore Arnaldo Daniello*, by U. A. Canello (Halle, 1883, 8vo); O. Schultz, *Die Briefe des Trobadors Raimbaut de Vaqueiras an Bonifaz I., Markgrafen von Monferrat* (Halle a. S., 1893); Italian edition (Florence, 1898); Cesare de Lollis, *Vita e poesie di Sordello di Goito* (Halle a. S., 1896); J. Coulet, *Le Troubadour Guilhem Montanhagol* (Toulouse, 1898); R. Zenker, *Die Lieder von Peires von Auvergne* (Erlangen, 1900); J. J. Salverda De Grove, *Le Troubadour Bertran d'Alamanon* (Toulouse, 1902); G. Bertoni, *I Trovatori minori di Genova* (Dresden, 1903), and *Rambertino Buvalelli, trovatore bolognase* (Dresden, 1908, 8vo); A. Jeanroy, "Les Poésies de Gavandan" in *Romania*, vol. xxxiv. (Paris, 1905). Concerning the music of the Troubadors, see J. B. Beck, *Die Melodien der Troubadours* (Strasburgh, 1908). Among editions of Provençal works of a miscellaneous kind are: Bartsch, *Denkmäler der provenzalischen Literatur* (Stuttgart, 1856, 8vo); H. Suchier, *Denkmäler der provenz. Literatur und Sprache*, vol. i. 8vo (Halle, 1883); Paul Meyer, *La Chanson de la croisade contre les Albigeois* (2 vols. 8vo, Paris, 1875–1879); idem, *Daurel et Beton, chanson de geste provençale* (Paris, 1880, 8vo); idem, *Le Roman de Flamenca* (Paris, 1865, 8vo; 2nd ed., 1901); idem., *Guillaume de la Barre, roman d'aventures par Arnaut Vidal de Castelnaudari* (Paris, 1895, 8vo); E. Stengel, *Die beiden ältesten provenzal. Grammatiken, Lo Donatz proensals und Las Razos de trobar* (Marburg, 1878, 8vo); *Le Brevairi d'amor de Matfre Ermengaud*, published by the Archaeological Society of Béziers (2 vols. 8vo, Béziers, 1862–1880); A. L. Sardou, *La Vida de Sant Honorat, légende en vers provençaux par Raymond Feraud* (Nice, 1875, 8vo); Noulet and Chabaneau, *Deux manuscrits provençaux du XIV^e siècle* (Montpellier, 1888, 8vo); Albanés, *La Vie de Sainte Douceline* (Marseilles, 1879, 8vo). Documents and dissertations on various points of Provençal literature will be found in almost all the volumes of *Romania* (Paris, in progress since 1872, 8vo), and the *Revue des langues romanes* (Montpellier, in progress since 1870, 8vo). See also the other journals devoted in Germany and Italy to the Romanic languages, *passim*. (P. M.)

Modern Provençal Literature.[1]—Literature in the south of France never died out entirely. Indeed, we have a link which, though too much importance may easily be attached to it, yet undoubtedly connects the products of the troubadours with the Provençal poetry of the present day. The Academy of Toulouse, founded in 1324, was flourishing in the 14th century, and, after many vicissitudes, is flourishing still. [The poets crowned by this body between 1324 and 1498 stand in the same relation to the troubadours as the *Meistersinger* do to the *Minnesänger:* academic correctness takes the place of inspiration. The institution flourished, even to the extent of establishing branches in Catalonia and Majorca; and in 1484, when its prosperity was threatened, a semi-fabulous person, Clémence Isaure, is said to have brought about a revival by instituting fresh prizes. The town of Toulouse never ceased to supply funds of some kind. In 1513 French poems were first admitted in the competitions, and under Louis XIV. (from 1679) these were alone held eligible. This unfair arrangement, by which some of the leading poets of northern France profited, held good till 1893, when the town very properly transferred its patronage to a new *Escolo moundino*,[1] but very soon restored its support to the older institution, on learning that Provençal poetry was again to be encouraged.] In the two centuries that followed the glorious medieval period we have a succession of works, chiefly of a didactic and edifying character, which scarcely belong to the realm of literature proper, but at least served to keep alive some kind of literary tradition. This dreary interval was relieved by a number of religious mystery plays, which, though dull to us, probably gave keen enjoyment to the people, and represent a more popular genre; the latest that have come down to us may be placed between the years 1450–1515. Not only did the literature deteriorate during this period, but dialects took the place of the uniform literary language employed by the troubadours, while the spoken tongue yielded more and more to French. In 1539 François I. forbade the use of Provençal in official documents—a fact that is worthy of note only as being significant in itself, not as an important factor in the decadence of Provençal letters.

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[1] In accordance with general usage, we are employing the term Provençal for the whole of the south of France, save where special reservation is made.

On the contrary, just about this time there are signs of a revival. In 1565 the Gascon, Pey de Garros, translated the Psalms into his dialect, and two years later published a volume of poems. His love for his native tongue is genuine, and his command over it considerable; he deplores its neglect, and urges others to follow his example. Auger Gaillard (*c.* 1530–1595) does infinitely less credit to his province: the popularity of his light pieces was probably due to their obscenity. More in the spirit of Garros is the charming trilingual *Salut* composed by the famous du Bartas in honour of a visit of Marguerite de Valois to Nérac (1579): three nymphs dispute as to whether she should be welcomed in Latin, French, or Gascon, and the last, of course, wins the day. Provence proper gave birth to a poet of considerable importance in Louis Bellaud de la Bellaudière (1532–1588), of Grasse, who, after studying at Aix, enlisted in the royal armies, and was made a prisoner at Moulins in 1572. During his captivity he wrote poems inspired by real love of liberty and of his native country (*Don-Don internal*, 1584 or 1585). At Aix Bellaud subsequently became the centre of a literary circle which included most of the local celebrities; all of these paid their tribute to the poet's memory in the edition of his works published by his uncle, Pierre Paul, himself the author of pieces of small value, included in the same volume (*Lous Passatens, obros et rimos*, &c., Marseilles, 1595). Even when Bellaud is wholly frivolous, and intent on worldly pleasures only, his work has interest as reflecting the merry, careless life of the time.

A writer very popular in Provence for the light-hearted productions of his youth was Claude Brueys (1570–1650), remarkable chiefly for comedies that deal largely with duped husbands (*Jardin deys musos provensalos*, not published till 1628). There is a certain charm, too, in the comedies of Claude's disciple, Gaspard Zerbin (*La Perlo deys musos et coumedies prouvensalos*, 1655); and those critics who have read the plays of Jean de Cabanes (1653–1712) and of Seguin (of Tarascon, *c.* 1640), still in MS., speak highly of them. The most consistently popular form of poetry in the south of France was always the *noël*. There has been no limit to the production of these; but very rarely does the author deserve special mention. An exception must be made in the case of Nicholas Saboly (1614–1675), who produced the best pieces of this class, both as regards beauty of language and the devotion they breathe. They have deservedly maintained their popularity to the present day. In Languedoc four poets have been cited as the best of the age—Goudelin, Michel, Sage and Bonnet. This is certainly so in the case of Pierre Goudelin (province Goudouli, 1579–1649), of Toulouse, the most distinguished name in south French literature between the period of the troubadours and that of Jasmin. He had a good classical education, traces of which appear in all his poetry, his language and his manner being always admirable, even where his matter is lacking in depth. He is often called "the Malherbe of the South," but resembles that writer only in form: his poetry, taken as a whole, has far more sap. Goudelin essayed and was successful in almost every short genre (*Lou Ramelet Moundi*, 1617, republished with additions till 1678), the piece of his which is most generally admired being the stanzas to Henri IV., though others will prefer him in his gayer moods. He enjoyed enormous popularity (extending to Spain and Italy), but never prostituted his art to cheap effects. His influence, especially but not exclusively in Provence, has been deep and lasting. The fame of Jean Michel, of Nîmes, rests on the *Embarras de la foire de Beaucaire*, a poem of astonishing vigour, but deficient in taste. Daniel Sage, of Montpellier (*Las Foulies*, 1650), was a man of loose morals, which are reflected in nearly all his works: his moments of genuine inspiration from other causes are rare. More worthy of being bracketed with Goudelin is the *avocat* Bonnet, author of the best among the open air plays that were annually performed at Béziers on Ascension Day: a number of these (dated 1616–1657) were subsequently collected, but none can compare with the opening one, Bonnet's *Jugement de Pâris*. Another very charming poet is Nicolas Fizes, of Frontignan, whose vaudeville, the *Opéra de Frontignan* (1670), dealing with a slight love intrigue, and an idyllic poem on the fountain of Frontignan, show a real poetic gift. A number of Toulouse poets, mostly *lauréats* of the Academy, may be termed followers of Goudelin: of these François Boudet deserves mention, who composed an ode, *Le Trinfe del Moundi* (1678), in honour of his native dialect. The classical revival that may be noted about this time is also generally ascribed to Goudelin's influence. Its most distinguished representative was Jean de Valès, of Montech, who made excellent translations from Virgil and Persius, and wrote a brilliant burlesque of the former in the manner of Scarron (*Virgile deguisat*, 1648; only four books published). He also composed a pastoral idyll, which, though too long and inclined to obscenity, contains much tender description. The greatest of the pastoral poets was François de Cortete (1571–1655), of Prades, whose comedies, *Ramounet* and *Miramoundo* (published, unfortunately with alterations, by his son in 1684), are written with such true feeling and in so pure a style that they can be read with real pleasure. A comedy of his dealing with Sancho Panza in the palace of the Duke has been edited. It is difficult to understand the enormous popularity of Daubasse (1664–1727), of Quercy, who belonged to the working classes; he was patronized by the nobility in exchange for panegyrics. Gascony produced two typical works in the 17th century: Ader's *Gentilhomme gascoun* (1610) and Dastros's *Trinfe de la langue gascoune* (1642). The former depicts a regular boasting Gascon who distinguishes himself in everything; while the latter is a plea in favour of the Gascon tongue, inspired by a genuine love of country. Gabriel Bedout (*Parterre gascoun*, 1642) is chiefly noted for his amorous *solitari*, called forth by the sufferings he endured from a hardhearted mistress. Louis Baron (b. 1612), living peacefully in his native village of Pouyloubrin, celebrated it with great tenderness.

In the 18th century the number of authors is much larger, but the bulk of good work produced is not equally great in proportion. The priests are mainly responsible for the literary output of Languedoc. Claude Peyrot (1709–1795) one of them, celebrates his county with true rural spirit in the *Printemps rouergat* and *Quartre sosous*. But the chief of the band is the Abbé Favre (1727–1783), the prior of Celleneuve, whose *Sermoun de moussu sistre*, delivered by a drunken priest against intemperance, is a masterpiece. He also wrote a successful mock-heroic poem (*Siège de Caderousse*) travesties of Homer and Virgil, a prose novel depicting the country manners of the time (*Histoire de Jean l'ont pris*), and two comedies, which likewise give a vivid picture of the village life he knew so well. Two genuine poets are the brothers Rigaud of Montpellier: Auguste's (1760–1835) description of a vintage is deservedly famous; and Cyrille (1750–1824) produced an equally delightful poem in the *Amours de Mounpëié*. Pierre Hellies of Toulouse (d. 1724) a poet of the people, whose vicious life finds an echo in his works, has a certain rude charm, at times distantly recalling Villon. In the Province Toussaint Gros (1698–1748), of Lyons, holds undisputed sway. His style and language are admirable, but unfortunately he wasted his gifts largely on trivial *pièces d'occasion*. Coye's (1711–1777) comedy, the *Fiancé paré*, is bright and still popular, while Germain's description of a visit paid by the ancient gods to Marseilles (*La Bourrido dei Dious*, 1760) has considerable humour. In Gascony the greatest poet is Cyrien Despourrins (1698–1755), whose pastoral idylls and mournful chansons, which he himself set to music, are imbued with tenderness and charm (most of them were collected at Pau, in 1828).

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[1] *Moundino*, *i.e.* of Toulouse; a common designation, derived from Raymond, the familiar name of the counts of Toulouse.

The Revolution produced a large body of literature, but nothing of lasting interest. However, it gave an impetus to thought in the south of France, as elsewhere; and there, as elsewhere, it called forth a spirit of independence that was all in favour of a literary revival. Scholars of the stamp of Raynouard (1761–1863), of Aix, occupied themselves with the brilliant literary traditions of the middle ages; newspapers sprang up (the Provençal *Bouil-Abaisso*, started by Désanat, and the bilingual *Lou Tambourin et le menestrel*, edited by Bellot, both in 1841); poets banded together and collected their pieces in volume form (thus, the nine *troubaire* who published *Lou Bouquet prouvençaou* in 1823). Much has been written about the *précurseurs de Félibrige*, and critics are sorely at variance as to the writers that most deserve this appellation. We shall not go far wrong if we include in the list Hyacinthe Morel (1756–1829), of Avignon, whose collection of poems, *Lou Saboulet*, has been republished by Mistral; Louis Aubanel (1758–1842), of Nîmes, the successful translator of Anacreon's Odes; Auguste Tandon, "the troubadour of Montpellier," who wrote *Fables, contes et autres pièces en vers* (1800); Fabre d'Olivet (1767–1825), the versatile *littérateur* who in 1803 published *Le Troubadour: Poësies occitaniques*, which, in order to secure their success, he gave out as the work of some medieval poet Diouloufet (1771–1840), who wrote a didactic poem, in the manner of Virgil, relating to silkworm-breeding (*Leis magnans*); Jacques Azaïs (1778–1856), author of satires, fables, &c.; D'Astros (1780–1863), a writer of fables in Lafontaine's manner; Castil-Blaze (1784–1857), who found time, amidst his musical pursuits, to compose Provençal poems, intended to be set to music; the Marquis de Fare-Alais (1791–1846), author of some light satirical tales (*Las Castagnados*). While these writers were all more or less academic, and appealed to the cultured few, four poets of the people addressed a far wider public: Verdié (1779–1820), of Bordeaux, who wrote comic and satirical pieces; Jean Reboul (1796–1864), the baker of Nîmes, who never surpassed his first effort, *L'Ange et l'enfant* (1828);[1] Victor Gelu (1806–1885), relentless and brutal, but undeniably powerful of his kind (*Fenian et Grouman; dix chansons provençales*, 1840); and, greatest of them all, the true and acknowledged forerunner of the *félibres*, Jacques Jasmin (1798–1864), the hairdresser of Agen, whose poems, both lyrical and narrative, continue to find favour with men of the highest culture and literary attainments, as with the villagers for whom they were primarily intended.

While much of this literature was still in the making, an event took place which was destined to eclipse in importance any that had gone before. In 1845 Joseph Roumanille (1818–1891), a gardener's son, of Saint-Remy (Bouches-du-Rhône), became usher in a small school at Avignon, which was attended by Frédéric Mistral (*q.v.*), a native of the same district, then fifteen years of age. The former, feeling the germs of poetry within him, had composed some pieces in French; but, finding that his old mother could not understand them, he was greatly distressed, and determined thenceforth to write in his native dialect only. These poems revealed a new world to young Mistral, and spurred him on to the resolve that became the one purpose of his life—*de remettre en lumière et conscience de sa gloire cette noble race qu'en plein '89 Mirabeau nomme encore la nation provençale.* There is no doubt that Mistral's is the more puissant personality, and that his finest work towers above that of his fellows; but in studying the Provençal renaissance, Roumanille's great claims should not be overlooked, and they have never been put forward with more force than by Mistral himself (in the preface to his *Isclos d'oro*). Roumanille's secular verse cannot fail to appeal to every lover of pure and sincere poetry (*Li Margaritedo*, 1836–1847; *Li Sounjarello*, 1852; *Li Flour de Sauvi*, 1850–1859, &c.), his *noëls* are second only to those of Saboly, his prose works (such as *Lou mege de Cucugnan*, 1863) sparkling with delightful humour. He it was who in 1852 collected and published *Li Prouvençalo*, an anthology in which all the names yet to become famous, and most of those famous already (such as Jasmin), are represented. In 1853 he was one of the enthusiastic circle that had gathered round J. B. Gaut at Aix, and whose literary output is contained in the *Roumavagi dei Troubaire* and in the shortlived journal *Lou gay saber* (1854). At the same time the first attempt at regulating the orthography of Provençal was made by him (in the introduction to his play, *La Part dou bon Dieu*, 1853). And in 1854 he was one of the seven poets who, on the 21st of May, foregathered at the castle of Fontségugne, near Avignon, and founded the *Félibrige*. [The etymology of this word has given rise to much speculation: the one thing certain about the word is that Mistral came across it in an old Provençal poem, which tells how the Virgin meets Jesus in the Temple, among the seven *félibres* of the law. The outlines of the constitution, as finally settled in 1876, are as follows: The region of the *Félibrige* is divided into four *mantenenço* (Provence, Languedoc, Aquitaine and Catalonia[2]). At the head of all is a *consistori* of fifty (called *majourau*), presided over by the *Capouliè*, who is chief of the entire *Félibrige*. The head of each *mantenenço* is called *sendi* (who is at the same time a *majourau*); and at the head of each "school" (as the subdivisions of the *mantenenço* are called) is a *cabiscòu*. The ordinary members, unlimited in number, are *mantenèire*. Annual meetings and *fêtes* are organized. The most widely read of the *Félibrige* publications is the *Armana prouvençau*, which has appeared annually since 1855, maintaining all the while its original scope and purpose; and though unpretentious in form, it contains much of the best work of the school.[3]] The other six were Mistral, Aubanel, A. Mathieu (a schoolfellow of Mistral's at Avignon), E. Garcin, A. Tavan and P. Giera (owner of the castle). Of these, Théodore Aubanel (1829–1886, of Avignon, son of a printer and following the same calling) has alone proved himself worthy to rank with Mistral and Roumanille. "Zani," the girl of his youthful and passionate love, took the veil; and this event cast a shadow over his whole life, and determined the character of all his poetry (*Lou mióugrano entre-duberto*, 1860; *Li Fiho d'Avignoun*, 1883). His is, without a doubt, the deepest nature and temperament among the *félibres*, and his lyrics are the most poignant. He has a keen sense of physical beauty in woman, and his verse is replete with suppressed passion, but he never sinks to sensuality. His powerful love drama *Lou pau dou peccat* was received with enthusiasm at Montpellier in 1878, and successfully produced (some years later in Arène's version) by Antoine at his Théâtre Libre—no mean criterion. It is the only play of real consequence that the school has yet produced.

We need not do more than glance at the work of the fourth of the group of poets who alone, amidst the numerous writers of lyrics and other works that attain a high level of excellence.

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[1] One of his chief titles to fame is that, together with Alphonse Dumas, he drew the attention of Lamartine to Mistral's *Mirèio*. Roumanille and Mistral showed their gratitude by republishing the best pieces of these two *précurseurs*, together with those of Castil-Blaze and others, in *Un Liame de Rasin* (1865).

[2] One of the most pleasing features of the movement is the spirit of fraternity maintained by the *félibres* with the poets and literary men of northern France, Spain, Italy, Rumania, Germany and other countries.

[3] In common with so many other productions of the *Félibrige*, this Almanac is published by the firm J. Roumanille, Libraire-Editour, Avignon.

appear to us to have so far secured permanent fame by the magnitude of their achievement. Félix Gras (1844–1891) settled at Avignon in his youth. His rustic epic, *Li Carbounié* (1876) is full of elemental passion and abounds in fine descriptions of scenery, but it lacks proportion. The heroic *geste* of *Toloza* (1882), in which Simon de Montfort's invasion of the south is depicted with unbounded vigour and intensity, shows a great advance in art. *Li Roumancero provençal* (1887) is a collection of poems instinct with Provençal lore, and in *Li Papalino* (1891) we have some charming prose tales that bring to life again the Avignon of the popes. Finally, the poet gave us three tales dealing with the period of the Revolution (*Li Rouge dou miejour*, &c.); their realism and literary art called forth general admiration.[1]

A few lines must suffice for some of the general aspects of the movement. It goes without saying that all is not perfect harmony; but, on the whole, the differences are differences of detail only, not of principle. While Mistral and many of the best *félibres* employ the dialect of the Bouches-du-Rhône, others, who have since seceded as the *Félibrige latin* (headed by Roque-Ferrier), prefer to use the dialect of Montpellier, owing to its central position. A third class favour the dialect of Limousin, as having been the literary vehicle of the troubadours; but their claim is of the slenderest, for the *félibres* are in no sense of the word the direct successors of the troubadours. Nearly all the leaders of the *Félibrige* are Legitimists and Catholics, their faith being the simple faith of the people, undisturbed by philosophic doubts. There are exceptions, however, chief among them the Protestant Gras, whose *Toloza* clearly reflects his sympathy with the Albigenses. Yet this did not stand in the way of his election as *Capoulié*—a proof, if proof were needed, that literary merit outweighs all other considerations in this artistic body of men. Finally, it may be noted that the *félibres* have often been accused of lack of patriotism towards northern France, of schemes of decentralization, and other heresies; but none of these charges holds good. The spirit of the movement, as represented by its leaders, has never been expressed with greater terseness, force and truth than in the three verses set by Félix Gras at the head of his *Carbounié*: "I love my village more than thy village; I love my Provence more than thy province; I love France more than all."

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PROVENCE (*Provincia, Proenza*), a province in the south-east of ancient France, bounded on the N. by the Dauphiné, on the E. by the Rhône and Languedoc, on the W. by the Alps and Italy, and on the S. by the Mediterranean. The coast, originally inhabited by Ligurians, was from an early date the home of some Phoenician merchants. About 600 B.C., according to tradition, some traders from Phocaea founded the Greek colony of *Massalia* (Marseilles) and the colonists had great difficulty in resisting the Cavares and the Salyes, *i.e.* the Ligurian peoples in the vicinity. Other colonies in the neighbourhood, such as Antibes, Agde, Nice, originated in this settlement. During the wars which followed, the inhabitants of Massalia asked assistance from the Romans, who thus made their first entry into Gaul (125 B.C.), and, after a campaign which lasted several years under the direction of the pro-consul C. Sextius Calvinus, conquered the territories between the Alps, the sea and the Rhône (with the province of Narbonne on the right bank of this river). These lands formed the *Provincia romana*, and the name was retained by Provence. The town of Aix (*Aquae Sextiae*) was founded to form the capital of this conquered land. In consequence of the conquest of Gaul by Caesar (50 B.C.) and the administrative reforms introduced by Augustus, the territory of the former *Provincia* was divided into the new provinces of Narbonensis II., of the Maritime Alps and of Viennois, but it still remained an important centre of Roman learning and civilization. Marseilles, which for some time had a prosperous Greek school, and also Aix now became of secondary importance, and Arles was made the chief town of the province, becoming after the capture of Trèves by the barbarians (A.D. 418) the capital of Gaul. Christianity spread fairly early into Provence, although the legend that this country was evangelized by Mary Magdalene and some of the apostles cannot be traced farther back than the 12th century. Trophimus established a church at Arles in the 3rd century, and during the two centuries which followed bishoprics were founded in all the cities of Provence.

At the beginning of the 5th century, Provence was attacked by the Visigoths. In 425 the Visigothic king Theodoric I. was defeated by Aetius under the walls of Arles, but the part taken by the Goths in the election of the emperor Avitus did not put a stop to their attacks (450). In 480 Arles was captured by Euric I., and the southern part of Provence, *i.e.* the country south of the Durance, thus came definitely under Visigothic rule. The more northern cities, such as Orange, Apt, Trois-Châteaux, &c., were again joined to the kingdom of Burgundy. Towards 510 Visigothic Provence was ceded to Theodoric, king of the Italian Ostrogoths, by Alaric II. as a mark of his gratitude for the support given to him during the war against the Franks. In addition to this, about 523, the Ostrogoths took advantage of the wars between the Franks and the Burgundians to extend their lands in the north as far as Gap and Embrun. Vitiges, king of the Ostrogoths, ceded Provence to the kings of the Franks about 537, when it was divided in a peculiar manner: the northern cities and those on the coast (Arles, Marseilles, Toulon, Antibes, Nice) were given back to Burgundy, whilst a narrow strip of territory with Avignon, Apt, Cavaillon, Riez, &c., extending from the west to the east as far as the Alps, was added to the kingdom of Austrasia, and from that time followed the fortunes of Auvergne, which, as is known, was generally dependent on Austrasia. Provence was united under one ruler during the reigns of Clotaire II. and Dagobert I., but at the death of the latter in 639 was divided again, only to be reunited under the successors of Dagobert II. (679). At this period the name of Provence was restricted to the southern cities, which had passed from the Gothic to the Frankish rule; it did not regain its original signification and denote the country extending as far as Lyonnais till the end of the 8th and the beginning of the 9th centuries.

At the beginning of the 8th century, some Arabs from Spain, who had crossed the Pyrenees and settled down in Septimania, attacked Provence, in 735 took the town of Arles and in 737 captured Avignon, thus becoming masters of one part of the country. Charles Martel who had already made two expeditions against them, in 736 and 737, with the help of the Lombards of Italy, succeeded in 739 in expelling them, and brought the country definitely under Frankish rule. Austrasian counts were given authority in the cities, and under Charlemagne and Louis the Pious the history of Provence became incorporated with that of the rest of the empire. At the time of the partition of Verdun (843) Provence fell to the share of the emperor Lothair I., who joined it to the duchy of Lyons in 855 to form a kingdom for his youngest son, Charles. On the death of the latter in 863 his inheritance was divided between his two brothers, when Lothair II., king of Lorraine, received the northern part, Lyonnais and Viennois, and to the other, the emperor Louis II., king of Italy, was given Provence. At his death in 875 Provence passed into the hands of Charles the Bald, and he entrusted the government to his brother-in-law, Duke Boso, who, taking advantage of the struggles between the Frankish princes which followed the death of Charles the Bald, reconstituted the former kingdom of Charles, the son of Lothair, and in 879 was acknowledged as its sovereign at Mantaille in Viennois. This is the kingdom of Provence (Provence, Viennois, Lyonnais and Vivarais), sometimes, but improperly, called Cisjuran Burgundy.

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[1] Gras was *Capoulié* from 1891 till 1901, succeeding his brother-in-law, Roumanille, who held the office from 1888 till 1891. The first *Capoulié* was, of course, Mistral (1876–1888). Gras's successor was Pierre Devoluy, of Die (appointed in April 1901).

Boso died in 887, having succeeded in maintaining his independence against the united Frankish princes. His widow Ermengarde, daughter of Louis II., with the assistance of the emperor Arnulf, had her son Louis acknowledged king at an assembly held at Valence in 890. Louis attempted to seize the crown of Italy in 900, and in 901 was even crowned emperor at Rome by Pope Benedict IV.; but in 905 he was surprised at Verona by his rival Berengar, who captured him, put out his eyes, and forced him to give up Italy and return to Provence; he lived here till his death in 928, leaving an illegitimate son, Charles Constantine. The principal figure in the country at this time was Hugo (Hugues) "of Arles," count, or duke, of Viennois and marquis of Provence, who had been king of Italy since 926. In order to retain possession of this country, he gave the kingdom of Louis the Blind to Rudolph II., king of Burgundy (*q.v.*), and thus the kingdom of Burgundy extended from the source of the Aar to the Mediterranean. But the sovereignty of Rudolph II. and his successors, Conrad (937–993) and Rudolph III. (993–1032), over Provence was almost purely nominal, and things were in much the same condition when, on the death of Rudolph III., the kingdom of Burgundy passed into the hands of the German kings, who now bore the title of kings of Arles, but very rarely exercised their authority in the country.

At the beginning of the 10th century Provence was in a state of complete disorganization, a result of the invasions of the Saracens, who, coming from Spain, took up their quarters in the neighbourhood of Fraxinetum (La Garde-Freinet in the department of Var) and ravaged the country pitilessly, the Christians being unable to oust them from their strongholds. All the real power was in the hands of the counts of the country. It is probable that from the 9th century several of the Provençal countships were united under one count, and that the count of Arles had the title of duke, or marquis, and exercised authority over the others. In the middle of the 10th century the countship of Provence was in the hands of a certain Boso, of unknown origin, who left it to his two sons William and Roubaud (Rotbold). These two profited by the commotion caused by the capture of the famous abbot of Cluny, St Maiolus (Mayeul), in 973, who had fallen into the hands of the Saracens, and marched against the Mussulmans, definitely expelling them from Fraxinetum. About the same period the marquisate seems to have been re-established in favour of Count William, who died in 993, and from that time the descendants of the two brothers, without making any partition, ruled over the different countships of Provence, only one of them, however, bearing the title of marquis. The counts of Provence had, from about the middle of the 11th century, a tendency to add the name of their usual residence after their title, and thus the lordships, known later under the names of the countships of Arles (or more properly Provence), of Nice, and of Venaissin, grew up. Roubaud had one son named William, who died without children, about 1043, and one daughter, Emma, who married William, count of Toulouse, by whom she had a son, Pons (1030–1063), the father of Raymund of Saint-Gilles (1063–1105). William also had a son of the same name. This William II. had three sons by his wife Gerberge—Fulk, Geoffrey and William. The last-mentioned had a son, William Bertrand (1044–1067), whose daughter Adelaide married, first, Ermengaud, count of Urgel, and then Raimbaud of Nice. Geoffrey was the father of Gerberge, who married Gilbert, count of Gévaudan, and he had a daughter Douce, who in 1112 married Raymund-Bérenger, count of Barcelona; by this marriage, Provence, in the correct sense of the word, passed over to the house of Barcelona. At the beginning of the 12th century the various marriages of the Provençal heiresses, of whom mention has just been made, led to the land being divided up among the different branches of the ancient countly family (1105, 1125 and 1149), and thus the countships of Provence, Venaissin and Forcalquier were definitely formed.

Under the command of Raymund of Saint-Gilles the Provençals took an important part in the first crusade, and the use of the term "Provençal" to denote the inhabitants of southern France, their language and their literature, seems to date from this period.

The history of the princes of the house of Barcelona, Raymund-Bérenger I. (1113–1131), Raymund-Bérenger II. (1131–1144) and Raymund-Bérenger III. (1144–1166), is full of accounts of their struggles with the powerful feudal house of Baux, which had extensive property in Provence; in 1146 one of the representatives of this house, Raymund, obtained from the emperor the investiture, though only in theory, of the whole countship of Provence. After the death of Raymund-Bérenger III., who was killed at the siege of Nice (1166), his cousin Alphonso II., king of Aragon, claimed his inheritance and took the title of the count of Provence. But his succession was disputed by the count of Toulouse, Raymund V., a marriage having been previously arranged between Raymund-Bérenger's daughter and his son, and he himself hastening to marry the widow Richilde, niece of the emperor Frederick I. The majority of the lay and ecclesiastical lords of Provence recognized Alphonso, who in 1176 signed a treaty with his competitor, by which Raymund V. gave up his rights to the king of Aragon in consideration of a sum of money. Alphonso was represented in Provence by his brothers Raymund-Bérenger and Sancho in turn, and in 1193 by his son Alphonso, who succeeded him. This Alphonso gave Aragon and Catalonia to his brother Peter (Pedro), and kept only Provence for himself, but on the death of his father-in-law, Count William II., in 1208, whose son had been disinherited, he added to it the county of Forcalquier. He was able to protect Provence from the consequences of the war of the Albigenses, and it was not until after his death (1209), during the minority of his son Raymund-Bérenger IV., who succeeded him under the regency of his uncle, Peter of Aragon, and later of his mother Gersende, that Provence was involved in the struggle of the count of Toulouse against Simon de Montfort, when the part played by the city of Avignon in the Albigensian movement finally led to Louis VIII.'s expedition against the town. William of Baux took advantage of the troubles caused by Raymund-Bérenger's minority to have the kingdom of Arles conferred upon himself by Frederick II.; this led, however, to no practical result. Raymund-Bérenger had also to fight against Raymund VII., count of Toulouse, the emperor having ceded to this latter in 1230 the countship of Forcalquier, and showed another mark of his favour in 1238, when, in consequence of some difficulties with the city of Arles, Raymund-Bérenger drove the imperial vicar from the town. The intervention of St Louis, who in 1234 had married Margaret, the eldest daughter of the count of Provence (the second, Eleanor, married Henry III. of England in 1236), put an end to the designs of the count of Toulouse. Raymund-Bérenger died in 1245, leaving a will by which he named as his heiress his fourth daughter, Beatrice, who shortly afterwards, in 1246, married the celebrated Charles of Anjou (see Charles I., king of Naples), brother of the king of France. After her death, in 1267, Charles still maintained his rights in Provence. The countship of Venaissin was left to him by his sister-in-law, Jeanne, countess of Toulouse, but in 1272 King Philip the Bold took possession of it, giving it up in 1274 to Pope Gregory X., who had claimed it for the Roman Church in pursuance of the treaty of 1229 between Raymund VII. of Toulouse and St Louis. Almost all the time and energy of Charles of Anjou were taken up with expeditions and wars concerning the kingdom of Naples, which he had gained by his victories over Manfred and Conradin in 1266 and 1268. His government of Provence was marked by his struggles with the towns. The movement which resulted in the emancipation of these had its origin fairly far back. In the first part of the 12th century the towns of Provence, no doubt following the example of those in Italy, began to form municipal administrations and consulates, independent of the viscounts, who in theory represented the authority of the count in the towns. This movement was occasionally interrupted by home disturbances, such as struggles against the civil and ecclesiastical authorities; nevertheless Marseilles, Arles, Tarascon, Avignon (whose consulate laws date from the 12th century), Brignoles and Grasse were self-governing and elected their magistrates, sometimes negotiating with the count, as a power with a power, and concluding political or commercial treaties without consulting him. The city of Nice, which was joined to Provence in 1176, had retained its freedom. This state of affairs was in direct opposition to the authoritative government of Charles of Anjou, who tried to bring back the most independent of these towns under his sway. In 1251 he seized Arles and Avignon and placed them under a *viguier* (vicar) nominated by himself. In 1257 Marseilles was also subdued, and ministers nominated by the court performed their duties side by side with the municipal officials.

The successors of Charles of Anjou also showed great interest in maintaining their rights over the kingdom of Naples, and only occasionally do they appear in the history of Provence. Charles II. (1285–1309), after failing in several attacks on the house of Aragon in southern Italy, lived in the country during the latter years of his reign as duke, and tried to reform some of the abuses which had grown up in the administration of justice and finance. Robert of Calabria (1309–1343), his son and successor, was forced to sustain a long siege in Genoa, whither he had been called by the Ghibelline party: a siege which cost a large number of lives to the Provençal navy. Robert was succeeded by his granddaughter Joanna, widow of Andrew of Hungary, who sold her rights over the city of Avignon to Pope Clement VI. in 1348, in order to raise funds to enable her to continue the struggle against the house of Aragon in her Neapolitan states. The political situation of the country was not much changed by Charles IV.'s residence in Provence, nor by the empty ceremony of his coronation as king of Arles (1365). Charles IV. gave up his rights, or his claims, to Louis, duke of Anjou, brother of Charles V., but the expedition which this prince made to take possession of Provence only resulted in the seizure of Tarascon, and failed before Arles (1368). Joanna had nominated as her heir Charles of Anjou-Gravina, duke of Duras, who had married her niece Margaret, but to provide herself with a protector from Louis of Hungary, who accused her of murdering her first husband Andrew and wished to dispute her right to the kingdom of Naples, she married again and became the wife of Otto of Brunswick. Charles of Duras, discontented with this marriage, took part against her, and she in her turn disinherited him and named Louis of Anjou as her eventual successor (1380). The duke of Anjou took possession of Provence, whilst Charles of Duras made the queen prisoner at Naples and gave orders for her to be put to death (1382). Louis of Anjou also made an expedition to Naples, but did not arrive till after her death, and he died in 1384. His son Louis II. (1384–1417) banished the viscount of Turenne from Provence, because he had taken advantage of his sovereign's absence to ravage the country. He did not live in Provence till the last years of his life; in 1415 he established a parlement. The following year the country was devastated by a terrible plague. The wars carried on by his successor Louis III. (1417–34) against the kings of Aragon, his rivals at Naples, were the cause of the complete ruin of Marseilles by the Aragonese fleet. The town, however, regained its former state comparatively quickly. Although Louis III. had centred almost all his attention on the expeditions in Italy, he managed to secure the lands belonging to the house of Baux on the death of the last of the family, the Baroness Alix (1426). René, duke of Lorraine (*q.v.*), Louis's brother and successor, after an unsuccessful attack on Naples (1460–1461), went to live on his property in France, and after 1471 was principally in Provence, where he built the castle of Tarascon and interested himself in art, literature, and pastoral amusements. He left his territories (Anjou, Lorraine, Provence) to his nephew Charles, count of Maine, by his will in 1474. Louis XI., king of France, protested at first in the name of the rights of the Crown, and even seized René's duchies. In consequence, however, of an interview between René and the king at Lyons, the former obtained a withdrawal of the seizure and ended his days peacefully in Provence (1480). The rights of his successor, Charles, were disputed by René II., duke of Lorraine, but, with the support of Louis XI., his attack on Provence was defeated. On the other hand, Louis had corrupted some of Charles's advisers, especially Palamède de Forbin, with the result that, at Charles's death in 1482, he left Provence to the king of France in his will. René of Lorraine protested in vain; Louis claimed the possession of the disputed territory, but Provence was not definitely annexed to France till 1486, under Charles VIII., and even then it preserved a certain individuality. In laws relating to this country the sovereigns added to their title of king of France "and count of Provence and of Forcalquier," and Provence always preserved a separate administrative organization.

In the 16th century Provence took part in a war between France and the imperialists. The constable de Bourbon, who had received the investiture of Provence from the emperor Charles V., crossed the Var in 1524 with an army, but was defeated at Marseilles. The expedition under Charles V. and the duke of Savoy in 1536 had no more definite result than the coronation of the emperor at Aix as king of Arles. About the same time the first signs of the Reformation became evident in Provence, at first in the country of the ancient Vaudois at Cabrières and at Mérindol in the county of Venaissin. A sentence passed in 1540 by the parlement of Provence against these heretics was carried out with great severity in 1545 by the president d'Oppède and the baron de la Garde, who burned the villages and massacred the inhabitants. Protestantism did not take a great hold on Provence, but drew a fair number of followers from the ranks of the lesser nobles, who, with Paul de Mauvans at their head, began the struggle against the Catholics under the comte de Carces. Charles IX.'s journey in Provence in 1567, followed by the establishment in the parlement at Aix of a court (*chambre*) in which Catholics and Protestants had an equal number of seats, led to a momentary cessation of hostilities. These were resumed between the *Carcistes* (Roman Catholics) and *Razats* (Protestants), and again interrupted by the peace of 1576, which gave some guarantees to the Protestants, with La Seyne as a place of security, and also by the plague of 1579, which affected the whole country. The league, on the other hand, made rapid progress in Provence under the direction of the comte de Sault and Hubert de la Garde, seigneur of Vins, and the governors of Épernon and La Valette vainly tried to pacify the country. La Valette and the political party or *Bigarrats* were finally more or less reconciled to the Protestants, and, at the time of the death of Henry III., the struggle was no more than a question of district politics. Weakened by the division between the comtesse de Sault and the young comte de Carces, the league applied to the duke of Savoy, who was besieging Marseilles. Carces and the other heads of the league submitted one after the other to the new governor Lesdiguières, who was succeeded by the duke of Guise in 1595, and in 1596 the religious wars in Provence were definitely ended by the capitulation of Marseilles.

During the reign of Henry IV. the country was comparatively peaceful; but under Richelieu the restriction of local freedom and the creation of new offices led to the insurrection of the *Cascaveous* (small bells, a name derived from their rallying sign), which Condé came to suppress in 1630–1631. At the time of the Fronde additional taxes were levied by the parlement at Aix, and the struggle began between the *Canivets* (Mazarins) and the *Sabreurs* (prince's party), who captured the governor, the comte d'Alais, for a short time. The duke of Mercoeur calmed the country down. Louis XIV.'s tour in Provence (1660) was marked by an insurrection at Marseilles, which brought about the abolition of the last remaining municipal liberties of the town. Provence was severely tried by the imperialist invasions of 1706 and 1746, and the great plague of 1720. Towards the end of the *ancien régime* the movement which resulted in the revolution of 1789 made itself felt in Provence, and was most apparent in the double election at Aix and at Marseilles of Mirabeau as deputy for the states-general.

Provence, with its own special language and its law so closely related to Roman law, has always been quite separate from the other French provinces. Theoretically it retained its provincial estates, the origin of which has been traced to the assemblages of the 12th century. They met annually, and included representatives of three orders: for the clergy, the archbishop of Aix, president *ex officio* of the estates, the other bishops of Provence, the abbots of St Victor at Marseilles, of Montmajour and of Thoronet; for the nobility, all the men of noble birth (*gentilhommes*) until 1623, when this privilege was restricted to actual holders of fiefs; for the third, the members of the twenty-two chief towns of the *vigueries*[1] and fifteen other privileged places, among which were Arles and Marseilles. There were theoretically no taxes, but only supplies given freely by the estates and assessed by them. However, this assembly did not meet after 1639. The administrative divisions of Provence were constantly changing. In 1307 Charles II. divided it into two *sénéchaussées*, Aix and Forcalquier, comprising twenty-two *vigueries*. At the end of the *ancien régime* the government (*gouvernement*) of Provence, which corresponded to the *généralité* of Aix, was made up of eight *sénéchaussées*, those of Lower Provence—Aix, Arles, Marseilles, Brignoles, Hyères, Grasse, Draguignan, Toulon; and four of Upper Provence—Digne, Sisteron, Forcalquier, Castellane. From a judicial point of view the parlement of Aix had replaced the former *conseil eminent* or *cour souveraine*. There was a *chambre des comptes* at Aix, and also a *cour des aides*. A decree, dated the 22nd of December 1789, divided Provence into the three departments of Bouche du Rhône, Basses-Alpes and Var, and in 1793 Vaucluse, the former county (*comtat*) of Venaissin, which belonged to the pope, was added to these. The boundaries of the department of Var were modified in 1860 after the annexation, when the department of the Alpes Maritimes was formed.

Authorities.—There is no good general history of Provence. For a complete work consult the ancient works of H. Bouche, *Chorographie et histoire chronologique de Provence* (2 vols. in fol., Aix, 1664); Papon, *Histoire générale de Provence* (4 vols. in 4to, Paris, 1777–1786); L. Méry, *Histoire de Provence* (3 vols. in 8vo, Marseilles, 1830–1837). For special periods of history see F. Kiener, *Verfassungsgeschichte der Provence, 510–1200* (8vo, Leipzig, 1900); R. Poupardin, *Le Royaume de Provence sous les Carolingiens* (in 8vo, Paris, 1901); G. de Manteyer, *La Provence du ier à xiie siècle* (in 8vo, Paris, 1907); Lambert, *Essai sur le régime municipal et l'affranchissement des communes en Provence* (in 8vo, Toulon, 1882); *Les Guerres religieuses en Provence* (2 vols. in 8vo, 1870); Cabasson, *Essai historique sur le parlement de Provence* (3 vols. in 8vo, Aix, 1826). (R. Po.)

PROVERB (Lat. *proverbium*, from *pro*, forth, publicly, *verbum*, word; the Greek equivalent is *παροιμία*, from *παρά*, alongside, and *οἶμος*, way, road, *i.e.* a wayside saying; Ger. *Sprichwort*), a form of folk-literature, or its later imitation, expressing, in the form of a simple, homely sentence, a pungent criticism of life. Many definitions have been attempted of a "proverb," of which none has met with universal acceptance. J. Howell's (d. 1666) three essentials, "shortness, sense and salt," omit the chief characteristic, popularity or general acceptance, and the definition of Erasmus—*Celebre dictum scita quapiam novitate insigne*—suits a good proverb rather than proverbs in general. Lord Russell's "The wisdom of many and the wit of one" is familiar.

For a general survey of the subject of proverbs, Archbishop Trench's *Proverbs and their Lessons* (new ed., 1905, by A. Smythe-Palmer, with additions and notes) is useful; it contains a fairly comprehensive bibliography, ancient and modern. Bohn's *Handbook of Proverbs*, and *Polyglot of Foreign Proverbs* (1857), based on the collections of John Ray (1670) and David Ferguson (1641), are very full. V. Stuckey Lean's *Collectanea* (5 vols.) 1902 is a storehouse of English proverbs, classified in various ways; *Notes and Queries*, 9th series (1898), vol. ii., contains a bibliography of English works. The principal foreign works are G. Strafforello, *La Sapienza del mondo* (3 vols., 1883) and Reinsberg and Düringsfeld, *Die Sprichwörter der germanischen und romanischen Sprachen* (2 vols., 1872–1875). There are many popular handbooks giving full collections of proverbs, English and foreign.

PROVERBS, BOOK OF (Heb. *Mishlē Shelomoh*, "Proverbs of Solomon," abridged by the later Jews to *Mishlē*; Septuagint, *παροιμίαι* or Π. Σαλ.; Lat. Vulg. *Parabolae sal.* and *Liber proverbiorum*), one of the Wisdom books of the Old Testament (see Wisdom Literature) and the principal representative in the Old Testament of gnomic thought. This sort of thought, which appears very early in Egypt (2000 B.C. or earlier), and relatively early among the Greeks (in the sayings of Thales and Solon as reported by Diogenes Laertius), was of late growth among the Hebrews. Doubtless they, like other peoples, had their simple proverbs, embodying their general observations of life; a couple of these have been preserved in the Old Testament: "Is Saul also among the Prophets?" (1 Sam. x. 12); "The fathers eat sour grapes, and the children's teeth are set on edge" (Jer. xxxi. 29; Ezek. xviii. 2). It is possible that Solomon uttered or collected a number of such sayings, based in part on observation of the habits of beasts and plants (1 Kings iv. 32 seq. [Heb. v. 12 seq.]; cf. Jotham's apologue, Judg. ix. 8 sqq., and Samson's riddle, Judg. xiv. 14). The Hebrew word *mashal*, commonly rendered "proverb," is a general term for didactic and elegiac poetry (as distinguished from the descriptive and the liturgical), its form being that of the couplet with parallelism of clauses; in the Old Testament it signifies a folk-saying (Ezek. xii. 22, xviii. 2), an allegory (Ezek. xvii. 2), an enigmatical saying (Ezek. xxi. 5), a byword (Jer. xxiv. 9; Deut. xxviii. 37), a taunting speech (Isa. xiv. 4; Hab. ii. 6), a lament (Mic. ii. 4), a visional or apocalyptic discourse (Num. xxiii. 7; xxiv. 15), a didactic discourse (Ps. xlix., lxxviii.), an argument or plea (Job xxix. 1). In the book of Proverbs it is either an aphorism (x.–xxii.) or a discourse (i.–ix., xxiii. 29–35, xxvii. 32–27).

The uses of the term being so various, its special signification in any case must be determined by the character of the passage in which it occurs; and an examination of the contents of Proverbs shows that the thought of the book differs widely from that of the literature prior to the 5th century B.C. The book appears on its face to be a compilation, various authors being mentioned in the titles: Solomon in x. 1 and xxv. 1; the "sages" in xxii. 17 and xxiv. 23; Agur in xxx. 2; the mother of King Lemuel in xxxi. 2; xxxi. 10–31 and, probably, xxx. 5–33 are anonymous; the ascription in i. 1 to Solomon may refer to i.–ix or to the whole book. Apart from the titles (which are not authoritative) the difference of style in the various sections indicates difference of authorship. There is, indeed, a certain unity of thought in the book; throughout it inculcates cardinal social virtues, such as industry, thrift, discretion, truthfulness, honesty, chastity, and in general it assumes wisdom to be the guiding principle of life. But the sections differ in form and tone. While chs. x.–xxix. and part of xxx. consist of aphorisms chs. i.–ix., xxxi. are composed of more or less elaborate discourses. In the aphoristic sections also there is variety; there are couplets (x. i.–xxii. 16; xxv.–xxix.), quatrains (xxii.–xxiv.) and tetrads and other numerical arrangements (xxx. 7–33). Compilatory character is indicated by repetitions; there are identical lines (x. 1 and xxix. 3; xi. 14 and xxiv. 6; xiii. 9 and xxiv. 20; xiv. 1 and xxiv. 3; xv. 18 and xxix. 22; xvii. 3 and xxvii. 21; xix. 13 and xxvii. 15; xx. 22 and xxiv. 29; xxiv. 23 and xxviii. 21) and identical couplets (xviii. 8 and xxvi. 22; xix. 1 and xxvii. 6; xix. 24 and xxvi. 15; xx. 16 and xxvii. 13; xxi. 9 and xxv. 34; xxii. 3 and xxvii. 12).

The dates of the various parts of the book must be determined by the character of the contents, there being no decisive external data. The fact that it stands in the third division of the Hebrew Canon, the Writings or Hagiographa, along with such late works as Job, Psalms, Chronicles, Daniel, Ecclesiastes and

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[1] The *viguerie* was the jurisdiction of a *viguier*, *i.e.* "vicar," a name given at various times and places in the south of France to very different feudal officials. The *viguerie* in the 17th and 18th centuries as an administrative subdivision in Provence corresponded to the *prévôté* elsewhere.

Esther, must be allowed weight; the presumption is that the arrangers of the Canonical books regarded it as being in general later than the Prophetical books. No help can be got from the titles. Examination of titles in the Prophets and the Psalms (to say nothing of Ecclesiastes and Wisdom of Solomon) makes it evident that these have been added by late editors who were governed by vague traditions or fanciful associations or caprice, and there is no reason to suppose the titles in Proverbs to be exceptions to the general rule. The ascription of parts of Proverbs to Solomon (i. 1, x. 1, xxv. 1) means nothing for us except that there was a disposition among the later Jews to refer their books to great names of the past, Enoch, Daniel, Job, Moses, David, Solomon, Ezra; as also, outside of Jewry, works were ascribed to Homer, Plato, Aristotle, Tacitus and others that were not composed by these authors. The supposition of a Solomonic authorship for Proverbs is excluded by the whole colouring of the book, in which monotheism and monogamy are assumed, without discussion, to be generally accepted, while in Solomon's time and by Solomon's self the worship of many gods and the taking of more than one wife were freely practised, without rebuke from priest or prophet. The high ethical conception of the kingly office in Proverbs is out of keeping with the despotic character of Solomon's government. It is supposed, indeed, by some modern writers that the notice in xxv. 1 (" These are proverbs of Solomon, that the men of Hezekiah king of Judah transcribed ") is too circumstantial to be merely a late tradition or scribal guess. But similarly definite titles are prefixed elsewhere, for example, to Ps. li.–lx., where they cannot possibly be correct. Hezekiah's time may have been selected by the author of the title (or by the tradition which he represents) as being the next great literary period in Judah after Solomon, the time of Micah and Isaiah, or the selection may have been suggested by the military glory of the period (the repulse of the Assyrian army) and by the fame of Hezekiah as a pious monarch and a vigorous reformer of the national religion. But to regard Hezekiah as a Jewish Pisistratus is to ascribe to the time a literary spirit of which the extant documents give no hint; the literature of the age was wholly occupied with the past history, the religious conditions and the political fortunes of the nation, subjects alien to the book of Proverbs.

The objections to the Solomonic age as the time of origination of the book apply also to the period extending from Solomon through the 6th century. But there are considerations that lead us to put its origin still later. One of these is the non-national character of the thought. The historical and prophetical books and the Pentateuch are wholly concerned with the nation. For them Israel is the centre of the world, the point around which all other things revolve—every other people derives its claim to consideration from its relation to Israel—the only subject deserving attention is the extent of the Jewish nation's obedience or disobedience to its divinely given law, on which depends its prosperity or its adversity. In Proverbs there is a notable absence of this point of view. The name Israel and the terms temple, prophet, priest, covenant, do not occur in the book. The " vision " (that is, prophetic vision) in the Hebrew text of xxix. 18 (" Where there is no vision, people throw off restraint ") is an error of text. No writer who was acquainted with Hebrew history could suppose that there was any relation between the national morality and the abundance of prophetic visions; the period in which such visions were most numerous is precisely that in which the corruption of morals is painted by the prophets in the darkest colours and, on the other hand, the people are said (in Pss. xliv. and lxxiv.) to have been obedient at a time when there was no prophet. Moreover, this reading supplies no antithesis in the couplet, the second line of which is: " But he who obeys instruction (or law), happy is he "; we should expect the first line to read: " Where there is no guidance people throw off restraint," as in xi. 14: " Where there is no guidance, a people falls, but in the multitude of counsellors there is safety." Prophets play so great a part in the early history that the ignoring of them here is significant. The decadence of prophecy is indicated in two passages that belong probably to the Greek period: in Zech. xiii. 2 sqq. prophecy is identified with the " unclean spirit," the pretender to visions is threatened with death by his parents, and, so great is the general contempt for the class, protests that he is no prophet but a tiller of the ground, accounting for the wounds on his person (such as these charlatans used to inflict on themselves) by declaring that they were received in the house of his friends (that is, apparently, in a drunken quarrel); from a very different point of view Joel ii. 28 seq. (Heb. iii. 1 seq.) predicts that in the latter times (in the ideal restoration of the people) all persons, free and bond, male and female, shall have the spirit of prophecy — that is, the old order shall be set aside and a new religious constitution established. Proverbs belongs to the time when prophecy, as a helpful institution, had disappeared, and wisdom had taken its place. So also the term law had here taken on a new meaning. It is no longer the law of Moses or that of the prophetic revelation—it is the standard of rightdoing resident in every man's mind, the creation of wise reflection; such a conception lies outside the point of view that forms the very substance of Hebrew thought in the period prior to the 5th century. It is true that the nationalistic tinge is found in late writings (Chronicles, Psalms), and that its absence, therefore, is not merely a matter of date; but it is hardly conceivable that an author of any time before the 5th century could have ignored the nationalistic point of view so completely as Proverbs does.

Another noteworthy feature of the book is the picture it gives of social life. The organization of the family is treated much more fully than in the Law and the Prophets, and has a more modern aspect. In Deut. xxi. 18 sqq. (of the 7th century) a disobedient son, complained of by his parents, is to be stoned to death by the men of the city; in Proverbs (xiii. 24, xxii. 15, xxiii. 13 seq., xxix. 15, 17) a bad child is to be chastised, and much is said of the training of children by instruction. The impression made by a number of passages (i. 8, xxiii. 22 *al.*) is that a regular system of family education existed, more definitely ethical than that indicated in Deut. vi. 7, which merely enjoins teaching children the details of the national law. In addition to this parental instruction we find hints of a sort of academic training, particularly in chs. i.–ix., in which the sage appears to address a circle of youths. If we may credit the Talmudic tract Pirke Aboth (ch. i.), Jewish academies under the charge of great teachers existed early in the 2nd century B.C., and the beginnings of such institutions may go back a century; they would probably be suggested by the Greek schools of philosophy, which early sprang up in Western Asia and Egypt under Alexander's successors.

Monogamy, as is remarked above, is assumed in Proverbs to be the recognized custom. Polygamy was legal and usual in the 7th century (Deut. xxi. 15) and the 6th (Lev. xviii. 17, 18), and doubtless continued to be practised some time after by the Jews, though on this point we have no definite information; Herod, who was a despot, and was not a Jew, cannot be taken as an illustration of Jewish custom; the obscure passage, Mal. ii. 10 sqq. (450–400 B.C.) may have monogamy in mind, but its position on this point is not clear. What is certain is that the definite assumption of monogamy is found only in such late books as Ben-Sira (Ecclesiasticus), Tobit and Judith. In regard to punishment for the violation of a husband's rights Proverbs shows a marked advance on the old usage. The Pentateuchal law (Lev. xx. 10) prescribes death as the punishment for adultery; Proverbs (v., vi. 27 sqq., vii.) treats the offence as a sin against the offender himself, an act of suicidal folly, the punishment coming sometimes from the jealous husband, but chiefly in the way of the physical depravation and social ignominy that befall the adulterer. This change of punishment imports not a falling off in the moral standard but rather the conviction that a crime of this sort is best dealt with by public opinion; in any case it means a change in the constitution of society.

The experiences described in Proverbs belong especially to city life. Something is said here and there bearing on agricultural pursuits, and there is a paragraph (xxvii. 23 sqq.)—a little treatise it may be called—enjoining on the landowner the necessity of paying special attention to his cattle, large and small; these, says the writer, are the real sources of wealth to the rural landowner. Possibly he means to insist on the advantages of country life over life in the city; if this be so, the paragraph bears witness to the prominence of the latter. Whether or not this is his design, advice to cattle-owners is natural in a manual of conduct. The Jews were mainly country-folk from the time of their settlement in Canaan to their final expulsion from the land by Titus and Hadrian, and the soil of Israelitish Palestine was better adapted to the raising of sheep and oxen than to the production of grain. Doubtless much attention was paid to this industry, but the composition of a little book on the subject, indicating a scientific interest in boviculture, points to a comparatively late period; the Greek and Roman works of this sort, by Aristotle, Theophrastus, Virgil and others, were late. This little treatise stands almost alone in Proverbs; the great mass of its aphorisms relate to vices and faults which, though possible in any tolerably well-organized community, were specially prominent in the cities in which the Jews dwelt after the conquests of Alexander. They are malicious gossip, greed of money, giving security, nocturnal robbery, murder, unchastity. Much space is given to the last-named vice throughout the book, and especially in chs. i. and ix.—obviously it is regarded as a notorious social evil. Comparatively little is said of it in the Pentateuch and the prophetical and historical books. That there were harlots and adulteresses in Israel from an early time is shown by such passages as Judg. xi. 1 (Jephthah's mother), 1 Kings iii. 16 (the judgment of Solomon), Hos. iii. 1. (Hosea's wife), by the denunciations of the crime and the laws against it, and by the employment of the terms harlotry and adultery as designations of religious unfaithfulness. Yet, apart from the references to cultic prostitution (which was adopted by the Israelites from the Canaanites), the mention of the vice in question is not frequent; in a polygamous society and in a country without great cities it was not likely to grow to great proportions. The case was different when the Jews were dispersed through the new Greek kingdoms, and lived in cities like Jerusalem and Alexandria, centres of wealth and luxury, inhabited by mixed populations; this form of debauchery then became commoner and better organized. Hetairae flocked to the cities. Naukratis in the Egyptian Delta was famous under the Ptolemies for its brilliant venal women. The temptations of Alexandria and the loose morals of the time (latter part of the 3rd century) are illustrated by the story told by Josephus (*Ant.* xii. 4, 6) of Joseph the son of Tobias. The picture of society given in Ben-Sira (ix. 3–9, xix. 2, xxiii. 16–26, xxv. 16–26, xxvi. 8–12, xlii. 9–14), based on life in Jerusalem and Alexandria in the 2nd and 3rd centuries B.C. agrees in substance with the descriptions of the Book of Proverbs. The tone of these descriptions throughout the book, but particularly in chs. i.–ix., is modern. A point of interest is that the exhortations to chastity are addressed to men only; the man is regarded as the victim, the woman as the temptress—women are never warned against men or against the general seductions of society. This silence may be due in part to a current opinion that women were more hedged in and guarded by social arrangements and less exposed to temptation than men; but it is chiefly the result of the fact that the Old Testament (like most ancient and modern works on practical ethics) addresses itself almost exclusively to men (certain classes of women are denounced in Amos iv. 1–3; Isa. iii. 16–iv. 1; Ezek. xiii. 17–23); the moral independence of women is not distinctly recognized. In this regard Ecclesiasticus agrees with Proverbs—it has no word of advice for women. The temptress in Proverbs appears to be a married woman; she is certainly such in chs. vi. and vii., and probably also throughout the book. The term "strange woman" (ii. 16 *al.*) means not a foreigner, but one who is alien to the man's family circle, the wife of another man. Such women may sometimes have been foreigners, but the sage's concern is with the man's violation of the marriage obligation, be the woman Jew or Gentile. In the earlier time marriages between Jewish men and Canaanite women seem to have been not uncommon; whether (outside of Herod's family) there were marriages with foreigners in the Greek period we have no means of determining.

Proverbs is remarkable for the attention it gives to kings. The prophets have nothing to say of them as a class. One passage in the Pentateuch (Deut. xvii. 15–20) prescribes that the Israelite king shall be the opposite of Solomon—he shall not accumulate horses, wives, silver and gold, and shall study the law. In the Psalter he is considered merely as a servant of Yahweh. Proverbs treats the king, in a quite modern way, as a member of society. He is described ideally as ruling by the might of wisdom (viii. 15, 16), and as controlled in his administration by truth, kindness and justice (xx. 8, 26, 28)—the wicked ruler who oppresses the poor is condemned as not reaching the ideal standard (xxviii. 3, 5, 16). Three manuals of conduct are devoted to him (xvi. 10–15, xxv. 2–7, xxxi. 2–9). His power is recognized—he is the source of life and death (xvi. 14, 15)—but he is treated as a human being who must be governed by the ordinary laws of right. It is especially illustrative of the times that instruction in table manners is offered to the guests of kings—they must be modest in their bearing, not putting themselves forward (xxv. 6, 7; cf. Luke xiv. 8, 11), and they must control their appetites (xxiii. 1, 2). The reference here must be to the numerous non-Jewish kings of the Greek period, and perhaps also to the Maccabean princes; the manners of the time are set forth in Josephus's account of Ptolemy's dinner, at which the Jew Hyrcanus was a guest (*Ant.* xii. 4, 9). The mingling of despotism and good-natured familiarity there described (and the spirit is doubtless correctly given by Josephus, whether or not his details are historical) agrees with the picture in Proverbs.

Finally, a late date for Proverbs is indicated by what may be called its philosophical element—a feature that it has in common with the other Wisdom books (see WISDOM LITERATURE). This element is recognizable throughout the book, but is most distinct in chs. i.–ix., in which wisdom is personified as the power regulating the affairs of human life (iii. 13–18, viii. 1–21). The portraiture approaches hypostatization in the cosmogonic ode (viii. 22–31), especially if the first line of *v.* 30 be rendered: "I was at his side as a master-workman"; but the Hebrew word (*amon*) rendered "master-workman" is of doubtful meaning, and the connexion rather calls for some such sense as "nursling, ward"; Yahweh himself is represented as the architect, and wisdom, the first of his works, is his companion, sporting in his presence like a beloved child. The whole passage (*vv.* 22–31) was early employed by Christian theologians (Irenaeus, Athanasius, Augustine and others) in the controversies respecting the nature of the Second Person of the Trinity, particularly in connexion with the idea of eternal generation; the argument turned in part on the question whether the verb in *v.* 22 was to be translated by "created" or by "possessed." Ecclesiasticus xxiv. and Wisdom of Solomon vii. should be compared with the Proverbs ode. In the remainder of the book (chs. x.–xxxi.) "wisdom" is sometimes common sense or sagacity, sometimes the reflective habit of mind and largeness of outlook, sometimes the recognition of the ideal standard of living. Contrasted with the wise are fools, and on these the sages vent their scorn abundantly (xii. 15, 16, xvii. 12, xviii. 6, 7, xxiii. 9 *al.*); xxvi. 1, 3–12 is a "book of fools." The conception of the good life is that of philosophically ordered rectitude. The religious element is prominent in x. 1–xxii. 16, but it is blended with the reflective. The philosophy of the book is practical, not speculative.

Comparison of Proverbs with Ecclesiasticus, Ecclesiastes and Wisdom of Solomon shows that it belongs, in its main features, in the same category as these. Its thought, differing so widely from that of the prophets and the Pentateuch, is most naturally referred to the period when the Jews came into intimate intellectual contact with the non-Semitic world, and particularly with the Greeks (philosophical influence is not to be looked for from Persia).

While the general period in which the book belongs may thus be determined with fair probability, it is less easy to fix the dates of its several parts. The earliest of the groups of which the book is composed seems to be x. 1–xxii. 16, xxv.–xxix. which consists of simple aphorisms relating to everyday affairs. This group, however, is itself composite; we may distinguish a collection of antithetic couplets (x.–xv. and most of xxviii., xxix), and one made up of comparisons and single sentences (xvi. 1—xxii. 16, xxv.–xxvii., and some verses in xxviii., xxix). Of these two the first, on account of its simpler form, appears to be the earlier, though they cannot stand far apart in time; and by combining them an editor formed the section as we now have it. These may have been severally made from current collections, a number of which were probably in existence. A general preface exhorting the pupil to give heed to the instruction of the sages (xxii. 17-21), introduces a group of quatrains in two sub-groups (xxii. 22—xxiv. 22 and xxiv. 23–34) characterized by a wide range of thought and by ethical depth. Probably later than these are the elaborate discourses of i.–ix. (excluding vi. 1–5, 6–11, 12–19 and ix. 7–12, misplaced paragraphs) containing praise of ideal wisdom and warnings against unchastity. Chs. xxx., xxxi., made up of various pieces, form a sort of appendix to the book; some of the pieces are artificial in form (xxx. 11–31), one is a full picture of a good housewife's home life (xxxi. 10–31), two are ascribed to the unknown persons Agur (xxx. 2–4) and King Lemuel's mother (xxxi. 2–9). Agur's dictum is one of pious agnosticism directed, apparently, against certain theologians who talked as if they were well acquainted with the ways of God. Agur's word, breathing the spirit of scepticism, falls into the category represented by Ecclesiastes, and we may probably set the year 200 (or possibly 150) B.C. as the lower limit of the Book of Proverbs; allowing a century for the collection and combination of the various parts, we shall have the year 300 B.C. as the date of its earliest section. Some of the material may have existed in aphoristic form before, but the composition of the present book may be put approximately in the century 300–200 B.C. Even its simplest maxims have a certain academic form.

In its general ethical code Proverbs represents the best standard of the times; the sages are at one with the more enlightened moralists of the Western world. All the ordinary social virtues such as truthfulness, honesty, kindness, chastity are emphasized and a great stress is laid on care for the poor (a social necessity at a tine when there were no well organized public charities). But Proverbs seems not to go the length of identifying righteousness with almsgiving, as is done in Dan. iv. 27 (24), Matt. v. 1, and substantially in Ecclus. iii. 30, xxix. 12 and Tobit iv. 10, xii. 9; in x. 2, "righteousness delivers from death," the word "righteousness" is probably to be taken in its ordinary ethical sense. The above-named virtues are all recognized in the earlier Hebrew writings, the prophets and the law, but in certain points Proverbs goes beyond these, notably in its prohibition of exultation over a fallen enemy (xxiv. 17) and of retaliation for injury received (xxiv. 29), and in its inculcation of kindness to enemies (xxv. 21). The injunction in Lev. xix. 18, "Thou shalt love thy neighbour as thyself," refers only to Israelite fellow-citizens, not to enemies (cf. the interpretation given in Matt. v. 43), and the command in Exod. xxiii. 4 seq., to care for one's enemy's ox or ass likewise refers to Israelites; Proverbs conceives the principle in a higher way and extends it beyond the limits of the nation. Slavery is recognized as a lawful institution, but little is said of it. There is no suggestion of moral training of the slave; he is to be taught not by words (xxix. 19) but by the rod, like the child (*v.* 15), and it is intimated (*v.* 21) that it is a mistake to bring up a servant delicately. This was doubtless the general view of the time; Ben-Sira frankly regards the servant as a chattel (Ecclus, xxxiii. 24-31). Proverbs greatly disapproves of the elevation of slaves to the position of rulers (xix. 10)—an occurrence not uncommon in those days. The estimate of woman as wife and mother, and especially as housewife, is high (xviii. 22, xix. 14, xxxi. 10-31). In vi. 20 the mother is spoken of, along with the father, as teacher of the children, and it is assumed, therefore, that she is competent; but nothing is said of the education of women—in xxxi. 26 the "wisdom" of the good wife (not "virtuous woman") is good sense, practical sagacity in housekeeping. The equality of all men as creatures of God, silently assumed in the earlier literature, is definitely expressed in Proverbs (xxii. 2, cf. Job xxxiv. 19, Ecclus. xi. 14). Humility, as the opposite of insolent pride, is recognized as a virtue (xviii. 12, cf. xvi. 18)—it is a modest estimate of one's worth, refusal to claim too great honour for one's self. In general it is the simple homely virtues that are enjoined on men in Proverbs—there is no mention of courage, fortitude, intellectual truthfulness, and no recognition of beauty as an element of life; the ethical type is Semitic, not Hellenic, and the sages emphasize only those qualities that seemed to them to be most effective in the struggle of life; their insistence on the practical, not the heroic, side of character is perhaps in part the consequence of the position of the Jewish people at that time, as also the silence respecting international ethics belongs to the thought of the times. The ground of moral judgments in the book is both external (the law of God) and internal (the conscience of man); these two are fused into one, and both go back ultimately to current customs and ideas. The motive assigned for right doing is individualistic utilitarian—the advantage accruing to the man either through the laws of society or through the rewards dispensed by God. This motive, which is the one assumed throughout the Old Testament, is effective for the mass of men, and becomes ethically high when the advantage had in view is of an elevated moral character. Proverbs does not offer the good of society as an aim of action, though it takes for granted that good conduct will promote the happiness of all. Assuming human freedom it at the same time assumes that the ills of life may be overcome by a wise employment of man's resources, and it silently regards universal happiness on earth as the goal of human development.

Its religious scheme is the simplest form of theism; religion is reverence for God and obedience to His laws. Though the sages doubtless recognized the temple-cult as of divine appointment and obligatory, they lay no stress upon it; for them the essence of religion is something else; right living, they say (xxi. 3), is more acceptable to God than sacrifice, and sacrifice without ethical feeling is abominable to Him (xv. 8). Subordinate supernatural beings (angels and demons), though of course accepted as real, are ignored as having no importance for life. There is no reference or allusion to national Messianic hopes (certainly none in xvi. 10–15); neither the political situation in the 3rd century B.C., nor the sages' point of view was friendly to such hopes. The view of the future life is the old Hebrew one: death is practically the end-all, Sheol is the negation of happy activity, and from it no one returns; in v. 23, vii. 27, ix. 18, x. 2, the reference is to premature death on earth. The aim of the sages is to make earthly life strong and happy. They lay no claim to divine inspiration—they speak simply as ordinary human thinkers, though they are convinced that they have eternal truth.

The reception of Proverbs into the Hebrew Canon was for a time opposed on the ground of a supposed contradiction between two aphorisms (xxvi. 4, 5,) and (vii. 7, 20) of too highly coloured descriptions (*Shabbath*, 30b, *Aboth Nathan*, cap. i.); these difficulties were got over, and the book was finally declared canonical. It is quoted over twenty times in the New Testament, and has always been highly valued as a manual of conduct.

Of the ancient versions the Septuagint is the only one that is of great service for the criticism of the Hebrew text of Proverbs. The Latin, the Peshitta Syriac and the Targum occasionally offer suggestions; the Hexaplar Syriac and the Coptic are of value for the determination of the text of the Septuagint.

BIBLIOGRAPHY.—The Hebrew text is discussed in all recent commentaries; see also Dyserinck, in *Theol. Tijdschrift* (1883); Oort, ibid. (1885), and *Text. hebr. emendationes* (1900); Bickell, in *Wiener Zeitschr. f. d. Kunde d. Morgenlandes* (1891); Chajes, *Proverb.-Studien* (1889); Müller and Kautzsch, in Haupt's *Sacred Books of the Old Test.* (1901). The Greek versions are treated by de Lagarde, *Anmerkungen* (1863); Baumgartner, *Étude critique* (1890). For the Syriac see Pinkuss in *Zeitschr. f. Alttest. Wissenschaft* (1894). Compare also Nestle's article "Bibelübersetzungen" in the third edition

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PROVIDENCE, the second largest city of New England, capital of Rhode Island, U.S.A., the county-seat of Providence county, and a port of entry, situated at the head of Providence river (the N. arm of Narragansett Bay) and at the influx of the Seekonk (or Blackstone), Moshassuck and Woonasquatucket rivers, about 35 m. from the Atlantic ocean, 45 m. by rail S.S.W. of Boston, and 188 m. E.N.E. of New York. Pop. (1890), 132,146; (1900), 175,597; (1905, state census), 198,635, of whom 65,746 were foreign-born, including 17,155 Irish, 12,114 Italians, 9795 English, 4221 English Canadians, 4005 French Canadians, 3685 Russians, 3347 Swedes, 2211 Germans, 2173 Portuguese (including some Bravas from the Cape Verde Islands), and 1930 Scotsmen. The figure for 1910 was 224,326. Providence is served by the New York, New Haven & Hartford railway and by steamboat lines to Newport, New York, Philadelphia, Baltimore and Norfolk. It extends over an area of more than 18 sq. m., and is irregularly laid out. The Seekonk and Providence rivers mark the eastern boundary, the Providence and Moshassuck rivers divide the middle and northern portion of the city into the east and west sides, and the Woonasquatucket river divides the west side into the northern and southern parts. The west side is a level or gently rolling plain only a few feet above the sea, but on the eastern side are a plateau and hills rising to a maximum height of about 200 ft. The larger and newer portion of the business district is along the western bank of the Providence, and some of the best business houses are on made land. The part of the city which has most historic interest is on the east side, where are the most attractive residences. Most of the manufactories are along the banks of the Woonasquatucket and Moshassuck. The names of streets—Pound, Sovereign, Shilling, Dollar, Doubloon, Benevolent, Benefit, Hope, Friendship, Peace, &c., reflect the early commercial importance of the city and its strong Quaker element.

The principal building is the large State House, completed in 1902, of Georgia marble and white granite, surmounted by a central dome of marble, 235 ft. high, and standing on a rise of ground (Capitol Hill) about ½ m. north by west of the steamboat landing at the head of Providence river; in the state chamber is a full length portrait of George Washington by Gilbert Stuart. The old State House on Benefit Street, on the east side, is now used as the 6th district (Providence and North Providence) court-house. Near the centre of the city (in Exchange Place) is the city-hall (1878), a handsome structure of granite; on its façade is a medallion of Roger Williams. Across Exchange Place from the city-hall is the Federal Building (1908), which houses the post-office, custom-house, U.S. courts, &c. The county court-house (1877) is the only other prominent government building. The Arcade (1828), 225 ft. long, with six massive Ionic columns at each entrance, the Butler Exchange, and a few other fine buildings fronting on Westminster Street are among the more prominent business buildings. In Cranston Street, between Waterloo and Dexter, is an Armory, with the largest hall in New England. A handsome public library building, opened in 1900, lying between Fountain, Greene and Washington Streets, houses a good collection of 140,000 vols. (in 1909); other libraries are the State Library (30,000 volumes), the State Law Library (50,000 volumes) in the Providence county court-house, the Providence Athenaeum (the Providence Library, established in 1753, united in 1836 with the Providence Athenaeum, established in 1831; in 1909 it had 73,000 volumes), the library of the Rhode Island Historical Society (established 1822; with 30,000 volumes and 50,000 pamphlets in 1909), and the libraries of Brown University. The meeting-house of the First Baptist Church, founded by Roger Williams, the oldest organization of this sect in the United States, was built in 1775 and was designed to resemble St Martin's-in-the-Fields, London. Its bell still rings the curfew at nine o'clock every evening; and the commencements of Brown University are held here. The Friends' meeting-house, another interesting old building, was erected in 1759. The Beneficent Church (Congregational, 1809–1810) is in the Colonial style, with a rounded dome. The Church of the Blessed Sacrament (Roman Catholic), in Academy Street, was designed by John La Farge. The Roman Catholic Cathedral of SS. Peter and Paul (1878) is of brown stone and has excellent interior decorations. Providence is the see of a Protestant Episcopal bishop. In Cathedral Square is a statue (1889) by Henry Hudson Kitson of Thomas A. Doyle, mayor of the city (1864–1869, 1870–1881, and from 1884 until his death in 1886). There is an equestrian statue (1887) by Launt Thompson of General A. E. Burnside in City Hall Park. In front of the post-office are two allegorical groups ("Providence" and "the United States") by J. Massey Rhind. In Columbus Park is a replica of Bartholdi's "Columbus," which was cast in silver by Providence metal workers for the Columbian Exposition in Chicago. Other statues are Hippolyte Hubert's Ebenezer Knight Dexter (erected 1894), George Thomas Brewster's bronze "Genius of Religious Liberty" on the dome of the State House, Franklin Simmons's Roger Williams (1877) in Roger Williams Park, a Hellenic bronze "Pancratiast" (1900, presented to the city by Paul Bajnotti of Turin) also in Roger Williams Park, and a Hellenistic statue of Augustus on the campus of Brown University. Two fountains also are worth mention: the Bajnotti Memorial Fountain in City Hall Park, a memorial to the wife of Paul Bajnotti, representing "The Struggle of Life" and designed by Enid Yandell; and the Elisha Dyer Memorial Fountain, a bronze athlete, by H. H. Kitson. There are art collections in Brown University and in the Annmary Brown Memorial (given to the city as a memorial to his wife, a daughter of Nicholas Brown, by Rush C. Hawkins, b. 1831). Among interesting old houses of the 18th century are the Admiral Hopkins House, in Hopkins Park, the Stephen Hopkins House (1742; 9 Hopkins St.), the John Carter Brown House (1791; 357 Benefit St.), and the John Brown House (1786; 52 Power St.). There are many colonial houses, red brick with marble trimmings, set well back from the street, with an occasional walled garden. There are many musical societies in Providence, including the Chopin Club (1879), the Arion Club (1880), the Einklang Singing Society (1890; German), the Verdandi Swedish Singing Society (1894), and the Providence Musical Association (1904). Other clubs are the Brown Union, University Club, a cricket and a polo club, golf clubs, yacht clubs and canoe clubs, the Handicraft Club, the Providence Art Club, the Hope Club and the Deutsche Gesellschaft.

Under the municipal park commissioners there are 33 public parks with a total area of 644·38 acres, and the city supports summer playgrounds; the state board of metropolitan park commissioners controls a large park system in the metropolitan park district, and a system of boulevards, connecting the several parks and other public reservations; there are nine metropolitan reservations, containing 677 acres, the largest being Lincoln Woods, of 460 acres, 4 m. north of the State House. Other metropolitan reservations are: Woonasquatucket Reservation (53 acres; 2½ m. west of the State House); Edgewood Beach (2½ m. south of the State House); and the Ten Mile River Reservation (100 acres; 4¾ m. north-east of the State House) on both sides of Ten Mile River. The finest municipal reservation is Roger

Williams Park (432 acres, of which 140 are water), with 9 m. of drives and boulevards, in the southern part of the city, 2½ m. from the State House. It was a part of the original tract ceded to Roger Williams by Miantonomo; 107 acres were a farm which Betsy Williams (d. 1871), a lineal descendant of Roger Williams, left to the city by will. In the park are a chain of lakes with a shore front of 7½ m., a boat-house, a casino, a speedway and athletic grounds, a municipal natural history museum, and the Betsy Williams Cottage (1775). Other municipal parks are: Neutaconkanut (40½ acres; 2½ m. west of the State House) on high land commanding a view to the east and south; Davis Park (38½ acres) with amusement grounds; Blackstone Park (43 acres, 1½ m. east of the State House) along the Seekonk river; Hopkins Park (¾ m. north of the State House), comprising the estate of Esek Hopkins (1718–1802), commander of the American Navy in the War of Independence, with a historical museum in the Admiral Hopkins House; and City Hall Park. Blackstone Boulevard is 1¾ m. long; and Pleasant Valley Parkway is 1¼ m. long. Enclosed by a railing near the eastern end of Power Street, on the bank of the Seekonk, is What Cheer Slate[1] Rock, according to tradition the first landing place of Roger Williams. In the North Burial Ground are the remains of Stephen Hopkins (1707–1785), a citizen of Providence, a delegate to the Albany convention of 1754, a colonial governor of Rhode Island (1755–1757, 1758–1762, 1763–1765, and 1767–1768), a member of the Continental Congress in 1774–1780 and a signer of the Declaration of Independence; of William Barton (1748–1831), who in the War of Independence captured General Richard Prescott near Newport on the 10th of July 1777; of Francis Wayland; and of Nicholas Brown, who was a patron of Brown University and one of the founders of the Providence Athenaeum and of the Butler Hospital for the Insane.

On the steep slope of College Hill (or Prospect Hill) in the east side near the business district, is Brown University (1764)—one of the eight colleges in the United States founded before 1776—closely connected with the history of Providence, Rhode Island, and the Baptist Church in America. It has an undergraduate department for men, with courses, largely elective, leading to the degrees of A.B. and Ph.B., and courses, almost wholly prescribed, in civil, mechanical and electrical engineering. It includes, besides "The Women's College in Brown University," a separate college for women, and a graduate department open to both men and women. The campus is shaded by some fine old elms and is surrounded by an iron fence with beautiful memorial gates. In 1910 there were twenty-two buildings, including the following: University Hall (erected in 1770 and used during the War of Independence as barracks and hospital by American and French soldiers); Sayles Memorial Hall (1881), containing the chapel, lecture halls and seminary rooms; three library buildings, the John Hay Library (which occupies the site of the old President's House), the old University Library (1878) and the John Carter Brown Library (1904); the Ladd Astronomical Observatory, with a 12-in. equatorial and much other valuable equipment; Rhode Island Hall (1840), containing a biological laboratory and a natural history museum; Manning Hall (1834), containing an art museum; Wilson Hall (1891), containing a physical and a psychological laboratory; Rogers Hall (1862), a chemical laboratory; an engineering building (1903); the Lyman gymnasium (1891) and Colgate Hoyt swimming pool (1904); an administration building (1902); the Sayles gymnasium (1906) for women; Rockefeller Hall (1903), occupied by the Brown Union, a students' organization and the Young Men's Christian Association; the residence halls: University Hall (1770, remodelled 1883), Hope College (1822 and 1891), Slater Hall (1879), Maxcy Hall (1895), and Caswell Hall (1903); and the Carrie (clock) Tower, erected in 1904 by Paul Bajnotti, of Turin, Italy, as a memorial to his wife, Carrie Mathilde Brown, of Providence. Besides the general library, containing (1909) about 164,000 volumes, the university owns the separately housed John Carter Brown Library of 20,000 volumes, one of the best collections in the world of material on early American history (especially of books printed before 1800), which, with an endowment of $500,000, was presented to the university in 1901 in accordance with the will of John Nicholas Brown, the son of John Carter Brown (1797–1874) a prominent Providence merchant, who began the collection. In 1909 the university had an endowment fund of $3,416,744, 90 instructors and 993 students, of whom 88 were graduates; of the undergraduates 179 were enrolled in the Women's College. The charter of the institution requires that it shall be governed by a board of thirty-six trustees, of whom twenty-two shall be Baptists, five Friends, four Congregationalists, and five Episcopalians, and by twelve fellows (including the president) of whom eight (including the president) shall be Baptists, "and the rest indifferently of any or all denominations." At the time it was framed the charter was considered extraordinarily liberal. Only two provisions are included regarding the character of instruction to be offered: first that "the public teaching shall in general respect the sciences," and second, that "into this liberal and catholic institution shall never be admitted any religious tests, but on the contrary all the members hereof shall forever enjoy full, free, absolute and uninterrupted liberty of conscience." The government has always been largely nonsectarian in spirit, and a movement was on foot in 1910 to abolish the denominational requirements for trustees and fellows.

Brown University, the first institution for higher education established by American Baptists, was incorporated in 1764, and although still under its original charter was known for the first forty years as Rhode Island College. The Latin or preparatory school was opened at Warren in 1764 and the college was started there in 1766, but in 1770 the institution was removed to Providence. Although its work was interrupted by the War of Independence, the institution was reopened in 1782 and ten years later it began to receive aid from Nicholas Brown (1769–1841), a wealthy merchant who graduated from the Rhode Island College in 1786; it was named in his honour in 1804, and up to the time of his death his gifts amounted to about $160,000. Dr Francis Wayland, the most eminent of its presidents, began his administration in 1827 and in twenty-eight years of service as its head he established the elective system and greatly raised the standard of scholarship. Brown actually became a university under Elisha Benjamin Andrews, who was president in 1889–1898, who developed the graduate school and undergraduate instruction in history and social and political science, and who was succeeded in 1899 by William Herbert Perry Faunce (b. 1859), who graduated at Brown in 1880. In 1900 and 1901 more than $2,000,000 was added to the endowment of the university. The Women's College was founded in 1891, and in 1897 it was accepted by the corporation as a department of the university. Among distinguished alumni of Brown are Henry Wheaton (1785–1848), John Hay, Richard Olney, James Burrill Angell (b. 1829) Adoniram Judson, William Learned Marcy, Wilbur Fisk, Horace Mann, Samuel Gridley Howe, Barnas Sears, Edwards Amasa Park, Samuel Sullivan Cox, George Park Fisher, George Dana Boardman, Alexander Lyman Holley, and Albert Harkness.

In Providence are the Rhode Island Normal School (in the north part of the city, in Gaspee St.; established in 1854; discontinued in 1857; re-established in 1871), which has a fine building (1898), the Rhode Island Institute for the Deaf (1876), and the Rhode Island School of Design (1877; partially supported by the state, since 1882, and by the city), affiliated with Brown University. The following secondary schools are in the city: four high schools, one of which is technical, La Salle Academy (1871; Roman Catholic, under the Brothers of the Christian Schools), Saint Xavier's Academy (Roman Catholic), the Academy of the Sacred Heart (Roman Catholic), Moses Brown School (Friends; at Portsmouth in 1784–1788; re-established in Providence in 1814), the Brown school for boys (non-sectarian), Fielden-Chace school for girls (non-sectarian), and the Lincoln School (non-sectarian). The public school system has benefited by the presence of Brown University, whose faculty has been largely represented on the school committee; by an agreement with the university its professor of the theory and practice of education is director of the training department in the high schools, and there are other schemes of co-operation. Transition classes between the kindergarten and primary were long peculiar to the Providence public schools. In 1908 a "Sunshine School" was established, with sun and fresh-air treatment for invalid pupils.

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[1] So called because Roger Williams was greeted here by Indians, who said "What cheer, Netop?" ("Netop" meaning friend).

The *Providence Journal* (Independent, daily, 1829), the most important newspaper published in the state, and the *Evening Bulletin* (Independent, 1863) are controlled by the same company.

The charitable institutions include the Rhode Island Hospital (1863, private), the Prisoners' Aid Association (1872), the Providence Rescue Home and Mission (1896), the Bethany Home of Rhode Island (1892), a temporary home for women; the House of the Good Shepherd (1904), the Lying-In Hospital (1884), Saint Joseph's Hospital (1892; Sisters of St Francis), two dispensaries, a City Hospital for the Treatment of Contagious Diseases (1909) on Capitol Hill; the Butler Hospital for the Insane, which is one of the oldest institutions of its kind in the country, was established by a bequest of $30,000 left in 1841 by Nicholas Brown, and has about 120 acres of beautiful grounds on the western bank of the Seekonk; the Dexter Asylum for the Poor (endowed with the Dexter Fund and limited to those who have a legal settlement in Providence, *i.e.* have paid taxes on $200 worth of property for five years; and hence a charity of little practical use); a home for aged men (1875), a home for aged women (1856), St Elizabeth's Home (1882, Protestant Episcopal) for incurable and convalescent women; a home for aged coloured women (1890), five temporary homes, the Rhode Island Catholic Orphan Asylum (1851, Sisters of Mercy), St Vincent de Paul's Infant Asylum (1892, Sisters of Divine Providence), St Mary's Orphanage (1873, Protestant Episcopal), the State Home and School (1885) for indigent and neglected children, Providence Children's Friend Society (1835), other homes for children, day nurseries, and the Providence Society for organizing charity (1892). Jewish charities are prominent. The St Vincent de Paul Society is the organized charity of the Roman Catholic churches.

The harbour of Providence and its approaches have been much improved since the middle of the 19th century by the Federal and state governments. Between 1853 and 1873 the low-water depth of the channel was increased from 4½ ft. to 12 ft., at a cost of $59,000; from 1878 to 1895 the depth of the channel was further increased to 25 ft., and anchorage basins were created with a minimum depth of 20 ft. for a width of 600 ft., with a minimum depth of 18 ft. for a width of 725 ft., with a minimum depth of 12 ft. for a width of 940 ft., and with a minimum depth of 6 ft. for a width of 1060 ft. Between 1896 and 1906 the channel from Sassafras Point to the ocean was widened to 400 ft. and by 1909 the anchorage area, having a depth of 25 ft., was further increased to about 288 acres. Between 1867 and 1909 the channel of the Seekonk river was dredged to a depth of 16 ft. as far as Pawtucket at the head of navigation. In 1908 the commerce, largely coastwise, of Providence Harbor, amounted to 3,379,594 tons, chiefly coal, general merchandise and fish, valued at $93,309,495. In 1909 the value of the foreign imports, chiefly salt from Turks Island and lumber from Nova Scotia, amounted to $1,893,551, and the value of the exports to $12,517. Of greater importance to Providence than its commerce are its manufactures, the value of which in 1905 was $91,980,963, or 16·9% more than in 1900. Its factory products were valued at 45·5% of the state's total; its wage earners were 40·9% of the state's total; and nearly one-half of the worsted goods and more than one-fourth of all the textiles made in the state were manufactured here, as were four-fifths of the rubber and elastic goods, nine-tenths of the foundry and machine-shop products, and all the gold and silver refined, not from the ore. The Gorham Company engage here in the manufacture of gold, silver and bronze works of art; the American Screw Company, the Brown & Sharpe Manufacturing Company, and the Nicholson File Company have factories here; and here the famous Corliss engines were first made about 1847. In 1905 Rhode Island ranked first among the states and Territories of the Union in the value of jewelry manufactured and more than 99% of this was made in Providence, which produced 26·9% (by value) of all the jewelry made in the United States. The value of the jewelry made in Providence in 1905 was $14,317,050, being 15·6% of the value of the city's entire factory product. Closely allied with this manufacture were the reducing and refining of gold and silver sweepings, &c. (none from ore), with a product value in 1905 of $4,260,698, and silversmithing and the manufacture of silver-ware with products in 1905 valued at $5,323,264. Actually the largest industry in 1905 was the manufacture of worsted goods, valued at $21,020,892. Other important manufactures are foundry and machine-shop products (1905, $9,358,687), woollen goods ($2,080,658), cotton goods ($1,025,264) and cotton small wares ($1,967,298), dyeing and finishing textiles ($2,254,074), rubber and elastic goods ($2,167,983), and malt liquors ($1,427,246).

Providence is governed under a city charter of 1832, subsequently amended. A town meeting is still held annually for the administration of the fund (referred to above) called the Dexter donation. Under the city charter only citizens who pay a tax on $134 worth of real property or $200 worth of personal property may vote for members of the city council. Until 1842 there was the further requirements that every voter should be the eldest son of a freeholder. The city council is composed of: a board of aldermen, one from each of the ten wards, which may redistrict the city every five years, and until 1895 acted as a returning board, and which is presided over by the mayor; and a common council of four members from each ward, elected in open ward-meeting by the qualified freeholders of the ward. Elections are annual. The aldermen and common council meet together to organize and to elect municipal officers, not otherwise provided for. The greater size of the common council gives it the power in joint sessions; and although the vote of the city for mayor is normally Democratic, the vote of the qualified freeholders (which is only about 40% of the total vote) for common-councilmen and aldermen is always Republican.

The two houses acted before 1895 as a board of registration; the council now chooses a board of three members with a term of three years. The city council and a school committee of 33 members (3 *ex officio*; 30 elected by wards, one each year from each ward for a three-year term) control the public schools. The mayor has had the veto power only since 1854; and until 1866 his veto could be overridden by a majority vote; a three-fifths vote of each chamber is now necessary. The mayor was at the head of the police department until 1901, when a commission of three was created; until 1906 these police commissioners were appointed by the governor of the state, but they are now chosen by the mayor with the approval of the board of aldermen. In the same way the mayor appoints a commissioner of public works for a term of three years. The three commissioners of the fire department and the three members of the board for the assessment of taxes are chosen by the city council. The city treasurer (since 1858) and the overseer of the poor and the harbour-master (since 1866) are elected by popular vote. The municipality owns and operates the waterworks and there are municipal bath-houses.

Providence was founded in 1636 by Roger Williams, an exile from Massachusetts, and its early history is closely bound up with the early history of Rhode Island, it being one of the four towns out of which this commonwealth was formed. Having agreed with Canonicus and Miantonomo, the Narraganset sachems, for the purchase of a considerable tract of land, Williams built his house about 50 ft. east of what is now North Main Street and nearly opposite the confluence of the Moshassuck and Woonasquatucket rivers, and he named the place Providence in recognition of his divine guidance hither. He and a few companions who had accompanied him into exile immediately established a town government with monthly town meetings, and in the next year, 1637, after the arrival of a few more settlers, a plantation covenant was adopted which laid the basis of the future commonwealth on a new principle—the complete separation of religious and civil affairs. In 1644 Williams secured a charter uniting Providence, Aquidneck (Portsmouth), and Newport, as "The Incorporation of Providence Plantations in the Narraganset Bay in New England"; these three towns (and Warwick) organized in Providence in May 1647 under this government. The charter of the 24th of November 1663, to the Governor and Company of the English Colony of Rhode Island and Providence Plantations, perpetuated the name Providence Plantations, which still remains a part of the legal title of the state. Providence was incorporated as a town by the Colonial Assembly in 1649; in 1730–1731, when the area of Providence was 370 sq. m., Scituate (including Foster), Glocester (including Burrillville), and Smithfield (including North Smithfield and Lincoln) were set off; in the next thirty years the area of the township was reduced to $5\frac{1}{2}$ sq. m. by the separation of Cranston, Johnston and North Providence, parts of which have been re-annexed since 1860. Providence was chartered as a city in 1832. During King Philip's War, in 1676, the town was attacked by Indians and the northern half was burned. In June 1772, a British schooner, the "Gaspee," while chasing a Providence packet-boat ran aground at what has since become known as Gaspee Point, whereupon its capture was planned by John Brown (1736–1828), a Providence merchant, and the plan—including the burning of the vessel—was carried out under the command of Abraham Whipple (1733–1819). During the war much privateering was carried on from Providence. The British occupation of Newport during the War of Independence caused the transfer of the important foreign commerce of that city to Providence, but as a consequence of their superior railway facilities most of this went to New York and Boston before the middle of the 19th century. In September 1815 Providence was visited by a gale which did about $1,000,000 damage to its shipping and other property. In 1830 Providence had ceased to be a great port and had begun to be a textile manufacturing place. Until 1900 Providence was one of the two capitals of the state, Newport being the other; since 1900 it has been the sole capital.

See H. C. Dorr, "The Planting and Growth of Providence," in the *Rhode Island Historical Tracts* (Providence, 1882); W. A. Greene and others, *The Providence Plantations for Two Hundred and Fifty Years* (Providence, 1886); W. R. Staples, *Annals of the Town of Providence* (Providence, 1843); W. B. Weeden, "Providence, the Colony of Hope," in L. P. Powell's *Historic Towns of New England* (New York, 1898); H. K. Stokes, "Finances and Administration of Providence" (Baltimore, 1903) in *Johns Hopkins University Studies in Historical and Political Science*; and William Kirk and others, *A Modern City: Providence, Rhode Island, and Its Activities* (Chicago, 1909).

PROVINCE (Lat. *provincia*; perhaps a contraction of *providentia*), a term originally applied, in ancient Rome, to the department or sphere of duty assigned to one of the higher magistrates, the consuls and praetors.[1] When, with the spread of the Roman arms, the government of conquered countries grew to be one of the most important duties of the higher magistrates, the term province, from designating the government of a conquered country as one particular duty of a Roman magistrate, came to be used generally as a designation of the country itself. Thus in later days it was applied to analogous territorial subdivisions of a country, as opposed to the centre of government; and apart from any territorial signification, the term is used generally for a sphere of duty.

It is to the older sense of the term as a subject territory lying outside of Italy and governed by Roman magistrates that the following historical remarks apply:—

As distinguished from Italy, the provinces paid tribute to Rome, for, at least from the time of the Gracchi, it was a recognized constitutional principle that the provinces were the estates of the Roman people and were to be managed for its benefit. Under the republic the constitution of a province was drawn up by the victorious Roman general assisted by ten commissioners appointed by the senate from its own body, and the province was henceforth governed on the lines laid down in this constitution or charter (*lex provinciae*). For administrative purposes the province was divided into districts, each with its capital, the magistrates and council of which were responsible for the collection of the district taxes. For judicial purposes the province was divided into circuits (*conventus*), and in the chief town of each circuit the governor of the province regularly held assizes.

Cities taken by the sword were destroyed, and their lands were turned into Roman domains and were let out by the censors at Rome to private persons, who undertook to pay a certain proportion of the produce. Royal domains, such as those of Syracuse, Macedonia, Pergamum, Bithynia and Cyrene were also confiscated. On the other hand communities which surrendered without offering an obstinate resistance were usually allowed to retain their personal freedom and private property, and their chief town was left in the enjoyment of its territory and civil rights; but all the lands were subjected to a tax, consisting either of a payment in kind (*vectigal*) or of a fixed sum of money (*tributum, stipendium*), and in some cases a custom-duty (*portorium*) was levied. It is to this latter class of communities (the *civitates vectigales* or *stipendiariae*) that the large majority of the provincial states belonged. In a better position were those states whose freedom was guaranteed by Rome on the ground of old alliances or special loyalty. Their freedom was recognized either by a treaty or by a decree of the Roman people or senate. As a decree of the people or senate could at any time be recalled, the position of the free states without a treaty was more precarious than that of the treaty states (*civitates foederatae*). The latter, though not allowed to meddle in foreign politics, enjoyed a certain amount of internal freedom, retained their lands, paid no taxes, and were bound to render those services only which were expressly stipulated for in the original treaty, such as furnishing ships and troops, supplying corn at a certain price and receiving Roman officials and soldiers *en route*. Amongst these treaty states were Massilia (Marseilles), Athens, Rhodes and Tyre. The privileges of the free but not treaty states were somewhat similar, but, as stated, more precarious. All political distinctions, save that between slave and freeman, disappeared when Caracalla bestowed the Roman franchise on the whole empire.

Provincial Diets.—Apart from the government by Roman officials, every province appears to have had, at least under the empire, a provincial assembly or Diet of its own (*concilium* or *commune*), and these Diets are interesting as the first attempts at representative assemblies. The Diet met annually, and was composed of deputies (*legati*), from the provincial districts. It arranged for the celebration of religious rites and games, especially (under the empire) for the worship of the emperor, the neglect of which was severely punished. The actual celebration was under the conduct of the high priest of the province, a person of much dignity and importance, perhaps the forerunner of the Christian bishop. The Diet also decreed the erection of statues and monuments; it passed votes of thanks to the outgoing governor, or forwarded complaints against him to Rome; and it had the right of sending embassies direct to the senate or the emperor.

The Provincial Governor.—The provinces were administered by governors sent direct from Rome, who held office for a year. From the formation of the first provinces in 227 B.C. down to the time of Sulla (82 B.C.) the governors were praetors (see PRAETOR); from the time of Sulla to that of Augustus the praetors remained in Rome during their year of office, and at the end of it assumed the government of a province with the title of propraetor. This applies, however, only to provinces which were in a settled state and could consequently be administered without a large military force. A province which was the seat of war, or was at least in a disturbed state, was committed to the care either of one of the consuls for the year or of a commander specially appointed for the purpose with the title of proconsul, who might be one of the consuls of the preceding or of a previous year, or else a former praetor, or even, in rare cases, a private individual who had held neither consulship nor praetorship. Thus the distinction between consular (or proconsular) and praetorial (or propraetorial) provinces varied from year to year with the military exigencies of different parts of the empire. At the close of the republic, however, we find even such a peaceful province as Asia administered by a proconsul. In the earlier period of the republic the senate either before or after the elections determined which provinces were to be governed by consuls and which by praetors, and after their election the consuls arranged between themselves by lot or otherwise which of the provinces nominated by the senate each should have, and similarly with the praetors. But in order to guard against partiality the Sempronian law of 123 B.C. provided that the senate should yearly nominate the two consular provinces before the election of the consuls, and that the consuls should after their election but before their entry on office arrange between themselves which of the two provinces each should have. The Pompeian law of 53 B.C. enacted that no one should hold the governorship of a province till at least five years after his consulship or praetorship. This law was repealed by Caesar after the battle of Pharsalia, but was re-enacted under Augustus; it severed the connexion which had previously existed between an urban magistracy and the governorship of a province, and turned the latter, from the mere prolongation of a Roman magistracy, into an independent office. Like magistracies at Rome a provincial governorship was regularly held for one year; but, unlike them, it could be prolonged, formerly by a vote of the people, later by a decree of the senate. The Julian law of Caesar (46 B.C.) enacted that the governorship of a consular province should be held for two, that of a praetorian province for one year. The necessary supplies of men and money were voted to the governor by the senate. His staff consisted of one or more lieutenants (*legati*), a quaestor (*q.v.*) and numerous subordinates. The lieutenants were nominated by the senate from men of senatorial rank; if they proved incompetent, the governor dismissed them; if they showed ability, he entrusted them with military or judicial functions. Besides these the governor took with him from Rome a number of young men of the upper classes to assist him in the government. These were known as the companions (*comites*) or suite of the governor, sometimes, but incorrectly, as the praetorian cohort (see Praetorians). These members of his suite were chosen by the governor himself, who was responsible for them, but they were maintained at the expense of the state, and under the empire received regular pay. In addition there was a crowd of beadles, clerks, couriers, criers, doctors, dragomans, &c., not to speak of freedmen and slaves for the personal service of the governor. Under the republic the governor was not allowed to take his wife with him to his province; under the empire he might do so, but he was answerable for her conduct. Before setting out for his province the governor, clad in the purple military robe of his office, offered sacrifice on the Capitol; then immediately after receiving the *imperium* or military command he marched out of the city (for the *imperium* could only be exercised outside of Rome and was forfeited by staying in the city), preceded by his sergeants (*lictores*), and accompanied by his suite. He was bound to travel direct to his province; the means of transport were supplied partly by the state, partly by the provinces through which he travelled. His year of office began from the day he set foot in his province, but the time of arrival varied with the length and difficulty of the route. In the hands of the governor all powers military and civil were united. He commanded all the troops in the province, and had power to raise levies of Roman citizens as well as of provincials, and to make requisitions of war material. He possessed both criminal and civil jurisdiction; as criminal judge he had the power of life and death, and from his sentence none but Roman citizens could appeal; as civil judge he was guided partly by the charter of the province (*lex provinciae*), partly by the edict which it was customary for him to issue before his entrance on office (compare Praetor), partly by the original laws of the country so far as their validity was acknowledged by the charter or by the governor's own edict. Under the empire Gaius wrote a commentary on the provincial edict, and it is usually supposed that this was a general edict drawn up for use in all the provinces and superseding all separate edicts for the different provinces. Mommsen, however, is of opinion that Gaius only commented on the edict of a particular province.

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[1] Only those magistrates who had *imperium* (military power) had a province. When the province of a quaestor is mentioned it refers to the province of the consul or praetor to whom the quaestor is subordinate. In familiar language any business was called a province.

Condition of the Provinces under the Republic.—Under the republic the Roman people regarded the provinces as so many estates from which they were to derive revenue. The weal or woe of the provincials was of no moment, but the development of the material resources of the provinces was of great moment. Hence agriculture and commerce were encouraged, settlements were made, roads and aqueducts were constructed; in short, the Roman aimed at exploiting his empire by a system of prudent economy as far as possible removed from the blind rapacity which has turned the empire of the Turk from a garden into a wilderness. But the Roman governors were too apt to look on their provinces as their own peculiar prey; they had usually bought their way to office at vast expense, and they now sought in the provinces the means of reimbursing themselves for the expenditure they had incurred at Rome. The annual change of governor was thus a frightful calamity to the provincials, for every year brought a repetition of the same extravagant demands to be met by the same or, as the province became exhausted, still heavier sacrifices. Redress was to be had originally by a complaint to the senate; after 149 B.C. there was a regular court established at Rome for the trial of cases of extortion (*repetundae*) by provincial governors. But, even when after much trouble and expense the provincials had arraigned their oppressor, it was difficult to secure his condemnation at the hands of juries composed (as they usually were) of men who had a fellow-feeling for the offender because they had themselves committed or hoped for means of committing similar offences. Besides the governor, two classes of harpies joined in wringing the uttermost farthing from the unhappy provincials. These were the *publicani* or farmers of the taxes, and the money-lenders (*negotiatores*), who supplied a temporary accommodation at ruinous rates of interest. Both these classes were recruited from the ranks of the Roman knights, and, since from the legislation of Gaius Gracchus (122 B.C.) the juries were drawn at first exclusively and after Sulla's time (81 B.C.) partially from the knightly order,[1] the provincial governor could not check the excesses of those blood-suckers without risking a condemnation at the hands of their brethren. Accordingly he generally made common cause with them, backing their exactions when needful by military force.

The Provinces under the Empire.—Under the empire the provinces fared much better. The monarchy tended to obliterate the distinction between Romans and provincials by reducing both to a common level of subjection to the emperor, who meted out equal justice to all his subjects. The first centuries of the Christian era were probably for some of the countries included in the Roman Empire the happiest of their history; Gibbon indeed fixed on the period from the death of Domitian to the accession of Commodus (96–180 A.D.) as the happiest age of the world.

Augustus, in 27 B.C., divided the provinces into imperial and senatorial. Those which, from their proximity to the frontier or the turbulence of their population, required the presence of an army were placed under the direct control of the emperor; those which needed no troops were left to be administered by the senate. (1) The senatorial provinces were ruled by an annual governor as under the republic. Of these provinces Augustus ordained that Africa and Asia should be consular, the rest praetorian; but all the governors of the senatorial provinces were now called proconsuls. Their powers and dignities were much the same as they had been under the republic, except that they had now no troops, or only a handful to maintain order. (2) The imperial provinces were governed by imperial lieutenants (*legati Caesaris*), who were nominated by the emperor and held office at his pleasure; all of them had the power of the sword (*jus gladii*). For the administration of the finances these lieutenants had procurators under them, while the governors of the senatorial provinces continued to have quaestors as under the republic. Another class of imperial provinces consisted of those which from the physical nature of the country (as the Alpine districts) or the backward state of civilization (as Mauretania and Thrace) or the stubborn character of the people (as Judaea and Egypt) were not adapted to receive a regular provincial constitution. These were regarded as domains of the emperor, and were managed by a procurator (in the case of Egypt by a praefect, see Praefect) nominated by and responsible to the emperor.

Under the empire all provincial governors received a fixed salary. Complaints against them were brought before the senate, and the accusers were allowed a senator to act as their advocate. The lengthened periods during which the governors, at least in the imperial provinces, held office, together with the oversight exercised by the emperor, alleviated materially the position of the provincials under the empire. In order to keep himself well informed of what was passing in the empire, Augustus established a post whereby official despatches were forwarded by couriers and official persons were conveyed by coaches. The post, however, was only for the use of the government; no private person was allowed, unless by an exceptional concession, to avail himself of it. (J. G. Fr.; X.)

Authorities.—The most exhaustive account of the Roman provinces and their administration will be found in Marquardt, *Römische Staatsverwaltung* (1881), vol. i. See also W. T. Arnold, *Roman Provincial Administration* (1879); Mommsen, *Roman Provinces under the Empire* (1884); C. Halgan, *L'Administration des provinces senatoriales sous l'empire*, with full bibliography of the subject; and T. M. Taylor, *Constitutional and Political History of Rome* (1899).

PROVINCETOWN, a township at the N. end of Cape Cod, in Barnstable county, Massachusetts, U.S.A. Pop. (1890), 4642; (1900), 4247; (1910 U.S. census) 4369. Area about 9½ sq. m. The township is served by the New York, New Haven & Hartford railway, and by a steamship line to Boston. The harbour, which is important as a harbour of refuge, is protected on the east by land, and the Federal government has strengthened this protection by dikes and groins and other sand-catching devices; it has five lighthouses. There is a magnificent beach stretching 30 m. from Provincetown village to Eastham. The village is a summer resort. Through many generations the inhabitants have gained their living chiefly from the sea; the township's fisheries, however, have greatly decreased in importance (the invested capital diminishing 67·1% in 1885–1895). The prosperity it retains is not a little due to Portuguese from the Cape Verde Islands and the Azores, and to British Americans. Provincetown village was long second only to Gloucester in the cod fisheries, which low prices and the introduction of larger vessels and correspondingly costlier fittings have greatly handicapped. Whaling retains a remnant of its old importance, and there are also mackerel and shore fisheries, oil-works, cold storage establishments for preserving fish for food and bait, and canning works for herring. The first settlement here was made about 1680; it became a "district" or precinct of Truro in 1714, and was established as a township with its present name in 1727. Provincetown harbour was possibly visited by Gaspar Cortereal in 1501; Gosnold explored it and its vicinity in 1602, and John Smith was here in 1614. It was in this harbour that the "Mayflower" compact (see MASSACHUSETTS) was drawn up and signed by the Pilgrims before they proceeded to Plymouth, in 1620; here John Carver was chosen the first governor of Plymouth Colony, and Provincetown was the first landing place (on Saturday the 11th [o.s.] of November) of the Pilgrims in the New World. A memorial of the "compact," of polished Acton granite, 6 ft. high, with two bronze tablets, was erected before the town-hall by the Old Colony Commission, and on High Pole Hill on the 20th of August 1907 the cornerstone of a second memorial (completed in 1909, dedicated Aug. 5, 1910), a granite tower, 252 ft. high, was laid, addresses being delivered by President Roosevelt, James Bryce and H. C. Lodge. In Provincetown harbour, on the 1st of January 1862, James M. Mason and John Slidell, the envoys of the Confederate States to Great Britain and France respectively, who had been taken by a Federal vessel from the British ship "Trent," were restored by the Federal authorities to H.B.M.S. "Rinaldo," after their detention in Fort Warren in Boston harbour.

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[1] Sulla excluded the equites from the list; the lex Aurelia (70) reinstated them.

PROVINS, a town of northern France, capital of an arrondissement of the department of Seine-et-Marne, at the junction of the Durtain with the Voulzie (an affluent of the Seine), 59 m. E.S.E. of Paris by rail. Pop. (1906), 7546. The town enjoys a certain reputation for its mineral waters (which contain iron, lime, and carbonic acid, and are used for bathing and drinking), and is also known from its trade in roses, but it derives a higher interest from numerous remains of its medieval prosperity. Provins is divided into two quarters—the ville-haute and the less ancient ville-basse—which in the 13th century were surrounded by fortifications. There still remains a great part of these fortifications, which made a circuit of about 4 m., strengthened at intervals by towers, generally round, and now, being bordered with fine trees, form the principal promenade of the town. The large tower situated within this line, and variously known as the king's, Caesar's or the prisoners' tower, is one of the most curious of the 12th century keeps now extant. The base is surrounded by a thick mound of masonry added by the English in the 15th century when they were masters of the town. The tower serves as belfry to the church of St Quiriace, which dates its foundation from the 12th century. These two buildings in the ville-haute rise picturesquely from the crest of a steep wooded hill above the ville-basse. The church preserves among its treasures the pontifical ornaments of St Edmund of Canterbury (d. 1242). The interior is plain, but very beautifully proportioned. The appearance of the exterior suffers from an inappropriate dome erected above the crossing. The palace of the counts of Champagne, some fragments of which also belong to the 12th century, is occupied by the communal college. The old tithe-barn is a building of the 13th century with two fine vaulted chambers, one of which is below ground. The church of St Ayoul dates from the 12th to the 16th centuries, the transept being the oldest part; it is in a state of great dilapidation, and the choir is used as a storehouse. St Croix belongs partially to the 13th century. Extensive cellars, used as warehouses in the middle ages, extend beneath portions of the town. On Mont Ste Catherine, opposite Provins, the general hospital occupies the site of an old convent of St Clare, of which there remains a cloister of the 14th century. The sub-prefecture, tribunals of first instance and of commerce are among the public institutions. There is an active trade in grain, livestock and wool, and the industries include flour-milling, nursery-gardening, brickmaking, and the manufacture of porcelain, pianos, gas and petrol engines, agricultural implements and sugar.

Provins began to figure in history in the 9th century. Passing from the counts of Vermandois to the counts of Champagne, it rapidly attained a high degree of prosperity. Cloth and leather were its staple manufactures, and its fairs, attended by traders from all parts of Europe, were of as much account as those of Beaucaire, while its money had currency throughout Europe. In the 13th century the population of the town is said to have reached 60,000; but the plague of 1348 and the famine of 1349 proved disastrous. The Hundred Years' War, during which Provins was captured and recaptured, completed the ruin of the town. During the religious wars it sided with the Catholic party and the League, and Henry IV. obtained possession of it in 1592 only after thirteen days' siege.

See Felix Bourquelot, *Histoire de Provins* (2 vols., Provins, 1839–1840).

PROVISION (Lat. *provisio*), a term meaning strictly the act of providing, or anything provided, especially in respect of food (provisions) or other necessaries. In constitutional law it signifies the act by which an ecclesiastical office or benefice is conferred by a person having competent authority for the purpose; and the word is specially used of appointments made by the pope in derogation of the rights of ecclesiastical patrons. Innocent III. (1198–1216) seems to have been the first pope who directed prelates to collate his nominees to canonries and other benefices, but it was during the pontificate of Innocent IV. (1243–1254) that the practice first assumed alarming proportions. Vigorous protests were then made in England and France against the large number of papal provisions in favour of non-resident Italian clerks. These protests were not without effect for a while; but the popes, finding it impossible to carry on the work of government without this means of rewarding their servants, soon began to show little regard to national protests. The English parliament held at Carlisle in 1307 petitioned the king for a remedy against this abuse, but though he promised redress nothing was done. Meanwhile the popes had been asserting claims to appoint bishops in certain events on their own initiative, and at last Clement V. (1305–1313) reserved to himself the right of appointment in all cases. After his time there is scarcely an instance of an English bishop being elected in accordance with the older procedure by the cathedral chapter. If an election were made the pope usually either overrode it by another appointment or, ignoring the election, appointed the elected clerk by a bull of provision. The Hundred Years' War caused an outburst of indignation against the use of papal provisions, whether to the canonries and collative offices or to bishoprics. The popes had taken up their residence at Avignon and had become mere creatures of the kings of France. The English nobility and gentry were bitter at seeing vast sums of money pass out of the country into the hands of their enemies. To remedy the evil the first Statute of Provisors was enacted in 1351. It declared that the free elections of bishops and other dignitaries should take place in accordance with the ancient practice; that bishops and ecclesiastics should have free presentations to benefices and offices in their gift; that in the event of any provision being made by the pope the king should have the same right of collation as his progenitors had before they granted free election; and similarly where the pope provided to a benefice or office in the gift of secular or regular clergy the king was to have the collation for that occasion. Provisors who interfered with the rights of the king or patron were liable to arrest and imprisonment on conviction. The act was supplemented in 1353 by the first Statute of Praemunire, by which appeals outside the realm were prohibited and persons who offended were made liable to outlawry. This legislation against papal provisions was anti-clerical rather than anti-papal. There are no signs that it was promoted by the English clergy, who seem to have accepted the claim of the popes to control their patronage. In spite of the statutes the popes still continued, as the papal registers show, to make provisions to English benefices and offices, and it is evident that the statutes were not enforced. The Statute of Provisors was confirmed by a second statute in 1364, but this again seems to have had little effect. Attempts were made to establish a concordat on the subject between the king and pope; its terms, however, were all in favour of the latter. At last, in 1389, a third Statute of Provisors was enacted which provided that the statute of 1351 should be firmly holden for ever and "put in due execution from time to time in all manner of points." The new statute was carried into effect as regards canonries and benefices; but, until the Reformation, bishops were nominally appointed by a papal bull of provision. The person appointed, however, was usually nominated by the king, and the bull was not issued without his consent.

Authorities.—*Statutes of the Realm*; *Calendar of Papal Registers*; J. Le Neve, *Fasti ecclesiae anglicanae*; *Rolls of Parliament*; F. W. Maitland, *Canon Law in the Church of England*; W. Stubbs, *Constitutional History of England*; *Anglia sacra*. (G. J. T.)

PROVISIONAL ORDER, a method of procedure followed by several government departments in England, authorizing action on the part of local authorities under various acts of parliament. Procedure by provisional order is a substitute for the more expensive course of private bill legislation; it is usually employed for such purposes as alteration of areas, compulsory purchase of land, building of light railways, &c. A preliminary local inquiry is first held in public by an inspector of the department to whom application has been made to issue it. Upon the report of the inspector and other information the department decides whether or not to issue the order. The order when issued has no force until it is confirmed by parliament. For this purpose it is included with other orders in a confirming bill, introduced by the minister at the head of the department concerned. In both houses of parliament all provisional order bills are referred to examiners for compliance with standing orders. In the House of Lords, if a provisional order bill is opposed, it is referred to a select committee and then to a committee of the whole house; if not opposed, it goes, after second reading, to a committee of the whole house, and in both cases then proceeds as a public bill. In the House of Commons, the bill goes after second reading to the committee of selection or to the general committee on railway and canal bills; if unopposed it is treated as an unopposed private bill; if opposed it goes to a private bill committee, which hears evidence for and against.

PROVO, a city and the county-seat of Utah county, Utah, U.S.A., on the Provo river, 3 m. E. of Utah Lake, and about 45 m. S. by E. of Salt Lake City. Pop. (1890), 5159; (1900), 6185 (1176 foreign-born); (1910) 8925. Provo is served by the Rio Grande Western and the San Pedro, Los Angeles & Salt Lake railways. It is situated at an altitude of about 4530 ft., in a region of fine scenery, Provo Cañon, Bridal Veil Falls and Utah Lake being of especial interest. The city has a general hospital and is the seat of the state mental hospital and of Brigham Young University (a Mormon institution), founded by Brigham Young in 1875, opened as an academy in 1876, and incorporated in 1896; it comprises a college and high commercial, music, arts and trades, agricultural and preparatory schools. Provo has various manufactures, including woollen goods, lime, pottery and bricks, and the city is a shipping point for a fertile agricultural and fruit-producing region. Within a radius of forty or fifty miles of Provo are a number of important mines. Provo was settled in 1849 and was chartered as a city in 1851.

PROVOST (through O. Fr. *prevost*, mod. *prévôt*, Lat. *praepositus*, set over, from *praeponere*, to place in front), a title attached to various ecclesiastical and secular offices. In ecclesiastical usage the word *praepositus* was at first applied by the Church fathers to any ecclesiastical ruler or dignitary. It early, however, gained a more specific sense as applied to the official next in dignity to the abbot of a monastery, or to the superior of a single cell. Thus in the rule of St Benedict the provost (*praepositus*) is the superior of the monastery immediately subordinate to the abbot, the dean (*decanus*) being associated with him. From the Benedictine rule this arrangement was taken over by Chrodegang of Metz when he introduced the monastic organization of cathedral chapters. In these the provostship (*praepositura*) was normally held by the archdeacon, while the office of dean fell to the archpriest. In many cathedrals the temporal duties of the archdeacons made it impossible for them to fulfil those of the provostship, and the headship of the chapter thus fell to the dean. In England the title "provost" has thus everywhere given way to that of "dean"; in Germany, on the other hand, "*Probst*" is still the style of the heads of certain chapters. The title has also been preserved in certain dioceses of the German Evangelical Church as the equivalent of *Superintendent*, and both the Roman Catholic and Protestant chaplains-general of the forces have sometimes, *e.g.* in Prussia, the title *Feldprobst*. The heads of Augustinian and Dominican friaries are termed "provost or prior" (*praepositus vel prior*), those of Cistercian monasteries "provost or warden" (*praepositus vel custos*). Finally the name *praepositus* was sometimes used for the secular *advocatus* of a monastery. With the ecclesiastical use of the title is connected its English application to the heads of certain colleges; "provost" is still the style of the principals of Queen's, Oriel and Worcester Colleges at Oxford, of King's College at Cambridge, of Trinity College at Dublin and of Eton College.[1]

As a secular title *praepositus* is also very old; we need only instance the *praepositus sacri cubiculi* of the late Roman Empire, and the *praepositus palatii* of the Carolingian court. The important developments of the title in France are dealt with below. From France the title found its way into Scotland, where it survives in the style (provost) of the principal magistrates of the royal boroughs ("lord provost" in Edinburgh, Glasgow, Aberdeen, Perth and Dundee), and into England, where it is applied to certain officers charged with the maintenance of military discipline. A provost-marshal is an officer of the army appointed when troops are on service abroad for the prompt repression of all offences. He may at any time arrest and detain for trial persons subject to military law committing offences, and may also carry into execution any punishments to be inflicted in pursuance of a court martial (Army Act 1881, § 74). A provost-sergeant is an officer responsible for the maintenance of order when soldiers are in the United Kingdom. A provost-sergeant may be either garrison or regimental, and he has under his superintendence the garrison or regimental police. (W. A. P.)

The Provost in France.—The word *prévôt* (provost) in old French law had many applications. In conformity with its etymology (*praepositus*) it could be applied to any person placed at the head of a branch of the public service, a position which, according to the old principles, habitually carried with it a right of jurisdiction. It is thus that there was at Paris the "provost of Paris," who was a royal judge, and the "provost of the merchants" (*prévôt des marchands*), the head of the Paris municipality.[2] There were besides—to mention only the principal provosts—the "provosts of the marshals of France" (*prévôts des maréchaux de France*), of whom more below; the "provost of the royal palace" (*prévôt de l'hôtel du roi*) or "grand provost of France" (*grand prévôt de France*), and the "provost general" (*prévôt général*) or "grand provost of the mint" (*grand prévôt des monnaies*). But the most important and best known provosts, who formed part of a general and comprehensive organization, were the "royal provosts" (*prévôts royaux*), the lower category of the royal judges. It must be borne in mind, however, that the magistrates belonging to the inferior category of royal judges (*juges subalternes*) had different designations in many parts of France. In Normandy and Burgundy they were called *châtelains*, and elsewhere—especially in the south—*viguiers*. These were titles which had established themselves in the great fiefs before their reunion with the Crown and had survived this. The royal provosts, on the other hand, were a creation of the Capetian monarchy.

The date of this creation is uncertain, but was without doubt some time in the 11th century. The provosts replaced the viscounts wherever the viscounty had not become a fief, and it is possible that in creating them the Crown was imitating the ecclesiastical organization in which the provost figured, notably in the chapters. The royal provosts had at first a double character. In the first place they fulfilled all the functions which answered locally to the royal power. They collected all the revenues of the domain and all the taxes and dues payable to the king within the limits of their jurisdiction. Doubtless, too, they had certain military functions, being charged with the duty of calling out certain contingents for the royal service; there survived until the end of the *ancien régime* certain military provosts *prévôts d'épée* (provosts of the sword) who were replaced in the administration of justice by a lieutenant. Finally, the provosts administered justice, though certainly their competence in this matter was restricted. They had no jurisdiction over noblemen, or over feudal tenants (*hommes de fief*), who claimed the jurisdiction of the court of their over-lord, where they were judged by their peers—the other vassals of the same lord. Neither had they jurisdiction over the open country, the *plat pays*, where this belonged to local *seigneurs*; and even in the towns over which they were set their jurisdiction was often limited by that of the municipal courts established for the benefit of the burgesses. The second characteristic of the old provosts was that their office was farmed for a limited time to the highest bidder. It was simply an application of the system of farming the taxes. The provost thus received the speculative right to collect the revenues of the royal domain in the district under his jurisdiction; this was his principal concern, and his judicial functions were merely accessory. By these short appointments the Crown guaranteed itself against another danger: the possible conversion by the functionary of the function into a property. Very early, however, certain provostships were bestowed *en garde*, *i.e.* the provost had to account to the king for all he collected. The *prévôtés en ferme* were naturally a source of abuses and oppression, the former seeking to make the most of the concession he had bought. Naturally, too, the people complained. From Joinville we learn how under St Louis the provostship of Paris became a *prévôté en garde*. At the death of Louis XI. the *prévôtés en ferme* were still numerous and provoked a remonstrance from the States-general of 1484. Their suppression was promised by Charles VIII. in 1493, but they are again referred to in the *grande ordonnance* of 1498. They disappeared in the 16th century, by which time the provosts become regular officials, their office being purchasable.

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[1] Where, however, the head-master, though technically subordinate to the provost, is the effective head of the school.

[2] Thus in a register of the Châtelet of Paris in the 14th century, we read: "à Paris est la prévôté de Paris et celle des marchands."

Other transformations had previously taken place. The creation of the royal *baillis* reduced the provosts to a subaltern rank. Each *bailli* had in his district a certain number of provosts, who became his inferiors in the official hierarchy. When appeals were instituted (and this was one of the earliest instances of their introduction) the provost, the sphere of whose competency was limited, was subject to an appeal to the *bailli*, though his judgment had hitherto been without appeal. Moreover, in the 14th century they had ceased to collect the revenues of the royal domain, except where the *prévôté* was *en ferme*, and royal collectors (*receveurs royaux*) had been appointed for this purpose. The summoning of the feudal contingents, the *ban* and *arrière-ban*, had passed into the hands of the *baillis*. Thus the provosts were left for their sole function as inferior judges for non-nobles, the appeals from their sentences going to the *baillis*, who also had jurisdiction in the first instance over actions brought against nobles and in cases reserved for the crown judges (*cas royaux*). This corresponded to a principle which had also applied in the chief feudal courts in the 13th and 14th centuries, where a distinction was made between judicial acts which could be performed *en prévôté*, and those which had to be performed in a solemn assize (*assise*); this did not, however, always imply the existence of a superior and an inferior official, a provost and a *bailli*.

The provost in the exercise of his legal functions sat alone as judge, and he alone exercised the judicial authority at his tribunal; but he had to consult with certain lawyers (*avocats* or *procureurs*) chosen by himself, whom, to use the technical phrase, he "summoned to his council" (*appelait à son conseil*). In 1578 official counsellors (*conseillers-magistrats*) were created, but were suppressed by the *ordonnance* of Blois of 1579. The office was restored in 1609 by a simple decree of the royal council, but it was opposed by the parlements, and it seems to have been conferred in but few cases.

The "provosts of the marshals of France," mentioned above, were non-legal officials (*officiers de la robe courte*) forming part of the body of the *maréchaussée* which was under the *ancien régime* what the *gendarmerie* was after the Revolution. Their original function was to judge offences committed by persons following the army, but in the course of the 14th and 15th centuries they acquired the right of judging certain crimes and misdemeanours, by whomsoever committed. They became stationary, with fixed spheres of authority, and the offences falling within their competency came to be called *cas prévôtaux*. These were, the worst crimes of violence, and all crimes and misdemeanours committed by old offenders (*repris de justice*), who were familiarly known as the *gibier des prévôts des maréchaux* (gaol-birds). Theirs was really a kind of military jurisdiction, from which there was no appeal; but the provost was bound to associate with himself a certain number of ordinary judges or graduates in law. The provost of the marshals did not himself judge what was a *cas prévôtal*; this had in each case to be decided by the nearest *bailliage* or presidial court. The presidial judges also dealt with *cas prévôtaux* in concurrence with the provosts of the marshals. (J. P. E.)

PROW, the fore-part of a ship, the stem and its surrounding parts, hence used like "keel," by metonymy, of the ship itself. It was in old naval parlance applied to the battery of guns placed in the fore gun-deck. The Fr. *proue* and cognate forms (Ital. *prua*, Port. and Span. *proa*, of which the English is an adaptation) represent Lat. *prora*, itself adapted from Gr. πρῷρα, formed from πρό, before, in front. From this word must be distinguished an obsolete "prow," brave, valiant, now only surviving in "prowess," and representing O. Fr. *prou*, mod. *preux*, from the first part of Lat. *prodesse*, to be profitable; the same source gives "proud."

PROXY (short for "procuracy"), a term denoting either (1) a person who is authorized to stand in place of another, (2) the legal instrument by which the authority is conferred. Proxies are now principally employed for certain voting purposes. A proxy may in law be either general or special. A general proxy authorizes the person to whom it is entrusted to exercise a general discretion throughout the matter in hand, while a special proxy limits the authority to some special proposal or resolution. Formerly a peer could give his vote in the British parliament by proxy, by getting another peer to vote for him in his absence, temporal peers only being privileged to vote for temporal, and spiritual peers for spiritual. This voting by proxy in the House of Lords was an ancient custom, often abused. In Charles II.'s reign the duke of Buckingham used to bring twenty proxies in his pocket, and the result was that it was ordered that no peer should bring more than two. In 1830 to 1867 inclusive proxies were only called seventy-three times; and on the 31st of March 1868, on the recommendation of a committee, a new standing order was adopted by which the practice of calling for proxies on a division was discontinued. In English bankruptcy proceedings creditors may vote by proxy, and every instrument of proxy, which may be either general or special, is issued either by the official receiver or trustee. Under the Bankruptcy Act of 1869 very great abuses of the system of proxies arose (see Bankruptcy), and were investigated by a select committee of the House of Commons. The committee recommended the abolition of general proxies; and though their recommendation was not carried out, the Bankruptcy Acts of 1883 and 1890 put considerable restrictions on the use of general proxies. A shareholder in a limited liability company may vote by proxy, and regulations to that effect prescribing the requirements, are usually embodied in the articles of association. A proxy to vote at a meeting must, by the Stamp Act 1870, bear a penny stamp. In the United States, proxies are further used for voting purposes in political conventions.

In the early practice of the admiralty courts in England a proxy was the authority by which the proctor or advocate appeared for either party to a suit. In the ecclesiastical courts a proxy is the warrant empowering a proctor to act for the party to a suit. Two proxies are usually executed, one authorizing the proctor to institute, the other to withdraw, proceedings. They are signed by the parties, attested by two witnesses, and deposited in the registry of the court (Phillimore, *Ecclesiastical Law*). In the convocations of the Church of England those who are absent are allowed to vote by proxy. "Proxies," or "procurations," were also by the canon law certain sums of money paid yearly by parish priests to the bishops or archdeacon *ratione visitationis*; originally the visitor demanded a proportion of meat and drink for his refreshment, and afterwards this was turned into a money "procuration"—*ad procurandum cibum et potum*. Marriage by proxy or deputy was a custom recognized either for reasons of state or ceremonial.

PRUDENTIUS, AURELIUS CLEMENS (348-*c.* 410), the most remarkable of the earlier Christian poets in the West, was probably born at Tarraco, though Saragossa and Calagurris have also been claimed as his birthplace. The meagre autobiographical preface, which he affixed to the complete edition of his works when he was fifty-seven years old, makes it clear that he received a liberal education—being of noble family—practised as a lawyer and entered official life, and finally held some high office under Theodosius. At the age of fifty-seven he retired to a monastery, but died shortly afterwards.

Bentley calls Prudentius "the Horace and Virgil of the Christians," but his diction is stilted and his metre often faulty. The list of his works given in the preface mentions the hymns, poems against the Priscillianists and against Symmachus and *Peristephanon*. The *Diptychon* or *Dittochaeon* is not mentioned. The twelve hymns of the *Cathemerinon liber* ("Daily Round") consist of six for daily use, five for festivals, and one intended for every hour of the day. Prudentius shows Ambrose as his master here, but gives to Ambrose's mystic symbolism much clearer expression. The *Apotheosis* and *Hamartigenia* are polemic, the first against the disclaimers of the divinity of Christ, the latter against the gnostic dualism of Marcion and his followers. In them Tertullian is the source of inspiration. Of more historical interest are the two books *Contra Symmachum*, of 658 and 1131 hexameter verses respectively, the first attacking the pagan gods, the second directed against the petition of Symmachus to the emperor for the restoration of the altar and statue of Victory which Gratian had cast down. The *Peristephanon* consists of fourteen hymns to martyrs. These were mostly Spanish, but some were suggested to Prudentius by sacred images in churches or by the inscriptions of Damasus. This book, with the *Cathemerinon liber* and the *Psychomachia*, was among the most widely read books of the middle ages. Its influence on the iconography of medieval art was great. The *Psychomachia* is aesthetically inferior, but had the greatest influence of all of Prudentius's writings. In it he depicts the struggle of Christendom with paganism under the allegory of a struggle between the Christian virtues and the pagan vices. The *Dittochaeon* is a series of quatrains, probably intended to explain forty-nine pictures of a basilica. The work is more interesting for archaeology than for literature.

Prudentius's works were published by Giselin at Antwerp in 1564, and by F. Arevalo at Rome in 1788, with complete commentary. This last is the edition reprinted in J. P. Migne's *Patrologia Latina*, vols. lix.–lx. (Paris, 1847). More recent editions are by Obbarius (Tübingen, 1845) and A. Dressel (Leipzig, 1886), while a critical edition has been undertaken by J. Bergmann.

See also J. Bergmann, *Lexicon prudentianum*, fasc. i. [a-adscendo] (Upsala, 1894); M. Schanz, *Gesch. d. röm. Lit.* (Munich, 1904); A. Ebert, *Allgem. Gesch. d. Lit. des Mittelalters*, vol. i. 2nd ed. Leipzig, 1889); M. Manitius, *Gesch. d. christl. lat. Poesie* (Stuttgart, 1891); T. R. Glover, *Life and Letters in the Fourth Century* (Cambridge, 1901); C. Brockhaus, *Aur. Prud. Clem. in seiner Bedeutung f. d. Kirche seiner Zeit* (Leipzig, 1872); A. Pnech, *Prudence; étude sur la poésie latine chrét. au IV^e siècle* (Paris, 1888); F. St John Thackeray, *Translations from Prudentius* (London, 1890); F. Maigret, *Le Poète chrétien Prudentius* (Paris, 1903); E. O. Winstedt, "The Double Recension in the Poems of Prudentius," *The Classical Review*, vol. xvii. (1903).

PRUD'HON, PIERRE (1758–1823), French painter, born at Cluny on the 4th of April 1758, was the third son of a mason. The monks of the abbey undertook his education, and by the aid of the bishop of Mâcon he was placed with Devosges, director of the art school at Dijon. In 1778 Prud'hon went to Paris armed with a letter to Wille, the celebrated engraver, and three years later he obtained the triennial prize of the states of Burgundy, which enabled him to go to Rome, where he became intimate with Canova. He returned to Paris in 1787, and led for some time a precarious existence. The illustrations which he executed for the *Daphnis and Chloe* published by Didot brought him into notice, and his reputation was extended by the success of his decorations in the Hôtel de Landry (now Rothschild), his ceiling painting of "Truth and Wisdom" for Versailles (Louvre), and of "Diana and Jupiter" for the Gallery of Antiquities in the Louvre. In 1808 he exhibited "Crime pursued by Vengeance and Justice" (Louvre, engraved by Royer which had been commissioned for the assize courts, and "Psyche carried off by Zephyrs" (engraved by Massard). These two remarkable compositions brought Prud'hon the Legion of Honour; and in 1816 he entered the Institute. Easy as to fortune, and consoled for the misery of his marriage by the devoted care of his excellent and charming pupil, Mlle Mayer, Prud'hon's situation seemed enviable; but Mlle Mayer's tragical suicide on the 26th of May 1821 brought ruin to his home, and two years later (Feb. 16, 1823) Prud'hon followed her to the grave. Mlle Mayer (1778–1821) was his ablest pupil. Her "Abandoned Mother" and "Happy Mother" are in the Louvre.

Voiart, "Notice historique de la vie et œuvres de P. Prud'hon," in *Arch. de l'art français*; Qu. de Quincy, *Discours prononcé sur la tombe de Prud'hon, Fév. 1823*; Eugène Delacroix, *Rev. des deux mondes*, 1846; Charles Blanc, *Hist. des peintres français*.

PRUNE (adapted in various forms, *e.g. prunne, proyne*, &c., from Fr. *prune*, Med. Lat. *pruna*, Lat. *prunum*, Gr. *προῦνον*, earlier *προῦμνον*, plum), the name generally given to the fruit of various species of plums, dried, and used either stewed as a dish or plain as a dessert fruit. The finest dessert prunes, known as "French plums," are produced from the St Julien plum-tree and are dried and exported from the valley of the Loire in France. California now produces a fine quality of "prune." In scientific nomenclature, *Prunus* is the name of a genus of rosaceous trees, the type of the tribe *pruneae*, of which the plum, apricot, peach, cherry, &c., are species (see further under PLUM). From this word must be distinguished "to prune," (1) to cut or trim superfluous growth from a shrub or tree in order to encourage fresh growth and bring into regular form, &c., and (2) to trim or dress the feathers with the bill, used of a bird "preening" itself. In the first sense the word is an adaptation (16th century) of the Old French *proigner*, the second sense appears in the end of the 14th century but is not found in French.

PRURITUS, an ailment characterized by intense itching of the surface of the body. It may occur in connexion with other morbid conditions, such as jaundice, diabetes, digestive disorders, &c., or as the result of the irritation produced by skin parasites. The most serious form is *pruritus senilis*, which affects old persons, and is often a cause of great suffering, depriving the patient of sleep. In such cases it is probably due to atrophic changes in the skin. No eruption is visible, except such marks as are produced by scratching. The treatment consists in the removal of any apparent cause, and measures to strengthen the system, such as the use of quinine, iron, &c. Soothing lotions composed of solutions of alkalis conjoined with chloral, opium, hydrocyanic acid, &c., may be applied to the affected skin at bedtime.

PRUSSIA (Ger. *Preussen*; Lat. *Borussia*), a kingdom of Germany, and the largest, most populous and most important state of the German Empire. (For map see GERMANY.) It is bounded on the N. by the Baltic, Mecklenburg, Denmark and the North Sea, on the E. by Russia, on the S. by Austria, the kingdom of Saxony, the Thuringian states, Bavaria and

Hesse-Darmstadt, on the W. by Alsace-Lorraine, Luxemburg, Belgium and the Netherlands. Its frontiers have a circuit of about 4750 m., and with the exception of the enclaves Oldenburg, Mecklenburg, Brunswick and other small German states, and certain small appurtenances, such as Hohenzollern, in the south of Württemberg, it forms a tolerably compact mass of territory, and occupies almost the whole of northern Germany. Its longest axis is from S.W. to N.E. With the exception of the sea on the north and the mountain-barrier on the south-east, the frontiers are political rather than geographical. The total area of the monarchy is 134,622 sq. m. and comprises almost two-thirds of the entire extent of the German Empire. Its kernel is the mark of Brandenburg, round which the rest of the state has been gradually built up.

Physical Features.—Fully three-fifths of Prussia belong to the great north European plain and may be generally characterized as lowlands. The plain is much wider on the east, where only the southern margin of Prussia is mountainous, than on the west, where the Hanoverian hills approach to within less than 100 m. of the sea. A line drawn from Düsseldorf through Halle to Breslau would, roughly speaking, divide the flat part of the country from the hilly districts. In the south-east Prussia is separated from Austria and Bohemia by the Sudetic chain, which begins at the valley of the Oder and extends thence towards the north-west. This chain includes the Riesen Gebirge, with the highest mountain in Prussia (Schneekoppe), and subsides gradually in the hills of Lusatia. The Harz Mountains, however, beyond the Saxon plain, follow the same general direction and may be regarded as a detached continuation of the system. To the south of the Harz the Prussian frontier intersects the northern part of the Thuringian Forest, which is also prolonged towards the north-west by the Weser Gebirge and the Teutoburger Wald. The south-west of Prussia is occupied by the plateau of the lower Rhine, including on the left bank the Hunsrück and the Eifel, and on the right the Taunus, the Westerwald and the Sauerland. Between the lower Rhenish and Thuringian systems are interposed the Vogelsberg, the Rhön, and other hills belonging to the Triassic system of the upper Rhine. The Silesian Mountains are composed chiefly of granite, gneiss and schists, while the Harz and the lower Rhenish plateau are mainly of Devonian and Silurian formation. To the north of the Sauerland is the important carboniferous system of the Ruhr, and there are also extensive coalfields in Silesia. With the exception of the Danube Prussia is traversed by all the chief rivers of Germany, comprising almost the entire course of the Oder and the Weser. Nearly the whole of the German coast-line belongs to Prussia, and it possesses all the important seaports (see also GERMANY) except Hamburg, Bremen and Lübeck.

Climate.—The climate of Prussia may be described as moderate, and is generally healthy. The greatest extremes of temperature are found between the east and west, the mean annual temperature in the bleak and exposed provinces of the north-east being about 44° F., while that of the sheltered valley of the Rhine is 6° higher. In winter the respective means are 26° and 35°; in summer the difference is not above 2° to 4°. In Prussia as a whole the thermometer ranges from 100° to 130°, but these extremes are rarely reached. The average annual rainfall is about 21 in.; it is highest in the hilly district on the west (34 in.) and on the north-west coast (30 to 32 in.), and lowest (16 in.) in the inland parts of the eastern provinces.

Population.—The following schedule shows the area and population of the whole kingdom and of each of its fourteen provinces on the 1st of December 1900, and the 31st of December 1905.

Provinces.	Area in Eng. sq. m.	Pop., 1900.	Pop., 1905.
East Prussia	14,284	1,996,626	2,030,176
West Prussia	9,859	1,563,658	1,641,746
Berlin	29	1,888,848	2,040,148
Brandenburg	15,382	3,108,554	3,531,906
Pomerania	11,620	1,634,832	1,684,326
Silesia	15,568	4,668,857	4,942,611
Posen	11,186	1,887,275	1,986,637
Saxony	9,751	2,832,616	2,979,221
Schleswig-Holstein[1]	7,338	1,387,968	1,504,248
Hanover	14,870	2,590,939	2,759,544
Westphalia	7,803	3,187,777	3,618,090
Hesse Nassau	6,062	1,897,981	2,070,052
Rhineland	10,423	5,759,798	6,436,337
Hohenzollern	441	66,780	68,282
	134,616	34,472,509	37,293,324

[1] Including Heligoland.

The increase of population proceeds most rapidly, as would be expected, in Berlin, and next follow Westphalia, the Rhineland, Brandenburg and Saxony, while it is weakest in Hohenzollern, Pomerania and East Prussia. The population is densest in the mining and manufacturing district of the Rhine, which is closely followed by the coal regions of Silesia and parts of Saxony and Westphalia. Both the birth-rate and the death-rate show a tendency to diminish. (For statistical tables under this head, see GERMANY.) In Prussia, the annual increase in the urban population is about seven times as great as that in the rural communities. In 1905 Prussia contained twenty-two towns each with upwards of 100,000 inhabitants. The annual rate of suicide in Prussia is high, and among German states is only exceeded in the kingdom of Saxony. Divided according to nationalities (by speech), the population of Prussia includes roughly 31,000,000 Germans, over 3,000,000 Poles (in the eastern provinces), 107,000 Lithuanians (in the north-east), 137,000 Danes (in Schleswig-Holstein), 65,000 Wends (in Brandenburg and Silesia), 25,000 Czechs (in Silesia) and 78,000 Walloons (near the Belgian frontier). In the rural districts of Posen and in parts of Silesia the Poles form the predominant element of the population.

Communication.—With most internal means of communication Prussia is well provided. Hardly any of its excellent highroads existed in the time of Frederick the Great, and many of them date from the Napoleonic era. The first Prussian railway was laid in 1838, but the railway system did not receive its full development until the events of 1866 removed the obstacles placed in the way by Hanover. Most of the lines were laid by private companies, and the government confined itself to establishing lines in districts not likely to attract private capital. In 1879, however, a measure was passed authorizing the acquisition by the state of the private railways, and in 1884 nine-tenths of the 13,800 m. of railway in Prussia were in the hands of government. The proportion of railway mileage in Prussia (5 m. per 10,000 inhabitants) is nearly as high as in Great Britain, but the traffic is much less. Between 1880 and 1886 the state-owned lines of railway increased by 9240 m., the increase being principally due to the policy of buying up private lines; and since 1886 there has been a further increase. In 1903 the state lines amounted to a total of 18,520 m., and the private lines to 1248 m. The former total includes lines in Hesse-Darmstadt, the railways of this grand duchy having been incorporated with the Prussian railways in 1896. The building of the railways in Prussia has in almost every case been influenced by military requirements; and this applies also to the making of private lines. The most important trunk line of Prussia is that which enters the western frontier at Herbesthal, and runs through Cologne, Düsseldorf, Hanover, Berlin, Dirschau and Königsberg, and leaves the eastern boundary at Eydtkuhnen for St Petersburg. Generally speaking, the principal lines of the country either radiate from Berlin or run alongside the frontiers and boundaries. To the former category belong the lines which connect the capital with Hamburg and Kiel, with Stettin, with Danzig and Königsberg, with Posen and Breslau (dividing at Frankfort-on-Oder), with Dresden, with Leipzig and Bavaria, with Frankfort-on-Main via Halle and Erfurt, with Coblenz via Cassel, and with Cologne via Magdeburg and Brunswick. The second category embraces lines from Hamburg to Stettin, from Stettin to Posen and Breslau, and from Breslau to Halle; the ring is again taken up at Frankfort-on-Main, and continues up the Rhine (on both banks) to Cologne, and thence through Münster and Bremen to Hamburg. Besides these there are two other important lines, one connecting Hamburg with Frankfort-on-Main via Hanover and Cassel, the other linking Hanover with Halle.

Prussia possesses also an extensive system of natural and artificial waterways. In the period 1880–1893 the Prussian Government spent no less than £11,677,750 upon the maintenance and construction of locks, canals, canal buildings, bridges, roadways, &c. Besides this there was a special vote of £6,197,600 for the construction of the Dortmund-Ems Canal and the improvement of the navigation of the Oder, Vistula, Spree and other waterways in Brandenburg. The most important of the canals are the North Sea and Baltic Canal (officially the Kaiser Wilhelm Canal), the Elbe-Trave Canal (to give Lübeck access to the Elbe), and the Dortmund-Ems Canal, and its continuation, the Dortmund-Rhine Canal (see further, GERMANY). The largest ship-owning ports are Flensburg, Stettin, Kiel, Rostock and Danzig; and Geestemünde owns the largest deep-sea fishing fleet.

Agriculture.—Of the total area of cultivable land in the German Empire fully 66% belongs to Prussia. About 29% of the soil of Prussia consists of good loam or clay, 32% is mediocre or of loam and sand mixed, 31% is predominantly sandy, and 6% is occupied by bogs and marshes. The north-eastern provinces contain a high proportion of poor soil, and in the north-west occur large tracts of heath and moor. The reclaimed marshlands in both districts, as well as the soil in the neighbourhood of the rivers, are usually very fertile, and tracts of fruitful ground are found in the valleys of the Rhine and its affluents and in the plain around Magdeburg, the so-called *Böhrde*. The most fertile Prussian province is Saxony, while the least productive are East and West

Prussia. The principal crop in Prussia is rye, of which the ordinary bread of the country is made; it grows in all parts of the kingdom, especially in the north and east, and occupies about one-fourth of the whole tilled surface. Oats occupy an area equal to about half that devoted to rye, and are also grown most extensively in the north-eastern districts. Wheat, which is chiefly cultivated in the south and west, does not cover more than a fourth as much ground as rye. Barley is most largely grown in Saxony and Silesia. Other grain crops are spelt (chiefly on the Rhine), buckwheat (Hanover and Schleswig-Holstein) and millet; maize is grown for fodder in some districts. The produce of grain does not cover the consumption and is supplemented by imports of rye and other cereals from Russia and Holland. Potatoes, used both as food and for the distillation of spirits, are cultivated over nearly as large an area as rye and are especially predominant in the eastern provinces. The common beet is extensively grown for the production of sugar in the provinces of Saxony, Hanover, Silesia, Pomerania and Brandenburg. Flax and hemp occupy considerable areas in East Prussia, Silesia and Hanover, while hops are raised chiefly in Posen and Saxony. The cultivation of rape-seed for oil has fallen off since the use of petroleum has become general. The tobacco of Silesia, Brandenburg, Hanover and the Rhine province is inferior to that of Germany; the annual value of Prussian-grown tobacco is about £500,000, or one-fourth of the total produce of the empire. Of the total cultivated area less than 5 % is divided into farms of less than 5 acres each, about 33 % amongst farms ranging from 5 to 50 acres, 32·01 % amongst farms ranging from 50 to 250 acres, and the rest amongst farms exceeding 250 acres. The provinces in which large estates (up to 2500 acres and more) are the rule, are Pomerania, Posen, Silesia, East Prussia, Brandenburg, West Prussia and Saxony, in the order named. The estates of the old landed gentry (*Rittergüter*) of Prussia, taking the estates above 500 acres each, aggregate in all some 13,400,000 acres. Small estates (peasant holdings) prevail principally in the Rhine province, Hesse-Nassau and Westphalia, and to some extent also in Hanover, Silesia and Saxony, but large peasant holdings (50 to 250 acres) exist only in Schleswig-Holstein, Hanover, East Prussia, Westphalia, Saxony and Brandenburg. Notwithstanding the continuous decline in prices, and other drawbacks from which agriculture has suffered throughout Europe, the Prussian farmers have on the whole fairly well maintained their position, owing mainly to the fact that they have been both eager and skilful in availing themselves of the opportunities offered by the progress of agricultural knowledge. One of the latest departures in this field has been the establishment of central stations for the distribution of electric power to the estates in its neighbourhood, the power to be used for driving both fixed and movable machinery (mills, chaff-cutters, threshing-machines, ploughs, &c.), for lighting buildings and houses, for cooking and heating, and on large estates for giving signals and conveying orders. The cultivation of the beetroot for sugar has had a far-reaching effect upon Prussian agriculture, especially in the provinces of Saxony, Silesia, Posen, Hanover, West Prussia, Pomerania, Brandenburg, the Rhine province, and other parts of the kingdom, where the beetroot is extensively cultivated. Owing to the deep cultivation of the soil and the incessant hoeing which the beet crop requires, the three or four crops which follow it are invariably good, and the liability to failure of the immediately succeeding crop is reduced to a minimum. Moreover, the fiscal policy of the Prussian government has been of first-rate assistance to the Prussian farmer. Hand in hand with the cultivation of the beetroot has gone the cultivation of barley and chicory, crops of scarcely inferior value from the cultivator's point of view. Barley is grown on more than 11¼ million acres. The Prussian province of Saxony produces one-half of the total quantity of chicory yielded every year throughout the empire; the principal centres for its manufacture in Prussia are Magdeburg, Berlin and Breslau.

Livestock.—The province of East Prussia, with the principal government stud of Trakehnen, is the headquarters of horse-rearing, and contains the greatest number of horses both relatively and absolutely. The horses bred there are generally suitable for the lighter kind of work only, and are in great request for military purposes. Horses of a stouter type are bred in Schleswig-Holstein and on the Rhine, but heavy draught horses have to be imported from France, Holland, Belgium and Denmark. The best cattle are reared in the maritime provinces, whence, as from the marshy lowlands of Hanover, they are exported in large numbers to England.

In the matter of freights the government renders material assistance to the Prussian farmer. As the state owns the railways, it carries agricultural produce, especially such as is destined for export, at lower preferential rates.

Forests.—Prussia contains a greater proportion of woodland (23 %) than any other large country in the south or west of Europe (France 17 %, Italy 12 %, Great Britain 3 %), though not so large a proportion as Russia, Austria and some of the minor German states. The most extensive forests are in East and West Prussia, Silesia, and Brandenburg, where coniferous trees prevail, and in the Rhenish and Hessian districts, where oaks and beeches are the most prominent growths. The north-west is almost entirely destitute of timber, and peat is there used universally as fuel. The government forests cover about 6,000,000 acres, or upwards of one-fourth of the whole, and are admirably managed, bringing in an annual revenue of 1¼ millions sterling. The state also controls the management of forests in private possession, and exerts itself to secure the planting of waste lands.

Viticulture.—The principal wine-growing districts of Prussia are the Rheingau and the Rhine provinces, though wine is also produced in Silesia, Westphalia and a few other districts. The valleys of the Nahe, Saar, Moselle and Ahr all produce excellent wine. The Prussian state owns several vineyards in the Rhine district. German vine-growers have suffered, in common with vine-growers in other countries of Europe, from the *Oidium tuckeri* and the *Phylloxera*, and the government has spent large sums of money in endeavouring to arrest the ravages caused.

Fisheries.—The fisheries on the Baltic Sea and its haffs, and on the North Sea, are important. In the former the take consists mainly of herrings, flat fish, salmon, mackerel and eels, while the chief objects of the latter are cod and oysters. Inland fishery has been encouraged by the foundation of numerous piscicultural establishments and by the enactment of close-time laws. Carp, perch, pike and salmon, the last-named especially in the Rhine, are the principal varieties; sturgeon are taken in the Elbe and Oder, and the lakes of East Prussia swarm with bream and lampreys. Game of various kinds abounds in different parts of Prussia, and the lakes are frequented by large flocks of waterfowl.

Mining and Metal Industries.—Prussia is the largest producer of coal, zinc, salt, lead and copper amongst the states of the German Empire, though in respect of iron she comes second to Alsace-Lorraine. Of the aggregate German output of coal Prussia supplies over 93 %, viz. the huge total of 101,966,158 tons, valued at £43,912,500 in 1900, as compared with some 47,000,000 tons in 1882, representing an increase of about 117 %, and of this the province of Westphalia produces the largest quantity. Next comes the Rhine province, that is, the Saar, Aachen, Düsseldorf and Roer coal-fields; then Silesia. An extremely important rôle is played in the coal industry of Prussia by the Rhenish-Westphalian Coal Syndicate, which has its headquarters at Essen, and which from the bulk of its output (about 40 % of the total German output) has succeeded in regulating the production and price of the coalfields generally. Out of a total output of lignite for the entire German Empire of 40,498,019 tons in 1900, Prussia yielded no less than 84 %, or a total of 34,007,542 tons, valued at £4,012,900, showing an annual increase of over 24 million tons and of 3½ millions sterling since 1882. Almost all the zinc produced in Germany comes out of the Silesian mines. The chief iron-producing regions are the Rhine province, Westphalia, Hesse-Nassau and Silesia. But in the production of lead and manganese Prussia enjoys almost an unchallenged monopoly. Salt is mined principally in the province of Saxony (Stassfurt, Aschersleben, Erfurt, Halle, Merseburg, Sangerhausen), the kali salts near Magdeburg and Glauber salts in the Rhine province and Hesse-Nassau. Iron is worked principally in the districts of Arnsberg, Düsseldorf, Oppeln in Silesia, Treves and Coblenz, and zinc for the most part near Oppeln in Silesia; lead and silver near Aachen, Oppeln and Wiesbaden, and sulphuric acid in all the mining districts, as well as near Potsdam, Breslau, Magdeburg and Merseburg. Petroleum is extracted to a limited extent at a couple of places in the province of Hanover. Down to 1899, in which year the monopoly was bought out by the Prussian government, 150 to 250 tons of amber were mined in East Prussia. A little is also collected on the coast near Pillau.

Industrial Development.—During the last quarter of the 19th century Prussia developed into a great manufacturing country. Among the causes which have been mainly instrumental in fostering the industrial development in Prussia are the fostering care of the government (at once energetic, comprehensive and watchful), co-operation and organization, which has been immensely facilitated by the habits of prompt obedience and order learnt in the course of the military training; the generally high intellectual level and technical and artistic skill of the workmen, due in part to the enforcement of sound elementary education and in part to the excellent technical high schools, trades "continuation schools," and hosts of special schools in which the arts and crafts are thoroughly and systematically taught; the use made of scientific discoveries and the power of taking advantage of scientific progress generally; the national aptitude for giving conscientious attention to minutiae, and for thoroughness and mastery of detail; the extensive employment of commercial travellers, having command of languages, in all parts of the world; and an earnest desire to find out and meet the wants and tastes of customers. Moreover, the social and economic conditions of the people have been in their favour. Wages have on the whole been lower than, for example, in England, though since 1896 they have shown a strong upward tendency, and the standard of comfort, and even in many cases the standard of living, has been lower. Litigation, too, is more expeditious and less costly. But the Prussian manufacturer has derived no small measure of advantage from the fact that he came into the field somewhat later than his foreign rivals. He has been enabled to utilize their experience, to profit from their drawbacks, faults and deficiencies, and to make a clean start in the light of this valuable acquired knowledge. His interests have also been materially promoted by the commercial and fiscal policies of his government. The chief industrial districts are, of course, those which yield coal, with, in addition, the great cities—Berlin, Magdeburg, Hanover, Breslau, Görlitz, Stettin, Essen, Dortmund, Elberfeld-Barmen, Düsseldorf, Cologne, Aix-la-Chapelle, Crefeld, Halle, Hanover, Frankfort-on-Main, Saarbrücken, Höchst, Solingen, Remscheid, Hagen, Königsberg, Danzig and many others. The iron and metal industries, especially the making of machinery, electrical plant, tramway plant, and the production of articles in wrought copper and brass, rank in the forefront. In these branches Berlin, and more lately its suburbs, as well as Magdeburg and Cologne, have played an active rôle, though the old centres of the metallurgical and iron and steel industries in the Rhine province and Westphalia have also expanded in an extraordinary degree. The growth of the chemical industries, which are essentially a German speciality, must also be mentioned in the front rank. The branches in which this supremacy stands unrivalled are those which produce aniline dyes, artificial indigo, illuminants (acetylene gas, Welsbach mantles, &c.), explosives, various chemical salts, pharmaceutical preparations, cellulose, glycerine, artificial (chemical) manures, and perfumes.[1] A third branch of industry in which German genius has won triumphs of the highest kind is shipbuilding.

Constitution.—The present constitution of Prussia was framed by the government of King Frederick William IV., with the cooperation of a constituent assembly, and was proclaimed on the 31st of January 1850. It consists of an hereditary monarchy with two houses of parliament and was subsequently modified by various enactments, notably that of the 12th of October 1854, reconstituting the upper chamber. The constitution affirms the legal equality of all citizens in the eye of the law, provides for universal military service, and guarantees the personal liberty of the subject, the security of property, immunity from domiciliary visits, the inviolability of letters, toleration of religious sects, freedom of the press, the right of association and public meetings, and liberty of migration.

The monarchy is hereditary in the male line of the house of Hohenzollern, and follows the custom of primogeniture. The king alone exercises the executive power, has the supreme command of the army, and is head of the Church, but shares the legislative power with his parliament. He appoints and discharges the ministers and other officials of the Crown, summons and dissolves parliament, possesses the right of pardon and mitigation of punishment, declares war and concludes peace, confers orders and titles and conducts the foreign policy of the country, though this prerogative has now, constitutionally speaking, passed from the king of Prussia to the German emperor. He is held to be irresponsible for his public actions, and his decrees require the countersign of a minister, whose responsibility, however, is not very clearly defined. The national tradition and feeling lend the Crown considerable power not formulated in the constitution, and the king is permitted to bring his personal influence to bear upon parliament in a way quite at variance with the English conception of a constitutional monarch. The annual civil list of the king of Prussia amounts to £770,554.

The legislative assembly or *Landtag*, consists of two chambers, which are convoked annually at the same time but meet separately. The right of proposing new measures belongs equally to the king and each of the chambers, but the consent of all three is necessary before a measure can pass into law. The chambers have control of the finances and possess the right of voting or refusing taxes. Financial questions are first discussed in the lower house, and the upper house can accept or reject the annual budget only *en bloc*. All measures are passed by an absolute majority, but those affecting the constitution must be submitted to a second vote after an interval of at least twenty-one days. Members may not be called to account for their parliamentary utterances except by the chamber in which they sit. No one may at the same time be a member of both chambers. The ministers of the Crown have access to both chambers and may speak at any time, but they do not vote unless they are actually members. The sittings of both chambers are public.

The general scheme of government, though constitutional, is not exactly "parliamentary" in the English sense of the word, as the ministers are independent of party and need not necessarily represent the opinions of the parliamentary majority. The *Herrenhaus*, or house of peers, contains two classes of members, the hereditary and non-hereditary. The former consists of the adult princes of the house of Hohenzollern, the mediatized princes and counts of the old imperial nobility, and the heads of the great territorial nobility. The non-hereditary members are chosen for life by the king from the ranks of the rich landowners, manufacturers and men of general eminence, and representatives "presented" for the king's approval by the landowners of the eight old provinces, by the larger towns and by the universities. Every member of the *Herrenhaus* must be specially summoned by the king. The *Abgeordnetenhaus* or chamber of deputies, consists of 433 members. elected for periods of five years by indirect suffrage, exercised by all male citizens who have reached the age of twenty-five and have not forfeited their communal rights. The original electors are arranged in three classes, according to the rate of taxes paid by them, in such a way that the gross amount of taxation is equal in each class. The country is accordingly divided into electoral districts, with the electors grouped in three categories, each of which selects a *Wahlmann* or electoral proxy, who exercises the direct suffrage. Members of the lower house must be thirty years old and in full possession of their civic rights. They receive a daily allowance (*Diäten*) of fifteen shillings during the sitting of the house, and travelling expenses.

The king exercises his executive functions through an irresponsible *Staatsrat*, or privy council, revived in 1884 after thirty years of inactivity, and by a nominally responsible cabinet or council of ministers (*Staats-Ministerium*). The latter consists of the president and minister of foreign affairs, and ministers of war, justice, finance, the interior, public worship and instruction, industry and commerce, public works and agriculture, domains and forests. Ministers conduct the affairs of their special departments independently, but meet in council for the discussion of general questions. They represent the executive in the houses of parliament and introduce the measures proposed by the Crown, but do not need to belong to either chamber. The affairs of the royal household and privy purse are entrusted to a special minister, who is not a member of the cabinet.

The Prussian governmental system is somewhat complicated by its relation to that of the empire. The king of Prussia is at the same time German emperor, and his prime minister is also the imperial chancellor. The ministries of war and foreign affairs practically coincide with those of the empire, and the custom-dues and the postal and telegraph service have also been transferred to the imperial government. Prussia has only seventeen votes in the federal council, or less than a third of the total number, but its influence is practically assured by the fact that the small northern states almost invariably vote with it. To the *Reichstag* Prussia sends more than half the members. The double parliamentary system works in some respects inconveniently, as the *Reichstag* and Prussian *Landtag* are often in session at the same time, and many persons are members of both. Where imperial and Prussian legislation come into conflict the latter must give way.

Local Government.—For administrative purposes Prussia is divided into fourteen *Provinzen* or provinces, *Regierungsbezirke* or governmental departments, *Stadtkreise* or urban districts (circles), and *Landkreise* or rural districts. The city of Berlin and the district of Hohenzollern form provinces by themselves. Recent legislation has aimed at the encouragement of local government and the decentralization of administrative authority by admitting lay or popularly elected members to a share in the administration alongside of the government officials. Certain branches of administration, such as the care of roads and the poor, have been handed over entirely to local authorities, while a share is allowed them in all. In the province the government is represented by the *Oberpräsident*, whose jurisdiction extends over all matters affecting more than one department. He is assisted by a council (*Provinzialrat*), consisting, besides himself as chairman, of one member appointed by government and five members elected by the provincial committee (*Provinzialausschuss*). The latter forms the permanent executive of the provincial diet (*Provinzial-Landtag*), which consists of deputies elected by the *kreise* or circles, and forms the chief provincial organ of local government. The *Regierungsbezirk* is solely a government division and is only indirectly represented in the scheme of local administration. The government authorities are the *Regierungs-Präsident*, who is at the head of the general internal administration of the department, and the *Regierung* or government board, which supervises ecclesiastical and educational affairs and exercises the function of the state in regard to the direct taxes and the domains and forests. The departmental president is also assisted by a *Bezirksrat* or district council, consisting of one official member and four others selected from inhabitants of the department by the provincial committee. Each *Landkreis* has a *Landrat*, an office which existed in the mark of Brandenburg as early as the 16th century. He is aided by the *Kreissausschuss*, or executive committee of the *Kreistag* (the diet of the circle). The *Landkreise* include towns having less than 25,000 inhabitants, rural communes (*Landgemeinden*) and manors (*Gutsbezirke*). *Stadtkreise* are towns with more than 25,000 inhabitants; they have each a town council (*Stadtverordnetenversammlung*) elected on a three-class property suffrage. The practical executive is entrusted to the magistracy (*Magistrat*), which usually consists of a burgomaster, a deputy burgomaster (both paid officials), several unpaid members, and, where necessary, a few other paid members. The unpaid members hold office for six years; the paid members are elected for twelve years, and their election requires ratification from the state.

Justice.—Down to the 1st of January 1900 (when the German civil code—*Bürgerliches Gesetzbuch*—was introduced) a threefold system of civil law had prevailed in Prussia, viz. the common law of Prussia (*Landrecht*), codified in 1794, in eastern and central

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[1] See Dr Frederick Rose, *Chemical Instruction and Chemical Industries in Germany* (1901–1902), being Nos. 561 and 573 of the "Miscellaneous Series of British Diplomatic and Consular Reports."

Prussia, the German common law (*Gemeines deutsches Recht*) in Schleswig-Holstein, Hanover, and parts of the Rhine provinces, and the *Code Napoléon* generally on the Rhine and in Alsace-Lorraine. The *bürgerliches Gesetzbuch* has now put an end to the former anomalies. The criminal law was unified by the penal code (*Strafgesetzbuch*) of 1871 and the military penal code (*militär. Strafgesetzbuch*) of 1872. A new penal code, promulgated in 1850, did away with the old patrimonial or seigniorial jurisdiction, and the administration of justice is now wholly in the hands of government. The courts of lowest instance are the *Amtsgerichte*, in which sits a single judge, accompanied in penal cases by two *Schöffen* or lay assessors (a kind of jurymen, who vote with the judge). Cases of more importance are decided by the *Landgerichte* or county courts, in which the usual number of judges is three, while in important criminal cases a jury of twelve persons is generally empanelled. From the *Landgerichte* appeals may be made to the *Oberlandesgerichte* or provincial courts. The *Oberlandesgericht* at Berlin is named the *Kammergericht* and forms the final instance for summary convictions in Prussia, while all other cases may be taken to the supreme imperial court at Leipzig. The judges (*Richter*) are appointed and paid by the state, and hold office for life. After finishing his university career the student of law who wishes to become a judge or to practise as qualified counsel (*Rechtsanwalt*, barrister and solicitor in one) passes a government examination and becomes a *Referendarius*. He then spends at least four years in the practical work of his profession, after which he passes a second examination, and, if he has chosen the bench instead of the bar, becomes an *Assessor* and is eligible for the position of judge. A lawyer who has passed the necessary examinations may at any time quit the bar for the bench, and a judge is also at liberty to resign his position and enter upon private practice. In all criminal cases the prosecution is undertaken by government, which acts through *Staatsanwälte*, or directors of prosecutions, in the pay of the state.

Army.—The military organization of the monarchy dates from 1814 and provides that every man capable of bearing arms shall serve in the army for a certain number of years. The peace strength of the Prussian contingent of the imperial German army consisted, in 1905, of 20,646 officers (including surgeons), 448,365 men and 82,786 horses. There were also 2196 farriers and shoesmiths. (For *Navy*, see GERMANY).

Religion.—The centre of the kingdom is solidly Protestant, the proportion of Roman Catholics increasing towards east and west and reaching its maximum on the Rhine and in the Slavonic provinces. East Prussia, however, with the exception of Ermeland, is Protestant. The Roman Catholics greatly outnumber the Protestants in the Rhine provinces (3 to 1), Posen, Silesia and West Prussia. All religious bodies are granted freedom of worship, and civil rights are not conditional upon religious confession.

The Evangelical or Protestant State Church of Prussia consists as it now stands of a union of the Lutherans and Calvinists, effected under royal pressure in 1817. According to the king this was not a fusion of two faiths but an external union for mutual admission to the Eucharist and for the convenience of using the same liturgy, prepared under the royal superintendence. Those who were unable from conscientious scruples to join the union became Separatist or Old Lutherans and Old Calvinists, but their numbers were and are insignificant. The king is " summus episcopus " or supreme pontiff of the Church, and is represented in the exercise of his ecclesiastical functions by the minister of public worship and instruction. The highest authority for the ordinary management of the Church is the *Oberkirchenrat* or supreme church council at Berlin, which acts through provincial consistories and superintendents appointed by the Crown. Recent legislation has made an effort to encourage self-government and give a congregational character to the Church by the granting of a presbyterial constitution, with parish, diocesan, provincial and general synods. The clergy are appointed by the Crown, by the consistories, by private or municipal patronage, or by congregational election.

The hierarchy of the Roman Catholic Church in Prussia consists of two archbishops (Cologne, Gnesen-Posen) and ten bishops. The prince-bishop of Breslau and the bishops of Ermeland, Hildesheim and Osnabrück are directly under the pope, and the bishoprics of Fulda and Limburg are in the archiepiscopal diocese of Freiburg in Baden. The higher ecclesiastics receive payment from the state, and the annual appropriation appearing in the budget for the Roman Catholic Church is as high as that made for the State Church. All the Roman Catholic religious orders in Prussia have been suppressed except those occupied with attendance on the sick.

The relations of the state with the dissenting Christian sects, such as the Baptists, Mennonites and Moravian Brethren, are practically confined to granting them charters of incorporation which ensure them toleration. The Mennonites were formerly allowed to pay an extra tax in lieu of military service, which is inconsistent with their belief, but this privilege has been withdrawn. The Old Catholics number about 30,000, but do not seem to be increasing.

The Jews belong mainly to the urban population and form 20 to 30% of the inhabitants in some of the towns in the Slavonic provinces. (For more exact details of the various religious creeds, see GERMANY.)

Education.—In Prussia education is compulsory, and the general level attained is very high. Every town or community must maintain a school, supported by local rates and under the supervision of the state. By the constitution of 1850, all persons are permitted to instruct, or to found teaching establishments, provided they can produce to the authorities satisfactory proofs of their moral, scientific and technical qualifications. Both public and private educational establishments are under the surveillance of the minister of public instruction, and all public teachers are regarded as servants of the state (*Staatsbeamte*). No compulsion exists in reference to a higher educational institution than primary schools. All children must attend school from their sixth to their fourteenth year. At the head of the administration stands the minister of public instruction and ecclesiastical affairs, to whom also the universities are directly subordinated. The higher (secondary) schools are supervised by provincial *Schulcollegia* or school boards, appointed by government, while the management of the elementary and private schools falls within the jurisdiction of the ordinary *Regierungen* or civil government. This is carried out through qualified school inspectors, frequently chosen from among the clergy.

The expenses of the primary schools (*Volksschulen*) are borne by the communes (*Gemeinden*), aided when necessary by subsidies from the state. The subjects of instruction are theology, reading, writing, spelling, arithmetic, the elements of geometry, history, geography and natural science, singing, drawing, sewing and gymnastics. All fees in the elementary schools are abolished. The number of illiterate recruits among those called upon each year to serve in the army affords a good test of the universality of elementary education. In 1899 the proportion of *Analphabeti*, or men unable to read or write, among the recruits levied was only 0·12%. The teachers for the elementary schools are trained in normal seminaries or colleges established and supervised by the state, and much has been done of late years to improve their position. In most of the larger towns the elementary schools are supplemented by middle schools (*Bürgerschulen*, *Stadtschulen*), which carry on the pupil to a somewhat more advanced stage, and are partly intended to draw off the unsuitable elements from the higher schools.

The secondary schools of Prussia may be roughly divided into classical and modern, though there are comparatively few in which Latin is quite omitted. The classical schools proper consist of *Gymnasia* and *Progymnasia*, the latter being simply gymnasia wanting the higher classes. In these boys are prepared for the universities and the learned professions, and the full course lasts for nine years. In the modern schools, which are divided in the same way into *Realgymnasia* and *Realprogymnasia*, and also have a nine years' course, Latin is taught, but not Greek, and greater stress is laid upon modern languages, mathematics and natural science. The three lower classes are practically identical with those of the gymnasia, while in the upper classes the thoroughness of training is assimilated as closely as possible to that of the classical schools, though the subjects are somewhat altered. Ranking with the realgymnasia are the *Oberrealschulen*, which differ only in the fact that Latin is entirely omitted, and the time thus gained devoted to modern languages. The *Höhere* (or upper) *Bürgerschulen*, in which the course is six years, rank with the middle schools above mentioned, and are intended mainly for those boys who wish to enter business life immediately on leaving school. All these secondary schools possess the right of granting certificates entitling the holders, who must have attained a certain standing in the school, to serve in the army as one-year volunteers. The gymnasial " certificate of ripeness " (*Maturitätszeugniss*), indicating that the holder has passed satisfactorily through the highest class, enables a student to enroll himself in any faculty at the university, but that of the realgymnasium qualifies only for the general or " philosophical " faculty, and does not open the way to medicine, the Church or the bar. Considerable efforts are, however, now being made to have the realgymnasium certificate recognized as a sufficient qualification for the study of medicine at least. At any of these schools a thoroughly good education may be obtained at a cost seldom exceeding, in the highest classes, £5 per annum. The teachers are men of scholarship and ability, who have passed stringent government examinations and been submitted to a year of probation. The great majority of the secondary schools have been established and endowed by municipal corporations.

Prussia possesses ten of the twenty German universities (not including the lyceum at Braunsberg and the Roman Catholic seminary at Münster). The largest Prussian university is that of Berlin, while Breslau, Bonn, Göttingen and Halle are the next in size. The oldest is the university of Greifswald, founded in 1456. Like the schools the universities are state institutions, and the professors are appointed and paid by government, which also makes liberal annual grants for apparatus and equipment. The full obligatory course of study extends over three, and in the case of medicine, four years. It is, however, not unusual for non-medical students also to spend four years at the university, and there is an agitation to make this compulsory. Students qualifying for a Prussian government appointment are required to spend at least three terms or half-years (*Semester*) at a Prussian university.

Ranking with the universities are the large technical high schools at Berlin, Hanover, Aix-la-Chapelle and Danzig, the mining academies of Berlin and Klausthal, and the academies of forestry at Eberswalde and Münden; the agricultural high schools of Berlin and Poppelsdorf (Bonn) and the two veterinary high schools of Berlin and Hanover. Music is taught at several *conservatoria*, the best known of which are at Berlin and Frankfort-on-Main.

The science and art of Prussia find their most conspicuous external expression in the academies of science and art at Berlin, both founded by Frederick I.; and each town of any size throughout the kingdom has its antiquarian, artistic and scientific societies. Recognized schools of painting exist at Berlin and Düsseldorf, and both these towns, as well as Cassel, contain excellent picture galleries. The scientific and archaeological collections of Berlin are also of great importance. Besides the university collections, there are numerous large public libraries, the chief of which is the royal library at Berlin (1,000,000 volumes).

Finance.—As in all civilized countries, the national accounts of Prussia expand by leaps and bounds, and they do this in spite of the advantage which the state derives from the possession of valuable revenue-yielding properties. Of these the most important are the railways. Next in point of revenue come the mines and salines. Then follow the state forests and the landed domains, though the income from this source is rapidly decreasing as agriculture declines. For 1905–1906 the public revenue and expenditure were estimated at £135,914,080. The principal sources of revenue are the railways, £81,268,493; domains and forests, £5,982,911; state lottery, £4,840,665; mines, &c., £10,585,875; direct taxes (principally income-tax), £11,505,365; indirect taxes, £4,789,965; administrative receipts, £8,410,684; and from the general financial control, £8,356,636. The chief items of the expenditure consist of payments for religion and education, £8,201,632; for justice, £6,260,330; working expenses, including £50,280,525 for working the state railways, £69,626,542; interest, &c., on public debt, £12,375,380; the ministry of finance, £6,585,722, and the ministry of the interior, £4,313,780. The public debt grew from £64,363,000 in 1872 to £360,447,654 in 1905. The greater part of this debt has been incurred in the purchase of the state railways.

See *Jahrbuch für die amtliche Statistik des preussischen Staats*, the *Statistisches Jahrbuch für das deutsche Reich*, and other publications of the statistical offices of Prussia and Germany. Good general accounts of the natural, social and political features of the country are given in Eiselen's *Der preussische Staat* (Berlin, 1862) and in Daniel's *Handbuch der Geographie* (several editions). The Prussian constitution and administrative system are concisely described in the *Handbuch der Verfassung und Verwaltung in Preussen*, by Graf Huë de Grais, and are treated at length in Von Rönne's *Staatsrecht der preussischen Monarchie* (4th ed., 1881–1884), and in Arndt, *Verfassungs-Urkunde für den preussischen Staat* (Berlin, 1900). In addition, see *Landeskunde Preussens* (Berlin, 1901), edited by Beuermann. Various volumes of *Forschungen zur deutschen Landes- und Volkskunde*, edited by Kirchhoff; *British Diplomatic and Consular Reports*; and James Baker, *Report on Technical and Commercial Education in East Prussia*, &c. (London, 1900).

History.—The name of Prussia is derived from the dukedom of Prussia (the present province of East Prussia), which was raised into a kingdom by the emperor in favour of Frederick III., elector of Brandenburg, on the 18th of January 1701. The title "king of Prussia"[1] applied at the outset only to Prussia proper, which formed no part of the Empire; in respect of his other dominions the king continued to bear titles (margrave, duke, &c.) which implied feudal subordination to the emperor. The extension of the style "kingdom of Prussia" so as to cover the whole of the territories, by whatever title held, of the electors of Brandenburg, was not, however, an empty assumption, but symbolized a new fact of first-class historic importance: the rise in Germany and in Europe of a new great power. The consolidation of this power had been the work of the Great Elector, the work of whose reign (1640–1688) laid the foundations of the modern Prussian state (see FREDERICK WILLIAM I., elector of Brandenburg, and BRANDENBURG: *History*).

The Great Elector's son Elector Frederick III. was an ostentatious and somewhat frivolous prince, who hazarded the acquisitions of his father by looking on his position as assured and by aiming rather at external tokens of his dignity than at a further consolidation of the basis on which it rested. The Brandenburg troops fought in the war of the second coalition against Louis XIV. and in that of the Spanish Succession; but neither the peace of Ryswick (1697) nor that of Utrecht (1713) brought the country any very tangible advantage. Brandenburg soldiers also helped the emperor in his wars with the Turks, and it was Frederick's action in covering the Dutch frontier with 6000 troops which left William of Orange free scope in his expedition to England. The most notable incident in Frederick's reign was, however, his acquisition of the title of king of Prussia, which had long formed the principal object of his policy. The emperor's consent was finally purchased by the promise of a contingent of 8000 men to aid him in the War of the Spanish Succession, and on the 18th of January 1701 Frederick crowned himself at Königsberg with accompanying ceremonies of somewhat inflated grandeur. Elector Frederick III. of Brandenburg became henceforth King Frederick I. of Prussia.[2] Superficial as this incident may at first sight appear, it added considerably to the moral and political momentum of the country, if only by giving to the subjects of the Prussian crown a common name, and its advantages were reaped by Frederick's two vigorous successors. About the same time (1697) the elector of Saxony also acquired the kingly dignity by his election to the throne of Poland, but in doing so he had to become a Roman Catholic, and thus left the Hohenzollerns without a rival among the Protestant dynasties of Germany. Frederick was extravagant; but he also did much for the intellectual life of the country, patronizing learned men, and founding the university of Halle (1694) and at Berlin the Academy of Arts (1699) and the Academy of Sciences (1700). Moreover, even under this improvident king the territory of Prussia increased. From Saxony the king bought the hereditary advocateship (*Erbvogtei*) of the *Reichsstift* of Quedlinburg, as well as the imperial city of Nordhausen, the bailiwick of Petersberg and the countship of Tecklenburg, while in 1702 from William III. of Orange he inherited Lingen, Mörs and Neunburg.

Frederick I., 1688–1713.

The court of Vienna consoled itself for the growing power of Prussia under the Great Elector by the reflection that it was probably temporary and due mainly to the vigorous individuality of that prince. The events of Frederick I.'s reign seemed to justify this view. At his accession Prussia might fairly claim to rank as the second state of Germany, but before the death of Frederick, Bavaria, Saxony and Hanover all raised themselves to at least a level with Prussia. Frederick's preoccupation in the western wars had allowed Sweden to reassert her pre-eminence in northern Europe, and it was Russia, and not Prussia, that now impeded her progress. The internal soundness of the country had also suffered: the finances were in a state of complete disorganization, and the burden of taxation was almost insupportable. If Frederick's son and successor had not been a man of vigorous character the downhill progress might have continued until it had removed Prussia altogether from the list of important states.

Frederick William I., 1713–1740.

The accession, on the 25th of February 1713, of Frederick William I. produced at once a complete change of system. The new king, whose literary education had been neglected, shared none of his father's artistic tastes and had a complete contempt for the trappings of royalty. On the other hand, he possessed administrative talents of no mean order and was singularly painstaking, industrious and determined in carrying out his plans. By carefully husbanding his finances Frederick William filled his treasury and was able to keep on foot one of the largest and best disciplined armies in Europe, thereby securing for Prussia an influence in European councils altogether disproportionate to its size and population. In internal management he made Prussia the model state of Europe, though his administration was of a purely arbitrary type, in which the estates were never consulted and his ministers were merely clerks to register his decrees. His first act was to reform the expensive institutions of the court; and the annual allowance for the salaries and pensions of the chief court officials and civil servants was at once reduced from 276,000 to 55,000 thalers. The peace of Utrecht (1713) left Frederick William free to turn his attention to the northern war then raging between Sweden on the one side and Russia, Poland, and Denmark on the other. Though at first disposed to be friendly to Sweden, he was forced by circumstances to take up arms against it. In September 1713 Stettin was captured by the allies and handed over to the custody of Frederick William, who paid the expenses of the siege and undertook to retain possession of the town until the end of the war. But Charles XII. refused to recognize this arrangement and returned from his exile in Turkey to demand the immediate restitution of the town. With this demand the king of Prussia naturally declined to comply, unless the money he had advanced was reimbursed; and the upshot was the outbreak of the only war in which Frederick William ever engaged. The struggle was of short duration, and was practically ended in 1715 by the capture of Stralsund by the united Prussians, Saxons and Danes under the command of the king of Prussia. The Swedes were driven from Pomerania, and at the peace of 1720 Frederick William received the greater part of Swedish Pomerania, including the important seaport of Stettin. Sweden now disappeared from the ranks of the Great Powers, and Prussia was left without a rival in northern Germany.

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[1] Strictly speaking, the title assumed was "king *in* Prussia" (König in Preussen), this apparently being meant to indicate that there was still a Prussia (West Prussia) of which he was not king, though it has also been otherwise explained.

[2] By the treaty of Utrecht, to which King Frederick William I. acceded on the 15th of May 1713, Prussia received upper Gelderland in exchange for the principality of Orange, and the king's title was acknowledged by the European powers.

A detailed history of Frederick William's reign would necessitate the recital of a long and tedious series of diplomatic proceedings, centring in the question of the succession to the duchies of Jülich and Berg. The treaty of Wusterhausen between Austria and Prussia was concluded in 1726, and was confirmed with some modifications by the treaty of Berlin in 1728. Frederick William engaged to recognize the Pragmatic Sanction, while the emperor on his side undertook to support Prussia's claims to Jülich and Berg. The policy of the latter, however, was far from straightforward, as he had already entered into a similar compact with the count palatine of Sulzbach, who was a Roman Catholic and therefore a more sympathetic ally. Frederick William's intervention in the matter of the succession to the throne of Poland, rendered vacant by the death of Augustus II. in 1733, proved barren of advantage to Prussia and failed to secure the hoped-for reversion of the duchy of Courland. A Prussian contingent took part none the less in the ensuing war between Austria and France, but Austria concluded peace in 1735 without consulting her ally. In 1737 the king withstood the pressure brought to bear upon him by England, France, Holland and Austria to induce him to submit to their settlement of the Jülich-Berg question; and in 1739, convinced at least of the confirmed duplicity of the emperor, he turned to his hereditary enemy for help and concluded a defensive alliance with France. The rivalry between Austria and Prussia had begun, which for the rest of the century formed the pivot on which the politics of Europe mainly turned.

Prussia under Frederick William I.

If the external history of Frederick William's reign is not especially glorious, and if in diplomacy he was worsted by the emperor, the country at least enjoyed the benefits of a twenty-five years' peace and efficient government. During this reign the revenues of Prussia were doubled, and the king left at his death an accumulated treasure of 9,000,000 thalers and an army of 85,000 men. Though not ranking higher than twelfth among the European states in extent and population, Prussia occupied the fourth place in point of military power. The king himself took the greatest interest in the management of his army, in which the discipline was of the strictest; and he carried the habits of the military martinet into all departments of the administration. His chief innovation was the abolition of the distinction between the military and the civil funds, and the assignment of the entire financial management of the country to a general directory of finance, war and domains. The directory was instructed to pay for everything out of a common fund, and so to regulate the expenditure that there should invariably be a surplus at the end of the year. As the army absorbed five-sevenths of the revenue, the civil administration had to be conducted with the greatest economy. The king himself set the example of the frugality which he expected from his officials, and contented himself with a civil list of 52,000 thalers (£7800). The domains were now managed so as to yield a greater income than ever before, and important reforms were made in the system of taxation. By the substitution of a payment in money for the obsolete military tenure the nobles were deprived of their practical exemption from taxation, and they were also required to pay taxes for all the peasant holdings they had absorbed. Attempts were made to better the condition of the peasants, and the worst features of villeinage were abolished in the Crown domains. The military system of cantonment, according to which each regiment was allotted a district in which to recruit, was of constitutional as well as military importance, since it brought the peasants into direct contact with the royal officials. The collection of the taxes of the peasantry was removed from the hands of the landowners. The duties of the state officials were laid down with great detail, and their performance was exacted with great severity. Justice seems to have been administered in an upright manner, though the frequent and often arbitrary infliction of the penalty of death by the king strikes us with astonishment. The agricultural and industrial interests of the country were fostered with great zeal. The most important industrial undertaking was the introduction of the manufacture of woollen cloth, the royal factory at Berlin supplying uniforms for the entire army. The commercial regulations, conceived in a spirit of rigid protection, were less successful. In the ecclesiastical sphere the king was able to secure toleration for the Protestants in other parts of Germany by reprisals on his own Roman Catholic subjects, and he also gave welcome to numerous Protestant refugees, including 18,000 exiled peasants from Salzburg (1732). He has the credit of founding the common-school system of Prussia and of making elementary education compulsory.

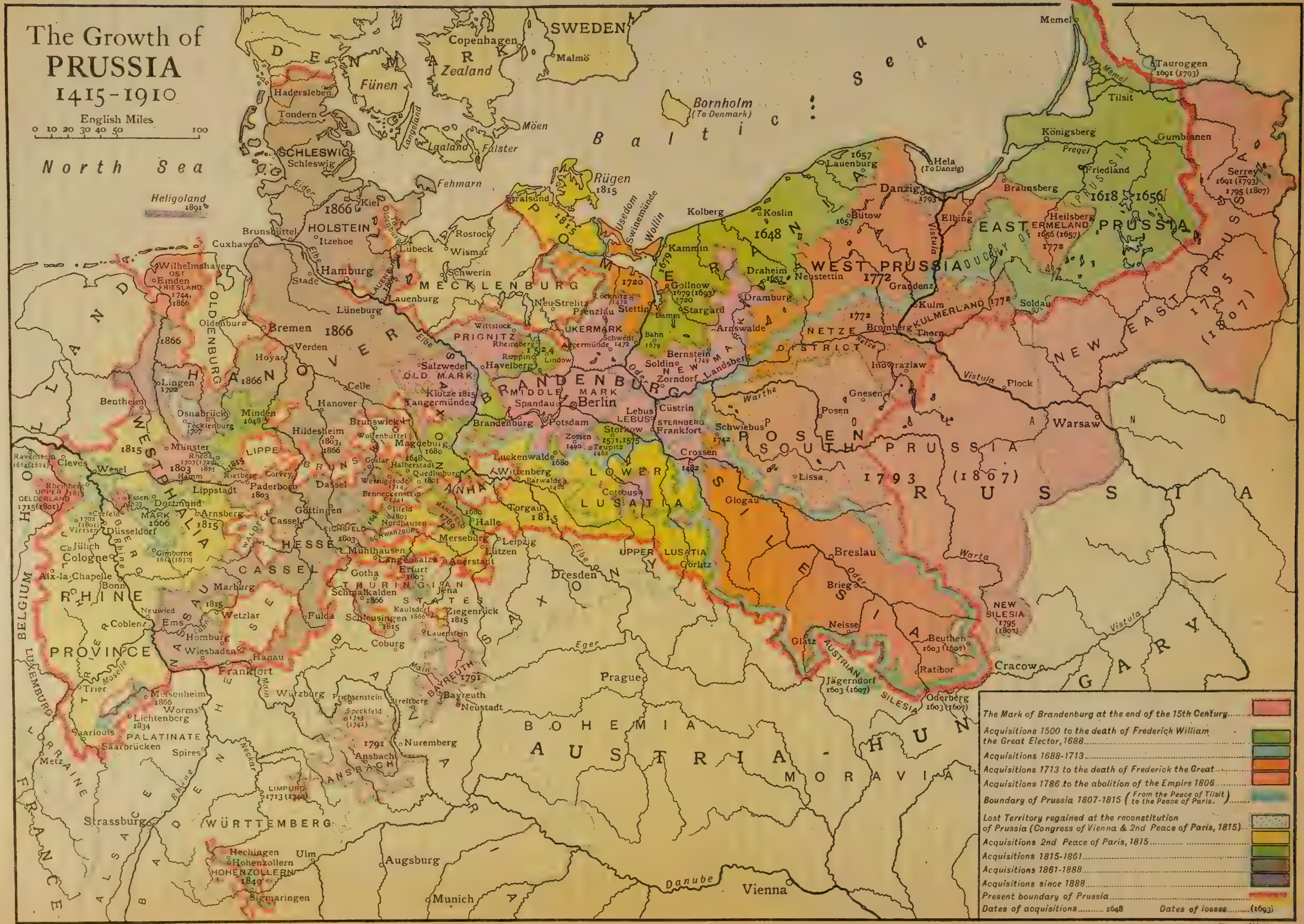
Frederick II., 1740–1786.

On the 31st of May 1740 Frederick William died, and was succeeded by his son as Frederick II., known in history as Frederick the Great. The young king at once resolved to use the well-filled treasury and well-disciplined army left to him by his father for the purpose of increasing the position of Prussia in Europe. The death of the emperor Charles VI., the last of the male line of the house of Habsburg, on the 20th of October 1740, gave him his opportunity, by raising the question of Maria Theresa's right to succeed under the Pragmatic Sanction (see Charles VI., emperor; MARIA THERESA; AUSTRIA-HUNGARY: *History*). Austrian duplicity in the matter of Jülich gave him a colourable pretext for his hostile attitude in reviving the long dormant claims of Prussia to the Silesian duchies. Within a year of his accession he had embarked on the Silesian War, and this was closely followed by the second, which ended in 1745, leaving Frederick in undisputed possession of almost the whole of Silesia, with the frontier that still exists. East Friesland, the Prussian claim to which dated from the time of the Great Elector, was absorbed in 1744 on the death without issue of the last duke. The two Silesian Wars completely exhausted the stores left by Frederick William, both of grenadiers and thalers, and Frederick gladly welcomed the interval of peace to amass new treasures and allow his subjects time to recover from their exertions. When the Seven Years' War broke out in 1756 he had an army of 150,000 men at his command, representing about one-seventh of the available male population of his little kingdom. He had also a fund of 11,000,000 thalers in his treasury, though this would have gone but a small way had he not been assisted by the subsidies of England and able to make the fertile plains of Saxony his chief basis of supply. (See SEVEN YEARS' WAR.)

Prussia under Frederick II.

Though without gain in extent or population, Prussia emerged from the war as an undoubted power of the first rank, and henceforth completely eclipsed Saxony, Bavaria and Hanover, while it was plain that Austria would no longer stand without a rival for the hegemony of the German Empire. The glorious victories over the French and Russians also awakened a spirit of German patriotism that had hitherto been almost unknown. But the price paid for these results was enormous. Of the 850,000 soldiers who, as is estimated, perished during the war about 180,000 fell in the service of Prussia, and the gross population of the kingdom had decreased in seven years to the extent of half a million souls. The misery and poverty indirectly attendant on the war were incalculable. The development of the country was thrown back for many years, which were almost a repetition of the period succeeding the Thirty Years' War. But while nearly a century elapsed before the traces of that struggle disappeared, Frederick repaired most of the ravages of the Seven

The Growth of PRUSSIA
1415-1910


English Miles
0 10 20 30 40 50 100
The Mark of Brandenburg at the end of the 15th Century
Acquisitions 1500 to the death of Frederick William the Great Elector, 1688
Acquisitions 1688-1713
Acquisitions 1713 to the death of Frederick the Great
Acquisitions 1786 to the abolition of the Empire 1806
Boundary of Prussia 1807-1815 (From the Peace of Tilsit to the Peace of Paris.)
Lost Territory regained at the reconstitution of Prussia (Congress of Vienna & 2nd Peace of Paris, 1815)
Acquisitions 2nd Peace of Paris, 1815
Acquisitions 1815-1861
Acquisitions 1861-1888
Acquisitions since 1888
Present boundary of Prussia
Dates of acquisitions 1648
Dates of losses (1693)
North Sea
Baltic Sea
Heligoland 1891
SWEDEN
Malmö
DENMARK
Copenhagen
Zealand
Fünen
Möen
Falster
Laaland
Langeland
Fehmarn
Bornholm (To Denmark)
Rügen 1815
Hela (To Danzig)
Memel
Tauroggen 1691 (1793)
Tilsit
Königsberg
Gumbinnen
Pregel
Friedland
Braunsberg
Heilsberg
ERMELAND 1656 (1657) 1772
1618
1656
EAST PRUSSIA
Elbing
Soldau
Serrey 1691 (1793) 1795 (1807)
NEW EAST PRUSSIA 1795 (1807)
Danzig 1793
WEST PRUSSIA 1772
Graudenz
Kulm
KULMERLAND 1772
Thorn
Bromberg
NETZE DISTRICT 1772
Inowrazlaw
Plock
Vistula
Warsaw
Gnesen
Posen
POSEN
SOUTH PRUSSIA 1793 (1807)
Lissa
Warthe
Warta
RUSSIA
NEW SILESIA 1795 (1807)
Cracow
HUNGARY
Lauenburg 1657
Bütow 1657
Kolberg
Koslin
1648
POMERANIA
Kammin
1679
Draheim 1657
Neustettin
Dramburg
Arnswalde
Gollnow 1679 (1693) 1720
Stargard
Damm
Stettin
1720
Usedom
Swinemünde
Wollin
Stralsund
1815
Löcknitz 1472
Prenzlau
Neu-Strelitz
UKERMARK
Schwedt
Angermünde 1472
Bahn 1679
Bernstein 1749
Soldino
NEW MARK
Zorndorf
Landsberg
Oder
Cüstrin
Lebus
LEBUS
STERNBERG
Frankfort
Schwiebus 1742
Crossen 1482
Glogau
SILESIA
Breslau
Brieg
Neisse
Glatz
AUSTRIAN SILESIA
Beuthen 1603 (1607)
Ratibor
Jägerndorf 1603 (1607)
Oderberg 1603 (1607)
BRANDENBURG
MIDDLE MARK
Berlin
Spandau
Potsdam
Brandenburg
PRIGNITZ
Wittstock
Rheinsberg
Ruppin 1524
Lindow
Havelberg
OLD MARK
Salzwedel
Klötze 1815
Tangermünde
Zossen 1490
Teupitz 1462
Storkow 1571, 1575
Luckenwalde 1680
Wittenberg
Bärwalde 1462
Cottbus
LOWER LUSATIA
UPPER LUSATIA
Görlitz
Torgau 1815
Leipzig
Lützen
Dresden
SAXONY
Elbe
MECKLENBURG
Rostock
Wismar
Schwerin
Lübeck
Lauenburg
Kiel
HOLSTEIN 1866
Itzehoe
SCHLESWIG
Schleswig
Hadersleben
Tondern
Eider
Brunsbüttel
Cuxhaven
Hamburg
Stade
Lüneburg
Bremen
HANOVER 1866
Verden
Hoya
Celle
Hanover
Hildesheim 1803, 1866
Brunswick
Wolfenbüttel
Magdeburg 1680
Halberstadt 1648
Quedlinburg 1803
Goslar
Wernigerode 1714
Benneckenstein 1741
Ilfeld 1803
Nordhausen
ANHALT
Halle 1680
Merseburg
Auerstadt
MANSFELD 1780
EICHSFELD 1803
SCHWARZBURG
Mühlhausen
Langensalza
Erfurt 1803
Gotha
Schmalkalden 1866
THURINGIAN STATES
Jena
Kaulsdorf 1866
Ziegenrück 1815
Schleusingen 1815
Lauenstein
Coburg
BAYREUTH 1791
Bayreuth
Neustadt
Nuremberg
Streitberg
Prichsenstein
Speckfeld 1713 (1742)
1791
Ansbach
ANSBACH
Würzburg
LIMPURG 1713 (1742)
WÜRTTEMBERG
Hechingen
Hohenzollern
HOHENZOLLERN 1849
Sigmaringen
Ulm
Augsburg
Munich
Danube
Vienna
BOHEMIA
Prague
Eger
AUSTRIA
MORAVIA
OLDENBURG
Oldenburg
Wilhelmshaven
OST FRIESLAND 1744, 1866
Emden
1866
Lingen 1702
Bentheim
Osnabrück
Tecklenburg 1707
Minden 1648
LIPPE
Rietberg
Corvey
Paderborn 1803
Dassel
Göttingen
Cassel
HESSE CASSEL
WALDECK
Lippstadt
Münster 1803
Rheda 1707 (1729) 1815
Hamm
WESTPHALIA 1815
Arnsberg
Dortmund
MARK 1666
Essen
Gimborne 1614 (1631)
Düsseldorf
BERG
Crefeld 1702 (1801)
Viersen
Wesel
Cleves
Ravenstein 1614 (1624)
Rheinberg UPPER GELDERLAND 1715 (1801)
Jülich
Cologne
Aix-la-Chapelle
Bonn
RHINE PROVINCE
Neuwied
Coblenz
Ems
Marburg 1815
Wetzlar
NASSAU
Homburg
Wiesbaden
Hanau
Fulda
Frankfort
Main
Neckar
Moselle
Trier
Saarlouis
Saarbrücken
Meisenheim 1866
Worms
Lichtenberg 1834
PALATINATE
Spires
Rhine
Strassburg
ALSACE
BADEN
LORRAINE
Metz
LUXEMBURG
BELGIUM
HOLLAND
FRANCE

Emery Walker sc.

Years' War in a tenth of the time. By great dexterity in the management of his finances he had kept clear of debt, and was soon able to advance large sums to the most impoverished districts. Foreign colonists were invited to repeople the deserted villages; taxes were in several instances remitted for a series of years; the horses of the army were employed in farm labour; and individual effort in every department was liberally supported by the government. By 1770 nearly all the ruined villages had been rebuilt; the ground was again under cultivation; order had been restored; the vacant offices had been filled; and the debased currency had been called in. Throughout the kingdom agriculture was encouraged by the drainage of marshy districts; industry was extended by the introduction of new manufactures, by bounties and by monopolies; and commerce was fostered by measures of protection. Frederick's methods of administration did not greatly differ from those of his predecessor, though the unrelenting severity of Frederick William was relaxed and the peculiarities of his system toned down. Frederick's own personal supervision extended to every department, and his idea of his position and duties made him his own first minister in the widest and most exacting sense of the term. His efforts to improve the administration and the bureaucracy were unceasing, and he succeeded in training a body of admirable public servants. One of his most sweeping reforms was in the department of law, where, with the able aid of the jurist Samuel von Cocceji (1679–1755), he carried out a complete revolution in procedure and personnel. One of the king's first acts was to abolish legal torture, and he rarely sanctioned capital punishment except in cases of murder. The application of the *privilegium de non appellando* (1746) freed Prussia from all relations with the imperial courts and paved the way for a codification of the common law of the land, which was begun under Frederick but not completed till the end of the century. In matters of religion Frederick not only exercised the greatest toleration, remarking that each of his subjects might go to heaven after his own fashion, but distinctly disclaimed the connexion of the state with any one confession. Equal liberty was granted in speaking and writing. Though his finances did not allow him to do much directly for education, his example and his patronage of men of letters exercised a most salutary effect. The old system of rigid social privilege was, however, still maintained, and unsurmountable barriers separated the noble from the citizen and the citizen from the peasant. The paramount defect of Frederick's administration, as future events proved, was the neglect of any effort to encourage independence and power of self-government among the people. Every measure emanated from the king himself, and the country learned to rely on him alone for help in every emergency.

In 1772 Prussia and Austria, in order to prevent an overweening growth of Russia, joined in the first partition of Poland. Frederick's share consisted of West Prussia and the Netze district, which filled up the gap between the great mass of his territories and the isolated district of East Prussia. It had also this advantage over later acquisitions at Poland's expense, that it was a thoroughly German land, having formed part of the colonizations of the Teutonic Order. In 1778 Prussia found herself once more in opposition to Austria on the question of the Bavarian succession, but the difficulty was adjusted without much bloodshed (see Potato War). The same question elicited the last action of importance in which Frederick engaged—the formation of a "Fürstenbund," or league of German princes under Prussian supremacy, to resist the encroachments of Austria. The importance of this union was soon obscured by the momentous events of the French Revolution, but it was a significant foreshadowing of the duel of Austria and Prussia for the pre-eminence in Germany. Frederick died on the 17th of August 1786, having increased his territories to an area of 75,000 sq. m., with a population of five and a half millions. The revenue also had immensely increased and now amounted to about twenty million thalers annually, of which, however, thirteen were spent on the army. The treasury contained a fund of sixty million thalers, and the country was free of debt. (See Frederick II., King of Prussia.)

Frederick William II., 1786–1797.

A continuation of the personal despotism under which Prussia had now existed for seventy years, as well as of its disproportionate influence in Europe, would have required a ruler with something of the iron will and ability of Frederick the Great. Unfortunately Frederick's nephew and successor, Frederick William II., had neither the energy nor the insight that his position demanded. He was too undecided to adhere to the vigorous external policy of his predecessor, nor did he on the other hand make any attempt to meet the growing discontent by an internal movement of liberal reform. The rule of absolutism continued, though the power now lay more in the hands of a "camarilla" or cabinet than in those of the monarch; and the statesmen who now came to the front were singularly short-sighted and inefficient. The freedom of religion and the press left by Frederick the Great was abrogated in 1788 by royal ordinance. In 1787 the army engaged in an expensive and useless campaign against Holland. The abandonment of Frederick's policy was shown in a tendency to follow the lead of Austria, which culminated in an alliance with that power against revolutionary France. But in 1795 Prussia, suspicious of the Polish plans of Russia and Austria, concluded the separate peace of Basel, almost the only redeeming feature of which was the stipulation that all north German states beyond a certain line of demarcation should participate in its benefits. This practically divided Germany into two camps and inflicted a severe blow on the imperial system. The indifference with which Prussia relinquished to France German lands on the left bank of the Rhine, compared with her eagerness to increase her Slavonic territories on the east, was certainly one of the great blunders of the reign. Prussia's share in the second and third partitions of Poland (1783 and 1795) nearly doubled her extent, but added little or nothing to her real power. The twelve years following the peace of Basel form one of the most sombre periods of the history of Prussia. Her prestige was lost by her persistent and ill-timed neutrality in the struggle with France; the old virtues of economy, order and justice disappeared from the bureaucracy; the army was gradually losing its excellence and was weakened rather than strengthened by the hordes of disaffected Polish recruits; the treasury was exhausted and a large debt incurred; the newly awakened feeling of German patriotism had died away, especially among the upper classes. (See Frederick William II., King of Prussia.)

Frederick William III., 1797–1840.

Frederick William III. possessed many virtues that did him credit in his private capacity, but he lacked the vigour that was at this juncture imperatively required from a ruler of Prussia, while he was unfortunately surrounded by counsellors who had as little conception as himself of Prussia's proper rôle. Not even the high-handed occupation of Hanover by the French in 1803 could arouse him; and the last shred of self-respect seemed to have been parted with in 1805 when Prussia consented to receive Hanover, the property of its ally England, from the hands of France. The formation of the Confederation of the Rhine in 1806 and the intelligence that France had agreed to restore Hanover to England at last convinced Frederick William of what he had to fear from Napoleon; while Napoleon on his side, being now free of his other antagonists, was only too glad of an opportunity to destroy his tool. Prussia declared war on the 9th of October 1806; and the short campaign that ensued showed that the army of Frederick the Great had lost its virtue, and that Prussia, single-handed, was no match for the great French commander. On the 14th of October the Prussian armies were overthrown at Jena and Auerstädt, and a total collapse set in. Disgraceful capitulations of troops and fortresses without a struggle followed one another in rapid succession; the court fled to East Prussia; and Napoleon entered Berlin in triumph. At the Peace of Tilsit (July 9, 1807) Frederick William lost half his kingdom, including all that had been acquired at the second and third partitions of Poland and the whole of the territory west of the Elbe. An enormous war indemnity was also demanded, and the Prussian fortresses were occupied by the French until this should be paid.

Prussia and Napoleon.

The next half-dozen years form a period of the greatest significance in the history of Prussia, embracing, as they do, the turning-point in the moral regeneration of the country. The disasters of 1806 elicited a strong spirit of patriotism, which was fanned by the exertions of the "Tugendbund," or League of Virtue, and by the writings of men like Fichte and Arndt. The credit of the reformation belongs mainly to the great minister Stein, and in the second place to the chancellor Hardenberg.

Stein's Reforms.

The condition on which Stein based his acceptance of office was itself of immense importance; he insisted that the system of governing through irresponsible cabinet councillors, which had gradually become customary, should cease, and that the responsible ministers of departments should be at once the confidential advisers and the executive agents of the king. Stein's edict of 1807 abolished serfdom and obliterated the legal distinction of classes by establishing freedom of exchange in land and free choice of occupation.[1] The "Städteordnung" of 1808 reformed the municipalities and granted them important rights of self-government. His administrative reforms amounted to a complete reconstruction of the ministerial departments and the machinery of provincial government, and practically established the system now in force. In 1810 Hardenberg, with a precipitancy which Stein would scarcely have approved, continued the reform in the condition of the peasants by making them absolute owners of part of their holdings, the landlords obtaining the rest as an indemnity for their lost dues.[2] The army was also reorganized by Scharnhorst and Gneisenau, while the condition imposed by Napoleon that it should not exceed 42,000 men was practically evaded by replacing each body of men by another as soon as it was fairly versed in military exercises. The educational reforms of Wilhelm von Humboldt established the school system of Prussia on its present basis, and the university of Berlin was founded in 1809 (see Stein, H. F. C. Freiherr von; Hardenberg, K. A. von).

Accessions in 1815.

Frederick William hesitated to take part in the Austrian rising in 1809, but his opportunity came in 1813, when Napoleon fled from Russia. General York, commander of the corps that Prussia had been obliged to contribute to the French expedition, anticipated the formal declaration of war by joining the Russians with his troops on his own responsibility (Dec. 30, 1812). On the outbreak of the war the people rose *en masse* and with the utmost enthusiasm. A treaty of alliance between Russia and Prussia was concluded at Kalisch, and Austria, after some hesitation, also joined the league against Napoleon. In the struggle that followed (see Napoleonic Campaigns) Prussia played one of the most prominent parts, and her general Blücher was the driving force of the allied armies. Between 1813 and the battle of Waterloo Prussia lost 140,000 men, and strained her financial resources to the utmost. As compensation she received at the Congress of Vienna the northern half of Saxony, her old possessions west of the Elbe, Swedish Pomerania, the duchies of Berg and Jülich, and other districts in Westphalia and on the Rhine. The acquisitions of the last partition of Poland, with the exception of the grand-duchy of Posen, were resigned to Russia; Friesland went to Hanover, and Bavaria was allowed to retain Baireuth and Ansbach, which had come into her hands in 1806. This arrangement of the map did not wholly restore Prussia to its former extent, as its area was now only 108,000 sq. m. compared with 122,000 sq. m. at the beginning of 1806, but the substitution of German for Slav territory and the shifting of the centre of gravity towards the west more than made up for any slight loss in size. Hanover still formed a huge wedge splitting Prussia completely in two, and the western frontier was very ragged. Prussia's position required caution, but forced upon it a national German policy; and the situation of the new lands was vastly more effectual in determining the future leader of Germany than was Austria's aggrandisement in Italy.

Prussia after 1815.

The task that confronted Frederick William III. in 1815—that of welding together the heterogeneous elements assembled under his crown by the great congress—was one that would have taxed the statesmanship of a stronger man than he. The population of Prussia had been more than doubled, and contained, besides 2,000,000 Slavs, people of every German race; and, as an additional problem, the annexation of the Rhine provinces had raised the number of Roman Catholic subjects of the most Protestant of the German monarchies to some two-fifths of the whole. On the 3rd of June 1814 the king had issued a cabinet order promising on his return to give a decision as to a national constitution, and this promise had been repeated in proclamations at Danzig and Posen (May 1815) and in the patent addressed to the new Saxon provinces on the 22nd of May: in addition to the provincial estates there was to be a national Diet for the whole country. When, however, the work of drawing up the constitution was put in hand, it soon became clear that it would meet with extraordinary difficulties. Liberalism was as yet a force only in the professional classes; the provinces, proud of their traditions, were loth to be merged in a common organization (Pomeranians and Silesians are described in contemporary documents as "nations"); above all, there was the fundamental antagonism, by no means extinct even now, between the old eastern provinces, with their strong feudal spirit, and the new western provinces, in which the ideas of the Revolution had gained a permanent ascendancy; and of all these conflicting tendencies, one only was organized into a compact body of opinion: the ultra-conservative feudal landowners (*Junker*) of the mark of Brandenburg, "heartless, wooden, half-educated people," as Stein called them, "fit only to be turned into corporals or calculating machines," but for all that the very backbone of the traditional Prussian monarchy.

Question of a Constitution.

Pan-German Agitation. Reaction in Prussia.

In spite of all this the king would probably have granted a constitution, but for the ill-timed alarums and excursions of the Liberal *Turnvereine* and *Burschenschaften*. The trials and humiliations he had passed through during the revolutionary epoch had left him in a condition of nervous apprehension, which the Wartburg festival of October 1818 (Kamptz's *Police Laws*, an uhlan's stays and a corporal's cane—symbols of Prussian methods—had been committed to the flames) and the murder of Kotzebue turned into reactionary panic. Metternich, who had never ceased to warn the king of the peril to the Prussian monarchy which would result from a central representative system, seized the opportunity; under his influence in October 1819, Frederick William by signing the Carlsbad Decrees (*q.v.*) definitely committed himself to the Austrian system of "stability." It was not, however, till the 11th of June 1821 that the king finally decided to postpone the constitution, and to summon a commission to organize a system of provincial estates, which were created by royal patent on the 5th of June 1823. For the rest, the question of a constitution was not again raised during the king's reign, and for years the Prussian police engaged in the congenial task of "demagogue hunting" (*Demagogenhetzerei*), popular heroes like Jahn and Arndt being haled to prison on frivolous charges, and even Gneisenau and Scharnhorst surrounded with spies.

Administrative Reorganization.

Meanwhile, by an ordinance of the 20th of April 1814 the kingdom had been divided into eight provinces, each province into government districts (*Regierungsbezirke*), and these again into "circles" administered by a *Landrat* (*landrätliche Kreise*). At the head of each *Regierungsbezirk* was a government board responsible to the *Oberpräsident*, who was responsible in his turn to the ministry under the chancellor. On the 20th of March 1817 was created a council of state (*Staatsrat*) consisting of the royal princes, high officials and a certain number of members nominated by the king, whose function was to supervise the administration and discuss projects of legislation. Its immediate tasks were to bring the new provinces into harmony with the Prussian system and to set order into the disorganized finances. Both problems were solved in a manner that did credit to the Prussian bureaucracy. By 1820, in spite of the damage caused by the war and of the exhaustion of the country, the financial situation was satisfactory, the king having contributed to this result by surrendering the Crown domains to the state, reserving only a charge of 2,500,000 thalers, the so-called *Kronfideikommissfonds*. The reconciliation of the new provinces to the new order was a matter of even more difficulty, notably in the case of the population of the Rhine districts, which had been accustomed to the easy-going methods and light taxation of the ecclesiastical princes. They were, however, to a certain extent reconciled by the wise liberality which left to them many of their peculiar institutions, *e.g.* the Code Napoléon in the Rhine provinces. Most burdensome of all was the law of the 3rd of September 1814 introducing universal military service and organizing the *Landwehr*; but it was precisely this which was to be the strongest factor in welding Prussia together and making her supreme in Germany.

The New Provinces.

The Zollverein.

Of all the reforms the most far-reaching was the creation, on the 1st of January 1834, of the famous customs union or *Zollverein*, which was to become the material basis of Prussia's influence in Germany. (For details see Germany: *History*, xi. 865.)

In educational matters also the government achieved results of lasting value. The university of Bonn was founded, the others were reorganized; numerous *Gymnasien* were built and above all

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[1] Previous to this measure the distinction between "noble," "burgher," and "peasant" land and occupations was strictly observed, and no transition of property or employment from one class to another was possible.

[2] The patrimonial jurisdiction of the landowners was not taken away till 1848.

Education and Religion.

elementary education was made universal and compulsory. Less happy was Frederick William's attempt to adjust the religious differences of his subjects with the corporal's cane. In 1817, the tercentenary of the Reformation, a royal decree announced that henceforth Lutherans and Reformed were to unite in one "Evangelical Church," the public use of the name "Protestant" being officially forbidden. The so-called Old Lutherans, who refused to conform, were forbidden to found a separate community, and refractory pastors were dragooned and imprisoned. A quarrel also broke out with the Roman Catholic Church on the question of "mixed marriages," which culminated in 1837 in the imprisonment of Baron Droste zu Vischering (*q.v.*), archbishop of Cologne, and of the archbishop of Posen.

In foreign politics, too, Prussia played but a secondary rôle after 1815. The king either attended, or was represented at, the various congresses up to that of Verona in 1822, but his sole idea was to support the views of Metternich, and later, those of the emperor Nicholas I. of Russia. (See EUROPE: *History*.)

Frederick William IV., 1840–1861.

Frederick William III. died on the 7th of June 1840. In spite of his faults, he had accomplished great things for Prussia, and his kindness of heart, his devotion to duty and the memory of his sufferings maintained his personal popularity to the last (see FREDERICK WILLIAM III., KING OF PRUSSIA). Of his son and successor, Frederick William IV., great things were expected, since his talents were undeniable and he had gained as crown prince a reputation for Liberalism. One of his first acts was to liberate Jahn and the imprisoned archbishops, to reinstate Arndt in office and to issue a general amnesty (Aug. 10, 1840). Five years later he allowed the Old Lutherans liberty to set up a Church of their own. But in spite of these promising beginnings, it was soon clear that the king was wholly out of touch with the ideas of modern Liberalism. In spite of the warnings of the emperor Nicholas I. and of Metternich, he sought to satisfy the cry for a constitution by issuing on the 13th of February 1847 a patent summoning the "united Diet" for Prussia—that is to say, a mere "concentration" of the provincial Diets. The story of the contest that followed between the Crown and the people is outlined elsewhere (see GERMANY). It is only necessary to give here some account of the constitutional development in Prussia itself.

Electoral Law of 1849 and Constitution of 1851.

The most important landmark in this respect was the law promulgated after the dissolution of the lower house of the revolutionary National Assembly on the 27th of April 1849. This law, which was only slightly modified by the electoral reform law of 1910, divided the parliamentary electors into three classes, their voting power being determined by property qualifications or by official and professional position. In the elections that followed, the disgusted democrats took no part, with the result that the chambers that met on the 7th of August 1849 were strongly Conservative and made no difficulty about revising the democratic constitution of 1848 in accordance with the royal wishes. The constitution, thus amended, was proclaimed on the 31st of January 1851, and has remained substantially that of Prussia ever since. Its immediate effect was an extraordinary series of reactionary measures, *e.g.* the restoration of the old manorial courts and of the provincial estates (1850). The actual constitution of the parliament as consisting of a House of Lords (*Herrenhaus*) and House of Delegates (*Abgeordnetenhaus*) was fixed in 1854, and in this assembly the dominant element continued to be that of the Prussian *Junkertum* or squirearchy, which supported the king and his government in all their reactionary efforts.

William I., 1861–1888.

Bismarck.

So far as the internal history of Prussia is concerned, little was altered by the substitution of William as regent for his brother, now hopelessly mad, in 1858. The new ruler, who became king in 1861, shared to the full his predecessor's views as to the divine right of the Prussian crown. He was prepared to accept the established constitutional forms, but he was not prepared to sacrifice to them what he firmly believed to be the divinely appointed mission of Prussia in Germany. Bismarck, who became prime minister in 1862, fully shared his master's views. He realized, what the lower house did not, that the German question could only be settled as the result of a trial of strength between Prussia and Austria and that therefore it was necessary for Prussia to spend money on armaments; and, since he could not give his real reasons to the parliament and the parliament refused to accept the reasons he did give, he raised the necessary funds in defiance of the votes of the House of Delegates. The result justified him in the eyes of the Prussian people. Bismarck's policy, culminating in the war of 1866, left Prussia the undisputed mistress of Germany (see SCHLESWIG-HOLSTEIN QUESTION; and GERMANY: *History*). By the Treaty of Prague (Aug. 23, 1866) Prussia acquired Hanover, Hesse-Cassel, Hesse-Nassau, Frankfort and the duchies of Schleswig-Holstein and Lauenburg; her territory had been increased by one-fifth and became for the first time satisfactorily rounded off and compacted; by the acquisition of the Elbe duchies, too, she laid the foundations of her future sea-power. In 1871 as the result of the German victory over France the king of Prussia became German Emperor.

Treaty of Prague, 1866.

Prussia in the German Empire.

From 1867 onward Prussia has had from the point of view of international politics no existence apart from the North German Federation and the German Empire; and even in internal affairs her preponderance and influence in Germany have been overwhelming. For all practical purposes the German Empire has been Prussia and, however much the still surviving particularist feeling of the lesser states has resented the process, the "Prussification," in greater or less degree, of all Germany was inevitable from the moment that the great imperial departments—army, customs, posts, railways—were placed under Prussian authority or conformed to the Prussian model. With this particular expansion of Prussia, however, we are not concerned, but solely with the internal development of the Prussian kingdom itself. The main tasks that lay before the government after 1870 were the assimilation of the new provinces, the reorganization of the administration, the economic development of the country, the settlement of the questions arising out of the attitude of the Roman Catholics on the one hand and the Social Democrats on the other. On the whole the new German provinces accepted their fate with equanimity, though in Hanover especially the deposed dynasty continued to command a considerable following of which the ablest spokesman was Windthorst (*q.v.*). Since the dispossessed princes refused to resign their claims, the large sum of money which had been assigned to them by the Prussian parliament was, so early as March 1868, sequestrated, and, under the name of the Guelph Fund (*Welfenfonds*), formed a secret service supply highly convenient for Bismarck's purposes. More difficult was the task, rashly undertaken by the government, of germanizing the Danish parts of Schleswig-Holstein and the Polish districts in the eastern provinces, a task which after thirty years of effort shows but very small results (see SCHLESWIG-HOLSTEIN QUESTION, *ad fin.*; and POSEN).

Prussian Problems after 1870.

The Kulturkampf.

Closely connected with the Polish question was the quarrel with the Roman Catholic Church, known as the *Kulturkampf*, of which Prussia was the focus (see GERMANY: *History*, xi. 880 seq.). The anti-Vatican policy, associated especially with the name of the minister Falk, necessitated an alliance of the government with the Liberals, and this led to a policy of at least administrative reform. The present administrative system (*Kreisordnung*) of Prussia was introduced in 1872 for certain provinces, but not extended to the whole kingdom until 1888, when it was applied to Posen. The Liberalism of the Prussian parliament was, however, of a very lukewarm temper; and when in 1878–1879 Bismarck decided to reverse the fiscal policy of the country and to pass repressive legislation against the Social Democrats, the Liberals were not strong enough to offer an effective resistance. In 1879 the moderate Liberal ministry resigned, and was succeeded by a Conservative cabinet, in which the most conspicuous figure was Robert von Puttkammer (*q.v.*). Henceforth the government depended for parliamentary support on a union of the National Liberals and Conservatives or of the Conservatives and Ultramontanes. An eventual understanding with the Holy See was inevitable, though the *Kulturkampf* was not actually settled until 1888, when the Prussian government, assisted by the diplomatic attitude of Pope Leo XIII., came to terms with Rome. Meanwhile in 1879 the era of Bismarck's experiments in state socialism had begun by the purchase by the state of three of the great railways, thus laying the foundation of the present system of state railways in Prussia.

Influence of Social Democracy: Reaction.

State Socialism.

On the 9th of March 1888 William I. died. His successor,

Frederick III., 1888. ***William II., 1888.*** ***Franchise Reform.*** ***Growth of Social Democracy.***

Frederick III., only lived till the 15th of June, the sole important act of his reign being the dismissal of Puttkammer. Under his successor William II. the development of Prussian affairs continued on the lines laid down under William I., the main difference being that, after the fall of Bismarck (March 20, 1890), the old antagonism between the unrepresented masses and the government tended to change into one between these masses and the Crown. For while in the unreformed parliament the squirearchy was still disproportionately represented,[1] Socialism—denounced by the king-emperor as treason against himself and the country—spread rapidly among the unrepresented population. Discontent grew apace, and the trouble culminated in 1908 and 1909. In 1906 a bill raising the number of members of the Diet from 433 to 443 and effecting an unimportant redistribution of seats had been passed, but a Radical amendment in favour of direct and universal suffrage and the secret ballot had been rejected by a large majority. In 1907 the elections for the Reichstag resulted in a remarkable defeat of the Socialist forces, and this had its effect in Prussia also. In 1908 a resolution in favour of universal suffrage was again brought forward. It was opposed by Prince Bülow, the German chancellor, and was rejected by a large majority. Riots followed in Berlin and demonstrations in favour of reform throughout the country, and at the new elections in June seven Socialist members were returned—a portentous phenomenon under the actual franchise. In the session of 1909 the reform resolution was again brought forward, and again thrown out by the Conservative majority.

Reform Bill of 1910.

Demonstrations and collisions with the police followed in most of the large Prussian towns, and in October four of the Socialist members returned in 1908 who had been unseated on technical grounds were re-elected. It became clear to the government that some sop must be thrown to popular opinion, and accordingly in the speech from the throne delivered on the 11th of January 1910 the king-emperor announced a measure of franchise reform. The agitation, however, continued, and the terms of the bill when it was introduced by Herr von Bethmann-Hollweg on the 10th of February were not such as to conciliate opposition. The chancellor and minister-president adhered to the principles enunciated by his predecessor;[2] the bill retained the triple class division of voters, public voting and plural votes; the voting, however, was to be direct and certain changes were suggested giving less to the moneyed interest and more to the professional classes. A furious agitation at once arose all over the country, culminating in a series of Socialist demonstrations on the 14th in Berlin and elsewhere; owing to the elaborate police precautions there was, however, no serious disturbance; but on the evening of the 18th there was street fighting between rioters and police in Frankfort. Meanwhile, on the 13th, the bill had been referred to a committee of the Diet. No party was satisfied with it; the Berlin municipality petitioned for its entire rejection; but its fate was ultimately determined by an agreement between the representatives of the Conservative and Catholic Centre parties on the committee, the latter agreeing to support the retention of indirect voting on condition of the former declaring in favour of the secret ballot (Feb. 22). In this sense the committee ultimately reported, in spite of the government's efforts to retain public voting and to concede direct election, and on the 14th of March the bill in this shape passed its second reading. On the 16th the third reading was carried, all the parties except the Conservatives and the Centre voting against it; Herr von Bethmann-Hollweg accepted the bill on behalf of the government, merely reserving the right to amend it in matters of detail. Demonstrations and riots in various centres showed how far this result was from satisfying the popular demands.

Thus Prussia retained, in contradistinction to the South German states, its traditional character, as a land ruled from above, the monarchy and the bureaucracy basing their authority not on the will of the people, but partly on divine right and partly on the middle-class terror of the social revolution, while as its ultimate sanction there remained the tremendous power of the king of Prussia as supreme "war lord" of Germany. It remained to be seen how long these conditions could last in a country which, during the tremendous material expansion of the period following the war, had developed an immense industrial population which saw, or thought it saw, its interests sacrificed to the agricultural classes, with their traditional feudalism and inherited loyalty to the Prussian system.

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PRUSSIA, in the original and narrower sense of the word, a territory of Germany, in the kingdom of Prussia, stretching along the Baltic coast for about 220 m., and occupying an area of 24,083 sq. m. The eastern part of this territory formed the duchy of Prussia, which was conquered and colonized by the Teutonic Order and was acquired by the elector of Brandenburg in 1618, furnishing his successor with his regal title in 1701. The western part, which had been severed from the eastern half and assigned to Poland in 1466, was not annexed to Prussia until the partition of Poland in 1772, while the towns of Danzig and Thorn remained Polish down to 1793. The two districts were united in 1824 to form a single province. But, as might have been expected, the union did not work well, and it was dissolved in 1878, its place being taken by the modern provinces of East and West Prussia. (See East Prussia and West Prussia.)

PRUSSIC ACID, or Hydrocyanic Acid, HCN, an organic acid first prepared in 1782–1783 by C. Scheele and subsequently examined by J. Gay-Lussac. It is present in varying amounts in certain plants, being a product of the hydrolysis of the cyanogenetic glucosides, *e.g.* amygdalin (*q.v.*). It may be prepared by heating a mixture of cyanogen and hydrogen to 500°–550° C. (M. Berthelot, *Ann. chim. phys.*, 1879 (5), 18, p. 380); by passing induction sparks through a mixture of acetylene and nitrogen; by the dry distillation of ammonium formate; by the decomposition of the simple cyanides with mineral acids; and by distilling potassium ferrocyanide with dilute sulphuric acid (F. Wöhler, *Ann.*, 1850, 73, p. 219), the anhydrous acid being obtained by fractional distillation of the aqueous distillate, special precautions being necessary owing to the excessively poisonous nature of the free acid:

$$K_4Fe(NC)_6+3H_2SO_4=2K_2SO_4+FeSO_4+6HCN.$$

The free acid is a colourless liquid with a smell resembling bitter almonds; it boils at 26·1° C., and may be solidified, in which condition it melts at −14° C. It burns with a blue flame, and is readily soluble in water, but the solution is unstable and decomposes on standing, giving amorphous insoluble substances, and ammonium formate, oxalic acid, &c. An aqueous solution of hydrogen peroxide converts it into oxamide, $(CONH_2)_2$, and reduction by zinc and hydrochloric acid gives methylamine. The anhydrous acid combines with hydrochloric, hydrobromic and hydriodic acids to form crystalline addition products, which are decomposed by water with the formation of the corresponding ammonium salt and formic acid. It combines with aldehydes and ketones to form the nitriles of oxy-acids, for example, $CH_3CHO+HCN=CH_3CH(OH)(CN)$. It is a very weak monobasic acid, and the aqueous solution has a very low electric conductivity.

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[1] Prince Schönaich-Carolath pointed out in 1908 that 314,000 Socialist voters were entirely unrepresented, while 324,000 Conservative voters returned 143 members, and that the propertied and agrarian section of the community returned over 300 members, the remainder only some 130 (*Annual Register*, 1908, p. 280).

[2] His speech is reported in *The Times* of the 11th of February 1910.

Cyanides.—The salts of this acid, known as cyanides, may be prepared by the action of cyanogen or of gaseous hydrocyanic acid on a metal; by heating the carbonates or hydroxides of the alkali metals in a current of hydrocyanic acid; by heating alkaline carbonates with carbon in the presence of free nitrogen: $BaCO_3 + 4C + N_2 = Ba(NC)_2 + 3CO$; by ignition of nitrogenous organic substances in the presence of alkaline carbonates or hydroxides; or by processes of double decomposition. The alkali and alkaline earth cyanides are soluble in water and in alcohol, and their aqueous solution, owing to hydrolytic dissociation, possesses an alkaline character. When heated in contact with air they undergo a certain amount of oxidation, being converted to some extent into the corresponding cyanate. The cyanides of other metals are decomposed by heat, frequently with liberation of cyanogen. The cyanides are usually reducing agents. Those of the heavy metals are mostly insoluble in water, but are soluble in a solution of potassium cyanide, forming more or less stable double salts, for example $KAg(NC)_2$, $KAu(NC)_2$. Lead cyanide, $Pb(NC)_2$, however, does not form such a salt, and is insoluble in potassium cyanide solution.

Ammonium cyanide, NH_4NC, a white solid found to some slight extent in illuminating gas, is easily soluble in water and alcohol, and is very poisonous. Its vapour is inflammable. It is obtained by passing ammonia gas over hot coal; by subliming a mixture of ammonium chloride and potassium cyanide; by passing a mixture of ammonia gas and chloroform vapour through a red hot tube; and by heating a mixture of ammonia and carbon monoxide: $CO+2NH_3=NH_4NC+H_2O$. *Barium cyanide*, $Ba(NC)_2$, prepared by the action of potassium cyanide on baryta, or by passing air over a heated mixture of barium carbonate and coal, is a white solid, which when heated with water to 300° C. loses the whole of its nitrogen in the form of ammonia. *Mercuric cyanide*, $Hg(NC)_2$, is a sparingly soluble salt formed by dissolving precipitated mercuric oxide in hydrocyanic acid, or by boiling potassium ferrocyanide with mercuric sulphate and water: $2K_4Fe(NC)_6+3HgSO_4=3Hg(NC)_2+3K_2SO_4+K_2Fe[Fe(NC)_6]$. Its aqueous solution is not an electrolyte, and consequently does not give the reactions of the mercury and cyanogen ions. When heated it yields mercury, cyanogen and paracyanogen. *Silver cyanide*, $AgNC$, is formed as a white precipitate by adding potassium cyanide to silver nitrate solution; or better, by adding silver nitrate to potassium silver cyanide, $KAg(NC)_2$, this double cyanide being obtained by the addition of one molecular proportion of potassium cyanide to one molecular proportion of silver nitrate, the white precipitate so formed being then dissolved by adding a second equivalent of potassium cyanide. On concentration the double salt separates as hexagonal tables. Dilute mineral acids decompose it with the formation of insoluble silver cyanide and hydrocyanic acid: $KNC \cdot AgNC+HNO_3=HCN+KNO_3+AgNC$. A boiling solution of potassium chloride with the double cyanide gives silver chloride and potassium cyanide.

Potassium cyanide, KNC, and *sodium cyanide*, $NaNC$, are two of the most important of the salts of hydrocyanic acid, the former being manufactured in large quantities for consumption in the extraction of gold (*q.v.*). Potassium cyanide may be obtained by fusing potassium ferrocyanide either alone—$K_4Fe(NC)_6=4KNC+FeC_2+N_2$—or with potassium carbonate [V. Alder, English patent 1353 (1900)]; in the latter case the chief reaction probably is: $K_4Fe(NC)_6+K_2CO_3=4KNC+2KOCN+CO+Fe$; more potassium ferrocyanide is occasionally added in small quantities, in order to decompose the cyanate formed; $2KOCN+2K_4Fe(NC)_6=10KNC+2FeO+4C+2N_2$; $2FeO+2C=2CO+2Fe$. The reaction is accompanied by much frothing, and the whole is filtered when in a state of tranquil fusion. Rossler and Hasslacher prepare the double potassium sodium cyanide by fusing potassium ferrocyanide with sodium, the product of fusion being extracted with water and the solution evaporated: $K_4Fe(NC)_6+2Na=Fe+4KNC \cdot 2NaNC$. This process gives a product free from cyanate, which was always formed in the older fusion processes.

Many other processes have been devised. D. T. Playfair [Eng. pat. 7764 (1890)] decomposes sulphocyanides by fusing with zinc: the zinc is heated with a small quantity of carbon and when completely fused potassium sulphocyanide is added, the mass being well stirred and heated until it thickens and begins to turn red; finally it is allowed to cool out of contact with air, lixiviated with water, the solution decanted, and evaporated to a paste *in vacuo*. The potassium sulphocyanide is obtained from ammonium sulphocyanide, which is formed by washing crude coal gas with water containing suspended sulphur. Various processes involving the use of atmospheric nitrogen have been devised, but in most cases they do not yield good results. More successful results are obtained by the use of ammonia. The Stassfürter Chem. Fabrik [Eng. pat. 9350–2 (1900)] pass ammonia over a mixture of alkali or alkaline carbonate and charcoal, first at a dull red heat and then at a bright red heat: $KHO+NH_3+C=KNC+H_2O+H_2$. H. Y. Castner [Fr. pat. 242938 (1894)] passes anhydrous ammonia over heated sodium to form sodamide, which is then brought in a molten condition into contact with carbon: $NaNH_2+C=NaNC+H_2$. The Deutsche Gold und Silber Scheide Anstalt [Eng. pat. 3328, 3329 (1901)] prepare sodium cyanamide by melting sodium with carbons or some hydrocarbon, and passing ammonia over the melt at from 400°–600° C. The temperature is then raised to 700°–800° C., and the sodium cyanamide in contact with the residual carbon forms sodium cyanide. H. W. Crowther and E. C. Rossiter (*Journ. Soc. Chem. Ind.*, 1893, 13, p. 887) digest carbon bisulphide with ammonia and lime in quantities slightly in excess of those demanded by the following equation: $2CS_2+2NH_3+2Ca(OH)_2=Ca(SCN)_2+Ca(SH)_2+4H_2O$; the product is then treated with a current of carbon dioxide, calcium carbonate being precipitated, sulphuretted hydrogen escaping, and calcium sulphocyanide remaining in solution. The sulphocyanide is converted into the potassium salt by adding potassium sulphate, and finally desulphurized by lead, zinc, or iron.

Potassium cyanide is an excessively poisonous, colourless, deliquescent solid; it is readily soluble in water, but almost insoluble in absolute alcohol. It is stable in dry air, but is easily oxidized when fused, in which condition it is a powerful reducing agent. It dissolves gold (*q.v.*) in the presence of water and atmospheric oxygen. It is also largely used by the jeweler, electroplater and photographer.

Double Cyanides.—The double cyanides formed by the solution of the cyanide of a heavy metal in a solution of potassium cyanide are decomposed by mineral acids with liberation of hydrocyanic acid and formation of the cyanide of the heavy metal. Besides these, other double cyanides are known which do not suffer such decomposition, the heavy metal present being combined with the cyanogen radical in the form of a complexion. The most important members of these classes are the ferro- and ferri-cyanides and the nitroprussides.

Potassium ferrocyanide, $K_4Fe(NC)_6$, (yellow prussiate of potash), was first obtained by decomposing Prussian blue with caustic potash: $Fe_4[Fe(NC)_6]_3+12KHO=3K_4Fe(NC)_6+4Fe(OH)_3$; it may be also obtained by warming a solution of ferrous sulphate with an excess of potassium cyanide: $FeSO_4+6KNC=K_4Fe(NC)_6+K_2SO_4$. The older processes for the commercial preparation of this salt, which were based on the ignition of nitrogenous substances with an alkaline carbonate and carbon, have almost all been abandoned, since it is more profitable to prepare the salt from the by-products obtained in the manufacture of illuminating gas. W. Fowlis [Eng. pat. 9474 (1892)] passes the gas (after freeing it from ammonia) through a solution of potassium carbonate containing ferric oxide or ferrous carbonate (actually ferrous sulphate and potassium carbonate) in suspension; the sulphuretted hydrogen in the gas probably converts the iron salts into ferrous sulphide which then, in the presence of the hydrocyanic acid in the gas, and the alkaline carbonate, forms the ferrocyanide, thus: $FeS+6HCN+2K_2CO_3=K_4Fe(NC)_6+H_2S+2CO_2+2H_2O$. The salt is recovered by crystallization. The process is not very efficient, since the solutions are too dilute and large quantities of liquid have to be handled. A large quantity of the salt is now prepared from the "spent oxide" of the gas works, the cyanogen compounds formed in the manufacture of the gas combining with the ferric oxide in the purifiers to form insoluble iron ferrocyanides. The soluble salts are removed by lixiviation, and the residue is boiled with lime to form the soluble calcium ferrocyanide, which is finally converted into the potassium salt by potassium chloride or carbonate.

The salt crystallizes in large yellow plates, containing three molecules of water of crystallization. It is soluble in water, but insoluble in alcohol. It is not poisonous. When fused with potassium carbonate it yields potassium cyanide; warmed with dilute sulphuric acid it yields hydrocyanic acid, but with concentrated sulphuric acid it yields carbon monoxide: $6H_2O+K_4Fe(NC)_6+6H_2SO_4=2K_2SO_4+FeSO_4+3(NH_4)_2SO_4+6CO$. Oxidizing agents (Cl, Br, H_2O_2, &c.) convert it into potassium ferricyanide (see below), a similar result being attained by the electrolysis of its aqueous solution: $2K_4Fe(NC)_6+2H_2O=2KOH+H_2+2K_3Fe(NC)_6$. Potassium ferrocyanide may be estimated quantitatively in acid solution by oxidation to ferricyanide by potassium permanganate (in absence of other reducing agents): $5K_4Fe(NC)_6+KMnO_4+4H_2SO_4=5K_3Fe(NC)_6+3K_2SO_4+MnSO_4+4H_2O$.

Hydroferrocyanic acid, $H_4Fe(NC)_6$, is best obtained by decomposing the lead salt with sulphuretted hydrogen under water, or by passing hydrochloric acid gas into a concentrated ether solution of the potassium salt. In the latter case the precipitate is dissolved in water, reprecipitated by ether, and washed with ether-alcohol.

It is a tetrabasic acid, of markedly acid character, and readily decomposes carbonates and acetates. It dissolves unchanged in concentrated sulphuric acid, and oxidizes readily in moist air, forming Prussian blue.

Prussian blue, $Fe_7(NC)_{18}$ or $Fe_4[Fe(NC)_6]_3$, ferric ferrocyanide, was discovered in 1710 by a German manufacturer named Diesbach, who obtained it by the action of fused alkali and iron salts on nitrogenous organic matter (*e.g.* blood). It is now prepared from the calcium ferrocyanide formed in gas purifiers (see above) by decomposition with ferrous sulphate. J. Bueb (Congress of German Gas Industries, March 1900) brings gas (free from tar) into intimate contact with a saturated solution of ferrous sulphate, when a "cyanogen mud" is obtained. This is heated to boiling, and the residue after filtration contains about 30% of Prussian blue. On the small scale it may be prepared by adding an acid solution of a ferrous salt to a solution of potassium ferrocyanide. The grey precipitate first formed is allowed to stand for some hours, well washed, and then oxidised by a warm solution of ferric chloride: $6K_2Fe[Fe(NC)_6] + 3O = Fe_7(NC)_{18} + 3K_4Fe(NC)_6 + Fe_2O_3$. It is a dark blue powder with a marked coppery lustre. It is insoluble in water and is not decomposed by acids.

Soluble Prussian blue, $K_2Fe_2[Fe(NC)_6]_2$, potassium ferric ferrocyanide, is formed when a solution of potassium ferrocyanide is added to an insufficiency of a solution of a ferric salt (1), or when potassium ferricyanide is added to a ferrous salt (2):

$$\text{(1)}\quad 2K_4Fe(NC)_6 + 2FeCl_3 = 6KCl + K_2Fe_2[Fe(NC)_6]_2$$
$$\text{(2)}\quad 2K_3Fe(NC)_6 + 2FeCl_2 = 4KCl + K_2Fe_2[Fe(NC)_6]_2.$$

It is soluble in water, but is insoluble in salt solutions.

Potassium ferricyanide, $K_3Fe(NC)_6$, red prussiate of potash, is obtained by oxidizing potassium ferrocyanide with chlorine, bromine, &c., $2K_4Fe(NC)_6 + Cl_2 = 2K_3Fe(NC)_6 + 2KCl$. G. Kassner (*Chem. Zeit.*, 1889, 13, p. 1701; 17, p. 1712) adds calcium plumbate to a solution of potassium ferrocyanide and passes carbon dioxide through the mixture: $2K_4Fe(NC)_6 + Ca_2PbO_4 + 4CO_2 = 2K_3Fe(NC)_6 + K_2CO_3 + PbCO_3 + 2CaCO_3$. The mixture of calcium and lead carbonates is filtered off and roasted at a low red heat in order to regenerate the calcium plumbate. It crystallizes in dark red monoclinic prisms which are readily soluble in water. The solution decomposes on standing, and in the presence of an alkali acts as an oxidizing agent: $2K_3Fe(NC)_6 + 2KHO = 2K_4Fe(NC)_6 + H_2O + O$. With silver nitrate it gives an orange red precipitate of silver ferricyanide, $Ag_3Fe(NC)_6$. With a pure ferric salt it only gives a brown coloration. It can be estimated quantitatively by mixing a dilute solution with potassium iodide and hydrochloric acid in excess, adding excess of zinc sulphate, neutralizing the excess of free acid with sodium bicarbonate, and determining the amount of free iodine by a standard solution of sodium thiosulphate. The zinc sulphate is added in order to remove the ferrocyanide formed as an insoluble zinc salt: $2K_3Fe(NC)_6 + 2KI = 2K_4Fe(NC)_6 + I_2$. As an alternative method it may be decomposed by hydrogen peroxide in alkaline solution and the amount of evolved oxygen measured: $2K_3Fe(NC)_6 + 2KHO + H_2O_2 = 2K_4Fe(NC)_6 + 2H_2O + O_2$.

Turnbull's blue, $Fe_5(NC)_{12}$ or $Fe_3[Fe(NC)_6]_2$, ferrous ferricyanide, is best obtained by adding a hot solution of potassium ferricyanide to a ferrous salt, and allowing the mixture to stand some time in the presence of an iron salt: $2K_3Fe(NC)_6 + 3FeSO_4 = Fe_3[Fe(NC)_6]_2 + 3K_2SO_4$. It is insoluble in dilute acids.

Hydroferricyanic acid, $H_3Fe(NC)_6$, obtained by adding concentrated hydrochloric acid to a cold saturated solution of potassium ferricyanide, crystallizes in brown needles, and is easily decomposed.

Nitroprussides.—The nitroprussides are salts of the type $M_2Fe(NC)_5{\cdot}NO$. The free acid forms dark red deliquescent crystals and is obtained by decomposing the silver salt with hydrochloric acid, or the barium salt with dilute sulphuric acid.

Sodium nitroprusside, $Na_2Fe(NC)_5NO2H_2O$, is the commonest salt. It is prepared by oxidizing potassium ferrocyanide with a diluted nitric acid. The solution is evaporated, separated from potassium nitrate, the free acid neutralized with soda, and the solution concentrated. It crystallizes in dark red prisms which are readily soluble in water; it is a valuable reagent for the detection of sulphur, this element when in the form of an alkaline sulphide giving a characteristic purple blue coloration with the nitroprusside. The *potassium salt* may be prepared by adding potassium cyanide to ferrous sulphate solution, the brown precipitate so formed being then heated with potassium nitrite:

$$5\ KNC + 2\ FeSO_4 = 2\ K_2SO_4 + KFe_2(NC)_5,$$
$$2\ KFe_2(NC)_5 + 2\ KNO_2 = 2\ FeO + 2\ K_2Fe(NC)_5{\cdot}NO.$$

Other complex cyanides are known which may be regarded as derived from the acids $H_2X(CN)_4$, X = Ni, Pd, Pt; $H_4X(CN)_6$, X = Fe, Co, Ru; $H_3X(CN)_6$, X = Fe, Co, Rh; and $H_2R(CN)_6$ (see Abegg, *Anorganischen Chemie*).

Organic Cyanides or Nitriles.—Hydrocyanic acid forms two series of derivatives by the exchange of its hydrogen atom for alkyl or aryl groups; namely the *nitriles*, of type R·CN, and the *isonitriles*, of type R·NC. The latter compounds may be considered as derivatives of the as yet unknown isohydrocyanic acid HNC.

Nitriles.—These substances were first isolated in 1834 by J. Pélouze (*Ann.*, 1834, 10, p. 249). They may be prepared by heating the alkyl iodides with potassium cyanide; by heating sulphuric acid esters with potassium cyanide; by distilling the acid-amides with phosphorus pentoxide; and by distilling amines (containing more than five atoms of carbon) with bromine and potash (A. W. Hofmann), for example

$$C_7H_{15}CH_2NH_2 \rightarrow C_7H_{15}CH_2NBr_2 \rightarrow C_7H_{35}CN.$$

In addition to these methods, the nitriles of the aromatic series may be prepared by distilling the aromatic acids with potassium sulphocyanide: $C_6H_5CO_2H + KCNS = HCNS + C_6H_5CO_2K$, $C_6H_5CO_2H + HCNS = C_6H_5CN + H_2S + CO_2$; from the primary aromatic amines by converting them into diazonium salts, which are then decomposed by boiling with potassium cyanide and copper sulphate; by fusing the potassium salts of the sulphonic acids with potassium cyanide; by leading cyanogen gas into a boiling hydrocarbon in the presence of aluminium chloride (A. Desgrex, *Bull. soc. chim.*, 1895, (3) 13, p. 735); and from the syn-aldoximes by the action of acetyl chloride or acetic anhydride.

They are mostly colourless liquids which boil without decomposition, or solids of low melting point. The lower members of the series are somewhat soluble in water. They behave in most respects as unsaturated compounds; they combine with hydrogen to form amines; with water to form acidamides; with sulphuretted hydrogen to form thio-amides; with alcohols, in the presence of acids, to form imido-ethers $R{\cdot}C(:NH){\cdot}OR^1$; with ammonia and primary amines to form amidines $R{\cdot}C(:NH){\cdot}NH_2$; and with hydroxylamine to form amidoximes, $R{\cdot}C(:NOH){\cdot}NH_2$. When heated with sodium they frequently polymerize. Heated with acids or alkalis they hydrolyse to acids: $RCN + HCl + 2H_2O = R{\cdot}COOH + NH_4Cl$. This reaction shows that the alkyl or aryl group is attached to the carbon atom in the nitrile.

Acetonitrile boils at 81·6° C., and is readily miscible with water. *Propionitrile* boils at 97° C.; it is somewhat easily soluble in water, but is thrown out of solution by calcium chloride. It was obtained by E. Frankl and C. C. Graham (*Journ. Chem. Soc.*, 1880, 37, p. 740) by the action of cyanogen gas on zinc ethyl. *Allyl cyanide* boils at 119° C. *Benzonitrile* boils at 190·6° C. When solidified it melts at −17° C. It is easily soluble in alcohol and ether.

The *Isonitriles* (isocyanides or carbylamines) were first prepared in 1866 by A. Gautier (*Ann.*, 1869, 151, p. 239) by the action of alkyl iodides on silver cyanide, and the distillation of the resulting compound with potassium cyanide in concentrated aqueous solution: $RI \rightarrow R{\cdot}Ag(NC)_2 \rightarrow R{\cdot}NC + KAg(NC)_2$. They may also be obtained by distilling a primary amine with alcoholic potash and chloroform: $R{\cdot}NH_2 + CHCl_3 + 3KHO = 3KCl + 3H_2O + R{\cdot}NC$ (A. W. Hofmann, *Ann.*, 1868, 146, p. 107). They are colourless liquids, readily soluble in alcohol and in ether, but insoluble in water. They possess an exceedingly unpleasant smell and are poisonous. They boil at temperatures somewhat lower than those of the corresponding nitriles; and are stable towards alkalis, but in the presence of mineral acids they readily hydrolyse, forming primary amines and formic acid: $RNC + 2H_2O = RNH_2 + H_2CO_2$. This reaction shows that the alkyl or aryl group is linked to the nitrogen atom. The carbon atom in the isonitriles is assumed by J. U. Nef to be divalent, since these substances readily form addition compounds, such addition taking place on the carbon atom, as is shown by the products of hydrolysis; for example with ethyl carbylamine:—

$$C_2H_5NC + CH_3COCl \rightarrow C_2H_5NC(COCH_3)Cl \rightarrow HCl + C_2H_5NH_3$$
$$+ CH_3CO{\cdot}CO_2H.$$

This view was confirmed by J. Wade (*Journ. Chem. Soc.*, 1902, 81, p. 1596) who showed that the products obtained by the action of alkyl iodides on the isonitriles in alcoholic solution at 100° C. yield amine hydroidides and formic acid when hydrolysed. Such a reaction can only take place if the addition of the alkyl group takes place on the nitrogen atom of the isonitrile, from which it follows that the nitrogen atom must be trivalent and consequently the carbon atom divalent. The reactions may probably be represented as follows:—

$$C_2H_5NC + C_2H_5I + 4C_2H_5OH = C_2H_5NH_2{\cdot}HI + HCO_2C_2H_5 + 2(C_2H_5)_2O,$$
$$C_2H_5NC(+C_2H_5I) \rightarrow C_2H_5N(C_2H_5{\cdot}I)C(+3C_2H_5OH)$$
$$\rightarrow (C_2H_5)_2NH{\cdot}HI + H{\cdot}CO_2C_2H_5 + (C_2H_5)_2O.$$

The isonitriles dissolve silver cyanide readily, forming a soluble silver salt (cf. KNC). At 200° C. the isonitriles are converted into nitriles.

Constitution of Metallic Cyanides.—Considerable discussion has taken place as to the structure of the metallic cyanides, since potassium cyanide and silver cyanide react with alkyl iodides to form nitriles and isonitriles respectively, thus apparently pointing to the fact that these two compounds possess the formulae KCN and AgNC. The metallic cyanides are analogous to the alkyl isocyanides, since they form soluble double silver salts, and the fact that ethyl ferrocyanide on distillation yields ethyl isocyanide also points to their isocyanide structure. J. Wade (*loc. cit.*) explains the formation of nitriles from potassium cyanide, and of isonitriles from silver cyanide by the assumption that unstable addition products are formed, the nature of which depends on the relative state of unsaturation of the carbon and nitrogen atoms under the varying conditions:—

$$\mathrm{KNC \rightarrow KN{:}C({:}C_2H_5I) \rightarrow KI + C_2H_5CN},$$
$$\mathrm{AgNC \rightarrow AgN({:}C_2H_5I)C \rightarrow AgI + C_2H_5NC};$$

that is, when the metal is highly electro-positive the carbon atom is the more unsaturated, the addition takes place on the carbon atom, and nitriles are produced. The same type of reaction occurs when the metal is relatively electro-positive to the added radical, for example, with ethyl isocyanide and acetyl chloride (see above); compare also $\mathrm{AgNC \rightarrow AgN({:}Cl{\cdot}COCH_3)C \rightarrow AgCl + CH_3COCN}$. On the other hand, when there is but little electro-chemical difference between the radical of the cyanide and that of the reacting compound then the nitrogen atom is the more unsaturated element and isonitriles are produced. This explanation also accounts for the formation of nitriles by the diazo reaction, thus:—

$$\mathrm{C_6H_5N_2Cl + CuNC \rightarrow CuN{:}C{\cdot}Cl{\cdot}N_2{\cdot}C_6H_5 \rightarrow CuCl +}$$
$$\mathrm{N{\vdots}C{\cdot}N_2{\cdot}C_6H_5 \rightarrow C_6H_5CN + N_2}.$$

Detection.—The metallic cyanides may be detected by adding ferrous sulphate, ferric chloride, and hydrochloric acid to their solution, when a precipitate of Prussian blue is produced; if the original solution contains free acid it must be neutralized by caustic potash before the reagents are added. As an alternative test the cyanide may be decomposed by dilute hydrochloric acid, and the liberated hydrocyanic acid absorbed in a little yellow ammonium sulphide. The excess of reagent is removed by evaporation and a small quantity of a ferric salt added, when a deep red colour is produced. Silver nitrate gives a white precipitate with cyanides, soluble in excess of potassium cyanide. The amount of hydrocyanic acid in a solution may be determined by adding excess of caustic potash and a small quantity of an alkaline chloride, and running into the dilute solution standard silver nitrate until a faint permanent turbidity (of silver chloride) is produced, that is, until the reaction, $\mathrm{2KNC + AgNO_3 = KAg(NC)_2 + KNO_3}$, is completed.

See R. Robine and M. Lengler, *The Cyanide Industry*, 1906 (Eng. trans. by J. A. Le Clerc); W. Bertelsmann, *Die Technologie der Cyanverbindungen*, 1906.

Pharmacology, Therapeutics and Toxicology of Hydrocyanic Acid.—The pharmacopoeial preparations of this acid are a 2% solution, which is given in doses of from two to six minims, the *tinctura chloroformi et morphinae composita*, which contains a half-minim of this solution in each ten minims, and the *aqua laurocerasi*, which owes its virtues to the presence of this acid, and is of inconstant strength, besides being superfluous. The acid is also the active ingredient of the preparations of Virginian Prune, to which the same strictures apply.

The simple cyanides share the properties of the acid, except those of platinum and iron. With these exceptions, the simple cyanides are readily decomposed even by carbonic acid, free prussic acid being liberated. The double cyanides are innocuous. Hydrocyanic acid is a protoplasmic poison, directly lethal to all living tissues, whether in a plant or an animal. It is by no means the most powerful poison known, for such an alkaloid as pseud-aconitine, which is lethal in dose of about 1/200 of a grain, is some hundreds of times more toxic, but prussic acid is by far the most rapid poison known, a single inhalation of it producing absolutely instantaneous death. The acid is capable of passing through the unbroken skin, whereupon it instantly paralyses the sensory nerves. It is very rapidly absorbed from raw surfaces and may thereby cause fatal consequences. It is naturally an antiseptic.

The therapeutic applications of the drug are based entirely upon its anaesthetic or anodyne power. A lotion containing ten minims of the dilute acid to an ounce of water and glycerin will relieve itching due to any cause; and is useful in some forms of neuralgia. It must never be employed when the skin is abraded. The diluted acid is used internally to relieve vomiting or gastric pain. It is also added to cough mixtures, when the cough is of the dry, painful kind, which serves no purpose, as nothing is expectorated. Such a cough is relieved by the sedative action on the central nervous system.

Toxicology.—Instantaneous death results from taking the pure acid. The diluted form, in toxic quantities, will cause symptoms usually within a few seconds. The patient is quite unconscious, the eyes are motionless, the pupils dilated, the skin cold and moist, the limbs relaxed, the pulse is slow and barely perceptible, the respirations very slow and convulsive. *Post mortem*, the body is livid, and the blood very dark. There may be an odour of prussic acid, but this soon disappears.

Treatment is only rarely of use, owing to the rapidity of the toxic action. The patient who survives half-an-hour will probably recover, as the volatile acid is rapidly excreted by the lungs. The drug kills by paralysing the nervous arrangements of the heart and respiration. The appropriate drug is therefore atropine, which stimulates the respiration and prevents the paralysis of the heart. One-fiftieth of a grain must be immediately injected subcutaneously. The stomach must be washed out and large doses of emetics given as soon as possible. Every second is of consequence. Ammonia should be given by inhalation, and artificial respiration must never be forgotten, as by it the paralysed breathing may be compensated for and the poison excreted. The use of chemical antidotes, such as iron salts, is futile, as the drug has escaped into the blood from the stomach long before they can be administered.

PRUTZ, HANS (1843–), German historian, son of Robert Eduard Prutz (1816–1872), the essayist and historian; was born at Jena on the 20th of May 1843, and was educated at the universities of Jena and Berlin. In 1865 appeared his monograph on Henry the Lion, duke of Saxony and Bavaria, which was followed by three volumes on the emperor Frederick Barbarossa (*Kaiser Friedrich I.*, Danzig, 1871–1874). Meanwhile from 1863 to 1873 he was teaching in secondary schools. In 1874 he received a government commission to undertake explorations in Syria, particularly at Tyre, and as a result he published in 1876 *Aus Phönicien*, a collection of historical and geographical sketches. In the same year appeared his first work on the Crusades, *Quellenbeiträge zur Geschichte der Kreuzzüge*, and a series of monographs on the same subject culminated in 1883 in the notable *Kulturgeschichte der Kreuzzüge*. Then turning to a wider theme Prutz contributed to Oncken's university history the two volumes on the political history of Europe during the middle ages (*Staatengeschichte des Abendlandes im Mittelalter*, Berlin, 1885–1887). In 1888 he reverted to a subject which he had touched upon in his *Geheimlehre und Geheimstatuten des Tempelherrenordens* (Danzig, 1879), and wrote the history of the rise and fall of the Templars (*Entwickelung und Untergang des Tempelherrenordens*), which is noticed in the article TEMPLARS. His *Preussische Geschichte* (4 vols., Stuttgart, 1899–1902), which is perhaps his most notable work, is an attempt to apply scientific rather than patriotic canons to a subject which has been mainly in the hands of historians with a patriotic bias. He also wrote *Aus des Grossen Kurfürsten letzten Jahren* (Berlin, 1897) and *Bismarcks Bildung, ihre Quellen und ihre Äusserungen* (Berlin, 1904). In 1902 Prutz resigned the chair of history in the university of Königsberg, which he had held since 1877, and took up his residence at Munich.

PRUTZ, ROBERT EDUARD (1816–1872), German poet and prose writer, was born at Stettin on the 30th of May 1816. He studied philology, philosophy and history at Berlin, Breslau and Halle, and in the last-named became associated, after taking his degree, with Arnold Ruge in the publication of the *Hallesche Jahrbücher*. Subjected on account of his advanced political views to police surveillance, he removed to Jena, where, on the strength of an excellent monograph, *Der Göttinger Dichterbund* (1841), he hoped to obtain an academic appointment. He was, however, expelled from the town for offending against the press laws, and it was not until 1846 that he received permission to lecture in Berlin. From 1849 to 1859 he was extraordinary professor of literature at Halle, but retired in 1859 to Stettin, where he died on the 21st of June 1872.

Prutz belonged to the group of political poets who dominated German literature between 1841 and 1848; his poems are more conspicuous for their liberal tendency than their poetry. Among them may be mentioned *Ein Märchen* (1841); *Gedichte* (1841); *Aus der Heimat* (1858); *Neue Gedichte* (1860); *Herbstrosen* (1865); *Buch der Liebe* (1869). Among his novels are noteworthy, *Das Engelchen* (1851) and *Der Musikantenturm* (1855). Much more important are his contributions to literary history and criticism: *Vorlesungen über die Geschichte des deutschen Theaters* (1847); *Ludwig Holberg* (1857); *Die deutsche Literatur der Gegenwart* (1859), and *Menschen und Bücher* (1862). Prutz also wrote some dramas of little merit.

See R. von Gottschall, in *Unsere Zeit* (1872).

PRYNNE, WILLIAM (1600–1669), English parliamentarian, son of Thomas Prynne by Marie Sherston, was born at Swainswick near Bath in 1600. He was educated at Bath Grammar School, matriculated at Oriel College, Oxford, in 1618, obtained his B.A. in 1621, was admitted a student of Lincoln's Inn the same year, and was called to the Bar in 1628. He was Puritan to the core, with a tenacious memory, a strength of will bordering upon obstinacy, and a want of sympathy with human nature. His first book, *The Perpetuity of a Regenerate Man's Estate* (1627), defended one of the main Calvinistic positions, and *The Unloveliness of Love-locks* and *Health's Sickness* (1628) attacked prevailing fashions without any sense of proportion, treating follies on the same footing as scandalous vices.

In 1629 Prynne came forward as the assailant of Arminianism in doctrine and of ceremonialism in practice, and thus drew down upon himself the anger of Laud. *Histrio-mastix*, published in 1633, was a violent attack upon stage plays in general, in which the author pointed out that kings and emperors who had favoured the drama had been carried off by violent deaths, which assertion might easily be interpreted as a warning to the king, and applied a disgraceful epithet to actresses, which, as Henrietta Maria was taking part in the rehearsal of a ballet, was supposed to apply to the queen. After a year's imprisonment in the Tower Prynne was sentenced by the star chamber on the 17th of February 1634 to be imprisoned for life, and also to be fined £5000, expelled from Lincoln's Inn, rendered incapable of returning to his profession, degraded from his degree in the university of Oxford, and set in the pillory, where he was to lose both his ears. The latter portion of the sentence was carried out on the 7th of May, and the rest of his punishment inflicted except the exaction of the fine. There is no reason to suppose that his punishment was unpopular. In 1637 he was once more in the star chamber, together with Bastwick and Burton. In *A Divine Tragedy lately acted* he had attacked the Declaration of Sports, and in *News from Ipswich* he had assailed Wren and the bishops generally. On the 30th of June a fresh sentence, that had been delivered on the 14th, was executed. The stumps of Prynne's ears were shorn off in the pillory, and he was branded on the cheeks with the letters S.L., meaning "seditious libeller," which Prynne, however, interpreted as "*stigmata laudis*." He was removed to Carnarvon Castle, and thence to Mont Orgueil Castle in Jersey, where he occupied himself in writing against popery.

Immediately upon the meeting of the Long Parliament in 1640 Prynne was liberated. On the 28th of November he entered London in triumph, and on the 2nd of March 1641, reparation was voted by the Commons, at the expense of his persecutors. Prynne now attacked the bishops and the Roman Catholics and defended the taking up of arms by the parliament. The words "Touch not mine anointed," he declared in the *Vindication of Psalm cv. ver. 15* (1642), only commanded kings not to oppress their subjects. In 1643 he took an active part in the proceedings against Nathaniel Fiennes for the surrender of Bristol, and showed a vindictive energy in the prosecution of Archbishop Laud. He manipulated the evidence against him, and having been entrusted with the search of Laud's papers, he published a garbled edition of the archbishop's private "Diary," entitled *A Breviate of the Life of Archbishop Laud*. He also published *Hidden Works of Darkness brought to Light* in order to prejudice the archbishop's case, and after his execution, *Canterbury's Doom* . . . an unfinished account of the trial commissioned by the House of Commons. Prynne supported a national church controlled by the state, and issued a series of tracts against independency, including in his attacks Henry Burton his former fellow sufferer in the pillory, John Lilburne and John Goodwin [*e.g. Independence Examined* (1644); *Brief Animadversions on Mr John Goodwin's Theomachia* (1644), &c.]. He denounced Milton's *Divorce at Pleasure*, was answered in the *Colasterion*, and contemptuously referred to in the sonnet "On the Forcers of Conscience." He also opposed violently the Presbyterian system, and denied the right of any Church to excommunicate except by leave of the state [*e.g. Four Short Questions* (1645); *A Vindication of Four Serious Questions* (1645)]. He was throughout an enemy of individual freedom in religion.

Prynne took the side of the parliament against the army in 1647, supported the cause of the eleven impeached members, and visited the university of Oxford as one of the parliamentary commissioners. On the 7th of November 1648 Prynne was returned as member for Newport in Cornwall. He at once took part against those who called for the execution of Charles, and on the 6th of December delivered a speech of enormous length in favour of conciliating the king. The result was his inclusion in "Pride's Purge" on the morning of the 6th, when, having resisted to military violence, he was imprisoned. After recovering his liberty Prynne retired to Swainswick. On the 7th of June 1649 he was assessed to the monthly contribution laid on the country by parliament. He not only refused to pay, but published *A Legal Vindication of the Liberties of England*, arguing that no tax could be raised without the consent of the two houses. In the same year he began a long account of ancient parliaments, intended to reflect on the one in existence, and in June 1650 he was imprisoned in Dunster Castle, afterwards at Taunton, and in June 1651 at Pendennis Castle. He was at last offered his discharge on giving a bond of £1000 to do nothing to the prejudice of the commonwealth. This he refused, and an unconditional order for his release was given on the 18th of February 1653. After his release Prynne further expressed his feelings in defence of advowsons and patrons, an attack on the Quakers (1655), and in a pamphlet against the admission of the Jews to England (*A Short Demurrer to the Jews*) issued in 1656. On the occasion of the offer of the crown to Cromwell he issued *King Richard the Third Revived* (1657), and on the creation of the new House of Lords *A Plea for the Lords* (1658).

On the restoration of the Rump Parliament by the army of the 7th of May 1659 fourteen of the secluded members, with Prynne among them, claimed admittance. The claim was refused, but on the 9th, through the inadvertence of the doorkeepers, Prynne, Annesly and Hungerford succeeded in taking their seats. When they were observed the house purposely adjourned for dinner. In the afternoon the doors were found guarded; the secluded members were not permitted to pass, and a vote was at once taken that they should not again be allowed to enter the house. Wrathful at the failure of his protest and at the continuance of the republican government, Prynne attacked his adversaries fiercely in print. In *England's Confusion*, published on the 30th of May 1659, in the *True and Full Narrative*, and in *The Brief Necessary Vindication*, he gave long accounts of the attempt to enter the house and of his ejection, while in the *Curtaine Drawne* he held up the claims of the Rump to derision. In *Shuffling, Cutting and Dealing*, 26th of May, he rejoiced at the quarrels which he saw arising, for "if you all complain I hope I shall win at last." *Concordia discors* pointed out the absurdity of the constant tendency to multiply oaths, while "remonstrances," "narratives," "queries," "prescriptions," "vindications," "declarations" and "statements" were scattered broadcast. Upon the cry of the "good old cause" he is especially sarcastic and severe in *The True Good Old Cause Rightly Stated* and other pamphlets. *Loyalty Banished* explains itself. His activity and fearlessness in attacking those in power during this eventful year were remarkable, and an ironical petition was circulated in Westminster Hall and the London streets complaining of his indefatigable scribbling. On the 27th of December Prynne made another fruitless attempt to take his seat. In obedience to the popular voice, however, on the 21st of February 1660, the ejected members of 1648, led in triumph by Prynne, wearing a basket-hilt sword, re-entered the house. He supported the Restoration in this parliament, and in the Convention Parliament, which met on the 25th of April 1660, and in which he sat for Bath, he urged severe measures against the regicides, and the exclusion of several individuals from the Act of Indemnity. He was foremost in support of the claims of the Presbyterians and against the bishops; advocated the indiscriminate infliction of penalties, and demanded that the officials of the commonwealth should be compelled to refund their salaries. He was nominated a commissioner for disbanding the army, and was appointed keeper of the records in the Tower, a post in which he performed useful services.

Prynne was again returned as member for Bath on the 8th of

May 1661, in spite of the vehement efforts of the Royalists headed by Sir T. Bridge. This parliament was bent upon the humiliation of the Presbyterians, and Prynne appears in his familiar character of protester. On the 18th of this month he moved that the Engagement, with the Solemn League and Covenant, should be burned by the hangman. About the same time he published a pamphlet advocating the reform of the Prayer Book, while a tract issued on the 15th of July, *Sundry reasons against the new intended Bill for governing and reforming Corporations*, was declared illegal, false, scandalous and seditious; Prynne being censured, and only escaping punishment by submission. The continued attacks upon the Presbyterians led him to publish his *Short, Sober, Pacific Examination of Exuberances in the Common Prayer*, as well as the *Apology for Tender Consciences touching Not Bowing at the Name of Jesus*. In 1662 there appeared also the *Brevia parliamentaria rediviva*, possibly a portion of the *Brief Register of Parliamentary Writs*, of which the fourth and concluding volume was published in 1664. During 1663 he served constantly on committees, and was chairman of the committee of supply in July, and again in April 1664.

In the third session Prynne was once more, on the 13th of May 1664, censured for altering the draft of a bill relating to public-houses after commitment, but the house again, upon his submission remitted the offence, and he again appears on the committee of privileges in November and afterwards. In 1665 and 1666 he published the second and first volumes respectively of the *Exact Chronological Vindication and Historical Demonstration* of the supreme ecclesiastical jurisdiction exercised by the English kings from the original planting of Christianity to the death of Richard I. In the latter year especially he was very busy with his pen against the Jesuits. In January 1667 he was one of three appointed to manage the evidence at the hearing of the impeachment of Lord Mordaunt, and in November of the same year spoke in defence of Clarendon, so far as the sale of Dunkirk was concerned, and opposed his banishment, and this appears to have been the last time that he addressed the house. In 1668 was published his *Aurum reginae* or *Records concerning Queen-gold*, the *Brief Animadversions on Coke's Institutes* in 1669, and the *History of King John, Henry III. and Edward I.*, in which the power of the Crown over ecclesiastics was maintained, in 1670. The date of the *Abridgment of the Records of the Tower of London*, published 1689, is doubtful, though the preface is dated 1656–1657. Prynne died unmarried, in his lodgings at Lincoln's Inn, on the 24th of October 1669, and was buried in the walk under the chapel there. He left one portion of his books to Lincoln's Inn and another to Oriel College. His works number about 200 and occupy, together with the replies which they excited, twenty-four columns in the catalogue of the British Museum. Lists of them are given in Wood's *Athenae Oxonienses* (ed. P. Bliss), vol. iii., and in *Documents relating to the Proceedings against William Prynne.*

Bibliography.—Article by C. H. Frith in the *Dict. of Nat. Biography*; Life of Prynne, in Wood's *Ath. Oxon.*, ed. by Bliss, iii. 844; *Documents relating to the Proceedings against Prynne*, ed. by S. R. Gardiner for the Camden Society (1877); *Hist. of Swainswick*, by R. E. M. Peach; Gardiner's *Hist. of England, of the Civil War and of the Commonwealth; Notes and Queries*, 8th series, vol. viii. p. 361 ("Letter to Charles II., May 2, 1660"), 9th series, vol. ii. p. 336.

(S. R. G.; P. C. Y.)

PRYOR, ROGER ATKINSON (1828–), American jurist and politician, was born near Petersburg, Virginia, on the 19th of July 1828. He graduated at Hampden-Sidney College in 1845 and at the law school of the university of Virginia in 1848, and in 1849 was admitted to the bar, but devoted himself for some years to journalism. He served as a Democrat in the National House of Representatives from December 1859 to March 1861, and was re-elected for the succeeding term, but owing to the secession of Virginia did not take his seat. He served in the provisional Confederate congress (1861) and also in the first regular congress (1862) of the Confederate constitution. He entered the Confederate army as a colonel, became a brigadier-general (April 16, 1862), and took part in the battles of Williamsburg, Seven Pines, second Bull Run and Antietam. Owing to a disagreement with President Davis he resigned his commission in 1863, but entered General Fitzhugh Lee's cavalry as a private in August of that year. He was taken prisoner on the 28th of November 1864, but was released on parole by order of the president. In 1865 he removed to New York City, where he practised law. He was judge of the New York court of common pleas in 1890–1894, and of the New York supreme court in 1894–1899. His wife, Sara Agnes (Rice) Pryor (b. 1830), published *The Mother of Washington and her Times* (1903), *Reminiscences of Peace and War* (1904), *The Birth of the Nation* (1907), and *My Day: Reminiscences of a Long Life* (1909).

PRYTANEUM and **PRYTANIS** (Gr. root *προ*, first or chief).

1. In general in ancient Greece, each state, city or village possessed its own central hearth and sacred fire, representing the unity and vitality of the community. The fire (cf. at Rome the fire in the temple of Vesta) was kept alight continuously, tended by the king or members of his family (cf. at Rome the vestal virgins, originally perhaps the daughters of the king). The building in which this fire was kept was the Prytaneum, and the chieftain (the king or prytanis) probably made it his residence. The word Prytanis (plur. *Prytaneis*) is generally applied specially to those who, after the abolition of absolute monarchy, held the chief office in the state. Rulers of this name are found at Rhodes as late as the 1st century B.C. The Prytaneum was regarded as the religious and political centre of the community and was thus the nucleus of all government, and the official "home" of the whole people. When members of the state went forth to found a new colony they took with them a brand from the Prytaneum altar to kindle the new fire in the colony;[1] the fatherless daughters of Aristides, who were regarded as children of the state at Athens, were married from the Prytaneum as from their home; Thucydides informs us (ii. 15) that in the Synoecism of Theseus (see Athens) the Prytanea of all the separate communities were joined in the central Prytaneum of Athens as a symbol of the union; foreign ambassadors and citizens who had deserved especially well of the state were entertained in the Prytaneum as public guests. In Achaea, this central hall was called the Leïton (town-hall), and a similar building is known to have existed at Elis. This site of the Prytaneum at Athens cannot be definitely fixed; it is generally supposed that in the course of time several buildings bore the name. The Prytaneum, mentioned by Pausanias, and probably the original centre of the ancient city, was situated somewhere east of the northern cliff of the Acropolis. Hence the frequent confusion with the Tholos which was near the council chamber and was the residence of the Prytaneis (see below) of the council. Curtius places the original Prytaneum south of the Acropolis in the Old Agora, speaks of a second identical with the Tholos in the Cerameicus, and regards that of Pausanius as a building of Roman times (*Stadtgeschichte*, p. 302). Wachsmuth holds the former view and regards the Tholos as merely a dining-room for the Prytaneis in the old democratic period. Many authorities hold that the original Prytaneum of the Cecropian city must have been on the Acropolis. From Aristotle's *Constitution of Athens* (ch. 3) we know that the Prytaneum was the official residence of the Archons, but, when the new Agora was constructed (by Peisistratus?), they took their meals in the Thesmotheteum for the sake of convenience. There was also a court of justice called the court of the Prytaneum; all that is known of this court is that it tried murderers who could not be found, and inanimate objects which had caused death. Judging from its rather fanciful functions and from its name, it is probably a relic of the pre-historic jurisdiction of the patriarch-king.

2. For the Prytaneis of the Boulē and of the Naucraries, see Boulē and Naucrary.

3. Prytaneia were court-fees paid when the prosecutor was claiming a part of the penalty which the defendant would be called upon to pay if he lost.

4. Prytanis was also the name of a legendary king of Sparta of the Eurypontid or Proclid line. He was the son of Eurypon and fourth in descent from Procles.

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[1] Cf. Indian tribes of North America.

Bibliography.—On the Prytaneum as the centre of an ancient state see article Fire, and references in a paper (*s.v.*) by Frazer (*Journal of Philology*, 1885, xiv. 28). For the site of the Athenian P. see E. Curtius, *Attische Studien*, and an article by Schöll (*Hermes*, v. 340); also general histories of Greece.

PRZEMYŚL, a town of Austria, in Galicia, 60 m. W. of Lemberg by rail. Pop. (1900), 46,295, mostly Polish. It is situated on the river San and is one of the strongest fortresses in Galicia. Przemyśl is the seat of a Roman Catholic and of a Greek uniat bishop, and has a Roman Catholic cathedral, begun in 1460. The industries comprise the manufacture of machinery, liqueurs and spodium or tutty, the refining of naphtha, corn-milling and the sawing of timber. The trade is chiefly in timber, corn, leather and linen. On the hill above the town are the ruins of an old castle, said to have been founded by Casimir the Great.

Przemyśl, one of the oldest towns in Galicia, claims to have been founded in the 8th century, and was at one time capital of a large independent principality. Casimir the Great and other Polish princes endowed it with privileges similar to those of Cracow, and it attained a high degree of prosperity. In the 17th century its importance was destroyed by inroads of Tatars, Cossacks and Swedes.

PRZHEVALSK, formerly Karakol (renamed in 1889), a town of Russian Turkestan, in the province of Semiryechensk, 8 m. S.E. of Lake Issyk-kul. Nikolai Przhevalsky (Przevalsky *q.v.*), the Russian explorer in Central Asia, died here in 1889, and a monument has been erected to his memory. It is a growing town, and had in 1897 a population of 7985.

PSALM (from the Gr. word ψάλλειν, to play the harp), the name used to designate the religious poems of the Hebrews, which are contained in the Psalter (see Psalms, Book of). Modern collections of religious poetry sometimes bear the title of *Psalms and Hymns*, but these are always more or less directly connected with the actual Psalms of David. Longfellow wrote "A Psalm of Life" (1839), which was an intimate confession of the religious aspirations of the author. The *Psaumes* of Clément Marot (1538) were curious adaptations of Hebrew ideas to French forms of the epigram and the madrigal. But it is doubtful whether the psalm, as distinguished from the Hebrew *Psalter*, can be said to have any independent existence. It is loosely used to describe any exalted strain of devotional melody. (See also Hymns.)

PSALMANAZAR, GEORGE (*c.* 1679–1763), French adventurer, was born about 1679, probably in Languedoc. According to his own account he was sent in his seventh year to a free school taught by two Franciscan monks, after which he was educated in a Jesuit college "in an archiepiscopal city." On leaving college he became a private tutor. He assumed personations in order to obtain money, his first being that of a pilgrim to Rome. Afterwards he travelled through Germany, Brabant and Flanders in the character of a Japanese convert. At Liége he enlisted in the Dutch service, shortly after which he posed as an unconverted Japanese. At Sluys he made the acquaintance of a Scottish chaplain, by whom he was brought over to England and introduced to the bishop of London. Having undergone conversion to Christianity, he was employed by the bishop to translate the Church catechism into what was supposed to be the Japanese language. In 1704 he published a fictitious *Historical and Geographical Description of Formosa*, and was shortly afterwards sent to Oxford. In 1707 he published *Dialogue between a Japanese and a Formosan.* There also appeared, without date, *An Inquiry into the Objections against George Psalmanazar of Formosa, with George Psalmanazar's Answer.* His pretensions were from the beginning doubted by many, and when exposure was inevitable he made a full confession. Throughout the rest of his life he exhibited, according to Dr Samuel Johnson, as reported by Mrs Piozzi, "a piety, penitence, and virtue exceeding almost what we read as wonderful in the lives of the saints." Psalmanazar published *Essays on Scriptural Subjects* (1753), contributed various articles to the *Ancient Universal History*, and completed Palmer's *History of Printing.* He died in London on the 3rd of May 1763. His memoirs appeared in 1764 under the title, *Memoirs of . . . commonly known by the name of George Psalmanazar*, but do not disclose his real name or the place of his birth.

PSALMS, BOOK OF, or Psalter, the first book of the Hagiographa in the Hebrew Bible.

Title and Traditional Authorship.—The Hebrew title of the book is תְּהִלִּים, *tĕhillīm*, or סֵפֶר תְּהִלִּים "the book of hymns," or rather "songs of praise."[1] The singular תְּהִלָּה is properly the infinitive or *nomen verbi* of הלל, a verb employed in the technical language of the Temple service for the execution of a jubilant song of praise to the accompaniment of music and the blare of the priestly trumpets (1 Chron. xvi. 4 seq., xxv. 3; 2 Chron. v. 12 seq.). The name is not therefore equally applicable to all psalms, and in the later Jewish ritual the synonym *Hallel* specially designates two series of psalms, cxiii.–cxviii. and cxlvi.–cl., of which the former was sung at the three great feasts —the encaenia, and the new moon, and the latter at the daily morning prayer. That the whole book is named "praises" is clearly due to the fact that it was the manual of the Temple service of song, in which praise was the leading feature. But for an individual psalm the usual name is מִזְמוֹר (in the Bible only in titles of psalms), which is applicable to any piece designed to be sung to a musical accompaniment. Of this word ψαλμός, "psalm," is a translation, and in the Greek Bible the whole book is called ψαλμοί or ψαλτήριον.[2] The title ψαλμοί or βιβλὸς ψαλμῶν is used in the New Testament (Luke xx. 42, xxiv. 44; Acts i. 20), but in Heb. iv. 7 we find another title, namely "David." Hippolytus tells us that in his time most Christians said "the Psalms of David," and believed the whole book to be his; but this title and belief are both of Jewish origin, for in 2 Macc. ii. 13 τὰ τοῦ Δαυίδ means the Psalter, and the title of the apocryphal "Psalter of Solomon" implies that the previously existing Psalter was ascribed to David. Jewish tradition does not make David the author of all the psalms; but as he was regarded as the founder and legislator of the Temple psalmody (1 Chron., *ut supra*; Ezra iii. 10; Neh. xii. 36, 45 seq.; Ecclus. xlvii. 8 seq.), so also he was held to have completed and arranged the whole book, though according to Talmudic tradition[3] he incorporated psalms by ten other authors, Adam, Melchizedek, Abraham, Moses, Heman, Jeduthun, Asaph, and the three sons of Korah. With this it agrees that the titles of the psalms name no one later than Solomon, and even he is not recognized as a psalmodist by the most ancient tradition, that of the LXX., which omits him from the title of Ps. cxxvii. and makes Ps. lxxii. be written not by him but of him. The details of the tradition of authorship show considerable variation; according to the Talmudic view Adam is author of the Sabbath psalm, xcii., and Melchizedek of Ps. cx., while Abraham is identified with Ethan the Ezrahite (Ps. lxxxix.). But, according to older Jewish tradition attested by Origen,[4] Ps. xcii. is by Moses, to whom are assigned Ps. xc.–c. inclusive, according to a general rule that all anonymous pieces are by the same hand with the nearest preceding psalm whose author is named; and Ps. cx., which by its title is Davidic, seems to have been given to Melchizedek to avoid the dilemma of Matt. xxii. 41 seq. Origen's rule accounts for all the psalms except i. and ii., which were sometimes reckoned as one poem (Acts xiii. 33 in the Western text; Origen; *B. Berakhoth*, f. 9b.), and appear to have been ascribed to David (Acts iv. 25)

The opinion of Jerome (*Praef. in ps. heb.*) and other Christian writers that the collector of the Psalter was Ezra does not seem to rest on Jewish tradition.

Nature and Origin of the Collection.—Whatever may be the value of the titles to individual psalms, there can be no question that the tradition that the Psalter was collected by David is not historical;

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[1] Hippol., ed. Lag., p. 188; Euseb. *H.E.* vi. 25, 2; Epiph. *Mens et Pond.* § 23; Jerome's preface to *Psalt. juxta Hebraeos.*

[2] Similarly in the Syriac Bible the title is *mazmōrē.*

[3] The passages are collected in Kimhi's preface to his commentary on the Psalms, ed. Schiller-Szinessy, Cambridge (1883).

[4] *Opp.* ii. 514 seq., ed. Rue; cf. Hippol. *ut supra*; Jerome, *Ep.* cxl. (ed. Cypr.), and *Praef. in Mal.*

for no one doubts that some of the psalms date from after the Babylonian exile. The truth that underlies the tradition is that the collection is essentially the hymn-book of the second Temple,[1] and it was therefore ascribed to David, because it was assumed, as we see clearly from Chronicles, that the order of worship in the second temple was the same as in the first, and had David as its father: as Moses completed the law of Israel for all time before the people entered Canaan, so David completed the theory and contents of the Temple psalmody before the Temple itself was built. When we thus understand its origin, the tradition becomes really instructive, and may be translated into a statement which throws light on a number of points connected with the book, namely, that the Psalter was (finally, at least) collected with a liturgical purpose. Thus, though the psalms represent a great range of individual religious experience, they avoid such situations and expressions as are too unique to be used in acts of public devotion. Many of the psalms are doxologies or the like, expressly written for the Temple; others are made up of extracts from older poems in a way perfectly natural in a hymn-book, but otherwise hardly intelligible. Such ancient hymns as Exod. xv. 1 sqq., Judges v., 1 Sam. ii. 1 sqq., are not included in the collection, though motives from them are embodied in more modern psalms: the interest of the collector, we see, was not historical but liturgical.

The question now arises: Was the collection a single act or is the Psalter made up of several older collections? And here we have first to observe that in the Hebrew text the Psalter is divided into five books, each of which closes with a doxology. The scheme of the whole is as follows:—

Book I., Ps. i.–xli.; all these are ascribed to David except i., ii., x. (which is really part of ix.), xxxiii. (ascribed to David in LXX.); doxology, xli. 13. Book II., Ps. xlii.–lxxii.: of these xlii.–xlix. are ascribed to the Korahites (xliii. being part of xlii.), l. to Asaph, li.–lxxi. to David (except lxvi., lxvii., lxxi. anonymous; in LXX. the last two bear David's name), lxxii. to Solomon; doxology, lxxii. 18, 19 followed by the subscription "The prayers of David the son of Jesse are ended." Book III., Ps. lxxiii.–lxxxix.; here lxxiii.–lxxxiii. bear the name of Asaph, lxxxiv., lxxxv., lxxxvii., lxxxviii. that of the Korahites, lxxxvi. of David, lxxxviii. of Heman, lxxxix. of Ethan; doxology, lxxxix. 52. Book IV., Ps. xc.–cvi.: all are anonymous except xc. (Moses), ci., ciii. (David),—LXX. gives also civ. to David; here the doxology is peculiar, "Blessed be Jehovah God of Israel from everlasting and to everlasting. *And let all the people say* Amen, Hallelujah." Book V., Ps. cvii.–cl.: of these cviii.–cx., cxxii., cxxiv., cxxxi., cxxxiii., cxxxviii.–cxlv. are ascribed to David and cxxvii. to Solomon, and cxx.–cxxxiv. are pilgrimage psalms, LXX. varies considerably from the Hebrew as to the psalms to be ascribed to David; the book closes with a group of doxological psalms.

The division into five books was known to Hippolytus, but a closer examination of the doxologies shows that it does not represent the original scheme of the Psalter; for, while the doxologies to the first three books are no part of the psalms to which they are attached, but really mark the end of a book in a pious fashion not uncommon in Eastern literature, that to book IV., with its rubric addressed to the people, plainly belongs to the psalm, or rather to its liturgical execution, and does not therefore really mark the close of a collection once separate. In point of fact books IV. and V. have so many common characters that there is every reason to regard them as a single great group. Again, the main part of books II. and III. (Ps. xlii.–lxxxiii.) is distinguished from the rest of the Psalter by habitually avoiding the name Jehovah (the Lord) and using Elohim (God) instead, even in cases like Ps. l. 7, where "I am Jehovah thy God" of Exod. xx. 2 is quoted but changed very awkwardly to "I am God thy God." This is not due to the authors of the individual psalms, but to an editor; for Ps. liii. is only another recension of Ps. xiv., and Ps. lxx. repeats part of Ps. xl., and here Jehovah is six times changed to Elohim, while the opposite change happens but once. The Elohim psalms, then, have undergone a common editorial treatment, distinguishing them from the rest of the Psalter. And they make up the mass of books II. and III., the remaining psalms, lxxxiv.–lxxxix., appearing to be a sort of appendix. But when we look at the Elohim psalms more nearly, we see that they contain two distinct elements, Davidic psalms and psalms ascribed to the Levitical choirs (sons of Korah, Asaph). The Davidic collection as we have it splits the Levitical psalms into two groups and actually divides the Asaphic Ps. l. from the main Asaphic collection, lxxiii.–lxxxiii. This order can hardly be original, especially as the Davidic Elohim psalms have a separate subscription (Ps. lxxii. 20). But if we remove them we get a continuous body of Levitical Elohim psalms, or rather two collections, the first Korahitic and the second Asaphic, to which there have been added by way of appendix by a non-Elohistic editor a supplementary group of Korahite psalms and one psalm (certainly late) ascribed to David. The formation of books IV. and V. is certainly later than the Elohistic redaction of books II. and III., for Ps. cviii. is made up of two Elohim psalms (lvii. 7–11, lx. 5–12) *in the Elohistic form*, though the last two books of the Psalter are generally Jehovistic. We can thus distinguish the following steps in the redaction: (*a*) the formation of a Davidic collection (book I.) with a closing doxology; (*b*) a second Davidic collection (li.–lxxii.) with doxology and subscription; (*c*) a twofold Levitical collection (xlii.–xlix.; l., lxxiii.–lxxxiii.); (*d*) an Elohistic redaction and combination of (*b*) and (*c*); (*e*) the addition of a non-Elohistic supplement to (*d*) with a doxology; (*f*) a collection later than (*d*), consisting of books IV. and V. And finally the anonymous psalms i., ii., which as anonymous were hardly an original part of book I., may have been prefixed after the whole Psalter was completed. We see, too, that it is only in the latest collection (books IV., V.) that anonymity is the rule, and titles, especially titles with names, occur only sporadically. Elsewhere the titles run in series and correspond to the limits of older collections.

Date of the Collection.—An inferior limit for the final collection is given by the Septuagint translation. But this translation was not written all at once, and its history is obscure; we only know from the prologue to Ecclesiasticus that the Hagiographa, and doubtless therefore the Psalter, were read in Greek in Egypt about 130 B.C. or somewhat later.[1] And the Greek Psalter, though it contains one apocryphal psalm at the close, is essentially the same as the Hebrew; there is nothing to suggest that the Greek was first translated from a less complete Psalter and afterwards extended to agree with the extant Hebrew. It is therefore reasonable to hold that the Hebrew Psalter was completed and recognized as an authoritative collection long enough before 130 B.C. to allow of its passing to the Greek-speaking Jews in Alexandria. Beyond this the external evidence for the completion of the collection does not carry us.

(W. R. S.)

But there is absolutely no necessity for supposing that when the grandson of Ben Sira reached Egypt the Psalter had been translated into Greek for any considerable time. Indeed it is at least equally probable that it was the recent translation of some of the poetical books of the Old Testament which fired him with a desire to translate his grandfather's book, and perhaps add the work of a member of the family to the Bible of the Egyptian Jews. It appears indeed from 1 Chron. xvi., 2 Chron. vi. 41, 42, that various psalms belonging to books IV. and V. were current in the time of the Chronicler. Unfortunately however it is impossible to date the book of Chronicles with certainty. The argument that the Chronicler must have been contemporary with the last persons named in his book is by no means convincing and on the other hand his account of the Temple services, in which he seems to be describing the Temple of his own days, harmonizes far better with a date at the end of the third, or even in the second, century B.C. than with the close of the Persian or the beginning of the Greek period. For the impression which we get from Nehemiah's memoirs is that in his days the community at Jerusalem was in the main poverty-stricken, while Malachi's exhortations to the people to pay their dues to the priests implies that in the middle of the fifth century B.C. the Temple was by no means wealthy. But in the comparative peace and freedom of the 3rd century B.C. the condition of Jerusalem was greatly ameliorated. Wealth accumulated to such a degree that Simon the son of Oniah was enabled practically to rebuild the Temple, and to maintain its services with a grandeur of ritual which they had probably never known before. It must be admitted that the gorgeousness of ritual described by the Chronicler is far more in harmony with the days of Simon than with any previous post-exilic period. How late the Chronicler wrote cannot perhaps be determined; but it is, at all events, impossible to prove that the author of Ecclesiasticus was acquainted with his work. Ben Sira indeed in his list of worthies mentions Zerubbabel, Joshua and Nehemiah; but Zerubbabel and Joshua he must have known from the books of Haggai and Zechariah, and he may well have been acquainted with that document relating to Nehemiah which the Chronicler incorporated with his book. Ben Sira's omission of the name of Ezra rather militates against the supposition that he had the Chronicler's book before him when he wrote. The conflict between Saduceeism and the *sopherim* was hardly so intense in his days as to warrant the supposition that he omitted the name of Ezra intentionally. Moreover, it is not certain that the psalms that the Chronicler quotes (xcvi., cv., cvi., cxxxii.)

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[1] This must be understood of the whole collection as completed, not of all its component parts. (R. H. K.)

[1] The text of the passage is obscure and in part corrupt, but the Latin "cum multum temporis ibi fuissem" probably expresses the author's meaning. A friend has written to the author that for *συγχρονίσας* we ought perhaps to read *συχνὸν ἐγχρονίσας*.

already existed in their place in our Psalter, or that Ps. cvi. even existed in its present form.

Other evidence of date is to be found in the Levitical psalms of the Elohistic collection. These, as we have seen, form two groups, referred to the sons of Korah and to Asaph. In Nehemiah xii. 46 Asaph is taken to be a contemporary of David and chief of the singers of his time, and in 1 Chron. xxv. 1 seq. one of the three chief singers belonging to the three great Levitical houses. But the older history knows nothing of an individual Asaph; in Ezra ii. 41 the gild of singers as a whole is called Bnē Asaph, as it was apparently in the time of Nehemiah (Neh. xi. 22, Heb.).[1] The singers or Asaphites are at this time still distinguished from the Levites; the oldest attempt to incorporate them with that tribe appears in Exod. vi. 24, where Abiasaph—that is, the eponym of the gild of Asaphites—is made one of the three sons of Korah. But when singers and Levites were fused the Asaphites ceased to be the only singers, and ultimately, as we see in Chronicles, they were distinguished from the Korahites and reckoned to Gershom (1 Chron. vi.), while the head of the Korahites is Heman, as in the title of Ps. lxxxviii. It is only in the appendix to the Elohistic psalm-book that we find Heman and Ethan side by side with Asaph, as in the Chronicles; but this does not necessarily prove that the body of the collection originated when there were only two gilds of singers.

But here it becomes necessary to ask what is the precise meaning which we are to assign to the phrases, "to David," "to Asaph," "to the sons of Korah." We certainly need not suppose that the Davidic, Asaphic and Korahite psalms severally once existed as separate books, for, if this had been the case, it is probable that the ascription would not have been prefixed to each separate psalm, but rather to the head of each collection (cf. Prov. i. 1, x. 1., xxv. 1), together with some such note at the end as is found in Job. xxxi. 40, Ps. lxxii. 20; moreover we should be compelled to assent to the view expressed in the Oxford Dictionary that those psalms which have the heading לַמְנַצֵּחַ (A. V. "to"—R. V. "for"—"the chief Musician") also originally formed a separate collection. But against this explanation of the heading לַמְנַצֵּחַ there is an almost insuperable objection; for, since both the first and second books contain psalms with this heading, it is clear that the "Chief Musician's—or Director's—Psalter" must have been in existence before either of these books; in which case, apart from the difficulty of the antiquity which we should be compelled to assign to this earliest Psalter, it is impossible to understand on what principle the first book of Psalms was formed. If the compiler of the first book aimed simply at making a collection of Davidic psalms from a major Psalter compiled by the "Director," why should he have deliberately rejected a number of Davidic psalms (Ps. li. sqq.) which, *ex hypothesi*, lay before him in this Psalter? It is surely as difficult to suppose that the Davidic psalms of the first book are a selection made from a greater collection of such psalms contained in the "Director's Psalter" as it is to imagine that St Mark's Gospel is an abridgment of St Matthew's. It is true that the preposition "to" (לְ) may denote authorship, as it does apparently in Isaiah xxxviii. 9, Hab. iii. 1, but it certainly has a much wider meaning; and indeed in some cases the idea of authorship is out of the question, for the psalms ascribed to the Korahites can scarcely have been supposed to be the joint composition of that body. Moreover, it is very doubtful whether the word מְנַצֵּחַ can be translated "Director." In 1 Chron. xv. 21 the verb of which מְנַצֵּחַ is the participle is used of the duty which was discharged by Mattithiah, Eliphelehu, Mikneiah, Obed-edom, Jeiel and Azaziah (and perhaps, if verse 20 is to be taken in close connexion with verse 21, by Zecharaiah, Aziel, Shemiramoth, Jeiel, Unni, Eliab, Maaseiah and Benaiah also) *on one definite occasion.* Unfortunately the exact nature of these men's performances is not quite clear, for it is said to have been connected with "harps set to the sheminith," or according to another interpretation, with "harps over the tenors." But whatever the obscure expression עַל־הַשְּׁמִינִית may mean, לְנַצֵּחַ cannot here mean to "direct," for a choir with six "directors" would have been a veritable beargarden. Obviously the word לְנַצֵּחַ must refer to something in the music; and inasmuch as the cymbals were for the purpose of producing a volume of sound (לְהַשְׁמִיעַ), it is reasonable to suppose that the musicians with treble lutes and with harps an octave lower (or with lutes and harps over the sopranos and tenors respectively) were to lead the singers in giving out the melody. ~~If~~ this explanation be correct—and it certainly accords best with the meaning of לְנַצֵּחַ in 1 Chron. xv. 21—the מְנַצֵּחַ will be that part of the orchestra which played the melody to be sung, virtually corresponding, *mutatis mutandis*, to what we now call the *choir organ*, and we need not complicate the compilation of the Psalter by postulating an altogether unnecessary "Director's Psalter." Now we have seen that the לְ prefixed to בְּנֵי קֹרַח cannot refer to authorship; we seem therefore shut up to one of two alternatives, either the psalms inscribed לִבְנֵי קֹרַח belonged to the *répertoire* of the Korahites, or they were intended to be sung in the Korahite style. It is indeed possible that each division of the Levitical singers had its own collection; but this is hardly probable unless we are to suppose that they never officiated simultaneously, in which case we should certainly have expected that the psalm quoted by the Chronicler (1 Chron. xvi.) would be included in the Asaphic collection. But there is no difficulty in supposing that each division of the Levitical musicians had its own traditional music, certain instruments being peculiar to the one and certain to the other, in which case the assignment of a psalm to the Asaphites or Korahites will merely denote the sort of music to which it is set. In like manner it is not improbable that לְדָוִד meant originally "to be sung in the Davidic mode";[2] that is, perhaps, "with harp accompaniment" (cf. 1 Sam. xvi. 16), or, since the Chronicler ascribes to David the initiation of the Temple music, "in the oldest traditional mode." Under such circumstances, however, a confusion would easily arise between the composer of the tune and the author; and when once the idea had arisen that David was the *author* of psalms, it would be natural to endeavour to discover in the story of his life suitable occasions for their composition.

The interpretation of the titles here suggested removes an objection brought against the assumption of a Maccabaean date for certain psalms, which lays stress on the fact that some of them, *e.g.* Ps. xliv., are written in a time of the deepest dejection, and yet are psalms of the Temple choirs; whereas, when the Temple was re-opened for worship, after its profanation by Antiochus, the Jews were victorious, and a much more joyful tone was appropriate. For if the titles לִבְנֵי קֹרַח, לְאָסָף, &c., do not denote that the psalms so inscribed were collected by the Temple choirs, there is no evidence that these psalms were *originally* sung in the Temple. The earlier collections of psalms may well have been used first in synagogues, and only adapted to the Temple worship when they had become part of the devotional life of the people. It is noteworthy that the psalms quoted by the Chronicler belong to the last collection, books IV. and V., which, as a whole, is far more suitable for liturgical use.

Since, then, the existence of separate books of psalms anterior to the present divisions of the Psalter is very doubtful, we must look for other evidences of date. Now, both the Korahite and Asaphic groups of psalms are remarkable that they hardly contain any recognition of present sin on the part of the community of Jewish faith—though they do confess the sin of Israel in the past—but are exercised with the observation that prosperity does not follow righteousness either in the case of the individual (xlix., lxxiii.) or in that of the nation, which suffers notwithstanding its loyalty to God, or even on account thereof (xliv., lxxix.). Now the rise of the problems of individual faith is the mark of the age that followed Jeremiah, while the confident assertion of national righteousness under misfortune is a characteristic mark of pious Judaism after Ezra, in the period of the law but not earlier. Malachi, Ezra and Nehemiah, like Haggai and Zechariah, are still very far from holding that the sin of Israel lies all in the past. Again, a considerable number of these psalms (xliv., lxxiv., lxxix., lxxx.) point to an historical situation which can be very definitely realized. They are post-exilic in their whole tone and belong to a time when prophecy had ceased and the synagogue worship was fully established (lxxiv. 8, 9). But the Jews are no longer the obedient slaves of the oppressing power; there has been a national rising and armies have gone forth to battle. Yet God has not gone forth with them: the heathen have been victorious, blood has flowed like water round Jerusalem, the Temple has been defiled, and these disasters assume the character of a religious persecution. These details would fit the time of religious persecution under Antiochus, to which indeed Ps. lxxiv. is referred (as a prophecy) in 1 Macc. vii. 16. It is contended by those who, like the late Professor W. Robertson Smith, are opposed to the dating of any psalms of the second collection in the Maccabaean period, that, since they are post-exilic, there is one and only one time in the Persian period to which they can be referred, viz. that of the great civil wars under Artaxerxes III. Ochus (middle of 4th century, B.C.). But there is no evidence that the Jews were involved in these; for the account which Josephus gives of Bagoses' oppression of the Jews represents the trouble as having arisen originally from internal dissensions, and does not hint at anything of the nature of a rebellion against Persia. Moreover the statement of Eusebius (*Chron. anno* 1658 Abr.) that Artaxerxes Ochus in the course of his campaign against Egypt transported a detachment of Jews to Hyrcania does not prove that Judaea as a whole had revolted. There is nothing even to connect these Jews with Palestine; they may have formed a part of the very considerable Jewish community which we know to have been settled in Egypt as early as the 5th century B.C. On the other hand, it is extremely improbable that the Jews of Judaea, whom Nehemiah had entirely detached from their immediate neighbours, would have taken part in any general rising against Persia. Between them and the Samaritans on the north and the Edomites on the south there was the most implacable hostility, which would probably be sufficient in itself to keep them from joining in the revolts in which other parts of Syria were involved. Moreover, even if the Jews had revolted, it cannot fairly be maintained that such a revolt must necessarily have had a religious character. Even Josephus does not say that the Persians tried to interfere with the Jews in the exercise of their religion; and nothing less than this would satisfy the language of Ps. xliv. 22: "Yea, for thy sake are we killed all the day long," &c. On the other hand, not only is the *atmosphere* of the second collection of psalms as a whole the atmosphere of godly Judaism in the 2nd century B.C., but it may fairly be claimed that this collection contains many psalms which may naturally be interpreted in the light of the history of that period, of which no satisfactory explanation (in their details) can be given if they are assigned to any other time. Thus, for example, Ps. xliv., with its description of the sufferings of the righteous for God's sake, would be perfectly appropriate in the mouth of one of the "godly" (*Ḥasîdîm*) about 167 B.C. Ps. xlv., though the unsoundness of the text in certain parts makes it difficult to speak with certainty, would suit the marriage of Alexander Balas at Ptolemais in 150 B.C., at which the high priest Jonathan was present as an honoured guest. In this connexion verse 10 is particularly appropriate as addressed to an Egyptian princess whose forefathers, though their rule had not on the whole been tyrannical, had been regarded by the Jews as heathen oppressors. Again, Ps. lx., with its ideal description of Jehovah's kingdom as including Gilead, Samaria, Moab, Edom and Philistia, though the ideal was not realized till the days of John Hyrcanus, would be quite appropriate in the mouth of a Maccabaean patriot. The author of Ps. lxviii. would seem to have been inspired by the sight or the description of the never-to-be-forgotten procession of the victorious Maccabees in 164 B.C. to rededicate the desecrated Temple. Hence the taunt to Bashan, the stronghold of the Seleucid government; hence the mention of Judah and Benjamin with the two Galilaean tribes Zebulon and Naphtali (as in Isaiah ix. 1—a passage which on independent grounds has been assigned to the time of Simon Maccabaeus), while schismatic Samaria is completely ignored. The historical background of Ps. lxxix. is apparently the same as that of Ps. xliv. Again, Ps. lxxxvii. would seem to date from a time when the Jews, having won freedom to worship God, were able to look forward to the conversion of their former oppressors (cf. Isaiah xi., xix.). That this psalm was composed at least as late as the 3rd century B.C. is made probable by the name here given to Egypt, *Raḥab*. Having regard to Job. ix. 13, xxvi. 12, Isaiah li. 9, there can be little doubt that *Raḥab* is the (? Palestinian) name of Tiāmat the dragon of the abyss, the natural symbol of the power of darkness, or of the kingdom of the world as opposed to the kingdom of the people of the saints of the Most High God. It is extremely improbable that such a name was applied to Egypt simply because Egypt possessed the crocodile. The origin of its application must be sought in a time when Egypt was regarded as hostile to the people of the Lord—that is to say, during the Ptolemaic rule over Palestine. These considerations, in addition to numerous phrases and expressions which cannot here be noticed, of which the full force can only be felt by those who have specially studied the Maccabaean period and those other portions of the Old Testament, such as Zechariah ix.–xiv., which may plausibly be assigned to it, make it almost certain that the second collection of psalms was made not earlier than the time of Jonathan or even of Simon.

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[1] The threefold division of the singers appears in the same list according to the Hebrew text of verse 17, but the occurrence of Jeduthun as a proper name instead of a musical note is suspicious, and makes the text of LXX. preferable. The first clear trace of the triple choir is therefore in Neh. xii. 24.

[2] Some confirmation of this explanation of the titles may be found in the fact that in place of לִידוּתוּן (Ps. xxxix. 1) we find in lxii. 1, lxxvii. 1, עַל־יְדוּתוּן, the latter expression being apparently an abbreviation of עַל־קוֹל יְדוּתוּן.

Now books IV. and V. are, as we have seen, later than the Elohistic redaction of books II. and III., so that the collection of the last part of the Psalter must, if our argument up to this point is sound, fall within the second half of the 2nd century B.C. And here it is to be noted that though no part of the Psalter shows clearer marks of a liturgical purpose, we find that in books IV. and V. the musical titles have entirely disappeared. This does not necessarily prove that "the technical terms of the Temple music had gone out of use, presumably because they were already become unintelligible, as they were when the Septuagint version was made"; for it does not follow that technical musical terms which had originated in the Temple at Jerusalem and were intelligible in Palestine would have been understood in Egypt. The absence of the musical titles, however, may be taken as an indication that the last collection of psalms was formed in a different place from that in which the earlier collections had arisen; and if, as seems probable, we may identify this place with the Temple at Jerusalem, the absence of musical titles is easily explained, for the number of skilled musicians who there ministered, and who would, of course, possess the tradition of the various modes and tones, would make precise musical directions superfluous. On the other hand, in a collection intended for synagogue use—and the second collection of psalms is as a whole far more suitable to a synagogue than to the Temple—where there would not be a large choir and orchestra of skilled musicians, it would obviously be desirable to state whether the psalm was to be sung to a Davidic, Asaphic or Korahite tone, or to give the name of a melody appropriate to it. Again, the general tone of large parts of this collection is much more cheerful than that of the Elohistic psalm-book. It begins with a psalm (xc.) ascribed in the title to Moses, and seemingly designed to express feelings appropriate to a situation analogous to that of the Israelites when, after the weary march through the wilderness, they stood on the borders of the promised land. It looks back on a time of great trouble and forward to a brighter future. In some of the following psalms there are still references to deeds of oppression and violence, but more generally Israel appears as happy under the law. The problems of divine justice are no longer burning questions, the righteousness of God is seen in the peaceful felicity of the pious (xci., xcii., &c.). Israel, indeed, is still scattered and not triumphant over the heathen, but even in the dispersion the Jews are under a mild rule (cvi. 46), and the commercial activity of the nation has begun to develop beyond the seas (cvii. 26 seq.). But some of the psalms refer to a time of struggle and victory. In Ps. cxviii. Israel, led by the house of Aaron—this is a notable point—has emerged triumphant from a desperate conflict, and celebrates at the Temple a great day of rejoicing for the unhoped-for victory: in Ps. cxlix. the saints are pictured with the praises of God in their throat and a sharp sword in their hands to take vengeance on the heathen, to bind their kings and nobles, and exercise against them the judgment written in prophecy. Such an enthusiasm of militant piety, plainly based on actual successes of Israel and the house of Aaron, can only be referred to the first victories of the Maccabees, culminating in the purification of the Temple in 164 B.C. This restoration of the worship of the national sanctuary, under circumstances that inspired religious feelings very different from those of any other generation since the return from Babylon, might most naturally be followed by an extension of the Temple psalmody; it certainly was followed by some liturgical innovations, for the solemn service of dedication on the 25th day of Chisleu was made the pattern of a new annual feast (that mentioned in John x. 22). In later times the psalms for the encaenia or feast of dedication embraced Ps. xxx. and the *hallel* Ps. cxiii.–cxviii.; and though Ps. xxx. may have been adapted from a collection already existing, there is every reason to think that the *hallel*, which especially in its closing part contains allusions that fit no other time so well, was first arranged for the same ceremony. The course of the subsequent history makes it very intelligible that the Psalter was finally closed, as we have seen from the date of the Greek version that it must have been, within a few years at most after this great event.[1] From the time of Hyrcanus downwards the ideal of the princely high priests became more and more divergent from the ideal of the pious in Israel, and in the Psalter of Solomon we see religious poetry turned against the lords of the Temple and its worship.

All this does not, of course, imply that there are not in books IV. and V. any pieces older than the completion of books II. and III., for the composition of a poem and its acceptance as part of the Levitical liturgy are not necessarily coincident in date, except in psalms written with a direct liturgical purpose. In the fifteen "songs of degrees" (Ps. cxx.–cxxxiv.) we have a case in point. According to the Mishna (*Middoth.* ii. 5) and other Jewish traditions, these psalms were sung by the Levites at the Feast of Tabernacles on the fifteen steps or degrees that led from the women's to the men's court. But when we look at the psalms themselves we see that they must originally have been a hymn-book, not for the Levites, but for the laity who came up to Jerusalem at the great pilgrimage feasts, and who themselves remembered, or their fathers had told them, the days when, as we see in Ps. xlii., it was impossible to make pilgrimage to Zion. They are hymns of the laity, describing with much beauty and depth of feeling the emotions of the pilgrim when his feet stood within the gates of Jerusalem, when he looked forth on the encircling hills, when he felt how good it was to be camping side by side with his brethren on the slopes of Zion (cxxxiii.), when a sense of Jehovah's forgiving grace and the certainty of the redemption of Israel triumphed over all the evils of the present and filled his soul with humble and patient hope.

The titles which ascribe four of the pilgrimage songs to David and one to Solomon are lacking in the true LXX., and inconsistent with the contents of the psalms. Better attested, because found in the LXX. as well as in the Hebrew, and therefore probably as old as the collection itself, are the name of Moses in Ps. xc. and that of David in Ps. ci., cii., cviii.–cx., cxxxviii.–cxlv. But where did the last collectors of the psalms find such very ancient pieces which had been passed by all previous collectors, and what criterion was there to establish their genuineness? No canon of literary criticism can treat as valuable external evidence an attestation which first appears so many centuries after the supposed date of the poems, especially when it is confronted by facts so conclusive as that Ps. cviii. is made up of extracts from Ps. lvii. and lx. and that Ps. cxxxix. is marked by its language as one of the latest pieces in the book. The only possible question for the critic is whether the ascription of these psalms to David was due to the idea that he was the psalmist *par excellence*,[1] to whom any poem of unknown origin was naturally ascribed, or whether we have in some at least of these titles an example of the habit so common in later Jewish literature of writing in the name of ancient worthies. In the case of Ps. xc. it can hardly be doubted that this is the real explanation, and the same account must be given of the title in Ps. cxlv., if, as seems probable, it is meant to cover the whole of the great *hallel* or *tehilla* (Ps. cxlv.–cl.), which must, from the allusions in Ps. cxlix., as well as from its place, be almost if not quite the latest thing in the Psalter.

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[1] Possibly under Simon; compare the other *hallel* (Ps. cxlvi.–cl. with 1 Macc. xiii. 50 seq.

For the later stages of the history of the Psalter we have, as we have seen, a fair amount of evidence pointing to conclusions of a pretty definite kind. We have still to consider the two great groups of psalms ascribed to David in books I. and II. We have endeavoured to show that the ascription "to David" in these groups did not originally denote authorship by David, and that, notwithstanding the subscription of Ps. lxxii., which may well be a later note, there is no necessity to suppose an original collection of Davidic psalms from which excerpts were made. It is, however, probable that the title soon came to be understood of David's authorship, with the result that further notes were added indicating the situation in David's life to which the psalms appeared to be appropriate. It is certainly not impossible that the two groups of "Davidic" psalms once formed separate collections independently compiled, and that the subscription to Ps. lxxii. *originally* stood at the end of the second collection; for in book I. every psalm, except the introductory poems i. and ii. and the late Ps. xxxiii., which may have been added as a liturgical sequel to Ps. xxxii., bears the title "of David," and in like manner the group Ps. li.–lxxii., though it contains a few anonymous pieces and one psalm which is either "of," or rather, according to the oldest tradition, "for Solomon," is composed of "Davidic" psalms. It would seem also that the collectors of books I.–III. know of no Davidic psalms outside of these two collections, for Ps. lxxxvi. in the appendix to the Elohistic collection is merely a cento of quotations from Davidic pieces with a verse or two from Exodus and Jeremiah. Now that the ascription "to David" was understood of David's authorship before the time of the LXX. is clear from such titles as that of Ps. xviii., for example, but there is no evidence that in early times David was regarded as the author of any of the psalms. Even the Chronicler, though he regarded David as the great founder of the Temple music, does not quote any psalm as composed by him, and the Chronicler's omission of 2 Sam. xxii.–xxiii. 7 makes it probable that this section has been inserted in the book of Samuel since he wrote. If, as is possible, Ecclus. xlvii. 8 is a reminiscence of Ps. ix. 2 and Ps. xviii. 2, we should indeed naturally infer that these two psalms were regarded by Ben Sira as the work of David; but this would prove nothing as to the date of the collection in which we now have them. It may fairly be contended therefore that the tradition that David is the author of the psalms which are assigned to him in books I. and II. comes to us from a period later than that in which the Chronicler wrote. And it is not too much to say that that view—which to some extent appears in the historical psalms of the Ehohistic Psalter—implies absolute incapacity to understand the difference between old Israel and later Judaism, and makes almost anything possible in the way of the ascription of comparatively modern pieces to ancient authors. In any case the titles are manifestly the product of the same uncritical spirit as we have just been speaking of, for not only are many of the titles certainly wrong, but they are wrong in such a way as to prove that they date from an age to which David was merely the abstract psalmist and which had no idea whatever of the historical conditions of his age. For example, Ps. xx. xxi. are not spoken by a king but addressed to a king by his people; Ps. v. xxvii. allude to the Temple (which did not exist in David's time) and the author of the latter psalm desires to live there continually. Even in the older Davidic psalm-book there is a whole series of hymns in which the writer identifies himself with the poor and needy, the righteous people of God suffering in silence at the hands of the wicked, without other hope than patiently to wait for the interposition of Jehovah (Ps. xii., xxv., xxxvii., xxxviii., &c.). Nothing can be further removed than this from any possible situation in the life of the David of the books of Samuel, and the case is still worse in the second Davidic collection, especially where we have in the titles definite notes as to the historical occasion on which the poems are supposed to have been written. To refer Ps. lii. to Doeg, Ps. liv. to the Ziphites, Ps. lix. to David when watched in his house by Saul, implies an absolute lack of the very elements of historical judgment. Even the bare names of the old history were no longer correctly known when Abimelech (the Philistine king in the stories of Abraham and Isaac) could be substituted in the title of Ps. xxxiv. for Achish, king of Gath. In a word, the ascription of these two collections to David has none of the characters of a genuine historical tradition.

At the same time it is clear that the two collections do not stand on quite the same footing. The second collection of "Davidic" psalms, as well as the Korahite and Asaphic psalms, have been subjected to an Elohistic redaction, for which we must find a reason if the history of the Psalter is to be written. An explanation that naturally suggests itself is that, at the time when books II. and III. (with the exception of the appendix, Ps. lxxxiv.–lxxxix.) were collected, it was already the custom, from motives of reverence, to abstain from pronouncing the Tetragrammaton. Upon this supposition it might be explained that book I. was collected before this scruple arose, and books IV. and V. when the custom had arisen of substituting in reading the word *Adonai*. But, as we have seen, it is impossible to separate the contents of the Elohistic books from those of the last collection. Both include psalms which are most naturally understood as referring to the persecution of Antiochus Epiphanes and to the Maccabaean victories, and cannot therefore be separated by a long interval of time. Moreover the scruple as to the pronunciation of the Tetragrammaton seems to have arisen earlier, as in the LXX. version of the Pentateuch יהוה is represented by Κύριος. And further, if the Elohistic redaction was due merely to a desire to avoid pronouncing the divine name, why was not the presumably earlier collection of psalms in book I. subjected to a similar redaction? It is therefore difficult to suppose that the Jewish Church as a whole passed through a stage in which it was felt desirable to substitute אֱלֹהִים in writing for יהוה. There is, however, no difficulty in supposing that such a thing was done in some sections of the Jewish Church, and it is probable that we must look for an explanation of the peculiarity not to the *time* but to the *place* where the second collection was formed. Now it must be frankly admitted that the earlier books of psalms exhibit no particular suitability for the Temple services. It is only in the last collection, books IV. and V., that we find any number of psalms appropriate to such a ritual as that of the Temple, and it is difficult to resist the conviction that the earlier collections were made for use, not in the Temple at Jerusalem but in some synagogue or synagogues. Thus, for example, the numerous psalms in which the poets, though speaking perhaps, not as individuals but as members of a class, describe themselves as poor and afflicted at the hands of certain ungodly men, who appear to be Jews, can hardly have been *originally* collected by the Temple choirs. For since the ministers of the Temple at Jerusalem were the aristocracy of the land, and were often, as we know both from the book of Malachi and from the history of the Maccabees, the chief offenders, it is extremely unlikely that they collected for the official services of the Temple compositions directed against themselves. It is also remarkable that hymns such as Exodus xv., which would be specially suitable to the Temple, find no place in the Psalter. Moreover, in Ps. xl., we have the striking assertion, which surely did not originate in the Temple, that God has no delight in sacrifice and offerings. On the other hand, the first collection of "Davidic" psalms taken as a whole would be perfectly appropriate in the worship of a Judaean community of *Ḥasîdîm* in the Maccabaean period. We have, unfortunately, no information as to the origin of synagogues, but their existence in pre-Maccabaean times may be inferred not only from the statement in Ps. lxxiv. 8, but also from the fact that there must have been some rallying points for the religion of the *Ḥasîdîm*: besides that supplied by occasional visits or pilgrimages to Jerusalem. We need not suppose that congregations gathered together to worship away from Jerusalem, especially in times of distress, would necessarily sing the religious poems which they had collected, though it is by no means improbable that they would do so. At any rate, Ps. cxxxvii. 4 may fairly be taken as evidence that those heathen among whom the Jews dwelt "in a strange land" had heard and admired the "songs of Zion." Certainly in happier times, when the worst period of storm and stress was over, there would be a desire to enliven the services with music, which would naturally be borrowed from the traditional music of the great national sanctuary.

In thus assigning the first collection of psalms to some Judaean community of *Ḥasîdîm* in the earlier Maccabaean period we need not conclude that all the psalms contained in this collection were first composed at this time. Although there is no psalm which can be shown with any probability to be pre-exilic, it is not impossible that there are some which date from as early a time as the age of Zerubbabel, by whose appointment national hopes were raised to so high a pitch. Thus, for example, Ps. xviii., xx., xxi., which in some respects recall the language of the song ascribed to Hannah in 1 Sam. ii., may possibly, like that song, be referred to this period. It must, however, be admitted that as a whole the psalms of the first collection are more suitable to a later date. Ps. viii., which is almost certainly quoted in Job. vii. 17, need not have been composed long before the book in which it is quoted: the references to the "godly" and to their persecutions at the hands of wicked men, who seem to be Jews, recall the Maccabaean age; in Ps. xxii. the speaker, who is not an individual but speaks in the name of a community, bears a remarkable resemblance to the "suffering servant" of Isaiah lii. 13–liii.

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[1] The explanation of לְדָוִד suggested above offers another alternative.—R. H. K.

and of this last passage it may be said that *all the translatable portions of it can be naturally explained*, if it refers to the time when the resistance of the *Hasîdîm*, whom the Sadducees had despised and shunned, had won freedom for Israel as a whole, and *at no other known period*; the fragment, Ps. xxiv. 7–10, is most easily understood of the time when the Lord who had shown Himself strong and mighty by His victories over the heathen returned in triumph to His Temple in 164 B.C.—in the days of Zerubbabel or of Nehemiah Jehovah had not recently shown Himself "mighty in battle."

In the light of these circumstances—and space here forbids more than the scantiest reference—we may reasonably suppose that the first book, with the exception of Ps. i., ii. and possibly xxxiii., is a collection of psalms in the shape which it assumed in a Judaean synagogue in the earlier days of the Maccabaean victories.

We have already noticed the difficulty of supposing that the Elohistic Psalter was compiled in a place where a Jehovistic Psalter was already in use. It is therefore probable that the second collection of psalms (books II. and III.), containing as it does an Elohistic recension of a psalm occurring in book I. in a Jehovistic form, must have been compiled for use in some other district. Since the last collection (books IV. and V.) which may reasonably be assigned to the Temple at Jerusalem uses freely the name יהוה, it may be inferred that the district where an objection was felt to *writing* the Tetragrammaton was some distance from Jerusalem, and probably not in such close touch with it as most of the country districts of Judaea would be. Such a district we may find in southern Galilee, "the land of Zebulon and the land of Naphtali," apparently the only portion of Palestine north of Samaria where the worshippers of Jehovah existed in any considerable numbers. It is at least remarkable that the names Zebulon and Naphtali in Isaiah ix. 1 (a passage which, as has been already noted, is probably Maccabaean) denote the region which had felt the brunt of the persecution of the heathen, while in Ps. lxviii. 27 (a poem of which every translatable verse is explicable if it refers to the great procession at the rededication of the Temple in 164 B.C.) the same two tribes are joined with Judah and Benjamin (*sc.* Judaea) as celebrating the Lord's victory. The dissenting inhabitants of Samaria are naturally absent from such a festival. It is not improbable that the Elohistic redaction of the second collection of psalms is due not so much to any Jewish scruples about *writing* the Tetragrammaton as to the fear that it might fall into the hands of the heathen who were trying to destroy the Hebrew Scriptures, and might thus be desecrated (cf. 1 Macc. i. 56, 57).

We may thus suppose that about the time of Jonathan the Maccabaean High Priest (if our explanation of Ps. xlv. is correct), at all events not earlier than 150 B.C., a south Galilaean synagogue made a collection of the various religious poems current among its members. Perhaps those which were to be sung according to the old Davidic mode formed the nucleus of the collection, and to these were added other poems to be sung according to the more intricate Korahite and Asaphic modes. The appendix to this collection (Ps. lxxxiv.–lxxxix.) being non-Elohistic presumably was collected elsewhere. It is possible that these last-mentioned psalms were originally an appendix to the Judaean collection and have been removed from their original place to after the other Levitical psalms.

In books IV. and V. we have a collection probably made originally for use in the Temple, consisting in the main of recent hymns, but embodying, at least to some extent, older traditional hymns of the Temple. On this hypothesis we are able to explain the presence of certain poetical pieces both in the book of Chronicles and in the Psalter. We need not suppose that the Chronicler quotes from the Psalter or vice versa, the matter which they have in common being probably derived from certain traditional songs current among the Levitical singers. Since this last collection includes a psalm (cx.) which can scarcely refer to any one earlier than Simon the Maccabee, and cannot well be later than his time, we are justified in assigning the compilation of this collection to about the year 140 B.C. But by this time a great change had taken place in the aims and aspirations of the Jews. The earlier Maccabaean policy of concentration had given place to one of expansion. The Jews in Jerusalem could not ignore the Jews of Galilee or even of the Dispersion. The hymns which had brought comfort to the faithful in the time of their distress had become an integral part of their religion which could not be given up. Jerusalem was now the religious metropolis of a great nation, and accordingly it was felt desirable that the hymn-books of the several parts of the nation should be combined into a hymn-book for the whole. The synagogue collections, since they contained psalms which at this time were probably considered to be the work of David, were placed first, and the Temple collection added to them. There was then prefixed to the whole collection a hymn (Ps. ii.) describing the hoped-for greatness of Simon's kingdom, and finally Pharisaic sentiment prefaced the whole by a psalm in praise of the law. In the final compilation, or perhaps in a subsequent redaction, some alterations were made in the original order, some notes were added describing the circumstances in which various psalms had been composed, and lastly, in order to assimilate the outward form of the Psalter to that of the Pentateuch, the three collections were divided into five books. The final redaction is probably to be dated between the years 140 and 130 B.C.

Musical Execution and Place of the Psalms in the Temple Service.—The musical notes found in the titles of the psalms and occasionally also in the text (Selah,[1] Higgaion) are so obscure that it seems unnecessary to enter here upon the various conjectures that have been made about them. The clearest point is that a number of the psalms were originally at least set to melodies named after songs,[2] and that one of these songs beginning אל־תשחת (Al-taṣhith in E. V., Ps. lvii. seq.), may be probably identified with the vintage song, Isa. lxv. 8. The original music of the psalms was therefore apparently based on popular melodies. A good deal is said about the musical services of the Levites in Chronicles, both in the account given of David's ordinances and in the descriptions of particular festival occasions. But unfortunately it has not been found possible to get from these accounts any clear picture of the ritual of any certainty as to the technical terms used. In Egypt by the translators of the Septuagint these terms were not understood.

The music of the temple attracted the attention of Theophrastus (ap. Porph. *De abst.* ii. 26), who was perhaps the first of the Greeks to make observations on the Jews. His description of the Temple ritual is not strictly accurate, but he speaks of the worshippers as passing the night in gazing at the stars and calling on God in prayer; his words, if they do not exactly fit anything in the later ritual, are well fitted to illustrate the original liturgical use of Ps. viii., cxxxiv. Some of the Jewish traditions as to the use of particular psalms have been already cited; it may be added that the Mishna (Tāmīd) assigns to the service of the continual burnt-offerings the following weekly cycle of psalms.—(1) xxiv., (2) xlviii., (3) lxxxii., (4) xciv., (5) lxxxi., (6) xciii., (Sabbath) xcii., as in the title. Many other details are given in the treatise *Sōfĕrīm*, but these for the most part refer primarily to the synagogue service after the destruction of the Temple. For details on the liturgical use of the Psalter in Christendom the reader may refer to Smith's *Dict. Chr. Ant.*, *s.v.* "Psalmody."

Ancient Versions.—(*A*) The oldest version, the LXX., follows a text generally closely corresponding to the Massoretic Hebrew, the main variations being in the titles and in the addition (lacking in some MSS.) of an apocryphal psalm ascribed to David when he fought with Goliath. Ps. ix. and x. are rightly taken as one psalm, but conversely Ps. cxlvii. is divided into two. The LXX. text has many "daughters," of which may be noticed (*a*) the Memphitic (ed. Lagarde, 1875); (*b*) the old Latin, which as revised by Jerome in 383 after the current Greek text forms the *Psalterium romanum*, long read in the Roman Church and still used in St Peter's; (*c*) various Arabic versions, including that printed in the polyglots of Le Jay and Walton, and two others of the four exhibited together in Lagarde's *Psalterium*, *Job*, *Proverbia*, *arabice*, 1876; on the relations and history of these versions see G. Hoffmann, in *Jenaer Literaturz.*, 1876, art. 539; the fourth of Lagarde's versions is from the Peshito. The Hexaplar text of the LXX., as reduced by Origen into greater conformity with the Hebrew by the aid of subsequent Greek versions, was further the mother (*d*) of the *Psalterium gallicanum*—that is, of Jerome's second revision of the Psalter (385) by the aid of the Hexaplar text; this edition became current in Gaul and ultimately was taken into the Vulgate; (*e*) of the Syro-Hexaplar version (published by Bugati, 1820, and in facsimile from the famous Ambrosian MS. by Ceriani, Milan, 1874). (*B*) The Christian Aramaic version or Peshito (P'shīttā) is largely influenced by the LXX., compare Baethgen, *Untersuchungen über die Psalmen nach der Peschita*, Kiel, 1878 (unfinished).

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[1] Of the various explanations that have been given of Selah the only one which possesses any probability is that given independently by Baethgen and others, viz. that it is a mispronunciation of an original סַלֵּה = ψάλλε. The word, which was probably derived from some Greek bandmaster, was presumably an instruction for a musical interlude. The LXX. translators who render it by διάψαλμα though not recognizing the derivation of the word, knew its meaning. —R. H. K.

[2] Compare the similar way of citing melodies with the prep. 'al or 'al kālā, &c., in Syriac (Land, *Anecd.* iv.; *Ephr. syr. hymni*, ed. Lamy).

This version has peculiar titles taken from Eusebius and Theodore of Mopsuestia (see Nestle, in *Theol. Literaturz.*, 1876, p. 283). (*C*) The Jewish Aramaic version or Targum is probably a late work.[1] The most convenient edition is in Lagarde, *Hagiographa chaldaice*, 1873. (*D*) The best of all the old versions is that made by Jerome after the Hebrew in 405. It did not, however, obtain ecclesiastical currency—the old versions holding their ground, just as English churchmen still read the Psalms in the version of the "Great Bible" printed in their Prayer Book. This important version was first published in a good text by Lagarde, *Psalterium juxta hebraeos hieronymi* (Leipzig, 1874).

Exegetical Works.—While some works of patristic writers are still of value for text criticism and for the history of early exegetical tradition, the treatment of the Psalms by ancient and medieval Christian writers is as a whole such as to throw light on the ideas of the commentators and their times rather than on the sense of a text which most of them knew only through translations. For the Psalms, as for the other books of the Old Testament, the scholars of the period of the revival of Hebrew studies about the time of the Reformation were mainly dependent on the ancient versions and on the Jewish scholars of the middle ages. In the latter class Ḳimhi stands pre-eminent; to the editions of his commentary on the Psalms enumerated in the article ḲIMHI must now be added the admirable edition of Dr Schiller-Szinessy (Cambridge, 1883), containing, unfortunately, only the first book of his longer commentary. Among the works of older Christian scholars since the revival of letters, the commentary of Calvin (1557) full of religious insight and sound thought—and the laborious work of M. Geier (1668, 1681 *et saepius*) may still be consulted with advantage, but for most purposes Rosenmüller's *Scholia in Psalms* (2nd ed., 1831–1822) supersedes the necessity of frequent reference to the predecessors of that industrious compiler. Of more recent works the freshest and most indispensable are Ewald's, in the first two half-volumes of his *Dichter des alten Bundes* (2nd ed., Göttingen, 1866; Eng. trans., 1880), and Ölshausen's (1853). To these may be added (excluding general commentaries on the Old Testament) the two acute but wayward commentaries of Hitzig (1836, 1863–1865), that of Delitzsch (1859–1860, then in shorter form in several editions since 1867; Eng. trans., 1871), and that of Hupfeld (2nd ed. by Riehm, 1867, 2 vols.). The last-named work, though lacking in original power and clearness of judgment, is extremely convenient and useful, and has had an influence perhaps disproportionate to its real exegetical merits. The question of the text was first properly raised by Ölshausen, and has since received special attention from, among others, Lagarde (*Prophetae chald.*, 1872, p. 46 seq.), Dyserinck (in the "scholia" to his Dutch translation of the Psalms, *Theol. Tijdschr.*, 1878, p. 279 seq.), and Bickell (*Carmina V. T. metrice*, &c., Innsbruck, 1882), whose critical services are not to be judged merely by the measure of assent which his metrical theories may command. In English we have, among others, the useful work of Perowne (5th ed., 1883), that of Lowe and Jennings, (2nd ed., 1885), and the valuable translation of Cheyne (1884). The mass of literature on the Psalms is so enormous that no full list even of recent commentaries can be here attempted, much less an enumeration of treatises on individual psalms and special critical questions. For the latter Kuenen's *Onderzoek*, vol. iii., is, up to its date (1865), the most complete, and the new edition now in preparation will doubtless prove the standard work of reference. As regards the dates and historical interpretation of the Psalms, all older discussions, even those of Ewald, are in great measure antiquated by recent progress in Pentateuch criticism and the history of the canon, and an entirely fresh treatment of the Psalter by a sober critical commentator is urgently needed.

The bibliography up to this point is taken from the article PSALMS by the late Professor W. Robertson Smith (*Ency. Brit.*, 1886), large portions of which are incorporated in the present article. It was the belief of Professor Robertson Smith that the second (Elohistic) collection of psalms originated in a time of persecution earlier than the time of Antiochus Epiphanes which he referred to the reign of Artaxerxes III. Ochus. This theory, which he set forth with all his accustomed learning and force, is still accepted in many quarters, many other passages of the Old Testament being likewise assigned to the same date. In the judgment of the present writer however, the results of Old Testament study (particularly in the Prophets) since Professor Robertson Smith's death have shown that this theory is untenable. Notwithstanding his reverence, therefore, for the great scholar with whose name it is associated, and to whose memory he would pay both grateful and humble tribute, he has ventured to omit or rewrite all those portions of the original article which he considers no longer tenable, while retaining every word which is still valuable.

Of the works on the Psalms which have appeared since the first publication of Professor W. Robertson Smith's article the following may be specially noticed: Cheyne, *The Book of Psalms* (1888), *The Origin of the Psalter*, Bampton Lectures (1891), and the article *Psalms* (in *Ency. Bib.*, 1902); Bickell, *Die Dichtungen der Hebräer* (3 der Psalter, 1883), from a revised and metrically arranged text; Baethgen, in Nowack's *Hand-Komm.* (1892); Wellhausen, in *Sacred Books of the Old Test.* (Eng. trans. by Furness, J. Taylor and Paterson, 1898); Duhm, in Marti's *Kurzer Hand-Comm.* (1899); Kirkpatrick, in *Cambridge Bible for Schools* (1893–1895); W. T. Davison, in Hastings's *Dict. Bible* (1902); Driver, *The Parallel Psalter* (1904); C. A. and E. G. Briggs, "Critical and Exegetical Commentary on the Psalms," vol. i. (1906), vol. ii. (1907), in *International Critical Commentary*. (R. H. K.)

PSALTERY, PSALTERION, or SAWTRIE (Fr. *psaltérion*, *salteire*; Ger. *Psalterium*; Ital. *salterio*, *istrumento di porco*), an ancient stringed instrument twanged by fingers or plectrum, and mentioned many times in the English Bible; a favourite instrument also during the middle ages in England, France and Italy. It is exceedingly doubtful whether the word was ever applied during the classic Greek period to any individual instrument; there is, moreover, no trace in the monuments of that time of the psalterion in any of the forms in which it afterwards became known during the middle ages. It is also puzzling to find no fewer than four different instruments translated *psalterion* in the Septuagint, *i.e.* Nebel, Psanterin, Ugab (organ) and Toph (Job xxi. 12). On the other hand the Aramaic word Pisantir or Psanterin (Dan. iii. 5, 10, 15) generally translated *psalterion*, and by some scholars claimed as a loan word from the Greek, corresponds to the *Santir*, a stringed instrument represented on Assyrian monuments of the 8th century B.C. (when as yet the word had not been used in Greek for a musical instrument) and still in use in Persia at the present day by the same name. The instrument itself, moreover, a dulcimer, which in its earlier forms differed from the psalterion mainly in that its strings were struck by curved sticks instead of being plucked, must in the absence of contrary evidence be considered as the prototype of the medieval psalterion or psaltery. Early medieval writers generally connect the psalterium and the cithara, probably because the strings of both were set in vibration in the same manner, by plucking or twanging.

The medieval psaltery consisted of a shallow box-soundchest over which strings varying in number were stretched, being fastened at one side to pegs and at the other to wrest pins. In the early rectangular form the strings, numbering 10 or 12, were, as in the cithara, of uniform length, the pitch being varied by the thickness and tension of the strings. When the triangular form succeeded the rectangular, the stringing was that of the harp, pitch being dependent on the length. The trapeze form, clearly borrowed from the oriental *Kanon*, and the curious Italian *istrumento di porco*, were the latest types to survive. In these later forms the vibrating length of the strings was regulated by means of two wooden bridges, converging as the strings became shorter. The psaltery was held in an upright position against the chest of the performer, until, owing to the increasing number of strings, it grew too cumbersome, and was placed flat on a table or on the knee. The German zither is the sole European survivor of the medieval psaltery. (K. S.)

PSAMMETICHUS (Egypt. *Psammetk*), the name of three kings of the Saite, XXVIth Dynasty, called by Herodotus respectively Psammetichus, Psammis and Psammenitus. The first of these is generally considered to be the founder of the dynasty; Manetho, however, carries it back through three or four predecessors who ruled at Sais as petty kings under the XXVth, Ethiopian, Dynasty. The name is frankly written so as to mean "the man of *methek*," *i.e.* "mixed drink," whether as a tippler or as a vendor of strong drink. The Egyptian scribes do not conceal the opprobrious elements, but it has been suggested that the name may be due to false etymology of a foreign name (though all the names throughout the dynasty appear to be Egyptian), or that Methek may have been an unknown deity. The story in Herodotus of the Dodecarchy and the rise of Psammetichus is fanciful. It is known from cuneiform texts that twenty local princelings were appointed by Esarhaddon and confirmed by Assur-bani-pal to govern Egypt. Niku (Necho), father of Psammetichus, was the chief of these kinglets, but they seem to have been quite unable to hold the Egyptians to the hated Assyrians against the more sympathetic Ethiopian. The labyrinth built by a king of the XIIth Dynasty is ascribed by Herodotus to the Dodecarchy, or rule of 12, which must represent this combination of rulers. If the dynasties were numbered thus before Manetho, the numeral may be the cause of Herodotus's confusion. After his father's death Psammetichus I. (664–610 B.C.) was able to defy the Assyrians and the Ethiopians, and during a long reign marked by intimate relations with the Greeks restored the prosperity of Egypt. The short reign of the second Psammetichus (594–589 B.C.) is noteworthy for the graffiti of his Greek, Phoenician and Carian mercenaries at Abu Simbel (*q.v.*). The third of the name was the unfortunate prince whose reign terminated after six months in the Persian conquest of Egypt (525 B.C.). It has been conjectured that the family of the Psammetichi was of Libyan origin; on the other hand, some would recognize negro features in a portrait of Psammetichus I., which might connect him with the Ethiopian rulers.

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[1] It contains, however, elements which are as early as the time of the New Testament. Cf. Ps. lxviii. 18 with Ephes. iv. 8.

See above, EGYPT: *History*; on the name, F. Ll. Griffith, *Catalogue of the Rylands demotic papyri*; the portrait, H. Schäfer in *Zeitschrift für aegyptische Sprache*, xxxiii. 116. (F. LL. G.)

PSELLUS (Gr. Ψέλλος), the name of several Byzantine writers, of whom the following may be mentioned:—

1. MICHAEL PSELLUS the elder, a native of Andros and a pupil of Photius, who flourished in the second half of the 9th century. His study of the Alexandrine theology, as well as of profane literature, brought him under the suspicions of the orthodox, and a former pupil of his, by name Constantine, accused him in an elegiac poem of having abandoned Christianity. In order to perfect his knowledge of Christian doctrine, Psellus had recourse to the instructions of Photius, and then replied to his adversary in a long iambic poem, in which he maintained his orthodoxy. None of his works has been preserved.

2. MICHAEL CONSTANTINE PSELLUS the younger, born in 1018 (probably at Nicomedia; according to some, at Constantinople) of a consular and patrician family. He studied at Athens and Constantinople, where he became intimate with John Xiphilinus. Under Constantine Monomachus (1042–1054) he became one of the most influential men in the empire. As professor of philosophy at the newly founded academy of Constantinople he revived the cult of Plato at a time when Aristotle held the field; this, together with his admiration for the old pagan glories of Hellas, aroused suspicions as to his orthodoxy. At the height of his success as a teacher he was recalled to court, where he became state secretary and vestarch, with the honorary title of Ὕπατος τῶν Φιλοσόφων (prince of philosophers). Following the example of his friend Xiphilinus he entered the monastery of Olympus (near Prusa in Bithynia), where he assumed the name of Michael. But, finding the life little to his taste, he resumed his public career. Under Isaac Comnenus and Constantine Ducas he exercised great influence, and was prime minister during the regency of Eudocia and the reign of his pupil Michael Parapinaces (1071–1078). It is probable that he died soon after the fall of Parapinaces.

Living during the most melancholy period of Byzantine history, Psellus exhibited the worst faults of his age. He was servile and unscrupulous, weak, fond of intrigue, intolerably vain and ambitious. But as a literary man his intellect was of the highest order. In the extent of his knowledge, in keenness of observation, in variety of style, in his literary output, he has been compared to Voltaire; but it is perhaps as the forerunner of the great Renaissance Platonists that he will be chiefly remembered. His works embraced politics, astronomy, medicine, music, theology, jurisprudence, physics, grammar and history.

Of his works, which are very numerous, many have not yet been printed. We may mention: *Chronographia* (from 976–1077), which in spite of its bias in favour of the Ducases is a valuable history of his time, chiefly on domestic affairs; three Epitaphioi or funeral orations over the patriarchs Cerularius, Lichudes and Xiphilinus. His letters (nearly 500 in number) are also full of details of the period. A complete list of his works is given in Fabricius, *Bibliotheca graeca*, x. 41; the most important have been published by C. Sathas in his Μεσαιωνικὴ βιβλιοθήκη, iv, v. On Psellus himself see Leo Allatius, *De Psellis et eorum scriptis* (1634); E. Egger in *Dictionnaire des sciences philosophiques* (1875); A. Rambaud in *Revue historique* (1877); P. V. Bezobrazov, *Michel Psellos* (1890; in Russian); C. Neumann, *Die Weltstellung des byzantinischen Reiches vor den Kreuzzügen* (1894); C. Krumbacher, *Geschichte der byzantinischen Literatur* (1897); J. E. Sandys, *Hist. of Classical Scholarship* (1906), i. 411.

PSEUDO-DIPTERAL (Gr. ψευδής, false, δίς, double, and πτερόν, a wing), the term given to a dipteral temple, *i.e.* in which there are two rows of columns round the naos, the inner row of which has been omitted to give more space for the processions or for shelter (see TEMPLE).

PSEUDONYM (Gr. ψευδώνυμος, having a false name, ψευδής, false and ὄνομα, name), a false or invented name, particularly the fictitious name under which an author produces his work in order to conceal his identity. The same end is gained by publication without any name, *i.e.* anonymously (Gr. ἀνώνυμος, without a name). The body of works thus produced either without the author's name or under a fictitious name is known as anonymous and pseudonymous literature, and many books have been published affording a key to the identity of the various writers, forming an important section of bibliography. Though Fredericus Geisler published a short treatise on the subject entitled *Larva detracta*, &c., in 1669, the chief early work was that of Vincent Placcius (1642–1699) whose *Theatrum anonymorum et pseudonymorum* was published in 1708, edited by L. F. Vischer with a preface and life by J. A. Fabricius; supplements were published in 1711 and in 1740. The next important work, only a fragment of the purposed scheme, was that of Adrien Baillet (*q.v.*), under the title of *Auteurs déguisés sous les noms étrangers*, &c. (1690). Antoine Alexandre Barbier (*q.v.*) published his standard work *Dictionnaire des ouvrages anonymes et pseudonymes* in 1806–1809 (2nd ed., 1822–1827). This was followed by the *Supercheries littéraires dévoilées* of J. M. Quérard (*q.v.*). The third edition of Barbier's work, embodying Quérard and much new matter, was published in 1872–1879. This was edited by P. Gustave Brunet, who published a supplement in 1889. Other works in French are those of C. Jolliet, *Les Pseudonymes du jour* (1867 and 1884), and F. Drujon, *Livres à clef* (1888). Of German works in this sphere of bibliography the *Index pseudonymorum, Wörterbuch der Pseudonymen* of Emil Weller appeared in 1856, of which several supplements were published later. The most monumental of all works are the *Deutsches Anonymen-Lexikon*, 1501–1850, by M. Holzmann and H. Bohatta (1902–1907), supplement, 1851–1908 (1909), and the *Deutsches Pseudonymen-Lexikon*, by the same authors (1906). See also F. Sintenis, *Die Pseudonyme der neueren deutschen Litteratur* (1899), and the supplementary volume (1909), to Meyers's *Konversations-Lexikon* (6th ed.). The chief Italian work is the *Dizionario di opere anonime e pseudonime di scrittori italiani*, by G. Melzi (1848–1859), with supplement by G. Passano (1887). The Dutch *Vermomde en naamlooze schrijvers . . . der Nederl. en Vlaamschen letteren*, by J. I. van Doorninck (1883–1885), was a second edition of an earlier work. The Academy of Upsala is publishing, under the editorship of L. Bygden, a Swedish dictionary *Svenskt anonym och pseudonym lexikon* (1898), &c. England was late in entering the field. The first work actually published was the *Handbook of Fictitious Names*, by R. Thomas (*Olphar Hamst*) (1868). Samuel Halkett, and the successor to his compilations, John Laing, both died before their work was published; edited and revised by Miss C. Laing it appeared in 1882–1888 in 4 vols. as the *Dictionary of the Anonymous and Pseudonymous Literature of Great Britain*, by S. Halkett and J. Laing. This remains the standard work on the subject in English. Other works are W. Cushing, *Initials and Pseudonyms* (American and English from the beginning of the 18th century); 2nd series (1886, 1888), and *Anonyms* (1890); F. Marchmont, *A Concise Handbook of Literature issued under Pseudonyms or Initials* (1896); see also especially W. P. Courtney, *The Secrets of our National Literature* (1908), the first chapter of which contains a sketch of the history of the subject, to which the above account is mainly due. The anonymous and pseudonymous Latin literature of the middle ages has been treated in modern times by A. Franklin, *Dictionnaire des noms, &c., latins 1100–1530* (1875), and A. G. Little, *Initia operum latinorum saec. 13–15* (1904).

PSEUDO-PERIPTERAL (Gr. ψευδής, false, περί, round, πτερόν, a wing), a term in architecture given to a temple in which the columns surrounding the naos have had walls built between them, so that they become engaged columns, as in the great temple at Agrigentum. In Roman temples, in order to increase the size of the cella, the columns on either side and at the rear became engaged columns, the portico only having isolated columns. (See TEMPLE.)

PSEUDOPOD, PSEUDOPODIUM, the name given to an extension of the naked protoplasm of certain Protozoa, notably the Sarcodina (*q.v.*), for crawling or creeping or for the prehension of food, but not for active swimming (see also AMOEBA).

PSILOMELANE, a mineral consisting of hydrous manganese oxide with variable amounts of barium, potassium, &c. It is sometimes considered to be a hydrous manganese manganate, but of doubtful composition. The amount of manganese present corresponds to 70–80% of manganous oxide with 10–15% of "available" oxygen. The mineral is amorphous and occurs as botryoidal and stalactitic masses with a smooth shining surface and submetallic lustre. The name has reference to this characteristic appearance, being from the Greek ψιλός (naked, smooth) and μέλας (black); a Latinized form is calvonigrite, and a German name with the same meaning is *Schwarzer Glaskopf*. Psilomelane is readily distinguished from other hydrous manganese oxides (manganite and wad) by its greater hardness (H. = $5\frac{1}{2}$); the sp. gr. varies from 3·7 to 4·7. The streak is brownish-black and the fracture smooth. Owing to its amorphous nature, the mineral often contains admixed impurities, such as iron hydrates. It is soluble in hydrochloric acid with evolution of chlorine. It is a common and important ore of manganese, occurring under the same conditions and having the same commercial applications as pyrolusite (*q.v.*). It is found at many localities; amongst those which have yielded typical botryoidal specimens may be mentioned the Restormel iron mine at Lostwithiel in Cornwall, Brendon Hill in Somerset, Hoy in the Orkneys, Sayn near Coblenz, and Crimora in Augusta county, Virginia. With pyrolusite it is extensively mined in Vermont, Virginia, Arkansas and Nova Scotia.

PSKOV, a government of the lake-region of north-west Russia, which extends from Lake Peipus to the source of the west Dvina, having the governments of St Petersburg and Novgorod on the N., Tver and Smolensk on the E., Vitebsk on the S. and Livonia on the W. It has an area of 17,064 sq. m. In the south-east it extends partly over the Alaun or Vorobiovy heights, which stretch west into Vitebsk and send to the north a series of irregular ranges which occupy the north-western parts of Pskov. A depression 120 m. long and 35 m. broad, drained by the Lovat and the Polista, occupies the interval between these two hilly tracts; it is covered with forests and marshes, the only tracts suitable for human occupation being narrow strips of land along the banks of the rivers, or between the marshes, and no communication is possible except along the watercourses.

With the exception of the south-eastern corner, where Carboniferous rocks crop out, nearly the whole of the government consists of Devonian strata of great thickness, with deposits of gypsum and white sandstone, the latter extensively quarried for building purposes. The bottom moraine of the Scandinavian and Finnish ice-sheet formerly extended over the whole of this region, and has left behind it numerous ridges (*kames* or *eskers*), the upper parts consisting of Glacial sands and post-Glacial clays, sands and peat-bogs. The soil is thus not only infertile, but also badly drained, and only those parts of the territory which are covered with thicker strata of post-Glacial deposits are suitable for agriculture.

The rivers are numerous and belong to three separate basins—to Lakes Peipus and Pskov the rivers in the north-west, to Lake Ilmen those in the middle, and to that of the Dvina the rivers in the south-east. A great number of small streams pour into Lake Pskov, the chief being the Velikaya. The Lovat and the Shelon, belonging to the basin of Lake Ilmen, are both navigable; while the west Dvina flows for 100 m. on the south border of the government or within it, and is used only for floating timber. There are no fewer than 850 lakes in Pskov, with a total area of 391 sq. m. The largest is Lake Pskov, which is 50 m. long and 13 broad, covers 300 sq. m. and has a depth of 3 to 18 ft.; it is connected by a channel, 40 m. long and 3 to 10 wide, with Lake Peipus. The marshes on the banks of the Polista are nearly 1250 sq. m. in extent. Forests occupy nearly one-third (32%) of the entire area, and in some districts (Kholm, Toropets, Porkhov) as much as two-thirds of the surface. Large pine forests are met with in the north; in other parts the birch and the aspen prevail; but almost one-quarter of the forest area is overgrown with brushwood.

The climate is very moist and changeable. The average temperature is 41° F. (17·1° in January and 64·8° in July).

The population of the government numbered 1,135,639 in 1897, when there were 584,931 women, and the urban population only 72,623. The estimated population in 1906 was 1,275,300 With the exception of 25,460 Esthonians (1897), the inhabitants are almost entirely Great Russians. They belong mainly to the Orthodox Greek Church, but the official number of Nonconformists, 32,066, is far below the mark. There are also about 12,000 Lutherans and 4000 Roman Catholics. The government is divided into eight districts, the chief towns of which, with their populations in 1897, are Pskov (*q.v.*), Kholm (5899), Novorzhev (2973), Opochka (5658), Ostrov (6252), Porkhov (5573), Toropets (7489) and Velikiye Luki (8481). Between 1875 and 1896 the peasantry increased their landed possessions by 91%, and the merchants bought considerable areas from the nobles, who altogether sold 43% of their estates. Although the soil is far from fertile, no less than 30% of the total area is under crops and 12% under meadows. The crops principally cultivated are rye, oats, barley, pease, potatoes, flax (for which the government is famous) and hemp. Grain has to be imported, but oats are exported. Owing to the efforts of the *zemstvos*, there has been a notable improvement in agriculture, especially in dairy-farming. Fishing in Lake Pskov and the smaller lakes is a source of income. The manufacture of wooden wares for local needs, ship-building, the timber trade, and the weaving of linen and woollens for local requirements are additional sources of income. Flax, flour, tobacco factories, saw-mills, distilleries and breweries are the principal industrial establishments. The population engage also in the preparation of lime, in stone-quarrying, and in the transport of merchandise. (P. A. K.; J. T. BE.)

PSKOV, in German, *Pleskau*, a town of Russia, capital of the government of the same name and an archiepiscopal see of the Orthodox Greek Church, situated on both banks of the Velikaya River, 9 m. S.E. from Lake Pskov and 170 m. by rail S.W. of St Petersburg. Pop. (1897), 30,424. The chief part of the town, with its kremlin on a hill, occupies the right bank of the river, to which the ruins of its old walls (built in 1266) descend; the Zapskovye stretches along the same bank of the Velikaya below its confluence with the Pskova; and the Zavelichye occupies the left bank of the Velikaya—all three keeping their old historical names. The cathedral in the kremlin has been four times rebuilt since the 12th century, the present edifice dating from 1691–1699, and contains some very old shrines, as also the graves of the bishops of Pskov and of several Pskov princes, including those of Dovmont (d. 1299), and Vsevolod (d. 1138). The church of Dmitriy Solunskiy dates originally from the 12th century; there are others belonging to the 14th and 15th. The Spaso-Mirozhskiy monastery, founded in 1156, and restored in 1890–1903, has many remarkable antiquities. The ruins of numerous rich and populous monasteries in or near the town attest its former wealth and greatness. The present town is ill-built, chiefly of wood, and shows traces of decay. It has a cadets' school, a normal school for teachers, and a few lower technical schools, an archaeological museum (1903) and some scientific societies. The private collections (coins, antiquities, art works, &c.) of Messrs Pushkin and Sudhov are two of the most remarkable in Russia. The manufactures are unimportant. Since the completion of the St Petersburg and Warsaw railway the trade of Pskov has increased. Pskov has regular steam communication with Dorpat.

History.—Pskov, formerly the sister republic of Novgorod, and one of the oldest cities of Russia, maintained its independence and its free institutions until the 16th century, being thus the last to be brought under the rule of Moscow. It already existed in the time of Rurik (9th century); and Nestor mentions under the year 914 that Olga, wife of Igor, prince of Novgorod, was brought from Pleskov (*i.e.* Pskov). The Velikaya valley and river were from a remote antiquity a channel for the trade of the south of Europe with the Baltic coast. Pskov being an important strategic point, its possession was obstinately disputed between the Russians and the Germans and Lithuanians throughout the 11th and 12th centuries. At that time the place had its own independent institutions; but it became in the 12th century a *prigorod* of the Novgorod republic—that is a city having its own free institutions, but included in certain respects within the jurisdiction of the metropolis, and compelled in time of war to march against the common enemy. Pskov had, however, its own prince (*defensor municipii*); and in the second half of the 13th century Prince (Timotheus) Dovmont fortified it so strongly that the town asserted its independence of Novgorod, with which, in 1348, it concluded a treaty wherein the two republics were recognized as equals. Its rule extended over the territory which now forms the districts of Pskov, Ostrov, Opochka, and Gdov (farther north on the east side of Lake Peipus). The *vyeche* or council of Pskov was sovereign, the councils of the subordinate towns being supreme in their own municipal affairs. The council was supreme in all affairs of general interest, as well as a supreme court of justice, and the princes were elected by it; these last had to defend the city and levied the taxes, which were assessed by twelve citizens. But while Novgorod constantly showed a tendency to become an oligarchy of the wealthier merchants, Pskov figured as a republic in which the influence of the poorer classes prevailed. Its trading associations, supported by those of the working classes, checked the influence of the wealthier merchants.

This struggle continued throughout the 14th and 15th centuries. Nothwithstanding these conflicts Pskov was a very wealthy city. Its strong walls, its forty large and wealthy churches, built during this period, its numerous monasteries, and its extensive trade, bear testimony to the wealth of the inhabitants, who then numbered about 60,000. As early as the 13th century Pskov was an important station for the trade between Novgorod and Riga. A century later it became a member of the Hanseatic League. Its merchants and trading associations had factories at Narva, Reval and Riga, and exported flax, corn, tallow, skins, tar, pitch, honey, and timber for ship-building. Silks, woollen stuffs, and all kinds of manufactured wares were brought back in exchange. In 1399 the prince of Moscow claimed the privilege of confirming the elected prince of Pskov in his rights; and though, fifty years later, Pskov and Novgorod concluded defensive treaties against Moscow, the poorer classes continued to seek at Moscow a protection against the richer citizens. After the fall of Novgorod (1475) Pskov was taken (1510) by Basil Ivanovich, prince of Moscow, and a *voyvode* or deputy was nominated to govern the city. Moscow, at the end of the 17th century, abolished the last vestiges of self-government at Pskov, which thenceforward fell into rapid decay. Near this city the Teutonic knights inflicted a severe defeat upon the Russians in 1502. Pskov became a stronghold of Russia against Poland, and was besieged (1581) for seven months by Stephen Bathory during the Livonian War, and in 1615 by Gustavus Adolphus of Sweden. Under Peter the Great it became a fortified camp.

(P. A. K.; J. T. Be.)

PSORIASIS, a skin affection characterized by the occurrence of flat dry patches of varying size covered with silvery white scales. Next to eczema and ringworm it is one of the most commonly found skin diseases. It occurs frequently during infancy and early adult life, and rarely begins after the age of fifty. Though a parasitic origin has been suggested, no bacteriological factor has yet been found, and it has been demonstrated that psoriasis may follow on nervous shock, gout, mental emotion and insufficient nourishment. It may also follow an attack of scarlet fever or erysipelas. The site of the disease may be determined by an abrasion or other injury of the skin, or even an irritation caused by friction of the clothing. The favourite starting point of the lesion is either the elbows or the fronts of the knees. It is nearly always symmetrical in its distribution, and spreads over the trunk and the extensor surfaces of the limbs, in contrast to eczema, which selects the flexor surfaces. The hairy scalp may also be affected. The eruption generally first shows itself as one or more papules, at first red and spreading, and later white from the formation of scales and red at the spreading margin, where it is surrounded by a hyperaemic zone. On removing the scales is seen a smooth hyperaemic zone dotted with red spots. The patches spread centrifugally and may remain stationary for a long time or coalesce with other patches and cover large areas of skin. In some cases involution of the central portion accompanies the spreading of the patch, and large concentric rings are formed. The lesions may persist for years, or spontaneously disappear, leaving behind a slight brown stain. The symptoms are usually slight and there is little or no irritation or itching, and no pain except in a form which is associated with osteo-arthritis. The disease, though of noted chronicity, is subject to sudden exacerbations, and may reappear at intervals after it has completely disappeared. It has little or no effect upon the general health. Several forms have been described, viz. the simple uncomplicated, the nervous, the osteo-arthritic, and the seborrhoeic. Varieties have also been named according to the character of the patches, such as psoriasis punctata, guttata, circinata or nummularis, or when large areas are involved and the skin is harsh, dry and cracked, it is known as psoriasis inveterata. The pathological changes taking place in the skin have been described as an inflammation of the papillae and corium, with a down-growth of the stratum mucosum between the papillae and an increase of the horny layer (keratosis). This latter, however, has been said to be due to the formation in it of tiny dry abscesses. The silvery appearance of the scales is due to the inclusion of air globules within them. The treatment is hygienic, constitutional and local. The clothing must be regulated so as to prevent undue perspiration or irritation or chafing of the skin. The most effective local application is chrysarobin used as an ointment. A bath of hot water and soap should first be given, or an alkaline bath, in order to remove all the scales; the ointment is then applied, but must be used over a small area at a time, as it is apt to set up dermatitis. Tarry applications, such as unguentum picis liquidae, creosote ointment or liquor carbonis detergens, are also useful; and radio-therapy has caused a rapid removal of the lesions, but neither it nor the ointment has prevented subsequent recurrence. In chronic cases the sulphur-water baths of Harrogate, Aix-les-Bains and Aachen have been successful. The internal administration of small doses of vinum antimoniale, in acute cases, or of arsenic (in gradually increasing doses of the liquor arsenicalis) in chronic cases, is undoubtedly beneficial.

PSOROSPERMIASIS, the medical term for a disease caused by the animal parasites known as psorosperms or gregarinidae, found in the liver, kidneys and ureters.

PSYCHE (ψυχή), in Greek mythology, the personification of the human soul. The story of the love of Eros (Cupid) for Psyche is a philosophical allegory, founded upon the Platonic conception of the soul. In this connexion Psyche was represented in Greek and Graeco-Roman art as a tender maiden, with bird's or butterfly's wings, or simply as a butterfly. Sometimes she is pursued and tormented by Eros, sometimes she revenges herself upon him, sometimes she embraces him in fondest affection. The tale of Cupid and Psyche, in the *Metamorphoses* of Apuleius, has nothing in common with this conception but the name. In it Psyche, the youngest daughter of a king, arouses the jealousy of Venus, who orders Cupid to inspire her with love for the most despicable of men. Cupid, however, falls in love with her himself, and carries her off to a secluded spot, where he visits her by night, unseen and unrecognized by her. Persuaded by her sisters that her companion is a hideous monster, and forgetful of his warning, she lights a lamp to look upon him while he is asleep; in her ecstasy at his beauty she lets fall a drop of burning oil upon the face of Cupid, who awakes and disappears. Wandering over the earth in search of him, Psyche falls into the hands of Venus, who forces her to undertake the most difficult tasks. The last and most dangerous of these is to fetch from the world below the box containing the ointment of beauty. She secures the box, but on her way back opens it and is stupefied by the vapour. She is only restored to her senses by contact with the arrow of Cupid, at whose entreaty Jupiter makes her immortal and bestows her in marriage upon her lover. The meaning of the allegory is obvious. Psyche, as the personification of the soul, is only permitted to enjoy her happiness so long as she abstains from ill-advised curiosity. The desire to pry into its nature brings suffering upon her; but in the end, purified by what she has undergone, she is restored to her former condition of bliss by the mighty power of love.

On this story see L. Friedländer, " Ueber das Märchen von Amor und Psyche " (in *Darstellungen aus der Sittengeschichte Roms*, 1888, vol. i.; for a treatment of the Greek conception, see E. Rohde, *Psyche*, 1894). For Psyche in art see A. Conze, *De Psyches imaginibus quibusdam* (1855); Max Collignon, *Essai sur les monuments grecs et romains relatifs au mythe de Psyché* (1877).

PSYCHICAL RESEARCH, a term which may be defined, partially, as an examination into the amount of truth contained in world-wide superstitions. Thus when Saul disguised himself before his séance with the witch of Endor, and when Croesus scientifically tested the oracles of Greece (finding clairvoyance or *lucidité* in the Delphic Pythoness), Saul and Croesus were psychical researchers. A more systematic student was the Neoplatonist philosopher Porphyry. In his letter to Anebo, answered in *Περὶ μυστηρίων* by Iamblichus (?) we find Porphyry concerned with the usual alleged phenomena—prophecy; the power of walking through fire unharmed; the movements of inanimate objects, untouched; the "levitation" of "mediums"; apparitions of spirits, their replies to questions, the falsehood of those replies; and so forth. Similar phenomena fill the lives of the saints and the records of witch trials. Apparitions, especially of the dying or the dead; the stereotyped disturbances in haunted houses; and the miraculous healing of diseases, are current in classical and medieval records. The exhibition of remote or even future events, to gazers in mirrors, crystals, vessels full of water, or drops of ink or blood, is equally notorious in classical, Oriental, medieval and modern literature; while the whole range of these phenomena is found in Chinese, Japanese, Hindu, ancient American, Red Indian and savage belief.

At various periods, and in proportion to the scientific methods of the ages, attempts have been made to examine these things scientifically. St Augustine wrote on the whole topic with remarkable acuteness and considerable scepticism; his treatment of miracles of healing is especially noteworthy. After Petrus Thyraeus (1546–1601), S. J. Wierus, Ludwig Lavater (1527–1586), and other authors of the 16th century, came the labours of Glanvill, Henry More, Richard Baxter, Boyle, Cotton Mather, and others in England and America, during and after the Restoration. Attempts were made to get first-hand evidences and Glanvill investigated the knocking drummer of Tedworth *in situ* (1663). The disturbances in the house of the Wesleys at Epworth (1716 and later) were famous, and have copious contemporary record. David Hume believed himself to have settled questions which, when revived by the case of Swedenborg and the experiments of Mesmer and his pupils, puzzled and interested Kant. The influence of Mesmer has never died out; the fact of " animal magnetism " (with such examples as the " divining rod," and the phenomena in general) was accepted in his manner, and explained, by Hegel. The researches of Braid (*c.* 1840–1850) gave a new name, " hypnotism," to what had been called " mesmerism " or " animal magnetism "; a name conveying no theory of " magnetic " or other " fluids." " Mesmerism " implies a theory of " emanations " from the operator to the patient; "hypnotism" implies no such hypothesis. In the middle of the 19th century Dr Gregory and Dr Mayo published their entertaining but unsystematic works, *Animal Magnetism* and *The Truths in Popular Superstitions* respectively. Esdaile and Elliotson were practical pioneers in the medical use of induced sleep or somnambulism. For their ideas and experiments *The Zoist* may be consulted. The epidemic of " spiritualism " and of " turning tables " then invaded Europe from America, and was discussed by Dr Carpenter, Faraday, Gasparin, De Morgan and many others. The adventures of Daniel Dunglas Home excited all Europe, and his effects were studied by Sir William Crookes with especial attention. Home disappeared after a lawsuit; his successes remain an unsolved enigma. Believers explained them by the agency of the spirits of the dead, the old savage theory. He had many followers, most of whom, if not all, were detected in vulgar impostures. Of the books of this period those of Mr Richard Dale Owen (1810–1890) are the most curious, but exact method was still to seek.

In 1882 the Society for Psychical Research, under the presidency of Henry Sidgwick, professor of moral philosophy in the university of Cambridge, was founded expressly for the purpose of introducing scientific method into the study of the " debateable phenomena." Other early members were Edmund Gurney, F. W. H. Myers, Andrew Lang, Professor Barrett, Mrs Sidgwick, F. Podmore, Lord Tennyson, Lord Rayleigh and Professor Adams; while among presidents were Professor Balfour Stewart, A. J. Balfour, Professor William James of Harvard and Sir William Crookes. The society has published many volumes of *Proceedings*. In France and in Germany and Italy many men of distinguished scientific position have examined the Italian " medium " Eusapia Palladino, and have contributed experiments, chiefly in the field of hypnotism and " telepathy." Hypnotism has been introduced into official experimental psychology and medicine with some success.

It is plain that the range of psychical research is almost unlimited. It impinges on anthropology (with its study of the savage theory of spirits—animism—and of diabolical possession), and on the usual province of psychology, in the problems of the hallucinations both of morbid patients and of people in normal mental health. The whole topic of the unconscious or subconscious self is made matter not of mere metaphysical speculation (as by Kant and Hamilton), but of exact observation, and, by aid of hypnotism and automatism, of direct experiment. The six original committees of the society undertook the following themes:—

1. An examination of the nature and extent of any influence which may be exerted by one mind upon another, apart from any generally recognized mode of perception.
2. The study of hypnotism and the forms of so-called mesmeric trance, clairvoyance and other allied phenomena.
3. A critical revision of Reichenbach's researches into certain organizations called " sensitive."
4. A careful investigation of any reports, resting on strong testimony, regarding apparitions at the moment of death or otherwise, or regarding disturbances in houses reputed to be haunted.
5. An inquiry into the various physical phenomena commonly called spiritualistic, with an attempt to discover their causes and general laws.
6. The collection and collation of existing materials bearing on the history of these subjects.

To these themes we might now add the study of "crystal-gazing," and of the hallucinatory visions which a fair percentage of people observe when staring into any clear deep, usually a glass ball; but ink (with some experimenters) does as well, or a glass water-jug. Of these themes, the third has practically led to nothing. The experiments of Reichenbach on the perception of flames issuing from magnets have not been verified. The collection of historical examples, again (6), has not been much pursued by the society, except in Mr Gurney's studies of witchcraft in *Phantasms of the Living*, by himself, Mr Podmore and Mr Myers. On the other hand, a vast number of experiments were made in " thought transference." (1) Diagrams drawn by A were reproduced by B; cards thought of, numbers and so forth were also reproduced in conditions that appeared to make the normal transference of the idea by sound, sight or touch impossible, and to put chance coincidence out of court. In one or two instances collusion was detected ingeniously. In others two explanatory theories have been broached. People may accidentally coincide in their choice of diagrams, or the "unconscious whispering" of a person fixing his mind hard on a number, card or what not may be heard or seen. But coincidence in diagrams does not apply when a ship, dumb-bells, a candlestick or a cat is drawn by both experimenters; nor can "unconscious whispering" be heard or seen when the experimenters are in different rooms. On the whole, the inquirers convinced themselves that one mind or brain may influence another mind or brain through no recognized channel of sense. This is, of course, an old idea (see Walton's *Life of Donne*, and his theory of the appearance of Mrs Donne, with a dead baby, to Dr Donne in Paris). The method of communication remains a problem. Are there "brain waves," analogous to the X-rays, from brain to recipient brain, or does mind touch mind in some unheard-of way? The former appears to be the hypothesis preferred by Sir William Crookes and Professor Flournoy (*Des Indes à la planète Mars*, pp. 363–365). On this showing there is nothing "supranormal" in "telepathy," as it is called. The latter theory of "a purely spiritual communication" is argued for by Mr Myers (*Proceedings of the Society for Psychical Research*, xv. 407–410). If we accept telepathy as experimentally demonstrated, and regard it as a *physical* process, we reduce (4), "apparitions at the moment of death or otherwise," to a normal though not very usual fact. Everyone would admit this in the case of mere empty hallucinations. A, in Paisley, sees P, in London, present in his room. P is neither dying nor in any other crisis, and A is, as both continue to be, in his normal health. Such experiences are by no means very uncommon, when there is nothing to suggest that P has exercised any telepathic influence on A. On the other hand, in *Phantasms of the Living*, and in the report on the Census of Hallucinations (*Proceedings*, vol. x.), the society has published large numbers of "coincidental" hallucinations, the appearance of P to A coinciding with the death or other crisis of the distant P. That such "wraiths" do occur is the popular and savage belief. But, it may be urged, many hallucinations occur and many deaths. People only remember the hallucinations which happened, or were made by erroneous reckoning to seem to happen, coincidentally with the decease of the person seen. This is not quite true, for a hallucination so vivid as to be taken for a real person and addressed as such is not easily forgotten by a sober citizen, even if "nothing happened" afterwards. None the less, the coincidental hallucinations have certainly a better chance of being remembered, while fancy is apt to exaggerate the closeness of the coincidence. Nothing can demonstrate that coincidences between death and hallucination occur more frequently than by the doctrine of chance they ought to do, except a census of the whole population. In the present indifference of government to psychical science no party is likely to institute such a census, and even if it were done, the frivolity of mankind would throw doubt on the statistics. It would be necessary to cross-examine each "percipient," and to ask for documentary or other corroborative evidence in each case.

The Society for Psychical Research collected statistics in proportion to its resources. More than 17,000 answers were received to questions rather widely circulated. The affirmative respondents were examined closely, their mental and physical health and circumstances inquired into, and collectors of evidence were especially enjoined to avoid selecting persons known to be likely to return affirmative replies. There were 80 cases at first hand in which the death of the person seen coincided, within twelve hours, with the visual hallucination of his or her presence, out of 352 instances of such hallucinations. By way of arriving at the true proportions, the hallucinations which coincided with nothing were multiplied by four. In this way allowance was made for obliviousness of non-coincidental hallucinations. The verdict of the committee was that, on the evidence before them, hallucinations coincided with deaths in a ratio of 440 times more than was to be expected by the law of probabilities. The committee came to the conclusion that a relation of cause and effect does exist between the death of A and the vision of A beheld by P. The hallucination is apparently caused from without by some unexplained action of the mind or brain of A on the brain or mind of P. This effect is also traced, where death does not occur, for example, in the many instances of false "arrivals." A is on his way to X, or is dreaming that he is on his way, and is seen at X by P, or by P, Q and R, as may happen. These cases are common, and were explained in Celtic philosophy by the theory of the "Co-Walker," a kind of "astral body." The facts are accounted for in the same way by Scandinavian popular philosophy. Possibly in many instances such hallucinations are the result of expectancy in the beholder. Yet if we go out to shoot or fish, excepting to encounter grouse or salmon, we do not usually see grouse or salmon if they are not there! Where the arrival is not expected, this explanation fails. In "second sight," even among savages, these occurrences are not infrequent, and doubtless admit of an explanation by telepathy. In two instances, known at first hand to the present writer, persons dreamed, at a distance, that they entered their own homes. In one the person was seen, in the other distinctly heard, by the inmates of his or her house. In several of these examples knocks are heard, as in spiritualist séances. In fact, if we accept the evidence, living but remote persons may, unconsciously, produce effects of sounds and of phantasms exactly like those which popular belief ascribes to the spirits of the dead.

If we admit the evidence, of which a great body exists, and if we attribute the phenomena to telepathy, curious inferences may be drawn. Thus if the phenomena are such as only the spirits of the dead could be credited with producing—if the dead were frequently recognized by various good witnesses—it would follow (on the hypothesis of telepathy) that telepathy is not a *physical* process caused by material waves or rays from living brain to brain, the dead having no brains in working order. On the other hand, if living brains may thus affect each other, a subjective hallucination experienced by the living A may conceivably be "wired on" to the living P. Thus A, in a given house, may have a mere subjective hallucination of the presence of the dead B, and may, unconsciously, infect with that hallucination other persons who come to the house. Thus once admit that any living brain may infect any other, and it becomes practically impossible for a spirit of the dead to prove his identity. Any information which he may give in any way must either be known to living people, however remote, or unknown. If known to a living person, he may, unconsciously, "wire it on" to the seer. If wholly unknown to everybody, the veracity of the information cannot be demonstrated, except later, if it refers to the unknown future. Thus the theory of telepathy, with a little good will, puts the existence and activity of the souls of the dead beyond possibility of proof.

These remarks apply to the researches of the society into alleged isolated phantasms of the dead, and into "haunted houses." As to the former cases, it is admitted on all hands that sane and sober people may have subjective hallucinations of the presence of living friends, not dying or in any other crisis. Obviously then, the appearance of a dead person may equally be an empty hallucination. Thus, a member of the House of Commons, standing at the entrance of a certain committee-room, saw another member, of peculiar aspect and gait, pass him and enter the room, his favourite haunt. Several hours passed before the percipient suddenly recollected that the other member had been dead for some months. Even superstition cannot argue that this appearance was a ghost. In the same way Hawthorne, the celebrated novelist, frequently, he has written, saw a dead club-man in his club. But suppose, for the sake of argument, that at intervals members of the house kept seeing such appearances of dead members of parliament, and suppose that they had never seen the prototypes in their lifetime, but yet correctly described them: then it might be said that their hallucinations had merely been "wired on" from the brain of some living member of parliament who knew the deceased.

Thus telepathy cuts two ways. It is, if accepted, a singular discovery, but it throws an enormous burden of proof on a "ghost" who wants to establish his identity. In the same way telepathy cuts at the root of "clairvoyance," or lucid view of events remote in space or distant in time. The vision may have been "wired on" telepathically by a living person who knew the remote event. The "supranormal" can only be proved if the information conveyed by the hallucination is verified in the future, or is proved by the finding of documents not known to exist at the time of the hallucination, but afterwards discovered. A curious possible instance was the discovery in 1856 of a MS. inventory of the jewels of Mary Stuart (1566), verifying in some degree a clairvoyant vision about the jewels published some years earlier (see "Queen Mary's Jewels" in the writer's *Book of Dreams and Ghosts*). For the same reasons the information nominally given by "spirits" of the dead through the mouth or by the automatic writing of Mrs Piper (Boston, U.S.) and other mediums may be explained by telepathy from the living who know the facts. This theory was rejected, for example, in the case of Mrs Piper, by Myers and Dr Richard Hodgson, who devoted much time to the examination of the lady (see *Proceedings*, vols. vi., viii., xiii., xiv., with criticisms by Mrs Sidgwick and the present writer in vol. xv. pt. xxxvi). In the late Dr Hodgson's opinion, the dead do communicate through the automatic writing or speaking of Mrs Piper. The published evidence (much is unpublished) does not seem to justify the conclusion, which is not accepted by Mrs Piper herself! Dr J. H. Hyslop has published enormous and minute reports on Mrs Piper, convincing to himself but not to most readers.

This leads us to the chief field of research in "automatisms," or actions of the subconscious or "subliminal" self. The prototype of such things is found in the performances of natural somnambulists, who in all ages have seemed to exhibit faculties beyond their power when in a normal condition. The experiments of Mesmer, and of those who followed in his track, down to the psychologists of to-day, proved (what had long been known to savages and conjurers) that a state of somnambulism could be induced from without. Moreover, it is proved that certain persons can, as it were, hypnotize themselves, even unwittingly, and pass into trance. In these *secondary* conditions of trance, such persons are not only amenable to "suggestion," but occasionally evolve what are called secondary personalities: they speak in voices not their own, and exhibit traits of character not theirs, but in harmony with the impersonation. The popular, savage and ancient theory of these phenomena was that the people thus affected were inspired by a god or spirit, or "possessed" by a demon or a dead man. Science now regards the gods or demons or spirits as mere exhibitions of the secondary personality, which wakens when the normal personality slumbers. The knowledge and faculties of the secondary personality, far exceeding those exhibited in the normal state, are explained to a great extent by the patient's command, when in the secondary state, of resources latent in the memory. The same explanation is offered for other phenomena, like those of automatic writing, knocking out answers by tilting tables, or discovering objects by aid of the "divining rod." The muscular actions that tilt the table, or wag the rod, or direct the pencil or planchette, are unconsciously made, and reveal the latent stores of subconscious knowledge, so that a man writes or knocks out information which he possessed, but did not suspect himself of possessing. These processes were familiar to the Neoplatonists, and in one form or other are practised by Chinese, Tibetans, Negroes, Malayans and Melanesians. A similar kind of automatism is revealed in the inspirations of genius, which often astonish the author or artist himself. An interesting example has been studied by Myers in the feats of arithmetic recorded about "calculating boys," who are usually unconscious of their methods. The whole of this vast field of the unconscious, or subconscious, or subliminal self has been especially examined by Myers, and by such psychologists as Ribot, Janet, Richet, Flournoy and many others.

The general result is a normal explanation, not yet complete, of the phenomena hitherto attributed to witchcraft, inspiration, possession, and so forth. Probably the devils, saints, angels and spirits who have communicated with witches, living saints, demoniacs and visionaries are mere hallucinatory reflections from the subconscious self, endowed with its store of latent memories and strangely acute percipient faculties. Thus a curious chapter of human history is at last within possible reach of explanation. Men regard phenomena as "supranormal" or "supernatural," or reject them altogether, till their *modus* is explained. But it would not be candid to say that the explanation is complete, or nearly complete. The nature of the hypnotic trance itself remains a matter of dispute. The knowledge automatically revealed can by no means always be accounted for, either by latent memory or by the sharpening of the normal faculties of perception, while the limits of telepathy (if it be accepted) are vaguely conjectured. Even the results of simple experiments in "crystal-gazing" are often very perplexing. Further experiment may reveal some normal explanation, while scepticism (which seldom takes the trouble to examine the alleged facts with any care) can always repose on a theory of malobservation and imposture. These, of course, are *verae causae*, while in this, as in all provinces of human evidence, bad memories and unconscious errors distort the testimony. Psychical research encourages, or ought to encourage, the cool impartiality in examining, collecting and recording facts, which is usually absent, in greater or less degree, from the work even of eminent historians. Men of equal honesty and acuteness may believe or disbelieve in the innocence of Mary Queen of Scots, or in the "spirits" which control Mrs Piper. As to alleged "physical phenomena" of unknown cause, one, the power of passing without lesion with naked feet over fire, has recently been attested by numerous competent observers and experimenters in the ritual of Fijians and other South Sea Islanders, Japanese, Bulgarians, natives of southern India and other races. (The evidence has been collected by the present writer in *Proceedings S.P.R.* vol. xv. pt. xxxvi. pp. 2–15. Compare a case examined and explained more or less by S. P. Langley, *Nature*, August 22, 1901.) The much more famous tales of movements of objects untouched have been carefully examined, and perhaps in no instance have professional performers proved innocent of fraud. Yet the best known living medium, Eusapia Palladino, though exposed at Cambridge, has been rehabilitated, after later experiments, in the opinion of many distinguished Continental observers, who entirely disbelieve in the old theory, the action of "spirits," and venture no other hypothesis.

The results of psychical research, after several years of work, are not really less than could be expected from toil in a field so difficult. The theory of alternating, or secondary, personalities is the key, as we have said, to a strange chapter in "the history of human error." The provisional hypothesis of telepathy puts a meaning into the innumerable tales of "wraiths" and of "second sight." It is never waste of time to investigate the area of human faculty; and practical results, in the medical treatment of abnormal intellectual conditions, have already been obtained. The conduct of our witch-burning ancestors now becomes intelligible, a step on the way to being pardonable. With their methods and inherited prejudices they could scarcely have reasoned otherwise than they did in certain cases of hysteria and autohypnotization. Many "miracles" of healing and of "stigmatization" become credible when verified in modern experience and explained by "suggestion"; though to "explain the explanation" is a task for the future. Such as it is, the theory was accepted by St Francis de Sales in the case of St Theresa. Results of wider range and of more momentous interest may yet be obtained. The science of electrical phenomena was not developed in a quarter of a century, and it would be premature to ask more from psychical research than it has achieved in a short period. The subject is not readily capable of exact experiment, human faculty being, as it were, capricious, when compared with ordinary physical processes. Imposture, conscious or unconscious, is also an element of difficulty. But already phenomena which are copiously reported throughout the whole course of history have been proved to possess an actual basis in fact, have been classified, and to some extent have been explained. Even if no light is ever to be cast on spiritual problems, at least the field of psychology has been extended.

The literature of psychical research is already considerable, and a complete bibliography would occupy much space. Readers who care to pursue the study will find their best guide in the *Proceedings of the Society for Psychical Research*, which contains a catalogue of the society's collection, including the Gurney Library (hypnotism), with reviews of modern books in many languages—French, German, Italian, Russian—as they appear. Among modern English books may be recommended *Phantasms of the Living*, by Gurney, Podmore and Myers; *Studies in Psychical Research*, by Podmore, with his *Apparitions and Thought-Transference*; and *Principles of Psychology*, by Professor William James, of Harvard. The historical side of the subject, especially as regards the beliefs of savages and of classical antiquity, may be studied in E. B. Tylor's *Primitive Culture* (under "Animism"), in Myers's *Classical Essays* (under "Greek Oracles"), and A. Lang's *Cock Lane and Common Sense*, and *Making of Religion*. Myers's work, *Human Personality*, contains vast collections of facts, with a provisional theory. Myers's regretted death prevented him from finally revising his book, which contains certain inconsistencies. It is plain that he tended more and more to the belief in the "invasion" and "possession" of living human organisms by spirits of the dead. The same tendency marks an article on "Psychical Research," by Sir Oliver Lodge, in *Harper's Magazine* (August 1908). Other students can find, in the evidence cited, no warrant for this return to the "palaeolithic psychology" of "invasion" and "possession." Th. Flournoy's *Des Indes à la planète Mars* is a penetrating study of pseudo-spiritual "messages." A criticism making against the notion of telepathy may be found in Herr Parish's *Hallucinations and Illusions* (Eng. trans.). Some errors and confusions in this work (due in part to the expansion of the original text) are noted in A. Lang's *Making of Religion*, appendix A. Such topics as TELEPATHY, CRYSTAL-GAZING, HYPNOTISM, SECOND SIGHT, the POLTERGEIST, &c., are dealt with under separate articles in this work. (A. L.)

PSYCHOLOGY (ψυχή, the mind or soul, and λόγος, theory), the science of mind, which can only be more strictly defined by an analysis of what "mind" means.

The Science of "Mind."

1. In the several natural sciences the scope and subject-matter of each are so evident that little preliminary discussion is called for. But with psychology, however much it is freed from metaphysics, this is different. It is indeed ordinarily assumed that its subject-matter can be at once defined. "It is what you can perceive by consciousness or reflection or the internal sense," says one, "just as the subject-matter of optics is what you can perceive by sight." Or, "psychology is the science of the phenomena of mind," we are told again, "and is thus marked off from the physical sciences, which treat only of the phenomena of matter." But, whereas nothing is simpler than to distinguish between seeing and hearing, or between the phenomena of heat and the phenomena of gravitation, a very little reflection may convince us that we cannot in the same fashion distinguish internal from external sense, or make clear to ourselves what we mean by phenomena of mind as distinct from phenomena of matter.

Internal and External.

To every sense there corresponds a sense-organ; the several senses are distinct and independent, so that no one sense can add to or alter the materials of another: the possession of five senses, *e.g.* furnishing no data as to the character of a possible sixth. Moreover, sense-impressions are passively received and occur in the first instance without regard to the feeling or volition of the recipient and without any manner of relation to the "contents of consciousness" at the moment. Now such a description will apply but very partially to the so-called "internal sense." For we do not by means of it passively receive impressions differing from all previous presentations, as the sensations of colour for one "couched" differ from all he has experienced before: the new facts consist rather in the recognition of certain relations among pre-existing presentations, *i.e.* are due to our mental activity and not to a special mode of what has been called our sensitivity. For when we taste we cannot hear that we taste, when we see we cannot smell that we see; but when we taste we may be conscious that we taste, when we hear we may be conscious that we hear. Moreover, the facts so ascertained are never independent of feeling and volition and of the contents of consciousness at the time, as true sensations are. Also if we consult the physiologist we learn that there is no evidence of any organ or "centre" that could be regarded as the "physical basis" of this inner sense; and, if self-consciousness alone is temporarily in abeyance and a man merely "beside himself," such state of delirium has little analogy to the functional blindness or deafness that constitutes the temporary suspension of sight or hearing.

To the concept of an internal perception or observation the preceding objections do not necessarily apply—that is to say, this concept may be so defined that they need not. But then in proportion as we escape the change of assuming a special sense which furnishes the material for such perception or observation, in that same proportion are we compelled to seek for some other mode of distinguishing its subject-matter. For, so far as the mere mental activity of perceiving or observing is concerned, it is not easy to see any essential difference in the process whether what is observed be psychical or physical. It is quite true that the so-called psychological observation is more difficult, because the facts observed are often less definite and less persistent, and admit less of actual isolation than physical facts do; but the process of recognizing similarities or differences, the dangers of mal-observation or non-observation, are not materially altered on that account. It may be further allowed that there is one difficulty peculiarly felt in psychological observation, the one most inaccurately expressed by saying that here the observer and the observed are one. But this difficulty is surely in the first instance due to the very obvious fact that our powers of attention are limited, so that we cannot alter the distribution of attention at any moment without altering the contents of consciousness at that moment. Accordingly, where there are no other ways of surmounting this difficulty, the psychological observer must either trust to representations at a later time, or he must acquire the power of taking momentary glances at the psychological aspects of the phase of consciousness in question. And this one with any aptitude for such studies can do with so slight a diversion of attention as not to disturb very seriously either the given state or that which immediately succeeds it. But very similar difficulties have to be similarly met by physical observers in certain special cases, as, *e.g.* in observing and registering the phenomena of solar eclipse; and similar aptitudes in the distribution of attention have to be acquired, say, by extempore orators or skilful surgeons. Just as little, then, as there is anything that we can with propriety call an inner sense, just so little can we find in the process of inner perception any satisfactory characteristic of the subject-matter of psychology. The question still is: What is it that is perceived or observed? and the readiest answer of course is: Internal experience as distinguished from external, what takes place in the mind as distinct from what takes place without.

This answer, it must be at once allowed, is adequate for most purposes, and a great deal of excellent psychological work has been done without ever calling it in question. But the distinction between internal and external experience is not one that can be drawn from the standpoint of psychology, at least not at the outset. From this standpoint it appears to be either (1) inaccurate or (2) not extra-psychological. As to (1), the boundary between the internal and the external was, no doubt, originally the surface of the body, with which the subject or self was identified; and in this sense the terms are of course correctly used. For a thing may, in the same sense of the word, be in one space and therefore not in—*i.e.* out of—another; but we express no intelligible relation if we speak of two things as being one in a given room and the other in last week. Any one is at liberty to say if he choose that a certain thing is "in his mind"; but if in this way he distinguishes it from something else not in his mind, then to be intelligible this must imply one of two statements—either that the something else is actually or possibly in some other mind, or, his own mind being alone considered, that at the time the something else does not exist at all. Yet, evident as it seems that the correlatives in and not-in must apply to the same category, whether space, time, presentation (or non-presentation) to a given subject, and so forth, we still find psychologists more or less consciously confused between "internal," meaning "presented" in the psychological sense, and "external," meaning not "not-presented" but corporeal or oftener extra-corporeal. But (2), when used to distinguish between presentations (some of which, or some relations of which with respect to others, are called "internal," and others or other relations, "external"), these terms are at all events accurate; only then they cease to mark off the psychological from the extra-psychological, inasmuch as psychology has to analyse this distinction and to exhibit the steps by which it has come about. But we have still to examine whether the distinction of phenomena of Matter and phenomena of Mind furnishes a better dividing line than the distinction of internal and external.

Mental and Material.

A phenomenon, as commonly understood, is what is manifest, sensible, evident, the implication being that there are eyes to see, ears to hear, and so forth—in other words, that there is presentation to a subject; and wherever there is presentation to a subject it will be allowed that we are in the domain of psychology. But in talking of physical phenomena we, in a way, abstract from this fact of presentation. Though consciousness should cease, the physicist would consider the sum total of objects to remain the same: the orange would still be round, yellow and fragrant as before. For the physicist—whether aware of it or not—has taken up a position which for the present may be described by saying that phenomenon with him means appearance or manifestation, or—as we had better say—object, not for a concrete individual, but rather for what Kant called *Bewusstsein überhaupt*, or, as some render it, the objective consciousness, *i.e.* for an imaginary subject freed from all the limitations of actual subjects save that of depending on "sensibility" for the material of experience. However, this is not all, for, as we shall see presently, the psychologist also occupies this position; at least if he does not his is not a true science. But, further, the physicist leaves out of sight altogether the facts of attention, feeling, and so forth, all of which actual presentation entails. From the psychological point of view, on the other hand, the removal of the subject removes not only all such facts as attention and feeling, but all presentation or possibility of presentation whatever. Surely, then, to call a certain object, when we abstract from its presentation, a material phenomenon, and to call the actual presentation of this object a mental phenomenon, is a clumsy and confusing way of representing the difference between the two points of view. For the terms "material" and "mental" seem to imply that the two so-called phenomena have nothing in common, whereas the same object is involved in both, while the term "phenomenon" implies that the point of view is in each case the same, when in truth what is emphasized by the one the other ignores.

Standpoint of Psychology.

2. Paradoxical though it may be, we must then conclude that psychology cannot be defined by reference to a special subject-matter as such concrete sciences, for example, as mineralogy and botany can be; and, since it deals in some sort with the whole of experience, it is obviously not an abstract science in any ordinary sense of that term. To be characterized at all, therefore, apart from metaphysical assumptions, it must be characterized by the standpoint from which this experience is viewed. It is by way of expressing this that widely different schools of psychology define it as subjective, all other positive sciences being distinguished as objective. But this seems scarcely more than a first approximation to the truth, and, as we have seen incidentally, is apt to be misleading. The distinction rather is that the standpoint of psychology is what is sometimes termed "individualistic," that of the so-called object-sciences being "universalistic," both alike being objective in the sense of being true for all, consisting of what Kant would call judgments of experience. For psychology is not a biography in any sense, still less a biography dealing with idiosyncrasies, and in an idiom having an interest and a meaning for one subject only, and incommunicable to any other. Locke, Berkeley and Hume have been severely handled because they regarded the critical investigation of knowledge as a psychological problem, and set to work to study the individual mind simply for the sake of this problem. But none the less their standpoint was the proper one for the science of psychology itself; and, however surely their philosophy was foredoomed to a collapse, there is no denying a steady psychological advance as we pass from Locke to Hume and his modern representatives. By "idea" Locke tells us he means "Whatsoever is the object of the understanding when a man thinks" (*i.e.* is conscious), and having, as it were, shut himself within such a circle of ideas he finds himself powerless to explain his knowledge of a world that is assumed to be independent of it; but he is able to give a very good account of some of these ideas themselves. He cannot justify his belief in the world of things whence certain of his simple ideas "were conveyed" any more than Robinson Crusoe could have explored the continents whose products were drifted to his desert island, though he might perhaps survey the island itself well enough. Berkeley accordingly, as Professor Fraser happily puts it, abolished Locke's hypothetical outer circle. Thereby he made the psychological standpoint clearer than ever—hence the truth of Hume's remark, that Berkeley's arguments "admit of no answer"; at the same time the epistemological problem was as hopeless as before—hence again the truth of Hume's remark that those arguments "produced no conviction." Of all the facts with which he deals, the psychologist may truly say that their *esse* is *percipi*, inasmuch as all his facts are facts of presentation, are ideas in Locke's sense, or objects which imply a subject. Before we became conscious there was no world for us; should our consciousness cease, the world for us ceases too; had we been born blind, the world would for us have had no colour; if deaf, it would have had no sounds; if idiotic, it would have had no meaning. Psychology, then, never transcends the limits of the individual. But now, though this Berkeleyan standpoint is the standpoint of psychology, psychology is not pledged to the method employed by Berkeley and by Locke. Psychology may be individualistic without being confined exclusively to the introspective method. There is nothing to hinder the psychologist from employing materials furnished by his observations of other men, of infants, of the lower animals, or of the insane; nothing to hinder him taking counsel with the philologist or even the physiologist, provided always he can show the psychological bearings of those facts which are not directly psychological. The standpoint of psychology is individualistic; by whatever methods, from whatever sources its facts are ascertained, they must—to have a psychological import—be regarded as having place in, or as being part of, *some one's consciousness or experience.* In this sense, *i.e.* as presented to an individual, "the whole choir of heaven and furniture of earth" may belong to psychology, but otherwise they are psychological nonentities. In defining psychology, however, the propriety of avoiding the terms *mind* or *soul*, which it implies, is widely acknowledged; mind because of the disastrous dualism of mind and matter, soul because of its metaphysical associations. Hence F. A. Lange's famous mot: modern psychology is *Psychologie ohne Seele.* But *consciousness*, which is the most frequent substitute, is continually confused with self-consciousness, and so is apt to involve undue stress on the subjective as opposed to the objective, as well as to emphasize the cognitive as against the conative factors. *Experience*, it is maintained, is a more fundamental and less ambiguous term. Psychology then is the science of individual experience. The problem of psychology, in dealing with this complex subject-matter, is in general—first, to ascertain its ultimate constituents, and, secondly, to determine and explain the laws of their interaction.

General Analysis.

3. In seeking to make a first general analysis of experience, we must start from individual human experience, for this alone is what we immediately know. From this standpoint we must endeavour to determine the "irreducible minimum" involved, so that our concept may apply to all lower forms of experience as well. Etymologically *experience* connotes practical acquaintance, efficiency and skill as the result of trial—usually repeated trial—and effort. Many recent writers on comparative psychology propose to make evidence of experience in this sense the criterion of psychical life. The ox knoweth his owner and the ass his master's crib, and so would pass muster; but the ant and the bee, who are said to learn nothing, would, in spite of their marvellous instinctive skill, be regarded as mere automata in Descartes's sense. That this criterion is decisive on the positive side will hardly be denied; the question how far it is available negatively we must examine later on. But it will be well first briefly to note some of the implications of this positive criterion: *Experience is the process of becoming expert by experiment.* The chief implication, no doubt, is that which in psychological language we express as the duality of subject and object. Looking at this relation as the comparative psychologist has to do, we find that it tallies in the main with the biological relation of organism and environment. The individuality of the organism corresponds to, though it is not necessarily identical with, the psychological subject, while to the environment and its changes corresponds the objective *continuum* or *totum objectivum* as we shall call it. This correspondence further helps us to see still more clearly the error of regarding individual experience as wholly subjective, and at the same time helps us to find some measure of truth in the naïve realism of Common Sense. As these points have an important bearing on the connexion of psychology and epistemology, we may attempt to elucidate them more fully.

Though it would be unwarrantable to resolve a *thing*, as some have done, into a mere meeting-point of relations, yet it is perhaps as great a mistake to assume that it can be anything determinate in itself apart from all relations to other things. By the physicist this mistake can hardly be made: for him action and reaction are strictly correlative: a material system can do no work on itself. For the biologist, again, organism and environment are invariably complementary. But in psychology, when presentations are regarded as subjective modifications, we have this mistaken isolation in a glaring form, and all the hopeless difficulties of what is called "subjective idealism" are the result. Subjective modifications no doubt are always one constituent of individual experience, but always as correlative to objective modifications or change in the objective *continuum*. If experience were throughout subjective, not merely would the term subjective itself be meaningless, not merely would the conception of the objective never arise, but the entirely impersonal and intransitive process that remained, though it might be described as absolute becoming, could not be called even solipsism, least of all real experience. Common Sense, then, is right in positing, wherever experience is inferred, (1) a factor answering to what we know as self, and (2) another factor answering to what each of us knows as the world. It is further right in regarding the world which each one immediately knows as a coloured, sounding, tangible world, more exactly as a world of sensible qualities. The assumption of naïve realism, that the world as each one knows it exists as such independently of him, is questionable. But this assumption goes beyond individual experience, and does not, indeed could not, arise at this standpoint.

Answering to the individuality and unity of the subjective factor, there is a corresponding unity and individuality of the objective. Every Ego has its correlative Non-Ego, whence in the end such familiar saying as *quot homines tot sententiae* and the like. The doctrine of Leibnitz, that "each monad is a living mirror. . . representative of the universe according to its point of view," will, with obvious reservations, occur to many as illustrative here. In particular, Leibnitz emphasized one point on which psychology will do well to insist. "Since the world is a plenum," he begins, "all things are connected together and everybody acts upon every other, more or less, according to their distance, and is affected by their reaction; hence each monad is a living mirror,"[1] &c. Subject and Object, or (as it will be clearer in this connexion to say) Ego and Non-Ego, are then not merely logically a universe, but actually *the universe*, so that, as Leibnitz put it, "He who sees all could read in each what is happening everywhere" (*Monadology*, § 61). Though every individual experience is unique, yet the more Ego$_1$ is similar to Ego$_2$ the more their complementaries Non-Ego$_1$, Non-Ego$_2$ are likewise similar; much as two perspective projections are more similar the more adjacent their points of sight, and more similar as regards a given position the greater its distance from both points. No doubt we must also make a very extensive use of the hypothesis of subconsciousness, just as Leibnitz did, before we can say that *the universe* is the objective factor in each and every individual's experience. But we shall have in any case to allow that, besides the strictly limited "content" rising above the threshold of consciousness, there is an indefinite extension of the presentational *continuum* beyond it. And the Leibnitzian Monadology helps us also to clear up a certain confusion that besets terms such as "content of consciousness," or "finite centre of experience"—a barbarous but intelligible phrase that has recently appeared—the confusion, that is, with a mosaic of mutually exclusive areas, or with a scheme of mutually exclusive logical compartments. Consciousnesses, though in one respect mutually exclusive, do not limit each other in this fashion. For there is a sense in which all individual experiences are absolutely the same, though relatively different as to their point of view, *i.e.* as to the manner in which for each the same absolute whole is sundered into subjective and objective factors.

This way of looking at the facts of mind helps, again, to dispel the obscurity investing such terms as *subjective*, *intersubjective*, *transsubjective* and *objective*, as these occur in psychological or epistemological discussions. For the psychologist must maintain that no experience is merely subjective: it is only epistemologists (notably Kant) who so describe individual experience, because objects experienced in their concrete particularity pertain, like so many idiosyncrasies, to the individual alone. In contrast with this, epistemologists then describe universal experience—the objects in which are the same for every experient—as objective experience *par excellence*. And so has arisen the time-honoured opposition of Sense-knowledge and Thought-knowledge: so too has arisen the dualism of Empiricism and Rationalism, which Kant sought to surmount by logical analysis. It is in the endeavour to supplement this analysis by a psychological genesis that the terms intersubjective and transsubjective prove useful. The problem for psychology is to ascertain the successive stages in the advance from the one form of experience or knowledge to the other. "When ten men look at the sun or the moon," said Reid, "they all see the same individual object." But according to Hamilton this statement is not "philosophically correct . . . the truth is that each of these persons sees a different object. . . . It is not by perception but by a process of reasoning that we connect the objects of sense with existences beyond the sphere of immediate knowledge."[2] Now it is to this "beyond" that the term *transsubjective* is applied, and the question before us is: How do individual subjects thus get *beyond* the immanence or immediacy with which all experience begins? By a "process of reasoning," it is said. But it is at least true in fact, whether necessarily true or not, that such reasoning is the result of social intercourse. Further, it will be generally allowed that Kant's *Analytik*, before referred to, has made plain the insufficiency of merely formal reasoning to yield the categories of Substance, Cause and End, by which we pass from mere perceptual experience to that wider experience which transcends it. And psychology, again, may claim to have shown that in fact these categories are the result of that reflective self-consciousness to which social intercourse first gives rise.

But such intercourse, it has been urged, presupposes the common ground between subject and subject which it is meant to explain. How, it is asked, if every subject is confined to his own unique experience, does this intersubjective intercourse ever arise? If *no* progress towards intellective synthesis were possible before intersubjective intercourse began, such intercourse, as presupposing something more than immediate sense-knowledge, obviously never could begin.[3] Let us illustrate by an analogy which Leibnitz's association of experience with a "point of view" at once suggests. If it were possible for the terrestrial astronomer to obtain observations of the heavens from astronomers in the neighbouring stars, he would be able to map in three dimensions constellations which now he can only represent in two. But unless he had ascertained unaided the heliocentric parallax of these neighbouring stars, he would have no means of distinguishing them as near from the distant myriads besides, or of understanding the data he might receive; and unless he had first of all determined the still humbler geocentric parallax of our sun, those heliocentric parallaxes would have been unattainable. So in like manner we may say "intersubjective parallax" presupposes what we may call "subjective parallax," and even this the psychological duality of object and subject. But such subjective parallax or acquaintance with other like selves is the direct outcome of the extended range in time which memory proper secures; and when in this way self has become an object, resembling objects become other selves or "ejects," to adopt with slight modification a term originated by the late W. K. Clifford. We may be quite sure that his faithful dog is as little of a solipsist as the noble savage whom he accompanies. Indeed, the rudiments of the social factor are, if we may judge by biological evidence, to be found very early. Sexual union in the physiological sense occurs in all but the lowest *Metazoa*, pairing and courtship are frequent among insects, while "among the cold-blooded fishes the battle of the stickleback with his rivals, his captivating manœuvres to lead the female to the nest which he has built, his mad dance of passion around her, and his subsequent jealous guarding of the nest, have often been observed and admired."[4] Among birds and mammals we find not merely that these psychological aspects of sexual life are greatly extended, but we find also prolonged education of offspring by parents and imitation of the parents by offspring. Even language, or, at any rate “ the linguistic impulse,” is not wholly absent among brutes.[1] Thus as the sensori-motor adjustments of the organism to its environment *generally* advance in complexity and range, there is a concomitant advance in the variety and intimacy of its relations *specially* with individuals of its kind. It is therefore reasonable to assume no discontinuity between phases of experience that for the individual are merely objective and phases that are also ejective as well; and once the ejective level is attained, some interchange of experience is possible. So disappears the great gulf fixed betwixt subjective or individual and intersubjective or universal experience by rival systems in philosophy.

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[1] *Principles of Nature and Grace*, § 3.

[2] *Lectures on Metaphysics*, ii. 153.

[3] And it is precisely for want of this mediation that Kant's "two stems of human knowledge, which *perhaps* may spring from a common but to us unknown root," leave epistemology still more or less hampered with the old dualism of sense and understanding.

[4] *Evolution of Sex*, by Geddes and Thomson, 1st ed. p. 265.

Subject or Ego.

4. From this preliminary epistemological discussion we may pass on to the psychological analysis of experience itself. As to this, there is in the main substantial agreement; the elementary facts of mind cannot be expressed in less than three propositions—“ I feel somehow,” “ I know something,” “ I do something.” But here at once there arises an important question, viz. What after all are we to understand by the subject of these propositions? The proposition “ I feel somehow ” is not equivalent to “ I know that I feel somehow.” To identify the two would be to confound consciousness with self-consciousness. We are no more confined to our own immediate observations here than elsewhere; but the point is that, whether seeking to analyse one's own consciousness or to infer that of a lobster, whether discussing the association of ideas or the expression of emotions, there is always an individual self or “ subject ” in question. It is not enough to talk of feelings or volitions: what we mean is that some individual—man or worm—feels, strives, acts, thus or thus. Obvious as this may seem, it has been frequently either forgotten or gainsaid. It has been forgotten among details or through the assumption of a medley of faculties, each treated as an individual in turn, and among which the real individual was lost. Or it has been gainsaid, because to admit that all psychological facts pertain to an experiencing subject or experient seemed to imply that they pertained to a particular spiritual substance, which was simple, indestructible, and so forth; and it was manifestly desirable to exclude such assumptions from psychology as a science aiming only at a systematic exposition of what can be known and verified by observation. But, however, much assailed or disowned, the concept of a “ mind ” or conscious subject is to be found implicitly or explicitly in all psychological writers whatever—not more in Berkeley, who accepts it as a fact, than in Hume, who treats it as a fiction. This being so, we are far more likely to reach the truth eventually if we openly acknowledge this inexpugnable assumption, if such it prove, instead of resorting to all sorts of devious periphrases to hide it. Now wherever the word *Subject*, or its derivatives, occurs in psychology we might substitute the word Ego and analogous derivatives, did such exist. But Subject is almost always the preferable term; its impersonal form is an advantage, and it readily recalls its modern correlative Object. Moreover, Ego has two senses, distinguished by Kant as pure and empirical, the latter of which was, of course, an object, the Me known, while the former was subject always, the I knowing. By pure Ego or Subject it is proposed to denote here the simple fact that everything experienced is referred to a Self experiencing. This psychological concept of a self or subject, then, is after all by no means identical with the metaphysical concepts of a soul or mind-atom, or of mind-stuff not atomic; it may be kept as free from metaphysical implications as the concept of the biological individual or organism with which it is so intimately connected.

Attempts to extrude the Ego.

The attempt, indeed, has frequently been made to resolve the former into the latter, and so to find in mind only such an individuality as has an obvious counterpart in this individuality of the organism, *i.e.* what we may call an objective individuality. But such procedure owes all its plausibility to the fact that it leaves out of sight the difference between the biological and the psychological standpoints. All that the biologist means by a dog is “ the sum of the phenomena which make up its corporeal existence.”[2] And, inasmuch as its presentation to any one in particular is a point of no importance, the fact of presentation at all may be very well dropped out of account. Let us now turn to psychology: Why should we not here follow Huxley and take “ the word ‘ soul ’ simply as a name for the series of mental phenomena which make up an individual mind ” ?[3] Surely the moment we try distinctly to understand this question we realize that the cases are different. “ Series of mental phenomena ” for whom ? For any passer-by such as might take stock of our biological dog ? No, obviously only for that individual mind itself; yet that is supposed to be made up of, to be nothing different from, the series of phenomena. Are we, then, (1) quoting J. S. Mill's words, “ to accept the paradox that something which *ex hypothesi* is but a series of feelings, can be aware of itself as a series ” ?[4] Or (2) shall we say that the several parts of the series are mutually phenomenal, much as A may look at B, who was just now looking at A ? Or (3) finally, shall we say that a large part of the so-called series, in fact every term but one, is phenomenal for the rest—for that one ?

As to the first, paradox is too mild a word for it; even contradiction will hardly suffice. It is as impossible to express “ being aware of ” by one term as it is to express an equation or any other relation by one term: what knows can no more be identical with what is known than a weight with what it weighs. If a series of feelings is what is known or presented, then what knows, what it is presented to, cannot be that series of feelings, and this without regard to the point Mill mentions, viz. that the infinitely greater part of the series is either past or future. The question is not in the first instance one of time or substance at all, but simply turns upon the fact that knowledge or consciousness is unmeaning except as it implies something knowing or conscious of something. But it may be replied: Granted that the formula for consciousness is something doing something, to put it generally; still, if the two somethings are the same when I touch myself or when I see myself, why may not agent and patient be the same when the action is knowing or being aware of; why may I not know myself—in fact, do I not know myself ? Certainly not; agent and patient never are the same in the same act; such terms as self-caused, self-moved, self-known, *et id genus omne*, either connote the incomprehensible or are abbreviated expressions —as, *e.g.* touching oneself when one's right hand touches one's left.

And so we come to the alternative: As one hand washes the other, may not different members of the series of feelings be subject and object in turn ? Compare, for example, the state of mind of a man succumbing to temptation (as he pictures himself enjoying the coveted good and impatiently repudiates scruples of conscience or dictates of prudence) with his state when, filled with remorse, he sides with conscience and condemns this “ former self ”—the “ better self ” having meanwhile become supreme. Here the cluster of presentations and their associated sentiments and motives, which together played the rôle of self in the first situation, have—only momentarily it may be true, but still have—for the time the place of not-self; and under abnormal circumstances this partial alternation may become complete alienation, as in what is called “ double consciousness.” Or again, the development of self-consciousness might be loosely described as taking the subject or self of one stage as an object in the next—self being, *e.g.* first identified with the body and afterwards distinguished from it. But all this, however true, is beside the mark; and it is really a very serious misnomer to speak, as *e.g.* Herbert Spencer does, of the development of self-consciousness as a “ differentiation of subject and object.” It is, if anything, a differentiation of object and object, *i.e.* in plainer words, it is a differentiation among presentations—a differentiation every step of which implies just that relation to a subject which it is supposed to supersede.

There still remains the alternative, expressed in the words of J. S. Mill, viz. “ the alternative of believing that the Mind or Ego is something different from any series of feelings or possibilities of them.” To admit this, of course, is to admit the necessity of distinguishing between Mind or Ego, meaning the unity or continuity of consciousness as a complex of presentations, and Mind or Ego as the subject to which this complex is presented. In dealing with the body from the ordinary biological standpoint no such necessity arises. But, whereas there the individual organism is spoken of unequivocally, in psychology, on the other hand, the individual mind may mean either (i.) the series of feelings or “ mental phenomena ” above referred to; or (ii.) the subject of these feelings for whom they are phenomena; or (iii.) the subject of these feelings or phenomena *plus* the series of feelings or phenomena themselves, the two being in that relation to each other in which alone the one is subject and the other a series of feelings, phenomena or objects. It is in this last sense that Mind is used in empirical psychology.[5] Its exclusive use in the first sense is favoured only by those who shrink from the speculative associations connected with its exclusive use in the second. But psychology is not called upon to transcend the relation of subject to object or, as we may call it, the fact of presentation. On the other hand, as has been said, the attempt to ignore one term of the relation is hopeless; and equally hopeless, even futile, is the attempt, by means of phrases such as consciousness or the unity of consciousness, to dispense with the recognition of a conscious subject.

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[1] Cf. Darwin, *Descent of Man*, i. 56.

[2] T. H. Huxley, *Hume*, “ English Men of Letters Series,” (1879). p. 171.

[3] Huxley, *op. cit.* p. 172.

[4] *Examination of Sir W. Hamilton's Philosophy*, ch. xii. *fin.*

[5] A meaning better expressed, as said above, by experience.

Feeling.

5. We might now proceed to inquire more closely into the character and relations of the three invariable constituents of psychical life which are broadly distinguished as cognitions, feelings and conations. But we should be at once confronted by a doctrine which, strictly taken, amounts almost to a denial of this tripartite classification of the facts of mind—the doctrine, viz. that *feeling* alone is primordial and invariably present wherever there is consciousness at all. Every living creature, it is said, feels, though it may never do any more; only the higher animals, and these only after a time, learn to discriminate and identify and to act with a purpose. This doctrine, as might be expected, derives its plausibility partly from the vagueness of psychological terminology, and partly from the intimate connexion that undoubtedly exists between feeling and cognition on the one hand and feeling and volition on the other. As to the meaning of the term, it is plain that further definition is requisite for a word that may mean (*a*) a touch, as feeling of roughness; (*b*) an organic sensation, as feeling of hunger; (*c*) an emotion, as feeling of anger; (*d*) feeling proper, as pleasure or pain. But, even taking feeling in the last, its stricter sense, it has been maintained that all the more complex forms of consciousness are resolvable into, or at least have been developed from, feelings of pleasure and pain. The only proof of such position, since we cannot directly observe the beginnings of conscious life, must consist of considerations such as the following. So far as we can judge, we find feeling everywhere; but, as we work downwards from higher to lower forms of life, the possible variety and the definiteness of sense-impressions both steadily diminish. Moreover, we can directly observe in our own organic sensations, which seem to come nearest to the whole content of primitive or infantile experience, an almost entire absence of any assignable *quale*. Finally, in our sense-experience generally, we find the element of feeling at a maximum in the lower senses and the cognitive element at a maximum in the higher. But the so-called intellectual senses are the most used, and use (we know) blunts feeling and favours intellection, as we see in chemists, who sort the most filthy mixtures by smell and taste without discomfort. If, then, feeling predominates more and more as we approach the beginning of conscious life, may we not conclude that it is its only essential constituent? On the contrary, such a conclusion would be rash in the extreme. Two lines, *e.g.* may get nearer and nearer and yet will never meet, if the rate of approach is simply proportional to the distance. A triangle may be diminished indefinitely, and yet we cannot infer that it becomes eventually all angles, though the angles get no less and the sides do. Before, then, we decide whether pleasure or pain alone can ever constitute a complete experience, it may be well to inquire into the connexion between feeling and cognition, on the one hand, and between feeling and conation on the other, so far as we can now observe. And this is an inquiry which will help us towards an answer to our main question, namely, that concerning the nature and connexions of what are commonly regarded as the three ultimate facts of mind.

Relation of Feeling to Cognition and Conation.

Broadly speaking, in any state of mind that we can directly observe, what we find is (1) that we are aware of a certain change in our sensations, thoughts or circumstances, (2) that we are pleased or pained with the change, and (3) that we act accordingly. We never find that feeling directly alters—*i.e.* without the intervention of the action of which it prompts—either our sensations or situation, but that regularly these latter with remarkable promptness and certainty alter it. We have not *first* a change of feeling, and then a change in our sensations, perceptions and ideas; but, these changing, change of feeling *follows*. In short, feeling appears to be an effect, which therefore cannot exist without its cause, though in different circumstances the same immediate cause may produce a different amount or even a different state of feeling. Turning from what we may call the receptive phase of an experience to the active or appetitive phase, we find in like manner that feeling is certainly not—in such cases as we can clearly observe—the whole of what we experience at any moment. True, in common speech we talk of liking pleasure and disliking pain; but this is either tautology, equivalent to saying we are pleased when we are pleased and pained when we are pained; or else it is an allowable abbreviation, and means that we like pleasurable *objects* and dislike painful *objects*, as when we say we like feeling warm and dislike feeling hungry. But feeling warm or feeling hungry, we must remember, is not pure feeling in the stricter sense of the word. Within the limits of our observation, then, we find that feeling accompanies some more or less definite presentation which for the sake of it becomes the object of appetite or aversion; in other words, feeling implies a relation to a pleasurable or painful presentation or situation, that, as cause of feeling or as end of the action to which feeling prompts, is doubly distinguished from it. Thus the very facts that lead us to distinguish feeling from cognition and conation make against the hypothesis that consciousness can ever be all feeling.

Feeling and Sensation distinct.

But, as already said, the plausibility of this hypothesis is in good part due to a laxity in the use of terms. Most psychologists before Kant, and some even to the present day, speak of pleasure and pain as sensations. But it is plain that pleasure and pain are not simple ideas, as Locke called them, in the sense in which touches and tastes are—that is to say, they are never like these localized or projected, nor are they elaborated in conjunction with other sensations and movements into percepts or intuitions of the external. This confusion of feeling with sensations is largely consequent on the use of one word *pain* both for certain organic sensations and for the purely subjective state of being pained. But such pains not only are always more or less definitely localized—which of itself is so far cognition, they are also distinguished as shooting, burning, gnawing, &c., all which symptoms indicate a certain objective quality. Accordingly psychologists have been driven by one means or another to recognize two "aspects" (Bain), or "properties" (Wundt), in what they call a sensation, the one a "sensible or intellectual" or "qualitative," the other an "affective" or "emotive," aspect or property. The term "aspect" is figurative and obviously inaccurate; even to describe pleasure and pain as properties of sensation is a matter open to much question. But the point which at present concerns us is simply that when feeling is said to be the primordial element in consciousness more is usually included under feeling than pure pleasure and pain, viz. some characteristic or quality by which one pleasurable or painful sensation is distinguishable from another. No doubt, as we go downwards in the chain of life the qualitative or objective elements in the so-called sensations become less and less definite; and at the same time organisms with well-developed sense-organs give place to others without any clearly differentiated organs at all. But there is no ground for supposing even the amoeba itself to be affected in all respects the same whether by changes of temperature or of pressure or by changes in its internal fluids, albeit all of these changes will further or hinder its life and so presumably be in some sort pleasurable or painful. On the whole, then, there are grounds for saying that the endeavour to represent all the various facts of consciousness as evolved out of feeling is due to a hasty striving after simplicity, and has been favoured by the ambiguity of the term feeling itself. If by feeling we mean a certain subjective state varying continuously in intensity and passing from time to time from its positive phase (pleasure) to its negative phase (pain), then this purely pathic state implies an agreeing or disagreeing something which psychologically determines it. If, on the other hand, we let feeling stand for both this state and the cause of it, then, perhaps, a succession of such "feelings" may make up a consciousness; but then we are including two of our elementary facts under the name of one of them. *The simplest form of psychical life, therefore, involves not only a subject feeling but a subject having qualitatively distinguishable presentations which are the occasion of its feeling.*

Presentation.

6. We may now try to ascertain what is meant by cognition as an essential element in this life, or, more exactly, what we are to understand by the term *presentation*. It was an important step onwards for psychology when Locke introduced that "new way of ideas" which Stillingfleet found alternately so amusing and so dangerous. By ideas Locke told him he meant "nothing but the immediate objects of our minds in thinking"; and it was so far a retrograde step when Hume restricted the term to certain only of these objects, or rather to these objects in a certain state, viz. as reproduced ideas or "images." And, indeed, the history of psychology seems to show that its most important advances have been made by those who have kept closely to this way of ideas; the establishment of the laws of association with their many fruitful applications and the whole Herbartian psychology may suffice as instances (see HERBART). The truth is that the use of such a term is itself a mark of an important generalization, one which helps to free us from the mythology and verbiage of the "faculty-psychologists." All the various mental facts spoken of as sensations, movements, percepts, images, intuitions, concepts, notions, have two characteristics in common: (1) they admit of being more or less attended to, and (2) they can be variously combined together and reproduced. It is here proposed to use the term *presentation* to denote them all, as being the best English equivalent for what Locke meant by idea and what Kant and Herbart called a *Vorstellung*.

Attention.

A presentation has then a twofold relation—first, directly to the subject, and, secondly, to other presentations. The former relation answers to the fact that a presentation is attended to, that the subject is more or less conscious of it: it is "in his mind" or presented. As presented to a subject a presentation might with advantage be called an object, or perhaps a psychical object, to distinguish it from what are called objects apart from presentation, *i.e.* conceived as independent of any particular subject. Locke, as we have seen, did so call it; still, to avoid possible confusion, it may turn out best to dispense with the frequent use of object in this sense. But on one account, at least, it is desirable not to lose sight altogether of this, which is after all the stricter as well as the older signification of object, namely, because it enables us to express definitely, without implicating any ontological theory, what we have so far seen reason to think is the fundamental fact in experience. Instead of depending mainly on that vague and treacherous word "consciousness," or committing ourselves to the position that ideas are modifications of a certain mental substance or identical with the subject to whom they are presented, we may leave all this on one side, and say that ideas are objects, and the relation of objects to subjects—that whereby the one is object and the other subject—is presentation; and it is because only objects sustain this relation that they may be spoken of simply as presentations. On the side of the subject this relation implies what, for want of a better word, may be called *attention*, extending the denotation of this term so as to include even what we ordinarily call inattention. Attention so used will thus cover part of what is meant by consciousness—so much of it, that is, as answers to being mentally active, active enough at least to "*receive* impressions." Attention on the side of the subject implies intensity on the side of the object: we might indeed almost call intensity the *matter* of a presentation, without which it is a nonentity.[1]

Continuity of Consciousness.

The inter-objective relations of presentations, on which their second characteristic, that of revivability and associability depends, though of the first importance in themselves, hardly call for examination in a general analysis like the present. But there is one point still more fundamental that we cannot wholly pass by: it is—in part at any rate—what is commonly termed the unity or continuity of consciousness. From the physical standpoint and in ordinary life we can talk of objects that are isolated and independent and in all respects distinct individuals. The screech of the owl, for example, has physically nothing to do with the brightness of the moon: either may come or go without changing the order of things to which the other belongs. But psychologically, for the individual percipient, they are parts of one whole; the more his attention is given to the one the more it is taken from the other. Also the actual recurrence of the one will afterwards entail the re-presentation of the other also. Not only are they still parts of one whole, but such distinctness as they have at present is the result of a gradual differentiation.

It is quite impossible for us now to imagine the effects of years of experience removed, or to picture the character of our infantile presentations before our interests had led us habitually to concentrate attention on some and to ignore others. In place of the many things which we can now see and hear, not merely would there then be a confused presentation of the whole field of vision and of a mass of undistinguished sounds, but even the difference between sights and sounds themselves would be without its present distinctness. Thus the further we go back the nearer we approach to a total presentation having the character of one general *continuum* in which differences are latent. There is, then, in psychology, as in biology, what may be called a principle of "progressive differentiation or specialization";[2] and this, as well as the facts of reproduction and association, forcibly suggests the conception of a certain objective continuum forming the background or basis to the several relatively distinct presentations that are elaborated out of it—the equivalent, in fact, of that unity and continuity of consciousness which has been supposed to supersede the need for a conscious subject.

Motor Presentations.

Subjective Selection.

There is one class of objects of special interest even in a general survey, viz. movements or motor presentations. These, like sensory presentations, admit of association and reproduction, and seem to attain to such distinctness as they possess in adult human experience by a gradual differentiation out of an original diffused mobility which is little besides emotional expression. Of this, however, more presently. It is primarily to such dependence upon feeling that movements owe their distinctive character, the possession, that is, under normal circumstances, of definite and assignable psychical antecedents, in contrast to sensory presentations, which are devoid of them. We cannot psychologically explain the order in which particular sights and sounds occur; but the movements that follow them, on the other hand, can be adequately explained only by psychology. The twilight that sends the hens to roost sets the fox to prowl, and the lion's roar which gathers the jackals scatters the sheep. Such diversity in the movements, although the sensory presentations are similar, is due, in fact, to what we might call the principle of "subjective or hedonic selection"—that, out of all the manifold changes of sensory presentation which a given individual experiences, only a few are the occasion of such decided feeling as to become objects of possible appetite or aversion. It is thus by means of movements that we are more than the creatures of circumstances and that we can with propriety talk of subjective selection. The representation of what interests us comes then to be associated with the representation of such movements as will secure its realization, so that—although no concentration of attention will secure the requisite intensity to a pleasurable object present only in idea—we can by what is strangely like a concentration of attention convert the idea of a movement into the fact, and by means of the movement attain the coveted reality.

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[1] Cf. Kant's *Principle of the Anticipations of Perception*: "In all phenomena the real, which is the object of sensation, has intensive magnitude."

[2] The biological principle referred to is that known as von Baer's law, viz. "that the progress of development is from the general to the special."

Conation.

7. And this has brought us round naturally to the third of the commonly accepted constituents of experience. What is *conation*, or rather *conative action*? For there are two questions often more or less confused, the question of motive or spring of action, as it is sometimes called —why is there action at all? and the question of means—how do definite actions come about? The former question relates primarily to the connexion of conation and feeling. It is only the latter question that we now raise. In ordinary voluntary movement we have first of all an idea or re-presentation of the movement, and last of all the actual movement itself—a new presentation which may for the present be described as the filling out of the re-presentation, which thereby attains that intensity, distinctness and embodiment we call reality. How does this change come about? The attempt has often been made to explain it by a reference to the more uniform, and apparently simpler, case of reflex action, including under this term what are called sensori-motor and ideo-motor actions. In all these the movement seems to be the result of a mere transference of intensity from the associated sensation or idea that sets on the movement. But when by some chance or mischance the same sensory presentation excites two or more nascent motor changes that conflict, a temporary block is said to occur; and, when at length one of these nascent motor changes finally prevails, then, it is said, "there is constituted a state of consciousness which displays what we term volition."[1] But this assumption that sensory and motor ideas are associated before volition, and that volition begins where automatic or reflex action ends, is due to that inveterate habit of confounding the psychical and the physical which is the bane of modern psychology. How did these particular sensory and motor presentations ever come to be associated? The only psychological evidence we have of any very intimate connexion between sensory and motor representations is that furnished by our acquired dexterities, *i.e.* by such movement as Hartley[2] styled "secondarily automatic." But then all these have been preceded by volition: as Herbert Spencer says, "the child learning to walk wills each movement before making it." Surely, then, a psychologist should take this as his typical case and prefer to assume that all automatic actions that come within his ken at all are in this sense secondarily automatic, *i.e.* to say that either in the experience of the individual or of his ancestors, volition or something analogous to it, preceded habit.

But, if we are thus compelled by a sound method to regard sensori-motor actions as degraded or mechanical forms of voluntary actions, instead of regarding voluntary actions as gradually differentiated out of something physical, we have not to ask: What happens when one of two alternative movements is executed? but the more general question: What happens when any movement is made in consequence of feeling? It is obvious that on this view the simplest *definitely purposive* movement must have been preceded by some movement simpler still. For any distinct movement purposely made presupposes the ideal presentation, before the actual realization, of the movement. But such ideal presentation, being a re-presentation, equally presupposes a previous actual movement of which it is the so-called mental residuum. There is then, it would seem, but one way left, viz. to regard those movements which are immediately expressive of pleasure or pain as primordial, and to regard the so-called voluntary movements as elaborated out of these. The vague and diffusive character of these primitive emotional manifestations is really a point in favour of this position. For such "diffusion" is evidence of an underlying continuity of motor presentations parallel to that already discussed in connexion with sensory presentations, a continuity which, in each case, becomes differentiated in the course of experience into comparatively distinct and discrete movements and sensations respectively.[3]

But whereas we can only infer, and that in a very roundabout fashion, that our sensations are not absolutely distinct but are parts of one massive sensation, as it were, we are still liable under the influence of strong emotion directly to experience the corresponding continuity in the case of movement. Such motor-continuum we may suppose is the psychical counterpart of that permanent readiness to act, or rather that continual nascent acting, which among the older physiologists was spoken of as "tonic action." This "skeletal tone," as it is now called, is found to disappear more or less completely from a limb when its sensory nerves are divided. "In the absence of the usual stream of afferent impulses passing into it, the spinal cord ceases to send forth the influences which maintain the tone."[4] And a like intimate dependence, we have every reason to believe, obtains throughout between sensation and movement. We cannot imagine the beginning of life but only life begun. The simplest picture, then, which we can form of a concrete state of mind is not one in which there are movements before there are any sensations or sensations before there are any movements, but one in which change of sensation is followed by change of movement, the link between the two being a change of feeling.

Dependence of Action of Feeling.

Having thus simplified the question, we may now ask again: How is this change of movement through feeling brought about? The answer, as already hinted, appears to be: By a change of attention. We learn from such observations as psychologists describe under the head of fascination, imitation, hypnotism, &c., that the mere concentration of attention upon a movement is often enough to bring the movement to pass. But, of course, in such cases neither emotion nor volition is necessarily implied; but none the less they show the close connexion that exists between attention and movement. Everybody, too, must often have observed how the execution of any but mechanical movements arrests attention to thoughts or sensations, and how, vice versa, a striking impression or thought interrupts him in the performance of skilled movements. Let us suppose, then, that we have at any given moment a certain distribution of attention between sensory and motor presentations; a change in that distribution then will mean a change in the intensity of some of all of these. But, in the case of motor presentations, change of intensity means change of movement. Such changes are, however, quite minimal in amount so long as the given presentations are not conspicuously agreeable or disagreeable. So soon as they are, however, there is evidence of a most intimate connexion between feeling and attention; but it is hardly possible adequately to exhibit this evidence without first attempting to ascertain the characteristics of the presentations, or groups of presentations, that are respectively pleasurable and painful, and this must occupy us later on.

Primordial Facts of Mind.

8. We are now at the end of our analysis, and the results may perhaps be most conveniently summarized by first throwing them into a tabular form and then appending a few remarks by way of indicating the main purport of the table. Taking no account of the specific difference between one concrete state of mind and another, and supposing that we are dealing with presentations

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[1] Compare Spencer's *Principles of Psychology*, i. §§ 217, 8.

[2] D. Hartley, *Observations on Man* (6th ed., 1834), pp. 66 sqq.

[3] It may be well to call to mind here that Alexander Bain also regarded emotional expression as a possible commencement of action, but only to reject it in favour of his own peculiar doctrine of "spontaneity," which, however, is open to the objection that it makes movement precede feeling instead of following it—an objection that would be serious even if the arguments advanced to support his hypothesis were as cogent as only Bain supposed them to be. Against the position maintained above he objects that "the emotional wave almost invariably affects a whole group of movements," and therefore does not furnish the "*isolated* promptings that are desiderated in the case of the will" (*Mental and Moral Science*, p. 323). But to make this objection is to let heredity count for nothing. In fact, wherever a variety of isolated movements is physically possible there also we always find corresponding instincts, "that untaught ability to perform actions," to use Bain's own language, which a minimum of practice suffices to perfect. But then these suggest gradual ancestral acquisition.

[4] Foster, *Text-Book of Physiology*, § 597.

in their simplest form, *i.e.* as sensations and movements, we have:—

A SUBJECT	(1) non-voluntarily attending to changes in the sensory-continuum;[1] [*Cognition*]	= Presentation of *sensory*	OBJECTS.
	(2) being, in consequence, either pleased or pained; [*Feeling*]		
	and (3) by voluntary attention or "innervation" producing changes in the motor-continuum.[1] [*Conation*]	= Presentation of *motor*	

Of the three phases or functions, thus analytically distinguishable, but not really separable, the first and the third correspond in the main with the *receptive* and *active* states or powers of the older psychologists. The second, being more difficult to isolate, was long overlooked; or, at all events, its essential characteristics were not distinctly marked, so that it was confounded either with (1) which is its cause, or with (3), its effect. But perhaps the most important of all psychological distinctions is that which traverses both the old bipartite and the prevailing tripartite analysis, viz. that between the subject on the one hand, as acting and feeling, and the objects of this activity on the other. With this distinction clearly before us, instead of crediting the subject with an indefinite number of faculties or capacities, we must seek to explain not only reproduction, association, &c., but all varieties of thinking and acting, by the laws pertaining to ideas or presentations, leaving to the subject only the one power of variously distributing that attention upon which the intensity of a presentation in part depends. What we call activity in the narrower sense (as *e.g.* purposive movement and intellection) is but a special form of this single subjective activity, although a very important one.

According to this view, then, *presentations*, *attention*, *feeling*, are not to be regarded as three co-ordinate genera, each of which is a complete "state of mind or consciousness," *i.e.* as being all alike included under this one supreme category. There is, as Berkeley long ago urged, no resemblance between activity and an idea; nor is it easy to see anything common to pure feeling and an idea, unless it be that both possess intensity. Classification seems, in fact, to be here out of place. Instead, therefore, of the one *summum genus*, state of mind or consciousness, with its three co-ordinate subdivisions—cognition, emotion, conation—our analysis seems to lead us to recognize three distinct and irreducible components—attention, feeling, and objects or presentations—as together, in a certain connexion, constituting one concrete state of mind or *psychosis*. Of such concrete states of mind or *psychoses* we may then say—so far agreeing with the older, bipartite psychology—that there are two forms, corresponding to the two ways in which attention may be determined and the two classes of objects attended to in each, viz. (1) the *sensory* or *receptive* attitude, when attention is non-voluntarily determined, *i.e.* where feeling follows the act of attention; and (2) the *motor* or *active* attitude, where feeling precedes the act of attention, which is thus determined voluntarily.

Attention.

9. Instead of a congeries of faculties we have assumed a single subjective activity and have proposed to call this *attention*. Some further explication of this position seems to be desirable. We start with the duality of subject and object as fundamental. We say of man, mouse, or monkey that it feels, perceives, remembers, infers, strives, and so forth. Leaving aside the first term, it is obvious that all the rest imply both an activity and an object. Is it possible to resolve these instances into a form in which the assumed diversity of the act will appear as a diversity of the object? At first sight it looks rather as if the kind of activity might vary while the object remained the same; that *e.g.* we perceived an object and later ~~on~~ remembered or desired it. It would then be most natural to refer these several activities to corresponding faculties of perception, memory and desire. This, indeed, is the view embodied in common speech, and for practical purposes it is doubtless the simplest and the best. Nevertheless, a more thorough analysis shows that when the supposed faculty is different the object is never entirely and in all respects the same. Thus in perception, *e.g.* we deal with "impressions" or primary presentations, and in memory and imagination with "ideas" (in the later sense) or secondary presentations. In desire the *want* of the object gives it an entirely different setting, adding a new characteristic, that of *value* or *worth*, so that its acquisition becomes the *end* of a series of efforts or movements. The older psychology, by its acceptance of the Cartesian doctrine that all the facts of immediate experience are to be interpreted as subjective modifications, failed to distinguish adequately between the subject as active and the objects of its activity. Hence the tendency to rest content with the popular distinction of various faculties in spite of the underlying sameness implied in the common application of "conscious" to them all. In fact, Locke's definition of idea (in the older and wider sense) as the immediate object of consciousness or thinking was censured by Reid as "the greatest blemish in the *Essay on Human Understanding*." But, accepting this definition as implied in the duality of subject and object, and accepting too the underlying sameness which the active form "conscious" undeniably implies, we have simply to ask: "Which is the better term to denote this common element—consciousness or attention?"

Consciousness, as the vaguest, most protean and most treacherous of psychological terms, will hardly serve our purpose. Attention, on the other hand, has an invariable active sense, and there is an appropriate verb, to attend. But many things, it may be said, are presented while few are attended to; if attention is to be made coextensive with the activity implied in consciousness, will not the vital distinction between attention and inattention be lost? In fact, however, this distinction implies a covert comparison, not an absolute contrast. In everyday life we recognize many degrees of attention, ranging from an extreme of intense concentration to one of complete remission, as Locke long ago pointed out.[2] Between these extremes there is perfect continuity, and not a difference of kind; to apply the one term attention to the whole range is very like applying the one term magnitude to large and small quantities alike.

But it is not enough to show that when we commonly talk of different faculties we also find psychological differences of object, and to assert that if there is one common factor in all psychical activity this factor is attention. To make our position secure it is needful to show directly that all the various faculties with which a subject can be credited are resolvable into attention and various classes or relations or states of presentations that are attended to. How far this is possible remains to be seen as we proceed. In the case of the so-called "intellectual powers" the position is generally conceded, but so far as the voluntary or active powers are concerned it is as generally denied. Now, in so far as volition implies not merely action, overt or intended, but also motives, in so far also it must be acknowledged it contains a factor *not* resolvable into attention to motor presentations. This further factor, which has been called "the volitional character of feeling," we here leave aside. Apart from this direct spring of action, then, the question is whether the active process itself differs from the cognitive or receptive process save in being attention to a special class of objects. First of all, it is noteworthy that both have the same characteristics. Thus, what Hamilton called "the law of limitation" holds of each alike and of either with respect to the other; and it holds too not only of the number of presentations but also of the intensity. We can be absorbed in action just as much as in perception or thought; also, as already said, movements, unless they are mechanical, inhibit ideas; and vice versa, ideas, other than associated trains, arrest movements. Intoxication, hypnotism or insanity, rest or exhaustion, tell on apperception as well as on innervation. The control of thoughts, equally with the control of movements, requires effort; and as there is a strain peculiar to intently listening or gazing, which is known to have a muscular concomitant, so too there is a strain characteristic of recollection and visualization, which may quite well turn out to be muscular too. When movements have to be associated, the same continuous attention is called for as is found requisite in associating sensory impressions; and, when such associations have become very intimate, dissociation is about equally difficult in both cases.

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[1] To cover more complex cases we might here add the words "or trains of ideas."

[2] "That there are ideas, some or other, always present in the mind of a waking man, every one's experience convinces him; though the mind employs itself about them with several degrees of attention. Sometimes the mind fixes itself with such intention . . . that it shuts out all other thoughts and takes no notice of the ordinary impressions made on the senses; . . at other times it barely observes the train of ideas . . . without directing and pursuing any of them; and at other times it lets them pass almost quite unregarded as faint shadows that make no impression" (*Essay*, ii. 19, §§ 3, 4).

There is one striking fact that brings to light the essential sameness of apperception and innervation, cited by Wundt for this very purpose. In so-called "reaction-time" experiments it is found, when the impression to be registered follows on a premonitory signal after a certain brief interval, that then the reaction (registering the impression) is often instantaneous; the reaction-time, in other words, is nil. In such a case the subject is aware not of three separate events, (1) the perception of the impression; (2) the reaction; (3) the perception of this; but the fact of the impression is realized and the registering movement is actualized at once and together: the subject is conscious of one act of attention and one only.

Theory of Presentations.

10. We come now to the exposition of the objects of attention or consciousness, *i.e.* to what we may call the objective or presentational factor of psychical life. The treatment of this will fall naturally into two divisions. In the first we shall have to deal with its general characteristics and with the fundamental processes which all presentation involves. In view of its general and more or less hypothetical character we may call it the theory of presentation. We can then pass on to the special forms of presentations, known as sensations, percepts, images, &c., and to the special processes to which these forms lead up.

Assumption of a Psychological Individual.

This exposition will be simplified if we start with a supposition that will enable us to leave aside, at least for the present, the difficult question of heredity. We know that in the course of each individual's life there is more or less of progressive differentiation or development. Further, it is believed that there has existed a series of sentient individuals beginning with the lowest form of life and advancing continuously up to man. Some traces of the advance already made may be reproduced in the growth of each human being now, but for the most part such traces have been obliterated. What was experience in the past has become instinct in the present. The descendant has no consciousness of his ancestor's failures when performing by "an untaught ability" what they slowly and perhaps painfully acquired. But, if we are to attempt to follow the genesis of mind from its earliest dawn, it is the primary experience rather than the eventual instinct that we have first of all to keep in view. To this end, then, it is proposed to assume that we are dealing with one individual who has continuously advanced from the beginning of psychical life, and not with a series of individuals of whom all save the first inherited certain capacities from their progenitors. The life-history of such an imaginary individual, that is to say, would correspond with all that was new in the experience of a certain typical series of individuals each of whom advanced a certain stage in mental differentiation. On the other hand, from this history would be omitted that inherited reproduction of the net results, so to say, of ancestral experience, that innate tradition by which alone, under the actual conditions of existence, progress is possible. The process of thus reproducing the old might differ as widely from that of producing the new as electrotyping does from engraving. However, the point is that as psychologists we know nothing directly about it; neither can we distinguish precisely at any link in the chain of life what is old and inherited—original in the sense of Locke and Leibnitz—from what is new or acquired—original in the modern sense. But we are bound as a matter of method to suppose all complexity and differentiation among presentations to have been originated, *i.e.* experimentally acquired, at some time or other. So long, then, as we are concerned primarily with the progress of this differentiation we may disregard the fact that it has not actually been, as it were, the product of one hand dealing with one *tabula rasa* to use Locke's—originally Aristotle's—figure, but of many hands, each of which, starting with a reproduction of what had been wrought on the preceding *tabulae*, put in more or fewer new touches before devising the whole to a successor who would proceed in like manner.

The Presentation-Continuum.

11. What is implied in this process of differentiation and what is it that becomes differentiated?—these are the questions to which we must now attend. Psychologists have usually represented mental advance as consisting fundamentally in the combination and recombination of various elementary units, the so-called sensations and primitive movements: in other words, as consisting in a species of "mental chemistry." If we are to resort to physical analogies at all—a matter of very doubtful propriety—we shall find in the growth of a seed or an embryo far better illustrations of the unfolding of the contents of consciousness than in the building up of molecules: the process seems much more a segmentation of what is originally continuous than an aggregation of elements at first independent and distinct. Comparing higher minds or stages of mental development with lower—by what means such comparison is possible we need not now consider—we find in the higher conspicuous differences between presentations which in the lower are indistinguishable or absent altogether. The worm is aware only of the difference between light and dark. The steel-worker sees half a dozen tints where others see only a uniform glow. To the child, it is said, all faces are alike; and throughout life we are apt to note the general, the points of resemblance, before the special, the points of difference. But even when most definite, what we call a presentation is still part of a larger whole. It is not separated from other presentations, whether simultaneous or successive, by something which is not of the nature of presentation, as one island is separated from another by the intervening sea, or one note in a melody from the next by an interval of silence. In our search for a theory of presentations, then, it is from this "continuity of consciousness" that we must take our start. Working backwards from this as we find it now, we are led alike by particular facts and general considerations to the conception of a *totum objectivum* or objective continuum which is gradually differentiated, thereby giving rise to what we call distinct presentations, just as some particular presentation, clear as a whole, as Leibnitz would say, becomes with mental growth a complex of distinguishable parts. Of the very beginning of this continuum we can say nothing; absolute beginnings are beyond the pale of science. Experience advances as this continuum is differentiated, every differentiation being a change of presentation. Hence the commonplace of psychologists—We are only conscious as we are conscious of change.

Gradual Differentiation of Presentation-Continuum.

But "change of consciousness" is too loose an expression to take the place of the unwieldy phrase differentiation of a presentation-continuum, to which we have been driven. For not only does the term "consciousness" confuse what exactness requires us to keep distinct, an activity and its object, but also the term "change" fails to express the characteristics which distinguish new presentations from other changes. Differentiation implies that the simple becomes complex or the complex more complex; it implies also that this increased complexity is due to the persistence of former changes; we may even say such persistence is essential to the very idea of development or growth. In trying, then, to conceive our psychological individual in the earliest stages of development we must not picture him as experiencing a succession of absolutely new sensations, which, coming out of nothingness, admit of being strung upon the "thread of consciousness" like beads picked up at random, or cemented into a mass like the bits of stick and sand with which the young caddis covers its nakedness. The notion, which Kant has done much to encourage, that psychical life begins with a confused manifold of sensations—devoid not only of logical but even of psychological unity—is one that becomes more inconceivable the more closely we consider it. An absolutely new presentation, having no sort of connexion with former presentations till the subject has synthesized it with them, is a conception for which it would be hard to find a warrant either by direct observation, by inference from biology, or in considerations of an a priori kind. At any given moment we have a certain whole of presentations, a "field of consciousness," psychologically one and continuous; at the next we have not an entirely new field but a partial change within this field. Many who would allow this in the case of representations, *i.e.* where idea succeeds idea by the workings of association, would demur to it in the case of primary presentations or sensations. "For," they would say, "may not silence be broken by a clap of thunder, and have not the blind been made to see?" To urge such objections is to miss the drift of our discussion, and to answer them may serve to make it clearer. Where silence can be broken there are representations of preceding sounds and in all probability even subjective presentations of sound as well; silence as experienced by one who has heard is very different from the silence of Condillac's statue before it had ever heard. The question is rather whether such a conception as that of Condillac's is possible; supposing a sound to be, qualitatively, entirely distinct from a smell, could a field of consciousness consisting of smells be followed at once by one in which sounds had part? And, as regards the blind coming to see, we must remember not only that the blind have eyes but that they are descended from ancestors who could see. What nascent presentations of sight are thus involved it would be hard to say; and the problem of heredity is one that we have for the present left aside.

The view here taken is (1) that at its first appearance in psychical life a new sensation or so-called elementary presentation is really a partial modification of some pre-existing presentation which thereby becomes as a whole more complex than it was before; and (2) that this complexity and differentiation of parts never become a plurality of discontinuous presentations, having a distinctness and individuality such as the atoms or elementary particles of the physical world are supposed to have. Beginners in psychology, and some who are not beginners, are apt to be led astray by expositions which set out from the sensations of the special senses, as if these furnished us with the type of an elementary presentation. The fact is we never experience a mere sensation of colour, sound, touch, and the like; and what the young student mistakes for such is really a perception, a sensory presentation combined with various sensory and motor presentations and with representations—and having thus a definiteness and completeness only possible to complex presentations. Moreover, if we could attend to a pure sensation of sound or colour by itself, there is much to justify the suspicion that even this is complex and not simple, and owes to such complexity its clearly marked specific quality. In certain of our vaguest and most diffused organic sensations there is probably a much nearer approach to the character of the really primitive presentations.

Diffusion and Restriction.

In such sensations we can distinguish three variations, viz. variations of quality, of intensity, and of what Bain called massiveness, or, as we shall say, extensity. This last characteristic, which everybody knows who knows the difference between the ache of a big bruise and the ache of a little one, between total and partial immersion in a bath, is, as we shall see later on, an essential element in our perception of space. But it is certainly not the whole of it, for in this experience of massive sensation alone it is impossible to find other elements which an analysis of spatial intuition unmistakably yields. Extensity and extension, then, are not to be confounded. Now, we find, even at our level of mental evolution, that an increase in the intensity of a sensation is apt to entail an increase in its extensity too. In like manner we observe a greater extent of movement in emotional expression when the intensity of the emotion increases. Even the higher region of imagination is no exception, as is shown by the whirl and confusion of ideas incident to delirium, and, indeed, to all strong excitement. But this "diffusion" or "radiation," as it has been called, diminishes as we pass from the class of organic sensations to the sensations of the five senses, from movements expressive of feeling to movements definitely purposive, and from the tumult of ideas excited by passion to the steadier sequences determined by efforts to think. Increased differentiation seems, then, to be intimately connected with increased "restriction." Probably there may be found certain initial differentiations which for psychology are ultimate facts that it cannot explain. As already said, the very beginning of experience is beyond us, though it is our business—*working from within*—to push back our analysis as far as we can. But some differentiations being given, then it may be safely said that, in accordance with what we have called the principle of subjective selection (see § 6), attention would be voluntarily concentrated upon certain of these and upon the voluntary movements specially connected with them. To such subjectively initiated modifications of the presentation-continuum, moreover, we may reasonably suppose "restriction" to be in large measure due. But increased restriction would render further differentiation of the given whole of presentation possible, and so the two processes might supplement each other. These processes have now proceeded so far that at the level of human consciousness we find it hard to form any tolerably clear conception of a field of consciousness in which an intense sensation, no matter what, might—so to say—diffuse over the whole. Colours, *e.g.* are with us so distinct from sounds that—except as regards the excitement of attention or the drain upon it—there is nothing in the intensest colour to affect the simultaneous presentation of a sound. But at the beginning whatever we regard as the earliest differentiation of sound might have been incopresentable with the earliest differentiation of colour, if sufficiently diffused, much as a field of sight all blue is now incopresentable with one all red. Or, if the stimuli appropriate to both were active together, the resulting sensation might have been not a blending of two qualities, as purple is said to be a blending of red and violet, but rather a neutral sensation without the specific qualities of either. Now, on the other hand, colours and sounds are necessarily so far localized that we are directly aware that the eye is concerned with the one and the ear with the other. This brings to our notice a fact so ridiculously obvious that it has never been deemed worthy of mention, although it has undeniably important bearings—the fact, viz. that certain sensations or movements are an absolute bar to the simultaneous presentation of other sensations or movements. We cannot see an orange as at once yellow and green, though we can feel it at once as both smooth and cool; we cannot open and close the same hand at the same moment, but we can open one hand while closing the other. Such incopresentability or contrariety is thus more than mere difference, and occurs only between presentations belonging to the same sense or to the same group of movements. Strictly speaking, it does not always occur even then; for red and yellow, hot and cold, are presentable together provided they have certain other differences which we shall meet again presently as differences of "local sign."

Incopresentability.

Retentiveness.

12. In the preceding paragraphs we have had occasion to distinguish between the presentation-continuum or whole field of consciousness, as we may for the present call it, and those several differentiations within this field which are ordinarily spoken of as presentations, and to which—now that their true character as parts is clear—

we too may confine the term. But it will be well in the next place, before inquiring more closely into their characteristics, to consider for a moment that persistence of preceding modifications which the principle of progressive differentiation implies. This persistence is best spoken of as retentiveness. It is often confused with memory, though this is something much more complex and special; for in memory there is necessarily some contrast of past and present, whereas here there is simply the persistence of the old. But what is it that persists? On our theory we must answer, the continuum as differentiated, not the particular differentiation as an isolated unit. If psychologists have erred in regarding the presentations of one moment as merely a plurality of units, they have erred in like manner concerning the so-called residua of such presentations. As we see a certain colour or a certain object again and again, we do not go on accumulating images or representations of it, which are somewhere crowded together like shades on the banks of the Styx; nor is such colour, or whatever it be, the same at the hundredth time of presentation as at the first, as the hundredth impression of a seal on wax would be. There is no such lifeless fixity in mind. The explanations of perception most in vogue are far too mechanical and, so to say, atomistic; but we must fall back upon the unity and continuity of our presentation-continuum if we are to get a better. Suppose that in the course of a few minutes we take half a dozen glances at a strange and curious flower. We have not as many complex presentations which we might symbolize as $F_1, F_2, \ldots F_6$. But rather, at first only the general outline is noted, next the disposition of petals, stamens, &c., then the attachment of the anthers, position of the ovary, and so on; that is to say, symbolizing the whole flower as $[p'(ab)\,s'\,(cd)\,o'\,(fg)]$, we first apprehend say $[p' \ldots s' \ldots o']$, then $[p'\,(ab)\,s' \ldots o' \ldots]$, or $[p'\,(a \ldots)\,s'\,(c \ldots)\,o'\,(f \ldots)]$, and so forth. It is because the traits first attended to persist that the later form an addition to them till the complex is at length complete. There is nothing in this instance properly answering to what are known as the reproduction and association of ideas; in the last and complete apprehension as much as in the first vague and inchoate one the flower is there as a primary presentation. There is a limit, of course, to such a procedure, but the instance taken, we may safely say, is not such as to exceed the bounds of a simultaneous field of consciousness. Assuming then that such increase of differentiation through the persistence of preceding differentiations holds of the presentation-continuum as a whole, we conclude that, in those circumstances in which we now have a specific sensation of, say, red or sweet, there would be for some more primitive experience nothing but a vague, almost organic, sensation, which, however, would persist, so that on a repetition of the circumstances it could be again further differentiated. The earlier differentiations, in short, do not disappear like the waves of yesterday in the calm of to-day, nor yet last on like old scars beside new ones; but rather the two are blended and combined, so that the whole field of consciousness, like a continually growing picture, increases indefinitely in complexity of pattern.

13. *Assimilation.*—This process, in which later differentiations blend with and thereby further restrict and specialize what is retained of earlier and less definite presentations, is thus a further implication of the principle of the progressive development of the presentational continuum. When not ignored altogether this further process has been commonly regarded as merely a simple form of "association," its peculiarity being, as it was supposed, that the presentations associated—though numerically distinct—were in quality perfectly identical. In point of fact, both these assumptions seem to be erroneous and due to the so-called psychologist's fallacy.[1] For the experiencing subject there is apparently at this stage—as we have already urged—neither the numerical distinctness nor the qualitative identity which the words "past impression (A_1)" and "present impression (A_2)" suggest. Still the connexion between this process of mere blending or fusion, which we shall call *assimilation*, and the process of association proper is so close, and the detailed analysis called for so complex, that we must needs defer further discussion till we come to treat of association as a whole (cf. below, § 24). It may then be possible to show that we have here to do with a process much simpler and more fundamental than association. But it is at least clear at once that if the term *association* is to be correctly used it will imply that the presentations associated are from the first distinct, are attended to as distinct, are associated solely in consequence of such attention, and remain to the last distinguishable.

In view of the intimate connexion between differentiation, retentiveness and assimilation it will sometimes be convenient to refer to all three together as constituting what we may call the *plasticity* of the presentational continuum.

Relativity.

14. This will be the most convenient place to take note of certain psychological doctrines which, though differing in some material respects, are usually included under the term Law of Relativity.

a. Hobbes's *Sentire semper idem et non sentire ad idem recidunt* is often cited as one of the first formulations of this law; and if we take it to apply to the whole field of consciousness it becomes at once true and trite: a field of consciousness unaltered either by change of impression or of idea would certainly be a blank and a contradiction. Understood in this sense the Law of Relativity amounts to what Hamilton called the Law of Variety: "that we are conscious only as we are conscious of difference."[2] But, though consciousness involves change, it is still possible that particular presentations in the field of consciousness may continue unchanged indefinitely. When it is said that "a constant impression is the same as a blank," what is meant turns out to be something not psychological at all, as, *e.g.*, our insensibility to the motion of the earth or to the pressure of the air—cases in which there is obviously no presentation, nor even any evidence of nervous change. Or else this paradox proves to be but an awkward way of expressing what we may call accommodation, whether physiological or psychological. Thus the skin soon adapts itself to certain seasonal alterations of temperature, so that heat or cold ceases to be felt: the sensation ceases because the nervous change, its proximate physical counterpart, has ceased. Again, there is what James Mill calls "an acquired incapacity of attention," such that a constant noise, for example, in which we have no interest, is soon inaudible. In such a case of psychological accommodation we should expect also to find on the physiological side some form of central reflection or isolation more or less complete. As a rule, no doubt, impressions do not continue constant for more than a very short time; still there are sad instances enough in the history of disease, bodily and mental, to show that such a thing can quite well happen, and that such constant impressions (and "fixed ideas," which are in effect tantamount to them), instead of becoming blanks, may dominate the entire consciousness, colouring or bewildering everything.

b. From the fact that the field of consciousness is continually changing it has been supposed to follow, not only that a constant presentation is impossible, but—as a further consequence—that every presentation is essentially nothing but a transition or difference. "All feeling," says Bain, the leading exponent of this view, "is two-sided. . . . We may attend more to one member of the couple than to the other. . . . We are more conscious of heat when passing to a higher temperature, and of cold when passing to a lower. The state we have passed *to* is our *explicit* consciousness, the state we have passed *from* is our *implicit* consciousness." But the transition need not be from heat to cold, or vice versa: it can equally well take place from a neutral state, which is indeed the normal state, of neither heat nor cold; a new-born mammal, *e.g.* must experience cold, having never experienced heat. Again, suppose a sailor becalmed gazing for a whole morning upon a stretch of sea and sky, what sensations are implicit here? Shall we say yellow as the greatest contrast to blue, or darkness as the contrary of light, or both? What, again, is the implicit consciousness when the explicit is sweet; is it bitter or sour, and from what is the transition in such a case? For one thing it seems clear that the transition of attention from one presentation to another and the differences between the presentations themselves are distinct facts. It is strange that the psychologist who has laid such stress on neutral states of surprise as being akin to feeling and so distinct from special presentations, should in any way confound the two. The mistake is perhaps accounted for by the fact that Bain, in common with the rest of his school, nowhere distinguishes between attention and the presentations that are attended to. If "change of impression" and being conscious or mentally alive are the same thing, it is then manifestly tautologous to say that one is the indispensable condition of the other. If they are not the same thing, then the succession of shocks or surprises cannot wholly determine the impressions which successively determine them.

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[1] As, *e.g.* in interpreting the conduct of children as if they were already "grown-up" persons; cf. J. Ward, *Jl. of Spec. Phily.* (1882), pp. 369 *fin.* 374; James, *Prin. of Psychy.* (1890), i. 196.

[2] *The Works of Thos. Reid*, supplementary note, p. 932.

But we have still to consider whether the impressions themselves are nothing but differences or contrasts. "We do not know any one thing of itself but only the difference between it and another thing," said Bain. But it is plain we cannot speak of contrast or difference between two states or things as a contrast or difference, if the states or things are not themselves presented; the so-called contrast or difference would then be itself a single presentation, and its supposed "relativity" but an inference. Difference is not more necessary to the presentation of two objects than two objects to the presentation of difference. And, what is more, a difference between presentation is not at all the same thing as the presentation of that difference. The former must precede the latter; the latter, which requires active comparison, need not follow. There is an ambiguity in the words "know," "knowledge," which Bain seems not to have considered: "to know" may mean either to perceive or apprehend, or it may mean to understand or comprehend.[1] Knowledge in the first sense is only what we shall have presently to discuss as the recognition or assimilation of an impression (see below, § 18); knowledge in the latter sense is the result of intellectual comparison and is embodied in a proposition. Thus a blind man who cannot know light in the first sense can know about light in the second if he studies a treatise on optics. Now in simple perception or recognition we cannot with any exactness say that two *things* are perceived: straight is a thing, *i.e.* a definite object presented; not so not-straight, which answers to no definite object at all. Only when we rise to intellectual knowledge is it true to say: "No one could understand the meaning of a *straight* line without being shown a line not straight, a bent or crooked line."[2] Two distinct presentations are necessary to the comparison that is here implied; but we must first recognize our objects before we *can* compare them, and this further step we may never take. We need, then, to distinguish between the comparativity of intellectual knowledge, which we must admit—for it rests at bottom on a purely analytical proposition—and the "differential theory of presentations," which, however plausible at first sight, must be wrong somewhere, since it commits us to absurdities. Thus, if we cannot have a presentation X but only the presentation of the difference between Y and Z, it would seem that in like manner we cannot have the presentation of Y or Z, nor therefore of their difference X, till we have had the presentation of A and B say, which differ by Y, and of C and D, which we may suppose differ by Z.

The lurking error in this doctrine, that all presentations are but differences, may perhaps emerge if we examine more closely what may be meant by difference. We may speak of (*a*) differences in intensity between sensations supposed to be qualitatively identical, as *e.g.* between the taste of strong and weak tea; or of (*b*) differences in quality between presentations of the same sense, as *e.g.* between red and green; or of (*c*) differences between presentations of distinct senses, as *e.g.* between blue and bitter. Now as regards (*a*) and (*b*), it will be found that the difference between two intensities of the same quality, or between two qualities of the same order, may be itself a distinct presentation, that is to say, in passing from a load of 10 ℔ to one of 20 ℔, for example, or from the sound of a note to that of its octave, it is possible to experience the change continuously, and to estimate it as one might the distance between two places on the same road. But nothing of this kind holds of (*c*).[3] In passing from the scent of a rose to the sound of a gong or a sting from a bee we have no such means of bringing the two into relation—scarcely more than we might have of measuring the length of a journey made partly on the common earth and partly through the looking-glass. In (*c*), then, we have only a diversity of presentations, but not a special presentation of difference; and we only have more than this in (*a*) or (*b*) provided the selected presentations occur together. We say that we know the difference between a sound and a taste; but what we mean is simply that we know what it is to pass from attending to the one to attending to the other. It is simply an experience of change. Change, however, implies continuity, and there is continuity here in the movement of attention and the affective state consequent on that, but not directly in the qualities themselves.

c. If red follows green we may be aware of a greater difference than we could if red followed orange; and we should ordinarily call a 10 ℔ load heavy after one of 5 ℔ and light after one of 20 ℔. Facts like these it is which make the differential theory of presentations plausible. On the strength of such facts Wundt has formulated a law of relativity, free, apparently, from the objections just urged against Bain's doctrine. It runs thus: "Our sensations afford no absolute but only a *relative* measure of external impressions. The intensities of stimuli, the pitch of tones, the qualities of light, we apprehend (*empfinden*) in general only according to their mutual relation, not according to any unalterably fixed unit given along with or before the impression itself."[4]

But if true this law would make it quite immaterial what the impressions themselves were: provided the relation continued the same, the sensation would be the same too, just as the ratio of 2 to 1 is the same whether our unit be miles or millimetres. In the case of intensities, *e.g.* there is a *minimum sensibile* and a *maximum sensibile.* The existence of such extremes is alone sufficient to turn the flank of the thoroughgoing relativists; but there are instances enough of intermediate intensities that are directly recognized. A letter-sorter, for example, who identifies an ounce or two ounces with remarkable exactness identifies each for itself and not the first as half the second; of an ounce and a half or of three ounces he may have a comparatively vague idea. And so generally within certain limits of error, *indirectly ascertained*, we can identify intensities, each for itself, neither referring to a common standard nor to one that varies from time to time—to any intensity, that is to say, that chances to be simultaneously presented; just as an enlisting sergeant will recognize a man fit for the Guards without a yard measure and whether the man's comrades are tall or short. As regards the qualities of sensations the outlook of the relativists is, if anything, worse. In what is called Meyer's experiment (described under VISION) what appears greenish on a red ground will appear of an orange tint on a ground of blue; but this contrast is only possible within certain very narrow limits. In fact, the phenomena of colour-contrast, so far from proving, distinctly disprove that we apprehend the qualities of light only according to their mutual relation. In the case of tones it is very questionable whether such contrasts exist at all. Summing up on the particular doctrine of relativity of which Wundt is the most distinguished adherent, the truth seems to be that, in some cases where two presentations whose difference is itself presentable occur in close connexion, this difference—as we indirectly learn—exerts a certain bias on the assimilation or identification of one or both of the presentations. There is no "unalterably fixed unit" certainly, but, on the other hand, "the mutual relations of impressions" are not everything.

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[1] Other languages give more prominence to this distinction; compare γνῶναι and εἰδέναι, *noscere* and *scire*, *kennen* and *wissen*, *connaître* and *savoir*. On this subject there are some acute remarks in a little-known book, the *Exploratio philosophica*, of Professor J. Grote. Hobbes, too, was well awake to this difference, as *e.g.* when he says, "There are two kinds of knowledge; the one, sense or knowledge original and remembrance of the same; the other, science or knowledge of the truth of propositions, derived from understanding."

[2] Bain, *Logic*, i. 3.

[3] Common language seems to recognize some connexion even here or we should not speak of harsh tastes and harsh sounds, or of dull sounds and dull colours and so forth. All this is, however, superadded to the sensation, probably on the ground of similarities in the accompanying organic sensations.

[4] *Physiologische Psychologie*, 1st ed., p. 421; the doctrine reappears in later editions, but no equally general statement of it is given.

Subconsciousness.

15. The term "field of consciousness" has occurred sundry times in the course of this exposition: it is one of several employed in describing what have been incidentally referred to as "degrees or grades of consciousness"—a difficult and perplexing topic that we must now endeavour further to elucidate. Sailors steering by night are said to look at the pole-star, "the cynosure of every eye," but this does not prevent them from seeing the rest of the starry vault. At a conversazione we may listen to some one speaker while still hearing the murmur of other voices, and while listening we may also see the speaker and thereby identify him the better. What in these instances is looked at or listened to has been called the "focus" of consciousness, the rest of what is heard or seen or otherwise presented being called the "field" within which attention is thus concentrated or brought to a point. Of these objects beyond the focus we have then only a lower degree of consciousness, and the more "distant" they are from the centre of interest the fainter and obscurer they are supposed to be or to become. Now, it is obvious that the continuity here implied, if strictly taken, logically commits us to a field of consciousness extending with ever diminishing intensity *ad indefinitum.* But we have next to notice certain new features that have led psychologists to give to the term field of consciousness a more restricted meaning. A meteor flashing across the sky would certainly divert the helmsman's attention, and for the nonce he would look at that and not at the star in the Little Bear's tail; a voice at our elbow accosting us, we should turn to the new speaker and listen to him, still hearing it may be, but no longer "following," the discourse thus for us interrupted. In these cases a change in the field of consciousness brings about a non-voluntary change in the focus. But it only does so provided it is sufficiently intense and abrupt, and the more attention is already concentrated the less effective a given disturbance will be. A whole swarm of meteors might have streaked the sky unheeded while Ulysses, life in hand, steered between Scylla and Charybdis, just as all the din of the siege failed to distract Archimedes bent over his figures in the sand. On the other hand, we can voluntarily transfer the focus of consciousness to any object within the field, provided again this is sufficiently differentiated from the rest. But, more than that, we can not only of our own motion turn to lock at or to listen to what we have only seen or heard, but not noticed before; we can also look out or listen for something not as yet distinguishable, perhaps not as yet existing at all. And here again the concentration of attention may be maximal, as when a shipwrecked crew scan the horizon for a sail, or a beleaguered troop hearken for the oncoming of rescue. Now, such anticipated presentations as soon as they are clearly discernible have already a certain finite intensity, and so they are said to have passed over "the threshold"—to use Herbart's now classic phrase—and to have entered the field of consciousness. Afterwards any further increase in their intensity is certainly gradual; are we then to suppose that before this their intensity changed instantly from zero to a finite quantity and not rather that there was an ultraliminal or subliminal phrase where too it only changed continuously? The latter alternative constitutes the hypothesis of *subconsciousness.*

According to this hypothesis the total field with which we began is divided into two parts by what Fechner emphatically called "the *fact* of the threshold," and the term field of consciousness is henceforth restricted to that part within which the focus of consciousness always lies, the outlying part being the region of subconsciousness. Difficulties now begin to be apparent. The intensity or vivacity of a presentation within the field of consciousness depends partly on what we may call its inherent or absolute intensity, partly on the attention that it receives; but this does not hold of presentations in subconsciousness. These sub-presentations, as we ought perhaps to call them, cannot be severally and selectively attended to, cannot be singled out as direct objects of experience. Many psychologists have accordingly maintained not only that they cannot with propriety be called presentations, but that they have no strictly psychical existence at all. This, however, is too extreme a view. If nothing of a presentational character can exist save in the field of consciousness as thus circumscribed by a definite boundary or threshold, a breach of continuity is implied such as we nowhere else experience: even the field of sight, from which the metaphor of a field of consciousness is derived, has no such definite margin. The threshold then is not comparable to a mathematical line on opposite sides of which there is an intensive discontinuity. This has been amply proved by the psychophysical investigations of Fechner and others. We listen, say, to a certain sound as it steadily diminishes; at length we cease to hear it. Again, we listen for this same sound as it steadily increases and presently just barely hear it. In general it is found that its intensity in the former case is less than it is in the latter, and there is also in both cases a certain margin of doubt between clear presence and clear absence; the presentation seems to flicker in and out, now there and now gone. Further, in comparing differences in sensations—of weight, brightness, temperature, &c.—we may fail wholly to detect the difference between *a* and *b*, *b* and *c*, and yet the difference between *a* and *c* may be clearly perceived. We have thus to recognize the existence of a difference between sensations, although there is no so-called "sensation of difference." But if this much continuity must be admitted we can hardly fail to admit more. If differences of presentation exist within the field of consciousness beyond the outermost verge of the "threshold of difference," we cannot consistently deny the existence of any presentations at all beyond the threshold of consciousness. Since the field of consciousness varies greatly and often suddenly with the amount and distribution of attention, we must, as already said, either recognize such subconscious presentations or suppose that clearly differentiated presentations, presentations that is to say of finite intensity, pass abruptly into or out of existence with every such variation of the field.

The hypothesis of subconsciousness, then, is in the main nothing more than the application to the facts of presentation of the law of continuity, its introduction into psychology being due to Leibnitz, who first formulated that law. Half the difficulties in the way of its acceptance are due to our faulty terminology. With Leibnitz consciousness was not coextensive with all psychical life, but only with certain higher phases of it.[1] Of late, however, the tendency has been to make consciousness cover all stages of mental development, and all grades of presentation, so that a presentation of which there is no consciousness resolves itself into the manifest contradiction of an unpresented presentation—a contradiction not involved in Leibnitz's "unapperceived perception." But such is not the meaning intended when it is said, for example, that a soldier in battle is often unconscious of his wounds or a scholar unconscious at any one time of most of the knowledge "hidden in the obscure recesses of his mind." There would be no point in saying a subject is not conscious of what is not presented at all; but to say that what is presented lacks the intensity requisite in the given distribution of attention to change that distribution appreciably is pertinent enough. Subconscious presentations may tell on conscious life—as sunshine or mist tells on a landscape, or the underlying writing on a palimpsest—although lacking either the intensity or the individual distinctness requisite to make them definite features. Even if there were no facts to warrant this concept of an ultra-liminal presentation of impressions it might still claim an a priori justification.

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[1] The following brief passage from his *Principes de la nature et de la grace* (§ 4) shows his meaning: "Il est bon de faire distinction entre la *Perception*, qui est l'état intérieur de la *Monade* représentant les choses externes, et *l'Apperception*, qui est la *Conscience*, ou la connaissance réflexive de cet état intérieur, laquelle n'est point donnée à toutes les âmes, *ni toujours à la même âme.* Et c'est faute de cette distinction que les Cartésiens ont manqué, en comptant pour rien les perceptions dont on ne s'apperçoit pas, comme le peuple compte pour rien les corps insensibles" (*Op. Phil.* Erdmann's ed., p. 715).

Subconscious Ideas.

The subconscious presentation of ideas as distinct from impressions calls, however, for some special consideration. As we can turn our attention to the sensory threshold and await the entrance of an expected impression, so we may await the emergence of a "memory-image"; and again the threshold turns out to be not a mathematically exact boundary but a region of varying depth.[1] What we are trying to recollect seems first to waver, now at the tip of our tongue and the next moment completely gone, then perhaps a moment afterwards rising into clear consciousness. Sometimes when asked, say, for the name of a certain college contemporary we reply: I cannot tell, but I should know the name if I heard it. We are aware that we could "recognize," though we cannot "reproduce." At other times we are confident that even recognition is no longer possible, and still if we met the man himself in the old scenes and heard his voice his name might yet recur. Nevertheless, it may be urged, it is surely incredible that all the incidents of a long lifetime and all the items of knowledge of a well-stored mind that may possibly recur—"the infinitely greater part of our spiritual treasures," as Hamilton says—are severally retained and continuously presented in the form and order in which they were originally experienced or acquired. This, however, is not implied. Images in contrast to impressions have always a certain generality. The same image may figure in very various connexions, as may the same letter, for example, in many words, the same word in many sentences. We cannot measure the literature of a language by its vocabulary, nor may we equate the extent of our "spiritual treasures" when these are successively unfolded with the psychical apparatus, so to say, in which they are subconsciously involved.[2] Take the first book of the *Aeneid*, which, as Macaulay would say, every schoolboy knows: as subconsciously involved, when the boy is not thinking of it, his knowledge is more comparable to a concordance than to the text itself, which nevertheless can be reproduced from it. In the text Aeneas occurs many times, in the concordance as a heading but once. But give him the cue *Aeneas scopulum*, and the boy reels off from the 180th line; or *Praecipue pius Aeneas*, and he starts with the 220th. But ask him for the 580th line; he is probably helpless, while a dunce with the book in his hand can read it off at once. Say instead *Et pater Aeneas*, and the boy can straightway complete the line while the dunce is now helpless. So though its explicit revival is successional, occurs, so to say, in single file, a whole scheme in which many ideas are involved may rise *towards* the threshold together. When our schoolboy, for example, turns from classics to geography, the mention of Atlas, which might then have recalled a Titan, now leads him to think only of his book of maps. And there is a like sudden shifting of the substratum of our thoughts, when, taking up the morning paper, we glance first at the foreign telegrams, then at the money market, and then at the doings of our political friends. Yet more remote than all, obscurer but more pervasive, like the clouds of cherubs or imps vaguely limned in medieval pictures, are the indefinite constituents of our emotional atmosphere, "gay motes that people the sunbeams" of our cheerfulness and make all *couleur de rose*, or "horrid shapes and sights unholy" that overcast the outlook when we "have the blues." And as attention relaxes, these advance into the foreground and become more or less palpable hopes or fears.

Because of the manifold forms into which they may evolve, subconscious images, while still involved, are sometimes called "psychical" or more definitely "presentational dispositions." The word *disposition* means primarily an arrangement, as when we talk of the disposition of troops in a battle or of cards in a game; the *disposita*, that is to say, are always something actual. Which of several potential dispositions they will actually assume will depend upon circumstances, but at least, as Leibnitz long ago maintained, "les puissances véritables ne sont jamais des simples possibilités." What is requisite to the realization of a given potentiality is sometimes a condition to be added, sometimes it is one to be taken away. A locomotive with the fire out has no tendency to move, but with steam up it is only hindered from moving by the closure of the throttle-valve or the friction of the brake. Now presentational dispositions we assume to be of the latter sort. They are processes or functions more or less inhibited, and the inhibition is determined by their relation to other psychical processes or functions. The analysis and genesis of these presentational interactions will occupy us at length by and by; it may then be possible to explain the gradual involution of what was successively unfolded in explicit consciousness into those combinations which Herbart called "apperception-masses," combinations devoid of the concrete hints of date and place which are essential to memory. Meanwhile the evidence adduced—decidedly cogent though admittedly indirect—together with the difficulties besetting the extreme view that beyond or below the threshold of consciousness there is nothing presentational, seems clearly to justify the hypothesis of subconsciousness. At the same time the principle of continuity, everywhere of fundamental importance when we are dealing with reality, forbids the attempt arbitrarily to assign any limits to the subconscious.

Many psychologists have proposed to explain subconscious retention by habit. But it is obvious that habit itself implies retention and is practically synonymous with disposition; it must therefore presuppose *disposita* if we are to escape the absurdities of *puissances ou facultés nues*, with which in this very connexion Leibnitz twitted Locke. Yet, obvious as all this may be, it is frequently ignored even by those who are fond of exposing the pretended explanations of the "faculty-psychologists" and quoting Molière to confute them. Thus we find J. S. Mill arguing: "I have the power to walk across the room though I am sitting in my chair; but we should hardly call this power a latent act of walking."[3] Nor should we call it a power at all if Mill had been paralysed, or if, instead of sitting in his chair, he had been lying in his cradle. What we want is the simplest psychological description of the situation after the power has been acquired by practice and is still retained. In such a case we can be conscious of the "idea" of the movement without the movement actually ensuing; yet only in such wise that the idea is more apt to pass over into action the intenser it is, and often actually passes over in spite of us. Surely there must be some functional activity answering to this conscious presentation; why may not a much less amount of it be conceived possible in subconscious presentation?

Sensation, Movement and the External World.

Definition of Sensation.

16. On the view of experience here maintained, we are bound to challenge the description of sensations[4] as due to physical stimuli—widely current though it is—as one that is psychologically inappropriate. The following definition, given by Bain, may be taken as a type: "By sensations, in the strict meaning, we understand the mental impressions, feelings or states of consciousness following on the action of external things on some part of the body, called on that account sensitive."[5] It is true, no doubt, that what the psychologist calls sensibility has as its invariable concomitant what physiologists call sensibility,

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[1] Herbart and Fechner describe subconscious presentations generally as existing *below* the threshold. On the other hand, we have spoken of subconscious *sensations* as existing *beyond* it. In view of the important differences between the two forms of presentations primary and secondary, this distinction of ultra-liminal and subliminal seems convenient and justifiable.

[2] This doctrine of the involution and evolution of ideas we owe to Leibnitz. Herbart attempted in a very arbitrary and a priori fashion to develop it into a physical statics and dynamics with the result—usual to extreme views—that later psychologists neglected it altogether. There are now signs of a fresh reaction, and we shall continually come across evidence of the wide range and great importance of the doctrine as we proceed.

[3] *Examination of Sir W. Hamilton's Philosophy*, 3rd ed., p. 329.

[4] For a detailed account of the various sensations and perceptions pertaining to the several senses the reader is referred to the articles VISION; HEARING; TOUCH; TASTE; SMELL, &c.

[5] *Senses and Intellect*, 4th ed. (1894), p. 101.

or what the more careful of them call irritability; and, true again, that this irritability is invariably preceded by a physical process called stimulation. But it may be urged, why not recognize a connexion that actually obtains, since otherwise sensation must remain unexplained? Well, in the first place, such "psychophysical" connexion is not a psychological explanation: it cannot be turned directly to account in psychology, either analytic or genetic. Next the psychological fact called sensation always is, and at bottom always must be, independently ascertained; for the physiological "neurosis" or irritation has not necessarily a concomitant "psychosis" or sensation and, strictly dealt with, affords no hint of such. Finally, this inexplicability of sensation is a psychological fact of the utmost moment: it answers to what we call reality in the primary sense of the term. The psychophysicist, in setting out to explain sensation, has—unawares to himself—left this fundamental reality behind him. For it belongs essentially to individual experience, and this—in assuming the physical standpoint—he has of course transcended. Nevertheless the mistake of method that here reveals itself was perhaps inevitable, for the facts of another's sense-organs and their physical excitants must have obtruded themselves on observation long before the reflective attitude was advanced enough to make strictly psychological analysis possible. The psychophysical standpoint, that is to say, was attained before the purely psychological; and the consequent bias is only now in process of correction. A series of physical processes, first without and then within the organism—ethereal or aërial vibrations, neural and cerebral excitations—was the starting-point. What comes first, immediately, and alone, in the individual's experience, and is there simply and positively *real*, was then misinterpreted as subjective modification, mental impression, *species sensibiles*, or the like. For from the days of Democritus to our own the same crude metaphor has prevailed without essential variation. And here the saying holds: *Vestigia nulla retrorsum.* Into the man's head the whole world goes, including the head itself. Such thoroughgoing "introjection" affords no ground for subsequent "projection." Thus the endeavour to explain sensation overreaches itself: the external object or thing that was supposed to cause sensations and to be therefore distinct from them, was in the end wholly resolved into these and regarded as built out of them by association (Mill) or by apperceptive synthesis (Kant). But no "mental chemistry," no initial alchemy of "forms," can generate objective reality from feelings or sense-impressions as psychophysically defined.[1] A's experience as it is for B is not real but inferential; and if the grounds of the inference, which are the only realities for B, are to be regarded as the causes of which A's experiences are merely the effects, then the two experiences are on a wholly different footing. When A treats B in the same fashion we get the world in duplicate: (1) as original and outside, *i.e.* as *cause*, and (2) as copied within each percipient's head, *i.e.* as *effect*. But when B interprets his own experience as he had interpreted A's we seem to have lost the real world altogether. In presence of this dilemma, the philosophers of our time, as already said, are feeling it needful to revise their psychology. The question of method is vital. If the psychophysical standpoint were the more fundamental, psychology would be based on physiology, and the old definition of sensation might stand. If, on the other hand, it is the exclusive business of psychology to analyse and trace the development of individual experience as it is for the experiencing individual, then—however much neurological evidence may be employed as a means of ascertaining psychological facts—the facts themselves must be scrupulously divested of all physical implications, the psychophysical method takes a secondary place, and the objective reality of "sensory" presentations stands unimpeached.

The duality of subject and object in experience compels us also to object to the description of sensations as "states of consciousness." Since it is the subject, not the object that *is* conscious, the term state of consciousness implies strictly a subjective reference; and so it is only applicable to sensations, if they are regarded as subjective modifications, either affective or active. The former would identify sensation with feeling, and this—for reasons already given—we must disallow. But it is true that a sensation, like other presentations, implies the subjective activity we call attention; it is not, however, a modification or state of this activity, but the object of it. This relation is expressed in German by means of the distinction generally of *Vorstellen* and *Vorstellung* and in the present case of *Empfinden* and *Empfindung*; and German psychology has gained in clearness in consequence. The distinction of conception and concept (conceit) is to be found in older English writers and was revived by Sir W. Hamilton, who suggested also the analogous distinction of perception and percept. It would be a great gain if there were a corresponding pair of terms to distinguish between "the sensing act" and the object "sensed," as some have been driven to say. Reception and recept at once occur and seem unexceptionable—apart, of course, from their novelty.[2] At any rate, if we are to rest content with our present untechnical terminology we must understand sensations to mean objective changes as they first break in upon the experience of our psychological individual; in this respect Locke's term "impression" has a certain appropriateness.

Characteristics of Sensation.

What we ordinarily call a single sensation has not only a characteristic quality but it is also quantitatively determined in respect of intensity, protensity (or duration) and extensity. A plurality of properties, it may be said, straightway implies complexity of some sort. This is obvious and undeniable; psychological—as distinct from psychical[3]—analysis of simple sensations is possible, and the description just given is reached by means of it. Such analysis, however, presupposes the comparison of many sensations; but to the complexity it discloses there is no answering plurality discernible in the immediate experience of a single sensation. To make this clearer let us start from a case in which such plurality *can* be directly verified. In a handful of rose petals we are aware at once of a definite colour, a definite odour and a definite "feel." Here there is a plurality (a+b+c), any part of which can be withdrawn from our immediate experience without prejudice to the rest, for we can close the eyes, hold the nose, or drop the petals on the table. Let us now turn to the colour alone; this we say has a certain quality, intensity, extensity, &c. But not only have we not one sense for quality, another for intensity, &c., but we cannot reduce the intensity to zero and yet have the quality remaining; nor can we suppress the quality and still retain the extensity. In this case then what we have is not a plurality of presentations (a+b+c), but a single presentation having a plurality of attributes (a b c) so related that the absence of any one annihilates the whole. But though, as already said, such single presentation gives, as it stands, no evidence of this plurality, yet it is to be remembered that in actual experience we do not deal with sensations in isolation; here, accordingly, we find evidence in plenty to justify our psychological analysis. In innumerable cases we experience varieties of intensity with little or no apparent change of quality, as happens, for example, when a sounding pitch-pipe is moved towards or away from the ear; and continuous changes of quality without any change of intensity, as happens when the pipe is shortened or lengthened without any alteration of position. We may have tactual or visual sensations which vary greatly in extensity without any striking change of quality, and we may have such sensations in every possible variety of quality without any changes of extensity.

The numerous and striking diversities among our present sensations are obviously not primordial; what account then can we give of their gradual differentiation? Some psychologists have assumed the existence of absolute "units of sensibility," all identically the same, and explain the unlikenesses in our existing sensations as resulting "from unlike modes of integration of these absolute units."[1]

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[1] Nothing shows this more plainly than the newly-coined term *epiphenomenon* now applied in this connexion

[2] Reception does not in English suggest the taking *back* of the Latin *recipere*; it expresses only the comparative passivity of sense. In contrast to *percipere* (to take entire possession of) it implies the absence of that assimilation which is essential to perception; and finally it contrasts appropriately with retention.

[3] This distinction, though continually overlooked, is vitally important. By *psychological* analysis we mean such analysis as the psychological observer can reflectively make, by *psychical* analysis only such analysis as is possible in the immediate experience of the subject observed.

Differentiation of Sensation.

The sole evidence on which they rely is physiological, the supposed existence of a single nerve shock or neural tremor. It is true that in an extirpated nerve what is known as the "negative variation" is approximately such an isolated event of uniform quality. But the same cannot be said of what happens during the stimulation of a nerve *in situ* with its peripheral and central connexions still intact. The only evidence apparently to which we can safely appeal in this inquiry is that furnished by biology. Protoplasm, the so-called "physical basis of life," is amenable to stimulation by every form of physical agency—mechanical, chemical, thermal, photical, electrical—with the single exception of magnetism; and in keeping with this it is found that unicellular organisms respond, and respond in ways more or less peculiar, to each of these possible modes of excitation. Since, so far as is known, there is no morphological separation of function in these lowest forms of life, it is reasonably assumed that the single cell acts the part of "universal sense-organ," and that the advance to such complete differentiation of sense-organs as we find among the higher vertebrates has been a gradual advance. Numerous facts can now be adduced of the occurrence of "transitional" or "alternating" sense-organs among the lower forms of multicellular animals; organs, that is to say, which are normally responsive to two or more kinds of stimulus, and thus hold an intermediate position between the universal sense-organ of the *Protozoa* and the special sense-organ of the *Mammalia*. For example, a group of cells which would behave towards all stimuli impartially were they independent unicellular organisms become, as an organ in a multicellular organism, amenable only to mechanical or only to chemical stimuli,—become, that is to say, an organ of touch and of hearing, or an organ of taste and also of smell; until, finally, when differentiation is sufficiently advanced, the group ends by becoming exclusively the organ of one specified sense, touch *or* hearing in the one case, taste *or* smell in the other.[2] Of course the imperfectly specialized sensations, say of the leech, and still more the wholly unspecialized sensations of the amoeba, cannot be regarded as blends of some or all of those which we are said to receive through our five senses. We must rather suppose that sensations at the outset corresponded very closely with the general vital action of stimuli as distinct from their action on specially differentiated sensory apparatus. Even now we are still aware of the general effects of light, heat, fresh air, food, &c., as invigorating or depressing quite apart from their specific qualities. Hence the frequent use of the term general or common sensibility (*coenesthesis*). But, though less definitely discriminated, the earlier, and what we call the lower, sensations are not any less concrete than the later and higher. They have been called general rather than specific, not because psychologically they lack any essential characteristic of sensation which those acquired later possess, but simply because physiologically they are not, like these, correlated to special sense-organs.

Complexity of Sensations.

But, short of resolving such sensations into combinations of one primordial modification of consciousness, if we could conceive such, there are many interesting facts which point clearly to a complexity that we can seldom directly detect. Several of our supposed sensations of taste, *e.g.*, are complicated with sensations of touch and smell: thus the pungency of pepper and the dryness of wine are tactual sensations, and their spicy flavours are really smells. How largely smells mingle with what we ordinarily take to be simply tastes is best brought home to us by a severe cold in the head, as this temporarily prevents the access of exhalations to the olfactory surfaces. The difference between the smooth feel of a polished surface and the roughness of one that is unpolished, though to direct introspection an irresolvable difference of quality, is probably due to the fact that several nerve-terminations are excited in each case: where the sensation is one of smoothness all are stimulated equally; where it is one of roughness the ridges compress the nerve-ends more, and the hollows compress them less, than the level parts do. The most striking instance in point, however, is furnished by the differences in musical sounds, to which the name *timbre* is given. To the inattentive or uninstructed ear notes or "compound tones" appear to be only qualitatively diverse and not to be complexes of simple tones. Yet it is possible with attention and practice to distinguish these partial tones in a note produced on one instrument, a horn, say, and to recognize that they are different from those of the same note produced on a different instrument, for example, a violin.

In like manner many persons believe that they can discriminate in certain colours, hence called "mixed," the elementary colours of which they are held to be composed; red and yellow, for example, in orange, or blue and red in violet. But in so thinking they appear to be misled, partly by the resemblance that certainly exists between orange and red, on the one hand, and orange and yellow on the other, the two colours between which in the colour spectrum it invariably stands; and partly by the knowledge that, as a pigment, orange is obtainable by the mixture of red and yellow pigments; and so in the other cases. As we shall see later, however (§ 39), in this particular case of sensory continua, resemblance is no proof of complexity. Were it otherwise we should have to conclude that a given tone, since this also resembles the two between which it is intermediate, ought to be a blend of both; whereas, in point of fact, the tone *d*—though as regards pitch it has a certain resemblance to *c* and *e*, its neighbours on either side—differs widely from the chord *c-e*, which is made up of these. In all cases in which the psychical complexity of a sensation is beyond dispute the partial sensations are distinguished by discernible differences of extensity, and usually of intensity as well. Thus, if the skin be touched by the point of a hot or cold bradawl the temperature sensation has not the punctual character of the touch but seems rather to surround this as a sort of penumbra. Similarly, the ground-tone of a clang-complex has not only a greater intensity but also a greater extensity than any of the over-tones.[3] There is also in such cases a certain rivalry or antagonism between the complex as an unanalysed whole and the complex as analysed, and even between the several partial sensations after such analysis. In the absence of such direct evidence it is unwarrantable to infer psychical complexity from complexity in the physical stimuli, even when this is really present. In the case of pigment mixture, however, there is no such physical complexity as is vulgarly supposed. And it is worth noting that white light is physically the most complex of all, whereas the answering sensation is not only simple but probably the most primitive of all visual sensations.

Quantitative Continuity.

Every sensation within the fields of consciousness has sensibly some continuous duration and seems sensibly to admit of some continuous variation in intensity and extensity. But whether this quantitative continuity of presentational change is more than apparent has been questioned. Sensations of almost liminal intensity are found to fluctuate every few seconds, and, as already remarked, when the threshold of intensity is actually reached, they seem intermittently to appear and disappear, a fact which Hume long ago did not fail to notice. The results of numerous experiments, however, justify the conclusion that these variations are due primarily to oscillation of attention, and furnish so far no ground for the assumption that even the liminal sensation is discontinuous. But again we can only detect a difference of intensity when this is of finite amount and bears a certain constant ratio to the initial intensity with which it is compared —a fact commonly known as Weber's Law. But this imperfection in our power of discrimination is no proof that our sensations vary discontinuously; and not only is there no positive evidence in favour of such discontinuity, but it is altogether improbable on general grounds. Lastly, there is always more or less distinctness in the several nerve-endings as well as isolation of the nerve-fibres themselves. The skin, for example, when carefully explored, turns out to be a complex mosaic of so-called "spots," severally responding to stimulation by sensations of pressure, heat, cold and pain. But from this to argue that the extensity of a sensation is really a mere aggregate without any continuity is on a par with calling a lake a collection of pools because it is fed by separate streams. If it could be shown that in the brain as a whole there is no functional continuity a formidable psychophysical problem would no doubt arise.

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[1] Cf. G. H. Lewes, *Problems of Life and Mind* (1879), vol. iii. pp. 250 sqq.; H. Spencer, *Principles of Psychology*, vol. i. § 60.

[2] Cf. W. A. Nagel, "Die Phylogenese specifischer Sinnesorgane," *Bibliotheca zoologica* (1894), pp. 1-42.

[3] Cf. Stumpf, *Tonpsychologie*, ii. 58 seq.

Quality of Sensations.

As regards the quality of sensations—the primitive sensation of sight appears to consist only of the single quality we call "light," a quality which ranges in intensity from a dazzling brightness that becomes painful and blinding down to a zero of complete darkness; a limit which, however, is never completely attained, since the retina is always more or less internally stimulated—hence what is called the eye's own light (*Eigenlicht*). The first responses to light-stimulation seem to be very much on a par with our own to diffused heat or cold; some organisms seek the light and others shun it. As little as our temperature-sense yields us a perception of form does the light-sense at this level yield any. Not until the stage of visual spatial perception is reached and some discrimination of form is possible, do black and white attain the meaning they now have for us. An object can be visually perceived only when its colour or shade differs from that of the surrounding field; so far black as a "secondary quality" is on a par with colour, that is to say, when we are talking of things it may be called a quality. But there is still an important difference; in a light field many colours or shades may be distinguished, but in a dark field none. Though it is correct to speak of perceiving a black object, must we not then maintain that—so far as it is really black[1]—the object yields us directly no sensation? Similarly, the piper is said to "feel" the holes in his whistle when actually he only touches the solid metal in which they are pierced; or the soldier is said to hear the tattoo, though he has no auditory sensation of the silence intervening between successive taps on the drum. And it has yet to be shown that there is any more justification for speaking of visual sensations without luminosity. Meanwhile we must maintain that in absolute darkness we do not *see* black, since we do not see at all. No doubt we are prone to identify the two concepts darkness and blackness, for what we may call their sensory content is the same, viz. the absence of visual sensation.

Whereas in nature the only diffused light we need consider is that emitted by the sun, the rays transmitted by the things about us vary in physical quality and in their effects upon protoplasm. As soon, therefore, as visual forms can be distinguished, a differentiation among light-sensations becomes obviously advantageous. The first colours to be differentiated were probably yellow and blue, or perhaps it would be truer to say "warm" colour and "cold" colour, upon which there followed a further differentiation of the warm colour into red and green.[2] It is interesting to note that all possible sensations of colour constitute a specific continuum. We may represent it by a sphere, in which (*a*) the maximum of luminosity is at one pole and the minimum at the other; (*b*) the series of colours proper (red to violet and through purple back to red), constituting a closed line, are located round the equator or in zones parallel to it, according to shade; and (*c*) the amount of saturation (or absence of white) for any given zone of illumination increases with distance from the axis.

In dealing with the quality of auditory sensations we have to distinguish between the simple sensations called tones and the sensation-complexes, either clangs or noises, which result from their combination. Simple tones also constitute a qualitative continuum, but it has only one dimension, their so-called "pitch"; this may be represented by a straight line ranging between two more or less indefinite extremes. If intensity, that is to say loudness, is taken into account, we have of course a continuum of two dimensions. The tone-continuum is also universally regarded as steadily diminishing in massiveness or extensity as the pitch rises. And, in fact, as we approach the lower limit, the so-called deep or grave tones become less "even," till at length distinct, more or less pervasive, tremors are felt rather than heard as distinct impulses on the ear-drum. The so-called high or acute tones again, as we approach their limit, are accompanied by tactual, often more or less painful, sensations, as if the ear were pierced by a fine needle. This connexion of auditory with tactual sensations confirms the independent evidence of biology pointing to an original differentiation of sound from touch. The special characteristics of tone-complexes, whether clangs or noises, are due to the remarkable analytic power which belongs to the sense of hearing. Two colours cannot be simultaneously presented unless they are differently localized, but several tones may form one complex whole within which they, as "partial" tones, are distinguishable, though spatially undifferentiated.

Unlike the higher senses of sight and hearing, the lower senses of touch, taste, smell, &c., do not constitute qualitative continua. Temperatures may indeed be represented as ranging in opposite directions, *i.e.* through heat or through cold, between a zero of no sensation and the organic sensations due to the destructive action of both extremes, heat and cold alike. But the continuity in this case is intensive rather than qualitative. Tastes fall into the four isolated qualities known as sweet, sour, bitter, saline; but smells hardly admit of classification at all. Sensations of touch and sight have in a pre-eminent degree a certain peculiar continuity which differentiations of extensity entail, and which we shall have presently to consider further under the title of local signs. The various sensations classed together as organic, hunger, thirst, physical pain, &c., are left to the physiologist to describe.

Movements.

Our motor presentations contrast with the sensory by their want of striking qualitative differences. They are divided into two groups: (*a*) motor presentations proper and (*b*) auxilio-motor of kinaesthetic presentations. The former answer to our "feelings of muscular effort" or "feelings of innervation." The latter are those presentations due to the straining of tendons, stretching and flexing of the skin, and the like, by which the healthy man knows that his efforts to move are followed by movement, and so knows the position of his body and limbs. It is owing to the absence of these presentations that the anaesthetic patient cannot directly tell whether his efforts are effectual or not, nor in what position his limbs have been placed by movements from without. Thus under normal circumstances motor presentations are always accompanied by auxilio-motor; but in disease and in passive movements they are separated and their distinctness thus made manifest. Originally we may suppose kinaesthetic presentations to have formed one imperfectly differentiated continuum, but now, as with sensations, they have become a collection of special continua, viz. the groups of movements possible to each limb and certain combinations of these movements.

But whereas kinaesthetic presentations were commonly allowed to be purely sensory, the concomitants of centripetal excitations—hence the older name of "muscular or sixth sense" applied to them by Sir Charles Bell, Weber, Sir William Hamilton and others—concerning motor presentations proper, a very different view, first tentatively advanced by the great physiologist Johannes Müller, and adopted by Helmholtz, Wundt, and especially by Bain, long prevailed. It is, however, now generally discredited, if not completely overthrown.[3] According to this view, "the characteristic feeling of exerted force" must be regarded, Bain maintained, "not as arising from an inward transmission . . . but as the concomitant of the *outgoing* current by which the muscles are stimulated to act" (*op. cit.* p. 79). The necessity for this assumption has certainly not been established on physiological grounds, nor apparently did Bain rely primarily on these; for at the very outset of his discussion we find him saying "that action is a more intimate and inseparable property of our constitution than any of our sensations, and enters as a component part into every one of our senses" (*op. cit.* p. 59). But this important psychological truth is affirmed as strenuously by some, at any rate (*e.g.* Professor James) of Bain's opponents as it was by Bain himself. Unhappily many, under the same psychophysical bias and so induced, like the upholders of this innervation theory, to look for evidence of subjective activity in the wrong place, have been led to doubt or to deny the reality of this activity altogether. In fact, this theory, while it lasted, tended to sustain an undue separation of so-called "sensory" from so-called "motor" presentations, as if living experience were literally an alternation of two independent states, one wholly passive and the other wholly active, corresponding to the anatomical distinction of organs of sense and organs of movement. The subject of experience or Ego does not pass to and fro between a *sensorium commune* or intelligence department and a *motorium commune* or executive, is not in successive intervals receptive and active, still less always passive, but rather always actively *en rapport* with an active Non-Ego, commonly called the External World.

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[1] As a matter of fact there are no objects absolutely black, none that are devoid of all lustre and completely absorbent of light. But this does not affect the argument.

[2] It is assumed that the physiological differentiation of the retina has advanced from the centre, where vision is most distinct, towards the margin where it is least so; and it is found that stimulation of the margin yields none but achromatic sensations, stimulation of a certain intermediate zone only sensations of yellow or blue, and central stimulation alone sensations of every hue. Further, total colour-blindness is extremely rare, whereas red-green colour-blindness is comparatively common.

[3] Cf. Bastian, *The Brain as an Organ of Mind* (1880), pp. 691 sqq.; Ferrier, *The Functions of the Brain* (1886), 2nd ed. pp. 382 sqq.; James, *Principles of Psychology* (1890), ch xxvi.

Perception.

Mental Synthesis or Integration.

17. In treating apart of the differentiation of our sensory and motor continua, as resulting merely in a number of distinguishable sensations and movements, we have been compelled by the exigencies of exposition to leave out of sight another process which really advances *pari passu* with this differentiation, viz. the integration or synthesis of these proximately elementary presentations into those complex presentations which are called percepts, intuitions, sensori-motor reactions and the like. It is, of course, not to be supposed that in the evolution of mind any creature attained to such variety of distinct sensations and movements as a human being possesses without making even the first step towards building up this material into the most rudimentary knowledge and action. On the contrary, there is every reason to think, as has been said already incidentally, that further differentiation was helped by previous integration, that perception prepared the way for distincter sensations, and purposive action for more various movements. This process of synthesis, which is in the truest sense a psychical process, deserves some general consideration before we proceed to the several complexes that result from it. Most complexes, certainly the most important, are consequences of that principle of subjective selection whereby interesting sensations lead through the intervention of feeling to movements; and the movements that turn out to subserve such interest come to have a share in it. In this way—which we need not stay to examine more closely now—it happens that a certain sensation, comparatively intense, and a certain movement, definite enough to control that sensation, engage attention, to the more or less complete exclusion of the other less intense sensations and more diffused movements that accompany them. Apart from this intervention of controlling movements, the presentation-continuum, however much differentiated, would remain for all purposes of knowledge little better than the disconnected manifold for which Kant took it. At the same time it is to be remembered that the subject obtains command of particular movements out of all the mass involved in emotional expression only because such movements prove on occurrence adapted to control certain sensations. A long process, in which natural selection probably played the chief part at the outset—subjective selection becoming more prominent as the process advanced—must have been necessary to secure as much purposive movement as even a worm displays. We must look to subjective interest to explain, so far as psychological explanation is possible, those syntheses of motor and sensory presentations which we call spatial perception and the intuitions of material things. For example, some of the earliest lessons of this kind seem to be acquired as we may presently see, in the process of exploring the body by means of the limbs,—a process for which grounds in subjective interest can obviously never be wanting.

Meaning of Perception.

Perception sometimes means only the recognition of a sensation or movement as distinct from its original presentation, thus implying the more or less definite revival of certain residua of past experience which resembled the present. More frequently it is used as the equivalent of what has been otherwise called the "localization and projection" of sensations—that is to say, of sensations apprehended either as affections of some part of our own body regarded as extended or as states of some foreign body beyond it. According to a former usage, strictly taken, there might be perception without any spatial presentation at all; a sensation that had been attended to a few times might be perceived as familiar. According to the latter, an entirely new sensation, provided it were complicated with motor experiences in the way required for its localization or projection, would be perceived. But as a matter of fact actual perception probably invariably includes both cases: impressions which we recognize we also localize or project, and impressions which are localized or projected are never entirely new—they are, at least, perceived as sounds or colours or aches, &c. It will, however, frequently happen that we are specially concerned with only one side of the whole process, as is the case with a tea-taster or a colour-mixer on the one hand, or, on the other, with the patient who is perplexed to decide whether what he sees and hears is "subjective," or whether it is "real." But there is still a distinction called for: perception as we now know it involves not only recognition (or assimilation) and localization, or "spatial reference," as it is not very happily termed, but it usually involves "objective reference" as well. We may perceive sound or light without any presentation of that which sounds or shines; but none the less we do not regard such sound or light as merely the object of our attention, as having only immanent existence, but as the quality or change or state of a thing, an object distinct not only from the subject attending but from all presentations whatever to which it attends. Here again the actual separation is impossible, because this factor in perception has been so intertwined throughout our mental development with the other two. Still a careful psychological analysis will show that such "reification," as we might almost call it, has depended on special circumstances, which we can at any rate conceive absent. These special circumstances are briefly the constant conjunctions and successions of impressions, for which psychology can give no reason, and the constant movements to which they prompt. Thus we receive together, *e.g.* those impressions we now recognize as severally the scent, colour, and "feel" of the rose we pluck and handle. We might call each a "percept," and the whole a "complex percept." But there is more in such a complex than a sum of partial percepts; there is the apprehension or intuition of the rose as a thing having this scent, colour and texture. We have, then, under perception to consider (*a*) the recognition and (*b*) the localization of impressions, and (*c*) the intuition of things.

Assimilation of Impressions.

18. The range of the terms recognition or assimilation of impressions is wide: between the simplest mental process they may be supposed to denote and the most complex there is a great difference. The penguin that watched unmoved the first landing of man upon its lonely rock becomes as wild and wary as more civilized fowl after two or three visits from its molester: it then recognizes that featherless biped. His friends at home also recognize him though altered by years of peril and exposure. In the latter case some trick of voice or manner, some "striking" feature, calls up and sustains a crowd of memories of the traveller in the past—events leading on to the present scene. The two recognitions are widely different, and it is from states of mind more like the latter than the former that psychologists have usually drawn their description of perception. At the outset, they say, we have a primary presentation or impression P, and after sundry repetitions there remains a mass or a series of P residua, $p_1 p_2 p_3 \dots$; perception ensues when, sooner or later, P_n "calls up" and associates itself with these representations or ideas. Much of our later perception, and especially when we are at all interested, awakens, no doubt, both distinct memories and distinct expectations; but, since these imply previous perceptions, it is obvious that the earliest form of recognition, or, as we might better call it, assimilation, must be free from such complications, can have nothing in it answering to the overt judgment, P_n is a P. Assimilation involves retentiveness and differentiation, as we have seen, and prepares the way for re-presentation; but in itself there is no confronting

the new with the old, no determination of likeness, and no subsequent classification. The pure sensation we may regard as a psychological myth; and the simple image, or such sensation revived, seems equally mythical, as we may see later on. The nth sensation is not like the first: it is a change in a presentation-continuum that has itself been changed by those preceding; and it cannot with any propriety be said to reproduce these past sensations, for they never had the individuality which such reproduction implies. Nor does it associate with images like itself, since where there is association there must first have been distinctness, and what can be associated can also, for some good time at least, be dissociated.

Localization of Impressions.

19. To treat of the localization of impressions is really to give an account of the steps by which the psychological individual comes to a knowledge of space. At the outset of such an inquiry it seems desirable first of all to make plain what lies within our purview, and what does not, lest we disturb the peace of those who, confounding philosophy and psychology, are ever eager to fight for or against the a priori character of this element of knowledge. That space is a priori in the epistemological sense it is no concern of the psychologist either to assert or to deny. Psychologically a priori or original in such sense that it has been either actually or potentially an element in all presentation from the very beginning it certainly is not. It will help to make this matter clearer if we distinguish what philosophers frequently confuse, viz. the concrete spatial experiences, constituting actual localization for the individual, and the abstract concept of space, generalized from what is found to be common in such experiences. A gannet's mind "possessed of" a philosopher, if such a conceit may be allowed, would certainly afford its tenant very different spatial experiences from those he might share if he took up his quarters in a mole. So, any one who has revisited in after years a place from which he had been absent since childhood knows how largely a "personal equation," as it were, enters into his spatial perceptions. Or the same truth may be brought home to him if, walking with a friend more athletic than himself, they come upon a ditch, which both know to be twelve feet wide, but which the one feels he can clear by a jump and the other feels he cannot. In the concrete "up" is much more than a different direction from "along." The hen-harrier, which cannot soar, is indifferent to a quarry a hundred feet above it—to which the peregrine, built for soaring, would at once give chase—but is on the alert as soon as it descries prey of the same apparent magnitude, but upon the ground. Similarly, in the concrete, the body is the origin or datum to which all positions are referred, and such positions differ not merely quantitatively but qualitatively. Moreover, our various bodily movements and their combinations constitute a network of co-ordinates, qualitatively distinguishable but geometrically, so to put it, both redundant and incomplete. It is a long way from these facts of perception, which the brutes share with us, to that scientific concept of space as having three dimensions and no qualitative differences which we have elaborated by the aid of thought and language, and which reason may see to be the logical presupposition of what in the order of mental development has chronologically preceded it. That the experience of space is not psychologically original seems obvious—quite apart from any successful explanation of its origin—from the mere consideration of its complexity. Thus we must have a plurality of objects—*A* out of *B*, *B* beside *C*, distant from *D*, and so on; and these relations of externality, juxtaposition, and size or distance imply further specialization; for with a mere plurality of objects we have not straightway spatial differences. Juxtaposition, *e.g.* is only possible when the related objects form a continuum; but, again, not any continuity is extensive. Now how has this complexity come about?

Extensity.

The first condition of spatial experience seems to lie in what has been noted above (§ 11) as the extensity of sensation. This much we may allow is original; for the longer we reflect the more clearly we see that no combination or association of sensations varying only in intensity and quality, not even if motor presentations are added, will account for this space-element in our perceptions. A series of touches *a*, *b*, *c*, *d* may be combined with a series of movements m_1, m_2, m_3, m_4; both series may be reversed; and finally the touches may be presented simultaneously. In this way we can attain the knowledge of the coexistence of objects that have a certain quasi-distance between them, and such experience is an important element in our perception of space; but it is not the whole of it. For, as has been already remarked by critics of the associationist psychology, we have an experience very similar to this in singing and hearing musical notes or the chromatic scale. The most elaborate attempt to get extensity out of succession and coexistence is that of Herbert Spencer. He has done, perhaps, all that can be done, and only to make it the more plain that the entire procedure is a *ὕστερον πρότερον*. We do not first experience a succession of touches or of retinal excitations by means of movements, and then, when these impressions are simultaneously presented, regard them as extensive, because they are associated with or symbolize the original series of movements; but, before and apart from movement altogether, we experience that massiveness or extensity of impressions in which movements enable us to find positions, and also to measure.[1] But it will be objected, perhaps not without impatience, that this amounts to the monstrous absurdity of making the contents of consciousness extended. The edge of this objection will best be turned by rendering the concept of extensity more precise. Thus, suppose a postage stamp pasted on the back of the hand; we have in consequence a certain sensation. If another be added beside it, the new experience would not be adequately described by merely saying we have a greater quantity of sensation, for intensity involves quantity, and increased intensity is not what is meant. For a sensation of a certain intensity, say a sensation of red, cannot be changed into one having two qualities, red and blue, leaving the intensity unchanged; but with extensity this change is possible. For one of the postage stamps a piece of wet cloth of the same size might be substituted and the massiveness of the compound sensation remain very much the same. Intensity belongs to what may be called graded quantity: it admits of increment or decrement, but is not a sum of parts. Extensity, on the other hand, does imply plurality: we might call it latent or merged plurality or a "ground" of plurality, inasmuch as to say that a single presentation has massiveness is to say that a portion of the presentation-continuum at the moment undifferentiated is capable of differentiation.

Local Signs.

Attributing this property of extensity to the presentation-continuum as a whole, we may call the relation of any particular sensation to this larger whole its *local sign*, and can see that, so long as the extensity of a presentation admits of diminution without the presentation becoming nil such presentation either has or may have two or more local signs—its parts, taken separately, though identical in quality and intensity, having a different relation to the whole. Such difference of relation must be regarded fundamentally as a ground or possibility of distinctness of sign—whether as being the ground or possibility of different complexes or otherwise—rather than as being from the beginning such an overt difference as the term "local sign," when used by Lotze, is meant to imply.[2] From this point of view we may say that more partial presentations are concerned in the sensation corresponding to two stamps than in that corresponding to one. The fact that these partial presentations, though identical in quality and intensity, on the one hand are not wholly identical, and on the other are presented only as a quantity and not as a plurality, is explained by the distinctness along with the continuity of their local signs. Assuming that to every distinguishable part of the body there corresponds a local sign, we may allow that at any moment only a certain portion of this continuum is definitely within the field of consciousness; but no one will maintain that a part of one hand is ever felt as continuous with part of the other or with part of the face. Local signs have thus an invariable relation to each other: two continuous signs are not one day coincident and the next widely separate.[1] This last fact is only implied in the mere massiveness of a sensation in so far as this admits of differentiation into local signs. We have, then, when the differentiation is accomplished, a plurality of presentations constituting an extensive continuum, presented simultaneously, and having certain fixed and invariable relations to each other. Of such experience the typical case is that of passive touch, though the other senses exemplify it. It must be allowed that our concept of space in like manner involves a fixed continuity of positions; but then it involves, further, the possibility of movement. Now in the continuum of local signs there is nothing whatever of this; we might call this continuum an implicit *plenum*. It only becomes the presentation of *occupied space* after its several local signs are complicated in an orderly way with *active* touches, when in fact we have experienced the contrast of movements with contact and movements without, *i.e. in vacuo*. It is quite true that we cannot now think of this plenum except as a space, because we cannot divest ourselves of these motor experiences by which we have explored it. We can, however, form some idea of the difference between the perception of space and this one element in the perception by contrasting massive internal sensations with massive superficial ones, or the general sensation of the body as " an animated organism " with our perception of it as extended. Or we may express the difference by remarking that extension implies the distinction of here and there, while extensity rather suggests ubiquity.

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[1] We are ever in danger of exaggerating the competence of a new discovery; and the associationists seem to have fallen into this mistake, not only in the use they have made of the concept of association in psychology in general, but in the stress they have laid upon the fact of movement when explaining our space-perceptions in particular. Indeed, both ideas have here conspired against them—association in keeping up the notion that we have only to deal with a plurality of discrete impressions, and movement in keeping to the front the idea of sequence. Mill's *Examination of Hamilton* (3rd ed., p. 266 seq.) surely ought to convince us that, unless we are prepared to say, as Mill seems to do, "that the idea of space is at bottom one of time" (p. 276), we must admit the inadequacy of our experience of movement to explain the origin of it.

[2] To illustrate what is meant by different complexes it will be enough to refer to the psychological implications of the fact that scarcely two portions of the sensitive surface of the human body are anatomically alike. Not only in the distribution and character of

It must seem strange, if this conception of extensity is essential to a psychological theory of space, that it has escaped notice so long. The reason may be that in investigations into the origin of our knowledge of space it was always the *concept* of space and not our concrete space *percepts* that came up for examination. Now in space as we conceive it one position is distinguishable from another solely by its co-ordinates, *i.e.* by the magnitude and signs of certain lines and angles, as referred to a certain datum, position or origin; and these elements our motor experiences seem fully to explain. But on reflection we ought, surely, to be puzzled by the question, how these coexistent positions could be known before those movements were made which constitute them different positions. The link we thus suspect to be missing is supplied by the more concrete experiences we obtain from our own body, in which two positions have a qualitative difference or " local colour " *independently of movement*. True, such positions would not be known as spatial without movement; but neither would the movement be known as spatial had those positions no other difference than such as arises from movement. In a balloon drifting steadily in a fog we should have no more experience of change of position than if it hung becalmed and still.

Positional signs.

We may now consider the part which movement plays in elaborating the presentations of this dimensionless continuum into percepts of space. In so doing we must bear in mind that while this continuum implies the incopresentability of two impressions having the same local sign, it allows not only of the presentation of sensations of varying massiveness, but also of a sensation involving the whole continuum *simultaneously*, as in Bain's classic example of the warm bath. As regards the motor element itself, the first point of importance is the incopresentability and invariability of a *successive* series of auxiliomotor or kinaesthetic presentations, P_1, P_2, P_3, P_4. P_1 cannot be presented along with P_2, and from P_4 it is impossible to reach P_1 again save through P_3 and P_2. Such a series, taken alone, could afford us, it is evident, nothing but the knowledge of an invariable sequence of impressions which it was in our own power to produce. Calling the series of P's " positional signs," the contrast between them and local signs is obvious. Both are invariable, but succession characterizes the one, simultaneity the other; the one yields potential position without place, the other potential place (τόπος) without position; hence we call them both merely signs.[2] But in the course of the movements necessary to the exploration of the body—probably our earliest lesson in spatial perception—these positional signs receive a new significance from the active and passive touches that accompany them, just as they impart to these last a significance they could never have alone.

It is only in the resulting complex that we have the presentations of actual position and of spatial magnitude. For space, though conceived as a coexistent continuum, excludes the notion of omnipresence or ubiquity; two positions l_d and l_g must coexist, but they are not strictly distinct positions so long as we conceive ourselves present in the same sense in both. But, if F_d and F_g are, *e.g.* two impressions produced by compass points touching two different spots as l_d and l_g on the hand or arm, and we place a finger upon l_d and move it to l_g, experiencing thereby the series P_1, P_2, P_3, P_4, this series constitutes l_d and l_g into positions and also invests F_d and F_g with a relation not of mere distinctness as τόποι but of definite distance. The resulting complex perhaps admits of symbolization as follows:—

$$\begin{array}{c} \ldots\ldots\ \mathrm{F}_a\mathrm{F}_b\mathrm{F}_c F_d \mathrm{F}_e\mathrm{F}_f F_g \mathrm{F}_h\mathrm{F}_k\ \ldots\ldots \\ T\ t\ t\ t \\ P_1 p_2 p_3 p_4 \end{array}$$

Here the first line represents a portion of the tactual continuum, F_d and F_g being distinct " feels," if we may so say, or passive touches presented along with the fainter sensations of the continuum as a whole, which the general " body-sense " involves; T stands for the active touch of the exploring finger and P_1 for the corresponding kinaesthetic sensation regarded as " positional sign "; the rest of the succession, as not actually present at this stage but capable of revival from past explorations, is symbolized by the $t\,t\,t$ and $p_2p_3p_4$.

When the series of movements is accompanied by active touches without passive there arises the distinction between one's own body and foreign bodies; when the initial movement of a series is accompanied by both active and passive touches, the final movement by active touches only, and the intermediate movements are unaccompanied by either, we get the further presentation of empty space lying between us and them—but only when by frequent experience of contacts along with those intermediate movements we have come to know all movement as not only succession but change of position. Thus active touches come at length to be projected, passive touches alone being localized in the stricter sense. But in actual fact, of course, the localization of one impression is not perfected before that of another is begun, and we must take care lest our necessarily meagre exposition give rise to the mistaken notion

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the nerve-endings but in the variety of the underlying parts—in one place bone, in another fatty tissue, in others tendons or muscles variously arranged—we find ample ground for diversity in " the local colouring " of sensations. And comparative zoology helps us to see how such diversity has been developed as external impressions and the answering movements have gradually differentiated an organism originally almost homogeneous and symmetrical. Between one point and another on the surface of a sphere there is no ground of difference; but this is no longer true if the sphere revolves round a fixed axis, still less if it also runs in one direction along its axis.

[1] The improvements in the sensibility of our " spatial sense " consequent on practice, its variations under the action of drugs, &c., are obviously no real contradiction to this; on the contrary, such facts are all in favour of making extensity a distinct factor in our space experience and one more fundamental than that of movement.

[2] Thus a place may be known topographically without its position being known geographically, and vice versa.

that localizing an impression consists wholly and solely in performing or imaging the particular movements necessary to add active touches to a group of passive impressions. That this cannot suffice is evident merely from the consideration that a single position out of relation to all other positions is a contradiction. Localization, though it depends on many special experiences of the kind described, is not like an artificial product which is completed a part at a time, but is essentially a growth, its several constituents advancing together in definiteness and interconnexion. So far has this development advanced that we do not even imagine the special movements which the localization of an impression implies, that is to say, they are no longer distinctly represented as they would be if we definitely intended to make them: the past experiences are "retained," but too much blended in the mere perception to be appropriately spoken of as remembered or imaged.

À propos of this almost instinctive character of even our earliest spatial percepts it will be appropriate to animadvert on a misleading implication in the current use of such terms as "localization," "projection," "bodily reference," "spatial reference" and the like. The implication is that external space, or the body as extended, is in some sort presented or supposed apart from the localization, projection or reference of impressions to such space. That it may be possible to put a book in its place on a shelf there must be (1) the book, and (2), distinct and apart from it, the place on the shelf. But in the evolution of our spatial experience impressions and positions are not thus presented apart. We *can* have, or at least we can suppose, an impression which is recognized without being localized as has been already said; but if it *is* localized this means that a more complex presentation is formed by the addition of new elements, not that a second distinct object is presented and some indescribable connexion established between the impression and it, still less that the impression is referred to something not strictly presented at all. The truth is that the body *as extended* is from the psychological point of view not perceived at all apart from localized impressions. In like manner impressions projected (or the absence of impressions projected) constitute all that is perceived as the occupied (or unoccupied) space beyond. It is not till a much later stage, after many varying experiences of different impressions similarly localized or projected, that even the mere materials are present for the formation of such an abstract concept of space as "spatial reference" implies.[1] Psychologists, being themselves at this later stage, are apt to commit the oversight of introducing it into the earlier stage which they have to expound.

Intuition of Things.

20. In a complex percept, such as that of an orange or a piece of wax, may be distinguished the following points concerning which psychology may be expected to give an account: (*a*) the object's reality, (*b*) its solidity or occupation of space, (*c*) its unity and complexity, (*d*) its permanence, or rather its continuity in time and (*e*) its substantiality and the connexion of its attributes and powers. Though, in fact, these items are most intimately blended, our exposition will be clearer if we consider each for a moment apart.

Actuality or Reality.

a. The terms actuality and reality have each more than one meaning. Thus what is real, in the sense of material, is opposed to what is mental; as the existent or actual it is opposed to the non-existent; and again, what is actual is distinguished from what is possible or necessary. But here both terms, with a certain shade of difference, in so far as actual is more appropriate to movements and events, are used, in antithesis to whatever is ideal or represented, for what is sense-given or presented. This seems at least their primary psychological meaning; and it is the one most in vogue in English philosophy at any rate, over-tinged as that is with psychology.[2] Any examination of this characteristic will be best deferred till we come to deal with ideation generally (see § 21 below). Meanwhile it may suffice to remark that reality or actuality is not a single distinct element added to the others which enter into the complex presentation we call a thing, as colour or solidity may be. Neither is it a special relation among these elements, like that of substance and attribute, for example. In these respects the real and the ideal, the actual and the possible, are alike; all the elements or qualities within the complex, and all the relations of those elements to each other, are the same in the rose represented as in the presented rose. The difference turns not upon what these elements are, regarded as qualities or relations presented or represented, but upon whatever it is that distinguishes the presentation from the representation of any given qualities or relations. Now this distinction, as we shall see, depends partly upon the relation of such complex presentation to other presentations in consciousness with it, partly upon its relation as a presentation to the subject whose presentation it is. In this respect we find a difference, not only between the simple qualities, such as cold, hard, red and sweet in strawberry ice, *e.g.* as presented and as represented, but also, though less conspicuously, in the spatial, and even the temporal, relations which enter into our intuition as distinct from our imagination of it. So then, reality or actuality is not strictly an item by itself, but a characteristic of all the items that follow.

Impenetrability.

b. In the so-called physical solidity or impenetrability of things our properly motor presentations or "feelings of effort or innervation" come specially into play. They are not entirely absent in those movements of exploration by which we attain a knowledge of space; but it is when these movements are definitely resisted, or are only possible by increased effort, that we reach the full meaning of body as that which occupies space. Heat and cold, light and sound, the natural man regards as real, and by and by perhaps as due to the powers of things known or unknown, but not as themselves things. At the outset things are all corporeal like his own body, the first and archetypal thing, that is to say: things are intuited only when touch is accompanied by pressure; and, though at a later stage passive touch without pressure may suffice, this is only because pressures depending on a subjective initiative, *i.e.* on voluntary muscular exertion, have been previously experienced. It is of more than psychological interest to remark how the primordial factor in materiality is thus due to the projection of a subjectively determined reaction to that action of a not-self of which sense-impressions consist—an action of the not-self which, of course, is not known as such till this projection of the subjective reaction has taken place. Still we must remember that accompanying sense-impressions are a condition of its projection: muscular effort without simultaneous sensations of contact would not yield the distinct presentation of something resistant occupying the space into which we have moved and would move again. Nay more, it is in the highest degree an essential circumstance in this experience that muscular effort, though subjectively initiated, is still only possible when there is contact with something that, as it seems, is making an effort the counterpart of our own. But this something is so far no more than thing-stuff; without the elements next to be considered our psychological individual would fall short of the complete intuition of distinct things.

Unity and Complexity.

c. The remaining important factors in the psychological constitution of things might be described in general terms as the time-relations of their components. Such relations are themselves in no way psychologically determined; impressions recur with a certain order or want of order quite independently of the subject's interest or of any psychological principles of synthesis or association whatever. It is essential that impressions should recur, and recur as they have previously occurred, if knowledge is ever to begin; out of a continual chaos of sensation, all matter and no form, such as some philosophers describe, nothing but chaos could result. But a flux of impressions having this real or sense-given order will not suffice; there must be also attention to and retention of the order, and these indispensable processes at least are psychological.

But for its familiarity we should marvel at the fact that out of the variety of impressions simultaneously presented we do not instantly group together all the sounds and all the colours, all the touches and all the smells; but, dividing what is given together, single out a certain sound or smell as belonging together with a certain colour and feel, similarly singled out from the rest, to what we call one thing. We might wonder, too—those at least who have made so much of association by similarity ought to wonder—that, say, the white of snow calls up directly, not other shades of white or other colours, but the expectation of cold or of powdery softness. The first step in this process has been the simultaneous projection into the same occupied space of the several impressions which we thus come to regard as the qualities of the body filling it. Yet such simultaneous and coincident projection would avail but little unless the constituent impressions were again and again repeated in like order so as to prompt anew the same grouping, and unless, further, this constancy in the one group was present along with changes in other groups and in the general field. There is nothing in its first experience to tell the infant that the song of the bird does not inhere in the hawthorn whence the notes proceed, but that the fragrance of the mayflower does. It is only where a group, as a whole, has been found to change its position relatively to other groups, and—apart from casual relations—to be independent of changes of position among them, that such complexes can become distinct unities and yield a world of things. Again, because things are so often a world within themselves, their several parts or members not only having distinguishing qualities but moving and changing with more or less independence of the rest, it comes about that what is from one point of view one thing becomes from another point of view several—like a tree with its separable branches and fruits, for example. Wherein then, more precisely, does the unity of a thing consist? This question, so far as it here admits of answer, carries us over to temporal continuity.

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[1] Cf. on this point Poincaré, *La Science et l'hypothèse*, pp. 74 sqq.

[2] Thus Locke says, "Our simple ideas [*i.e.* presentations or impressions, as we should now say] are all real . . . and not fictions at pleasure; for the mind . . . can make to itself no simple idea more than what it has received" (*Essay*, ii. 30, 2). And Berkeley says, "The ideas imprinted on the senses by the Author of Nature are called *real things*; and those excited in the imagination, being less regular, vivid and constant, are more properly termed *ideas* or *images of things*, which they copy or represent" (*Prin. of Hum. Know.*, pt. i. § 33).

Temporal Continuity.

d. Amidst all the change above described there is one thing comparatively fixed: our own body is both constant as a group and a constant item in every field of groups; and not only so, but it is beyond all other things an object of continual and peculiar interest, inasmuch as our earliest pleasures and pains depend solely upon it and what affects it. The body becomes, in fact, the earliest form of self, the first datum for our later conceptions of permanence and individuality. A continuity like that of self is then transferred to other bodies which resemble our own, so far as our direct experience goes, in passing continuously from place to place and undergoing only partial and gradual changes of form and quality. As we have existed—or, more exactly, as the body has been continuously presented—during the interval between two encounters with some other recognized body, so this is regarded as having continuously existed during its absence from us. However permanent we suppose the conscious subject to be, it is hard to see how, without the continuous presentation to it of such a group as the bodily self, we should ever be prompted to resolve the discontinuous presentations of external things into a continuity of existence. It might be said: Since the second presentation of a particular group would, by the mere workings of psychical laws, coalesce with the image of the first, this coalescence would suffice to "generate" the concept of continued existence. But such assimilation is only the ground of an intellectual identification and furnishes no motive, one way or the other, for real identification: between a second presentation of A and the presentation at different times of two A's there is so far no difference. Real identity no more involves exact similarity than exact similarity involves sameness of things; on the contrary, we are wont to find the same thing alter with time, so that exact similarity after an interval, so far from suggesting one thing, is often the surest proof that there are two concerned. Of such real identity, then, it would seem we must have direct experience; and we have it in the continuous presentation of the bodily self; apart from this it could not be "generated" by association among changing presentations. Other bodies being in the first instance personified, that then is regarded as one thing—from whatever point of view we look at it, whether as part of a larger thing or as itself compounded of such parts—which has had one beginning in time. But what is it that has thus a beginning and continues indefinitely? This leads to our last point.

Substantiality.

e. So far we have been concerned only with the combination of sensory and motor presentations into groups and with the differentiation of group from group; the relations to each other of the constituents of each group still for the most part remain. To these relations in the main must be referred the correlative concepts of substance and attribute, the distinction in substances of qualities and powers, of primary qualities and secondary, and the like.[1]

Of all the constituents of things only one is universally present, that above described as physical solidity, which presents itself according to circumstances as impenetrability, resistance or weight. Things differing in temperature, colour, taste and smell agree in resisting compression, in filling space. Because of this quality we regard the wind as a thing, though it has neither shape nor colour, while a shadow, though it has both but not resistance, is the very type of nothingness. This constituent is invariable, while other qualities are either absent or change—form altering, colour disappearing with light, sound and smells intermitting. Many of the other qualities—colour, temperature, sound, smell—increase in intensity if we advance till we touch a body occupying space; with the same movement too its visual magnitude varies. At the moment of contact an unvarying tactual magnitude is ascertained, while the other qualities and the visual magnitude reach a fixed maximum; then first it becomes possible by effort to change or attempt to change the position and form of what we apprehend. This tangible plenum we thenceforth regard as the seat and source of all the qualities we project into it. In other words, that which occupies space is psychologically the substantial; the other real constituents are but its properties or attributes, the marks or manifestations which lead us to expect its presence.

Imagination or Ideation.[2]

Impressions and Ideas.

21. Before the intuition of things has reached a stage so complete and definite as that just described, imagination or ideation as distinct from perception has well begun. In passing to the consideration of this higher form of mental life we must endeavour first of all analytically to distinguish the two as precisely as may be and then to trace the gradual development of the higher.

To begin, it is very questionable whether Hume was right in applying Locke's distinction of simple and complex to ideas in the narrower sense as well as to impressions. "That idea of red," says Hume, "which we form in the dark and that impression which strikes our eyes in the sunshine differ only in degree, not in nature."[3] But what he seems to have overlooked is that, whereas we may have a mere sensation red, we can only have an image or representation of a red *thing* or a red *form*, *i.e* of red in some way ideally projected or intuited. In other words, there are no ideas—though there are concepts—answering to simple or isolated impressions. The synthesis which has taken place in the evolution of the percept can only partially fail in the idea, and never so far as to leave us with a chaotic "manifold" of mere sensational remnants. On the contrary, we find that in "constructive imagination" a new kind of effort is often requisite in order partially to dissociate these representational complexes as a preliminary to new combinations. But it is doubtful whether the results of such an analysis are ever the ultimate elements of the percept, that is, merely isolated impressions in a fainter form. We may now try to ascertain further the characteristic marks which distinguish what is imaged from what is perceived.

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[1] The distinction between the thing and its properties is one that might be more fully treated under the head of "Thought and Conception." Still, inasmuch as the material warrant for these concepts is contained more or less implicity in our percepts, some consideration of it is in place here.

[2] Ideation—"a word of my own coining," says James Mill.

[3] *Treatise of Human Nature*, bk. i. pt. i. § 1.

Characteristics of Ideas.

The most obvious difference is that which Hume called "the force or liveliness" of primary presentations as compared with secondary presentations. But what exactly are we to understand by this somewhat figurative language? A simple difference of intensity cannot be all that is meant, for—though we may be momentarily confused—we can perfectly well distinguish the faintest impression from an image; moreover, we can reproduce such faintest impressions in idea. The whole subject of the intensity of representations awaits investigation. Between moonlight and sunlight or between midday and dawn we can discriminate many grades of intensity; but it does not appear that there is any corresponding variation of intensity between them when they are not seen but imagined. Many persons suppose they can imagine a waxing or a waning sound or the gradual abatement of an intense pain; but what really happens in such cases is probably not a rise and fall in the intensity of a single representation, but a change in the complex represented. In the primary presentation there has been a change of quality along with change of intensity, and not only so, but most frequently a change in the muscular adaptations of the sense-organs too, to say nothing of organic sensations accompanying these changes. A representation of some or all of these attendants is perhaps what takes place when variations of intensity are supposed to be reproduced. Again, hallucinations are often described as abnormally intense images which simply, by reason of their intensity, are mistaken for percepts. But such statement, though supported by very high authority, is almost certainly false, and would probably never have been made if physiological and epistemological considerations had been excluded as they ought to have been. Hallucinations, when carefully examined, seem just as much as percepts to contain among their constituents some primary presentation—either a so-called subjective sensation of sight and hearing or some organic sensation due to deranged circulation or secretion. Intensity alone, then, will not suffice to discriminate between impressions and images.

What we may call superior steadiness is perhaps a more constant and not less striking characteristic of percepts. Ideas are not only in a continual flux, but even when we attempt forcibly to detain one it varies continually in clearness and completeness, reminding one of nothing so much as of the illuminated devices made of gas jets, common at fêtes, when the wind sweeps across them, momentarily obliterating one part and at the same time intensifying another. There is not this perpetual flow and flicker in what we perceive. The impressions entering consciousness at any one moment are psychologically independent of each other; they are equally independent of the impressions and images presented the moment before—independent, *i.e.* as regards their order and character, not, of course, as regards the share of attention they secure. Attention to be concentrated in one direction must be withdrawn from another, and images may absorb it to the exclusion of impressions as readily as a first impression to the exclusion of a second. But, when attention *is* secured, a faint impression has a fixity and definiteness lacking in the case of even vivid ideas. One ground for this definiteness and independence lies in the localization or projection which accompanies all perception. But why, if so, it might be asked, do we not confound percept and image when what we imagine is imagined as definitely localized and projected? Because we have a contrary percept to give the image the lie; where this fails, as in dreams, or where, as in hallucination, the image obtains in other ways the fixity characteristic of impressions, such confusion does in fact result. But in normal waking life we have the whole presentation-continuum, as it were, occupied and in operation: we are distinctly conscious of being embodied and having our senses about us.

But how is this contrariety between impression and image possible? With eyes wide open, and while clearly aware of the actual field of sight and its filling, one can recall or imagine a wholly different scene: lying warm in bed one can imagine oneself out walking in the cold. It is useless to say the times are different, that what is perceived is present and what is imaged is past or future.[1] The images, it is true, have certain temporal marks—of which more presently—by which they may be referred to what is past or future; but as imaged they *are* present, and, as we have just observed, are regarded as actual whenever there are no correcting impressions. We cannot at once see the sky red and blue; how is it we can imagine it the one while perceiving it to be the other? When we attempt to make the field of sight at once red and blue, as in looking through red glass with one eye and through blue glass with the other, either the colours merge and we see a purple sky or we see the sky first of the one colour and then of the other in irregular alternation. That this does not happen between impression and image shows that, whatever their connexion, images as a whole are distinct from the presentation-continuum and cannot with strict propriety be spoken of as revived or reproduced impressions. This difference is manifest in another respect, viz. when we compare the effects of diffusion in the two cases. An increase in the intensity of a sensation of touch entails an increase in the extensity; an increase of muscular innervation entails irradiation to adjacent muscles; but when a particular idea becomes clearer and more distinct, there rises into consciousness an associated idea qualitatively related probably to impressions of quite another class, as when the smell of tar calls up memories of the sea-beach and fishing-boats. Since images are thus distinct from impressions, and yet so far continuous with each other as to form a train in itself unbroken, we should be justified, if it were convenient, in speaking of images as changes in a new continuum; and later on we may see that this is convenient.

Impressions then—unlike ideas—have no associates to whose presence their own is accommodated and on whose intensity their own depends. Each bids independently for attention, so that often a state of distraction ensues, such as the train of ideas left to itself never occasions. The better to hear we listen; the better to see we look; to smell better we dilate the nostrils and sniff; and so with all the special senses: each sensory impression sets up nascent movements for its better reception.[2] In like manner there is also a characteristic adjustment for images which can be distinguished from sensory adjustments almost as readily as these are distinguished from each other. We become most aware of this as, *mutatis mutandis*, we do of them, when we voluntarily concentrate attention upon particular ideas instead of remaining mere passive spectators, as it were, of the general procession. To this ideational adjustment may be referred most of the strain and "head-splitting" connected with recollecting, reflecting and all that people call headwork; and the "absent look" of one intently thinking or absorbed in reverie seems directly due to the absence of sensory adjustment that accompanies the concentration of attention upon ideas.

Connexion of Impressions and Images.

22. But, distinct as they are, impressions and images are still closely connected. In the first place, there are two or three well-marked intermediate stages, so that, though we cannot directly observe it, we seem justified in assuming a steady transition from the one to the other. As the first of such intermediate stages, it is usual to reckon what are often, and—so far as psychology goes—inaccurately, styled after-images. They would be better described as after-sensations, inasmuch as they are due either (1) to the persistence of the original peripheral excitation after the stimulus is withdrawn, or (2) to the effects of the exhaustion or the repair that immediately follows this excitation. In the former case they are qualitatively identical with the original sensation and are called "positive," in the latter they are complementary to it and are called "negative" (see VISION). These last, then, of which we have clear instances only in connexion with sight, are obviously in no

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[1] Moreover, as we shall see, the distinction between present and past or future psychologically presupposes the contrast of impression and image.

[2] Organic sensations, though distinguishable from images by their definite though often anatomically inaccurate localization, furnish no clear evidence of such adaptations. But in another respect they are still more clearly marked off from images, viz. by the pleasure or pain they directly occasion.

sort re-presentations of the original impression, but a sequent presentation of diametrically opposite quality; while positive after-sensations are, psychologically regarded, nothing but the original sensations in a state of evanescence. It is this continuance and gradual waning after the physical stimulus has completely ceased that give after-sensations their chief title to a place in the transition from impression to image. There is, however, another point: after-sensations are less affected by movement than impressions are. If we turn away our eyes we cease to see the flame at which we have been looking, but the after-image remains still projected before us and continues localized in the dark field of sight, even if we close our eyes altogether. This fact that movements do not suppress them, and the fact that yet we are distinctly aware of our sense-organs being concerned in their presentation, serve to mark off after-sensations as intermediate between primary and secondary presentations. The after-sensation is in reality more elementary than either the preceding percept or its image. In both these, in the case of sight, objects appear in space of three dimensions, *i.e.* with all the marks of solidity and perspective;[1] but the so-called after-image lacks all these.

Still further removed from normal sensations (*i.e.* sensations determined by the stimuli appropriate to the sense-organ) are the "recurrent sensations" often unnoticed but probably experienced more or less frequently by everybody—cases, that is, in which sights or sounds, usually such as at the time were engrossing and impressive, suddenly reappear several hours or even days after the physical stimuli, as well as their effects on the terminal sense-organ, seem entirely to have ceased. Thus workers with the microscope often see objects which they have examined during the day stand out clearly before them in the dark; it was indeed precisely such an experience that led the anatomist Henle first to call attention to these facts. But he and others have wrongly referred them to what he called a "sense-memory"; all that we know is against the supposition that the eye or the ear has any power to retain and reproduce percepts. "Recurrent sensations" have all the marks of percepts which after-sensations lack; they only differ from what are more strictly called "hallucinations" in being independent of all subjective suggestion determined by emotion or mental derangement.

In what Fechner has called the "memory after-image" or the primary memory-image, as it is better termed, we have the image proper in its earliest form. As an instance of what is meant may be cited the familiar experience that a knock at the door, the hour struck on the clock, the face of a friend whom we have passed unnoticed, may sometimes be recognized a few minutes later by means of the persisting image, although—apparently—the actual impression was entirely disregarded. But in vision the primary memory-image can always be obtained, and is obtained to most advantage, by looking intently at some object for an instant and then closing the eyes or turning them away. The image of the object will appear for a moment very vividly and distinctly, and can be so recovered several times in succession by an effort of attention. Such reinstatement is materially helped by rapidly opening and closing the eyes, or by suddenly moving them in any way. In this respect a primary memory-image resembles an after-sensation, which can be repeatedly revived in this manner when it would otherwise have disappeared. This seems to show that the primary memory-image in such cases owes its vivacity in part to a positive after-sensation; at any rate it proves that it is in some way still sense-sustained. But in other respects the two are very different: the after-sensation is necessarily presented if the intensity of the original excitation suffices for its production, and cannot be presented otherwise, however much we attend. Moreover, the after-sensation is only for a moment positive, and then passes into the negative or complementary phase, when, so far from even contributing towards the continuance of the original percept, it directly hinders it. Primary memory-images on the other hand, and indeed all images, depend mainly upon the attention given to the impression; provided that was sufficient, the faintest impression may be long retained, and without it very intense ones will soon leave no trace. The primary memory-image retains so much of its original definiteness and intensity as to make it possible with great accuracy to compare two physical phenomena, one of which is in this way "remembered" while the other is really present. For the most part this is indeed a more accurate procedure than that of dealing with both together, but it is only possible for a very short time. From Weber's experiments with weights and lines[2] it would appear that even after 10 seconds a considerable waning has taken place, and after 100 seconds all that is distinctive of the primary image has probably ceased.

On the whole, then, it appears that the ordinary memory-image is a joint effect; it is not the mere residuum of changes in the presentation-continuum, but an effect of these only when there has been some concentration of attention upon them. It has the form of a percept, but is not constituted of revived *impressions*, for the essential marks of impressions are absent; there is no localization in, or projection into, external space, neither is there the motor adaptation, nor the tone of feeling, incident to the reception of impressions. Ideas do not reproduce the intensity of these original constituents, but only their quality and complication. What we call the vividness of an idea is of the nature of intensity, but it is an intensity very partially and indirectly determined by that of the original impression; it depends much more upon the state of what we shall call the memory-continuum and the attention the idea receives. The range of vividness in ideas is probably comparatively small; what are called variations in vividness are often really variations in distinctness and completeness.[3] Where we have great intensity, as in hallucinations, primary presentations may be reasonably supposed to enter into the complex.

It is manifest that the memory-continuum has been in someway formed out of or differentiated from the presentation-continuum by the movements of attention, but the precise connexion of the two continua is still very difficult to determine. We see perhaps the first distinct step of this evolution in the primary memory-image: here there has been no cessation in presentation, and yet the characteristic marks of the impression are gone, so much so, indeed, that superposition without "fusion" with an exactly similar impression is possible. We have now to inquire into the genesis and development of ideation.

Genesis and Development of Ideation.

23. We find ourselves sometimes engrossed in present perceptions, as when tracing, for example, the meanderings of an ant; at other times we may be equally absorbed in reminiscences; or, again, in pure reverie and "castle-building." Here are three well-marked forms of conscious life: the first being concerned with what is, the second with what has been, and the third with the merely possible. Again, the first involves definite spatial and temporal order, though the temporal order, as just said, is in the main restricted to the "sensible present"; the second involves only definite time-order; and the last neither in a definite way. Thus, analytically regarded, perception, memory, imagination, show a steady advance. In infancy the first

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[1] The following scant quotation from Fechner, one of the best observers in this department, must suffice in illustration. "Lying awake in the early morning after daybreak, with my eyes motionless though open, there usually appears, when I chance to close them for a moment, the black after-image of the white bed immediately before me and the white after-image of the black stove-pipe some distance away against the opposite wall. . . . Both [after images] appear as if they were in juxtaposition in the same plane; and, though—when my eyes are open—I seem to see the white bed in its entire length, the after-image—when my eyes are shut—presents instead only a narrow black stripe owing to the fact that the bed is seen considerably foreshortened. But the memory-image on the other hand completely reproduces the pictorial illusion as it appears when the eyes are open" (*Elemente der Psychophysik*, ii. 473).

[2] *Die Lehre vom Tastsinne*, &c., pp. 86 seq.

[3] As we have seen that there is a steady transition from percept to image, so, if space allowed, the study of hallucinations might make clear an opposite and abnormal process—the passage, that is to say, of images into percepts, for such, to all intents and purposes, are hallucinations of perception, psychologically regarded.

predominates, while senility lapses back to the second; in the third, where similarities suggest themselves and the contrast of actual and possible is explicit, we have at length the groundwork of logical comparison. Nevertheless, since imagination plays a conspicuous part in child life before much personal reminiscence appears, it would seem probable that ideas do not first arise as definite memory-images or reminiscences. On the other hand, in the so-called homing instincts of the lower animals we have evidence of isolated " memories " of a simpler form than ours.

The subject is as difficult as it is interesting and important, and we can hardly hope at present for a final solution. One chief obstacle, as is so often the case in psychology, lies in the unsettled connotation of such leading terms as *memory*, *association* and *idea*. Even what is most fundamental of all, that " plasticity " which we have analysed into retentiveness, differentiation and integration, is sometimes described as if it already involved memory-ideas and their association. Ideas, that is to say, are identified with mere " residua " of former " impressions," and yet at the same time are spoken of as " copies " of these: which is much like saying the evening twilight is a *replica* of the noonday glare as well as its parting gleam. Again, the continuous differentiation and redintegration of the presentational continuum which mark the progress of perceptual experience are resolved into an original multiplicity of presentational atoms which are associated by " adhesion " of the contiguous. Yet before the differentiation there was no plurality, and after the integration there is only a complex unity, comparable perhaps with another organic whole, but certainly not with a mosaic stuck together with cement. This mistaken identification by the Associationist psychology of later processes with simpler and earlier ones, by which they are only partially explained, has not only obscured the science with inappropriate concepts but has prevented the question on which we are entering—that concerning the genesis and development of ideas—from being ever effectually raised. The discussion of this question will incidentally yield the best refutation of those views.

Experience, we say, is the acquisition of practical acquaintance and efficiency as the result of repeated opportunity and effort. This means that strangeness on the cognitive side gives place to familiarity, and that on the active side clumsiness is superseded by skill. But though analytically distinct, the two sides are, as we have already insisted, actually inseparable: to the uninteresting we are indifferent, and what does not call for active response is ignored. If the original presentations whether sensory or motor, be A, B, C, we find then that they gradually acquire a new character, become, let us say, $A\gamma$, $B\gamma$, $C\gamma$, γ representing the eventual familiarity or facility, as the case may be. We find, again, a certain sameness in this character, however various the presentations to which it pertains, a sameness which points to the presence of subjective constituents, and to these we may assign the " feelings " that enter into accommodation and adjustment. This factor is important as evidence of a subjective co-operation which may enable us to dispense with the mutual " adhesions " and " attractions " among presentations, on which the Associationists rely. But it is obvious that there must be an objective factor as well; and it is this objective factor in the process giving rise to γ that now primarily concerns us. We have described that process as assimilation or immediate recognition: the older psychology described it as association of the completely similar, or as automatic association. That the two views have something in common is shown by the juxtaposition of " automatic " and " immediate," " similarity " and " assimilation." To prepare the way for further discussion, let us first ascertain these points of agreement. " When I look at the full moon," said Bain, " I am instantly impressed with the state arising from all my former impressions of her disc added together." This we may symbolize in the usual fashion as $A + a_n \cdots + a_3 + a_2 + a_1$. Now, it will be granted (1) that the present occurrence (full moon) has been preceded by a series of like occurrences, enumerable as 1, 2, 3, $\cdots$ n; (2) that the present experience ($A\gamma$) is what it is in consequence of the preceding experiences of these occurrences; and (3) that it " arises instantly " as the joint result of such preceding experiences. But it is denied (1) that this present experience is the mere sum, or even the mere " fusion," of the experiences preceding it; (2) that they were qualitatively identical; (3) that they persist severally unaltered, in such wise that experience " drags at each remove a lengthening chain " of them. In the case of dexterities, where γ answers to facility, it is obvious that there is no such series of identicals (a_1, a_2, $\cdots$ a_n) at all. From the first rude beginning—say the schoolboy's pothooks—up to the finished performance of the adept there is continuous approximation: awkward and bungling attempts, passing gradually into the bold strokes of mastery. Nor is the case essentially different in cognition where γ answers to familiarity; if we attend, as it is plain we ought, not to the physical fact cognized, but to the individual's perception of it. This, too, is an acquisition, has entailed activity, and is marked by gradual approximation towards clearness and distinctness. The successive experiences of n identical occurrences does not then result in an accumulation of n identical *residua*. The ineptness of the atomistic psychology with its " physical " and " chemical " analysis is nowhere more apparent than here. Considering the intimate relation of life and mind, and the strong physiological bias shown by the Associationists from Hartley onwards, it is surely extraordinary how completely they have failed to appreciate the light-bearing significance of such concepts as function and development. Facility and faculty (or function) are much the same, both etymologically and actually. As the perfected structure is not so many rudimentary structures " added together," but something that supersedes them completely, must we not say the same of the perfected function? The less fit is not embodied in the fittest that finally survives. Development implies change of form in a continuous whole: every growth *into* means an equal growth *out of*: thus one cannot find the caterpillar in the butterfly. Between organic development and mental development there is then more than an analogy.

But though assimilation cannot be analysed into a series of identical ideas (a_1, a_2, $\cdots$ a_n), either " added together " or " instantaneously fused," yet it does result in an a which may *provisionally* be called an idea. Such idea is, however, neither a memory-idea in the proper sense nor an idea within the meaning of the term implied in imagination or ideation. For it is devoid of the temporal signs[1] indicated by the subscript numerals in a_1, a_2, $\cdots$, and it does not yet admit of reproduction as part of an ideational continuum, one, that is, divested of the characteristics belonging to the actual and sensibly present. It is, so to say, embryonic, something additional to the mere sensation assimilated, and yet something less than a " free or independent idea." It is, as it has been happily called,[2] a tied (*gebundene*) or implicit idea. We have clear evidence of the sense-bound stage of this immature " idea " in the so-called " memory after-image " (cf. § 22). There is, however, nothing in this of memory, save as the term is loosely used for mere retentiveness; and *after-percept* would therefore be a less objectionable name for it. This after-percept is entirely sense-sustained and admits of no ideal recall, though—*in minds sufficiently advanced*—it may persist for a few moments, and so form the basis of such comparison with a second sensation, as we find in the experiments of Weber, Fechner and others.[3] At a still lower level, or in actual perception, we cannot assume even this amount of partial independence, though continuity clearly points to something beyond the bare sensation, which is a pure abstraction, as we may presently see.

It is saying too little to maintain, as some do, that this " something " is subconscious, on the ground that it is not discoverable by direct analysis. Yet it is saying too much, regardless of this defect, to describe a percept as a presentative-representative complex, if representation is to imply the presence of a free or independent idea. To call this "something" a tied or nascent idea on the ground of its possible later development into an independent representation seems, then, nearest the truth. The same meaning is sometimes expressed in a wholly different and designedly paradoxical way, by saying that all cognition (perception) is *recognition.* This statement has been met by elaborate expositions of the difference between knowing and knowing *again*, the irrelevance of which any lexicon would show; and, further, by the demand: How on such a view is a *first* cognition possible, or how is an indefinite regress of assimilation to be avoided? We may confidently reply that it cannot be avoided: an absolute beginning of experience, whether phylogenetically or ontogenetically, is beyond us. Assimilation means further assimilation; in this sense all cognition is further cognition, and a bare sensation is, as said, an abstraction representing a limit to which we can never regress.

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[1] On this term cf. below, §§ 24, 28.

[2] Cf. Drobisch, *Empirische Psychologie* (1842), § 31; Höffding, " Ueber Wiederkennen, Association und psychische Activität," in *Vierteljahrsschr. f. wissenschaftl. Philosophie*, Bd. xiii. and xiv. To Höffding we are also indebted for the term *Bekanntheitsqualität*, which has suggested the γ character used above. Cf. also Ward, " Assimilation and Association," *Mind* (1894–1895).

[3] Recent experiments, however, seem to prove that the after-percept is not the sole factor, and often is not a factor at all in such successive comparison (so-called); but that what is now termed " the absolute impression " may supplement it or even replace it altogether. As to what is meant by absolute impression, cf. § 14, c.

We find evidence, again, of ideas in the making in what Lewes called preperception. Of this instances in plenty are furnished by everyday illusions, as when a scarecrow is hailed by the traveller who mistakes it for a husbandman, or when what is taken for an orange proves to be but an imitation in wax. In reality all complex percepts involve preperception; and, so far, it must be allowed that such percepts are directly analysable into presentative-representative complexes. Nevertheless, the representative element is not yet, and may never become, an idea proper. The sight of ice yields a forefeel of its coldness, the smell of baked meats a foretaste of their savour. Such prepercepts differ from free ideas just as after-percepts do: they are still sense-bound and sense-sustained. Nor can this complication be with any propriety identified either with the association pertaining to memory or with that specially pertaining to ideation; though, no doubt, the two processes—complication and association—are genetically continuous, as are their respective constituents, nascent and free ideas.[1] The whole course of perceptual integration being determined and sustained by subjective interest, involves from the outset, as we have seen, concurrent conative impulses; and thus the same assimilation that results in familiarity and preperception on the subjective side results in facility and purpose on the conative. Knowing immediately *what to do* is here the best evidence of knowing *what there is* to do with; the moth that flies into the candle has assuredly no preperception of it, and does not act with purpose. Bearing this in mind, we may now see one way, and probably the earliest, in which tied ideas become free.

The contrast between the actual and the possible constitutes, as we have seen, the main difference beween experience at the perceptual and experience at the ideational stage. A subject confined to the former level knows not yet this difference. Such knowledge is attained, not through any quasi-mechanical interaction of presentations, but usually through bitter experience. The chapter of accidents is the Bible of fools, it has been said; but we are all novices at first, and get wisdom chiefly by the method of trial and failure. Things are not always different in what to us are their essential properties, but they so differ from time to time. Resemblances are frequent enough to give us familiarity and confidence; yet uniformity is flecked by diversity, and thwarted intentions disclose possibilities for which we were not prepared. What was taken for sugar turns out to be salt; what was seized as booty proves to be bait. We catch many Tatars, and so learn wariness in a rough school. In such wise preperceptions displaced by the actual fact yield the "what" severed from the "that," the "ideal" freed at length from the exclusive hold of the real. In a new situation after such adventures the attitude assumed—if, for brevity, we describe it in terms of our own still more advanced experience—is of this sort: "It may be a weasel, if so, I back; it may be a rabbit, if it is, I spring." Instead of unquestioned preperception that "makes the mouth water," we have the alternative possibilities present as "free ideas," and action is in suspense, the alternative courses, that is to say, again present only in idea. It is easy to see how in such situations one free idea, a "what" sundered from its "that," will tend to loosen the sensory ties of alternative, still implicit ideas. On the cognitive side, from immediate assimilation an advance is made towards mediate cognition, towards comparison; on the active side there is advance from impulsive action towards deliberate action.[2]

We conclude, then, that implicit ideas—the products of assimilation, and integrated as such in complex percepts and the motor co-ordinations to which they lead—are more likely to emerge as free ideas the more this perceptual complexity increases. Perception in the lower animals, who give no signs of either memory or ideation, has apparently no such complexity. A fish, for example, can feel, smell, taste, see, and even hear, but we cannot assume solely on that account that it has any percepts to which its five senses contribute, as they do to our percept, say, of an orange or a peppermint. Taking voluntary movements as the index of psychical life, it would seem that the fish's movements are instigated and guided by its senses, not collectively but separately. Thus a dog-fish, according to Steiner, seeks its food exclusively by scent; so that when its olfactory bulbs are severed, or the fore-brain, in which they end, is destroyed, it ceases to feed spontaneously. The carp, on the other hand, appears to search for its food wholly under the guidance of sight, and continues to do so just as well when the fore-brain is removed, the mid-brain, whence the optic nerves spring, seeming to be the chief seat of what intelligence it has.[3] Again, Bateson observes: "There can be no doubt that soles also perceive objects approaching them, for they bury themselves if a stroke at them is made with a landing-net; yet they have no recognition of a worm hanging by a thread immediately over their heads, and will not take it even if it touch them, but continue to feel for it aimlessly on the bottom of the tank, being aware of its presence by the sense of smell."[4] To this inability to combine simple percepts into one complex percept of a single object or situation we may reasonably attribute the fish's lack of true ideas, and consequent lack of sagacity. The sagacity even of the higher animals does not amount to "general intelligence," such as enables a child "to put two and two together," as we say, whatever "two and two" may stand for. So far as life consists of a series of definite situations and definite acts, so far the things done or dealt with together, the contents of the several *foci* or concentrations of attention, form so many integrated and comparatively isolated wholes. Round the more complicated of these, and closely connected with them, free ideas arise as sporadic groups, making possible those "lucid intervals," those fitful gleams of intelligence in the very heat of action, which occasionally interrupt the prevailing irrationality of the brutes. And as we cannot credit even the higher animals with general trains of ideas, just as little can we credit them with a continuous memory: indeed, it is questionable how far memory of the past, as past, belongs to them at all. For they live entirely in an up-stream, expectant attitude, and it is in this aspect that "free ideas" arise when they arise at all. We cannot imagine a dog regretting, like one of *Punch's* heroes, that he "did not have another slice of that mutton."[5]

The free idea (a) then at its first emergence has neither an assignable position in a continuous memory-record, as a_1 or a_2, nor has it a definite relation as a "generic idea" to possible specializations such as a' or a''. These further developments bring us to the general consideration of mental association.

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[1] Hence the earlier process has been named "impressional association" (Stout, *Analytic Psychology*, 1896, ii. pp. 27–29), and again "animal association" (Thorndike, *Animal Intelligence, an Experimental Study of the Associative Processes in Animals*, 1898, pp. 71, 87, and *passim*). But it seems preferable to confine the term "association" to the later process, in which alone the component presentations have that amount of distinctness and individuality which the term properly connotes.

[2] Some light is perhaps here thrown on the reciprocal relation of "association by contrast" and "association by similarity" as severally the differentiation of partial similars and the integration of partial dissimilars.

[3] J. Steiner, *Die Functionen des Centralnervensytems u.s.w.*, 2te Abth. Die Fische (1888), pp. 50, 126, 19 seq., 101.

[4] W. Bateson, "The Sense-Organs and Perceptions of Fishes," *Journ. Marine Biol. Assoc.* (1890), p. 239.

[5] Cf. Stout, *Manual of Psychology* (1899), vol. ii. ch. i.; also F. H. Bradley, "Memory and Inference," *Mind* (1899), pp. 145 sqq.; and especially Thorndike, *Animal Intelligence*, cited above.

Mental Association and the Memory-Continuum.

Association by Similarity not Fundamental.

24. Great confusion has been occasioned, as we have seen incidentally, by the lax use of the term "association," and this confusion has been increased by a further laxity in the use of the term "association by similarity." In so far as the similarity amounts to identity, as in assimilation, we have a process which is more fundamental than association by contiguity, but then it is not a process of association. And when the reviving presentation is only partially similar to the presentation revived, the nature of the association does not appear to differ from that operative when one "contiguous" presentation revives another. In the one case we have, say, *a b x* recalling *a b y*, and in the other *a b c* recalling *d e f*. Now anybody who will reflect must surely see that the similarity between *a b x* and *a b y*, as distinct from the identity of their partial constituent *a b*, cannot be the means of recall; for this similarity is nothing but the state of mind—to be studied presently—which results when *a b x* and *a b y*, *having been recalled* are in consciousness together and then *compared*. But if *a b*, having concurred with *y* before and being now present in *a b x*, again revives *y*, the association, so far as that goes, is manifestly one of contiguity, albeit as soon as the revival is complete, the state of mind immediately incident may be what Bain loved to style "the flash of similarity." So far as the mere revival itself goes, there is no more similarity in this case than there is when *a b c* revives *d e f*. For the very *a b c* that now operates as the reviving presentation was obviously never in time contiguous with the *d e f* that is revived; if all traces of previous experiences of *a b c* were obliterated there would be no revival. In other words, the *a b c* now present must be "automatically associated," or, as we prefer to say, must be assimilated to those residua of *a b c* which were "contiguous" with *d e f*, before the representation of this can occur. And this, and nothing more than this, we have seen, is all the "similarity" that could be at work when *a b x* "brought up" *a b y*.

Contiguity Inexplicable.

On the whole, then, we may assume that the only principle of association we have to examine is the so-called *association by contiguity*, which, as ordinarily formulated, runs: Any presentations whatever, which are in consciousness together or in close succession, cohere in such a way that when one recurs it tends to revive the rest, such tendency increasing with the frequency of the conjunction. It has been often contended that any investigation into the nature of association must be fruitless.[1] But, if association is thus a first principle, it ought at least to admit of such a statement as shall remove the necessity for inquiry. So long, however, as we are asked to conceive presentations originally distinct and isolated becoming eventually linked together, we shall naturally feel the need of some explanation of the process, for neither the isolation nor the links are clear—not the isolation, for we can only conceive two presentations separated by other presentations intervening; nor the links, unless these are also presentations, and then the difficulty recurs. But, if for contiguity we substitute continuity and regard the associated presentations as parts of a new continuum, the only important inquiry is how this new whole was first of all integrated.

Formation of Memory-Continuum.

To ascertain this point we must examine each of the two leading divisions of contiguous association—that of simultaneous presentations and that of presentations occurring in close succession. The last, being the clearer, may be taken first. In a series of associated presentations *A B C D E*, such as the movements made in writing, the words of a poem learned by heart, or the simple letters of the alphabet themselves, we find that each member recalls its successor but not its predecessor. Familiar as this fact is, it is not perhaps easy to explain it satisfactorily. Since *C* is associated both with *B* and *D*, and apparently as intimately with the one as with the other, why does it revive the later only and not the earlier? *B* recalls *C*; why does not *C* recall *B*? We have seen that any reproduction at all of *B*, *C* or *D* depends primarily upon its having been the object of special attention, so as to occupy at least momentarily the focus of consciousness. Now we can in the first instance only surmise that the order in which they are reproduced is determined by the order in which they were thus attended to when first presented. The next question is whether the association of objects simultaneously presented can be resolved into an association of objects successively attended to. Whenever we try to recall a scene we saw but for a moment there are always a few traits that recur, the rest being blurred and vague, instead of the whole being revived in equal distinctness or indistinctness. On seeing the same scene a second time our attention is apt to be caught by something unnoticed before, as this has the advantage of novelty; and so on, till we have "lived ourselves into" the whole, which may then admit of simultaneous recall. Bain, who is rightly held to have given the best exposition of the laws of association, admits something very like this in saying that "coexistence is an artificial growth formed from a certain peculiar class of mental successions." But, while it is easy to think of instances in which the associated objects were attended to successively, and we are all perfectly aware that the surest—not to say the only—way to fix the association of a number of objects is by thus concentrating attention on each in turn, it seems hardly possible to mention a case in which attention to the associated objects could not have been successive. In fact, an aggregate of objects on which attention could be focused at once would be already associated.

The exclusively successional character of contiguous association has recently been denied, and its exclusively simultaneous character maintained instead. It is at once obvious that this opposition of succession and simultaneity cannot be pressed so as to exclude duration altogether and reduce the whole process to an instantaneous event. Nor is there any ground for saying that there is a fixed and even distribution of attention to whatever is simultaneously presented: facts all point the other way. Still, though we cannot exclude the notion of process from consciousness, we may say that presentations attended to together become *pro tanto* a new whole, are synthesized or complicated. Such primary synthesis leads not to an association of ideas, but rather to the formation of one percept, which may become eventually a free idea. The disconcerted preperception which sets this free may likewise liberate a similar or contrasting idea, but it will not resolve either complex into the several "ideas" of its sensory or motor constituents, with which only the psychologist is familiar. The actual recurrence of some of these constituents may again reinstate the rest, not, however, as memories or as "thoughts," but only as tied ideas in a renewed perception.

Again, it has become usual to distinguish the association of contiguous experiences and the so-called association of similars or opposites as respectively external and internal *forms* of association. The new terminology is illuminating: the substitution of *forms* for *laws* marks the abandonment of the old notion that association was by "adhesion" of the contiguous and "attraction" of the similar. We are thus left to find the cause of association in interested attention; and that, we may safely say, is an adequate, and apparently the sole adequate, cause for the two commonly recognized forms of external association, the so-called simultaneous and the successive. But these two are certainly not co-ordinate; and if our analysis be sound, the former—for which we would retain the Herbartian term complication—yields us not members of an association but a member for association. So far, then, we should have but one form of association, that of the successive contents of focalized attention: and but one result, the representation or memory-continuum,[2] in contrast to the primary- or presentation-continuum, whence its constituents arise. Turning now to the distinction of external and internal, it at once strikes the unprejudiced mind that "internal association" is something of an anomaly, since the very notion of association implies externality. Also, on closer inspection what we find is not an association of similars or opposites as such, but—something quite distinct—a similarity or contrast of associates; of ideas, that is to say, which are contiguous members of the memory (or experience) continuum, or of ideas which have become contiguous through its reduplication.

The only case, then, that now remains to be considered is that—to take it in its simplest form—of two primary presentations *A* and *X*, parts of different special continua or distinct—*i.e.* non-adjacent—parts of the same, and occupying the focus of consciousness in immediate succession. This constitutes their integration; for the result of this occupation may be regarded as a new continuum in which A and X become adjacent parts. For it is characteristic of a continuum that an increase in the intensity of any part leads to the intenser presentation of adjacent parts; and in this sense A and X, which were not originally continuous, have come to be so. We have here, then, some justification for the term secondary- or memory-continuum when applied to this continuous series of representations to distinguish it from the primary or presentation-continuum from which its constituents are derived. The most important peculiarity of this continuum, therefore, is that it is a series of representations integrated by means of the movements of attention out of the differentiations of the primary or presentation-continuum, or rather out of so much of these differentiations as pertain to what we know as the primary memory-image. These movements of attention, if the phrase may be allowed, come in the end to depend mainly upon interest, but at first appear to be determined entirely by mere intensity.[1] To them it is proposed to look for that continuity which images lose in so far as they part with the local signs they had as percepts and cease to be either localized or projected. Inasmuch as it is assumed that these movements form the connexion between one representation and another in the memory-train, they may be called "temporal signs."[2] The evidence for their existence can be more conveniently adduced presently; it must suffice to remark here that it consists almost wholly of facts connected with voluntary attention and the voluntary control of the flow of ideas, so that temporal signs, unlike local signs, are fundamentally motor and not sensory. And, unlike impressions, representations can have each but a single sign,[3] the continuum of which, in contrast to that of local signs, is not rounded and complete, but continuously advancing. But in saying this we are assuming for a moment that the memory-continuum forms a perfectly single and unbroken train. If it ever actually were such, then, in the absence of any repetition of old impressions and apart from voluntary interference with the train, consciousness, till it ceased entirely, would consist of a fixed and mechanical round of images. Some approximation to such a state is often found in uncultured persons who lead uneventful lives, and still more in idiots, who can scarcely think at all.

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[1] So Hume, *Treatise of Human Nature*, pt. i. § 4 (Green and Grose's ed., p. 321); also Lotze, *Metaphysik*, 1st ed., p. 526.

[2] Experience-continuum would perhaps be a better name, since it is only a preliminary to a true memory record, as we shall presently see.

Formation of Ideational Continuum.

25. In actual fact, however, the memory-train is liable to change in two respects, which considerably modify its structure, viz. (1) through the evanescence of some parts, and (2) through the partial recurrence of like impressions, which produces reduplications of varying amount and extent in other parts. As regards the first, we may infer that the waning or sinking towards the threshold of consciousness which we can observe in the primary mental image continues in sub-consciousness after the threshold is past. For the longer the time that elapses before their revival the fainter, the less distinct, and the less complete are the images when revived, and the more slowly they rise. All the elements of a complex are not equally revivable, as we have seen already: tastes, smells and organic sensations, though powerful as impressions to revive other images, have little capacity for ideal reproduction themselves, while muscular movements, though perhaps of all presentations the most readily revived, do not so readily revive other presentations. Idiosyncrasies are, however, frequent; thus we find one person has an exceptional memory for sounds, another for colours, another for forms. Still it is in general true that the most intense, the most impressive, and the most interesting presentations persist the longest. But the evanescence, which is in all cases comparatively rapid at first, deepens sooner or later into real or apparent oblivion. In this manner it comes about that parts of the memory-continuum lose all distinctness of feature and, being without recognizable content, shrivel up to a dim and meagre representation of life that has lapsed—a representation that just suffices, for example, to show us that "our earliest recollections" are not of our first experiences, or to save them from being not only isolated but discontinuous. Such discontinuity can, of course, never be absolute; we must have something represented even to mark the gap. Oblivion and the absence of all representation are thus the same, and the absence of all representation cannot psychologically constitute a break. The terms "evolution" and "involution" have in this respect been happily applied to the rising and falling of representations. When we recall a particular period of our past life, or what has long ceased to be a familiar scene, events and features gradually unfold and, as it were, spread out as we keep on attending. A precisely opposite process may then be supposed to take place when they are left in undisturbed forgetfulness; this process is called obliviscence.

Obliviscence.

Repetition.

More important changes are produced by the repetition of parts of the memory-train. The effect of this is not merely to prevent the evanescence of the particular image or series of images, but by partial and more or less frequent reduplications of the memory-train or "thread" upon itself to convert it into a partially new continuum, which we might perhaps call the ideational continuum or "tissue."[4] The reduplicated portions of the train are strengthened, while at the points of divergence it becomes comparatively weakened, and this apart from the effects of obliviscence. One who had seen the king but once would scarcely be likely to think of him without finding the attendant circumstances recur as well; this could not happen after seeing him in a hundred different scenes. The central representation of the whole complex would have become more distinct, whereas the several diverging lines would tend to dissipate attention and, by involving opposing representations, to neutralize each other, so that probably no definite background would be reinstated. Even this central representation would be more or less generalized. It has been often remarked that one's most familiar friends are apt to be mentally pictured less concretely and vividly than persons seen more seldom and then in similar attitudes and moods; in the former case a "generic image" has grown out of such more specific representations as the latter affords. Still further removed from memory-images are the images that result from such familiar percepts as those of horses, houses, trees, &c.

Generic Images.

Trains of Ideas.

Thus as the joint effect of obliviscence and reduplication we are provided with trains of ideas distinct from the memory-thread and thereby with the material, already more or less organized, for intellectual and volitional manipulation. We do not experience the flow of ideas—save very momentarily and occasionally—altogether undisturbed; even in dreams and reverie it is continually interrupted and diverted. Nevertheless it is not difficult to ascertain that, so far as it is left to itself, it takes a very different course from that which we should have to retrace if bent on reminiscence and able to recollect perfectly. The readiness and steadiness of this flow are shown by the extremely small effort necessary in order to follow it. Nevertheless from its very nature it is liable, though not to positive breaches of continuity from its own working, yet to occasional blocks or impediments to the smooth succession of images at points where reduplications diverge, and either permanently or at the particular time neutralize each other.[1]

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[1] This connexion of association with continuous movements of attention makes it easier to understand the difficulty above referred to, viz. that in a series $A\ B\ C\ D$ . . ., B revives C but not A, and so on—a difficulty that the analogy of adhesiveness or links leaves unaccountable. To ignore the part played by attention in association, to represent the memory-continuum as due solely to the concurrence of presentations, is perhaps the chief defect of the associationist psychology, both English and German. Spencer's endeavour to show "that psychical life is distinguished from physical life by consisting of successive changes only instead of successive and simultaneous changes" (*Principles of Psychology*, pt. iv. ch. ii., in particular pp. 403, 406) is really nothing but so much testimony to the work of attention in forming the memory-continuum, especially when, as there is good reason to do, we reject his assumption that this growing seriality is physically determined.

[2] A term borrowed from Lotze (*Metaphysik*, 1st ed., p. 295), but the present writer is alone responsible for the sense here given to it and the hypothesis in which it is used.

[3] Apart, that is to say, of course, from the reduplications of the memory-train spoken of below.

[4] This contrast of thread and tissue is suggested, of course, by Herbart's terms *Reihe* and *Gewebe*. It is justified by the fact that memory proper follows the single line of temporal continuity, while ideation furnishes the basis for manifold logical connexions.

Conflict of Presentations.

The flow of ideas is, however, exposed to positive interruptions from two distinct sides—by the intrusion of new presentations and of voluntary interference. The only result of such interruptions which we need here consider is *the conflict of presentations* that may ensue. Herbart and his followers have gone so far as to elaborate a complete system of psychical statics and dynamics, based on the conception of presentations as forces and on certain more or less improbable assumptions as to the modes in which such forces interact. Since our power of attention is limited, it continually happens that attention is drawn off by new presentations at the expense of old ones. But, even if we regard this non-voluntary redistribution of attention as implying a struggle between presentations, still such conflict to secure a place in consciousness is very different from a conflict between presentations that are already there. Either may be experienced to any degree possible without the other appearing at all; thus, absorbed in watching a starry sky, one might be unaware of the chilliness of the air, though recognizing at once, as soon as the cold is felt, that, so far from being incompatible, the clearness and the coldness are causally connected. This difference between a conflict of presentations to enter the field of consciousness—if we allow for a moment the propriety of the expression—and that opposition or incompatibility between presentations which is only possible when they are in consciousness has been strangely confused by the Herbartians. In the former the intensity of the presentation is primarily alone of account; in the latter, on the contrary, quality and content are mainly concerned. Only the last requires any notice here, since such opposition arises when the ideational continuum is interrupted in the ways just mentioned, and apparently arises in no other way. Certainly there is no such opposition between primary presentations: there we have the law of incopresentability preventing the presentation of opposites with the same local sign; and their presentation with different local signs involves, on this level at all events, no conflict. But what has never been presented could hardly be represented, if the ideational process were undisturbed: even in our dreams white negroes or round squares, for instance, never appear. In fact, absurd and bizarre as dream-imagery is, it never at any moment entails overt contradictions, though contradiction may be implicit.

But between ideas and percepts actual incompatibility is frequent. In the perplexity of Isaac, *e.g.* —" The voice is Jacob's voice, but the hands are the hands of Esau "—we have such a case in a familiar form. There is here not merely mental arrest but actual conflict: the voice perceived identifies Jacob, at the same time the hands identify Esau. The images of Esau and Jacob by themselves are different, but do not conflict; neither is there any strain, quite the contrary, in recognizing a person partly like Jacob and partly like Esau. For there is no direct incompatibility between smooth and rough, so long as one pertains only to voice and the other only to hands, but the same hands and voice cannot be both smooth and rough. Similar incompatibilities may arise without the intrusion of percepts, as when, in trying to guess a riddle or to solve a problem, or generally to eliminate intellectual differences, we have images which in themselves are only logically opposite, psychologically opposed, or in conflict, because each strives to enter the same complex. In all such conflicts alike we find, in fact, a relation of presentations the exact converse of that which constitutes similarity. In the latter we have two complete presentations, $a\ b\ x$ and $a\ b\ y$, as similar, each including the common part $a\ b$; in the former we have two partial presentations, x and y, as contraries, each excluding the other from the incomplete $a\ b$—. And this $a\ b$, it is to be noted, is not more essential to the similarity than to the conflict. But in the one case it is a generic image (and can logically be predicated of two subjects); in the other it is a partially determined individual (and cannot be subject to opposing predicates). Except as thus supplementing $a\ b$, x and y do not conflict; black and white are not incompatible save as attributes of the same thing. The possibility of most of these conflicts—of all, indeed, that have any logical interest—lies in that reduplication of the memory-continuum which gives rise to these new complexes, generic images or general ideas.

Reminiscence and Expectation: Temporal Perception.

26. Having thus attempted to ascertain the formation of the ideational continuum out of the memory-train, the question arises: How now are we to distinguish between imagining and remembering, and again, between imagining and expecting? It is plainly absurd to make the difference depend on the presence of belief in memory and expectation and on its absence in mere imagination; for the belief itself depends on this difference instead of constituting it. One real and obvious distinction, however, which Hume pointed out as regards memory, is the fixed order and position of the ideas of what is remembered or expected as contrasted with " the liberty " of the imagination to transpose and change its ideas. This order and position in the case of memory are, of course, normally those of the original impressions, but it seems rather naïve of Hume to tell us that memory " is tied down to these without any power of variation," while imagination has liberty to transpose as it pleases, as if the originals sat to memory for their portraits, while to imagination they were but studies. Such correspondence being out of the question—as Hume takes care to state as soon as it suits him—all we have, so far, is this fixity and definiteness as contrasted with the kaleidoscopic instability of ideation. In this respect what is remembered or expected resembles what is perceived: the grouping not only does not change capriciously and spontaneously, but resists any mental efforts to change it. But, provided these characteristics are there, we should be apt to believe that we are remembering, just as, *mutatis mutandis*, with like characteristics we might believe that we were perceiving: hallucination is possible in either case.

Imagination and Memory.

This fixity of order and position is, however, not sufficient to constitute a typical reminiscence where the term is exactly used. But remembering is often regarded as equivalent to knowing and recognizing, as when on revisiting some once familiar place one remarks, " How well I remember it!" What is meant is that the place is recognized, and that its recognition awakens memories. Memory includes recognition; recognition as such does not include memory. In human consciousness, as we directly observe it, there is, perhaps, no pure recognition: here the new presentation in not only assimilated to the old, but the former framing of circumstance is reinstated, and so perforce distinguished from the present. It may be there is no warrant for supposing that such redintegration of a preceding field is ever absolutely nil, still we are justified in regarding it as extremely vague and meagre, both where mental evolution is but slightly advanced and where frequent repetition in varying and irrelevant circumstances has produced a blurred and neutral zone. The last is the case with a great part of our knowledge; the writer happens to know that *bos* is the Latin for " ox " and *bufo* the Latin for " toad," and may be said to remember both items of knowledge, if " remember " is only to be synonymous with " retain." But if he came across *bos* in reading he would think of an ox and nothing more; *bufo* would immediately call up not only " toad " but Virgil's *Georgics*, the only place in which he has seen the word, and which he never read but once. In the former there is so far nothing but recognition (which, however, of course rests upon retentiveness); in the latter there is also remembrance of the time and circumstances in which that piece of knowledge was acquired. Of course in so far as we are aware that we recognize we also think that remembrance is at any rate possible, since what we know we must previously have learned—recognition excluding novelty. But the point here urged is that there is an actual reminiscence only when the recognition is accompanied by a reinstatement of portions of the memory-train continuous with the previous presentation of what is now recognized. Summarily stated, we may say that between knowing and remembering on the one hand and imagining on the other the difference primarily turns on the fixity and completeness of the grouping in the former; in the latter there is a shifting play of images more or less " generic," reminding one of " dissolving views." Hence the first two approximate in character to perception, and are rightly called recognitions. Between them, again, the difference turns primarily on the presence or absence of temporal signs. In what is remembered these are still intact enough to ensure a localization in the past of what is recognized; in what is known merely such localization is prevented, either because of the obliviscence of temporal connexions or because the reduplications of the memory-train that have consolidated the central group have entailed their suppression. There is further the difference first mentioned, which is often only a difference of degree, viz. that reminiscences have more circumstantiality, so to say, than mere recognitions have: more of the collateral constituents of the original concrete field of consciousness are reinstated. But of the two characteristics of memory proper—(a) concreteness or circumstantiality, and (*b*) localization in the past—the latter is the more essential. It sometimes happens that we have the one with little or nothing of the other. For example, we may have but a faint and meagre representation of a scene, yet if it falls into and retains a fixed place in the memory train we have no doubt that some such experience was once actually ours. On the other hand, as in certain so-called illusions of memory, we may suddenly find ourselves reminded by what is happening at the moment of a preceding experience exactly like it—some even feel that they know from what is thus recalled what will happen next; and yet, because we are wholly unable to assign such representation a place in the past, instead of a belief that it happened, there arises a most distressing sense of bewilderment, as if one were haunted and had lost one's personal bearings.[1] It has been held by some psychologists[2] that memory proper includes the representation of one's past self as agent or patient in the event or situation recalled. And this is true as regards all but the earliest human experience, at any rate; still, whereas it is easy to see that memory is essential to any development of self consciousness, the converse is not at all clear, and would involve us in a needless circle.

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[1] It is a mark of the looseness of much of our psychological terminology that facts of this kind are commonly described as cases of association. Dr Bain calls them " obstructive association," which is about on a par with " progress backwards "; Mr Sully's " divergent association " is better. But it is plain that what we really have is an arrest or inhibition consequent on association, and nothing that is either itself association or that leads to association.

Expectation.

27. Intimately connected with memory is expectation. We may as the result of reasoning conclude that a certain event will happen; we may also, in like manner, conclude that a certain other event has happened. But as we should *not* call the latter memory, so it is desirable to distinguish such indirect anticipation as the former from that expectation which is directly due to the interaction of ideas. Any man knows that he will die, and may make a variety of arrangements in anticipation of death, but he cannot with propriety be said to be expecting it unless he has actually present to his mind a series of ideas ending in that of death, such series being due to previous associations, and unless, further, this series owes its representation at this moment to the actual recurrence of some experience to which that series succeeded before. And as familiarity with an object or event in very various settings may be a bar to recollection, so it may be to expectation: the average Englishman, *e.g.* is continually surprised without his umbrella, though only too familiar with rain, since in our climate one not specially attentive to the weather obtains no clear representation of its successive phases. But after a series of events *A B C D E* . . . has been once experienced we instinctively expect the recurrence of *B C* . . . on the recurrence of *A*, *i.e.* provided the memory-train continues so far intact. Such expectation, at first perhaps slight—a mere tendency easily overborne—becomes strengthened by every repetition of the series in the old order, till eventually, if often fulfilled and never falsified, it becomes certain and, as we commonly say, irresistible. To have a clear case of expectation, then, it is not necessary that we should distinctly remember any previous experience like it, but only that we should have actually present some earlier member of a series which has been firmly associated by such previous experiences, the remaining members, or at least the next, if they continue serial, being revived through that which is once again realized. This expectation may be instantly checked by reflection, just as it may, of course, be disappointed in fact; but these are matters which do not concern the inquiry as to the nature of expectation while expectation lasts.

Present, Past, and Future.

We shall continue this inquiry to most advantage by widening it into an examination of the distinction of present, past and future. To a being whose presentations never passed through the transitions which ours undergo—first divested of the strength and vividness of impressions, again reinvested with them and brought back from the faint world of ideas—the sharp contrasts of "now" and "then," and all the manifold emotions they occasion, would be quite unknown. Even we, so far as we confine our activity and attention to ideas are almost without them. Time-order, succession, antecedence, and consequence, of course, there might be still, but in that sense of events as "past and gone for ever," which is one of the melancholy factors in our life; and in the obligation to wait and work in hope or dread to what is "still to come" there is much more than time-order. It is to presentations in their primary stage, to impressions, that we owe what real difference we find between now and then, whether prospective or retrospective, as it is to them also that we directly owe our sense of the *real*, of what *is* and exists as opposed to the non-existent that is not. But the present alone and life in a succession of presents, or, in other words, continuous occupation with impressions, give us no knowledge of the present as present. This we first obtain when our present consciousness consists partly of memories or partly of expectations as well. An event expected differs from a like event remembered chiefly in two ways—in its relation to present impressions and images and in the active attitude to which it leads. The diverse feelings that accompany our intuitions of time and contribute so largely to their colouring are mainly consequences of these differences. Let us take a series of simple and familiar events *A B C D E*, representing ideas by small letters, and perceptions by capitals whenever it is necessary to distinguish them. Such series may be present in consciousness in such wise that *a b c d* are imaged while *E* is perceived anew, *i.e.* the whole symbolized as proposed would be *a b c d E*; such would be, *e.g.* the state of a dog that had just finished his daily meal. Again, there may be a fresh impression of *A* which revives *b c d e*; we should have then (1) *A b c d e*—the state of our dog when he next day gets sight of the dish in which his food is brought to him. A little later we may have (2) *a b C d e*. Here *a b* are either after-sensations or primary memory-images, or have at any rate the increased intensity due to recent impression; but this increased intensity will be rapidly on the wane even while *C* lasts, and *a b* will pale still further when *C* gives place to *D*, and we have (3) *a b c D e*. But, returning to (2), we should find *d e* to be increasing in intensity and definiteness, as compared with their state in (1), now that *C*, instead of *A*, is the present impression. For, when *A* occupied this position, not only was *e* raised less prominently above the threshold of consciousness by reason of its greater distance from *A* in the memory-continuum, but, owing to the reduplications of this continuum, more lines of possible revival were opened up, to be successively negatived as *B* succeeded to *A* and *C* to *B*; even dogs know that "there is many a slip 'twixt the cup and the lip." But, where *A B C D E* is a series of percepts such as we have here supposed—and a series of simpler states would hardly afford much ground for the distinctions of past, present and future—there would be a varying amount of active adjustment of sense-organs and other movements supplementary to full sensation. In (2), the point at which we have *a b C d e*, for instance, such adjustments and movements as were appropriate to *b* would cease as *B* lapsed and be replaced by those appropriate to *C*. Again, as *C* succeeded to *B*, and *d* in consequence increased in intensity and definiteness, the movements adapted to the reception of *D* would become nascent, and so on. Thus, psychologically regarded, the distinction of past and future and what we might call the oneness of direction of time depend, as just described, (1) upon the continuous sinking of the primary memory-images on the one side, and the continuous rising of the ordinary images on the other side, of that member of a series of percepts then repeating which is actual at the moment; and (2) on the prevenient adjustments of attention, to which such words as "expect," "await," "anticipate," all testify by their etymology. These conditions in turn will be found to depend upon all that is implied in the formation of the memory-train and upon that recurrence of like series of impressions which we attribute to the "uniformity of nature." If we never had the same series of impressions twice, knowledge of time would be impossible, as indeed would knowledge of any sort.

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[1] Any full discussion of *paramnesia*, as these very interesting states of mind are called, belongs to mental pathology.

[2] As, *e.g.* James Mill (*Analysis of the Human Mind*, ch. x.), who treats this difficult subject with great acuteness and thoroughness.

Succession.

28. Time is often figuratively represented as a line, and we may perhaps utilize this figure to make clear the relation of our perception of time to what we call time itself. The present, though conceived as a point or instant of time, is still such that we actually can and do in that moment attend to a plurality of presentations to which we might otherwise have attended to severally in successive moments. Granting this implication of simultaneity and succession, we may, if we represent succession as a line, represent simultaneity as a second line at right angles to the first; pure time—or time-length without time-breadth, we may say—is a mere abstraction. Now it is with the former line that we have to do in treating of time as it is (or as we conceive it), and with the latter in treating of our perception of time, where, just as in a perspective representation of distance, we are confined to lines in a plane at right angles to the actual line of depth. In a succession of events *A B C D E* . . . the presence of *B* means the absence of *A* and of *C*, but the presentation of this succession involves the simultaneous presence, in some mode or other, of two or more of the presentations *A B C D*. In our temporal perception, then, all that corresponds to the differences of past, present and future is presented simultaneously. To this fact the name of "specious present" or "psychical present" has been given. What we have is not a moving point or moment of objective time, but rather a moving line, the contents of which, continuously changing, simultaneously represent a portion of the line of objective succession, viz. the immediate past as still present in primary memory-images, and the immediate future as anticipated in prepercepts and nascent acts.[1] This truism—or paradox—that all we know of succession is but an interpretation of what is really simultaneous or coexistent, we may then concisely express by saying that we are aware of time only through time-perspective, and experience shows that it is a long step from a succession of presentations to such presentation of succession. The first condition of such presentation is that we should have represented together presentations that were in the first instance attended to successively, and this we have both in the persistence of primary memory-images and in the simultaneous reproduction of longer or shorter portions of the memory-train. In a series thus secured there may be time-marks, though no time, and by these marks the series will be distinguished from other simultaneous series. To ask which is first among a number of simultaneous presentations is unmeaning; one might be logically prior to another, but in time they are together and priority is excluded. Nevertheless after each distinct representation *a*, *b*, *c*, *d* there probably follows, as we have supposed, some trace of that movement of attention of which we are aware in passing from one presentation to another. In our present reminiscences we have, it must be allowed, little direct proof of this interposition, though there is strong indirect evidence of it in the tendency of the flow to follow the order in which the presentations were first attended to. With the movements themselves we are familiar enough, though the residua of such movements are not ordinarily conspicuous. These residua, then, are our temporal signs, and, together with the representations connected by them, constitute the memory-continuum. But temporal signs alone will not furnish all the pictorial exactness of the time-perspective. They give us only a fixed series; but the working of obliviscence, by insuring a progressive variation in intensity and distinctness as we pass from one member of the series to the other, yields the effect which we call time-distance. By themselves such variations would leave us liable to confound more vivid representations in the distance with fainter ones nearer the present, but from this mistake the temporal signs save us; and, as a matter of fact, where the memory-train is imperfect such mistakes continually occur. On the other hand, where these variations are slight and imperceptible, though the memory-continuum preserves the order of events intact, we have still no such distinct appreciation of comparative distance in time as we have nearer the present where these perspective effects are considerable.

Duration.

29. When in retrospect we note that a particular presentation *X* has had a place in the field of consciousness, while certain other presentations, *A B C D* . . . ., have succeeded each other, then we may be said in observing this relation of the two to perceive the duration of *X*. And it is in this way that we do subjectively estimate longer periods of time. But first, it is evident that we cannot apply this method to indefinitely short periods without passing beyond the region of distinct presentation; and, since the *knowledge* of duration implies a relation between distinguishable presentations *A B C D* and *X*, the case is one in which the hypothesis of subconsciousness can hardly help any but those who confound the fact of time with the knowledge of it. Secondly, if we are to compare different durations at all, it is not enough that one of them should last out a series *A B C D*, and another a series *L M N O*; we also want some sort of common measure of those series. Locke was awake to this point, though he expresses himself vaguely (*Essay*, ii. 14, §§ 9-12). He speaks of our ideas succeeding each other "at certain distances not much unlike the images in the inside of a lantern turned round by the heat of a candle," and "guesses" that "this appearance of theirs in train varies not very much in a waking man." Now what is this "distance" that separates *A* from *B*, *B* from *C*, and so on, and what means have we of knowing that it is tolerably constant in waking life? It is probably that the residuum of which we have called a temporal sign; or, in other words, it is the movement of attention from *A* to *B*. But we must endeavour here to get a more exact notion of this movement. Everybody knows what it is to be distracted by a rapid succession of varied impressions, and equally what it is to be wearied by the slow and monotonous recurrence of the same impressions. Now these "feelings" of distraction and tedium owe their characteristic qualities to movements of attention. In the first, attention is kept incessantly on the move; before it is accommodated to *A*, it is disturbed by the suddenness, intensity, or novelty of *B*; in the second, it is kept all but stationary by the repeated presentation of the same impression. Such excess and defect of surprises make one realize a fact which in ordinary life is so obscure as to escape notice. But recent experiments have set this fact in a more striking light, and made clear what Locke had dimly before his mind in talking of a certain distance between the presentations of a waking man. In estimating very short periods of time, of a second or less—indicated say by the beats of a metronome—it is found that there is a certain period for which the mean of a number of estimates is correct, while shorter periods are on the whole over-estimated, and longer periods under-estimated. This we may perhaps take to be evidence of the time occupied in accommodating or fixing attention. Whether the "point of indifference" is determined by the rate of usual bodily movement, as Spencer asserts and Wundt conjectures, or conversely, is a question we need not discuss just now. But, though the fixation of attention does of course really occupy time, it is probably not in the first instance perceived as time, *i.e.* as continuous "protensity," to use a term of Hamilton's, but as intensity. Thus, if this supposition be true, there is an element in our concrete time-perception which has no place in our abstract conception of time. In time conceived as physical there is no trace of intensity; in time psychically experienced duration is primarily an intensive magnitude, witness the comparison of times when we are "bored" with others when we are amused. It must have struck every one as strange who has reflected upon it that a period of time which seems long in retrospect—such as an eventful excursion—should have appeared short in passing; while a period, on the contrary, which in memory has dwindled to a wretched span seemed everlasting till it was gone. But, if we consider that in retrospect length of time is represented primarily and chiefly by impressions that have survived, we have an explanation of one-half; and in the intensity of the movements of attention we shall perhaps find an explanation

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[1] Cf. W. James, *Principles of Psychology*, i. 629 sqq.; L. W. Stern, "Psychische Präsenzzeit," *Z. f. Psych.*, (1897), xiii. 325 sqq.

of the other. What tells in retrospect is the series *a b c d e*, &c.; what tells in the wearisome present is the intervening $t_1t_2t_3$, &c., or rather the original accommodation of which these temporal signs are the residuum. For, as we have seen elsewhere, the intensity of a presentation does not persist, so that in memory the residuum of the most intense feeling of tedium may only be so many t's in a memory-continuum whose surviving members are few and uninteresting. But in the actual experience, say, of a wearisome sermon, when the expectation of release is continually balked and attention forced back upon a monotonous dribble of platitudes, the one impressive fact is the hearer's impatience. On the other hand, so long as we are entertained, attention is never involuntary, and there is no continually deferred expectation. Just as we are said to walk with least effort when our pace accords with the rate of swing of our legs regarded as pendulums, so in pastimes impressions succeed each other at the rate at which attention can be most easily accommodated, and are such that we attend willingly.[1] We are absorbed in the present without being unwillingly confined to it; not only is there no motive for retrospect or expectation, but there is no feeling that the present endures. Each impression lasts as long as it is interesting, but does not continue to monopolize the focus of consciousness till attention to it is fatiguing, because uninteresting. In such facts, then, we seem to have proof that our perception of duration rests ultimately upon quasi-motor acts of varying intensity, the duration of which we do not directly experience as duration at all. They do endure and their intensity is a function of their duration; but the intensity is all that we directly perceive. In other words, it is here contended that what Locke called an instant or moment—" the time of one idea in our minds without the succession of another, of one wherein therefore we perceive no succession at all "—is psychologically not " a part in duration " in that sense in which, as he says, " we cannot conceive any duration without succession " (*Essay*, ii. 16, 12).

Is time Discrete or Continuous?

But, if our experience of time depends primarily upon acts of attention to a succession of distinct objects, it would seem that time, subjectively regarded, must be discrete and not continuous. This, which is the view steadily maintained by the psychologists of Herbart's school, was implied if not stated by Locke, Berkeley and Hume. Locke hopelessly confuses time as perceived and time as conceived; and can only save himself from pressing objections by the retort, " It is very common to observe intelligible discourses spoiled by too much subtlety in nice divisions." But Berkeley and Hume, with the mathematical discoveries of Newton and Leibnitz before them, could only protest that there was nothing answering to mathematical continuity in our experience. And, whereas Locke had tried to combine with his general psychological account the inconsistent position that " none of the distinct ideas we have of either [space or time] is without all manner of composition," Berkeley declares, " For my own part, whenever I attempt to frame a simple idea of time, abstracted from the succession of ideas in my mind, which flows uniformly and is participated by all beings, I am lost and embrangled in inextricable difficulties. I have no notion of it at all, only I hear others say it is infinitely divisible, and speak of it in such a manner as leads me to harbour odd thoughts of my existence. . . . Time therefore being nothing, abstracted from the succession of ideas in our minds, it follows that the duration of any finite spirit must be estimated *by the number of ideas or actions* succeeding each other in that same spirit or mind " (*Principles of Knowledge*, i. § 98). Hume, again, is at still greater pains to show that " the *idea* which we form of any finite quality is not infinitely divisible, but that by proper distinctions and separations we may run this idea up to inferior ones, which will be perfectly simple and indivisible . . . that the imagination reaches a *minimum*, and may raise up to itself an idea of which it cannot conceive any subdivision, and which cannot be diminished without a total annihilation " (*Human Nature*, pt. ii. § 1, Green's ed., pp. 334 seq.).

At first blush we are perhaps disposed to accept this account of our time-perception, as Wundt, *e.g.* does, and to regard the attribution of continuity as wholly the result of after-reflection.[2] But it may be doubted if this is really an exact analysis of the case. Granted that the impressions to which we chiefly attend are distinct and discontinuous in their occupation of the focus of consciousness, and that, so far, the most vivid element in our time-experience is discrete; granted further that in recollection and expectation such objects are still distinct—all which seems to imply that time is a mere plurality—yet there is more behind. The whole field of consciousness is not occupied by distinct objects, neither are the changes in this field discontinuous. The experimental facts above-mentioned illustrate the transition from a succession the members of which are distinctly attended to to one in which they are indistinctly attended to, *i.e.* are not discontinuous enough to be separately distinguished. Attention does not move by hops from one definite spot to another, but, as Wundt himself allows, by alternate diffusion and concentration, like the foot of a snail, which never leaves the surface it is traversing. We have a clear presentation discerned as *A* or *B* when attention is gathered up; and, when attention spreads out, we have confused presentations not admitting of recognition. But, though not recognizable, such confused presentations are represented, and so serve to bridge over the comparatively empty interval during which attention is unfocused. Thus our perception of a period of time is not comparable to so many terms in a series of finite units any more than it is to a series of infinitesimals. When attention is concentrated in expectation of some single impression, then, no doubt, it is brought to a very fine point (" zugespitzt," as Herbart would say); and a succession of such impressions would be represented as relatively discrete compared with the representation of the scenery of a day-dream. But absolutely discrete it is not and cannot be. In this respect the truth is rather with Herbert Spencer, who, treating of this subject from another point of view, remarks, " When the facts are contemplated objectively, it becomes manifest that, though the changes constituting intelligence approach to a single succession, they do not absolutely form one " (*Psychology*, i. § 180).

On the whole, then, we may conclude that our concrete time-experiences are due to the simultaneous representation of a series of definite presentations both accompanied and separated by more or fewer indefinite presentations more or less confused; that, further, the definite presentations have certain marks or temporal signs due to the movements of attention; that the rate of these movements or accommodations is approximately constant; and that each movement itself is primarily experienced as an intensity.

Experimental Investigations concerning Memory and Association.

30. Of the vast mass of experimental work undertaken in recent years, that relating to memory and association is probably the most important. A brief account of some of it is therefore offered at this point, by way of illustrating the character of the " new psychology."

The learning and retaining of a stanza of poetry, say, is obviously a function of many variables, such as the mode of presentation (whether the words are heard only, or heard and seen, or both heard, seen and spoken aloud), the length, familiarity with the words and ideas used, the number of repetitions, the attention given, &c. Familiarity of course implies previous learning and retaining; the first essential, therefore, in any attempt to study these processes from the beginning, is the exclusion of this factor. Accordingly Ebbinghaus, the pioneer in experiments of this kind,[3] devised the new material, which is now regularly employed, namely, closed monosyllables, not themselves words, and strung together promiscuously into lines of fixed length so as never to form words: *bam, rit, por, sig, nef, gud*, &c., is an instance of such " senseless verses." With very slight attention most persons would be able to reproduce three or four such syllables on a single reading or hearing; and by greater concentration six or seven might be so reproduced. This maximum, called sometimes the " span of prehension, " has been repeatedly made the subject of special inquiry. In idiots it is found, as might be expected, remarkably low; in school children it increases rapidly between the ages of eight and fourteen, and then remains almost stationary, individual differences being small compared with the striking differences that appear when longer lines make repetitions necessary.[4] This comparatively constant span of prehension is doubtless closely connected with certain other psychical constants, such as the duration of the psychical present and of the primary memory-image, the *tempo* of movements of attention (§§ 28, 29), &c. There are isolated investigations of these several conditions, but the subject as a whole still awaits systematic treatment.[1] That it is not wanting in interest is evident when we consider that if our span of prehension were enlarged, a corresponding increase in the variety and range of metre and rhyme in poetry, of "phrase" in music, and of evolution in the dance would be possible. The limits at present imposed on these and like complexities find their ultimate explanation in the constants just mentioned.

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[1] To this rate the " indifference point " mentioned above is obviously related. It has also been called " adequate time " or " optional time." It is, however, a *tempo* that varies with the subject-matter attended to; when effective attention is more difficult the tempo is slower than it is when to attend is easy.

[2] Cf. Wundt, *Logik*, i. 432.

[3] H. Ebbinghaus, " Ueber das Gedächtniss: Untersuchungen zur experimentellen Psychologie " (1885).

[4] Cf. J. Jacobs and F. Galton on the " Span of Prehension," *Mind*, (1887), pp. 75 sqq.; Bourdon, " Influence de l'âge sur la mémoire immédiate," *Rev. phil.* (1894) xxxviii., 148 sqq.

With lines of greater length than seven syllables some repetition is requisite before they can be said correctly: the number of such repetitions was found by Ebbinghaus to increase very rapidly with the number of syllables to be learnt. In his own case, for lines of 12, 16, 24, 36 syllables the repetitions necessary were on the average 16·6, 30, 44, 55 respectively. Thus for a line exceeding in length that of the span of prehension only about five times, he required fifty-five times as many repetitions, if we may call the single presentation of the syllables a "repetition." Substituting poetry for gibberish of equal amount, Ebbinghaus found that one-tenth the number of repetitions sufficed; the enormous saving thus effected showing how numerous and intimate are the ready-made associations that "rhyme and reason" involve. But at one and the same time to memorize five verses even of sense requires more than five times as many repetitions as the memorizing of one. Two or three lines of inquiry here present themselves, *e.g.* (1) as to the comparative value of successive repetitions when several are taken together; (2) as to retention after an interval, as (*a*) a function of the number of repetitions previously made, and as (*b*) a function of the time; (3) as to the respective effects of more or less cumulating, or more or less distributing, the repetitions, on the number of these required.

1. It is at once obvious that beyond a certain point exhaustion of attention renders further repetition for a time futile; thus Ebbinghaus found 64 repetitions at one sitting of six 16-syllable nonsense verses, a task lasting some three-quarters of an hour, "was apt to bring on asthenia, a sort of epileptic *aura*, and the like!" But keeping well within this heroic limit, a certain "law of diminishing return," to use an economic analogy, discloses itself. Thus taking a line of 10 syllables, the number of syllables reproduced correctly and in their proper order, after 1, 3, 6, 9 and 12 "repetitions," were 2·2, 2·5, 2·8, 3·4, 3·9 respectively, as the averages of a series of experiments with each of eight persons.[2] "The first repetition is undoubtedly the best," assuming, of course, that the subjects start with their attention fully concentrated. Some persons naturally do this, many do not; the experimenter has therefore to take special precautions to secure uniformity in this respect.

2. (*a*) On relearning a line after an interval of twenty-four hours there was in Ebbinghaus's case an average saving of one repetition for every three made the day before. A line of 16 syllables, for example, required some 30 repetitions, and could then be said off correctly. If only 8 repetitions were taken at first, the line being "underlearnt," it probably appeared quite strange the next day, yet the *proportional* saving was no less; on the other hand, if an additional 30 repetitions followed immediately on the first, the line being "doubly learnt," in spite of the familiarity next day apparent, the proportional saving was no greater. The *absolute* saving would, of course, be less. We are so far led to infer that the stronger associations effected by many repetitions at one time fall off more rapidly than weaker associations effected by fewer repetitions in the same way. Herbart in his "psychical dynamics"—influenced probably by physical analogies—conjectured that the "sinking" or "inhibition" of presentations generally was proportional to their intensity: the less there was to sink, the slower the sinking became. Recent experiments certainly point in this direction. (*b*) As to retention as a function of the time—we all know that memories fade with time, but not at what precise rate. Ebbinghaus, by a series of prolonged experiments, ascertained the rate to be proportional to the logarithm of the time—a result already implied in that connecting retention and intensity; albeit in inquiries of this kind independent confirmation is always of value.

3. Had the proportional saving just described held good indefinitely, some 100 repetitions of the 16 syllables at one time should have dispensed with any further repetition twenty-four hours afterwards; whereas, in fact, this result seemed never attainable. Beyond a certain degree of accumulation, an ever-diminishing return was manifest, and that apparently short of the stage at which exhaustion of attention began to be felt. But, contrariwise, when the repetitions were distributed over several days, an ever-increasing efficiency was then the result. Thus, for Ebbinghaus, 38 repetitions spread over three days were as effective as 68 taken together. The results of careful experiments by Jost with two different subjects, using G. E. Müller's "method of telling" (to be described later on), are still more conclusive. Comparing 8 repetitions on three successive days with 4 repetitions on six, and 2 on twelve, the efficiencies, tested twenty-four hours later, were respectively as 11·5, 35, and 54; and probably, as Jost surmises, the effect of the maximum distribution—single "repetition" on twenty-four successive days—would have been more advantageous still, securing in fact the superiority of a first impression (cf. 1, above) on every occasion. This result again, is in part explained by the law of sinking already found. For if the sinking were simply proportional to the time, or were independent of the intensity, there would so far be no reason why one mode of distributing a given number of repetitions should be more economical than another. There is, however, another reason for this superiority, less clearly implied, to which we shall come presently.

Invariably, and almost of necessity, a more or less complex rhythmical articulation becomes apparent as the syllables are repeated, even when—as in the improved methods of G. E. Müller and his *collaborateurs*—they are presented singly and at regular intervals. A series of twelve syllables, for example, would be connected into six trochees, with a caesura in the middle of the verse; while in each half of it the first and last accented syllables would be specially emphasized; thus:

bām fĭs | lūp tŏl | *gēn* kĕr || *dūb* năf | &c.

In trying to suppress this tendency and to repeat the syllables in a monotonous, *staccato* fashion, just as they were presented, the *tempo*, though really unchanged, seemed to be distinctly quickened, a consequence, doubtless, of the greater effort involved. Moreover, the attempt, which was seldom successful, about doubled the number of repetitions required for learning off, thereby showing how much is gained by this psychical organization of disconnected material. But the gain thus ensured was manifest in other ways. Each foot, whether dissyllabic or trisyllabic, became a new complex unit, the elements to be connected by successive association being thereby reduced to a half or a third, and the whole line seemingly shortened. The varied intonation, again, helped to fix the place of each foot in the verse, thus further facilitating the mind's survey of the whole. Such a transformation can hardly be accounted for so long as retention and association are regarded as merely mechanical and passive processes.

Psychical rhythm, upon which we here touch, has also been experimentally investigated at great length, alike in its physiological psychological and aesthetical aspects. The topic is far too intricate and unsettled for discussion here, yet two or three points may be noted in passing. We are not specially concerned with *objective* rhythms, recurring series of impressions—that is to say, in which there are actually periodic variations of intensity, interval and the like. What is remarkable is that even a perfectly regular succession of sounds (or touches), qualitatively and quantitatively all alike, a series therefore devoid of all objective rhythm, is nevertheless apprehended as rhythmically grouped, provided the rate lies between the limits of about 0·8″ and 0·14″. The slower of these rates leads to simple groups of two, replaced by groups of four or eight as the rate increases; groups of three and six also occur, though less frequently. The average duration of the groups, whether these are large or small, is comparatively constant, measuring rather more than one second. The subject usually keeps time by taps, nods or other accompanying movements; the pulse and respiration are also implicated. These organic rhythms have even been regarded as the prime source of all psychical rhythm and of its manifold aesthetic effects. Some connexion there is unquestionably. As the decimal system corresponds to our possession of ten fingers, and our movements to the structure of our limbs, so here we may assume that physiological processes fix the limits within which psychical rhythm is possible, but yet may be as little an adequate cause of it or its developments as fingers are of arithmetic, or legs of an Irish jig. In motor rhythms, such as the last, the initiative is obviously psychical, and the respiratory and other periodic organic processes simply follow suit. And even sensory rhythms can often be varied at the subject's own choice, or on the suggestion of another; and then again the breathing is altered in consequence. Familiar instances of such procedure are to be found in the "tunes" so readily attributed to the puff of a locomotive, to the churning of a steamer's screw, and the like. Psychical rhythm, then, we may conclude, is due to attention or apperception, but the conditions determining it are many, and their relations very complex. If the presentations to be "rhythmized" (the *rhythmizomenon*, as the Germans say) succeed each other slowly, the length (or shall we say the breadth?) of the "psychical present" tells one way: the first impression is below the threshold when the third appears. If they arrive rapidly, their intensity and duration and the span of prehension tell another way; for it is essential that they retain their individual distinctness and only so many can be grasped at once. But if the series continue long enough, or be frequently experienced, sub-groups may be treated as individuals; and indeed till some facility is acquired, the subject attending is aware of no rhythm. In the act of attention itself there are phases, in so far as expectation involves preadjustment to what is coming: usually the first members of a tact are predominant, and the rhythm tends to "fall"; several alternations of accent within a complex rhythmic whole are of course still compatible with this. But it is important to note that, whether simple or complex, the rhythm is an intuited unity as truly as a geometrical figure may be. Unlike a geometrical figure, however, it rarely or never has symmetry. We cannot reverse a tune and obtain an effect comparable with that obtained by reprinting the score backwards in line with the original. We now pass to a question in which the psychological bearing of this fact becomes apparent.[1]

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[1] Cf. Dietze, "Untersuchungen über den Umfang des Bewusstseins u.s.w.," *Phil. Studien* (1885), pp. 362 sqq.; L. W. Stern, "Psychische Präsenzzeit," *Ztschr. f. Psychologie* (1897), xiii. 325 sqq.; Daniels, "Memory After-image and Attention," *Am. Jour. of Psychology* (1893), vi. 558 sqq.

[2] W. G. Smith, "The Place of Repetition in Memory," *Psychological Rev.* (1896), pp. 20 sqq. The figures given are unquestionably low, partly, as the writer points out, in consequence of the method employed, but partly, as his detailed tables show, in consequence of the lax attention of three out of his eight subjects. Objections have been taken to the plan of this investigation, but it is doubtful if they invalidate the result here mentioned. Cf. Jost, "Die Associationsfestigkeit in ihrer Abhängigkeit von der Vertheilung der Wiederholungen," *Ztschr. f. Psychologie*, xiv. 455 sqq.

But first a new method of dealing with memory-problems must be mentioned, in which the connexion between rhythmizing and memorizing has been turned to account by the Göttingen psychologists. The method of Ebbinghaus consisted in ascertaining the repetitions saved in consequence of previous repetitions, when the verse was relearnt some fixed time later. Hence this method is called the learning method or the method of saving. When, a given time after a certain number of repetitions (say) in trochaic measure, the subject is confronted with one of the accented syllables and asked to name the unaccented syllable that belongs to it, he will answer sometimes rightly, sometimes wrongly, and sometimes be unable to answer at all. This, the new, method is therefore named *Treffer-methode*, the method of "shots," or, let us say, the telling method. It enables the experimenter to obtain far more insight into details than was possible before, for the "misses" as well as the "hits" are instructive. Moreover, by measuring the time of each answer (*Trefferzeit*) and comparing these times together, much can be learnt; in stronger or recent associations, for example, the answers being quicker than in weaker or older ones.

Does association work forwards only or backwards also, as the middle link of a chain, when lifted, raises the contiguous links on either side of it? This is certainly not the case when the forward direction makes sense, but with nonsense verses, if the mechanical analogy is a sound one, such reversal is to be expected. For here there are none of the "obstructing associations" which "rhyme and reason" imply. In learning a verse backwards Ebbinghaus found a saving of 12·4 % of the time originally taken up in learning it forwards. A saving almost as great (10·4 %) was effected by relearning a like verse forwards, but skipping one syllable: the order of syllables, that is to say, being 1, 3, 5, . . . 15, 2, 4, . . . 16. Even when learning backwards and skipping one syllable, Ebbinghaus found a saving of 5 %. But the number of his experiments (four) was too few to give this result much value, as he fully admits. These experiments as a whole, then, might incline us to suppose that association does work in both directions, though the connexions backwards are considerably weaker. But if so the associations both ways should be alike at least in form—continuous, that is to say, backwards, *d c b a*, as well as forwards, *a b c d*. The facts at present available are, however, against this. In two or three hundred experiments by Müller and Pilzecker, verses of twelve syllables were repeated a set number of times in anapaestic measure—accented, that is to say, on the 3rd, 6th, 9th and 12th. After a fixed interval the subject, confronted with one of the accented syllables, mentioned any of the other syllables which he called to mind. Now the cases in which the syllable *immediately* preceding was revived were only about half as frequent as those in which the syllable *next but one preceding* was revived; the time of telling (*Trefferzeit*) for the latter was also *shorter*. This result is incompatible with the theory of continuous backward association, but it is readily explained by the fact that the group of three syllables had become one complex whole, and it shows that the tendency to reinstate the initial member of the group is stronger than that to reinstate the middle. The saving effected in Ebbinghaus's experiment is also thus explained.[2]

A somewhat paradoxical situation is brought to light when the method of saving and the method of telling are used together. In the experiments by Jost, mentioned above, the series of verses were repeated thirty times; after an interval of twenty-four hours one series was tested by the first method and the other by the second. Two new series were then taken: the first repeated four times, and after an interval of a minute tested by the first method; the other was then repeated in like manner, and tested after the same interval by the second method. The old series was found (by the method of saving) to require on an average 5·85 repetitions for relearning, and the new 9·6; yet on the method of telling, the new series yielded 2·7 "hits," with an average time of about $1\frac{3}{4}$ second for each, while the old yielded only ·9 "hits," with an average time of $4\frac{1}{2}$ seconds for each. Thus one may be able to reproduce relatively little of a given subject-matter, and yet require only a few repetitions in order to learn it off anew; on the other hand, one may know relatively much, and still find many more repetitions requisite for such complete learning. The "age" of the associations is then important. Other things being equal, we may conclude that each fresh repetition effects more for old associations than for recent ones. It might be supposed that the strength of the old associations was more uniform and on the average greater than the strength of the new; so that while none of the old were far below the threshold, few, if any, were above it; whereas more of the new might be above the threshold though the majority had lapsed entirely. And the latter would certainly be the case if the subject of experiment tried to make sure of a few "hits," and paid no attention to the rest of the series. Due care was, however, taken that the ends of the experiment should not in this way be defeated. Also, there is ample evidence to show that the supposed greater uniformity in strength of old associations is not, in fact, the rule. We seem left, then, to conjecture that the difference is the effect of the process of assimilation working subconsciously—that psychical aspect of nervous growth which Professor James has aptly characterized by saying that "we learn to skate in summer and to swim in winter." It continually happens that we can recognize connexions that we are quite unable to reproduce. To the diminished "strength" of an association, as tested by the method of telling, there may then quite well be an equivalent set-off in more developed assimilation. As a seed germinates it has less latent energy, but this is replaced by growth in root and stem: similar relations may obtain when an old association is said merely to lose "strength." On the other hand—within the range of the primary memory-image—we can often reproduce what after a longer interval we should fail to recognize. We seem warranted, then, in concluding that this conception of "association-strength," so freely used by G. E. Müller and his co-workers, requires more analysis than it has yet received. The two factors which their methods disclose in it appear to confirm the distinction we have already made between impressions and free ideas. They help us also to understand, further, the superiority of distributed over cumulated repetition, of "inwardly digesting" over "cram."

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[1] The following are among the more important papers on rhythm: T. L. Bolton, "Rhythm," *Am. Journ. of Psychology* (1894), pp. 145 sqq.; E. E. Meumann, "Untersuchungen z. Psychologie u. Aesthetik des Rhythmus," *Phil. Studien* (1894), x. 249 sqq., 393 sqq.; M. K. Smith, "Rhythmus und Arbeit," *Phil Studien* (1900), xvi. 71 sqq. 197 sqq.; *Arbeit und Rhythmus* (1899), by K. Bucher, a well-known economist, bringing out the teleological aspects of rhythm.

[2] There are still other forms of what seems at first sight to be regressive association, but none that do not admit of explanation without this assumption.

Feeling.

31. Such summary survey as these limits allow of the more elementary facts of cognition is here at an end; so far the most conspicuous factors at work have been those of what might be termed the ideational mechanism. In the higher processes of thought we have to take more account of mental activity and of the part played by language. But it seems preferable, before entering upon this, to explore also the emotional and active constituents of mind in their more elementary phases.

In our preliminary survey we have seen that psychical life consists in the main of a continuous alternation of predominantly receptive and predominantly reactive consciousness. In its earliest form experience is simply an interplay of alternations of sensation and movement. At a later stage we find that in the receptive phase ideation is added to sensation; and that in the active phase thought and fancy, or the voluntary manipulation and control of the ideational trains, are added to the voluntary manipulation and control of the muscles. At this higher level also it is possible that either form of receptive consciousness may lead to either form of active: sensations may lead to thought rather than to action in the restricted sense, and ideas apart from sensations may prompt to muscular exertion. There is a further complication still: not only may either sensations or ideas lead to either muscular or mental movements, but movements themselves, whether of mind or limb, may as mere presentations determine other movements of either kind. In this respect, however, movements and thoughts either in themselves or through their sensational and ideational accompaniments may be regarded as pertaining to the receptive side of consciousness. With these provisos, then, the broad generalization may hold that receptive states lead through feeling to active states, and that presentations that give neither pleasure nor pain meet with no responsive action. But first the objection must be met that presentations that are in themselves purely indifferent lead continually to very energetic action, often the promptest and most definite action. To this there are two answers. First, on the higher levels of psychical life presentations in themselves indifferent are often indirectly interesting as signs of, or as means to, other presentations that are more directly interesting. It is enough for the present, therefore, if it be admitted that all such indifferent presentations are without effect as often as they are *not* instrumental in furthering the realization of some desirable end. Secondly, a large class of movements, such as those called sensori-motor and ideo-motor, are initiated by presentations that are frequently, it must be allowed, neither pleasurable nor painful. In all such cases, however, there is probably only an apparent exception to the principle of subjective selection. They may all be regarded as instances of another important psychological principle which we shall have to deal with more fully by and by, viz. that voluntary actions, and especially those that either only avert pain or are merely subsidiary to pleasure-giving actions, tend at length, as the effect of habit in the individual and of heredity in the race, to become "secondarily automatic," as it has been called. Such mechanical or instinctive dexterities make possible a more efficient use of present energies in securing pleasurable and interesting experiences, and, like the rings of former growths in a tree, afford a basis for further advance, as old interests pall and new ones present themselves. Here, again, it suffices for our present purpose if it be granted that there is a fair presumption in favour of supposing all such movements to have been originally initiated by feeling, as certainly very many of them were.

Of the feeling itself that intervenes between these sensory and motor presentations there is but little to be said. The chief points have been already insisted upon, viz. that it is not itself a presentation, but a purely subjective state, at once the effect of a change in receptive consciousness and the cause of a change in motor consciousness; hence its continual confusion either with the movements, whether ideational or muscular, that are its expression, or with the sensations or ideas that are its cause. For feeling as such is, so to put it, matter of *being* rather than of direct knowledge; and all that we know about it we know from its antecedents or consequents in presentation.

Causes of Feeling.

Pure feeling, then, ranging solely between the opposite extremes of pleasure and pain, we are naturally led to inquire whether there is any corresponding contrast in the causes of feeling on the one hand, and on the other in its manifestations and effects. To begin with the first question, which we may thus formulate: What, if any, are the invariable differences characteristic of the presentations or states of mind we respectively like and dislike; or, taking account of the diverse sources of feeling—sensuous, aesthetic, intellectual, active—is there anything that we can predicate alike of all that are pleasurable and deny of all that are painful, and vice versa? It is at once evident that at least in presentations objectively regarded no such common characters will be found; if we find them anywhere it must be in some relation to the conscious subject *i.e.* in the fact of presentation itself. There is one important truth concerning pleasures and pains that may occur at once as an answer to our inquiry, and that is often advanced as such, viz. that whatever is pleasurable tends to further and perfect life, and whatever is painful to disturb or destroy it. The many seeming exceptions to this law of self-conservation, as it has been called, probably all admit of explanation in conformity with it, so as to leave its substantial truth unimpeached.[1] But this law, however stated, is too teleological to serve as a purely psychological principle, and, as generally formulated and illustrated, it takes account of matters quite outside the psychologist's ken. We are not now concerned to know *why* a bitter taste *e.g.* is painful or the gratification of an appetite pleasant, but *what* marks distinctive of all painful presentations the one has and the other lacks. From a biological standpoint it may be true enough that the final cause of sexual and parental feelings is the perpetuation of the species; but this does not help us to ascertain what common character they have as actual sources of feeling for the individual. From the biological standpoint again, even the senile decadence and death of the individual may be shown to be advantageous to the race; but it would certainly be odd to describe this as advantageous to the individual; so different are the two points of view. What we are in search of, although a generalization, has reference to something much more concrete than concepts like race or life, and does not require us to go beyond the consciousness of the moment to such ulterior facts as they imply.

Were it possible it would be quite unnecessary to examine in detail every variety of pleasurable and painful consciousness in connexion with a general inquiry of this sort. It will be best to enumerate at the outset the only cases that specially call for investigation. Feeling may arise mainly from (*a*) single sensations or movements, including in these what recent psychologists call their *tone*; or it may be chiefly determined by (*b*) some combination or arrangement of these primary presentations—hence what might be styled the lower aesthetic feelings. We have thus among primary presentations a more material and a more formal cause or ground of feeling. The mere representation of these sources of feeling involves nothing of moment: the idea of a bright colour or a bitter taste has not definiteness or intensity enough to produce feeling; and the ideal presentation of a harmonious arrangement of sounds or colours does not in itself differ essentially as regards the feeling it occasions from the actual presentation. When we advance to the level at which there occur ideas more complex and more highly representative —or re-representative, as Mr Spencer would say—than any we have yet considered we can again distinguish between material and formal grounds of feeling. To the first we might refer, *e.g.* (*c*) the egoistic, sympathetic, and religious feelings; this class will probably require but brief notice. The second, consisting of (*d*) the intellectual and (*e*) the higher aesthetic feelings, is psychologically more important. There is a special class of feelings, which might be distinguished from all the preceding as *reflex*, since they arise from the memory or expectation of feelings but in fact these are largely involved in all the higher feelings, and this brief reference to them will suffice: of such hope, fear, regret are examples.

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[1] See Spencer, *Data of Ethics*, chs. i.–iv.; G. H. Schneider, *Freud und Leid des Menschengeschlechts*, ch. i.

Sensations and Movements.

a. The quality and intensity as well as the duration and frequency of a sensation or movement all have to do with determining to what feeling it gives rise. It will be best to leave the last two out of account for a time. Apart from these, the pleasantness or painfulness of a movement appears to depend solely upon its intensity, that is to say, upon the amount of effort necessary to effect it, in such wise that a certain amount of exertion is agreeable and any excess disagreeable. Some sensations also, such as those of light and sound, are agreeable if not too intense, their pleasantness increasing with their intensity up to a certain point, on nearing which the feeling rapidly changes and becomes disagreeable or even painful. Other sensations, as bitter tastes, *e.g.* are naturally unpleasant, however faint—though we must allow the possibility of an acquired liking for moderately bitter or pungent flavours. But in every case such sensations produce unmistakable manifestations of disgust, if at all intense. Sweet tastes, on the other hand, however intense, are pleasant to an unspoiled palate, though apt before long to become mawkish, like "sweetest honey, loathsome in his own deliciousness," as confectioners' apprentices are said soon to find. The painfulness of all painful sensations or movements increases with their intensity without any assignable maximum being reached.

A comparison of examples of this kind, which it would be tedious to describe more fully and which are indeed too familiar to need much description, seems to show (1) that, so far as feeling is determined by the intensity of a presentation, there is pleasure so long as attention can be adapted or accommodated to the presentation, and pain so soon as the intensity is too great for this; and (2) that, so far as feeling is determined by the quality of a presentation, those that are pleasurable enlarge the field of consciousness and introduce or agreeably increase in intensity certain organic sensations, while those that are painful contract the field of consciousness and introduce or disagreeably increase in intensity certain organic sensations. There are certain other hedonic effects due to quality, the examination of which we must for the present defer. Meanwhile as to the first point it may be suggested, as at any rate a working hypothesis, that in itself any and every simple sensation or movement is pleasurable if there is attention forthcoming adequate to its intensity. In the earliest and simplest phases of life, in which the presentation-continuum is but little differentiated, it is reasonable to suppose that variation in the intensity of presentation preponderates over changes in the quality of presentation, and that to the same extent feeling is determined by the former and not by the latter. And, whereas this dependence on intensity is invariable, there is no ground for supposing the quality of any primary presentation, when not of excessive intensity, to be invariably disagreeable; the changes above-mentioned in the hedonic effects of bitter tastes, sweet tastes, or the like tend rather to prove the contrary. This brings us to the second point, and it requires some elucidation. We need here to call to mind the continuity of our presentations and especially the existence of a background of organic sensations or somatic consciousness, as it is variously termed. By the time that qualitatively distinct presentations have been differentiated from this common basis it becomes possible for any of these, without having the intensity requisite to affect feeling directly, to change it indirectly by means of the systemic sensations accompanying them, or, in other words, by their tone. The physiological concomitants of these changes of somatic tone are largely reflex movements or equivalents of movements, such as alterations in circulatory, respiratory and excretory processes. Such movements are psychologically movements no longer, and are rightly regarded as pertaining wholly to the sensory division of presentations. But originally it may have been otherwise. To us now, these organic reflexes seem but part and parcel of the special sensation whose tone they form, and which they accompany even when that sensation, so far as its mere intensity goes, might be deemed indifferent. But perhaps at first the special qualities that are now throughout unpleasant may have been always presented with an excessive intensity that would be painful on this score alone, and the reflexes that at present pertain to them may then have been psychologically the expression of this pain.[1] At any rate it is manifestly unfair to refuse either to seek out the primitive effects of the sensations in question and allow for the workings of heredity, or to reckon this accompanying systemic feeling as part of them. The latter seems the readier and perhaps, too, the preferable course. A word will now suffice to explain what is meant by enlarging and contracting the field of consciousness and agreeably increasing or decreasing certain elements therein.

The difference in point is manifest on comparing the flow of spirits, buoyancy and animation which result from a certain duration of pleasurable sensations with the lowness or depression of spirits, the gloom and heaviness of heart, apt to ensue from prolonged physical pain. Common language, in fact, leaves us no choice but to describe these contrasted states by figures which clearly imply that they differ in the range and variety of the presentations that make up consciousness, and in the quickness with which these succeed each other.[2] It is not merely that in hilarity as contrasted with dejection the train of ideas takes a wider sweep and shows greater liveliness, but as it were at the back of this, on the lower level of purely sensory experience, certain organic sensations which are ordinarily indifferent acquire a gentle intensity, which seems by flowing over to quicken and expand the ideational stream as we see, for instance, in the effects of mountain air and sushine. Or, on the other hand, these sensations become so violently intense as to drain off and ingulf all available energy in one monotonous corroding care, an oppressive weight which leaves no place for free movement, no life or leisure to respond to what are wont to be pleasurable solicitations.[3]

As regards the duration and the frequency of presentation, it is in general true that the hedonic effect soon attains its maximum, and then, if pleasant, rapidly declines, or even changes to its opposite. Pains in like manner decline, but more slowly and without in the same sense changing to pleasures. The like holds of too frequent repetition. Physiological explanation of these facts, good as far as it goes, is, of course, at once forthcoming: sensibility is blunted, time is required for restoration, and so forth; but at least we want the psychological equivalent of all this. In one respect we find nothing materially new; so far as continued presentation entails diminished intensity we have nothing but diminished feeling as a consequence; so far as its continued presentation entails satiety the train of agreeable accompaniments ceases in which the pleasurable tone consisted. But in another way long duration and frequent repetition produce indirectly certain characteristic effects on feeling in consequence of habituation and accommodation. We may get used to a painful presentation in such wise that we cease to be conscious of it as positively disagreeable, though its cessation is at once a source of pleasure; in like manner we come to require things simply because it is painful to be without them, although their possession has long ceased to be a ground of positive enjoyment. This loss (or gain) consequent on accommodation [1] has a most important effect in changing the sources of feeling: it helps to transfer attention from mere sensations to what we may distinguish as interests.

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[1] In the lowly organisms that absorb food directly through the skin such bitter juices as exist naturally might at once produce very violent effects—comparable, say, to scalding; and the reflexes then established may have been continued by natural selection so as to save from poisoning the higher organisms, whose absorbent surfaces are internal and only guarded in this way by the organ of taste. Some light is thrown on questions of this kind by the very interesting experiments of Dr Romanes; for a general account of these see his *Jelly-fish, Star-fish, and Sea-urchins*, ch. ix.

[2] This is one among many cases in which the study of a vocabulary is full of instruction to the psychologist. The reader who will be at the trouble to compare the parallel columns under the heading "Passive Affections," in Roget's *Thesaurus of English Words and Phrases*, will find ample proof both of this general statement and of what is said above in the text.

[3] Observation and experiment show that the physical signs of pain in the higher animals consist in such changes as a lowered and weaker pulse, reduction of the surface temperature, quickened respiration, dilatation of the iris, and the like. And so far as can be ascertained these effects are not altogether the emotional reaction to pain but in large measure its actual accompaniments, the physical side of what we have called its *tone*. The following is a good description of these general characteristics of feeling: "En même temps, il se fait une série de mouvements généraux de flexion, comme si l'animal voulait se rendre plus petit, et offrir moins de surface à la douleur. Il est intéressant de remarquer que, pour l'homme comme pour tous les animaux, on retrouve ces mêmes mouvements généraux de flexion et d'extension répondant aux sentiments différents de plaisir et de la douleur. Le plaisir répond à un mouvement d'épanouissement, de dilatation, d'extension. Au contraire, dans la douleur, on se rapetisse, on se referme sur soi; c'est un mouvement général de flexion" (C. Richet, *L'Homme et l'Intelligence: la douleur*, p. 9).

Combinations of Sensations and of Movements.

b. Certain sensations or movements not separately unpleasant become so when presented together or in immediate succession; and contrariwise, some combinations of sensations or of movements may be such as to afford pleasure distinct from, and often greater than, any that they separately yield. Here again we find that in some cases the effect seems mainly to depend on intensity, in others mainly on quality. (i.) As instances of the former may be mentioned the pleasurableness of a rhythmic succession of sounds or movements, of symmetrical forms and curved outlines, of gentle crescendos and diminuendos in sound, and of gradual variations of shade in colour, and the painfulness of flickering lights, "beats" in musical notes, false time, false steps, false quantities, and the like. In all these, whenever the result is pleasurable, attention can be readily accommodated—is, so to say, economically meted out; and, whenever the result is painful, attention is surprised, balked, wasted. Thus we can make more movements and with less expenditure of energy when they are rhythmic than when they are not, as the performances of a ball-room or of troops marching to music amply testify. Of this economy we have also a striking proof in the ease with which rhythmic language is retained. (ii.) As instances of the latter may be cited those arrangements of musical tones and of colours that are called harmonious or the opposite. Harmony, however, must be taken to have a different meaning in the two cases. When two or three tones harmonize there results, as is well known, a distinct pleasure over and above any pleasure due to the tones themselves. On the other hand, tones that are discordant are unpleasant in spite of any pleasantness they may have singly. Besides the negative condition of absence of beats, a musical interval to be pleasant must fulfil certain positive conditions, sufficiently expressed for our purpose by saying that two tones are pleasant when they give rise to few combination-tones, and when among these there are several that coincide, and that they are unpleasant when they give rise to many combination-tones, and when among these there are few or none that coincide. Too many tones together prevent any from being distinct. But where tones coincide the number of tones actually present is less than the number of possible tones, and there is a proportionate simplification, so to put it: more is commanded and with less effort. An ingenious writer [2] on harmony, in fact, compares the confusion of a discord to that of "trying to reckon up a sum in one's head and failing because the numbers are too high." A different explanation must be given of the so-called harmonies of colour. The pleasurable effect of graduations of colour or shade—to which, as Ruskin tells us, the rose owes its victorious beauty when compared with other flowers—has been already mentioned: it is rather a quantitative than a qualitative effect. What we are now concerned with are the pleasurable or painful combinations of different ungraduated colours. A comparison of these seems to justify the general statement that those colours yield good combinations that are far apart in the colour circle, while those near together are apt to be discordant. The explanation given, viz. that the one arrangement secures and the other prevents perfect retinal activity, seems on the whole satisfactory—especially if we acknowledge the tendency of all recent investigations and distinguish sensibility to colour and sensibility to mere light as both psychologically and physiologically two separate facts. Thus, when red and green are juxtaposed, the red increases the saturation of the green and the green that of the red, so that both colours are heightened in brilliance. But such an effect is only pleasing to the child and the savage; for civilized men the contrast is excessive, and colours less completely opposed, as red and blue, are preferred, each being a rest from the other, so that as the eye wanders to and fro over their border different elements are active by turns. Red and orange, again, are bad, in that both exhaust in a similar manner and leave the remaining factors out of play.

Ideation and intellection.

c. The more or less spontaneous workings of imagination, as well as that direct control of this working necessary to thinking in the stricter sense, are always productive of pain or pleasure in varying degrees. Though the exposition of the higher intellectual processes has not yet been reached, there will be no inconvenience in at once taking account of their effects on feeling, since these are fairly obvious and largely independent of any analysis of the processes themselves. It will also be convenient to include under the one term "intellectual feelings," not only the feelings connected with certainty, doubt, perplexity, comprehension, and so forth, but also what the Herbartian psychologists—whose work in this department of psychology is classical—have called *par excellence* the formal feelings—that is to say, feelings which they regard as entirely determined by the form of the flow of ideas, and not by the ideas themselves. Thus, be the ideas what they may, when their onward movement is checked by divergent or obstructing lines of association, and especially when in this manner we are hindered, say, from recollecting a name or a quotation (as if, *e.g.* the names of Archimedes, Anaximenes and Anaximander each arrested the clear revival of the other), we are conscious of a certain strain and oppressiveness, which give way to momentary relief when at length what is wanted rises into distinct consciousness and our ideas resume their flow. Here again, too, as in muscular movements, we have the contrast of exertion and facility, when "thoughts refuse to flow" and we work "invita Minerva," or when the appropriate ideas seem to unfold and display themselves before us like a vision before one inspired. To be confronted with propositions we cannot reconcile—*i.e.* with what is or appears inconsistent, false, contradictory—is apt to be painful; the recognition of truth or logical coherence, on the other hand, is pleasurable. The feeling in either case is, no doubt, greater the greater our interest in the subject-matter; but the mere conflict of ideas as such is in itself depressing, while the discernment of agreement, of the one in the many, is a distinct satisfaction. Now in the one case we are conscious of futile efforts to comprehend as one ideas which the more distinctly we apprehend them for the purpose only prove to be the more completely and diametrically opposed: we can only affirm and mentally envisage the one by denying and suppressing the representation of the other; and yet we have to strive to predicate both and to embody them together in the same mental image. Attention is like a house divided against itself: there is effort but it is not effective, for the field of consciousness is narrowed and the flow of ideas arrested. When, on the other hand, we discern a common principle among diverse and apparently disconnected particulars, instead of all the attention we can command being taxed in the separate apprehension of these "disjecta membra," they become as one, and we seem at once to have at our disposal resources for the command of an enlarged field and the detection of new resemblances.

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[1] It has been definitely formulated, but in physiological language, by Bain as the Law of Novelty: "No second occurrence of any great shock or stimulus, whether pleasure, pain, or mere excitement, is ever fully equal to the first, notwithstanding that full time has been given for the nerves to recover from their exhaustion" (*Mind and Body*, p. 51). Cf. also his *Emotions and Will*, 3rd ed., p. 83.

[2] Preyer, *Akustische Untersuchungen*, p. 59

Higher Aesthetic Feelings.

d. Closely related to these formal intellectual feelings are certain of the higher aesthetic feelings. A reference to some of the commonplaces of aesthetical writers may be sufficient briefly to exhibit the leading characteristics of these feelings. There is a wide agreement among men in general as to what is beautiful and what is not, and it is the business of a treatise on empirical aesthetics from an analysis of these matters of fact to generalize the principles of taste—to do, in fact, for one source of pleasure and pain what we are here attempting in a meagre fashion for all. And these principles are the more important in their bearing upon the larger psychological question, because among aesthetic effects are reckoned only such as are pleasing or otherwise in themselves, apart from all recognition of utility, of possession, or of ulterior gratification of any kind whatever. Thus, if it should be objected that the intellectual satisfaction of consistency is really due to its utility, to the fact that what is incompatible and incomprehensible is of no avail for practical guidance, at least this objection will not hold against the aesthetic principle of *unity in variety*. In accordance with this primary maxim of art criticism, at the one extreme art productions are condemned for monotony, as incapable of sustaining interest because "empty," "bald" and "poor"; at the other extreme they are condemned as too incoherent and disconnected to furnish a centre of interest. And those are held as so far praiseworthy in which a variety of elements, be they movements, forms, colours or incidents, instead of conflicting, all unite to enhance each other and to form not merely a mass but a whole. Another principle that serves to throw light on our inquiry is that which has been called the principle of *economy*,[1] viz. that an effect is pleasing in proportion as it is attained by little effort and simple means. The brothers Weber in their classic work on human locomotion discovered that those movements that are aesthetically beautiful are also physiologically correct; grace and ease, in fact, are well-nigh synonymous, as Herbert Spencer points out, and illustrates by apt instances of graceful attitudes, motions and forms. The same writer,[2] again, in seeking for a more general law underlying the current maxims of writers on composition and rhetoric is led to a special formulation of this principle as applied to style, viz. that "economy of the recipient's attention is the secret of effect."

Perhaps of all aesthetical principles the most wide-reaching, as well as practically the most important, is that which explains aesthetic effects by association. Thus, to take one example where so many are possible, the croaking of frogs and the monotonous ditty of the cuckoo owe their pleasantness, not directly to what they are in themselves, but entirely to their intimate association with spring-time and its gladness. At first it might seem, therefore, that in this principle there is nothing fresh that is relevant to our present inquiry, since a pleasure that is only due to association at once carries back the question to its sources; so that in asking why the spring, for example, is pleasant we should be returning to old ground. But this is not altogether true; aesthetic effects call up not merely ideas but ideals. A great work of art improves upon the real in two respects: it intensifies and it transfigures. It is for art to gather into one focus, cleared from dross and commonplace, the genial memories of a lifetime, the instinctive memories of a race; and, where theory can only classify and arrange what it receives, art—in a measure free from "the literal unities of time and place"—creates and glorifies. Still art eschews the abstract and speculative; however plastic in its hands, the material wrought is always that of sense. We have already noticed more than once the power which primary presentations have to sustain vivid re-presentations, and the bearing of this on the aesthetic effects of works of art must be straightway obvious. The notes and colours, rhymes and rhythms, forms and movements, which produce the lower aesthetic feelings also serve as the means of bringing into view, and maintaining at a higher level of vividness, a wider range and flow of pleasing ideas than we can ordinarily command.

Egoistic and Socialistic Feelings.

When we reach the level at which there is distinct self-consciousness (cf. § 44), we have an important class of feelings determined by the relation of the presentation of self to the other contents of consciousness. And as the knowledge of other selves advances *pari passu* with that of one's own self, so along with the egoistic feelings appear certain social or altruistic feelings. The two have much in common; in pride and shame, for example, account is taken of the estimate other persons form of us and of our regard for them; while, on the other hand, when we admire or despise, congratulate or pity another, we have always present to our mind a more or less definite conception of self in like circumstances. It will therefore amply serve all the ends of our present inquiry if we briefly survey the leading characteristics of some contrasted egoistic feelings, such as self-complacency and disappointment. When a man is pleased with himself, his achievements, possessions or circumstances, such pleasure is the result of a comparison of his present position in this respect with some former position or with the position of someone else. Without descending to details, we may say that two prospects are before him, and the larger and fairer is recognized as his own. Under disappointment or reverse the same two pictures may be present to his mind, but accompanied by the certainty that the better is not his or is his no more. So far, then, it might be said the contents of his consciousness are in each case the same, the whole difference lying in the different relationship to self. But this makes all the difference even to the contents of his consciousness, as we shall at once see if we consider its active side. Even the idlest and most thoughtless mind teems with intentions and expectations, and in its prosperity, like the fool in the parable, thinks to pull down its barns and build greater, to take its ease, eat, drink and be merry. The support of all this pleasing show and these far-reaching aims is, not the bare knowledge of what abundance will do, but the reflection—These many goods are mine. In mind alone final causes have a place, and the end can produce the beginning; the prospect of a summer makes the present into spring. But action is paralysed or impossible when the means evade us. In so far as a man's life consists in the abundance of the things he possesseth, we see then why it dwindles with these. The like holds where self-complacency or displicency rests on a sense of personal worth or on the honour or affection of others.

Summary and Result.

32. We are now at the end of our survey of certain typical pleasurable and painful states. The answer to our inquiry which it seems to suggest is that there is pleasure in proportion as a maximum of attention is effectively exercised, and pain in proportion as such effective attention is frustrated by distractions, shocks, or incomplete and faulty adaptations, or fails of exercise, owing to the narrowness of the field of consciousness and the slowness and smallness of its changes. Something must be said in explication of this formula, and certain objections that might be made to it must be considered. First of all it implies that feeling is determined partly by quantitative, or, as we might say, material conditions, and partly by conditions that are formal or qualitative. As regards the former, both the intensity or concentration of attention and its diffusion or the extent of the field of consciousness have to be taken into account. Attention, whatever else it is, is a limited quantity—

> Pluribus intentus minor est ad singula sensus—

to quote Hamilton's pet adage. Moreover, as we have seen, attention requires time. If, then, attention be distributed over too wide a field, there is a corresponding loss of intensity, and so of distinctness: we tend towards a succession of indistinguishables—indistinguishable, therefore, from no succession. We must not have more presentations in the field of consciousness than will allow of some concentration of attention: a maximum diffusion will not do. A maximum concentration, in like manner—even if there were no other objection to it—

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[1] Cf. Fechner, *Vorschule der Aesthetik*, ii. 263. Fechner's full style for it is "Princip der ökonomischen Verwendung der Mittel oder des kleinsten Kraftmasses."

[2] *Essays, Scientific, Political and Speculative*, vol. ii., Ess. I. and VIII.

would seem to conflict with the general conditions of consciousness, inasmuch as a single simple presentation, however intense, would admit of no differentiation, and any complex presentation is in some sort a plurality. The most effective attention, then, as regards its quantitative conditions, must lie somewhere between the two zeros of complete indifference and complete absorption. If there be an excess of diffusion, effective attention will increase up to a certain point as concentration increases, but beyond that point will decrease if this intensification continues to increase; and vice versa, if there be an excess of concentration. But, inasmuch as these quantitative conditions involve a plurality of distinguishable presentations or changes in consciousness, the way is open for formal conditions as well. Since different presentations consort differently when above the threshold of consciousness together, one field may be wider and yet as intense as another, or intenser and yet as wide, owing to a more advantageous arrangement of its constituents.[1]

Negative Pleasures.

The doctrine here developed, viz., that feeling depends on efficiency, is in the main as old as Aristotle; all that has been done is to give it a more accurately psychological expression, and to free it from the implications of the faculty theory, in which form it was expounded by Hamilton. Of possible objections there are at least two that we must anticipate, and the consideration of which will help to make the general view clearer. First, it may be urged that, according to this view, it ought to be one continuous pain to fall asleep, since in this state consciousness is rapidly restricted both as to intensity and range. This statement is entirely true as regards the intensity and substantially true as regards the range, at least of the higher consciousness: certain massive and agreeable organic sensations pertain to falling asleep, but the variety of presentations at all events grows less. But then the capacity to attend is also rapidly declining; even a slight intruding sensation entails an acute sense of strain in one sense, in place of the massive pleasure of repose throughout; and any voluntary concentration either in order to move or to think involves a like organic conflict, futile effort, and arrest of balmy ease. There is as regards the more definite constituents of the field of consciousness a close resemblance between natural sleepiness and the state of monotonous humdrum we call tedium or ennui; and yet the very same excitement that would relieve the one by dissipating the weariness of inaction would disturb the other by renewing the weariness of action: the one is commensurate with the resources of the moment, the other is not. Thus the maximum of effective attention in question is, as Aristotle would say, a maximum "relative to us." It is possible, therefore, that a change from a wider to a narrower field of consciousness may be a pleasurable change, if attention is more effectively engaged. Strictly speaking, however, the so-called negative pleasures of rest do not consist in a mere narrowing of the field of consciousness so much as in a change in the amount of concentration. Massive organic sensations connected with restoration take the place of the comparatively acute sensations of jaded powers forced to work. We have, then, in all cases to bear in mind this subjective relativity of all pleasurable or painful states of consciousness.

Do Pleasures Differ Qualitatively?

33. But there is still another and more serious difficulty to face. It has long been a burning question with theoretical moralists whether pleasures differ only quantitatively or differ qualitatively as well, whether psychological analysis will justify the common distinction of higher and lower pleasures or force us to recognize nothing but differences of degree, of duration, and so forth—as expounded, *e.g.* by Bentham, whose cynical *mot*, "pushpin is as good as poetry provided it be as pleasant," was long a stumbling block in the way of utilitarianism. The entire issue here is confused by an ambiguity in terms that has been already noticed: pleasure and pleasures have not the same connotation. By *a* pleasure or pleasures we mean some assignable presentation or presentations experienced as pleasant—*i.e.* as affording pleasure; by pleasure simply is meant this subjective state of feeling itself. The former, like other objects of knowledge, admit of classification and comparison: we may distinguish them as coarse or as noble, or, if we will, as cheap and wholesome. But while the *causes* of feeling are manifold, the feeling itself is a subjective state, varying only in intensity and duration. The best evidence of this lies in the general character of the actions that ensue through feeling—the matter which has next to engage us. Whatever be the variety in the sources of pleasure, whatever be the moral or conventional estimate of their worthiness, if a given state of consciousness is pleasant we seek so far to retain it, if painful to be rid of it: we prefer greater pleasure before less, less pain before greater. This is, in fact, the whole meaning of preference as a psychological term. Wisdom and folly each prefer the course which the other rejects. Both courses cannot, indeed, be objectively preferable; that, however, is not a matter for psychology. But as soon as reflection begins, exceptions to this primary principle of action seem to arise continually, even though we regard the individual as a law to himself. Such exceptions, however, we may presently find to be apparent only. At any rate the principle is obviously true before reflection begins—true so long as we are dealing with actually present sources of feeling, and not with their re-presentations. But to admit this is psychologically to admit everything, at least if experience is to be genetically explained. Assuming then that we start with only quantitative variations of feeling, we have to attempt to explain the development of formal and qualitative differences in the character given to the grounds of feeling. But, if aversions and pursuits result from incommensurable states of pain and pleasure, there seems no other way of saving the unity and continuity of the subject except by speculative assumption—the doctrine known as the freedom of the will in its extremest form. The one position involves the other, and the more scientific course is to avoid both as far as we can.

The question, then, is: How, if action depends in the last resort on a merely quantitative difference, could it ever come about that what we call the higher sources of feeling should supersede the lower? If it is only quantity that turns the scales, where does quality come in, for we cannot say, *e.g.* that the astronomer experiences a greater thrill of delight when a new planet rewards his search than the hungry savage in finding a clump of pig-nuts? *Tempora mutantur nos et mutamur in illis* contains the answer in brief. We shall understand this answer better if we look at a parallel case, or what is really our own from another point of view. We distinguish between higher and lower forms of life: we might say there is more life in a large oyster than in a small one, other things being equal, but we should regard a crab as possessing not necessarily more life—as measured by waste of tissue—but certainly as manifesting life in a higher form. How, in the evolution of the animal kingdom, do we suppose this advance to have been made? The tendency at any one moment is simply towards more life, simply towards growth; but this process of self-conservation imperceptibly but steadily modifies the self that is conserved. The creature is bent only on filling its skin; but in doing this as easily as may be it gets a better skin to fill, and accordingly seeks to fill it differently. Though cabbage and honey are what they were before, they have changed relatively to the grub now it has become a butterfly. So, while we are all along preferring a more pleasurable state of consciousness before a less, the content of our consciousness is continually changing; the greater pleasure still outweighs the less, but the pleasures to be weighed are either wholly different, or at least are the same for us no more. What we require then, is not that the higher pleasures shall always afford greater pleasure than the lower did, but that to advance to the level of life on which pleasure is derived from higher objects shall on the whole be more pleasurable and less painful than to remain behind. And this condition seems provided in the fact of accommodation above referred to and in the important fact that attention can be more effectively expended by what we may therefore call improvements in the form of the field of consciousness. But when all is said and done a certain repugnance is apt to arise against any association of the differences between the higher and lower feelings with differences of quantity. Yet such repugnance is but another outcome of the common mistake of supposing that the real is obtained by pulling to pieces rather than by building up. No logical analysis—nay, further, no logical synthesis—is adequate to the fullness of things. For the rest, such aversion is wholly emotional, and has no more an intellectual element in it than has the disgust we feel on first witnessing anatomical dissections.[1]

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[1] As it is impossible to say that any distinguishable presentation is absolutely simple, the hypothesis of subconsciousness would leave us free to assume that any pleasantness or unpleasantness that cannot be explained on the score of intensity is due to some obscure harmony or discord, compatibility or incompatibility, of elements not separately discernible. But this, though tempting, is not really a very scientific procedure. If a particular presentation is pleasurable or painful in such wise as to lead to a redistribution of attention, it is reasonable to look for an explanation primarily in its connexion with the rest of the field of consciousness. Moreover, it is obvious—since what takes place in subconsciousness can only be explained in analogy with what takes place in consciousness—that, if we have an inexplicable in the one, we must have a corresponding inexplicable in the other. If the feeling produced by what comports itself as a simple presentation cannot be explained by what is in consciousness, we should be forced to admit that some presentations are unpleasant simply because they are unpleasant—an inexplicability which the hypothesis of subconsciousness might push farther back but would not remove.

Emotion and Emotional Expression.

Effects of Feeling.

34. We now pass from the causes of feeling to its effects. We have assumed (§ 7) that the simplest and earliest of these effects are to be found in the various bodily movements commonly described as the expression or manifestation of emotion. But in a notorious article, entitled "What is an Emotion?" Professor James[2] attempted to turn this, the common-sense position, upside down. Before proceeding we must, therefore, examine his alternative theory: "Common sense says: we lose our fortune, are sorry and weep; we meet a bear, are frightened and run; we are insulted by a rival, are angry and strike." But, Professor James continues, "the hypothesis here to be defended says that this order of sequence is incorrect: that the one mental state is not immediately induced by the other, that the bodily manifestations must first be interposed between, and that the more rational statement is that we feel sorry because we cry, angry because we strike, afraid because we tremble, and not that we cry, strike or tremble because we are sorry, angry or fearful, as the case may be." In a word, whereas it is commonly supposed that the emotion precedes and produces the expression, it seems here to be maintained that the expression precedes and produces the emotion. But the sequence denied in the first case is a psychological sequence, the sequence maintained in the second is a physiological sequence. The subject's experiences of the bodily expressions is here the emotion, and these are physically, not psychically, determined. "They are sensational processes," says Professor James; "processes due to inward currents set up by physical happenings."

The new theory is, then, in part psychological, in part psychophysical. As to the first part, which the author calls "the vital point of the whole theory," it consists mainly in exposing the ambiguity of the phrase "bodily expression of an emotion"—a phrase which is liable to mislead us into fancying that emotion, like thought, may be antecedent to, or independent of, any expression or utterance. My fear or anger may chance to be *expressive* to another, but they are of necessity *impressive* to me. "A disembodied human emotion is a sheer nonentity." In so far as I have a certain emotion, in so far I have "the feelings of its bodily symptoms." This is true, not to say trite; but how do these symptoms arise? With this question we pass to the psychophysical side of the theory, and here it becomes perplexing, and is itself perplexed; for to this question it is driven to return two distinct and divergent answers. First, we are told that it is not the emotion that gives rise to the bodily expression, but that, on the contrary, "the bodily changes follow directly the perception of the existing fact," it being beyond doubt "that objects do excite bodily changes by a preorganised mechanism." Again: "Each emotion is," for Professor James, "a resultant of a sum of elements, and each element is caused by a physiological process of a sort already well known. The elements are all organic changes, and each of them is *the reflex effect of the existing object.*" The old attempts at classification and description being contemptuously dismissed as belonging only to "the lowest stage of science," we are informed that now we step from a superficial to a deep order of inquiry. "The questions now are *causal*: 'Just what changes does this object and what changes does that object excite?' and 'How come they to excite these particular changes, and not others?'" But we have not had to wait for the James-Lange theory to raise these questions, and surely there are none that bring out its defects more glaringly. "Objects" that determine bodily changes by means of preorganized mechanism and without psychical interposition might fairly be taken to be physical objects; and indeed the whole process is expressly described as reflex. But only very slovenly physiologists talk of "objects" exciting reflexes: it is inexact even to say that sensations do so. All that reflex action requires is a *stimulus*. "The essence of a reflex action," says Foster, "consists in the transmutation, by means of the irritable protoplasm of a nerve-cell, of afferent into efferent impulses." Let Professor James be confronted first by a chained bear and next by a bear at large: to the one object he presents a bun, and to the other a clean pair of heels; or let him first be thrilled by a Beethoven symphony and then by a Raphael Madonna. Will he now undertake to account, in terms of stimuli and their reflex effects, for the very different results of the similar "causes" in the one case, or for the similar results of the very different "causes" in the other? Such a challenge would certainly be declined, and Professor James would remind us that in his nomenclature "it is the total situation on which the reaction of the subject is made."[3] But there is just a world of difference between "object" = stimulus transformed by preorganised mechanism into an efferent discharge, and "object" = total situation to which the subject reacts. The attempt to explain emotion causally on the lines of the former meaning lands us in the conscious automaton theory, with which we must deal presently: this Professor James rejects. The latter meaning, on the other hand, involves the recognition of the subject's attitude as essential to the reaction, and of this as determined by pleasure, pain or by some "interest" resting ultimately on these. Such, with scarcely an exception, has always been, and still remains, the analysis of emotion in vogue among psychologists. It brings to the fore a new category, that of worth or value, one wholly extraneous to the physiologist's domain, and repugnant to the mechanical analogies which are there in place. No doubt such a concept is attained only by reflexion, but the experiences from which it is drawn, the affective states and the conative tendencies of the subject experiencing, must have preceded. From this central standpoint alone the objective situation has a worth which explains the subject's attitude, and here alone can we find the clue which will enable us to answer the questions of cause that Professor James propounds.

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[1] "To look at anything in its elements makes it appear inferior to what it seems as a whole. Resolve the statue or the building into stone and the laws of proportion, and no worthy causes of the former beautiful result seem now left behind. So, also, resolve a virtuous act into the passions and some quantitative law, and it seems to be rather destroyed than analysed, though after all what was there else it could be resolved into?" Sir A. Grant, *Aristotle's Ethics*, Essay IV., "The Doctrine of the Mean," i. 210 (2nd ed.).

[2] *Mind* (1884), ix. 188 sqq.; and, again, *Principles of Psychology*, ch. xxv. Very similar views were advanced independently and almost at the same time by the Danish physiologist C. Lange; hence the name James-Lange theory, by which their views are commonly known. Of Lange's work a German translation was published in 1887.

[3] "Physical Basis of Emotion," *Psychological Review* (1894), p. 518. In this reply to criticisms Professor James is supposed to have modified his views: it would be nearer the truth to say that he has made admissions incompatible with them.

The experimental investigations of Mosso, Féré, Lehmann, and others have shown that the vaso-motor and such like bodily changes as are prominent in emotional excitement are present also to some extent in all forms of conscious activity. The more unwonted and interesting the situation, the more diffused movements predominate over movements that are purposive; the further assimilation, both on the cognitive and the reactive side, has advanced, the more diffusion is replaced by restriction and adaptation. But we are not warranted in separating these factors of voluntary activity into distinct processes, as the physiologist, for example, separates the functions of striped and unstriped muscle. Unless we are prepared to treat *all* activity as reflex—as the physiologist may quite well do, if he keep strictly to his own point of view—it does not seem possible to regard emotional expression as so much organic sensation with which purposive movement has nothing to do. No doubt this connexion of vegetal and animal functions remains one of the obscurest in all psycho-biology, though its teleological fitness is obvious enough.

Nevertheless, Professor James's main position is that an emotion is but a sum of organic sensations; and in order to establish this he is led to the second and very different statement which we have now to examine. Here, so far from suggesting inquiries as to the "objects" that excite emotion, his point is to maintain that in so far as the bodily cause is set up, *be the means what they may*, in so far the emotion is present.[1] And here, at length, the contention is explicit: Emotions *are* a certain complex of organic sensations, and such complexes *are* emotions: the two are not merely coexistent, they are identical. The exciting object is thus, after all, physiological; that is to say, it is whatever stimulus sets up the sensations. It cannot be psychological, "the total situation for the reacting subject," for in this sense the emotion, it is maintained, may be "objectless." In support of his position Professor James first of all cites pathological cases of such objectless emotion. He next follows up these with accounts of other cases in which emotional apathy seemed to keep pace with sensory anaesthesia, arguing that, according to his theory, a subject absolutely anaesthetic should also be incapable of emotion, although "emotion-inspiring objects might evoke the usual bodily expression from him." Whether *any* testimony from lunatics, hypnotics and other minds diseased could suffice to establish this novel doctrine is questionable: that the evidence so far adduced is insufficient, Professor James himself seems to allow. There are some four or five of the apathetic cases altogether: three of them are regarded by the mental pathologists who describe them as adverse to Professor James's theory.[2] Of the fourth case, reported by a pathologist on Professor James's side, the latter himself candidly observes, "We must remember that the patient's inemotivity may have been a co-ordinate result with the anaesthesia of his neural lesions, and not the anaesthesia's mere effect." This missing link in the argument is supplied by the experiments of Professor Sherrington,[3] and these show conclusively that normal emotional states *are* possible along with complete visceral anaesthesia. As to emotional excitement induced by intoxication or disease, and so far *groundless*, the most that can safely be said is that the object may be vague, ill-defined and shifting, but not that it is absent altogether. States of physical exaltation, depression or irritability readily arouse by association appropriate *troupes* of imagery; only when they fail of this are we entitled to say that there is no object, and then we must add that there is also no emotion.

Emotional and Conative Action.

35. As in dealing with the causes of feeling, so we may now in like manner proceed to inquire whether in its manifestations or effects there is any contrast corresponding to the opposing extremes of pleasure and pain. We have already seen reasons for dismissing reflex movements or movements not determined by feeling as psychologically secondary, the effects of habit and heredity, and for regarding those diffusive movements that are immediately expressive of feeling as primordial—such movements as are strictly purposive being gradually selected or elaborated from them. But some distinction is called for among the various movements expressive of emotion; for there is more in these than the direct effect of feeling regarded as merely pleasure or pain. It has been usual with psychologists to confound emotions with feeling, because intense feeling is essential to emotion. But, strictly speaking, a state of emotion is a complete state of mind, a psychosis, and not a psychical element, if we may so say. Thus in anger we have over and above pain a more or less definite object as its cause, and a certain characteristic reactive display—frowns, compressed lips, erect head, clenched fists, in a word, the combative attitude—as its effect, and similarly of other emotions; so that generally in the particular movements indicative of particular emotions the primary and primitive effects of feeling are overlaid by what Darwin has called serviceable associated habits. The purposive actions of an earlier stage of development become, though somewhat atrophied as it were, the emotive outlet of a later stage: in the circumstances in which our ancestors worried their enemies we only show our teeth. We must, therefore, leave aside the more complex emotional manifestations and look only to the simplest effects of pleasure and of pain, if we are to discover any fundamental contrast between them.[4]

Emotional Expression.

Joy finds expression in dancing, clapping the hands and meaningless laughter, and these actions are not only pleasurable in themselves but such as increase the existing pleasure. Attention is not drafted off or diverted; but rather the available resources seem reinforced, so that the old expenditure is supported as well as the new. To the pleasure on the receptive side is added pleasure on the active side. The violent contortions due to pain, on the other hand, are painful in themselves, though less intense than the pains from which they withdraw attention; they are but counter-irritants that arrest or inhibit still more painful thoughts or sensations. Thus, according to Darwin, "sailors who are to be flogged sometimes take a piece of lead into their mouths in order to bite it with their utmost force, and thus to bear the pain." When in this way we take account of the immediate effects as well as of the causes of feeling, we find it still more strikingly true that only in pleasurable states is there an efficient expenditure of attention. It is needless now to dwell upon this point, although any earlier mention of it would hardly have been in place. But we should fail to realize the contrast between the motor effects of pleasure and of pain if we merely regarded them as cases of diffusion. The intenser the feeling the intenser the reaction, no doubt, whether it be smiles or tears, jumping for joy, or writhing in agony; but in the movements consequent on pleasure the diffusion is the result of mere exuberance, an overflow of good spirits, as we sometimes say, and these movements, as already remarked, are always comparatively purposeless or playful. Even the earliest expressions of pain, on the contrary, seem but so many efforts to escape from the cause of it; in them there is at least the blind purpose to flee from a definite ill, but in pleasure only the enjoyment of present fortune.

From Plato downwards psychologists and moralists have been fond of discussing the relation of pleasure and pain. It has been maintained that pain is the first and more fundamental fact, and pleasure nothing but relief from pain; and, again, on the other side, that pleasure is prior and positive, and pain only the negation of pleasure. So far as the mere change goes, it is obviously true that the diminution of pain is *pro tanto* pleasant, and the diminution of pleasure *pro tanto* unpleasant; and if relativity had the unlimited range sometimes assigned to it this would be all we could say. But we must sooner or later recognize the existence of a comparatively fixed neutral state, deviations from which, of comparatively short duration and of sufficient intensity, constitute distinct states of pleasure or pain. Such states, if not of liminal intensity, may then be further diminished without reversing their pleasurable or painful character. The turning-point here implied may, of course, gradually change too—as a result, in fact, of the law of accommodation. Thus a long run of pleasure would raise "the hedonistic zero," while—to the small extent to which accommodation to pain is possible—a continuance of pain would lower it. But such admission makes no material difference where the actual feeling of the moment is alone concerned and retrospect out of the question. On the whole it seems, therefore, most reasonable to regard pleasure and pain as emerging out of a neutral state, which is prior to and distinct from both—not a state of absolute indifference, but of simple contentment, marked by no special active display. But it is by reference to such state of equilibrium or ἀπαθία that we see most clearly the superior volitional efficacy of pain upon which pessimists love to descant. "Nobody," says Von Hartmann, "who had to choose between no taste at all for ten minutes or five minutes of a pleasant taste and then five minutes of an unpleasant taste, would prefer the last". Most men and all the lower animals are content "to let well alone."

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[1] *Text-Book of Psychology* (1890), p. 383.

[2] G. H. J. Berkley, "Two Cases of General Cutaneous and Sensory Anaesthesia without marked Psychical Implications," *Brain* (1891), xiv. 441 sqq.

[3] "Experiments on the Value of Vascular and Visceral Factors for the Genesis of Emotion," *Proc. Roy. Soc.* (1900), lxvi. 390 sqq.; and *Nature*, lxii. 328 sqq.

[4] Of the three principles Darwin advances in explanation of emotional expression that which he places last—perhaps because it admits of less definite illustration—seems both psychologically and physiologically more fundamental than the more striking principle of serviceable associated habits which he places first; indeed the following, which is his statement of it, implies as much: "Certain actions which we recognize as expressive of certain states of mind are the direct result of the constitution of the nervous system, and have been from the first independent of the will, and to a large extent of habit" (*Expression of the Emotions*, p. 66). It is in illustration of this principle too that Darwin describes the movements expressive of joy and grief, emotions which in some form or other are surely the most primitive of any.

Purposive Action.

To ascertain the origin and progress of purposive action it seems, then, that we must look to the effects of pain rather than to those of pleasure. It is true that psychologists not infrequently describe the earliest purposive movements as appetitive; or at least they treat appetitive and aversive movements as co-ordinate and equally primitive, pleasures being supposed to lead to actions for their continuance as much as pains to actions for their removal. No doubt, as soon as the connexion between a pleasurable sensation and the appropriate action is completely established, as in the case of imbibing food, the whole process is then self-sustaining till satiety begins. But the point is that such facility was first acquired under the teaching of pain—the pain of unsatisfied hunger. The term "appetite" is apt both by its etymology and its later associations to be misleading. What are properly called the "instinctive" appetites are—when regarded from their active side—movements determined by some existing uneasy sensation. So far as their earliest manifestation in a particular individual is concerned, this urgency seems almost entirely of the nature of a *vis a tergo*; and the movements are only more definite than those simply expressive of pain because of inherited pre-adaptation, on which account, of course, they are called "instinctive." But what one inherits another must have acquired, and we have agreed here to leave heredity on one side and consider only the original evolution.

But if none but psychological causes were at work this evolution would be very long and in its early stages very uncertain. At first, when only random movements ensue, we may fairly suppose both that the chance of at once making a happy hit would be small and that the number of chances, the space for repentance, would also be small. Under such circumstances natural selection would have to do almost everything and subjective selection almost nothing. So far as natural selection worked, we should have, not the individual subject making a series of tries and perfecting itself by practice, as in learning to dance or swim, but we should have those individuals whose structure happened to vary for the better surviving, increasing and displacing the rest. How much natural selection, apparently unaided, can accomplish in the way of complicated adjustment we see in the adaptation of the form and colour of plants and animals to their environment. Both factors, in reality, operate at once, and it would be hard to fix a limit to either, though to our minds natural selection seems to lose in comparative importance as we advance towards the higher stages of life.

But psychologically we have primarily to consider subjective selection, *i.e.* first of all, the association of particular movements with particular sensations through the mediation of feeling. The sensations here concerned are mainly painful excitations from the environment, the recurring pains of innutrition, weariness, &c., and pleasurable sensations due to the satisfaction of these organic wants—pleasures which, although not a mere "filling-up," as Plato at one time contended, are still preceded by pain, but imply over and above the removal of this a certain surplus of positive good. There seem only a few points to notice. (*a*) When the movements that ensue through pleasure are themselves pleasurable there is ordinarily no ground for singling out any one; such movements simply enhance the general enjoyment, which is complete in itself and so far contains no hint of anything beyond. (*b*) Should one of these spontaneous movements of pleasure chance to cause pain, no doubt such movement is speedily arrested. Probably the most immediate connexion possible between feeling and purposive action is that in which a painful movement leads through pain to its own suppression. But such connexion is not very fruitful of consequences, inasmuch as it only secures what we may call internal training and does little to extend the relation of the individual to its environment. (*c*) Out of the irregular, often conflicting movements which indirectly relieve pain some one may chance to remove the cause of it altogether. Upon this movement, the last of a tentative series, attention, released from the pain, is concentrated; and in this way the evil and the remedy become so far associated that on a recurrence of the former the many diffused movements become less, and the one purposive movement more, pronounced; the one effectual way is at length established and the others, which were but palliatives, disappear. (*d*) When things have advanced so far that some one definite movement is definitely represented along with the painful sensation it remedies, it is not long before a still further advance is possible and we have *preventive movements*. Thanks to the orderliness of things, dangers have their premonitions. After a time, therefore, the occurrence of some signal sensation revives the image of the harm that has previously followed in its wake, and a movement—either like the first, or another that has to be selected from the random tries of fear—occurs in time to avert the impending ill. (*e*) In like manner, provided the cravings of appetite are felt, any signs of the presence of pleasurable objects prompt to movements for their enjoyment or appropriation. In these last cases we have action determined by percepts. The cases in which the subject is incited to action by ideas as distinct from percept require a more detailed consideration; such are the facts mainly covered by the term "desire."

Desire.

By the time that ideas are sufficiently self-sustaining to form trains that are not wholly shaped by the circumstances of the present, entirely new possibilities of action are opened up. We can desire to live again through experiences of which there is nothing actually present to remind us, and we can desire a new experience which as yet we only imagine. We often, no doubt, apply the term to the simpler states mentioned under (*e*) in the last paragraph: the fox in the fable is said to have desired the grapes he vilified because out of his reach. Again, at the other extreme it is usual to speak of a desire for honour, or for wealth, and the like; but such are not so much single states of mind as inclinations or habitual desires. Moreover, abstractions of this kind belong to a more advanced stage of development than that at which desire begins, and of necessity imply more complicated grounds of action than we can at present examine. The essential characteristics of desire will be more apparent if we suppose a case somewhere between these extremes. A busy man reads a novel at the close of the day, and finds himself led off by a reference to angling or tropical scenery to picture himself with his rods packed *en route* for Scotland, or booked by the next steamer for the fairyland of the West Indies. Presently, while the ideas of Jamaica or fishing are at least as vividly imagined as before, the fancied preparations receive a rude shock as the thought of his work recurs. Some such case we may take as typical and attempt to analyse it.

First of all it is obviously true, at least of such more concrete desires, that what awakens desire at one time fails to do so at another, and that we are often so absorbed or content with the present as not to be amenable to (new) desires at all. A given *x* or *y* cannot, then, be called desirable *per se*, it is only desirable by relation to the contents of consciousness at the moment. Of what nature is this relation? (1) At the level of psychical life that we have now reached very close and complete connexions have been formed between ideas and the movements necessary for their realization, so that when the idea is vividly present these movements are apt to be nascent. This association is the result of subjective selection—*i.e.* of feeling—but being once established, it persists like other associations independently of it. (2) Those movements are especially apt to become nascent which have not been recently executed, which are therefore fresh and accompanied by the organic sensations of freshness, but also those which are frequently executed, and so from habit readily aroused. The latter fact, which chiefly concerns habitual desires, may be left aside for a time. (3) At times, then, when there is a lack of present interests, or when these have begun to wane, or when there is positive pain, attention is ready to fasten on any new suggestion that calls for more activity, requires a change of active attitude, or promises relief. Such spontaneous concentration of attention ensures greater vividness to the new idea, whatever it be, and to its belongings. In some cases this greater vividness may suffice. This is most likely to happen when the new idea affords intellectual occupation, and this is at the time congenial, or with indolent and imaginative persons who prefer dreaming to doing. (4) But when the new idea does not lead off the pent-up stream of action by opening out fresh channels, when, instead of this, it is one that keeps them intent upon itself in an attitude comparable to expectation, then we have desire. In such a state the intensity of the re-presentation is not adequate to the intensity of the incipient actions it has aroused. This is most obvious when the latter are directed towards sensations or percepts, and the former remains only an idea. If it were possible by concentrating attention to convert ideas into percepts, there would be an end of most desires: "if wishes were horses beggars would ride." (5) But our voluntary power over movements is in general of this kind: here the fiat may become fact. When we cannot hear we can at least listen, and, though there be nothing to fill them, we can at least hold out our hands. It would seem, then, that the source of desire lies essentially in this excess of the active reaction above the intensity of the re-presentation (the one constituting the "impulse," the other the "object" of desire, or the desideratum), and that this disparity rests ultimately on the fact that movements have, and sensations have not, a subjective initiative. (6) The impulse or striving to act will, as already hinted, be stronger the greater the available energy, the fewer the present outlets, and, habits apart, the fresher the new opening for activity. (7) Finally, it is to be noted that, when such inchoate action can be at once consummated, desire ends where it begins: to constitute a definite state of desire there must be not only an obstacle to the realization of the desideratum—if this were all we should rather call the state one of wishing—but an obstacle to its realization by means of the actions its representation has aroused.

Relation of Desire to Feeling.

However the desire may have been called forth, its intensity is primarily identical with the strength of this impulse to action, and has no definite or constant relation to the amount of pleasure that may result from its satisfaction. The feeling directly consequent on desire as a state of want and restraint is one of pain, and the reaction which this pain sets up may either suppress the desire or prompt to efforts to avoid or overcome the obstacles in its way. To inquire into these alternatives would lead us into the higher phases of voluntary action; but we must first consider the relation of desire to feeling more closely.

Instances are by no means wanting of very imperious desires accompanied by the clear knowledge that their gratification will be positively distasteful.[1] On the other hand it is possible to recollect or picture circumstances known or believed to be intensely pleasurable without any desire for them being awakened at all: we can regret or admire without desiring. Yet there are many psychologists who maintain that desire is excited only by the prospect of the pleasure that may arise through its gratification, and that the strength of the desire is proportional to the intensity of the pleasure thus anticipated. *Quidquid petitur petitur sub specie boni* is their main formula. The plausibility of this doctrine rests partly upon a seemingly imperfect analysis of what strictly pertains to desire and partly on the fact that it is substantially true both of what we may call "presentation-prompted" action, which belongs to an earlier stage than desire, and of the more or less rational action that comes later. In the very moment of enjoyment it may be fairly supposed that action is sustained solely by the pleasure received and is proportional to the intensity of that pleasure. But there is here no re-presentation and no seeking; the conditions essential to desire, therefore, do not apply. Again, in rational action, where both are present, it may be true—to quote the words of an able advocate of the view here controverted—that "our character as rational beings is to desire everything exactly according to its pleasure value."[2] But consider what such conceptions as the good, pleasure value and rational action involve. Here we have foresight and calculation, regard for self as an object of permanent interest—Butler's cool self-love; but desire as such is blind, without either the present certainty of sense or the assured prevision of reason. Pleasure in the past, no doubt, has usually brought about the association between the representation of the desired object and the movement for its realization; but neither the recollection of this pleasure nor its anticipation is necessary to desire, and even when present they do not determine what urgency it will have. The best proof of this lies in certain habitual desires. Pleasures are diminished by repetition, whilst habits are strengthened by it; if the intensity of desire, therefore, were proportioned to the "pleasure value" of its gratification, the desire for renewed gratification should diminish as this pleasure grows less; but, if the present pain of restraint from action determines the intensity of desire, this should increase as the action becomes habitual. And observation seems to show that, unless prudence suggests the forcible suppression of such belated desires or the active energies themselves fail, they do in fact become more imperious, although less productive of positive pleasure, as time goes on.

In this there is, of course, no exception to the general principle that action is consequent on feeling—a greater pleasure being preferred before a less, a less pain before a greater; for, though the feeling that follows upon its satisfaction be less or even change entirely, still the pain of the unsatisfied desire increases as the desire hardens into habit. It is also a point in favour of the position here taken that appetites, which may be compared to inherited desires, certainly prompt to action by present pain rather than by prospective pleasure.

Intellection.

36. Desire naturally prompts to the search for the means to its satisfaction and frequently to a mental rehearsal of various possible courses of action, their advantages and disadvantages. Thus, by the time the ideational continuum has become—mainly by the comparatively passive working of association—sufficiently developed to furnish free ideas as thinking material, motives are forthcoming for thinking to begin. It is obviously impossible to assign any precise time for this advance; like all others, it is gradual. Fitfully, in strange circumstances and under strong excitement, the lower animals give unmistakable signs that they can understand and reason. But thought as a permanent activity may be fairly said to originate in and even to depend upon the acquisition of speech. This indispensable instrument, which more than anything else enables our psychological individual to advance to the distinctly human or rational stage, consists of gestures and vocal utterances, which were originally—and, indeed, are still to a large extent—emotional expressions.[3] Our space will only allow us to note in what

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[1] As such an instance may be cited Plato's story of Leontius, the son of Aglaeon, in *Rep.* iv. 439 *fin.*

[2] Bain, *Emotions and Will*, 3rd ed., p. 438.

[3] It must be noted that, though we still retain our psychological standpoint, the higher development of the individual is only possible through intercourse with other individuals, that is to say, through society. Without language we should be mutually exclusive and impenetrable, like so many physical atoms; with it each several mind may transcend its own limits and share the minds of others. As a

way language when it already exists, is instrumental in the development as distinct from the communication of thought. But first of all, what in general is thinking, of which language is the instrument?

Distinction between Sense and Understanding.

In entering upon this inquiry we are really passing one of the hardest and fastest lines of the old psychology—that between sense and understanding. So long as it was the fashion to assume a multiplicity of faculties the need was less felt for a clear exposition of their connexion. A man had senses and intellect much as he had eyes and ears; the heterogeneity in the one case was no more puzzling than in the other. But for psychologists who do not cut the knot in this fashion it is confessedly a hard matter to explain the relation of the two. The contrast of receptivity and activity hardly avails, for all presentation involves activity and essentially the same activity, that of attention. Nor can we well maintain that the presentations attended to differ in kind, albeit such a view has been held from Plato downwards. *Nihil est in intellectu quod non fuerit prius in sensu*: the blind and deaf are necessarily without some concepts that we possess. If pure being is pure nothing, pure thought is equally empty. Thought consists of a certain elaboration of sensory and motor presentations and has no content apart from these. We cannot even say that the forms of this elaboration are psychologically a priori; on the contrary, what is epistemologically the most fundamental is the last to be psychologically realized. This is not only true as a fact; it is also true of necessity, in so far as the formation of more concrete concepts is an essential preliminary to the formation of others more abstract—those most abstract, like the Kantian categories, &c., being thus the last of all to be thought out or understood. And though this formative work is substantially voluntary, yet, if we enter upon it, the form at each step is determined by the so-called matter, and not by us; in this respect "the spontaneity of thought" is not really freer than the receptivity of sense.[1] It is sometimes said that thought is synthetic, and this is true; but imagination is synthetic also; and the processes which yield the ideational train are the only processes at work in intellectual synthesis. Moreover, it would be arbitrary to say at what point the mere generic image ceases and the true concept begins—so continuous are the two. No wonder, therefore, that English psychology has been prone to regard thought as only a special kind of perception—perceiving the agreement or disagreement of ideas—and the ideas themselves as mainly the products of association. Yet this is much like confounding observation with experiment or invention—the act of a cave-man in betaking himself to a drifting tree with that of Noah in building himself an ark. In reverie, and even in understanding the communications of others, we are comparatively passive spectators of ideational movements, non-voluntarily determined. But in thinking or "intellection," as it has been conveniently termed, there is always a search for something more or less vaguely conceived, for a clue which will be known when it occurs by seeming to satisfy certain conditions. Thinking may be broadly described as solving a problem—finding an AX that is B. In so doing we start from a comparatively fixed central idea or intuition and work along the several diverging lines of ideas associated with it—hence far the aptest and in fact the oldest description of thought is that it is *discursive*. Emotional excitement—and at the outset the natural man does not think much in cold blood—quickens the flow of ideas: what seems relevant is at once contemplated more closely, while what seems irrelevant awakens little interest and receives little attention. At first the control acquired is but very imperfect; the actual course of thought of even a disciplined mind falls far short of the clearness, distinctness, and coherence of the logician's ideal. Familiar associations are apt to hurry attention away from the proper topic, so that thought becomes not only discursive but wandering; in place of concepts of fixed and crystalline completeness, such as logic describes, we may find a congeries of ideas but imperfectly compacted into one generic idea, subject to continual transformation and implicating much that is irrelevant and confusing.

Thought and Language.

Thus, while it is possible for thought to begin without language, just as arts may begin without tools, yet language enables us to carry the same process enormously farther. In the first place it gives us an increased command of even such comparatively concrete generic images as can be formed without it. The name of a thing or action becomes, for one who knows the name, as much an objective mark or attribute as any quality whatever can be. The form and colour of what we call an "orange" are perhaps even more intimately combined with the sound and utterance of this word than with the taste and fragance which we regard as strictly essential to the thing. But, whereas its essential attributes often evade us, we can always command its nominal attribute, in so far as this depends upon movements of articulation. By uttering the name (or hearing it uttered) we have secured to us, in a greater or less degree, that superior vividness and definiteness that pertain to images reinstated by impressions: our idea approximates to the fixity and independence of a percept (cf. § 21 above). With young children and uncultured minds—who, by the way, not uncommonly "think aloud"—the gain in this respect is probably more striking than those not confined to their mother-tongue or those used to an analytical handling of language at all realize.[2] When things are thus made ours by receiving names from us and we can freely manipulate them in idea, it becomes easier mentally to bring together facts that logically belong together, and so to classify and generalize. For names set us free from the cumbersome tangibility and particularity of perception, which is confined to just what is presented here and now. But as ideas increase in generality they diminish in definiteness and unity; they not only become less pictorial and more schematic, but they become vague and unsteady as well, because formed from a number of concrete images only related as regards one or two constituents, and not assimilated as the several images of the same thing may be. The mental picture answering to the word "horse" has, so to say, body enough to remain a steady object when under attention from time to time; but that answering to the word "animal" is perhaps scarcely twice alike. The relations of things could thus never be readily recalled or steadily controlled if the names of those relations, which as words always remain concrete, did not give us a definite hold upon them—make them comprehensible. Once these "airy nothings" have a name, we reap again the advantages a concrete constituent affords: by its means that which is relevant becomes more closely associated, and that which is irrelevant—abstracted from—falls off. When what answers to the logical connotation or meaning of a concept is in this way linked with the name, it is no longer necessary that such "matter or content" should be distinctly present in consciousness. It takes time for an image to raise its associates above the threshold; and, when all are there, there is more demand upon attention in proportion. There is thus a manifest economy in what Leibnitz happily styled "symbolic," in contrast to "intuitive" thinking. Our power of efficient attention is limited, and with words for counters we can, as Leibnitz remarks, readily perform operations involving very complex presentations, and wait till these operations are concluded before realizing and spreading out the net result in sterling coin.

Thought and Ideation.

But this simile must not mislead us. In actual thinking there never is any complete separation between the symbol and the ideas symbolized: the movements of the one are never entirely suspended till those of the other are complete. "Thus," says Hume, "if, instead of saying, that in war the weaker have always recourse

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herd of individuals mankind would have a natural history as other animals have; but personality can only emerge out of intercourse with persons, and of such intercourse language is the means. But important as is this addition of a transparent and responsive world of minds to the dead opaqueness of external things, the development of our psychological individual still remains a purely individual development. The only new point is—and it is of the highest importance to keep it in sight—that the materials of this development no longer consist exclusively of presentations elaborated by a single mind in accordance with psychical laws. Nevertheless that combination of individual experiences which converts subjective idiosyncrasy and isolation into the objectivity and solidarity of Universal Mind only affects the individual in accordance with psychical laws, and we have no need therefore to overstep our proper domain in studying the advance from the non-rational phase to the phase of reason.

[1] Locke, so often misrepresented, expressed this truth according to his lights in the following: "The earth will not appear painted with flowers nor the fields covered with verdure whenever we have a mind to it. . . . Just thus is it with our understanding: all that is voluntary in our knowledge is the employing or withholding any of our faculties from this or that sort of objects and a more or less accurate survey of them" (*Essay*, iv. 13, 2).

[2] Ruskin, in his *Fors clavigera*, relates that the sight of the word "crocodile" used to frighten him when a child so much that he could not feel at ease again till he had turned over the page on which it occurred.

to negotiation, we should say, that they have always recourse to conquest, the custom which we have acquired of attributing certain relations to ideas still follows the words and makes us immediately perceive the absurdity of that proposition."[1] How intimately the two are connected is shown by the surprises that give what point there is to puns, and by the small confusion that results from the existence of homonymous terms. The question thus arises—What are the properly ideational elements concerned in thought? Over this question psychologists long waged fight as either nominalists or conceptualists. The former maintain that what is imaged in connexion with a general concept, such as *triangle*, is some individual triangle "taken in a certain light,"[2] while the latter maintain that an "abstract idea" is formed embodying such constituents of the several particulars as the concept connotes, but dissociated from the specific or accidental variations that distinguish one particular from another. As often happens in such controversies, each side saw the weak point in the other. The nominalists easily showed that there was no distinct abstract idea representable apart from particulars; and the conceptualists could as easily show that a particular presentation "considered in a certain light" is no longer merely a particular presentation nor yet a mere crowd of presentations. The very thing to ascertain is what this consideration in a certain light implies. Perhaps a speedier end might have been put to this controversy if either party had been driven to define more exactly what was to be understood by image or idea. Such ideas as are possible to us apart from abstraction are, as we have seen, revived percepts, not revived sensations, are complex total re-presentations made up of partial re-presentations, which may figure in other totals (cf. § 21). Reproductive imagination is so far but a faint rehearsal of actual percepts, and constructive imagination but a faint anticipation of possible percepts. In either case we are busied with elementary presentations complicated or synthesized to what are tantamount to intuitions, in so far as the forms of intuition remain in the idea, though the fact, as tested by movement, &c., is absent. The several partial re-presentations, however, which make up an idea might also be called ideas, not merely in the wide sense in which every mental object may be so called, but also in the narrower sense as secondary presentations, *i.e.* as distinguished from primary presentations or impressions. But such isolated images of an impression, even if possible, would no more be intuitions than the mere impression itself would be one: taken alone the one would be as free of space and time as is the other. Till it is settled, therefore, whether the ideational elements concerned in conception are intuitive complexes or something answering to the ultimate elements of these, nothing further can be done.

In the case of what are specially called "concrete" as distinct from "abstract" concepts—if this rough-and-ready, but unscientific, distinction may be allowed—the idea answering to the concept differs little from an intuition, and we have already remarked that the generic image (*Gemeinbild* of German psychologists) constitutes the connecting link between imagination and conception. But even concerning these it is useless to ask what does one imagine in thinking, *e.g.* of triangle or man or colour. We never—except for the sake of this very inquiry—attempt to fix our minds in this manner upon some isolated concept; in actual thinking ideas are not in consciousness alone and disjointedly, but as part of a context. When the idea "man" is present, it is present in some proposition or question, as—Man is the paragon of animals; In man there is nothing great but mind; and so on. It is quite clear that in understanding or mentally verifying such statements very different constituents out of the whole complex "man" are prominent in each. Further, what is present to consciousness when a general term is understood will differ, not only with a different context, but also the longer we dwell upon it: we may either analyse its connotation or muster its denotation, as the context or the cast of our minds may determine. Thus what is relevant is alone prominent, and the more summary the attention we bestow the less the full extent and intent of the concept are displayed. To the nominalist's objection, that it is impossible to imagine a man without imagining him as either tall or short, young or old, dark or light, and so forth, the conceptualist might reply that at all events percepts may be clear without being distinct, that we can recognize a tree without recognizing what kind of tree it is, and that, moreover, the objection proves too much: for, if our image is to answer exactly to fact, we must represent not only a tall or a short man, but a man of definite stature—one not merely either light or dark, but of a certain precise complexion. But the true answer rather is that in conceiving as such we do not necessarily imagine *a* man or *a* tree at all, any more than—if such an illustration may serve—in writing the equation to the parabola we necessarily draw a parabola as well.

The individuality of a concept is thus not to be confounded with the sensible concreteness of an intuition either distinct or indistinct, and "the pains and skill" which Locke felt were required in order to frame what he called an abstract idea are not comparable to the pains and skill that may be necessary to discriminate or decipher what is faint or fleeting. The material "framed" consists no doubt of ideas, if by this is meant that in thinking we work ultimately with the ideational continuum, but what results is never a mere intuitive complex nor yet a mere group of such. The concept or "abstract idea" only emerges when a certain intelligible relation is established among the members of such a group; and the very same intuition may furnish the material for different concepts as often as a different *geistiges Band* is drawn between them. The stuff of this bond, as we have seen, is the word, and this brings into the foreground of consciousness when necessary those elements—whether they form an intuition or not—which are relevant to the concept. Conception, then, is not identical with imagination, although the two terms are still often, and were once generally, regarded as synonymous. The same ultimate materials occur in each; but in the one they start with and retain a sensible form, in the other they are elaborated into the form which is called "intelligible."

General Character and Growth of Intellection.

37. The distinctive character of this intellectual synthesis lies, we have seen, in the fact that it is determined entirely by what is synthesized, whether that be the elementary constituents of intuitions or general relations of whatever kind among these. It differs, therefore, in being selective from the synthesis of association, which rests upon contiguity and unites together whatever occurs together. It differs also from any synthesis, though equally voluntary in its initiation, which is determined by a purely subjective preference, since intellection depends upon objective relations alone. Owing to the influence of logic, which has long been in a much more forward state than psychology, it has been usual to resolve intellection into comparison, abstraction, and classification, after this fashion: ABCM and ABCN are compared, their differences M and N left out of sight, and the class notion ABC formed including both; the same process repeated with ABC and ABD yields a higher class notion AB; and so on. But our ideational continuum is not a mere string of ideas of concrete things, least of all such concrete things as this view implies. Not till our daily life resembles that of a museum porter receiving specimens will our higher mental activity be comparable to that of the savant who sorts such specimens into cases and compartments. What we perceive is a world of things in continual motion, waxing, waning, the centres of manifold changes, affecting us and apparently affected by each other, amenable to our action and, as it seems, continually interacting among themselves. Even the individual thing, as our analysis of perception has attempted to show, is not a mere sum of properties which can be taken to pieces and distributed like type, but a whole combined of parts very variously related. To understand intellection we must look at its actual development under the impetus of practical needs,

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[1] *Treatise of Human Nature* (Green and Grose's ed.), pt. i. § vii. p. 331.

[2] Cf. Berkeley, *Principles of Human Knowledge*, Introd. § 16, Hume, *op. cit.* § 7.

rather than to logical ideals of what it ought to be. Like other forms of purposive activity, thinking is primarily undertaken as a means to an end, and especially the end of economy. It is often easier and always quicker to manipulate ideas than to manipulate real things; to the common mind the thoughtful man is one who “uses his head to save his heels.” In all the arts of life, in the growth of language and institutions, in scientific explanation, and even in the speculations of philosophy, we may remark a steady simplification in the steps to a given end or conclusion, or—what is for our present inquiry the same thing—the attainment of better results with the same means. The earliest machines are the most cumbrous and clumsy, the earliest speculations the most fanciful and anthropomorphic. Gradually imitation yields to invention, the natural fallacy of *post hoc, ergo propter hoc* to methodical induction, till what is essential and effective is realized and appreciated and what is accidental and inert is discarded and falls out of sight. In this way man advances in the construction of a complete mental clue or master key to the intricacies of the real world, but this key is still the counterpart of the world it enables us to control and explain.

To describe the process by which such insight is attained as a mere matter of abstraction deserves the stigma of “soulless blunder” which Hegel applied to it. Of course if attention is concentrated on X it must *pro tanto* be abstracted from Y, and such command of attention may require “some pains and skill.” But to see in this invariable accompaniment of thinking its essential feature is much like the schoolboy's saying that engraving consists in cutting fine shavings out of a hard block. The great thing is to find out what are the light-bearing and fruit-bearing combinations. Moreover, thinking does not begin with a conscious abstraction of attention from recognized differences in the way logicians describe. The actual process of generalization, for the most part at all events, is much simpler. The same name is applied to different things or events because only their more salient features are perceived at all. Their differences, so far from being consciously and with effort left out of account, often cannot be observed when attention is directed to them: to the inexperienced all *is* gold that glitters. Thus, and as an instance of the principle of progressive differentiation already noted (§ 6), we find genera recognized before species, and the species obtained by adding on differences, not the genus by abstracting from them. Of course such vague and indefinite concepts are not at first logically general: they only become so when certain common elements are consciously noted as pertaining to presentations in other respects qualitatively different, as well as numerically distinct. But actually thinking starts from such more potential generality as is secured by the association of a generic image with a name. So far the material of thought is always general—is freed, that is, from the local and temporal and other defining marks of percepts.

Thought as Analytic.

38. The process of thinking itself is psychologically much better described as (1) an analysis and (2) a re-synthesis of this material already furnished by the ideational trains. The logical resolution of thought into hierarchies of concepts arranged like Porphyry's tree, into judgments uniting such concepts by means of a logical copula, &c., is the outcome of later reflection—mainly for technical purposes—upon thought as a completed product, and entirely presupposes all that psychology has to explain. The logical theory of the formation of concepts by generalization (or abstraction) and by determination (or concretion)—*i.e.* by the removal or addition of defining marks—assumes the previous existence of the very things to be formed, for these marks or attributes—X's and Y's, A's and B's—are themselves already concepts. Moreover, the act of generalizing or determining is really an act of judgment, so that the logician's account of conception presupposes judgment, while at the same time his account of judgment presupposes conception. But this is no evil; for logic does not essay to exhibit the actual genesis of thought but only an ideal for future thinking. Psychologically, however—that is to say, chronologically—the judgment is first. The growing mind, we may suppose, passes beyond simple perception when some striking peculiarity in what is at the moment perceived is a bar to its recognition. The stalking hunter is not instantly recognized as the destroying biped, because he crawls on all fours; or the scarecrow looks like him, and yet not like him, for, though it stands on two legs, it never moves. There is thus no immediate assimilation; recognition under such circumstances is in itself a judgment, involving an analysis more or less explicit. But of more account is the further judgment to which it leads, that which connects the new fact with the generic idea. Though actually complex, generic images are not explicitly known as complexes when they first enter into judgments; as the subjects of such judgments they are but starting-points for predication—It crawls; It does not move; and the like. Such impersonal judgments, according to most philologists, are in fact the earliest; and we may reasonably suppose that by means of them our generic images have been partially analysed, and have attained to something of the distinctness and constancy of logical concepts. But the analysis is rarely complete: a certain confused and fluctuating residuum remains behind. The psychological concept merges at sundry points into those cognate with it—in other words, the continuity of the underlying memory-train still operates; only the ideal concept of logic is in all respects *totus, teres, atque rotundus*. Evidence of this, if it seem to any to require proof, is obtainable on all sides, and, if we could recover the first vestiges of thinking, would doubtless be more abundant still.

Logical Bias in Psychology.

But, if we agree that it is through acts of judgment which successively resolve composite presentations into elements that concepts first arise, it is still very necessary to inquire more carefully what these elements are. On the one side we have seen logicians comparing them to so many letters, and on the other psychologists enumerating the several sensible properties of gold or wax—their colour, weight, texture, &c.—as instances of such elements. In this way formal logic and sensationalist psychology have been but blind leaders of the blind. Language, which has enabled thought to advance to the level at which reflection about thought can begin, is now an obstacle in the way of a thorough analysis of it. A child or savage would speak only of “red” and “hot,” but we of “redness” and “heat.” They would probably say, “Swallows come when the days are lengthening and snipe when they are shortening”; we say, “Swallows are spring and snipe are winter migrants.” Instead of “The sun shines and plants grow,” we should say, “Sunlight is the cause of vegetation.” In short, there is a tendency to resolve all concepts into substantive concepts; and the reason of this is not far to seek. Whether the subject or starting-point of our discursive thinking be actually what we perceive as a thing, or whether it be a quality, an action, an effectuation (*i.e.* a transitive action), a concrete spatial or temporal relation, or finally, a resemblance or difference in these or in other respects, it becomes by the very fact of being the central object of thought *pro tanto* a unity, and all that can be affirmed concerning it may so far be regarded as its property or attribute. It is, as we have seen, the characteristic of every completed concept to be a fixed and independent whole, as it were, crystallized out of the still-fluent matrix of ideas. Moreover, the earliest objects of thought and the earliest concepts must naturally be those of the things that live and move about us; hence, then—to seek no deeper reason for the present—this natural tendency, which language by providing distinct names powerfully seconds, to reify or personify not only things but every element and relation of things which we can single out, or, in other words, to concrete our abstracts.[1] It is when things have reached this stage that logic begins. But ordinary, so-called formal, logic, which intends to concern itself not with thinking but only with the most general structure of thought, is debarred from recognizing any difference between concepts that does not affect their relations as terms in a proposition. As a consequence it drifts inevitably into that compartmental logic or logic of extension which knows nothing of categories or predicables, but only of the one relation of whole and part qualitatively considered. It thus pushes this reduction to a common denomination to the utmost: its terms, grammatically regarded, are always names and symbolize classes or compartments of things. From this point of view all disparity among concepts, save that of contradictory exclusion, and all connexion, save that of partial coincidence, are at an end.

Of a piece with this are the logical formula for a simple judgment, X is Y, and the corresponding definitions of judgment as the comparison of two concepts and the recognition of their agreement or disagreement.[1] It certainly is possible to represent every judgment as a comparison, although the term is strictly adequate only to judgments of one kind and affords but a very artificial description of others. But for a logic mainly concerned with inference—*i.e.* with explicating what is implicated in any given statements concerning classes—there is nothing more to be done than to ascertain agreements or disagreements; and the existence of these, if not necessarily, is at least most evidently represented by spatial relations. Such representation obviously implies a single ground of comparison only and therefore leaves no room for differences of category. The resolution of all concepts into class concepts and that of all judgments into comparisons thus go together. On this view if a concept is complex it can only be so as a class combination; and, if the mode of its synthesis could be taken account of at all, this could only be by treating it too as an element in the combination like the rest: iron is a substance, &c., virtue a quality, &c., distance a relation, &c., and so on. There is much of directly psychological interest in this thoroughgoing reduction of thought to a form which makes its consistency and logical concatenation conspicuously evident. But of the so-called matter of thought it tells us nothing. And, as said, there are many forms in that matter of at least equal moment, both for psychology and for epistemology: these formal logic has tended to keep out of sight.

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[1] See Wundt, *Logik*, i. 107 seq., where this process is happily styled “die kategoriale Verschiebung der Begriffe.”

It has generally been under the bias of such a formal or computational logic that psychologists, and especially English psychologists, have entered upon the study of mind. They have brought with them an analytic scheme which affords a ready place for sensations or "simple ideas" as the elements of thought, but none for any differences in the combinations of these elements. Sensations being in their very nature concrete, all generality becomes an affair of names; and, as Sigwart has acutely remarked, sensationalism and nominalism always go together. History would have borne him out if he had added that a purely formal logic tends in like manner to be nominalistic.

Forms of Synthesis.

If we are still to speak of the elements of thought, we must extend this term so as to include not only the sensory elements we are said to receive but three distinct ways in which this pure matter is combined: (1) the forms of intuition—Time and Space[2]; (2) the real categories—Substance, Attribute, State, Act, Effect, End or Purpose, &c.—the exact determination of which is not here in place; and (3) certain formal (logical and mathematical) categories—as Unity, Difference, Identity, Likeness. These cannot be obtained by such a process of abstraction and generalization as logicians and psychologists alike have been wont to describe. They are not primarily concepts more general than all others in the sense in which animal is more general than man, but rather distinct methods of relating or synthesizing presentations. Kant, though he accepted almost unquestioned the logic and psychology current in his day, has yet been the occasion, in spite of himself, of materially advancing both, and chiefly by the distinction he was led to make between formal and transcendental logic. In his exposition of the latter he brings to light the difference between the "functions of the understanding" in synthesizing—or, as we might say, organizing—percepts into concepts and the merely analytic subsumption of *abc* and *abd* under *ab*—*a*; *b*, *c* and *d* being what they may. Unlike other concepts, categories as such do not in the first instance signify objects of thought, however general, but these functions of the understanding in constituting objects. In fine, they all imply some special process, and the general characteristic of the resulting products is what we have first of all to note

Objects of Higher Order: their Analysis and Genesis.

39. By transposing a tune from one key to another we may obtain two entirely diverse aggregates of notes, and yet the melody may remain unchanged. On the other hand, by varying the order of the notes two distinct tunes may result from the same collection of tones. Sense furnishes merely the parts: whence, then, this identity of the whole in spite of their diversity, this diversity of the whole in spite of their identity? From the sameness or difference of the several "intervals," it is replied. But the answer is insufficient; for the tune is a unity, not a mere series, and, further, with every interval the same problem recurs. For the interval, too, is a whole, though a simpler one: it does not necessarily change with a change of its constituents, nor remain the same as long as their distance is unaltered. Feelings and "associations," again, cannot account for the result, inasmuch as such accompaniments are not invariably present: moreover, they obviously presuppose the melody instead of producing it. Of such complex wholes or combinations—as distinct from mere aggregates or collections—there are many forms; as, for example, geometrical figures and patterns, motions and other changes, numbers, logical connexions, &c. In view of this variety it seems to strike the unprejudiced as wild to expect that "the progress of psychophysics" may disclose an explanation of such combinations conforming to the old scholastic maxim, *Nihil est in intellectu quod non fuerit prius in sensu.* Yet hopes of such a *generatio aequivoca* are entertained![3] Meanwhile the "old psychology," at any rate, is content to regard such complex wholes as new presentations, the products, that is to say, not of a quasi-mechanical interaction of their constituents, but of intellectual synthesis.

What is here said of the combinations whereby the items of an aggregate are construed as parts of a whole holds equally of the comparisons whereby such items are related, as like or unlike, compatible or incompatible. Before either combination or comparison is possible, such items or particulars must be "given." But it is conceivable that they should be given and no intellectual synthesis ensue; such a consciousness has been happily named *anoetic*.[4] Whether or no it actually exists is another matter: it is a conceivable limit, and has the theoretical usefulness of limiting conceptions generally. But relative *anoesis* suffices here. Suppose, then, we have: (*a*) *item*, a sound; *item*, ditto; *item*, ditto; or (*b*) *item*, blue; *item*, green. The sensationalist, from Hume onwards, has complained that he does not find in the one case a further item: *total three*; nor in the other a further item: *unlikeness*. After vainly seeking the living whole among the dead particulars, he next surmises that they generate it by their conjoint action! But whence this notion of "action"; and how, if such *disjecta membra* suffice, do they so often fail of their effect, so that we cannot "see the wood for the trees"? Combinations and comparisons then, we conclude, are not given, but "grounded" on what is given, and is thus their *fundamentum*. Hence Meinong, who has studied the psychology of intellection with especial care, has called the new presentations, due to this process of "grounding" (*Fundiren*), "objects of a higher order," or ideal objects.[5] They have validity in respect of the particulars on which they are grounded, but not reality as data existing for perception alongside of such particulars.

The reader will here be reminded of Hume's distinction between knowledge and probability. His four philosophical relations, "which, depending solely upon ideas, can be the objects of knowledge and certainty—resemblance, continuity, degrees in quality and proportions in quantity or number"—are objects of higher order and *ideal*. "The other three, which depend not upon the idea, and may be absent or present even while *that* remains the same"—namely, identity, the situations in time and place, and causation—are thus obviously not the result of grounding or *noesis* merely, are not ideal but *empirical*, and have, that is to say, existential import. In fact, the second of these, the situations, though they imply synthesis in the wider sense in which all complex perception does, do not involve intellectual synthesis at all: are neither ideal combinations nor ideal relations. And since such temporal and spatial situations enter into both the other two—numerical identity and causation—the mixed, a posteriori character of these is obvious. Whatever be the defects of Hume's psychology, his classification of relations is so far sound, and its epistemological importance can hardly be overrated. It is accordingly to be regretted that the one vague term "relation" does not allow us to make these distinctions more precise. The German language, with the two terms *Verhältniss* and *Beziehung*, can do more.

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[1] Cf. Hamilton: "To judge (κρίνειν, *judicare*) is to recognize the relation of congruence or of confliction in which two concepts, two individual things, or a concept and an individual, compared together, stand to each other" (*Lectures on Logic*, i. 225).

[2] As to these it must suffice to refer to what has been already said; cf. § 11 and § 28.

[3] Cf. *e.g.* F. Schumann, "Zur Psychologie der Zeitanschauung," *Ztschr. f. Psychologie*, xvii. 130, 136.

[4] G. F. Stout, *Analytic Psychology*. i. 50 seq.

[5] A. Meinong, "Ueber Gegenstände höherer Ordnung u.s.w.," *Ztschr. f. Psychologie* (1899), xxi. 182 sqq. Special mention must be made of an earlier paper by C. v. Ehrenfels ("Ueber Gestaltqualitäten," *Vierteljahrsschr. f. wissensch. Philosophie*, 1890, pp. 249 sqq.), round which the whole subsequent discussion of this topic centres. Cf., too, Stout, *op. cit.* bk. i. ch. iii.

It will be convenient at this point to digress somewhat for a moment to consider a question of some psychological interest. When we say that two "contents" are similar, and when too they admit of analysis, we can, if need be, enumerate certain elements as the ground of their partial likeness, and certain others as the ground of their partial diversity. We may further say that, abstracting from these last, we can regard the points of resemblance as constituting a general class to which the two contents belong as specific instances. But how is either comparison or abstraction possible when the two resembling contents appear as simple, and so far unanalysable? Instances, of course, are familiar to every one: thus we call red and orange colours, and say they resemble each other more than do red and blue. In presence of this question logicians and psychologists are apt to be at loggerheads. The logician maintains that abstraction and resemblance (as distinct from qualitative identity) imply complexity; and surely here he cannot be gainsaid. Yet there are the facts: reds and blues of sorts and a whole scale of degrees of likeness and unlikeness; but no constituent parts, no assignable marks of identity or diversity, are forthcoming, such as we find when we class sugar and salt together as solid or soluble, and pronounce them like in colour and unlike in taste. Here the logician's symbols $a+b+c$, $a+b+d$, have their counterparts: there—for the percipient's consciousness at all events—they have not. We cannot "consider and attend to either the sameness or the differences in" red and blue, as we can to the like or the unlike properties in salt and sugar. None the less it would be hasty to conclude that colours or any given sensations are simple. We are often struck by the likeness of complex wholes—two faces, say—long before we can discern the exact points of resemblance. Still, so long as there is no perceptible complexity in the individual presentations there can be no analysis of them, and, therefore, neither abstraction nor comparison based upon it. Can we find elsewhere the complexity that generalization and comparison invariably imply? Though colour may be regarded as a general term applicable alike to red, green and blue, just as animal is a general term applicable alike to bird, beast and fish, it is a mistake to infer that the processes are the same because of this similarity in their products. We seem bound to distinguish between consciously logical or "noetic" processes and processes that are unconsciously logical or "hyponoetic," as we may perhaps call them. In the former the subjective aspect is left aside; in the latter it cannot be. The only common mark we can psychologically assign to colours is that they are all seen, and to tones—as the element of notes and noises—that they are all heard. So often as we talk of tasting tastes, smelling smells, feeling touches, language leads us to bear witness to this fact. When the sunset red changes to the twilight grey, I still see; but when the thunder follows the lightning there is a double change, though not an absolute one: from seeing I pass to hearing, but I am sentient still. And if progressive differentiation be the order of experience then the "universal" sentience precedes the differentiations seeing, hearing, &c., and, again, the "universal" colour the differentiations, red, green, blue, &c. Such "first universals," then, are not reached by abstraction, but are given in the fundamental continuity of experience, and their subsequent differentiation admits neither of definition nor the classification applicable to discrete complexes, which are the material of logical comparison only. When red is pronounced liker or nearer to yellow than it is to green, this is because a smaller change is experienced in the transition from red to yellow than in that from red to green, and because in the latter yellow is reached and passed before green appears.[1] Proximity and resemblance are, then, so far one and the same; also both are equally relative, admit of the same indefinite gradation, and have the same limit in *zero*, regarded either as coincidence or identity. The conception of "distance between" answers, then, to what we have called a hyponoetic relation, and this is plainly distinct from the analysis of discrete complexes, with which, as said, noetic comparison is alone concerned: the one implies and the other excludes the notion of continuity and change—a fact which helps still further to distinguish the two.

Categories.

Formal Categories: Unity.

40. We come now to deal with the categories in more detail. To begin with what are *par excellence* formal categories, and among these with that which is the most fundamental and formal of all—How do we come by the conception of unity? "Amongst all the ideas we have," says Locke, "as there is none suggested to the mind by more ways, so there is none more simple than that of unity, or one. It has no shadow of variety or composition in it; every object our senses are employed about, every idea in our understandings, every thought of our minds, brings this idea along with it."[2] But to assign a sensible origin to unity is certainly a mistake—one of a class of mistakes already more than once referred to, which consist in transferring ~~to~~ the data of sense all that is implied in the language necessarily used in speaking of them. The *term* "a sensation" no doubt carries along with it the idea of unity, but the bare sensation as received brings along with it nothing but itself. And, if we consider sensory consciousness merely, we do not receive a sensation, and then another sensation, and so on *seriatim*; but we have always a continuous diversity of sensations even when these are qualitatively sharply differentiated. Moreover, if unity were an impression of sense and passively received, it would, in common with other impressions, be unamenable to change. We cannot see red as blue, but we can resolve many (parts) into one (whole), and vice versa.[3] Unity, then, is the result of an act the occasions for which, no doubt, are at first non-voluntarily determined; but the act is still as distinct from them as is attention from the objects attended to. It is to that movement of attention already described in dealing with ideation (§ 24) that we must look as the source of this category. This same movement, in like manner, yields us temporal signs; and the complex unity formed by a combination of these is what we call number. When there is little or no difference between the field and the focus of attention, unifying is an impossibility, whatever the impressions received may be. On the other hand, as voluntary acts of concentration become more frequent and distinct the variegated continuum of sense is shaped into intuitions of definite things and events. Also, as soon as words facilitate the control of ideas, it becomes possible to single out special aspects and relations of things as the subjects or starting-points of our discursive thinking. Thus the forms of unity are manifold: every act of intuition or thought, whatever else it is, is an act of unifying.

It is obvious that the whole field of consciousness at any moment can never be actually embraced as one. What is unified becomes thereby the focus of consciousness and so leaves an outlying field; so far unity may be held to imply plurality. But it cannot with propriety be said that in a simple act of attention the field of consciousness is analysed into two distinct parts, *i.e.* two unities—*this* (now attended to) and *the other* or the rest (abstracted from). For the not-this is but the rest of a continuum and not itself a whole; it is left out but not determined, as the bounding space is left out when a figure is drawn. To know two unities we must connect both together; and herein comes to light the difference between the unity which is the form of the concept or subject of discourse and the unity of a judgment. The latter is of necessity complex; the former may or may not be. But in any case the complexity of the two is different. If the subject of thought is not only clear but distinct—*i.e.* not merely defined as a whole but having its constituents likewise more or less defined—such distinctness is due to previous judgments. At any future time these may of course be repeated; such are the analytical or explicative judgments of logic. As the mere subject of discourse it is, however, a single unity simultaneously apprehended; the relation ascertained between it and its predicate constitutes the unity of judgment, a unity which is comprehended only when its parts are successively apprehended.

Law of Dichotomy or Duality.

But, though a judgment is always a complex unity, the extent of this complexity seems at first sight to vary as the form of synthesis varies. Formal logic, as we have seen, by throwing the form of synthesis into the predicate has no difficulty in reducing every judgment to an S is P. But, if we at all regard the matter thought, it is certain, for example, that "It is an explosion" is less complex than "The enemy explodes the mine." The first answers one question; the second answers three. But as regards the more complex judgment both the process of ascertaining the fact and the language in which it is expressed show that the three elements concerned in it are not synthesized at once.

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[1] Assuming, of course, that the change is the simplest or directest possible, *i.e.* a change of "colour proper" without change of saturation.

[2] *Essay concerning Human Understanding*, II. xvi. § 1.

[3] "We may regard one of the words here printed as *one*, in that by a definite act we unite a plurality of letters in our image and separate it from its neighbours: we may also regard the one word as *many* when we attend to the transition from one letter to another and mark each step" (Sigwart, *Logic*, ii. § 66).

Suppose we start from the explosion—and changes or movements are not only apt to attract attention first, but, when recognized as events and not as abstracts personified, they call for some supplementing beyond themselves—then in this case we may search for the agent at work or for the object affected, but not for both at once. Moreover, if we find either, a complete judgment at once ensues: "The enemy explodes," or "The mine is exploded." The original judgment is really due to a synthesis of these two. But, when the results of former judgments are in this manner taken up into a new judgment, a certain "condensation of thought" ensues. Of this condensation the grammatical structure of language is evidence, though logical manipulation—with great pains—obliterates it. Thus our more complex judgment would take the form—"The enemy is now mine-exploding" or "The mine is enemy-exploded," according as one or other of the simpler judgments was made first. An examination of other cases would in like manner tend to show that intellectual synthesis is always—in itself and apart from implications—a binary synthesis. Wundt, to whom belongs the merit of first explicitly stating this "law of dichotomy or duality"[1] as the cardinal principle of discursive thinking, contrasts it with synthesis by mere association. This, as running on continuously, he represents thus—A—B—C—D—. . . ; the synthesis of thought, on the other hand, he symbolizes by forms such as the following:—

$$\overparen{AB};\ \overparen{\overparen{AB}\ \ \overparen{CD}};\ \overparen{\overparen{AB}\ \ \overparen{C_{\overparen{DE}}}};\ \&c.$$

Thus, Socrates is a philosopher; the philosopher Socrates discovered a method; the philosopher Socrates discovered the dialectical method; &c. The point is that the one thing attended to in an intellective act is the synthesis of two ideas, and of two ideas only, because, as only one movement of attention is possible at a time, only two ideas at a time can be synthesized. In that merely associative synthesis by which the memory-continuum is produced attention moves from A to B and thence to C without any relation between A and B being attended to at all, although they must have relations, that of sequence *e.g.* at least.

Difference and Likeness.

"Difference," says Hume, "I consider rather as a negation of relation than anything real or positive. Difference is of two kinds, as opposed either to identity or resemblance. The first is called a difference of *number*, the other of *kind*." The truth seems rather to be that difference in Hume's sense of numerical difference[2] is so far an element in all relations as all imply distinct correlatives. To this extent even identity—or at least the recognition of it—rests on difference, that form of difference, viz. which is essential to plurality. But absolute difference (*i.e.* diversity) of kind may be considered tantamount not, indeed, to the negation, but at least to the absence of all formal relation. That this absolute difference—or disparateness, as we may call it—affords no ground for relations becomes evident when we consider (1) that, if we had only a plurality of absolutely different presentations, we should have no consciousness at all (cf. § 11); and (2) that we never compare—although we distinguish—presentations which seem absolutely or totally disparate, as *e.g.* a thunderclap and the taste of sugar, or the notion of free trade and that of the Greek accusative. All actual comparison of what is qualitatively different rests upon at least partial likeness. This being understood, it is noteworthy that the recognition of unlikeness is, if anything, more "real or positive" than that of likeness, and is certainly the simpler of the two. In the comparison of sensible impressions—as of two colours, two sounds, the lengths or the directions of two lines, &c.—we find it easier in some cases to have the two impressions that are compared presented together, in others to have first one presented and then the other. But, either way, the essential matter is to secure the most effective presentation of their difference, which in every case is something positive and, like any other impression, may vary in amount from bare perceptibility to the extremest distance that the continuum to which it belongs will admit. Where no difference or distance at all is perceptible there we say there is likeness or equality. Is the only outcome, then, that when we pass from *ab* to *ac* there is a change in consciousness, and that when *ab* persists there is none? To say this is to take no account of the operations (we may symbolize them as $ac \rightarrow ab : c$, $ab \rightarrow ab : o$) by which the difference or the equality results. The change of presentation (c) and absence of change (o) are not here what they are as merely passive occurrences, so to put it. This is evident from the fact that in the former there is positive presentation and in the latter no presentation at all. The relation of unlikeness, then, is distinguished from the mere "position" or fact of change by (1) the voluntary concentration of attention upon *ab* and *ac* with a view to the detection of this change as *their* difference, and by (2) the act, relating them through it, in that they are judged unlike to that extent. The type of comparison is such superposition of geometrical lines or figures (as, *e.g.* in Euclid I. iv.): if they coincide we have concrete equality; if they do not their difference is a line or figure. All sensible comparisons conform essentially to this type. In comparing two shades we place them side by side, and passing from one to the other seek to determine not the absolute shade of the second but its shade relative to the first—in other words, we look out for contrast. We do not say of one "It is dark," for in the scale or shades it may be light, but "It is darker"; or vice versa. Where there is no distance or contrast we simply have not *two* impressions, and, as said—if we consider the difference by itself—no impression at all. Two coincident triangles must be perceived as one. The distinction between the one triangle thus formed by two coinciding and the single triangle rests upon something extraneous to this bare presentation of a triangle that is one and the same in both cases. The marks of this numerical distinctness may be various: they may be different temporal signs, as in reduplications of the memory-continuum; or they may be constituents peculiar to each, from which attention is for the moment abstracted, any one of which suffices to give the common or identical constituent a new setting. In general, it may be said (1) that the numerical distinctness of the related terms is secured in the absence of all qualitative difference solely by the intellectual act which has so unified each as to retain what may serve as an individual mark; and (2) that they become related as "like" either in virtue of the active adjustment to a change of impression which their partial assimilation defeats, or in virtue of an anticipated continuance of the impression which this assimilation confirms.

Identity.

It is in keeping with this analysis that we say in common speech that two things in any respect similar are so far the same. This ambiguity in the word "same," whereby it means either individual identity or indistinguishable resemblance has been often noticed, and from a logical or objective point of view justly complained of as "engendering fallacies in otherwise enlightened understandings." But apparently no one has inquired into its psychological basis, although more than one writer has admitted that the ambiguity is one "in itself not always to be avoided."[3] It is not enough to trace the confusion to the existence of common names and to cite the forgotten controversies of scholastic realism. We are not now concerned with the conformity of thought to things or with logical analysis, but with the analysis of a psychological process. The tendency to treat presentations as if they were copies of things—the objective bias, as we may call it—is the one grand obstacle to psychological observation. Some only realize with an effort that the idea of extension is not extended; no wonder, then, if it should seem "unnatural" to maintain that the idea of two like things does not consist of two like ideas. But, assuming that both meanings of identity have a psychological justification, it will be well to distinguish them and to examine their connexion. Perhaps we might term the one "material identity" and the other "individual identity"—following the analogy of expressions such as "different things but all made of the same stuff," "the same person but entirely changed." Thus there is unity and plurality concerned in both, and herein identity or sameness differs from singularity or mere oneness, which so far entails no relation. But the unity and the plurality are different in each, and each is in some sort the converse of the other. In the one, two different individuals partially coincide; in the other, one individual is partially different; the unity in the one case is an individual presentation, in the other is the presentation of an individual.

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[1] Wundt, *Logik: eine Untersuchung der Principien der Erkenntniss* (2nd ed., 1893), i. 59 sqq.

[2] Hume's numerical difference, that is to say, is really distinctness, not quantitative difference.

[3] Cf. J. S. Mill, *Logic*, bk. i. ch. iii. § 11, and *Examination of Hamilton*, 3rd ed., ch. xiv. p. 306, note; also Meinong, "Hume-Studien" II., *Wiener Sitzungsberichte* (*Phil. Hist. Cl.*), ci. 709.

Material Identity.

In material identity the unity is that of a single presentation, whether simple or complex, which enters as a common constituent into two or more others. It may be possible, of course, to individualize it, but as it emerges in a comparison it is a single presentation and nothing more. On account of this absence of individual marks this single presentation is what logicians call "abstract"; but this is not psychologically essential. It may be a generic image which has resulted from the neutralization of individual marks, but it may equally well be a simple presentation, like red, to which such marks never belonged. We come here from a new side upon a truth which has been already expounded at length, viz. that presentations are not given to us as individuals but as changes in a continuum. Time and space—the instruments, as it were, of individualization, which are presupposed in the objective sciences—are psychologically later than this mere differentiation.

Individual Identity.

The many vexed questions that arise concerning individual identity are metaphysical rather than psychological. But it will serve to bring out the difference between the two forms of identity to note that an identification cannot be established solely by qualitative comparison; an *alibi* or a breach of temporal continuity will turn the flank of the strongest argument from resemblance. Moreover, resemblance itself may be fatal to identification when the law of being is change.

Real Categories.

41. As regards the real categories, it may be said generally that these owe their origin in large measure to the anthropomorphic or mythical tendency of human thought—τὸ ὅμοιον τῷ ὁμοίῳ γινώσκεσθαι. Into the formation of these conceptions two very distinct factors enter—(1) the facts of what in the stricter sense we call "self-consciousness," and (2) certain spatial and temporal relations among our presentations themselves. On the one hand, it has to be noted that these spatial and temporal relations are but the occasion or motive—and ultimately perhaps, we may say, the warrant—for the analogical attribution to things of selfness, efficiency and design, but are not directly the source of the forms of thought that thus arise. On the other hand, it is to be noted also that such forms, although they have an independent source, would never apart from suitable material come into actual existence. If the followers of Hume err in their exclusive reliance upon "associations naturally and even necessarily generated by the order of our sensations" (J. S. Mill), the disciple of Kant errs also who relies exclusively on "the synthetic unity of apperception." The truth is that we are on the verge of error in thus sharply distinguishing the two at all; if we do so momentarily for the purpose of exposition it behoves us here again to remember that mind grows and is not made. The use of terms like "innate," "a priori," "necessary," "formal," &c., without further qualification leads only too easily to the mistaken notion that all the mental facts so named are alike underived and original, independent not only of experience but of each other; whereas but for the forms of intuition the forms of thought would be impossible—that is to say, we should never have a self-consciousness at all if we had not previously learnt to distinguish occupied and unoccupied space, past and present in time, and the like. But, again, it is equally true that, if we could not feel and move as well as receive impressions, and if experience did not repeat itself, we should never attain even to this level of spatial and temporal intuition. Kant shows a very lame and halting recognition of this dependence of the higher forms on the lower both in his schematism of the categories, and again in correcting in his Analytic the opposition of sense and understanding as respectively receptive and active with which he set out in his Aesthetic. Still, although what are called the subjective and objective factors of real knowledge advance together, the former is in a sense always a step ahead. We find *again* without us the permanence, individuality, efficiency, and adaptation we have found *first of all* within (cf. § 20, *b* and *d*). But such primitive imputation of personality, though it facilitates a first understanding, soon proves itself faulty and begets the contradictions which have been one chief motive to philosophy. We smile at the savage who thinks a magnet must need food or the child who is puzzled that the horses in a picture remain for ever still; but few consider that underlying all common-sense thinking there lurks the same natural precipitancy. We attribute to extended things a unity which we know only as the unity of an unextended subject; we attribute to changes among these extended things what we know only when we act and suffer ourselves; and we attribute further to them in their changes a striving for ends which we know only because we feel. In asking what they are, how they act, and why they are thus and thus, we assimilate them to ourselves, in spite of the differences which lead us by-and-by to see a gulf between mind and matter. Such instinctive analogies have, like other analogies, to be confirmed, refuted, or modified by further knowledge, *i.e.* by the very insight into things which these analogies have themselves made possible. That in their first form they were mythical, and that they could never have been at all unless originated in this way, are considerations that make no difference to their validity—assuming, that is, that they admit, now or hereafter, of a logical transformation which renders them objectively valid. This legitimation is, of course, the business of philosophy; we are concerned only with the psychological analysis and origin of the conceptions themselves.

Causality.

42. As it must here suffice to examine one of these categories, let us take that which is the most important and central of the three, viz. causality or the relation of cause and effect, as that will necessarily throw some light upon the constitution of the others. To begin, we must distinguish three things, which, though very different, are very liable to be confused. (1) Perceiving, in a definite case, *e.g.* that on the sun shining a stone becomes warm, we may say the sun makes the stone warm. This is a concrete instance of predicating the causal relation. In this there is, explicitly at all events, no statement of a general law or axiom, such as we have when we say (2) "Every event must have a cause"—a statement commonly known as the principle of causality. This again is distinct from what is on all hands allowed to be an empirical generalization, viz. (3) that such and such particular causes have invariably such and such particular effects. With these last psychology is not directly concerned at all: it has only to analyse and trace to its origin the bare conception of causation as expressed in (1) and involved in both these generalizations. Whether only some events have causes, as the notion of chance implies, whether all causes are uniform in their action or some capricious and arbitrary, as the unreflecting suppose—all this is beside the question for us.

One point in the analysis of the causal relation Hume may be said to have settled once for all: it does not rest upon or contain any immediate intuition of a causal nexus. The two relations that Hume allowed to be perceived (or "presumed to exist"), viz. contiguity in space of the objects causally related and priority in time of the cause before the effect, are the only relations directly discernible. We say indeed "The sun warms the stone" as readily as we say "The sun rises and sets," as if both were matters of direct observation then and there. But that this is not so is evident from the fact that only in some cases when one change follows upon another do we regard it as following from the other: casual coincidence is at least as common as causal connexion. Whence the difference, then, if not from perception? Hume's answer,[1] repeated in the main by English psychologists since, is, as all the world knows, that the difference is the result of association, that when a change α in an object A has been frequently observed to precede a change β in another object B, this repetition *determines* the mind to a transition from the one to the other. It is this determination, which could not be present at first, that constitutes "the third relation betwixt these objects." This "internal impression" generated by association is then projected; "for 'tis a common observation that the mind has a great propensity to spread itself on external objects."

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[1] *Treatise of Human Nature*, pt. iii. § xiv., "of the idea of necessary connexion."

The subjective origin and the after-projection we must admit, but all else in Hume's famous doctrine seems glaringly at variance with facts. In one respect it proves too much, for not all constant sequences are regarded as causal, as according to his analysis they ought to be; again, in another respect it proves too little, for causal connexion is continually predicated on a first occurrence. The natural man has always distinguished between causes and signs or portents; but there is nothing to show that he produced an effect many times before regarding himself as the cause of it. J. S. Mill has indeed obviated the first objection epistemologically by adding to constant conjunction the further characteristic of "unconditionality." But this is a conception that cannot be psychologically explained from Hume's premisses, unless perhaps by resolving it into the qualification that the invariability must be complete and not partial, whereupon the second objection applies. "Unconditional" is a word for which we can find no meaning as long as we confine our attention to temporal succession. It will not do to say both that an invariable succession generates the idea, and that such invariable succession must be not only invariable but also unconditional in order to generate it. We may here turn the master against the disciple: "the same principle," says Hume, "cannot be both the cause and the effect of another, and this is perhaps the only proposition concerning that relation which is either intuitively or demonstratively certain" (*op. cit.* p. 391). Unconditionality is then part of the causal relation and yet not the product of invariable repetition.

Perhaps the source of this element in the relation will become clear if we examine more closely the so-called "internal impression" of the mind, which according to Hume constitutes the whole of our idea of power or efficacy. To illustrate the nature of this impression Hume cites the instant passage of the imagination to a particular idea on hearing the word commonly annexed to it, when "'twill scarce be possible for the mind by its utmost efforts to prevent that transition" (*op. cit.* p. 393). It is this determination, then, which is felt internally, not perceived externally, that we mistakenly transfer to objects and regard as an intelligible connexion between them. But, if Hume admits this, must he not admit more? Can it be pretended that it is through the workings of association among our ideas that we first feel a determination which our utmost efforts can scarce resist, or that we feel such determination under no other circumstances? If it be allowed that the natural man is irresistibly determined to imagine an apple when he hears its name or to expect thunder when he sees lightning, must it not also be allowed that he is irresistibly determined much earlier and in a much more impressive way when overmastered by the elements or by his enemies? But, further, such instances bring to light what Hume's "determination" also implies, viz. its necessary correlative, effort or action. Even irresistible association can only be known as such by efforts to resist it. Hume allows this when he says that his principles of association "are not infallible causes; for one may fix his attention during some time on any one object without looking farther" (*op. cit.* p. 393). But the fact is, we know both what it is to act and what it is to suffer, to go where we would and to be carried where we would not, quite apart from the workings of association. And, had Hume not confused the two different inquiries, that concerning the origin of the idea of causation and that concerning the ground of causal inference or law of causation, it could never have occurred to him to offer such an analysis of the former as he does.

Keeping to the former and simpler question, it would seem that when in ordinary thinking we say A causes this or that in B we project or analogically attribute to A what *we* experience in acting, and to B what *we* experience in being acted on; and the structure of language shows that such projection was made long before it was suspected that what A once did and B once suffered will be done and suffered in the same circumstances again. The occasions suitable for this projection are determined by the temporal and spatial relations of the objects concerned, which relations are matter of intuition. These are of no very special interest from a psychological point of view, but the subjective elements we shall do well to consider further. First of all, we must note the distinction of immanent action and transuent action; the former is what we call action simply, and implies only a single thing, the agent; the latter, which we might with advantage call effectuation, implies two things, a patient as well as an agent. In scientific language the agent in an intransitive act is called a *causa immanens* and so distinguished from the agent in effectuation or *causa transiens*. Common thought, however, does not regard mere action as caused at all; and we shall find it, in fact, impossible to resolve action into effectuation. But, since the things with which we ordinarily deal are complex, have many parts, properties, members, phases, and in consequence of the analytic procedure of thought, there ensues, indeed, a continual shifting of the point of view from which we regard any given thing, so that what is in one aspect one thing is in another many (cf. § 20). So it comes about that, when regarding himself as one, the natural man speaks of himself as walking, shouting, &c.; but, when distinguishing between himself and his members, he speaks of raising his voice, moving his legs, and so forth. Thus no sooner do we resolve any given action into an effectuation, by analytically distinguishing within the original agent an agent and a patient, than a new action appears. Action is thus a simpler notion than causation and inexplicable by means of it. It is certainly no easy problem in philosophy to determine where the resolution of the complex is to cease, at what point we must stop, because in the presence of an individual thing and a simple activity. At any rate, we reach such a point psychologically in the conscious subject, and that energy in consciousness we call attention. If this be allowed, Hume's critique of the notion of efficacy is really wide of the mark. "Some,"[1] he says, "have asserted that we feel an energy or power in our own mind; and that, having in this manner acquir'd the idea of power, we transfer that quality to matter, where we are not able immediately to discover it. . . . But to convince us how fallacious this reasoning is, we need only consider that the will, being here consider'd as a cause, has no more a discoverable connexion with its effects than any material cause has with its proper effect. . . . The effect is there [too] distinguishable and separable from the cause, and could not be foreseen without the experience of their constant conjunction" (*op. cit.* p. 455). This is logical analysis, not psychological; the point is that the will is not considered as a cause and distinguished from its effects, nor in fact considered at all. It is not a case of sequence between two separable impressions; for we cannot really make the indefinite regress that such logical distinctions as that between the conscious subject and its acts implies. Moreover, our activity as such is not directly presented at all: we *are*, being active; and further than this psychological analysis will not go.[2] There are, as we have seen, two ways in which this activity is manifested, the receptive or passive and the motor or active in the stricter sense—(cf. § 8) and our experience of these we project in predicating the causal relation. But two halves do not make a whole; so we have no complete experience of effectuation, for the simple reason that we cannot be two things at once. We are guided in piecing it together by the temporal and spatial relations of the things concerned. Hence, perhaps, some of the antinomies that beset this concept. In its earliest form, then, the so-called necessary connexion of cause and effect is perhaps nothing more than that of physical constraint. To this, no doubt, is added the strength of expectation—as Hume supposed—when the same effect has been found invariably to follow the same cause. Finally, when upon the basis of such associated uniformities of sequence a definite intellectual elaboration of such material ensues, the logical necessity of reason and consequent finds a place, and so far as deduction is applicable cause and reason become interchangeable ideas.

Belief.

43. The mention of logical necessity brings us to a new topic, viz. the "objectivity" of thought and cognition generally. The psychological treatment of this topic is tantamount to an inquiry into the characteristics of the states of mind we call certainty, doubt, belief—all of which centre round the one fact of *evidence*. Between the certainty that a proposition is true and the certainty that it is not there may intervene many grades of uncertainty. We may know that A is sometimes B, or sometimes not; or that some at least of the conditions of B are present or absent; or the presentation of A may be too confused for distinct analysis. This is the region of probability, possibility, more or less obscurity. Leaving this aside, it will be enough to notice those cases in which certainty may be complete. With that certainty which is absolutely objective, *i.e.* with knowledge, psychology has no direct concern; it is for logic to furnish the criteria by which knowledge is ascertained.

Emotion and desire are frequent indirect *causes* of subjective certainty, in so far as they determine the constituents and the grouping of the field of consciousness at the moment—"pack the jury" or "suborn the witnesses," as it were. But the *ground* of certainty is in all cases some quality or some relation of these presentations *inter se*. In a sense, therefore, the ground of all certainty is objective—in the sense, that is, of being something at least directly and immediately determined for the subject and not by it. Where certainty is mediate, one judgment is often spoken of as the ground of another; but a syllogism is still psychologically a single, though not a simple, judgment, and the certainty of it as a whole is immediate. Between the judgment A is B and the question Is A B? the difference is not one of content nor scarcely one of form: it is a difference which depends upon the effect of the proposition on the subject judging. (i.) We have this effect before us most clearly if we consider what is by common consent regarded as the type of certainty and evidence, the certainty of present sense-impressions whence it is said, "Seeing is believing." The evident is here the actual, and the "feeling or consciousness" of certainty is in this case nothing but the sense of being taken fast hold of and forced to apprehend what is there. (ii.) The like is true of memory and expectation: in these also there is a sense of being tied down to what is given, whereas in mere imagination, however lively, this non-voluntary determination is absent (cf. § 26). Hume saw this at times clearly enough, as, *e.g.* when he says, "An idea assented to *feels* different from a fictitious idea that the fancy alone presents to us." But unfortunately he not only made this difference a mere difference of intensity, but spoke of belief itself as "an operation of the mind" or "manner of conception that bestowed on our ideas this additional force or vivacity."[1] In short, Hume confounded one of the indirect causes of belief with the ground of it, and again, in describing this ground committed the ὕστερον πρότερον of making the mind determine the ideas instead of the ideas determine the mind. (iii.) In speaking of intellection he is clearer: "The answer is easy with regard to propositions that are prov'd by intuition or demonstration. In that case the person who assents not only conceives the ideas according to the proposition, but is necessarily determin'd to conceive them in that particular manner" (*op. cit.* p. 395). It has been often urged—as by J. S. Mill, for example—that belief is something "ultimate and primordial." No doubt it is; but so is the distinction between activity and passivity, and it is not here maintained that certainty can be analysed into something simpler, but only that it is identical with what is of the nature of passivity—objective determination. As Bain put it, "The leading fact in belief . . . is our primitive credulity. We begin by believing everything; whatever is is true" (*Emotions and Will*, 3d ed., p. 511). But the point is that in this primitive state there is no act answering to "believe" distinct from the non-voluntary attention answering to "perceive," and no reflection such as a modal term like "true" implies. With eyes open in the broad day no man says, "I am certain there is light"; he simply sees. He may by-and-by come absolutely to disbelieve much that he sees—*e.g.* that things are nearer when viewed through a telescope—just as he will come to disbelieve his dreams, though while they last he is certain in these too. The consistency we find it possible to establish among certain of our ideas becomes an ideal, to which we expect to find all our experience conform. Still the intuitive evidence of logical and mathematical axioms is psychologically but a new form of the actual; we are only certain that two and two make four and we are not less certain that we see things nearer through a telescope.

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[1] Hume here has Locke and Berkeley specially in view. Locke as a patient and acute inquirer was incomparably better as a psychologist than a man addicted to literary foppery like Hume, for all his genius, could possibly be. On the particular question, see Locke, *Essay*, bk. ii. c. 21, §§ 3–5.

[2] In an article (*Mind*, 1886, p. 317) Mr F. H. Bradley created some stir by declaring that "the present use of these phrases [active energy] is little better than a scandal and a main obstacle in the path of English psychology." In *Mind* for 1902 and 1903 he has made important contributions towards clearing up the supposed confusion, and the subject is still being debated. But the main contention of the text, that activity is for psychology at all events ultimate and unanalysable, seems still to await refutation. A brief notice of some of the diverse views obtaining will be found in an address, "The Problems of General Psychology," by J. Ward *Philosophical Review* (1904), pp. 608 sqq.

Presentation of Self, Self-Consciousness and Conduct.

44. The concept of self we have just seen underlying and to a great extent shaping the rest of our intellectual furniture; on this account it is at once desirable and difficult to analyse it and ascertain the conditions of its development. In attempting this we must carefully distinguish between the bare presentation of self and that reference of other presentations to it which is often called specially self-consciousness, "inner sense," or internal perception. Concerning all presentations whatever—that of self no less than the rest—it is possible to reflect, "This presentation is mine; it is my object; I am the subject attending to it." The presentation of self, then, is one presentation among others, the result, like them, of the differentiation of the original continuum. But it is obvious that this presentation must be in existence first before other presentations can be related to it. On the other hand, it is only in and by means of such relations that the concept of self is completed. We begin, therefore, with self simply as an object, and end with the concept of that object as the subject or "myself" that knows itself. The self has, first of all (*a*) a unique interest and (*b*) a certain inwardness, (*c*) it is an individual that (*d*) persists, (*e*) is active, and finally (*f*) knows itself. These several characteristics of self are intimately involved; so far as they appear at all they advance in definiteness from the lowest level of mere sentience to those moments of highest self-consciousness in which conscience approves or condemns volition.

Self and the Body.

The earliest and to the last the most important element in self—what we might perhaps term its root or material element—is that variously styled the organic sensations—vital sense, coenaesthesis, or somatic consciousness. This largely determines the tone of the special sensations and enters, though little suspected, into all our higher feelings. If, as sometimes happens in serious nervous affections, the whole body or any part of it should lose common sensibility, the whole body or that part is at once regarded as strange and even as hostile. In some forms of hypochondria, in which this extreme somatic insensibility and absence of zest leave the intellect and memory unaffected, the individual doubts his own existence or denies it altogether. Ribot cites the case of such a patient, who, declaring that he had been dead for two years, thus expressed his perplexity:—"J'existe, mais en dehors de la vie réelle, matérielle, et, malgré moi, rien ne m'ayant donné la mort. Tout est mécanique chez moi et se fait inconsciemment."[2] It is not because they accompany physiological functions essential to the efficiency of the organism as an organism, but simply because they are the most immediate and most constant sources of feeling, that these massive but ill-defined organic sensations are from the first the objects of the directest and most unreflecting interest. Other objects have at the outset but a mediate interest through subjective selection in relation to these, and never become so instictively and inseparably identified with self, never have the same inwardness. This brings us to a new point. As soon as definite perception begins, the body as an extended thing is distinguished from other bodies, and such organic sensations as can be localized at all are localized within it. At the same time the actions of other bodies upon it are accompanied by pleasures and pains, while their action upon each other is not. The body also is the only thing directly set in motion by the reactions of these feelings, the purpose of such movements being to bring near to it the things for which there is appetite and to remove it from those towards which there is aversion. It is thus not merely the type of occupied space and the centre from which all positions are reckoned, but it affords us an unfailing and ever-present intuition of the actually felt and living self, to which all other things are external, more or less distant, and at times absent altogether. The body then first of all gives to self a certain measure of individuality, permanence and inwardness.

Inner Self.

But with the development of ideation there arises within this what we may call an inner zone of self, having still more unity and permanence. We have at this stage not only an intuition of the bodily self doing or suffering here and now, but also memories of what it has been and done under varied circumstances in the past. External impressions have by this time lost in novelty and become less absorbing, while the train of ideas, largely increased in number, distinctness and mobility, diverts attention and often shuts out the things of sense altogether. In all such reminiscence or reverie a generic image of self is the centre, and every new image as it arises derives all its interest from relation to this; and so apart from bodily appetites new desires may be quickened and old emotions stirred again when all that is actually present is dull and unexciting. But desires and emotions, it must be remembered, though awakened by what is only imaginary, invariably entail actual organic perturbations, and with these the generic image of self comes to be intimately united. Hence arises a contrast between the inner self, which the natural man locates in his breast or φρήν, the chief seat of these emotional disturbances, and the whole visible and tangible body besides. Although from their nature they do not admit of much ideal representation, yet, when actually present, these organic sensations exert a powerful and often irresistible influence over other ideas; they have each their appropriate train, and so heighten in the very complex and loosely compacted idea of self those traits they originally wrought into it, suppressing to an equal extent all the rest. Normally there is a certain equilibrium to which they return, and which, we may suppose, determines the so-called temperament, *naturel* or disposition, thus securing some tolerable uniformity and continuity in the presentation of self. But even within the limits of sanity great and sudden changes of mood are possible, as, *e.g.* in hysterical persons or those of a "mercurial temperament," or among the lower animals at the onset of parental or migratory instincts. Beyond those limits—as the concomitant apparently of serious visceral derangements or the altered nutrition of parts of the nervous system itself—complete "alienation" may ensue. A new self may arise, not only distinct from the old and devoid of all save the most elementary knowledge and skill that the old possessed, but diametrically opposed to it in tastes and disposition—obscenity, it may be, taking the place of modesty and cupidity or cowardice succeeding to generosity or courage. The most convincing illustrations of the psychological growth and structure of the presentation of self on the lower levels of sensation and ideation are furnished by these melancholy spectacles of minds diseased; but it is impossible to refer to them in detail here.[1]

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[1] *Treatise of Human Nature*, Green and Grose's ed., i. 396.

[2] "Bases affectives de la personnalité" in *Revue philosophique*, xviii. 149.

Self as a Person.

Passing to the higher level of intellection, we come at length upon the concept which every intelligent being more or less distinctly forms of himself as a person, M. or N., having such and such a character, tastes and convictions, such and such a history, and such and such an aim in life. The main instrument in the formation of this concept, as of others, is language, and especially the social intercourse that language makes possible. Up to this point the presentation of self has shaped that of not-self,—that is to say, external things have been comprehended by the projection of its characteristics. But now the order is in a sense reversed: the individual advances to a fuller self-knowledge by comparing the self within with what is first discernible in other persons without. So far *avant l'homme est la société*; it is through the "us" that we learn of the "me" (cf. § 36, note 1). Collective action for common ends is of the essence of society, and in taking counsel together for the good of his tribe each one learns also to take counsel with himself for his own good on the whole; with the idea of the common weal arises the idea of happiness as distinct from momentary gratification. The extra-regarding impulses are now confronted by a reasonable self-love, and in the deliberations that thus ensue activity attains to its highest forms—those of thought and volition. In the first we have a distinctly active manipulation of ideas as compared with the more passive spectacle of memory and imagination. Thereby emerges a contrast between the thinker and these objects of his thought, including among them the mere generic image of self, from which is now formed this concept of self as a person. A similar, even sharper, contrast also accompanies the exercise of what is very misleadingly termed "self-control," *i.e.* control by this personal self of "the various natural affections"—to use Butler's phrase—which often hinder it as external objects hindered them. It is doubtful whether the reasoning, regulating self is commonly regarded as definitely localized. The effort of thinking and concentrating attention upon ideas is no doubt referred to the brain, but this is only comparable with the localization of other efforts in the limbs; when we think we commonly feel also, and the emotional basis is of all the most subjective and inalienable. If we speak of this latest phase of self as *par excellence* "the inner self," such language is then mainly figurative, inasmuch as the contrasts just described are contrasts into which spatial relations do not enter.

Self-consciousness.

45. The term "reflection," or internal perception is applied to that state of mind in which some particular presentation or group of presentations (x or y) is not simply in the field of consciousness but there as consciously related to self, which is also presented at the same time. Self here may be symbolized by M, to emphasize the fact that it is in like manner an object in the field of consciousness. The relation of the two is commonly expressed by saying, "This (x or y) is my (M's) percept, idea or volition; I (M) it is that perceive, think, will it." Self-consciousness, in the narrowest sense, as when we say "I know myself, I am conscious that I am," &c., is but a special, though the most important, instance of this internal perception: here self (M) is presented in relation to self (with a difference, M′); the subject itself—at least, so we say—is or appears as its own object.

It has been often maintained that the difference between consciousness and reflection is not a real difference, that to know and to know that you know are "the same thing considered in different aspects."[2] But different aspects of the same thing are *not* the same thing, for psychology at least. Not only is it not the same thing to feel and to know that you feel; but it might even be held to be a different thing still to know that you feel and to know that you know that you feel—such being the difference perhaps between ordinary reflection and psychological introspection.[3] The difficulty of apprehending these facts and keeping them distinct seems obviously due to the necessary presence of the earlier along with the later; that is to say, we can never know that we feel without feeling. But the converse need not be true. How distinct the two states are is shown in one way by their notorious incompatibility, the direct consequence of the limitation of attention: whatever we have to do that is not altogether mechanical is ill done unless we lose ourselves in the doing of it. This mutual exclusiveness receives a further explanation from the fact so often used to discredit psychology, viz. that the so-called introspection, and indeed all reflection, are really retrospective. It is not while we are angry or lost in reverie that we take note of such states, but afterwards, or by momentary side glances intercepting the main interest, if this be not too absorbing.

But we require an exacter analysis of the essential fact in this retrospect—the relation of the presentation x or y to that of self or M. What we have to deal with, it will be observed, is, implicitly at least, a judgment. First of all, then, it is noteworthy that we are never prompted to such judgments by everyday occurrences or acts of routine, but only by matters of interest, and, as said, generally when these are over or have ceased to be all-engrossing. Now in such cases it will be found that some effect of the preceding state of objective absorption persists, like wounds received in battle, unnoticed till the fight is over—such *e.g.* as the weariness of muscular exertion or of long concentration of attention; some pleasurable or painful after-sensation passively experienced, or an emotional wave subsiding but not yet spent; "the jar of interrupted expectation," or the relief of sudden attainment after arduous striving, making prominent the contrast of contentment and want in that particular; or, finally, the quiet retrospect and mental rumination in which we note what time has wrought upon us and either regret or approve what we were and did. All such presentations are of the class out of which, as we have seen, the presentation of self is built up, and so form in each case the concrete bond connecting the generic image of self with its object. In this way and in this respect each is a concrete instance of what we call a state, act, affection, &c., and the judgments in which such relations to the standing presentation of self are recognized are the original and the type of all real predications. The opportunities for reflection are at first few, the materials being as it were thrust upon attention, and the resulting "percepts" are but vague. By the time, however, that a clear concept of self has been attained the exigencies of life make it a frequent object of contemplation, and as the abstract of a series of instances of such definite self-consciousness we reach the purely formal notion of a subject or pure ego. For empirical psychology this notion is ultimate; its speculative treatment falls altogether—usually under the heading "rational psychology"—to metaphysics.

Conduct.

46. The growth of intellection and self-consciousness reacts powerfully upon the emotional and active side of mind. To describe the various sources of feeling and of desire that thus arise—aesthetic, social and religious sentiments, pride, ambition, selfishness, sympathy, &c.—is beyond the scope of systematic psychology, and certainly quite beyond the limits of an article like the present. But at least a general *résumé* of the characteristics of activity on this highest or rational level is indispensable. If we are to gain any oversight in a matter of such complexity it is of the first importance to keep steadily in view, as a fundamental principle, that as the causes of feeling become more complex, internal, and representative the consequent actions change in like manner. We have noted this

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[1] This subject has a very wide literature. The following are specially interesting: Ribot, *Les Maladies de la personnalité* (3rd ed., 1889); Boris Sidis and S. P. Goodhart, *Multiple Personality* (1905); Morton Prince, *The Dissociation of a Personality* (1906).

[2] So—misled possibly by the confusions incident to a special faculty of reflection, which they controvert—James Mill, *Analysis*, i. 224 seq. (corrected, however, by both his editors, pp. 227 and 230), and also Hamilton, *Lect.* i. 192.

[3] It has been thought a fatal objection to this view that it implies the possibility of an indefinite regress; but why should it not? We reach the limit of our experience in reflection, or at most in deliberate introspection, just as in space of three dimensions we reach the limit of our experience in another respect. But there is no absurdity in supposing a consciousness more evolved and explicit than our self-consciousness, and advancing on it as it advances on that of the unreflecting brutes.

connexion already in the case of the emergence of desires, and seen that desire in prompting to the search for means to its end is the *primum movens* of intellection (cf. § 35). But intellect does much more than devise and contrive in unquestioning subservience to the impulse of the moment, like some demon of Eastern fable; even the brutes, whose cunning is on the whole of this sort, are not without traces of self-control. As motives conflict and the evils of hasty action recur to mind, deliberation succeeds to mere invention and design. In moments of leisure, the more imperious cravings being stilled, besides the rehearsal of failures or successes in the past, come longer and longer flights of imagination into the future. Both furnish material for intellectual rumination, and so we have at length (1) concepts of general and distant ends, as wealth, power, knowledge, and —self-consciousness having arisen—that concept also of the happiness or perfection of self, and (2) maxims or practical generalizations as to the best means to these ends. Instead of actions determined by the *vis a tergo* of blind passion we have conduct shaped by what is literally prudence or foresight, the pursuit of ends that are not esteemed desirable till they are judged to be good. The good, it is truly urged, is not to be identified with the pleasant, for the one implies a standard and a judgment, and the other nothing but a bare fact of feeling; thus the good is often not pleasant and the pleasant not good; in talking of the good, in short, we are passing out of the region of nature into that of character. It is so, and yet this progress is itself so far natural as to admit of psychological explication. As already urged (§ 34), the causes of feeling change as the constituents of consciousness change; also they depend more upon the form of that consciousness as this increases in complexity. When we can deliberately range to and fro in time and circumstances, the good that is not directly pleasant may indeed be preferred to what is only pleasant while attention is confined to the seen and sensible; but then the choice of such good is itself pleasant—pleasanter than its rejection would have been.

Freedom. The mention of deliberation brings us to the perennial problem of "the freedom of the will." But to talk of will is to lapse into the confusions of the old faculty—psychology. As Locke long ago urged: "The question is not proper, *whether the will be free*, but *whether a man be free.*"[1] In the absence of external constraint, when a man does what *he* likes, we say he is "externally free"; but he may still be the slave of every momentary impulse, and then it is said that he is not "internally" free. The existence and nature of this internal freedom is the problem. But if such freedom is held to imply a certain sovereignty or autonomy of self over against momentary propensions and blind desires, there can obviously be no question of its existence till the level of self-consciousness is reached and maxims or principles of action are possible. The young child, the brute and the imbecile, even when they do as they like, have not this freedom, though they may be said to act spontaneously A resolutely virtuous man will have more of this freedom than the man of good moral disposition who often succumbs to temptation; but it is equally true that the hardened sinner has more of it than one still deterred in his evil ways by scruples of conscience. A man is internally free, then, whenever the ends he pursues have his whole-hearted approval, whether he say with Milton's Satan, "Evil be thou my good," or with Jesus, "Thy will be done." But this freedom is always within our experience a relative freedom; hence at a later time we often declare that in some past act of choice we were not our true selves, not really free. But what is this true self more than our ideal? Or perhaps we prefer to say that we were free and could have acted otherwise; and no doubt we might, if the place of the purely formal and abstract concept of self had been occupied by some other phase of that empirical self which is continuously, but at no one moment completely, presented. It must then be admitted that psychological analysis in this case is not only actually imperfect, but must always remain so—so long, at any rate, as all that we discern by reflection is less than all we are. But this admission does not commit us to allowing the possible existence of a *liberum arbitrium indifferentiae*, sometimes called "absolute indeterminism"; for that would seem to differ in no respect from absolute chance or caprice. On the other hand, the rigidly determinist position can only be psychologically justified by ignoring the activity of the experiencing subject altogether. At bottom it treats the analysis of conduct as if it were a dynamical problem pure and simple. But motives are never merely so many quantitative forces playing upon something inert, or interacting entirely by themselves. At the level of self-consciousness especially motives are reasons and reason is itself a motive. In the blind struggle of so-called "self-regarding" impulses might is the only right; but in the light of principles or practical maxims right is the only might.[2] This superiority in position of principles is only explicable by reference to the inhibitory power of attention, which alone makes deliberation possible and is essentially voluntary; that is, subjectively determined. But no, it may be objected, deliberation in such cases is just the result of painful experiences of the evil of hasty action, and only ensues when this motive is strong enough to restrain the impulse that would otherwise prevail. Even if this be granted, it does not prove that the subject's action is determined for and not by him; it merely states the obvious fact that prudence and self-control are gradually acquired. Authoritative principles of action, such as self-love and conscience, are no more psychologically on a par with appetites and desires than thought and reason are on a par with the association of ideas.

Relation of Body and Mind.

Parallelism. 47. The question of subjective initiative leads us naturally to that concerning the connexion of mind and organism, to which we now proceed. In development and efficiency, in the intensity and complexity of their processes, mind and brain keep invariably and exactly in line together. Striking and impressive instances of this correspondence are to be found in comparative psychology, and especially in mental pathology; but it is needless here to enlarge on a point which in the main is beyond dispute. In this correspondence lay the plausibility of the old materialism. But a closer scrutiny discloses an equally impressive disparity: we reject materialism, accordingly, while still maintaining this *psychoneural parallelism* to be a well-established fact. From this we must distinguish a second sense of parallelism founded on the disparity just mentioned as pertaining to the psychical and neural correlates. We may call this *physiologico-psychological*, or, more briefly, *methodological, parallelism.* It disclaims as illogical the attempt to penetrate to psychical facts from the standpoint of physiology, so persistently and confidently pursued by the old materialists. It also forbids the psychologist to piece out his own shortcomings with tags borrowed from the physiologist. The concepts of the two sciences are to be kept distinct, as the facts themselves to which they relate are distinct. Confusion is inevitable if the psychologist, for example, talks of his volition as the cause of his arm moving, when by arm movement he means the process described by the physiologist in terms of efferent excitations, muscular flexions, and so forth; or if the physiologist speaks of a sensation of red as produced by retinal stimulation due to light-waves of a certain length, when by sensation he means what he immediately experiences on looking at a field poppy. This methodological convention, as we may call it, implies a more stringent interpretation of causation than that expounded by J. S. Mill and his contemporaries. It does not, however, forbid psychological inferences on the basis of physiological facts, nor vice versa. But in spite of this distinctness of the facts, and of the standpoints from which they are respectively studied, their causal relation cannot be simply ignored: it is, however, a problem that pertains strictly to the higher standpoint of philosophy. There have been in all four different theories of this relation within modern times: (1) that of mutual interaction—the common-sense view—very inconsistently maintained by Descartes; (2) the "occasionalism" substituted for this by Geulincx and the later Cartesians; (3) the pre-established harmony of Leibnitz; and (4) the monism of Spinoza, which reduced matter and mind to parallel attributes of the One Substance. The last of these—severed, however, from Spinoza's metaphysics—is still perhaps the prevailing theory, and to it the term *psychophysical parallelism* most properly applies. For whereas the parallelism first mentioned states a real correspondence between psychical processes and neural processes, but leaves open the question of a possible interaction between matter and mind, modern psychophysical parallelism is a pure hypothesis concerning the relation of psychical facts to physical theories, on the ground of which—as we shall presently see—any interaction between matter and mind is expressly denied.

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[1] *Essay concerning Human Understanding*, II. xxi. §§ 16 sqq.

[2] The right is only relative, of course, when the maxims are "hypothetical"—to use Kant's phrase,—but it is absolute when the maxim is "categorical."

But in the exposition of this hypothesis these two meanings of parallelism are frequently confused or interchanged. The same term "body" is applied both to an aggregate of matter and to the living organism. Now life must be regarded as either inherent in matter, or as the result simply of a particular material configuration, or as physically inexplicable. But, for the present at all events, it cannot be explained physically; nor are we even within measurable distance of such an explanation: so much is beyond cavil. Yet the hypothesis of psychophysical parallelism confines us to one or other of the former alternatives: at the same time its unwarrantable identification with psychoneural parallelism—where we find a real correspondence between mind and *organism*—tends to conceal the gravity of such assumptions. The standpoint of physiology, therefore, must be described not as identical with that of physics, but as intermediate between it and the standpoint of psychology. If the fact of life could be reduced to physical terms, physiology then, no doubt, would have to fall into line with physics, much as chemistry, for example, may have had to do. On the other hand, till a physical explanation of life is forthcoming, physiology belongs, with psychology, to the biological group of sciences, and cannot divest itself completely of the teleological concepts essential to them, not a vestige of which belongs to bare physics. It is just because of this community in their concepts that there actually is a certain "point to point" correspondence or parallelism between the psychical and the neural: as an *organ* a neuron is a unit; physically regarded, it ceases to be one. Yet this illicit identification of organism and material body is thought to be legitimate, inasmuch as physiological processes are found to rest invariably on a physical basis: and inasmuch as, though methodological parallelism forbids the physiologist to identify *psychosis* with *neurosis*, no limits can be imposed on his efforts to ascertain the mechanism of the neurosis itself. But if this be granted, is not psychophysical parallelism justified, in principle at all events? By no means: as little, for example, as an explanation of the mechanism of a locomotive would justify us in ascribing its origin, its maintenance or its guidance to the machine itself. When life and mind are explained by their mechanism the physicist may summon the biologist, as Mephistopheles did Faust, "*Her zu mir*": then, but not before.

"Double Aspect" Theory.

A favourite mode of stating psychophysical parallelism is that known as the *Double Aspect Theory*. In this, besides the unjustified identification of the first and third meanings, we find also an equally unjustified interpretation of parallelism in the second sense. All that methodology prescribes is that psychologists and neurologists—and, we may add, that physicists too—shall severally, as "specialists," mind their own business. Again, all that the first two jointly ascertain is simply the fact of correspondence: the explanation of it is still to seek. Two propositions are now advanced which are held to meet this need. First—and negatively—the connexion, it is said, is not causal: mind does not act on body, nor body on mind: the changes on each side form two independent series, each "going along by itself." In other words, the series themselves are said to exemplify what methodology enjoins on the sciences that investigate them—they mind their own business and never intrude into each other's domains. Nevertheless their interaction is not prima facie contradictory or absurd, and ordinary thought, as we have seen, assumes that it exists. What evidence, then, is there for denying it absolutely? Empirical evidence for such a universal negative there can hardly be; it must be established therefore—if established at all—on a priori grounds. Meanwhile two facts, already noticed, make seriously against it. On the psychical side sensations point to an intrusion of some sort, and are not psychically explicable (cf. § 16), and the like—for the present at all events—must be said of the fact of life on the physical side. Apart from all this, it seems plain that methodological parallelism, so far from justifying the denial of interaction, simply precludes its discussion on the dualistic level to which that parallelism is confined. The gulf implied is indeed not absolute—of so much, parallelism in the first sense assures us—but those who are forced to keep to their own side of it obviously are not the people to settle how it is crossed. We are aware that the dualism is not absolute, it is replied: it is only phenomenal, and the two series of phenomena are conditioned by an underlying unity of substance. Such is the second, and positive, proposition of the theory. Again asking for evidence, we are told that this underlying unity is unknown—in fact, unknowable. This unknowable substance is assumed, then, simply because—*the impossibility of causal connexion being taken as established*—no other alternative remains. The negative proposition is thus the foundation of the theory, and without it this agnostic monism becomes entirely arbitrary. We have, therefore, to continue our search for the grounds on which the possibility of interaction is denied. But it will be worth while first to examine certain ambiguities besetting the positive statement.

Difference of aspect may result solely from difference of standpoint, or it may be due to difference in the reality itself. The circle, seen as concave from within and as convex from without, is an ancient instance of the first still in great favour; the pillar that was cloud and darkness to the Egyptians, but light to the children of Israel, may serve to exemplify the second. The former we may call the phenomenal, and the latter the ontal, meaning of "aspect." With these two very different meanings our theory plays fast and loose, as suits its own convenience. To do this is easy—in so far as the reality is unknown and unknowable; and necessary—since in the end, the reality, however unknowable, must somehow include both the phenomenal aspects and all that pertains to them, and so far therefore be known. In dealing with "aspect" in the first sense, the one question to be raised concerns the nature and relation of the respective standpoints. To one belongs what we know as individual experience, and this is essentially concrete, immediate, and qualitatively diverse; to the other belongs an abstract, conceptual scheme, wholly quantitative, familiarly known as the mechanical theory. Between these there is plainly no such co-ordination as the inept comparison with the inside and the outside of a circle implies.[1] Neither is there, on the other hand, the same complete opposition; for the entire mechanical theory is based upon individual experience as enlarged and developed by inter-subjective intercourse. Both the sense-knowledge of the one and the thought-knowledge of the other relate to the one objective factor involved in both. So far, then, there is fundamentally only one standpoint—that of the subjective factor to the objective factor, which is immediately perceived in the one and mediately conceived in the other. The question here raised is thus primarily epistemological, but it is a question, as we have seen, in which psychology is intimately concerned. "Aspect" in the second sense is independent of standpoints. We have here to deal with attributes of the one reality, more or less in Spinoza's sense: this reality itself, as possessed of disparate attributes, is so far dual, and the question of causal connexion between these attributes is not escaped. For to know that a thing has invariably two distinct attributes does not enable us to determine straightway how the changes or "modes" of the one are connected with those of the other. (1) The same attribute might be always the initiating or independent variant, and then would come the question of finding out which of the two it was; or (2) it might be that now one, now the other, took the lead, the grounds of this alternation being then the topic for inquiry; or, finally, (3) it might be, as our theory assumes, that there was but a single series of double changes. The questions here raised are philosophical questions, but again they are questions in which psychology is intimately concerned. Our examination thus yields two results: first, there is fundamentally only a single standpoint—that of experience, now at the perceptual, now at the conceptual, level; and secondly, the distinction of aspects is not merely phenomenal, but pertains "somehow" to reality. The question is how; and this leads us to resume our inquiry into the grounds on which interaction is denied.

These grounds neither pertain to psychology nor to physiology. In spite of the outstanding difficulties connected with sensation and life, which these sciences severally raise, such denial is upheld mainly on the strength of an interpretation of the principle known as the conservation of energy—an interpretation of it, however, which many of the ablest physicists disallow. The energy of the physical world, it is maintained, is a strictly invariable amount; matter, therefore, cannot act on mind, for such action would entail a decrease, nor can mind act on matter, since that would entail an increase, of this energy. In other words, the material world is held to be a "closed system"; and as all the changes within it are mass-motions, there can be none which are not the effect and equivalent of antecedent mass-motions. But now this statement must be established on physical grounds: to assume it otherwise would be openly to beg the very question at issue. For if mind does act on matter, the physical mechanism *is* subject to changes from without, and so often its motions are *not* due to antecedent motions; and this—the common-sense view—cannot, of course, be summarily dismissed as impossible or absurd. Now, energy is essentially a metrical notion, and its conservation in finite and isolated material systems has been ascertained by careful quantitative experiments. To say that the energy of the material universe is constant is only a way of expressing the generalization of this result—is tantamount, in other words, to saying that it holds of all finite isolated systems. The *whole* universe may perhaps be called isolated, but we do not know that it is finite. We cannot, therefore, apply metrical concepts to it; and consequently we cannot interpret the conservation of energy as meaning that the physical part of it is a closed system. But if not a closed system, then the energy of a given group of bodies may be increased or decreased without interaction between that group and other bodies—may be increased or decreased by psychophysical interaction, that is to say. And, moreover, such psychophysical interaction would not invalidate the conservation of energy, rightly understood; for that merely means that the energy of a group of bodies can be altered only from without, and this might happen whenever such interaction occurred.[1] We seem, therefore, justified for the present in rejecting psychophysical parallelism as one of the three possible modes of relating mind and matter regarded as attributes of the real. Not only are there psychological as well as biological objections which it has not yet overcome, but there are so far no physical grounds in its favour.

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[1] In fact, if there were, since it is only as we contemplate finite portions of the circle that the distinction of concave and convex is present, the nearer we approximated to its elements the more this difference of aspect would disappear. If on the physical side we called these elements atoms, there would be an answering element of "mind-stuff" on the psychical; and there would be no more unity and no other diversity in a given man's mind than in his brain regarded as a complex of primordial atoms. Wild as all this seems, yet views of the kind have been seriously put forward more than once as the logical outcome of psychophysical parallelism.

"Conscious Automaton" Theory.

At this point we may again for a moment turn aside to consider a modified form of the doctrine—the so-called *Conscious Automaton Theory*, an attempt to blend the old Cartesian views concerning the minds of man and brute. According to Huxley,[2] the best known modern exponent of this theory, "our mental conditions are simply the symbols in consciousness of the changes that take place automatically in the organism." This consciousness is supposed "to be related to the mechanism of the body simply as a collateral product of its working, and to be as completely without any power of modifying that working as the steam-whistle . . . is without influence upon the locomotive's machinery": thus "the feeling we call volition is not the cause of a voluntary act, but the symbol of that state of the brain which is the immediate cause of that act." In other words, physical changes are held to be independent of psychical, whereas psychical changes are declared to be their "collateral products." They are called *collateral* products, or "epiphenomena," to obviate the charge of materialism, and to conform to the interpretation of the conservation of energy that we have just discussed. Such a theory is, strictly speaking, one of parallelism no longer: rather it adopts, instead, the first of the two possibilities we have noted above as opposed to parallelism. According to it, matter is the initiating or independent variant, on whose changes mind simply follows suit. It is open to two fatal objections. First, it is methodologically unsound: its psychology is physiological in the bad sense. It regards all states of consciousness as passive, *i.e.* as ultimately either "feelings" or "reflexes." Volitional activity is declared illusory; and if this be true, intellectual activity must be illusory too. But to detect illusion requires experience of reality—we only know the sham by knowing the genuine first; and even passive states could not be experienced as such save by contrast with states that are active. To the physical side, then, we naturally turn for this knowledge which we are told is not to be found on the psychical; and we do so the more readily as, according to the present theory, the physical holds the primary place. But we turn in vain; for matter is inert, and its energy only "works" by taking the line of least resistance, like water running down hill. Moreover, such activity as we are in search of could only be found here in case the physical mechanism showed signs of being intelligently directed, and that would also be evidence that psychical activity is not illusory. Is, then, the physical side after all primary? No, we reply: the assumption is epistemologically unsound. This is our second objection. The *order* implied in the distinction of physical phenomena and psychical *epi*phenomena is contrary to all experience and indefensible. A physical phenomenon is either actually perceived or possibly perceptible; otherwise it is devoid of empirical reality altogether. But objects of perception are so far psychical; that is, they belong to immediate or individual experience. Therefore we cannot regard them as independent of this experience, nor this as their collateral product, *i.e.* as epiphenomenal. Again, the *phenomenality* supposed to be common to both involves, as we have already seen, a fundamental identity in the standpoint of each: they belong to the same continuous experience at different levels. And lastly, their abstract, merely quantitative, character shows that it is the concepts of physics, and not the facts of immediate experience, that are symbolic, and so to say epithetic. The attempt—either empirically or speculatively—to outflank mind by way of matter is an absurdity on a par with getting into a basket in the hope of being able to carry oneself.

These epistemological considerations may help us to deal with the prime and ultimate argument for strict parallelism. When all is said and done, it is urged, still the interaction of mind and matter remains inconceivable. But this is hardly a sufficient reason for denying what is prima facie a fact. Occasionalists, from Geulincx to Lotze, have acknowledged the same obscurity in *all* cases of transeunt action. Yet they did not venture to deny that sensations were interruptions in the psychical series, the "occasions" for which were only to be found in the physical; nor that purposive movements were interruptions in the physical series, the "occasions" for which were only to be found in the psychical. And surely such a position is more in harmony with experience than that of the parallelists, who maintain that each series "goes along of itself"—a statement which, as we have repeatedly urged, contradicts psychology and assumes the physical "explanation" of life. Whereas occasionalism leaves the question of ultimate means to be dealt with by a metaphysics which will respect the facts,[3] parallelism forecloses it on the basis of a ready-made metaphysics—modern naturalism, that is to say—in which psychology as an independent science is entirely ignored. Starting with a dualism as absolute as that of Descartes—but replacing his two substances by one, enjoying the *otium cum dignitate* of the Unknowable—starting, too, from the physical side, no wonder such a philosophy finds that what is for us the most familiar and of the supremest interest, the concrete world of sense and striving, is for it the altogether inconceivable, the supreme "world riddle." And yet if the naturalist could deign to listen to the plainest teachings of psychology and of epistemology, the riddle would seem no longer insoluble, for his phenomenal dualism and his agnostic monism would alike disappear. The material mechanism which he calls Nature would rank not as the profoundest reality there is to know: it would rather become—what indeed "machine" primarily connotes—an instrumentality subservient to the "occasions" of the living world of ends; and so regarded, it would cease to be merely calculable, and would be found intelligible as well. Psychophysical parallelism, then, we conclude, is not a philosophically tenable position; and—pending the metaphysical discussion as to the ultimate nature of interaction generally—we have to rest content with the second of the three possible modes of connexion above defined, as occasionalism formulates it. According to this, the two series, the psychical and the physical, are not independent and "closed" against each other; but in certain circumstances—*e.g.* in perception—physical changes are the occasion of psychical, and in certain circumstances—*e.g.* in purposive movements—psychical changes are the occasion of physical: the one change not being explicable from its psychical antecedents, nor the other from its physical.

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[1] The possibility is enough: we cannot tell what actually happens, and do not, therefore, know how far the direction of matter by mind calls for a modification or limitation of physical hypotheses. Cf. Ward, *Naturalism and Agnosticism* (3rd ed., 1906), ii. 73–86.

[2] Essay on "Animal Automatism," *Collected Essays*, vol. i.

[3] Cf. Lotze, *Metaphysik*, § 61 *fin.*

Into the metaphysical discussion we cannot, of course, enter here. It must suffice to say that it will not be conducted on the lines of our present inquiry: it will not start from a dualism of matter and mind, either regarded as substances or as phenomena. Its problem will rather be the interaction of subject and object—a duality in the unity of experience, which by no means coincides with the dualism of matter and mind, neurosis and psychosis, and the like.

Comparative Psychology

48. Psychoneural parallelism is no doubt a well established generalization; nevertheless, concerning its exact range and its precise meaning there are differences of opinion. It is applicable, every one will allow, so soon as there is evidence of experiences individually acquired (cf. § 3); and from such point onwards, in ascending any biological phylum, we find that the psychical and neural aspects differentiate and develop together. But how when we descend? Interpreting the neural correlate physiologically, and not morphologically, as referring primarily to function and not to structure, we find that even in unicellular organisms it is still present as irritability and conductivity (leading to contraction, secretion, &c.). But as at higher levels psychosis is correlative to neurosis, the principle of continuity would seem to justify us in assuming a like correspondence here. Moreover, "learning by experience," the comparative psychologist's criterion, obviously presupposes some antecedent and underlying process, of which it is the differentiation and development. And our general analysis of mind, if correct, enables us to describe this process—"the irreducible psychical minimum," of which we are here in search. We have such complete psychosis—and it is the simplest we know—in the emotional or diffused movements that follow immediately upon sensation; and these are so far purposive—though not intentional—that they tend to heighten or retain what is pleasurable, and to alleviate or remove what is painful. Given that plasticity, which is the psychological presupposition of all acquisition, then learning by experience is a possible development from such a primitive stage.

But though every psychosis have its concomitant neurosis, it is uncertain how far the converse holds good. The action of the heart, for example, depends upon neuroses of which we have now no *direct* consciousness. Facts of this kind have led to three hypotheses concerning the lowest forms of life, differing more or less from that just proposed. (i.) Perfectibility and instinct are found, it is said, to be in inverse ratio. Hence in the lowest forms of life there is no "learning by experience," because a stationary state of complete adjustment to environment has been already attained, and all reactions have therefore become "secondarily automatic": consciousness, having served its purpose, has disappeared. To such a very Buddhistic psychology it may be objected: (1) that even organic reflexes tell upon the so-called vital sense or *coenaesthesis*, and so far—the irreducible minimum being still intact—do not preclude all possibility of learning, should occasion arise; and (2) that the psychical life, even of a Protozoan, does not, according to the best evidence, show any such mechanical finality as is here supposed.[1] (ii.) According to the second view, which is advocated by Herbert Spencer, the behaviour of the lower organisms is wholly made up of such reflexes, supposed to be devoid of all psychical concomitants; but consciousness—so far from having disappeared—first comes upon the scene at the opportune moment when the increasing complexity of the mechanism calls for its guidance. Psychologically this hypothesis is less defensible than the last, and it has already been dealt with at some length (cf. § 7). It not only assumes, as that does, far more uniformity in the interaction of organism and environment than the facts warrant, but in regarding life as prior to mind, and as the means of its evolution, it burdens science with two insoluble problems instead of one. For even if it were possible chemically to build up protoplasm, we should still be as far from organisms as a heap of bricks are from putting themselves together as a house. (iii.) The last view we have to notice is essentially an extension of the preceding, and is chiefly interesting as a *reductio ad absurdum* of that. The physics of colloidal substances—at present wanting, but confidently expected "in the near future" by certain biologists—is the key which is to unlock the mysteries of protoplasm. Certain organisms, regarded as varieties of such a substance, react positively to a given physical property of the environment, and others negatively: thus a moth flies towards the light, and a centipede runs from it—the one is positively, the other negatively, "heliotropic"; the radicle of a seed, growing downwards, is, positively, the plumule, growing upwards, is, negatively, "geotropic." Instincts are but complexes of such tropisms, and owe their character entirely to the symmetrical form and definite structure of the colloidal substance. Now if it facilitate the work of the biologist to say that when what we ordinarily regard as a hungry caterpillar climbs to the tip of a branch it is forced so to do by positive heliotropism; that then positive chemiotropism sets up mastication of the young buds; and that, lastly, "we can imagine this process leading to the destruction of the substances in the skin of the animal that are sensitive to light, and upon which the heliotropism depended," so leaving it free to crawl downwards and come in contact with the new buds which have in the meantime unfolded[2]—if such language serve any useful purpose, all well and good; only it must be applied to the hungry man too: in short, all behaviour must be described in the same terms. For the champion of colloids to betake himself to consciousness as he approaches the higher forms of life is as much a breach of methodological parallelism as it is for the psychologist to fall back upon protoplasm as he approaches the lower. But to suppose that psychical processes first appear in the complicated form of association of ideas—which learning by experience is taken to imply—and at the same time to assume that such experience, even when it appears, is "ultimately due to the motions of colloidal substances," these are incongruous absurdities which only the grossest ignorance would be bold enough to maintain.

Concluding, as we have done, that mind and matter—as we may provisionally call them—do really interact, we naturally infer that organic structures are not the result solely of material processes, but involve the co-operation of mental direction and selection: in other words, we are led to regard structure as partly shaped and perfected by function, rather than function as solely determined by structure, itself mechanically evolved. And such a view is justified by the fact that mechanical evolution is primarily a process of "degradation" rather than development, a case of *facilis descensus* contrasting with the upward struggle of life *per aspera ad astra.* Still, the notion of life or mind as formative and directive has its difficulties. In the first place, we have no experience of mind organizing matter—no experience of the actual process, that is to say—however sure we may feel of the fact.[3] Hence the occasionalism to which here, at any rate, science is confined. But even so, the difficulty is not wholly removed. In the handicrafts whence we derive the conception of organs the artificer handles, but does not literally order, his tools—as if they too were intelligent. The conscious direction of such movements is doubtless facilitated by the fact that many of the complex co-ordinations actually involved in them are carried out automatically, thanks to structural modifications, either inherited or acquired. And, regarding life phylogenetically, we can imagine this process carried back indefinitely. Indeed, if it be illogical to talk of mechanisms evolving themselves and giving rise to the beings whose ends they serve, we have no choice but to accept this dualism of mind-shaping and matter inert. No choice, that is, unless we can establish the primacy of the psychological standpoint. Here we have duality but not dualism, and the object is not inert, *i.e.* is not matter. But still there remain two difficulties—possibly resolvable into one—the plasticity already referred to as involved in all biological development and hereditary transmission; as to these, psychology is almost wholly in the dark.[1]

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[1] Cf. H. S. Jennings, *Behaviour of the Lower Organisms* (1906).

[2] Cf. J. Loeb, *Comparative Psychology* (1901), pp. 188 sqq.—an interesting book, full of psychological crudities.

[3] But, of course, a thoroughgoing spiritualism ought to explain the very existence of matter as really the appearance or manifestation of mind.

AUTHORITIES.—*Historical*: There are few good works on the history of psychology; the only one in English, R. Blakey, *History of the Philosophy of Mind from the Earliest Period to the Present Time* (London, 1848), is poor. F. A. Carus's *Geschichte der Psychologie* (Leipzig, 1808) is at least useful for reference. A work bearing the same title by H. Siebeck (the first part consisting of two divisions—(i.) *Die Psychologie von Aristoteles*, (ii.) *Die Psychologie von Aristoteles bis zu Thomas von Aquino* (Gotha, 1880 and 1884) is thoroughly and carefully done. Siebeck has also contributed a series of articles, "Zur Psychologie der Scholastik," to the *Archiv f. d. Gesch. d. Philos.* (vols. i.–iii.). *Die Philosophie in ihrer Geschichte* (*I. Psychologie*), by Professor Harms (Berlin, 1878), is also good. T. A. Ribot's *La Psychologie anglaise contemporaine* (3rd ed., 1892) and *La Psychologie allemande contemporaine* (2nd ed., 1885) are lucid and concise in style, though the latter work in places is superficial and inaccurate. Of Max Dessoir's *Geschichte der neueren deutschen Psychologie* the section dealing with the 17th-century writers prior to Kant went into a second edition in 1897; it contains a useful collection of material. From *Les Origines de la psychologie contemporaine* (2nd ed., 1908), by the neo-Thomist scholar Mgr. D. Mercier, much may be learnt, though its purpose is not primarily historical.

Positive: The recent output of systematic works on psychology has been voluminous. Among the most important of these may be mentioned J. Sully's *The Human Mind* (2 vols., 1892); W. James, *Principles of Psychology* (2 vols., 1890); G. F. Stout, *Analytic Psychology* (2 vols., 1896); *A Manual of Psychology* (2nd. ed., 1901); H. Höffding, *Outlines of Psychology* (1891; translated from the Danish); G. T. Ladd, *Psychology, Descriptive and Explanatory* (1894); W. Wundt, *Grundriss der Psychologie* (4th ed., 1901, translated); F. Jodl, *Lehrbuch der Psychologie* (2 vols., 2nd ed., 1902). Dealing mainly with experimental psychology are: Külpe, *Grundriss der Psychologie auf experimenteller Grundlage dargestellt* (1893; translated); Ebbinghaus, *Grundzüge der Psychologie* (3rd ed., 1908), Bd. I.; and E. B. Titchener, *Experimental Psychology: a Manual of Laboratory Practice* (2 vols., 1901); C. S. Myers, *Experimental Psychology* (1908).

Of the older more advanced textbooks Professor Volkmann's *Lehrbuch der Psychologie* (2 vols., 3rd ed., 1885; edited by Cornelius) is written in the main from a Herbartian standpoint. To the honoured name of Lotze belongs a distinguished place in any enumeration of modern productions in philosophy; his *Medicinische Psychologie* (Göttingen, 1852) is still valuable. A large part of his *Mikrokosmos* (3 vols., 3rd ed., 1876–1880; trans. into English, 2 vols., 1885) and one book of his *Metaphysik* (2nd ed., 1884; also trans. into English) are, however, devoted to psychology. The doctrine of evolution has been as fruitful in this study as in other sciences that deal with life. In this respect Herbert Spencer's *Principles of Psychology* (2 vols., 3rd ed., 1881) and *Data of Ethics* (1879) occupy a foremost place. Dr Alexander Bain's standard volumes, *The Senses and the Intellect* (4th ed., 1894) and *The Emotions and the Will* (3rd ed., 1875), contain a good deal of "physiological psychology," but no adequate recognition of the importance of the modern theory of development. Wundt's *Physiologische Psychologie* (3 vols., 6th ed., 1908 seq.) is indispensable to the student of this subject.

Specially interesting as treating psychological problems on new lines are *La Psychologie des idées-forces*, by A. Fouillée (2 vols., 1893)—perhaps the best French contribution to recent psychology; its cardinal point is the fundamentally dynamical character of the psychical. R. Avenarius, *Kritik der reinen Erfahrung* (2 vols., 1888–1890; 2nd ed., 1908), is an attempt, on the model of Kirchhoff and Mach's treatment of physics, to *describe* experience, taking the relation of the central nervous system to the environment as starting-point. Its strange and forbidding terminology prevented the timely recognition of its merits; but since the author's death in 1896—from overwork and disappointment—quite a literature has grown up, partly expository, partly controversial, devoted to this latest *critique*. H. Cornelius, *Psychologie als Erfahrungswissenschaft* (1897), rather epistemological than psychological, claims affinity with the *critiques* of Kant and Avenarius. In J. Rehmke's *Lehrbuch der allgemeinen Psychologie* (2nd ed., 1905)—a psychology *with* a soul, and claiming to be philosophy as well—the problems of perception and of psychoneural interaction are discussed at length. F. Brentano, *Psychologie vom empirischen Standpunkte* (1874), vol. i., treats presentations and judgments as fundamentally distinct, feeling and willing, on the other hand, as fundamentally one. His influence on Austrian psychologists has been considerable, and is more or less apparent in the following: K. Twardowski, *Zur Lehre vom Inhalt und Gegenstand der Vorstellungen* (1894); A. Meinong, *Psychologisch-ethische Untersuchungen zur Werththeorie* (1894), and also numerous important papers; v. Ehrenfels, *System der Werththeorie* (2 vols., 1897–1898); A. Höfler, *Psychologie* (1897).

Important as treating of particular topics are C. Stumpf, *Tonpsychologie* (2 vols., 1883–1890); A. Lehmann, *Die Hauptgesetze des menschlichen Gefühlsleben* (trans. from the Danish; 1892); various monographs by T. A. Ribot on diseases of memory, will, personality, on the psychology of attention, of the emotions, of general ideas, &c., all translated into English; J. M. Baldwin, *Social and Ethical Interpretations in Mental Development* (1897); W. Wundt, *Völkerpsychologie* (3 vols., 1900); W. McDougall, *An Introduction to Social Psychology* (1908).

There are several periodicals devoted exclusively to psychology, the chief being the *American Journal of Psychology*; the *Psychological Review*; *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*; *L'Année psychologique*; the *British Journal of Psychology*; and *Archiv für die gesammte Psychologie*. (J. W.*)

PSYCHOPHYSICS (from Gr. ψυχή, soul, φύσις, nature), a department of psychology which deals with the physiological aspects of mental phenomena, and in particular investigates the quantitative relations between stimuli and the resultant sensations. Following the introspective school of which the last leader was Alexander Bain, the tendency of psychological investigation, in the hands of Fechner, Helmholtz, Wundt, Münsterberg, was predominantly psychophysical, and psychological study, especially in Germany, where the first fully-equipped laboratory was set up in Leipzig (1879) by Wundt, and in America became largely a matter of experiment and apparatus. Such apparatus has been devised for optical, acoustical, haptical (Gr. ἅπτειν, touch), taste and smell experiments. Haptical apparatus includes the *kinesimeter* (for cutaneous sensation), the *thermaesthesiometer* (for heat and cold sensation), the *algometer* or *algesimeter* (for pain sensations), the *aesthesiometer* (*e.g.* those of Jastrow and Münsterberg). Among important apparatus for measuring the time relations of mental processes are the *d'Arsonval chronometer*, which marks hundredths of a second, and the *Hipp chronoscope*, in which the stimulus and the clock are electrically connected.

For authorities see Baldwin's *Dict. of Philos. and Psych. s.v.* "Laboratory," and the latest psychological textbooks.

PTARMIGAN (*Lagopus mutus* or *alpinus*), a gallinaceous bird akin to the grouse (*q.v.*). The word in Gaelic is *tarmachan*, which appears from the end of the 16th century in many forms, such as *tormican*, *tarmichen*, and even "termagant."

PTERIA (mod. *Boghaz Keui*), the ancient capital of the "White Syrians" of Cappadocia, which Croesus of Lydia is stated by Herodotus to have taken, enslaved and ruined, after he had declared war on the rising power of Persia and crossed the Halys (after the middle of the 6th century B.C.). Thereafter he fought a drawn battle near the city, and retired again across the river to his ultimate defeat and doom. Pteria is mentioned by no other ancient authority, but it is of great interest if, as seems highly probable, (1) its "White Syrian" inhabitants were what we call "Hittites" (*q.v.*), or at least, participants in the "Hittite civilization"; (2) its remains are to be seen in the immense prehistoric city and remarkable rock-sculptures near Boghaz Keui in Cappadocia, about 100 m. east of Angora and beyond the Kizil Irmak (*Halys*). This is the chief "Hittite" site in Asia Minor, far superior in extent to either Euyuk or Giaur Kalesi, which seem to have been its dependencies, and a centre from which roads, marked by the occurrence of "Hittite" monuments, radiate towards Syria and the Aegean. Sir W. M. Ramsay has shown with great probability that it was the importance of Pteria and its bridge over the Halys which diverted the Persian "royal road" far to the north of its natural line. This road, in fact, followed an earlier main track whose ultimate objective had been different.

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[1] On the subject of comparative psychology generally, see *Animal Behaviour* (1900), by Professor C. Lloyd Morgan; L. T. Hobhouse, *Mind in Evolution* (1901).

The remains of Boghaz Keui are indubitably pre-Persian and pre-Greek. They consist of a large fortified city on a steep slope enclosed by two deep ravines, and falling to northward over 800 ft. from summit to base. The acropolis was strengthened with a circle of stone redoubts, between which led very narrow gateways, and with internal redoubts as well. Just inside what seems to have been its principal entrance is a rock face inscribed with nine lines of "Hittite" characters, greatly perished (Nishan Tash), and a similar inscription, equally illegible, can be detected on a neighbouring rock. Below the acropolis on the north-east is a residential quarter, containing large ruins of what seems to have been a palace or temple built round a central court. The whole site is surrounded by a strong wall, 14 ft. thick, with towers about 100 ft. apart. The monument, however, which earliest rendered Boghaz Keui famous is the sculptured rock grotto, 1 m. to the east, called Yasili Kaya. Here two hypaethral galleries are adorned with reliefs in panels, the larger gallery showing two processions, which, starting on both walls from the entrance, meet at the head of the grotto. On the left wall are 45 figures, headed by a gigantic male figure, erect on the bent necks of two men. On the right wall he is opposed by a female of almost equal stature standing on a leopard or lioness, and followed by a young male with battle-axe, erect on a similar beast. Behind these are some 20 figures of mitred priests, &c. There can be no doubt that the female is the great Nature goddess of western Asia, attended by her spontaneously-generated son, with whose help she creates the world (see GREAT MOTHER OF THE GODS). Priests or minor divinities follow them. The other procession, according to the analogy of other monuments, should be composed of mortals bearing *sacra* and headed by their king, who makes offering or dedicates his city to, or engages in some mystic union with, the goddess. The figure following him seems to be that of his high priest. "Hittite" symbols are carved above many of the figures. Besides the processions there are five independent reliefs in the small gallery and its approach, one repeating the figure of the high priest.

In 1906, as the result of the discovery of cuneiform tablets at Boghaz Keui by E. Chantre in 1890, a concession for the excavation of the site was obtained by the Berlin Oriental Society, and H. Winckler was sent to make a preliminary examination. He found a number of tablets in two languages, Babylonian and local, the latter being that of the Arzawa letters found at Tell el-Amarna. Among them was a cuneiform copy of the treaty made by Rameses II. in his 20th year with the king of the Kheta, and inscribed on a wall at Karnak. In 1907 Winckler returned with O. Puchstein and others and made regular excavations, laying bare much of the fortifications and two temples, and finding inscribed monuments and many more tablets. From those written in Babylonian Winckler has established the fact that Boghaz Keui was the capital of a powerful Hatti dynasty from the middle of the 16th century B.C. to at least 1200 B.C. He claims further that its ancient name was Hatti. At the height of its power it ruled all Asia Minor down to the Aegean and northern Syria to the headwaters of the Orontes, and was also overlord of the Mitanni and the Amurri (Amarru) in Mesopotamia. It had continual relation on terms of equality with Egypt and Babylonia. The four kings of the Kheta, alluded to by name in Egyptian texts, have been identified with kings of Boghaz Keui. The decline of Hatti power began with the expansion of Assyria after 1100 B.C. and Cappadocia seems to have been inferior to Phrygia after the rise of the Midaean dynasty in the 9th and 8th centuries. It should be added that the identification of Boghaz Keui with the Pteria of Heroditus has not yet been confirmed, and the latter name has been claimed for a primitive site at Ak-alan near Samsun by Th. Makridi Bey, as the result of his excavations for the Constantinople Museum in 1907 (see HITTITES).

AUTHORITIES.—C. Ritter, *Erdkunde*, xviii; C. Texier, *Descr. de l'Asie Mineure* (i., 1843); J. Hamilton, *Researches*, &c. (1842); H. Barth, *Reise von Trapezunt*, &c. (*Ergänz. Petermann's Geog. Mith.*; 1860); G. Perrot and E. Guillaume, *Expl. arch. de la Galatie* (1862–1872); K. Humann and O. Puchstein, *Reisen in Kleinasien u. Nordsyrien* (1890); Murray's *Guide to Asia Minor* (1894); G. Perrot and C. Chipiez, *Hist. de l'art* (1886) vol. iv.; Lord Warkworth, *Notes of a Diary*, &c. (1898); E. Chantre, *Mission en Cappadocie* (1898). (For recent excavations see HITTITES.) (D. G. H.)

PTERIDOPHYTA (Gr. *πτέρις*, fern, and *φυτόν* plant), or as they are frequently called, the Vascular Cryptogams, the third of the large subdivisions of the vegetable kingdom. The Ferns form the great majority of existing Pteridophytes; the importance and interest of the other groups, of which the Club-mosses and Horsetails are the most familiar examples, depend largely on the fact that they are the surviving representatives of large families of plants which flourished in earlier geological periods. (See PALAEOBOTANY.)

Life history.

The relation which exists between the two alternating stages or generations, which together constitute the complete life-cycle of all plants higher than the Thallophyta, is perhaps the most natural characteristic of the Pteridophyta. From the germinated spore of a fern plant, which must not be confused with the "seed" of seed-bearing plants, a small, flat, green organism is developed; this is the prothallus (gametophyte, sexual generation; fig. 7). As the result of fertilization of an ovum produced by this, the fern plant (sporophyte, asexual generation) originates; from it spores are ultimately set free, with the germination of which the life-history again commences. The point common to all Pteridophyta is that from the first the gametophyte is an independent organism, while the sporophyte, though in the first stages of its development it obtains nutriment from the prothallus, becomes physiologically independent when its root develops. This independence of the two generations for the greater part of their lives distinguishes this group on the one hand from the Bryophyta (in which the sporophyte is throughout its life attached to the gametophyte), and on the other hand from the Gymnosperms and Angiosperms (in which the more or less reduced gametophyte remains enclosed within the tissues of the sporophyte). The gametophyte, which is usually dorsiventral, though in some cases radially symmetrical (fig. 1, *b*), is a small thallus attached to the soil by rhizoids. In structure it is equally simple, being composed of parenchymatous tissue without any clearly marked conducting system. Usually it grows exposed to the light and contains chlorophyll, but subterranean saprophytic prothalli also occur in the Lycopodiaceae and Ophioglossaccae (fig. 1, *c*, *d*, *f*, *g*). In the heterosporous forms the gametophyte is more or less reduced (fig. 1, *e*, *i*). The reproductive organs ultimately produced on the same or on different individuals are of two kinds, the antheridia and archegonia; the origin of both is from single superficial cells of the prothallus. The antheridium (fig. 8) at maturity consists of a layer of cells forming the wall which encloses a group of small cells; from each of the latter a single motile spermatozoid originates. The archegonium (fig. 9) consists of a more or less projecting neck and the venter, which is usually enclosed by the tissue of the prothallus. A central series of cells can be distinguished in it, the lowest of which is the ovum; above this come

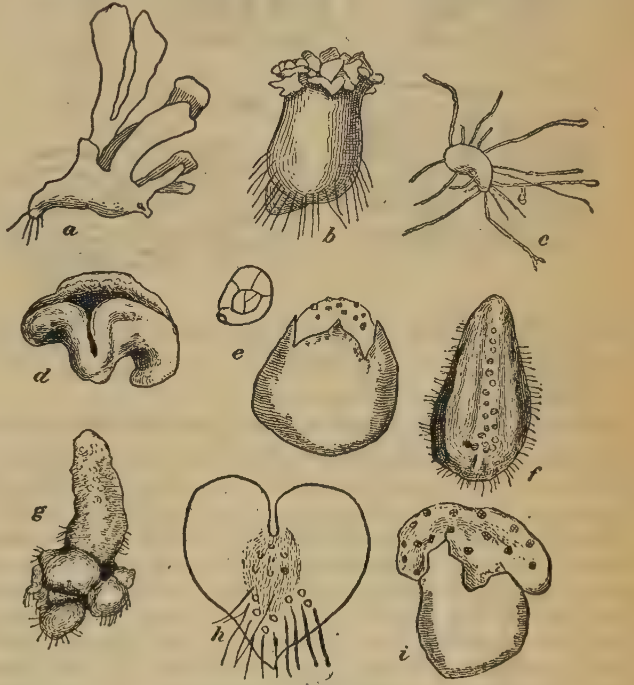


FIG. 1.—Diagrammatic sketches of prothalli of—
a, Equisetum. *e*, Selaginella.
b, Lycopodium cernuum. *f*, Botrychium virginianum.
c, L. phlegmaria. *g*, Helminthostachys.
d, L. clavatum. *h*, A Fern.
i, Salvinia.

the ventral canal cell and one or more canal cells. When the archegonium has opened by the separation of the terminal cells of the neck, the disintegration of the canal cells leaves a tubular passage, at the base of which is the ovum (fig. 9, *b*). Down this canal the spermatozoid, which in the Ferns has been shown to be attracted by reason of its positive irritability to malic acid, passes and fuses with the ovum. After fertilization the latter surrounds itself with a cell-wall and develops into the sporophyte. The early segmentation of the embryo differs in the several groups, but usually the first leaf or leaves, the apex of the stem and the first root are differentiated early, while a special absorbent organ (the foot) maintains for some time the physiological connexion between the sporophyte and the prothallus. The sporophyte is always highly organized both as regards form and structure. Root, stem and leaf can be distinguished even in the simplest forms, and the plant is traversed by a well-developed vascular system. The reproductive organs of the sporophyte are the sporangia, within which the spores are produced; the sporangia are often borne on or in relation to leaves, which may be more or less distinct from the foliage leaves in form and structure (cf. fig. 2). The cells of the wall of the sporangium are usually so constructed as to determine the dehiscence of the sporangium and the liberation of its spores. The spores produced in each sporangium vary from very many to a single one in the case of some heterosporous forms. These latter bear spores of two kinds, microspores and megaspores, in separate sporangia. From the microspore an extremely reduced male prothallus and from the megaspore the female prothallus, develops (cf. fig. 1, *e*). The spores of the homosporous Vascular Cryptogams are usually of small size; the prothalli produced from them usually bear both antheridia and archegonia, though under special conditions an imperfect sexual differentiation may result. The complete life-history, with its regular alternation of gametophyte and sporophyte, is now known in all except a few rare genera of recent Pteridophyta, and will be described in connexion with the several groups. A cytological difference of great importance between the two generations can only be mentioned in passing. The nuclei of the cells of the sexual generation possess a definite number of chromosomes and this number is also characteristic of the sexual cells. On fertilization the number is doubled and all the cells of the spore-bearing generation have the double number. On the formation of the spores a reduction to the number characteristic of the gametophyte takes place.

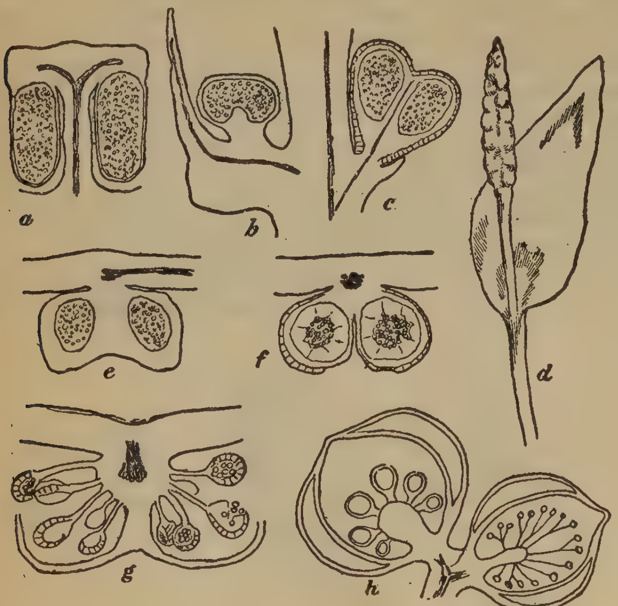


FIG. 2.—Diagrammatic sketches of spore-producing members of—
a, Equisetum. *d*, Ophioglossum. *g*, Nephrodium.
b, Lycopodium. *e*, Kaulfussia. *h*, Salvinia.
c, Psilotum. *f*, Angiopteris.
(All except *d* represent vertical sections of sporangiophore or sorus.)

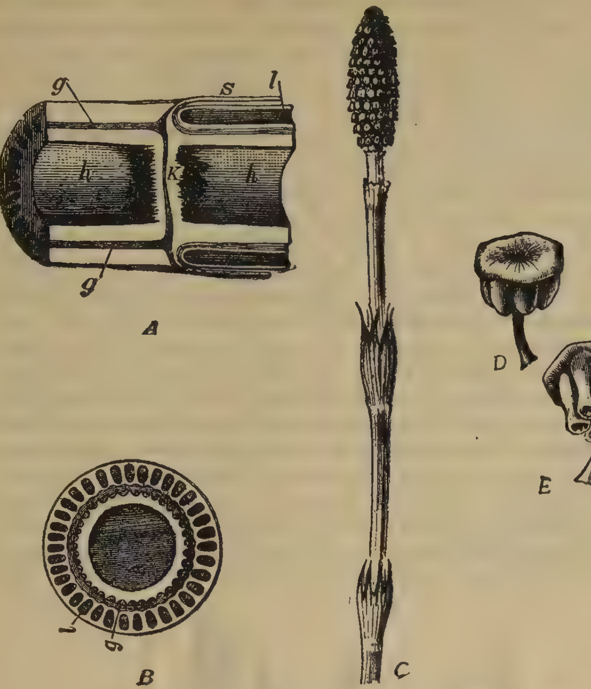
Classification. The systematic arrangement of the Vascular Cryptogams for the purposes of identification and description necessarily remains unchanged, while the comparative morphology is being more fully worked out. But modifications in the order of placing the natural groups are of importance in expressing the results of such investigations. Such a scheme may be placed here in a tabular form before entering on the consideration of the life-history, natural history, morphology, and classification of the several groups:—

Pteridophyta.

I. EQUISETALES		*Equisetaceae.*
		Calamariaceae.
II. SPHENOPHYLLALES		*Sphenophyllaceae.*
		Cheirostrobaceae.
III. PSILOTALES		*Psilotaceae.*
IV. LYCOPODIALES		*Lycopodiaceae.*
		Selaginellaceae.
		Lepidodendraceae.
		Isoetaceae.
V. OPHIOGLOSSALES		*Ophioglossaceae.*
VI. FILICALES	*Filicaceae*	*Marattiaceae.*
		Osmundaceae.
		Schizaeaceae.
		Gleicheniaceae.
		Matoniaceae.
		Loxsomaceae.
		Hymenophyllaceae.
		Cyatheaceae.
		Polypodiaceae.
	Hydropterideae	*Salviniaceae.*
		Marsiliaceae.

These main subdivisions are of unequal size and importance. The Sphenophyllales are only known in a fossil state, while the Equisetales, Lycopodiales and Filicales include both living and extinct representatives. The small groups of recent plants forming the Psilotales and Ophioglossales are given independence in this scheme of classification owing to their exact affinities with the other phyla being at present doubtful.

I. EQUISETALES.—The plants of the single living genus *Equisetum*, which vary in height from a few inches to 40 ft., have subterranean rhizomes, from which the erect shoots arise. The habit of the plant depends on the degree of branching rather than upon the foliage. The internodes are elongated and hollow. The leaves are borne in whorls, those of each whorl cohering, except at their extreme tips, to form a sheath. The leaves of successive whorls alternate with one another, and this applies also to the branches which arise in the axil of the leaf sheath. In most species many of these buds, which alternate with the leaves, remain dormant, but in others the aerial shoots are copiously and repeatedly branched. In some species branches of the rhizome with tuberous internodes are formed, which serve as a means of vegetative reproduction. The roots which arise from the base of the lateral buds remain undeveloped on the aerial stem. The vascular bundles equal in number the leaf-teeth from which they enter the stem and form a single ring. Each bundle runs downwards through one internode and then divides into two branches which insert themselves on the alternating bundles entering at this node. The young stems, and the older stems of certain species, are clearly monostelic; but in other species an inner and outer endodermis may be present, or an endodermal layer surrounds each bundle. The vascular bundles themselves are collateral, the xylem consisting of the protoxylem, towards the centre of the stem, and two groups of xylem, between which the phloem is situated; the protoxylem elements soon break down, giving rise to the carinal canal. Only the median or carinal strand of xylem is common to stem and leaf; the lateral cauline strands possibly represent the remains of a centripetally developed mass of primary xylem. There is no secondary thickening except at the node in *E. maximum*, where some short tracheides, arranged in radial rows, arise from a cambium. The stems, the surface of which exhibits a number of ridges with intervening furrows, perform the greater part of the work of assimilation. The chlorophyll-containing tissue reaches the surface at the sides and base of the furrows,



(*C, D, E* from Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.)

FIG. 3.—*Equisetum maximum.*

A, Longitudinal section of the rhizome, including a node and portions of the adjoining internodes; *k*, septum between the two internodal cavities, *hh*; *gg*, vascular bundles; *l*, vallecular canal; *s*, leaf-sheath.

B, Transverse section of the rhizome; *g*, vascular bundle; *l*, vallecular canal.

C, Fertile shoot showing two leaf-sheaths and the terminal strobilus.

D, E, Sporophylls bearing sporangia, which in E have opened.

where stomata of peculiar form occur in the epidermis, while subepidermal strands of sclerenchyma occupy the ridges. In the cortical tissue beneath each furrow a wide intercellular space is present running the length of the internode, and called the vallecular canal. The central cylinder of the root, in which there are several xylem and phloem strands, has around it a two-layered endodermis, the inner layer of which appears to take the place of a pericycle. The sporangia are borne upon lateral outgrowths of the axis (the sporangiophores), which arise in whorls and are associated in definite strobili or cones (fig. 3, C); at the base of the cone an outgrowth of the axis like a rudimentary leaf sheath (the annulus) is present. Each sporangiophore (fig. 3 D) consists of a stalk expanding into a peltate disk of hexagonal outline; from the inner surface of the latter six to nine large sporangia hang parallel with the stalk. The single vascular bundle supplies a branch to the base of each sporangium. The latter arises from a number of superficial cells, the cells destined to form the spores being derived from a single one of these. A tapetal layer is derived from the cells surrounding the sporogenous group, and the arrest of a number of the spore-mother-cells further contributes to the nourishment of the remainder, each of which gives rise to four spores. The outermost layer of the cell-wall of the ripe spore splits along spiral lines, giving rise to the elaters; these two long strips of wall, attached by their middle points to the spore, tend to straighten out in dry, and close round the spore in damp air. They thus assist in the opening of the sporangium, which takes place by a slit on its inner face. Further, several spores will be likely to germinate together owing to their elaters becoming entangled; a fact of some importance, since the antheridia and archegonia, though occurring sometimes on the same prothallus, are more often borne on separate individuals. The prothalli contain abundant chlorophyll, and are dorsiventral. Those that bear the antheridia are the smaller, and are either filamentous, or flattened, and irregularly lobed. The antheridia are deeply sunk in the tissue; the spermatozoids consist of a spiral of two or three coils, the numerous cilia being attached to the pointed anterior end. The female prothalli, which are sometimes branched, consist of a thick cushion bearing thin, erect lobes, at the base of which the archegonia are situated. The necks of the latter are short, the central series of cells consisting of ovum, ventral canal cell and one or two canal cells. The half of the embryo directed towards the archegonial neck gives rise to the apex of the stem and a sheath of three leaves, the other half to the small foot and the primary root. The first shoots are of limited growth, being replaced by lateral branches, which gradually acquire the number of leaf-teeth characteristic of the species.

Fossil species, some of which attained a great size, are known, to which the name *Equisetites* is given, since they appear to be closely allied to the existing forms. Two other extinct genera, *Phyllotheca* and *Schizoneura*, may be mentioned here. Abnormal specimens of *Equisetum* in which the strobilus is interrupted by whorls of leaves are of interest for comparison with the fructification of *Phyllotheca*. The most important and best known of the extinct Equisetales are, however, the Calamites (see PALAEOBOTANY: *Palaeozoic*). In the primary structure of the stem the Calamites present many points of resemblance to *Equisetum*, but secondary thickening went on in both stem and root. These plants, which appear to have grown in swampy soil, thus attained the dimensions of considerable trees. The leaves, which were of simple form (except in *Archaeocalamites*, where they forked), were inserted in whorls at the nodes; they were either free from one another or cohered by their bases into a sheath. The branches alternated in position with the leaves, and sprang from just above the insertion of the latter. Some of the branches terminated in cones, which present a general similarity to those of *Equisetum*. This similarity is closest in *Archaeocalamites*, an ancient type found in Upper Devonian rocks; in this the strobilus consists of peltate sporangiophores inserted in whorls on the axis. In the other Calamarian strobili known the whorls of sporangiophores are separated by whorls of bracts. In some the sporangiophores stood midway between the sterile whorls, while in others they approached the whorl above or below. There is a close resemblance between these sporangiophores and those of *Equisetum*, but as a rule only four sporangia were borne on each. Some Calamites were heterosporous, sporangia with microspores and megaspores being found in the same cone.

Our knowledge of the extinct Equisetales, full as it is with respect to certain types, does not suffice for a strictly phylogenetic classification of the group. The usual subdivision is into Equisetaceae including *Equisetum* and *Equisetites* (with which *Phyllotheca* and *Schizoneura* may be provisionally associated), and Calamariaceae, including *Calamites* and *Archaeocalamites*.

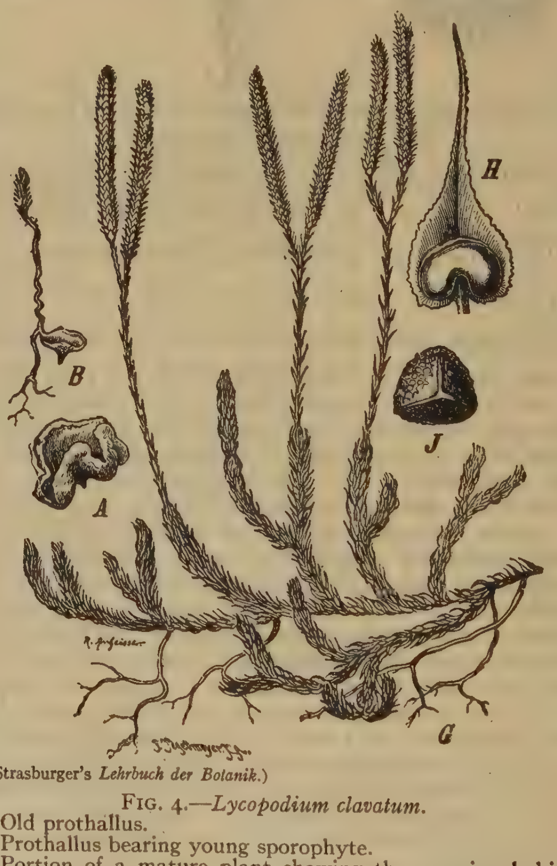
II. SPHENOPHYLLALES.—The two very distinct genera *Sphenophyllum* and *Cheirostrobus*, included in this group, are known only from the Palaeozoic rocks. Though the high specialization of this ancient group of plants renders the determination of their natural affinities difficult, indications are afforded by anatomy and the morphology of the strobilus.

In general appearance the species of *Sphenophyllum* (the remains of *Cheirostrobus* known do not allow of any idea of its habit being formed) present some resemblances to the Equisetales. The long, sparingly branched stem bore at the somewhat swollen nodes whorls of six to eighteen wedge-shaped or linear leaves, which did not alternate in successive whorls. Both the broader and narrower leaves may be more or less deeply divided, and both forms may occur on the same shoot. From the relation of the thickness of the stem to its length it may be inferred that the shoots of *Sphenophyllum* derived support from adjoining plants. Without entering into detail regarding the anatomy, it may be stated that secondary thickening took place in both genera. The single stele in the stem consisted of the phloem surrounding a solid central strand of xylem, the groups of protoxylem being situated at the projecting angles. In *Sphenophyllum*, in which the transverse section of the xylem is triangular, there were three or six protoxylem groups; in *Cheirostrobus* they were more numerous. The anatomy of the stem is thus very unlike that characteristic of the Equisetales, and presents essential points of resemblance to the Lycopodiales and especially to the Psilotales. The general morphology of the cones, on the other hand, suggests some affinity with the Equisetales. The cone of *Sphenophyllum* consisted of an axis bearing at the nodes whorls of bracts, united below into a sheath. The overlapping bracts afforded protection to the sporangia, which were borne on sporangiophores springing from the upper surface of the coherent bracts near their origin from the axis; two sporangiophores usually arose from each bract, and sometimes adhered to its upper surface for some distance. Each bent round at the upper end, and bore one or two sporangia on the side turned towards the axis. The mature sporangium had a wall of a single layer of cells, which were larger towards the base, where they continued into the epidermis of the sporangiophore. In *Sphenophyllum fertile* both the ventral lobes of the sporophyll (corresponding to the sporangiophores in other species) and the dorsal lobes, which in other species are sterile, were developed as peltate sporangiophores. In other species of *Sphenophyllum*, which are known only as impressions, single sporangia, or groups of four, appear to have been inserted directly on the upper surface of the bracts. In *Cheirostrobus* a similar relation of sporangiophores to bracts existed, but here each bract was divided into three segments. From each segment, near its base, a stalked peltate sporangiophore arose; this bore four sporangia, which hung parallel to the stalk. That these three sterile segments, with their sporangiophores, are together comparable to one of the bracts of *Sphenophyllum*, with its sporangiophores, is shown by the vascular supply in each case being derived from a single leaf-trace. So far as is at present known, the Sphenophyllales were homosporous. The differences between the two genera described above are sufficiently marked to justify the division of the Sphenophyllales into the two orders Sphenophyllaceae and Cheirostrobaceae. A consideration of the characters of both shows that the Psilotales are the nearest living representatives of the Sphenophyllales, while resemblances suggesting actual relationship exist between this group and the Equisetales and Lycopodiales. It has been suggested that the Sphenophyllales may have sprung from a very old stock which existed prior to the divergence of the latter groups. So long, however, as our knowledge of these phyla is confined, as at present, to specialized forms, the nature of the relationship between them must remain to some extent hypothetical.

III. PSILOTALES.—The two genera *Psilotum* and *Tmesipteris*, which are provisionally isolated in this group, have usually been classed with the Lycopodiales. Recent work both on their anatomy and on the morphology and structure of their spore-producing organs has however tended to show that their peculiarities can be best understood in the light of our knowledge of the Sphenophyllales. Some authorities place them in this group and there is much to be said in support of the close relationship implied. The Psilotaceae, however, differ from the Sphenophyllales in a number of definite features, such as the arrangement of the leaves singly and not in whorls, and the mode of branching. These differences and our comparatively imperfect knowledge of the Sphenophyllaceous plants which most closely resemble the Psilotaceae appear to justify the provisional isolation of the latter as a distinct group, showing affinities with both the Sphenophyllales and Lycopodiales. In both *Psilotum* and *Tmesipteris* the functions of the root-system, which is completely absent, are performed by leafless rhizomes bearing absorbent hairs and inhabited by an endophytic fungus. *Psilotum* lives epiphytically or in soil rich in humus, while *Tmesipteris* is epiphytic (and, it has been suggested, partially parasitic) upon stems of tree ferns: the former has small scale-like leaves; those of the latter are of considerable size. The stem is monostelic, the protoxylem groups being towards the periphery of the xylem, the development of which is thus centripetal; the centre of the stele is occupied by sclerenchymatous tissue. The leaves, which bear the sporangia, are dichotomous, and do not form definite cones, but alternate in irregular zones with the foliage leaves. The sporophylls may exceptionally undergo further dichotomies and bear more numerous synangia. The sporangia of the Psilotaceae are associated in synangia, which occupy the same position relatively to the sporophyll, as the single sporangium of *Lycopodium* or the group of sporangia in *Spenophyllum majus*. The careful study of the development of the synangium of *Tmesipteris*, which consists of two loculi, and of *Psilotum*, which consists of three, has shown that their structure can be explained as originating by the septation of a single sporangium resembling that of *Lycopodium*. Other views of the nature of the Psilotaceous synangium are, however, possible, and indeed the existence of both simple and complicated sporangiophores in the Sphenophyllaceae leaves the question open as to whether the synangium in existing Psilotaceae is a relatively simple type of sporangiophore which has persisted unaltered or is the result of reduction from a more elaborate structure. There is some reason to believe that the prothallus of *Psilotum* resmbles some *Lycopodium* prothalli, but conclusive evidence is wanting; that of *Tmesipteris* is unknown.

IV. LYCOPODIALES.—The living representatives of this group are of small size compared with the related plants which lived in Palaeozoic times. A large proportion of the living species are tropical, though others have a wide distribution. As general characteristics of the Lycopodiales, the simple form of the leaves, which are generally of small size, and the situation of the sporangia on the upper surface of the sporophylls, which are often associated in cones, close to their insertion on the axis, may be mentioned; there are both homosporous and heterosporous forms, the prothalli exhibiting corresponding differences. A number of species of *Lycopodium* are epiphytic and those of *Isoëtes* live submerged in water. Vegetative reproduction is effected in various ways: by the separation of the branches of a creeping stem in some *Lycopodia*, the persistence through the winter of the apex of the shoot in *L. inundatum*, and by the formation of leafy bulbils on the aerial stem of *L. Selago* and others. A highly specialized means of vegetative reproduction is seen in the tubers of *Phylloglossum* and the embryos of some Lycopods. The modifications shown by the gametophyte of *Lycopodium* will be described below. All such special relations of the plant to its environment, which might be expected in the few forms of a large group which has persisted beyond the others, are less marked in the genus *Selaginella*. It would appear as if the latter was more suited to the conditions of the existing flora, and many of the specific forms within it may rather be regarded as recently evolved than as simply persistent.

Lycopodiaceae.—This order contains the two genera *Phylloglossum* and *Lycopodium*; the former has a single species, confined to Australia, Tasmania and New Zealand, while nearly one hundred species of *Lycopodium* are known. Erect and creeping terrestrial plants and pendulous epiphytes occur in the latter genus. The simple leaves, which are of small size and do not possess a ligule, are arranged spirally around the branched stem in the majority of the species. The roots of the erect forms often grow downwards in the cortex of the stem to reach the soil. The anatomy of *Lycopodium* presents considerable variety in detail, but the stem is always monostelic and the development of the xylem centripetal, the protoxylems being situated at the periphery of the stele; pericycle and endodermis surround the stele, and the wide cortex may be more or less

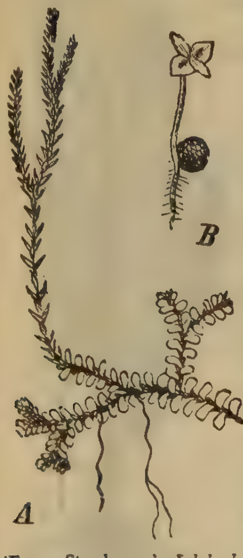


(From Strasburger's *Lehrbuch der Botanik.*)

FIG. 4.—*Lycopodium clavatum.*

A, Old prothallus.
B, Prothallus bearing young sporophyte.
G, Portion of a mature plant showing the creeping habit, the adventitious roots and the specialized erect branches bearing the strobili or cones.
H, Sporophyll bearing the single sporangium on its upper surface.
J, Spore, highly magnified.

sclerenchymatous. The central cylinder of the root often shows a striking resemblance to that of the stem. The Lycopodiaceae are homosporous. The spores are formed in sporangia of considerable size, situated on the upper surface and near the base of the sporophylls. The latter may differ from the foliage leaves and be arranged in definite cones, or the two may be similar and occupy alternate zones of a shoot with continued growth; sometimes rudiments of sporangia are found at the bases of the leaves (fig. 4). In the development of the sporangium the sporogenous tissue is derived from a number of superficial cells by divisions parallel to the surface. The tapetum is derived from the layer of cells surrounding the sporogenous group. Short trabeculae of sterile tissue have been found to project into the cavity of the sporangium of some species. The spores, when liberated by the dehiscence of the sporangium, give rise to the prothallus, which is now, owing mainly to the investigations of Treub and Bruchmann, known in a number of tropical and temperate species. In habit and mode of life of the prothallus these present striking differences, which may be correlated with the situations inhabited by the sporophyte, and are perhaps to be regarded as adaptations which have enabled the species to survive. Thus in *L. cernuum* and others the prothallus is green and grows on the surface of the soil (fig. 1, *b*); in the species living on the moors it is subterranean and saprophytic, though sometimes capable of developing chlorophyll when exposed to light (fig. 1, *d*); while in *L. Phlegmaria* and other epiphytic forms the prothallus consists of fine branches growing saprophytically in rotting wood (fig. 1, *c*). A comparison of these various types would appear to indicate that the primitive form of prothallus in the genus was radially symmetrical and contained chlorophyll. The prothalli of *L. cernuum* come nearest to this; in them the meristem forms a zone slightly below the summit, which may bear a number of green lobes. The different forms of the prothallus found in *L. Selago* give an idea of how the more extremely modified types could be derived from such a prothallus as that of *L. cernuum*. All the saprophytic prothalli contain an endophytic fungus in definite layers of their tissue. The antheridia and archegonia are produced above the meristematic zone, and are more or less sunk in the tissues of the prothallus. The most important difference in the sexual organs concerns the length of the archegonial neck; this is shortest and has only a single canal cell in *L. cernuum*, while in *L. complanatum* it is longer than in any other Vascular Cryptogam, and contains a number of canal cells. The spermatozoids are biciliate. The embryo in *L. cernuum* and other forms with superficial green prothalli is attached to the prothallus by a small foot, and develops at first as a tuberous body (the protocorm) bearing rhizoids; this forms a number of simple leaves, and upon it the apex of the shoot arises later. In the saprophytic forms the protocorm is absent, and in some of them the foot is of large size (fig. 4, *B*). When new individuals of species which possess a protocorm arise vegetatively from the leaves or roots of young plants, the protocorm appears in the young sporophyte. This fact leads to the consideration of *Phylloglossum*, which resembles the embryo of *Lycopodium cernuum* in so many respects that it has been spoken of as a permanently embryonic form of Lycopod: it is in some respects the simplest existing Pteridophyte. Its prothallus resembles that of *L. cernuum*, but wants the crown of assimilating lobes. The plant is reproduced by tubers, which resemble the protocorm in bearing first a number of protophylls and later the upright shoot with its single terminal strobilus. The sporangia agree with those of *Lycopodium* in structure and position.



(From Strasburger's *Lehrbuch der Botanik.*)

FIG. 5.—*Selaginella.*
A, *S. helvetica* (nat. size).
B, *S. denticulata*, young plant attached to the megaspore (enlarged).

Selaginellaceae.—The single genus of this order (*Selaginella*) contains between three and four hundred species. There is considerable diversity among them as regards external form, the majority having dorsiventral aerial shoots with dimorphic leaves (fig. 5, *A*), while in others the shoots are radially symmetrical and the leaves alike. The stem contains one, two or several steles; in one species the stele is tubular. The phloëm completely surrounds the xylem, which usually develops from two protroxylem groups. In the aerial stem of the British species (*S. spinosa*) the radial stele has a number of protoxylem groups arranged round the periphery, much as in *Lepidodendron*. The cells of the endodermis are developed as trabeculae, which traverse the continuous air-space surrounding each stele. The simple, uni-nerved leaves have a ligule near the base; the base of the ligule is somewhat sharply marked off from the other tissues of the leaf. In some species a depression of the leaf-surface encloses the ligule, regarding the function of which little is known. The roots, the stele of which is monarch, may arise directly from the stem, or are borne on rhizophores, which spring from the shoot at the point of branching, and root on reaching the soil. In structure they resemble the roots, but their morphological nature is uncertain. The sporophylls are arranged radially in the cones, which are terminal on the branches. A single sporangium is borne on the axis just above the insertion of each sporophyll. *Selaginella* is heterosporous, the megasporangia being often found towards the base of the cone. The development of the micro- and megasporangia is the same up to the stage of isolation of the spore mother-cells. The sporogenous tissue, which is referable to several archesporial cells, is surrounded by a tapetum, mostly derived from the sporogenous group. In the microsporangium all the mother-cells undergo the tetrad division, giving rise to the numerous microspores. In the megasporangium, on the other hand, the four megaspores, which arise from a single mother-cell, are nourished at the expense of the other sporogenous cells and of the tapetum. On germination the microspores give rise to a reduced prothallus, consisting of the small cell first cut off and a wall of cells enclosing two to four central ones; from these latter the biciliate spermatozoids originate. The megaspore becomes filled with the female prothallus, the formation of cell-walls commencing at the pointed end of the spore, where from the first the nuclei are more numerous, and later extending to the base. The surface of the prothallus, which is exposed when the thick wall of the spore is ruptured, may produce a few rhizoids; upon it the archegonia, consisting of a short neck and the central series of ovum, ventral canal cell and canal cell, arise (fig. 1, *e*). After fertilization the embryo forms a short suspensor; the apex of the stem, with a leaf on each side of it, is first distinguishable; at the base of this is the foot; while the root arises on the farther side of the latter. Thus the position of the root in *Selaginella* is different from what obtains in the other Vascular Cryptogams. A point of interest in this heterosporous genus is that the formation of the prothallus may commence before the megaspore is liberated from the sporangium.

Lepidodendraceae.—This order includes only extinct forms, the best known of which are the plants placed in the genera *Lepidodendron* and *Sigillaria*. These plants, a fuller description of which must be sought in the article PALAEOBOTANY: *Palaeozoic*, underwent secondary increase in thickness and attained the size of large trees; the aerial stem was more or less branched dichotomously. The leaves, which were of simple form and provided with a ligule, were, as the leaf-scars on the stem show, variously arranged. In *Sigillaria* the latter form vertical rows, while in *Lepidodendron* the arrangement is a complicated spiral. The stem had a single stele, the primary xylem of which was polyarch and centripetally developed. The upright stems were attached to the soil by a number of dichotomously branched members (*Stigmaria*), which, whatever their morphological nature may be, appear to have performed the function of roots: they bore numerous cylindrical appendages, which penetrated the soil on all sides. The cones, which in some instances at least were heterosporous, presented a general resemblance to those of *Lycopodium* and *Selaginella*, a single sporangium being situated on the upper surface of each sporophyll. The cavities of the large sporangia were sometimes traversed by trabeculae of sterile tissue resembling those found in *Isoëtes*. In some of the heterosporous forms (*Lepidocarpon*, *Miadesmia*) the sporangia were sometimes surrounded by an integument; and since only a single megaspore attained maturity, the structure of the megasporangium suggests a comparison with an ovule.

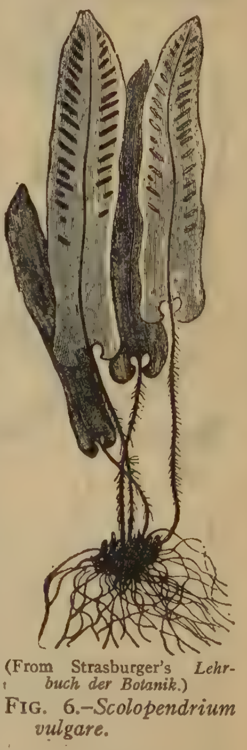
Isoëtaceae.—The single genus (*Isoëtes*) contains about fifty, mostly aquatic, species, though a few are amphibious or terrestrial. The plants present considerable uniformity in general habit, consisting of a short, unbranched stem, bearing the closely-crowded awl-shaped leaves, which in the larger species attain the length of a foot. Each leaf bears a ligule resembling that of *Selaginella* in structure and position. The stem is monostelic, the centre of the stele being occupied by a mass of short tracheides; but little can be said as to the primary structure of the central cylinder, which appears to be reduced. A meristematic zone forms a short distance outside the xylem, from which secondary tissue is developed both internally and externally; that to the inside contains both xylem and phloëm elements. By the unequal development of the secondary cortex the stem becomes two- or three-lobed; the roots, which branch dichotomously, spring from the furrows between the lobes. The leaves have a single main bundle, and in the mesophyll are four longitudinal series of large intercellular spaces separated by transverse diaphragms. The sporangia, which are situated singly on the adaxial surface of the leaves, between their insertion on the stem and the ligule, arise from a considerable number of epidermal cells. The cells composing the young sporangium are at first similar, but ultimately become differentiated into sterile trabeculae, which may stretch from the inner to the outer wall, and the mother-cells of the spores. The latter are more numerous in the microsporangium than in the megasporangium. The tapetal layer is partly formed from the sporangial wall and partly as a layer covering the trabeculae. The spores, which are set free by the rotting of the sporangial wall, germinate much as in the case of *Selaginella*, though the similarity may be a case of independent resemblance. Important points of difference are found in the multiciliate spermatozoids, and in the embryo, which has no suspensor.

The several orders of Lycopodiales described above, while presenting a number of features in common, are distinctly isolated from one another. A natural classification of such specialized plants can only be obtained when the extinct forms are more fully known. What is known at present, while it does not indicate the phylogeny of the Lycopodiales, at least shows that such living orders as Lycopodiaceae and Selaginellaceae cannot be regarded as forming a linear series. The difficulty is increased when it is borne in mind that the small surviving forms probably have a long geological history, and may have coexisted with the Lepidodendraceae. For these reasons no attempt has been made to arrange the orders in larger divisions, since such a division as that of the ligulate and eligulate forms, while convenient for practical purposes, may not express the phylogeny of the group. The Psilotaceae, formerly included in the Lycopodiales, have been described separately owing to their resemblance to the Sphenophyllales. It remains to be mentioned that the Isoëtaceae have been regarded as more nearly allied to the Filicales than to the former, near which they are here placed.

V. Ophioglossales.—The peculiarities of this small order of Pteridophyta render their systematic position a matter of doubt, especially in the absence of evidence as to their geological history, and justify their separation for the present from the other main natural groups. In the three genera, *Ophioglossum*, *Botrychium* and *Helminthostachys*, there is an underground rhizome, from which one leaf or a few leaves with sheathing bases are produced annually; the roots arise in more or less definite relation to the insertion of the leaves. The latter are simple, or irregularly lobed in *Ophioglossum*, more or less compoundly pinnate in *Botrychium* and palmately pinnate in *Helminthostachys*. The fertile branch or branches are situated on the adaxial surface of the leaves, and may be simple, as in *Ophioglossum* (fig. 2, *d*), or more or less compound, the degree of branching in the sterile and fertile segments exhibiting a general parallelism. The stem is monostelic, the arrangement of the xylem and phloem being collateral. The endodermis and pericycle surround the whole stele in *Botrychium* and *Helminthostachys*; in *Ophioglossum* each bundle has a separate sheath. Well-marked secondary thickening occurs in *Botrychium*. In the roots of *Ophioglossum* and *Botrychium* and in the first formed roots of *Helminthostachys* an endophytic fungus is present, forming a mycorhiza—the stele in the larger roots has the usual radial arrangement of xylem and phloem; monarch roots occur in *Ophioglossum*. The morphology of the fertile spike is a disputed question, upon the answer to which the systematic position of the Ophioglossaceae largely rests. The spike is most simple in *Ophioglossum*, where it bears on each side a row of large sporangia, which hardly project from the surface, the vascular bundles occupying a central position. In the young spike, which arises when the leaf is still very small, a band of tissue derived from superficial cells is distinguishable along either side; this sporangiogenic band gives rise to the sporogenous groups, the sterile septa between them, and the outer walls of the sporangia. The spike of *Helminthostachys* corresponds to that of *Ophioglossum*, but in it the sporangia are borne on two lateral rows of branched sporangiophores. The sporangia themselves resemble those of *Botrychium*, which project from the ultimate subdivisions of the branched spike; each is developed from a number of cells, the sporogenous tissue arising from a single cell. Two diverse views of the morphology of the fertile spike in these plants have been entertained. The older view was that it was a fertile segment of the leaf; and though its ventral position presents a difficulty, this must be regarded as a possible explanation; the occasional occurrence of sporangia on the lamina in *Botrychium* has been regarded as supporting it. On the other hand, the spike has been explained as due to the elaboration of a single sporangium occupying a similar position with regard to the leaf as in the Lycopodiales, and evidence of considerable weight has been brought forward in support of this interpretation. The important bearing of this question on the relationship of the Ophioglossaceae to the phyla of the Filicales and Lycopodiales will be obvious.

The position of the fertile spike in relation to the leaf corresponds to that of the synangium or sporangiophores in the Psilotales and Sphenophyllales. The Ophioglossaceae are homosporous, and the prothalli, which are known in species of all three genera, are subterranean and saprophytic (fig. 1, *f*, *g*). The prothallus of *O. pedunculosum*, as observed by Mettenius, subsequently reached the surface and produced green lobes; those of the other species known are wholly saprophytic, and contain an endophytic fungus. Those of *Ophioglossum* are cylindrical, while the dorsiventral prothallus of *Botrychium* bears the sexual organs on the upper surface. They present a general, but probably homoplastic, resemblance to the saprophytic prothalli of certain *Lycopodia*. Important points of difference exist, however, in the apical position of the meristem of the Ophioglossaceous prothalli, in the presence of a basal cell to the archegonium, and in the multiciliate spermatozoids. In these respects, in the megaphyllous habit and in certain anatomical features, the Ophioglossaceae approach the Filicales. Some species of *Botrychium* have recently been found to have embryos provided with a suspensor. The position of the Ophioglossaceae can at present only be regarded as an open question, in considering which the possible antiquity of the group must be borne in mind.

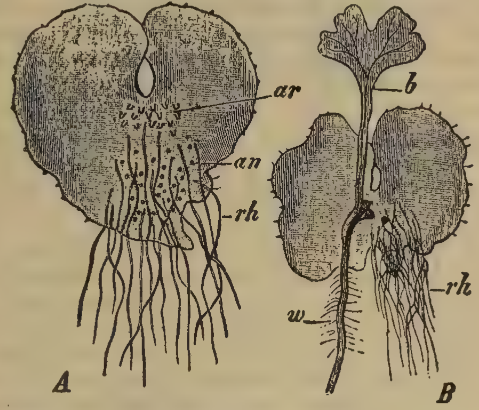
VI. Filicales.—This group of Pteridophyta differs from the others in being well represented in our present flora by forms, many of which can be regarded not as archaic types which have persisted to the present day, but as having been evolved in comparatively recent periods. The Ferns exhibit a wide range in size from the minute epiphytic Hymenophyllaceae, with leaves barely a centimetre in length, to gigantic tree-ferns 80 ft. or more in height. A general characteristic of their habit is the large size of the leaves, which are often highly compound, relatively to the stem. Some ferns have a longer or shorter erect stem often clothed by the persistent bases of the leaves; in others the stem creeps on the surface of the substratum or is subterranean. Its surface is clothed with filamentous or scaly hairs (paleae), which protect the growing point; and adventitious roots spring from it. The position of the branches varies in the group; they are only exceptionally axillary (Hymenophyllaceae, Botryopterideae). The anatomy of the stele in the stem exhibits on the whole a progression from a solid protostele through a tubular solenostele to one or more circles of separate steles derived by the breaking up of the solenostele. The leaf-traces usually interrupt the continuity of the stele of the axis on their departure. The sporangia are borne in groups (sori) on the under surface of the leaves; sometimes the fertile leaves differ more or less from the purely vegetative ones. The form of the sorus and the structure of the sporangium are of great systematic importance. The sorus is frequently protected by an outgrowth from the surface or margin of the leaf called the indusium. Heterospory is only known in the Hydropterideae. The prothallus developed from the spore is green and in most cases dorsiventral, bearing the archegonia and antheridia on the under surface.



(From Strasburger's *Lehrbuch der Botanik*.)

Fig. 6.—*Scolopendrium vulgare*.

Some of the more striking adaptive modifications in the gametophyte and sporophyte, and certain effects of altered external conditions which have been ascertained experimentally, may be briefly mentioned. The dorsiventrality of the prothallus has been shown to depend mainly on the illumination, the filamentous form being retained in feeble light; a similar result is obtained when the prothalli are cultivated in water. These facts may have a bearing on the filamentous prothalli of some Hymenophyllaceae. The reproduction of the prothallus by gemmae in species of *Trichomanes*, *Vittaria* and *Monogramme* is another interesting adaptation; the prothallus of *Gymnogramme* *leptophylla* is perennial, the sporophyte being annually borne on it. The phenomena of apogamy and apospory which have now been observed in a number of Ferns, may be mentioned here. In the former the prothallus produces one or more fern-plants vegetatively, the projection which develops into the sporophyte in many cases occupying the position of an archegonium. In some apogamous Ferns sporangia may occur on the prothallus and the vegetative organs of the sporophyte may also occur singly. In apospory the converse phenomenon is seen, the gametophyte springing vegetatively from the sporangium, receptacle of the sorus, or leaf-margin of the fern-plant. In a number of cases, though not in all, apospory appears to be correlated with a failure of the sporangia to develop.



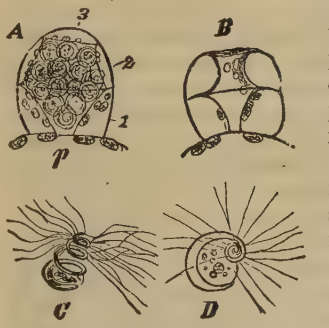
(From Strasburger's *Lehrbuch der Botanik.*)

FIG. 7.—*Nephrodium filix-mas.*

A, Prothallus viewed from the lower surface; *ar*, archegonia; *an*, antheridia; *rh*, rhizoids (much enlarged).

B, Prothallus bearing a young fern plant; *b*, first leaf; *w*, primary root.

The adaptations in the vegetative organs of the sporophyte are similar to those in the Flowering Plants. Thus there are a few Ferns which climb, others are water plants, while many, especially those which live as epiphytes, are more or less xerophytic. Some of the epiphytic forms (*Polypodium quercifolium*, *Platycerium*) have strongly dimorphic leaves, the sterile leaves serving in some cases to catch falling débris, and thus to provide the plant with soil. Lastly, the symbiotic relation between the plant and ants is found in Ferns, the rhizome of *Polypodium carnosum* containing cavities inhabited by these insects. The existence of these myrmecophilous Ferns suggests a possible explanation of the nectaries on the leaves of some other species, such as the Common Bracken.



(From Strasburger's *Lehrbuch der Botanik.*)

FIG. 8.—*Polypodium vulgare.*

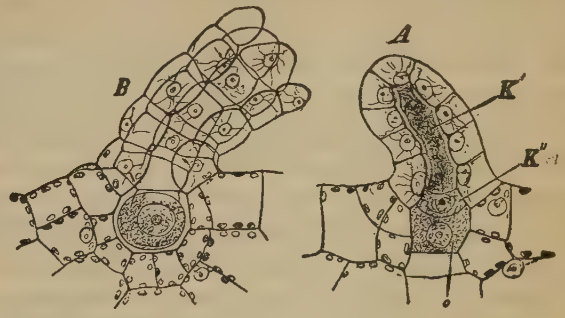
A, Mature antheridium.

B, Empty antheridium; *p*, prothallial cell; 1, 2, cells of antheridial walls; 3, cap cell.

C, *D*, Spermatozoids.

The main existing groups of the Filicaceae may now be briefly described, with special reference to the characters of gametophyte and sporophyte, which have been found of value in determining affinities.

Marattiaceae.—These are ferns of considerable size, the large leaves of which are borne on a short, erect, swollen stem (*Angiopteris*, *Marattia*), or arise from a more or less horizontal rhizome (*Danaea*, *Kaulfussia*). The leaves, at the base of which are two large stipule-like outgrowths, have a thick leaf-stalk, and are simple or simply pinnate in *Danaea*, pinnate in *Archangiopteris*, bi- to tri-pinnate in *Marattia* and *Angiopteris*, and digitately lobed in *Kaulfussia*. The stem, from the ground tissue of which sclerenchyma is absent, has a complicated system of steles arranged in concentric circles; the thick roots, the central cylinders of which have several alternating groups of xylem and phloem, arise in relation to these. The pinnae, except in a few filmy forms, are thick; in *Kaulfussia* large pores derived from stomata occur in the epidermis. The sori are borne on the under surface of the pinnae, usually in a single row on either side of the midrib, but in *Kaulfussia* dotted over the expanded lamina. The large sporangia, each of which originates from a number of superficial cells, are here incompletely separated from one another and arranged in a single circle forming a synangium. The association is closest in *Danaea*, where the individual sporangia of the elongated sorus, which is sunk in a depression of the leaf, open by pores; in *Marattia* and *Kaulfussia* (fig. 2, *e*) they dehisce by slits on the inner face; while in *Angiopteris* (fig. 2, *f*) they are almost free from one another. The spores produce a green prothallus of large size, the sexual organs of which hardly project from the surface. The cotyledon and stem grow up vertically through the prothallus, the root turning downwards into the soil.



(From Strasburger's *Lehrbuch der Botanik.*)

FIG. 9.—*Polypodium vulgare.*

A, Unopened archegonium; *o*, ovum; *k''*, ventral canal cell; *k'*, neck-canal-cell.

B, Mature opened archegonium.

Osmundaceae.—The two genera of this group, *Osmunda* and *Todea*, have thick erect stems, covered with the closely crowded leaf bases. The stem is monostelic, the vascular tissues being separated into curved groups comparable with collateral vascular bundles, which surround the pith. The somewhat thick roots are diarch. The leaves are large and pinnate; their lamina is usually thick, though filmy species of *Todea* occur. The leaf-base shows indications of stipular outgrowths. In *Todea* the sori, each of which consists of a single circle of bulky sporangia, are borne on the under surface of the pinnae. In *Osmunda* the region of the leaf which bears the sporangia has its lamina little developed; the leaf thus bears sterile and fertile pinnae, or, as in *O. cinnamomea*, sterile and fertile leaves may be present. The sporangia originate from single cells, though surrounding cells may contribute to the formation of the stalk. The latter is thick and short, and the wall of the sporangium, which opens by a median slit, has a group of thick-walled cells at the summit, forming the annulus. The prothalli are similar to those of the other Filicaceae, but more massive; the same may be said of the archegonia and antheridia, which, however, project more than in the preceding group.

Schizaeaceae.—The anatomy of the stem differs in the four recent genera of this order, and presents a series possibly illustrating the origin of a number of concentric steles from a solid stele, the intermediate step being represented by those forms in which the central cylinder is tubular. The sporangia are borne singly or in sori of two or three on the margin or under surface of leaves, the fertile pinnae of which differ more or less from the sterile segments. The sporangium is of considerable size, and dehisces by a median slit, the annulus being a more or less definitely limited horizontal ring of cells near the apex. The prothallus and sexual organs may resemble those of the Polypodiaceae; in *Aneimia* and *Mohria* the prothallus, though flattened, is not bilaterally symmetrical, the growing point being on one side; a filamentous type of prothallus is known in *Schizaea*.

Gleicheniaceae.—These forms have a horizontal rhizome, from which simply pinnate leaves arise in *Platyzoma*, while *Gleichenia* bears compound pinnate leaves with continued apical growth. The rhizome usually has a solid central cylinder in *Gleichenia*, while that of *Platyzoma* is tubular. The sporangia arise simultaneously in the sorus, which is borne on the under surface of the ordinary pinna; in those species with large sporangia the latter form a single circle, in others sporangia may also arise from the central part of the receptacle. The annulus is horizontal and the dehiscence median. The prothalli, while resembling those of the Polypodiaceae, have points of similarity with those of the preceding groups.

Matoniaceae.—This contains the single genus *Matonia*, two species of which are known from the eastern tropics. They are of special interest, since they have been shown to be the surviving forms of a group species which have been identified from Jurassic and Cretaceous rocks. The living species have a long rhizome, from the upper surface of which the large leaves arise; these are branched in a pedate manner, each branch being pinnate. The structure of the rhizome is complicated, a transverse section showing that the centre may be occupied by a solid stele, outside of which are two tubular steles. The sori are borne on the under surface of the pinnae, each consisting of a single series of large sporangia covered by a coriaceous indusium, which is attached to the central part of the receptacle. The sporangium, which corresponds on the whole to that of the Gleicheniaceae, has a somewhat oblique annulus; the dehiscence also is not truly median. The gametophyte is unknown.

Loxsomaceae.—The single genus *Loxsoma* has a tubular stele in its rhizome, which bears leaves resembling those of some *Davallias*. The elongated receptacle of the marginal sori is surrounded by a basal cup-shaped indusium. The sporangia, which arise in basipetal succession on the receptacle, dehisce by a median slit, though the annulus is somewhat oblique; they have resemblances to the Gleicheniaceae. When mature, the sporangia are raised above the margin of the indusium by the elongation of the receptacle, thus facilitating the dispersion of the spores. The gametophyte is unknown.

Hymenophyllaceae.—This group, which contains the two genera *Hymenophyllum* and *Trichomanes*, is characterized by the prevalent "filmy" texture of the leaves. Many of the species inhabit situations in which the air is constantly moist, especially in the tropics; some are terrestrial; others, some of which are very minute, are epiphytic on tree-stems. A single solid central cylinder is found in the rhizome. The sori, which are marginal, have a long receptacle, bearing the sporangia in basipetal succession, and are surrounded by a cup-shaped indusium. The sporangia present a considerable range in size, the largest being found in species of *Hymenophyllum*, the smallest in *Trichomanes*. Each has an almost horizontal annulus resembling that of *Gleichenia*, but the dehiscence is lateral. The gametophyte in *Hymenophyllum* is flat and variously lobed; that of *Trichomanes* may be similar, but in other species is filamentous. The archegonia and antheridia present points of similarity to those of the Gleicheniaceae.

Cyatheaceae.—This order includes the majority of existing tree-ferns, as well as some of smaller size. The stem has a ring of flattened steles. The sorus has a somewhat elongated receptacle, on which the sporangia arise basipetally; the indusium may be cup-shaped, bivalve or wanting. The dehiscence of the sporangium is almost transverse, as in the Polypodiaceae, but the annulus is slightly oblique. The prothalli correspond to those of the next group.

Polypodiaceae.—This group, which contains the remaining ferns, includes a number of distinct lines of descent and will doubtless require subdivision as our knowledge of the morphology of the genera classed in it becomes extended. Space will not allow of an account of the progress already made in this direction. The stem in the more primitive forms has a tubular stele (solenostele); for the most part two to many steles, arranged in a ring (dictyostele). In a number of genera, which there is reason to regard as relatively primitive, the sporangia show the same regular basipetal succession as in some of the preceding groups; in the great majority, however, the succession is not regular, but those of various ages are intermixed in the sorus (fig. 2, *g*). The sporangia dehisce by a transverse slit, the annulus being truly vertical or, in some of the genera in which they are regularly arranged, very slightly oblique. The structure of the prothallus and sexual organs will be evident from figs. 7, 8 and 9; some of the more interesting modifications have been referred to above.

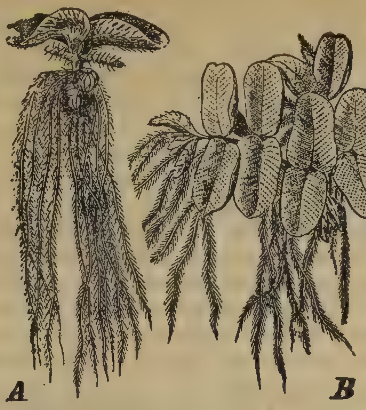
Our knowledge of the extinct Filicales cannot be readily summarized, since it is in a transition state, owing to the recent evidence which has shown that many of the fern-like plants of the Palaeozoic period belonged to a group of seed-bearing plants derived from a filicineous ancestry. There is, however, abundant evidence that the Ferns were represented in the most ancient floras known, though they were not such a dominant group as has hitherto been supposed. The best known of these ancient Ferns belong to the Botryopterideae; the characters of this group point to its having been the starting-point of several series of existing Ferns (see PALAEOBOTANY: *Palaeozoic*).

A consideration of the Filicaceae as arranged above will show that the several sub-orders may in general terms be said to form a series between those in which the sorus consists of a single circle of bulky sporangia and those Polypodiaceae in which the numerous small sporangia appear to be grouped without order in the sorus. When the survey is extended to the extinct Ferns of which the fructification is known, many of those from the more ancient rocks are found to group themselves with the existing sub-orders with large sporangia, such as the Marattiaceae, Gleicheniaceae and Schizaeaceae; the Polypodiaceae, on the other hand, do not appear until much later. The extinct forms cannot be dealt with in detail here; but it may be pointed out that their order of appearance affords a certain amount of direct evidence that the existing Ferns with a single circle of large sporangia in the sorus are relatively primitive. The series which can be constructed from a study of the sorus is in general supported by the anatomy of the sporophyte, and by the structure and sexual organs of the gametophyte. A more detailed investigation of all the characters of the Ferns will be needed before the course of evolution thus broadly indicated can be traced, but the results obtained afford a deeper insight into the general method of progression and the selective factors in the process. On the ground mainly of an examination of the sorus and sporangium, Bower has shown that the Filicaceae may be divided into three groups—the *Simplices*, *Gradatae* and *Mixtae*—in which the sporangia arise simultaneously, in basipetal succession, or irregularly in the sorus respectively. The first includes the Marattiaceae, Osmundaceae, Schizaeaceae, Gleicheniaceae and Matoniaceae; the second the Loxsomaceae, Hymenophyllaceae, Cyatheaceae and the Dennstaedtineae (a group including species placed in the *Synopsis Filicum* in *Dicksonia* and *Davallia*); while the remaining Polypodiaceae constitute the Mixtae. The change from the one type of sorus to the other may have taken place in several different lines of descent, some of which have been traced. A consideration of the biology of the sorus gives an insight into the advantages obtained by the one type over the preceding, as regards protection, spore production and the dispersal of the spores, and thus indicates the way in which natural selection may have acted. The differences in the form and mode of dehiscence of the sporangia (those of the Simplices having median dehiscence and a horizontal annulus, those of the Gradatae a more or less oblique position of the annulus and of the plane of dehiscence, while in the Mixtae the annulus is vertical and the dehiscence transverse) stand in relation to the position of the sporangia in the sorus relatively to one another. The application of the important criteria which Bower has thus pointed out to the construction of a strictly phylogenetic classification of the Filicaceae cannot be made until the anatomy, the sexual generation and the palaeobotanical evidence have been further examined from this point of view. Though on this account and because the subdivisions Simplices, Gradatae and Mixtae do not correspond to definite phylogenetic groups, they have not been used in classifying the Ferns above; they are of great importance as an advance towards a natural classification.

HYDROPTERIDEAE.—Two very distinct orders of heterosporous Filicales, the Salviniaceae and the Marsiliaceae, are included in this group. The difficulty of determining their exact relationship to the other orders of Ferns is increased by the more or less completely aquatic habit of the plants and the modifications and reductions in structure associated with this. The absence of an annulus from their indehiscent sporangia makes it impossible to compare them with the other Ferns in respect of this important character. It has been suggested with considerable probability that the Marsiliaceae are allied to the Schizaeaceae, while the Salviniaceae may possibly be related to the Hymenophyllaceae or to some other family of the Gradatae. Space will only permit of a brief general account of the more obvious features of the several genera, the structure and life-history of which are known in great detail. Unlike as they are in many respects, the two orders agree in being heterosporous. The microspores on germination produce a small, greatly reduced male prothallus bearing one or two antheridia which give rise to a number of spirally coiled, multiciliate spermatozoids. The single large megaspore contained in each megasporangium produces a small prothallus, which bears one or a few archegonia; these are exposed on the surface of the prothallus at the summit of the germinated megaspore (fig. 1, *i*).

1. The Salviniaceae include the two genera *Salvinia* (fig. 10) and *Azolla*. The small dorsiventral plants are in both cases floating aquatics. *Azolla* has roots depending from the lower surface of the stem into the water, while these organs are completely wanting in *Salvinia*, their place being taken functionally by highly divided leaves borne on the ventral surface of the stem. *Nostoc* colonies are constantly present in a special cavity of the dorsal lobe of the leaf in *Azolla*. The sporangia in both genera are associated in sori enclosed by indusia springing from the base of the receptacle. In *Salvinia* (fig. 2, *h*) the sori are borne towards the base of the submerged leaves, in *Azolla* on the reduced ventral lobe of the leaf. They consist either of microsporangia or megasporangia, which are arranged in basipetal succession on the receptacle. In the megasorus of *Azolla*

there is only the one terminal, functional sporangium. The microspores are united by means of hardened protoplasm into one or more masses, while the solitary megaspores have a more or less complicated episporium.



(Reduced. After Bischoff from Strasburger's *Lehrbuch der Botanik.*)

FIG. 10.—*Salvinia natans.*
A, From the side. *B*, From above.

2. The Marsiliaceae also include two genera, *Marsilia* and *Pilularia*, the latter of which is found in Britain. The plants grow as a rule in marshy places, though some species of *Marsilia* are xerophytic. The creeping stem produces roots from the ventral surface and leaves from the dorsal surface; the leaves when young are circinately coiled. The leaves are simple and linear in *Pilularia*, but in *Marsilia* bear a pinnate four-lobed lamina. The highly specialized sporocarps are borne on the basal portions of the leaves, as a rule singly, but in some species of *Marsilia* in numbers. The development of the sporocarp shows that it corresponds to a pinna, although when mature it may appear to occupy a ventral position in relation to the vegetative portion of the leaf. It has a complicated structure in both genera; in *Pilularia* its shape is nearly spherical, while in *Marsilia* it is elongated and bean-shaped. The sori are developed in depressions and are thus protected within the resistent outer wall of the sporocarp. There are usually four sori in *Pilularia*, while in *Marsilia* they form two longitudinal rows. Each sorus includes both microsporangia, with numerous spores, and megasporangia, each of which contains a single megaspore with a complicated wall. Enclosed within the sporocarp they can endure a period of drought, but on the return of moist conditions are extruded from the sporocarp by the swelling of a special mucilaginous tissue and the spores become free. The development of the prothalli is in general similar to that of the Salviniaceae, though the resemblance may be homoplastic. The stem in the less reduced forms is solenostelic with sclerenchymatous ground tissue occupying the centre of the stele.

In the absence of direct evidence from Palaeobotany, and bearing in mind the modifications associated with adaptation to an aquatic life in other plants, the recognition of any more definite affinity for these heterosporous ferns than that indicated above appears to be inadvisable. Further evidence is necessary before they can be removed from such a position of convenience as is assigned to them here and placed in proper relation to the series of the Filicaceae.

Phylogeny.

The several phyla of Pteridophyta having now been briefly described, their relationship to one another remains for consideration. The available evidence does not suffice to solve this question, although certain indications exist. In the earliest land vegetations of which we have any sufficient record specialized forms of Equisetales, Lycopodiales, Sphenophyllales and Filicales existed, so that we are reduced to hypotheses founded on the careful comparison of the recent and extinct members of these groups. In this connexion it may be pointed out that the fuller study of the extinct forms has as yet been of most use in emphasizing the difficulty of the questions at issue. It has thus led to a condition of uncertainty as regards the relationship of the great groups of Vascular Cryptogams, in which, however, lies the hope of an ultimate approach to a satisfactory solution. The study of the Sphenophyllales, however, as has been pointed out above, appears to indicate that the Equisetales and Lycopodiales may be traced back to a common ancestry. As to the relationship of the Filicales to the other phyla, evidence from extinct plants appears to be wanting. If, as has been suggested by Bower, the strobiloid types are relatively primitive, the large-leaved Pteridophyta must be supposed to have arisen early from such forms. The question cannot be discussed fully here, but enough has been said above to show that in the light of our present knowledge the main phyla of the Vascular Cryptogams cannot be placed in any serial relationship to one another.

It may even be regarded as an open question whether some of them may not have arisen independently and represent parallel lines of evolution from Bryophytic or Algal forms. This leads us to consider the question whether any indications exist as to the manner in which the Pteridophyta arose. It will be evident that no direct record of this evolution can be expected, and recourse must be had to hypotheses founded on the indirect evidence available. There appears to be no reason to doubt that the sexual generation is homologous with the thallus of a Liverwort, or of such an Alga as *Coleochaete*. It is with regard to the origin of the spore-bearing generation of the Pteridophyta that differences of opinion exist. This, though at first dependent on the prothallus, soon becomes independent. It may be regarded as derived from a wholly dependent sporogonium not unlike that of some of the simpler Bryophyta; the latter are assumed to have arisen from primitive Algal forms, in which, as the first step in the interpolation of the second generation in the life cycle, the fertilized ovum gave rise to a group of swarm spores, each of which developed into a new sexual plant. On this view the origin of the sporophyte is looked for in the gradual development of sterile tissue in the generation arising from the fertilized ovum, and a consequent postponement of spore-formation. Certain green Algae (*e.g. Oedogonium, Coleochaete*), the Bryophyta, and the simpler Pteridophyta, such as *Phylloglossum*, have been regarded as illustrating the method of progression, though there is no reason to regard the existing forms as constituting an actual series. For a discussion of this view, which regards the alternation of generations in Pteridophytes as antithetic and the two generations as not homologous with one another, reference may be made to the works of Celakovsky and Bower. Although the antithetic theory is supported by many facts regarding the life-history and structure of the group of plants under consideration, it is quite possible that a stage in which the sporophyte was wholly dependent on the gametophyte may never have been passed through in their evolution. The spore-bearing generation may throughout its phylogenetic history have been independent at one part of its life, and have been derived by modification of individuals homologous with those of the sexual generation, and not by the progressive sterilization of a structure the whole of which was originally devoted to asexual reproduction. A number of facts regarding the Algae, and also those relating to such deviations from the normal life cycle as apogamy or apospory, may be regarded as lending support to this view, which, in contrast to the theory of antithetic alternation, has been called that of homologous alternation. Without entering further into the discussion of these alternative theories, for which the literature of the subject must be consulted, it may be pointed out that on the latter view the strobiloid forms of Pteridophyta would not necessarily be regarded as primitive relatively to the large-leaved forms, and also that the early stages of the origin of the sporophyte in the two cases may have proceeded on different lines.

Another question of great interest, which can only be touched upon here and may fitly close the consideration of this division of the Vegetable Kingdom, concerns the evidence as to the derivation of higher groups from the Pteridophyta. The most important positive evidence on this point indicates that the most ancient Gymnosperms were derived from the Filicales rather than from any other phylum of the Vascular Cryptogams. Extinct forms are known intermediate between the Ferns and the Cycads, and a number of these have been shown to bear seeds and must be classed as Pteridospermae. These forms will, however, be found discussed in the articles treating of extinct plants and the Gymnosperms, but their recognition will serve to emphasize, in conclusion, the important position the Pteridophyta hold with regard to the existing flora.

Cultivation.—Numerous species of ferns, both temperate and tropical, are cultivated as valued ornamental plants. Species of the other groups are occasionally grown for scientific purposes in the larger botanic gardens, but their cultivation, which often presents special difficulties, need not be referred to here. While a number of ferns can be multiplied vegetatively, by buds formed on the leaves and in other ways, the regular mode of propagation is by sowing the spores shed from the ripe sporangia. The spores should be thinly sprinkled on the surface of the soil in well-drained pots, which should stand in saucers filled with water and be covered with glass plates. After the prothalli have attained some size and bear sexual organs the pots should be occasionally sunk in water so as to flood the prothalli for a few minutes and facilitate fertilization. The young plants developed on the prothalli should be carefully pricked out into other pans and later transferred to 3-in. pots. When the pots are fairly filled with roots the plants may be shifted into larger ones.

The best time for a general repotting of ferns is in spring, just before growth commences. Those with creeping rhizomes can be propagated by dividing these into well-rooted portions, and, if a number of crowns is formed, they can be divided at that season. In most cases this can be performed with little risk, but the *Gleichenias*, for example, must only be cut into large portions, as small divisions of the rhizomes are almost certain to die; in such cases, however, the points of the rhizomes can be led over and layered into small pots, several in succession, and allowed to remain unsevered from the parent plant until they become well rooted. In potting the well-established plants, and all those of considerable size, the soil should be used in a rough turfy state, not sifted but broken, and one-sixth of broken crocks or charcoal and as much sand as will insure free percolation should be mixed with it.

The stove ferns require a day temperature of 65° to 75°, but do not thrive in an excessively high or close dry atmosphere. They require only such shade as will shut out the direct rays of the sun, and, though abundant moisture must be supplied, the atmosphere should not be loaded with it. The water used should always be at or near the temperature of the house in which the plants are growing. Some ferns, as the different kinds of *Gymnogrammae* and *Cheilanthes*, prefer a drier atmosphere than others, and the former do not well bear a lower winter temperature than about 60° by night. Most other stove ferns, if dormant, will bear a temperature as low as 55° by night and 60° by day from November to February. About the end of the latter month the whole collection should be turned out of the pots and redrained or repotted into larger pots as required. This should take place before growth has commenced. Towards the end of March the night temperature may be raised to 60°, and the day temperature to 70° or 75°, the plants being shaded in bright weather. Such ferns as *Gymnogrammas*, which have their surface covered with golden or silver powder, and certain species of scaly-surfaced *Cheilanthes* and *Nothochlaena*, as they cannot bear to have their fronds wetted, should never be syringed; but most other ferns may have a moderate sprinkling occasionally (not necessarily daily) and as the season advances sufficient air and light must be admitted.

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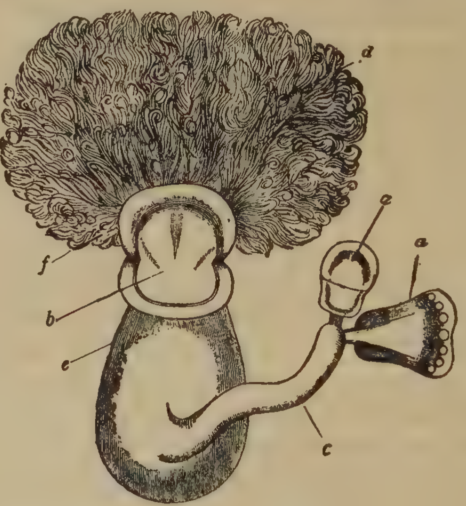
(W. H. L.)

PTEROBRANCHIA, a zoological group established by Ray Lankester in 1877. It contained at that time the single genus *Rhabdopleura*, a minute animal dredged by Sars off the Lofoten Islands, and by Norman off the Shetlands. *Rhabdopleura* was at first regarded as an aberrant Polyzoon, but with the publication of the *Challenger Report* (*Cephalodiscus*) in 1887, it became clear that *Cephalodiscus*, the second genus now included in the order, had affinities in the direction of the Enteropneusta. The connexion of the Pterobranchia with the Polyzoa is in the highest degree questionable.

Rhabdopleura is no doubt of world-wide distribution, since it has been recorded in various localities from Greenland to South Australia, usually in water of not less than forty fathoms. *Cephalodiscus*, which for many years was known solely as the result of a single dredging by the "Challenger" from 245 fathoms in the Straits of Magellan, has recently been found in entirely different parts of the world, as for instance between Japan and Korea at 100 fathoms, at about half that depth off the south-east coast of Celebes, and between tide-marks on the coast of Borneo. It appears to be common in the neighbourhood of Cape Town, while the recent Antarctic expeditions have shown that it occurs in various localities from the Falkland Islands to the Antarctic circle. No less than twelve species, referred to three sub-genera (*Demiothecia*, *Idiothecia*, *Orthoecus*), have now been described; but it is at present uncertain whether more than a single species of *Rhabdopleura* is valid, although several specific names have been suggested for specimens from different localities.

Both genera are characterized by their habit of secreting a tubular gelatinoid investment, the "coenoecium," composed of a number of superposed lamellae, doubtless the result of its intermittent secretion, mainly though perhaps not exclusively, by the proboscides of the zooids. In *Rhabdopleura* each zooid forms its own delicate tube composed of a characteristic series of distinct rings. In *Cephalodiscus* the coenoecium is more massive, and may contain a continuous irregular cavity in which the zooids live (*Demiothecia*), or may be secreted in such a way that each zooid has its own independent tube (*Idiothecia*, *Orthoecus*).

The zooids are a modification of the type of structure known in *Balanoglossus*, from which they differ principally in the following respects: (i.) The alimentary canal, instead of being straight, has a U-shaped flexure, the dorsal line between the mouth and the anus being short. (ii.) The proboscis (fig. 1, *b*), known as the "buccal shield," is a large organ, strongly flattened in an antero-posterior direction, its ventral lobe usually concealing the mouth. (iii.) The collar is produced dorsally into arms (one pair in *Rhabdopleura*, four to eight pairs in *Cephalodiscus*), each of which bears numerous ciliated tentacles, the organs by which the microscopic food-particles are conveyed to the mouth. (iv.) The third division of the body, the metasome, is prolonged ventrally into a relatively enormous outgrowth containing the loop of the alimentary canal, beyond which projects a stalk (fig. 1, *c*), of a length varying with the state of contraction and perhaps with the species. (v.) The stalk gives rise to buds, by which the colonial habit is acquired. While in *Rhabdopleura* the buds remain in organic continuity with the parent, in *Cephalodiscus* they become free at an early stage, and the coenoecium accordingly contains a number of separate individuals. In the living *Cephalodiscus* a zooid can crawl by means of its proboscis over the gelatinous processes of the outer side of the coenoecium, a position which it can assume owing to the very great extensibility of the stalk, the proximal suctorial end of which remains attached to the inner surface of some part of the coenoecium (Andersson, 1907).

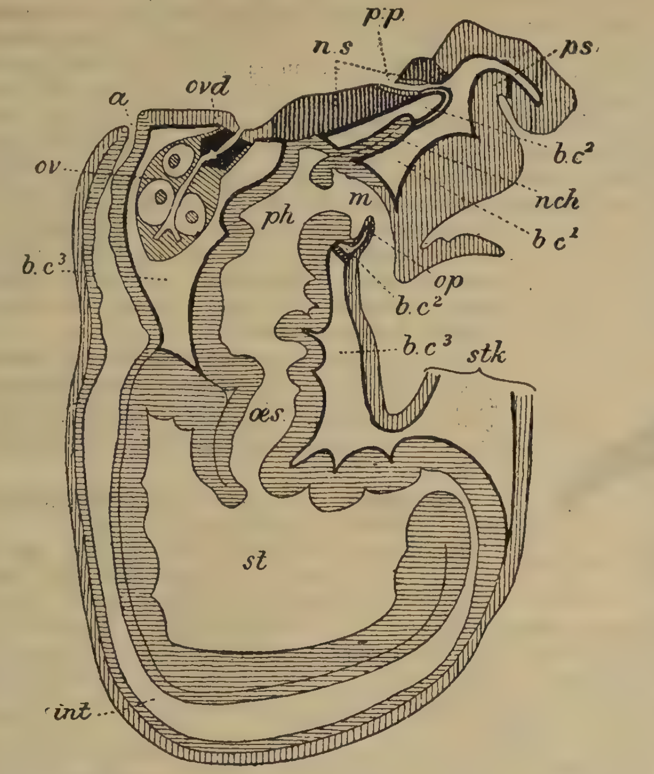


(From a drawing by Professor McIntosh.)

FIG. 1.—Zooid of *Cephalodiscus dodecalophus*.

a, *a*, Buds.
b, Proboscis.
c, Stalk.
d, Arms and tentacles.
e, Ventral edge of proboscis.
f, Its dorsal edge.

In correspondence with the fundamental constitution of the zooid, each of the three segments has its own body-cavity separated from the others. The main proboscis-cavity (fig. 2, *b.c.*^{1}) is unpaired, and opens to the exterior by the two proboscis pores (*p.p.*). It contains a closed vesicle regarded by Schepotieff as a right proboscis-cavity and in any case representing the pericardium of *Balanoglossus*, the glomerulus of which is also probably represented. The collar-cavity (*b.c.*^{2}) is paired, although its ventral mesentery is not complete. It extends into the arms, which originate in the bud (fig. 1) as dorsal outgrowths of the collar. The ventral and lateral parts of the anterior margin of the collar constitute the so-called operculum (*op.*), a structure which not only acts as a lower lip, but must be important in separating the food-current produced by the cilia of the tentacles from the external apertures of the collar-canals and gill-slits. The collar-canals (fig. 3, *c.p.*) are a pair of ovoid organs which open from the collar-cavity to the exterior, their external pores lying immediately behind the base of the operculum.



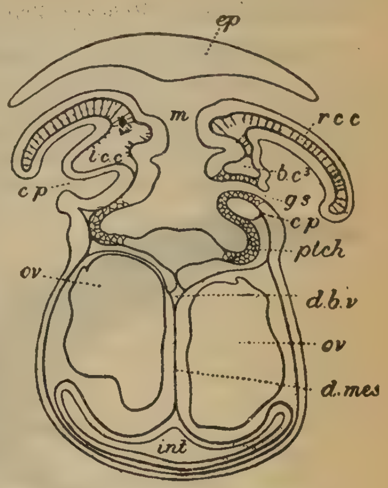
(After Harmer.)

Fig. 2.—Median (sagittal) section of *Cephalodiscus dodecalophus.*

a,	Anus.	*op.*,	Operculum, or ventral lip.
$b.c^1$.,	Body-cavity of proboscis.	*ov.*,	Ovary.
$b.c^2$.,	Of collar.	*ovd.*,	Oviduct.
$b.c^3$.,	Of metasome.	*ph.*,	Pharynx.
int.,	Intestine.	*p.p.*,	Proboscispore.
m.,	Mouth.	*p.s.*,	Proboscis.
nch.,	Notochord.	*st.*,	Stomach.
n.s.,	Central nervous system.	*stk.*,	Stalk.
oes.,	Oesophagus.		

While it is not improbable that the collar-pores and the proboscis-pores may evacuate excretory substances, there can be little doubt that their primary function is to regulate the turgidity of the segment to which they respectively belong. A pair of gill-slits (fig. 3, *g.s.*), which do not occur in *Rhabdopleura*, open immediately behind the collar-pores. It is probable that they serve to strain off the superfluous water which is introduced into the mouth during the process of feeding. An anterior median diverticulum of the pharynx (fig. 2, *nch.*), growing forwards in the septum between the proboscis-cavity and the collar-cavities, and supported dorsally by the median mesentery of the collar, is the representative of the so-called notochord or stomochord of *Balanoglossus*; and if the view that this organ is really a notochord is well founded, it may be regarded as the homologue of the anterior end of the Vertebrate notochord.

The metasome contains nearly the whole of the alimentary canal, in which pharynx (fig. 2, *ph.*), oesophagus (*oes.*), stomach (*st.*) and intestine (*int.*), may be distinguished. The remarkable position of the anus (*a*) on the dorsal side has already been alluded to. The metasomatic cavities are divided by dorsal (fig. 3, *d.mes.*) and ventral mesenteries, the latter following the outer curvature of the loop of the alimentary canal. The most conspicuous blood vessel possessed by *Cephalodiscus* is the dorsal vessel (*d.b.v.*). A ventral vessel occurs on the anterior side of the metasome and forms a loop extending down the entire length of the stalk, while a "heart" projects into the cavity of the pericardium, probably connected on the ventral side of the notochord with the ventral vessel, and on its dorsal side with the dorsal vessel. At their opposite ends the dorsal and ventral vessels are probably connected with one another by means of a splanchnic sinus surrounding the stomach. The original specimen of *C. dodecalophus* contained exclusively female zooids, in which a single pair of ovaries (figs. 2, 3, *ov.*) lie in the metasomatic cavities, and open to the exterior dorsally by short, highly pigmented oviducts (fig. 2, *ovd.*). In *C. nigrescens* and in some other species a zooid may contain a pair of ovaries, a pair of testes, or an ovary and a testis, although the males, females and hermaphrodites do not differ from one another in external characters. In *C. sibogae* (Celebes) the single colony known is of the male sex. The reproductive individuals have undergone an extraordinary simplification of the organs concerned with the collection and digestion of food. Thus the arms are reduced to a single pair and possess no tentacles, there is no definite operculum, and the alimentary canal is vestigial. The testes, which correspond in position with the ovaries of a female *Cephalodiscus*, constitute the greater part of the animal. Associated with these males are neuter zooids, which usually possess no functional reproductive organs, but have in other respects the structure of an ordinary female *Cephalodiscus*. It appears probable that there is a vascular connexion between these and the male individuals, which thus derive their nutriment from the neuters. The reproductive organs of *Rhabdopleura* have but seldom been observed. They resemble those of *Cephalodiscus* in structure and in position, except that in each sex the gonad occurs on the right side of the body only (Schepotieff, 1906).



(After Masterman.)

Fig. 3.—Section transverse to the long axis of *Cephalodiscus dodecalophus* (morphologically a frontal section).

$b.c^3$.,	Body cavity of metasome.
c.p.,	Collar-canal, above which is seen the operculum.
d.b.v.,	Dorsal blood-vessel.
d.mes.,	Dorsal mesentery.
ep.,	Proboscis.
g.s.,	Gill-slit.
int.,	Intestine.
l.c.c.,	Left collar-cavity.
m.,	Mouth.
ov.,	Ovary.
plch,	Vacuolated tissue of pharyngeal wall, the so-called "pleurochords" of Masterman.
r.c.c.,	Right collar-cavity.

The eggs of *Cephalodiscus* possess a large amount of yolk, and it is practically certain that there is no pelagic larval form. The embryos are hatched in an early stage, but their metamorphosis has not been observed. The early development appears to resemble that of the large-yolked species of *Balanoglossus*. In the bud-development, the three-segmented condition is extremely conspicuous, and a striking feature is the great relative size of the proboscis (fig. 1). A considerable part of the alimentary canal is said to be derived from the ectoderm in the buds of both *Cephalodiscus* and *Rhabdopleura*. Schepotieff (1907) states that in the young buds of the latter the central part of the alimentary canal is developed from cells which are apparently not of ectodermic origin.

The affinity of the Pterobranchia to the Enteropneusta may be regarded as definitely established. Considering the wide differences between the two groups in the size and external characters, and in the mode of life, including the mode of feeding, it is indeed surprising that in every important organ the two groups should show a fundamental morphological identity. Their relations to *Phoronis* are doubtful (see Phoronidea). The question of their affinity to other divisions of the animal kingdom depends principally on the views which are held with regard to the relationships of the Enteropneusta and Phoronidea respectively. The suggestion has been made by Allmann and recently upheld by Schepotieff that *Rhabdopleura* is related to some of the Graptolites.

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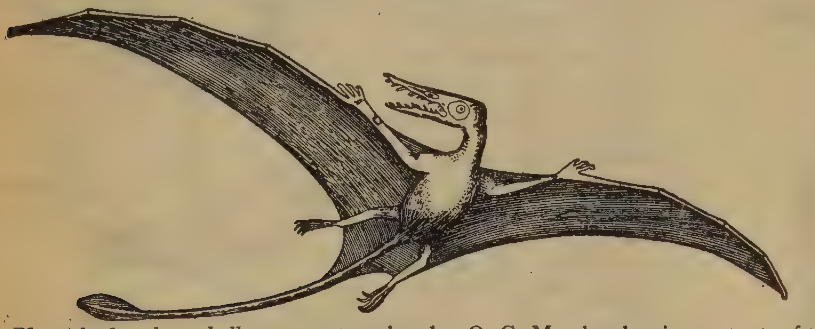
(1903), vol. xlvi. 715; "*Cephalodiscus:* Budding," &c., *Trans. Roy. Soc. Edin.* (1900), vol. xxxix. 507; (7) Ridewood, "*Cephalodiscus*" *Mar. Invest. S. Africa* (1906), vol. iv. 173; *National Antarctic Exp., Nat. Hist.*, ii. (1907); *Quart. Journ. Mic. Sci.* (1907), vol. ii., 221; (8) G. O. Sars, "*Rhabdopleura,*" *Christiania Univ. Program.* (1869), vol. i.; (9) Schepotieff, "*Rhabdopleura,*" *Zool. Jahrb. Abt. Anat.* (1906), vol. xxiii., 463; (1907), vol. xxiv., 193; "*Cephalodiscus*" (1907), vol. xxiv. 553; "*Rhabdopleura* and Graptolites," *Neues Jahrb. f. Mineral* (1905), Bd. ii. p. 79. (S. F. H.)

PTERODACTYLES (Gr. for wing-fingers), an extinct order of flying reptiles, variously known as Pterosauria (Gr. for wing-lizards) or Ornithosauria (Gr. for bird-lizards), whose remains occur in all Mesozoic formations from the Lower Lias to the Upper Cretaceous inclusive. Their bones are of very light, though strong construction, and hollow like those of flying birds, with well-fitting articulations, quite different from those of ordinary reptiles. The head is large and remarkably birdlike in shape, while it is fixed on the neck at the same angle as in birds. The brain is small, but resembles that of birds in its general conformation. The trunk is relatively small, with few slender ribs and a keeled breastbone (sternum). The forelimbs are always a pair of wings, the fifth digit or "little" finger being enormously elongated for the support of a smooth flying membrane (seen in specimens from the lithographic stone of Bavaria). The wings are thus constructed on the same plan as those of a bat, but instead of four fingers, only one is elongated to bear the membrane. The hind-limbs are comparatively feeble, and must have been of very little use for walking.



Rhamphorhynchus phyllurus: restoration by O. C. Marsh, showing extent of flying membranes.—Upper Jurassic (Lithographic stone); Bavaria.

The remains of pterodactyles are found chiefly in marine deposits, so that these reptiles must have frequented the coastlines. They probably fed partly on fish, partly on insects; but no traces of food have hitherto been observed within the fossil skeletons. The oldest satisfactorily known member of the group is *Dimorphodon* from the Lower Lias of Dorsetshire. The typical species has a skull about 20 centim. in length, with large teeth in front, smaller teeth behind: its tail is much elongated and slender. Equally fine skeletons of *Campylognathus* have been found in the Upper Lias of Württemberg. Other long-tailed pterodactyles occur well preserved in the Upper Jurassic (lithographic stone) of Bavaria and Württemberg, which is so fine-grained as to show impressions of the wing-membrane. In *Rhamphorhynchus* there is also a rhomboidal expansion of membrane at the end of the tail. The short-tailed *Pterodactylus* itself, sometimes no larger than a sparrow, is also found in the same formation. It was originally described by Collini in 1784 as an unknown sea-animal, and its true nature was first determined by Cuvier in 1809, when he named it "Pterodactyle." The Pterosaurians of the Cretaceous period, just before their extinction both in Europe and in North America, were of enormous size, and some became toothless. A pair of wings of the toothless *Pteranodon* from the Chalk of Kansas, now in the British Museum, measures about five and a half metres in span. Fragments of equally large pterodactyles with teeth are found in the English Chalk.

See H. G. Seeley, *The Ornithosauria* (Cambridge, 1870) and *Dragons of the Air* (London, 1901); S. W. Williston, paper in *Kansas University Quarterly* (1897), vi. 35; G. F. Eaton, papers in *Amer. Journ. Science* (1903–1904), 4th series, vols. xvi., xvii.

(A. S. Wo.)

PTERON (Gr. πτερόν, a wing), an architectural term used by Pliny for the peristyle of the tomb of Mausolus, which was raised on a lofty podium, and so differed from an ordinary peristyle raised only on a stylobate, as in Greek temples, or on a low podium, as in Roman temples.

PTOLEMAEUS, of Alexandria, surnamed Chennus, Greek grammarian during the reigns of Trajan and Hadrian. According to Suïdas, he was the author of an historical drama named *Sphinx*, of an epic, *Anthomeros*, in 24 books (both lost) and a *Strange History*. The last is probably identical with the work of which an abridgment has been preserved in Photius (*cod.* 190). It contains a medley of all sorts of legends and fables belonging to both the mythological and historical periods. It is probable that Chennus was also the author of a lost treatise on the life and works of Aristotle, ascribed to "Ptolemaeus" in an Arabic list of his works, taken from a Syriac version of the Greek original (A. Baumstark, *Aristoteles bei den Syrern vom v.-viii. Jahrh.*, Leipzig, 1900).

See editions of Photius's abridgment by J. Roulez (1834); and in A. Westermann, *Mythographi graeci* (1843); R. Hercher, *Über die Glaubwürdigkeit der neuen Geschichte des Ptolemäus Chennus* (Leipzig, 1856); J. E. Sandys, *Hist. of Classical Scholarship* (2nd ed., 1906).

PTOLEMIES, a dynasty of Macedonian kings who ruled in Egypt from 323 to 30 B.C.

The founder, Ptolemy (Πτολεμαῖος), son of Lagus, a Macedonian nobleman of Eordaea, was one of Alexander the Great's most trusted generals, and among the seven "body-guards" attached to his person. He plays a principal part in the later campaigns of Alexander in Afghanistan and India. At the Susa marriage festival in 324 Alexander caused him to marry the Persian princess Artacama; but there is no further mention of this Asiatic bride in the history of Ptolemy. When Alexander died in 323 the resettlement of the empire at Babylon is said to have been made at Ptolemy's instigation. At any rate he was now appointed satrap of Egypt under the nominal kings Philip Arrhidaeus and the young Alexander. He at once took a high hand in the province by killing Cleomenes, the financial controller appointed by Alexander the Great; he also subjugated Cyrenaïca. He contrived to get possession of Alexander's body which was to be interred with great pomp by the imperial government and placed it temporarily in Memphis. This act led to an open rupture between Ptolemy and the imperial regent Perdiccas. But Perdiccas perished in the attempt to invade Egypt (321). In the long wars between the different Macedonian chiefs which followed, Ptolemy's first object is to hold his position in Egypt securely, and secondly to possess the Cyrenaïca, Cyprus and Palestine (Coele-Syria). His first occupation of Palestine was in 318, and he established at the same time a protectorate over the petty kings of Cyprus. When Antigonus, master of Asia in 315, showed dangerous ambitions, Ptolemy joined the coalition against him, and, on the outbreak of war, evacuated Palestine. In Cyprus he fought the partisans of Antigonus and reconquered the island (313). A revolt of Cyrene was crushed in the same year. In 312 Ptolemy, with Seleucus, the fugitive satrap of Babylonia, invaded Palestine and beat Demetrius, the son of Antigonus, in the great battle of Gaza. Again he occupied Palestine, and again a few months later, after Demetrius had won a battle over his general and Antigonus entered Syria in force, he evacuated it. In 311 a peace was concluded between the combatants, soon after which the surviving king Alexander was murdered in Macedonia, leaving the satrap of Egypt absolutely his own master. The peace did not last long, and in 309 Ptolemy commanded a fleet in person which detached the coast towns of Lycia and Caria from Antigonus and crossed to Greece, where Ptolemy took possession of Corinth, Sicyon and Megara (308). In 306 a great fleet under Demetrius attacked Cyprus, and Ptolemy's brother, Menelaus, was defeated and captured in the decisive battle of Salamis. The complete loss of Cyprus followed. Antigonus and Demetrius now assumed the title of kings; Ptolemy, as well as Cassander, Lysimachus and Seleucus, answered this challenge by doing the same. In the winter (306–5) Antigonus tried to follow up the victory of Cyprus by invading Egypt, but here Ptolemy was strong, and held the frontier successfully against him. Ptolemy led no further expedition against Antigonus overseas. To the Rhodians, besieged by Demetrius (305–4), he sent such help as won him divine honours in Rhodes and the surname of *Sotēr* ("saviour"). When the coalition was renewed against Antigonus in 302, Ptolemy joined it, and invaded Palestine a third time, whilst Antigonus was engaged with Lysimachus in Asia Minor. On a report that Antigonus had won a decisive victory, for a third time he evacuated the country. But when news came that Antigonus had been defeated and slain at Ipsus (301) by Lysimachus and Seleucus, Ptolemy occupied Palestine for the fourth time. The other members of the coalition had assigned Palestine to Seleucus after what they regarded as Ptolemy's desertion, and for the next hundred years the question of its ownership becomes the standing ground of enmity between the Seleucid and Ptolemaïc dynasties. Henceforth, Ptolemy seems to have mingled as little as possible in the broils of Asia Minor and Greece; his possessions in Greece he did not retain, but Cyprus he reconquered in 295–4. Cyrene, after a series of rebellions, was finally subjugated about 300 and placed under his stepson Magas (Beloch, *Griech. Gesch.* III. [ii.], p. 134 seq.). In 285 he abdicated in favour of one of his younger sons by Berenice (*q.v.*), who bore his father's name of Ptolemy; his eldest (legitimate) son, Ptolemy Ceraunus, whose mother, Eurydice, the daughter of Antipater, had been repudiated, fled to the court of Lysimachus. Ptolemy I. Soter died in 283 at the age of 84. Shrewd and cautious, he had a compact and well-ordered realm to show at the end of fifty years of wars. His name for *bonhomie* and liberality attached the floating soldier-class of Macedonians and Greeks to his service. Nor did he neglect conciliation of the natives. He was a ready patron of letters, and the great library, which was Alexandria's glory, owed to him its inception. He wrote himself a history of Alexander's campaigns, distinguished by its straightforward honesty and sobriety.

Ptolemy II. *Philadelphus* (309–246), was of a delicate constitution, no Macedonian warrior-chief of the old style. His brother Ptolemy Ceraunus found compensation by becoming king in Macedonia in 281, and perished in the Gallic invasion of 280–79 (see Brennus). Ptolemy II. maintained a splendid court in Alexandria. Not that Egypt held aloof from wars. Magas of Cyrene opened war on his half-brother (274), and Antiochus I., the son of Seleucus, desiring Palestine, attacked soon after. Two or three years of war left Egypt the dominant naval power of the eastern Mediterranean; the Ptolemaïc sphere of power extended over the Cyclades to Samothrace, and the harbours and coast towns of Cilicia Trachea ("Rough Cilicia"), Pamphylia, Lycia and Caria were largely in Ptolemy's hands (Theoc. *Idyll.* xvii. 86 seq.). The victory won by Antigonus, king of Macedonia, over his fleet at Cos (between 258–56; see Beloch, III. [ii.], p. 428 seq.) did not long interrupt his command of the Aegean. In a second war with the Seleucid kingdom, under Antiochus II. (after 260), Ptolemy sustained losses on the seaboard of Asia Minor and agreed to a peace by which Antiochus married his daughter Berenice (250?). Ptolemy's first wife, Arsinoë (I.), daughter of Lysimachus, was the mother of his legitimate children. After her repudiation he married, probably for political reasons, his full-sister Arsinoë (II.), the widow of Lysimachus, by an Egyptian custom abhorrent to Greek morality. The material and literary splendour of the Alexandrian court was at its height under Ptolemy II. Pomps and gay religions flourished. Ptolemy deified his parents as the θεοὶ ἀδελφοί, and his sister-wife, after her death (270), as *Philadelphus*. This surname was used in later generations to distinguish Ptolemy II. himself, but properly it belongs to Arsinoë only, not to the king. Callimachus, made keeper of the library, Theocritus, and a host of lesser poets, glorified the Ptolemaïc family. Ptolemy himself was eager to increase the library and to patronize scientific research. He had the strange beasts of far-off lands sent to Alexandria. But, an enthusiast for Hellenic culture, he seems to have shown but little interest in the native religion. The tradition which connects the Septuagint translation of the Old Testament into Greek with his name is not historical. Ptolemy had many brilliant mistresses, and his court, magnificent and dissolute, intellectual and artificial, has been justly compared with the Versailles of Louis XIV.

Ptolemy III. *Euergetes I.* (reigned 246–221), son of Ptolemy II. and Arsinoë I. At the beginning of his reign he reunited the Cyrenaïca to Egypt by marrying Berenice the daughter and successor of Magas (who had died about 250). At the same time he was obliged to open war on the Seleucid kingdom, where Antiochus II. was dead and his sister Berenice had been murdered, together with her infant son, by Antiochus's former wife, Laodice, who claimed the kingdom for her son Seleucus II. Ptolemy marched triumphantly into the heart of the Seleucid realm, as far at any rate as Babylonia, and received the formal submission of the provinces of Iran, while his fleets in the Aegean recovered what his father had lost upon the seaboard, and made fresh conquests as far as Thrace. This moment marks the zenith of the Ptolemaïc power. After Ptolemy returned home, indeed, Seleucus regained northern Syria and the eastern provinces, but the naval predominance of Egypt in the Aegean remained, although there are traces of its being replaced locally, towards the end of Euergetes' reign, by that of Macedonia—in Amorgos, Naxos, Syros, Nisyros, Cos and parts of Crete (see Beloch, III. [ii.], p. 463). After his final peace with Seleucus, Ptolemy no longer engaged actively in war, although his forces might occasionally mingle in the broils of Asia Minor, and he supported the enemies of Macedonia in Greece. It seems probable that his internal policy differed from his father's in patronizing the native religion more liberally; he has left larger traces at any rate among the monuments that are known to-day.

Ptolemy IV. *Philopator* (reigned 221–204), son of the preceding, was a wretched debauchee under whom the decline of the Ptolemaïc kingdom began. His reign was inaugurated by the murder of his mother, and he was always under the dominion of favourites, male and female, who indulged his vices and conducted the government as they pleased. Self-interest led his ministers to make serious preparations to meet the attacks of Antiochus III. (the Great) on Palestine, and the great Egyptian victory of Raphia (217), at which Ptolemy himself was present, secured the province till the next reign. The arming of Egyptians in this campaign had a disturbing effect upon the native population of Egypt, so that rebellions were continuous for the next thirty years. Philopator was devoted to orgiastic forms of religion and literary dilettantism. He built a temple to Homer and composed a tragedy, to which his vile favourite Agathocles added a commentary. He married (about 215) his sister Arsinoë (III.), but continued to be ruled by his mistress Agathoclea, sister of Agathocles.

Ptolemy V. *Epiphanes* reigned 204–181), son of Philopator and Arsinoë, was not more than five years old when he came to the throne, and under a series of regents the kingdom was paralysed. Antiochus III. and Philip V. of Macedonia made a compact to divide the Ptolemaïc possessions overseas. Philip seized several islands and places in Caria and Thrace, whilst the battle of Panium (198) definitely transferred Palestine from the Ptolemies to the Seleucids. Antiochus after this concluded peace, giving his own daughter Cleopatra to Epiphanes to wife (193–192). Nevertheless, when war broke out between Antiochus and Rome Egypt ranged itself with the latter power. Epiphanes in manhood was chiefly remarkable as a passionate sportsman; he excelled in athletic exercises and the chase. Great cruelty and perfidy were displayed in the suppression of the native rebellion, and some accounts represent him as personally tyrannical.

The elder of his two sons, Ptolemy VI. *Philometor* (181–145), succeeded as an infant under the regency of his mother Cleopatra. Her death was followed by a rupture between the Ptolemaïc and Seleucid courts, on the old question of Palestine.

Antiochus IV. Epiphanes invaded Egypt (170) and captured Philometor.

The Alexandrians then put his younger brother Ptolemy VII. *Euergetes II.* (afterwards nicknamed *Physkon*, on account of his bloated appearance) upon the throne. Antiochus professed to support Philometor, but, when he withdrew, the brothers agreed to be joint-kings with their sister Cleopatra as queen and wife of Philometor. Antiochus again invaded Egypt (168), but was compelled by the Roman intervention to retire. The double kingship led to quarrels between the two brothers in which fresh appeals were continually made to Rome. In 163 the Cyrenaïca was assigned under Roman arbitration to Euergetes as a separate kingdom. As he coveted Cyprus as well, the feud still went on, Rome continuing to interfere diplomatically but not effectively. In 154 Euergetes invaded Cyprus but was defeated and captured by Philometor. He found his brother, however, willing to pardon and was allowed to return as king to Cyrene. In 152 Philometor joined the coalition against the Seleucid king Demetrius I. and was the main agent in his destruction. The protégé of the coalition, Alexander Balas, married Philometor's daughter Cleopatra (Thea), and reigned in Syria in practical subservience to him. But in 147 Philometor broke with him and transferred his support, together with the person of Cleopatra, to Demetrius II., the young son of Demetrius I. He himself at Antioch was entreated by the people to assume the Seleucid diadem, but he declined and installed Demetrius as king. In 145 in the battle on the Oenoparas near Antioch, in which Alexander Balas was finally defeated, Philometor received a mortal wound. Philometor was perhaps the best of the Ptolemies. Kindly and reasonable, his good nature seems sometimes to have verged on indolence, but he at any rate took personal part, and that bravely and successfully, in war.

Philometor's infant son, Ptolemy Philopator Neos (?)[1], was proclaimed king in Alexandria under the regency of his mother Cleopatra. Euergetes however, swooping from Cyrene, seized the throne and married Cleopatra, making away with his nephew. He has left an odious picture of himself in the historians—a man untouched by benefits or natural affection, delighting in deeds of blood, his body as loathsome in its blown corpulence as his soul. Something must be allowed for the rhetorical habit of our authorities, but that Euergetes was ready enough to shed blood when policy required seems true. He soon found a more agreeable wife than Cleopatra in her daughter Cleopatra, and thenceforth antagonism between the two queens, the "sister" and the "wife," was chronic. In 130–1 Cleopatra succeeded in driving Euergetes for a time to Cyprus, when he revenged himself by murdering the son whom she had borne him (surnamed *Memphites*). Massacres inflicted upon the Alexandrians and the expulsion of the representatives of Hellenic culture are laid to his charge. On the other hand, the monument and papyri show him a liberal patron of the native religion and a considerable administrator. In fact, while hated by the Greeks, he seems to have had the steady support of the native population. But there are also records which show him, not as an enemy, but a friend, like his ancestors, to Greek culture. He himself published the fruit of his studies and travels in a voluminous collection of notebooks, in which he showed a lively eye for the oddities of his fellow kings. The old Ptolemaïc realm was never again a unity after the death of Euergetes II. By his will he left the Cyrenaïca as a separate kingdom to his illegitimate son Ptolemy Apion (116–96), whilst Egypt and Cyprus were bequeathed to Cleopatra (Kokke) and whichever of his two sons by her, Ptolemy VIII. *Soter II.* (nicknamed Lathyros) and Ptolemy IX. Alexander I., she might choose as her associate. The result was, of course, a long period of domestic strife. From 116 to 108 Soter reigned with his mother, and at enmity with her, in Egypt, whilst her favourite son, Alexander, ruled Cyprus. Cleopatra compelled Soter to divorce his sister-wife Cleopatra and marry another sister, Selene. Cleopatra plunged into the broils of the Seleucid house in Syria and perished. In 108 Cleopatra Kokke called Alexander to Egypt, and Soter flying to Cyprus took his brother's place and held the island against his mother's forces. The attempts which Soter and Cleopatra respectively made in 104–3 to obtain a predominance in Palestine came to nothing. Alexander now shook off his mother's yoke and married Soter's daughter Berenice. Cleopatra Kokke died in 101 and from then till 89 Alexander reigned alone in Egypt. In 89 he was expelled by a popular uprising and perished the following year in a sea-fight with the Alexandrian ships off Cyprus. Soter was recalled (88) and reigned over Egypt and Cyprus, now reunited, in association with his daughter Berenice. This, his second, reign in Egypt (88–80), was marked by a native rebellion which issued in the destruction of Thebes. On his death Berenice assumed the government, but the son of Alexander I., Ptolemy X. Alexander II., entering Alexandria under Roman patronage, married, and within twenty days assassinated, his elderly cousin and stepmother. He was at once killed by the enraged people and with him the Ptolemaïc family in the legitimate male line became extinct. Ptolemy Apion meanwhile, dying in 96, had bequeathed the Cyrenaïca to Rome. The Alexandrian people now chose an illegitimate son of Soter II. to be their king, Ptolemy XI. *Philopator Philadelphus Neos Dionysus*, nicknamed *Auletes*, the flute-player (80–51), setting his brother as king in Cyprus. The rights of these kings were doubtful, not only because of their illegitimate birth, but because it was claimed in Rome that Alexander II. had bequeathed his kingdom to the Roman people. Two Seleucid princes, children of Soter's sister Selene, appeared in Rome in 73 to urge their claim to the Ptolemaïc throne. Ptolemy Auletes was thus obliged to spend his reign in buying the support of the men in power in Rome. Cyprus was annexed by Rome in 58, its king committing suicide. From 58 to 55 Auletes was in exile, driven out by popular hatred, and worked by bribery and murder in Rome to get himself restored to Roman power. His daughter Berenice meanwhile reigned in Alexandria, a husband being found for her in the Pontic prince Archelaus. In 55 Auletes was restored by the proconsul of Syria, Aulus Gabinius. He killed Berenice and, dying in 51, bequeathed the kingdom to his eldest son, aged ten years, who was to take as wife his sister Cleopatra, aged seventeen. In the reign of Ptolemy XII. *Philopator* (51–47) and Cleopatra Philopator, Egyptian history coalesces with the general history of the Roman world, owing to the murder of Pompey off Pelusium in 48 and the Alexandrine War of Julius Caesar (48–47). In that war the young king perished and a still younger brother, Ptolemy XIII. *Philopator*, was associated with Cleopatra till 44, when he died, probably by Cleopatra's contriving. From then till her death in 30, her son, born in 47, and asserted by Cleopatra to be the child of Julius Caesar, was associated officially with her as Ptolemy XIV. *Philopator Philometor Caesar*; he was known popularly as Caesarion. (For the incidents of Cleopatra's reign see Cleopatra, Arsinoë.) After her death in 30 and Caesarion's murder Egypt was made a Roman province. Cleopatra's daughter by Antony (Cleopatra Selene) was married in 25 to Juba II. of Mauretania. Their son Ptolemy, who succeeded his father (A.D. 23–40), left no issue.[2]

See Mahaffy, *The Empire of the Ptolemies* (1895) and *Egypt under the Ptolemaïc Dynasty* (1899); Strack, *Die Dynastie der Ptolemäer* (1897); Bouché-Leclercq, *Histoire des Lagides* (1904, 1907); Meyer, *Das Heerwesen der Ptolemäer und Römer* (Leipzig, 1900).

(E. R. B.)

PTOLEMY (Claudius Ptolemaeus), the celebrated mathematician, astronomer and geographer, was a native of Egypt, but there is an uncertainty as to the place of his birth. Some ancient manuscripts of his works describe him as of Pelusium, but Theodorus Meliteniota, a Greek writer on astronomy of the

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[1] Or, according to another view, Eupator. On the obscure questions raised by these two surnames, see L. Pareti, *Ricerche sui Tolemei Eupatore e Neo Filopatore* (Turin, 1908).

[2] The Ptolemies were not in antiquity distinguished by the ordinal numbers affixed to their names by modern scholars and represented according to the usual convention by Roman figures. This is merely done for our convenience. In the case of the later Ptolemies different systems of notation prevail according as the problematic Eupator and Philopator Neos are reckoned in or not.

12th century, says that he was born at Ptolemais Hermii, a Grecian city of the Thebaid. It is certain that he observed at Alexandria during the reigns of Hadrian and Antoninus Pius, and that he survived Antoninus. Olympiodorus, a philosopher of the Neoplatonic school who lived in the reign of the emperor Justinian, relates in his scholia on the *Phaedo* of Plato that Ptolemy devoted his life to astronomy and lived for forty years in the so-called Πτερὰ τοῦ Κανώβου, probably elevated terraces of the temple of Serapis at Canopus near Alexandria, where they raised pillars with the results of his astronomical discoveries engraved upon them. This statement is probably correct; we have indeed the direct evidence of Ptolemy himself that he made astronomical observations during a long series of years; his first recorded observation was made in the eleventh year of Hadrian, 127 A.D.,[1] and his last in the fourteenth year of Antoninus, 151 A.D. Ptolemy, moreover, says, "We make our observations in the parallel of Alexandria." St Isidore of Seville asserts that he was of the royal race of the Ptolemies, and even calls him king of Alexandria; this assertion has been followed by others, but there is no ground for their opinion. Indeed Fabricius shows by numerous instances that the name Ptolemy was common in Egypt. Weidler, from whom this is taken, also tells us that according to Arabian tradition Ptolemy lived to the age of seventy-eight years; from the same source some description of his personal appearance has been handed down, which is generally considered as not trustworthy, but which may be seen in Weidler, *Historia astronomiae*, p. 177, or in the preface to Halma's edition of the *Almagest*, p. 61.

Mathematics.

Ptolemy's work as a geographer is discussed below, and an account of the discoveries in astronomy of Hipparchus and Ptolemy is given in the article ASTRONOMY: *History*. Their contributions to pure mathematics, however, require to be noticed here. Of these the chief is the foundation of trigonometry, plane and spherical, including the formation of a table of chords, which served the same purpose as our table of sines. This branch of mathematics was created by Hipparchus for the use of astronomers, and its exposition was given by Ptolemy in a form so perfect that for 1400 years it was not surpassed. In this respect it may be compared with the doctrine as to the motion of the heavenly bodies so well known as the Ptolemaic system, which was paramount for about the same period of time. There is, however, this difference, that, whereas the Ptolemaic system was then overthrown, the theorems of Hipparchus and Ptolemy, on the other hand, will be, as Delambre says, for ever the basis of trigonometry. The astronomical and trigonometrical systems are contained in the great work of Ptolemy, Ἡ *μαθηματικὴ σύνταξις*, or, as Fabricius after Syncellus writes it, Μ*εγάλη σύνταξις τῆς ἀστρονομίας*; and in like manner Suïdas says *οὗτος* [Πτολ.] *ἔγραψε τὸν μέγαν ἀστρονόμον ἤτοι σύνταξιν*. The *Syntaxis* of Ptolemy was called Ὁ *μέγας ἀστρονόμος* to distinguish it from another collection called Ὁ *μικρὸς ἀστρονόμος*, also highly esteemed by the Alexandrian school, which contained some works of Autolycus, Euclid, Aristarchus, Theodosius of Tripolis, Hypsicles and Menelaus. To designate the great work of Ptolemy the Arabs used the superlative *μεγίστη*, from which, the article *al* being prefixed, the hybrid name *Almagest*, by which it is now universally known, is derived.

We proceed now to consider the trigonometrical work of Hipparchus and Ptolemy. In the ninth chapter of the first book of the *Almagest* Ptolemy shows how to form a table of chords. He supposes the circumference divided into 360 equal parts (*τμήματα*), and then bisects each of these parts. Further, he divides the diameter into 120 equal parts, and then for the subdivisions of these he employs the sexagesimal method as most convenient in practice, *i.e.* he divides each of the sixty parts of the radius into sixty equal parts, and each of these parts he further subdivides into sixty equal parts. In the Latin translation these subdivisions become "partes minutae primae" and "partes minutae secundae," whence our "minutes" and "seconds" have arisen. It must not be supposed, however, that these sexagesimal divisions are due to Ptolemy; they must have been familiar to his predecessors, and were handed down from the Chaldaeans. Nor did the formation of the table of chords originate with Ptolemy; indeed, Theon of Alexandria, the father of Hypatia, who lived in the reign of Theodosius, in his commentary on the *Almagest* says expressly that Hipparchus had already given the doctrine of chords inscribed in a circle in twelve books, and that Menelaus had done the same in six books, but, he continues, every one must be astonished at the ease with which Ptolemy, by means of a few simple theorems, has found their values; hence it is inferred that the method of calculation in the *Almagest* is Ptolemy's own.

As starting-point the values of certain chords in terms of the diameter were already known, or could be easily found by means of the *Elements* of Euclid. Thus the side of the hexagon, or the chord of 60°, is equal to the radius, and therefore contains sixty parts. The side of the decagon, or the chord of 36°, is the greater segment of the radius cut in extreme and mean ratio, and therefore contains approximately $37^{p}\ 4'\ 55''$ parts, of which the diameter contains 120 parts. Further, the square on the side of the regular pentagon is equal to the sum of the squares on the sides of the regular hexagon and of the regular decagon, all being inscribed in the same circle (Eucl. XIII. 10); the chord of 72° can therefore be calculated, and contains approximately $70^{p}\ 32'\ 3''$. In like manner, the square on the chord of 90°, which is the side of the inscribed square, is twice the square on the radius; and the square on the chord of 120°, or the side of the equilateral triangle, is three times the square on the radius; these chords can thus be calculated approximately. Further, from the values of all these chords we can calculate at once the chords of the arcs which are their supplements.

This being laid down, we now proceed to give Ptolemy's exposition of the mode of obtaining his table of chords, which is a piece of geometry of great elegance, and is indeed, as De Morgan says, "one of the most beautiful in the Greek writers."

He takes as basis and sets forth as a lemma the well-known theorem, which is called after him, concerning a quadrilateral inscribed in a circle: The rectangle under the diagonals is equal to the sum of the rectangles under the opposite sides. By means of this theorem the chord of the sum or the difference of two arcs whose chords are given can be easily found, for we have only to draw a diameter from the common vertex of the two arcs the chord of whose sum or difference is required, and complete the quadrilateral; in one case a diagonal, in the other one of the sides is a diameter of the circle. The relations thus obtained are equivalent to the fundamental formulae of our trigonometry—

$$\sin(A+B) = \sin A \cos B + \cos A \sin B,$$
$$\sin(A-B) = \sin A \cos B - \cos A \sin B,$$

which can therefore be established in this simple way.

Ptolemy then gives a geometrical construction for finding the chord of half an arc from the chord of the arc itself. By means of the foregoing theorems, since we know the chords of 72° and of 60°, we can find the chord of 12°; we can then find the chords of 6°, 3°, $1\frac{1}{2}$° and three-fourths of 1°, and lastly, the chords of $4\frac{1}{2}$°, $7\frac{1}{2}$°, 9°, $10\frac{1}{2}$°, &c.—all those arcs, namely, as Ptolemy says, which being doubled are divisible by 3. Performing the calculations, he finds that the chord of $1\frac{1}{2}$° contains approximately $1^{p}\ 34'\ 55''$, and the chord of three-fourths of 1° contains $0^{p}\ 47'\ 8''$. A table of chords of arcs increasing by $1\frac{1}{2}$° can thus be formed; but this is not sufficient for Ptolemy's purpose, which was to frame a table of chords increasing by half a degree. This could be effected if he knew the chord of one-half of 1°; but, since this chord cannot be found geometrically from the chord of $1\frac{1}{2}$°, inasmuch as that would come to the trisection of an angle, he proceeds to seek in the first place the chord of 1°, which he finds approximately by means of a lemma of great elegance, due probably to Apollonius. It is as follows: If two unequal chords be inscribed in a circle, the greater will be to the less in a less ratio than the arc described on the greater will be to the arc described on the less. Having proved this theorem, he proceeds to employ it in order to find approximately the chord of 1°, which he does in the following manner—

$$\frac{\text{chord } 60'}{\text{chord } 45'} < \frac{60}{45},\ \textit{i.e.} < \frac{4}{3},\ \therefore \text{chord } 1^\circ < \frac{4}{3}\ \text{chord } 45';$$

again—

$$\frac{\text{chord } 90'}{\text{chord } 60'} < \frac{90}{60},\ \textit{i.e.} < \frac{3}{2},\ \therefore \text{chord } 1^\circ > \frac{2}{3}\ \text{chord } 90'.$$

For brevity we use a modern notation. It has been shown that the chord of 45′ is $0^{p}\ 47'\ 8''$ q.p., and the chord of 90′ is $1^{p}\ 34'\ 15''$ q.p.; hence it follows that approximately

$$\text{chord } 1^\circ < 1^{p}\ 2'\ 50''\ 40''' \text{ and } > 1^{p}\ 2'\ 50''.$$

Since these values agree as far as the seconds, Ptolemy takes $1^{p}\ 2'\ 50''$ as the approximate value of the chord of 1°. The chord of 1° being thus known, he finds the chord of one-half of a degree, the approximate value of which is $0^{p}\ 31'\ 25''$, and he is at once in a position to complete his table of chords for arcs increasing by half a degree. Ptolemy then gives his table of chords, which is arranged in three columns; in the first he has entered the arcs, increasing by half-degrees, from 0° to 180°; in the second he gives the values of the chords of these arcs in parts of which the diameter contains 120, the subdivisions being sexagesimal; and in the third he has inserted the thirtieth parts of the differences of these chords for each half-degree, in order that the chords of the intermediate arcs, which do not occur in the table, may be calculated, it being assumed that the increment of the chords of arcs within the table for each interval of 30′ is proportional to the increment of the arc.[1]

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[1] Weidler and Halma give the ninth year; in the account of the eclipse of the moon in that year Ptolemy, however, does not say, as in other similar cases, *he* had observed, but it had been observed (*Almagest*, iv. 9).

Trigonometry, we have seen, was created by Hipparchus for the use of astronomers. Now, since spherical trigonometry is directly applicable to astronomy, it is not surprising that its development was prior to that of plane trigonometry. It is the subject-matter of the eleventh chapter of the *Almagest*, whilst the solution of plane triangles is not treated separately in that work.

To resolve a plane triangle the Greeks supposed it to be inscribed in a circle; they must therefore have known the theorem—which is the basis of this branch of trigonometry: The sides of a triangle are proportional to the chords of the double arcs which measure the angles opposite to those sides. In the case of a right-angled triangle this theorem, together with Eucl. I. 32 and 47, gives the complete solution. Other triangles were resolved into right-angled triangles by drawing the perpendicular from a vertex on the opposite side. In one place (*Alm.* vi. ch. 7; i. 422, ed. Halma) Ptolemy solves a triangle in which the three sides are given by finding the segments of a side made by the perpendicular on it from the opposite vertex. It should be noticed also that the eleventh chapter of the first book of the *Almagest* contains incidentally some theorems and problems in plane trigonometry. The problems which are met with correspond to the following: Divide a given arc into two parts so that the chords of the doubles of those arcs shall have a given ratio; the same problem for external section. Lastly, it may be mentioned that Ptolemy (*Alm.* vi. ch. 7; i. 421, ed. Halma) takes $3^p\ 8'\ 30''$, *i.e.* $3+\frac{8}{60}+\frac{30}{3600}=3{\cdot}1416$, as the value of the ratio of the circumference to the diameter of a circle, and adds that, as had been shown by Archimedes, it lies between $3\frac{1}{7}$ and $3\frac{10}{71}$.

The foundation of spherical trigonometry is laid in chapter xi. on a few simple and useful lemmas. The starting-point is the well-known theorem of plane geometry concerning the segments of the sides of a triangle made by a transversal: The segments of any side are in a ratio compounded of the ratios of the segments of the other two sides. This theorem, as well as that concerning the inscribed quadrilateral, was called after Ptolemy—naturally, indeed, since no reference to its source occurs in the *Almagest*. This error was corrected by Mersenne, who showed that it was known to Menelaus, an astronomer and geometer who lived in the reign of the emperor Trajan. The theorem now bears the name of Menelaus, though most probably it came down from Hipparchus; Chasles, indeed, thinks that Hipparchus deduced the property of the spherical triangle from that of the plane triangle, but throws the origin of the latter farther back and attributes it to Euclid, suggesting that it was given in his *Porisms*.[2] Carnot made this theorem the basis of his theory of transversals in his essay on that subject. It should be noticed that the theorem is not given in the *Almagest* in the general manner stated above; Ptolemy considers two cases only of the theorem, and Theon, in his commentary on the *Almagest*, has added two more cases. The proofs, however, are general. Ptolemy then lays down two lemmas: If the chord of an arc of a circle be cut in any ratio and a diameter be drawn through the point of section, the diameter will cut the arc into two parts the chords of whose doubles are in the same ratio as the segments of the chord; and a similar theorem in the case when the chord is cut externally in any ratio. By means of these two lemmas Ptolemy deduces in an ingenious manner—easy to follow, but difficult to discover—from the theorem of Menelaus for a plane triangle the corresponding theorem for a spherical triangle: If the sides of a spherical triangle be cut by an arc of a great circle, the chords of the doubles of the segments of any one side will be to each other in a ratio compounded of the ratios of the chords of the doubles of the segments of the other two sides. Here, too, the theorem is not stated generally; two cases only are considered, corresponding to the two cases given *in plano*. Theon has added two cases. The proofs are general. By means of this theorem four of Napier's formulae for the solution of right-angled spherical triangles can be easily established. Ptolemy does not give them, but in each case when required applies the theorem of Menelaus for spherics directly. This greatly increases the length of his demonstrations, which the modern reader finds still more cumbrous, inasmuch as in each case it was necessary to express the relation in terms of chords—the equivalents of sines—only, cosines and tangents being of later invention.

Such, then, was the trigonometry of the Greeks. Mathematics, indeed, has ever been, as it were, the handmaid of astronomy, and many important methods of the former arose from the needs of the latter. Moreover, by the foundation of trigonometry, astronomy attained its final general constitution, in which calculations took the place of diagrams, as these latter had been at an earlier period substituted for mechanical apparatus in solving the ordinary problems.[3] Further, we find in the application of trigonometry to astronomy frequent examples and even a systematic use of the method of approximations—the basis, in fact, of all application of mathematics to practical questions. There was a disinclination on the part of the Greek geometer to be satisfied with a mere approximation, were it ever so close; and the unscientific *agrimensor* shirked the labour involved in acquiring the knowledge which was indispensable for learning trigonometrical calculations. Thus the development of the calculus of approximations fell to the lot of the astronomer, who was both scientific and practical.[4]

We now proceed to notice briefly the contents of the *Almagest*. It is divided into thirteen books. The first book, which may be regarded as introductory to the whole work, opens with a short preface, in which Ptolemy, after some observations on the distinction between theory and practice, gives Aristotle's division of the sciences and remarks on the certainty of mathematical knowledge, "inasmuch as the demonstrations in it proceed by the incontrovertible ways of arithmetic and geometry." He concludes his preface with the statement that he will make use of the discoveries of his predecessors, and relate briefly all that has been sufficiently explained by the ancients, but that he will treat with more care and development whatever has not been well understood or fully treated. Ptolemy unfortunately does not always bear this in mind, and it is sometimes difficult to distinguish what is due to him from that which he has borrowed from his predecessors.

Ptolemy then, in the first chapter, presupposing some preliminary notions on the part of the reader, announces that he will treat in order—what is the relation of the earth to the heavens, what is the position of the oblique circle (the ecliptic), and the situation of the inhabited parts of the earth; that he will point out the differences of climates; that he will then pass on to the consideration of the motion of the sun and moon, without which one cannot have a just theory of the stars; lastly, that he will consider the sphere of the fixed stars and then the theory of the five stars called "planets." All these things—*i.e.* the phenomena of the heavenly bodies—he says he will endeavour to explain in taking for principle that which is evident, real and certain, in resting everywhere on the surest observations and applying geometrical methods. He then enters on a summary exposition of the general principles on which his *Syntaxis* is based, and adduces arguments to show that the heaven is of a spherical form and that it moves after the manner of a sphere, that the earth also is of a form which is sensibly spherical, that the earth is in the centre of the heavens, that it is but a point in comparison with the distances of the stars, and that it has not any motion of translation. With respect to the revolution of the earth round its axis, which he says some have held, Ptolemy, while admitting that this supposition renders the explanation of the phenomena of the heavens much more simple, yet regards it as altogether ridiculous. Lastly, he lays down that there are two principal and different motions in the heavens—one by which all the stars are carried from east to west uniformly about the poles of the equator; the other, which is peculiar to some of the stars, is in a contrary direction to the former motion and takes place round different poles. These preliminary notions, which are all older than Ptolemy, form the subjects of the second and following chapters. He next proceeds to the construction of his table of chords, of which we have given an account, and which is indispensable to practical astronomy. The employment of this table presupposes the evaluation of the obliquity of the ecliptic, the knowledge of which is indeed the foundation of all astronomical science. Ptolemy in the next chapter indicates two means of determining this angle by observation, describes the instruments he employed for that purpose, and finds the same value which had already been found by Eratosthenes and used by Hipparchus. This "is followed by spherical geometry and trigonometry enough for the determination of the connexion between the sun's right ascension, declination and longitude, and for the formation of a table of declinations to each degree of longitude. Delambre says he found both this and the table of chords very exact."[5]

In book ii., after some remarks on the situation of the habitable parts of the earth, Ptolemy proceeds to make deductions from the principles established in the preceding book, which he does by means of the theorem of Menelaus. The length of the longest day being given, he shows how to determine the arcs of the horizon intercepted between the equator and the ecliptic—the amplitude of the eastern point of the ecliptic at the solstice—for different degrees of obliquity of the sphere; hence he finds the height of the pole and reciprocally. From the same data he shows how to find at what places and times the sun becomes vertical and how to calculate the ratios of gnomons to their equinoctial and solstitial shadows at noon and conversely, pointing out, however, that the latter method is wanting in precision. All these matters he considers fully and works out in detail for the parallel of Rhodes. Theon gives us three reasons for the selection of that parallel by Ptolemy: the first is that the height of the pole at Rhodes is 36°, a whole number, whereas at Alexandria he believed it to be 30° 58′; the second is that Hipparchus had made at Rhodes many observations; the third is that the climate of Rhodes holds the mean place of the seven climates subsequently described. Delambre suspects a fourth reason, which he thinks is the true one, that Ptolemy had taken his examples from the works of Hipparchus, who observed at Rhodes and had made these calculations for the place where he lived. In chapter vi. Ptolemy gives an exposition of the most important properties of each parallel, commencing with the equator, which he considers as the southern limit of the habitable quarter of the earth. For each parallel or climate, which is determined by the length of the longest day, he gives the latitude, a principal place on the parallel, and the lengths of the shadows of the gnomon at the solstices and equinox. In the next chapter he enters into particulars and inquires what are the arcs of the equator which cross the horizon at the same time as given arcs of the ecliptic, or, which comes to the same thing, the time which a given arc of the ecliptic takes to cross the horizon of a given place. He arrives at a formula for calculating ascensional differences and gives tables of ascensions arranged by 10° of longitude for the different climates from the equator to that where the longest day is seventeen hours. He then shows the use of these tables in the investigation of the length of the day for a given climate, of the manner of reducing temporal[1] to equinoctial hours and vice versa, and of the nonagesimal point and the point of orientation of the ecliptic. In the following chapters of this book he determines the angles formed by the intersections of the ecliptic—first with the meridian, then with the horizon, and lastly with the vertical circle—and concludes by giving tables of the angles and arcs formed by the intersection of these circles, for the seven climates, from the parallel of Meroe (thirteen hours) to that of the mouth of the Borysthenes (sixteen hours). These tables, he adds, should be completed by the situation of the chief towns in all countries according to their latitudes and longitudes; this he promises to do in a separate treatise and has in fact done in his *Geography*.

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[1] Ideler has examined the degree of accuracy of the numbers in these tables and finds that they are correct to five places of decimals.

[2] On the theorem of Menelaus and the rule of six quantities, see Chasles, *Aperçu historique sur l'origine et développement des méthodes en géométrie*, note vi. p. 291.

[3] Comte, *Système de politique positive*, iii. 324.

[4] Cantor, *Vorlesungen über Geschichte der Mathematik*, p. 356.

[5] De Morgan, in Smith's *Dictionary of Greek and Roman Biography*, *s.v.* "Ptolemaeus, Claudius."

Book iii. treats of the motion of the sun and of the length of the year. In order to understand the difficulties of this question Ptolemy says one should read the books of the ancients, and especially those of Hipparchus, whom he praises "as a lover of labour and a lover of truth" (ἀνδρὶ φιλοπόνῳ τε ὁμοῦ καὶ φιλαληθεῖ). He begins by telling us how Hipparchus was led to discover the precession of the equinoxes; he relates the observations by which Hipparchus verified the eccentricity of the solar orbit imperfectly known to his Chaldaean predecessors, and gives the hypothesis of the eccentric by which he explained the inequality of the sun's motion. Ptolemy concludes this book by giving a clear exposition of the circumstances on which the equation of time depends. Ptolemy, moreover, applies Apollonius's hypothesis of the epicycle to explain the inequality of the sun's motion, and shows that it leads to the same results as the hypothesis of the eccentric. He prefers the latter hypothesis as more simple, requiring only one and not two motions, and as equally fit to clear up the difficulties. In the second chapter there are some general remarks to which attention should be directed. We find the principle laid down that for the explanation of phenomena one should adopt the simplest hypothesis that it is possible to establish, provided that it is not contradicted by the observations in any important respect.[2] This fine principle, which is of universal application, may, we think—regard being paid to its place in the *Almagest*—be justly attributed to Hipparchus. It is the first law of the "philosophia prima" of Comte.[3] We find in the same page another principle, or rather practical injunction, that in investigations founded on observations where great delicacy is required we should select those made at considerable intervals of time in order that the errors arising from the imperfection which is inherent in all observations, even in those made with the greatest care, may be lessened by being distributed over a large number of years. In the same chapter we find also the principle laid down that the object of mathematicians ought to be to represent all the celestial phenomena by uniform and circular motions. This principle is stated by Ptolemy in the manner which is unfortunately too common with him—that is to say, he does not give the least indication whence he derived it. We know, however, from Simplicius, on the authority of Sosigenes,[4] that Plato is said to have proposed the following problem to astronomers: "What regular and determined motions being assumed would fully account for the phenomena of the motions of the planetary bodies?" We know, too, from the same source that Eudemus says in the second book of his *History of Astronomy* that "Eudoxus of Cnidus was the first of the Greeks to take in hand hypothesis of this kind,"[5] that he was in fact the first Greek astronomer who proposed a geometrical hypothesis for explaining the periodic motions of the planets—the famous system of concentric spheres. It thus appears that the principle laid down here by Ptolemy can be traced to Eudoxus and Plato; and it is probable that they derived it from the same source, namely, Archytas and the Pythagoreans. We have indeed the direct testimony of Geminus of Rhodes that the Pythagoreans endeavoured to explain the phenomena of the heavens by uniform and circular motions.[6]

Books iv., v. are devoted to the motions of the moon, which are very complicated; the moon in fact, though the nearest to us of all the heavenly bodies, has always been the one which has given the greatest trouble to astronomers.[7] Book iv., in which Ptolemy follows Hipparchus, treats of the first and principal inequality of the moon, which quite corresponds to the inequality of the sun treated of in the third book. As to the observations which should be employed for the investigation of the motion of the moon, Ptolemy tells us that lunar eclipses should be preferred, inasmuch as they give the moon's place without any error on the score of parallax. The first thing to be determined is the time of the moon's revolution; Hipparchus, by comparing the observations of the Chaldaeans with his own, discovered that the shortest period in which the lunar eclipses return in the same order was 126,007 days and 1 hour. In this period he finds 4267 lunations, 4573 restitutions of anomaly and 4612 tropical revolutions of the moon less 7½° q.p.; this quantity (7½°) is also wanting to complete the 345 revolutions which the sun makes in the same time with respect to the fixed stars. He concluded from this that the lunar month contains 29 days and 31′ 50″ 8‴ 20⁗ of a day, very nearly, or 29 days 12 hours 44′ 3″ 20‴. These results are of the highest importance. In order to explain this inequality, or the equation of the centre, Ptolemy makes use of the hypothesis of an epicycle, which he prefers to that of the eccentric. The fifth book commences with the description of the astrolabe of Hipparchus, which Ptolemy made use of in following up the observations of that astronomer, and by means of which he made his most important discovery, that of the second inequality in the moon's motion, now known by the name of the "evection." In order to explain this inequality he supposed the moon to move on an epicycle, which was carried by an eccentric whose centre turned about the earth in a direction contrary to that of the motion of the epicycle. This is the first instance in which we find the two hypotheses of eccentric and epicycle combined. The fifth book treats also of the parallaxes of the sun and moon, and gives a description of an instrument—called later by Theon the "parallactic rods"—devised by Ptolemy for observing meridian altitudes with greater accuracy.

The subject of parallaxes is continued in the sixth book of the *Almagest*, and the method of calculating eclipses is there given. The author says nothing in it which was not known before his time.

Books vii., viii. treat of the fixed stars. Ptolemy verified the fixity of their relative positions and confirmed the observations of Hipparchus with regard to their motion in longitude, or the precession of the equinoxes. The seventh book concludes with the catalogue of the stars of the northern hemisphere, in which are entered their longitudes, latitudes and magnitudes, arranged according to their constellations; and the eighth book commences with a similar catalogue of the stars in the constellations of the southern hemisphere. This catalogue has been the subject of keen controversy amongst modern astronomers. Some, as Flamsteed and Lalande, maintain that it was the same catalogue which Hipparchus had drawn up 265 years before Ptolemy, whereas others, of whom Laplace is one, think that it is the work of Ptolemy himself. The probability is that in the main the catalogue is really that of Hipparchus altered to suit Ptolemy's own time, but that in making the changes which were necessary a wrong precession was assumed. This is Delambre's opinion; he says, "Whoever may have been the true author, the catalogue is unique, and does not suit the age when Ptolemy lived; by subtracting 2° 40′ from all the longitudes it would suit the age of Hipparchus; this is all that is certain."[8] It has been remarked that Ptolemy, living at Alexandria, at which city the altitude of the pole is 5° less than at Rhodes, where Hipparchus observed, could have seen stars which are not visible at Rhodes; none of these stars, however, are in Ptolemy's catalogue. The eighth book contains, moreover, a description of the milky way and the manner of constructing a celestial globe; it also treats of the configuration of the stars, first with regard to the sun, moon and planets, and then with regard to the horizon, and likewise of the different aspects of the stars and of their rising, culmination and setting simultaneously with the sun.

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[1] Καιρικαί, temporal or variable. These hours varied in length with the seasons; they were used in ancient times and arose from the division of the natural day (from sunrise to sunset) into twelve parts.

[2] *Alm.* ed. Halma, i. 159.

[3] *Système de politique positive*, iv. 173.

[4] This Sosigenes, as Th. H. Martin has shown, was not the astronomer of that name who was a contemporary of Julius Caesar, but a Peripatetic philosopher who lived at the end of the 2nd century.

[5] Brandis, *Schol. in Aristot. edidit acad. reg. borussica* (Berlin, 1836), p. 498.

[6] Εἰσαγωγὴ εἰς τὰ φαινόμενα, c. i. in Halma's edition of the works of Ptolemy, vol. iii. ("Introduction aux phénomènes célestes, traduite du grec de Géminus," p. 9), Paris, 1819.

[7] This has been noticed by Pliny, who says, "Multiformi haec (luna) ambage torsit ingenia contemplantium, et proximum ignorari maxime sidus indignantium" (*N.H.*, ii. 9).

[8] Delambre, *Histoire de l'astronomie ancienne*, ii. 264.

The remainder of the work is devoted to the planets. The ninth book commences with what concerns them all in general. The planets are much nearer to the earth than the fixed stars and more distant than the moon. Saturn is the most distant of all, then Jupiter and then Mars. These three planets are at a greater distance from the earth than the sun.[1] So far all astronomers are agreed. This is not the case, he says, with respect to the two remaining planets, Mercury and Venus, which the old astronomers placed between the sun and earth, whereas more recent writers[2] have placed them beyond the sun, because they were never seen on the sun.[3] He shows that this reasoning is not sound, for they might be nearer to us than the sun and not in the same plane, and consequently never seen on the sun. He decides in favour of the former opinion, which was indeed that of most mathematicians. The ground of the arrangement of the planets in order of distance was the relative length of their periodic times; the greater the circle, the greater, it was thought, would be the time required for its description. Hence we see the origin of the difficulty and the difference of opinion as to the arrangement of the sun, Mercury and Venus, since the times in which, as seen from the earth, they appear to complete the circuit of the zodiac are nearly the same—a year.[4] Delambre thinks it strange that Ptolemy did not see that these contrary opinions could be reconciled by supposing that the two planets moved in epicycles about the sun; this would be stranger still, he adds, if it is true that this idea, which is older than Ptolemy, since it is referred to by Cicero,[5] had been that of the Egyptians.[6] It may be added, as strangest of all, that this doctrine was held by Theon of Smyrna,[7] who was a contemporary of Ptolemy or somewhat senior to him. From this system to that of Tycho Brahe there is, as Delambre observes, only a single step.

We have seen that the problem which presented itself to the astronomers of the Alexandrian epoch was the following: it was required to find such a system of equable circular motions as would represent the inequalities in the apparent motions of the sun, the moon and the planets. Ptolemy now takes up this question for the planets; he says that "this perfection is of the essence of celestial things, which admit of neither disorder nor inequality," that this planetary theory is one of extreme difficulty, and that no one had yet completely succeeded in it. He adds that it was owing to these difficulties that Hipparchus—who loved truth above all things, and who, moreover, had not received from his predecessors observations either so numerous or so precise as those that he has left—had succeeded, as far as possible, in representing the motions of the sun and moon by circles, but had not even commenced the theory of the five planets. He was content, Ptolemy continues, to arrange the observations which had been made on them in a methodic order and to show thence that the phenomena did not agree with the hypotheses of mathematicians at that time. He showed that in fact each planet had two inequalities, which are different for each, that the retrogradations are also different, whilst other astronomers admitted only single inequality and the same retrogradation; he showed further that their motions cannot be explained by eccentrics nor by epicycles carried along concentrics, but that it was necessary to combine both hypotheses. After these preliminary notions he gives from Hipparchus the periodic motions of the five planets, together with the shortest times of restitutions, in which, moreover, he has made some slight corrections. He then gives tables of the mean motions in longitude and of anomaly of each of the five planets,[8] and shows how the motions in longitude of the planets can be represented in a general manner by means of the hypothesis of the eccentric combined with that of the epicycle. He next applies his theory to each planet and concludes the ninth book by the explanation of the various phenomena of the planet Mercury. In the tenth and eleventh books he treats, in like manner, of the various phenomena of the planets Venus, Mars, Jupiter and Saturn.

Book xii. treats of the stationary and retrograde appearances of each of the planets and of the greatest elongations of Mercury and Venus. The author tells us that some mathematicians, and amongst them Apollonius of Perga, employed the hypothesis of the epicycle to explain the stations and retrogradations of the planets. Ptolemy goes into this theory, but does not change in the least the theorems of Apollonius; he only promises simpler and clearer demonstrations of them. Delambre remarks that those of Apollonius must have been very obscure, since, in order to make the demonstrations in the *Almagest* intelligible, he (Delambre) was obliged to recast them. This statement of Ptolemy is important, as it shows that the mathematical theory of the planetary motions was in a tolerably forward state long before his time. Finally, book xiii. treats of the motions of the planets in latitude, also of the inclinations of their orbits and of the magnitude of these inclinations.

Ptolemy concludes his great work by saying that he has included in it everything of practical utility which in his judgment should find a place in a treatise on astronomy at the time it was written, with relation as well to discoveries as to methods. His work was justly called by him Μαθηματικὴ σύνταξις, for it was in fact the mathematical form of the work which caused it to be preferred to all others which treated of the same science, but not by "the sure methods of geometry and calculation." Accordingly, it soon spread from Alexandria to all places where astronomy was cultivated; numerous copies were made of it, and it became the object of serious study on the part of both teachers and pupils. Amongst its numerous commentators may be mentioned Pappus and Theon of Alexandria in the 4th century and Proclus in the 5th. It was translated into Latin by Boetius, but this translation has not come down to us. The *Syntaxis* was translated into Arabic at Bagdad by order of the enlightened caliph Al-Mamūn, who was himself an astronomer, about 827 A.D., and the Arabic translation was revised in the following century by Tobit ben Korra. The *Almagest* was translated from the Arabic into Latin by Gerard of Cremona (*q.v.*). In the 15th century it was translated from a Greek manuscript in the Vatican by George of Trebizond. In the same century an epitome of the *Almagest* was commenced by Purbach (d. 1461) and completed by his pupil and successor in the professorship of astronomy in the university of Vienna, Regiomontanus. The earliest edition of this epitome is that of Venice (1496), and this was the first appearance of the *Almagest* in print. The first complete edition of the *Almagest* is that of P. Liechtenstein (Venice, 1515)—a Latin version from the Arabic. The Latin translation of George of Trebizond was first printed in 1528, at Venice. The Greek text, which was not known in Europe until the 15th century, was first published in the 16th by Simon Grynaeus, who was also the first editor of the Greek text of Euclid, at Basel (1538). This edition was from a manuscript in the library of Nuremberg—where it is no longer to be found—which had been presented by Regiomontanus, to whom it was given by Cardinal Bessarion.

Other works of Ptolemy, which we now proceed to notice very briefly, are as follow. (1) *Φάσεις ἀπλανῶν ἀστέρων καὶ συναγωγὴ ἐπισημασιῶν*, *On the Apparitions of the Fixed Stars and a Collection of Prognostics.* It is a calendar of a kind common amongst the Greeks under the name of *παράπηγμα*, or a collection of the risings and settings of the stars in the morning or evening twilight, which were so many visible signs of the seasons, with prognostics of the principal changes of temperature with relation to each climate, after the observations of the best meteorologists, as, for example, Meton, Democritus, Eudoxus, Hipparchus, &c. Ptolemy, in order to make his *Parapegma* useful to all the Greeks scattered over the enlightened world of his time, gives the apparitions of the stars not for one parallel only but for each of the five parallels in which the length of the longest day varies from 13½ hours to 15½ hours—that is, from the latitude of Syene to that of the middle of the Euxine. This work was printed by Petavius in his *Uranologium* (Paris, 1630), and by Halma in his edition of the works of Ptolemy, vol. iii. (Paris, 1819). (2) *Ὑποθέσεις τῶν πλανωμένων ἢ τῶν οὐρανίων κύκλων κινήσεις*, *On the Planetary Hypothesis.* This is a summary of a portion of the *Almagest*, and contains a brief statement of the principal hypotheses for the explanation of the motions of the heavenly bodies. It was first published (Gr., Lat.) by Bainbridge, the Savilian professor of astronomy at Oxford, with the Sphere of Proclus and the Κανὼν βασιλειῶν (London, 1620), and afterwards by Halma, vol. iv. (Paris, 1820). (3) Κανὼν βασιλειῶν, *A Table of Reigns.* This is a chronological table of Assyrian, Persian, Greek and Roman sovereigns, with the length of their reigns, from Nabonasar to Antoninus Pius. This table (cf. G. Syncellus, *Chronogr.* ed. Dind. i. 388 seq.) was printed by Scaliger, Calvisius, Petavius, Bainbridge and by Halma, vol. iii. (Paris, 1819). (4) Ἁρμονικῶν βιβλια γ'. This *Treatise on Music* was published in Greek and Latin by Wallis at Oxford (1682). It was afterwards reprinted with Porphyry's commentary in the third volume of Wallis's works (Oxford, 1699). (5) Τετράβιβλος σύνταξις, *Tetrabiblon* or *Quadripartitum.* This work is astrological, as is also the small collection of aphorisms, called Καρπός or *Centiloquium*, by which it is followed. It is doubtful whether these works are genuine, but the doubt merely arises from the feeling that they are unworthy of Ptolemy. They were both published in Greek and Latin by Camerarius (Nuremberg, 1535), and by Melanchthon (Basel, 1553). (6) *De analemmate.* The original of this work of Ptolemy is lost. It was translated from the Arabic and published by Commandine (Rome, 1562). The *Analemma* is the description of the sphere on a plane. We find in it the sections of the different circles, as the diurnal parallels, and everything which can facilitate the intelligence of gnomonics. This description is made by perpendiculars let fall on the plane; whence it has been called by the moderns "orthographic projection." (7) *Planisphaerium, The Planisphere.* The Greek text of this work also is lost, and we have only a Latin translation of it from the Arabic. The "planisphere" is a projection of the sphere on the equator, the eye being at the pole—in fact what is now called "stereographic" projection. The best edition of this work is that of Commandine (Venice, 1558). (8) *Optics.* This work is known to us only by imperfect manuscripts in Paris and Oxford, which are Latin translations from the Arabic. The *Optics* consists of five books, of which the fifth presents most interest: it treats of the refraction of luminous rays in their passage through media of different densities, and also of astronomical refractions, on which subject the theory is more complete than that of any astronomer before the time of Cassini. De Morgan doubts whether this work is genuine on account of the absence of allusion to the *Almagest* or to the subject of refraction in the *Almagest* itself; but his chief reason for doubting its authenticity is that the author of the *Optics* was a poor geometer. (G. J. A.)

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[1] This is true of their mean distances; but we know that Mars at opposition is nearer to us than the sun.

[2] Eratosthenes, for example, as we learn from Theon of Smyrna.

[3] Transits of Mercury and Venus over the sun's disk, therefore, had not been observed.

[4] This was known to Eudoxus. Sir George Cornewall Lewis (*An Historical Survey of the Astronomy of the Ancients*, p. 155), confusing the *geocentric* revolutions assigned by Eudoxus to these two planets with the *heliocentric* revolutions in the Copernican system, which are of course quite different, says that "the error with respect to Mercury and Venus is considerable"; this, however, is an error not of Eudoxus but of Cornewall Lewis, as Schiaparelli has remarked.

[5] "Hunc [solem] ut comites consequuntur Veneris alter, alter Mercurii cursus" (*Somnium Scipionis, De rep.* vi. 17). This hypothesis is alluded to by Pliny, *N.H.* ii. 17, and is more explicitly stated by Vitruvius, *Arch.* ix. 4.

[6] Macrobius, *Commentarius ex Cicerone in somnium Scipionis*, i. 19.

[7] Theon (Smyrnaeus Platonicus), *Liber de astronomia*, ed. Th. H. Martin (Paris, 1849), pp. 174, 294, 296. Martin thinks that Theon, the mathematician, four of whose observations are used by Ptolemy (*Alm.* ii. 176, 193, 194, 195, 196, ed. Halma), is not the same as Theon of Smyrna, on the ground chiefly that the latter was not an observer.

[8] Delambre compares these mean motions with those of our modern tables and finds them tolerably correct. By "motion in longitude" must be understood the motion of the centre of the epicycle about the eccentric, and by "anomaly" the motion of the star on its epicycle.

The publication of a new edition of Ptolemy's works under the title, *Claudii Ptolemaei opera quae exstant omnia*, was recently undertaken at Leipzig. The first volume (in two parts, 1898, 1903) contains the Greek text of the *Almagest* edited by J. L. Heiberg. Consult also J. E. Montucla, *Histoire des mathématiques*, i. 293; J. B. J. Delambre, *Connaissance des temps* (1816); and *Histoire de l'astronomie ancienne*, vol. 2; J. J. A. Caussin, *Nouvelles mémoires de l'acad. des inscriptions*, t. vi.; P. Tannery, *Recherches sur l'histoire de l'astronomie ancienne*, ch. vi.-xv.; Narrieu, *History of Astronomy* (1833); Fabricius, *Bibliotheca graeca*, ed. Harles, vol. 5; Halma's 1813–1816 edition of his *Almagest* (Greek with French translation); A. Berry, *A Short History of Astronomy*, pp. 62–73; *British Museum Catalogue.*

Geography.

Ptolemy is hardly less celebrated as a geographer than as an astronomer, and his *Geographikē syntaxis* exercised as great an influence on geographical progress (especially during the period of the Classical Renaissance), as did his *Almagest* on astronomical. This exceptional position was largely due to its scientific form, which rendered it convenient and easy of reference; but, apart from this, it was really the most considerable attempt of the ancient world to place the study of geography on a scientific basis. The astronomer Hipparchus had indeed pointed out, three centuries before Ptolemy, that the only way to construct a trustworthy map of the inhabited world would be by observations of the latitude and longitude of all the principal points on its surface. But the materials for such a map were almost wholly wanting, and, though Hipparchus made some approach to a correct division of the known world into zones of latitude, "climates" or *klimata*, as he termed them, trustworthy observations of latitude were then very few, while the means of determining longitudes hardly existed. Hence probably it arose that no attempt was made to follow up the suggestion of Hipparchus until Marinus of Tyre, who lived shortly before Ptolemy, and whose work is known to us only through the latter. Marinus' scientific materials being inadequate, he contented himself mostly with determinations derived from itineraries and other rough methods, such as are still employed where more accurate means of determination are not available. The greater part of Marinus' treatise was occupied with the discussion of his authorities, and it is impossible, in the absence of the original work, to decide how far his results attained a scientific form. But Ptolemy himself considered them, on the whole, so satisfactory that he made his predecessor's work the basis of his own in regard to all the Mediterranean countries, that is, in regard to almost all those regions of which he had definite knowledge. In the more remote regions of the world, Ptolemy availed himself of Marinus' information, but with reserve, and himself explains the reasons that induced him sometimes to depart from his predecessor's conclusions. It is unjust to term Ptolemy a plagiarist from Marinus, as he himself fully acknowledges his obligations to that writer, from whom he derived the whole mass of his materials, which he undertook to arrange and present to his readers in a scientific form. It is this form, unique among those ancient geographical treatises which have survived, that constitutes one great merit of Ptolemy's work. At the same time it shows the increased knowledge of Asia and Africa acquired since Strabo and Pliny.

1. *Mathematical Geography.*—As an astronomer, Ptolemy was of course better qualified to explain the mathematical conditions of the earth and its relations to the celestial bodies than most preceding geographers. His general views had much in common with those of Eratosthenes and Strabo. Thus he assumed that the earth was a globe, the surface of which was divided by certain great circles—the equator and the tropics—parallel to one another, dividing the earth into five zones, the relations of which with astronomical phenomena were of course clear to his mind as a matter of theory, though in regard to the regions bordering on the equator, as well as to those adjoining the polar circle, he could have had no confirmation of his conclusions from actual observation. He adopted also from Hipparchus the division of the equatorial circle into 360 parts (*degrees*, as they were subsequently called, though the word does not occur in this sense in Ptolemy), and supposed other circles to be drawn through this, from the equator to the pole, to which he gave the name of *meridians.* He thus, like modern geographers, conceived the whole surface of the earth as covered with a network of *parallels of latitude* and *meridians of longitude*, terms which he himself was the first extant writer to employ in this technical sense. Within the network thus constructed it was his task to place the outline of the world, so far as known to him.

But at the very outset of his attempt he fell into an error vitiating all his conclusions. Eratosthenes (276–196 B.C.) was the first who had attempted scientifically to determine the earth's circumference, and his result of 250,000 (or 252,000) stadia, *i.e.* 25,000 (25,200) geographical miles, was generally adopted by subsequent geographers, including Strabo. Poseidonius, however (*c.* 135–50 B.C.), reduced this to 180,000, and the latter computation was inexplicably adopted by Marinus and Ptolemy. This error made every degree of latitude or longitude (measured at the equator) equal to only 500 stadia (50 geographical miles), instead of its true equivalent of 600 stadia. The mistake would have been somewhat neutralized had there existed a sufficient number of points of which the position was fixed by observation; but we learn from Ptolemy himself that such observations for latitude were very few, while the means of determining longitudes were almost wholly wanting.[1] Hence the positions laid down by him were, with few exceptions, the result of computations from itineraries and the statements of travellers, liable to much greater error in ancient times than at the present day, from the want of any accurate mode of observing bearings, of measuring time (by portable instruments), or of estimating distances at sea, except by the rough estimate of the time employed in sailing from point to point. Even the use of the log was unknown to the ancients. But, great as were the errors resulting from such imperfect means of calculation, they were increased by the permanent error arising from Ptolemy's system of graduation. Thus if he concluded (from itineraries) that two places were 5000 stadia distant, he would place them 10° apart, and thus in fact separate them by 6000 stadia.

Another source of permanent error (though of less importance), which affected all his longitudes, arose from his prime meridian. Here also he followed Marinus, who, supposing that the Fortunate Islands (vaguely answering to our Canaries *plus* the Madeira group) lay farther west than any part of Europe or Africa, had taken the meridian through the (supposed) outermost of this group as his prime meridian, from whence he calculated his longitudes eastwards to the Indian Ocean. But as both Marinus and Ptolemy had no exact knowledge of the islands in question, the line thus assumed was purely imaginary, drawn through the supposed position of an island which they placed $2\frac{1}{2}^\circ$ (instead of $9^\circ 20'$) west of the Sacred Promontory (*i.e.* Cape St Vincent, regarded by Marinus and Ptolemy, as by previous geographers, as the westernmost point of Europe). Hence all Ptolemy's longitudes, reckoned eastwards, were about 7° less than they would have been if really measured from the meridian of Ferro, which continued so long in use. This error was the more unfortunate as the longitude was really calculated, not from this imaginary line, but from Alexandria, westwards as well as eastwards (as Ptolemy himself has done in his eighth book), and afterwards reversed, so as to suit the supposed method of computation.

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[1] Hipparchus pointed out the mode of determining longitudes by observations of eclipses, but the instance to which he referred (of the celebrated eclipse before the battle of Arbela, which was also seen at Carthage) was a mere matter of popular observation, of no scientific value. Yet Ptolemy seems to have known of no other.

The equator was in like manner placed by Ptolemy at a considerable distance from its true geographical position. The place of the equinoctial line was well known to him as a matter of theory, but as no observations could have been made in those regions he could only calculate its place from that of the tropic, which he supposed to pass through Syene. And as he here, as elsewhere, reckoned a degree of latitude as equivalent to 500 stadia, he inevitably made the interval between the tropic and the equator too small by one-sixth; and the place of the former being fixed by observation, he necessarily carried up the supposed place of the equator too high by more than 230 geographical miles. But as he had practically no geographical acquaintance with the equinoctial regions this error was of little importance.

With Marinus and Ptolemy, as with preceding Greek geographers, the most important line for practical purposes was the parallel of 36° N., which, passing through the Straits of Gibraltar, Rhodes Island and the Gulf of Issus, and thus dividing the Mediterranean (as Dicaearchus and his successors usually regarded it) into two, was continued in theory along the chain of Mt Taurus till it joined the mountains north of India; thence to the Eastern Ocean it was regarded as constituting the dividing line of the inhabited world, along which the length of the latter must be measured. But so inaccurate were the observations and so imperfect the materials at command, even in regard to the best known regions, that Ptolemy, following Marinus, describes this parallel as passing through Caralis in Sardinia and Lilybaeum in Sicily, the one being really in 39° 12′ lat., the other in 37° 50′. Still more strangely he places Carthage 1° 20′ south of the dividing parallel, while it really lies nearly 1° north of it.

The problem that had especially attracted the attention of geographers from Dicaearchus to Ptolemy was to determine the length and breadth of the inhabited world. This question had been fully discussed by Marinus, who had arrived at conclusions widely different from his predecessors. Towards the north, indeed, there was no great difference of opinion, the latitude of Thule being generally recognized as that of the highest northern land, and this was placed both by Marinus and Ptolemy in 63° N., not far beyond the true position of the Shetland Islands, which had come to be generally identified with the mysterious Thule of Pytheas. The western extremity, as already mentioned, had been in like manner determined by the prime meridian drawn through the supposed position of the outermost of the Fortunate Islands. But towards the south and east Marinus gave an enormous extension to Africa and Asia, beyond what had been known to or suspected by earlier geographers, and, though Ptolemy reduced Marinus' calculations, he retained an exaggerated estimate of their results.

The additions thus made to the estimated dimensions of the known world were indeed in both directions based upon a real extension of knowledge, derived from recent information; but the original statements were so perverted by misinterpretation as to give results (in map-construction) differing widely from the truth. The southern limit of the world had been fixed by Eratosthenes and even by Strabo at the parallel which passed through the eastern extremity of Africa (Cape Guardafui), the Cinnamon Region (Somaliland) and the country of the Sembritae (Sennaar). This parallel, which would correspond nearly to that of 10° of true latitude, they supposed to be situated at a distance of 3400 stadia (340 geographical miles) from that of Meroe (the position of which was pretty accurately known) and 13,400 to the south of Alexandria; while they conceived it as passing eastward through Taprobane (Ceylon, often Ceylon *plus* Sumatra?), universally recognized as the southernmost land of Asia. Both these geographers were ignorant of the vast extension of Africa to the south of this line and even of the equator, and conceived it as trending away west from the Cinnamon Land and then north-west to the Straits of Gibraltar. Marinus had, however, learned from itineraries both by land and sea the fact of this extension, of which he had conceived so exaggerated an idea that even after Ptolemy had reduced it by more than half it was still much in excess of the truth. The eastern coast of Africa was indeed tolerably well known, being frequented by Greek and Roman traders, as far as a place called Rhapta (opposite to Zanzibar?), placed by Ptolemy not far from 7° S. To this he added a bay extending to Cape *Prasum* (Delgado?), which he placed in 15½° S. At the same time he assumed the position in about the same parallel of a region called *Agisymba*, inhabited by Ethiopians and abounding in rhinoceroses, which was supposed to have been discovered by a Roman general, Julius Maternus, whose itinerary was employed by Marinus. Taking, therefore, this parallel as the limit of knowledge to the south, while he retained that of Thule to the north, Ptolemy assigned to the inhabited world a breadth of nearly 80°, instead of less than 60°, as in Eratosthenes and Strabo.

It had been a common belief among Greek geographers, from the earliest attempts at scientific geography, not only that the length of the inhabited world greatly exceeded its breadth, but that it was more than twice as great, an unfounded assumption to which their successors seem to have felt themselves bound to conform. Thus Marinus, while extending his Africa unduly southward, exaggerated Asia still more grossly eastward. Here also he really possessed a great advance in knowledge over all his predecessors, the silk trade with China having led to an acquaintance, though of a vague and general kind, with regions east of the Pamir and Tian Shan, the limits of Asia as previously known to the Greeks. Marinus had learned that traders proceeding eastward from the Stone Tower (near the Pamir?) to Sera, the capital of the Seres (inland China?), occupied seven months on the journey; thence he calculated that the distance between the two points was 36,200 stadia or 3620 geographical miles. Ptolemy, while he points out the erroneous mode of computation on which this conclusion was founded, could not correct it by any real authority, and hence reduced it summarily by one half. He therefore placed Sera (Singanfu?), the easternmost point on his map of Asia, 45½° from the Stone Tower, which again he fixed, on the authority of itineraries cited by Marinus, at 24,000 stadia or 60° of longitude from the Euphrates, reckoning in both cases a degree of longitude (in this latitude) as equivalent to 400 stadia. Both distances were greatly in excess, independently of error arising from graduation. The distances west of the Euphrates were of course comparatively well known, nor did Ptolemy's calculation of the length of the Mediterranean differ very materially from those of previous Greek geographers, though still greatly exceeding the truth, after allowing for the permanent error of graduation. This last, it must be remembered, would be cumulative, the longitudes being computed from a fixed point in the west, instead of being reckoned east and west from Alexandria, which was undoubtedly the mode in which they were really calculated. These causes of error combined to make Ptolemy allow 180° long., or 12 hours' interval, between the Fortunate Islands meridian and Sera (really about 130°).

But in thus estimating the length and breadth of the known world, Ptolemy attached a very different sense to these terms from that which they had generally borne. Most earlier Greek geographers and "cosmographers" supposed the inhabited world to be surrounded on all sides by sea, and to form a vast island in the midst of a circumfluous ocean. This notion (perhaps derived from the Homeric "ocean stream," and certainly not based upon direct observation) was nevertheless in accordance with truth, great as was the misconception involved of the continents included. But Ptolemy in this respect went back to Hipparchus, and assumed that the land extended indefinitely north in the case of eastern Europe, east, south-east and north in that of Asia, and south, south-west and south-east in that of Africa. His boundary line was in each of these cases an arbitrary limit, beyond which lay the Unknown Land, as he calls it. But in Africa he was not content with this extension southward; he also prolonged the continent eastward from its southernmost known point, so as to form a connexion with south-east Asia, the extent and position of which he wholly misconceived.

In this last case Marinus derived from the voyages of recent navigators in the Indian seas a knowledge of extensive lands hitherto unknown to the Helleno-Roman world, and Ptolemy acquired more information in this quarter. But he formed a false conception of the bearings of the coasts thus made known, and of the position of the lands to which they belonged, and, instead of carrying the line of coast northwards from the Golden Chersonese (Malay Peninsula) to the Land of the Sinae (sea-coast China), he brought it down again towards the south after forming a great bay, so that he placed Cattigara—the principal emporium in this part of Asia, and the farthest point known to him—on a supposed coast of unknown extent, but with a direction from north to south, and facing west. The hypothesis that this land was continuous with southernmost Africa, so as to enclose the Indian Ocean as one vast lake, though a mere assumption, is stated by him as definitely as if based upon positive information. It must be noticed that Ptolemy's extension of Asia eastwards, so as to diminish by 50° of longitude the interval between easternmost Asia and westernmost Europe, fostered Columbus' belief that it was possible to reach the former from the latter by direct navigation, crossing the Atlantic.

Ptolemy's errors respecting distant regions are one thing; it is another thing to discover, in regard to the Mediterranean basin, the striking imperfections of his geographical knowledge. Here he had indeed some well-established data for latitudes. That of Massilia had been determined, within a few miles, by Pytheas, and those of Rome, Alexandria and Rhodes were approximately known, all having been observation-centres for distinguished astronomers. The fortunate accident that Rhodes lay on the same parallel with the Straits of Gibraltar enabled Ptolemy to connect the two ends of the Inland Sea on the famous parallel of 36° N. Unfortunately Ptolemy, like his predecessors, supposed its course to lie almost uniformly through the open sea, ignoring the great projection of Africa towards the north from Carthage westward. The erroneous position assigned to Carthage being supposed to rest upon astronomical observation, doubtless determined that of all North Africa. Thus Ptolemy's Mediterranean, from Massilia to the opposite point of Africa, had a width of over 11° of latitude (really 6½°). He was still more at a loss in respect of longitudes, for which he had no trustworthy observations; yet he came nearer the truth than previous geographers, all of whom had greatly exaggerated the length of the Inland Sea. Their calculations, like those of Marinus and Ptolemy, could only be founded on the imperfect estimates of mariners; and Ptolemy, in translating these conclusions into scientific form, vitiated his results by his system of graduation. Thus while Marinus calculated 24,800 stadia as the length of the Mediterranean from the Straits to the Gulf of Issus, this was stated by Ptolemy at 62°, or about 20° too much. Even after correcting the error due to his computation of 500 stadia to a degree, there remains an excess of nearly 500 geographical miles.

Another error which disfigured the eastern portion of Ptolemy's Mediterranean map was the position of Byzantium, which Ptolemy (misled by Hipparchus) placed in the same latitude with Massilia, thus carrying it up more than 2° above its true position. This pushed the whole Euxine—with whose general form and dimensions he was fairly well acquainted—too far north by the same amount; besides this he enormously exaggerated the extent of the Palus Maeotis (the Sea of Azov), which he also represented as having its direction from south to north; by the combined effect of these two errors he carried up its northern extremity (with the Tanais estuary and city) as high as 54° 30′ (the true south shore of the Baltic). Ptolemy, however, was the first writer of antiquity who showed some conception of the relations between the Tanais or Don (usually considered by the ancients as the boundary between Europe and Asia) and the Rha or Volga, which he correctly described as flowing into the Caspian. He was also the first geographer after Alexander to return to the correct view (found in Herodotus and Aristotle) that the Caspian was an inland sea, without communication with the ocean.

As to north Europe, Ptolemy's views were vague and imperfect. He had indeed more acquaintance with the British Islands than any previous geographer, and showed a remarkable knowledge of certain British coast-lines. But he (1) placed Ireland (*Ivernia*) farther north than any part of Wales, and (2) twisted round the whole of Scotland, so as to make its length from west to east and to place the northern extremities of Britain and Ireland almost on the same parallel. These errors are probably connected and are naturally accompanied by the placing of Thule, the Orkneys (*Orcades*) and the Hebrides (*Ebudae*) indiscriminately on the left or north of Caledonia. Here he was perhaps embarrassed by adopting Marinus' conclusion that Thule lay in 63° N., while regarding it, like earlier geographers, as the northernmost of all lands. Ptolemy also supposed the northern coast of Germany, beyond the Cimbric Chersonese (Denmark), to be the southern shore of the Northern Ocean, with a general direction from west to east. Of the almost wholly landlocked Baltic he was entirely ignorant, as well as of the Scandinavian Peninsula; his Scandia is an island smaller than Corsica, lying in the true position of southern central Sweden. Some way east of the Vistula, Ptolemy, however, makes the Sarmatian coast trend north, to the parallel of Thule; nor did he conceive this as an actual limit, but believed the Unknown Land to extend indefinitely in this direction as also to the north of Asiatic Scythia.

As to the latter region, vague and erroneous as were his views concerning this enormous tract from Sarmatia to China, they show an advance on those of earlier geographers. Ptolemy was the first who had anything like a clear idea of the great north-and-south dividing range of Central Asia (the Pamir and Tian Shan), which he called Imaus, placing it nearly 40° too far east, and making it divide Scythia into two portions (Within Imaus and Beyond Imaus), somewhat corresponding to Russian and Chinese Central Asia. Ptolemy also applies the term Imaus to a section of the backbone range which in his system crosses Asia from west to east. This section lies east of the Indian Caucasus, and forms an angle with the other Imaus running north.

On the southern shores of Asia Ptolemy's geography is especially faulty, though he shows a greatly increased general knowledge of these regions. For more than a century the commercial relations between western India and Alexandria, the chief eastern emporium of the Roman Empire, had become more important and intimate than ever before. The tract called the *Periplus of the Erythraean Sea*, about A.D. 80, contains sailing directions for merchants from the Red Sea to the Indus and Malabar, and even indicates that the coast from Barygaza (Baroch) had a general southward direction down to and far beyond Cape Komari (Comorin), which, taken together with its account of the shore-line as far as the Ganges, affords some suggestions at least of a peninsular character for south India. But Ptolemy, following Marinus, not only gives to the Indian coasts, from Indus to Ganges, an undue extension in longitude, but practically denies anything of an Indian peninsula, placing capes Komaria and Kory (his southernmost points in India) only 4° S. of Barygaza, the real interval being over 800 geographical miles, or, according to Ptolemy's system of graduation, 16° of latitude. This error, distorting the whole appearance of south Asia, is associated with another as great, but of opposite tendency, in regard to Taprobane (in which ancient ideas of Ceylon and Sumatra are confusedly mingled). The size of this was exaggerated by most earlier Greek geographers; but Ptolemy extended it through 15° of latitude and 12° of longitude, so as to make it about fourteen times as large as the reality, and bring down its southern extremity more than 2° south of the equator.

Similar distortions in regions beyond the Ganges, concerning which Ptolemy is our only ancient authority, are less surprising. Between the date of the *Periplus* and that of Marinus it seems probable that Greek mariners had not only crossed the Gangetic gulf and visited the land on the opposite side, which they called the Golden Chersonese, but pushed considerably farther east, to Cattigara. But these commercial voyagers either brought back inaccurate notions, or Ptolemy's preconceptions destroyed the value of the new information, for nowhere does he distort the truth more wildly. After passing the Great Gulf, beyond the Golden Chersonese, he makes the coast trend southward, and thus places Cattigara (perhaps one of the south China ports) 8½° south of the equator. In this he was perhaps influenced by his notion of a junction of Asia and Africa in a *terra incognita* south of the Indian Ocean.

In regard to West Africa, we may notice that he conceives this coast as running almost due north and south to 10° N., and then (after forming a great bay) as bending away to the unknown southwest. Though the Fortunate Islands were so important to his system as his prime meridian, he was entirely misinformed about them, and extended the group through more than 5° of latitude, so as to bring down the most southerly of them to the real parallel of the Cape Verde Islands.

In regard to the mathematical construction or projection of his maps, not only was Ptolemy greatly in advance of all his predecessors, but his theoretical skill was altogether beyond the nature of the materials to which he applied it. The methods by which he obviated the difficulty of transferring the delineation of different countries from the spherical surface of the globe to the plane surface of an ordinary map differed little from those in use at the present day, and the errors arising from this cause (apart from those produced by his fundamental error of graduation) were really of little consequence compared with the defective character of his information and the want of anything approaching to a survey of the countries delineated. He himself was well aware of his deficiencies in this respect, and, while giving full directions for the scientific construction of a general map, he contents himself, for the special maps of different countries, with the simple method employed by Marinus of drawing the parallels of latitude and meridians of longitude as straight lines, assuming in each case the proportion between the two, as it really stood with respect to some one parallel towards the middle of the map, and neglecting the inclinations of the meridians to one another. Such a course, as he himself repeatedly affirms, will not make any material difference within the limits of each special map.

Ptolemy especially devoted himself to the mathematical branch of his subject, and the arrangement of his work, in which his results are presented in a tabular form, instead of being at once embodied in a map, was undoubtedly designed to enable the student to construct his maps for himself. This purpose it has abundantly served, and there is little doubt that we owe to the peculiar form thus given to his results their transmission in a comparatively perfect condition to the present day. Unfortunately the specious appearance of these results has led to the belief that what was stated in so scientific a form must necessarily be based upon scientific observations. Though Ptolemy himself has distinctly pointed out in his first book the defective nature of his materials, and the true character of the data furnished by his tables, few readers studied this portion of his work, and his statements were generally received with undoubting faith. It is only in modern times that his apparently scientific work has been shown to be in most cases a specious edifice resting upon no adequate foundations.

There can be no doubt that the work of Ptolemy was from the time of its first publication accompanied with maps, which are regularly referred to in the eighth book. But how far those which are now extant represent the original series is a disputed point. In two of the most ancient MSS. it is expressly stated that the maps which accompany them are the work of one Agathodaemon of Alexandria, who "drew them according to the eight books of Claudius Ptolemy." This expression might equally apply to the work of a contemporary draughtsman under the eyes of Ptolemy himself, or to that of a skilful geographer at a later period, and nothing is known from any other source concerning this Agathodaemon. The attempt to identify him with a grammarian of the same name who lived in the 5th century is wholly without foundation. But it appears, on the whole, most probable that the maps appended to the MSS. still extant have been transmitted by uninterrupted tradition from the time of Ptolemy.

2. *Progress of Geographical Knowledge in Certain Special Regions.*—Ptolemy records, after Marinus, the penetration of Roman expeditions to the land of the Ethiopians and to Agisymba, clearly some region of the Sudan beyond the Sahara desert, perhaps the basin of Lake Chad. But while this name was the only recorded result of these expeditions, Ptolemy also gives much other information concerning the interior of North Africa (whence derived we know not) to which nothing similar is found in any earlier writer. Unfortunately this new information was of so crude a character, and is presented in so embarrassing a form, as to perplex rather than assist. Thus Ptolemy's statements concerning the rivers Gir and Nigir, and the lakes and mountains with which they were connected, have baffled successive generations of interpreters. It may safely be said that they present no resemblance to the real features of the country as now known, and cannot be reconciled with them except by arbitrary conjecture.

As to the Nile, both Greeks and Romans had long endeavoured to discover the sources of this river, and an expedition sent out for that purpose by the emperor Nero had undoubtedly penetrated as far as the marshes of the White Nile in about 9° N. Ptolemy's statement that the Nile derived its waters from two streams which rose in two lakes a little south of the equator was nearer the truth than any of the theories concocted in modern times before the discovery of the Victoria and Albert Nyanza. In connexion with this subject he introduces a range of mountains running from east to west, which he calls the Mountains of the Moon, and which, however little understood by Ptolemy, may be considered to represent in a measure the fact of the alpine highlands now known to exist in the neighbourhood of the Nyanzas and in British and German East Africa (Ruwenzori, Kenya, Kilimanjaro, &c.).

In Asia, as in Africa, Ptolemy had obtained, as we have seen, a vague, sometimes valuable, often misleading, half-knowledge of extensive regions, hitherto unknown to the Mediterranean world, and especially of Chinese Asia and its capital of Sera (Singanfu). North of the route leading to this far eastern land (supposed by Ptolemy to be nearly coincident with the parallel of 40°) lay a vast region of which apparently he knew nothing, but which he vaguely assumed to extend indefinitely northwards as far as the limits of the Unknown Land. The Jaxartes, which since Alexander had been the boundary of Greek geography in this direction, was still the northern limit of all that was really known of Central Asia. Beyond that Ptolemy places many tribes, to which he could assign no definite locality, and mountain ranges which he could only place at haphazard. As to south-east Asia, in spite of his misplacement of Cattigara and the Sinae or Thinae, we must recognize in the latter name a form of China; from the Sinae being placed immediately south of the Seres, it is possible that Ptolemy was aware of the connexion between the two—the Chinese coast known only by maritime voyages, and inland China, known only by continental trade.

As to Mediterranean countries, we have seen that Ptolemy professed (in the main) to follow Marinus; the latter, in turn, largely depended on Timosthenes of Rhodes (*fl. c.* 260 B.C.), the admiral of Ptolemy Philadelphus, as to coasts and maritime distances. Claudius Ptolemy, however, introduced many changes in Marinus' results, some of which he has pointed out though there are doubtless many others which we have no means of detecting. For the interior of the different countries Roman roads and itineraries must have furnished both Marinus and Ptolemy with a mass of valuable materials. But neither seems to have taken full advantage of these; and the tables of the Alexandrian geographer abound with mistakes—even in countries so well known as Gaul and Spain—which might easily have been obviated by a more judicious use of such Roman authorities.

In spite of the merits of Ptolemy's geographical work it cannot be regarded as a complete or satisfactory treatise upon the subject. It was the work of an astronomer rather than a geographer. Not only did its plan exclude all description of the countries with which it dealt, their climate, natural productions, inhabitants and peculiar features, but even its physical geography proper is treated in an irregular and perfunctory manner. While Strabo was fully alive to the importance of the rivers and mountain chains which (in his own phrase) "geographize" a country, Ptolemy deals with this part of his subject in so careless a manner as to be often worse than useless. In Gaul, for instance, the few notices he gives of the rivers that play so important a part in its geography are disfigured by some astounding errors; while he does not notice any of the great tributaries of the Rhine, though mentioning an obscure streamlet, otherwise unknown, because it happened to be the boundary between two Roman provinces.

BIBLIOGRAPHY.—Ptolemy's *Geographia* was printed for the first time in a Latin translation, accompanied with maps, in 1462(?), and numerous other editions followed in the latter part of the 15th and earlier half of the 16th centuries, but the Greek text did not make its appearance till 1533, when it was published at Basel in quarto, edited by Erasmus. All these early editions, however, swarm with textual errors, and are critically worthless. The same may be said of the edition of P. Bertius (Gr. and Lat., Leiden, 1618, typ. Elzevir), which was long the standard library edition. It contains a new set of maps drawn by Mercator, as well as a fresh series (not intended to illustrate Ptolemy) by Ortelius, the Roman Itineraries, including the *Tabula peutingeriana*, and much other miscellaneous matter. The first attempt at a really critical edition was made by F. G. Wilberg, and C. H. F. Grashof (4to, Essen, 1838–1845), but this only covered the first six books of the entire eight. The edition of C. F. A. Nobbe (3 vols., 18mo., Leipzig, 1843), presents the best Greek text of the whole work, and has a useful index. The best edition, so far as completed, is that published in A. F. Didot's *Bibliotheca graecorum scriptorum* (*Claudii Ptolemaei geographia*; 2 vols., Paris, 1883 and 1901), originally edited by Carl Müller and continued by C. T. Fischer, with a Latin translation and a copious commentary, geographical as well as critical. See also, F. C. L. Sickler, *Claudii Ptolemaei Germania* (Hesse Cassel, 1833); W. D. Cooley, *Claudius Ptolemy and the Nile* (London, 1854); J. W. McCrindle, *Ancient India described by Ptolemy* (Bombay, 1885), reprinted from *Indian Antiquary* (1884); Henry Bradley, "Ptolemy's Geography of the British Isles," in *Archaeologia*, vol. xlviii. (1885); T. G. Rylands, *Geography of Ptolemy Elucidated* (Dublin, 1893); and a Polish study of Ptolemy's Germany and Sarmatia, in the Historical-Philosophical Series (2) of the Cracow University (1902), vol. xvi. (E. H. B.; C. R. B.)

PTOMAINE POISONING (Gr. πτῶμα, corpse), a phrase now popularized in the sense of a certain class of food-poisoning. The word "ptomaine" was invented by the Italian chemist Selmi for the basic substances produced in putrefaction. They belong to several classes of chemical compounds. (See MEDICAL JURISPRUDENCE.)

PUBERTY (Lat. *pubertas*, from *pubes*, *puber*, mature, adult), that period of life at which the generative organs in both sexes become functionally active (see REPRODUCTIVE SYSTEM). In northern countries males enter upon sexual maturity between fourteen and sixteen, sometimes not much before the eighteenth year, females between twelve and fourteen. In tropical climates puberty is much earlier. In English common law the age of puberty is conclusively presumed to be fourteen in the male and twelve in the female. Puberty is of much ethnological interest, as being the occasion among many races for feasts and religious ceremonies. In Rome a feast was given to the family and friends: the hair of boys was cut short, a lock being thrown into the fire in honour of Apollo, and one into water as an offering to Neptune. Girls offered their dolls to Venus, and the *bulla*—a little locket of gold worn round children's necks, often by boys as well as girls—was taken off and dedicated in the case of the former to Hercules or the household lares, in the case of the latter to Juno. The attainment of puberty is celebrated by savages with ceremonies some of which seem to be directly associated with totemism. The Australian rites of initiation include the raising of those scars on the bodies of clansmen or clanswomen which serve as tribal badges or actually depict the totem. Among many savage peoples lads at puberty undergo a pretence of being killed and brought to life again.

PUBLICANI, literally men employed "in connexion with the revenue," (*publicum*, from *populus*, people), or possibly "in the public service," the name given in ancient Rome to a body of men who either hired state property or monopolies for a certain period, during which they could farm such property to their own profit, or bought of the state for a fixed sum the right to farm for a term of years the taxes due to the treasury from the public land in Italy (see AGRARIAN LAWS) or the land held by Roman subjects in the provinces. In very early times the senate entrusted to officials appointed for the purpose the control of the sale of salt (Livy ii. 9); and it was a natural development from this that the state, instead of appointing officials to manage its monopolies, should let out those monopolies to individuals. A regular system was soon established by which the censor, who held office every fifth year, placed all the sources of public revenue in the hands of certain individuals or companies, who on payment of a fixed sum into the treasury, or on giving adequate security for such payment, received the right to make what profit they could out of the revenues during the five years that should elapse before the next censorship. The assignment was made to the highest bidder at a public auction held by the censor. The same system was applied to the public works, the *publicanus* (or company) in this case being paid a certain sum, in return for which he took entire charge of a certain department of the public works, and winning his appointment by making the lowest tender. That this system was well established at the time of the Second Punic War is assumed in Livy's account of the various offers made by the wealthier class of citizens to relieve the exhausted treasury after the battle of Cannae. On the one hand we have companies offering a price for branches of the revenue which was calculated rather to meet the needs of the state than to ensure any profit for themselves (Livy xxiii. 49). On the other hand individuals are represented as undertaking the management of public works on the understanding that they will expect no payment until the conclusion of the war (ibid. xxiv. 18).

In very early times the *publicani* may have been men closely connected with the government. But since wealth was a necessary qualification for the post, and wealth at Rome became more and more confined to the commercial class, the *publicani* became identical with the leading representatives of the class of capitalists and traders. This class was always distinct at Rome from the hereditary nobilty which monopolized the government of the state, and members of the senatorial class were excluded from it by definite enactment (see SENATE). Although common interest was strong enough to secure for the government in time of external danger the loyal support of the commercial class, yet after the close of the great wars a market hostility grew up between it and the government.

The extension of the Roman system of tax-farming to the provinces did not at first increase the importance of the *publicani* in Italy; for in the earlier provinces, in which the collection of the revenues was put up to auction in the province itself, the *publicani* were generally natives. But C. Gracchus, who carried a law that the taxes of the new province of Asia should be put up to auction by the censor in Rome, gave to the Roman capitalists an opportunity of greatly extending their financial operations and thus in a short time of securing important political powers. It was in their capacity of *publicani* in the wealthiest provinces that the capitalist or equestrian *judices* (see EQUITES) became a menace to the provincial governors who represented the senatorial power. Cicero often applies the name *publicani* to the whole order; and on the various occasions when the demands of the equestrian party determined the policy of the state we can clearly trace the interests of the *publicani*, who were involved in an infinite number of commercial and financial transactions in the provinces, as the motive of its action. Thus the cruel fate of the Roman business men in Cirta led the capitalist class to force the Jugurthine War upon the senate in 112 B.C.; the disorganization of Asiatic commerce by the pirates led the same party to support the proposal to confer extraordinary powers on Pompey in 67 B.C.; and the rigour of the senate in opposing any relaxation of the burdensome contract made by the tax-farmers of Asia in 60 B.C. led to that estrangement between the senate and the capitalist class which enabled the democratic party to work its will and pave the way for the principate.

The companies of *publicani* continued some of their operations in the provinces under the early principate, but they lost many of their opportunities of oppression and embezzlement. We hear of a vigorous attempt made by Nero to suppress their unjust exactions, and they appear to have been kept under much closer supervision.

The term *publicanus* was applied at this time, and probably earlier, to the subordinate officials employed by the companies of *publicani* for the actual collection of the revenue, and thus acquired the general sense of "tax-collector," even in provinces where the system of tax-farming by contract with societies of *publicani* was not in existence. (A. M. CL.)

PUBLIC HEALTH, LAW OF. State medicine as an organized department of administration is entirely of modern growth. By the common law of England the only remedy for any act or omission dangerous to health was an action for damages or an indictment for nuisance. The indictment for nuisance still lies for many offences which are now punishable in a summary manner under the powers of modern legislation. But for a long time it was the only, not as now a concurrent, remedy. At a comparatively early date statutes were passed dealing with matters for which the common law had provided too cumbrous a remedy, while the plague called forth the act of 1 Jac. I. c. 31 (1603), which made it a capital offence for an infected person to go abroad after being commanded by the proper authority to keep his house. The act for the rebuilding of London after the great fire, 19 Car. II. c. 3 (1668), contained various provisions as to the height of houses, breadth of streets, construction of sewers and prohibition of noisome trades. Numerous local acts gave the authorities of the more important towns power over the public health. But it was not until 1848 that a general Public Health Act, embracing the whole of England (except the Metropolis), was passed. The Public Health Act 1848 created a general board of health as the supreme authority in sanitary matters, but greater local sanitary control was given by an act of 1858. The local government board, the present central authority, was created by an act of 1871. Numerous acts dealing with public health were passed from 1849 to 1874; and the law was digested into the Public Health Act 1875, as amended by the Local Government Act 1894 and other acts.

The tendency of English sanitary legislation has been to place local sanitary regulations in the hands of the local authorities, subject to general superintendence by a government department. The jurisdiction of a local authority is both preventive and remedial. The matters falling under it are very numerous, but the more important will be found in the article ENGLAND: *Local Government*. The act of 1875 was followed by the Public Health Acts Amendment Act 1890, the Public Health Act 1896 and the Public Health Acts Amendment Act 1907. The first of these statutes confers enlarged powers on such local authorities as choose to adopt it—the right of adoption being general in the case of urban authorities, and in that of rural authorities limited to certain specified provisions unless extended by the local government board. The Public Health Acts 1896 and 1904 abolished the old system of quarantine (*q.v.*), and empowered the local government board to make regulations as to the landing or embarking of infected persons from ships, British or foreign; while the act of 1907 enabled local authorities to adopt many of the useful clauses introduced into private bills from time to time, relating not only to sanitary provisions, but to streets and buildings, milk, &c. supply, recreation grounds, sky-signs, &c.

Elaborate provision has been made for the notification of infectious diseases by the Infectious Diseases (Notification) Acts 1889 and 1899. The former statute was originally adoptive only, but it has now been extended by the latter to every district in England or Wales—in London notification has been compulsory since 1891. Reference should be made also to the following statutes: the Infectious Disease (Prevention) Act 1890 provides for the inspection of dairies, and the cleansing and disinfecting of premises, and under the Public Health (Ports) Act 1896 the local government board may by order assign to any port sanitary authority powers or duties arising under this statute. The scope of the Baths and Washhouses Acts 1846 to 1882 sufficiently appears from the title. The Isolation Hospitals Act 1893 enables county councils to promote the establishment of hospitals for the reception of patients suffering from infectious diseases; the Cleansing of Persons Act 1897 enables local authorities to permit persons who apply to them, on the ground that they are infested with vermin, to have the gratuitous use of cleansing apparatus; and the Vaccination Acts of 1898 and 1907 profoundly modified the law as to vaccination by giving a discretion to magistrates. See too, among other acts, those of 1881 (alkali works), 1882 (fruit pickers), 1883 (epidemics), 1889 (cholera), 1904 (shop hours), 1905 (medical inspection of aliens) and numerous others.

In addition to these statutes, account has to be taken of a large body of legislation which relates indirectly to the law of public health, or at least comes well within its range of operation. It deals with a very great variety of subjects, and only the slightest sketch of its results need be given here. (For factories and workshops, see LABOUR LEGISLATION, and for merchant shipping, see SEAMEN.) The Coal Mines Regulation Act 1896 aims at the prevention of accidents due to inflammable gas and coal-dust in coal mines. The Cotton Cloth Factories Acts 1889 and 1897 enable the home secretary to make regulations for health in cotton mills. The Rivers Pollution Prevention (Borders Councils) Act 1898 enables joint committees of English and Scottish county councils of counties on both sides of the Border to exercise the powers of the Rivers Pollution Prevention Act 1876, in relation to any river or tributary which is partly in England and partly in Scotland—an expression including the Tweed. The Notification of Births Act 1907 and the Children Act 1908 (see CHILDREN: *Law relating to*) have given great protection to infant life. Lastly, reference may be made to the Contagious Diseases (Animals) Act 1894, which consolidated the law on this subject.

London.—Down to the year 1891 London was governed in matters of public health by a series of special statutes (especially the Metropolitan Police Acts), and by provisions in the general statutes. The law as to the Metropolis was consolidated, and is now regulated by the Public Health (London) Act 1891. The sanitary authorities for the execution of the act were the commissioners of sewers for the City of London, the vestries of the larger and the district boards of some of the smaller parishes, and varying authorities for Woolwich and some other places. Under the London Government Act 1899, the powers of each existing vestry and district board are transferred to the council of the borough comprising the area within the jurisdiction of such vestry and district board; and the borough councils take over certain of the powers of the county council (*e.g.* as to dairies, milk, slaughter-houses and offensive businesses) and exercise concurrent jurisdiction with it in other matters. Provision is made for the appointment of medical officers of health and sanitary inspectors. The medical officer is for some purposes placed on the footing of a district poor-law medical officer, and he cannot be removed without the consent of the local government board. In its structure and substance the Public Health (London) Act 1891, which consists of 144 sections, closely resembles the general acts (see London, § iv.).

The law of public health in London is also affected by a number of later statutes relating to the Metropolis alone, such as the London Building Acts 1894 and 1898, the Baths and Washhouses Act 1896, the Canals Protection (London) Act 1898, &c.

Scotland.—Sanitary legislation occurs as early as the reign of Alexander III. The *Statuta Gilde*, c. 19, forbade the deposit of dung or ashes in the street, market, or on the banks of the Tweed at Berwick, under a penalty of eight shillings. At a later date the act of 1540, c. 20, enacted that no flesh was to be slain in Edinburgh on the east side of the Leith Wynd; that of 1621, c. 29, fixed the locality of fleshers and candlemakers. The various statutes relating to public health in Scotland are now consolidated and amended by the Public Health (Scotland) Act 1897, which, together with the Infectious Diseases Notification Act 1889 and the Burgh Police (Scotland) Act 1892, constitute the statutory law of Scottish sanitary administration. The central authority is the local government board for Scotland. The local authorities are—(i.) in burghs under the Burgh Police (Scotland) Act 1892, the town council or burgh commissioners; (ii.) in other burghs, the town council or board of police; (iii.) in districts where the county is divided into districts, the district committee; (iv.) in counties not so divided, the county council. The substantive provisions are similar to those of the English acts.

Ireland.—Several acts of the Irish parliament dealt with specific nuisances, *e.g.* 5 Geo. III. c. 15, forbidding the laying of filth in the streets of cities or county towns, and making regulations as to sweeping and scavenging. There were also numerous private acts dealing with water-supply and the obstruction of watercourses. In 1878 the existing legislation was consolidated by the Public Health (Ireland) Act 1878, a close copy of the English act of 1875. Most of the English acts apply to Ireland with modifications and adaptations.

United States.—After the Civil War boards of health were established in the chief cities. Public health is under the control of the local authorities to a greater extent than in England. By the Act of Congress of the 25th of February 1799 officers of the United States are bound to observe the health laws of the states. A national board of health was created by the act of the 3rd of March 1879, c. 202; and it was succeeded by the Public Health and Marine Hospital Service, whose chief officer is the surgeon-general and which has jurisdiction in quarantine and in epidemics of a peculiarly dangerous nature.

Authorities.—English: Glen, *Public Health Acts*, 13th edition (London, 1906); Lumley, *Public Health Acts*, 7th edition (London, 1908); Redlich and Hirst, *Local Government* (1904); Hunter, *Open Spaces* (London, 1896); Hunt, *London Local Government* (London, 1897); Hunt, *London Government Act 1899* (London, 1899); Macmorran, Lushington and Naldrett, *London Government Act 1899* (London, 1899); Shaw's *Vaccination Manual* (London, 1899); Macmorran, *Public Health (London) Act 1891* (2nd ed., 1910); *Encyclopaedia of Local Government Law* (by various authors), begun in 1905; *Annual Report* of Local Government Board; Annual Volume of Statutory Rules and Orders. Scottish: Macdougall and Murray, *Handbook of Public Health* (Edinburgh). Irish: Vanston, *Public Health in Ireland* (Dublin, 1892); Vanston's *Public Health Supplement* (Dublin, 1897). American: Bouvier, *Law Dict.*, ed. Rawle (London and Boston, 1897).

PUBLIC HOUSE, in its general English acceptation, a house in respect of which a licence has been obtained for the consumption of intoxicating liquors. Public houses are frequently distinguished as "tied" and "free." A tied house is one rented from a person or firm from whom the tenant is compelled to purchase liquors or other commodities to be consumed therein. A free house has no such covenant. The keepers of public houses ("publicans" or "licensed victuallers") are subject, in the conduct of their business, to a number of restrictions laid down by various acts of parliament; while, in order to ply their trade, they require a justices' licence and an excise licence. (See Liquor Laws; Temperance.)

By the Parliamentary Elections Act (1853) a public house must not be used for elections, meetings or committee rooms. By the Payment of Wages in Public Houses Prohibition Act (1883) it is illegal to pay wages to any workman in a public house, except such wages as are paid by the resident owner or occupier. By the Sheriffs Act (1887) when a debtor is arrested he must not be taken to a public house without his free consent, nor must he be charged with any sum for liquor or food, except what he freely asks for.

PUBLILIUS (less correctly Publius) **SYRUS,** a Latin writer of mimes, flourished in the 1st century B.C. He was a native of Syria and was brought as a slave to Italy, but by his wit and talent he won the favour of his master, who freed and educated him. His mimes, in which he acted himself, had a great success in the provincial towns of Italy and at the games given by Caesar in 46 B.C. Publilius was perhaps even more famous as an improvisatore, and received from Caesar himself the prize in a contest in which he vanquished all his competitors, including the celebrated Decimus Laberius. All that remains of his works is a collection of Sentences (*Sententiae*), a series of moral maxims in iambic and trochaic verse. This collection must have been made at a very early date, since it was known to Aulus Gellius in the 2nd century A.D. Each maxim is comprised in a single verse, and the verses are arranged in alphabetical order according to their initial letters. In course of time the collection was interpolated with sentences drawn from other writers, especially from apocryphal writings of Seneca; the number of genuine verses is about 700. They include many pithy sayings, such as the famous "judex damnatur ubi nocens absolvitur" (adopted as its motto by the *Edinburgh Review*).

The best texts of the *Sentences* are those of E. Wölfflin (1869) A. Spengel (1874) and W. Meyer (1880), with complete critical apparatus and index verborum; recent editions with notes by O. Friedrich (1880), R. A. H. Bickford-Smith (1895), with full bibliography; see also W. Meyer, *Die Sammlungen der Spruchverse des Publilius Syrus* (1877), an important work.

PUBLISHING. In the technical sense, publishing is the business of producing and placing upon the market printed copies of the work of an author (see Book). Before the invention of printing the actual maker of a manuscript was to a great extent his own publisher and his own bookseller. Increase of facilities for the production of copies led to a steady though slow differentiation of functions. The author was the first factor to be isolated and confined to a well-marked province, yet we may find upon the title-page of some old books an intimation that they might be purchased either at the shop of the bookseller who published them or at the lodgings of the author.

The separation of publishing from bookselling came later (see Bookselling). Booksellers were the first publishers of printed books, as they had previously been the agents for the production and exchange of authentic manuscript copies; and as they are quite competent to make contracts with papermakers, printers and bookbinders, there is no particular reason why they should not be publishers still, except the tendency of every composite business to break up, as it expands, into specialized departments. That tendency may be seen at work in the publishing business itself. When publishers had conquered their own province, and had confined booksellers to bookselling, they held in their own hands the entire business of distribution to the trade. But a class of wholesale booksellers has grown up, and although important retail booksellers in London continue to deal directly with the publishers, the retail booksellers throughout the country draw their supplies quite largely from the wholesale agents.

The intellectual movement which was largely responsible for the French Revolution, and the general stir and upheaval which followed that portentous cataclysm, precipitated the separation of production from distribution in the book trade, by the mere expansion of the demand for books. That separation was practically complete at the beginning of the 19th century, although it would not be difficult to find survivals of the old order of things at a much later date. The old bookseller-publishers were very useful men in their time. They met pretty fairly the actual needs of the public; and as regards the author, they took the place of the private patron upon whom he was previously dependent. No doubt the author had much to endure at their hands, still, they did undoubtedly improve his status by introducing him to public patronage and placing him upon a sounder economic basis. If in the earlier days they were less than liberal in their terms, it may be remembered that their own business was not very extensive or very remunerative. They were not equipped either with brains or with capital to extend that business in answer to the growing demand for books. By the daily routine of their shops they were tied down to narrow views, and their timidity is characteristically shown by the fact that to publish a book of any importance required the co-operation of a number of booksellers who shared the expenses and the profits.

Enterprise could not be expected from a committee of that kind and of that composition; hence there was not merely an opportunity, but a clamorous demand for men of larger ideas and wider outlook to undertake the proper business of publishing, unhampered by the narrowing influences of retail trade.

Besides unconsciously improving the position of authors by enabling them to appeal to the public instead of to patrons, whom Johnson classed with other evils in the line "toil, envy, want, the patron and the gaol," the bookseller-publishers gave them, or many of them, steady employment as literary assistants and advisers.

As the demand for books increased, these worthy tradesmen felt with growing acuteness their own want of literary ability and of education. They called in men of letters to supply their own deficiencies. No doubt they expected the lowest kind of hack work from their assistants, no doubt the pay was poor, no doubt they trampled upon the sensibilities of the man of letters, and no doubt he irritated them by his unbusinesslike habits. Still, the association was useful to both parties; and indeed, one may lay down many books at the present day with a sigh of regret that the writers had never been compelled to go through an apprenticeship of the kind.

The emergence of the publishers as a separate class was accompanied by differentiation of the functions of their literary assistants. The routine drudgery which men of education and ability formerly had to undergo fell to a class now known as "proof readers," who are on the watch for typographical errors, grammatical slips, ambiguities of expression, obvious lapses of memory and oversights of all kinds. Men of letters became "publishers' readers," and their duty was to appraise the worth of the manuscripts submitted, and to advise their employers as to the value of the matter, the originality of the treatment, and the excellence of the style. Their advice was also sought upon literary projects that may have suggested themselves to the publishers, and novel suggestions emanating from themselves were welcomed. Men of letters in positions of that kind could obviously exercise very considerable influence over the proceedings of the publishing firms to which they were attached, and many an unknown writer has owed the acceptance of his work to the sympathetic insight of the publishers' reader.

The man of letters as publisher's reader is, however, a transitory phenomenon in the evolution of the publishing business. His primary function is to tell the publisher what is intrinsically good, but probably he has always to some extent discharged the secondary function of advising the publisher as to what it would pay to publish. The qualities which make a man a sound critic of intrinsic worth are quite different from those that make him a good judge of what the public will buy. When books were comparatively few, and when the reading public was comparatively small, select and disposed to give considerable attention to the few books it read, the critical faculty was of more importance than the business one. But when the output of books became large, and when, as the consequence of educational changes, the reading public became numerous, uncritical and hurried and superficial in its reading, the importance of the critical faculty in the publisher's reader dwindled, while the faculty of gauging the public mind and guessing what would sell became increasingly valuable. The publisher's literary adviser belongs to the period when the publishing business had expanded sufficiently to compel the publisher to look for skilled assistance in working more or less upon the older traditions. But when, as is now the case, expansion has gone so far as to swamp the older traditions, and to make publishing a purely commercial affair, the literary reader gives place to the man of business with aptitude for estimating how many copies of a given book can be sold. This is practically recognized by at least one London publisher, who in recent years paid no salary to his reader, but gave him a small commission upon every copy that was sold of any book the publication of which he had recommended. Nothing could more plainly indicate that literary faculty is not wanted, and that the reader's function is to judge, not literary value, but commercial utility.

The market is flooded with books badly written, badly constructed, as poor in matter as in style, hastily flung together, and outrageously padded to suit conventional relations between size and price. They are books which no man of literary taste or judgment could ever recommend for publication on their merits, but they are published, just as crackers are at Christmas, on a calculation that a certain number will find buyers. Even if the publisher sees no prospect of an adequate sale, he publishes the books all the same, upon terms which ensure to him a manufacturing profit and throw the risk of loss upon other shoulders.

There is no reproach, stated or implied, to the publisher. He is merely a man of his age carrying on his business upon terms which the age prescribes through a number of concurrent causes. Any reproach that may fall upon him he invites by sometimes giving himself the airs of one belonging to an earlier age, and claiming credit for acting upon principles that are obsolete.

An author, even if he be an immortal genius, is, from the economic point of view, a producer of raw material. A publisher, however eminent, is from the same point of view a middleman who works up the author's raw material into a saleable form and places it upon the market. The relationship between the two is one that occurs with great frequency in business, always giving rise to efforts by each party to adjust the division of profits for his own advantage. If there be anything peculiar to the publishing business it is that the party who in that business most successfully adjusts matters for his own advantage is liable to be charged by the other with some form of moral obliquity. The diatribes of authors against publishers are familiar to every one; and publishers on their side have some hard things to say about authors, though their sentiments are less piquantly and less publicly expressed. The publisher is usually a more or less capable man of business, while the author is generally—though there are very notable exceptions—quite ignorant of business and apparently incapable of learning the rudiments. It necessarily follows that the author, left to himself, accepts agreements and signs contracts which are much less favourable than they need be to his acquisition of a due share of the profits jointly made by himself and the publisher. What makes his position still worse is the circumstance that each author fights for his own hand, whereas the publishers, although in competition with one another, are also to some extent in combination.

In these circumstances it occurred to Sir Walter Besant and some others that a remedy for this inferiority in position might be found in a combination of authors for mutual help and protection. After a troublesome period of incubation the Society of Authors was established in London in 1883, with Lord Tennyson as its first president, and with a goodly list of 35 vice-presidents. It offered useful assistance to authors ignorant of business in the way of examining contracts, checking publishers' accounts, revising their sometimes too liberal estimates of costs of production, and giving advice as to the publishers to be applied to or avoided in any given case. It has no doubt been of great service in checking the abuses of the publishing trade and in compelling the less scrupulous among the publishers to conform more or less exactly to the practice of the more honourable. On general questions such as that of copyright it serves to focus the opinions of authors, though here it champions their interests against the public rather than against the publishers. But the society has never been an effective combination of authors; and indeed the obstacles, material and moral, to such a combination are so great as to render complete success extremely improbable. Nothing could better illustrate this difficulty than the fact that, concurrently with the Society of Authors, a totally different machinery for the furtherance of the interests of authors came into existence. The "literary agent" made his appearance about 1880. He is supposed to be an expert in all matters pertaining to publishing and to the book market. He takes the author's business affairs entirely into his hands; utilizes the competition among publishers to sell the author's work to the highest bidder; checks accounts, estimates and sales; keeps the author's accounts for him; and charges a commission upon the proceeds. Here we have the author fighting as of old for his own hand. The only difference is that he does his fighting by proxy, hiring a stronger man than himself to deal the blows on his account. There is no question whatever of solidarity with his fellow-authors, and the whole system is a direct negation of the principle upon which the Society of Authors was founded.

On the other hand, both publishers and booksellers have long had the disposition, and to some extent the ability, to co-operate, and the efforts of both sets of men have unfortunately been in the direction of maintaining, if not raising, the price of books to the public. Since the formation of the Publishers' Association in 1896 the publishing trade has been strongly organized on the trade-union pattern, and its operations have been assisted by the less powerful Booksellers' Association. Books, like many other articles, are sold by the makers at list prices, and the retailer's profit is furnished by discounts off these prices. Under such a system competition among retailers takes the form of the sacrifice by the more enterprising of a portion of their discount. They prefer a large sale at a low profit to a small sale at a high profit. It is always the desire of the less enterprising to put an end to this competition by artificial regulations compelling all to sell at the same price.

Many attempts have been made to destroy freedom of dealing in books. In July 1850 twelve hundred booksellers within 12 m. of the London General Post Office signed a stringent agreement not to sell below a certain price. This agreement was broken almost immediately. Another attempt was made in 1852; but at a meeting of distinguished men of letters resolutions were adopted declaring that the principles of the Booksellers' Association of that period were opposed to free trade, and were tyrannical and vexatious in their operations. *The Times* took an active part in defending and enforcing the conclusions which they sanctioned. The question was eventually referred to a commission, consisting of Lord Campbell, Dean Milman and George Grote, which decided that the regulations were unreasonable and inexpedient, and contrary to the freedom which ought to prevail in commercial transactions. An attempt was also made in 1869 to impose restrictions upon the retail bookseller; but that also failed, mainly by reason of the ineffective organization which the publishers then had at command.

Feeling their hands greatly strengthened by the establishment of their Association, the publishers were emboldened to make another effort to put an end to reductions in the selling price of books. After much discussion between authors, publishers and booksellers, a new scheme was launched on the 1st of January 1900. Books began to be issued at *net* prices, from which no bookseller was permitted to make any deduction whatever. This decree was enforced by the refusal of all the publishers included in the Association to supply books to any bookseller who should dare to infringe it in the case of a book published by any one of them. In other words, a bookseller offending against one publisher was boycotted by all. Thus, what is known as the "net system" depended absolutely upon the close trade union into which the publishers had organized themselves. The Booksellers' Association signed an agreement to charge the full published price for every net book, but that body had no real power to impose its will upon recalcitrant booksellers. Its assent to the terms of the publishers merely relieved them of the fear of active opposition on the part of the wholesale booksellers and the large retail booksellers, mainly located in London.

All books were not issued at net prices even in 1910, though the practice had extended enormously since it began in 1900. But the principle was applied all round. In the case of such books as six-shilling novels the discount price of four shillings and sixpence was treated as the net price, and the usual penalty was inflicted upon those who dared to sell at any lower price, at all events within twelve months of the ~~date~~ of publication.

Owing to the fact that the net system was gradually introduced, net books and discount books being issued side by side with discount books in the majority, the full effect of the innovation was not immediately apparent. But the establishment of *The Times* Book Club in 1905 brought the system to the test. That Club aimed at giving to the readers of *The Times* a much more prompt and copious supply of new books than could be obtained from the circulating libraries. The scheme was at first very favourably received by the publishers, who saw in it the promise of largely increased orders for their goods. They obtained these orders, but then something else happened which they had not foreseen. Of the books they issued the vast majority were of only ephemeral interest. For a few weeks, sometimes only for a few days, everybody wanted to glance at them, and then the public interest dwindled and died. As the copies ceased to be in demand for circulation the Book Club naturally tried to take advantage of the buying demand, which always exists, though it is always repressed by the very high prices charged by publishers in Great Britain. The Book Club sold its surplus copies at reduced prices, and was obliged to do so, since otherwise it would have been swamped with waste paper. But the authors and publishers now rose in arms. Forgetting that they had been paid the full trade price for every copy, they said that the Book Club was spoiling the market, and that a wholesale buyer had no right to sell at the best price he could get. Hence arose what came to be known as the Book War, between *The Times* and the associated publishers and booksellers, the publishers withdrawing their advertisements from *The Times* and doing their best to refuse books to the Book Club. The conflict made a considerable commotion, and the arguments on both sides were hotly contested. It did not, however, alter the fact that the public will not pay high prices for books having no permanent value.

The Booksellers' Association, dominated by the large booksellers in London and a few great towns, made common cause with the Publishers' Association. Their interests were not affected by the net system, and they saw in the Book Club an energetic competitor. The small booksellers up and down the country are injuriously affected, because it is more difficult than ever for them to stock books on which there is a very small margin of profit, and the sale of which they cannot any longer push by the offer of a discount. Formerly, if a book did not sell at the full price, they could sacrifice their profit and even part of what they paid for it, thus saving at least part of their invested capital. Now if a book does not sell at the net price they have to keep it so long that it is probably unsaleable at any price and forms a dead loss. Hence they cannot afford to stock books at all, and that channel of distribution is blocked.

The cast-iron retail price is economically wrong. A bookseller with a large turn-over in the midst of a dense population can afford to sell at a small profit. He finds his reward in increased sales. His action is good for the public, for the author, and for the publisher himself, were he enlightened enough to see it. But a small bookseller in a remote country town cannot afford to sell at an equally low profit, because he has not access to a public large enough to yield correspondingly increased sales. Yet both are arbitrarily compelled to sell only at a uniform price fixed by the publisher. What makes the matter worse is that there is no cast-iron wholesale price. The small bookseller has to pay more for his books than the large one who buys in dozens of copies. Carriage on his small parcels often eats up what profit is left to him. As he is not allowed to have books "on sale or return," he has no chance whatever; and as a distributing agency the small bookseller has become negligible.

It is not a necessary consequence of the net system that new books should cost the public more than before. If it has become the practice to sell a ten-shilling book for seven shillings and sixpence, and if that practice be thought objectionable, the obvious remedy, supposing publishers to have no other end in view, is to publish the book at the price for which it is sold. But the net system has been used to enforce the sale of the book at the published price and nothing less, which obviously amounts to compelling the public to pay more than before for the book. Again, if the object were to benefit the retail bookseller by relieving the pressure of competition, it is plain that after abolishing discounts the publishers would charge the same wholesale prices as before to the booksellers. But, on the contrary, they have so adjusted their prices that the retailer gets no more profit upon a book sold net than he formerly obtained from a book of the same published price after allowing a discount. Thus the object and result of the net system is to increase the profits of the publishers at the expense of the public. This has been accomplished at a time when paper is cheaper than at any previous period, and when machinery has reduced the cost of composition, printing and binding to an almost equal extent. It is a remarkable illustration of the power of combination among quasi-monopolists to raise the price of their commodities even in the face of a falling market.

The Book War came to an end in 1908; but though the publishers and booksellers appeared in the result to have brought the Book Club within terms which were satisfactory to them, the whole situation had really been changed. The public for the first time had been educated. Public attention had been forcibly directed to the fact that there is no reason in the nature of things why the price of books should increase, but on the contrary, every reason why they should be cheaper than at any previous period. A certain mystery which had hung over the publishing trade was effectually dispelled. The man in the street learned that books priced to him at six shillings can be produced by the joint labours of the paper maker, the printer, and the bookbinder for about sixpence, and that in many cases the author gets little or nothing out of the difference. There followed a quickening of the public demand for literature at reasonable prices, and enterprising people were found to meet the demand. A vast quantity of good literature, much better than nine-tenths of what is written to-day, has been brought within reach of persons of the smallest incomes. Hundreds of standard works have appeared in convenient and readable editions at a shilling, at sevenpence and even sixpence per volume. These cheap editions have an enormous sale, not only because they are low in price, but because they have permanent value. For the cost of a novel which he will never look at twice, and which perhaps was hardly worth reading once, a man may obtain half a dozen books that have stood the test of time, and that will become the valued companions of his leisure. He gets them too in a form suited not only to his purse, but to the limited storage accommodation at the disposal of the mass of modern readers, who can neither buy nor house the stately editions that adorn the libraries of the wealthy. Thus, in respect of the large class of books read for recreation, we have reached the paradoxical position that cheapness and excellence go hand-in-hand; and that the disparaging adjective frequently linked with "cheap" is more properly associated with dear and pretentious.

Nor does the counter movement stop even here. There is a growing tendency to bring out books of current production in cheap editions, and also to publish the original edition at prices which must give a painful shock to the authors of the net system. Cheap magazines, and the *feuilletons* which newspapers are adopting from French practice, make considerable inroads upon the province of the six-shilling novel; and as regards more serious books the newspapers now give an amount of information about their contents which goes far to console the public for the prohibitive prices of the books themselves. These movements are developing and will continue to develop, seriously interfering with the plans of those who devised the net system. The combination publishers have never understood that, apart from the very small percentage of works which make real additions to the sum of knowledge or of genuine literary achievement, the reading of the books they turn out is a pastime, which has to compete in public favour with a great variety of other pastimes. They have chosen to make their form of recreation extremely expensive, with the double result that the public turn to others, and that even their own is increasingly supplied by cheaper agencies.

There are certain classes of books which must always be relatively expensive, because they appeal only to students of some particular branch of science or of art or of literature, whose number is not great. But these are books of enduring value. Their price is justified not only by their prolonged service, but by the erudition or the exceptional qualities which go to the writing of them, as well as by the frequently exceptional cost of producing them. But as regards the vast output of books which merely amuse an idle hour, the existence of a large body of readers is the only excuse for their appearance, and if they cannot be produced at a low price ensuring an extensive sale they ought not to be produced at all. Thus there is more than a mere money question involved in the contention about price. An artificial system of prices leads to the printing of a vast quantity of trash, which demoralizes the reading public and is a serious obstacle to the success of the better books. Such a system operates, in fact, as a protective duty in favour of mediocrity and even of something worse. It is no defence of such a system that it panders to the vanity of incompetent scribblers, and enables publishers to make money by soiling paper that had better have been kept clean.

A rational system of prices would automatically solve some of the difficulties of the book-world. If a book is selling by tens of thousands of copies, as every book printed for pastime ought to do, it would not matter at what price any large buyer chose to resell his purchases. They would only be a drop in the bucket, and all the contention about second-hand prices would disappear. Then there is the troublesome system of "remainders," that is to say, the unsaleable copies of thousands of books published every year. The editions are small enough—probably not more than one thousand copies—yet, in spite of circulating libraries, a third or a half of that modest number remains in the warehouses of the publishers. Sometimes they are sold for about the cost of their flimsy covers; sometimes they simply go to be reduced to their original pulp at the paper mills. If a book has any sale justifying its production, there will be no question of remainders, supposing its supply to have been regulated by the most ordinary prudence. The sale of such a book never stops dead, and any small surplus of copies can always be got rid of at a small reduction in price.

Towards the end of the 19th century came a large influx into England of American literature, especially fiction. Not only was there a growing appreciation of many American writers, but the attractive "get-up" of American books made its influence felt upon the British market. Some of the American methods of distribution were also introduced into Great Britain, but at first with only partial success. The most successful effort was the sale of important expensive works through the medium of newspapers. Canvassing, which was a common method of distributing books in the United States, met with little support in the United Kingdom, although about the middle of the 19th century a large trade was done through England and Scotland by canvassers, who sold in numbers and parts such works as Family Bibles, Daily Devotions, Lives of Christ and Foxe's *Book of Martyrs*.

The methods of publishing in America are similar to those adopted in Great Britain, but the discount to the booksellers is generally given *pro rata* according to the number purchased. It is, however, in respect of the means of distribution that the systems of the two countries differ most. In America the general stores to a large extent take the place of the English bookseller, and by their energy and extensive advertising a wider public is served. In the distribution of fiction the American plan of "booming" a book by copious advertising, although expensive, is often the means of inducing a large sale, and of bringing an author's name before the public. In 1901 the net system, as adopted in Great Britain, was partially introduced into America.

The continental methods of publishing and distributing, especially in Germany, differ, in many respects very materially, from those of Great Britain. In even the smallest German towns there is a bookseller who receives on sale, immediately upon publication, a supply of such new books as he or the publisher may think suitable to his class of book-buyers. The bookseller submits these books to his customers, and by this method most books issued are at once placed at the disposal of any buyer interested in the particular subject. The large sums spent in other countries upon advertisements are thus saved. At the book fairs held in Leipzig at Easter and Michaelmas the accounts for books sent on sale are made up and paid. In France all books have to be licensed before publication, but the methods of publication differ little from those of other continental countries, in all of which book prices are much lower than in England.

PUCCINI, GIACOMO (1858–   ), Italian operatic composer, was born at Lucca, of a family already distinguished in music; his great-great-grandfather Giacomo, great-grandfather Antonio, grandfather Domenico, and father Michele, being all well known in the art. He was educated at the Milan Conservatoire, and in 1884 his opera *Le Villi* was performed at the Teatro del Verme. In 1889 his *Edgar* was performed at La Scala, and in 1893 his *Manon Lescaut* in Turin. But it was the production of *La Bohème* in Turin in 1896 that made him famous, and this opera had a great success everywhere. *Tosca* followed in 1900, and in 1904 *Madama Butterfly* confirmed the highest opinions of his talent.

PUCHTA, GEORG FRIEDRICH (1798–1846), German jurist, born at Kadolzburg in Bavaria on the 31st of August 1798, came of an old Bohemian Protestant family which had immigrated into Germany to avoid religious persecution. His father, Wolfgang Heinrich Puchta (1769–1845), a legal writer and district judge, imbued his son with legal conceptions and principles. From 1811 to 1816 young Puchta attended the gymnasium at Nuremberg, where he acquired a taste for Hegelianism. In 1816 he went to the university of Erlangen, where, in addition to being initiated by his father into legal practice, he fell under the influence of the writings of Savigny and Niebuhr. Taking his doctor's degree at Erlangen, he established himself here in 1820 as *privatdozent*, and in 1823 was made professor extraordinary of law. In 1828 he was appointed ordinary professor of Roman law at Munich. In 1835 he was appointed to the chair of Roman and ecclesiastical law at Marburg, but he left this for Leipzig in 1837, and in 1842 he succeeded Savigny at Berlin. In 1845 Puchta was made a member of the council of state (*Staatsrat*) and of the legislative commission (*Gesetzgebungskommission*). He died at Berlin on the 8th of January 1846. His chief merit as a jurist lay in breaking with past unscientific methods in the teaching of Roman law and in making its spirit intelligible to students. Among his writings must be especially mentioned *Lehrbuch der Pandekten* (Leipzig, 1838, and many later editions), in which he elucidated the dogmatic essence of Roman law in a manner never before attempted; and the *Kursus der Institutionen* (Leipzig, 1841–1847, and later editions), which gives a clear picture of the organic development of law among the Romans. Among his other writings are *Das Gewohnheitsrecht* (Erlangen, 1828–1837); and *Einleitung in das Recht der Kirche* (Leipzig, 1840).

Puchta's *Kleine zivilistische Schriften* (posthumously published in 1851 by Professor A. A. Friedrich Rudorff), is a collection of thirty-eight masterly essays on various branches of Roman law, and the preface contains a sympathetic biographical sketch of the jurist. See also Zeher, *Über die von Puchta der Darstellung des römischen Rechts zu Grunde gelegten rechtsphilosophischen Ansichten* (1853).

PÜCKLER-MUSKAU, HERMANN LUDWIG HEINRICH, FÜRST VON (1785–1871), German author, was born at Muskau in Lusatia on the 30th of October 1785. He served for some time in the bodyguard at Dresden, and afterwards travelled in France and Italy. In 1811, after the death of his father, he inherited the barony of Muskau and a considerable fortune. As an officer under the duke of Saxe-Weimar he distinguished himself in the war of liberation and was made military and civil governor of Bruges. After the war he retired from the army and visited England, where he remained about a year. In 1822, in compensation for certain privileges which he resigned, he was raised to the rank of *Fürst* by the king of Prussia. Some years earlier he had married the Gräfin von Pappenheim, daughter of Fürst von Hardenberg; in 1826 the marriage was legally dissolved though the parties did not separate. He again visited England and travelled in America and Asia Minor, living after his return at Muskau, which he spent much time in cultivating and improving. In 1845 he sold this estate to Prince Frederick of the Netherlands, and, although he afterwards lived from time to time at various places in Germany and Italy, his principal residence was his seat, Schloss Branitz near Kottbus, where he laid out splendid gardens as he had already done at Muskau. In 1863 he was made an hereditary member of the Prussian Herrenhaus, and in 1866 he attended the Prussian general staff in the war with Austria. He died at Branitz on the 4th of February 1871, and, in accordance with instructions in his will, his body was cremated. As a writer of books of travel he held a high position, his power of observation being keen and his style lucid and animated. His first work was *Briefe eines Verstorbenen* (4 vols., 1830–1831), in which he expressed many independent judgments about England and other countries he had visited and about prominent persons whom he had met. Among his later books of travel were *Semilassos vorletzter Weltgang* (3 vols., 1835), *Semilasso in Afrika* (5 vols., 1836), *Aus Mehemed-Alis Reich* (3 vols., 1844) and *Die Rückkehr* (3 vols., 1846–1848). He was also the author of *Andeutungen über Landschaftsgärtnerei* (1834).

See Ludmilla Assing, *Pückler-Muskaus Briefwechsel und Tagebücher* (9 vols., 1873–1876); *Fürst Hermann von Pückler-Muskau* (1873); and Petzold, *Fürst Hermann von Pückler-Muskau in seiner Bedeutung für die bildende Gartenkunst* (1874).

PUDDING, a term, now of rather wide application, for a dish consisting of boiled flour enclosing or containing meat, vegetables or fruit, or of batter, rice, sago or other farinaceous foods boiled or baked with milk and eggs. Properly a pudding should be one boiled in a cloth or bag. There are countless varieties, of which the most familiar are the Christmas plum-pudding, the Yorkshire pudding and the suet pudding. The word was originally and is still so used in Scotland for the entrails of the pig or other animal stuffed with meat, minced, flavoured and mixed with oatmeal and boiled. The etymology is obscure. The French *boudin* occurs in the Scottish original sense at the same time as *poding* (13th century) in English. *Boudin* has been connected with Italian *boldone* and Latin *botulus*, sausage, but the origins of these words are quite doubtful. Attempts have been made to find the origin in a stem *pud-*, to swell, cf. "podgy," L. Ger. *Pudde-wurst*, black-pudding, &c.

PUDSEY, a municipal borough in the Pudsey parliamentary division of the West Riding of Yorkshire, England, 6 m. W. by S. of Leeds, on the Great Northern railway. Pop. (1891), 13,444; (1901), 14,907. The principal buildings are the church of St Lawrence in Gothic style, erected in 1821, and the mechanics' institute, a fine building, comprising class-rooms, a library, a public hall and a lecture hall. A public park was opened in 1889. The town has an important woollen trade and possesses dyeing and fulling mills. Part of the parish, Tyersall, is in the borough of Bradford. Pudsey is mentioned in Domesday. It was sold by Edward II. to the Calverley family, from which it passed to an ancestor of the Milners. The town was incorporated in 1899, and the corporation consists of a mayor, 6 aldermen and 18 councillors. Area, 2399 acres.

PUDUKKOTTAI, a state of southern India, in subordination to Madras, lying between the British districts of Tanjore and Madura. Area, 1100 sq. m. Pop. (1901), 380,440, showing an increase of 2% in the decade. The state consists mainly of an undulating plain, nowhere of great fertility and in many parts barren; it is interspersed with rocky hills, especially in the south-west. Granite and laterite are quarried, red ochre is worked, and silk and cotton fabrics, bell-metal vessels and perfumes are among the principal manufactures. There is also some export trade in groundnuts and tanning bark. The chief, whose title is tondaman, is of the Kallan or robber caste. His ancestors received a grant of territory for loyal services to the British during the wars in the Carnatic at the end of the 18th century. Estimated gross revenue, £80,000; no tribute. The state has for some years past been well administered under a council, with a representative assembly. The town of Pudukkottai had a population in 1901 of 20,347. It is well laid out, and contains several fine new buildings.

PUEBLA, a state of Mexico, occupying the south-east angle of the great central plateau, or that part of it known as the Anahuac table-land. It is bounded N. and E. by the state of Vera Cruz, S. by the states of Oaxaca and Guerrero, and W. by the states of Morelos, Mexico, Tlaxcala and Hidalgo. Area, 12,204 sq. m. Pop. (1900), 1,021,133, largely civilized Indians. Lofty mountains overlook the plateau from the north-east and west, three of the highest peaks, Orizaba, Popocatepetl and Ixtaccihuatl rising above the permanent snow-line, while another, Malinche, lifts its isolated mass nearly to that limit. In the south the table-land breaks away and long fertile valleys lead downward toward the warm southern plains. The central table-land forms part of the watershed between the eastern and western drainage systems, some of the streams in the north and south-east emptying into the Gulf of Mexico, while the Atoyac, which has its source in Tlaxcala, crosses the state and discharges into the Pacific through the Mescala. Puebla has a temperate, healthful climate, one of the best in Mexico. The soil is generally fertile and the rainfall abundant. Agriculture is the principal industry. The Mexican, Interoceanic and Mexican Southern railways cross the state and afford ample transportation facilities.

PUEBLA (full title *La Puebla de los Angeles*, and more recently, *Puebla de Zaragoza*), a city of Mexico and capital of the state of the same name, on the banks of the Atoyac river, 60 m. S.E. of the city of Mexico, with which it is connected by two lines of railway. Pop. (1900), 93,152, including a large percentage of Indians. Its railway connexions put it in daily communication with the national capital, Vera Cruz, Pachuca, Oaxaca, and the terminal ports of the Tehuantepec railway—Coatzacoalcos and Salina Cruz. The city is built on a broad healthy plain, about 7200 ft. above sea-level. It is well provided with street railways, electric and gas illumination, water and drainage. The great Doric cathedral, about 165×320 ft., is perhaps the finest ecclesiastical building in Latin America. It was begun about 1552, but not completed until 1649. Among other churches, famous for their lavish decorations, are those of San José, San Cristobal, Santa Catarina and San Domingo. The "Teatro Principal," built in 1790, is said to be the oldest existing theatre on the continent. There are two other theatres, and an immense bull-ring. Among the more conspicuous public buildings are the palace of justice, the building of the state legislature, a school of medicine to which is attached the Palafoxiana Library of over 100,000 volumes, an academy of fine arts, and the national college. At Fort Guadalupe, near the city, there are several hot sulphur springs, which are used for medicinal baths. Puebla is one of the busiest manufacturing cities in Mexico, and among its products are cotton and woollen textiles, soap, glass, straw hats, pottery and leather goods. There are also some large foundries.

Puebla was founded in 1532 by Sebastian Ramirez de Fuenleal, archbishop of Santo Domingo, and the celebrated Franciscan friar Toribio Motolinia. In 1550 it became the see of the bishopric originally created in 1526 at Tlaxcala. The appellation "de los Angeles," which is now practically dropped, originated in a popular belief that during the building of the cathedral two angels every night added as much to the height of the walls as the workmen had completed on the preceding day. Its present title was given in honour of General Ignacio Zaragoza (1829–1862), who successfully defended the city against the first French attack in 1862. It was captured in the following year by the French, and then by the Mexicans under Porfirio Diaz in 1867. In the war between Mexico and the United States it was captured by General Winfield Scott and was his headquarters from June to August 1847.

PUEBLO, a city and the county-seat of Pueblo county, the second largest city of Colorado, U.S.A., and one of the most important industrial centres west of the Missouri river, situated on the Arkansas river, about 120 m. S. by E. of Denver. Pop. (1890), 24,558; (1900), 28,157, of whom 4705 were foreign-born, 1250 being Austrian, 587 German, 529 Italian, 415 Irish, 391 Swedish, 385 English and 341 English Canadian; (1910, census), 44,395. It is served by five great continental railway systems—the Denver & Rio Grande, the Atchison, Topeka & Santa Fé, the Missouri Pacific, the Chicago, Rock Island & Pacific and the Colorado & Southern, giving it altogether a dozen outlets. It lies about 4680 ft. above the sea, in a valley at the junction of the prairies with the foothills of the Rockies, on both banks of the Arkansas river, near its confluence with Fountain Creek; the city has an exceptionally good climate and attracts many winter visitors. There are a state insane asylum and four hospitals, of which the Minnequa Hospital (for the employés of the Colorado Fuel & Iron Co.) and St Mary's Hospital are the most notable. Among the public buildings are the McClelland public library (1891) and the court-house, the latter of white stone quarried in the vicinity. The Mineral Palace (1891), having a roof formed of twenty-eight domes, in the northern part of the city, contains a collection of the minerals of the state. Pueblo is chiefly an industrial city, and is often called the Steel City, or the Pittsburg of the West. Cheap fuel is furnished by the excellent coal of Canyon City (about 30 m. west), Walsenburg (about 40 m. south-west) and Trinidad (about 75 m. south). Petroleum deposits in the immediate vicinity are of growing importance. Fluxing material is only about 50 m. away, around Cripple Creek. The rich river valley yields abundant crops of alfalfa, sugar beets, cantaloupes, apples and peaches, and the dry lands behind its shores prove fertile under irrigation or under the Campbell system of dry farming; on the plains livestock interests are important. In 1905 Pueblo's total factory products were valued at $2,197,293 (an increase of 52·6% since 1900); if the output of the great smelting and refining establishments just outside the city limits had been included, the value would have been considerably larger. Pueblo is the greatest smelting centre west of the Missouri and probably the greatest in the United States. The bulk of the steel rails used on western railways are from the mills of the Pueblo district.

Pueblo was originally a Mexican settlement. A considerable body of Mormons settled here temporarily on their way to Utah in 1846–1847, and a trading post was established in 1850; but the site, owing principally to Indian troubles, had been practically abandoned before 1858, when another settlement was made on the Fontaine qui Bouille, or Fountain Creek. Two years later Pueblo was surveyed and platted. The first railway—the Denver & Rio Grande—came through in 1872. Pueblo was chartered as a city in 1870, and again, with an enlarged area, in 1887.

PUEBLO INDIANS, the Spanish name (*pueblo* = village) for the town-building tribes of American Indians of the Keresan, Shoshonean, Tanoan and Zuñian stocks, whose representatives are now practically confined to New Mexico and Arizona. Formerly they had a far greater range. They were alike in their sedentary agricultural characteristics, and had not the warlike disposition of the Plains Indians. Their modern history begins with their discovery in 1539 by Father Marcos de Niza. In the following year they were subdued by Francisco Vasquez de Coronado. Two years later they made a successful revolt, but in 1586 they had again to submit. In 1680 they once more rebelled, but by 1692 they were finally conquered. Their houses are communal, generally but one structure for the whole village. These houses are sometimes built of stone, but oftener of adobe, several storeys high, each storey receding from the one below. The common plan is a hollow square or curved figure, though in some cases the form of a pyramid is followed. A feature of each town is the underground chamber used for tribal ceremonies. Many of the towns are built on high table-lands inaccessible except by steep trails. The Pueblos are a short, sturdy type of American Indians, very active, but mild-mannered and much darker than those of the plains. They are farmers and herdsmen, and are skilful in basket-work, weaving, pottery and carving. They are notable for their highly developed ceremonial customs, and their blankets and earthenware are decorated with religious symbolism.

PUELCHE, a tribe of South-American Indians of Araucanian stock. Their home is the Pampas region of southern Argentina around the Colorado river. They are chiefly nomadic, breeding cattle and horses, and lead a wild, lawless life.

PUENTEAREAS, a town of north-western Spain in the province of Pontevedra; on the Tuy-Santiago de Compostella railway and on the river Tea, a right-hand tributary of the Miño. Pop. (1900), 13,452. Puenteareas is the chief town of a fertile hilly region, which produces wine, grain and fruit, and contains many cattle farms. The industries of the town itself are porcelain manufactures, tanning and distilling. Close by are the ruins of the castle of Sobroso, which played an important part in the medieval civil wars.

PUENTE GENIL, or Puente Jenil, a town of southern Spain, in the province of Cordova; on the right bank of the river Genil or Jenil, a tributary of the Guadalquivir. Pop. (1900), 12,956. Puente Genil is on the Cordova-Malaga railway, and is the starting-point of the line to Linares. A bridge across the Genil, from which the name of the town is derived, joins the lower part of Puente Genil with the higher, which is built on rising ground extending to the olive groves above. There are several convents, schools for primary and higher education, hospitals, a municipal library and a theatre. The principal industry is the manufacture of olive oil. There are also flour-mills and linen factories. The *alhondiga* or permanent market is always well stocked with grain, vegetables and livestock.

PUERPERAL FEVER (Lat. *puerpera*, from *puer*, child, and *parere*, to bring forth), the name given to the varieties of general infection, long regarded as a specific disease ("child-bed fever," "lying-in fever"), to which women are subject after parturition, owing to the genital tract being peculiarly exposed, in septic surroundings, to the invasion of pathogenic bacteria (see Sepsis). Owing largely to the labours of I. P. Semmelweiss (*q.v.*) the grave mortality formerly attending this condition has been enormously reduced; and the necessity of rigid cleanliness in the treatment of lying-in cases is fully recognized. When unhappily this is not the case, and infection takes place, its complications must be treated according to the circumstances, antiseptic douching being employed, or preferably curetting the endometrium with a sharp curette and swabbing with disinfectant solution. In definitely septicaemic cases antistreptococcic serum may be useful.

PUERTO CABELLO, a city and port of Venezuela, in the state of Carabobo, 20 m. N. by W. of Valencia, the capital of the state. Pop. (1891), 10,145. Puerto Cabello has railway connexions with Valencia and Caracas. It stands on a small peninsula which partly shelters a large bay, called "Golfo Triste," by the early Spanish navigators. After La Guayra the harbour is the principal port of Venezuela, and it is provided with mole, wharves, railway communication with the interior, and other facilities for the handling of merchandise and produce. The town and harbour were strongly fortified in colonial times, but the port defences were greatly damaged in 1902 in a bombardment by some German vessels of the allied blockading fleet. Among the exports are coffee, cacao, dyewoods, hides, skins, and copper ores. Puerto Cabello suffered much in the War of Independence, changing hands several times and remaining in the possession of Spain down to 1823.

PUERTO CORTES (Cortez or Caballos), a seaport on the Atlantic coast of Honduras; in 15° 51′ N. and 87° 56′ W., at the northern terminus of the transcontinental railway from Fonseca Bay, and near the mouth of the river Chamalecon. Pop. (1905), about 2500. The harbour, an inlet of the Gulf of Honduras, is deep, spacious and secure, and there is a railway pier at which vessels can load and discharge. The exports include bananas, coffee, cabinet woods, rubber, sarsaparilla, livestock, deerskins and gold. The harbour was discovered in 1527 by Gonzalo d'Avila, and the town was founded a few years later by order of Hernando Cortes, from whom it derives its name.

PUERTO DE SANTA MARIA, a seaport of southern Spain, in the province of Cadiz, on the right bank of the river Guadalete, with a station on the railway from Cadiz to Seville. Pop. (1900), 20,120. Puerto de Santa Maria, commonly called "El Puerto," is probably the *Menesthei Portus* of Ptolemy. Its most important industry is the wine trade; there are also glass, liqueur, alcohol, starch and soap manufactures. The principal buildings are a Moorish citadel, a Gothic church founded in the 13th century, a Jesuit college, and a bull-ring which accommodates 12,000 spectators. The town is noted for its bull-fights, that given here in honour of Wellington being the subject of the considerably idealized description in Byron's *Childe Harold.*

PUERTO PRÍNCIPE (officially, Camagüey), a city and the capital of the province of Camagüey in east-central Cuba, about 528 m. E.S.E. of Havana. Pop. (1899), 25,102; (1907), 29,616. In addition to the axis-railway of the island, which connects it with Havana and Santiago, the city has connexion by a branch line with Nuevitas. Puerto Príncipe lies on a broad plain about equally distant from the north and south coasts of the island, and between two small rivers, the Tínima and Hatibonica. In appearance it is one of the most ancient of Cuban towns. Many of the churches, convents and other ecclesiastical establishments were built in the second half of the 18th century, some in the first half; and some parts of the original cathedral of 1617 have probably survived later alterations and additions. Some of the bridges, too, built in the 18th century, are picturesque. The city hall was begun in 1733. There is a provincial institute for secondary education. The city is the seat of a court of appeal. Puerto Príncipe is connected by railway, 47 m. long, with its port, Nuevitas (pop. in 1907, 4386), which is on the north side of the island and has a spacious land-locked bay of good depth, approached through a break in the off-lying coral keys and a narrow canyon entrance. About 50 m. south of Puerto Príncipe is Santa Cruz del Sur (pop. in 1907, 1640) on the south coast. Cabinet woods, fruit, tobacco, sugar, wax, honey and cattle products are the leading exports. In 1514 Diego Velasquez founded, on Nuevitas Bay (then known as the Puerto del Príncipe), a settlement that was moved in 1515 or 1516 to the site of the present city of Puerto Príncipe (or Santa Maria del Puerto del Príncipe). From very early times the surrounding plains were given over to horse and cattle-raising. As early as the beginning of the 17th century Havana depended on this supply to furnish the fleets of royal ships which monopolized trade between Spain and America. From very early times, too, a prosperous clandestine trade was maintained with Providence, the Bahamas, and especially with Curaçoa and Jamaica (after its capture by the English in 1655). After the capital, Puerto Príncipe was the richest prize of the island when it was captured and plundered in 1668 by a force of Frenchmen and Englishmen under Henry Morgan, the buccaneer. In the 18th century land grants and illicit trade led to serious disturbances. In 1775 Nuevitas was resettled, and in 1780 was made a legal (*habilitado*) port. After the cession of Santo Domingo to France in 1800, the Real Audiencia, the supreme court of the Spanish West Indies, was removed to Puerto Príncipe. A superior *audiencia* was created for Havana in 1838, but the older court continued to exist throughout the Spanish period. Puerto Príncipe boasts of being the most Creole of Cuban cities. It was prominent in the war of 1868–78 and in the disaffection preceding and following it.

PUERTO REAL, a seaport of southern Spain, in the province of Cadiz; on the north shore of the inner arm of the Bay of Cadiz and on the Seville-Cadiz railway. Pop. (1900), 10,535. Puerto Real (Port Royal) is the *Portus Gaditanus* of the Romans, and is probably the most ancient trading-station on the Bay of Cadiz. It owes its modern name to the fact that it was rebuilt in 1488 by Ferdinand and Isabella. The port has good quays, a dry dock of the Spanish Transatlantic Company, connected with their important works, and safe anchorage close to the wharves for the largest steamers. The town has fine squares, and broad, well-built streets, a handsome town-hall, many schools, a bull-ring, several convents, and a 16th-century Gothic parish church, with three naves and a remarkable atrium. There is an active trade in wine and oils; other industries are the construction and repairing of ships, and the production of salt.

PUFENDORF, SAMUEL (1632–1694), German jurist, was born at Chemnitz, Saxony, on the 8th of January 1632. His father was a Lutheran pastor, and he himself was destined for the ministry. Educated at Grimma, he was sent to study theology at the university of Leipzig. Its narrow and dogmatic teaching was profoundly repugnant to him, and he soon abandoned it for the study of public law. He went so far as to quit Leipzig altogether, and betook himself to Jena, where he formed an intimate friendship with Erhard Weigel the mathematician, whose influence helped to develop his remarkable independence of character. Pufendorf quitted Jena in 1637 and became a tutor in the family of Petrus Julius Coyet, one of the resident ministers of Charles Gustavus, king of Sweden, at Copenhagen. At this time Charles Gustavus was endeavouring to impose upon Denmark a burdensome alliance, and in the middle of the negotiations he brutally opened hostilities. The anger of the Danes was turned against the envoys of the Swedish sovereign; Coyet, it is true, succeeded in escaping, but the second minister, Steno Bjelke, and the whole suite were arrested and thrown into prison. Pufendorf shared this misfortune, and was subjected to a strict captivity of eight months' duration. He occupied himself during this time in meditating upon what he had read in the works of Grotius and Hobbes. He mentally constructed a system of universal law; and, when, at the end of his captivity, he accompanied his pupils, the sons of Coyet, to the university of Leiden, he was enabled to publish, in 1661, the fruits of his reflections under the title of *Elementa jurisprudentiae universalis, libri duo*. The work was dedicated to Charles Louis, elector palatine, who created for Pufendorf at Heidelberg a new chair, that of the law of nature and nations, the first of the kind in the world. In 1667 he wrote, with the assent of the elector palatine, a tract, *De statu imperii germanici, liber unus*. Published under the cover of a pseudonym at Geneva in 1667, it was supposed to be addressed by a gentleman of Verona, Severinus de Monzambano, to his brother Laelius. The pamphlet made a great sensation. Its author directly arraigned the organization of the Holy Roman Empire and exposed its feebleness, denounced in no measured terms the faults of the house of Austria, and attacked with remarkable vigour the politics of the ecclesiastical princes. Before Pufendorf, Philipp Bogislaw von Chemnitz, publicist and soldier, had written, under the pseudonym of "Hippolytus a Lapide," *De ratione status in imperio nostro romano-germanico*. Inimical, like Pufendorf, to the house of Austria, Chemnitz had gone so far as to make an appeal to France and Sweden. Pufendorf, on the contrary, rejected all idea of foreign intervention, and advocated that of national initiative. In 1670 Pufendorf was called to the university of Lund. His sojourn there was fruitful. In 1672 appeared the *De jure naturae et gentium, libri octo*, and in 1675 a résumé of it under the title of *De officio hominis et civis*.

In the *De jure naturae et gentium* Pufendorf took up in great measure the theories of Grotius and sought to complete them by means of the doctrines of Hobbes and of his own ideas. His first important point was that natural law does not extend beyond the limits of this life and that it confines itself to regulating external acts. He combated Hobbes's conception of the state of nature and concluded that the state of nature is not one of war but of peace. But this peace is feeble and insecure, and if something else does not come to its aid it can do very little for the preservation of mankind. As regards public law Pufendorf, while recognizing in the state (*civitas*) a moral person (*persona moralis*), teaches that the will of the state is but the sum of the individual wills that constitute it, and that this association explains the state. In this a priori conception, in which he scarcely gives proof of historical insight, he shows himself as one of the precursors of J. J. Rousseau and of the *Contrat social*. Pufendorf powerfully defends the idea that international law is not restricted to Christendom, but constitutes a common bond between all nations because all nations form part of humanity.

In 1677 Pufendorf was called to Stockholm as historiographer-royal. To this new period belong *Einleitung zur Historie der vornehmsten Reiche und Staaten*, also the *Commentarium de rebus suecicis, libri XXVI., ab expeditione Gustavi Adolphi regis in Germaniam ad abdicationem usque Christinae* and *De rebus a Carolo Gustavo gestis*. In his historical works Pufendorf is hopelessly dry; but he professes a great respect for truth and generally draws from archives. In his *De habitu religionis christianae ad vitam civilem* he traces the limits between ecclesiastical and civil power. This work propounded for the first time the so-called "collegial" theory of church government (*Kollegialsystem*), which, developed later by the learned Lutheran theologian Christoph Mathäus Pfaff (1686–1760), formed the basis of the relations of church and state in Germany and more especially in Prussia.

This theory makes a fundamental distinction between the supreme jurisdiction in ecclesiastical matters (*Kirchenhoheit* or *jus circa sacra*), which it conceives as inherent in the power of the state in respect of every religious communion, and the ecclesiastical power (*Kirchengewalt* or *jus in sacra*) inherent in the church, but in some cases vested in the state by tacit or expressed consent of the ecclesiastical body. The theory was of importance because, by distinguishing church from state while preserving the essential supremacy of the latter, it prepared the way for the principle of toleration. It was put into practice to a certain extent in Prussia in the 18th century; but it was not till the political changes of the 19th century led to a great mixture of confessions under the various state governments that it found universal acceptance in Germany. The theory, of course, has found no acceptance in the Roman Catholic Church, but it none the less made it possible for the Protestant governments to make a working compromise with Rome in respect of the Catholic Church established in their states.

In 1688 Pufendorf was called to the service of Frederick William, elector of Brandenburg. He accepted the call, but he had no sooner arrived than the elector died. His son Frederick III. fulfilled the promises of his father; and Pufendorf, historiographer and privy councillor, was instructed to write a history of the Elector Frederick William (*De rebus gestis Frederici Wilhelmi Magni*). The king of Sweden did not on this account cease to testify his goodwill towards Pufendorf, and in 1694 he created him a baron. In the same year, on the 26th of October, Pufendorf died at Berlin and was buried in the church of St Nicholas, where an inscription to his memory is still to be seen.

Pufendorf was at once philosopher, lawyer, economist, historian and statesman. His influence was considerable, and he has left a profound impression on thought, and not on that of Germany alone. But the value of his work was much under-estimated by posterity. Much of the responsibility for this injustice rested with Leibnitz, who would never recognize the incontestable greatness of one who was constantly his adversary, and whom he dismissed as "vir parum jurisconsultus et minime philosophus." It was on the subject of the pamphlet of Severinus de Monzambano that their quarrel began. The conservative and timid Leibnitz was beaten on the battlefield of politics and public law, and the aggressive spirit of Pufendorf aggravated yet more the dispute, and so widened the division. From that time the two writers could never meet on a common subject without attacking each other.

See H. von Treitschke, "Samuel von Pufendorf," *Preussische Jahrbücher* (1875), xxxv. 614, and xxxvi. 61; Bluntschli, *Deutsches Staats-Wörterbuch*, viii. 424, and *Geschichte des allgemeinen Staatsrechts und der Politik*, p. 108; Lorimer, *The Institutes of the Law of Nations*, i. 74; Droysen, "Zur Kritik Pufendorfs," in his *Abhandlungen zur neueren Geschichte*; Roscher, *Geschichte der National-Oekonomik in Deutschland*, p. 304; Franklin, *Das deutsche Reich nach Severinus von Monzambano*.

PUFF-BALL, in botany, the common name for a genus of fungi (known botanically as *Lycoperdon*), and so called because of the cloud of brown dust-like spores which are emitted when the mature plant bursts. They are common in meadows and woods and on heaths or lawns, and when young resemble white balls, sometimes with a short stalk, and are fleshy in texture. If cut across in this state, they show a compact rind enclosing a loose tissue, in the interspaces of which the spores are developed; as the fungus matures it changes to yellowish-brown and brown and when ripe the rind tears at the apex and the spores escape through the aperture when any pressure is applied to the ball. When white and fleshy the fungus is edible. The fibrous mass which remains after the spores have escaped has been used for tinder or as a styptic for wounds. The giant puff-ball, *Lycoperdon giganteum*, reaches a foot or more in diameter.

PUFF-BIRD, the name first given, according to W. Swainson (*Zool. Illustrations*, 1st series, vol. ii., text to pl. 99), by English residents in Brazil to a group of birds now placed in the subfamily *Bucconinae*, which with the *Galbulinae* or jacamars form the family *Galbulidae* of Coraciiform birds standing between the trogons (*q.v.*) and barbets, for a long time confounded, under the general name of barbets, with the *Capitonidae* of modern systematists. Each group has formed the subject of an elaborate monograph—the *Capitonidae* being treated by C. H. T. and G. F. L. Marshall (London, 1870–1871), and the *Bucconidae* by P. L. Sclater (London, 1879–1882). The *Bucconinae* are zygodactylous birds confined to the neotropical region, in the middle parts of which, and especially in its sub-Andean subregion, they are, as regards species, abundant; while only two seem to reach Guatemala and but one Paraguay. As with most South American birds, the habits and natural history of the *Bucconidae* have been but little studied, and of only one species, which happens to belong to a rather abnormal genus, has the nidification been described. This is the *Chelidoptera tenebrosa*, which is said to breed in holes in banks, and to lay white eggs much like those of the kingfisher and consequently those of the jacamars. From his own observation Swainson writes (*loc. cit.*) that puff-birds are very grotesque in appearance. They will sit nearly motionless for hours on the dead bough of a tree, and while so sitting "the disproportionate size of the head is rendered more conspicuous by the bird raising its feathers so as to appear not unlike a puff-ball. . . . When frightened their form is suddenly changed by the feathers lying quite flat." They are very confiding birds and will often station themselves a few yards only from a window. The *Bucconidae* almost without exception are very plainly-coloured, and the majority have a spotted or mottled plumage suggestive of immaturity. The first puff-bird known to Europeans seems to have been that described by G. de L. Marcgrav, under the name of "*tamatia*," by which it is said to have been called in Brazil, and there is good reason to think that his description and figure—the last, comic as it is in outline and expression, having been copied by F. Willughby and many of the older authors—apply to the *Bucco maculatus* of modern ornithology—a bird placed by M. J. Brisson (*Ornithologie*, iv. 524) among the kingfishers. But if so, Marcgrav described and figured the same species twice, since his "*Matuitui*" is also Brisson's "*Martin-pescheur tacheté du Brésil*."

P. L. Sclater divides the family into 7 genera, of which *Bucco* is the largest and contains 20 species. The others are *Malacoptila* and *Monacha*, each with 7, *Nonnula* with 5, *Chelidoptera* with 2, and *Micromonacha* and *Hapaloptila* with 1 species each. The most showy puff-birds are those of the genus *Monacha*, with an inky-black plumage, usually diversified by white about the head, and a red or yellow bill.

PUFFIN, the common English name of a sea-bird, the *Fratercula arctica* of most ornithologists, known however on various parts of the British coasts as the bottlenose, coulterneb, pope, sea-parrot and tammy-norie, to say nothing of other still more local designations, some (as marrott and willock) shared also with allied species of *Alcidae*, to which family it belongs. Of old time puffins were a valuable commodity to the owners of their breeding-places, for the young were taken from the holes in which they were hatched, and "being exceeding fat," as Carew wrote in 1602 (*Survey of Cornwall*, fol. 35), were "kept salted, and reputed for fish, as coming neerest thereto in their taste." In 1345, according to a document from which an extract is given in Heath's *Islands of Scilly* (p. 190), those islands were held of the Crown at a yearly rent of 300 puffins[1] or 6s. 8d., being one-sixth of their estimated annual value. A few years later (1484), either through the birds having grown scarcer or money cheaper, only 50 puffins are said (*op. cit.* p. 196) to have been demanded. It is stated by both Gesner and Caius that they were allowed to be eaten in Lent. Ligon, who in 1673 published a *History of the Island of Barbadoes*, speaks (p. 37) of the ill taste of puffins "which we have from the isles of Scilly," and adds "this kind of food is only for servants." Puffins used to resort in vast numbers to certain stations on the coast, and are still plentiful on some, reaching them in spring with remarkable punctuality on a certain day, which naturally varies with the locality, and after passing the summer there leaving their homes with similar precision. They differ from most other *Alcidae* in laying their single egg (which is white with a few grey markings when first produced, but speedily begrimed by the soil) in a shallow burrow, which they either dig for themselves or appropriate from a rabbit, for on most of their haunts rabbits have been introduced. Their plumage is of a glossy black above—the cheeks grey, encircled by a black band—and pure white beneath; their feet are of a bright reddish orange, but the most remarkable feature of these birds, and one that gives them a very comical expression, is their huge bill. This is very deep and laterally flattened, so as indeed to resemble a coulter, as one of the bird's common names expresses; but moreover it is parti-coloured —blue, yellow and red—curiously grooved and still more curiously embossed in places, that is to say during the breeding-season, when the birds are most frequently seen. But it had long been known to some observers that such puffins as occasionally occur in winter (most often washed up on the shore and dead) presented a beak very different in shape and size, and to account for the difference was a standing puzzle. Many years ago Bingley (*North Wales*, i. 354) stated that puffins "are said to change their bills annually." The remark seems to have been generally overlooked; but it has proved to be very near the truth, for after investigations carefully pursued during some years by Dr Bureau of Nantes he was in 1877 enabled to show (*Bull. Soc. Zool. France*, ii. 377–399)[2] that the puffin's bill undergoes what may be called an annual moult, some of its most remarkable appendages, as well as certain horny outgrowths above and beneath the eyes, dropping off at the end of the breeding season, and being reproduced the following year. Not long after the same naturalist announced (*op. cit.*) iv. 1–68) that he had followed the similar changes which he found to take place, not only in other species of puffins, as the *Fratercula corniculata* and *F. cirrhata* of the Northern Pacific, but in several birds of the kindred genera *Ceratorhina* and *Simorhynachus* inhabiting the same waters. The name puffin has also been given in books to one of the shearwaters which belong to the sub-family *Procellariina* of the Petrels (*q.v.*), and its latinized form *Puffinus* is still used in that sense in scientific nomenclature. This fact seems to have arisen from a mistake of Ray's who, seeing in Tradescant's Museum and that of the Royal Society some young shearwaters from the Isle of Man, prepared in like manner to young puffins, thought they were the birds mentioned by Gesner as the remarks inserted in Willughby's *Ornithologia* (p. 251) prove; for the specimens described by Ray were as clearly shearwaters as Gesner's were puffins.

PUGACHEV, EMEL'YAN IVANOVICH (? 1741–1775), Russian pretender, the date of whose birth is uncertain, was the son of a small Cossack landowner. He married a Cossack girl Sofia Nedyuzheva, in 1758, and the same year was sent with his fellow Cossacks to Prussia, under the lead of Count Zachary Chernuishev. In the first Turkish War (1769–74) of Catherine II. Pugachev, now a Cossack ensign, served under Count Peter Panin and was present at the siege of Bender. Invalided home, he led for the next few years a wandering life; was more than once arrested and imprisoned as a deserter; and finally, after frequenting the monasteries of the "Old Believers," who exercised considerable influence over him, suddenly proclaimed himself (1773) to be Peter III. The story of Pugachev's strong resemblance to the murdered emperor is a later legend. Pugachev dubbed himself Peter III. the better to attract to his standard all those (and they were many) who attributed their misery to the government of Catherine II., for Peter III. was generally remembered as the determined opponent of Catherine. As a matter of fact Pugachev and his followers were hostile to every form of settled government. The one thought of the destitute thousands who joined the new Peter was to sweep away utterly the intolerably oppressive upper-classes. Pugachev's story was that he and his principal adherents had escaped from the clutches of Catherine, and were resolved to redress the grievances of the people, give absolute liberty to the Cossacks, and put Catherine herself away in a monastery. He held a sort of mimic court at which one Cossack impersonated Nikita Panin, another Zachary Chernuishev, and so on. The Russian government at first made light of the rising. At the beginning of October 1773 it was simply regarded as a nuisance, and 500 roubles was considered a sufficient reward for the head of the troublesome Cossack. At the end of November 28,000 roubles were promised to whomsoever should bring him in alive or dead. Even then, however, Catherine, in her correspondence with Voltaire, affected to treat "*l'affaire du Marquis de Pugachev*" as a mere joke, but by the beginning of 1774 the joke had developed into a very serious danger. All the forts on the Volga and Ural were now in the hands of the rebels; the Bashkirs had joined them; and the governor of Moscow reported great restlessness among the population of central Russia. Shortly afterwards Pugachev captured Kazan, reduced most of the churches and monasteries there to ashes, and massacred all who refused to join him. General Peter Panin, the conqueror of Bender, was thereupon sent against the rebels with a large army, but difficulty of transport, lack of discipline, and the gross insubordination of his ill-paid soldiers paralysed all his efforts for months, while the innumerable and ubiquitous bands of Pugachev were victorious in nearly every engagement. Not till August 1774 did General Mikhelson inflict a crushing defeat upon the rebels near Tsaritsyn, when they lost ten thousand in killed and prisoners. Panin's savage reprisals, after the capture of Penza, completed their discomfiture. Pugachev was delivered up by his own Cossacks on attempting to fly to the Urals (Sept. 14), and was executed at Moscow on the 11th of January 1775.

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[1] There cannot be much doubt that the name puffin given to these young birds, salted and dried, was applied on account of their downy clothing, for an English informant of Gesner's described one to him (*Hist. avium*, p. 110) as wanting true feathers, and being covered only with a sort of woolly black plumage. It is right, however, to state that Caius expressly declares (*Rarior. animal. libellus*, fol. 21) that the name is derived "a naturali voce pupin." Skeat states that the word is a diminutive, which favours the view that it was originally used as a name for these young birds. The parents were probably known by one or other of their many local appellations.

[2] See *Zoologist* for 1878, pp. 233–240.

See N. Dubrovin, *Pugachev and his Associates* (Rus.; Petersburg, 1884); *Catherine II., Political Correspondence* (Rus. Fr. Ger.; Petersburg, 1885, &c.); S. I. Gnyedich, *Emilian Pugachev* (Rus.; Petersburg, 1902). (R. N. B.)

PUGET, PIERRE (1622–1694), French painter, sculptor, architect and engineer, was born at Marseilles on the 31st of October 1622. At the age of fourteen he carved the ornaments of the galleys built in the port of his native city, and at sixteen the decoration and construction of a ship were entrusted to him. Soon after he went to Italy on foot, and was well received at Rome by Pietro di Cortona, who employed him on the ceilings of the Barberini Palace and on those of the Pitti at Florence. In 1643 he returned to Marseilles, where he painted portraits and carved the colossal figure-heads of men-of-war. After a second journey to Italy in 1646 he painted also a great number of pictures for Aix, Toulon, Cuers and La Ciotat, and sculptured a large marble group of the Virgin and Child for the church of Lorgues. His caryatides for the balcony of the Hôtel de Ville of Toulon were executed between 1655 and 1657. N. Fouquet employed Puget to sculpture a Hercules for his château in Vaux. The artist's desire to paint gradually subsided before his passion for sculpture, and a serious illness in 1665 brought Puget a prohibition from the doctors which caused him wholly to put aside the brush. The fall of Fouquet in 1660 found Puget at Genoa. Here he executed for Sublet des Noyers his French Hercules (Louvre), the statues of St Sebastian and of Alexandre Sauli in the church of Carignano (*c.* 1664), and much other work. The Doria family gave him a church to build; the senate proposed that he should paint their council chamber. But Colbert bade Puget return to France, and in 1669 he again took up his old work in the dockyards of Toulon. The arsenal which he had there undertaken to construct under the orders of the duke of Beaufort was destroyed by fire, and Puget, disheartened, took leave of Toulon. In 1685 he went back to Marseilles, where he continued the long series of works of sculpture on which he had been employed by Colbert. His statue of Milo (Louvre) had been completed in 1682, Perseus and Andromeda (Louvre) in 1684; and Alexander and Diogenes (bas-relief, Louvre) in 1685, but, in spite of the personal favour which he enjoyed, Puget, on coming to Paris in 1688 to push forward the execution of an equestrian statue of Louis XIV., found court intrigues too much for him. He was forced to abandon his project and retire to Marseilles, where he remained till his death on the 2nd of December 1694. His last work, a bas-relief of the Plague of Milan, which remained unfinished, was placed in the council chamber of the town hall of his native city.

In spite of Puget's visits to Paris and Rome his work never lost its local character: his Hercules is fresh from the galleys of Toulon; his saints and virgins are men and women who speak Provençal. His best work, the St Sebastian at Genoa, though a little heavy in parts, shows admirable energy and life, as well as great skill in contrasting the decorative accessories with the simple surface of the nude. There is in the museum of Aix in Provence the bust of a long-haired young man in pseudo-classical costume which is believed to be a portrait of Louis XIV. made by Puget at the time of the king's visit in 1660.

See Léon Lagrange, *Pierre Puget* (Paris, 1868, with a catalogue of works); Charles Ginoux, *Annales de la vie de P. Puget* (Paris, 1894); Philippe Auquier, *Pierre Puget . . . biographie critique* (Paris, 1903).

PUGILISM (from Lat. *pugil*, boxer, Gr. πύξ, with clenched fist), the practice or sport of fighting with the fists. The first mention of such fighting in literature is found in the 23rd book of the *Iliad*, and shows that in Homer's time the art was already highly developed. The occasion was the games at the funeral of Patroclus, the champions engaged being Epeus, the builder of the wooden horse, and Euryalus. Each combatant seems to have been naked except for a belt, and to have worn the cestus. The fight ends with the defeat of Euryalus. According to Virgil (*Aeneid*, v.) similar games took place within the walls of Troy at the funeral of Hector, the principal boxers being Dares, the winner, and the gigantic Butex, a pupil of Amycus, Paris, the Trojan champion, abstaining from the contests. Further on we find the account of the games on the occasion of the funeral of Anchises, in the course of which Dares, the Trojan, receiving no answer to his challenge from the Sicilians, who stood aghast at his mighty proportions, claims the prize; but, just as it is about to be awarded him, Entellus, an aged but huge and sinewy Sicilian, arises and casts into the arena as a sign of his acceptance of the combat the massive cesti, all stained with blood and brains, which he has inherited from King Eryx, his master in the art of boxing. The Trojans are now appalled in their turn, and Dares, aghast at the fearful implements, refused the battle, which, however, is at length begun after Aeneas has furnished the heroes with equally matched cesti. For some time the young and lusty Dares circles about his gigantic but old and stiff opponent, upon whom he rains a torrent of blows which are avoided by the clever guarding and dodging of the Sicilian hero. At last Entellus, having got his opponent into a favourable position, raises his tremendous right hand on high and aims a terrible blow at the Trojan's head; but the wary Dares deftly steps aside, and Entellus, missing his adversary altogether, falls headlong by the impetus of his own blow, with a crash like that of a falling pine. Shouts of mingled exultation and dismay break from the multitude, and the friends of the aged Sicilian rush forward to raise their fallen champion and bear him from the arena; but, greatly to the astonishment of all, Entellus motions them away and returns to the fight more keenly than before. The old man's blood is stirred, and he attacks his youthful enemy with such furious and headlong rushes, buffeting him grievously with both hands, that Aeneas puts an end to the battle, though barely in time to save the discomfited Trojan from being beaten into insensibility.

Although fist-fighting was supposed by the Greeks of the classic period to have been a feature of the mythological games at Olympia, it was not actually introduced into the historical

Olympic contests until the 23rd Olympiad after the re-establishment of the famous games by Iphitus (about 880 B.C.). Onomastos was the first Olympic victor. In heroic times the boxers are supposed to have worn the *ζῶμα*, or belt, but in the Greek games the contestants, except for the cestus, fought entirely naked, since the custom had been introduced in the 15th Olympiad, and was copied by the contestants at the Pythian, Nemean, Isthmian and Panathenaic games (see Games, Classical). At Olympia the boxers were rubbed with oil to make them supple and limit the flow of perspiration, a precaution the more necessary as the Olympic games were held during the hottest part of the year. The cesti, of which there were several varieties, were bound on the boxers' hands and wrists by attendants or teachers acting as seconds. On account of the weight of the gloves worn, the style of boxing differed from that now in vogue (see Boxing), the modern straight-from-the-shoulder blow having been little used. Both Homer and Virgil speak of "falling blows," and this was the common method of attack, consisting more in swinging and hammering than in punching. The statue of a Greek boxer in the Louvre shows the right foot forward, the left hand raised as if to ward off a blow from above, and the right hand held opposite the breast, the whole attitude more resembling that of a warrior with sword and shield than of a modern boxer. The pugilists of Rome, who were in many cases Greeks and employed Greek methods, exaggerated the brutality of the fist-fight to please the Roman taste, and the sanguinary contest between Dares and Entellus, described above, although in some respects an anachronism as an account of a pugilistic battle in primitive times, was doubtless an exact portrayal of the encounters to be seen in Virgil's day in the circuses of Rome. Nevertheless it must not be understood that the boxing matches at the Greek games were not themselves severe to the point of brutality, in spite of the fact that style and grace of movement were sedulously taught by the masters of the time. The Greek champions trained for months before the games, but encounters between athletes armed with such terrible weapons as the loaded cestus were bound to result in very serious bruises and even disfigurement. Pluck was as highly thought of as at the present day, and it was related of a certain Eurydamas that, when his teeth were battered in, he swallowed them rather than show that he was hurt, whereupon his antagonist, in despair at seeing his most furious blows devoid of effect, gave up the battle. As, on account of the swinging style of blows, the ears were particularly liable to injury ear-protectors (*ἀμφωτίδες*) were generally used in practice, though not in serious combats. The so-called "pancratist's ear," swollen and mis-shapen, was a characteristic feature of the Greek boxer. The satirists of the time flung their grim jests at the champion bruisers. Lucilius writing of a Greek boxer of Etruria (*Anthologia epigrammatum graecorum*), says, "Aulos, the pugilist, consecrates to the God of Pisa all the bones of his cranium, gathering up one by one. Let him but return alive from the Nemean Games, O mighty Jupiter, and he will also offer thee, without doubt, the vertebrae of his neck, which is all he has left!"

The rules of Greek boxing were strict. No wrestling, grappling, kicking nor biting were allowed, and the contest ended when one combatant owned himself beaten. On this account pugilism and the *pancratium* (see below) were forbidden by Lycurgus, lest the Spartans should become accustomed to an acknowledgment of defeat (Plutarch, *Lycurgus*). In spite of the terrible injuries which often resulted from these contests it was strictly forbidden to kill an adversary, on pain of losing the prize. Rhodes, Aegina, Arcadia and Elis produced most of the Olympic victors in boxing, which was considered as an excellent training for war. According to Lucan (*Anach.* 3) Solon recommended it for pedagogic purposes, and the contest with the *sphairai*, or studded cesti, was added by Plato to his list of warlike exercises as being the nearest approach to actual battle.

The Greek athletic contest called *pancratium* (*παγκράτιον*, complete, or all-round, contest), which was introduced into the Olympic games in the 38th Olympiad, was a combination of boxing and wrestling in which the contestants, who fought naked, not wearing even the cestus, were allowed to employ any means except biting to wring from each other the acknowledgment of defeat. Boxing, wrestling, kicking, dislocation of joints, breaking of bones, pulling of hair and strangling were freely indulged in. The fight began with sparring for openings and was continued on the ground when the contestants fell. Many pancratists excelled in obtaining quick holds of their opponents' fingers, which they crushed and dislocated so completely that all effective opposition ceased. Sudden attacks resulting in the dislocation of an arm or leg were also taught, reminding one of the Japanese jiu-jitsu. The *pancratium* was considered by the Greeks the greatest of all athletic contests and, needless to say, only the most powerful athletes attempted it. It became popular in Rome during the Empire and remained so until the time of Justinian.

Diagoras of Rhodes, his three sons and many grandsons, who were sung by Pindar (*Olymp.* 7), were the most celebrated of the Olympic boxing champions. One of the sons, Dorieus, was three times victorious at Olympia in the *pancratium*, and during his career won eight Olympian, eight Isthmian, seven Nemean and one of the Pythian prizes. Many famous champions also came from the Greek colonies, like the Locrian Euthymus, who conquered three times at Olympia. Another celebrated fighter and wrestler was Milo of Crotona (520 B.C.).

Boxing was evidently in vogue in very ancient times in Italy, imported, in all probability, from Greece, for Livy (i. 35) relates that, at the first celebration of the great Roman games (*ludi, romani magnique varie appellati*) by Tarquinius Priscus (6th century B.C.), boxers were brought from outlying provinces; and there was an old tradition that a school of pugilism flourished in Etruria in heroic times. During the republic boxing was cultivated as a gentlemanly exercise, and we find Cato the Elder giving his son instruction in the art (Plutarch, *Cato Major*). Tacitus (Ann. xvi. 3) says that the emperor Caligula imported the best Campanian and African pugilists for the gladiatorial games, and Strabo (iii. 3) records that the Lusitanians and also the Indians, who gave virgins as prizes, boxed. The art remained popular in Italy down to a late period of the Empire.

From the fall of the Roman Empire to the beginning of the 19th century pugilism seems to have been unknown among civilized nations with the single exception of the English.

The first references to boxing in England as a regular sport occur towards the end of the 17th century, but little mention is made of it before the time of George I., when "prize-fighters" engaged in public encounters for money, with the backsword, falchion, foil, quarter-staff and single-stick, and, to a less extent, with bare fists, the last gradually gaining in popularity with the decline of fencing. The most celebrated of these fighters and the one who is generally considered to have been the first champion of England, fighting with the bare fists, was James Figg, who was supreme from 1719 to 1730. Figg was succeeded by Pipes and Gretting, both of whom made way in 1734 for Jack Broughton, who built the amphitheatre for public displays near Tottenham Court Road and who was undisputed champion until 1750. Broughton seems to have been a man of intelligence, and to him is ascribed the scientific development of the art of boxing. During his time the sport became truly national and the prize-fighter the companion of the greatest in the land. Among Broughton's successors were Slack, "Big Ben" Brain, Daniel Mendoza (a Jew who flourished about 1790 and was the proprietor of the Lyceum in the Strand), J. Jackson, Tom Cribb, Jem Belcher, Pearce (called the "Game Chicken"), and John Gully, who afterwards represented Pontefract in Parliament.

To Broughton is ascribed the invention of boxing-gloves for use in practice. All prize-fights, however, took place with bare knuckles in roped-off spaces called rings, usually in the open air. Pugilists toughened their hands by "pickling" them in a powerful astringent solution. A fight ended when one of the "bruisers," as they were called, was unable to "come to the scratch," *i.e.* the middle of the ring, at the call of the referee at the beginning of a new round. Each round ended when one fighter fell or was knocked or thrown to the ground, but a pugilist "going down to avoid punishment," *i.e.* without being struck by the opponent, was liable to forfeit the fight. Wrestling played an important rôle in the old prize-ring, and a favourite method of weakening an adversary was to throw him heavily and then fall upon him, seemingly by accident, as the manœuvre, if done intentionally, was foul. The fighting was of the roughest description, low tricks of all kinds being practised when the referee's attention was diverted, gouging out an adversary's eye being by no means unknown. Until 1795 pugilists wore long hair, but during a fight in that year Jackson caught Mendoza by his long locks and held him down helpless while he hit him. This was adjudged fair by the referee, with the result that prize-fighters have ever since cropped their head. Nevertheless there were rules which no fighter dared to overstep, such as those against kicking, hitting below the belt, and striking a man when he had fallen.

From the time of Cribb the English champions were Tom Spring (1824), Jem Ward (1825), Jem Burke (1833), W. Thompson, called "Bendigo" (1839–1845), Ben Caunt (1841), W. Perry, the "Tipton Slasher" (1850), Harry Broome (1851), Tom Sayers (1857–1860), Jem Mace (1861–1863), Tom King (1863), and again Mace, until 1872.

In America boxing began to be popular about the beginning of the 19th century. The first recognized national champion was Tom Hyer (1841–1848), who was followed by James Ambrose (born in Ireland), called "Yankee Sullivan"; John Morrissey (afterwards elected to the United States Congress); John C. Heenan; Tom Allen (of England); Jem Mace (of England); J. Kilrain; John L. Sullivan (1880–1891); J. J. Corbett (1892–1897); Robert Fitzsimmons (1897–1900) (born in Cornwall); James J. Jeffries. The defeat of the last named by the negro Jack Johnson in 1910 caused a great sensation.

What is still the most celebrated prize-fight of modern times took place at Farnborough in April 1860, between Tom Sayers and the huge youthful American pugilist J. C. Heenan, the "Benicia Boy," who had been defeated in America by Morrissey, but had succeeded to the championship upon the latter's retirement. The English champion was a much smaller and lighter man than his challenger, a fact which increased the popular interest in the fight. Although the local English authorities endeavoured to prevent it taking place, Heenan complaining that he had "been chased out of eight counties," the ring at Farnborough was surrounded by a company containing representatives of the highest classes, and the exaggerated statement was made that "Parliament had been emptied to patronize a prize-fight." The battle lasted for 2 hours and 20 minutes, during which Heenan, owing to his superiority in weight and reach, seemed to have the advantage, although nearly blinded by Sayers's hard straight punches. During one of the opening rounds a tendon in Sayers's right forearm was ruptured in guarding, and he fought the rest of the battle with a pluck which roused the enthusiasm of the spectators. Heenan had neglected to harden his hands properly, with the result that they soon swelled to unnatural proportions, rendering his blows no more effective than if he had worn boxing-gloves. Nevertheless towards the close of the fight Heenan repeatedly threw Sayers violently, and held him on the ropes enclosing the ring, which, just as the police interfered, were cut by persons who asserted that Heenan was on the point of strangling Sayers. In spite of the indecisive outcome of the battle both fighters claimed the victory, but the match was officially adjudged a draw. This was the last great prize-fight with bare fists on English soil, as public opinion was aroused, and orders were given to the police thenceforth to regard prize-fights as illegal, as tending to a "breach of the peace." Several surreptitious prize-fights did indeed occur within a few years after the Sayers-Heenan battle; but more than once, notably in the fight between Heenan and Tom King, one of the participants was "doctored," *i.e.* drugged, and this lack of fairplay, added to the brutality of fist-fights, gave the death-blow to pugilism of the old kind. In its place came fighting and boxing with padded gloves, small ones weighing about 4 oz. being used by professionals, while amateurs, who boxed and sparred rather than fought (see BOXING), made use of larger and softer gloves.

An added impetus was given to boxing as well as pugilism in 1866 by the founding of the "Amateur Athletic Club" by John C. Chambers, who, assisted by the marquess of Queensberry, drew up the code of rules for competitions still in vogue and called after that nobleman, who, in 1867, presented cups for the amateur championships at the different weights. These rules prohibit all rough and unfair fighting, as well as wrestling, and divide a match into rounds of three (or two) minutes each, with half a minute rest between the rounds. It is a matter of agreement in professional battles whether in "breaking away" after a clinch blows may be struck or not. When a contestant is knocked down (a man on one knee is technically down) he is allowed ten seconds, usually counted aloud by the referee, in which to rise and renew the fight. Should he be unable to do so he is "counted out" and loses the match.

See *Fistiana* (London, 1868); *American Fistiana* (New York, 1876); Egan, *Boxiana* (London, 1818–1824); *Fencing, Boxing and Wrestling*, in the Badminton Library (London, 1889); R. G. A. Winn, *Boxing*, Isthmian Library (London, 1897).

PUGIN, AUGUSTUS WELBY NORTHMORE (1812–1852), English architect, son of Augustus Charles Pugin (1762–1832), a Frenchman by birth who settled in London as an architectural draughtsman and had several pupils who rose to fame, was born in Store Street, Bedford Square, on the 1st of March 1812. After an education at Christ's Hospital he entered his father's office, where he displayed a remarkable talent for drawing. His father was for many years engaged in preparing a large series of works on the Gothic buildings of England, almost, if not quite, the first illustrated with accurate drawings of medieval buildings; and the son's early youth was mostly occupied in making minute measured drawings for these books. In this way his enthusiasm for Gothic art was first aroused. All through his life, both in England and during many visits to Germany and France, he continued to make great numbers of drawings and sketches, in pen and ink or with sepia monochrome, perfect in their delicacy and precision of touch, and masterpieces of skilful treatment of light and shade. At first he acted as assistant in his father's work, and his own independent efforts to obtain business were not very successful. In 1827 he was employed to design furniture in a medieval style for Windsor Castle; and in 1831—the year he married his first wife, Ann Garnett, who died in childbirth a year later—he designed scenery for the new opera of *Kenilworth* at Her Majesty's theatre. But he got into money difficulties, and soon after his marriage he was imprisoned for debt. When he came out he again incurred serious losses over an attempt to start a shop for supplying architectural accessories of his own designing, which he had to give up. But after his second marriage in 1833 to Louisa Burton (d. 1844), and his reception into the Roman Catholic Church shortly afterwards, he began to obtain more steady architectural practice and by degrees he acquired the reputation which has made his name stand foremost among those responsible for the English Gothic revival (see ARCHITECTURE: *Modern*: "The Gothic Revival"). No man had so thoroughly mastered the principles of the Gothic style in its various stages, both in its leading lines and in the minutest details of its mouldings and carved enrichments. In 1837–1843 he assisted Sir Charles Barry by working out the details of the designs for the new Houses of Parliament at Westminster; and though his exact share in the designs was subsequently the subject of bitter controversy after both he and Barry were dead, there is no doubt that, while he was working as Barry's paid clerk, a great deal in the excellence of the details was due to him and to his training of the masons and carvers. His conversion to Roman Catholicism, while part and parcel of his devotion to Gothic art, naturally brought him employment as an architect mainly from Roman Catholics; and many of his executed works suffered from the fact that his designs were not fully carried out, owing to a desire to save money or to spend it so as to make the greatest possible display. For this reason his genius is often more fairly displayed by his drawings than by the buildings themselves. In almost every case his design was seriously injured, both by cutting down its carefully considered proportions and by introducing shams (above all things hateful to Pugin), such as plaster groining and even cast-iron carving. The cathedral of St George at Southwark, and even the church in Farm Street, Berkeley Square, London, are melancholy instances of this. Thus his life was a series of disappointments; no pecuniary success compensated him for the destruction of his best designs, as in him the man of business was thoroughly subordinate to the artist. He himself used to say that the only church he had ever executed with unalloyed satisfaction was the one at Ramsgate, which he not only designed but paid for. Pugin was very broad in his love for the medieval styles, but on the whole preferred what is really the most suited to modern requirements, namely the Perpendicular of the 15th century, and this he employed in its simpler domestic form with much success both in his own house at Ramsgate and in the stately Adare Hall in Ireland built for Lord Dunraven. The cathedral of Killarney and the chapel of the Benedictine monastery of Douai were perhaps the ecclesiastic buildings which were carried out with least deviation from Pugin's original conception.

Apart from his work as an architect, his life presents little of detail to record. In 1836 he published his *Contrasts; or a Parallel between the Architecture of the 15th and 19th centuries*, in which he seriously criticized the architecture of Protestantism. His other principal publications were *True Principles of Christian Architecture* (1841); *Glossary of Ecclesiastical Ornament* (1844); and *Treatise on Chancel Screens and Rood Lofts* (1851). He was a skilful etcher, and illustrated in this way a number of his works, which were written with much eloquence, great antiquarian knowledge and considerable humour. This last gift is exemplified in a series of etched plates in his *Contrasts*; on one side is some noble structure of the middle ages, and on the other an example of the same building as erected in the 19th century. In 1849 he married a third wife, daughter of Thomas Knill. Early in 1852 he was attacked by insanity, and he died on the 14th of September that year. His eldest son by his second wife, Edward Welby Pugin (1834–1875), was also an accomplished architect, who carried on his father's work.

See B. Ferrez, *Recollections of A. W. Pugin and his Father* (London, 1861).

PUISNE (from O. Fr. *puisné*, modern *puîné*, later born, inferior; Lat. *postea*, afterwards, and *natus*, born), a term in law meaning "inferior in rank." It is pronounced "puny," and the word, so spelt, has become an ordinary adjective meaning weak or undersized. The judges and barons of the common law courts at Westminster, other than those having a distinct title, were called *puisne*. By the Supreme Court of Judicature Act 1877, a "puisne judge" is defined as a judge of the High Court other than the lord chancellor, the lord chief justice of England, the master of the rolls, the lord chief justice of the common pleas, and the lord chief baron, and their successors respectively.

PUJAH, or POOJA, the Hindu ceremonies in idol-worship. Colloquially the word has come to be applied by Anglo-Indians to any kind of rite; thus "pujah of the flag" is the sepoy term for trooping of the colours.

PUKET (also known by the Chinese name *Tongkah*), the first Siamese port on the west coast of the Malay Peninsula, situated on the eastern side of the island of Junk Ceylon (Malay, "Ujong Salang") in 7° 50′ N. and 98° 24′ E. It is the headquarters of the high commissioner of the Siamese administrative division of the same name, and has a population of about 30,000, of which more than a third is Chinese. Beneath the town and around it lie deposits of tin ore which have been worked by Chinese from ancient times, and the extraction of which still furnishes occupation for the majority of the inhabitants. In 1907, dredging for tin in the harbour was undertaken by a European company. Puket has been a resort of European merchants since the 16th century. During the ancient wars between Siam and Burma it was more than once attacked by the latter, but was relieved by forces from Nakhon Sri Tammarat (Ligore) on the mainland. The Siamese mining department has a branch at Puket under control of European officers.

PULASKI, CASIMIR, COUNT (1748–1779), Polish soldier, was born in Podolia in 1748, and took a prominent share, under his father Count Joseph Pulaski, in the formation of the confederation of Bar and in the military operations which followed, becoming ultimately commander-in-chief of the Polish patriot forces. Driven into exile about 1772, Pulaski went to America and joined the army of Washington in 1777. He distinguished himself at once in the battle of Brandywine, was made a brigadier-general and chief of cavalry by Congress, and fought at Germantown, and in the battles of the winter 1777–78, after which he raised a mixed corps called the Pulaski legion. At the head of this force he won further distinction in the southern theatre of war, and successfully defended Charleston in May 1779. He was mortally wounded soon afterwards at the unsuccessful attack on Savannah (Oct. 9) and died two days later on board ship. Congress voted a monument to his memory; and though this vote has never been carried into execution, Lafayette laid the corner-stone of a monument in Savannah in 1824, and this was completed in 1855.

PULCI, LUIGI (1431–1487), Italian poet, was born at Florence, of a well-connected family. His elder brother Luca (d. 1470) was also a poet, author of *Pistole*, *Driadeo d'amore*, and *Ciriffo Calvaneo*. Luigi was patronized by Cosimo, Piero, and Lorenzo de' Medici, and was the author of various works in poetry and prose. He is famous, however, as the first to bring artistic romance into Italian literature in his heroic poem *Morgante Maggiore* (Venice, 1481), an epic of a giant converted to Christianity, who accompanies Orlando (Roland). (See ITALIAN LITERATURE.)

PULGAR, HERNANDO DE (1436–*c.* 1492), Spanish prose-writer, was born at Pulgar (near Toledo) in 1436 and was educated at the court of John II. Henry IV. made him one of his secretaries, and under Isabella he became councillor of state, was charged with a mission to France, and in 1482 was appointed historiographer-royal. He is said to have died in 1492. His *Crónica de los Reyes Católicos*, wrongly ascribed in the first edition (1565) to Antonio de Lebrija, is often inaccurate and always obsequious; but the record is not without value as regards events within the author's personal experience. Pulgar's *Claros Varones de Castilla* (1486), an account of celebrities at the court of Henry IV., is interesting in matter and style. He compiled a commentary (1485?) on the *Coplas de Mingo Revulgo*. His *Letters*, written to various persons of eminence, were first published in 1485–1486.

PULICAT, a town of British India, in Chingleput district, Madras, 25 m. N. of Madras city. Pop. (1901), 5448. The Dutch built a fort here as early as 1609, and it was for a long time their chief settlement on the Coromandel coast. Repeatedly captured, it did not finally become British until 1825. It gives its name to the Pulicat lake, a shallow lagoon stretching for about 37 m. along the coast. The seaward side is formed by the island of Sriharikot, which supplies firewood to Madras city.

PULKOVO, or PULKOWA, a village of Russia, in the government of St Petersburg, 10 m. S. of the city of St Petersburg. Pop. 2000. It contains the Pulkovo observatory, on a hill 248 ft. high, in 59° 46′ 18″ N. and 30° 19′ 40″ E. It was built in 1833–1839.

PULLEY, a wheel, either fixed to a turning axle or carried freely on a stationary one, the periphery of which is adapted to receive some form of wrapping connector. A pulley carried on a rotating shaft and connected to another pulley on a second shaft by an endless band consisting of a flat belt, rope, chain or similar connector serves for the transmission of power from the one shaft to the other and is known as a driving pulley;

while combinations of pulleys or "sheaves," mounted in fixed or movable frames or "blocks," constitute mechanisms used to facilitate the raising of heavy weights. The word appears in Mid. Eng. as *pulley* or *polley* (late), also as *poleyne* (*Prompt. Parvul.*). The first forms seem to be from the O. Fr. *poulie*, which itself is regarded as coming from the O. Eng. *pullèan*, to pull. The Low Lat. forms *polea*, *polegia*, whence Span. *polea* and Ital. *poleggia*, are apparently from the Fr. *poulie*. The earliest form, *poleyne*, is represented in Fr. by *poulain*, literally a colt, Low Lat. *pullanus*, *pullus*, the young of any animal, the root of which is seen in English "foal." *Poulain* was used of a rope to let casks down into a cellar or to raise heavy weights. The use of the name of an animal for a mechanical device is not uncommon, cf. "crane," or "easel," from Du. *exel*, literally "little ass."

Driving pulleys are usually constructed of cast iron, and are of circular form, having a central nave by which they are secured to the shaft by keys or other fastenings, and straight or curved arms connecting the nave to the rim, which latter is of a form adapted to the connector. Pulleys are usually cast in one piece, and the proportions of the various parts are designed to resist the unknown stresses due to contraction of the casting in cooling, in addition to the stresses to which pulleys are subjected in use. The rim is slightly wider than the belt, and is of such a section as will suffice to resist the stress due to the pull of the belt, which is commonly taken as 80 ℔ per inch of width for single belting and 140 ℔ per inch of width for double belting. The rim is also subject to a centrifugal tension of amount wv^2/g pounds per square inch of section, where w is the weight in pounds of a length of one foot of the pulley rim one square inch in section, and v is the velocity of the rim in feet per second. This stress amounts to 1043 ℔ per square inch, if the velocity is 100 ft. per second. The combination of these stresses generally limits the rim velocity of cast-iron pulleys to 80 or 100 ft. per second. The dimensions of the nave depend to a large extent on the method of keying or otherwise securing the pulley to the shaft. The number of the arms is arbitrary, and they may be curved to diminish the liability to fracture from contraction in the cooling of the cast iron, but in other respects are preferably straight, since they are then lighter and stronger. The arms are elliptical in cross-section, diminishing from the nave to the rim, and are usually designed as equally loaded cantilevers, fixed at the nave and free at the rim. These assumptions are probably not nearly correct, and, as the stresses caused by the cooling of the casting are unknown, it is necessary to choose a low working stress of about one ton per square inch. The statical experiments of C. H. Benjamin (*American Machinist*, 1898) on cast-iron pulleys loaded by a belt to imitate the conditions in practice led him to the conclusion that the rim is usually not sufficiently rigid to load the arms equally, and that the ends of the arms are subjected to bending movements of opposite sign, that at the nave being almost invariably the greater.

Pulleys are also built up of wrought iron and steel, and can then be constructed entirely free from internal stress; they are thus much lighter and stronger, and are not liable to fly to pieces like cast iron if they break. Fig. 1 shows a built-up pulley having a cast-iron nave A, straight wrought-iron arms B, screwed therein and connected to a steel plate-rim C by riveted ends, and also by screwed flanges D riveted on each side to the rim. The pulley is in halves to facilitate fixing, and when in place the sections C are joined by plates E, bolted or riveted to the rim. The two halves of the nave are secured by bolts or rivets passing through the flanges F, and the pulley is connected to the shaft by a sunk key or by conical keys driven in between the shaft and the boss, which latter is bored to suit. A modified form of this arrangement of cone keys is shown in the figure, in which a screwed conical bush M, divided into several parts longitudinally, is clamped round the shaft, and screwed into the corresponding part of the nave until the grip is sufficient. The parts of the bush are glued to a sheet of emery paper, so that its rough side may give a better grip on the shaft.

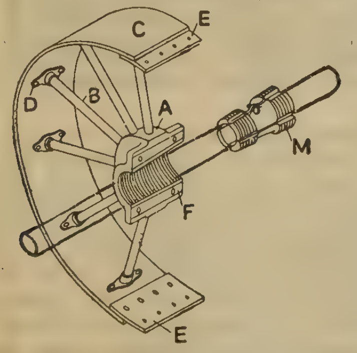

Fig. 1.—Built-up Pulley.

Pulleys are also made of paper, wood and other materials. Wooden pulleys are preferably made of maple, the rim being formed of small sections morticed, pinned and glued together, with the grain set in such directions that any warping of the material will leave the cylindrical form practically unaltered. Wooden pulleys are generally made in two halves, bolted together at the rim and nave, and are provided with wooden spokes dovetailed into the rim and secured by keys. The pulley is secured to the shaft by conical keys, to give a frictional grip on both the shaft and the pulley; these keys may have their exterior surfaces eccentric to the shaft, with corresponding recesses in the nave, so that the pulley and keys virtually form one piece.

If the centre of gravity of a pulley is on the axis of rotation, and the whole mass is distributed so that the axis of inertia coincides with the axis of rotation, there can be no unbalanced force or unbalanced couple as the pulley revolves. The magnitude of the unbalanced force, for a mass of w pounds at a radius of r feet and a velocity of v feet per second, is expressed by wv^2/gr ℔; and, since the force varies as the square of the velocity, it is necessary carefully to balance a pulley running at a high speed to prevent injurious vibrations. This can be accomplished by attaching balance-weights to the pulley until it will remain stationary in all positions, when its shaft rests on two horizontal knife-edges in the same horizontal plane, or, preferably, the pulley and shaft may be supported on bearings resting on springs, and balanced by attached masses until there is no perceptible vibration of the springs at the highest speed of rotation.

The rims of pulleys, round which flat bands are wrapped, may be truly cylindrical, in which case the belt will run indifferently at any part of the pulley, or the rim may be swelled towards the centre, when the central line of the band will tend to run in the diametral plane of the pulley. This self-guiding property may be explained by the tendency which a flat band has, when running upon a conical pulley in a direction normal to its axis, to describe a spiral path as it wraps on to the surface because of the lateral stiffness of the material; the advancing side therefore tends to rise towards the highest part of the cone. If two cones are placed back to back the belt tends to rise to the ridge and stay there. In practice the pulley rim is curved to a radius of from three to five times its breadth, and this not only guides the belt, but allows the line of direction of the advancing side to deviate to a small extent, depending on the elasticity of the material.

Parallel shafts may be driven by flexible bands or connectors passing over pulleys, the central planes of which coincide, without any guiding arrangements for the belting. The shafts revolve in the same or opposite directions, according as the belt is open or crossed. Means of changing the relative speeds of rotation are furnished by pulleys of continuously varying diameter, or by speed cones (see MECHANICS: *Applied*). A common arrangement for driving a lathe spindle, in either direction at several definite speeds, is to provide a countershaft on which are mounted two fixed pulleys and two loose pulleys to accommodate two driving belts from the main shaft, one of which is open and the other crossed. The belts are moved laterally by the forks of a striking gear pressing on the advancing sides of the belts, and the pulleys are arranged so that the belts either wrap round the loose pulleys, or can be shifted so that one wraps round a fixed pulley, while the other still remains on its loose pulley. Motion in either direction is thereby obtained, and a considerable variation in the speed of rotation can be obtained by providing a cone pulley on the countershaft, which drives the cone pulley secured to the lathe spindle by a separate band. The dimensions of the pulleys are generally so arranged that the return motion of the lathe spindle is faster than the forward motion. An alternative arrangement consists in providing two loose pulleys on the counter-shaft, driven by open and crossed belts respectively, and arranging two clutches on the shaft, so that by the movement of a sliding block, controlled by hand, one or other of the clutches can be put in gear.

The proportions of cone pulleys for open or crossed belts may be determined by considering the expression for the half length (l) of a belt wrapping round pulleys of radius r_1 and r_2 respectively, and with centres distant c apart. The value of l may be easily shown to be $(r_1+r_2)\pi/2+(r_1\pm r_2)\alpha+c\cos\alpha$, where the positive sign is to be taken for a crossed belt and the negative sign for an open belt. In determining the dimensions of corresponding drums of cone pulleys it is evident that for a crossed belt the sum of the radii of each pair remains a constant, since the angle α is constant, while for an open belt α is variable and the values of the radii are then obtained by solving the equations

$$r_1=l/\pi-c(\alpha\sin\alpha+\cos\alpha)+\tfrac{1}{2}c\sin\alpha,$$
$$r_2=l/\pi-c(\alpha\sin\alpha+\cos\alpha)-\tfrac{1}{2}c\sin\alpha.$$

The value of α is in general small, and an approximate solution may be obtained by substituting two or three terms of the expansions for $\sin\alpha$ and $\cos\alpha$. This, however, leads to a troublesome numerical solution. An accurate geometrical solution by C. Culmann gives the linear equivalents of the above equations in the following manner. A rectangle ABCD (fig. 2), with side $AB=\pi c/2$ and $AD=c$, is constructed, and the quadrant AEF is drawn with centre D and radius DA. F B is the evolute of this circle, and for any radius DE at an angle α and corresponding tangent EG terminated by the evolute, the perpendicular distance of G from the line AD is $c(\cos\alpha+\alpha\sin\alpha)$. If now a line be drawn from A to the bisector H of the side BC, it will meet the vertical through G in I and $IJ=c(\cos\alpha+\alpha\sin\alpha)/\pi$. A circular arc, centre D and radius $c/2$, meets D E in K, and the perpendicular KL gives $\tfrac{1}{2}c\sin\alpha$. This distance is marked off from the point I in each direction, whereby the points M and N are obtained, the distance apart of which represents the value r_1-r_2. If now the value $l/\pi=OJ$ be marked off, and a horizontal line be drawn through the point O, the line OM represents r_1+r_2. Repeating this construction for all values of α between 0° and 90°, we obtain a curve BPC, which can be used for determining the ratios of corresponding drums of cone pulleys or of conical drums for open belts. The curve BPC is generally used with the abscissae spaced more conveniently for practical applications, and a modification of the diagram by J. F. Klein (*Journ. Franklin Inst.*, vol. lxxix.) is often used instead.

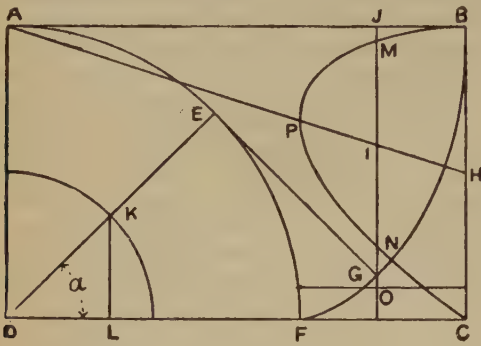

FIG. 2.

When pulleys are mounted on shafts which are parallel to one another, the band will retain its position, provided that its central line advances towards each pulley in the diametral plane of this latter. This condition is fulfilled in the example shown by fig. 3, in which the central planes of each pulley pass through the points of delivery of the other pulley for the given direction of motion. If the motion is reversed the condition is no longer satisfied and the belt will leave the pulleys. In more complicated cases guide pulleys must be used. In the most general case for inclined pulleys, any two points may be chosen on the line of intersection of the diametral planes, and tangents drawn to the pitch circles of the pulleys. Guide pulleys are set with their diametral planes in the planes containing corresponding pairs of tangents, and a continuous belt wrapped round these pulleys in due order can then be run in either direction.

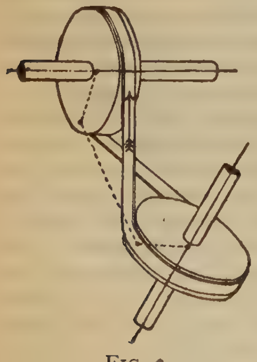

FIG. 3.

The rims of pulleys for hemp or other ropes or cords are grooved, and the sides are usually either inclined at 45° or curved to give a sharper angle at the outside than at the bottom of the groove; in the latter case, as the rope wears it engages in a groove of greater angle and less effective grip. Wire ropes are injured by the lateral crushing of the material, and in this case the grooves are wide enough to allow the rope to rest on the rounded bottom, which is lined with leather or wood to diminish the wear and increase the friction. In English practice there are as many separate endless ropes as there are pairs of grooves in the two pulleys to be connected, but in cases of American practice the rope is continuously wound round the two pulleys, and the free end passes over a pulley mounted on a movable weighted carriage to adjust the tension. It is of considerable importance that the effective radius of action of the rope remain constant throughout each pulley, otherwise the wear on the rope becomes very great and its life is diminished. The grooves must be turned exactly alike, and the rope must be of the same diameter throughout to diminish slip.

Pulleys may be detachably connected to a shaft by friction clutches, so that they may be thrown in and out of engagement at will. The section, fig. 4, shows a clutch for a rope-driven pulley A, which runs freely on a bush B on the shaft, and is provided with an enlarged cylindrical nave or clutch box C. A split ring D, carried by the clutch and turning with it, can be thrust against the clutch box by right- and left-handed screws E, so that a sufficient grip is obtained to cause the clutch and the pulley to turn as one piece. The engagement of the pulley and clutch is determined by a hand-controlled block F sliding on the shaft, the movement of which is communicated to the right- and left-handed screw shafts by links G connected to the levers H.

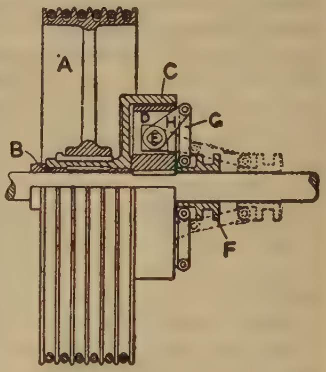

FIG. 4.

The resistance to slipping of a flat belt on a pulley may be obtained by considering the equilibrium of a small arc of the pulley surface subtending an angle $d\theta$ at the centre, and having tensions T and $T+dT$ at its extremities. Neglecting quantities of the second order, the pressure on the pulley is $Td\theta$, and the friction is $\mu Td\theta$ where μ is the coefficient of friction between the belt and the pulley. We have therefore $dT=\mu Td\theta$ and $dT/T=\mu d\theta$. Integrating the expression for an angle of wrapping θ, we obtain the relation $\log_\epsilon T_1/T_2=\mu\theta$, where T_1 and T_2 are the end tensions. For leather belts on cast-iron pulleys the value of μ may be taken as 0·4, giving a ratio of the tensions on the tight and slack sides of $T_1/T_2=3{\cdot}514$, when the angle of wrapping is 180°. For ropes in the grooves of cast-iron pulleys, where ϕ is the inclination of the sides of the grooves, the value of the normal pressure is increased in the ratio of $\operatorname{cosec}\tfrac{1}{2}\phi=1$. A usual value of μ for hemp ropes on cast-iron pulleys is 0·3, and the exponential log ratio is therefore $0{\cdot}3\pi\operatorname{cosec}\tfrac{1}{2}\phi$ when $\theta=\pi$. At high speeds the centrifugal tension of the belt or rope, of amount wv^2/g, may be considerable, and must be subtracted from the end tensions.

Pulley Blocks.—Frames or blocks containing pulleys or sheaves are used in combination for lifting heavy weights. There are usually two blocks, of which one A (fig. 5) is fixed, and the other B is movable, and a rope or chain, with one end secured to one of the blocks at C, passes round the sheaves in a continuous coil, leaving a free end D at which the effort is applied. In the arrangement shown there are three equal sheaves in each block, and each set turns on a pin secured in the framing. The load, supported by the lower hook, is raised by hauling on the free end and, neglecting any slight obliquity of the plies of rope, the free end moves six times as fast as the lower block carrying the weight, and in the absence of friction and other resistances the mechanical advantage will be in the same ratio of the effort to the resistance. In practice the full advantage of this or any other similar combination is not realized, because of the friction of the sheaves against the pin or shaft, and more important still is the stiffness of the rope, which requires work to be done upon it to bend it round the sheave and straighten it again. The effect of pin friction is equivalent to diminishing the radius of the effort and increasing that of the resistance.

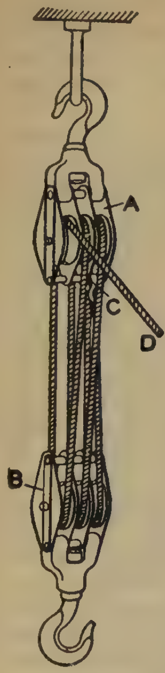

FIG. 5.—Sheave Pulley Block.

For a single pulley of diameter D, turning on a fixed pin of diameter d, the relation of the effort E to the load W, where f is the coefficient of friction, is expressed by $E/W=(D+fd)/(D-fd)=1+2fd/D$ approximately. The resistance of the rope to bending causes an additional resistance, which experiment shows can be expressed in the form Wd^2/cD where c is a coefficient. Hence $E=W(1+2fd/D+d^2/CD)=kW$ for a single pulley. In a six-sheaved pulley tackle the relation between E and W may be expressed as $W = E\ (1/k+1/k^2+1/k^3+1/k^4+1/k^5+1/k^6) = E(k^6-1)/k^6(k-1)$, and with a probable value of $k=1{\cdot}1$ this gives $W=4{\cdot}355\ E$ instead of $W=6E$. If the free end of the rope is released the weight will descend, and the tackle is then said to overhaul. The conditions which enable a pulley tackle to sustain a weight when the effort is removed may be examined, to a first approximation, if we assume that the internal friction acts in such a way as virtually to diminish the effort E and to increase the resistance R by amounts proportional to the magnitude of each, and in addition to cause a loss M due to the weights of the parts themselves. We may therefore express the relation in the form $(1-a)E=(1+b)R+M$, whence we obtain $R/E=(1-a)/(1+b+M/R)$. If now the machine be reversed and R becomes an effort corresponding to a resistance E′ then we have $R(1-b)=(1+a)E'+M$, giving

$$E'/R=(1-b-M/R)/(1+a). \qquad (1)$$

If the load is self-sustaining E′ is zero or negative, and hence $b+M/R$ must be equal to or greater than unity, and therefore it is impossible for the ratio of R/E to rise to a greater value than $(1-a)/2$, and hence at least half the effort is wasted if the tackle has the valuable property of sustaining a load when the effort is removed. If, however, an artificial resistance can be introduced, to come into action only when the effort is removed, it is possible to obtain a tackle of greater efficiency. As an example we may take the case where a brake is provided offering a resistance, c R, proportional to the load sustained, and where the values a and b are small compared with unity. Equation (1) becomes $E/R=(1-b-c-M/R)/(1-a)$, and hence $b+c+M/R$ is equal to or greater than unity when the load is self-sustained, and we thus obtain a relation between R and E in the form $1-a/2-c$, which shows to a first approximation, that as c approaches unity a high efficiency is obtainable, while the self-sustaining power of the tackle is retained.

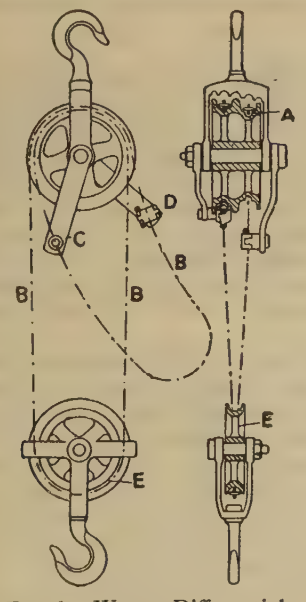

FIG. 6.—Weston Differential Pulley Block.

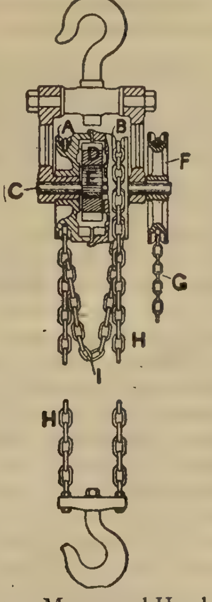

FIG. 7.—Moore and Head Pulley Block.

In order to obtain a greater ratio of R to E, without using a large number of sheaves, various arrangements are used, of which the Weston differential pulley block is a typical example. The upper block carries a pair of chain pulleys A (fig. 6), secured together and of slightly different effective diameters D and d. An endless chain B, passing through guides C and D, encircles these pulleys and the single loose pulley E of the lower block, as indicated. With this arrangement a single revolution of the upper sheave causes the endless chain to wind up the chain on one side by an amount πD, and to unwind an amount πd on the other side, and in consequence the lower sheave is raised by $\pi(D-d)/2$. Hence, neglecting friction, $E\pi D=\frac{1}{2}R\pi(D-d)$, *i.e.* $E=\frac{1}{2}R(1-d/D)$. The value d/D usually lies between the limits 10/11 and 15/16, and, if a greater difference of E from R is required, a further mechanical advantage can be obtained by employing a separate hand-wheel and chain, or by forming the upper sheave with an annular spur-wheel gearing with a pinion driven by a hand-wheel and chain, as in the Tangye form of Weston pulley-block. The efficiency of the Weston pulley-block is less than 50%, and it does not therefore overhaul. An objection to this form of block is the great length of the endless chain, which may drag on the ground and pick up dirt and grit, and thereby interfere with the smooth working of the mechanism. Other forms, which do not require so lengthy a chain, sometimes employ an epicyclic train to obtain the reduced velocity of the load. The Moore and Head block has two equal chain-wheels A, B, fig. 7, loosely mounted on an axle C, and provided with annular toothed gear-wheels which usually differ by one tooth. A spur pinion D, gearing with both wheels, is carried loosely upon an eccentric E forming part of the central pin, so that when this latter is turned by the hand-wheel F and chain G the axis of the pinion describes a circle the diameter of which equals the throw of the eccentric, and a small relative motion of the two sheaves takes place, depending on the number of the teeth of the annular wheels. The motion obtained is divided between the two vertical parts of the chain H, which is wrapped round each sheave in opposite directions, with a free loop I between, while the ends are attached to the lifting hook. This form is self-sustaining at all loads.

In order to obtain a self-sustaining pulley tackle, which will have an efficiency of more than 50%, various arrangements are adopted, which during lifting automatically throw out of action a brake and cause it to come into action again when the effort is removed. A worm-gear tackle of this description is shown in fig. 8, in which a worm A, operated by a hand-wheel B and chain C, drives the worm-wheel D, thereby coiling up a chain E, one end F of which is secured to the upper block, and the other end hangs loosely, after passing round the sprocket-wheel. The worm is of great pitch, so that if the effort were removed the weight would descend, did not the axial end thrust of the worm shaft throw into action a friction brake H, the resistance of which prevents motion downwards. In the brake shown, the cone I is pressed against a corresponding recess in the ratchet-wheel J, which latter turns loosely in the casing and is provided with a pawl not shown in the figure; this pawl allows freedom of motion when the load is being raised. The frictional grip between the two surfaces prevents return motion of the worm shaft and the load remains suspended, but it may be lowered by turning the hand-wheel so as to overcome the friction brake. Various other arrangements of friction brakes have been devised to give a resistance proportional to the load.

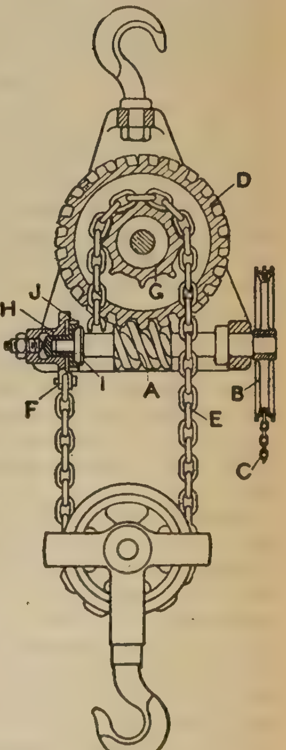

FIG. 8.—Worm-gear Pulley Block with Automatic Brake.

Blocks, for lifting very heavy weights, are sometimes provided with an electric motor for driving the worm. The worm-wheel shaft then sometimes carries a spur-pinion gearing with a spur-wheel on the lifting shaft, whereby a much greater mechanical advantage is obtained with a small loss by friction of the spur gearing.

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PULLMAN, formerly a town of Cook county, Illinois, U.S.A., and now a part of the city of Chicago. Here are the works of the Pullman Palace Car Company, steel forging plants, and other factories. The place was founded in 1880 by George Mortimer Pullman (1831–1897), the inventor of the Pullman sleeping car, and the founder (1867) of the Pullman Palace Car Company, who attempted to make it a "model town." Even the public works were the property of the Pullman Company and were managed as a business investment. Popular discontent with the conditions led to the annexation of Pullman to Chicago in 1889, but until 1910 the corporation held most of the property. In June and July 1894 a bitter railway strike developed from a controversy between employed and employers in the Pullman works. (See CHICAGO and ILLINOIS: *History*.)

PULPIT (from Lat. *pulpitum*, a staging, platform: equivalents are Fr. *chaire d'église*, Ital. *pulpito*, Ger. *Kanzel*), a raised platform with enclosed front, whence sermons, homilies, &c., were delivered. Pulpits were probably derived in their modern form from the *ambones* in the early Christian Church (see AMBO). There are many old pulpits of stone, though the majority are of wood. Those in churches are generally hexagonal or octagonal; and some stand on stone bases, and others on slender wooden stems, like columns. The designs vary accordingly to the periods in which they were erected, having panelling, tracing, cuspings, crockets, and other ornaments then in use. Some are extremely rich, and ornamented with colour and gilding. A few also have fine canopies or sounding-boards. Their usual place is in the nave, mostly on the north side, against the second pier from the chancel arch. Pulpits for addressing the people in the open air were common in the medieval period, and stood near a road or cross. Thus there was one at Spital Fields, and one at St Paul's, London. External pulpits still remain at Magdalen College, Oxford, and at Shrewsbury. Pulpits, or rather places for reading during the meals of the monks, are found in the refectories at Chester, Beaulieu, Shrewsbury, &c., in England; and at St Martin des Champs, St Germain des Prés, &c., in Paris; also in the cloisters at St Dié and St Lo. Shortly after the Reformation the canons ordered pulpits to be erected in all churches where there were none before. It is supposed that to this circumstance we owe many of the time of Elizabeth and James. Many of them are very beautifully and elaborately carved, and are evidently of Flemish workmanship. The pulpits in the Mahommedan mosques, which are known as "mimbars," are quite different in form, being usually canopied and approached by a straight flight of steps. These have a doorway at the foot, with an enriched lintel and boldly moulded head; the whole of the work to this and to the stairs, parapet and pulpit itself being of wood, richly inlaid, and often in part gorgeously painted and gilt.

PULQUE, or PULQUE FUERTE, the national beverage of the Mexican natives. It is prepared by fermenting the juice of a number of species of the agave (*agava potatorum*, *americana*, &c.). The cultivation of the agave for purposes of pulque manufacture constitutes a considerable local industry, the capital invested running into several millions sterling. The juice obtained by tapping the agave is termed *aguamiel.* A quantity of this is allowed to ferment naturally for about ten days, and the product so obtained is termed *madre pulque* (mother of pulque). A small quantity of this is added to fresh aguamiel, and thereby a rapid fermentation is induced, the pulque being ready for consumption within a day or two. It has a somewhat heavy flavour, resembling sour milk, but it is much esteemed by the natives on account of its cooling, and according to them wholesome and nutritious, properties.

PULSE. (1) (O. Fr. *pols*, Lat. *puls*, *pultis*, Gr. *πόλτος*, a porridge of beans, peas, &c.), in botany, a collective term for beans, peas, and other members of the order Leguminosae (*q.v.*), which is characterized by having a legume or pod for the fruit. (2) (M. Eng. *pous*, *pouce*, O. Fr. *pous*, mod. *pousse*, Lat. *pulsus*, *sc. venarum*, the beating of the veins, *pellere*, to drive, beat), throbbing or beating; in physiology the rhythmical beating due to the changes of blood-tension in the arteries consequent on the contractions of their elastic tissues (see VASCULAR SYSTEM).

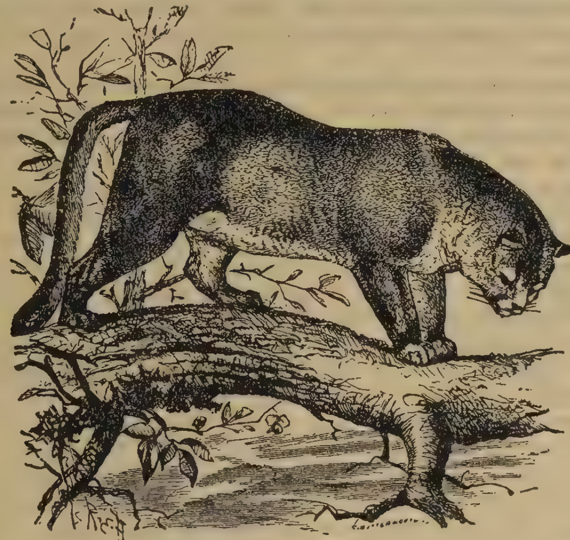
PULSZKY, FERENCZ AUREL (1814–1897), Hungarian politician and author, was born on the 17th of September 1814 at Eperjes. After studying law and philosophy at the high schools of his native town and Miskolcz, he travelled abroad. England particularly attracted him, and his fascinating book, *Aus dem Tagebach eines in Grossbritannien reisenden Ungarns* (Pesth, 1837), gained for him the membership of the Hungarian Academy. Elected to the Reichstag of 1840, he was in 1848 appointed to a financial post in the Hungarian government, and was transferred in like capacity to Vienna under Esterhazy. Suspected of intriguing with the revolutionists, Pulszky fled to Budapest to avoid arrest. Here he became an active member of the committee of national defence, and when obliged to fly the country he joined Kossuth in England and with him made a tour in the United States of America. In collaboration with his wife he wrote a narrative of this voyage, entitled *White, Red, Black* (3 vols., London, 1853). He was condemned to death (1852) *in contumaciam* by a council of war. In 1860 he went to Italy, took part in Garibaldi's expedition to Aspromonte (1862), and was interned as a prisoner of war in Naples. Amnestied by the emperor of Austria in 1866, he returned home and re-entered public life; was from 1867–1876, and again in 1884, a member of the Hungarian Diet, joining the Déak party. In addition to his political activity, he was president of the literary section of the Hungarian Academy, and director of the National Museum at Budapest, where he became distinguished for his archaeological researches. He employed his great influence to promote both art and science and Liberal views in his native country. He died on the 9th of September 1897. Among his writings are *Die Jacobiner in Ungarn* (Leipzig, 1851) and *Eletem és Korom* (Pest, 1880), and many treatises on Hungarian questions in the publications of the Academy of Pest.

Some *Reminiscences* of Kossuth and Pulszky were published by F. W. Newman in 1888.

PULTUSK, a town of Russian Poland, in the government of Warsaw, 33 m. N. of the city of Warsaw, on the right bank of the Narew. Pop. (1897), 15,878. The town was almost entirely destroyed by fire in 1875. It is now well built, and had before the fire a palace (1319) which was formerly a residence of the bishops of Plock. The industries include woollen, linen and hosiery mills, copper works and potteries. In 1703 Charles XII. of Sweden defeated and captured the greater part of a Saxon army near this town, and in the same locality the French defeated the Russians in December 1806. The town was founded as early as 956.

PUMA, a name, probably of native origin, introduced into European literature by the early Spanish writers on South America (as Garcilaso de la Vega and Hernandez) for one of the largest cats (*Felis concolor*) of the New World. It is generally called "couguar" by the French, "leon" by the Spanish Americans, and "panther" by the Anglo-American hunters of the United States (see CARNIVORA). Though often spoken of as the American lion, chiefly on account of its colour, it rather resembles the leopard of the Old World in size and habits: usually measuring from nose to root of tail about 40 in., the tail being rather more than half that length. The head is small compared with that of other cats and has no mane. The ears are large and rounded. The tail is cylindrical, with some bushy elongation of the hairs near the end, but not forming a distinct tuft. The general colour of the upper parts and sides of the adult is a tawny yellowish brown, sometimes having a grey or silvery shade, but in some cases dark or inclining to red; and upon these and other differences, which are probably constant locally, a number of sub-species have been named. The lower parts, inner surface of the limbs, throat, chin and upper lip are dirty white; the outside of the ears, particularly at their base, and a patch on each side of the muzzle black; the end of the tail dusky. The young are, when first born, spotted with dusky brown and the tail ringed. These markings generally fade, and quite disappear before the animal becomes full grown.

The puma has an exceedingly wide range of geographical distribution, extending over a hundred degrees of latitude, from Canada in the north to Patagonia in the south, and formerly was generally diffused in suitable localities from the Atlantic to the Pacific Ocean, but the advances of civilization have curtailed the extent of the districts which it inhabits. In Central America it is still common in the dense forests which clothe the mountain ranges as high as 8000 or 9000 ft. above the sea level. Though an expert climber, it is by no means confined to wooded districts, being frequently found in scrub and reeds along the banks of rivers, and even in the open pampas and prairies. Its habits much resemble those of the rest of the group to which it belongs; and, like the leopard, when it happens to come within reach of an abundant and easy prey, as the sheep or calves of an outlying farming station, it kills far more than it can eat, either for the sake of the blood only or to gratify its propensity for destruction. It rarely attacks man, and when pursued escapes if possible by ascending trees. Several instances have occurred of pumas becoming tame in captivity. Edmund Kean, the actor, had one which followed him about like a dog. When caressed pumas purr like domestic cats.



The Puma (*Felis concolor*).

PUMICE (Lat. *pumex*, *spumex*, *spuma*, froth), a very porous, froth-like, volcanic glass. It is an igneous rock which was almost completely liquid at the moment of effusion and was so rapidly cooled that there was no time for it to crystallize. When it solidified the vapours dissolved in it were suddenly released and the whole mass swelled up into a froth which immediately consolidated. Had it cooled under more pressure it would have formed a solid glass or obsidian (*q.v.*); in fact if we take fragments of obsidian and heat them in a crucible till they fuse they will suddenly change to pumice when their dissolved gases are set free. Hence it can be understood that pumice is found only in recent volcanic countries. Artificial substances resembling pumice can be produced by blowing steam through molten glass or slag, and when a mass of slag is suddenly cooled by being tipped into the sea (as is the case at the blast furnaces of Whitehaven in Cumberland) it swells up into a pumiceous form so light and full of vesicles that it will float on water. Any type of lava, if the conditions are favourable, may assume the pumiceous state; but basalts and andesites do not so often occur in this form as do trachytes and rhyolites. Pumices are most abundant and most typically developed from acid rocks; for which reason they usually accompany obsidians, in fact in Lipari and elsewhere the base of a lava flow may be black obsidian while the upper portion is a snow white pumice.

Small crystals of various minerals occur in many pumices; the commonest are felspar, augite, hornblende and zircon. If they are abundant they greatly diminish the economic value of the rock, as they are hard and wear down more slowly than the glassy material; consequently they produce scratches. The cavities of pumice are sometimes rounded, but may also be elongated or tubular owing to the flowing movement of the solidifying lava. The glass itself forms threads, fibres and thin partitions between the vesicles. Rhyolite and trachyte pumices are white, contain 60 to 75% of silica and the specific gravity of the glass is 2·3 to 2·4; andesite pumices are often yellow or brown; while pumiceous basalts, such as occur in the Sandwich Islands, are pitch black when perfectly fresh.

Good pumice is found in Iceland, Hungary, Nevada, Teneriffe, New Zealand, Pantellaria and the Lipari Islands. The last-named are the chief sources of pumice for the arts and manufactures. At Campo Bianco in Lipari there is an extinct volcanic cone with a breached crater from which a dark stream of obsidian has flowed. For industrial purposes the best varieties are obtained from Monte Pelato and Monte Chirica. The pumice is extracted by means of shafts and tunnels driven through the soft incoherent stone. It is brought out in blocks of irregular shape and size and is trimmed into slabs and graded into several qualities before it is exported to Canneto, which is the centre of the pumice trade. The workmen say that the good pumice occurs in beds or veins, which are probably lava flows and are separated by valueless rock or by obsidian. The value depends entirely on the regularity, size and shape of the steam cavities and on the absence of minute crystals. From time immemorial the extraction and sale of pumice have been one of the principal sources of wealth to the inhabitants of this island. An inferior pumice, known in Lipari as Alessandrina, is used for smoothing oilcloth. Though all the Aeolian Isles are volcanic no pumice is exported from any of the others. In Iceland, Teneriffe and Hungary pumice also occurs, but not in sufficient quantity or of such quality as to render it worth working on a large scale. It is estimated that in Lipari there are 170 pumice quarries (or mines) giving employment to 1200 persons and producing 6000 tons of pumice per annum. The price varies with the quality: from 3 lire per 100 kilogrammes for the commonest sorts to 200 or 300 lire for the best pieces, the average being about 15 lire. Much pumice is also used nowadays in the form of a fine powder, produced by crushing the rock, and forms an ingredient of metal polishes and some kinds of soap. It is often confounded with diatom earth or tripoli powder, but can easily be recognized by the aid of the microscope or by simple chemical tests.

Among the older volcanic rocks pumice occurs, but usually has its cavities filled up by deposits of secondary minerals introduced by percolating water; hence it is of no value for industrial purposes. Pumice, in minute fragments, has been shown to have an exceedingly wide distribution over the earth's surface at the present day. It occurs in all the deposits which cover the floor of the deepest portion of the oceans, and is especially abundant in the abysmal red clay. In some measure this pumice has been derived from submarine volcanic eruptions, but its presence is also accounted for by the fact that pumice will float on water for months, and is thus distributed over the sea by winds and currents. After a long time it becomes waterlogged and sinks to the bottom, where it gradually disintegrates and is incorporated in the muds and oozes which are gathering there. After the great eruption of Krakatoa in 1883 banks of pumice covered the surface of the sea for many miles and rose in some cases for four or five ft. above the water level. In addition to this much finely broken pumice was thrown into the air to a great height and was borne away by the winds, ultimately settling down in the most distant parts of the continents and oceans. (J. S. F.)

PUMP,[1] a machine which drives a liquid from one point to another, generally at different levels, the latter being usually the higher; an air-pump is an appliance for exhausting or removing the air or other gas from a vessel, whilst a compression pump compresses the air. The simplest forms of pumps employed for forcing liquids are "plunger pumps," consisting essentially of a piston moving in a cylinder, provided with inlet and outlet pipes, together with certain valves. The disposition of these valves divides this type of pump into suction pumps and force pumps.

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[1] The word appears apparently first in English in the *Promptorium Parvulorum*, c. 1440, of a ship's pump (*hauritorium*), in Dutch (*pompe*), a little later, dialectically, of a conduit pipe for water, but in the sense of a means of raising water it does not occur in Dutch or Ger. before the 16th century. The Fr. *pompe* is derived from Teut. The Ger. variant of *Pumpe* is *Plumpe*, which is generally taken as being an echoic word, imitating the sound of the plunger, but the primary notion seems to be that of a pipe or tube. Cf. Ital. term, *tromba*, *i.e.* trumpet, pipe (see the note on the word in the *New English Dictionary*).

Fig. 1 shows the arrangement in a suction pump. A is the cylinder within which the piston B is moved up and down by the rod C. D is the inlet pipe (the lower extremity of which is placed beneath the surface of the liquid to be removed), and G is the outlet pipe. E is a valve in the inlet pipe opening into the cylinder; and the piston is perforated by one or more holes, each fitted with valves opening outwards on its upper surface. On raising the piston, the valve F remains closed and a vacuum tends to be created in the cylinder, but the pressure of the atmosphere forces the liquid up the tube D and it raises the valve E and passes into the cylinder. On reversing the motion the valve E closes and the liquid is forced through the valve F to the upper part of the cylinder. On again raising the piston, more liquid enters the lower part of the cylinder, whilst the previously raised liquid is ejected from the delivery pipe. Obviously the action is intermittent. Moreover, the height of the lift is conditioned by the atmospheric pressure, for this is the driving force; and since this equals 34 ft. of water, the lift cannot be theoretically more than this distance when water is being pumped. In practice it may be considerably less, owing to leakage at the valves and between the piston and cylinder.

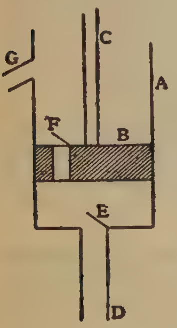

FIG. 1.

In the force pump (fig. 2) there is no such limitation to the lift. In this case the piston is solid, and the outlet pipe, G which is placed at the bottom of the cylinder, has a valve F opening outwards, the inlet pipe and valve are the same as before. On raising the piston the liquid rises in the cylinder, the valve E opening and F remaining shut. On reversing the motion the valve E closes and the liquid is driven past the valve F. On again raising the piston the valve E opens admitting more liquid whilst F remains closed. It is seen that the action is intermittent, liquid only being discharged during a down stroke, but since the driving force is that which is supplied to the piston rod, the lift is only conditioned by the power available and by the strength of the pump. A continuous supply can be obtained by leading the delivery pipe into the base of an air chamber H, which is fitted with a discharge pipe J of such a diameter that the liquid cannot escape from it as fast as it is pumped in during a down stroke. The air inside is compressed in consequence and during an upstroke of the piston this air tends to regain its original volume and so expels the water, thus bringing about a continuous supply. For a description of modern pumps, see HYDRAULICS.

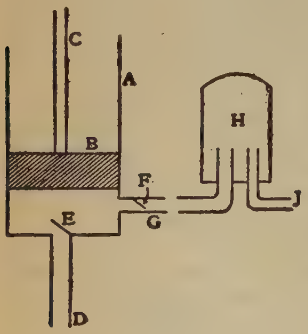

FIG. 2.

Air-pumps.—Pumps for evacuating vessels may be divided into three classes: (1) mechanical, (2) mercurial, and (3) jet pumps; the last named are treated in HYDRAULICS.

Mechanical.

The invention of the mechanical air-pump is generally attributed to Otto von Guericke, consul of Magdeburg, who exhibited his instrument in 1654; it was first described in 1657 by Gaspar Schott, professor of mathematics at Württemberg, in his *Mechanica hydraulico-pneumatica*, and afterwards (in 1672) by Guericke in his *Experimenta nova Magdeburgica de vacus spatia.* It consisted of a spherical glass vessel opening below by means of a stop-cock and narrow nozzle into the cylinder of an "exhausting syringe," which inclined upwards from the extremity of the nozzle. The cylinder, in which a well-fitting piston worked, was provided at its lower end with two valves. One of these opened from the nozzle into the cylinder, the other from the cylinder into the outside air. During the down-stroke of the piston the former was pressed home, so that no air entered the nozzle and vessel, while the latter was forced open by the air which so escaped from the cylinder. During the return-stroke the latter was kept closed in virtue of the partial vacuum formed within the cylinder, while at the same time the former was forced open by the pressure of the denser air in the vessel and nozzle. Thus, at every complete stroke of the piston, the air in the vessel or receiver was diminished by that fraction of itself which is expressed by the ratio of the volume of the available cylindrical space above the outward opening valve to the whole volume of receiver, nozzle and cylinder. The action is essentially that of the common suction pump. The construction was subsequently improved by many experimenters, notably by Boyle, Hawksbee, Smeaton and others; and more recently two pump barrels were employed, so obtaining the same degree of exhaustion much more rapidly. This type of pump is, however, not very efficient, for there is not only leakage about the valves and between the piston and cylinder, but at a certain degree of exhaust the air within the vessel is insufficient to raise the inlet valve; this last defect has been met in some measure by using an extension of the piston to open and close the valve.

The so-called oil air-pumps are much more efficient; the valve difficulty is avoided, and the risk of leakage minimized; whilst in addition there is no air clearance between the piston and the base of the cylinder as in the older mechanical forms. The Fleuss pump may be taken as an example. The piston, provided with a valve opening upwards, is packed in the cylinder by a leather cup which is securely pressed against the sides of the cylinder by the atmospheric pressure. The piston rod passes through a valve in the upper part of the cylinder which is held to its seat by a spring. The inlet pipe enters an elliptical vessel which communicates with the cylinder a little way up from its base, whilst at the base there is a relief tube leading into the elliptical vessel already mentioned. Oil is placed both above the upper valve seating, and also in the cylinder up to the height of the lower edge of the inlet pipe. The action is as follows: On raising the piston it cuts off communication with the inlet pipe and then compresses the air above, forcing it through the upper valve and oil into the atmosphere. Some of the oil is also driven out, but as the valve does not close until the piston has descended a short distance, a certain amount of oil returns. On lowering the piston its valve opens and air passes in from the vessel to be exhausted; this is further rarefied on the next stroke and so on. The Max Kohl pumps are based on the same principle, but are constructed with more elaborate detail, leading to a greater efficiency, an exhaust of 0·0008 mm. being claimed as readily obtainable.

Mercurial.

The invention of the barometer and Torricelli's explanation of the vacuity above the mercury column placed before the members of the Florentine academy a ready method of obtaining vacua; for to exhaust a vessel it was only necessary to join, by means of a tube provided with stop-cocks, the vessel to a barometer tube, fill the compound vessel with mercury and then to invert it in a basin containing this liquid, whereupon the mercury column fell, leaving a Torricellian vacuum in the vessel, which could be removed after shutting off the stop-cocks. This was the only method known until the invention of the mechanical air-pumps; it was subsequently employed by Count Rumford, and as late as 1845, Edward A. King patented filament electric lamps exhausted by the same methods. Although modern mercurial pumps have assumed a multiplicity of forms, their actions can be reduced to two principles, one statical, the other hydrodynamical—at the same time instruments have been devised utilizing both these principles.

Statical Pumps.—The earliest mercurial pump, devised by Swedenborg and described in his *Miscellanea observata circa res naturales* (1722), was statical in action, consisting essentially in replacing the solid piston of the mechanical pump by a column of mercury, which by being alternately raised and lowered gradually exhausted a vessel. A more complicated pump, but of much the same principle, was devised in 1784 by Joseph Baader, to be improved by C. F. Hindenburg in 1787, by A. N. Edelcrantz in 1804 and by J. H. Patten in 1824; whilst in 1881 Rankine Kennedy resuscitated the idea for the purpose of exhausting filament electric lamps. The pump devised by

H. Geissler of Bonn, and first described in 1858 by W. H. Theo. Meyer in a pamphlet *Ueber das geschichtete electrische Licht* surpassed all previous forms in both simplicity and efficiency.

The general scheme of Geisler's pump is shown in fig. 3. A and B are pear-shaped glass vessels connected by a long narrow india-rubber tube, which must be sufficiently strong in the body (or strengthened by a linen coating) to stand an outward pressure of 1 to $1\frac{1}{2}$ atmospheres. A terminates below in a narrow vertical tube *c* which is a few inches longer than the height of the barometer, and to the lower end of this tube the india-rubber tube is attached which connects A with B. At the upper end of A is a glass two-way stop-cock, by turning which the vessel A can either be made to communicate with the vessel to be exhausted, or with the atmosphere, or can be shut off from both when the cock holds an intermediate position. The apparatus, after having been carefully cleaned and dried, is charged with pure and dry mercury which must next be worked backwards and forwards between A and B to remove all the air-bells. The air is then driven out of A by lifting B to a sufficient level, turning the cock so as to communicate with the atmosphere and letting the mercury flow into A until it gets to the other side of the stop-cock, which is then placed in the intermediate position. Supposing the vessel to be exhausted to have already been securely connected to the pump, we now lower the reservoir B so as to reduce the pressure in A sufficiently below the tension in the gas to be sucked in, and, by turning the cock so as to connect A with the vessels to be exhausted, cause the gas to expand into and almost fill A. The cock is now shut against both communications, the reservoir lifted, the gas contents of A discharged and so on, until, when after an exhaustion mercury is let into A, the metal strikes against the top without interposition of a gas-bell. In a well-made apparatus the pressure in the exhausted vessel is now reduced to $\frac{1}{10}$ or $\frac{1}{20}$ of a millimetre, or even less. An absolute vacuum cannot be produced on account of the unavoidable air-film between the mercury and the walls of the apparatus.

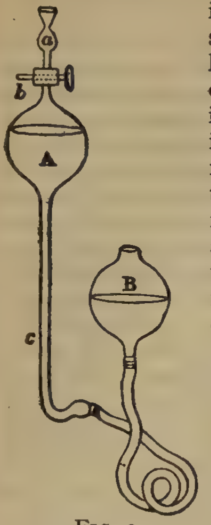

Fig. 3.
Geisler's Air-Pump.

As it takes a height of about 30 in. of mercury to balance the pressure of the atmosphere, a Geisler pump necessarily is a somewhat long-legged and unwieldy instrument; in addition, the long tube is liable to breakage. It can be considerably shortened, the two vessels A and B brought more closely together, and the somewhat objectionable india-rubber tube be dispensed with, if we connect the air-space in B with an ordinary air pump, and by means of it do the greater part of the sucking and the whole of the lifting work. An instrument thus modified was constructed by Poggendorff in 1865.

Even a Geisler's stop-cock requires to be lubricated to be absolutely gas-tight, and this occasionally proves a nuisance. Hence a number of attempts have been made to do without stop-cocks altogether. In the pump generally attributed to Töpler, but which was previously devised by J. Mile of Warsaw in 1828, who termed it a "hydrostatic air-pump without cylinders, taps, lids or stoppers," this is attained by using, both for the inlet and the outlet, vertical capillary glass tubes, soldered, the former to somewhere near the bottom, the latter to the top of the vessel. These tubes, being more than 30 in. high, obviously act as efficient mercury-traps; but the already considerable height of the pump is thus multiplied by two. This consideration led Alexander Mitscherlich, F. Neisen and others to introduce glass valves in lieu of stop-cocks. A pump similar to Töpler's construction was devised by Mendeléeff, and the original device has been much improved by Wiedemann, Bessel-Hagen and others.

The Dynamic Pump.

The best-known pump of this type was invented in 1865 by H. Sprengel, although the idea had been previously conceived by Magnus and Buff. The instrument, in its original (simplest) form (fig. 4), consists of a vertical capillary glass tube *a* of about 1 mm. bore, provided with a lateral branch *b* near its upper end, which latter, by an india-rubber joint governable by a screw-clamp, communicates with a funnel. The lower end is bent into the shape of a hook, and dips into a pneumatic trough. The vessel to be exhausted is attached to *b*, and, in order to extract its gas contents, a properly regulated stream of mercury is allowed to fall through the vertical tube. Every drop of mercury, as it enters from the funnel, entirely closes the narrow tube like a piston, and in going past the place where the side tube enters entraps a portion of air and carries it down to the trough, where it can be collected. If the vertical tube, measuring from the point where the branch comes in, is a few inches greater than the height of the barometer, and the glass and mercury are perfectly clean, the apparatus slowly but surely produces an almost absolute vacuum.

The great advantages of Sprengel's pump lie in the simplicity of its construction and in the readiness with which it adapts itself to the collecting of the gas. It did excellent service in the hands of Graham for the extraction of gases occluded in metals. Many improvements upon the original construction have been proposed.

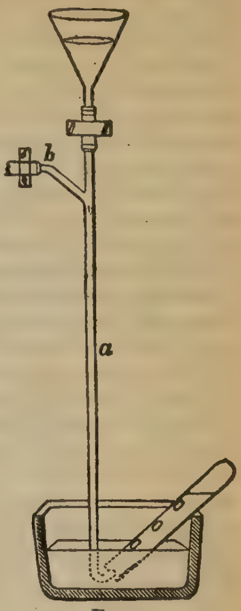

Fig. 4.
Sprengel's Air-Pump.

Many other devices have been introduced for facilitating the production of vacua. For example Raps in 1893 described an automatic arrangement to be used in connexion with a Töpler pump; whilst in 1893 Schulze-Berge devised a rotary form. For the description of these forms see Winkelmann, *Handbuch der Physik* (1906), i. 1316. The history of mercurial pumps is treated by S. P. Thompson, *The Development of the Mercurial Air Pump* (1888). For the production of high vacua, see Vacuum Tube; Liquid Gases.

PUMPKIN, the fruit of the gourd *Cucurbita Pepo*, well-known in English cottage gardens, and largely cultivated in continental Europe and North America. The pumpkin varies much in form, being sometimes nearly globular, but more generally oblong or ovoid in shape; the rind is smooth and very variable in colour. It is a useful plant to the American backwoods farmer, yielding, both in the ripe and unripe condition, a valuable fodder for his cattle and pigs, being frequently planted at intervals among the maize that constitutes his chief crop. The larger kinds acquire a weight of 40 to 80 ℔ but smaller varieties are in more esteem for garden culture. When ripe, the pumpkin is boiled or baked, or made into various kinds of pie, alone or mixed with other fruit; while small and green it may be eaten like the vegetable marrow. The name squash is applied in America to this and other species of the genus *Cucurbita*. The name is adapted from an American Indian word (see L. H. Bailey, *Cyclopaedia of American Horticulture*, where is a fuller account of the squashes). Summer squashes are mostly varieties of *C. Pepo*; winter squashes are either *C. maxima* or *C. moschata*, chiefly the former. The varieties of pumpkins and squashes are numerous and of great variety in size and shape; it is difficult to keep them pure if various kinds are grown together, but the true squashes (*C. maxima*) do not hybridize with the true pumpkin species. If carefully handled to avoid cracking of the skin, and kept dry and fairly warm, winter squashes may be kept for months.

PUN, a play upon words, particularly the use of a word in two or more different applications or of two or more words similar in sound but with different meanings by which a humorous or ludicrous effect is produced; thus Charles I.'s Court Jester is said to have made the punning grace "great praise be to God and little Laud to the devil" for which the archbishop dismissed him from his service. Another famous pun was that upon *The Beggar's Opera*, which "made Gay rich and Rich gay." Thomas Hood was the king of pun-makers. "They went and told the sexton, and the sexton toll'd the bell" ("Sally Brown") is one example among the innumerable puns with which his poems are filled. The derivation of the word is not known. It first appears in the second half of the 17th century. Skeat

(*Etym. Dict.*, 1898) identifies it with an obsolete and dialectal variant of "pound," to beat in the sense of "to pound words, to beat them into new senses, to hammer at forced similes." The *New English Dictionary* considers it was probably one of the shortened words, like "mob," "cit," &c., which were common in slang after the Restoration. In R. L'Estrange, *Counsellor Manners's Last Legacy* (1676), "pun" is found with punnet, pundigrion and quibble, "of which fifteen will not make up one single jest." Possibly these may be all referred to "punctilio" (It. *puntiglio*, dim. of *punto*, point, Lat. *punctum*), a small, fine point, a cavil or quibble. No historical connexion, however, has been found between the words.

PUNCH, the abbreviated form of Punchinello (Ital. *Policinella*, *Pulcinella*), the most popular of the puppets or marionettes (*q.v.*), and the chief figure in the "Punch and Judy" show. It is of Italian origin, though its history is by no means free from obscurity. The earlier etymologists sought to trace the name to various mythical individuals, by whom, it was alleged, the type was first furnished. F. Galiani adopts the theory which derives it from the name of Puccio d'Aniello, a vintager of Acerra near Naples, who, having by his wit and grotesque appearance vanquished some strolling comedians in their own sphere, was induced to join the troop, and whose place, by reason of his popularity, was supplied after his death by a masked actor who imitated his dress and manner. The claims of other individuals—Paolo Cinella, Polliceno, and Pulcinella, a Neapolitan dealer in fowls—have also found supporters, and the derivation of the name and character from some old mystery representing Pontius (O. Eng. *Pownce*; Fr. *Ponce*) Pilate and Judas, or the Jews, was formerly popular. It has even been suggested that the title is a modification of πολὺ κινέω (I move much) as expressive of the restlessness which is characteristic of the puppet; and the assumption that the character was invariably of diminutive size has given rise to its reference to the word *pollice*, the thumb (cf. *Däumling*, Tom Thumb). The most plausible theory, however, regards the name in its Italian form as a diminutive of *pulcino*, fem. *pulcina*, a chicken. It is sometimes stated that, in consequence of the habit of using the word "chicken" as a term of endearment, it came to mean "a little child," and hence "a puppet" (W. Skeat). But this again involves the assumption that the application of the name to the character was in some measure determined by the size of the puppets, whereas it would appear to have been transferred from the comic stage to the puppet show and the Pulcinella of the stage was not necessarily a dwarf. The choice, therefore, seems to lie between the theory of Quadrio, that it was applied on account of the resemblance of the hooked nose to a beak, and that of J. Baretti, which ascribes its employment to the nasal squeak and timorous impotence of the original character. With respect to the development of the modern type, it has been assumed that the whole family of Italian *maschere* (Arlecchino, Brighella, and the like) are modified survivals of the principal Oscan characters of the *Atellanae*, and that Punchinello is the representative of Maccus, the fool or clown. In proof of this it is urged that Acerra, the supposed residence of Puccio d'Aniello and the traditional source of the character, is in the neighbourhood of Aversa, the old Atella; and reference is also made to a bronze statue of Maccus, discovered at Rome in 1727, an engraving of which has been preserved in Ficoroni's *Le Maschere sceniche e le figure comiche d'antichi Romani*. But the resemblance of the statue to the puppet is scarcely to be termed a striking one, and the large nose and deformed figure are somewhat hazardous ground on which to base a theory—especially in view of the fact that such points of likeness as there are in it to the northern Punch are not to be found in the Neapolitan Pulcinella. It is possible that some relic of the old *Ludi Osci*, transmitted through the Vice of the mystery plays, is to be found in the character; but any direct descent from the Maccus of the Atellanae seems precluded by the fact that, while there are traces of the gradual development of the northern Punch from the Neapolitan Pulcinella, the latter with its grey hat, white smock and trousers, masked face, and undistorted body is widely different from its alleged prototype. It seems necessary, therefore, to regard the Pulcinella as in large part a distinct creation of comparatively modern date. Prior to the 17th century there is no indication in the Italian burlesque poets of the existence of Pulcinella, though L. A. Riccoboni places the creation of the part before 1600.

Andrea Perrucci (1699) and Gimma assert with some show of authority that Silvio Fiorillo, a comedian named after his principal part Captain Matamoros (the Italian *Miles Gloriosus*), invented the Neapolitan Pulcinella. It was afterwards improved by Andrea Calcese, surnamed Ciuccio, who died of the plague in 1656, and who, according to Gimma, imitated in the character the peasants of Acerra. This would place the origin of the Italian Pulcinella somewhere about the commencement of the 17th century, the original character appearing to have been that of a country clown, hook-nosed, shrill-voiced, cowardly, boastful and often stupid, yet given at times to knavish tricks and shrewd sayings. In thorough accordance with this date, we find that the earliest known appearance of Polichinelle in France is at the beginning of the reign of Louis XIV., in the show of the puppet-playing dentist Jean Brioché. It might have been expected that the shrewder and wittier side of the character would most commend itself to the French mind, and there is good reason to believe that the Polichinelle of Brioché was neither a blunderer nor a fool. The puppet was almost immediately seized upon as the medium of political satire of the kind exemplified in the *Letter of Polichinelle to Cardinal Mazarin* (1649), and it is described in the *Combat de Cyrano de Bergerac*, as a "petit Ésope de bois, remuant, tournant, virant, dansant, riant, parlant, petant" and as "cet hétéroclite marmouset, disons mieux, ce drolifique bossu." In this there appears signs of transformation, whether the importation to France took place before or after the alleged improvements of Calcese. The hunchback had been long associated in France with wit and laughter, and there are, therefore, some grounds for C. Magnin's theory that the northern Punch is of French origin, a Gallic type under an Italian name, though there does not seem to be sufficient reason for adopting his suggestion that Polichinelle was a burlesque portrait of Béarnais. The date of its introduction into England has been disputed, J. Payne Collier being of opinion that Punch and King William came together, a second theory suggesting an earlier origin with the Huguenot refugees. In view of its popularity in France prior to the Restoration, however, it would be strange if its migration had been so long delayed, and it is more than probable that it crossed the channel in the wake of the Royalists. Apart from the general references by S. Pepys (1662) and by J. Evelyn (1667) to an Italian puppet-show at Covent Garden, the former makes mention (1669) of some poor people who called their fat child Punch, "that word being become a word of common use for all that is thick and short." An allusion to "Punchinellos" is also to be found in Butler's satire on English imitation of the French, and Aubrey speaks of "a Punchinello holding a dial" as one of the ornaments of Sir Samuel Lely's house at Whitehall. But, though the puppet did not travel in the train of William of Orange, allusions to it became far more frequent after the Revolution of 1688, and the skill of the Dutch in their treatment of puppet mechanism may have enhanced its attractiveness. In 1703 it was introduced at Bartholomew Fair into a puppet play of the creation of the world; in 1709 (*Tatler*, No. 16) it was to be found in a representation of the Deluge, though in a different part from that of the Momus Polichinelle of Alexis Piron's *Arlequin-Deucalion* (1722); and in 1710 (*Spectator*, No. 14) it is mentioned as a leading figure in Powell's puppet-show at Covent Garden. The alleged satire on Robert Walpole, entitled *A Second Tale of a Tub, or the History of Robert Powel, the Puppet-Showman* (1715), furnishes some details of Punch performances, and has an interesting frontispiece representing Powell with Punch and his wife. The Judy (or Joan, as she appears to have been sometimes called) is not of a specially grotesque order, but the Punch is easily recognizable in all but the features, which are of the normal puppet type.

Other allusions are to be found in Gay's *Shepherd's Week—Saturday* (1714) and Swift's *Dialogue between Mad Mullinix and Timothy* (1728). The older Punchinello was far less restricted in his actions and circumstances than his modern successor. He fought with allegorical figures representing want and weariness as well as with his wife and with the police, was on intimate terms with the patriarchs and the seven champions of Christendom, sat on the lap of the queen of Sheba, had kings and dukes for his companions, and cheated the Inquisition as well as the common hangman. Powell seems to have introduced a trained pig which danced a minuet with Punch, and the French (among whom Punch is now usually styled Guignol, originally a puppet hailing from Lyons) having occasionally employed a cat in the place of the dog Toby, whose origin is somewhat uncertain. A typical version of the modern play, with illustrations, was published by Payne Collier and Cruikshank in 1828 (3rd ed., 1844). (R. M. W.)

PUNCH. (1) To pierce, perforate, make a hole or stamp a mark, &c., with a tool known as a "puncheon" or "punch." The verb is derived from the substantive; the original is Lat. *punctio*, a pricking, from *pungere*, to prick. This gave Ital. *punzone*, O. Fr. *poinson*, mod. *poinçon*. Both these French forms mean also a cask, from which the English "puncheon," a liquid measure varying in capacity from 72 to 120 gallons is taken. This is probably the same word as that for the tool, and refers to a mark or sign stamped or "punched" on the cask. The origin may therefore be paralleled by the explanation of "hogshead" as referring to a mark of an "oxhead" branded on the measure. (2) To beat or hit, especially in such colloquialisms, as "to punch one's head." This is not the same word as (1) but is a shortened form of "punish," from Lat. *punire*, of which the ultimate origin is *poena*, penalty, from which is derived "pain." (3) The name of a drink, composed of spirits, water, sliced lemons or limes, or lemon-juice, together with sugar and spice, and served hot. According to the spirit with which it is made, it is known as brandy, whisky, rum punch, &c. Milk-punch is made of milk and spirit, bottled and served cold. The word is the English representative of the Hindostani *panch*, five (from the number of ingredients), and was introduced from the East.

PUNCTUATION (Lat. *punctum*, a point), the theory or art of "pointing" a literary composition so as to divide it properly into sentences and portions of sentences, which the "points" are used to mark at their close, with a view to precision in the meaning of a continuous set of written words, by the indication of what would be pauses or changes of expression if they were spoken. The uses of the chief "points" are explained as follows in the "Rules for Compositors" at the Oxford University Press, compiled by Mr Horace Hart, the university printer:—

The "full stop" or "period" (.) marks the end of a sentence. The "colon" (:)—Greek κῶλον, a limb—is at the transition point of the sentence. The "semicolon" (;) separates different statements. The "comma" (,)—Gr. κόμμα, from κόπτειν, *i.e.* a piece cut off—separates clauses, phrases and particles. (The terms "period"—Greek περίοδος—"colon," "comma," now identified in punctuation with the signs here given, were borrowed from the Greek grammarians, who originally described either the whole sentence or a longer or shorter part of it respectively in this way.) Among other signs, the "dash" (—) marks abruptness or irregularity. The "exclamation" (!) marks surprise. The "interrogation" or "query" (?) asks a question. The apostrophe (') marks elisions or the possessive case. "Quotes," quotation-marks or "inverted commas" (" ") define quoted words. Irregularities or interpolations in a sentence are marked by various forms of bracket ( ) or parenthesis. Literary usage and the practice of printing-houses vary, however, so much that it is impossible to define exactly and shortly the part played by some of these points in a reasonable system of punctuation. The Oxford Rules already mentioned, which deal also with spelling and other pitfalls in literary composition and printing, carry the authority of such experts as Dr J. A. H. Murray and Dr Henry Bradley; and the art of punctuation may be studied also in such works as H. Beadnell's *Spelling and Punctuation*, P. Allardyce's *Stops: or how to punctuate*, T. L. de Vinne's *Correct Composition*, and T. Lefevre's *Guide pratique du compositeur*. The acceptance of a conventional system of modern punctuation is mainly due to the invention of printing, and to the ingenuity and care of individual typographers. In the earlier forms of writing the letters ran on continuously in lines; it was only by degrees that actual words were divided from one another by spacing within the line; then later came the distribution of words into sentences by means of points, and the introduction by Aldus Manutius in the 16th century of a regular system for these. The chief signs were inherited by the printers from the dots of the Greek grammarians, but often with altered meanings; thus the Greek interrogation mark (;) becomes the modern semicolon. (See PALAEOGRAPHY and TYPOGRAPHY.)

PUNDIT (Hindī *pandit*; Skr. *pandita*), a learned man, a teacher, particularly one skilled in Sanskrit and Hindu law, religion and philosophy. Before the institution of the High Courts in 1862, the Supreme Court of India had a law officer styled the Pundit of the Supreme Court, who advised the English judges on points of Hindu law. The term is frequently applied, somewhat derisively, or humorously, to learned persons, to those who claim by long official or other experience to lay down the law or dictate principles of conduct.

PUNIC WARS, a name specially appropriated to the wars between Rome and Carthage in the 3rd and 2nd centuries B.C. The origin of these conflicts is to be sought in the position which Rome acquired about 275 B.C. as suzerain and protector of all Italy. Her new obligation to safeguard the peninsula against foreign interference made it necessary that she should not allow the neighbouring island of Sicily to fall into the hands of a strong and expansive power. Carthage, on the other hand, had long been anxious to conquer Sicily and so to complete the chain of island posts by which she controlled the western Mediterranean.

First Punic War (264–241 B.C.[1]).—The proximate cause of the first outbreak was a crisis in the city of Messana, commanding the straits between Italy and Sicily. A band of Campanian mercenaries, which had forcibly esablished itself within the town and was being hard pressed in 264 by Hiero II. of Syracuse, applied for help both to Rome and Carthage and thus brought a force from either power upon the scene. The Carthaginians, arriving first, occupied Messana and effected a reconciliation with Hiero. The Roman commander nevertheless persisted in throwing troops into the city, and by seizing the person of the Carthaginian admiral during a parley induced him to withdraw his garrison. The Romans thus won an important strategic post, but their aggression was met by a declaration of war from Carthage and Syracuse.

Operations began with a joint attack upon Messana, which the Romans easily repelled. In 263 they advanced with a considerable force into Hiero's territory and induced him to seek peace and alliance with them. Having thus secured their foothold on the island they set themselves to wrest it completely from Carthage. In 262 they besieged and captured the enemy's base at Agrigentum, and proved that Punic mercenary troops could not stand before the infantry of the legions. But they made little impression upon the Carthaginian fortresses in the west of the island and upon the towns of the interior which mostly sided against them. Thus in the following campaigns their army was practically brought to a standstill.

In 260 the war entered upon a new phase. Convinced that they could gain no serious advantage so long as the Carthaginians controlled the sea and communicated freely with their island possessions, the Romans built their first large fleet of standard battleships. At Mylae, off the north Sicilian coast, their admiral C. Duilius defeated a Carthaginian squadron of superior manœuvring capacity by a novel application of grappling and boarding tactics. This victory left Rome free to land a force on Corsica and expel the Carthaginians (259), but did not suffice to loosen their grasp on Sicily.

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[1] The chronology here given is the traditional one, but recent researches tend to show that many events have been antedated by one year.

After two more years of desultory warfare the Romans decided to carry the war into the enemy's home territory. A large armament sailed out in 256, repelled a vigorous attack by the entire Carthaginian fleet off Cape Ecnomus (near Agrigentum) and established a fortified camp on African soil at Clypea. The Carthaginians, whose citizen levy was utterly disorganized, could neither keep the field against the invaders nor prevent their subjects from revolting. A single campaign compelled them to sue for peace, but the terms which the Roman commander Atilius Regulus offered were intolerably harsh. Accordingly they equipped a new army in which, by the advice of a Greek captain of mercenaries named Xanthippus, cavalry and elephants formed the strongest arm. In 255, under Xanthippus's command, they offered battle to Regulus, who had taken up position with an inadequate force near Tunes, outmanœuvred him and destroyed the bulk of his army. A second Roman armament, which subsequently reached Africa after defeating the full Carthaginian fleet off Cape Hermaeum, did not venture to reopen the campaign, but withdrew all the remaining troops.

The Romans now directed their efforts once more against Sicily. In 254 they carried the important fortress of Panormus (Palermo) by an attack from the sea; but when Carthage threw reinforcements into the island the war again came to a standstill. In 251 at last the Roman general L. Metellus brought about a pitched battle near Panormus in which the enemy's force was effectively crippled. This victory was followed by an investment of the chief Punic base at Lilybaeum by land and sea. The besiegers met with a gallant resistance, and in 249 were compelled to withdraw by the loss of their fleet in a surprise attack upon the neighbouring harbour of Drepanum (Trapani), in which the admiral Claudius Pulcher was repulsed with a loss of 93 ships. Meanwhile other losses in storms on the high seas so reduced the Roman fleet that the attack upon Sicily had to be suspended. At the same time the Carthaginians, who felt no less severely the financial strain of the prolonged struggle and had a war in Africa on their hands, reduced their armaments and made no attempt to deliver a counter-attack. The only noteworthy feature of the ensuing campaigns is the skilful guerilla war waged by a new Carthaginian commander, Hamilcar Barca, from his strong positions on Mt Ercte (247–244) and Mt Eryx (244–242) in Western Sicily, by which he effectually screened Lilybaeum from the Roman land army.

In 242 Rome resumed operations on sea. By a magnificent effort on the part of private citizens a fleet of 200 warships was equipped and sent out to renew the blockade of Lilybaeum. The Carthaginians hastily collected a relief force, but in a battle fought off the Aegates or Aegusae islands (west of Drepana) their fleet was caught at a disadvantage and mostly sunk or captured (March 10, 241). This victory, by giving the Romans undisputed command of the sea, rendered certain the ultimate fall of the Punic strongholds in Sicily. The Carthaginians accordingly opened negotiations and consented to a peace by which they ceded Sicily and the Lipari Islands to Rome and paid an indemnity of 3200 talents (about £800,000).

The Interval between the First and Second Wars (241–218 B.C.). —The loss of naval supremacy not only deprived Carthage of her predominance in the western Mediterranean, but exposed her oversea empire to disintegration under renewed attacks by Rome. The temper of the Roman people was soon made manifest during a conflict which broke out between the Carthaginians and their discontented mercenaries. Italian traders were allowed to traffic in munitions of war with the mutineers, and a gross breach of the treaty was perpetrated when a Roman force was sent to occupy Sardinia, whose insurgent garrison had offered to surrender the island (239). To the remonstrances of Carthage the Romans replied with a direct declaration of war, and only withheld their attack upon the formal cession of Sardinia and Corsica and the payment of a further indemnity.

From this episode it became clear that Rome intended to use her victory to the utmost. To avoid complete humiliation Carthage had no resource but to humiliate her adversary. The recent complications of foreign and internal strife had indeed so weakened the Punic power that the prospect of renewing the war under favourable circumstances seemed remote enough. But the scheme of preparing for a fresh conflict found a worthy champion in Hamilcar Barca, who sought to compensate for the loss of Sicily by acquiring a dominion in Spain where Carthage might gain new wealth and form a fresh base of operations against Rome. Invested with an unrestricted foreign command, he spent the rest of his life in founding a Spanish empire (236–228). His work was continued by his son-in-law Hasdrubal and his son Hannibal, who was placed at the head of the army in 220. These conquests aroused the suspicions of Rome, which in a treaty with Hasdrubal confined the Carthaginians to the south of the Ebro, and also guaranteed the independence of Saguntum, a town on the east coast which pretended to a Greek origin. In 219 Hannibal laid siege to Saguntum and carried the town in spite of a stubborn defence. It has always been a debateable point whether his attack contravened the new treaty. The Romans certainly took this view and sent to Carthage to demand Hannibal's surrender. But his defiant policy was too popular to be disavowed; the Carthaginian council upheld Hannibal's action, and drew upon itself an immediate declaration of war.

Second Punic War (218–201 B.C.): *a. The "Hannibalic" War.*— It seemed as though the superiority of the Romans at sea must enable them to choose the field of battle. They decided to embark one army for Spain and another for Sicily and Africa. But before their preparations were complete Hannibal began that series of operations by which he dictated the course of the war for the greater part of its duration. Realizing that so long as Rome commanded the resources of an undivided Italian confederacy no foreign attack could beat her down beyond recovery, he conceived the plan of cutting off her supply of strength at the source by carrying the war into Italy and causing a disruption of the League. His chances of ever reaching Italy seemed small, for the sea was guarded by the Roman fleets and the land route was long and arduous. But the very boldness of his enterprise contributed to its success; after a six months' march through Spain and Gaul and over the Alps, which the Romans were nowhere in time to oppose, Hannibal arrived in the plain of the Po with 20,000 foot and 6000 horse, the pick of his African and Spanish levies (autumn 218: for details see HANNIBAL).

His further advance was here disputed by some Roman troops which had been recalled from the Spanish expedition. But the superiority of the Carthaginian cavalry and the spread of insurrection among the Gaulish inhabitants forced the defenders to fall back upon the Apennines. At the end of the year the Roman army was reinforced by the division from Sicily and led out to battle on the banks of the Trebia. Hannibal, by superior tactics, repelled the assailants with heavy loss, and thus made his position in north Italy secure.

In 217 the campaign opened in Etruria, into which the invading army, largely reinforced by Gauls, penetrated by an unguarded pass. A rash pursuit by the Roman field force led to its being entrapped on the shore of Lake Trasimene and destroyed with a loss of 40,000 men. This catastrophe left Rome completely uncovered; but Hannibal, having resolved not to attack the capital before he could collect a more overwhelming force, directed his march towards the south of Italy, where he hoped to stir up the peoples who had formerly been Rome's most stubborn enemies. The natives, however, were everywhere slow to join the Carthaginians, and a new Roman army under the dictator Q. Fabius Maximus ("Cunctator"), which, without ever daring to close with Hannibal, persistently dogged his steps on his forays through Apulia and Campania, prevented his acquiring a permanent base of operations.

The eventful campaign of 216 was begun by a new aggressive move on the part of Rome. An exceptionally strong field army, estimated at 85,000 men, was sent forth in order to crush the Carthaginians in open battle. On a level plain near Cannae in

Apulia, which Hannibal had chosen for his battle-ground, the Roman legions delivered their attack. Hannibal deliberately allowed his centre to be driven in by their superior numbers, while Hasdrubal's cavalry wheeled round so as to take the enemy in flank and rear. The Romans, surrounded on all sides and so cramped that their superior numbers aggravated their plight, were practically annihilated, and the loss of citizens was perhaps greater than in any other defeat that befel the Republic. The moral effect of the battle was no less momentous. The south Italian nations at last found courage to secede from Rome, the leaders of the movement being the people of Capua, the second greatest town of Italy. Reinforcements were sent from Carthage, and several neutral powers prepared to throw their weight into the scale on Hannibal's behalf. At first sight it seems strange that the battle of Cannae did not decide the war. But the resources of Rome, though terribly reduced in respect both of men and of money, were not yet exhausted. In north and central Italy the insurrection spread but little, and could be sufficiently guarded against with small detachments. In the south the Greek towns of the coast remained loyal, and the numerous Latin colonies continued to render important service by interrupting free communication between the rebels and detaining part of their forces. In Rome itself the quarrels between the nobles and commons, which had previously unsettled her policy, gave way to a unanimity unparalleled in the annals of the Republic. The guidance of operations was henceforth left to the senate, which by maintaining a firm and persistent policy until the conflict was brought to a successful end earned its greatest title to fame.

The subsequent campaigns of the Italian War assume a new character. Though the Romans contrived at times to raise 200,000 men, they could only spare a moderate force for field operations. Their generals, among whom the veterans Fabius and M. Claudius Marcellus frequently held the most important commands, rarely ventured to engage Hannibal in the open, and contented themselves with observing him or skirmishing against his detachments. Hannibal, whose recent accessions of strength were largely discounted by the necessity of assigning troops to protect his new allies or secure their wavering loyalty, was still too weak to undertake a vigorous offensive. In the ensuing years the war resolved itself into a multiplicity of minor engagements which need not be followed out in detail. In 216 and 215 the chief seat of war was Campania, where Hannibal vainly attempted to establish himself on the coast and experienced a severe repulse at Nola. In 214 the main Carthaginian force was transferred to Apulia in hopes of capturing Tarentum. Though Croton and Locri on the Calabrian coast had fallen into his hands, Hannibal still lacked a suitable harbour by which he might have secured his oversea communications. For two years he watched in vain for an opportunity of surprising the town, while the Romans narrowed down the sphere of revolt in Campania and defeated other Carthaginian commanders. In 212 the greater part of Tarentum and other cities of the southern seaboard at last came into Hannibal's power. But in the same year the Romans found themselves strong enough to place Capua under blockade. They severely defeated a Carthaginian relief force, and could not be permanently dislodged even by Hannibal himself. In 211 Hannibal made a last effort to relieve his allies by a feint upon Rome itself, but the besiegers refused to be drawn away from their entrenchments, and eventually Capua was starved into surrender. Its fall was a sign that no power could in the long run uphold a rival Italian coalition against Rome. After a year of desultory fighting the Romans in 209 gained a further important success by recovering Tarentum. Though Hannibal from time to time still won isolated engagements, yet slowly but surely he was being driven back into the extreme south of the peninsula.

In 207 the arrival of a fresh invading force produced a new crisis. Hasdrubal, who in 209–208 had marched overland from Spain, appeared in north Italy with a force scarcely inferior to the army which his brother had brought in 218. After levying contingents of Gauls and Ligurians he marched down the east coast with the object of joining hands with his brother in central Italy for a direct attack upon Rome. By this time the drain of men and money was telling so severely upon her confederacy that some of her most loyal allies protested their inability to render further help. Yet by a supreme effort the Romans raised their war establishment to the highest total yet attained and sent a strong field army against either Carthaginian leader. The danger to Rome was chiefly averted by the prompt insight and enterprise of the consul C. Nero, who commanded the main army in the south. Having discovered that Hannibal would not advance beyond Apulia until his brother had established communications with him, Nero slipped away with part of his troops and arrived in time to reinforce his colleague Livius, whose force had recently got into touch with Hasdrubal near Sena Gallica (Sinigaglia). The combined Roman army frustrated an attempt of Hasdrubal to elude it and forced him to fight on the banks of the Metaurus. The battle was evenly contested until Nero by a dexterous flanking movement cut the enemy's retreat. Hasdrubal himself fell and the bulk of his army was destroyed.

The campaign of 207 decided the war in Italy. Though Hannibal still maintained himself for some years in Calabria, this was chiefly due to the exhaustion of Rome after the prodigious strain of past years and the consequent reduction of her armaments. In 203 Italy was finally cleared of Carthaginian troops. Hannibal, in accordance with orders from home, sailed back to Africa, and another expedition under his brother Mago, which had sailed to Liguria in 205 and endeavoured to rouse the slumbering discontent in Cisalpine Gaul and Etruria, was driven back on the coast and withdrawn about the same time.

b. The Subsidiary Campaigns.—Concurrently with the great struggle in Italy the Second Punic War was fought out on several other fields. It will suffice merely to allude to the First Macedonian War (214–205) which King Philip V. commenced when the Roman power seemed to be breaking up after Cannae. The diversions which Roman diplomacy provided for Philip in Greece and the maintenance of a patrol squadron in the Adriatic prevented any effective co-operation on his part with Hannibal.

Sardinia and Sicily.

In view of the complete stagnation of agriculture in Italy the Romans had to look to Sardinia and Sicily for their food supply. Sardinia was attacked by a Carthaginian armament in 215, but a small Roman force sufficed to repel the invasion. In Sicily a more serious conflict broke out. Some isolated attacks by Punic squadrons were easily frustrated by the strong Roman fleet. But in 215 internal complications arose. The death of Hiero II., Rome's steadfast friend, left the kingdom of Syracuse to his inexperienced grandson Hieronymus. Flattered by the promises of Carthaginian emissaries the young prince abruptly broke with the Romans, but before hostilities commenced he was assassinated. The Syracusan people now repudiated the monarchy and resumed their republican constitution, but they were misled by false threats of terrible punishment at the hands of Rome to play into the hands of the Carthaginians. The attacks of a Roman army and fleet under Marcellus which speedily appeared before the town were completely baffled by the mechanical contrivances of the Syracusan mathematician Archimedes (213). Meantime the revolt against Rome spread in the interior, and a Carthaginian fleet established itself in the towns of the south coast. In 212 Marcellus at last broke through the defence of Syracuse and in spite of the arrival of a Carthaginian relief force mastered the town by slow degrees. A guerilla warfare succeeded in which the Carthaginians maintained the upper hand until in 210 they lost their base at Agrigentum. Thereupon they were rapidly dislodged from their remaining positions, and by the end of the year Sicily was wholly under the power of Rome.

Spain.

The conflict in Spain was second in importance to the Italian War alone. From this country the Carthaginians drew large supplies of troops and money which might serve to reinforce Hannibal; hence it was in the interest of the Romans to challenge their enemy within his Spanish domain.

Though the force which Rome at first spared for this war was small in numbers and rested entirely upon its own resources, the generals Publius and Gnaeus Scipio by skilful strategy and diplomacy not only won over the peoples north of the Ebro and defeated the Carthaginian leader Hasdrubal Barca in his attempts to restore communication with Italy, but carried their arms along the east coast into the heart of the enemy's domain. But eventually their successes were nullified by a rash advance. Deserted by their native contingents and cut off by Carthaginian cavalry, among which the Numidian prince Massinissa rendered conspicuous service, the Roman generals were slain and their troops were destroyed in detail (212 or 211).

Disturbances in Africa prevented the Punic commanders from reaping the full fruit of their success. Before long the fall of Capua enabled Rome to transfer troops from Italy to Spain, and in 209 the best Roman general of the day, the young son and namesake of the recently slain P. Scipio, was placed in command. The new leader signalized his arrival by a bold and successful *coup-de-main* upon the great arsenal of Carthago Nova. Though he failed to prevent Hasdrubal Barca from marching away to Italy, Scipio profited by his departure to push back the remaining hostile forces the more rapidly. A last effort by the Carthaginians to retrieve their losses with a fresh army was frustrated by a great victory at Ilipa (near Corduba), and by the end of 206 they were completely driven out of the peninsula.

The War in Africa.

In 205 Scipio, who had returned to Rome to hold the consulship, proposed to follow up his victories by an attack upon the home territory of Carthage. Though the presence of Hannibal in Italy at first deterred the senate from sanctioning this policy, the general popularity of the scheme overbore all resistance. Scipio was granted a force which he organized and supplemented in Sicily, and in 204 sailed across to Africa. He was here met by a combined levy of Carthage and King Syphax of Numidia, and for a time penned to the shore near Utica. But in the winter he extricated himself by a surprise attack upon the enemy's camp, which resulted in the total loss of the allied force by sword or flame. In the campaign of 203 a new Carthaginian force was destroyed by Scipio on the Great Plains not far from Utica, their ally Syphax was captured, and the renegade Massinissa (*q.v.*) reinstated in the kingdom from which Syphax had recently expelled him. These disasters induced the Carthaginians to sue for peace, but before the very moderate terms which Scipio offered could be definitely accepted a sudden reversal of opinion caused them to recall Hannibal's army for a final trial of war, and to break off negotiations. In 202 Hannibal assumed command of a composite force of citizen and mercenary levies stiffened with a corps of his veteran Italian troops. After an abortive conference with Scipio he prepared for a decisive battle at Zama (an inland site not yet identified with certainty). Scipio's force was smaller in numbers, but well trained throughout and greatly superior in cavalry. His infantry, after evading an attack by the Carthaginian elephants, cut through the first two lines of the enemy, but was unable to break the reserve corps of veterans. The battle was ultimately decided by the cavalry of the Romans and their new ally Massinissa, which by a manœuvre recalling the tactics of Cannae took Hannibal's line in the rear and completely destroyed it. The Carthaginians having thus lost their last army again applied for peace and accepted the terms which Scipio offered. They were compelled to cede Spain and the Mediterranean islands still in their hands, to surrender their warships, to pay an indemnity of 10,000 talents (about £2,400,000) within fifty years and to forfeit their independence in affairs of war and foreign policy.

The Second Punic War, by far the greatest struggle in which either power engaged, had thus ended in the complete triumph of Rome. This triumph is not to be explained in the main by any faultiness in the Carthaginians' method of attack. The history of the First Punic War, and that of the Second outside of Italy, prove that the Romans were irresistible on neutral or Carthaginian ground. Carthage could only hope to win by invading Italy and using the enemy's home resources against him. The failure of Hannibal's brilliant endeavour to realize these conditions was not due to any strategical mistakes on his part. It was caused by the indomitable strength of will of the Romans, whose character during this period appears at its best, and to the compactness of their Italian confederacy, which no shock of defeat or strain of war could entirely disintegrate. It is this spectacle of individual genius overborne by corporate and persevering effort which lends to the Second Punic War its peculiar interest.

The Third Punic War (149–146 B.C.)—The political power of Carthage henceforth remained quite insignificant, but its commerce and material resources revived in the 2nd century with such rapidity as to excite the jealousy of the growing mercantile population of Rome and the alarm of its more timid statesmen. Under the influence of these feelings the conviction —sedulously fostered by Cato the Elder, the Censor—that "Carthage must be destroyed" overbore the scruples of more clear-sighted statesmen. A *casus belli* was readily found in a formal breach of the treaty, committed by the Carthaginians in 154, when they resisted Massinissa's aggressions by force of arms. A Roman army was despatched to Africa, and although the Carthaginians consented to make reparation by giving hostages and surrendering their arms, they were goaded into revolt by the further stipulation that they must emigrate to some inland site where they would be debarred from commerce. By a desperate effort they created a new war equipment and prepared their city for a siege (149). The Roman attack for two years completely miscarried, until in 147 the command was given to a young officer who had distinguished himself in the early operations of the war—Scipio Aemilianus, the adoptive grandson of the former conqueror of Carthage. Scipio made the blockade stringent by walling off the isthmus on which the town lay and by cutting off its sources of supplies from oversea. His main attack was delivered on the harbour side, where he effected an entrance in the face of a determined and ingenious resistance. The struggle did not cease until he had carried house by house the streets that led up to the citadel. Of a population probably exceeding half a million only 50,000 remained at the final surrender. The survivors were sold into slavery; the city was razed to the ground and its site condemned by solemn imprecations to lie desolate for ever. The territory of Carthage, which had recently been much narrowed by Massinissa's encroachments, was converted into a Roman province under the name of "Africa."

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The subsidiary authorities are: Diodorus, bks. 20–27, 32; Appian, *Res Libycae, Hispanicae, Hannibalicae*; Zonaras's epitome of Dio Cassius, frs. 43, 54, 57; Plutarch's *Lives of Fabius and Marcellus*; Cornelius Nepos's *Lives of Hamilcar and Hannibal*, and short references in Justin, Eutropius, Aurelius Victor and Orosius. The sources and methods of composition of these authors have been discussed in numerous articles and dissertations, mostly German, of which the most important are mentioned in Niese's work (quoted below). These essays have brought out few certain results, but they tend to show that the narratives, so far as they are not based on Polybius or earlier authorities, are of little value.

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PUNISHMENT (from Lat. *punire*, to punish, from *poena*, punishment, Gr. *ποινή*), the infliction of some kind of pain or loss upon a person for a misdeed, *i.e.* the transgression of a law or command. Punishment may take forms varying from capital punishment, flogging and mutilation of the body to imprisonment, fines, and even deferred sentences which come into operation only if an offence is repeated within a specified time. The progress of civilization has resulted in a vast change alike in the theory and in the method of punishment. In primitive society punishment was left to the individuals wronged or their families, and was vindictive or retributive: in quantity and quality it would bear no special relation to the character or gravity of the offence. Gradually there would arise the idea of proportionate punishment, of which the characteristic type is the *lex talionis*,[1] "an eye for an eye." The second stage was punishment by individuals under the control of the state, or community; in the third stage, with the growth of law, the state took over the primitive function and provided itself with the machinery of "justice" for the maintenance of public order. Henceforward crimes are against the state, and the exaction of punishment by the wronged individual is illegal (cf. LYNCH LAW). Even at this stage the vindictive or retributive character of punishment remains, but gradually, and specially after the humanist movement under thinkers like Beccaria and Jeremy Bentham, new theories begin to emerge. Two chief trains of thought have combined in the condemnation of primitive theory and practice. On the one hand the retributive principle itself has been very largely superseded by the protective and the reformative; on the other punishments involving bodily pain have become objectionable to the general sense of society. Consequently corporal and even capital punishment occupy a far less prominent position, and tend everywhere to disappear. It began to be recognized also that stereotyped punishments, such as belong to penal codes, fail to take due account of the particular condition of an offence and the character and circumstances of the offender. A fixed fine, for example, operates very unequally on rich and poor.

Modern theories date from the 18th century, when the humanitarian movement began to teach the dignity of the individual and to emphasize his rationality and responsibility. The result was the reduction of punishment both in quantity and in severity, the improvement of the prison system, and the first attempts to study the psychology of crime and to distinguish between classes of criminals with a view to their improvement (see CRIME; PRISON; CHILDREN'S COURTS; JUVENILE OFFENDERS). These latter problems are the province of criminal anthropology and criminal sociology, sciences so called because they view crime as the outcome of anthropological and social conditions. The man who breaks the law is himself a product of social evolution and cannot be regarded as solely responsible for his disposition to transgress. Habitual crime is thus to be treated as a disease. Punishment can, therefore, be justified only in so far as it (1) protects society by removing temporarily or permanently one who has injured it, or acting as a deterrent,[2] or (2) aims at the moral regeneration of the criminal. Thus the retributive theory of punishment with its criterion of justice as an end in itself gives place to a theory which regards punishment solely as a means to an end, utilitarian or moral, according as the common advantage or the good of the criminal is sought.

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PUNJAB, a province of British India, so named from the "five rivers" by which it is watered: the Jhelum, Chenab, Ravi, Beas and Sutlej, all tributaries of the Indus. Geographically the Punjab is the triangular tract of country of which the Indus and the Sutlej to their confluence form the two sides, the base being the lower Himalaya hills between those two rivers; but the British province now includes a large tract outside those boundaries. Along the northern border Himalayan ranges divide it from Kashmir and Tibet. On the west it is separated from the North-West Frontier province by the Indus, until that river reaches the border of Dera Ghazi Khan district, which is divided from Baluchistan by the Suliman range. To the south lie Sind and Rajputana, while on the east the rivers Jumna and Tons separate it from the United Provinces.

Political Divisions.

The Punjab includes two classes of territory, that belonging to the British Crown, and that in possession of 34 feudatory chiefs, almost all of whom pay tribute. The total area of the province is 133,741 sq. m., of which 97,209 sq. m. are British territory, and the remainder belongs to native states. The British territory is divided into 29 districts, grouped under the five divisions of Delhi, Lahore, Jullundur, Rawalpindi and Multan; while the native states vary in size from Bahawalpur, with an area of 15,000 sq. m., to the tiny state of Darkoti, with an area of 8 sq. m. and a total population of 518 souls. They may be grouped under three main heads: the Phulkian states of Patiala, Jind and Nabha and the Sikh state of Kapurthala, occupying the centre of the eastern plains; the Mahommedan state of Bahawalpur between the Sutlej and the Rajputana desert; and the hill states, among the Punjab Himalayas held by ancient Rajput families, including Chamba, Mandi, Suket, Sirmur and the Simla states.

Physical Features.—The mountain regions of the Punjab fall under four separate groups. To the north-east of the province lies the Himalayan system, with the fringing range of the Siwaliks at its foot. In the south-eastern corner the Aravalli system sends out insignificant outliers, which run across Gurgaon and Delhi districts and strike the Jumna at Delhi. The lower portion of the western frontier is constituted by the great Suliman chain; while the north-western districts of the province are traversed by the hill system known as the Salt range. The mountain system of the Himalayas, so far as it concerns the Punjab, consists primarily of three great ranges running in a generally north-westerly direction from the head-waters of the Sutlej to the Indus: the western Himalayas or Zanskar or Bara Lacha range, the mid-Himalayas or Pir Panjal range, and the outer or sub-Himalayas. From these three great ranges spring numerous minor ranges, as ribs from a backbone, the whole forming a confused system of mountain chains and valleys, the breadth of which is some 90 m. at its eastern extremity from Lahul to the Siwaliks of Hoshiarpur, and some 150 m. measured at its western extremity across Kashmir.

The Five Rivers.

The "five rivers" of the Punjab are each of large volume; but, on account of the great width of sandy channel in their passage through the plains, their changing courses, and shifting shoals, they are of no value for steam navigation, though they all support a considerable boat-traffic. Of recent years most of them have been utilized for purposes of irrigation, and have turned the sandy desert of the Punjab into one of the great wheat fields of the British Empire.

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[1] *Talio*, in juridical Latin, the abstract noun from *talis*, such, alike, hence "retaliation." See Exod. xxi. 24; Lev. xxiv. 20; Deut. xix. 21.

[2] This idea combined with the retributive is found as early as Deut. xix. 20, "And those which remain shall hear and fear, and shall henceforth commit no more any such evil."

While the general name Punjab is applied to the whole country of the "five rivers," there are distinct names for each of the *doabs* (*do*, two; *ab*, water) or tracts between two adjoining rivers. The country between the Sutlej and the Beas is called the Jullundur Doab; it includes the districts of Jullundur and Hoshiarpur. The long strip between the Beas and the Ravi, containing the greater part of Gurdaspur, Amritsar, Lahore, Montgomery, and Multan districts, is called the Bari Doab. Rechna Doab is the tract between the Ravi and the Chenab, embracing Sialkot and Gujranwala districts, with the trans-Ravi portions of the districts of the Bari Doab. Chaj or Jech is the doab between the Chenab and the Jhelum (Gujrat and Shahpur districts and part of Jhang), and Sind Sagar is the name of the large doab between the Jhelum and the Indus, including Rawalpindi, Jhelum and Muzaffargarh districts, with parts of Shahpur, Bannu and Dera Ismail Khan. The higher and dryer parts of the doabs are called *bar*. They are waste, but not barren, scantily covered with low shrubs, and capable, when watered, of being well cultivated. The *bar* is the great camel-grazing land. Large areas of Muzaffargarh and Multan districts are *thal*, barren tracts of shifting sand. The middle part of the Bari Doab, in Amritsar district, bears the distinctive name of Manjha (middle) as the centre and headquarters of the Sikh nation, containing their two sacred tanks of Amritsar and Taran Taran. The Malwa Sikhs, again, are those of the cis-Sutlej country.

The Punjab Plains.

South of the Himalayas stretch the great plains, which constitute by far the larger proportion of the province. With the exception of the Himalayan and Salt range tracts the Punjab presents, from the Jumna on the east to the Sulimans in the west, one vast level, unbroken save by the wide eroded channels within which the great rivers ever shift their beds, by the insignificant spurs of the Aravalli range in the south-eastern corner, and the low hills of Chiniot and Kirana in Jhang. The whole of these vast plains is of alluvial formation. Stones are unknown save at the immediate foot of the hills; micaceous river sand is to be found everywhere at varying depths; and the only mineral is nodular accretions of limestone, called *kankar*, which is used for the construction of roads. The soil is a singularly uniform loam, the quality being determined by the greater or smaller proportion of sand present. In the local hollows and drainage lines the constant deposit of argillaceous particles has produced a stiff tenacious soil, especially adapted to rice cultivation, while in the beds of the great rivers, and on the wind-fretted water-sheds pure sand is commonly found. Where neither sand nor the saline efflorescence called *reh* is present, the soil is uniformly fertile, if only the rainfall be sufficient or means of irrigation be available. Throughout the greater part of the western plains, however, the insufficiency of rainfall is a permanent condition; and until recently the uniform aspect of the country was that of wide steppes of intrinsically fertile soil, useful, however, only as grazing grounds for herds of camels or cattle.

Natural Divisions.

The Punjab may be divided into four great natural divisions: the Himalayan tract, the submontane tract, the eastern and western plains and the Salt range tract, which have characteristics widely different from each other. The Himalayan tract, which includes the Punjab hill states, consists of 20,000 sq. m. of sparsely inhabited mountain, with tiny hamlets perched on the hill-sides or nestling in the valleys. The people consist chiefly of Rajputs, Kanets, Ghiraths, Brahmans and Dagis or menials. The eastern and western plains, which are divided from each other by a line passing through Lahore, are dissimilar in character. The eastern are arable plains of moderate rainfall and almost without rivers, except along their northern and eastern edges. They are inhabited by the Hindu races of India, and contain the great cities of Delhi, Amritsar and Lahore. They formed, until the recent spread of irrigation, the most fertile, wealthy and populous portion of the province. The western plains, except where canal irrigation has been introduced, consist of arid pastures with scanty rainfall, traversed by the five great rivers, of which the broad valleys alone are cultivable. They are inhabited largely by Mahommedan tribes, and it is in this tract that irrigation has worked such great changes. The Chenab and Jhelum Canal colonies are already pronounced successes, and it is hoped that in process of time the Lower Bari Doab and the Sind-Sagar Doab will be similarly fertilized. The submontane tract, skirting the foot of the hills, has an area of 10,000 sq. m., consisting of some of the most fertile and thickly populated portions of the province. Its population comes midway between the peoples of the hills and of the plains in race, religion and language, Mahommedanism being less prevalent, Hindi more generally spoken, and Rajputs and hill menials more common than in the plains. The Gujars form a special feature of this zone. Its only large town is Sialkot. The Salt range tract includes the districts of Rawalpindi and Jhelum and a small portion of Shahpur district, and consists of some 9000 sq. m. of broken and confused country.

Geology.—By far the greater part of the Punjab is covered by alluvial and wind-blown deposits of the plain of the Indus. The Salt range hills form a plateau with a steeply scarped face to the south, along which there is an axis of abrupt folding, accompanied by faulting. The rocks found in the Salt range belong to the Cambrian, Carboniferous, Permian, Triassic and Jurassic systems, while Tertiary beds cover the plateau behind. The extensive and valuable deposits of salt, from which the range takes its name, occur near the base of the Cambrian beds. Gypsum, kieserite and other salts are also found. Between the Cambrian and the Carboniferous beds there is an unconformity, which, however, is not very strongly marked, in spite of the lapse of time which it indicates. At the bottom of the Carboniferous series there is usually a boulder bed, the boulders in which have been brought from a distance and are scratched and striated as if by ice. It is generally admitted that this deposit, together with contemporaneous boulder beds in the peninsula of India, in Australia and in South Africa, indicate a southern glacial period in late Carboniferous times. Above the sandstone series at the base of which the boulder bed lies, come the *Productus* and *Ceratite* limestones. The former is believed to belong to the Upper Carboniferous and Permian, the latter to the Trias. Jurassic beds are found only in the western portion of the range.

Climate.—Owing to its sub-tropical position, scanty rainfall and cloudless skies, and the wide expanse of untilled plains, the climate of the Punjab presents greater extremes of both heat and cold than any other part of India. From the middle of April to the middle of September it is extremely hot, while from the beginning of October to the end of March there is a magnificent cool season, resembling that of the Riviera, with warm bright days and cool nights. Frosts are frequent in January. In the first three months of the hot season, from April till the end of June, a dry heat is experienced, with a temperature rising to 120° F. in the shade. At the end of June the monsoon arrives, the rains break, and though the heat is less intense the air is moist, and from the middle of August the temperature gradually falls. This is the most unhealthy period of the year, being exceedingly malarious. The Punjab enjoys two well-marked seasons of rainfall; the monsoon period, lasting from the middle of June till the end of September, on which the autumn crops and spring sowings depend; and the winter rains, which fall early in January, and though often insignificant in amount materially affect the prosperity of the spring harvest. Excepting in the Himalayas the rainfall is greatest in the east of the province, as the Bombay monsoon is exhausted in its passage over the great plains of Sind and Rajputana, while the west winds from Baluchistan pass over an arid tract and leave such moisture as they may have collected on the western slopes of the Suliman range; so that the Punjab depends for its rain very largely on the south-east winds from the Bay of Bengal. The submontane tract has an annual average of 36 to 32 in., the eastern plains vary from 20 to 14 in., and the western plains from 10 to 5 in.

Minerals.—Besides rock-salt, the mineral products of the Punjab are not many. Limestone, good for building, is obtained at Chiniot on the Chenab and at a few other places. There are extensive alum-beds at Kalabagh on the Indus. A small quantity of coal is found in the Salt range in disconnected beds, the Dandot colliery in the Jhelum district being worked by the North-Western railway. Petroleum is found in small quantities at a number of places in Rawalpindi, being gathered from the surface of pools or collected in shallow pits. In almost all parts of the Punjab there is *kankar*, rough nodular limestone, commonly found in thick beds, a few feet below the surface of the ground, used for road metal and burned for lime.

Agriculture.—As in other parts of India, there are commonly two harvests in the year. The spring crops are wheat, barley, gram, various vegetables, oil-seeds, tobacco and a little poppy; the autumn crops are rice, millets, maize, pulses, cotton, indigo and sugar-cane. Wheat has become the most important export of the province. In the spring of 1906 an area of 8½ million acres was harvested, producing 3½ million tons. Tea is cultivated in Kangra district. Flax has been produced successfully, but the cultivation has not been extended. Hops have been grown experimentally, for the Murree brewery, on neighbouring hills; the cultivation in Kashmir has been more encouraging. Potatoes are grown extensively on cleared areas on the hills. The Punjab produces freely many of the Indian fruits. Grapes are grown in many of the Himalayan valleys where the rain is not excessive; but they are inferior to those brought from Kabul.

Forests.—The forest area of the Punjab consists of 9278 sq. m., of which 1916 sq. m. are reserved and 4909 sq. m. protected. The wasteful destruction of trees is checked in the hill forests rented from native states by the British government. The principal reserved forests are the deodar (*Cedrus Deodara*) and chil (*Pinus longifolia*) tracts in the hills, the plantations of shisham (*Dalbergia Sissu*) and sal (*Shorea robusta*) in the plains, and the fuel *rakhs* or preserves (*Acacia*, *Prosopis*, &c.).

Manufactures.—Most of the native manufactures of the Punjab are those common to other parts of India, such as the ordinary cotton fabrics, plain woollen blankets, unglazed pottery, ropes and cord, grass matting, paper, leather-work, brass vessels, simple agricultural implements and the tools used in trades. Other manufactures, not so general, yet not peculiar to the Punjab, are woollen fabrics, carpets and shawls, silk cloths and embroidery, jewelry and ornamental metal-work, wood and ivory carving, turned and lacquered woodwork, glazed pottery, arms and armour and musical instruments. But some of these classes of manufacture are represented by work of special kinds or special excellence in particular parts of the Punjab, notably the silk fabrics of Multan and Bahawalpur; the carpets of Lahore and Amritsar; the *kashi* or glazed tile-work (an ancient art still practised in a few places); *koft-kari*, inlaid metal-work (gold wire on steel), chiefly made at Gujrat and Sialkot; shawls and other fine woollen fabrics, made by Kashmiri work-people at Ludhiana and Nurpur, as well as in Kashmir; silk embroidery for shawls, scarfs and turbans, at Delhi, Lahore and Multan; embroidery on cloth for elephant-trappings, bed and table covers, &c., at Lahore and Multan; enamelled ornaments, in Kangra and Multan; quill embroidery on leather, in Kangra and Simla; lacquered woodwork, at Pak Pattan. Cotton-weaving gives employment to about a million persons, but the most flourishing industry is the woollen factories of Amritsar, Gurdaspur and elsewhere. Injury has been done to some of the native arts of the Punjab, as of other parts of India, by unwise copying of European patterns. The Lahore School of Art attempts to correct this and promote the study and execution of native forms and designs. The Lahore Museum contains illustrations of the arts and manufactures, as well as raw products, of the Punjab; and also a large collection of the sculptures, mostly Buddhist, and many of Greek workmanship, found in the north-west of the province.

Trade.—The trade of the Punjab is almost wholly dependent upon agriculture. In a normal year the principal feature of the trade is the movement of wheat to Karachi, which is the chief port for the province. But in a bad season, when the rains fail, this movement is at once checked, the wheat is held up in reserve and an eastward movement in cheaper grains begins. In 1904 32½ million maunds of wheat were exported, but 1905 was a bad season and the amount fell to 21 million maunds. The other chief articles of export are pulse and raw cotton. The chief imports are European cotton and woollen piece-goods and yarn, Indian piece-goods, sugar, metals and jute goods. The through trade in the main staples of grain and piece-goods is in the hands of large European and native firms. In addition to the foreign trade there is a considerable provincial trade with the United Provinces, and a trans-frontier trade with Kashmir, Ladakh, Yarkand and Tibet on the north, and with Afghanistan on the west.

Irrigation.—Irrigation for large areas is from canals and from reservoirs, and for smaller areas from wells. The canals are of two kinds: those carrying a permanent stream throughout the year, and those which fill only on the periodical rising of the rivers, the latter being known as "inundation canals." There are only a few parts of the country presenting facilities for forming reservoirs, by closing the narrow outlets of small valleys and storing the accumulated rainfall. The old canals made by the Mahommedan rulers, of which the principal are Feroz's Canal from the Jumna and the Hasli Canal from the Ravi, have been improved or reconstructed by the British government. The principal new canals are the Sirhind, drawn from the Sutlej near Rupar, which irrigates parts of the native states of Patiala, Nabha and Jhind, as well as British territory; the Bari Doab Canal from the Ravi; the Chenab Canal from the Chenab, irrigating the prosperous Chenab colony; and the Jhelum Canal irrigating the Jhelum colony. The total area irrigated by the canals of the province in 1905–1906 was 6,914,500 acres, the eight major works, the Western Jumna, Bari Doab, Sirhind, Lower Chenab, Lower Jhelum, Upper Sutlej, Sidhnai and Indus accounting for all but 751,000 acres. The ravages of the boll-worm in the cotton crop made 1906 an unfavourable year; but in spite of that the Lower Chenab Canal paid nearly 21% on the capital invested, the Bari Doab 11% and the Western Jumna nearly 10%.

Railways.—The Punjab is well supplied with railways, which have their central terminus at Delhi. One main line of the North-Western runs from Umballa through Lahore and Rawalpindi towards Peshawar; another main line runs from Lahore to Multan, and thence to the sea at Karachi; while a third runs along the left bank of the Indus, from Attock southwards. From Delhi to Umballa there are two lines, one of the North-Western through Meerut and Saharanpur in the United Provinces, and a more direct one, which is continued to Kalka, at the foot of the hills, whence a further continuation to Simla has been opened. The south-east of the province is served by two branches of the Rajputana system, which have their termini at Delhi and Ferozepore; and also by the Southern Punjab, which runs from Delhi to Bahawalpur.

Population.—The total population of the Punjab (including native states) according to the census of 1901 was 24,754,737, showing an increase of 6·4% in the decade. The Jats, who number some five millions, form the backbone of the cultivating community. Large numbers of them have become Sikhs or Mahommedans in the tracts where those religions predominate. The Rajputs, with a total of over a million and three-quarters, comprise tribes of different religions, races and social systems. By religion they are mostly Mahommedan, only about one-fourth being Hindus, while a very few are Sikhs. By race they include the ancient ruling tribes of the Jumna valley, the Tomar and Chauhan, which gave Delhi its most famous Hindu dynasties; the Bhattis of the south and centre, which have migrated from Bikanir and Jeysulmere into their present seats; the Sials of Jhang; and the Punwars of the south-west. In the northern or submontane districts the Rajputs also represent the old ruling tribes, such as the Chibbs of Gujrat, the Janjuas of the Salt range and others, while in Kangra district they preserve a very old type of Hindu aristocracy. The Gujars are an important agricultural and pastoral tribe. They are most numerous in the eastern half of the province and in the districts of the extreme north-west, especially in Gujrat, to which they have given their name. Baluchis and Pathans are strongly represented in the south-west. The distinctive religion of the Punjab is Sikhism (*q.v.*), though Sikhs form only 8·5% of the total population. Of the rest, Mahommedans are more numerous than Hindus.

Language.—Of the 24,754,737 people in the Punjab about 18,000,000 speak the provincial language, Punjabi, which varies in character in different parts of the province. About 4,000,000 speak Hindustani (see HINDOSTANI), this number including those whose ordinary vernacular is Hindi, but who understand and are gradually adopting the more comprehensive Hindustani. These two languages are the most generally used throughout the province, but not equally in all parts. The other languages in use are more or less local. The hill dialects, known as Pahari, are akin to the language spoken in Rajputana; and so also is the speech of the Gujars. Hindustani is the language of the law courts and of all ordinary officials and other communications with chiefs and people.

Administration.—The administration is conducted by a lieutenant-governor, who is appointed by the governor-general, subject to the approval of the Crown. Two commissioners take the place of the board of revenue in most other provinces. A survival of the "non-regulation" system is to be found in the title of deputy-commissioner for the district officer elsewhere called collector. The highest judicial authority is styled the chief court, consisting of five judges, which corresponds to the high court elsewhere. A legislative council, first created in 1897, was enlarged in 1909 to 26 members, of whom ten are officials and five are elected. The province is distributed into five divisions or commissionerships. Most of the commissioners also exercise political functions over the native states within their jurisdiction.

Education.—The Punjab University, which was founded in 1882, differs from other Indian universities in being more than a merely examining body. It is responsible for the management of the Oriental College at Lahore, and takes a part in the improvement of vernacular literature. It also conducts Oriental examinations side by side with those in English, and has been the first to introduce a series of examinations in science from matriculation to the degree, as well as a final school examination in clerical and commercial subjects. The higher and special educational institutions are the Lahore Government College, the Cambridge

University Mission College at Delhi, the Medical School and the Mayo School of Art at Lahore; and the Punjab Chiefs' College, also at Lahore.

History.—For the early history of the Punjab from the Aryan immigration to the fall of the Mogul dynasty see INDIA: *History.* It deserves, however, to be noted here that from the time of Alexander onwards Greek settlers remained in the Punjab, and that Greek artists gave their services for Buddhist work and introduced features of their own into Indian architecture. Besides the bases and capitals of large Greek columns at Shahderi (Taxila) and elsewhere, numerous sculptures of Greek workmanship have been found at various places. These are single statues (probably portraits), also figures of Buddha, and representations of scenes in his legendary history, and other subjects. They are obtained from ruins of monasteries and other buildings, from mounds and the remains of villages or monumental topes. Of Buddhist buildings now remaining the most conspicuous as well as distinctive in character are the topes (*stupa*), in shape a plain hemisphere, raised on a platform of two or more stages. One of the largest of these is at Manikiala, 14 m. east of Rawalpindi. These Buddhist buildings and sculptures are all probably the work of the two centuries before and the three or four after the beginning of the Christian era. The character of the sculptures is now well known from the specimens in the India Museum, South Kensington, and both originals and casts of others in the Lahore Museum. Unfortunately they have no names or inscriptions, which give so much value to the sculptures of the Bharhut tope.

The several bodies of settlers in the Punjab from the earliest times have formed groups of families or clans (not identical with Indian castes, but in many cases joining them), which have generally preserved distinct characteristics and followed certain classes of occupation in particular parts of the country. Some of the existing tribes in the Punjab are believed to be traceable to the early Aryan settlers, as the Bhatti tribe, whose special region is Bhattiana south of the Sutlej, and who have also in the village of Pindi Bhattian a record of their early occupation of a tract of country on the left bank of the Chenab, west of Lahore. The Dogras, another Aryan clan, belong to a tract of the lower hills between the Chenab and the Ravi. Others similarly have their special ancient localities. To the earlier settlers—the dark race (Dasyu) whom the Aryans found in the country, and who are commonly spoken of as aborigines—belonged, as is supposed, the old tribe called Takka, whose name is found in Taksha-sila or Taxila. And from the later foreigners again, the Indo-Scythians, are probably descended the great Jat tribe of cultivators, also the Gujars and others.

It was during the events which brought Baber, the first of the Mogul dynasty, to the throne, that the sect of the Sikhs was founded by Nanak; and it was under the persecution of Aurangzeb that they were raised into a nation of warriors by Govind Singh, the tenth and last of the *gurus.* For their tenets and history see SIKHISM.

The break-up of the Mogul Empire in the 18th century allowed the Sikhs to establish themselves, as a loosely organized community of marauders, in the eastern plains of the Punjab, on both banks of the Sutlej. Here, after long internecine warfare, one of their chieftains succeeded in enforcing his authority over the rest. This was Ranjit Singh, the "Lion of the Punjab," born in 1780, who acquired possession of Lahore as his capital in 1799. Ranjit was a man of strong will and immense energy, of no education but of great acuteness in obtaining the knowledge that would be of use to him. When he endeavoured to include the Sikh states south of the Sutlej within his jurisdiction, the heads of these states—chiefs of Sirhind and Malwa, as they were called—sought and obtained in 1808 the protection of the British, whose territories had now extended to their neighbourhood. The British were at this time desirous of alliance with Lahore as well as with Kabul, for protection against supposed French designs on India. A British envoy, Charles Metcalfe, was received by Ranjit at Kasur in 1809 and the alliance was formed. Ranjit steadily strengthened himself and extended his dominions. In 1809 he got possession of Kangra, which the Nepalese were besieging. In 1813 he acquired the fort of Attock on the other side of the Punjab; and in the same year he obtained from Shah Shuja, now a refugee in Lahore, what he coveted as much as territory, the celebrated Koh-i-nor diamond, which had been carried off by Nadir Shah from Delhi. In 1818, after some failures in previous years, he captured Multan. Kashmir, which had successfully opposed him several times, was annexed the following year, and likewise the southern part of the country between the Indus and the hills. The Peshawar valley he succeeded in adding four years later, but he found it best to leave an Afghan governor in charge of that troublesome district. These trans-Indus and other outlying tracts were left very much to themselves, and only received a military visit when revenue was wanted. Peshawar was never really ruled till Avitabile was sent there in later years. When he was gradually raising his large and powerful army Ranjit received into his service certain French and other officers, who drilled his troops and greatly improved his artillery. Whilst he relied on these foreigners for military and sometimes also for administrative services, he drew around him a body of native ministers of great ability, of whom the brothers Gulab Singh and Dhian Singh of Jammu were the most influential.

Ranjit always maintained friendly relations with the British government, and just before his death gave tacit approval to the scheme for placing Shah Shuja on the throne of Kabul. His death in 1839 was followed by six years of internal anarchy, princes and ministers being murdered in quick succession, while all real power passed to the army of 90,000 trained troops. At last this army, unpaid and unmanageable, demanded to be led into British territory, and had their way. They crossed the Sutlej in December 1845. The battles of Moodkee, Ferozeshah and Aliwal were followed by the rout of the Sikh army at Sobraon on the 10th of February 1846, when they were driven back into the Sutlej with heavy loss, and the British army advanced to Lahore. Of the Sikh guns 256 fell into the hands of the British in these actions on the Sutlej. A treaty was made at Lahore on the 9th of March with the chiefs and ministry who were to hold the government on behalf of the young maharaja, Duleep Singh. By this treaty the Jullundur Doab and the hill district of Kangra were ceded to the British, also the possessions of the maharaja on the left bank of the Sutlej. In addition the British demanded a money payment of £1,500,000. The services of Gulab Singh, raja of Jammu, to the Lahore state, in procuring the restoration of friendly relations with the British, were specially recognized. His independent sovereignty in such lands as might be made over to him was granted. The Sikh government, unable to pay the whole of the money demand, further ceded, as equivalent for £1,000,000, the hill country between the Beas and the Indus, including Kashmir and Hazara. Gulab Singh was prepared to give the amount in place of which Kashmir was to have become British, and by a separate treaty with him, on the 16th of March 1846, this was arranged. At the urgent request of the durbar a British force was left at Lahore for the protection of the maharaja and the preservation of peace. To restore order and introduce a settled administration a British resident was appointed, who was to guide and control the council of regency, and assistants to the resident were stationed in different parts of the country.

Peace was not long preserved. The governor of Multan, Diwan Mulraj, desired to resign. Two British officers sent by the resident to take over charge of the fort were murdered, on the 19th of April 1848, and their escort went over to the diwan. Another of the assistants to the resident, Lieutenant Herbert Edwardes, then in the Derajat, west of the Indus, on hearing of their fate, collected a force with which to attack the Multan army while the insurrection was yet local. This he did with signal success. But Multan could not fall before such means as he possessed. The movement spread, the operations widened, and the Sikh and British forces were in the field again. Multan was taken. The severe battle of Chillianwalla on the 13th of January 1849 left the Sikhs as persistent as after the two terrible days of Ferozeshah in the previous campaign. And it needed the crushing defeat of Gujrat, on the 21st of February 1849, to bring the war to a conclusion, and this time to give the Punjab to England. It was annexed on the 2nd of April 1849.

For the government of the new province, including the Jullundur Doab, previously annexed, and the cis-Sutlej states, a board of administration was appointed consisting of three members. In place of this board a chief commissioner was appointed in 1853, aided by a judicial commissioner and a financial commissioner. British troops, European and native, of the regular army were stationed at the chief cities and other places east of the Indus and at Peshawar. For the rest of the trans-Indus territory a special body of native troops, called the Punjab frontier force, was raised and placed under the orders of the chief commissioner. During the Mutiny of 1857 the Punjab, under Sir John Lawrence as chief commissioner, was able to send important aid to the force engaged in the siege of Delhi, while suppressing the disturbances which arose, and meeting the dangers which threatened, within the Punjab itself. In 1858 the Delhi territory, as it was called, west of the Jumna, was transferred from the North-Western Provinces to the Punjab. The enlarged province was raised in rank, and on the 1st of January 1859 the chief commissioner became lieutenant-governor. In 1901 the frontier districts beyond the Indus were severed from the Punjab and made into a separate province called the North-West Frontier province.

See J. D. Cunningham, *History of the Sikhs* (1849); S. S. Thorburn, *The Punjab in Peace and War* (1904); Sir Lepel Griffin, *Ranjit Singh* ("Rulers of India" series, 1892); P. Gough and A. Innes, *The Sikhs and our Sikh Wars* (1897); Professor Rait, *Life of Lord Gough* (1903); Mahomet Latif, *History of the Punjab* (Calcutta, 1891); and *Punjab Gazetteer* (2 vols., Calcutta, 1908).

PUNKAH (Hindostani *pankha*), strictly a fan. In its original sense the punkah is a portable fan, made from the leaf of the palmyra; but the word has come to be used in a special sense by Anglo-Indians for a large swinging fan, fixed to the ceiling, and pulled by a coolie during the hot weather. The date of this invention is not known, but it was familiar to the Arabs as early as the 8th century, though it does not seem to have come into common use in India before the end of the 18th century. Of recent years it has largely been supplanted by the electric fan in barracks and other large buildings.

PUNSHON, WILLIAM MORLEY (1824–1881), English Nonconformist divine, was born at Doncaster, Yorkshire, on the 29th of May 1824. He was educated in his native town, and, after spending a few years in business, at the Wesleyan College, Richmond. In 1845 he received his first appointment, at Marden, Kent, and soon became famous as a preacher. After serving the usual period of probation he was ordained at Manchester in 1849 and for the next nineteen years travelled in several circuits, including some of the London ones (1858–1864). In 1868 he went to Chicago as the representative of the Wesleyan Methodist conference, and settling in Canada did much to advance the cause of his denomination. His preaching and lecturing drew great crowds both in the Dominion and in the United States, and he was five times president of the Canadian conference. He returned to England in 1873, was elected president of conference 1874, and in 1875 one of the missionary secretaries. He published several volumes of sermons, and a book of verse entitled *Sabbath Chimes* (1867, new edition 1880).

PUNT (from Lat. *ponto*, pontoon; connected with *pons*, bridge), a flat-bottomed boat, used for shallow waters, and propelled by a pole, by paddles, or occasionally by sails. Formerly the word was applied to many such flat boats used for ferries, barges, lighters, &c., but it is now generally confined to a light flat boat very long in proportion to its width, with square ends, both at stem and bow, slightly narrowing from the centre, and propelled by pushing against the bottom of the river or other water by a long pole. Such boats are much used for sport or pleasure on rivers with shallow and hard gravelly beds; a small punt with a mounted duck gun and propelled by paddles or short oars is used for wild-fowling. A professional punting championship of England was instituted in 1876, and an amateur championship in 1886. Etymologically considered, "punt" certainly was adapted from *ponto*, a word used by Caesar (*Bell. civ.* p. iii. 22) of a light vessel for transport in Gaul. Later (as by Gallius and Ausonius) it was also applied to a floating-raft used as a bridge, a pontoon, and so connected with *pons*, bridge.

There are two other words which must be distinguished from the above. One means, in Rugby football, to catch the ball in the hands, drop and kick it before it reaches the ground, as distinguished from a "drop-kick," where the kick is given half-volley, as it reaches the ground. This word is probably cognate with "bunt," a dialect word meaning to push, and both represent nasalized forms of the onomatopoeic "put" or "but." The second, in the substantive "punter," used in the general sense of a gambler or better, originally referred to one who at card games such as basset, baccarat, &c., stakes against the bank. Both "punt" and "punter" are to be referred to Fr. *ponter*, and *ponte*, which is usually taken as an adaptation of Span. *punto*, a point.

PUNTARENAS, or Punta Arenas, a seaport and capital of the district (*comarca*) of Puntarenas, Costa Rica; on the Gulf of Nicoya, an inlet of the Pacific Ocean, and at the western terminus of the interoceanic railway from Limón. Pop. (1904), 3569. Puntarenas is the principal harbour of Costa Rica on the Pacific, and a port of call for the United States liners which ply between San Francisco and Panama. It has an iron pier and ample warehouse accommodation for its large and growing export trade in coffee and bananas. The district of Puntarenas comprises the entire littoral from Burica Point to the Rio de las Lajas, an affluent of the Gulf of Nicoya.

PUPIL (Lat. *pupillus*, orphan, minor, dim. of *pupus*, boy, allied to *puer*, from root *pu-* or *peu-*, to beget, cf. "pupa," Lat. for "doll," the name given to the stage intervening between the larval and imaginal stages in certain insects), properly a word taken from Roman law for one below the age of puberty (*impubes*), and not under *patria potestas*, who was under the protection of a *tutor*, a ward or minor (see Infant; and Roman Law). The term was thus taken by the Civil Law and Scots Law for a person of either sex under the age of puberty in the care of a guardian. Apart from these technical meanings the word is generally used of one who is undergoing instruction or education by a teacher. In education the term "pupil-teacher" is applied to one who, while still receiving education, is engaged in teaching in elementary schools. The system was introduced into England from Holland about 1840. At first the education which the pupil-teachers received was given at the schools to which they were attached. During the last quarter of the 19th century was developed a system of "pupil-teacher centres" where training and education was given. In 1907 was introduced "bursaries," as an alternative; these enable those intending to become teachers to continue their education at training colleges or selected schools as "student teachers." (See Education.)

A special use of the Lat. feminine diminutive *pupilla* has been adopted in English and other languages for the central orifice in the iris of the eye, the pupil. The origin of the sense may be found in the parallel use in early English of "baby," referring to small images seen reflected in that part of the eye (see Eye and Vision).

PURBECKIAN, in geology, the highest and youngest member of the Jurassic system of rocks. The name is derived from the district known as the Isle of Purbeck in Dorsetshire where the strata are splendidly exposed in the cliffs west of Swanage. The rocks include clays, shales and marls with marly, tufaceous and shelly limestones and occasional oolitic and sandy strata. Nodules of chert are present in some of the limestones. The Purbeck beds follow the line of the Jurassic outcrop from Dorsetshire, through the Vale of Wardour, Swindon, Garsington, Brill and Aylesbury; they have been proved by borings to lie beneath younger rocks in Sussex; in Lincolnshire they are represented in part by the Spilsby Sands, and in Yorkshire by portions of the Speeton Clay. The thickness of the series in Wiltshire is 80 to 90 ft., but in Dorsetshire it reaches nearly 400 ft. In most places the Purbeckian rests conformably upon the Portland beds and it is conformably overlaid by the Wealden formations; but there are in some districts distinct indications that the Portland rocks were uplifted and worn to some extent prior to the deposition of the Purbeck beds. The Purbeckian in England is divisible into three subdivisions, viz. Upper, Middle and Lower. The Upper Purbeck comprises 50–60 ft. of fresh-water clays and shales with limestones, the "Purbeck marble" and *Unio*-bed, in the lower part. The Middle division (50–150 ft.), mainly thin limestones with shaly partings, contains the principal building stones of the Swanage district; near the base of this subdivision there is a 5-in. bed from which an interesting suite of mammalian remains has been obtained; in this portion of the Purbeck series there are some marine bands. The Lower Purbeck (95–160 ft.) consists of fresh-water and terrestrial deposits, marls, and limestones with several fossil soils known as "dirt beds." This division is very extensively exposed on the Isle of Portland, where many of the individual beds are known by distinctive names. The chief building stones of Upway belong to this part of the Purbeckian.

No zonal fossil has been recognized for the British Purbeckian strata, but the horizon is approximately equivalent to that of *Perisphinctes transitorius* of the European continent. The Purbeckian equivalents of Spilsby and Speeton are in the zone of *Belemnites lateralis.* Other marine fossils are *Hemicidaris purbeckensis* and *Ostrea distorta*, the latter being abundant in the "Cinder bed" of the Middle Purbeck. The fresh-water mollusca include *Viviparus* (*Paludina*), *Planorbis*, *Melanopsis*, *Unio*, *Cyrena.* A large number of insect genera has been found in the Middle and Lower Purbeck beds. Dinosaurs (*Iguanodon*, *Echinodon*), crocodiles (*Goniopholis*, *Petrosuchus*), *Cimoliosaurus*, the plesiosaurs and the chelonians (*Chelone*, *Pleurosternum*), are representative reptiles. The mammals, mostly determined from lower jaws, found in the beds mentioned above include *Plagiaulax*, *Amblotherium*, *Stylodon*, *Triconodon*, *Spalacotherium* and several others. The isopod crustacean *Archeoniscus Brodei* is very common in the Purbeck of the Vale of Wardour. The silicified stumps and trunks of cycads and coniferous trees, often surrounded by great masses of calcareous concretions (Burrs), are very noticeable in the dirt beds of Portland and near Lulworth. Chara is found in the fresh-water cherts of the Middle Purbeck.

Many geologists have ranged the Purbeck beds with the overlying Wealden formation on account of the similarity of their fresh-water faunas; but the marine fossils, including the fishes, ally the Purbeck more closely with the Upper Jurassic rocks of other parts, and it may be regarded as the equivalent of the Upper Volgian of Russia. The Purbeckian is present in the neighbourhood of Boulogne; in Charente it is represented by thin limestones with *Cyrena* and by gypsiferous marls; in north-west Germany three subdivisions are recognized, in descending order Purbeck Kalk, Serpulit and Münder Mergel.

The building stones of the Purbeck beds have already been mentioned; the Purbeck or Paludina marble, a grey or greenish limestone full of shells, was formerly extensively employed in cathedrals and churches. Stone tiles or "slatts" were once used locally for roofing from the Lower Purbeck of Portland, Swanage and Swindon. Gypsum was formerly worked from the Lower Purbeck at Swanage.

See JURASSIC; also *The Jurassic Rocks of Great Britain* (1895), vol. v. and "The Geology of the Isle of Purbeck and Weymouth," *Memoirs of the Geol. Survey* (1898).

PURCELL, HENRY (1658–1695), English musical composer, was born in 1658 in St Ann's Lane, Old Pye Street, Westminster. His father, Henry Purcell (or Pursell), was a gentleman of the chapel-royal, and in that capacity sang at the coronation of Charles II.; he had three sons, Edward, Henry and Daniel—the last of whom (d. 1717) was also a prolific composer. After his father's death in 1664 young Henry Purcell was placed under the guardianship of his uncle, Thomas Purcell (d. 1682), a man of extraordinary probity and kindness. Through the interest of this affectionate guardian, who was himself a gentleman of His Majesty's chapel, Henry was admitted to the chapel-royal as a chorister, and studied first under Captain Henry Cooke (d. 1672), "master of the children," and afterwards under Pelham Humfrey (1647–1674), his successor, a pupil of Lully. He is said to have composed well at nine years old; but the earliest work that can be certainly identified as his is an ode for the king's birthday, written in 1670. (The dates for his compositions are often uncertain, though recent research has done much to fix them more authoritatively.) After Humfrey's death he continued his studies under Dr John Blow. In 1676 he was appointed copyist at Westminster Abbey—not organist, as has sometimes been erroneously stated—and in the same year he composed the music to Dryden's *Aurenge-Zebe*, and Shadwell's *Epsom Wells* and *The Libertine.*[1] These were followed in 1677 by the music to Mrs Behn's tragedy, *Abdelazor*, and in 1678 by an overture and masque for Shadwell's new version of Shakespeare's *Timon of Athens.* The excellence of these compositions is proved by the fact that they contain songs and choruses which never fail to please, even at the present day. The masque in *Timon of Athens* is a masterpiece, and the chorus "In these delightful pleasant groves" in *The Libertine* is constantly sung with applause by English choral societies. In 1679 he wrote some songs for Playford's *Choice Ayres, Songs and Dialogues*, and also an anthem, the name of which is not known, for the chapel-royal. From a letter written by Thomas Purcell, and still extant, we learn that this anthem was composed for the exceptionally fine voice of the Rev. John Gostling, then at Canterbury, but afterwards a gentleman of His Majesty's chapel. Purcell wrote several anthems at different times for this extraordinary voice, a *basso profundo*, the compass of which is known to have comprised at least two full octaves, from D below the stave to D above it. The dates of very few of these sacred compositions are known; but one, "They that go down to the sea in ships," though certainly not written until some time after this period, will be best mentioned here. In thankfulness for a providential escape of the king from shipwreck Gostling, who had been of the royal party, put together some verses from the Psalms in the form of an anthem, and requested Purcell to set them to music. The work is a very fine one but very difficult, and contains a passage which traverses the full extent of Gostling's voice, beginning on the upper D and descending two octaves to the lower.

In 1680 Dr Blow, who had been appointed organist of Westminster Abbey in 1669, resigned his office in favour of his pupil; and Purcell, at the age of twenty-two, was placed in one of the most honourable positions an English artist could occupy. He now devoted himself almost entirely to the composition of sacred music, and for six years entirely severed his connexion with the theatre. But during the early part of the year, and in all probability before entering upon the duties of his new office, he had produced two important works for the stage, the music for Lee's *Theodosius* and D'Urfey's *Virtuous Wife.* The composition of his opera *Dido and Aeneas*, which forms a very important landmark in the history of English dramatic music (see OPERA), has been attributed to this period, though its earliest production has been shown by Mr W. Barclay Squire to have been between 1688 and 1690. It was written to a libretto furnished by Nahum Tate, at the request of Josiah Priest, a professor of dancing, who also kept a boarding-school for young gentlewomen, first in Leicester Fields and afterwards at Chelsea. It is a musical drama in the strictest sense of the term, a genuine opera, in which the action is entirely carried on in recitative, without a word of spoken dialogue from beginning to end; and the music is of the most genial character—a veritable inspiration, overflowing with spontaneous melody, and in every respect immensely in advance of its age. It never found its way to the theatre, though it appears to have been very popular among private circles. It is believed to have been extensively copied, but one song only was printed by Purcell's widow in *Orpheus Britannicus*, and the complete work remained in manuscript until 1840, when it was printed by the Musical Antiquarian Society, under the editorship of Sir George Macfarren.

In 1682 Purcell was appointed organist of the chapel-royal, vice Edmund Lowe deceased, an office which he was able to hold conjointly with his appointment at Westminster Abbey. He had recently married, his eldest son being born in this year. His first printed composition, *Twelve Sonatas*, was published in 1683. For some years after this his pen was busily employed in the production of sacred music, odes addressed to the king and royal family, and other similar works. In 1685 he wrote two of his finest anthems, "I was glad" and "My heart is inditing," for the coronation of James II. In 1687 he resumed his connexion with the theatre by furnishing the music for Dryden's tragedy, *Tyrannic Love*. In this year also Purcell composed a march and quick-step, which became so popular that Lord Wharton adapted the latter to the fatal verses of *Lillibulero*; and in or before January 1688 he composed his anthem "Blessed are they that fear the Lord," by express command of the king. A few months later he wrote the music for D'Urfey's play, *The Fool's Preferment*. In 1690 he wrote the songs for Dryden's version of Shakespeare's *Tempest*, including "Full fathom five" and "Come unto these Yellow Sands," and the music for Betterton's adaptation of Fletcher and Massinger's *Prophetess* (afterwards called *Dioclesian*) and Dryden's *Amphitryon*; and in 1691 he produced his dramatic masterpiece, *King Arthur*, also written by Dryden, and first published by the Musical Antiquarian Society in 1843. In 1692 he composed songs and music for *The Fairy Queen* (an adaptation of Shakespeare's *Midsummer Night's Dream*), the score of which (discovered in 1901) was edited in 1903 for the Purcell Society by J. S. Shedlock.

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[1] *The Libertine* was suggested by Tirso de Molina's tale, *El Burlador de Sevilla*, afterwards dramatically treated by Molière and chosen by Da Ponte as the foundation of Mozart's *Don Giovanni.*

But Purcell's greatest work is undoubtedly his Te Deum and Jubilate, written for St Cecilia's Day, 1694, the first English Te Deum ever composed with orchestral accompaniments. In this he pressed forward so far in advance of the age that the work was annually performed at St Paul's Cathedral till 1712, after which it was performed alternately with Handel's Utrecht Te Deum and Jubliate until 1743, when it finally gave place to Handel's Dettingen Te Deum. Purcell did not long survive the production of this great work. He composed an anthem for Queen Mary's funeral, and two elegies. He died at his house in Dean's Yard, Westminster, on the 21st of November 1695, and was buried under the organ in Westminster Abbey. He left a widow and three children, three having predeceased him. His widow died in 1706. She published a number of his works, including the now famous collection called *Orpheus Britannicus* (two books, 1698, 1702).

Besides the operas already mentioned, Purcell wrote *Don Quixote*, *Bonduca*, *The Indian Queen* and others, a vast quantity of sacred music, and numerous odes, cantatas and other miscellaneous pieces. (See the list in Grove's *Dictionary of Music*.)

A Purcell Club was founded in London in 1836 for promoting the performance of his music, but was dissolved in 1863. In 1876 a Purcell Society was founded, which has done excellent work in publishing new editions of his works.

PURCHAS, SAMUEL (1575?–1626), English compiler of works on travel and discovery, was born at Thaxted, Essex, and graduated at St John's College, Cambridge, in 1600; later he became B.D., with which degree he was admitted at Oxford in 1615. In 1604 he was presented by James I. to the vicarage of Eastwood, Essex, and in 1614 became chaplain to Archbishop Abbot and rector of St Martin's, Ludgate, London. He had previously spent much time in London on his geographical work. In 1613 he published *Purchas, his Pilgrimage; or, Relations of the World and the Religions observed in all Ages* (4th ed. much enlarged, 1626); in 1619 *Purchas, his Pilgrim. Microcosmus, or the histories of Man. Relating the wonders of his Generation, vanities in his Degeneration, Necessity of his Regeneration;* and in 1625 *Hakluytus Posthumus or Purchas his Pilgrimes, contayning a History of the World in Sea Voyages and Lande Travells, by Englishmen and others* (4 vols.). This continuation of Hakluyt's *Principal Navigations* was partly based on MSS. left by Hakluyt. The fourth edition of the *Pilgrimage* is usually catalogued as vol. v. of the *Pilgrimes*, but the two works are essentially distinct. Purchas died in September or October 1626, according to some in a debtors' prison. None of his works was reprinted till the Glasgow reissue of the *Pilgrimes* in 1905–1907. As an editor and compiler Purchas was often injudicious, careless and even unfaithful; but his collections contain much of value, and are frequently the only sources of information upon important questions affecting the history of exploration.

PURCHASE, in its common sense, that which is acquired by the payment of money or its equivalent. The original meaning of the word (O. Fr. *pourchacier*, *pourchasser*, &c., popular Lat. *pro-captiare*) was to pursue eagerly, hence to acquire. Thus "purchase" was early used by the lawyers (*e.g.* Britton, in 1292) for the acquirement of property by other means than inheritance or mere act of law, including acquirement by escheat, prescription, occupancy, alienation and forfeiture; more generally, purchase in law means acquisition of land by bargain or sale, according to the law of "vendor and purchaser" (see CONVEYANCING). A later development of meaning is found in the use of the word for a mechanical contrivance by which power can be excited or applied, a hold or fulcrum. This first appears (16th century) in the nautical use of the verb, to haul up a rope or cable by some mechanical device, the root idea being apparently to "gain" advantage over the rope bit by bit.

PURDAH (Pers. *parda*), the curtain which screens women from the sight of men in Eastern countries; a *purdah-nashin* is a woman who sits behind the curtain. The term has passed into common Anglo-Indian usage, and to "lift the purdah" means to reveal a secret.

PURGATORY (Late Lat. *purgatorium*, from *purgare*, to purge), according to Roman Catholic faith, a state of suffering after death in which the souls of those who die in venial sin, and of those who still owe some debt of temporal punishment for mortal sin, are rendered fit to enter heaven. It is believed that such souls continue to be members of the Church of Christ; that they are helped by the suffrages of the living—that is, by prayers, alms and other good works, and more especially by the sacrifice of the Mass; and that, although delayed until "the last farthing is paid," their salvation is assured. Catholics support this doctrine chiefly by reference to the Jewish belief in the efficacy of prayer for the dead (2 Macc. xii. 42 seq.), the tradition of the early Christians, and the authority of the Church.

Irenaeus regards as heretical the opinion that the souls of the departed pass immediately into glory; Tertullian, Cyprian, the Acts of St Perpetua, Clement of Alexandria, Cyril of Jerusalem, Basil, Gregory of Nyassa, Ambrose, Chrysostom and Jerome, all speak of prayer for the dead and seem to imply belief in a purgatory, but their view seems to have been affected by the pre-Christian doctrine of Hades or Sheol. Some of the Greeks, notably Origen, teach that even the perfect must go through fire in the next world. Augustine writes (*De VIII. Dulcitii quaestionibus*) that "it is not incredible" that imperfect souls will be "saved by some purgatorial fire," to which they will be subjected for varying lengths of time according to their needs; but in other passages he expresses conflicting opinions (*De civitate*, xx. 25, xxi. 13, 26; *Enchiridion*, 69). Gregory the Great was the first to formulate the doctrine in express terms, "*de quibusdam levibus culpis esse ante judicium purgatorius ignis credendus est*" (*Dial.* iv. 39). Thenceforth it became part of the theology of the Western Church, and was definitely affirmed at the councils of Lyons (1274), Florence (1439) and Trent. Concerning the word *purgatory*, Innocent IV. writes: "Forasmuch as (the Greeks) say that this place of purification is not indicated by their doctors by an appropriate and accurate word, we will, in accordance with the tradition and authority of the holy fathers, that henceforth it be called *purgatorium*, for in this temporary fire are cleansed not deadly capital sins, which must be remitted by penance, but those lesser venial sins which, if not removed in life, afflict men after death."

Many points about purgatory, on which the Church has no definition, have been subjects of much speculation among Catholics. Purgatory, for example, is usually thought of as having some position in space, and as being distinct from heaven and hell; but any theory as to its exact latitude and longitude, such as underlies Dante's description, must be regarded as imaginative. Most theologians since Thomas Aquinas and Bonaventura have taught that the souls in purgatory are tormented by material fire, but the Greeks have never accepted this opinion. It must be inferred from the whole practice of indulgences as at present authorized that the pains of purgatory are measurable by years and days; but here also everything is indefinite. The Council of Trent, while it commands all bishops to teach "the sound doctrine of purgatory handed down by the venerable fathers and sacred councils," bids them exclude from popular addresses all the "more difficult and subtle questions relating to the subject which do not tend to edification."

The Eastern Church affirms belief in an intermediate state after death, but the belief is otherwise as vague as the expressions of the pre-Nicene fathers on the subject. An authoritative statement of the present Eastern doctrine is to be found in the Longer Catechism of the Orthodox Church (Q. 376):—

"Such souls as have departed with faith but without having had time to bring forth fruits meet for repentance may be aided towards the attainment of a blessed resurrection by prayers offered in their behalf, especially such as are offered in union with the oblation of the bloodless sacrifice of the Body and Blood of Christ, and by works of mercy done in faith for their memory."

The efficacy of prayers for the dead, and indirectly the doctrine of purgatory, were denied by early Gnostic sects, by Aërius in the 4th century, and by the Waldenses, Cathari, Albigenses and Lollards in the middle ages. Protestants, with the exception of a small minority in the Anglican communion, unanimously reject the doctrine of purgatory, and affirm that "the souls of believers are at their death made perfect in holiness and do immediately pass into glory." Rejection of an intermediate state after death follows the Protestant idea of justification by faith as logically as the doctrine of purgatory results from the Catholic idea of justification by works.

An analogy to purgatory can be traced in most religions. Thus the fundamental ideas of a middle state after death and of a purification preparatory to perfect blessedness are met with in Zoroaster, who takes souls through twelve stages before they are sufficiently purified to enter heaven; and the Stoics conceived of a middle place of enlightenment which they called ἐμπύρωσις.

The principal authoritative statements of the Catholic Church on the doctrine of purgatory were made at the Council of Florence (*Decret. unionis*), and at that of Trent (Sess. vi. can. 30; Sess. xxii., c. 2, can. 3; Sess. xxv.). See H. J. D. Denziger's *Enchiridion*; J. Bautz, *Das Fegfeuer* (Mainz, 1883); and L. Redner, *Das Fegfeuer* (Regensburg, 1856). A very elaborate treatise from the Catholic standpoint is that of Cardinal Bellarmine, *De purgatorio*. The subject is discussed, moreover, in all major works on dogmatic theology. There is a representative Catholic statement by Hense in the *Kirchenlexikon* under the title "Fegfeuer," 2nd ed., vol. 4, col. 1284–1296; and a corresponding Protestant presentation by Rud. Hoffmann in Hauck's *Realencyklopädie*, 3rd ed. vol. v. pp. 788–792. (C. H. Ha.)

PURI, or JAGANNATH, a town and district of British India, in the Orissa division of Bengal. The town is on the sea-coast, and has a railway station. Pop. (1901), 49,334, including an exceptional number of pilgrims. As containing the world-famous shrine of Jagannath (see JUGGERNAUT), Puri is perhaps the most frequented of all Hindu places of pilgrimage. Sanitation is effected by the Puri Lodging-House Act, which provides for the appointment of a special health officer, and for the licensing of lodging-houses both in the town and along the pilgrims' route.

The DISTRICT OF PURI has an area of 2499 sq. m. The population in 1901 was 1,017,284, showing an increase of 7·6% in the decade. For the most part the country is flat, the only mountains being a low range which, rising in the west, runs south-east in an irregular line towards the Chilka lake and forms a water-parting between the district and the valley of the Mahanadi. The middle and eastern divisions of the district, forming the south-western part of the Mahanadi delta, consist entirely of alluvial plains, watered by a network of channels through which the most southerly branch of that river, the Koyakhai, finds its way into the sea. The other rivers are the Bhargavi, the Daya and the Nun, all of which flow into the Chilka lake and are navigable by large boats during the rainy season, when the waters come down in tremendous floods, bursting the banks and carrying everything before them. The Chilka lake is one of the largest in India; its length is 44 m., and its breadth in some parts 20 m. It is separated from the sea only by a narrow strip of sand. The lake is saline and everywhere very shallow, its mean depth ranging from 3 to 5 ft. Puri district is rich in historical remains, from the primitive rock-hewn caves of Buddhism—the earliest relics of Indian architecture—to the medieval sun temple at Kanarak and the shrine of Jagannath. The annual rainfall averages 58 in.

Puri first came under British administration in 1803. The only political events in its history since that date have been the rebellion of the maharaja of Khurda in 1804 and the rising of the *paiks* or peasant militia in 1817–18. In the Orissa famine of 1866 more than one-third of the population of Puri is said to have perished. The district suffered from drought in 1897. It is served by the East Coast railway, which was opened throughout from Calcutta to Madras in 1891, with a branch to Puri town.

See *Puri District Gazetteer* (Calcutta, 1908).

PURIFICATION, in the study of comparative religion, may be defined as the expulsion or elimination by ritual actions and ceremonies from an individual or a community, a place or a dwelling, of the contagion of a taboo (*q.v.*) or ritual pollution, which is often conceived of as due to the presence of or haunting by an unclean spirit, and having for its effect disease, pain and death. In the higher religions the idea of purification has slowly developed into that of ethical liberation from sin and guilt. This development involves a distinction between the outward act and the inner act or motive, which we do not find even in the relatively advanced codes of the ancient Jews or of the Athenians of the 5th century B.C., for in both of these the taboo or guilt of homicide was the same whether accidentally or wilfully committed. It is part of this development that contrition, remorse and repentance come to be recognized, together with merely ritual acts, such as baptism and sacramental meals, as a condition of regaining the lost purity or status. The ethical ideal of atonement and purity of heart is at last attained when, as in the Society of Friends, all ritual acts are abandoned as indifferent to moral progress. The dross of the primitive taboo still encumbers the conscience in churches which insist on outward ritual performances as an element in holiness or moral perfection and purity. The tendency of civilization is more and more to antiquate them as obstacles rather than aids to the formation of character.

In most primitive societies the chief sources of ritual pollution are birth, death, bloodshed, blood, especially menstruous blood. Numberless other things are or have been taboo among different peoples, such as trees, colours, foods and drinks, persons, places, seasons. Persons and things brought even involuntarily into contact or association with these are tabooed, and only recover their normal condition by some rite of purification or *catharsis*. Such rites operate by the transference elsewhere of the stain or impurity contracted. Very generally the impurity is due to the haunting by an unclean spirit or ghost, who must be driven off by exorcists invoking the name of a more powerful and clean spirit, which usually enters the thing or person possessed in place of the unclean. On this side rites of purification may become rites of consecration. In lower civilizations disease and madness are held to be caused by evil spirits which are similarly expelled; and on this side purificatory rites develop into the medical art. It must be borne in mind that a drug was originally not a substance succeeding by dint of its chemical properties and physical reactions on our bodies, but a talisman or charm taken internally and succeeding by reason of its magical properties.

Among the methods of purification used widely among different races and in various religions, the following may be enumerated, though the list might be indefinitely extended.

1. Piacular sacrifices, often recurring annually, intended to renew the life of the god in the worshippers. "Without shedding of blood there is no remission of sins" (Heb. ix. 22).
2. Vicarious sacrifice, whereby the guilt of an individual or of a clan is transferred into an animal, like the Jewish scapegoat, which is forthwith destroyed or sent over the frontier.
3. Washing or sprinkling with water, as a rule previously blessed or exorcised; or with the water of separation (*i.e.* water mixed with ashes of a red heifer).
4. Washing with *gomez*, or urine of the sacred cow.
5. Anointing with holy oil.
6. Smearing with the blood, *e.g.* of the passover lamb or of a pig; or by actual baptism with the blood of an ox as in the Taurobolium (see MITHRAS).
7. Fumigation with smoke of incense used at sacrifices, the incense itself being the gum of a holy tree and gathered with magical precautions.
8. Rubbing with sulphur or other lyes. Use of hellebore, hyssop, &c.
9. Burning with fire objects in which the impurity has been confined.
10. Sprinkling with water in which the cross has been washed (used for flocks and fields in Armenia).
11. Evil spirits are expelled by invocation of the name of a being more powerful than they, and by the introduction of a clean spirit.
12. By fasting.
13. In the old Parsee religion the *drugs* or demons which infect a corpse can be driven off by the look of certain kinds of dogs.
14. An impure contagion may be removable together with hair, nails or bits of clothing. Hence the use of the tonsure and the custom of shaving the head in vows.

15. By Houses may be purged of evil spirits by sweeping them out with a broom, or by many of the cathartic media above enumerated for purification of the person.

16. By use of salt.

17. By celibacy, virginity and abstention from sexual intercourse.

18. By confession or expulsion of the evil in speech.

19. By spitting and blowing the nose in order to evacuate devils harbouring in the head and throat.

20. By spittle, as in the baptismal rite of the Latins.

21. By passing between fires or jumping through fire.

22. By sitting or standing on or wearing the fleece of a holy animal.

23. By beating and stinging with ants, by branding, tattooing, knocking out of teeth.

24. By circumcision and other more serious mutilations.

In many of these rites the old man contaminated in some way is put off and the mystic is reborn. This idea of rebirth is especially prominent in the blood-bath of the Taurobolium (No. 6) and in Christian baptism (*q.v.*); also in the initiatory rites of various savages who even make a pretence of killing their boys and bringing them back to life again. (F. C. C.)

PURIM, a Jewish festival held on the 14th and 15th of Adar, the last month of the Jewish calendar. According to Jewish tradition it is held in celebration of the deliverance of the Jews from the massacre plotted against them by their enemy Haman in the time of Artaxerxes, who fixed upon the former date by casting "lots" (=Hebrew loan-word *Purim*). It is preceded by a fast on the 13th day of Adar, known as the Fast of Esther, based upon Esther iv. 16.

Purim is the carnival of the Jewish year. Friends exchange gifts, and thus occasion is taken to relieve the necessities of the poor in the most considerate manner under the guise of gifts. The children masquerade, and their parents are enjoined to drink wine until they cannot distinguish between blessing Mordecai and cursing Haman. The Megillah or Roll of Esther is read both at home and in the synagogue, and wherever, during the reading, the name of Haman is mentioned, it is accompanied with tramping the feet. In former times Haman was burnt in effigy, holding on to a ring and swinging from one side of the fire to the other (see L. Ginzberg, *Geonica*, 1909, pp. 1, 419; Davidson, *Parody*, pp. 21–22). This custom, which is still observed among the Jews of Caucasia (Tchorni, *Sepher ha-Masaoth*, pp. 191–192), is very ancient, as it is mentioned in the Talmud (Sanhedrin 64). From the 17th century onward Purim plays were performed mostly by the children, who improvised a dramatic version of the story of Esther. This grew to be the characteristic folk-drama of the ghetto, and has not died out in eastern Europe to the present day.

Much ingenuity has been spent upon the name and origin of the feast. As regards the name, we may dismiss at once the suggestions of J. Fuerst (*Kanon des Alten Testaments*) that it is derived from the Persian *bahar*, "spring," and of Hitzig (*Geschichte Israels*), who derives it from the modern Arabic *Phur*, "the New Year." These conjectures were made in the pre-scientific era of philology. Scarcely more is to be said in favour of the suggestion made by Von Hammer; but better known in connexion with the name of Lagarde, who connects the name Purim with the old Zoroastrian festival of the dead, entitled *Farwardigan*. Lagarde, who is followed by Renan, connects this form with the LXX. variant of the Hebrew (φρουραί); but there is absolutely nothing about Purim which suggests any relation with a festival of the dead. Graetz's suggestion (*Monats. Jud.* xxxv. 10 seq.) that it is derived from the Hebrew *purah*, meaning wine-press (Is. lxiii. 3), obviously fails to connect a spring festival of joyousness with the autumn vine harvest. Zimmern (*ZATW* xl. 157 seq.) connects Purim with the *puchru* or assembly of the gods, which forms part of the Babylonian New Year festival Zagmuku, but the inserted guttural is against the identification.

The most plausible etymology connects the name with the Assyrian *puru*, either in the sense of "turn" of office at the beginning of the New Year or in that of "pebble" used for votes or lots, as with the Greek ψῆφος. It is a curious coincidence, to say the least, that Dieulafoy found among the ruins of the Memnonium at Susa (the ancient Shushan, given as the scene of the events narrated in the Book of Esther) a quadrangular prism bearing different numbers on its four faces. This etymological connexion, suggested by Jensen (*Kosmologie*, 84), brings the festival of Purim into close relation with the Babylonian New Year festival known as *Zagmuku*, in which one of the most prominent ceremonials was the celebration of the assembly of the gods under the presidency of Marduk (Merodach) for the purpose of determining the fates of the New Year. Meissner (*ZDMG*, i. 296 seq.) and others have suggested that the drunkenness and masquerading current at the period of Purim are directly derived from the general period of licence allowed at the Sacaea festival of the Babylonian New Year. Even the fact that this latter was celebrated on the first of Nisan, or a fortnight after the Jewish date for Purim, is confirmed by the Book of Esther itself, which states that "In the first month, which is the month Nisan, they cast Pur, that is, the lot, before Haman" (Esther iii. 7–ix. 26). The change of date may have been made in order not to conflict with the Passover on the 15th of Nisan. The connexion that has been suggested between the names of Mordecai and Esther and those of the Assyrian deities Marduk and Ishtar would be a further strong confirmation of the proposed etymology and derivation of the feast (see ESTHER).

Going still further, J. G. Frazer connects Purim with the whole series of spring festivals current in western Asia, in which the old god of vegetation was put to death and a new human representative of him elected and allowed to have royal and divine rights, so as to promote the coming harvest (*Golden Bough*, 2nd. ed., vol. iii. p. 154 seq.). The death of the god, he suggests, is represented by the Fast of Esther on the 13th of Adar, the day before Purim, while the rejoicing on Purim itself, and the licence accompanying it, recall the union of the god and goddess of vegetation, of which he sees traces in the relations of Mordecai and Esther. There may possibly be "survivals" of the influence of some such celebrations both on the Book of Esther and on the ceremonies of Purim, but there is absolutely no evidence that the Jews took over the interpretation of these festivals with their celebration. Nor is there any record of royal privileges attaching to any person at the period of Purim such as occurs in the festivals with which it is supposed to be connected by Frazer. His further suggestion, therefore, that the ironical crowning of Jesus with the crown of thorns and the inscription over the Cross, together with the selection of Barabbas, had anything to do with the feast of Purim, must be rejected. The connexion of the Passion with the Passover rather than Purim would alone be sufficient to nullify the suggestion. However, it is practically certain, both from the etymology of the word Purim and from the resemblance of the festivals, that the feast, as represented in the Book of Esther, was borrowed from the Persians, who themselves appeared to have adapted it from the Babylonians. This is confirmed by the fact that the Book of Esther contains several Persian words and shows throughout a familiarity with Persian conditions. This renders it impossible to accept Haupt's suggestion that Purim is connected with the celebration of Nicanor's Day, to celebrate the triumph of Judas Maccabaeus over the Syrian general Nicanor at Adasa (161 B.C.) on the 13th of Adar, since this is the date of the Fast of Esther, and, besides, the Second Book of Maccabees, which refers to Nicanor's Day, speaks of it as the day before Mordecai's Day (2 Macc. xvi. 36). If, as seems probable, the earlier Greek version of the Book of Esther was made about 179 B.C. (Swete, *Introduction of the Old Testament in Greek*, p. 25), this suggestion of the connexion of Purim with the Maccabean period made by Haupt and, before him, by Willrich, falls to the ground.

At the same time it is difficult to understand why Jews in Palestine and Egypt should have accepted a purely Persian or Babylonian festival long after they had ceased to be connected with the Persian Empire. One can understand its adoption during, or soon after, the reign of Cyrus, whose policy was so favourable to the Jews, and it might easily have become as popular among them as Christmas tends to become among modern Jews. When the exiles returned from Babylon they probably brought back with them the practice of keeping the festival.

The date at which the feast of Purim was first adopted by the Jews from their Persian neighbours would be definitely determined if we knew the date of the Book of Esther. The festival is first mentioned in 2 Macc. xv. 36, and from that time onwards has formed one of the most popular festivals of the Jewish calendar. It became customary to burn an effigy of Haman at the conclusion of the feast, and this was regarded as in some ways an attack on Christianity and was therefore forbidden by the Theodosian code, XVI. viii. 18. This prohibition may have been due to the fact mentioned by Socrates (*Hist. eccles.* vii.) that, in 416 A.D., the Jews of Inmester, a town in Syria, ill-treated a Christian child during some Purim pranks and caused his death. It has even been suggested that this gave rise to the myth of the blood accusation in which Jews are alleged to sacrifice a Christian child at Passover; but this is unlikely, since it has never been suggested that this crime was committed in connexion with Purim. But Jewish sources of the 10th century state that the custom of burning an effigy of Haman was still kept up at that time (L. Ginzberg, *Geonica*, ii.), and this is confirmed by Albiruni (*Chronology*, tr. Sachau, 273) and Makrizi, and indeed the custom was carried on down to the present century by Jewish children, who treated Haman as a sort of Guy Fawkes. Frazer suggests (*loc. cit.* 172) that this is a survival of the burning of the man-god, like Hercules or Sandan, who again represented the old spirit of vegetation which was dying away in spring to revive with the new vegetation. The earliest mention, however, of this burning of Haman in effigy cannot be traced back earlier than the Talmud in the 5th century.

In connexion with Purim many quaint customs were introduced by the Jews of later times. All means are adapted to increase the hilarity of the two days, which are filled with feasting, dancing, singing and making merry generally. In Germany it was even customary for men to dress up as women, and women as men, against the command of Deut. xxii. 5. In Frankfort the women were allowed to open their lattice windows in the synagogue in honour of the deliverance brought about by Esther. Execration of Haman, as the typical persecutor of the Jews, took various forms. In Germany wooden mallets were used in the synagogue to beat the benches when Haman's name was read out from the scroll of Esther, and during the festivities these mallets were sometimes used on the heads of the bystanders. Cakes were made of a certain shape to be eaten by the children, which were called, in Germany, *Hamantaschen* (Haman-pockets) and *Hamanohren* (Haman-ears), and in Italy, *Orecchie d'Aman.* In Italy a puppet representing Haman was set up on high amidst shouts of vengeance and blowing of trumpets. In Caucasus the women made a wooden block to represent Haman, which, on being discovered by the men on their return to the synagogue, was thrown into the fire. Besides gifts to friends, parents made Purim gifts to their children, especially in the form of Purim cakes. To preside over these festivities it was customary to have a master of the ceremonies, who was called king in Provence, somewhat after the manner of the Feast of Fools. In later days the same function was performed by the Purim Rabbi, who often indulged in parodies of the ritual.

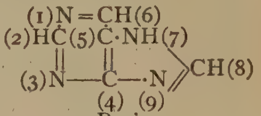
With Purim is connected the only trace of a true folk-drama among Jews. The first Spanish drama written by Jews was entitled "Esther," by Solomon Usque and Lazaro Gratiano, published in 1567; and there is another entitled "Comedia famosa de Aman y Mordechay," produced anonymously in Leiden in 1699. Among the German Jews *Purim-Spiele* were frequent and can be traced back to the 16th century, where there is reference to their being regularly performed at Tannhausen. The earliest one of these printed was entitled "Ahaswerosh-Spiel," appeared at Frankfort in 1708, and was reprinted by Schudt in *Juedische Merck-Wuerdigkeiten,* ii. 314 seq. These were followed by a large number of similar reproductions, none of any great merit, but often showing ingenuity in parodying more serious portions of the Jewish ritual (Davidson, *Parody,* pp. 27, 50, 199–203).

Besides the general festival of Purim, various communities of Jews have instituted special local Purims to commemorate occasions when they have been saved from disaster. Thus the Jews of Cairo celebrated Purim on the 28th of Adar in memory of their being miraculously saved from the persecution of Ahmed Pasha in 1524. The Jews of Frankfort celebrate their special Purim on the 20th of Adar because of their deliverance from persecution by Fettmilch in 1616. The Jews of Algiers similarly celebrated the repulse of the emperor Charles V. in 1541, by which they escaped coming once more into the yoke of the Spaniards. Similar occasions for rejoicing were introduced by individuals into their families to celebrate their escape from danger. Thus Abraham Danzig celebrated in this manner his escape from the results of an explosion of a powder magazine at Wilna in 1804. Rabbi Enoch Altschul of Prague recorded his own escape on the 22nd of Tebet 1623 in a special roll or *megillah,* which was to be read by his family on that date with rejoicing similar to the general Purim. David Brandeis of Jung-Bunzlau in Bohemia was saved from an accusation of poisoning on the 10th of Adar 1731, and instituted a similar family Purim celebration in consequence.

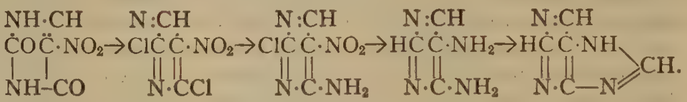
See Biblical Dictionaries of Hastings and Cheyne, *s.v.*; *Jew. Ency., s.v.* "Purim"; "Purim Plays," "Purims, Special"; W. Erbt, *Die Purimsage* (Berlin, 1900); Abrahams, *Jewish Life in the Middle Ages*; Lagarde, *Purim, ein Beitrag zur Geschichte der Religion* (Göttingen, 1885); Steinschneider, *Purim und Parodie* (Berlin, 1902); P. Haupt, *Purim* (Leipzig, 1906); Davidson, *Parody in Jewish Literature*, pp. 21, 27, 30, 135–9 (New York, 1908).

(J. Ja.)

PURIN, $C_5H_4N_4$, in chemistry, the name given by Emil Fischer to the parent substance of a large group of compounds, the more important of which are sarcine, xanthine, uric acid, adenine, paraxanthine, guanine, theophylline, theobromine and caffeine. Its formula is shown in the inset, the positions taken by substituent atoms or groups being numbered as shown. E. Fischer (*Ber.*, 31, p. 2564) obtained it in 1898 by reducing 2·6-di-iodo purin, obtained from 2·6·8 trichlor purin (see below *sub Uric acid*), hydriodic acid and phosphonium iodide at 0°, with zinc dust and water, the zinc double salt so obtained being decomposed by sulphuretted hydrogen, the precipitated zinc sulphide filtered off and the solution concentrated. It has also been synthesized by O. Isay (*Ber.*, 1906, 39, p. 250) from 5-nitro-uracil. This substance with phosphorus oxychloride gives 2·4-dichlor-5-nitro pyrimidine, which with ammonia gives 4-amino-2-chlor-5-nitro pyrimidine; by reducing this compound with hydriodic acid and phosphonium iodide, 4·5-diamino-pyrimidine is obtained, which with formic acid furnishes purin; thus:—



Purin.

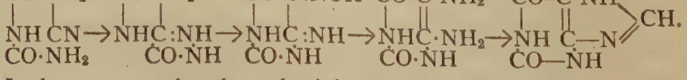


Purin crystallizes in microscopic needles, which melt at 216° C. It possesses the properties of both an acid and a base. It is characterized by its ready solubility in water and by its stability towards oxidizing agents.

Oxypurins.—Sarcine or hypoxanthine, $C_5H_4N_4O$, is 6-oxypurin. It is found in many animal liquids and organs and in the seeds of many plants, and was discovered by J. Scherer in milk (*Ann.* 1850, 73, p. 328) and by A. Strecker in muscle. It crystallizes in needles which decompose at 150° C. It was synthesized by E. Fischer (*Ber.*, 1897, 30, p. 2228) by heating 2·6·8-trichlorpurin with aqueous caustic potash, and reducing the dichlorhypoxanthine so obtained by hydriodic acid. Its aqueous solution shows acid properties, decomposing carbonates. It also forms a hydrochloride, $C_5H_4N_4O{\cdot}HCl{\cdot}H_2O$. When oxidized by hydrochloric acid and potassium chlorate it yields alloxan and urea, whilst with potassium permanganate it gives oxalic acid.

3-*Methylhypoxanthine* was synthesized by W. Traube and F. Winter (*Arch. Pharm.*, 1906, 244, p. 11), whilst *8-oxypurin* was obtained by E. Fischer and L. Ach in 1897 (*Ber.*, 30, p. 2213), and by O. Isay (*Ber.*, 1906, 39, p. 251).

Xanthine, $C_5H_4N_4O_2$, or 2·6-dioxypurin, was discovered in 1817 by Marcet in a urinary calculus; it also occurs in various animal organs (the liver, pancreas and muscular tissue), in urine, and in beetroot juice. It may be prepared by boiling nuclein with water (A. Kossel, *Zeit. physiol. Chem.*, 1880, 4, p. 290); by the decomposition of guanine with nitrous acid (A. Strecker, *Ann.*, 1858, 108, p. 141); and by heating the formyl derivative of 4·5-diamino-2·6-dioxypyrimidine to 120° C. (W. Traube, *Ber.*, 1900, 33, p. 3035). This pyrimidine is prepared from cyanacetyl urea, which on treatment with a concentrated solution of sodium hydroxide is converted into 4-amino-2·6-dioxypyrimidine. The isonitroso derivative of this compound is then reduced by ammonium sulphide to 4·5-diamino-2·6-dioxypyrimidine, the formyl derivative of which, on heating passes into xanthine.



It decomposes when heated, giving ammonia, carbon dioxide and hydrocyanic acid. It possesses both acid and basic properties. When heated with concentrated hydrochloric acid to 220° C, it decomposes into carbon dioxide, ammonia, glycine and formic acid. Potassium chlorate and hydrochloric acid oxidize it to alloxan and urea. Methylation of its lead salt gives theobromine.

The isomeric 6·8-dioxypurin was prepared by E. Fischer and L. Ach (*loc. cit*).

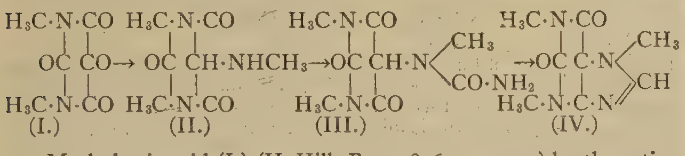
1-*Methylxanthine* was found in urine by M. Krüger and G. Salomon (*Zeit. physiol. Chem.*, 1897, 24, p. 364); 3-*methylxanthine* was obtained by E. Fischer and F. Ach (*Ber.*, 1898, 30, 1980) from 3-methyl uric acid; and *7-methylxanthine* or heteroxanthine, which is found in human urine, may be obtained from theobromine (E. Fischer, *Ber.*, 1897, 30, p. 2400; see also ibid., 1898, 31, p. 117).

Theophylline, $C_5(CH_3)_2H_2O_2N_4$, or 1·3-dimethyl-2·6-dioxypurin, was isolated by A. Kossel from tea-leaves (*Ber.*, 1888, 21, p. 2164). It was synthesized by E. Fischer and L. Ach (*Ber.*, 1895, 28, p. 3135) from 1·3-dimethyl uric acid, which on treatment with phosphorus pentachloride yields chlortheophylline, from which theophylline is obtained by reduction with hydriodic acid. W. Traube (*Ber.*, 1900, 33, p. 3035) formed the nitroso derivative of iminodimethyl barbituric acid (obtained by the action of phosphorus oxychloride on cyanacetic acid and dimethyl urea), and reduced it by ammonium sulphide to 1·3-dimethyl-4·5-diamino-2·6-dioxypyrimidine, the formyl derivative of which, when heated to 250° C., loses the elements of water and yields theophylline (cf. *Xanthine*). It behaves as a weak base. When oxidized by potassium chlorate and hydrochloric acid it yields dimethylalloxan. Its silver salt on methylation yields caffeine.

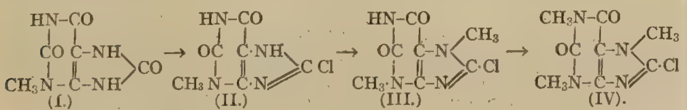
The isomeric *Paraxanthine*, or 1·7-dimethyl-2·6-dioxypurin, occurs in urine. It has been obtained from theobromine (E. Fischer, *Ber.*, 1897, 30, p. 2400); from 1·7-dimethyl uric acid (E. Fischer and H. Clemm, *Ber.*, 1898, 31, p. 2622); and from 8-chlorcaffeine (E. Fischer, *Ber.*, 1906, 39, p. 423). On methylation it yields caffeine.

A third isomer *Theobromine*, or 3·7-dimethyl-2·6-dioxypurin, is found in the cocoa-bean (from *Theobroma cacao*) and in the kola-nut. It is obtained by methylating xanthine, or from 3·7-dimethyl uric acid (E. Fischer, *Ber.*, 1897, 30, p. 1839). This acid, by the action of phosphorus oxychloride and pentachloride, is converted into 3·7-dimethyl-6-chlor-2·8-dioxypurin, which with ammonia gives the corresponding amino compound. This substance with phosphorus oxychloride yields 3·7-dimethyl-6-amino-2-oxy-8-chlorpurin, which on reduction with hydriodic acid leads to 3·7-dimethyl-6-amino-2-oxypurin, from which theobromine is obtained by the action of nitrous acid. It is also obtained by W. Traube's method (*Ber.*, 1900, 33, p. 3047) from cyanacetyl methyl urea, which gives 3-methyl-4·5-diamino-2·6-dioxypyrimidine, whose formyl derivative yields 3-methylxanthine, from which theobromine is obtained by methylation. It crystallizes in anhydrous needles which sublime at 290–295° C. It behaves as a weak base. Potassium chlorate and hydrochloric acid oxidize it to methyl alloxan and methyl urea, chromic acid mixture oxidizes it to carbon dioxide, methylamine and methylparabanic acid. When boiled with baryta it yields carbon dioxide, ammonia, methylamine, formic acid and sarcosine. Methylation of its silver salt yields caffeine.

Caffeine, $C_5H(CH_3)_3N_4O_2$, is 1·3·7-trimethyl-2·6-dioxypurin. For its general properties and method of extraction see CAFFEINE. It may be synthesized by methylating chlortheophylline and reducing the resulting product (E. Fischer and L. Ach, *Ber.*, 1895, 28, p. 3135); by the action of phosphorus oxychloride on tetramethyl uric acid, the resulting chlorcaffeine being reduced (*Ber.*, 1897, 30, p. 3010); from dimethylalloxan (*Ber.*, 1897, 30, p. 564); from 3-methyl uric acid (*Ber.*, 1898, 31, p. 1980), and from 1·3-dimethyl-4·5-diamino-2·6-dioxypyrimidine (W. Traube, *Ber.*, 1900, 33, p. 3042). The three latter methods may be outlined as follows. Dimethylalloxan (I.) condenses with methylamine in the presence of sulphurous acid to form an addition product (II.), which on hydrolysis yields 1·3·7-trimethyl uramil; this substance gives with potassium cyanate, 1·3·7-trimethyl pseudo-uric acid (III.), which on dehydration yields 1·3·7-trimethyl uric acid (hydroxycaffeine); this substance with phosphorus pentachloride gives chlorcaffeine, which yields caffeine (IV.) on reduction:—



3-Methyl uric acid (I.) (H. Hill, *Ber.*, 1876, 9, p. 370) by the action of phosphorus oxychloride is converted into 3-methyl-2·6-dioxy-8-chlorpurin (3-methyl-chlorxanthine) (II.), which, on treatment with methyl iodide in alkaline solution, gives chlortheobromine (III.), from which chlorcaffeine (IV.) can be obtained by further methylation:—

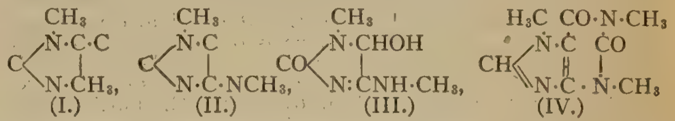


Dimethyl-diamino-dioxypyrimidine (see *Theophyllin* above) yields a formyl derivative which on treatment with sodium ethylate furnishes a sodium salt. This salt heated for some hours with methyl iodide yields caffeine.

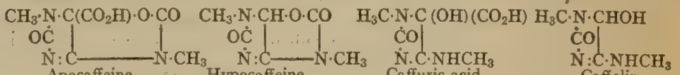
The constitution of caffeine was settled by E. Fischer (*Ann.*, 1882, 215, p. 253). Earlier investigations had shown that oxidation with nitric acid gave dimethylparabanic acid or cholesterophane (J. Stenhouse, *Ann.*, 1843, 45, p. 366); that chlorine water oxidized it to amalic acid or tetramethyl alloxantin (Fr. Rochleder, *Ann.* 1849, 71, p. 1), and that hydrolysis with baryta gave caffeidine (A. Strecker, *Ann.*, 1862, 123, p. 360), which could be further hydrolysed to sarcosine, methylamine, formic acid and carbon dioxide (O. Schultzen, *Zeit. f. Chemie*, 1867, p. 614). Fischer confirmed these results and showed further that oxidation with chlorine water gave monomethyl urea and dimethyl alloxan, pointing to the presence of three methyl groups in the molecule. Further, on bromination, a brom-derivative is obtained which on treatment with alcoholic potash yields ethoxy-caffeine, which readily hydrolyses to hydroxy-caffeine. This substance behaves as an unsaturated compound and combines with a molecule of bromine to form a derivative which on treatment with alcoholic potash yields diethoxy-hydroxycaffeine. Diethoxy-hydroxycaffeine on hydrolysis with concentrated hydrochloric acid yields apocaffeine, $C_7H_7N_3O_5$, and hypocaffeine, $C_6H_7N_3O_3$:

$$C_8H_9(OC_2H_5)_2(OH)N_4O_2 \rightarrow \left\{ \begin{array}{l} C_7H_7N_3O_5+CH_3NH_2+2C_2H_5OH \\ C_6H_7N_3O_3+CO_2+CH_3NH_2+2C_2H_5OH. \end{array} \right.$$

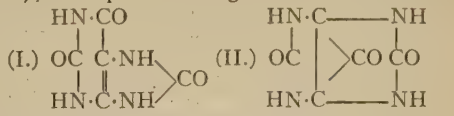
Apocaffeine when boiled with water loses carbon dioxide and yields caffuric acid, $C_6H_9N_3O_4$, which on hydrolysis with basic lead acetate is converted into mesoxalic acid, methylamine and monomethyl urea. Reduction of caffuric acid yields hydrocaffuric acid, $C_6H_9N_3O_3$, which readily hydrolyses to methyl hydantoin. Consequently hydrocaffuric and caffuric acids, apocaffeine and caffeine must contain the grouping (I.). Hypocaffeine on hydrolysis loses carbon dioxide and gives caffolin, $C_5H_9N_3O_2$, which on oxidation with alkaline potassium ferricyanide yields monomethyl urea and methyl oxamic acid, whilst if oxidized by alkaline potassium permanganate it yields dimethyl oxamide. Hence caffolin contains the grouping (II.), and in consequence of its close relationship to hydrocaffuric acid is to be written as (III.). It follows that the caffeine molecule must be written as (IV.), a result confirmed by the later synthesis of caffeine itself from dimethyl alloxan (see above).



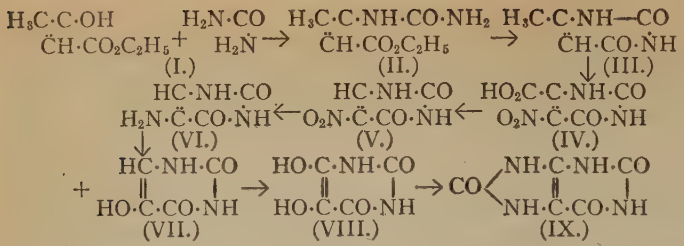
The above decomposition products of caffeine probably possess the following constitutions:—


Apocaffeine. Hypocaffeine. Caffuric acid. Caffolin.

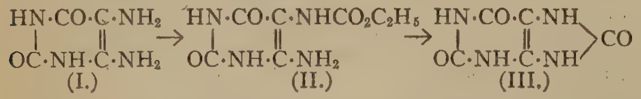
Uric acid, $C_5H_4N_4O_3$, or 2·6·8-trioxypurin, was discovered in 1776 in urinary calculi by Scheele. It is found in the juice of the muscles, in blood, in urine, in the excrement of serpents and birds, and in guano. The determination of the constitution and of the relation of uric acid to the other members of the group has been a process of gradual growth. G. Brugnatelli (*Giornale di fisica, chemica, &c., di Brugnatelli*, 1818, 11, pp. 38, 117) obtained alloxan, and W. Prout (*Phil. Trans.*, 1818, p. 420) obtained ammonium purpurate from uric acid, but the first elaborate investigation on the acid was by J. v. Liebig and F. Wöhler (*Ann.*, 1838, 26, p. 241), who obtained from it allantoin, alloxantin, dialuric acid, parabanic acid, oxaluric acid, mesoxalic acid, &c. Further examination of the group was undertaken by A. Schlieper (*Ann.*, 1845, 55, p. 256; 56, p. 1), who obtained hydurilic acid and dilituric acid, and by A. v. Baeyer (*Ann.*, 1863, 127, pp. 1, 199; 1864, 130, p. 129; 131, p. 291), who showed that uric acid and many of its derivatives may be looked on as derivatives of barbituric acid. In 1875 L. Medicus (*Ann.*, 1875, 175, p. 230) proposed the formula (I.) for the acid, whilst R. Fittig in 1877 (*Traité de chim. org.*, p. 324 [1878]) suggested the formula (II.); subsequent investigations of R. Behrend and



of E. Fischer showed the first formula to be correct. The first syntheses of uric acid are due to J. Horbaczewski (*Monats.*, 1882, p. 796; 1885, p. 356), who obtained very poor yields. These were followed by the more satisfactory methods of R. Behrend and O. Roosen (*Ann.*, 1888, 251, p. 235) of E. Fischer and L. Ach (*Ber.*, 1895, 28, p. 2473) and of W. Traube (*Ber.*, 1900, 33, p. 3035). Horbaczewski obtained the acid by heating urea with amino-acetic acid (glycine) to 200–230° C, and by fusing urea with trichlorlactamide. In Behrend's method acetoacetic ester and urea (I.) are condensed and the resulting β-uramidocrotonic ester (II.) on hydrolysis gives methyl uracil (III.), which on treatment with concentrated nitric acid yields nitro-uracil carboxylic acid (IV.). This acid when boiled with water loses carbon dioxide, forming nitro-uracil (V.), which on reduction gives amido-uracil (VI.) and oxy-uracil (VII). Oxidation of oxy-uracil with bromine water leads to dioxyuracil (VIII.), which when heated with urea and concentrated sulphuric acid yields uric acid (IX.):—



E. Fischer dehydrated pseudo-uric acid (formed from potassium cyanate and uramil) by heating it with anhydrous oxalic acid to 185° C, or with a large excess of 20% hydrochloric acid (*Ber.*, 1897, 30, p. 560), and so obtained uric acid. This method is quite general. W. Traube condenses the sulphate of 4·5-diamino-2·6-dioxypyrimidine (I.) (see *Xanthine*, above) with chlorcarbonic ester. The resulting urethane (II.) when heated to 180–190° C loses a molecule of alcohol, giving uric acid (III.).



Uric acid is a white, microcrystalline powder. It is odourless and tasteless, and is insoluble in most reagents. Its solubility in water is increased by the presence of various inorganic salts, such as sodium phosphate, sodium acetate, borax, and particularly by lithium carbonate. It dissolves completely in concentrated sulphuric acid, but is reprecipitated on the addition of water. It behaves as a weak dibasic acid. It is decomposed by heat into ammonia, urea, cyanuric acid and carbon dioxide. On fusion with caustic alkalis it yields alkaline cyanide, cyanate, oxalate and carbonate. It may be recognized by means of the "murexide" reaction, which consists in evaporating the acid to dryness with nitric acid, when a yellowish residue is obtained which becomes purple-red if moistened with ammonia. On the quantitative estimation of uric acid see F. W. Tunnicliffe (*Chem. Centralb.*, 1897, 11, p. 987; E. H. Bartley, ibid., p. 644 and F. G. Hopkins, *Chem. News*, 1892, 66, p. 106).

Methyl Uric Acids.—1-Methyl uric acid was prepared by E. Fischer and H. Clemm (*Ber.*, 1897, 30, p. 3091) from monomethyl alloxan and ammonium sulphite, which condense together to form 1-methyluramil. This, with potassium cyanate, gives 1-methyl-4ψ-uric acid, which on dehydration gives 1-methyl uric acid. 3- or α-Methyl uric acid was prepared by Hill (*Ber.*, 1876, 9, p. 370) by heating acid lead urate with methyl iodide. It is best obtained by heating 3-methyl chlorxanthine with hydrochloric acid to 125° C. (E. Fischer, *Ber.*, 1898, 31, p. 1984). 7- or γ-Methyl uric acid is prepared by heating 7-methyl-2·6·8-trichlorpurin (which results from phosphorus pentachloride and theobromine) with hydrochloric acid to 130° C., or by the condensation of alloxan with methylamine in the presence of sulphur dioxide (E. Fischer, *Ber.*, 1897, 30, p. 563; cf. 1-methyl uric acid). It is the most soluble in water of the methyl uric acids. 9- or β-Methyl uric acid was obtained by E. Fischer (*Ber.*, 1884, 17, pp. 332, 1777) by heating normal lead urate with methyl iodide to 100° C. The product so obtained was converted by the action of phosphorus oxychloride and pentachloride into 9-methyl-8-oxy-2·6-dichlorpurin, and this when heated with hydrochloric acid to 140° C. gave the required methyl uric acid. It is distinguished from 3-methyl uric acid by its much smaller solubility in water and by the greater stability of its ammonium salt. A fifth isomer, δ-methyl uric acid, has been described by W. v. Loeben (*Ann.*, 1897, 298, p. 181) who obtained it by condensing acetoacetic ester and monomethyl urea according to Behrend's method. The constitution of this acid is not definitely known.

1·3 or γ-Dimethyl uric acid is obtained by converting dimethyl alloxan into dimethyluramil, which with potassium cyanate gives dimethyl-ψ-uric acid; this acid is then dehydrated (E. Fischer, *Ber.*, 1895, 28, p. 2475; 1897, 30, p. 560). 1·7-Dimethyl uric acid is similarly obtained by starting with monomethyl alloxan and methylamine (E. Fischer and H. Clemm, *Ber.*, 1897, 30, p. 3095).

1·9-Dimethyl uric acid is obtained from 9-methyl-8-oxy-2·6-dichlorpurin (see *9-Methyl uric acid* above). By successive treatment with ammonia and nitrous acid this is converted into 9-methyl-6·8-dioxy-2-chlorpurin, which on condensation with formaldehyde in alkaline solution yields 9-methyl-7-oxymethyl-6·8-dioxy-2-chlorpurin. Methylation of this latter compound introduces a methyl group into position 1, and the dimethyl compound so formed on dilution with water and the simultaneous action of superheated steam yields 1·9-dimethyl-6·8-dioxy-2-chlorpurin, from which 1·9-dimethyl uric acid is obtained by hydrolysis with concentrated hydrochloric acid at 100° C. (E. Fischer, and F. Ach *Ber.*, 1899, 32, p. 257). 3·7 or δ-Dimethyl uric acid is prepared by methylating 7-methyl uric acid (E. Fischer, *Ber.*, 1897, 30, p. 564) or by heating bromtheobromine with alkalis (*Ber.*, 1895, 28, p. 2482). 3·9-Dimethyl uric acid is prepared by heating neutral lead urate with methyl iodide (H. B. Hill and C. F. Mabery, *Amer. Chem. Journ.*, 1880–1881, 2, p. 308) and by methylating 3-methyl uric acid (E. Fischer, *Ber.*, 1899, 32, p. 269). 7·9 or β-Dimethyl uric acid is prepared by heating 7·9-dimethyl-8-oxy-2·6-dichlorpurin with hydrochloric acid to 130° C.

1·3·7-Trimethyl uric acid or hydroxycaffeine, may be prepared from caffeine, or by direct methylation of uric acid at 0° C. (E. Fischer). 1·3·9-Trimethyl uric acid is prepared by methylating 1·3-dimethyl uric acid (E. Fischer and L. Ach, *Ber.*, 1895, 28, p. 2478). 1·7·9-Trimethyl uric acid is prepared by methylating 9-methyl-6·8-dioxy-2-chlorpurin (see *1·9-dimethyl uric acid*, above) and heating the resulting trimethyl dioxychlorpurin with concentrated hydrochloric acid to 110–115° C. (E. Fischer and F. Ach, *Ber.*, 1899, 32, p. 256).

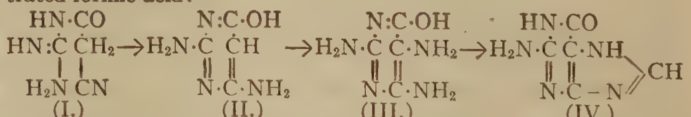
Tetramethyl uric acid was first prepared (*Ber.*, 1884, 17, p. 1784) by methylating 3·7·9-trimethyl uric acid. It may also be obtained by methylating uric acid and the other methyl uric acids. It has a neutral reaction.

Aminopurins.—*Adenine* is 6-aminopurin. It has been found in ox pancreas and also in tea. It is prepared by heating 2·6·8-trichlorpurin with ammonia, and reducing the resulting 6-amino-2·8-dichlorpurin with hydriodic acid; or by heating 8-oxy-2·6-dichlorpurin (from uric acid and phosphorus oxychloride) with alcoholic ammonia to obtain 8-oxy-2-chlor-6-aminopurin, which with phosphorus oxychloride at 140° C., gives 6-amino-2·8-dichlorpurin. Reduction of this compound with hydriodic acid yields adenine (E. Fischer, *Ber.*, 1897, 30, p. 2238; 1898, 31, p. 104). It crystallizes from water in leaflets which contain three molecules of water of crystallization. The anhydrous base melts at 360–365° C. Nitrous acid converts it into hypoxanthine; whilst hydrochloric acid at 180-200° C. decomposes it completely into ammonia, carbon dioxide, formic acid and glycocoll (A. Kossel, *Ber.*, 1890, 23, p. 225; 1893, 26, p. 1914).

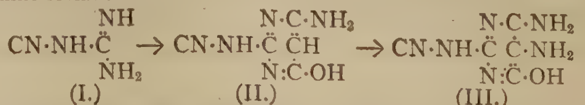
Isoadenine or 2-aminopurin, is obtained from 2·4-dichlor-5-nitropyrimidine (see *Purin*, above) by heating it with ammonia, when 2·4-diamino-5-nitropyrimidine is formed. Reduction of this compound by means of stannous chloride and hydrochloric acid gives 2·4·5-triaminopyrimidine which readily condenses with formic acid to isoadenine (O. Isay, *Ber.*, 1906, 39, p. 250). It has also been obtained by J. Tafel and B. Ach (*Ber.*, 1901, 34, p. 1177) by the electrolytic reduction of guanine to desoxyguanine, the acetate of which is warmed with bromine and subsequently oxidized.

9-Methyl adenine was first obtained by I. Krüger (*Zeit. f. physiol. Chem.*, 1894, 18, p. 434) by methylating adenine, and has been synthesized by E. Fischer (*Ber.*, 1898, 31, p. 104) from 9-methyl-2·6-dichlor-8-oxypurin. For 7-methyl adenine see E. Fischer, *Ber.*, 1898, 31, p. 104.

Guanine, or 2-amino-6-oxypurin, is found in the pancreas of various animals and also very abundantly in guano, from which it was first extracted by B. Unger (*Ann.*, 1844, 51, p. 395; 1846, 58, p. 18). It has been obtained synthetically from 6-oxy-2·8-dichlorpurin (E. Fischer, *Ber.*, 1897, 30, p. 2252) by heating it with alcoholic ammonia to 150° C. and reducing the resulting 6-oxy-2-amino-8-chlorpurin with hydriodic acid. W. Traube (*Ber.*, 1900, 33, p. 1371) condensed cyanacetic ester with guanidine and the resulting compound (I.) with caustic soda gives 2·4-diamino-6-oxypyrimidine (II.). This substance yields an isonitroso-derivative which on reduction with ammonium sulphide gives 2·4·5-triamino-6-oxypyrimidine (III.), from which guanine (IV.) is obtained by heating with concentrated formic acid:—



It may also be obtained as follows [E. Merck, German Patents 158591 (1903); 162336 (1904)]. Dicyandiamide (I.) condenses with cyanacetic ester to form 2-cyanamino-4-amino-6-oxypyrimidine (II.). This yields an isonitroso-derivative which on reduction gives 2-cyanamino-4·5-diamino-6-oxypyrimidine (III.). This compound when boiled with a 90% solution of formic acid gives guanine formate:—

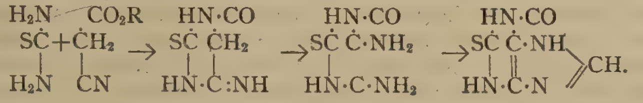


It is an amorphous powder, insoluble in water, alcohol and ether, and has both acid and basic properties. Nitrous acid converts it into xanthine. When oxidized by hydrochloric acid and potassium chlorate it yields guanidine, parabanic acid and carbon dioxide.

6-Amino-2-oxypurin, an isomer of guanine, is prepared by heating dichloradenine or 6-amino-2·6·8-trichlorpurin, obtained from 2·6·8 trichlorpurin and ammonia (Fischer, *Ber.*, 1897, 30, p. 2239) with sodium ethylate to 130° C. and reducing the resulting 6-amino-2-ethoxy-8-chlorpurin with hydriodic acid (E. Fischer, *Ber.*, 1897, 30, p. 2245). 6-Amino-8-oxypurin, another isomer of guanine, is prepared by heating 8-oxy-2·6-dichlorpurin with alcoholic ammonia and reducing the resulting amino-oxy-chlor compound with hydriodic acid (E. Fischer, *loc. cit.*).

7-Methyl guanine is obtained from 7-methyl-6-oxy-2-chlorpurin (see above) by the action of aqueous ammonia at 150° C. It also results instead of the expected 7-methyl-2-oxy-6-aminopurin, when 7-methyl-6-amino-2-chlorpurin is treated with dilute alkalis (E. Fischer, *Ber.*, 1898, 31, p. 542), owing to ring splitting in the 1·6-position, followed by eliminating of halogen acid.

Thiopurins.—W. Traube (*Ann.*, 1904, 331, pp. 66 seq.) has obtained many compounds of the purin group by using thiourea, which is condensed with cyanacetic ester, &c., to form thiopyrimidines. These in turn yield thiopurins, which on oxidation with dilute nitric acid are converted into purin compounds, thus:—



$$\begin{array}{c}\mathrm{H_2N\quad CO_2R}\\ \mathrm{S\dot{C}+\dot{C}H_2}\\ |\qquad|\\ \mathrm{H_2N\quad CN}\end{array} \rightarrow \begin{array}{c}\mathrm{HN\cdot CO}\\ \mathrm{S\dot{C}\ \dot{C}H_2}\\ |\quad|\\ \mathrm{HN\cdot C:NH}\end{array} \rightarrow \begin{array}{c}\mathrm{HN\cdot CO}\\ \mathrm{S\dot{C}\ \dot{C}\cdot NH_2}\\ |\qquad\\ \mathrm{HN\cdot C\cdot NH_2}\end{array} \rightarrow \begin{array}{c}\mathrm{HN\cdot CO}\\ \mathrm{S\dot{C}\ \dot{C}\cdot NH}\\ |\quad\|\\ \mathrm{HN\cdot C\cdot N}\end{array}\!\!>\mathrm{CH}.$$

Various thiopurins have been obtained by E. Fischer (*Ber.*, 1898, 31, p. 431), principally by acting with potassium sulphydrate on chlorinated purin compounds.

2·6·8-Trithiopurin is obtained from the corresponding trichlorpurin and potassium sulphydrate. It forms a light yellow mass which carbonizes on heating. It is almost insoluble in water and alcohol; but readily dissolves in dilute solutions of the caustic alkalis and of ammonia.

Much work has been done by J. Tafel (*Ber.*, 1900, seq.) on the electrolytic reduction of the members of the purin group. The substance to be reduced is dissolved in a 50–75% solution of sulphuric acid and placed in a porous cell containing a lead cathode, the whole being then placed in a 20–60% solution of sulphuric acid in the anode cell. It is found that xanthine and its homologues take up four atoms of hydrogen per molecule and give rise to the so-called desoxy-compounds, which are stronger bases than the original substances. Uric acid takes up six hydrogen atoms per molecule and gives *purone*, $C_5H_8N_4O_2$, and it is apparently the oxygen atom attached to the carbon atom number 6 which is replaced by hydrogen, since when purone is heated with baryta, two molecules of carbon dioxide are liberated for one of purone. Consequently purone must contain two urea residues, which necessitates the presence of the $>CO$ groups in positions 2 and 8. (F. G. P.*)

PURITANISM (Lat. *puritas*, purity), the name given—originally perhaps in a hostile sense on the analogy of Catharism (see CATHARS)—to the movement for greater strictness of life and simplicity in worship which grew up in the Church of England in the 16th century among those who thought that there had not been a sufficient divergence from the Roman Church, and which ultimately led to the rise of a number of separatist denominations. Thomas Fuller (*Church History*) traces the earliest use of the term "Puritan" to 1564. The terms "Precisian," "Puritan," "Presbyterian," were all used by Archbishop Parker in his letters about this time as nicknames for the same party, and ten years later the name was in common use.

See ENGLAND, CHURCH OF; CONGREGATIONALISM; PRESBYTERIANISM, &c.; also D. Neal, *History of the Puritans* (ed. Toulmin, 5 vols., 1822); E. Dowden, *Puritan and Anglican* (1901); J. Heron, *A Short History of Puritanism* (1908).

PURLIEU, a word used of the outlying parts of a place or district, sometimes in a derogatory sense. It was a term of the old English forest law (*q.v.*), and meant, as defined by Manwood (*Treatise of the Forest Laws*), "a certain territory of ground adjoining unto the forest,. . .which. . .was once forest-land and afterwards disafforested by the perambulations made for the severing of the new forests from the old." The owner of freelands in the purlieu to the yearly value of forty shillings was known as a "purlieu-man" or "purley-man." There seems no doubt that "purlieu" or "purley" represents the Anglo-French *puralé*, *puralee* (O. Fr. *pouraler*, *puraler*, to go through, Lat. *perambulare*), a legal term meaning properly a perambulation to determine the boundaries of a manor, parish, &c.

PURLIN, a term in architecture for the longitudinal timbers of a roof, which are carried by the principal rafters and the end walls and support the common rafters.

PURNEA or PURNIAH, a town and district of British India, in the Bhagalpur division of Bengal. The town is on the left bank of the little river Saura, with a railway station. Pop. (1901), 14,007. It has a bad reputation for fever.

The DISTRICT OF PURNEA has an area of 4994 sq. m. and a population (1901) of 1,874,794, showing a decrease of 3·6% in the decade. The district extends from the Ganges northwards to the frontier of Nepal. It is a level, depressed tract of country, consisting for the most part of a rich, loamy soil of alluvial formation. It is traversed by several rivers flowing from the Himalayas, which afford great advantages of irrigation and water-carriage; in the west the soil is thickly covered with sand deposited by changes in the course of the Kusi. Among other rivers are the Mahananda and the Panar. Under Mahommedan rule Purnea was an outlying province, yielding little revenue and often in a state of anarchy. Its local governor raised a rebellion against Suraj-ud-daula in 1757, after the capture of Calcutta. The principal crops are rice, pulses and oilseeds. The cultivation of indigo is declining, but that of jute is extending. The district is traversed by branches of the Eastern Bengal railway, which join the Bengal and North-Western railway at Katihar.

PURPLE, a colour-name, now given to a shade varying between crimson and violet. Formerly it was used, as the origin of the name shows, of the deep crimson colour called in Latin *purpura*, *purpureus* and in Greek πορφύρα, πορφύρεος (from πορφύρειν, to grow dark, especially used of the sea). This was properly the name of the shellfish (*Purpura*, *Murex*) which yielded the famous Tyrian dye, the particular mark of the dress of emperors, kings, chief magistrates and other dignitaries, whence "the purple" still signifies the rank of emperors or kings.

The title of *porphyrogenitus* (Gr. πορφυρογέννητος) was borne particularly by Constantine VII., Byzantine emperor, but was also used generally of those born of the Byzantine imperial family. This title, generally translated "born in the purple," either refers to the purple robes in which the imperial children were wrapped at birth, or to a chamber or part of the imperial palace, called the *Porphyra* (πόρφυρα), where the births took place. Whether this *Porphyra* signified a chamber with purple hangings or lined with porphyry is not known (see Selden, *Titles of Honour*, ed. 1672, p. 60 seq.).

PURPURA, in pathology, a general term for the symptom of purple-coloured spots upon the surface of the body, due to extravasations of blood in the skin, accompanied occasionally with haemorrhages from mucous membranes. The varieties of purpura may be conveniently divided as follows: (*a*) toxic, following the administration of certain drugs, notably copaiba, quinine, ergot, belladonna and the iodides; also following snakebite; (*b*) cachectic, seen in persons suffering from such diseases as tuberculosis, heart disease, cancer, Bright's disease, jaundice, as well as from certain of the infectious fevers, extravasations of the kind above mentioned being not infrequently present; (*c*) neurotic; (*d*) arthritic, which includes the form known as "Purpura simplex," in which there may or may not be articular pain, and the complaint is usually ushered in by lassitude and feverishness, followed by the appearance on the surface of the body of the characteristic spots in the form of small red points scattered over the skin of the limbs and trunk. The spots are not raised above the surface, and they do not disappear on pressure. Their colour soon becomes deep purple or nearly black; but after a few days they undergo the changes which are observed in the case of an ordinary bruise, passing to a green and yellow hue and finally disappearing. When of minute size they are termed "petechiae" or "stigmata," when somewhat larger "vibices," and when in patches of considerable size "ecchymoses." They may come out in fresh crops over a lengthened period.

Purpura rheumatica (Schönlein's disease) is a remarkable variety characterized by sore throat, fever and articular pains accompanied by purpuric spots and associated with urticaria and occasionally with definite nodular infiltrations. This is by many writers considered to be a separate disease, but it is usually regarded as of rheumatic origin.

Purpura haemorrhagica (acute haemorrhagic purpura) is a more serious form, in which, in addition to the phenomena already mentioned as affecting the skin, there is a tendency to the occurrence of haemorrhage from mucous surfaces, especially from the nose, but also from the mouth, lungs, stomach, bowels, kidneys, &c., sometimes in large and dangerous amount. Great physical prostration is apt to attend this form of the disease, and a fatal result sometimes follows the successive haemorrhages, or is suddenly precipitated by the occurrence of an extravasation of blood into the brain.

The treatment will bear reference to any causes which may be discovered as associated with the onset of the disease, such as unfavourable hygienic conditions, and nutritive defects should be rectified by suitable diet. The various preparations of iron seem to be the best medicinal remedies in this ailment, while more direct astringents, such as gallic acid, ergot of rye, turpentine or acetate of lead, will in addition be called for in severe cases and especially when haemorrhage occurs. Sir A. Wright considers that in all cases of purpura the coagulation-time of the blood should be estimated. In such cases the time taken for clotting may be increased to three times as long as that taken by normal blood. He therefore advises calcium chloride in order to increase coagulability. In severe haemorrhages, adrenalin is often useful.

PURRAH, PURROH, or PORO, a secret society of Sierra Leone, West Africa. Only males are admitted to its ranks, but two other affiliated and secret associations exist, the Yassi and the Bundu, the first of which is nominally reserved for females, but members of the Purrah are admitted to certain ceremonies. All the female members of the Yassi must be also members of the Bundu, which is strictly reserved to women. Of the three, the Purrah is by far the most important. The entire native population is governed by its code of laws. It primarily represents a type of freemasonry, a "friendly" society to which even infants are temporarily admitted, the ceremony in their case consisting merely of carrying them into the Purrah "bush" and out again. But this side of the Purrah is merged in its larger objects as represented by its two great aspects, the religious and the civil. Under the former, boys join it at puberty, while under the latter it is practically the native governing body, making laws, deciding on war and peace, &c.

The Purrah has its special ritual and language, tattooing and symbols, but details are unknown, as the oath of secrecy is always kept. It meets usually in the dry season, between the months of October and May. The rendezvous is in "the bush," an enclosure, separated into apartments by mats and roofed only by the overhanging trees, serving as a club-house. There are three grades, the first for chiefs and "big men," the second for fetish-priests and the third for the crowd. The ceremonies of the Purrah are presided over by the Purrah "devil," a man in fetish dress, who addresses the meeting through a long tube of wood.

The Purrah can place its taboo on anything or anybody; and as no native would venture to defy its order, much trouble has been caused where the taboo has been laid upon crops. In 1897 the British or local government was compelled to pass a special ordinance absolutely forbidding the imposition of the taboo on all indigenous products. Of the affiliated societies the Yassi appears to some extent to be an association for providing men and women, who believe themselves ill through "fetish," with medical treatment, on payment of certain fees. The women's Bundu is in many ways a replica of the men's Purrah, though without political power.

See T. J. Alldridge, *The Sherbro and its Hinterland* (1901).

PURSE (Late Lat. *bursa*, adapted from Gr. *βύρσα*, hide, skin; possibly O. Eng. *pusa*, bag, has influenced the change from *b* to *p*), a small bag for holding money, originally a leather pouch tied at the mouth, but now of various shapes. The great seal of England is borne by the purse-bearer in a purse, usually styled "burse," decorated with the arms of the kingdom, the "burse" being thus one of the insignia of office of the lord chancellor of England. The "privy purse" is the amount of public money set apart in the civil list for the private and personal use of the sovereign (see PRIVY PURSE).

PURSER, the old name for the paymaster of the British and American navies still used in merchant vessels of to-day. In the British navy he was appointed by a warrant from the admiralty and was paid partly by salary and partly by a percentage (10%) on the value of unexpended stores.

PURSLANE, the common name for a small fleshy annual with prostrate stems, entire leaves and small yellow flowers, known botanically as *Portulaca oleracea*. It is a native of India, which was introduced into Europe as a salad plant, and in some countries has spread so as to become a noxious weed. In certain parts of the United States the evil qualities of "pussly" have become proverbial. Its juice is refreshing and is used in tropical countries as a refrigerant in fever. Some of the species of the same genus, such as *P. grandiflora* and its varieties, are grown in gardens on rock-work owing to the great beauty and deep colouring of their flowers, the short duration of individual blossoms being compensated for by the abundance with which they are produced.

PURSUIVANT (O. Fr. *porsivant*, *poursivant*, mod. *poursuivant*, strictly an attendant, from *poursuivre*, to follow), the name of a member of the third and lowest rank of heraldic officers, formerly an attendant on the heralds. There are four pursuivants in the English Heralds' College, Rouge Croix, Bluemantle, Rouge Dragon and Portcullis; three in the Court of Lyon King of Arms (Scotland), Carrick, Unicorn and March; and four in the court of Ulster King of Arms (Ireland), Athlone and three St Patrick pursuivants. (See HERALD and HERALDRY.)

PURULIA, a town of British India, headquarters of Manbhum district in Bengal, on the Sini-Asansol branch of the Bengal-Nagpur railway. Pop. (1901), 17,291. It is a growing centre of trade.

PURVEYANCE (Lat. *providere*, to provide), in England in former times the right of the sovereign when travelling through the country to receive food and drink and maintenance generally from his subjects for himself and his retinue. The custom dates from Anglo-Saxon times and is analogous to the right of *fodrum*, or *annona militaris*, exercised by the Frankish kings. Although in early times purveyance was reasonable and necessary, enabling the king to make journeys for the purpose of administering justice and discharging the other duties of government, it was liable to grave abuses, and under the later Plantagenet kings it became very oppressive. Provision for the royal needs was interpreted in the widest possible sense, and the right was exercised, not only on behalf of the king, but on behalf of his relatives. Besides victuals it included the compulsory use of horses and carts and even the enforcement of personal labour. Not infrequently no payment was made; when it was it often took the form of tallies, which gave the recipient the right to deduct the amount from any taxes he might have to pay in the future. Purveyors were appointed to requisition goods, and they also fixed the price. The abuses of purveyance, which appear to have reached their climax during the reign of Edward I., frequently provoked legislation. Chapter xxviii. of Magna Carta is directed against them, while further attempts to curb them were made in the Statute of Westminster of 1275 and in the *Articuli super cartas* of 1300. Purveyance was entirely forbidden by the ordinance of 1311, but in spite of all prohibitions its evils grew and flourished. During the reign of Edward III. ten statutes were directed against it, and by a law of 1362 it was restricted to the personal wants of the king and queen; at the same time the hated name of purveyor was changed to that of buyer, and ready money was ordered to be paid for the articles taken. From this time little was heard about the evils of purveyance until 1604, when the House of Commons petitioned James I., giving some striking illustrations of its hardships. It was asserted that when the royal officials required 200 carts they ordered 800 or 900 to be brought, in order that they might obtain bribes from the owners. Bacon called purveyance "the most common and general abuse of all others in the kingdom." Twice James entered into negotiations with his parliament for commuting his crown rights, of which purveyance was one, for an annual payment, but no arrangement was reached. In 1660, however, the right of purveyance, which had fallen into disuse with the execution of Charles I., was surrendered by Charles II. in return for the grant of an excise on beer and liquors. The custom was exercised by almost all European sovereigns, and in France at least was as oppressive as in England. The word purveyor now means merely a vendor, generally a vendor of food and drink.

See W. Stubbs, *Constitutional History of England* (1896), vol. ii.; H. Hallam, *Constitutional History of England* (1863); and S. R. Gardiner, *History of England* (1905), vol. i.

PUSA, a village of British India, in Darbhanga district, Bengal, near the right bank of the Burhi Gandak River; pop. (1901), 4570. It was acquired as a government estate in 1796, and was long used as a stud dépôt and afterwards as a tobacco farm. In 1904 it was selected as the site of a college and laboratory for agricultural research.

PUSEY, EDWARD BOUVERIE (1800–1882), English divine, was born at Pusey near Oxford on the 22nd of August 1800. His father was Philip Bouverie (d. 1828), a younger son of Jacob Bouverie, 1st Viscount Folkestone, and took the name of Pusey on succeeding to the manorial estates at that place. After having been at Eton, he became a commoner of Christ Church, Oxford, and was elected in 1824 to a fellowship at Oriel. He thus became a member of a society which already contained some of the ablest of his contemporaries—among them J. H. Newman and John Keble. Between 1825 and 1827 he studied Oriental languages and German theology at Göttingen. His first work, published in 1828, as an answer to Hugh James Rose's Cambridge lectures on rationalist tendencies in German theology, showed a good deal of sympathy with the German "pietists," who had striven to deliver Protestantism from its decadence; this sympathy was misunderstood, and Pusey was himself accused of holding rationalist views.

In the same year (1828) the duke of Wellington appointed him to the regius professorship of Hebrew with the attached canonry of Christ Church. The misunderstanding of his position led to the publication in 1830 of a second part of Pusey's *Historical Enquiry*, in which he denied the charge of rationalism. But in the years which immediately followed the current of his thoughts began to set in another direction. The revolt against individualism had begun, and he was attracted to its standard. By the end of 1833 he showed a disposition to make common cause with those who had already begun to issue the *Tracts for the Times.* "He was not, however, fully associated in the movement till 1835 and 1836, when he published his tract on baptism and started the Library of the Fathers" (Newman's *Apologia*, p. 136). He became a close student of the fathers and of that school of Anglican divines who had continued, or revived, in the 17th century the main traditions of pre-Reformation teaching. A sermon which he preached before the university in 1843, *The Holy Eucharist a Comfort to the Penitent*, so startled the authorities by the re-statement of doctrines which, though well known to ecclesiastical antiquaries, had faded from the common view, that by the exercise of an authority which, however legitimate, was almost obsolete, he was suspended for two years from the function of preaching. The immediate effect of his suspension was the sale of 18,000 copies of the condemned sermon; its permanent effect was to make Pusey for the next quarter of a century the most influential person in the Anglican Church, for it was one of the causes which led Newman to sever himself from that communion. The movement, in the actual origination of which he had had no share, came to bear his name: it was popularly known as Puseyism (sometimes as Newmania) and its adherents as Puseyites. His activity, both public and private, as leader of the movement was enormous. He was not only on the stage but also behind the scenes of every important controversy, whether theological or academical. In the Gorham controversy of 1850, in the question of Oxford reform in 1854, in the prosecution of some of the writers of *Essays and Reviews*, especially of Benjamin Jowett, in 1863, in the question as to the reform of the marriage laws from 1849 to the end of his life, in the Farrar controversy as to the meaning of everlasting punishment in 1877, he was always busy with articles, letters, treatises and sermons. The occasions on which, in his turn, he preached before his university were all memorable; and some of the sermons were manifestoes which mark distinct stages in the history of the High Church party of which he was the leader. The practice of confession in the Church of England practically dates from his two sermons on *The Entire Absolution of the Penitent*, in 1846, in which the revival of high sacramental doctrine is complemented by the advocacy of a revival of the penitential system which medieval theologians had appended to it. The sermon on *The Presence of Christ in the Holy Eucharist*, in 1853, first formulated the doctrine round which almost all the subsequent theology of his followers revolved, and which revolutionized the practices of Anglican worship. Of his larger works the most important are his two books on the Eucharist—*The Doctrine of the Real Presence* (1855) and *The Real Presence . . . the Doctrine of the English Church* (1857); *Daniel the Prophet* in which he endeavours to maintain the traditional date of that book; *The Minor Prophets, with Commentary*, his chief contribution to the study of which he was the professor; and the *Eirenicon*, in which he endeavoured to find a basis of union between the Church of England and the Church of Rome.

In private life Pusey's habits were simple almost to austerity. He had few personal friends, and rarely mingled in general society; though bitter to opponents, he was gentle to those who knew him, and his munificent charities gave him a warm place in the hearts of many to whom he was personally unknown. In his domestic life he had some severe trials; his wife died, after eleven years of married life, in 1839; his only son, who was a scholar like-minded with himself, who had shared many of his literary labours, and who had edited an excellent edition of St Cyril's commentary on the minor prophets, died in 1880, after many years of suffering. From that time Pusey was seen by only a few persons. His strength gradually declined, and he died on the 16th of September 1882, after a short illness. He was buried at Oxford in the cathedral of which he had been for fifty-four years a canon. In his memory his friends purchased his library, and bought for it a house in Oxford, known as the Pusey House, which they endowed with sufficient funds to maintain three librarians, who were charged with the duty of endeavouring to perpetuate in the university the memory of the principles which he taught.

Pusey is chiefly remembered as the eponymous representative of the earlier phase of a movement which carried with it no small part of the religious life of England in the latter half of the 19th century. His own chief characteristic was an almost unbounded capacity for taking pains. His chief influence was that of a preacher and a spiritual adviser. As a preacher he lacked all the graces of oratory, but compelled attention by his searching and practical earnestness. His correspondence as a spiritual adviser was enormous; his deserved reputation for piety and for solidity of character made him the chosen confessor to whom large numbers of men and women unburdened their doubts and their sins. But if he be estimated apart from his position as the head of a great party, it must be considered that he was more a theological antiquary than a theologian. Pusey in fact was left behind by his followers even in his lifetime. His revival of the doctrine of the Real Presence, coinciding as it did with the revival of a taste for medieval art, naturally led to a revival of the pre-Reformation ceremonial of worship. With this revival of ceremonial Pusey had little sympathy: he at first protested against it (in a university sermon in 1859); and, though he came to defend those who were accused of breaking the law in their practice of it, he did so on the express ground that their practice was alien to his own. But this revival of ceremonial in its various degrees became the chief external characteristic of the new movement; and "Ritualist" thrust "Puseyite" aside as the designation of those who hold the doctrines for which he mainly contended. On the other hand, the pivot of his teaching was the appeal to primitive antiquity; and in this respect he helped to start inquiry which has since gone far beyond the materials which were open to one of his generation.

See J. Rigg, *Character and Life-Work of Dr Pusey* (1883); B. W. Savile, *Dr Pusey, an Historic Sketch, with Some Account of the Oxford Movement* (1883), and especially the *Life* by Canon Liddon, completed by J. C. Johnston and R. J. Wilson (5 vols., 1893–1899), Newman's *Apologia*, and other literature of the Oxford Movement.

Pusey's elder brother, Philip Pusey (1799–1855), was a member of parliament and a friend and follower of Sir Robert Peel. He was one of the founders of the Royal Agricultural Society, and was chairman of the implement department of the great exhibition of 1851. He was a fellow of the Royal Society, a writer on varied topics to the reviews and the author of the hymn "Lord of our Life and God of our Salvation."

PUSHBALL, a game played by two sides on a field usually 140 yds. long and 50 yds. wide, with a ball 6 ft. in diameter and 50 ℔ in weight. The sides usually number eleven each, there being five forwards, two left-wings, two right-wings and two goal-keepers. The goals consist of two upright posts 18 ft. high and 20 ft. apart with a crossbar 7 ft. from the ground. The game lasts for two periods with an intermission. Pushing the ball under the bar counts 5 points; lifting or throwing it over the bar counts 8. A touchdown behind goal for safety counts 2 to the attacking side. The game was invented by M. G. Crane, of Newton, Massachusetts, in 1894, and was taken up at Harvard University the next year, but has never attained any considerable vogue. In Great Britain the first regular game was played at the Crystal Palace in 1902 by teams of eight. The English rules are somewhat different from those obtaining in the United States. Pushball on horseback was introduced in 1902 at Durland's Riding Academy in New York, and has been played in England at the Military Tournament.

PUSHKAR, a town of British India, in Ajmere district, Rajputana, 7 m. N. of Ajmere town. Pop. (1901), 3831. It derives its name from a small lake among the hills, 2389 ft. above the sea, in which Brahma is once said to have bathed as a penance. It contains one of the very few temples, in all India, dedicated to Brahma. At the annual celebration (Oct.–Nov.) about 100,000 pilgrims come to bathe in the lake.

PUSHKIN, ALEXANDER (1799–1837), Russian poet, was born at Moscow, on the 7th of June 1799. He belonged to an ancient family of boyars; his maternal great-grandfather, a favourite negro ennobled by Peter the Great, bequeathed to him curly hair and a somewhat darker complexion than falls to the lot of the ordinary Russian. In 1811 the future poet entered the newly founded lyceum of Tsarskoe Selo, situated near St Petersburg. On quitting the lyceum in 1817 he was attached to the ministry of foreign affairs, and in this year he began the composition of his *Ruslan and Ly'udmila*, a poem which was completed in 1820. Meanwhile Pushkin mixed in all the gayest society of the capital, and it seemed as if he would turn out a mere man of fashion instead of a poet. But a very daring *Ode to Liberty* written by him had been circulated in manuscript in St Petersburg. This production having been brought to the notice of the governor, the young author only escaped a journey to Siberia by accepting an official position at Kishinev in Bessarabia, in southern Russia. If we follow the chronological order of his poems, we can trace the enthusiasm with which he greeted the ever-changing prospects of the sea and the regions of the Danube and the Crimea.

At this time Pushkin was, or affected to be, overpowered by the Byronic "Weltschmerz." Having visited the baths of the Caucasus for the re-establishment of his health in 1822, he felt the inspiration of its magnificent scenery, and composed *The Prisoner of the Caucasus*, narrating the story of the love of a Circassian girl for a youthful Russian officer. This was followed by the *Fountain of Bakhchisarai*, which tells of the detention of a young Polish captive, a Countess Potocka, in the palace of the khans of the Crimea. About the same time he composed some interesting lines on Ovid, whose place of banishment, Tomi, was not far distant. To this period belongs also the *Ode to Napoleon*, which is inferior to the fine poems of Byron and Manzoni, or indeed of Lermontov, on the same subject. In the *Lay concerning the Wise Oleg* we see how the influence of Karamzin's *History* had led the Russians to take a greater interest in the early records of their country. The next long poem was the *Gipsies* (Tzuigani), an Oriental tale of love and vengeance, in which Pushkin has admirably delineated these nomads, whose strange mode of life fascinated him. During his stay in southern Russia he allowed himself to get mixed up with the secret societies then rife throughout the country. He also became embroiled with his chief, Count Vorontzov, who sent him to report upon the damages which had been committed by locusts in the southern part of Bessarabia. Pushkin took this as a premeditated insult, and sent in his resignation; and Count Vorontzov in his official report requested the government to remove the poet, "as he was surrounded by a society of political and literary fanatics, whose praises might turn his head and make him believe that he was a great writer, whereas he was only a feeble imitator of Lord Byron, an original not much to be commended." The poet quitted Odessa in 1824, and on leaving wrote a fine *Ode to the Sea*. Before the close of the year he had returned to his father's seat at Mikhailovskoe, near Pskov, where he soon involved himself in trouble on all sides. In his retirement he devoted a great deal of time to the study of the old Russian popular poetry, the *builinas*, of which he became a great admirer. Recollections of Byron and André Chenier gave the inspiration to some fine lines consecrated to the latter, in which Pushkin appeared more conservative than was his wont, and wrote in a spirit antagonistic to the French Revolution. In 1825 he published his tragedy *Boris Godunov*, a bold effort to imitate the style of Shakespeare. Up to this time the traditions of the Russian stage, such as it was, had been French.

In 1825 the conspiracy of the Dekabrists broke out. Many of the conspirators were personal friends of Pushkin, especially Küchelbecker and Pustchin. The poet himself was to a certain extent compromised, but he succeeded in getting to his house at Mikhailovskoe and burning all the papers which might have been prejudicial to him. Through influential friends he succeeded in making his peace with the emperor, to whom he was presented at Moscow soon after his coronation. The story goes that Nicholas said to Count Bludov on the same evening, "I have just been conversing with the most witty man in Russia." In 1828 appeared *Poltava*, a spirited narrative poem, in which the expedition of Charles XII. against Peter and the treachery of the hetman Mazeppa were described. In 1829 Pushkin again visited the Caucasus, on this occasion accompanying the expedition of Prince Paskevich. He wrote a pleasing account of the tour; many of the short lyrical pieces suggested by the scenery and associations of his visit are delightful, especially the lines on the Don and the Caucasus. In 1831 Pushkin married Natalia Goncharov, and in the following year was again attached to the ministry of foreign affairs, with a salary of 5000 roubles. He now busied himself with an historical account of the revolt of the Cossack Pugachev, who almost overthrew the empire of Catherine and was executed at Moscow in the latter part of the 18th century. While engaged upon this he wrote *The Captain's Daughter*, one of the best of his prose works. In 1832 was completed the poem *Eugene Onyegin*, in which the author modelled his style upon the lighter sketches of Byron in the Italian manner. Yet no one can accuse Pushkin of want of nationalism in this poem: it is Russian in every fibre.

In 1837 the poet, who had been long growing in literary reputation, fell mortally wounded in a duel with Baron George Heckeren d'Anthès, the adopted son of the Dutch minister then resident at the court of St Petersburg. D'Anthès, a vain and frivolous young man, had married a sister of the poet's wife. Notwithstanding this he aroused Pushkin's jealousy by some attentions which he paid Natalia; but the grounds for the poet's anger, it must be confessed, do not appear very great. Pushkin died, after two days' suffering, on the afternoon of Friday the 10th of February. D'Anthès was tried by court-martial and expelled the country. In 1880 a statue of the poet was erected at the Tver Barrier at Moscow, and fêtes were held in his honour, on which occasion many interesting memorials of him were exhibited to his admiring countrymen and a few foreigners who had congregated for the festivities. Pushkin left four children; his widow was afterwards married to an officer in the army, named Lanskoi; she died in 1863.

Pushkin's poetical tales are spirited and full of dramatic power. The influence of Byron is undoubtedly seen in them, but they are not imitations, still less is anything in them plagiarized. *Boris Godunov* is a fine tragedy; on the whole *Eugene Onyegin* must be considered Pushkin's masterpiece. Here we have a great variety of styles—satire, pathos and humour mixed together. The character-painting is good, and the descriptions of scenery introduced faithful to nature. The poem in many places reminds us of Byron, who himself in his mixture of the pathetic and the humorous was a disciple of the Italian school. Pushkin also wrote a great many lyrical pieces. Interspersed among the poet's minor works will be found many epigrams, but some of the best composed by him were not so fortunate as to pass the censorship, and must be read in a supplementary volume published at Berlin. As a prose writer Pushkin has considerable merits. Besides his *History of the Revolt of Pugachev*, which is perhaps too much of a compilation, he published a small volume of tales under the *nom de plume* of Ivan Byelkin. These all show considerable dramatic power: the best are *The Captain's Daughter*, a tale of the times of Catherine II.; *The Undertaker*, a very ghostly story, which will remind the English reader of some of the tales of Edgar Poe; *The Pistol Shot*; and *The Queen of Spades*.

The academy of St Petersburg has recently issued a complete edition of the works of Pushkin, including his letters. See the bibliography in the editions of Gennadi (7 vols., St Petersburg, 1861) and Annenkov (6 vols., St Petersburg, 1855). (W. R. M.)

PUSHTU, the language of the Pathan races of Afghanistan and the North-West Frontier province of India. It belongs to the Iranian group of the Indo-European languages, but possesses many Panjabi words. In Afghanistan it is the dominant language, but is not spoken west of the Helmund. In India it has two main dialects, the northern, hard or Pukhtu, and the southern, soft or Pushtu. The dividing line of the two dialects runs eastwards from Thal through the Kohat district almost to the Indus, but it then turns northwards, as the speech of the Akhora Khattaks belongs to the Pushtu or southern dialect. Thus Pukhtu is spoken in Bajour, Swat and Buner, and by the Yusufzais, Bangash, Orakzais, Afridis and Mohmands; while Pushtu is spoken by the Waziris, Khattaks, Marwats and various minor tribes in the south. The language division corresponds roughly with the tribal system of the Pathans, who are aristocratic in the north and democratic in the south. The classical dialect of Pukhtu is that of the Yusufzais, in which the earliest works in the language were composed. The Orakzai dialect differs from that of the Afridis, in that it is broader but less guttural and spoken more rapidly. The standard dialect is that of Peshawar. The literature is richest in poetry, Abdur Rahman, of the 17th century, being the best-known poet. Pushtu was spoken in the North-West Frontier province in 1901 by 1,142,011 persons, or 54% of the population.

See Grierson, *Linguistic Survey of India*; Roos-Keppel, *Manual of Pushtu* (1901); Lorimer, *Grammar of Waziri Pushtu* (1902).

PUTEAUX, a north-western suburb of Paris, on the left bank of the Seine, 4½ m. from the centre of the city. Pop. (1906), 28,718. Puteaux has a church of the 16th century with good stained glass windows. There is a fort on the Seine.

PUTEOLI (mod. *Pozzuoli, q.v.*), an ancient town of Campania, Italy, on the northern shore of the Bay of Puteoli, a portion of the Bay of Naples, from which it is 6 m. W. The statement made by Stephanus of Byzantium and Jerome, that the city was founded under the name of Dicaearchia by a colony of Samians about 520 B.C., is probably correct, for, though in the territory of Cumae, it does not appear to have been occupied previous to 520, Misenum having been the original port of Cumae. On the other hand, Cumae probably extended her supremacy over it not long after. Its history in the Samnite period is unknown; but the coins of Fistelia (or Fistlus in Oscan) probably belong to Puteoli, as Mommsen thought. Nor do we know anything of its history between 334 (when it probably became a *civitas sine suffragio* under Roman domination, shortly afterwards receiving, in 318, a *praefectus iure dicundo*) and 215, when the Romans introduced a garrison of 6000 men to protect the town from Hannibal, who besieged it in vain for three days in 214. In 194 a Roman colony of 300 men was established. The *lex parieti faciundo*, an interesting inscription of 105 B.C. relating to some building works in front of the temple of Serapis, shows that Puteoli had considerable administrative independence, including the right to date such a public document by the names of its own magistrates. Sulla retired to Puteoli after his resignation of the dictatorship in 79, and ten days before his death reconciled the disputes of the citizens by giving them a constitution. Cicero had a house in Puteoli itself, and a villa on the edge of the Lucrine lake (which, though nearer to Puteoli, was in the territory of Cumae), and many prominent men of the republic possessed country houses in the neighbourhood of Puteoli (see BAIAE; AVERNUS LACUS; LUCRINUS LACUS; MISENUM). In the Civil War it sided with Pompey, and later on with Brutus and Cassius. Nero admitted the old inhabitants to the privileges of the colony, thus uniting in one the two previously distinct communities. In 61 St Paul landed here, and spent seven days before leaving for Rome (Acts xxviii. 13). Vespasian, as a reward for its having taken his part, gave the town part of the territory of Capua, and installed more colonists there—whence it took the title Colonia Flavia, which it retained till the end of the empire.

The remains of Hadrian, who died at the neighbouring town of Baiae, were buried at Puteoli, and Antoninus Pius, besides erecting a temple to his memory on the site of Cicero's villa, instituted sacred games to be held in the city every five years. Commodus held the title of duumvir quinquennalis. It was mainly, however, as a great commercial port that Puteoli was famous in ancient times. It joined with Naples to erect one of the finest porticoes of Constantinople at the time of its construction. A letter of Symmachus gives us interesting details as to public corn distributions of the 4th century, throwing some light on the population. Like Ostia, Puteoli was considered a special port of Rome, and, on account of the safety and convenience of its harbour, it was preferred to Ostia for the landing of the more costly and delicate wares. As at Ostia, the various gilds were of considerable importance, but we find no *centonarii* or *fabri*, perhaps owing to its relations with the East, where these popular gilds were prohibited. Puteoli was preferred to Naples, (*a*) as being in Roman territory, (*b*) because the customs duty was only leviable once, not twice as it would have been at Naples—once by the local authorities, and once by the Roman authorities on entrance into Roman territory.[1] It exported iron from Elba, mosaics, pottery, manufactured locally with earth from Ischia (which was in considerable demand until 1883), sulphur (which indeed was extracted in the neighbourhood until the 18th century), probably alum (which is still worked), perfumes, pozzolana earth (taking its name from the place), cretaceous earth for mixing with grain (*alica*) from the Leucogaean hills, glass cups engraved with views of Puteoli, mineral dyes (the blue invented by one Vestorius is mentioned by Vitruvius and the purple of Puteoli by Pliny, as being of special excellence), &c., but not agricultural products, except certain brands of Campanian wine; but its imports were considerably greater. During the Punic Wars it was still a naval port, but in the latter part of the 2nd century B.C. it became the greatest commercial harbour of Italy and we find Lucilius about 125 B.C. placing it next in importance to Delos, then the greatest harbour of the ancient world. We note a little later the existence of merchants of Puteoli in the East. Under the empire we find Eastern cults taking root here sooner than in Rome. The construction of the harbour of Claudius at the mouth of the Tiber adversely affected Puteoli. Nero's scheme for the construction of a canal from Lake Avernus to Ostia would have restored the balance in its favour (though it certainly could not have been continuous all the way to Rome with the means of engineering then available).

The corn supply of Rome came partly through Puteoli, partly through Ostia. Seneca (*Epist.* 77) describes the joy of the inhabitants in the spring when the fleet of corn vessels from Alexandria was seen approaching, and Statius tells us that the crew of the ship which arrived first made libations to Minerva when passing the promontory which bore her name (the Punta Campanella at Sorrento). It is uncertain what official had the charge of the corn supply at Puteoli under the Republic, but in the time of Antoninus Pius we find an *Aug(usti) dis(pensator) a frumento Puteolis et Ostis* dependent no doubt on a *procurator annonae* of the two ports.

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[1] A mass of pottery débris found in 1875 gave important information as to the local manufacture. Some fragments came from Arretium, others, not quite so good, were of local work, but of the same style.

Claudius established here, as at Ostia, a cohort of *vigiles* as a fire-brigade. Brundusium was similarly protected. There was also a station of the imperial post, sailors of the imperial fleet at Misenum being apparently employed as couriers. The artificial mole was probably of earlier date than the reign of Augustus (possibly 2nd century B.C.); and by that time at any rate there were docks large enough to contain the vessels employed in bringing the obelisks from Egypt. Remains of the piles of the mole still exist, and are popularly known as Caligula's Bridge, from the mistaken idea that they belong to the temporary structure which that emperor flung across the bay from the mole at Puteoli to the shore at Baiae. Inscriptions record repairs to the breakwater by Antoninus Pius in 139 in fulfilment of a promise made by Hadrian before his death. Alaric (410), Genseric (455) and Totila (545) successively laid Puteoli in ruins. The restoration effected by the Byzantines was partial and short-lived.

The original town of Puteoli was situated on the narrow hill of the Castello. Scanty traces of fortifications of the Roman period seem to have come to light in recent tunnelling operations. The streets of the old town probably, as at Naples, preserve the ancient alignment. There are also traces of the division of the lands in the immediate vicinity of the town into squares by parallel paths (*decumani* and *cardines*) at regular intervals of 1111⅑ Roman feet, postulating as the basis of the division a square with a side of 10,000 Roman feet, divided into 81 smaller squares—an arrangement which could not have existed at Puteoli, and must have arisen elsewhere. It is remarkable as being contrary to Roman surveyors' practice, according to which the basis of division is the intersection at right angles of the *cardo* and *decumanus*, which would give an even (not an odd) number of smaller squares. The size of the ancient town at its largest can be roughly fixed by its tombs. Inscriptions show that it was divided into *regiones*. The market hall (*macellum*) (compare the similar buildings at Pompeii and elsewhere), generally known as the temple of Serapis, from a statue of that deity found there, was excavated in 1750. It consisted of a rectangular court surrounded by chambers on the outside and with a colonnade of thirty-six columns of cipollino (Carystian) marble and grey granite. The three columns still standing, some 39 ft. high, belong to a façade of four still higher columns erected in front of the absidal *cella* or sanctuary, with three niches for statues—no doubt of the protecting deities. The borings of marine shellfish visible in these columns between 11 and 19 ft. from the ground, and the various levels of pavement in the macellum help to indicate, according to Günther's researches (*Archaeologia*, lvii. 499; *Earth Movements in the Bay of Naples*, 1903), that the level of the shore fell very slightly during the Roman period, when it was some 20 ft. higher than at present; that it fell more rapidly during the middle ages, was then raised again early in the 16th century (before the upheaval of the Monte Nuovo in 1538) and has since been sinking gradually. In the centre was a round colonnade with sixteen columns of Numidian marble (*giallo antico*) now in the theatre of the palace at Caserta. Dubois (*op. cit.*, 286 sqq.) reproduces important drawings and a description made by the architect Caristie in 1820. The well-preserved amphitheatre, the subterranean parts of which below the arena are intact, with a main passage down the centre, a curved passage all round with holes for trap doors in its roof, and numerous small chambers, also with trap doors in their vaulted roofs for admitting the wild beasts, whose cages were on the other side of the curved passage, to the arena, are especially interesting. There were also arrangements for flooding the arena, but these can only have been in use before the construction of the greater part of the subterranean portion with its cages, &c. The whole amphitheatre measures 489 by 381 ft., and the arena 245 by 138 ft. Of the upper portion the interior is well preserved, but very little of the external arcades remains. It was not constructed before the reign of Vespasian, for inscriptions record that it was built by the *Colonia Flavia.* There was, however, an amphitheatre in the reign of Nero, who himself fought in games given there, and the glass cup of Odemira shows two. A ruin still exists which may be doubtfully attributed to the latter (Dubois, p. 192). Remains of thermae also exist in various places, the mineral springs having been much used in Roman times. The cathedral of S. Proculus (containing the tomb of the musician Pergolesi, d. 1736) is built into a temple of Augustus, erected by L. Calpurnius, 6 columns of which, with their Corinthian capitals, still exist. Other ruins—of a circus, of tombs, &c., exist, and there are also considerable remains of villas in the neighbourhood.

Puteoli was supplied with water by two aqueducts, both subterranean, one of which, bringing water from springs in the immediate neighbourhood, is still in use, while the other is a branch of the Serino aqueduct, which was probably taken to Misenum by Agrippa. Several remains of reservoirs exist; one very large one is now called Piscina di Cardito.

Among the inscriptions one of the most interesting is the letter of the Tyrian merchants resident at Puteoli to the senate of Tyre, written in 174, asking the latter to undertake the payment of the rent of their factory, and the reply of the senate promising to do so. (This is the interpretation adopted by Dubois, pp. 86, 92, following Dittenberger.) We find other Eastern merchants resident here—merchants from Heliopolis, Berytus (Beirut), Nabataea, Palestine, and from Asia Minor, Greece, &c. We find far less trace of commercial relations with the West, though there was considerable importation of commodities from southern Spain—wine, oil, metals, salt fish, &c., while a good deal of pottery was exported to Spain and southern Gaul. We find, indeed, two cases of men who held municipal honours at Puteoli and in the Rhone valley. Puteoli was reached direct by a road from Capua traversing the hills to the north by a cutting (the Montagna Spaccata), which went on to Neapolis, and by the Via Domitiana from Rome and Cumae. There was also a short cut from Puteoli to Neapolis by the tunnel of Pausilipon, made under Augustus. It is not possible to trace the episcopal see of Puteoli with any certainty further back than the beginning of the 4th century. In 305, S. Januarius (S. Gennaro, the patron saint of Naples), bishop of Beneventum, S. Proculus, patron of Puteoli, and others, suffered martyrdom at Puteoli.

See the careful study by C. Dubois, *Pouzzoles antique* (Paris, 1907) (Bibliothèque des écoles françaises d'Athènes et de Rome, fasc. 98). (T. As.)

PUTLITZ, GUSTAV HEINRICH GANS, EDLER ZU (1821–1890), German author, was born at Retzien near Perleberg in West Prignitz, on the 20th of March 1821. He studied law at Berlin and Heidelberg, and was attached to the provincial government at Magdeburg from 1846–1848. In 1853 he married Gräfin Elisabeth von Königsmark, and lived on his estate until 1863, when he became director of the Court theatre at Schwerin. This post he left in 1867, was for a short time chamberlain to the crown prince of Prussia, afterwards the emperor Frederick, and from 1873 to 1889 successfully directed the Court theatre at Karlsruhe. He died at Retzien on the 5th of September 1890. Putlitz made his debut as a writer with a volume of romantic stories, *Was sich der Wald erzählt* (1850), which attained great popularity (fifty editions) and found many imitators; but he was most successful in his comedies, notably *Badekuren* (1859); *Das Herz vergessen* (1853); and *Spielt nicht mit dem Feuer!* (1887), while of his narratives *Die Alpenbraut* (1870) and *Walpurgis* (1870) are distinguished by refined terseness of style and delicacy of portraiture.

A selection of his works, *Ausgewählte Werke*, was published in 6 vols. in Berlin (1872–1877), and a supplementary volume in 1888; his comedies, *Lustspiele*, appeared in two series of 4 vols. each (1851–1860 and 1869–1872). See E. zu Putlitz, *Gustav zu Putlitz. Ein Lebensbild aus Briefen* (3 vols., 1894–1895).

PUTNAM, ISRAEL (1718–1790), American soldier, was born in Salem Village (now Danvers), Massachussetts, on the 7th of January 1718. His first American ancestor (of the same family as George Puttenham), came from Aston Abbotts, Bucks, and was one of the first settlers of Salem Village. In 1740 he removed to a farm in the present townships of Pomfret and Brooklyn, Connecticut. Here in the winter of 1742–1743 he went down into a wolf den (still shown in Pomfret) and at close quarters killed a huge wolf. Putnam took an active part in the French and Indian War, enlisting as a private in 1755 and rising to the rank of major in March 1758. He was conspicuous for personal courage and for skill in Indian warfare, and was the hero of numerous exploits. In 1764, during Pontiac's conspiracy, he commanded the Connecticut troops (five companies) in the expedition under Colonel John Bradstreet for the relief of Detroit. He was a prominent member of the Sons of Liberty and a leader in the opposition to the Stamp Act; was elected to the general assembly of Connecticut in 1766 and 1767; and increased his political influence by opening a tavern, "The General Wolfe," in Brooklyn, Conn. In August 1774, as chairman of the committee of correspondence for Brooklyn parish, he went with the committee's message and contributions to the Boston Patriots; and in October became lieutenant-colonel of the 11th regiment of Connecticut militia. News of the fighting at

Lexington and Concord reached him while he was ploughing on his farm; he instantly left the plough in the furrow and hastened to Cambridge; and he was later made second brigadier of the Connecticut forces. He was with the force, commanded by Colonel William Prescott, which on the night of the 16th of June fortified Breed's Hill, and on the next day he took a conspicuous part in resisting the British attack[1] (see Bunker Hill). Soon afterward, on his own authority, he occupied Prospect Hill, an important point for the siege of Boston, in which he commanded the centre (two brigades) of the American army at Cambridge. After the evacuation of Boston he was in command of New York City till Washington's arrival (April 13, 1776), and then was put in general charge of the city's fortifications. Immediately before the battle of Long Island he succeeded General John Sullivan in command of the troops on Brooklyn Heights, and in the battle of Long Island (of Aug. 27) he was in immediate command of the American side. In the retreat from New York City he commanded one of the three grand divisions, and took part in the battle of Harlem Heights (September 16). His attempt to close the Hudson by sinking vessels in the channel was unsuccessful. In December he was ordered to Philadelphia to superintend the fortification of the city, was stationed at Princeton, New Jersey, from January to May 1777, and in May took command of the Hudson Highlands at Peekskill, which with Forts Montgomery and Clinton he abandoned in October, being out-manœuvred by the British, and having been weakened by Washington's repeated demands for reinforcements. In the spring of 1778 he was superseded by General Alexander McDougall, but in April a court of inquiry acquitted him of "any fault, misconduct or negligence" in connexion with the loss of Forts Montgomery and Clinton. After a few months' recruiting service in Connecticut he returned to the main army at White Plains. In the winter of 1778–1779 he commanded the troops quartered near Redding, Conn., where Putnam Memorial Park now is.[2] In May he took command of the right wing on the west side of the Hudson. An attack of paralysis in December 1779 terminated his active service in the war. He spent his last years on his farm in Brooklyn, Conn., where he died on the 29th of May 1790. A bronze equestrian statue by Karl Gerhardt, over a sarcophagus, was erected at Brooklyn, Conn., by the state in 1888, and there is another statue (1874) in Bushnell Park, Hartford, by J. Q. A. Ward.

Putnam was a brave, intrepid and very industrious soldier rather than a great general, but his fame in the Indian wars, his personal courage, his bluff heartiness and his good-fellowship made him an idol of the rank and file; and he is one of the popular heroes in American history. He seems to have taken no part in the political manœuvrings and cabals which busied many of the officers of the American army.

See W. F. Livingston, *Israel Putnam, Pioneer, Ranger and Major-General* (New York, 1901) in the "American Men of Energy" series; I. N. Tarbox, *Life of Israel Putnam* (Boston, 1876); and *Essay on the Life of the Honorable Major-General Israel Putnam* (Hartford, 1788; enlarged ed., Boston, 1818), by David Humphreys, for a time Putnam's aide-de-camp.

PUTNAM, RUFUS (1738–1824), American soldier and pioneer, was born in Sutton, Massachusetts, on the 9th of April 1738 (O.S.). His grandfather was a half brother to Israel Putnam's father. He served in the French and Indian War in 1757–60; was a millwright in New Braintree in 1761–1768, during which time he studied surveying; and from 1769 until the War of Independence was a farmer and surveyor. In 1773, with Israel Putnam and two others, he visited West Florida to examine lands which, it was expected, were to be granted to the provincial troops for their services against the French and Indians, and which he charted (see Mississippi). He became lieutenant-colonel in one of the first regiments raised after the battle of Lexington, and served before Boston; in March 1776 he was made chief engineer of the works at New York; in August he was appointed engineer with the rank of colonel; and when Congress did not act on his plan (submitted in Oct. 1776) for the establishment of a distinct engineer corps he resigned (Dec. 1776), and in 1777 served in the northern army under Major-General Horatio Gates, commanding two regiments in the second battle of Saratoga. In 1778 he laid out fortifications, including Fort Putnam, at West Point, and in 1779 he served under Major-General Anthony Wayne after the capture of Stony Point. For the remainder of the war he saw little active service. In January 1783 he was commissioned brigadier-general. After the war he returned to Rutland, Mass., where he had bought a confiscated farm in 1780. In March 1786 he founded, with other officers of the War of Independence, the Ohio Company of Associates for the purchase and settlement of Western lands. In November 1787, after Congress had made its grant to the Ohio Company, he was appointed by the company superintendent of its proposed settlement on the Ohio, and in 1788 he led the small party which founded Marietta, Ohio. He was a judge of the court of the North-West Territory in 1790–1796; was a brigadier-general in the army and a commissioner to treat with the Indians in 1792–1793; was surveyor-general of the United States in 1796–1803; and in 1802 was a member of the Ohio state constitutional convention. He died, in Marietta, on the 4th of May 1824. He has been called "The Father of Ohio," and he contributed greatly toward the material building up of the North-West Territory.

See John W. Campbell, *Biographical Sketches* (Columbus, Ohio, 1838); Sidney Crawford, "Rufus Putnam, and his Pioneer Life in the North-West," vol. xii., new series, pp. 431–454, *Proceedings of the American Antiquarian Society* (Worcester, 1899), and Rowena Buell (ed.), *The Memoirs of Rufus Putnam* (Boston, 1903), in which his autobiography, his journal and other papers, now in the library of Marietta College, are reprinted. His *Journal, 1757–1760*, dealing with his experiences in the French and Indian War, was edited with notes by E. C. Dawes (Albany, New York, 1886).

PUTNAM, a city and the county-seat of Windham county, Connecticut, U.S.A., in the township of Putnam, on the Quinebaug river, at the mouth of the Mill river, in the N.E. part of the state, about 6 m. from the Rhode Island boundary and about 7½ m. from that of Massachusetts. Pop. (1900), of the township (including the city), 7348; of the city, 6667 (2012 being foreign born); (1910) 6637. Putnam is at the intersection of two branches of the New York, New Haven & Hartford railway, and is connected by electric line with Worcester, Norwich and Providence. The city is the seat of two Roman Catholic institutions, St Mary's Convent and Notre Dame Academy, and has a public library and an endowed hospital. The Quinebaug and Mill rivers provide excellent water-power. The township (named in honour of General Israel Putnam) was incorporated in 1855, and the city was chartered in 1895.

PUTTEE, or Puttie, the name, adapted from the Hindī *paṭṭī*, bandage (Skr. *paṭṭa*, strip of cloth), for a covering for the lower part of the leg from the ankle to the knee, consisting of a long narrow piece of cloth wound tightly and spirally round the leg, and serving both as a support and protection, worn especially by riders, and taking the place of the leather or cloth gaiter. It has been adopted as part of the uniform of the mounted soldier in the British army.

PUTTENHAM, GEORGE (d. 1590), the reputed author of *The Arte of English Poesie* (1589). The book was entered at Stationers' Hall in 1588, and published in the following year with a dedicatory letter to Lord Burghley written by the printer Richard Field, who professed ignorance of the writer's name and position. There is no contemporary evidence for the authorship, and the name of Puttenham is first definitely associated with it in the *Hypercritica* of Edmund Bolton, published in 1722, but written in the beginning of the 17th century, perhaps as early as 1605. The writer of the *Arte of English Poesie* supplies certain biographical details. He was educated at Oxford, and at the age of eighteen he addressed an eclogue entitled *Elpine* to Edward VI. In his youth he had visited Spain, France and Italy, and was better acquainted with foreign courts than with his own. In 1579 he presented to Queen Elizabeth his *Partheniades* (printed in a collection of *MSS. Ballads* by F. J. Furnivall), and he wrote the treatise in question especially for the delectation of the queen and her ladies. He mentions nine other works of his, none of which are extant. There is no direct evidence beyond Bolton's ascription to identify the author with George or Richard Puttenham, the sons of Robert Puttenham and his wife Margaret, the sister of Sir Thomas Elyot, who dedicated his treatise on the *Education or Bringing up of Children* to her for the benefit of her sons. Both made unhappy marriages, were constantly engaged in litigation, and were frequently in disgrace. Richard was in prison when the book was licensed to be printed, and when he made his will in 1597 he was in the Queen's Bench Prison. He was buried, according to John Payne Collier, at St Clement Danes, London, on the 2nd of July 1601. George Puttenham is said to have been implicated in a plot against Lord Burghley in 1570, and in December 1578 was imprisoned. In 1585 he received reparation from the privy council for alleged wrongs suffered at the hands of his relations. His will is dated the 1st of September 1590. Richard Puttenham is known to have spent much of his time abroad, whereas there is no evidence that George ever left England. This agrees better with the writer's account of himself; but if the statement that he addressed *Elpine* to Edward VI. when he was eighteen years of age be taken to imply that the production of this work fell within that king's reign, the date of the author's birth cannot be placed anterior to 1529. At the date (1546) of his inheritance of his grandfather, Sir Thomas Elyot's estates, Richard Puttenham was proved in an inquisition held at Newmarket to have been twenty-six years old.

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[1] So loose was the army's organization that it is impossible to settle the question whether Putnam or Prescott was in command at Bunker Hill. Apparently their authority did not clash and was practically independent. See Justin Winsor in his *Narrative and Critical History*, vi. 190–191 (reprinted in Livingston's *Israel Putnam*, as app. ii.).

[2] On the 26th of February 1779, with a small outpost, he was surprised near Greenwich by a superior force under General William Tryon. He ordered a retreat, started to Stamford for reinforcements and, being closely pursued by several dragoons, is said to have ridden down a steep hill (marked in 1900 with a granite monument), and thus escaped. From Stamford he hastened back with reinforcements and took thirty-eight prisoners from Tryon.

Whoever the author may have been, there is no doubt about the importance of the work, which is the most systematic and comprehensive treatise of the time on its subject. It is "contrived into three bookes: the first of poets and poesies, the second of proportion, the third of ornament." The first section contains a general history of the art of poetry, and a discussion of the various forms of poetry; the second treats of prosody, dealing in turn with the measures in use in English verse, the caesura, punctuation, rhyme, accent, cadence, "proportion in figure," which the author illustrates by geometrical diagrams, and the proposed innovations of English quantitative verse; the section on ornament deals with style, the distinctions between written and spoken language, the figures of speech; and the author closes with lengthy observations on good manners. It is interesting to note that in his remarks on language he deprecates the use of archaisms, and although he allows that the purer Saxon speech is spoken beyond the Trent, he advises the English writer to take as his model the usual speech of the court, of London and the home counties.

Many later "poetics" are indebted to this book. The original edition is very rare. Professor Edward Arber's reprint (1869) contains a clear summary of the various documents with regard to the authorship of this treatise. The history of the Puttenhams is discussed in H. H. S. Croft's edition of Elyot's *Boke called the Governour*. A careful investigation brought him to the conclusion that the evidence was in favour of Richard. There are other modern editions of the book, notably one in J. Haslewood's *Ancient Critical Essays* (1811–1815).

PUTTING THE SHOT (or WEIGHT), a form of athletic sports (*q.v.*). It is the only weight event now remaining in the championship programme which requires a "put" as distinct from a throw, a put being a fair and square push straight from the shoulder, quite distinct from throwing or bowling, which are not allowed in putting the shot. The exercise originated in Great Britain, where, before the formation of the Amateur Athletic Association, the shot (a round weight of 16 ℔) was put from a joist about 6 ft. long with a run of 7 ft., the distance being measured from the impression made by the falling missile to the point on the joist, or a line continuing it, opposite the impression. Hence the putter failed to get the full benefit of any put save a perfectly straight one. The present British rule is that the put shall be made from a 7-ft. square, and the distance taken from the first pitch of the shot to the front line of the square or that line produced, as by the old method. In America the put is made from a 7-ft. circle, and the distance measured from the pitch to the nearest point of the circle, which has a raised edge in front to prevent overstepping and consequent fouls. Individual putters have slight variations of method, but the following description is substantially good for all. The putter stands in the back part of the square or circle with his weight entirely upon his right leg, which is bent. The body is inclined slightly backward, the left arm stretched out in front as a balance, and the right hand, the shot resting in the palm, is held against, or an inch or two from, the neck below and behind the right ear. From this position a hop forward is made with the right leg, the foot landing in the middle of the square and the balance being preserved, so that the right shoulder is kept well back. Then, letting the right leg bend well down, the athlete springs up with a rapid twist of the body, so that the right shoulder is brought forward, and the right arm is thrust forward with all possible force, the secret being to throw all the weight and power of the body and arm into the put at the very moment of delivery. Mere brute strength and weight have less to do with successful shot-putting than in hammer-throwing or throwing the 56-℔ weight, and on this account some comparatively light men have repeatedly beaten larger and taller putters. Thus G. R. Gray, a Canadian by birth, who for many years held the world's record of 47 ft. for the 16-℔ shot, was a smaller and less powerful man than several whom he defeated; and another champion of light weight was W. F. Robertson of Scotland, who weighed only 150 ℔. Among the best putters of earlier times were E. J. Bor, London Athletic Club, who made a put of 42 ft. 5 in. in 1872; W. Y. Winthrop and G. Ross. The talent of Irish athletes both in Great Britain and America for weight putting and throwing is remarkable, among the most famous of Irish putters being W. J. M. Barry and Denis Hogan, the latter of whom won the amateur championship in seven consecutive years from 1893, and again in 1904 and 1905. The record in 1910 for the 16-℔ shot was 51 ft., made at San Francisco in 1909 by R. Rose.

PUTTKAMMER, ROBERT VON (1828–1900), Prussian statesman, was born at Frankfort-on-the-Oder on the 5th of May 1828. His father, Eugen von Puttkammer, *Oberpräsident* of Posen, belonged to a widely extended noble family, of which Bismarck's wife and Robert von Puttkammer's own wife were also members. Robert von Puttkammer, after a short course of law, began his official career in 1850 as *Auskultator* in the courts at Danzig, but in 1852 entered the civil service, receiving after his promotion to the rank of *Assessor* in 1854 a post in the railway department of the ministry for trade and industry. In 1859 he became a member of the presidial council (*Oberpräsidialrat*) at Coblenz, capital of the Prussian Rhine province, and from 1860 to 1866 was *Landrat* at Demmin in Pomerania. During the war with Austria he acted as civil commissary in Moravia. From 1867 to 1871 he was a councillor in the chancery of the North German Confederation. In 1871 he was appointed president of the governmental district of Gumbinnen in East Prussia, in 1875 district president (*Bezirkspräsident*) in Lorraine, and in 1877 *Oberpräsident* in Silesia. From 1874 onward he was frequently elected to the *Reichstag* and the Prussian Chamber of Deputies, in which he attached himself to the German Conservative party. Puttkammer was the chosen instrument of the Clerical Conservative policy initiated by Bismarck when the Socialist peril made it expedient to conciliate the Catholic Centre. As *Oberpräsident* of Silesia he had already done much to mitigate the rigour of the application of the "May Laws," and as minister of public worship and of the interior he continued this policy. He is also remembered as the author of the ordinance of the 21st of January 1880 on the simplification of German orthography. This was at first vigorously opposed, not least by Bismarck himself; but its convenience soon became evident, it was increasingly put into practice, and was so well based that later reformers have only needed to follow the lines laid down by Puttkammer. As minister of the interior Puttkammer's activities were less commendable. His reactionary conservative temper was in complete harmony with the views of Bismarck and the emperor William, and with their powerful support he attempted, in defiance of modern democratic principles and even of the spirit of the constitution, to re-establish the old Prussian system of rigid discipline from above. He was above all concerned to nip in the bud any tendencies in the bureaucracy to revolt, and it was on his initiative that, on the 4th of January 1882, a royal ordinance laid it down as the duty of all officials to give the government their unconditional support at political elections. Similarly though he carried out many useful administrative reforms, in a vain effort to combat Social Democracy he seriously interfered with the liberty of public meeting and attempted the forcible suppression of strike movements. This "Puttkammer régime" was intensely unpopular; it was attacked in the *Reichstag* not only by Radicals like Richter and Rickert, but by National Liberals like Bennigsen, and when the emperor Frederick III., whose Liberal tendencies were notorious, succeeded to the throne, it was clear that it could not last. In spite of Bismarck's support Puttkammer was forced to resign on the 8th of June 1888. Under William II., however, whose principles were those of his grandfather, Puttkammer was largely rehabilitated. On the 1st of January 1889 he received the Order of the Black Eagle. He was appointed a secular canon (Domherr) of Merseburg, and in 1891 became *Oberpräsident* of Prussian Pomerania. In this office, which he held till 1899, he did very useful work in collaboration with the provincial estates. He died on his property at Karzin in Pomerania on the 15th of March 1900. (J. Hn.)

PUTTY, originally tin oxide in a state of fine division used for polishing glass, granite, &c., now known as "putty powder" or "polisher's putty" (from O. Fr. *potée*, a potful, hence brass, tin, pewter, &c., calcined in a pot). More commonly the term is applied to a kind of cement composed of fine powdered chalk intimately mixed with linseed oil, either boiled or raw, to the consistency of a tough dough. It is principally used by glaziers for bedding and fixing sheets of glass in windows and other frames, and by joiners and painters for filling up nail-holes and other inequalities in the surface of woodwork. The oxidation of the oil gradually hardens the putty into a very dense adherent mass, but when it is required to dry quickly, boiled oil and sometimes litharge and other driers are used. The word is also used of a fine lime cement employed by masons.

PUVIS DE CHAVANNES, PIERRE CÉCILE (1824–1898), French painter, was born at Lyons on the 14th of December 1824. His father was a mining engineer, the descendant of an old family of Burgundy. Pierre Puvis was educated at the Lyons College and at the Lycée Henri IV. in Paris, and was intended to follow his father's profession when a serious illness interrupted his studies. A journey to Italy opened his mind to fresh ideas, and on his return to France he announced his intention of becoming a painter, and went to study first under Henri Scheffer, and then under Couture. On leaving this master in 1852 he established himself in a studio in the Place Pigalle (which he did not give up till 1897), and there organized a sort of academy for a group of fellow students who wished to work from the living model. Puvis first exhibited in the Salon of 1850 a "Pietà," and in the same year he painted "Mademoiselle de Sombreuil Drinking a Glass of Blood to Save her Father," and "Jean Cavalier by his Mother's Deathbed," besides an "Ecce Homo," now in the church of Champagnat (Saône-et-Loire). In 1852 and in the two following years Puvis's pictures were rejected by the Salon, and were sent to a private exhibition in the Galeries Bonne Nouvelle. The public laughed at his work as loudly as at that of Courbet, but the young painter was none the less warmly defended by Théophile Gautier and Théodore de Banville. For nine years Puvis was excluded from the Salons. In 1857 he had painted "Martyrdom of St Sebastian," "Meditation," "Village Firemen," "Julie," "Herodias," and "Saint Camilla"—compositions showing a great variety of impulse, still undecided in style and reflecting the influence of the Italian masters as well as of Delacroix and Couture. In 1859 Puvis reappeared in the Salon with the "Return from Hunting" (now in the Marseilles Gallery). But not till he produced "Peace" and "War" did he really impress his critics, inaugurating a vast series of decorative paintings. For these two works a second-class medal was awarded to him, and the state offered to purchase the "Peace." Puvis, not choosing to part the pair, made a gift of "War" to the state. He then set to work again, and in 1864 exhibited "Autumn" and "Sleep," but found no purchasers. One of these pictures is now in the Lyons Museum, and the other at Lille. "Peace" and "War" were placed in the great gallery of the museum at Amiens, where Puvis completed their effect by painting four panels—a "Standard-Bearer," "Woman Weeping over the Ruins of her Home," a "Reaper," and a "Woman Spinning." These works were so much admired that further decorations were ordered for the same building, and the artist presented to the city of Amiens "Labour" and "Repose," for which the municipality could not afford to pay. At their request Puvis undertook another work, intended for the upper landing of the staircase, and in 1865 a composition entitled "Ave Picardia Nutrix," allegorical of the fertility of the province, was added to the collection. In 1879 the city wished to complete the decoration of the building, and the painter, again at his own expense, executed the cartoon of "Ludus pro patria," exhibited in the Salon of 1881 and purchased by the state, which at the same time gave him a commission for the finished work. While toiling at these large works, Puvis de Chavannes rested himself by painting easel pictures. To the salon of 1870 he had sent a picture called "Harvest;" the "Beheading of John the Baptist" figured in the Great Exhibition of 1889; then followed "Hope" (1872), the "Family of Fisher-Folk" (1875), and "Women on the Seashore" (1879). But these canvases, however interesting, are not to be named by the side of his grand decorative works. Two paintings in the Palais Longchamp at Marseilles, ordered in 1867, represent "Marseilles as a Greek Colony" and "Marseilles, the Emporium of the East." After these, Puvis executed for the town-hall of Poitiers two decorative paintings of historical subjects: "Radegund," and "Charles Martel." The Panthéon in Paris also possesses a decorative work of great interest by this painter: "The Life of Saint Geneviève," treated in three panels. In 1876 the Department of Fine Arts in Paris gave the artist a commission to paint "Saint Geneviève giving Food to Paris" and "Saint Geneviève watching over Sleeping Paris," in which he gave to the saint the features of Princess Cantacuzene, his wife, who died not long before he did. At the time of his death—on the 24th of October 1898—the work was almost finished. After completing the first paintings in the Panthéon, which occupied him for three years and eight months, Puvis de Chavannes undertook to paint the staircase leading to the gallery of fine arts in the Lyons Museum, and took for his subjects the "Vision of the Antique," a procession of youths on horseback, which a female figure standing on a knoll points out to Pheidias; the "Sacred Grove"; and two allegorical figures of "The Rhône" and "The Saône." It was in the same mood of inspiration by the antique that he painted the hemicycle at the Sorbonne, an allegory of "Science, Art, and Letters," a work of great extent, for which he was paid 35,000 francs (£1400). At the Hôtel de Ville in Paris, again, Puvis decorated the grand staircase and the first reception-room. These works employed him from 1889 till 1893. In the reception-room he painted two panels, "Winter" and "Summer"; the mural paintings on the staircase, which had previously been placed in the hands of Baudry and of Delaunay, are devoted to the glory of the attributes of the city of Paris. On the ceiling we see Victor Hugo offering his lyre to the city of Paris. The pictures in the Rouen Museum (1890–1892) show a different vein, and the artist's power of conceiving and setting forth a plastic scheme enabling him to decorate a public building with beautiful human figures and the finest lines of landscape. We see here toilers raising a colossal monolith, part of some ancient monument, to add it to other architectural pieces; then the busy scene of a pottery; and finally artists painting in the open air. Puvis, as a rule, adhered to the presentment of the nude or of the lightest drapery; here, however, in response to some critical remarks, he has clad his figures exclusively in modern dress. After prolonged negotiations, begun so early as in 1891, with the trustees of the Boston Library, U.S.A., Puvis de Chavannes accepted a commission to paint nine large panels for that building, to be inserted in separate compartments, three facing the door, three to the right and three to the left. These pictures, begun in 1895, were finished in 1898. In these works of his latest period Puvis de Chavannes soars boldly above realistic vision. In the figures which people the walls with poetic images he endeavours to achieve originality of the embodying forms, and at the same time a plastic expression of ideas born of a mind whose conceptions grew ever loftier, while yet the artist would not abandon the severe study of nature. Such works as the great paintings at Amiens, Rouen, Marseilles, the Panthéon, the Sorbonne, and the Hôtel de Ville are among the most important productions of French art in the 19th century. Puvis de Chavannes was president of the National Society of Fine Arts (the New Salon). His principal pupils and followers are Ary Renan (d. 1900), Baudouin, J. F. Auburtin and Cottet.

See A. Michel, "Exposition de M. Puvis de Chavannes," *Gazette des beaux-arts* (1888); Marius Vachon, *Puvis de Chavannes* (1900); J. Buisson, "Puvis de Chavannes, Souvenirs Intimes," *Gazette des beaux-arts* (1899). (H. Fr.)

PUY, a geological term used locally in Auvergne for a volcanic hill. Most of the puys of central France are small cinder-cones, with or without associated lava, whilst others are domes of trachytic rock, like the domite of the Puy-de-Dôme. The puys may be scattered as isolated hills, or, as is more usual, clustered together, sometimes in lines. The chain of puys in central France probably became extinct in late prehistoric time. Other volcanic hills more or less like those of Auvergne are also known to geologists as puys; examples may be found in the Eifel and in the small cones on the Bay of Naples, whilst the relics of denuded puys are numerous in the Swabian Alps of Württemberg, as pointed out by W. Branco. Sir A. Geikie has shown that the puy type of eruption was common in the British area in Carboniferous and Permian times, as abundantly attested in central Scotland by remains of the old volcanoes, now generally reduced by denudation to the mere neck, or volcanic vent, filled with tuff and agglomerate, or plugged with lava.

See Sir A. Geikie, *Ancient Volcanoes of Great Britain* (1897).

PUY-DE-DÔME, a department of central France, four-fifths of which belonged to Basse-Auvergne, one sixth to Bourbonnais, and the remainder to Forez (Lyonnais). Area, 3094 sq. m. Pop. (1906), 535,419. It is bounded N. by Allier, E. by Loire, S. by Haute-Loire and Cantal, and W. by Corrèze and Creuse. The highest point of the department, the Puy de Sancy (6188 ft.), is also the most elevated peak of central France; it commands the group of the volcanic Monts Dore, so remarkable for their rocky corries, their erosion valleys, their trap dykes and *orgues* of basalt, their lakes sleeping in the depths of ancient craters or confined in the valleys by streams of lava, and their wide plains of pasture-land. The Puy de Sancy, forming part of the watershed, gives rise on its northern slope to the Dordogne, and on the east to the Couze, a sub-tributary of the Loire, through the Allier. The Monts Dore are joined to the mountains of Cantal by the non-volcanic group of the Cézallier, of which the highest peak, the Luguet (5102 ft.), rises on the confines of Puy-de-Dôme and Cantal. On the north the Monts Dore are continued by a plateau of a mean height of from 3000 to 3500 ft., upon which are seen sixty cones raised by volcanic outbursts in former times. These are the Monts Dôme, which extend from south to north as far as Riom, the most remarkable being the Puy-de-Dôme (4800 ft.), from which the department takes its name, and the Puy-de-Pariou, the latter having a crater more than 300 ft. in depth. A meteorological observatory occupies the summit of the Puy-de-Dôme, which was once crowned by a Roman temple, the ruins of which still exist. To the east of the department, along the confines of Loire, are the Monts du Forez, rising to 5380 ft. and continued north by the Bois Noirs. Between these mountains and the Dôme extends the fertile plain of Limagne. The drainage of Puy-de-Dôme is divided between the Loire, by its affluents the Allier and the Cher, and the Gironde, by the Dordogne. The Allier traverses the department from south to north, receiving on its right the Dore, which falls into the Allier at the northern boundary and lowest level of the department (879 ft.); on its left are the Alagnon from the Cantal, the two Couzes from the Luguet and the Monts Dore, and the Sioule, the most important of all, which drains the north-west slopes of the Monts Dore and Dôme, and joins the Allier beyond the limits of the department. The Cher forms for a short space the boundary between the departments of Puy-de-Dôme and Creuse, close to that of Allier. The Dordogne, while still scarcely formed, flows past Mont-Dore-les-Bains and La Bourboule and is lost in a deep valley which divides this department from that of Corrèze. None of these streams is navigable, but boats can be used on the Allier during floods. The climate of Puy-de-Dôme is usually very severe, owing to its high level and its distance from the sea; the mildest air is found in the northern valleys, where the elevation is least. During summer the hills about Clermont-Ferrand, exposed to the sun, become all the hotter because their black volcanic soil absorbs its rays. On the average 25 or 26 in. of rain fall in the year; in the Limagne around which the mountains arrest the clouds rainfall is less. Nevertheless the soil of this plain, consisting of alluvial deposits of volcanic origin, and watered by torrents and streams from the mountains, makes it one of the richest regions of France. In the highest altitudes the rainfall attains 64 in.

About two-thirds of the inhabitants of Puy-de-Dôme are engaged in agriculture. The Limagne yields a variety of products and the vine flourishes on its hill-sides. The high mountains provide pasture for large flocks of cows and sheep, and cheese-making is an industry of much importance. The intermediate region is cultivated chiefly for cereals, the chief of which are rye, wheat, oats and barley. Potatoes are largely grown, and, to a less extent, peas, beans, beetroot and colza. The Limagne produces fruits of all kinds—apricots, cherries, pears, walnuts and apples, from which considerable quantities of cider are made. The department possesses considerable mineral wealth. There are important coal-mines at Brassac on the Allier, on the borders of Haute-Loire, at St Éloy near the department of Allier, and at Bourg-Lastic on the borders of Corrèze. Peat, asphalt, bituminous schists, antimony, mispickel and argentiferous lead are also worked. Of the last named there are mines and foundries at Pontgibaud on the Sioule. Amethysts and other rare minerals are found and there are numerous stone-quarries. The watering-places of Mont Dore, Royat and La Bourboule receive separate notice. The springs of St Nectaire, containing sodium and iron chlorides and bicarbonates, are efficacious in liver complaints, rheumatism and gravel. The waters of Châteauneuf (on the Sioule), also known to the Romans, contain iron bicarbonates and are resorted to for skin diseases. Those of Châtelguyon, like the waters of Carlsbad and Marienbad, are used for disorders of the digestive organs, congestions of the liver, rheumatism, &c. There are many other mineral springs of varied character. Manufactures are for the most part grouped around Thiers, which produces a large amount of cheap cutlery, paper and leather, and Clermont-Ferrand, the capital. The department contains factories for lace and braid (in the mountains), for buntings and camlets and wool, cotton and hemp mills. There are wool-carding works and factories for linens, cloths and counterpanes, also silk-mills, tanneries, manufactories for chamois and other leathers, for caoutchouc (Clermont-Ferrand), sugar-works, manufactures of edible pastes with a reputation as high as those of Italy, and manufactures of fruit-preserves. The department exports grain, fruits, cattle, wines, cheese, wood, mineral waters, cutlery, &c. It is served by the Orléans and Paris-Lyon railway companies. Many thousands of the inhabitants, belonging chiefly to the district of Ambert, leave it during winter and find work elsewhere as navvies, chimney-sweeps, pit-sawyers, &c. The department comprises 5 arrondissements—Clermont-Ferrand, Ambert, Issoire, Riom, Thiers—50 cantons and 471 communes. It is included in the bishopric and *académie* (educational division) of Clermont-Ferrand and the region of the XIII. army corps, of which the headquarters are in the same town; the appeal court is at Riom.

The more noteworthy places in the department are Clermont-Ferrand, Issoire, Thiers, Riom, Ambert, Mont-Dore-les-Bains, La Bourboule and Royat (all separately noticed). Near Clermont-Ferrand is Mont Gergovie (see Gergovia) the scene of the victory of Vercingetorix over Julius Caesar. Other places of interest are Billom, Chamalières, Courpière, Orcival, St Nectaire and St Saturnin, which possess churches in the Romanesque style of Auvergne. There are ruined feudal strongholds of great interest at Murols and Tournoël (near Volvic). Vic-le-Comte has a sainte-chapelle which is a beautiful example of the transition from Gothic to Renaissance architecture, and Aigueperse has a Gothic church of the 13th to the 15th century. Near Pontgibaud are the ruins (13th century) of the Carthusian abbey of Port St Marie.

PUYLAURENS, ANTOINE DE LAAGE, Duc de (d. 1635), French courtier, was born of an old Languedoc family. Attached to the household of Gaston, duke of Orleans, brother of Louis XIII., he gained a complete ascendancy over the weak prince by pandering to his pleasures, and became his adviser in the intrigues against Cardinal Richelieu. It was Puylaurens who arranged the escape of Gaston to Brussels in 1632 after the capture of Henri, duc de Montmorency, and then negotiated his return with Richelieu, on condition that he should be reconciled to the king. As a reward Richelieu gave him Aiguillon, erected into a duchy. But he plunged into new intrigues, and was imprisoned first in the Louvre in 1635, then in Vincennes, where he died the same year.

PUZZLE, a perplexing question, particularly a mechanical toy or other device involving some constructional problem, to be solved by the exercise of patience or ingenuity. Some of the oldest mechanical puzzles are those of the Chinese, one of the most familiar being that known as the *tangram* (*chi ch'iao t'ue*), which consists of a square of wood or other material cut into five triangles, of different sizes, a small square and a lozenge, which can be so placed as to form over 300 different figures. This puzzle is sometimes made of ivory carved with the delicate workmanship for which the Chinese craftsmen are renowned, and is enclosed in a carved box. Another well-known puzzle is known as the "Chinese rings," consisting of a series of rings running linked together on a bar, the problem being to take them off the bar and replace them. The commonest of all puzzles are coloured maps, pictures ("jig-saw") or designs, dissected into numerous variously shaped pieces, to be fitted together to form the complete design. A great number of puzzles are based on mathematical principles, such as the "fifteen puzzle," the "railway shunting puzzle," and the like.

See W. W. Rouse Ball, *Mathematical Recreations and Amusements* (1892).

The etymology of the word "puzzle" is disputed. It has been usual to consider that the verb, which appears first at the end of the 16th century, is derived from the substantive, and that this is an aphetic form of "apposal" or "opposal" *i.e.* opposition, hence a question for solution, cf. Lydgate, *Fall of Princes*, quoted by Skeat (*Etym. Dict.* 1898). The *New English Dictionary*, however, takes it as clear from the chronological evidence and sense-development that the substantive is derived from the verb, which, in its earliest examples, means to put in embarrassing material circumstances, to bewilder, to perplex. This seems against making "to puzzle" a derivative of "to pose," *i.e.* "oppose," to examine by putting questions. Some connexion may be found with a much earlier word "poselet," confused, bewildered, which does not occur later than the end of the 14th century.

PWLLHELI ("salt pit," or "pool"), a municipal and contributory parliamentary borough (Carnarvon district), seaport and market-town of Carnarvonshire, North Wales, 20 m. S. of Carnarvon and 270 m. from London by rail. Pop. (1901), 3675. It is on the north side of Cardigan Bay, on the shore of Tremadoc Bay, with a sandy beach 4 m. in length and good bathing. It is the terminus of the Cambrian railway (the London & North-Western railway being 4 m. distant at Afonwen junction). Pwllheli commands a good view of Merionethshire and of the Snowdon range, with the entire sweep of Cardigan Bay, Carreg yr ymbill (gimlet stone) at the mouth of the harbour, Abersoch and St Tudwal's Islands. Many hundred acres of land have been reclaimed from the sea here and along the coast of the bay; there are costly embankments and good harbourage. The coast is locally noted for fisheries (especially of lobsters and oysters) and some ship-building is carried on. Pwllheli was incorporated by Edward the Black Prince. At Nevin (*Nefyn*), 6 m. distant, Edward I. held a tournament or revel, in 1284, on a magnificent scale, to commemorate his conquest of Wales.

PYANEPSIA, or Pyanopsia (from Gr. *πύανος* = *κύαμος*, bean, and *ἕψειν*, to boil), an ancient festival in honour of Apollo, held at Athens on the 7th of the month Pyanepsion (October). A hodge-podge of pulse was prepared and offered to Apollo (in his capacity as sun god and ripener of fruits) and the Horae, as the first-fruits of the autumn harvest. Another offering on this occasion was the *eiresiōnē*. This was a branch of olive or laurel, bound with purple or white wool, round which were hung various fruits of the season, pastries, and small jars of honey, oil and wine. It was intended as a thank-offering for blessings received, and at the same time as a prayer for similar blessings and protection against evil in future; hence, it was called a "suppliant" branch (*ἱκετηρία*). The name is generally derived from *εἶρος* (wool) in reference to the woollen bands, but some connect it with *εἴρειν* (to speak), the *eiresiōnē* being regarded as the "spokesman" of the suppliants. It was carried in procession by a boy whose parents were both alive to the temple of Apollo, where it was suspended on the gate. The doors of private houses were similarly adorned. The branch was allowed to hang for a year, when it was replaced by a new one, since by that time it was supposed to have lost its virtue. During the procession a chant (also called *eiresiōnē*) was sung, the text of which has been preserved in Plutarch (*Theseus*, 22):—

> "Eiresiōnē carries figs and rich cakes;
> Honey and oil in a jar to anoint the limbs;
> And pure wine, that she may be drunken and go to sleep."

The semi-personification of *eiresiōnē* will be noticed; and, according to Mannhardt, the branch "embodies the tree-spirit conceived as the spirit of vegetation in general, whose vivifying and fructifying influence is thus brought to bear upon the corn in particular."

Aetiologists connected both offerings with the Cretan expedition of Theseus, who, when driven ashore at Delos, vowed a thank-offering to Apollo if he slew the Minotaur, which afterwards took the form of the *eiresiōnē* and Pyanopsia. To explain the origin of the hodge-podge, it was said that his comrades on landing in Attica gathered up the scraps of their provisions that remained and prepared a meal from them.

See W. Mannhardt, *Wald- und Feldkulte* (1905), ii. 214, for an exhaustive account of the *eiresiōnē* and its analogies; J. G. Frazer, *The Golden Bough* (1900), i. 190; J. E. Harrison, *Prolegomena to Greek Religion* (1908), ch. 3; L. R. Farnell, *Cults of the Greek States* (1907), iv. 286.

PYAPON, a town and district of Lower Burma. The town is situated on a river of the same name, one of the numerous mouths of the Irrawaddy, about 12 m. from the sea. Pop. (1901), 5883. The district, which was only formed in 1903, lies within the delta of the Irrawaddy. It is a vast plain, intersected by tidal creeks and subject to inundation at high spring tides. The swampy jungle is being rapidly reclaimed for rice cultivation, which is the sole crop. Area, 2137 sq. m.; pop. (1901), 226,443, showing an increase of 63% in the decade.

PYAT, FELIX (1810–1889), French Socialist, was born at Vierzon (Cher) on the 4th of October 1810, the son of a Legitimist lawyer. Called to the bar in Paris in 1831, he threw his whole energies into journalism. The violent personalities of a pamphlet entitled *Marie Joseph Chênier et le prince des critiques* (1844), in reply to Jules Janin, brought him a six months' sojourn in La Pélagie, in the cell just quitted by Lamennais. He worked with other dramatists in a long series of plays, with an interval of six years on the *National*, until the revolution of 1848. George Sand, whom he had introduced in 1830 to the staff of the *Figaro*, now asked Ledru-Rollin to make him commissary-general of the Cher. After three months' tenure of this office he was returned by the department to the Constituent Assembly, where he voted with the Mountain, and brought forward the celebrated motion for the abolition of the presidential office. About this time he fought a duel with Proudhon, who had called him the "aristocrat of the democracy." He joined Ledru-Rollin in the attempt of the 13th of June 1849, after which he sought refuge in Switzerland, Belgium, and finally in England. For a glorification of regicide on the occasion of the Orsini attempt against Napoleon III. he was brought before an English court, but acquitted, and the general amnesty of 1869 permitted his return to France, but further outbursts against the authorities, followed by prosecution, compelled him to return to England. The revolution of the 4th of September brought him back to Paris, and it was he who in his paper *Le Combat* displayed a black-edged announcement of the *pourparlers* for the surrender of Metz. After the insurrection of the 31st of October he was imprisoned for a short time. In January 1871, *Le Combat* was suppressed, only to be followed by an equally virulent *Vengeur*. Elected to the National Assembly, he retired from Bordeaux with Henri Rochefort and others until such time as the "parricidal" vote for peace should be annulled. He returned to Paris to join the committee of public safety, and, in Hanotaux's words, was the *âme ulcérée* of the Commune, but was blamed for the loss of the fort of Issy. He was superseded there by Delescluze, but he continued to direct the violent acts of the Commune, the overthrow of the Vendôme column, the destruction of Thiers's residence and of the expiatory chapel built to the memory of Louis XVI. He escaped the vengeance of the Versailles government, crossed the frontier in safety, and, though he had been condemned to death in his absence in 1873, the general amnesty of July 1880 permitted his return to Paris. He was returned to the Chamber of Deputies for the department of Bouches-du-Rhône in March 1888 and took his seat on the extreme Left, but died at Saint-Gratien on the 3rd of August 1889.

PYATIGORSK, a town and watering-place of Russian Caucasia, in the province of Terek, 141 m. by rail N.W. of Vladikavkaz. Pop. (1882), 13,670; (1897), 18,638. It owes its origin to its mineral waters, which have long been known to the inhabitants of Caucasia. The sulphur springs, about fifteen in number, come from a great depth, and vary in temperature from 75° to 96° F.; they are used both for drinking and for bathing. The first buildings were erected in 1812, and in 1830 the name of Pyatigorsk ("town of the five mountains") was given to the new settlement. Its subsequent rapid increase was greatly stimulated by the completion of the railway connexion with Rostov-on-the-Don. The town is charmingly situated on a small plateau, 1680 ft. above sea-level, at the foot of the Beshtau, Mashuk and three other outliers of the Caucasus range, which protect it on the north. The snow-covered summits of the Elbruz are visible to the south. The most noteworthy features are a cathedral, a monument to the poet M. Y. Lermontov (1814–1841), and a hydropathic.

PYCNOGONIDA, or PANTOPODA, marine Arachnida (*q.v.*) remarkable for the reduction of the opisthosoma or abdomen to an insignificant tubercular or rod-like process (whence their trivial name of "nobody crabs"), and for the development of the oral region into a relatively immense suctorial proboscis. They form a compact group, differing from all the other orders of Arachnida in certain structural characters of such morphological importance that it is impossible to affiliate them closely with any group of that class. For instance, in all typical existing Arachnida the ganglionic centres which innervate the ambulatory appendages are coalesced to form a single nervous mass, whereas in the Pycnogonida the ganglia supplying these limbs retain their original distinctness. More important still is the circumstance that in the Pycnogonida there may be as many as seven pairs of leg-like limbs behind the mouth; but in the typical Arachnida there are never more than five such pairs. Curiously enough, too, although the number of these appendages, in all the orders of typical Arachnida is, with the exception of some degenerate Acari, a quite constant character, the number in the Pycnogonida is very variable. In most cases there are four pairs of ambulatory limbs, but in two antarctic genera, namely *Pentanymphon*, belonging to the family Nymphonidae and *Decalopoda*, probably belonging to the Colossendeidoe, they are increased to five pairs. In front of these four or five pairs of ambulatory limbs there may be two pairs of longish post-oral limbs, called respectively the ovigerous legs and the palpi; but these may be totally absent. Finally, the single pair of pre-oral appendages may be well developed, three-jointed and chelate, or reduced in size and complexity, or altogether suppressed.

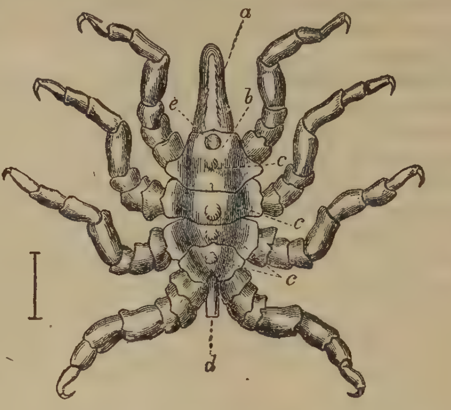

FIG. 1.—*Male of Pycnogonum littorale*, Müller.

a, Parts of mouth forming a beak.
b, Cephalic area.
c, *c*, Thoracic segments.
d, Rudimentary abdomen.
e, Eyes.

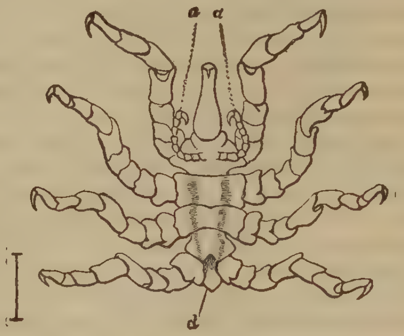

FIG. 2.—The same; under size.
a, *a*, Ovigerous legs.

As examples of this class exhibiting extremes of variation in the development and reduction of the appendages may be cited *Decalopoda*, which has the full complement of eight pairs of appendages, and the female of *Pycnogonum littorale*, in which all the appendages are aborted save four pairs of ambulatory limbs.

All the principal organs of the body are concentrated in that part which bears the appendages. The generative glands are lodged on each side, sending prolongations into the appendages, and their ducts open upon the second segments of more or fewer of them. The alimentary canal, beginning with the mouth at the extremity of the proboscis and terminating with the anus at the extremity of the tail-like opisthosoma, also sends long saccular prolongations into the limbs. Food is imbibed by means of the suctorial pharynx lodged in the proboscis, the sucking action being effected by means of muscles radiating from the wall of the pharynx to that of the inner surface of the exoskeleton of the proboscis. The circulatory system, where it has been observed, consists of a heart formed of about three chambers communicating with each other. In each chamber there is a pair of orifices for the entry of the blood; and the fluid is expelled through an orifice at the anterior extremity of the first chamber. No organs of respiration are known, the integument being the medium for the oxygenation of the blood.

The sexes are distinct, but commonly there is little external difference between the males and the females. Sometimes the female is considerably the larger of the two; and frequently the ovigerous legs are less well developed than in the male. Sometimes indeed these limbs are entirely wanting in the female, whereas this is never the case in the male. Finally, in the females the generative orifices are much more conspicuous than in the males, and the fourth joint of the legs is often swollen. The invariable presence of the ovigerous appendages in the males is correlated with the habit practised by this sex of carrying the fecundated eggs. The eggs are usually aggregated in two spherical masses round the middle of each of the ovigerous legs; sometimes, however, there are two such masses on each leg, or as many as four or five, whereas occasionally there is but one on the right or left side. More rarely, as in some species cf *Pallene*, there are few very large eggs attached separately to the legs, or the eggs may be carried in a single mass attached to the underside of the body, as in some species of *Pycnogonum*. Cases have been recorded of the females carrying their own eggs, as has been observed in a specimen of *Nymphon brevicaudatum*, but this seems to be a rare phenomenon.

The newly-hatched young frequently differs greatly from the adult. The body, which is oval, subquadrate and unsegmented, has the proboscis well developed, but bears only three pairs of appendages; those of the first pair are large, three jointed and chelate, the basal segment containing a large so-called byssus gland, the duct of which opens at the tip of a spiniform or setiform process; these appendages are the mandibles of the adult. The appendages of the next two pairs are simple and small, and are generally held to be the palpi and ovigerous legs. This first larval stage, sometimes called the protonymphon, may be free living or may be retained within the egg-shell. In the second stage, which may also be contained in the egg, two or three of the remaining pairs of appendages have appeared, those representing the first pair of ambulatory limbs of the adult being as a rule better developed than the next. In the third stage the fourth pair of ambulatory limbs and the abdomen of the adult have begun to develop and gradually increase in size until the adult form is attained. But even within the limits of a single genus, *e.g.* *Nymphon*, the stage at which the young emerges from the egg is subject to considerable specific variation.

Pycnogonida vary greatly in size, the span of legs when extended ranging from about 2 in. in *Pycnogonum littorale* to 2 ft. in *Colossendeis gigas*. They are wholly marine and occur at depths varying from only a few fathoms to over 2500 fathoms. One of the best known British species is *Pycnogonum littorale*, a stoutly built form with only four pairs of appendages in the female. It occurs between tide marks on British coasts, but recedes to considerable depths, and on the Atlantic coast of America has been dredged at a depth of 430 fathoms. It is also wide-ranging, and has been recorded even from the coast of Chile. As a rule, but by no means an invariable rule, deep-water species have smoother bodies and much longer and thinner legs than shallow-water forms. The latter also commonly have four distinct eyes, whereas the former met with at a depth of over 400 fathoms not uncommonly have the eyes obsolete. There are many exceptions, however, to these rules. The habits of all Pycnogonida appear to be very similar. They are not swimmers, but crawl slowly over the bottom of the sea or amongst the fronds of seaweed, and they have been met with in polar, temperate and tropical seas. (R. I. P.)

PYCNOSTYLE (Gr. πυκνός, close, compact, and στῦλος, column), the architectural term given by Vitruvius to the intercolumniation of the columns of a temple, when this was equal to 1½ diameters.

PYE, HENRY JAMES (1745–1813), English poet laureate, was born in London on the 20th of February 1745, and educated at Magdalen College, Oxford. His father, a Berkshire landowner, died in 1766, leaving him a legacy of debt amounting to £50,000, and the burning of his home at Great Faringdon further increased his difficulties. In 1784 he was elected M.P. for Berkshire. He was obliged to sell the paternal estate, and, retiring from Parliament in 1790, became a police magistrate for Westminster. Although he had no command of language and was destitute of poetic feeling, his ambition was to obtain recognition as a poet, and he published many volumes of verse. Of all he wrote his prose *Summary of the Duties of a Justice of the Peace out of Sessions* (1808) is most worthy of record. He was made poet laureate in 1790, perhaps as a reward for his faithful support of Pitt in the House of Commons. The appointment was looked on as ridiculous, and his birthday odes were a continual source of contempt. His most elaborate poem was an epic, *Alfred* (1801). He was the first poet laureate to receive a fixed salary of £27 instead of the historic tierce of Canary wine. He died at Pinner, Middlesex, on the 11th of August 1813.

PYGMALION, in Greek mythology, son of Cilix, and grandson of Agenor, king of Cyprus. He fell in love with an ivory statue he had made; Aphrodite granted life to the image, and Pygmalion married the miraculously-born virgin (Ovid, *Metam.* x. 243). There is no ancient authority for the introduction of the name Galatea into the story. Pygmalion is also the name given in Virgil (*Aeneid*, i, 347) to a king of Tyre, who murdered Sychaeus, the husband of his sister Dido.

PYGMY, or PIGMY (Gr. πυγμαῖος, from πυγμή, a Greek measure of length corresponding to "the distance between the elbow and knuckles" of a man of average size), a term for a diminutive human being. We owe the word to Homer, who in the *Iliad* (iii. 6) uses it to describe a race of tiny folk dwelling in a far southern land, whither the cranes fly when inclement winters and piercing frosts visit the northern shores. Fierce battles were often mentioned by later writers as occurring between the pygmies and cranes, and were even represented on their vases. On these the pygmies were depicted as dwarfs with large heads, negro features, close, curly hair, and sometimes armed with lances. Aristotle firmly believed in the existence of these pygmies, whom he characterized as a race of men of small stature inhabiting the marshes of upper Egypt towards the sources of the Nile. That their existence was a matter of common knowledge and speculation is indicated by the fact that Philostratus describes the sleeping Hercules beset by swarms of pygmies. Herodotus (ii. 32), relying apparently on authentic information, describes graphically how a party of five Nasamonians, while journeying through the African desert, came at last to a plain where fruit-trees grew. While gathering the fruit they were seized by some dwarfish men of strange speech, who led them across forest marshes to a town, where dwelt people of a similar appearance, and near which a great river flowed from west to east containing crocodiles. This river was probably the Niger, and the people referred to were no doubt the ancestors of the existing pygmies of equatorial Africa. Representations of these pygmies have been found sculptured on the tombs at Sakkarah, which are referred to the Vth Dynasty of Egypt, 3366 B.C. The pygmies depicted in bas-relief on these tombs faithfully reproduce the racial characteristics of the present race of pygmies inhabiting the Ituri and Semliki forests. They no doubt served in the households of the Egyptian kings, and figured both in Egyptian and Roman triumphs.

Various writers have localized pygmies in different portions of the earth's surface. Pliny makes mention of dwarfed races in both Asia and Africa. Reference is made to the Catizi dwarfs in Thrace, and to a similar race dwelling in Caria. Ctesias, a century after Herodotus, wrote of a race of pygmies in the heart of India, describing them as black and ugly, and only two *pygmai* in height. The Chinese author, Chao Fu-Kua, in the beginning of the 13th century, described a tribe of black pygmies dwelling in the Philippine Islands; in the depth of the valleys there lived, he said, a tribe of men called Hai-tan, small in size, with round, yellow eyes, curly hair, and with the teeth showing through their lips. These were no doubt the ancestors of the present Aëtas. Relics of a pygmy race are supposed to exist now in Sicily and Sardinia, *i.e.* along the high road between Pleistocene Africa and Europe. Near Schaffhausen, Dr Kollman found skeletal remains of small human beings, which have been regarded by some authorities as belonging to the European pygmies of the Neolithic period. Some anthropologists of authority, indeed—in spite of the absence of definite data in support of such a view—believe that a dwarf negroid race at one time existed in northern Europe, and may have given rise to the traditional tales of elves, goblins, gnomes and fairies.

At the present time the existing pygmy races may be subdivided into two main groups or sub-races: (*a*) the African pygmies (Negrilloes), (*b*) the Asiatic pygmies (Negritoes).

a. The African pygmies are dispersed over a large zone extending right across equatorial Africa, from Uganda to the Gaboon, the width of this zone being about six degrees, *i.e.* three degrees north and south of the equator. In Uganda they are now principally confined to a belt of forest lying to the east and west of the Semliki River, though many centuries ago these forest dwarfs must have been the principal inhabitants of the whole of the Uganda Protectorate. They are much more abundant in the forests of the Belgian Congo, being found as far south as the range of the Angola, and to the north and north-west as far as the Bahr-el-Ghazal and the German Cameroons. They are also found in the interior of the French Congo and in the Gaboon. They comprise the *Akkas*

(Tiky-Tiky) of the upper Nile, and of the Niam-Niam country; the *Wambutti* (Mbuti, Mambute, Bambute) of the great Ituri forest, and the *Batua* (Watwa) living to the south of the great curve of the Congo river. In the vast forest tract lying between the region of the great lakes and the Atlantic Ocean there are other scattered tribes of pygmies differing in no essential particulars from these, and severally known as Afiffi (of the Momfu country); Obongo, Wochua, Akua, Achango (of the French Congo), Ba-Bengaye (of Sanga), Boyaeli and Bayago (of the Cameroons). Negrilloes have also been noted outside these limits, *e.g.* in the basin of the upper Kasai, as far east as Lake Tanganyika, and even to the north of Lakes Stefanie and Rudolf in British East Africa. There has been considerable mixture of the Negrilloes with the neighbouring Bantu peoples, *e.g.* Adumas, &c.

b. The distribution of the Asiatic pygmies is mainly Oceanic. The following are the three principal tribes. (1) *The Aëtas* (Philippine Islands). The name "Aëtas" is derived from the Malay word *hitam*, meaning black. These little folk dwell in small groups in the interior of Luzon Island, and are to be met with also in the islands of Mindoro, Panay and Negros, and in the north-east of Mindanoa. The total number of Philippine Negritoes is about 20,000. (2) *The Andamanese* (Andaman Islands). These live in isolated groups of fifty to eighty persons. They appear to be dying out, and in 1891 numbered less than 4000. The term Mincopis has sometimes been applied to these Negritoes. (3) *The Sakai* (interior of the Malay Peninsula). Some of these Malay Negritoes are also known as Semangs, Menik, Sen-oi and Jembe. They live for the most part in small groups of from two to three families. In the Ulu-Papung district alone the pure Negritoes in 1890 numbered over 5000. There is much mixture, however, with the surrounding Malay population. Thus the Mintra and Jakhuns are Sakai-Malay cross-breeds. In Malacca the Pangyans of Kelantan and Petani and the neighbouring Tumiors are pure Negritoes, while the Belendas are probably cross-breeds. Some anthropologists believe that the Sakas of the islands on the north-east coast of Sumatra are also derived from Negritoes.

A group of Negritoes—the Karons—has also been discovered in a small area in the north-west coast of New Guinea.[1] Here also there are Negrito-Papuan cross-breeds. There is much diversity of opinion as to whether the recently extinct Kalangs of Java—in some respects the most ape-like of all human beings—did or did not belong to the true Negrito race.

There seems little doubt that at one time the Negrito element was fairly widespread throughout Malaysia, though there is no positive evidence in support of de Quatrefages's contention that the Negrito race once inhabited a vast domain in Indo-oceanic Asia, extending from New Guinea up to the Persian Gulf, and from the Malay Archipelago to Japan. The Malay Peninsula, and possibly some parts of India, are the only portions of the Asiatic mainland where traces of a distinct negroid substratum have been discovered.

A passing reference may here be made to the Bushmen of South Africa, whose average height (4 ft. 8 in.) approximates to that of the true pygmies. Some authorities believe that there is a distinct ethnical relationship between the Negrilloes and the Bushmen, though in many respects the forest pygmies seem more closely allied to the West African Bantu negroes than to the Bushmen-Hottentot group. Professor Elliot-Smith is, indeed, of opinion the pygmies of Central Africa are essentially dwarfed negroes. Schweinfurth, who rediscovered the Akka pygmies of equatorial Africa, believed that they and the Bushmen of South Africa were the remnants of the aboriginal population of the continent, now becoming extinct. The Bushmen have totally different characteristics from the true pygmies. The steatopygia, the dolichocephalic cranium, the lozenge-shaped face with its deep wrinkles, the high protruding cheek-bones, the narrow oblique eyes, the peculiar speech with its marvellous "clicks," the fawn-yellow skin, the absence of downy hair on the body, and other characteristics of the Bushmen, sharply differentiate them from the true forest pygmies.

Consideration of the distribution and general characteristics of the existing pygmy races—Negrilloes and Negritoes—has induced many anthropologists to conclude that we are dealing with the but little modified descendants of an extremely ancient race—the ancestors possibly of all the negro tribes. Sir W. H. Flower himself, as far back as 1880, stated that he was inclined to regard the Negritoes as representing an infantile, undeveloped, or primitive form of the type from which the African negroes on the one hand, and the Asiatic Melanesians on the other, with all their various modifications, may have sprung. If this view be correct, it seems probable that the members of the pygmy races are the existing human beings which most closely resemble primitive man. On the other hand, there are those who regard the pygmies as a retrograde and degenerative type of the negro race and therefore of comparatively recent growth. Though the balance of evidence seems in favour of the former hypothesis, the question must still be regarded as *sub judice.* The first hypothesis would certainly go far to explain the present distribution of the pygmy races. If we regard, as many authorities do, the Indo-African continent, submerged in comparatively recent geological times by the waters of the Indian Ocean, as being the original home of primitive man, then it is easy to understand how he migrated from the subsiding Indo-African continent westward into the heart of Africa, and eastward to the Malay Peninsula by way of the Eastern Archipelago, at that time forming part of the mainland. Those members of the primitive race who migrated westward are supposed to have spread over the larger portion of the continent of Africa. They appear to have divided off into two main branches, the Negrillo pygmies of central Africa and the Bushmen of the southern portion of the continent. These two sub-races appear to have been the aboriginal inhabitants of the country, though their direct descendants have now been driven into the great forest fastnesses by the more powerful Bantu races which sprang from the parent stem at a later date. A. H. Keane, who considers the recently extinct Kalang pygmies as the aborigines of Java, thinks it probable that this island was the first region reached by primitive man and his Miocene precursor during the eastward migration from the subsiding Indo-African continent.

General Characters of the Pygmy Races.—As regards *stature*, the smallest are the African Negrilloes, their average height being 1·38 m. (4½ ft.). One of the six Mambute Negrilloes brought to England by Colonel Harrison in 1906 measured just over 3½ ft. Individuals not exceeding 3 ft. are met with, though the midgets of one or two *pygmai* in height, whose existence is indicated in the early Greek writings, must be relegated to the realm of mythology.

The Philippine Aëtas measure 1·47 m., while the average height of the Sakai and Andamanese is 1·49 m.

The present writer estimated the *weight* of six adult Mambute pygmies (four males and two females) from the Ituri forest, and found the average weight to be seventy-seven pounds. Two of these, one man and one woman, each weighed only fifty-three pounds. All the pure pygmy tribes—whether Negrilloes or Negritoes—in addition to their small size have certain well-marked characters in common. The most notable of these are crisp, closely-curled hair, flattened nose, broad at the base, deeply depressed at the root and with exaggerated development of the *alae nasi*, long upper lip with the mucous membrane moderately everted, large ape-like mouth, receding chin, pronounced prognathism, abundant fine woolly hair on the body, brachycephalic cranium, proportionately long arms and short legs, and a general simian appearance.

The *colour* of the skin shows considerable variation. The pure-blooded African Akkas are of a peculiar dirty reddish-yellow colour, the Mambute pygmies of the Ituri forest have a skin of a deep chocolate-brown hue, while that of the Oceanic Negritoes is of a dark brown or blackish colour, differing but little from that of the surrounding Papuans and Melanesians. The eyes of the pygmies are often large and staring, giving a characteristic "wild appearance."

The abdomen is protuberant in the case of the African pygmies, but not so in the case of the Oceanic Negritoes. The mid-point of the body is above the umbilicus, instead of being below as in the case of Europeans and Asiatics. There is no definite steatopygia, though in a few individual cases among the black Negrillo women the buttocks attain considerable dimensions.

The feet are large and turned slightly inwards, while the toes are relatively longer than those of Europeans. In some there is a tendency for the four smaller toes to diverge from the great toe. Being wonderfully adroit climbers, they sometimes make use of their feet by grasping branches between the great toe and the rest of the toes.

Their clothing is chiefly conspicuous by its absence. The African pygmies go about, for the most part, quite naked, except for the occasional presence of a small covering over the *pudenda*, the men wearing a small piece of deer-skin, and the women one or two bunches of green leaves, which they renew daily. The resemblance to the traditional fig-leaf covering is obvious. The Andamanese wear practically no clothing. The Karons of New Guinea wear a few strips of bark dangling from a string round the loins. The Negrilloes seldom, if ever, tattoo their body. They are fond of beads and other articles of adornment; the upper lips are often pierced with holes, through which quills are thrust. They cut their short curly hair into all sorts of fantastic patterns, and often twist some of it into peaks into which they plait feathers.

Pygmy dwellings are extremely primitive structures. In Africa they are simply arbours constructed of bent interlaced branches and plantain leaves, about 7 ft. in diameter and 4 ft. high, with a small hole near the bottom, through which the pygmy crawls on all fours. Ten or twelve of these arbours constitute a village. These arbours are only temporary habitations, as the pygmies are always moving on to different portions of the forest in pursuit of game. The Philippine Aëtas show the same nomadic tendencies. The dwellings of the Malay Semangs are mere lean-to's, constructed of matted palm-leaves, while the Karons of New Guinea live in wretched hovels of foliage and branches, and in some districts have no habitations whatever.

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[1] In *The Times* of June 3, 1910, was reported a discovery, made by an expedition organized by the British Ornithologists' Union, of a tribe of pygmy people (probably Negritoes) in the great snow mountains of Dutch New Guinea, at an altitude of about 2000 ft. The average height of these pygmies is about 4 ft. 3 in.

The pygmies are seldom if ever tillers of the soil. The African forest dwarfs live mainly on the flesh of birds, deer and other animals, which they shoot with bows and arrows. They eat white ants, bee grubs and the larvae of beetles, also honey, wild beans and mushrooms. They are fond of fruits, particularly bananas, which they obtain from their bigger neighbours by barter or by plunder. They eat the vegetables raw, while the meat is broiled in the ashes of the fire until quite dry. Their utensils consist solely of a few clay cooking-pots and gourds for water. There is no record of cannibalism among the pygmy races. The six Mambute pygmies brought to England in 1906 soon became acclimatized. They took most kindly to European diet and clothing. At the expiry of eighteen months they went back to the Ituri forest much improved in health, having each gained on an average 9½ lb in weight.

They are most daring hunters, and marvellously skilful archers. Though of small size they are well made and agile, and are able to dart in and out with the greatest of ease amongst the tall tangled vegetation of the tropical woodlands. The Batwa, from the south of the Congo, successfully attack elephants, shooting them with their tiny poisoned arrows. The poison is obtained from the juice of certain plants, and also from decaying animal matter derived from the putrefaction of ants. The Andaman pygmies live exclusively by hunting and fishing.

The African pygmies marry at a very early age, often when only nine or ten years old. Marriage is simply a question of the purchase of the girl from her father; the purchase-price being from ten to fifteen arrows, occasionally supplemented, in the case of a desirable wife, by one or two spears or some tobacco. A man may have as many wives as he can afford to buy. A mother gives birth to her offspring in the forest, severing the navel-cord with her teeth, and burying the placenta in the ground. The families are usually small, rarely exceeding three in number. There is great rejoicing when a boy is born, while the unlucky girl baby is beaten by her father with plantain leaves. The boys are often circumcised. There is great affection between the husband and the wife and between the parents and the children. The duration of life is short in the equatorial forests, death usually taking place before the age of forty. The dead are buried in graves, the chief's wives being sometimes killed and buried along with him.

The African pygmies have little if any belief in life after death. They say death is the end of everything. They have a vague belief in "Oudah," a sort of pygmy devil, who is responsible for sudden death and such-like calamities. There is no trace of spirit or ancestor worship. The Andaman Islanders have a vague belief in a sort of god—"Püluga"—an invisible being who lives in a large stone house in the sky, and who made all things. They also believe in an evil one, to whom they attribute sickness and death.

There is no hereditary chief. In many cases a group of pygmies simply cluster round a skilful hunter. In the case of the Mambute pygmies, a chief is succeeded, not by his son, but by his best friend. There are no governmental laws. Murder in the Ituri forest is punished by the next-of-kin lying in wait for the culprit and killing him.

The Negrilloes are fond of music and have numerous folk-songs. They also twang on stringed bows, and beat drums made of hollowed-out tree trunks covered in at the ends with antelope skin. They are also great dancers, keeping perfect time to the beating of the drums their bodies going through the most extraordinary contortions. They all dance together in a long line, which twists about like a snake.

The forest dwarfs have some idea of drawing, each arrow shaft having its distinctive carving. The Andamanese display a considerable degree of intelligence. The Karons of New Guinea, on the other hand, seem to be of a low type of intelligence.

The Negrilloes have acquired a great reputation among the neighbouring tribes for their knowledge of poisons and their antidotes. Their treatment of all pains and inflammations consists in linear scarification of the skin of the affected part. They invariably use sharpened arrow-heads for this purpose.

Close observation has convinced the present writer that the African pygmies are endowed with a high degree of intelligence. Sir Harry Johnston believes them to be the intellectual superiors of the big negroes. They exhibit vivacity and adroitness, quickness in picking up information and languages, and surprising readiness in grasping the salient points of a subject. They are wonderful mimics, and have a marked sense of humour, making witty remarks which set the others off into peals of laughter. They are as a rule bright and cheerful in disposition, will sometimes fly into sudden fits of ill temper and as quickly recover their good humour. They are cleanly in their habits, have a natural sense of modesty and refinement, and punctiliously observe the ordinary decencies of life.

The pygmies of the Malay Peninsula have a perfectly distinct language of their own. A glossary and grammar with phonetic rules of the Sen-oi dialect has been published, showing no connexion with any other known language.

The African pygmies, for the most part, speak a more or less corrupt form of the language of the adjacent negro tribes, *e.g.* Keswahili, Bantu, Momfu. They have some words, however, peculiar to themselves, which may be the fragments of their own original language. (R. M. L.)

PYLE, HOWARD (1853–), American artist and writer, was born at Wilmington, Delaware, on the 5th of March 1853. He was a pupil of the Art Students' League, New York, and first attracted attention by his line drawings after the manner of Albrecht Dürer. His brilliant work as an illustrator made him one of the foremost of American artists, his drawings to illustrate American colonial life, particularly in New England and New Amsterdam, being especially noteworthy; and he published a number of books of fiction, written and illustrated by himself. He also became prominent in decorative painting, his works including "The Battle of Nashville" for the capitol at St Paul, Minnesota, and "The Landing of Carteret" for the Essex county court house, Newark, New Jersey. At his home in Wilmington, Delaware, he established a school of art, instruction being gratuitous, and many successful American illustrators were educated there. In 1907 Howard Pyle was elected a member of the National Academy of Design.

PYLOME, in Zoology, the name given to the principal opening (or openings) of the shell (theca, test) of such Protozoa as possess one. (See FORAMINIFERA, RADIOLARIA.)

PYLOS (mod. Navarino), in ancient geography a town and bay on the west coast of Messenia, noted chiefly for the part it played in the Peloponnesian War. The bay, roughly semicircular in shape, is protected by the island of Sphacteria (mod. Sphagia), over 2½ m. long from N. to S., and is entered by two channels, that on the S., some 1,400 yds. wide, and that on the N., 220 yds. wide and now almost silted up. To the north lies an extensive shallow basin, called the lagoon of Osman Aga, originally part of the great harbour but now cut off from it by a narrow sandbank. North of Sphagia is the rocky headland of Pylos or Coryphasium, called in modern times Palaeo-Navarino or Palaeokastro, from the Venetian ruins on its summit. Originally an island, this headland was in classical times, as now, connected by a narrow bar with the lower promontory of Hagios Nikolaos on the north; it is now united to the mainland also by the sandbar already mentioned. Most scholars, ancient and modern, have identified this with the Homeric Pylos, the home of Neleus and Nestor, and a cave on the north slope of Coryphasium is pointed out as that in which Hermes hid the stolen cattle of Apollo. But this view presents considerable difficulties, and Strabo (viii. 348 sqq.) argued that the Pylos of Nestor must be the place of that name in Triphylia. After the Dorian migration Pylos declined, and it is referred to by Thucydides (iv. 3) as a deserted headland in 425 B.C. In May of that year, the seventh of the Peloponnesian War, the Athenians sent an expedition to Sicily under command of Eurymedon and Sophocles. With them was the general, Demosthenes, who landed at Coryphasium with a body of Athenian troops and hastily fortified it. The Spartans, who were then invading Attica, withdrew their forces and attacked them vigorously by sea and land, but were repulsed, and the Athenians were enabled by the arrival and victory of their fleet to blockade on the island of Sphacteria a body of 420 Spartiates with their attendant helots. A truce was concluded, but peace negotiations were defeated by Cleon (*q.v.*), who was himself appointed to conduct operations with Demosthenes. A large body of light troops was landed and drove the Spartans from their encampment by a well in the middle of the island to its northern extremity. Their heroic resistance was overcome by a rear attack directed by a Messenian, who led a body of men by a difficult path along the cliffs on the east, and the 292 Spartan survivors laid down their arms 72 days after the beginning of the blockade. Their surrender made a deep impression on the whole Greek world, which had learned to regard a Spartan surrender as inconceivable, and to Sparta their loss was so serious that the Athenians might have concluded the war on very favourable terms had they so wished. Though Pylos should have been ceded to Sparta under the terms of the peace of Nicias (421 B.C.) it was retained by the Athenians until the Spartans recaptured it early in 409 B.C. (Diodorus xiii. 64).

In the middle ages the name Pylos was replaced by that of Avarino ('Αβαρῖνος) or Navarino, derived from a body of Avars who settled there; the current derivation from the Navarrese Company, who entered Greece in 1381 and built a castle at this spot, cannot now be maintained (*Eng. Hist. Review*, xx. 307, xxi. 106; *Hermathena*, xxxi. 430 sqq.). From 1498 to 1821 Navarino was in the hands of the Turks, save at two periods when it was held by the Venetians, who named it Zonklon. In 1821 the Greeks captured the town, situated near the southern extremity of the bay, but in 1825 they had to retire before Ibrahim Pasha. On the 20th of October 1827, however, his fleet of 82 vessels was annihilated in the Bay of Navarino by 26 British, French and Russian ships under Admiral Codrington (see Navarino, the Battle of).

See W. M. Leake, *Travels in the Morea*, i. 398 sqq. (London, 1830), and *Peloponnesiaca*, 190 sqq. (London, 1846); E. Curtius, *Peloponnesos*, ii. 173 sqq. (Gotha, 1852); C. Bursian, *Geographie von Griechenland*, ii. 175 sqq. (Leipzig, 1868); Pausanias iv. 36, and the commentary in J. G. Frazer, *Pausanias's Description of Greece*, iii. 456 sqq., v. 608 sqq. (London, 1898); W. G. Clark, *Peloponnesus*, 214 sqq. (London, 1858); W. Vischer, *Erinnerungen und Eindrücke aus Griechenland*, 431 sqq. (Basel, 1857); G. Grote, *History of Greece*, pt. ii. ch. 52; G. Busolt, *Griechische Geschichte*, iii. 1086 sqq.; F. M. Cornford, *Thucydides mythistoricus*, 82 sqq. (London, 1907). The operations at Pylos, described by Thucydides iv. 2–41, have been discussed on the basis of personal observation by Dr G. B. Grundy (*Journal of Hellenic Studies*, xvi. 1 sqq.; *Classical Review*, x. 371 sqq., xi. 155 sqq., 448; *J.H.S.*, xviii. 232 sqq.) and Professor R. M. Burrows (*J.H.S.*, xvi. 55 sqq.; *C.R.* xi. 1 sqq.; *J.H.S.*, xviii. 147 sqq., 345 sqq.; *C.R.* xix. 129 sqq.). Though differing on many points, they agree in thinking (1) that the island of Sphagia is the ancient Sphacteria, Palaeokastro the ancient Coryphasium or Pylos; (2) that in 425 B.C. the lagoon of Osman Aga was navigable and communicated by a navigable channel with the Bay of Navarino; (3) that Thucydides, if the MS. reading is correct, underestimates the length of the island, which he gives as 15 stades instead of 24 (nearly 3 m.), and also the breadth of the southern channel between it and the mainland. Cf. *J.H.S.*, xx. 14 sqq., xxvii. 274 sqq., and Frazer's summary (*op. cit.* v. 608 sqq.). (M. N. T.)

PYM, JOHN (1584–1643), English statesman, was the son and heir of Alexander Pym, of Brymore, Somersetshire, a member of an ancient family which had held this seat in direct male descent from the time of Henry III. He matriculated as a commoner at Broadgates Hall (now Pembroke College), Oxford, in 1599, and entered the Middle Temple in 1602. He acquired a sound knowledge of the law, and became receiver-general of the king's revenue for Wilts., thus gaining a valuable insight into business and finance. He was returned to parliament as member for Calne in 1614 and again in 1621. He at once became conspicuous in the struggle between Crown and parliament. To the committee appointed to consider the state of religion he made his first great speech on the 28th of November 1621. He held fast to the Elizabethan principle that the Roman Catholics should be subjected to disabilities, not because of their religion, but because of their politics. He, therefore, moved that a special commission for the suppression of recusancy should be appointed, and that an association, after the model of those formed under Elizabeth, should be entered into for defence of the king's person and for the execution of the laws concerning religion. Pym supported Sir Edward Coke in the remonstrance on the prevailing discontents, and was a chief promoter of the petition which incurred James's violent displeasure, and of the Commons' answer defending their privileges, which was afterwards torn from the records by the king's own hand. On the dissolution of parliament which immediately followed, Pym, with other "ill-tempered spirits," was arrested in January 1622, and was confined first to his house in London, and then to Brymore. He associated himself with the party of Francis, 4th earl of Bedford, was returned for Tavistock in 1624, and represented this borough in all the ensuing parliaments. He supported Eliot in urging war against Spain for the defence of Protestantism and the Palatinate, and showed throughout his career, as far as his attention was ever directed to foreign policy, a steady inclination in favour of France.

In the parliament of 1625 he continued his campaign against the Roman Catholics, and drew up with Sir Edwin Sandys the articles against them, and the petition to the king for the direct execution of the penal laws. In the parliament of 1626 he was the chief mover, in April, in the prosecution of Richard Montagu, who had advocated Romish doctrines. On the 8th of May he was manager of Buckingham's impeachment, when it was his special duty to press articles ix., x., xi., relating to the improper distribution of rewards and honours. In the third parliament of Charles I., in 1628, Pym overruled Eliot in deciding that Buckingham's impeachment should now be subordinated to the struggle on general grievances. He zealously pushed on the Petition of Right, resisting on the 20th of May the clause added by the Lords to safeguard the king's "sovereign power," declaring that "he knew not what it was." On the 9th of June he carried up to the Lords the impeachment of Roger Manwaring, and delivered a famous speech in which he expounded the fundamental principles which guided his policy.

> "Histories," he said, "are full of the calamities of whole states and nations . . . . [when] one part seeks to uphold the old form of government and the other part to introduce a new . . . But it is equally true that time must needs bring about some alterations. . . . Those things only are eternal which are constant and uniform. Therefore it is observed by the best writers on this subject, that those commonwealths have been most durable and perpetual which have often reformed and recompensed themselves according to their first institution and ordinance."

On the 11th of June he joined in the attack upon Buckingham, whom he regarded as the "cause of all these grievances." On the 27th of January 1629 he was reporter of the committee on religion, and declared that convocation was dependent upon parliament. He again, in February 1629, differed from Eliot, who treated the dispute about tonnage and poundage as a point of privilege, declaring that "the liberties of this house are inferior to the liberties of the kingdom," and desiring to deal with it on higher ground as a breach of law and the constitution. He took no part in the subsequent disturbance in the house, and his name is not mentioned as actively resisting Charles's arbitrary government during the eleven years which followed the dissolution. At this period the state of public affairs may well have appalled the most hopeful and the most patriotic, but there seems no sufficient authority for the belief that Pym, with Hampden and Cromwell, actually embarked for New England and were prevented from sailing by orders from the government. An allusion, however, to a similar plan formed "by some very considerable personages," "diverted by a miraculous providence," is made in a sermon by Thomas Cave in 1642. Pym himself was directly interested in the colonies, being patentee of Connecticut and Providence, and of the latter company also treasurer, and there can be little doubt that like other leaders of the opposition during this period, he regarded America as a possible refuge.

On the assembly of the Short Parliament on the 13th of April 1640, Pym was the acknowledged leader. "Whilst men gazed upon each other," says Clarendon (*Hist.* ii. 68), "looking who should begin (much the greater part having never before sat in parliament), Mr Pym, a man of good reputation . . . who had been as long in these assemblies as any man there living, broke the ice." On the 17th of April he made a great speech of nearly two hours, in which he enumerated the national grievances, deplored almost in the words of Bacon "the interruption of that sweete communion which ought to be betwixt the king and his people in matters of grant and supply," pointed out the practical injury inflicted on commerce and every sort of enterprise including colonial expansion by illegal and arbitrary taxation, and concluded by asking the Lords to join in finding out causes and remedies. His words made a deep impression. On the 27th of April he resisted the grant of supply, and when the Lords passed a resolution that supply should precede the discussion of grievances, Pym, as manager of the Commons, on the 1st of May, read them a severe lecture on the breach of privilege they had committed. Finally, on the 4th, it was resolved that Pym should next day petition the king to make terms with the Scots, to avoid which Charles summarily dissolved the parliament.

All the energies of Pym were now concentrated on obliging Charles to summon another parliament. He was the author of the petition of the twelve peers to the king for redress of grievances and for calling a new parliament, by the wide distribution of which an appeal was made to the nation, and he was the promoter of the petition signed by 10,000 citizens of London. In company with Hampden he rode through the provinces, rousing and organizing public opinion. Meanwhile Charles's attempt to implicate Pym in treasonable communications with the Scots, though there is little doubt that they existed, met with complete failure. Thus, when the king was forced to call the Long Parliament on the 3rd of November, Pym was its acknowledged author and leader. His great work was now, as he conceived it, to save the national liberties and the national religion. Clarendon (*Hist.* iii. 2) records some "sharp discourse" of Pym with himself at this time, "that they had now an opportunity to make their country happy by removing all grievances and pulling up the causes by the roots, if all men would do their duties." He had seen Vane's notes of Strafford's speeches at the council when he had advised the subduing of "this kingdom" by the Irish army, and on the 7th of November, after declaring to the house the dangerous designs then on foot, Pym moved for a sub-committee to examine into Strafford's conduct in Ireland. The latter's sudden arrival at London on the 9th with the intention of instantly impeaching the popular leaders of treason was met by Pym with corresponding quickness and resolution. On the 11th, after a debate of four hours in the Commons, by his directions with locked doors, he carried up Strafford's impeachment to the Lords, and by this great stroke rendered him at once powerless.

On the 16th of December he moved the impeachment of Laud, whom he joined with Strafford as conspiring to subvert the government of the kingdom, and carried up the articles to the Lords on the 26th of February 1641. He was the chief promoter of the case against Strafford, while the attempts of the queen to gain him over were without result, and on the 28th of January 1641 he brought up to the Lords the list of charges. On the 23rd of March he opened the case, when he argued that to attempt to subvert the laws of the kingdom was high treason, and delivered a violent denunciation against the fallen minister, attributing to him systematic cruelty, avarice and corruption. He soon afterwards heard of the army plot, and the necessity of destroying Strafford became more apparent. He now disclosed Vane's notes. To the attainder, which was at this stage resolved upon, he was opposed (since he clung to the more judicial procedure by impeachment), but when overruled he supported it, at the same time procuring that the legal arguments should not be interrupted. He delivered his final speech on the 13th of April, a great oratorical performance, when he again appealed to the Elizabethan political faith and to that of Bacon, who had so severely censured any action which divided the king from the nation. The man who violated this union was guilty of the blackest treason. "Shall it be treason," he asked, "to embase the King's coin though but a piece . . . of sixpence . . . and not to embase the spirits of his subjects; to set a stamp and character of servitude upon them?" Towards the end of his tremendous indictment of Strafford, Pym broke down, fumbled among his papers, and lost the thread of his argument. But his temporary failure did not diminish the force and effect of his words, all the more impressive because actually spoken in the presence of the sovereign. "I believe," wrote Baillie (*Letters*, i. 348) "the king never heard a lecture of so free language against that his idolized prerogative."

Attempts were now once more made to gain over Pym to the administration. He had two interviews with the king, but without result, and Charles again determined to resort to force. On the 2nd of May he endeavoured to get possession of the Tower. On the 3rd the Protestation, on Pym's motion, was taken by the Commons within closed doors, and afterwards circulated in the country, and on the 5th Pym disclosed the army plot. These incidents decided the struggle and Strafford's fate. The Lords immediately passed the attainder, together with the bill for making parliaments indissoluble without their own consent. Soon afterwards were swept away those institutions of Tudor growth which had become the chief instruments of oppression, the council of the North, the court of high commission, and the star chamber, while the Crown abandoned the claim to levy customs without consent of parliament. Meanwhile Pym had also taken the lead in the religious controversy. During the dispute between the two houses on this question on the 8th and 9th of February 1641, while supporting the London petition for the abolition of the bishops, he had declared his opinion that "it was not the intention of the House to abolish episcopacy or the Book of Common Prayer, but to reform both wherein offence was given to the people." This, no doubt, expressed his real intentions and policy. When, however, it became clear that the bishops were merely the nominees of the king to carry out "innovations in religion" and preach arbitrary government, Pym was easily persuaded to support their abolition, and voted in opposition to the moderate party for the *Root and Branch* Bill of May 1641, and again for taking away their votes in October. But in his "Vindication," published in March 1643, he especially states that his action with regard to the bishops in "no way concluded me guilty of revolt from the orthodox doctrine of the Church of England."

The first act in the great political struggle had ended in the complete triumph of Pym. His chief care now was to defend the parliament from violence, since this was the only method of retaliation left at the king's disposal. Through the medium of the countess of Carlisle, Charles's plans were regularly disclosed to Pym. In June he heard of the second army plot, and on the 22nd he carried up the ten propositions to the Lords, requesting their concurrence in effecting the disbandment of the armies and the removal of evil counsellors. After Charles's departure for Scotland, Pym served on the committee for defence, appointed on the 14th of August, and was chairman of the committee which sat during the recess from the 9th of September to the 20th of October to watch the progress of affairs and communicate with Scotland. On the latter day letters arrived from Hampden, who had accompanied Charles, with news of the "incident," and immediate measures were taken to guard the parliament, by bringing up the train-bands. On the 30th Pym revealed his knowledge of the second army plot. On the 1st of November came news of the Ulster insurrection, which created a serious difficulty for the parliament, when it was finally declared, at Pym's instance, that if the king did not change his advisers parliament would provide for the needs of Ireland independently. On the 22nd of November Pym made a great speech on the Grand Remonstrance, of which he was the chief promoter, when he referred to plots "very near the king, all driven home to the court and popish party."

Charles returned on the 25th. He immediately substituted a force commanded by Dorset for the guard already placed at Westminster, but was compelled to withdraw it, and on Pym's motion the house appointed its own watch. Everything now pointed to the advent of a frightful catastrophe. Charles appointed Lunsford to the Tower, rejected the Grand Remonstrance and the Impressment Bill, and began to assemble an armed force. In consequence Pym urged, but unsuccessfully, on the 30th of December the summoning of the train-bands to guard the parliament, and moved the impeachment of the bishops, who had declared the proceedings of the parliament to be sinful and illegal. At the critical moment, however, Charles wavered. He renewed his offer to Pym of the exchequer on the 1st of January 1642, and this meeting with a refusal, or again drawing back himself, he determined on the impeachment of the five members on the 3rd of January. The latter had been forewarned of the king's plans, and when on the 5th he entered the House of Commons with an armed band to seize them, they had removed themselves in safety (see LENTHAL, WILLIAM). Charles's first look on entering was for his great opponent, and he was greatly disconcerted at not finding him in his usual place. To his question "Is Mr Pym here?" there was no answer, and nothing remained but to retreat with his mission completely unachieved.

The second act in the great national drama had thus, as the first, ended in a victory for Pym. On the 11th, with the other members, he was escorted in triumph back to Westminster, and while the other four stood uncovered, Pym returned thanks from his place to the citizens. On the 25th of January he delivered a great speech to the Lords on the perils attending the kingdom, and referring to their hesitation on the subject of the militia, declared that he should be sorry that history should have to relate that the House of Peers had had no part in the preservation of the state in the present extremity of danger. The Commons ordered his speech to be printed, and it provided the chief material for the paper war between Charles and the parliament which now followed. Still endeavouring to avoid a complete breach of constitutional forms, Pym caused to be added to the resolution of the Commons on the 20th of May 1642, which declared that "the king intends to make war against the parliament," the words "seduced by wicked counsel."

When war broke out, Pym remained at headquarters in control of the parliament and executive, and on the 4th of July was appointed to the committee of safety which directed the movements of the parliamentary forces. His attitude was firm but moderate. He opposed the attempt to prevent Colepepper giving the king's message to the house on the 27th of August. On the 20th of October, upon Charles refusing to accept the petition of the parliament and advancing towards London, Pym proposed the parliamentary covenant, and that those who refused it should be "cast out of the House." He succeeded in overcoming the opposition in the city to the heavy taxation now imposed. On the 10th of November, after Edgehill, he spoke in support of the negotiations for peace, at the same time warning the citizens that "to have printed liberties and not to have liberty in truth and realities is but to mock the kingdom." In February 1643 he still showed an inclination for peace, and during the negotiation of the treaty at Oxford supported the disbandment of the armies. When it was evident that peace would not be secured, he proposed in order to carry on the war an excise, hitherto unknown in England, which met with the same violent hostility afterwards aroused by Walpole's scheme. In March he published a "Declaration and Vindication" of his public conduct, in which he threw the whole blame of the appeal to arms on the opposite party, and expressed his fidelity to the Church and constitution. In May he entered, together with the other leaders, into resultless negotiations with the queen, and on the 23rd he took up her impeachment to the Lords. In June he reported on Waller's plot, which exposed the insincerity of Charles's negotiations, and on the 26th of June wrote a "sharp letter" to Essex on his inaction. In July, after the defeat at Adwalton Moor, he prevented the house from again initiating negotiations for peace, which he declared "full of hazard and full of danger," and on the 3rd of August, after having visited Essex at Kingston, persuaded him to separate himself from the peace propositions of the Lords and to march to relieve Gloucester. He thus incurred the hatred of the peace party, and on the 9th of August a mob of women surrounded the house calling for Pym's destruction, and were not dispersed without some bloodshed.

Pym had already, on the 3rd of January, proposed to the house an alliance with the Scots, and the Royalist victories now induced parliament to consent to what had before been rejected. The establishment of Presbyterianism was accepted by Pym as a disagreeable necessity, and he was one of the first to take the covenant on the 25th of September. This alliance, which was afterwards destined to have so decisive an influence on the military campaign, and was the first occasion on which the two nations had united in public action, closes Pym's great career. He was made master of the ordnance on the 8th of November, but died on the 8th of December at Derby House, where he resided. On the 15th of December he received a public funeral in Westminster Abbey, whence his body was ejected at the Restoration. A sum of £10,000 was voted by the parliament to pay Pym's debts and provide for his family. About 1614 Pym married Anne Hooke, or Hooker (d. 1620), by whom he had five children, including two sons, Alexander, who died unmarried, and Charles, who was created a baronet; this title, together with Pym's male line, became extinct in the person of Pym's grandson Charles in 1688, Brymore then passing to his sister Mary, wife of Sir Thomas Hales, Bart.

Pym had little of the Puritan in his character or demeanour. His good humour, humanity and cheerfulness in all circumstances, "his pleasant countenance and sweet behaviour," were marked characteristics; the aspersions, however, on his morals, as well as the accusations of bribery, are completely unsubstantiated and discredited. His death came as an irreparable loss to the parliamentary cause. "Since Pym died," writes Baillie (*Letters*, ii. 216), "not a state head among them; many very good and able spirits, but not any of so great and comprehensive a braine as to manage the multitude of weightie affaires as lyes on them." He was one of the greatest leaders that the House of Commons has produced, a most capable man of business, and indefatigable in assiduous attention to its details. He possessed great tact in influencing the conduct of the house and in removing personal jealousies on critical occasions, and he excelled as a party leader in choosing and directing the course of policy, and in keeping his followers united and organized in its prosecution, as well as in stimulating and guiding popular opinion outside in its support. The frequent appeals to the nation by protestations, oaths of association and popular petitions, were a very striking feature in Pym's policy, one of the chief sources of his strength, and new in English history. We may indeed perhaps see in these and in the canvassing of constituencies conducted by Pym and Hampden the beginnings of party government. His eloquence lay rather in the clearness of his expression and in the depth and solidity of his ideas than in the more showy arts of oratory. Much of his success as a leader was the result of the confidence inspired by his high character, his well-tried courage and resolution at critical moments, his skill and vigilance in unmasking and frustrating the designs of the opposite faction. But Pym was not only great as a party leader; he had the real instinct of construction, the true test of the statesman. This construction, he believed, in the spirit of genuine conservatism, must always be progress along the lines of natural development, and not by the methods of revolutionary or extraneous innovation. It was Pym's chief charge against Charles, Strafford and Laud that they had arrested this progress, and were thus leading the nation to ruin and dissolution. Such was the theory and conviction, inherited from Bacon and passed on to Halifax and Burke, which underlay and inspired Pym's policy.

The article on Pym by S. R. Gardiner, in the *Dict. Nat. Biog.* with its references to authorities, must be supplemented by the same author's *Hist. of England and of the Civil War*. Pym's life has also been written at length by J. Forster in Lardner's *Cabinet Cyclopaedia*, *Eminent British Statesmen*, vol. iii., and by Wood in *Ath. oxon.* iii. 72, who adds a list of Pym's printed speeches. His character, drawn by Clarendon, *Hist.* iii. 30 and vii. 409, is inaccurate and obviously prejudiced. See also J. Forster's *Grand Remonstrance*, *Arrest of the Five Members*, *Life of Sir J. Eliot*; Verney's *Notes of the Long Parliament*; Whitelocke's *Memorials*, (needing corroboration of other authorities); R. Baillie's *Letters*; *Eng. Hist. Rev.* xvii. 736; Rushworth's *Collections*; *Thomason Tracts*, E 153 (10), 63 (8), 172 (14), 164 (3), 200 (13) (26) (37) (49) (65), 199 (24) (49), 78 (13); *Somers Tracts* iv. 217, 355, 461, 466; *Affaniae* and *Death's Sermon*, by C. Fitzgeffrey; *Add. MSS.* Brit. Mus. 14,827; 11,692; *Lords and Commons Journals*. There are a large number of references to Pym in *Calendars of State Papers Dom.* 1619–1643, and *Colonial Series* 1574–1660, and in the *Hist. MSS. Comm. Series*; but the supposed notebook of Pym mentioned in *Rep.* x. app. vi. 82, has been shown by Gardiner to be that of another person (*Eng. Hist. Rev.*, Jan. 1895, p. 105). (P. C. Y.)

PYRAMID, the name for a class of buildings, first taken from a part of the structure,[1] and mistakenly applied to the whole of it by the Greeks, which has now so far acquired a more definite meaning in its geometrical sense that it is desirable to employ it in that sense alone. A pyramid therefore should be understood as meaning a building bounded by a polygonal base and plane triangular sides which meet in an apex.[2] Such a form of architecture is only known in Middle Egypt, and there only during the period from the IVth to the XIIth Dynasty (before 3000 B.C.)—having square bases and angles of about 50°. In other countries various modifications of the tumulus, barrow or burial-heap have arisen which have come near to this type; but these when formed of earth are usually circular, or if square have a flat top, and when built of stone are always in steps or terraces. The imitations of the true Egyptian pyramid at Thebes, Meroe and elsewhere are puny hybrids, being merely chambers with a pyramidal outside and porticos attached; and the structures found at Cenchreae, or the monument of Caius Sestius at Rome, are isolated and barren trials of a type which never could be revived: it had run its course in a country and a civilization to which alone it was suitable.

The origin of the pyramid type has been entirely explained by the discovery of the various stages of development of the tomb. In prehistoric times a square chamber was sunk in the ground, the dead placed in it, and a roof of poles and brushwood overlaid with sand covered the top. The Ist Dynasty kings developed a wooden lining to the chamber; then a wooden chamber free-standing in the pit, with a beam roof, then a stairway at the side to descend; then a pile of earth held in by a dwarf wall over it. By the IIIrd Dynasty this dwarf wall had expanded into a solid mass of brickwork, about 280 by 150 ft. and 33 ft. high. This was the *mastaba* type of tomb, with a long sloping passage descending to the chamber far below it. This pile of brickwork was then copied in stonework early in the IIIrd Dynasty (Saqqara). It was then enlarged by repeated heightening and successive coats of masonry. And lastly a smooth casing was put over the whole, and the first pyramid appeared (Medum).

It is certain that the pyramids were each begun with a definite design for their size and arrangement; at least this is plainly seen in the two largest, where continuous accretion (such as Lepsius and his followers propound) would be most likely to be met with. On looking at any section of these buildings it will be seen how impossible it would have been for the passages to have belonged to a smaller structure (Petrie, 165). The supposition that the designs were enlarged so long as the builder's life permitted was drawn from the compound mastabas of Saqqara and Medum; these are, however, quite distinct architecturally from true pyramids, and appear to have been enlarged at long intervals, being elaborately finished with fine casing at the close of each addition.

Around many of the pyramids peribolus walls may be seen, and it is probable that some enclosure originally existed around each of them. At the pyramids of Gizeh the temples attached to these mausolea may be still seen. As in the private tomb, the false door which represented the exit of the deceased person from this world, and towards which the offerings were made, was always on the west wall in the chamber, so the pyramid was placed on the west of the temple in which the deceased king was worshipped. The temple being entered from the east (as in the Jewish temples), the worshippers faced the west, looking towards the pyramid in which the king was buried. Priests of the various pyramids are continually mentioned during the old kingdom, and the religious endowments of many of the priesthoods of the early kings were revived under the Egyptian renaissance of the XXVIth Dynasty and continued during Ptolemaic times. A list of the hieroglyphic names of nineteen of the pyramids which have been found mentioned on monuments (mostly in tombs of the priests) is given in Lieblein's *Chronology*, p. 32. The pyramid was never a family monument, but belonged—like all other Egyptian tombs—to one person, members of the royal family having sometimes lesser pyramids adjoining the king's (as at Khufu's); the essential idea of the sole use of a tomb was so strong that the hill of Gizeh is riddled with deep tomb-shafts for separate burials, often running side by side 60 or 80 ft. deep, with only a thin wall of rock between; and in one place a previous shaft has been partially blocked with masonry, so that a later shaft could be cut partly into it, macled with it like a twin-crystal.

The usual construction of pyramids is a mass of masonry composed of horizontal layers of rough-hewn blocks, with a small amount of mortar; and this mass in the later forms became more and more rubbly, until in the VIth Dynasty it was merely a cellular system of retaining walls of rough stones and mud, filled up with loose chips, and in the XIIth Dynasty the bulk was of mud bricks. Whatever was the hidden material, however, there was always on the outside a casing of fine stone, elaborately finished, and very well jointed; and the inner chambers were of similarly good work. Indeed the construction was in all cases so far sound that, had it not been for the spite of enemies and the greed of later builders, it is probable that every pyramid would have been standing in good order at this day. The casings were not a mere "veneer" or "film," as they have been called, but were of massive blocks, usually greater in thickness than in height, and in some cases (as at South Dahshur) reminding the observer of horizontal leaves with sloping edges.

Inside of each pyramid, always low down, and usually below the ground level, was built a sepulchral chamber; this was reached in all cases by a passage from the north, sometimes beginning in the pyramid face, sometimes descending into the rock on which the pyramid was built in front of the north side. This chamber, if not cut in the rock altogether (as in Menkaura's), or a pit in the rock roofed with stone (as in Khafra's), was built between two immense walls which served for the east and west sides, and between which the north and south sides and roofing stood merely in contact, but unbonded. The gable roofing of the chambers was formed by great sloping cantilevers of stone, projecting from the north and south walls, on which they rested without pressing on each other along the central ridge; thus there was no thrust, nor were there any forces to disturb the building; and it was only after the most brutal treatment, by which these great masses of stone were cracked asunder, that the principle of thrust came into play, though it had been provided for in the sloping form of the roof, so as to delay so long as possible the collapse of the chamber. This is best seen in the pyramid of Pepi (Petrie), opened from the top right through the roof. See also the Abusir pyramids (Howard Vyse) and the king's and queen's chambers of the great pyramid (Howard Vyse, Piazzi Smyth, Petrie). The roofing is sometimes, perhaps usually, of more than one layer; in Pepi's pyramid it is of three layers of stone beams, each deeper than their breadth, resting one on another, the thirty stones weighing more than 30 tons each. In the king's chamber (Gizeh) successive horizontal roofs were interposed between the chamber and the final gable roof, and such may have been the case at Abu Roash (Howard Vyse).

The passages which led into the central chambers have usually some lesser chamber in their course, and are blocked once or oftener with massive stone portcullises. In all cases some part, and generally the greater part, of the passages slopes downwards, usually at an angle of about 26°, or 1 in 2. These passages appear to have been closed externally with stone doors turning on a horizontal pivot, as may be seen at South Dahshur. and as is described by Strabo and others (Petrie). This suggests that the interiors of the pyramids were accessible to the priests, probably for making offerings; the fact of many of them having been forcibly entered otherwise does not show that no practicable entrance existed, but merely that it was unknown, as, for instance, in the pyramids of Khufu and Khafra, both of which were regularly entered in classical times, but were forced by the ignorant Arabs.

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[1] The vertical height was named by the Egyptians *pir-em-us* (see E. Revillout, *Rev. Ég.*, 2nd year, 305–309), hence the Greek form *pyramis*, pl. *pyramides* (Herod.), used unaltered in the English of Sandys (1615), from which the singular *pyramid* was formed.

[2] For figures of geometrical pyramids see CRYSTALLOGRAPHY, and for their mensuration see MENSURATION.

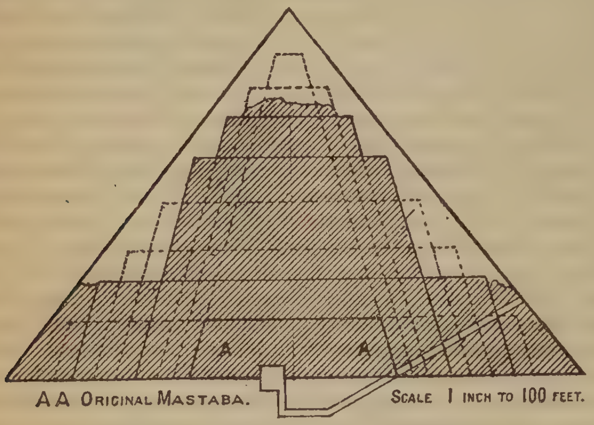


Fig. 1.—Pyramid of Medum (Meidoun).

The pyramids of nearly all the kings of the IVth, Vth and VIth Dynasties are mentioned in inscriptions, and also a few of later times. The first which can be definitely attributed is that of Khufu (or Cheops), called "the glorious," the great pyramid of Gizeh. Dad-ef-ra, who appears next to Khufu in the lists, had his pyramid at Abu Roash. Khafra rested in the pyramid now known as the second pyramid of Gizeh. Menkaura's pyramid was called "the upper," being at the highest level on the hill of Gizeh. The lesser pyramids of Gizeh, near the great and third pyramids, belong respectively to the families of Khufu and Khafra (Howard Vyse). The pyramid of Aseskaf, called "the cool," is unknown, so also is that of Userkaf of the Vth Dynasty, called the "holiest of buildings." Sahura's pyramid, the north one of Abusir, was named "the rising soul," much as Neferarkara's at Abusir was named "of the soul." Raenuser's pyramid, "the firmest of buildings," is the middle pyramid of Abusir. The pyramid of Menkauhor, called "the most divine building," is somewhere at Saqqara. Assa's pyramid is unidentified; it was "the beautiful." Unas not only built the mastaba Farun, long supposed to be his pyramid, but had a pyramid called "the most beautiful of buildings" at Saqqara, which was opened in 1881 (see *Recueil des travaux*, by M. Maspero, iii., for those opened at Saqqara). In the VIth Dynasty the "pyramid of souls," built by Ati (Rauserka), is unknown. That of Teta, "the most stable of buildings," was opened at Saqqara in 1881, as well as that of Pepi (Rameri), "the firm and beautiful." The pyramids of Rameren, "the beautiful rising," and of Neferarkara, "the firm life," are unknown. Haremsaf's pyramid was opened at Saqqara in 1881. Of the last two kings of the VIth Dynasty we know of no pyramids. In the VIIth or VIIIth Dynasty most probably the brick pyramids of Dahshur were erected. In the XIth Dynasty the pyramid, "the most glorious building," of Mentuhotep II. is at Deir el Bahri, and the mud pyramid of one of the Antef kings is known at Thebes. In the XIIth Dynasty the pyramids, the "lofty and beautiful" of Amenemhat I. and "the bright" of Usertesen II., are known in inscriptions, while the pyramid of Senusert I. is at Lisht, that of Senusert II. is at Illahun, that of Senusert III. at Dahshur (N. brick), and the brick pyramid at Howara is of Amenemhat III., who built the adjoining temple.

Of the architectural peculiarities of some particular pyramids some notice must now be given. The pyramid of Medum (figs. 1, 2) was the first true pyramid. It was begun as a mastaba, AA, like other such tombs, such as that of King Neter-khet at Beyt Khalaf. This mastaba was then enlarged by heightening it and adding a coating, and this process, repeated seven times, resulted in a high stepped mass of masonry. Such had been made before, at the step pyramid of Saqqara; but for the first time it was now covered with one uniform slope of masonry from base to top, and a pyramid was the result. The chamber is peculiar for being entered by a vertical shaft in the floor. The great pyramid (fig. 3) of Gizeh (Khufu's) is very different in its internal arrangements from any other known. The pyramid covers upwards of 13 acres, and is about 150 ft. higher than St Paul's Cathedral. As compared with St Peter's, Rome, it covers an area which is as 29 to 11, or nearly three times as much, and it is 50 ft. higher. The greater number of passages and chambers, the high finish of parts of the work, and the accuracy of construction all distinguish it. The chamber which is most normal in its situation is the subterranean chamber; but this is quite unfinished, hardly more than begun. The upper chambers, called the "king's" and "queen's," were completely hidden, the ascending passage to them having been closed by plugging blocks, which concealed the point where it branched upwards out of the roof of the long descending passage. Another passage, which in its turn branches from the ascending passage to the queen's chamber, was also completely blocked up. The object of having two highly-finished chambers in the mass may have been to receive the king and his co-regent (of whom there is some historical evidence) and there is very credible testimony to a sarcophagus having existed in the queen's chamber, as well as in the king's chamber. On the details of construction in the great pyramid it is needless to enter here; but it may be stated that the accuracy of work is such that the four sides of the base have only a mean error of six-tenths of an inch in length and 12 seconds in angle from a perfect square.[1]

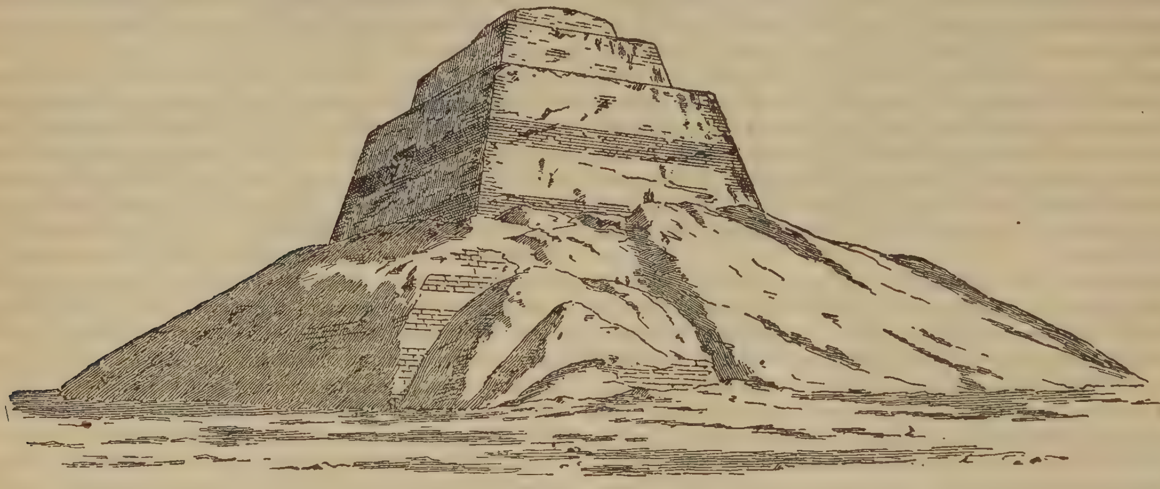
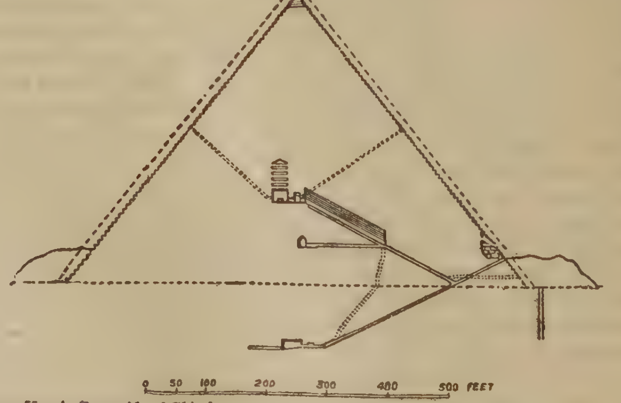


Fig. 2.—Pyramid of Medum.

The second pyramid of Gizeh, that of Khafra, has two separate entrances (one in the side, the other in the pavement) and two



From Vyse's *Pyramids of Ghizeh.*

Fig. 3.—Section of Great Pyramid.

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[1] With respect to the construction of this and other pyramids, see Howard Vyse; on measurements of the inside of the great pyramid and descriptions, see Piazzi Smyth; and on measurements in general mechanical means, and theories, see Petrie.

chambers (one roofed with slabs, the other all rock-hewn), these chambers, however, do not run into the masonry, the whole bulk of which is solid so far as is known. This pyramid has a part of the original casing on the top; and it is also interesting as having the workmen's barracks still remaining at a short distance on the west side, long chambers capable of housing about 4000 men. The great bulk of the rubbish from the work is laid on the south side, forming a flat terrace level with the base, and covering a steep rock escarpment which existed there. The waste heaps from the great pyramid were similarly tipped out over the cliff on its northern side. Thus the rubbish added to the broad platform which set off the appearance of the pyramids; and it has remained undisturbed in all ages, as there was nothing to be got out of it. The third pyramid, that of Menkaura, was cased around the base with red granite for the sixteen lowest courses. The design of it has been enlarged at one bound from a small pyramid (such as those of the family of Khufu) to one eight times the size, as it is at present, the passages needed therefore to be altered. But there is no sign of gradual steps of enlargement: the change was sudden, from a comparatively small design to a large one. The basalt sarcophagus of this pyramid was ornamented with the panel decoration found on early tombs, unlike the granite sarcophagi of the two previous pyramids, which are plain. Unhappily it was lost at sea in 1838.

An additional interest belongs to the third pyramid (of Menkaura) owing to its chamber being ceiled with a pointed arch (fig. 4). But it is not a true arch, the stones being merely cantilevers opposite to each other, with the underside cut to the above form (see fig. 5). Farther south are the pyramids of Abusir, described in the work of Colonel Howard Vyse, and since excavated by the Germans. Next come those of Saqqara. The construction of the step-pyramid or cumulative mastaba has been noticed above; its passages are very peculiar and intricate, winding around the principal chamber, which is in the centre, cut in the rock, very high, and with a tomb-chamber built in the bottom of it, which is closed with a great plug of red granite, a circular stopper fitting into a neck in the chamber roof. A doorway faced with glazed tiles bearing the name of King Neter-khet of the IIIrd Dynasty existed here; the tiles were taken to Berlin by Lepsius. The other pyramids of Saqqara are those of Unas, Pepi, Haremsaf, &c. They are distinguished by the introduction of very long religious texts, covering the whole inside of the chambers and passages; these are carefully carved in small hieroglyphics, painted bright green, in the white limestone. Beyond these come the pyramids of Dahshur, which are in a simple and massive style, much like those of Gizeh. The north pyramid of Dahshur has chambers roofed like the gallery in the great pyramid by successive overlappings of stone, the roof rising to a great height, with no less than eleven projections on each side. The south pyramid of Dahshur has still the greater part of its casing remaining, and is remarkable for being built at two different angles, the lower part being at the usual pyramid angle, while the upper part is but 43°. This pyramid is also remarkable for having a western passage to the chambers, which was carefully closed up. Beyond the Memphitic group are the scattered pyramids of Lisht (Senusert I.), Illahun (Senusert II.), and Howara (Amenemhat III.), and the earliest pyramid of Medum (Sneferu). Illahun is built with a framework of stone filled up with mud bricks, and Howara is built entirely of mud bricks, though cased with fine stone like the other pyramids.

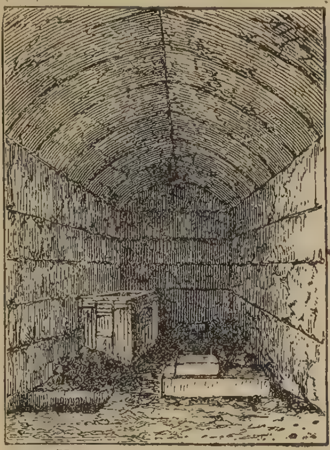
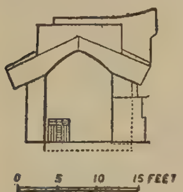

From Vyse.

FIG. 4.—Sepulchral Chamber, Third Pyramid.



From Vyse.

FIG. 5.—Section of Sepulchral Chamber, Third Pyramid.

The dimensions of the pyramids that are accurately known are in inches:—

Place.	King.	Date B.C.	Base.	Error.	Angle.	Height.	Azimuth.
Medum . . .	Sneferu	4750	5682·0	6·2	51° 52′	3619	24′ 25″ W.
Gizeh . . .	Khufu	4700	9068·8	·65	51° 52′	5776	3′ 43″ W.
,,	Khafra	4600	8474·9	1·5	53° 10′	5664	5′ 26″ W.
,,	Menkaura	4550	4153·6	3·0	51° 10′	2581	14′ 3″ E.
Dahshur S. . .	?	?	7459·0	3·7	{43° 5′} {55° 1′}	4134	9′ 12″ W.
Dahshur Small .	?	?	2064·6	1·1	44° 34′	2034	10′ 12″ W.

The first two closely agree to the proportion of 7 high on 11 base, approximately the ratio of a radius to its circle. And on dividing the base at Medum by 11 the modulus is 515·64, and the base of Khufu÷11 is 824·44. These moduli are 25 cubits of 20·625 and 40 cubits of 20·611; so it appears that the form was of the same type, but with moduli of 25 and 40 cubits respectively.

Beyond these already described there are no true pyramids, but we will briefly notice those later forms derived from the pyramid. At Thebes some small pyramids belong to the kings of the XIth Dynasty; the tomb-chamber is in the rock below. The size is under 50 ft. square. These are not oriented, and have a horizontal entrance, quite unlike the narrow pipe-like passages sloping down into the regular pyramids (see Mariette, in *Bib. arch. trans.* iv. 193). In Ethiopia, at Gebel Barkal, are other so-called pyramids of a very late date. They nearly all have porches; their simplicity is lost amid very dubious decorations; and they are not oriented. They are all very acute, and have flat tops as if to support some ornament. The sizes are but small, varying from 23 to 88 ft. square at Gebel Barkal and 17 to 63 ft. square at Meroe. The interior is solid throughout, the windows which appear on the sides being useless architectural members (see Hoskin's *Ethiopia*, 148, &c.). The structures sometimes called pyramids at Biahmu in the Fayum have no possible claim to such a name; they were two great enclosed courts with sloping sides, in the centres of which were two seated statues raised on pedestals high enough to be seen over the walls of the courts. This form would appear like a pyramid with a statue on the top; and a rather similar case in early construction is shown on the sculptures of the old kingdom. Obelisks then were single monuments (not in pairs) and stood in the midst of a great courtyard with sides sloping like a mastaba; such open courtyards on a small scale are found in the mastabas at Gizeh, and are probably copied from the domestic architecture of the time.

On the vexed question of inscriptions on the pyramids it will suffice to say that not one fragment of early inscription is known on the casing of any pyramid, either *in situ* or broken in pieces. Large quantities of travellers' "graffiti" doubtless existed, and some have been found on the casing of the great pyramid; these probably gave rise to the accounts of inscriptions, which are expressly said to have been in many different languages.

The mechanical means employed by the pyramid-builders have been partly ascertained. The hard stones, granite, diorite and basalt were in all fine work sawn into shape by bronze saws set with jewels (either corundum or diamond), hollows were made (as in sarcophagi) by tubular drilling with tools like our modern diamond rock-drills (which are but reinvented from ancient sources, see *Engineering*, xxxvii. 282). The details of the questions of transport and management of the large stones remain still to be explained.

See Colonel Howard Vyse, *Operations at the Pyramids* (1840); Professor C. Piazzi Smyth, *Life and Work at the Great Pyramid* (1867); W. M. Flinders Petrie, *Pyramids and Temples of Gizeh*, (1883).
(W. M. F. P.)

PYRAMIDION (diminutive of "pyramid"), an architectural term for the copper-gilt casing covering the apex of an obelisk, and generally extended to its upper termination of pyramidical form.

PYRAMUS AND THISBE, the hero and heroine of a Babylonian love-story told by Ovid (*Metam.* iv. 55–465). Their parents refused to consent to their union, and the lovers used to converse through a chink in the wall separating their houses. At last they resolved to flee together, and agreed to meet under a mulberry tree near the tomb of Ninus. Thisbe was the first to arrive, but, terrified by the roar of a lion, took to flight. In her haste she dropped her veil, which the lion tore to pieces with jaws stained with the blood of an ox. Pyramus, believing that she had been devoured by the lion, stabbed himself. Thisbe returned to the rendezvous, and finding her lover mortally wounded, put an end to her own life. From that time the fruit of the mulberry, previously white, was always black.

See G. Hart, *Die Ursprung und Verbreitung der Pyramus- und-Thisbesage* (1889–1892).

PYRARGYRITE, a mineral consisting of silver sulphantimonite, Ag_3SbS_3, known also as dark red silver ore, an important source of the metal. It is closely allied to, and isomorphous with, the corresponding sulpharsenite known as proustite (*q.v.*) or light red silver ore. "Ruby silver" or red silver ore (German *Rotgültigerz*) was mentioned by G. Agricola in 1546, but the two species so closely resemble one another that they were not completely distinguished until chemical analyses of both were made by J. L. Proust in 1804.

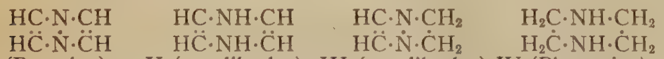
Both crystallize in the ditrigonal pyramidal (hemimorphic-hemihedral) class of the rhombohedral system, possessing the same degree of symmetry as tourmaline. Crystals are perfectly developed and are usually prismatic in habit; they are frequently attached at one end, the hemimorphic character being then evident by the fact that the oblique striations on the prism faces are directed towards one end only of the crystal. Twinning according to several laws is not uncommon. The angles are nearly the same in the two species; the rhombohedral angle *rr′* being 71° 22′ in pyrargyrite and 72° 12′ in proustite. The hexagonal prisms of pyrargyrite are usually terminated by a low hexagonal pyramid (310) or by a drusy basal plane. The colour of pyrargyrite is usually greyish-black and the lustre metallic-adamantine; large crystals are opaque, but small ones and thin splinters are deep ruby-red by transmitted light, hence the name, from Gr. πῦρ (fire) and ἄργυρος (silver), given by E. F. Glocker in 1831. The streak is purplish-red, thus differing markedly from the scarlet streak of proustite and affording a ready means of distinguishing the two minerals. The hardness is 2½, and the specific gravity 5·85: the refractive indices and birefringence are very high, $\omega=3{\cdot}084$, $\epsilon=2{\cdot}881$. There is no very distinct cleavage and the fracture is conchoidal. The mineral occurs in metalliferous veins with calcite, argentiferous galena, native silver, native arsenic, &c. The best crystallized specimens are from St Andreasberg in the Harz, Freiberg in Saxony, and Guanajuato in Mexico. It is not uncommon in many silver mines in the United States, but rarely as distinct crystals; and it has been found in some Cornish mines.

Although the "red silver ores" afford a good example of isomorphism, they rarely form mixtures; pyrargyrite rarely contains as much as 3% of arsenic replacing antimony, and the same is true of antimony in proustite. Dimorphous with pyrargyrite and proustite respectively are the rare monoclinic species pyrostilpnite or fireblende (Ag_3SbS_3) and xanthoconite (Ag_3AsS_3): these four minerals thus form an isodimorphous group. (L. J. S.)

PYRAZINES, Piazines, or Paradiazines, in organic chemistry, a group of compounds containing a ring system composed of 4 carbon atoms and 2 nitrogen atoms, the nitrogen atoms being in the para position. The di- and tri-methyl derivatives are found in the fusel oil obtained by fermentation of beetroot sugar (E. C. Morin, *Comptes rendus*, 1888, 106, p. 360). They were first prepared synthetically by reducing the isonitrosoketones. They may also be prepared by the inner condensation of α-aminoaldehydes or α-aminoketones in the presence of a mild oxidizing agent, such as mercuric chloride or copper sulphate in boiling alkaline solution (L. Wolff, *Ber.*, 1893, 26, p. 1830; S. Gabriel, ibid. p. 2207); and by the action of ammonia on α-halogen ketonic compounds (W. Staedel and L. Rugheimer, *Ber.*, 1876, 9, p. 563; V. Meyer and E. Braun, *Ber.*, 1888, 21, p. 19). They are also formed when grape sugar is heated with ammonia or when glycerin is heated with ammonium chloride and ammonium phosphate (C. Stoehr, *Journ. prakt. Chem.*, 1895 (2), 51, p. 450; 1896 (2), 54, p. 481). They are feeble basic compounds which distil unchanged. They are mostly soluble in water and somewhat hygroscopic in character. Their salts are easily dissociated. They form characteristic compounds with mercuric and auric chlorides. Their alkyl derivatives readily oxidize to pyrazine carboxylic acids.

Pyrazine, $C_4H_4N_2$, crystallizes from water in prisms, which have a heliotrope odour. It melts at 55° C. and boils at 115° C. It may also be obtained by elimination of carbon dioxide from the pyrazine dicarboxylic acid formed when quinoxaline is oxidized with alkaline potassium permanganate (S. Gabriel). 2·5·-*Dimethylpyrazine*, or ketine, $C_4H_2(CH_3)_2N_2$, is obtained by reducing isonitrosoacetone, or by heating glycerin with ammonium chloride and ammonium phosphate. It boils at 153° C.

Two classes of dihydropyrazines are known, namely the 1·4 and 2·3· dihydro-compounds, corresponding to the formulae II. and III., pyrazine being I.:—

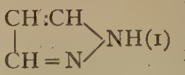


$$\begin{array}{llll} HC{\cdot}N{\cdot}CH & HC{\cdot}NH{\cdot}CH & HC{\cdot}N{\cdot}CH_2 & H_2C{\cdot}NH{\cdot}CH_2 \\ H\ddot{C}{\cdot}\dot{N}{\cdot}\ddot{C}H & H\ddot{C}{\cdot}NH{\cdot}\ddot{C}H & H\ddot{C}{\cdot}\dot{N}{\cdot}\dot{C}H_2 & H_2\dot{C}{\cdot}NH{\cdot}\dot{C}H_2 \end{array}$$

I (Pyrazine) II (1·4 dihydro) III (2·3 dihydro) IV (Piperazine).

Those of the former type are obtained by condensing α-bromketones with primary amines (A. T. Mason, *Journ. Chem. Soc.*, 1893, 63, p. 1355); the latter type result on condensing alkylene diamines with α-diketones. The 2·3 derivatives are somewhat unstable compounds, since on heating they readily give up two hydrogen atoms. *Tetrahydropyrazines* of the 1·2·3·4 type have also been obtained (L. Garzini, *Ber.*, 1891, 24, 956 R). *Hexahydropyrazine* or *piperazine* (formula IV. above), also known as diethylene diamine, may be prepared by reducing pyrazine, or, better, by combining aniline and ethylene bromide to form diphenyl diethylene diamine, the dinitroso compound of which hydrolyses to para-dinitrosophenol and piperazine. It is a strong base, melting at 104° and boiling at 145°–146°. It is used in medicine on account of the high solubility of its salt with uric acid.

PYRAZOLES, in organic chemistry, a series of heterocyclic compounds containing a five-membered ring consisting of three carbon atoms united to two nitrogen atoms, thus:



the derivatives are orientated from the imino group, the second position being at the other nitrogen atom. *Pyrazole*, $C_3H_4N_2$, was obtained by E. Buchner (*Ber.*, 1889, 22, p. 2165) by heating pyrazole 3.4.5.-tricarboxylic acid; and by L. Balbiano (*Ber.*, 1890, 23, p. 1103), who condensed epichlorhydrin with hydrazine hydrate in the presence of zinc chloride:

$$C_3H_5OCl+2N_2H_4=C_3H_4N_2+N_2H_4{\cdot}HCl+H_2O+H_2.$$

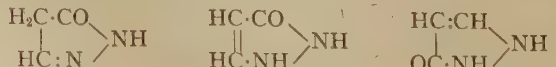
It may also be prepared by the union of diazomethane with acetylene (H. v. Pechmann, *Ber.*, 1897, 31, p. 2950), and by warming the acetal of propargyl aldehyde with an aqueous solution of hydrazine sulphate (*Ber.*, 1903, 36, p. 3662). It crystallizes in colourless needles, is very stable and behaves as a weak base. It does not combine with the alkyl iodides. Ammoniacal silver nitrate gives a precipitate of pyrazole silver.

The homologues of pyrazole may be obtained by digesting β-diketones or β-keto-aldehydes with phenylhydrazine; by heating the phenylhydrazones of some monoketones with acetic anhydride; by elimination of hydrogen from pyrazolines, and by distilling pyrazolones and pyrazolidones over zinc dust. They are all weak bases, which combine directly with the alkyl iodides and form double salts with mercuric and platinic chlorides. On oxidation with potassium permanganate the *C*-alkyl-derivatives give carboxylic acids, whilst the *N*-phenyl derivatives frequently split off the phenyl group (especially if it be amidated) and have it replaced by hydrogen. On reduction, the pyrazoles with a free :NH group are scarcely affected, whilst the *N*-phenyl derivatives give pyrazolines, or by the use of very strong reducing agents the ring is ruptured and trimethylenediamine derivatives are formed. They yield substitution derivatives with the halogens, bromine being the most effective. The chloro-derivatives are most readily prepared from the pyrazolones by the action of phosphorus oxychloride.

The pyrazole carboxylic acids may also be obtained by condensing β-diketone or oxymethylene ketone carboxylic esters with hydrazines, or the diazo fatty esters with acetylene dicarboxylic esters: $N_2CH{\cdot}CO_2R+C_2(CO_2R)_2=C_3HN_2(CO_2R)_3[3{\cdot}4{\cdot}5]$; by heating β-diketones and diazo-acetic ester with sodium hydroxide (A. Klages, *Ber.*, 1903, 36, p. 1128), and from the diazo-anhydrides of β-diketones or β-ketonic acids. These acids all split CO_2 readily when heated, most easily from the carboxyl group in position 3. and with most difficulty from the group in position 4.

The *dihydropyrazoles* or *pyrazolines* are less stable than the pyrazoles and are more like unsaturated compounds. They may be obtained by the reduction of pyrazoles (especially *N*-phenyl derivatives) with sodium in alcoholic solution; by condensing diazo-acetic ester or diazomethane with ethylenic compounds (fumaric ester, &c.) (E. Buchner, *Ber.*, 1890, 23, p. 703; *Ann.*, 1895, 284, p. 212; H. v. Pechmann, *Ber.*, 1894, 27, p. 1891), and by rearrangement of the hydrazones of α-olefine aldehydes or ketones on warming or on distillation. They are weak bases which are only soluble in concentrated acids. On reduction they yield pyrazolidines, or the ring is broken; and when oxidized they form blue or red colouring matters. The carboxylic acids show a remarkable behaviour on heating, the nitrogen is entirely eliminated, and trimethylene carboxylic acids are obtained (see Polymethylenes). Pyrazoline is a colourless liquid which boils at 144° C. It may be prepared by the action of diazomethane on ethylene (E. Azzarello, *Gazz.*, 1906, 36, (i.), p. 628).

The *pyrazolones* (ketodihydropyrazoles), first prepared by L. Knorr in 1883, result from the elimination of the elements of alcohol from the hydrazones of β-ketonic acids; or on the oxidation of the pyrazolidones with ferric chloride. Three types are possible with the formulae:

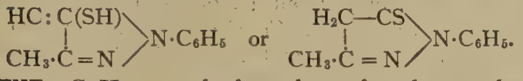


Pyrazolone-5 Antipyrine type Pyrazolone-3

They form salts with both acids and bases, and yield benzylidine and isonitroso derivatives. Pyrazolone is obtained by the condensation of hydrazine with formylacetic ester. It is a colourless crystalline solid which melts at 164° C. 1-*Phenyl-3-methylpyrazolone*-5 is antipyrine (*q.v.*). The isomeric 1-*phenyl-5-methylpyrazolone*-3 is formed by condensing aceto-acetic ester with acetophenylhydrazine in the presence of phosphorus oxychloride, or by the action of ferric chloride on the corresponding pyrazolidone, which is produced by condensing phenylhydrazine with a β-halogen butyric acid. When methylated it yields *isoantipyrine*, an isomer of antipyrine, which is more poisonous.

The pyrazolidines are tetrahydropyrazoles. The *N*-phenyl derivative, from sodium phenylhydrazine and trimethylene bromide, is an oil which readily oxidizes to phenylpyrazoline on exposure. The corresponding keto-derivatives, or *pyrazolidones*, are produced by the action of hydrazines on the β-haloid acids or αβ-olefine dicarboxylic acids. Isomeric compounds may arise here when phenylhydrazine is used, the keto-group taking either the 3 or 5 position; thus with β-iodopropionic acid 1-phenylpyrazolidone-5 is formed, whilst potassium β-iodopropionate gives the 3-compound. Isomers of this type may be distinguished by the fact that the pyrazolidone-5 compounds are basic, whilst the 3-compounds are acidic. The simplest member of the series, pyrazolidone-5, is a liquid which is formed by the action of hydrazine on acrylic acid. The 3·5-pyrazolidones are the cyclic hydrazides of the malonic acid series.

Thiopyrazoles have been obtained by A. Michaelis (*Ann.*, 1904, 331, p. 197; *Ber.*, 1904, 37, p. 2774) by the action of an aqueous or alcoholic solution of the methyl chloride or iodide of phenylmethylchlorpyrazole on a solution of an alkaline hydrosulphide into which carbon bisulphide has been passed; or by the action of sodium thiosulphate on antipyrine hydrochloride or a similar compound. The simplest member of the group is probably to be represented as

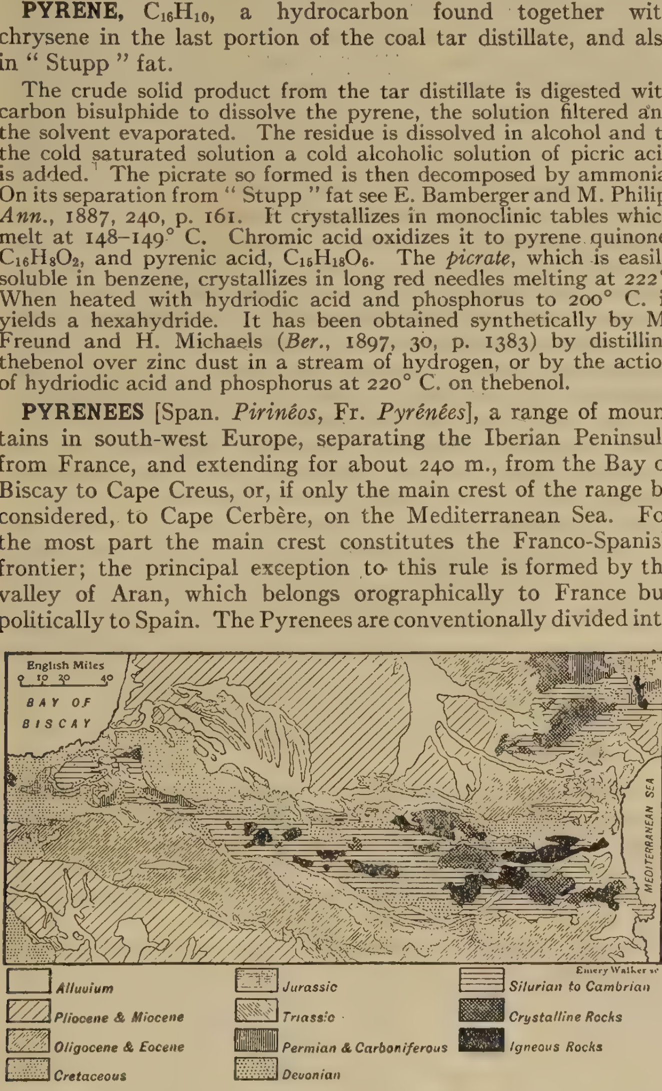


$$\begin{matrix}HC:C(SH)\\ |\\ CH_3\cdot C=N\end{matrix}\!>\!N\cdot C_6H_5 \quad \text{or} \quad \begin{matrix}H_2C—CS\\ |\\ CH_3\cdot C=N\end{matrix}\!>\!N\cdot C_6H_5.$$

PYRENE, $C_{16}H_{10}$, a hydrocarbon found together with chrysene in the last portion of the coal tar distillate, and also in "Stupp" fat.

The crude solid product from the tar distillate is digested with carbon bisulphide to dissolve the pyrene, the solution filtered and the solvent evaporated. The residue is dissolved in alcohol and to the cold saturated solution a cold alcoholic solution of picric acid is added. The picrate so formed is then decomposed by ammonia. On its separation from "Stupp" fat see E. Bamberger and M. Philip, *Ann.*, 1887, 240, p. 161. It crystallizes in monoclinic tables which melt at 148–149° C. Chromic acid oxidizes it to pyrene quinone, $C_{16}H_8O_2$, and pyrenic acid, $C_{15}H_{18}O_6$. The *picrate*, which is easily soluble in benzene, crystallizes in long red needles melting at 222°. When heated with hydriodic acid and phosphorus to 200° C. it yields a hexahydride. It has been obtained synthetically by M. Freund and H. Michaels (*Ber.*, 1897, 30, p. 1383) by distilling thebenol over zinc dust in a stream of hydrogen, or by the action of hydriodic acid and phosphorus at 220° C. on thebenol.

PYRENEES [Span. *Pirinéos*, Fr. *Pyrénées*], a range of mountains in south-west Europe, separating the Iberian Peninsula from France, and extending for about 240 m., from the Bay of Biscay to Cape Creus, or, if only the main crest of the range be considered, to Cape Cerbère, on the Mediterranean Sea. For the most part the main crest constitutes the Franco-Spanish frontier; the principal exception to this rule is formed by the valley of Aran, which belongs orographically to France but politically to Spain. The Pyrenees are conventionally divided into three sections, the central, the Atlantic or western, and the eastern. The central Pyrenees extend eastward from the Port de Canfranc to the valley of Aran, and include the highest summits of the whole chain, Aneto or Pic de Néthou (11,168 ft.), in the Maladetta ridge, Posets (11,047 ft.), and Mont Perdu or Monte Perdido (10,997 ft.). In the Atlantic Pyrenees the average altitude gradually diminishes westward; while in the eastern Pyrenees, with the exception of one break at the eastern extremity of the Pyrénées Ariégeoises, the mean elevation is maintained with remarkable uniformity, till at last a rather sudden decline occurs in the portion of the chain known as the Albères. This threefold division is only valid so far as the elevation of the Pyrenean chain is concerned, and does not accurately represent its geological structure or general configuration. The careful examination of the chain by members of the English and French Alpine Clubs has since 1880 considerably modified the views held with respect to its general character; the southern versant, formerly regarded as inferior in area, has been proved to be the more important of the two. It has been recognized, as shown in the maps of MM. Schrader, de St Sand and Wallon, that, taken as a whole, the range must be regarded, not as formed on the analogy of a fern-frond or fish-bone, with the lateral ridges running down to the two opposite plains, but rather as a swelling of the earth's crust, the culminating portion of which is composed of a series of primitive chains, which do not coincide with the watershed, but cross it obliquely, as if the ground had experienced a sidewise thrust at the time when the earth's crust was ridged up into the long chain under the influence of contraction. Both the orderly arrangement of these diagonal chains and the agreement which exists between the tectonic and geological phenomena are well shown in the geological and hypsometrical maps published in the *Annuaire du Club Alpin français* for 1891 and 1892 by MM. Schrader and de Margerie. The primitive formations of the range, of which little beyond the French portions had previously been studied, are shown to be almost all continued diagonally on the Spanish side, and the central ridge thus presents the appearance of a series of wrinkles with an inclination (from north-west to south-east) greater than that of the chain as a whole. Other less pronounced wrinkles run from south-west to north-east and intersect the former series at certain points, so that it is by alternate digressions from one to the other series that the irregular crest of the Pyrenees acquires its general direction. Far from having impressed its own direction on the orientation of the chain at large, this crest is merely the resultant of secondary agencies by which the primitive mass has been eroded and lessened in bulk, and though its importance from a hydrographic point of view is still considerable, its geological significance is practically nil.



Geology.—The Pyrenees are divided by E. de Margerie and F. Schrader into a number of longitudinal zones. The central zone consists of Primary rocks, together with great masses of granite. It forms most of the higher summits, but west of the Pic d'Anie it disappears beneath an unconformable covering of Cretaceous deposits. On the French side the central zone is followed by (1) the zone of Ariège, consisting of Lower Cretaceous and Jurassic beds, together with granitic masses; (2) the zone of the Petites Pyrénées, Upper Cretaceous and Eocene; and (3) the zone of the Corbières, consisting of Eocene and Primary rocks. On the Spanish side, from north to south, are (1) the zone of Mont Perdu, Upper Cretaceous and Eocene; (2) the zone of Aragon, Eocene; and (3) the zone of the Sierras, Trias, Cretaceous and Eocene. In France the zones are clearly defined only in the eastern part of the chain, while towards the west they merge into one another. In Spain, on the other hand, it is in the central part of the chain that the zones are most distinct. Although the number of zones recognized is the same on the two flanks, they do not correspond. The zone of the Corbières has no equivalent in Spain, while in France there is no definite zone of Eocene like that of Aragon. The zone of the Petites Pyrénées, however, is clearly homologous with that of the Sierras. On the northern side granitic masses occur in the zone of Ariège amongst the Jurassic and Lower Cretaceous beds. On the southern side they are not found except in the axial zone, and the Jurassic and Lower Cretaceous deposits are reduced to a narrow band. In spite of these differences between the two flanks, the structure is to some extent symmetrical. On the north the greater number of the overfolds lean towards the north, while on the south they lean towards the south. Thus the chain shows the typical fan-structure which has long been recognized in the western Alps.

Since the publication of the maps by de Margerie and Schrader it has been shown that the phenomena of "recouvrement" play almost as large a part in the Pyrenees as in the Alps themselves. Large masses of rock have been brought upon nearly horizontal faults (thrust-planes) over the edges of either beds with which they originally had no connexion. In the region of Salies-du-Salat, for example, patches of Trias lie discordantly upon the edges of the Cretaceous and Tertiary beds. Several other similar cases have been described; but denudation has been carried further than in the western Alps, and accordingly the masses overlying the thrust-planes have been more completely removed (*q.v.*).

The earth movements which raised the Pyrenees appear to have begun in the Eocene period, but it was in Oligocene times that the principal folding took place. The Pyrenees are therefore contemporaneous with the Alps; but they appear to have escaped the Miocene disturbances which affected the latter.

The arrangement of the Pyrenees in chains gently inclined near the centre but longitudinal everywhere else, is illustrated by the courses of the streams which flow down towards Spain. On the French side most of the longitudinal valleys have disappeared; and this is why the range has so long been described as sending out transverse spurs, the more important slope remaining unknown. It is, however, still possible to distinguish some traces of this formation towards the east, where atmospheric denudation has been less active. On the south the principal streams, after cutting their way through the highest zone at right angles to the general direction of the range, become involved half-way to the plains in great longitudinal folds, from which they make their escape only after traversing long distances without finding an outlet.

The importance shown to attach to the Spanish versant has greatly modified the values formerly assigned to the area and mean elevation of the Pyrenees. Instead of the 13,440 sq. m. formerly put down for the total, M. Schrader found the area to be 21,044 sq. m. Of this total 6390 sq. m. fall to the northern slope and 14,654 sq. m., *i.e.* more than double, to the southern, the difference being mainly due to the zone of plateaux and sierras. The mean elevation, estimated by Élie de Beaumont at 1500 metres (4900 ft.), has been sensibly diminished by the addition of that zone to the system, and it must now be placed at only 1200 metres (3930 ft.) for the range as a whole; so important a part is played by the above-mentioned plateaux of small elevation in a chain whose highest summit reaches 11,168 ft., while the passes show a greater altitude than those of the Alps.

Four conspicuous features of Pyrenean scenery are the absence of great lakes, such as fill the lateral valleys of the Alps; the rarity and great elevation of passes; the large number of the mountain torrents locally called *gaves*, which often form lofty waterfalls, surpassed in Europe only by those of Scandinavia; and the frequency with which the upper end of a valley assumes the form of a semicircle of precipitous cliffs, locally called a *cirque*. The highest waterfall is that of Gavarnie (1515 ft.), at the head of the Gave de Pau; the Cirque de Gavarnie, in the same valley, is perhaps the most famous example of the cirque formation. Not only is there a total lack of those passes, so common in the Alps, which lead across the great mountain chains at a far lower level than that of the neighbouring peaks, but between the two extremities of the range, where the principal highroads and the only railways run between France and Spain, there are only two passes practicable for carriages—the Col de la Perche, between the valley of the Tet and the valley of the Segre, and the Col de Somport or Pot de Canfranc, on the old Roman road from Saragossa to Oloron.

Projects for further railway construction, including the building of tunnels on a vast scale, have been approved by the French and Spanish governments (see Spain: *Communications*).

The metallic ores of the Pyrenees are not in general of much importance, though there are considerable iron mines at Vic de Sos in Ariège and at the foot of Canigou in Pyrénées-Orientales. Coal deposits capable of being profitably worked are situated chiefly on the Spanish slopes but the French side has numerous beds of lignite. Mineral springs are abundant and very remarkable, and specially noteworthy are the hot springs, in which the Alps, on the contrary, are very deficient. The hot springs, among which those of Bagnères de Luchon and Eaux-Chaudes may be mentioned, are sulphurous and mostly situated high, near the contact of the granite with the stratified rocks. The lower springs, such as those of Bagnères de Bigorre (Hautes-Pyrénées), Rennes (Aude) and Campagne (Aude), are mostly selenitic and not very warm.

The amount of the precipitation, including rain and snow, is much greater in the western than in the eastern Pyrenees, which leads to a marked contrast between these sections of the chain in more than one respect. In the first place, the eastern Pyrenees are without glaciers, the quantity of snow falling there being insufficient to lead to their development. The glaciers are confined to the northern slopes of the central Pyrenees, and do not descend, like those of the Alps, far down in the valleys, but have their greatest length in the direction of the mountain-chain. They form, in fact, a narrow zone near the crest of the highest mountains. Here, as in the other great mountain ranges of central Europe, there are evidences of a much wider extension of the glaciers during the Ice age. The case of the glacier in the valley of Argelès in the department of Hautes-Pyrénées is the best-known instance. The snow-line varies in different parts of the Pyrenees from 8800 to 9200 ft. above sea-level.

A still more marked effect of the preponderance of rainfall in the western half of the chain is seen in the aspect of the vegetation. The lower mountains in the extreme west are very well wooded, but the extent of forest declines eastwards, and the eastern Pyrenees are peculiarly wild and naked, all the more since it is in this part of the chain that granitic masses prevail. There is a change, moreover, in the composition of the flora in passing from west to east. In the west the flora, at least in the north, resembles that of central Europe, while in the east it is distinctly Mediterranean in character, though the difference of latitude is only about 1°, on both sides of the chain from the centre whence the Cobières stretch north-eastwards towards the central plateau of France. The Pyrenees are relatively as rich in endemic species as the Alps, and among the most remarkable instances of that endemism is the occurrence of the sole European species of *Dioscorea* (yam), the *D. pyrenaica*, on a single high station in the central Pyrenees, and that of the monotypic genus *Xatardia*, only on a high alpine pass between the Val d'Eynes and Catalonia. The genus most abundantly represented in the range is that of the saxifrages, several species of which are here endemic.

In their fauna also the Pyrenees present some striking instances of endemism. There is a distinct species of ibex (*Capra pyrenaica*) confined to the range, while the Pyrenean desman or water-mole (*Mygale pyrenaica*) is found only in some of the streams of the northern slopes of these mountains, the only other member of this genus being confined to the rivers of southern Russia. Among the other peculiarities of the Pyrenean fauna are blind insects in the caverns of Ariège, the principal genera of which are *Anophthalmus* and *Adelops*.

The ethnology, folk-lore, institutions and history of the Pyrenean region form an interesting study: see Andorra; Aragon; Basques; Bearn; Catalonia; Navarre.

See H. Beraldi, *Cent ans aux Pyrénées* (1901), *Les Sierras, cent ans après Ramond* (1902), *Après cent ans. Les Pics d'Europe* (1903), and *Les Pyrénées orientales et l'Ariège* (1904); P. Joanne, *Pyrénées* (1905); H. Belloc, *The Pyrenees* (1909); for geology, in addition to the papers cited above, A. Bresson, *Études sur les formations des Hautes et Basses Pyrénées* (Paris, Ministère des Travaux Publics, 1903); L. Carez, *La Géologie des Pyrénées françaises* (Paris, Min. des Tr. P., 1903, &c.); J. Roussel, *Tableau stratigraphique des Pyrénées* (Paris, Min. des Tr. P., 1904); and for climate and flora T. Cook, *Handbook to the Health Resorts on the Pyrenees*, &c. (1905), and J. Bentham, *Catalogue des plantes indigènes des Pyrénées et de Bas-Languedoc* (1826).

PYRÉNÉES-ORIENTALES, a department of south-western France, bordering on the Mediterranean and the Spanish frontier, formed in 1790 of the old province of Roussillon and of small portions of Languedoc. The population, which includes many Spaniards, numbered 213,171 in 1906. Area, 1599 sq. m.

The department is bounded N. by Ariège and Aude, E. by the Mediterranean, S. by Catalonia and W. by the republic of Andorra. Its borders are marked by mountain peaks, on the north by the Corbières, on the north-west and south-west by the eastern Pyrenees, on the extreme south-east by the Albères, which end in the sea at Cape Cerbera. Spurs of these ranges project into the department, covering its whole surface, with the exception of the alluvial plain of Roussillon, which extends inland from the sea-coast. Deep and sheltered bays in the vicinity of Cape Cerbera are succeeded farther north by flat sandy beaches, along which lie lagoons separated from the sea by belts of sand. The lagoon of St Nazaire is 2780 acres in extent, and that of Leucate on the borders of Aude is 19,300 acres. Mont Canigou (9137 ft.), though surpassed in height by the Carlitte Peak (9583 ft.), is the most remarkable mountain in the eastern Pyrenees, since it stands out to almost its full height above the plain, and exhibits with great distinctness the succession of zones of vegetation. From the base to a height of 1400 ft. are found the orange, the aloe, the oleander, the pomegranate and the olive; the vine grows to the height of 1800 ft.; next come the chestnut (2625 ft.), the rhododendron (from 4330 to 8330 ft.), pine (6400), and birch (6560); while stunted junipers grow to the summit.

The drainage of the department is shared by the Tet and the Tech, which rise in the Pyrenees, and the Agly, which rises in the Corbières. All three flow eastwards into the Mediterranean. The Aude, the Ariège (an affluent of the Garonne) and the Sègre (an affluent of the Ebro) also take their rise within the department and include a small part of it in their respective basins. The Tet rises at the foot of the Carlitte Peak and descends rapidly into a very narrow valley before it debouches at Ille (between Prades and Perpignan) upon the plain of Roussillon, where it flows over a wide pebbly bed and supplies numerous canals for irrigation. It is nowhere navigable, and its supply of water varies much with the seasons, all the more that it is not fed by any glacier. The Agly, which soon after its rise traverses the magnificent gorge of St Antoine de Galamus and, nearing its mouth, passes Rivesaltes (famous for its wines), serves almost exclusively for irrigation. The Tech, which after the Tet is the most important river of the department, flows through Vallespir (*vallis aspera*,) which, notwithstanding its name, is a green valley, clothed with wood and alive with industry; in its course the river passes Prats de Mollo and Arles-sur-Tech, before reaching Amélie-les-Bains and Céret. In the lowlands the climate is that of the Mediterranean, characterized by mild winters, dry summers and short and sudden rain-storms. Amélie-les-Bains is much frequented on account of its mild climate and sheltered position. The thermometer ranges from 85° to 95° F. in summer, and in winter only occasionally falls as low as 26° or 27°. The mean amount of the rainfall is 27 in. on the coast, but increases towards the hills. The most common wind is the *tramontane* from N.N.W., as violent as the mistral of Provence and extremely parching. The *marinada* blows from the S.S.E.

The cultivated land in Pyrénées-Orientales is devoted to wine-growing, market-gardening and fruit culture, the production of cereals being comparatively unimportant. The main source of wealth to the department is its wine, of which some kinds are strongly alcoholic and others are in request as liqueur wines (Rivesaltes, Banyuls). The cultivation of early vegetables (artichokes, asparagus, tomatoes, green peas), which is specially flourishing in the irrigated lowlands, and fruit-growing (peaches, apricots, plums, pears, quinces, pomegranates, almonds, apples, cherries, walnuts, chestnuts), which is chiefly carried on in the river valleys, yield abundant returns. The woods produce timber for the cabinet-maker, cork, and bark for tanning. Large flocks of sheep feed in the pastures of the Pyrenees and Corbières; the keeping of silkworms and bees is also profitable. In iron Pyrénées-Orientales is one of the richest departments in France, the greater part of the ore being transported to the interior. Lignite and various kinds of stone are worked. The mineral waters are much resorted to. Amélie-les-Bains has hot springs, chalybeate or sulphurous. In the arrondissement of Céret there are also the establishments of La-Preste-les-Bains, near Prats de Mollo, with hot sulphurous springs, and of Le Boulou, the Vichy of the Pyrenees. Near Prades are the hot sulphurous springs of Molitg, and a little north of Mont Canigou are the hot springs of Vernet, containing sodium and sulphur. In the valley of the Tet the sulphurous and alkaline springs of Thuès reach a temperature of 172° F. The baths of Les Escaldas, near Montlouis, are hot, sulphurous and alkaline. There are oil-works and sawmills, and the manufactures of the department include the making of whip-handles, corks, cigarette paper, barrels, bricks, woollen and other cloths, and *espadrilles* (a kind of shoe made of coarse cloth with esparto soles). Of the ports of the department Port Vendres alone has any importance. Imports include timber, Spanish and Algerian wine, cereals, coal; among the exports are wine, timber, vegetables, fruit, honey, oil and manufactured articles. The department is served by the Southern railway. The chief route across the Pyrenees is from Perpignan by way of Montlouis, a fortified place, to Puigcerda, in the Spanish province of Gerona, through the pass of La Perche, skirting in the French department an enclave of Spanish territory. Three other roads run from Perpignan to Figueras through the passes of Perthus (defended by the fort of Bellegarde), Banyuls and Balistres, the last-named being traversed by a railway. The chief towns of the three arrondissements are Perpignan, Céret and Prades: there are 17 cantons and 232 communes. The department constitutes the diocese of Perpignan, and is attached to the appeal court and the academy of Montpellier and to the region of the XVI. army corps, of which Perpignan is the headquarters.

Perpignan, the capital town and a fortress of the first class, Amélie-les-Bains and Elne are the more noteworthy places, and are treated separately. Rivesaltes (5448) is the most populous town after Perpignan. Other places may be mentioned. Planès has a curious church, triangular in shape, and of uncertain date. Popular tradition ascribes to it a Moslem origin. The church and cloister at Arles-sur-Tech are also of the 12th century. Boule-d'Amont has a Romanesque church which once belonged to the Augustine abbey of Serrabona. It is peculiar in that its aisles open out into lateral porches, instead of communicating with the nave. The church of Casteil, which is of the 11th century, is a relic of the ancient abbey of St Martin de Canigou. At St Michel-de-Guxa, near Prades, are fine ruins of a Benedictine abbey. The hamlet of Fontromeu, near Odeillo, has a chapel with a statue of the Virgin, which is visited by numerous pilgrims.

PYRETHRUM. The pyrethrum or "feverfew" (nat. ord. Compositae), now regarded as a section of the genus Chrysanthemum, flowers in the early summer months, and is remarkable for its neat habit and the great variety of character and colour which it presents. The type form is the Caucasian species *P. roseum* of botanists, hardy perennial, with finely cut leaves and large flower heads, having a ray of deep rose-coloured ligulate florets surrounding the yellow centre or disk. They bloom during the months of May and June, as well as later, and are always most welcome ornaments for the flower borders, and useful for cutting for decorative purposes. There are now many excellent varieties, both single and double-flowered, in cultivation.

The pyrethrum grows best in soil of a loamy texture; this should be well manured and deeply trenched up before planting, and should be mulched in the spring by a surface dressing of half-decayed manure. The plants may be increased by division, the side shoots being taken off early in spring rather than in autumn, with a portion of roots attached. Plants disturbed in autumn frequently die during the winter. They may be placed either in separate beds or in the mixed flower border as may be required. In beds they can be supplemented as the season passes on by the intermixture of later blooming subjects, such as gladioli. Slugs are often destructive to the young shoots, but may be checked by a few sprinklings of soot or lime. Seeds should be sown in spring in a cold frame, and the young plants should be put out into beds when large enough, and should flower the following May. New varieties are being constantly introduced; the reader is referred to the catalogues of nurserymen for named kinds. The powdered root of *P. roseum* and other species is used in the manufacture of insect powders. *P. parthenifolium* var. *aurem* is the "golden-feather" of gardens, so much employed as an edging to flower-beds. *P. parthenium*, pellitory or "feverfew," was formerly used in medicine. Its double-flowered form is well worth growing. *P. uliginosum* is the "great ox-eye daisy" that flowers in September and October.

PYRGI (mod. S. SEVERA), an ancient town of Etruria, Italy, on the south-west coast, 9 m. W.N.W. of Caere. The name is Greek (*πύργοι*, towers), and the place of considerable antiquity. Remains of its defensive walls exist in polygonal blocks of limestone and sandstone, neatly jointed. They enclosed a rectangular area some 200 yds. in width and at least 220 yds. in length. The south-west extremity has probably been destroyed by the sea. It contained a rich temple of Leucothea, the foundation of which was ascribed to the Pelasgi. It was plundered by Dionysius in 384 B.C. Later it became dependent on Caere, though it is not probable that it was originally merely the harbour of Caere; Alsium (*q.v.*) is a good deal nearer (5 m. south). The Romans planted a colony here, which is first mentioned in 191 B.C. Later still it supplied fish to the capital, and became a favourite summer resort, as did also Punicum (S. Marinella) 5 m. to the north-west, where are many remains of villas. Both were stations on the coast road (Via Aurelia).

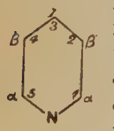
See H. Dennis, *Cities and Cemeteries of Etruria*, i. 289. (London, 1883).

(T. As.)

PYRGOS, a town of Greece, in the province of Elis and Achaea, 43 m. S.S.W. of Patras. It is the third town in importance in the Peloponnesus, and is connected with its harbour, Katakolon, 7½ m. distant, and also with Patras and Olympia, by rail. It has frequently been injured by earthquakes. Pop. (1907), 13,690.

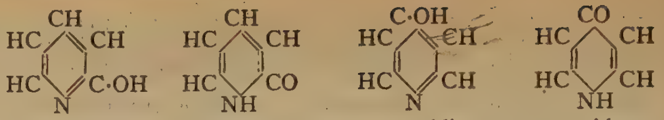
PYRIDINE, C_5H_5N, an organic base, discovered by T. Anderson (*Trans. Roy. Soc. Edin.*, 1851, 20, p. 251) in bone oil. It is also found among the distillation products of bituminous coal, lignite, and various shales, and has been detected in fusel oil and crude petroleum. It is a decomposition product of various alkaloids (nicotine, sparteine, cinchonine, &c.), being formed when they are strongly heated either alone or with zinc dust. It may be synthetically prepared by distilling allyl ethylamine over heated lead oxide (W. Königs, *Ber.*, 1879, 12, p. 2341) by passing a mixture of acetylene and hydrocyanic acid through a red-hot tube (W. Ramsay, *Ber.*, 1877, 10, p. 736); by heating pyrrol with sodium methylate and methylene iodide to 200° C. (M. Dennstedt and J. Zimmermann, *Ber.*, 1885, 18, p. 3316); by heating isoamyl nitrate with phosphorus pentoxide (E. T. Chapman and M. H. Smith, *Ann.*, 1868, *Suppl.* 6, p. 329); and by heating piperidine in acetic acid solution with silver acetate (J. Tafel, *Ber.*, 1892, 25, p. 1619). The amount of pyridine produced in most of these processes is very small, and the best source for its preparation is the "light-oil" fraction of the coal-tar distillate. The basic constituents are removed by dilute sulphuric acid, the acid layer removed, and the bases liberated by alkali, separated, dried, and fractionally distilled.

Pyridine is a colourless liquid of a distinctly unpleasant, penetrating odour. It boils at 114·5° C., and is miscible with water in all proportions. It is a tertiary base, and combines readily with the alkyl halides to form pyridinium salts. Nascent hydrogen reduces it to piperidine, $C_5H_{11}N$ (see below), whilst hydriodic acid above 300° C. reduces it to *n*-pentane (A. W. Hofmann, *Ber.*, 1883, 16, p. 590). It is a very stable compound, chromic and nitric acids being without action upon it, whilst the halogens only yield substitution derivatives with difficulty. It reacts with sulphuric acid only at high temperatures, yielding a sulphonic acid. It forms addition compounds with mercuric and auric chlorides. On the constitution of the pyridine nucleus, see Körner, *Gior. dell' acad. di Palermo*, 1869, and C. Riedel, *Ber.*, 1883, 16, p. 1609. As regards the isomerism of the pyridine substitution products, three mono-derivatives are known, the different positions being indicated by the Greek letters α, β and γ, as shown in the inset formula. This formula also allows of the existence of six di-derivatives, six tri-derivatives, three tetra- and one penta-derivative, when the substituent groups are identical; all of which are in agreement with known facts.

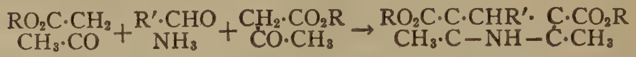


The three monochlorpyridines are known, the α and γ compounds resulting from the action of phosphorus pentachloride on the corresponding oxypyridines, and the β compound from the action of chloroform on potassium pyrrol. *α-Aminopyridine*, $C_5H_4N\cdot NH_2$, is formed by heating 5-aminopyridine-2-carboxylic acid. It is a crystalline solid which melts at 56° C. and boils at 204° C. It can only be diazotized in the presence of concentrated sulphuric acid, and even then the free diazonium sulphate is not stable, readily passing in the presence of water to α-oxypyridine. *β-Aminopyridine* is obtained by heating β-pyridyl urethane with fuming hydrochloric acid until no more carbon dioxide is liberated (T. Curtius and E. Mohr, *Ber.*, 1898, 31, p. 2493), or by the action of bromine and caustic soda on the amide of nicotinic acid (F. Pollak, *Monats.*, 1895, 16, p. 54). It melts at 64° C. and boils at 250-252° C. The aminopyridines are readily soluble in water, and resemble the aliphatic amines in their general chemical properties.

The *oxypyridines* may be prepared by distilling the corresponding oxypyridine carboxylic acids with lime, or by fusing the pyridine carboxylic acids with caustic potash. The mono-oxypyridines are easily soluble in water and possess only feeble basic properties. The β compound is hydroxylic in character, whilst the α and γ derivatives behave frequently as if they possess the tautomeric keto-structure, yielding according to the conditions of the experiment either *N*- or *O*-ethers (H. v. Pechmann, *Ber.*, 1895, 28, p. 1624), thus corresponding to the formulae—

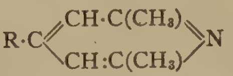

α-oxypyridine α-pyridone γ-oxypyridine γ-pyridone

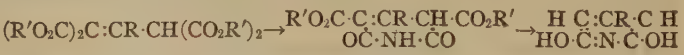
The homologues of pyridine may be synthesized in various ways. One of the most important is the so-called "collidine" synthesis of A. Hantzsch (*Ann.*, 1882, 215, p. 1; *Ber.*, 1882, 15, p. 2914) which consists in the condensation of two molecules of aceto-acetic ester with one of an aldehyde and one of ammonia:—



$$\begin{array}{c}\mathrm{RO_2C\cdot CH_2}\\\mathrm{CH_3\cdot CO}\end{array}+\begin{array}{c}\mathrm{R'\cdot CHO}\\\mathrm{NH_3}\end{array}+\begin{array}{c}\mathrm{CH_2\cdot CO_2R}\\\mathrm{CO\cdot CH_3}\end{array}\rightarrow\begin{array}{c}\mathrm{RO_2C\cdot C\cdot CHR'\cdot \ C\cdot CO_2R}\\\mathrm{CH_3\cdot C-NH-C\cdot CH_3}\end{array}$$

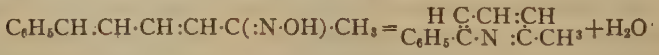
The resulting dihydro-compound is then oxidized with nitrous acid, the ester hydrolysed and the resulting acid heated with lime; carbon dioxide is eliminated and a trisubstituted pyridine of the type is obtained. The reaction is apparently a general one for all aldehydes. On the course of the reaction see also C. Beyer, *Ber.*, 1891, 24, p. 1662, and E. Knoevenagel, *Ber.*, 1898, 31, p. 738. In this reaction the proportions of aldehyde and aceto-acetic ester may be interchanged and αγ disubstituted pyridines are then obtained. Of the other methods for preparing pyridine homologues mention may be made of the discovery by A. Ladenburg that the pyridinium alkyl iodides rearrange themselves when strongly heated and yield α and γ alkyl pyridines (*Ber.*, 1883, 16, p. 1410 seq.; *Ann.*, 1888, 247, p. 1). S. Ruhemann prepared γ-substituted dioxypyridines by condensing alkyl-dicarboxy-glutaconic esters with ammonia.





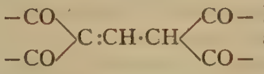
$$\mathrm{(R'O_2C)_2C{:}CR\cdot CH(CO_2R')_2}\rightarrow\begin{array}{c}\mathrm{R'O_2C\cdot C{:}CR\cdot CH\cdot CO_2R'}\\\mathrm{OC\cdot NH\cdot CO}\end{array}\rightarrow\begin{array}{c}\mathrm{H\ C{:}CR\cdot C\ H}\\\mathrm{HO\cdot C{:}N\cdot C\cdot OH}\end{array}$$

M. Scholtz (*Ber.*, 1895, 28, p. 1726) prepared αα- methylphenylpyridine by distilling cinnamenylidene acetoxime,



$$\mathrm{C_6H_5CH{:}CH\cdot CH{:}CH\cdot C({:}N\cdot OH)\cdot CH_3}=\begin{array}{c}\mathrm{H\ C\cdot CH{:}CH}\\\mathrm{C_6H_5\cdot C\cdot N\ \ {:}C\cdot CH^3}\end{array}+\mathrm{H_2O}$$

The 1·5 diketones of the type inset, when heated with ammonia, also yield pyridine derivatives. Alkyl pyridines are also obtained by heating aldehyde ammonias alone or with aldehydes and ketones (A. v. Baeyer, *Ann.*, 1870, 155, pp. 281, 294; J. Plöchl, *Ber.*, 1887, 20, p. 722).



The subjoined table shows the chief homologues of pyridine:—

Name.	Formula.	Position of Substituent.	Remarks.
Picolines	$C_5H_4(CH_3)N$	α	Liquid, b.p. 129°. Oxidizes to picolinic acid. Condenses readily with aldehydes.
		β	Liquid, b.p. 143°. Oxidizes to nicotinic acid. Does not condense with aldehydes.
		γ	Liquid, b.p. 144–145°.
Lutidines	$C_5H_4(C_2H_5)N$	α, β, γ,	Three isomers. All liquids. The β compound is a decomposition product of cinchonine, quinine, strychnine and brucine.
	$C_5H_3(CH_3)_2N$	αα′, αγ, αβ′ ββ′, βγ.	Five isomers. All liquids.
Collidines	$C_5H_4(C_3H_7)N$	α, β.	Liquids. The α compound is a decomposition product of conine. Both contain the normal propyl group.
		α, γ.	Containing the isopropyl group.
	$C_5H_3(CH_3)(C_2H_5)N$	α′α, γβ, αγ, αβ′	Liquids.
	$C_5H_2(CH_3)_3N$	αγα′	Liquid, b.p. 171–172°. Prepared by the Hantzsch synthesis.
		αγβ′	Found in coal-tar.

Pyridine carboxylic acids are usually prepared by oxidizing the homologues of the base; they also result as decomposition products of various alkaloids. The more important are shown in the table.

Name.	Formula.	Position of Substituent.	Remarks.
Picolinic acid.	$C_5H_4(CO_2H)N$	α	M.p. 137°. Easily soluble in water. Yellow coloration with $FeSO_4$. Position of carboxyl group determined by synthesis from α-naphthylamine (Z. Skraup and A. Cobenzl, *Monats.*, 1883, 4, p. 436).
Nicotinic acid.	$C_5H_4(CO_2H)N$	β	M.p. 228–229°. An oxidation product of nicotine, hydrastine and berberine. Constitution determined by synthesis from β-naphthylamine (Skraup).
Quinolinic acid.	$C_5H_3(CO_2H)_2N$	αβ	M.p. 192–195° with decomposition into nicotinic acid. Formed by oxidation of quinoline.
Cinchomeronic acid.	$C_5H_3(CO_2H)_2N$	βγ	M.p. 258–259°. Formed by oxidation of quinine, cinchonine, and of isoquinoline.
α-Carbocinchomeronic acid.	$C_5H_2(CO_2H)_3N$	αβγ	M.p. 249–250°. Crystallizes with $1\frac{1}{2}H_2O$. An oxidation product of cinchonine, quinine and papaverine.
Berberonic acid.	$C_5H_2(CO_2H)_3N$	αγβ′	M.p. 243°. An oxidation product of berberine. Gives a red coloration with $FeSO_4$. Boiling with glacial acetic acid gives cinchomeronic acid.

Trigonelline, $C_7H_7NO_2$, the methyl betaine of nicotinic acid, was discovered in 1885 by E. Jahns (*Ber.*, 1885, 18, p. 2518), and is found in the seeds of *Trigonella* and *Strophanthus hispidus*. It is very soluble in water. With baryta it yields methylamine, and when heated with concentrated hydrochloric acid to 260° C. it yields methyl chloride and nicotinic acid. It was synthesized by A. Hantzsch (*Ber.*, 1886, 19, p. 31) by condensing methyl iodide and potassium nicotinate at 150° C. the resulting iodide being then decomposed by moist silver oxide. A. Pictet (*Ber.*, 1897, 30, p. 2117) obtained it by oxidizing nicotine methyl hydroxide with potassium permanganate. *Apophyllenic acid*, $C_8H_7NO_4{\cdot}H_2O$, the methyl betaine of cinchomeronic acid, was synthesized by W. Roser (*Ann.*, 1886, 234, p. 118).

Piperidine or hexa-hydropyridine, $C_5H_{11}N$, was first obtained in 1848 by distilling piperine with lime. It is formed in the hydrolysis of piperine by alcoholic potash, by the reduction of trimethylene cyanide (A. Ladenburg) and by the action of alkalis on ε-chloramylamine, $Cl(CH_2)_5{\cdot}NH_2$ (S. Gabriel, *Ber.*, 1892, 25, p. 421). It is also produced in the electrolytic oxidation of *N*-nitroso piperidine in sulphuric acid solution (F. B. Ahrens, *Ber.*, 1898, 31, p. 2275). It is a liquid which boils at 105–106° C., and possesses an ammoniacal smell. It is readily soluble in water, alcohol and ether, and is a very powerful base. It is oxidized to pyridine by heating with concentrated sulphuric acid to 300° C., or with nitrobenzene to 250° C., or with silver acetate to 180° C. Being an imide it readily yields a nitroso derivative, and *N*-alkyl and acidyl derivatives. The piperidine ring is easily split. When heated with fuming hydriodic acid to 300° C. it yields normal pentane and ammonia, and hydrogen peroxide oxidizes it to glutarimide and to a piperidinium oxide or oxime (R. Wolffenstein, *Ber.*, 1904, 37, p. 3228). A. W. Hofmann (*Ber.*, 1881, 14, p. 660), by a process of exhaustive methylation and distillation, obtained the unsaturated hydrocarbon *piperylene*, $CH_2{:}CH{\cdot}CH_2{\cdot}CH{:}CH_2$, from piperidine (see also A. Ladenburg, *Ann.*, 1894, 279, p. 344).

$$C_5H_{11}N(+CH_3I) \rightarrow C_5H_{10}N(CH_3)_2I\ (+AgOH) \rightarrow C_5H_{10}N(CH_3)_2{\cdot}OH$$

$$\text{(distil)}\downarrow$$

$$C_5H_9N(CH_3)_3{\cdot}OH \leftarrow (+AgOH)C_5H_9N(CH_3)_3I \leftarrow (+CH_3I)C_5H_9N(CH_3)_2$$

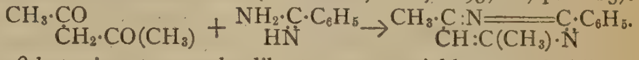
$$\text{(distil)}\downarrow$$

$$C_5H_8 + N(CH_3)_3 + H_2O$$

J. v. Braun (*Ber.*, 1904, 37, p. 2915) showed that benzoyl piperidine, when heated with phosphorus pentachloride to 200° C. in sealed tubes, yields benzonitrile, and pentamethylene dichloride, thus leading to a simple method of preparing pentamethylene compounds. At 125–130° C. the compound $C_6H_5C{\cdot}Cl{:}N(CH_2)_5{\cdot}C$ is obtained; this with water yields benzoylamidochloramylamine, $C_6H_5CONH(CH_2)_5Cl$, which when heated with hydrochloric acid to 170–180° C. furnishes ε-chloramylamine, $NH_2(CH_2)_5Cl$. α-Propyl-piperidine is the alkaloid conine (*q.v.*).

PYRIMIDINES, Metadiazines or Miazines, in organic chemistry, a series of heterocyclic compounds containing a ring complex, composed of four carbon atoms and two nitrogen atoms the nitrogen atoms being in the meta-position. The oxyderivatives of the tetrahydro- and hexahydro-pyrimidines are the uracils and the ureides of malonic acid (see Purin). The purins themselves may be considered as a combination of the pyrimidine and glyoxaline ring systems. For formulae see below; the numbers about the first ring explain the orientation of pyrimidine derivatives.

The pyrimidines may be obtained by condensing 1·3-diketones with the amidines (A. Pinner, *Ber.*, 1893, 26, p. 2125).



$$\begin{array}{l}CH_3{\cdot}CO\\ \quad \dot{C}H_2{\cdot}CO(CH_3)\end{array} + \begin{array}{l}NH_2{\cdot}C{\cdot}C_6H_5\\ \quad H\dot{N}\end{array} \rightarrow \begin{array}{l}CH_3{\cdot}C{:}N{=\!=\!=}C{\cdot}C_6H_5.\\ \quad \dot{C}H{:}C(CH_3){\cdot}\dot{N}\end{array}$$

The β-ketonic esters under like treatment yield oxypyrimidines, whilst if cyanacetic ester be employed then amino-oxypyrimidines are obtained. By using urea, guanidine, thiourea and related compounds instead of amidines, one obtains the uracils. The *cyanalkines* (aminopyrimidines) were first obtained, although their constitution was not definitely known, by E. Frankland and H. Kolbe (*Ann.* 1848, 65, p. 269) by heating the nitriles of acids with metallic sodium or with sodium ethylate between 130° C. and 180° C.

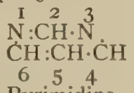
$$3CH_3CN = C_4HN_2(CH_3)_2{\cdot}NH_2[2{\cdot}4{\cdot}6].$$

Pyrimidine, $C_4H_4N_2$, itself is a water-soluble base which melts at 21° C. and possesses a narcotic smell. Its methyl derivatives yield the corresponding carboxylic acids when oxidized by potassium permanganate. The amino derivatives are stable bases which readily yield substitution derivatives when acted upon by the halogen elements. *Cyanmethine*, $C_6H_9N_3$ (dimethyl-aminopyrimidine—2·4·6), melts at 180–181°C. The simple oxypyrimidines are obtained by the action of nitrous acid on the amino derivatives, or by heating these latter with concentrated hydrochloric acid to 180° C. They show both basic and phenolic properties and are indifferent to the action of reducing agents. Acid oxidizing agents, however, completely destroy them. By the action of phosphorus pentachloride, the hydroxyl group is replaced by chlorine.

Hydropyrimidines.—The dihydro derivatives are most probably those compounds which are formed in the condensation of acidyl derivatives of acetone, with urea, guanidine, &c. Tetrahydropyrimidines are obtained by the action of amidines on trimethylene bromide:

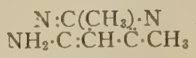
$$Br(CH_2)_3Br + C_6H_5C({:}NH){\cdot}NH_2 = 2HBr + C_4H_7N_2(C_6H_5)[2].$$

The 2·6-diketo-tetrahydropyrimidines or uracils may be considered as the ureides of β-aldehydo, and β-ketonic acids. Uracil and its homologues may be obtained in many cases from the hydrouracils by the action of bromine, and subsequent elimination of the elements of hydrobromic acid; or by the condensation of aceto-acetic ester and related substances with urea, thiourea, guanidine, &c. *Uracil*, $C_4H_4O_2N_2$, crystallizes in colourless needles, is soluble in hot water and melts with decomposition at 335° C. *Hydrouracil*, $C_4H_6O_2N_2$, is obtained by the action of bromine and caustic alkalis on succinamide (H. Weidel and E. Roithner, *Monats.*, 1896, 17, p. 172); by the fusion of β-aminopropionic acid with urea; by the electrolytic reduction of barbituric acid (J. Tafel, *Ber.*, 1900, 33, p. 3385), and by the condensation of acrylic acid with urea at 210–220° C. (E. Fischer, *Ber.*, 1901, 34, p. 3759). It crystallizes in needles and is soluble in water. It melts at 275° C. 4-*Methyluracil*, $C_5H_6O_2N_2$, has long been known, having first been synthesized by R. Behrend (see Purin). It crystallizes in needles which melt at 320° C. and is soluble in caustic alkalis. On oxidation with potassium permanganate it is converted into acetyl urea, together with other products. 5-*Methyluracil* (Thymin) is obtained from the corresponding methyl bromhydrouracil (E. Fischer); or from 2·4·6-trichlor-5-methylpyrimidine by the action of sodium methylate. This yields a 2·4-dimethoxy-5-methyl-6-chlorpyrimidine, which on reduction and subsequent treatment with hydrochloric acid is converted into thymin (O. Gerngross, *Ber.*, 1905, 38, p. 3394). For methods of preparation and properties of numerous other pyrimidine compounds see T. B. Johnson, *Journ. Biol. Chem.*, 1906, &c.; *Amer. Chem. Journ.*, 1906, &c.; W. Traube, *Ber.*, 1900, &c.; O. Isay, ibid., 1906, 39, p. 251.



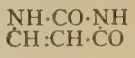
$$\begin{array}{l}\overset{1}{N}{:}\overset{2}{C}H{\cdot}\overset{3}{N}\\ \underset{6}{\dot{C}H}{:}\underset{5}{C}H{\cdot}\underset{4}{\dot{C}H}\end{array}$$

Pyrimidine



$$\begin{array}{r}N{:}C(CH_3){\cdot}N\\ NH_2{\cdot}C{:}\dot{C}H{\cdot}\dot{C}{\cdot}CH_3\end{array}$$

Cyanmethine



$$\begin{array}{l}NH{\cdot}CO{\cdot}NH\\ \dot{C}H{:}CH{\cdot}\dot{C}O\end{array}$$

Uracil

PYRITES, a term applied to iron disulphide when crystallized in the cubic system, but used also in a general sense to designate a group of metallic sulphides of which this mineral is the most characteristic example. When employed as a group-name the constituent species are distinguished by prefixes: thus the type is called iron pyrites, whilst other species are known as copper pyrites, arsenical pyrites, &c. The original word pyrites (from Gr. πῦρ, fire) had reference to the fact that sparks might be elicited on striking the mineral violently, as with flint, so that πυρίτης λίθος meant a stone which struck fire. Hence the name seems to have been applied also to flint, and perhaps to emery and other hard stones. Nodules of pyrites have been found in prehistoric barrows and elsewhere under conditions suggesting their use as a primitive means of producing fire. Even in late historic time it was employed in some of the old wheel-lock guns. Iron-pyrites was formerly called marcasite, a word variously written marcasin, marchasite, marchesite, marquesite, &c. The two names are now applied to distinct mineral species. The compound FeS_2 is dimorphous, and the modern practice is to distinguish the cubic forms as pyrites and the orthorhombic as marcasite (*q.v.*). Sometimes, however, the term pyrites is loosely applied to both species, and the cubic pyrites is then differentiated by the name "pyrite"—a form which brings the last syllable into harmony with the spelling of the names of most minerals.

Iron pyrites, or pyrite, belongs crystallographically to the parallel-faced hemihedral class of the cubic system. Its common forms are the cube, the octahedron, and the pentagonal dodecahedron. Fig. 1 shows *P* the cube {100}, *d* the octahedron {111}, and *e* the pentagonal dodecahedron π {210}. In fig. 2 π {210} and {111} are associated with *f* the dyakis-dodecahedron π {321}; whilst fig. 3 shows a combination of π {210} and π {421}. The faces of the cube are sometimes striated parallel to the edges between *P* and *e* (fig. 1), the striae on each face being therefore at right angles to those of the adjoining faces, and indicating an oscillatory combination of the cube and pentagonal dodecahedron. Fig. 4 illustrates a characteristic twin, formed by two interpenetrating pentagonal dodecahedra. Such supplementary twins, known in Germany as "twins of the Iron Cross," are commonly brown by superficial conversion into limonite.

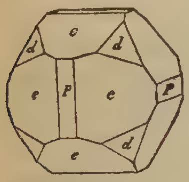


FIG. 1.

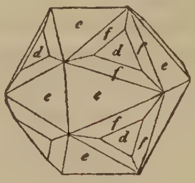


FIG. 2.

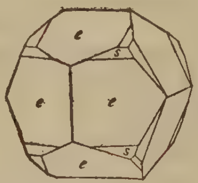


FIG. 3.

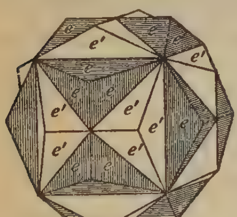


FIG. 4.

Pyrites presents a conchoidal fracture, and a very indistinct cubic cleavage. Its hardness is about 6, and its specific gravity 4·9 to 5·2, being rather more than that of marcasite. Moreover, the colour of pyrites is pale brass-yellow, whilst that of marcasite when untarnished may be almost tin-white. From copper-pyrites (chalcopyrite) iron-pyrites is distinguished by its superior hardness and by its paler colour. On exposure to meteoric influences pyrites commonly becomes brown, by formation of ferric hydrate or limonite, whence the change is called "limonitization." Such a change is very common on the outcrop of mineral veins, forming what miners call "gozzan." Another kind of alteration which pyrites may suffer has been termed "vitriolization," since the products are ferrous sulphate, with free sulphuric acid and sometimes a basic ferric sulphate. It is often said that this saline change is more characteristic of marcasite than of pyrite, but according to H. N. Stokes this statement is incorrect. Contrary, too, to popular belief, he has found a fibrous structure more common in pyrite than in marcasite. In some cases the two forms of iron disulphide occur in intimate association and are difficult to distinguish.

According to the formula FeS_2, pyrites contains theoretically 46·67 % of iron and 53·33 of sulphur. Practically, however, it frequently contains other metals, such as copper, cobalt and nickel. Gold is often present, and in many gold-mining districts the precious metal is obtained mainly from auriferous pyrites. As pyrites, from its brass-yellow colour, is sometimes mistaken for gold, it has been vulgarly called "fool's gold." Traces of thallium, which are present in some pyrites, may be detected in the flues of the furnaces where the metal is roasted. Arsenic is an impurity which may be of serious consequence in some of the purposes to which pyrites is applied. The presence of copper, nickel ~~and~~ arsenic is possibly due in many cases to traces of kindred minerals, like chalcopyrite, pentlandite and mispickel.

Pyrites is a mineral of very wide distribution, occurring under varied conditions and probably originating in various ways. It is common in mineral-veins, usually associated with quartz, and is often known to miners as "mundic." It occurs crystallized, commonly in cubes, in schistose and slaty rocks, and less abundantly in the younger sedimentary deposits. In coal it not infrequently forms bands and nodules known as "brasses," and may also be finely disseminated through the coal as "black pyrites"; but much of the so-called pyrites of coal is really marcasite. Films of pyrites sometimes coat the joint-planes of coal. It is believed that the bluish colour of many clays and limestones is referable to the presence of finely divided pyrites, and it is known that certain deposits of blue mud now forming around continental shores owe their colour, in part, to disseminated iron sulphide. Pyritous shales have been largely used in the manufacture of alum, and are therefore known as "alum-shales." Many fossils are mineralized with pyrites, which has evidently been reduced by the action of decomposing organic matter on a solution of ferrous sulphate, or perhaps less directly on ferrous carbonate dissolved in water containing carbonic acid, in the presence of certain sulphates. A similar action probably explains the origin of pyrites and marcasite in coal and lignite, in clay and shales, and in limestone like chalk.

Pyrites is largely worked for sake of the sulphur which it contains, and in many cases it has displaced brimstone in the manufacture of sulphuric acid. For this purpose its value depends on the proportion of sulphur present. Pyrites low in sulphur is incapable of sustaining its own combustion without the aid of an external source of heat, and 45 % of sulphur is, for economic reasons, usually regarded as the lowest admissible for sulphuric acid manufacture. It is also important for this purpose that the ore should be as free as possible from arsenic (see SULPHURIC ACID).

An extremely important variety of pyrites is that which is more or less cupriferous, and is commonly known commercially as "copper-pyrites" (*q.v.*), though distinct mineralogically from that mineral. It consists, indeed, mainly of iron-pyrites, with a notable but variable proportion of copper, sometimes with silver and gold, and not infrequently associated with lead and zinc sulphides. The copper probably exists as disseminated chalcopyrite. Deposits of such cupriferous pyrites are widely distributed and are often of great magnitude. They are generally of lenticular form, and usually occur in or near the contact of eruptive rocks with schists or slates; the presence of the igneous rock being probably connected genetically with their origin. Among the best-known deposits of this character are those in the Huelva district, in the south-west of Spain, including the mines of Rio Tinto, Tharsis, Calañas, &c.; with those of San Domingos in Portugal. At Rio Tinto the ore is divided into three classes:—

(1) The poorest, containing an average of about 1½ % of copper, which is treated locally by leaching with water and liquor containing ferric sulphate, whereby the copper is dissolved out and afterwards precipitated by pig-iron, whilst the residue is exported as ordinary iron-pyrites. (2) Export ore, with from 2 to 5 % of copper, in which the sulphur, copper and precious metals are utilized, and the residual iron oxide then sold as "purple ore" for use in iron manufacture. (3) Smelting ore, which averages about 6 % of copper, and is treated metallurgically as described under COPPER.

The world's annual production of iron-pyrites is about 1,700,000 tons. The largest producer is Spain, with upwards of 350,000 tons, including the cupriferous pyrites. France yields about 300,000 tons, largely from the Sain Bel mines, department of the Rhône. Then follows Portugal, with its important output of cupreous pyrites. In the United States the production of pyrites now reaches more than 200,000 tons per annum. The state of Virginia is the chief producer, followed successively by Georgia, North Carolina, Colorado, Massachusetts, California, Missouri, New York, &c. From Indiana and

Ohio a quantity of pyrites is obtained as a by-product in coal-mining. Newfoundland yields cupreous pyrites, worked at Pilley's Island, whilst the nickeliferous pyrites of Sudbury in Ontario is partly magnetic (see PYRRHOTITE). Magnetic pyrites of commercial importance occurs also in Virginia and Tennessee. The United Kingdom yields but little pyrites, the annual output being not more than about 10,000 tons. Large quantities of "sulphur ore" were, however, formerly worked in the Vale of Avoca, Co. Wicklow, Ireland. Finely crystallized specimens of pyrite are obtained from many other localities, especially from Cornwall, Elba and Traversella, near Ivrea, in Piedmont.

See, for the early history of pyrites, J. F. Henckel's *Pyritologia, oder Kieshistorie* (Leipzig, 1725); of which an English translation appeared in 1757, entitled *Pyritologia; or a History of the Pyrites, the Principal Body in the Mineral Kingdom.* For a modern description of the deposit of pyrites of economic importance reference may be made to *A Treatise on Ore Deposits*, by J. A. Phillips (2nd ed. by H. Louis, 1896). For chemical means of distinguishing pyrite from marcasite consult H. N. Stokes, "On Pyrite and Marcasite," *Bull. U. S. Geol. Surv. No.* 186 (1901). (F. W. R.*)

PYRITZ, a town of Germany, in the Prussian province of Pomerania, 16 m. S.W. of Stargard by the railway to Cüstrin. Pop. (1905), 8600. It is still surrounded by walls with towers, and has two Evangelical churches. There are small manufactures of machinery, bricks and sugar. Excellent wheat is grown in the vicinity, while another industry is the breeding of cattle. Near the town is a fountain, erected to mark the spring in which Otto, bishop of Bamberg, baptized the first Pomeranian converts to Christianity in 1124. Pyritz became a town in 1150.

PYROCATECHIN, or PYROCATECHOL, ortho-dioxybenzene, $C_6H_4(OH)_2$, first prepared in 1839 by H. Reinsch on distilling catechin (the juice of *Mimosa catechu*); occurs free in kino and in beechwood tar; its sulphonic acid is present in the urine of the horse and man. It results in the alkaline fusion of many resins, and may be prepared by fusing ortho-phenolsulphonic acid, *o*-chlorphenol, *o*-bromphenol, and *o*-phenoldisulphonic acid with potash, or, better, by heating its methyl ether, guaiacol, $C_6H_4(OH)(OCH_3)$, a constituent of beechwood tar, with hydriodic acid.

Pyrocatechin crystallizes in white rhombic prisms, which melt at 104° and boil at 245°; it is readily soluble in water, alcohol and ether. Ferric chloride gives a green coloration with the aqueous solution, whilst the alkaline solution rapidly changes to a green and finally to a black colour on exposure to the air. It reduces silver solutions in the cold and alkaline copper on heating.

Guaiacol may be obtained directly from beechwood tar, from pyrocatechin by methylation with potash and potassium methyl sulphate at 180°, or from anisol by nitration, reduction of the ortho-nitroanisol to amino-anisol, which is then diazotized and boiled with water. It melts at 28° and boils at 250°. It is employed in medicine as an expectorant. The dimethyl ether or veratrol is also used in medicine. Many other pyrocatechin derivatives have been suggested for therapeutic application. Guaiacol carbonate is known as duotal, the phosphate as phosphatol, the phosphite as guaiaco-phosphal; phosphotal is a mixture of the phosphites of creosote phenols. The valerianic ester of guaiacol is known as geosote, the benzoic as benzosol, the salicylic as guaiacolsalol, while the glycerin ether appears as guaiamar.

Pyrocatechin readily condenses to form heterocyclic compounds; cyclic esters are formed by phosphorus trichloride and oxychloride, carbonyl chloride, sulphuryl chloride, &c.; whilst ortho-phenylenediamine, *o*-aminophenol, and *o*-aminothiophenol give phenazine, phenoxazine and thiodiphenylamine.

PYROGALLOL, or PYROGALLIC ACID, a trioxybenzene, $C_6H_3(OH)_3$ (1 : 2 : 3), prepared by Scheele in 1786 by heating gallic acid, $C_6H_2(OH)_3CO_2H$. It is also obtained by heating para-chlorphenoldisulphonic acid with potassium hydroxide.

It forms white plates, melting at 132°, readily soluble in water, and subliming without decomposition. It is an energetic reducing agent, a property utilized in its application in gas analysis to absorb oxygen, and in photography (*q.v.*) as a developer. The aqueous solution is turned bluish black by ferrous sulphate containing a ferric salt. It does not combine with hydroxylamine, as does the isomeric phloroglucin which yields a trioxime (see POLYMETHYLENES). Pyrogallol dimethyl ether is found in beechwood tar. Pyrogallol has antiseptic properties and is employed medicinally in the treatment of psoriasis. Eugallol, or monacetyl pyrogallol and lenigallel, or triacetyl pyrogallol, are also used.

PYROLUSITE, a mineral consisting essentially of manganese dioxide (MnO_2), of importance as an ore of manganese. It is a soft, black, amorphous mineral, often with a granular, fibrous or columnar structure, and sometimes forming reniform crusts. It has a metallic lustre, and a black or bluish-black streak, and readily soils the fingers. The specific gravity is about 4·8.

Supposed crystals of pyrolusite have been proved to be pseudomorphs after manganite; in fact the mineral often results by the dehydration and oxidation of manganite ($Mn_2O_3.H_2O$), and for this reason it frequently contains a little water. True crystals of manganese dioxide are referred to the rare species polianite: they are tetragonal and isomorphous with cassiterite. Pyrolusite is an alteration product of other manganese minerals—manganite, rhodochrosite, rhodonite, &c. It occurs as irregular masses and nodules in the residual clayey materials resulting from the decomposition of various rocks, for example, limestone. That it is readily deposited from solution is shown by the frequent occurrence of black dendritic markings in the crevices of rocks, excellent examples of which are seen in mocha stone (*q.v.*) and in the lithographic stone of Solenhofen in Bavaria. It is deposited from the waters of some springs, and manganiferous nodules are dredged from the floor of the deep sea.

As an ore it is extensively mined at Ilmenau and several other places in Thuringia, at Vorderehrensdorf near Prossnitz in Moravia, Platten in Bohemia, in North Wales, at several places in the United States (Vermont, Virginia, Arkansas, &c.), Nova Scotia and Brazil. Pyrolusite, together with the rather less important ore, psilomelane, has various economic applications. It is extensively used for the manufacture of spiegeleisen and ferromanganese, and of various alloys, such as manganese-bronze. As an oxidizing agent it is used in the preparation of chlorine and disinfectants (permanganates), and for decolorizing glass: when mixed with molten glass it oxidizes the ferrous iron to ferric iron, and so discharges the green and brown tints, hence the name pyrolusite, from Gr. πῦρ (fire) and λούειν (to wash). As a colouring material, it is used in calico printing and dyeing; for imparting violet, amber and black colours to glass, pottery and bricks; and in the manufacture of green and violet paints. (L. J. S.)

PYROMETER (Gr. πῦρ, fire, μέτρον, a measure), an instrument for measuring high temperatures. The term was first used by Musschenbroek to denote an instrument wherein the expansion of a metal rod measured the temperature. Discontinuous thermoscopes, depending on the fusion of a metal or salt, are also employed. Prinsep prepared a series of alloys of silver and gold, and of gold and platinum, whose melting points, as determined by accurate instruments, covered a range of temperature from 954° to 1775°, at intervals of from 25° to 30°. By placing ingots in a furnace and observing which one melted a fair idea of the temperature was obtained. Carnelley and Williams employed certain salts of known melting point; whilst the Seger's cones, employed in porcelain manufacture, depend on the fusion of small cones made of clay. (See THERMOMETRY for scientific forms.)

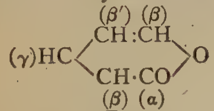
PYROMORPHITE, a mineral species composed of lead chlorophosphate $(PbCl)Pb_4(PO_4)_3$, sometimes occurring in sufficient abundance to be mined as an ore of lead.

Crystals are common, and have the form of a hexagonal prism terminated by the basal planes, sometimes combined with narrow faces of a hexagonal pyramid. Crystals with a barrel-like curvature are not uncommon. Globular and reniform masses are also found. As proved by the etched figures on the faces, crystals possess the same parallel-faced hemihedrism as apatite, with which mineral pyromorphite and also mimetite are isomorphous. Between pyromorphite and the corresponding chloro-arsenate (mimetite, (*q.v.*) the resemblance in external characters is so close that, as a rule, it is only possible to distinguish between them by chemical tests: and they were formerly confused under the names "green lead ore" and "brown lead ore" (German, *Grünbleierz* and *Braunbleierz*). The phosphate was first distinguished chemically by M. H. Klaproth, in 1784, and it was named pyromorphite by J. F. L. Hausmann in 1813, being so named from the Gr. πῦρ (fire) and μορφή (form), because when a fragment of the mineral is fused the globule assumes a faceted form on solidifying. The colour of the mineral is usually some bright shade of green, yellow or brown, and the lustre is resinous. The hardness is 3½ and the specific gravity 6·5–7·1. Owing to isomorphous replacement of the phosphorus by arsenic there may be a gradual passage from pyromorphite to mimetite. Varieties containing calcium isomorphously replacing lead are lower in density (specific gravity 5·9–6·5) and usually lighter in colour; they bear the names "polysphaerite" (because of the globular form), "miesite" from Mies in Bohemia, "nussierite" from Nussière near Beaujeu, Rhône, France, and "cherokine" from Cherokee county in Georgia.

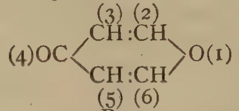
Pyromorphite has resulted from the alteration of galena in the oxidized portions of metalliferous veins, and is frequently met with in the upper levels of lead mines. Finely crystallized specimens have been found at Braubach and Ems in Nassau, Wheal Alfred in Cornwall, Roughten Gill in Cumberland, Leadhills in Scotland, Phoenixville in Pennsylvania, Huelgoat in Finistère, Brittany, &c. At the last-named locality, as well as at Wheal Hope, near Truro in Cornwall, there were formerly found curious pseudomorphs of galena after pyromorphite, known as "blue lead ore."

(L. J. S.)

PYRONES, in chemistry, a group of heterocyclic compounds, containing a six-membered ring composed of five carbon atoms and one oxygen atom. Two types are known, namely, the α-pyrones, which may be regarded as the lactones of δ-oxydiolefine carboxylic acids, and the γ-pyrones, which may be regarded as anhydrides of diolefine dioxyketones:—



α–Pyrone.



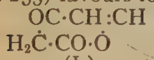
γ–Pyrone.

As a class, the pyrones are rather unstable compounds, the ring being readily broken. When digested with ammonia, the oxygen atom is replaced by the imino (:NH) group, and pyridones or oxypyridines are formed.

α-Pyrones.—The coumalic compounds belong to this series, and were first obtained by A. Hantzsch in 1884 (*Ann.* 222, p. 1) and H. v. Pechmann (*Ber.*, 1884, 17, p. 936).

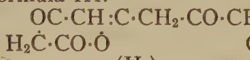
α-Pyrone or coumalin, $C_5H_4O_2$, is obtained by distilling the mercury salt of coumalic acid (from malic acid and sulphuric acid) in a current of hydrogen. It is an oily liquid which boils at 206–209° C., and with alkalis it gives formyl crotonic acid, $HO_2C\cdot CH:CH\cdot CH_2\cdot CHO$. *α′γ-Dimethyl-α-pyrone* or mesitene lactone, $C_7H_8O_2$, is obtained from iso-dehydracetic acid (from aceto-acetic ester and sulphuric acid). *Phenylcoumalin* or *α′-phenyl-α-pyrone*, $C_5H_3(C_6H_5)O_2$, is found in coto-bark. When heated with alkalis it yields benzoic acid and acetophenone; reduction by hydriodic acid gives δ-phenyl valeric acid, and when heated with ammonium acetate and ammonia it yields phenylpyridone. It forms an addition product with phenol and with aniline; the latter gives diphenylpyridone when boiled with concentrated hydrochloric acid. *Paracotoin*, $C_{18}H_8O_4$, which also occurs in coto-rind, appears to be a bisoxymethylene phenylpyrone, $C_5H_3O_2\cdot C_6H_3(CH_2O_2)$.

Various *pyronones* (keto-dihydropyrones) derived from the compound having formula I. (below) are known, the most important of which is *dehydracetic acid*, $C_8H_8O_4$, first obtained by Geuther (*Jena'sche Zeit*, 1866, p. 8). It may be prepared by distilling aceto-acetic ester alone, by heating it with acetic anhydride to 200° C. or by heating acetyl chloride with pyridine to 200–220° C. J. N. Collie regards it as having formula II., whilst Feist (*Ann.* 1890, 257, p. 253) favours formula III.



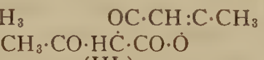
$$\begin{array}{l} \quad OC\cdot CH:CH \\ H_2\dot{C}\cdot CO\cdot \dot{O} \end{array}$$

(I.)



$$\begin{array}{l} \quad OC\cdot CH:C\cdot CH_2\cdot CO\cdot CH_3 \\ H_2\dot{C}\cdot CO\cdot \dot{O} \end{array}$$

(II.)

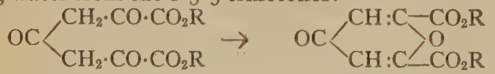


$$\begin{array}{r} OC\cdot CH:C\cdot CH_3 \\ CH_3\cdot CO\cdot H\dot{C}\cdot CO\cdot \dot{O} \quad \end{array}$$

(III.)

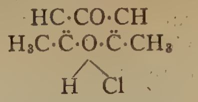
It crystallizes in tables which melt at 108–109° C., and is a weak acid. Alcoholic potash converts it into aceto-acetic ester, and with concentrated aqueous caustic potash it is completely decomposed into acetone, acetic acid and carbon monoxide.

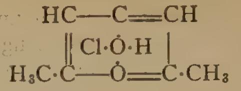
γ-Pyrones.—Many of these compounds are found as naturally occurring substances: thus chelidonic acid is found in *Chelidonium majus* and meconic acid in opium, and the more complex flavone and flavonol derivatives are also found in various plants. The γ-pyrones may be synthesized by eliminating water from the 1·3·5 triketones:—



Acetone dioxalic ester. → Chelidonic ester.

γ-Pyrone or pyrocomane, $C_5H_4O_2$, melting at 32° C. and boiling at 210–215° C., is obtained by eliminating carbon dioxide from chelidonic acid (obtained as above), or from comanic acid, obtained by heating chelidonic acid. *αα′-Dimethyl-γ-pyrone*, $C_5H_2(CH_3)_2O_2$, is obtained by the action of hydriodic acid on the ester of the corresponding acid (Feist, *Ann.*, 1890, 257, p. 272); by the action of carbonyl chloride on the copper derivative of acetoacetic ester, and by the action of concentrated hydrochloric acid on dehydracetic acid. It forms a barium salt which with an acid yields diacetyl acetone. The most striking property of this compound is that it forms salts with mineral acids (J. N. Collie and Tickle, *Journ. Chem. Soc.*, 1899, p. 710). For example, hydrochloric acid adds on at the oxygen atom, since the salts so formed are relatively unstable and undergo complete hydrolysis in dilute aqueous solution. The oxygen atom is probably tetravalent, and the salts are to be regarded as oxonium salts (see OXYGEN). Collie (*Journ. Chem. Soc.*, 1904, 85, p. 971) is of the opinion that both oxygen atoms are to be regarded as tetravalent in these salts and gives the second formula below for the molecule:—





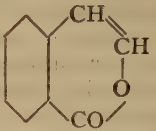
Meconic acid, or oxypyrone tricarboxylic acid (3·2·6) $C_5HO_2(OH)(CO_2H)_2$, found in opium, crystallizes in prisms and gives a characteristic deep red colour with ferric chloride. On heating to 200° it gives comenic acid, $C_5H_2O_2(OH)(CO_2H)$, and on distillation pyromeconic acid or β-oxypyrone. On comenic acid see A. Peratoner, *Gazz.*, 1906, 36 (i.), p. 1.

The tetrahydro-γ-pyrones may be obtained by the condensation of aldehydes with acetone-dicarboxylic ester in the presence of hydrochloric acid.

Benzopyrones.

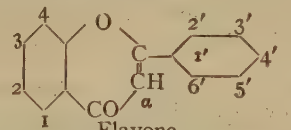
Compounds of this type are known in both the α and γ series, the former including the coumarins (*q.v.*) and isocoumarins, and the latter a number of naturally occurring dyestuffs which may be considered as derivatives of flavone (see under).

The *isocoumarins* (annexed formula) may be prepared by the action of acid chlorides or anhydrides on orthocyanbenzyl cyanide (*Ber.*, 1892, 25, p. 3563); by the molecular rearrangement of the benzal or alkylidene phthalides (S. Gabriel, *Ber.*, 1885, 18, p. 2443; 1887, 20, p. 2363), and by the action of manganese dioxide and hydrochloric acid on β-naphthoquinone.

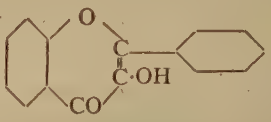


Isocoumarin.

The parent substance of the γ-group, namely *benzo-γ-pyrone* (chromone), was obtained in 1900 by S. Ruhemann (*Journ. Chem. Soc.*, 77, p. 1179) by heating its carboxylic acid (formed by the action of concentrated sulphuric acid on phenoxyfumaric acid) *in vacuo*. It crystallizes in colourless needles, and its solution in concentrated sulphuric acid is yellow with a blue fluorescence. The naturally occurring compounds, chrysin, galanzin, quercetin, apigenine, &c., are considered to be derivatives of flavone (or flavonol), which is a phenyl-2-benzo-γ-pyrone (S. Kostanecki, *Ber.*, 1898–1906). Flavone and flavonol possess the following constitutions, the positions of the substituents being indicated by the numbers:—

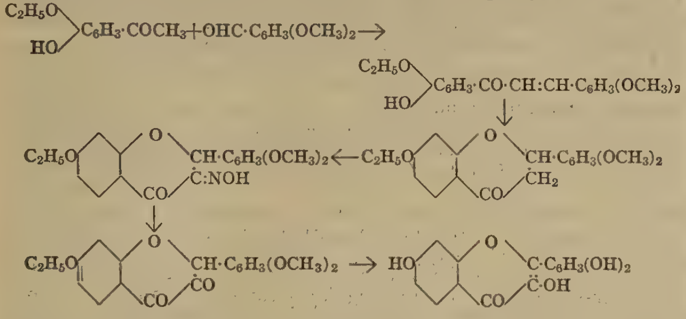


Flavone.



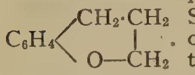
Flavonol.

Flavone, $C_{15}H_{10}O_2$, is obtained by the action of potassium hydroxide on the acetyl derivative of benzylidene-ortho-oxyacetophenone. It forms colourless needles, which dissolve in concentrated sulphuric acid with a yellow colour and show a faint blue fluorescence. On fusion with caustic alkalis it yields salicylic acid, acetophenone, ortho-oxyacetophenone and benzoic acid, the latter two products being also formed by its hydrolysis with sodium ethylate. *Chrysin* or 1·3-dioxyflavone, $C_{15}H_{10}O_4$, is a yellow dye, which may be obtained from the buds of different varieties of the poplar. On hydrolysis it yields phloroglucin and benzoic and acetic acids. It has been synthesized by heating trimethoxy benzoyl acetophenone (from ethyl benzoate and phloracetophenone trimethyl ether) with hydriodic acid, and also by the action of hydriodic acid on 2·4-dibrom-1·3-dimethoxyflavonone. *Galanzin* or α·1·3-trioxyflavone or 1·3-dioxyflavonol, $C_{15}H_{10}O_5$, crystallizes in yellow needles. It has been synthesized from hydroxydimethoxy-chalkone, $C_6H_5\cdot CH:CH\cdot CO[1]\cdot C_6H_2(OH)(OCH_3)_2[2\cdot 4\cdot 6\cdot]$, the resulting 1·3-dimethoxy-flavanone compound yielding a nitroso-compound from which galanzin is obtained by the action of concentrated hydriodic acid. *Apigenine* or 1·3·4′-trioxyflavone, $C_{15}H_{10}O_5$, found in woad and in parsley, crystallizes in pale yellow needles. On fusion at moderate temperatures with caustic alkalis it gives phloroglucin and para-oxyacetophenone, whilst at higher temperatures it yields protocatechuic and para-oxybenzoic acids and phloroglucin. It is obtained synthetically by brominating 1·3·4′-trimethoxyflavonone, the resulting tribromo-compound by the consecutive reactions of alcoholic potash and hydriodic acid yielding apigenine. *Kaempferol* or 1·3·4′-trioxyflavonol, $C_{15}H_{10}O_5$, is found in the blossoms of *Delphinium consolida* and *D. zazil.* It is obtained by the action of hydriodic acid on kaempherid, and crystallizes in yellowish needles, which on fusion with caustic alkalis give para-oxybenzoic acid and phloroglucin. It is obtained synthetically from hydroxy-trimethoxy-chalkone, $CH_3O[4]\cdot C_6H_4[1]\cdot CH:CH\cdot CO\cdot[1]C_6H_2(OH)(OCH_3)_2[2\cdot 4\cdot 6]$ by a method similar to that used for galanzin. *Kaempferid* occurs together with galanzin and alpinin in galganta root. It crystallizes in pale yellow needles, which dissolve in the caustic alkalis with an intense yellow colour, and in concentrated sulphuric acid with a yellow colour and blue fluorescence. *Fisetin* or 3·3′·4′-trioxyflavonol, $C_{15}H_{10}O_6$, occurs in the wood of *Quebracho colorado*, and can be obtained by heating fustic with dilute acids. It crystallizes in pale yellow needles. In dilute alcoholic alkalis it shows a dark green fluorescence. On fusion with caustic alkalis it yields phloroglucin, resorcin and protocatechuic acid, whilst if air be passed through its alcoholic solution it yields protocatechuic acid and resorcin. It is obtained synthetically from 2-oxy-3·4-dimethoxy-4-ethoxy-chalkone. The various steps in this synthesis are shown below, since the method employed is applicable to other members of the group.


C_2H_5O
HO
$C_6H_3\cdot COCH_3 + OHC\cdot C_6H_3(OCH_3)_2$
$C_6H_3\cdot CO\cdot CH{:}CH\cdot C_6H_3(OCH_3)_2$
O
$CH\cdot C_6H_3(OCH_3)_2$
$C{:}NOH$
CH_2
CO
$C\cdot C_6H_3(OH)_2$
$C\cdot OH$

This structure of the fisetin molecule was confirmed by Herzig (*Monats.*, 1891, 12, p. 177), who showed that the tetraethyl ether of fisetin on hydrolysis with alcoholic potash gave diethylprotocatechuic acid and diethylfisetol, the latter on oxidation yielding ethyl-β-resorcylic acid, which had been previously obtained by oxidizing resacetophenone ethyl ether. *Luteolin* or 1·3·3′·4′-tetroxyflavone, $C_{15}H_{10}O_6$, is found in the weld obtained from *Reseda luteola*. It crystallizes in small yellow needles, which dissolve in solutions of the caustic alkalis with a bright yellow colour. On fusion with caustic alkalis it yields phloroglucin and protocatechuic acid. It is obtained synthetically from 1·3·3′·4′-tetramethoxy-flavanone by bromination, the tribromo-compound being decomposed by the successive use of alcoholic potash and concentrated hydriodic acid. *Quercetin* or 1·3·3′·4′-tetroxyflavonol, $C_{15}H_{10}O_7$, is a decomposition product of quercitrin rind, and is found in many plants. It is obtained by the hydrolysis of quercitrin with dilute sulphuric acid. It is a pale yellow crystalline powder. Alcohol hydrolyses it to protocatechuic acid and phloroglucin. It is prepared synthetically from 2-hydroxy-3·4·4′·6′-tetramethoxy-chalkone. *Rhamnetin*, $C_{15}H_9O_6\cdot OCH_3$, the monomethyl ether, is a pale yellow powder. *Rhamnazin*, $C_{15}H_8O_5(OCH_3)_2$, the dimethyl ether, crystallizes in yellow needles. *Morin* or 1·3·2′·4′-tetroxyflavonol, $C_{15}H_{10}O_7$, occurs in the wood of *Autscorpis integrifolia*, and crystallizes in long yellow needles, which on fusion with caustic alkali decompose into phloroglucin, resorcin and oxalic acid. On reduction with sodium amalgam in alkaline solution it yields phloroglucin and β-resorcylic acid. It yields a tetramethyl ether and a penta-acetate. It has been synthesized from 1·3·2′·4′-tetramethoxy flavanone by converting this into its isonitroso compound, which yields morin trimethyl ether on hydrolysis by sulphuric acid. *Myricetin* or 1·3·3′·4′·5′-penta-oxy flavonol, $C_{15}H_{10}O_8$, found in the rind of *Myrica nagi* and also in Sicilian sumach, crystallizes in yellow needles which dissolve with a green colour in dilute alkalis. On fusion with caustic alkalis it yields gallic acid and phloroglucin.

The parent substance of the group, namely *chroman* (annexed formula), was obtained by J. v. Braun and A. Steindorff in 1905 (*Ber.*, 38, p. 850) by diazotizing ortho-amino-γ-chlorpropylbenzene and heating the resulting chlorpropylphenol with a caustic alkali. It is a colourless oil which boils at 214–215° C. and possesses a characteristic peppermint odour.



For the dibenzo-pyrones see XANTHONE.

PYROPE (pronounced pĭrōp), a deep red variety of garnet, named from the Gr. *πυρωπός* (fiery) in allusion to its colour. It is used, like almandine (*q.v.*), as a gem-stone, but may be distinguished by the absence of any tinge of violet in its colour and by its lower specific gravity (3·7 or 3·8, while that of almandine is 4·1 to 4·3). The typical colour of pyrope is blood-red, though sometimes a trace of orange gives rise to a hyacinthine hue: occasionally the mineral becomes nearly black, as seen in the pyrope of Arendal in Norway. Crystals are rare, but cubic forms have been observed. Pyrope may be regarded as a magnesium-aluminium garnet (see GARNET), but it usually contains more or less calcium, iron, manganese and chromium; and the rich colour of the mineral seems due to the presence of some of the last three metals, though their exact condition in the mineral has not been determined.

Pyrope generally occurs in grains embedded in peridotites (olivine rocks) or in serpentine resulting from their alteration, or it is found as loose grains in detritus due to the disintegration of the matrix. The grains may be surrounded by a chloritic rind, or by a crust of a fibrous mineral called by A. Schrauf kelyphite (from the Gr. *κέλυφος*, a nut-shell), which seems in some cases to be an amphibole. In the serpentine of Zöblitz and of Greifendorf near Leipzig, in Saxony, pyrope is characteristically developed; and the Saxon garnets, found loose in gravels, were referred to by G. Agricola as far back as 1546. Several localities in Bohemia are famous for yielding pyrope, and from its characteristic occurrence here it is often known, even when found elsewhere, as Bohemian garnet. The garnet-bearing district is a tract of about 70 square kilometres in the north of Bohemia, the chief locality being Meronitz near Bilin. It is notable that the pyrope is found at Meronitz in a clayey calcareous tufa or conglomerate, with opal and serpentine, products of the decomposition of a peridotite. It occurs also in sands and gravels near Chrastian, Lobositz, Triblitz, Podseditz, Chodolitz, and at several other localities in the Mittel Gebirge, between Teplitz and Leitmeritz. It is believed that the original pyrope-bearing rocks resulted from the eruptive activity which gave rise to Linhorka Hill, near Starrey. The garnets in the detritus are accompanied by zircon, spinel, corundum, cyanite, tourmaline, olivine, &c. Though generally very small, they are abundant, and are used not only as ornamental stones, but as a counterpoise in delicate weighing and as an abrasive agent. To obtain the stones the detritus is washed, and the garnets picked out by hand and then sized through sieves. The pyrope is generally rose-cut or step-cut, and often mounted with a foil. Beads are faceted all over. Some pyrope is cut *en cabochon*, forming, like almandine, carbuncle, and if very dark the stone is hollowed at the back so as to form a "garnet-shell." The industry of cutting Bohemian garnets is centred in Turnau on the Iser, near Reichenberg; but there are also works at other localities. Large stones are very rare, but a Bohemian pyrope as large as a hen's egg is preserved in the Imperial treasury at Vienna; and another the size of a pigeon's egg in the Grüne Gewölbe of Dresden.

Pyrope occurs in many localities in the western part of the United States, especially in Colorado, Arizona and New Mexico, where it is often called "ruby." It is found loose in sand accompanied by olivine, and has resulted from the alteration of a peridotite. The Navajo Indians of New Mexico collect the garnet from the sands of the ant-hills and scorpion-holes. Very fine pyrope occurs in the diamond-fields of South Africa, having been derived from olivine-bearing rocks. It occurs in the blue-ground and in the detritus of the river-diggings. The Cape garnets have usually a rich colour, but some stones incline to an orange hue. The finest pyrope is often cut as a brilliant, and passes under the misleading name of "Cape ruby." A pyrope-bearing rock, rather like that of South Africa, occurs in Elliott county, Kentucky, U.S.A.; it is notable, too, that pyrope is found near Elie in Fife, in Scotland, where it occurs in volcanic agglomerates and in basaltic dikes. Sir A. Geikie has pointed out the suggestive resemblance of the occurrence there to that in South Africa.

See "Bohemian Garnets," by G. F. Kunz, *Trans. Amer. Inst. Mining Eng.* (1893), xxi. 241; and "Die böhmischen Granatlagerstätten," by Dr Hans Oehmichen, *Zeit. f. prakt. Geol.* (1900), viii. 1. Both papers contain bibliographical lists. (F. W. R.*)

PYROPHORUS (Gr. πῦρ, fire, φέρειν, to bear), a substance which spontaneously inflames on contact with the air. One of the earliest known is that of Homberg, prepared by heating a mixture of alum and finely divided carbon to redness in a closed tube. On opening the tube and emptying out the black residue (consisting of potassium sulphide, aluminium sulphate and carbon) it promptly catches fire. Many readily oxidizable substances, especially when very finely divided, have the same property. Metallic iron and cobalt, when prepared under certain conditions, are pyrophoric, as is also ferrous oxide. Spontaneously inflammable liquids are also known, *e.g.* certain alkyl metallic compounds, phosphorus dihydride, &c.

PYROPHYLLITE, a mineral species belonging to the clay family, and composed of hydrous aluminium silicate $HAl(SiO_3)_2$. It occurs in two more or less distinct varieties, namely, as crystalline folia and as compact masses; distinct crystals are not known.

The folia have a pronounced pearly lustre, owing to the presence of a perfect cleavage parallel to their surfaces: they are flexible but not elastic, and are usually arranged radially in fan-like or spherical groups. This variety, when heated before the blowpipe, exfoliates and swells up to many times its original volume, hence the name pyrophyllite, from the Greek *πῦρ* (fire) and *φύλλον* (a leaf), given by R. Hermann in 1829. The colour of both varieties is white, pale green, greyish or yellowish; they are very soft (H. = 1–2) and are greasy to the touch. The specific gravity is 2·8–2·9. The two varieties are thus very similar respectively to talc (*q.v.*) and its compact variety steatite, which is, however, a hydrous magnesium silicate. The compact variety of pyrophyllite is used for slate pencils and tailors' chalk ("French chalk"), and is carved by the Chinese into small images and ornaments of various kinds. Other soft compact minerals (steatite and pinite) used for these Chinese carvings are included with pyrophyllite under the terms agalmatolite and pagodite.

Pyrophyllite occurs in schistose rocks, often associated with cyanite, of which it is an alteration product. Pale green foliated masses, very like talc in appearance, are found at Beresovsk near Ekaterinburg in the Urals, and at Zermatt in Switzerland. The most extensive deposits are in the Deep river region of North Carolina, where the compact variety is mined, and in South Carolina and Georgia.

PYROXENE, an important group of rock-forming minerals, very similar in chemical composition and general characters to the amphiboles (*q.v.*). Although crystallizing in three different systems, they all possess distinct prismatic cleavages, the angles between which are about 87° (the cleavage angle in the amphiboles being 56°). They are metasilicates, but, as shown in the following table, the composition varies widely in the different species, with corresponding differences in the various physical characters. The name pyroxene was originally given by R. J. Haüy in 1796 to the black crystals of augite found in the lavas of Vesuvius and Etna: he derived the name from the Greek πῦρ (fire) and ξένος (a stranger), because he thought that the crystals had been accidentally caught up by the lavas which contained them. As a matter of fact, the pyroxenes are, next to the felspars, the commonest constituents of igneous rocks of almost all kinds, being especially characteristic of those of basic composition. An igneous rock composed almost wholly of pyroxene is known as a pyroxenite. Besides being minerals of primary origin in igneous rocks, the pyroxenes are also of frequent occurrence in metamorphic rocks, for example, in crystalline limestones, being then of secondary origin.

At the present day the name pyroxene is used as a group name for all the minerals enumerated below, though sometimes it is also applied as a specific name to include the monoclinic members diopside, hedenbergite, schefferite and augite.

Orthorhombic Series.	
Enstatite	$MgSiO_3$.
Bronzite	$(Mg,Fe)SiO_3$.
Hypersthene	$(Fe,Mg)SiO_3$.
Monoclinic Series.	
Diopside	$CaMg(SiO_3)_2$.
Hedenbergite	$CaFe(SiO_3)_2$.
Schefferite	$(Ca,Mg)(Fe,Mn)(SiO_3)_2$.
Augite	$\left\{\begin{array}{l}Ca(Mg,Fe)(SiO_3)_2 \text{ with} \\ (Mg,Fe)(Al,Fe)_2SiO_6.\end{array}\right.$
Acmite	$NaFe'''(SiO_3)_2$.
Spodumene	$LiAl(SiO_3)_2$.
Jadeite	$NaAl(SiO_3)_2$.
Wollastonite	$CaSiO_3$.
Pectolite	$HNaCa_2(SiO_3)_3$.
Rosenbuschite	$Na_2Ca_3[(Si,Zr,Ti)O_3]_4$.
Anorthic Series.	
Rhodonite	$MnSiO_3$.
Babingtonite	$(Ca,Fe,Mn)SiO_3 \cdot Fe_2'''(SiO_3)_3$.
Hiortdahlite	$(Ca,Na)_2F[(Si,Zr)O_2]$.

For details respecting the special characters and modes of occurrence of most of these species reference may be made to the respective headings: others not so treated are briefly mentioned below. Hedenbergite, or calcium iron pyroxene, is a black mineral closely allied to diopside (*q.v.*) and, owing to the isomorphous replacement of iron by magnesium, there is no sharp line of division between them. Schefferite, or manganese pyroxene, is a brown mineral found in the manganese mines of Sweden. Pectolite is a secondary mineral occurring as white masses with a radially fibrous structure in the veins and cavities of basic igneous rocks. Babingtonite is found as small black crystals on felspar in the granite of Baveno in Italy, and in the Haytor iron mine in Devonshire. Rosenbuschite, hiortdahlite, and some other rare members containing zirconium and fluorine, occur as accessory constituents in the nepheline-syenite of southern Norway.

PYROXENITE, a rock consisting essentially of minerals of the pyroxene group, such as augite and diallage, hypersthene, bronzite or enstatite. Names have been given to members of this group according to their component minerals, *e.g.* pyroxenite (augite), diallagite (diallage), hypersthenite (hypersthene), bronzitites (bronzite), websterite (diallage and hypersthene). Closely allied to this group are the hornblendites, consisting essentially of hornblende. The term perknite (Gr. περκνός, dark) has also been used to designate the whole series.

They are essentially of igneous origin, though some pyroxenites are included in the metamorphic complex of the Lewisian of Scotland; those pyroxene rocks which result from the contact alteration of impure limestones are described as pyroxene hornfelses (calc-silicate hornfelses). The pyroxenites are closely allied to the gabbros and norites, from which they differ by the absence of felspar, and to the peridotites, which are distinguished from them by containing olivine. This connexion is indicated also by their mode of occurrence, for they usually accompany masses of gabbro and peridotite and seldom are found by themselves. They are strictly plutonic and often very coarse-grained, containing individual crystals which may be several inches in length. The principal accessory minerals, in addition to olivine and felspar, are chromite and spinels, garnet, iron oxides, rutile, scapolite. They frequently occur in the form of dikes or segregations in gabbro and peridotite: *e.g.* in Shetland, Cortlandt on the Hudson river, North Carolina (websterite), Baltimore, New Zealand, and in Saxony. The component minerals often have a close resemblance to those of the surrounding rock. By decomposition the rocks consisting of pyroxene pass into serpentines, which sometimes preserve the original structures of the primary minerals, such as the lamination of hypersthene and the rectangular cleavage of augite. Under pressure-metamorphism hornblende is developed and various types of amphibolite and hornblende-schist are produced. Occasionally rocks rich in pyroxene are found as basic facies of nepheline syenite; a good example is provided by the melanite pyroxenites associated with borolanite (*q.v.*) at Ledbeg in Sutherlandshire.

(J. S. F.)

PYRRHO OF ELIS (*c.* 360–270 B.C.), a Greek sceptic philosopher and founder of the school known as Pyrrhonism. Diogenes Laërtius (ix. 61), quoting from Apollodorus, says that he was at first a painter, and that pictures by him were in existence in the gymnasium at Elis. Later he was diverted to philosophy by the works of Democritus, and became acquainted with the Megarian dialectic through Bryson, pupil of Stilpo. With Anaxarchus, he went to the East in the train of Alexander, and studied in India under the Gymnosophists (*q.v.*) and under the Magi in Persia. From the Oriental philosophy he seems to have adopted a life of solitude. Returning to Elis, he lived in poor circumstances, but highly honoured by the Elians and also by the Athenians, who gave him the rights of citizenship. His doctrines are known mainly through the satiric writings (*Σίλλοι*) of his pupil Timon of Phlius (the Sillographer). The main principle of his thought is expressed in the word *acatalepsia*, which implies the impossibility of knowing things in their own nature. Against every statement the contradictory may be advanced with equal reason (*ἰσοσθενεία τῶν λόγων*). Secondly, it is necessary in view of this fact to preserve an attitude of intellectual suspense (ἐποχή), or, as Timon expressed it, *οὐδὲν μᾶλλον* (*i.e.* no assertion more valid than another). The same idea is expressed also by the terms *ἀρρεψία* (equilibrium) and *ἀφασία* (refusal to speak, non-committal silence). Thirdly, these results are applied to life in general. Pyrrho concludes that, since nothing can be known, the only proper attitude is imperturbability (*ataraxia*). The impossibility of knowledge, even in regard to our own ignorance or doubt, should induce the wise man to withdraw into himself, avoiding the stress and emotion which belong to the contest of vain imaginings. This drastic scepticism is the first and the most thorough exposition of agnosticism in the history of thought. Its ethical results may be compared with the ideal tranquillity of the Stoics and the Epicureans. (For its relation to the New Academy and to scepticism in general see SCEPTICISM and MEGARIAN SCHOOL OF PHILOSOPHY.)

See histories of philosophy by Zeller, Erdmann, Ueberweg; Ritter and Preller, § 364; Waddington, *Pyrrhon et le pyrrhonisme* (1877); Zimmermann, *Darstellung d. pyrrh. Phil.* (1841) and *Ueber Ursprung und Bedeutung d. pyrrh. Phil.* (1843); Wachsmuth, *De Timone Phliasio* (1859).

PYRRHOTITE, a mineral species consisting of iron sulphide and crystallizing in the hexagonal system. The formula is $Fe_n S_{n+1}$ where n may vary from 5 to 16; usually it is $Fe_7 S_8$ or $Fe_{11} S_{12}$, the latter being also the composition of the artificially prepared compound. Small amounts of nickel and cobalt are often present.

Crystals have the form of hexagonal plates bounded at their edges by faces of a hexagonal prism and pyramids, which are deeply striated horizontally. More frequently, however, the mineral is massive, with a laminar or granular structure. The colour is bronze-yellow and the lustre metallic; the streak is greyish-black. The hardness is 4 and the specific gravity 4·58–4·64. The mineral is magnetic, sometimes with polarity, and it is therefore often called "magnetic pyrites."

Pyrrhotite occurs in metalliferous veins, and as grains and plates disseminated through various rocks. In the gabbros and norites of Norway and Sweden it has been concentrated by magmatic differentiation at the margins of the igneous masses. Large bodies of massive pyrrhotite occur at Bodenmais in Bavaria and in Wheal Jane near Truro in Cornwall. Crystallized specimens are from the metalliferous veins at Morro Velho in Brazil, Kongsberg in Norway, and Andreasberg in the Harz. Crystals of pyrrhotite have also been observed in meteoric stones; but iron sulphide appears more commonly in meteorites, especially in meteoric irons, as troilite (FeS), which, if really distinct from pyrrhotite, has not been met with in terrestrial rocks. (L. J. S.)

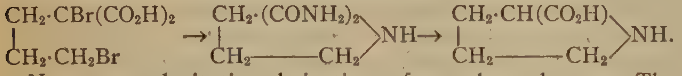
PYRRHUS (*c.* 318–272 B.C.), king of Epirus, son of Aeacides, and a member of the royal family of the Molossians. He claimed descent from Pyrrhus, the son of Achilles, and was also connected with the royal family of Macedonia through Olympias, the mother of Alexander the Great. When a mere lad he became king of the wild mountain tribes of Epirus, and learned the art of war in the school of Demetrius Poliorcetes and his father Antigonus. He fought by their side at the battle of Ipsus (301) in Phrygia, in which they were decisively defeated by the combined armies of Seleucus Nicator and Lysimachus. Soon afterwards he was sent to the court of Ptolemy of Egypt at Alexandria as a pledge for the faithful carrying out of a treaty of alliance between his brother-in-law Demetrius and Ptolemy. Through Ptolemy, whose step-daughter Antigone he married, Pyrrhus was enabled to establish himself firmly on the throne of Epirus, and became a formidable opponent to Demetrius, who was now king of Macedonia and the leading man in the Greek world. He defeated one of Demetrius's generals in Aetolia, invaded Macedonia, and forced Demetrius to conclude a truce with him. For about seven months Pyrrhus was in possession of a large part of Macedonia, Demetrius finding it convenient to make this surrender on condition that Pyrrhus did not meddle with the affairs of Peloponnesus. But in 286 he was defeated by Lysimachus at Edessa, driven out of Macedonia, and compelled to fall back on his little kingdom of Epirus. In 281 came the great opportunity of his life. An embassy was sent to him from the Greek city Tarentum in southern Italy with a request for aid against Rome, whose hostility the Tarentines had recklessly provoked. After some hesitation on the part of the Tarentines, Pyrrhus's conditions were accepted, and a treaty was concluded. His general Milo crossed with a body of troops and occupied the citadel. Pyrrhus soon followed with a miscellaneous force of about 25,000 men (partly furnished by Ptolemy Ceraunus of Macedonia) and some elephants. The Tarentines and Italian Greeks shrank, however, from anything like serious effort, and resented his calling upon them for men and money. Rome meantime levied a special war contribution, called on her subjects and allies for their full contingent of troops, and posted strong garrisons in all towns of doubtful fidelity. She was now the dominant power in Italy, but her position was critical, as in the north she had had trouble with the Etruscans and the Gauls, while in the south the Lucanians and the Bruttians were making common cause with Tarentum and the Greek cities. For the first time in history Greeks and Romans met in battle at Heraclea near the shores of the Gulf of Tarentum, and the cavalry and elephants of Pyrrhus secured for him a complete victory over the consul M. Valerius Laevinus, though at so heavy a cost as to convince him of the great uncertainty of final success (hence is derived the phrase of a Pyrrhic victory). Although he now had the Samnites as well as the Lucanians and the Bruttians and all the Greek cities of southern Italy with him, he found every city closed against him as he advanced on Rome through Latium. The peace negotiations, carried on by the skilful diplomatist Cineas, the minister of Pyrrhus, led to no result; the senate seemed inclined to come to terms, but the fiery and patriotic eloquence of the aged and blind Appius Claudius (the censor) carried the day. Cineas was ordered to leave the city at once and to tell his master that Rome could not negotiate so long as foreign troops remained on the soil of Italy. In the second year of the war (279), Pyrrhus again defeated a Roman army at Asculum (mod. Ascoli) in Apulia, but Rome still had armies in the field and her Italian confederation was not broken up. For a while he quitted Italy for Sicily, at the invitation of the Syracusans, with the idea of making himself the head of the Sicilian Greeks and driving the Carthaginians out of the island. In his military operations he was on the whole successful; and Rome and Carthage, in face of the common danger, concluded an offensive and defensive alliance against him. He passed three years in Sicily, but offended the Greek cities, which he governed in the fashion of a despot. Finding that he could no longer hold Sicily in face of the ill feeling thus aroused, and reproached by the Samnites for having deserted them, he decided to return to Italy. On the voyage he was attacked by the Carthaginians and lost several vessels. When he reached Italy, the Tarentines and the other Greek cities, having lost confidence in him, refused to supply him with men or money. Thoroughly disheartened, he made one more effort and engaged a Roman army at Beneventum (275) in the Samnite country, but his arrangements miscarried, and he was defeated with the loss of his camp and the greater part of his army. Nothing remained but to go back to Greece. He left a garrison in Tarentum and returned the following year to his home in Epirus after a six years' absence. The brief remainder of his life was passed in camps and battles, without any glorious result. He gained a victory on Macedonian soil over Antigonus Gonatas, king of Macedonia, whose troops hailed him as king. In 273 he was invited into Peloponnesus by Cleonymus to settle by force of arms a dispute about the royal succession at Sparta. He besieged the city, but was repulsed with great loss. Next, at the invitation of a political faction, he went to Argos, where, during a fight by night in the streets, he was struck on the head by a huge tile. He fell from his horse, and was put to death by one of the soldiers of Antigonus.

Pyrrhus was a brilliant and dashing soldier, but he was aptly compared to a gambler who made many good throws with the dice, but could not make proper use of them in the game. He obtained no lasting results, and was never more than a captain of mercenaries, yet there was something chivalrous about him which seems to have made him a general favourite. After his death Macedonia had, for a time at least, nothing to fear, and the liberty of Greece was quite at the mercy of that power. Pyrrhus wrote a history of the art of war, which is praised by Cicero, and quoted by Dionysius of Halicarnassus and Plutarch.

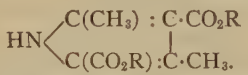
The chief ancient authority for the life of Pyrrhus is Plutarch; see also Polybius xviii. 11, and elsewhere; Dion. Halic. xviii. 1, xix. 6–9; Pausanias i. 13; Justin xviii. 1, 2, xxiii. 3, xxv. 4, 5. Modern monographs by G. F. Hertzberg, "Rom und König Pyrrhus" (popular; in O. Jäger's *Darstellungen aus der römischen Geschichte*, 1870); R. von Scala, *Der Pyrrhische Krieg* (1884), with map of Roman garrison system in 281; R. Schubert, *Geschichte des Pyrrhus* (1894), with full list of authorities; also ROME: *History*, "The Republic."

PYRROL, C_4H_5N or $C_4H_4{\cdot}NH$, an organic base found in coal-tar and Dippel's oil. It may be synthetically prepared by the dry distillation of ammonium mucate, or, better, by heating it with glycerin to 180-200° C. (H. Schwanert, *Ann.*, 1860, 116, p. 257); by passing the vapour of diethylamine through a red-hot tube; by distilling succinimide with zinc dust (C. A. Bell, *Ber.*, 1880, 13, p. 877); by distilling calcium pyroglutaminate: $HO_2C{\cdot}CH(NH_2){\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H = C_4H_4NH+CO_2+2H_2O$ (L. Haitinger, *Monats.*, 1882, 3, p. 228); and by boiling succinic dialdehyde with ammonia and glacial acetic acid (C. Harries, *Ber.*, 1901, 34, p. 1497). It is a feebly basic, colourless liquid which boils at 130° C., and possesses a smell resembling that of chloroform. It is slightly soluble in water, and turns brown on exposure to air. It has to some extent the character of a secondary amine; the hydrogen of the imino group can be replaced by potassium. It is resinified by the action of concentrated mineral acids. On warming solutions of pyrrol in dilute acid, ammonia is evolved, and an amorphous powder of variable composition, known as *pyrrol-red*, separates out. The pyrrol ring is easily broken, *e.g.* hydroxylamine gives the dioxime of succinic aldehyde. Pyrrol is readily converted into pyridine derivatives by acting with bromoform, chloroform, or methylene iodide on its potassium salt, β-brom-and β-chlor-pyridine being obtained with the first two compounds, and pyridine itself with the last. Iodine in alkaline solution converts pyrrol into *iodol* (tetra-iodopyrrol), crystallizing in yellowish-brown needles, which decompose on heating. It may also be prepared by heating tetra-brom- or tetra-chlorpyrrol with potassium iodide in alcoholic solution (German patent, 38423, 1886). It is used as an antiseptic.

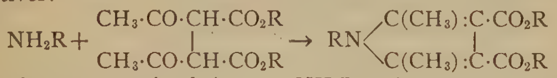
Zinc dust and hydrochloric acid reduce pyrrol to *pyrrolin* (dihydropyrrol), $C_4H_6\cdot NH$, a liquid which boils at 90° C. (748 mm.); it is soluble in water and has strongly basic properties and an alkaline reaction. Hydriodic acid at high temperature reduces pyrrol to *pyrrolidine* (tetra-hydropyrrol), C_4H_8NH. Pyrrolidine has also been prepared by A. Thiele (*Ber.*, 1905, 38, p. 4154) from β-chlorpropionic aldehyde diethyl acetal. The chlorine atom in this compound is replaced by the cyano-group, which is then reduced to the CH_2NH_2. group and coupled up with benzene sulphochloride to form the compound $C_6H_5SO_2NH(CH_2)_3\cdot CH(OC_2H_5)_2$. This substance easily splits out alcohol, and the ring compound then formed yields pyrrolidine on reduction by sodium in amyl alcohol solution. An α-pyrrolidine carboxylic acid and its hydroxy derivatives have been detected by E. Fischer among the products of hydrolysis of proteids. R. Willstätter (*Ber.*, 1900, 33, p. 1164) obtained this acid by the action of a methyl alcoholic solution of ammonia on dibrompropylmalonic ester at 140° C., the diamide formed being then hydrolysed either by hydrochloric acid or baryta water:—



Numerous substitution derivatives of pyrrol are known. The *N*-derivatives are prepared by the action of alkyl halides and acid chlorides on potassium pyrrol. The *C*-derivatives have been prepared in various ways. L. Knorr, by the action of ammonia on aceto-acetic ester, obtained β-imidobutyric ester, which with nitrous acid yields α-isonitroso-β-imidobutyric ester, $CH_3\cdot C(:NH)\cdot C(:N\cdot OH)\cdot CO_2C_2H_5$. Reduction of this ester leads to the formation of ammonia, hydroxylamine, and dimethyl pyrrol dicarboxylic ester,



He also found that diaceto succinic ester reacts with compounds of the type $NH_2R(R=H, CH_3, OH, NHC_6H_5$, &c.) to form pyrrol derivatives:—



By using compounds of the type NH_2R and acetophenone aceto-acetic ester $C_6H_5CO\cdot CH_2\cdot CH(COCH_3)\cdot CO_2R$, C. Paal obtained similar results. For the benzo-pyrrols see INDOLE.

PYRUVIC ACID, or PYRORACEMIC ACID, $CH_3CO\cdot CO_2H$, an organic acid first obtained by J. Berzelius by the dry distillation of tartaric or racemic acids (*Pogg. Ann.*, 1835, 36, p. 1). It may be prepared by boiling α-dichlorpropionic acid with silver oxide; by the hydrolysis of acetyl cyanide with hydrochloric acid (J. Claisen and J. Shadwell, *Ber.*, 1878. 11, pp. 620, 1563); and by warming oxalacetic ester with a 10% solution of sulphuric acid. It is usually made by distilling tartaric acid with potassium bisulphate at about 200–250° C., the crude product being afterwards fractionated. It is a liquid which boils at about 165° C. (with partial decomposition); it may be solidified, and when pure melts at 13·6° C. (L. Simon *Bull. Soc. Chim.*, 1895 [3], 13, p. 335). It is readily soluble in water, alcohol and ether. It reduces ammoniacal silver solutions. When heated with hydrochloric acid to 100° C. it yields carbon dioxide and pyrotartaric acid, $C_5H_8O_4$, and when warmed with dilute sulphuric acid to 150° C. it gives carbon dioxide and acetaldehyde. Sodium amalgam or zinc and hydrochloric acid reduce it to lactic acid, whilst hydriodic acid gives propionic acid. It readily condenses with aromatic hydrocarbons in the presence of sulphuric acid. It is somewhat readily oxidized; nitric acid gives carbonic and oxalic acids, and chromic acid, carbonic and acetic acids. It forms a well-crystallized hydrazone with phenylhydrazine; and α-nitroso propionic acid with hydroxylamine. It is monobasic and yields salts which only crystallize with great difficulty; when liberated from these salts by a mineral acid it forms a syrupy non-volatile mass. In aqueous solution it gives a red colour with ferric chloride. It shows characteristic ketone reactions, yielding a bisulphite compound and combining with hydrocyanic acid to form the nitrile of α-oxyisosuccinic acid. When warmed with baryta water it gives uvitic acid.

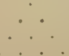
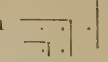
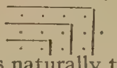
Pyruvic nitrile, or acetyl cyanide, $CH_3CO\cdot CN$, may be prepared by the action of silver cyanide on acetyl chloride; or of acetyl chloride on nitrosoacetone (L. Claisen and O. Manasse, *Ber.*, 1887, 20, p. 2196). It is a liquid which boils at 93° C. and with caustic alkalis polymerizes to diacetyldicyanide.

PYTHAGORAS (6th century B.C.), Greek philosopher, was, in all probability, a native of Samos or one of the neighbouring islands (others say a Tyrrhenian, a Syrian or a Tyrian), and the first part of his life may therefore be said to belong to that Ionian seaboard which had already witnessed the first development of philosophic thought in Greece (see IONIAN SCHOOL). The exact year of his birth has been variously placed between 586 and 569 B.C., but 582 may be taken as the most probable date. He was a pupil of Pherecydes (*q.v.*), and later of Hermodamas (Diog. Laërt. viii. 2). He left in Ionia the reputation of a learned and universally informed man. "Of all men Pythagoras, the son of Mnesarchus, was the most assiduous inquirer," says Heracleitus, and then proceeds in his contemptuous fashion to brand his predecessor's wisdom as only eclectically compiled information or polymathy (πολυμαθια). This accumulated wisdom, as well as most of the tenets of the Pythagorean school, was attributed in antiquity to the extensive travels of Pythagoras, which brought him in contact (so it was said) not only with the Egyptians, the Phoenicians, the Chaldaeans, the Jews and the Arabians, but also with the Druids of Gaul, the Persian Magi and the Brahmans. But these tales represent only the tendency of a later age to connect the beginnings of Greek speculation with the hoary religions and priesthoods of the East. There is no intrinsic improbability, however, in the statement of Isocrates (*Laud. Busir.* 28, p. 227 Steph.) that Pythagoras visited Egypt and other countries of the Mediterranean, for travel was one of the few ways of gathering knowledge. Some of the accounts (*e.g.* Callimachus) represent Pythagoras as deriving much of his mathematical knowledge from Egyptian sources, but, however it may have been with the practical beginnings of geometrical knowledge, the scientific development of mathematical principles can be shown to be an independent product of Greek genius. Some of the rules of the Pythagorean ritual have their Egyptian parallels, as Herodotus points out, but it does not necessarily follow that they were borrowed from that quarter, and he is certainly wrong in tracing the doctrine of metempsychosis (*q.v.*) to Egypt.

The historically important part of his career begins with his migration to Crotona, one of the Dorian colonies in the south of Italy, about the year 529. According to tradition, he was driven from Samos by the tyranny of Polycrates. At Crotona Pythagoras speedily became the centre of a widespread and influential organization, which seems to have resembled a religious brotherhood or an association for the moral reformation of society much more than a philosophic school. Pythagoras appears, indeed, in all the accounts more as a moral reformer than as a speculative thinker or scientific teacher; and the doctrine of the school which is most clearly traceable to Pythagoras himself in the ethico-mystical doctrine of transmigration. The Pythagorean brotherhood had its rise in the wave of religious revival which swept over Hellas in the 6th century B.C., and it had much in common with the Orphic communities which sought by rites and abstinences to purify the believer's soul and enable it to escape from "the wheel of birth." Its aims were undoubtedly those of a religious order rather than a political league. But a private religious organization of this description had no place in the traditions of Greek life, and could only maintain itself by establishing "the rule of the saints" on a political basis. The Pythagoreans appear to have established their supremacy for a time over a considerable part of Magna Graecia, but this entanglement with politics led in the end to the dismemberment and suppression of the society. The authorities differ hopelessly in chronology, but according to the balance of evidence the first reaction against the Pythagoreans took place in the lifetime of Pythagoras after the victory gained by Crotona over Sybaris in 510. Dissensions seem to have arisen about the allotment of the conquered territory, and an adverse party was formed in Crotona under the leadership of Cylon. This was probably the cause of Pythagoras's withdrawal to Metapontum, which an almost unanimous tradition assigns as the place of his death in the end of the 6th or the beginning of the 5th century. The order appears to have continued powerful in Magna Graecia till the middle of the 5th century, when it was violently trampled out. The meeting-houses of the Pythagoreans were everywhere sacked and burned; mention is made in particular of "the house of Milo" in Crotona, where fifty or sixty leading Pythagoreans were surprised and slain.

The persecution to which the brotherhood was subjected throughout Magna Graecia was the immediate cause of the spread of the Pythagorean philosophy in Greece proper. Philolaus, who resided at Thebes in the end of the 5th century (cf. Plato, *Phaedo*, 61 D), was the author of the first written exposition of the system. Lysis, the instructor of Epaminondas, was another of these refugees. This Theban Pythagoreanism had an important influence upon Plato's thought, and Philolaus had also disciples in the stricter sense. But as a philosophic school Pythagoreanism became extinct in Greece about the middle of the 4th century. In Italy—where, after a temporary suppression, it attained a new importance in the person of Archytas of Tarentum—the school finally disappeared about the same time.

Aristotle in his accounts of Pythagorean doctrines never refers to Pythagoras but always with a studied vagueness to "the Pythagoreans" (*οἱ καλούμενοι Πυθαγόρειοι*). Nevertheless, certain doctrines may be traced to the founder's teaching. Foremost among these is the theory of the immortality and transmigration of the soul (see METEMPSYCHOSIS). Pythagoras's teaching on this point is connected by one of the most trustworthy authorities with the doctrine of the kinship of all living beings; and in the light of anthropological research it is easy to recognize the close relationship of the two beliefs. The Pythagorean rule of abstinence from flesh is thus, in its origin, a taboo resting upon the blood-brotherhood of men and beasts; and the same line of thought shows a number of the Pythagorean rules of life which we find embedded in the different traditions to be genuine taboos belonging to a similar level of primitive thought. The moral and religious application which Pythagoras gave to the doctrine of transmigration continued to be the teaching of the school. The view of the body (*σῶμα*) as the tomb (*σῆμα*) of the soul, and the account of philosophy in the *Phaedo* as a meditation of death, are expressly connected by Plato with the teaching of Philolaus; and the strain of asceticism and other worldliness which meets us here and elsewhere in Plato is usually traced to Pythagorean influence. Plato's mythical descriptions of a future life of retribution and purificatory wandering can also be shown to reproduce Pythagorean teaching, though the substance of them may have been drawn from a common source in the Mysteries.

The scientific doctrines of the Pythagorean school have no apparent connexion with the religious mysticism of the society or their rules of living. They have their origin in the same disinterested desire of knowledge which gave rise to the other philosophical schools of Greece, and the idea of "philosophy" or the "theoretic life" as a method of emancipation from the evils of man's present state of existence, though a genuine Pythagorean conception, is clearly an afterthought. The discourses and speculations of the Pythagoreans all connect themselves with the idea of number, and the school holds an important place in the history of mathematical and astronomical science. An unimpeached tradition carries back the Pythagorean theory of numbers to the teaching of the founder himself. Working on hints contained in the oldest traditions, recent investigators have shown that the discoveries attributed to Pythagoras connect themselves with a primitive numerical symbolism, according to which numbers were represented by dots arranged in symmetrical patterns, such as are still to be seen in the marking of dice or dominoes. Each pattern of units becomes on this plan a fresh unit. The "holy tetractys," by which the later Pythagoreans used to swear, was a figure of this kind  representing the number 10 as the triangle of 4, and showing at a glance that $1 + 2 + 3 + 4 = 10$. The sums of the series of any successive numbers may be graphically represented in a similar way, and are hence spoken of as "triangular numbers," while the sums of the series of successive odd numbers are called "square numbers," and those of successive even numbers "oblong numbers"; thus 3 and 5 added to the unit give a figure of this description  while 4 and 6, added to 2, are thus represented  Such a method of representing number in areas leads naturally to problems of a geometrical nature, and as the practical use of the right-angled triangle was already familiar in the arts and crafts, there is no reason to dispute the well-established tradition which assigns to Pythagoras the discovery of the proposition that in such a triangle the square on the hypotenuse is equal to the sum of the squares on the other two sides. And it is probably also correct to attribute to him the discovery of the harmonic intervals which underlie the production of musical sounds. Impressed by this reduction of musical sounds to numbers and by the presence of numerical relations in every department of phenomena, Pythagoras and his early followers enunciated the doctrine that "all things are numbers." Numbers seemed to them, as Aristotle put it, to be the first things in the whole of nature, and they supposed the elements of numbers to be the elements of all things, and the whole heaven to be a musical scale and a number (*Meta.* A. 986a). Numbers, in other words, were conceived at that early stage of thought not as relations or qualities predicable of things, but as themselves constituting the substance or essence of the phenomena—the rational reality to which the appearances of sense are reducible.

But the development of these ideas into a comprehensive metaphysical system was no doubt the work of Philolaus in the latter part of the 5th century. His formulation of the theory implies a knowledge of the teaching of Parmenides and Empedocles, and had itself in turn a great influence upon Plato. The "elements of numbers," of which Aristotle speaks in the passage quoted above, were, according to the Pythagoreans, the Odd and the Even, which they identified with the Limit and the Unlimited; and Aristotle distinctly says that they did not treat these as "priorities of certain other substances" such as fire, water or anything else of that sort, but that the unlimited itself and the one were the reality of the things of which they were predicated, and that is why they said that number was "the reality of everything" (*Meta.* A. 587). Numbers, therefore, are spatially conceived, "one" being identified with the point in the sense of a unit having position and magnitude. From combinations of such units the higher numbers and geometrical figures arise—"two" being identified with the line, "three" with the surface, and "four" with the solid—and the Pythagoreans proceeded to explain the elements of Empedocles as built up out of geometrical figures in the manner followed by Plato in the *Timaeus*. The identification of the numerical opposites, the Odd and the Even, with the Limit and the Unlimited—otherwise difficult to explain—may perhaps be understood, as Burnet suggests, by reference to the arrangement of the units or "terms" (*ὅροι*) in patterns. "When the odd is divided into two equal parts," he quotes from Stobaeus, "a unit is left over in the middle; but when the even is so divided, an empty field is left over, without a master and without a number, showing that it is defective and incomplete." The idea of opposites, derived, perhaps, originally from Heracleitus, was developed by the Pythagoreans in a list of ten fundamental oppositions, bearing a certain resemblance to the tables of categories framed by later philosophers, but in its arbitrary mingling of mathematical, physical and ethical contrasts characteristic of the uncritical beginnings of speculative thought: (1) limited and unlimited, (2) odd and even, (3) one and many, (4) right and left, (5) male and female, (6) rest and motion, (7) straight and curved, (8) light and darkness, (9) good and evil, (10) square and oblong. To the Pythagoreans, as to Heracleitus, the universe was in a sense the realized union of these opposites, but interpretations of Pythagoreanism which represent the whole system as founded on the opposition of unity and duality, and proceed to identify this with the opposition of form and matter, of divine activity and passive material, betray on the surface their post-Platonic origin. Still more is this the case when in Neoplatonic fashion they go on to derive this original opposition from the supreme unity or God. The further speculations of the Pythagoreans on the subject of number rest mainly on analogies, which often become capricious and tend to lose themselves at last in a barren symbolism. "Seven" is called *παρθένος* and *Ἀθήνη*, because within the decade it has neither factors nor product. "Five," on the other hand, signifies marriage, because it is the union of the first masculine with the first feminine number (3+2, unity being considered a number apart). The thought already becomes more fanciful when "one" is identified with reason, because it is unchangeable; "two" with opinion, because it is unlimited and indeterminate; "four" with justice, because it is the first square number, the product of equals.

The astronomy of the Pythagoreans was their most notable contribution to scientific thought, and its importance lies in the fact that they were the first to conceive the earth as a globe, self-supported in empty space, revolving with the other planets round a central luminary. They thus anticipated the heliocentric theory, and Copernicus has left it on record that the Pythagorean doctrine of the planetary movement of the earth gave him the first hint of its true hypothesis. The Pythagoreans did not, however, put the sun in the centre of the system. That place was filled by the central fire to which they gave the names of Hestia, the hearth of the universe, the watch-tower of Zeus, and other mythological expressions. It had then been recently discovered that the moon shone by reflected light, and the Pythagoreans (adapting a theory of Empedocles), explained the light of the sun also as due to reflection from the central fire. Round this fire revolve ten bodies, first the Antichthon or counter-earth, then the earth, followed in order by the moon, the sun, the five then known planets and the heaven of the fixed stars. The central fire and the counter-earth are invisible to us because the side of the earth on which we live is always turned away from them, and our light and heat come to us, as already stated, by reflection from the sun. When the earth is on the same side of the central fire as the sun, the side of the earth on which we live is turned towards the sun and we have day; when the earth and the sun are on opposite sides of the central fire we are turned away from the sun and it is night. The distance of the revolving orbs from the central fire was determined according to simple numerical relations, and the Pythagoreans combined their astronomical and their musical discoveries in the famous doctrine of "the harmony of the spheres." The velocities of the bodies depend upon their distances from the centre, the slower and nearer bodies giving out a deep note and the swifter a high note, the concert of the whole yielding the cosmic octave. The reason why we do not hear this music is that we are like men in a smith's forge, who cease to be aware of a sound which they constantly hear and are never in a position to contrast with silence.

AUTHORITIES.—Zeller's account of Pythagoreanism in his *Philosophie der Griechen* gives a full account of the sources, with critical references in the notes to the numerous monographs on the subject, but the labour and ingenuity of more recent scholars has succeeded in clearing up a number of points since he wrote. Diels, *Doxographi graeci* (1879), and *Die Fragmente der Vorsokratiker*, vol. i. (2nd ed., 1906). Gomperz, *Greek Thinkers*, vol. i., and especially Burnet's *Early Greek Philosophy* (2nd ed., 1908), give the results of the latest investigations. Tannery's *Science hellène*; Milhaud's *La Science grecque* and *Philosophes géomètres*; Cantor's *History of Mathematics*; and Gow's *Short History of Greek Mathematics*, refer to the mathematical and physical doctrines of the school.

(A. S. P.-P.)

PYTHAGOREAN GEOMETRY

As the introduction of geometry into Greece is by common consent attributed to Thales, so all are agreed that to Pythagoras is due the honour of having raised mathematics to the rank of a science. We know that the early Pythagoreans published nothing, and that, moreover, they referred all their discoveries back to their master (see PHILOLAUS). Hence it is not possible to separate his work from that of his early disciples, and we must therefore treat the geometry of the early Pythagorean school as a whole. We know that Pythagoras made numbers the basis of his philosophical system, as well physical as metaphysical, and that he united the study of geometry with that of arithmetic.

The following statements have been handed down to us. (*a*) Aristotle (*Meta.* i. 5, 985) says "the Pythagoreans first applied themselves to mathematics, a science which they improved; and, penetrated with it, they fancied that the principles of mathematics were the principles of all things." (*b*) Eudemus informs us that "Pythagoras changed geometry into the form of a liberal science, regarding its principles in a purely abstract manner, and investigated its theorems from the immaterial and intellectual point of view (ἀΰλως καὶ νοερῶς)."[1] (*c*) Diogenes Laërtius (viii. 11) relates that "it was Pythagoras who carried geometry to perfection, after Moeris[2] had first found out the principles of the elements of that science, as Anticlides tells us in the second book of his *History of Alexander*; and the part of the science to which Pythagoras applied himself above all others was arithmetic." (*d*) According to Aristoxenus, the musician, Pythagoras seems to have esteemed arithmetic above everything, and to have advanced it by diverting it from the service of commerce and by likening all things to numbers.[3] (*e*) Diogenes Laërtius (viii. 13) reports on the same authority that Pythagoras was the first person who introduced measures and weights among the Greeks. (*f*) He discovered the numerical relations of the musical scale (Diog. Laërt. viii. 11). (*g*) Proclus[4] says that "the word 'mathematics' originated with the Pythagoreans." (*h*) We learn also from the same authority[5] that the Pythagoreans made a fourfold division of mathematical science, attributing one of its parts to the "how many" (τὸ πόσον) and the other to the "how much" (τὸ πηλίκον); and they assigned to each of these parts a twofold division. They said that discrete quantity or the "how many" is either absolute or relative, and that continued quantity or the "how much" is either stable or in motion. Hence they laid down that arithmetic contemplates that discrete quantity which subsists by itself, but music that which is related to another; and that geometry considers continued quantity so far as it is immovable, but that astronomy (ἡ σφαιρική) contemplates continued quantity so far as it is of a self-motive nature. (*i*) Diogenes Laërtius (viii. 25) states, on the authority of Favorinus, that Pythagoras "employed definitions in the mathematical subjects to which he applied himself."

The following notices of the geometrical work of Pythagoras and the early Pythagoreans are also preserved. (1) The Pythagoreans define a point as "unity having position" (Procl. *op. cit.* p. 95). (2) They considered a point as analogous to the monad, a line to the dyad, a superficies to the triad, and a body to the tetrad (ibid. p. 97). (3) They showed that the plane around a point is completely filled by six equilateral triangles, four squares, or three regular hexagons (ibid. p. 305). (4) Eudemus ascribes to them the discovery of the theorem that the interior angles of a triangle are equal to two right angles, and gives their proof, which was substantially the same as that in Euclid I. 32[6] (ibid. p. 379). (5) Proclus informs us in his commentary on Euclid I. 44 that Eudemus says that the problems concerning the application of areas—where the term "application" is not to be taken in its restricted sense (παραβολή), in which it is used in this proposition, but also in its wider signification, embracing ὑπερβολή and ἔλλειψις, in which it is used in Book VI. Props. 28, 29—are old, and inventions of the Pythagoreans[7] (ibid. p. 419). (6) This is confirmed by Plutarch,[8] who says, after Apollodorus, that Pythagoras sacrificed an ox on finding the geometrical diagram, either the one relating to the hypotenuse, viz. that the square on it is equal to the sum of the squares on the sides, or that relating to the problem concerning the application of an area.[9] (7) Plutarch[10] also ascribes to Pythagoras the solution of the problem, To construct a figure equal to one and similar to another given figure. (8) Eudemus states that Pythagoras discovered the construction of the regular solids (Procl. *op. cit.* p. 65). (9) Hippasus, the Pythagorean, is said to have perished in the sea on account of his impiety, inasmuch as he boasted that he first divulged the knowledge of the sphere with the twelve pentagons (the inscribed ordinate dodecahedron): Hippasus assumed the glory of the discovery to himself, whereas everything belonged to Him—"for thus they designate Pythagoras, and do not call him by name."[11] (10) The triple interwoven triangle or pentagram—star-shaped regular pentagon—was used as a symbol or sign of recognition by the Pythagoreans and was called by them "health" (ὑγιεία).[12] (11) The discovery of the law of the three squares (Euclid I. 47), commonly called the "theorem of Pythagoras," is attributed to him by many authorities, of whom the oldest is Vitruvius.[1] (12) One of the methods of finding right-angled triangles whose sides can be expressed in numbers (Pythagorean triangles)—that setting out from the odd numbers—is referred to Pythagoras by Heron of Alexandria and Proclus.[2] (13) The discovery of irrational quantities is ascribed to Pythagoras by Eudemus (Procl. *op. cit.* p. 65). (14) The three proportions—arithmetical, geometrical and harmonical—were known to Pythagoras.[3] (15) Iamblichus[4] says, "Formerly, in the time of Pythagoras and the mathematicians under him, there were three means only—the arithmetical, the geometrical and the third in order, which was known by the name sub-contrary (ὑπεναντία), but which Archytas and Hippasus designated the harmonical, since it appeared to include the ratios concerning harmony and melody." (16) The so-called most perfect or musical proportion, *e.g.* 6 : 8 : : 9 : 12, which comprehends in it all the former ratios, according to Iamblichus,[5] is said to be an invention of the Babylonians and to have been first brought into Greece by Pythagoras. (17) Arithmetical progressions were treated by the Pythagoreans, and it appears from a passage in Lucian that Pythagoras himself had considered the special case of *triangular* numbers: Pythagoras asks some one, "How do you count?" He replies, "One, two, three, four." Pythagoras, interrupting, says, "Do you see? what you take to be four, that is ten and a perfect triangle and our oath."[6] (18) The odd numbers were called by the Pythagoreans "gnomons,"[7] and were regarded as generating, inasmuch as by the addition of successive gnomons—consisting each of an odd number of unit squares—to the original square unit or monad the square form was preserved. (19) In like manner, if the simplest oblong (ἑτερομήκες), consisting of two unit squares or monads in juxtaposition, be taken and four unit squares be placed about it after the manner of a gnomon, and then in like manner six, eight . . . unit squares be placed in succession, the oblong form will be preserved. (20) Another of his doctrines was, that of all solid figures the sphere was the most beautiful, and of all plane figures the circle.[8] (21) According to Iamblichus the Pythagoreans are said to have found the quadrature of the circle.[9]

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[1] Proclus Diadochus, *In primum Euclidis elementorum librum commentarii*, ed. Friedlein, p. 65.

[2] Moeris was a king of Egypt who, Herodotus tells us, lived 900 years before his visit to that country.

[3] Aristox. *Fragm.* ap. Stob. *Eclog. Phys.* i. 2, 6.

[4] Procl. *op. cit.* p. 45.

[5] *Op. cit.* p. 35.

[6] We learn from a fragment of Geminus, which has been handed down by Eutocius in his commentary on the *Conics* of Apollonius (Apoll. *Conica*, ed. Halleius, p. 9), that the ancient geometers observed two right angles in each species of triangle, in the equilateral first, then in the isosceles, and lastly in the scalene, whereas later writers proved the theorem generally thus—"The three internal angles of every triangle are equal to two right angles."

[7] The words of Proclus are interesting. "According to Eudemus the inventions respecting the *application*, *excess* and *defect* of areas are ancient, and are due to the Pythagoreans. Moderns, borrowing these names, transferred them to the so-called conic lines, the parabola, the hyperbola, the ellipse, as the older school, in their nomenclature concerning the description of areas *in plano* on a finite right line, regarded the terms thus: An area is said to be *applied* (παραβάλλειν) to a given right line when an area equal in content to some given one is described thereon; but when the base of the area is greater than the given line, then the area is said to be in *excess* (ὑπερβάλλειν); but when the base is less, so that some part of the given line lies without the described area, then the area is said to be in *defect* (ἐλλείπειν). Euclid uses in this way in his sixth book the terms *excess* and *defect*. . . . The term *application* (παραβάλλειν), which we owe to the Pythagoreans, has this signification."

[8] *Non posse suaviter vivi sec. Epicurum*, c. xi.

[9] Εἴτε πρόβλημα περὶ τοῦ χωρίου τῆς παραβολῆς. Some authors, rendering the last five words "concerning the area of the parabola," have ascribed to Pythagoras the quadrature of the parabola, which was one of the great discoveries of Archimedes.

[10] *Symp.* viii., Quaest. 2, c. 4.

[11] Iamblichus, *De vit. Pyth.* c. 18, § 88.

[12] Lucian, *Pro lapsu in salut.* § 5; also schol. on Aristoph. *Nub.* 611. That the Pythagoreans used such symbols we learn from Iamblichus (*De vit. Pyth.* c. 33, §§ 237 and 238). This figure is referred to Pythagoras himself, and in the middle ages was called *Pythagorae figura*; even so late as Paracelsus it was regarded by

On examining the purely geometrical work of Pythagoras and his early disciples, as given in the preceding extracts, we observe that it is much concerned with the geometry of areas, and we are indeed struck with its Egyptian character. This appears in the theorem (3) concerning the filling up a plane with regular figures—for floors or walls covered with tiles of various colours were common in Egypt; in the construction of the regular solids (8), for some of them are found in Egyptian architecture; in the problems concerning the application of areas (5); and lastly, in the theorem of Pythagoras (11), coupled with his rule for the construction of right-angled triangles in numbers (12). We learn from Plutarch that the Egyptians were acquainted with the geometrical fact that a triangle whose sides contain three, four and five parts is right-angled, and that the square of the greatest side is equal to the squares of the sides containing the right angle. It is probable too that this theorem was known to them in the simple case where the right-angled triangle is isosceles, inasmuch as it would be at once suggested by the contemplation of a floor covered with square tiles—the square on the diagonal and the sum of the squares on the sides contain each four of the right-angled triangles into which one of the squares is divided by its diagonal. It is easy now to see how the problem to construct a square which shall be equal to the sum of two squares could, in some cases, be solved numerically. From the observation of a chequered board it would be perceived that the element in the successive formation of squares is the gnomon or carpenter's square. Each gnomon consists of an odd number of squares, and the successive gnomons correspond to the successive odd numbers, and include, therefore, all odd squares. Suppose, now, two squares are given, one consisting of sixteen and the other of nine unit squares, and that it is proposed to form from them another square. It is evident that the square consisting of nine unit squares can take the form of the fourth gnomon, which, being placed round the former square, will generate a new square containing twenty-five unit squares. Similarly it may have been observed that the twelfth gnomon, consisting of twenty-five unit squares, could be transformed into a square each of whose sides contains five units, and thus it may have been seen conversely that the latter square, by taking the gnomonic or generating form with respect to the square on twelve units as base, would produce the square of thirteen units, and so on. This method required only to be generalized in order to enable Pythagoras to arrive at his rule for finding right-angled triangles whose sides can be expressed in numbers, which, we are told, sets out from the odd numbers. The *n*th square together with the *n*th gnomon forms the $(n+1)$th square; if the *n*th gnomon contains m^2 unit squares, m being an *odd* number, we have $2n+1=m^2, \therefore n=\frac{1}{2}(m^2-1)$, which gives the rule of Pythagoras.

The general proof of Euclid I. 47 is attributed to Pythagoras, but we have the express statement of Proclus (*op. cit.* p. 426) that this theorem was not proved in the first instance as it is in the *Elements*. The following simple and natural way of arriving at the theorem is suggested by Bretschneider after Camerer.[10] A square can be dissected into the sum of two squares and two equal rectangles, as in Euclid II. 4; these two rectangles can, by drawing their diagonals, be decomposed into four equal right-angled triangles, the sum of the sides of each being equal to the side of the square; again, these four right-angled triangles can be placed so that a vertex of each shall be in one of the corners of the square in such a way that a greater and less side are in continuation. The original square is thus dissected into the four triangles as before and the figure within, which is the square on the hypotenuse. This square, therefore, must be equal to the sum of the squares on the sides of the right-angled triangle.

It is well known that the Pythagoreans were much occupied with the construction of regular polygons and solids, which in their cosmology played an essential part as the fundamental forms of the elements of the universe. We can trace the origin of these mathematical speculations in the theorem (3) that "the plane around a point is completely filled by six equilateral triangles, four squares, or three regular hexagons." Plato also makes the Pythagorean Timaeus explain—"Each straight-lined figure consists of triangles, but all triangles can be dissected into rectangular ones which are either isosceles or scalene. Among the latter the most beautiful is that out of the doubling of which an equilateral arises, or in which the square of the greater perpendicular is three times that of the smaller, or in which the smaller perpendicular is half the hypotenuse. But two or four right-angled isosceles triangles, properly put together, form the square; two or six of the most beautiful scalene right-angled triangles form the equilateral triangle; and out of these two figures arise the solids which correspond with the four elements of the real world, the tetrahedron, octahedron, icosahedron and the cube"[11] (*Timaeus*, 53, 54, 55). The construction of the regular solids is distinctly ascribed to Pythagoras himself by Eudemus (8). Of these five

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him as a symbol of health. It is said to have obtained its special name from the letters υ, γ ι, θ (=ει), α having been written at its prominent vertices.

[1] *De arch.* ix.; Praef. 5, 6, 7. Amongst other authorities are Diogenes Laërtius (viii. 11), Proclus (*op. cit.*, p. 426), and Plutarch (*ut supra*, 6). Plutarch, however, attributes to the Egyptians the knowledge of this theorem in the particular case where the sides are 3, 4, and 5 (*De Is. et Osir.* c. 56).

[2] Heron Alex. *Geom. et stereom. rel.*, ed. F. Hultsch, pp. 56, 146; Procl. *op. cit.* p. 428. The method of Pythagoras is as follows: he took an odd number as the lesser side; then, having squared this number and diminished the square by unity, he took half the remainder as the greater side, and by adding unity to this number he obtained the hypotenuse, *e.g.* 3, 4, 5; 5, 12, 13.

[3] Nicom. Ger. *Introd. Ar.* c. xxii.

[4] *In Nicomachi arithmeticam*, ed. S. Tennulius, p. 141.

[5] *Op. cit.* p. 168. As an example of this proportion Nicomachus and, after him, Iamblichus give the numbers 6, 8, 9, 12, the harmonical and arithmetical means between two numbers forming a geometric proportion with the numbers themselves $\left(a:\frac{2ab}{a+b}::\frac{a+b}{2}:b\right)$. Iamblichus further relates (*loc. cit.*) that many Pythagoreans made use of this proportion, as Aristaeus of Crotona, Timaeus of Locri, Philolaus and Archytas of Tarentum and many others, and after them Plato in his *Timaeus* (see Nicom. *Inst. arithm.*, ed. Ast, p. 153, and *Animadversiones*, pp. 327–329; and Iambl. *op. cit.* p. 172 seq.).

[6] Βίων πρᾶσις, 4, i. 317, ed. C. Jacobitz.

[7] Γνώμων means that by which anything is known or "criterion"; its oldest concrete signification seems to be the carpenter's square (*norma*) by which a right angle is known. Hence it came to denote a perpendicular, of which, indeed, it was the archaic name (Proclus, *op. cit.* p. 283). Gnomon is also an instrument for measuring altitudes, by means of which the meridian can be found; it denotes, further, the index or style of a sundial, the shadow of which points out the hours. In geometry it means the square or rectangle about the diagonal of a square or rectangle, together with the two complements, on account of the resemblance of the figure to a carpenter's square; and then, more generally, the similar figure with regard to any parallelogram, as defined by Euclid II. def. 2. Again, in a still more general signification, it means the figure which, being added to any figure, preserves the original form. See Heron, *Definitiones* (59). When gnomons are added successively in this manner to a square monad, the first gnomon may be regarded as that consisting of three square monads, and is indeed the constituent of a simple Greek fret; the second of five square monads, &c.; hence we have the gnomonic numbers.

[8] Diag. Laërt. *De vit Pyth.* viii. 19.

[9] Simplicius, *In Aristotelis physicorum libros quattuor priores commentaria*, ed. H. Diels, p. 60.

[10] See Bretsch. *Die Geom. vor Euklides*, p. 82; Camerer, *Euclidis elem.* i. 444, and the references given there.

[11] The dodecahedron was assigned to the fifth element, *quinta pars*, *aether*, or, as some think, to the universe. (See PHILOLAUS.)

solids three—the tetrahedron, the cube and the octahedron—were known to the Egyptians and are to be found in their architecture. Let us now examine what is required for the construction of the other two solids—the icosahedron and the dodecahedron. In the formation of the tetrahedron three, and in that of the octahedron four, equal equilateral triangles had been placed with a common vertex and adjacent sides coincident; and it was known that if six such triangles were placed round a common vertex with their adjacent sides coincident, they would lie in a plane, and that, therefore, no solid could be formed in that manner from them. It remained, then, to try whether five such equilateral triangles could be placed at a common vertex in like manner; on trial it would be found that they could be so placed, and that their bases would form a regular pentagon. The existence of a regular pentagon would thus become known. It was also known from the formation of the cube that three squares could be placed in a similar way with a common vertex; and that, further, if three equal and regular hexagons were placed round a point as common vertex with adjacent sides coincident, they would form a plane. It remained in this case, too, only to try whether three equal regular pentagons could be placed with a common vertex and in a similar way; this on trial would be found possible and would lead to the construction of the regular dodecahedron, which was the regular solid last arrived at.

We see that the construction of the regular pentagon is required for the formation of each of these two regular solids, and that, therefore, it must have been a discovery of Pythagoras. If we examine now what knowledge of geometry was required for the solution of this problem, we shall see that it depends on Euclid IV. 10, which is reduced to Euclid II. 11, which problem is reduced to the following: To produce a given straight line so that the rectangle under the whole line thus produced and the produced part shall be equal to the square on the given line, or, in the language of the ancients, To apply to a given straight line a rectangle which shall be equal to a given area—in this case the square on the given line—and which shall be *excessive* by a square. Now it is to be observed that the problem is solved in this manner by Euclid (VI. 30, 1st method), and that we know on the authority of Eudemus that the problems concerning the *application* of areas and their *excess* and *defect* are old, and inventions of the Pythagoreans (5). Hence the statements of Iamblichus concerning Hippasus (9)—that he divulged the sphere with the twelve pentagons—and of Lucian and the scholiast on Aristophanes (10)—that the pentagram was used as a symbol of recognition amongst the Pythagoreans—become of greater importance.

Further, the discovery of irrational magnitudes is ascribed to Pythagoras by Eudemus (13), and this discovery has been ever regarded as one of the greatest of antiquity. It is commonly assumed that Pythagoras was led to this theory from the consideration of the isosceles right-angled triangle. It seems to the present writer, however, more probable that the discovery of incommensurable magnitudes was rather owing to the problem: To cut a line in extreme and mean ratio. From the solution of this problem it follows at once that, if on the greater segment of a line so cut a part be taken equal to the less, the greater segment, regarded as a new line, will be cut in a similar manner; and this process can be continued without end. On the other hand, if a similar method be adopted in the case of any two lines which can be represented numerically, the process would end. Hence would arise the distinction between commensurable and incommensurable quantities. A reference to Euclid X. 2 will show that the method above is the one used to prove that two magnitudes are incommensurable; and in Euclid X. 3 it will be seen that the greatest common measure of two commensurable magnitudes is found by this process of continued subtraction. It seems probable that Pythagoras, to whom is attributed one of the rules for representing the sides of right-angled triangles in numbers, tried to find the sides of an isosceles right-angled triangle numerically, and that, failing in the attempt, he suspected that the hypotenuse and a side had no common measure. He may have demonstrated the incommensurability of the side of a square and its diagonal. The nature of the old proof—which consisted of a *reductio ad absurdum*, showing that, if the diagonal be commensurable with the side, it would follow that the same number would be odd and even[1]—makes it more probable, however, that this was accomplished by his successors. The existence of the irrational as well as that of the regular dodecahedron appears to have been regarded by the school as one of their chief discoveries, and to have been preserved as a secret; it is remarkable, too, that a story similar to that told by Iamblichus of Hippasus is narrated of the person who first published the idea of the irrational, viz. that he suffered shipwreck, &c.[2]

Eudemus ascribes the problems concerning the application of figures to the Pythagoreans. The simplest cases of the problems, Euclid VI. 28, 29—those, viz. in which the given parallelogram is a square—correspond to the problem: To cut a given straight line internally or externally so that the rectangle under the segments shall be equal to a given rectilineal figure. The solution of this problem—in which the solution of a quadratic equation is implicitly contained—depends on the problem, Euclid II. 14, and the theorems, Euclid II. 5 and 6, together with the theorem of Pythagoras. It is probable that the finding of a mean proportional between two given lines, or the construction of a square which shall be equal to a given rectangle, is due to Pythagoras himself. The solution of the more general problem, Euclid VI. 25, is also attributed to him by Plutarch (7). The solution of this problem depends on that of the particular case and on the application of areas; it requires, moreover, a knowledge of the theorems: Similar rectilineal figures are to each other as the squares on their homologous sides (Euclid VI. 20); and, If three lines are in geometrical proportion, the first is to the third as the square on the first is to the square on the second. Now Hippocrates of Chios, about 440 B.C., who was instructed in geometry by the Pythagoreans, possessed this knowledge. We are justified, therefore, in ascribing the solution of the general problem, if not (with Plutarch) to Pythagoras, at least to his early successors.

The theorem that similar polygons are to each other in the duplicate ratio of their homologous sides involves a first sketch, at least, of the doctrine of proportion and the similarity of figures.[3] That we owe the foundation and development of the doctrine of proportion to Pythagoras and his school is confirmed by the testimony of Nicomachus (14) and Iamblichus (15 and 16). From these passages it appears that the early Pythagoreans were acquainted not only with the arithmetical and geometrical means between two magnitudes, but also with their harmonical mean, which was then called "subcontrary." The Pythagoreans were much occupied with the representation of numbers by geometrical figures. These speculations originated with Pythagoras, who was acquainted with the summation of the natural numbers, the odd numbers and the even numbers, all of which are capable of geometrical representation. See the passage in Lucian (17) and the rule for finding Pythagorean triangles (12) and the observations thereon *supra*. On the other hand, there is no evidence to support the statement of Montucla that Pythagoras laid the foundation of the doctrine of *isoperimetry*, by proving that of all figures having the same perimeter the circle is the greatest, and that of all solids having the same surface the sphere is the greatest. We must also deny to Pythagoras and his school a knowledge of the conic sections, and in particular of the quadrature of the parabola, attributed to him by some authors; and we have noticed the misconception which gave rise to this erroneous inference.

Certain conclusions may be drawn from the foregoing examination of the mathematical work of Pythagoras and his school, which enable us to form an estimate of the state of geometry about 480 B.C. First, as to *matter*. It forms the bulk of the first two books of Euclid, and includes a sketch of the doctrine of proportion—which was probably limited to commensurable magnitudes—together with some of the contents of the sixth book. It contains, too, the discovery of the irrational (ἄλογον) and the construction of the regular solids, the latter requiring the description of certain regular polygons—the foundation, in fact, of the fourth book of Euclid. Secondly, as to *form*. The Pythagoreans first severed geometry from the needs of practical life, and treated it as a liberal science, giving definitions and introducing the manner of proof which has ever since been in use. Further, they distinguished between *discrete* and *continuous* quantities, and regarded geometry as a branch of mathematics, of which they made the fourfold division that lasted to the middle ages—the *quadrivium* (fourfold way to knowledge) of Boetius and the scholastic philosophy. And it may be observed that the name of "mathematics," as well as that of "philosophy," is ascribed to them. Thirdly, as to *method*. One chief characteristic of the mathematical work of Pythagoras was the combination of arithmetic with geometry. The notions of an equation and a proportion—which are common to both, and contain the first germ of algebra—were introduced among the Greeks by Thales. These notions, especially the latter, were elaborated by Pythagoras and his school, so that they reached the rank of a true scientific method in their theory of proportion. To Pythagoras, then, is due the honour of having supplied a method which is common to all branches of mathematics, and in this respect he is fully comparable to Descartes, to whom we owe the decisive combination of algebra with geometry.

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[1] For this proof, see Euclid X. 117; see also Aristot. *Analyt. Pr.* i. c. 23 and c. 44.

[2] Knoche, *Untersuchungen über die neuaufgefundenen Scholien des Proklus Diadochus zu Euclids Elementen*, pp. 20 and 23 (Herford, 1865).

[3] It is agreed on all hands that these two theories were treated at length by Pythagoras and his school. It is almost certain, however, that the theorems arrived at were proved for commensurable magnitudes only, and were assumed to hold good for all. The Pythagoreans themselves seem to have been aware that their proofs were not rigorous, and were open to serious objection; in this we may have the explanation of the secrecy which was attached by them to the idea of the incommensurable and to the pentagram which involved, and indeed represented, that idea. Now it is remarkable that the doctrine of proportion is *twice* treated in the *Elements* of Euclid—first, in a general manner, so as to include incommensurables, in book v., which tradition ascribes to Eudoxus, and then arithmetically in book vii., which, as Hankel has supposed, contains the treatment of the subject by the older Pythagoreans.

See G. J. Allman, *Greek Geometry from Thales to Euclid* (Cambridge, 1889); M. Cantor, *Vorlesungen über Geschichte der Mathematik* (Leipzig, 1894); James Gow, *Short History of Greek Mathematics* (Cambridge, 1884). (G. J. A.)

PYTHAGORAS, of Rhegium, a noted Greek sculptor of the 5th century B.C., a contemporary of Myron and Polyclitus, and their rival in making statues of athletes. He was born at Samos and migrated in his youth to Rhegium in Italy. He made a statue of Philoctetes notable for the physical expression of pain, an Apollo shooting the Python at Delphi, and a man singing to the lyre. He is said to have introduced improvements in the rendering of muscles, veins and hair.

PYTHEAS, of Marseilles (*Massilia*), a celebrated Greek navigator and geographer, from whom the Greeks apparently derived their earliest definite information concerning western Europe, and especially the British Islands. He was probably contemporary with Alexander the Great; he certainly wrote before Dicaearchus, a pupil of Aristotle who died about 285 B.C. His work is lost, and we are left almost wholly in the dark as to its form and character, but the various titles under which it is quoted (*e.g.* Γῆς περίοδος, or Τὰ περὶ τοῦ Ὠκεανοῦ) point to a geographical treatise, in which Pytheas had embodied the results of his observations, rather than to a continuous narrative of his voyage.

Some modern writers have supposed Pytheas to have been sent out, at public expense, in command of an expedition organized by the republic of Massilia; but there is no ancient authority for this, and Polybius, who had unquestionably seen the original work, expressly states that he had undertaken the voyage in a private capacity and with limited means. All that we know concerning the voyage of Pytheas (apart from detached notices) is contained in a brief passage of Polybius, cited by Strabo, in which he tells us that Pytheas, according to his own statement, had not only visited Britain, but had personally explored a large part of it ("travelled all over it on foot," according to one reading of the text in Strabo, bk. iv. ch. i.), and estimated its circumference at more than 40,000 stadia (4000 geographical miles). To this he added the account of Thule (which he placed six days' voyage north of Britain) and the adjoining regions, in which there was no longer any distinction between air, earth and sea, but a kind of mixture of all three, resembling the gelatinous mollusc known as *pulmo marinus*, which rendered all navigation and progress in any other mode alike impossible. This substance Pytheas had himself seen, according to Strabo (bk. iv. ch. i.), but the other phenomena he described only from hearsay. After this he visited "the whole of the coasts of Europe" (*i.e.* those bordering on the ocean) as far as the *Tanais* (Strabo, bk. ii. ch. iv. § 1). This last sentence has led some modern writers to suppose that he made two different voyages; but this is improbable; the expressions of Polybius imply that his explorations in both directions, first towards the north and afterwards towards the east, formed part of the same voyage.

The countries visited, and to a certain extent explored, by Pytheas, were previously unknown to the Greeks—except, perhaps, by vague accounts received through the Phoenicians—and were not visited by any subsequent authority during more than two centuries. Hence some of the later Greek geographers altogether disregarded his statements, and treated his voyage as a fiction. Eratosthenes, indeed (276–196 B.C.), attached great value to his authority as to Britain and Spain, though doubting some of his statements; but Polybius (*c.* 204–122 B.C.) considered the whole work of Pytheas a tissue of fables, like that of Euhemerus concerning Panchaea; and even Strabo, in whose time the western regions of Europe were comparatively well known, adopted to a great extent the view of Polybius.

In modern times a critical examination has arrived at a more favourable judgment, and though Gossellin in his *Recherches sur la géographie des anciens* (iv. 168–180) and Sir G. C. Lewis in his *History of Ancient Astronomy* (pp. 466–481) revived the sceptical view, the tendency of modern critics has been rather to exaggerate than to depreciate the value of what was really added by Pytheas to knowledge. Our information concerning him is so imperfect, and the scanty notices preserved to us from his work are so meagre and discordant, that it is difficult to arrive at anything like a sound conclusion. It may, however, be considered as fairly established that Pytheas made a voyage round the western coasts of Europe, proceeding from Gades, the great Phoenician emporium, and probably the farthest point familiar to the Greeks, round Spain and Gaul to the British Islands, and that he followed the eastern coast of Britain for a considerable distance to the north, obtaining information as to its farther extension in that direction which led him greatly to exaggerate its size. At the same time he heard vaguely of the existence of a large island to the north of it—probably derived from the fact of the Orkneys and Shetlands being really found in that position—to which he gave the name of *Thule.*

The most important statement made by Pytheas in regard to Thule was that connected with the astronomical phenomena affecting the duration of day and night therein. Unfortunately the reports transmitted to us differ so widely that it is almost impossible to determine what Pytheas himself stated. It is, however, probable that the version given in one passage by Pliny (*H.N.* iv. 16, 104) correctly represents his authority. According to this, the days at the summer solstice were twenty-four hours in length, and conversely at the winter solstice the nights were of equal duration. Of course this would be true had Thule been situated under the Arctic Circle, which Pytheas evidently considered it to be, and his skill as an astronomer would lead him to accept as a fact what he knew must be true at some point as a voyager proceeded onwards towards the north.

Still more difficult is it to determine the extent and character of Pytheas's explorations towards the east. The statement that he proceeded along the coasts of Europe "from Gades to the Tanais" is evidently based upon the supposition that this would be a simple and direct course along the northern shores of Germany and Scythia—Polybius himself, in common with the other Greek geographers till a much later period, being ignorant of the projection of the Danish or Cimbric peninsula, and the circumnavigation that it involved—of all which no trace is found in the extant notices of Pytheas. Notwithstanding this, some modern writers have supposed him to have entered the Baltic and penetrated as far as the Vistula (his *Tanais*). The only foundation for this is to be found in the fact that in a passage cited by Pliny (*H. N.* xxxvii. 2, 35) Pytheas is represented as stating that amber was brought from an island called Abalus, distant a day's voyage from the land of the Guttones, a German nation who dwelt on an estuary of the ocean called Mentonomus, 6000 stadia in extent. It was a production thrown up by the waves of the sea, and was used by the inhabitants to burn instead of wood. It has been conjectured that the "estuary" here mentioned refers to the Baltic, the existence of which as a separate sea was unknown to all ancient geographers; but the obscure manner in which it is indicated, as well as the inaccuracy of the statements concerning the place from whence the amber was actually derived, both point to the sort of hearsay accounts which Pytheas might readily have picked up on the shores of the German Ocean, without proceeding farther than the mouth of the Ems, Weser or Elbe, which last is supposed by Ukert to have been the limit of his voyage in this direction. It must be observed also that amber is found in Friesland and on the west coast of Schleswig, as well as in the Baltic, though not in equal abundance.

As to the Cassiterides, or Tin Islands, the exploration of which would naturally be one of the chief objects of Pytheas, he seems to have furnished Timaeus, who wrote less than a century after him, with details upon the same, especially in regard to the commercial centre of Iktis (St Michael's Mount in Cornwall ?), which are preserved by Diodorus. The trade with these regions was probably at this period in Phoenician hands, but we know that at a later time a considerable portion of the supply was carried overland through Gaul to Massilia.

Pytheas certainly had one merit which distinguished him from almost all his contemporaries—he was a good astronomer, and was one of the first who made observations for the determination of latitudes, among others that of his native place Massilia, which he fixed with remarkable accuracy; his result, which was within a few miles of the truth, was adopted by Ptolemy, and became the basis of the Ptolemaic map of the western Mediterranean. His calculations of the length of the longest day at four different points in the neighbourhood of Britain are probably based on native reports. If these figures (16, 17, 18 and 19 hours) are to be pressed, they would refer to, say, Ushant (48° N.), Flamborough Head (54°), Tarbet Ness in Ross (58°) and the northernmost Shetlands (61°). Pytheas was also the first among the Greeks who arrived at any correct notion of the tides, and not only indicated their connexion with the moon, but pointed out their periodical fluctuations in accordance with the phases of that luminary. Other observations concerning the manners and customs of the inhabitants of remote northern regions prove that he had himself really visited them. Among these are the gradual disappearance of various kinds of grain as one advanced towards the north; the use of fermented liquors made from corn and honey; and the habit of threshing out their corn in large covered barns, instead of on open threshing-floors as in Greece and Italy, on account of the want of sun and abundance of rain. Pytheas's notice of the depth of the Bay of Biscay, of the length of the projection of Brittany, of Ushant under the name of *Uxisama*, and of three promontories of Britain, two of which seem to correspond to Land's End (*Belerion*), and North Foreland (*Kantion*), must not be forgotten.

The fragments of Pytheas have been collected by Arvedson (Upsala, 1824), and by Fuhr (*De Pythea massiliensi*, Darmstadt, 1835). Of the numerous treatises and dissertations on the subject, see Ukert, "Bemerkungen über Pytheas," in vol. i. of his *Geog. d. Griechen u. Römer*, pp. 298–309, which contains an excellent summary of all that is known concerning Pytheas; Sir George C. Lewis, *Historical Survey of the Astronomy of the Ancients*, pp. 466–480 (London, 1862); Sir Edward H. Bunbury, *History of Ancient Geography*, vol. i. ch. xv. § 2 (London, 1883); C. I. Elton, *Origins of English History*, cf. especially app. i. pp. 400, &c. (London, 1882); Hugo Berger, *Geschichte der wissenschaftlichen Erdkunde der Griechen*, pt. 3 (2nd ed., Leipzig, 1903). A very elaborate investigation of the whole subject will be found in Müllenhoff, *Deutsche Alterthumskunde*, i. 211–497 (Berlin, 1870). See also Sir Clements Markham's paper, "Pytheas, the Discoverer of Britain," in the *Geographical Journal* (June 1893); and H. F. Tozer, *History of Ancient Geography*, pp. 152–164 (Cambridge, 1897). (E. H. B.; C. R. B.)

PYTHIS, or PYTHIUS, one of the most noted Greek architects of the later age. He cultivated the Ionic style, in which he constructed the temple of Athena at Priene. The dedicatory inscription, which is in the British Museum, records that the founder was Alexander the Great. Pythis also made a great marble quadriga which surmounted the Mausoleum.

PYTHON, in Greek mythology, son of Gaea, an enormous serpent, said to have been produced from the mud after the flood of Deucalion. Its haunt was a cavern near Mt Parnassus. Four days after its birth it was slain by Apollo (Apollodorus i. 4), who was hence surnamed Pythius. According to Ephorus (in Strabo ix. 646), Python, surnamed Dracon (serpent), was a brigand near Delphi. The python in reality represents the pestilential vapours rising from stagnant lakes and pools, which are dispersed by Apollo and his arrows—that is, the shafts of the sun. The old derivation (Homeric *Hymn to Apollo*, 371), according to which Delphi was originally called Pytho, because the slain serpent was left there to "rot" (πύθεσθαι), points to this explanation.

See C. Pascal, *Studii di antichità e mitologia* (1896).

PYTHON, a genus of very large snakes of the family Boidae (see SNAKES) inhabiting the tropical parts of Africa, Asia and Australia. They differ from the true boas (*q.v.*), with which they are often confounded by carrying a few teeth in the premaxilla, by the double row of subcaudal shields and by the possession of a pair of supraorbital bones. Most of them have pits in some of the upper and lower labial shields.

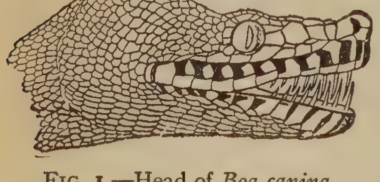


FIG. 1.—Head of *Boa canina.*

Python reticulatus is the commonest species in Indo-China and the Malay Islands; four upper labial shields on either side are pitted. It is, next to the *Anaconda*, one of the largest of all snakes, some specimens being known which measured about 30 ft. in length. *P. molurus*, scarcely smaller, is the python or rock-snake of India and Ceylon. The African species are much smaller, up to 15 ft. in length, e.g. *P. sebae* of tropical and southern Africa and the beautiful *P. regius* of West Africa. *P. spilotes* is the "carpet-snake" of Australia and New Guinea. A small relative of pythons is *Loxocemus bicolor* of South Mexico, the only New World example.

The giant pythons could no doubt overpower and kill by constriction almost any large mammal, since such snakes weigh many hundredweights and possess terrific strength, but the width of their mouth—although marvellously distensible—has, of course, a limit, and this is probably drawn at the size of a goat. Before a python swallows such large prey, its bones are crushed and the body is mangled into the shape of a sausage. The snake begins with the head, and a great quantity of saliva is discharged over the body of the victim as it is hooked into the throat by the alternately right and left forward motions of the distended well-toothed jaws. If for any reason a snake should disgorge its prey, this will be found smothered with slime. Hence the fable that they cover it with saliva before deglutition.

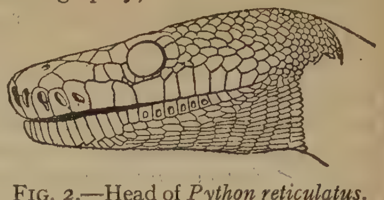


FIG. 2.—Head of *Python reticulatus.*

Most pythons are rather ill-tempered, differing in this respect from the boas. They are chiefly arboreal, and prefer localities in the vicinity of water to which mammals and birds, their usual prey, resort. They move, climb and swim with equal facility. The female collects her eggs, sometimes as many as one hundred, into a heap, round which she coils herself, covering them so that her head rests in the centre on the top. In this position the snake remains without food throughout the whole period of incubation, or rather keeping guard, for about two months. (H. F. G.)

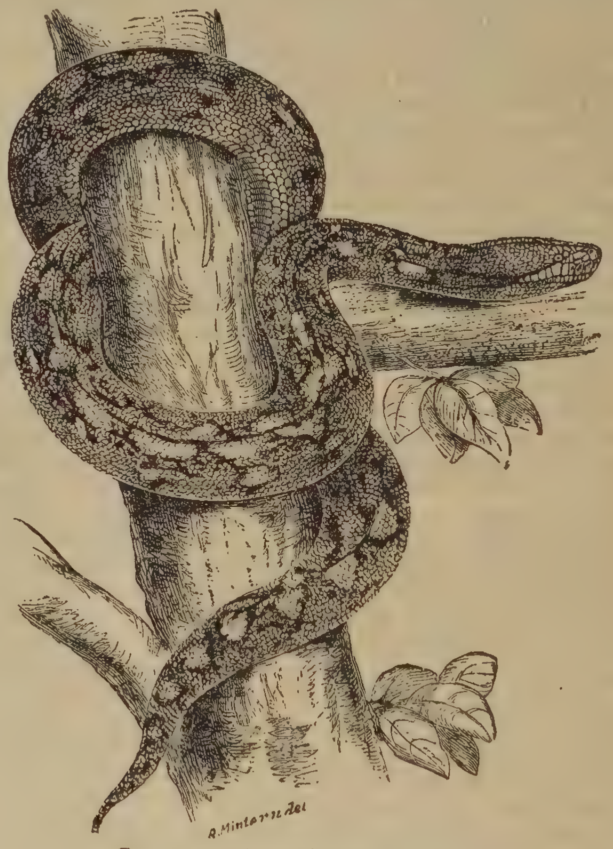
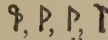


FIG. 3.—*Python reticulatus* (India).

PYX (Gr. πυξίς, a box or chest), a term for various forms of receptacle. In ecclesiastical usage it is the sacred vase or tabernacle in which the Host is reserved. In the English Mint the pyx is the chest in which are placed one coin from every 15 ℔ of newly coined gold and one from every 60 ℔ of newly coined silver to await the "trial of the pyx" (see MINT). This chest was formerly kept in the Chapel of the Pyx in Westminster Abbey.

Q the letter which immediately succeeds P in the alphabet of Latin and the modern languages of western Europe. It represents the Koppa of the earliest Greek alphabets surviving in that form of the Ionic alphabet, which ultimately superseded all others, merely as the numerical symbol for 90. In the Phoenician alphabet a sibilant Zade (Tzaddi) stands between *q* and *p*. Hence Q is the nineteenth letter in the Phoenician alphabet, the eighteenth in the Greek numerical alphabet, which alone contains it, the sixteenth (owing to the omission of *θ* and *ξ*) in the Latin, and (from the addition of J) the seventeenth in the English alphabet. Its earliest form is a rough ellipse transfixed by an upright line, φ. In various Semitic alphabets this has been altered out of recognition, apparently from the writing of the symbol in cursive handwriting without lifting the pen. As a result forms like  are developed. In Greece the head of the symbol is generally circular, and only in a few early inscriptions is the upright carried through the circle, φ. The common form is ϙ with the upright stem short. This is also the earliest form in the Latin alphabet, but forms with the upright turned to the right as in a modern Q are found in the Republican period, while this tail becomes longer and curved in the early Empire. The pronunciation of the Semitic Koph (Qōf) was that of a velar guttural produced against the back part of the soft palate with great energy (hence called an "emphatic" sound). In Greek there is no evidence that ϙ was pronounced differently from K; hence no doubt its early disappearance in most dialects. It survived longest when followed by *o* or *υ*, as at the beginning of the name of the town of Corinth. In Latin it is regularly used in combination with *u*. In classical Latin its use is confined to the cases where, as in English *quill*, &c., the *u* is pronounced as *w* before a following vowel, but in old Latin it is found also in other combinations. Many languages find the combination *qu*, when both sounds are consonantal (*qw*), difficult; *q* being the deepest guttural while *u̯* (English *w*) is a lip sound, the points of production are nearly as far separate as they can be. There is thus a tendency to assimilation, and instead of a guttural followed by a labial semi-vowel, a new labial consonant *p* is produced. In Greek this is common when the combination is followed by the vowel *o*, as in πῶ, ποῖ, &c., from the same stem as the Latin *quō*, *quī*, &c. This, however, is not found in all dialects alike (see GREEK LANGUAGE). In other languages, like Oscan and Umbrian which are closely akin to Latin, or the Welsh branch of the Celtic languages, *p* occurs regularly without regard to the nature of the vowel following. Thus, corresponding to the Latin *quattuor*, we find the Oscan *petora*, the Gaulish *petor-ritum*, "four-wheeler," the Welsh *pedwar*, "four," &c., while the Irish *cethir*, "four," corresponds more closely to the Latin. (P. GI.)

QARAITES, or KARAITES, a Jewish sect of the middle ages, claiming to be distinguished by adherence to Scripture as contrasted with oral tradition, whence the name (from קרא *qara*, to read, as if "readers," *scripturarii*; sometimes also בְּנֵי מִקְרָא "children of the Text" as read). They have frequently been identified with the Sadducees or with the Samaritans, with neither of whom have they any historical connexion or much spiritual affinity. The schism arose at Bagdad about the middle of the 8th century, when the hereditary claims of Anan, a learned Talmudist, to the office of Resh Galutha were set aside by the Gaonim (heads of rabbinical schools) at Sura and Pumbeditha, because he was believed to undervalue the authority of the Talmud. Anan, nevertheless, allowed himself to be proclaimed Exilarch by his followers, a step construed into treason by the Mahommedan government. He was sentenced to death, but his life was saved by his fellow prisoner, Abu Ḥanifa, the founder of the great school of Moslem theology and jurisprudence. Ultimately he and his followers were permitted to migrate to Palestine. They erected a synagogue in Jerusalem which continued to be maintained until the time of the Crusades. From this centre the sect diffused itself thinly over Syria, spread into Egypt, and ultimately reached S.E. Europe.

Anan, who is said to have died in A.D. 765, was the author of a commentary on the Pentateuch and other works in Talmudic Hebrew and Arabic. Most of these are lost, and we are thus left chiefly dependent on the hostile indications of opponents. His code was recovered in Egypt by the Qaraite Moses b. Elijah Bashyazi (1544–1572). Fragments were published by Harkavy (Voskhod 1897–1898). It is clear that Anan, although theoretically antagonistic to rabbinic methods, was in the end compelled to incline towards them. Considerable influence, too, was exercised on his theology by Abu Hanifa. In general we know that he showed great bitterness against the Talmud and its upholders (the "Rabbanites") for their modification of the written law by arbitrary additions and subtractions, but there is nothing to indicate that he himself had the insight or the fervour by which he could have become the pioneer of a really great reformation. The questions appear to have turned entirely on points of minute detail. Several of them related to the regulation of the calendar, the new moon, for example, being fixed by the Qaraites by direct observation, not by astronomical calculation, and the intercalary year also being determined empirically; others related to paschal and pentecostal ritual, such as the precise hour for killing the lamb or for burning its remains. The differences which affected social life most deeply were those relating to Sabbath observance and the forbidden degrees of marriage, the Qaraites not recognizing any distinction between relationships of consanguinity and those of affinity, while in their zeal to avoid all risk of infringement of the sacredness of the day of rest they prohibited the burning of any light at all in their houses from sunset to sunset.

Of late years much Qaraite literature has been published. The most valuable contribution to learning made by it is in the direction of Hebrew philology and the natural exegesis of the scriptural text. Little information as to the Qaraites can be derived from their liturgies; they differ fundamentally from those used by Rabbanites in being composed almost entirely of scriptural versicles and in containing practically no *Piyyutim* (liturgical poems). The controversies as to the rule of faith which so deeply divided the Christian Church in the 16th century gave to this obscure sect an illusory and passing importance, the Catholics frequently hurling the epithet Karaei, in token of contempt, at the Protestants, who in their turn willingly accepted it as sufficiently descriptive of their attitude towards Scripture. The Qaraites never have been numerous; in 1904 their total number was estimated at 12,000, 10,000 being found in Russia: the present community in Jerusalem numbers only a few families. They occur in Constantinople and elsewhere in Turkey, and in Egypt, but are chiefly met with in southern Russia, and especially in the Crimean districts of Eupatoria, Theodosia and Sevastopol. Here their historical capital and chief synagogue was formerly the "Jews' Castle" (*Tshufut-Kale*), near Bakh-chisarai. The place is now deserted; its cemetery was the seat of Firkowitsch's notorious forgeries (inscriptions of 1st century), by which he sought to establish a fabulous antiquity for his sect. According to Strack (*A. Firkowitsch u. seine Entdeckungen*, 1876) the oldest tombstones do not go back beyond the 14th century. The modern Qaraites are generally well spoken of for their honesty, perseverance and simple habits of life; they are gradually approximating to the Rabbanites, with whom, in some places, they are on terms of social intimacy. The Russian government exempts the Qaraites from the restrictions to which the rest of the Jews are subject; this circumstance is probably due to the insignificance of the Qaraites numerically.

Among the older authorities may be mentioned Morinus, *Exercit. Bibl.* lib. ii. ex. 7 (1669); and Triglandius, *Diatribe de Secta Karaeorum*

(1703). See Grätz, *Gesch. der Juden*, especially in vol. v. (1806), with the additions and corrections of Harkavy in the Hebrew translation; and Fürst, *Gesch. des Karäerthums* (1865); S. Pinsker, *Liqquṭe Qadmoniyyot*: articles by A. Harkavy and by S. Poznanski in the *Jewish Quarterly Review* (*e.g.* x. 238–276, and vols. xviii.–xx.). See also *Jewish Encyclopedia, s.v.* “ Anan,” “ Karaites,” &c.
(I. A.)

QARO (or Caro), **JOSEPH BEN EPHRAIM** (1488–1575), codifier of Jewish law, whose code is still authoritative with the mass of Jews, was born in 1488. As a child he shared in the expulsion from Spain (1492), and like most prominent Jews of the period was forced to migrate from place to place. In 1535 he settled in Safed, Palestine, where he spent the rest of his life. Safed was then the headquarters of Jewish mysticism. Qaro was himself a mystic, for the tribulations of the time turned many men’s minds towards Messianic hopes; nor was he by any means the only great Jewish legalist who was also a mystic. Mysticism in such minds did not take the form of a revolt against authority, but was rather the spiritual flower of pietism than an expression of antinomianism. It is, however, as a legalist that Qaro is best known. In learning and critical power he was second only to Maimonides in the realm of Jewish law. He was the author of two great works, the second of which, though inferior as an intellectual feat, has surpassed the first in popularity. This was inevitable, for the earlier and greater book was designed exclusively for specialists. It was in the form of a commentary (entitled *Beth Yoseph*) on the *Turim* (see ’Asher Ben Yeḥiel). In this commentary Qaro shows an astounding mastery over the Talmud and the legalistic literature of the middle ages. He felt called upon to systematize the laws and customs of Judaism in face of the disintegration caused by the Spanish expulsion. But the *Beth Yoseph* is by no means systematic.

Qaro’s real aim was effected by his second work, the *Shulḥan ’Arukh* (“ Table Prepared ”). Finished in 1555, this code was published in four parts in 1565. The work was not accepted without protest and criticism, but after the lapse of a century, and in consequence of certain revisions and amplifications, it became the almost unquestioned authority of the whole Jewish world. Its influence was to some extent evil. It “put Judaism into a strait-jacket.” Independence of judgment was inhibited, and the code stood in the way of progressive adaptation of Jewish life to the life of Europe. It included trivialities by the side of great principles, and retained elements from the past which deserved to fall into oblivion. But its good effects far outweighed the bad. It was a bond of union, a bar to latitudinarianism, an accessible guide to ritual, ethics and law. Above all, it gave a new lease of life to the great theory which identified life with religion. It sanctified the home, it dignified common pursuits. When, however, the era of reform dawned in the 19th century, the new Judaism found itself impelled to assume an attitude of hostility to Qaro’s code.

See Graetz, *Geschichte der Juden*, vol. ix. (English trans. vol. iv.); Ginzberg, in *Jewish Encyclopedia*, arts. “ Caro ” and “ Codification ”; Schechter, *Studies in Judaism*, second series, pp. 202 seq. (I. A.)

QUACK, one who pretends to knowledge of which he is ignorant, a charlatan, particularly a medical impostor. The word is a shortened form of “ quacksalver ” (Du. *kwaksalver*), in which form it is common in the 17th century, “salver ” meaning “ healer,” while “ quack ” (Du. *kwakken*) is merely an application of the onomatopoeic word applied to the sounds made by a duck, *i.e.* gabble or gibberish. In English law, to call a medical practitioner a “ quack ” is actionable *per se* without proof of special damage (*Allen* v. *Eaton* (1630), 1 Roll. Abs. 54). The often-quoted legal definition of a “ quack ” is “ a boastful pretender to medical skill,” but a “ quack ” may have great skill, and it is the claim to cure by remedies which he knows have no efficacy which makes him a “ quack ” (see *Dakhyl* v. *Labouchere*, *The Times*, 29th of July 1904, and 5th and 9th of November 1907).

QUADRATRIX (from Lat. *quadrator*, squarer), in mathematics, a curve having ordinates which are a measure of the area (or quadrature) of another curve. The two most famous curves of this class are those of Dinostratus and E. W. Tschirnhausen, which are both related to the circle.

The quadratrix of Dinostratus was well known to the ancient Greek geometers, and is mentioned by Proclus, who ascribes the invention of the curve to a contemporary of Socrates, probably Hippias of Elis. Dinostratus, a Greek geometer and disciple of Plato, discussed the curve, and showed how it effected a mechanical solution of squaring the circle. Pappus, in his *Collections*, treats of its history, and gives two methods by which it can be generated. (1) Let a spiral line be drawn on a right circular cylinder; a screw surface is then obtained by drawing lines from every point of this spiral perpendicular to its axis. The orthogonal projection of a section of this surface by a plane containing one of the perpendiculars and inclined to the axis is the quadratrix. (2) A right cylinder having for its base an Archimedean spiral is intersected by a right circular cone which has the generating line of the cylinder passing through the initial point of the spiral for its axis. From every point of the curve of intersection, perpendiculars are drawn to the axis. Any plane section of the screw (*plectoidal* of Pappus) surface so obtained is the quadratrix. Another construction is shown in fig. 1. ABC is a quadrant in which the line AB and the arc AC are divided into the same number of equal parts. Radii are drawn from the centre of the quadrant to the points of division of the arc, and these radii are intersected by the lines drawn parallel to BC and through the corresponding points on the radius AB. The locus of these intersections is the quadratrix. A mechanical construction is as follows: Let AMP be a semicircle with centre O (fig. 2). Let PQ be the ordinate of the point P on the circle, and let M be another point on the circle so related to P that the ordinate PQ moves from A to O in the same time as the vector OM describes a quadrant. Then the locus of the intersection of PQ and OM is the quadratrix of Dinostratus.

The cartesian equation to the curve is $y=x\cot\frac{\pi x}{2a}$, which shows that the curve is symmetrical about the axis of y, and that it consists of a central portion flanked by infinite branches (fig. 2). The asymptotes are $x=\pm 2na$, n being an integer. The intercept on the axis of y is $2a/\pi$; therefore, if it were possible to accurately construct the curve, the quadrature of the circle would be effected. The curve also permits the solution of the problems of duplicating a cube (*q.v.*) and trisecting an angle.

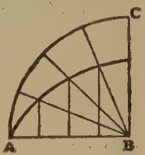


Fig. 1.

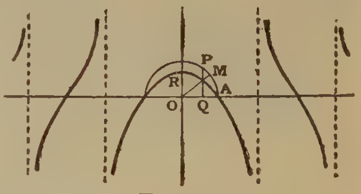


Fig. 2.

The quadratrix of Tschirnhausen is constructed by dividing the arc and radius of a quadrant in the same number of equal parts as before. The mutual intersections of the lines drawn from the points of division of the arc parallel to AB, and the lines drawn parallel to BC through the points of division of AB, are points on the quadratrix (fig. 3). The cartesian equation is $y=a\cos \pi x/2a$. The curve is periodic, and cuts the axis of x at the points $x=\pm(2n-1)a$, n being an integer; the maximum values of y are $\pm a$. Its properties are similar to those of the quadratrix of Dinostratus.

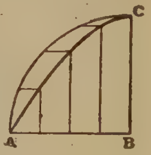


Fig. 3.

QUADRATURE (from Lat. *quadratura*, a making square), in astronomy, that aspect of a heavenly body in which it makes a right angle with the direction of the sun; applied especially to the apparent position of a planet, or of the moon at first and last quarters. In mathematics, quadrature is the determination of a square equal to the area of a curve or other figure.

QUADRIGA, the ancient four-horsed chariot (Lat. *quadrigae*, contracted from *quadrijugae*), which was regarded as one of the seven sacred features in Rome. It was chiefly used as the triumphal car of generals or emperors. The earliest example mentioned is that which was modelled in terra-cotta and raised on the pediment of the temple of Jupiter Capitolinus. In later time it formed the chief decorative feature which crowned the triumphal arches, and there are numerous representations of it on coins.

QUADRILATERAL, in geometry, a figure enclosed by four straight lines. It is also a military term applied to a combination of four fortresses mutually supporting one another. The fortresses of Namur, Liége, Maastricht, and Louvain, and also those of Silistria, Rustchuk, Shumla, and Varna, were so called. But the most famous quadrilateral was that of the four fortified towns of north Italy—Mantua, Peschiera, Verona, and Legnago, the two former of which are situated on the Mincio and the two latter on the Adige. The real value of the quadrilateral, which gave Austria such a firm hold on Lombardy, lay in the great natural strength of Mantua and in the readiness with which troops and supplies could be poured into Verona from the north.

QUADRILLE, the name of a game of cards and of a dance. The game, played by four persons with a pack of forty cards, was a variation of the Spanish game of ombre (*q.v.*) and superseded it in popularity about 1725, to give way in turn to whist. The dance is of French origin and is usually danced by four couples in square. In the 18th century the *contredanse* was introduced into the ballet, and groups of four, eight or twelve dancers dressed alike performed different figures; these were first called *quadrilles des contredanses*, later shortened to *quadrilles*. The dance became popular outside the ballet, and its figures, five in number, with a finale, bore the names of the different *contredanses, Le Pantalon, l'Été, La Poule, La Trénitz, La Pastourelle*. The dance was introduced into England in 1815. The word in both its applications comes through Ital. *quadriglio* or Span. *cuadrilla* from Lat. *quadra*, a square, four-sided figure (*quattuor*, four).

QUADROON (a corruption of *quarteroon*, Span. *cuarteron*, from *cuarto*, Lat. *quartus*, fourth), strictly a person having one-fourth negro blood, the offspring of a mulatto and a white. The children of a mulatto and a negro are called in America *zambos* or *sambos* (possibly from Span. *zambro*, Lat. *scambus*, bow-legged), and the use of Sambo as a proper name for a black servant may have thus originated.

QUAESTOR (from Lat. *quaero*, investigate), a Roman magistrate whose functions, at least in the later times of the republic, were mainly financial, though he was originally concerned chiefly with criminal jurisdiction. The origin of the quaestorship is obscure, but it was probably instituted simultaneously with the consulship in 509 B.C.[1] The number of the quaestors was originally two, but this was successively increased to four (in 421 B.C.), eight (in 267 or 241 B.C.), and by Sulla (in 81 B.C.) to twenty. Julius Caesar raised the number to forty (in 45 B.C.), but Augustus reduced it again to twenty, which remained the regular number under the empire. The original quaestors were afterwards distinguished by the title of urban quaestors (*quaestores urbani*). When the number was raised from two to four in 421 B.C. the office was thrown open to the plebeians. It was the lowest of the great offices of state and hence it was regularly the first sought by aspirants to a political career (*cursus honorum*). Towards the close of the republic, if not earlier, the successful candidate was bound to have completed his thirtieth year before he entered on office, but Augustus lowered the age to twenty-five. Originally the quaestors seem to have been nominated by the consuls, but later, perhaps from the fall of the decemvirs (449 B.C.), they were elected by the people assembled in tribes (*comitia tributa*) under the presidency of a consul or another of the higher magistrates. The quaestors held office for one year, but, like the consuls and praetors, they were often continued in office with the title of proquaestor. Indeed it was a rule that the quaestor attached to a higher magistrate should hold office as long as his superior; hence, when a consul regularly presided over the city for one year, and afterwards as proconsul governed a province for another year, his quaestor also regularly held office for two years. Before the election of the quaestors the senate decided the duties to be undertaken by them, and after election these duties were distributed amongst the new quaestors either by lot or by the choice of the higher magistrates to whom quaestors were assigned. A peculiar burden laid on the quaestors, not as an official duty, but rather as a sort of fee exacted from all who entered on the political career, was the paving of the high roads, for which Claudius substituted the exhibition of gladiatorial games. Various classes of quaestors may be distinguished according to the duties they had respectively to discharge.

1. *The Urban Quaestors.*—Originally the duties of the quaestors, like those of the consuls, were undefined; the consuls were the superior magistrates of the republic, the quaestors their assistants. From a very early time, however, the quaestors possessed criminal jurisdiction. In the code of the Twelve Tables they are designated *quaestores parricidii*, "inquisitors of parricide or murder";[2] and perhaps originally this was their full title, which was afterwards abbreviated into quaestors when their functions as criminal judges fell into the background. In addition to parricide or murder we can hardly doubt that all other crimes fell within the jurisdiction of the quaestors; political crimes only seem to have been excepted. The criminal jurisdiction of the quaestors appears only to have terminated when towards the close of the republic trial by permanent courts (*quaestiones perpetuae*) was extended to criminal cases.[3]

The quaestors had also charge of the public treasury (*aerarium*) in the temple of Saturn, and this was in the later times of the republic their most important function. They kept the keys of the treasury and had charge of its contents, including not only coin and bullion but also the military standards and a large number of public documents, which in later times comprised all the laws as well as the decrees of the senate. Their functions as keepers of the treasury were withdrawn from the urban quaestors by Augustus and transferred to other magistrates, but the office itself continued to exist into the 3rd century, though as to the nature of the duties attached to it we have little or no information.

2. *The Military Quaestors.*—These were instituted in 421 B.C., when two new quaestors were added to the original two. They never had a distinctive appellation like that of the urban quaestors, from whom however, they were clearly distinguished by the fact that, while the urban quaestors did not stand in a special relation of subordination to any particular magistrate, a non-urban quaestor was regularly assigned as an indispensable assistant or adjutant to every general in command, whose name or title the quaestor usually added to his own.[4] Originally they were the adjutants of the consuls only, afterwards of the provincial praetors, and still later of the proconsuls and propraetors. The dictator alone among military commanders had no quaestor, because a quaestor would have been a limitation to his powers. The governor of Sicily had two quaestors; all other governors and commanders had but one. Between the quaestor and his superior a close personal relation, analogous to that between a son and his father, existed, and was not severed when their official connexion ceased. Not till the close of the republic do cases occur of a quaestor being sent to a province invested with praetorial and even consular powers; in one case at least the quaestor so sent had a second quaestor placed under him. The duties of the military quaestor, like those of the treasury quaestor, were primarily financial. Moneys due to a provincial governor from the state treasury were often, perhaps regularly, received and disbursed by the quaestor; the magazines seem to have been under his charge; he coined money, on which not unfrequently his name appears alone. The booty taken in war was not necessarily under the control of the quaestor, but was dealt with, especially in later times, by inferior officers called *praefecti fabrum*. But, though his duties were primarily financial, the quaestor was after all the chief assistant or adjutant of his superior in command, and as such he was invested with a certain degree of military power; under the republic his military rank was superior to that of the legates, though under the empire this relation was reversed. When the general left his province before the arrival of his successor he usually committed it to the care of his quaestor, and, if he died or was incapacitated from naming his successor, the quaestor acted as his representative. Unlike the urban quaestor, the military quaestor possessed not a criminal but a civil jurisdiction corresponding to that of the aediles at Rome.

3. *The Italian Quaestors.*—The subjugation of Italy occasioned the institution (in 267 B.C.) of four new quaestors, who appear to have been called *quaestores classici* because they were originally intended to superintend the building of the fleet (*classis*); their functions, however, are very imperfectly known. Though no doubt intended to assist the consuls, they were not subordinated (like the military quaestors) to a special consul. They were stationed at Ostia, at Cales in Campania, and in Gaul about the Padus (Po). The station of the fourth is not mentioned; perhaps it was Lilybaeum in Sicily.

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[1] Plutarch (*Popl.* 12) states that the office was instituted by the first consul. Tacitus, on the other hand (*Ann.* xi. 22), says that it dated from the time of the kings, but his ground is merely that they were mentioned in the *Lex Curiata* of the consul Brutus, which Tacitus assumes to have been identical with that of the kings.

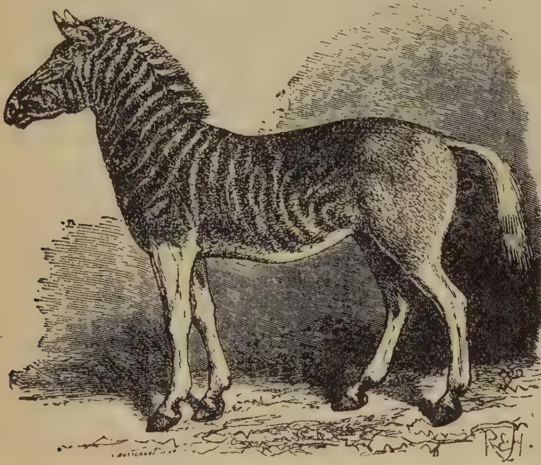
[2] The etymology and original meaning of *parricidium* are doubtful. In the latter part of the word we have, of course, the same root as in *caedere*, "to kill," but whether or not the former part is from *pater*, "a father," or from the same root that we have in *per-peram*, *per-jurium*, is a moot point. Mommsen takes the latter view.

[3] It is often supposed that the *quaestores parricidii* were an old magistracy quite distinct from the ordinary quaestors. For the identification of the two, see Mommsen, *Römisches Staatsrecht*, ii. pt. 1, p. 506.

[4] Thus Cicero speaks of the *provincia consularis* of the quaestor, and we find *quaestor Cn. Pompei*, &c.

Literature.—For a fuller treatment of all these points see Mommsen, *Staatsrecht*, ii. p. 523 foll.; for the existence of the quaestorship under the monarchy, and a different view of the second station of the Italian quaestors, see A. H. J. Greenidge, *Roman Public Life*, pp. 63, 215.

QUAGGA, or Couagga, an animal of the genus *Equus* (see Horse), nearly allied to Burchell's zebra, formerly met with in vast herds on the great plains of South Africa between the Cape Colony and the Vaal river, but now completely extinct. Generally speaking, the colour of the head, neck, and upper-parts of the body was reddish-brown, irregularly banded and marked with dark brown stripes, stronger on the head and neck and gradually becoming fainter until lost behind the shoulder. There is a broad dark median dorsal stripe. The under surface of the body, the legs, and tail are nearly white, without stripes. The crest is very high, surmounted by a standing mane, banded alternately brown and white. It is, however, not improbable that there were two or more local races, for which separate names have been proposed. Though never really domesticated, quaggas have occasionally been trained to harness. The accompanying illustration is reduced from a painting made from one of two which were driven in Hyde Park by Mr. Sheriff Parkins in the early part of the 19th century. The name is an imitation of the shrill barking neigh of the animal, "oug-ga, oug-ga," the last syllable very much prolonged; it is also commonly applied to the bonnte-quagga, or Burchell's zebra (see Horse and Zebra).



The Quagga (*Equus quagga*).

QUAGMIRE, a bog or marsh, a piece of ground so saturated with water that it cannot support any weight. The word is composed of "quag" or "quake" (O.E. *cwacian*; cf. "quaver," "quiver") and "mire," mud (Icel. *myri*, Swed. *myr*).

Skeat suggests that quag may be connected with the root seen in "quick," and quotes (*Etym. Dict.* 1898) *Piers Plowman*, c. xxi. 64, of an earthquake, the earth "quook as it quyke were," *i.e.* shook as if it were alive.

QUAICH, or Quaigh, a form of Scottish drinking vessel. The word is an adaptation of the Gaelic *cuach*, cup, bowl; cf. Welsh *cawg*, and is usually referred to the Gr. *καῦκος*, *καῦκα*, through Lat. *caucus*. In the 18th century it is sometimes spelled "quaff," and a connexion has been suggested with "quaff," to drink with a large or at a single draught; the *New English Dictionary*, however, considers this doubtful. The "quaich" was doubtless inspired by the low silver bowls with two flat handles, frequently used as bleeding vessels in England and Holland in the 17th century. The earliest quaichs were made of a solid block of wood, or of small staves of wood, often of different colours, supported by hoops, like barrels. They are generally fitted with two, and, more rarely, three short projecting handles. In addition to wood, they are made of stone, brass, pewter, horn, and of silver. The latter were often engraved with lines and bands in imitation of the staves and hoops of the wooden quaichs. The origin of these vessels in Scotland is traced to the Highlands; it was not until the end of the 17th century that they became popular in such large centres as Edinburgh and Glasgow. The silversmiths of such local gilds as Inverness and Perth frequently mounted them in silver, as may be seen from the hall-marks on the existing examples. They are found, of silver and pewter, in use as communion cups in various parts of Scotland; four, with the Edinburgh hall-mark for 1722, belong to Ayr parish church; and a large one with the same hall-mark for 1663–1684 is used as an alms-dish at Alvah, Banffshire. The loving cup at Donaldson's hospital, Edinburgh, is a large silver quaich, with the Edinburgh stamp for 1724, which belonged to the founder of that hospital. The finest collection of these vessels is in the possession of the marquess of Breadalbane. (E. A. J.)

QUAIL (O. Fr. *Quaille*, Mod. Fr. *Caille*, Ital. *Quaglia*, Low Lat. *Quaquila*, Du. *Kwakkel* and *Kwartel*, Ger. *Wachtel*, Dan. *Vagtel*), a well-known bird throughout almost all countries of Europe, Asia and Africa— in modern ornithology the *Coturnix communis* or *C. dactylisonans*. This last epithet was given from the peculiar three-syllabled call-note of the cock, which has been grotesquely rendered in several European languages, and in some parts of Great Britain the species is popularly known by the nickname of "wet-my-lips" or "wet-my-feet." The quail varies somewhat in colour, and the variation is rather individual than attributable to local causes; but generally the plumage may be described as reddish-brown above, almost each feather being transversely patched with dark brown interrupted by a longitudinal stripe of light buff; the head is dark brown above, with three longitudinal streaks of ochreous-white; the sides of the breast and flanks are reddish-brown, distinctly striped with ochreous-white; the rest of the lower parts are pale buff, clouded with a darker shade, and passing into white on the belly. The cock, besides being generally brighter in tint, not unfrequently has the chin and a double-throat band of reddish or blackish-brown, which marks are wanting in the hen, whose breast is usually spotted. Quails breed on the ground, and lay from nine to fifteen eggs of a yellowish-white, blotched and spotted with dark brown. Though essentially migratory by nature, not a few quails pass the winter in the northern hemisphere and even in Britain, and many more in southern Europe. In March and April they cross the Mediterranean from the south on the way to their breeding homes in large bands, but these are said to be as nothing compared with the enormous flights that emigrate from Europe towards the end of September. During both migrations immense numbers are netted for the market, since they are almost universally esteemed as delicate meat. The flesh of quails caught in spring commonly proves dry and indifferent, but that of those taken in autumn, especially when they have been kept long enough to grow fat, as they quickly do, is excellent. In no part of the British islands at present do quails exist in sufficient numbers to be the especial object of sport. In old days they were taken in England in a net, attracted thereto by means of a quail-call—a simple instrument,[1] the use of which is now wholly neglected—on which their notes are easily imitated. In South Africa and India allied species, *C. delegorguii* and *C. coromandelica*, the latter known as the Rain-Quail, respectively occur, as well as the commoner one, which in Australia and Tasmania is wholly replaced by *C. pectoralis*, the Stubble-Quail of the colonists. In New Zealand another species, *C. novae-zelandiae*, was formerly very abundant in some districts. Some fifteen or perhaps more species of quails, inhabiting the Indian and Australian regions, have been separated, perhaps unnecessarily, to form the genera *Synoecus*, *Perdicula*, *Excalphatoria*, and so forth.

America has some fifty or sixty species of birds which are commonly deemed quails, though by some authors placed in a distinct family or sub-family Odontophorinae.[2] The best known is the Virginian Quail, or Colin, as it is sometimes called—that being, according to Hernandez, its old Mexican name. It is the *Ortyx* (or *Colinus*) *virginianus* of modern ornithology, and has a wide distribution in North America, being called "partridge" in the Southern states, and elsewhere being known by the nickname of "Bob-White," aptly bestowed upon it from a call-note of the cock. Many unsuccessful attempts have been made to introduce this bird to England (as indeed similar trials have been made in the United States with quails from Europe). The beautiful tufted Quail of California, *Lophortyx californica*, has also been tried at large in Europe without success; but it is well established as an aviary bird. A few of the American Quails or Colins roost in trees.

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[1] One is figured in Rowley's *Ornithological Miscellany* (ii. p. 363).

[2] They form the subject of a monograph in folio by J. Gould, published between 1844 and 1850. See also S. D. Judd, *Bulletin 21* of U.S. Dept. of Agriculture (1905); D. G. Elliot, *Game Birds of North America* (1897).

Interesting from many points of view as is the group of birds last mentioned, there is another which, containing a score of species (or perhaps more) often termed Quails or Button-Quails, is of still greater importance in the eyes of the systematist. This is that comprehended by the genus *Turnix*, or *Hemipodius* of some authors, the anatomical structure of which removes it far from the genera *Coturnix*, *Ortyx*, and their allies, and even from any of the normal *Gallinae*. T. H. Huxley regarded it as the representative of a generalized stock from which the *Charadriomorphae* and *Alectoromorphae*, to say nothing of other groups, have sprung. The button-quails are now placed as a separate sub-order, *Turnices*, of the order *Galliformes* (see Bird). One species, *T. sylvatica*, inhabits Barbary and southern Spain, and under the name of Andalucian Hemipode has been included (though on evidence not wholly satisfactory) among British birds as a reputed straggler. The rest are natives of various parts of the Ethiopian, Indian and Australian regions. It is characteristic of the genus *Turnix* to want the hind toe; but the African *Ortyxelus* and the Australian *Pedionomus*, which have been referred to its neighbourhood, have four toes on each foot. (A. N.)

QUAIN, SIR RICHARD, Bart. (1816–1898), Irish physician, was born at Mallow-on-the-Blackwater, Co. Cork, on the 30th of October 1816. He received his early education at Cloyne, and was then apprenticed to a surgeon-apothecary in Limerick. In 1837 he entered University College, London, where he graduated with high honours as M.B. in 1840, and as M.D. (gold medal) in 1842. Six years later he was chosen an assistant-physician to the Brompton Hospital for Diseases of the Chest, and with that institution he retained his connexion until his death, first as full (1855) and subsequently as consulting physician (1875). He became a fellow of the Royal College of Physicians in 1851, and filled almost every post of honour it could offer except the presidency, in the contest for which he was beaten by Sir Andrew Clark in 1888. He became physician-extraordinary to Queen Victoria in 1890, and was created a baronet in the following year. He died in London on the 13th of March 1898. Quain, who was elected a fellow of the Royal Society in 1871, was the author of several memoirs, dealing for the most part with disorders of the heart, but his name will be best remembered by the *Dictionary of Medicine*, the preparation of which occupied him from 1875 to 1882 (2nd edition, 1894; 3rd, 1902). He sat on the Royal Commission on Rinderpest (cattle plague) in 1865. He was a cousin of Jones Quain (1796–1865), the author of *Quain's Elements of Anatomy*, and of Richard Quain (1800–1887), who was president of the Royal College of Surgeons in 1868, and left £75,000 to University College, London, with which the Quain professorships of botany, English language and literature, law, and physics were endowed. A half-brother of the last two, Sir John Richard Quain (1816–1876), was appointed a judge of the Queen's Bench in 1871.

QUAINT (O. Fr. *cointe*, from Lat. *cognitus*, known, probably influenced by association with Lat. *comptus*, neat), an adjective meaning unusual or fanciful, often applied to things with a sense of old-fashioned charm or prettiness. "Queer," which has much the same meaning, is of doubtful etymology, but is generally taken as adapted from Ger. *quer*, crooked.

QUAKERS, originally a cant name applied in derision to the members of the Society of Friends, but now used without any contemptuous significance. It was said to have originated in the saying of Justice Bennet at Derby in 1650, "Tremble (or quake) at the word of the Lord," but it is now certain that it was used as early as 1647, and arose from the physical manifestations of religious emotion characteristic of many of the early Friends. (See Friends, Society of.)

QUANTUM MERUIT (Lat. for "as much as he has deserved"), in the law of contract, originally a form of action on the case, grounded on a promise to pay the plaintiff for work done as much as it was worth. It has been abolished as a special form of action, but the term is still in use where, in cases of special contract, there has been a breach amounting to a discharge by one party before the other party has done all that he was bound to do. In such a case the plaintiff sues for a *quantum meruit* or the value of so much as he has done.

QUARANTINE (Fr. *quarantaine*, a period of forty days[1]), a term originally applied to the old sanitary preventive system of detention of ships and men, unlading of cargo in lazarets, fumigation of susceptible articles, &c., which was practised at seaports on account of the plague, in connexion with the Levantine trade. It is now a thing of the past in the United Kingdom and in the majority of other states. But, in common usage, the same word is applied to the sanitary rules and regulations which are the modern substitutes for quarantine.

The plague was the only disease for which quarantine was practised (not to mention the earlier isolation of lepers, and the attempts to check the invasion of syphilis in northern Europe about 1490) down to the advent of yellow fever in Spain at the beginning of the 19th century, and the arrival of Asiatic cholera in 1831. Venice took the lead in measures to check the spread of plague, having appointed three guardians of the public health in the first years of the Black Death (1348). The next record of preventive measures comes from Reggio in Modena in 1374. The first lazaret was founded by Venice in 1403, on a small island adjoining the city; in 1467 Genoa followed the example of Venice; and in 1476 the old leper hospital of Marseilles was converted into a plague hospital—the great lazaret of that city, perhaps the most complete of its kind, having been founded in 1526 on the island of Pomègue. The practice at all the Mediterranean lazarets was not different from the English procedure in the Levantine and North-African trade. On the approach of cholera in 1831 some new lazarets were set up at western ports, notably a very extensive establishment near Bordeaux, afterwards turned to another use.

The plague had disappeared from England, never to return, for more than thirty years before the practice of quarantine against it was definitely established by an act of Parliament of Queen Anne's reign (1710). The first act was called for, owing to an alarm lest plague should be imported from Poland and the Baltic; the second act of 1721 was due to the disastrous prevalence of plague at Marseilles and other places in Provence; it was renewed in 1733 owing to a fresh outbreak of the malady on the continent of Europe, and again in 1743 owing to the disastrous epidemic at Messina. In 1752 a rigorous quarantine clause was introduced into an act regulating the Levantine trade; and various arbitrary orders were issued during the next twenty years to meet the supposed danger of infection from the Baltic. Although no plague cases ever came to England all those years, the restrictions on traffic became more amd more stringent (following the movements of medical dogma), and in 1788 a very oppressive Quarantine Act was passed, with provisions affecting cargoes in particular. The first year of the 19th century marked the turning-point in quarantine legislation; a parliamentary committee sat on the practice, and a more reasonable act arose on their report. In 1805 there was another new act, and in 1823–24 again an elaborate inquiry followed by an act making the quarantine only at discretion of the privy council, and at the same time recognizing yellow fever "or other highly infectious disorder" as calling for quarantine measures along with plague. The steady approach of cholera in 1831 was the last occasion in England of a thoroughgoing resort to quarantine restrictions. The pestilence invaded every country of Europe despite all efforts to keep it out. In England the experiment of hermetically sealing the ports was not seriously tried when cholera returned in 1849, 1853 and 1865–66. In 1847 the privy council ordered all arrivals with clean bills from the Black Sea and the Levant to be admitted to free pratique, provided there had been no case of plague during the voyage; and therewith the last remnant of the once formidable quarantine practice against plague may be said to have disappeared.

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[1] The strict sense of the term is also preserved in the "widows' quarantine," the right of a widow to remain in the principal house belonging to her husband for forty days after his death.

For a number of years after the passing of the first Quarantine Act (1710) the protective practices in England were of the most haphazard and arbitrary kind. In 1721 two vessels laden with cotton goods, &c., from Cyprus, then a seat of plague, were ordered to be burned with their cargoes, the owners receiving £23,935 as indemnity. By the clause in the Levant Trade Act of 1752 vessels for the United Kingdom with a foul bill (*i.e.* coming from a country where plague existed) had to repair to the lazarets of Malta, Venice, Messina, Leghorn, Genoa or Marseilles, to perform their quarantine or to have their cargoes "sufficiently opened and aired." Since 1741 Stangate Creek (on the Medway) had been made the quarantine station at home; but it would appear from the above clause that it was available only for vessels with clean bills. In 1755 lazarets in the form of floating hulks were established in England for the first time, the cleansing of cargo (particularly by exposure to dews) having been done previously on the ship's deck. There was no medical inspection employed, but the whole routine left to the officers of customs and quarantine. In 1780, when plague was in Poland, even vessels with grain from the Baltic had to lie forty days in quarantine, and unpack and air the sacks; but owing to remonstrances, which came chiefly from Edinburgh and Leith, grain was from that date declared to be a "non-susceptible article." About 1788 an order of council required every ship liable to quarantine, in case of meeting any vessel at sea, or within four leagues of the coast of Great Britain or Ireland, to hoist a yellow flag in the daytime and show a light at the maintopmast head at night, under a penalty of £200. After 1800, ships from plague-countries (or with foul bills) were enabled to perform their quarantine on arrival in the Medway instead of taking a Mediterranean port on the way for that purpose; and about the same time an extensive lazaret was built on Chetney Hill near Chatham at an expense of £170,000, which was almost at once condemned owing to its marshy foundations, and the materials sold for £15,000. The use of floating hulks as lazarets continued as before. In 1800 two ships with hides from Mogador (Morocco) were ordered to be sunk with their cargoes at the Nore, the owners receiving £15,000. About this period it was merchandise that was chiefly suspected: there was a long schedule of "susceptible articles," and these were first exposed on the ship's deck for twenty-one days or less (six days for each instalment of the cargo), and then transported to the lazaret, where they were opened and aired forty days more. The whole detention of the vessel was from sixty to sixty-five days, including the time for reshipment of her cargo. Pilots had to pass fifteen days on board a "convalescent ship." The expenses may be estimated from one or two examples. In 1820 the "Asia," 763 tons, arrived in the Medway with a foul bill from Alexandria, laden with linseed; her freight was £1475 and her quarantine dues £610. The same year the "Pilato," 495 tons, making the same voyage, paid £200 quarantine dues on a freight of £1060. In 1823 the expenses of the quarantine service (at various ports) were £26,090, and the dues paid by shipping (nearly all with clean bills) £22,000. A return for the United Kingdom and colonies in 1849 showed, among other details, that the expenses of the lazaret at Malta for ten years from 1839 to 1848 had been £53,553. From 1846 onwards the establishments in the United Kingdom were gradually reduced, while the last vestige of the British quarantine law was removed by the Public Health Act 1896, which repealed the Quarantine Act 1825 (with dependent clauses of other acts), and transferred from the privy council to the Local Government Board the powers to deal with ships arriving infected with yellow fever or plague, the powers to deal with cholera ships having been already transferred by the Public Health Act of 1875.

The existing British regulations are those of 9th November 1896; they apply to yellow fever, plague and cholera. Officers of the Customs, as well as of Coast Guard and Board of Trade (for signalling), are empowered to take the initial steps. They certify in writing the master of a supposed infected ship, and detain the vessel provisionally for not more than twelve hours, giving notice meanwhile to the port sanitary authority. The medical officer of the port boards the ship and examines every person in it. Every person found infected is certified of the fact, removed to a hospital provided (if his condition allow), and kept under the orders of the medical officer. If the sick cannot be removed, the vessel remains under his orders. Every person suspected (owing to his or her immediate attendance on the sick) may be detained on board forty-eight hours, or removed to the hospital for a like period. All others are free to land on giving the addresses of their destinations to be sent to the respective local authorities, so that the dispersed passengers and crew may be kept individually under observation for a few days. The ship is disinfected, dead bodies buried at sea, infected clothing, bedding, &c., destroyed or disinfected, and bilge-water and water-ballast (subject to exceptions) pumped out at a suitable distance before the ship enters a dock or basin. Mails are subject to no detention. A stricken ship within 3 miles of the shore must fly at the main a yellow and black flag borne quarterly from sunrise to sunset.

International Conventions.—Since 1852 several conferences have been held between delegates of the Powers, with a view to uniform action in keeping out infection from the East and preventing its spread within Europe; all but that of 1897 were occupied with cholera. No result came of those at Paris 1852, Constantinople 1866, Vienna 1874, and Rome 1885, but each of the subsequent ones has been followed by an international convention on the part of nearly one-half of the Powers represented. The general effect has been an abandonment of the high quarantine doctrine of "constructive infection" of a ship as coming from a scheduled port, and an approximation to the principles advocated by Great Britain for many years. The principal States which retain the old system are Spain, Portugal, Turkey, Greece and Russia (the British possessions Gibraltar, Malta and Cyprus being under the same influence). The aim of each international sanitary convention has been to bind the Powers to a uniform minimum of preventive action, with further restrictions permissible to individual States. The minimum is now very nearly the same as the British practice, which has been in turn adapted to continental opinion in the matter of the importation of rags.

The Venice convention of 1892 was on cholera by the Suez Canal route; that of Dresden, 1893, on cholera within European countries; that of Paris, 1894, on cholera by the pilgrim traffic; and that of Venice, in 1897, was in connexion with the outbreak of plague in the East, and the conference met to settle on an international basis the steps to be taken to prevent, if possible, its spread into Europe. One of the first points to be dealt with in 1897 was to settle the incubation period for this disease, and the period to be adopted for administrative purposes. It was admitted that the incubation period was, as a rule, a comparatively short one, namely, of some three or four days. After much discussion ten days was accepted by a very large majority. The principle of notification was unanimously adopted. Each Government is to notify to other Governments the existence of plague within their several jurisdictions, and at the same time state the measures of prevention which are being carried out to prevent its diffusion. The area deemed to be infected is limited to the actual district or village where the disease prevails, and no locality is deemed to be infected merely because of the importation into it of a few cases of plague while there has been no diffusion of the malady. As regards the precautions to be taken on land frontiers, it was decided that during the prevalence of plague every country had the inherent right to close its land frontiers against traffic. As regards the Red Sea, it was decided after discussion that a healthy vessel may pass through the Suez Canal, and continue its voyage in the Mediterranean during the period of incubation of the disease the prevention of which is in question. It was also agreed that vessels passing through the Canal in quarantine might, subject to the use of the electric light, coal in quarantine at Port Said by night as well as by day, and that passengers might embark in quarantine at that port. Infected vessels, if these carry a doctor and are provided with a disinfecting stove, have a right to navigate the Canal in quarantine, subject only to the landing of those who are suffering from plague, and of such persons as have been in actual contact with the sick or with infected articles, together with the disinfection of the infected compartment of the vessel. Passing on to the conclusions dealing with regulations to be imposed "in Europe," the following are the chief points to be noted:—As regards measures to be adopted at ports of arrival, the conclusions of the Dresden convention were as far as practicable adhered to. In the case of healthy vessels, *i.e.* those on board of which there is no illness, though they have sailed from an infected port, it was decided that they should at once have free *pratique*, but at the option of the local authority certain measures of disinfection of soiled articles may be required. For suspected vessels, viz. those on board of which there has been plague, but no fresh case within twelve days, some limited processes of disinfection, &c., as defined, having been complied with, it is recommended that the crew and passengers should be subject to surveillance for a period of ten days from the date of the arrival of the vessel. In the case of infected vessels, viz. those on which plague is actually present, or on which that disease has occurred ten days before arrival, the sick are to be landed and isolated, and the remainder of those on board are to be subjected, at the discretion of the local authority, to "observation" or "surveillance" for a period not exceeding ten days from the date of the occurrence of the last case of plague. In this convention the terms "observation" and "surveillance" are for the first time clearly defined; the definition as to the latter stating that under that system passengers are not to be isolated, but are to be allowed at once to proceed to their homes, where they can remain under medical supervision so long as may be deemed necessary by the local authority. The results of this conference indicated a great advance on the part of the nationalities represented towards a liberal and truly scientific conception of the means to be adopted by their respective Governments for the prevention and control of infective diseases.

LITERATURE.—A quarantine committee of the Social Science Association collected, in 1860–61, valuable consular returns on the practice of quarantine in all parts of the world; these were edited by Milroy and ordered to be printed (with the report and summary) as three parliamentary papers communicated to the board of trade. The third paper (6th August 1861, No. 544) contains, in an appendix, an *Historical Sketch of Quarantine Legislation and Practice in Great Britain*, by Dr Milroy. Russell's *Treatise of the Plague* (4to, London, 1791) contains "remarks on quarantines, lazarettoes, &c.," and an account of the mode of "shutting up" practised by households in Aleppo on the outbreak of plague in the town. The inexpediency of quarantine in the United Kingdom is discussed by John Simon in the eighth *Report of the Medical Officer of the Privy Council* for 1865, p. 35, and also in *Report (Medical) of Local Government Board*, xxiv. 1892–93.

QUARE IMPEDIT, in English law, a form of action by which the right of presentation to a benefice is tried. It is so called from the words of the writ formerly in use, which directed the sheriff to command the person disturbing the possession to permit the plaintiff to present a fit person, or to show cause "why he hinders" the plaintiff in his right. The action was one of the few real actions preserved by the Real Property Limitation Act 1833, and survived up to 1860. The effect of the Common Law Procedure Act 1860, § 26, was to assimilate proceedings in *quare impedit* as far as possible to those in an ordinary action. It is now usually brought against a bishop to try the legality of his refusal to institute a particular clerk. The bishop must fully state upon the pleadings the grounds on which he refuses. *Quare impedit* is peculiarly the remedy of the patron; the remedy of the clerk is the proceeding called *duplex querela* in the ecclesiastical court. The action is not barred till the expiration of sixty years, or of three successive incumbencies adverse to the plaintiff's right, whichever period be the longer (Real Property Limitation Act, 1833, § 29). Where the patron of a benefice is a Roman Catholic, one of the universities presents in his place (1689, 1 Will. & Mary, sess. 1, c. 29). By 13 Anne c. 13 (1714), during the pendency of a *quare impedit* to which either of the universities is a party in right of the patron being a Roman Catholic, the court has power to administer an oath for the discovery of any secret trust, and to order the *cestui que trust* to repeat and subscribe a declaration against transubstantiation. In Scotland the effect of a *quare impedit* is attained by action of declarator. In the United States, owing to the difference of ecclesiastical organization, the action is unknown.

QUARITCH, BERNARD (1819–1899), English bookseller and collector, was born at Worbis, Germany, on the 23rd of April 1819. After being apprenticed to a bookseller, he went to London in 1842, and was employed by Bohn the publisher. In 1847 he started a bookseller's business off Leicester Square, becoming naturalized as a British subject. In 1848 he started to issue a monthly *Catalogue of Foreign and English Books*. About 1858 he began to purchase rare books, one of the earliest of such purchases being a copy of the Mazarine Bible, and within a period of forty years he possessed six separate copies of this rare and valuable edition. In 1860 he removed to Piccadilly. In 1873 he published the *Bibliotheca Xylographica, Typographica et Palaeographica*, a remarkable catalogue of early productions of the printing press of all countries. He became a regular buyer at all the principal book-sales of Europe and America, and from time to time published a variety of other catalogues of old books. Amongst these may be mentioned the *Supplemental Catalogue* (1877), and in 1880 an immense catalogue of considerably over 2000 pages. The last complete catalogue of his stock was published in 1887–88 under the title *General Catalogue of Old Books and Manuscripts*, in seven volumes, increased with subsequent supplements to twelve. All these catalogues are of considerable bibliographical value. By this time Quaritch had developed the largest trade in old books in the world. Among the books that he published was FitzGerald's *Omar Khayyâm*, and he was the agent for the publications of the British Museum and the Society of Antiquaries. He died at Hampstead on the 17th of December 1899, leaving his business to his son.

QUARLES, FRANCIS (1592–1644), English poet, was born at Romford, Essex, and baptized there on the 8th of May 1592. His father, James Quarles, held several places under Elizabeth, and traced his ancestry to a family settled in England before the Conquest. He was entered at Christ's College, Cambridge, in 1608, and subsequently at Lincoln's Inn. He was made cupbearer to the Princess Elizabeth, Electress Palatine, in 1613, remaining abroad for some years; and before 1629 he was appointed secretary to Ussher, the primate of Ireland. About 1633 he returned to England, and spent the next two years in the preparation of his *Emblems*. In 1639 he was made city chronologer, a post in which Ben Jonson and Thomas Middleton had preceded him. At the outbreak of the Civil War he took the Royalist side, drawing up three pamphlets in 1644 in support of the king's cause. It is said that his house was searched and his papers destroyed by the Parliamentarians in consequence of these publications. He died on the 8th of September in that year.

Quarles married in 1618 Ursula Woodgate, by whom he had eighteen children. His son, John Quarles (1624–1665), was exiled to Flanders for his Royalist sympathies and was the author of *Fons Lachrymarum* (1648) and other poems.

The work by which Quarles is best known, the *Emblems*, was originally published in 1635, with grotesque illustrations engraved by William Marshall and others. The forty-five prints in the last three books are borrowed from the *Pia Desideria* (Antwerp, 1624) of Herman Hugo. Each "emblem" consists of a paraphrase from a passage of Scripture, expressed in ornate and metaphorical language, followed by passages from the Christian Fathers, and concluding with an epigram of four lines. The *Emblems* was immensely popular with the vulgar, but the critics of the 17th and 18th centuries had no mercy on Quarles. Sir John Suckling in his *Sessions of the Poets* disrespectfully alluded to him as he "that makes God speak so big in's poetry." Pope in the *Dunciad* spoke of the *Emblems*,

> "Where the pictures for the page atone
> And Quarles is saved by beauties not his own."

The works of Quarles include: *A Feast for Wormes. Set forth in a Poeme of the History of Jonah* (1620), which contains other scriptural paraphrases, besides the one that furnishes the title; *Hadassa; or the History of Queene Ester* (1621); *Job Militant, with Meditations Divine and Morall* (1624); *Sions Elegies, wept by Jeremie the Prophet* (1624); *Sions Sonets sung by Solomon the King* (1624), a paraphrase of the Canticles; *The Historie of Samson* (1631); *Alphabet of Elegies upon . . . Dr Aylmer* (1625); *Argalus and Parthenia* (1629), the subject of which is borrowed from Sir Philip Sidney's *Arcadia;* four books of *Divine Fancies digested into Epigrams, Meditations and Observations* (1632); a reissue of his scriptural paraphrases and the *Alphabet of Elegies* as *Divine Poems* (1633); *Hieroglyphikes* *of the Life of Man* (1638); *Enchyridion, containing Institutions Divine and Moral* (1640–41), a collection of four " centuries " of miscellaneous aphorisms; *Observations concerning Princes and States upon Peace and Warre* (1642), and *Boanerges and Barnabas—Wine and Oyle for . . . afflicted Soules* (1644–46), both of which are collections of miscellaneous reflections; three violent Royalist tracts (1644), *The Loyall Convert, The Whipper Whipt*, and *The New Distemper*, reissued in one volume in 1645 with the title of *The Profest Royalist; his quarrell with the Times*, and some elegies. *Solomon's Recantation* . . . (1645) contains a memoir by his widow. Other posthumous works are *The Shepheards' Oracles* (1646), a second part of *Boanerges and Barnabas* (1646), a broadside entitled *A Direfull Anathema against Peace-haters* (1647), and an interlude, *The Virgin Widow* (1649).

An edition of the *Emblems* (Edinburgh, 1857) was embellished with new illustrations by C. H. Bennett and W. A. Rogers These are reproduced in the complete edition (1874) of Quarles included in the " Chertsey Worthies Library " by Dr A. B. Grosart, who provides an introductory memoir and an appreciation which greatly overestimates Quarles's value as a poet.

QUARREL. (1) (Through Fr. *querelle* from Lat. *querela*, complaint), originally a complaint against a person, particularly a legal accusation or charge, hence a ground or cause for complaint or anger, or, more generally, an outbreak of anger or violent dispute. (2) (Through O. Fr. *quarrel* or *quarel*, from med. Lat. *quadrellus*, diminutive of *quadrus*, square), a heavy short bolt or arrow with a square head, used in a cross-bow or arbalest. In architecture this term (and also the doublet " quarry ") is applied to any square-shaped opening, in the Beauchamp Roll to the quatrefoils in Perpendicular windows, sometimes to squares of paving, but most commonly to the lozenge-shaped pieces of glass in lead casements (see GLASS, STAINED).

QUARRY. (1) (Through Fr. from med. Lat. *quareia* for *quadraria; quadrare*, to square or hew stone), a place from which stones are dug, the term being usually confined to a place where such operation is carried on in the open air, as opposed to a " mine " (see QUARRYING). (2) (Through O. Fr. *cuirée, cuir*, skin, leather, Lat. *corium*; cf. mod. Fr. *curée*, spoils), properly certain parts of a deer or other beast of chase given as a reward to the hounds and placed upon the hide of the animal, also parts of a bird given similarly to a hawk or falcon. The word is thus applied to the animal hunted or the bird killed by the hawk, and generally to any object of the chase.

QUARRYING, the art of winning or obtaining from the earth's crust the various kinds of stone used in construction, the operation being, in most cases, conducted in open workings.

Kinds of stone quarried.

According to their composition, building stones are broadly classed as granites, sandstones, limestones and slates. Under the first of these heads is included a number of crystalline rock species, such as granite, syenite, gneiss, &c., which to the geologist are quite distinct, but which in commerce are all spoken of as granite. They are chiefly composed of one or more minerals of the felspar group mingled with one or more of the micas or with hornblende, and usually contain quartz. Sandstones are chiefly composed of fragments of quartz cemented into solid rock by silica and oxide of iron. Of these there are many varieties, including flagstone used for foot-pavements. Limestones consist principally of carbonate of lime. Their chief variations are the crystalline form known as marble and the deposit from mineral springs known as Mexican onyx. Slates are mudstones or shales hardened by heat and pressure, and rendered fissile by the latter agent. Chemically they consist chiefly of hydrous silicate of alumina. Theoretically, granites are massive, and have no bedding or stratification like sandstones and limestones; but all rock masses are usually found to be more or less shattered by movements of the earth's crust which occur as a result of its constant readjustment to the cooling and shrinking interior, so that the rocks are divided by cracks or fissures, which are commonly known as joints. In the massive granites these joints, which usually occur in two or more planes at right angles to one another, are of the greatest importance to the quarryman, as they enable him to separate masses of stone with approximately parallel faces. In gneisses the parallel arrangement of the minerals usually coincides with a direction of easy cleavage, known to quarrymen as the " rift "; at right angles to this direction is usually one less easy parting, known as the " grain." Sandstones and limestones are stratified rocks which have been formed as sediments in bodies of water; and whether their beds are found in the normal position of horizontality, or whether they have been tilted and folded by earth movements, the direction of easiest separation is coincident with the original planes of sedimentation and parallel to them. This is therefore called the " rift, " while the " grain " is at right angles to it. In gneisses, sandstones and limestones joints also occur; and while frequently convenient for the division of the beds into masses of useful size, they may be a detriment, as when they occur so close together as to fall within the limits of a block available for commercial purposes. In commerce the various kinds of building stone are usually designated by the name of the locality or region in which the quarry is situated. In the case of the more important varieties this geographic name usually conveys to the architect or builder full information concerning the colour, texture and other properties of the material. For example, the names Hallowell or Quincy granite, Medina or Berea sandstone, and Vermont or Tennessee marble, convey in the United States full information to those interested.

Methods employed.

The methods of quarrying vary with the composition and hardness of the rocks, their structure, cleavage, and other physical properties; also with the position and character of the deposits or rock-masses. The general purpose of the work is to separate the material from its bed in masses of form and size adapted to the intended use. Cutting the stone to accurate dimensions, dressing, rubbing and polishing are subsequent operations not involved in quarrying.

The practice of quarrying consists in uncovering a sufficient surface of the rock by removing superficial soil, sand or clay, or by sinking a shaft or slope, and then with proper tools and, when necessary, with explosives, detaching blocks of form and size adapted to the purpose in view. Frequently the outer portion of the rock has been affected by the action of the weather and other atmospheric agencies, so that it has become discoloured or softened by decay. This weathered material must be removed before stone can be obtained for use.

A quarry should, if possible, be opened on a hillside, for in this case it is usually much easier to dispose of the water which necessarily collects in any deep excavation, and which, if drainage by gravity is not afforded, must be removed by pumping, at considerable expense. As it is generally most convenient to operate on a vertical face of rock, the preliminary work of opening a quarry is usually directed toward the production of this result; but its accomplishment involves the waste of a certain amount of stone, which must be broken into irregular and useless pieces. The separation of blocks of building stone is effected ordinarily by drilling holes along the outlines of the block to be removed, and then, by exploding blasting-powder in the holes, or by driving wedges into them, exerting sufficient force to overcome the cohesion of the rock and rend it asunder. In many quarries it is found most convenient to separate a large mass and afterwards divide it into blocks of the required size. When the rock is stratified, or has an easily determined " rift," the holes are drilled at right angles to the plane of separation. When there is no stratification or " rift," or these natural planes of separation are too far apart, or when the position of the joints is not advantageous, a row of horizontal holes must be drilled into the face or " breast " of the quarry, along which separation is effected by the use of wedges. Of late at certain American quarries, in a granite which has no rift or direction of ready cleavage, compressed air has been brought into service to effect the separation of extensive layers. A hole is drilled as deep as the desired thickness of the layer to be separated, and a small charge of dynamite is exploded at the bottom of it. This develops a cavity in which a small charge of powder is next exploded, producing a crack or crevice parallel to the surface of the rock. A pipe for conveying compressed air is now sealed into the opening, and gradually increasing pressure is introduced. This results in the gradual extension of the crevice developed by the explosion of the powder. In the absence of compressed air, water under pressure may be used and also small powder charges exploded at intervals of a few days. In thinly bedded sandstones, where vertical joints are frequent, it is often possible to separate the desired slabs and flagstones with crowbars and wedges, without drilling or the use of explosives. When blasting is necessary, some form of gunpowder is generally used, rather than a violent explosive like dynamite, in order to avoid shattering the rock. This, however, applies only to dimension stone. When the production of broken stone for road-making, concrete, or similar purposes is the sole end in view, violent explosives are preferred. In limestones and marbles and in the softer sandstones, channelling machines, driven by steam, are employed, by which vertical or oblique grooves or channels can be cut with great rapidity to a depth of several feet. A level bed of rock is cleared, and on this are laid rails, along which the machine moves. After the channels are cut, a row of holes is bored perpendicular to the former at the desired distance below the surface of the bed, and by driving wedges into these the required blocks are separated.

Mining stone.

When the beds of stone to be quarried are thin, and when to remove the whole of the overlying mass of earth or rock would be too expensive, it is found convenient to treat the quarry as if it were a mine, and to rely upon methods similar to those practised in mining. A horizontal bed of rock is usually opened at its outcrop on some hillside, or if this is impracticable, as shaft or slope is excavated to reach it. If dimension stone is required, a deep horizontal groove is cut near the top or the bottom of the bed. The quarry face is then divided into blocks by saw-cuts, channels, or rows of drill-holes, and the blocks are separated by wedging or blasting. As the excavation or stoping progresses, portions of the rock are left in place as pillars to support the roof. At many localities in Europe where roofing slate is quarried, it is found in beds dipping more or less from the horizontal. These deposits are worked by stopes which follow the inclination of the bed, from which, at convenient intervals, levels are driven across, to take advantage of the cleavage of the slate. As in other subterranean quarries, pillars of rock are left to support the roof, since artificial supports would be more expensive. At some of the marble quarries in Vermont, U.S.A., where the strata are very nearly vertical, the beds are worked to a great depth with a comparatively small surface opening.

See G. P. Merrill, *Stones for Building and Decoration* (New York, 1898); C. Le N. Foster, *A Text-Book of Ore and Stone Mining* (London and Philadelphia, 1894); O. Herrman, *Steinbruchindustrie und Steinbruchgeologie* (Berlin, 1899). (F. J. H. M.)

QUARTER (through Fr. from Lat. *quartarius*, fourth part), a word with many applications of its original meaning, namely, one of the four divisions of anything; thus as a measure of weight a quarter equals 28 ℔, one-fourth of the hundredweight of 112 ℔; as a measure of capacity for grain it equals 8 bushels; similarly in liquid measure the shorter form "quart" is a quarter of a gallon = 2 pints, so "quartern" is a quarter of a pint (a gill), or, as a measure for bread, 4 ℔. "Quarter" is also used of the fourth part of the moon's monthly revolution, and of a fourth part of the legal year, marked off by the "quarter-days" (see below). For the division of the heraldic shield into four "quarters" and the use of the term "quartering," the marshalling of several coats on one shield, see HERALDRY. From the four principal points of the compass and the corresponding division of the horizon, &c., the word is used generally of direction or situation, and hence of a district in a town, &c., especially when assigned to or occupied by a particular class. It has thus become the usual term applied to stations, buildings, lodgings, &c., in the regular occupation of military troops (see BARRACKS, CAMP, and CANTONMENTS).

There are many technical uses of the word, in which the original meaning has been lost or obscured; thus in carpentry and architecture it is applied to the main upright posts in framing, sometimes called "studs"; the filling in quarters were formerly named "prick posts"; in farriery, to one side of the "coffin" of a horse's foot; in bootmaking, to the side piece of leather reaching from the vamp to the heel. The "quarter" of a ship is the after part of her side from the main-chains to the stern (see QUARTERDECK).

There has been much discussion as to the origin of the use of the word "quarter" in the sense of mercy, clemency, the sparing of the life of a beaten enemy and the acceptance of his surrender. The same use is found in Fr. *quartier*. Cotgrave explains this word as "faire war, wherein souldiers are taken prisoners and ransomed at a certaine rate." The real origin cannot be, as has often been repeated, following De Brieux (*Origines de plusieurs façons de parler*, 1672), that it was due to a supposed agreement between the Dutch and Spaniards for ransoming officers and men at one quarter of their pay. The true source is either the assignment of "quarters," *i.e.* lodgings, to captured prisoners whose lives were spared, or the use of the word, now obsolete, for relations with or conduct towards another, often in the sense of fair treatment; thus in Bacon's *Essay on Cunning*, "two, that were competitors, . . . kept good quarter between themselves."

Quarter days are the days that begin each quarter of the year. In England they are the 25th of March (Lady Day), the 24th of June (Midsummer Day), the 29th of September (Michaelmas Day) and the 25th of December (Christmas Day). They are the days on which it is usually contracted that rents should be paid and houses or lands entered upon or quitted. In Scotland there are two legal terms, the 15th of May (Whitsunday) and the 11th of November (Martinmas); these, together with the two conventional terms, 2nd of February (Candlemas) and the 1st of August (Lammas), make up the Scottish quarter days. In the Scottish burghs, however, the removal terms are the 28th of May and the 28th of November. In the United States the quarter days are, in law, the 1st of January, April, July and October.

QUARTERDECK, the after part of the upper deck of a ship. In former times the upper deck of a line-of-battle ship or frigate ended at the mainmast, and was connected with the forecastle by two narrow passages, or gangways running along the sides. The quarterdeck is the residence and symbol of authority in a warship. The starboard, or right side looking forward, is reserved to the senior officer. A sailor who had a complaint to make was said to come to the mainmast, because he placed himself at the forward end of the quarterdeck near the mast. According to the ancient custom of the sea, the quarterdeck is to be saluted by all who come upon it, and the salute is returned by all officers present.

QUARTER SESSIONS, COURT OF, in English law, the name for the justices of the peace of any county, riding, parts, division or liberty of a county, or of any county of a city or county of a town, in general or quarter sessions assembled; it includes the court of the recorder of a municipal borough having a separate court of quarter sessions. The word "general" in this context is contrasted with "special" or "petty." The court is a local court of record having a limited criminal jurisdiction, and also to some extent civil jurisdiction. As a court of record it has, in addition to its other jurisdiction, power to punish summarily without the assistance of a jury contempts committed in its presence, such as insults to the justices or disturbance of its proceedings. At the present time the whole of England and Wales is within the local jurisdiction of some court of quarter sessions. But the history of the court in counties is quite distinct from its history in boroughs.

Counties.—As regards counties the court originated in statutes of 1326, 1344 and 1360, which provided for justices in counties, and the commission of the peace. The court derived its name from the direction in a statute of 1388 that the "justices shall keep their sessions in every quarter of the year *at the least*." By a statute of 1414 they were directed to make their sessions four times in the year: that is to say, in the first week after the feasts of St Michael, the Epiphany, the clause of Easter and the translation of St Thomas the Martyr, *and more often if need be*.[1] These dates have only been slightly varied, first in 1814 in consequence of the adoption of the Gregorian calendar, later in 1830 by specifying the first week after the 11th of October, 28th of December, 31st of March and 24th of June respectively, instead of the church feasts; and in 1894 by

[1] An earlier statute not repealed (36 Edw. III. c. 12) fixes the third and fourth sessions differently, viz. second week of mid-Lent, and between Whit Sunday and Midsummer Day

giving the justices a limited power of fixing their sessions so as not to clash with the assizes. It will be seen that the statutes do not limit the justices to four sessions a year: and they are free to sit oftener by adjournment of the quarterly sessions to another time, and even to another place, in their county, or to hold additional sessions. All the sessions thus held are "general," though not all may be "quarter" sessions. The Assizes and Quarter Sessions Act 1908 gave the useful power of dispensing with the holding of quarter sessions if there is no business to transact.

Constitution of the Court.—Such a court sits for every judicial county in England, and is composed of two or more of the justices in the commission of the peace for the county, including *ex officio* justices. The quorum of the court is fixed by the commission of the peace at two. At one time certain specified justices described as of the quorum must be present, but under the present commission there are no such persons. In certain counties more than one commission of the peace is issued, *e.g.* for the three ridings of Yorkshire (N. E. and W.) and the liberty of Ripon, the three parts of Lincolnshire (Lindsey, Kesteven and Holland), the isle of Ely and the rest of Cambridgeshire, the soke of Peterborough, and the rest of Northamptonshire.[1] In all counties, &c., except that of London, the justices in the commission elect a chairman and vice-chairman, neither of them necessarily a lawyer, to preside at the sittings of the court. In the county of London there are a paid chairman and deputy chairman, who must be barristers of at least ten years' standing, and are appointed by the crown. There is special legislation as to quarter sessions in the county palatine of Lancaster; and in the Salford Hundred of that county there is a paid chairman. There is also special legislation as to Kent, and arrangements have been made by which in Sussex and Suffolk the quarter sessions for the east and west divisions are virtually distinct courts. Under the Quarter Sessions Act 1858 the court may sit in two divisions of at least two justices at the same time and place, but not simultaneously in separate parts of the same county except under statutory authority as in London.

The court may sit while the assizes for the county are being held, but usually refrains from doing so because of the inconvenience which would be occasioned, and adjusts its sittings so as to avoid clashing with the assizes. The chief officer of the court is the clerk of the peace, who acts as clerk to the court, records its proceedings, calls and swears the juries, draws many of the indictments, receives the bills returned by the grand jury, arraigns the prisoners and taxes the costs. In a county he is appointed by a standing joint-committee of the quarter sessions and the county council, and has charge of, and responsibility for, the records and documents of the county subject to the directions of the custos rotulorum or the quarter sessions or the county council (Local Govt. Act 1888, s. 83).

Boroughs.—The jurisdiction of the court of quarter sessions of a borough does not depend upon the commission of the peace, but upon the Municipal Corporations Act 1882. Many boroughs have a separate commission of the peace (which does not contain the words of the county commission giving jurisdiction to try indictments), but have not received the grant of a separate court of quarter sessions: and such boroughs are within the jurisdiction of the court of quarter sessions for the county within which the borough lies. Before the Municipal Corporations Act 1835, many boroughs had criminal jurisdiction under their charters. Under that act and the act of 1882 a grant of quarter sessions to a city or borough is made by the crown in council on petition of the town council. The recorder, a barrister of not less than five years' standing appointed by the crown, is sole judge of the court, though the mayor can adjourn it in the absence of the recorder; he has a discretion to fix his own dates for the holding of the court, so long as he holds it once in every quarter of a year; and it may be held more frequently if he think fit, or a secretary of state so directs; he has no power to allow, apportion, make or levy a borough rate or to grant a licence for the sale of excisable liquors by retail; a deputy may be appointed by the recorder, or in the event of his being unable to make the appointment by a secretary of state. Subject to these qualifications the court has the same jurisdiction as county quarter sessions.

The city of London is not subject to the Municipal Corporations Act 1882, and its court of quarter sessions is created by the city charters, and is held before the mayor and aldermen with the recorder. It does not now sit to try indictments, which all go to the Central Criminal Court.

There is special legislation as to quarter sessions in the Cinque Ports. In a borough the clerk of the peace is appointed by the town council and holds office during good behaviour (Municipal Corporations Act 1882, s. 164).

Criminal Jurisdiction, Original.—Courts of quarter sessions in counties and boroughs have both original and appellate jurisdiction depending on the commission of the peace and on legislation beginning in 1344. This jurisdiction is derived in counties from the commission of the peace, which directs the justices "to inquire the truth more fully by the oath of good and lawful men of the county, by whom the truth of the matter shall be better known of all manner of crimes, trespasses, and all and singular other offences of which the justices of our peace may or ought lawfully to inquire," "and to hear and determine all and singular the crimes, trespasses and offences aforesaid" "according to the laws and statutes of our realm." "Provided always that if a case of difficulty upon the determination of any of the premises before you shall happen to arise then let judgment in no wise be given" "unless in the presence of one of the justices of assize for the county." This proviso has been read as requiring the justices to reserve the graver felonies for trial at the assizes, or to transmit to assizes indictments found at quarter sessions which raised difficult questions. Quarter sessions never dealt with forgery or perjury, but at one time assumed jurisdiction over almost every other form of crime. By the Quarter Sessions Act 1842 and subsequent legislation, they are forbidden to try the following offences: treason or misprision of treason; murder, capital felony or any felony (except burglary) which is punishable on a first conviction by penal servitude for life; offences against the king's title, prerogative, person or government, or against either House of parliament; offences against the Official Secrets Act 1889; offences subject to the penalties of praemunire; blasphemy and offences against religion, and composing or publishing blasphemous, seditious or defamatory libels; administering and taking unlawful oaths; perjury and subordination and making or suborning another to make a false oath, declarations or affirmations punishable as perjury or as a misdemeanour; abduction of women and girls and offences under the Criminal Law Amendment Act 1885; bigamy and offences against the laws of marriage; concealment of birth; bribery and corruption at elections or of agents or public officials (but they can try offences against the Public Bodies Corrupt Practices Act 1889); setting fire to crops, woods and heaths; stealing or destroying certain classes of documents; offences against the factor sections (ss. 75–85) of the Larceny Act as amended by the Larceny Act 1901; and conspiracies to commit offences which the court could not try if committed by one person. Trials before the court with a jury are governed by the same procedure as trials on indictment in a court of assize. Under the Vagrancy Act 1823 and amending acts, they have special powers of sentencing incorrigible rogues sent to them by courts of summary jurisdiction, and under the act of 1360 and the commission of the peace they can, but now rarely do, exercise an original and summary jurisdiction as to articles of the peace (see RECOGNIZANCE). They have power to estreat recognizances entered into before themselves or before courts of summary jurisdiction and returned to them for record or forfeiture, but by the Summary Jurisdiction Act 1879 the exercise of the latter power has been rendered unnecessary.

Appellate.—An appeal lies to quarter sessions from convictions by a court of summary jurisdiction only where such an appeal is expressly given by statute. The number of statutes giving such right of appeal is very great. The appellate jurisdiction has been considerably increased by the Summary Jurisdiction Act 1879, which allows (s. 19) an appeal (with certain exceptions) from every conviction or order of a court of summary jurisdiction inflicting imprisonment without the option of a fine. The appeal may be brought in accordance with the act giving the appeal or the Summary Jurisdiction Acts. Most of the special procedure in statutes giving the right to appeal has been swept away by the Summary Jurisdiction Act 1884.

Civil Jurisdiction, Original.—Originally the county justices were confined to the exercise in or out of sessions of the powers given by the commission of the peace and of certain statutory duties as to rioters, &c. Under the Tudors and Stuarts the justices acting under the supervision of the Privy Council and the court of king's bench gradually became the rulers of the county in administrative and social as well as judicial matters (F. W. Maitland, *Justice and Police*, 1885, p. 80). The process by which this result was attained is traced in Webb's *English Local Government* (1907, vol. i.). The effect of the change was the supersession by nominees of the crown of the common law authorities and officers of county, hundred and township. But the change extended only to a small extent to municipal boroughs. By legislation in and since 1888 most of the administrative powers and duties of justices in general and quarter sessions have been transferred to the incorporated and elective councils of counties, boroughs and urban and rural districts. But the justices still possess certain original, civil or quasi-civil jurisdiction with respect to the extinction of licences to sell intoxicants, and jointly with the county councils over the county police, and as to closing highways, and also powers as to fixing the petty sessional divisions of their county.

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[1] In the soke of Peterborough commissions of oyer and terminer, and gaol delivery, as well as a commission of the peace, are issued.

Appellate.—Theoretically quarter sessions have original jurisdiction in any matter as to which two justices have jurisdiction, unless the statute giving the jurisdiction gives an appeal to quarter sessions as a result of this rule. Most of the civil jurisdiction of quarter sessions is now appellate, *i.e.* with reference to orders made by justices out of quarter sessions as to the settlement and removal of paupers, or under the Highway, Licensing and Bastardy Acts, or as to appeals against assessments or rating. The procedure as to each form of appeal depends partly on the statute by which it is given and partly on the general provisions of the Summary Jurisdiction Acts 1879 and 1884. In substance their only original jurisdiction in civil or quasi-civil matters is now in cases of apprenticeship (5 Eliz. c. 4) and articles of the peace (1 Edw. III. st. 2, c. 16).

Appeal from Quarter Sessions.—There is no appeal properly so called from quarter sessions to the High Court either on facts or law. But decisions on law may be reviewed by the High Court (king's bench division) by means of *certiorari*, *mandamus* or prohibition; convictions on indictment before courts of quarter sessions are within the provisions of the Criminal Appeal Act 1907 (see APPEAL), except convictions on indictments for obstruction or non-repair of a public bridge, highway or river, from which an appeal lies to the court of appeal in the same way as in the case of civil actions tried at assizes. Quarter sessions have also power to reserve a special case for the High Court on conviction or indictment (Crown Cases Act 1848), and also in other cases to consult the High Court by special case stated under the commission or under the Quarter Sessions Act 1849. Questions of law alone can be referred by special case, and there is no means of compelling the court to state a case. The procedure as to cases not within the acts of 1848, 1849 and 1907 is regulated by the Crown Office Rules of 1906, and s. 2 of the Judicature Act 1894, which gives the High Court certain powers of drawing inferences of fact from the evidence taken in the court below.

Scotland.—Justices of the peace were established in Scotland by act of 1587, c. 82, and quarter sessions by act of 1661, c. 338 (12mo edition, c. 38), which directs that the justices of peace in each respective shire shall meet and convene together four times in the year, on the first Tuesday of March, May and August, and the last Tuesday of October, to administer justice to the people on things that are within their jurisdiction, and punish the guilty for faults and crimes done and committed in the preceding quarter. The obsolete details in this act were repealed in 1906, but the power of requiring law burrows, *i.e.* sureties to keep the peace, is preserved. By the Union with Scotland Amendment Act 1707 provision was made for appointing justices of the peace in shires, stewartries and burghs in Scotland: and the justices to be appointed are given authority to exercise whatever doth appertain to the office and court of a justice of peace by virtue of the laws and acts of parliament made in England before the Union in relation to and for the preservation of the public peace. "Provided that in the sessions of the peace the methods of trial and judgments shall be according to the law of Scotland." The quarter sessions do not sit for the trial of indictments, but have powers of reviewing the decisions of justices in petty sessions (see SUMMARY JURISDICTION). This power extends, *inter alia*, to revenue cases and cases under the Pawnbrokers Acts. Their jurisdiction as to the grant and refusal of liquor licences was taken away by the Licensing Scotland Act 1903, but they still have appellate jurisdiction as to offences under the Licensing Acts, ss. 101–103. An appeal lies to the Circuit Court of Justiciary unless the statute under which they act otherwise provides. In criminal matters their functions are not considerable, most of the work done by justices in England being in Scotland dealt with by the sheriff or his substitutes, or by stipendiaries in the great cities. Their decisions in criminal cases are reviewable by the Court of Justiciary and in revenue cases by the court of exchequer. Their original jurisdiction is very limited and almost wholly civil. Thus they have power to divide a county and to make rules for the purposes of the Justices of the Peace Small Debts Acts 1825 and 1849.

Ireland.—In Irish municipal boroughs a court of quarter sessions may be granted and a recorder appointed under an act of 1840. In the case of Dublin, Cork, Belfast, Londonderry and Galway, the office of recorder may be united with that of chairman of quarter sessions for the adjoining county. The general criminal jurisdiction of the quarter sessions has the same origin and is on the same lines as in England; but the limitations imposed as to offences which may be tried are not so narrow as in England. The sessions, &c., are regulated in the main by an act of 1851. The appellate jurisdiction rests on different statutes from those applicable to England, but is on the same lines (see 14 & 15 Vict. c. 93; 40 & 41 Vict. c. 56). In Ireland quarter sessions courts are held before a salaried officer once styled the assistant barrister and now chairman, who is usually also judge of a civil bill court (the Irish county court), or recorder of a neighbouring city or borough. The appointment and tenure of office of the chairman is regulated by statutes dating from 1851 to 1889. The jurisdiction of the court is not limited by the Quarter Sessions Act 1842.

India.—In India courts of record were established in Madras and Bombay, originally styled mayors' courts and subsequently made recorders' courts, with a jurisdiction corresponding as to criminal matters to that of a borough court of quarter sessions in England. Throughout India there are under the Criminal Procedure Code of 1898 courts of sessions in each province for the purpose of criminal jurisdiction, which take the place of assizes and quarter sessions in England. They are under the supervision of the High Courts; but can try and sentence for any crime, subject as to sentences of death to confirmation by the High Court.

Canada.—In Canada courts of general quarter sessions exist in some provinces, *e.g.* Quebec. In New Brunswick they are replaced by the county court. Their jurisdiction to try indictable offences is defined by Part 42 of the Criminal Code 1892.

Australia.—In Queensland the place of quarter sessions is taken by the district courts, which have a criminal jurisdiction substantially the same as that of the English court of quarter sessions (31 Vict. No. 30, s. 117). In New South Wales quarter sessions continue. In Victoria a court of general sessions has been created by statute with powers closely resembling those of the English court of quarter sessions (*re Dunn*, 1906, Victoria State Rep. 493).

United States.—Courts of quarter sessions exist in many of the states; their jurisdiction is determined by state legislation, and extends as a rule only to the less grave crimes. They are in most, if not all, states held before professional judges. (W. F. C.)

QUARTER-STAFF, a staff of wood from 6 to 9 ft. in length, used as a means of attack and defence; originally no doubt it was the cudgel or sapling with which many heroes are described by early writers as being armed. The quarter-staff attained great popularity in England in the middle ages. It was usually made of oak, the ends often shod with iron, and it was held with both hands, the right hand grasping it one quarter of the distance from the lower end (whence the name) and the left at about the middle.

Egerton Castle (*Schools and Masters of Fence*) says that the staff was the "foil," or practice-substitute for the *long sword*, or *two-hander*. In earlier times it may also have been used as a practice weapon for the spear and bill. In the prints illustrative of the life of Richard Beauchamp, earl of Warwick (1382–1439), reproduced in Joseph Strutt's *Manners, Customs, Arms, Habits, &c. of the Inhabitants of England*, may be seen a combat between two knights after they have splintered their lances and dismounted, in which both are fighting with pointed staves about as long as a quarter-staff and held in the same manner. In the 17th century the staff was still popular in England.

At the present time the quarter-staff is used to a limited extent in military circles as a school for bayonet play. It is somewhat lighter than the old weapon, being usually made of bamboo and about 8 ft. long. Sabre-masks, gloves, padded jackets and shin-guards are worn. Another kind of staff, called by Captain A. Hutton (*Cold Steel*) the Great Stick, about 5 ft. long and made of stout rattan, is used in the French and Italian armies in general gymnastic exercises and as a school for bayonet play. The Italian method rather resembles that of the old two-handed sword, while the French approaches more closely to English quarter-staff play.

See *Quarter-Staff*, by T. A. McCarthy (London, 1883); *Broadsword and Singlestick*, by R. G. Allanson-Winn and C. Phillips-Wolley (London, 1898).

QUARTO, a shortened form of Lat. *in quarto*, "in a fourth," *i.e.* of a sheet of paper, applied to a size of paper, and to a size of a printed volume. Paper is *in quarto* when a whole single sheet is folded twice so as to form four leaves; a book is technically termed of "quarto" size when made up of sheets folded twice.

QUARTZ, a widely distributed mineral species, consisting of silicon dioxide, or silica (SiO_2). It is the commonest of minerals, and is met with in a great variety of forms and with very diverse modes of occurrence. The various forms of silica have attracted attention from the earliest times, and the water-clear crystallized variety was known to the Greeks as κρύσταλλος (clear ice), being supposed by them to have been formed from water by the intense cold of the Alps; hence the name "crystal," or more commonly rock-crystal, applied to this variety. The name quartz is an old German word of uncertain origin: it was used by G. Agricola in 1529.

Quartz is a mineral which is put to many uses. Several of the varieties are cut into gems and ornaments, balance weights, pivot supports for delicate instruments, agate mortars, &c.; or used for engraving, for instance, cameos and the elaborately carved crystal vases of ancient and medieval times. Clear transparent rock-crystal is used for optical purposes and spectacle lenses. Fused quartz has recently been used for the construction of lenses and laboratory vessels, or it may be drawn out into the finest elastic fibres and used for suspending mirrors, &c., in physical apparatus. For striking fire, flint is used even to the present day. Buhrstone, a cellular variety of chalcedonic quartz from the Tertiary strata of the Paris basin, is largely used for millstones. Quartz is a valuable grinding and polishing material, and is used for making sand-paper and scouring-soap. It is also largely used in the manufacture of glass and porcelain, "silver sand" being a pure quartz sand.

Quartz crystallizes in the trapezohedral-hemihedral class of the rhombohedral division of the hexagonal system. Crystals of this class possess neither planes nor centre of symmetry, but only axes of symmetry: perpendicular to the principal triad axis there are three uniterminal dyad axes of symmetry. Usually, however, this lower degree of symmetry is not indicated by the faces developed on the crystals. The majority of crystals of quartz are bounded only by the faces of a hexagonal prism $m\{2\bar{1}\bar{1}\}$ and a hexagonal bipyramid (fig. 1), though sometimes the prism is absent (fig. 2). Frequently the faces are of different sizes (fig. 3): mis-shapen crystals are common and sometimes very puzzling, but they can always be orientated by the aid of the very characteristic striations on the prism faces, which serve also to distinguish quartz from other minerals of similar appearance. These striations (fig. 3) are horizontal in direction, being parallel to the edges of intersection between the prism and pyramid faces, and are due to the frequent oscillatory combination of these faces. The apparent hexagonal bipyramid is really a combination of two rhombohedra, the direct rhombohedron $r\{100\}$ and the inverse rhombohedron $z\{22\bar{1}\}$. The faces of these two rhombohedra exhibit differences in surface characters, those of *r* being usually brighter in lustre than those of *z*; further, the former often predominate in size (figs. 4 and 5), and the latter may sometimes be completely absent. When both the prism and the rhombohedron *z* are absent, the crystals resemble cubes in appearance, since the angles between the faces of the rhombohedron are 85° 46′. The additional faces *s* and *x* (figs. 4 and 5), which indicate the true degree of symmetry of quartz, are of comparatively rare occurrence except on crystals from certain localities. The six small faces $s\{41\bar{2}\}$ situated on alternate corners at each end of the crystal, are called the "rhomb" faces, because of their shape; if extended they would give a trigonal bipyramid. The "trapezohedral," or "plagihedral," faces $x\{41\bar{2}\}$ belong to a trigonal trapezohedron. The two crystals shown in figs. 4 and 5 are enantiomorphous, *i.e.* they are non-superposable, one being the mirror reflection of the other: they are left-handed and right-handed crystals respectively. The faces *s* are striated parallel to their edge of intersection with *r*; this serves to distinguish *r* and *z*, and thus, in the absence of *x* faces, to distinguish left- or right-handed crystals. Numerous other faces have been observed on crystals of quartz, but they are of rare occurrence. The basal plane, so common on calcite and many other rhombohedral minerals, is of the greatest rarity in quartz, and when present only appears as a small rough face formed by the corrosion of the crystal. Faces of prisms other than *m* are also small and of exceptional occurrence.

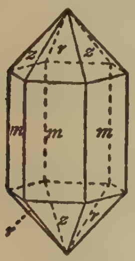

FIG. 1.

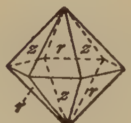

FIG. 2.

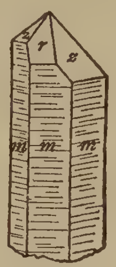

FIG. 3.

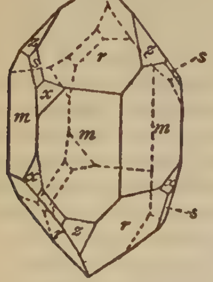

FIG. 4.

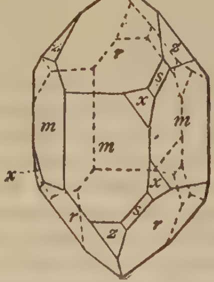

FIG. 5.

Twinned crystals of quartz are extremely common, but are complex in character and can only be deciphered when the faces *s* and *x* are present, which is not often the case. Usually they are interpenetration twins with the principal axis as twin-axis; the prism planes of the two individuals coincide, and the faces *r* and *z* also fall into the same plane. Such twins may therefore be mistaken for simple crystals unless they are attentively studied; but the twinning is often made evident by the presence of irregularly bounded areas of the duller *z* faces coinciding with the brighter *r* faces. In a rarer type of twinning, in which the twin-plane is $\{52\bar{1}\}$ (a plane truncating the edge between *r* and *z*), the two individuals are united in juxtaposition with their principal axis nearly at right angles (84° 33′). A few magnificent specimens of rock-crystal twinned according to this law have been found at La Gardette in Isère, and in Japan they are somewhat abundant.

The pyro-electric characters of quartz are closely connected with its peculiar type of symmetry and especially with the three uniterminal dyad axes. A crystal becomes positively and negatively electrified in alternate prism edges when its temperature changes. A similar distribution of electric charges is produced when a crystal is subjected to pressure; quartz being thus also piezo-electric. Etched figures, both natural and artificial (in the latter case produced by the action of hydrofluoric acid), on the faces of the crystals are in accordance with the symmetry, and may serve to distinguish left- and right-handed crystals.

In its optical characters, quartz is also of interest, since it is one of the two minerals (cinnabar being the other) which are circularly polarizing. This phenomenon is connected with the symmetry of the crystals, and is also shown by the crystals of certain other substances in which there are neither planes nor centre of symmetry. A ray of plane-polarized light traversing a right-handed crystal of quartz in the direction of the triad axis has its plane of polarization rotated to the right, while a left-handed crystal rotates it to the left. A section 1 mm. thick, cut perpendicular to the principal axis of a quartz crystal, rotates the plane of yellow (D) light through 22°, and of blue (G) light through 43°. Such a section when examined in the polariscope shows an interference figure with a coloured centre, there being no black cross inside the innermost ring (this is not shown in very thin sections). Superimposed sections of right- and left-handed quartz, as may sometimes be present in sections of twinned crystals, exhibit Airy's spirals in the polariscope. The indices of refraction of quartz for yellow (D) light are $\omega=1{\cdot}5442$ and $\epsilon=1{\cdot}5533$; the optic sign is therefore positive.

Quartz has a hardness of 7 (being chosen as No. 7 on Mohs' scale), and it cannot be scratched with a knife; its specific gravity is 2·65. There is no distinct cleavage; though an imperfect cleavage may sometimes be developed parallel to the faces of the rhombohedron *r* by plunging a heated crystal into cold water. The glassy conchoidal fracture is a characteristic feature of the crystallized mineral. A peculiar rippled or "thumb-marked" fracture is sometimes to be seen, especially in amethyst (*q.v.*), and is due to repeated intergrowths of right- and left-handed material. The mineral is a non-conductor of electricity; it is unattacked by acids with the exception of hydrofluoric acid, and is only slightly dissolved by solutions of caustic alkalis. It is infusible before the gas blowpipe, but in the oxyhydrogen flame fuses to a clear colourless glass, which has a hardness of 5 and specific gravity 2·2.

Many peculiarities of the growth of crystals are well illustrated by the mineral quartz. Thus in "ghost quartz," in which one crystal is seen inside another, the stages of growth are marked out by thin layers of enclosed material. In "capped quartz" these layers are thicker, and the successive shells of the crystal may be easily separated. "Sceptre quartz," in which a short thick crystal is mounted on the end of a long slender prism, indicates a change in the conditions of growth. Crystals with a helical twist are not uncommon. Enclosures of other minerals (rutile, chlorite, haematite, göthite, actinolite, asbestos and many others) are extremely frequent in crystals of quartz. Cavities, either rounded or with the same shape ("negative crystals") as the surrounding crystal, are also common; they are often of minute size and present in vast numbers. Usually these cavities contain a liquid (water, a saline solution, carbon dioxide or petroleum) and a movable bubble of gas. The presence of these enclosed impurities impairs the transparency of crystals. Crystals of quartz are usually attached at one end to their rocky matrix, but sometimes, especially when embedded in a soft matrix of clay, gypsum or salt, they may be bounded on all sides by crystal faces (fig. 1). In size they vary between wide limits, from minute sparkling points encrusting rock surfaces and often so thickly clustered together as to produce a drusy effect, to large single crystals measuring a yard in length and diameter and weighing half a ton.

The characters as given above apply more particularly to crystals of quartz, but in the various massive and compact varieties the material may be quite different in general appearance. Thus in the microcrystalline chalcedony (*q.v.*) the lustre is waxy, the fracture fibrous to even, and the external form botryoidal or stalactitic: flint and chert are compact and have a splintery fracture: jasper (*q.v.*) is a compact variety intermixed with much iron oxide and clay and has a dull and even fracture. Further, these varieties may be of almost any colour, whereas transparent crystals have only a limited range of colour, being either colourless (rock-crystal), violet (amethyst), brown (smoky quartz) or yellow (citrine).

Quartz occurs as a primary and essential constituent of igneous rocks of acidic composition such as granite, quartz-porphyry and rhyolite, being embedded in these either as irregularly shaped masses or as porphyritic crystals. In pegmatite (graphic granite) and granophyre it often forms a regular intergrowth with felspar. It is also a common constituent, as irregular grains, in many gneisses and crystalline schists, a quartz-schist being composed largely of quartz. By the weathering of silicates, silica passes into solution and quartz is deposited as a secondary product in the cavities of basic igneous rocks, and in fact in the crevices and along the joints of rocks of almost all kinds. Extensive veins of quartz are especially frequent in schistose rocks. Vein-quartz, often of economic importance as a matrix of gold, may, however, in some cases have been of igneous origin. In mineral veins and lodes crystallized quartz is usually the most abundant gangue mineral; the crystals are often arranged perpendicular to the walls of the lode, giving rise to a "comby" structure. In limestones of various kinds it occurs as nodules and bands of chert and flint, being in this case of organic origin. Quartz being a mineral very resistant to weathering agencies, it forms the bulk of sands and sandstones; and when the sand grains are cemented together by a later deposit of secondary quartz a rock known as quartzite results. Pseudomorphous quartz, *i.e.* quartz replacing other minerals, is of frequent occurrence, and as a petrifying material replacing organic remains it is often met with. As a deposit from hot springs, quartz is much less common than opal. Crystals of quartz may be readily prepared artificially by a number of methods; for example, by heating glass or gelatinous silica with water under pressure.

For particulars respecting the special characters, modes of occurrence and localities of the more important varieties of quartz, reference may be made to the following articles: Agate, Amethyst, Aventurine, Bloodstone, Cairngorm, Carnelian, Cat's-Eye, Chalcedony, Chrysoprase, Flint, Heliotrope, Jasper, Mocha-Stone, Onyx, Rock-Crystal, Sard, Sardonyx. For other forms of silica see Opal and Tridymite. (L. J. S.)

QUARTZITE, in petrology, a sandstone which by the deposit of crystalline quartz between its grains has been compacted into a solid quartz rock. As distinguished from sandstones, quartzites are free from pores and have a smooth fracture, since when struck with the hammer they break through the sand grains, while in sandstones the fracture passes through the cementing material and the rounded faces of the grains are exposed, giving the broken surface a rough or granular appearance. The conversion of sandstone into quartzite is sometimes the work of percolating water under ordinary conditions. In the Reading beds of England, which are for the most part loose sands, there are often many large blocks of quartzite which weather out and are exposed at the surface, being known as grey-wethers. The silicification of these rocks must have taken place at no great depth and under ordinary pressures. Most quartzites, however, are found among ancient rocks, such as the Cambrian or Pre-Cambrian. Instances are the Lickey quartzite of Shropshire, the Holyhead quartzite of Anglesey, the Durness quartzite of Sutherlandshire, the Banffshire and Perthshire quartzites and the Cherbourg quartzite. As these rocks lie in regions where there has been a considerable amount of metamorphism we may infer that (in addition to time and pressure) folding and rise of temperature favour the production of rocks of this type.

A normal quartzite has in microscopic section its clastic structure well preserved; the rounded sand grains are seen with patches of new quartz in the interspaces, and the latter is often deposited in crystalline continuity, so that the optical properties of the grains are similar to those of the material which surrounds them: a line of iron oxides or other impurities often indicates the boundary of the original sand grain. As might be expected, however, many of the oldest quartzites have been crushed by folding movements and the quartz consists in large part of a mosaic of small crystalline fragments of irregular shape with interlocking margins; these are called "sheared quartzites," and when they contain white mica in parallel crystalline flakes they become more fissile and pass into quartz-schists. Where sandstones are baked by intrusive granite or diabase they are often converted into pure quartzite, the heat evidently occasioning the deposit of interstitial quartz.

The commonest minerals in quartzite, in addition to quartz, are felspar (microcline, orthoclase, oligoclase), white mica, chlorite, iron oxides, rutile, zircon and tourmaline. Except felspar they are usually present only in small quantity; the less frequent accessories include hornblende, sillimanite, garnet, biotite, graphite, magnetite and epidote. In colour quartzites are often snowy white; they frequently have a fine angular jointing and break up into rubble under the action of frost. Quartzites are too hard and splintery to be used as building stones to any large extent: they furnish a thin and very barren soil, and because they weather slowly tend to project as hills or mountain masses. They are rarely fossiliferous (*e.g.* Gorran in Cornwall), though many of them contain worm casts which may be dragged out into long sinuous markings when the rock is much folded (Durness quartzite). Although much used as road stones, being very hard, they are readily crushed to powder unless well embedded in the road surface; the Cherbourg and Emborough (near Bristol) stones are employed for this purpose. Quartzite blocks may be used in tube mills for crushing and grinding ores, cements, &c.; rarely they have been adopted as a substitute for flint by Palaeolithic man for the fabrication of weapons and tools. (J. S. F.)

QUARTZ-PORPHYRY, in petrology, the name given to a group of hemi-crystalline acid rocks containing porphyritic crystals of quartz in a more fine-grained matrix which is usually of micro-crystalline or felsitic structure. In the hand specimens the quartz appears as small rounded, clear, greyish, vitreous blebs, which are crystals (double hexagonal pyramids) with their edges and corners rounded by resorption or corrosion. Under the microscope they are often seen to contain rounded enclosures of the ground-mass or fluid cavities, which are frequently negative crystals with regular outlines resembling those of perfect quartz crystals. Many of the latter contain liquid carbonic acid and a bubble of gas which may exhibit vibratile motion under high magnifying powers. In addition to quartz there are usually phenocrysts of felspar, mostly orthoclase, though a varying amount of plagioclase is often present. The felspars are usually full and cloudy from the formation of secondary kaolin and muscovite throughout their substance. Their crystals are larger than those of quartz and sometimes attain a length of two inches. Not uncommonly scales of biotite are visible in the specimens, being hexagonal plates, which may be weathered into a mixture of chlorite and epidote. Other porphyritic minerals are few, but hornblende, augite and bronzite are sometimes found, and garnet, cordierite and muscovite may also occur. The garnets are small, of rounded shape and red or brownish colour; in some cases they appear to have been corroded or absorbed. Cordierite forms six-sided prisms with flat ends; these divide, between crossed nicols, into six triangular areas radiating from a centre, as the crystals, which belong to the rhombic system, are not simple but consist of three twins interpenetrating and crossing. In the vast majority of cases the cordierite has weathered to an aggregate of scaly chlorite and muscovite; this is known as pinite and is of dark green colour and very soft. The quartz-porphyries or elvans which occur as dikes in Cornwall and Devon frequently contain this mineral. The augite and hornblende of these rocks are in most cases green, and are frequently decomposed into chlorite, but even then can usually be identified by their shape. A colourless rhombic pyroxene (enstatite or bronzite) occurs in a limited number of the rocks of this group and readily weathers to bastite. Apatite, magnetite, and zircon, all in small but frequently perfect crystals, are almost universal minerals of the quartz-porphyries.

The ground-mass is finely crystalline and to the unaided eye has usually a dull aspect resembling common earthenware; it is grey, green, reddish or white. Often it is streaked or banded by fluxion during cooling, but as a rule these rocks are not vesicular. Two main types may be recognized by means of the microscope—the felsitic and the microcrystalline. In the former the ingredients are so fine-grained that in the thinnest slices they cannot be determined by means of the microscope. Some of these rocks show perlitic or spherulitic structure, and such rocks were probably originally glassy (obsidians or pitchstones), but by lapse of time and processes of alteration have slowly passed into very finely crystalline state. This change is called devitrification; it is common in glasses, as these are essentially unstable. A large number of the finer quartz-porphyries are also in some degree silicified or impregnated by quartz, chalcedony and opal, derived from the silica set free by decomposition (kaolinization) of the original felspar. This re-deposited silica forms veins and patches of indefinite shape or may bodily replace a considerable area of the rock by metasomatic substitution. The opal is amorphous, the chalcedony finely crystalline and often arranged in spherulitic growths which yield an excellent black cross in polarized light. The microcrystalline ground-masses are those which can be resolved into their component minerals in thin slices by use of the microscope. They prove to consist essentially of quartz and felspars, which are often in grains of quite irregular shape (micrograniṫic). In other cases these two minerals are in graphic intergrowth, often forming radiate growths of spherulites consisting of fibres of extreme tenuity; this type is known as granophyric. There is another group in which the matrix contains small rounded or shapeless patches of quartz in which many rectangular felspars are embedded; this structure is called micropoikilitic, and though often primary is sometimes developed by secondary changes which involve the deposit of new quartz in the ground-mass. As a whole those quartz-porphyries which have microcrystalline ground-masses are rocks of intrusive origin. Elvan is a name given locally to the quartz-porphyries which occur as dikes in Cornwall; in many of them the matrix contains scales of colourless muscovite or minute needles of blue tourmaline. Fluorite and kaolin appear also in these rocks, and the whole of these minerals are due to pneumatolytic action by vapours permeating the porphyry after it had consolidated but probably before it had entirely cooled.

Many ancient rhyolitic quartz-porphyries show on their weathered surfaces numerous globular projections. They may be several inches in diameter, and vary from this size down to a minute fraction of an inch. When struck with a hammer they may detach readily from the matrix as if their margins were defined by a fissure. If they are broken across their inner portions are often seen to be filled with secondary quartz, chalcedony or agate: some of them have a central cavity, often with deposits of quartz crystals; they also frequently exhibit a succession of rounded cracks or dark lines occupied by secondary products. Rocks having these structures are common in N. Wales and Cumberland; they occur also in Jersey, the Vosges and Hungary. It has been proposed to call them *pyromérides*. Much discussion has taken place regarding the origin of these spheroids, but it is generally admitted that most of them were originally spherulites, and that they have suffered extensive changes through decomposition and silicification.

Many of the older quartz-porphyries which occur in Palaeozoic and Pre-Cambrian rocks have been affected by earth movements and have experienced crushing and shearing. In this way they become schistose, and from their felspar minute plates of sericitic white mica are developed, giving the rock in some cases very much of the appearance of mica-schists. If there have been no phenocrysts in the original rock, very perfect mica-schists may be produced, which can hardly be distinguished from sedimentary schists, though chemically somewhat different on account of the larger amounts of alkalis which igneous rocks contain. When phenocrysts were present they often remain, though rounded and dragged apart while the matrix flows around them. The glassy or felsitic enclosures in the quartz are then very suggestive of an igneous origin for the rock. Such porphyry-schists have been called porphyroids or porphyroid-schists, and in America the name aporhyolite has been used for them. They are well known in some parts of the Alps, Westphalia, Charnwood (England), and Pennsylvania. The *hälleflintas* of Sweden are also in part acid igneous rocks with a well-banded schistose or granulitic texture.

The quartz-porphyries are distinguished from the rhyolites by being either intrusive rocks or Palaeozoic lavas. All Tertiary acid lavas are included under rhyolites. The intrusive quartz-porphyries are equally well described as granite-porphyries. The palaeozoic effusive quartz-porphyries (or acid lavas) would be called rhyolites by many English petrologists, who regard geological age as of no importance in petrological classifications. But the name quartz-porphyry, though somewhat ambiguous, is so expressive and so firmly established by long-continued use that it cannot be discarded, especially as a descriptive name for the use of field geologists. (J. S. F.)

QUASSIA, the generic name given by Linnaeus to a small tree of Surinam in honour of the negro Quassi or Coissi, who employed the intensely bitter bark of the tree (*Quassia amara*) as a remedy for fever. The original quassia was officially recognized in the *London Pharmacopoeia* of 1788. In 1809 it was replaced by the bitter wood or bitter ash of Jamaica, *Picraena excelsa*, which was found to possess similar properties and could be obtained in pieces of much larger size. Since that date this wood has continued in use in Britain under the name of quassia to the exclusion of the Surinam quassia, which, however, is still employed in France and Germany. *Picraena excelsa* is a tree 50 to 60 ft. in height, and resembles the common ash in appearance. It has large compound leaves composed of four or five pairs, with a terminal odd one, of short-stalked, oblong, blunt, leathery leaflets, and inconspicuous green flowers. The fruit consists of black shining drupes about the size of a pea. It is found also in other West Indian islands, as Antigua and St Vincent. *Quassia amara* is a shrub or small tree belonging to the same natural order as *Picraena*, viz. Simarubaceae, but is readily distinguished by its large handsome red flowers arranged in terminal clusters. It is a native of Panama, Venezuela, Guiana and northern Brazil. Jamaica quassia is imported into England in logs several feet in length and often nearly one foot in thickness, consisting of pieces of the trunk and larger branches. The thin greyish bark is usually removed. The wood is nearly white, or of a yellowish tint, but sometimes exhibits blackish markings due to the mycelium of a fungus. The wood has a pure bitter taste, and is without odour or aroma. It is usually to be met with in the form of turnings or raspings, the former being obtained in the maufacture of the "bitter cups" which are made of this wood. The chief constituent is a bitter neutral principle known as quassin. It exists in the wood to the extent of about $\frac{1}{10}$%. It forms crystalline needles soluble in alkalis, chloroform and 200 parts of water. There is also present a volatile oil. The wood contains no tannin, and for this reason quassia, like chiretta and calumba, may be preserved with iron. The infusion is useful as a bitter tonic—a group of substances of which calumba is the type—and is also a very efficient anthelmintic for the threadworm (*Oxyuris vermicularis*). It is used by brewers as a substitute for hops.

QUATERNARY, in geology, the time-division which embraces the Pleistocence and Holocene epochs, *i.e.* the later portion of the Cainozoic era, equivalent to the "Post-Pliocene" or "Post-Tertiary" of certain writers. The term was proposed by J. Desnoyers in 1829 to cover those formations which were formed just anterior to the present. There are other ways of regarding the Quaternary time. Sir A. Geikie (*Text Book of Geology*, 4th ed., 1903) divides it into an upper, post-glacial or Human period, and a lower, Pleistocene or Glacial period; but he subdivides the former into an Historic and a Prehistoric epoch, a scheme presenting difficulties, for the Palaeolithic or lower stage of prehistoric time cannot really be separated from the Pleistocene (*q.v.*). E. Kayser (*Formationskunde*, 3rd. ed., 1906), who is in agreement with the definition accepted above, employs a nomenclature which is rarely adopted by British geologists; he divides the *Quartarformation* (Quartär) into a younger, modern epoch, the Alluvium, and an older epoch, the Pleistocene or Diluvium (= Glacial). A. de Lapparent, on the other hand (*Traité de géologie*, 5th ed., 1906), treats the *Era moderne* or *Quaternaire* as a great time division equivalent in value to the Tertiary, Secondary, &c., which is so far represented only by a first epoch, the Pleistocene.

QUATERNIONS, in mathematics. The word "quaternion" properly means "a set of four." In employing such a word to denote a new mathematical method, Sir W. R. Hamilton was probably influenced by the recollection of its Greek equivalent, the Pythagorean Tetractys (Τετρακτύς, the number four), the mystic source of all things. Quaternions (as a mathematical method) is an extension, or improvement, of Cartesian geometry, in which the artifices of co-ordinate axes, &c., are got rid of, all directions in space being treated on precisely the same terms. It is therefore, except in some of its degraded forms, possessed of the perfect isotropy of Euclidian space. From the purely geometrical point of view, a quaternion may be regarded as the quotient of two directed lines in space—or, what comes to the same thing, as the factor, or operator, which changes one directed line into another. Its analytical definition will appear later.

History.—The evolution of quaternions belongs in part to each of two weighty branches of mathematical history—the interpretation of the imaginary (or impossible) quantity of common algebra, and the Cartesian application of algebra to geometry. Sir W. R. Hamilton was led to his great invention by keeping geometrical applications constantly before him while he endeavoured to give a real significance to $\sqrt{-1}$. We will therefore confine ourselves, so far as his predecessors are concerned, to attempts at interpretation which had geometrical applications in view.

One geometrical interpretation of the negative sign of algebra was early seen to be mere reversal of direction along a line. Thus, when an image is formed by a plane mirror, the distance of any point in it from the mirror is simply the negative of that of the corresponding point of the object. Or if motion in one direction along a line be treated as positive, motion in the opposite direction along the same line is negative. In the case of time, measured from the Christian era, this distinction is at once given by the letters A.D. or B.C., prefixed to the date. And to find the position, in time, of one event relatively to another, we have only to subtract the date of the second (taking account of its sign) from that of the first. Thus[1] to find the interval between the battles of Marathon (490 B.C.) and Waterloo (A.D. 1815) we have

$$+1815-(-490)=2305 \text{ years}.$$

And it is obvious that the same process applies in all cases in which we deal with quantities which may be regarded as of one directed dimension only, such as distances along a line, rotations about an axis, &c. But it is essential to notice that this is by no means necessarily true of operators. To turn a line through a certain angle in a given plane, a certain operator is required; but when we wish to turn it through an equal negative angle we must not, in general, employ the negative of the former operator. For the negative of the operator which turns a line through a given angle in a given plane will in all cases produce the negative of the original result, which is not the result of the reverse operator, unless the angle involved be an odd multiple of a right angle. This is, of course, on the usual assumption that the sign of a product is changed when that of any one of its factors is changed,—which merely means that -1 is commutative with all other quantities.

John Wallis seems to have been the first to push this idea further. In his *Treatise of Algebra* (1685) he distinctly proposes to construct the imaginary roots of a quadratic equation by going out of the line on which the roots, if real, would have been constructed.

In 1804 the Abbé Buée (*Phil. Trans.*, 1806), apparently without any knowledge of Wallis's work, developed this idea so far as to make it useful in geometrical applications. He gave, in fact, the theory of what in Hamilton's system is called Composition of Vectors in one plane—*i.e.* the combination, by $+$ and $-$, of complanar directed lines. His constructions are based on the idea that the imaginaries $\pm\sqrt{-1}$ represent a unit line, and its reverse, perpendicular to the line on which the real units ± 1 are measured. In this sense the imaginary expression $a+b\sqrt{-1}$ is constructed by measuring a length a along the fundamental line (for real quantities), and from its extremity a line of length b in some direction perpendicular to the fundamental line. But he did not attack the question of the representation of products or quotients of directed lines. The step he took is really nothing more than the kinematical principle of the composition of linear velocities, but expressed in terms of the algebraic imaginary.

In 1806 (the year of publication of Buée's paper) Jean Robert Argand published a pamphlet[2] in which precisely the same ideas are developed, but to a considerably greater extent. For an interpretation is assigned to the product of two directed lines in one plane, when each is expressed as the sum of a real and an imaginary part. This product is interpreted as another directed line, forming the fourth term of a proportion, of which the first term is the real (positive) unit-line, and the other two are the factor-lines. Argand's work remained unnoticed until the question was again raised in Gergonne's *Annales*, 1813, by J. F. Français. This writer stated that he had found the germ of his remarks among the papers of his deceased brother, and that they had come from Legendre, who had himself received them from some one unnamed. This led to a letter from Argand, in which he stated his communications with Legendre, and gave a *résumé* of the contents of his pamphlet. In a further communication to the *Annales*, Argand pushed on the applications of his theory. He has given by means of it a simple proof of the existence of n roots, and no more, in every rational algebraic equation of the nth order with real coefficients. About 1828 John Warren (1796–1852) in England, and C. V. Mourey in France, independently of one another and of Argand, reinvented these modes of interpretation; and still later, in the writings of Cauchy, Gauss and others, the properties of the expression $a+b\sqrt{-1}$ were developed into the immense and most important subject now called the *theory of complex numbers* (see NUMBER). From the more purely symbolical view it was developed by Peacock, De Morgan, &c., as *double algebra.*

Argand's method may be put, for reference, in the following form. The directed line whose length is a, and which makes an angle θ with the real (positive) unit line, is expressed by $a(\cos\theta+i\sin\theta)$, where i is regarded as $+\sqrt{-1}$. The sum of two such lines (formed by adding together the real and the imaginary parts of two such expressions) can, of course, be expressed as a third directed line)—the diagonal of the parallelogram of which they are conterminous sides. The product, P, of two such lines is, as we have seen, given by

$$1 : a(\cos\theta+i\sin\theta) : : a'(\cos\theta'+i\sin\theta') : \mathrm{P},$$

or

$$\mathrm{P}=aa'\{\cos(\theta+\theta')+i\sin(\theta+\theta')\}.$$

Its length is, therefore, the product of the lengths of the factors, and its inclination to the real unit is the sum of those of the factors. If we write the expressions for the two lines in the form $\mathrm{A}+\mathrm{B}i$, $\mathrm{A}'+\mathrm{B}'i$, the product is $\mathrm{AA}'-\mathrm{BB}'+i(\mathrm{AB}'+\mathrm{BA}')$; and the fact that the length of the product line is the product of those of the factors is seen in the form

$$(\mathrm{A}^2+\mathrm{B}^2)(\mathrm{A}'^2+\mathrm{B}'^2)=(\mathrm{AA}'-\mathrm{BB}')^2+(\mathrm{AB}'+\mathrm{BA}')^2.$$

In the modern theory of complex numbers this is expressed by saying that the *Norm* of a product is equal to the product of the norms of the factors.

Argand's attempts to extend his method to space generally were fruitless. The reasons will be obvious later; but we mention them just now because they called forth from F. J. Servois (Gergonne's *Annales*, 1813) a very remarkable comment, in which was contained the only yet discovered trace of an anticipation of the method of Hamilton. Argand had been led to deny that such an expression as i^i could be expressed in the form $\mathrm{A}+\mathrm{B}i$,—although, as is well known, Euler showed that one of its values is a real quantity, the exponential function of $-\pi/2$. Servois says, with reference to the general representation of a directed line in space:—

> "L'analogie semblerait exiger que le trinôme fût de la forme $p\cos\alpha+q\cos\beta+r\cos\gamma$: α, β, γ étant les angles d'une droite avec trois axes rectangulaires; et qu'on eût
>
> $$(p\cos\alpha+q\cos\beta+r\cos\gamma)(p'\cos\alpha+q'\cos\beta+r'\cos\gamma)$$
> $$=\cos^2\alpha+\cos^2\beta+\cos^2\gamma=1.$$
>
> Les valeurs de p, q, r, p', q', r', qui satisferaient à cette condition seraient *absurdes*; mais seraient-elles imaginaires, reductibles à la forme générale $\mathrm{A}+\mathrm{B}\sqrt{-1}$? Voilà une question d'analyse fort singulière que je soumets à vos lumières. La simple proposition que je vous en fais suffit pour vous faire voir que je ne crois point que toute fonction analytique non réelle soit vraiment reductible à la forme $\mathrm{A}+\mathrm{B}\sqrt{-1}$."

As will be seen later, the fundamental i, j, k of quarternions, with their reciprocals, furnish a set of six quantities which satisfy the conditions imposed by Servois. And it is quite certain that they cannot be represented by ordinary imaginaries.

Something far more closely analogous to quaternions than anything in Argand's work ought to have been suggested by De Moivre's theorem (1730). Instead of regarding, as Buée and Argand had done, the expression $a(\cos\theta+i\sin\theta)$ as a directed line, let us suppose it to represent the operator which, when applied to any line in the plane in which θ is measured, turns it in that plane through the angle θ, and at the same time increases its length in the ratio $a:1$. From the new point of view we see at once, as it were, why it is true that

$$(\cos\theta+i\sin\theta)^m=\cos m\theta+i\sin m\theta.$$

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[1] Strictly speaking, this illustration of Tait's is in error by unity because in our calendar there is no year denominated zero. Thus the interval between June the first of 1 B.C. and June the first of 1 A.D. is one year, and not two years as the text implies. (A.McA.)

[2] *Essai sur une manière de représenter les Quantités Imaginaires dans les Constructions Geométriques.* A second edition was published by J. Hoüel (Paris, 1874). There is added an important Appendix, consisting of the papers from Gergonne's *Annales* which are referred to in the text above. Almost nothing can, it seems, be learned of Argand's private life, except that in all probability he was born at Geneva in 1768.

For this equation merely states that m turnings of a line through successive equal angles, in one plane, give the same result as a single turning through m times the common angle. To make this process applicable to any plane in space, it is clear that we must have a special value of i for each such plane. In other words, a unit line, drawn in any direction whatever, must have -1 for its square. In such a system there will be no line in space specially distinguished as the *real unit line*: all will be alike imaginary, or rather alike real. We may state, in passing, that every quaternion can be represented as $a(\cos\theta+\pi\sin\theta)$,—where a is a real number, θ a real angle, and π a directed unit line whose square is -1. Hamilton took this grand step, but, as we have already said, without any help from the previous work of De Moivre. The course of his investigations is minutely described in the preface to his first great work (*Lectures on Quaternions*, 1853) on the subject. Hamilton, like most of the many inquirers who endeavoured to give a real interpretation to the imaginary of common algebra, found that at least two kinds, orders or ranks of quantities were necessary for the purpose. But, instead of dealing with points on a line, and then wandering out at right angles to it, as Buée and Argand had done, he chose to look on algebra as the science of "pure time,"[1] and to investigate the properties of "sets" of time-steps. In its essential nature a set is a linear function of any number of "distinct" units of the same species. Hence the simplest form of a set is a "couple"; and it was to the possible laws of combination of couples that Hamilton first directed his attention. It is obvious that the way in which the two separate time-steps are involved in the couple will determine these laws of combination. But Hamilton's special object required that these laws should be such as to lead to certain assumed results; and he therefore commenced by assuming these, and from the assumption determined how the separate time-steps must be involved in the couple. It we use Roman letters for mere numbers, capitals for instants of time, Greek letters for time-steps, and a parenthesis to denote a couple, the laws assumed by Hamilton as the basis of a system were as follows:—

$$(\mathrm{B}_1, \mathrm{B}_2)-(\mathrm{A}_1, \mathrm{A}_2)=(\mathrm{B}_1-\mathrm{A}_1, \mathrm{B}_2-\mathrm{A}_2)=(\alpha, \beta);$$
$$(\mathrm{a}, \mathrm{b})\ (\alpha, \beta)=(\mathrm{a}\alpha-\mathrm{b}\beta, \mathrm{b}\alpha+\mathrm{a}\beta).^2$$

To show how we give, by such assumptions, a real interpretation to the ordinary algebraic imaginary, take the simple case $\mathrm{a}=0$, $\mathrm{b}=1$, and the second of the above formulae gives

$$(0, 1)(\alpha, \beta)=(-\beta, \alpha).$$

Multiply once more by the number-couple (0, 1), and we have

$$(0,1)(0, 1)(\alpha,\beta)=(0, 1)(-\beta, \alpha)=(-\alpha, -\beta)=(-1, 0)(\alpha, \beta)=-(\alpha, \beta).$$

Thus the number-couple (0, 1), when twice applied to a step-couple, simply changes its sign. That we have here a perfectly real and intelligible interpretation of the ordinary algebraic imaginary is easily seen by an illustration, even if it be a somewhat extravagant one. Some Eastern potentate, possessed of absolute power, covets the vast possessions of his vizier and of his barber. He determines to rob them both (an operation which may be very satisfactorily expressed by -1); but, being a wag, he chooses his own way of doing it. He degrades his vizier to the office of barber, taking all his goods in the process; and makes the barber his vizier. Next day he repeats the operation. Each of the victims has been restored to his former rank, but the operator -1 has been applied to both.

Hamilton, still keeping prominently before him as his great object the invention of a method applicable to space of three dimensions, proceeded to study the properties of triplets of the form $x+iy+jz$, by which he proposed to represent the directed line in space whose projections on the co-ordinate axes are x, y, z. The composition of two such lines by the algebraic addition of their several projections agreed with the assumption of Buée and Argand for the case of coplanar lines. But, assuming the distributive principle, the product of two lines appeared to give the expression

$$xx'-yy'-zz'+i(yx'+xy')+j(xz'+zx')+ij(yz'+zy').$$

For the square of j, like that of i, was assumed to be negative unity. But the interpretation of ij presented a difficulty—in fact the main difficulty of the whole investigation—and it is specially interesting to see how Hamilton attacked it. He saw that he could get a hint from the simpler case, already thoroughly discussed, provided the two factor lines were in one plane through the real unit line. This requires merely that

$$y : z :: y' : z' \text{ ; or } yz'-zy'=0;$$

but then the product should be of the same form as the separate factors. Thus, in this special case, the term in ij ought to vanish. But the numerical factor appears to be $yz'+zy'$, while it is the quantity $yz'-zy'$ which really vanishes. Hence Hamilton was at first inclined to think that ij must be treated as nil. But he soon saw that "a less harsh supposition" would suit the simple case. For his speculations on sets had already familiarized him with the idea that multiplication might in certain cases not be commutative; so that, as the last term in the above product is made up of the two separate terms $ijyz'$ and $jizy'$, the term would vanish of itself when the factor-lines are coplanar provided $ij=-ji$, for it would then assume the form $ij(yz'-zy')$. He had now the following expression for the product of any two directed lines:—

$$xx'-yy'-zz'+i(yx'+xy')+j(xz'+zx')+ij(yz'-zy').$$

But his result had to be submitted to another test, the Law of the Norms. As soon as he found, by trial, that this law was satisfied, he took the final step. "This led me," he says, "to conceive that perhaps, instead of seeking to *confine* ourselves to *triplets*, . . . we ought to regard these as only *imperfect forms of* Quaternions, . . . and that thus my old conception of *sets* might receive a new and useful application." In a very short time he settled his fundamental assumptions. He had now three distinct space-units, i, j, k; and the following conditions regulated their combination by multiplication:—

$$i^2=j^2=k^2=-1,\ ij=-ji=k,\ jk=-kj=i,\ ki=-ik=j.^3$$

And now the product of two quaternions could be at once expressed as a third quaternion, thus—

$$(a+ib+jc+kd)(a'+ib'+jc'+kd')=\mathrm{A}+i\mathrm{B}+j\mathrm{C}+k\mathrm{D},$$

where

$$\mathrm{A}=aa'-bb'-cc'-dd',$$
$$\mathrm{B}=ab'+ba'+cd'-dc',$$
$$\mathrm{C}=ac'+ca'+db'-bd',$$
$$\mathrm{D}=ad'+da'+bc'-cb'.$$

Hamilton at once found that the Law of the Norms holds,—not being aware that Euler had long before decomposed the product of two sums of four squares into this very set of four squares. And now a directed line in space came to be represented as $ix+jy+kz$, while the product of two lines is the quaternion

$$-(xx'+yy'+zz')+i(yz'-zy')+j(zx'-xz')+k(xy'-yx').$$

To any one acquainted, even to a slight extent, with the elements of Cartesian geometry of three dimensions, a glance at the extremely suggestive constituents of this expression shows how justly Hamilton was entitled to say: "When the conception . . . had been so far unfolded and fixed in my mind, I felt that the *new instrument for applying calculation to geometry*, for which I had so long sought, was now, at least in part, attained." The date of this memorable discovery is October 16, 1843.

Suppose, for simplicity, the factor-lines to be each of unit length. Then x, y, z, x', y', z' express their direction-cosines. Also, if θ be the angle between them, and x'', y'', z'' the direction-cosines of a line perpendicular to each of them, we have $xx'+yy'+zz'=\cos\theta$, $yz'-zy''=x''\sin\theta$, &c., so that the product of two unit lines is now expressed as $-\cos\theta+(ix''+jy''+kz'')\sin\theta$. Thus, when the factors are parallel, or $\theta=0$, the product, which is now the square of any (unit) line is -1. And when the two factor lines are at right angles to one another, or $\theta=\pi/2$, the product is simply $ix''+jy''+kz''$, the unit line perpendicular to both. Hence, and in this lies the main element of the symmetry and simplicity of the quaternion calculus, all systems of three mutually rectangular unit lines in space have the same properties as the fundamental system i, j, k. In other words, if the system (considered as rigid) be made to turn about till the first factor coincides with i and the second with j, the product will coincide with k. This fundamental system, therefore, becomes unnecessary; and the quaternion method, in every case, takes its reference lines solely from the problem to which it is applied. It has therefore, as it were, a unique internal character of its own.

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[1] *Theory of Conjugate Functions, or Algebraic Couples, with a Preliminary and Elementary Essay on Algebra as the Science of Pure Time*, read in 1833 and 1835, and published in *Trans. R. I. A.* xvii. ii. (1835).

[2] Compare these with the long-subsequent ideas of Grassmann.

[3] It will be easy to see that, instead of the last three of these, we may write the single one $ijk=-1$.

Hamilton, having gone thus far, proceeded to evolve these results from a characteristic train of a priori or metaphysical reasoning.

Let it be supposed that the product of two directed lines is something which has quantity; *i.e.* it may be halved, or doubled, for instance. Also let us assume (*a*) space to have the same properties in all directions, and make the convention (*b*) that to change the sign of any one factor changes the sign of a product. Then the product of two lines which have the same direction cannot be, even in part, a directed quantity. For, if the directed part have the same direction as the factors, (*b*) shows that it will be reversed by reversing either, and therefore will recover its original direction when both are reversed. But this would obviously be inconsistent with (*a*). If it be perpendicular to the factor lines, (*a*) shows that it must have simultaneously every such direction. Hence it must be a mere number.

Again, the product of two lines at right angles to one another cannot, even in part, be a number. For the reversal of either factor must, by (*b*), change its sign. But, if we look at the two factors in their new position by the light of (*a*), we see that the sign must not change. But there is nothing to prevent its being represented by a directed line if, as further applications of (*a*) and (*b*) show we must do, we take it perpendicular to each of the factor lines. Hamilton seems never to have been quite satisfied with the apparent heterogeneity of a quaternion, depending as it does on a numerical and a directed part. He indulged in a great deal of speculation as to the existence of an extra-spatial unit, which was to furnish the *raison d'être* of the numerical part, and render the quaternion homogeneous as well as linear. But for this we must refer to his own works.

Hamilton was not the only worker at the theory of sets. The year after the first publication of the quaternion method, there appeared a work of great originality, by Grassmann,[1] in which results closely analogous to some of those of Hamilton were given. In particular, two species of multiplication ("inner" and "outer") of directed lines in one plane were given. The results of these two kinds of multiplication correspond respectively to the numerical and the directed parts of Hamilton's quaternion product. But Grassmann distinctly states in his preface that he had not had leisure to extend his method to angles in space. Hamilton and Grassmann, while their earlier work had much in common, had very different objects in view. Hamilton had geometrical application as his main object; when he realized the quaternion system, he felt that his object was gained, and thenceforth confined himself to the development of his method. Grassmann's object seems to have been, all along, of a much more ambitious character, viz. to discover, if possible, a system or systems in which every conceivable mode of dealing with sets should be included. That he made very great advances towards the attainment of this object all will allow; that his method, even as completed in 1862, fully attains it is not so certain. But his claims, however great they may be, can in no way conflict with those of Hamilton, whose mode of multiplying couples (in which the "inner" and "outer" multiplication are essentially involved) was produced in 1833, and whose quaternion system was completed and published before Grassmann had elaborated for press even the rudimentary portions of his own system, in which the veritable difficulty of the whole subject, the application to angles in space, had not even been attacked. Grassmann made in 1854 a somewhat savage onslaught on Cauchy and De St Venant, the former of whom had invented, while the latter had exemplified in application, the system of "*clefs algébriques*," which is almost precisely that of Grassmann. But it is to be observed that Grassmann, though he virtually accused Cauchy of plagiarism, does not appear to have preferred any such charge against Hamilton. He does not allude to Hamilton in the second edition of his work. But in 1877, in the *Mathematische Annalen*, xii., he gave a paper "On the Place of Quaternions in the *Ausdehnungslehre*," in which he condemns, as far as he can, the nomenclature and methods of Hamilton.

There are many other systems, based on various principles, which have been given for application to geometry of directed lines, but those which deal with products of lines are all of such complexity as to be practically useless in application. Others, such as the *Barycentrische Calcül* of Möbius, and the *Méthode des equipollences* of Bellavitis, give elegant modes of treating space problems, so long as we confine ourselves to projective geometry and matters of that order; but they are limited in their field, and therefore need not be discussed here. More general systems, having close analogies to quaternions, have been given since Hamilton's discovery was published. As instances we may take Goodwin's and O'Brien's papers in the *Cambridge Philosophical Transactions* for 1849. (See also ALGEBRA: *special kinds*.)

Relations to other Branches of Science.—The above narrative shows how close is the connexion between quaternions and the ordinary Cartesian space-geometry. Were this all, the gain by their introduction would consist mainly in a clearer insight into the mechanism of co-ordinate systems, rectangular or not—a very important addition to theory, but little advance so far as practical application is concerned. But, as yet, we have not taken advantage of the perfect symmetry of the method. When that is done, the full value of Hamilton's grand step becomes evident, and the gain is quite as extensive from the practical as from the theoretical point of view. Hamilton, in fact, remarks,[2] "I regard it as an inelegance and imperfection in this calculus, or rather in the state to which it has hitherto been unfolded, whenever it becomes, or *seems* to become, necessary to have recourse . . . to the resources of ordinary algebra, for the *solution of equations in quaternions*." This refers to the use of the x, y, z co-ordinates,—associated, of course, with i, j, k. But when, instead of the highly artificial expression $ix+jy+kz$, to denote a finite directed line, we employ a single letter, α (Hamilton uses the Greek alphabet for this purpose), and find that we are permitted to deal with it exactly as we should have dealt with the more complex expression, the immense gain is at least in part obvious. Any quaternion may now be expressed in numerous simple forms. Thus we may regard it as the sum of a number and a line, $a+\alpha$, or as the product, $\beta\gamma$, or the quotient, $\delta\epsilon^{-1}$, of two directed lines, &c., while, in many cases, we may represent it, so far as it is required, by a single letter such as q, r, &c.

Perhaps to the student there is no part of elementary mathematics so repulsive as is spherical trigonometry. Also, everything relating to change of systems of axes, as for instance in the kinematics of a rigid system, where we have constantly to consider one set of rotations with regard to axes fixed in space, and another set with regard to axes fixed in the system, is a matter of troublesome complexity by the usual methods. But every quaternion formula is a proposition in spherical (sometimes degrading to plane) trigonometry, and has the full advantage of the symmetry of the method. And one of Hamilton's earliest advances in the study of his system (an advance independently made, only a few months later, by Arthur Cayley) was the interpretation of the singular operator $q(\quad)q^{-1}$, where q is a quaternion. Applied to any directed line, this operator at once turns it, conically, through a definite angle, about a definite axis. Thus rotation is now expressed in symbols at least as simply as it can be exhibited by means of a model. Had quaternions effected nothing more than this, they would still have inaugurated one of the most necessary, and apparently impracticable, of reforms.

The physical properties of a heterogeneous body (provided they vary continuously from point to point) are known to depend, in the neighbourhood of any one point of the body, on a quadric function of the co-ordinates with reference to that point. The same is true of physical quantities such as potential, temperature, &c., throughout small regions in which their variations are continuous; and also, without restriction of dimensions, of moments of inertia, &c. Hence, in addition to its geometrical applications to surfaces of the second order, the theory of quadric functions of position is of fundamental importance in physics. Here the symmetry points at once to the selection of the three principal axes as the directions for i, j, k; and it would appear at first sight as if quaternions could not simplify, though they might improve in elegance, the solution of questions of this kind. But it is not so. Even in Hamilton's earlier work it was shown that all such questions were reducible to the solution of linear equations in quaternions; and he proved that this, in turn, depended on the determination of a certain operator, which could be represented for purposes of calculation by a single symbol. The method is essentially the same as that developed, under the name of "matrices," by Cayley in 1858; but it has the peculiar advantage of the simplicity which is the natural consequence of entire freedom from conventional reference lines.

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[1] *Die Ausdehnungslehre*, Leipsic, 1844; 2nd ed., vollständig und in strenger Form bearbeitet, Berlin, 1862. See also the collected works of Möbius, and those of Clifford, for a general explanation of Grassmann's method.

[2] *Lectures on Quaternions*, § 513.

Sufficient has already been said to show the close connexion between quaternions and the theory of numbers. But one most important connexion with modern physics must be pointed out. In the theory of surfaces, in hydrokinetics, heat-conduction, potentials, &c., we constantly meet with what is called "Laplace's operator," viz. $\frac{d^2}{dx^2}+\frac{d^2}{dy^2}+\frac{d^2}{dz^2}$. We know that this is an invariant; *i.e.* it is independent of the particular directions chosen for the rectangular co-ordinate axes. Here, then, is a case specially adapted to the isotropy of the quaternion system; and Hamilton easily saw that the expression $i\frac{d}{dx}+j\frac{d}{dy}+k\frac{d}{dz}$ could be, like $ix+jy+kz$, effectively expressed by a single letter. He chose for this purpose ∇. And we now see that the square of ∇ is the negative of Laplace's operator; while ∇ itself, when applied to any numerical quantity conceived as having a definite value at each point of space, gives the direction and the rate of most rapid change of that quantity. Thus, applied to a potential, it gives the direction and magnitude of the force; to a distribution of temperature in a conducting solid, it gives (when multiplied by the conductivity) the flux of heat, &c.

No better testimony to the value of the quaternion method could be desired than the constant use made of its notation by mathematicians like Clifford (in his *Kinematic*) and by physicists like Clerk-Maxwell (in his *Electricity and Magnetism*). Neither of these men professed to employ the calculus itself, but they recognized fully the extraordinary clearness of insight which is gained even by merely translating the unwieldy Cartesian expressions met with in hydrokinetics and in electrodynamics into the pregnant language of quaternions. (P. G. T.)

Supplementary Considerations.—There are three fairly well-marked stages of development in quaternions as a geometrical method. (1) Generation of the concept through imaginaries and development into a method applicable to Euclidean geometry. This was the work of Hamilton himself, and the above account (contributed to the 9th ed. of the *Ency. Brit.* by Professor P. G. Tait, who was Hamilton's pupil and after him the leading exponent of the subject) is a brief *résumé* of this first, and by far the most important and most difficult, of the three stages. (2) Physical applications. Tait himself may be regarded as the chief contributor to this stage. (3) Geometrical applications, different in kind from, though more or less allied to, those in connexion with which the method was originated. These last include (*a*) C. J. Joly's projective geometrical applications starting from the interpretation of the quaternion as a point-symbol;[1] these applications may be said to require no addition to the quaternion algebra; (*b*) W. K. Clifford's bi-quaternions and G. Combebiac's tri-quaternions, which require the addition of quasi-scalars, independent of one another and of true scalars, and analogous to true scalars. As an algebraic method quaternions have from the beginning received much attention from mathematicians. An attempt has recently been made under the name of multenions to systematize this algebra.

We select for description stage (3) above, as the most characteristic development of quaternions in recent years. For (3) (*a*) we are constrained to refer the reader to Joly's own *Manual of Quaternions* (1905).

The impulse of W. K. Clifford in his paper of 1873 ("Preliminary Sketch of Bi-Quaternions," *Mathematical Papers*, p. 181) seems to have come from Sir R. S. Ball's paper on the *Theory of Screws*, published in 1872. Clifford makes use of a quasi-scalar ω, commutative with quaternions, and such that if p, q, &c., are quaternions, when $p+\omega q=p'+\omega q'$, then necessarily $p=p'$, $q=q'$. He considers two cases, viz. $\omega^2=1$ suitable for non-Euclidean space, and $\omega^2=0$ suitable for Euclidean space; we confine ourselves to the second, and will call the indicated bi-quaternion $p+\omega q$ an *octonion*. In octonions the analogue of Hamilton's vector is localized to the extent of being confined to an indefinitely long axis parallel to itself, and is called a *rotor*; if ρ is a rotor then $\omega\rho$ is parallel and equal to ρ, and, like Hamilton's vector, $\omega\rho$ is not localized; $\omega\rho$ is therefore called a vector, though it differs from Hamilton's vector in that the product of any two such vectors $\omega\rho$ and $\omega\sigma$ is zero because $\omega^2=0$. $\rho+\omega\sigma$ where ρ, σ are rotors (*i.e.* ρ is a rotor and $\omega\sigma$ a vector), is called a *motor*, and has the geometrical significance of Ball's wrench upon, or twist about, a screw. Clifford considers an octonion $p+\omega q$ as the quotient of two motors $\rho+\omega\sigma, \rho'+\omega\sigma'$. This is the basis of a method parallel throughout to the quaternion method; in the specification of rotors and motors it is independent of the origin which for these purposes the quaternion method, pure and simple, requires.

Combebiac is not content with getting rid of the origin in these limited circumstances. The fundamental geometrical conceptions are the point, line and plane. Lines and complexes thereof are sufficiently treated as rotors and motors, but points and planes cannot be so treated. He glances at Grassmann's methods, but is repelled because he is seeking a unifying principle, and he finds that Grassmann offers him not one but many principles. He arrives at the *tri-quaternion* as the suitable fundamental concept.

We believe that this tri-quaternion solution of the very interesting problem proposed by Combebiac is the best one. But the first thing that strikes one is that it seems unduly complicated. A point and a plane fix a line or axis, viz. that of the perpendicular from point to plane, and therefore a calculus of points and planes is *ipso facto* a calculus of lines also. To fix a weighted point and a weighted plane in Euclidean space we require 8 scalars, and not the 12 scalars of a tri-quaternion. We should expect some species of bi-quaternion to suffice. And this is the case. Let $\eta, \tilde{\omega}$ be two quasi-scalars such that $\eta^2=\eta$, $\omega\eta=\omega$, $\eta\omega=\omega^2=0$. Then the bi-quaternion $\eta q+\omega r$ suffices. The plane is of vector magnitude $\frac{1}{2}Vq$, its equation is $\frac{1}{2}S\rho q=Sr$, and its expression is the bi-quaternion $\eta Vq+\omega Sr$; the point is of scalar magnitude $\frac{1}{2}Sq$, and its position vector is β, where $\frac{1}{2}V\beta q=Vr$ (or what is the same, $\beta=[Vr+q.Vr.q^{-1}]/Sq$), and its expression is $\eta Sq+\omega Vr$. (Note that the $\frac{1}{2}$ here occurring is only required to ensure harmony with tri-quaternions of which our present bi-quaternions, as also octonions, are particular cases.) The point whose position vector is Vrq^{-1} is on the axis and may be called the centre of the bi-quaternion; it is the centre of a sphere of radius Srq^{-1} with reference to which the point and plane are in the proper quaternion sense polar reciprocals, that is, the position vector of the point relative to the centre is $Srq^{-1}.\ Vq/Sq$, and that of the foot of perpendicular from centre on plane is $Srq^{-1}.\ Sq/Vq$, the product being the (radius)^2, that is $(Srq^{-1})^2$. The axis of the member $xQ+x'Q'$ of the second-order complex Q, Q' (where $Q=\eta q+\omega r$, $Q'=\eta q'+\omega r'$ and x, x' are scalars) is parallel to a fixed plane and intersects a fixed transversal, viz. the line parallel to $q'q^{-1}$ which intersects the axes of Q and Q'; the plane of the member contains a fixed line; the centre is on a fixed ellipse which intersects the transversal; the axis is on a fixed ruled surface to which the plane of the ellipse is a tangent plane, the ellipse being the section of the ruled surface by the plane; the ruled surface is a cylindroid deformed by a simple shear parallel to the transversal. In the third-order complex the centre locus becomes a finite closed quartic surface, with three (one always real) intersecting nodal axes, every plane section of which is a trinodal quartic. The chief defect of the geometrical properties of these bi-quaternions is that the ordinary algebraic scalar finds no place among them, and in consequence Q^{-1} is meaningless.

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[1] It appears from Joly's and Macfarlane's references that J. B. Shaw, in America, independently of Joly, has interpreted the quaternion as a point-symbol.

Putting $1-\eta=\xi$ we get Combebiac's tri-quaternion under the form $Q=\xi p+\eta q+\omega r$. This has a reciprocal $Q^{-1}=\xi p^{-1}=\eta q^{-1}-\omega p^{-1}rq^{-1}$, and a conjugate KQ (such that $K[QQ']=KQ'KQ$, $K[KQ]=Q$) given by $KQ=\xi Kq+\eta Kp+\omega Kr$; the product QQ' of Q and Q' is $\xi pp'+\eta qq'+\omega(pr'+rq')$; the quasi-vector $\frac{1}{2}(1-K)Q$ is Combebiac's linear element and may be regarded as a point on a line; the quasi-scalar (in a different sense from the rest of this article) $\frac{1}{2}(1+K)Q$ is Combebiac's scalar $(Sp+Sq)+$Combebiac's plane. Combebiac does not use K; and in place of ξ, η he uses $\mu=\eta-\xi$, so that $\mu^2=1, \omega\mu=-\mu\omega=\omega, \omega^2=0$. Combebiac's tri-quaternion may be regarded from many simplifying points of view. Thus, in place of his general tri-quaternion we might deal with products of an odd number of point-plane-scalars (of form $\mu q+\omega r$) which are themselves point-plane-scalars; and products of an even number which are octonions; the quotient of two point-plane-scalars would be an octonion, of two octonions an octonion, of an octonion by a point-plane-scalar or the inverse a point-plane-scalar. Again a unit point μ may be regarded as by multiplication changing (*a*) from octonion to point-plane-scalar, (*b*) from point-plane-scalar to octonion, (*c*) from plane-scalar to linear element, (*d*) from linear element to plane-scalar.

If $Q=\xi p+\eta q+\omega r$ and we put $Q=(1+\frac{1}{2}\omega t)(\xi p+\eta q)\times(1+\frac{1}{2}\omega t)^{-1}$ we find that the quaternion t must be $2f(r)/f(q-p)$, where $f(r)=rq-Kpr$. The point $\rho=Vt$ may be called the centre of Q and the length St may be called the radius. If Q and Q' are commutative, that is, if $QQ'=Q'Q$, then Q and Q' have the same centre and the same radius. Thus Q^{-1}, Q, Q^2, Q^3, . . . have a common centre and common radius. Q and KQ have a common centre and equal and opposite radii; that is, the t of KQ is the negative conjugate of that of Q. When $Su=0$, $(1+\frac{1}{2}\omega u)\ (\ \ )\ (1+\frac{1}{2}\omega u)^{-1}$ is an operator which shifts (without further change) the tri-quaternion operand an amount given by u in direction and distance.

BIBLIOGRAPHY.—In 1904 Alexander Macfarlane published a *Bibliography of Quaternions and allied systems of Mathematics* for the International Association for promoting the study of Quaternions and allied systems of Mathematics (Dublin University Press); the pamphlet contains 86 pages. In 1899 and 1901 Sir W. R. Hamilton's classical *Elements of Quaternions* of 1866 was republished under C. J. Joly's editorship, in two volumes (London). Joly adds valuable notes and thirteen important appendices. In 1890 the 3rd edition of P. G. Tait's *Elementary Treatise on Quaternions* appeared (Cambridge). In 1905 C. J. Joly published his *Manual of Quaternions* (London); the valuable contents of this are doubled by copious so-called examples; every earnest student should take these as part of the main treatise. The above three treatises may be regarded as the great storehouses; the handling of the subject is very different in the three. The following should also be mentioned: A. McAulay, *Octonions, a development of Clifford's Bi-quaternions* (Cambridge, 1898); G Combebiac, *Calcul des triquaternions* (Paris, 1902); Don Francisco Pérez de Muñoz, *Introduccion al estudio del cálculo de Cuaterniones y otras Álgebras especiales* (Madrid, 1905); A. McAulay, *Algebra after Hamilton, or Multenions* (Edinburgh, 1908). (A. McA.)

QUATORZAIN (from Fr. *quatorze*, fourteen), the term used in English literature, as opposed to "sonnet," for a poem in fourteen rhymed iambic lines closing (as a sonnet strictly never does) with a couplet. The distinction was long neglected, because the English poets of the 16th century had failed to apprehend the true form of the sonnet, and called Petrarch's and other Italian poets' sonnets quatorzains, and their own incorrect quatorzains sonnets. Almost all the so-called sonnets of the Elizabethan cycles, including those of Shakespeare, Sidney, Spenser and Daniel, are really quatorzains. They consist of three quatrains of alternate rhyme, not repeated in the successive quatrains, and the whole closes with a couplet. A more perfect example of the form could hardly be found than the following, published by Michael Drayton in 1602:—

Dear, why should you commend me to my rest,
When now the night doth summon all to sleep?
Methinks this time becometh lovers best,
Night was ordained together friends to keep.
How happy are all other living things
Which though the day conjoin by several flight,
The quiet evening yet together brings,
And each returns unto his love at night,
O thou that art so courteous unto all,
Why should'st thou, Night, abuse me only thus,
That every creature to his kind dost call,
And yet 'tis thou dost only sever us?
Well could I wish it would be ever day,
If, when night comes, you bid me go away.

Donne, and afterwards Milton, fought against the facility and incorrectness of this form of metre and adopted the Italian form of sonnet. During the 19th century, most poets of distinction prided themselves on following the strict Petrarchan model of the sonnet, and particularly in avoiding the final couplet. In his most mature period, however, Keats returned to the quatorzain, perhaps in emulation with Shakespeare; and some of his examples, such as "When I have fears," "Standing aloof in giant ignorance," and "Bright Star," are the most beautiful in modern literature. The "Fancy in Nubibus," written by S. T. Coleridge in 1819, also deserves notice as a quatorzain of peculiar beauty.

QUATRAIN, sometimes spelt *Quartain* (from Fr. *quatre*, four), a piece of verse complete in four rhymed lines. The length or measure of the verse is immaterial, but they must be bound together by a rhyme-arrangement. This form has always been popular for use in the composition of epigrams, on account of its brevity and neatness, and may be considered as a modification of the Greek or Latin epigram at its concisest.

QUATREFAGES DE BRÉAU, JEAN LOUIS ARMAND DE (1810–1892), French naturalist, was born at Berthezène, near Vallerangue (Gard), on the 10th of February 1810, the son of a Protestant farmer. He studied medicine at Strassburg, where he took the double degree of M.D. and D.Sc., one of his theses being a *Théorie d'un coup de canon* (November 1829); next year he published a book, *Sur les aérolithes*, and in 1832 a treatise on *L'Extraversion de la vessie*. Removing to Toulouse, he practised medicine for a short time, and contributed various memoirs to the local *Journal de médecine* and to the *Annales des sciences naturelles* (1834–36). But being unable to continue his researches in the provinces, he resigned the chair of zoology to which he had been appointed, and in 1839 settled in Paris, where he found in H. Milne-Edwards a patron and a friend. Elected professor of natural history at the Lycée Napoléon in 1850, he became a member of the Academy of Sciences in 1852, and in 1855 was called to the chair of anthropology and ethnography at the Musée d'histoire naturelle. Other distinctions followed rapidly, and continued to the end of his otherwise uneventful career, the more important being honorary member of the Royal Society of London (June 1879), member of the Institute and of the Académie de médecine, and commander of the Legion of Honour (1881). He died in Paris on the 12th of January 1892. He was an accurate observer and unwearied collector of zoological materials, gifted with remarkable descriptive power, and possessed of a clear, vigorous style, but somewhat deficient in deep philosophic insight. Hence his serious studies on the anatomical characters of the lower and higher organisms, man included, will retain their value, while many of his theories and generalizations, especially in the department of ethnology, are already forgotten.

The work of de Quatrefages ranged over the whole field of zoology from the annelids and other low organisms to the anthropoids and man. Of his numerous essays in scientific periodicals, the more important were: *Considérations sur les caractères zoologiques des rongeurs* (1840); "De l'organisation des animaux sans vertèbres des Côtes de la Manche" (*Ann. Sc. Nat.*, 1844); "Recherches sur le système nerveux, l'embryogénie, les organs des sens, et la circulation des annélides" (Ibid., 1844–50); "Sur les affinités et les analogies des lombrics et des sangsues" (Ibid.); "Sur l'histoire naturelle des tarets" (Ibid., 1848–49). Then there is the vast series issued under the general title of "Études sur les types inférieurs de l'embranchement des annelés," and the results of several scientific expeditions to the Atlantic and Mediterranean coastlands, Italy and Sicily, forming a series of articles in the *Revue des deux mondes*, or embodied in the *Souvenirs d'un naturaliste* (2 vols., 1854). These were followed in quick succession by the *Physiologie comparée, metamorphoses de l'homme et des animaux* (1862); *Les Polynésiens et leurs migrations* (1866); *Histoire naturelle des annelés marins et de l'eau douce* (2 vols., 1866); *La Rochelle et ses environs* (1866); *Rapport sur les progrès de l'anthropologie* (1867); *Ch. Darwin et ses précurseurs français* (1870), a study of evolution in which the writer takes somewhat the same attitude as A. R. Wallace, combating the Darwinian doctrine in its application to man; *La Race prussienne* (1871); *Crania Ethnica*, jointly with Dr Hamy (2 vols., with 100 plates, 1875–82), a classical work based on French and foreign anthropological data, analogous to the *Crania Britannica* of Thurnam and Davis, and to S. G. Morton's *Crania Americana* and *Crania Aegyptiaca*; *L'Espèce humaine* (1877); *Nouvelles Études sur la distribution géographique des négritos* (1882); *Hommes fossiles et hommes sauvages* (1884); and *Histoire générale des races humaines* (2 vols., 1886–89), the first volume being introductory, while the second attempts a complete classification of mankind.

QUATREFOIL, in Gothic architecture, the piercing of tracery in a window or balustrade with small semicircular openings known as "foils"; the intersection of these foils is termed the cusp.

QUATREMÈRE, ÉTIENNE MARC (1782–1857), French Orientalist, the son of a Parisian merchant, was born in Paris on the 12th of July 1782. Employed in 1807 in the manuscript department of the imperial library, he passed to the chair of Greek in Rouen in 1809, entered the Academy of Inscriptions in 1815, taught Hebrew and Aramaic in the Collège de France from 1819, and finally in 1827 became professor of Persian in the School of Living Oriental Languages.

Quatremère's first work was *Recherches . . . sur la langue et la littérature de l'Égypte* (1808), showing that the language of ancient Egypt must be sought in Coptic. His translation of Makrizi's Arabic history of the Mameluke sultans (2 vols., 1837–41) shows his erudition at the best. He published among other works *Mémoires sur les Nabatéens* (1835); a translation of Rashīd al-Dīn's *Hist. des Mongols de la Perse* (1836); *Mém. géog. et hist. sur l'Égypte* (1810); the text of Ibn Khaldūn's *Prolegomena*; and a vast number of useful memoirs in the *Journal asiatique*. His numerous reviews in the *Journal des savants* should also be mentioned. Quatremère made great lexicographic collections in Oriental languages, fragments of which appear in the notes to his various works. His MS. material for Syriac has been utilized in Payne Smith's *Thesaurus*; of the slips he collected for a projected Arabic, Persian and Turkish lexicon some account is given in the preface to Dozy, *Supp. aux dictt. arabes*. They are now in the Munich library.

A biographical notice by M. Barthélemy Sainte-Hilaire is prefixed to Quatremère's *Mélanges d'histoire et de philologie orientale* (1861).

QUAY, MATTHEW STANLEY (1833–1904), American political "boss," was born in Dillsburg, York county, Pennsylvania, on the 30th of September 1833. He graduated at Jefferson College (now Washington and Jefferson College) in 1850 and was admitted to the bar in 1854. He served in various capacities in the Civil War, and in 1865–1867 was a member of the state House of Representatives, becoming secretary of the commonwealth in 1873–1878 and again in 1879–1882, recorder of Philadelphia in 1878–1879, and state treasurer in 1886–1887. He was chairman of the Republican national executive campaign committee in 1888, and was a member of the United States Senate in 1887–1899 and again in 1901–1904. For nearly twenty years he dominated the government of Pennsylvania, and also played a very prominent part in national affairs. In 1899 he was brought to trial on a charge of misappropriating state funds, and, although he was acquitted, the feeling among the reform element in his own party was so bitter against him that the legislature was deadlocked and his re-election was postponed for two years. He died on the 28th of May 1904.

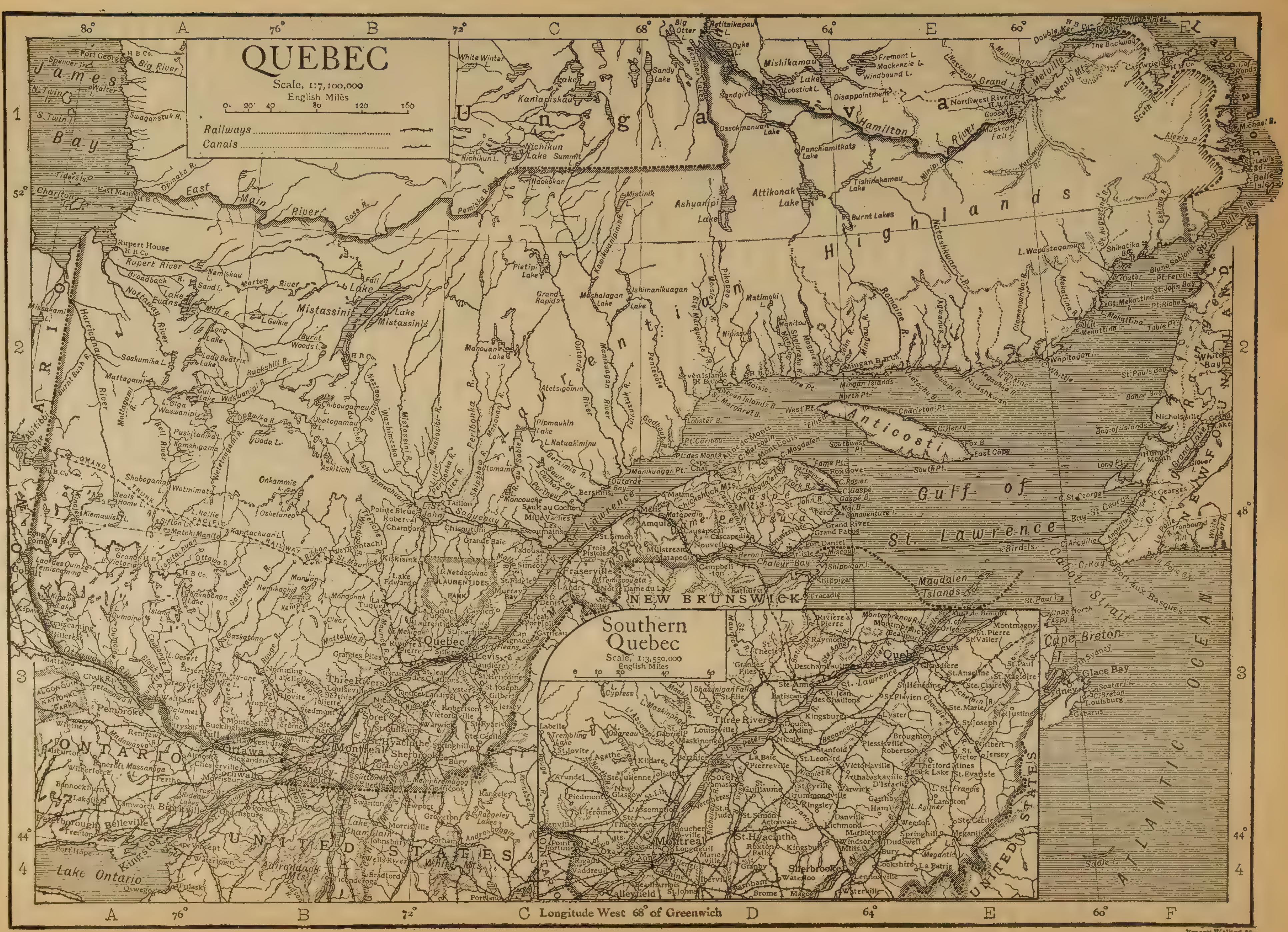
QUAY, a wharf or landing-place for the loading and unloading of water-borne cargo. The word, now pronounced like "key," takes the form of Fr. *quai*, older *cay* or *caye*, cf. Spanish *cayo*, a bar, barrier or reef. The earlier form in English is "kay," and it was so pronounced. "Key" was also earlier pronounced "kay," and the change in pronunciation in the one was followed also in the other. In spelling also the word was assimilated to "key," in the sense of a reef, or, especially, of the low range of reefs or islets on the coasts of Spanish America, *e.g.* on the coast of Florida, the chain of islets known as Florida Keys.

QUEBEC, a province of the Dominion of Canada, bounded S. by New Brunswick and the United States, W. by Ontario, N. by the district of Ungava, and E. by the gulf of St Lawrence and the strip of eastern Labrador which belongs to Newfoundland. If Ungava be considered as added to the province of Quebec, Hudson Strait is the northern boundary. The province includes the island of Anticosti, the Bird Islands and the Magdalen Islands, in the gulf of St Lawrence. The western boundary, separating Quebec from Ontario, extends through Point au Baudet on the river St Lawrence to Point Fortune on the Ottawa river, from which place the boundary follows the Ottawa to Lake Temiscaming. From the north end of this latter lake it runs due north to Hudson Bay. The province of Quebec thus extends from Blanc Sablon, a fishing harbour at the western end of the Strait of Belle Isle (which separates Canada from Newfoundland) in 59° 7′ W. to Lake Temiscaming in 79° 40′ W., a distance of about 1350 miles. The area of the province is 351,873 sq. m. The general direction of the province is north-east and south-west, following the course of its chief physical feature, the river St Lawrence. Speaking generally, it may be said that the province of Quebec comprises the hydrographical basin of the river St Lawrence as far west as the intersection of the parallel of 45° N. with the latter. The St Lawrence flows near the southern edge of its basin, only some 50,000 sq. m. of the area of the province lying south of the river.

The province of Quebec falls into three main physiographical divisions, viz.: (1) the Laurentian Highlands, (2) the Valley of the St Lawrence, and (3) the Notre Dame Mountains and the rolling country lying to the south-east of this range.

(1) The Laurentian Highlands are sometimes referred to as the "Laurentian Mountains," as they appear to constitute a mountain range when viewed from the gulf or the river St Lawrence. This portion of the province, however, is really a plateau having an elevation of 1000 to 2000 ft. above sea level, but this plateau north of latitude 55° falls away to lower levels toward Hudson Bay and Hudson Strait. Along the extreme eastern border of these Laurentian Highlands on the coast of Labrador, however, the country rises to much greater altitudes, forming an extremely rugged district which attains in places an elevation of 6000 ft. above sea-level. This plateau forms what is known as the Laurentian peneplain and is hummocky in character, the surface, however, being but slightly accentuated and the sky line seen from the higher points in the area being nearly level. It is densely wooded and everywhere abounds in lakes, great and small, lying either in basins etched in the rock surface by glacial action or else bounded by the irregularly distributed drift which more or less completely covers the surface of the underlying rocks. From these lakes issue very numerous streams tributary to the larger rivers. These lakes and rivers form so continuous a series of waterways that a traveller who knows their courses, and the portages connecting them, can traverse this immense tract of country in any direction by canoe. These streams also, cascading down from the elevated surface of the plateau to sea-level, afford immense water power, which is used to an increasing extent as the methods of long-distance electrical transmission of power become more and more perfect. These waters are, moreover, clear and pure, and the country is one in which malaria and similar diseases are unknown. Some of the rivers draining the Laurentian country run in very deep, high-walled valleys or fjords cut in the solid rock; a number of which, comparable in character although perhaps not in depth to those of Norway and Greenland, pass outward from the central portion of the peneplain north, east and south. As an example of such fjords in the province of Quebec, those occupied by the waters of the Hamilton, Mingan and Saguenay rivers may be cited as well as that, now partially silted up, which is occupied by Lake Temiscaming and the Mattawa river. The walls of solid gneiss between which the Saguenay flows are in places from 1500 to 1800 ft. in height, while the waters of the river in places reach a depth of 1400 ft.

This Laurentian country in the province of Quebec and its continuation into the adjacent province contain the chief timber


QUEBEC
Scale, 1:7,100,000
English Miles
0 20 40 80 120 160
Railways
Canals
Southern Quebec
Scale, 1:3,550,000
English Miles
0 10 20 40 60
Longitude West 68° of Greenwich
Ungava
Laurentian Highlands
Gulf of St. Lawrence
Anticosti
James Bay
ATLANTIC OCEAN
NEWFOUNDLAND
ONTARIO
NEW BRUNSWICK
UNITED STATES
Quebec
Montreal
Three Rivers
Lake Mistassini

Emery Walker Sc.

supplies of the Dominion, supplies which with a little husbanding on the part of the government could be made to afford a bountiful supply of timber for all future generations. The country also contains valuable mineral deposits, and is the great home of the fur-bearing animals of the Dominion. While, however, along the southern border it supports a considerable agricultural population, the Laurentian country cannot be considered as one which in respect to its agricultural capabilities can ever take rank with the southern portions of eastern Canada or with the great plains and British Columbia which lie to the west.

(2) That portion of the lowlands of the St Lawrence valley which belongs to the province of Quebec forms a wedge-shaped area extending along the river from a short distance below the city of Quebec to the western border of the province. It is throughout a practically level plain of very fertile land, on which are situated the chief towns and cities of the province, and on it also are settled the majority of the rural population. These lowlands are bounded on the north by the Laurentian plateau, and on the south by the Notre Dame Mountains, which physical features gradually converge, the latter mountains reaching the shore of the river St Lawrence a short distance to the east of the city of Quebec. The plain in this way gradually narrows on going to the north-east, and is finally closed off in that direction. It was a portion of this plain that was first occupied by the early French settlers. Much of its surface, as has been said, is absolutely level, and it nowhere exceeds an elevation of a few hundred feet. Its uniform expanse, however, is broken by a line of eight isolated hills composed of rocks of igneous origin, being a series of eroded remnants of ancient volcanoes which now rise abruptly from the plain and constitute the most striking features of the landscape. They are known as the Monteregian Hills and rise to elevations of 560 ft. to 1600 ft. above sea-level. From the summit of Mount Royal, at the foot of which lies the city of Montreal, all the other Monteregian Hills are plainly visible, and the margin of the Laurentian Highlands may be seen bounding the horizon some 30 m. to the north, while southward the Green Mountains, and the Adirondacks in the state of New York, are distinctly visible on a clear day.

(3) The Notre Dame Mountains and the Eastern Townships. The Appalachian Mountain range, passing out of the state of Vermont, where it is known as the Green Mountains, crosses into the province of Quebec between Lake Champlain and Lake Memphremagog, and becoming lower and less rugged continues in a north-easterly direction to a point about 30 m. south of the city of Quebec. Thence it pursues its course, following the general trend of the river St Lawrence at a varying distance from its southern margin, and reaches the latter river near Metis. From the border to this point the range is known as the Notre Dame Mountains. The highest peak in the Notre Dame Mountains is Sutton Mountain—3100 ft. Continuing on to the north-east it develops into the high land of the Gaspé Peninsula, of which the most elevated portion constitutes the Shickshock Mountains, the higher summits of which rise to elevations of 3000 to 4000 ft. above sea-level. The whole central area of the Gaspé Peninsula is a forest-clad wilderness.

To the south-east of the Notre Dame Mountains is an undulating country known as the "Eastern Townships." These hills, as mentioned above, are lower and less rugged than the Green Mountains, the general elevation of the country being from 500 to 1000 ft. above sea-level. There are a number of large and fine lakes in this district, among which may be mentioned lakes Metapedia, Temiscouata, Memphremagog, Aylmer, St Francis and Megantic.

In the belt of the Notre Dame Mountains the country is not in the strict sense of the term a mountainous one, but rather a rolling country containing much good farming and pasture land, while the Eastern Townships is a fine agricultural country, embracing some of the best farming and grazing land in the Dominion. This latter district was originally settled by Loyalists from the United States at the time of the revolt of the colonies, but is now being gradually occupied by French Canadians from the more northern portions of the province, the younger generation of English-speaking Canadians preferring to take up land and settle in Ontario or the western provinces of Manitoba, Saskatchewan, Alberta and British Columbia.

The whole country is exceptionally well watered and abounds in numerous large rivers, bays and lakes. The principal river is the St Lawrence, which flows through the entire length of the province. A short distance above Montreal it receives from the north-west the Ottawa, a large and beautiful river over 600 m. in length with many tributaries, among which the most important are the Gatineau, the Lièvre, the North, the Rouge and the Kinojevis. The St Lawrence is navigable for large ocean steamships as far as Montreal, beyond which place navigation is interrupted by rapids. The St Maurice rises in Lake Oskelaneo, flowing into the St Lawrence at Three Rivers, and is over 400 m. long. It has many tributaries, and drains an area of 21,000 sq. m. Twenty-four miles above Three Rivers on the St Maurice are the falls of Shawinigan, 150 ft. high, from which a large amount of electrical power is obtained, a portion of which is used in the production of aluminium, while several thousand horse-power are transmitted to the city of Montreal. The Batiscan river enters the St Lawrence at Batiscan. The Jacques Cartier, the Ste Anne and the Montmorency are northern tributaries of the St Lawrence. The Montmorency is famous for its falls, situated about 8 m. from Quebec city, and 250 ft. high. These beautiful falls, however, have in recent years been greatly reduced in volume, the water being largely employed for the development of electricity, and also for the supply of power to a large cotton-mill in the vicinity. Near these falls is Haldimand House, once the residence of the duke of Kent, father of Queen Victoria. The Saguenay rises in Lake St John and discharges into the St Lawrence at Tadousac after a course of 100 m. On the south side of the St Lawrence is the Richelieu river, which rises in Lake Champlain and enters the St Lawrence at Sorel on Lake St Peter. Champlain sailed up this river in 1609. Other important streams are the St Francis, rising in Lake Memphremagog; the Chaudière, rising in Lake Megantic, with its beautiful falls 125 ft. high about 10 m. above Quebec; the Chateauguay, Yamaska, Etchemin, du Loup, Assomption and Bécancour. Among the largest lakes in the province are Lake St John, which has an area of 360 sq. m.; Lake Temiscaming, having an area of 126 sq. m.; Lake Matapedia, Lake Megantic and Lake Memphremagog.

The largest islands in the province of Quebec are: Anticosti, now used as a game preserve; Bonaventure, an important fishing station to the east of Gaspé; and the Magdalen Islands, situated in the gulf of St Lawrence about 50 m. north of Prince Edward Island.

Geology and Minerals.—Beginning with the oldest rocks, the more northern part of the province of Quebec is underlain by the Laurentian system of Sir William Logan. This includes a great series of very highly altered sediments, largely limestones, known as the Grenville series, which is penetrated by great intrusions of anorthosite, &c., and is invaded by and rests upon enormous bathyliths of granite, which are sometimes referred to as the "Fundamental Gneiss." The Grenville series is best developed along the southern margin of the Laurentian Highlands between Three Rivers and the Georgian Bay. Two of the great anorthosite intrusions occur on the margin of the Laurentian country to the north of Montreal and about Lake St John. The Laurentian system is succeeded to the south by the Potsdam sandstone, probably equivalent to the Upper Cambrian of Britain. On this rests a dolomitic limestone—the Calciferous formation—and on this the great and highly fossiliferous limestones known as the Chazy and Trenton formations. These limestones afford the best building stone of the province, while the Potsdam sandstone is also frequently employed for building purposes. Above the Trenton is the Utica shale, rich in graptolites and trilobites. This is succeeded by the Hudson River group composed largely of sandstones and calcareous beds. These constitute the complete Ordovician succession. Upper Silurian and Devonian beds, the latter holding fossil plants and fishes, occur in the south-east portion of the province, while on the shore of Chaleur Bay these are succeeded by the lowest beds of the Carboniferous. No coal occurs in the province of Quebec. In the region of the Notre Dame Mountains and the Eastern Townships there are great intercalations of ancient volcanic rocks and many important mineral deposits. Among these may be mentioned gold, copper, asbestos and chromic iron ore; also serpentine, marble and roofing slates. The asbestos deposits are the most extensive and most productive in the world, the chief centre of asbestos mining being at Thetford Mines. A large part of the country, more especially on the lower levels, is covered with Pleistocene deposits of the so-called Glacial age. Till or boulder clay is usually at the base of these deposits. On this rests a finer stratified blue clay, in some places rich in fossil shells and known as the *Leda* clay. It affords a good material for the manufacture of bricks and tiles. Above the *Leda* clay are sands and gravels known as the *Saxicava* sand. This is also stratified and frequently contains an abundance of fossils. These stratified clays and sands are due to a re-sorting of the boulder clay by the action of water, and imply a submergence at the close of the Glacial period with a subsequent elevation. In certain alluvial deposits in the vicinity of the St Maurice river there occur deposits of bog iron ore which have been worked for many years.

Climate.—The climate of Quebec is variable. In the winter the cold is generally steady and the atmosphere clear and bracing. About Montreal snow lies on the ground from the end of November until the following April, affording good sleighing for four months in the year. The inhabitants enjoy with zest and spirit all the outdoor sports common in the country, such as skating, curling, tobogganing, snowshoeing, ski-ing and sliding. The snowfall is heavy, and though the winds are often sharp they are not often raw or damp, nor is there any fog. The summer is warm and pleasant. The extreme heat is indicated at 90° F. The finest season of the year is the autumn, which lasts about six or eight weeks. The following is a table of temperatures as recorded by the meteorological stations at certain points in the province:—

Table showing Normal Temperature, Precipitation &c., at various Stations in the Province of Quebec.

	Latitude.	Longitude.	Altitude.	Average Mean Temperature.			Precipitation.
				Summer.	Winter.	Year.	
			Feet.				Inches.
Anticosti, W. Pt.	49° 52′	64° 32′	15	55° 8′	14° 2′	35° 4′	35·89
Bird Islands	47° 51′	61° 8′	125	55° 4′	20° 7′	38° 2′	28·76
Chicoutimi	48° 25′	71° 5′	150	61° 7′	6° 1′	35° 3′	20·38
Quebec	46° 48′	71° 13′	296	63° 6′	12° 3′	38° 4′	41·98
Brome	45° 10′	72° 36′	678	63° 6′	14° 8′	40° 2′	35·35
Montreal	45° 30′	73° 35′	187	66° 9′	15° 6′	42° 0′	39·24
Cape Magdalen	49° 16′	65° 20′	93	57° 8′	13° 9′	37° 1′	31·55

The normal percentage of bright sunshine at Montreal is 41 and at Quebec 39, a higher average than northern Europe. (F. D. A.)

Area and Population.—The boundaries of Quebec have been more than once enlarged since 1867. By the extension given to them in 1898, the province has an area of 351,873 sq. m., of which 341,756 sq. m. are land and 10,117 sq. m. are water. This estimate includes the islands of Orleans, Anticosti, and the Magdalen group, but not the gulf of St Lawrence or the territorial seas. In 1901 the population was 1,648,898, 992,667 being classed as rural and 656,231 as urban. Since 1891 the rural population has increased but little, but there has been a growth of about 11% in the population of the towns and cities. No province has taken so small a share in the development of the West. True to his ancestral instincts, the French-Canadian remains close to the place of his birth. If he emigrates, it is to the neighbouring cities of New England or to the eastern districts of the province of Ontario. On the other hand, in the rural parts of the province, the French are driving out the English-speaking settlers, especially in the south-western counties, settled by Loyalists at the close of the War of American Independence, and known as the Eastern Townships. Nearly 98% of the population are Canadian-born. Of these over 80% are of French descent; of the remainder about 7% are English, 7% Irish and 4% Scots. Save to the city of Montreal there is little immigration; but so prolific are the French that the population of the province increases as fast as that of the rest of the Dominion, in which to the natural increase is added a large immigration. The census gives the number of the average family as 5·36, but families with twelve and eighteen children are not uncommon. The English-speaking population is almost wholly confined to the towns, especially Montreal, in which city it controls the chief shipping and commercial interests. Of the original inhabitants about 8000 Indians remain, chiefly on reserves in the neighbourhood of Montreal and Quebec. Though quite peaceful, they are on the whole less civilized than those of eastern and southern Ontario. The capital is Quebec, with a population of about 70,000, which increases but slowly. The largest city is Montreal, the commercial and shipping centre of the Dominion, at the head of ocean steamship navigation, with a population of about 350,000. Other cities are Hull (practically a suburb of Ottawa; pop. in 1901, 13,993); Sherbrooke (11,765); Three Rivers (9981); Lévis (7783).

The French, Irish and Indians are almost entirely of the Roman Catholic faith; a majority of the English are Anglican, with some Methodists; the Scots are Presbyterian. The Roman Catholic Church enjoys extensive rights and privileges, and nowhere in the world is devotion to that faith more widespread or more unquestioning.

Administration.—As in all the provinces, the executive power is nominally vested in a lieutenant-governor, appointed for five years by the federal government, and assisted by an executive council (or cabinet) who have seats in, and are responsible to, the local legislature. In reality the lieutenant-governor is a figure-head, and power is in the hands of the legislature, which consists of two houses, a Legislative Council, appointed nominally by the lieutenant-governor, really by the premier, and an Assembly, chosen by what is practically manhood suffrage. Either French or English may be used in addressing either house. The municipalities have large powers of local government, which are used with more or less efficiency, the predatory tendencies of the ward-politician being sometimes apparent, though of late years an improvement has been effected. The finances of the province are drawn from the same sources as those of Ontario (*q.v.*). Their administration has not been so economical as in the sister province, and there is a net provincial debt of over £4,000,000.

Education.—In primary education Quebec is still behind the other provinces, but great progress has been made since Federation; illiteracy is decreasing, and 80% of the population over five years of age can read and write. The Council of Public Instruction is divided into two committees of equal number, a Catholic and a Protestant, and all ratepayers are allowed to state whether they prefer their taxes to go to the Protestant or to the Catholic school. Both religious bodies have combined to carry out this system with very little friction or proselytizing. The Catholic schools are controlled by the clergy, the episcopate forming, *ex officio*, one-half of the Catholic section of the council. In the cities of Quebec and Montreal the schools are efficient and the teachers well paid; but in the rural districts the schools, especially those of the Catholics, are often inadequate, the buildings being poor, and the teachers receiving a mere pittance, in some cases less than £20 per annum. Over 95% of the teachers in the primary schools are women. The great majority of the schools are controlled by the council, but there are also a number of independent schools, primary and secondary, usually under religious control; of these the so-called "Collèges Classiques," supported by the Catholic Church, are the most important. The chief universities are McGill (undenominational), at Montreal (founded 1820), and Laval (Roman Catholic) (founded 1852), with its headquarters at Quebec, and with a large branch at Montreal. (See MONTREAL and QUEBEC CITY). There is also a small Anglican university, that of Bishop's College, Lennoxville (founded 1853), in connexion with which is Bishop's College school, on the model of the public schools of England. To McGill is affiliated a well-equipped Agricultural College established at Ste Anne de Bellevue by Sir William Macdonald (b. 1832), at a cost of over £2,000,000; and to Laval an Agricultural School at Oka, founded in 1893 by the Trappist Fathers. There are numerous normal and model schools, the most important being that of Ste Anne de Bellevue in connexion with Macdonald College.

Agriculture.—The French Canadian is a thrifty though somewhat unprogressive farmer, and loves the land with an even greater attachment than do the peasants of old France. Till recently his agriculture was of a very domestic character. He grew enough wheat to grind into flour, and enough oats to feed his horses; raised sheep whose wool his wife spun into rough cloth in the winter evenings; and even grew his own tobacco. Now his horizon is widening, and his imports and exports are increasing. The general climatic conditions are much the same as in Ontario, and the crops are similar. All the chief cereals are successfully cultivated, oats being the chief crop. The wise care of both federal and provincial governments has fostered the dairy farming of the province. In 1906 over £4,200,000 of cheese was produced, and over £5,200,000 of butter. Most of the butter is made in well-equipped creameries, in the number of which Quebec exceeds any other province; in exports of cheese she equals Ontario. In the production of fruit she ranks second to Ontario, Nova Scotia coming third. Perhaps the most typical Canadian industry, the making of syrup and sugar from the sap of the maple tree as it rises in the spring, centres in this province. Over two-thirds of the tobacco grown in the Dominion is raised in Quebec, about 10,000 acres being under cultivation. At first of a coarse character, it is improving in quality. The total annual value of the agricultural produce of the province is about £18,000,000, about half that of Ontario. Several agricultural and dairy schools are supported or assisted by the provincial government, and much good is being done by the Agricultural College at Ste Anne de Bellevue.

The province still possesses large areas of crown land, which is sold at a nominal price to *bona fide* settlers. In the northern part of the province new and fertile areas have been opened up by the Grand Trunk Pacific railway.

Forests.—Next to agriculture in importance are the various industries which depend on the products of the forest. Over 150,000 sq. m. of forest land are still uncleared, chiefly in the northern part of the province, though the best timber is said to grow south of the watershed. In the north, pine, spruce, and fir predominate, and, farther south, the maple; spruce, lime (linden, bass-wood, *Tilia Americana*) and poplar, are used extensively in the making of paper pulp. The annual value of the wood cut in the province is about £4,000,000, rather less than that of Ontario, and not quite two-fifths that of the whole Dominion. An export duty is levied on all pulp wood exported.

Fur and Fish.—The value of the annual catch of fish is estimated at £450,000, most of which consists of the product of the cod and herring fisheries in the gulf of St Lawrence. From Isle Verte eastward almost all the settlers along the coast depend largely on the produce of this industry. It is carried on mainly in small boats, which put out in the morning and return at nightfall, few large vessels being employed. Throughout the province are numerous trout-streams, and many of the northern lakes are well supplied with trout, bass and pike. In Lake St John is caught the celebrated winninish, a land-locked salmon growing to the size of six or eight pounds, and well known to anglers. Moose, deer, bear and other animals provide excellent shooting in the Laurentian mountains, and in the wooded districts of the north.

Manufactures.—In manufactures Quebec ranks second among the provinces, Ontario coming first. The largest Canadian manufacturing town is Montreal, where most of the industries are controlled by the English-speaking minority. No other part of the Dominion is so rich in water power, which is provided to a limitless extent by the falls of the rivers Montmorenci, St Maurice (Shawinigan Falls), Ste Anne, the rapids on the St Lawrence and the Richelieu, and many others. Tanning, and the making of paper pulp and of furniture, prosper on account of the great forests of the province. The French-Canadian workman is hardy and intelligent, and Quebec may yet become the manufacturing centre of the Dominion, though as yet higher wages are paid in the American cities across the border, and thousands of French-speaking workmen are employed in the factories of Lowell and other American border towns.

Communications.—The rivers were long the chief roads, by water in summer, over the ice in winter; but though the St Lawrence is still the main artery of the province, the bulk of travel and of transport is now done by rail. The first railway in Canada was built in 1830 to carry stone from the wharves to aid in the construction of the citadel of Quebec. The first passenger railway was built in 1836, between Laprairie on the St Lawrence river and St John's on the Richelieu. There is now good railway communication between all the chief points, and branch lines are opening up new areas to settlement. While a few main roads are kept in good condition, those in the country parts are very indifferent.

BIBLIOGRAPHY.—The various departments of the provincial government publish annual reports on a great variety of subjects. The annual *Canada Year Book*, published by the Federal Government, gives much information in a tabular form. Interesting articles are contained in J. Castell Hopkins, *Canada; an Encyclopaedia* (Toronto, 1898–1900). The legal enactments in which the municipal system is embodied are found in the Revised Statutes of the province (Acts 4178–4640). On education and religion A. Siegfried, *Le Canada; les deux races* (1905; translated into English under the title of *The Race Question in Canada*, 1906), is well-informed and impartial. (W. L. G.)

QUEBEC, the capital of the Canadian province of the same name, situated on the north bank of the river St Lawrence, at its junction with the St Charles, about 300 m. from the gulf of St Lawrence and 180 m. by river N.E. of Montreal, in 71° 12′ 19″·5 W. and 46° 48′ 17″·3 N. The origin of the name Quebec has been much disputed, but it is apparently the Algonkian word for a strait, or sudden narrowing, the river at its junction with the St Charles being about 2500 yds. wide, but narrowing opposite Cape Diamond to 1314.

Quebec is built on the northern extremity of an elevated tableland which forms the left bank of the St Lawrence for a distance of 8 m. The highest part of the headland is Cape Diamond, 333 ft. above the level of the water, and crowned by the citadel; towards the St Lawrence it presents a bold and precipitous front, while on the landward side and towards the St Charles the declivity is more sloping and gradual. The harbour of Quebec is spacious and deep enough to hold the largest ships, and, with the Louise basin and Lorne graving-dock,—the latter on the opposite shore at Lévis,—forms one of the best harbours in America. It is usually open from the end of April to the middle of December, being closed by ice during the winter. The Louise basin consists of twin wet-docks and tidal harbours, with areas of 40 and 20 acres respectively, and a minimum depth of 26 ft. The harbour is protected towards the north-east by the island of Orleans, on either side of which there is an approach, though that to the north of the island is used only by small vessels. The spring tides rise and fall about 18 ft. Quebec is divided into upper and lower town,—access to the former being obtained by steep and winding streets, by several flights of narrow steps, or by an elevator. Much of the lower town still recalls the older portions of such French provincial towns as Rouen or St Malo. The streets, with one or two exceptions, are narrow and irregular; but it remains the principal business quarter of the city. In the upper town, where the streets are wider and well paved, are the better class of dwelling-houses and public buildings, most of the churches, the public walks and gardens, and many of the retail shops. To the west are the suburbs of St John and St Roch. The latter occupies the lower plain, and is of some commercial importance; the former is on the same level as the upper town. South-west of St John stretch the historic Plains of Abraham. On this battleground stands a simple column 40 ft. high, marking the spot where General Wolfe fell. It was erected in 1849 by the British army in Canada, to replace a monument erected in 1832 by the governor-general, Lord Aylmer, which had been broken and defaced by ruffians. Till 1908 the Plains were also disfigured by a gaol and a rifle factory, but these have been removed, and the battleground converted into a public park. In the governor's garden, which overlooks the St Lawrence, is a monument 65 ft. in height, erected in 1828 under the administration of Lord Dalhousie, dedicated to the memory of Wolfe and Montcalm. An iron pillar surmounted by a bronze statue, the gift of Prince Jerome Napoleon, stands on the Ste Foy road, and was erected in 1855–60 to commemorate the achievements of the British and French troops in the brilliant but fruitless French victory of April 28, 1760. The chief point of interest in the upper town is Dufferin Terrace, a magnificent promenade overlooking the St Lawrence, 1400 ft. long and 200 ft. above the level of the river. Part of this terrace occupies the site of the old Château St Louis, which was destroyed by fire in 1834. At the eastern end of the terrace stands a fine statue of Champlain, erected in 1898. Near by, and conspicuous from the river, is the Hotel Frontenac, erected by the Canadian Pacific railway on the model of an old French château. Nothing remains of the fortifications erected under the French régime. The present walls and the citadel, which covers an area of about 40 acres, were built in 1823–32 at a cost of over £7,000,000. Since then, several of the gates have been destroyed, and others rebuilt, but in other respects the walls are practically intact, and, though obsolete as fortifications, add greatly to the picturesque beauty of the city. Between 1865 and 1871 three forts were built on the Lévis side of the river, but were neither manned nor armed. Quebec's natural position still makes it one of great military strength, though depending on naval control of the sea and of the gulf of St Lawrence.

Besides numerous Protestant churches, including a small Anglican cathedral, there is a Jewish synagogue; but the bulk of the population is Roman Catholic. The cathedral, founded in 1647, and enlarged at intervals, is a large but not very striking building in the upper town. It contains some good oil paintings and some much-prized relics, but is rather garish in its ornamentation. Of the numerous other churches, the most interesting is Notre Dame des Victoires, in the lower town, erected in 1688, and named in honour of the defeat of Phips in 1690 and the shipwreck of Sir Hovenden Walker in 1711. Laval University, which derives its name from François de Montmorency Laval, the first bishop of Quebec, who founded in 1663 a seminary for the training of priests, is under strict Roman Catholic control. It was instituted in 1852 by a royal charter from Queen Victoria and in 1876 received a charter from Pope Pius IX. The building is large and spacious, and the university includes faculties of theology, law, medicine and arts, a library of 125,000 volumes, a museum and a picture gallery. A large branch of the university has been established at Montreal, and has often, but vainly, sought permission to become an independent Catholic university. In connexion with Laval are the grand seminary founded in 1663, where theology is taught, and the minor seminary for literature and philosophy. Other Roman Catholic institutions are Laval Normal and Model School, the Ursuline Convent, the Convent of the Good Shepherd and several nunneries. The convent and church of the Ursulines, founded in 1641, contains nearly 100 nuns and lay sisters, and nearly 600 pupils. It possesses some excellent paintings and a number of relics, among which is the skull of the French general, Montcalm. Morrin College, founded in 1859 by Dr Morrin, was for some years an efficient college in arts and theology, under Presbyterian control, but is now defunct. High schools for boys and girls and numerous academies are supported by the Protestants, under the dual system of education in the province. The Literary and Historical Society—the oldest chartered institution of the kind in Canada, founded by Lord Dalhousie in 1824—the Canadian Institute, the Geographical Society, the Young Men's Christian Association, the Advocates' Library and the Parliamentary Library, have valuable collections of books, the latter containing 70,000 volumes, and numerous MSS. chiefly relating to the early history of the province. The principal benevolent institutions are the marine hospital, the Hôtel Dieu, founded in 1639 by the duchess of Aiguillon, the general hospital (1693), the Jeffrey Hale Hospital, and the lunatic asylum at Beauport controlled by the Grey Nuns (sisters of charity). The provincial parliament buildings, erected in 1878–92, are situated in extensive grounds on Grande Allée. The main building is quadrangular in form, and is ornamented with numerous statues. The seat of the lieutenant-governor is at Spencerwood, a pleasant country estate outside the city. Other prominent buildings are the palace of the Roman Catholic Archbishop, which adjoins Laval University, the court house, post office, custom house, city hall (1890–95) and masonic hall. Quebec is well lighted with gas and electric light, and has a system of electric tramcars, a plentiful supply of power being obtained from the Montmorency Falls (268 ft. in height), 6 m. N.E. The climate is severe, but bracing, the mean temperature in winter being 10°, in summer 68°, and the mean of the year 39°. The main lines of the Grand Trunk, Canadian Pacific and Intercolonial railways are on the south bank of the St Lawrence, but branch lines connect the city with Montreal, and it is the headquarters of the Quebec and Lake St John, and various smaller railways. Steam ferries connect the city with Lévis on the opposite bank, but the project of a bridge, though of great importance to the city, has been in various ways delayed. In August 1907 the portion completed fell into the St Lawrence.

The city returns three members to the Canadian House of Commons, and three to the Provincial House of Assembly. It is governed by a mayor and council of aldermen, who hold office for two years, and are usually re-elected, one mayor having held office for eleven successive years. Quebec is the seat of a Roman Catholic archbishop and of an Anglican bishop. Economically, Quebec was long the chief port of Canada. A series of strikes almost ruined its export trade, and numerous severe fires, of which that of 1845 was the chief, also lessened its importance. For many years the export trade passed almost entirely to Montreal, but the increasing size of seagoing vessels makes navigation above Quebec more and more difficult, especially for fast passenger steamships, and for such vessels Quebec is again becoming the terminus. Quebec's staple export is timber, the greater portion of which comes from the Ottawa and St Maurice districts. Formerly the rafts floating down the river were collected in the coves which extend along both sides of the river, above the city, and were fastened by booms along the banks. Now much of the timber is sent by rail. On the right bank of the stream, not far from Quebec, are extensive sawmills. Deals and square timber form the bulk of the export, but some furniture is also sent, and an increasing quantity of wheat is shipped. The building of wooden ships was formerly one of the chief industries of Quebec. The principal manufactures are iron castings, machinery, cutlery, nails, leather, rifles, gunpowder, musical instruments, boots and shoes, paper, india-rubber goods, ropes, tobacco, steel. The population increases but slowly, having risen from 59,699 in 1871 to 68,840 in 1901; of these over 60,000 are French and Roman Catholic.

The first known white man to visit Quebec was Jacques Cartier, the French navigator, in 1535, who found on the site a large Indian village, called Stadacona. In July 1608 the present city was founded, and named by Champlain. Its growth was slow, and in 1629 it had but two permanently settled families, with a shifting population of monks, officials and fur traders. In that year it was captured by the English under Sir David Kirke (1597–1656; see H. Kirke, *The First English Conquest of Canada*, London, 1871, reprinted 1908), but in 1632 it was restored to the French by the treaty of St Germain-en-Laye. In 1663 the colony of New France was created a royal province, and Quebec became the capital. In 1690 Sir William Phips, governor of Massachusetts, attempted to reconquer it with a fleet and army fitted out by New England, but was defeated by the French governor, Frontenac. In 1711 a great British expedition sent against it under Sir Hovenden Walker was shipwrecked in the gulf of St Lawrence, and the French held possession till 1759 (see below), when it was captured by the British troops on the 18th of September, five days after the battle of the Plains of Abraham; it was finally ceded to Great Britain by the treaty of Paris in 1763. In 1775 the American generals Montgomery and Benedict Arnold attacked the city, but Montgomery was killed (December 31, 1775) and Arnold was compelled to retreat in the following spring.

In 1763–1841, in 1851–55, and in 1859–65 Quebec was the capital of Canada, and it is still its most historic and picturesque city.

See *Quebec under Two Flags*, by A. G. Doughty and N. E. Dionne (Quebec, 1903). *Canada, an Encyclopaedia*, by J. C. Hopkins (Toronto, 1898–1900), has a good account (vol. v. pp. 241–248). (W. L. G.)

Wolfe's Quebec Expedition, 1759.—Both in itself and also as the central incident of the British conquest of Canada, the taking of Quebec is one of the epics of modern military history. The American campaigns of the Seven Years' War, hitherto somewhat spasmodic, were, after Amherst's capture of Louisburg in 1758, co-ordinated and directed to a common end by that general, under whom James Wolfe, a young major-general of thirty-three years of age, was to command an expedition against Quebec from the lower St Lawrence, while Amherst himself led a force from New England by Lake Champlain on Montreal. Wolfe's column consisted of about 7000 troops, and was convoyed by a powerful fleet under Admiral Saunders. The expedition sailed 300 m. up the St Lawrence, disembarked on the Isle of Orleans and encamped facing the city. The defenders were commanded by Montcalm, a soldier whose character and abilities, like Wolfe's, need no comment here. The French were superior in numbers, though a considerable part of their force was irregular; but they had the defender's difficult task of being strong everywhere. Wolfe began the attack by seizing Point Lévis, and thence bombarding Quebec. This, however, affected the main defences of the upper city but little, and they were moreover protected from closer attack by the St Lawrence and the St Charles. The third side of the triangle was the "plains of Abraham," to which it was thought there was no approach from the river. After wasting some weeks, therefore, Wolfe decided to cross the St Lawrence 7 m. below Quebec and to fight his way to the city by the St Charles side. But Montcalm's fortified posts spread out from Quebec through Beauport as far as the Montmorency, and this formidable obstacle checked the English advance at the outset. No artifice could lure the defenders away, and at last Wolfe attacked the line of the Montmorency and was repulsed with heavy loss (July 31). Wolfe's fragile health gave way under the disappointment, and despondency set in in the English camp. But as soon as the young leader had recovered a little, he summoned his brigadiers and worked out a plan for attacking by the upper waters and the heights of Abraham. Access to the heights could be obtained, it was found, by a tiny cove (Wolfe's cove), from which a steep footpath led to the summit. It was no place for artillery, and even for infantry the climb was long and exhausting, but the attempt was made. Considered as a way of taking Quebec, it was in the last degree a forlorn hope, but Wolfe, as a true soldier, felt the imperative necessity of preventing his opponent from sending reinforcements to the force opposing Amherst, and staked everything upon achieving this at least. "Happy if our efforts here," as he wrote, "can contribute to the success of His Majesty's arms in any other part of America." What with losses in action and by sickness, and detachments to guard the camps and batteries, only 3600 men could be spared for the attempt. These embarked on the warships on the evening of September 12, and sailed up stream. The watchful Montcalm sent a detachment to observe their movements, but the ships proceeded to a point well above the cove, luring the detachment out of the way. Then at 1 a.m. Wolfe, with half his force, dropped down stream in the boats of the squadron and landed. The path was guarded by a redoubt, but the light infantry which led the advance scarcely attempted to follow it, scrambling up the hillside wherever they could find a foothold. The garrison of the redoubt, startled by the unforeseen attack, abandoned the work, and by daylight Wolfe had assembled his 3600 men on the plains above the city. Montcalm meanwhile had been held in check by a demonstration of part of the fleet under Admiral Saunders on Beauport, but at last, realizing that the real attack was coming from the other flank, he hurried all the troops he could collect over the St Charles and drew them up on the plain, with their backs to the walls of the upper town. He took the offensive at once. He had plenty of militiamen and irregulars, and these rapidly drove the British light infantry on to their main body, which was threatened on both flanks. On so small a battlefield, the troops in Wolfe's line of battle quickly became aware that the enemy was attacking in superior force. But their leader steadied them by his personal example, and when the French came within close range one "perfect volley" from the whole line decided the battle. Then as the French stopped, with great gaps in their lines, Wolfe led on his men to complete the victory. He received two painful wounds and then a shot through the breast. His last order, one rare indeed in the annals of 18th-century fighting, was to send a force to the St Charles bridge to cut off the retreat of the French. Montcalm too was mortally wounded, and died next day. On the 18th of September Quebec surrendered.

QUEBEC ACT, the title usually given to a bill introduced into the House of Lords on May 2, 1774, entitled "An Act for making more Effectual Provision for the Government of the Province of Quebec, in North America." It passed the House of Lords on May 17, was discussed in the Commons from May 26 to June 13, and finally passed with some amendments. These were accepted by the Lords, in spite of the opposition of Lord Chatham, and the bill received the royal assent on June 22. The debates in the House of Commons are not found in the Parliamentary History, but were published separately by J. Wright in 1839. The speech of Lord Chatham is given in the *Chatham Correspondence* (iv. 351–353).

By this act the boundaries of the Canadian province of Quebec were extended so as to include much of the country between the Ohio and the Mississippi. The French inhabitants of the province were granted the liberty to profess "the religion of the Church of Rome"; the French civil law was established, though in criminal law the English code was introduced. Government was vested in a governor and council, a representative assembly not being granted till the Constitutional Act of 1791.

The granting of part of the Western territory to Quebec, and the recognition of the Roman Catholic religion, greatly angered the American colonies. On the other hand, it did much to keep the French Canadians from joining the Americans in the coming struggle. The act is still looked back to by the French in Canada as their great charter of liberty.

QUEDLINBURG, a town of Germany in the Prussian province of Saxony, situated on the Bode, near the N.W. base of the Harz Mountains, 12 miles S.E. by rail from Halberstadt on the line Magdeburg-Thale. Pop. (1905) 24,798, almost all Protestants. It consists of the old town, which is still partly surrounded by a turreted wall, the new town and four suburbs. On the west it is commanded by the castle, formerly the residence of the abbesses of Quedlinburg, connected with which is the interesting Schlosskirche, which was dedicated in 1129 and completely restored in 1862–82. The German king, Henry the Fowler, his wife Matilda, and Aurora, countess of Königsmark, the mistress of Augustus the Strong, are buried in the Schlosskirche. There are many interesting articles in the treasury. The Gothic town hall, a 14th-century building, restored and enlarged in 1900, contains a collection of antiquities, and near it stands a stone figure of Roland. The town also possesses a gymnasium founded in 1540 and now containing the abbey library and a municipal museum. It has a fine memorial of the war of 1870–71. Quedlinburg is famous for its nurseries and market gardens, and exports vegetable and flower seeds to all parts of Europe and America. Its chief manufactures are iron goods, machinery and cloth, and it has a trade in grain and cattle. Near the town is the church of St Wipertus, which dates from the 12th century, and has a crypt of the 10th century.

Quedlinburg was founded as a fortress by Henry the Fowler about 922, its early name being Quitlingen. Soon it became a favourite residence of the Saxon emperors and was the scene of several diets. It afterwards joined the Hanseatic League. The abbey of Quedlinburg was planned by Henry the Fowler, although its actual foundation is due to his son Otto the Great. It was a house for the daughters of noble Saxon families and was richly endowed, owning at one time a territory about 40 sq. m. in area. The abbesses, who were frequently members of the imperial house, the second of them being Otto's daughter Matilda, ranked among the princes of the empire, and had no ecclesiastical superior except the pope. The town at first strove vigorously to maintain its independence of them, and to this end invoked the aid of the bishop of Halberstadt. In 1477, however, the abbess Hedwig, aided by her brothers, Ernest and Albert of Saxony, compelled the bishop to withdraw, and for the next 200 years both town and abbey were under the protection of the elector of Saxony. In 1539 the townsmen accepted the reformed doctrines and the abbey was converted into a Protestant sisterhood. In 1697 the elector of Saxony sold his rights over Quedlinburg to the elector of Brandenburg for 240,000 thalers. The abbesses, however, retained certain rights of jurisdiction, and disputes between them and the Prussian government were frequent until the secularization of the abbey in 1803. The last abbess was Sophia Albertina (d. 1829), sister of King Charles XIII. of Sweden. After forming for a few years part of the kingdom of Westphalia, the abbey lands were incorporated with Prussia in 1815.

See the *Urkundenbuch der Stadt Quedlinburg*, edited by Janicke (Halle, 1873–82); Ranke and Kugler, *Beschreibung und Geschichte der Schlosskirche zu Quedlinburg* (Berlin, 1838); Lorenz, *Alt-Quedlinburg*, 1485–1698 (Halle, 1900); and Huchs, *Führer durch Quedlinburg*. For the history of the abbey see Fritsch, *Geschichte des Reichsstifts und der Stadt Quedlinburg* (Quedlinburg, 1828).

QUEEN (O.E. *cwen*, wife, related to "quean," O.E. *cwene*, a hussy; cf. Gr. γυνή: from root *gan-*, to produce; cf. *genus*, "kin," &c.), the title of the consort or wife of a king ("queen consort"), or of a woman who is herself the sovereign ruler of a state ("queen regnant"); the widow of a former reigning sovereign is a "queen dowager," and, when the mother of the reigning sovereign, a "queen mother."

For the position of the queen in English constitutional law see Consort, and for her household see Household, Royal.

QUEEN ANNE'S BOUNTY, the name applied to a perpetual fund of first-fruits and tenths granted by a charter of Queen Anne, and confirmed by statute in 1703 (2 & 3 Anne, c. 11), for the augmentation of the livings of the poorer Anglican clergy. First-fruits (*annates*) and tenths (*decimae*) formed originally part of the revenue paid by the clergy to the papal exchequer. The former consist of the first whole year's profit of all spiritual preferments, the latter of one-tenth of their annual profits after the first year. In accordance with the provisions of two acts (5 & 6 Anne, c. 24, and 6 Anne, c. 27) about 3900 poor livings under the annual value of £50 were discharged from first-fruits and tenths. The income derived from first-fruits and tenths was annexed to the revenue of the crown in 1535 (26 Hen. VIII. c. 3), and so continued until 1703. Since that date there has been a large mass of legislation dealing with Queen Anne's Bounty, the effect of which will be found set forth in a *Report of a Joint Select Committee on the Queen Anne's Bounty Board*, 1900. The governors consist of the archbishops and bishops, some of the principal officers of the government, and the chief legal and judicial authorities. The augmentation proceeds on the principle of assisting the smallest benefices first. All the cures not exceeding £10 per annum must have received £200 before the governors can proceed to assist those not exceeding £20 per annum. In order to encourage benefactions, the governors may give £200 to cures not exceeding £45 a year, where any person will give the same or a greater sum. The average income from first-fruits and tenths is a little more than £16,000 a year. In 1906 the trust funds in the hands of the governors amounted to £7,023,000. The grants in 1906 amounted to £28,607, the benefactions to £29,888. The accounts are laid annually before the king in council and the houses of parliament. The duties of the governors are not confined to the augmentation of benefices. They may in addition lend money for the repair and rebuilding of residences and for the execution of works required by the Ecclesiastical Dilapidations Acts, and may receive and apply compensation money in respect of the enfranchisement of copyholds on any benefice. The governors are unpaid; the treasurer and secretary receives a salary of £1000 a year. He is appointed by patent under the great seal, and holds office during the pleasure of the crown.

QUEENBOROUGH, a municipal borough in the Faversham parliamentary division of Kent, England, in the Isle of Sheppey, close to the junction of the Swale and Medway, 2 m. S. of Sheerness on the South-Eastern & Chatham railway. Pop. (1901) 1544. The prosperity of the town has been revived in modern times by the establishment by the railway company of a branch line from Sittingbourne in connexion with a service of mail and passenger steamers to Flushing (Holland), which run twice daily. The first copperas factory in England was established at Queenborough in 1579, by Matthias Falconer, of Brabant. In 1890 Portland cement works were built, and there is a large trade in timber. The town is governed by a mayor, 4 aldermen and 12 councillors. Area, 302 acres.

A fortress, called Sheppey Castle, is said to have existed from an early period for guarding the passage of the Swale river. Queenborough Castle was built about 1361 by Edward III., who named the town after Queen Philippa and made it a free borough, with a governing body of a mayor and two bailiffs. Charters were granted by subsequent sovereigns down to Charles I., who reincorporated the town under the title of the mayor, jurats, bailiffs and burgesses of Queenborough. The castle never had any military history, and having been seized by parliament together with the other royal possessions, and being considered of insufficient importance for repair, was demolished during the Commonwealth. The borough subsequently decreased in importance. The chief part of the population were employed in the oyster fishery. The town was first represented in parliament by two members in 1572; it lost its franchise by the Reform Act of 1832.

QUEEN CHARLOTTE ISLANDS, a compact group lying off the northern part of the coast of British Columbia, and forming part of that province of Canada. Geologically the group is composed mainly of Triassic, Cretaceous and Tertiary strata, penetrated by intrusive rocks. It occupies a position similar to that held by Vancouver Island farther to the south, in regard to the mainland coast and its immediately adjacent islands, but is separated by a somewhat wider sea from the coast. It was named by Captain Dixon, who visited the islands in the "Queen Charlotte" in 1787. Although the islands promise to become important, because of their excellent harbours, the discovery of good seams of bituminous coal (beside the anthracite already known), their abundant timber of certain kinds and their prolific fisheries, but little settlement has taken place. The wonderfully productive halibut fisheries of Hecate Strait, which separates these islands from the mainland and its adjacent islands, have attracted the attention of fishing companies, and great quantities of this fish are taken regularly and shipped across the continent in cold storage. The natives, the Haida people, constitute with little doubt the finest race, and that most advanced in the arts, of the entire west coast of North America. They had developed in its highest degree the peculiar conventional art of the north-west coast Indians, which is found in decreasing importance among the Tsimshians on the west, the Tlingit on the north and the Kwakiutl and other tribes farther south on the Pacific coast. The carved totem posts of the Haida, standing in front of the heavily framed houses, or at a little distance from them, represent the coats of arms of the respective families of the tribes and generally exhibit designs treated in a bold and original manner, highly conventionalized but always recognizable in their purport by any one familiar with the distinctive marks of the animal forms portrayed. These primitive monuments are, however, rapidly falling to decay, and the people who erected them are becoming reduced in number and spirit. The native population of the islands is less than 700. (F. D. A.)

QUEENSBERRY, EARLS, MARQUESSES AND DUKES OF. The Queensberry title, one of the many with which the Scottish house of Douglas is associated, originated in the creation of Sir William Douglas (d. 1640) as earl of Queensberry in 1633. He was the eldest son of Sir James Douglas of Drumlanrig (d. 1616). His grandson William, the 3rd earl (1637–1695), was created marquess of Queensberry in 1682 and duke of Queensberry in 1684; he was lord justice general and an extraordinary lord of session. He was also lord high treasurer of Scotland, and served James II. as lord high commissioner to the parliament of 1685, but in 1686 he was deprived of his offices. He had assented to the accession of William and Mary and had again enjoyed the royal favour before he died on the 28th of March 1695. His son James Douglas, the 2nd duke (1662–1711), was born at Sanquhar Castle on the 18th of September 1662, and was educated at the university of Glasgow, afterwards spending some time in foreign travel. At the Revolution of 1688 he sided with William of Orange and was made a privy councillor; after he had become duke of Queensberry in 1695 he was appointed an extraordinary lord of session and keeper of the privy seal. He was the royal commissioner to the famous Scottish parliament which met in 1700, and just after the accession of Anne in 1702 he was made one of the secretaries of state for Scotland. In the latter part of 1703 he came under a temporary cloud through his connexion with the Jacobite intriguer, Simon Fraser, Lord Lovat, who had utilized Queensberry's jealousy of the duke of Atholl to obtain a commission from him to get evidence in France which would implicate Atholl. The plot was betrayed by Robert Ferguson, and Queensberry was deprived of his offices. However, in 1705 he was restored and in 1706 he was again commissioner to the Scottish parliament; in this capacity he showed great ability in carrying through the treaty for the union of the two crowns, which, chiefly owing to his influence and skill, was completed in 1707. For this he was very unpopular in Scotland, but he received a pension of £3000 a year. In 1708 he was created duke of Dover and marquess of Beverley, and he obtained a special remainder by which his titles were to pass to his second surviving son Charles, and not to his eldest son James, who was an idiot. In February 1709 he was appointed third secretary of state, and he died on the 6th of July 1711.

Charles Douglas, the 3rd duke (1698–1778), who had been created earl of Solway in 1706, was lord justice general from 1763 until his death in October 1778. In 1720 he married Catherine, daughter of Henry Hyde, 4th earl of Clarendon; this lady, a famous beauty, although very eccentric, was the friend of many of the wits and writers of her day, notably of Gay, Swift and Walpole. She died on the 17th of July 1777. Their two sons predeceased the duke, and when he died his British titles, including the dukedom of Dover, became extinct, but the Scottish titles passed to his cousin, William, 3rd earl of March (1724–1810).

This William Douglas, who now became the 4th duke of Queensberry, is best known by his soubriquet of "Old Q." On the turf he was one of the most prominent figures of his time, and his escapades and extravagances were notorious. From 1766 to 1776 he was vice-admiral of Scotland, and in 1760 he was made a lord of the bedchamber by George III.; but later he was an associate of the prince of Wales, being removed from his office in the royal household in 1789. A generous patron of the stage and of art, he was to the end of his life a "noble sportsman" of the dissolute type, and his degeneracy was the theme both of Wordsworth and of Burns. He died unmarried, but not without children, in London on the 23rd of December 1810. The dukedom of Queensberry and some of his other titles, together with his fine seat Drumlanrig Castle, now passed to Henry Scott, 3rd duke of Buccleuch, in whose family they still remain; but the marquessate of Queensberry descended to Sir Charles Douglas (1777–1837), the representative of another branch of the Douglas family, who became the 5th marquess.

John Sholto Douglas, 8th marquess of Queensberry (1844–1900), son of Archibald William, the 7th marquess (1818–1858), became a well-known patron of sport and particularly of pugilism. He helped to found the Amateur Athletic Club in 1860, and the new rules for prize-fighting, drawn up in 1867, were called after him the "Queensberry Rules." He married the daughter of Alfred Montgomery, and was succeeded by his son, Percy Sholto, 9th marquess (b. 1868).

QUEENSCLIFF, a town of Grant county, Victoria, Australia, 68 m. by land and 32 by sea S.W. by S. of Melbourne. Pop. (1901) 2025. It lies on Shortlands Bluff, a small peninsula connected with the mainland by the Narrows, a contracted strip of land some 400 yds. broad. Queenscliff is a favourite watering-place, having a fine pier and excellent and safe sea-bathing. It is also a pilot station; and the quarantine station for vessels entering Port Phillip is near the town.

QUEENS'S COUNTY, a county of Ireland, in the province of Leinster, bounded N.W. and N. by King's County, E. by Kildare, S. by Carlow and Kilkenny, and W. by Tipperary; area, 424,723 acres, or about 664 sq. m. The surface is for the most part level or gently undulating, but in the north-west rises into the elevations of the Slieve Bloom Mountains, the highest summit being Arderin, 1733 ft. In the central part of the county there is a large extent of bog. The south-east portion is included in the Leinster coalfield. Nearly the whole of the county is drained either by the Barrow, which has its source in the Slieve Bloom Mountains, and forms at various points the boundary with King's County, Kildare and Carlow, or by the Nore, which enters the county from Tipperary near Borris-in-Ossory, and flows east and then south till it reaches Kilkenny. The lakes are few and small, the largest being Lough Anaghmore on the north-western boundary. The Grand Canal enters the county at Portarlington, and runs southwards to the Barrow in Kildare, a branch passing westwards 12 miles to Mountmellick.

The limestone plain prevails in this county, but the high coalfield, shared with Kilkenny and Carlow, rises from it in the south; while the Slieve Bloom Mountains, a round-backed Old Red Sandstone mass with Silurian inliers, dominate the lowland west of Maryborough. The limestone itself produces a range of hills near Stradbally, on which the fortress of Dunamase stands conspicuously. Esker-gravels provide sandy soils in many places. Clay-ironstone was formerly raised in connexion with the anthracite from the coalfield.

The climate is dry and healthy. Originally a great extent of the surface was occupied with bog, but by draining much of it has been converted into good land. For the most part it is very fertile except in the hilly districts towards the north, and there is some remarkably rich land in the south-east. The acreage under pasture is not quite twice that of tillage. Dairy-farming is extensively practised. Agriculture forms the chief occupation, but the manufacture of woollen and cotton goods is carried on to a small extent. The main line of the Great Southern & Western railway traverses the county from N.E. to S.W. by way of Portarlington and Maryborough; from the latter town branches run N. to Mountmellick and S. to Waterford, and from Ballybrophy a line runs W. to Birr (Parsonstown) and to Limerick.

The population (63,855 in 1891; 57,417 in 1901) decreases in excess of the average of the Irish counties, and emigration is considerable. Of the total about 88% are Roman Catholic, and almost the whole is rural. Maryborough (the county town, pop. 2957), Mountmellick (2407) and Mountrath (1304), with Portarlington (1943, partly in King's County), are the principal towns. The county is divided into eleven baronies. Ecclesiastically it is in the Protestant dioceses of Dublin, Killaloe and Ossory, and in the Roman Catholic dioceses of Kildare and Leighlin, Ossory and Killaloe. Assizes are held at Maryborough, and quarter sessions at Abbeyleix, Borris-in-Ossory, Graigue (a suburb of Carlow), Maryborough, Mountmellick and Stradbally. The county is divided into the Leix and Ossory parliamentary divisions. To the Irish parliament two members were returned for the county and two each for the boroughs of Ballinakill, Maryborough and Portarlington.

The territory now included in Queen's County covered the districts of Leix, Slewmargy, Irry and part of Glenmaliry, until in 1556 it was made shire ground under the name of Queen's County, in honour of Queen Mary, the place chosen for the county town being named Maryborough. Three miles south of Stradbally is Dun of Clopook, an ancient dun or fort occupying the whole extent of the hill. Aghaboe, where there are the ruins of the abbey, was formerly the seat of the bishopric of Ossory. There are no remains of the abbey of Timahoe founded by St Mochua in the 6th century, but in the neighbourhood there is a fine round tower, 96 ft. high. Abbeyleix, a small market town south of Maryborough, had a famous Cistercian foundation of the 12th century. The church of Killeshin, in the S.E. of the county, exhibits fine carving of the Norman period. Among the principal old castles are the ruined fortress of the O'Mores occupying the precipitous rock of Dunamase, 3 m. E. of Maryborough, Borris-in-Ossory on the Nore, and Lea Castle on the Barrow, near Portarlington, erected by the Fitzgeralds about 1260, burnt by Edward Bruce in 1315, again rebuilt, and in 1650 laid in ruins by the soldiers of Cromwell.

QUEENSFERRY, a royal and police burgh of Linlithgowshire, Scotland. Pop. (1901) 1850. It is situated on the S. side of the Firth of Forth, 9 m. by road N.W. of Edinburgh and about 1 m. from Dalmeny station on the North British railway, and is sometimes called South Queensferry, to distinguish it from the Queensferry on the opposite shore. Of old it was the ferry giving access to Dunfermline and other places on the north side of the firth, its use in this respect by Margaret, the queen of Malcolm Canmore, originating its name; just as Port Edgar, ½ m. W., was named after her brother, Edgar Atheling. The Hawes Inn, which figures in Scott's *Antiquary*, was the terminus of the run from Edinburgh in the coaching days. Queensferry became a burgh of royalty in 1363, a royal burgh in 1639 and a police burgh in 1882, and belongs to the Stirling district group of parliamentary burghs (with Stirling, Culross, Dunfermline and Inverkeithing). The principal structures include, besides the small parish church of Dalmeny (the best example of pure Norman in Scotland), the Countess of Rosebery Memorial Hall (erected in 1893 by the earl of Rosebery), a library and reading-room, and a public hall which also does duty as a town hall. A Carmelite friary was converted into an Episcopal chapel in 1890. There is a large oil-works in the parish. Dalmeny House, the seat of the earl of Rosebery, lies in beautifully wooded grounds about 2 m. E. of the ferry. In the park, on the seashore facing Drum Sands, stands Barnbougle Castle, a building of unknown age which became the seat of the Mowbrays in the 12th century. After passing into the hands of the earls of Haddington, it was purchased in 1662 by Sir Archibald Primrose, an ancestor of the earl of Rosebery. The castle was thoroughly restored in 1880. Dundas Castle, 1½ m. S. of Queensferry, was a seat of the Dundases from 1124 to 1875, was besieged in 1449, received a visit from Cromwell in 1651 and was partly rebuilt about 1850. Hopetoun House, nearly 3 m. W. of the ferry, was begun about 1696 from the plans of Sir William Bruce of Kinross and completed by Robert Adam. It is the seat of the marquess of Linlithgow. Abercorn, a little to the west, gave the title of duke to a branch of the Hamiltons. It was the site of an ancient monastery, and from 681 to 685 the see of the earliest bishopric in Scotland.

QUEENSLAND, a state of the Australian commonwealth, occupying the whole of the north-eastern portion of the Australian continent, and comprising also the islands in Torres Strait. (For map, see AUSTRALIA.) It lies between 10° and 29° S., and is bounded on the N. by Torres Strait and the Gulf of Carpentaria, on the W. by South Australia and the Northern Territory, on the S. by New South Wales and on the E. by the Pacific Ocean. It has an area of 668,497 sq. m., a coast-line of 3000, is 1250 m. long and 950 m. wide at its widest part.

With so extensive a seaboard Queensland is well favoured with ports on the Pacific side. Moreton Bay receives the Brisbane river, on whose banks Brisbane, the capital, stands. Maryborough port is on the Mary, which flows into Wide Bay; Bundaberg, on the Burnett; Gladstone, on Port Curtis; Rockhampton, up the Fitzroy (Keppel Bay); Mackay, on the Pioneer; Bowen, on Port Denison; Townsville, on Cleveland Bay. Cairns and Port Douglas are near Trinity Bay; Cardwell is on Rockingham Bay; Cooktown, on the Endeavour; Thursday Island port, near Cape York; and Normanton and Burketown near the Gulf of Carpentaria. The quiet Inner Passage, between the shore of the Great Barrier Reef, 1200 m. long, favours the north-eastern Queensland ports. Brisbane was founded in 1826, but colonization was restricted until 1842, when the Moreton Bay district of New South Wales was thrown open to settlers. It was named "Queensland" on its separation from the mother colony in 1859. A broad plateau, from 2000 to 5000 ft. in height, extends from north to south, at from 20 to 100 m. from the coast, forming the Main Range. The Coast Range is less elevated. A plateau goes westward from the Great Dividing Range, throwing most of its waters northward to the gulf. The Main Range sends numerous but short streams to the Pacific, and a few long ones south-westward, lost in earth or shallow lakes, unless feeding the river Darling. Going northward, the leading rivers, in order, are the Logan, Brisbane, Mary, Burnett, Fitzroy, Burdekin, Herbert, Johnstone and Endeavour. The Fitzroy receives the Mackenzie and Dawson; the Burdekin is supplied by the Cape, Belyando and Suttor. The chief gulf streams are the Mitchell, Flinders, Leichhardt and Albert. The great dry western plains have the Barcoo, Diamantina, Georgina, Warrego, Maranoa and Condamine. (T. A. C.)

Geology.—Queensland consists geologically of three areas. The eastern division of the state, including all the Cape York Peninsula and the mountainous areas behind the coast, is occupied by the Queensland Highlands, which are built up of a foundation of Archean and contorted Lower Palaeozoic rocks, upon which rest some sheets of comparatively horizontal Upper Palaeozoic and Mesozoic rocks. The rocks of the Highlands sink to the west below the Western Plains, which consist in the main of a sheet of Cretaceous clays, capped by isolated ridges and peaks of Desert Sandstone. In the far west the plains end against the foot of an Archean tableland, which is the north-eastern projection of the Western Plateau of Australia.

The oldest rocks in Queensland are gneisses and schists, which appear to underlie the whole of the state. They were originally regarded as metamorphosed Silurian rocks, ~~which had~~ been converted into gneiss, mica-schists and hornblende-schists. Their Silurian age was affirmed owing to their lithological resemblance to rocks in Victoria, which were then regarded as Silurian, but have since been shown to be Archean. The gneisses and schists occupy the Barklay Tableland, the Cloncurry Goldfield and the rocks of the Mackinlay district in the west of the state. The second chief Archean area is around Charters Towers and the Cape Goldfield; it includes quartzites, conglomerates and slates, striking from north-west to south-east. The third Archean area occupies the Gilbert, Woolgar and Etheridge Goldfields, and is composed of schists trending from west to east, and with dikes of diorite and quartz-porphyry. Smaller Archean outcrops occur south of Bowen in the Clarke Range and on the Peak Downs. To the Archean series doubtless belong some of the many granitic massifs, including those of Charters Towers, Ravenswood and Croydon; but some of the granitic rocks are of Lower Carboniferous age, and some are apparently Mesozoic.

The Lower Palaeozoic sedimentary rocks are widely distributed, but owing to the rarity of fossils they are not well known. In the south-west of Queensland there are some Ordovician rocks, the eastern continuation of those in the Macdonnell Ranges. Silurian limestones occur in the mining field of Chillagoe and at Mount Wyatt. The Upper Palaeozoic systems are well developed, even when many of the schists, which have been included in the Devonian, are eliminated. The Middle Devonian is represented by the Burdekin limestones, which contain a rich fossil fauna corresponding to the Bucban and Bindi limestones of Victoria. The Middle Devonian limestones occur on the Marble and Hunter Islands in the Northumberland Archipelago. The Devonian rocks in the Pentland and Gilbert district are estimated by Jack to be over 20,000 ft. in thickness; but they probably include some Lower Palaeozoic beds.

The Queensland Carboniferous system is divided into five series—the Gympie, Star and the three divisions of the Bowen beds. The lowest series is the Gympie, which occurs between Brisbane and Maryborough. It consists of shales and sandstones, and is traversed by dikes of diorite, which often contain pyrites and gold. The age of these gold-bearing rocks is proved by the presence of such fossils as *Productus cora* and *Protoretepora ampla*. The Gympie series is well developed in the districts of Burnett, Broad Sound Bay and Wide Bay, along the coast from Port Curtis to the south of Cape Palmerston. The Gympie beds are greatly contorted; and those of the Star series are regarded as younger, because they are less disturbed. They are best known in the basins of the Great and Little Star rivers, tributaries of the Upper Burdekin. They are best developed on the Belyando river and in the Drummond Range, where the shales and sandstones yield abundant fossil fish; on the Star river the shales contain *Lepidodendron*. The Bowen beds are divided into three series which represent the upper part of the Carboniferous. The Lower Bowen series consists of agglomerates and altered rocks exposed in the Toussaint Range; farther south, the Lower Bowen beds consist of grits, sandstones and shales, which have been altered by some granitic intrusions. The Middle Bowen series contains beds with *Productus cora* and *Glossopteris*. The Upper Bowen beds contain coal seams, abundant remains of *Glossopteris* and one marine band. They form the centre of the basin of the Bowen coalfield; while the Middle Bowen beds outcrop in a band around it. The Upper Bowen beds occur also at Townsville and Cooktown in Northern Queensland.

The rocks of the Mesozoic group may be divided into two divisions, of which the lower includes terrestrial deposits containing coal seams; the upper is mainly a marine formation, but it terminates with a further development of terrestrial deposits. The Lower Mesozoic division includes the Burrum and Ipswich series. The Burrum series occurs along the eastern coast from Laguna Bay, through Wide Bay and Maryborough, to Blackwater Creek; and it extends inland for about 30 m., where it is faulted against the Gympie beds. The western edge of the Burrum beds are described as highly altered in places, by contact with granites. The Ipswich series occupies 12,000 sq. m. in the south-eastern corner of Queensland, and is the northern continuation of the Upper Clarence series of New South Wales. It contains coal seams which have been worked, though the coal is of inferior value to that of the Carboniferous of New South Wales. One seam, on Stewarts Creek, near Rockhampton, is 26 ft. thick. Interbedded basalts occur in the Ipswich beds, forming the scarp of the Toowoomba Range. The Burrum and Ipswich beds have been included in the Trias and the Jurassic, or in both systems as the Trias-Jura, but according to A. C. Seward their characteristic fossil, *Taeniopteris daintreei*, is of Lower Oolitic age.

The Cretaceous system is represented by a lower group of marine clays forming the Rolling Downs formation. They are said to rest conformably upon the Ipswich beds, and some of the fossils found in these beds were first described as Upper Oolitic. The affinities of the fauna are in part with Lower Cretaceous and in part with the Cenomanian; so both these series may be represented. The Rolling Downs formation consists in the main of clays, forming the impermeable cover over the subterranean stores of water, which maintain the flowing wells of central Australia. The Rolling Downs formation underlies the whole of the Western Plains of Queensland, from the foot of the Queensland Highlands, westward to the Barklay Tableland; and it extends from the Gulf of Carpentaria on the north, across the state into South Australia and New South Wales. The Desert Sandstone overlies the Rolling Downs formation. Its age is shown to be Upper Cretaceous by some marine fossils from Maryborough and Croydon, which are said to be from rocks interbedded in it. In the interior, the Desert Sandstone is entirely of terrestrial and lacustrine origin, and the only fossils are obscure plant remains and the silicified trunks of trees. *Glossopteris* has been collected on Betts Creek from a rock identified as Desert Sandstone, which is said to overlie the Rolling Downs formation; but there is probably some mistake in the stratigraphy, as *Glossopteris* is only found in Coal Measures which are clearly of Palaeozoic age. If it had survived into the Cretaceous, some specimens of it would doubtless have been obtained from the coal seams of the Lower Mesozoic. The Desert Sandstone once covered nearly three-quarters of Queensland, having a wider range than the Rolling Downs formation. It was formed partly on land, partly in fresh-water lakes and partly in arms of the sea, as at Croydon and Maryborough. There is no trace of volcanic rocks in this period, and the vitreous surface of the Desert Sandstone is due to the deposition of efflorescent chert. The Desert Sandstone formation has now been weathered into isolated plateaus and tent-shaped hills.

The Cainozoic group includes many volcanic rocks, mainly sheets of basalt, as at Townsville and Hughenden. Near Herberton, between the head of the Burdekin and the Einasleigh River, the basalts occupy 2000 sq. m. of country. Their age appears to be Oligocene, as they probably correspond with the oldest Cainozoic basalts of Victoria. Volcanic rocks of a later period occur north of Cooktown, and in the Einasleigh River, where the eruptive centres are recognizable; and a series of hot springs, some of which are described as geysers, represent the last stage of volcanic activity. The most important Cainozoic sedimentary rocks are the bone breccias, made up of bones of extinct marsupials, such as *Diprotodon*, *Thylacoleo* and giant Kangaroos. They appear to have been bogged in the mud by drying water holes, during droughts. The bones also occur in beds of gravel and sand, and they have been found in places covered by 188 ft. of overlying deposits. Caves occur in the limestones, and on their floors there are beds yielding bones of marsupials and extinct birds; but no well authenticated case of the ancient remains of man has yet been established.

The chief mineral product of Queensland is gold, found in veins in Archean, Palaeozoic and Lower Mesozoic rocks. The most famous gold mines are Mount Morgan, now changing into a copper mine, Charters Towers and Gympie. Tin is found in the fields of Herberton, Cooktown and Stannary Hills. Copper occurs near Herberton, Chillagoe and Mungana, coal in southern Queensland in the Upper Carboniferous and Lower Mesozoic deposits.

A full account of the geology of Queensland up to 1892 is given in Jack and Etheridge's *Geology of Queensland*. The tectonic geology of the coast-line has been described by E. C. Andrews, and the general geology is described in the numerous valuable publications of the Geological Survey of Queensland. A summary of the mineral resources was issued by the Queensland government in 1901. Information regarding the artesian water supply is given in the Annual Reports of the Queensland Hydraulic Engineer.
(J. W. G.)

Flora.—The Queensland flora comprehends most of the forms peculiar to Australia, with the addition of about five hundred species belonging to the Indian and Malayan regions. There are no mountain ranges of sufficient altitude to make any appreciable change in the plant-life. Bellenden Ker, the highest mountain in tropical Australia, has a height of only 5200 ft., and the plants growing upon its summit, as well as on the highest parts of the neighbouring mountains, are for the most part similar to those on the low lands in the southern parts of the state, and the plants which may be considered as peculiar to these heights are few in number of species. They consist of a *Leptospermum* and a (?) *Myrtus*, which attain a height of about 30 or 40 ft., and have widespreading, densely leaved heads. The most attractive of the tall shrubs are *Dracophyllum Sayeri*, of which there are two forms, *Rhododendron Lochae* and *Orites fragrans*. A few orchids of small growth are met with, but the only large species known to inhabit these localities is the normal form of *Dendrobium speciosum*. These high spots have a few ferns peculiar to them, and of others it is the only known Australian habitat; for instance, the pretty white-fronded Java Bristle-fern (*Trichomanes pallidum*) has only so far in Australia been met on the south peak of Bellenden Ker; here also *Todea Fraseri* may be seen with trunks 2 to 3 ft. high. The sides of these mountains are clothed by a dense forest scrub growth, some of the trees being very tall, but diminishing in height towards the summits. Palms and fern-trees are plentiful, but the greatest variety are met with at about 4000 ft. altitude. So far this is the only known habitat of that beautiful fern-tree *Alsophila Rebeccae* var. *commutata*, peculiar for the wig-like growth at the summit of its stem, which is formed by the metamorphosed lower pinnae and pinnules.

The Myrtaceous genus *Eucalyptus*, of which sixty species are found, furnishes the greater part of what is designated "Hardwoods," the kinds being variously termed "Box," "Gum," "Ironbark," "Bloodwood," "Tallow-wood," "Stringy-bark," &c. These are mostly trees of large size. Other large trees of the order which supply hard, durable timber are the broad-leaved tea-tree (*Melaleuca leucadendron* and others), "Swamp Mahogany" (*Tristania suaveolens*), "Brisbane Box" (*T. conferta*), "Turpentine" (*Syncarpia laurifolia*), "Peebeen" (*S. Hillii*), "Penda" (*Xanthostemon oppositifolius*). These are most generally cut at sawmills. Other orders, however, furnish equally serviceable, large-sized timber, particularly the following:—"Sour Plum" (*Owenia venosa*, Meliaceae), "Red Cedar" (*Cedrela Toona*), "Crow's Ash" (*Flindersia australis*, Meliaceae), "Burdekin Plum" (*Pleiogynium Solandri*, Anacardiaceae); "Bean-tree" (*Castanospermum australe*, Leguminosae), "Johnstone River Teak" (*Afzelia australis*, Leguminosae), "Ringy Rosewood" (*Acacia glaucescens*, Leguminosae), "Black Walnut" (*Cryptocarya Palmerstoni*, Laurineae), "Hill's Teak" (*Dissiliaria baloghioides*). Many trees yield wood particularly adapted for carving and engraving, such as the "Native Pomegranate" (*Capparis nobilis*), the "Native Orange" (*Citrus australis*), "Sour Plum" (*Owenia acidula*), "Ivorywood" (*Siphonodon australe*). Coachbuilders and wheelwrights use the wood of many myrtaceous trees and several others, with Flindersias (Meliaceae), whilst tool-handles are also formed from these and other trees. There is also a large variety of woods suited for cabinet-making and building. A large number furnish tannin barks, gums, &c. The tannin barks are mostly derived from various kinds of acacia. Three spice barks, locally known as sassafras, are employed for flavouring—in the northern parts, *Daphnandra aromatica*, a Monimiaceous tree, and *Cinnamomum Tamala*; and in the southern parts *Cinnamomum Oliveri*. Many indigenous plants are used in domestic medicines, and several are recognized in the Pharmacopaeia, such as Eucalypts, Cinnamomums, Sideroxylons, Alstonias, Duboisias and Pipers.

With regard to fodder-plants, no country is better furnished; there are many herbs and a large number of salt bushes and other shrubs, which form excellent auxiliaries to the food supply for stock. It is, however, to the grasses that the excellence of the pastures is mainly due. On the extensive plains where the best species abound may be seen a large number of the genus *Panicum*, of which the following are looked upon with the greatest favour:—"Vandyke grass," a form of *P. flavidum*, "Cockatoo grass" (*P. semialatum*), on the roots of which a species of cockatoo, in some parts of North Queensland, feeds; "Barley grass" (*P. decompositum* and *P. distachyum*); "Blue grass" (*Andropogon sericeus*, *A. pertusus*, *A. refractus*, and *A. erianthoides*); "Russell River grass" (*Paspalum galmarra*, nearly allied to the South American species *P. paniculatum*, *P. minutiflorum*, and *P. brevifolium*, *Agropyrum scabrum*); "Tall Oat grass" (*Anthistiria avenacea*); "Landsborough grass" (*Anthistiria membranacea*); *Danthonia racemosa*, *D. pilosa*, *D. pallida*, and *D. semiannularis*; *Sporobolus Benthami*, an excellent species found near the Diamantina and Georgina rivers, and *S. actinocladus*; *Stipa aristiglumis*, *Leptochloa chinensis*, *Microlaena stipoides*; "Early spring grass" (*Eriochloa punctata*), with the following "Love grasses":—*Eragrostis Brownii*, *E. chaetophylla*, *E. pilosa* and *E. tenella*. The "Mitchell grasses" (*Astrebla pectinata*) and its varieties, viz. the Wheat (*triticoides*), the weeping (*elymoides*) and the curly (*curvifolia*), are those that have the most extraordinary vitality, but some stockholders consider that the "Sugar grass" or "Brown Top" (*Pollinia fulva*) surpasses them in its quickness of bursting into leaf with the first showers of rain.

Amongst the fruits are *Antidesma Bunius*, *A. Dallachyanum*, *A. erostre*, *A. Ghaesembilla*, and *A. parvifolium*, called cherries or currants according to the size of the fruit they bear, the jelly made from the fruit of some species being in nowise inferior to that made from the European red currant. The Kumquat or lime of Southern Downs country (*Atalantia glauca*) makes a peculiarly nice-flavoured preserve. Of the allied genus *Citrus* two species are met with in the south, *C. australis*, which has a round fruit 1 to 2 in. in diameter; the other, *C. australasica*, with long finger-like fruits 3 or more inches long and about 1 in. in diameter; of this a red variety (*C. inodora*), which is only met with in the tropics, bears a fruit often 2½ in. long by 1¼ in diameter. All these fruits are juicy, and of an agreeably sharp, acid flavour. "Davidson's Plum" (*Davidsonia pruriens*) is a fruit with a sharply acid, rich, plum-coloured juice, sometimes attaining the size of a goose's egg. Of the genus *Eugenia*, over thirty are indigenous, and fully one-third produce more or less useful fruits. One Fig (*Ficus gracilipes*) produces a fruit used for jam and jelly. Two Garcinias are recorded as indigenous, but of one only (*G. Mestoni*) is the fruit known. It is of a depressed globular form, sometimes 3 in. in diameter, very juicy, and of a pleasant flavour. *Leptomeria acida*, one of the very early fruits used by Australian colonists, is met with in some localities. The "Finger Berry" or "Native Loquat" (*Rhodomyrtus macrocarpa*) makes a good jam, but is in bad repute for use in the raw state, perhaps owing to a peculiar fungus at times found to infest the berries. The Queensland Raspberry (*Rubus rosaefolius*) is widely spread and commonly used, but the fruit is rather insipid. The representatives of the genus *Vitis* all belong to the sub-genus *Cissus*; several of them, although somewhat acrid, are useful for jam and jelly: probably the best for the purpose is one met with near the Walsh River, *V. Gardineri*, which is said to bear bunches from 1 ℔ to 2 ℔ in weight, the berries being large and of pleasant flavour. A large number of nut-like fruits are used by the aborigines for food, but the only one used by the white population is the fruit of *Macadamia ternifolia*, the Queensland nut.

The foliage of many plants yields by distillation essential oils, particularly Eucalypts, Backhousias and other Myrtaceous plants, as well as some belonging to Rutaceae and Labiatae, especially the genus *Mentha*. Apart from plants of economic value, there is a profusion of ornamental plants, shrubs, trees and parasites. Of ferns, one-half of the kinds met with in Australia are found in Queensland as well as in the other states, one-fourth in Queensland alone, the remaining fourth belonging to the other states, but not to Queensland. The indigenous ferns equal in number those of New Zealand, and are three times the number of those of Great Britain.

Fauna.—The land fauna of Queensland is essentially one with that of the entire continent. But the geographical position of the state, which exposes it to the climatic and transporting influences of the intertropical Pacific, has to a notable extent impressed on its fauna characters of its own. It has thus been made the headquarters of Australian bird-life on land and fish-life at sea, the moisture of its coastal regions and the warmth of its tidal waters being eminently favourable to that wealth of insect and other low types of life which determines the multiplication of the higher. The quadrupeds of Queensland are of the ordinary Australian type already described. Of the predominant class, the marsupials, one of the most interesting forms is the Tree-Kangaroo (*Dendrolagus*), as, apart from the habit of climbing trees, which is shared to some extent by the Rock-Wallabies, they afford a proof of the one-time continuity of the fauna with that of the islands to the north, when land communication still existed between the two areas. Of these curious animals, two species at least are known. As to the rest of the marsupials, there is of course a general resemblance to those of the continent as a whole, but this is accompanied by much evolution of forms, especially among the smaller sorts, recognized by differences which are occasionally sufficient to mark off distinct generic, or even more differentiated groups. The larger Kangaroos are pretty conservative in character everywhere, while the common Wallabies, the Rock-Wallabies and the Kangaroo-Rats exhibit a greater tendency to differ from their southern and western kindred. The Koala, or native Bear, is almost absolutely invariable, a sign of the antiquity of the race. The Opossums and the so-called Flying-Opossums are not many in species, and are dwarfed descendants from a more flourishing ancestry. The Bandicoot family (Peramelidae) is fairly represented; it includes the rabbit-bandicoot, which crosses in its eastern range the western border of the country. Carnivorous marsupials of destructive powers are few; the largest of them, the spotted-tailed native cat (*Dasyurus maculatus*), is the most troublesome. Superior in size to the domestic cat, this pretender to the rank of cat is able to devastate a whole hen-roost in a single night, and is even said by the aboriginals to attack their infants. With the exception of a smaller species of the same kind, and a brush-tailed ally very much smaller, but yet able to kill a fowl with a single bite, the rest (marsupial mice) are but partly carnivorous, chiefly insectivorous, and therefore useful. This fauna is now fortunately deprived of the *Thylacinus* (Native Tiger) and *Sarcophilus* (Native Devil), which have been driven by physical changes southwards to Tasmania, and, it was thought until lately, of the Wombats, but a new species of these inoffensive burrowers has recently been discovered within the southern borders of the state. One other peculiarity in the form of a marsupial mammal is the little Musk-Rat (*Hypsiprymnus*), inhabiting those northern scrubs which are so prolific in other animal forms foreign to the rest of Australia, and seem to have received some of their denizens from the Malay Archipelago and some from the Papuan Islands. The remarkable deposits of fossil bones, extending in patches throughout the length of the country, are sufficient proof that in former times a much larger number of animals were supported by it than are now to be found within its borders. Queensland has only one native carnivorous beast, the dingo, not a marsupial. Rats and mice of native origin are in considerable variety; among them are the Jumping Rats (*Hapolotis*), Jerboa-like little animals, which are seldom seen. The bats are of several species; the most notorious of them are the great fruit-bats, or flying-foxes, which the fruit grower could well enough spare. The Sirenian mammal, the dugong, haunts nearly the whole of the coast-line. The Echidna, a porcupine ant-eater, and the playtpus are met with in the south. Batrachians are limited to the frogs and their nearest allies—that is, to the tailless division of the order, the tailed batrachians (newts, &c.) being, as far as is known at present, entirely absent. The greater part of the frogs are arboreal in habit, the most familiar being the large Green Tree Frog. The exuberance and diversity of their food have doubtless been the cause of their differentiation into many distinct species, which enables them to play a very useful part in checking the undue increase of noxious insects. Snakes, on the other hand, are in too great variety for human interests, as they live very largely on insect-feeders. The great majority belong to the venomous Colubridae, but fortunately the kinds of which the bite is more or less deadly are not numerous, and snake-bite is one of the rarest causes of death. Those with the worst reputation are the Black Snake and the Orange-bellied Black Snake (*Pseudechis*), the Brown Snake (*Diemansia*), the Keeled Snake (*Tropidechis*), and the Death Adder (*Acanthopis*). The principal non-venomous species are the Pythons or constricting snakes, *e.g.* the common Carpet Snake (*Morelia*), the long lithe Tree Snake (*Dendrophis*) and the Fresh-water Snake (*Tropidonotus*). The Black-headed Rock Snake (*Aspidiotes*), one of the Pythons, is said to reach the length of from 20 to 25 ft., but to be perfectly inoffensive. Several kinds of marine snakes occur on the coasts, and all are to be accounted dangerous. Of reptiles, the most numerous group by far is that of the lizards, which have among them representatives of each of the leading families of the class except the Chameleons. Tortoises are exemplified by many forms in the fresh waters; on the coasts by the leather-back, the edible turtle and the tortoise-shell turtle. Queensland waters are not at present infested by any species of alligator, though in times past one of large size was a scourge on the borders of the then inland sea. The crocodilian of its coasts is the crocodile of the Indian Seas, which ranges over the whole of the western tropical Pacific, and wanders south into Queensland waters as far as Keppel Bay. In the fresh-water pools of the northern tableland is found a small and harmless crocodile (*Philas*) of a very uncommon form. The avifauna is to the naturalist exceedingly attractive, for it is full of surprises and interesting lines of research, while to the artist it is a storehouse of form and colour. Where flowering and honey-yielding trees prevail, a profusion of birds seek their food either on the insects attracted by the honey, or, if so fitted, on the honey itself. Accordingly, the most striking feature of the bird-life, amid the forests of eucalypts and acacias, is its richness in honey-eaters and insect destroyers. The former, however, taken as a whole, are not a natural group, but include a family of perching birds and a portion of the parroquet family, both furnished with brush tongues adapted to the extraction of honey. A second characteristic is the great development of that quaint company, the bower birds, among them the regent bird, satin bird, cat birds, &c., constructors of the elaborate playgrounds which have excited so much attention. A third is the presence in one small part of the territory of a cassowary, and on its seaboard of three kinds of rifle birds, both extensions southwards of the tropical families of cassowaries and paradise birds. In the same region of prolific vegetation the handsome fruit-pigeons are also outliers of a large family of such pigeons spread through the Papuan jungles. There is one species of lyre-bird found in the southern highlands; the giant kingfisher, a laughing jackass, is found in the same region. The Scrub-turkey (*Catheturus*) heaps its mound of rotting *débris* to ferment in the shade of the jungles and give warmth to its eggs; the Scrub-hen (*Megapodius*) piles up sand on the beach for the sun to furnish the necessary temperature. The comparative paucity of birds of prey (Falconidae), and the almost total absence of rasorial game- and poultry-birds, may be noted. Birds pursued for sport or profit, however, are not wanting. The Emu and the Bustard or Plain Turkey afford sport in the open country, Quail and Snipe in or near the timber, while rivers and lakes still unvisited by the gun are covered with Ducks and Geese, Swans and Pelicans. It has been said that Australia has no migratory birds: this is an error, founded upon an undue restriction of the term migratory. Several species could be mentioned which are truly migratory in Queensland, as the Drongo-shrike, Bee-eater, Dollar-bird, &c. On the land surface, among its lowly organized products, interest centres in the multitudinous forms of insect-life, of which, excepting the Butterflies and Moths (Lepidoptera) and Beetles (Coleoptera), comparatively little is known at present. Insects inimical to man, with the exception, in some localities, of ants, flies and mosquitoes, are inconsiderable in number, and possess few hurtful properties. Centipedes, scorpions and leeches are less troublesome than in most other tropical regions. Spiders present themselves in astonishing variety, but only one kind, a small black spider with red spots (*Lathrodectus*), is malignant. Among the larger insects proper, the great-winged Phasmas, the Skeleton or Stick-insects, the Leaf-insects, and the splendid Swallow-tailed Butterflies are especially notable. Many of the Beetles are remarkable for size or brilliancy of colour.

Fishes and Fisheries.—The class fishes is extraordinarily profuse in diversified forms, the coral reefs being the grazing- and hunting-grounds of hosts of gorgeously decorated fish, chiefly of the Wrasse family; these, however, are almost equalled in beauty by the Chaetodons, Gurnards, &c., of other habitats. Among the Perches are the enormous Groper, which may attain the weight of 4 cwt., the Murray Cod, and the Giant Perch, both excellent food-fish of about 70 ℔ in weight. Sharks of many species abound. A survival from the Mesozoic period is the *Ceratodus* or Burnett Salmon, which, formerly inhabiting the headwaters of the Murray, still breeds in two of the smaller rivers north of the Bunya Range. This fish possesses a rudimentary lung in addition to ordinary gills. The barrier reefs are thickets of corals of the most varied forms, in life glowing with colour, in death shrubs of snowy purity. Among the shell-fish conspicuous for beauty or rarity are the exquisitely delicate paper nautilus and Venus comb (*Murex tenuispina*), the orange and other valuable cowries, and the gigantic clam-shell, which may require a ship's tackle to lift it from its bed. The fishery of the trepang, bêche-de-mer or sea slug employs a considerable number of boats about the coral reefs. Boiled, smoke-dried and packed in bags, the trepang sells for exportation to China, though its agreeable and most nourishing soup is relished by Australian invalids. One species of this sea slug—the teat-fish—fetches as much as £240 per ton. The pearl fishery is a prosperous and progressive one in or near Torres Straits. A licence is paid, and the traffic is under government supervision. Thursday Island is the chief seat of this industry. The shells are procured by diving, and fetch from £120 to £200 a ton. Mother-of-pearl and tortoise-shell constitute important exports of the colony, capable of great expansion. Oysters are as fine flavoured as they are abundant. Turtles are caught to the northward. Of the fish which frequent the coast, one of the best known varieties is the sea mullet (*Mugilidae*), large shoals of which strike the Australian coast 100 m. south of Sydney, and travel northwards, arriving on the southern coast-line of Queensland in the months of April and May, crossing bars and ascending rivers on the appearance of south-easterly weather. These magnificent fish often attain a weight of from 10 ℔ to 12 ℔. Small schools of bream succeed the mullet, and are followed in September and October by the poombah or tailor-fish, a fish of exceptional flavour, and much esteemed by epicures. These are succeeded by jewfish, specimens of which caught in southern waters have been known to exceed a weight of 50 ℔, whiting, garfish and flatheads, while flounders, black and tongue soles are occasionally caught by seine or hauling nets. White and black trevally, groper and rock cod, and a variety of bonito identical with the tunny of the Mediterranean Sea are also frequently met with. Several species of the tassel fish (*Polynemus macrocohoir*), from which isinglass is procured, have been taken by fishermen. King-fish, batfish, gurnards and eels of many varieties are also common. Schnapper, bream, rock cod, parrot-fish and groper are caught by hook and line in from 10 to 30 fathoms of water off the rocky headlands of the southern coast. Sardines, whitebait and sprats make their appearance in large shoals on the coast at intervals. The barramundi (*Osteoglossum leichardti*), which occurs in the Dawson and western waters, is found also on the east coast, and is one of the most esteemed fresh-water fish in Queensland. Dugong, which formerly were found in herds along the northern coast and as far south as Moreton Bay, are caught in set nets of 36 in. mesh, 100 fathoms in length. Different varieties of turtle are plentiful, the green edible turtle being caught by large set nets, and preserved and tinned for export. In Torres Strait and the northern coast the hawksbill turtle, yielding the valuable tortoise-shell of commerce, is said to be captured in a peculiar manner, the sucking-fish or remora (*Echeneis naucrates*) being utilized by the islanders for that purpose. The remora is carried alive in the bottom of the canoe, a long thin line being attached to the fish's tail and another usually to the gill. On a turtle being sighted and approached to within the length of the line, the sucking-fish is thrown towards it, and immediately it swims to and attaches itself by its singular head sucker to the under surface of the turtle, which if of moderate size is easily pulled into the canoe.

Amongst the crustacea may be enumerated the gigantic clams which are found on the reefs of the Inner Route. Occasionally some are met with weighing nearly half a ton, embedded in coral. Fresh-water clams are found in the rivers in the northern districts. The edible oyster (*Ostrea graminifora*) has been largely cultivated in southern Queensland. Amongst other crustacea, the squat lobster (*Themis orientalis*) is, with giant prawns and quampi, or small golden-lipped pearl shell, obtained by trawling in the southern waters. Many varieties of crabs are also found on reefs and foreshores at low tide; prawns and shrimps are caught, dried, and form an article for export to China; mussels, pinna or razor-shell cockles, and eugaries (a species of small shell-fish) are also abundant.

Climate.—As one-half of Queensland lies within the tropics the climate is naturally warm, though the temperature has a daily range less than that of other countries under the same isothermal lines. This circumstance is due to the sea breezes, which blow with great regularity. The hot winds which prevail during the summer in some of the other states are unknown in Queensland. Of course, in a territory of such large extent there are many varieties of climate, and the heat is greater along the coast than on the elevated lands of the interior. In the northern parts of the state the high temperature is trying to persons of European descent. The mean temperature at Brisbane during December, January and February is about 76°, while during June, July and August it averages about 60°. In towns farther north, however, the average is higher. Winter in Rockhampton, for instance, averages nearly 65°, while the summer average rises almost to 85°. At Townsville and Normanton the average is higher still. The average rainfall is high, especially along the northern coast, where it ranges from 60 to 70 in. per annum. At Brisbane 50·01 in. is the average of 35 years, and even on the plains of the interior from 20 to 30 in. usually fall every year. West of the coast range the air is dry and hot, and in summer the thermometer rises frequently to 106° in the shade. The monsoons play an important part in cooling the atmosphere near the coast, and are very regular in the north. The winter climate is perfection, especially in the north, but frosts are frequent and regular west of the coast range. Ice is commonly seen at Herberton, 17° S., during winter, and on the Darling Downs frosts are of nightly occurrence.

Population.—The population of Queensland in 1905 was estimated at 528,048—290,206 males and 237,842 females, the density of population per sq. m. being about 0·79. In 1861, that is, two years after the separation from New South Wales, the population of the colony stood at 34,400; in 1871 it had reached 125,100; in 1881, 227,000; in 1891, 410,300, and at the census of 1901, 498,129. The policy of assisted immigration contributed greatly to Queensland's progress, and people of foreign descent are proportionately more numerous than in any of the other states, though they only amount to 8·71% of the total population. At the census of 1901 there were 13,166 Germans, 3161 Danes, 2142 Scandinavians, and among coloured aliens 8587 Chinese, 2269 Japanese, 939 Hindoos and Cingalese, 9327 Pacific Islanders, and 1787 other races, making a total of 22,909 coloured aliens. It is estimated that the total aboriginal population of Queensland is about 25,000.

The births in 1905 were 13,626, of which 950 were illegitimate, and the deaths 5503, the respective rates per thousand of the population being 25·92 and 10·47. The decline in the birth rate will be gathered from the following table:—

Period.	Birth Rate per 1000 of Population.	Period.	Birth Rate per 1000 of Population.
1861–65	43·07	1886–90	38·81
1866–70	43·91	1891–95	35·15
1871–75	40·81	1896–1900	30·40
1876–80	36·72	1901–05	26·60
1881–85	36·37		

The death rate shows a remarkable diminution: in 1861–65 it averaged 21·06 per 1000; in 1871–75, 17·94; in 1881–85, 19·10; and in 1891–95, 12·82. The marriage rate in 1905 was 6·04 per 1000, being an increase on the figures for 1904 of 95.

The chief cities and towns, with their population in 1905, are:—Brisbane, 128,000; Rockhampton, 15,461; Gympie, 13,200; Maryborough, 12,000; Townsville, 10,950; Toowoomba, 10,700; Ipswich, 8637; Mount Morgan, 8836; Charters Towers, 6000; Bundaberg, 5000.

Administration.—As one of the Commonwealth states Queensland returns six senators and nine representatives to the federal parliament. The state parliament consists of a legislative council of 37 members nominated for life, and a legislative assembly of 72 members, who each receive £300 per annum for their services. For purposes of local government the state in 1905 was divided into 46 municipalities and 125 shires. The boroughs control 354 sq. m. and the shires 667,898 sq. m.; the revenue and expenditure of the former in 1905 being respectively £312,510 and £321,645, and of the latter £190,837 and £180,457. Revenue is mainly derived from rates levied on the capital value of assessed properties, which amounted for the whole state to £42,358,173, representing an annual value of £2,647,400. All improvements are exempt from assessment, and much of the revenue is expended in road-making and the building of bridges. Rates are supplemented by an endowment from the central government.

Education.—Public education is free, unsectarian and compulsory. State or provisional schools are formed wherever an average attendance of twelve children can be got. Theoretically the school age is from six to twelve years, but in practice compulsory attendance is seldom if ever enforced in certain parts, owing mainly to the difficulty of providing suitable schools within reasonable access. In 1905 there were 1044 state schools, with 2382 teachers and 88,903 scholars. Of private schools the number in 1905 was 171, with 739 teachers and 14,891 pupils. Exclusive of coloured aliens almost the whole adult population can read and write. In 1905 the sum spent on education was £281,575. Ten grammar schools are endowed by the state. By a system of competitive scholarships the government gives free education in grammar schools to scholars in state schools, and also three-yearly exhibitions to universities to students who pass an examination of a high standard. State aid is also rendered to schools of art, schools of design, free libraries and technical schools.

There is no state church. Amongst the different denominations the Church of England, at the date of the last census, numbered 37·5 % of the population, the Roman Catholic 24·5 %, the Presbyterians 11·7, the Methodists 9·5, the Baptists 2·60, the Jews 0·2, other Christian bodies 12·3, Pagans and Mahommedans, 4·43.

Finance.—For the year ending June 1905, the receipts amounted to £3,595,399, equal to £6, 17s. 10d. per inhabitant. The chief items of revenue were: taxation, £454,574; crown lands, £623,416; railways, £1,409,414; balance refunded by the federal government, £752,532. The expenditure for that year was £3,581,403, equal to £6, 17s. 4d. per inhabitant; the chief items being:—interest on public debt, £1,547,091; railways, £812,931; education, £322,496; charitable institutions, £135,338. The public debt of the state at the end of 1905 was £39,068,827, or £74, 6s. 3d. per inhabitant; the bulk of this sum, £23,567,554, having been expended on railways. The following shows the growth of the public indebtedness:—

Year.	Total Debt.	Debt per Inhabitant.
1861	£70,000	£2 0 9
1871	4,047,850	32 6 11
1881	13,245,150	58 7 2
1891	29,457,134	73 12 5
1901	39,338,427	76 8 6
1905	39,068,827	74 6 3

Defence.—The Commonwealth defence forces in Queensland had an actual strength at the end of 1905 of 7212 men, comprising a permanent force of 258, 2486 militia, 959 cadets and 3189 riflemen.

Mining.—In Mount Morgan Queensland possesses one of the chief gold mines of the world, and this mine is also one of the leading copper mines of the Commonwealth. In 1905 the value of the mineral production of the state was £3,726,275, being an excess over that of the previous year of £22,034, the highest in the history of the state. This advance was due, not to any improvement in the gold yield, which, latterly, has receded from the high level of former years, but to the increased output of the industrial metals. The value of the minerals, other than gold, won during 1905 amounted to £1,208,980, almost one-third of the total value of the year's mineral production, in which gold represented £2,517,295; silver, £69,176; copper, £503,547; tin, £297,454, and coal, £155,477.

Agriculture.—The total area under cultivation in Queensland in 1905 was 622,987 acres, the principal crops being:—wheat, 119,356 acres; maize, 113,720 acres; hay, 37,425 acres; green forage, 66,183 acres; potatoes, 7170 acres; barley, 5201 acres. Sugar-cane cultivation is important. The progress of the industry may be gauged from the following figures:—area under cane in 1864, 94 acres; 1871, 9581 acres; 1881, 28,026 acres; 1891, 50,948 acres; 1901, 112,031 acres; 1905, 134,107 acres. The greater part of the field work on the Queensland plantations was long performed by coloured labour, chiefly South Sea islanders. In 1901, however, the federal parliament passed an act under the provisions of which a limited number of Pacific islanders were allowed to enter Australia up to the 31st of March 1904, but after that date their coming was to be prohibited. All agreements for the employment of these Kanakas were to terminate on the 31st of December 1906, after which date all Pacific islanders were to be deported. Fruit cultivation has attained considerable importance. In 1905, 2044 acres were under vines; 6198 under bananas; 1845 under pineapples; 3078 under oranges; 374 under mangoes; 173 under strawberries; 537 under apples. The soil and climate of Queensland are admirably fitted for the production of excellent cotton, but this promise has not been realized. In 1871 the export of this staple was over 2,600,000 ℔, valued at £79,000; the production gradually diminished and in 1898 absolutely ceased. The year 1902 saw a revival when 8 acres were planted; and in 1905 171 acres were devoted to cotton-growing. While the area set apart for tobacco cultivation continues to increase, the yield in 1905 being 10,230 cwt. (cured leaf) from 933 acres, the production of coffee dropped from 132,554 ℔ in 1904 to 82,230 ℔ in 1905.

Stock-raising is, however, the principal industry of the country. At the close of 1905 the numbers of the principal kinds of stock depastured were: cattle, 2,963,695; sheep, 12,535,231; horses, 430,565; swine, 164,087. The cattle industry has been greatly affected by the ravages of the cattle tick and by a succession of disastrous seasons, and the number in the state in 1905 was considerably less than half the number mustered in 1894. As the state is very lightly stocked a few good seasons will serve to bring the number of cattle up to the previous greatest record. The sheep industry in Queensland though of less importance than the cattle, is still considerable, and of the six states of Australia, Queensland ranks second in the number which it depastures. The sheep depastured in 1905 were some nine millions less than in 1892. The weight of wool exported in 1905 was 53,072,727 ℔; in 1892, however, the export was over 105 millions. Good progress has been made in dairying, the production of butter in 1905 being 20,320,000 ℔; of cheese, 2,682,089 ℔; of bacon and ham, 10,500,335 ℔. It is estimated that the annual value of the pastoral and dairying industry of Queensland is about £8,224,000. The export of live cattle in 1905 amounted in value to £1,500,855; of fresh and preserved meat, £707,345; of wool, £2,280,924; of tallow, £183,372—in 1894 the tallow export was nearly 30,000 tons, valued at £596,000.

Manufactures.—Queensland is not populous enough to have manufactures on a large scale, nevertheless there are 21,705 persons employed in the 1911 establishments of the state. The majority of these persons are engaged in the preparation of natural products for export, such as sugar, preserved meats and the like, or in industries arising out of the domestic requirements of the population. The horse power employed in 1905 was 28,009; the value of plant and machinery was £3,988,056; and of land and premises £2,709,951; while the value of the output stood at £8,130,480.

Commerce.—The shipping entering Queensland ports in 1905 had a tonnage of 1,067,741 as compared with 468,607 in 1890. The imports in 1905 were £6,699,345, which is much less than the average of Australia, but nearly all the Queensland importations are for home consumption, whereas New South Wales, Victoria and South Australia have a large re-export trade. In 1861 the imports were valued at £968,000, or £31 per inhabitant; in 1871, £1,563,000, or £13 per inhabitant; in 1881, £4,064,000, or £18, 6s. per inhabitant; in 1891, £5,079,000, or £12, 13s. per inhabitant; in 1900, £7,184,112, or £14, 13s. 3d. per inhabitant. The disparity between the capitation figures of various years is due chiefly to two causes: the irregularity of the state borrowings, and the manner in which private capital has been sent from England and from the Australian states for investment in Queensland, both the borrowings and the investments appearing in the imports. The important bearing of these two items on the Queensland import trade may be gathered from the fact that, since 1863, there has been an inflow of capital into the state at the rate of about one million and a quarter sterling per annum. The exports from Queensland in 1905 were valued at £11,939,594, which is equal to the very high average of £22, 14s. 3d. per head; nearly the whole amount represents goods and produce of local origin. Going back to 1861 the amount of exports at the various decennial periods was:—

Year.	Value of Total Exports.	Exports per Head.
1861	£709,599	£22 14 8
1871	2,760,045	22 18 8
1881	3,540,366	15 18 6
1891	8,305,387	20 13 6
1901	9,249,366	18 5 10

Brisbane is the chief seat of trade, but this port does not hold so predominating a position as do the chief cities of the other states in regard to their minor ports. In 1905 the trade at the seven principal seaports of Queensland was:—

Port.	Imports.	Exports.
Brisbane	£4,104,574	£3,524,939
Rockhampton	437,068	1,708,489
Townsville	671,853	1,838,055
Bundaberg	121,567	498,381
Maryborough	157,023	248,706
Mackay	80,468	499,034
Cairns	184,716	873,370

Railways.—Up to 1905 the state had expended £21,683,355 upon the construction and equipment of railways. The mileage open for traffic at the end of that year was 3113; there were also 268 m. of privately owned railways. Railway construction in the state commenced in 1864, some five years after the introduction of responsible government. Progress during the early years was very slow; in 1871 only 218 m. had been constructed and in 1881 only 800 m.; between 1881 and 1891 railway construction was pushed on rapidly, an average of 152 m. a year being opened between those dates. In 1891 the length open for traffic was 2320 m., and in 1901 2801 m. The state railways in 1905 earned £1,483,535 and the working expenses were £851,627, leaving the net earnings £631,908, which is equal to 2·91 % upon the capital expended. As the rate of interest paid on the outstanding loans of the Queensland government is 3·94, there is an actual loss to the state of 0·30 %. This loss, however, is more than counterbalanced by the advantages resulting from the construction of the railways.

Posts and Telegraphs.—There were 1360 post offices in the state in 1905; telegraph stations numbered 515, and there were 19 telephone exchanges. The revenue from these three services in 1905 was respectively £233,523, £88,285 and £31,765—a total of £353,573, as against an expenditure of £415,420.

Banking.—The liabilities of the eleven banks trading in the state in 1905 totalled £13,770,865, and the assets £16,362,292. The deposits amounted to £13,217,084. The banks held coin and bullion to the value of £1,897,576. In the Government Savings Bank there was a sum of £3,992,758 to the credit of 84,163 depositors. The deposits in all banks amounted, therefore, to £17,209,842, which represents £32, 11s. 10d. per head of population.

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History

The Portuguese may have known the northern shore nearly a century before Torres, in 1605, sailed through the strait since called after him, or before the Dutch landed in the Gulf of Carpentaria. Captain Cook passed along the eastern coast in 1770, taking possession of the country as New South Wales. Flinders visited Moreton Bay in 1802. Oxley was on the Brisbane in 1823, and Allan Cunningham on Darling Downs in 1827. Sir T. L. Mitchell in 1846–47 made known the Maranoa, Warrego, and Barcoo districts. Leichhardt in 1845–47 traversed the coast country, going round the gulf to Port Essington, but was lost in his third great journey. Kennedy followed down the Barcoo, but was killed by the blacks while exploring York Peninsula. Burke and Wills crossed western Queensland in 1860. Landesborough, Walker, M‘Kinlay, Hann, Jack, Hodgkinson and Favence continued the researches. Squatters and miners opened new regions. Before its separation in 1859 the country was known as the Moreton Bay district of New South Wales. A desire to form fresh penal depôts led to the discovery of Brisbane river in December 1823, and the proclamation of a penal settlement there in August 1826. The convict population was gradually withdrawn again to Sydney, and in 1842 the place was declared open to free persons only. The first land sale in Brisbane was on August 9, 1843. An attempt was made in 1846, under the colonial ministry of Gladstone, to establish at Gladstone on Port Curtis the colony of North Australia for ticket-of-leave men from Britain and Van Diemen's Land. Earl Grey, when secretary for the Colonies, under strong colonial appeals arrested this policy, and broke up the convict settlement. In 1841 there were 176 males and 24 females; in 1844, 540 in all; in 1846, 1867. In 1834 the governor and the English rulers thought it necessary to abandon Moreton Bay altogether, but the order was withheld. The first stock belonged wholly to the colonial Government, but flocks and herds of settlers came on the Darling Downs in 1841. In 1844 there were 17 squatting stations round Moreton Bay and 26 in Darling Downs, having 13,295 cattle and 184,651 sheep. In 1849 there were 2812 horses, 72,096 cattle, and 1,077,983 sheep. But there were few persons in Brisbane and Ipswich. The Rev. Dr Lang then began his agitation in England on behalf of this northern district.

Some settlers, who sought a separation from New South Wales, offered to accept British convicts if the ministry granted independence. In answer to their memorial a shipload of ticket-of-leave men was sent in 1850. In spite of the objection of Sydney, the Moreton Bay district was separated from New South Wales by an Order in Council of 13th May 1859, and proclaimed the colony of Queensland. The population was then about 20,000, and the revenue £6475.

The constitution, which was based upon the New South Wales Act of 1853, provided for 16 electoral districts, with a representation of 26 members. A Legislative Council was also formed, to which the governor of New South Wales, Sir William Denison, appointed 5 members, to hold office for four years, and Sir George Ferguson Bowen, the first governor of the new colony, 8 life members. Robert (afterwards Sir Robert) George Wyndham Herbert was the first premier and colonial secretary, and held office until 1866. Of the 39 representatives in the first Parliament, 20 were pastoralists; the others may be roughly classed as barristers, solicitors, and merchants. The pastoralists were the pioneers of settlement in the colony; those best known were the Archers of Gracemere, the Bells of Jimboor, the Gores of Yandilla, the Bigges of Mount Brisbane, Mr (afterwards Sir) Arthur Hodgson, Robert Ramsay, Gordon Sandeman, and Messrs Kent and Wienholt. The white population at the end of 1859 was 25,788, and the exports were valued at £500,000.

Herbert's Administration, 1859–1866.—The first Parliament was opened on May 29, 1860. The providing of revenue and the establishment of immigration were the chief matters for consideration. The treasury was practically empty, but Sir Saul Samuel, treasurer of New South Wales, took a broad and generous view of the situation, and rendered financial aid, whilst in 1861 the first Government loan of £123,800 was authorized, the money being appropriated to public works and European immigration. Labour was so scarce that as early as 1851 the squatters had imported Chinese; various schemes for the introduction of coolies on a large scale were now mooted, but public opinion was decidedly against any increase in the number of coloured aliens then in the colony. In 1859 the educational system was a mixed national and denominational one; there were 10 schools of the latter class, 1 of the former, and 30 private schools. In 1860 a Board of General Education was established, which extinguished the denominational system and placed the schools under State control. In the same year State aid to religion was abolished. The governor, in opening Parliament in 1863, pronounced decisively against the reintroduction of convicts. In that year Queensland boldly grappled with the extension of colonizing, and a settlement was established at the northerly point of Cape York peninsula by Mr Jardine. During the following two years ports were opened along the coast, and pastoral occupation spread far into the northern and western interiors. The first sod of the first railway, from Ipswich to the Darling Downs, was turned on 15th February 1864. On February 1, 1866, Mr Herbert retired, and Mr Macalister became premier and Mr Mackenzie colonial secretary. In the following July the failure of the Overend and Gurney and Agra banks, in the latter of which the Government had public moneys, caused the collapse of a loan which was being negotiated in London. A panic followed: the Government could not pay the railway contractors, and the navvies employed by them started for Brisbane, threatening to hang the ministers and loot the town. On arrival, however, they were easily headed off to a reserve. By this time the treasury was empty, general insolvency prevailed, and the community appeared to be wrecked. Treasury bills to the amount of £300,000 were issued, and the governor in council was authorized to legalize treasury notes, when necessary, as currency, payable in gold on demand, to tide over the crisis. Prior to this, however, the treasurer took preliminary steps to issue £300,000 "Legal Tender Notes"—inconvertible "greenbacks"—but Sir George Bowen informed the premier that he should veto such a scheme, and suggested the issue of treasury bills. Mr Macalister thereupon resigned, and Mr Herbert, who had made arrangements to proceed to England (where subsequently he became permanent secretary of the Colonial Office), took office again to help the colony through the difficulty. His second ministry lasted for eighteen days, and, having passed the Treasury Bills Act, he retired from the public life of Queensland. The only determined opposition the Herbert ministry met with was from the townspeople's representatives, whose contention was that the squatters dipped too deeply into the public purse for public works expenditure; but an important factor in the early parliamentary days was the opposition between the Brisbane and Ipswich parties in the House, the latter town aspiring to be the capital of the colony.

The Discovery of the Goldfields, 1866–1879.—Macalister returned to power in August 1866, and dealt so vigorously with the after-effects of the financial crisis that by the end of 1867 affairs had approached their normal condition. A new era was now opened for Queensland by the discovery of gold. The Gympie field was discovered by Nash in 1867, and a big "rush" resulted. In 1872 Hugh Mosman discovered Charters Towers, the premier goldfield of the colony; and Hann, the rich Palmer diggings. Other important discoveries were also made, and Queensland has ever since been a gold-producing colony. Mining is the foundation upon which much of the progress of the colony has been built, and the legislation and records show continuous traces of the influence of the gold-getter. In 1873 John Murtagh Macrossan, a digger, was returned to Parliament expressly as a mining representative; and other men of a different stamp from the representatives of the squatters and townspeople, who had hitherto composed the House, now began to enter public life. From 1870 to 1879 progress was satisfactory, trade interests were prosperous, and in this decade the foundations of the public and social structure of Queensland were laid. Agriculture was extended, and sugar-growing took the place of cotton cultivation. (The first crop of sugar was grown by the Hon. Louis Hope at Cleveland, about 1862.) Hitherto politics had been non-partisan, and legislation was chiefly of a domestic character. From the time of Herbert's departure until the appearance of Thomas McIlwraith and Samuel Walker Griffith, the two master-spirits of Queensland parliamentary life, the political history of the colony was composed of short-lived administrations, with Messrs Macalister, Mackenzie, Palmer, Lilley, George Thorn and John Douglas (afterwards Government Resident at Thursday Island) as premiers. Arthur Hunter Palmer (whose administration, from 1870 to 1874, had the longest life), a New South Wales squatter, entered the Queensland Parliament in 1866. He was one of the most popular of Queensland's parliamentary leaders, and has left the impress of his labours on the public works, and educational and defence force systems of the colony. In 1870 Queensland was disappointed in her ambition of becoming the connecting-point for Australia with the European and Eastern cable systems. A company—the British Australian Telegraph Company—was formed in London to connect Australia by cable with Singapore. The plan provided for a land line from the Queensland telegraphs at Burketown to Port Darwin, in the Northern Territory, where the cable was to be landed. Writing on 25th January 1870, the Telegraph Construction and Maintenance Company officially informed the governor of Queensland that it had received a contract from the British Australian Telegraph Company to construct "cables and land lines, to be laid between Singapore and Burketown, in North Australia." The Construction Company deputed Commander Noel Osborn to negotiate with the Governments of South Australia and Queensland in reference to the land line; but on arrival in Adelaide he accepted the offer of the South Australian Government to construct and maintain a telegraph line right across the continent from Port Darwin to Adelaide, and Queensland was informed that the original plan had been abandoned. Although the company was thus saved the expense of making and maintaining the Port Darwin–Burketown line, it was regarded as having broken faith with Queensland, which had specially pushed on her telegraph system to connect with the proposed line. In consequence of this incident Queenslanders have not always had the facilities for cheap cabling to Europe enjoyed by the other colonies, though the subsequent owners of the cable, the Eastern Companies, were in no way responsible for the act of their predecessors.

A resolution in favour of the payment of members was carried in 1871. In 1872 the first Agent-General in London, Richard Daintree, was appointed. The same year the Railways Act Amendment Act was passed, authorizing the construction of railways by private enterprise, land being offered as compensation for the outlay. Electoral representation was increased to forty-two members. In January 1874 Palmer resigned, and Macalister came into power for two years, the most important measure of his Government being the State Education Act of 1875, on which the present educational system is based. Both Messrs McIlwraith and Griffith were members of the Macalister ministry, but the former resigned in October 1874, owing to a difference of opinion as to a proposed land-grant railway from Dalby to Normanton. In 1878 Mr (afterwards Sir) James Francis Garrick first became a cabinet minister, joining the Douglas ministry as secretary for public works and mines.

Active Politics, 1879–1890.—On 21st January 1879 the first McIlwraith administration came into power, and an important extension of local government was one of the early measures passed, divisional boards being formed to take charge of public works in districts not included in municipalities. In the following session, 1880, the Opposition, led by Mr Griffith, bitterly opposed the Government proposals on Kanaka labour, land-grant railways, and a European mail service via Torres Straits. The Government, however, concluded an agreement with the British India Steam Navigation Company for a monthly mail service between Brisbane and London for an annual subsidy of £55,000. The Railway Companies Preliminary Act, giving the governor in council power to treat with persons willing to construct railways in return for grants of 8000 acres of land for each mile of rails laid, was also passed. This measure was generally unpopular, and no railways were built under its provisions. During the session Mr Griffith impeached the premier in connexion with contracts for the purchase of 15,000 tons of steel railway metals, and their carriage to the colony, made in London whilst McIlwraith was there in January 1880. A select committee in the colony, and afterwards a Royal Commission in London, subsequently reported in the premier's favour. The discovery of the celebrated Mount Morgan gold mine, and the initiation of artesian well-boring by R. L. Jack, Government geologist, took place in 1881. In 1883 a great drought prevailed, and the compulsory stoppage of public works demoralized the labour market. Early in the year information reached the colony that Germany proposed to annex a portion of New Guinea, which, together with other islands in the Papuan Gulf, was becoming of great strategic value to Australia; and the premier, fearing that it would thus be lost to the empire, instructed Mr H. M. Chester, police magistrate at Thursday Island, to proceed to Port Moresby and take possession of the unappropriated portion of the island in the name of the crown. This act was afterwards—to the indignation of Australia—repudiated by Lord Derby; and, eventually, under the Berlin Treaty of 1886, England and Germany entered into joint-possession of that part of New Guinea lying east of 141° E. In July Sir Thomas McIlwraith (created K.C.M.G. in 1882) was defeated by 27 votes to 16 on a proposal to arrange for the construction of a land-grant railway from Charleville to the Gulf of Carpentaria. The general elections which followed were fought mainly on the questions of coloured labour for the sugar plantations and land-grant railways. The Government was defeated, and Griffith formed his first administration. Later in the year the premier drafted the Federal Council Act at Sydney, and through his efforts Queensland eventually joined the Federal Council of Australasia. In 1884 a ten-million Loan Act was passed, intended to secure continuity in borrowing for railway construction, but many of the lines specified were unsurveyed. According to the view now generally held in Queensland, this loan seriously hampered the colony in after years. In 1887 the number of seats in the Assembly was increased to 72 (the present number), and several reforms were effected in the public service, notably the establishment of the department of agriculture. At the general elections in 1888 Sir Thomas McIlwraith was returned for North Brisbane, defeating Sir Samuel Griffith (who had been created K.C.M.G. in 1886) by a large majority, and resumed office as premier and leader of the "National Party." Ill-health, however, soon compelled him to leave the colony, and he was succeeded by Boyd Dunlop Morehead. Sir Thomas McIlwraith's inflexible nature was evidenced all through his public life. On the death of Sir Anthony Musgrave in Brisbane in 1888, he maintained that the Government should be consulted as to the appointment of the new governor. Lord Knutsford declined to accept this view, and appointed Sir Henry Blake. The premier formally protested, and a deadlock ensued, which was only removed by the resignation of the governor-designate. In 1889 payment of members at the rate of £300 a year, plus 1s. 6d. per mile travelling expenses, was established. In 1890 a financial crisis arose. Sir Thomas McIlwraith had returned to the colony and dissociated himself from the ministry. He conferred on the situation with Sir Samuel Griffith, and a want-of-confidence motion was nearly carried. Morehead resigned, and a coalition ministry, with Griffith as premier, chief secretary and attorney-general, and McIlwraith as treasurer, was formed. An agitation for the separation of Queensland into two or three separate colonies—mentioned as early as 1866—was very marked during this period. It took formidable shape at Townsville in 1882, the chief argument in its favour being that the north and central districts did not get a fair share of the public expenditure. Delegates were sent to London on several occasions to interview the Colonial Secretary, but success did not attend these direct appeals. Sir Samuel Griffith's Decentralization Bill of 1890, which proposed to erect separate legislatures in the three divisions with powers of local government, was a blow to separationists, and the agitation gradually disappeared.

The Labour Party in Politics, 1890–1900.—The decade from 1890 to 1900 was chiefly notable, apart from the accomplishment of Federation, for the rise of the Labour party as a power in politics and the gradual disappearance of the squatter as a dominant factor. In 1890 the old opponents, Sir Samuel Griffith and Sir Thomas McIlwraith, were still working side by side. The revenue for the year fell short of the estimates by half a million sterling, and a heavy accumulated deficit had to be grappled with by Parliament. Sir Thomas McIlwraith, the treasurer, proposed a dividend tax and other imposts, which were agreed to, and a Treasury Bills Act authorizing an issue of £500,000 was also passed. A Constitution Act establishing triennial Parliaments, in place of quinquennial, which had hitherto existed, also went through. In August the great maritime strike spread to Brisbane, and crippled trade and commerce for several months. In 1891 a loan for £2,500,000, which was issued in London under the auspices of the Bank of England, failed. Sir Thomas McIlwraith reflected strongly in Parliament on the conduct of the Bank of England, and the governor of the bank wrote to Sir James Garrick, the agent-general, protesting against Sir Thomas McIlwraith's statements, and breaking off relations with the colony; but mutual explanations afterwards healed the breach.

Litigation was initiated by the London board of the Queensland Investment and Land Mortgage Company against the Queensland directors, on the ground that they had made advances without taking adequate security. The case was tried by the chief justice, Sir Charles Lilley, in 1891 and 1892, the defendants being Sir Thomas McIlwraith, Sir Arthur Palmer, then president of the Legislative Council, and Messrs F. H. Hart and E. R. Drury. The judge submitted 143 questions to the jury, and though these were answered generally in favour of the defendants, judgment was entered largely for the plaintiffs. On appeal, heard before a specially constituted court, presided over by the late Sir William Windeyer of New South Wales, this judgment was reversed, with costs. Lack of employment and a disastrous strike of bush workers paralysed the colony in this year. The strike began in January at Logan Downs station, where 200 shearers refused to sign the Pastoralists' Convention agreement. This strike was remarkable for the determined and aggressive attitude of the men, and the firm, though conciliatory, manner in which it was handled by Mr (afterwards Sir) Horace Tozer, the colonial secretary, who had to provide military forces and artillery to hold the strikers in check. The trouble lasted many months; and after it was over a farcically planned plot to seize the central district and proclaim a republic was revealed in the *Brisbane Courier*. As an outcome of this strike, "New Australia"—a settlement on communistic lines—was founded in Paraguay (*q.v.*). The year 1892 was one of gloom and depression: want of money interfered with public works, and the impending stoppage of Kanaka labour and the low price of sugar almost ruined the planters. Sir Samuel Griffith then announced his conversion to the policy of continuing Kanaka labour for the sugar plantations, and also of land-grant railways. An act was passed authorizing agreements with companies for the extension of the trunk lines on this principle; but the measure was unpopular, and no transactions under the act are recorded. Financial depression reached its height in 1893: the salaries of ministers and civil servants were reduced, and drastic retrenchments were made in every department. In February, 107 in. of rain fell at the head of the Brisbane river, and enormous losses were caused by the resulting floods; several vessels, including the Queensland Government gunboat *Paluma*, were washed into the Brisbane Botanic Gardens, and left high and dry when the waters subsided. A second flood followed and caused further losses. Rockhampton, Bowen, Townsville, and other places also suffered severely from floods. On 13th March Sir Samuel Griffith was gazetted chief justice, and on the 27th Mr (afterwards Sir) Hugh M. Nelson became premier and treasurer, and Sir Thomas McIlwraith chief secretary and secretary for railways. Parliament was dissolved on 3rd April, and after the general elections the ministry returned with 38 supporters, against Labour, 16, and Opposition and Independent, 18. During the month several financial institutions suspended payment, and on 15th May the Queensland National Bank closed its doors. Parliament was hurriedly summoned to deal with the financial crisis and the question of the Government funds held by the Queensland National Bank. Treasury notes, issued against coin held by the treasurer, were made legal tender throughout the colony; an issue of £1,000,000 treasury bills to retire the treasury notes was authorized, and a series of acts dealing with the suspended banks were passed. To assist the unemployed, labour and co-operative communities were started, but proved failures. An impetus was given to the sugar industry by the Sugar Works Guarantee Act, which authorized the treasurer to guarantee debentures issued by companies for the erection of sugar mills and plant. In 1894 little legislation was achieved, the policy of the Government being directed towards national rehabilitation. In 1895 Sir Thomas McIlwraith left the colony for London, where he died on 17th July 1900. At the general election of 1896 the Labour party slightly improved its position. In that year a committee of investigation reported a heavy deficit in the affairs of the Queensland National Bank, and made certain recommendations. In 1897 the bank was reconstructed a second time upon terms very favourable to the institution. An act was passed granting powers to a company to construct a railway from the rich mining district of Chillagoe to the terminus of the Cairns railway at Mareeba; at the end of fifty years the State was to have the right to acquire the line. In April 1898 the Queensland-born statesman, T. J. Byrnes, whose early death in the following September was lamented throughout Australia, succeeded Sir Hugh Nelson as premier. On 24th October the trial of the three ex-directors of the Queensland National Bank, Messrs F. H. Hart, B. D. Morehead and A. B. Webster, was commenced. The prosecution was instituted by the Government, on the advice of three barristers to whom the report of the committee of investigation into the affairs of the bank, which sat in 1897, was submitted. After a trial lasting 12 days, a verdict of "Not guilty" was returned. Proposals for the acquisition of 250,000 acres of land in New Guinea, made by a syndicate of London capitalists, were provisionally agreed to, but were eventually rejected, owing to a popular outcry raised in the colony and in New South Wales and Victoria. In 1896 the first of a series of factory acts was passed, and in 1907 Wages Boards were established for fixing the statutory minimum rate of wages. (See AUSTRALIA.)

Federation was a burning question in the neighbouring colonies during the year, but Queenslanders generally took little interest in the movement, and the colony was not represented at the Federal Convention at Melbourne when the Commonwealth Bill was passed. In 1899 Mr (afterwards Sir J. R.) Dickson, who had succeeded Byrnes as premier, was enlisted on the side of the "Billites," and in June of that year an Enabling Bill was passed. In September the Referendum supported the act by the narrow majority of 7492 votes on a poll of 69,484. Towards the end of the second session the ministry narrowly escaped defeat on the Railway Standing Committees Bill, and resigned. Mr Dawson, leader of the Labour Opposition, then formed a ministry, and held office from 1st December to 7th December 1899. He was then defeated on a motion by R. Philp, and resigned, and Philp became premier, and was in power when Queensland joined the Commonwealth. The year was shadowed by the continuance of a terrible drought, which towards the end of 1900 became so aggravated that the revenue began to fall off, owing to decreased receipts from railways and land. In that year Philp's chief policy was the passing of legislation to permit of the construction of railways by private enterprise. The Labour party offered vigorous opposition; but notwithstanding this a certain amount of progress was made. The Government appointed Dr Maxwell, an American sugar expert, to superintend the sugar industry in the colony; a State school of mines was established at Charters Towers; and the compulsory clauses of the Education Act were put in force for the first time. Another act of importance was the establishment of a Government land bank. A powerful agitation for the extension or renewal of the leases of pastoral lands was raised, but no legislation resulted. A suggestion that Sir Samuel Griffith should retire from the chief justiceship, on a pension of £1750 a year (to be reduced by any emoluments received), to enable him to enter Federal politics, fell through. Some important discoveries of coal were made during the year, and dredging the northern rivers for gold became an established industry. J. R. Dickson represented the colony in London at the conference of Federal delegates in 1900, when the final details of the Commonwealth were settled. Early in 1901 he was created K.C.M.G., but died somewhat suddenly, at Sydney, on 9th January of that year, shortly after he had been made a member of the first Federal ministry.

Alien Immigration.—The working classes of Queensland have always objected to the presence of coloured aliens, and successive Governments have legislated against indiscriminate immigration into the colony. In 1876 Governor Cairns reserved an act imposing certain disabilities upon Chinese working on goldfields. In that year a poll tax of £10 was imposed upon Chinese arriving. In 1884 another principle was adopted: masters of ships were only allowed to carry to Queensland ports one Chinese for every 50 registered tons, and the poll tax was increased to £30. In 1888 Queensland took the lead in summoning an intercolonial conference on Chinese immigration, the outcome of which was the adoption of uniform legislation: in the Queensland Act passed that year the main provision was that only one Chinese for every 500 registered tons should be permitted to be carried to the colony from Chinese ports. The poll tax was then abolished. This act was also reserved, but received the Royal Assent on 5th February 1890, after slight modification had been made.

Treaty arrangements with Japan had been carried through by the Imperial Government, at the initiation of Queensland, under which the Japanese Government undertook to prevent the emigration of coolies to the colony; and a Pearl Shell Fisheries Act was passed in 1895 placing restrictions upon the acquisition of vested interests in the industry by Japanese and other aliens. At Federation eight acts—two Imperial and six local—regulated the importation of Kanakas from the South Seas: that of 1880 was the basis of the system under which Kanakas were recruited in the islands, brought to the colony in schooners, employed there, and returned to their homes at the end of their three years' engagements. The 1884 act confined Kanakas to field work. In December 1884 a Royal Commission was appointed, consisting of Messrs W. Kinnaird Rose, J. F. Buckland, and Hugh M. Milman, to report upon the system of recruiting Kanakas. Following the report of the Commission, which was in effect that many islanders had been recruited "by force and fraud," Sir Samuel Griffith, then premier, introduced the important Pacific Island Labourers Amendment Act of 1885, which stopped the importation of Kanakas after 1890. It was—and is—an article of faith with the working classes that white labour could be utilized for sugar cultivation. Yet from the passing of the act the sugar industry began to decay, no fresh capital was put into it, plantations dwindled down in value 50 to 75%, mills were closed, and the magnificent industry threatened to die out. Sir Samuel Griffith, being converted by these signs of the times from his position that sugar could flourish in the colony without coloured labour, issued on 12th February 1892 his "Manifesto to the People of Queensland," in which he acknowledged that to prevent the collapse of sugar-growing it was necessary to resume the immigration of Polynesians. This manifesto was the forerunner of the 1892 act, which reintroduced Kanaka labour. Since this time there has been no further State legislation on the subject, but the Federal Parliament has dealt with the matter (see above).

Land Legislation.—In Queensland's early days, with the predominance of the squatting class, the lands were freely leased in large blocks for sheep and cattle grazing. The squatter furnished 50% of the public revenue with his rents, and opened up the great interior by his pioneering enterprise. As, however, population increased, the necessity for the agriculturist arose, and it became requisite to legislate in the interests of the small holder. Successive Queensland Governments have had some of their hardest work in adapting their land legislation to the needs of the community, recent policy being to reduce large estates and place the cultivator on the soil. At separation from New South Wales the holding of land was regulated by Orders in Council, under an Imperial act of 1846: untransferable leases of "runs" for fourteen years were issued, the minimum size of the run was measured in sheep-carrying capacity—4000 sheep being the least number, and £10 the minimum rent. The lessee was able to buy up his holding in blocks of 160 acres at a time, £1 per acre being the minimum price, and was entitled to a renewal of his lease at its expiry. The minimum lease principle shut out the small agriculturist. The first leading acts passed by Queensland were the Crown Lands Alienation Act of 1868, dealing with the settled districts, and the Pastoral Leases Act of 1869, dealing with the unsettled districts—these divisions were fixed by the first-named measure. The "resumption" principle was introduced by the 1868 act: lands in the settled districts were resumed after twelve months from the passing of the measure, and lessees were granted leases of half of their holdings for ten years; the other moiety was thrown open for settlement. The 1869 act granted new leases for twenty-one years at practically the same low rentals, but 10% was added to the rent after each period of seven years; the area of a run was fixed at from 25 to 100 sq. m. This act greatly pleased the squatters. In 1884 the Dutton Act was passed. Its importance lies in its dealings with the 1869 act leases: on their expiry the State resumed from one-quarter to one-half of the area as crown lands, which were thrown open to selectors, and new leases of from ten to fifteen years were granted for the balance. Grazing farms (20,000 acres) and agricultural farms (1280 acres) were established. This measure was very unpopular with the squatters. With the act of 1897 it forms the basis of the existing land regulations of Queensland. Under the 1897 act the passing of the land into the hands of agriculturists was further marked by the creation of agricultural homesteads (160, 320, or 640 acres), grazing homesteads (20,000 acres), scrub selections (10,000 acres), and unconditional selections (1280 acres). Some of these classes of selections could be purchased right out, and all were leased at extremely moderate rates. Sales of country lands were established. Two measures were passed, in 1894 and 1897—the Agricultural Lands Purchases Acts—under which the State was authorized to purchase suitable estates of specially fertile land already alienated, to be cut up and thrown open as agricultural farms. These measures confirmed Queensland's determination to encourage agriculture. Owing to the expiration of pastoral leases and the fact that no legislation existed for their renewal for a term long enough to encourage the investment of capital, a formidable agitation prevailed in the colony, the lessees bitterly complaining of the uncertainty of their tenure. The British Australasian Society was formed in Great Britain, to protect the interests of British capital invested in the pastoral industry in Queensland. In 1900, out of the total Queensland area of 427,838,080 acres, no less than 411,793,786 acres remained in the hands of the State unalienated. (J. T. Cr.)

QUEENSTOWN, a town of the Cape province, South Africa, in the upper valley of the Great Kei river, 155 m. by rail N.W. of East London. Pop. (1904) 9616, of whom 4157 were white. Founded in 1853 and named after Queen Victoria, it was laid out in an unusual form. From each angle of a central hexagonal-shaped open space there runs one of the main thoroughfares. This arrangement was adopted to facilitate defence in case of an attack by Kaffirs, Queenstown at the time of its foundation being a border settlement. Up to 1868 the burghers held their lands on a military tenure. It contains several fine buildings, including the town hall, court-house and public offices and the Anglican church of St Michael. Many of the streets are lined with oaks and blue gums. Situated on the Karroo, at an elevation of 3500 ft., between the Stormberg and Amatola Mountains, it is the centre of a wheat and sheep-rearing district, and is a busy commercial town. The climate is healthy, and Queenstown has a reputation as a sanatorium.

QUEENSTOWN, a town of Montagu county, Tasmania, on the Queen river, 23 m. by rail by Strahan, and 353 m. W. of Hobart. It is the centre of the Mount Lyell mining district and has numerous smelting works, brick-works, and sawmills. The county is mountainous and finely wooded. Pop. (1901) 5051; of the district, 10,451.

QUEENSTOWN (formerly Cove of Cork), a seaport, watering-place, and naval station of county Cork, Ireland, picturesquely situated on the south side of Great Island, on the slope of an eminence rising abruptly above Cork Harbour. Pop. (1901) 7909. It is 12 m. E.S.E. of Cork and 177 m. S.W. of Dublin by the Great Southern & Western railway. It consists chiefly of terraces rising one above another with wide streets and handsome houses. On account of the mildness of the climate it is frequented by visitors both in summer and winter. Previous to the American War, Cove of Cork was a small fishing village, but it subsequently increased rapidly. It received its present name on the occasion of the visit in 1849 of Queen Victoria, being her first landing-place in Ireland. The town is governed by an urban district council. The harbour, which is defended by the Carlisle and Camden Forts at its entrance, and by Fort Westmoreland on Spike Island, can shelter a large fleet. Spike, Rocky and Haulbowline islands are used in the formation of a government dockyard, which with the adjoining victualling yard covers an area of 55 acres. There is an enclosed basin 9 acres in extent, with 32 ft. 8 in. depth over the sill at high-water spring tides; and a dry dock at its southern end has a length of 408 ft. on the blocks. Queenstown is a port of call for American mail steamers, and the mails are transmitted overland by express trains; it is also a port of embarkation for colonial troops, and a government emigration station. The admiral's flagship is stationed here. The oldest yacht club in the United Kingdom, the Royal Cork (founded in 1720 as the Cork Harbour Water Club), has its headquarters here, with a club-house, and holds an annual regatta. Among the principal buildings are the modern Catholic cathedral of St Colman for the diocese of Cloyne, designed by A. W. Pugin, and the Protestant Episcopal church for the united parishes of Clonmel and Temple Robin. A fine promenade, over a mile in length, connects Queenstown with Rushbrook, a favourite watering-place. The picturesque shores of the harbour are dotted with country residences and village-resorts, such as Crosshaven and Church Bay.

QUELPART (Chai-Ju), an island to the south of Korea, used as a Korean penal settlement. In measures 40 m. from E. to W. and 17 from N. to S. It rises gradually from the seaboard, is heavily wooded and is cleared for cultivation to a height of 2000 ft. There are several crateriform hills, and Hali San (Mount Auckland) has an altitude of 6558 ft. The island is entirely volcanic, and the soil is finely disintegrated lava. Broken black lava forms the beach, and blocks of it are the universal building material. There is no good drinking water. The flora and fauna are scarcely investigated. Pines of three species, junipers, larches, oaks, maples, willows and the *Thuja Orientalis* have been identified. The known fauna comprise boars, bears, deer, swans, geese, pheasants and quail. The roads are scarcely passable bridle tracks. Quelpart was introduced to European notice by the Dutchman, Hendrik Hamil, who was shipwrecked there in 1653.

The estimated population is 100,000, Korean by race, language and costume. There are about ninety villages. The valleys and slopes are carefully cultivated in fields divided by stone walls, and produce beans, peas, sweet potatoes, "Russian turnip radish," barley, a little rice and millet, the last being the staple article of diet. Nuts, oranges, limes and plums are grown. Small but strong ponies are bred for export, and small cattle and pigs for home use. Apart from agriculture, the industries consist in the manufacture of fine bamboo hats and mats, and wooden combs for export and local use. For fishing the islanders use double-decked raft boats, similar to those of southern Formosa. Their lucrative pearl fisheries have been practically monopolized by the Japanese, who use proper diving apparatus. A valuable product is a species of clam, the shell of which furnishes a specially iridescent mother-o'-pearl, which the natives barter with the Japanese for inlaying lacquer. European goods are not imported, but Japanese articles find ready barter. There are no markets, and only a few poor shops.

Chu-sung, the capital and seat of government, a few miles from Port Pelto, has a black lava wall 25 ft. high, with three gates and towers; an imposing audience-hall in Chinese style; and a great bell tower, with a fine bronze bell, sounded to drive off "evil dragons." Its population is estimated at 16,000. The governor has a hereditary army for coercive purposes. The uniform is a complete suit of mail, with a helmet, from which leather curtains fall over the shoulders. The weapons are equally antique.

There are no good harbours, and the only anchorage for large vessels is Tai-chung, or Yung-su, at the east end, with 9 to 13 fathoms of water. Pelto has ancient breakwaters for the protection of small boats, erected, as many believe, by the Mongol conqueror, Kublai Khan, who in 1273 built on Quelpart one hundred ships for the invasion of Japan.

QUENSTEDT, FRIEDRICH AUGUST VON (1809–1889), German geologist and palaeontologist, was born at Eisleben in Saxony on the 9th of July 1809. He was educated at Berlin, and after having acted as assistant in the mineralogical museum he was appointed professor of mineralogy and geognosy in the university of Tübingen in 1837, a post which he occupied until his death. His earlier work related chiefly to crystallography and mineralogy, on which subjects he published text-books that were widely used. He became distinguished for his researches on palaeontology, and especially for those on the fossils of the Jurassic system. The museum at Tübingen owed its establishment to his exertions. He died at Tübingen on the 21st of December 1889.

His chief publications were: *Method der Krystallographie* (1840); *Das Flözgebirge Württembergs* (1843); *Petrefactenkunde Deutschlands* (7 vols. and atlases, 1846–84); *Die Cephalopoden* (1846–49); *Handbuch der Petrefactenkunde* (2 vols., 1852, 3rd ed. 1882–85); *Der Jura* (2 vols., 1858); *Handbuch der Mineralogie* (1855, 3rd ed. 1877); *Die Ammoniten des Schwäbischen Jura* (1883–84). Obituary by W. T. Blandford, *Quart. Journ. Geol. Soc.* vol. xlvi., 1890.

QUENTAL, ANTHERO DE (1842–1891), Portuguese poet, was born on the island of St Michael, in the Azores, on the 18th of April 1842. He studied at the university of Coimbra, and soon distinguished himself by unusual talent, as well as turbulence and eccentricity. He began to write poetry at an early age, chiefly, though not entirely, devoting himself to the sonnet. After the publication of one volume of verse, he entered with great warmth into the revolt of the young men which dethroned Castilho, the chief living poet of the elder generation, from his place as dictator over modern Portuguese literature. He then travelled, engaged on his return in political and socialistic agitations, and found his way through a series of disappointments to the mild pessimism, a kind of Western Buddhism, which animates his latest poetical productions. His melancholy was increased by a spinal disease, which after several years of retirement from the world, eventually drove him to suicide in his native island, on the 11th of September 1891. Anthero stands at the head of modern Portuguese poetry after João de Deus. His principal defect is monotony—his own self is his solitary theme, and he seldom attempts any other form of composition than the sonnet. On the other hand, few poets who have chiefly devoted themselves to this form have produced so large a proportion of really exquisite work. The comparatively few pieces in which he either forgets his doubts and inward conflicts, or succeeds in giving them an objective form, are among the most beautiful in any literature. The purely introspective sonnets are less attractive, but equally finely wrought, interesting as psychological studies, and impressive from their sincerity. His mental attitude is well described by himself as "the effect of Germanism on the unprepared mind of a Southerner." He had learned much, and half-learned more, which he was unable to assimilate, and his mind became a chaos of conflicting ideas, settling down into a condition of gloomy negation, save for the one conviction of the vanity of existence, which ultimately destroyed him. A healthy participation in public affairs might have saved him, but he seemed incapable of entering upon any course that did not lead to delusion and disappointment. The great popularity acquired, notwithstanding, by poetry so metaphysical and egotistic is a testimony to the artistic instinct of the Portuguese.

As a prose writer Quental displayed high talents, though he wrote little. His most important prose work is the *Considerações sobre a philosophia da historia literaria Portugueza*, but he earned fame by his pamphlets on the Coimbra question, *Bom senso e bom gosto*, a letter to Castilho, and *A dignidade das lettras e litteraturas officiaes*.

His friend Oliveira Martins edited the Sonnets (Oporto, 1886), supplying an introductory essay; and an interesting collection of studies on the poet by the leading Portuguese writers appeared in a volume entitled *Anthero de Quental. In Memoriam* (Oporto, 1896). The sonnets have been turned into most European languages; into English by Edgar Prestage (*Anthero de Quental, Sixty-four Sonnets*, London, 1894), together with a striking autobiographical letter addressed by Quental to his German translator, Dr Storck.

QUÉRARD, JOSEPH MARIE (1797–1865), French bibliographer, was born at Rennes on the 25th of December 1797. He was apprenticed to a bookseller in his native town, and was sent abroad on business. He remained in Vienna from 1819 to 1824, and there drew up the first volumes of his great work, *La France littéraire, ou Dictionnaire bibliographique des savants, historiens, et gens de lettres de la France, &c.* (10 vols., 1826–1842), dealing especially with the 18th and early 19th centuries, which he was enabled to complete by a government subsidy granted by Guizot in 1830, and by the help of the Russian bibliophile Serge Poltoratzky. The firm of Didot, who were his publishers, took out of his hands the *Littérature française contemporaine* with which he had intended to complete his work, and placed it with Ch. Louandre and F. Bourquelot. Quérard avenged himself by pointing out the errors of his successors. In spite of his claims Quérard was unable to secure a position in any of the public libraries. He died in Paris on the 3rd of December 1865.

Among his other works are: *Les supercheries littéraires dévoilées* (5 vols., 1845–56); *Bibliographie La Menaisienne* (1849); *Dictionnaire des ouvrages-polyonymes et anonymes de la littérature française, 1700–1850* (1846–47); an additional volume to *La France littéraire* entitled *Écrivains pseudonymes, &c.* (1854–56). See Mar. Jozon d'Erquar, *Quérard*, in *La France littéraire* (1854), vol. xi.

QUERCITRON, a yellow dyestuff obtained from the bark of the quercitron oak, *Quercus tinctoria*, a fine forest tree indigenous in North America. The name is a shortened form of "quercicitron," from Lat. *quercus*, oak, and "citron," and was invented by Dr Edward Bancroft (1744–1821), who by act of parliament in 1785 was granted special privileges in regard to the importation and use of the substance. The dyestuff is prepared by grinding the bark in mills after it has been freed from its black epidermal layer, and sifting the product to separate the fibrous matter, the fine yellow powder which remains forming the quercitron of commerce. The ruddy-orange decoction of quercitron contains quercitannic acid, whence its use in tanning, and an active dyeing principle, quercitrin, $C_{21}H_{22}O_{12}$. The latter substance is a glucoside, and in aqueous solution under the influence of mineral acids it yields quercetin, $C_{15}H_{60}O_7$, which is precipitated, and the pentoside rhamnose. Quercetin is a crystalline powder of a brilliant citron yellow colour, entirely insoluble in cold and dissolving only sparingly in hot water, but quite soluble in alcohol. Either by itself or in some form of its glucoside quercitrin, quercetin is found in several vegetable substances, among others in cutch, in Persian berries (*Rhamnus catharticus*), buckwheat leaves (*Polygonum Fagopyrum*), Zante fustic wood (*Rhus Cotinus*), and in rose petals, &c. Quercitron was first introduced as a yellow dye in 1775, but it is principally used in the form of flavin, which is the precipitate thrown down from a boiling decoction of quercitron by sulphuric acid. Chemically, quercetin is a member of a fairly extensive class of natural colouring matters derived from β phenyl benzo-γ-pyrone or flavone, the constitution of which followed on the researches of St von Kostanecki, A. G. Perkin, Herzig, Goldschmidt and others. Among the related colouring matters are: chrysin from poplar buds, apigenin from parsley, luteolin from weld and dyers' broom, fisetin from young fustic and yellow cedar, galangin from galanga root, and myricetin from *Myrica Nagi*.

QUERCY (Lat. *pagus Caturcinus*, Fr. *Cahorsin*), a county in France before the Revolution. The name is taken from that of a Gallic tribe, the Cadurci, and was applied to a small district watered by the Dordogne, the ~~Lot~~ and the Tarn. It was bordered by Limousin, Rouergue, Armagnac, Périgord and Agenais. In the middle ages it was divided into upper, or black, Quercy, and lower, or white, Quercy, the capital of the former being Cahors and of the latter Montauban. Its two other chief towns were Figeac and Moissac. Ecclesiastically it was included almost entirely in the diocese of Cahors until 1317, when a bishopric for lower Quercy was established at Montauban. Judicially it was under the authority of the *parlement* of Bordeaux; for financial purposes it was part of the *généralité* of Montauban. The estates of the county had the bishop of Cahors for president; other members were the bishop of Montauban and other ecclesiastics, four viscounts, four barons and some other lords and representatives of eighteen towns.

Under the Romans Quercy was part of *Aquitania prima*, and Christianity was introduced therein during the 4th century. Early in the 6th century it passed under the authority of the Franks, and in the 9th century was part of the Frankish kingdom of Aquitaine. At the end of the 10th century its rulers were the powerful counts of Toulouse. During the wars between England and France in the reign of Henry II., the English placed garrisons in the county, and by the treaty of Paris in 1259 lower Quercy was ceded to England. Both the king of England and the king of France confirmed and added to the privileges of the towns and the district, each thus hoping to attach the inhabitants to his own interest. In 1360, by the treaty of Brétigny, the whole county passed to England, but in 1440 the English were finally expelled. In the 16th century Quercy was a stronghold of the Protestants, and the scene of a savage religious warfare. The civil wars of the reign of Louis XIII. centred around Montauban. Quercy was early an industrial district. It gave its name to *cadurcum*, a kind of light linen, and the bankers of Cahors were famous.

QUERÉTARO, a city of Mexico, capital of the state of Querétaro-Arteaga, 152 m. by rail N.W. of the national capital. Pop. (1900) 33,152, including a large Indian element. Querétaro is served by the Mexican Central railway. The city stands on a plain at the foot of the Cerro de las Campanas, 6168 ft. above sea-level. Among the important buildings are the Cathedral (said to have been built originally about 1535, and subsequently restored at various times), the Iturbide theatre (in which occurred the trial of Maximilian), the government offices, the federal palace and the churches of Santa Rosa, Santa Clara and San Augustin. The federal palace and the church of Santa Rosa are examples of the work of the celebrated Mexican architect, Francisco Eduardo de Tresguerras (1765–1833), who restored the church of Santa Clara also. The gilded wood carvings of Santa Clara are noteworthy; and in the courtyard of the federal palace there are other specimens of the same work. The water-supply is brought over a fine aqueduct 5 m. long, dating from 18th century. Among manufactures are cottons, woollens, pottery and ironwares. Querétaro has one of the oldest and largest cotton factories in Mexico, employing about 2000 operatives, and maintaining a small private military force for protection. It was built in the days when brigandage held the whole country in terror, and was strongly fortified and provided with artillery and garrison. The latter was also used to escort pack trains of goods and supplies before the building of the railway. This old factory has also played its part in the civil wars of the country since 1840, becoming a fortress whenever Querétaro became involved in military operations.

Querétaro occupies the site of an Otomie Indian town dating from about 1400. It was captured by the Spaniards in 1531 and was raised to the rank of a city in 1655. It was the scene of a revolutionary outbreak against Spain in 1810. In 1848 a Mexican congress met here to ratify the treaty of peace with the United States, and in 1867 Querétaro was the scene of Maximilian's last stand against the republicans (under Escobedo), which resulted in his capture and subsequent execution on the Cerro de las Campanas just N. of the city.

QUERÉTARO-ARTEAGA, a central state of Mexico, bounded N. by San Luis Potosí, E. by Hidalgo, S.E. by the state of Mexico, S. by Michoacan and W. by Guanajuato; area, 3556 sq. m. Pop. (1900) 232,389, largely Indian. The state belongs to the elevated plateau region, with its semi-arid conditions. The N. part of the state is traversed from E. to W. by the wooded Sierra Gorda, whose spurs reach southward to the central districts. The central and S. parts are covered by plains, broken by low hills. The rivers are small and flow chiefly to the San Juan, a part of the Panuco drainage basin. There are some small lakes and swamps and a number of mineral springs. Sugar, cotton, Indian corn, beans and considerable quantities of wheat are grown, but agriculture is largely hampered by the uncertainty of the rainfall. The chief wealth of the state is in its mines. Silver, gold, copper, mercury, lead, tin, antimony and precious stones are found, in some cases in very rich deposits. The richest mining districts are those of Cadereyta and Tolimán, where there are metallurgical works for the reduction of ores. The Mexican Central and Mexican National railways cross the S. end of the state and afford transportation facilities for the agricultural districts, but the mining districts of the N. are still dependent upon old methods. The capital of the state is the historic city of Querétaro (*q.v.*), and other important towns, with their populations in 1900, are: San Juan del Rio (8124), Landa (about 7000), Ahuacatlan (5929 in 1895), Jalpan (about 6000), and Tolimán, celebrated for its opals.

QUERFURT, a town of Germany, in the province of Prussian Saxony, situated in a fertile country on the Querne, 18 m. W. from Merseburg, on a branch line from Oberröblingen. Pop. (1905) 4884. Its chief industries are sugar-refining, lime-burning and brewing. Querfurt was for some time the capital of a principality which had an area of nearly 200 sq. m. and a population of about 20,000. The ruling family having become extinct in 1496, it passed to that of Mansfeld. In 1635, by the peace of Prague, it was ceded to the elector of Saxony, John George I., who handed it over to his son Augustus of Saxe-Weissenfels; but in 1746 it was again united with electoral Saxony. It was incorporated with Prussia in 1815.

See Schneider, *Querfurter Stadt- und Kreischronik* (Querfurt, 1902).

QUERN, the primitive form of hand-mill for grinding corn, consisting of two flat circular stones; the lower stone, often shaped with a rim, has a wooden or metal pin in the centre which passes through a hole in the upper stone; the worker pours the grain through the hole with one hand, revolving the upper stone with the other by means of a peg fixed to one side. The Old English word is *cweorn*; it is a word common to Teutonic languages, cf. Du. *kweern*, Swed. *qvarn* and various forms in Old German; cognate words are found in Slavonic languages pointing to a pre-Aryan root. It is not related to "churn." (See Flour.)

QUESADA Y MATHEUS, JENARO DE (1818–1889), 1st Marquis of Miravalles, Spanish soldier, was born at Santander, on the 6th of February 1818. He was a son of General Vicente Quesada, a Conservative officer who was murdered and atrociously mutilated in the streets of Madrid by a revolutionary mob in the early days of Queen Isabella's reign. As Quesada belonged to an ancient family connected with the dukes of Fernan Nuñez, he was made a cornet when only six years old, was educated at the seminary for nobles and in 1833 was promoted lieutenant in the 1st Foot Guards. He served from 1833 to 1836 against the Carlists. When his father was assassinated in 1836 he resigned, went to France, got employment in a merchant's office and was only induced to return to the army in 1837 by his relatives, who got him a company in the guards. He distinguished himself often in the Carlist war, but his promotion was slow, and he declined to have anything to do with politics. He confined himself to his duties as a soldier, always fighting on the side of governments against Carlist, Republican and Progressist risings. He only became a general of division in 1853, and at the head of the Madrid garrison he fought hard in 1854 to avert the triumph of Espartero, O'Donnell and Dulce, who publicly recognized his gallant conduct. When the war in Morocco broke out, Marshal O'Donnell gave Quesada the command of a division, which played so conspicuous a part in that campaign and at the battle of Wad el Ras that its commander was made lieutenant-general and grand cross of Charles III. He was director-general of the Civil Guard when the military rebellion of the 22nd of June 1866 broke out in Madrid, and after he had been wounded in the leg he remained at the head of the loyal troops until the insurgents were crushed. He did not accept any military post during the revolution until Marshal Serrano in 1874 offered him the direction of the staff, and he only accepted it after clearly stating that he was a royalist and partisan of Alfonso XII. In his long and brilliant career he never swerved from his steadfast resolve never to be mixed up in any political or military intrigues or pronunciamientos —to use his own words, "not even to restore my king." As soon as the king was restored, the government of Señor Canovas made Quesada first general-in-chief of the army of Central Spain, and in February 1875 general-in-chief of the army of the North. With the assistance of another officer who also had never dabbled in pronunciamientos, General O'Ryan, Quesada restored discipline in the armies confronting Don Carlos, and for twelve months concerted and conducted the operations that forced the pretender to retire into France and his followers to lay down their arms. The government confided to the marquis of Miravalles the difficult task of ruling the northern provinces for several years after the war, and he succeeded in conciliating the sympathies of the Basques and Navarrese, though the penalty of their last rising had been the loss of most of their ancient liberties or *fueros*. Quesada was made marquis of Miravalles, grandee after the war, minister of war in 1883 and senator. Though he was a strict, stern disciplinarian of the old school and an unflinching Conservative, Catholic and royalist, even his political and military opponents respected him, and were proud of him as an unblemished type of the Castilian soldier and gentleman. He died at Madrid on the 19th of January 1889, and was given full military honours. (A. E. H.)

QUESNAY, FRANÇOIS (1694–1774), French economist, was born at Mérey, near Paris, on the 4th of June 1694, the son of an advocate and small landed proprietor. Apprenticed at the age of sixteen to a surgeon, he soon went to Paris, studied medicine and surgery there, and, having qualified as a master-surgeon, settled down to practice at Mantes. In 1737 he was appointed perpetual secretary of the academy of surgery founded by François la Peyronie, and became surgeon in ordinary to the king. In 1744 he graduated as a doctor of medicine; he became physician in ordinary to the king, and afterwards his first consulting physician, and was installed in the palace of Versailles. His apartments were on the *entresol*, whence the *Réunions de l'entresol* received their name. Louis XV. esteemed Quesnay much, and used to call him his thinker; when he ennobled him he gave him for arms three flowers of the pansy (*pensée*), with the motto *Propter excogitationem mentis*.

He now devoted himself principally to economic studies, taking no part in the court intrigues which were perpetually going on around him. About the year 1750 he became acquainted with Jean C. M. V. de Gournay (1712–1759), who was also an earnest inquirer in the economic field; and round these two distinguished men was gradually formed the philosophic sect of the *Économistes*, or, as for distinction's sake they were afterwards called, the *Physiocrates*. The most remarkable men in this group of disciples were the elder Mirabeau (author of *L'Ami des hommes*, 1756–60, and *Philosophie rurale*, 1763), Nicolas Baudeau (*Introduction à la philosophie économique*, 1771), G. F. Le Trosne (*De l'ordre social*, 1777), André Morellet (best known by his controversy with Galiani on the freedom of the corn trade), Mercier Larivière and Dupont de Nemours. Adam Smith, during his stay on the continent with the young duke of Buccleuch in 1764–66, spent some time in Paris, where he made the acquaintance of

Quesnay and some of his followers; he paid a high tribute to their scientific services in his *Wealth of Nations*. Quesnay died on the 16th of December 1774, having lived long enough to see his great pupil, Turgot, in office as minister of finance. He had married in 1718, and had a son and a daughter; his grandson by the former was a member of the first Legislative Assembly.

The publications in which Quesnay expounded his system were the following:—two articles, on "Fermiers" and on "Grains," in the *Encyclopédie* of Diderot and D'Alembert (1756, 1757); a discourse on the law of nature in the *Physiocratie* of Dupont de Nemours (1768); *Maximes générales de gouvernement économique d'un royaume agricole* (1758), and the simultaneously published *Tableau économique avec son explication, ou extrait des économies royales de Sully* (with the celebrated motto, "Pauvres paysans, pauvre royaume; pauvre royaume, pauvre roi"); *Dialogue sur le commerce et les travaux des artisans*; and other minor pieces. The *Tableau économique*, though on account of its dryness and abstract form it met with little general favour, may be considered the principal manifesto of the school. It was regarded by the followers of Quesnay as entitled to a place amongst the foremost products of human wisdom, and is named by the elder Mirabeau, in a passage quoted by Adam Smith, as one of the three great inventions which have contributed most to the stability of political societies, the other two being those of writing and of money. Its object was to exhibit by means of certain formulas the way in which the products of agriculture, which is the only source of wealth, would in a state of perfect liberty be distributed among the several classes of the community (namely, the productive classes of the proprietors and cultivators of land, and the unproductive class composed of manufacturers and merchants), and to represent by other formulas the modes of distribution which take place under systems of Governmental restraint and regulation, with the evil results arising to the whole society from different degrees of such violations of the natural order. It follows from Quesnay's theoretic views that the one thing deserving the solicitude of the practical economist and the statesman is the increase of the net product; and he infers also what Smith afterwards affirmed, on not quite the same ground, that the interest of the landowner is "strictly and indissolubly connected with the general interest of the society." A small *édition de luxe* of this work, with other pieces, was printed in 1758 in the palace of Versailles under the king's immediate supervision, some of the sheets, it is said, having been pulled by the royal hand. Already in 1767 the book had disappeared from circulation, and no copy of it is now procurable; but the substance of it has been preserved in the *Ami des hommes* of Mirabeau, and the *Physiocratie* of Dupont de Nemours.

His economic writings are collected in the 2nd vol. of the *Principaux économistes*, published by Guillaumin, Paris, with preface and notes by Eugène Daire; also his *Œuvres économiques et philosophiques* were collected with an introduction and note by Aug. Oncken (Frankfort, 1888); a facsimile reprint of the *Tableau économique*, from the original MS., was published by the British Economic Association (London, 1895). His other writings were the article "Évidence" in the *Encyclopédie*, and *Recherches sur l'évidence des verités géométriques*, with a *Projet de nouveaux éléments de géométrie*, 1773. Quesnay's *Éloge* was pronounced in the Academy of Sciences by Grandjean de Fouchy (see the *Recueil* of that Academy, 1774, p. 134). See also F. J. Marmontel, *Mémoires; Mémoires de Mme. du Hausset*; H. Higgs, *The Physiocrats* (London, 1897).

QUESNEL, PASQUIER (1634–1719), French Jansenist theologian, was born in Paris on the 14th of July 1634, and, after graduating in the Sorbonne with distinction in 1653, joined the French Oratory in 1657. There he soon became prominent; but his Jansenist sympathies led to his banishment from Paris in 1681. He took refuge with the friendly Cardinal Coislin, bishop of Orléans; four years later, however, foreseeing that a fresh storm of persecution was about to burst, he fled to Brussels, and took up his abode with Antoine Arnauld (*q.v.*). There he remained till 1703, when he was arrested by order of the archbishop of Malines. After three months' imprisonment he made a highly dramatic escape, and settled at Amsterdam, where he spent the remainder of his life. After Arnauld's death in 1694 Quesnel was generally regarded as the leader of the Jansenist party; and his *Réflexions morales sur le Nouveau Testament* played almost as large a part in its literature as Jansen's *Augustinus* itself. As its title betokens, this was a devotional commentary on the Scriptures, wherein Quesnel managed to explain the aims and ideals of the Jansenist party better than any earlier writer had done; and it accordingly became the chief object of Jesuit attack. It appeared in many forms and under various titles, the original germ going back so far as 1668; the first complete edition was published in 1692. The bull *Unigenitus*, in which no fewer than 101 sentences from the *Réflexions morales* were condemned as heretical, was obtained from Clement IX. on the 8th of September 1713. Quesnel died at Amsterdam on the 2nd of December 1719.

See also Mme. Albert Le Roy, *Un Janseniste en exil* (Paris, 1900; and Maulvault, *Répertoire de Port Royal* (Paris, 1902).
(St. C.)

QUETELET, LAMBERT ADOLPHE JACQUES (1796–1874), Belgian astronomer, meteorologist and statistician, was born at Ghent on the 22nd of February 1796, and educated at the lyceum of that town. In 1819 he was appointed professor of mathematics at the athenaeum of Brussels; in 1828 he became lecturer at the newly created museum of science and literature, and he continued to hold that post until the museum was absorbed in the free university in 1834. In 1828 he was appointed director of the new royal observatory which it had been decided to found, chiefly at his instigation. The building was finished in 1832, and the instruments were ready for work in 1835, from which date the observations were published in 4to volumes (*Annales de l'Observatoire Royal de Bruxelles*), but Quetelet chiefly devoted himself to meteorology and statistics. From 1834 he was perpetual secretary of the Brussels Academy, and published a vast number of articles in its *Bulletin*, as also in his journal, *Correspondance mathématique et physique* (11 vols., 1825–39). He died at Brussels on the 17th of February 1874. His son, Ernest Quetelet (1825–78), was from 1856 attached to the observatory, and on his death succeeded him as director. He made a great number of observations of stars with proper motion.

Quetelet's astronomical papers refer chiefly to shooting stars and similar phenomena. He organised extensive magnetical and meteorological observations, and in 1839 he started regular observations of the periodical phenomena of vegetation, especially the flowering of plants. The results are given in various memoirs published by the Brussels Academy, and in his works *Sur le climat de la Belgique* and *Sur la physique du globe* (the latter forms vol. xiii. of the Annales, 1861). He is, however, chiefly known by the statistical investigations which occupied him from 1823 onward. In 1835 he published his principal work, *Sur l'homme et le développement de ses facultés, ou essai de physique sociale* (2nd ed., 1869), containing a résumé of his statistical researches on the development of the physical and intellectual qualities of man, and on the "average man" both physically and intellectually considered. In 1846 he brought out his *Lettres à S. A. R. le duc régnant de Saxe-Coburg et Gotha sur la théorie des probabilités appliquée aux sciences morales et politiques* (of which Sir J. Herschel wrote a full account in the *Edinburgh Review*), and in 1848 *Du système social et des lois qui le régissent*. In these works he shows how the numbers representing the individual qualities of man are grouped round the numbers referring to the "average man" in a manner exactly corresponding to that in which single results of observation are grouped round the mean result, so that the principles of the theory of probabilities may be applied to statistical researches on the subjects. These ideas are further developed in various papers in the *Bulletin* and in his *L'Anthropométrie, ou mesure des différentes facultés de l'homme* (1871), in which he lays great stress on the universal applicability of the binomial law,—according to which the number of cases in which, for instance, a certain height occurs among a large number of individuals is represented by an ordinate of a curve (the binomial) symmetrically situated with regard to the ordinate representing the mean result (average height). A detailed *Essai sur la vie et les travaux de L. A. J. Quetelet*, by his pupil and assistant E. Mailly, was published at Brussels in 1875.

QUETTA, the capital of British Baluchistan, India, which also gives its name to a district. It rose to prominence in 1876, when Sir Robert Sandeman founded a residency there. The name is a variation of the word *kwat-kot*, signifying a fortress, and the place is still locally known as Shal Kot. Quetta is the southernmost point in the line of frontier posts and system of strategic railways on the north-west frontier of India, 536 m. by rail N. of Karachi. It forms the headquarters of the fourth division of the southern army, with a strong garrison of all arms. The railway was built in 1879, with a view to its continuance to Kandahar; but its present terminus is New Chaman on the Afghan border. A branch line to Nushki was completed in 1905. The cantonment and civil station of Quetta stand in the open plain about 5500 ft. above sea-level, within a ring of mountains (such as Takatu, Murdar and Chiltan), which overlook it from a height of over 11,000 ft. To the north-west the view is open across the base of the Pishin valley to the Khojak Pass and Kandahar. Southwards is the open valley leading to the Bolan Pass, traversed by the railway. North of Quetta is the open plain leading to Pishin and the Harnai, also traversed by the Sibi-Pishin railway, which passes through the fortifications. These defensive works, stretching from the base of Takatu to the foot of the Mashelak hills on the west, bar the way to advance from the Khojak Pass. During the last quarter of the 19th century Quetta grew from a dilapidated group of mud buildings, with an inferior bazaar and a few scattered remnants of neglected orchard cultivation, into a strong fortress, and one of the most popular stations of the Indian army. Quetta was visited by the prince of Wales (George V.) in 1906, and a staff college for the Indian army was opened here in 1907. It has become the trade mart for western Afghanistan, eastern Persia, and much of central Asia. The population of the town and cantonment in 1901 was 24,584.

The District of Quetta (including Pishin) has an area of 5127 sq. m. Pop. (1901) 114,087, of whom more than three-fourths are Afghans, showing an increase of 45% in the decade. The general aspect of the country is hilly, rocky and sterile, particularly towards the north; but in many parts the soil is rich and good, yielding wheat, rice, madder, tobacco, and lucerne, besides numerous grasses. The district has abundant orchards, furnishing grapes, apples, pears, pomegranates, figs, &c.; melons and all kinds of English vegetables are also largely cultivated. The valley is watered by the Pishin Lora and by government irrigation works, including artesian wells. Wild sheep and goats abound in the hills of the district. The climate appears to be healthy and the temperature moderate, ranging from 40° F. in the winter to about 78° in the summer. The annual rainfall (including snow) averages about 10 in. The actual line of valley which contains Quetta and the Bolan Pass was originally rented from the khan of Kalat on terms which were changed in 1882 to a quit-rent of Rs25,000 per annum, and a further compensation of Rs30,000 in lieu of transit duties in the Bolan Pass. This perpetual leasehold was afterwards extended so as to include Nushki and give the British government the command of the trade route to Sistan. The Quetta district is now administered, together with the assigned districts of Pishin, Tal Chotiali, and Sibi (assigned by the treaty of Gandamak as being nominally Afghan territory) by a regular staff of civil officials.

See Thornton, *Life of Sir Robert Sandeman* (London, 1896); *Quetta-Pishin District Gazetteer* (Ajmer, 1907). (T. H. H.*)

QUEUE or **CUE** (from Fr. *queue*, O. Fr. *cue*, Lat. *cauda*, tail), a tail of hair, either of the natural hair when so worn or of a wig, plaited together and tied with ribbon, hanging down the back of the neck. In Europe and European colonies and settlements this method of wearing the hair prevailed after the heavy periwig had gone out of fashion. The bob-wig or tie-wig with the queue survives in the English barrister's wig. In the second half of the 18th century the queue was worn thick and short and sometimes encased in leather, when it was termed a "club." In the navy and army the queue survived its disuse in civil life. The three pieces of black velvet sewn on to the collar of the full dress tunic of the officers of the Royal Welsh Fusiliers, and styled the "flash," are said to be a relic of the ribbon which tied the queue. The most familiar use of this fashion of wearing the hair is the pigtail of the Manchus, which was imposed on all Chinese men as a symbol of loyalty and obedience at the conquest of China (see China: *Social Life*). A particular meaning of the word is for the line of persons formed in order awaiting their turn for admission to a theatre or other place. This appears also in French, from which it is borrowed. In the form "cue" (Fr. *queue*) the word is used of the tapering, striking implement in the game of billiards (*q.v.*). It is often stated that the theatrical use of "cue" for the concluding words of an actor's dialogue or speech which marks the beginning of another actor's part is merely an adaptation of the meaning "tail." The *New English Dictionary* points out that there is no trace of this use in French. In 16th and 17th century plays the endings of parts are marked Q. or qu-, which has been taken to represent Lat. *quando*, when.

QUEVEDO Y VILLEGAS, FRANCISCO GÓMEZ DE (1580–1645), Spanish satirist and poet, was born at Madrid, where his father, who came from the mountains of Burgos, was secretary to Anne of Austria, fourth wife of Philip II. Early left an orphan, Quevedo was educated at the university of Alcalá, where he acquired a knowledge of classical and modern tongues—of Italian and French, Hebrew and Arabic, of philosophy, theology, civil law, and economics. His fame reached beyond Spain; at twenty-one he was in correspondence with Justus Lipsius on questions of Greek and Latin literature. His abstruse studies influenced Quevedo's style; to them are due the pedantic traits and mania for quotations which characterize most of his works.

He betook himself to the court and mingled with the society that surrounded Philip III. The cynical greed of ministers, the meanness of their flatterers, the corruption of the royal officers, the financial scandals, afforded ample scope to Quevedo's talent as a painter of manners. At Valladolid, where the court resided from 1601 to 1606, he mingled freely with these intrigues and disorders, and lost the purity of his morals but not his uprightness and integrity. In 1611 he fought a duel in which his adversary was killed, fled to Italy, and later on became secretary to Pedro Téllez Girón, duke de Osuna, and viceroy of Naples. Thus he learned politics—the one science which he had perhaps till then neglected,—initiated himself into the questions that divided Europe, and penetrated the ambitions of the neighbours of Spain, as well as the secret history of the intriguers protected by the favour of Philip III. The result was that he wrote several political works, particularly a lengthy treatise, *La Politica de Dios* (1626), in which he lays down the duties of kings by displaying to them how Christ has governed His church. The disgrace of Osuna (1620) compromised Quevedo, who was arrested and exiled to his estate at La Torre de Juan Abad in New Castile. Though involved in the process against the duke, Quevedo remained faithful to his patron, and bore banishment with resignation. On the death of Philip III. (31st of March 1621) he recommended himself to the first minister of the new king by celebrating his accession to power and saluting him as the vindicator of public morality in an epistle in the style of Juvenal. Olivares recalled him from his exile and gave him an honorary post in the palace, and from this time Quevedo resided almost constantly at court, exercising a kind of political and literary jurisdiction due to his varied relations and knowledge, but especially to his biting wit, which had no respect for persons. General politics, social economy, war, finance, literary and religious questions, all came under his dissecting knife, and he had a dissertation, a pamphlet, or a song for everything. One day he is defending St James, the sole patron of Spain, against a powerful coterie that wished to associate St Theresa with him; next day he is writing against the duke of Savoy, the hidden enemy of Spain, or against the measures taken to change the value of the currency; or once more he is engaged with the literary school of Góngora, whose affectations seem to him to sin against the genius of the Castilian tongue. And in the midst of this incessant controversy on every possible subject he finds time to compose a picaresque romance, the *Historia de la Vida del Buscón, llamado Don Pablos, Exemplo de Vagamundos, y Espejo de Tacaños* (1626); to write his *Sueños* (1627), in which all classes are flagellated; to pen a dissertation on *The Constancy and Patience of Job* (1631), to translate St Francis de Sales and Seneca, to compose thousands of verses, and to correspond with Spanish and foreign scholars.

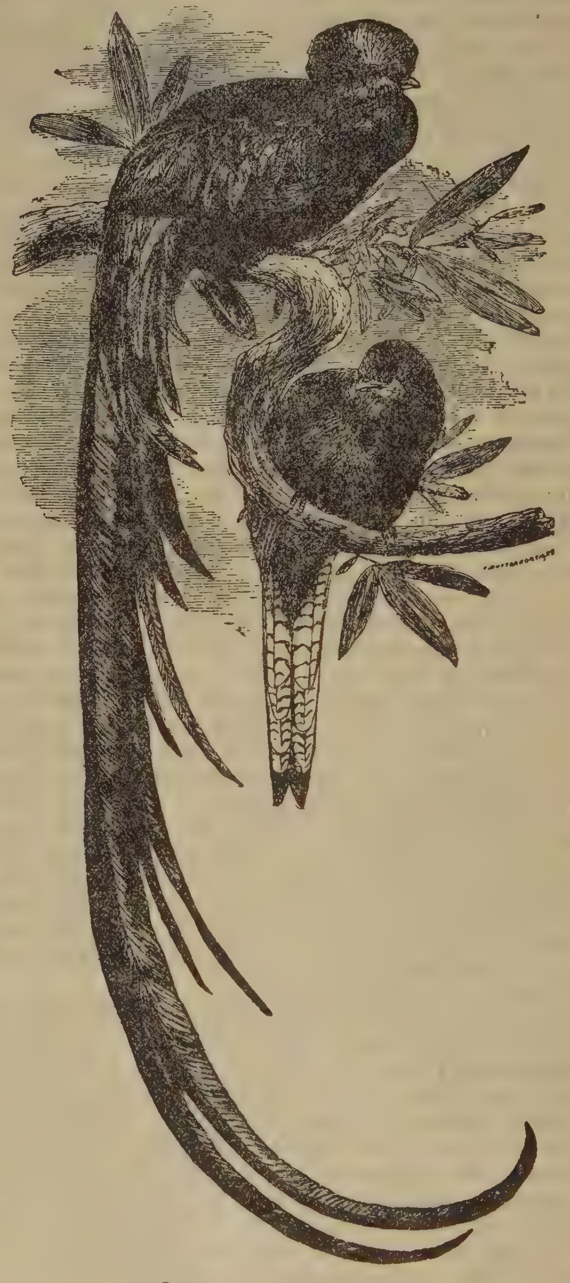
But Quevedo was not to maintain unscathed the high position won by his knowledge, talent, and biting wit. The government of Olivares, which he had welcomed as the dawn of a political and social regeneration, made things worse instead of better, and led the country to ruin. Quevedo saw this and could not hold his peace. An anonymous petition in verse enumerating the grievances of his subjects was found, in December 1639, under the very napkin of Philip IV. It was shown to Olivares, who exclaimed, "I am ruined"; but before his fall he sought vengeance on the libeller. His suspicions fell on Quevedo, who had enemies glad to confirm them. Quevedo was arrested on December 7, and carried under a strong escort to the monastery of St Mark at Leon, where he was kept in rigorous confinement till the fall of the minister (January 1643) restored him to light and freedom, but not to the health which he had lost in his dungeon. He had little more than two years to live, and these were spent in inactive retreat, first at La Torre de Juan Abad, and then at the neighbouring Villanueva de los Infantes, where he died September 8, 1645.

As a satirist and humorist Quevedo stands in the first rank of Spanish writers; his other literary work does not count for much. I. I. Chifflet, in a letter of February 2, 1629, calls him "a very learned man to be a Spaniard," and indeed his erudition was of a solid kind, but he merits attention not as humanist, philosopher, and moralist, but as the keen polemic writer, the pitiless mocker, the profound observer of all that is base and absurd in human nature, and at the same time as a finished master of style and of all the secrets of the Spanish tongue. His style, indeed, is not absolutely pure; though he ridiculed so well the bad taste of *culteranismo*, he fell himself into the style called *conceptismo*, which strains after ambiguous expressions and alembicated "points." But, though involved and overcharged with ideas, his diction is of singular force and originality; after Cervantes he is the greatest Spanish prose writer of the 17th century.

There is an excellent collected edition of Quevedo's prose works with a good life of the author by D. Aureliano Fernandez-Guerra (*Bibl. Ribadeneyra*, vols. xxiii. and xlviii.); his poetical works in vol. lxix. of the same collection are badly edited by D. Florencio Janer. There is a second edition, enlarged and annotated by Señor Menéndez y Pelayo. E. Mérimée, in *Essai sur la vie et les œuvres de Francisco de Quevedo* (Paris, 1886), has supplied an excellent critical and biographical monograph with a bibliography.

(J. F.-K.)

QUEZAL, or QUESAL, the Spanish-American name for one of the most beautiful of birds, abbreviated from the Aztec or Maya *Quetzal-tototl*, the last part of the compound word meaning fowl, and the first, also written *Cuetzal*, the long feathers of rich green with which it is adorned.[1] The Quezal is one of the Trogons (*q.v.*), and was originally described by Hernandez (*Historia*, p. 13), whose account was faithfully copied by F. Willughby. Yet the bird remained practically unknown to ornithologists until figured in 1825, from a specimen belonging to Leadbeater,[2] by C. J. Temminck (*Pl. col.*, 372), who, however, mistakenly thought it was the same as the *Trogon pavoninus*, a congeneric but quite distinct species from Brazil, that had just been described by Spix. The scientific determination of the Quetzal-bird of Central America seems to have been first made by C. L. Bonaparte in 1826, as *Trogon paradiseus*, according to his statement in the Zoological Society's *Proceedings* for 1837 (p. 101); but it is not known whether the fact was ever published. In 1832 the *Registro Trimestre*, a literary and scientific journal printed at Mexico, contained a communication by Dr. Pablo de la Llave, describing this species (with which he first became acquainted before 1810, from examining more than a dozen specimens obtained by the natural-history expedition to New Spain and kept in the palace of the Retiro near Madrid) under the name by which it is now known, *Pharomacrus mocino*.[3]



Quezal, male and female.

These facts, however, being almost unknown to the rest of the world, J. Gould, in the Zoological *Proceedings* for 1835 (p. 29), while pointing out Temminck's error, gave the species the name of *Trogon resplendens*, which it bore for some time. Yet little or nothing was generally known about the bird until Delattre sent an account of his meeting with it to the *Echo du monde savant* for 1843, which was reprinted in the *Revue zoologique* for that year (pp. 163–165). In 1860 the nidification of the species, about which strange stories had been told to the naturalist last named, was determined, and its eggs, of a pale bluish-green, were procured by Robert Owen (*P. Z. S.*, 1860, p. 374; *Ibis*, 1861, p. 66, pl. ii. fig. 1); while further and fuller details of its habits were made known by O. Salvin (*Ibis*, 1861, pp. 138–149), from his own observation of this very local and remarkable species. Its chief home is in the mountains near Coban in Vera Paz, but it also inhabits forests in other parts of Guatemala at an elevation of from 6000 to 9000 ft.

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[1] The Mexican deity Quetzal-coatl had his name, generally translated "Feathered Snake," from the *quetzal*, feather or bird, and *coatl*, snake, as also certain kings or chiefs, and many places, *e.g.* Quezalapan, Quezaltepec, and Quezaltenango, though perhaps some of the last were named directly from the personages (cf. Bancroft, *Native Races of the Pacific States*, vol. v., Index). Quetzalitzli is said to be the emerald.

[2] This specimen had been given to Canning (a tribute, perhaps, to the statesman who boasted that he had "called a New World into existence to redress the balance of the Old") by Mr Schenley, a diplomatist, and was then thought to be unique in Europe; but, apart from those which had reached Spain, where they lay neglected and undescribed, James Wilson says (*Illustr. Zoology*, pl. vi. text) that others were brought with it, and that one of them was given to the Edinburgh Museum. On the 21st day of the sale of Bullock's Museum in 1819, Lot 38 is entered in the Catalogue as "The Tail Feather of a magnificent undescribed Trogon," and probably belonged to this species.

[3] De la Llave's very rare and interesting memoir was reprinted by M. Sallé in the *Revue et magazin de zoologie* for 1861 (pp. 23–33).

The Quezal is hardly so big as a Turtle-Dove. The cock has a fine yellow bill and a head bearing a rounded crest of filamentous feathers; lanceolate scapulars overhang the wings, and from the rump spring the long flowing plumes which are so characteristic of the species, and were so highly prized by the natives before the Spanish conquest that no one was allowed to kill the bird when taken, but only to divest it of its feathers, which were to be worn by the chiefs alone. These plumes, the middle and longest of which may measure from 3 ft. to 3½ ft., with the upper surface, the throat, and chest, are of a resplendent golden-green,[1] while the lower parts are of a vivid scarlet. The middle feathers of the tail, ordinarily concealed, as are those of the Peacock, by the uropygials, are black, and the outer white with a black base. In the hen the bill is black, the crest more round and not filamentous, the uropygials scarcely elongated, and the vent only scarlet. The eyes are of a yellowish-brown. Southern examples from Costa Rica and Veragua have the tail-coverts much narrower, and have been considered to form a distinct species, *P. costaricensis*. Among other species are *P. antisianus*, *P. fulgidus*, *P. auriceps* and *P. pavoninus*, from various parts of South America, but though all are beautiful birds, none possess the wonderful singularity of the quezal. (A. N.)

QUEZALTENANGO, the capital of the department of Quezaltenango, Guatemala, 70 m. by road W. of Guatemala city and at the terminus of a railway from Champerico on the Pacific coast. Pop. (1905) about 31,000. It is situated on the river Siguila, and at the foot of the volcano of Santa Maria. In size the second city in the republic, it has a large agricultural trade and manufactures of linen, woollen and cotton goods. It contains a fine cathedral and some good public buildings, including two national institutes for higher education; and it is well supplied with water and electricity for light and power. The majority of its inhabitants are Indians or half-breeds of Quiché descent. Quezaltenango was the capital of a Quiché kingdom, and was known as Xelahuh or Xelahue until 1524, when it was conquered by the Spaniards under Pedro de Alvarado. In 1902 it was partially destroyed by an earthquake and an eruption of Santa Maria.

QUIBERON, CAMPAIGN AND BATTLE OF. Quiberon Bay, on the S. coast of Brittany, France, was the scene of the great naval battle which defeated the plan laid by the ministers of King Louis XV. of France, for the invasion of England in 1759, during the Seven Years' War (*q.v*). An army had been collected at Vannes, in the south-east of Brittany, and transports had been brought together in the landlocked waters of the Morbihan which are connected with Quiberon Bay. The scheme of the French ministers was to combine twenty-one ships of the line lying at Brest under the command of M. de Conflans, with twelve which were to be brought round from Toulon by M. de la Clue. The army was then to be carried to some point on the coast of England or Scotland by the united squadrons. The British government was well informed of its enemy's intentions, and took vigorous measures of defence. Admiral Sir E. Hawke, afterwards Lord Hawke, was directed to blockade Brest with a fleet of twenty-five sail of the line, four ships of fifty guns and nine frigates. The four ships of fifty guns together with four frigates were detached, first under Commodore John Reynolds, and then under Commodore Robert Duff, to lie in Quiberon Bay and watch the entry to the Morbihan. During the whole summer, from the beginning of June, Sir E. Hawke kept his station off Brest, and the detached squadron occupied Quiberon Bay. The task of blockading M. de la Clue at Toulon was given to Edward Boscawen, who had with him fourteen sail of the line. Boscawen reached his station on the 16th of May 1759. At the beginning of July want of stores and water, together with the injury inflicted on some of his vessels by a French battery, compelled him to go to Gibraltar to provision and refit. He reached the port on the 4th of August. On the 5th M. de la Clue left Toulon, and on the 17th passed the straits of Gibraltar, where he was sighted by the look-out ships of Boscawen. The British fleet hurried out to sea, and pursued in two divisions, separated by a distance of some miles owing to the haste with which they left port. During the night of the 17th and 18th of August five of M. de la Clue's ships lost sight of his flagship, and steered for Cadiz. The other seven, which had been delayed for a time in the hope of rejoining their consorts, were overtaken by Boscawen and attacked in the afternoon of the 18th. One, the "Centaur" (74), was captured after a very gallant resistance, in which the British flagship was severely damaged. During the night of the 18th–19th of August, two of the French ships altered course to the west, and escaped. The remaining four fled to the north, and into Portuguese waters, where two were driven ashore and destroyed, while two were captured near Lagos. The five in Cadiz were blockaded by Boscawen's second-in-command, Admiral Broderick. La Clue was mortally wounded, and died ashore in Portugal. Although the defeat of his squadron had ruined the scheme for the combination of their forces, the French ministers decided to persevere with the invasion. M. de Conflans was ordered to put to sea. On the 9th of November a severe gale forced Sir E. Hawke from in front of Brest, and as his ships were in want of stores he sailed for Torquay. Finding the way clear, Conflans put to sea on the 14th, and steered for Quiberon. Sir E. Hawke left Torquay to resume his station on the same day. On the 15th he learnt from a look-out ship that the French had been seen at sea to the north-west of Belleisle, and steering south-west. Concluding that they were bound for the Morbihan he followed. Calms and contrary winds prevented either fleet from making much progress till the evening of the 19th, when the French were rather over 60 m. to the south-west of Belleisle, which is south of Quiberon. The wind had now changed to the north-west and was beginning to blow hard. M. de Conflans made for Quiberon under reduced canvas for fear of making the land in the night, the coast being one of the most dangerous in the world, on account of the rocky islands of Houat and Hoedik, and the long string of reefs which lie inside Belleisle. Hawke was steering in the same direction farther out at sea. On the morning of the 20th of November, Conflans was nearing the south point of Belleisle. The small squadron of Commodore Duff, warned of his approach, endeavoured to escape to sea before he could shut them in at Quiberon. One of the ships worked out through the very dangerous passage to the north of Belleisle; the others came round the south of the island, where they were nearly cut off and captured. As the pursuers came close to them the sails of Hawke's fleet were seen rising over the horizon. M. de Conflans immediately called off the pursuers, and endeavoured to form his line of battle. By midday he was able to estimate the full strength of Hawke's fleet of twenty-three sail of the line, which with the four 50-gun ships of Commodore Duff made twenty-seven vessels to his twenty-one. He therefore altered his mind, and decided to run inside the islands of Houat and Hoedik, and gain the anchorage of Quiberon. He concluded that as the day was far advanced and the wind was increasing, the British admiral would not dare to follow him into so dangerous a place. But Sir E. Hawke considered that the circumstances justified him in taking all risks, and seeing his enemy in retreat he ordered a pursuit. As the van of the French led by their admiral was turning inside the Cardinal rocks at the southern end of the reefs, his rear was attacked. The two fleets entered the Bay late in the evening, and there followed a battle unique in naval history, for it was fought in the dark, among rocks, in a severe gale, and on a lee shore. Two of the British liners were wrecked on a rock called the Four, but five of the French were taken or destroyed, among the latter was the flagship of Conflans, who escaped to the shore on a spar. Seven of the French ships ran into the little river Vilaine, being compelled to throw their guns overboard to lighten themselves before crossing the bar. Nine escaped to the south. The small number of prizes taken gives no measure of the importance of the victory, which broke the spirit and strength of the French fleet so effectually that it did not appear at sea again during the rest of the war, *i.e.* until 1763.

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[1] Preserved specimens, exposed to the light, lose much of their beauty.

See Beatson's *Naval and Military Memoirs of Great Britain*, vol. ii. p. 321 et seq.; Burrows's *Life of Lord Hawke*; Tronde, *Batailles navales de la France*, vol. i. p. 379 et seq. (D. H.)

QUICHÉ or KICHÉS, a tribe of Central American Indians of Mayan stock. They inhabited western Guatemala, where their descendants still survive. They were at the time of the conquest the most powerful of the three Mayan peoples in Guatemala, the other two being the Cakchiquel and the Zutugil. Their chronicles are said to date back to the 8th century. Their sacred book, the *Popol Vuh*, containing a mythological cosmogony, survives in a 17th-century manuscript written by a Christianized Guatemalan. To this tradition may be due the remarkable similarity of the Quiché creation story to that of the Old Testament. Their capital was Utatlan, near the site of the modern Santa Cruz Quiché, and was skilfully fortified. They had an elaborate system of government and religion. Records were kept in picture-writing. The Quiché were the first Indians met by Pedro de Alvarado in 1524 on his expedition into Guatemala.

See further CENTRAL AMERICA and MEXICO; for the *Popol Vuh* see English edition by L. Spence (1909); see also Nuttall, *Ancient American Civilizations* (Camb. Mass., 1901), and W. Bollaert in *Proc. Roy. Soc. Lit.* vii. 1862.

QUICHERAT, JULES ÉTIENNE JOSEPH (1814–1882), French historian and archaeologist, was of Burgundian origin. His father, a working cabinet-maker, came from Paray le Monial to Paris to support his large family; Quicherat was born there on the 13th of October 1814. He was fifteen years younger than his brother Louis, a great Latin scholar and lexicographer, who survived him. Although very poor, he was admitted to the college of Sainte-Barbe, where he received a thorough classical education. He showed his gratitude to this establishment by writing its history (*Histoire de Sainte-Barbe, collège, communauté, institution*, 3 vols. 1860–1864). At the end of his studies he hesitated for some time before deciding what career he would follow, until Michelet put an end to his indecision by inspiring him with a taste for history. In 1835 Quicherat entered the École des Chartes; he left two years later at the head of the college. Once more inspired by the example of Michelet, who had just written an admirable work on Joan of Arc (*q.v.*), he published the text of the two trials of Joan, adding much contemporary evidence on her heroism in his *Procès de condamnation et de rehabilitation de Jeanne d'Arc* (5 vols. 1841–1849), as well as half a volume of *Aperçus nouveaux sur l'histoire de Jeanne d'Arc*, in which it seems that the last word has been said on important points. From the 15th century he drew other inspirations. He published memoirs of the adventures of a brigand, *Rodrigue de Villandrando* (1844), which gradually grew into a volume (1877), full of fresh matter. He wrote full biographies of two chroniclers of Louis XI., one very obscure, Jean Castel (in the *Bibliothèque de l'École des Chartes*, 1840), the other, Thomas Basin, bishop of Lisieux, who was, on the contrary, a remarkable politician, prelate and chronicler. Quicherat published the works of the latter, most of which were now brought out for the first time (4 vols. 1855–1859). In addition to these he wrote *Fragments inédits de Georges Chastellain* (1842), *Lettres, mémoires et autres documents relatifs à la guerre du bien public en* 1465 (1843, in vol. ii. of *Mélanges historiques*, part of *Documents inédits*), &c. These works did not wholly occupy his time: in 1847 he inaugurated a course of archaeological lectures at the École des Chartes, and in 1849 was appointed professor of diplomacy at the same college. His teaching had exceptionally good results. Although he was not eloquent and had a nasal voice, his hearers were loth to miss any of his thoughtful teaching, which was unbiased and well expressed. Of his lectures the public saw only some articles on special subjects which were distributed in a number of reviews. Note should be made of a short treatise on *La Formation française des anciens noms de lieu* (1867); a memoir *De l'ogive et de l'architecture dite ogivale* (1850), where he gives his theory on the use of stone arches—important for the history of religious architecture; an article on *L'Âge de la cathédrale de Laon* (1874), in which he fixed the exact date of the birth of Gothic architecture; *Histoire du costume en France* (1875; 2nd ed. 1877), which was first published in the form of anonymous articles in the *Magasin pittoresque*, and which the author wished to retain the character of a popular work. Following the advice of his friends, he began to write out, towards the end of his life, his lectures on archaeology, but only the introductory chapters, up to the 11th century, were found among his papers. On the other hand, the pupils trained by him circulated his principles throughout France, recognizing him as the founder of national archaeology. In one point he seems to have taken a false step; with a warmth and pertinacity worthy of a better cause he maintained the identity of Caesar's *Alesia* with Alaise (Doubs), and he died without becoming a convert to the opinion, now universally accepted, that Alise Sainte-Reine (Côte d'or) is the place where Vercingétorix capitulated. But even this error benefited science; some well directed excavations at Alaise brought many Roman remains to light, which were subsequently sent to enrich the museum at Besançon. After 1871, his course of lectures on diplomacy having been given up, Quicherat, still professor of archaeology, was nominated director of the École des Chartes. He filled this post with the same energy which he had shown in the many scientific commissions in which he had taken part. In 1878 he gave up his duties as professor, which then fell to the most conspicuous of his pupils, Robert de Lasteyrie. He died suddenly at Paris on the 8th of April 1882, a short time after having corrected the proofs of *Supplément aux témoignages contemporains de Jeanne d'Arc*, published in the *Revue historique*. After his death it was decided to bring out his hitherto unpublished papers (*Mélanges d'archéologie et d'histoire*, vol. i., Celtic, Roman and Gallo-Roman antiquities, ed. A. Giry and Aug. Castan, 1885; vol. ii., *Archéologie du moyen âge*, ed. R. de Lasteyrie, 1886); among these are some important fragments of his archaeological lectures, but his *Histoire de la laine*, with which he was occupied for many years, is missing.

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QUICHUA, a South American Indian tribe and stock, the ruling people of Peru when the Spaniards arrived. The Quichuan stock then included the Quichuas proper and the many vassal tribes of the ancient empire of Peru. To-day it numbers some three millions. The modern Quichuas average a height of 5 ft. to 5 ft. 6 in. They are of slender build, but with well proportioned muscular limbs, and are capable of enduring great fatigue. Their complexions are of a fresh olive colour, the skin very smooth and soft, beardless, hair straight and black, the nose aquiline. They are skilful farmers and herdsmen. (See PERU.)

QUICK, a word which, by origin, and in early and many surviving uses, meant "living," "alive." It is common to Teutonic languages, cf. Ger. *keck*, lively, Du. *kwik*, and Dan. *kvik*; cf. also Dan. *kvaeg*, cattle. The original root is seen in Skt. *jiva*; Lat. *vivus*, living, alive; Gr. *βίος*, life. In its original sense the chief uses are such as "the quick and the dead," of the Apostles' Creed, a "quickset" hedge, *i.e.* consisting of slips of living privet, thorn, &c., the "quick," *i.e.* the tender parts of the flesh under hard skin or particularly under the nail. The phrase "quick with child" is a conversion of with a quick, *i.e.* living child. From the sense of having full vigour, living or lively qualities or movements, the word got its chief current meaning of possessing rapidity or speed of movement, mental or physical. It is thus used in the names of things which are in a constant or easily aroused condition of movement, *e.g.* "quicksand," loose water-logged sand, readily yielding to weight or pressure, and "quicksilver," the common name of the metal mercury (*q.v.*).

QUIERZY [Kiersy], **CAPITULARY OF,** a capitulary of the emperor Charles the Bald, comprising a series of measures for safeguarding the administration of his realm during his second Italian expedition, as well as directions for his son Louis the Stammerer, who was entrusted with the government during his father's absence. It was promulgated on the 14th of June 877 at Quierzy-sur-Oise in France (dep. of Aisne), the site of a Carolingian royal *palatium*, before a great concourse of lords. In this document Charles takes elaborate precautions against Louis, whom he had every reason to distrust. He forbids him to sojourn in certain palaces and in certain forests, and compels him to swear not to despoil his stepmother Richilde of her allodial lands and benefices. At the same time Charles refuses to allow Louis to nominate to the countships left vacant in the emperor's absence. In principle the *honores* (benefices) and the office of a deceased count must be given to his son, who would be placed provisionally in possession by Louis; the definitive investiture, however, could be conferred only by Charles. The capitulary thus served as a guarantee to the aristocracy that the general usage would be followed in the existing circumstances, and also as a means of reassuring the counts who had accompanied the emperor into Italy as to the fate of their benefices. It cannot, however, be regarded as introducing a new principle, and the old opinion that the capitulary of Quierzy was a legislative text establishing the hereditary system of fiefs has been proved to be untenable. A former capitulary of Charles the Bald was promulgated at Quierzy on the 14th of February 857, and aimed especially at the repression of brigandage.

See E. Bourgeois, *Le Capitulaire de Kiersy-sur-Oise* (Paris, 1885), and "L'Assemblée de Quierzy sur-Oise" in *Études d'histoire du moyen-âge, dédiées à Gabriel Monod* (Paris, 1896). (R. Po.)

QUIETISM, a complicated religious movement that swept through France, Italy and Spain during the 17th century. Its chief apostles were Miguel de Molinos, a Spaniard resident in Rome; Fénelon, the famous French divine, and his countrywoman, Madame Jeanne Marie Guyon. Quietism was essentially a reaction against the bureaucratic ecclesiasticism always latent within the church of Rome, though it had come more especially to the front during the struggles of the counter-Reformation carried through by the Jesuits. A Catholic cut to the orthodox pattern did not look, and would have thought it wrong to look, beyond the spiritual fare provided for him by the ecclesiastical authorities; all his relations with his Maker were conducted through the intermediacy of the Church. In the dogmatic sphere he believed whatever the Church believed, because the Church believed it; to the Church's institutions—the sacraments and the confessional—he looked for guidance in the practical affairs of life. Protestantism had tried to put an end to this state of things by sweeping away the Church altogether, but the Quietists were more tolerant than Luther. They did not wish to abolish the Church; they admitted that it was a necessary stage in the evolution of the human soul; but they insisted that it could only bring a man on to the lowest slopes of Paradise. Those who aspired to be really holy must learn to look beyond the Church, and enter into immediate, personal relations with their Maker. But how were they to do so? Like their contemporaries, the French Jansenists, and the Quakers and Anabaptists of northern Europe, the Quietists fell back on a doctrine of immediate inspiration of the individual conscience. To the many God spoke only in general terms through the Church; but to the few He made His will directly known. But how did He do so? How distinguish the voice of God from the vagaries of our own imagination? Quietism offered an easy test. The less "sense of proprietorship" a man had in his own good actions—the more they came from a source outside himself—the surer might he be that they were divine. If, on the other hand, they were the fruit of his deliberate thought and will, that was enough to show that they did not come from God, but from his sinful self. Hence the first duty of the Quietist was to be "passive." So far as was possible he must numb all his spontaneous activities of every kind; then he could fold his hands, and wait in dreamy meditation until inspiration came. And since all our activities have their root in desire, the shortest road to passivity was to suppress all desires and wishes of every kind. Thus the great object of the Quietist was to "sell or kill that cruel beast, self-conscious will." Then he would be dead to hope and fear; he would be icily indifferent to his fate, either in this world or the next. Thenceforward no human tastes or affections would stand in the way of his performing the will of God. He was, as Fénelon said, like a feather blown about by all the winds of grace. His mind was a mere *tabula rasa*, on which the Spirit printed any pattern that it chose. Hence arose the great Quietist doctrine of disinterested love. "The Quietists maintain," says a contemporary writer, "that Christian perfection means a love of God so absolutely free from all desire of happiness that it is indifferent to salvation. The soul is moved neither by hope nor fear, nor even by the foretaste of eternal bliss. Its only motive is to do the will and promote the glory of God. Other things are of no account: neither grace, nor merit, nor happiness, nor even perfection, in so far as it attaches to us. Nay, the soul must be ready to renounce its hopes of heaven, and the scrupulous will often feel themselves bound to do so; for in the last and fiercest trials they are invincibly persuaded of their own damnation. In this sentence of condemnation they generously acquiesce; and thenceforward, having nothing more to lose, they stand tranquil and intrepid, without fear and without remorse. This is what the Quietists call the state of holy indifference. Their soul has lost all wish for action, all sense of proprietorship in itself, and has thereby reached the summit of Christian perfection" (André, *Vie du Père Malebranche*, ed. Ingold, Paris, 1886, p. 271).

Quietism is an outgrowth from the mysticism of the great 16th-century Spaniards, St Teresa and St John of the Cross, though it would be unfair to hold them responsible for all the utterances of their disciples. Certainly St Teresa made much of "passivity," but she only regarded it as a refuge for a few specially constituted souls; whereas the Quietists designedly brought it within the reach of everyone. In St Teresa the passivity itself was balanced by a strong attachment to the virtues of the active life, and an equally strong devotion to the Church. Among the Quietists both these checks disappear, and passivity becomes the one and only test of holiness. But if passivity is all in all, there is no room for the virtues of the active life; all Quietists cherished the ancient saying that one moment's contemplation is worth a thousand years' good works. Still less room had they for the Church. It only professed to guide men to God; but those who had already found God stood in no need of a guide. Nay, they did not even stand in need of revelation. "If Christ be the way," wrote the Quietist Malaval, "let us certainly pass by Him to God, but he who is always passing never arrives at his journey's end." Such utterances go far to explain the severity with which the Roman Church tried to stamp out the later developments of Quietism. In its earlier stages, before it had crystallized into a definite doctrine, the ecclesiastical authorities had been tolerant enough. The Spanish monk, Juan Falconi, who is generally reckoned as the father of Quietism, died in the odour of sanctity in 1632; some thirty years later his fellow-countryman, Molinos, transported his doctrines to Rome, where they gained unbounded popularity with bishops and cardinals, and even with pope Innocent XI. In 1675 Molinos published the *Guida Spirituale*, the great text-book of his school. But his success soon aroused the suspicion of the Jesuits, the great champions of militant ecclesiasticism. "Passivity" accorded ill with a zealous frequentation of the confessional, their chief centre of influence. Failing to turn public opinion against Molinos in Rome, they brought pressure to bear on Louis XIV. through his confessor, Père La Chaise. At the instance of the French ambassador Molinos was arrested (1685); his papers were seized, and his chief disciples examined by the Inquisition. Two years later he was convicted of heresy, and sentenced to imprisonment for life.

The later stages of the Quietist drama were played out in France. Here Quietist ideas had long been spreading under the leadership of enthusiasts like François Malaval (1627–1719), a blind layman of Marseilles. A more romantic figure was Jeanne Marie Guyon (1648–1717), a widow of good family and remarkable personal charm, who devoted her life to missionary journeys on behalf of "passivity." In 1688 fate brought her to the French court, where she made a great impression on Mme. de Maintenon and other persons of quality. But her most illustrious captive was Fénelon, then tutor to the duke of Burgundy, eldest son of the Dauphin. "They met," says Saint-Simon; "they pleased each other, and their sublime amalgamated." In other words, they corresponded with a freedom that Fénelon afterwards had cause to regret. For Mme. Guyon's paradoxical and extravagant lauguage soon scandalized her friends. In 1693 she was examined by Bossuet, and dismissed with a severe caution. Further imprudences led to her arrest, and a long imprisonment in the Bastille. On her release in 1703 she settled down quietly at Blois, where she died in 1717. Meanwhile Fénelon had become involved in her fortunes. When Bossuet first took action, Fénelon defended her with a zeal that drew down suspicion on his own head; and he was only promoted to the archbishopric of Cambrai after signing what was really a disguised retractation (1695). Meanwhile Bossuet was at work on an *Instruction sur les états d'oraison*, which was intended to distinguish once for all what was true in Quietism from what was false. Fénelon, feeling sure that Bossuet would do the Quietists less than justice, determined to be beforehand with him. While Bossuet's book was still in the press, he suddenly brought out an *Explication des maximes des saints* (1697). The little volume raised a violent storm. For two years Fénelon was at bitter feud with Bossuet; he was banished from Versailles; finally, he was censured by the pope (1699), although in very measured terms. For Fénelon by no means shared all the ideas of Mme. Guyon; in the language of the divinity schools he was, at most, a "semi-Quietist." For the more ecstatic side of Quietism, so much in evidence with his friend, he had no taste whatsoever; but he thought that "passivity," when interpreted with large modifications, led the way to a state of peaceful, other-world serenity highly grateful to the denizens of a crowded court, where was much splendid ennui and but little peace. Further, he was the counsellor of many over-scrupulous souls; and Quietist disinterestedness, also much modified, enabled him to tell them that they were not necessarily castaways because they suffered much from "spiritual dryness," and seldom enjoyed the sweets of piety. But in the heat of battle with Bossuet, Fénelon carried his principles beyond all reasonable bounds. The theme of his *Maxims* is that, as men grow in holiness they become utterly indifferent to themselves. Not only do they cease to covet the consolations of religion; they lose all incidental pleasure in its exercise. Their whole soul is taken up in loving God; and they neither know nor care whether God loves them in return. But Bossuet had little trouble in persuading the world that *Wenn ich Dich liebe, was geht es Dich an?* is but a sorry foundation on which to build up a personal religion; and the condemnation of the *Maxims* proved the deathblow to official Quietism. But flickers of "passivity," not always easily distinguishable from the teaching of Molinos, are still here and there produced by violent reaction from the prevailing legalism of the church of Rome.

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QUILIMANE, or KILMANE (the former being the Portuguese spelling), a town of Portuguese East Africa, in 18° 1′ S., 36° 59′ E., 14 m. inland from the mouth of the river Quilimane or Qua Qua. The river, an independent stream during the rest of the year, during the rainy season becomes a deltaic branch of the Zambezi, with which it is connected by a channel called Mutu. The town (officially São Martinho de Quilimane) lies on the north bank of the river at a point where it is about a mile broad. There is ample and deep anchorage in the river, but the entrance is obstructed by a bar, over which there is 9 ft. of water at low tide, and from 16 to 22 ft. at high tide. Almost all the European merchants live in one long, acacia-shaded street or boulevard skirting the river, while the Indian merchants or Banyans occupy another street running at right angles to the first street. Behind lies the native town. The total population in 1909 was 2200, including 400 Europeans and 320 Asiatics. The trade of Quilimane, formerly the only port for the produce of the Zambezi valley, steadily declined after the establishment of Chinde (*q.v.*). Efforts made at the beginning of the 20th century to develop local resources met with little success, owing to high duties and freights. A railway 18 m. long runs to Maquival, a large *prazo* for the cultivation of tropical produce. The imports are largely cotton goods from England and India, provisions from Portugal, and hardware from Germany. The exports are chiefly copra, ground-nuts, sugar, sesamum, india-rubber, wax, ivory, and beans. The average annual value of the trade for the ten years 1897–1906 was:—imports £60,509, exports £34,547. The natives are noted for their skill in the manufacture of jewelry, chiefly gold and silver ornaments. The town lies low and is unhealthy, despite efforts to improve its condition.

The Quilimane river was entered by Vasco da Gama in 1498, who there discovered an Arab settlement. The present town was founded by the Portuguese in the 16th century, and became in the 18th and the early part of the 19th centuries one of the great slave marts on the east coast of Africa. It was the starting-point of several notable expeditions—that of Francisco Barreto to the country of the Monomotapa in 1569, and that of David Livingstone up the Zambezi to Lake Nyasa in 1861 being the most famous. Until 1853 the trade of the port was forbidden to any save Portuguese. The European population, until the last quarter of the 19th century, consisted mainly of convicts from Portugal. (See PORTUGUESE EAST AFRICA, *History*.)

QUILL, a term applied to the bare, hard, hollow tube of the feather of a bird, also to the large flight feathers or *remiges*, and especially to the strong feathers of the goose, swan, or crow used in the making of quill pens (see FEATHER and PEN). The word is of obscure origin; a word with similar meaning, *Kiel*, is found in German, and French has *quille*, ninepin, apparently connected with Ger. *Kegel*. Certain ancient stringed instruments were played with a *plectrum* or plucker made of the quill of a bird's feather, and the word has thus been used of a *plectrum* made of other material and differing in shape, and also of an analogous object for striking the strings in the harpsichord, spinet or virginal. The verb "to quill" is to fold lace, muslin or other light material into narrow flutes or pleats; when so pleated the material is called "quilling." The French term "quillon," apparently formed from *quille*, ninepin, is applied to the projecting arms or cross guards of the hilt of a sword.

QUILLER-COUCH, SIR ARTHUR THOMAS (1863–), English writer, known under the pseudonym of "Q" was born in Cornwall on the 21st of November 1863. He was educated at Newton Abbot College, at Clifton College, and Trinity College, Oxford. After taking his degree in 1886 he was for a short time classical lecturer at Trinity. While he was at Oxford he published (1887) his *Dead Man's Rock* (a romance in the vein of Stevenson's *Treasure Island*), and he followed this up with *Troy Town* (1888) and *The Splendid Spur* (1889). After some journalistic experience in London, mainly as a contributor to the *Speaker*, in 1891 he settled at Fowey in Cornwall. His later novels include *The Blue Pavilions* (1891), *The Ship of Stars* (1899), *Hetty Wesley* (1903), *The Adventures of Harry Revel* (1903), *Fort Amity* (1904), *The Shining Ferry* (1905), *Sir John Constantine* (1906). He published in 1896 a series of critical articles, *Adventures in Criticism*, and in 1898 he completed R. L. Stevenson's unfinished novel, *St Ives*. From his Oxford days he was known as a writer of excellent verse. With the exception of the parodies entitled *Green Bays* (1893), his poetical work is contained in *Poems and Ballads* (1896). In 1895 he published a delightful anthology from the 16th and 17th-century English lyrists, *The Golden Pomp*, followed in 1900 by an equally successful *Oxford Book of English Verse*, 1250–1900 (1900). In Cornwall he was an active worker in politics for the Liberal party. He was knighted in 1910.

QUILLOTA, a town of Chile in the province of Valparaiso, on the left bank of the Aconcagua river, 20 m. above its mouth and 26 m. E.N.E. of the city of Valparaiso. Pop. (1902 estimate) 9876. The valley is noted for its beauty, fertility, and healthfulness, and is the centre of thriving fruit and wine industries. Among its fruits is the "chirimoya" (*Anona cherimolia*). There are rich copper mines in the vicinity. Quillota is situated on a railway between Valparaiso and Santiago, which passes through a mountainous, semi-barren country. It is one of the oldest towns of Chile, dating from the first years of the conquest.

QUILON, a seaport of India, on the Malabar coast, in the state of Travancore. Pop. (1901) 15,691. Quilon enjoys great facilities of water communication, and has an active export trade in timber, coco-nuts, ginger, pepper, &c. The palace of the maharaja of Travancore stands on the bank of Quilon lake, a beautiful sheet of water. Besides being on a projecting point, Quilon is rendered still more unsafe to approach by the bank of hard ground called the Tangasseri reef, which extends some distance to the south-west and west of the point and along the coast to the northward. There is good anchorage, however, in a bight about 3 m. from the fort. Quilon is one of the oldest towns on the Malabar coast, and continued to be a place of considerable importance down to the beginning of the 16th century. It is now the headquarters of the Travancore army, with a subsidiary battalion. Cotton weaving and spinning and the manufacture of tiles are the chief industries. It is the terminus of a railway across the hills from Tinnevelly. Adjoining Quilon is the British village of Tangasseri, formerly a Portuguese and then a Dutch settlement, which is administered with Anjengo; pop. (1901) 1733.

QUILT, properly a coverlet for a bed, consisting of a mass of feathers, down, wool or other soft substance, surrounded by an outer covering of linen, cloth, or other material. In its earlier uses the "quilt" was made thick, and served as a form of mattress. The term was also given to a stitched wadded lining for body armour, and also, when made stout and closely padded, to a substitute for armour. The word came into English from O. Fr. *cuilte*, *coilte*, or *coute*, mod. *couette*. This is derived from Lat. *culcita* or *culcitra*, a stuffed mattress or cushion. From the form *culcitra* came O. Fr. *cotre* or *coutre*, whence *coutre pointe*, Low Lat. *culcita puncta*, *i.e.* stitched or quilted cushion; this was corrupted to *contre pointe*, Eng. *counterpoint*, which in turn was changed to "counterpane" (as if from Lat. *pannus*, piece of cloth). Thus "counterpane," a coverlet for a bed, and "quilt," are by origin the same word.

QUIMPER, formerly Quimper-Corentin, a town of France, capital of the department of Finistère, 158 miles north-west of Nantes and 68 miles south-east of Brest on the railway between those towns. Pop. (1906) 16,559. The delightful valley in which it lies is surrounded by high hills and traversed by the Steir and the Odet, which, meeting above the town, form a navigable channel for vessels of 150 tons to the sea (11 miles). There is a small general shipping trade. Of the town walls (15th century) a few portions are preserved in the terrace of the episcopal palace and in the neighbourhood of the college. Quimper is the seat of a bishopric in the province of Rennes. The cathedral, dedicated to St Corentin and erected between 1239 and 1515, has a fine façade (*c.* 1425), the pediment of which is crowned by a modern equestrian statue of King Grallon, and adorned (like several other external parts of the building) with heraldic devices in granite. Two lateral towers with modern spires (1854–56) and turrets reach a height of 247 feet. The axis of the choir is deflected towards the north, a feature not uncommon, but here exaggerated. The nave and the transept are in the style of the 15th century, and the central boss bears the arms of Anne of Brittany (1476–1514). The terminal chapel of the apse dates from the 13th century. In the side chapels are the tombs of several early bishops. The high altar, tabernacle, and ciborium are costly works of contemporary art. The pulpit panels represent episodes in the life of St Corentin. Of the other churches may be mentioned the church of Locmaria, dating from the 11th century, and the chapel of the 15th century connected with the episcopal palace. A number of houses, in wood or stone, date from the 15th, 16th and 17th centuries. The museum, built in 1869–70, contains archaeological collections and about 1300 paintings and drawings. In 1868 a bronze statue of Laennec the inventor of the stethoscope (born at Quimper in 1781) was erected in Place St Corentin.

Quimper, or at least its suburb Locmaria (which lies below the town on the left bank of the Odet), was occupied in the time of the Romans, and traces of the ancient foundations exist. Later Quimper became the capital of Cornouailles and the residence of its kings or hereditary counts. It is said to have been Grallon Meur (*i.e.* the Great) who brought the name of Cornouailles from Great Britain and founded the bishopric, which was first held by St Corentin about 495. Hoel, count of Cornouailles, marrying the sister and heiress of Duke Conan in 1066, united the countship with the duchy of Brittany. Quimper suffered in the local wars of succession. In 1344 it was sacked by Charles of Blois. Monfort failed in his attempt to take the town by storm on August 11, 1345, but it opened its gates to his son John IV. in 1364 after the victory at Auray. At a later period it sided with the League. Doubtless on account of its distance from the capital, Quimper, like Carpentras and Landerneau, has been a frequent butt of French popular wit.

QUIMPERLÉ, a town of western France, capital of an arrondissement in the department of Finistère, at the confluence of two rivers which unite to form the Laiter, 28 m. E.S.E. of Quimper by rail. Pop. (1906) town 6203, commune 9176. Quimperlé grew up round the abbey of Ste Croix, founded in the 11th century, the romanesque basilica of which, restored in modern times, still remains. The church of St Michel (14th and 15th centuries), with a fine tower, crowns the hill above the town. Quimperlé has a tribunal of first instance, and carries on the manufacture of farm implements, railway material, paper, &c., and trades in grain, timber, cattle and agricultural products. The town has a small port.

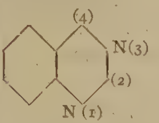
QUIN, JAMES (1693–1766), English actor of Irish descent, was born in London on the 24th of February 1693. He was educated at Dublin, and probably spent a short time at Trinity College. Soon after his father's death in 1710, he made his first appearance on the stage at Abel in Sir Robert Howard's *The Committee* at the Smock Alley Theatre. Quin's first London engagement was in small parts at Drury Lane, and he secured his first triumph at Bajazet in Nicolas Rowe's *Tamerlane*, on the 8th of November 1715. The next year he appeared as Hotspur at Lincoln's Inn, where he remained for fourteen years. On the 10th of July 1718 he was convicted of manslaughter for having killed Bowen, another actor, in a duel which the victim had himself provoked. Quin was not severely punished, the affair being regarded as more of an accident than a crime. The public took a similar view of another episode in which Quin, on being attacked by a young actor who had been angered by the sarcastic criticism of his superior, drew upon him and killed him. But if he was eager in his own defence he was no less so in that of others In 1721 a drunken nobleman reeled on to the stage of the theatre and assaulted the manager, Rich, whose life was saved by Quin's prompt armed interference. This resulted in a riot, and thereafter a guard was stationed in all theatres. In 1732 Quin appeared at Covent Garden, returning to Drury Lane from 1734 to 1741, and in 1742 was again at Covent Garden, where he remained until the close of his career. On the 14th of November 1746 Quin played Horatio and Garrick Lothario to the Calista of Mrs Cibber in Rose's *Fair Penitent.* The applause of the audience was so great as to disconcert if not actually to alarm the two actors. Public interest was yet more keenly stimulated in comparing Garrick's and Quin's impersonations of Richard III., the popular verdict being loudly in favour of Garrick. But Quin's Falstaff in King Henry IV. was emphatically preferred to the Hotspur of his rival. In consequence of an attempt made by Garrick in 1750–51 to draw him away from Covent Garden, Quin was enabled to extort from his manager a salary of £1000 a year, the highest figure then reached in the profession. Quin's last regular appearance was on the 15th of May 1757, as Horatio in the *Fair Penitent*, though in the following year he twice played Falstaff for the benefit of friends. He had retired to Bath, where he lived a happy life, with late hours and much eating and drinking, until his death on the 21st of January 1766. He was buried in the abbey church at Bath. Some coolness which had arisen between Quin and Garrick before the former's retirement was dissipated on their subsequent meeting at Chatsworth at the duke of Devonshire's, and Quin paid many a visit to Garrick's villa at Hampton in the latter part of his life. The epitaph in verse on his tomb was written by Garrick. Quin's will displayed a generous nature, and among numerous bequests was one of fifty pounds to "Mr Thomas Gainsborough, limner."

In the Garrick Club in London are two portraits of the actor ascribed to Hogarth, and a portrait by Gainsborough is in Buckingham Palace. His personality was not gracious. His jokes were coarse; his temper irascible; his love of food, his important airs, and his capacity for deep drinking do not command respect; on the other hand, a few of his jokes were excellent, and there was no rancour in him. On many occasions he showed his willingness to help persons in distress. His character is summarized by Smollett in *Humphrey Clinker.* As an actor his manner was charged with an excess of gravity and deliberation; his pauses were so portentous as in some situations to appear even ludicrous; but he was well fitted for the delivery of Milton's poetry, and for the portrayal of the graver rôles in his repertory.

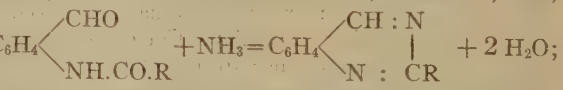
See *The Life of Mr. James Quin, Comedian*, published in 1766 and reprinted in 1887.

QUINAULT, PHILIPPE (1635–1688), French dramatist and librettist, was born in Paris on the 3rd of June 1635. He was educated by the liberality of Tristan l'Hermite, the author of *Mariamne.* Quinault's first play was produced at the Hôtel de Bourgogne in 1653, when he was only eighteen. The piece succeeded, and Quinault followed it up, but he also read for the bar; and in 1660, when he married a widow with money, he bought himself a place in the Cour des Comptes. Then he tried tragedies (*Agrippa*, &c.) with more success than desert. He received one of the literary pensions then recently established, and was elected to the Academy in 1670. Up to this time he had written some sixteen or seventeen comedies, tragedies, and tragi-comedies, of which the tragedies were mostly of very small value and the tragi-comedies of little more. But his comedies—especially his first piece *Les Rivales* (1653), *L'Amant indiscret* (1654), which has some likeness to Molière's *Etourdi*, *Le Fantôme amoureux* (1659), and *La Mère coquette* (1665), perhaps the best—are much better. But in 1671 he contributed to the singular miscellany of *Psyché*, in which Corneille and Molière also had a hand, and which was set to the music of Lulli. Here he showed a remarkable faculty for lyrical drama, and from this time till just before his death he confined himself to composing libretti for Lulli's work. This was not only very profitable (for he is said to have received four thousand livres for each, which was much more than was usually paid even for tragedy), but it established Quinault's reputation as the master of a new style,—so that even Boileau, who had previously satirized his dramatic work, was converted, less to the opera, which he did not like, than to Quinault's remarkably ingenious and artist-like work in it. His libretti are among the very few which are readable without the music, and which are yet carefully adapted to it. They certainly do not contain very exalted poetry or very perfect drama. But they are quite free from the ludicrous doggerel which has made the name libretto a byword, and they have quite enough dramatic merit to carry the reader, much more the spectator, along with them. It is not an exaggeration to say that Quinault, coming at the exact time when opera became fashionable out of Italy, had very much to do with establishing it as a permanent European *genre.* His first piece after *Psyché* was a kind of classical masque. *Les Fêtes de l'Amour et de Bacchus* (1672). Then came *Cadmus* (1674), *Alceste* (1674), *Thésée* (1675), *Atys* (1676), one of his best pieces, and *Isis* (1677). All these were classical in subject, and so was *Proserpine* (1680), which was superior to any of them. *The Triumph of Love* (1681) is a mere ballet, but in *Persée* (1682) and *Phaeton* (1683) Quinault returned to the classical opera. Then he finally deserted it for romantic subjects, in which he was even more successful. *Amadis de Gaule* (1684), *Roland* (1685), and *Armide* (1686) are his masterpieces, the last being the most famous and the best of all. The very artificiality of the French lyric of the later 17th century, and its resemblance to alexandrines cut into lengths, were aids to Quinault in arranging lyrical dialogue. Lulli died in 1687, and Quinault, his occupation gone, became devout, and began a poem called the "Destruction of Heresy." He died on the 26th of November 1688

The best edition of his works is that of 1739 (Paris, 5 vols.).



QUINAZOLINES (Phenmiazines or benzopyrimidines), in organic chemistry, heterocyclic compounds of the structure shown in the inset formula. They may be regarded as resulting from the fusion of a benzene with a pyrimidine nucleus in the 5.6 position. They are isomeric with the cinnolines, phthalazines and quinoxalines. They may be obtained by the action of alcoholic ammonia on the acidyl derivatives of ortho-aminobenzaldehydes and ortho-aminoketones (A. Bischler, *Ber.*, 1891–95):



$$C_6H_4\left<\begin{matrix}CHO\\ \\NH.CO.R\end{matrix}\right. + NH_3 = C_6H_4\left<\begin{matrix}CH:N\\ \quad|\\ N:CR\end{matrix}\right. + 2\,H_2O;$$

and from the corresponding dihydro compounds on oxidation with potassium permanganate. They are stable, tertiary bases, and may be distilled without decomposition; they form addition products with alkyl iodides and double salts with mercuric and platinum chlorides. On reduction with sodium in presence of alcohol they yield dihydro derivatives. Those in which the :CH group adjacent to the benzene nucleus is unsubstituted are oxidized by chromic acid to ketodihydroquinazolines (quinazolones).

Quinazoline ($C_6H_2N_8$) is obtained by oxidizing its dihydro-derivative with potassium ferricyanide. The dihydro derivatives exist in three different series, since the addition of two atoms of hydrogen in the diazine ring can take place in three different positions, namely, in the 3.4, 1.4 and 1.2 positions, and these different types are distinguished by the symbols Δ1, Δ2, Δ3, denoting that the double linkage is between the first and second, second and third, and third and fourth atoms in the diazine ring. The Δ1 series, which are obtained by the elimination of the elements of water from the acidyl derivatives of ortho-aminobenzylamines, are rather strong bases which form stable salts and yield the corresponding keto derivatives on oxidation (C. Paal, *Ber.*, 1889–1896). 4-Keto-dihydroquinazoline (β-quinazolone) is formed by oxidizing the dihydro base with potassium permanganate; by boiling acidyl-ortho-aminobenzamide with water (A. Weddige, *Jour. prak. Chem.*, 1885, (2) 31, p. 124); or by heating anthranilic acid with formamide (S. Niementowski, *Ber.*, 1895, 28, p. 443). It reacts both in the enol and keto forms, yielding both N-ethers and O-ethers, the latter being obtained by the action of sodium alcoholates on 4-chlorquinazolines. The Δ2 series is obtained by heating acidyl-ortho-aminobenzylamines with zinc chloride, whilst the Δ3 series, which is only known in the form of its keto derivatives (α-quinazolines), results from the fusion of urea with ortho-aminobenzaldehydes and benzophenones, the elements of water and of ammonia being eliminated (S. Gabriel and Th. Posner, *Ber.*, 1895, 28, p. 1037). They possess feeble basic and phenolic characters. The tetra-hydroquinazolines are obtained by reducing the quinazolines and dihydroquinazolines and by condensing ortho-aminobenzylamine with aldehydes (M. Busch, *Jour. prak. Chem.*, 1896, (2) 53, p. 414). The ring is easily split on hydrolysis, giving rise to ortho-disubstituted benzenes. The keto derivatives of this series result by the action of carbonyl chloride on ortho-aminobenzylamines of the type $H_2N.C_6H_4.CH_2NHR$ (M. Busch, *Ber.*, 1892, 25, p. 2853), or from the urea derivatives of ortho-aminobenzylamine. They are weak bases which are indifferent to both acids and alkalis, and which on oxidation yield the corresponding 2.4-diketo derivatives.

QUINCE (Lat. *Cydonia* or *Cotonea*, Ital. *Cotogna*, Fr. *coing*, Mid. Eng. *coin*, *quin*, whence a collective plural "quins," corrupted to singular "quince"), a fruit-tree concerning which botanists differ as to whether or not it is entitled to take rank as a distinct genus or as a section of the genus *Pyrus* (natural order Rosaceae, *q.v.*). It is not a matter of much importance whether we call the quince *Pyrus Cydonia* or *Cydonia vulgaris*. For practical purposes it is perhaps better to consider it as distinct from *Pyrus*, differing from that genus in the twisted manner in which the petals are arranged in the bud, and in the many-celled ovary, in which the numerous ovules are disposed horizontally, not vertically as in the pears. The quinces are much-branched shrubs or small trees with entire leaves, small stipules, large solitary white or pink flowers like those of a pear or apple, but with leafy calyx lobes and a many-celled ovary, in each cell of which are numerous horizontal ovules. The common quince is a native of Persia and Anatolia, and perhaps also of Greece and the Crimea, but in these latter localities it is doubtful whether or not the plant is not a relic of former cultivation. By Franchet and Savatier *P. Cydonia* is given as a native of Japan with the native name of "maroumerou." It is certain that the Greeks knew a common variety upon which they engrafted scions of a better variety which they called κυδώνιον, from Cydon in Crete, whence it was obtained, and from which the later names have been derived. Pliny (*H.N.* xv. 11) mentions that the fruit of the quince, *Malum cotoneum*, warded off the influence of the evil eye; and other legends connect it with ancient Greek mythology, as exemplified by statues in which the fruit is represented, as well as by representations on the walls of Pompeii. The fragrance and astringency of the fruit of the quince are well known, and the seeds were formerly used medicinally for the sake of the mucilage they yield when soaked in water, a peculiarity which is not met with in pears. This mucilage is analogous to, and has the same properties as, that which is formed from the seeds of linseed.

The quince is but little cultivated in Great Britain, two or three trees planted in the slip or orchard being in general found to be sufficient for a supply of the fruit; in Scotland it seldom approaches maturity, unless favoured by a wall. The fruit has a powerful odour, but in the raw state is austere and astringent; it, however, makes an excellent preserve, and is often used to give flavour and poignancy to stewed or baked apples.

There are three principal varieties of the quince, the Portugal, the apple-shaped and the pear-shaped. The Portugal is a taller and more vigorous grower than the others, and has larger and finer fruit; the apple-shaped, which has roundish fruit, is more productive, and ripens under less favourable conditions than either of the others; while the pear-shaped has roundish-pyriform fruit, which ripens later than that of the apple-shaped variety.

The quince prefers a rich, light and somewhat moist soil. The tree is generally propagated by cuttings or layers, the former making the best plants, but being longer in growing. It is much used as a dwarfing stock for certain kinds of pears, and for this purpose the young plants when bedded out in the quarters should be shortened back to about 18 or 20 inches; the effect is to restrain the growth of the pear, increase and hasten its fruitfulness, and enable it to withstand the effects of cold. Those required to form standard fruit-bearing trees should be trained up to a single stem till a height of 5 or 6 feet is attained.

The common Japan quince, *Pyrus* or *Cydonia japonica*, is grown in gardens for the sake of its flowers, which vary in colour from creamy white to rich red, and are produced during the winter and early spring months. The fruit is green and fragrant but quite uneatable. *C. Maulei*, a more recently introduced shrub from Japan, bears a profusion of equally beautiful orange-red flowers, which are followed by fruit of a yellow colour and agreeable fragrance, so that, when cooked with sugar, it forms an agreeable conserve, as in the case of the ordinary quince.

QUINCY, JOSIAH (1744–1775), American patriot, son of Josiah Quincy (1709–1784), was born in Boston on the 23rd of February 1744. He was a descendant of Edmund Quincy, who emigrated to Massachusetts in 1633, and received in 1636 a grant of land at Mount Wollaston, or Merry Mount, afterwards a part of Braintree and now Quincy. He graduated at Harvard in 1763, and studied law in the office of Oxenbridge Thacher (d. 1765), to whose large practice he succeeded. In 1767 Quincy contributed to the Boston *Gazette* two bold papers, signed "Hyperion," declaiming against British oppression; they were followed by a third in September 1768; and on the 12th of February 1770 he published in the *Gazette* a call to his countrymen to break off all social intercourse "with those whose commerce contaminates, whose luxuries poison, whose avarice is insatiable, and whose unnatural oppressions are not to be borne." After the "Boston massacre" (5th of March 1770) he and John Adams defended Captain Preston and the accused soldiers and secured their acquittal.[1] He used the signatures "Mentor," "Callisthenes," "Marchmont Needham," "Edward Sexby," &c., in later letters to the Boston *Gazette*. He travelled for his health in the South in 1773, and left in his journal an interesting account of his travels and of society in South Carolina; this journey was important in that it brought Southern patriots into closer relations with the popular leaders in Massachusetts. In May 1774 he published *Observations on the Act of Parliament, commonly called "The Boston Port Bill," with Thoughts on Civil Society and Standing Armies*, in which he urged "patriots and heroes" to "form a compact for opposition—a band for vengeance." In September 1774 he left for England, where he consulted with leading Whigs as to the political situation in America; on the 16th of March 1775 he started back, but he died on the 26th of April in sight of land.

See the *Memoir of the Life of Josiah Quincy, Jun., of Massachusetts* (Boston, 1825; 2nd ed., 1874), by his son, which contains his more important papers.

His son, Josiah Quincy (1772–1864), American lawyer and author, was born in Boston on the 4th of February 1772. He studied at Phillips Academy, Andover, graduated at Harvard in 1790, studied law, and was admitted to the bar in 1793, but was never a prominent advocate He became a leader of the Federalist party in Massachusetts; was an unsuccessful candidate for the national House of Representatives in 1800; served in the Massachusetts Senate in 1804–5; and was a member in 1805–13 of the national House of Representatives, where he was one of the small Federalist minority. He attempted to secure the exemption of fishing vessels from the Embargo Act, urged the strengthening of the American navy, and vigorously opposed the erection of Orleans Territory (Louisiana) into a state in 1811, and stated as his "deliberate opinion, that if this bill passes, the bonds of this Union are virtually dissolved; that the States that compose it are free from their moral obligations to maintain it; and that, as it will be the right of all, so it will be the duty of some to prepare definitely for a separation,—amicably if they can, violently if they must." This is probably "the first assertion of the right of secession on the floor of Congress." Quincy left Congress because he saw that the Federalist opposition was useless, and thereafter was a member of the Massachusetts Senate until 1820; in 1821–22 he was a member and speaker of the state House of Representatives, from which he resigned to become judge of the municipal court of Boston. In 1823–28 he was mayor of Boston, and in his term Faneuil Hall Market House was

[1] His eldest brother, Samuel Quincy (1735-1789), was at this time solicitor-general of Massachusetts, and opened this trial. He remained loyal to the Crown, left Boston in 1776, and was attorney for the Crown in Antigua until his death.

built, the fire and police departments were reorganized, and the city's care of the poor was systematized. In 1829–1845 he was president of Harvard College, of which he had been an overseer since 1810, when the board was reorganized; he has been called "the great organizer of the university": he gave an elective (or "voluntary") system an elaborate trial; introduced a system of marking (on the scale of 8) on which college rank and honours, formerly rather carelessly assigned, were based; first used courts of law to punish students who destroyed or injured college property; and helped to reform the finances of the university. During his term Dane Hall (for law) was dedicated, Gore Hall was built, and the Astronomical Observatory was equipped. His last years were spent principally on his farm in Quincy, where he died on the 1st of July 1864.

He wrote a *Memoir* of his father (1825); a *History of Harvard University* (2 vols., 1840), marred by a tendency to belittle the clerical régime; *The Journals of Major Samuel Shaw* (1847); *The History of the Boston Athenaeum* (1851); *The Municipal History of the Town and City of Boston* (1852); a *Memoir of the Life of J. Q. Adams* (1858); and *Essays on the Soiling of Cattle* (1859), only one of his many practical contributions to agriculture. See Edmund Quincy, *Life of Josiah Quincy* (Boston, 1867).

Josiah Quincy (1802–1882), son of the last-named, was mayor of Boston in 1845–1849, and author of *Figures of the Past* (1882); his brother Edmund (1808–1877) was a prominent Abolitionist, and author of the biography of his father and of a romance, *Wensley* (1854); and his sister Eliza Susan (1798–1884) was her father's secretary and the biographer of her mother. Josiah Quincy (1802–1882) had two sons—Josiah Phillips (1829-1910), a lawyer, who wrote, besides some verse, *The Protection of Majorities* (1876) and *Double Taxation in Massachusetts* (1889); and Samuel Miller (1833–1887), who practised law, wrote on legal subjects, served in the Union army during the Civil War, and was breveted brigadier-general of volunteers in 1865. Josiah Quincy (b. 1859), a son of Josiah Phillips Quincy, was prominent in the Democratic party in Massachusetts, and was mayor of Boston in 1895–1899.

QUINCY, a city and the county-seat of Adams county, Illinois, U.S.A., in the western part of the state, on the Mississippi river, about 105 m. W. of Springfield. Pop. (1890) 31,494; (1900) 36,252, of whom 4961 were foreign-born—3988 being of German birth—and 2029 were negroes; (1910, census) 36,587. Land area (1906), 5·8 sq. m. Quincy is served by the Chicago, Burlington & Quincy, the Quincy, Omaha & Kansas City, and the Wabash railways, and by lines of river steamers, which find an excellent harbour in Quincy Bay, an arm of the Mississippi. The city is built on the river bluffs, which command an extensive view. In Indian Mounds park, within the city limits and owned by the city, are prehistoric mounds. The Quincy Library, founded in 1837, has been a free public library since 1889. Among the principal public buildings are the Court House and the Federal Government building. The State Soldiers' and Sailors' Home (1887), with grounds covering 222 acres, is in Quincy; one of its fifty-five buildings (Lippincott Memorial Hall) was erected by the veterans of the institution in memory of Charles E. Lippincott, the first superintendent. There is a monument in Quincy in memory of George Rogers Clark, and the homestead (built in 1835) of John Wood, founder of the city, is now owned by the Quincy Historical Society, organized in 1896. Quincy is the seat of St Francis Solanus College (1860) and St Mary's Institute (Roman Catholic); The Chaddock Boys' School (Methodist Episcopal), until 1900 known as Chaddock College; two schools of music; and the Gem City Business College. Among the charitable institutions are Blessing Hospital (1875), St Mary's Hospital (1867; in charge of the Sisters of the Poor of St Francis), the Woodland Home for Orphans and Friendless (1853), St Aloysius Orphans' Home (1865), and several homes for the aged and infirm. The city is the seat of a Protestant Episcopal bishop. Quincy is the industrial and commercial centre of a large region. The value of factory products in 1905 was $10,748,224, an increase of 35·7 per cent. since 1900. Among the manufactures are stoves and furnaces, foundry and machine shop products, carriages and wagons, flour and grist mill products, malt liquors, dairymen's and poulterers' supplies, show-cases, men's clothing, agricultural implements, saddlery and harness, and lumber.

In 1822 John Wood (1798–1880), the first white settler, built a log cabin here, and in 1825, Quincy, then having less than ten inhabitants, was made the county-seat of Adams county, both town and county being named through Wood's influence in honour of John Quincy Adams. Wood was lieutenant-governor of the state in 1857–1860, and acting-governor in 1860–1861. A bronze statue (dedicated in 1883) in his memory stands in Washington Park. There was a general hospital of the United States Army in Quincy during the Civil War. Quincy was incorporated as a town in 1834, and was chartered as a city in 1839.

QUINCY, a city of Norfolk county, Massachusetts, situated on Massachusetts Bay, and separated from Boston by the Neponset river on the N. and from Weymouth by Fore river on the S. Pop. (1890) 16,723; (1900) 23,899, of whom 7662 were foreign-born; (1910 census) 32,642; area, about 16 sq. m. It is served by the New York, New Haven & Hartford railway, and by an interurban electric line. To a large degree Quincy is a residential suburb of Boston. The birthplaces of John Adams, built in 1681, and of John Quincy Adams, built in 1716, are still standing. The Stone Temple, or First (Unitarian) Congregational Church, is the burial-place of the two Adamses. Quincy was also the home of Charles Francis Adams. John Adams gave to the town his valuable private library, and in 1822 founded here the Adams Academy for boys (now closed). In the home of Josiah Quincy (1802–1882) in Wollaston Park is the Quincy Mansion School for Girls. Woodward Institute (1894) is an endowed high school for girls. The public school system, the "Quincy System," was made famous in 1875–1880 by Col. Francis Wayland Parker (1837–1902), who abolished learning lessons by rote, and introduced Froebelian principles. A public library was opened in 1871, and in 1882 it was housed in the Crane Memorial Hall, designed by H. H. Richardson, and given by the family of Thomas Crane (1803–1875), who had spent his early youth in the town, but had lived in New York City from 1827 until his death. The library contained about 26,000 volumes in 1908. The city has a fine system of parks, among them being Merrymount and Faxon, the latter named in honour of the family of Henry H. Faxon, who in 1882 secured a negative vote by the town to the question whether "licenses be granted for the sale of intoxicating liquors"; subsequently there has been a similar vote each year. The manufactures of Quincy were long unimportant, with the exception of "Quincy granite,"[1] which was first quarried in 1825,—this being the first "systematic siliceous crystalline rock quarrying" in New England—and of which the output in the form of tombstones and monuments in 1905 was valued at $2,018,198, and in the form of "marble and stone work" was valued at $364,924. But manufacturing rapidly increased in importance between 1900 and 1905; in this period the value of factory products increased 198.2%, to $8,982,446, and the capital invested increased 389%, to $9,220,870. Quincy granite, a hornblende, pyroxene, bluish or greyish, without mica, was used for the construction of the Bunker Hill monument at Charlestown (in 1826), and of King's Chapel, Boston; and for interior decorations it has found some use, for example in the Philadelphia city buildings. Engines, and iron and steel ships are built at a shipyard[2] on the Fore river, and tubular rivets and studs, gearing, foundry products, and translucent fabrics are among the city's other products.

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[1] Since 1877 the *Granite Cutters' Journal* has been published here by the Granite Cutters' International Association of America. For a description of the granite quarried in the vicinity of Quincy, see T. N. Dale, *The Chief Commercial Granites of Mass., New Hampshire and Rhode Island* (Washington, 1908), Bulletin 354 of the U.S. Geol. Survey.

[2] Here were built various vessels of the U.S. Navy, including the battleship "North Dakota."

The site of the present city was settled in 1625 as Merry Mount or Mount Wollaston by Thomas Morton (*q.v.*)—the present Wollaston Heights is a part of the grant of 600 acres made in 1636 by the town of Boston to William Hutchinson, husband of Anne, the Antinomian, and was formerly known as Taylor's Hill. A Puritan settlement was made here in 1634. This first settled part of Braintree (*q.v.*)—a name given in 1640 to the community then organized—after 1708 was officially called the North Precinct of the Town of Braintree; here the Adamses and the Hancocks lived, and Quincy was the birthplace of John Hancock—in a house on Hancock lot lived the first Josiah Quincy; the Mount Wollaston farm was a legacy to John Quincy (1689–1767), in whose honour the township was named on its separation from the township of Braintree in 1792, and whose name was borne by his great grandson, John Quincy Adams. In 1826 a railway about 4 m. long to the Neponset river was built here—the first in New England—for carrying granite from the quarries to tide-water; the cars were drawn by horses. The township had previously been engaged in maritime pursuits, agriculture, and the manufacture of leather. Township government, owing to the abolition of the committee on general business and the consequent confusion of handling so many and minute details, and to the addition to the population of a large Irish element and a large New Hampshire element, both workmen in the quarries, reached the minimum of efficiency in 1840–1870; in 1870, however, the town-meetings were reformed, and in 1874 a committee to consider business details was again appointed. In 1888 Quincy was chartered as a city.

See "A Study of Church and Town Government," by C. F. Adams, in the second volume of his *Three Episodes of Massachusetts History* (Boston, 1892), for an admirable history of the community; his *Centennial Milestone, an Address in Commemoration of the One Hundredth Anniversary of the Incorporation of Quincy, Mass.* (Cambridge, Massachusetts, 1892); D. M. Wilson, *Quincy, Old Braintree and Merry Mount* (Boston, 1907), and *Where American Independence Began* (Boston, 1902); and D. M. Wilson and C. F. Adams, *Col. John Quincy of Mount Wollaston, 1689–1767* (Quincy, 1909), published by the Quincy Historical Society, and containing addresses made at the celebration in February 1908 in honour of Col. Quincy; and W. S. Pattee, *History of Old Braintree and Quincy* (Quincy, 1878).

QUINET, EDGAR (1803–1875), French historian and man of letters, was born at Bourg-en-Bresse, in the department of the Ain, France, on the 17th of February 1803. His father, Jerome Quinet, had been a commissary in the army, but being a strong republican and disgusted with Napoleon's usurpation, he gave up his post and devoted himself to scientific and mathematical study. Edgar, who was an only child, was much alone, but his mother (Eugénie Rozat Lagis, who was a person of education and strong though somewhat unorthodox religious views) exercised great influence over him. He was sent to school first at Bourg and then at Lyons. His father wished him on leaving school to go into the army, and then suggested business. But Quinet was determined upon literature, and after a time got his way. His first publication, the *Tablettes du juif errant*, appeared in 1823. Being struck with Herder's *Philosophie der Geschichte*, he undertook to translate it, learnt German for the purpose, published his work in 1827, and obtained by it considerable credit. At this time he was introduced to Cousin, and made the acquaintance of Michelet. He had visited Germany and England before the appearance of his book. Cousin procured him a post on a government mission to the Morea in 1829, and on his return he published in 1830 a book on *La Grèce moderne*. Some hopes of employment which he had after the revolution of February were frustrated by the reputation of speculative republicanism which he had acquired. But he joined the staff of the *Revue des deux mondes*, and for some years contributed to it numerous essays, the most remarkable of which was that on *Les Épopées françaises du XIIème siècle*, an early, though not by any means the earliest, appreciation of the long-neglected *chansons de geste*. *Ahasvérus*, his first original work of consequence, appeared in 1833. This is a singular prose poem, in language sometimes rather bombastic but often beautiful. Shortly afterwards he married Minna Moré, a German girl with whom he had fallen in love some years before. Then he visited Italy, and, besides writing many essays, produced two poems, *Napoléon* (1835) and *Prométhée* (1838), which being written in verse (of which he was not a master) are inferior to *Ahasvérus*. In 1838 he published a vigorous reply to Strauss's *Leben Jesu*, and in that year he received the Legion of Honour. In 1839 he was appointed professor of foreign literature at Lyons, where he began the brilliant course of lectures afterwards embodied in the *Génie des religions*. Two years later he was transferred to the Collège de France, and the *Génie des religions* itself appeared (1842).

Quinet's Parisian professorship was more notorious than fortunate, owing, it must be said, to his own fault. His chair was one of Southern Literature, but, neglecting his proper subject, he chose, in conjunction with Michelet, to engage in a violent polemic with the Jesuits and with Ultramontanism. Two books bearing exactly these titles appeared in 1843 and 1844, and contained, as was usual with Quinet, the substance of his lectures. These excited so much disturbance, and the author so obstinately refused to confine himself to literature proper, that in 1846 the government put an end to them—a course which was not disapproved by the majority of his colleagues. By this time Quinet was a pronounced republican, and something of a revolutionist. He appeared in arms during the disturbances which overthrew Louis Philippe, and was elected by the department of the Ain to the Constituent and then to the Legislative Assembly, where he figured among the extreme radical party. He had published in 1848 *Les Révolutions d'Italie*, one of his principal though not one of his best works. He wrote numerous pamphlets during the short-lived Second Republic, attacked the Roman expedition with all his strength, and was from the first an uncompromising opponent of Prince Louis Napoleon. He was banished from France after the *coup d'état*, and established himself at Brussels. His wife had died some time previously, and he now married Mademoiselle Asaky, the daughter of a Roumanian poet. At Brussels he lived for some seven years, during which he published *Les Esclaves* (1853), a dramatic poem, *Marnix de Sainte-Aldégonde* (1854), a study of that Reformer in which he very greatly exaggerates Sainte-Aldégonde's literary merit, and some other books. He then moved to Veytaux, on the shore of the Lake of Geneva, where he continued to reside till the fall of the empire. Here his pen was busier than ever. In 1860 appeared a singular book, somewhat after the fashion of *Ahasvérus*, entitled *Merlin l'enchanteur*, in 1862 a *Histoire de la campagne de 1815*, in 1865 an elaborate book on the French Revolution, in which the author, republican as he was, blamed the acts of the revolutionists unsparingly, and by that means drew down on himself much wrath from more thoroughgoing partisans. Many pamphlets date from this period, as does *La Création* (1870), a third book of the class of *Ahasvérus* and *Merlin*, but even vaguer, dealing not with history, legend, or philosophy, but with physical science for the most part.

Quinet had refused to return to France to join the liberal opposition against Napoleon III., but immediately after Sedan he returned. He was then restored to his professorship, and during the siege wrote vehemently against the Germans. He was elected deputy by the department of the Seine in 1871, and was one of the most obstinate opponents of the terms of peace between France and Germany. He continued to write till his death, which occurred at Versailles on the 27th of March 1875. *Le Siège de Paris et la défense nationale* appeared in 1871, *La République* in 1872, *Le Livre de l'exilé* in the year of its author's death and after it. This was followed by three volumes of letters and some other work. Quinet had already in 1858 published a semi-biographic book called *Histoire de mes idées*.

Quinet's character was extremely amiable, and his letters to his mother, his accounts of his early life, and so forth, are likely always to make him interesting. He was also a man of great moral conscientiousness, and as far as intention went perfectly disinterested. As a writer, his chief fault is want of concentration;

as a thinker and politician, vagueness and want of practical determination. His historical and philosophical works, though showing much reading, fertile thought, abundant facility of expression, and occasionally, where prejudice does not come in, acute judgment, are rather (as not a few of them were in fact) reported lectures than formal treatises. His rhetorical power was altogether superior to his logical power, and the natural consequence is that his work is full of contradictions. These contradictions were, moreover, due, not merely to an incapacity or an unwillingness to argue strictly, but also to the presence in his mind of a large number of inconsistent tastes and prejudices which he either could not or would not co-ordinate into an intelligible creed. Thus he has the strongest attraction for the picturesque side of medievalism and catholicity, the strongest repulsion for the restrictions which medieval and Catholic institutions imposed on individual liberty. He refused to submit himself to any form of positive orthodoxy, yet when a man like Strauss pushed unorthodoxy to its extreme limits Quinet revolted. As a politician he acted with the extreme radicals, yet universal suffrage disgusted him as unreasonable in its principle and dangerous in its results. His pervading characteristic, therefore, is that of an eloquent vagueness, very stimulating and touching at times, but as deficient in coercive force of matter as it is in lasting precision and elegance of form. He is less inaccurate in fact than Michelet, but he is also much less absorbed by a single idea at a time, and the result is that he seldom attains to the vivid representation of which Michelet was a master.

BIBLIOGRAPHY.—His numerous works appeared in a uniform edition of twenty-eight volumes (1877–79). His second wife, in 1870, published certain *Mémoires d'exil*, and *Lettres d'exil* followed in 1885. In that year Prof. George Saintsbury published a selection of the *Lettres à sa mère* with an introduction. For many years Quinet received little attention in France, but it was revived, though not very strongly, by the publication in 1899 of Madame Quinet's *Cinquante ans d'amitié* (that between her husband and Michelet), and by the centenary of his birth. On this latter (1903) appeared *A l'occasion du centénaire*, by E. Ledrain; see also *Libres Penseurs réligieux*, by E. Paris (1905). There is in English an elaborate *Early Life and Writings of Edgar Quinet*, by R. Heath (London, 1881). (G. SA.)

QUININE, the most important alkaloid contained in cinchona bark (see CINCHONA). In 1810 Gomez of Lisbon obtained a mixture of alkaloids which he named cinchonino, by treating an alcoholic extract of the bark with water and then adding a solution of caustic potash. In 1820 Pelletier and Caventou proved that the cinchonino of Gomez contained two alkaloids, which they named quinine and cinchonine. Later quinidine and cinchonidine were discovered, and subsequently several other alkaloids, but in smaller quantity.

Chemistry.—The alkaloids exist in the bark chiefly in combination with cinchotannic and quinic acids. The cinchotannic acid apparently becomes altered by atmospheric oxidation into a red-colouring matter, known as cinchono-fulvic or cinchona red, which is very abundant in some species, as in *C. succirubra*. For this reason those barks which, like *C. Calisaya*, *C. officinalis*, and *C. Ledgeriana*, contain but little colouring matter are preferred, the quinine being more easily extracted from them in a colourless form. The exact mode of extraction adopted by manufacturers is secret. That hitherto adopted by the Indian Government for the preparation of the cinchona febrifuge (see below) is simple, but the whole of the alkaloid present in the bark is not obtained by it. This method is to exhaust the powdered bark with water acidulated with hydrochloric acid and then to precipitate the alkaloids by caustic soda. Another method consists in mixing the powdered bark with milk of lime, drying the mass slowly with frequent stirring, exhausting the powder with boiling alcohol, removing the excess of alcohol by distillation, adding sufficient dilute sulphuric acid to dissolve the alkaloid and throw down colouring matter and traces of lime, &c., filtering, and allowing the neutralized liquid to deposit crystals. The sulphates of the alkaloids thus obtained are not equally soluble in water, and the quinine sulphate can be separated by fractional crystallization, being less soluble in water than the other sulphates.

Quinine of commerce is the neutral sulphate, $C_{20}H_{24}N_2O_2{\cdot}H_2SO_4{\cdot}8H_2O$, which occurs in commerce in the form of very light slender white acicular crystals. It is soluble in about 780 parts of cold water, but in 30 of boiling water, 60 of rectified spirit (sp. gr. 0·83), and 40 of glycerin. Its solubility in water is lessened by sodium or magnesium sulphate, but is increased by potassium nitrate, ammonium chloride, and most acids. It is not soluble in fixed oils or in ether, although the pure alkaloid is soluble in both. It becomes phosphorescent on trituration. When prescribed it is generally rendered more soluble in water by the addition of dilute sulphuric acid or of citric acid, one drop of the former or $\frac{3}{4}$ths of a grain of the latter being used for each grain of the quinine sulphate. Quinine is precipitated from its solution by alkalis and their carbonates. It is, however, very soluble in excess of ammonia.

The acid solution of sulphate of quinine is fluorescent, especially when dilute; and it is laevo-rotatory. When a solution of chlorine is first added and then ammonia an emerald green colour, due to the formation of thalleoquin, is developed. This test answers with a solution containing only 1 part of quinine in 5000, or in a solution containing not more than $\frac{1}{20000}$ part if bromine be used instead of chlorine. The fluorescence is visible in an acid solution containing 1 part in 200,000 of water. By adding an alcoholic solution of iodine to a solution of the sulphate in acetic acid a compound known as herapathite, $4Qu{\cdot}3H_2SO_4{\cdot}2HI{\cdot}I_4{\cdot}6H_2O$, is obtained, which possesses optical properties similar to those of tourmaline; it is soluble in 1000 parts of boiling water; and its sparing solubility in cold alcohol has been utilized for estimating quinine quantitatively. The other alkaloids are distinguished from quinine thus: quinidine resembles quinine, but is dextro-rotatory, and the iodide is very insoluble in water; the solution of cinchonidine, which is laevo-rotatory, does not give the thalleoquin test, nor fluorescence; cinchonine resembles cinchonidine in these respects, but is dextro-rotatory.

Commercial sulphate of quinine frequently contains from 1 to 10% of cinchonidine sulphate, owing to the use of barks containing it. The sulphate of cinchonidine is more soluble than that of quinine; and, when 1 part of quinine sulphate suspected to contain it is nearly dissolved in 24 parts of boiling water, the sulphate of quinine crystallizes out on cooling, and the cinchonidine is found in the clear mother liquor, from which it can be precipitated by a solution of potassium and sodium tartrate. Samples of quinine in which cinchonidine is present usually contain a smaller percentage of water than the pure sulphate. Traces of quinidine are also sometimes, though rarely, found in commercial quinine, but its presence does not detract in a medicinal point of view from the value of the latter.

Owing to its voluminous character as much as 18% of water may remain present in apparently dry samples of sulphate of quinine. If it loses more than 14·6% of water when dried at 100° C. it contains an excessive amount of moisture. Owing to its variability in this respect, and to its insolubility, certain other salts have largely replaced the sulphate in modern medicine.

Sulphate of quinine manufactured from cuprea bark (*Remijia pedunculata*) may contain from ·10 to ·90% of sulphate of homoquinine, which almost coincides in solubility with sulphate of quinine. Homoquinine is decomposed on treatment with caustic soda into quinine and a new alkaloid, cupreine, in the proportion of 2 to 3. Cupreine is soluble in a solution of caustic soda (differing in this respect from quinine), and therefore it is easy to prepare sulphate of quinine perfectly free from either homoquinine or cupreine. The medicinal properties of cupreine and homoquinine are of no practical importance.

In consequence of the high price of the alkaloid an attempt was made some years ago by the Government of India to manufacture from cinchona bark a cheap febrifuge which should represent the alkaloids contained in the bark and form a substitute for quinine. This mixture is known as cinchona febrifuge, and is prepared chiefly from *C. succirubra*, which succeeds better in India than the other species in cultivation, and grows at a lower elevation, being consequently procurable in large quantities at a comparatively low price. A mixture of the cinchona alkaloids, consisting principally of cinchonidine sulphate, with smaller quantities of the sulphates of quinine and cinchonine, is sold under the name of "quinetum" at a cheaper rate than quinine.

The chemical constitution of quinine and the allied alkaloids is not definitely settled, although certain relationships are well established. Thus quinine is methoxycinchonine or methylcupreine, cupreine being an oxycinchonine. These relations are shown by the formulae:—cinchonine $= C_{19}H_{21}N_2{\cdot}OH$; cupreine $= C_{19}H_{20}N_2(OH)_2$; quinine $= C_{19}H_{20}N_2(OH)(OCH_3)$. Cinchonine yields on oxidation cinchoninic acid (γ-quinoline carboxylic acid). $C_9H_6N{\cdot}CO_2H$, whilst quinine gives quininic acid, $C_9H_5(OCH_3)(CO_2H)$. This permits the writing of cinchonine, for example, as $C_9H_6N{\cdot}C_{10}H_{15}(OH)N$, the hydroxy group being in the part ${\cdot}C_{10}H_{15}(OH)N$, about which the constitution is uncertain. The subject has been especially studied by Skraup, Königs, and von Miller; Königs and von Miller have proposed formulae consisting of a piperidine ring substituted with a vinyl group; in the former that is a bridge of ${\cdot}CH_2{\cdot}C(OH){\cdot}$ from the nitrogen atom to the γ-carbon atom, connexion with the quinoline residue being made at the hydroxylic carbon atom through a $\cdot CH_2\cdot$ group: whilst in the latter the piperidine ring is substituted by a methyl group in addition to the vinyl group and the bridge is simply $\cdot C(OH)\cdot$, with which connexion is made as before.

Medicine.—The sulphate is still used in medicine, and the British Pharmacopeia has admitted two others, which are much more valuable—the hydrochloride and the acid hydrochloride—whilst the hydrobromide is also used. The hydrochloride—formerly known as the hydrochlorate—$C_{20}H_{24}N_2O_2\cdot HCl\cdot 2H_2O$, resembles the sulphate in appearance, the crystals being, however, somewhat larger. It is soluble in less than 40 parts of cold water, and in 3 parts of alcohol (90%). The doses are similar to those of the sulphate, but somewhat smaller, owing to its greater solubility. The acid hydrochloride is the most valuable of all salts of quinine. It is soluble in its own weight of water, and is the most rapidly and completely absorbed of all the salts of this alkaloid. It occurs in a colourless crystalline powder, having the formula $C_{20}H_{24}N_2O_2\cdot 2HCl\cdot 3H_2O$.

The sulphate of quinine used in medicine may contain up to 3% of cinchonidine, but should be free from cinchonine, quinidine and cupreine. There are four pharmacopeial preparations. The ferri et quininae citras, one of the "scale preparations" of iron, is given as a haematinic and tonic in doses of about 10 grains. It is very unpleasant to take. The pharmacopeial pilule quininae contains 5 parts of the sulphate in 6. The syrupus ferri phosphatis cum quinina et strychnina (Easton's Syrup) contains $\frac{4}{5}$ths of a grain of quinine in each drachm, that is, in each dose. Here the quinine acts as a bitter tonic. The tinctura quininae ammoniata or "ammoniated quinine" is made by mixing 175 grains of quinine sulphate, 2 fluid oz. of liquor ammoniae (the pharmacopeial solution of ammonia), and 18 fluid oz. of a 60% solution of alcohol. The dose of $\frac{1}{2}$ to 1 drachm contains little more than a grain of quinine, the antipyretic action of which is negligible. Its value in the early stages of a bronchitis or tracheitis is due to the ammonia. The small quantity of quinine it contains is conditioned by the solubility of the alkaloid, which is precipitated when this tincture is diluted with water. No particular value attaches to the pharmacopeial preparations of the hydrochloride.

Physiological Action.—Our knowledge of this subject is mainly due to Professor Binz of Bonn. Quinine has considerable powers as an antiseptic, this term defined for some time as indicating the power to kill bacteria. Whilst quinine possesses this power, however, it is far more potently lethal to a particular form of *animal* organism known as the *plasmodium malariae.* Against the bacteria quinine is not at all an exceptionally powerful antiseptic, though more powerful than carbolic acid. Many bacteria are killed by a ·2% solution of the alkaloid. Quinine does not affect the unbroken skin, and cannot be absorbed from it, but it is slightly irritant to the pain-conducting nerves of a raw surface.

The first feature of the internal action of quinine is its intensely bitter taste. This induces a reflex secretion from the salivary and gastric glands, which is followed or accompanied by increased vascularity of the gastric mucous membrane, and by some degree of activity on the part of the muscular wall of the stomach. This means that the appetite is strengthened, and digestion rendered more rapid and complete. In this sense alone quinine is a tonic. The hydrochloric acid of the gastric juice is stated to convert any salt of quinine into a chloride, and it seems probable that the absorption of quinine takes place mainly from the stomach, for when the drug reaches the alkaline secretions of the duodenum it is precipitated, and probably none of it is thereafter absorbed. The greater part of a dose of quinine sulphate administered by the mouth may be recovered, as a rule, from the faeces, this being much the most wasteful method of giving quinine. The absorption of the acid hydrochloride is much more complete. Quinine hydrochloride circulates in the alkaline blood without precipitation, probably owing to the presence of carbonic acid in the blood.

The action of quinine on the blood itself—quite apart from its action on malarial blood—is of great complexity and importance. Whilst it is not a haematinic, in that it does not increase the number of the red blood corpuscles, it very markedly influences the stability of the compounds of the haemoglobin with oxygen. Like alcohol and prussic acid, quinine interferes with oxidation, so that oxyhaemoglobin is relatively unable to give up its oxygen to the tissues, the metabolism of which is therefore greatly modified. This property is doubtless partly—though not wholly—explanatory of the antipyretic action of quinine. The leucocytes or white blood corpuscles are very markedly affected by quinine, the characteristic "amoeboid" movements of the cells being arrested. Hence quinine stops the process of *diapedesis* or emigration of the leucocytes from the blood-vessels into the tissues, and if applied to the extravascular spaces it arrests the leucocytic movements there. The explanation that this influence on the leucocytes explained the favourable action of quinine on certain inflammatory processes no longer holds, since we know that the inflammatory conditions are of microbic origin, and that the movements of the leucocytes are not objectionable, but highly desirable as a means of defence against bacteria and their products. Quinine, therefore, is not beneficial in inflammatory conditions as far as this particular property is concerned.

The action of quinine on the circulatory apparatus is not marked. It is only in very large doses that it weakens the intracardiac nervous ganglia, slows and weakens the pulse, and dangerously lowers the blood pressure. Similarly the depressant action on the respiratory centre in the medulla oblongata occurs only after the administration of enormous doses.

The action of quinine on the temperature is important, for it is the safest of all known antipyretics. Its action on the normal temperature is *nil.* The drug is not an *antithermal.* But when the temperature is raised, quinine will frequently lower it. The action is not due to any influence on the thermic centres, nor to any production of diaphoresis, but to the influence of quinine upon the stability of oxyhaemoglobin. Quinine was the first antipyretic used, and after the introduction of such preparations as antipyrin and acetanilide it may still be said to be the safest, though it is much less powerful. The maximum dose of the sulphate is about 40 grains, and of the acid hydrochloride about 25 grains. The temperature usually begins to fall in about two hours. The influence of quinine upon a malarial temperature is due to an entirely different cause (see below).

In some of the lower vertebrates quinine reduces the activity of the spinal cord, but in the human species it appears to stimulate the nervous mechanism of the uterus under certain conditions, and it is therefore included under the class of *oxytocic* or *ecbolic* drugs.

Quinine is excreted in some degree by nearly all the glands of the body, but mainly by the kidneys. Traces of it may be detected in the urine within an hour of its administration, and most of it is eliminated within eight or ten hours. The study of the urine is highly interesting in correlation with that of the influence of quinine upon the oxidising power of the blood, and upon the movements of the leucocytes. The amount of urea, creatin, creatinin, sulphates and phosphates in the urine is diminished, clearly showing that quinine exerts an inhibitory influence over the metabolic processes of the body. This conclusion is further confirmed by the observation that the amount of carbonic acid excreted by the lungs is also diminished. The uric acid excreted in the urine (mostly in the form of urates) is markedly diminished. This product is largely derived from the nuclei of the leucocytes, which contain large quantities of the nucleo-proteids, of which uric acid is a decomposition product. It is therefore plain that the diminution of leucocytic movement is to be regarded as a sign of diminished metabolism within the cells.

Therapeutics.—The supreme value of quinine is as a specific antidote to malaria, against which it also possesses a powerful prophylactic action. Ten or fifteen grains of the sulphate are often given three times a day for this latter purpose, and smaller doses of the much more efficacious acid hydrochloride will be found to convey even more certain immunity. In treating malaria (including ague, remittent fever, intermittent fever, and all its other forms) with this drug certain important facts are to be observed. Quinine administered by the mouth or by any other means will soon enter the blood, and will then kill the *haematozoon malariae*, whether it be free in the blood-plasma, in the leucocytes or in the red blood corpuscles. There is one exception, however. Quinine is apparently powerless to kill the organism when it is in its reproductive phase. This phase corresponds to the pyretic attack. There is therefore no purpose to be served by administering quinine during a malarial paroxysm. Two successful methods may be adopted. The quinine may be given in a single large dose—30 grains of the sulphate, or 20 of the acid hydrochloride—an hour or two before the attack is due, *i.e.* just before the parent organism in the red blood corpuscles is about to discharge the new generation of young parasites into the blood-plasma. An equally effective method, which may be combined with the above, is to give the quinine in 10-grain doses of the acid hydrochloride every four hours between the attacks. Whichever method be adopted, the paroxysm that was expected will probably not appear. After a single full dose of quinine no parasites can as a rule be observed in the blood for several days. In beginning treatment, it is well to clear the hepatic and alimentary passages by a preliminary dose of calomel combined with a secretory cholagogue, such as enonymin or iridin. The quinine treatment may be begun with success on the day following an attack. Quinine is much less efficacious in the treatment of post-malarial symptoms, such as neuralgia and haematuria, when no parasites can be detected in the blood. In such cases quinine is often inferior to arsenic.

Quinine is largely used as a bitter tonic in doses of about half a grain. The acid hydrochloride is the best salt to employ.

Quinine has some analgesic power, and is a safe and often efficient drug in the treatment of neuralgia, even when the patient has not had malaria. Somewhat smaller doses than those given in pyrexia should be employed.

Cinchonism is the name applied to the congeries of toxic symptoms which follow the prolonged administration of quinine, but may appear after one small dose in certain persons. The symptoms closely resemble those of salicylism, and also, though in less degree, those of carbolism. The patient is deaf, but complains of ringing in the ears, which may assume various forms, especially in musical people. There is headache, which, with the continuance of the drug, becomes exceedingly severe, the vision and equilibrium are affected, and there is often some gastro-intestinal irritation. In cases where the drug has been deliberately given for its poisonous action the results are still more severe. There may be bleeding from the nose, cutaneous congestion, deafness, blindness, coma or delirium, and even death from cardiac failure. After death there is found one noteworthy lesion, a commencing acute inflammation of the internal ear. In persons who have a marked idiosyncrasy towards cinchonism, the symptoms may often be successfully averted if small doses of hydrobromic acid—10 minims of the dilute solution—are given with the quinine.

A non-official preparation of quinine—Warburg's Tincture—occasionally succeeds where the ordinary preparations fail. The dose is 1 to 4 drachms. It contains 1 part of quinine in 50. Of the thirteen or more other ingredients, there may specially be noticed the salicylic and benzoic acids.

The other alkaloids of cinchona bark—quinidine, cinchonidine, and cinchonine—also possess similar properties, but all are much less effective than quinine. This is also the case with the cinchona febrifuge prepared from *C. succirubra*.

The great disadvantage of the official preparations is the bitter taste and insolubility. It is found, however, that all the soluble salts are bitter, whilst the tasteless ones are insoluble. Substitutes may therefore be divided into those administered orally and those administered hypodermically. Of the insoluble salts we may notice the tannate, the propionic acid ester (euquinine) and carbonic acid ester (aristoquin), the salicylic acid ester (saloquinine); and of the soluble substitutes, quinopyrine (a compound of quinine hydrochloride and antipyrine) and quinine hydrochlorocarbamide (a compound of quinine, urea and hydrochloric acid).

Until 1867 English manufacturers of quinine were entirely dependent upon South America for their supplies of cinchona bark, which were obtained exclusively from uncultivated trees, growing chiefly in Bolivia, Peru, and Ecuador, the principal species which were used for the purpose being *Cinchona Calisaya; C. officinalis; C. macrocalyx*, var. *Palton; C. Pitayensis, C. micrantha* and *C. lancifolia*. Since the cultivation of cinchona trees was commenced in Java, India, Ceylon and Jamaica, several other species, as well as varieties and hybrids cultivated in those countries, have been used.[1] Later, *C. lancifolia*, var. *Calisaya*, known as the calisaya of Santa Fé, was strongly recommended for cultivation, because the shoots of felled trees afford bark containing a considerable amount of quinine; *C. Pitayensia* has been introduced into the Indian plantations on account of yielding the valuable alkaloid quinidine, as well as quinine.

The first importation from India took place in 1867, since which time the cultivated bark has arrived in Europe in constantly increasing quantities, London being the chief market for the Indian barks and Amsterdam for those of Java. *Cinchona Calisaya* has also been cultivated extensively in Bolivia and in Tolima, United States of Columbia.

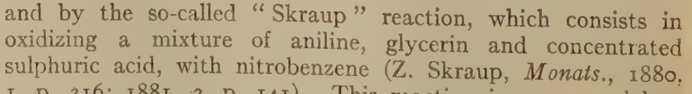
In order to obtain the cultivated bark as economically as possible, experiments were made which resulted in the discovery that, if the bark were removed from the trunks in alternate strips so as not to injure the cambium, or actively growing zone, a new layer of bark was formed in one year which was richer in quinine than the original bark and equal in thickness to that of two or three years' ordinary growth. This is known in commerce as "renewed bark." The process has been found to be most conveniently practised when the trees are eight years old, at which age the bark separates most easily. The yield of quinine has been ascertained to increase annually until the eleventh year, at which it seems to reach its maximum. The portion of the trunk from which the bark has been removed is sometimes protected by moss, and the new bark which forms is then distinguished by the name of "mossed bark." The species which yield the largest amount of quinine are by no means the easiest to cultivate, and experiments have consequently been made in cross-fertilization and grafting with the view of giving vigour of growth to delicate trees yielding a large amount of alkaloid or of increasing the yield in strong-growing trees affording but little quinine. Grafting, however, has not been found to answer the purpose, since the stock and the graft have been found to retain their respective alkaloids in the natural proportion just as if growing separately. Hybridization also is very uncertain, and is very difficult to carry out effectually; hence the method of propagating the best varieties by cuttings has been adopted, except in the case of those which do not strike readily, as in *C. Ledgeriana*, in which the plants are grown from the shoots of felled trees.

Some years ago it was discovered that a bark imported from Colombia under the name of cuprea bark, or "hard" bark, and derived from *Remijia pedunculata, Triana*, and other species, contained quinine to the extent of $\frac{1}{2}$ to $2\frac{1}{2}$ %, and in 1881 this bark was exported in enormous quantities from Santander, exceeding in amount the united importations of all the other cinchona barks; and by reason of its cheapness this has since that date been largely used for the manufacture of quinine.

Cinchona bark as imported is never uniform in quality. The South American kinds contain a variable admixture of inferior barks, and the cultivated Indian barks comprise, under the respective names of yellow, pale, and red barks, a number of varieties of unequal value.

The alkaloids are contained, according to Howard, chiefly in the cellular tissue next to the liber. No definite knowledge has as yet been attained of the exact steps by which quinine is formed in nature in the tissues of the bark. From analyses of the leaves, bark and root, it appears that quinine is present only in small quantities in the leaves, in larger quantity in the stem bark, and increasing in proportion as it approaches the root, where quinine appears to decrease and cinchonine to increase in amount, although the root bark is generally richer in alkaloids than that of the stem. The altitude at which the trees are grown seems to affect the production of quinine, since it has been proved that the yield of quinine in *C. officinalis* is less when the trees are grown below 6000 ft. than above that elevation, and that cinchonidine, quinidine, and resin are at the same time increased in amount. It has also been shown by Broughton that *C. Peruviana*, which yields cinchonine but no quinine at a height of 6000 ft., when grown at 7800 ft. gives nearly as much quinine, and almost as readily, as *C. officinalis*. Karsten also ascertained by experiments made at Bogotá on *C. lancifolia* that the barks of one district were sometimes devoid of quinine, while those of the same species from a neighbouring locality yielded $3\frac{1}{2}$ to $4\frac{1}{2}$ % of the sulphate; moreover, Dr De Vrij found that the bark of *C. officinalis* cultivated at Utakamand varied in the yield of quinine from 1 to 9 %. In these cases the variation may have been due to altitude. Free access of air to the tissues also seems to increase the yield of quinine, for the renewed bark is found to contain more quinine than the original bark

QUINOLINE (Benzopyridine), C_9H_7N, an organic base first obtained from coal-tar in 1834 by F. Runge (*Pogg. Ann.*, 1834, 31, p. 68), and later by C. Gerhardt by the distillation of cinchonine, quinine and other alkaloids with caustic potash (*Ann.*, 1842, 42, p. 310; 44, p. 279). It also occurs with pyridine and its homologues in bone-oil. It may be prepared by distilling cinchoninic acid with lime; by the reduction of ortho-aminocinnamic aldehyde (A. Baeyer and V. Drewson, *Ber.*, 1883, 16, p. 2207); by passing the vapour of allyl aniline over heated lead oxide; by the condensation of ortho-aminobenzaldehyde with acetaldehyde in the presence of aqueous caustic soda (P. Friedländer and C. F. Gohring, *Ber.*, 1882, 15, p. 2572; 1883, 16, p. 1833); by the action of orthotoluidine on glyoxal at 150° C. (V. Kulisch, *Monats.*, 1894, 15, p. 276); by the action of phosphorus pentachloride on hydrocarbostyril (the inner anhydride of ortho-aminohydrocinnamic acid), the chlorinated compound first formed being then reduced by hydriodic acid (A. Baeyer):



$$C_6H_4\left\langle\begin{matrix}CH_2-CH_2\\ \quad\ |\\ NH-CO\end{matrix}\right. \rightarrow C_6H_4\left\langle\begin{matrix}CH=C\cdot Cl\\ \quad\ |\\ N\ \ =C\cdot Cl\end{matrix}\right. \rightarrow C_6H_4\left\langle\begin{matrix}CH=CH\\ \quad\ |\\ N=CH\end{matrix}\right.;$$

and by the so-called "Skraup" reaction, which consists in oxidizing a mixture of aniline, glycerin and concentrated sulphuric acid, with nitrobenzene (Z. Skraup, *Monats.*, 1880, 1, p. 316; 1881, 2, p. 141). This reaction is a very violent one, and its mechanism may probably be explained as follows: The glycerin is first converted into acrolein, which combines with the aniline to form acrolein-aniline, and this product is then oxidized by the nitrobenzene: $C_3H_8O_3 \rightarrow C_3H_4O\ (+C_6H_5NH_2) \rightarrow C_6H_5N{:}CH{\cdot}CH{:}CH_2 \rightarrow C_9H_7N$. The nitrobenzene may be replaced by arsenic acid, when the reaction proceeds much more quietly and a cleaner product is obtained (C. A. Knueppel, *Ber.*, 1896, 29, p. 703). The Skraup reaction is a perfectly general one for primary amino-compounds; the halogen-, nitro- and oxy-anilines (aminophenols) react similarly, as do also the toluidines, naphthylamines, amino-anthracene, meta- and para-phenylene diamines, and ortho- and γ-aminoquinoline.

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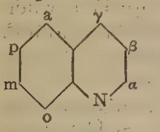
[1] In Java, *C. Calisaya*, vars. *anglica, javanica, Hasskarliana* and *Ledgeriana*; *C. officinalis*, var. *angustifolia*; *C. lancifolia, C. caloptera C. micrantha* and *C. succirubra*. In India, *C. succirubra, C. officinalis*, vars. *angustifolia, crispa, Uritusinga* and *Bonplandiana*, and to a lesser extent *C. Calisaya*, vars. *Boliviana* and *microcarpa*; *C. micrantha, C. Peruviana* and *C. nitida* form only a small proportion of the plantations. Since J. E. Howard pointed out that *C. Pahudiana*, and *C. Calisaya*, vars. *javanica, Hasskarliana* and *anglica*, were likely to lead to disappointment as quinine-yielding species, these have been replaced in the plantations as rapidly as possible by the more valuable species, of which *C. Ledgeriana*, yielding from 5 to 10 % or even more of quinine, *C. officinalis*, and a hybrid between *C. officinalis* and *C. succirubra*, which has been named *C. robusta*, are the most important.

Quinoline is a colourless liquid with a smell resembling that of pyridine. It boils at 238° C. and is very hygroscopic. It is a tertiary base and forms well-defined salts. It is almost insoluble in water, but dissolves readily in the common organic solvents. It combines readily with the alkyl halides. H. Decker (*Ber.*, 1905, 38, p. 1144) has found that many ortho substituted quinolines will not combine with methyl iodide owing to steric hindrance, but the difficulty can be overcome in most cases by using methyl sulphate and heating the reaction components to 100° C. for half an hour. Nitric acid and chromic acid have little action on quinoline, but alkaline potassium permanganate oxidizes it to carbon dioxide, ammonia, oxalic, and quinolinic acids (S. Hoogewerff and W. A. v. Dorp, *Rec. Pays Bas*, 1882, 1, p. 107). Bleaching powder oxidizes it to chlorcarbostyril. It is reduced by the action of zinc and ammonia to di- and tetra-hydroquinolines. A hexahydro- and a decahydroquinoline have been obtained by heating tetrahydroquinoline with hydriodic acid and phosphorus to high temperatures (E. Bamberger, *Ber.*, 1890, 23, p. 1138). Numerous substitution products of quinoline are known, and the positions in the molecule are generally designated in accordance with the scheme shown in the inset formula: the letters *o*, *m*, *p*, *a*, standing for *ortho-*, *meta-*, *para-*, and *ana-*.

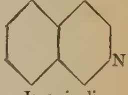


The oxyquinolines possess a certain importance owing to their relationship to the alkaloids. Those with the hydroxyl group in the benzene nucleus are prepared from the aminophenols by the Skraup reaction. Only two are known containing the hydroxyl group in the pyridine nucleus, namely, *carbostyril* (α-oxyquinoline), which is formed by the reduction of ortho-aminocinnamic acid with ammonium sulphide (L. Chiozza, *Ann.*, 1852, 83, p. 118) or with ferrous sulphate and baryta, and *kynurine* (γ-oxyquinoline), which is obtained by the action of nitrous acid on γ-aminoquinoline (A. Claus and H. Howitz, *Jour. prak. Chem.*, 1894, 158, p. 232). It is also formed by the condensation of anthranilic acid with acetaldehyde (S. Niementowski, *Ber.*, 1895, 28, p. 2811). They are both crystalline solids, the former melting when anhydrous at 199–200°, and the latter at 52° C.

Of the homologues of quinoline, the most important are quinaldine, lepidine, γ-phenylquinoline, and flavoline. *Quinaldine* (α-methylquinoline) is present in coal-tar; it may be prepared by condensing aniline with paraldehyde and concentrated hydrochloric acid (O. Doebner and W. v. Miller, *Ber.*, 1881, 14, pp. 2812 et seq.). The reaction is a perfectly general one, for the aniline may be replaced by other aromatic amines and the aldehyde by other aldehydes, and so a large number of quinoline homologues may be prepared in this way. Quinaldine may also be obtained by condensing ortho-aminobenzaldehyde with acetone in presence of caustic soda (P. Friedlander, *loc. cit.*). It is a colourless liquid which boils at 247° C. The $-CH_3$ group is very reactive, condensing readily with aldehydes and with phthalic anhydride. Potassium permanganate oxidizes it to acetylanthranilic acid, $HOOC(1){\cdot}C_6H_4{\cdot}(2)NH{\cdot}COCH_3$, while chromic acid oxidizes it to quinaldic acid (quinoline-α-carboxylic acid). *Lepidine* (γ-methylquinoline) was first obtained by distilling cinchonine with caustic potash. It may be prepared synthetically by condensing ortho-aminoacetophenone with paraldehyde and caustic soda (L. Knorr, *Ann.*, 1886, 236, p. 69) or from aniline, acetone, formaldehyde and hydrochloric acid (C. Beyer, *Jour. prak. Chem.*, 1885, 140, p. 125). It may also be prepared by condensing αγ-dimethylquinoline and formaldehyde, the resulting α-ethanollepidine, $C_9H_5{\cdot}CH_3N(CH_2{\cdot}CH_2{\cdot}OH)$, breaks down on heating and forms lepidine (W. Königs and A. Mengel, *Ber.*, 1904, 37, p. 1322). It is a colourless liquid which boils at 255° C. Chromic acid oxidizes it to cinchoninic acid (see below), whilst potassium permanganate oxidizes it to lepidinic acid (γ-methylquinolinic acid) and cinchomeronic acid (see PYRIDINE). *γ-Phenylquinoline*, which is probably the parent substance of the cinchona alkaloids, is prepared by heating γ-phenylquinaldic acid, the oxidation product of the γ-phenylquinaldine, which results from the action of alcoholic potash on a mixture of ortho-aminobenzophenone and acetone (W. Königs and R. Geigy, *Ber.*, 1885, 18, p. 2400), or by the action of sulphuric acid on benzoyl-acetone anilide (C. Beyer, *Ber.*, 1887, 20, p. 1767). It crystallizes in needles which melt at 61° C. *Flavoline* (α-phenyl-γ-methylquinoline) is formed on heating flavenol (see below) with excess of zinc dust, or by heating molecular proportions of ortho-amino-acetophenone and acetophenone, in dilute alcoholic solution, with a small quantity of 10% caustic soda solution (O. Fischer, *Ber.*, 1886, 19, p. 1037). Closely related to flavoline is *flavaniline* or (α)-para-aminophenyl-γ-methylquinoline, which is formed when acetanilide and anhydrous zinc chloride are heated together for many hours at 250–270° C. (O. Fischer and C. Rudolph, *Ber.*, 1882, 15, p. 1500), or by heating ortho- and para-aminoacetophenone with zinc chloride to 90° C. (O. Fischer, *Ber.*, 1886, 19, p. 1038). It crystallizes from benzene in prisms, which melt at 97° C. Sodium nitrite in the presence of excess of acid converts it into the corresponding hydroxylic compound *flavenol*.

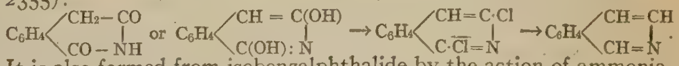
The oxy derivatives of the quinoline homologues are best obtained from the aniline derivatives of β-ketonic acids. At 110° C. aniline and acetoacetic ester condense to form anilido-acetoacetic ester, $CH_3CO{\cdot}CH_2{\cdot}CO{\cdot}NH{\cdot}C_6H_5$, which is converted by concentrated acids into α-oxy-γ-methylquinoline (L. Knorr, *Ann.*, 1886, 236, p. 73). On the other hand, at about 240° C., the amine and ester react to form β-anilidocrotonic ester, $CH_3{\cdot}C(NHC_6H_5) : CH{\cdot}COOC_2H_5$, which yields γ-oxy-α-methylquinoline (M. Conrad and L. Limpach, *Ber.*, 1887, 20, p. 947).

Numerous carboxylic acids of quinoline are known, the most important of which are quinaldic, cinchoninic and acridinic acids. *Quinaldic acid* (quinoline-α-carboxylic acid) is produced when quinaldine is oxidized by chromic acid. It crystallizes in needles, which contain two molecules of water of crystallization, and melt at 156° C. When heated above the melting-point it loses carbon dioxide and yields quinoline. Alkaline potassium permanganate oxidizes it to pyridine tricarboxylic acid (2·3·6). *Cinchoninic acid* (quinoline-γ-carboxylic acid) is formed when cinchonine is oxidized by nitric acid, or by the oxidation of lepidine. It crystallizes from water in needles or prisms and in the anhydrous state melts at 253–254° C. Potassium permanganate oxidizes it to pyridine tricarboxylic acid (2·3·4). *Acridinic acid* (quinoline-αβ-dicarboxylic acid) is formed when acridine is oxidized by potassium permanganate (C. Graebe and H. Caro, *Ber.*, 1880, 13, p. 100). It crystallizes in needles, which are easily soluble in alcohol, and when heated above 130° C. lose carbon dioxide and leave a residue of quinoline-β-carboxylic acid.



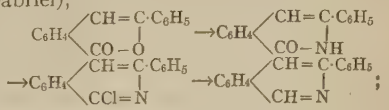
Isoquinoline.

Isoquinoline, isomeric with quinoline, was first discovered in coal-tar in 1885 by S. Hoogewerff and W. A. v. Dorp (*Rec. Pays Bas*, 1885, 4, 125); its formula is shown in the inset. It may be separated from the quinoline which accompanies it by means of the difference in the solubility of the sulphates of the two compounds, isoquinoline sulphate being much less soluble than quinoline sulphate. It may be prepared by passing the vapour of benzylidene ethylamine through a red-hot tube (A. Pictet and S. Popovici, *Ber.*, 1892, 25, p. 733); by the action of concentrated sulphuric acid on benzyl amino-acetaldehyde, $C_6H_5{\cdot}CH_2{\cdot}NH{\cdot}CH_2{\cdot}CHO$ (E. Fischer), or on benzylidene amino-acetal, $C_6H_5CH : N \cdot CH_2 \cdot CH(OC_2H_5)_2$ (C. Pomeranz, *Monats.*, 1892, 14, p. 116); by heating cinnamenyl aldoxime with phosphorus pentoxide to 70° C. (E. Bamberger, *Ber.*, 1894, 27, p. 1955), $C_6H_5CH : CH{\cdot}CH : NOH \rightarrow [C_6H_5CH : CH{\cdot}NH{\cdot}COH] \rightarrow C_9H_7N$; by the action of hydriodic acid on the oxydichlorisoquinoline formed when phosphorus pentachloride reacts with hippuric acid; by the distillation of homophthalimide over zinc dust (M. Le Blanc, *Ber.*, 1888, 21, p. 2299), or by treatment with phosphorus oxychloride followed by the reduction of the resulting dichlorisoquinoline with hydriodic acid (S. Gabriel, *Ber.*, 1886, 19, pp. 1655, 2355):



$$\mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{CH_2-CO}\\ \qquad\ \ |\\ \mathrm{CO-NH}\end{array}\right. \text{ or } \mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{CH = C(OH)}\\ \qquad\quad\ |\\ \mathrm{C(OH):N}\end{array}\right. \rightarrow \mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{CH{=}C{\cdot}Cl}\\ \qquad\ |\\ \mathrm{C{\cdot}Cl{=}N}\end{array}\right. \rightarrow \mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{CH{=}CH}\\ \qquad\ |\\ \mathrm{CH{=}N}\end{array}\right. .$$

It is also formed from isobenzalphthalide by the action of ammonia, followed by phosphorus oxychloride and reduction of the chlorinated product (S. Gabriel),

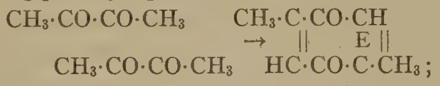


$$\mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{CH{=}C{\cdot}C_6H_5}\\ \qquad\ |\\ \mathrm{CO-O}\end{array}\right. \rightarrow \mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{CH{=}C{\cdot}C_6H_5}\\ \qquad\ |\\ \mathrm{CO-NH}\end{array}\right.$$
$$\rightarrow \mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{CH{=}C{\cdot}C_6H_5}\\ \qquad\ |\\ \mathrm{CCl{=}N}\end{array}\right. \rightarrow \mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{CH{=}C{\cdot}C_6H_5}\\ \qquad\ |\\ \mathrm{CH{=}N}\end{array}\right. ;$$

and from isocoumarin carboxylic acid by conversion into isocarbostyril on heating, and subsequent reduction by distillation with zinc dust (E. Bamberger, *Ber.*, 1892, 25, p. 1138). It melts at 22–23° C. and boils at 240° C., and behaves in most respects similarly to quinoline. By oxidation with alkaline potassium permanganate it yields phthalic acid and cinchomeronic acid. Reduction by means of tin and hydrochloric acid gives a tetrahydro derivative.

Numerous derivatives of isoquinoline are obtained in the decomposition of various vegetable alkaloids. Papaverine on fusion with alkalis yields a dimethoxyisoquinoline, whilst hydrohydrastinine, hydrocotarnine and the salts of cotarnine may be considered as derivatives of reduced isoquinolines (see OPIUM).

QUINONES, in organic chemistry, a group of compounds in which two hydrogen atoms of a benzene nucleus are replaced by two oxygen atoms. This replacement may take place either in the ortho or para positions, giving rise to orthoquinones or to paraquinones; metaquinones do not appear to have been isolated. The para or true quinones are obtained by the oxidation of hydrocarbons with chromic acid or of various para di-derivatives of benzene with chromic acid mixture, such, for example, as para-aminophenol, para-phenylene diamine, para-aminoazobenzene, &c. H. v. Pechmann (*Ber.*, 1888, 21, p. 1417) has shown that α-diketones are converted into paraquinones by the action of warm solutions of the caustic alkalis, diacetyl yielding para-xyloquinone:

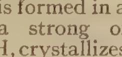
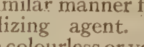


$$\begin{array}{l}\mathrm{CH_3\cdot CO\cdot CO\cdot CH_3}\\ \mathrm{CH_3\cdot CO\cdot CO\cdot CH_3}\end{array} \rightarrow \begin{array}{c}\mathrm{CH_3\cdot C\cdot CO\cdot CH}\\ \| \qquad \mathrm{E}\,\|\\ \mathrm{HC\cdot CO\cdot C\cdot CH_3}\end{array};$$

whilst P. H. Bayrac (*Bull. soc. chim.*, 1894 (3) 11, p. 1129) obtained anilino-derivatives of the paraquinones by the action of an aqueous solution of potassium chromate on an acetic acid solution of para-aminodimethylaniline and phenol: $C_6H_5OH+H_2N\cdot C_6H_4\cdot N(CH_3)_2 \rightarrow O{:}C_6H_4{:}N\cdot C_6H_4\cdot N(CH_3)_2$; these compounds yield the quinone when heated with mineral acids.

The paraquinones are generally crystalline solids of a yellowish colour, having a characteristic sharp odour and being volatile in steam. They are readily reduced to the corresponding hydroquinones or para-dihydroxy-benzenes, and also combine with hydroxylamine hydrochloride to form nitrosophenols, $ON\cdot C_6H_4\cdot OH$, which can further yield quinone dioximes, $HON{:}C_6H_4{:}NOH$. Paraquinones also combine with ammonia and with amines yielding amino-derivatives and hydroquinones. The orthoquinones more resemble the α-diketones; they are crystalline solids of a red or yellow colour, but differ from the paraquinones in being devoid of smell and not volatile in a current of steam.

Benzoquinone (para) or ordinary quinone, $C_6H_4O_2$, is formed by the oxidation of aniline with sodium bichromate and sulphuric acid. It sublimes in golden yellow needles. Hot concentrated nitric acid oxidizes it to picric acid and oxalic acid, whilst on treatment with hydrochloric acid and potassium chlorate it yields chloranil (tetrachloroquinone). It combines directly with two and four atoms of bromine. Free hydroxylamine reduces it to hydroquinone. It combines directly with aniline to form dianilidoquinone, dianilidoquinone-anil and dianilidoquinone-dianil or azophenine. Two alternative structural formulae have been given to benzoquinone, namely:

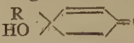
 and 

The former, due to C. Graebe (*Zeit. f. Chemie*, 1867, 3, p. 39), ascribes to the molecule a peroxide configuration which accounts for its oxidizing powers but not for the fact that each oxygen atom is capable of replacement by one atom of chlorine. The second formula, due to R. Fittig (*Ann.*, 1876, 180, p. 23) readily explains the formation of the mono- and di-oximes of quinone and also that it readily combines with bromine.

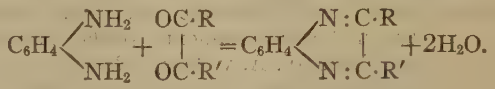
Quinone-chlorimide, $ClN : C_6H_4 : O$, is obtained when para-aminophenol is oxidized with bleaching powder. It is a yellow crystalline solid readily volatile in steam. The dichlorimide, $ClN : C_6H_4 : NCl$, is formed in a similar manner from paraphenylene diamine. It is a strong oxidizing agent. Quinone-dioxime, $HON : C_6H_4 : NOH$, crystallizes in colourless or yellow needles, which decompose when heated to about 240° C. Potassium ferrocyanide in alkaline solution oxidizes it to dinitrosobenzene, whilst cold concentrated nitric acid oxidizes it to para-dinitrobenzene. Quinhydrone, $C_6H_4O_2\cdot C_6H_4(OH)_2$, is formed by the direct union of quinone and hydroquinone or by careful oxidation of hydroquinone with ferric chloride solution. On boiling with water it decomposes into quinone and hydroquinone.

Benzoquinone (ortho).—C. L. Jackson (*Amer. Chem. Jour.*, 1901, 26, p. 10) attempted to prepare this compound by the action of iodine on the lead salt of pyrocatechin suspended in chloroform. A deep red solution was obtained, but the free quinone was not isolated since the solution on standing deposits nearly black crystals of dihydroxyphenylhydroxybenzoquinone $(HO)_2C_6H_3\cdot C_6H_2O_2\cdot OH$. R. Willstätter (*Ber.*, 1904, 37, p. 4744), by dissolving pyrocatechin in absolute ether containing ignited sodium sulphate and then adding dry silver oxide, obtained the quinone in dark red crystalline plates which decompose between 60° and 70° C.

For naphthalene quinones see NAPHTHALENE; for anthracene quinone see ANTHRAQUINONE; and for phenanthrene quinone see PHENANTHRENE.

Quinoles.—The quinoles are a series of compounds of the type ,obtained by the oxidation of para-alkylated phenols with nitric acid, Caro's acid or bromine (Auwers, *Ber.*, 1897–1903; E. Bamberger, ib., 1903, 36, p. 2028; Th. Zincke, ib., 1895, 28, p. 3121); by the action of sulphuric acid on para-substituted phenylhydroxylamines (E. Bamberger), and by the action of the Grignard reagent on quinones (Bamberger). They are crystalline solids which are readily converted into para-alkylated phenols by reducing agents. They possess a weak acid and also an alcoholic character.

QUINOXALINES (Benzopyrazines), in organic chemistry, heterocyclic compounds containing a ring complex made up of a benzene ring and a pyrazine ring (formula I.); they are isomeric with the cinnolenes, phthalazines and quinazolines. They are formed by the condensing ortho-diamines with 1·2 diketones (Hinsberg, *Ann.*, 1887, 237, p. 327), the parent substance of the group (quinoxaline) resulting when glyoxal is so condensed, whilst substitution derivatives arise when α-ketonic acids, α-chlorketones, α-aldehyde alcohols and α-ketone alcohols are used in place of diketones.

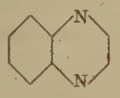


$$\mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{NH_2}\\ \\ \mathrm{NH_2}\end{array}\right. + \begin{array}{c}\mathrm{OC\cdot R}\\ |\\ \mathrm{OC\cdot R'}\end{array} = \mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{N:C\cdot R}\\ \qquad |\\ \mathrm{N:C\cdot R'}\end{array}\right. + 2\mathrm{H_2O}.$$

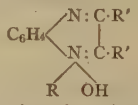
In a similar manner, diamino derivatives are formed when cyanogen is condensed with ortho-diamines, and these amino compounds readily pass into the corresponding dioxy derivatives when acted upon with dilute hydrochloric acid.

The quinoxalines are weak bases, and are stable towards oxidizing agents but are readily reduced to hydro derivatives. The tetrahydroquinoxalines are formed by condensing ortho-diamines with ortho-dihydroxy benzenes, and the keto-dihydro derivatives arise similarly by condensing mono-alkyl diamines with ketonic acids (Kehrmann and Messinger, *Ber.*, 1892, 25, pp. 1628 et seq.).

The azonium bases (formula II.) of this series are produced when the dihydroquinoxalines (obtained by similar condensations from the mono-alkyl-ortho-diamines) are oxidized with ferric chloride.



I. Quinoxaline.



II. Azonium bases.

QUINSY, a common term for acute suppurative tonsilitis (*q.v.*). The English word (formerly "squinzey") is a corruption of Fr. *esquinancie*, from Gr. *κυνάγχη* (*κύων*, dog, and *ἄγχειν*, to choke), and is derived from the suffocating tendency of the ailment.

QUINTAIN (O. Fr. *quintaine*, from Lat. *quintana*, a street between the fifth and sixth maniples of a camp, where warlike exercises took place), an instrument used in the age of chivalry in practising for the tournament. Originally perhaps the mere trunk of a tree upon which the knight practised his sword-strokes, as may be seen in an ancient illustration reproduced in Strutt's *Sports and Pastimes*, the quintain developed into various forms of posts at which the soldier tilted with his lance, not only on horseback but on foot and even in boats. An early form consisted of the wooden figure of a Saracen armed with shield and sword; the object being to strike the figure on the forehead directly between the eyes. This, according to Strutt, was called by the Italians "running at the armed man" or "at the Saracen." The "pel," or post-quintain, was generally about 6 ft. high.

As late as the 18th century running at the quintain survived in English rural districts. In one variation of the pastime the quintain was a tun filled with water, which, if the blow was a poor one, was emptied over the striker. A later form was a post with a cross-piece, from which was suspended a ring, which the horseman endeavoured to pierce with his lance while at full speed. This sport, called "tilting at the ring," was very popular in England and on the continent of Europe in the 17th century, and is still practised as a feature of military and equestrian sport.

QUINTANA, MANUEL JOSÉ (1772–1857), Spanish poet and man of letters, was born at Madrid on the 11th of April 1772, and after completing his studies at Salamanca was called to the bar. In 1801 he produced a tragedy, *El Duque de Viseo*, founded on M. G. Lewis's *Castle Spectre*; his *Pelayo* (1805), written on a patriotic theme, was more successful. The first volume of his *Vidas de Españoles célebres* (1807–33), containing lives of Spanish patriots, stirred the public imagination and secured Quintana the post of secretary to the Cortes during the French invasion. His proclamations and odes fanned the national enthusiasm into flame. But he was ill rewarded for his services, for on the return of Ferdinand VII. he was imprisoned at Pamplona from 1814 to 1820. He was finally given a small post in the civil service, became tutor to Queen Isabella, and was nominated senator. Though publicly "crowned" as the representative poet of Spain (1855), he seems to have lived in poverty. He died on the 11th of March 1857. His poems, thirty-four in number, are inspired by philanthropy and patriotism; the style is occasionally gallicized, and the thought is not profound, but his nobility of sentiment and resounding rhetoric attract every generation of Spaniards.

See an excellent monograph by E. Piñeyro, *Manuel José Quintana, ensayo crítico y biográfico* (Paris, 1892).

QUINTESSENCE, in ancient and scholastic philosophy, the name given to the fifth immaterial element, over and above the four material elements, air, water, earth and fire, which Aristotle assumed to be permeating the whole world, and called *οὐσία*: in medieval philosophy this was called *quinta essentia*, the fifth essence, and by many was considered material and therefore capable of extraction. The ancient Indian philosophers also contain the same idea of a fifth element; thus there were five Sanskrit elements (*bhutas*), earth, wind, fire, water and aether. In the history of chemistry the name was applied, by analogy, to the most concentrated extract of a substance.

QUINTILIAN [MARCUS FABIUS QUINTILIANUS] (*c.* A.D. 35–95), Roman rhetorician, was born at Calagurris in Spain. Concerning his family and his life but few facts remain. His father taught rhetoric, with no great success, at Rome, and Quintilian must have come there at an early age to reside, and must have there grown up to manhood. The years from 61 to 68 he spent in Spain, probably attached in some capacity to the retinue of the future emperor Galba, with whom he returned to the capital. For at least twenty years after the accession of Galba he was at the head of the foremost school of oratory in Rome, and may fairly be called the Isocrates of his time. He also gained some, but not a great, repute as a pleader in the courts. His greatest speech appears to have been a defence of the queen Berenice, on what charge is not known. He appears to have been wealthy for a professional man. Vespasian created for him a professorial chair of rhetoric, liberally endowed with public money, and from this time he was unquestionably, as Martial calls him, "the supreme controller of the restless youth." About the year 88 Quintilian retired from teaching and from pleading, to compose his great work on the training of the orator (*Institutio Oratoria*). After two years' retirement he was entrusted by Domitian with the education of two grand-nephews, whom he destined as successors to his throne. Quintilian gained the titular rank of consul, and probably died not long before the accession of Nerva (A.D. 96). A wife and two children died early.

Such is the scanty record that remains of Quintilian's uneventful life. But it is possible to determine with some accuracy his relation to the literature and culture of his time, which he powerfully influenced. His career brings home to us the vast change which in a few generations had passed over Roman taste, feeling and society. In the days of Cicero rhetorical teaching had been entirely in the hands of the Greeks. The Greek language, too, was in the main the vehicle of instruction in rhetoric. The first attempt to open a Latin rhetorical school, in 94 B.C., was crushed by authority, and not until the time of Augustus was there any professor of the art who had been born to the full privileges of a Roman citizen. The appointment of Quintilian as professor by the chief of the state marks the last stage in the emancipation of rhetorical teaching from the old Roman prejudices.

During the hundred years or more which elapsed between the death of Cicero and the birth of Quintilian education all over the Roman Empire had spread enormously, and the education of the time found its end and climax in rhetoric. Mental culture was for the most part acquired, not for its own sake, but as a discipline to develop skill in speaking, the paramount qualification for a public career. Rome, Italy and the provinces alike resounded with rhetorical exercitations, which were promoted on all sides by professorships, first of Greek, later also of Latin rhetoric, endowed from municipal funds. The mock contests of the future orators roused a vast amount of popular interest. In Gaul, Spain and Africa these pursuits were carried on with even greater energy than at Rome. The seeds of the existing culture, such as it was, bore richer fruit on the fresh soil of the western provinces than in the exhausted lands of Italy and the East. While Quintilian lived, men born in Spain dominated the Latin schools and the Latin literature, and he died just too soon to see the first provincial, also of Spanish origin, ascend the imperial throne.

As an orator, a teacher and an author, Quintilian set himself to stem the current of popular taste which found its expression in what we are wont to call silver Latin. In his youth the influence of the younger Seneca was dominant. But the chief teacher of Quintilian was a man of another type, one whom he ventures to class with the old orators of Rome. This was Domitius Afer, a rhetorician of Nîmes, who rose to the consulship. Quintilian, however, owed more to the dead than to the living. His great model was Cicero, of whom he speaks at all times with unbounded eulogy, and whose faults he could scarce bring himself to mention; nor could he well tolerate to hear them mentioned by others. The reaction against the Ciceronian oratory which had begun in Cicero's own lifetime had acquired overwhelming strength after his death. Quintilian failed to check it, as another teacher of rhetoric, equally an admirer of Cicero, had failed—the historian Livy. Seneca the elder, a clear-sighted man who could see in Cicero much to praise, and was not blind to the faults of his own age, condemned the old style as lacking in power, while Tacitus, in his *Dialogue on Orators*, includes Cicero among the men of rude and "unkempt" antiquity. The great movement for the poetization of Latin prose which was begun by Sallust ran its course till it culminated in the monstrous style of Fronto. In the courts judges, juries and audiences alike demanded what was startling, quaint or epigrammatic, and the speakers practised a thousand tricks to satisfy the demand. Oratory became above all things an art whose last thought was to conceal itself. It is not surprising that Quintilian's forensic efforts won for him no lasting reputation among his countrymen.

The *Institutio Oratoria* is one long protest against the tastes of the age. Starting with the maxim of Cato the Censor that the orator is "the good man who is skilled in speaking," Quintilian takes his future orator at birth and shows how this goodness of character and skill in speaking may be best produced. No detail of training in infancy, boyhood or youth is too petty for his attention. The parts of the work which relate to general education are of great interest and importance. Quintilian postulates the widest culture; there is no form of knowledge from which something may not be extracted for his purpose; and he is fully alive to the importance of method in education. He ridicules the fashion of the day, which hurried over preliminary cultivation, and allowed men to grow grey while declaiming in the schools, where nature and reality were forgotten. Yet he develops all the technicalities of rhetoric with a fulness to which we find no parallel in ancient literature. Even in this portion of the work the illustrations are so apposite and the style so dignified and yet sweet that the modern reader, whose initial interest in rhetoric is of necessity faint, is carried along with much less fatigue than is necessary to master most parts of the rhetorical writings of Aristotle and Cicero. Quintilian's literary sympathies are extraordinarily wide. When obliged to condemn, as in the case of Seneca, he bestows generous and even extravagant praise on such merit as he can find. He can cordially admire even Sallust, the true fountain-head of the style which he combats, while he will not suffer Lucilius to lie under the aspersions of Horace. The passages in which Quintilian reviews the literature of Greece and Rome are justly celebrated. The judgments which he passes may be in many instances traditional, but, looking to all the circumstances of the time, it seems remarkable that there should then have lived at Rome a single man who could make them his own and give them expression. The form in which these judgments are rendered is admirable. The gentle justness of the sentiments is accompanied by a curious felicity of phrase. Who can forget "the immortal swiftness of Sallust," or "the milky richness of Livy," or how "Horace soars now and then, and is full of sweetness and grace, and in his varied forms and phrases is most fortunately bold"? Ancient literary criticism perhaps touched its highest point in the hands of Quintilian.

To comprehensive sympathy and clear intellectual vision Quintilian added refined tenderness and freedom from self-assertion. Taking him all in all, we may say that his personality must have been the most attractive of his time—more winning and at the same time more lofty than that of the younger Pliny, his pupil, into whom no small portion of the master's spirit, and even some tincture of the master's literary taste, was instilled. It does not surprise us to hear that Quintilian attributed any success he won as a pleader to his command of pathos, a quality in which his great guide Cicero excelled. In spite of some extravagances of phrase, Quintilian's lament (in his sixth book) for his girl-wife and his boy of great promise is the most pathetic of all the lamentations for bereavement in which Latin literature is so rich. In his precepts about early education Quintilian continually shows his shrinking from cruelty and oppression.

Quintilian for the most part avoids passing opinions on the problems of philosophy, religion and politics. The professed philosopher he disliked almost as much as did Isocrates. He deemed that ethics formed the only valuable part of philosophy and that ethical teaching ought to be in the hands of the rhetoricians. In the divine government of the universe he seems to have had a more than ornamental faith, though he doubted the immortality of the soul. As to politics Quintilian, like others of his time, felt free to eulogize the great anti-Caesarean leaders of the dying republic, but only because the assumption was universal that the system they had championed was gone for ever. But Quintilian did not trouble himself, as Statius did, to fling stones at the emperors Caligula and Nero, who had missed their deification. He makes no remark, laudatory or otherwise, on the government of any emperor before Domitian. No character figured more largely in the rhetorical controversies of the schools than the ideal despot, but no word ever betrayed a consciousness that the actual occupant of the Palatine might exemplify the theme. Quintilian has often been reproached with his flattery of Domitian. No doubt it was fulsome. But it is confined to two or three passages, not thrust continually upon the reader, as by Statius and Martial. To refuse the charge of Domitian's expected successors would have been perilous, and equally perilous would it have been to omit from the *Institutio Oratoria* all mention of the emperor. And there was at the time only one dialect in which a man of letters could speak who set any value on his personal safety. There was a choice between extinction and the writing of a few sentences in the loathsome court language, which might serve as an official test of loyalty.

The Latin of Quintilian is not always free from the faults of style which he condemns in others. It also exhibits many of the usages and constructions which are characteristic of the silver Latin. But no writer of the decadence departs less widely from the best models of the late republican period. The language is on the whole clear and simple, and varied without resort to rhetorical devices and poetical conceits. Besides the *Institutio Oratoria*, there have come down to us under Quintilian's name 19 longer (ed. Lehnert, 1905) and 145 shorter (ed. Ritter, 1884) *Declamationes*, or school exercitations on themes like those in the *Controversiae* of Seneca the elder. The longer pieces are certainly not Quintilian's. The shorter were probably published, if not by himself, at least from notes taken at his lessons. It is strange that they could ever have been supposed to belong to a later century; the style proclaims them to be of Quintilian's school and time. The works of Quintilian have often been edited. Of the editions of the whole works the chief is that by Burmann (1720); of the *Institutio Oratoria* that by Spalding, completed by Zumpt and Bonnell (1798–1834, 5th ed., Meister, 1882, the last volume containing a lexicon), and that by Halm (1868), and another by Meister (1886); Eng. trans., J. S. Watson (1856). The tenth book of the *Institutio Oratoria* has often been separately edited, as by Krueger (ed. 3, 1888), Peterson (1891), Bonnell, Mayor and others. (J. S. R.)

QUINTUS SMYRNAEUS, Greek epic poet, probably flourished in the latter part of the 4th century A.D. He is sometimes called Quintus Calaber, because the only MS. of his poem was discovered at Otranto in Calabria by Cardinal Bessarion in 1450. According to his own account (xii. 310), he tried his hand at poetry in his early youth, while tending sheep at Smyrna. His epic in fourteen books, known as Τὰ μεθ’ Ὅμηρον or *Posthomerica*, takes up the tale of Troy at the point where Homer's *Iliad* breaks off (the death of Hector), and carries it down to the capture of the city by the Greeks. The first five books, which cover the same ground as the *Aethiopis* of Arctinus of Miletus, describe the doughty deeds and deaths of Penthesileia the Amazon, of Memnon, son of the Morning, and of Achilles; the funeral games in honour of Achilles, the contest for the arms of Achilles and the death of Ajax. The remaining books relate the exploits of Neoptolemus, Eurypylus and Deïphobus, the deaths of Paris and Oenone, the capture of Troy by means of the wooden horse, the sacrifice of Polyxena at the grave of Achilles, the departure of the Greeks, and their dispersal by the storm. The poet has no originality; in conception and style his work is closely modelled on Homer. His materials are borrowed from the cyclic poems from which Virgil (with whose works he was probably acquainted) also drew, in particular the *Aethiopis* of Arctinus and the *Little Iliad* of Lesches.

Editio princeps by Aldus Manutius (1504); Köchly (ed. major with elaborate prolegomena, 1850; ed. minor, 1853); Z. Zimmermann (author of other valuable articles on the poet), (1891); see also Kehmptzov, *De Quinti Smyrnaei Fontibus ac Mythopoiia* (1889); C. A. Sainte-Beuve, *Étude sur . . . Quinte de Smyrne* (1857); F. A. Paley, *Quintus Smyrnaeus and the "Homer" of the tragic Poets* (1879); G. W. Paschal, *A Study of Quintus Smyrnaeus* (Chicago, 1904).

QUIPUS (*Khipus, Qippos*), the ancient Peruvian name for a method of recording which was in use at the time of the arrival of the Spaniards. It consisted of a cord two feet in length to which were attached a series of knotted-strings (Peruv. *quipu*, a knot) hanging like a fringe. These strings were coloured, and the knots, their number and size, their distance apart, the colours, the order in which the coloured threads hung, all had a signification, *e.g.* white was silver, yellow gold; white meant peace, red war, &c. In this manner a rough register of important events, of births, deaths and marriages, and other statistics was kept, the *quipus* even constituting a rude history of the people. They were also much used for conveying orders to military chiefs in the provinces.

The idea of knotted strings to aid memory is so simple that it is common to many peoples. A Pelew islander, visiting England, knotted strings as a diary of all that struck him during his travels. In the Hawaiian Islands native carriers have knotted-string records of their rounds. The Peruvian quipus is simply the perfecting of a system of mnemonics common to the Red Indians. See also WAMPUM.

QUIRE (in earlier forms *quaer*, *quair* and *quere*, from the O. Fr. *quaier*, modern *cahier*, a copy-book, manuscript book; Lat. *quaterni*, set of four, from *quattuor*), originally the term for four sheets of paper or parchment folded so as to make eight leaves, the ordinary unit in manuscripts and early printed books; the term is now chiefly applied to a twentieth part of a ream of writing paper, twenty-four sheets. In bookbinding and publishing the expression "in quires" is used of the sheets of a book when not folded or bound. "Quire" was formerly used of a small book contained in a single quire of paper, and so is frequently found in the title of short poems, treatises, &c. A familiar example is the *Kingis Quair* of King James I. of Scotland. "Choir," a body of singers or the part of a church where the singers sit, was formerly spelled "quire," following the pronunciation of the word (See CHOIR).

QUIRINUS, the Sabine name of the god Mars, probably an adjective meaning "wielder of the spear" (Quiris, cf. Janus Quirinus). Other suggested etymologies are: (1) from the Sabine town Cures; (2) from *curia*, *i.e.* he was the god of the Roman state as represented by the thirty curies. A. B. Cook (*Class. Rev.* xviii., p. 368) explains Quirinus as the oak-god (*quercus*), and Quirites as the men of the oaken spear. From early times he was worshipped at Rome on the Quirinal hill, whither, according to tradition, a body of Sabines under Titus Tatius had migrated from Cures and taken up their abode. In the religious system of Numa, Quirinus and Mars were both recognized as divine beings, distinct but of similar attributes and functions; thus, like Mars, Quirinus was at once a god of war and a nature god, the protector of fields and flocks. Subsequently, at the end of the republic, Quirinus became identified with the deified Romulus, son of Mars. One of the greater flamens was attached to the service of Quirinus, a second college of Salii founded in his honour, and a festival "Quirinalia" celebrated on the 17th of February, the day of the supposed translation of Romulus to heaven. Old Roman formulæ of prayer mention a Hora Quirini, his female cult associate, afterwards identified with Hersilia, the wife of Romulus.

The name was also borne by the following saints: (1) a Roman tribune who suffered martyrdom under Hadrian; (2) a bishop of Siscia in Pannonia; (3) the patron of the Tegernsee in Bavaria, beheaded in Rome in 269 and invoked by those suffering from gout. The petroleum (Quirinus-oil) found in the neighbourhood of the lake takes its name from him.

QUIRITES (literally "spearmen"; see QUIRINUS), the earliest name of the burgesses of Rome. Combined in the phrase "populus Romanus Quirites (or Quiritium)" it denoted the individual citizen as contrasted with the community. Hence *ius Quiritium* in Roman law is full Roman citizenship. Subsequently the term lost the military associations due to the original conception of the people as a body of warriors, and was applied (sometimes in a deprecatory sense, cf. Tac. *Ann.* i. 42) to the Romans in domestic affairs, *Romani* being reserved for foreign affairs. (For the distinction between Quiritary and praetorian ownership, see ROMAN LAW.)

QUITO, the capital of the republic of Ecuador, the see of an archbishopric covering the same territory, and the capital of the province of Pichincha, in lat. 0° 14′ S., long. 79° 45′ W., about 114 m. from the Pacific coast and 165 m. in a direct line N. E. of Guayaquil, with which it is connected by a railway completed in 1908. Pop. (1906) 50,840, of whom 1365 were foreigners, mostly Colombians. It occupies a small basin of the great central plateau formed by the volcano Pichincha on the W., the Puengasi ridge on the E., and ridges N. and S. formed by spurs from the eastern side of Pichincha. The ground upon which the city is built is uneven and is traversed from W. to E. by two deep ravines (*quebradas*), one of which is arched over in great part to preserve the alignment of the streets, the drainage of which escapes through a cleft in the ridge northward to the plain of Tumbaco. The city is in great part laid out in rectangular squares, the streets running nearly with the cardinal points of the compass. The houses of Quito are chiefly of the old Spanish or Moorish style. The building material in general use is sun-dried bricks, which in the better houses is covered with plaster or stucco. The public buildings are of the heavy Spanish type. Facing the principal square (Plaza Mayor), and occupying the whole S. side, is the cathedral; on the W. side is the government palace; on the N. the archbishop's palace; and on the E. the municipal hall. The elevation of this plaza is 9343 ft. above sea-level. The finest building in the city is the Jesuits' church, whose façade is covered with elaborate carving. Among public institutions are the university, which occupies part of the old Jesuit college, an astronomical observatory, and eleven large monastic institutions, six of which are for nuns. One of the convents, that of San Francisco, covers a whole block, and ranks among the largest institutions of its kind in the world. A part of it is in ruins, and another part has been for some time used as military barracks by the government. The university has faculties of theology, law and medicine, and has 200 to 250 students, but it is antiquated in character and poorly supported. The eminent botanist and chemist, Dr William Jameson (1796–1872), was a member of its faculty for many years. The city has no large commercial houses, and only an insignificant export trade, chiefly hides and forest products from the wooded mountain slopes near by. Religious paintings of a medieval type are produced in large numbers and exported. The native manufactures include tanned leather, saddles, shoes, ponchos, woollen and cotton cloth, fibre sandals and sacking, blankets, coarse matting and coarse woollen carpets. Superior hand-made carpets are also made, and Quito artisans show much skill in wood carvings and in gold and silver works; the women excel in fine needlework and lace-making.

Quito derives its name from the Quitus, who inhabited the locality a long time before the Spanish conquest. In 1533 Sebastian Benalcazar took peaceable possession of the native town (which had been successivly a capital of the Seyris and Incas), and in 1541 it was elevated to the rank of a Spanish city. Its full title was San Francisco del Quito, and it was capital of the province or presidency of Quito down to the end of Spanish colonial rule. It has suffered repeatedly from earthquakes, the greatest damage occurring from those of 1797 and 1859.

QUIVER, a case for holding arrows. The word is taken from O. Fr., where it appears in such forms as *quivre*, *cuevre* or *coivre*. This is apparently cognate with the O. E. *cocer*, Ger. *Köcher*, quiver or case. The ultimate origin is obscure, and the medieval Latin and Greek words *cucurum* and *κούκουρον* are stated to be from the German. The word meaning "to shake" or "tremble" must be distinguished; this is connected with "quaver," "quake"; the *New English Dictionary* takes these words to be onomatopoeic in origin.

QUOINS (an old variant spelling of "coin," from Lat. *cuneus*, a wedge), in architecture, the term for the external angle of a building, generally applied to the ashlar masonry employed to stop the rubble masonry or brickwork of the wall at the angles, as also of buttresses, doorways or projecting features. In Saxon work the quoins were built with large stones laid horizontally and vertically in alternate courses, technically known as "long and short" work. Sometimes, to give greater importance to the angles of towers, the quoin stones are rusticated, and this treatment is found extensively employed in ancient German towns. At Eastbury Manor House in Essex, built in brick, the quoins at the angles of the walls, doorway and windows were plastered in imitation of stonework.

QUOITS (O. Fr. *coiter*, *quoiter*, to incite), a pastime resembling the ancient discus-throwing which formed one of the five games of the Greek pentathlon (see DISCUS), the two main differences between the ancient and modern sports being that the quoit is ring-shaped (one surface being rounded, the other—the back—being flat) and is lighter than the discus, and its throwing is a test rather of accuracy than strength. Few traces of a game resembling quoits can be found on the continent of Europe, and its origin may be sought for on the borderland of Scotland and England. There are references to it in the Midlands dating from the beginning of the 15th century, and it was one of the games prohibited in the reigns of Edward III. and Richard II. in favour of archery. Ascham, in his *Toxophilus* (1545), says that "quoiting be too vile for scholars," and in old times it was chiefly played by the working classes, who often used horseshoes for want of quoits, a custom still prevailing in country districts. According to the modern rules, slightly modified from the code drawn up in 1869, two iron or steel pins 18 yds. apart are driven into the ground, leaving 1 in. exposed. Each is situated in the centre of an "end," a circle of stiff clay 3 ft.

in diameter. The quoits, made of iron, may be of any weight, but are usually about 9 lb each. They must not exceed 8½ in. in diameter, or be less than 3½ in. in the bore, or more than 2¼ in. in the web. When delivering his quoit a player must stand within 4 ft. 6 in. of the centre of the end and at its side. Matches are played between teams or individuals, the object of the game being to throw the quoit as near to the pin as possible, a "ringer," *i.e.* a quoit actually surrounding the pin, counting two, and a quoit nearer to the pin than any of the adversary's, counting one. A match may be for any number of points, the team or player scoring that number first being the winner. In championship matches all quoits farther than 18 in. from the end, are foul and removed. All measurements are made from the middle of the pin to the nearest edge of the quoit. If one or more quoits are lapped, the one most accessible is first measured and withdrawn. All quoits on their backs are a foul. The general principle of curling, to drive the opponents' quoits away from the pin and place one's own near or on it, is followed.

Scotland, Lancashire and the Midlands are the principal centres of quoiting in Great Britain. In Scotland the game is patronized by the Curling Clubs, and this is also the case in the United States and Canada. Billy Hodson was champion of Great Britain in the middle of the 19th century, and his trip to America in the early 'sixties is of historical interest, as it resulted in two contests for the championship of the world with James McLaren of Newark, N. J., a native of Scotland, who was champion of America. One hard-fought match was won by each, the deciding one remaining unplayed. The championship of America is rewarded by the "Bell Medal," presented by the Grand National Curling Club of America.

QUORUM (Lat. for "of whom"), in its general sense, a term denoting the number of members of any body of persons whose presence is requisite in order that business may be validly transacted by the body or its acts be legal. The term is derived from the wording of the commission appointing justices of the peace which appoints them all, jointly and severally to keep the peace in the county named. It also runs—"We have also assigned you, and every two or more of you (of whom [*quorum*], any one of you the aforesaid A, B, C, D, &c., we will shall be one) our justices to inquire the truth more fully," whence the justices so-named were usually called justices of the *quorum*. The term was afterwards applied to all justices, and subsequently by transference, to the number of members of a body necessary for the transaction of its business. No general rule can be laid down as to the number of members of which a quorum should consist; its size is usually prescribed by definite enactment or provision; it is entirely a matter for self-constituted bodies as to what their quorum shall be, and it usually depends on the size of the body. In bodies which owe their existence to an act of the legislature, the necessary quorum is usually fixed by statute. In England, in the House of Lords, three form a quorum, though on a division there must be thirty members present. In the House of Commons, forty members, including the Speaker, form a quorum. The quorum of a standing committee of the House of Lords is seven, and of the House of Commons, twenty.

QUOTA, a proportional share or part that is due from or to any person or body of persons, in Med. Lat. *quota, sc. pars*, from *quotus*, an adjective formed from *quot*, how many. The word first appears in connexion with the levying of men, money or supplies for military and naval purposes from districts, towns or seaports, and thus is equivalent to "contingent" (Lat. *contingere*, to happen to, fall to one's lot or share, *cum*, with, and *tangere*, to touch), used since the 18th century specifically of a contribution of men or ships according to a scale fixed between the contracting parties.

QUOTATION, a passage repeated from the writings or speech of another. The verb "to quote" comes from Med. Lat. *quotare* (from *quot*, how many), to refer to by numbers, *i.e.* of page, chapter, &c., also to separate into chapters, verses, &c. The term is also specifically applied to the statement of the current prices of goods and commodities, and of stocks and shares (see STOCK EXCHANGE).

Useful lists of familiar quotations may be found in the following:—H. T. Riley, *Dictionary of Latin and Greek Quotations*, ed. Bohn; P. H. Dalbiac, *Dictionary of English Quotations* (1896); in the same series, T. B. Harbottle, *Classical Quotations* (1897), and T. B. Harbottle and P. H. Dalbiac, *French and Italian Quotations* (1901); Robinson Smith, *English Quotations* (n.d.); H. P. Jones, *A New Dictionary of Foreign Phrases and Classical Quotations*; J. K. Hoyt and A. L. Ward, *The Cyclopaedia of Practical Quotations, English and Latin* (1892); Cassell's *Book of Quotations* (1901); J. Bartlett, *Familiar Quotations...in Ancient and Modern Literature* (1902); in *Notes and Queries*, the indices to the various series contain, grouped under the heading "Quotation," a large number of out-of-the-way quotations.

QUO WARRANTO, in English law, the name given to an ancient prerogative writ calling upon any person usurping any office, franchise, liberty or privilege belonging to the Crown, to show "by what warrant" he maintained his claim, the onus being on the defendant. It lay also for non-user or misuser of an office, &c. If the Crown succeeded, judgment of forfeiture or ousterlemain was given against the defendant. The procedure was regulated by statute as early as 1278 (the statute of *Quo Warranto*, 6 Edw. I. c. 1), passed in consequence of the commission of *quo warranto* issued by Edward I. A distinction was drawn in the report between *libertates*, jurisdiction exercised by the lord as lord, and *regalia*, jurisdiction exercised by Crown grant. After a time the cumbrousness and inconvenience of the ancient practice led to its being superseded by the modern form of an information in the nature of a *quo warranto*, exhibited in the King's Bench Division either by the attorney-general *ex officio* or by the king's coroner and attorney at the instance of a private person called the relator. The information will not be issued except by leave of the court on proper cause being shown. It does not lie where there has been no user or where the office has determined. Nor does it lie for the usurpation of every kind of office. But it lies where the office is of a public nature and created by statute, even though it is not an encroachment upon the prerogative of the Crown. Where the usurpation is of a municipal office the information is regulated by 9 Anne c. 25 (1711), under which the defendant may be fined and judgment of ouster given against him, and costs may be granted for or against the relator. Such an information must, in the case of boroughs within the Municipal Corporations Act 1882, be brought within twelve months after disqualification (s. 225); in the case of other boroughs, within six years after the defendant first took upon himself the office (32 Geo. III. c. 58, s. 2). The information in the nature of a *quo warranto*, though nominally a criminal, has long been really a civil proceeding, and has recently been expressly declared to be so (Supreme Court of Judicature Act 1884, s. 15). In cases not falling within 9 Anne c. 25, judgment of ouster is not usually given. The most famous historical instance of *quo warranto* was the action taken against the corporation of London by Charles II. in 1684. The King's Bench adjudged the charter and franchises of the city of London to be forfeited to the Crown (*State Trials*, vol. viii. 1039). This judgment was reversed by 2 Will. & Mary, sess. 1, c. 8; and it was further enacted, in limitation of the prerogative, that the franchises of the city should never be seized or forejudged on pretence of any forfeiture or misdemeanour. In Scotland the analogous procedure is by action of declarator.

In the United States the right to a public office is tried by *quo warranto* or similar procedure, regulated by the state laws. Proceedings by *quo warranto* lie in a United States court for the removal of persons holding office contrary to art. xiv. s. 3 of the Amendments to the Constitution (act of the 31st of May 1870, c. 14).

R THE twentieth letter in the Phoenician alphabet, the nineteenth in the numerical Greek, the seventeenth in the ordinary Greek and the Latin and (owing to the addition of J) the eighteenth in the English. Its earliest form in the Phoenician alphabet when written from right to left was **A**, thus resembling the symbol for D with one side of the triangle prolonged. In Aramaic and other Semitic scripts which were modified by opening the heads of the letters, the symbol in time became very much changed. Greek, however, maintained the original form with slight variations from place to place. Not infrequently in the Greek alphabets of Asia Minor and occasionally also in the West, R was written as D, thus introducing a confusion with D (*q.v.*). Elsewhere a short tail was added, as occasionally in the island of Melos, in Attica and in western Greece, but nowhere does this seem to have been universal. The earliest Latin forms are exactly like the Greek. Thus in the very early inscriptions found in the Forum in 1899 R appears as ꟼ (from right to left), P and D (from left to right). Later the forms *R* and R come in; sometimes the back is not quite connected in the middle to the upright, when the form *R* is produced. The name of the Semitic symbol is Rēsh; why it was called by the Greeks Rhō (ῥῶ) is not clear. The *h* which accompanies *r* in the transliteration of Greek ρ, indicates that it was breathed, not voiced, in pronunciation. No consonant varies more in pronunciation than *r*. According to Brockelmann, the original Semitic *r* was probably a trilled *r*, *i.e.* an *r* produced by allowing the tip of the tongue to vibrate behind the teeth while the upper surface of the tongue is pressed against the sockets of the teeth. The ordinary English *r* is also produced against the sockets of the teeth, but without trilling; another *r*, also untrilled, which is found in various parts of the south of England, is produced by turning up the tip of the tongue behind the sockets of the teeth till the tongue acquires something of a spoon shape. This, which is also common in the languages of modern India, is called the cerebral or cacuminal *r*, the former term, which has no meaning in this connexion, being only a bad translation of a Sanscrit term. The common German *r* is produced by vibrations of the uvula at the end of the soft palate, and hence is called the uvular *r*. There are also many other varieties of this sound. In many languages *r* is able to form syllables by itself, in the same way that *l*, *m*, *n* may do, as in the English *brittle* (*britl*), *written* (*ritn*). In Europe *r* with this value is most conspicuous in Slavonic languages like Bohemian (Czech) and Croatian; in English *r* in this function is replaced by a genuine vowel in words like *mother* (*moðð*). This syllabic *r* is first recorded for Sanscrit, where it is common, but is replaced in the languages descended from Sanscrit by *r* and a vowel or by a vowel only, according to the position in which it occurs. Most philologists are of opinion that syllabic *r* existed also in the mother-tongue of the Indo-European languages. (P. Gi.)

RAABE, HEDWIG (1844–1905), German actress, was born in Magdeburg on the 3rd of December 1844, and at the age of fourteen was playing in the company of the Thalia theatre, Hamburg. In 1864 she joined the German Court theatre at St Petersburg, touring about Germany in the summer with such success that in 1868 she relinquished her Russian engagement to devote herself to starring. In 1871 she married Albert Niemann (b. 1831), the operatic tenor. She excelled in classical rôles like Marianne in Goethe's *Geschwister* and Franziska in *Minna von Barnhelm*. It was she who first played Ibsen in Berlin. She died on the 21st of April 1905.

RAABE, WILHELM (1831–1910), German novelist, whose early works were published under the pseudonym of Jakob Corvinus, was born at Eschershausen in the duchy of Brunswick on the 8th of September 1831. He served apprenticeship at a bookseller's in Magdeburg for four years (1849–1854); but tiring of the routine of business, studied philosophy at Berlin (1855–1857). While a student at that university he published his first work, *Die Chronik der Sperlingsgasse* (1857), which at once attained to great popularity. Raabe next returned to Wolfenbüttel, and then lived (1862–1870) at Stuttgart, where he devoted himself entirely to authorship and wrote a number of novels and short stories; notably *Unseres Herrgotts Kanzlei* (1862); *Der Hungerpastor* (1864); *Abu Telfan* (1867) and *Der Schüdderump* (1870). In 1870 Raabe removed to Brunswick and published the narratives *Horacker* (1876)—perhaps his masterpiece; *Das Odfeld* (1889); *Kloster Lugau* (1894) and *Hastenbeck* (1899), and numerous other stories. The distinguishing characteristic of Raabe's work is a genial humour which reminds us occasionally of Dickens; but this humour is often combined with a pessimism that is foreign to the English novelist.

Raabe's *Gesammelte Erzählungen* appeared in 4 vols. (1896–1900); there is no uniform edition of his larger novels. See P. Gerber, *Wilhelm Raabe* (1897); A. Otto, *Wilhelm Raabe* (1899); A. Bartels, *Wilhelm Raabe: Vortrag* (1901).

RABA BEN JOSEPH BEN ḤAMA (*c.* 280–352), Babylonian rabbi or amora. He is closely associated in his studies with Abaye. The latter was head of the Academy at Pumneditha. Raba founded a new school at Maḥuza, which eventually became so long as Raba lived the only academy in Babylonia (Persia). The development of Talmudic Law (or *Halakhah*) was much indebted to this rabbi, whose influence in all branches of Jewish learning was supreme. His friendship with the King Shapur II. enabled Raba to secure a relaxation of the oppressive laws enacted against the Jews of Persia.

See Graetz, *History of the Jews*; (Eng. trans., vol. ii. ch. xxi.); Bacher, *Agada der Babyl. Amoräer*, p. 108, &c. and 114–133. (I. A.)

RABAH ZOBEIR (d. 1900), the conqueror of Bornu (an ancient sultanate on the western shores of Lake Chad, included since 1890 in British Nigeria), was a half-Arab, half-negro chieftain. He was originally a slave or follower of Zobeir Pasha (*q.v.*), and is said to have formed one of the party which served as escort to Miss Tinne (*q.v.*) in her journeys in the Bahr-el-Ghazal in 1862–64. In 1879, Zobeir being in Egypt, his son Suleiman and Rabah were in command of Zobeir's forces in the Bahr-el-Ghazal. They persisted in slave-raiding, and denied the khedive's authority, and Colonel C. G. Gordon sent against them Romolo Gessi Pasha. Gessi captured Suleiman and routed Rabah, who in July 1879 fled westward with some seven hundred Bazingirs (black slave soldiers). He made himself master of Kreich and Dar Banda, countries to the south and south-west of Wadai. In 1884–85 he was invited by Mahommed Ahmed (the mahdi) to join him at Omdurman, but did not do so. According to one account he learnt that the mahdi intended, had he gone to Omdurman, to put him to death. In 1891 Paul Crampel, a French explorer, was killed in Dar Banda by a chieftain tributary to Rabah, and Crampel's stores, including 300 rifles, were sent to Rabah. With this reinforcement of arms he marched towards Wadai, but being stoutly opposed by the people of that country he turned west and established himself in Bagirmi, a state south-east of Lake Chad. In 1893 Rabah overthrew the sultan of Bornu. In his administration of the country he showed considerable ability and a sense of public needs. To the British, represented by the Royal Niger Company, Rabah gave comparatively little trouble. During 1894–95 he continually (but unavailingly) asked the company's representatives at Yola and Ibi to supply him with gunpowder. Rabah then tried threats, and in 1896 all communication between him and the company ceased. Early in 1897 he began an advance in the direction of Kano, the most important city in the Fula empire. The news of the crushing defeat by Sir George Goldie of the Fula at Bida, and of the capture of Illorin, induced

Rabah to return to Bornu. He gave the British no further trouble, but turned his attention to the French. Émile Gentil had in this same year (1897) reached Lake Chad, via the Congo and Bagirmi, and had installed a French resident with the sultan of Bagirmi. As soon as Gentil had withdrawn, Rabah again fell upon Bagirmi, and forced sultan and resident to flee. In 1899 the French sent an expedition to reconquer the country, but at first they were unsuccessful. In the summer of 1899 Rabah attacked and routed the French advanced post, held by Naval-Lieutenant Bretonnet, and the latter was killed. In October following another battle was fought, in which the French, under Captain Robillot, completely defeated Rabah, who retreated north-east towards Wadai. Gathering a fresh army, he returned to Bagirmi and joined issue with the French a third time. In a battle fought on the 22nd of April 1900 Rabah was slain and his host defeated. The chieftain's head was cut off and taken to the French camp. In this engagement Major Lamy, the French commandant, also lost his life.

The French continued the campaign against Rabah's sons, two of whom were killed. Rabah had left instructions that if his army was finally defeated by the French, his successor should return to Bornu and make friends with the British. Rabah's third son, Fader-Allah, accordingly threw himself entirely upon British protection. He made a favourable impression, and it was contemplated to recognize him as sultan of Bornu. However, in the later part of 1901 Fader-Allah, who had 2500 riflemen, again made aggressive movements against the French. In retaliation, Captain Dangeville pursued him into British territory. A battle was fought at Gujba, Fader-Allah being defeated. He fled mortally wounded, and died the same night, being buried in the bed of a small river, the course of which had been diverted for the purpose.

Connected accounts of Rabah's career are contained in É. Gentil's *La Chute de l'empire de Rabah* (Paris, 1902) and in M. von Oppenheim's *Rabeh und das Tschadseegebiet* (Berlin, 1902). (F. R. C.)

RABAT (*Ribàt*), a city on the Atlantic coast of Morocco, in 34° 3′ N., 6° 46′ W., 130 m. S. of Cape Spartel, on the southern side and at the mouth of the Bu Ragrag, which separates it from Salli on the northern bank. It is a commercial town of about 26,000 to 30,000 inhabitants, occupying a rocky plateau and surrounded by massive but dilapidated walls, strengthened by three forts on the seaward side. To the south of the town stands a modern palace, defended by earthworks and Krupp guns. The conspicuous feature in the view from the ocean is the Borj el Hasan, an unfinished square-built tower, 145 ft. high, built on an elevation about 65 ft. above the sea to the west of the walled town. At one time the Bu Ragrag afforded a much better harbour than it does now; the roadstead is quite unprotected, and there is a dangerous bar at the mouth of the river, which hampers the shipping, and makes the growth of trade slow. The depth of water over the bar varies from 7 to 12 ft. Rabat trades with Fez and the interior of Morocco, with the neighbouring coast towns and Gibraltar, and with Marseilles, Manchester and London, and is the greatest industrial centre in Morocco.

Rabat was founded by Yak'ub el Mansur in 1184, but Salli was then already an ancient city, and on the scarped hills to the west of Rabat stand the ruins of Sala, a Roman colony, known as Shella. It contains a mausoleum of the Beni Marīn dynasty.

RABAUT, PAUL (1718–1794), French pastor of "the Church of the Desert" (see HUGUENOTS), was born at Bédarieux, near Montpellier, on the 29th of January 1718. In 1738 he was admitted as a preacher by the synod of Languedoc, and in 1740 he went to Lausanne to complete his studies in the seminary recently founded there by Antoine Court (*q.v.*). In 1741 Rabaut was placed at the head of the church of Nîmes, and in 1744 he was vice-president of the general synod. During the persecution of 1745–1752 Rabaut himself was obliged to hide. When the marquis of Paulmy d'Argenson was sent to Languedoc to make a military inspection, Rabaut succeeded in interviewing him (1750). For a time the persecution ceased, but it broke out again in 1753, a price being put upon Rabaut's head. Louis François de Bourbon, prince de Conti, interested himself in the Protestants in 1755, and in July Rabaut visited him. During the years 1755–1760 periods of persecution and toleration alternated. By the year 1760, however, the efforts of Antoine Court and P. Rabaut had been so successful that French Protestantism was well established and organized. Court de Gébelin, Paul Rabaut, and his son Saint-Étienne now exerted themselves to get it recognized by the law and government. When the people revolted, the minister Turgot in 1775 requested Rabaut to calm them. His success aroused the jealousy of his colleagues, who tried to undo the good work started by Antoine Court. But Rabaut persevered in his efforts to improve legally the position of the Protestants. In 1785, when he was visited by General La Fayette, it was arranged that Rabaut's son, Rabaut Saint-Étienne, should go to Paris on behalf of the Reformed Church. In November 1787 Louis XVI.'s edict of toleration was signed, though it was not registered until the 29th of January 1788. Two years later liberty of conscience was proclaimed by the National Assembly, of which Rabaut Saint-Étienne was chosen vice-president, and it was declared that non-Catholics might be admitted to all positions. After the fall of the Girondists, however, in which Rabaut Saint-Étienne was involved, Paul Rabaut, who had refused to renounce his title of pastor, was arrested, dragged to the citadel of Nîmes, and kept in prison seven weeks (1794). He died at Nîmes on the 25th of September 1794, soon after his release.

See J. Pons de Nîmes, *Notice biographique sur Paul Rabaut* (1808); Charles Dardier, *Paul Rabaut, ses lettres à Antoine Court* (1884) and *Paul Rabaut, ses lettres à divers* (1891).

RABAUT SAINT-ÉTIENNE, JEAN PAUL (1743–1793), French revolutionist, was born at Nîmes, the son of Paul Rabaut (*q.v.*), the additional surname of Saint-Étienne being assumed from a small property near Nîmes. Like his father, he became a pastor, and distinguished himself by his zeal for his co-religionists, working energetically to obtain the recognition of the civil rights which had been granted to them by Louis XVI. in 1788. Having gained a great reputation by his *Histoire primitive de la Grèce*, he was elected deputy to the States General in 1789 by the third estate of the *bailliage* of Nîmes. In the Constituent Assembly he worked on the framing of the constitution, spoke against the establishment of the republic, which he considered ridiculous, and voted for the suspensive veto, as likely to strengthen the position of the crown. In the Convention he sat among the Girondists, opposed the trial of Louis XVI., was a member of the commission of twelve, and was proscribed with his party. He remained in hiding for some time, but was ultimately discovered and guillotined on the 5th of December 1793.

See J. A. Dartique, *Rabaut St-Étienne à l'Assemblée Constituante* (Paris, 1903); and A. Lods, "Correspondance de Rabaut St-Étienne" in *La Révolution française* (1898), "L'arrestation de Rabaut St Étienne" in *La Révolution française* for 1903 (cf. the same review for 1901), and "Les débuts de Rabaut St-Étienne aux États Généraux et à la Convention" in the *Bulletin historique de la Société de l'histoire du protestantisme français* (1901), also an *Essai sur la vie de Rabaut Saint-Étienne* (1893) separately published. An edition of the *Œuvres de Rabaut Saint-Étienne* (2 vols., 1826) contains a notice by Collin de Plancy.

RABBA, a town of British West Africa, in the province of Nupe, Northern Nigeria, on the left bank of the Niger, in 9° 6′ N., and 200 m. above the confluence of the Niger and the Benue. At the time of Richard Lander's visit in 1830 it was a place of 40,000 inhabitants and one of the most important markets in the country. In 1867 Gerhard Rohlfs found it with only 500 inhabitants. The town has somewhat recovered its position since the establishment of British rule in 1902.

RABBAH BAR NAḤMANI (*c.* 270–*c.* 330), a Babylonian rabbi or amora (*q.v.*). He was for twenty-two years head of the Academy at Pumbeditha. His great dialectic skill acquired for him the epithet "uprooter of mountains." The Talmud owes much to this rabbi. He is said to have perished in a jungle into which he had fled from the officers of the Persian king.

See Graetz, *History of the Jews* (Eng. trans.), vol. ii. ch. xxi.; Bacher, *Agada der Babyl. Amoräer*, 97–101. (I. A.)

RABBAN BAR SAUMA (fl. 1280–1288), Nestorian traveller and diplomatist, was born at Peking about the middle of the 13th century, of Uigur stock. While still young he started on a pilgrimage to Jerusalem, and travelling by way of Tangut, Khotan, Kashgar, Talas in the Syr Daria valley, Khorasan, Maragha and Mosul, arrived at Ani in Armenia. Warnings of the danger of the routes to southern Syria turned him from his purpose; and his friend and fellow-pilgrim, Rabban Marcos, becoming Nestorian patriarch (as Mar Yaballaha III.) in 1281, suggested Bar Sauma's name to Arghun Khan, sovereign of the Ilkhanate or Mongol-Persian realm, for a European embassy, then contemplated. The purpose of this was to conclude an anti-Moslem alliance, especially against the Mameluke power, with the chief states of Christendom. On this embassy Bar Sauma started in 1287, with Arghun's letters to the Byzantine emperor, the pope and the kings of France and England. In Constantinople he had audience of Andronicus II.; he gives an enthusiastic description of St Sophia. He next travelled to Rome, where he visited St Peter's, and had prolonged negotiations with the cardinals. The papacy being then vacant, a definite reply to his proposals was postponed, and Bar Sauma passed on to Paris, where he had audience of the king of France (Philip the Fair). In Gascony he apparently met the king of England (Edward I.) at a place which seems to be Bordeaux, but of which he speaks as the capital of *Alanguitar* (*i.e.* Angleterre). On returning to Rome, he was cordially received by the newly elected pontiff Nicolas IV., who gave him communion on Palm Sunday, 1288, allowed him to celebrate his own Eucharist in the capital of Latin Christendom, commissioned him to visit the Christians of the East, and entrusted to him the tiara which he presented to Mar Yaballaha. His narrative is of unique interest as giving a picture of medieval Europe at the close of the Crusading period, painted by a keenly intelligent, broad-minded and statesmanlike observer.

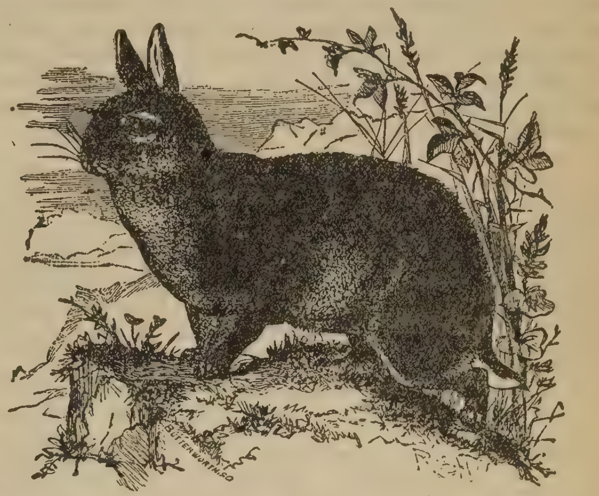
See J. B. Chabot's translation and edition of the *Histoire du Patriarche Mar Jabalaha III. et du moine Rabban Cauma* (from the Syriac) in *Revue de l'Orient latin*, 1893, pp. 566–610; 1894, pp. 73–143, 235–300; O. Raynaldus, *Annales Ecclesiastici* (continuation of Baronius), A.D. 1288, §§ xxxv.–xxxvi.; 1289, § lxi.; L. Wadding, *Annales Minorum*, v. 169, 196, 170–173; C. R. Beazley, *Dawn of Modern Geography*, ii. 15, 352; iii. 12, 189–190, 539–541.

RABBET, in carpentry and masonry, the name for a rectangular groove or slot cut in the edge of a piece of wood or stone, to which another corresponding piece can be fitted (see Joinery and Masonry). The word is an adaptation of the O. Fr. *rabat* or *rabbat*, from *rabattre*, *i.e. abattre*, beat back, abate, to make a recess, and is thus a doublet of "rebate" (*q.v.*), which is now frequently used instead of "rabbet," the joint being also known as a "rebated joint."

RABBI, a Hebrew word meaning "my master," "my teacher." It is derived from the adjective *rab* (in Aramaic, and frequently also in Hebrew, "great"), which acquired in modern Hebrew the signification of "lord," in relation to servants or slaves, and of "teacher," "master," in relation to the disciple. The master was addressed by his pupils with the word *rabbi* ("my teacher"), or *rabbenu* ("our teacher"). It became customary to speak of Moses as *Moshe rabbenu* ("our teacher Moses"). Jesus makes it a reproach against the scribes that they cause themselves to be entitled by the people *rabbi* (ῥαββί, Matt. xxiii. 7): and He Himself is saluted by the disciples of John as *rabbi* (John i. 38, where the word is explained as equivalent to διδάσκαλε). As an honorary title of the scribes, with whose name it was constantly linked, "Rabbi" only came into use during the last decades of the second Temple. Hillel and Shammai, the contemporaries of Herod, were mentioned without any title. Gamaliel I., the grandson of Hillel, was the first to whose name the appellation *Rabban* (the same as *rabbon*, and also pronounced as *ribbon*, cf. ῥαββουνί, Mark x. 51; John xx. 16) was prefixed. This title, a higher distinction than that of *rabbi*, is in tradition borne only by the descendants of Gamaliel I., the last being Gamaliel III., the son of Jehuda I. (Aboth ii. 2), and by Joḥanan b. Zaccai, the founder of the school of Jamnia (Jabneh). Otherwise all Tannaites (see Tanna), the scholars of the Mishnah period, were distinguished by the title of "rabbi." The Jehuda I. mentioned above, the redactor of the Mishnah, was honoured as the "Rabbi" *κατ' ἐξοχήν* ("par excellence"), and in the tradition of the houses of learning, if it was necessary to speak of him or to cite his opinions and utterances, he was simply referred to as "Rabbi," without the mention of any name. Scholars who were not definitely ordained—and among these were men of high distinction—were simply mentioned by their names without the Rabbi-title. In the post-Talmudic age the Qaraites, who rejected the tradition of the Talmud, designated the Jews who adhered to that tradition as Rabbanites. Similarly the term Rabbins, or Rabbis, is applied to modern Jewish clergy. The plural *rabbanim* was employed to describe the later Jewish scholars (so, for example, in the historian Abraham Ibn Daud, 12th century). By "rabbinical literature" is understood the post-Talmudic Jewish literature; in particular, so far as its subject is the literature of the tradition and its contents.

Rab became a proper name as the standing nomenclature of the celebrated amora, *Abba Arika* (*q.v.*). (W. Ba.)

RABBIT, the modern name of the well-known rodent, formerly called (as it still is in English legal phraseology) Cony,[1] a member of the family *Leporidae* (see Rodentia). Till recently the rabbit has generally been known scientifically as *Lepus cuniculus*, but it is now frequently regarded, at least by systematic naturalists, as the representative of a genus by itself, under the name of *Oryctolagus cuniculus*. Some zoologists, indeed, include in the same genus the South African thick-tailed hare, but by others this is separated as *Pronolagus crassicaudatus*. From the hare the wild rabbit is distinguished externally by its smaller size, shorter ears and feet, the absence or reduction of the black patch at the tip of the ears, and its greyer colour. The skull is



The Rabbit (*Oryctolagus cuniculus*).

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[1] There are no native names either in Teutonic or Celtic languages; such words as German *Kaninchen* or English *cony* are from the Latin *cuniculus*, while the Irish, Welsh and Gaelic are adaptations from English. "Rabbit," which is now the common name in English, was for long confined to the young of the cony, and so the *Promptorium Parvulorum*, *c.* 1440, "Rabet, yonge conye, *cunicellus*." The ultimate source of "rabbit" is itself unknown. The *New English Dictionary* takes it to be of northern French origin. There is a Walloon *robett*. Skeat suggests a possible connexion with Spanish *rabo*, tail, *rabear*, to wag the hind-quarters. The familiar name for toasted cheese, "Welsh rabbit," is merely a joke, and the alteration to "Welsh rare-bit" is due to a failure to see the joke, such as it is. Parallels may be found in "Prairie oyster," the yolk of an egg with vinegar, pepper, &c. added; or "Scotch woodcock," a savoury of buttered eggs on anchovy toast.

very similar to that of the hare, but is smaller and lighter, with a slenderer muzzle and a longer and narrower palate. Besides these characters, the rabbit is separated from the hare by the fact that it brings forth its young naked, blind, and helpless; to compensate for this, it digs a deep burrow in the earth in which they are born and reared, while the young of the hare are born fully clothed with fur, and able to take care of themselves, in the shallow depression or "form" in which they are produced. The weight of the rabbit is from 2½ to 3 lb, although wild individuals have been recorded up to more than 5 lb. Its general habits are too well known to need detailed description. It breeds from four to eight times a year, bringing forth each time from three to eight young; its period of gestation is about thirty days, and it is able to bear when six months old. It attains to an age of about seven or eight years.

The rabbit is believed to be a native of the western half of the Mediterranean basin, and still abounds in Spain, Sardinia, southern Italy, Sicily, Greece, Tunis and Algeria; and many of the islands adjoining these countries are overrun with these rodents. Thence it has spread, partly by man's agency, northwards throughout temperate western Europe, increasing rapidly wherever it gains a footing; and this extension is still going on, as is shown by the case of Scotland, where early in the 19th century rabbits were little known, while they are now found in all suitable localities up to the extreme north. It has also gained admittance into Ireland, and now abounds there as much as in England. Out of Europe the same extension of range has been going on. In New Zealand and Australia rabbits, introduced either for profit or sport, have increased to such an extent as to form one of the most serious pests that the farmers have to contend against, as the climate and soil suit them perfectly and their natural enemies are too few and too lowly organized to keep them within reasonable bounds. In North America about thirty species and twice as many geographic races (subspecies) are known, and the occurrence of several distinct fossil forms shows that the genus has long been established. The chief variety is the common grey or cottontail (*Lepus floridanus*). For the "jack-rabbit," see HARE.

The rabbit has been domesticated from an early period. Little doubt exists amongst naturalists that all the varieties of the domestic animal are descended from *Oryctolagus cuniculus*. The variations which have been perpetuated and intensified by artificial selection are, with the exception of those of the dog, greater than have been induced in any other mammal. For not only has the weight been more than quadrupled in some of the larger breeds, and the structure of the skull and other parts of the skeleton greatly altered, but the proportionate size of the brain has been reduced and the colour and texture of the fur altered in a remarkable manner. The lop-eared breed is the oldest English variety, and has been cultivated carefully since about 1785, the aim of the breeder being directed to the development of the size of the ears, and with such success that they sometimes measure more than 23 in. from tip to tip and exceed 6 in. in width. This development, which is accompanied by changes in the structure of the skull, depends on breeding the animals in warm damp hutches, without which the best developed parents fail to produce the desired offspring. In colour lop-eared rabbits vary greatly. The Belgian hare is a large breed of a hardy and prolific character, which closely resembles the hare in colour, and is not unlike it in form. Some years ago these rabbits were sold as "leporides" or hybrids, produced by the union of the hare and the rabbit; but the most careful experimenters have failed to obtain any such hybrid, and the naked immature condition in which young rabbits are born as compared with the clothed and highly developed young hare renders it unlikely that hybrids could be produced. Nor does the flesh of the Belgian rabbit resemble that of the hare in colour or flavour. A closely allied variety, though of larger size, is known as the Patagonian rabbit, although it has no relation to the country after which it is called.

The Angora rabbit is characterized by the extreme elongation and fineness of the fur, which in good specimens reaches 6 or 7 in. in length, requiring great care and frequent combing to prevent it from becoming matted. The Angoras most valued are albinos, with pure white fur and pink eyes; in some parts of the Continent they are kept by the peasants and clipped regularly.

Amongst the breeds which are valued for the distribution of colour on the fur are the Himalayan and the Dutch. The former is white, but the whole of the extremities—viz. the nose, the ears, tail and feet—are black or very dark in colour. This very pretty breed has no connexion with the mountains from which it takes its name, but is a variety produced by careful breeding and selection. Though produced by crossing, it now generally breeds true to colour, at times throwing back, however, to the silver greys from which it was derived. The rabbits known as Dutch are small, and valued for the disposition of the colour and markings. The entire body behind the shoulder-blades is uniformly coloured, with the exception of the feet; the anterior part of the body, including the fore legs, neck, and jaws, is white, the cheeks and ears being coloured. In some strains the coloured portion extends in front of the fore legs, leaving only a ring of white round the neck. The more accurately the coloured portion is defined, the higher is the animal esteemed. The silver grey is a uniform-coloured breed, the fur of which is a rich chinchilla grey, varying in depth in the different strains. From the greater value of the fur, silver greys have been frequently employed to stock warrens, as they breed true to colour in the open if the ordinary wild rabbits are excluded. Other colours known, as silver fawn and silver brown, are closely related. A blue breed has been recently introduced. The largest and heaviest of all is the Flemish giant, with iron-grey fur above and white below. Other breeds include the Japanese, with an orange coat, broadly banded on the hind-quarters with black; the pink-eyed and short and thick-furred albino Polish; the Siberian, probably produced by crossing the Himalayan with the Angora; and the black-and-tan and blue-and-tan.

See also HARE, SHOOTING, and COURSING. (W. H. F.; R. L.*)

RABBLE, a general term for a disorderly crowd, apparently connected with the verb "to rabble," to talk or work in a confused manner, Du. *rabbelen*, Ger. dialect *rabbeln*, cf. Gr. *ῥαβάσσειν*, to howl. In iron and steel manufacture, a puddling-tool, for stirring the molten metal, is called a "rabble." This is a different word, adapted from Fr. *râble*, for *roable*, Med. Lat. *rotabulum*, Lat. *rutabulum* (*ruere*, to rake), a fire-shovel or oven rake.

RABBŪLĀ, a distinguished bishop of the Syrian church early in the 5th century. He was a native of Ḳenneshrīn, a town some few miles south of Aleppo and the seat of a bishopric. His father was a heathen priest, and though his mother was a devoted Christian he continued in pagan belief and practice until some time after his marriage. During a journey to his country estates he was converted to Christianity partly through coming in contact with a case of miraculous healing and partly through the teaching and influence of Eusebius, bishop of Ḳenneshrīn, and Acacius, bishop of Aleppo. With all the energy of his fiery nature he threw himself into the practice of Christian asceticism, sold all his possessions, and separated from his wife and kinspeople. He resided for some time in a monastery, and then passed to a life of greater hardship as a solitary hermit. On the death of Diogenes, bishop of Edessa, in the year 411–412, Rabbūlā was chosen his successor, and at once accepted the position offered him, without any of the customary show of reluctance. As a bishop he was marked by extraordinary energy, by the continued asceticism of his personal life, by his magnificent provision for all the poor and suffering in his diocese, by his care for discipline among the clergy and monks who were under his authority, and latterly by the fierce determination with which he combated all heresies and especially the growing school of the followers of Nestorius. On one occasion he visited Constantinople and there preached before Theodosius II. (who was then favourable to Nestorius) and a great congregation a sermon in denunciation of Nestorian doctrine, of which a portion survives in the Syriac version.[1] He became the friend of Cyril of Alexandria, with whom he corresponded, and whose treatise *De recta fide* he translated into Syriac.[2] After a busy episcopal life of twenty-four years he died in August 435, and was immensely lamented by the people of his diocese. His successor was the Nestorian Ibas.

The literary remains of Rabbūlā are small in bulk, and are mostly to be found in Overbeck. Perhaps his main importance to the historian of Syriac literature lies in the zeal with which he strove to replace the Diatessaron or Gospel Harmony of Tatian by the edition of the separate Gospels, ordering that a copy of the latter should be placed in every church and should be read (see Wright's *Syr. Lit.* p. 9). According to his biographer (Overbeck, p. 172) he himself produced a version (or revision) of the New Testament in Syriac. This may have been, as Wright suggests (*Syr. Lit.* p. 11), "a first step in the direction of the Philoxenian version." But there is great probability in F. C. Burkitt's hypothesis that the product of Rabbūlā's work, at least as regards the Gospels, is to be found in the current Peshīṭta text, which "represents the Greek text as read in Antioch about 400 A.D." and "was prepared by Rabbula . . . and published by his authority as a substitute for the Diatessaron."[1]

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[1] Overbeck, *op. cit.* pp. 239–244.

[2] The version survives in a British Museum MS.; see Wright's *Catalogue* p. 719.

Rabbūlā seems to have been a man of great force, devotion and self-denial: on the one hand intellectually gifted, and on the other thoroughly consistent in his practice of religion. But his attractiveness is marred, as in the case of many of his contemporaries, by the bitterness of a narrow orthodoxy.

(N. M.)

RABELAIS, FRANÇOIS (*c.* 1490–1553), French humorist, was born at Chinon on the Vienne in the province of Touraine. The date of his birth is wholly uncertain: it has been put by tradition, and by authorities long subsequent to his death, as 1483, 1490, and 1495. There is nothing in the positive facts of his life which would not suit tolerably well with any of these dates; most 17th-century authorities give the earliest, and this also accords best with the age of the eldest of the Du Bellay brothers, with whom Rabelais was (perhaps) at school. In favour of the latest it is urged that, if Rabelais was born in 1483, he must have been forty-seven when he entered at Montpellier, and proportionately and unexpectedly old at other known periods of his life. In favour of the middle date, which has, as far as recent authorities are concerned, the weight of consent in its favour, the testimony of Guy Patin (1601–1672), a witness of some merit and not too far removed in point of time, is invoked. The only contribution which need be made here to the controversy is to point out that if Rabelais was born in 1483 he must have been an old man when he died, and that scarcely even tradition speaks of him as such.

With regard to his birth, parentage, youth, and education everything depends upon this tradition, and it is not until he was according to one extreme hypothesis thirty-six, according to the other extreme twenty-four, that we have solid testimony respecting him. In the year 1519, on the 5th of April, the François Rabelais of history emerges. The monks of Fontenay le Comte bought some property (half an inn in the town), and among their signatures to the deed of purchase is that of François Rabelais. Before this all is cloudland. It is said that he had four brothers and no sisters, that his father had a country property called La Devinière, and was either an apothecary or a tavern-keeper. Half a century after his death De Thou mentions that the house in which he was born had become a tavern and then a tennis-court. It still stands at the corner of a street called the Rue de la Lamproie, and the tradition may be correct. An indistinct allusion of his own has been taken to mean that he was tonsured in childhood at seven or nine years old; and tradition says that he was sent to the convent of Seuilly. From Seuilly at an unknown date tradition takes him either to the university of Angers or to the convent school of La Baumette or La Basmette, founded by good King René in the neighbourhood of the Angevin capital. Here he is supposed to have been at school with the brothers Du Bellay, with Geoffroy d'Estissac and others. The next stage in this (so far as evidence goes, purely imaginary) career is the monastery of Fontenay le Comte, where, as has been seen, he is certainly found in 1519 holding a position sufficiently senior to sign deeds for the community, where he, probably in 1511, took priest's orders, and where he also pursued, again certainly, the study of letters, and especially of Greek, with ardour. From this date, therefore, he becomes historically visible. The next certain intelligence which we have of Rabelais is somewhat more directly biographical. The letters of the well-known Greek scholar Budaeus, two of which are addressed to Rabelais himself and several more to his friend and fellow-monk Pierre Amy, together with some notices by André Tiraqueau, a learned jurist, to whom Rabelais rather than his own learning has secured immortality, show beyond doubt what manner of life the future author of *Gargantua* led in his convent. The letters of Budaeus show that an attempt was made by the heads of the convent or the order to check the studious ardour of these Franciscans; but it failed, and there is no positive evidence of anything like actual persecution, the phrases in the letters of Budaeus being merely the usual exaggerated Ciceronianism of the Renaissance. Some books and papers were seized as suspicious, then given back as innocent; but Rabelais was in all probability disgusted with the cloister—indeed his great work shows this beyond doubt. In 1524, the year of the publication of Tiraqueau's book above cited, his friend Geoffroy d'Estissac procured from Clement VII. an indult, licensing a change of order and of abode for Rabelais. From a Franciscan he became a Benedictine, and from Fontenay he moved to Maillezais, of which Geoffroy d'Estissac was bishop. But even this learned and hospitable retreat did not apparently satisfy Rabelais. In or before 1530 he left Maillezais, abandoned his Benedictine garb for that of a secular priest, and, as he himself puts it in his subsequent *Supplicatio pro Apostasia* to Pope Paul III., "*per seculum diu vagatus fuit.*" For a time the Du Bellays provided him with an abode near their own château of Langey. He is met at Montpellier in the year just mentioned. He entered the faculty of medicine there on the 16th of September and became bachelor on the 1st of November, a remarkably short interval, which shows what was thought of his acquirements. Early in 1531 he lectured publicly on Galen and Hippocrates, while his more serious pursuits seem to have been chequered by acting in a *morale comédie*, then a very frequent university amusement. Visits to the Îles d'Hières, and the composition of a fish sauce in imitation of the ancient *garum*, which he sent to his friend Étienne Dolet, are associated, not very certainly, with his stay at Montpellier, which, lasting rather more than a year at first, was renewed at intervals for several years.

In 1532, however, he had moved from Montpellier to Lyons. Here he plunged into manifold work, literary and professional. He was appointed before the beginning of November physician to the Hôtel Dieu, with a salary of forty livres per annum, and lectured on anatomy with demonstrations from the human subject. He edited for Sebastian Gryphius, in the single year 1532, the medical *Epistles* of Giovanni Manardi, the *Aphorisms* of Hippocrates, with the *Ars Parva* of Galen, and an edition of two supposed Latin documents, which, however, happened unluckily to be forgeries.

At this time Lyons was the centre and to a great extent the headquarters of an unusually enlightened society, and indirectly it is clear that Rabelais became intimate with this society. A manuscript distich, which was found in the Toulouse library, deals with the death of an infant named Théodule, whose country was Lyons and his father Rabelais, but we know nothing more about the matter. What makes the Lyons sojourn of the greatest real importance is that at this time probably appeared the beginnings of the work which was to make Rabelais immortal. It is necessary to say "probably," because the strange uncertainty which rests on so much of his life and writings exists here also. There is no doubt that both Gargantua and Pantagruel were popular names of giants in the Middle Ages, though, curiously enough, no mention of the former in French literature much before Rabelais's time has been traced. In 1526, however, Charles de Bordigné, in a satiric work of no great merit, entitled *la Légende de Pierre Faifeu*, has the name Gargantua with an allusion, and in 1532 (if not earlier) there appeared at Lyons *les Grandes et inestimables chroniques du grand et énorme géant Gargantua*. This is a short book on the plan of the later burlesques and romances of the Round Table. Arthur and Merlin appear with Grantgosier, as he is here spelt, Galemelle (Gargamelle), Gargantua himself, and the terrible mare. But there is no trace of the action or other characters of *Gargantua* that was to be, nor is the manner of the piece in the least worthy of Rabelais. No one supposes that he wrote it, though it has been supposed that he edited it and that in reality it is older than 1532, and may be the direct subject of Bordigné's allusion six years earlier. What does, however, seem probable is that the first book of *Pantagruel* (the second of the whole work) was composed with a definite view to this chap book and not to the existing first book of *Gargantua*, which was written afterwards, when Rabelais discovered the popularity of his work and felt that it ought to have some worthier starting-point than the *Grandes chroniques*. The earliest known and dated edition of *Pantagruel* is of 1533, of *Gargantua* 1535, though this would not be of itself conclusive, especially as we actually possess editions of both which, though undated, seem to be earlier. But the definite description of Gargantua in the title as "Père de Pantagruel," the omission of the words "second livre" in the title of the first book of *Pantagruel* while the second and third are duly entitled "tiers" and "quart," the remarkable fact that one of the most important personages, Friar John, is absent from book ii., the first of *Pantagruel*, though he appears in book i. (*Gargantua*), and many other proofs show the order of publication clearly enough. There is also in existence a letter of Calvin, dated 1533, in which he speaks of *Pantagruel*, but not of *Gargantua*, as having been condemned as an obscene book. Besides this, 1533 saw the publication of an almanac, the first of a long series which exists only in titles and fragments, and of the amusing *Prognostication Pantagrueline* (still, be it observed, Pantagrueline, not Gargantuine). Both this and *Pantagruel* itself were published under the anagrammatic pseudonym of "Alcofribas Nasier," shortened to the first word only in the case of the *Prognostication*.

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[1] See *S. Ephraim's Quotations from the Gospel* (Cambridge, 1901), p. 57 f.; *Evangelion du-Mepharreshe* (Cambridge, 1904), ii. 5; and *Early Eastern Christianity* (London, 1904), lecture ii.

This busy and interesting period of Rabelais's life was brought to a close apparently by his introduction or reintroduction to Jean du Bellay, who, in October 1533, passing through Lyons on an embassy to Rome, engaged Rabelais as physician. The visit did not last very long, but it left literary results in an edition of a description of Rome by Marliani, which Rabelais published in September 1534. It is also thought that the first edition of *Gargantua* may have appeared this year.

In the spring of 1535 the authorities of the Lyons hospital, considering that Rabelais had twice absented himself without leave, elected Pierre de Castel in his room; but the documents which exist do not seem to infer that any blame was thought due to him, and the appointment of his successor was once definitely postponed in case he should return. At the end of 1535 Rabelais once more accompanied Jean du Bellay, now a cardinal, to Rome and stayed there till April in the next year. This stay furnishes some biographical documents of importance in the shape of letters to Geoffroy d'Estissac, of the already-mentioned *Supplicatio pro Apostasia*, and of the bull of absolution which was the reply to it. This bull not only freed Rabelais from ecclesiastical censure, but gave him the right to return to the order of St Benedict when he chose, and to practise medicine. He took advantage of this bull and became a canon of St Maur. In 1537 he took his doctor's degree at Montpellier, lectured on the Greek text of Hippocrates, and next year made a public anatomical demonstration. During these two years he seems to have resided either at Montpellier or at Lyons. But in 1539 he entered the service of Guillaume du Bellay-Langey, elder brother of Jean, and would appear to have been with him (he was governor of Piedmont) till his death on 9th January 1543. Rabelais wrote a panegyrical memoir of Guillaume, which is lost, and the year before saw the publication of an edition of *Gargantua* and *Pantagruel*, book i., together (both had been repeatedly reprinted separately), in which some dangerous expressions were cut away. Nothing at all is known of his life, whereabouts, or occupations till the publication of the third book, which appeared in 1546, "avec privilége du roi," which had been given in September 1545.

Up to this time Rabelais, despite the condemnation of the Sorbonne referred to above, had experienced nothing like persecution or difficulty. Even the spiteful or treacherous act of Dolet, who in 1542 reprinted the earlier form of the books which Rabelais had just slightly modified, seems to have done him no harm. But the storm of persecution which towards the end of the reign of Francis I. was fatal to Dolet himself and to Des Périers, while it exiled and virtually killed Marot, threatened him. There is no positive evidence of any measures taken or threatened against him; but it is certain that he passed nearly the whole of 1546 and part of 1547 at Metz in Lorraine as physician to the town at the salary of 120 livres, and Sturm speaks of him as having been "cast out of France by the times" (with the exclamation φεῦ τῶν χρόνων) in a contemporary letter, and says that he himself in another letter gives a doleful account of his pecuniary affairs and asks for assistance. At Francis's death on 31st March 1547 Du Bellay went to Rome, and at some time not certain Rabelais joined him. He was certainly there in February 1549, when he dates from Du Bellay's palace a little account of the festivals given at Rome to celebrate the birth of the second son of Henry II. and Catherine de' Medici. This account, the *Sciomachie* as it is called, is extant. In the same year a monk of Fontevrault, Gabriel du Puits-Herbault, made in a book called *Theotimus* the first of the many attacks on Rabelais. It is, however, as vague as it is violent, and it does not seem to have had any effect. Rabelais had indeed again made for himself protectors whom no clerical or Sorbonist jealousy could touch. The *Sciomachie* was written to the cardinal of Guise, whose family were all-powerful at court, and Rabelais dedicated his next book to Odet de Chatillon, afterwards cardinal, a man of great influence. Thus Rabelais was able to return to France, and in 1550 was presented to the livings of Meudon and St Christophe de Jambet. It may, however, surprise those who have been accustomed to hear him spoken of as "curé de Meudon," and who have read lives of him founded on legend, to find that there is very little ground for believing that he ever officiated or resided there. He certainly held the living but two years, resigning it in January 1552 along with his other benefice, and it is noteworthy that at the episcopal visitation of 1551 he was not present. To this supposed residence at Meudon and to the previous stay at Rome, however, are attached two of the most mischievous items of the legend, though fortunately two of the most easily refutable. It is said that Rabelais met and quarrelled with Joachim du Bellay the poet at Rome, and with Ronsard at Meudon and elsewhere, that this caused a breach between him and the Pléiade, that he satirized its classicizing tendencies in the episode of the Limousin scholar, and that Ronsard after his death avenged himself by a libellous epitaph. The facts are these. Nothing is heard of the quarrel with Du Bellay or of any meeting with him, nothing of the meetings and bickerings with Ronsard, till 1697, when Bernier tells the story without any authority. The supposed allusions to the Pléiade date from a time when Ronsard was a small boy, and are mainly borrowed from an earlier writer still, Geoffroy Tory. Lastly, the epitaph, read impartially, is not libellous at all, but simply takes up the vein of the opening scenes of *Gargantua* in reference to Gargantua's author. There is indeed no reason to suppose that either Ronsard or Du Bellay was a fervent admirer of Rabelais, for they belonged to a very different literary school; but there is absolutely no evidence of any enmity between them, and Du Bellay actually refers to Rabelais with admiration.

Some chapters of Rabelais's fourth book had been published in 1548, but the whole did not appear till 1552. The Sorbonne censured it and the parliament suspended the sale, taking advantage of the king's absence from Paris. But it was soon relieved of the suspension. He died, it is said, on the 9th of April 1553, but actual history is quite silent save on the point that he was not alive in May of the next year, and the legends about his deathbed utterances—"La farce est jouée," "Je vais chercher un grand peut-être," &c.—are altogether apocryphal. The same may be said of the numerous silly stories told of his life, such as that of his procuring a free passage to Paris by inscribing packets "Poison for the king," and so forth.

Ten years after the publication of the fourth book and nine after the supposed date of the author's death there appeared at Lyons sixteen chapters entitled *lÎ'le sonnante par maistre François Rabelais*, and two years later the entire fifth book was printed as such. In 1567 it took place with the others, and has ever since appeared with them. But from the beginning of the 17th century there have never been wanting disbelievers in its authenticity. The controversy is one of some intricacy, but as it is also one of capital importance in literary history the heads of it at least must be given here. The opponents of the book rely (1) on the testimony of a certain Louis Guyon, who in 1604 declared that the fifth book was made long after Rabelais's death by an author whom he knew, and who was not a doctor, and on the assertion of the bibliographer Du Verdier, about the same time, that it was written by an "écolier de Valence"; (2) on the fact that the anti-monastic and even anti-Catholic polemic is much more accentuated in it; (3) on the arguments that parts are apparently replicas or rough drafts of passages already appearing in the four earlier books; and (4) that some allusions are manifestly posterior to even the furthest date which can be assigned for the reputed author's decease. On the other hand, it is urged that, though Guyon and Du Verdier were in a sense contemporaries, they wrote long after the events, and that the testimony of the former is vitiated, not merely by its extreme vagueness, but by the fact that it occurs in a *plaidoyer*, tending to exculpate physicians from the charge of unorthodoxy; that Du Verdier in another place assigns the *Pantagrueline Prognostication* to this same unknown student of Valence, and had therefore probably confused and hearsay notions on the subject; that the rasher and fiercer tone, as well as the apparent repetitions, are sufficiently accounted for on the supposition that Rabelais never finally revised the book, which indeed dates show that he could not have done, as the fourth was not finally settled till just before his death; and that it is perfectly probable, and indeed almost certain, that it was prepared from his papers by another hand, which is responsible for the anachronous allusions above referred to. But the strongest argument, and one which has never been attacked by authorities really competent to judge, is that the "griffe de l'aigle" is on the book, and that no known author of the time except Rabelais was capable of writing the passage about the *Chats fourrês*, the better part of the history of Queen Whims (La Quinte) and her court, and the conclusion giving the Oracle of the Bottle. To this argument we believe that the more competent a critic is, both by general faculty of appreciation and by acquaintance with contemporary French literature, the more positive will be the assent that he yields. The reader must, however, be on his guard against confusing the authenticity of the fifth book generally with that of supposed early copies of it. Quite recently it was announced that an edition of 1549 had turned up in Germany; but the investigations of M. R. Stein, *un Rabelais apocryphe* (1901), repeated and confirmed by M. A. Lefranc in the *Revue des études Rabelaisiennes* (1905), disposed of the matter. The substance of the apocryphal document is quite different from our fifth book.

Gargantua and *Pantagruel*, notwithstanding their high literary standing and the frequency with which certain passages from them are cited, are, owing partly to their archaism of language and partly to the extreme licence which their author has allowed himself, so little read that no notice of them or of him could be complete without some sketch of their contents. The first book, *Gargantua*, describes the birth of that hero (a giant and the son of gigantic parents), whose nativity is ushered in by the account of a tremendous feast. In this the burlesque exaggeration of the pleasures of eating and drinking, which is one of the chief exterior notes of the whole work, is pushed to an extreme—an extreme which has attracted natural but perhaps undue attention. Very early, however, the author becomes serious in contrasting the early education of his hero—a satire on the degraded schools of the middle ages—with its subsequent and reformed stage, in the account of which all the best and noblest ideas of the humanist Renaissance in reference to pedagogy are put with exceptional force. Gargantua is recalled from Paris, whither he had been sent to finish his education, owing to a war between his father, Grandgosier, and the neighbouring king, Picrochole. This war is described at great length, the chief hero of it being the monk, Friar John, a very unclerical cleric, in whom Rabelais greatly delights. Picrochole defeated and peace made, Gargantua establishes the abbey of Thelema in another of Rabelais's most elaborate literary passages, where all the points most obnoxious to him in monastic life are indicated by the assignment of their exact opposites to this model convent. The second book, which introduces the principal hero of the whole, Pantagruel, Gargantua's son, is, on any other hypothesis but that already suggested of its prior composition, very difficult to explain, but in itself it is intelligible enough. Pantagruel goes through something like a second edition (really a first) of the educational experiences of his father. Like him, he goes to Paris, and there meets with Panurge, the principal triumph of Rabelaisian character-drawing, and the most original as well as puzzling figure of the book. Panurge has almost all intellectual accomplishments, but is totally devoid of morality: he is a coward, a drunkard, a lecher, a spiteful trickster, a spendthrift, but all the while infinitely amusing. This book, like the other, has a war in its latter part; Gargantua scarcely appears in it and Friar John not at all. It is not till the opening of the third book that the most important action begins. This arises from Panurge's determination to marry—a determination, however, which is very half-hearted, and which leads him to consult a vast number of authorities, each giving occasion for satire of a more or less complicated kind. At last it is determined that Pantagruel and his followers (Friar John has reappeared in the suite of the prince) shall set sail to consult the Oracle of the *Dive Bouteille*. The book ends with the obscurest passage of the whole, an elaborate eulogy of the "herb pantagruelion," which appears to be, if it is anything, hemp. Only two probable explanations of this have been offered, the one seeing in it an anticipation of Joseph de Maistre's glorification of the executioner, the other a eulogy of work, hemp being on the whole the most serviceable of vegetable products for that purpose. The fourth and fifth books are entirely taken up with a description of the voyage. Many strange places with stranger names are visited, some of them offering obvious satire on human institutions, others, except by the most far-fetched explanations, resolvable into nothing but sheer extravaganza. At last the Land of Lanterns, borrowed from Lucian, is reached, and the Oracle of the Bottle is consulted. This yields the single word "Trinq," which the attendant priestess declares to be the most gracious and intelligible she has ever heard from it. Panurge takes this as a sanction of his marriage, and the book ends abruptly. This singular romance is diversified by, or, to speak more properly, it is the vehicle of the most bewildering abundance of digression, burlesque amplification, covert satire on things political, social and religious, miscellaneous erudition of the literary and scientific kind. Everywhere the author lays stress on the excellence of "Pantagruelism," and the reader who is himself a Pantagruelist (it is perfectly idle for any other to attempt the book) soon discovers what this means. It is, in plain English, humour. The definition of humour is a generally acknowledged *crux*, and till it is defined the definition of Pantagruelism will be in the same position. But that it consists in the extension of a wide sympathy to all human affairs, together with a comprehension of their vanity, may be said as safely as anything else. Moroseness and dogmatism are as far from the Pantagruelism of Rabelais as maudlin sentimentality or dilettantism. Perhaps the chief things lacking in his attitude are, in the first place, reverence, of which, however, from a few passages, it is clear he was by no means totally devoid, and secondly, an appreciation of passion and poetry. Here and there there are touches of the latter, as in the portrait of Quintessence, but passion is everywhere absent—an absence for which the comic structure and plan of the book do not by any means supply a complete explanation.

For a general estimate of Rabelais's literary character and influence the reader may be referred to the article FRENCH LITERATURE. But some detailed remarks must be given here. There are three questions without the discussion of which this notice of one of the foremost writers of the world would not be worthy of its present place. These are—What is the general drift and purpose of *Gargantua* and *Pantagruel*, supposing there to be any? What defence can be offered, if any defence is needed, for the extraordinary licence of language and imagery which the author has permitted himself? What was his attitude towards the great questions of religion, philosophy and politics? These questions succeed each other in the order of reason, and the answer to each assists the resolution of the next.

There have been few more remarkable instances of the *lues commentatoria* than the work of the editors of Rabelais. Almost every one appears to have started with a Rabelais ready made in his head, and to have, so to speak, read that Rabelais into the book. Those who have not done this, like Le Duchat, Motteux and Esmangart, have generally committed the error of tormenting themselves and their author to find individual explanations of personages and events. The extravagance of the last-named commentator takes the form of seeing elaborate allegories; that of some others devotes itself chiefly to identifying the characters of the romance with more or less famous historical persons. But the first blunder, that of forming a general hypothetical conception of Rabelais and then adjusting interpretation of the work to it, is the commoner. This conception, however, has singularly varied. According to some expositors, among whom one of the latest and not the least respectable is M. Fleury, Rabelais is a sober reformer, an apostle of earnest work, of sound education, of rational if not dogmatic religion, who wraps up his morals in a farcical envelope partly to make them go down with the vulgar and partly to shield himself from the consequences of his reforming zeal. According to others, of whom we have had in England a distinguished example in Sir Walter Besant, Rabelais is all this but with a difference. He is not religious at all; he is more or less anti-religious; and his book is more or less of a general protest against any attempt to explain supernaturally the riddle of the earth. According to a third class, the most distinguished recent representative of which was M. Paul Lacroix, the Rabelaisian legend does not so much err in principle as it invents in fact. Rabelais is the incarnation of the "esprit Gaulois," a jovial, careless soul, not destitute of common sense or even acute intellectual power, but first of all a good fellow, rather preferring a broad jest to a fine-pointed one, and rollicking through life like a good-natured undergraduate. Of all these views it may be said that those who hold them are obliged to shut their eyes to many things in the book and to see in it many which are not there. The religious part of the matter will be dealt with presently; but it is impossible to think that any unbiased judge reading Rabelais can hold the grave-philosopher view or the reckless-good-fellow view without modifications and allowances which practically deprive either of any value. Those who, as it has been happily put, identify Rabelais with Pantagruel, strive in vain, on any view intellectually consistent or morally respectable, to account for the vast ocean of pure or impure laughter and foolery which surrounds the few solid islets of sense and reason and devotion. Those who in the same way identify Rabelais with Panurge can never explain the education scheme, the solemn apparition of Gargantua among the farcical and fantastic variations on Panurge's wedding, and many other passages; while, on the other hand, those who insist on a definite propaganda of any kind must justify themselves by their own power of seeing things invisible to plain men. But these vagaries are not only unjustifiable; they are entirely unnecessary. No one reading Rabelais without *parti pris*, but with a good knowledge of the history and literature of his own times and the times which preceded him, can have much difficulty in appreciating his book. He had evidently during his long and studious sojourn in the cloister (a sojourn which was certainly not less than five-and-twenty years, while it may have been five-and-thirty, and of which the studiousness rests not on legend but on documentary evidence) acquired a vast stock of learning. He was, it is clear, thoroughly penetrated with the instincts, the hopes, and the ideas of the Renaissance in the form which it took in France, in England and in Germany—a form, that is to say, not merely humanist but full of aspirations for social and political improvement, and above all for a joyous, varied, and non-ascetic life. He had thoroughly convinced himself of the abuses to which monachism lent itself. Lastly, he had the spirit of lively satire and of willingness *desipere in loco* which frequently goes with the love of books. It is in the highest degree improbable that in beginning his great work he had any definite purpose or intention. The habit of burlesquing the *romans d'aventures* was no new one, and the form lent itself easily to the two literary exercises to which he was most disposed—apt and quaint citation from and variation on the classics and satirical criticism of the life he saw around him. The immense popularity of the first two parts induced him to continue them, and by degrees (the genuineness of the fifth book, at any rate in substance, is here assumed) the possibility of giving the whole something like a consistent form and a regular conclusion presented itself to him. The voyage in particular allowed the widest licence of satirical allusion, and he availed himself of that licence in the widest sense. Here and there persons are glanced at, while the whole scenery of his birthplace and its neighbourhood is curiously worked in; but for the most part the satire is typical rather than individual, and it is on the whole a rather negative satire. In only two points can Rabelais be said to be definitely polemic. He certainly hated the monkish system in the debased form in which it existed in his time; he as certainly hated the brutish ignorance into which the earlier systems of education had suffered too many of their teachers and scholars to drop. At these two things he was never tired of striking, but elsewhere, even in the grim satire of the *Chats fourrés*, he is the satirist proper rather than the reformer. It is in the very absence of any cramping or limiting purpose that the great merit and value of the book consist. It holds up an almost perfectly level and spotless mirror to the temper of the earlier Renaissance. The author has no universal medicine of his own (except Pantagruelism) to offer, nor has he anybody else's universal medicine to attack. He ranges freely about the world, touching the laughable sides of things with kindly laughter, and every now and then dropping the *risibile* and taking to the *rationale*. It is not indeed possible to deny that in the Oracle of the Bottle, besides its merely jocular and fantastic sense, there is a certain "echo," as it has been called, "of the conclusion of the preacher," a certain acknowledgment of the vanity of things. But in such a book such a note could hardly be wanting unless the writer had been a fanatic, which he was not, or a mere voluptuary, which he was not, or a dullard, which he was least of all. It is, after all, little more than a suggestion, and is certainly not strengthened by anything in the body of the work. Rabelais is, in short, if he be read without prejudice, a humorist pure and simple, feeling often in earnest, thinking almost always in jest. He is distinguished from the two men who alone can be compared with him in character of work and force of genius combined—Lucian and Swift—by very marked characteristics. He is much less of a mere mocker than Lucian, and he is entirely destitute, even when he deals with monks or pedants, of the ferocity of Swift. He neither sneers nor rages; the *rire immense* which distinguishes him is altogether good-natured; but he is nearer to Lucian than to Swift, and Lucian is perhaps the author whom it is most necessary to know in order to understand him rightly.

If this general view is correct it will probably condition to some extent the answer to be given to the two minor questions stated above. The first is connected with the great blemish of *Gargantua* and *Pantagruel*—their extreme coarseness of language and imagery. It is somewhat curious that some of those who claim Rabelais as an enemy of the supernatural in general have been the loudest to condemn this blemish, and that some of them have made the exceedingly lame excuse for him that it was a means of wrapping up his propaganda and keeping it and himself safe from the notice of the powers that were. This is not complimentary to Rabelais, and, except in some very small degree, it is not likely to be true. For as a matter of fact obscenity no less than impiety was charged against him by his ultra-orthodox enemies, and the obscenity no less than the supposed impiety gave them a handle against him before such bodies as the Sorbonne and the parliaments. As for the extreme theory of the anti-Rabelaisians, that Rabelais was a "dirty old blackguard" who liked filth and wallowed in it from choice, that hardly needs comment. His errors in this way are of course, looked at from an absolute standard, unpardonable. But judged relatively there are several, we shall not say excuses, but explanations of them. In the first place, the comparative indecency of Rabelais has been much exaggerated by persons unfamiliar with early French literature. The form of his book was above all things popular, and the popular French literature of the middle ages as distinguished from the courtly and literary literature, which was singularly pure, can hardly be exceeded in point of coarseness. The *fabliaux*, the early burlesque romances of the *Audigier* class, the farces of the 15th century, equal (the grotesque iteration and amplification which is the note of *Gargantua* and *Pantagruel* being allowed for, and sometimes without that allowance) the coarsest passages of Rabelais. His coarseness, moreover, disgusting as it is, has nothing of the corruption of refined voluptuousness about it, and nothing of the sniggering indecency which disgraces men like Pope, like Voltaire, and like Sterne. It shows in its author a want of reverence, a want of decency in the proper sense, a too great readiness to condescend to the easiest kind of ludicrous ideas and the kind most acceptable at that time to the common run of mankind. The general taste having been considerably refined since, Rabelais has in parts become nearly unreadable—the worst and most appropriate punishment for his faults. As for those who have tried to make his indecency an argument for his laxity in religious principle, that argument, like another mentioned previously, hardly needs discussion. It is notoriously false as a matter of experience. Rabelais could not have written as he has written in this respect and in others if he had been an earnestly pious person, taking heed to every act and word, and studious equally not to offend and not to cause offence. But no one in his senses would dream of claiming any such character for him.

This brings us to the last point—what his religious opinions were. He has been claimed as a free-thinker of all shades, from undogmatic theism to atheism, and as a concealed Protestant. The last of these claims has now been very generally given up, and indeed Erasmus might quite as reasonably be claimed for the Reformation as Rabelais. Both disliked and attacked the more crying abuses of their church, and both at the time and since have been disliked and attacked by the more imprudent partisans of that church. But Rabelais, in his own way, held off from the Reformation even more distinctly than Erasmus did. The accusation of free-thinking, if not of directly anti-Christian thinking, has always been more common and has recently found much favour. It is, however, remarkable that those who hold this opinion never give chapter and verse for it, and it may be said confidently that chapter and verse cannot be given. The sayings attributed to Rabelais which colour the idea (such as the famous "Je vais chercher un grand peut-être," said to have been uttered on his death-bed) are, as has been said, purely apocryphal. In the book itself nothing of the kind is to be found. Perhaps the nearest approach to it is a jest at the Sorbonne couched in the Pauline phrase about "the evidence of things not seen," which the author removed from the later editions. But irreverences of this kind, as well as the frequent burlesque citations of the Bible, whether commendable or not, had been, were, have since been, and are common in writers whose orthodoxy is unquestioned; and it must be remembered that the later Middle Age, which in many respects Rabelais represents almost more than he does the Renaissance, was, with all its unquestioning faith, singularly reckless and, to our fancy, irreverent in its use of the sacred words and images, which were to it the most familiar of all images and words. On the other hand, there are in the book, in the description of Gargantua's and Pantagruel's education, in the sketch of the abbey of Thelema, in several passages relating to Pantagruel, expressions which either signify a sincere and unfeigned piety of a simple kind or else are inventions of the most detestable hypocrisy. For these passages are not, like many to be found from the Renaissance to the end of the 18th century, obvious flags of truce to cover attacks—mere bowings in the house of Rimmon to prevent evil consequences. There is absolutely no sign of the tongue in the cheek. They are always written in the author's highest style, a style perfectly eloquent and unaffected; they can only be interpreted (on the free-thinking hypothesis) as allegorical with the greatest difficulty and obscurity, and it is pretty certain that no one reading the book without a thesis to prove would dream of taking them in a non-natural sense. It is not, indeed, to be contended that Rabelais was a man with whom religion was in detail a constant thought, that he had a very tender conscience or a very scrupulous orthodoxy. His form of religious sentiment was not evangelical or mystical, any more than it was ascetic or ceremonial or dogmatic. As regards one of the accepted doctrines of his own church, the excellence of the celibate life, of poverty, and of elaborate obedience to a rule, he no doubt was a strong dissident; but the evidence that, as a Christian, he was unorthodox, that he was even a heretical or latitudinarian thinker in regard to those doctrines which the various Christian churches have in common, is not merely weak, it is practically non-existent. The counter-testimony is, indeed, not very strong, and still less detailed. But that is not the point. It is sufficient to say that there is absolutely nothing within the covers of Rabelais's works incompatible with an orthodoxy which would be recognized as sufficient by Christendom at large, leaving out of the question those points of doctrine and practice on which Christians differ. Beyond this no wise man will go, and short of it hardly any unprejudiced man will stop.

Bibliography.—The dates of the original editions of Rabelais's works have been given where possible already. The earlier books were repeatedly reissued during the author's life, and always with some correction. What may be called the first complete edition appeared in 1567 at Lyons, published by Jean Martin. It is computed that no less than sixty editions were printed before the close of the 16th century. A very considerable time, however, elapsed before the works were, properly speaking, edited. Huet devoted much pains to them, but his results were not made public. The first edition which calls for notice, except in a complete bibliography, is that of Le Duchat (Amsterdam, 1711). Le Duchat was a very careful student, and on the whole a very efficient editor, being perhaps, of the group of students of old French at the beginning of the 18th century, which included La Monnoye and others, the most sober, critical and accomplished. But at that time the knowledge of the period was scarcely far enough advanced. The next important date in the bibliography of Rabelais is 1823, in which year appeared the most elaborate edition of his work yet published, that of Esmangart and Johanneau (9 vols.), including for the first time the *Songes Drolatiques*, a spurious but early and not uninteresting collection of grotesque figure drawings illustrating Gargantua and Pantagruel, and the second edition of M. de l'Aulnaye, containing a bad text but a useful glossary. From this time the editions have been very numerous. Among them may be mentioned those illustrated by Gustave Doré, first on a small scale (1854), afterwards more elaborately (1870); that of the Collection Didot by Burgaud des Marets and Rathery (1857 and later); the Bibliothèque Elzévirienne edition by MM. Lacour and A. de Montaiglon; that of the Nouvelle Collection Jannet (seven small volumes, 1867–74), completed by M. Moland and very useful; and lastly, the edition of M. Marty-Laveaux in the Collection Lemerre (1868–1903), the handsomest, the most accurate, and the most complete, in the scholarly sense, yet published. Commentaries on Rabelais, independent of editions, have been numerous from the work of Jean Bernier, *Jugement et nouvelles observations sur les œuvres . . . de M. François Rabelais* (1697), onwards. Of those of the last half-century the best are, besides essays in the works of most of the great critics: E. Noel, *Rabelais* (1850); A. Mayrargues, *Rabelais* (1868); Jean Fleury (1876); Paul Stapfer (the best of all) (1889); and G. Vallat (1899). Separate points have been treated importantly by A. Heulhard, *Dernières années de Rabelais* (1884), and others; while the *Revue des études Rabelaisiennes* (1903 onwards) contains valuable studies, especially those of M. Abel Lefranc.

Rabelais was very early popular in England. There are possible allusions to him in Shakespeare, and the current clerical notion of him is very unjustly adopted by Marston in the words "wicked Rabelais"; but Bacon described him better as the great jester of France, and a Scot, Sir Thomas Urquhart, translated the earlier books in 1653. This was not worthily completed till the luckless Motteux, or, as his compatriots call him, Le Motteux, finished it with an extensive commentary. It has been frequently reprinted. A new translation by W. F. Smith appeared in 1893. Criticism of a scattered kind on Rabelais in English is abundant, that of Coleridge being the most important, while the constant evidence of his influence in Southey's *Doctor* is also noteworthy. But he was hardly treated as a whole before Sir Walter Besant's book on the subject in the "Foreign Classics for English Readers" (1879), which the author followed up with *Readings from Rabelais* (1883). Somewhat elaborate treatments of him in connexion with contemporary literature will be found in George Saintsbury's *The Earlier Renaissance* (1901) and in A. Tilley's *Literature of the French Renaissance* (1904). (G. Sa.)

RABENER, GOTTLIEB WILHELM (1714–1771), German satirist, was born on the 17th of September 1714 at Wachau near Leipzig, and died at Dresden on the 22nd of March 1771. In 1741 he made his *début* as satirist in Schwabe's *Belustigungen des Verstandes und Witzes*, and was subsequently a contributor to the *Bremer Beiträge*. Rabener's satires are in prose and mainly levelled at the follies of the middle classes. The papers which he published in the *Bremer Beiträge* were subsequently collected in a *Sammlung satirischer Schriften* (2 vols., 1751), to which two volumes were added in 1755.

Rabener's *Sämtliche Werke* appeared in 6 vols. in 1777; the edition by E. Ortlepp (1839) also contains his correspondence, first published by C. F. Weisse in 1772. See P. Richter, *Rabener und Liscow* (1884), and D. Jacoby in *Allg. Deutsche Biographie* (1888).

RABIRIUS, a Latin epic poet of the age of Augustus. Among the papyrus fragments discovered at Herculaneum in the early part of the 19th century were sixty-seven (mutilated) hexameters, referring to the final struggle between Antony and Octavian and the death of Cleopatra, generally supposed to be part of a poem by Rabirius, since Seneca (*De Benef.* vi. 3, 1) informs us that he wrote on those subjects. If genuine, they justify the qualified commendation of Quintilian rather than the exaggerated praise of Velleius Paterculus (ii. 36, 3), who couples Rabirius and Virgil as the two most eminent poets of his time.

Fragments in E. Bährens, *Fragmenta Poetarum Romanorum* (1885); W. Scott, *Fragmenta Herculanensia* (Oxford, 1885); O. Ribbeck, *Geschichte der römischen Dichtung*, ii. (1889); M. Schanz, *Geschichte der römischen Litteratur*, ii. 1 (1899); Teuffel, *Hist. of Roman Literature* (Eng. trans., 1900), 252, 9.

RABIRIUS, GAIUS, a Roman senator, who was defended (63 B.C.) by Cicero in a speech still extant. Nearly forty years after the death of L. Appuleius Saturninus, Titus Labienus (whose uncle had lost his life among the followers of Saturninus on that occasion) was put up by Caesar to accuse Rabirius of having been implicated in the murder. Caesar's real object was to warn the Senate against interference by force with popular movements, to uphold the sovereignty of the people and the inviolability of the person of the tribunes. The obsolete accusation of *perduellio* was revived, and the case was heard before Julius and Lucius Caesar as commissioners specially appointed (*duoviri perduellionis*). Rabirius was condemned, and the people, to whom the accused had exercised the right of appeal, were on the point of ratifying the decision, when Metellus Celer pulled down the military flag from the Janiculum, which was equivalent to the dissolution of the assembly. Caesar's object having been attained, the matter was then allowed to drop.

A nephew, known as C. Rabirius Postumus, was also defended by Cicero (54 B.C.) in the extant speech *Pro Rabirio Postumo*, when charged with extortion in Egypt and complicity with Aulus Gabinius (*q.v.*).

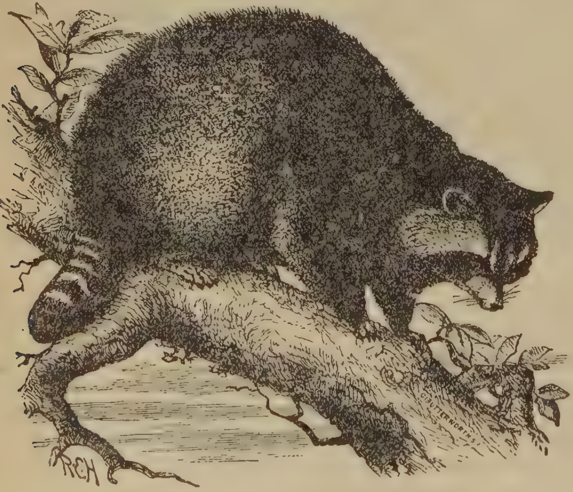
See Cicero, *Pro Rabirio*, ed. W. E. Heitland (1882); Dio Cassius, xxxvii. 26–28; H. Putsche, *Über das genus judicii der Rede Ciceros pro C. Rabirio* (Jena, 1881); O. Schulthess, *Der Prozess des C. Rabirius* (Frauenfeld, 1891).

RACAN, HONORÉ DE BUEIL, Marquis de (1589–1670), French poet, was born at the château of La Roche-Racan in 1589. He became page at the court of Henry IV. and then entered the army, seeing some active service. Racan was very poor and was practically uneducated, for, if his own account may be credited, he had not learnt even Latin. But in middle life he inherited some property, and he was thus able to devote himself to the practice of poetry, in which he was the faithful, and perhaps the most distinguished, disciple of Malherbe. He had known Malherbe when he was a page at the court of Henry IV., and had early contributed to the fashionable albums of the day. In 1625 he published his most important work, *Bergeries*, a dramatic pastoral in five acts, a part of which, entitled *Arthénice*, was played in 1618. Racan was also the author of *Sept psaumes* (1631), *Odes sacrées tirées des psaumes de David* (1651), *Dernières œuvres et poésies chrétiennes* (1660), in all of which he was hampered by his inability to read the sacred writings except in other French paraphrases. He was one of the original members of the French Academy. He died in February 1670.

His *Œuvres complètes* were edited by Tenant de Latour in 1857, and the edition includes a biographical notice. See Sainte-Beuve, *Causeries du lundi*.

RACCONIGI, a town of Piedmont, Italy, in the province of Cuneo, 24 m. S. of Turin, and 31 m. N. of Cuneo by rail, 837 ft. above sea-level. Pop. (1901) 7364 (town); 9077 (commune). It has a royal château built in 1570, with a large park laid out in 1755 by the French gardener Molard from designs by Le Notre, and enlarged in 1835. Since 1901 it has been the summer residence of the king of Italy.

RACCOON (or RACOON), a name borne by the typical representative of a group of American arboreal placental mammals belonging to the order CARNIVORA (*q.v.*) and the family Procyonidae. The word is a corruption of the North-American Indian "arrathkune" or "arathcone." The Fr. *raton* or *raton laveur*, Ger. *Waschbär*, and other European names are derived from a curious habit the raccoon has of dipping or washing its food in water before eating it. The typical raccoon (*Procyon lotor*) is a thickly built animal about the size of a badger, with a coat of long coarse greyish-brown hairs, short ears, and a bushy black-and-white-ringed tail. Its range extends over the whole of the United States, and stretches on the west northwards to Alaska and southwards well into Central America, where it attains its maximum size. The following notes on the habits of the raccoon are from Dr C. Hart Merriam's *The Mammals of the Adirondacks*:—



The Raccoon (*Procyon lotor*).

> "Raccoons are omnivorous beasts and feed upon mice, small birds, birds' eggs, turtles and their eggs, frogs, fish, crayfish, molluscs, insects, nuts, fruits, maize and sometimes poultry. Excepting alone the bats and flying-squirrels, they are the most strictly nocturnal of all our mammals, and yet I have several times seen them abroad on cloudy days. They haunt the banks of ponds and streams, and find much of their food in these places, such as crayfish, mussels and fish, although they are unable to dive and pursue the latter under water, like the otter and mink. They are good swimmers and do not hesitate to cross rivers that lie in their path. . . . The raccoon hibernates during the severest part of the winter, retiring to its nest rather early, and appearing again in February or March, according to the earliness ~~or~~ lateness of the season. It makes its home high up in the hollow of some large tree, preferring a dead limb to the trunk itself. It does little in the way of constructing a nest, and from four to six young are commonly born at a time, generally early in April in this region. The young remain with the mother about a year."

The South-American species, *P. cancrivorus*, the crab-eating raccoon, is very similar to *P. lotor*, but differs by its shorter fur, larger size, proportionally more powerful teeth and other minor characters. It extends over the whole of South America, as far south as the Rio Negro, and is common in all suitable localities. Its habits are similar to those of the North-American species.

RACCOON-DOG (*Nyctereutes procyonoides*), a small wild dog, with sharp-pointed muzzle, short rounded ears, bushy tail and long fur, found in China, Japan and Amurland. The total length is about 32 in., of which the tail measures 4 in. The prevailing hues are black and dusky yellow, the distribution of which varies in different individuals. In habit these dogs are chiefly nocturnal; and they are said to hibernate. In winter they feed on fish, and in summer on mice, forming small packs to hunt their prey.

RACE, an homonymous word of which the principal meanings are (1) a trial or contest of speed; (2) a tribe, breed, a group of individuals descended from a common ancestor. In the first case the word is an adaptation of O.Nor. *rás*, a cognate form in O.E. being *raés*, rush, onset; while the O.E. descendant *reese* was frequently used in medieval poetry. The particular use of the word for a swift current of water running through a narrow channel, *e.g.* the Race of Alderney, and for the water conducted in an artificial channel to a point where its power is to be used, as in "mill-race," may be due to the O.Fr. *raz* or *raze*, probably of Breton origin. The second word, an ethnical or national stock, comes from Fr. *rase*, adapted from Ital. *razzo*, cf. Span. *raza*. It has been referred to an O.H.G. *reiza*, line, mark, cognate with Eng. "write," *i.e.* the line marking descent.

RACHEL (1821–1858), French actress, whose real name was Elizabeth Felix, the daughter of poor Jew pedlars, was born on the 28th of February 1821, at Mumpf, in the canton of Aargau, Switzerland. At Reims she and her elder sister, Sophia, afterwards known as Sarah, joined a troupe of Italian children who made their living by singing in the cafés, Sarah singing and Elizabeth, then only four years of age, collecting the coppers. In 1830 they came to Paris, where they sang in the streets, Rachel giving such patriotic songs as the *Parisienne* and the *Marseillaise* with a rude but precocious energy which evoked special admiration and an abundant shower of coppers. Étienne Choron, a famous teacher of singing, was so impressed with the talents of the two sisters that he undertook to give them gratuitous instruction, and after his death in 1833 they were received into the Conservatoire. Rachel made her first appearance at the Gymnase in Paul Duport's *La Vendéenne* on the 4th of April 1837, with only mediocre success. But on the 12th of June in the following year she succeeded, after great difficulty, in making a *début* at the Théâtre Français, as Camille in Corneille's *Horace*, when her remarkable genius at once received general recognition. In the same year she played Roxane in Racine's *Bajazet*, winning a complete triumph, but it was in Racine's *Phèdre*, which she first played on the 21st of January 1843, that her peculiar gifts were most strikingly manifested. Her range of characters was limited, but within it she was unsurpassable. She excelled particularly in the impersonation of evil or malignant passion, in her presentation of which there was a majesty and dignity which fascinated while it repelled. By careful training her voice, originally hard and harsh, had become flexible and melodious, and its low and muffled notes under the influence of passion possessed a thrilling and penetrating quality that was irresistible. In plays by contemporary authors she created the characters of Judith and Cleopatra in the tragedies of Madame de Girardin, but perhaps her most successful appearance was in 1849 in Scribe and Legouvé' *Adrienne Lecouvreur*, which was written for her. In 1841 and in 1842 she visited London, where her interpretations of Corneille and Racine were the sensation of the season. In 1855 she made a tour in the United States with comparatively small success, but this was after her powers, through continued ill-health, had begun to deteriorate. She died of consumption at Cannet, near Nice, on the 4th of January 1858, and was buried in the Jewish part of the cemetery of Père Lachaise in Paris. Rachel's third sister was Lia Felix (*q.v.*).

See Jules G. Janin, *Rachel et la tragédie* (1858); Mrs Arthur Kennard, *Rachel* (Boston, 1888); and A. de Faucigny-Lucinge, *Rachel et son temps* (1910).

RACINE, JEAN (1639–1699), French tragic dramatist, was born at La Ferté Milon in the old duchy of Valois on an uncertain date in December 1639. He was certainly christened on the 22nd, and the ceremony was at that time often, though not invariably, performed on the day of birth. Racine belonged to a family of the upper bourgeoisie, which had indeed been technically ennobled some generations earlier, and bore the punning arms of a rat and a swan (*rat, cygne*). The poet himself subsequently dropped the rat. His family were connected with others of the same or a slightly higher station in La Ferté and its neighbourhood—the Desmoulins, the Sconins, the Vitarts, all of whom appear in Racine's life. His mother was Jeanne Sconin. His father, of the same name as himself, was only four-and-twenty at the time of the poet's birth. He seems to have been a solicitor (*procureur*) by profession, and held, as his father, the grandfather of the dramatist, had done, the office of *controleur au grenier à sel*. Racine was the eldest child. Little more than a year afterwards his sister Marie was born and his mother died. Jean Racine the elder married again, but three months later he himself died, and the stepmother is never heard of in connexion with the poet or his sister. They were left without any provision, but their grandparents, Jean Racine the eldest and Marie Desmoulins, were still living, and took charge of them. These grandparents had a daughter, Agnes, who figures in Racine's history. She was a nun and later abbess of Port Royal under the style of Mère de Sainte Thècle, and the whole family had strong Jansenist leanings. Jean Racine the eldest died in 1649, and the poet was sent to the Collége de Beauvais. This (which was the grammar-school of the town of that name, and not the famous Collége de Beauvais at Paris) was intimately connected with Port Royal, and to this place Racine was transferred in November 1655. His special masters there were Nicole and Le Maître. The latter, in an extant letter written to his pupil, speaks of himself as "votre papa." It is evident from documents that he was a very diligent student both at Beauvais and Port Royal. He wrote verse both in Latin and French, and his Port Royal odes, which it has been the fashion with the more fanatical admirers of his later poetry to ridicule, are far from despicable.

Racine stayed at Port Royal for three years, and left it, when nearly nineteen, in October 1658. He was then entered at the Collége d'Harcourt and boarded with his second cousin, Nicolas Vitart, steward of the duke of Luynes. Later, if not at first, he lived in the Hôtel de Luynes itself. It is to be observed that his Jansenist surroundings continued with him here, for the duke of Luynes was a severe Port Royalist. It is, however, clear from Racine's correspondence, which, as we have it, begins in 1660 and is for some years very abundant and interesting, that he was not at all of an austere disposition at this time. Occasionally the liveliness of the letters passes the bounds of strict decency, though there is nothing very shocking in them, and those to Madame (or, as the habit of the time called her, Mademoiselle) Vitart are free from anything of this kind. It does not appear that Racine read much philosophy, as he should have done, but he occasionally did some business in superintending building operations at Chevreuse, the duke's country house. He would seem, however, to have been already given up irrevocably to literature. This by no means suited the views of his devout relations at Port Royal, and he complains in one of his letters that an unlucky sonnet on Mazarin had brought down on him "excommunications sur excommunications." The marriage of Louis XIV. was the occasion of an ambitious ode, *La nymphe de la Seine*, which was submitted before publication to Jean Chapelain, the too famous author of the *Pucelle*. Chapelain made many suggestions which Racine duly adopted. Nor did the ode bound his ambitions, for in 1660 he finished one piece, *Amasie*, and undertook another, *Les Amours d'Ovide*, for the theatre. The first, however, was rejected by the actors of the Marais, and it is not certain that the other was ever finished or offered to those of the Hôtel de Bourgogne. Racine's letters show that he was intimate with more than one actress at this time; he also made acquaintance with La Fontaine, and the foundations at any rate of the legendary "society of four" (Boileau, La Fontaine, Molière and Racine) were thus laid.

His relations were pretty certainly alarmed by this very pardonable worldliness, though a severe expostulation with him for keeping company with the abominable actors is perhaps later in date. Racine was accordingly disturbed in his easy-going life at Paris. In November 1661 he went to Uzès in Languedoc to live with his uncle the Père Sconin, vicar-general of that diocese, whose attempts to secure a benefice for his nephew were, however, in vain. Racine was back in Paris before the end of 1663. His letters from Uzès to La Fontaine, to Le Vasseur, and others are in much the same strain as before, but there is here and there a marked tone of cynicism in them. He also attempted a little courtiership. An ode on the recovery of Louis XIV. from a slight illness probably secured him the promise of a pension, of which he speaks to his sister in the summer of 1664. It is uncertain whether this pension is identical with "gratifications" which we know that Racine for some years received, and which were sometimes eight and sometimes six hundred livres. It would seem not, as one of these gratifications had been allotted to him the year before he so wrote to his sister. The ode in which he thanked the king for his presents, *La Renommée*, is said to have introduced him to Boileau, to whose censorship there is no doubt that he owed much, if not everything; and from this date, November 1663, the familiarity of "the four" seems to have existed in full force. Unfortunately it is precisely at this date that his correspondence ceases, and it is not renewed till after the close of his brief but brilliant career as a dramatist (*Esther* and *Athalie* excepted). From this time forward the gossip of the period, and the *Life* by his son Louis, are the chief sources of information. Unfortunately Louis Racine, though a man of some ability and of unimpeached character, was only six years old when his father died, and had no direct knowledge. Still his account represents family papers and traditions; and seems to have been carefully, as it is certainly in the main impartially, written. From other sources—notably Boileau, Claude Brossette and Jean Baptiste de Valincourt—a good deal of pretty certainly authentic information is obtainable, and there exists a considerable body of correspondence between Boileau and the poet during the last ten years of Racine's life.

The first but the least characteristic of the dramas by which Racine is known, *La Thébaide*, was finished by the end of 1663, and on Friday 20th June 1664 it was played by Molière's company at the Palais Royal theatre. Some editors assert that Molière himself acted in it, but the earliest account of the cast we have, and that is sixty years after date, omits his name, though those of Madeleine Béjard and Mademoiselle de Brie occur. There is also a tradition that Molière suggested the subject; but Louis Racine distinctly says that his father wrote most of the play at Uzès before he knew Molière. From Racine's own earlier letters it appears that the play was designed for the rival theatre, and that "La Déhanchée," Racine's familiar name for Mademoiselle de Beauchâteau, with whom he was intimate, was to play Antigone. The play itself is by far the weakest of Racine's works. He has borrowed much from Euripides and not a little from Jean de Rotrou; and in his general style and plan he has as yet struck out no great variation from Corneille. It was acted twelve times during the first month, and was occasionally revived during the year following. This is apparently the date of the pleasant picture of the four friends which La Fontaine draws in his *Psyche*, Racine figuring as Acante, "qui aimait extrêmement les jardins, les fleurs, les ombrages," in which surroundings he helped to compose the lampoon of *Chapelain décoiffé* on a writer who had helped him with criticism, obtained royal gifts for him, and, in a fashion, started him in the literary career.

We have no definite details as to Racine's doings during the year 1664, but in February 1665 he read at the Hôtel de Nevers before La Rochefoucauld, Madame de la Fayette, Madame de Sévigné, and other scarcely less redoubtable judges the greater part of his second acted play, *Alexandre le Grand*, or, as Pomponne (who tells the fact) calls it, *Porus*. It was anxiously expected by the public, and Molière's company played it on the 4th of December—Monsieur, his wife Henrietta of England, and many other distinguished persons being present. The gazetteer, Adrien Perdou de Subligny vouches for its success, and the receipts were good and steady. But a fortnight afterwards *Alexandre* was played, "de complot avec M. Racine," says La Grange, by the rival actors (who had four days before performed it in private) at the Hôtel de Bourgogne. A vast amount of ink has been spilt on this question, but no one has produced any valid justification for Racine. That the piece failed at the Palais Royal, as is stated in the earliest attempt to excuse Racine, and the only one made in his lifetime, is not true. His son simply says that he was "mécontent des acteurs," which indeed is self-evident. It is certain that Molière and he ceased to be friends in consequence of this proceeding; and that Molière was in fault no one who has studied the character of the two men will easily believe. If, however, *Alexandre* was the occasion of showing the defects of Racine's character as a man, it raised him vastly in public estimation as a poet. He was now for the first time proposed as a serious rival to Corneille. There is a story that he read the piece to the author of the *Cid* and asked his verdict. Corneille praised the piece highly, but not as a drama, "Il l'assurait qu'il n'était pas propre à la poésie dramatique." There is no reason for disbelieving this, for the character of Alexander could not fail to shock Corneille, and he was notorious for not mincing his words. The contrast between the two even at this early period was accurately apprehended and put by Saint Evremond in his masterly *Dissertation sur l'Alexandre*, but this was not published for a year or two. To this day it is the best criticism of the faults of Racine, though not, it may be, of the merits, which had not yet been fully seen. It may be added that in the preface of the printed play the poet showed the extreme sensitiveness to criticism which perhaps excuses, and which certainly often accompanies, a tendency to criticize others. These defects of character showed themselves still more fully in another matter. The Port Royalists, as has been said, detested the theatre, and in January 1666 Nicole, their chief writer, spoke in one of his *Lettres sur les visionnaires*, directed against Desmurets de Saint-Sulin, of dramatic poets as "empoisonneurs publics." Racine immediately published a letter to the author. It is very smartly written, and if Racine had contented himself with protesting against the exaggeration of the decriers of the stage there would have been little harm done. But he filled the piece with personalities, telling an absurd story of Mère Angélique Arnauld's supposed intolerance, drawing a ridiculous picture of Le Maître (a dead man and his own special teacher and friend), and sneering savagely at Nicole himself. The latter made no reply, but two lay adherents of Port Royal took up the quarrel with more zeal than discretion or ability. Racine wrote a second pamphlet as bitter and personal as the first, but less amusing, and was about to publish it when fortunately Boileau, who had been absent from Paris, returned and protested against the publication. It remained accordingly unprinted till after the author's death, as well as a preface to both which he had prepared with a view to publishing them together and so discharging the accumulated resentment arising from a long course of "excommunications."

After this disagreeable episode Racine's life, for ten years and more, becomes simply the history of his plays, if we except his liaisons with the actresses Mademoiselle du Parc and Mademoiselle de Champmeslé, and his election to the Academy on the 17th of July 1673. Mademoiselle du Parc (marquise de Gorla) was no very great actress, but was very beautiful, and she had previously captivated Molière. Racine induced her to leave the Palais Royal company and join the Hôtel. She died in 1668, and long afterwards the infamous Catherine Voisin accused Racine of having poisoned her. Mademoiselle de Champmeslé was plain, but an admirable actress, and apparently very attractive in some way, for not merely Racine but Charles de Sévigné and many others adored her. For five years before his marriage Racine seems to have been her *amant en titre*, but long afterwards, just before his own death, when he heard of her mortal illness, he spoke of her to his son without a flash of tenderness.

The series of his unquestioned dramatic triumphs began with *Andromaque*, and this play may perhaps dispute with *Phèdre* and *Athalie* the title of his masterpiece. It is much more uniformly good than *Phèdre*, and the character of Hermione is the most personally interesting on the French tragic stage. It is said that the first representation of *Andromaque* was on 10th November 1667, in public and by the actors of the Hôtel de Bourgogne, but the first contemporary mention of it by the gazettes, prose and verse, is on the 17th, as performed in the queen's apartment. Perrault, by no means a friendly critic as far as Racine is concerned, says that it made as much noise as the *Cid*, and so it ought to have done. Whatever may be thought of the *tragédie pathétique* (a less favourable criticism might call it the "sentimental tragedy"), it could hardly be better exemplified than in this admirable play. A ferocious epigram of Racine's own tells us that some critics thought Pyrrhus too fond of his mistress, and Andromache too fond of her husband, but in the contemporary depreciations is to be found the avowal of its real merit. Pyrrhus was taken by Floridor, the best tragic actor by common consent of his time, and Orestes by Montfleury, also an accomplished player. But Mademoiselle du Parc, who played Andromache, had generally been thought below, not above, her parts, and Mademoiselle des Oeillets, who played the difficult rôle of Hermione, was old and had few physical advantages. No one who reads *Andromaque* without prejudice is likely to mistake the secret of its success, which is, in few words, the application of the most delicate art to the conception of really tragic passion. Before leaving the play it may be mentioned that it is said to have been in the part of Hermione, three years later, that Mademoiselle de Champmeslé captivated the author. *Andromaque* was succeeded, at the distance of not more than a year, by the charming comedietta of *Les Plaideurs*. We do not know exactly when it was played, but it was printed on the 5th of December 1668. Many anecdotes are told about its origin and composition. The *Wasps* of Aristophanes, and the known fact that Racine originally destined it, not for a French company, but for the Italian troupe which was then playing the *Commedia dell' arte* in Paris, dispense us from enumerating them. The result is a piece admirably dramatic, but sufficiently literary to shock the *profanum vulgus*, which too frequently gives the tone at theatres. It failed completely, the chief favouring voice being, according to a story sufficiently well attested and worthy of belief even without attestation, that of the man who was best qualified to praise and who might have been most tempted to blame of any man then living. Molière, says Valincourt, the special friend of Racine, said in leaving the house, "Que ceux qui se moquoient de cette pièce meritoient qu'on se moquoient d'eux." But the piece was suddenly played at court a month later; the king laughed, and its fortunes were restored. It need only be added that, if Louis XIV. admired *Les Plaideurs*, Napoleon did not, and excluded it from his travelling library. It was followed by a very different work, *Britannicus*, which appeared on 13th December 1669. This was much less successful than *Andromaque*, and seems to have held its own but a very few nights. Afterwards it became very popular, and even from the first the exquisite versification was not denied. But there is no doubt that in *Britannicus* the defects of Racine display themselves pretty clearly to any competent critic. The complete nullity of Britannicus himself and of Junie, and the insufficient attempt to display the complex and dangerous character of Nero are not redeemed by Agrippina, who is really good, and Burrhus, who is solidly painted as a secondary character. Voltaire calls it "la pièce des connaisseurs," a double-edged compliment. The next play of Racine has, except *Phèdre*, the most curious history of all. "*Bérénice*," says Fontenelle succinctly, "fut un duel," and he acknowledges that his uncle was not the conqueror. Henrietta of Orleans proposed (it is said without letting them know the double commission) the subject to Corneille and Racine at the same time, and rumour gives no very creditable reasons for her choice of the subject. Her death preceded the performance of the two plays, both of which, but especially Racine's, were successful. There is no doubt that it is the better of the two, but Claude Chapelle's not unfriendly criticism in quoting the two lines of an old song—

> "Marion pleure, Marion crie,
> Marion veut qu'on la marie"—

is said to have annoyed Racine very much, and it has a most malicious appropriateness. *Bajazet*, which was first played on 4th January 1672, is perhaps better. As a play, technically speaking, it has great merit, but the reproach commonly brought against its author was urged specially and with great force against this by Corneille. It is impossible to imagine anything less Oriental than the atmosphere of *Bajazet*; the whole thing is not only French but ephemerally French—French of the day and hour; and its ingenious scenario and admirable style scarcely save it. This charge is equally applicable with the same reservations to *Mithridate*, which appears to have been produced on 13th January 1673, the day after the author's reception at the Academy. It was extremely popular, and Racine could hardly have lodged a more triumphant diploma piece. His next attempt, *Iphigénie*, was a long step backwards and upwards in the direction of *Andromaque*. It is not that the characters are eminently Greek, but that Greek tragedy gave Racine examples which prevented him from flying in the face of the propriety of character as he had done in *Bérénice*, *Bajazet*, and *Mithridate*, and that he here called in, as in *Andromaque*, other passions to the aid of the mere sighing and crying which form the sole appeal of these three tragedies. It succeeded brilliantly and deservedly, but, oddly enough, the date of its appearance is very uncertain. It was acted at court on the 18th of August 1674, but it does not seem to have been given to the public till the early spring of 1675.

The last and finest of the series of tragedies proper was the most unlucky. *Phèdre* was represented for the first time on New Year's Day 1677, at the Hôtel de Bourgogne. Within a week the opposition company or *troupe du roi* launched an opposition *Phèdre* by Nicolas Pradon. This singular competition, which had momentous results for Racine, and in which he to some extent paid the penalty of the *lex talionis* for his own rivalry with Corneille, had long been foreseen. Racine had from the first been bitterly opposed, and his enemies at this time had the powerful support of the duchess of Bouillon, one of Mazarin's nieces, together with her brother the duke of Nevers and divers other personages of high position. These persons of quality, guided, it is said, by Madame Deshoulières, selected Pradon, a dramatist of little talent but of much facility, to compose a *Phèdre* in competition with that which it was known that Racine had been elaborating. The partisans on both sides did not neglect means for correcting fortune. On her side the duchess of Bouillon is accused of having bought up the front places in both theatres for the first six nights; on his, Racine is said to have prevailed on the best actresses of the company that played Pradon's piece to refuse the title part. There is even some ground for believing that he endeavoured to prevent the opposition play from being played at all. It was of no value, but the measures of the cabal had been so well taken that the finest tragedy of the French classical school was all but driven from the stage, while Pradon's was a positive success. A war of sonnets and epigrams followed, during which it is said that the duke of Nevers menaced Racine and Boileau with the same treatment which Dryden and Voltaire actually received, and was only deterred by the protection which Condé extended to them.

The unjust cabal against his piece no doubt made a deep impression on Racine. But it is impossible to decide exactly how much influence this had on the subsequent change in his life. For thirteen years he had been constantly employed on a series of brilliant dramas. He now broke off his dramatic work entirely and in the remaining twenty years of his life wrote but two more plays, and those under special circumstances and of quite a different kind. He had been during his early manhood a libertine in morals and religion; he now married, became irreproachably domestic, and almost ostentatiously devout. No authentic account of this change exists; for that of Louis Racine, which attributes the whole to a sudden religious impulse, is manifestly little more than the theory of a son, pious in both senses of the word. Probably all the motives which friends and foes have attributed entered more or less into his action. At any rate, what is certain is that he reconciled himself with Arnauld and Port Royal generally, accepted, with whatever sincerity, their doctrine of the incompatibility of the stage and the Christian life, and on the 1st of June married Catherine de Romanet and definitely settled down to a quiet domestic life, alternated with the duties of a courtier. For his repentance was by no means a repentance in sackcloth and ashes. The drama was not then very profitable to dramatists, but Louis Racine tells us that his father had been able to furnish a house, collect a library of some value, and save 6000 livres. His wife had money, and he had possessed for some time (it is not certain how long) the honourable and valuable post of treasurer of France at Moulins. His annual "gratification" had been increased from 800 to 1500 livres, then to 2000, and in the October of the year of his marriage he and Boileau were made historiographers-royal with a salary of 2000 crowns. Besides all this he had, though a layman, one or two benefices. It would have been pleasanter if Louis Racine had not told us that his father regarded His Majesty's choice as "an act of the grace of God to detach him entirely from poetry." For the historiographer of Louis XIV. was simply his chief flatterer. However, little came of this historiography. The joint incumbents of the office made some campaigns with the king, sketched plans of histories and left a certain number of materials and memoirs; but they executed no substantive work. Racine, whether this be set down to his credit or not, was certainly a fortunate and apparently an adroit courtier. His very relapse into Jansenism coincided with his rise at court, where Jansenism was in no favour, and the fact that he had been in the good graces of Madame de Montespan did not deprive him of those of Madame de Maintenon. Neither in *Esther* did he hesitate to reflect upon his former patroness. But a reported sneer of the king, who was sharp-eyed enough, "Cavoie avec Racine se croit bel esprit; Racine avec Cavoie se croit courtisan," makes it appear that his comparatively low birth was not forgotten at Versailles.

Racine's first campaign was at the siege of Ypres in 1678, where some practical jokes are said to have been played on the two civilians who acted this early and peculiar variety of the part of special correspondent. Again in 1683, in 1687 and in each year from 1691 to 1693 Racine accompanied the king on similar expeditions. The literary results of these have been spoken of. His labours brought him, in addition to his other gains, frequent special presents from the king, one of which was as much as 1000 pistoles. In 1690 he further received the office of "gentilhomme ordinaire du roi," which afterwards passed to his son. Thus during the later years of his life he was more prosperous than is usual with poets. His domestic life appears to have been a happy one.

Louis Racine tells us that his mother "did not know what a verse was," but Racine certainly knew enough about verses for both. They had seven children. The eldest, Jean Baptiste, was born in 1678; the youngest, Louis, in 1692. It has been said that he was thus too young to have many personal memories of his father, but he tells one or two stories which show Racine to have been at any rate a man of strong family affection, as, moreover, his letters prove. Between the two sons came five daughters, Marie, Anne, Elizabeth, Françoise and Madeleine. The eldest, after showing "vocation," married in 1699, Anne and Elizabeth took the veil, the youngest two remained single but did not enter the cloister. To complete the notice of family matters—much of Racine's later correspondence is addressed to his sister Marie, Madame Rivière.

The almost complete silence which Racine imposed on himself after the comparative failure of *Phèdre* was broken once or twice even before the appearance of his two last exquisite tragedies. The most honourable of these was the reception of Thomas Corneille on 2nd January 1685 at the Academy in the room of his brother. The discourse which Racine then pronounced turned almost entirely on his great rival, of whom he spoke even more than becomingly. But it was an odd conjunction of the two reigning passions of the latter part of his life—devoutness and obsequiousness to the court—which made him once more a dramatist. Madame de Maintenon had established an institution, first called the Maison Saint Louis, and afterwards (from the place to which it was transferred) the Maison de Saint Cyr, for the education of poor girls of noble family. The tradition of including acting in education was not obsolete. At first the governess, Madame de Grinon, composed pieces for representation, but, says Madame de Caylus, a witness at first hand and a good judge, they were "detestable." Then recourse was had to chosen plays of Corneille and Racine, but here there were obvious objections. The favourite herself wrote to Racine that "nos petites filles" had played *Andromaque* "a great deal too well." She asked the poet for a new play suited to the circumstances, and, though Boileau advised him against it, it is not wonderful that he yielded. The result was the masterpiece of *Esther*, with music by Moreau, the court composer and organist of Saint Cyr. Although played by schoolgirls and in a dormitory, it had an enormous success, with which it may be charitably hoped that the transparent comparison of the patroness to the heroine had not too much to do. Printed shortly afterwards, it had to suffer a certain reaction, or perhaps a certain vengeance, from those who had not been admitted to the private stage. But no competent judge could hesitate. Racine probably had read and to some extent followed the *Aman* of Antoine de Montchrétien, but he made of it only the use which a proved master in literature has a perfect right to make of his forerunners. The beauty of the chorus, which Racine had restored more probably from a study of the Pléiade tragedy than from classical suggestions, the perfection of the characters and the wonderful art of the whole piece need no praise. Almost immediately the poet was at work on another and a still finer piece of the same kind, and he had probably finished *Athalie* before the end of 1690. The fate of the play, however, was very different from that of *Esther*. Some fuss had been made about the worldliness of great court fêtes at Saint Cyr, and the new play, with settings as before by Moreau, was acted both at Versailles and at Saint Cyr with much less pomp and ceremony than *Esther*. It was printed in March 1691, and the public cared very little for it. The truth is that the last five-and-twenty years of the reign of Louis XIV. were marked by one of the lowest tides of literary accomplishment and appreciation in the history of France. The just judgment of posterity has ranked *Athalie*, if not as Racine's best work (and there are good grounds for considering it to be this), at any rate as equal to his best. Thenceforward Racine was practically silent, except for four *cantiques spirituelles*, in the style and with much of the merit of the choruses of *Esther* and *Athalie*. The general literary sentiment led by Fontenelle (who inherited the wrongs of Corneille, his uncle, and whom Racine had taken care to estrange further) was against the arrogant critic and the irritable poet, and they made their case worse by espousing the cause of La Bruyère, whose personalities in his *Caractères* had made him one of the best-hated men in France, and by engaging in the Ancient and Modern battle with Charles Perrault. Racine, moreover, was a constant and spiteful epigrammatist, and the unlucky habit of preferring his joke to his friend stuck by him to the last. A savage epigram on the *Sesostris* of Hilaire Bernard de Longepierre, who had done him no harm, was his familiar acquaintance, and had actually put him above Corneille in a *parallèle* between them, dates as late as 1695. Still the king maintained him in favour, and so long as this continued he could afford to laugh at Grub Street and the successors of the Hôtel de Rambouillet alike. At last, however, there seems to have come a change, and it is even probable that royal displeasure had some effect on his health. Disease of the liver appears to have been the immediate cause of his death, which took place on 12th April 1699. The king seems to have, at any rate, forgiven him after his death, and he gave the family a pension of 2000 livres. Racine was buried at Port Royal, but even this transaction was not the last of his relations with that famous home of religion and learning. After the destruction of the abbey in 1711 his body was exhumed and transferred to Saint Étienne du Mont, his gravestone being left behind and only restored to his ashes a hundred years later, in 1818. His eldest son was never married; his eldest daughter and Louis Racine have left descendants to the present day.

Racine may be considered from two very different points of view,—(1) as a playwright and poetical artificer, and (2) as a dramatist and a poet. From the first point of view there is hardly any praise too high for him. He did not invent the form he practised, and those who, from want of attention to the historical facts, assume that he did are unskilful as well as ignorant. When he came upon the scene the form of French plays was settled, partly by the energetic efforts of the Pléiade and their successors, partly by the reluctant acquiescence of Corneille. It is barely possible that the latter might, if he had chosen, have altered the course of French tragedy; it is nearly certain that Racine could not. But Corneille, though he was himself more responsible than any one else for the acceptance of the single-situation tragedy, never frankly gave himself up to it, and the inequality of his work is due to this. His heart was, though not to his knowledge, elsewhere, and with Shakespeare. Racine, in whom the craftsman dominated the man of genius, worked with a will and without any misgivings. Every advantage of which the Senecan tragedy adapted to modern times was capable he gave it. He perfected its versification; he subordinated its scheme entirely to the one motive which could have free play in it,—the display of a conventionally intense passion, hampered by this or that obstacle; he set himself to produce in verse a kind of Ciceronian correctness. The grammar-criticisms of Vaugelas and the taste-criticisms of Boileau produced in him no feeling of revolt, but only a determination to play the game according to these new rules with triumphant accuracy. And he did so play it. He had supremely the same faculty which enabled the rhétoriqueurs of the 15th century to execute apparently impossible *tours de force* in ballades couronnées, and similar tricks. He had besides a real and saving vein of truth to nature, which preserved him from tricks pure and simple. He would be, and he was, as much a poet as prevalent taste would let him be. The result is that such plays as *Phèdre* and *Andromaque* are supreme in their own way. If the critic will only abstain from thrusting in tierce, when according to the particular rules he ought to thrust in quart, Racine is sure to beat him.

But there is a higher game of criticism than this, and this game Racine does not attempt to play. He does not even attempt the highest poetry at all. His greatest achievements in pure passion—the foiled desires of Hermione and the jealous frenzy of Phèdre—are cold, not merely beside the crossed love of Ophelia and the remorse of Lady Macbeth, but beside the sincerer if less perfectly expressed passion of Corneille's Cléopâtre and Camille. In men's parts he fails still more completely. As the decency of his stage would not allow him to make his heroes frankly heroic, so it would not allow him to make them utterly passionate. He had, moreover, cut away from himself, by the adoption of the Senecan model, all the opportunities which would have been offered to his remarkably varied talent on a freer stage. It is indeed tolerably certain that he never could have achieved the purely poetical comedy of *As You Like It* or the *Vida es Sueño*, but the admirable success of *Les Plaideurs* makes it at least probable that he might have done something in a lower and a more conventional style. From all this, however, he deliberately cut himself off. Of the whole world which is subject to the poet he took only a narrow artificial and conventional fraction. Within these narrow bounds he did work which no admirer of literary craftsmanship can regard without admiration. It would be unnecessary to contrast his performances with his limitations so sharply if those limitations had not been denied. But they have been and are still denied by persons whose sentence carries weight, and therefore it is still necessary to point out the fact of their existence.

Bibliography.—Nearly all Racine's works are mentioned in the above notice. There is here no room for a bibliographical account of their separate appearances. The first collected edition was in 1675–76, and contained the nine tragedies which had then appeared. The last and most complete which appeared in the poet's lifetime (1697) was perhaps revised by him, and contains the dramas and a few miscellaneous works. Like the *editio princeps*, it is in 2 vols. 12mo. The posthumous editions are innumerable and gradually became more and more complete. The most noteworthy are the Amsterdam edition of 1722; that by Abbé d'Olivet, also at Amsterdam, 1743; the Paris quarto of 1760; the edition of Luneau de Boisjermain, Paris and London, 1768; the magnificent illustrated folios of 1805 (Paris); the edition of Germain Garnier with La Harpe's commentary, 1807; Geoffroy's of the next year; Aimé Martin's of 1820; and lastly, the *Grands écrivains* edition of Paul Mesnard (Paris, 1865–73). This last contains almost all that is necessary for the study of the poet, and has been chiefly used in preparing the above notice. Louis Racine's *Life* was first published in 1747. Translations and imitations of Racine are innumerable. In English the *Distressed Mother* of Ambrose Philips and the *Phaedra and Hippolytus* of Edmund Smith (1672–1710), both composed more or less under Addison's influence, are the most noteworthy.

As for criticism on him, a bibliography of it would be nearly a bibliography of French critical literature. The chief recent instance of substantive work is G. Larroumet's monograph in the *Grands écrivains français* (1898), but F. Brunetière, Émile Faguet, and other critics have constantly and in various ways endeavoured to apply the general reaction from Romanticism to a semi-classical attitude to this greatest of French "classics." The conclusions above given remain unaffected by this temporary set of opinion. Racine will never be *enfoncé*—"put to rout"—as the extravagant Romantics thought him to be for a time. But, on the other hand, his limitations will remain, and no ingenious but arbitrary and extemporized theories of drama as to "conflicts of will" and the like can suffice to veil his defect in universality, his comparative shallowness, and his inadequate appreciation, or at least representation, of the richness, the intricacy and the unconventionality of nature.

(G. Sa.)

RACINE, LOUIS (1692–1763), French poet, second son of Jean Racine, was born in Paris on the 6th of November 1692. Early conscious of a vocation for poetry, he had been dissuaded from following his inclination by Boileau on the ground that the gift never existed in two successive generations. In 1722 his small means induced him to accept a position in the revenue in Provence, but a marriage with a certain Mademoiselle Presle secured his independence. In 1755 he lost his son in the disasters consequent on the Lisbon earthquake. This misfortune, commemorated by Écouchard Lebrun, broke Racine's spirit. He sold his library, and gave himself up entirely to the practice of religion. In 1719 he had become a member of the Académie des Inscriptions, but had never offered himself as a member of the Académie Française, for fear, it is said, of incurring refusal on account of his Jansenist opinions. *La Grace* (1720) and *Religion* (1742), his most important work, are inspired by a sincere piety, and are written in verse of uniform clearness and excellence. His other works include epistles, odes, among which the *Ode sur l'harmonie* (1736) should be mentioned, *Mémoires* (1747) of Jean Racine, and a prose translation of *Paradise Lost* (1755). Louis Racine died on the 29th of January 1763. He was characterized by Voltaire as "le bon versificateur Racine, fils du grand poète Racine."

His *Œuvres complètes* were collected (6 vols.) in 1808.

RACINE, a city and the county-seat of Racine county, Wisconsin, U.S.A., on the W. shore of Lake Michigan at the mouth of the Root river, about 25 m. S.S.E. of Milwaukee and about 60 m. N. of Chicago. Pop. (1890) 21,014; (1900) 29,102, of whom 9242 were foreign-born; (1910 census) 38,002. Racine is served by the Chicago & North Western and the Chicago, Milwaukee & St Paul railways, by two interurban electric railways, connecting with Milwaukee and Chicago, and by steamboat lines. The river has been deepened and its mouth protected by breakwaters, providing an excellent harbour; in 1909 vessels drawing 19 ft. could pass through the channel. Among the public buildings are the City Hall, the County Court House, the Federal Building, the Carnegie Library, the High School, two hospitals and the Taylor Orphan Asylum (1872). Among educational institutions, besides the public schools, are Racine College (Protestant Episcopal, 1853), St Catherine's Academy (Roman Catholic) and two business colleges. Racine is, next to Milwaukee, the most important manufacturing centre in Wisconsin. The value of its factory products in 1905 was $16,458,965, an increase of 41% over that of 1900. Of this, $5,177,079 (or 31·5% of the city's total) represented agricultural implements and machinery. Carriages and wagons ($2,729,311) and automobiles ranked next in importance.

Racine was the French form of the name of the Root river. The first Europeans positively known to have visited the site of Racine were Vincennes, Tonty and several Jesuit missionaries, who stopped here for a time on their way down the coast in 1699. Early in the 19th century Jambeau, a French trader, established himself on the Root river, and in 1834 Gilbert Knapp (1798–1889), who had been a lake captain since 1818, induced several residents of Chicago to make their homes at its mouth. The place was at first called Port Gilbert. The settlement grew rapidly, a sawmill was built in 1835, and the present name was adopted in 1837. In 1841 Racine was incorporated as a village and in 1848 was chartered as a city.

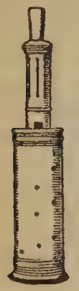
See S. S. Hurlburt, *Early Days at Racine* (Racine, 1872); *History of Racine and Kenosha Counties* (Chicago, 1879).

RACK, an homonymous word of which the principal branches are the words meaning (1) a mass of cloud driving before the wind in the upper air, (2) to draw off wine or other liquor from the lees, (3) a bar or framework of bars, (4) an instrument of torture. The etymology of (1) shows that it is ultimately to be connected with "wreck" and "wrack," drifted seaweed, and means that which is driven by or drifts with the wind; cf. Norw. *rak*, wreckage, refuse, Icel. *reka*, to drive, toss. In (2) the term seems to have come from the Gascon wine-trade, as Skeat (*Etym. Dict.*, 1910) points out, and was adapted from Prov. *arracar*, to decant wine, *raca*, the stems and husks of grapes, dregs. Both (2) and (3) are in origin to be connected. The O. E. *reccan* and Ger. *recken* mean "to stretch," and so "rack" means something stretched out, a straight bar or rail, especially a toothed bar gearing with a cog-wheel, a framework of bars, as in the cradle of upright bars in which fodder can be placed for cattle, and the instrument of torture, which in Ger. is *Recke* or *Rackbank*. The "rack" for torture was an oblong frame of wood, slightly raised from the ground, having at one end a fixed bar to which the legs were fastened, and at the other a movable bar to which the hands were tied. By means of pulleys and levers this latter could be rolled on its own axis, thus straining the ropes till the sufferer's joints were dislocated. Its first employment in England is said to have been due to John Holland, 4th duke of Exeter, constable of the Tower in 1447, whence it was popularly known as "the Duke of Exeter's daughter."

In 1628 the whole question of its legality was raised by the attempt of the privy council to rack John Felton, the assassin of the duke of Buckingham. This the judges resisted, unanimously declaring its use to be contrary to the laws of England.

RACKETT, or RACKETT-BASSOON (Fr. *cervelas* or *cervelat*; Ger. *Rackett*, *Rankett* or *Wurstfagott*), a kind of dwarf bassoon, now obsolete, with a body measuring only from 4½ to 11 in. in length, but nevertheless containing the necessary length of tubing to give the bassoon or contra-bassoon pitch. The rackett consists of a barrel-like body, resembling the barrel drone of the musette (see BAGPIPE), made of wood or ivory. Round a centre tube are grouped eight parallel channels of very narrow cylindrical bore communicating with each other and forming a continuous tube nine times the length of the small body.

A reed mouthpiece in combination with a cylindrical tube invests the latter with the acoustic properties of a closed pipe by creating a node at the mouthpiece end; the fundamental note given by such a tube is, therefore, an octave deeper in pitch than would be an open pipe of the same length. The bassoon has a conical bore and the properties of the open pipe, wherefore the aggregate length of the channels in the rackett only requires to be half that of the bassoon, a physical phenomenon to which this curious freak owed its existence. In the rackett the holes are bored obliquely through from the channels to the circumference—three in front for the left and three for the right hand, with an additional hole for the little finger; while at the back are placed the vent and three holes, one for the left thumb and two for the right, the second hole being controlled by the ball of the thumb. The rackett is played by means of a large double reed placed within a *pirouette* or cap, so that the lips do not come into contact with the reed, but only send a stream of compressed air into the *pirouette*, whereby the reed is set in vibration. The consequence of this principle of construction, peculiar to the bagpipe chaunter and drones (with a slight variation) and to cromornes, hautbois de Poitou and a few other obsolete instruments, is that no harmonics can be obtained, since the vibrating length and the tension of the reed cannot be controlled by the player; the compass is therefore obtained by means of the fundamental and of the ten holes of the instrument, aided by cross-fingering. (K. S.)



From Capt. C. R. Day's *Catalogue of Musical Instruments*, by permission of Eyre & Spottiswoode.

RACQUETS, or RACKETS, a game played in an enclosed court with a ball and an implement with which the ball is struck called a racquet, from which the game takes its name. The racquet[1] is about 2½ ft. long, the head, which was formerly pear-shaped, being in the modern racquet nearly circular, from 7 to 8 in. in diameter and tightly cross-strung with cat-gut. The balls, which are about 1¼ in. in diameter, are made of strips of cloth tightly wound over each other, with a sewn covering of smooth white leather, the floor and walls of English courts being coloured black; in India, where the floor and walls of the court are painted white, black balls are used. There are no regulation dimensions for a racquet court, nor for the racquet or ball, though substantial uniformity is observed in practice. The game is usually played either by two or by four players; and in England the court is the same for the four-handed and the two-handed game, the floor measuring usually 60 ft. by 30 ft., or occasionally an inch or two more each way; but in America larger courts measuring on the floor 80 ft. by 40 ft., a size formerly not uncommon in England, are sometimes built for the four-handed game. Modern racquet courts have four walls and a roof, though in India they are sometimes left unroofed for the sake of coolness. The floor, which must be perfectly level and smooth, should be made of cement; but is sometimes paved, with less perfect results. The floor cannot be too hard, since the faster the ball travels the better the game; similarly the walls, which should be built of masonry faced with cement and most carefully smoothed, cannot be too hard and fast. The front and side walls are about 30 ft. high, the back wall being about half that height, with a gallery for spectators (containing the marker's and umpires' box) above it. The court is entered by a door in the centre of the back wall, which when shut must be perfectly flush with that wall, and without any projecting handle. The court is lighted from the roof. The diagram (fig. 2) shows the divisions and markings of the court. On the front wall is fixed a wooden board, the upper edge of which, 26 in. from the floor, constitutes the "play-line," and which usually fills the whole space from that height to the floor; and at a height from the floor of 8 ft. or a few inches more is a second line, called the "cut-line" or "service-line," painted white or in colour. At a distance of 38 ft. (in a court 60 ft. by 30 ft.) from the front wall and parallel to it, a white line is painted on the floor from wall to wall, called the "short-line"; and from the centre of the short-line to the centre of the back wall is the "fault-line," dividing into two equal rectangles the space between the back wall and the short-line. These rectangles are the service-courts and are called the right-hand and left-hand court respectively. Against the side walls outside these courts, but so that one side in each case is formed by the short-line, are squares 8 ft. by 8 ft. called the service-boxes.

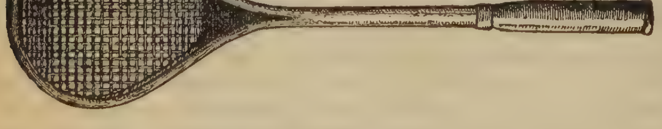


FIG. 1.—The Racquet.

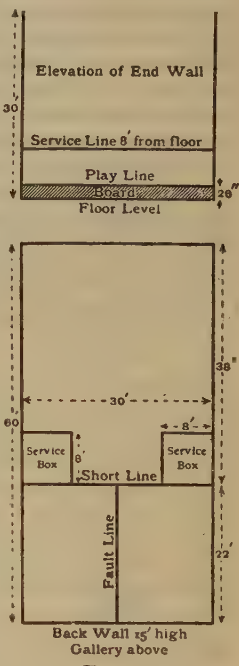


FIG. 2.

The Game.—Racquets is usually played either by two persons ("singles"), or four persons playing two against two ("doubles"); and the general idea of the game is the same as that in tennis, lawn tennis and fives, the object of the player in all these games being to score a point by striking the ball either before it reaches the ground or on its first bound, in accordance with the rules of the game, in such a way that his adversary may fail to make a "good," *i.e.* a valid, stroke in return. In the four-handed game one of each set of partners takes the right-hand court and his partner the left. The game consists of 15 points called "aces." Aces can only be scored by the "hand-in" (the player, or side, having the "innings"), and the "hand-out" must therefore win a stroke or strokes to obtain innings before he or they can score an ace; in "doubles" each of the partners has an innings, and both must therefore be ousted before "hand-out" obtains the innings; but to this rule the first innings of each game affords an exception (see below). The "hand-in" always has "service," *i.e.* he opens the rally (the "rally" being the series of strokes made alternately by the two sides until one or other of them fails to make a good return) by "serving" the ball from the hand. This first stroke, or "serve," must be made in the following manner. The server, standing with one foot at least inside one of the service-boxes, must toss the ball from his hand, and while it is in the air he must hit it with his racquet so that it strikes the front wall above the service-line and falls to the floor within the service-court on the opposite side; after striking the front wall the ball may, but need not, strike the side wall or back wall, or both, and it may do so either before or after touching the floor. The serve is a "fault" if the ball (1) strikes the front wall above the board but on or below the service-line, in which case it is called a "cut"; or (2) touches the floor on the first bound, outside the proper service-court, when it is called "short" or "fault" according to the position of its pitch (see below). If the "hand-out" player to whom the fault is served "takes" it (*i.e.* if he plays at it), the fault is condoned and the play proceeds as if the serve had been good. If, however, the fault be not taken, the server must serve again from the same box; and if he serves a second fault he loses his "hand" or innings, and his partner or his opponent, as the case may be, takes his place. Two consecutive faults have thus the same result as the loss of a stroke in the rally by the "hand-in." A serve which makes the ball strike the board, or the floor before reaching the front wall, or which sends it "out-of-court" (*i.e.* into the gallery or roof of the court), counts the same as two consecutive faults; it costs the server his innings. Skill in service is a most important part of proficiency in racquets; a player can hardly become first-rate unless he possesses a "strong service." As in tennis a great deal of "cut" may be imparted to the ball by the stroke of the racquet, which makes the ball in its rebound from the wall behave like a billiard ball carrying "side" when striking a cushion; and when this "cut" is combined with great pace in the bound of the ball off the side wall, the back wall, and the floor, at varying angles which the server has to a great degree under his control, it becomes exceedingly difficult for hand-out to "get up" the serve (*i.e.* to hit it on the first bound, sending it above the play-line on the back wall), and still more so to make a good stroke which will render it difficult for his adversary in his turn to get up the ball and thus continue the rally. It often happens, therefore, that a long sequence of aces, sometimes the whole 15 aces of a game, are scored consecutively by service which hand-out is unable to return. A noteworthy instance of successful service occurred in the semi-final tie of the doubles Amateur Championship matches at the Queen's Club in 1897 when W. L. Foster opened service and scored all the aces in the first two games, and added six in the third, thus putting on a sequence of 36 aces before losing his "hand." To obtain first innings is therefore an initial advantage, although in doubles it is limited by the rule that only one partner shall have a "hand" (innings) in the opening service.

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[1] The word comes, through Fr. *raquette*, from Sp. and Port. *raqueta*. The origin is doubtful, but Arab. *rāḥa(t)*, palm of the hand, has been suggested; "fives" played with the hand long preceded the game with a bat; cf. also Fr. name for fives, *paume*.

The question which side shall have this advantage is decided by spinning a racquet, the "rough" and "smooth" sides of which take the place of "heads" and "tails" when a coin is tossed. The side winning the spin opens the game by serving as described above. The server may begin in either of the service boxes; but when he has started, the service must proceed from the two boxes alternately till the close of the innings of the side, whether singles or doubles. When the other side obtains the innings they may in like manner begin in either box, without regard to where the last service of their opponents was delivered. In singles, hand-out changes sides in the court after each serve, answering to the change over of the server; in doubles the serve is taken alternately by the two hand-out players, who permanently occupy the right- and left-hand courts respectively, being allowed to change the order in which they receive the service only once in any game, or at the end of any game or rubber. Except in the very rare case of left-handed players most of the play in the left half of the court, including the taking of all service on that side, is back-handed; and the stronger of the two partners in back-hand play usually therefore takes the left-hand court. The best position in the court for the hand-out about to take the serve depends entirely on the nature of the service, and he has to use his judgment the instant the ball leaves the server's racquet in order to determine where it will strike the floor and at what precise point in its course it will be best for him to attempt to take it. A strong fast service, heavily cut, that sends the ball darting round the corner of the court, leaving the back wall at an extremely acute angle, or dropping almost dead off it, can only be got up by standing near the back wall a long way across the court and taking the ball by a wrist stroke at the last instant before it falls to the ground a second time. On the other hand when the server avoids the side wall altogether and strikes the back wall direct and hard, whether he achieves a "nick" serve (*i.e.* the ball striking precisely in the angle between the back wall and the floor) or hits the wall high up, hand-out will have little time to spare in changing position to get within reach of the ball. Some good players make a practice wherever possible, especially in the case of heavily cut service, of taking the serve on the volley (*i.e.* before the ball reaches the ground), sometimes of taking the ball after it leaves the side wall and before it reaches the back wall; practice alone enables the player to decide with the necessary promptitude how each stroke is to be played. In returning the serve, or in playing any stroke during the rally, the ball may strike any of the other walls before the front wall; but though this "boasted" stroke is quite legitimate, and is sometimes the only way of getting up a difficult ball, it is not considered good style deliberately to slash the ball round the corners in order to keep it in the fore end of the court. Good play consists for the most part in hard low hitting, especially as close as possible along the side walls into the corners of the back wall. One of the most effective strokes in racquets is the "drop," which means that the ball is hit so that it only just reaches the front wall and drops close to it, while the player conceals his intention by appearing to strike hard. "The drop-stroke," says Mr Eustace Miles, who regrets that it is less cultivated than formerly, "is one of the most beautiful, and of all drop-strokes, the volley or half-volley is the best." The "half-volley," in which the ball is struck at the moment of its contact with the floor and before it has had time to rise, is also employed with great effect in hard play; it makes the return much quicker than when the ball is allowed to rise to the full length of the bound, and requires corresponding quickness on the part of the adversary. It sometimes happens, too, that the player finding himself too near the pitch of the ball to take it at the end of the bound, yet not near enough to volley it, is compelled to take it on the half-volley as the only chance of getting it up. Accuracy in volleying and half-volleying, especially if the ball be kept low, is a most difficult art to acquire, but a good long rally in which are included a number of hard rapid half-volleys within a couple of inches of the board, is the prettiest feature of the game.

If hand-out succeeds in returning the serve, the rally proceeds until one side or the other fails to make a good return. A good return means (1) that the ball is struck by the racquet before its second bound on the floor, and without its having touched any part of the clothes or person of the striker or his partner; (2) that it is hit against the front wall above the board without first touching the floor or going out of court; and (3) that it returns off the front wall into play (*i.e.* to the floor of the court or to an adversary's racquet) without going out of court. If hand-in be the one to fail in making a good return, he loses his "hand," or innings, and (in singles) hand-out goes in and proceeds to serve; in doubles one of the hand-in partners loses his "hand," and the second partner goes in and serves till he in turn similarly loses his "hand," except that in the case of the opening service in the game there is (as already mentioned) only one "hand" in any event. If hand-out fails to make a good return to the serve or to any stroke in the rally, hand-in scores an ace, and the side that first scores 15 aces wins the game. When, however, the score reaches "13-all" (*i.e.* when each side has scored 13 aces), hand-out may, before the next serve is delivered, declare that he elects to "set" the game either to 5 or 3, whichever he prefers; and similarly when the score stands at "14-all," hand-out may "set" the game to 3. He makes this declaration by calling "set-5!" or "set-3!" and it means that 5 aces, or 3 aces, as the case may be, shall be required to win the game.

In the confined space of a racquet court it is not always easy, especially in doubles, for the players to avoid obstructing each other. It is provided in the rules that "each player must get out of his opponents' way as much as possible," and that it shall be a "let" (an Old English word for impediment or hindrance) and "the service or rally shall count for nothing, and the server shall serve again from the same service-box, (*a*) if the ball in play touch the striker's opponent on or above the knee, and if in the marker's opinion it be thereby prevented from reaching the front wall above the board (the play-line); or (*b*) if either player undesignedly prevent his opponent from returning the ball served in play." If a player considers that he has been thus obstructed by his opponent he may "claim a let," and the marker adjudicates his claim. The marker's decision is final; but "if in doubt which way to decide, the marker may direct that the ace be played over again." It is the duty of the marker, who occupies a box in the gallery, to "call the game." As soon as the server serves the ball the marker calls "Play!" if the ball strikes the front wall above the service-line; and "Cut!" if it strikes below the service-line; if the ball falls in front of the short-line the marker calls "Short!"; if the wrong side of the fault-line he calls "Fault!"; but whether it be "cut," "short," or "fault," the serve counts as a fault in its effect. To every good return, as to every good serve, the marker calls "Play!" If a return is made after the second bound of the ball (called a "double") the marker calls "Double!" or "Not up!"; if the ball is hit into the gallery, or against its posts or cushions, or above the girders or cross-beams of the roof, he calls "Out-of-court!" At the end of every rally he calls the state of the game, always naming first the score of hand-in:—"One-love" (love being the term for zero) meaning that hand-in has scored one ace and hand-out nothing, "Two-love," "Five-all," "Five-ten," "Fourteen-eleven," and so on, till one side has scored 15, when the marker calls "Game!" He then in similar fashion calls the state of the match—"Two games to one," or whatever it may be—before the commencement of the next game. The server in possession at the end of the game continues to serve in the new game, subject as before to the rule limiting the first innings of the game to a single "hand." The usual number of games in matches is five for singles, and seven for doubles. In matches where there are umpires and a referee, there is an appeal to them from the marker's decision except as regards questions relating to the service, on which the marker's decision is final.

Records.—Attempts have been made to trace racquets, like tennis, to an ancient origin; but although it is doubtless true that the striking of a ball with the hand or some primitive form of bat is one of the oldest forms of pastimes, and that racquets has been evolved from such an origin, the game as now known can hardly be said to have existed before the 19th century. Joseph Strutt's work on *The Sports and Pastimes of the People of England*, published at the beginning of the 19th century, makes no mention of racquets; and the century was far advanced before the racquet court was promoted from being an adjunct of the pot-house and the gaol, in which connexion the court within the purlieus of the Fleet prison has been immortalized in the pages of *Pickwick*, to a position scarcely less dignified than that of the tennis-court with its royal and historical associations. It was at the public schools that racquets first obtained repute. The school courts were at first unroofed, and in some cases open also at the back and sides, or on one side. Among the most famous of the early racquets professionals, before the period of the modern closed court, were Robert Mackay (1820), the brothers Thomas and John Pittman, J. Lamb, J. C. Mitchell and Francis Erwood (1860). One of the most famous matches ever played at racquets was that in which Erwood was beaten by Sir William Hart-Dyke, who used the "drop" stroke with telling effect, and who, after representing Oxford in the first four inter-university matches, was the only amateur racquet player who ever defeated the open champion. A notable date in the history of racquets was the year 1853, when the court at the old Prince's Club in Hans Place, London, was built. Here the annual racquet matches between Oxford and Cambridge Universities, singles and doubles, were first played in 1858, and the Public Schools Championship (doubles only) ten years later. Modern racquets may perhaps be said to date from the time of the brothers Gray, who as professionals greatly raised the standard of skill in the game, and as teachers at the schools and universities improved the play of amateurs. William Gray beat Foulkes, the champion of America, in 1867; Henry Gray and Joseph Gray were also great players. The latter was beaten in 1875 by H. B. Fairs ("Punch") but held the championship from 1878 to 1887. Another member of the same family was Walter Gray, who was as distinguished for the power of his stroke as his brother William was for the accuracy of his "drop" and the ease and grace of his volley and half-volley. Walter Gray was followed in the championship by Peter Latham, the first professional to combine the open Tennis Championship with the Racquets Championship; and in the opinion of Mr Eustace Miles "there has probably lived no player who could have beaten him at either game." Latham was the first to use the heavily cut service at racquets, and he is also remarkable for the power of his wrist stroke. In the last twelve years or so of the 19th century Latham stood alone, and in the opinion of the best judges he was the greatest of all racquet players. When once he had won the championship he never lost it, and when at last he resigned his title he was succeeded by Gilbert Browne, a player of a decidedly inferior calibre, who in 1903 was challenged and beaten by an Indian marker called Jamsetji. For the next six years, during which Jamsetji held the championship, comparatively little was heard of professional racquets; but in 1909 interest was revived by a handicap at Queen's Club for a prize of £100, in which Peter Latham himself took part, and which was won by Jennings of Aldershot. As a result of this contest a challenge was issued by W. Hawes, the marker at Wellington College, to play any other professional for £200 a side and the championship of England. The challenge was accepted by C. Williams, a young player of Prince's Club, who easily won the match, and with it the title of champion.

The institution of annual matches between Oxford and Cambridge Universities in 1858, and of the Public Schools Championship in 1868, gave an immense stimulus to the game among amateurs. Of the 51 inter-university (singles) matches from 1858 to 1908, Oxford won 26 and Cambridge 25; of the 52 contests in doubles Oxford won 25 and Cambridge 27. Among the public schools Harrow has been far the most successful, having won the championship challenge cup 19 times out of 42 contests. Moreover, under the condition permitting any school winning it in three consecutive years to retain the challenge cup permanently, Harrow became possessed of three cups, having won the championship 1871–1874 inclusive, 1879–1881 inclusive, and 1883–1887 inclusive. The next most successful school has been Eton, eight times champion; Charterhouse having won five times, and no other school more than three times. For the first twenty years of the contest, with a single exception when Rugby won in 1870, no school except Eton or Harrow gained the championship; and it is not surprising therefore that the majority of famous amateurs learnt the game at one or other of these schools. Among Etonians were W. Hart-Dyke, C. J. Ottaway, the Hon. Alfred Lyttelton, the Hon. Ivo Bligh (afterwards Lord Darnley), C. T. Studd and H. Philipson; Harrow has produced R. D. Walker, one of the best of the earliest amateur racquet players, C. F. Buller, T. S. Dury, A. J. Webbe, M. C. Kemp, E. M. Butler, the brothers Eustace Crawley and H. E. Crawley, C. D. Buxton, H. M. Leaf, Percy Ashworth and C. Browning. The famous Malvern family of Foster has been as conspicuous in the racquet court as on the cricket field, the eldest, H. K. Foster, being probably the finest amateur player of his generation. F. Dames Longworth, Major A. Cooper-Key, Colonel Spens, E. M. Baerlein and Eustace H. Miles have also been in the front rank of amateur players. The opening of the Queen's Club, West Kensington, was a notable event in the history of the game, especially as it was followed by the establishment of amateur championships in singles and doubles in 1888, of which the results have been as follows:—

AMATEUR CHAMPIONSHIP

I. *Singles*

1888. C. D. Buxton.
1889. E. M. Butler.
1890. P. Ashworth.
1891. H. Philipson.
1892. F. Dames Longworth.
1893. F. Dames Longworth.
1894. H. K. Foster.
1895. H. K. Foster.
1896. H. K. Foster.
1897. H. K. Foster.
1898. H. K. Foster.
1899. H. K. Foster.
1900. H. K. Foster.
1901. F. Dames Longworth.
1902. E. H. Miles.
1903. E. M. Baerlein.
1904. H. K. Foster.
1905. E. M. Baerlein.
1906. S. H. Sheppard.
1907. E. B. Noel.
1908. E. M. Baerlein.
1909. E. M. Baerlein.
1910. E. M. Baerlein.

II. *Doubles*

1890. P. Ashworth and W. C. Hedley.
1891. P. Ashworth and E. L. Metcalfe.
1892. E. M. Butler and M. C. Kemp.
1893. F. H. Browning and H. K. Foster.
1894. H. K. Foster and F. C. Ridgeway.
1895. F. Dames Longworth and F. H. Browning.
1896. H. K. Foster and P. Ashworth.
1897. H. K. Foster and P. Ashworth.
1898. H. K. Foster and W. L. Foster.
1899. H. K. Foster and P. Ashworth.
1900. H. K. Foster and P. Ashworth.
1901. F. Dames Longworth and V. H. Pennell.
1902. E. M. Baerlein and E. H. Miles.
1903. H. K. Foster and B. S. Foster.
1904. E. H. Miles and E. M. Baerlein.
1905. E. H. Miles and E. M. Baerlein.
1906. E. H. Miles and F. Dames Longworth.
1907. W. L. Foster and B. S. Foster.
1908. F. Dames Longworth and V. H. Pennell.
1909. E. M. Baerlein and P. Ashworth.
1910. B. S. Foster and Hon. C. N. Bruce.

A military championship was inaugurated in 1903 and is played annually at Princes' Club. In 1908, mainly through the exertions of Major A. Cooper-Key, a "Tennis, Racquets and Fives Association" was founded for the purpose of encouraging these games, safeguarding their interests and providing a legislative body whose authority would be recognized by all tennis and racquet players.

Racquets in America.—In the United States and in Canada racquets is a popular game, and most of the leading athletic clubs have good courts. The American champions Foulkes, Boakes and George Standing were all beaten by English professionals, but had a great reputation in their own country; and Tom Pettitt, Ellis and Moore are names that stand high in the records of the game. Among American amateurs, Lamontayne did much to encourage racquets in New York in the early period of its history; and in more recent times Quincy Shaw, de Garmendia, R. Fearing, Payne Whitney, Mackay, L. Waterbury and P. D. Haughton have shown themselves racquet players of very high merit, although Mr Eustace Miles is of opinion that "an English player like H. K. Foster, or Dames Longworth, or Ashworth, would give any American amateur upwards of seven aces."

Squash racquets is a form of the game which provides admirable practice for the beginner, and has advantages of its own which offer attractions even to those who are proficient players of real racquets. It is played with a hollow india-rubber ball about the size of a fives ball (*i.e.* nearly twice the size of an ordinary racquet ball) and with a racquet rather shorter in the handle than those used in racquets proper. The court may be of any dimensions, but is always much smaller than a real racquet court; the squash ball, being not nearly so fast as the racquet ball, would not reach the back wall in a 60 ft. court on the first bound unless hit high as well as hard against the front wall. The rules of the game itself are precisely the same as in real racquets. Squash racquets originated at Harrow, where the boys were in the habit of playing in an improvised court in the corner of the school-yard against the old school building; the windows, buttresses and water-pipe on the face of the wall forming irregularities which developed great skill on the part of the players in taking advantage of the difficulties thus caused. The marked success of Harrow in the Public Schools Championship at racquets, especially during the first twenty years of its institution (see above), has been attributed to the early training and practice gained at squash racquets in the school-yard, and in other courts which came into use as the popularity of this form of the game increased. Towards the end of the 19th century squash racquets became adopted at other schools and at the universities; and as the court is much cheaper to build than that required for real or "hard ball" racquets, and the game is cheaper as well as easier to play, many private courts came into existence. On the initiative of Lord Desborough, who had learnt the game at Harrow, several squash courts were provided at the Bath Club, London, where handicap tournaments are annually played. At Lord's cricket ground, when a new pavilion was erected in 1890, squash racquet courts were included in the building. The dimensions of the courts at Lord's, which may be taken as the best model, are as follows: length 42 ft. by 24 ft.; height of back wall 8 ft. 8 in.; height of service-line from floor 8 ft. 9 in.; height of play-line 2 ft. 4 in. The short-line is 23 ft. from the front wall. The place which squash racquets has come to occupy may be estimated from the fact that Mr. Eustace Miles pronounces it "an almost indispensable preparation" for tennis and racquets as those games are played under modern conditions; and the same authority sufficiently describes its merits when he observes that it "gives, at a small cost of time or money, abundance of hard and brisk and simple yet exciting exercise for all times of life, of the year, and even of the day—if we have good artificial light." The squash courts at Lord's and at the Bath Club are lighted by electricity, so that play is not dependent on the condition of the atmosphere, or on the season of the year.

See *Tennis, Lawn Tennis, Rackets and Fives* in the "Badminton Library"; *Racquets, Tennis and Squash*, by Eustace Miles (London, 1902); *Sporting and Athletic Register* (London, 1908). (R. J. M.)

RADAUTZ, a town in Bukovina, Austria, 35 m. S. by W. of Czernowitz by rail. Pop. (1900) 14,343, of which about 70% are Germans and 25% are Rumanians. It was formerly the seat of a Greek bishopric, removed to Czernowitz in 1786, and possesses a cathedral (1402) with the tombs of several Moldavian princes. The Austrian government has here a large stud. To the W. of Radautz are situated the old monasteries of Putna and Suczawica, dating from the 15th century. They still contain many old and valuable ecclesiastical objects of art, although a great part has been removed to the various monasteries in Moldavia.

RADBERTUS PASCHASIUS (d. *c.* 860), French theologian, was born at or near Soissons towards the close of the 8th century. He became a monk of Corbie, near Amiens in Picardy, in 814, and assumed the cloister name of Paschasius. He soon gained recognition as a learned and successful teacher, and the younger Adalhard, St Anskar the apostle of Sweden, Odo bishop of Beauvais and Warinus abbot of Corvei in Saxony may be mentioned among the more distinguished of his pupils. Between 842 and 846 he was chosen abbot, but as a disciplinarian he was more energetic than successful, and about 851 he resigned the office. He never took priestly orders. He died and was buried in Corbie.

Radbertus is one of the most important theologians in the history of the church. "He was perhaps the most learned and able theologian after Alcuin, as well versed in Greek theology as he was familiar with Augustinianism, a comprehensive genius, who felt the liveliest desire to harmonize theory and practice, and at the same time give due weight to tradition" (Harnack). His great work was the *Liber de Corpore et Sanguine Domini* (first ed. 831; new ed., with an epistle to Charles the Bald, 844), which was not only the first systematic and thorough treatise on the sacrament of the eucharist, but is the first clear dogmatic statement of transubstantiation, and as such opened an unending controversy. It was at once attacked by Ratramnus and Hrabanus Maurus, but was so completely in touch with the practice of the church and the spirit of the age, as to win the verdict of Catholic orthodoxy.

On the eucharistic controversy see the article on Radbertus by Steitz in Herzog-Hauck's *Real-Encyklopädie*; Bach, *Dogmengeschichte des Mittelalters*, i. 156 ff.; Ernst, *Die Lehre des h. Paschasius Radbertus v. d. Eucharistie* (1896); Renz, *Die Geschichte des Messopferbegriffs* (1901); K. G. Goetz, *Die Abendmahlsfrage in ihrer geschichtlichen Entwicklung* (1904), a complete survey of the whole problem, beginning with Radbertus. A. Harnack's treatment in his *History of Dogma* (vol. v., p. 308 ff.) is clear and appreciative.

RADCLIFFE, ANN (1764–1823), English novelist, only daughter of William and Ann Ward, was born in London on the 9th of July 1764. She was the author of three famous novels: *The Romance of the Forest* (1791), *The Mysteries of Udolpho* (1794) and *The Italian* (1797). When she was twenty-three years old she married William Radcliffe, an Oxford graduate and student of law. He gave up his profession for literature, and afterwards became proprietor and editor of the *English Chronicle*. After *The Italian* she gave up writing for publication, and was reported to have been driven mad by the horrors of her own creations, but the nearest approach to eccentricity on Mrs Radcliffe's part was dislike of public notice. Of scenery Mrs Radcliffe was an enthusiastic admirer, and she made driving tours with her husband every other summer through the English counties. She died on the 7th of February 1823. In the history of the English novel, Mrs Radcliffe holds an interesting place. She is too often confounded with her imitators, who vulgarized her favourite "properties" of rambling and ruinous old castles, dark, desperate and cadaverous villains, secret passages, vaults, trapdoors, evidences of deeds of monstrous crime, sights and sounds of mysterious horror. She deserves at least the credit of originating a school of which she was the most distinguished exponent; and none of her numerous imitators approach her in ingenuity of plot, fertility of incident or skill in devising apparently supernatural occurrences capable of explanation by human agency and natural coincidence. She had a genuine gift for scenic effect, and her vivid imagination provided every tragic situation in her stories with its appropriate setting. Sir Walter Scott wrote an appreciative essay for the edition of 1824, and Miss Christina Rossetti was one of her admirers. She exercised a great influence on her contemporaries, and "Schedoni" in *The Italian* is one of the prototypes of the Byronic hero.

RADCLIFFE, SIR GEORGE (1593–1657), English politician, son of Nicholas Radcliffe (d. 1599) of Overthorpe, Yorkshire, was educated at Oldham and at University College, Oxford. He attained some measure of success as a barrister, and about 1626 became the confidential adviser of Sir Thomas Wentworth, afterwards earl of Strafford, who was related to his wife, Anne Trappes (d. 1659). Like his master he was imprisoned in 1627 for declining to contribute to a forced loan, but he shared the good, as well as the ill, fortunes of Wentworth, acting as his adviser when he was president of the council of the north. When Wentworth was made lord deputy of Ireland, Radcliffe, in January 1633, preceded him to that country, and having been made a member of the Irish privy council he was trusted by the deputy in the fullest possible way, his advice being of the greatest service. In 1640, Radcliffe, like Strafford, was arrested and was impeached, but the charges against him were not pressed, and in 1643 he was with Charles I. at Oxford. He died at Flushing in May 1657. Radcliffe wrote *An essay towards the life of my Lord Strafford*, from which the material for the various lives of the statesman has been largely taken.

See Sir T. D. Whitaker, *Life and Correspondence of Sir G. Radcliffe* (1810).

RADCLIFFE, JOHN (1650–1714), English physician, was born at Wakefield in 1650. He matriculated at University College, Oxford, and after taking his degree in 1669 was elected to a fellowship at Lincoln College, which he gave up in 1677 when, under the statutes of the college, he was called on to take orders. Graduating in medicine in 1675, he practised first in Oxford, but in 1684 removed to London, where he soon became one of the leading physicians. He frequently attended William III. until 1699, when he caused offence by remarking, as he looked at the King's swollen ankles, that he would not have his legs for his three kingdoms. On the 1st of November 1714 he died of apoplexy at his house in Carshalton. By his will he left property to University College for founding two medical travelling fellowships and for other purposes. Other property was put at the disposal of his executors to use as they thought best, and was employed, among other things, in building the Radcliffe Observatory, Hospital and Library at Oxford, and in enlarging St Bartholomew's Hospital in London. Radcliffe was elected M.P. for Bramber in 1690 and for Buckingham in 1713.

RADCLIFFE, an urban district in the Radcliffe-cum-Farnworth parliamentary division of Lancashire, England, on the river Irwell, 2 m. S.S.W. of Bury, on the Lancashire & Yorkshire railway. Pop. (1901) 25,368. The church of St Bartholomew dates from the time of Henry IV.; some of the Norman portions of the building remain. Cotton-weaving, calico-printing, and bleaching, dyeing, paper-making, iron-founding and machine-making are the principal industries, and there are extensive collieries in the neighbourhood.

RADEBERG, a town of Germany, in the kingdom of Saxony, pleasantly situated in a fertile district on the Röder, 10 m. N.E. of Dresden, by the railway to Görlitz and Breslau. Pop. (1905) 13,301. It has an Evangelical and a Roman Catholic church, and an old castle. Its principal industries are the manufacture of glass, machinery, furniture and paper, and it produces a light Pilsener beer which is largely exported. Near the town are the Augustusbad and the Hermannsbad, two medicinal springs.

RADEGUNDA, ST (d. 587), Frankish queen, was the daughter of Berthaire, king of the Thuringians. Berthaire was killed by his brother Hermannfried, who took Radegunda and educated her, but was himself slain by the Frankish kings Theuderich and Clotaire (529), and Radegunda fell to Clotaire, who later married her. Her piety was already so noteworthy that it was said that Clotaire had married a nun, not a queen. She left him when he unjustly killed her brother, and fled to Medardus, bishop of Poitiers, who, notwithstanding the danger of the act, consecrated her as a nun. Radegunda stayed in Poitiers, founded a monastery there, and lived for a while in peace. Here Venantius Fortunatus, the Italian poet, found a friendly reception, and two of the poems printed under his name are usually attributed to Radegunda. From him we gain a most pleasing picture of life at the monastery. The queen died on the 13th of August 587.

See the references in A. Molinier, *Sources de l'histoire de France.*

RADETZKY, JOSEF, COUNT OF RADETZ (1766–1858), Austrian soldier, was born at Trzebnitz in Bohemia in 1766, to the nobility of which province his family, originally Hungarian, had for several centuries belonged. Orphaned at an early age, he was educated by his grandfather, and after the old count's death, at the Theresa academy at Vienna. The academy was dissolved during his first year's residence, and he joined the army as a cadet in 1785. Next year he became an officer, and in 1787 a first lieutenant in a cuirassier regiment. He served as a galloper on Lacy's staff in the Turkish War, and in the Low Countries during the Revolutionary War. In 1795 he fought on the Rhine. Next year he served with Beaulieu against Napoleon in Italy, and inwardly rebelled at the indecisive "cordon" system of warfare which his first chief, Lacy, had instituted and other Austrian generals only too faithfully imitated. His personal courage was conspicuous; at Fleurus he had led a party of cavalry through the French lines to discover the fate of Charleroi, and at Valeggio on the Mincio, with a few hussars, he rescued Beaulieu from the midst of the enemy. Promoted major, he took part in Wurmser's Mantua campaign, which ended in the fall of the place. As lieutenant-colonel and colonel he displayed both bravery and skill in the battles of the Trebbia and Novi (1799), and at Marengo, as colonel on the staff of Melas, he was hit by five bullets, after endeavouring on the previous evening to bring about modifications in the plan suggested by the "scientific" Zach. In 1801 Radetzky received the knighthood of the Maria Theresa order. In 1805, on the march to Ulm, he received news of his promotion to major-general and his assignment to a command in Italy under the archduke Charles, and thus took part in the successful campaign of Caldiero. Peace again afforded him a short leisure, which he used in studying and teaching the art of war. In 1809, now a lieutenant field marshal, he fought at Wagram, and in 1810 he received the commandership of the Maria Theresa order and the colonelcy of the 5th Radetzky hussars. From 1809 to 1812, as chief of the general staff, he was active in the reorganization of the army and its tactical system, but, unable to carry out the reforms he desired owing to the opposition of the Treasury, he resigned the post. In 1813 he was Schwarzenberg's chief of staff, and as such had considerable influence on the councils of the Allied sovereigns and generals. Langenau, the quarter-master-general of the Grand Army, found him an indispensable assistant, and he had a considerable share in planning the Leipzig campaign and as a tactician won great praises in the battles of Brienne and Arcis sur Aube. He entered Paris with the allied sovereigns in March 1814, and returned with them to the congress of Vienna, where he appears to have acted as an intermediary between Metternich and the czar Alexander, when these great personages were not on speaking terms.

During the succeeding years of peace he disappeared from the public view. He resumed his functions as chief of the staff, but his ardent ideas for reforming the army came to nothing in the face of the general war-weariness and desire to "let well alone." His zeal added to the number of his enemies, and in 1829, after he had been for twenty years a lieutenant field marshal, it was proposed to place him on the retired list. The emperor, unwilling to go so far as this, promoted him general of cavalry and shelved him by making him governor of a fortress. But very soon afterwards the Restoration settlement of Europe was shaken by fresh upheavals, and Radetzky was brought into the field of war again. He took part under Frimont in the campaign against the Papal States insurgents, and succeeded that general in the chief command of the Austrian army in Italy in 1834. In 1836 he became a field marshal. He was now seventy years of age, but he displayed the activity of youth in training and disciplining the army he commanded. But here too he was in advance of his time, and the government not only disregarded his suggestions and warnings but also refused the money that would have enabled the finest army it possessed to take the field at a moment's notice. Thus the events of 1848 in Italy, which gave the old field marshal his place in history among the great commanders, found him, in the beginning, not indeed unprepared but seriously handicapped in the struggle with Charles Albert's army and the insurgents. How by falling back to the Quadrilateral and there, checking one opponent after another, he was able to spin out time until reinforcements arrived, and how thenceforward up to the final triumph of Novara on the 23rd of March 1849, he and his army carried all before them, is described in the article ITALIAN WARS. The well-disciplined sense of duty to the superior officer, which was remarked even in the brilliant and sanguine young army reformer of 1810, had become more intense in the long years of peace, and after keeping his army loyal in the midst of the confusion of 1848, he made no attempt to play the part of Wallenstein or even to assume Wellington's rôle of family adviser to the nation. While as a patriot he dreamed a little of a united Germany, he remained to the end simply the commander of one of the emperor's armies. He died, still in harness, though infirm, on the 5th of January 1858.

In military history Radetzky's fame rests upon one great achievement, but in the history of the Austrian army he lives as the frank and kindly "Vater Radetzky" whom the soldiers idolized. He was fortunate in the moment of his death. In the year following, another and a greater Italian war broke out, his beloved army, disintegrated by peace economies which the old field marshal had been unable any longer to redress by ceaseless personal training, and in addition suffering from divided command and confused staff work, was defeated in every encounter.

RADEVORMWALD, a town of Germany, in the Prussian Rhine province, 10 m. E. from Remscheid, on the branch line of railway from Krebsöge. Pop. (1905) 10,978. It consists of the town proper and of several suburbs, and has five Evangelical and two Roman Catholic churches. Its chief manufactures are skates, files, locks and similar articles, and it has also cloth and cotton factories.

See J. H. Becker, *Geschichte der Stadt Radevormwald* (Cologne, 1864).

RADHANPUR, a native state of India, in the Palanpur agency, Bombay. It is situated in the north-western corner of Gujarat, close to the Runn of Cutch. The country is an open plain without hills and with few trees. It contains an area of 1150 sq. m. with a population in 1901 of 61,548, showing a decrease of 37% during the decade, due to the results of famine. The estimated revenue is £27,000. The chief products are cotton, wheat and the common varieties of grain; the only manufacture of any importance is the preparation of a fine description of saltpetre. Radhanpur first came under British protection in 1813. The chief, whose title is Nawab, belongs to the Babi family, who have held power in Gujarat for more than two centuries. The town of Radhanpur had a population in 1901 of 11,879. It is a walled town, with an export trade in rapeseed, grain and cotton.

RADIATA, a term introduced by Cuvier in 1812 to denote the lowest of his four great animal groups or "embranchements." He defined them as possessing radial instead of bilateral symmetry, and as apparently destitute of nervous system and sense organs, as having the circulatory system rudimentary or absent, and the respiratory organs on or coextensive with the surface of the body; he included under this title and definition five classes,—Echinodermata, Acalepha, Entozoa, Polypi and Infusoria. Lamarck (*Hist. nat. d. Anim. s. Vertèbres*) also used the term, as when he spoke of the Medusae as *radiata medusaria et anomala*; but he preferred the term Radiaria, under which he included Echinodermata and Medusae. Cuvier's term in its wide extension, however, passed into general use; but, as the anatomy of the different forms became more fully known, the difficulty of including them under the common designation made itself increasingly obvious. Milne-Edwards removed the Polyzoa; the group was soon further thinned by the exclusion of the Protozoa on the one hand and the Entozoa on the other; while in 1848 Leuckart and Frey clearly distinguished the Coelenterata from the Echinodermata as a separate sub-kingdom, thus condemning the usage by which the term still continued to be applied to these two groups at least. In 1855, however, Owen included under Lamarck's term Radiaria the Echinodermata, Anthozoa, Acalepha and Hydrozoa, while Agassiz also clung to the term Radiata as including Echinodermata, Acalepha and Polypi, regarding their separation into Coelenterata and Echinodermata as "an exaggeration of their anatomical differences" (*Essay on Classification*, London, 1859). These attempts, however, to perpetuate the usage were finally discredited by Huxley's important *Lectures on Comparative Anatomy* (1864), in which the term was finally abolished, and the "radiate mob" finally distributed among the Echinodermata, Polyzoa, Vermes (Platyhelminthes), Coelenterata and Protozoa.

RADIATION, THEORY OF. The physical activities that flourish on the surface of the earth derive their energy, in a form which is highly available thermodynamically, from the radiation of the sun. This has been ascertained to be dynamic energy, transmitted in waves by the vibrations of a medium occupying space, as the energy of sound is transmitted by the vibrations of the atmosphere. The elasticity that transmits it may be assumed to be mathematically perfect: any slight loss in transit of the light from the most distant stars, which recent statistical comparisons of brightness with distance may possibly indicate, is to be explained far more suitably by the presence of nebulous matter than by any imperfection of the aether. The latter would thus be the one perfect frictionless medium known to us: it could not be such if it were constituted, like matter, of independent molecules. It is thus on a higher plane, and may even be considered to be a dynamical specification of space itself. A molecule of matter is a kinetic system compounded of simpler elements; its energy may be classified into constitutive energy essential to its continued existence, and vibratory energy which it can receive from or radiate away into aether. A piece of matter isolated in free aether would in time lose all energy of the latter type by radiation; but the former will remain so long as the matter persists, along with the energy of the uniform translatory motion to which it is ultimately reduced. Thus all matter is in continual exchange of vibratory energy with the aether: it is with the laws of this exchange of energy that the general theory of Radiation deals, as distinguished from the mechanism of the aethereal vibrations, which is usually treated as the Theory of Light (see AETHER).

1. The foundation of this subject is the principle, arrived

at independently by Balfour Stewart and Kirchhoff about the year 1858, that the constitution (§ 6) of the radiation which pervades an enclosure, surrounded by bodies in a steady thermal state, must be a function of the temperature of those bodies, and of nothing else. It was subsequently pointed out by Stewart (*Brit. Assoc. Report*, 1871) that if the enclosure contains a radiating and absorbing body which is put in motion, all being at the same temperature, the constituents of the radiation in front of it and behind it will differ in period on account of the Doppler-Fizeau effect, so that there will be an opportunity of gaining mechanical work in its settling down to an equilibrium; there must thus be some kind of thermodynamic compensation, which might arise either from aethereal friction, or from work required to produce the motion of the body against pressure exerted on it by the surrounding radiation. The hypothesis of friction is now excluded in ultimate molecular physics, while the thermodynamic bearing of a pressure exerted by radiation, such as is demanded by Maxwell's electric theory, has been more recently developed on other lines by Bartoli and Boltzmann (1884), and combined with that of the Doppler effect by W. Wien (1893) in development of the ideas above expressed.

The original reasoning of Stewart and Kirchhoff rests on the dynamical principle, that by no process of ordinary reflexion or transmission can the period, and therefore the wave-length, of any harmonic constituent of the radiation be changed; each constituent remains of the same wave-length from the time it is emitted until the time it is again absorbed. If we imagine a field of radiation to be enclosed within perfectly reflecting walls, then, provided there is no material substance in the field which can radiate and absorb, the constitution of the radiation in it may be any whatever, and it will remain permanent. It is only the presence of material bodies that by their continued emission and absorption can transform the surrounding radiation towards the unique constitution which corresponds to their temperature. We can define the temperature of an isolated field of radiation, of this definite ultimate constitution, to be the same as that of the material bodies with which it would thus be in equilibrium. Further, the mutual independence of the various constituents of any field of radiation enclosed by perfect reflectors allows us to assign a temperature to each constituent, such as the part involving wave-lengths lying between λ and $\lambda+\delta\lambda$; that will be the temperature of a material system with which this constituent by itself is in equilibrium of emission and absorption. But to reason about the temperature of radiation in this way we must be sure that it completely pervades the space, and has no special direction; this is ensured by the continual reflexions from the walls of the enclosure. The question of the temperature of a directed wave-train travelling through space, such as a beam of light, will come up later. The temperature of each constituent in a region of undirected radiation is thus a function of its wave-length and its intensity alone. It is the fundamental principle of thermodynamics, that temperatures tend to become uniform. In the present case of a field of radiation, this equalization cannot take place directly between the various constituents of the radiation that occupy the same space, but only through the intervention of the emission and absorption of material bodies; the constituent radiations are virtually partitioned off adiabatically from direct interchange. Thus in discussing the transformations of temperatures of the constituent elements of radiation, we are really reasoning about the activity of material bodies that are in thermal equilibrium with those constituents; and the theoretical basis of the idea of temperature, as depending on the fortuitous residue of the energy of molecular motions, is preserved.

2. *Mechanical Pressure of Undulatory Motions.*—Consider a wave-train of any kind, in which the displacement is $\xi=a\cos m(x+ct)$ so that it is propagated in the direction in which x decreases; let it be directly incident on a perfect reflector travelling towards it with velocity v, whose position is therefore given at time t by $x=vt$. There will be a reflected train given by $\xi'=a'\cos m'(x-ct)$, the velocity of propagation c being of course the same for both. The disturbance does not travel into the reflector, and must therefore be annulled at its surface; thus when $x=vt$ we must have $\xi+\xi'=0$ identically. This gives $a'=-a$, and $m'(c-v)=m(c+v)$. The amplitude of the reflected disturbance is therefore equal to that of the incident one; while the wave-length is altered on the ratio $\frac{c-v}{c+v}$, which is approximately $1-2\frac{v}{c}$, where v/c is small, and is thus in agreement with the usual statement of the Doppler effect. The energy in the wave-train being half potential and half kinetic, it is given by the integration of $\rho(d\xi/dt)^2$ along the train, where ρ represents density. In the reflected train it is therefore augmented, when equal lengths are compared, in the ratio $\left(\frac{c+v}{c-v}\right)^2$; but the length of the train is diminished by the reflexion in the ratio $\frac{c-v}{c+v}$; hence on the whole the energy transmitted per unit time is increased by the reflexion in the ratio $\frac{c+v}{c-v}$. This increase per unit time can arise only from work done by the advancing reflector against pressure exerted by the radiation. That pressure, per unit surface, must therefore be equal to the fraction $\frac{2}{c-v}$ of the energy in a length $c+v$ of the incident wave-train; thus it is the fraction $\frac{c^2-v^2}{c^2+v^2}$ of the total density of energy in front of the reflector, belonging to both the incident and reflected trains. When v is small compared with c, this makes the pressure equal to the density of vibrational energy, in accordance with Maxwell's electrodynamic formula (*Elec. and Mag.*, 1871).

The argument may be illustrated by the transverse vibrations of a tense cord, the reflector being then a lamina through a small aperture in which the cord passes; the lamina can thus slide along the cord and sweep the vibratory motion in front of it. In this case the force acting on the lamina is the resultant of the tensions T of the cord on the two sides of the aperture, giving a lengthwise force $\frac{1}{2}\mathrm{T}d(\xi+\xi')^2/dx^2$ when, as usual, powers higher than the second of the ratio of amplitude to wave-length are neglected; this, when v/c is small, is an oscillatory force of amount $2\rho(d\xi/dt)^2$, whose time-average agrees with the value above obtained. If we consider a finite train of waves thus sent back from a moving reflector, the time integral of the pressure must represent force transmitted along the cord, or a gain of longitudinal momentum in the reflected waves, or both together.

When it is a case of transverse waves in an elastic medium, reflected by an advancing obstacle, the origin of the working pressure is not so obvious, because we cannot easily formulate a mechanism for the advancing reflector like that of the lamina above employed. In the case of light-waves we can, however, imagine an ideal material body, constituted of very small molecules, that would sweep them in front of it with the same perfection as a metallic mirror actually reflects the longer Hertzian waves. The pressure will then be identified physically, as in the case of the latter waves, with the mechanical forces acting on the screening oscillatory electric current-sheet which is induced on the surface of the reflector. The displacement represented above by ξ, which is annulled at the reflector, may then be taken to be either the tangential electric force or the normal component of the vector whose velocity is the magnetic force. The latter interpretation is theoretically interesting, because that vector, which is the dynamical displacement in electron-theory, usually occurs only through its velocity. The general case of oblique incidence can be treated on similar lines; each filament of radiation (ray) in fact exerts its own longitudinal push equal to its energy per unit length, and it is only a matter of summation.

The usual formula for the pressure of electric radiation is derived from a theory, namely, that of the ordinary electrodynamic equations, which considers the velocity of the matter, or rather of the electrons associated with it, to be so small compared with that of radiation that the square of the ratio of these velocities can be neglected. The formula above obtained is of general application, and shows that for high values of v the pressure must fall off. It has been urged as an objection to the thermodynamic reversibility of a ray (§ 8) that the work of the radiant pressure exerted at its front is lost, as there is no obstacle to sustain it; but on an obstacle moving with the velocity of the wave-front the pressure would vanish, so that this objection does not now hold.

In every such case of an advancing perfect reflector the aggregate amplitude of the superposed incident and reflected wave-trains, of different wave-lengths and periods, will be represented by

$$\xi+\xi'=2a\sin\frac{mv}{c-v}\left(x-\frac{c^2}{v}t\right)\sin\frac{mc}{c-v}(x-vt);$$

thus the appearance presented will be that of a train of waves each of length $(1-v/c)2\pi/m$, and progressing with the velocity v of the reflector, which travels at one of the nodes of the train. This slowly travelling wave-train corresponds to the stationary train which would be produced by a stationary perfect reflector; but the amplitude is now a varying quantity which, once uniform vibration has been fully established along any path, may itself be described as running on after the manner of a superposed wave-train of very great wave-length $(c/v-1)2\pi/m$ and of very great velocity c^2/v. A somewhat similar state of things arises when a wave-train is incident on a stationary reflector very nearly normally, as may sometimes be seen with incoming rollers along a shelving beach; the visible disturbance at a reflecting ridge, arising from each single wave-crest, then rushes along the ridge at a speed which is at first sight surprising, as it is enormously in excess of the speed possible for any simple train of waves travelling into quiescent aether.

3. *Wien's Law.*—Let us consider a spherical enclosure filled with radiation, and having walls of ideal perfectly reflecting quality so that none of the radiation can escape. If there is no material body inside it, any arbitrarily assigned constitution of this radiation will be permanent. Let us suppose that the radius a of the enclosure is shrinking with extremely small velocity v. A ray inside it, incident at angle ι, will always be incident on the walls in its successive reflexions at the same angle, except as regards a negligible change due to the motion of the reflector (§ 2); and the length of its path between successive reflexions is $2a\cos\iota$. Each undulation on this ray will thus undergo reflexion at intervals of time equal to $2a\cos\iota/c$, where c is the velocity of light, and it is easily verified that on each reflexion it is shortened by the fraction $2v\cos\iota/c$ of itself: thus in the very long time T required to complete the shrinkage it is shortened by the fraction $v\mathrm{T}a$, which is $\delta a/a$ where δa is the total shrinkage in radius, and is independent of the value of ι. The wave-length of each undulation in the radiation inside the enclosure is therefore reduced in the same ratio as the radius. Now suppose that the constitution of the enclosed radiation corresponded initially to a definite temperature. During the shrinkage thermal equilibrium must be maintained among its constituents; otherwise there would be a running down of their energies towards uniformity of temperature, if material radiating bodies are present, which would be superposed on the mechanical operations belonging to the shrinkage, and the process could not be reversible. Such a state of affairs is not possible, for it would land us in processes of the following type. Expand the enclosure, gaining the mechanical work of the radiant pressure against its walls, whatever that may be. Then equalize the intensities of the constituent radiations to those corresponding to a common temperature, by taking advantage of the absorptions of material bodies at the actual temperatures of these radiations; when this is done, as it may actually be to some extent by aid of the sifting produced by partitions which transmit some kinds of radiation more rapidly than others, a further gain of work can be obtained at the expense of the radiant energy. Then contract the remaining radiant energy to its previous volume, which requires an expenditure of less work on the walls of the enclosure than the expansion of the greater amount of radiation originally afforded; and, finally, gain still more work by again equalizing the temperatures of its constituents. The energy now remaining, being of smaller amount and under similar conditions, must have a temperature lower than the initial one. This process might be repeated indefinitely, and would constitute an engine without an extraneous refrigerator, violating Carnot's principle by deriving an unlimited supply of mechanical work from thermal sources at a uniform temperature.

Thus, independently of any knowledge of the intensity of the mechanical pressure of radiation, or indeed of whether such a pressure exists at all, it is established that the shrinkage of the enclosure must directly transform the contained radiation to the constitution which corresponds to some definite new temperature. Now we have seen that the wave-lengths of its constituents are all reduced in the same ratio by this process. If, then, we can prove that the intensities of these constituents are also all changed in a common ratio by the reflexions at the shrinking envelope, it will follow that the distributions of the radiation among the various wave-lengths are, at these two temperatures, and therefore at any two temperatures, homologous, in the sense that the intensity curves, after the wave-lengths in one of them have been reduced in a ratio depending definitely on the two temperatures, differ only in the absolute scale of magnitude of the ordinates.

This procedure modifies Wien's argument by employing a uniformly shrinking spherical enclosure (cf. *Brit. Assoc. Report*, 1900). If the enclosure is not spherical, the angles of incidence at successive reflexions of the same ray will differ by finite amounts; we must then estimate the average effect of the shrinkage. In the form of enclosure here employed all rays are affected alike, and no averaging is required; while by the principle of Stewart and Kirchhoff what is established for any one form is of general validity.

4. *Pressure of Natural Radiation.*—The question reserved above has now to be settled. At first sight it might have appeared that the reflexion is simply total; but, as has been seen in § 2, the advancing perfect reflector does work against the pressure of the radiation, and this work must be changed into radiant energy and thus go to increase the intensity of the reflected ray. Considering electric radiation incident at angle ι, the tangential electric force is annulled at the reflector; hence the amplitude of the electric vibration is conserved on reflexion, though its phase is reversed. As already seen, the wave-length is shortened approximately by the fraction $2v\cos\iota/c$ in each reflexion; thus, just as in § 2, the energy transmitted per unit time per unit area is increased in the same ratio; and allowing for the factor $\cos\iota$ of foreshortening, there is therefore a radiant pressure equal to the total density of radiant energy in front of the reflector multiplied by $\cos^2\iota$. This argument, being independent of the wave-length, applies to each constituent of the radiation in this direction separately; thus their energies are all increased in the same ratio by the reflexion, as was to be proved. When we are dealing with the natural radiation in an enclosure, which is distributed equally in all directions, this factor $\cos^2\iota$ must be averaged; and we thus attain Boltzmann's result that the radiant pressure is then one-third of the density of radiant energy in front of the reflector, this statement holding good as regards each constituent of the natural radiation taken separately.

5. *Adiabatic Relations.*—Consider the enclosure filled with radiation of energy-density E at volume V, of any given constitution but devoid of special direction, and let it be shrunk to volume $\mathrm{V}-\delta\mathrm{V}$ against its own pressure; if the density thereby become $\mathrm{E}-\delta\mathrm{E}$, the conservation of the energy requires

$$\mathrm{EV}+\tfrac{1}{3}\mathrm{E}\delta\mathrm{V}=(\mathrm{E}-\delta\mathrm{E})(\mathrm{V}-\delta\mathrm{V}),$$

so that $\frac{4}{3}\mathrm{E}\delta\mathrm{V}+\mathrm{V}\delta\mathrm{E}=0$, or E varies as $\mathrm{V}^{-\frac{4}{3}}$.

Again—but now with a restriction to radiation with its energy distributed as regards wave-length so as to be of uniform temperature—the performance of this mechanical work $\frac{1}{3}E\delta V$ has changed the energy of radiation EV from the state that is in equilibrium of absorption and emission with a thermal source at temperature T to the state in equilibrium with an absorber of some other temperature $T-\delta T$, and that in a reversible manner; thus by Carnot's principle

$$\tfrac{1}{3}E\delta V/EV = -\delta T/T,$$

so that T varies as $V^{-\frac{1}{3}}$, or inversely as the linear dimensions when the enclosure is shrunk uniformly.

Combining these results, it appears that E varies as T^4; this is Stefan's empirical law for the complete radiation corresponding to the temperature, first established on these lines by Boltzmann. Starting from the principle that this radiation must be a function of the temperature alone, this adiabatic process has in fact given us the form of the function. These results cannot, however, be extended without modification to each separate constituent of the complete radiation, because the shrinkage of the enclosure alters its wave-length and so transforms it into a different constituent.

6. *Law of Distribution of Energy.*—The effect of compressing the complete radiation is thus to change it to the constitution belonging to a certain higher temperature, by shortening all its wave-lengths by the proportion of one-third of the compression by volume, the temperature being in fact raised by the same proportion; at the same time increasing in a uniform ratio the amounts corresponding to each interval $\delta\lambda$, so as to get the correct total amount of energy for the new temperature. In the compression each constituent alters so that $T\lambda$ remains constant, and the energy $E_\lambda\delta\lambda$ in the range $\delta\lambda$ in other respects changes as a function of T alone. Hence generally $E_\lambda\delta\lambda$ must be of form $F(T)f(T\lambda)\delta\lambda$. But for each temperature $\int_0^\infty E_\lambda\delta\lambda$ is equal to E and so varies as T^4, by Stefan's law; that is,

$$T^{-1}F(T)\int_0^\infty f(T\lambda)d(T\lambda) \propto T^4,$$

so that $T^{-1}F(T) \propto T^4$. Thus, finally, $E_\lambda\delta\lambda$ is of form $AT^5f(T\lambda)\delta\lambda$ or $A\lambda^{-5}\phi(T\lambda)\delta\lambda$, which is Wien's general formula.

7. *Transformation of a Single Constituent.*—It is of interest to follow out this adiabatic process for each separate constituent of the radiation, as a verification, and also in order to ascertain whether anything new is thereby gained. To this end let now $E(\lambda,T)\delta\lambda$ represent the intensity of the radiation between λ and $\lambda+\delta\lambda$ which corresponds to the temperature T. The pressure of this radiation, when it is without special direction, is in intensity one-third of this; thus the application of Carnot's principle shows, as before, that in adiabatic compression $T \propto V^{-\frac{1}{3}}$, so that a small linear shrinkage in the ratio $1-x$ raises T in the ratio $1+x$. We have still to express the equation of energy. The vibratory energy $E(\lambda,T)\delta\lambda \,.\, V$ in volume V, together with the mechanical work $\frac{1}{3}E(\lambda,T)\delta\lambda \,.\, 3xV$, yields the vibratory energy

$$E\{\lambda(1-x),\ T(1+x)\}\delta\lambda(1-x)\,.\,V(1-3x);$$

thus, writing E and E_λ or $E(\lambda,T)$ we have, neglecting x^2,

$$E(1+x) = \left(E - x\lambda\frac{dE}{d\lambda} + xT\frac{dE}{dT}\right)(1-4x),$$

so that

$$5E + \lambda\frac{dE}{d\lambda} - T\frac{dE}{dT} = 0,$$

a partial differential equation of which the integral is

$$E = A\lambda^{-5}\phi(T\lambda),$$

the same formula as was before obtained.

This method, treating each constituent of the radiation separately, has in one respect some advantage, in that it is necessary only to postulate an enclosure which totally reflects that constituent, this being a more restricted hypothesis than an absolutely complete reflector.

To determine theoretically the form of the function ϕ we must have some means of transforming one type of radiation into another, different in essence from the adiabatic compression already utilized. The condition that the entropy of the independent radiations in an enclosure is a minimum when they are all transformed to the same temperature with total energy unaltered, is already implicitly fulfilled; it would thus appear that any further advance must involve (§ 11) the dynamics of the radiation and absorption of material bodies.

8. *Temperature of an Isolated Ray.*—The temperature of each independent constituent of a radiation has here been taken to be a function of the intensity E_λ, where $E_\lambda\delta\lambda$ is the energy per unit volume in the range between wave-lengths λ and $\lambda+\delta\lambda$; the condition is, however, imposed that this radiation is indifferent as to direction. When a beam of radiation travels without loss in a definite direction across a medium, its form varies as it progresses; but it is reversible inasmuch as it can be turned back at any stage, or concentrated without loss, by perfect reflectors. If the energy of the beam has a temperature, its value must therefore remain constant throughout the progress of the beam, by the principle of Carnot. Now by virtue of a relation in geometrical optics, which on a corpuscular theory would be one aspect of the fundamental dynamical principle of Action, the cross-section δS at any place on the beam, and the conical angle $\delta\omega$ within which the directions of its rays are there included, are such that the value of $V^{-2}\delta S\delta\omega$ is conserved along the beam, V being the velocity of propagation of the undulations. If we represent the amount of radiant energy transmitted per unit time across the section δS of the beam by $I\delta S\delta\omega$, it will follow that in passing along the beam its intensity of illumination I varies as V^{-2}, or as the square of the index of refraction, provided there is no loss of energy in transmission. This condition requires that changes of index shall be gradual, otherwise there would be loss of energy by partial reflexions; in free aether I is itself constant along the beam. The volume-density of the energy in any part of the directed beam is $V^{-1}I\delta\omega$; it is thus inversely as the solid angular concentration of the rays and directly as the cube of the index of refraction. Now we may consider this beam, of aggregate intensity $I\delta S\delta\omega$, to form an elementary filament of the radiation issuing in the direction of the normal from a perfect radiator. As such a body absorbs completely and therefore radiates equally in all directions in front of it, the total intensity of radiation from its element of surface δs is $\delta s \int I \cos\theta\delta\omega$, or $\delta s \,.\, \pi I$, while the volume-density of the total advancing and receding radiation in front of it is $2V^{-1}\int I d\omega$, and therefore $4\pi V^{-1}I$. If we take here $I\delta\lambda$ to represent the intensity between wave-lengths λ and $\lambda+\delta\lambda$, this density is the quantity E_λ of which the temperature of the radiator is a function. Thus the quantity I—which optically is a measure of the brightness of the beam, and is conserved along it to the extent that $\mu^2 I$ is the same from whichever of its cross-sections the beam is supposed to be emitted—also determines its temperature, the latter being that of an enclosure containing undirected radiation of the same range $\delta\lambda$ which is density $E_\lambda\delta\lambda$ given by $E_\lambda = 4\pi V^{-1}I$, where V is the velocity of radiation in the enclosure. When a beam of radiation travels without suffering absorption, its temperature thus continues to be that of its source multiplied by the coefficient of emission of the source for that kind of radiation, this coefficient being less than unity except in the case of a perfect radiator; but when its intensity I falls by δI in any part of its path owing to absorption or other irreversible process, this involves a further fall of temperature of the energy of the beam and a rise of entropy which can be completely determined when the relation connecting $\mu^{-3}E_\lambda$ with T and λ is known. Any directed quality in radiant energy increases its effective temperature. Splitting a beam into two at a reflecting and refracting surface diminishes the temperature of each part; it is true that if the reflecting surface were non-molecular the operation could be reversed, but actually the reversed rays would encounter the reflecting molecules in different collocations, and could not (§ 11) recombine into the same detailed phase-relations as before. The direct solar radiation falling on the Earth is almost completely convertible into mechanical effect on account of its very high temperature; there seems ground for believing that certain constituents of it can actually be almost wholly turned to account by the

green leaves of plants. But the same solar radiation, when broken up into diffused sky light, which has no definite direction, has fallen into equilibrium with a much lower temperature, through loss of its reversibility. It has been remarked that the temperatures of the planets can be roughly compared by means of this principle, if their coefficients of absorption of the solar radiation are assumed; that of Neptune comes out below −200° C., if we suppose that it is not kept higher by a supply of internal heat.

To obtain dynamical precision in this discussion an exact definition of the narrow beam such as is usually called a ray is essential. It can be specified as a narrow filament of radiation, such as may be isolated within an infinitely thin, impermeable, bounding tube without thereby producing any disturbance of the motion. If either the tube or the surrounding radiation were not present to keep the beam in shape, it would spread sideways, as in optical diffraction. But the function of the tube is one of pure constraint; thus the change of energy-content of a given length of the tube is represented by energy flowing into it at the end where the radiation enters, and leaving it at the other end, but with no leakage at the sides. The total radiation may be considered as made up of such filaments.

9. *Temperature of the Sun.*—The mean temperature of the radiating layers of the Sun may be estimated from Stefan's law, by computing the intensity of the radiation at his surface from that terrestrially observed, on the basis of the law of inverse squares; the result is about 6500° C. The application of Wien's law, which makes the wave-length of maximum energy vary inversely as the temperature, for the case of a perfectly radiating source, gives a result 5500° C. These numbers will naturally differ because (i) the Sun is not a perfect radiator, the constitution of his radiation in fact not following the law of that of a black body, (ii) the various radiating layers have different temperatures, (iii) the radiation may be in part due to chemical and electrical causes, and in so far would not be determined by the temperature alone. The fair agreement of these two estimates indicates, however, that the radiation is largely regulated by the temperature, that the layers from which the main part of it comes are at temperatures not very different, and that not very much of the complete radiation established in these layers and emitted from them is absorbed by the overlying layers.

10. *Fluorescence.*—When radiation of certain wave-lengths falls on a fluorescent body, it is largely absorbed, but in such manner as directly to excite other radiation of different type which is emitted in addition to the true temperature-radiation of the body. The distinction involved is that the latter radiation is spontaneously convertible with the heat of the absorbing body at its own temperature, without any external stimulus or compensation; it is, in fact, on the basis of this convertibility that the thermodynamic relations of the temperature-radiation have been established. According to the experimental law of Stokes, the wave-lengths of the fluorescent radiation are longer than those of the radiation which excites it. If the latter were directly transformed, in undiminished amount, into the fluorescent kind, this is what would be expected. For such a spontaneous change must involve loss of availability; and, beyond the wave-length of maximum energy in the spectrum, the temperature of a given density of radiation is greater the shorter its wave-length, as it is a function of that density and the wave-length alone such that greater radiation always corresponds to higher temperature. But it would appear that the opposite should be the case for radiation of long wave-lengths, lying on the other side of the maximum, in which the tendency would thus be for spontaneous change into shorter waves; this may perhaps be related to the fact that the lines of longer wave-lengths in spectra often come out brighter at lower temperatures, for they are then thrown on the other side of the maximum and cannot be thus degraded. The principle does not, however, have free play in the present case, even when the incident radiation is diffused and so has not the abnormally high temperature associated with a directed beam (§ 8), since part of it might be degraded into low-temperature heat, or there might be other compensation of chemical type for any abnormally high availability that might exist in the fluorescent radiation. It has been found that fluorescent radiation, showing a continuous or banded spectrum, can be excited in many gases and vapours; milky phosphorescence of considerable duration, and thus doubtless associated with chemical change, is produced in vacuum tubes, containing oxygen or other complexly constituted gases, by the electric discharge.

11. *Entropy of a Ray.*—If each definitely constituted beam of radiation has its own temperature and everything is reversible as above, a question arises as to the location of the process of averaging which enters into the idea of temperature. The answer can depend only on the fact, that although the beam is definite as to wave-length and intensity, yet it is far from being a simple wave-train, in that it is constituted of trains of limited lengths and various phases and polarizations, coming from the independent radiating molecules. When such a beam has once emerged, it travels without change, and can be reflected back intact to its source, and is in so far reversible; but when it has arrived there, the molecules of the source will have changed their positions, and it cannot be wholly reabsorbed in the same manner as it was emitted. There must thus be some feature in the ultimate averaged constitution of the beam, emitted from a body in the definite steady state of internal motion determined by its temperature, which adapts it for spontaneous uncompensated reabsorption into a body at its own (or a lower) temperature, but not at a higher one.

The question of the determination of the form of the function ϕ in § 6 would thus appear to be closely connected with the other problems, hitherto imperfectly fathomed, relating to the statistics of kinetic molecular theory. A very interesting attack on the problem from this point of view has recently been made in various forms by Planck. It of course suffices to examine some simple type of radiating system, and the results will be of general validity. He considers an enclosure filled with radiation involving an entirely arbitrary succession of phases and polarizations along each ray, and also containing a system of fixed linear electric oscillators of the Hertzian type, which are taken to represent the transforming action of radiating and absorbing matter. The radiation contained in the enclosure will be passed through these oscillators over and over again, now absorbed, now radiated, and each constituent will thus settle down in a unilateral or irreversible manner towards some definite intensity and composition. But it does not appear that a system of vibrators of this kind, each with its own period, can perform one of the main functions of a material absorber, namely, the transformation of the relative intensities of the various types of radiation in the enclosure to those corresponding to a common temperature. There would be equilibrium established only between the mean internal vibratory energy in the vibrators of each period and the density of radiation of that period; there is needed also some means of interchanging energy between vibrators of different periods, which probably involves doing away with their fixity, or else employing more complex vibrators and assuming a law of distribution of their internal energy. In the absence of any method of introducing this temperature equilibrium directly, Planck originally sought, in the case of each independent constituent, for a function of its intensity of energy and its wave-length, restricted as to form by a certain assumed molecular relation, which has the property of continually increasing after the manner of entropy, during the progress of that constituent of the radiation in such a system towards its steady state. If the actual entropy S per unit volume could be thus determined, the relation of Clausius $\delta S = \delta E/T$ would supply the connexion between the temperature and the density of radiant energy E. This procedure led him, in an indirect and tentative manner, to a relation $d^2S/dE^2 = -\alpha/E$, so that $S = -\alpha E \log \beta E$, where α, β are functions of λ; an expression which conducts through Clausius's relation to $E = (e\beta)^{-1} e^{-1/\alpha T}$.

The previous argument then gives $E(\lambda,T)\delta\lambda = c_1\lambda^{-5}e^{-c/\lambda T}\delta\lambda$, a type of formula which was originally suggested by Wien on the basis of the analogy that it assigns the same distribution for the radiant energy, among the various frequencies of vibration, as for the energy of the molecules in a gas among their various velocities of translation. But the experimental inadequacy of this formula afterwards suggested a new procedure, as *infra*.

Processes may be theoretically assigned for the direct continuous transformation of radiant into mechanical energy. Thus we can imagine a radiating body at the centre of a wheel, carrying oblique vanes along its circumference, which reflect the radiation on to a ring of parallel fixed vanes, which finally reverse its path and return it to the centre. The pressure of the radiation will drive the wheel, and in case its motion is not resisted, a very great velocity may be theoretically obtained. The thermodynamic compensation in such cases lies in the reduction of the effective temperature of the portion of the radiation not thus used up. We might even do away with the radiating body at the centre of the wheel, and consider a beam of definite radiation reflected backwards and forwards across a diameter. It is easy to see that its path will remain diametral; the work done by it in driving the wheel will be concomitant with increase of the wave-length, and therefore with expansion of the length occupied by the beam. The thermodynamic features are thus analogous to those of the more familiar case of an envelope filled with gas, which can change its thermal energy into mechanical energy by expansion of the envelope against mechanical resistances. In the case of the expanding gas $pv = \frac{2}{3}E_o$, where E_o is the total translatory energy of the molecules, while in adiabatic expansion $p = kv^{-\gamma}$. Thus the work gained in unlimited expansion, $\int p\,dv$, is $\frac{2}{3}E_o/(\gamma-1)$. The final temperature being absolute zero, this should by Carnot's principle be equal to the total initial energy of the gas that is in connexion with temperature, constitutive energy of the molecules being excluded; when $\gamma-1$ is less than $\frac{2}{3}$ there is thus internal thermal energy in the molecules in addition to the translatory energy. In the case of the beam of radiation, of length l, between n and $n+\delta n$ reflexions, where δn is an integer, its *total* energy E is by § 2 reduced according to the law $\frac{\delta E}{E} = -\frac{4cv\delta n}{(c+v)^2}$. Also $\frac{\delta l}{l} = \frac{2v\delta n}{c+v}$; thus $\frac{\delta E}{E} = -\frac{2c}{c+v}\frac{\delta l}{l}$. When v is small compared with c, this gives $E = \kappa l^{-2}$; and p is then $2E/l$, so that $\int p\,dl = E$, the temperature of the beam being ultimately reduced to absolute zero by the unlimited expansion. This is in accord with Carnot's principle, in that the whole energy of the beam travelling in a vacuum is mechanically available when reduction to absolute zero of temperature is in our power.

12. *Experimental Knowledge.*—Under the stimulus of Wien's investigation and of improvements in the construction of linear thermopiles and bolometers for the refined measurement of the distribution of energy along a spectrum, the general character of the curve connecting energy and wave-length in the complete radiation at a given temperature has been experimentally ascertained over a wide range. At each temperature there is a wave-length λ_m of maximum radiation, which is displaced towards the ultra-violet as the temperature rises, and Wien's law of homology (§ 6) shows that $\lambda_m T$ should be constant. This deduction, and the law of homology itself, as also the law of Stefan and Boltzmann that the total radiation varies as T^4, have been closely verified by the experiments of Rubens and Kurlbaum, Lummer and Pringsheim, Paschen and others. They established a steady field of radiation inside a material enclosure by raising the walls to a definite temperature, and measured the radiant intensity emitted from it through an opening or slit in the walls, by means of a bolometer or thermopile, this being the radiation of the so-called perfectly black body. The principle here involved formed one of the foundations of Balfour Stewart's early treatment of the theory, and had already been employed by him and Stokes (1860) in experiments on the polarized emission from tourmaline: cf. Stokes, *Math. and Phys. Papers*, iv. 136. It has been remarked by Planck and by Thiesen that the coefficient of T^4 in Stefan's law, and the value of $\lambda_m T$, are two absolute physical constants independent of any particular kind of matter, which in conjunction with the constant of gravitation would determine an entirely absolute system of physical units. The form of the function $\phi(T\lambda)$ adopted by Wien and in Planck's earlier discussions, namely, $c_1e^{-c/T\lambda}$, was found to agree fairly with experiment over the range from 100° C. to 1300° C., when $c_1 = 1{\cdot}24\times10^{-5}$, and $c = 1{\cdot}4435$ in c.g.s. measure, but not so well when the range is farther extended: it appeared that a larger value ~~of~~ c was needed to represent the radiation for high values of $T\lambda$, that is, for high temperature or for very long wave-lengths. Thiesen proposed the somewhat more general form $c_1(T\lambda)^k e^{-c/T\lambda}$, and suggested that the value $k=\frac{1}{2}$ agrees better with the experimental numbers than Wien's value $k=0$. Lord Rayleigh was led (*Phil. Mag.*, June 1900) towards this form with k equal to unity from entirely different theoretical considerations, on the assumption of the Maxwell-Boltzmann distribution of the energy of a system, consisting of an isolated block of aether, among its free periods of vibration, infinite in number; in some cases this form appeared to give as good results as Wien's own.

Acting on a suggestion advanced by Lord Rayleigh, Rubens and Kurlbaum soon afterwards widely extended the test of the formulae by means of the so-called *Reststrahlen.* A substance such as an aniline dye, which exhibits selective absorption of any group of rays, also powerfully reflects those rays; and Rubens has been able thus to isolate in considerable purity the rays belonging to absorption bands very far down in the invisible ultra-red, having wave-length of order 10^{-3} cm., which are intensely absorbed by substances such as sylvine, by means of five or six successive reflexions of the beam of radiation. By experiments ranging between temperatures −200° C. and + 1500° C. of the source of radiation, it has been found that the intensity of this definite radiation tends to vary simply as T, with close approximation, thus increasing indefinitely with the temperature, whereas Wien's formula would make it tend to a definite limit. The only existing formula (except the one suggested by Lord Rayleigh) that proved to be in accord with this result was a new one advanced shortly before and supported on theoretical grounds by Planck, namely, $E_\lambda\delta\lambda = C\lambda^{-5}\delta\lambda/(e^{c/\lambda T}-1)$, which for small values of λT agrees with Wien's original form, known to be there satisfactory, while for larger values it tends towards $C/c\,.\,\lambda^{-4}T$; the new formula is, in fact, the simplest and most likely form that satisfies these two conditions. The point of Lord Rayleigh's argument was that, at any rate at low frequencies, the law of distribution would suggest an equable partition of the energy between temperature heat and radiant vibrations, and that therefore the energy of the latter should ultimately vary as T; and this prediction, which has thus been verified, may be grafted on to any formula that is in other respects appropriate.

Recognizing that his previous hypothesis, restricting the nature of the entropy in addition to its property of continually increasing, had thus to be abandoned, Planck had in fact made a fresh start on the basis of a train of ideas which was introduced by Boltzmann in 1877, in order to obtain a precise physical conception of entropy. According to the latter, for an indefinitely numerous system of molecules, with known properties and in given circumstances, there is a definite probability of the occurrence of each statistical distribution of velocities, or say each "complexion" of the system, that is formally possible when all velocities consistent with given total energy are considered to be equally likely as regards each molecule; the distribution of greatest possible probability is the state of thermal equilibrium of the system, and the probability of any other state is a function of the entropy of that state. This conception can be developed only in very simple cases; the application to an ideal monatomic gas-system led Boltzmann to take the entropy proportional to the logarithm of the probability. This logarithmic law is in fact demanded in advance by the principle that the entropy of a system should be the sum of the entropies of its parts. By means of a priori considerations of this nature, referring to the distribution of internal vibratory energy among a system of linear electric vibrators of given period, and its equilibrium of exchanges with the surrounding radiant energy, Planck has been guided to an expression for the law of dependence of the entropy of that system on the temperature, which corresponds to the form of the law of radiation above stated. The result gains support from the fact that the expressions for the coefficients to which he is led give determinations of the absolute physical constants of molecular theory, such as the constant of Avogadro, which are in close accord with other recent determinations. But on the other hand these determinations are already involved in the earlier formula of Rayleigh, which expresses the distribution for long waves, based merely on the Maxwell-Boltzmann principle of the equable partition of the energy among the high free periods belonging to the enclosure which contains it. It is maintained by Jeans that the reason why this principle is of avail only for very long wave-lengths is that a steady state is never reached for the shorter ones, a doctrine which as he admits would entirely remove the foundations of the application of thermodynamic principles to this subject. By an argument based on the theory of dimensions, Lorentz has been led to the conclusion that consistency between temperatures, as measured molecularly, and as measured by the laws of radiation, requires that the ultimate indivisible electric charges or electrons must be the same in all kinds of matter.

The abstract statistical theory of entropy, which is here invoked, admits of generalization in a way which is a modification of that of Planck, itself essentially different from the earlier idea of Boltzmann. The molecules of matter, whose interactions control physical phenomena, including radiation, are too numerous to be attended to separately in our knowledge. They, and the phenomena in which they interact, must thus be sorted out into differential groups or classes. Elements of energy of specified types might at first sight constitute such classes: but the identity of a portion of energy cannot be traced during its transformations, while an element of physical disturbance can be definitely followed, though its energy changes by interaction with other elements as it proceeds. The whole disturbance may thus be divided into classes, or groups of similar elements, each with permanent existence: and these may be considered as distributed in series of cells, all equivalent in extent, which constitute and map out the material system or other domain of the phenomena. The test of this equivalence of extent is superposition, in the sense that the same element of disturbance always occupies during its wanderings the same number of cells. This framework being granted, the probability of any assigned statistical distribution of the elements of disturbance now admits of calculation; and it represents, as above, the logarithm of the entropy of that distribution, multiplied however by a coefficient which must depend on the minuteness of scale of the statistics. But in the calculation, all the physical laws which impose restrictions on the migrations of the elements of disturbance must be taken into account; it is only after this is done that the rest of the circumstances can be treated as fortuitous. All these physical laws are, however, required and used up in determining the complex of equivalent cells into which the system which forms the seat of the energy is mapped out. On this basis thermodynamics can be constructed in a priori abstract fashion, and with deeper and more complete implications than the formal Carnot principle of negation of perpetual motions can by itself attain to. But the ratio of the magnitude of the standard element of disturbance to the extent of the standard cell remains inherent in the results, appearing as an absolute physical constant whose value is determined somehow by the other fundamental physical constants of nature. A prescribed ratio of this kind is, however, a different thing from the hypothesis that energy is constituted atomically, which underlies, as Lorentz pointed out, Planck's form of the theory. It has indeed already been remarked that the mere fact of the existence of a wave-length λ_m of maximum radiation, whether obeying Wien's law $\lambda_m T = \text{constant}$ or not, implies by itself some prescribed absolute physical quantity of this kind, whose existence thus cannot be evaded, though we may be at a loss to specify its nature.

13. *Modification by a Magnetic Field.*—The theory of exchanges of radiation, which makes the equilibrium of radiating bodies depend on temperature alone, requires that, when an element of surface of one body is radiating to an element of surface of another body at the same temperature, the amounts of energy interchanged (when reflexion is counted in along with radiation) should be equal. This proposition is a general dynamical consequence—on the basis of the laws of reciprocity developed in this connexion (after W. Rowan Hamilton) mainly by Helmholtz, Kirchhoff, and Rayleigh—of the form of the equations of propagation of vibrations in the medium. But in a material medium under the influence of a strong magnetic field these equations are altered by the addition of extraneous terms involving differential coefficients of the third order, and the dynamical consistency of the cardinal principle of the theory of exchanges is no longer thus directly verified. A system of this kind has, in fact, been imagined by Wien in which the principle is imperfectly fulfilled. A beam coming from a body A, and polarized by passage through a nicol, may have its plane of vibration rotated through half a right angle by crossing a magnetically active plate, and may then pass through another nicol, properly orientated for transmission, so as finally to fall on another body B. On the other hand, the radiation from B which gets through this adjacent nicol will have its plane of vibration rotated through another half right angle by the magnetically active plate, and so will not get through the first nicol to the body A. Such possibilities of unequal exchange of radiation between A and B are the result of the want of reversibility of the radiation in the extraneous magnetic field, which might have been expected to lead to proportionate inequalities of concentration; in this example, however, though the defect of reversibility is itself slight, its results appear at first sight to prevent any equilibrium at all. But a closer examination removes this discrepancy. In order to make the system self-contained, reflectors must be added to it, so as to send back into the sources the polarized constituents that are turned aside out of the direct line by the nicols. Then, as Brillouin has pointed out, and as in fact Rayleigh had explained some years before, the radiation from B does ultimately get across to A after passage backward and forward to the reflectors and between the nicols: this, it is true, increases the length of its path, and therefore diminishes the concentration of a single narrow beam, but any large change of path would make the beam too wide for the nicols, and thus require other corrections which may be supposed to compensate. The explanation of the slight difference that is to be anticipated on theoretical grounds might conceivably be that in such a case the magnetic influence, being operative on the phases, alters the statistical constitution of the radiation of given wave-length from the special type that is in equilibrium with a definite temperature, so that after passage through the magnetic medium it is not in a condition to be entirely absorbed at that temperature; there would then be some other element, in addition to temperature, involved in equilibrium in a magnetic field. If this is not so, there must be some thermodynamic compensation involving reaction, extremely small, however, on the magnetizing system.

14. *Origin of Spectra.*—In addition to the thermal radiations of material substances, those, namely, which establish temperature-equilibrium of the enclosure in which they are confined, there are the fluorescent and other radiations excited by extraneous causes, radiant or electric or chemical. Such radiations are an indication, by the presence of higher wave-lengths than belong in any sensible degree to the temperature, that the steady state has not arrived; they thus fade away, either immediately on the cessation of the exciting cause, or after an interval. The radiations, consisting of definite narrow bright bands in the spectrum, that are characteristic of the gaseous state in which each molecule can vibrate freely by itself, are usually excited by electric or chemical agency; thus there is no ground for assuming that they always constitute true temperature radiation. The absorption of these radiations by strata of the same gases at low temperatures seems to prove that the unaltered molecules themselves possess these free periods, which do not, therefore, belong specially to dissociated ions. Although very difficult to excite directly, these free vibrations are then excited and absorb the energy of the incident waves, under the influence of resonance, which naturally becomes extremely powerful when the tuning is exact; this

indicates, moreover, that the true absorption bands in a gas of sufficiently low density must be extremely narrow. There is direct evidence that many of the more permanent gases do not sensibly emit light on being subjected to high temperature alone, when chemical action is excluded, while others give in these circumstances feeble continuous spectra; in fact, looking at the matter from the other side, the more permanent gases are very transparent to most kinds of radiation, and therefore must be very bad radiators as regards those kinds. The dark radiation of flames has been identified with that belonging to the specific radiation of their gaseous products of combustion. There is thus ground for the view that the impacts of the colliding molecules in a gas, or rather their mutual actions as they swing sharply round each other in their orbits during an encounter, may not be sufficiently violent to excite sensibly the free vibrations of the definite periods belonging to the molecules. But they may produce radiation in other ways. While the velocity of an electron or other electric charge is being altered, it necessarily sends out a stream of radiation. Now the orbital motions of the electrons in an actual molecule must be so adjusted, as appears to be theoretically possible, that it does not emit radiation when in a steady state and moving with constant velocity. But in the violent changes of velocity that occur during an encounter this equipoise will be disturbed, and a stream of radiation, without definite periods, but such as might constitute its share of the equilibrium thermal radiation of the substance, may be expected while the encounter lasts. At very high temperatures the energy of this thermal radiation in an enclosure entirely overpowers the kinetic energy of the molecules present, for the former varies as T^4, while the latter measures T itself when the number of molecules remains the same. The radiation which can be excited in gases, confined as it is to extremely narrow bands in the spectrum, may indeed be expected to possess such intensity as to be thermally in equilibrium with extremely high temperatures. That the same gases absorb such radiations when comparatively cold and dark does not, of course, affect the case, because emissive and absorptive powers are proportional only for incident radiations of the intensity and type corresponding to the temperature of the body. Thus if our adiabatic enclosure of § 3 is prolonged into a tube of unlimited length which is filled with the gas, then when the temperature has become uniform that gas must send back out of the tube as much radiation as has passed down the tube and been absorbed by it; but if the tube is maintained at a lower temperature, it may return much less. The fact that it is now possible by great optical dispersion to make the line-spectra of prominences in the middle of the Sun's disk stand out bright against the background of the continuous solar spectrum, shows that the intensities of the radiations of these prominences correspond to a much higher temperature than that of the general radiating layer underneath them; their luminosity would thus seem to be due to some cause (electric or chemical) other than mere temperature. On the other hand, the general reversing gaseous layer which originates the dark Fraunhofer lines is at a lower temperature than the radiating layer; it is only when the light from the lower layers is eclipsed that its own direct bright-line spectrum flashes out. It is not necessary to attribute this selective flash-spectrum to temperature radiation; it can very well be ascribed to fluorescence stimulated by the intense illumination from beneath. When the radiation in a spectrum is constituted of wide bands it may on these principles be expected to be in equilibrium with a lower temperature than when it is constituted of narrow lines, if the total intensity is the same in the cases compared; this is in keeping with the easier excitation of band spectra (cf. the banded absorption spectra), and with the fact that various gases and vapours do appear to emit band spectra more or less related to the temperature.

15. *Constitution of Spectra.*—In the problem of the unravelling of the constitutions of the very complex systems of spectral lines belonging to the various kinds of matter, considerable progress has been made in recent years. The beginning of definite knowledge was the discovery of Balmer in 1885, that the frequencies of vibration (n) of the hydrogen lines could be represented, very closely and within the limits of error of observation, by the formula $n \propto 1 - 4m^{-2}$, when for m is substituted the series of natural numbers 3, 4, 5, . . . 15. Soon afterwards series of related lines were picked out from the spectra of other elements by Liveing and Dewar. Rydberg conducted a systematic investigation on the basis of a modification of Balmer's law for hydrogen, namely, $n = n_o - N/(m+\mu)^2$. He found that in the group of alkaline metals three series of lines exist, the so-called principal and two subordinate series, whose frequencies fit approximately into this formula, and that similar statements apply to other natural groups of elements; that the constant N is sensibly the same for all series and all substances, while n_o and μ have different values for each; and that other approximate numerical relations exist. In each series the lines of high frequency crowd together towards a definite limit on the more refrangible side; near this limit they would, if visible, constitute a band. The principal or strongest series of lines shows reversal very readily. The lines of the first subordinate series are usually nebular, while those of the second subordinate or weakest series are sharp; but with a tendency to broaden towards the less refrangible side. In most series there are, however, not more than six lines visible: helium and hydrogen are exceptions, no fewer than thirty lines of the principal series of the latter having been identified, the higher ones in stellar spectra only. But very remarkable progress has recently been made by R. W. Wood, by exciting fluorescent spectra in a metallic vapour, and also by applying a magnetic field to restore the lines sensitive to the Zeeman effect after the spectrum has been cut off by crossed nicols. The large aggregates of lines thus definitely revealed are also resolved by him into systems in other ways; when the stimulating light is confined to one period, say a single bright line of another substance, the spectrum excited consists of a limited number of lines equidistant in frequency, the interval common to all being presumably the frequency of some intrinsic orbital motion of the molecule. In this way the series belonging to some of the alkali metals have been obtained nearly complete.

Simultaneously with Rydberg, the problem of series was attacked by Kayser and Runge, who, in reducing their extensive standard observations, used the formula $n = A + Bm^{-2} + Cm^{-4}$, higher terms in this descending series being presumed to be negligible. This cannot be reconciled with Rydberg's form, which gives on expansion terms involving m^{-3}; but for the higher values of m the discrepancies rapidly diminish, and do not prevent the picking out of the lines, the frequency-differences between successive lines then varying roughly as the inverse squares of the series of natural numbers. For low values of m neither mode of expression is applicable, as was to be expected; and it remains a problem for the future to ascertain if possible the rational formula to which they are approximations. More complex formulas have been suggested by Ritz and others, partly on theoretical grounds.

Considered dynamically, the question is that of the determination of the formula for the disturbed motions of the system which constitutes the molecule. Although we are still far from any definite line of attack, there are various indications that the quest is a practicable one. The lines of each series, sorted out by aid of the formulae above given, have properties in common: they are usually multiple lines, either all doublets in the case of monad elements, or generally triplets in the case of those of higher chemical valency; in very few cases are the series constituted of single lines. It is found also that the components of all the double or triple lines of a subordinate series are equidistant as regards frequency. In the case of a related group of elements, for example the alkaline metals, it appears that corresponding series are displaced continually towards the less refrangible end as the atomic weight rises; it is found also that the interval in frequency between the double lines of a series diminishes with the atomic weight, and is proportional to its square. These relations suggest that the atomic weight might here act in part after the manner of a load attached to a fundamental vibrating system, which might conceivably be formed on the same plan for all the metals of the group; such a load would depress all the periods, and at the same time it would split them up in the manner above described, if it introduced dissymmetry into the vibrator. The discovery of Zeeman that a magnetic field triples each spectral line, and produces definite polarizations of the three components, in many cases further subdividing each component into lines placed usually all at equal intervals of frequency, is explained, and was in part predicted, by Lorentz on the basis of the electron theory, which finds the origin of radiation in a system of unitary electric charges describing orbits or executing vibrations in the molecule. Although these facts form substantial sign-posts, it has not yet been found possible to assign any likely structure to a vibrating system which would lead to a frequency formula for its free periods of the types given above. Indeed, the view is open that the group of lines constituting a series form a harmonic analysis of a single fundamental vibration not itself harmonic. If that be so, the intensities and other properties of the lines of a series ought all to vary together; it has in fact been found by Preston, and more fully verified by Runge and others, that the lines are multiplied into the same number of constituents in a magnetic field, with intervals in frequency that are the same for all of them. When the series consists of double or triple lines the separate components of the same compound line are not affected similarly, which shows that they are differently constituted. The view has also found support that the different behaviours of the various groups of lines in a spectrum show that they belong to independent vibrators. The form of the vibration sent out from a molecule into the aether depends on the form of the aggregate hodograph of the electronic orbits, which is in keeping with Rayleigh's remark that the series-laws suggest the kinematic relations of revolving bodies rather than the vibrations of steady dynamical systems.

According to Rydberg, there is ground for the view that a natural group of chemical elements have all the same type of series spectrum, and that the various constants associated with this spectrum change rapidly in the same directions in passing from the elements of one group to the corresponding ones of the following groups, after the manner illustrated in graphical representations of Mendeléeff's law by means of a continuous wavy curve in which each group of elements lies along this same ascending or descending branch; the chemical elements thus being built up in a series of types or groups, so that the individuals in successive groups correspond one to one in a regular progression, which may be put in evidence by connecting them by transverse curves. Illustrations have been worked out mathematically by J. J. Thomson of the effect of adding successive outer rings of electrons to stable vibrating collocations.

The frequencies of the series of very close lines which constitute a single band in a banded spectrum are connected by a law of quite different type, namely, in the simpler cases $n^2 = \mathrm{A} - \mathrm{B}m^2$. It may be remarked that this is the kind of relation that would apply to a row of independent similar vibrators in which the neighbours exert slight mutual influence of elastic type. If ξ denote displacement and x distance along the row, the equation $\frac{d^2\xi}{dt^2} + k^2\xi = -g\frac{d^2\xi}{dx^2}$ would represent the general features of their vibration, the right-hand side arising from the mutual elastic influences. If the ends of the line of vibrators, of length l, are fixed, or if the vibrators form a ring, the appropriate type of solution is $\xi \propto \sin \mu x \sin pt$, where $\mu l = m\pi$ and m is integral; further $-p^2 + k^2 = g\mu^2$, hence $p^2 = k^2 - \frac{g\pi^2}{l^2} m^2$, which is of the type above stated. Dynamical systems of this kind are illustrated by the Lagrangean linear system of connected bodies, such as, for example, a row of masses fixed along a tense cord, and each subject to a restoring elastic force of its own in addition to the tension of the cord. A single spectral line might thus be transformed into a band of this type, as the effect of disturbance arising from slight elastic connexions established in the molecule between a system of similar vibrators. But the series in line-spectra are of entirely different constitution; thus for the series expressed by the formula $p^2 = p_o{}^2 - \mathrm{B}m^{-2}$ the corresponding period-equation might be expressed in some such form as $\sin k(p^2 - p_o{}^2)^{-\frac{1}{2}} = \text{constant}$, which belongs to no type of vibrator hitherto analysed.

AUTHORITIES.—The experimental memoirs on the constitution of radiation are mostly in the *Annalen der Physik*; references are given by P. Drude, *Lehrbuch der Optik*, Leipzig, 1900; cf. also reports in the collection issued by the International Congress of Physics, Paris, 1900. See also Lord Rayleigh's *Scientific Papers*, in various connexions; and Larmor, in *Brit. Assoc. Reports*, 1900–1902, also the Bakerian Lecture, *Roy. Soc. Proc.*, 1909, for a general discussion of molecular statistical theory in this connexion. Planck's *Theorie der Wärmestrahlung*, 1906, gives a discussion from his point of view; there is a summary by Wien in *Ency. Math. Wiss.* v. (3) pp. 282-357; also a lecture of H. A. Lorentz to the Math. Congress at Rome, 1908, and papers by J. H. Jeans, *Phil. Mag.*, 1909, on the partition of energy. In spectrum analysis Kayser's extensive treatise is the standard authority. Winckelmann's *Handbuch der Physik*, vol. ii. (by Kayser, Drude, &c.), may also be consulted. (J. L.*)

RADICAL (Lat. *radix*, a root), in English politics, a term applied to politicians who desire to make *thorough*, or *radical*, changes in the constitution and in the social order generally. Although it had been used in a somewhat similar way during the reign of Charles II., the term Radical, in its political sense, originated about the end of the 18th century, probably owing its existence to Charles James Fox, who, in 1797, declared that "radical reform" was necessary. The ideas of the first Radicals were borrowed largely from the authors of the French Revolution. The word was more generally employed during the disturbed period between the close of the Napoleonic wars and the passing of the great Reform Bill of 1832, and was applied to agitators like Henry Hunt and William Cobbett. After the Reform Bill had become law, the advocates of violent change were drawn into the Chartist movement, and the Radicals became less revolutionary both in speech and object. Thus in 1842 an observer writes:—"The term Radical, once employed as a name of low reproach, has found its way into high places, and is gone forth as the title of a class who glory in their designation." About this time many members of Parliament were known as Radicals, among these men being George Grote and Joseph Hume. The Radicals never formed a distinct party in the House of Commons, and subsequently they formed simply the advanced section of the Liberal party. For a few years in the 19th century the wearing of a white hat was looked upon as the distinguishing mark of a Radical, a hat of this colour having been worn by Hunt when addressing meetings.

See W. Harris, *History of the Radical Party in Parliament* (1885); S. Bamford, *Passages in the Life of a Radical* (new ed., 1893); C. B. Roylance Kent, *The English Radicals: an Historical Sketch* (1899).

RADIOACTIVITY. The subject of radioactivity deals with phenomena exhibited by a special class of bodies of high atomic weight of which uranium, thorium, radium and actinium are the best known examples. These substances possess the property of spontaneously emitting radiations of a special character which are able to penetrate through matter opaque to ordinary light. The beginning of this subject dates from 1896, and was an indirect consequence of the discovery of the X rays made a few months before by Röntgen. It was known that the production of X rays in a vacuum tube was accompanied by a strong phosphorescence of the glass, and it occurred to several investigators that ordinary substances made phosphorescent by visible light might emit a penetrating radiation similar to X rays. Following out this idea, H. Becquerel (1),[1] a distinguished French physicist, exposed amongst other substances a phosphorescent compound of uranium, uranium-potassium sulphate, enveloped in paper beneath a photographic plate. A weak photographic effect was obtained. This was shown to be due to a penetrating radiation capable of passing through sheets of matter opaque to ordinary light. Further investigation showed that this photographic action was exhibited by all compounds of uranium and by the metal itself, and had nothing to do with phosphorescence. It was shown equally if the uranium were kept in darkness and did not vary appreciably with time. Becquerel showed that the rays from uranium like X rays were capable of discharging a body whether positively or negatively electrified. A uranium compound brought close to the charged plate of a gold leaf electroscope causes a rapid collapse of the gold leaves. This property of uranium, and also of the radioactive bodies in general, has supplied a delicate and quantitative method of accurate comparison of the intensity of the radiations from substances under varying conditions. A modified form of gold leaf electroscope has come into general use for comparison of the radioactivity of substances. Rutherford (2) made a systematic examination of the discharging effect produced by the rays from uranium and showed that it was due to the production of charged carriers or ions in the volume of the gas through which the radiations pass. In an electric field, the positive ions travel to the negative electrode and vice versa, thus causing a discharge of the electrified body. If a sufficiently strong field is used, the ions are all swept to the electrodes before appreciable loss of their number can occur by recombination. The rate of discharge then reaches a steady maximum value which is not altered by a large increase in voltage. This maximum current through the gas is called the saturation current. The ions produced in gases by the rays from uranium and other radioactive substances are in general identical with those produced by X rays, and the mechanism of conductivity of the gas is very similar in both cases (see CONDUCTION, ELECTRIC: § *Through Gases*).

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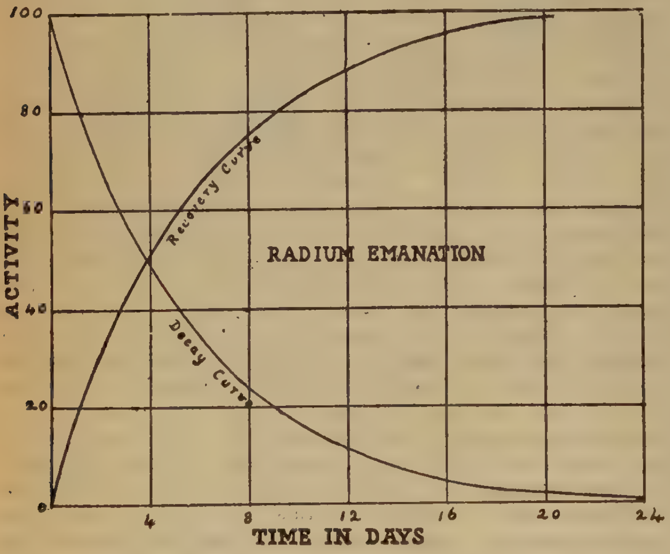
[1] These numbers refer to papers noted under *References* (below).



Some time after Becquerel's discovery, Mme Curie (3) made a systematic examination of the electric method of a large number of chemical elements and their compounds to test whether they possessed the "radioactive" property of uranium. Only one other element, thorium, was found to show this effect to a degree comparable with that of uranium—a result independently observed by Schmidt. Mme Curie examined the activity of the various compounds of uranium and found that their radioactivity was an atomic property, *i.e.* the activity was proportional to the amount of the element uranium present, and was independent of its combination with other substances. In testing the activity of the minerals containing uranium, Mme Curie found that the activity was always four to five times as great as that to be expected from their content of uranium. If the radioactivity were an atomic phenomenon, this could only be explained by the presence in these minerals of another substance more active than uranium itself. Relying on this hypothesis, Mme Curie made a chemical examination of uranium minerals in order to try to separate this new radioactive substance. In these experiments, the Austrian Government generously provided Mme Curie with a ton of the residues from the State manufactory of uranium at Joachimstahl, Bohemia. At that place there are extensive deposits of pitchblende or uranite which are mined for the uranium. After separation of the latter, the residues are three to five times as radioactive weight for weight as the uranium. From this residue Mme Curie separated a substance far more radioactive than uranium, which she called polonium in honour of the country of her birth. This substance is usually separated with bismuth in the mineral, but by special methods can be partly separated from it. A further examination revealed the presence of a second radioactive substance which is normally separated with the barium, to which the name "radium" was given. This name was happily chosen, for in the pure state radium bromide has a very great activity—about two million times as great as an equal weight of uranium. By means of successive fractionations of the chloride, the radium was gradually concentrated, until finally the radium was obtained so that the barium lines showed very faintly. The atomic weight was found by Mme Curie to be 225. In a recent redetermination, using a larger quantity of 0·4 grams of pure radium chloride, Mme Curie (4) found the atomic weight to be 226·2. Thorpe (5) using a smaller quantity obtained a value 227. The spectrum of the purified sample of radium chloride obtained by Mme Curie was first examined by Demarçay. It was found to have a characteristic spark spectrum of bright lines analogous in many respects to the spectra of the alkaline earths. Giesel (6) found that pure radium bromide gives a brilliant carmine colour to the bunsen flame. The flame spectrum shows two broad bright bands in the orange-red. There is also a line in the blue-green and two weak lines in the violet. Giesel (7) has taken an active part in the preparation of pure radium compounds, and was the first to place preparations of pure radium bromide on the market. He found that the separation of radium from the barium mixed with it proceeded much more rapidly if the crystallizations were carried out using the bromide instead of the chloride. He states that six to eight crystallizations are sufficient for an almost complete separation. From the chemical point of view radium possesses all the characteristic properties of a new element. It has a definite atomic weight, a well-marked and characteristic spectrum, and distinct chemical properties. Its comparative ease of separation and great activity has attracted much attention to this substance, although we shall see that very similar radioactive properties are possessed by a large number of distinct substances.

Radium emits three distinct types of radiation, known as the α, β and γ rays, of which an account will be given later. It produces in addition a radioactive emanation or gas which is about 100,000 times as active weight for weight as radium itself. The emanation released from 10 milligrams of pure radium bromide causes a glass tube into which it is introduced to phosphoresce brightly. A brilliant luminosity is produced in phosphorescent substances like zinc sulphide, willemite and barium platino-cyanide when introduced into a tube containing the emanation. The radium emanation, a more detailed account of which will be given later, has proved of the greatest utility in radioactive experiments. The property of radium of producing the emanation has been utilized as a very delicate and certain method, not only of detection but of estimation of small quantities of radium. This "emanation method" depends upon the introduction of the emanation, liberated from a substance by boiling or heating, into a suitable electroscope. The rate of discharge of the electroscope due to the emanation affords a quantitative measure of the amount of radium present. In this way, it is not difficult to determine with certainty the presence of radium in a body which contains only 10^{-11} gram of radium. With care, 10^{-12} gram can just be detected. This emanation method has been employed with great success in measuring the quantity of radium in minerals and in rocks. A very simple method has been devised of determining the quantity of radium present when it is not less than 1/100 milligram. The tube containing the radium is placed some distance from an electroscope which is surrounded by a lead screen about 3 mms. thick. This cuts off the α and β rays and the effect in the electroscope is then due to the penetrating γ rays. By comparison of the rate of discharge with that of a standard preparation of radium at the same distance, the quantity of radium can at once be deduced, provided the radium is in equilibrium with its emanation. This is usually the case if the radium preparation is one month old. This method is simple and direct, and has the great advantage that the radium tube under test need not be opened, nor its contents weighed. We shall see later that the amount of radium in an old mineral is always proportional to the amount of uranium present. Rutherford and Boltwood (8) found that 3·4 parts of radium by weight are present in ten million parts of uranium. Consequently an old mineral containing 1000 kilos of uranium should contain 340 milligrams of pure radium.

In addition to radium and polonium, a number of other radioactive substances have been found in uranium minerals. With the exception of the radium emanation, none of these have yet been isolated in a pure state, although preparations of some of them have been obtained comparable in activity with radium itself. Debierne (9) found a radioactive substance which was separated from pitchblende with the rare earths and had chemical properties similar to those of thorium. This he called *actinium.* Giesel (10) independently noted the presence of a new radioactive substance which was usually separated with lanthanum and cerium from the minerals. It possessed the property of giving out a radioactive emanation or gas, the activity of which died away in a few seconds. For this reason he called it the *emanating substance* and afterwards *emanium.* Later work has shown that emanium is identical in chemical and radioactive properities with actinium, so that the former name will be retained.

We have already seen that Mme Curie gave the name polonium to a radioactive substance separated with bismuth. Later Marckwald found that a very radioactive substance was deposited from a solution of a radioactive mineral on a polished bismuth plate. The active matter was found to be deposited in the bismuth with tellurium, and he gave the name *radiotellurium* to this substance. In later work, he showed that the new substance could be chemically separated from tellurium. By treating the residues from 15 tons of Joachimsthal pitchblende, Marckwald (11) finally obtained 3 milligrams of intensely active material—far more active weight for weight than radium. It has been definitely settled that the active substance of Marckwald is identical with polonium. Both substances give out a type of easily absorbed α rays and both lose their activity at the same rate. The activity of polonium decays in a geometrical progression with the time and falls to half its initial value in 140 days. This law of decay, as we shall see, is characteristic of all radioactive products, although the period of decay is different in each case.

Mme Curie and Debierne (12) have described further experiments with polonium. The latter substance was extracted from several tons of pitchblende and purified until 2 milligrams of material were obtained containing about 1/10 milligram of pure polonium. From a knowledge of the relative periods of transformation of radium and polonium, it can be calculated that the amount of polonium in a radium mineral is 1/5000 of the amount of radium, while the activity of pure polonium measured by the α rays should be 5000 times greater than that of radium. As we have seen, polonium is rapidly transformed, and it is of great interest to determine the nature of the substance into which polonium changes. We shall see later that there is considerable evidence that polonium changes into lead.

Recently Boltwood (13) has separated another substance from uranium minerals which he has called "ionium." This substance is sometimes separated from the mineral with actinium and has chemical properties very similar to those of thorium. Preparations of ionium have been obtained several thousand times as active as uranium. Ionium emits α rays of short range and has a period of transformation probably much longer than that of radium. Ionium has a special interest inasmuch as it is the substance which changes directly into radium. A preparation of ionium initially free from radium grows radium at a rapid rate. Hofmann found that the lead separated from uranium minerals and named it radiolead. The active constituent in the lead is radium D, which changes into radium E and then into radium F (polonium). Both radium D and radium F are products of the transformation of radium. In addition to these radioactive substances mentioned above, a large number of other radioactive substances have been discovered. Most of these lose their activity in the course of a few hours or days. The properties of these substances and their position in the radioactive series will be discussed later.

Radiations from Radioactive Substances.—All the radioactive substances possess in common the property of emitting radiations which darken a photographic plate and cause a discharge of electrified bodies. Very active preparations of radium, actinium and polonium also possess the property of causing strong phosphorescence in some substances. Bodies which phosphoresce under X rays usually do so under the rays from radioactive matter. Barium platinocyanide, the mineral willemite (zinc silicate) and zinc sulphide are the best known examples.

There are in general three types of radiation emitted by the radioactive bodies, called the α, β and γ rays. Rutherford (2) in 1899 showed that the radiation from uranium was complex and consisted of (*a*) an easily absorbed radiation stopped by a sheet of paper or a few centimetres of air which he called the α rays and (*b*) a far more penetrating radiation capable of passing through several millimetres of aluminium, called the β rays. Later Villard found that radium emitted a very penetrating kind of radiation called the γ rays capable of passing before absorption through twenty centimetres of iron and several centimetres of lead.

Giesel and, later, Curie and Becquerel showed that the β rays of radium were deflected by a magnetic field. By the work of Becquerel and Kaufmann the β rays have been shown to consist of negatively charged particles projected with a velocity approaching that of light, and having the same small mass as the electrons set free in a vacuum tube. In fact the β rays are electrons spontaneously ejected from the radioactive matter at a speed on an average much greater than that observed in the electrons set free in a vacuum tube.

The very penetrating γ rays are not deflected in a magnetic or electric field and are believed to be a type of radiation similar to X rays. The γ rays are only observed in radioactive substances which emit β rays, and the penetrating power of the γ rays appears to be connected with the initial velocity of expulsion of the β rays. Two general theories have been advanced to account for the properties of these rays. On one view, the γ rays are to be regarded as electromagnetic pulses which have their origin in the expulsion of the β particle from the atom. On the other hand Bragg has collected evidence in support of the view that the γ rays are corpuscular and consist of uncharged particles or "neutral doublets." There is as yet no general consensus of opinion as to the true nature of the γ rays.

Rutherford (14) showed in 1903 that the α rays were deflected in a powerful magnetic or electric field. The amount of deflection is very small compared with the β rays under similar conditions. The direction of deflection in a magnetic field is opposite to that of the β rays, showing that the α rays consist of a stream of positively charged particles. A pencil of rays from a thick layer of radioactive matter is complex and consists of particles moving at varying velocities If, however, a thin film of radioactive matter of one kind is taken, the particles which escape without absorption are found to be homogeneous and consist of particles projected at an identical speed. Observations of the velocity and mass of the particle have been made by Rutherford. The general method employed for this purpose is similar to that used for the determination of the velocity and mass of the electron in a vacuum tube. The deflection of a pencil of rays in a vacuum is determined for both a magnetic and electric field. From these observations the velocity and value e/m (the ratio of the charge carried by the particle to its mass) are determined. The value of e/m has been found to be the same for the particles from all the types of radioactive matter that have been examined, indicating that the α particles from all radioactive substances are identical in mass. The value of e/m found for the α particle is $5{\cdot}07 \times 10^3$. Now the value of e/m for the hydrogen atom set free in the electrolysis of water is 9660. On the assumption that the value of the charge e is the same for the α particle as for the hydrogen atom, the value would indicate that the α particle has about twice the mass of the hydrogen atom, *i.e.* has the same mass as the hydrogen molecule. If the charge on the α particle is twice that on the hydrogen atom, the value of e/m indicates that the α particle is a helium atom, for the latter has an atomic weight of four times that of hydrogen. It was difficult at first to decide between these and other hypotheses, but we shall show later that there is now no doubt that the α particle is in reality a helium atom carrying two elementary charges. We may consequently regard the α rays as a stream of helium atoms which are projected from a radioactive substance with a high velocity. The maximum velocity of the α particle from radium is 2×10^9 cms. per second, or one-fifteenth of the velocity of light. Although the α rays are the least penetrating of the radiations, it will be seen that they play an extremely important part in radioactive phenomena. They are responsible for the greater part of the ionization and heating effects of radioactive matter and are closely connected with the transformations occurring in them.

Under ordinary experimental conditions the greater part of the ionization observed in a gas is due to the α particles. This ionization due to the α rays does not extend in air at atmospheric pressure for more than 7 cms. from radium, and 8·6 cms. from thorium. If a screen of aluminium about ·01 cms. thick is placed over the active material, the α rays are completely absorbed, and the ionization above the screen is then due to the β and γ rays alone. If a layer of lead about 2 mms. thick is placed over the active material, the β rays are stopped, and the ionization is then due almost entirely to the penetrating γ rays. By the use of screens of suitable thickness we are thus able to sift out the various types of rays. These three types of radiations all set up secondary radiations in passing through matter. A pencil of β rays falling on matter is widely scattered in all directions. This scattered radiation is sometimes called the secondary β rays. The γ rays give rise to secondary rays which consist in part of scattered γ rays and in part electrons moving with a high velocity. These secondary rays in turn produce tertiary rays and so on. The impact of the α rays on matter sets free a number of slow moving electrons which are very easily deflected by a magnetic or electric field. This type of radiation was first observed by J. J. Thomson, and has been called by him the δ rays.

Emanations or Radioactive Gases.—In addition to their power of emitting penetrating radiations, the substances thorium, actinium and radium possess another very striking and important property. Rutherford (15) in 1900 showed that thorium compounds (especially the oxide) continuously emitted a radioactive emanation or gas. This emanation can be carried away by a current of air and its properties tested apart from the substance which produces it. A little later Dorn showed that radium possesses a similar property, while Giesel and Debierne observed a similar effect with actinium. These emanations all possess the property of ionizing a gas and, if sufficiently intense, of producing marked photographic and phosphorescent action. The activity of the radioactive gases is not permanent but disappears according to a definite law with the time, viz. the activity falls off in a geometric progression with the time. The emanations are distinguished by the different rates at which they lose their activity. The emanation of actinium is very shortlived, the time for the activity to fall to half value, *i.e.* the period of the emanation, being 3·7 seconds. The period of the thorium emanation is 54 seconds and of the radium emanation 3·9 days. This property of emitting an emanation is shown in a very striking manner by actinium. A compound of actinium is wrapped in a sheet of thin paper and laid on a screen of phosphorescent zinc sulphide. In a dark room the phosphorescence, marked by the characteristic scintillation, is seen to extend on all sides from the active body. A puff of air is seen to remove the emanation and with it the greater part of the phosphorescence. Fresh emanation immediately diffuses out and the experiment may be repeated indefinitely. The emanations have all the properties of radioactive gases. They can be transferred from point to point by currents of air. The emanations can be separated from the air or other gas with which they are mixed by the action of extreme cold. Rutherford and Soddy (16) showed that under ordinary conditions the temperature of condensation of the radium emanation mixed was −150° C.

The emanations are produced from the parent matter and escape into the air under some conditions. Rutherford and Soddy (17) made a systematic examination of the emanating power of thorium compounds under different conditions. The hydroxide emanates most freely, while in thorium nitrate, practically none of the emanation escapes into the air. Most of the compounds of actinium emanate very freely. Radium compounds, except in very thin films, retain most of the emanation in the compound. The occluded emanation can in all cases be released by solution or by heating. On account of its very slow period of decay, the emanation of radium can be collected like a gas and stored, when it retains its characteristic properties for a month or more.

Induced Activity.—Curie (18) showed that radium possessed another remarkable property. The surface of any body placed near radium, or still better, immersed in the emanation from it, acquires a new property. The surface after removal is found to be strongly active. Like the emanations, this induced activity in a body decays with the time, though at quite a different rate from the emanation itself. Rutherford (19) independently showed that thorium possessed a like property. He showed that the bodies made active behaved as if a thin film of intensely active matter were deposited on their surface. The active matter could be partly removed by rubbing, and could be dissolved off by strong acids. When the acid was evaporated the active matter remained behind. It was shown that induced activity was due to the emanations, and could not be produced if no emanation was present. We shall see that induced activity on bodies is due to a deposit of non-gaseous matter derived from the transformation of the emanations. Each emanation gives a distinctive active deposit which decays at different rates. The active deposits of radium, thorium and actinium are very complex, and consist of several types of matter. Several hours after removal from the emanation the active deposit from radium decays to half-value—26 minutes, for actinium half-value—34 minutes, for thorium half-value—10·5 hours. The active deposits obtained on a platinum wire or plate are volatilized before a white heat, and are again deposited on the cooler bodies in the neighbourhood. Rutherford showed that the induced activity could be concentrated on the negative electrode in a strong electric field, indicating that the radioactive carriers had a positive charge. The distribution of the active deposit in a gas at low pressure has been investigated in detail by Makower and Russ.

Theory of Radioactive Transformations.—We have seen that the radioactive bodies spontaneously and continuously emit a great number of α and β particles. In addition, new types of radioactive matter like the emanations and active deposits appear, and these are quite distinct in chemical and physical properties from the parent matter. The radiating power is an atomic property, for it is unaffected by combination of the active element with inactive bodies, and is uninfluenced by the most powerful chemical and physical agencies at our command. In order to explain these results, Rutherford and Soddy (20) in 1903 put forward a simple but comprehensive theory. The atoms of radioactive matter are unstable, and each second a definite fraction of the number of atoms present break up with explosive violence, in most cases expelling an α or β particle with great velocity. Taking as a simple illustration that an α particle is expelled during the explosion, the resulting atom has decreased in mass and possesses chemical and physical properties entirely distinct from the parent atom. A new type of matter has thus appeared as a result of the transformation. The atoms of this new matter are again unstable and break up in turn, the process of successive disintegration of the atom continuing through a number of distinct stages. On this view, a substance like the radium emanation is derived from the transformation of radium. The atoms of the emanation are far more unstable than the atoms of radium, and break up at a much quicker rate. We shall now consider the law of radioactive transformation according to this theory. It is experimentally observed that in all simple radioactive substances, the tensity of the radiation decreases in a geometrical progression with the time, *i.e.* $I/I_0 = e^{-\lambda t}$ where I is the intensity of the radiation at any time t, I_0 the initial intensity, and λ a constant. Now according to this theory, the intensity of the radiation is proportional to the number of atoms breaking up per second. From this it follows that the atoms of active matter present decrease in a geometrical progression with the time, *i.e.* $N/N_0 = e^{-\lambda t}$ where N is the number of atoms present at a time t, N_0 the initial number, and λ the same constant as before. Differentiating, we have $dN/dt = -\lambda N$, *i.e.* λ represents the fraction of the total number of atoms present which break up per second. The radioactive constant λ has a definite and characteristic value for each type of matter. Since λ is usually a very small fraction, it is convenient to distinguish the products by stating the time required for half the matter to be transformed. This will be called the period of the product, and is numerically equal to $\log_e 2/\lambda$. As far as our observation has gone, the law of radioactive change is applicable to all radioactive matter without exception. It appears to be an expression of the law of probability, for the average number breaking up per second is proportional to the number present. Viewed from this point of view, the number of atoms breaking up per second should have a certain average value, but the number from second to second should vary within certain limits according to the theory of probability. The theory of this effect was first put forward by Schweidler, and has since been verified by a number of experimenters, including Kohlrausch, Meyer, and Begener and H. Geiger. This variation in the number of atoms breaking up from moment to moment becomes marked with weak radioactive matter, where only a few atoms break up per second. The variations observed are in good agreement with those to be expected from the theory of probability. This effect does not in any way invalidate the law of radioactive change. On an average the number of atoms of any simple kind of matter breaking up per second is proportional to the number present. We shall now consider how the amount of radioactive matter which is supplied at a constant rate from a source varies with the time. For clearness, we shall take the case of the production of emanation, by radium. The rate of transformation of radium is so slow compared with that of the emanation that we may assume without sensible error that the number of atoms of radium breaking up per second, *i.e.* the supply of fresh emanation, is on the average constant over the interval required. Suppose that initially radium is completely freed from emanation. In consequence of the steady supply, the amount of emanation present increases, but not at a constant rate, for the emanation is in turn breaking up. Let q be the number of atoms of emanation produced by the radium per second and N the number present after an interval t, then $dN/dt = q - \lambda N$ where λ is the radioactive constant of the emanation. It is obvious that a steady state will ultimately be reached when the number of atoms of emanation supplied per second are on the average to the atoms which break up per second. If N_0 be the maximum number, $q = \lambda N_0$. Integrating the above equation, it follows that $N/N_0 = 1 - e^{-\lambda t}$. If a curve be plotted with N as ordinates and time as abscissae, it is seen that the recovery curve is complementary to the decay curve. The two curves for the radium emanation period, 3·9 days, are shown in fig. 1, the maximum ordinate being in each case 100.

This process of production and disappearance of active matter holds for all the radioactive bodies. We shall now consider some special cases of the variation of the amount of active matter with time which have proved of great importance in the analysis of radioactive changes.

(*a*) Suppose that initially the matter A is present, and this changes into B and B into C, it is required to find the number of atoms P, Q and R of A, B and C present at any subsequent time t.

Let λ_1, λ_2, λ_3 be the constants of transformation of A, B and C respectively. Suppose n be the number of atoms of A initially present. From the law of radioactive change it follows:

$$P = ne^{-\lambda_1 t}$$

$$dQ/dt = \lambda_1 P - \lambda_2 Q \quad \text{(1)}$$

$$dR/dt = \lambda_2 Q - \lambda_3 R \quad \text{(2)}$$

Substituting the value of P in terms of n in (1), $dQ/dt = \lambda_1 ne^{-\lambda_1 t} - \lambda_2 Q$; the solution of which is of the form

$$Q = n(ae^{-\lambda_1 t} + be^{-\lambda_2 t}),$$

where a and b are constants. By substitution it is seen that $a = \lambda_1/(\lambda_2 - \lambda_1)$. Since $Q = 0$ when $t = 0$, $b = -\lambda_1/(\lambda_2 - \lambda_1)$

$$\text{Thus } Q = \frac{n\lambda_1}{\lambda_1 - \lambda_2}(e^{-\lambda_2 t} - e^{-\lambda_1 t}) \quad \text{(3)}$$

Similarly it can be shown that

$$R = n(ae^{-\lambda_1 t} + be^{-\lambda_2 t} + ce^{-\lambda_3 t}) \quad \text{(4)}$$

$$\text{where } a = \frac{\lambda_1\lambda_2}{(\lambda_1 - \lambda_2)(\lambda_1 - \lambda_3)},\ b = \frac{\lambda_1\lambda_2}{(\lambda_2 - \lambda_1)(\lambda_2 - \lambda_3)},\ c = \frac{\lambda_1\lambda_2}{(\lambda_3 - \lambda_1)(\lambda_3 - \lambda_2)}.$$

It will be seen from (3), that the value of Q, initially zero, increases to a maximum and then decays; finally, according to an exponential law, with the period of the more slowly transformed product, whether A or B.

(*b*) A primary source supplies the matter A at a constant rate, and the process has continued so long that the amounts of the products A, B, C have reached a steady limiting value. The primary source is then suddenly removed. It is required to find the amounts of A, B and C remaining at any subsequent time t.

In this case of equilibrium, the number n_0 of particles of A supplied per second from the source is equal to the number of particles which change into B per second, and also of B into C. This requires the relation

$$n_0 = \lambda_1 P_0 = y_2 Q_0 = \lambda_3 R_0$$

where P_0, Q_0, R_0 are the initial number of particles of A, B, C present, and λ_1, λ_2, λ_3 are their constants of transformation.

Using the same quotations as in case (1), but remembering the new initial conditions, it can easily be shown that the number of particles P, Q and R of the matter A, B and C existing at the time t after removal are given by

$$P = \frac{n_0}{\lambda_1} e^{-\lambda_1 t},$$

$$Q = \frac{n_0}{\lambda_1 - \lambda_2}\left(\frac{\lambda_1}{\lambda_2} e^{-\lambda_2 t} - e^{-\lambda_1 t}\right),$$

$$R = n_0(ae^{-\lambda_1 t} + be^{-\lambda_2 t} + ce^{-\lambda_3 t}),$$

$$\text{where } a = \frac{\lambda_2}{(\lambda_1 - \lambda_2)(\lambda_1 - \lambda_3)},\ b = \frac{-\lambda_1}{(\lambda_1 - \lambda_2)(\lambda_2 - \lambda_3)},\ c = \frac{\lambda_1\lambda_2}{\lambda_3(\lambda_1 - \lambda_3)(\lambda_2 - \lambda_3)}.$$

The curves expressing the rate of variation of P, Q, R with time are in these cases very different from case (1).

(*c*) The matter A is supplied at a constant rate from a primary source. Required to find the number of particles of A, B and C present at any time t later, when initially A, B, and C were absent.

This is a converse case from case (2) and the solutions can be obtained from general considerations. Initially suppose A, B and C are in equilibrium with the primary source which supplied A at a constant rate. The source is then removed and the amounts of A, B and C vary according to the equation given in case (2). The source after removal continues to supply A at the same rate as before. Since initially the product A was in equilibrium with the source, and the radioactive processes are in no way changed by the removal of the source, it is clear that the amount of A present in the two parts in which the matter is distributed is unchanged. If P_1 be the amount of A produced by the source in the time t, and P the amount remaining in the part removed, then $P_1+P=P_0$ where P_0 is the equilibrium value. Thus

$$P_1/P_0=1-P/P_0.$$

The ratio P/P_0 can be written down from the solution given in case (2). Similarly the corresponding values of Q_1/Q_0, R_1/R_0 may be at once derived. It is obvious in these cases that the curve plotted with P/P_0 as ordinates and time as abscissae is complementary to the corresponding curve with P_1/P_0 as ordinates. This simple relation holds for all recovery and decay curves of radioactive products in general.

We have so far considered the variation in the number of atoms of successive products with time when the periods of the products are known. In practice, the variation of the number of atoms is deduced from measurements of activity, usually made by the electric method. Using the same notation as before, the activity of any product is proportional to its rate of breaking up, *i.e.* to λ_1P where P is the number of atoms present. If two products are present, the activity is the sum of two corresponding terms λ_1P and λ_2Q. In practice, however, no two products emit α or β particles with the same velocity. The difference in ionizing power of a single α particle from the two products has thus to be taken into account. If, under the experimental conditions, the ionization produced by an α particle from the second product is K times that from the first product, the activity observed is proportional to $\lambda_1P+K\lambda_2Q$. In this way, it is possible to compare the theoretical activity curves of a mixture of products with those deduced experimentally.

Analysis of Radioactive Changes.—The analysis of the successive changes occurring in uranium, thorium, radium and actinium has proved a very difficult matter. In order to establish the existence of a new product and to fix its position in the scheme of changes, it is necessary to show (*a*) that the new product has a distinctive period of decay and shows some distinctive physical or chemical properties; (*b*) that the product under consideration arises directly from the product preceding it in the scheme of changes, and is transformed into the product succeeding it.

In general, it has been found that each product shows some distinctive chemical or physical behaviour which allows of its partial or complete separation from a mixture of other products. It must be remembered that in most cases the amount of radioactive matter under examination is too small to detect by weight, but its presence is inferred from its characteristic radiations and rate of change. In some cases, a separation may be effected by ordinary chemical methods; for example thorium X is separated from thorium by precipitation of thorium with ammonia. The Th X remains in the filtrate and is practically free from thorium. In other cases, a separation is effected by a separation of a metal in the solution of active matter. For example, polonium (radium F) always comes down with bismuth and may be separated by placing a bismuth plate in a solution. Radium C is separated from radium B by adding nickel filings to a solution of the two. Radium C is deposited on the nickel. In other cases, a partial separation may be effected by electrolysis or by differences in volatility when heated. For example, when radium A, B and C are deposited on a platinum plate, on heating the plate, radium B is volatilized and is deposited on any cold surface in the neighbourhood. A very striking method of separating certain products has been recently observed depending upon the recoil of an atom which breaks up with the expulsion of an α particle. The residual atom acquires sufficient velocity in consequence of the ejection of an α particle to escape and be deposited on bodies in the neighbourhood. This is especially marked in a low vacuum. This property was independently investigated by Russ and Makower (21) and by Hahn (22). The latter has shown that by means of the recoil, actinium C may be obtained pure from the active deposit containing actinium A, B and C, for B emits α rays, and actinium C is driven from the plate by the recoil. In a similar way a new product, thorium D, has been isolated. By the recoil method, radium B may be separated from radium A and C. The recoil method is one of the most definite and certain methods of settling whether an α ray product is simple or complex.

While in the majority of cases the products break up either with the emission of α or β particles, some products have been observed which do not emit any characteristic radiation and have been called "rayless products." For example, radium D and thorium A are changing substances which break up without emitting either penetrating α or β rays. They appear to emit slow δ rays which can only be detected by special methods. The presence and properties of a rayless product can be easily inferred if it is transformed into a product emitting a radiation, for the variation in activity of the latter affords a method of determining the amount of the parent product present. The distinction between a "ray" and a "rayless" product is not clear. It may be that the atom of a rayless product undergoes a re-arrangement of its constituent parts giving rise to an atom of the same mass but of different properties. In the case of an α ray or β ray product, the expulsion of an α or β particle affords an obvious explanation of the appearance of a new product with distinctive physical properties.

In the table a list of the known products of transformation is given. In each case, the half period of transformation is given and the type of radiation emitted. If the product emits α rays, the range of ionization of the α particle in air is given.

TABLE OF RADIOACTIVE PRODUCTS

Product.	Half Period of Transformation.	Rays.	Range of Rays in Air in Cms.
URANIUM—	5×10^9 years	α	3·5
Uranium X	22 days	$\beta+\gamma$	..
Ionium	?	α	2·8
RADIUM—	1760 years	α	3·5
Ra Emanation	3·86 days	α	4·33
Radium A	3 mins.	α	4·83
Radium B	26 mins.	slow β	..
Radium C	19 mins.	$\alpha+\beta+\gamma$	7·06
Radium D	17 years	slow β	..
Radium E	5 days	β	..
Radium F	140 days	α	3·86
Radium G = lead?	..	..	..
THORIUM—	about 10^{10} yrs.	..	3·5
(Th. 1)	5·5 years	rayless	..
Mesothorium (Th. 2)	6·2 hours	$\beta+\gamma$	..
Radiothorium	737 days	α	3·9
Thorium X	3·6 days	α	5·7
Th Emanation	54 secs	α	5·5
Thorium A	10·6 hours	slow β	..
Thorium B	55 mins.	α	5·0
Thorium C	very short?	α	8·6
Thorium D	3 mins.	$\beta+\gamma$	..
ACTINIUM—	?	rayless	..
Radioactinium	19·5 days	$\alpha+\beta$	4·8
Actinium X	11·8 days	α	6·55
Act Emanation	3·7 secs.	α	5·8
Actinium A	36 mins.	slow β	..
Actinium B	2·15 mins.	α	5·50
Actinium C	5·1 mins.	$\beta+\gamma$	..

In each of the groups under the heading uranium, thorium and actinium, each product is derived from the direct transformation of the product above it.

Products of Radium.—Radium is transformed directly into the emanation which in turn goes through a rapid series of transformations called radium A, B and C. The complete analysis of these changes has involved a large amount of work. The emanation changes first into radium A, a substance of period 3 minutes emitting only α rays. Radium A changes into radium B, a product of period 26 minutes emitting β rays of penetrating power small compared with those emitted from the next product radium C. The product radium C has proved of considerable importance, for it not only emits very penetrating α rays and β rays, but is the origin of the γ rays arising from radium in equilibrium. When a wire charged negatively has been exposed for some time in the presence of the radium emanation, it becomes coated with an invisible film of radium A, B and C. After removal from the emanation for 20 minutes, radium A has practically disappeared and the α rays arise entirely from radium C. Radium C has proved very valuable in radioactive measurements as providing an intense source of homogeneous α rays. Twenty-four hours after removal, the activity due to radium B and C has become exceedingly small. The wire, however, still shows a very small residual activity, first noted by Mme Curie. This residual activity measured by the α rays rapidly increases with the time and reaches a maximum in about three years. The active deposit of slow change has been examined in detail by Rutherford (23) and by Meyer and Schweidler (24). It has been shown to consist of three successive products called radium D, E and F. Radium D is a rayless substance of slow period of transformation. Its period has been calculated by Rutherford to be about 40 years, and by Meyer and Schweidler about 12 years. Antonoff (25) fixes the period of about 17 years. Radium D changes into E, a β ray product of period about 5 days, and E into F, an α ray product of period 140 days. It was at first thought that radium E was complex, but no evidence of this has been observed by Antonoff. The product radium F is of special interest, for it is identical with polonium—the first active body separated by Mme Curie. In a similar way it has been shown that radium D is the primary source of the activity observed in lead or "radiolead" separated by Hofmann. It is interesting to note what valuable results have been obtained from an examination of the minute residual activity observed on bodies exposed in the presence of the radium emanation.

Radium Emanation.—The radium emanation is to be regarded as a typical radioactive product or transition element which exists in a gaseous form. It is produced from radium at a constant rate, and is transformed into radium A and helium. Its half-period of transformation is 3·86 days. The emanation from radium has been purified by condensing it in liquid air, and pumping out the residual gases. The volume (26) of the emanation at normal pressure and temperature to be derived from one gram of radium in equilibrium is about 0·6 cubic millimetres. This small quantity of gas contains initially more than three-quarters of the total activity of the radium before its separation. In a pure state, the emanation is 100,000 times as active weight for weight as pure radium. Pure emanation in a spectrum tube gives a characteristic spectrum of bright lines (27). The discharge in the gas is bluish in colour. With continued sparking, the emanation is driven into the walls of the tube and the electrodes. Notwithstanding the minute volume of emanation available, the boiling-point of the emanation has been determined at various pressures. At atmospheric pressure Rutherford (28) found the boiling-point to be −67° C., and Gray and Ramsay (29) 71° C. Liquid emanation appears colourless when first condensed; when the temperature is lowered, the liquid emanation freezes, and at the temperature of liquid air glows with a bright rose colour. The density of liquid emanation has been estimated at 5 or 6.

Approximate estimates of the molecular weight of the radium emanation were early made by diffusion methods. The molecular weight in most cases came out about 100. In a comparison by Perkins of the rate of diffusion of the emanation with that of a monatomic vapour of high molecular weight, viz. mercury, the value deduced was 234. Since the radium atom in breaking up gives rise to one atom of the emanation and one atom of helium, its atomic weight should be $226-4=222$. The emanation appears to have no definite chemical properties, and in this respect belongs to the group of inert monatomic gases of which helium and argon are the best known examples. It is partially soluble in water, and readily absorbed by charcoal.

Thorium.—The first product observed in thorium was the emanation. This gives rise to the active deposit which has been analysed by Rutherford, Miss Brooks and by Hahn, and shown to consist of probably four products—thorium A, B, C and D. Thorium A is a rayless product of period 10·5 hours; thorium B an α ray product of period about one hour. The presence of thorium C has been inferred from the two types of α rays present in the active deposit, but no chemical separation of B and C has yet been found possible. Hahn has shown that thorium D—a β ray product of period 3 minutes—can easily be separated by the recoil method. A special interest attaches to the product thorium X (30), which was first separated by Rutherford and Soddy, since experiments with this substance laid the foundation of the general theory of radioactive transformations. A close analysis of thorium has led to the separation of a number of new products. Hahn (31) found that a very active substance emitting α rays, which gave rise to thorium X, could be separated from thorium minerals. This active substance, called *radiothorium*, has been closely examined by Hahn and Blanc. Its period of decay was found by Hahn to be about 2 years, and by Blanc to be 737 days. From an examination of the activity of commercial thorium nitrate of different ages, Hahn showed that another product must be present, which he called *mesothorium*. This is separated from thorium with Th X by precipitation with ammonia. Thorium is first transformed into the rayless product mesothorium, of period about 5 years. This gives rise to a β ray product of quick transformation, which in turn changes into *radiothorium*. This changes into thorium X, and so on through a long series of changes. When isolated in the pure state, radiothorium would have an activity about a thousand times greater than radium, but would lose its activity with time with a period of about 2 years. Mesothorium, when first separated, would be inactive, but in consequence of the production of radiothorium, its activity would rapidly increase for several years. After reaching a maximum, it would finally decay with a period of five years. Since a large amount of thorium is separated annually from thorium minerals, it would be of great importance at the same time to separate the radiothorium and mesothorium present. For many purposes active preparations of these substances would be as valuable as radium itself, and the amount of active matter from this source would be greater than that at present available from the separation of radium from uranium minerals.

Actinium.—The transformations observed in actinium are very analogous to those in thorium. Actinium itself is a rayless product which changes into radioactinium, an α ray product of period 19·5 days, first separated by Hahn (32). This changes into actinium X, of period 10·2 days, first separated by Godlewski (33). Actinium X is transformed into the emanation which in turn gives rise to three further products, called actinium A, B and C. Although very active preparations of actinium have been prepared, it has so far not been found possible to separate the actinium from the rare earths with which it is mixed. We do not in consequence know its atomic weight or spectrum.

Origin of Radium.—According to the transformation theory, radium, like all other radioactive products, must be regarded as a changing element. Preliminary calculations showed that radium must have a period of transformation of several thousand years. Consequently in order that any radium could exist in old minerals, the supply must be kept up by the transformation of some other substance. Since radium is always found associated with uranium minerals, it seemed probable from the beginning that uranium must be the primary element from which radium is derived. If this were the case, in old minerals which have not been altered by the action of percolating waters, the ratio of the amount of radium to uranium in a mineral must be a constant. This must evidently be the case, for in a state of equilibrium the rate of breaking up of radium must equal the rate of supply of radium from uranium. If P, Q be the number of atoms of uranium and radium respectively in equilibrium, and λ_1, λ_2 their constants of change, then

$$\lambda_2 Q=\lambda_1 P \text{ or } Q/P=\lambda_1/\lambda_2=T_2/T_1.$$

where T_2 and T_1 are the half-periods of transformation of uranium and radium respectively. The work of Boltwood (34), Strutt (35) and McCoy (36) has conclusively shown that the ratio of radium to uranium in old minerals is a constant. Boltwood and Strutt determined the quantity of radium present in a mineral by the emanation method, and the amount of uranium by analysis.

In order, however, to obtain a direct proof of the genetic relation between uranium and radium, it is necessary to show that radium appears after some time in a uranium compound from which all trace of radium has been initially removed. It can readily be calculated that the growth of radium should be easily observed by the emanation method in the course of one week, using a kilogram of uranium nitrate. Experiments of this kind were first made by Soddy (37), but initially no definite evidence was obtained that radium grew in the solution at all. The rate of production of radium, if it took place at all, was certainly less than $\frac{1}{10,000}$th part of the amount to be expected if uranium were transformed directly into radium. It thus appeared probable that one or more products of slow period of transformation existed between uranium and radium. Since uranium must be transformed through these intermediate stages before radium appears, it is evident that the initial rate of production of radium under these conditions might be extremely small. This conclusion has been confirmed by Soddy, who has shown that radium does appear in the solution which has been placed aside for several years.

Since the direct parent of radium must be present in radioactive minerals, one of the constituents separated from the mineral must grow radium. This was shown to be the case by Boltwood (38), who found that actinium preparations produced radium at a fairly rapid rate. By the work of Rutherford and Boltwood, it was found that the growth of radium was not due to actinium itself, but to a new substance separated in some cases with the actinium. This new substance, which emits *α* rays, was separated by Boltwood (38), and called by him "Ionium." It has chemical properties very similar to thorium. Soddy has shown that the period of ionium is probably not less than 20,000 years, indicating that ionium must exist in uranium minerals in not less than ten times the quantity of radium. It has not yet been directly shown that uranium produces ionium, but there can be no doubt that it does do so. Since ionium produces radium, Boltwood (38) has determined by direct experiment that radium is half transformed in 2000 years—a number in good agreement with other data on that subject. The constant relation between uranium and radium will only hold for old minerals where there has been no opportunity for chemical alteration or removal of its constituents by the action of percolating water or other agencies. It is quite possible that altered minerals of no great age will not show this constant relation. It seems probable that this is the explanation of some results of Mlle Gleditsch, where the relation between uranium and radium has been found not to be constant for some mineral specimens.

Connexion of the Radioelements.—We have already seen that a number of slowly transforming radioactive substances, viz. polonium (radium F), radiolead (radium D) and ionium are linked up to the uranium-radium series of transformations. Boltwood (39) has made a systematic examination of the relative activity in the form of very thin films due to each of the products present in the uranium-radium family. The results are shown in the following table, where the activity of pure uranium itself is taken as unity:—

Uranium	1·00	Radium B	0·04(?)
Ionium	0·34	Radium C	0·91
Radium	0·45	Radium F	0·46
Emanation	0·62	Actinium and its products	0·28
Radium A	0·54		

Total activity mineral, 4·64 times uranium.

Taking into account the differences in the ionization due to an *α* particle from the various products, the results indicate that uranium expels two *α* particles for one from each of the other *α* ray products in the series of transformations. This indicates either that two particles are expelled during the transformation of the atom of uranium, or that another *α* ray product is present which has so far not been separated from the uranium.

Although thorium is nearly always present in old uranium minerals and uranium in thorium minerals, there does not appear to be any radioactive connexion between these two elements. Uranium and thorium are to be regarded as two distinct radioactive elements. With regard to actinium, there is still no definite information of its place in the scheme of transformations. Boltwood has shown that the amount of actinium in uranium minerals is proportional to the content of uranium. This indicates that actinium, like radium, is in genetic connexion with uranium. On the other hand, the activity of actinium with its series of *α* ray products is less than that of radium itself or uranium. In order to explain this anomaly, Rutherford has suggested that at a certain stage of disintegration of the uranium-radium series, the disintegration is complex, and two distinct kinds of matter appear, one in much larger quantity than the other. On this view, the smaller fraction is actinium, so that the latter is a branch descendant of the main uranium-radium series.

End Products of Transformation.—It is now definitely established that the *α* particle expelled from any type of radioactive matter is an atom of helium, so that helium is a necessary accompaniment of radioactive changes involving the expulsion of *α* particles. After the radioactive transformations have come to an end, each of the elements uranium and thorium and actinium should give rise to an end or final product, which may be either a known element or some unknown element of very slow period of transformation. Supposing, as seems probable, that the expulsion of an *α* particle lowers the atomic weight of an element by four units—the atomic weight of helium—the atomic weights of each of the products in the uranium and radium series can be simply calculated. Since uranium expels two *α* particles, the atomic weight of the next ray product, ionium, is 238·5−8 or 230·5. The atomic weight of radium comes out to be 266·5, a number in good agreement with the experimental value. Similarly the atomic weight of polonium is 210·5, and that of the final product after the transformation of polonium should be 206·5. This value is very close to the atomic weight of lead, and indicates that this substance is the final product of the transformation of radium.

This suggestion was first put forward by Boltwood (40), who has collected a large amount of evidence bearing on this subject. Since in old minerals the transformations have been in progress for periods of time, in some cases measured by hundreds of millions of years, it is obvious that the end product, if a stable element, should be an invariable companion of the radioelement and be present in considerable quantity. Boltwood has shown that lead always occurs in radioactive minerals, and in many cases in amount about that to be expected from their uranium content and age. It is difficult to settle definitely this very important problem until it can be experimentally shown that radium is transformed into lead, or, what should prove simpler in practice, that polonium changes into helium and lead. Unfortunately for a solution of this problem within a reasonable time, a very large quantity of polonium would be necessary. Mme. Curie and Debierne have obtained a very active preparation of polonium containing about $\frac{1}{10}$th milligram of pure polonium. Rutherford and Boltwood and Curie and Debierne have both independently shown that polonium produces helium —a result to be expected, since it emits *α* particles.

Production of Helium.—In 1902 Rutherford and Soddy suggested that the helium which is invariably found in radioactive minerals was derived from the disintegration of radioactive matter. In 1903 Ramsay and Soddy definitely showed that helium was produced by radium and also by its emanation. From the observed mass of the *α* particle, it seemed probable from the first that the *α* particle was an atom of helium. This conclusion was confirmed by the work of Rutherford and Geiger (41), who showed that the *α* particle was an atom of helium carrying two unit charges of electricity. In order to prove definitely this relation, it was necessary to show that the *α* particles, quite independently of the active matter from which they were expelled, gave rise to helium. This was done by Rutherford and Royds (42), who allowed the *α* particles from a large quantity of emanation to be fired through the very thin glass walls of the containing tube. The collected particle gave the spectrum of helium, showing, without doubt, that the *α* particle must be a helium atom.

Since the *α* particle is an atom of helium, all radioactive matter which expels *α* particles must give rise to helium. In agreement with this, Debierne and Giesel have shown that actinium as well as radium produces helium. Observations of the production of helium by radium have been made by Ramsay and Soddy, Curie and Dewar, Himstedt and others. The rate of production of helium per gram of radium was first definitely measured by Dewar (43). His preliminary measurements gave a value of 134 cubic mms. of helium per year per gram of radium and its products. Later observations extending over a larger interval give a rate of production about 168 cubic mms. per year. As a result of preliminary measurements, Boltwood and Rutherford (44) have found a growth of 163 cubic mms. per year. It is of interest to note that the rate of production of helium by radium is in excellent agreement with the value calculated theoretically. From their work of counting the particles and measuring their charge, Rutherford and Geiger showed that the rate of production of helium should be 158 cubic mms. per year.

Properties of the α Rays.—We have seen that the rays are positively charged atoms of helium projected at a high velocity, which are capable of penetrating through thin metal sheets and several centimetres of air. Early observations indicated that the ionization due to a layer of radioactive matter decreased approximately according to an exponential law with the thickness of the absorbing matter placed over the active matter. The true nature of the absorption of the *α* rays was first shown by Bragg and by Bragg and Kleeman (45). The active particles projected from a thin film of active matter of one kind have identical velocities, and are able to ionize the air for a definite distance, termed the "range" of the *α* particle. It was found that the ionization per centimetre of path due to a narrow pencil of *α* rays increases with the distance from the active matter, at first slowly, then more rapidly, near the end of the range. After passing through a maximum value the ionization falls off rapidly to zero. The range of an *α* particle in air has a definite value which can be accurately measured. If a uniform screen of matter is placed in the path of the pencil of rays the range is reduced by a definite amount proportional to the thickness of the screen. All the *α* particles have their velocity reduced by the same amount in their passage through the screen. The ranges in air of the *α* rays from the various products of the radioelements have been measured. The ranges for the different products vary between 2·8 cms. and 8·6 cms.

Bragg has shown that the range of an *α* particle in different elements is nearly proportional to the square roots of their atomic weights. Using the photographic method, Rutherford (46) showed that the velocity V of an *α* particle of range R cms. in air is given by $V^2=K(R+1\cdot25)$, where K is a constant. In his experiments he was unable to detect particles which had a velocity lower than $8\cdot8\times10^8$ cms. per second. Geiger (47), using the scintillation method, has recently found that *α* particles of still lower velocity can be detected under suitable conditions by the scintillations produced on a zinc sulphide screen. He has found that the connexion between velocity and range can be closely expressed by $V^3=KR$, where K is a constant.

On account of the great energy of motion of the *α* particle, it was at first thought that it pursued a rectilinear path in the gas without appreciable deflection due to its encounters with the molecules. Geiger (48) has, however, shown by the scintillation method that the *α* particles are scattered to a marked extent in passing through matter. The scattering increases with the atomic weight of the substance traversed, and becomes more marked with decreasing velocity of the *α* particle. A small fraction of the *α* particles falling on a thick screen are deflected through more than a right angle, and emerge again on the side of incidence.

Rutherford and Geiger (49) have devised an electrical method of counting the *α* particles expelled from radioactive matter. The *α* particle enters through a small opening into a metal tube containing a gas at a reduced pressure. The ionization produced by the *α* particle in its passage through the gas is magnified several thousand times by the movement of the ions in a strong electric field. In this way, the entrance of an *α* particle into the detecting vessel is shown by a sudden and large deflection of the measuring instrument. By this method, they determined that $3\cdot4 \times 10^{10}$ *α* particles are ejected per second from one gram of radium itself and from each of its *α* ray products in equilibrium with it. By measuring the charge on a counted number of *α* particles, it was found that the *α* particle carries a positive charge of $9\cdot3 \times 10^{-10}$ electrostatic units. From other evidence, it is known that this must be twice the fundamental unit of charge carried by the hydrogen atom. It follows that this unit charge is $4\cdot65 \times 10^{-10}$ units. This value is in good agreement with numerous recent determinations of this fundamental quantity by other methods. With this data, it is possible to calculate directly the values of some important radioactive data. The calculated and observed values are given below:—

	Calculated.	Observed.
Volume of the emanation in cubic millimetres per gram of radium	·585	·6
Volume of helium in cubic millimetres produced per year per gram of radium	158	169
Heating effect of radium per gram per hour in gram calories	113	118
Half-period of transformation of radium in year	1760	2000

The calculated values are in all cases in good agreement with the experimental numbers.

It is well known from the experiments of Sir William Crookes (50) that the *α* rays produce visible scintillations when they fall on a screen of phosphorescent zinc sulphide. This is shown in the instrument called the spinthariscope. By means of a suitable microscope, the number of these scintillations on a given area in a given time can be counted. The number so obtained is practically identical with the number of *α* particles incident on the screen, determined by the electrical method of counting. This shows that each *α* particle produces a visible flash of light when it falls on a suitable zinc sulphide screen. The scintillations produced by *α* rays are observed in certain diamonds, and their number has been counted by Regener (51) and the charge on each particle has been deduced. The latter was the first to employ the scintillation method for actual counting of *α* particles. Kinoshita has shown that the number of *α* particles can also be counted by the photographic method, and that each particle must produce a detectable effect.

Absorption of β Rays.—We have seen that the *β* particles, which are emitted from a number of radioactive products, carry a negative charge and have the same small mass as the particles constituting the cathode rays. The velocity of expulsion and penetrating power of the *β* rays varies widely for different products. For example, the rays from radium B are very easily absorbed, while some of the rays from radium C are of a very penetrating type. It has been found that for a single *β* ray product, the particles are absorbed according to an exponential law with the thickness of matter traversed, and Hahn has made use of this fact to isolate a number of new products. It has been generally assumed that the exponential law of absorption is a criterion that the *β* rays are all expelled at the same speed. In addition, it has been supposed that the *β* particles do not decrease much in velocity in passing through matter. Wilson has recently made experiments upon homogeneous *β* rays, and finds that the intensity of the radiation falls off in some cases according to a linear rather than to an exponential law, and that there is undoubted evidence that the *β* particles decrease in velocity in traversing matter. Experiments upon the absorption of *β* rays are greatly complicated by the scattering of the *β* rays in their encounters with the molecules. For example, if a pencil of *β* rays falls on a metal, a large fraction of the rays are scattered sufficiently to emerge on the side of incidence. This scattering of the β rays has been investigated by Eve, McLennan, Schmidt, Crowther and others. It has been found that the scattering for different chemical elements is connected with their atomic weight and their position in the periodic table. McCelland and Schmidt have given theories to account for the absorption of β rays by matter. The whole problem of absorption and scattering of particles by substances is very complicated, and the question is still under active examination and discussion. The negative charge carried by the β rays has been measured by a number of observers. It has been shown by Rutherford and Makower that the number of β particles expelled per second from one gram of radium in equilibrium is about that to be expected if each atom of the β ray products in breaking up emits one β particle.

Heat Emission of Radioactive Matter.—In 1903 it was shown by Curie and Laborde (52) that a radium compound was always hotter than the surrounding medium, and radiated heat at a constant rate of about 100 gram calories per hour per gram of radium. The rate of evolution of heat by radium has been measured subsequently by a number of observers. The latest and most accurate determination by Schweidler and Hess, using about half a gram of radium, gave 118 gram calories per gram per hour (53). There is now no doubt that the evolution of heat by radium and other radioactive matter is mainly a secondary phenomenon, resulting mainly from the expulsion of α particles. Since the latter have a large kinetic energy and are easily absorbed by matter, all of these particles are stopped in the radium itself or in the envelope surrounding it, and their energy of motion is transformed into heat. On this view, the evolution of heat from any type of radioactive matter is proportional to the kinetic energy of the expelled α particles. The view that the heating effect of radium was a measure of the kinetic energy of the α particles was strongly confirmed by the experiments of Rutherford and Barnes (54). They showed that the emanation and its products when removed from radium were responsible for about three-quarters of the heating effect of radium in equilibrium. The heating effect of the radium emanation decayed at the same rate as its activity. In addition, it was found that the ray products, viz. the emanation radium A and radium C, each gave a heating effect approximately proportional to their activity. Measurements have been made on the heating effect of uranium and thorium and of pitchblende and polonium. In each case, the evolution of heat has been shown to be approximately a measure of the kinetic energy of the α particles.

Experiments on the evolution of heat from radium and its emanation have brought to light the enormous amount of energy accompanying the transformation of radioactive matter where α particles are emitted. For example, the emanation from one gram of radium in equilibrium with its products emits heat initially at the rate of about 90 gram calories per hour. The total heat emitted during its transformation is about 12,000 gram calories. Now the initial volume of the emanation from one gram of radium is ·6 cubic millimetres. Consequently one cubic centimetre of emanation during its life emits 2×10^7 gram calories. Taking the atomic weight of the emanation as 222, one gram of the emanation emits during its life 2×10^9 gram calories of heat. This evolution of heat is enormous compared with that emitted in any known chemical reaction. There is every reason to believe that the total emission of energy from any type of radioactive matter during its transformation is of the same order of magnitude as for the emanation. The atoms of matter must consequently be regarded as containing enormous stores of energy which are only released by the disintegration of the atom.

A large amount of work has been done in measuring the amount of the thorium and radium emanation in the atmosphere, and in determining the quantity of radium and thorium distributed on the surface of the earth. The information already obtained has an important bearing on geology and atmospheric electricity.

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(E. RU.)

RADIOLARIA, so called by E. Haeckel in 1862 (Polycystina, by C. G. Ehrenberg, 1838), the name given to Marine Sarcodina, in which the cytoplasmic body gives off numerous fine radiating pseudopods (rarely anastomosing) from its surface, and is provided with a chitinous "central capsule," surrounding the inner part which encloses the nucleus, the inner and outer cytoplasm communicating through either one or three apertures or numerous pores in the capsule. The extracapsular cytoplasm is largely transformed into a gelatinous substance ("calymma"), through which a granular network of plasm passes to form a continuous layer bearing the pseudopods at the surface; this gelatinous layer is full of large vacuoles, "alveoli," as in other pelagic Sarcodina (Heliozoa, *q.v.*), Globigerinidae, &c., among Foraminifera (*q.v.*). The protoplasm may contain oil-globules, pigment-grains, reserve-grains and crystals. There is frequently a skeleton present, either of silica (pure or containing a certain amount of organic admixture), or of "acanthin" (possibly a proteid, allied to vitellin, but regarded by W. Schewiakoff as a hydrated silicate of calcium and aluminium); never calcareous or arenaceous. The skeleton may consist of spicules, isolated or more or less compacted, or form a latticed shell, which, in correlation with the greater resistance of its substance, is of lighter and more elegant structure than in the Foraminifera. The alveoli contain a liquid, which, as shown by Brandt, is rich in carbon dioxide, and in proportion to its abundance may become much lighter than sea-water; and possibly the gelatinous substance of the calymma is also lighter than the medium. In Acantharia the protoplasm at the base of the projecting spines is often differentiated into a bundle of fibres converging on to the spines some way up (distally); these, comparable to the myonemes of Infusoria (*q.v.*), &c., and termed "myophrisks", possibly serve to drag outwards the surface and so extend it, with concurrent dilatation of the alveoli, and lower the specific gravity of the animal. In this group also a thick temporary flagellum "sarcoflagellum" may be formed, apparently by the coalescence of a number of pseudopodia. The pigmented mass or "phaeodium" in the ectoplasm of Phaeodaria appears to be an excretory product, formed within the central capsule and passing immediately outwards; a similar uniform deposit of pigmented granules occurs in the Colloid species, *Thalassicolla nucleata.* The wall of the central capsule is simple in the Spumellaria, but formed of two layers in the Nassellaria and Phaeodaria. In the Nassellaria the oscule is simply a perforated area, and a cone of differentiated fibres in the intracapsular cytoplasm has its base on it: it is termed the "porocone," and the fibres may possibly be muscular (myonemes). In Phaeodaria, the inner membrane at each oscule is prolonged through the outer into a tube ("proboscis"): the outer membrane of the principal oscule forms a large radially striated circular plate, the "astropyle," or "operculum." The innermost shell of some with concentric shells may lie within the central capsule, or even within the nucleus; this is due to the growth of these organs after the initial shell is formed, so that they pass out by lobes through the latticed openings of the embryonic shell, which lobes ultimately coalesce outside the embryonic chamber, and so come finally to invest it (fig. III. 17). In some, a symbiosis occurs with *Zooxanthella*, Brandt, a Flagellate of the group Chrysomadineae, which in the resting state inhabits the extracapsular cytoplasm growing and dividing freely therein, and only (under study) becoming free and flagellate on the death of the host (fig. III. 4, 6–13). The Silicoflagellata or Dictyochidae, also possessing a vegetable colouring matter, but with a skeleton of impure silica (like that of Phaeodaria), may pass some of their lives in symbiosis with Radiolaria.

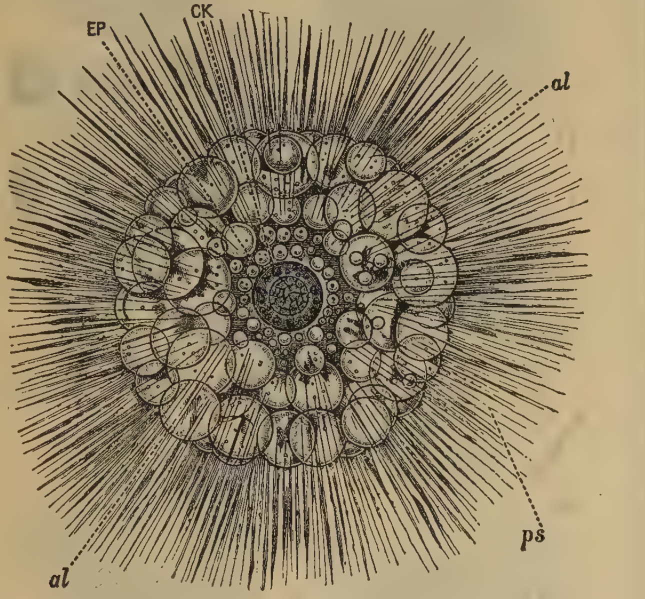

FIG. I.—*Thalassicolla pelagica*, Haeckel; ×25. CK, central capsule; EP, extracapsular protoplasm; *al*, alveoli, liquid-holding vacuoles in the protoplasm similar to those of Heliozoa, Hastigerina, &c.; *ps*, pseudopodia. The minute unlettered dots are the "yellow cells."

Living Radiolaria were first observed and partially described by W. J. Tilesius in 1803–6 and 1814, by W. Baird in 1830, and by C. G. Ehrenberg in 1831, as luminous organisms in the sea; F. J. F. Meyen in 1834 recognized their animal character and the siliceous nature of their spicules. Ehrenberg a little later described a large number of Nassellarian skeletons under the name of Polycystina (1838), but without more than a very slight knowledge of a few living forms. T. H. Huxley in 1851 made the first adequate study of the living animal, and was followed by Joh. Müller in the same decade. E. Haeckel began his publications in 1862, and in two enormous, abundantly illustrated, systematic works, besides minor publications, has dealt exhaustively with the cytology, classification, and distribution of the class. Next in value come the contributions of Richard Hertwig (largely developmental), besides those of L. Cienkowsky, Karl Brandt and A. Borgert, while to F. Dreyer and V. Häcker we owe valuable studies on the physical relations of the skeleton.

Our classification is taken from Haeckel.

A. **Spumellaria,** Haeck. (**Peripylaea,** Hertwig). Central capsule perforated with numerous evenly distributed pores. Skeleton siliceous, latticed or of detached spicules, or absent. Form homaxonic or with at least three planes of symmetry intersecting at right angles, rarely irregular or spiral, sometimes forming colonies, *i.e.* with several central capsules in a common external cytoplasm.

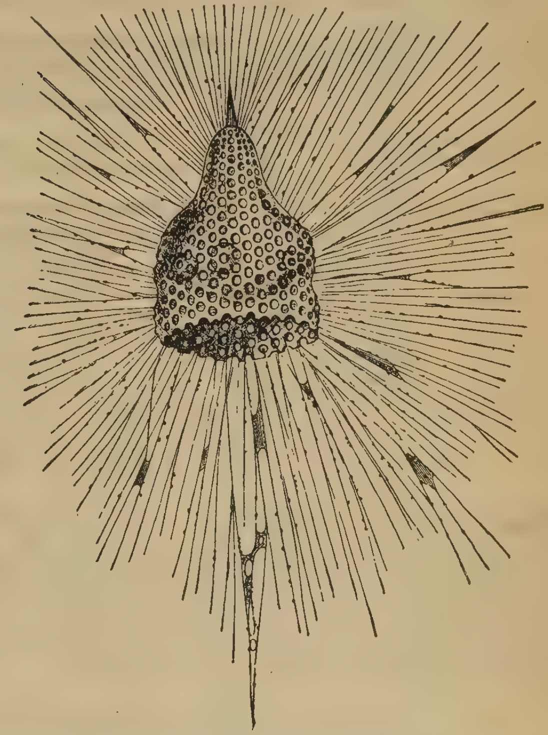

FIG. II.—*Eucyrtidium cranioides*, Haeck.; ×150; one of the Nassellaria. Entire animal as seen in the living condition. The central capsule is hidden by the beehive-shaped siliceous shell within which it is lodged.

I. Skeleton of detached spicules, or absent.
  Fam. 1. Colloidea. Skeleton absent. *Thalassicolla*, Huxl. (figs. I. and III. 1); *Thalassophysa*, Haeck.; *Collozoum*, Haeck. (fig. III. 2–5, 15, 16); *Actissa*, Haeck.
  Fam. 2. Beloidea. Skeleton spicular. *Sphaerozoum*, Haeck.; *Raphidozoum*, Haeck.
II. Skeleton latticed or spongy-reticulate.
  Fam. 3. Sphaeroidea. Skeleton homaxial, sometimes colonial. *Collosphaera*, Mull.; *Haliomma*, Ehrb.; *Actinomma*, Haeck. (fig. III. 17), showing concentric latticed shells, the smallest intranuclear, all connected by radial spines; *Spongosphaera*, Haeck. (fig. IV. 8); *Heliosphaera*, Haeck. (fig. III. 14).
  Fam. 4. Prunoidea. Skeleton a prolate spheroid or cylinder of circular section, sometimes constricted like a dice-box.
  Fam. 5. Discoidea. Shell flattened, of circular plan, rarely becoming spiral.
  Fam. 6. Larcoidea. Shell with three unequal axes, elliptical in the plane of any two, more rarely becoming irregular or spiral.

B. **Acantharia,** Haeck. (**Actipylaea,** Hertw.). Skeleton of spicules of acanthin radiating from a centre, and usually twenty.

disposed on five successive zones of four on alternating meridians, the zones corresponding to equator, tropics and circumpolar circles on the globe; pores of central capsule in scattered groups.

Fam. 1. Actinelida. Spines numerous, more than twenty, irregularly grouped. *Litholophus*, Haeck.; *Xiphacantha*, Haeck.
Fam. 2. Acanthonida. Spines twenty, simple, usually equal. *Acanthometra*, J. Müll. (fig. iv. 6, 7); *Astrolonche*, Haeck.; *Amphilonche*, Haeck. (fig. iii. 18).
Fam. 3. Sphaerophractida: Spines equal, branching and often coalescing into a latticed shell, homaxonic.
Fam. 4. Prunophractida: Branching spines coalescing into a latticed shell which is elongated and elliptical in at least one plane.

C. **Nassellaria,** Haeck. (**Monopylaea,** Hertw.). Silico-skeletal Radiolaria in which the central capsule is typically monaxonic (cone-shaped), with a single perforate area (pore-plate) placed on the basal face of the cone; the membrane of the capsule, the nucleus single; the skeleton is extracapsular, and forms a scaffold-like or beehive-like structure of monaxonic form, a tripod or calthrop, a sagittal ring, or a combination of these.

Fam. 1. Nassoidea, Haeck. Skeleton absent. *Cystidium*, Haeck.
Fam. 2. Plectida, Haeck. Skeleton formed of a single branching spicule, a tripod or usually a 4-radiate calthrop, its branches sometimes reticulate. Genera: *Plagiacantha*, Haeck.; *Plegmatium*, Haeck.
Fam. 3. Spyroidea. Shell latticed around the sagittal ring ("cephalis"), sometimes with a lower chamber added.
Fam. 4. Botridea, Haeck. Shell latticed, composed of several chambers agglomerated without definite order; a single central capsule. Genera: *Botryocyrtis*, Haeck.; *Lithobotrys*, Haeck.
Fam. 5. Cyrtoidea, Haeck. Skeleton a monaxonic or triradiate shell, or continuous piece (beehive-shaped). Genera: *Halicalyptra*, Haeck.; *Eucyrtidium*, Haeck. (fig. ii.); *Carpocanium*, Haeck. (fig. iv. 3).
Fam. 6. Stephoidea, Haeck. Skeleton a sagittal ring continuous with the branched spicule, and sometimes growing out into other rings or branches. Genera: *Acanthodesmia*, Haeck.; *Zygostephanus*, Haeck.; *Lithocircus*, Haeck. (fig. iv. 1).

D. **Phaeodaria,** Haeck. (**Tripylaea,** Hertw.). Radiolaria of cruciate symmetry, prolonged into tubular processes with three oscula to the central capsule, one inferior, the principal, and two symmetrically placed on either side of the opposite pole; skeleton of spicules, a network of hollow filaments, or a minutely alveolate shell, of a combination of silica with organic substance; extra-capsular protoplasm containing in front of the large oscule an agglomeration of dusky purplish or greenish pigment ("phaeodium").

Fam. 1. Phaeocystida, Haeck. Siliceous skeleton absent or of separate needles. Genera: *Aulacantha*, Haeck.; *Thalassoplancta*, Haeck.
Fam. 2. Phaeosphaerida. Spicules united into a latticed shell. Genera: *Aulosphaera*, Haeck. (fig. iv. 9); *Auloplegma*, Haeck.; *Cannacantha*, Haeck.
Fam. 3. Phaeogromida, Haeck. Shell continuous, traversed by fine canals or finely alveolate, provided with at least one pylome. Genera: *Challengeria*, Wyv., Thomson; *Lithogromia*, Haeck.
Fam. 4. Phaeoconchida. Shell as in Phaeosphaerida, but of two symmetrical halves (valves), which meet in the plane of the three oscules ("frontal" of Haeckel, who terms the plane of symmetry through the shells "sagittal"). Genera: *Conchidium*, Haeck.; *Coelodendrum*, Haeck. (fig. iv. 4).

The following passages may be repeated here from Sir E. Ray Lankester's article "Protozoa" in the 9th edition of this Encyclopaedia:—

"The important differences in the structure of the central capsule of different Radiolaria were first shown by Hertwig, who also discovered that the spines of the Acanthometridea consist not of silica but of an organic compound (but see above). In view of this latter fact and of the peculiar numerical and architectural features of the Acanthometrid skeleton, it seems proper to separate them altogether from the other Radiolaria. The Peripylaea may be regarded as the starting-point of the Radiolarian pedigree, and have given rise on the one hand to the Acanthometridea, which

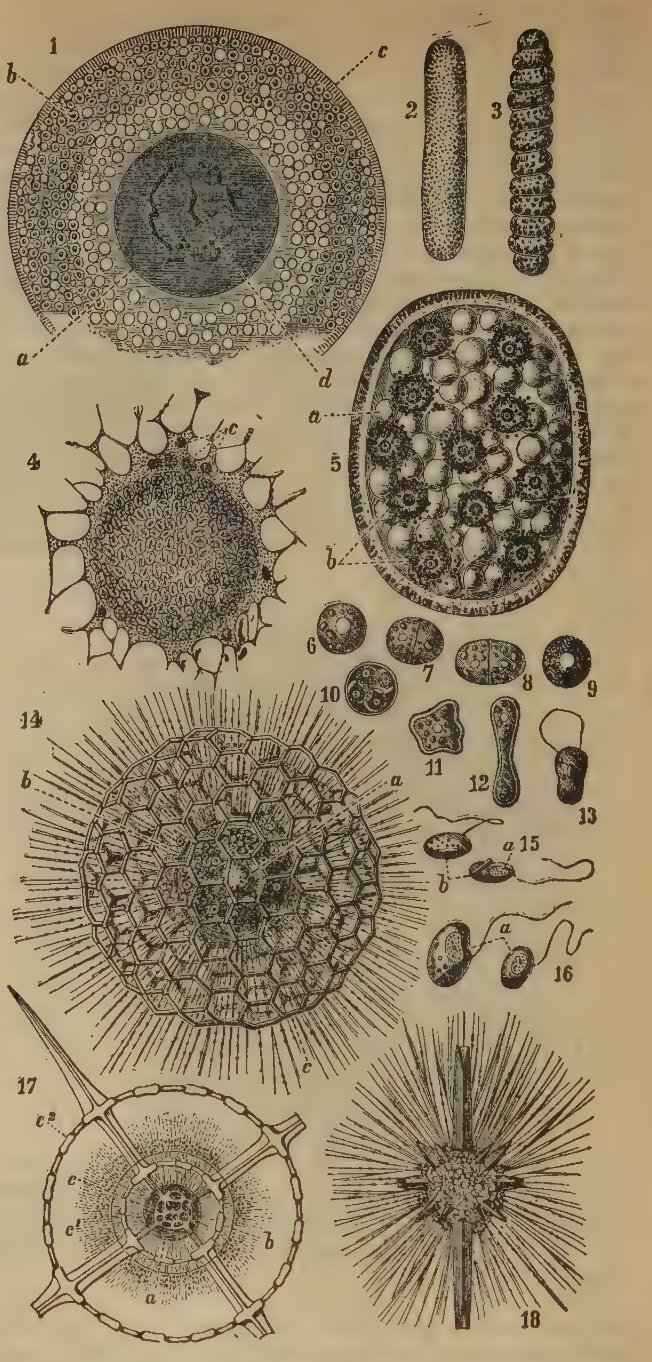

Fig. III.—Radiolaria. 1. Central capsule of *Thalassicolla nucleata*, Huxley, in radial section. *a*, the large nucleus (Binnenbläschen); *b*, corpuscular structures of the intracapsular protoplasm containing concretions; *c*, wall of the capsule (membranous shell), showing the fine radial pore-canals; *d*, nucleolar fibres (chromatin substance) of the nucleus. 2, 3. *Collozoum inerme*, J. Müller, two different forms of colonies, of the natural size. 4. Central capsule from a colony of *Collozoum inerme*, showing the intracapsular protoplasm and nucleus, broken up into a number of spores, the germs of swarm-spores or flagellulae; each encloses a crystalline rod. *c*, yellow cells lying in the extracapsular protoplasm. 5. A small colony of *Collozoum inerme*, magnified 25 diameters. *a*, alveoli (vacuoles) of the extracapsular protoplasm; *b*, central capsules, each containing besides protoplasm a large oil-globule. 6–13. Yellow cells of various Radiolaria: 6, normal yellow cell; 7. 8, division with formation of transverse septum; 9, a modified condition according to Brandt; 10, division of a yellow cell into four; 11, amoeboid condition of a yellow cell from the body of a dead Sphaerozoon; 12, a similar cell in process of division; 13, a yellow cell the protoplasm of which is creeping out of its cellulose envelope. 14. *Heliosphaera inermis*, Haeck., living example; *a*, nucleus; *b*, central capsule; *c*, siliceous basket-work skeleton. 15. Two swarm-spores (flagellulae) of *Collozoum inerme*, set free

from such a central capsule as that drawn in 4; each contains a crystal *b* and a nucleus *a*. 16. Two swarm-spores of *Collozoum inerme*, of the second kind, viz. devoid of crystals, and of two sizes, a macrospore and a microspore. They have been set free from central capsules with contents of a different appearance from that drawn in 4. *a*, nucleus. 17. *Actinomma asteracanthion*, Haeck.; one of the Peripylaea. Entire animal in optical section. *a*, nucleus; *b*, wall of the central capsule; *c*, innermost siliceous shell enclosed in the nucleus; c^1, middle shell lying within the central capsule; c^2, outer shell lying in the extracapsular protoplasm. Four radial siliceous spines holding the three spherical shells together are seen. The radial fibrillation of the protoplasm and the fine extracapsular pseudopodia are to be noted. 18. *Amphilonche messanensis*, Haeck.; one of the Acanthometridea. Entire animal as seen living.

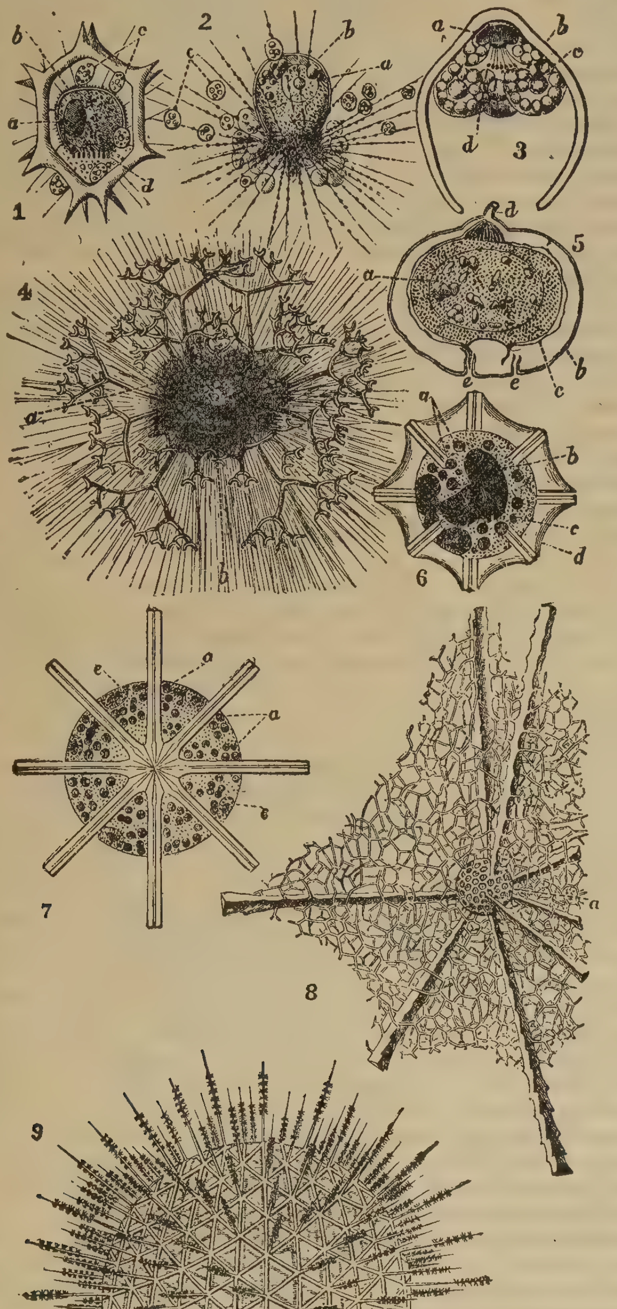

Fig. IV.—Radiolaria. 1. *Lithocircus annularis*, Hertwig; one of the Monopylaea. Whole animal in the living state (optical section); *a*, nucleus; *b*, wall of the central capsule; *c*, yellow cells; *d*, perforated area of the central capsule (Monopylaea). 2. *Cystidium inerme*, Hertwig; one of the Monopylaea. Living animal. An example of a Monopylaeon destitute of skeleton. *a*, nucleus; *b*, capsule-wall; *c*, yellow cells in the extracapsular protoplasm. 3. *Carpocanium diadema*, Haeck.; optical section of the beehive-shaped shell to show the form and position of the protoplasmic body. *a*, the tri-lobed nucleus; *b*, the siliceous shell; *c*, oil-globules; *d*, the perforate area (pore-plate) of the central capsule. 4. *Coelodendrum gracillimum*, Haeck.; living animal, complete; one of the Tripylaea. *a*, the characteristic dark pigment (phaeodium) surrounding the central capsule *b*. The peculiar branched siliceous skeleton, consisting of hollow fibres, and the expanded pseudopodia are seen. 5. Central capsule of one of the Tripylaea, isolated, showing *a*, the nucleus; *b*, *c*, the inner and the outer laminae of the capsule wall; *d*, the chief or polar aperture; *e*, *e*, the two secondary apertures. 6, 7. *Acanthometra claparedei*, Haeck. 7 shows the animal in optical section, so as to exhibit the characteristic meeting of the spines at the central point as in all Acanthometridea; 6 shows the transition from the uninuclear to the multinuclear condition by the breaking up of the large nucleus. *a*, small nuclei; *b*, large fragments of the single nucleus; *c*, wall of the central capsule; *d*, extracapsular jelly (not protoplasm); *e*, peculiar intracapsular yellow cells. 8. *Spongosphaera streptacantha*, Haeck.; one of the Peripylaea. Siliceous skeleton not quite completely drawn on the right side. *a*, the spherical extracapsular shell (compare fig. III. 17), supporting very large radial spines which are connected by a spongy network of siliceous fibres. 9. *Aulosphaera elegantissima*, Haeck.; one of the Phaeodaria. Half of the spherical siliceous skeleton.

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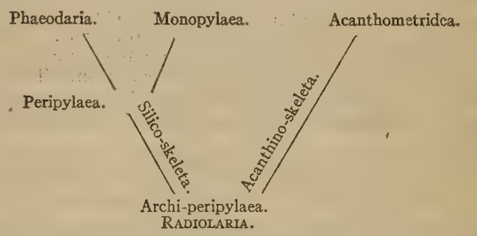
retain the archaic structure of the central capsule whilst developing a peculiar skeleton, and on the other hand to the Monopylaea and Phaeodaria, which have modified the capsule but retained the siliceous skeleton.



“The occasional total absence of any siliceous or acanthinous skeleton does not appear to be a matter of classificatory importance, since skeletal elements occur in close allies of those very few forms which are totally devoid of skeleton. Similarly it does not appear to be a matter of great significance that some forms (Polycyttaria) form colonies, instead of the central capsules separating from one another after fission has occurred.

“It is important to note that the skeleton of silex or acanthin does not correspond to the shell of other Sarcodina, which appears rather to be represented by the membranous central capsule. The skeleton does, however, appear to correspond to the spicules of Heliozoa, and there is an undeniable affinity between such a form as Clathrulina and the Sphaerid Peripylaea (such as Heliosphaera, fig. III. 14). The Radiolaria are, however, a very strongly marked group, definitely separated from all other Sarcodina by the membranous central capsule sunk in their protoplasm. Their differences *inter se* do not affect their essential structure. The variations in the chemical composition of the skeleton and in the perforation of the capsule do not appear superficially. The most obvious features in which they differ from one another relate to the form and complexity of the skeleton, a part of the organism so little characteristic of the group that it may be wanting altogether. It is not known how far the form-species and form-genera which have been distinguished in such profusion by Haeckel as the result of a study of the skeletons are permanent (*i.e.* relatively permanent) physiological species. There is no doubt that very many are local and conditional varieties, or even merely stages of growth, of a single Protean species. The same remark applies to the species discriminated among the shell-bearing Reticularia. It must not be supposed, however, that less importance is to be attached to the distinguishing and recording of such forms because we are not able to assert that they are permanent species.

“The *streaming of the granules of the protoplasm* has been observed in the pseudopodia of Radiolaria as in those of Heliozoa and Reticularia; it has also been seen in the deeper protoplasm; and granules have been definitely seen to pass through the pores of the central capsule from the intracapsular to the extracapsular protoplasm. A feeble vibrating movement of the pseudopodia has been occasionally noticed.

“The *production of swarm-spores* has been observed only in Acanthometra and in the Polycyttaria and Thalassicollidae, and only in the two latter groups have any detailed observations been made. Two distinct processes of swarm-spore production have been observed by Cienkowski, confirmed by Hertwig,—distinguished by the character of the resulting spores, which are called ‘crystalligerous’ and ‘isospores’ (fig. III. 15) in the one case, and ‘dimorphous’ or ‘anisospores’ in the other (fig. III. 16). In both processes the nucleated protoplasm within the central capsule breaks up by a more or less regular cell-division into small pieces, the details of the process differing a little in the two cases. In those individuals which produce crystalligerous swarm-spores, each spore encloses a small crystal (fig. 111. 15). On the other hand, in those individuals which produce dimorphous swarm-spores, the contents of the capsule (which in both instances are set free by its natural rupture) are seen to consist of individuals of two sizes, 'megaspores' and 'microspores,' neither of which contain crystals (fig. 111. 16). The further development of the spores has not been observed in either case. Both processes have been observed in the same species, and it is suggested that there is an alternation of sexual and asexual generations, the crystalligerous spores developing directly into adults, which in their turn produce in their central capsules dimorphous swarm-spores (megaspores and microspores), which in a manner analogous to that observed in the Volvocinean Flagellata copulate (permanently fuse) with one another (the larger with the smaller) before proceeding to develop. The adults resulting from this process would, it is suggested, produce in their turn crystalligerous swarm-spores. Unfortunately we have no observations to support this hypothetical scheme of a life-history.

"*Fusion* or *conjugation* of adult Radiolaria, whether preliminary to swarm-spore-production or independently of it, has not been observed—this affording a distinction between them and Heliozoa.

"Simple fission of the central capsule of adult individuals, preceded of course by nuclear fission, and subsequently of the whole protoplasmic mass, has been observed in several genera of Acantharia and Phaeodaria, and is probably a general method of reproduction in the group. In Spumellaria it gives rise to colonial 'Polycyttarian' forms when the extracapsular protoplasm does not divide.

"The siliceous shells of the Radiolaria are found abundantly in certain rocks from Palaeozoic times onwards. They furnish, together with Diatoms and Sponge spicules, the silica which has been segregated as flint in the Chalk formation. They are present in quantity (as much as 10%) in the Atlantic ooze, and in the celebrated 'Barbados earth' (a Tertiary deposit) are the chief components."

Bibliography.—The most important systematic works are those of E. Haeckel, *Die Radiolarien* (1862–87), and the "Report" on the Radiolaria of the "*Challenger*" *Expedition* (vol. xviii., 1887), which contains full lists of the older literature. Among the most important recent studies we cite K. Brandt, "Die Koloniebildenden Radiolarien" in *Fauna and Flora des Golfes von Neapel*, xii. (1885); A. Borgert in *Zeitschrift f. Wissenschaftliche Zoologie*, li. (1891), and *Zoologische Jahrbücher* (*Anatomie*), xiii. (1900); F. Dreyer in *Jenäischer Zeitschr.*, xix. (1892); V. Häcker in *Zeitsch. f. Wiss. Zool.*, lxxxiii. (1905). (M. Ha.)

RADIOMETER. It had been remarked at various times, amongst others by Fresnel, that bodies delicately suspended within a partial vacuum are subject to apparent repulsion by radiation. The question was definitely investigated by Sir W. Crookes, who had found that some delicate weighings *in vacuo* were vitiated by this cause. It appeared that a surface blackened so as to absorb the radiant energy directed on it was repelled relatively to a polished surface. He constructed an apparatus in illustration, which he called a *radiometer* or *light-mill*, by pivoting a vertical axle carrying equidistant vertical vanes inside an exhausted glass bulb, one side of each vane being blackened and the other side bright, the blackened sides all pointing the same way round the axle. When the rays of the sun or a candle, or dark radiation from a warm body, are incident on the vanes, the dark side of each vane is repelled more than the bright side, and thus the vanes are set into rotation with accelerated speed, which becomes uniform when the forces produced by the radiation are balanced by the friction of the pivot and of the residual air in the globe. The name radiometer arose from an idea that the final steady speed of rotation might be utilized as a rough measure of the intensity of the exciting radiation.

The problem of the cause of these striking and novel phenomena at first produced considerable perplexity. A preliminary question was whether the mechanical impulsion was a direct effect of the light, or whether the radiation only set up internal stresses, acting in and through the residual air, between the vanes and the walls of the enclosure. The answer to this was found experimentally by Arthur Schuster, who suspended the whole instrument in delicate equilibrium, and observed the effect of introducing the radiation. If the light exerted direct impulsion on the vanes, their motion would gradually drag the case round after them, by reason of the friction of the residual air in the bulb and of the pivot. On the other hand, if the effects arose from balanced stresses set up inside the globe by the radiation, the effects on the vanes and on the case would be of the nature of action and reaction, so that the establishment of motion of the vanes in one direction would involve impulsion of the case in the opposite direction; but when the motion became steady there would no longer be any torque either on the vanes or on the case, and the latter would therefore come back to its previous position of equilibrium; finally, when the light was turned off, the decay of the motion of the vanes would involve impulsion of the case in the direction of their motion until the moment of the restoring torque arising from the suspension of the case had absorbed the angular momentum in the system. Experiment showed that the latter prediction was what happened. The important part played by the residual air in the globe had also been deduced by Osborne Reynolds from observing that on turning off the light, the vanes came to rest very much sooner than the friction of the pivot alone would account for; in fact, the rapid subsidence is an illustration of Maxwell's great theoretical discovery that viscosity in a gas (as also diffusion both of heat and of the gas itself) is sensibly independent of the density. Some phenomena of retardation in the production of the effect had led Sir G. G. Stokes and Sir W. Crookes to the same general conclusion.

The origin of these phenomena was recognized, among the first by O. Reynolds, and by P. G. Tait and J. Dewar, as a consequence of the kinetic theory of the constitution of gaseous media. The temperature of a gas is measured by the mean energy of translation of its molecules, which are independent of each other except during the brief intervals of collision; and collision of the separate molecules with the blackened surface of a vane, warmed by the radiation, imparts heat to them, so that they rebound from it with greater velocity than they approached. This increase of velocity implies an increase of the reaction on the surface, the black side of a vane being thus pressed with greater force than the bright side. In air of considerable density the mean free path of a molecule, between its collisions with other molecules, is exceedingly small, and any such increase of gaseous pressure in front of the black surface would be immediately neutralized by flow of the gas from places of high to places of low pressure. But at high exhaustions the free path becomes comparable with the dimensions of the glass bulb, and this equalization proceeds slowly. The general nature of the phenomena is thus easily understood; but it is at a maximum at pressures comparable with a millimetre of mercury, at which the free path is still small, the greater number of molecules operating in intensifying the result. The problem of the stresses in rarefied gaseous media arising from inequalities of temperature, which is thereby opened out, involves some of the most delicate considerations in molecular physics. It remains practically as it was left in 1879 by two memoirs communicated to the *Phil. Trans.* by Osborne Reynolds and by Clerk Maxwell. The method of the latter investigator was purely a priori. He assumed that the distribution of molecules and of their velocities, at each point, was slightly modified, from the exponential law belonging to a uniform condition, by the gradient of temperature in the gas (see Diffusion). The hypothesis that the state was steady, so that interchanges arising from convection and collisions of the molecules produced no aggregate result, enabled him to interpret the new constants involved in this law of distribution, in terms of the temperature and its spacial differential coefficients, and thence to express the components of the kinetic stress at each point in the medium in terms of these quantities. As far as the order to which he carried the approximations—which, however, were based on a simplifying hypothesis that the molecules influenced each other through mutual repulsions inversely as the fifth power of their distance apart—the result was that the equations of motion of the gas, considered as subject to viscous and thermal stresses, could be satisfied by a state of equilibrium under a modified internal pressure equal in all directions. If, therefore, the walls of the enclosure held the gas that is directly in contact with them, this equilibrium would be the actual state of affairs; and it would follow from the principle of Archimedes that, when extraneous forces such as gravity are not considered, the gas would exert no resultant force on any body immersed in it. On this ground Maxwell inferred that the forces acting in the radiometer are connected with gliding of the gas along the unequally heated boundaries; and as the laws of this slipping, as well as the constitution of the adjacent layer, are uncertain, the problem becomes very intricate. Such slipping had shown itself at high exhaustions in the experiments of A. A. Kundt and E. G. Warburg in 1875 on the viscosity of gases; its effects would be corrected for, in general, by a slight effective addition to the thickness of the gaseous layer.

Reynolds, in his investigation, introducing no new form of law of distribution of velocities, uses a linear quantity, proportional to the mean free path of the gaseous molecules, which he takes to represent (somewhat roughly) the average distance from which molecules directly affect, by their convection, the state of the medium; the gas not being uniform on account of the gradient of temperature, the change going on at each point is calculated from the elements contributed by the parts at this particular distance in all directions. He lays stress on the dimensional relations of the problem, pointing out that the phenomena which occur with large vanes in highly rarefied gas could also occur with proportionally smaller vanes in gas at higher pressure. The results coincide with Maxwell's so far as above stated, though the numerical coefficients do not agree. According to Maxwell, priority in showing the necessity for slipping over the boundary rests with Reynolds, who also discovered the cognate fact of thermal transpiration, meaning thereby that gas travels up the gradient of temperature in a capillary tube, owing to surface-actions, until it establishes such a gradient of pressure (extremely minute) as will prevent further flow. In later memoirs Reynolds followed up this subject by proceeding to establish definitions of the velocity and the momentum and the energy at an element of volume of the molecular medium, with the precision necessary in order that the dynamical equations of the medium in bulk, based in the usual manner on these quantities alone, without directly considering thermal stresses, shall be strictly valid—a discussion in which the relation of ordinary molar mechanics to the more complete molecular theory is involved.

Of late years the peculiarities of the radiometer at higher gas-pressures have been very completely studied by E. F. Nichols and G. F. Hull, with the result that there is a certain pressure at which the molecular effect of the gas on a pair of nearly vertical vanes is balanced by that of convection currents in it. By thus controlling and partially eliminating the aggregate gas-effect, they succeeded in making a small radiometer, horizontally suspended, into a delicate and reliable measurer of the intensity of the radiation incident on it. With the experience thus gained in manipulating the vacuum, the achievement of thoroughly verifying the pressure of radiation on both opaque and transparent bodies, in accordance with Clerk Maxwell's formula, has been effected (*Physical Review*, 1901, and later papers) by E. F. Nichols and G. F. Hull; some months earlier Lebédew had published in the *Annalen der Physik* a verification for metallic vanes so thin as to avoid the gas-action, by preventing the production of sensible difference of temperature between the two faces by the incident radiation. (See RADIATION.)

More recently J. H. Poynting has separated the two effects experimentally on the principle that the radiometer pressure acts along the normal, while the radiation pressure acts along the ray which may be directed obliquely. (J. L.*)

RADISH, *Raphanus sativus* (nat. order Cruciferae), in botany, a fleshy-rooted annual, unknown in the wild state. Some varieties of the wild radish, *R. Raphanistrum*, however, met with on the Mediterranean coasts, come so near to it as to suggest that it may possibly be a cultivated race of the same species. It is very popular as a raw salad. There are two principal forms, the spindle-rooted and the turnip-rooted.

The radish succeeds in any well-worked not too heavy garden soil, but requires a warm, sheltered situation. The seed is generally sown broadcast, in beds 4 to 5 ft. wide, with alleys between, the beds requiring to be netted over to protect them from birds. The earliest crop may be sown about the middle of December, the seed-beds being at once covered with litter, which should not be removed till the plants come up, and then only in the daytime, and when there is no frost. If the crop succeeds, which depends on the state of the weather, it will be in use about the beginning of March. Another sowing may be made in January, a third early in February, if the season is a favourable one, and still another towards the end of February, from which time till October a small sowing should be made every fortnight or three weeks in spring, and rather more frequently during summer. About the end of October, and again in November, a late sowing may be made on a south border or bank, the plants being protected in severe weather with litter or mats. The winter radishes, which grow to a large size, should be sown in the beginning of July and in August, in drills from 6 to 9 in. apart, the plants being thinned out to 5 or 6 in. in the row. The roots become fit for use during the autumn. For winter use they should be taken up before severe frost sets in, and stored in dry sand. Radishes, like other fleshy roots, are attacked by insects, the most dangerous being the larvae of several species of fly, especially the radish fly (*Anthomyia radicum*). The most effectual means of destroying these is by watering the plants with a dilute solution of carbolic acid, or much diluted gas-water; or gas-lime may be sprinkled along the rows.

Forcing.—To obtain early radishes a sowing in the British Isles should be made about the beginning of November, and continued fortnightly till the middle or end of February; the crop will generally be fit for use about six weeks after sowing. The seed should be sown in light rich soil, 8 or 9 in. thick, on a moderate hotbed, or in a pit with a temperature of from 55° to 65°. Gentle waterings must be given, and air admitted at every favourable opportunity; but the sashes must be protected at night and in frosty weather with straw mats or other materials. Some of these crops are often grown with forced potatoes. The best forcing sorts are Wood's early frame, and the early rose globe, early dwarf-top scarlet turnip, and early dwarf-top white turnip.

Those best suited for general cultivation are the following:—

Spindle-rooted.—Long scarlet, including the sub-varieties scarlet short-top, early frame scarlet, and Wood's early frame; long scarlet short-top, best for general crop.

Turnip-rooted.—Early rose globe-shaped, the earliest of all; early dwarf-top scarlet turnip, and early dwarf-top white turnip; earliest Erfurt scarlet, and early white short-leaved, both very early sorts; French breakfast, olive-shaped; red turnip and white turnip, for summer crops.

Winter sorts.—Black Spanish, white Chinese, Californian mammoth.

RADIUM (from Lat. *radius*, ray), a metallic chemical element obtained from pitchblende, a uranium mineral, by P. and Mme. Curie and G. Bémont in 1898; it was so named on account of the intensity of the radioactive emanations which it yielded. Its discovery was a sequel to H. Becquerel's observation in 1896 that certain uranium preparations emitted a radiation resembling the X rays observed by Röntgen in 1895. Like the X rays, the Becquerel rays are invisible; they both traverse thin sheets of glass or metal, and cannot be refracted; moreover, they both ionize gases, *i.e.* they discharge a charged electroscope, the latter, however, much more feebly than the former. Characteristic, also, is their action on a photographic plate, and the phosphorescence which they occasion when they impinge on zinc sulphide and some other salts. Notwithstanding these resemblances, these two sets of rays are not indentical. Mme. Curie, regarding radioactivity—*i.e.* the emission of rays like those just mentioned—as a property of some undiscovered substance, submitted pitchblende to a most careful analysis. After removing the uranium, it was found that the bismuth separated with a very active substance—polonium; this element was afterwards isolated by Marckwald, and proved to be identical with his radiotellurium; that the barium could be separated with another active substance—radium; whilst a third fraction, composed mainly of the rare earths (thorium, &c.), yielded to Debierne another radioactive element—actinium, which proved to be identical with the emanium of Giesel. Another radioactive substance—ionium—was isolated from carnotite, a uranium mineral, by B. B. Boltwood in 1905. Radioactive properties have also been ascribed to other elements, *e.g.* thorium and lead. There is more radium than any other radioactive element, but its excessive rarity may be gauged by the facts that Mme. Curie obtained only a fraction of a gramme of the chloride and Giesel ·2 to ·3 gramme of the bromide from a ton of uranium residues.

There is a mass of evidence to show that radium is to be regarded as an element, and in general its properties resemble those of the metals of the alkaline earths, more particularly barium. To the bunsen flame a radium salt imparts an intense carmine-red colour (barium gives a green). The spectrum, also, is very characteristic. The atomic weight, 226·4, places the element in a vacant position in group II. of the periodic classification, along with the alkaline earth metals.

Generally speaking, the radiation is not simple. Radium itself emits three types of rays: (1) the α rays, which are regarded as positively charged helium atoms; these rays are stopped by a single sheet of paper; (2) the β rays, which are identified with the cathode rays, *i.e.* as a single electron charged negatively; these rays can penetrate sheets of aluminium, glass, &c., several millimetres thick; and (3) the γ rays—which are non-electrified radiations characterized by a high penetrating power, 1% surviving after traversing 7 cm. of lead or 150 cm. of water. In addition, radium evolves an "emanation" which is an extraordinarily inert gas, recalling the "inactive" gases of the atmosphere. We thus see that radium is continually losing matter and energy as electricity; it is also losing energy as heat, for, as was observed by Curie and Laborde, the temperature of a radium salt is always a degree or two above that of the atmosphere, and they estimated that a gramme of pure radium would emit about 100 gramme-calories per hour.

The Becquerel rays have a marked chemical action on certain substances. The Curies showed that oxygen was convertible into ozone, and Sudborough that yellow phosphorus gave the red modification when submitted to their influence. More interesting are the observations of D. Berthelot, F. Bordas, C. Doelter and others, that the rays induce important changes in the colours of many minerals. (See RADIOACTIVITY.)

The action of radium on human tissues was unknown until 1901, when, Professor Becquerel of Paris having incautiously carried a tube in his waistcoat pocket, there appeared on the skin within fourteen days a severe inflammation which was known as the famous "Becquerel burn." Since that time active investigation into the action of radium on diseased tissues has been carried on, resulting in the establishment in Paris in 1906 of the "Laboratoire biologique du Radium." Similar centres for study have been inaugurated in other countries, notably one in London in 1909. The diseases to which the application has been hitherto confined are papillomata, lupus vulgaris, epithelial tumours, syphilitic ulcers, pigmentary naevi, angiomata, and pruritus and chronic itching of the skin; but the use of radium in therapeutics is still experimental. The different varieties of rays used are controlled by the intervention of screens or filtering substances, such as silver, lead or aluminium. Radium is analgesic and bactericidal in its action.

See *Radiumtherapie*, by Wickham and Degrais (1909); *Die therapeutische Wirkung der Radiumstrahlen*, by O. Lassar, in *Report* of Radiology Congress, Brussels, 1906; E. Dorn, E. Baumann and S. Valentiner in *Physische Zeitung* (1905); Abbé in *Medical Record* (October 1907).

RADIUS, properly a straight rod, bar or staff, the original meaning of the Latin word, to which also many of the various meanings seen in English were attached; it was thus applied to the spokes of a wheel, to the semi-diameter of a circle or sphere and to a ray or beam of light, "ray" itself coming through the Fr. *raie* from *radius*. From this last sense comes "radiant," "radiation," and allied words. In mathematics, a radius is a straight line drawn from the centre to the circumference of a circle or to the surface of a sphere; in anatomy the name is applied to the outer one of the two bones of the fore-arm in man or to the corresponding bone in the fore-leg of animals. It is also used in various other anatomical senses in botany, ichthyology, entomology, &c. A further application of the term is to an area the extent of which is marked by the length of the radius from the point which is taken as the centre; thus, in London, for the purpose of reckoning the fare of hackney-carriages, the radius is taken as extending four miles in any direction from Charing Cross.

RADNOR, EARLS OF. The 1st earl of Radnor was John Robartes (1606–1685), who succeeded his father, Richard Robartes, as 2nd baron Robartes of Truro in May 1634, the barony having been purchased under compulsion for £10,000 in 1625. The family had amassed great wealth by trading in tin and wool. Educated at Exeter College, Oxford, John Robartes fought on the side of the Parliament during the Civil War, being present at the battle of Edgehill and at the first battle of Newbury, and was a member of the committee of both kingdoms. He is said to have persuaded the earl of Essex to make his ill-fated march into Cornwall in 1644; he escaped with the earl from Lostwithiel and was afterwards governor of Plymouth. Between the execution of Charles I. and the restoration of Charles II. he took practically no part in public life, but after 1660 he became a prominent public man, owing his prominence partly to his influence among the Presbyterians, and ranged himself among Clarendon's enemies. He was lord deputy of Ireland in 1660–1661 and was lord lieutenant in 1669–1670; from 1661 to 1673 he was lord privy seal, and from 1679 to 1684 lord president of the council. In 1679 he was created viscount Bodmin and earl of Radnor, and he died at Chelsea on the 17th of July 1685. His eldest son, Robert, viscount Bodmin, who was British envoy to Denmark, having predeceased his father, the latter was succeeded as 2nd earl by his grandson, Charles Bodvile Robartes (1660–1723), who was a member of parliament under Charles II. and James II., and was lord lieutenant of Cornwall from 1696 to 1705 and again from 1714 to 1723. Henry, the 3rd earl (*c.* 1690–1741), was also a grandson of the 1st earl, and John, the 4th earl (*c.* 1686–1757), was another grandson. When John, whose father was Francis Robartes (*c.* 1650–1718), a member of parliament for over thirty years and a musician of some repute, died unmarried in July 1757, his titles became extinct.

Lanhydrock, near Bodmin, and the other estates of the Robartes family passed to the earl's nephews, Thomas and George Hunt. Thomas Hunt's grandson and heir, Thomas James Agar-Robartes (1808–1882), a grandson of an Irish peer, James Agar, 1st viscount Clifden (1734–1789), was created baron Robartes of Lanhydrock and of Truro in 1869, after having represented East Cornwall in seven parliaments. His son and successor, Thomas Charles Agar-Robartes, the 2nd baron (b. 1844), succeeded his kinsman as 6th viscount Clifden in 1899.

In 1765 William Bouverie, 2nd viscount Folkestone (1725–1776), son of Sir Jacob Bouverie, bart. (d. 1761), of Longford, Wiltshire, who was created viscount Folkestone in 1747, was made earl of Radnor. Descended from a Huguenot family, William Bouverie was a member of parliament from 1747 until he succeeded to the peerage in February 1761. He died on the 28th of January 1776. His son and successor, Jacob, the 2nd earl (1750–1828), who took the name of Pleydell-Bouverie in accordance with the will of his maternal grandfather, Sir Mark Stuart Pleydell, bart. (d. 1768), was the father of William Pleydell-Bouverie, the 3rd earl (1779–1869), a politician of some note. In 1900 his great-grandson, Jacob Pleydell-Bouverie (b. 1868), became 6th earl of Radnor.

RADNORSHIRE (Sir Faesyfed), an inland county of Wales, bounded N. by Montgomery, N.E. by Shropshire, E. by Hereford, S. and S.W. by Brecknock and N.W. by Cardigan. This county, which is lozenge-shaped, contains 471 sq. m., and is consequently the smallest in area of the six South Welsh counties. Nearly the whole surface of Radnorshire is hilly or undulating, whilst the centre is occupied by the mountainous tract known as Radnor Forest, of which the highest point attains an elevation of 2163 ft. Towards the S. and S.E. the hills are less lofty, and the valleys broaden out into considerable plains abounding in rivulets. The hills for the most part present smooth, rounded outlines, and are covered with heather, bracken and short grass, though tracts of boggy soil in the uplands are not uncommon. There are rich pastures and numerous woods in the valleys of the Wye and Teme. The Wye Valley has long been celebrated for its beauty, while Radnor Forest and the wild district of Cwmdauddwr present striking views of primeval and unspoiled scenery. Radnorshire is well supplied with water, its principal river being the Wye (Gwy), which, after crossing the N.W. corner of the county, forms its boundary from Rhayader onward to the English border. Salmon, trout and grayling are plentiful, and the Wye is consequently much frequented by anglers; as are also its tributaries—the Elan (which has been utilized for the great Birmingham reservoirs) the Ithon, the Edw or Edwy, the Lug, the Arrow and the Somergil. The Teme, which divides Radnor from Shropshire on the N.E., is a tributary of the Severn. All these streams are clear and rapid, and abound in fish. In the numerous rocky ravines of the mountainous districts are found many waterfalls, of which the most celebrated is "Water-break-its-Neck," to the W. of New Radnor. Omitting the artificially constructed reservoirs in the valleys of the Elan and Claerwen, the lakes of Radnorshire are represented only by a few pools of which Llynbychlyn near Painscastle is the largest.

Geology.—Ordovician rocks occupy most of the western side of the county, they are succeeded eastward by the Silurian formations, the Llandovery, Wenlock and Ludlow beds in the order here given. East of New Radnor an inlier of Wenlock rocks is surrounded by Ludlow beds; while at Old Radnor a ridge of very ancient rocks appears. In the south-east of the county Old Red Sandstone rests upon the Silurian. Between Llandrindod, where there are saline, sulphurous and chalybeate wells, and Builth, is a disturbed area of Ordovician strata with masses of andesitic and diabasic igneous rocks. In the vicinity of Rhayader the strata have been classed as the Rhayader pale shales (Tarannon), the Caban group (Upper Llandovery), the Gwastaden group (Lower Llandovery); these rest upon shales of Bala age.

Climate and Industries.—The climate of Radnorshire is bracing, if somewhat bleak, and the rainfall is not so heavy as in the neighbouring counties of Montgomery and Brecknock, but thick drizzling mists are of constant occurrence. The winters are often very severe, and deep snowfalls are not uncommon. Good hay and tolerable crops of cereals are raised in the valleys, and the margin of cultivation has risen considerably since 1880. The extensive upland tracts, which still cover over one-third of the total area of the county, afford pasturage for mountain ponies and for large flocks of sheep. The quality of the wool of Radnorshire has long been celebrated, and also the delicacy of the Welsh mutton of the small sheep that are bred in this county. The most important sheep fairs are held at Rhayader, which also contains some woollen factories. There are practically no mining industries, nor are the quarries of great value. The valley of the Wye is rich in medicinal springs, and the saline, sulphur and chalybeate waters of Llandrindod have long been famous and profitable, and are growing in popular esteem.

Communications.—The Central Wales branch of the London & North-Western railway enters the county at Knighton, traverses it by way of Llandrindod and passes into Brecknock at Builth Road Junction on the Wye. The Cambrian railway, after passing through the N.W. corner of the county to Rhayader, follows the course of the Wye, by way of Builth and Hay. Two small branch lines connect New Radnor and Presteign with the system of the Great Western.

Population and Administration.—The area of Radnorshire is 301,164 acres, and the population in 1891 was 21,791, while in 1901 it had risen to 23,362; an increase chiefly due to the immigration of outside labourers to the Elan Valley waterworks. There is no existing municipal borough, although New Radnor, now a mere village with 405 inhabitants (1901), was incorporated in 1561 and its municipal privileges were not formally abolished till 1883. The chief towns are Presteign (pop. 1245); Llandrindod (1827); Knighton (2139), and Rhayader (1215); all, except Rhayader, being urban districts. Radnorshire is included in the South Wales circuit, and assizes are held at Presteign, which ranks as the county town. There is no existing parliamentary borough, and the whole county returns one member to parliament. Ecclesiastically, Radnorshire is divided into 46 parishes, of which 38 lie in the diocese of St Davids, and 8 in that of Hereford.

History.—The wild district of Maesyfed (a name of which the derivation is much disputed), corresponding substantially with the modern Radnorshire, originally formed part of the territory of the Silures, who were vanquished by the Romans. Christianity seems to have been introduced into this barren region during the 5th and 6th centuries by itinerant Celtic missionaries, notably by St David, St Padarn and St Cynllo. Towards the close of the 9th century Maesyfed was absorbed into the middle kingdom of Powys, and in the 10th century it was included in the realm of Elystan Glodrudd, prince of Fferlys, or Feryllwg, who ruled over all land lying between the Wye and Severn. In the reign of William the Conqueror, the Normans began to penetrate into Maesyfed, where, according to Domesday Book, the king already laid claim to Radenoure, or Radnor (a name of doubtful meaning), in the lordship of Melenith (Moelynaidd), which was subsequently bestowed on the Mortimer family, when castles were erected at Old Radnor (Penygraig), New Radnor and Cefnllys. Later, the Norman invaders forced their way up the Wye Valley, the de Breos family, lords of Elvel (Elfael), building fortresses at Painscastle and at Colwyn or Maud's Castle. In 1188 Archbishop Baldwin, accompanied by Ranulf de Glanville and Giraldus Cambrensis, entered Wales for the purpose of preaching the Third Crusade, and was met in full state at New Radnor by the Lord Rhys, prince of South Wales. The Wye Valley long formed one of the debatable districts between Welsh and Normans, and in 1282 Llewelyn ap Griffith, prince of Wales, was at Aberedw shortly before his death in a skirmish near Builth. After the annexation of Wales by Edward I., the district of Maesyfed remained under the immediate jurisdiction of the Lords-Marchers, represented by the great families of Mortimer and Todeney. During the summer of 1402 Owen Glendower entered the Marches and raided the lands of the young Edward Mortimer, earl of March, whilst the royal troops were severely defeated at the battle of Bryn Glâs near Pilleth. By the Act of Union (1536) Maesyfed was erected out of the suppressed lordships into an English shire on the usual model. For administrative purposes it was now divided into six hundreds, and assizes were ordained to be held in alternate years at Presteign and New Radnor. The newly created county was likewise privileged to return two members to parliament; one for the county, and one for the united boroughs of New Radnor, Rhayader, Knighton, Cefnllys and Knucklas (Cnwclas). The parliamentary district of the Radnor boroughs was, however, disfranchised and merged in the county representation under the act of 1885. The shire of Radnor with its immense tracts of sheep-walk, its absence of large towns and its sparse rural population has always been reckoned the poorest and least important of the Welsh counties, nor since its creation under Henry VIII. has it ever played a prominent part in the national life of Wales. During the Commonwealth the local clergy were made to suffer severely under the drastic administration of Vavasor Powell (1617–1670), himself a Radnorshire man as a native of Knucklas. Of recent years the rise of Llandrindod as a fashionable watering-place and the construction of the Birmingham reservoirs in the Elan Valley have tended to increase the material prosperity of the county.

Among the leading families of Radnorshire, may be mentioned Lewis of Harpton Court; Baskerville of Clyro; Thomas (formerly Jones) of Pencerrig; Lewis-Lloyd of Nantgwyllt; Gwynne of Llanelwedd, and Prickard of Dderw.

Antiquities.—Radnorshire contains numerous memorials of early British times, of which the entrenchment called Crug-y-buddair in the parish of Beguildy is specially worthy of note. Of Roman remains, the most important are those of the fortified camp at Cwm near Llandrindod, which is believed to be identical with the military station of Magos or Magna. The course of Offa's Dyke (Clawdd Offa) is perceptible at various points in the hilly regions west of Knighton and Presteign. Very slight traces exist of the many castles erected at various times after the Norman invasion. The parish churches of Radnorshire are for the most part small and of rude construction, and many of them have been modernized or rebuilt. The churches at Old Radnor, Presteign and Llanbister, however, are interesting edifices, and a few possess fine oaken screens, as at Llananno and Llandegley. There was only one monastic house of consequence, the Cistercian abbey of St Mary, founded by Cadwallon ap Madoc in 1143 in "the long valley" of the Clywedog, six miles east of Rhayader, and from its site commonly called Abbey Cwm Hir. Its existing ruins are insignificant, but the proportions of the church, which was 238 ft. long, are still traceable. The modern mansion adjoining, known as Abbey Cwm Hir, was for some generations the residence of the Fowler family, once reputed the wealthiest in the county.

Customs, &c.—Although in most instances the old Celtic place-names survive throughout the western portion of the county, it is only in the wild remote districts of Cwmdauddwr and St Harmon's that the Welsh tongue predominates, and in this region some of the old Welsh superstitions linger amongst the peasants and shepherds of the hills. In the eastern part of the county English is spoken universally, and the manners and customs of the inhabitants differ little from those prevailing in the neighbouring county of Hereford. On the western side of Radnor Forest the modern spirit of progress has destroyed most of the old local customs. Until the beginning of the 19th century the ancient Welsh service of the *pylgain* on Christmas morning was observed in Rhayader church; and the same town was formerly remarkable for an interesting ceremony, evidently of great antiquity, whereat after a funeral each attendant mourner was wont to throw a stone upon a certain spot near the church with the words "Carn ar dy ben" (a stone on thy head). The laying of malicious sprites by means of lighted tapers was formerly practised in the churches of the Wye Valley; and a curious service, commemorative of the dead and known as "the Month's End," is still observed in certain parish churches, a month after the actual funeral has taken place. The practice of farmers and their wives or daughters riding to the local markets on ponies, the older women sometimes knitting as they proceed, still continues, and is specially characteristic of agricultural life in Radnorshire.

See *A General History of the County of Radnor* (compiled from the MS. of the late Rev. Jonathan Williams and other sources) (Brecknock, 1905).

RADOM, a government of Russian Poland, occupying a triangular space between the Vistula and Pilica, and bounded N. by the governments of Warsaw and Siedlce, E. by Lublin, S. by the crownland of Austrian Galicia and the Polish government of Kielce, and W. by that of Piotrków. The area is 4768 sq. m. Its southern part stretches over the well-wooded Sandomir heights, a series of short ranges of hills, 800 to 1000 ft. in altitude, intersected by deep valleys, which, running west and east and drained by tributaries of the Vistula, are excellently adapted for agriculture. In its central parts, the government is level, the soil fertile, and the surface, which is diversified here and there with wood, is broken up by occasional spurs (800 ft.) of the Lysa Góra Mountains. The northern districts consist of low, flat tracts with undefined valleys, exposed to frequent floods and covered over large areas with marshes; the basin of the Pilica, notorious for its unhealthiness, is throughout a low marshy plain. Devonian, Carboniferous, Permian and Triassic deposits appear in the south, Cretaceous and Jurassic in the middle, and Tertiary in the north. Extensive tracts are covered with Glacial deposits,—the Scandinavian erratics reaching as far south as Ilza; these last in their turn are overlain by widespread post-Glacial lacustrine deposits. The climate is cold and moist, the mean temperature for the year being 47°·5 Fahr., for January −5°·8, and for July 77°. The Vistula skirts the government on the south and east, and is an important means of communication, steamers plying as far up as Sandomir (Sędomierz). The Sandomir district suffers occasionally from disastrous inundations of the river. The tributaries of the Vistula are short and small, those of the Pilica are sluggish streams meandering amidst marshes. The estimated population in 1906 was 932,800. The government is divided into seven districts, the chief towns of which are Radom, Ilza, Konskie, Kozienice, Opatów, Opoczno and Sandomir. Out of the total area about 50% is under cultivation and 28% under forests. The principal crops are wheat, rye, barley, oats, buck-wheat, hemp, flax and potatoes, these last chiefly cultivated for distilleries. Grain is exported. Live stock is kept in large numbers. Manufactures have considerably developed of late years, the government being rich in iron ore, while coal and zinc occur, as also marble, gypsum, alabaster, potters' clay and red sandstone. The iron industry occupies more than 60,000 workmen, and turns out annually some 100,000 tons of pig iron, 25,000 tons of iron, and 550,000 tons of steel. There are several sugar-works, tanneries, flour-mills, machinery works, distilleries, breweries and brickworks. Trade is not very extensive, the only channel of commerce being the Vistula. (P. A. K., J. T. Be.)

RADOM, a town of Russia, capital of the government of the same name, 100 m. by rail S. from Warsaw. Pop. 28,749, half of whom were Jews. It is one of the best built provincial towns of Poland. The church of St Wlaclaw, contemporary with the foundation of the town, was transformed by the Austrians into a storehouse, and subsequently by the Russian government into a military prison. The old castle is in ruins, and the old Bernardine monastery is used as barracks. Radom has several iron and agricultural machinery works and tanneries. In 1216 it occupied the site of what is now Old Radom. New Radom was founded in 1340 by Casimir the Great, king of Poland. Here Jadwiga was elected queen of Poland in 1382, and here too in 1401 the first act relating to the union of Poland with Lithuania was signed; the *seim* or diet of 1505, where the organic law of Poland was sworn by the king, was also held at Radom. Several great fires, and still more the Swedish war of 1701–7, were the ruin of the old city. After the third partition of Poland in 1795 it fell under Austrian rule; it was in 1815 annexed to Russia, and became chief town of the province of Sandomir.

RADOMYSL, formerly Mychek, a town of Russia, in the government of Kiev, 31 m. W. of the city of Kiev, on the Teterev river. Pop. 18,154. It is a very old town, being mentioned in 1150; from 1746 to 1795 it was the residence of the metropolitan of the United Greek Church. It has tanneries and flour-mills, and exports timber, corn and mushrooms.

RADOWITZ, JOSEPH MARIA VON (1797–1853), Prussian general and statesman, was born at Blankenburg in the Harz Mountains, his family being of Hungarian origin. As a young lieutenant in the Westphalian artillery he was wounded and taken prisoner at the battle of Leipzig (1813), subsequently entered the Hanoverian service, and in 1823 that of Prussia. His promotion was rapid, and in 1830 he became chief of the general staff of the artillery. In 1836 he went as Prussian military plenipotentiary to the federal diet at Frankfort, and in 1842 was appointed envoy to the courts of Carlsruhe, Darmstadt and Nassau. He had early become an intimate friend of the crown prince (afterwards King Frederick William IV.), and the Prussian constitution of February 1847 was an attempt to realize the ideas put forward by him in his *Gespräche aus der Gegenwart über Staat und Kirche*, published under the pseudonym "Waldheim" in 1846. In November 1847 and March 1848 Radowitz was sent by King Frederick William to Vienna to attempt to arrange common action for the reconstruction of the German Confederation. In the Frankfort parliament he was leader of the extreme Right; and after its break-up he was zealous in promoting the Unionist policy of Prussia, which he defended both in the Prussian diet and in the Erfurt parliament. He was practically responsible for the foreign policy of Prussia from May 1848 onwards, and on the 27th of September 1850 he was appointed minister of foreign affairs. He resigned, however, on the 2nd of November, owing to the king's refusal to settle the difficulties with Austria by an appeal to arms. In August 1852 he was appointed director of military education; but the rest of his life was devoted mainly to literary pursuits. He died on the 25th of December 1853.

Radowitz published, in addition to several political treatises, *Ikonographie der Heiligen, ein Beitrag zur Kunstgeschichte* (Berlin, 1834) and *Devisen und Mottos des spätern Mittelalters* (*ib.*, 1850). His *Gesammelte Schriften* were published in 5 vols. at Berlin, 1852–53. See Hassel, *Joseph Maria von Radowitz* (Berlin, 1905, &c.).

RAE, JOHN (1813–1893), Scottish Arctic explorer, was born on the 30th of September 1813, in the Orkney Islands, which he left at an early age to study medicine at Edinburgh University, qualifying as a surgeon in 1833. He made a voyage in a professional capacity in one of the ships of the Hudson's Bay Company, and entering the service of the company was resident surgeon for ten years at their station at Moose Factory, at the head of James Bay. In 1846 he made a boat-voyage to Repulse Bay, and having wintered there, in the following spring surveyed 700 miles of new coast-line connecting the earlier surveys of Ross and Parry. An account of this expedition, *A Narrative of an Expedition to the Shores of the Arctic Sea in 1846 and 1847*, was published by him in 1850. During a visit to London in 1848 he joined the expedition which was then preparing to go out under Sir John Richardson in search of Franklin; and in 1851, at the request of the Government and with a very slender outfit, he travelled some 5300 miles, much of it on foot, and explored and mapped 700 miles of new coast on the south side of Wollaston and Victoria Lands. For this achievement he received the Founder's gold medal of the Royal Geographical Society. In 1853 he commanded another boat-expedition which was fitted out by the Hudson's Bay Company, which connected the surveys of Ross with that of Deane and Simpson, and proved King William's Land to be an island. It was on this journey that he obtained the first authentic news regarding the fate of Franklin, thereby winning the reward of £10,000 promised by the admiralty. He subsequently travelled across Iceland, and in Greenland and the northern parts of America, surveying routes for telegraph lines. Dr Rae attributed much to his success in Arctic travel to his adoption of the methods of the Eskimo, a people whom he had studied very closely. He was a keen sportsman, an accurate and scientific observer. He died at his house in London and was buried in the Orkney Islands.

RAE BARELI, a town and district of British India, in the Lucknow division of the United Provinces. The town is on the river Sai, 48 m. S.E. of Lucknow, on the Oudh & Rohilkhand railway. Pop. (1901) 15,880. It possesses many architectural features, chief of which is a strong and spacious fort erected in 1403, and constructed of bricks 2 ft. long by 1 ft. thick and 1½ wide. Among other ancient buildings are the magnificent palace and tomb of nawab Jahan Khan, governor in the time of Shah Jahan, and four fine mosques. The town is an important centre of trade, and muslins and cotton cloth are woven.

The District of Rae Bareli has an area of 1748 sq. m. The general aspect of the district is slightly undulating, and the country is beautifully wooded. The soil is remarkably fertile, and the cultivation of a high class. The principal rivers of the district are the Ganges and the Sai: the former skirts it for 54 miles and is everywhere navigable for boats of 40 tons; the latter traverses it from N.W. to S.E. In 1901 the population was 1,033,761, showing a slight decrease during the decade. The principal crops are rice, pulse, wheat, barley, millet and poppy. Rae Bareli town is connected with Lucknow by a branch of the Oudh & Rohilkhand railway, which in 1898 was extended to Benares.

See *Rae Bareli District Gazetteer*, Allahabad, 1905.

RAEBURN, SIR HENRY (1756–1823), Scottish portrait-painter, was born at Stockbridge, a suburb of Edinburgh, on the 4th of March 1756, the son of a manufacturer of the city. He was early left an orphan. Being placed in Heriot's Hospital, he received there the elements of a sound education, and at the age of fifteen was apprenticed to a goldsmith in Edinburgh. Here he had some little opportunity for the practice of the humbler kinds of art, and various pieces of jewelry, mourning rings, and the like, adorned with minute drawings on ivory by his hand, are still extant. Soon he took to the production of carefully finished miniatures; and, meeting with success and patronage, he extended his practice to oil-painting, being all the while quite self-taught. The worthy goldsmith his master watched the progress of his pupil with interest, gave him every encouragement, and introduced him to David Martin, who had been the favourite assistant of Allan Ramsay junior, and was now the leading portrait-painter in Edinburgh. Raeburn received considerable assistance from Martin, and was especially aided by the loan of portraits to copy. Soon the young painter had gained sufficient skill to render it advisable that he should devote himself exclusively to painting. When he was in his twenty-second year he was asked to paint the portrait of a young lady whom he had previously observed and admired when he was sketching from nature in the fields. She was the daughter of Peter Edgar of Bridgelands and widow of Count Leslie. The lady was speedily fascinated by the handsome and intellectual young artist, and in a month she became his wife, bringing him an ample fortune. This early insurance against the risks of his chosen profession, did not, however, diminish his anxiety to excel. The acquisition of wealth affected neither his enthusiasm nor his industry, but rather spurred him to greater efforts to acquire a thorough knowledge of his craft. After the approved fashion of artists of the time, it was resolved that Raeburn should visit Italy, and he accordingly started with his wife. In London he was kindly received by Sir Joshua Reynolds, who gave him excellent advice as to his study in Rome, especially recommending to his attention the works of Michelangelo. He also offered him more substantial pecuniary aid, which was declined as unneeded; but Raeburn carried with him to Italy many valuable introductions from the president of the Academy. In Rome he made the acquaintance of Gavin Hamilton, of Batoni, and of Byers. For the advice of the last-named he used to acknowledge himself greatly indebted, particularly for the recommendation that "he should never copy an object from memory, but, from the principal figure to the minutest accessory, have it placed before him." After two years of study in Italy he returned to Edinburgh in 1787, where he began a most successful career as a portrait-painter. In that year he executed an admirable seated portrait of the second Lord President Dundas.

Of his earlier portraiture we have interesting examples in the bust-likeness of Mrs Johnstone of Baldovie and in the three-quarter-length of Dr James Hutton, works which, if they are somewhat timid and tentative in handling and wanting in the trenchant brush-work and assured mastery of subsequent productions, are full of delicacy and character. The portraits of John Clerk, Lord Eldin, and of Principal Hill of St Andrews belong to a somewhat later period. Raeburn was fortunate in the time in which he practised portraiture. Sir Walter Scott, Blair, Mackenzie, Woodhouselee, Robertson, Home, Ferguson, and Dugald Stewart were resident in Edinburgh, and they all, along with a host of others less celebrated, honoured the painter's canvases. Of his fully matured manner we could have no finer examples than his own portrait and that of the Rev. Sir Henry Moncrieff Wellwood, the bust of Dr Wardrop of Torbane Hill, the two full-lengths of Adam Rolland of Gask, the remarkable paintings of Lord Newton and Dr Alexander Adam in the National Gallery of Scotland, and that of William Macdonald of St Martin's. It was commonly believed that Raeburn was less successful in his female than in his male portraits, but the exquisite full-length of his wife, the smaller likeness of Mrs R. Scott Moncrieff in the Scottish National Gallery, and that of Mrs Robert Bell, and others, are sufficient to prove that he could portray all the grace and beauty of the gentler sex.

Raeburn spent his life in Edinburgh, rarely visiting the metropolis, and then only for brief periods, thus preserving his own sturdy individuality, if he missed the opportunity of engrafting on it some of the fuller refinement and delicacy of the London portraitists. But though he, personally, may have lost some of the advantages which might presumably have resulted from closer association with the leaders of English art, and from contact with a wider public, Scottish art certainly gained much from his disinclination to leave his native land. He became the acknowledged chief of the school which was growing up in Scotland during the earlier years of the 19th century, and to his example and influence at a critical period is undoubtedly due much of the striking virility by which the work of his followers and immediate successors is distinguished. Evidences of this influence can be perceived even in the present day. His leisure was employed in athletic sports, in his garden, and in architectural and mechanical pursuits, and so varied were the interests that filled his life that his sitters used to say of him, "You would never take him for a painter till he seizes the brush and palette." Professional honours fell thick upon him. In 1812 he was elected president of the Society of Artists in Edinburgh, in 1814 associate, and in the following year full member of the Royal Academy. In 1822 he was knighted by George IV. and appointed His Majesty's limner for Scotland. He died at Edinburgh on the 8th of July 1823.

In his own day the portraits of Raeburn were excellently and voluminously engraved, especially by the last members of the great school of English mezzotint. In 1876 a collection of over 300 of his works was brought together in the Royal Scottish Academy galleries; in the following year a series of twelve of his finest portraits was included in the winter exhibition of the Royal Academy, London; and a volume of photographs from his paintings was edited by Dr John Brown.

Raeburn possessed all the necessary requirements of a popular and successful portrait-painter. He had the power of producing a telling and forcible likeness; his productions are distinguished by breadth of effect, by admirable force of handling, by execution of the swiftest and most resolute sort. Wilkie has recorded that, while travelling in Spain and studying the works of Velazquez, the brush-work of that master reminded him constantly of the "square touch" of Raeburn. But the portraits of Velazquez are unsurpassable examples of tone as well as of handling, and it is in the former quality that Raeburn is often wanting, possibly because his inclinations led him to study effects of diffused light in preference to those which were strong in contrasts of light and shade. The colour of his portraits is sometimes crude and out of relation, inclining to the use of positive and definite local pigments, and too little perceptive of the changeful subtleties and modifications of atmospheric effect. His draperies frequently consist of little more than two colours—the local hue of the fabric and the black which, more or less graduated, expresses its shadows and modelling. In his flesh, too, he wants—in all but his very best productions—the delicate refinements of colouring which distinguish the works of the great English portrait-painters. His faces, with all their excellent truth of form and splendid vigour of handling, are often hard and bricky in hue. Yet, after all allowances have been made for what deficiencies there may be in his work, his right to a place among the greater British masters cannot be contested. The masculine power, the vitality and the strength of characterization which are so apparent in his paintings entitle him to the serious attention of all lovers of fine achievement; and there is much to be learned from study of his methods. His sincerity and freedom from artificial graces of style can be specially recognized, and his frank directness is always attractive.

See *Life of Sir Henry Raeburn, R.A.*, by his great-grandson William Raeburn Andrew, M.A. Oxon. (2nd ed., 1894), which contains some of the latest information, together with a complete catalogue of the exhibition of 1876. There may also be consulted *Works of Sir Henry Raeburn, R.A.*, with tributes by Dr John Brown and others, published by Andrew Elliot, Edinburgh; *Tribute to the Memory of Raeburn* by Dr Andrew Duncan, the *Catalogues* of the loan exhibitions in Edinburgh of 1884 and 1901; and the Essay by W. E. Henley—*Sir Henry Raeburn* by William Ernest Henley (1890) with a finely produced series of plates, printed by T. & A. Constable for the now defunct Royal Association for Promotion of the Fine Arts in Scotland. But the leading work on the subject, and the most splendidly illustrated, is *Sir Henry Raeburn* by Sir Walter Armstrong, with an introduction by R. A. M. Stevenson and a biographical and descriptive catalogue by J. L. Caw (1901).

RÆDWALD (d. *c.* 620), king of the East Angles, was the son of King Tytili. He became a Christian during a stay in Kent, but on his return to East Anglia he sanctioned the worship both of the Christian and the heathen religions. Very little is known about his reign, which probably began soon after 600. For a time he recognized the overlordship of Æthelberht, king of Kent, but he seems to have shaken off the Kentish yoke. He gained some superiority over the land south of the Humber with the exception of Kent and is counted among the Bretwaldas. Rædwald protected the fugitive Edwin, afterwards king of Northumbria, and in his interests he fought a sanguinary battle with the reigning Northumbrian king, Æthelfrith, near Retford in Nottinghamshire, where Æthelfrith was defeated and killed in April 617. He was followed as king of the East Angles by his son Eorpwald.

See Bede, *Historiae ecclesiasticae*, edited by C. Plummer (Oxford, 1896); and J. R. Green, *The Making of England* (1897–1899).

RAETIA (so always in inscriptions; in classical MSS. usually RHAETIA), in ancient geography, a province of the Roman Empire, bounded on the W. by the country of the Helvetii, on the E. by Noricum, on the N. by Vindelicia and on the S. by Cisalpine Gaul. It thus comprised the districts occupied in modern times by the Grisons, the greater part of Tirol, and part of Lombardy. The land was very mountainous, and the inhabitants, when not engaged in predatory expeditions, chiefly supported themselves by cattle-breeding and cutting timber, little attention being paid to agriculture. Some of the valleys, however, were rich and fertile, and produced corn and wine, the latter considered equal to any in Italy. Augustus preferred Raetian wine to any other. Considerable trade was also carried on in pitch, honey, wax and cheese. Little is known of the origin or history of the Raetians, who are described as one of the most powerful and warlike of the Alpine tribes. It is distinctly stated by Livy (v. 33) that they were of Etruscan origin (a view favoured by Niebuhr and Mommsen). A tradition reported by Justin (xx. 5) and Pliny (*Nat. Hist.* iii. 24, 133) affirmed that they were a portion of that people who had settled in the plains of the Po and were driven into the mountains by the invading Gauls, when they assumed the name of Raetians from their leader Raetus; a more probable derivation, however, is from Celtic *rait*, "mountain land." Even if their Etruscan origin be accepted, at the time when the land became known to the Romans, Celtic tribes were already in possession of it and had amalgamated so completely with the original inhabitants that, generally speaking, the Raetians of later times may be regarded as a Celtic people, although non-Celtic tribes (Lepontii, Euganei) were settled among them. The Raetians are first mentioned (but only incidentally) by Polybius (xxxiv. 10, 18), and little is heard of them till after the end of the Republic. There is little doubt, however, that they retained their independence until their subjugation in 15 B.C. by Tiberius and Drusus (cf. Horace, *Odes*, iv. 4 and 14). At first Raetia formed a distinct province, but towards the end of the 1st century A.D. Vindelicia was added to it; hence Tacitus (*Germania*, 41) could speak of Augusta Vindelicorum (Augsburg) as "a colony of the province of Raetia." The whole province (including Vindelicia) was at first under a military prefect, then under a procurator; it had no standing army quartered in it, but relied on its own native troops and militia for protection. In the reign of Marcus Aurelius it was governed by the commander of the *Legio iii. Italica.* Under Diocletian it formed part of the diocese of the *vicarius Italiae*, and was subdivided into Raetia *prima* and *secunda* (each under a *praeses*), the former corresponding to the old Raetia, the latter to Vindelicia. The boundary between them is not clearly defined, but may be stated generally as a line drawn eastwards from the lacus Brigantinus (Lake of Constance) to the river Oenus (Inn). During the last years of the Western Empire, the land was in a desolate condition, but its occupation by the Ostrogoths in the time of Theodoric, who placed it under a *dux*, to some extent revived its prosperity. The chief towns of Raetia (excluding Vindelicia) were Tridentum (Trent) and Curia (Coire or Chur). It was traversed by two great lines of Roman roads—one leading from Verona and Tridentum across the Brenner (in which the name of the Brenni has survived) to Oenipons (Innsbruck) and thence to Augusta Vindelicorum; the other from Brigantium (Bregenz) on Lake Constance, by Coire and Chiavenna to Como and Milan.

See P. C. Planta, *Das alte Rätien* (Berlin, 1872); T. Mommsen in *Corpus Inscriptionum Latinarum*, iii. p. 706; J. Marquardt, *Römische Staatsverwaltung*, i. (2nd ed., 1881) p. 288; L. Steub, *Über die Urbewohner Rätiens und ihren Zusammenhang mit den Etruskern* (Munich, 1843); J. Jung, *Römer und Romanen in den Donauländern* (Innsbruck, 1877); Smith's *Dict. of Greek and Roman Geography* (1873); T. Mommsen, *The Roman Provinces* (Eng. trans., 1886), i. pp. 16, 161, 196; Mary B. Peaks, *The General Civil and Military Administration of Noricum and Raetia* (Chicago, 1907).

RAFF, JOSEPH JOACHIM (1822–1882), German composer and orchestral conductor, was born near Zürich, Switzerland, on the 27th of May 1822, and educated chiefly at Schwyz. Here, under the care of the Jesuit fathers, he soon became an excellent classical and mathematical scholar, but received scarcely any instruction in his favourite art of music, in which, nevertheless, he made extraordinary progress through sheer force of natural genius, developed by persevering study which no external obstacles could induce him to discontinue. So successful were his unaided efforts that, when in 1843 he sent some MSS. to Mendelssohn, that warm encourager of youthful talent felt justified in at once recommending him to Breitkopf & Härtel, the Leipzig publishers, who brought out a large selection of his early works. Soon after this he became acquainted with Liszt, who gave him much generous encouragement. He first became personally acquainted with Mendelssohn at Cologne in 1846, and gave up all his other engagements for the purpose of following him to Leipzig, but his intention was frustrated by the great composer's death in 1847. After this disappointment he remained for some time at Cologne, where his attention was alternately devoted to composition and to the preparation of critiques for the periodical *Cäcilia.* Thus far he was a self-taught artist; but he felt the need of systematic instruction so deeply that, retiring for a time from public life, he entered at Stuttgart upon a long course of severe and uninterrupted study, and with so much success that in 1850 he appeared before the world in the character of an accomplished and highly cultivated musician. Raff now settled for a time in Weimar in order to be near Liszt. Hans von Bülow had already brought him into notice by playing his *Concertstück* for pianoforte and orchestra in public, and the favour with which this fine work was everywhere received encouraged him to attempt a greater one. During his stay in Stuttgart he had begun the composition of an opera entitled *König Alfred*, and had good hope of securing its performance at Dresden; but the political troubles with which Germany was then overwhelmed rendered its production in the Saxon capital impossible. At Weimar he was more fortunate. In due time *König Alfred* was produced there under Liszt's able direction at the court theatre with complete success; and later, in 1870, he wrote his second opera, *Dame Kobold*, for performance at the same theatre. A third opera, *Samson*, remained unstaged.

Raff lived at Weimar until 1856, when he obtained a large *clientèle* at Wiesbaden as a teacher of the pianoforte. In 1859 he married Doris Genast, an actress of high repute, and thenceforward devoted himself with renewed energy to the work of composition, displaying an inexhaustible fertility of invention tempered by great technical skill. He resided chiefly at Wiesbaden till 1877, when he was appointed director of the Hoch-Conservatorium at Frankfort, an office which he retained until his death on the 25th of June 1882.

More than 200 of Raff's compositions have been published, including ten symphonies—undoubtedly his finest works—quartets, concertos, sonatas, songs, and examples of nearly every known variety of style; yet he never repeats himself. Notwithstanding his strong love for the romantic school, he is never guilty of extravagance, and, if in his minor works he is sometimes a little commonplace, he never descends to vulgarity. His symphonies *Lenore* and *Im Walde* are wonderful examples of musical painting.

RAFFAELLINO DEL GARBO (1466, or perhaps 1476–1524), Florentine painter. His real name was Raffaello Capponi; Del Garbo was a nickname, bestowed upon him seemingly from the graceful nicety (*garbo*) of his earlier works. He has also been called Raffaello de Florentia, and Raffaello de Carolis. He was a pupil of Filippino Lippi, with whom he remained till 1490, if not later. He showed great facility in design, and excited hopes which the completed body of his works fell short of. He married and had a large family; embarrassments and a haphazard manner of work ensued; and finally he lapsed into a very dejected and penurious condition. Three of his best tempera pictures are in the Berlin Gallery; one of the Madonna standing with her Infant between two musician-angels, is particularly attractive. We may also name the oil-painting of the "Resurrection" done for the church of Monte Oliveto, Florence, now in the academy of the same city, ordinarily reputed to be Raffaellino's masterpiece; the ceiling of the Caraffa Chapel in the church of the Minerva, Rome; and a "Coronation of the Virgin" in the Louvre, which is a production of much merit, though with somewhat over-studied grace. Angelo Allori was his pupil.

RAFFET, DENIS AUGUSTE MARIE (1804–1860), French illustrator and lithographer, was born in Paris in 1804. At an early age he was apprenticed to a wood turner, but took up the study of art at evening classes. He became acquainted with Cabanel, who made him apply his skill to the decoration of china, and with Rudor, from whom he received instruction in lithography, in the practice of which he was to rise to fame. He then entered the École des Beaux-Arts, but returned definitely to lithography in 1830, when he produced on stone his famous designs of "Lutzen," "Waterloo," "Le bal," "La revue" and "Les adieux de la garnison," by which his reputation became immediately established. Raffet's chief works were his lithographs of the Napoleonic campaigns, from Egypt to Waterloo, vigorous designs that are inspired by ardent patriotic enthusiasm. As an illustrator his activity was prodigious, the list of works illustrated by his crayon amounting to about forty-five, among which are Béranger's poems, the *History of the Revolution* by Thiers, the *History of Napoleon* by de Norvins, the great *Walter Scott* by Defauconpret, the French Plutarch and Frédéric Bérat's *Songs*. He went to Rome in 1849, was present at the siege of Rome, which he made the subject of some lithographs, and followed the Italian campaign of 1859, of which he left a record in his *Episodes de la campagne d'Italie de 1859*. His portraits in pencil and water-colour are full of character. He died at Genoa in 1860. In 1893 a monument by Frémiet was unveiled in the Jardin de l'Infante at the Louvre, Paris.

See *Raffet*, by F. Lhomme (Paris, 1892).

RAFFLE, a special kind of lottery, in which a particular article is put up as the prize, the winner being drawn for by lot out of the number of those who have paid a fixed sum for admission to the drawing; the total amount realized by the sale of the tickets is supposed to approximate to the value of the object raffled for. The word appears in English as early as Chaucer (*The Parson's Tale*) where it is used in its original sense of a game of dice, the winner being that one who threw three dice all alike, or, next, the highest pair. The Fr. *rafle*, Med. Lat. *raffla*, was also used in the sense of a "sweeping-off" of the stakes in a game; it has been connected with Ger. *raffen*, to carry off.

RAFFLES, SIR THOMAS STAMFORD (1781–1826), English administrator, founder of Singapore, was born on the 5th of July 1781, on board a merchantman commanded by his father, Benjamin Raffles, when off Port Morant, Jamaica. He received his early education at a school at Hammersmith, but when only fourteen he obtained temporary work in the secretary's office of the East India Company. In 1800 he was appointed junior clerk on the establishment. In 1805 the East India Company decided to make Penang a regular presidency, and sent out a governor with a large staff, including Stamford Raffles, who was appointed assistant-secretary. On the eve of his departure he married Mrs Fancourt (Olivia Mariamne Devenish), widow of a surgeon on the Madras Establishment; she proved herself a helpful wife and counsellor to her husband in his rapid rise to fortune during the following nine years, dying prematurely in Java in November 1814. On his way out to Penang, Raffles began the study of the Malay language, and had mastered its grammar before his arrival. He continued his studies, finding a congenial fellow-worker and kindred spirit in John Leyden, who was invalided to Penang. In August 1806 Raffles was appointed acting secretary during the illness of that official, and in 1807 he received the full appointment. In the meantime he had acted as Malay interpreter, which entailed heavy and unappreciated work in addition to his regular duties. In 1808 his health gave way, and he was ordered for a change to Malacca. This proved a turning-point in his career. The East India Company had decided to abandon Malacca, and orders had been issued to dismantle it. Raffles perfected his study of Malay during his stay at this place, and learning from the Malays, with whom he mixed freely, that the abandonment of so important a position would be a grave fault, he drew up a report explaining the great importance of Malacca, and urging in the strongest manner its retention. This report was sent by the Penang authorities not only to London, but to the governor-general, the earl of Minto. The latter was so impressed by the report that he at once gave orders for suspending the evacuation of Malacca, and in 1809 the company decided to reverse its own decision. When the whole question was calmly considered in the light of subsequent events, many years later, the verdict was that Raffles had "prevented the alienation of Malacca from the British Crown." A direct correspondence with Lord Minto was established by the mediation of Leyden, who wrote to Raffles that the governor-general would be gratified in receiving communications direct from him. In June 1810 Raffles, of his own accord, proceeded to Calcutta, where Lord Minto gave him the kindest reception. Raffles remained four months in Calcutta, and gained the complete confidence of the governor-general. He brought Lord Minto round to his opinion that the conquest of the island of Java, then in the hands of the French, was an imperative necessity. To prepare the way for the expedition, Raffles was sent to Malacca as "agent to the Governor-General with the Malay States." He did his work well and thoroughly—even to the extent of discovering that the short and direct route to Batavia by the Caramata passage would be safe for the fleet. In August 1811 the expedition, accompanied by Lord Minto, and with Sir Samuel Auchmuty in command of the troops (11,000 in number, half English and half Indian), occupied Batavia without fighting. On the 25th of the same month a battle was fought at Cornelis, a few miles south of Batavia, and resulted in a complete English victory. On the 18th of September the French commander, General Janssens, formally capitulated at Samarang, and the conquest of the island was completed. Lord Minto's first act was to appoint Raffles lieutenant-governor of Java. From September 1811 until his departure for England in March 1816, Raffles ruled this large island with conspicuous success and the most gratifying results. To give only one fact in support of this statement, he increased the revenue eightfold at the same time that he abolished transit dues, reduced port dues to one-third and removed the fetters imposed on trade and intercourse with the Javanese by Dutch officialdom. In his own words, his administration aimed at being "not only without fear, but without reproach." He had a still greater ambition, which was, in his own words, "to make Java the centre of an Eastern insular Empire," and to establish the closest relations of friendship and alliance with the Japanese, whom he described as "a highly polished people, considerably advanced in science, highly inquisitive and full of penetration." It is interesting to note that when another great Englishman, Rajah Brooke, began his career in Sarawak in 1838, he announced: "I go to carry Sir Stamford Raffles's views in Java over the whole Archipelago."

The policy of Raffles was based on the assumption that Java would be retained, but for reasons of European policy it was decided that it must be restored to Holland. After his return to England in 1816 he endeavoured to obtain a reconsideration of the question, but the decision taken was embodied in a treaty and beyond all possibility of modification. During his stay in England Raffles was knighted by the prince regent, published his *History of Java* (1817) and discussed with Sir Joseph Banks a project for the foundation in London of a zoological museum and garden on the model of the Jardin des Plantes at Paris. He also married his second wife, Sophia, daughter of T. W. Hull of Co. Down; he had many children by both marriages, but the only one to live beyond childhood was a daughter, who died fifteen years after her father's death, and before she was twenty. He left, therefore, no direct descendants.

In November 1817 Sir Stamford quitted England on his return to the East, where the lieutenant-governorship of Fort Marlborough (Sumatra) had been kept in reserve for him. His administration of Sumatra, which lasted from March 1818 till December 1823, was characterized by the same breadth of view, consistency of purpose and energy in action that had made his government of Java remarkable. He had not, however, done with the Dutch, who, on their recovery of Java, endeavoured to establish a complete control over the Eastern archipelago, and to oust British trade. This design Sir Stamford set himself to baffle, and although he was more frequently censured than praised by his superiors for his efforts, he had already met with no inconsiderable success in minor matters when, by a stroke of genius and unrivalled statecraft, he stopped for all time the Dutch project of a *mare clausum* by the acquisition and founding of Singapore on the 29th of January 1819.

In 1824 Sir Stamford returned to England, but unfortunately the differences between him and the East India Company had resulted in an accumulation of disputes which placed a severe strain on his enfeebled constitution. The memorials and statements that he had to compile for his own vindication would fill a large volume, but at last the court passed (12th of April 1826) a formal decision in his favour. It did not omit, however, to censure him for "his precipitate and unauthorized emancipation of the Company's slaves," or after his death to make his widow pay £10,000 for various items, which included the expense of his mission to found Singapore! Harassed as he was by these personal affairs, he still found time to carry out his original scheme with regard to a zoological society in London. He took the largest part in the creation of the existing society, and his fine Sumatra collection formed its endowment. He was unanimously elected its president at the first meeting, and by a remarkable unanimity of opinion on the part of those who helped in the work, he has been recognized as "the Founder of the Zoological Society." He was contemplating entering parliamentary life when his sudden death on his birthday, 1826, ended his brilliant career at the early age of forty-five. Sir Frederick Weld, lieutenant-governor at Singapore, when unveiling the statue of his predecessor at that place in 1887, crystallized the thoughts of his countrymen and anticipated the verdict of history in a single sentence: "In Raffles, England had one of her greatest sons."

See Lady Raffles, *Memoir of Sir Thomas Stamford Raffles* (1830); D. C. Boulger, *Life of Sir Stamford Raffles* (1897); Hugh Egerton, *Sir Stamford Raffles* (1899); J. Buckley, *Records of Singapore* (1903). (D. C. B.)

RAFN, KARL CHRISTIAN (1795–1864), Danish archaeologist, was born in Brahesborg, Fünen, on the 16th of January 1795, and died at Copenhagen on the 20th of October 1864. He is chiefly known in connexion with the controversy as to the question of the discovery of America by the Norsemen, his views being contained in his chief work, *Antiquitates Americanae* (Copenhagen, 1837). See Leif Ericsson.

RAFTER, a beam in a sloping roof to which is attached the framework for the slating, tiling or other external covering (see Roofs). The O.Eng. *raefter* is cognate with Icel. *raftr*, Dan. and Swed. *rafte* or *raft*, a beam, which, in the special sense of a floating collection of timbers, gives the English "raft." The ultimate base of these words is the root *raf-*, to cover, seen in Gr. ὄροφος, roof.

RAGATZ, a famous watering-place in the Swiss canton of St Gall, situated on the left bank of the Rhine, and by rail 13½ m. N. of Coire or 61½ m. S.E. of Zürich. It stands at a height of 1696 ft., at the entrance to the magnificent gorge of the Tamina, about 3 m. up which by carriage road are the extraordinarily placed Baths of Pfäfers (2247 ft.). Since 1840 the hot mineral waters of Pfäfers are conducted in pipes to Ragatz, which is in a more pleasant position. Consequently Ragatz has much increased in importance since that date. In 1900 its native population was 1866, mainly German-speaking, while there were 1472 Romanists to 392 Protestants. The annual number of visitors is reckoned at 30,000. In the churchyard is the grave of the philosopher Schelling (d. here in 1854). About 2 m. by road above Ragatz are the 17th-century buildings (now the cantonal lunatic asylum) of the great Benedictine abbey of Pfäfers (720–1838), to which all this region belonged till 1798; while midway between them and Ragatz are the ruins of the 14th-century castle of Wartenstein, now accessible from Ragatz by means of a funicular railway. (W. A. B. C.)

RAGLAN, FITZROY JAMES HENRY SOMERSET, 1st Baron (1788–1855), British field marshal, was the eighth and youngest son of Henry, 5th duke of Beaufort, by Elizabeth, daughter of Admiral the Hon. Edward Boscawen, and was born on the 30th of September 1788. His elder brother, General Lord (Robert) Edward (Henry) Somerset (1776–1842), distinguished himself as the leader of the Household Cavalry brigade at Waterloo. Lord Fitzroy Somerset was educated at Westminster school, and entered the army in 1804. In 1807 he was attached to the Hon. Sir Arthur Paget's embassy to Turkey, and the same year he was selected to serve on the staff of Sir Arthur Wellesley in the expedition to Copenhagen. In the following year he accompanied the same general in a like capacity to Portugal, and during the whole of the Peninsular War was at his right hand, first as aide-de-camp and then as military secretary. He was wounded at Busaco, became brevet-major after Fuentes de Oñoro, accompanied the stormers of the 52nd light infantry as a volunteer at Ciudad Rodrigo and specially distinguished himself at the storming of Badajoz, being the first to mount the breach, and afterwards showing great resolution and promptitude in securing one of the gates before the French could organize a fresh defence. During the short period of the Bourbon rule in 1814 and 1815 he was secretary to the English embassy at Paris. On the renewal of the war he again became aide-de-camp and military secretary to the duke of Wellington. About this time he married Emily Harriet, daughter of the 3rd earl of Mornington, and Wellington's niece. At Waterloo he was wounded in the right arm and had to undergo amputation, but he quickly learned to write with his left hand, and on the conclusion of the war resumed his duties as secretary to the embassy at Paris. From 1818 to 1820, and again in 1826–29, he sat in the House of Commons as member for Truro. In 1819 he was appointed secretary to the duke of Wellington as master-general of the ordnance, and from 1827 till the death of the duke in 1852 was military secretary to him as commander-in-chief. He was then appointed master-general of the ordnance, and was created Baron Raglan. In 1854 he was promoted general and appointed to the command of the English troops sent to the Crimea (see Crimean War) in co-operation with a strong French army under Marshal St Arnaud and afterwards, up to May 1855, under Marshal Canrobert. Here the advantage of his training under the duke of Wellington was seen in the soundness of his generalship, and his diplomatic experience stood him in good stead in dealing with the generals and admirals, British, French and Turkish, who were associated with him. But the trying winter campaign in the Crimea also brought into prominence defects perhaps traceable to his long connexion with the formalities and uniform regulations of military offices in peace time. For the hardships and sufferings of the English soldiers in the terrible Crimean winter before Sevastopol, owing to failure in the commissariat, both as regards food and clothing, Lord Raglan and his staff were at the time severely censured by the press and the government; but, while Lord Raglan was possibly to blame in representing matters in a too sanguine light, it afterwards appeared that the chief neglect rested with the home authorities. But this hopefulness was a shining military quality in the midst of the despondency that settled upon the allied generals after their first failures, and at Balaklava and Inkermann he displayed the promptness and resolution of his youth. He was made a field marshal after Inkermann. During the trying winter of 1854–55, the suffering he was compelled to witness, the censures, in great part unjust, which he had to endure and all the manifold anxieties of the siege seriously undermined his health, and although he found a friend and ardent supporter in his new French colleague, General Pélissier (*q.v.*), disappointment at the failure of the assault of the 18th of June 1855 finally broke his spirit, and very shortly afterwards, on the 28th of June 1855, he died of dysentery. His body was brought home and interred at Badminton.

His elder son having been killed at the battle of Ferozeshah (1845), the title descended to his younger son Richard Henry Fitzroy Somerset, 2nd Baron Raglan (1817–1884); and subsequently to the latter's son, George Fitzroy Henry Somerset, 3rd baron (b. 1857), under-secretary for war 1900–2, lieutenant-governor of the Isle of Man (1902) and a prominent militia officer.

RAGMAN ROLLS, the name given to the collection of instruments by which the nobility and gentry of Scotland were compelled to subscribe allegiance to Edward I. of England between the conference of Norham in May 1291 and the final award in favour of Baliol in November 1292, and again in 1296. Of the former of these records two copies were preserved in the chapter-house at Westminster (now in the Record Office, London), and it has been printed by Rymer (*Foedera*, ii. 542). Another copy, preserved originally in the Tower of London, is now also in the Record Office. The latter record, containing the various acts of homage and fealty extorted by Edward from Baliol and others in the course of his progress through Scotland in the summer of 1296 and in August at the parliament of Berwick, was published by Prynne from the copy in the Tower and now in the Record Office. Both records were printed by the Bannatyne Club in 1834. The derivation of the word "ragman" has never been satisfactorily explained, but various guesses as to its meaning and a list of examples of its use for legal instruments both in England and Scotland will be found in the preface to the Bannatyne Club's volume, and in Jamieson's *Scottish Dictionary*, *s.v.* "Ragman." The name "ragman roll" survives in the colloquial "rigmarole," a rambling, incoherent statement.

The name of "Ragman" has been sometimes confined to the record of 1296, of which an account is given in *Calendar of Documents relating to Scotland preserved in the Public Record Office, London* (1884), vol. ii., Introd., p. xxiv; and as to the seals see p. lii and appendix.

RAG-STONE (probably equivalent to "ragged" stone), a name given by some architectural writers to work done with stones which are quarried in thin pieces, such as the Horsham sandstone, Yorkshire stone, the slate stones, &c.; but this is more properly flag or slab work. By rag-stone, near London, is meant an excellent material from the neighbourhood of Maidstone. It is a very hard limestone of bluish-grey colour, and peculiarly suited for medieval work. It is often laid as uncoursed work, or random work (see Random), sometimes as random coursed work and sometimes as regular ashlar. The first method, however, is the more picturesque. (See Masonry.)

RAGUSA (Serbo-Croatian *Dubrovnik*), an episcopal city, and the centre of an administrative district in Dalmatia, Austria. Pop. (1900) of town and commune, 13,174, including a garrison of 1122. Its situation and its undisturbed atmosphere of antiquity combine to make Ragusa by far the most picturesque city on the Dalmatian coast. It occupies a ridge or promontory, which juts out into the Adriatic Sea, under the bare limestone mass of Monte Sergio. Its seaward fortifications rise directly from the water's edge, one fort, on the north mole, standing boldly on a tall rock almost isolated by a little inlet of the Adriatic. On the landward side a massive round tower dominates the city from a still higher eminence. Beyond the walls and the deep moat, especially on the northward side towards the port of Gravosa, are many pleasant villas, surrounded by gardens in which the aloe, palm and cypress are conspicuous among a number of flowering trees and shrubs. The island of Lacroma lies less than half a mile to the south. Between the seaward ridge and the mountain, the Stradone, or main street, runs along a narrow valley which, until the 13th century, was a marshy channel, dividing the Latin island of Ragusa from the Slavonic settlement of Dubrovnik, on the lower slopes of Monte Sergio. Parallel to the Stradone, on the north, is the Prijeki, a long, very narrow street, flanked by tall houses with overhanging balconies, and greatly resembling a Venetian alley. Despite the havoc wrought by earthquake in 1667, the whole city is rich in antiquarian interest. It possesses one church, of the Byzantine period, which is mentioned in 13th-century documents as even then of great age. Two stately convents of the 14th century stand at the ends of the city; for the Franciscans were set to guard the western gate, or Porta Pile, against the hostile Slavs, while the Dominicans kept the eastern gate, or Porta Ploce. The Franciscan cloister is a fine specimen of late Romanesque; that of the Dominicans is hardly inferior, though of later date. The Dominican church is approached by a sloping flagged lane, having on one side a beautifully ornamented balustrade of the 18th century. Another 14th-century building is the Sponza, or custom-house, from which the state derived its principal revenue. A fountain and a curious clock-tower in the Piazza, which terminates the Stradone towards the east, were erected by Onofrio, the architect and engineer whose aqueduct, built about 1440, supplied Ragusa with water from the neighbouring hills. The Rector's Palace, another noteworthy example of late Romanesque, combined with Venetian Gothic, is one of the masterpieces of Dalmatian architecture. It has a fine façade of six arches, and the capitals of the supporting pillars are very curiously carved. Especially interesting is the figure of Aesculapius, whose traditional birthplace was *Epidaurum* or *Epidaurus*, the parent city of Ragusa. The cathedral dates from the 18th century; and to the same period belongs another church, rebuilt after a fire, but originally erected as a votive offering after the pestilence of 1348, and dedicated to San Biagio (St Blaize), the patron of Ragusa, whose name and effigy continually appear on coins and buildings. Among many fine pieces of jewellers' work preserved in the ecclesiastical treasuries may be mentioned the silver statuette of San Biagio, and the reliquary which contains his skull—a 17th-century casket in filigree and enamels with Byzantine medallions of the 11th or 12th century.

The harbour of Ragusa, once one of the chief ports of southern Europe, is too small for modern needs; but Gravosa (*Gruž*), a village at the mouth of the river Ombla, on the north, is a steamship station and communicates by rail with Herzegovina and the Bocche di Cattaro. Ragusa has thus some transit trade with the interior. Its industries include the manufacture of liqueurs, oil, silk and leather; but Malmsey, its famous wine, could no longer be produced after the vine-disease of 1852.

History.—The name *Ragusa* is of uncertain origin. Constantine Porphyrogenitus, in the 10th century, connects its early form, *Lausa*, with λαῦ, a "precipice." Jireček dissents from this view, and from the common opinion that *Dubrovnik* is derived from the Slavonic *dubrava*, "woody." The city first became prominent during the 7th century. In 639 and 656 the flourishing Latin communities of Salona and Epidaurum were destroyed by the Avars, and the island rock of Ragusa was colonized by the survivors. Tradition identifies Epidaurum, whence the majority came, with the neighbouring village of Ragusavecchia; but some historians, including Gelcich, place it on the shores of the Bocche di Cattaro. Both sites show signs of Roman occupation. A colony of Slavs soon joined the Latin settlers at Ragusa, and thus, from an early date, the city formed a link between two great civilizations (see VLACHS). In the 9th century it is said to have repulsed the Saracens; in the 10th it defended itself against the Narentine pirates, and Simeon, tsar of the Bulgarians. Some writers consider that it submitted to Venice in 998, with the rest of Dalmatia; but this is generally denied by the native historians. During the 11th century an enforced alliance with the Normans drew the republic into war with Venice and Byzantium; and in the 12th century it was attacked by the Bosnians and Serbs. From 1205 to 1358 it acknowledged Venetian suzerainty; its chief magistrate was the Venetian count; and its archbishops, who wielded much political influence, were often Venetian nominees. The constitution took shape during this period, and the first statute-book was published in 1272. Only patricians could hold office in the senate, grand council and lesser council, three bodies which shared the work of government with the count, or, after 1358, the rector. The ancient popular assembly was almost obsolete before the 14th century. Ragusan policy was usually peaceful, and disputes with other nations were frequently arranged by a system of arbitration called *stanicum*. To refugees of all nations, even to those who had been its own bitter foes, the city afforded asylum; and by means of treaty and tribute it worked its way to a position of mercantile power which Europe could hardly parallel. It was conveniently situated at the seaward end of a great trade route, which bifurcated at Plevlje to Byzantium and the Danube. A compact with the Turks, made in 1370 and renewed in the next century, saved Ragusa from the fate of its more powerful neighbours, Servia and Byzantium, besides enabling the Ragusan caravans to penetrate into Hungary, Croatia, Bosnia, Servia, Bulgaria and Rumania. From 1358 to 1526 the republic was a vassal state of Hungary, and no longer controlled by its greatest commercial rival. It acquired, among other territories, the important ship-building and salt-producing centre Stagno Grande (*Ston Veliki*), on the promontory of Sabbioncello; and from 1413 to 1416 it held the islands of Curzola, Brazza and Lesina by lease from Hungary. Meanwhile, Ragusan vessels were known not only in Italy, Sicily, Spain, Greece, the Levant and Egypt, but in the more northern parts of Europe. The English language retains in the word "argosy" a reminiscence of the carracks of Ragusa, long known to Englishmen as *Argouse*, *Argusa* or *Aragosa*. In the 16th century the Ragusan merchants went even to India and America, but they were unable to compete with their rivals from western Europe. Many of their seamen took service with Spain; and twelve of their finest ships were lost with the Invincible Armada in 1588. After 1526 the downfall of Hungary left Ragusa free; and about this time a great development of art and literature, begun in the 15th century and continued into the 17th, earned for the city its title of the "South Slavonic Athens." (See SERVIA, *Literature*.) The earthquake of 1667, which had been preceded by lesser shocks in 1520, 1521, 1536 and 1639, destroyed a considerable portion of the city, and killed about one-fifth of the inhabitants. Only during the Napoleonic wars did the republic regain its prosperity. From 1800 to 1805 it was the sole Mediterranean state remaining neutral, and thus it secured a very large share of the carrying trade. In 1805, however, it was seized by the French; Napoleon deprived it of independence; and in 1814 it was annexed to Austria.

See L. Villari, *The Republic of Ragusa* (London, 1904), for a thorough description and history, with a full bibliography. T. G.

Jackson, *Dalmatia, the Quarnero and Istria* (Oxford, 1887), gives the best account of Ragusan architecture and antiquities. The most accurate native history is G. Gelcich (Gelčić), *Dello Sviluppo civile di Ragusa* (Ragusa, 1884). The course of Ragusan trade may be studied in C J. Jireček, *Die Handelsstrassen und Bergwerke von Serbien, &c.* (Prague, 1879); and Heyd, *Histoire du commerce du Lévant au moyen âge* (Leipzig, 1885).

RAGUSA, a town of Sicily in the province of Syracuse, 70 m. S.W. of Syracuse by rail and 32 m. direct. It consists of an upper (Ragusa Superiore) and a lower town (Ragusa Inferiore), each of which forms a separate commune. Pop. (1906) of the former, 35,529; of the latter, 866. It has some churches with fine Gothic architecture, and is commercially of some importance, a stone impregnated with bitumen being quarried and prepared for use for paving slabs by being exposed to the action of fire. On the hill occupied by the castle of Ragusa Inferiore stood the ancient Hybla Heraea, a Sicel town, under the walls of which Hippocrates of Gela fell in 491 B.C. A Greek settlement seems to have arisen in the neighbourhood close to the present railway station, about the middle of the 6th century B.C., and to have disappeared at the end of the 5th. Orsi points out that the remains (cuttings in the rock and a part of the castle wall), attributed by Freeman (*History of Sicily*, i. 163) to Sicel times, are in reality post-Roman.

See Orsi in *Notizie degli scavi* (1899), 402–418.

RAHWAY, a city of Union county, New Jersey, U.S.A., in the north-eastern part of the state, on the Rahway river and about 20 m. S.W. of New York City. Pop. (1890) 7105; (1900) 7935, of whom 1345 were foreign-born; (1910 U.S. census) 9337. Rahway is served by the main line of the Pennsylvania railroad, and is connected with neighbouring cities by electric lines. It has wide streets and attractive parks, and is, to some extent, a residential suburb of New York and other neighbouring cities. It has a public library (1864), with upwards of 17,000 volumes, and about 1½ m. distant is the New Jersey Reformatory (1903), to which prisoners between the ages of sixteen and thirty may be sentenced instead of to the State Prison. There are various manufactures. Rahway was first settled in 1720, and was named in honour of the Indian chief Rahwack, whose tribe owned the site and the surrounding territory; it was chartered as a city in 1858. For many years Rahway was popularly known as Spanktown, and in January 1777, during the War of Independence, a skirmish, known as the battle of Spanktown, was fought here.

RAICHUR, a town of India, in the state of Hyderabad, at the junction of the Madras and Great Indian Peninsula railways, 351 m. N.E. from Madras. Pop. (1901) 22,165. It gives its name to the *doab*, or tract between the rivers Kistna and Tungabhadra, which was the scene of much fighting between Mahommedans and Hindus as debatable land during the 16th century. It contains a well-preserved fort and two old mosques. It is a thriving centre of trade, with several cotton-presses.

RAID, in the language of international law, an invasion by armed forces, unauthorized and unrecognized by any state, of the territory of a state which is at peace. Piracy is the attack on the high sea of any vessel by an armed vessel, not authorized or recognized by any state, for the purpose of robbery. A raid for the purpose of carrying off movable property and converting it to the use of the captors would still be distinguishable from piracy, because it was committed on territory subject to an exclusive territorial jurisdiction. Where the attack or invasion by an armed ship not authorized or recognized by any state is not for the purpose of capturing property, it is properly speaking a raid and not piracy. An attack though in time of peace, by armed forces authorized or recognized by a regular government, is not a raid but an act of war, there being a government responsible for the act committed. The fact of any act being authorized, not by the supreme government, but by a chartered company, or by its governing officer, makes no difference in international law, the directorate of a chartered company exercising its powers by delegation of the state under which it holds its charter. The acts of its armed forces cannot in reason be distinguished from the acts of the armed forces of the state government. Thus compensation is just as much due for them as for the deliberate acts of the state itself, and any claim of an injured state can only be preferred against the state to which the company belongs. Invasion by the regular forces of a state, or by the regular forces of its delegated authority, being an act of war, the laws of war apply to it, and, on capture, such forces, or any members or part of such forces, are prisoners of war. On the other hand, the state whose subordinate authorities commit acts of war against a friendly state has the option of following them up as a commencement of hostilities, or of giving satisfactory compensation to the invaded state. Where the invasion is not by forces subject to the orders of a state, the invaded state has the right to apply its own laws for the repression of disturbances in its territory. Thus, in the so-called Jameson Raid, the Transvaal government had no right to treat Dr Jameson, an officer holding his powers under the British government, and his subordinates, as outlaws, and it was probably so advised, and the British government owed proper compensation for an act for the consequences of which, under international law, it was responsible.

British domestic law punishes raiding under the Foreign Enlistment Act 1870 (33 & 34 Vict. c. 90).[1] Section 11 of this act provides as follows.—"If any person within the limits of His Majesty's dominions, and without the licence of His Majesty, prepares or fits out any naval or military expedition to proceed against the dominions of any friendly state, the following consequences shall ensue: (1) Every person engaged in such preparation or fitting out, or assisting therein, or employed in any capacity in such expedition, shall be guilty of an offence against this act, and shall be punishable by fine and imprisonment or either of such punishments, at the discretion of the Court before which the offender is convicted; and imprisonment, if awarded, may be either with or without hard labour. (2) All ships and their equipments, and all arms and munitions of war, used in or forming part of such expedition, shall be forfeited by His Majesty." Section 12 provides for the punishment of accessaries as principal offenders, and section 13 limits the term of imprisonment for any offence under the act to two years. In the Sandoval case (1886),[2] in which Colonel Sandoval, who was not a British subject, bought guns and ammunition and shipped them to Antwerp, where they were put on board a vessel, which afterwards made an attack on Venezuela, it was held that the offence of fitting out and preparing an expedition within British territory against a friendly state, under this section, is sufficiently constituted by the purchase of guns and ammunition in the British Empire, and their shipment for the purpose of being put on board a ship in a foreign port, with knowledge of the purchaser and shipper that they are to be used in a hostile demonstration against such state, though the shipper takes no part in any overt act of war, and the ship is not fully equipped for the expedition within any British port. Under the same section, Dr Jameson, administrator of the British South Africa Company, and his confederates were tried before the Central Criminal Court and sentenced to different terms of imprisonment.[3] The offence committed under a British act is, of course, that of preparing and fitting out an expedition on British territory. Any acts subsequently committed by any British expedition on foreign soil are beyond the operation of domestic legislation, and fall to be dealt with by the domestic legislation of the state within which they occur, or by diplomacy, as the case may be. (T. BA.)

RAIFFEISEN, FRIEDRICH WILHELM (1818–1888), founder of the German system of agricultural co-operative banks, was born at Hamm on the Sieg on the 30th of March 1818, being the son of Gottfried Raiffeisen, burgomaster of that place. Educated privately, he entered the artillery in Cologne, but defective eyesight compelled him to leave the army. He then entered the public service at Coblenz, and in 1845 was appointed burgomaster of Weyerbusch. Here he was so successful that in 1848 he was transferred in a like capacity to Flammersfeld, and in 1852 to Heddersdorf. Raiffeisen devoted himself to the improvement of the social condition of the cultivators of the soil, and did good work in the planning of public roads and in other ways. The distress of the years 1846–47, the causes of which he discerned in the slight amount of credit obtainable by the small landed proprietors, led him to seek for a remedy in co-operation, and at Heddersdorf and at Weyerbusch he founded the first agricultural co-operative loan banks (*Darlehnskassenverein*). These banks were called after him, and their foundation resulted in a widespread system of land banks, supported by the government. In 1865 the state of his health compelled him to retire, but he continued to take an interest in the movement he had originated, and in 1878 he founded at Neuwied a periodical, *Das landwirtschaftliche Genossenschaftsblatt*. He died on the 11th of March 1888.

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[1] The preamble to the Foreign Enlistment Act 1870 stated that its object was "to make provision for the regulation of the conduct of Her Majesty's subjects during the existence of hostilities between foreign states with which Her Majesty is at peace." This preamble was repealed by the Statutes Law Revision (No. 2) Act 1893.

[2] *R.* v. *Sandoval*, 1886, 56 *Law Times*, 526.

[3] *R.* v. *Jemeson*, 1896, 2 Q.B., 425.

Among Raiffeisen's writings are, *Die Darlehnskassenvereine als Mittel zur Abhilfe* (Neuwied, 1866; new ed., 1887); *Anleitung zur Geschäfts- und Buchführung ländlichen Spar- und Darlehnskassenvereine* (new ed., 1896); and *Kurze Anleitung zur Gründung von Darlehnskassenvereinen* (new ed., 1893). See A. Wattig, *Friedrich Wilhelm Raiffeisen* (1890); H. W. Wolff, *People's Banks. A Record of Social and Economic Success* (1895); and Fassbender, *Friedrich Wilhelm Raiffeisen* (Berlin, 1902).

RAIGARH, a feudatory state of India, in the Chattisgarh division of the Central Provinces. Area, 1486 sq. m. Pop. (1901) 174,929, showing an increase of 4% in the decade. Estimated revenue, £10,000; tribute, £260. The chief belongs to the old Gond royal family. The state is traversed by the Bengal-Nagpur railway, with a station at Raigarh town, 363 m. from Calcutta. Rice is the chief crop; iron ore is worked by indigenous methods, and coal is known to exist. Fine tussore silk is produced at Raigarh town (pop. 6764). Raigarh is also the name of a hill fortress in Kolaba district, Bombay, which Sivaji made his chief place of residence. Here he was crowned in 1674.

RAIKES, ROBERT (1735–1811), English educationist, the founder of Sunday schools, was the son of Robert Raikes, a printer in Gloucester and proprietor of the *Gloucester Journal*, and was born on the 14th of September 1735. On the death of his father in 1757 he succeeded him in the business, which he continued to conduct till 1802. Along with some others he started a Sunday school at Gloucester in 1780, and on his giving publicity to the enterprise in the columns of his journal the notice was copied into the London papers and awakened considerable attention. For nearly thirty years he continued actively engaged in the promotion of his undertaking, and he lived to witness its wide extension throughout England. He died on the 5th of April 1811. His statue stands on the Thames Embankment.

Among various accounts of the life and work of Raikes mention may be made of that by P. M. Eastman, 1880.

RAIL. (1) (From Fr. *Râle*, cf. Ger. *Ralle*, Low Lat. *Rallus*, of unknown origin), originally the English name of two birds, distinguished from one another by a prefix as land-rail and water-rail, but latterly applied in a much wider sense to all the species which are included in the family *Rallidae*.

The land-rail, also very commonly known as the corn-crake, and sometimes as the daker-hen, is the *Rallus crex* of Linnaeus and *Crex pratensis* of recent authors. Its monotonous grating cry has given it its common name in several languages. With comparatively few individual exceptions, the land-rail is essentially migratory. It is the *Ortygometra* of classical authors—supposed by them to lead the quail (*q.v.*) on its voyages—and in the course of its wanderings has now been known to reach the coast of Greenland, and several times that of North America, to say nothing of Bermuda, in every instance we may believe as a straggler from Europe or Barbary. The land-rail looks about as big as a partridge, but on examination its appearance is found to be very deceptive, and it will hardly ever weigh more than half as much. The plumage above is of a tawny brown, the feathers being longitudinally streaked with blackish brown; beneath it is of a yellowish white; but the flanks are of a light chestnut barred with white. The species is very locally distributed, and in a way for which there is at present no accounting. In some dry upland and corn-growing districts it is plentiful; in others, of apparently the same character, it but rarely occurs; and the same may be said in regard to low-lying marshy meadows, in most of which it is in season always to be heard, while in others having a close resemblance to them it is never met with. The nest is on the ground, generally in long grass, and therein from nine to eleven eggs are commonly laid. These are of a cream-colour, spotted and blotched with light red and grey. The young when hatched are thickly clothed with black down, as is the case in nearly all species of the family.

The water-rail, locally known as the skiddy or billcock, is the *Rallus aquaticus* of ornithology, and seems to be less abundant than the preceding, though that is in some measure due to its frequenting places into which from their swampy nature men do not often intrude. Having a general resemblance to the land-rail,[1] it can be in a moment distinguished by its partly red and much longer bill, and the darker coloration of its plumage—the upper parts being of an olive brown with black streaks, the breast and belly of a sooty grey, and the flanks dull black barred with white. Its geographical distribution is very wide, extending from Iceland (where it is said to preserve its existence during winter by resorting to the hot springs) to China; and though it inhabits Northern India, Lower Egypt and Barbary, it seems not to pass beyond the tropical line. It never affects upland districts as does the land-rail, but always haunts wet marshes or the close vicinity of water. Its love-note is a loud and harsh cry, not continually repeated as is that of the land-rail, but uttered at considerable intervals and so suddenly as to have been termed "explosive." Besides this, which is peculiar to the cock-bird, it has a croaking call that is frog-like. The eggs resemble those of the preceding, but are more brightly and delicately tinted.

The various species of rails, whether allied to the former or latter of those just mentioned, are far too numerous to be here noticed. Hardly any part of the world is without a representative of the genera *Crex* or *Rallus*, and every considerable country has one or perhaps more of each—though it has been the habit of systematists to refer them to many other genera, the characters of which are with difficulty found. Thus in Europe alone three other species allied to *Crex pratensis* occur more or less abundantly; but one of them, the spotted rail or crake, has been made the type of a so-called genus *Porzana*, and the other two, little birds not much bigger than larks, are considered to form a genus *Zapornia*. The first of these, which used not to be uncommon in the eastern part of England, has a very near representative in the Carolina rail or sora, *Crex carolina*, of North America, often there miscalled the ortolan, just as its European analogue, *C. porzana*, is in England often termed the dotterel. But, passing over these as well as some belonging to genera that can be much better defined, and other still more interesting forms of the family, as *Aphanapteryx*, coot (*q.v.*), moor-hen (*q.v.*) and ocydrome (*q.v.*), a few words must be said of the more distant group formed by the South American *Heliornis*, and the African and Indian *Podica*, comprising four or five species, to which the name "Finfoots" has been applied—from the lobes or flaps of skin that fringe their toes. Though for a long while placed among the *Podicipedidae* (see GREBE), their osteology no less than their habits appear to indicate their alliance with the rails, and they are placed as a separate family, *Heliornithidae* of the order *Gruiformes*, to which the rails belong; but they seem to show the extreme modification of that type in adaptation to aquatic life. The curious genus *Mesites* of Madagascar, whose systematic place has been so long in doubt, has been referred by A. Milne-Edwards (*Ann. Sc. Naturelle*, ser. 6, vii. art. 2) to the neighbourhood of the rails, but is now associated as a sub-order *Mesitae* with Galliform birds. On the other hand the jacanas or *Parridae*, which from their long toes were once thought to belong to the rails, are now generally admitted to be Limicoline, while the genus *Aramus*—the courlan or limpkin of the southern United States—still occupies a very undetermined position. (A. N.)

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[1] Formerly it seems to have been a popular belief in England that the land-rail in autumn transformed itself into a water-rail, resuming its own characters in spring.

(2) (Through O.Fr. *reille*, from Lat. *regula*, a rule; the Du. and Swed. *regel*, Ger. *Riegel*, bolt or bar, are probably also from the Latin), a horizontal bar of wood, metal or other material resting on, or fixed in, upright posts to form a fence, or as a support for hanging things on, to form the "hand-rail" of a stair, &c.; on a ship the upper part of the bulwarks, *e.g.* the "taffrail," round the stern bulwarks; especially, one of the pair of iron or steel bars on which a train or tram runs (see RAILWAYS).

There are two other words "rail": (*a*) an obsolete word (O.E. *hrægel*), for a garment, often in the compound "night-rail"; and (*b*) a verb, to abuse, use angry language, from Fr. *railler*, possibly from the same root as Lat. *radere*, to scrape. The word is also seen in "rally," to banter, tease (distinguish, however, "rally," to bring together, especially of defeated troops (from Fr. *rallier*; *re*, again, and *allier*, ally, Lat. *alligare*)).

RAILWAYS. Railways had their origin in the tramways (*q.v.*) or wagon-ways which at least as early as the middle of the 16th century were used in the mineral districts of England round Newcastle for the conveyance of coal from the pits to the river Tyne for shipment. It may be supposed that originally the public roads, when worn by the cartage of the coal, were repaired by laying planks of timber at the bottom of the ruts, and that then the planks were laid on the surface of special roads or ways[1] formed between the collieries and the river. "The manner of the carriage," says Lord Keeper North in 1676, "is by laying rails of timber . . . exactly straight and parallel, and bulky carts are made with four rowlets fitting these rails, whereby the carriage is so easy that one horse will draw down four or five chaldrons of coals" (from 10·6 to 13·2 tons). The planks were of wood, often beech, a few inches wide, and were fastened down, end to end, on logs of wood, or "sleepers," placed crosswise at intervals of two or three feet. In time it became a common practice to cover them with a thin sheathing or plating of iron, in order to add to their life; this expedient caused more wear on the wooden rollers of the wagons, and, apparently towards the middle of the 18th century, led to the introduction of iron wheels, the use of which is recorded on a wooden railway near Bath in 1734. But the iron sheathing was not strong enough to resist buckling under the passage of the loaded wagons, and to remedy this defect the plan was tried of making the rails wholly of iron. In 1767 the Colebrookdale Iron Works cast a batch of iron rails or plates, each 3 ft. long and 4 in. broad, having at the inner side an upright ledge or flange, 3 in. high at the centre and tapering to a height of 2½ in. at the ends, for the purpose of keeping the flat wheels on the track. Subsequently, to increase the strength, a similar flange was added below the rail. Wooden sleepers continued to be used, the rails being secured by spikes passing through the extremities, but about 1793 stone blocks also began to be employed—an innovation associated with the name of Benjamin Outram, who, however, apparently was not actually the first to make it. This type of rail (fig. 1) was known as the plate-rail, tramway-plate or barrow-way-plate—names which are preserved in the modern term "platelayer" applied to the men who lay and maintain the permanent way of a railway.

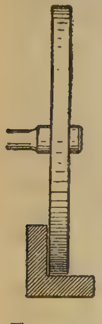
FIG. 1.—Plate-Rail.

Another form of rail, distinguished as the edge-rail, was first used on a line which was opened between Loughborough and Nanpantan in 1789. This line was originally designed as a "plate-way" on the Outram system, but objections were raised to rails with upstanding ledges or flanges being laid on the turnpike road which was crossed at Loughborough on the level. In other cases this difficulty was overcome by paving or "cause-waying" the road up to the level of the top of the flanges, but on this occasion William Jessop, of the Butterley Iron Works, near Derby, proposed to get over it by laying down two plates of iron, perfectly flat and level with the road but each having on its outside a groove ¾ in. wide and ¾ in. deep to control extra guiding wheels which were to be of somewhat larger diameter than the bearing wheels and to be affixed to them. The rest of the line was laid with what were substantially plate-rails placed on their edge instead of flat. These were cast in 3 ft. lengths, of a double-flanged section, and for the sake of strength they were "fish-bellied" or deeper in the middle than at the ends. At one end of each rail the flange spread out to form a foot which rested on a cross sleeper, being secured to the latter by a spike passing through a central hole, and above this foot the rail was so shaped as to form a socket into which was fitted the end of the next rail. Each length was thus fastened to a sleeper at one end, while at the other it was socketed into the end of its fellow. This method, however, was not found satisfactory: the projecting feet were liable to be broken off, and in 1799 or 1800 Jessop abandoned them, using instead separate cast-iron sockets or chairs, which were fastened to the sleepers and in which the rails were supported in an upright position. In the first instance he proposed to place the guiding wheels outside the bearing wheels, and the Nanpantan line was laid on this plan with a width of 5 ft. between the guide wheels; but before it was opened he decided not only to cast the guiding wheels and bearing wheels in one piece but also to put the former inside the rails, arguing that with this arrangement the edge-rails themselves would keep the wheels in position on the axles, whereas with that first contemplated fastenings would have been required for them (fig. 2). Jessop thus produced what was virtually the flanged wheel of to-day, having the flanges inside the rails, and further, it is said, established what has become the standard gauge of the world, 4 ft. 8½ in., or 5 ft. minus the width of two of his rails.

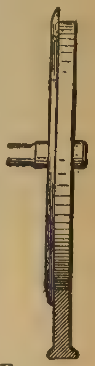
FIG. 2.—Edge-Rail.

These two systems of constructing railways—the plate-rail and the edge-rail—continued to exist side by side until well on in the 19th century. In most parts of England the plate-rail was preferred, and it was used on the Surrey iron railway, from Wandsworth to Croydon, which, sanctioned by parliament in 1801, was finished in 1803, and was the first railway available to the public on payment of tolls, previous lines having all been private and reserved exclusively for the use of their owners. In South Wales again, where in 1811 the railways in connexion with canals, collieries and iron and copper works had a total length of nearly 150 miles, the plate-way was almost universal. But in the north of England and in Scotland the edge-rail was held in greater favour, and by the third decade of the century its superiority was generally established. The manufacture of the rails themselves was gradually improved. By making them in longer lengths a reduction was effected in the number of joints—always the weakest part of the line; and another advance consisted in the substitution of wrought iron for cast iron, though that material did not gain wide adoption until after the patent for an improved method of rolling rails granted in 1820 to John Birkinshaw, of the Bedlington Ironworks, Durham. His rails were wedge-shaped in section, much wider at the top than at the bottom, with the intermediate portion or web thinner still, and he recommended that they should be made 18 ft. long, even suggesting that several of them might be welded together end to end to form considerable lengths. They were supported on sleepers by chairs at intervals of 3 ft., and were fish-bellied between the points of support. As used by George Stephenson on the Stockton & Darlington and Whitstable & Canterbury lines they weighed 28 ℔ per yard. On the Liverpool & Manchester railway they were usually 12 ft. or 15 ft. long and weighed 35 ℔ to the yard, and they were fastened by iron wedges to chairs weighing 15 or 17 ℔ each. The chairs were in turn fixed to the sleepers by two iron spikes, half-round wooden cross sleepers being employed on embankments and stone blocks 20 in. square by 10 in. deep in cuttings. The fish-bellied rails, however, were found to break near the chairs, and from 1834 they began to be replaced with parallel rails weighing 50 ℔ to the yard.

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[1] "Another thing that is remarkable is their way-leaves; for, when men have pieces of ground between the colliery and the river, they sell leave to lead coals over their ground" (Roger North).

The next important development in rail design originated in America, which, for the few lines that had been laid up to 1830, remained content with wooden bars faced with iron. In that year Robert Livingston Stevens (1787–1856), devised for the Camden & Amboy railway a rail similar as to its top to those in use in England, but having a flat base or foot by which it was secured to the sleepers by hook-headed spikes, without chairs (fig. 3); he had to get the first lot of these rails, which were 15 ft. long and weighed 36 ℔ to the yard, manufactured in England, since there were then no mills in America able to roll them. This type, which is often known as the Vignoles rail, after Charles Blacker Vignoles (1793–1875), who re-invented it in England in 1836, is in general use in America and on the continent of Europe. The bridge-rail (fig. 4)—so called because it was first laid on bridges—was supported on continuous longitudinal sleepers and held down by bolts passing through the flanges, and was employed by I. K. Brunel on the Great Western railway, where, however, it was abandoned after the line was converted from broad to standard gauge in 1892. In the double-headed rail (fig. 5), originated by Joseph Locke in 1837, and first laid on the Grand Junction railway, the two tables were equal. This rail was more easily rolled than others, and, being reversible, was in fact two rails in one. But as it was laid in cast-iron chairs the lower table was exposed to damage under the hammering of the traffic, and thus was liable to be rendered useless as a running surface. In consequence the bull-headed rail (fig. 6) was evolved, in which the lower table was made of smaller size and was intended merely as a support, not as a surface to be used by the wheels. There was a waste of metal in these early rails owing to the excessive thickness of the vertical web, and subsequent improvements have consisted in adjusting the dimensions so as to combine strength with economy of metal, as well as in the substitution of steel for wrought iron (after the introduction of the Bessemer process) and in minute attention to the composition of the steel employed.

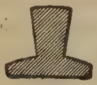

Fig. 3.—Flat-Bottomed Rail.

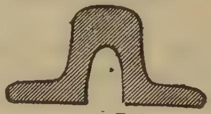

Fig. 4.—Bridge-Rail.

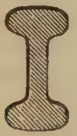

Fig. 5.—Double-Headed Rail.

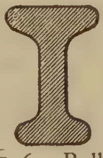

Fig. 6.—Bull-Headed Rail.

It was found, naturally, that the rails would not rest in their chairs at the joints, but were loosened and bruised at the ends by the blows of the traffic. The fish-joint was therefore devised in 1847 by W. Bridges Adams, the intention being by "fishing" the joints to convert the rails into continuous beams. In the original design two chairs were placed, one under each rail, a few inches apart, as in fig. 7. The joint was thus suspended between the two chairs, and two keys of iron, called "fishes," fitting the side channels of the rails, were driven in on each side between the chairs and the rails. In subsequent modifications the fishes were, as they continue to be, bolted to and through the rails, the sleepers being placed rather further apart and the joint being generally suspended between them.

The iron tramway or railway had been known for half a century and had come into considerable use in connexion with collieries and quarries before it was realized that for the carriage of general merchandise it might prove a serious competitor to the canals, of which a large mileage had been constructed in Great Britain during that period. In the article on "Railways" in the Supplement to the *Encyclopaedia Britannica*, published in 1824, it is said: "It will appear that this species of inland carriage [railways] is principally applicable where trade is considerable and the length of conveyance short; and is chiefly useful, therefore, in transporting the mineral produce of the kingdom from the mines to the nearest land or water communication, whether sea, river or canal. Attempts have been made to bring it into more general use, but without success; and it is only in particular circumstances that navigation, with the aid either of locks or inclined planes to surmount the elevations, will not present a more convenient medium for an extended trade." It must be remembered, however, that at this time the railways were nearly all worked by horse-traction, and that the use of steam had made but little progress. Richard Trevithick, indeed, had in 1804 tried a high-pressure steam locomotive, with smooth wheels, on a plate-way near Merthyr Tydvil, but it was found more expensive than horses; John Blenkinsop in 1811 patented an engine with cogged wheel and rack-rail which was used, with commercial success, to convey coal from his Middleton colliery to Leeds; William Hedley in 1813 built two locomotives—Puffing Billy and Wylam Dilly—for hauling coal from Wylam Colliery, near Newcastle; and in the following year George Stephenson's first engine, the Blucher, drew a train of eight loaded wagons, weighing 30 tons, at a speed of 4 m. an hour up a gradient of 1 in 450. But, in the words of the same article, "This application of steam has not yet arrived at such perfection as to have brought it into general use."

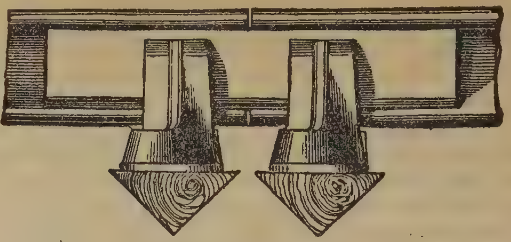

Fig. 7.—The original Fish-Joint of W. Bridges Adams.

The steam locomotive, however, and with it the railways, soon began to make rapid progress. On the Stockton & Darlington railway, which was authorized by parliament in 1821, animal power was at first proposed, but on the advice of Stephenson, its engineer, steam-engines were adopted. This line, with three branches, was over 38 m. in length, and was in the first instance laid with a single track, passing-places being provided at intervals of a quarter of a mile. At its opening, on the 27th of September 1825, a train of thirty-four vehicles, making a gross load of about 90 tons, was drawn by one engine driven by Stephenson, with a signalman on horseback in advance. The train moved off at the rate of from 10 to 12 m. an hour, and attained a speed of 15 m. an hour on favourable parts of the line. A train weighing 92 tons could be drawn by one engine at the rate of 5 m. an hour. The principal business of the new railway was the conveyance of minerals and goods, but from the first passengers insisted upon being carried, and on the 10th of October 1825 the company began to run a daily coach, called the "Experiment," to carry six inside, and from fifteen to twenty outside, making the journey from Darlington to Stockton and back in two hours. The fare was 1s., and each passenger was allowed to take baggage not exceeding 14 ℔ weight. The rate for carriage of merchandise was reduced from 5d. to one-fifth of a penny per ton per mile, and that of minerals from 7d. to 1½d. per ton per mile. The price of coals at Darlington fell from 18s. to 8s. 6d. a ton.

The example of the Stockton & Darlington line was followed by the Monklands railway in Scotland, opened in 1826, and several other small lines—including the Canterbury &

Whitstable, worked partly by fixed engines and partly by locomotives—quickly adopted steam traction. But the Liverpool & Manchester railway, opened in 1830, first impressed the national mind with the fact that a revolution in the methods of travelling had really taken place; and further, it was for it that the first high-speed locomotive of the modern type was invented and constructed. The directors having offered a prize of £500 for the best engine, trials were held on a finished portion of the line at Rainhill in October 1829, and three engines took part—the Rocket of George and Robert Stephenson, the Novelty of John Braithwaite and John Ericsson, and the Sanspareil of Timothy Hackworth. The last two of these engines broke down under trial, but the Rocket fulfilled the conditions and won the prize. Its two steam cylinders were 8 in. in diameter, with a stroke of 16½ in., and the driving wheels, which were placed in front under the funnel, were 4 ft. 8½ in. in diameter. The engine weighed 4¼ tons; the tender following it, 3 tons 4cwt.; and the two loaded carriages drawn by it on the trial, 9 tons 11 cwt.: thus the weight drawn was 12¾ tons, and the gross total of the train 17 tons. The boiler evaporated 18¼ cub. ft., or 114 gals., of water an hour, and the steam pressure was 50 ℔ per square inch. The engine drew a train weighing 13 tons 35 m. in 48 minutes, the rate being thus nearly 44 m. an hour; subsequently it drew an average gross load of 40 tons behind the tender at 13·3 m. an hour. The Rocket possessed the three elements of efficiency of the modern locomotive—the internal water-surrounded fire-box and the multitubular flue in the boiler; the blast-pipe, by which the steam after doing its work in the cylinders was exhausted up the chimney, and thus served to increase the draught and promote the rapid combustion of the fuel; and the direct connexion of the steam cylinders, one on each side of the engine, with the two driving wheels mounted on one axle. Of these features, the blast-pipe had been employed by Trevithick on his engine of 1804, and direct driving, without intermediate gearing, had been adopted in several previous engines; but the use of a number (25) of small tubes in place of one or two large flues was an innovation which in conjunction with the blast-pipe contributed greatly to the efficiency of the engine. After the success of the Rocket, the Stephensons received orders to build seven more engines, which were of very similar design, though rather larger, being four-wheeled engines, with the two driving wheels in front and the cylinders behind; and in October 1830 they constructed a ninth engine, the Planet, also for the Liverpool & Manchester railway, which still more closely resembled the modern type, since the driving wheels were placed at the fire-box end, while the two cylinders were arranged under the smoke-box, inside the frames. The main features of the steam locomotive were thus established, and its subsequent development is chiefly a history of gradual increase in size and power, and of improvements in design, in material and in mechanical construction, tending to increased efficiency and economy of operation.

In America the development of the locomotive dates from almost the same time as in England. The earliest examples used in that country, apart from a small experimental model constructed by Peter Cooper, came from England. In 1828, on behalf of the Delaware & Hudson Canal Company, which had determined to build a line, 16 m. long, from Carbondale to Honesdale, Pennsylvania, Horatio Allen ordered three locomotives from Messrs Foster & Rastrick, of Stourbridge, and one from George Stephenson. The latter, named the America, was the first to be delivered, reaching New York in January 1829, but one of the others, the Stourbridge Lion, was actually the first practical steam locomotive to run in America, which it did on the 9th of August 1829. The first American-built locomotive, the Best Friend, of Charleston, was made at the West Point Foundry, New York, in 1830, and was put to work on the South Carolina railroad in that year. It had a vertical boiler, and was carried on four wheels all coupled, the two cylinders being placed in an inclined position and having a bore of about 6 in. with a stroke of 16 in. It is reported to have hauled 40 or 50 passengers in 4 or 5 cars at a speed of 16–21 m. an hour. After a few months of life it was blown up, its attendant, annoyed by the sound of the escaping steam, having fastened down the safety-valve. A second engine, the West Point, also built at West Point Foundry for the South Carolina railroad, differed from the Best Friend in having a horizontal boiler with 6 or 8 tubes, though in other respects it was similar. In 1831 the Baltimore & Ohio Company offered a prize of $4000 for an American engine weighing 3½ tons, able to draw 15 tons at 15 m. an hour on the level: it was won by the York of Messrs Davis & Gartner in the following year. Matthias W. Baldwin, the founder of the famous Baldwin Locomotive Works in Philadelphia, built his first engine, Old Ironsides, for the Philadelphia, Germantown & Morristown railroad; first tried in November 1832, it was modelled on Stephenson's Planet, and had a single pair of driving wheels at the fire-box end and a pair of carrying wheels under the smoke-box. His second engine, the E. L. Miller, delivered to the South Carolina railroad in 1834, presented a feature which has remained characteristic of American locomotives—the front part was supported on a four-wheeled swivelling bogie-truck, a device, however, which had been applied to Puffing Billy in England when it was rebuilt in 1815.

The Liverpool & Manchester line achieved a success which surpassed the anticipations even of its promoters, and in consequence numerous projects were started for the construction of railways in various parts of Great Britain. In the decade following its opening nearly 2000 m. of railway were sanctioned by parliament, including the beginnings of most of the existing trunk-lines, and in 1840 the actual mileage reached 1331 m. The next decade saw the "railway mania." The amount of capital which parliament authorized railway companies to raise was about 4½ millions on the average of the two years 1842–1843, 17⅞ millions in 1844, 60 millions in 1845, and 132 millions in 1846, though this last sum was less than a quarter of the capital proposed in the schemes submitted to the Board of Trade; and the wild speculation which occurred in railway shares in 1845 contributed largely to the financial crisis of 1847. In 1850 the mileage was 6635, in 1860 it was 10,410, and in 1870 it was 15,310. The increase in the decade 1860–1870 was thus nearly 50%, but subsequently the rate of increase slackened, and the mileages in 1880, 1890 and 1900 were 17,935, 20,073 and 21,855. In the United States progress was more rapid, for, beginning at 2816 in 1840, the mileage reached 9015 in 1850, 30,600 in 1860, 87,801 in 1880, and 198,964 in 1900. Canada had no railway till 1853, and in South America construction did not begin till about the same time. France and Austria opened their first lines in 1828; Belgium, Germany, Russia, Italy and Holland in the succeeding decade; Switzerland and Denmark in 1844, Spain in 1848, Sweden in 1851, Norway in 1853, and Portugal in 1854; while Turkey and Greece delayed till 1860 and 1869. In Africa Egypt opened her first line (between Alexandria and Cairo) in 1856, and Cape Colony followed in 1860. In Asia the first line was that between Bombay and Tannah, opened in 1853, and in Australia Victoria began her railway system in 1854 (see also the articles on the various countries for further details about their railways).

Transcontinental Railways.—A railway line across North America was first completed in 1869, when the Union Pacific, building from the Missouri river at Omaha (1400 m. west of New York), met the Central Pacific, which built from San Francisco eastwards, making a line 1848 m. long through a country then for the most part uninhabited. This was followed by the Southern Pacific in 1881, from San Francisco to New Orleans, 2489 miles; the Northern Pacific, from St Paul to Portland, Ore., in 1883; the Atchison, Topeka & Santa Fé, from Kansas City to San Diego; and the Great Northern, from St Paul to Seattle and New Westminster in 1893. Meanwhile the Canadian Pacific, a true transcontinental line, was built from Montreal, on Atlantic tide-water, to the Pacific at Vancouver, 2906 m. But these lines have been dwarfed since 1891 by the Siberian railway, built by the Russian government entirely across the continent of Asia from Cheliabinsk (1769 m. by rail east of St Petersburg) to Vladivostok, a distance of 4073 m., with a branch from Kharbin about 500 m. long to Dalny and Port Arthur. The main line was finished in 1902, except for a length of about 170 m. in very difficult country around the south end of Lake Baikal; this was constructed in 1904, communication being maintained in the interval by ferry-boats, which conveyed all the carriages of a train across the lake, more than 40 m., when the ice permitted. A transcontinental line was long ago undertaken across South America from Buenos Aires to Valparaiso, where the continent is only about 900 m. wide. The last section through the Andes was finished in 1910. (H. M. R.)

General Statistics

Mileage.—At the close of 1907 there were approximately 601,808 miles of railway in the world, excluding tramways. On the whole, the best statistical source for this information is the annual computation published by the *Archiv für Eisenbahnwesen*, the official organ of the Prussian Ministry of Public Works; but the figure quoted above utilizes the Board of Trade returns for the United Kingdom and the report of the Interstate Commerce Commission for the United States. In the United States and in certain other countries, a fiscal year, ending on the 30th of June or at some other irregular period, is substituted for the calendar year.

The partition of this total between the principal geographical divisions of the world is given in Table I.

Table I.—Mileage of the World

	Miles.		Miles.
Europe	199,371	Africa	18,516
America	309,974	Australia	17,766
Asia	56,181		

Table II., classifying the mileage of Europe, shows that Russia has taken the lead, instead of Germany, as in former years. If the Asiatic portions of the Russian Empire were given in the same table, the total Russian mileage would appear nearly as large as that of Germany and Italy together.

Table II.—Railways of Europe in 1907

	Miles.		Miles.
Germany	36,066	Portugal	1,689
Austria-Hungary, including Bosnia and Herzegovina	25,853	Denmark	2,141
Great Britain and Ireland	23,108	Norway	1,607
France	29,717	Sweden	8,322
European Russia, including Finland	36,280	Servia	379
Italy	10,312	Rumania	1,995
Belgium	4,874	Greece	771
Holland	2,230	European Turkey, Bulgaria, Rumelia	1,968
Switzerland	2,763	Malta, Jersey, Isle of Man	68
Spain	9,228		
		Total	199,371

In the United States railway mileage now tends to increase at the rate of slightly over 5000 miles a year, which is about 2½% on the present main line mileage. In the 'eighties, the country passed through a period of competitive building, which was productive of much financial disaster. Thus, in 1882, 11,569 m. were built—an addition equivalent to more than 11% of mileage then existing—and in 1887, 12,876 m. were built. Unjustifiable railway expansion had much to do with the American commercial panics of 1884 and 1893. After the reconstruction period of the 1893 panic, however, the tendency for a number of years was to spend larger sums in bettering existing railways rather than in new extensions. The decade from 1896 until 1905, inclusive, saw huge sums spent on yards, passing tracks, grade reduction, elimination of curves, substitution of large locomotives and cars for small ones, &c. During those ten years, the route mileage increased 34,991 m., or 17%, while the mileage of second, third, fourth and yard tracks and sidings increased 32,666 m., or nearly 57%. The number of locomotives increased 12,407, or 35%, and the number of freight cars, 545,222, or 42%. Moreover, the average tractive power per locomotive and the average capacity per freight car advanced greatly in this period, although specific figures cannot be given.

Thus it may fairly be said that the railway system of the United States was reconstructed between 1896 and 1905, so far as concerns rails, sleepers, ballast and the general capacity of a given group of lines to perform work. About 1905, however, a new tendency became apparent. At that time the so-called transcontinental railways, connecting the Pacific coast of the United States with the central portions of the country, and thus with the group of railways reaching the Atlantic seaboard, consisted of five railways within the borders of the United States, and one in Canada. In Canada the Canadian Pacific was the only transcontinental line, extending from St John, on the bay of Fundy, and from Quebec, on the river St Lawrence, to Vancouver, on the strait of Georgia, the distance from St John to Vancouver being approximately 3379 m. Within the boundaries of the United States the northernmost of the transcontinental lines was the Great Northern railway, extending from a point opposite Vancouver, B.C., and from Seattle, Wash., to Duluth, on Lake Superior, and to St Paul and Minneapolis, Minn., where connexion through to Chicago was made over an allied line, the Chicago, Burlington & Quincy, owned jointly by the Great Northern and the Northern Pacific.

Next, south of the Great Northern, lay the Northern Pacific railway, starting on the west from Portland, Ore., and from Seattle and Tacoma, Wash., and extending east to Duluth, St Paul and Minneapolis by way of Helena, Mont. The Central Pacific–Union Pacific route to the coast, with its important affiliated companies, the Oregon Short Line and the Oregon Railroad & Navigation Company, extended from San Francisco, Cal., and Portland, Ore., to Omaha, Neb., by way of Salt Lake City; the Atchison, Topeka & Santa Fé extended from San Francisco and Los Angeles, Cal., to Chicago and to Galveston, Tex.; while the Southern Pacific had its line from San Francisco and Los Angeles to Galveston and New Orleans, running for the greater part of the distance just north of the Mexican border.

Thus it will be observed that the five great cities of the Pacific coast—Seattle and Tacoma, Wash., Portland, Ore., and San Francisco and Los Angeles, Cal.—were already well supplied with railways; but the growth of the fertile region lying west of the transcontinental divide was most attractive to American railway builders; and railways serving this district, almost all of them in trouble ten years before, were showing great increases in earnings. In 1903 the Gould lines determined to enter this Pacific territory. Hitherto the western terminus of this group of lines had been Salt Lake City, Utah; by the exceedingly bold construction of the Western Pacific from Salt Lake City to Oakland, Cal., opposite San Francisco, an additional line to the Pacific coast was provided, having low grades and being in all respects well adapted for cheap operation.

Shortly after the plans were announced for building the Western Pacific, the Chicago, Milwaukee & St Paul also decided to extend west. Before that time the St Paul had been a great local railway, operating primarily in the Dakotas, Minnesota, Iowa, Wisconsin and Illinois; but by the construction of a long arm from the Missouri river to Spokane, Seattle and Tacoma, it became a transcontinental line of the first importance, avoiding the mistakes of earlier railway builders by securing a line with easy gradients through the most favourable regions.

At the same time that these two extensions were being undertaken by old and well-established railways, a new company—the Kansas City, Mexico & Orient—was engaged in constructing a line almost due south-west from Kansas City, Mo., to the lower part of the gulf of California in Mexico; while an additional independent line was under construction from Denver in a north-westerly direction towards the Pacific coast. The guarantee for this activity may be illustrated by a single fact: the combined building operations, in 1908, of San Francisco, Seattle, Portland, Los Angeles, Spokane and Salt Lake City exceeded the combined building operations of Philadelphia, Pittsburg, Kansas City, Boston, Baltimore and Cincinnati during the same year. San Francisco spent more in new permanent structures than Philadelphia, and Seattle spent more than Pittsburg.

Recent American railway development, viewed in its larger aspects, has thus been characterized by what may be described as the rediscovery of the Pacific coast. How far this movement will extend it is impossible to say; it is certain, however, that it will be enormously important in re-aligning trade conditions in the United States, Canada and Mexico.

Table III. illustrates the railway mileage in the continent of America at the close of 1907.

Table III.—Railways of America in 1907

	Miles.		Miles.
United States	236,949	Dutch Guiana	37
Canada	22,452	Ecuador	186
Newfoundland	666	Peru	1,332
Mexico	13,612	Bolivia	702
Central America	1,392	Brazil	10,714
Greater Antilles	2,430	Paraguay	157
Lesser Antilles	336	Uruguay	1,210
Colombia	449	Chile	2,939
Venezuela	634	Argentina	13,673
British Guiana	104		
		Total	309,974

Outside the United States and Canada, the most interesting American developments are in Mexico and Argentina, these countries having nearly the same amount of railway mileage. In Mexico the national government is carrying out a consistent policy of developing its railway lines. It has succeeded in restoring the credit of these enterprises, and is proceeding with care and skill to form the lines into an efficient transportation system. In Argentina about 15% of the railways are owned and operated by the government, the balance being in the hands of private companies, largely controlled in England. Development of these lines has been primarily an extension from the large cities in the East to the agricultural districts in the West, but a change of great importance was brought about in 1910 by the completion of the last tunnel on the Argentine Transandine Railway, which serves to connect Santiago, Valparaiso and the other great cities of the west coast with Buenos Aires, Montevideo, Bahia, Rio de Janeiro and the other great cities of the east coast. Naturally the company named does not reach all of these points, but its line across the Andes supplies the indispensable link of communication, in the absence of which the east coast towns and the west coast towns have hitherto been as widely separated as if they had been located on different continents—indeed, far more widely separated in point of time and of freight charges than Great Britain and the United States.

Table IV. shows as closely as possible the railway route mileage open in Asia at the close of 1907.

TABLE IV.—RAILWAYS OF ASIA IN 1907

	Miles.		Miles.
Central Russia in Asia	2,808	Malay States	636
Siberia and Manchuria	5,565	Dutch East Indies	1,509
China	4,162	Siam	571
Korea	688	Ceylon	561
Japan	5,013	Cochin China	1,761
British India	29,893	Cambodia	
Persia	33	Annam	
Asia Minor, Syria, Arabia and Cyprus	2,930	Tonkin	
Portuguese East Indies	51	Pondicherry	
		Malacca	
		Philippines	
		Total	56,181

Although more than half of the total mileage of Asia is in British India, it is probable that the greatest proportionate gains in the near future will be in China, Siberia and Manchuria, and Central Russia in Asia. In proportion to its population China has the least railway development of any of the great countries of the world; the probability that its present commercial awakening will extend seems large, and in that case it will need a vast increase in its interior communications.

In Africa, it will be seen by Table V. that the railway mileage in the British possessions amounts to almost five-sixths of the total.

TABLE V.—RAILWAYS OF AFRICA IN 1907

	Miles.		Miles.
Egypt	3,445	British Provinces, except South Africa	1,235
Algiers and Tunis	3,049	French Provinces	1,246
Congo States	399	Italian Provinces	71
Abyssinia	192	Portuguese Provinces	703
British South Africa	7,028		
German Provinces	1,148		
		Total	18,516

The so-called Cape-to-Cairo route shows occasional extensions, particularly in the opening up of new country in Central Africa by the Rhodesian railway system. The Rhodesian railway system in 1910 had penetrated north of Broken Hill, which is just above the fifteenth parallel of south latitude, while the Egyptian railway system had reached Gondokoro, located close to the fifth parallel of north latitude. The intervening distance, through country exceedingly unhealthy for white men, and therefore promising no traffic except raw materials, does not seem a likely field for rapid railway extension.

In Australia the increase in railway mileage in the five years ending December 31st, 1907 was about 7%—a small proportion as compared with America, Asia or Africa. The greatest increase, both relative and absolute, was in Queensland; the smallest in South Australia, which added only 24 m. during the five years. Yet the mileage open per 10,000 inhabitants in Australia, as a whole, far surpasses that in any other of the broad geographical divisions.

TABLE VI.—RAILWAYS OF AUSTRALIA IN 1907

	Miles.		Miles.
New Zealand	2,571	Queensland	3,405
Victoria	5,517	Tasmania	620
New South Wales	3,471	West Australia	2,259
South Australia	1,924	Hawaiian Group	88
		Total	19,855

Table VII. illustrates the mileage open to the end of 1907 per 100 sq. m. of territory and per 10,000 inhabitants. It will be observed that Belgium leads all the countries of the world in what may be called its railway density, with the United Kingdom a far-distant second in the list, and Persia last. In railway mileage per 10,000 inhabitants, however, Queensland, in the Australian group, reports a figure much greater than any other country; while at the other end of the list Persia holds the record for isolation.

TABLE VII.—MILES OPEN AT THE END OF 1907

Europe

	Per 100 sq. miles.	Per 10,000 inhabitants.
Germany	17·2	6·4
Austro-Hungary	10·0	5·5
United Kingdom	19·0	5·6
France	14·2	7·6
Russia in Europe, including Finland	1·8	3·4
Italy	9·3	3·2
Belgium	42·8	7·3
Holland	15·0	3·9
Switzerland	17·2	8·3
Spain	4·8	5·2
Portugal	4·7	3·1
Denmark	14·3	8·7
Norway	1·3	7·2
Sweden	4·8	16·2
Servia	2·1	1·5
Rumania	3·2	3·4
Greece	3·1	3·2
Turkey in Europe, Bulgaria, Rumelia	1·9	2·0
Malta, Jersey, Man	16·1	1·9
Total	5·3	5·1

America, 1907

	Per 100 sq. miles.	Per 10,000 inhabitants.
United States	6·4	26·8
Canada	0·6	42·1
Newfoundland	1·6	31·1
Mexico	1·8	9·4
Colombia	0·08	1·0
Venezuela	0·16	2·6
British Guiana	0·11	3·5
Ecuador	0·16	1·3
Peru	0·32	2·9
Bolivia	0·16	3·1
Brazil	0·32	7·1
Paraguay	0·16	2·5
Uruguay	1·8	13·0
Chile	1·0	8·9
Argentina [1]	1·3	28·0

Asia, 1907

	Per 100 sq. miles.	Per 10,000 inhabitants.
Central Russia in Asia	1·3	3·6
Siberia and Manchuria	0·11	9·8
China	0·1	0·12
Korea	0·8	0·68
Japan	3·1	1·1
British India	1·4	1·0
Ceylon	2·3	1·6
Persia	0·005	0·04
Asia Minor, Syria, Arabia, Cyprus	0·5	1·5
Portuguese Indies	3·5	0·9
Malay Archipelago	1·9	8·8
Dutch Indies	0·6	0·5
Siam [2]	0·16	0·6

Africa, 1907

	Per 100 sq. miles.	Per 10,000 inhabitants.
Egypt	1·0	3·5
Algiers and Tunis	0·8	4·5
Cape Colony	1·3	21·6
Natal	3·5	12·6
Transvaal	1·1	15·7
Orange Colony	1·8	42·6

Complete estimates for the balance of Africa not available.

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[1] No accurate returns for Central America, Greater and Lesser Antilles and Dutch Guiana.

[2] Estimates of area and population incomplete for Cochin China, Cambodia, Annam, Tonkin, Pondicherry, Malacca and Philippines.

Australia, 1907

	Per 100 sq. miles.	Per 10,000 inhabitants.
New Zealand	2·4	30·9
Victoria	3·9	28·5
New South Wales	1·1	25·4
South Australia	0·16	53·0
Queensland	0·5	70·2
Tasmania	2·4	36·0
West Australia	0·16	54·8
Hawaiian Group	1·3	8·1
Total	0·6	35·9

Capital.—The total construction capital invested in the railways of the world in 1907 was estimated by the *Archiv für Eisenbahnwesen* at £8,986,150,000; the figure is necessarily incomplete, though it serves as a rough approximation. This total was divided nearly evenly between the countries of Europe and the rest of the world. The United States of America, with a capital of £3,059,800,000 invested in its railways on the 30th of June 1906, was easily ahead of every other country, and in 1908 the figure was increased to £3,443,027,685, of which £2,636,569,089 was in the hands of the public. On a route-mileage basis, however, the capital cost of the British railway system is far greater than that of any other country in the world, partly because a vast proportion of the lines are double, treble or even quadruple, partly because the safety requirements of the Board of Trade and the high standards of the original builders made actual construction very costly.

The total paid-up railway capital of the United Kingdom amounted, in 1908, to £1,310,533,212, or an average capitalization of £56,476 per route mile, though it should be noted that this total included £196,364,618 of nominal additions through "stock-splitting," &c. Per mile of single track, the capitalization in England and Wales, Scotland, Ireland and the United Kingdom, is shown in Table VIII.

TABLE VIII.—PAID-UP CAPITAL, 1908

	Route Miles.	Single-Track Miles.	Paid-up Capital.	Paid-up Capital per Route Mile.	Paid-up Capital per Single-Track Mile.
England and Wales	15,999	29,748[1]	£1,080,138,674	£67,513	£36,309[1]
Scotland	3,843	4,531[1]	185,345,494	48,229	33,510[1]
Ireland	3,363	4,037	45,049,044	13,396	11,159
United Kingdom	23,205	39,316	1,310,533,212	56,476	33,333

The table excludes sidings, because they cannot fairly be compared with running tracks, mile for mile. Yet the mileage of sidings in the United Kingdom amounted to 14,353 in 1908, and the cost of constructing them was probably not far from £60,000,000.

On a single-track-mile basis, the following comparison may be made between apparent capital costs in Great Britain and the United States:—

	Single-Track Mileage.	Paid-up Capital per Mile.
United Kingdom, 1908	39,316	£33,333
United States, 1908	254,192	10,372[2]

The figures for the United States are from the report of the Interstate Commerce Commission for the year ended 30th of June 1908, and comprise mileage of first, second, third and fourth tracks, and paid-up capital in the hands of the public only. The British figures are from the Board of Trade returns for the calendar year 1908. In comparing the figures, it should be noted that main line mileage in the Eastern states, as for example that of the Pennsylvania railroad and the New York, New Haven & Hartford, does not differ greatly in standards of safety or in unit cost from the best British construction, although improvement work in America is charged to income far more liberally than it has been in England. But there are long stretches of pine loam in the South where branch lines can be, and are, built and equipped for £2400 or less per mile, while the construction of new main line in the prairie region of the West ought not to cost more than £4000 per single-track-mile, under present conditions.

The problem of the early railway builders in the United States was to conquer the wilderness, to build an empire, and at the same time to bind the East to the West and the North to the South. There can be little doubt but that the United States would long ago have disintegrated into separate, warring republics, had they not been bound together by railways, and standards of safety were rightly subordinated to the main task to be accomplished. Conquest is not usually bloodless, whether achieved at the van of a marching column or at the head of a hastily-built railway, and the process under which the American railway system took form left the way open for a distressing record of accidents to the traveller and the railway servant. But as traffic becomes more dense, year by year, the rebuilding process is constant, and American railway lines are gradually becoming safer.

In Europe the average route-mile capital is £27,036, and Table IX. shows the differences between various countries.

TABLE IX.—ROUTE-MILE CAPITAL IN EUROPE

Germany (1907)	£22,298
France (1905)	25,285
Belgium (State railways 1906)	35,381
Italy (State railways 1906–7)	26,008
Denmark (State railways 1907–8)	10,433
Norway (1907–8)	8,027
Sweden (1905)	6,647
Russia (excluding Finland, 1905)	16,534
Finland (State railways 1907)	7,300

Statistical Study of Railway Operation.—The study of railway operation through statistics has two distinct aspects. It has been well said that statistics furnish the means by which the railway manager disciplines his property; this is the aspect of control. On the other hand, the banker, the government official and the economist use railway statistics to obtain information which may be characterized as static rather than dynamic. Both uses ultimately rest upon comparison of the observed data from a certain property with the observed data from other properties, or with predetermined standards of performance.

In general, the British working unit supplied as public information has always been the goods-train-mile and the passenger-train-mile, these figures being the products of the number of trains into the number of miles they have travelled. In America, the basic units have been the ton-mile and the passenger-mile, and these figures are now required to be furnished to the Interstate Commerce Commission and to most of the state commissions as well. Both the British manager and the American manager, however, are supplied with a considerable number of daily, weekly and monthly reports, varying on different railways, which are not made public. The daily sheets usually include a summarized statement of the performance of every train on the line, covering the amount of business done, the destination of the loads, &c. For a number of years there has been a movement in Great Britain to require the inclusion of ton-mile statistics in the stated returns to the Board of Trade, but most railway managers have objected to the change on the ground that their own confidential information was already adequate for purposes of control, and that ton-mile statistics would require additional clerical force to a costly extent. The Departmental Committee of the Board of Trade, sitting in 1909 to consider railway accounting forms, while recommending ton-miles to the careful consideration of those responsible for railway working in Great Britain, considered the question of their necessity in British practice to be still open, and held that, at all events, they should not be introduced under compulsion.

REFERENCES.—*Annual Reports* of the Interstate Commerce Commission; Poor's *Manual of Railroads* (annual, New York); *Statistical Abstract of the United States* (annual, Washington, published by the U. S. Bureau of Statistics); A. T. Hadley, *Railroad Transportation, Its History and Laws* (New York, 1885); E. R. Johnson, *American Railway Transportation* (New York, 1908); L. G. McPherson, *Railroad Freight Rates* (New York, 1909); S. Daggett, *Railroad Reorganization* (Boston, 1908); M. L. Byers, *Economics of Railway Operation* (New York, 1908); E. R. Dewsnup (ed.), *Railway Organization and Working* (Chicago, 1906); *Interstate Commerce Commission; Rate Regulation Hearings before the U.S. Senate Committee* (Washington, 5 vols., 1905); and on current matters, *The Official Railway Guide* (monthly, New York), the *Railroad Age Gazette* (weekly, New York) and the *Commercial and Financial Chronicle* (weekly, New York). (R. Mo.)

ECONOMICS AND LEGISLATION

It was at one time an axiom of law and of political economy that prices should be determined by free competition. But in the development of the railway business it soon became evident that no such dependence on free competition was possible, either in practice or in theory. This difficulty is not peculiar to railways; but it was in the history of railway economy and railway control that certain characteristics which are now manifesting themselves in all directions where large investments of fixed capital are involved were first brought prominently to public notice.

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[1] These figures are derived from a total. They are not exact, but may be taken as representing an approximation correct within one per cent.

[2] Dollars to pounds sterling @ 4·87.

For a large number of those who use a railway, competition in its more obvious forms does not and cannot exist. Independent carriers cannot run trains over the same line and underbid one another in offering transportation services. It would be practically impossible for a line thus used by different carriers to be operated either with safety, or with economy, or with the advantage to the public which a centralized management affords. It is equally impossible for the majority of shippers to enjoy the competition of parallel lines. Such duplication of railways involves a waste of capital. If parallel lines compete at all points, they cause ruin to the investors. If they compete at some points and not at others, they produce a discrimination or preference with regard to rates and facilities, which builds up the competitive points at the expense of the non-competitive ones. Such partial competition, with the discrimination it involves, is liable to be worse for the public than no competition at all. It increases the tendency, already too strong, towards concentration of industrial life in large towns. It produces an uncertainty with regard to rates which prevents stability of prices, and is apt to promote the interests of the unscrupulous speculator at the expense of those whose business methods are more conservative. So marked are these evils that such partial competition is avoided by agreements between the competing lines with regard to rates, and by divisions of traffic, or pools, which shall take away the temptation to violate such rate agreements. The common law has been somewhat unfavourable to the enforcement of such agreements, and statutes in the United States, both local and national, have attempted to prohibit them; but the public advantage from their existence has been so great as to render their legal disabilities inoperative. In those parts of the continent of Europe where railways are owned and administered by state authority, the necessity for such agreements is frankly admitted.

But if rates are to be fixed by agreement, and not by competition, what principle can be recognized as a legitimate basis of railway rate-making? The first efforts at railway legislation were governed by the equal mileage principle; that is, the attempt was made to make rates proportionate to the distance. It was, however, soon seen that this was inadmissible. So much of the expense of the handling, both of freight and of passengers, was independent of the length of the journey that a mileage rate sufficiently large for short distances was unnecessarily burdensome for long ones, and was bound to destroy long-distance traffic, if the theory were consistently applied. The system has been retained in large measure in passenger business, but only because of the conflict which inevitably occurs between the authorities and the passengers with regard to the privilege of breaking and resuming a journey when passenger rates are arranged on any other plan. In freight schedules it has been completely abandoned.

A somewhat better theory of rate regulation was then framed, which divided railway expenditures into movement expense, connected with the line in general, and terminal expense, which connected itself with the stations and station service. Under this system each consignment of freight is compelled to pay its share of the terminal expense, independently of distance, *plus* a mileage charge proportionate to the length of the journey or haul. There has been also a further attempt in England to divide terminal charges into station and service terminals, according to the nature of the work for which compensation is sought. But none of these classifications of expense reaches the root of the matter. A system of charges which compels each piece of traffic to pay its share of the charges for track and for stations overlooks the fundamental fact that a very large part of the expenses of a railway—more than half—is not connected either with the cost of moving traffic or of handling traffic at stations, but with the cost of maintaining the property as a whole. Of this character are the expenditures necessary for maintenance of way, for general administration and for interest on capital borrowed, which are almost independent of the total amount of business done, and quite independent of any individual piece of business. To say that all traffic must bear its share of these interest and maintenance charges is to impose upon the railways a rate which would cut off much of the long-distance traffic, and much of the traffic in cheap articles, which is of great value to the public, and which, from its very magnitude, is a thing that railways could not afford to lose. It is also a fact that with each recurring decade these general expenses (also called indirect, undistributed or fixed charges) have an increased importance as compared with the particular (direct, distributed or operating) expense attaching naturally to the particular portions of the traffic. For with increased density of population it becomes profitable to make improvements on the original location, even though this may involve increased charges for interest and for some parts of its maintenance, for the sake of securing that economy of operation, through larger train-loads, which such an improved location makes possible.

Whatever the ostensible form of a railway tariff, the contribution of the different shipments of freight to these general expenses is determined on the principle of charging what the traffic will bear. Under this principle, rates are reduced where the increase of business which follows such reduction makes the change a profitable one. They are kept relatively high in those cases where the expansion of business which follows a reduction is small, and where such a change is therefore unprofitable. This theory of charging what the traffic will bear is an unpopular one, because it has been misapplied by railway managers and made an excuse for charging what the traffic will not bear. Rightly applied, however, it is the only sound economic principle. It means taxation according to ability—that ability being determined by actual experiment.

In the practical carrying out of this principle, railways divide all articles of freight into classes, the highest of which are charged two or three, or even four times the rates of the lowest. This classification is based partly upon special conditions of service, which make some articles more economical to carry than others (with particular reference to the question whether the goods are offered to the companies in car-loads or in small parcels), but chiefly with regard to the commercial value of the article, and its consequent ability to bear a high charge or a low one. For each of these classes a rate-sheet gives the actual rate-charge per unit of weight between the various stations covered by the tariff. This rate increases as the distance increases, but not in equal proportion; while the rates from large trade centres to other trade centres at a great distance are not higher than those to intermediate points somewhat less remote; if the law permits, there is a tendency to make them actually a little lower. Besides the system of charges thus prescribed in the classification and rate-sheet, each tariff provides for a certain number of special rates or charges made for particular lines of trade in certain localities, independently of their relation to the general system. If these special rates are published in the tariff, and are offered to all persons alike, provided they can fulfil the conditions imposed by the company, they are known as commodity rates, and are apparently a necessity in any scheme of railway charges. If, however, they are not published, and are given to certain persons as individual favours, they become a prolific source of abuse, and are quite indefensible from the standpoint of political economy.

While the superficial appearance of the railway tariff is different for different countries, and sometimes for different parts of the same country, the general principles laid down are followed in rate-making by all well-managed lines, whether state or private. It is a mistake to suppose that the question of public or private ownership will make any considerable difference in the system of rate-making adopted by a good railway. A state system will be compelled, by the exigencies of the public treasury, to arrange its rates to pay interest on its securities; a private company will generally be prevented, by the indirect competition of railways in other parts of the country which it serves, from doing very much more than this. The relative merit of the two systems depends upon the question how we can secure the best efficiency and equity in the application of the principles thus far laid down. There are three different systems of control:—

1. *Private operation, subject only to judicial regulation*, was exemplified most fully in the early railway history of the United States. Until 1870 railway companies were almost free from special acts of control; and, in general, any company that could raise or borrow the capital was allowed to build a railway wherever it saw fit. In the United Kingdom there was almost as much immunity from legislative interference with charges, but the companies were compelled to secure special charters, and to conform to regulations made by the Board of Trade in the interests of public safety. The advantage of this relatively free system of railway building and management is that it secures efficient and progressive methods. Most of the improvements in operation and in traffic management have had their origin in one of these two countries. The disadvantage attendant upon this system is that the courts are reluctant to exercise the right of regulation, except on old and traditional lines, and that in the face of new business methods the public may be inadequately protected. There is also this further disadvantage, that in the gradual progress of consolidation railway companies take upon themselves the aspect of large monopolies, of whose apparently unrestricted power the public is jealous. As a result of these difficulties there has been, both in the United Kingdom and in the United States, a progressive increase of legislative interference with railways. In the former the Railway and Canal Traffic Act of 1854 specially prohibited preferences, either in facilities or in rates. The Regulation of Railways Act of 1873 provided for a Railway Commission, which should be so constituted as to take cognizance of cases on the investigation of which the courts were reluctant to enter. Finally, the legislation of 1888 put into the hands of a reorganized Railway Commission and of the Board of Trade powers none the less important in principle because their action has been less in its practical effect than the advocates of active control demanded. In the United States the years from 1870 to 1875 witnessed sweeping and generally ill-considered legislation ("Granger" Acts) concerning railway charges throughout the Mississippi valley; while the years from 1884 to 1887 were marked by more conservative, and for that reason more enforceable, acts, which culminated in the Interstate Commerce Act, prohibiting personal discrimination and gradually restricting discrimination between places, and providing for a National Commission of very considerable power—not to speak of the pooling clause, which was extraneous to the general purpose of the act, and has tended to defeat rather than strengthen its operation.

2. *Operation by private companies, under specific provisions of the government authorities with regard to the method of its exercise*, has been the policy consistently carried out in France, and less systematically and consistently in other countries under the domination of the Latin race. It was believed by its advocates that this system of prescribing the conditions of construction and operation of lines could promote public safety, prevent waste of capital and secure passengers and shippers against extortionate rates. These expectations have been only partially fulfilled. Well trained as was the civil service of France, the effect of this supervision in deadening activity was sometimes more marked than in its effect in preventing abuse. Moreover, such a system of regulation almost necessarily carries with it a guarantee of monopoly to the various companies concerned, and not infrequently large gifts in the form of subsidies, for without such aid private capital will not submit to the special burdens involved. These rights, whether of monopoly or of subsidy, form a means of abuse in many directions. Where the government is bad, they are a fruitful source of corruption; even where it is good, they enable the companies to drive hard bargains with the public, and prevent the expected benefits of official control from being realized.

3. *State operation and ownership* is a system which originated in Belgium at the beginning of railway enterprise, and has been consistently carried out by the Scandinavian countries and by Hungary. Since 1860 it has been the policy of Australia. It has generally come to be that of Germany and, so far as the finances of the countries allow, of Austria and Russia; British India also affords not a few examples of the same method. The theory of state ownership is excellent. So large a part of the railway charge is of the nature of a tax, that there seem to be a priori reasons for leaving the taxing powers in the hands of the agents of the government. In practice its operation is far more uncertain. Whether the intelligence and efficiency of the officials charged by the state with the handling of its railway system will be sufficient to make them act in the interest of the public as fully as do the managers of private corporations, is a question whose answer can only be determined by actual experience in each case. If they fail to have these qualities, the complete monopoly which a government enjoys, and the powers of borrowing which are furnished by the use of the public credit, increase instead of diminishing the danger of arbitrary action, unprogressiveness and waste of capital. Even in matters like public safety it is by no means certain that government authorities will do so well as private ones. The question is one which practical railway men have long since ceased to argue on general principles; they recognize that the answer depends upon the respective degree of talent and integrity which characterize the business community on the one hand and the government officials on the other.

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BRITISH RAILWAY LEGISLATION

Construction.

The first thing a railway company in Great Britain has to do is to obtain a special or private act of parliament authorizing the construction of the line. Not that the mere laying or working of a railway requires parliamentary sanction, so long as the work does not interfere with other people's rights and interests. An example of a railway built without any legislative authority is the little mountain railway from Llanberis to the summit of Snowdon, which was made by the owner of the land through which it passes. Such a railway has no statutory rights and no special obligations, and the owner of it is liable to be sued for creating a nuisance if the working of the line interferes with the comfort of those residing in the neighbourhood. When, however, a company desires to construct a line on a commercial scale, to acquire land compulsorily, to divert rivers and streams, to cross roads either on the level or by means of bridges, to pass near houses, to build tunnels or viaducts, and to execute all the other works incidental to a railway, and to work the line when completed without interference, it is essential that the authority of parliament should be obtained. The company therefore promotes a bill, which is considered first by select committees of the two houses of parliament, and afterwards by the two houses themselves, during which period it faces the opposition, if any, of rival concerns, of local authorities and of hostile landowners. If this is successfully overcome, and the proposals meet with the approval of parliament, the bill is passed and, after securing the Royal Assent, becomes an act of parliament. The company is then free to proceed with the work of construction, and at once becomes subject to various general acts, such as the Companies Clauses Act, which affects all joint-stock companies incorporated by any special act; the Land Clauses Act, which has reference to all companies having powers to acquire land compulsorily; the Railway Clauses Act, which imposes certain conditions on all railways alike (except light railways); the various Regulation of Railways Acts; the Carriers Protection Act; acts for the conveyance of mails, parcels, troops; acts relating to telegraphs, to the conveyance of workmen and to the housing of the labouring classes; and several others which it is unnecessary to specify. From the early days of railways parliament has also been careful to provide for the safety of the public by inserting in the general or special acts definite conditions, and by laying upon the Board of Trade the duty of protecting the public using a railway.

Inspection.

The first act which has reference to the safety of passengers is the Regulation of Railways Act of 1842, which obliges every railway company to give notice to the Board of Trade of its intention to open the railway for passenger traffic, and places upon that public department the duty of inspecting the line before the opening of it takes place. If the officer appointed by the Board of Trade should, after inspection of the railway, report to the department that in his opinion "the opening of the same would be attended with danger to the public using the same, by reason of the incompleteness of the works or permanent way, or the insufficiency of the establishment for working such railway," it is lawful for the department to direct the company to postpone the opening of the line for any period not exceeding one month at a time, the process being repeated from month to month as often as may be necessary. The company is liable to a fine of twenty pounds a day if it should open the line in contravention of such order or direction. The inspections made by the officers of the Board of Trade under this act are very complete: the permanent way, bridges, viaducts, tunnels and other works are carefully examined; all iron or steel girders are tested; stations, including platforms, stairways, waiting-rooms, &c., are inspected; and the signalling and "interlocking" are thoroughly overhauled. A code of requirements in regard to the opening of new railways has been drawn up by the department for the guidance of railway companies, and as the special circumstances of each line are considered on their merits, it rarely happens that the department finds it necessary to prohibit the opening of a new railway. The Regulation of Railways Act of 1871 extends the provisions of the above act to the opening of "any additional line of railway, deviation line, station, junction or crossing on the level" which forms a portion of or is connected with a passenger railway, and which has been constructed subsequently to the inspection of it. This act further defines the duties and powers of the inspectors of the Board of Trade, and also authorizes the Board to dispense with the notice which the previous act requires to be given prior to the opening of a railway.

It may be remarked that neither of these acts confers on the Board of Trade any power to inspect a railway after it has once been opened, unless and until some addition or alteration, such as is defined in the last-named act, has been made. When a line has once been inspected and passed, it lies with the company to maintain it in accordance with the standard of efficiency it originally possessed, but no express statutory obligation to do so is imposed upon the company, and whether it does so or not, the Board of Trade cannot interfere.

Inquiries into Accidents.

The act of 1871 further renders it obligatory upon every railway company to send notice to the Board of Trade in the case of (1) any accident attended with loss of life or personal injury to any person whatsoever; (2) any collision where one of the trains is a passenger train; (3) any passenger train or part of such train leaving the rails; (4) any other accident likely to have caused loss of life or personal injury, and specified on that ground by any order made from time to time by the Board of Trade. The department is authorized, on receipt of such report, to direct an inquiry to be made into the cause of any accident so reported, and the inspector appointed to make the inquiry is given power to enter any railway premises for the purposes of his inquiry, and to summon any person engaged upon the railway to attend the inquiry as a witness, and to require the production of all books, papers and documents which he considers important for the purpose. The inspector, after making his investigation, is required to make a report to the Board of Trade as to the causes of the accident and the circumstances attending the same, with any observations on the subject which he deems right, and the Board "shall cause every such report to be made public in such manner as they think expedient." The usual mode of publishing such reports is to forward them to railway companies concerned, as well as to the press, and on application to any one else who is interested. The reports are subsequently included in a Blue-book and presented to parliament. It should be noted that although the inspecting officer may in his report make any recommendations that he may think fit with a view to guarding against any similar accident occurring in the future, no power is given to the Board of Trade, or to any other authority, to compel any railway company to adopt such recommendations. This omission is sometimes held to be an error, but as a fact it is an advantage. The moral effect of the report, with the criticisms of the company's methods and recommendations appended thereto, is great, and it rarely happens that a company refuses to adopt, or at any rate to test, the recommendations so made. If, on the other hand, the company is of opinion that the suggestions of the inspecting officer are not likely to prove beneficial, or are for any reason unadvisable, it is at liberty to reject them, the responsibility of doing so resting entirely upon itself. The effect of this latitude is to give the company ample discretion in the matter, and to enable the act to be administered and the object of it to be attained without undue interference.

Working.

In 1889 a very important act was passed placing upon the Board of Trade the obligation to call upon railway companies throughout the United Kingdom (1) to adopt upon all passenger lines the "block" system of working; (2) to "interlock" their points and signals; (3) to fit all trains carrying passengers with some form of automatic continuous brake. Prior to this some companies had, to a certain extent, done these things, but few, if any, were completely equipped in these respects. A reasonable period was afforded them, according to circumstances, to comply with these requirements, and at the present time the work is practically complete. In this respect the lines of the United Kingdom are far ahead of those of any other country, and a diminution of accidents, particularly of collisions, has resulted therefrom. America is now following the lead thus set, and all the most important lines in the United States have adopted block working and interlocking, but a great deal still remains to be done. In certain respects, on the other hand, America has gone further than the United Kingdom, especially in the matter of automatic signalling, and in the operating of points and signals by electrical power or air-pressure instead of manual labour. In America, also, freight trains are fitted with an automatic continuous brake, whereas in the United Kingdom this appliance is required by law only in the case of passenger trains, and in fact is not fitted to goods and mineral trains except in a few isolated instances.

Hours of Labour.

The above-named acts enable the Board of Trade to take all the necessary steps to ensure that the safety of passenger trains is sufficiently guarded. More recently legislation has been passed to safeguard the lives and interests of railway servants. In 1893 an act was passed by parliament giving the Board power to interfere if or when representations are made to them by or on behalf of any servant or class of servants of a railway company that the hours of work are unduly long, or do not provide sufficient intervals of uninterrupted rest between the periods of duty, or sufficient relief in respect of Sunday duty. In such cases the company concerned may, after inquiry, be called upon to submit such a schedule of the hours during which the man or men are employed as will bring those hours within limits which appear to the department reasonable. In the event of the company failing to comply with the demands of the department, the latter is empowered to refer the case to the Railway and Canal Commissioners, who form a special Court constituted by the Railway and Canal Traffic Act of 1888, for deciding, among other things, questions relating to rates and charges, for protecting traders from undue charges and undue preference, for regulating questions of traffic, and for deciding certain disputes between railway companies and the public. The Commissioners are then empowered to deal with the matter, and if "a railway company fail to comply with any order made by the Railway and Canal Commissioners, or to enforce the provisions of any schedule" approved by them, it is liable to a fine of a hundred pounds for every day during which the default continues. This act has been the means of effecting a considerable reduction in the hours worked by railway men on certain railways, and no case has yet arisen in which a reference to the Commissioners has been necessary. Such modifications of the hours of work have not only been beneficial to the men, but have improved the discipline of the staff and the punctuality and regularity of the train service, particularly in respect of the goods trains.

The Notice of Accidents Act of 1884, which obliges employers of labour to report to the Board of Trade, when "there occurs in any employment" as defined by the schedule of the act, "any accident which causes to any person employed therein, either loss of life or such bodily injury as to prevent him on any one of the three working days next after the occurrence of the accident from being employed for five hours on his ordinary work," affects railways in course of construction, but not, as a rule, otherwise.

Safety of Servants.

Although the administration of the above-mentioned acts of parliament has had a beneficial effect upon the safety of the public, and has enabled an enormous volume of traffic to be handled with celerity, punctuality and absence of risk, it has during recent years come to notice that the number of casualties among railway servants is still unduly great, and in 1899 a Royal Commission was appointed to investigate the causes of the numerous accidents, fatal and non-fatal, to railway men. As a consequence of the report of this Commission the Railway Employment (Prevention of Accidents) Act of 1900 was passed, putting upon the Board of Trade the duty of making "such rules as they think fit with respect to any of the subjects mentioned in the schedule to this act, with the object of reducing or removing the dangers and risks incidental to railway service." Rules may also be made in respect to other matters besides those mentioned in the schedule, and companies may be called upon to adopt or reject, as the case may be, any appliance, the use or disuse of which may be considered desirable in the interest of the men. Before, however, the rules so made become binding upon the companies, the latter have the right of appealing against them to the Railway Commissioners. Failure to comply with any of the rules renders a company "liable for each offence, on conviction under the Summary Jurisdiction Acts, to a fine not exceeding fifty pounds, or in the case of a continuing offence to a fine not exceeding ten pounds for every day during which the offence continues after conviction." Rules drafted by the Board of Trade under this act came into force on the 8th of August 1902, the subjects referred to being (1) labelling of wagons; (2) movements of wagons by propping and tow-roping; (3) power-brakes on engines; (4) lighting of stations and sidings; (5) protection of points, rods, &c.; (6) construction and protection of gauge-glasses; (7) arrangement of tool-boxes, &c., on engines; (8) provision of brake-vans for trains upon running lines beyond the limits of stations; (9) protection to permanent-way men when relaying or repairing permanent way. The final settlement of a rule requiring brake-levers to be fitted on both sides of goods-wagons was, however, deferred, owing to objections raised by certain of the railway companies.

Other acts which are of importance in connexion with accidents are the Accidents Compensation Act of 1846, the Employers' Liability Act of 1880, and the Workmen's Compensation Act of 1897.

The public acts of parliament referring to British railways are collected in Bigg's *General Railway Acts.* (H. A. Y.)

AMERICAN RAILWAY LEGISLATION

Before 1870.—The earliest legislation is contained in charters granted by special act, for the construction of railways. These special acts gradually gave way to general statutes under which railway corporations could be created without application to the legislature. In the east, where, as a rule, charters had been uniform and consistent, the change to general incorporation law was due to a desire to render incorporations speedier and less expensive. In the west, general laws came rather as a result of the abuses of special legislation. By 1850, general incorporation laws were found in nearly all the eastern states, and by 1870 in those of the west.

Early legislation was confined almost entirely to matters of construction. In cases where statutes did touch the question of regulation, they had to do with the operation of trains and with the provision of facilities for shippers and passengers, rather than with questions of rates. It was natural that this should be so, for the new transportation agency was so much more efficient than anything previously available that the people were eager to take advantage of its superior service. As a rule, the making of rates was left to the corporations. If the maximum rates were prescribed, as they sometimes were, the limit was placed so high as to be of no practical value for control. Such crude attempts as were made to prevent rates from being excessive concerned themselves with profits, and were designed to confiscate for the state treasury any earnings beyond a certain prescribed dividend. Publicity of rates was not generally required, and provisions against discrimination were rare. In the period before 1850 there was but little realization of the public nature of the railway industry and of the possibilities of injury to the public if railway corporations were left uncontrolled.

In regions where capital was lacking eagerness for railway facilities led the people to demand the direct co-operation of the state, and many projects, most of which ended in disaster, were undertaken either by the state itself or through the aid of the state's credit. For example, Michigan, in 1837, in the first session of its state legislature, made plans for the construction of 557 miles of railway under the direct control of the state, and the governor was authorized to issue bonds for the purpose. The unfortunate results of this policy led many of the states, from about 1850, to put constitutional limitations upon the power of their legislatures to lend the state's credit or to involve the state as stockholder in the affairs of any corporation.

As railway building increased in response to traffic needs, and as the consolidation of short lines into continuous systems proceeded, legislation applicable to railways became somewhat broader in scope and more intelligent. About 1850 there began to appear on the statute books laws requiring publicity of rates and the submission of annual reports to the legislature, prescribing limits to corporate indebtedness, and also making provision for safety in operation and for the character and quality of railway service. Consolidation and leasing were commonly permitted in the case of continuous lines, but were regularly prohibited in the case of parallel and competing lines. The practice of pooling seems not to have attracted the attention of the legislature. In general it may be asserted that legislation of this period was ill-considered, haphazard, and on a petty scale. Moreover, it was of little practical importance even within its narrow range, for it does not appear to have been generally enforced.

1870–1900.—Railway legislation first assumed importance in connection with the "Granger Movement" in the middle west. There the policy of subsidies for railway building had been carried to a reckless extreme. Roads had been constructed in advance of settlement, and land-seekers had been transported to these frontier sections only to become dependent upon the railways for their very existence. To the unusual temptations thus offered for favouritism and discriminations in rates, the railways generally yielded. This preferential and discriminating policy, combined with other causes which cannot here be discussed, resulted in the Granger legislation of the 'seventies. In the first instance laws were enacted prescribing schedules of maximum freight and passenger rates with stringent penalties against rebates and discriminations. These measures proving unsatisfactory, they were soon superseded by statutes creating railway commissions with varied powers of regulation. The commission method of control was not a new one. Such bodies, established to appraise land for railway purposes, to apportion receipts and expenditures of interstate traffic, and in a general way to supervise railway transportation, had been in existence in New England before 1860, one of the earliest being that of Rhode Island in 1839. In 1869 Massachusetts had instituted a commission of more modern type, which was given only powers of investigation and recommendation, the force of public opinion being relied upon to make its orders effective. Western commissions, the offspring of the Granger movement, were of a more vigorous type. Most of them had power to impose schedules of maximum rates; practically all of them had authority to prescribe rates upon complaint of shippers; and they could all seek the aid of the courts to enforce their decrees. Their power to initiate rates, conferred upon them by their legislatures, was sustained by the Supreme Court of the United States, the Court reserving to itself only the power to decide whether the prescribed rates were reasonable.

But the jurisdiction of the state commissions was, by judicial interpretation, limited to commerce beginning and ending within the limits of the single state. The most important part of railway transportation, that which was interstate in character, was left untouched. It was this impotence of the state commission that furnished the strongest incentive to Congressional action. The result was the passage, in 1887, of the Interstate Commerce Act, which was directed towards the extirpation of illegal and unjust practices in commerce among the states. Its primary purpose was to embody in statutory form the common-law principle of equal treatment under like circumstances, and to provide machinery for enforcement. It aimed at the prohibition of discrimination between persons, places and commodities. It made provision for publicity of rates and for due notice of any change in rates; it forbade pooling of freight or earnings, and required annual reports from the carriers. For its enforcement, it created an Interstate Commerce Commission of five members, with powers of investigation, and with authority to issue remedial orders upon complaint and after hearing. Findings of the Commission were to be prima facie evidence in any court proceeding for the enforcement of its orders.

In this connexion, reference should be made to the Anti-Trust Act of 1890, which, by its judicial interpretation, has been held to include railways and to forbid rate agreements between competing carriers.

The act of 1887 remained in force without substantial amendment until 1906, although with constantly diminishing prestige, a result largely due to adverse decisions concerning the powers of the Commission. Ten years after the passage of the law, the court decided that the Commission had no power to prescribe a rate, and that its jurisdiction over rates was confined to a determination of the question whether the rate complained of was unreasonable. The Commission had much difficulty at the beginning in securing the testimony of witnesses, who invoked the Constitution of the United States as a bar against self-incrimination, and the immunity clause of the act had to be amended before testimony could be obtained. The so-called "long-and-short-haul clause," which forbade a greater charge for a long than for a short haul over the same line, if circumstances were substantially similar, was also robbed of all its vitality by court decision. The section requiring annual reports, while it led to the creation of a Bureau of Statistics, did not give the Commission power to compel complete or satisfactory answers to its requests for information. The only element of real strength that the statute acquired during the first twenty years of its history came from the Elkins Act of 1903, which stipulated that the published rate should be the legal rate, and declared any departure from the published rate to be a misdemeanour. It held shipper as well as carrier, and corporation as well as its officer or agent, liable for violations of the act, and conferred upon United States courts power to employ equity processes in putting an end to discrimination. Conviction for granting rebates was by this law made easier and more effective.

Since 1900.—The movement in favour of more vigorous railway regulation became pronounced after 1900. Twenty years of experience and observation had revealed the defects of the earlier legislation, and had concentrated public attention more intelligently than ever before upon the problem of strengthening the weak spots. The state commissions, since their establishment in the 'seventies and the 'eighties, had increased their functions and influence. Many of them, beginning only with powers of recommendation, had obtained a large extension of authority. By 1908, thirty-five of the forty state commissions were of the mandatory type, and thirteen of these had been created since 1904. They had been given power to require complete annual reports from carriers, with a consequent great increase in public knowledge concerning railway operation and practice. The most recent type of state commission is the so-called Public Utility Commission, of which the best examples are those of New York and Wisconsin, established in 1907. In both states, the Commissions have power over electric railways and local public utilities furnishing heat, light and power, as well as over steam railway transportation, and the Wisconsin Commission also has control over telephone companies. In both states the consent of the Commission is necessary for the issue of corporate securities.

Mention should be made of the mass of general legislation passed, principally by western states, since 1905, in response to a popular demand for lower rates. This demand has in many instances led to ill-considered legislation, has frequently ignored the prerogatives and even the existence of the state commissions, and has brought about the passage by state legislatures of maximum freight and passenger rate laws, with rates so low in many cases that they have been set aside by the courts as unconstitutional. The numerous laws limiting the fare for passengers to two cents per mile are an illustration of this tendency.

In the field of federal legislation, no significant change took place until the passage of the Hepburn Act of 1906, which was an amendment of the act of 1887. While failing to correct all the defects in the original statute, the amended law was a decided step in the direction of efficient regulation. It increased the jurisdiction of the Commission by placing under the act express companies, sleeping-car companies and pipe lines for the transportation of oil. It extended the meaning of the term "railroad" to include switches, spurs and terminal facilities, and the term "transportation" to include private cars, and all collateral services, such as refrigeration, elevation and storage. The Elkins Act of 1903 was incorporated in the statute, and an imprisonment penalty was added to the existing fine. It forbade the granting of passes except to certain specified classes, —a provision entirely absent from the original measure. It expressly conferred upon the Commission the power to prescribe maximum rates, upon complaint and after hearing, as well as to make joint rates, and to establish through rates when the carriers had themselves refused to do so. It enacted that published rates should not be changed except on thirty days' notice, whether the change involved an increase or a decrease, and it required annual reports to be made under oath, penalties being prescribed for failure to comply with the Commission's requests for information. Power was also given to prescribe uniform systems of accounts for all classes of carriers, and to employ special examiners to inspect the books and accounts. Carriers were forbidden to keep any accounts, records or memoranda other than those approved by the Commission.

Orders of the Commission became effective within such time, not less than thirty days, as the Commission should prescribe, and penalties began to take effect from the date fixed by the Commission, unless the carrier secured an injunction from the Court suspending the order. Such injunction might not issue except after hearing, of which five days' notice must be given. Decisions of the Commission were not reviewable by the Court unless the Commission had exceeded its authority, or had issued an unconstitutional order.

A new and important act was signed by the President on the 18th of June 1910. It created a Commerce Court (composed of five judges nominated by the president of the United States from the Federal circuit judges), transferred to it jurisdiction in cases instituted to enforce or set aside orders of the Inter-State Commerce Commission, and made the United States instead of the Commission a party in all such actions. The law forbids a railway or any other common carrier to charge more for a short haul than for a long haul over the same line, unless, in special cases, it is authorized to do so by the Commission. It forbids a railway which has reduced its rates while in competition with a water route to raise them again when the competition has ceased, unless the Commission permits it to do so because of other changed conditions. It extends the initiative of the Commission from the investigation of complaints to the investigation of rates on its own motion; authorizes it to suspend rates in advance of their going into effect, pending an investigation which may be continued for ten months, and to establish through routes; and provides for a special commission, appointed by the President, to investigate questions pertaining to the issuance of railway securities.

Bibliography.—See A. T. Hadley, *Railroad Transportation* (New York, 1885); B. H. Meyer, *Railway Legislation in the United States* (New York, 1903); F. A. Cleveland and F. W. Powell, *Railroad Promotion and Capitalization in the United States* (New York, 1909); L. H. Haney, *A Congressional History of Railways* (2 vols., Madison, Wis., 1908 and 1910); *Elkins Committee Report* (1905); F. H. Dixon, "The Interstate Commerce Act as Amended," *Quarterly Journal of Economics*, xxi. 22 (Nov. 1906); F. H. Dixon, "Recent Railroad Commission Legislation," *Political Science Quarterly*, xx. 612 (Dec. 1905). (F. H. D.*)

Accident Statistics

Statistics of railway accidents may be divided into three classes: casualties (*a*) to passengers, (*b*) to servants or *employés* and (*c*) to other persons; and again into (1) train accidents, (2) accidents to persons doing work on or about trains and (3) other accidents.

Such statistics are studied mainly with the object of learning the lessons which they may afford as to preventive measures for the future; and from this point of view the most important element is the single item of passengers killed in train accidents (*a* 1). The number injured is, indeed, a fact of interest, no less than the number killed, but comparisons under this head are unsatisfactory because it is impracticable or unprofitable to go into sufficient detail to determine the relative seriousness of the injuries. The statistics of the killed usually afford all necessary stimulus to improvement. Accidents to passengers other than those caused by collisions or derailments of trains are very largely due to causes which it is fair to class either as unavoidable or as due mainly to the fault or carelessness of the victim himself. That this is so is indicated by the fact that, although the railways—always made to suffer severely in pecuniary damages for injuries for which their officers or servants are held responsible by the courts—have for years taken almost every conceivable precaution, the number of accidents, in proportion to the number of persons travelling, diminishes but slowly—so slowly that, in view of the variety of conditions to be considered, it would hardly be safe to conclude that the diminution is due to any definite improvement in the safeguards provided. Collisions, on the other hand, are preventable, and derailments nearly so, and the records of deaths and injuries in this class in successive years are therefore justly taken as an index to the efficiency with which the railways are managed.

The number of servants killed in train accidents is the next in importance. The safety of passengers is, indeed, the first care of the railway manager; but the *employés*, exposed to many risks from which the passengers are protected, must be looked after. On the British railways the men who run the trains are safeguarded very efficiently, and the collisions and derailments which are serious enough to do injury to the trainmen or the enginemen are really rare. The roadway, tracks and rolling stock are so well maintained that those causes which lead to the worst derailments have been eliminated almost completely, and the record of serious collisions has been reduced nearly to zero by the universal use of the block system and by systematic precautions at junctions. In America the record is far less satisfactory. The best railways of the United States and Canada have, indeed, been greatly improved, and their main lines approach the high standards of safety which prevail in Great Britain, both as regards maintenance and care of roadway and vehicles (as a preventive of derailments) and the use of the block system (as a preventive of collisions); but when the inquirer looks at America as a whole—the total length of lines in the United States being over 230,000 m., ten times the total of the United Kingdom—he is considering a figure which includes an enormous mileage of railway lying in thinly settled regions where the high standards of safety maintained on the best railways have scarcely been thought of. The duty of a railway with deficient plant or facilities would seem to be to make up for their absence by moderating the speeds of its trains, but public sentiment in America appears so far to have approved, at least tacitly, the combination of imperfect railways and high speeds.

Apart from collisions and derailments, a large proportion of all accidents is found to be due primarily to want of care on the part of the victims. Accidents to workmen in marshalling, shunting, distributing and running trains, engines and cars, may be taken as the most important class, after train accidents, because this work is necessary and important and yet involves considerable hazard. On British railways the duty of the companies to provide all practicable safeguards and to educate and caution the servants may be said to have been faithfully performed, and the accident totals must be taken as being somewhat near the "irreducible minimum"—unless some of the infirmities of the human mind can be cured. In America the number of men killed and injured in handling freight trains has been very large. In the year ending June 30, 1909, exclusive of casualties due to collisions, derailments and other accidents to trains, the number killed was 811 and of injured 28,156 (*Accident Bulletin*, No. 32, p. 14). The number killed (811) is equal to about three in every thousand trainmen employed. From this and all other causes, the number of trainmen killed in the year ending June 30, 1909, was about 8 in 1000.

The use of automatic couplers for freight cars throughout the United States, introduced in 1893–1900, greatly reduced the number of deaths and injuries in coupling, and the use of air brakes on freight cars, now universal, has reduced the risk to the men by making it less necessary for them to ride on the roofs of high box-cars, while at the same time it has made it possible to run long trains with fewer men; but except in these two features the freight service in America continues to be a dangerous occupation. The high and heavy cars, the high speeds, the severe weather in the northern states in winter, the fluctuating nature of the business, resulting often in the employment of poorly qualified men and in other irregularities, are among the causes of this state of things.

Being struck or run over by a train while standing or walking on the track is the largest single cause of "railway accidents." Workmen are killed and injured in this way, both while on duty and when going to and from their work; passengers, with or without right, go in front of trains at stations and at highway crossings at grade level; and trespassers are killed and injured in large numbers on railways everywhere, at and near stations, at crossings, and out on the open road, where they have no shadow of right. Of trespassers the number killed per mile of line is about as large in England as in America, the density of population and of traffic in Great Britain apparently counterbalancing the laxity of the laws against trespassing in America. In the thickly settled parts of the United States the number of trespassers killed on the railway tracks, including vagrants who suffer in collisions and derailments while stealing rides, is very large. In New York and four adjacent states, having about as many miles of railway as the United Kingdom, the number in the year ending June 30, 1907, was 1552. In the United Kingdom the number for the corresponding year was 447, or less than one-third.

As was suggested at the outset, railway accident statistics are useful only as showing how to make life and limb safer, though in pursuing this object increased economy should also be secured. Railways have always been held by the legislatures and by the courts strictly accountable for their shortcomings, so far as accountability can be enforced by compelling the payment of damages to victims of accidents; but in spite of this, a want of enterprise and even some apparent neglect of passengers' and servants' plain rights, have often been apparent, and the Board of Trade, with its powers of supervision, inspection and investigation, must therefore be classed as one of the most beneficent factors in the promotion of safety on British railways. Its powers have been exercised with the greatest caution, yet with consistent firmness; and the publicity which has been given to the true and detailed causes of scores and scores of railway accidents by the admirable reports of the Board of Trade inspectors has been a powerful lever in improving the railway service. Useful compulsory laws regarding the details of train management are difficult to frame and hard to carry out; but the Board has exercised a persistent persuasiveness and has secured most of its objects. Its investigations justified the law making the block system compulsory, thus removing the worst danger of railway travel. Its constant and impartial expositions of cases of over-work and insufficient training of *employés* have greatly helped to elevate the character of these *employés*.

In the United States the governments have done far less. A majority of the states have railway commissions, but the investigation of railway accidents, with comparatively few exceptions, has not been done in such a way as to make the results useful in promoting improved practice. Many of the commissions have done little or nothing of value in this respect. The Federal government, having authority in railway matters only when interstate traffic is affected, gathers statistics and publishes them; but in the airing of causes—the field in which the British Board of Trade has been so useful—nothing so far has been done except to require written reports monthly from the railways. These are useful so far as they go, but they lack the impartiality that would be secured by an inquiry such as is held in England.

TABLE X.—CASUALTIES ON THE RAILWAYS OF THE UNITED KINGDOM

	1908.		1907.	
	Killed.	Injured.	Killed.	Injured.
Passengers:—				
1. In train accidents	0	283	18	534
2. Other accidents in or around trains, &c.	102	2,242	102	2,132
3. Other causes	5	863	5	836
Total of passengers	107	3,388	125	3,502
Servants:—				
4. In train accidents	6	164	13	236
5. Other accidents in or around trains, &c.	376	4,976	441	5,577
6 Other causes	50	19,041	55	15,701
Total of servants	432	24,181	509	21,514
Other Persons:—				
7 In train accidents	0	7	5	11
8. At level crossings	51	44	50	30
9. Trespassing on line	291	99	278	115
10. Suicides (including unsuccessful attempts)	188	19	169	18
11. On business at stations	32	580	36	618
12. Miscellaneous	27	167	39	167
Total of "other persons"	589	916	577	959
Grand total	1,128	28,485	1,211	25,975

The casualties enumerated in items 1, 4 and 7 of Table X. aggregate 6 killed and 454 injured; the six deaths were due to collisions, while of the cases of injury 372 occurred by collisions, 47 by derailments, and 35 by other accidents to trains. This undoubtedly is the greatest record for train safety ever known in the world. Item 1 shows no passengers killed in train accidents during the year. This was the case once before, in 1901; and the total of fatal accidents to passengers and servants, taken together, has in several years been very low (1896, eight; 1901, eight; 1902, ten; 1904, thirteen), but never before was it down to six.

Items 2 and 5 in Table X. are made up of the classes of accidents shown in Table XI.

TABLE XI.—DETAIL CAUSES OF CERTAIN ACCIDENTS

	Year 1908.	
	Killed.	Injured.
Item 2, Passengers:—		
1. From falling between trains and platforms—		
(*a*) When entering trains	21	53
(*b*) When alighting from trains	2	110
2. From falling on to the platform, ballast, &c.:—		
(*a*) When entering trains	5	115
(*b*) When alighting from trains	10	874
3. From falling off platforms and being struck or run over by trains	8	19
4. While crossing the line at stations—		
(*a*) Where there is either a subway or footbridge	9	6
(*b*) Where there is neither a subway nor footbridge	9	6
5. By the closing of carriage doors	..	748
6. From falling out of carriages during the running of trains	19	64
7. By other accidents	19	247
Total of passengers	102	2242
Item 5, Servants:—		
By accidents occurring during shunting operations, viz.—		
1. While coupling or uncoupling vehicles	16	675
2. By coming in contact, while riding on vehicles, with other vehicles, &c., standing on adjacent lines	2	19
3. While passing over, under, or standing on buffers.	2	13
4. When getting on or off, or falling off engines, wagons, &c.	4	278
5. While braking, spragging, or chocking wheels	15	627
6. While attending to ground-points	1	98
7. While moving vehicles by capstans, turntables, props, levers, &c.	16	498
8. By other accidents not included in the preceding	41	587
9. From falling off trains, engines, &c., in motion	5	43
10. When getting on or off engines, vans, &c., during the running of trains	2	226
11. By coming in contact with over-bridges or erections on the sides of the line	5	53
12. While attending to the machinery, &c., of engines in motion	2	674
13. While working on the permanent-way, sidings, &c.	52	100
14. While attending to gates at level-crossings	3	3
15. While walking, crossing or standing on the line on duty:—		
(*a*) At stations	84	245
(*b*) At other parts of the line	40	46
16. From being caught between vehicles	23	95
17 From falling, or being caught between trains and platforms, walls, &c.	10	70
18 While walking, &c., along the line to or from work	34	31
19. Miscellaneous	19	595
Total of servants	376	4976

Table XII. analyses the classes of accident comprised in items 3 and 6 of Table X.

TABLE XII.—DETAIL CAUSES OF CERTAIN ACCIDENTS

	1908.		1907.	
	Killed.	Injured.	Killed.	Injured.
Passengers:—				
a. While ascending or descending steps at stations	3	370	5	339
b. By being struck by barrows, by falling over packages, &c., on station platforms	..	142	.	122

TABLE XII.—DETAIL CAUSES OF CERTAIN ACCIDENTS—*continued.*

	1908. Killed.	1908. Injured.	1907. Killed.	1907. Injured.
c. From falling off platforms upon the ballast	1	105	..	110
d. By other accidents	1	246	..	265
Total of passengers	5	863	5	836
Servants:—				
1. While loading, unloading or sheeting wagons, trucks and horse-boxes	8	4,018	5	2,899
2. While moving goods and luggage in stations or sheds	2	1,992	2	975
3. While working at cranes or capstans	3	411	8	304
4. By the falling of wagon-doors, lamps, bales of goods, &c.	1	583	..	390
5. While attending to engines at rest	4	2,479	4	2,363
6. From falling off, or when getting on or off, engines or vehicles at rest	3	1,504	2	1,495
7. From falling off, or when getting on or off, platforms	1	483	2	404
8. From falling off ladders, scaffolds, &c.	11	449	11	400
9. By stumbling while walking on the line	2	1,068	1	1,049
10. By being trampled on or kicked by horses while engaged in railway work	1	94	..	71
11. From being struck by articles thrown from passing trains	..	7	..	6
12. From the falling of rails, sleepers, &c., when at work on the line	..	686	1	611
13. Otherwise injured when at work on the line or in sidings	5	2,182	5	1,981
14. Miscellaneous	9	3,085	14	2,753
Total of servants	50	19,041	55	15,701

TABLE XIII.—NATURE OF ACCIDENTS TO TRAINS, VEHICLES AND PERMANENT-WAY

	1908. United Kingdom.	1907. United Kingdom.
(*A*) Accidents to trains:—		
1. Collisions between passenger trains or parts of passenger trains	43	48
2. Collisions between passenger trains and goods or mineral trains or light-engines	78	70
3. Collisions between goods trains or parts of goods trains and light-engines	180	216
4. Collisions between trains and vehicles standing foul of the line	7	22
5. Collisions between trains and buffer-stops or vehicles standing against buffer-stops:—		
(*a*) From trains running into stations or sidings at too high a speed	20	17
(*b*) From other causes	15	25
6. Trains coming in contact with projections from other trains or vehicles on parallel lines	30	7
7. Passenger trains or parts of passenger trains leaving the rails	94	106
8. Goods trains or parts of goods trains, light-engines, &c., leaving the rails	407	483
9. Trains running through gates at level-crossings or into other obstacles	368	364
10. Fires in trains	195	170
11. Miscellaneous	3	4
(*B*) Accidents to or failure of rolling stock and permanent-way:—		
12. Bursting of boilers or tubes, &c., of engines	7	13
13. Failure of machinery, springs, &c., of engines	61	86
14. Failure of tires	125	172
15. ,, wheels	2	8
16. ,, axles	165	160
17. ,, couplings	2,346	2,440
18. ,, ropes used in working inclines	..	..
19. ,, tunnels, bridges, viaducts, culverts, &c.	3	..
20. Broken rails	287	289
21. Flooding of portions of permanent-way	24	40
22. Slips in cuttings or embankments	18	28
23. Fires at stations or involving injury to bridges or viaducts	30	22
24. Miscellaneous	1	..

Percentages.—On British railways the casualties from train accidents, especially fatal injuries, have been reduced to so small a proportion of the number of passengers travelling, or the number of servants employed, that the figures showing the percentages vary from year to year considerably; but in other classes of accidents, in which a large proportion of the cases may be classed as unpreventable, the percentages do not vary greatly. The following are the more significant ratios in the year 1907, as shown in the Board of Trade returns:—

(*a*) Passengers killed in train accidents, approximately (1908, 0 in 1,500,000,000.)	1 in 83,000,000
(*b*) Passengers injured in train accidents, approximately (1908, approximately 1 in 6,000,000.)	1 in 3,000,000
(*c*) Servants killed in train accidents:—	
Number of servants killed per 10,000,000 train miles	0·329
Engine drivers, ratio killed to number employed	1 in 5,628
Firemen, ratio killed to number employed	1 in 12,857
Passenger guards, ratio killed to number employed	1 in 4,237
Goods guards and brakemen, ratio killed to number employed	1 in 8,438
(*d*) Servants killed in work about trains, &c. (excluding train accidents), ratio killed to number employed	1 in 790
Goods guards and brakemen, ratio killed to number employed	1 in 409
Shunters, ratio killed to number employed	1 in 337
Engine drivers, ratio killed to number employed	1 in 1,126
Passenger guards, ratio killed to number employed	1 in 1,059

Railway Accidents in America.—The statistics of accidents in America are kept in a form somewhat different from the foregoing. Table XIV. is taken from the Accident Bulletin of the Interstate Commerce Commission (No. 32), the items being numbered to correspond as nearly as practicable with the numbers in the British table (No. X.). The items 7–8 embrace the statistics which most nearly correspond to the items 7–12 in the British table.

TABLE XIV.—CASUALTIES ON THE RAILWAYS OF THE UNITED STATES OF AMERICA

Year ending June 30.

	1909. Killed.	1909. Injured.	1908. Killed.	1908. Injured.
Passengers:—				
1. In train accidents	131	5,865	165	7,430
2, 3. Other causes	204	6,251	241	5,215
Total of passengers	335	12,116	406	12,645
Servants:—				
4. In train accidents	520	4,877	642	6,818
5, 6. Other causes	1,936	46,927	2,716	49,526
Total of servants	2,456	51,804	3,358	56,344

Year ending June 30, 1907.

Other Persons:—	Trespassing. Killed.	Trespassing. Injured.	Not Trespassing. Killed.	Not Trespassing. Injured.	Total. Killed.	Total. Injured.
7. In train accidents	97	171	52	1202	149	1373
8. Struck by trains at highway crossings	237	274	696	1523	933	1797
Do. at stations	421	423	89	259	510	682
Do. at other places	3732	2063	113	200	3845	2263
Other causes	1125	2581	94	1287	1219	3868
Total of "other persons"	5612	5512	1044	4471	6656	9983

The salient feature of Table XIV. is the diminution from 1908 to 1909. This is mainly due to a great falling off in traffic, because of a general business depression; from 1907 to 1909 the reduction in the accident record is still greater. In items 1 and 4 the increase in safety is due in part, no doubt, to the extension of the use of the block system. The accidents to "other persons" cannot readily be compared with items 7–12 in the British record, except as to the totals and a few of the items.

In any comparison between British and American records the first point to be borne in mind is the difference in mileage and traffic. The American railways aggregate approximately ten times the length of the British lines; but in train miles the difference is far less. In the latest years in which comparisons can be made, the passenger journeys in the United Kingdom amounted to 1500 millions (including season-ticket holders, estimated) and the train miles to 428·3 millions, while the corresponding figures in the United States were 873·9 millions and 1171·9 millions. The average length of the passenger's journey in the United States is reported to be about 32 m.; in Great Britain it is undoubtedly less, but no record is published. Of the total train mileage in America more than half is freight; in Great Britain much more than half is passenger.

TABLE XV.—TOTAL CASUALTIES ON RAILWAYS OF THE UNITED STATES

	1908.		1907.	
	Killed.	Injured.	Killed.	Injured.
Passengers	383	11,592	610	13,041
Employees	3,470	83,367	4,534	87,644
Other persons	6,460	10,275	6,695	10,331
Total	10,313	105,234	11,839	111,016

Table XV. shows the casualties on American railways in 1907 and 1908 (year ending June 30). These figures differ from those in Table XIV. because of differences in classification. In Table XIV. the item "passengers killed" includes those on some electric railways, which presumably are not covered in the statement here given; also passengers in freight trains, &c. Under "employees" this table includes men in shops, &c., not shown in Table XIV.

In 1907 one passenger in 2,318,051 was killed, and one in 107,004 was injured, in train accidents. The number of *employés* killed in train accidents was 12·9 in 10 million train miles. Of train men (including engine-drivers and firemen), one out of 125 employed was killed (all causes), and one in eight injured.

The great differences between the records of the United States and the United Kingdom seem to afford justification for the view, which has often been expressed, that in America the spirit of hurry and recklessness manifest in many of the activities of the people prevails even among the men on whom rests the grave responsibility of running trains in safety. Yet the best safety devices are made in America, and means of reducing these death records are well known.

France.—Railway accidents in France are recorded in a shape somewhat different from that found in either Great Britain or America. The principal items for the years 1906 and 1907 are shown in Table XVI. The length of railways in the republic was 39,963 km. (24,832 m.), the number of persons employed on them was rather less than 300,000, the number of passengers carried annually being between 450 and 500 millions. The number of passengers (36) killed in train accidents in 1907 was equal to 0·0759 per million passengers carried and 0·0024 per million kilometres travelled by passengers, or 0·1503 per million kilometres travelled by trains.

TABLE XVI.—RAILWAY CASUALTIES IN FRANCE

	1907.		1906.	
	Killed.	Injured.	Killed.	Injured.
In train accidents—				
Passengers	36	430	14	500
Servants	23	168	21	132
	59	598	35	632
Other accidents, due to railway operations—				
Passengers and others	11	39	14	29
Servants	18	24	8	17
	29	63	22	46
Other accidents, victim's own fault—				
Passengers and others	290	189	305	155
Servants	281	465	265	421
	571	654	570	576
Grand total	659	1315	627	1254

The most significant item in the table, 36 passengers killed in train accidents, is perhaps to be considered as abnormally large, the totals under this head for the preceding six years beginning with 1901 being 7, 35, 3, 18, 4, 14, or an average of 11·57 per year. The French secretary of Public Works, who has furnished these statistics, keeps also similar records of the local or light railways, on which the number of fatal accidents appears to be exceedingly small.

Germany.—The number of persons killed on the railways of the German Empire in the year 1907 was 1249, classified as in Table XVII. This number does not include suicides and attempts at suicide, of which there were 333, all but 24 being successful. In these statistics, the third item, "other persons," includes post office and customs officials and other persons connected with the railway service, as well as railway officers and servants off duty. The totals of passengers killed and injured in train accidents are not separated from those killed and injured from other causes, but ratios are given showing that for four years no passengers were killed in this class.

TABLE XVII.—RAILWAY CASUALTIES IN THE GERMAN EMPIRE
(From *Statistic der im Betriebe befindlichen Eisenbahnen*; E. S. Mittler & Son, Berlin)

	1907.		1906.	
	Killed.	Injured.	Killed.	Injured.
Passengers	135	653	118	597
Servants	714	1673	703	1513
Other persons	400	365	360	373
	1249	2691	1181	2483

See the *Quarterly and Annual Reports*, issued by the Board of Trade, London, and the *Annual Statistical Reports* and *Quarterly Accident Bulletins*, published by the Interstate Commerce Commission, Washington. (B. B. A.)

FINANCIAL ORGANIZATION

The methods of financing railway enterprises, both new projects and existing lines, have been influenced very largely by the attitude of the state and of municipal authorities. Railways may be built for military reasons or for commercial reasons, or for a combination of the two. The Trans-Siberian railway was a military necessity if Russia was to exercise dominion throughout Siberia and maintain a port on the Yellow Sea or the Sea of Japan. The Union Pacific railroad was a military necessity to the United States if the authority of the national government was to be maintained in the Far West. The cost of such ventures and the detailed methods by which they are financed are of relatively small importance, because they are not required to earn a money return on the investment. To a less degree, the same is true of railways built for a special instead of a general commercial interest. The Baltimore & Ohio railroad was built to protect and further the commercial interests of the city of Baltimore; the Cincinnati Southern railway is still owned by the city of Cincinnati, which built the line in the 'seventies for commercial protection against Louisville, Ky. From a commercial point of view such ventures are differentiated from railway projects built for general commercial reasons because they do not depend on their own credit. The government, national or local, furnishes the borrowing power, and makes the best bargain it can with the men it designates to operate the line.

Where a railway is built for general commercial reasons, however, it must furnish its own credit; that is to say, it must convince investors that it can be worked profitably and give them an assured return on the funds they advance. The state is interested in the commercial railway venture as a matter of public policy, and because it can confer or withold the right of eminent domain, without which the railway builder would be subjected to endless annoyance and expense. This governmental sanction has been obtainable only with difficulty, and after the exercise of numerous legal forms, in Great Britain and on the continent of Europe. In the United States, on the other hand, it has been obtained with considerable ease. In the earlier years of American railway building, each project was commonly the subject of a special law; then special laws were in turn succeeded by general railway laws in the several states, and these in turn have come to be succeeded in most parts of the country by jurisdiction vested in the state railway commission. Each of these changes has tended to improve the existing status, to legitimize railway enterprise, and to safeguard capital or investment.

The laws regulating original outputs for capital were strictly drawn in Great Britain and on the continent of Europe; in America they were drawn very loosely. As a result it has been far easier for the American than for the European railway builder to take advantage of the speculative instinct in obtaining money. Instead of the borrowing power being restricted to a small percentage of the total capital, as in European countries, most of the railway mileage of America has been built with borrowed money, represented by bonds, while stock has been given freely as an inducement to subscribe to the bonds on the theory that the bonds represented the cost of the enterprise, and the stock the prospective profits. As a natural result weak railway companies in the United States have frequently been declared insolvent by the courts, owing to their inability in periods of commercial depression to meet their acknowledged obligations, and in the reorganization which has followed the shareholders have usually had to accept a loss, temporary or permanent.

The situation in Great Britain has been wholly different. The debt in that country is relatively small in amount, and is not represented by securities based upon hypothecation of the company's real property, as with the American railway bond, resting on a first, second or third mortgage. But British share capital has been issued so freely for extension and improvement work of all sorts, including the costly requirements of the Board of Trade, that a situation has been reached where the return on the outstanding securities tends to diminish year by year. Although this fact will not in itself make the companies liable to any process of reorganization similar to that following insolvency and foreclosure of the American railway, it is probable that reorganization of some sort must nevertheless take place in Great Britain, and it may well be questioned whether the position of the transportation system of that country would not have been better if it had been built up and projected on the experience gained by actual earlier losses, as in the United States.

Thus the characteristic defect in the British railway organization has been the tendency to put out new capital at a rate faster than has been warranted by the annual increases in earnings. The American railways do not have to face this situation; but, after a long term of years, when they were allowed to do much as they pleased, they have now been brought sharply to book by almost every form of constituted authority to be found in the states, and they are suffering from increased taxation, from direct service requirements, and from a general tendency on the part of regulating authorities to reduce rates and to make it impossible to increase them. Meantime, the purchasing power of the dollar which the railway company receives for a specified service is gradually growing smaller, owing to the general increases year by year in wages and in the cost of material. The railways are prospering because they are managed with great skill and are doing increasing amounts of business, though at lessening unit profits. But there is danger of their reaching the point where there is little or no margin between unit costs of service and unit receipts for the service. It will probably be inevitable for American railway rates to trend somewhat upward in the future, as they have gradually declined in the past; but the process apparently cannot be accomplished without considerable friction with the governing authorities. The attitude of the courts is not that the railways should work without compensation, but that the compensation should not exceed a fair return on funds actually expended by the railway. This is in line with the provisions in the Constitution of the United States regarding the protection of property, but the difficulty in applying the principle to the railway situation lies in the fact that costs have to be met by averaging the returns on the total amount of business done, and it is often impossible, in specific instances, to secure a rate which can be considered to yield a fair return on the specific service rendered. Hence losses in one quarter must be compensated by gains in another—a process which the law, regarding only the gains, renders very difficult.

The growth of railways has been accompanied by a world-wide tendency toward the consolidation of small independent ventures into large groups of lines able to aid one another in the exchange of traffic and to effect economies in administration and in the purchase of supplies. Both in England and in America this process of consolidation has been obstructed by all known legislative devices, because of the widespread belief that competition in the field of transportation was necessary if fair prices were to be charged for the service. But the general tendency to regulate rates by authority of the state has apparently rendered unnecessary the old plan of rate regulation through competition, even if it had not been demonstrated often and again that this form of regulation is costly for all concerned and is effective only during rare periods of direct conflict between companies. Nevertheless, in spite of difficulties, consolidation has gone on with great rapidity. When Mr E. H. Harriman died he exercised direct authority over more than 50,000 m. of railway, and the tendency of all the great American railway systems, even when not tied to one another in common ownership, is to increase their mileage year by year by acquiring tributary lines. The smaller company exchanges its stock for stock of the larger system on an agreed basis, or sells it outright, and the bondholders of the absorbed line often have a similar opportunity to exchange their securities for obligations of the parent company, which are on a stronger basis or have a broader market. Similarly in Great Britain there is a tendency towards combination by mutual agreement among the companies while they still preserve their independent existence.

Table XVIII. shows the paid-up capital, gross receipts, net receipts and proportion of net receipts to total paid-up capital on the railways of the United Kingdom for a series of years.

TABLE XVIII.—BRITISH RAILWAYS

Year.	Route Miles.	Paid-up Capital.	Gross Receipts.	Net Receipts.	Percent Net to Capital.
1878	17,333	£698.545,154	£62,862,674	£29,673,306	4·25
1888	19,812	864,695,963	72,894,665	35,132,558	4·06
1898	21,659	1,134,468,462	96,252,501	40,291,958	3·55
1899	21,700	1,152,317,501	101,667,065	41,576,378	3·61
1900	21,855	1,176,001,890	104,801,858	40,058,338	3·41
1901	22,078	1,195,564,478	106,558,815	39,069,076	3·27
1902	22,152	1,216,861,421	109,469,720	41,628,502	3·42
1903	22,435	1,235,528,917	110,888,714	42,326,859	3·43
1904	22,634	1,258,294,681	111,833,272	42,660,741	3·39
1905	22,847	1,272,600,935	113,531,019	43,466,356	3·42
1906	23,063	1,286,883,341	117,227,931	44,446,077	3·45
1907	23,108	1,294,065,662	121,548,923	44,939,729	3·47
1908	23,205	1,310,533,212	119,894,327	43,486,526	3·32

A similar comparison (Table XIX.) can be made for the United States of America, statistics prior to the establishment of the Interstate Commerce Commission being taken from *Poor's Manual of Railroads* as transcribed in government reports.

TABLE XIX.—AMERICAN RAILWAYS

Year.	Route Miles.	Issued Capital.	Gross Receipts.	Net Receipts.†	Percent Net to Capital.
1878	81,747	$4,772,297,349	$490,103,351	$187,575,167	3·93
1888	156,114	9,281,914,605	960,256,270	301,631,051	3·25
1898	190,870	10,818,554,031	1,269,263,257	407,018,432	3·76
1899	194,336	11,033,954,898	1,339,655,114	435,753,291	3·95
1900	198,964	11,491,034,960	1,519,570,830	509,289,944	4·43
1901	202,288	11,688,147,091	1,622,014,685	540,140,744	4·62
1902	207,253	12,134,182,964	1,769,447,408	598,206,186	4·93
1903	213,422	12,599,990,258	1,950,743,636	634,924,788	5·04
1904	220,112	13,213,124,679	2,024,555,061	623,509,113	4·72
1905	225,196	13,805,258,121	2,134,208,156	679,518,807	4·92
1906	230,761	14,570,421,478	2,386,285,473	774,051,156	5·31
1907	236,949	*16,082,146,683	2,649,731,911	820,254,887	5·10
1908	237,389‡	16,767,544,827	2,393,805,989	651,561,587	3·88

* Includes $145,321,601 assigned to other than railway property, but earning net receipts.

† After taxes; to compare with British figures.

‡ This figure should be received with caution. The Interstate Commerce Commission made certain accounting changes this year.

(R. Mo.)

CONSTRUCTION

Location.—An ideal line of railway connecting two terminal points would be perfectly level and perfectly straight, because in that case the resistance due to gradients and curves would be eliminated (see § *Locomotive Power*) and the cost of mechanical operation reduced to a minimum. But that ideal is rarely if ever attainable. In the first place the route of a railway must be governed by commercial considerations. Unless it be quite short, it can scarcely ever be planned simply to connect its two terminal points, without regard to the intervening country; in order to be of the greatest utility and to secure the greatest revenue it must be laid out with due consideration of the traffic arising at intermediate places, and as these will not usually lie exactly on the direct line, deviations from straightness will be rendered necessary. In the second place, except in the unlikely event of all the places on the selected route lying at the same elevation, a line that is perfectly level is a physical impossibility; and from engineering considerations, even one with uniform gradients will be impracticable on the score of cost, unless the surface of the country is extraordinarily even. In these circumstances the constructor has two broad alternatives between which to choose. On the one hand he may make the line follow the natural inequalities of the ground as nearly as may be, avoiding the elevations and depressions by curves; or on the other he may aim at making it as nearly straight and level as possible by taking it through the elevations in cuttings or tunnels and across the depressions on embankments or bridges. He will incline to the first of these alternatives when cheapness of first cost is a desideratum, but, except in unusually favourable circumstances, the resulting line, being full of sharp curves and severe gradients, will be unsuited for fast running and will be unable to accommodate heavy traffic economically. If, however, cost within reasonable limits is a secondary consideration and the intention is to build a line adapted for express trains and for the carriage of the largest volume of traffic with speed and economy, he will lean towards the second. In practice every line is a compromise between these two extremes, arrived at by carefully balancing a large number of varying factors. Other things being equal, that route is best which will serve the district most conveniently and secure the highest revenue; and the most favourable combination of curves and gradients is that by which the annual cost of conveying the traffic which the line will be called on to carry, added to the annual interest on the capital expended in construction, will be made a minimum.

Cuttings and Embankments.—A cutting, or cut, is simply a trench dug in a hill or piece of rising ground, wide enough at the bottom to accommodate one or more pairs of rails, and deep enough to enable the line to continue its course on the level or on a moderate gradient. The slopes of the sides vary according to the nature of the ground, the amount of moisture present, &c. In solid rock they may be vertical; in gravel, sand, or common earth they must, to prevent slipping, rise 1 ft. for 1 to 1½ or 2 ft. of base, or even more in treacherous clay. In soft material the excavation may be performed by mechanical excavators or "steam navvies," while in hard it may be necessary to resort to blasting. Except in hard rock, the top width of a cutting, and therefore the amount of material to be excavated, increases rapidly with the depth; hence if a cutting exceeds a certain depth, which varies with the particular circumstances, it may be more economical, instead of forming the sides at the slope at which the material of which they are composed will stand, to make them nearly vertical and support the soil with a retaining wall, or to bore a tunnel. An embankment-bank, or fill, is the reverse of a cutting, being an artificial mound of earth on which the railway is taken across depressions in the surface of the ground. An endeavour is made so to plan the works of a railway that the quantity of earth excavated in cuttings shall be equal to the quantity required for the embankments; but this is not always practicable, and it is sometimes advantageous to obtain the earth from some source close to the embankment rather than incur the expense of hauling it from a distant cutting. As embankments have to support the weight of heavy trains, they must be uniformly firm and well drained, and before the line is fully opened for traffic they must be allowed time to consolidate, a process which is helped by running construction or mineral trains over them.

An interesting case of embankment and cutting in combination was involved in crossing Chat Moss on the Liverpool & Manchester railway. The moss was 4½ m. across, and it varied in depth from 10 to 30 ft. Its general character was such that cattle could not stand on it, and a piece of iron would sink in it. The subsoil was composed principally of clay and sand, and the railway had to be carried over the moss on the level, requiring cutting, and embanking for upwards of 4 m. In forming 277,000 cub. yds. of embankment 670,000 yds. of raw peat were consumed, the difference being occasioned by the squeezing out of the water. Large quantities of embanking were sunk in the moss, and, when the engineer, George Stephenson, after a month's vigorous operations, had made up his estimates, the apparent work done was sometimes less than at the beginning of the month. The railway ultimately was made to float on the bog. Where embankment was required drains about 5 yds. apart were cut, and when the moss between them was dry it was used to form the embankment. Where the way was formed on the level, drains were cut on each side of the intended line, and were intersected here and there by cross drains, by which the upper part of the moss was rendered dry and firm. On this surface hurdles were placed, 4 ft. broad and 9 long, covered with heath, upon which the ballast was laid.

Bridges.—For conveying small streams through embankments, channels or culverts are constructed in brickwork or masonry. Larger rivers, canals, roads, other railways and sometimes deep narrow valleys are crossed by bridges (*q.v.*) of timber, brick, stone, wrought iron or steel, and many of these structures rank among the largest engineering works in the world. Sometimes also a viaduct consisting of a series of arches is preferred to an embankment when the line has to be taken over a piece of flat alluvial plain, or when it is desired to economize space and to carry the line at a sufficient height to clear the streets, as in the case of various railways entering London and other large towns. In connexion with a railway many bridges have also to be constructed to carry public roads and other railways over the line, and for the use of owners or tenants whose land it has cut through ("accommodation bridges"). In the early days of railways, roads were often taken across the line on the level, but such "level" or "grade" crossings are now usually avoided in the case of new lines in populous countries, except when the traffic on both the road and the railway is very light. In many instances old level crossings have been replaced by over-bridges with long sloping approaches; in this way considerable expenditure has been involved, justified, however, by the removal of a danger to the public and of interruptions to the traffic on both the roads and the railways. In cases where the route of a line runs across a river or other piece of water so wide that the construction of a bridge is either impossible or would be more costly than is warranted by the volume of traffic, the expedient is sometimes adopted of carrying the wagons and carriages across bodily with their loads on train ferries, so as to avoid the inconvenience and delay of transshipment. Such train ferries are common in America, especially on the Great Lakes, and exist at several places in Europe, as in the Baltic between Denmark and Sweden and Denmark and Germany, and across the Straits of Messina.

Gradients.—The gradient or grade of a line is the rate at which it rises or falls, above or below the horizontal, and is expressed by stating either the horizontal distance in which the change of level amounts to 1 ft., or the amount of change that would occur in some selected distance, such as 100 ft., 1000 ft. or 1 m. In America a gradient of 1 in 100 is often known as a 1% grade, one of 2 in 100 as a 2% grade, and so on; thus a 0·25% grade corresponds to what in England would be known as a gradient of 1 in 400. The ruling gradient of a section of railway is the steepest incline in that section, and is so called because it governs or rules the maximum load that can be placed behind an engine working over that portion of line. Sometimes, however, a sharp incline occurring on an otherwise easy line is not reckoned as the ruling gradient, trains heavier than could be drawn up it by a single engine being helped by an assistant or "bank" engine; sometimes also "momentum" or "velocity" grades, steeper than the ruling gradient, are permitted for short distances in cases where a train can approach at full speed and thus surmount them by the aid of its momentum. An incline of 1 in 400 is reckoned easy, of 1 in 200 moderate and of 1 in 100 heavy. The ruling gradient of the Liverpool & Manchester railway was fixed at 1 in 900, excepting the inclines at Liverpool and at Rainhill summit, for working which special provision was made; and I. K. Brunel laid out the Great Western for a long distance out of London with a ruling gradient of 1 in 1320. Other engineers, however, such as Joseph Locke, cheapened the cost of construction by admitting long slopes of 1 in 80 or 70. One of the steepest gradients in England on an important line is the Lickey incline at Bromsgrove, on the Midland railway between Birmingham and Gloucester, where the slope is 1 in 37 for two miles. The maximum gradient possible depends on climatic conditions, a dry climate being the most favourable. The theoretical limit is about 1 in 16; between 1 in 20 and 1 in 16 a steam locomotive depending on the adhesion between its wheels and the rails can only haul about its own weight. In practice the gradient should not exceed 1 in 22½, and even that is too steep, since theoretical conditions cannot always be realized; a wet rail will reduce the adhesion, and the gradients must be such that some paying load can be hauled in all weathers. When an engineer has to construct a railway up a hill having a still steeper slope, he must secure practicable gradients by laying out the line in ascending spirals, if necessary tunnelling into the hill, as on the St Gothard railway, or in a series of zigzags, or he must resort to a rack or a cable railway.

Rack Railways.—In rack railways a cog-wheel on the engine engages in a toothed rack which forms part of the permanent way. The earliest arrangement of this kind was patented by John Blenkinsop, of the Middleton Colliery, near Leeds, in 1811, and an engine built on his plan by Mathew Murray, also of Leeds, began in 1812 to haul coals from Middleton to Leeds over a line 3½ m. long. Blenkinsop placed the teeth on the outer side of one of the running rails, and his reason for adopting a rack was the belief that an engine with smooth wheels running on smooth rails would not have sufficient adhesion to draw the load required. It was not till more than half a century later that an American, Sylvester Marsh, employed the rack system for the purpose of enabling trains to surmount steep slopes on the Mount Washington railway, where the maximum gradient was nearly 1 in 2½. In this case the rack had pin teeth carried in a pair of angle bars. The subsequent development of rack railways is especially associated with a Swiss engineer, Nicholas Riggenbach, and his pupil Roman Abt, and the forms of rack introduced by them are those most commonly used. That of the latter is multiple, several rack-plates being placed parallel to each other, and the teeth break joint at ½, ⅓ or ¼ of their pitch, according to the number of rack-plates. In this way smoothness of working is ensured, the cog-wheel being constantly in action with the rack. Abt also developed the plan of combining rack and adhesional working, the engine working by adhesion alone on the gentler slopes but by both adhesion and the rack on the steeper ones. On such lines the beginning of a rack section is provided with a piece of rack mounted on springs, so that the pinions of the engine engage smoothly with the teeth. Racks of this type usually become impracticable for gradients steeper than 1 in 4, partly because of the excessive weight of the engine required and partly because of the tendency of the cog-wheel to mount the rack. The Locher rack, employed on the Mount Pilatus railway, where the steepest gradient is nearly 1 in 2, is double, with vertical teeth on each side, while in the Strub rack, used on the Jungfrau line, the teeth are cut in the head of a rail of the ordinary Vignoles type.

Cable Railways.—For surmounting still steeper slopes, cable railways may be employed. Of these there are two main systems: (1) a continuous cable is carried over two main drums at each end of the line, and the motion is derived either (*a*) from the weight of the descending load or (*b*) from a motor acting on one of the main drums; (2) each end of the cable is attached to wagons, one set of which accordingly ascends as the other descends. The weight required to cause the downward motion is obtained either by means of the material which has to be transported to the bottom of the hill or by water ballast, while to aid and regulate the motion generally steam or electric motors are arranged to act on the main drums, round which the cable is passed with a sufficient number of turns to prevent slipping. When water ballast is employed the water is filled into a tank in the bottom of the wagon or car, its quantity, if passengers are carried, being regulated by the number ascending or descending.

Curves.—The curves on railways are either simple, when they consist of a portion of the circumference of a single circle, or compound, when they are made up of portions of the circumference of two or more circles of different radius. Reverse curves are compound curves in which the components are of contrary flexure, like the letter S; strictly the term is only applicable when the two portions follow directly one on the other, but it is sometimes used of cases in which they are separated by a "tangent" or portion of straight line. In Great Britain the curvature is defined by stating the length of the radius, expressed in chains (1 chain = 66 ft.), in America by stating the angle subtended by a chord 100 ft. long; the measurements in both methods are referred to the central line of the track. The radius of a 1-degree curve is 5730 ft., or about 86⅔ chains, of a 15-degree curve 383 ft. or rather less than 6 chains; the former is reckoned easy, the latter very sharp, at least for main lines on the standard gauge. On some of the earlier English main lines no curves were constructed of a less radius than a mile (80 chains), except at places where the speed was likely to be low, but in later practice the radius is sometimes reduced to 40 or 30 chains, even on high-speed passenger lines.

When a train is running round a curve the centrifugal force which comes into play tends to make its wheel-flanges press against the outer rail, or even to capsize it. If this pressure is not relieved in some way, the train may be derailed either (1) by "climbing" the outer rail, with injury to that rail and, generally, to the corresponding wheel-flanges; (2) by overturning about the outer rail as a hinge, possibly without injury to rails or wheels; or (3) by forcing the outer rail outwards, occasionally to the extent of shearing the spikes that hold it down at the curve, thus spreading or destroying the track. In any case the details depend upon whether the vehicle concerned is an engine, a wagon or a passenger coach, and upon whether it runs on bogie-trucks or not. If it is an engine, particular attention must be directed to the type, weight, arrangement of wheels and height of centre of gravity above rail level. In considering the forces that produce derailment the total mass of the vehicle or locomotive may be supposed to be concentrated at its centre of gravity. Two lines may be drawn from this point, one to each of the two rails, in a plane normal to the rails, and the ends of these lines, where they meet the rails, may be joined to complete a triangle, which may conveniently be regarded as a rigid frame resting on the rails. As the vehicle sweeps round the curve the centre of gravity tends to be thrown outwards, like a stone from a horizontal sling. The vertical pressure of the frame upon the outer rail is thus increased, while its vertical pressure on the inner rail is diminished. Simultaneously the frame as a whole tends to slide horizontally athwart the rails, from the inner towards the outer rail, urged by the same centrifugal forces. This sliding movement is resisted by placing a check rail on the inner side of the inner rail, to take the lateral thrust of the wheels on that side. It is also resisted in part by the conicity of the wheels, which converts the lateral force partly into a vertical force, thus enabling gravity to exert a restoring influence. When the lateral forces are too great to be controlled "climbing" occurs. Accidents due to simple climbing are, however, exceedingly rare, and are usually found associated with a faulty track, with "plunging" movements of the locomotive or vehicle, or with a "tight gauge" at curves or points.

From consideration of the rigid triangular frame described above, it is clear that the "overturning" force acts horizontally from the centre of gravity, and that the length of its lever arm is, at any instant, the vertical distance from the centre of gravity to the level of the outer rail. This is true whatever be the tilt of the vehicle at that instant. The restoring force exerted by gravity acts in a vertical line from the centre of gravity; and the length of its lever arm is the horizontal distance between this vertical line and the outer rail. If therefore the outer rail is laid at a level above that of the inner rail at the curve, overturning will be resisted more than would be the case if both rails were in the same horizontal plane, since the tilting of the vehicle due to this "superelevation" diminishes the overturning moment, and also increases the restoring moment, by shortening in the one case and lengthening in the other the lever arms at which the respective forces act. The amount of superelevation required to prevent derailment at a curve can be calculated[1] under perfect running conditions, given the radius of curvature, the weight of the vehicle, the height of the centre of gravity, the distance between the rails, and the speed; but great experience

[1] See *The Times Engineering Supplement* (August 22, 1906), p. 265.

is required for the successful application of definite formulae to the problem. For example, what is a safe speed at a given curve for an engine, truck or coach having the load equally distributed over the wheels may lead to either climbing or overturning if the load is shifted to a diagonal position. An ill-balanced load also exaggerates "plunging," and if the period of oscillation of the load happens to agree with the changes of contour or other inequalities of the track vibrations of a dangerous character, giving rise to so-called "sinuous" motion, may occur.

In general it is not curvature, but change of curvature, that presents difficulty in the laying-out of a line. For instance, if the curve is of S-form, the point of danger is when the train enters the contra-flexure, and it is not an easy matter to assign the best superelevation at all points throughout the double bend. Closely allied to the question of safety is the problem of preventing jolting at curves; and to obtain easy running it is necessary not merely to adjust the levels of the rails in respect to one another, but to tail off one curve into the next in such a manner as to avoid any approach to abrupt lateral changes of direction. With increase of speeds this matter has become important as an element of comfort in passenger traffic. As a first approximation, the centre-line of a railway may be plotted out as a number of portions of circles, with intervening straight tangents connecting them, when the abruptness of the changes of direction will depend on the radii of the circular portions. But if the change from straight to circular is made through the medium of a suitable curve it is possible to relieve the abruptness, even on curves of comparatively small radius. The smoothest and safest running is, in fact, attained when a "transition," "easement" or "adjustment" curve is inserted between the tangent and the point of circular curvature.

For further information see the following papers and the discussions on them: "Transition Curves for Railways," by James Glover, *Proc. Inst. C.E.* vol. 140, part ii.; and "High Speed on Railway Curves," by J. W. Spiller, and "A Practical Method for the Improvement of Existing Railway Curves," by W. H. Shortt, *Proc. Inst. C.E.* vol. 176, part ii.

Gauge.—The gauge of a railway is the distance between the inner edges of the two rails upon which the wheels run. The width of 4 ft. 8½ in. may be regarded as standard, since it prevails on probably three-quarters of the railways of the globe. In North America, except for small industrial railways and some short lines for local traffic, chiefly in mountainous country, it has become almost universal; the long lines of 3 ft. gauge have mostly been converted, or a third rail has been laid to permit interchange of vehicles, and the gauges of 5 ft. and more have disappeared. A considerable number of lines still use 4 ft. 9 in., but as their rolling stock runs freely on the 4 ft. 8½ in. gauge and vice versa, this does not constitute a break of gauge for traffic purposes. The commercial importance of such free interchange of traffic is the controlling factor in determining the gauge of any new railway that is not isolated by its geographical position. In Great Britain railways are built to gauges other than 4 ft. 8½ in. only under exceptional conditions; the old "broad gauge" of 7 ft. which I. K. Brunel adopted for the Great Western railway disappeared on the 20th–23rd of May 1892, when the main line from London to Penzance was converted to standard gauge throughout its length. In Ireland the usual gauge is 5 ft. 3 in., but there are also lines laid to a 3 ft. gauge. On the continent of Europe the standard gauge is generally adopted, though in France there are many miles of 4 ft. 9 in. gauge; the normal Spanish and Portuguese gauge is, however, 5 ft. 5¾ in., and that of Russia 5 ft. In France and other European countries there is also an important mileage of metre gauge, and even narrower, on lines of local or secondary importance. In India the prevailing gauge is 5 ft. 6 in., but there is a large mileage of other gauges, especially metre. In the British colonies the prevailing gauge is 3 ft. 6 in., as in South Africa, Queensland, Tasmania and New Zealand; but in New South Wales the normal is 4 ft. 8½ in. and in Victoria 5 ft. 3 in., communication between different countries of the Australian Commonwealth being thus carried on under the disadvantage of break of gauge. Though the standard gauge is in use in Lower Egypt, the line into the Egyptian Sudan was built on a gauge of 3 ft. 6. in., so that if the so-called Cape to Cairo railway is ever completed, there will be one gauge from Upper Egypt to Cape Town. In South America the 5 ft. 6 in. gauge is in use, with various others.

Mono-Rail Systems.—The gauge may be regarded as reduced to its narrowest possible dimensions in mono-rail lines, where the weight of the trains is carried on a single rail. This method of construction, however, has been adopted only to a very limited extent. In the Lartigue system the train is straddled over a single central rail, elevated a suitable distance above the ground. A short line of this kind runs from Ballybunnion to Listowel in Ireland, and a more ambitious project on the same principle, on the plans of Mr F. B. Behr, to connect Liverpool and Manchester, was sanctioned by Parliament in 1901. In this case electricity was to be the motive-power, and speeds exceeding 100 m. an hour were to be attained, but the line has not been built. In the Langen mono-rail the cars are hung from a single overhead rail; a line on this system works between Barmen and Elberfeld, about 9 m., the cars for a portion of the distance being suspended over the river Wupper. In the system devised by Mr Louis Brennan the cars run on a single rail laid on the ground, their stability being maintained by a heavy gyrostat revolving at great speed in a vacuum.

Permanent Way.—When the earth-works of a line have been completed and the tops of the embankments and the bottoms of the cuttings brought to the level decided upon, the next step is to lay the permanent way, so-called probably in distinction to the temporary way used during construction. The first step is to deposit a layer of ballast on the road-bed or "formation," which often slopes away slightly on each side from the central line to facilitate drainage. The ballast consists of such materials as broken stone, furnace slag, gravel, cinders or earth, the lower layers commonly consisting of coarser materials than the top ones, and its purpose is to provide a firm, well-drained foundation in which the sleepers or cross-ties may be embedded and held in place, and by which the weight of the track and the trains may be distributed over the road-bed. Its depth varies, according to the traffic which the line has to bear, from about 6 in. to 1 ft. or rather more under the sleepers, and the materials of the surface layers are often chosen so as to be more or less dustless. Its width depends on the numbers of tracks and their gauge; for a double line of standard gauge it is about 25 ft., a space of 6 ft. ("six-foot way") being left between the inner rails of each pair in Great Britain (fig. 8), and a rather larger distance in America (fig. 9), where the over-hang of the rolling stock is greater. The intervals between the sleepers are filled in level with ballast, which less commonly is also heaped up over them, especially at the projecting ends.

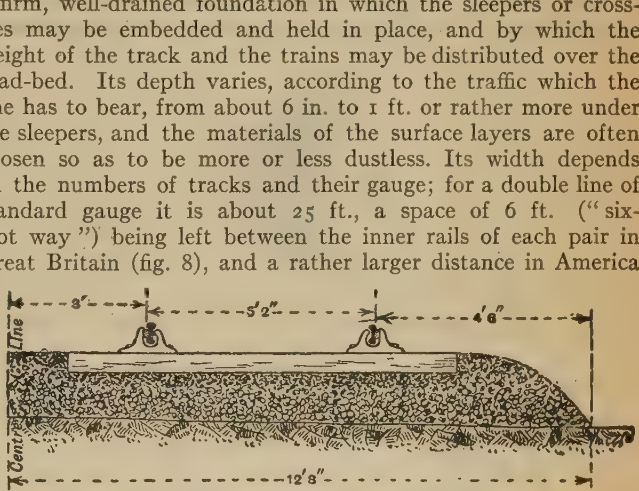

Fig. 8.—Half of English Double Track.

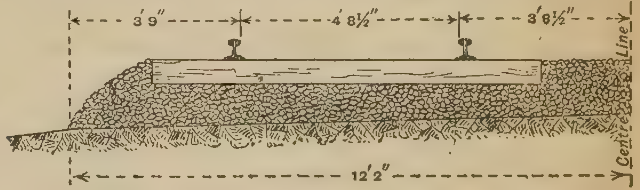

Fig. 9.—Half of American Double Track.

Sleepers, called ties or cross-ties in America, are the blocks or slabs on which the rails are carried. They are nearly always placed transversely, across the direction of the lines, the longitudinal position such as was adopted in connexion with the broad gauge on the Great Western in England having been abandoned except in special cases. Stone blocks were tried as sleepers in the early days of railways, but they proved too rigid, and besides, it was found difficult to keep the line true with them. Wood is the material most widely used, but steel is employed in some countries where timber is scarce or liable to destruction by white ants, though it is still regarded as too expensive in comparison with wood for general adoption. Steel sleepers were used experimentally on the London & North-Western, but were abandoned owing to the shortness of their life. In Germany, where they have met with greater favour, there were over 26½ millions in use in 1905,[1] and they have been tried by some American railways. Numerous forms of ferro-concrete sleepers have also been devised.

In Great Britain, Germany and France, at least 90% of the wooden sleepers are "treated" before they are laid, to increase their resistance to decay, and the same practice is followed to some extent in other European countries. A great number of preservative processes have been devised. In that most largely used, known as "creosoting," dead oil of tar, to the amount of some 3 gallons per sleeper, is forced into the wood under pressure, or is sucked in by vacuum, both the timber and the oil being heated. In the United States only a small percentage of the ties are treated in any way beyond seasoning in the open air, timber, in the opinion of the railway officials, being still too cheap in nearly all parts of that country to justify the use of preservatives. Some railway companies, however, having a long mileage in timberless regions, do "treat" their sleepers.

Typical dimensions for sleepers on important British railways are:—length 9 ft., breadth 10 in., and depth 5 in. In America 8 ft. is the most common length, the breadth being 8 in., and the depth 6 or 7 in.

There are two main ways of attaching the rails to the sleepers, corresponding to two main types of rails—the bull-headed rail and the Vignoles or flange rail. In the first method, which is practically universal in Great Britain and is also employed to some extent in France and India, the rails ~~have~~ rounded bases and are supported by being wedged, with wooden keys, in cast-iron chairs which are bolted to the sleepers. In the second method the rails have flat flanged bases which rest directly on the sleepers (fig. 10). The chairs on the British system weigh about 45 or 50 ℔ each on important lines, though they may be less where the traffic is light, and are fixed to the sleepers each by two, three or four fastenings, either screw spikes, or round drift bolts entered in holes previously bored, or fang bolts or wooden trenails. Sometimes a strip of felt is interposed between the chair and the sleeper, and sometimes a serrated surface is prepared on the sleeper for the chair which is forced into its seat by hydraulic pressure. The keys which hold the rail in the chairs are usually of oak and are placed outside the rails; the inside position has also been employed, but has the disadvantage of detracting from the elasticity of the road since the weight of a passing train presses the rails up against a rigid mass of metal instead of against a slightly yielding block of wood. The rails, which for heavy main line traffic may weigh as much as 100 ℔ per yard, or even more, are rolled in lengths of from 30 to 60 ft., and sleepers are placed under them at intervals of between 2 and 3 ft. (centre to centre), 11 sleepers to a 30 ft. rail being a common arrangement. On the London & North-Western railway there are 24 sleepers to each 60 ft. rail. A small space is left between the end of one rail and that of the next, in order to allow for expansion in hot weather, and at the joint the two are firmly braced together by a pair of fish-plates (fig. 11). These are flat bars of iron or steel from 18 in. to 2 ft. long, which are lodged in the channels of the rail, one on each side, and secured with four bolts passing through the web; sometimes, to give additional stiffness, they extend down below the lower table of the rail and are bent round so as to clip it. Occasionally the joints thus formed are "supported" on a sleeper, as was the practice in the early days of railway construction, but they are generally "suspended" between two sleepers, which are set rather more closely together than at other points in the rail. Preferably, they are so arranged that those in both lines of rails come opposite each other and are placed between the same pair of sleepers.

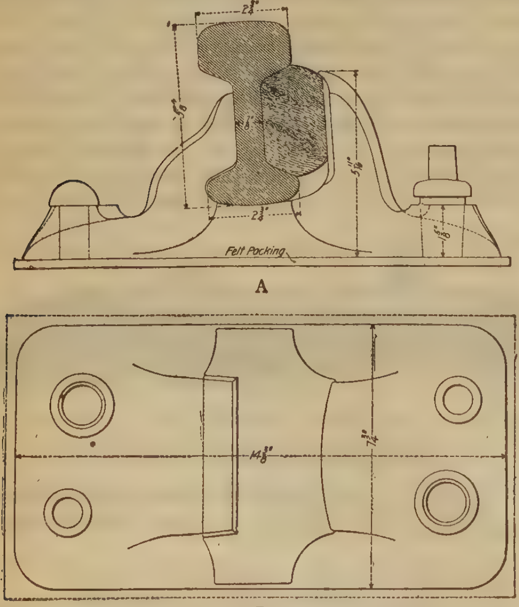

Fig. 10.—A, Section of British Bull-Headed Rail, 90 ℔ to the yard, showing also chair and fastenings. B, Plan of Chair.

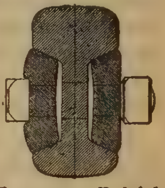

Fig. 11.—British Rail and Rail Joint.

Flat-bottomed rails are fastened to the sleepers by hook-headed spikes, the heads of which project over the flanges. In the United States the spikes are simply driven in with a maul, and the rails stand upright, little care being taken to prepare seats for them on the sleepers, on which they soon seat themselves. The whole arrangement is simple and cheap in first cost, and it lends itself admirably to fast track-laying and to repairs and changes of line. On the continent of Europe the practice is common of notching the sleeper so as to give the rail a slight cant inwards—a result obtained in England by canting the rail in the chairs—and metal plates or strips of felt are put under the rail, which is carefully fastened to the sleeper by screwed spikes (fig. 12). This method of construction is more expensive than the American in first cost, but it gives a more durable and stable track. Such metal plates, or "tie-plates," have come into considerable use also in the United States, where they are always made of rolled steel, punched with rectangular holes through which the spikes pass. They serve two principal

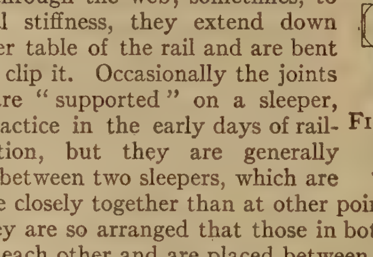

Fig. 12.—French Rail, 90¼ ℔ to the yard, showing rail joint and seat in the sleeper.

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[1] See a full account of steel sleepers in a paper read by A. Haarmann before the Verein der Deutschen Eisenhüttenleute on Dec. 8, 1907, translated in the *Railway Gazette* (London) on April 3, 10 and 17, 1908.

purposes: they diminish the wear of the sleeper under the rail by providing a larger bearing surface, and they help to support the spikes and so to keep the gauge. On all the accepted forms there are two or more flanges at the bottom, running lengthwise of the plate and crosswise of the rail; these are requisite to give proper stiffness, and further, as they are forced into the tie by the weight of passing traffic, they help to fix the plate securely in place. The joints of flanged rails are similar to those employed with bull-headed rails. Various forms, mostly patented, have been tried in the United States, but the one most generally adopted consists of two symmetrical angle bars (fig. 13), varying in length (from 20 to 48 in.), in weight and in the number of bolts, which may be four or six.

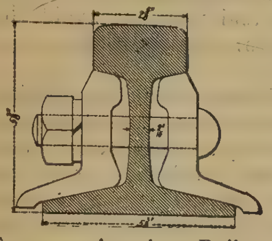


FIG. 13.—American Rail, 90 ℔ to the yard, showing rail joint.

The substitution of steel for iron as the material for rails which made possible the axle loads and the speeds of to-day, and, by reducing the cost of maintenance, contributed enormously to the economic efficiency of railways, was one of the most important events in the history of railways, and a scarcely less important element of progressive economy has been the continued improvement of the steel rail in stiffness of section and in toughness and hardness of material. Carbon is the important element in controlling hardness, and the amount present is in general higher in the United States than in Great Britain. The specifications for bull-headed rails issued by the British Engineering Standards Committee in 1904 provided for a carbon-content ranging from 0·35 to 0·50%, with a phosphorus maximum of 0·075%. In the United States a committee of the American Society of Civil Engineers, appointed to consider the question of rail manufacture in consequence of an increase in the number of rail-failures, issued an interim report in 1907 in which it suggested a range of carbon from 0·55 to 0·65% for the heaviest sections of Bessemer steel flange rails, with a phosphorus maximum of 0·085%; while the specifications of the American Society for Testing Materials, current at the same period, put the carbon limits at 0·45 to 0·55%, and the phosphorus limit at 0·10. For rails of basic open-hearth steel, which is rapidly ousting Bessemer steel, the Civil Engineers' specifications allowed from 0·65 to 0·75% of carbon with 0·05% of phosphorus, while the specifications of the American Railway Engineering and Maintenance of Way Association provided for a range of 0·75 to 0·85% of carbon, with a maximum of 0·03% of phosphorus. The rail-failures mentioned above also drew renewed attention to the importance of the thermal treatment of the steel from the time of melting to the last passage through the rolling mill and to the necessity of the finishing temperature being sufficiently low if the product is to be fine grained, homogeneous and tough; and to permit of this requirement being met there was a tendency to increase the thickness of the metal in the web and flanges of the rails. The standard specification adopted by the Pennsylvania railway in 1908 provided that in rails weighing 100 ℔ to the yard 41% of the metal should be in the head, 18·6% in the web, and 40·4% in the base, while for 85 ℔ rails 42·2% was to be in the head, 17·8% in the web and 40·0% in the base. These rails were to be rolled in 33-ft. lengths. According to the specification for 85 ℔ rails adopted by the Canadian Pacific railway about the same time, 36·77% of the metal was to be in the head, 22·21% in the web and 41·02% in the base.

Points and Crossings.—To enable trains to be transferred from one pair of rails to another pair, as from the main line to a siding, "points" or "switches" are provided. At the place where the four rails come together, the two inner ones (one of the main line and the other of the siding), known as "switch rails" (*b*, fig. 14), are tapered to a fine point or tongue, and rigidly connected together at such a distance apart that when one of the points is pressed against the outer or "stock" rail (*a*) of either the siding or the main line there is sufficient space between the other tongue and the other stock rail to permit the free passage of the flanges of the wheels on one side of the train, while the flanges on the other side find a continuous path along the other switch rail and thus are deflected in the desired direction. The same arrangement is employed at junctions where different running lines converge. The points over which a train travels when directed from the main to a branch line are called "facing points" (FP), while those which it passes when running from a branch to a main line are "trailing points" (TP). In Great Britain the Board of Trade requires facing points to be avoided as far as possible; but, of course, they are a necessity at junctions where running lines diverge and at the crossing places which must be provided to enable trains to pass each other on single-track lines. At stations the points that give access to sidings are generally arranged as trailing points with respect to the direction of traffic on the main lines; that is, trains cannot pass direct into sidings, but have to stop and then run backwards into them. In shunting yards the points are commonly set in the required direction by means of hand levers placed close beside the lines, but those at junctions and those which give access from the main lines to sidings at wayside stations are worked by a system of rods from the signal cabin, or by electric or pneumatic power controlled from it and interlocked with the signals (see SIGNAL: § *Railway*). Crossings are inevitable adjuncts of points. Where a branch diverges from a main line, one rail of the one must cross one rail of the other, and a V-crossing is formed (V). Where, as at a double-line junction, one pair of rails crosses another pair, "diamond" crossings (D) are formed. At both types of crossing, check rails (*c*) must be provided to guide the wheel-flanges, and if these are not accurately placed the safety of the trains will be endangered. At double-line junctions trains passing over the diamond crossings evidently block traffic going in the opposite direction to that in which they are travelling. To avoid the delay thus caused the branch line which would occasion the diamond crossing if it were taken across on the level is sometimes carried over the main line by an over-bridge ("flying junction") or under it by an under-bridge ("burrowing junction").

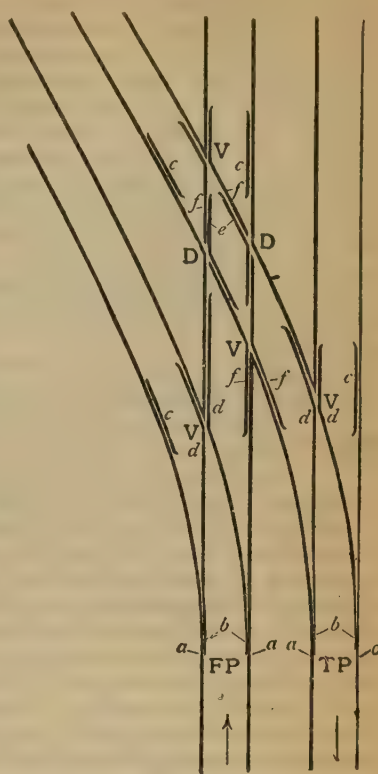


FIG. 14.—Points and Crossings.
FP = Facing points.
TP = Trailing points.
a = Stock rail.
b = Switch rail.
V = Single or V-crossing.
D = Diamond crossing.
c = Check rails.
d = Wing rails.
e = Winged check rails.
f = Diamond points.

Railway Stations.—Railway stations are either "terminal" or "intermediate." A terminal station embraces (1) the passenger station; (2) the goods station; (3) the locomotive, carriage and waggon depots, where the engines and the carrying stock are kept, cleaned, examined and repaired. At many intermediate stations the same arrangements, on a smaller scale, are made; in all of them there is at least accommodation for the passenger and the goods traffic. The stations for passengers and goods are generally in different and sometimes in distant positions, the place selected for each being that which is most convenient for the traffic. The passenger station abuts on the main line, or, at termini, forms the natural terminus, at a place as near as can conveniently be obtained to the centre of the population which constitutes the passenger traffic; and preferably its platforms should be at or near the ground level, for convenience of access. The goods station is approached by a siding or fork set off from the main line at a point short of the passenger station. In order to keep down the expense of shunting the empty trains and engines to and from the platforms the carriage and locomotive depots should be as near the passenger station as possible; but often the price of land renders it impracticable to locate them in the immediate vicinity and they are to be found at a distance of several miles.

Passenger stations.

In laying out the approaches and station yard of a passenger station ample width and space should be provided, with well-defined means of ingress and egress to facilitate the circulation of vehicles and with a long setting-down pavement to enable them to discharge their passengers and luggage without delay. The position of the main buildings—ticket offices, waiting and refreshment-rooms, parcels offices, &c.—relative to the direction of the lines of rails may be used as a means of classifying terminal stations. They are placed either on the departure side parallel to the platform ("side" stations) or at right angles to the rails and platforms ("end" stations). Many large stations, however, are of a mixed type, and the offices are arranged in a fork between two or more series of platforms, or partly at the end and partly on one side. Where heavy suburban traffic has to be dealt with, the expedient is occasionally adopted of taking some of the lines round the end in a continuous loop, so that incoming trains can deposit their passengers at an underground platform and immediately proceed on their outward journey. Intermediate stations, like terminal ones, should be convenient in situation and easy of approach, and, especially if they are important, should be on the ground level rather than on an embankment or in a cutting. The lines through them should be, if possible, straight and on the level; the British Board of Trade forbids them being placed on a gradient steeper than 1 in 260, unless it is unavoidable. Intermediate stations at the surface level are naturally constructed as side stations, and whether offices are provided on both sides or whether they are mainly concentrated on one will depend on local circumstances, the amount of the traffic, and the direction in which it preponderates. When the railway lies below the surface level the bulk of the offices are often placed on a bridge spanning the lines, access being given to the platforms by staircases or lifts, and similarly when the railway is at a high level the offices may be arranged under the lines. Occasionally on a double-track railway one platform placed between the tracks serves both of them; this "island" arrangement, as it is termed, has the advantage that more tracks can be readily added without disturbance of existing buildings, but when it is adopted the exit from the trains is at the opposite side to that which is usual, and accidents have happened through passengers alighting at the usual side without noticing the absence of a platform. At stations on double-track railways which have a heavy traffic four tracks are sometimes provided, the two outside ones only having platforms, so that fast trains get a clear road and can pass slow ones that are standing in the station. In Great Britain, it may be noted, trains almost invariably keep to the left, whereas in most other countries right-handed running is the rule.

The arrangement and appropriation of the tracks in a station materially affect the economical and efficient working of the traffic. There must be a sufficient provision of sidings, connected with the running tracks by points, for holding spare rolling stock and to enable carriages to be added to or taken off trains and engines to be changed with as little delay as possible. At terminal stations, especially at such as are used by short-distance trains which arrive at and start from the same platform, a third track is often laid between a pair of platform tracks, so that the engine of a train which has arrived at the platform can pass out and place itself at the other end of the train, which remains undisturbed. At the new Victoria station (London) of the London, Brighton & South Coast railway—which is so long that two trains can stand end to end at the platforms—this system is extended so as to permit a train to start out from the inner end of a platform even though another train is occupying the outer end. One of the advantages of electric trains on the multiple control system is that they economize terminal accommodation, because they can be driven from either end indifferently, and therefore avoid the necessity for tracks by which engines can change from one end of the train to the other.

The platforms on British railways have a standard elevation of 3 ft. above rail level, and they are not now made less than 2½ ft. in height. In other countries they are generally lower; in the United States they are commonly level with, or only a few inches higher than, the top of the rails. They may consist of earth with a retaining wall along the tracks and with the surface gravelled or paved with stone or asphalt, or they may be constructed entirely of timber, or they may be formed of stone slabs supported on longitudinal walls. They should be of ample dimensions to accommodate the traffic—the British Board of Trade requires them to be not less than 6 ft. wide at small stations and not less than 12 ft. wide at large ones—and they should be as free as possible from obstructions, such as pillars supporting the roof. At intermediate stations the roofs are often carried on brackets fixed to the walls of the station buildings, and project only to the edge of the platforms. At larger stations where both the platforms and the tracks are covered in, there are two broad types of construction, with many intermediate variations: the roof may either be comparatively low, of the "ridge and furrow" pattern, borne on a number of rows of pillars, or it may consist of a single lofty span extending clear across the area from the side walls. The advantage claimed for roofs formed with one or two large spans is that they permit the platforms and tracks to be readily rearranged at any time as required, whereas this is difficult with the other type, especially since the British Board of Trade requires the pillars to be not less than 6 ft. away from the edges of the platforms. On the other hand, wide spans are more expensive both in first cost and in maintenance, and there is the possibility of a failure such as caused the collapse in December 1905 of the roof of Charing Cross (S.E.R.) station, London, which then consisted of a single span. Whatever the pattern adopted for the roof, a sufficient portion of it must be glazed to admit light, and it should be so designed that the ironwork can be easily inspected and painted and the glass readily cleaned. For the illumination of large stations by night electric arc lamps are frequently employed, but some authorities favour high-pressure incandescent gas-lighting.

Locomotive depots.

At busy stations separate tracks are sometimes appropriated to the use of light engines and empty trains, on which they may be run between the platforms and the locomotive and carriage depots. A carriage depot includes sheds in which the vehicles are stored, arrangements for washing and cleaning them, and sidings on which they are marshalled into trains. At a locomotive depot the chief building is the "running shed" in which the engines are housed and cleaned. This may be rectangular in shape ("straight" shed), containing a series of parallel tracks on which the engines stand and which are reached by means of points and crossings diverging from a main track outside; or it may take a polygonal or circular form (round house or rotunda), the lines for the engines radiating from a turn-table which occupies the centre and can be rotated so as to serve any of the radiating lines. The second arrangement enables any particular engine to enter or leave without disturbing the other; but on the other hand an accident to the turn-table may temporarily imprison the whole of them. In both types pits are constructed between the rails on which the engines stand to afford easy access for the inspection and cleaning of their mechanism. Machine shops are usually provided to enable minor repairs to be executed; the tendency, both in England and America, is to increase the amount of such repairing plant at engine sheds, thus lengthening the intervals between the visits of the engines to the main repairing shops of the railway. A locomotive depot further includes stores of the various materials required in working the engines, coal stages at which they are loaded with coal, and an ample supply of water. The quality of the last is a matter of great importance; when it is unsuitable, the boilers will suffer, and the installation of a water-softening plant may save more in the expenses of boiler maintenance than it costs to operate. The water cranes or towers which are placed at intervals along the railway to supply the engines with water require similar care in regard to the quality of the water laid on to them, as also to the water troughs, or track tanks as they are called in America, by which engines are able to pick up water without stopping. These consist of shallow troughs about 18 in. wide, placed between the rails on perfectly level stretches of line. When water is required, a scoop is lowered into them from below the engine, and if the speed is sufficient the water is forced up it into the tender-tanks. Such troughs were first employed on the London & North-Western railway in 1857 by John Ramsbottom, and have since been adopted on many other lines.

Goods stations.

Goods stations vary in size from those which consist of perhaps a single siding, to those which have accommodation for thousands of wagons. At a small roadside station, where the traffic is of a purely local character, there will be some sidings to which horses and carts have access for handling bulk goods like coal, gravel, manure, &c., and a covered shed for loading and unloading packages and materials which it is undesirable to expose to the weather. The shed may have a single pair of rails for wagons running through it along one side of a raised platform, there being a roadway for carts on the other side; or if more accommodation is required there may be two tracks, one on each side of the platform, which is then approached by carts at the end. In either case the platform is fitted with a crane or cranes for lifting merchandise into and out of the wagons, and doors enable the shed to be used as a lock-up warehouse. In a large station the arrangements become much more complicated, the precise design being governed by the nature of the traffic that has to be served and by the physical configuration of the site. It is generally convenient to keep the inwards and the outwards traffic distinct and to deal with the two classes separately; at junction stations it may also be necessary to provide for the transfer of freight from one wagon to another, though the bulk of goods traffic is conveyed through to its destination in the wagons into which it was originally loaded. The increased loading space required in the sheds is obtained by multiplying the number and the length of lines and platforms; sometimes also there are short sidings, cut into the platforms at right angles to the lines, in which wagons are placed by the aid of wagon turn-tables, and sometimes the wagons are dealt with on two floors, being raised or lowered bodily from the ground level by lifts. The higher floors commonly form warehouses where traders may store goods which have arrived or are awaiting despatch. An elaborate organization is required to keep a complete check and record of all the goods entering and leaving the station, to ensure that they are loaded into the proper wagons according to their destination, that they are unloaded and sorted in such a way that they can be delivered to their consignees with the least possible delay, that they are not stolen or accidentally mislaid, &c.; and accommodation must be provided for a large clerical and supervisory staff to attend to these matters. British railways also undertake the collection and delivery of freight, in addition to transporting it, and thus an extensive range of vans and wagons, whether drawn by horses or mechanically propelled, must be provided in connexion with an important station.

Shunting Yards.—It may happen that from a large station sufficient traffic may be consigned to certain other large stations to enable full train-loads to be made up daily, or several times a day, and despatched direct to their destinations. In general, however, the conditions are less simple. Though a busy colliery may send off its product by the train-load to an important town, the wagons will usually be addressed to a number of different consignees at different depots in different parts of the town, and therefore the train will have to be broken up somewhere short of its destination and its trucks rearranged, together with those of other trains similarly constituted, into fresh trains for conveyance to the various depots. Again, a station of moderate size may collect goods destined for a great variety of places but not in sufficient quantities to compose a full train-load for any of them, and then it becomes impossible, except at the cost of uneconomical working, to avoid despatching trains which contain wagons intended for many diverse destinations. For some distance these wagons will all travel over the same line, but sooner or later they will reach a junction-point where their ways will diverge and where they must be separated. At this point trains of wagons similarly destined for different places will be arriving from other lines, and hence the necessity will arise of collecting together from all the trains all the wagons which are travelling to the same place.

The problem may be illustrated diagrammatically as follows (fig. 15): A may be supposed to be a junction outside a large seaport where branches from docks *a*, *b*, *c* and *d* converge, and where the main line also divides into three, going to B, C and D respectively. A train from *a* will contain some wagons for B, some for C and some for D, as will also the trains from *a*, *b*, *c* and *d*. At A therefore it becomes necessary to disentangle and group together all the wagons that are intended for B, all that are intended for C, and all that are intended for D. Even that is not the whole of the problem. Between A and B, A and C, and A and D, there may be a string of stations, *p*, *q*, *r*, *s*, &c., all receiving goods from *a*, *b*, *c* and *d*, and it would manifestly be inconvenient and wasteful of time and trouble if the trains serving those intermediate stations were made up with, say, six wagons from *a* to *p* next the engine, five from *b* to *p* at the middle, and four from *c* to *p* near the end. Hence at A the trucks from *a*, *b*, *c* and *d* must not only be *sorted* according as they have to travel along A B, A C, or A D, but also must be *marshalled* into trains in the order of the stations along those lines. Conversely, trains arriving at A from B, C and D must be broken up and remade in order to distribute their wagons to the different dock branches.

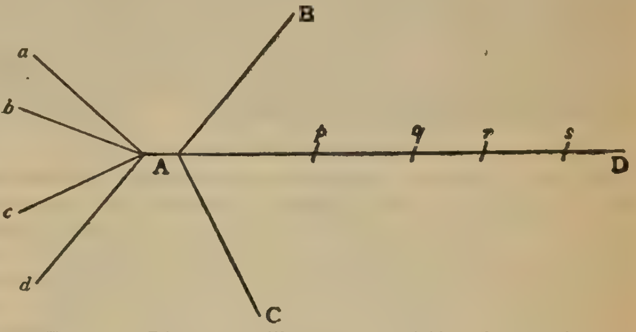


FIG. 15.—Diagram to illustrate use of Shunting Yards.

To enable the wagons to be shunted into the desired order yards containing a large number of sidings are constructed at important junction points like A. Such a yard consists essentially of a group or groups of sidings, equal in length at least to the longest train run on the line, branching out from a single main track and often again converging to a single track at the other end; the precise design, however, varies with the amount and character of the work that has to be done, with the configuration of the ground, and also with the mode of shunting adopted. The oldest and commonest method of shunting is that known as "push-and-pull," or in America as "link-and-pin" or "tail" shunting. An engine coupled to a batch of wagons runs one or more of them down one siding, leaves them there, then returns back with the remainder clear of the points where the sidings diverge, runs one or more others down another siding, and so on till they are all disposed of. The same operation is repeated with fresh batches of wagons, until the sidings contain a number of trains, each intended, it may be supposed, for a particular town or district. In some cases nothing more is required than to attach an engine and brake-van ("caboose") and despatch the train; but if, as will happen in others, a further rearrangement of the wagons is necessary to get them into station order this is effected on the same principle.

Push-and-pull shunting is simple, but it is also slow, and therefore efforts have been made at busy yards where great numbers of trains are dealt with to introduce more expeditious methods. One of these, employed in America, is known as "poling." Alongside the tracks on which stand the trains that are to be broken up and from which the sidings diverge subsidiary tracks are provided for the use of the shunting engines. These engines have a pole projecting horizontally in front of them, or are attached to a "pole-car" having such a pole. The method of working is for the pole to be swung out behind a number of wagons; one engine is then started and with its pole pushes the wagons in front of it until their speed is sufficient to carry them over the points, where they are diverted into any desired siding. It then runs back to the train to repeat the operation, but while it is doing so a second engine similarly equipped has poled away a batch of wagons on the opposite side. In this way a train is distributed with great rapidity, especially if the points giving access to the different sidings are worked by power so that they can be quickly manipulated.

Another method, which was introduced into America from Europe about 1890, is that of the summit or "hump." The wagons are pushed by an engine at their rear up one slope of an artificial mound, and as they run down the other slope by gravity are switched into the desired siding. Sometimes a site can be found for the sorting sidings where the natural slope of the ground is sufficiently steep to make the wagons run down of themselves. One of the earliest and best known of such "gravity" yards is that at Edgehill, near Liverpool, on the London & North-Western railway, which was established in 1873. Here, at the highest level, there are a number of "upper reception lines" converging to a single line which leads to a group of "sorting sidings" at a lower level. These in turn converge to a pair of single lines which lead to two groups of marshalling sidings, called "gridirons" from their shape, and these again converge to single lines leading to "lower reception and departure lines" at the bottom of the slope. The wagons from the upper reception lines are sorted into trains on the sorting sidings, and then, in the gridirons, are arranged in the appropriate order and marshalled ready to be sent off from the departure lines. (H. M. R.)

LOCOMOTIVE POWER

The term "power" is used in technical sense to mean the rate at which work is done against a resistance, and is measured in units of energy expended per unit of time. The unit of power commonly used by engineers is the horse-power, and this unit corresponds to a rate of working of 550 foot-℔ of work per second. The problems arising out of the special consideration of the power required to propel a railway train against the resistances opposing its motion, the way the power is applied to trains, the agent by means of which the power is exerted, are conveniently grouped together under the general heading of Locomotive Power. There are certain fundamental relations common to all tractive problems, and these are briefly considered in §§ 1 and 2, after which the article refers particularly to steam locomotives, although §§ 4, 5, 7, 8, 9, and 10 have a general application to all modes of traction.

§ 1. *Fundamental Relations.*—The resistance against which a train is moved along a railway is overcome by means of energy obtained from the combustion of fuel, or in some few cases by energy obtained from a waterfall. If the total resistance against which the train is maintained in motion with an instantaneous velocity of V feet per second is R, the rate at which energy is expended in moving the train is represented by the product RV, and this must be the rate at which energy is supplied to the train after deducting all losses due to transmission from the source of power. Thus if R is equal to 10,000 ℔ when the velocity is 44 ft. per second, equivalent to 30 m. per hour, the rate of working against the resistance is 440,000 foot-℔ per second.

In whatever form energy is produced and distributed to the train it ultimately appears as mechanical energy applied to turn one or more axles against the resistance to their rotation imposed by the weight on the wheels and the motion of the train.

The rate at which work is done on a particular axle is measured by the product $T\omega$, where T is the torque or turning moment exerted on the axle by the motor or mechanism applied to it for this purpose, and ω is the angular velocity of the axle in radians per second. Hence if all the energy supplied to the train is utilized at one axle there is the fundamental relation

$$T\omega = RV \qquad (1)$$

Continuing the above arithmetical illustration, if the wheels to the axle of which the torque is applied are 4 ft. diameter, $\omega = 44/2 = 22$ radians per second, and therefore $T = 440{,}000/22 = 20{,}000$ ℔ ft. If the energy supplied is distributed between several axles the relation becomes

$$T_1\omega_1 + T_2\omega_2 + T_3\omega_3 \ldots = RV \qquad (2)$$

where T_1, T_2, T_3, &c. are the torques on the axles whose respective angular velocities are ω_1, ω_2, ω_3, &c.

The fundamental condition governing the design of all tractive machinery is that the wheels belonging to the axles to which torque is applied shall roll along the rails without slipping, and exert a tractive force on the train.

The fundamental relation between the applied torque and the tractive force F will be understood from fig. 16, which shows in a diagrammatic form a wheel and axle connected to the framework of a vehicle, in the way adopted for railway trains. The journal of the axle A, is carried in a bearing or axle-box B, which is free to move vertically in the wide vertical slot G, formed in the frame and called generally "the horns," under the control of the spring. The weight W_1 carried by the part of the frame supported by the wheel (whose diameter is D) is transmitted first to the pins P_1, P_2, which are fixed to the frame, and then to the spring links L_1, L_2, which are jointed at their respective ends to the spring S, the centre of which rests on the axle-box.

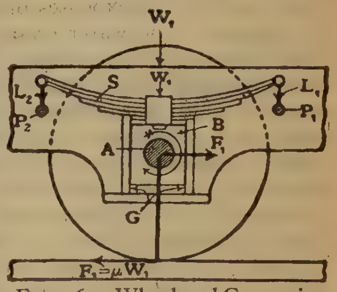


FIG. 16.—Wheel and Connexion to Frame.

Let a couple be applied to the axle tending to turn it in the direction shown by the arrow. This couple, we may assume, will be equally divided between the two wheels, so that the torque acting on each will be $\frac{1}{2}T$. Assuming the wheels to roll along the rail without slipping, this couple will be equivalent to the couple formed by the equal opposite and parallel forces, F_1 acting in the direction shown, from the axle-box on to the frame, and $F_1 = \mu\theta$, acting along the rail. The torque corresponding to this couple is $F_1 \times \frac{1}{2}D = \frac{1}{2}\mu W_1 D$, and hence follows the fundamental relation, $\frac{1}{2}T = \frac{1}{2}F_1 D = \frac{1}{2}\mu W_1 D$, or if W now represents the weight supported by the axle, F will be the tractive force exerted on the frame by the two axle-boxes to propel the vehicle, and the more convenient relation is established,

$$T = \tfrac{1}{2}FD = \tfrac{1}{2}\mu WD \qquad (3)$$

If T has a greater value than this relation justifies the wheels will slip. F is called the "tractive force" at the rail. The coefficient of friction μ is a variable quantity depending upon the state of the rails, but is usually taken to be $\frac{1}{6}$. This is the fundamental equation between the forces acting, however the torque may be applied. Multiplying through by ω we obtain

$$T\omega = \tfrac{1}{2}F\omega D = \tfrac{1}{2}\mu W\omega D = RV \qquad (4)$$

This is a fundamental energy equation for any form of locomotive in which there is only one driving-axle.

The couple T is necessarily accompanied by an equal and opposite couple acting on the frame, which couple endeavours to turn the frame in the opposite direction to that in which the axle rotates. The practical effect of this opposite couple is slightly to tilt the frame and thus to redistribute slightly the weights on the wheels carrying the vehicle.

If there are several driving-axles in a train, the product $T\omega$ must be estimated for each separately; then the sum of the products will be equal to RV. In equation (4) there is a fixed relation between ω, V and D given by the expression

$$\omega = 2V/D \qquad (5)$$

Here D is in feet, V in feet per second and ω in radians per second. If the speed is given in miles per hour, S say,

$$V = 1{\cdot}466\ S \qquad (6)$$

The revolutions of the axle per second, n, are connected with the radians turned through per second by the relation

$$n = \omega/2\pi = \omega/6{\cdot}38 \qquad (7)$$

§ 2. *Methods of Applying Locomotive Power.*—By locomotive power is to be understood the provision of power to maintain the rates of working on the driving-axles of a train indicated by the relation (4). The most usual way of providing this power is by the combustion of coal in the fire-box of a boiler and the utilization of the steam produced in a steam-engine, both boiler and engine being carried on a frame mounted on wheels in such a way that the crank-shaft of the steam-engine becomes the driving-axle of the train. From equation (3) it is clear that the wheels of the driving-axle must be heavily loaded in order that F may have a value sufficiently great to propel the train. The maximum weight which one pair of wheels are usually allowed to carry on a first-class track is from 18 to 20 tons. If a larger value of the tractive force is required than this provides for, namely from 4 to 5 tons, the driving-wheels are coupled to one or more pairs of heavily loaded wheels, forming a class of what are called "coupled engines" in contradistinction to the "single engine" with a single pair of loaded driving-wheels. Mechanical energy may be developed in bulk at a central station conveniently situated with regard to a coal-field or a waterfall, and after transformation by means of electric generators into electric energy it may be transmitted to the locomotive and then by means of electric motors be retransformed into mechanical energy at the axles to which the motors are applied. Every axle of an electric locomotive may thus be subjected to a torque, and the large weight which must be put on one pair of wheels in order to secure sufficient adhesion when all the driving is done from one axle may be distributed through as many pairs of wheels as desired. In fact, there need be no specially differentiated locomotive at all. Motors may be applied to every axle in the train, and their individual torques adjusted to values suitable to the weights naturally carried by the several axles. Such an arrangement would be ideally perfect from the point of view of the permanent-way engineer, because it would then be possible to distribute the whole of the load uniformly between the wheels. This perfection of distribution is practically attained in present-day practice by the multiple control system of operating an electric train, where motors are applied to a selected number of axles in the train, all of them being under the perfect control of the driver.

The fundamental difference between the two methods is that while the mechanical energy developed by a steam engine is in the first case applied directly to the driving-axle of the locomotive, in the second case it is transformed into electrical energy, transmitted over relatively long distances, and retransformed into mechanical energy on the driving-axles of the train. In the first case all the driving is done on one or at most two axles, sufficient tractive force being obtained by coupling these axles when necessary to others carrying heavy loads. In the second case every axle in the train may be made a driving-axle if desired, in which case the locomotive as a separate machine disappears. In the second case, however, there are all the losses due to transmission from the central station to the train to be considered, as well as the cost of the transmitting apparatus itself. Ultimately the question resolves itself into one of commercial practicability. For suburban traffic with a service at a few minutes' interval and short distances between the stations electric traction has proved itself to be superior in many respects to the steam locomotive, but for main line traffic and long distance runs it has not yet been demonstrated that it is commercially feasible, though it is known to be practically possible. For the methods of electric traction see TRACTION; the remainder of the present article will be devoted to the steam locomotive.

§ 3. *General Efficiency of Steam Locomotive.*—One pound of good Welsh coal properly burned in the fire-box of a locomotive yields about 15,000 British thermal units of heat at a temperature high enough to enable from 50 to 80% to flow across the boiler-heating surface to the water, the rest escaping up the chimney with the furnace gases. The steam produced in consequence of this heat transference from the furnace gas to the water carries heat to the cylinder, where 7 to 11% is transformed into mechanical energy, the remainder passing away up the chimney with the exhaust steam. The average value of the product of these percentages, namely $0{\cdot}65 \times 0{\cdot}09 = 0{\cdot}06$ say, may be used to investigate generally the working of a locomotive; the actual value could only be determined by experiment in any particular case. With this assumption, 0·06 is the fraction of the heat energy of the coal which is utilized in the engine cylinders as mechanical work; that is to say, of the 15,000 B.Th.U. produced by the combustion of 1 ℔ of coal, $15{,}000 \times 0{\cdot}06 = 900$ only are available for tractive purposes.

Coals vary much in calorific value, some producing only 12,000 B.Th.U. per ℔ when burnt, whilst 15,500 is obtained from the best Welsh coals. Let E represent the pounds of coal burnt per hour in the fire-box of a locomotive, and let c be the calorific value in B.Th.U. per ℔; then the mechanical energy available in foot-pounds per hour is approximately $0{\cdot}06 \times 778 \times Ec$, and this expressed in horse-power units gives

$$\text{I.H.P.} = \frac{0{\cdot}06 \times 778 \times Ec}{1{,}980{,}000.} = 648.$$

A "perfect engine" receiving and rejecting steam at the same temperatures as the actual engine of the locomotive, would develop about twice this power, say 1400 I.H.P. This figure represents the ideal but unattainable standard of performance. This question of the standard engine of comparison, and the engine efficiency is considered in § 15 below, and the boiler efficiency in § 11 below.

The indicated horse-power developed by a cylinder may always be ascertained from an indicator diagram and observations of the speed. Let p be the mean pressure in pounds per square inch, calculated from an indicator diagram taken from a particular cylinder when the speed of the crank-shaft is n revolutions per second. Also let l be the length of the stroke in feet and let a be the area of one cylinder in square inches, then, assuming two cylinders of equal size,

$$\text{I.H.P.} = 2\,plan/550 \tag{8}$$

The I.H.P. at any instant is equal to the total rate at which energy is required to overcome the tractive resistance R. The horse-power available at the driving-axle, conveniently called the brake horse-power, is from 20 to 30% less than the indicated horse-power, and the ratio, $\text{B.H.P./I.H.P.} = \epsilon$, is called the mechanical efficiency of the steam engine. The relation between the b.h.p. and the torque on the driving-axle is

$$550\ \text{B.H.P.} = T\omega \tag{9}$$

It is usual with steam locomotives to regard the resistance R as including the frictional resistances between the cylinders and the driving-axle, so that the rate at which energy is expended in moving the train is expressed either by the product RV, or by the value of the indicated horse-power, the relation between them being

$$550\ \text{I.H.P.} = RV \tag{10}$$

or in terms of the torque

$$550\ \text{I.H.P.} \times \epsilon = RV\epsilon = T\omega \tag{11}$$

The individual factors of the product RV may have any value consistent with equation (10) and with certain practical conditions, so that for a given value of the I.H.P. R must decrease if V increases. Thus if the maximum horse-power which a locomotive can develop is 1000, the tractive resistance R, at 60 m. per hour (=88 ft. per second) is $R = (1000 \times 550)/88 = 6250$ ℔. If, however, the speed is reduced to 15 m. per hour (=22 ft. per second) R increases to 25,000 ℔. Thus an engine working at maximum power may be used to haul a relatively light load at a high speed or a heavy load at a slow speed.

§ 4. *Analysis of Train Resistance.*—Train resistance may be analysed into the following components:—

(1) Journal friction and friction of engine machinery.
(2) Wind resistance.
(3) Resistance due to gradients, represented by R_g.
(4) Resistance due to miscellaneous causes.
(5) Resistance due to acceleration, represented by R_a.
(6) Resistance due to curves.

The sum of all these components of resistance is at any instant equal to the resistance represented by R. At a uniform speed on a level straight road 3, 5 and 6 are zero. The total resistance is conveniently divided into two parts: (1) the resistance due to the vehicles hauled by the engine, represented by R_v; (2) the resistance of the engine and tender represented by R_e. In each of these two cases the resistance can of course be analysed into the six components set out in the above list.

§ 5. *Vehicle Resistance and Draw-bar Pull.*—The power of the engine is applied to the vehicles through the draw-bar, so that the draw-bar pull is a measure of the vehicle resistance. The draw-bar pull for a given load is a function of the speed of the train, and numerous experiments have been made to find the relation connecting the pull with the speed under various conditions. The usual way of experimenting is to put a dynamometer car (see DYNAMOMETER) between the engine and the train. This car is equipped with apparatus by means of which a continuous record of the draw-bar pull is obtained on a distance base; time indications are also made on the diagram from which the speed at any instant can be deduced. The pull recorded on the diagram includes the resistances due to acceleration and to the gradient on which the train is moving. It is usual to subtract these resistances from the observed pull, so as to obtain the draw-bar pull reduced to what it would be at a uniform speed on the level. This corrected pull is then divided by the weight of the vehicles hauled, in which must be included the weight of the dynamometer car, and the quotient gives the resistance per ton of load hauled at a certain uniform speed on a straight and level road. A series of experiments were made by J. A. F. Aspinall on the Lancashire & Yorkshire railway to ascertain the resistance of trains of bogie passenger carriages of different lengths at varying speeds, and the results are recorded in a paper, "Train Resistance," *Proc. Inst. C.E.* (1901), vol. 147. Aspinall's results are expressed by the formula

$$r_v = 2{\cdot}5 + \frac{S^{\frac{5}{3}}}{50{\cdot}8 + 0{\cdot}0278,L} \tag{12}$$

where r_v is the resistance in pounds per ton, S is the speed in miles per hour, and L is the length of the train in feet measured over the carriage bodies. The two following expressions are given in the *Bulletin* of the International Railway Congress (vol. xii. p. 1275), by Barbier, for some experiments made on the Northern railway of France with a train of 157 tons mean weight; they are valid between 37 and 77 m. per hour:—

$$r_v = 3{\cdot}58 + \frac{1{\cdot}65S(1{\cdot}61S+50)}{1000} \text{ for 4-wheel coaches,} \qquad (13)$$

$$r_v = 3{\cdot}58 + \frac{1{\cdot}64S(1{\cdot}61S+10)}{1000} \text{ for bogie coaches.} \qquad (14)$$

The Baldwin Locomotive Company give the formulae

$$r_v = 3{\cdot}36 + \frac{0{\cdot}56S}{3} \qquad (15)$$

and

$$r_v = 1{\cdot}68 + 0{\cdot}224S \text{ for speeds from 47 to 77 m. per hour.} \qquad (16)$$

All the above formulae refer to carriage stock. The resistance of goods wagons has not been so systematically investigated. In the paper above quoted Aspinall cites a case where the resistance of a train of empty wagons 1830 ft. long was 18·33 ℔ per ton at a speed of 26 m. per hour, and a train of full wagons 1045 ft. long gave only 9·12 ℔ per ton at a speed of 29 m. per hour. The resistance found from the above expressions includes the components 1, 2 and 4 of § 4. The resistance caused by the wind is very variable, and in extreme cases may double the resistance found from the formulae. A side wind causes excessive flange friction on the leeward side of the train, and increases the tractive resistances therefore very considerably, even though its velocity be relatively moderate. The curves corresponding to the above expressions are plotted in fig. 17, four values of L being taken for formula (12) corresponding to trains of 5, 10, 15 and 20 bogie carriages.

The resistance at starting is greater than the running resistance at moderate speeds. From Aspinall's experiments it appears to be about 17 ℔ per ton, and this value is plotted on the diagram.

The resistance to motion round a curve has not been so systematically studied that any definite rule can be formulated applicable to all classes of rolling stock and all radii of curves. A general result could not be obtained, even from a large number of experiments, because the resistance round curves depends upon so many variable factors. In some cases the gauge is laid a little wider than the standard, and there are varying amounts of superelevation of the outer rail; but the most formidable factor in the production of resistance is the guard-rail, which is sometimes put in with the object of guiding the wheel which runs on the inner rail of the curve on the inside of the flange.

§ 6. *Engine Resistance.*—From experiments made on the North-Eastern railway (see a paper by W. H. Smith on "Express Locomotive Engines," *Proc. Inst. Mech. Eng.*, October 1898), it appeared that the engine resistance was about 35 % of the total resistance, and in the train-resistance experiments on the Lancashire & Yorkshire railway quoted above the engine resistance was also about 35 % of the total resistance, thus confirming the North-Eastern railway results. Barbier (*loc. cit.*) gives as the formula for the engine resistance

$$r_e = 8{\cdot}51 + 3{\cdot}24S(1{\cdot}61S+30)/1000 \qquad (17)$$

where S is the speed in miles per hour. This formula is valid between speeds of 37 and 77 m. per hour, and was obtained in connexion with the experiments previously quoted on the Northern railway of France with an engine and tender weighing about 83 tons. Barbier's formula is plotted in fig. 17, together with a curve expressing generally the results of some early experiments on the Great Western railway carried out by Sir D. Gooch. The extension of the Barbier curve beyond the above limits in fig. 17 gives values which must be regarded as only very approximate.

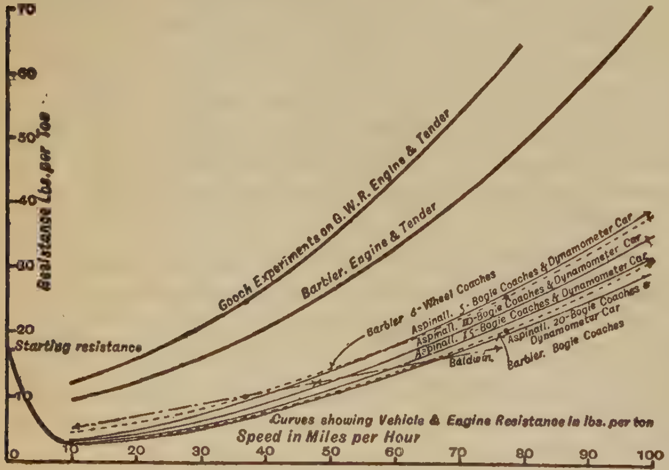


FIG. 17.

§ 7. *Rate at which work is done against the resistances given by the curves in fig. 17.*—When the weight of the engine and tender and the weight of the vehicles are respectively given, the rate at which work must be done in the engine cylinders in order to maintain the train in motion at a stated speed can be computed by the aid of the curves plotted in fig. 17. Thus let an engine and tender weighing 80 tons haul vehicles weighing 200 tons at a uniform speed on the level of 40 m. per hour. As given by the Barbier curves in fig. 17, the engine resistance at 40 m. per hour is 20 ℔ per ton, and the vehicle resistance 8·5 ℔ per ton at the same speed. Hence

Engine resistance, $R_e = 80 \times 20 = 1600$ ℔
Vehicle resistance, $R_v = 200 \times 8{\cdot}5 = \underline{1700}$,,
Train resistance, $R = 3300$,,

The speed, 40 m. per hour, is equal to 58·6 ft. per second; therefore the rate of working in foot-pounds per second is 3300×58·6, from which I.H.P. = (3300×58·6)/550 = 354. This is the horse-power, therefore, which must be developed in the cylinders to maintain the train in motion at a uniform speed of 40 m. per hour on a level straight road with the values of the resistances assumed.

§ 8. *Rate at which work is done against a gradient.*—Gradients are measured either by stating the number of feet horizontally, G say, in which the vertical rise is 1 ft., or by the vertical rise in 100 ft. measured horizontally expressed as a percentage, or by the number of feet rising vertically in a mile. Thus a gradient of 1 in 200 is the same as a half per cent. grade or a rise of 26·4 ft. per mile. The difference between the horizontal distance and the distance measured along the rail is so small that it is negligible in all practical calculations. Hence if a train is travelling up the gradient at a speed of V ft. per second, the vertical rise per second is V/G ft. If W_1 is the weight of the train in pounds, the rate of working against the gradient expressed in horse-power units is

$$\text{H.P.} = W_1V/550\,G. \qquad (18)$$

Assuming the data of the previous section, and in addition that the train is required to maintain a speed of 40 m. per hour up a gradient of 1 in 300, the extra horse-power required will be

$$\text{H.P.} = \frac{280 \times 2240 \times 58{\cdot}6}{300 \times 550} = 223.$$

This must be exerted in addition to the horse-power calculated in the previous section, so that the total indicated horse-power which must be developed in the cylinders is now 354+223=577. If the train is running down a gradient this horse-power is the rate at which gravity is working on the train, so that with the data of the previous section, on the assumption that the train is running down a gradient of 1 in 300, the horse-power required to maintain the speed would be 354−223=131.

§ 9.—*Rate at which work is done against acceleration.*—If W_1 is the weight of the train in pounds and *a* the acceleration in feet per second, the force required to produce the acceleration is

$$f = W_1a/g. \qquad (19)$$

And if V is the average speed during the change of velocity implied by the uniform acceleration *a*, the rate at which work is done by this force is

$$fV = W_1Va/g \qquad (20)$$

or in horse-power units

$$\text{H.P.} = W_1Va/550g. \qquad (21)$$

Assuming the data of § 7, suppose the train to change its speed from 40 to 41 m. per hour in 13 seconds. The average acceleration in feet per second is measured by the fraction

$$\frac{\text{Change of speed in feet per sec.}}{\text{Time occupied in the change}} = \frac{60{\cdot}07 - 58{\cdot}6}{13} = 0{\cdot}113.$$

Therefore the horse-power which must be developed in the cylinders to effect this change of speed is from (21)

$$\text{H.P.} = \frac{280 \times 2240 \times 0{\cdot}113 \times 59}{550 \times 32} = 237.$$

The rate of working is negative when the train is retarded; for instance, if the train had changed its speed from 41 to 40 m. per hour in 13 seconds, the rate at which work would have to be absorbed by the brake blocks would represent 237 H.P. This is lost in heat produced by the friction between the brake blocks and the wheels, though in some systems of electric driving some of the energy stored in the train may be returned to the central station during retardation. The principal condition operating in the design of locomotives intended for local services with frequent stops is the degree of acceleration required, the aim of the designer being to produce an engine which shall be able to bring the train to its journey speed in the shortest time possible. For example, suppose it is required to start a train weighing 200 tons from rest and bring it to a speed of 30 m. per hour in 30 seconds. The weight of the engine may be assumed in advance to be 80 tons. The acceleration, *a*, which may be supposed uniform, is 1·465. The average velocity is 15 m. per hour, which is equal to 22 ft. per second; therefore the tractive force required is, from (19),

$$(280 \times 2240 \times 1{\cdot}465)/32 = 28{,}720 \text{ ℔},$$

and the corresponding horse-power which must be developed in the cylinders is, from (20), *f*V/550, and this is with *f* and V equal to the above values, 1149. To obtain the tractive force the weight on the coupled wheels must be about five times this amount—that is, 64 tons; and to obtain the horse-power the boiler will be one of the largest that can be built to the construction gauge. After acceleration to the journey speed of 30 m. per hour the horse-power required is reduced to about one-third of that required for acceleration alone.

§ 10. *General expression for total rate of working.*—Adding the various rates of working together

$$\frac{\mathrm{RV}}{550}=\mathrm{I.H.P.}=\frac{(\mathrm{W}_e r_e+\mathrm{W}_v r_v)\mathrm{V}}{550}\pm\frac{2240\mathrm{WV}}{550\mathrm{G}}\pm\frac{2240\mathrm{WV}a}{550g} \qquad (22)$$

where W_e is weight of engine and tender in tons, W_v the weight of vehicles in tons, W the weight of train in tons $=\mathrm{W}_e+\mathrm{W}_v$, r_e and r_v the respective engine and vehicle resistances taken from the curves fig. 17 at a speed corresponding to the average speed during the acceleration a, G the gradient, g the acceleration due to gravity, and V the velocity of the train in feet per second. In this expression it is assumed that the acceleration is uniform, and this assumption is sufficiently accurate for any practical purpose to which the above formula would be applied in the ordinary working of a locomotive. If a is variable, then the formula must be applied in a series of steps, each step corresponding to a time interval over which the acceleration may be assumed uniform.

Dividing through by V and multiplying through by 550,

$$\mathrm{R}=\mathrm{W}_e r_e+\mathrm{W}_v r_v\pm\frac{2240\mathrm{W}}{\mathrm{G}}\pm\frac{2240\mathrm{W}a}{g}, \qquad (23)$$

an expression giving the value of R the total tractive resistance. If the draw-bar pull is known to be R_v, then applying the same principles to the vehicle alone which above are applied to the whole train,

$$\text{total draw-bar pull}=\mathrm{W}_v r_v\pm\frac{2240\mathrm{W}_v}{\mathrm{G}}\pm\frac{2240\mathrm{W}_v a}{g}. \qquad (24)$$

This expression may be used to find r_v when the total draw-bar pull is observed as well as the speed, the changes of speed and the gradient. The speed held to correspond with the resistance must be the mean speed during the change of speed. The best way of deducing r_v is to select portions of the dynamometer record where the speed is constant. Then a disappears from all the above expressions. These expressions indicate what frequent changes in the power are required as the train pursues its journey up and down gradients, against wind resistance, journal friction and perhaps the resistance of a badly laid track; and show how both the potential energy and kinetic energy of the train are continually changing: the first from a change in vertical position due to the gradients, the second from changes in speed. These considerations also indicate what a difficult matter it is to find the exact rate of working against the resistances, because of the difficulty of securing conditions which eliminate the effect both of the gradient and of acceleration.

§ 11. *The Boiler.—Maximum Power.*—The maximum power which can be developed by a locomotive depends upon the maximum rate of fuel combustion which can be maintained per square foot of grate. This maximum rate depends upon the kind of coal used, whether small, friable, bituminous or hard, upon the thickness of the fire, and upon the correct design and setting of the blast-pipe. A limit is reached to the rate of combustion when the draught becomes strong enough to carry heavy lighted sparks through the tubes and chimney. This, besides reducing the efficiency of the furnace, introduces the danger of fire to crops and buildings near the line. The maximum rate of combustion may be as much as 150 ℔ of coal per square foot of grate per hour, and in exceptional cases even a greater rate than this has been maintained. It is not economical to force the boiler to work at too high a rate, because it has been practically demonstrated that the boiler efficiency decreases after a certain point, as the rate of combustion increases. A few experimental results are set forth in Table XX., from which it will be seen that with a relatively low rate of combustion, a rate which denotes very light service, namely 28 ℔ of coal per square foot of grate per hour, the efficiency of the boiler is 82%, which is as good a result as can be obtained with the best class of stationary boiler or marine boiler even when using economizers.

The first group consists of experiments selected from the records of a large number made on the boiler of the locomotive belonging to the Purdue University, Indiana, U.S.A.

The second group consists of experiments made on a boiler belonging to the Great Eastern Railway Company. The first one of the group was made on the boiler fixed in the locomotive yard at Stratford, and the two remaining experiments of the group were made while the engine was working a train between London and March.

The third group consists of experiments selected from the records of a series of trials made on the London & South-Western railway with an express locomotive.

§ 12. *Draught.*—One pound of coal requires about 20 ℔ of air for its proper combustion in the fire-box of a locomotive, though this quantity of air diminishes as the rate of combustion increases. For instance, an engine having a grate area of 30 sq. ft. and burning 100 ℔ of coal per square foot of grate per hour would require that 60,000 ℔ of air should be drawn through the furnace per hour in order to burn the coal. This large quantity of air is forced through the furnace by means of the difference of pressure established between the external atmospheric pressure in the ash-pan and the pressure in the smoke-box.

TABLE XX

Kind, and calorific value of coal.	Dry coal fired per square foot of grate per hour. ℔	Pounds of water evaporated per ℔ of coal from and at 212° F.	Boiler efficiency.	Reference.
Indiana block coal from the neighbourhood of Brazil. Estimated calorific value, 13,000 B.Th.U. per ℔	49	7·83	0·58	Prof. Goss (*Amer Soc. of Mech. Eng.*, vol. 22, 1900).
	109	6·59	0·49	
	181	5·71	0·42	
Nixon's Navigation. Calorific value, 15,560 B.Th.U. per ℔	35·5	13	0·80	"Experiments on Steam Boilers," Donkin and Kennedy, (*Engineering*, London, 1897).
	28·1	13·3	0·82	
	31·7	13·1	0·81	
Calorific value, 13,903	62·5	11·15	0·77	Adams and Pettigrew (*Proc. Inst. C.E.*, vol. 125).
Calorific value, 12,840	80·9	8·86	0·66	

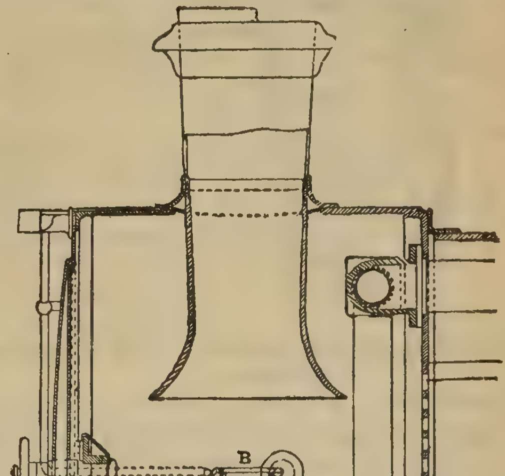


FIG. 18.—Smoke-box, L. & N.W.R. four-coupled 6 ft. 6 in. passenger engine.

The exhaust steam passing from the engine through the blast-pipe and the chimney produces a diminution of pressure, or partial vacuum, in the smoke-box roughly proportional to the weight of steam discharged per unit of time. The difference of pressure between the outside air and the smoke-box gases may be measured by the difference of the water levels in the limbs of a U tube, one limb being in communication with the smoke-box, the other with the atmosphere. The difference of levels varies from 1 to as much as 10 in. in extreme cases. The draught corresponding to the smallest rate of combustion shown in Table XX. in Professor Goss's experiments, was 1·72 in. of water, and for the highest rate, namely 181, 7·48 in. of water. To get the best effect the area of the blast-nozzle must be properly proportioned to the size of the cylinders and be properly set with regard to the base of the chimney. The best proportions are found by trial in all cases.

Figs. 18 and 19 show two smoke-boxes typical of English practice. Fig. 18 is the smoke-box of the 6 ft. 6 in. six-coupled express passenger engines designed by G. Whale for the London & North-Western Railway Company in 1904, and fig. 19 shows the box of the four-coupled express passenger engine designed by J. Holden for the Great Eastern Railway Company. In the case of the London & North-Western engine (fig. 18), the blast-pipe orifice B is placed at about the centre of the boiler barrel, and the exhaust steam is discharged straight into the trumpet-shaped end of the chimney, which is continued down inside the smoke-box. In fig. 19 the blast orifice B is set much lower, and the steam is discharged through a frustum of a cone set in the upper part of the smoke-box into the short chimney. Fig. 20 shows the standard proportions recommended by the committee of the Railway Master Mechanics' Association on Exhaust Pipes and Steam Passages (*Proc. Amer. Railway Master Mechanics' Assoc.*, 1906). According to the Report, for the best results both H and h should be made as great as practicable, and then $d=0{\cdot}21D+0{\cdot}16h$, $b=2d$ or $0{\cdot}5D$, $P=0{\cdot}32D$, $p=0{\cdot}22D$, $L=0{\cdot}6D$ or $0{\cdot}9D$, but not of intermediate values. This last relation is, however, not well established. For much detailed information regarding American smoke-box practice, reference may be made to *Locomotive Sparks*, by Professor W. F. M. Goss (London, 1902).

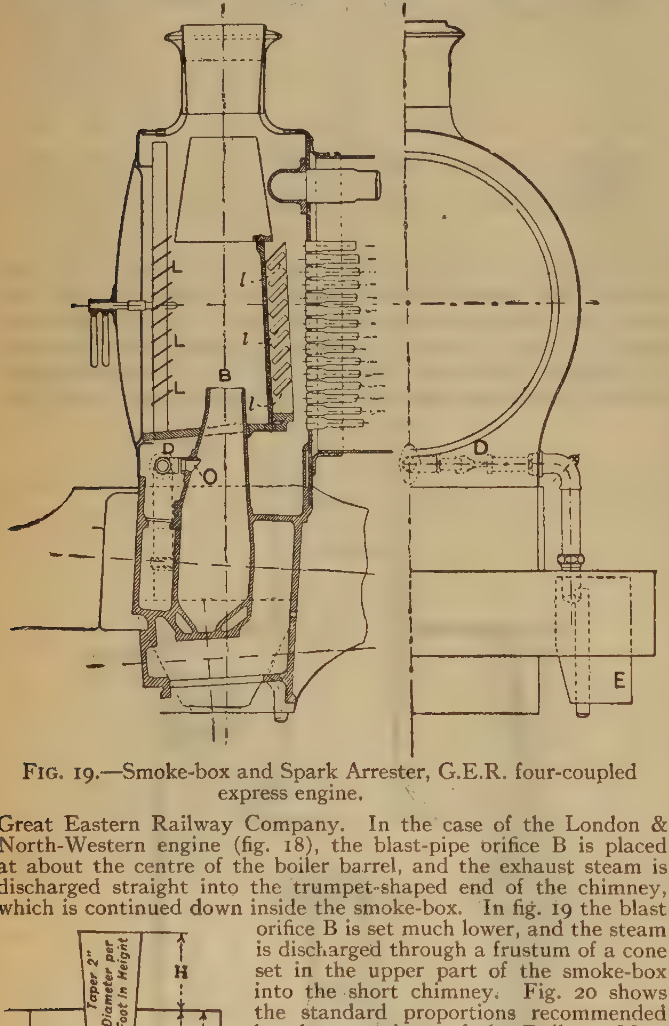


FIG. 19.—Smoke-box and Spark Arrester, G.E.R. four-coupled express engine.

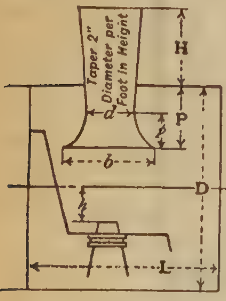


FIG. 20.—Smoke-box, American Railway Master Mechanics' Association.

The arrangements for arresting sparks in American practice and on the continent of Europe are somewhat elaborate. In English practice where a spark-arrester is put in it usually takes the form of a wire-netting dividing the smoke-box horizontally into two parts at a level just above the top row of tubes, or arranged to form a continuous connexion between the blast-pipe and the chimney.

Fig. 19 illustrates an arrangement designed by J. Holden. The heavy sparks are projected from the tubes in straight lines and are caught by the louvres L, L, L, and by them deflected downwards to the bottom of the smoke-box, where they collect in a heap in the space D round a tube which is essentially an ejector. At every blast a small quantity of steam is caught by the orifice O and led to the ejectors, one on each side, with the result that the ashes are blown out into the receptacles on each side of the engine, one of which is shown at E. The louvres *l*, *l*, *l* are placed to shield the central region occupied by the blast-pipe.

As the indicated horse-power of the engine increases, the weight of steam discharged increases, and the smoke-box vacuum is increased, thereby causing more air to flow through the furnace and increasing the rate of combustion. Thus the demand for more steam is automatically responded to by the boiler. It is this close automatic interdependence of engine and boiler which makes the locomotive so extraordinarily well suited for the purpose of locomotive traction.

§ 13. *The Steam Engine.*—The steam engine of a locomotive has the general characteristics of a double-acting non-condensing engine (see STEAM ENGINE). Distribution of steam is effected by a slide valve, sometimes fitted with a balancing device, and sometimes formed into a piston valve. All types of valves are with few exceptions operated by a link motion, generally of the Stephenson type, occasionally of the Allan type or the Gooch type, or with some form of radial gear as the Joy gear or the Walschaert gear, though the latter gear has characteristics which ally it with the link motions. The Stephenson link motion is used almost universally in England and America, but it has gradually been displaced by the Walschaert gear on the continent of Europe, and to some extent in England by the Joy gear. The general characteristics of the distribution effected by these gears are similar. Each of them, besides being a reversing gear, is an expansion gear both in forward and backward running. The lead is variable in the Stephenson link motion, whilst in the Walschaert and the Joy gears it is constant. Illustrations of these gears are given in the article STEAM ENGINE, and the complete distribution of steam for both forward and backward running is worked out for a typical example of each of them in *Valves and Valve Gear Mechanisms* by W. E. Dalby (London, 1906).

§ 14. *Cylinder Dimensions.—Adhesion.—Tractive Force.*—A locomotive must be designed to fulfil two conditions. First, it must be able to exert a tractive force sufficient to start the train under the worst conditions possible on the railway over which it is to operate—for instance, when the train is stopped by signal on a rising gradient where the track is curved and fitted with a guard-rail. Secondly, it must be able to maintain the train at a given speed against the total resistances of the level or up a gradient of given inclination. These conditions are to a certain extent mutually antagonistic, since an engine designed to satisfy either condition independently of the other would be a different engine from that designed to make the best compromise between them.

Equation (3), § 1 expresses the fundamental condition which must be satisfied when a locomotive is starting a train. The torque exerted on the driving-axle by the steam engine just at starting may be that due to the full boiler pressure acting in the cylinders, but usually the weight on the coupled wheels is hardly sufficient to enable advantage to be taken of the full boiler pressure, and it has to be throttled down by the regulator to prevent slipping. Sand, driven between the wheel and the rail by a steam jet, used just at starting, increases the adhesion beyond the normal value and enables a larger pressure to be exerted on the piston than would otherwise be possible. When the train is started and is moving slowly, the torque acting on the driving-axle may be estimated as that due to about 85% of the full boiler pressure acting in the cylinders. The torque due to the two cylinders is variable to a greater or less extent, depending upon the degree of expansion in the cylinders and the speed. The form of the torque curve, or crank effort curve, as it is sometimes called, is discussed in the article STEAM ENGINE, and the torque curve corresponding to actual indicator diagrams taken from an express passenger engine travelling at a speed of 65 m. per hour is given in *The Balancing of Engines* by W. E. Dalby (London, 1906).

The plotting of the torque curve is laborious, but the average torque acting, which is all that is required for the purposes of this article, can be found quite simply, thus:—Let p be the mean effective pressure acting in one cylinder, a, the area of the cylinder, and l, the stroke. Then the work done during one revolution of the crank is $2pla$ per cylinder. Assuming that the mean pressure in the other cylinder is also p, the total work done per revolution is $4pla$. If T is the mean torque, the work done on the crank-axle per revolution is $2\pi T$. Hence assuming the mechanical efficiency of the engine to be ϵ, and substituting $\frac{\pi}{4}d^2$ for the area a,

$$2\pi T = 4pla\epsilon = pl\pi d^2\epsilon,$$

so that

$$T = \tfrac{1}{2}pd^2l\epsilon.$$

But from § 1, $T = \frac{1}{2}DF$;

therefore

$$F = pd^2l\epsilon/D \qquad (25)$$

F in this expression is twice the average magnitude of the equal and opposite forces constituting the couple for one driving-wheel illustrated in fig. 16, one force of which acts to propel the train whilst the other is the value of the tangential frictional resistance between the wheel and the rail. This force F must not exceed the value μW or slipping will take place. Hence, if p is the maximum value of the mean effective pressure corresponding to about 85% of the boiler pressure,

$$\mu W = pd^2l\epsilon/D \qquad (26)$$

is an expression giving a relation between the total weight on the coupled wheels, their diameters and the size of the cylinder. The magnitude of F when p and ϵ are put each equal to unity, is usually called the tractive force of the locomotive per pound of mean effective pressure in the cylinders. If p is the mean pressure at any speed the total tractive force which the engine is exerting is given by equation (25) above. The value of ϵ is variable, but is between ·7 and ·8, and for approximate calculations may be taken equal to unity. In the following examples the value will be assumed unity.

These relations may be illustrated by an example. Let an engine have two cylinders each 19 in. diameter and 26 in. stroke. Let the boiler pressure be 175 ℔ per square inch. Taking 85% of this, the maximum mean effective pressure would be 149 ℔ per square inch. Further, let the diameter of the driving-wheels be 6 ft. 3 in. Then the tractive force is, from (25),

$$(149 \times 19^2 \times 2 \cdot 166)/6 \cdot 25 = 18{,}600 \text{℔} = 8 \cdot 3 \text{ tons}.$$

Assuming that the frictional resistance at the rails is given by $\frac{1}{5}$ the weight on the wheels, the total weight on the driving-wheels necessary to secure sufficient adhesion to prevent slipping must be at least $8 \cdot 3 \times 5 = 41 \cdot 5$ tons. This would be distributed between three coupled axles giving an average of 1·38 tons per axle, though the distribution might not in practice be uniform, a larger proportion of the weight falling on the driving-axle. If the starting resistance of the whole train be estimated at 16 ℔ per ton, this engine would be able to start 1·163 tons on the level, or about 400 tons on a gradient of 1 in 75, both these figures including the weight of the engine and tender, which would be about 100 tons.

The engine can only exert this large tractive force so long as the mean pressure is maintained at 149 ℔ per square inch. This high mean pressure cannot be maintained for long, because as the speed increases the demand for steam per unit of time increases, so that cut-off must take place earlier and earlier in the stroke, the limiting steady speed being attained when the rate at which steam is supplied to the cylinders is adjusted by the cut-off to be equal to the maximum rate at which the boiler can produce steam, which depends upon the maximum rate at which coal can be burnt per square foot of grate. If C is the number of pounds of coal burnt per square foot of grate per hour, the calorific value of which is c B.Th.U. per pound, the maximum indicated horse-power is given by the expression

$$\text{I.H.P. maximum} = \frac{CcA \times 778}{1980000} \times \eta,$$

where A is the area of the grate in square feet, and η is the combined efficiency of the engine and boiler. With the data of the previous example, and assuming in addition that the grate area is 24 sq. ft., that the rate of combustion is 150 ℔ of coal per square foot of grate per hour, that the calorific value is 14000, and finally that $\eta = 0 \cdot 06$, the maximum indicated horse-power which the engine might be expected to develop would be $0 \cdot 06 \times 150 \times 14000 \times 24 \times 778/1980000 = 1190$, corresponding to a mean effective pressure in the cylinders of 59·5 ℔ per square inch.

Assuming that the train is required to run at a speed of 60 m. per hour, that is 88 ft. per second, the total resistance R, which the engine can overcome at this speed, is by equation (10)

$$R = (1190 \times 550)/88 = 7 \cdot 400 \text{ ℔}.$$

Thus although at a slow speed the engine can exert a tractive force of 18,600 ℔, at 60 m. per hour, the tractive force falls to 7400 ℔, and this cannot be increased except by increasing the rate of combustion (neglecting any small changes due to a change in the efficiency η). Knowing the magnitude of R, the draw-bar pull, and hence the weight of vehicle the engine can haul at this speed, can be estimated if the resistances are known. Using the curves of fig. 17 it will be found that at 60 m. per hour the resistance of the engine and tender is 33 ℔ per ton, and the resistance of a train of bogie coaches about 14 ℔ per ton. Hence if W is the weight of the vehicles in tons, and the weight of the engine and tender be taken at 100 tons, the value of W can be found from the equation $14W + 3300 = 7440$, from which $W = 296$ tons. This is the load which the engine would take in ordinary weather. With exceptionally bad weather the load would have to be reduced or two engines would have to be employed, or an exceptionally high rate of combustion would have to be maintained in the fire-box.

It will be seen at once that with a tractive force of 7400 ℔ a weight of 37,000 ℔ (=16·5 tons) would be enough to secure sufficient adhesion, and this could be easily carried on one axle. Hence for a level road the above load could be hauled at 60 m. per hour with a "single" engine. When the road leads the train up an incline, however, the tractive force must be increased, so that the need for coupled wheels soon arises if the road is at all a heavy one.

§15. *Engine Efficiency. Combined Engine and Boiler Efficiency.*—The combined engine and boiler efficiency has hitherto been taken to be 0·06; actual values of the boiler efficiencies are given in Table XX. Engine efficiency depends upon many variable factors, such as the cut-off, the piston speed, the initial temperature of the steam, the final temperature of the steam, the quality of the steam, the sizes of the steam-pipes, ports and passages, the arrangement of the cylinders and its effect on condensation, the mechanical perfection of the steam-distributing gear, the tightness of the piston, &c. A few values of the thermal efficiency obtained from experiments are given in Table XXI. in the second column, the first column being added to give some idea of the rate at which the engine was working when the data from which the efficiency has been deduced were observed. The corresponding boiler efficiencies are given in the third column of the table, when they are known, and the combined efficiencies in the fourth column. The figures in this column indicate that 0·06 is a good average value to work with.

TABLE XXI

The numbers in this column refer to fig. 22.	Indicated horse-power.	Engine Efficiency.	Boiler Efficiency.	Combined Efficiency.	Boiler Pressure ℔ per sq. in.	
	128	0·073			Mean about 128 but throttled.	Deduced from data given by Professor Goss (*Trans. Am. Soc. Mech. Eng.* vol. 14).
	205	0·075				
	222	0·080				
	399	0·088				
1	mean 129	0·057	0·815	0·047	mean about 120	Deduced from Kennedy and Donkin's trials (*Engineering*, London, 1887).
2	490	0·098	0·775	0·077	167	Deduced from Adams and Pettigrew's trials (*Proc. Inst. C.E.* vol. 125).
3	582	0·11	0·665	0·073	169	
4	520	0·084	0·52	0·044	140	Deduced from Smith's experiments (*Proc. Inst. Mech. Eng.* October 1898).
5	692	0·083	0·65	0·054	175	
6	558	0·074	0·69	0·051	175	
7	603	0·086	0·63	0·054	175	
8	570	0·081	0·64	0·052	160	

It is instructive to inquire into the limiting efficiency of an engine consistent with the conditions under which it is working, because in no case can the efficiency of a steam-engine exceed a certain value which depends upon the temperatures at which it receives and rejects heat. Thus a standard of comparison for every individual engine may be obtained with which to compare its actual performance. The standard of comparison generally adopted for this purpose is obtained by calculating the efficiency of an engine working according to the Rankine cycle. That is to say, expansion is adiabatic and is continued down to the back pressure which in a non-condensing engine is 14·7 lb per square inch, since any back pressure above this amount is an imperfection which belongs to the actual engine. The back pressure is supposed to be uniform, and there is no compression.

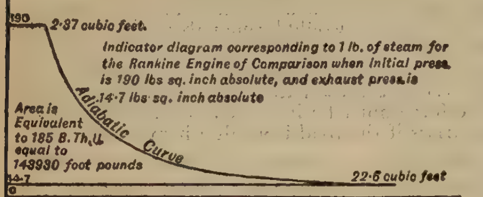

190
2·37 cubic feet.
Indicator diagram corresponding to 1 lb. of steam for the Rankine Engine of Comparison when initial press. is 190 lbs sq. inch absolute, and exhaust press. is 14·7 lbs sq. inch absolute
Adiabatic Curve
Area is Equivalent to 185 B.Th.U. equal to 143930 foot pounds
14·7
0
22·6 cubic feet

FIG. 21.

Fig. 21 shows the pressure-volume diagram of the Rankine cycle for one pound of steam where the initial pressure is 175 lb per square inch by the gauge, equivalent to 190 lb per square inch absolute. In no case could an engine receiving steam at the temperature corresponding to this pressure and rejecting heat at 212° F. convert more heat into work than is represented by the area of this diagram. The area of the diagram may be measured, but it is usually more convenient to calculate the number of B.Th.U. which the area represents from the following formula, which is expressed in terms of the absolute temperature T_1 of the steam at the steam-pipe, and the temperature $T_2 = 461° + 212° = 673°$ absolute corresponding to the back pressure:—

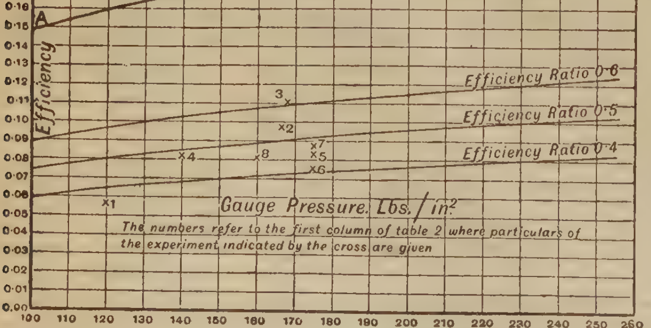
$$\left.\begin{array}{c}\text{Maximum available work}\\ \text{per pound of steam}\end{array}\right\} = U = (T_1 - T_2)\left(1 + \frac{L_1}{T_1}\right) - T_2 \log_e \frac{T_1}{T_2}.$$

With the initial pressure of 190 lb per square inch absolute it will be found from a steam table that $T_1 = 838°$ absolute. Using this and the temperature 673° in the expression, it will be found that $U = 185$ B.Th.U. per pound of steam. If h_2 is the water heat at the lower temperature, h_1 the water heat at the higher temperature, and L_1 the latent heat at the higher temperature, the heat supply per pound of steam is equal to $h_1 - h_2 + L_1$, which, from the steam tables, with the values of the temperatures given, is equal to 1013 B.Th.U. per pound. The thermal efficiency is therefore

$$185/1013 = 0·183.$$

That is to say, a perfect engine working between the limits of temperature assigned would convert only 18% of the total heat supply into work. This would be an ideal performance for an engine receiving steam at 190 lb initial pressure absolute, and rejecting steam at the back pressure assumed above, and could never be attained in practice. When the initial pressure is 100 lb per square inch by the gauge the thermal efficiency drops to about nearly 15% with the same back pressure. The way the thermal efficiency of the ideal engine increases with the pressure is exhibited in fig. 22 by the curve AB. The curve was drawn by calculating the thermal efficiency from the above expression for various values of the initial temperature, keeping the final temperature constant at 673°, and then plotting these efficiencies against the corresponding values of the gauge pressures.

The actual thermal efficiencies observed in some of the cases cited in Table XXI. are plotted on the diagram, the reference numbers on which refer to the first column in the table. Thus the cross marked 3 in fig. 22 represents the thermal efficiency actually obtained in one of Adams and Pettigrew's experiments, namely, 0·11, the pressure in the steam-pipe being 167 lb per square inch. From the diagram it will be seen that the corresponding efficiency of the ideal engine is about 0·18. The efficiency ratio is therefore 0·11/0·18 = 0·61. That is to say, the engine actually utilized 61% of the energy which it was possible to utilize by means of a perfect engine working with the same initial pressure against a back pressure equal to the atmosphere. Lines representing efficiency ratios of 0·6, 0·5 and 0·4 are plotted on the diagram, so that the efficiency ratios corresponding to the various experiments plotted may be readily read off. The initial temperature of the standard engine of comparison must be the temperature of the steam taken in the steam-pipe. For further information regarding the standard engine of comparison see the article STEAM ENGINE and also the "Report of the Committee on the Thermal Efficiency of Steam Engines," *Proc. Inst. C.E.* (1898).



The numbers refer to the first column of table 2 where particulars of the experiment indicated by the cross are given

FIG. 22.—Engine Efficiency Curves.

§ 16. *Piston Speed.*—The expression for the indicated horse-power may be written

$$\text{I.H.P.} = pav/550 \qquad (27)$$

where v is the average piston speed in feet per second. For a stated value of the boiler pressure and the cut-off the mean pressure p is a function of the piston speed v. For the few cases where data are available—data, however, belonging to engines representing standard practice in their construction and in the design of cylinders and steam ports and passages—the law connecting p and v is approximately linear and of the form

$$p = c - bv \qquad (28)$$

where b and c are constants. (See W. E. Dalby, "The Economical Working of Locomotives," *Proc. Inst. C.E.*, 1905–6, vol. 164.) Substituting this value of p in (27)

$$\text{I.H.P.} = \frac{(c - bv)av}{550} \qquad (29)$$

the form of which indicates that there is a certain piston speed for which the I.H.P. is a maximum. In a particular case where the boiler pressure was maintained constant at 130 lb per square inch, and the cut-off was approximately 20% of the stroke, the values $c = 55$ and $b = 0·031$ were deduced, from which it will be found that the value of the piston speed corresponding to the maximum horsepower is 887 ft. per minute. The data from which this result is deduced will be found in Professor Goss's paper quoted above in Table XXI. The point is further illustrated by some curves published in the *American Engineer* (June 1901) by G. R. Henderson recording the tests of a freight locomotive made on the Chicago & North-Western railway. Any modification of the design which will reduce the resistance to the flow of steam through the steam passages at high speeds will increase the piston speed for which the indicated horse-power is a maximum.

§ 17. *Compound Locomotives.*—The thermal efficiency of a steam-engine is in general increased by carrying out the expansion of the steam in two, three or even more stages in separate cylinders, notwithstanding the inevitable drop of pressure which must occur when the steam is transferred from one cylinder to the other during the process of expansion. Compound working permits of a greater range of expansion than is possible with a simple engine, and incidentally there is less range of pressure per cylinder, so that the pressures and temperatures per cylinder have not such a wide range of variation. In compound working the combined volumes of the low-pressure cylinders is a measure of the power of the engine, since this represents the final volume of the steam used per stroke. The volume of the high-pressure cylinder may be varied within wide limits for the same low-pressure volume; the proportions adopted should, however, be such that there is an absence of excessive drop between them as the steam is transferred from one to the other. Compound locomotives have been built by various designers, but opinion is still uncertain whether any commercial economy is obtained by their use. The varying load against which a locomotive works, and the fact that a locomotive is non-condensing, are factors which reduce the margin of possible economy within narrow limits. Coal-saving can be shown to the extent of about 14% in some cases, but the saving depends upon the kind of service on which the engine is employed. The first true compound locomotive was constructed in 1876 from designs by A. M. Mallet, at the Creusot works in Bayonne. The first true compound locomotive in England was constructed at Crewe works in 1878 by F. W. Webb. It was of the same type as Mallet's engine, and was made by simply bushing one cylinder of an ordinary two-cylinder simple engine, the bushed cylinder being the high-pressure and the other cylinder the low-pressure cylinder. Webb evolved the type of three-cylinder compound with which his name is associated in 1882.

There were two high-pressure cylinders placed outside the frames and driving on a trailing wheel, and one low-pressure cylinder placed between the frames and driving on a wheel placed in front of the driving-wheel belonging to the high-pressure cylinders. The steam connexions were such that the two high-pressure cylinders were placed in parallel, both exhausting into the one low-pressure cylinder. The first engines of this class were provided with high-pressure cylinders, 11 in. diameter and 24 in. stroke, a low-pressure cylinder 26 in. diameter, 24 in. stroke, and driving-wheels 6 ft. 6 in. diameter; but subsequently these dimensions were varied. There were no coupling rods. A complete account of Webb's engines will be found in a paper, "The Compound Principle applied to Locomotives," by E. Worthington, *Proc. Inst. C.E.*, 1889, vol. xcvi. Locomotives have to start with the full load on the engine, consequently an outstanding feature of every compound locomotive is the apparatus or mechanism added to enable the engine to start readily. Generally steam from the boiler is admitted direct to the low-pressure cylinder through a reducing valve, and valves and devices are used to prevent the steam so admitted acting as a back pressure on the high-pressure cylinder. In the Webb compound the driver opened communication from the high-pressure exhaust pipe to the blast-pipe, and at the same time opened a valve giving a supply of steam from the boiler direct to the low-pressure valve chest. T. W. Worsdell developed the design of the two-cylinder compound in England and built several, first for the Great Eastern railway and subsequently for the North-Eastern railway. The engines were built on the Worsdell and Von Borries plan, and were fitted with an ingenious starting-valve of an automatic character to overcome the difficulties of starting. Several compounds of a type introduced by W. M. Smith on the North-Eastern railway in 1898 have been built by the Midland railway. In these there are two low-pressure cylinders placed outside the frame, and one high-pressure cylinder placed between the frames. All cylinders drive on one crank-axle with three cranks at 120°. The driving-wheels are coupled to a pair of trailing wheels. A controlling valve enables the supply of steam to the low-pressure cylinders to be supplemented by boiler steam at a reduced pressure. For a description and illustrations of the details of the starting devices used in the Webb, Worsdell and Smith compounds, see an article, "The Development of the Compound Locomotive in England," by W. E. Dalby in the *Engineering Magazine* for September and October 1904. A famous type of compound locomotive developed on the continent of Europe is the four-cylinder De Glehn, some of which have been tried on the Great Western railway. There are two high-pressure cylinders placed outside the frame, and two low-pressure placed inside the frames. The low-pressure cylinders drive on the leading crank-axle with cranks at right angles, the high-pressure cylinders driving on the trailing wheels. The wheels are coupled, but the feature of the engine is that the coupling-rods act merely to keep the high-pressure and low-pressure engines in phase with one another, very little demand being made upon them to transmit force except when one of the wheels begins to slip. In this arrangement the whole of the adhesive weight of the engine is used in the best possible manner, and the driving of the train is practically equally divided between two axles. The engine can be worked as a four-cylinder simple at the will of the driver. S. M. Vauclain introduced a successful type of four-cylinder compound in America in 1889. A high- and low-pressure cylinder are cast together, and the piston-rods belonging to them are both coupled to one cross-head which is connected to the driving-wheels, these again being coupled to other wheels in the usual way. The distribution of steam to both cylinders is effected by one piston-valve operated by a link motion, so that there is considerable mechanical simplicity in the arrangement. Later Vauclain introduced the "balanced compound." In this engine the two piston-rods of one side are not coupled to a common cross-head, but drive on separate cranks at an angle of 180°, the pair of 180° cranks on each side being placed at right angles.

§18. *The Balancing of Locomotives.*—The unbalanced masses of a locomotive may be divided into two parts, namely, masses which revolve, as the crank-pins, the crank-cheeks, the coupling-rods, &c.; and masses which reciprocate, made up of the piston, piston-rod, cross-head and a certain proportion of the connecting-rod. The revolving masses are truly balanced by balance weights placed between the spokes of the wheels, or sometimes by prolonging the crank-webs and forming the prolongation into balance weights. It is also the custom to balance a proportion of the reciprocating masses by balance weights placed between the spokes of the wheels, and the actual balance weight seen in a driving-wheel is the resultant of the separate weights required for the balancing of the revolving parts and the reciprocating parts. The component of a balance weight which is necessary to balance the reciprocating masses introduces a vertical unbalanced force which appears as a variation of pressure between the wheel and the rail, technically called the hammer-blow, the magnitude of which increases as the square of the speed of the train. In consequence of this action the compromise is usually followed of balancing only $\frac{2}{3}$ of the reciprocating masses, thus keeping the hammer-blow within proper limits, and allowing $\frac{1}{3}$ of the reciprocating masses to be unbalanced in the horizontal direction. It is not possible to do anything better with two-cylinder locomotives unless bob-weights be added, but with four-cylinder four-crank engines complete balance is possible both in the vertical and in the horizontal directions. When the four cranks are placed with two pairs at 180°, the pairs being at 90°, the forces are balanced without the introduction of a hammer-blow, but there remain large unbalanced couples, which if balanced by means of revolving weights in the wheels again reintroduce the hammer-blow, and if left unbalanced tend to make the engine oscillate in a horizontal plane at high speed. The principles by means of which the magnitude and position of balance weights are worked out are given in the article MECHANICS (*Applied Mechanics*), and the whole subject of locomotive balancing is exhaustively treated with numerous numerical examples in *The Balancing of Engines* by W. E. Dalby, London, 1906.

§19. *Classification.*—Locomotives may be classified primarily into "tender engines" and "tank engines," the water and fuel in the latter being carried on the engine proper, while in the former they are carried in a separate vehicle. A tender is generally mounted on six wheels, or in some cases on two bogies, and carries a larger supply of water and fuel than can be carried by tanks and the bunker of a tank engine. A tender, however, is so much dead-weight to be hauled, whilst the weight of the water and fuel in a tank engine contributes largely to the production of adhesion. A classification may also be made, according to the work for which engines are designed, into passenger engines, goods engines, and shunting or switching engines. A convenient way of describing any type of engine is by means of numerals indicating the number of wheels—(1) in the group of wheels supporting the leading or chimney end, (2) in the group of coupled wheels, and (3) in the group supporting the trailing end of the engine. In the case where either the leading or trailing group of small wheels is absent the numeral 0 must be used in the series of three numbers used in the description. Thus 4–4–2 represents a bogie engine with four-coupled wheels and one pair of trailing wheels, the well-known Atlantic type; 4–2–2 represents a bogie engine with a single pair of driving-wheels and a pair of trailing wheels; 0–4–4 represents an engine with four-coupled wheels and a trailing bogie, and 4–4–0 an engine with four-coupled wheels and a leading bogie. A general description of the chief peculiarities of various kinds of locomotives is given in the following analysis of types:—

(1) "Single-driver" type, 4–2–2 or 2–2–2. Still used by several railways in Great Britain for express passenger service, but going out of favour; it is also found in France, and less often in Germany, Italy, and elsewhere in Europe. It is generally designed as a 4–2–2 engine, but some old types are still running with only three axles,

the 2–2–2. It is adapted for light, high-speed service, and noted for its simplicity, excellent riding qualities, low cost of maintenance, and high mechanical efficiency; but having limited adhesive weight it is unsuitable for starting and accelerating heavy trains.

(2) "Four-coupled" type, 4–4–0, with leading bogie truck. For many years this was practically the only one used in America for all traffic, and it is often spoken of as the "American" type. In America it is still the standard engine for passenger traffic, but for goods service it is now employed only on branch lines. It has been extensively introduced, both in Great Britain and the continent of Europe, for passenger traffic, and is now the most numerous and popular class. It is a safe, steady-running and trustworthy engine, with excellent distribution of weight, and it is susceptible of a wide range of adaptability in power requirements.

(3) "Four-coupled" three-axle type, 2–4–0. Used to some extent in France and Germany and considerably in England for passenger traffic of moderate weight. Engines of this class, with 78-inch driving wheels and the leading axle fitted with Webb's radial axle-box, for many years did excellent work on the London & North-Western railway. The famous engine "Charles Dickens" was one of this class. Built in 1882, it had by the 12th of September 1891 performed the feat of running a million miles in 9 years 219 days, and it completed two million miles on the 5th of August 1902, having by that date run 5312 trips with express trains between London and Manchester.

(4) "Four-coupled" three-axle type, with trailing axle, 0–4–2. Used on several English lines for fast passenger traffic, and also on many European railways. The advantages claimed for it are: short coupling-rods, large and unlimited fire-box carried by a trailing axle, compactness, and great power for a given weight. Its critics, however, accuse it of lack of stability, and assert that the use of large leading wheels as drivers results in rigidity and produces destructive strains on the machinery and permanent way.

(5) "Four-coupled" type, with a leading bogie truck and a trailing axle, 4–4–2. It is used to a limited extent both in England and on the continent of Europe, and is rapidly increasing in favour in the United States, where it originated and is known as the "Atlantic" type. It has many advantages for heavy high-speed service, namely, large and well-proportioned boiler, practically unlimited grate area, fire-box of favourable proportions for firing, fairly low centre of gravity, short coupling-rods, and, finally, a combination of the safe and smooth riding qualities of the four-coupled bogie type, with great steaming capacity and moderate axle loads. Occasionally a somewhat similar type is designed with the bogie under the fire-box and a single leading axle forward under the smoke-box—an arrangement in favour for suburban tank engines. In still rarer cases both a leading and a trailing bogie have been fitted.

(6) "Six-coupled" with bogie, or "Ten-wheel" type, 4–6–0. A powerful engine for heavy passenger and fast goods service. It is used to a limited extent both in Great Britain and on the continent of Europe, but is much more common in America. The design combines ample boiler capacity with large adhesive weight and moderate axle loads, but except on heavy gradients or for unusually large trains requiring engines of great adhesion, passenger traffic can be more efficiently and economically handled by four-coupled locomotives of the eight-wheel or Atlantic types.

(7) "Six-coupled" total-adhesion type (all the weight carried on the drivers), 0–6–0. This is the standard goods engine of Great Britain and the continent of Europe. In America the type is used only for shunting. It is a simple design of moderate boiler power.

(8) "Six-coupled" type, with a leading axle, 2–6–0. This is of American origin, and is there known as the "Mogul." It is used largely in America for goods traffic. In Europe it is in considerable favour for goods and passenger traffic on heavy gradients. The type is, however, less in favour than either the ten-wheel or the eight-coupled "Consolidation" for freight traffic.

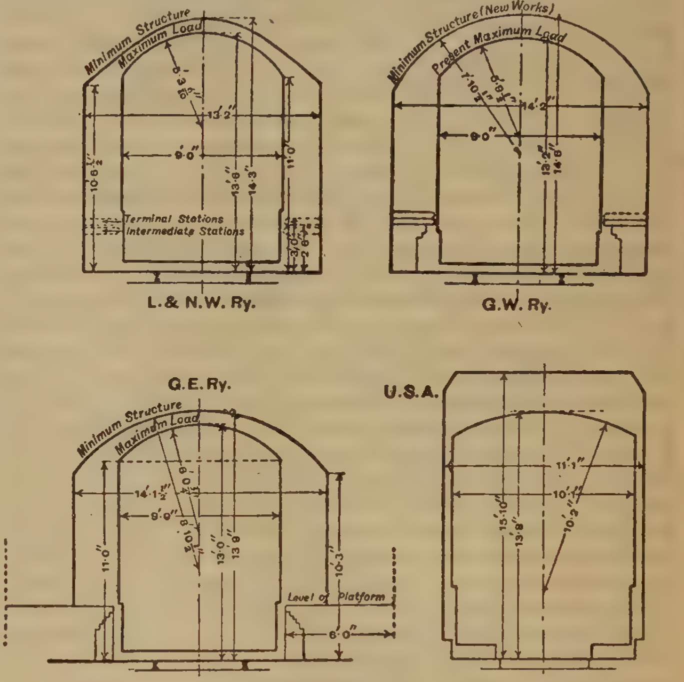
(9) "Eight-coupled" total-adhesion type, 0–8–0; now found on a good many English railways, and common on the continent of Europe for heavy slow goods traffic. In America it is comparatively infrequent, as total-adhesion types are not in favour.

(10) "Eight-coupled" type, with a leading axle, 2–8–0. This originated in America, where it is termed the "Consolidation." In the United States it is the standard heavy slow-speed freight engine, and has been built of enormous size and weight. The type has been introduced in Europe, especially in Germany, where the advantages of a partial-adhesion type in increased stability and a larger boiler are becoming appreciated. Occasionally the American eight-coupled type has a bogie instead of a single leading axle (4–8–0), and is then termed a "Twelve-wheeler," or "Mastodon."

(11) "Ten-coupled" type, with a leading axle, 2–10–0. This originated in America, where it is known as the "Decapod." It is used to a limited extent for mountain-grade goods traffic, and has the advantage over the "Consolidation" or eight-coupled type of lighter axle loads for a given tractive capacity.

In addition to the foregoing list, various special locomotive types have been developed for suburban service, where high rates of acceleration and frequent stops are required. These are generally tank engines, carrying their fuel and water on the engine proper. Their boilers are of relatively large proportions for the train weight and average speed, and the driving wheels of small diameter, a large proportion of their total weight being "adhesive." Other special types are in limited use for "rack-railways," and operate either by engagement of gearing on the locomotive into a rack between the track rails, or by a combination of this and rail adhesion.

§ 20. *Current Developments.*—The demand of the present day is for engines of larger power both for passenger and goods service, and the problem is to design such engines within the limitations fixed by the 4 ft. 8½ in. gauge and the dimensions of the existing tunnels, arches, and other permanent works. The American engineer is more fortunately situated than his English brother with regard to the possibility of a solution, as will be seen from the comparative diagrams of construction gauges, figs. 23, 24, 25, 26. Fig. 23 shows the construction gauge for the London & North-Western railway, fig. 24 that for the Great Western[1] railway, fig. 25 that for the Great Eastern railway, whilst fig. 26 gives a general idea of the American gauge in a particular case, generally typical, however, of the American limits. In consequence of this increasing demand for power, higher boiler pressures are being used, in some cases 225 ℔ per sq. in. for a simple two-cylinder engine, and cylinder volume is slightly increased with the necessary accompaniment of heavier loads on the coupled wheels to give the necessary adhesion. Both load and speed have increased so much in connexion with passenger trains that it is necessary to divide the weight required for adhesion between three-coupled axles, and the type of engine gradually coming into use in England for heavy express traffic is a six-coupled engine with a leading bogie, with wheels which would have been considered small a few years ago for the speed at which the engine runs. The same remarks apply to goods engines. There is a general increase in cylinder power, boiler pressure and weight, and in consequence in the number of coupled axles. Not only are the load and speed increasing, but the distances run without a stop are increasing also, and to avoid increasing the size of the tenders, water-troughs, first instituted by J. Ramsbottom on the London & North-Western railway in 1859, have been laid in the tracks of the leading main lines of Great Britain. For local services where stoppages are frequent the demand is for engines capable of quickly



FIGS. 23–26.

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[1] At the beginning of 1908 the Great Western's loading gauge on its main lines was widened to 9 ft. 8 in. from a height of 5 ft. above rail level.

Table XXII.—Comparative Data of Locomotives

No.	Owning Railway.	Type.	Cylinders.			Diam. of Driving-Wheels.	Weight (Ton = 2240 lb).			Grate Area.	Total Heating Surface.	Remarks.
			Position.	Diam.	Stroke.		Total of Engine.	Total on Coupled Wheels.	Total with Tender.			
				In.	In.	In.	Tons.	Tons.	Tons.	Sq. Ft.	Sq. Ft.	
	"Rocket" (Liverpool & Manchester)	0-2-2	Outside	8	16½	56½	4·25	..	7·45	6	137.75	In Victoria and Albert Museum, South Kensington.
1	Caledonian	4-4-0	Inside	19	26	78	51·70	34·65	96·7	23	1600	"Dunalastair III." (900) class.
2	London & South-Western	4-4-0	Inside	18½	26	79	48·85	33·45	93·0	24	1500	Fitted with cross-water tubes in fire-box giving 165 sq. ft. of heating surface.
3	Midland	4-4-0	Inside	19	26	78½	58·5	38·75	104·4	28·4	1557	Belpaire fire-box. Pressure 220 lb per sq. in.
4	Great Western	4-6-0	Outside	18⅜	30	80½	72	54·8	112	27	2000	Fitted with superheater contributing 360 sq. ft. of heating surface to the total. Boiler pressure 200 lb per sq. in.
5	Great Eastern	4-4-0	Inside	19	26	84	50·3	33·20	85·35	21·3	1630	Fired with Holden's system of liquid fuel.
6	London & North-Western	4-6-0	Inside	19½	26	75	65·75	46·75	102·75	25	1990	Experiment class. Boiler pressure 185 lb per sq. in.
7	Great Western	4-6-0	2 inside 2 outside	14¼	26	80½	75·6	55·4	115·6	27	2076	4-cylinder simple. Fitted with superheater contributing 269 sq. ft. of heating surface to the total. Boiler pressure 225 lb per sq. in.
8	London & South-Western	4-6-0	2 inside 2 outside	16	24	72	73	51·5	..	31·5	2727	4-cylinder simple. Working pressure 175 lb per sq. in. Fitted with cross-tubes in fire-box.
9	Lancashire & Yorkshire	4-4-2	Inside	19	26	87	58·75	35·0	89.41	26·05	2052	Belpaire fire-box.
10	Great Northern	4-4-2	Outside	19	24	78	58	31	99	26·75	1442	990 class.
11	North-Eastern	4-4-2	2 inside 2 outside	22 14¼	26	85	73·6	39·15	116·2	29	1969	..
12	Highland	4-6-0	Outside	19½	26	69	58·85	43·85	96·95	26	2050	Steam pressure 200 lb per sq. in.
13	Midland	4-4-0	2 L.-P. outside 1 H.-P. inside	21 19	26 26	84	59·8	39·1	102·7	28·4	1458	3-cylinder compound. Working pressure 220 lb per sq. in.
14	Midland	0-6-0	Inside	18½	26	63	43·8	43·8	84·95	21·1	1412	175 lb per sq. in.
15	North-Eastern	0-6-0	Inside	18½	26	55	34·4	34·4	82·05	20·0	1658	..
16	Caledonian	4-6-0	Outside	19	26	60	60·4	45·9	98·4	21	2018	Pressure 175 lb per sq. in.
17	Lancashire & Yorkshire	0-8-0	Inside	20	26	54	53·78	53·78	84·45	26·05	2038	..
18	Great Western	4-4-2	2 H.-P. outside 2 L.-P. inside	14·2 23·6	25·2	80·5	73·8	38·5	108·9	33·3	2755	De Glehn compound. Boiler pressure 227 lb per sq. in.
19	Chicago & Alton	4-4-2	Outside	20	28	80	82·8	43·7	155	33·5	2696	Balanced piston valves.
20	Atchison, Topeka & Sante Fé	4-4-2	2 outside 2 inside	25 15	26 26	79	86·5	45·3	160	49·5	3215	4-cylinder balanced compound. Vauclain type.
21	Central of Georgia	4-6-2	Outside	20	28	68	84·0	50·7	150	46·8	3357	Balanced valve.
22	Pennsylvania	2-6-0	Outside	20	28	62	71·43	62·09	125	30·2	2431.3	..
23	Chicago, Rock Island & Pacific	2-8-0	Outside	23	30	63	88·8	79·2	147	49·7	2912	..
24	Atchison, Topeka & Sante Fé	2-10-2	Outside Outside	19 32	32 32	57	128·4	104·5	201	58·5	4796	Tandem compound.
25	Great Northern, U.S.A.	2-6-6-2	Outside Outside	21½ 33	32 32	55	158·5	141	225	78	5658	Driving-wheels divided into two groups of six-coupled wheels. Leading group driven by L.-P. cylinders, trailing group by H.-P. cylinders. Mallet type.
26	Erie Railroad	0-8-8-0	Outside Outside	25 39	28 28	51	183	183	..	100	6108	Mallet type.
27	Argentine Great Western	2-10-0	Outside	19½	28	51	79·5	70·8	124·17	36	2440	5 ft. 6 in. gauge.
28	Belgian State	2-6-0	2 outside 2 inside	17⅛	24	78	82·0	52·0	..	32·4	1672	4-cylinder simple expansion. Pressure 205 lb per sq. in.
29	Nord	4-4-2	2 outside 2 inside	13.4 22	25·2	80·3	66·2	32·5	107·3	29·7	2368	Serve tubes. Boiler pressure 235 lb per sq. in.
30	Est	4-6-0	2 H.-P. outside 2 L.-P. inside	13·78 21·65	25·2	70	62·4	48·7	..	27·6	2155	Serve tubes.
31	Austro-Hungarian State	2-10-0	2 H.-P. inside 2 L.-P. outside	14·56 24·80	28·34	57	77·2	67·4	..	49·5	2777	Fitted with superheater contributing 678 sq. ft. to the total.
32	Nord	6-2-2-6	2 outside 2 outside	15·75 24·8	26·8	57·2	100	71	..	32·3	2660	Articulated tank engine on two motor bogies mounted on a central girder, splayed at ends to take buffer beams. H.-P. cylinders drive one bogie, L.-P. the other.
33	Paris, Orleans	4-6-0	2 outside 2 inside	14·17 23·62	25·19	73	72·6	53	109·5	33·37	2577	Serve tubes. Boiler pressure 235 lb per sq. in.
34	Italian State	6-4-0	2 H.-P. on one side 2 L.-P. on other	14·17 23·22	23·62	75·6	69.5	42·6	106	32·29	2217	Serve tubes. Boiler pressure 220 lb per sq. in.
35	Austrian State	2-6-2	2 H.-P. inside 2 L.-P. outside	14·56 24·80	28·34	71·5	68·9	42·9	107·9	43·0	2775	Boiler pressure 220 lb per sq. in.
36	Prussian State	4-4-2	2 H.-P. outside 2 L.-P. inside	14·17 22·04	23·62	78	61·0	29·9	107·9	29·0	2520	Lentz double-beat equilibrium valves. Serve tubes. Boiler pressure 205 lb per sq. in

accelerating the train to the journey speed. The nature of this problem is illustrated by the numerical example in § 9. When the service is frequent enough to give a good power factor continuously, the steam locomotive cannot compete with the electric motor for the purpose of quick acceleration, because the motors applied to the axles of a train may for a short time absorb power from the central station to an extent far in excess of anything which a locomotive boiler can supply.

With regard to the working of the locomotive, J. Holden developed the use of liquid fuel on the Great Eastern railway to a point beyond the experimental stage, and used it instead of coal with the engines running the heavy express traffic of the line, its continued use depending merely upon the relative market price of coal and oil. Compound locomotives have been tried, as stated in § 17, but the tendency in England is to revert to the simple engine for all classes of work, though on the continent of Europe and in America the compound locomotive is largely adopted, and is doing excellent work. A current development is the application of superheaters to locomotives, and the results obtained with them are exceedingly promising.

The leading dimensions of a few locomotives typical of English, American and European practice are given in Table XXII.

(W. E. D.)

Rolling Stock

The rolling stock of a railway comprises those vehicles by means of which it effects the transportation of persons and things over its lines. It may be divided into two classes, according as it is intended for passenger or for goods traffic.

Passenger Train Stock.—In the United Kingdom, as in Europe generally, the vehicles used on passenger trains include first-class carriages, second-class carriages, third-class carriages, composite carriages containing compartments for two or more classes of passengers, dining or restaurant carriages, sleeping carriages, mail carriages or travelling post offices, luggage brake vans, horse-boxes and carriage-trucks. Passenger carriages were originally modelled on the stage-coaches which they superseded, and they are often still referred to as "coaching stock." Early examples had bodies about 15 ft. long, $6\frac{1}{2}$ ft. wide and $4\frac{3}{4}$ ft. high; they weighed 3 or 4 tons, and were divided into three compartments holding six persons each, or eighteen in all.

The distinction into classes was made almost as soon as the railways began to carry passengers. Those who paid the highest fares ($2\frac{1}{2}$d. or 3d. a mile) were provided with covered vehicles, on the roofs of which their luggage was carried, and from the circumstance that they could book seats in advance came the term "booking office," still commonly applied to the office where tickets are issued. Those who travelled at the cheaper rates had at the beginning to be content with open carriages having little or no protection from the weather. Gradually, however, the accommodation improved, and by the middle of the 19th century second-class passengers had begun to enjoy "good glass windows and cushions on the seat," the fares they paid being about 2d. a mile. But though by an act of 1844 the railways were obliged to run at least one train a day over their lines, by which the fares did not exceed the "Parliamentary" rate of 1d. a mile, third-class passengers paying $1\frac{1}{4}$d. or $1\frac{1}{2}$d. a mile had little consideration bestowed on their comfort, and were excluded from the fast trains till 1872, when the Midland railway admitted them to all its trains. Three years later that railway did away with second-class compartments and improved the third class to their level. This action had the effect, through the necessities of competition, of causing travellers in the cheaper classes to be better treated on other railways, and the condition of the third-class passenger was still further improved when Parliament, by the Cheap Trains Act of 1883, required the railways to provide "due and sufficient" train accommodation at fares not exceeding 1d. a mile. In the United Kingdom it is now possible to travel by every train, with very few exceptions, and in many cases to have the use of restaurant cars, for 1d. a mile or less, and the money obtained from third-class travellers forms by far the most important item in the revenue from passenger traffic. Since the Midland railway's action in 1875 several other English companies have abandoned second-class carriages either completely or in part, and in Scotland they are entirely unknown.

On the continent of Europe there are occasionally four classes, but though the local fares are often appreciably lower than in Great Britain, only first and second class, sometimes only first class, passengers are admitted to the fastest trains, for which in addition a considerable extra fare is often required. In Hungary and Russia a zone-tariff system is in operation, whereby the charge per mile decreases progressively with the length of the journey, the traveller paying according to the number of zones he has passed through and not simply according to the distance traversed. In the United States there is in most cases nominally only one class, denominated first class, and the average fare obtained by the railways is about 1d. per mile per passenger. But the extra charges levied for the use of parlour, sleeping and other special cars, of which some of the best trains are exclusively composed, in practice constitute a differentiation of class, besides making the real cost of travelling higher than the figures just given.

Restaurant and sleeping cars.

In America and other countries where distances are great and passengers have to spend several days continuously in a train sleeping and restaurant cars are almost a necessity, and accordingly are to be found on most important through trains. Such cars in the United States are largely owned, not by the railway companies over whose lines they run, but by the Pullman Car Company, which receives the extra fees paid by passengers for their use. Similarly in Europe they are often the property of the International Sleeping Car Company (Compagnie Internationale des Wagons-Lits), and the supplementary fares required from those who travel in them add materially to the cost of a journey. In the United Kingdom, where the distances are comparatively small, sleeping and dining cars must be regarded rather as luxuries; still even so, they are to be met with very frequently. The first dining car in England was run experimentally by the Great Northern railway between London and Leeds in 1879, and now such vehicles form a common feature on express trains, being available for all classes of passengers without extra charge beyond the amount payable for food. The introduction of corridor carriages, enabling passengers to walk right through the trains, greatly increased their usefulness. The first English sleeping cars made their appearance in 1873, but they were very inferior to the vehicles now employed. In the most approved type at the present time a passage runs along one side of the car, and off it open a number of transverse compartments or berths resembling ships' cabins, mostly for one person only, and each having a lavatory of its own with cold, and sometimes hot, water laid on. A charge of 7s. 6d. or 10s., according to distance, is made for each bed, in addition to the first-class fare. In the United States the standard sleeping car has a central alley, and along the sides are two tiers of berths, arranged lengthwise with the car and screened off from the alley by curtains. To some extent cars divided into separate compartments are also in use in that country. On the continent of Europe the typical sleeping car has transverse compartments with two berths, one placed above the other.

Passenger carriages.

The first railway carriages in England had four wheels with two axles, and this construction is still largely employed, especially for short-distance trains. Later, when increased length became desirable, six wheels with three axles came into use; vehicles of this kind were made about 30 ft. long, and contained four compartments for first-class passengers or five for second or third class, carrying in the latter case fifty persons. Their weight was in the neighbourhood of 10 tons. In both the four-wheeled and the six-wheeled types the axles were free to rise and fall on springs through a limited range, but not to turn with respect to the body of the carriage, though the middle axle of the six-wheeled coach was allowed a certain amount of lateral play. Thus the length of the body was limited, for to increase it involved an increase in the length of the rigid wheel base, which was incompatible with smooth and safe running on curves. (On the continent of Europe, however, six-wheeled vehicles are to be found much longer than those employed in Great Britain.) This difficulty is avoided by providing the vehicles with four axles (or six in the case of the largest and heaviest), mounted in pairs (or threes) at each end in a bogie or swivel truck, which being pivoted can move relatively to the body and adapt itself to the curvature of the line. This construction was introduced into England from America about 1874, and has since been extensively adopted, being now indeed standard for main line stock. It soon led to an increase in the length of the vehicles; thus in 1885 the Midland railway had four-wheeled bogie third-class carriages with bodies 43 ft. long, holding seventy persons in seven compartments and weighing nearly 18 tons, and six-wheeled bogie composite carriages, 54 ft. long and weighing 23 tons, which included 3 first-class and 4 third-class compartments, with a cupboard for luggage, and held 58 passengers. The next advance, introduced on the Great Western railway in 1892, was the adoption of corridor carriages having a passage along one side, off which the compartments open, and connected to each other by vestibules, so that it is possible to pass from one end of the train to the other. This arrangement involves a further increase of length and weight. For instance, four-wheeled bogie third-class corridor carriages employed on the Midland railway at the beginning of the 20th century weighed nearly 25 tons, and had bodies measuring 50 ft.; yet they held only 36 passengers, because not only had the number of compartments been reduced to six, as compared with seven in the somewhat shorter carriage of 1885, by the introduction of a lavatory at each end, but each compartment held only 6 persons, instead of 10, owing to the narrowing of its width by the corridor.

It will be seen from these particulars—which are typical of what has happened not only on other British railways, but also on those of other countries—that much more space has to be provided and more weight hauled for each passenger than was formerly the case. Thus, on the Midland railway in 1885, each third-class passenger, supposing the carriage to have its full complement, was allowed 0·62 ft. of lineal length, and his proportion of the total weight was 5·7 cwt. Less than 20 years later the lineal length allowed each had increased to nearly 1·4 ft., and the weight to nearly 14 cwt. Passengers in sleeping cars appropriate still more space and weight; in Great Britain some of these cars, though 40 tons in weight and over 65 ft. in length, accommodate only 11 sleepers, each of whom thus occupies nearly 6 ft. of the length and requires over 3½ tons of dead weight to be hauled.

In America the long open double-bogie passenger cars, as originally introduced by Ross Winans on the Baltimore & Ohio railway, are universally in use. They are distinguished essentially from the British type of carriage by having in the centre of the body a longitudinal passage, about 2 ft. wide, which runs their whole length, and each car having communication with those on either side of it, the conductor, and also vendors of books, papers and cigars, are enabled to pass right through the train. The cars are entered by steps at each end, and are provided with lavatories and a supply of iced water. The length is ordinarily about 50 ft., but sometimes 80 or 90 ft. The seats, holding two persons, are placed transversely on each side of the central passage, and have reversible backs, so that passengers can always sit facing the direction in which the train is travelling. Cars of this saloon type have been introduced into England for use on railways which have adopted electric traction, but owing to the narrower loading gauge of British railways it is not usually possible to seat four persons across the width of the car for its whole length, and at the ends the seats have to be placed along the sides of the vehicle. A considerable amount of standing room is then available, and those who have to occupy it have been nicknamed "strap-hangers," from the fact that they steady themselves against the motion of the train by the aid of leather straps fixed from the roof for that purpose. Cars built almost entirely of steel, in which the proportion of wood is reduced to a minimum, are used on some electric railways, in order to diminish danger from fire, and the same mode of construction is also being adopted for the rolling stock of steam railways.

Vestibules.

End doors opening on end platforms have always been characteristic of American passenger equipment. Their use secures a continuous passage-way through the train, but is attended with some discomfort and risk when the train is in motion. The opening of the doors was apt to cause a disagreeable draught through the car in cold weather, and passengers occasionally fell from the open platform, or were blown from it, when the train was moving. To remedy these defects vestibules were introduced, to enclose the platform with a housing so arranged as to be continuous when the cars are made up into trains, and fitted with side doors for ingress and egress when the trains are standing. A second advantage of the vestibule developed in use, for it was found that the lateral swaying of the cars was diminished by the friction between the vestibule frames. The fundamental American vestibule patent, issued to H. H. Sessions of Chicago in November 1887, covered a housing in combination with a vertical metallic plate frame of the general contour of the central passage-way, which projected slightly beyond the line of the couplings and was held out by horizontal springs top and bottom, being connected with the platform housing by flexible connexions at the top and sides and by sliding plates below. A common form is illustrated in fig. 27. Subsequent improvements on the Sessions patent have resulted in a modified form of vestibule in which the housing is made the full width of the platform, though the contact plate and springs and the flexible connexions remain the same as before. The application of vestibules is practically limited to trains making long journeys, as it is an obstruction to the free ingress and egress of passengers on local trains that make frequent stops.

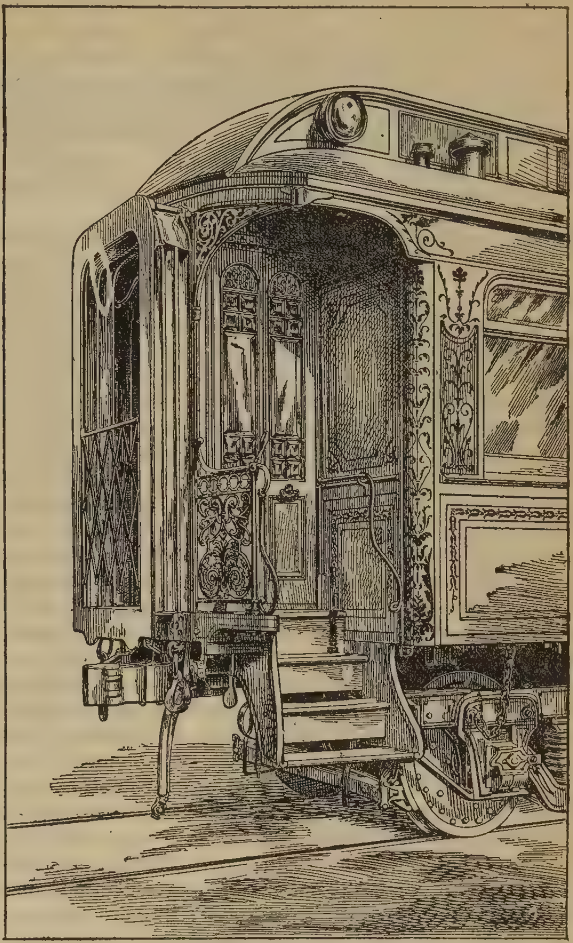

Fig. 27.—A "Vestibule"; the "lazytongs" gate is folded away when two cars are coupled together, giving free passage from end to end of the train.

Heating and lighting.

In the United States the danger of the stoves that used to be employed for heating the interiors of the cars has been realized, and now the most common method is by steam taken from the locomotive boiler and circulated through the train in a line of piping, rendered continuous between the cars by flexible coupling-hose. The same method is finding increased favour in Great Britain, to the supersession of the old hot-water footwarmers. These in their simplest form are cans filled with water, which is heated by immersing them in a vessel containing boiling water. In some cases, however, they are filled with fused acetate of soda; this salt is solid when cold, but when the can containing it is heated by immersion in hot water it liquefies, and in the process absorbs heat which is given out again on the change of state back to solid. Such cans remain warm longer than those containing only hot water. On electric railways the trains are heated by electric heaters. As to lighting, the oil lamp has been largely displaced by gas and electricity. The former is often a rich oil-gas, stored in steel reservoirs under the coaches at a pressure of six or seven atmospheres, and passed through a reducing valve to the burners; these used to be of the ordinary fish-tail type, but inverted incandescent mantles are coming into increasing use. Gas has the disadvantage that in case of a collision its inflammability may assist any fire that may be started. Electric light is free from this drawback. The current required for it is generated by dynamos driven from the axles of the coaches. With "set" or "block" trains, that is, trains having their vehicles permanently coupled up, one dynamo may serve for the whole train, but usually a dynamo is provided for each coach, which is then an independent unit complete in itself. It is necessary that the voltage of the current shall be constant whatever be the increase of the speed of the train, and therefore of the dynamo. In most of the systems that have been proposed this result is attained by electrical regulation; in one, however, a mechanical method is adopted, the dynamo being so hung that it allows the driving belt to slip when the speed of the axle exceeds a certain limit, the armature thus being rotated at an approximately constant speed. In all the systems accumulators are required to maintain the light when the train is at rest or is moving too slowly to generate current.

Weight and speed. In all countries passenger trains must vary in weight according to the different services they have to perform; suburban trains, for example, meant to hold as many passengers as possible, and travelling at low speeds, do not weigh so much as long-distance expresses, which include dining and sleeping cars, and on which, from considerations of comfort, more space must be allowed each occupant. The speed at which the journey has to be completed is obviously another important factor, though the increased power of modern locomotives permits trains to be heavier and at the same time to run as fast, and often faster, than was formerly possible, and in consequence the general tendency is towards increased weight as well as increased speed. An ordinary slow suburban train may weigh about 100 tons exclusive of the engine, and may be timed at an inclusive speed, from the beginning to the end of its journey, as low as 12 or 15 m. an hour; while usually the fastest express trains maintaining inclusive speeds of say 45 m. an hour, and made up of the heaviest and strongest rolling stock, do not much exceed 300 tons in any country, and are often less. The inclusive speed over a long journey is of course a different thing from the average running speed, on account of the time consumed in intermediate stops; the fewer the stops the more easily is the inclusive speed increased,—hence the advantage of the non-stop runs of 150 and 200 m. or more which are now performed by several railways in Great Britain, and on which average speeds of 54 or 55 m. per hour are attained between stopping-places. Over shorter distances still more rapid running is occasionally arranged, and in Great Britain, France and the United States there are instances of trains scheduled to maintain an average speed of 60 m. an hour or more between stops. Still higher speeds, up to 75 or even 80 m. an hour, are reached, and sustained for shorter or longer distances every day by express trains whose average speed between any two stopping-places is very much less. But isolated examples of high speeds do not give the traveller much information as to the train service at his disposal, for on the whole he is better off with a large number of trains all maintaining a good average of speed than with a service mostly consisting of poor trains, but leavened with one or two exceptionally fast ones. If both the number and the speed of the trains be taken into account, Great Britain is generally admitted still to remain well ahead of any other country.

Goods Trains.—The vehicles used for the transportation of goods are known as goods wagons or trucks in Great Britain, and as freight cars in America. The principal types to be found in the United Kingdom and on the continent of Europe are open wagons (the lading often protected from the weather by tarpaulin sheets), mineral wagons, covered or box wagons for cotton, grain, &c., sheep and cattle trucks, &c. The principal types of American freight cars are box cars, gondola cars, coal cars, stock cars, tank cars and refrigerator cars, with, as in other countries, various special cars for special purposes. Most of these terms explain themselves. The gondola or flat car corresponds to the European open wagons and is used to carry goods not liable to be injured by the weather; but in the United States the practice of covering the load with tarpaulins is unknown, and therefore the proportion of box cars is much greater than in Europe. The long hauls in the United States make it specially important that the cars should carry a load in both directions, and so box cars which have carried grain or merchandise one way are filled with wool, coal, coke, ore, timber and other coarse articles for the return journey. On this account it is common to put small end doors in American box cars, through which timber and rails may be loaded.

The fundamental difference between American freight cars and the goods wagons of Europe and other lands is in carrying capacity. In Great Britain the mineral trucks can ordinarily hold from 8 to 10 tons (long tons, 2240 ℔), and the goods trucks rather less, though there are wagons in use holding 12 or 15 tons, and the specifications agreed to by the railway companies associated in the Railway Clearing House permit private wagon owners (who own about 45% of the wagon stock run on the railways of the United Kingdom) to build also wagons holding 20, 30, 40 and 56 tons. On the continent of Europe the average carrying capacity is rather higher; though wagons of less than 10 tons capacity are in use, many of those originally rated at 10 tons have been rebuilt to hold 15, and the tendency is towards wagons of 15–20 tons as a standard, with others for special purposes holding 40 or 45 tons.

The majority of the wagons referred to above are comparatively short, are carried on four wheels, and are often made of wood. American cars, on the other hand, have long bodies mounted on two swivelling bogie-trucks of four wheels each, and are commonly constructed of steel. About 1875 their average capacity differed little from that of British wagons of the present day, but by 1885 it had grown to 20 or 22 short tons (2000 ℔) and now it is probably at least three times that of European wagons. For years the standard freight cars have held 60,000 ℔ and now many carry 80,000 ℔ or 100,000 ℔; a few coal cars have even been built to contain 200,000 ℔. This high carrying capacity has worked in several ways to reduce the cost of transportation. An ordinary British 10-ton wagon often weighs about 6 tons empty, and rarely much less than 5 tons; that is, the ratio of its possible paying load to its tare weight is at the best about 2 to 1. But an American car with a capacity of 100,000 ℔ may weigh only 40,000 ℔, and thus the ratio of its capacity to its tare weight is only about 5 to 2. Hence less dead weight has to be hauled for each ton of paying load. In addition the increased size of the American freight car has diminished the interest on the first cost and the expenses of maintenance relatively to the work done; it has diminished to some extent the amount of track and yard room required to perform a unit of work; it has diminished journal and rolling friction relatively to the tons hauled, since these elements of train resistance grow relatively less as the load per wheel rises; and finally, it has tended to reduce the labour costs as the train loads have become greater, because no more men are required to handle a heavy train than a light one.

It is sometimes argued that if these things are true for one country they must be true for another, and that in Great Britain, for example, the use of more capacious cars would bring down the cost of carriage. It may be pointed out, however, that the social and geographical conditions are different in the United Kingdom and the United States, and in each country the methods of carrying goods and passengers have developed in accordance with the requirements of those conditions. In the one country the population is dense, large towns are numerous and close to one another, the greatest distances to be travelled are short, and relatively a large part of the freight to be carried is merchandise and manufactured material consigned in small quantities. In the other country precisely the opposite conditions exist. Under the first set of conditions quickness and flexibility of service are relatively more important than under the second set. Goods therefore are collected and despatched promptly, and, to secure rapid transit, are packed in numerous wagons, each of which goes right through to its destination, with the consequence that, so far as general merchandise is concerned, the weight carried in each is a quarter or less of its capacity. But if full loads cannot be arranged for small wagons, there is obviously no economy in introducing larger ones. On the other hand, where, as in America, the great volume of freight is raw material and crude food-stuffs, and the distances are great, a low charge per unit of transportation is more important than any consideration such as quickness of delivery; therefore full car-loads of freight are massed into enormous trains, which run unbroken for distances of perhaps 1000 m. to a seaport or distributing centre.

Weight and speed.

The weight and speed of goods trains vary enormously according to local conditions, but the following figures, which refer to traffic on the London & North-Western railway between London and Rugby, may be taken as representative of good English practice. Coal trains, excluding the engine, weigh up to 800 or 900 tons, and travel at from 18 to 22 m. an hour; ordinary goods or merchandise trains, weighing 430 tons, travel at from 25 to 30 m. an hour; and quick merchandise trains with limited loads of 300 tons make 35 to 40 m. an hour. In the United States mineral and grain trains, running at perhaps 12 m. an hour, may weigh up to about 4000 tons, and loads of 2000 tons are common. Merchandise trains run faster and carry less. Their speed must obviously depend greatly on topographical conditions. In the great continental basin there are long lines with easy gradients and curves, while in the Allegheny and Rocky Mountains the gradients are stiff, and the curves numerous and of short radius. Such trains, therefore, range in weight from 600 to 1800 tons or even more, and the journey speeds from terminus to terminus, including stops, vary from 15 to 30 m. an hour, the rate of running rising in favourable circumstances to 40 or even 60 m. an hour.

Couplers.—The means by which vehicles are joined together into trains are of two kinds—automatic and non-automatic, the difference between them being that with the former the impact of two vehicles one on the other is sufficient to couple them without any human intervention such as is required with the latter. The common form of non-automatic coupler, used in Great Britain for goods wagons, consists of a chain and hook; the chain hangs loosely from a slot in the draw-bar, which terminates in a hook, and coupling is effected by slipping the chain of one vehicle over the hook of the next. For this operation, or its reverse, a man has to go in between the wagons, unless, as in Great Britain, he is provided with a coupling-stick—that is, a pole having a peculiarly shaped hook at one end by which the chain can be caught and thrown on or off the draw-bar hook. This coupling gear is placed centrally between a pair of buffers; formerly these were often left "dead"—that is, consisted of solid prolongations of the frame of the vehicle, but now they are made to work against springs which take up the shocks that occur when the wagons are thrown violently against one another in shunting. In British practice the chains consist of three links, and are of such a length that when fully extended there is a space of a few inches between opposing buffers; this slack facilitates the starting of a heavy train, since the engine is able to start the wagons one by one and the weight of the train is not thrown on it all at once. For passenger trains and occasionally for fast goods trains screw couplings are substituted for the simple chains. In these the central bar which connects the two end links has screw threads cut upon it, and by means of a lever can be turned so as either to shorten the coupling and bring the vehicles together till their buffers are firmly pressed together, or to lengthen it to permit the end link to be lifted off the hook.

Another form of coupler, which used to be universal in the United States, though it has now been almost entirely superseded by the automatic coupler, was the "link and pin," which differed fundamentally from the couplers commonly used in Europe, in the fact that it was a buffer as well as a coupler, no side buffers being fitted. In it the draw-bar, connected through a spring to the frame of the car, had at its outboard end a socket into which one end of a solid link was inserted and secured by a pin. The essential change from the link and pin to the automatic coupler is in the outboard end or head of the draw-bar. The socket that received the link is replaced by a hook, shown at *A* in fig. 28, which is usually called the knuckle. This hook swings on the pivot *B*, and has an arm which extends backwards, practically at right angles with the working face of the hook, in a cavity in the head, and engages with the locking-pin *C*. This locking-pin is lifted by a suitable lever which extends to one or both sides of the car; lifting it releases the knuckle, which is then free to swing open, disconnecting the two cars. The knuckle stands open until the coupling is pushed against another coupling, when the two hooks turn on their pivots to the position shown in fig. 28, and, the locking-pin dropping into place, the couplers are made fast. This arrangement is only partly automatic, since it often happens that when two cars are brought together to couple the knuckles are closed and must be opened by hand. There are various contrivances by which this may be done by a man standing clear of the cars, but often he must go in between their ends to reach the knuckle.

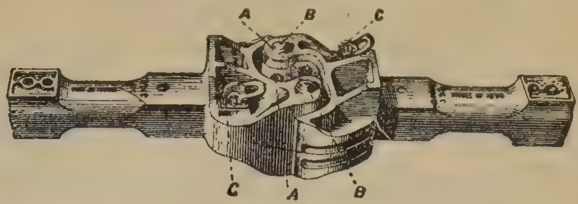

Fig. 28.—Automatic Coupling for Freight Cars (U.S.A.).

This form of automatic coupler has now gained practically universal acceptance in the United States. To effect this result required many years of discussion and experiment. The Master Car Builders' Association, a great body of mechanical officers organized especially to being about improvement and uniformity in details of construction and operation, expressed its sense of the importance of "self-coupling" so far back as 1874, but no device of the kind that could be considered useful had then been invented. At that time a member of the Association referred to the disappearance of automatic couplers which had been introduced thirty or forty years before. This body pursued the subject with more or less diligence, and in 1884 laid down the principle that the automatic coupler should be one acting in a vertical plane—that is, the engaging faces should be free to move up and down within a considerable range, in order to provide for the differences in the height of cars. By the fixing of this principle the task of the inventor was considerably simplified. In 1887 a committee reported that the coupler question was the "knottiest mechanical problem that had ever been presented to the railroad," and over 4000 attempted solutions were on record in the United States Patent Office. The committee had not found one that did not possess grave disadvantages, but concluded that the "principle of contact of the surfaces of vertical surfaces embodied in the Janney coupler afforded the best connexion for cars on curves and tangents"; and in 1887 the Association recommended the adoption of a coupler of the Janney type, which, as developed later, is shown in fig. 28. The method of constructing the working faces of this coupler is shown in fig. 29. The principle was patented, but the company owning the patent undertook to permit its free use by railway companies which were members of the Master Car Builders' Association, and thus threw open the underlying principle to competition. From that time the numerous patents have had reference merely to details. Many different couplers of the Janney type are patented and made by different firms, but the tendency is to equip new cars with one of only four or five standard makes. The adoption of automatic couplers was stimulated in some degree by laws enacted by the various states and by the United States; and the Safety Appliance Act passed by Congress in 1893 made it unlawful for railways to permit to be hauled on their lines after the 1st of January 1898 any car used for interstate commerce that was not equipped with couplers which coupled automatically by impact, and which could be uncoupled without the necessity for men going in between the ends of the cars. The limit was extended to the 1st of August 1900 by the Interstate Commerce Commission, which was given discretion in the matter.

Automatic couplers resembling the Janney are adopted in a few special cases in Great Britain and other European countries,

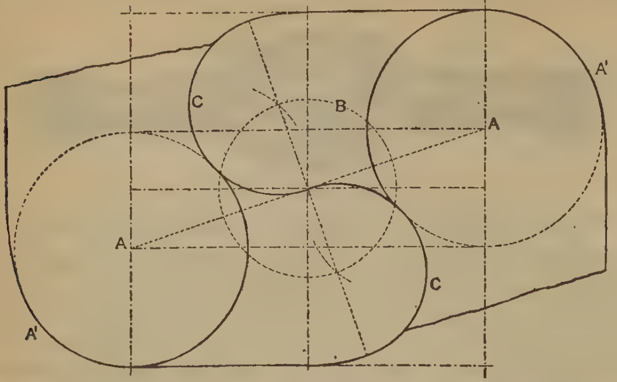

Fig. 29.—Development of the Working Faces of the Janney Coupler. The sides of the square are 6 in., and the centres AA are taken at 2 in. from the top and bottom of the square. The circles A′A′, which are struck with 2-inch radius, define the first portion of the knuckle. The inner circle B has a radius of 1½ in. From its intersection with A′A′ arcs are struck cutting B in two points. These intersections determine the centres of the semicircles CC which form the ends of the respective knuckles. These semicircles and the circles A′A′ are joined by tangents and short arcs struck from the centre of the figure.

but the great majority of couplings remain non-automatic. It may be pointed out that the general employment of side buffers in Europe greatly complicates the problem of designing a satisfactory automatic coupling, while to do away with them and substitute the combined buffer-coupling, such as is used in the United States, would entail enormous difficulties in carrying on the traffic during the transition stage.

Brakes.—In the United States the Safety Appliance Act of 1893 also forbade the railways, after the 1st of January 1898, to run trains which did not contain a "sufficient number" of cars equipped with continuous brakes to enable the speed to be controlled from the engine. This law, however, did not serve in practice to secure so general a use of power brakes on freight trains as was thought desirable, and another act was passed in 1903 to give the Interstate Commerce Commission authority to prescribe what should be the minimum number of power-braked cars in each train. This minimum was at first fixed at 50%, but on and after the 1st of August 1906 it was raised to 75%, with the result that soon after that date practically all the rolling stock of American railways, whether passenger or freight, was provided with compressed air brakes. In the United Kingdom the Regulation of Railways Act 1889 empowered the Board of Trade to require all passenger trains, within a reasonable period, to be fitted with automatic continuous brakes, and now all the passenger stock, with a few trifling exceptions, is provided with either compressed-air or vacuum brakes (see Brake), and sometimes with both. But goods and mineral trains so fitted are rare, and the same is the case on the continent of Europe, where, however, such brakes are generally employed on passenger trains. (H. M. R.)

Intra-Urban Railways

Development.

The great concentration of population in cities during the 19th century brought into existence a class of railways to which the name of intra-urban may be applied. Such lines are primarily intended to supply quick means of passenger communication within the limits of cities, and are to be distinguished on the one hand from surface tramways, and on the other from those portions of trunk or other lines which lie within city boundaries, although the latter may incidentally do a local or intra-urban business. Intra-urban railways, as compared with ordinary railways, are characterized by shortness of length, great cost per mile, and by a traffic almost exclusively passenger, the burden of which is enormously heavy. For the purpose of connecting the greatest possible number of points of concentrated travel, the first railways were laid round the boundaries of areas approximately circular, the theory being that the short walk from the circumference of the circle to any point within it would be no serious detention. It has been found, however, in the case of such circular or belt railways, that the time lost in traversing the circle and in walking from the circumference to the centre is so great that the gain in journey speed over a direct surface tramway or omnibus is entirely lost. Later intra-urban railways in nearly every case have been built, so far as possible, on straight lines, radiating from the business centre or point of maximum congestion of travel to the outer limits of the city; and, while not attempting to serve all the population through the agency of the line, make an effort to serve a portion in the best possible manner—that is, with direct transit.

The actual beginning of the construction of intra-urban railways was in 1853, when powers were obtained to build a line, 2¼ m. long, from Edgware Road to King's Cross, in London, from which beginning the Metropolitan and Metropolitan District railways developed. These railways, which in part are operated jointly, were given a circular location, but the shortcomings of this plan soon became apparent. It was found that there was not sufficient traffic to support them as purely intra-urban lines, and they have since been extended into the outskirts of London to reach the suburban traffic.

The Metropolitan and Metropolitan District railways followed the art of railway building as it existed at the time they were laid out. Wherever possible the lines were constructed in open cutting, to ensure adequate ventilation; and where this was not possible they were built by a method suggestively named "cut and cover." A trench was first excavated to the proper depth, then the side walls and arched roof of brick were put in place, earth was filled in behind and over the arch, and the surface of the ground restored, either by paving where streets were followed, or by actually being built over with houses where the lines passed under private property. Where the depth to rail-level was too great for cut-and-cover methods, ordinary tunnelling processes were used; and where the trench was too shallow for the arched roof, heavy girders, sometimes of cast iron, bridged it between the side walls, longitudinal arches being turned between them (fig. 30).

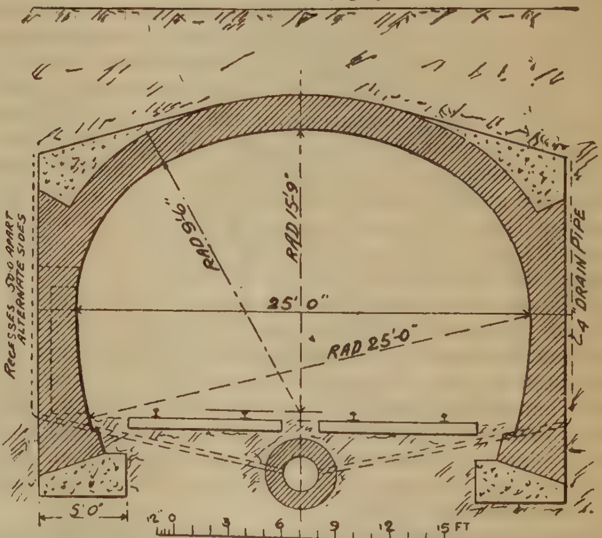

Fig. 30.—Type-Section of Arched Covered Way, Metropolitan District railway, London.

The next development in intra-urban railways was an elevated line in the city of New York. Probably the first suggestion for an elevated railway was made by Colonel Stevens, of Hoboken, New Jersey, as early as 1831, when the whole art of railway construction was in its infancy. He proposed to build an elevated railway on a single line of posts, placed along the curb-line of the street: a suggestion which embodies not only the general plan of an elevated structure, but the most striking feature of it as subsequently built—namely, a railway supported by a single row of columns. The first actual work, however, was not begun till 1870, when the construction of an iron structure on a single row of columns was undertaken. The superiority, so far as the convenience of passengers is concerned, of an elevated over an underground railway, when both are worked by steam locomotives, and the great economy and rapidity of construction, led to the quick development and extension of this general design. By the year 1878 there were four parallel lines in the city of New York, and constructions of the same character had already been projected in Brooklyn and Chicago and, with certain modifications of details, in Berlin. In the year 1894 an elevated railway was built in Liverpool, and in 1900 a similar railway was constructed in Boston, U.S.A., and the construction of a new one undertaken in New York. These elevated railways as a rule follow the lines of streets, and are of two general types. One (fig. 31), the earliest form, consisted of a single row of columns supporting two lines of longitudinal girders carrying the rails, the lateral stability of the structure being obtained by anchoring the feet of the columns to their foundations. The other type (fig. 32) has two rows of columns connected at the top by transverse girders, which in turn carry the longitudinal girders that support the railway. In Berlin, on the Stadtbahn—which for a part of its length traverses private property—masonry arches, or earthen embankments between retaining walls, were substituted for the metallic structure wherever possible.

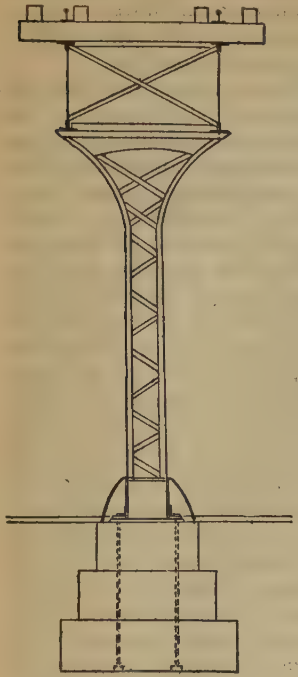
Fig. 31.—Single-Column Elevated Structure.

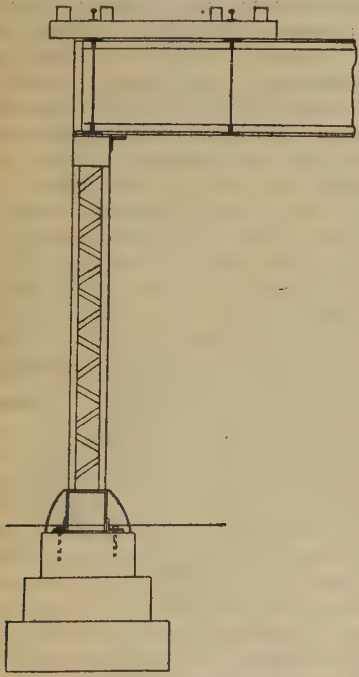
Fig. 32.—Double-Column Elevated Structure (half-section).

The next great development, marking the third step in the progress of intra-urban railway construction, took place in 1886, when J. H. Greathead (*q.v.*) began the City & South London railway, extending under the Thames from the Monument to Stockwell, a distance of 3½ m. Its promoters recognized the unsuitability of ordinary steam locomotives for underground railways, and intended to work it by means of a moving cable; but before it was completed, electric traction had developed so far as to be available for use on such lines. Electricity, therefore, and not the cable, was installed (fig. 33). In the details of construction the shield was the novelty. In principle it had been invented by Sir Marc I. Brunel for the construction of the original Thames tunnel, and it was afterwards improved by Beach, of New York, and finally developed by Greathead. (For the details of the shield and method of its operation, see Tunnel.) By means of the shield Greathead cut a circular hole at a depth ranging from 40 to 80 ft. below the surface, with an external diameter of 10 ft. 9 in.; this he lined with cast-iron segments bolted together, giving a clear diameter of 10 ft. 2 in. Except at the shafts, which were sunk on proposed station sites, there was no interference with the surface of the streets or with street traffic during construction. Two tunnels were built approximately parallel, each taking a single track. The cross-section of the cars was made to conform approximately to the section of the tunnel, the idea being that each train would act like a piston in a cylinder, expelling in front of it a column of air, to be forced up the station shaft next ahead of the train, and sucking down a similar column through the station shaft just behind. This arrangement was expected to ensure a sufficient change in air to keep such railways properly ventilated, but experience has proved it to be ineffective for the purpose. This method of construction has been used for building other railways in Glasgow and London, and in the latter city alone the "tube railways" of this character have a length of some 40 m. The later examples of these railways have a diameter ranging from 13 to 15 ft.

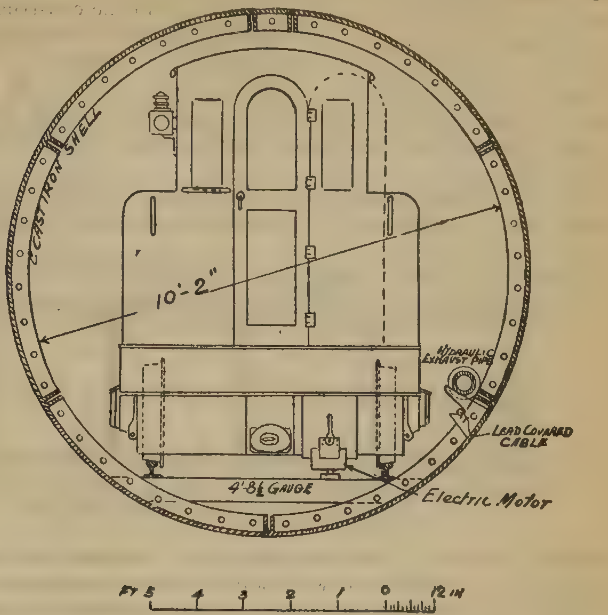

Fig. 33.—Section of Tunnel and Electric Locomotive, City & South London railway.

The fourth step in the development of intra-urban railways was to go to the other extreme from the deep tunnel which Greathead introduced. In 1893 the construction was completed in Budapest of an underground railway with a thin, flat roof, consisting of steel beams set close together, with small longitudinal jack arches between them, the street pavement resting directly on the roof thus formed (fig. 34). The object was to bring the level of the station platforms as close to the

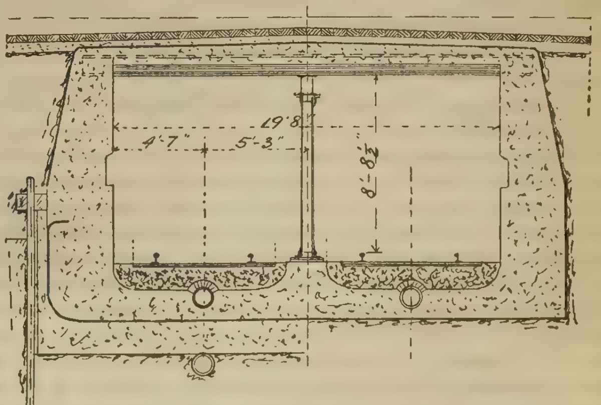

Fig. 34.—Electric Underground Railway, Budapest.

surface of the street as the height of the car itself would permit; in the case of Budapest the distance is about 9 ft. This principle of construction has since been followed in the construction of the Boston subway, of the Chemin de Fer Métropolitain in Paris, and of the New York underground railway. The Paris line is built with the standard gauge of 4 ft 8½ in., but its tunnels are designedly made of such a small cross-section that ordinary main line stock cannot pass through them.

The New York underground railway (fig. 35) marks a still further step in advance, in that there are practically two different railways in the same structure. One pair of tracks is used for a local service with stations about one-quarter of a mile apart, following the general plan of operation in vogue on all other intra-urban railways. The other, or central, pair of tracks is for trains making stops at longer distances. Thus there is a differentiation between the long-distance traveller who desires to be carried from one extreme of the city to the other and the short-distance traveller who is going between points at a much less distance.

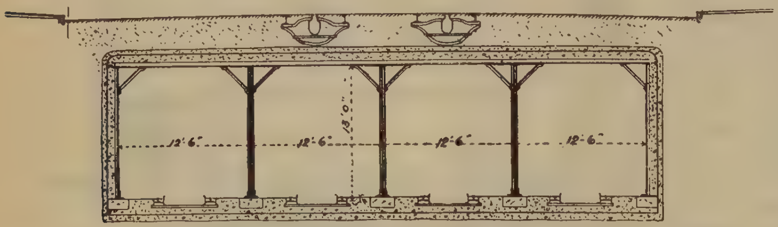

FIG. 35.—New York Rapid Transit railway, showing also the tracks and conduits of the electric surface tramway.

To sum up, there are of intra-urban railways two distinct classes: the elevated and the underground. The elevated is used where the traffic is so light as not to warrant the expensive underground construction, or where the construction of an elevated line is of no serious detriment to the adjoining property. The underground is used where the congestion of traffic is so great as to demand a railway almost regardless of cost, and where the conditions of surface traffic or of adjoining property are such as to require that the railway shall not obstruct or occupy any ground above the surface.

Underground railways are of three general types: the one of extreme depth, built by tunnelling methods, usually with the shield and without regard to the surface topography, where the stations are put at such depth as to require lifts to carry the passengers from the station platform to the street level. This type has the advantage of economy in first construction, there being the minimum amount of material to be excavated, and no interference during construction with street traffic or subsurface structures; it has, however, the disadvantage of the cost of operation of lifts at the stations. The other extreme type is the shallow construction, where the railway is brought to the minimum distance below the street level. This system has the advantage of the greatest convenience in operation, no lifts being required, since the distance from the street surface to the station platform is about 12 to 15 ft.; it has the disadvantages, however, of necessitating the tearing up of the street surface during construction, and the readjustment of sewer, water, gas and electric mains and other subsurface structures, and of having the gradients partially dependent on the surface topography. The third type is the intermediate one between those two, followed by the Metropolitan and Metropolitan District railways, in London, where the railway has an arched roof, built usually at a sufficient distance below the surface of the street to permit the other subsurface structures to lie in the ground above the crown of the arch, and where the station platforms are from 20 to 30 ft. beneath the surface of the street—a depth not sufficient to warrant the introduction of lifts, but enough to be inconvenient.

Operation.

In the operation of intra-urban railways, steam locomotives, cables and electricity have severally been tried: the first having been used in the earlier examples of underground lines and in the various elevated systems in the United States. The fouling of the air that results from the steam-engine, owing to the production of carbonic acid gas and of sulphurous fumes and aqueous vapour, is well known, and its use is now practically abandoned for underground working. The cable is slow; and unless development along new lines of compressed air or some sort of chemical engine takes place, electricity will monopolize the field. Electricity is applied through a separate locomotive attached to the head of the train, or through motor carriages attached either at one end or at both ends of the train, or by putting a motor on every axle and so utilizing the whole weight of the train for traction, all the motors being under a single control at the head of the train, or at any point of the train for emergency. The distance between stations on intra-urban railways is governed by the density of local traffic and the speed desired to be maintained. As a general rule the interval varies from one-quarter to one-half mile; on the express lines of the New York underground railway, the inter-station interval averages about 1½ m. On steam-worked lines the speed of trains is about 11 to 15 m. per hour, according to the distance between stations Later practice takes advantage of the great increase in power that can be temporarily developed by electric motors during the period of acceleration; this, in proportion to the weight of the train to be hauled, gives results much in advance of those obtained on ordinary steam railways. Since high average speed on a line with frequent stops depends largely on rapidity of acceleration, the tendency in modern equipment is to secure as great an output of power as possible during the accelerating period, with corresponding increase in weight available for adhesion. With a steam locomotive all the power is concentrated in one machine, and therefore the weight on the drivers available for adhesion is limited. With electricity, power can be applied to as many axles in the train as desired, and so the whole weight of the train, with its load, may be utilized if necessary. Sometimes, as on the Central London railway, the acceleration of gravity is also utilized; the different stations stand, as it were, on the top of a hill, so that outgoing trains are aided at the start by having a slope to run down, while incoming ones are checked by the rising gradient they encounter.

Cost.

The cost of intra-urban railways depends not only on the type of construction, but more especially upon local conditions, such as the nature of the soil, the presence of subsurface structures, like sewers, water and gas mains, electric conduits, &c.; the necessity of permanent underpinning or temporary supporting of house foundations, the cost of acquiring land passed under or over when street lines are not followed, and, in the case of elevated railways, the cost of acquiring easements of light, air and access, which the courts have held are vested in the abutting property. The cost of building an ordinary two-track elevated railway according to American practice varies from $300,000 to $400,000 a mile, exclusive of equipment, terminals or land damages. The cost of constructing the deep tubular tunnels in London, whose diameter is about 15 ft. exclusive, in like manner, of equipment, terminals or land damages, is about £170,000 to £200,000 a mile. The cost of the Metropolitan and Metropolitan District railways of London varied greatly on account of the variations in construction. The most difficult section—namely, that under Cannon Street—where the abutting buildings had to be underpinned, and a very dense traffic maintained during construction, while a network of sewers and mains was readjusted, cost at the rate of about £1,000,000 a mile. The contract price of the New York underground railway, exclusive of the incidentals above mentioned, was $35,000,000 for 21 m., of which 16 m. are underground and 5 are elevated. The most difficult portion of the road, 4½ m. of four-track line, cost $15,000,000. (W. B. P.)

LIGHT RAILWAYS

Great Britain.

The term light railways is somewhat vague and indefinite, and therefore to give a precise definition of its significance is not an easy matter. No adequate definition is to be found even in the British statute-book; for although parliament has on different occasions passed acts dealing with such railways both in Great Britain and Ireland, it has not inserted in any of them a clear and sufficient statement of what it intends shall be understood by the term, as distinguished from an ordinary railway. Since the passing of the Light Railways Act of 1896, which did not apply to Ireland, it is possible to give a formal definition by saying that a light railway is one constructed under the provisions of that act; but it must be noted that the commissioners appointed under that act have authorized many lines which in their physical characteristics are indistinguishable from street tramways constructed under the Tramways Act, and to these the term light railways would certainly not be applied in ordinary parlance. Still, they do differ from ordinary tramways in the important fact that the procedure by which they have been authorized is simpler and cheaper than the methods by which special private acts of parliament have to be obtained for tramway projects. Economy in capital outlay and cheapness in construction is indeed the characteristic generally associated with light railways by the public, and implicitly attached to them by parliament in the act of 1896, and any simplifications of the engineering or mechanical features they may exhibit compared with the standard railways of the country are mainly, if not entirely, due to the desire to keep down their expenses.

The saving of cost is effected in two ways: (1) Instead of having to incur the expenses of a protracted inquiry before parliament, the promoters of a light railway under the act of 1896 make an application to the light railway commissioners, who then hold a local inquiry, to obtain evidence of the usefulness of the proposed railway, and to hear objections to it, and, if they are satisfied, settle the draft order and hand it over to the Board of Trade for confirmation. The Board may reject the order if it thinks the scheme to be of such magnitude or importance that it ought to come under the direct consideration of parliament, or it may modify it in certain respects, or it may remit it to the commissioners for further inquiry. But once the order is confirmed by the Board, with or without modifications, it has effect as if it had been enacted by parliament, and it cannot afterwards be upset on the ground of any alleged irregularity in the proceedings. (2) The second source of economy is to be sought in the reduced cost of actually making the line and of working it when made. Thus the gauge may be narrow, the line single, the rails lighter than those used in standard practice, while deep cuttings and high embankments may be avoided by permitting the curves to be sharper and the gradients steeper: such points conduce to cheapness of construction. Again, low speeds, light stock, less stringent requirements as to continuous brakes, signals, block-working and interlocking, road-crossings, stations, &c., tend to cheapness in working. On the lines actually authorized by the Board of Trade under the 1896 act the normal minimum radius of the curves has been fixed at about 600 ft.; when a still smaller radius has been necessary, the speed has been reduced to 10 m. an hour and a guard-rail insisted on inside the curve. Again, the speed has been restricted to 20 m. an hour on long inclines with gradients steeper than 1 in 50, and also on a line which had scarcely any straight portions and in which there were many curves of 600 ft. radius and gradients of 1 in 50. In the case of a line of 2½ ft. gauge, with a ruling gradient of 1 in 40, a maximum speed of 15 m. an hour and a minimum radius of curve of 300 ft. have been prescribed. Curves of still smaller radius have entailed a maximum speed of 10 m. an hour. It must be understood that a railway described as "light" is not necessarily built of narrower gauge than the standard. Many lines, indeed, have been designed on the normal 4 ft. 8½ in. gauge, and laid with rails weighing from 50 to 70 ℔ per yard; a flat-footed 60 ℔ rail, with the axle load limited to 14 tons, has the advantage for such lines that it permits the employment of a proportion of the locomotives used on main lines. The orders actually granted have allowed 50 ℔, 56 ℔, 60 ℔ and 70 ℔ rails, with corresponding axle loads of 10, 12, 14 and 16 tons. On a line of 2 ft. gauge, rails of 40 ℔ have been sanctioned. In regard to fencing and precautions at level-crossings, less rigid requirements may be enforced than with standard railways; and in some cases where trains are likely to be few, it has been provided that the normal position of the gates at crossings shall be across the line. Again, if the speed is low and the trains infrequent, the signalling arrangements may be of a very simple and inexpensive kind, or even dispensed with altogether. It should be mentioned that the act provided that the Treasury might advance a portion of the money required for a line in cases where the council of any county, borough or district had agreed to do the same, and might also make a special advance in aid of a light railway which was certified by the Board of Agriculture to be beneficial to agriculture in any cultivated district, or by the Board of Trade to furnish a means of communication between a fishing-harbour and a market in a district where it would not be constructed without special assistance from the state.

As a general classification the commissioners have divided the schemes that have come before them into three classes: (A) those which like ordinary railways take their own line across country; (B) those in connexion with which it is proposed to use the public roads conjointly with the ordinary road traffic; and (Neutral) which includes inclined railways worked with a rope, and lines which possess the conditions of A and B in about equal porportions.

The Light Railways Act 1896 was to remain in force only until the end of 1901 unless continued by parliament, but it was continued year by year under the Expiring Laws Continuance Act. In 1901 the president of the Board of Trade introduced a bill to continue the act until 1906, and to amend it so as to make it authorize the construction of a light railway on any highway, the object being to abolish the restriction that a light railway should run into the area of at least two local authorities; but it was not proceeded with. Towards the end of 1901 a departmental committee of the Board of Trade was formed to consider the Light Railways Act, and in 1902 the president of the Board of Trade (Mr Gerald Balfour) stated that as a result of the deliberations of this committee, a new bill had been drafted which he thought would go very far to meet all the reasonable objections that had been urged against the present powers of the local authorities. This bill, however, was not brought forward. In July 1903, Lord Wolverton, on behalf of the Board of Trade, introduced a bill to continue and amend the Light Railways Act. It provided that the powers of the light railway commissioners should continue until determined by parliament, and also provided, *inter alia*, that in cases where the Board of Trade thought, under section (9) subsection (3) of the original act, that a proposal should be submitted to parliament, the Board of Trade itself might submit the proposals to parliament by bringing in a bill for the confirmation of the light railway order, with a special report upon it. Opposition on petition could be heard before a select committee or a joint committee as in the case of private bills. The bill was withdrawn on the 11th of August 1903, Lord Morley appealing to the Board of Trade to bring in a more comprehensive measure to amend the unsatisfactory state of legislation in relation to tramways and light railways. In 1904 the president of the Board of Trade brought in a bill on practically the same lines as the amending bill of 1903. It reached second reading but was not proceeded with. Similar amending bills were introduced in the 1905 and 1906 sessions, but were withdrawn. During the first ten years after the act came into force 545 applications for orders were received, 313 orders were made, and 282 orders were confirmed. The orders confirmed were for 1731 m., involving an estimated capital expenditure of £12,770,384. At the end of 1906 only 500 m. had been opened for traffic, and the mileage of lines opened was much less in proportion to the mileage sanctioned in the cases of lines constructed on their own land than in the case of lines more of the nature of tramways. (In other countries where the mileage of main lines of railways in proportion to area and population is roughly the same as in the United Kingdom, the mileage of light railways already constructed is considerable, while many additional lines are under construction. At the end of 1903 there were 6150 m. working in France, costing on an average £4500 per mile, earning £275 per mile per annum; 3730 miles in Prussia costing £4180 per mile, earning £310 per mile per annum; 1430 m. in Belgium at £3400 per mile, earning £320 per mile per annum.) The average cost per mile in Great Britain on the basis of the prescribed estimates is £5860, but this figure does not include the cost of equipment and does not cover the whole cost of construction. According to the light railway commissioners, experience satisfied them (*a*) that light railways were much needed in many parts of the country and that many of the lines proposed, but not constructed, were in fact necessary to admit of the progress, and even the maintenance, of existing trade interests; and (*b*) that improved means of access were requisite to assist in retaining the population on the land, to counteract the remoteness of rural districts, and also, in the neighbourhood of industrial centres, to cope with the difficulties as to housing and the supply of labour. They pointed out that while during the first five years the act was in force there were 315 applications for orders, during the second five years there were only 142 applications, and that proposals for new lines had become less numerous owing to the various difficulties in carrying them to a successful completion and to the difficulty of raising the necessary capital even when part of it was provided with the aid of the state and of the local authorities. They expressed the opinion that an improvement could be effected enabling the construction of many much-needed lines by an amendment of some of the provisions of the Light Railways Act, and by a reconsideration of the conditions under which financial or other assistance should be granted to such lines by the state and by local authorities.

The so-called light railways in the United States and the British colonies have been made under the conditions peculiar to new countries. Their primary object being the development and peopling of the land, they have naturally been made as cheaply as possible; and as in such cases the cost of the land is inconsiderable, economy has been sought by the use of lighter and rougher permanent way, plant, rolling stock, &c. Such railways are not "light" in the technical sense of having been made under enactments intended to secure permanent lowness of cost as compared with standard lines. On the continent of Europe many countries have encouraged railways which are light in that sense. France began to move in this direction in 1865, and has formulated elaborate provisions for their construction and regulation. Italy did the same in its laws in 1873, 1879, 1881, 1887 and 1889; and Germany fostered enterprise of this kind by the imperial edicts of 1875, 1878 and 1892. Holland, Hungary and Switzerland were all early in the field; and Belgium has succeeded, through the instrumentality of the semi-official Société Nationale de Chemins de Fer Vicinaux, started in 1885, in developing one of the most complete systems of rural railway transport in the world.

France. In France the lines which best correspond to British light railways are called *Chemins de fer d'intérêt local*. These are regulated by a decree No. 11,264 of 6th August 1881, which the Ministry of Public Works is charged to carry out. The model "form of regulation" lays down the scales of the drawings and the information to be shown thereon. For the first installation a single line is prescribed, but the *concessionaire* must provide space and be prepared to double when required. The gauge may be either 1·44 metres (4 ft. 8·7 in.), or 1 metre (3 ft. 3·37 in.), or ·75 metre (2 ft. 5·5 in.). The radius of curves for the 1·44 m. gauge must not be less than 250 metres, 100 metres for the 1 m. gauge and 50 metres for the ·75 m. gauge. A straight length of not less than 60 metres for the largest gauge and 40 metres for the smallest must be made between two curves having opposite directions. Except in special cases, gradients must not exceed 3 in 100; and between gradients in the opposite sense there must be not less than 60 metres of level for 1·44 m. and 40 metres for 1 m. and ·75 m. gauges. The position of stations and stopping-places is regulated by the council of the department. The undertaking, once approved, is regarded as a work of public utility, and the undertakers are invested with all the rights that a public department would have in the case of the carrying out of public works. At the end of the period of the concession the *département* comes into possession of the road and all its fixed appurtenances, and in the last five years of the period the *département* has the right to enter into possession of the line, and apply the revenue to putting it into a thorough state of repair. It has also the right to purchase the undertaking at the end of the first fifteen years, the net profits of the preceding seven years to govern the calculation of the purchase price. The maximum 1st, 2nd and 3rd class passenger fares are, per kilometre, ·067 f. (·6d.), ·050 f. (·455d.) and ·037 f. (·34d.) respectively, when the trains are run at *grande vitesse*, the fares including 30 kilogrammes weight of personal baggage.

Belgium. In Belgium a public company under government control ("Société Nationale de Chemins de Fer Vicinaux") does all that in France forms the responsibility of the Ministry of the Interior and of the prefect of the department. Over an average of years it appears that 27% of the capital cost was found by the state, 28% by the province, 40·9% by the communes and 4·1% by private individuals. At the end of 1908 there were 2085 m. in operation, and the total mileage authorized was 2603, while the construction of a considerable further mileage was under consideration. As far as possible, these railways are laid beside roads, in preference to independent formation; the permanent way costs £977 per mile in the former as against £793 in the latter. If laid in paving, the price varies between £1108 and £2266 per mile. Through villages, and where roads have to be crossed, the line is of the usual tramway type. The line is of 1 metre gauge, with steel rails weighing 21½ kilos (42 ℔) per yard. In the towns a deeper rail is used, weighing about 60 ℔ per yard. In three lines of the Vicinaux system, in the aggregate 45 m. in length, the sharpest curves are 30 metres, 35 metres and 40 metres respectively. There are gradients of 1 in 20 and 1 in 25. The speed is limited to 30 kilometres (about 18 m.) in the country and 6 m. per hour in towns and through villages.

Italy. In Italy many railways which otherwise fulfil the conditions of a light railway are constructed with a gauge of 4 ft. 8½ in. The weights are governed by what the railway has to carry and the speed. Light locomotives, light rails and light rolling stock are employed. There are no bridges, except where watercourses occur. Cuttings are reduced to a minimum; and where the roads are sufficiently wide, the rails are laid on the margins. The advantage of uniformity of gauge is in the use of trucks for goods which belong to the rolling stock of the main lines. In Italy these railways are called "economic railways," and are divided into five types. Types I., II. and III. are of 4 ft. 8½ in. gauge, type IV. of 0·95 m. and type V. of 0·70 m.; but as there is no example of type V., the classification is practically one of 1·445 m. (4 ft. 8½ in.) and one of 0·95 (3 ft. 0·5 in.). The chief difference between the first three types lies in the weight of rails and rolling stock and in the radius of the curves. The real light railway of Italy is that of type IV.: gauge, 0·95 m. (3 ft. 0·5 in.); weight of rails, 12 (26·45 ℔) to 20 (44 ℔) kilos; mean load per axle, 6 tons; minimum curve, 70 m. (229 ft. 2·6 in.) radius; width of formation, 3·50 m. (11 ft. 5·5 in.); top width of ballast, 2·10 m. (6 ft. 10·7 in.); depth of ballast under sleepers, 0·10 m. (3 ft. 9·5 in.); maximum gradient, 1 in 50; length of sleepers, 1·70 m. (5 ft. 6·92 in.); width between parapets and width of tunnels, 1 m. over width of carriage; height of tunnels, 5 m. (16 ft. 4·85 in.); locomotives, maximum weight per axle 6 tons, rigid wheel base 1·80 m. (5 ft. 10·86 in.), diameter of driving-wheels 1 m. (3 ft. 3·37 in.).

Germany. In Germany the use of light railways (*Klein-bahnen*) has made great strides. The gauges in use vary considerably between 4 ft. 8½ in., the standard national gauge, and 1 ft. 11¾ in., which appears to be the smallest in use. They are under the control of the Post and Telegraph department, the state issuing loans to encourage the undertakings; the authorities in the provinces and communes also give support in various ways, and under various conditions, to public bodies or private persons who desire to promote or embark in the industry. These conditions, as well as the degree of control over the construction and working of the lines, are left to the regulation of the provincial governments. Similarly, the same authorities decide for themselves the conditions under which the public roads may be used, and the precautions for public safety, all subject to the confirmation of the imperial government.

Portable railways. What are known as "portable railways" should be included in the same category as light railways. With a 24 in. gauge, lines of a portable kind can be made very handily and the cost is very much less than that of a permanently constructed light railway. The simplicity is great; they can be quickly mounted and dismounted; the correct gauge can be perfectly maintained; the sections of rails and sleepers (which are of iron) are very portable, and skilled labour is not required to lay or to take them up; the making of a "turn-out" is easy, by taking out a 15 ft. section of the way and substituting a section with points and crossings. The safe load per wheel varies between 12 cwt. on a 10 in. 16 ℔ wheel and 40 cwt. on an 18 in. 56 ℔ wheel. The rolling stock is constructed either for farm produce or heavy minerals, the latter holding 10 to 27 cub. ft. For timber, 4 or 5 ft. bogies can be used. A useful wagon for agricultural transport on a 24 in. gauge line is 16 ft. long by 5 ft. wide; it weighs 72 cwt. and costs £30. A portable line of this kind will have 20 ℔ steel rails and 2112 steel sleepers—4 ft. 6 in. long—to a mile, laid 2 ft. 6 in. apart centre to centre. The total cost per mile of such a line, including all bolts, nuts, fish-plates and fastenings, ready for laying, delivered in the United Kingdom, is under £500 a mile.

See Evans Austin, *The Light Railways Act 1896*, which contains the rules of the Board of Trade; W. H. Cole, *Light Railways at Home and Abroad*; Lieut.-Col. Addison, *Report to the Board of Trade* (1894) *on Light Railways in Belgium*. (C. E. W.; E. Ga.)

RAIMBACH, ABRAHAM (1776–1843), English line-engraver, a Swiss by descent, was born in London in 1776. Educated at Archbishop Tenison's Library School, he was an apprentice to J. Hall the engraver from 1789 to 1796. For nine years part of his working-time was devoted to the study of drawing in the Royal Academy and to executing occasional engravings for the booksellers, whilst his leisure hours were employed in painting portraits in miniature. Having formed an intimacy with Sir David Wilkie, Raimbach in 1812 began to engrave some of that master's best pictures. At his death, in 1843, he held a gold medal awarded to him for his "Village Politicians" at the Paris Exhibition of 1814. He was elected corresponding member of the Institute of France in 1835.

RAIMUND, FERDINAND (1790–1836), Austrian actor and dramatist, was born on the 1st of June 1790, in Vienna. In 1814 he acted at the Josefstädter Theater, and in 1817 at the Leopoldstädter Theater. In 1823 he produced his first play, *Der Barometermacher auf der Zauberinsel*, which was followed by *Der Diamant des Geisterkönigs* (1824) and the still popular *Bauer als Millionär*. The last-mentioned play, which appeared in 1826, *Der Alpenkönig und der Menschenfeind* (1828) and *Der Verschwender* (1833) are Raimund's masterpieces. He committed suicide on the 5th of September 1836, owing to the fear that he had been bitten by a mad dog. Raimund was a master of the Viennese *Posse* or farce; his rich humour is seen to best advantage in his realistic portraits of his fellow-citizens.

Raimund's *Sämtliche Werke* (with biography by J. N. Vogl) appeared in 4 vols. (1837); they have been also edited by K. Glossy and A. Sauer (4 vols., 1881; 2nd ed., 1891), and a selection by E. Castle (1903). See E. Schmidt in *Charakteristiken*, vol. i. (1886); A. Farinelli, *Grillparzer und Raimund* (1897); L. A. Frankl, *Zur Biographie F. Raimunds* (1884); and especially A. Sauer's article in the *Allgem. Deutsche Biographie*.

RAIN (O.E. *regn*; the word is common to Teutonic languages, cf. Ger. *Regen*, Swed. and Dan. *regn*; it has been connected with Lat. *rigare*, to wet, Gr. *βρέχειν*), the water vapour of the atmosphere when condensed into drops large enough to be precipitated upon the earth. Hence the term is extended to signify the fall of such drops in a shower, and in the plural, "the rains," it signifies the rainy seasons in India and elsewhere where under normal climatic conditions such seasons are clearly distinguished from the dry. A rain-band is "a dark band in the solar spectrum, caused by the presence of water-vapour in the atmosphere" (*New Engl. Dict.*); a rain-gauge is an instrument used to measure the amount of rainfall (see METEOROLOGY, where the whole subject of precipitation is fully treated).

RAINBOW, formerly known as the *iris*, the coloured rings seen in the heavens when the light from the sun or moon shines on falling rain; on a smaller scale they may be observed when sunshine falls on the spray of a waterfall or fountain. The bows assume the form of concentric circular arcs, having their common centre on the line joining the eye of the observer to the sun. Generally only one bow is clearly seen; this is known as the *primary rainbow*; it has an angular radius of about 41°, and exhibits a fine display of the colours of the spectrum, being red on the outside and violet on the inside. Sometimes an outer bow, the *secondary rainbow*, is observed; this is much fainter than the primary bow, and it exhibits the same play of colours, with the important distinction that the order is reversed, the red being inside and the violet outside. Its angular radius is about 57°. It is also to be noticed that the space between the two bows is considerably darker than the rest of the sky. In addition to these prominent features, there are sometimes to be seen a number of coloured bands, situated at or near the summits of the bows, close to the inner edge of the primary and the outer edge of the secondary bow; these are known as the *spurious*, *supernumerary* or *complementary rainbows*.

The formation of the rainbow in the heavens after or during a shower must have attracted the attention of man in remote antiquity. The earliest references are to be found in the various accounts of the Deluge. In the Biblical narrative (Gen. ix. 12–17) the bow is introduced as a sign of the covenant between God and man, a figure without a parallel in the other accounts. Among the Greeks and Romans various speculations as to the cause of the bow were indulged in; Aristotle, in his *Meteors*, erroneously ascribes it to the reflection of the sun's rays by the rain; Seneca adopted the same view. The introduction of the idea that the phenomenon was caused by refraction is to be assigned to Vitellio. The same conception was utilized by Theodoric of Vriberg, a Dominican, who wrote at some time between 1304 and 1311 a tract entitled *De radialibus impressionibus*, in which he showed how the primary bow is formed by two refractions and one internal reflection; *i.e.* the light enters the drop and is refracted; the refracted ray is then reflected at the opposite surface of the drop, and leaves the drop at the same side at which it enters, being again refracted. It is difficult to determine the influence which the writings of Theodoric had on his successors; his works were apparently unknown until they were discovered by G. B. Venturi at Basel, partly in the city library and partly in the library of the Dominican monastery. A full account, together with other early contributions to the science of light, is given in Venturi's *Commentari sopra la storia de la Teoria del Ottica* (Bologna, 1814). John Fleischer (sometimes incorrectly named Fletcher), of Breslau, propounded the same view in a pamphlet, *De iridibus doctrina Aristotelis et Vitellonis* (1574); the same explanation was given by Franciscus Maurolycus in his *Photismi de lumine et umbra* (1575).

The most valuable of all the earlier contributions to the scientific explanation of rainbows is undoubtedly a treatise by Marco Antonio de Dominis (1566–1624), archbishop of Spalatro. This work, *De radiis visūs et lucis in vitris perspectivis et iride*, published at Venice in 1611 by J. Bartolus, although written some twenty years previously, contains a chapter entitled "Vera iridis tota generatio explicatur," in which it is shown how the primary bow is formed by two refractions and one reflection, and the secondary bow by two refractions and two reflections. Descartes strengthened these views, both by experiments and geometrical investigations, in his *Meteors* (Leiden, 1637). He employed the law of refraction (discovered by W. Snellius) to calculate the radii of the bows, and his theoretical angles were in agreement with those observed. His methods, however, were not free from tentative assumptions, and were considerably improved by Edmund Halley (*Phil. Trans.*, 1700, 714). Descartes, however, could advance no satisfactory explanation of the chromatic displays; this was effected by Sir Isaac Newton, who, having explained how white light is composed of rays possessing all degrees of refrangibility, was enabled to demonstrate that the order of the colours was in perfect accord with the requirements of theory (see Newton's *Opticks*, book i. part 2, prop. 9).

The geometrical theory, which formed the basis of the investigations of Descartes and Newton, afforded no explanation of the supernumerary bows, and about a century elapsed before an explanation was forthcoming. This was given by Thomas Young, who, in the Bakerian lecture delivered before the Royal Society on the 24th of November 1803, applied his principle of the interference of light to this phenomenon. His not wholly satisfactory explanation was mathematically examined in 1835 by Richard Potter (*Camb. Phil. Trans.*, 1838, 6, 141), who, while improving the theory, left a more complete solution to be made in 1838 by Sir George Biddell Airy (*Camb. Phil. Trans.*, 1838, 6, 379).

Geometrical theory.

The geometrical theory first requires a consideration of the path of a ray of light falling upon a transparent sphere. Of the total amount of light falling on such a sphere, part is reflected or scattered at the incident surface, so rendering the drop visible, while a part will enter the drop. Confining our attention to a ray entering in a principal plane, we will determine its deviation, *i.e.* the angle between its directions of incidence and emergence, after one, two, three or more internal reflections. Let EA be a ray incident at an angle i (fig. 1); let AD be the refracted ray, and r the angle of refraction. Then the deviation experienced by the ray at A is $i-r$. If the ray suffers one internal reflection at D, then it is readily seen that, if DB be the path of the reflected ray, the angle ADB equals $2r$, *i.e.* the deviation of the ray at D is $\pi-2r$. At B, where the ray leaves the drop, the deviation is the same as at A, viz. $i-r$. The total deviation of the ray is consequently given by $D=2(i-r)+\pi-2r$.

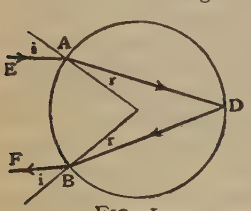

FIG. 1.

Similarly it may be shown that each internal reflection introduces a supplementary deviation of $\pi-2r$; hence, if the ray be reflected n times, the total deviation will be $D=2(i-r)+n(\pi-2r)$.

The deviation is thus seen to vary with the angle of incidence; and by considering a set of parallel rays passing through the same principal plane of the sphere and incident at all angles, it can be readily shown that more rays will pass in the neighbourhood of the position of minimum deviation than in any other position (see REFRACTION). The drop will consequently be more intensely illuminated when viewed along these directions of minimum deviation, and since it is these rays with which we are primarily concerned, we shall proceed to the determination of these directions.

Since the angles of incidence and refraction are connected by the relation $\sin i=\mu \sin r$ (Snell's Law), μ being the index of refraction of the medium, then the problem may be stated as follows: to determine the value of the angle i which makes $D=2(i-r)+n(\pi-2r)$ a maximum or minimum, in which i and r are connected by the relation $\sin i=\mu \sin r$, μ being a constant. By applying the method of the differential calculus, we obtain $\cos i=\sqrt{\{(\mu^2-1)/(n^2+2n)\}}$ as the required value; it may be readily shown either geometrically or analytically that this is a minimum. For the angle i to be real, $\cos i$ must be a fraction, that is $n^2+2n>\mu^2-1$, or $(n+1)^2>\mu^2$. Since the value of μ for water is about $\frac{4}{3}$, it follows that n must be at least unity for a rainbow to be formed; there is obviously no theoretical limit to the value of n, and hence rainbows of higher orders are possible.

So far we have only considered rays of homogeneous light, and it remains to investigate how lights of varying refrangibilities will be transmitted. It can be shown, by the methods of the differential calculus or geometrically, that the deviation increases with the refractive index, the angle of incidence remaining constant. Taking the refractive index of water for the red rays as $\frac{108}{81}$, and for the violet rays as $\frac{109}{81}$, we can calculate the following values for the minimum deviations corresponding to certain assigned values of n.

n	Red.	Violet.
1	$\pi-42^\circ\cdot1$	$\pi-40^\circ\cdot22$
2	$2\pi-129^\circ\cdot2$	$2\pi-125^\circ\cdot48$
3	$3\pi-231^\circ\cdot4$	$3\pi-227^\circ\cdot08$
4	$4\pi-317^\circ\cdot07$	$4\pi-310^\circ\cdot07$

To this point we have only considered rays passing through a principal section of the drop; in nature, however, the rays impinge at every point of the surface facing the sun. It may be readily deduced that the directions of minimum deviation for a pencil of parallel rays lie on the surface of cones, the semi-vertical angles of which are equal to the values given in the above table. Thus, rays suffering one internal reflection will all lie within a cone of about 42°; in this direction the illumination will be most intense; within the cone the illumination will be fainter, while, without it, no light will be transmitted to the eye.

Fig. 2 represents sections of the drop and the cones containing the minimum deviation rays after 1, 2, 3 and 4 reflections; the order of the colours is shown by the letters R (red) and V (violet). It is apparent, therefore, that all drops transmitting intense light after one internal reflection to the eye will lie on the surfaces of cones having the eye for their common vertex, the line joining the eye to the sun for their axis, and their semi-vertical angles equal to about 41° for the violet rays and 43° for the red rays. The observer will, therefore, see a coloured band, about 2° in width, and coloured violet inside and red outside. Within the band, the illumination will be faint; outside the band there will be perceptible darkening until the second bow comes into view. Similarly, drops transmitting rays after two internal reflections will be situated on covertical and coaxial cones, of which the semi-vertical angles are 51° for the red rays and 54° for the violet. Outside the cone of 54° there will be faint illumination; within it, no secondary rays will be transmitted to the eye. We thus see that the order of colours in the secondary bow is the reverse of that in the primary; the secondary is half as broad again (3°), and is much fainter, owing to the longer path of the ray in the drop, and the increased dispersion.

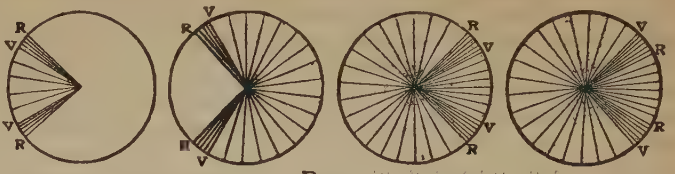

FIG. 2

Similarly, the third, fourth and higher orders of bows may be investigated. The third and fourth bows are situated between the observer and the sun, and hence, to be viewed, the observer must face the sun. But the illumination of the bow is so weakened by the repeated reflections, and the light of the sun is generally so bright, that these bows are rarely, if ever, observed except in artificial rainbows. The same remarks apply to the fifth bow, which differs from the third and fourth in being situated in the same part of the sky as the primary and secondary bows, being just above the secondary.

The most conspicuous colour band of the principal bows is the red; the other colours shading off into one another, generally with considerable blurring. This is due to the superposition of a great number of spectra, for the sun has an appreciable apparent diameter, and each point on its surface gives rise to an individual spectrum. This overlapping may become so pronounced as to produce a rainbow in which colour is practically absent; this is particularly so when a thin cloud intervenes between the sun and the rain, which has the effect of increasing the apparent diameter of the sun to as much as 2° or 3°. This phenomenon is known as the "white rainbow" or "Ulloa's Ring or Circle," after Antonio de Ulloa.

Physical theory.

We have now to consider the so-called spurious bows which are sometimes seen at the inner edge of the primary and at the outer edge of the secondary bow. The geometrical theory can afford no explanation of these coloured bands, and it has been shown that the complete phenomenon of the rainbow is to be sought for in the conceptions of the wave theory of light. This was first suggested by Thomas Young, who showed that the rays producing the bows consisted of two systems, which, although emerging in parallel directions, traversed different paths in the drop. Destructive interference between these superposed rays will therefore occur, and, instead of a continuous maximum illumination in the direction of minimum deviation, we should expect to find alternations of brightness and darkness. The later investigations of Richard Potter and especially of Sir George Biddell Airy have proved the correctness of Young's idea. The mathematical discussion of Airy showed that the primary rainbow is not situated directly on the line of minimum deviation, but at a slightly greater value; this means that the true angular radius of the bow is a little less than that derived from the geometrical theory. In the same way, he showed that the secondary bow has a greater radius than that previously assigned to it. The spurious bows he showed to consist of a series of dark and bright bands, whose distances from the principal bows vary with the diameters of the raindrops. The smaller the drops, the greater the distance; hence it is that the spurious bows are generally only observed near the summits of the bows, where the drops are smaller than at any lower altitude. In Airy's investigation, and in the extensions by Boitel, J. Larmor, E. Mascart and L. Lorentz, the source of light was regarded as a point. In nature, however, this is not realized, for the sun has an appreciable diameter. Calculations taking this into account have been made by J. Pernter (*Neues über den Regenbogen*, Vienna, 1888) and by K. Aichi and T. Tanakadate (*Jour. College of Science*, Tokyo, 1906, vol. xxi. art. 3).

Experimental confirmation of Airy's theoretical results was afforded in 1842 by William Hallows Miller (*Camb. Phil. Trans.* vii. 277). A horizontal pencil of sunlight was admitted by a vertical slit, and then allowed to fall on a column of water supplied by a jet of about $\frac{1}{30}$th of an inch in diameter. Primary, secondary and spurious bows were formed, and their radii measured; a comparison of these observations exhibited agreement with Airy's analytical values. Pulfrich (*Wied. Ann.*, 1888, 33, 194) obtained similar results by using cylindrical glass rods in place of the column of water.

In accordance with a general consequence of reflection and refraction, it is readily seen that the light of the rainbow is partially polarized, a fact first observed in 1811 by Jean Baptiste Biot (see POLARIZATION).

Lunar rainbows. The moon can produce rainbows in the same manner as the sun. The colours are much fainter, and according to Aristotle, who claims to be the first observer of this phenomenon, the lunar bows are only seen when the moon is full.

Marine rainbow is the name given to the chromatic displays formed by the sun's rays falling on the spray drawn up by the wind playing on the surface of an agitated sea.

Intersecting rainbows are sometimes observed. They are formed by parallel rays of light emanating from two sources, as, for example, the sun and its image in a sheet of water, which is situated between the observer and the sun. In this case the second bow is much fainter, and has its centre as much above the horizon as that of the direct system is below it.

REFERENCES.—For the history of the theory of the rainbow, see G. B. Venturi, *Commentari sopra la storia de la teoria del Ottica* (Bologna, 1814); F. Rosenberger, *Geschichte der Physik* (1882–90). The geometrical and physical theory is treated in T. Preston's *Theory of Light*; E. Mascart's *Traité d'optique* (1899–1903); and most completely by J. Pernter in various contributions to scientific journals and in his *Meteorologische Optik* (1905–9).

RAINOLDS (or REYNOLDS), **JOHN** (1549–1607), English divine, was born about Michaelmas 1549 at Pinhoe, near Exeter, and was educated at Merton and Corpus Christi Colleges, Oxford, becoming a fellow of the latter in 1568. In 1572–73 he was appointed reader in Greek, and his lectures on Aristotle's *Rhetoric* laid the sure basis of his fame. He resigned the office in 1578 and his fellowship in 1586, through inability to agree with the president William Cole, and became a tutor at Queen's College. By this time he had acquired a considerable reputation as a disputant on the Puritan side, and the story goes that Elizabeth visiting the university in 1592 "schooled him for his obstinate preciseness, willing him to follow her laws, and not run before them." In 1593 he was made dean of Lincoln. The fellows of Corpus were anxious to replace Cole by Rainolds, and exchange was effected, Rainolds being elected president in December 1598. The chief events of his subsequent career were his share in the Hampton Court Conference, where he was the most prominent representative of the Puritan party and received a good deal of favour from the king, and in the Authorized Version of the Bible. Of this project he was initiator, and himself worked with the company who undertook the translation of the Prophets. He died of consumption on the 21st of May 1607, leaving a great reputation for scholarship and high character.

RAINY, ROBERT (1826–1906), Scotch Presbyterian divine, was born on the 1st of January 1826; his father, Dr Harry Rainy, professor of forensic medicine in Glasgow University, was the son of a Sutherlandshire minister. Young Rainy was intended for his father's profession, but he was caught by the evangelical fervour of the Disruption movement, and after studying for the Free Church he became a minister, first in Aberdeenshire and then in Edinburgh, till in 1862 he was elected professor of Church history in the theological seminary, New College, a post he only resigned in 1900. In 1874 he was made principal of the college and was subsequently known as Principal Rainy. He had come to the front as a champion of the liberal party in the Union controversy within the Free Church, and in combating Dean Stanley's Broad Church views in the interests of Scotch evangelicism; and about 1875 he became the undisputed leader of the Free Church. He guided it through the controversies as to Robertson Smith's heresies, as to the use of hymns and instrumental music, and as to the Declaratory Act, brought to a successful issue the union of the Free and United Presbyterian Churches, and threw the weight of the united church on the side of freedom of Biblical criticism. He was the first moderator of the General Assembly of the United Free Church of Scotland, having previously been moderator of the Free General Assembly. Though not a great scholar, he was eminent as an ecclesiastical statesman, and his influence was far-reaching. After the strain of the fight with the so-called "Wee Frees" in 1904–5 his health broke down, and he went to Australia for recovery, but died at Melbourne on the 22nd of December 1906

See Lives by P. Carnegie Simpson (1909) and R. Mackintosh (1907).

RAIPUR, a town and district of British India, in the Chhattisgarh division of the Central Provinces. The town is 994 ft. above sea-level, 188 m. E. of Nagpur; and has a station on the Bengal-Nagpur railway. Pop. (1901) 32,114. There are ruins of an immense fort, with many tanks and old temples. It has a German mission and a government high school. The Rajkumar college, for the education of the sons of the chiefs of Chhattisgarh, was transferred here from Jubbulpore in 1894.

The DISTRICT OF RAIPUR has an area of 9831 sq. m. It spreads over a vast plateau closed in by ranges of hills branching from the great Vindhyan chain. It is drained by the Seonath and the Mahanadi rivers. Geologically the country consists in the hilly tracts of gneiss and quartzite; the sandstone rocks in the west are intersected with trap dykes. Iron ore is abundant, and red ochre of high repute is found. In the interior the principal strata are a soft sandstone slate (covered generally by a layer of laterite gravel) and blue limestone, which crops out in numerous places on the surface and is invariably found in the beds of the rivers. Throughout the plains the soil is generally fertile. The climate is generally good; the mean temperature is 78° F., and the annual rainfall averages 55 in. The population on the present area in 1901 was 1,096,858, showing a decrease of 2·5% in the decade. The principal crop is rice. There are manufactures of cotton goods and brassware. The north-west corner of the district is crossed by the main line of the Bengal-Nagpur railway, and a narrow-gauge branch runs from Raipur town due south. The district suffered severely from famine in 1896–97, and again in 1899–1900.

Raipur was governed by a branch of the Haihaivansi dynasty of Ratanpur for many centuries until their deposition by the Mahrattas in 1750. The country was then already in a condition of decay, and soon afterwards it relapsed into absolute anarchy. In 1818 it was taken under British superintendence and made rapid progress. It fell with the rest of the Nagpur dominions to the British government in 1854. In 1906 its area was reduced by the formation of the new district of Drug.

RAIS (or RETZ), **GILLES DE** (1404–1440), marshal of France and the central figure of a 15th-century *cause célèbre*, whose name is associated with the story of Bluebeard, was the son of Guy de Montmorency-Laval, the adopted son and heir of Jeanne de Rais and of Marie de Craon. He was born at Machecoul in September or October 1404, and, being early left an orphan, was educated by his maternal grandfather, Jean de Craon. Chief among his great possessions was the barony of Rais (erected in the 16th century into the peerage-duchy of Retz), south of the Loire, on the marches of Brittany. He joined the party of the Montforts, supporting Jean V. of Brittany against the rival house of Penthièvre. He helped to release Duke John from Olivier de Blois, count of Penthièvre, who had taken him prisoner by craft, and was rewarded by extensive grants of land, which were subsequently commuted by the Breton parliament for money payments. In 1420, after other projects of marriage had fallen through, in two cases by the death of the bride, he married Katherine of Thouars, a great heiress in Brittany, La Vendée and Poitou. In 1426 he raised seven companies of men-at-arms, and began active warfare against the English under Artus de Richemont, the newly made constable of France. He had already built up a military reputation when he was chosen to accompany Joan of Arc to Orleans. He continued to be her special protector, fighting by her side at Orleans, and afterwards at Jargeau and Patay. He had advocated further measures against the English on the Loire before carrying out the coronation of Charles VII. at Reims. On the 17th of July he was made marshal of France at Reims, and after the assault on Paris he was granted the right to bear the arms of France as a border to his shield, a privilege that was, however, never ratified. In the winter he was in Normandy, at Louviers, whether with a view to the release of Joan, then a prisoner at Rouen, cannot be stated. Meanwhile his fortune was disappearing, although he had been one of the richest men in France. He had expended great sums in the king's service, and he maintained a court of knights, squires, heralds and priests, more suited to royal than baronial rank. He kept open house, was a munificent patron of literature and of music, and his library contained many valuable works, he himself being a skilled illuminator and binder. He also indulged a passion for the stage. At the chief festivals he gave performances of mysteries and moralities, and it has been asserted that the *Mystère de la Passion*, acted at Angers in 1420, was staged by him in honour of his own marriage. The original draft of the *Mystery of Orleans* was probably written under his direction, and contains much detail which may be well accounted for by his intimate acquaintance with the Maid. In his financial difficulties he began to alienate his lands, selling his estates for small sums. These proceedings provided his heirs with material for lawsuits for many years. Among those who profited by his prodigality were the duke of Brittany, and his chancellor, Jean de Malestroit, bishop of Nantes, but in 1436 his kinsfolk appealed to Charles VII., who proclaimed further sales to be illegal. Jean V. refused to acknowledge the king's right to promulgate a decree of this kind in Brittany, and replied by making Gilles de Rais lieutenant of Brittany and by acknowledging him as a brother-in-arms. Gilles hoped to redeem his fortunes by alchemy; he also spent large sums on necromancers, who engaged to raise the devil for his assistance. On the other hand he sought to guarantee himself from evil consequences by extravagant charity and a splendid celebration of the rites of the church. The abominable practices of which he was really guilty seem not to have been suspected by his equals or superiors, though he had many accomplices and his criminality was suspected by the peasantry. His wife finally left him in 1434–35, and may possibly have become acquainted with his doings, and when his brother René de la Suze seized Champtocé, all traces of his crimes had not been removed, but family considerations no doubt imposed silence. His servants kidnapped children, generally boys, on his behalf, and these he tortured and murdered. The number of his victims was stated in the ecclesiastical trial to have been 140, and larger figures are quoted. The amazing impunity which he enjoyed was brought to an end in 1440, when he was imprudent enough to come into conflict with the church by an act of violence which involved sacrilege and infringement of clerical immunity. He had sold Saint Étienne de Malemort to the duke of Brittany's treasurer, Geffroi le Ferron. In the course of a quarrel over the delivery of the property to this man's brother, Jean le Ferron, Gilles seized Jean, who was in clerical orders, in church, and imprisoned him. He then proceeded to defy the duke, but was reconciled to him by Richemont. In the autumn, however, he was arrested and cited before the bishop of Nantes on various charges, the chief of which were heresy and murder. With the latter count the ecclesiastical court was incompetent to deal, and on the 8th of October Gilles refused to accept its jurisdiction. Terrified by excommunication, however, he acknowledged the evidence of the witnesses, and by confession he secured absolution. He had been pronounced guilty of apostasy and heresy by the inquisitor, and of vice and sacrilege by the bishop. A detailed confession was extracted by the threat of torture on the 21st of October. A separate and parallel inquiry was made by Pierre de l'Hôpital, president of the Breton parliament, by whose sentence he was hanged (not burned alive as is sometimes stated), on the 26th of October 1440, with two of his accomplices. In view of his own repeated confessions it seems impossible to doubt his guilt, but the numerous irregularities of the proceedings, the fact that his necromancer Prelati and other of his chief accomplices went unpunished, taken together with the financial interest of Jean V. in his ruin, have left a certain mystery over a trial, which, with the exception of the process of Joan of Arc, was the most famous in 15th-century France. His name is connected with the tale of Bluebeard (*q.v.*) in local tradition at Machecoul, Tiffauges, Pornic and Chéméré, though the similarity between the two histories is at best vague. The records of the trial are preserved in the Bibliothèque Nationale in Paris, at Nantes and elsewhere.

See Eugène Bossard, *Gilles de Rais, dit Barbe Bleue* (2nd ed., 1886), which includes the majority of the documents of the trial published originally by De Maulde; E. A. Vizetelly, *Bluebeard* (1902); H. C. Lea, *Hist. of the Inquisition* (iii. 468, seq.); A. Molinier, *Les Sources de l'histoire de France* (No. 4185). Huysmans in *Là-bas* describes his hero as engaged on a life of Gilles de Rais, and takes the opportunity for a striking picture of the trial.

RAISIN (Fr. *raisin*, grape; Lat. *racemus*), the name given to the dried fruits of certain varieties of the grape vine, *Vitis vinifera*, which grow principally in the warm climate of the Mediterranean coasts and are comparatively rich in sugar. The use of dried grapes or raisins as food is of great antiquity (Num. vi. 3; 1 Sam. xxv. 18, xxx. 12). In medieval times raisins imported from Spain were a prized luxury in England, and to the present day Great Britain continues to be the best customer of the raisin-producing regions. "Raisins of the sun" are obtained by letting the fruit continue on the vines after it has come to maturity, where there is sufficient sunshine and heat in the autumn, till the clusters dry on the stocks. Another plan is partially to sever the stalk before the grapes are quite ripe, thus stopping the flow of the sap, and in that condition to leave them on the vines till they are sufficiently dry. The more usual process, however, is to cut off the fully ripe clusters and expose them, spread out, for several days to the rays of the sun, taking care that they are not injured by rain. In unfavourable weather they may be dried in a heated chamber, but are then inferior in quality. In some parts of Spain and France it is common to dip the gathered clusters in boiling water, or in a strong potash lye, a practice which softens the skin, favours drying and gives the raisins a clear glossy appearance. Again, in Asia Minor the fruit is dipped into hot water on the surface of which swims a layer of olive oil, which communicates a bright lustre and softness to the skin. Some superior varieties are treated with very great care, retained on their stalks, and sent into the market as clusters for table use; but the greater part are separated from the stalks in the process of drying and the stalks winnowed out of the fruit. Raisins come from numerous Mediterranean localities, and present at least three distinct varieties—(1) ordinary or large raisins, (2) sultana seedless raisins, and (3) currants or Corinthian raisins (see CURRANT). The greater proportion of the common large raisins of English commerce comes from the provinces of Malaga, Valencia and Alicante in Spain; these are known by the common name of Malaga raisins. Those of the finest quality, called Malaga clusters, are prepared from a variety of muscatel grape, and preserved on the stalks for table use. This variety, as well as Malaga layers, so called from the manner of packing, are exclusively used as dessert fruit. Raisins of a somewhat inferior quality, known as "lexias," from the same provinces, are used for cooking and baking purposes. Smyrna raisins also come to some extent into the English market. The best quality, known as Elemé, is a large fruit, having a reddish-yellow skin with a sweet pleasant flavour. Large-seeded dark-coloured raisins are produced in some of the islands of the Greek archipelago and in Crete, but they are little seen in the British markets. In Italy the finest raisins are produced in Calabria, inferior qualities in central Italy and in Sicily. From the Lipari Islands a certain quantity of cluster raisins of good quality is sent to England. In the south of France raisins of high excellence—Provence raisins in clusters—are obtained at Roquevaire, Lunel and Frontignan. Sultana seedless raisins are the produce of a small variety of yellow grape, cultivated exclusively in the neighbourhood of Smyrna. The vines are grown on a soil of decomposed hippurite limestone, on sloping ground rising to a height of 400 ft. above the sea, and all attempts to cultivate sultanas in other raisin-growing localities have failed, the grapes quickly reverting to a seed-bearing character. The dried fruit has a fine golden-yellow colour, with a thin, delicate, translucent skin and a sweet aromatic flavour. A very fine seedless oblong raisin of the sultana type with a brownish skin is cultivated in the neighbourhood of Damascus.

RAJA, the Hindu title for a chief, or prince, derived from the same root as the Latin *rex*. Other forms are rao, rana and rawal, while chiefs of high rank are styled maharaja, maharao and maharana. The Hindustani form is rai, and the title of the Hindu emperor of Vijayanagar in S. India was raya. It is not confined to the rulers of native states, being conferred by the British government on Hindu subjects, sometimes as an hereditary distinction. In the form of rao it appears as a suffix to the names of most Mahrattas, and to the names of Kanarese Brahmans.

RAJAHMUNDRY, or RAJAMAHENDRI, a town of British India, in the Godavari district of Madras. Pop. (1901) 36,408. It stands on the left bank of the river Godavari, at the head of the delta, 360 m. N. of Madras, and has a station on the East Coast railway, which is here carried across the river by a bridge of 56 spans. The government college is one of the four provincial schools established in 1853. There are also a training college and high school. Carpets, rugs and wooden wares are manufactured.

Tradition divides the merit of founding Rajahmundry between the Orissa and Chalukya princes. In 1470 it was wrested from Orissa by the Mahommedans, but early in the 16th century it was retaken by Krishna Raja. It continued under Hindu rule till 1572, when it yielded to the Moslems of the Deccan under Rafat Khan. It passed into the possession of the French in 1753, but they were driven out by the British under Colonel Forde in 1758.

RAJASTHANI (properly RĀJASTHĀNĪ, the language of Rājasthān of Rajputana), an Indo-Aryan vernacular closely related to Gujarati (*q.v.*). It is spoken in Rajputana and the adjoining parts of central India, and has several dialects the principal of which are Jaipurī, Mārwāṛī, Mēwātī and Mālvī. Hāṛautī, an important variety of Jaipurī, is spoken in the states of Kota and Bundi. Carey, the well-known Serampur missionary, paid great attention to Rajasthani in the early part of the 19th century, translating the New Testament into no fewer than six dialects, viz. Hāṛautī, Ujainī (*i.e.* Mālvī), Udaipurī (a form of Mārwāṛī), Mārwāṛī proper, Jaipurī proper and Bīkānērī (another form of Mārwāṛī). In 1901 the total number of speakers of Rājasthānī was 10,917,712. (G. A. GR.)

RAJGARH, a native state of central India, in the Bhopal agency. Area, 940 sq. m. Pop. (1901) 88,376, showing a decrease of 26% in the decade, due to the results of famine. Estimated revenue, £33,000; tribute (to Sindhia), £3640. The chief, whose title is rawat, is a Rajput of the Umat clan. Grain and opium are the principal articles of trade. The town of Rajgarh, which is surrounded by a battlemented wall, had a population of 5399 in 1901.

RAJKOT, India, capital of a native state in Bombay, and headquarters of the political agent for Kathiawar. Pop. (1901) 36,151. It is situated in the middle of the peninsula of Kathiawar, and is the centre of the railway system. There is a military cantonment. The Rajkumar college, for the education of the sons of chiefs on the lines of an English public school, has achieved great success. Besides the high school there are training colleges for masters and mistresses. The Rasulkhanji hospital has a department for women, opened in 1897. All these institutions are maintained at the joint expense of the chiefs of Kathiawar. The state of Rajkot, which is a branch of Nawanagar, has an area of 282 sq. m. Pop. (1901) 49,795. Estimated revenue, £20,000.

RAJMAHAL, a former capital of Bengal, India, now a village in the district of the Santal Parganas, situated on the right bank of the Ganges, where that river makes a turn to the south. Pop. (1901) 2047. It was chosen for his residence by Man Singh, Akbar's Rajput general in 1592, but the capital of the province was shortly afterwards transferred to Dacca. It contains many palaces and mosques, now in ruins and overgrown with jungle. It has a station on the loop line of the East Indian railway, but trade has declined since the Ganges abandoned its old bed; and Sahibganj has taken its place. Rajmahal has given its name to a range of hills, almost the only hills in Bengal proper, which here come down close to the bank of the Ganges. They cover a total area of 1366 sq. m., and their height never exceeds 2000 ft. They are inhabited by an aboriginal race, known as Paharias or "hill-men," of whom two tribes may be distinguished: the Male Sauria Paharias and the Mal Paharias; total pop. (1901) 73,000. The former, if not the latter also, are closely akin to the larger tribe of Oraons. Their language, known as Malto, of the Dravidian family, was spoken by 60,777 persons in 1901. The Paharias have contributed an element to the administrative history of Bengal. Augustus Clevland, a civilian who died in 1784 and whose name is still honoured, was the first who succeeded in winning their confidence and recruiting among them a corps of hill-rangers. The methods that he adopted are the foundation of the "non-regulation" system, established in 1796; and the hills were exempted from the permanent settlement. The Santals, a different aboriginal race, have since immigrated in large numbers into the Daman-i-koh, or "skirts of the hills"; but the Paharias alone occupy the plateaux on the top, where they are permitted to practise the privilege of shifting cultivation, which renders scientific forestry impossible. The approach from the plains below to each plateau is guarded by a steep ladder of boulders.

See E. W. Dalton, *Descriptive Ethnology of Bengal* (Calcutta, 1872); F. B. Bradley-Birt, *The Story of an Indian Upland* (1905).

RAJPIPLA, a native state of India, in the Rewa Kantha agency, Bombay, occupying a hilly tract between the rivers Nerbudda and Tapti; area, 1517 sq. m. Pop. (1901) 117,175, showing a decrease of 32% in the decade, due to the results of famine; estimated revenue, £60,000; tribute (to the Gaekwar of Baroda), £3000. The chief, whose title is maharana, is a Gohel Rajput, of the same family as the thakor saheb of Bhaunagar. A light railway, constructed at the cost of the state, connects Nandod with Anklesvar in Broach district. The old fort of Rajpipla, in the hills, is now deserted. The modern capital is Nandod, situated on the river Karjan, 32 m. from Surat. Pop. (1901) 11,236.

RAJPUT, a race of India, not confined to Rajputana, but spread over the N. of the country. According to the census of 1901 there were 9,712,156 Rajputs in all India, of whom only 620,229 lived in Rajputana. The great majority adhere to the Hindu religion, but 1,875,387 are entered as Mahommedans. The Rajputs form the fighting, landowning and ruling caste. They claim to be the modern representatives of the Kshatriyas of ancient tradition; but their early history is obscure, and recent research supports the view that they include descendants of more than one wave of immigrant invaders. Linguistic evidence supports tradition in proving that their unity was broken up by the Mahommedan conquest, for the inhabitants of the Himalayan valleys still speak a language akin to those of Rajputana proper, though separated from them by the wide Gangetic valley.

The Rajputs are fine, brave men, and retain the feudal instinct strongly developed. Pride of blood is their chief characteristic, and they are most punctilious on all points of etiquette. The tradition of common ancestry permits a poor Rajput yeoman to consider himself as well born as any powerful landholder of his clan, and superior to any high official of the professional classes. No race in India can boast of finer feats of arms or brighter deeds of chivalry, and they form one of the main recruiting fields for the Indian army of to-day. They consider any occupation other than that of arms or government derogatory to their dignity, and consequently during the long period of peace which has followed the establishment of the British rule in India they have been content to stay idle at home instead of taking up any of the other professions in which they might have come to the front. Those who are not zamindars have, therefore, rather dropped behind in the modern struggle for existence. As cultivators they are lazy and indifferent, and they prefer pastoral to agricultural pursuits. Looking upon all manual labour as humiliating, none but the poorest class of Rajput will himself hold the plough.

Within the limits of Rajputana the Rajputs form a vast body of kindred, and any Rajput can marry any Rajput woman who does not belong to his own clan. The most numerous of the clans is the Rahtor, to which the chiefs of Marwar, Bikanir and Kishangarh belong. Its strength in 1901 was 122,160. Next comes the Kachwaha clan, which is strong in Jaipur and Alwar, both chiefs belonging to its members. It numbers 100,186. The Chauhan follows with an aggregate of 86,460, among whom are the chiefs of Bundi, Kotah and Sirohi. The Jadu or Jadon, which includes in its ranks the chiefs of Karauli and Jaisalmer, numbers 74,666. The Sisodhyias, who include the ancient and illustrious house of Udaipur, number 51,366. The Ponwar clan, to which Vikramaditya, the celebrated king of Ujjain, from whom the Hindu Era is named, is said to have belonged, numbers 43,435. The Solanki and Parihar clans, once powerful, are now only 18,949 and 9448 respectively.

RAJPUTANA, a collection of native states in India, under the political charge of an agent to the governor-general, who resides at Abu in the Aravalli Hills. It lies between 23° and 30° N. and between 69° 30′ and 75° 15′ E., and includes 18 states and 2 estates or chiefships. For political purposes these are subdivided into eight subordinate groups, consisting of three residencies and five agencies. These are as follow: (1) Mewar residency, with headquarters at Udaipur, comprising the states of Udaipur (Mewar), Dungarpur, Partabgarh and Banswara; (2) Jaipur residency, with headquarters at Jaipur, comprising the states of Jaipur and Kishangarh, with the estate of Lawa; (3) Western Rajputana states residency, with headquarters at Jodhpur, comprising the states of Jodhpur, Jaisalmer and Sirohi; (4) Bikanir agency, with headquarters at Bikanir; (5) Alwar agency, with headquarters at Alwar; (6) Eastern Rajputana states agency, with headquarters at Bharatpur, comprising the states of Bharatpur, Dholpur, and Karauli; (7) Haraoti-Tonk agency, with headquarters at Deoli, comprising the states of Tonk and Bundi, with the estate of Shahpura; (8) Kotah-Jhalawar agency, with headquarters at Kotah, comprising the states of Kotah and Jhalawar. All of these states are under Rajput rulers, except Tonk, which is Mahommedan, and Bharatpur and Dholpur, which are Jat. The small British province of Ajmere-Merwara is also included within the geographical area of Rajputana.

Physical Features.—The total area of Rajputana is about 127,541 sq. m. It is bounded on the west by Sind, and on the north-west by the Punjab state of Bahawalpur. Thence its northern and north-eastern frontier marches with the Punjab and the United Provinces until it touches the river Chambal, where it turns south-eastward for about 200 m., dividing the states of Dholpur, Karauli, Jaipur and Kotah from Gwalior. The southern boundary runs in a very irregular line across the central region of India, dividing the Rajputana states from a number of native states in Central India and Gujarat. The most striking physical feature is the Aravalli range of mountains, which intersects the country almost from end to end in a line running from south-west to north-east. Mount Abu is at the south-western extremity of the range, and the north-eastern end may be said to terminate near Khetri in the Shaikhawati district of Jaipur, although a series of broken ridges is continued in the direction of Delhi. About three-fifths of Rajputana lies north-west of the range, leaving two-fifths on the east and south. The tract lying to the north-west contains the states of Bikanir, Jaisalmer and Jodhpur. With the exception of the sub-montane districts of Jodhpur, which lie immediately below the Aravallis, this division is sandy, ill-watered and unproductive, improving gradually from a desert in the north-west and west to comparatively fertile land on the east. The country to the east and south-east of the Aravallis affords a striking contrast to the sandy plains on the north-west of the range, and is blessed with fertile lands, hill-ranges and long stretches of forest, where fuel and fodder are abundant.

The chief rivers of Rajputana are the Luni, the Chambal and the Banas. The first of these, the only river of any consequence in the north-western division, flows for 200 m. from the Pushkar valley, close to Ajmere, to the Runn of Cutch. In the south-eastern division the river system is important. The Chambal is by far the largest river in Rajputana, through which it flows for about one-third of its course, while it forms its boundary for another third. The source of the river is in the highlands of the Vindhyas, upwards of 2000 ft. above the sea; it soon becomes a considerable stream, collecting in its course the waters of other rivers, and finally discharging itself into the Jumna after a course of 560 m. Next in importance ranks the Banas, which rises in the south-west near Kankroli in Udaipur. It collects nearly all the drainage of the Udaipur plateau with that of the eastern slopes and hill-tracts of the Aravallis, and joins the Chambal a little beyond the north-eastern extremity of the Bundi state, after a course of about 300 m. Other rivers are the W. Banas and the Sabarmati, which rise among the south-west hills of Udaipur and take a south-westerly course. The river Mahi, which passes through the states of Partabgarh and Banswara, receiving the Som, drains the south-west corner of Rajputana through Gujarat into the Gulf of Cambay. Rajputana possesses no natural freshwater lakes, but there are several important artificial lakes, all of which have been constructed with the object of storing water. The only basin of any extent is the Sambhar salt lake, of about 50 m. in circuit.

Geology.—Geologically considered, the country may be divided into three regions—a central, and the largest, comprising the whole width of the Aravalli system, formed of very old sub-metamorphic and gneissic rocks; an eastern region, with sharply defined boundary, along which the most ancient formations are abruptly replaced by the great basin of the Vindhyan strata, or are overlaid by the still more extensive spread of the Deccan trap, forming the plateau of Malwa; and a western region, of very ill-defined margin, in which, besides some rocks of undetermined age, it is more or less known or suspected that Tertiary and Secondary strata stretch across from Sind, beneath the sands of the desert, towards the flanks of the Aravallis. Rajputana produces a variety of metals. Ore of cobalt is obtained in no other locality in India, and although zinc blende has been found elsewhere it is known to have been extracted only in this province. Copper and lead are found in several parts of the Aravalli range and of the minor ridges in Alwar and Shaikhawati, and iron ores abound in several states. Alum and blue vitriol (sulphate of copper) are manufactured from decomposed schists at Khetri in Shaikhawati. Good building materials are obtained from many of the rocks of the country, among which the Raialo limestone (a fine-grained crystalline marble) and the Jaisalmer limestone stand pre-eminent.

Climate.—The climate throughout Rajputana is very dry and hot during the summer; while in the winter it is much colder in the north than in the lower districts, with hard frost and ice on the Bikanir borders. The rainfall is very unequally distributed: in the western part, which comes near to the limits of the rainless region of Asia, it is very scanty, and scarcely averages more than 5 in.; in the south-west the fall is more copious, sometimes exceeding 100 in. at Abu; but, except in the south-west highlands of the Aravallis, rain is most abundant in the south-east. Notwithstanding all its drawbacks, Rajputana is reckoned one of the healthiest countries in India, at least for the native inhabitants.

Population.—In 1901 the population was 9,723,301, showing a decrease of 20% in the decade owing to the great famines of 1897–1898 and 1900–1901. The greatest mortality was caused by virulent malarial fever, which raged during the autumn months of 1900 and the early months of 1901. Epidemics of cholera, which occurred during the years of scarcity and famine, also swept away large numbers.

It is commonly supposed that, because nearly the whole country is ruled by Rajputs, therefore the population consists mainly of Rajput tribes; but these are merely the dominant race, and the territory is called Rajputana because it is politically possessed by Rajputs. The whole number of this race is 620,229, and nowhere do they form a majority of the whole population in a state; but they are strongest, numerically, in the northern states and in Udaipur. By rigid precedence the Brahmans occupy the first rank; they are numerous and influential, and with them may be classed the peculiar and important caste of Bhats, the keepers of secular tradition and of the genealogies. Next come the mercantile castes, mostly belonging to the Jain sect; these are followed by the powerful cultivating tribes, such as the Jats and Gujars, and then come the so-called aboriginal tribes, chief of whom are the Minas, Bhils and Meos. Rajasthani is the chief language of the country, one or other of its dialects being spoken by 7,035,093 persons or more than 72 % of the total population. The gross revenue of all the states is estimated at 2¼ millions sterling.

The mass of the people are occupied in agriculture. In the large towns banking and commerce flourish to a degree beyond what might be expected. In the north the staple products for export are salt, grain, wool and cotton, in the south opium and cotton; while the imports consist of sugar, hardware and piece goods. Rajputana is very poor in industrial production. The principal manufactures are cotton and woollen goods, carvings in ivory and working in metals, &c., all of which handicrafts are chiefly carried on in the eastern states. The system of agriculture is very simple; in the country west of the Aravallis only one crop is raised in the year, while in other parts south and east of the Aravallis two crops are raised annually, and various kinds of cereals, pulses and fibres are grown. In the desert tracts fine breeds of camels, cattle, horses and sheep are to be found wherever there is pasturage. Irrigation, mostly from wells, is almost confined to the N. portion. The country is traversed throughout by the Rajputana railway, with its Malwa branch in the south, and diverging to Agra and Delhi in the north. Jodhpur, Udaipur and Bikanir have constructed branch railways at their own cost, the first of which was extended in 1901 to Hyderabad in Sind. In 1909 another line was opened running N. near the E. boundary from Kotah to Bharatpur.

History.—Only faint outlines can be traced of the condition of Rajputana previous to the invasion of Upper India by the Mahommedans, and these indicate that the country was subject for the most part to two or three powerful tribal dynasties. Chief of these were the Rahtors, who ruled at Kanauj; the Chauhans of Ajmere; the Solankis of Anhilwara, in Gujarat; the Gehlots with the Sisodhyias sept, still in Mewar or Udaipur; and the Kachwaha clan, still in Jaipur. These tribal dynasties of Rajputs were gradually supplanted by the Moslem invaders of the 11th century and weakened by internal feuds. At the beginning of the 16th century the Rajput power began to revive, only to be overthrown by Baber at Fatehpur Sikri in 1527. The clans were finally either conquered, overawed or conciliated by Akbar—all except the distant Sisodhyia clan, which, however, submitted to Jehangir in 1616. From Akbar's accession to Aurangzeb's death, a period of 151 years, the Mogul was India's master. Aurangzeb's death and the invasion of Nadir Shah led to a triple alliance among the three leading chiefs, which internal jealousy so weakened that the Mahrattas, having been called in by the Rahtors to aid them, took possession of Ajmere about 1756; thenceforward Rajputana became involved in the general disorganization of India. By the end of the century nearly the whole of Rajputana had been virtually subdued by the Mahrattas. The victories of Generals Wellesley and Lake, however, saved the Rajputs; but on Lord Wellesley's departure from India the floodgates of anarchy were reopened for ten years. On the outbreak of the Pindari War in 1817 the British government offered its protection. The Pindaris were put down, Amir Khan submitting and signing a treaty which constituted him the first ruler of the existing state of Tonk. By the end of 1818 similar treaties had been executed by the other Rajput states with the paramount power. Sindhia gave up the district of Ajmere to the British, and the pressure of the great Mahratta powers upon Rajputana was permanently withdrawn. Since then the political history of Rajputana has been comparatively uneventful. The great storm of the Mutiny of 1857, though dangerous while it lasted, was short. Most of the rajas remained loyal; and the capture of the town of Kotah, which had been held by the mutineers of that state, in March 1858, marked the extinction of armed rebellion.

Rajputana is of great archaeological interest, possessing some fine religious buildings in ruins and others in excellent preservation. Among the latter are the mosques at Ajmere and the temples on Abu. But the most characteristic features of architecture in the country are shown in the forts and palaces of the chiefs and in their cenotaphs.

See J. Tod, *Annals and Antiquities of Rajasthan* (1829, 1832); W. W. Webb, *Currencies of the Hindu States of Rajputana* (1893); *Chiefs and Leading Families of Rajputana* (1903); and *Rajputana Gazetteer* (Calcutta, 1908).

RAJSHAHI, a district and division of British India, in the province of Eastern Bengal and Assam. The administrative headquarters are at Rampur Boalia. The area of the district is 2593 sq. m., comprising an alluvial plain seamed with old river-beds and studded with marshes. The Ganges and the Mahananda are its principal rivers; the former constitutes a great natural boundary-line to the south and south-west, and the latter, which rises in the Himalayas, borders the district on the west for a few miles before joining the Ganges. Other rivers are the Narad and Baral, important offshoots of the Ganges; the Atrai, a channel of the Tista; and the Jamuna, a tributary of the Atrai. Both the Atrai and the Jamuna belong to the Brahmaputra system and are navigable throughout the year for small cargo boats. The drainage of Rajshahi is not carried off by means of its rivers, but through the chains of marshes and swamps, the most important of which is the Chalan *bhil* or lake, which discharges itself into the Brahmaputra. In 1901 the population was 1,462,407, showing an increase of 1·6% in the decade. Rice is the staple crop, with pulses, oilseeds and jute. Indigo has disappeared. Sericulture has received a stimulus from the efforts of the agricultural department, supported by private enterprise, to improve the breed of silkworms. The hemp grown on a small tract in the north of the district supplies all the *ganja* that is consumed in Bengal. The district is traversed from south to north by the main line of the Eastern Bengal railway to Darjeeling, with a branch to Bogra. Most of the permanent buildings in the district were severely damaged by the earthquake of the 12th of June 1897. When the East India Company took over the administration of Bengal in 1765, the *zamindari* of Rajshahi or Nattor was one of the largest and most important in the province. It appears to have extended from Bhagalpur on the west to Dacca on the east, and to have included an important subdivision called Nij-Chakla Rajshahi on the south of the Ganges. The total area was estimated at 13,000 sq. m., or more than five times the size of the present district. Having been found much too large to be effectually administered by one central authority, Rajshahi was stripped in 1793 of a considerable portion of its outlying territory, and a natural boundary-line was drawn to the west, south and east along the Ganges and Brahmaputra. Its north-western limits were reduced in 1813, when the present district of Malda was constituted. The erection of Bogra into a separate jurisdiction in 1821 still further reduced its area, and in 1832 the limits of Rajshahi were fixed by the constitution of Pabna into an independent jurisdiction.

The Division of Rajshahi is coextensive with northern Bengal, from the Ganges to the mountains. It comprises the seven districts of Rajshahi, Dinajpur, Jalpaiguri, Malda, Rangpur, Bogra and Pabna. Total area, 18,091 sq. m. Pop. (1901) 9,130,072.

RAKE (O.E. *raca*, cognate with Du. *raak*, Ger. *Rechen*, from a root meaning to scrape together, heap up), an agricultural and horticultural implement consisting of a toothed bar fixed transversely to a handle, and used for the collection of cut hay, grass, &c., and, in gardening, for loosening the soil, light weeding and levelling, and generally for purposes performed in agriculture by the harrow. The teeth of the hand-rake are of wood or iron. For the horse-drawn rake, a bar with long curved steel teeth is mounted on wheels (see Hay and Haymaking). The word "rake" has been used since the 17th century in the sense of a man of a dissolute or dissipated character. This is a shortened form of the earlier "rake-hell," apparently in common use in the 16th century. In military and naval use "to rake" means to enfilade, to fire so that the shot may pass lengthwise along a ship, a line of soldiers, entrenchments, &c. In the nautical sense of the projection or slope of a ship's bows or stern or the inclination of a mast, the word is apparently an adaptation of the Scandinavian *raka*, to reach, in the sense of reach forward.

RÁKÓCZY, the name of a noble Hungarian family, which in the 10th century was settled in the county of Zemplén, and members of which played an important part in the history of Hungary during the 17th century.

George I., prince of Transylvania (1591–1648), who began his career as governor of Onod, was the youngest son of Sigismund Rákóczy (1544–1608), who shared in the insurrection of Stephen Bocskay against the Emperor Rudolph II., and was for a short time prince of Transylvania. In 1616 he married his second wife, the highly gifted zealous Calvinist, Susannah Lorántffy, who exercised a great influence over him. He then took a leading part in the rebellion of Gabriel Bethlen, who made him commandant of Kassa, and was elected prince of Transylvania on the 26th of November 1630 by the diet of Segesvár. He followed the policy of Gabriel Bethlen, based on the maintenance of the political and religious liberties of the Hungarians. His alliance with Gustavus Adolphus of Sweden for that purpose was no secret at Vienna, where the court estimated at their right value Rákóczy's hypocritical assurances of pacific amity. On the 2nd of February 1644, at the solicitation of the Swedish and French ambassadors, and with the consent of the Porte, he declared war against the Emperor Ferdinand III. Nearly the whole of imperial Hungary was soon in his hands, and Ferdinand, hardly pressed by the Swedes at the same time, was compelled to conclude (Sept. 16, 1645) with Rákóczy the peace of Linz, which accorded full religious liberty to the Magyars, and ceded to Rákóczy the fortress of Regéc and the Tokaj district. On the death of Wladislaus IV. (1648) Rákóczy aimed at the Polish throne also, but died before he could accomplish his design. His capital, Gyula Fehérvár, was a great Protestant resort and asylum.

See *Secret Correspondence of the Age of George Rákóczy I.* (Hung.), ed. Ágoston Ötvös (Klausenburg, 1848); *Rákóczy's Correspondence with Pázmány, Esterhazy,* &c. (Hung.), ed. Antal Beke (Budapest, 1882); Sándor Szilagyi, *The Rákóczy Family in the 18th Century* (Hung.) (Pest, 1861).

George II., prince of Transylvania (1621–1660), was the eldest son of George I. and Susannah Lorántffy. He was elected prince of Transylvania during his father's lifetime (Feb. 19, 1642), and married (Feb. 3, 1643), Sophia Báthory, who was previously compelled by his mother to reject the Roman faith and turn Calvinist. On ascending the throne (Oct. 11, 1648), his first thought was to realize his father's Polish ambitions. With this object in view, he allied himself, in the beginning of 1649, with the Cossack hetman, Bohdan Chmielnicki, and the hospodars of Moldavia and Wallachia. It was not, however, till 1657, as the ally of Gustavus Adolphus, that he led a rabble of 40,000 semi-savages against the Polish king, John Casimir. He took Cracow and entered Warsaw with the Swedes, but the moment his allies withdrew the whole scheme collapsed, and it was only on the most humiliating terms that the Poles finally allowed him to return to Transylvania. Here (Nov. 3, 1657) the diet, at the command of the Porte, deposed him for undertaking an unauthorized war, but in January 1658 he was reinstated by the Medgyes Diet. Again he was deposed by the grand vizier, and again reinstated as if nothing had happened, but all in vain. The Turks again invaded Transylvania, and Rákóczy died at Nagyvárad of the wounds received at the battle of Gyula (May 1660).

See Imre Bethlen, *Life and Times of George Rákóczy II.* (Hung.) (Nagy-Enyed, 1829); *Life* (Hung.) in Sándor Szilagyi's *Hungarian Historical Biographies* (Budapest, 1891).

Francis I., prince of Transylvania (1645–1676), was the only son of George Rákóczy II. and Sophia Báthory. He was elected prince of Transylvania during his father's lifetime (Feb. 18, 1652), but lost both crown and father at the same time, and withdrew to the family estates, where, at Patak and Makovica, he kept a splendid court. His mother converted him to Catholicism, and on the 1st of March 1666 he married Helen Zrinyi. In 1670 he was implicated in the Zrinyi-Frangepán conspiracy, and only saved his life by the interposition of the Jesuits on the payment of an enormous ransom.

See Sándor Szilagyi, *The Rákóczy Family in the 17th Century* (Hung.) (Pest, 1861).

Francis II., prince of Transylvania (1676–1735), was born at Borsi, Zemplén county, on the 27th of March 1676. Having lost his father during infancy, he was educated under the guardianship of his heroic mother, Helen Zrinyi, in an ultra-patriotic Magyar environment, though the Emperor Leopold I. claimed a share in his tutelage. In 1682 his mother wedded Imre Thököly, who took no part in the education of Rákóczy, but used him for his political purposes. Unfortunately his stepfather's speculations suffered shipwreck, and Rákóczy lost the greater part of his estates. It is said that the imperialists robbed him of 1,000,000 florins' worth of plate and supported a whole army corps out of his revenues (1683–85). As a child of twelve he witnessed the heroic defence by his mother of his ancestral castle of Munkács against Count Antonio Caraffa (d. 1693). On its surrender (Jan. 7, 1688) the child was transferred to Vienna that he might be isolated from the Hungarian nation and brought up as an Austrian magnate. Cardinal Kollonics, the sworn enemy of Magyar separatism, now became his governor, and sent him to the Jesuit college at Neuhaus in Bohemia. In 1690 he completed his course at Prague, and in 1694 he married Maria Amelia of Hesse-Rheinfels, and lived for the next few years on his Hungarian estates. At this time Rákóczy's birth, rank, wealth and brilliant qualities made him the natural leader of the Magyar nation, and his name was freely used in all the insurrections of the period, though at first he led a life of the utmost circumspection (1697–1700). Hungary was then regarded at Vienna as a conquered realm, whose naturally rebellious inhabitants could only be kept under by force of arms. Kollonics was the supreme ruler of the kingdom, and his motto was "Make of the Magyar first a slave, then a beggar, and then a Catholic." It was a matter of life or death for the Magyars to resist such a reign of terror and save the national independence by making Hungary independent of Austria as heretofore. Rákóczy and a few other patriotic magnates deeply sympathized with the sufferings of the nation, and on the eve of the war of the Spanish Succession they entered into correspondence with Louis XIV. for assistance through one Longueval, a Belgian general in the Austrian service, who professed to be a friend of the Rákóczyans, who initiated him into all their secrets. Longueval betrayed his trust, and Rákóczy was arrested and imprisoned at Eperjes. His wife saved him from certain death by enabling him to escape to Poland in the uniform of a dragoon officer. On the 18th of June 1703 he openly took up arms against the emperor, most of whose troops were now either on the Rhine or in upper Italy; but, unfortunately, the Magyar gentry stood aloof from the rising, and his ill-supported peasant levies (the Kuruczes) were repeatedly scattered. Yet at first he had some success, and on the 26th of September was able to write to Louis XIV. that the whole kingdom up to the Danube was in his power. He also issued his famous manifesto, *Recrudescunt vulnera inclytae gentis Hungariae*, to justify himself in the eyes of Europe. The battle of Blenheim made any direct help from France impossible, and on the 13th of June 1704 his little army of 7000 men was routed by the imperialists at Koronco and subsequently at Nagyszombat. Want of arms, money, native officers and infantry, made, indeed, any permanent success in the open field impossible. Nevertheless, in May 1705, when the Emperor Leopold I. was succeeded by Joseph I., the position of Rákóczy was at least respectable. With the aid of several eminent French officers and engineers he had drilled his army into some degree of efficiency, and had at his disposal 52 horse and 31 foot regiments. Even after the rout of Pudmerics (Aug. 11, 1705), he could put 100,000 men in the field. In September 1705 he was also able to hold a diet at Szécsény, attended by many nobles and some prelates, to settle the government of the country.

Rákóczy, who had already been elected Prince of Transylvania (July 6, 1704), now surrounded himself with a council of state of 24 members. The religious question caused him especial difficulty. An ardent Catholic himself, nine-tenths of his followers were nevertheless stern Calvinists, and in his efforts to secure them toleration he alienated the pope, who dissuaded Louis XIV. from assisting him. Peace negotiations with the emperor during 1705 came to nothing, because the court of Vienna would not acknowledge the independence of Transylvania, while France refused to recognize the rebels officially till they had formally proclaimed the deposition of the Habsburgs, which last desperate measure was actually accomplished by the Ónod diet on the 13th of June 1707. This was a fatal mistake, for it put an end to any hope of a compromise, and alienated both the emperor's foreign allies and the majority of the Magyar gentry, while from Louis XIV. Rákóczy only got 100,000 thalers, the Golden Fleece, and a promise (never kept) that the Hungarians should be included in the general peace. But into a direct alliance with Rákóczy the French king would not enter, and Laszló Vetési, Rákóczy's envoy at Versailles, in 1708 advised his master to place no further reliance on the French court. Shortly afterwards, at Trencsen (Aug 3, 1708), Rákóczy's army was scattered to the winds. The rout of Trencsen was followed by a general abandonment. The remnant of the host, too, was now thoroughly demoralized and dared not face the imperialists. A fresh attempt to renew the war in 1710 was speedily ruined by the disaster of Romhány (Jan. 22), and a desperate effort to secure the help of Peter the Great also failing, Rákóczy gave up everything for lost, and on the 21st of February 1711 quitted his country for ever, refusing to accept the general amnesty conceded after the peace of Szatmár (see HUNGARY, *History*). He lived for a time in France on the bounty of Louis XIV., finally entering the Carmelite Order. In 1717, with forty comrades, he volunteered to assist the Turks against the Austrians, but on arriving at Constantinople discovered there was nothing for him to do. He lived for the rest of his life at the little town of Rodostó, where he died on the 8th of April 1735. His remains were solemnly transferred to Hungary in 1907 at the expense of the state.

See *Autobiography of Prince Francis Rákóczy* (Hung.) (Miskolcz, 1903); E. Jurkovich, *The Liberation Wars of Prince Francis Rákóczy* (Hung.) (Beszterczebánya, 1903); S. Endrödi, *Kurucz Notes, 1700–1720* (Hung.) (Budapest, 1897). (R. N. B.)

RALEIGH, SIR WALTER (*c.* 1552–1618), British explorer, poet and historian, was born probably in 1552, though the date is not quite certain. His father, Walter Raleigh of Fardell, in the parish of Cornwood, near Plymouth, was a country gentleman of old family, but of reduced estate. Walter Raleigh the elder was three times married. His famous son was the child of his third marriage with Catherine, daughter of Sir Philip Champernown of Modbury, and widow of Otho Gilbert of Compton. By her first marriage she had three sons, John, Humphrey and Adrian Gilbert. Mr. Raleigh had been compelled to give up living in his own house of Fardell. His son was born at the farmhouse of Hayes near the head of Budleigh Salterton Bay, on the coast of Devonshire between Exmouth and Sidmouth. The name is written with a diversity exceptional even in that age. Sir Walter, his father, and a half-brother used different forms. The spelling Raleigh was adopted by Sir Walter's widow, and has been commonly used, though there has been a tendency to prefer "Ralegh" in recent times. It was almost certainly pronounced "Rawley."

In 1568 he was entered as a commoner of Oriel College, Oxford, but he took no degree, and his residence was brief. In 1569 he followed his cousin Henry Champernown, who took over a body of English volunteers to serve with the French Huguenots. From a reference in his *History of the World* it has been supposed that he was present at the battle of Jarnac (13th of March 1569), and it has been asserted that he was in Paris during the Massacre of St Bartholomew in 1572. Nothing, however, is known with certainty of his life till February 1575, when he was resident in the Temple. During his trial in 1603 he declared that he had never studied the law, but that his breeding had been "wholly gentleman, wholly soldier." In June 1578 his half-brother Sir Humphrey Gilbert obtained a patent for six years authorizing him to take possession of "any remote barbarous and heathen lands not possessed by any Christian prince or people." The gentry of Devon had been much engaged in maritime adventure of a privateering or even piratical character since the reign of Henry VIII. In the reign of Elizabeth they were the leaders in colonial enterprises in conflict with the Spaniards in America. During 1578 Humphrey Gilbert led an expedition which was a piratical venture against the Spaniards, and was driven back after an action with them and the loss of a ship in the Atlantic. Raleigh accompanied his half-brother as captain of the "Falcon," and was perhaps with him in an equally unsuccessful voyage of the following year. Gilbert was impoverished by his ventures, and Raleigh had to seek his fortune about the court. In the course of 1580 he was twice arrested for duels, and he attached himself to the queen's favourite, the earl of Leicester, and to the earl of Oxford, son-in-law of Burghley, for whom he carried a challenge to Sir Philip Sidney. By the end of 1580 he was serving as captain of a company of foot in Munster. He took an active part in suppressing the rebellion of the Desmonds, and in the massacre of the Spanish and Italian adventurers at Smerwick in November. His letters prove that he was the advocate of a ruthless policy against the Irish, and did not hesitate to recommend assassination as a means of getting rid of their leaders.

In December 1581 he was sent home with despatches, as his company had been disbanded on the suppression of the Desmonds. His great fortune dates from his arrival at court where he was already not unknown. Raleigh had been in correspondence with Walsingham for some time. The romantic stories told by Sir Robert Naunton in the *Fragmenta Regalia*, and by Fuller in his *Worthies*, represent at least the mythical truth as to his rise into favour. It is quite possible that Raleigh, at a time when his court clothes represented "a considerable part of his estate," did (as the old story says) throw his mantle on the ground to help the queen to walk dry-shod over a puddle, and that he scribbled verses with a diamond on a pane of glass to attract her attention, though we only have the gossip of a later generation for our authority. It is certain that his tall and handsome person, his caressing manners and his quick wit pleased the queen. The rewards showered on him were out of all proportion to his services in Ireland, which had not been more distinguished than those of many others. In March 1582 he was granted a reward of £100, and the command of a company, nominally that he might be exercised in the wars, but in reality as a form of pension, since he was allowed to discharge his office by deputy and remained at court. In February 1583 he was included in the escort sent to accompany the duke of Anjou from England to Flanders. In 1583 the queen made him a grant of Durham House in the Strand (London), the property of the see of Durham, which had however been used of late as a royal guest-house. In the same year the queen's influence secured him two beneficial leases from All Souls, Oxford, which he sold to his advantage, and a patent to grant licences to "vintners,"—that is, tavern keepers. This he subleased, and when his agent, one Browne, cheated him, he got the grant revoked, and reissued on terms which allowed him to make £2000 a year. In 1584 he had a licence for exporting woollen cloths, a lucrative monopoly which made him very unpopular with the merchants. He was knighted in 1584. In 1585 he succeeded the earl of Bedford as Warden of the Stannaries. Raleigh made a good use of the great powers which the wardenship gave him in the mining districts of the west. He reduced the old customs to order, and showed himself fair to the workers. In 1586 he received a grant of 40,000 acres of the forfeited lands of the Desmonds, on the Blackwater in Ireland. He was to plant English settlers, which he endeavoured to do, and he introduced the cultivation of the potato and of tobacco. In 1587 he received a grant in England of part of the forfeited land of the conspirator Babington.

During these years Raleigh was at the height of his favour. It was the policy of Queen Elizabeth to have several favourites at once, lest any one might be supposed to have exclusive influence with her. Raleigh was predominant during the period between the predominance of Leicester and the rise of the earl of Essex, who came to court in 1587. It is to be noted that Elizabeth treated Raleigh exclusively as a court favourite, to be enriched by monopolies and grants at the expense of her subjects, but that she never gave him any great office, nor did she admit him to the council. Even his post of captain of the Guard, given in 1587, though honourable, and, to a man who would take gifts for the use of his influence, lucrative, was mainly ornamental. His many offices and estates did not monopolize the activity of Raleigh. The patent given to his half-brother Sir Humphrey Gilbert was to run out in 1584. To avert this loss Raleigh, partly out of his own pocket and partly by securing the help of courtiers and capitalists, provided the means for the expedition to Newfoundland in 1583, in which Gilbert, who had been reduced to sell "the clothes off his wife's back" by his previous misfortunes, finally perished. Sir Humphrey's patent was renewed in favour of Sir Walter in March 1584.

Raleigh now began the short series of ventures in colonization which have connected his name with the settlement of Virginia. It has often been said that Raleigh showed a wise originality in his ideas as to colonization. But in truth the patent granted to him, which gave him and his heirs the proprietary right over all territory they occupied subject to payment of one-fifth of the produce of all mines of precious metals to the crown, is drawn closely on Spanish precedents. Nor was there any originality in his desire to settle English colonists, and encourage other industries than mining. The Spaniards had pursued the same aim from the first. In April 1584 Raleigh sent out two captains, Philip Amadas and Arthur Barlowe, on a voyage of exploration. They sailed by the Canaries to Florida, and from thence followed the coast of North America as far as the inlet between Albemarle and Pamlico sounds in the modern state of North Carolina. The name of Virginia was given to a vast and undefined territory, but none of Raleigh's captains or settlers reached the state of Virginia. In the same year he became member of parliament for Devonshire, and took the precaution to secure a parliamentary confirmation of his grant. His first body of settlers, sent out in 1585 under Sir Richard Grenville, landed on what is now Roanoke Island in North Carolina Sir R. Grenville showed himself mainly intent on taking prizes, going and coming. The settlers got on bad terms with the natives, despaired, and deserted the colony when Sir Francis Drake visited the coast in 1586. Attempts at colonization at the same place in 1586 and 1587 proved no more successful (see NORTH CAROLINA), and in 1589 Raleigh, who represented himself as having spent £40,000 on the venture, resigned his rights to a company of merchants, preserving to himself a rent, and a fifth of whatever gold might be discovered.

After 1587 Sir Walter Raleigh was called upon to fight for his place of favourite with the earl of Essex (see ESSEX, 2nd EARL OF). During the Armada year 1588 he was more or less in eclipse. He was in Ireland for part of the year with Sir R. Grenville, and was employed as vice-admiral of Devon in looking after the coast-defences and militia levy of the county. During this year he received a challenge from Essex which did not lead to an encounter. In 1589 he was again in Ireland. He had already made the acquaintance of Edmund Spenser and now visited him at his house at Kilcolman. It was by Raleigh's help that Spenser obtained a pension, and royal aid to publish the first three books of the *Faerie Queen*. The exact cause of Raleigh's partial disgrace at court is not known, but it was probably due to the queen's habitual policy of checking one favourite by the promotion of another. In 1589 he accompanied the expedition to the coast of Portugal, which was intended to cause a revolt against King Philip II., but failed completely. In 1591 he was at the last moment forbidden to take part in the voyage to the Azores, and was replaced by his cousin Sir R. Grenville, whose death in action with the Spaniards was the subject of one of Sir Walter's most vigorous pieces of prose writing. In 1592 he was again at sea with an expedition to intercept the Spanish trade, but was recalled by the queen. The cause of his recall was the discovery that he had seduced one of her maids of honour, Elizabeth Throgmorton. Raleigh denied in a letter to Robert Cecil that there was any truth in the stories of a marriage between them. On his return he was put into the Tower, and if he was not already married was married there. To placate the queen he made a fantastic display of despair at the loss of her favour. It must be remembered that the maids of honour could not marry without the consent of the queen, which Elizabeth was always most reluctant to give and would be particularly unwilling to give when the husband was an old favourite of her own. Raleigh proved a good husband and his wife was devoted to him through life. As the ships of the expedition had taken a valuable prize, the Portuguese carrack "Madre de Dios," and as there was a dispute over the booty, he was released to superintend the distribution. He had been a large contributor to the cost of the expedition, but the queen, who sent only two ships, took the bulk of the spoil, leaving him barely enough to cover his expenses.

Raleigh now retired from court to an estate at Sherborne in Dorsetshire, which just before his disgrace he had extorted from the bishop of Salisbury, to whose see it belonged, by a most unscrupulous use of the royal influence. A son was born to him here in 1594, and he kept up a friendly correspondence with Sir Robert Cecil, afterwards earl of Salisbury, the secretary of state. But a life of constant retirement was uncongenial to Raleigh, and as his profuse habits, together with the multiplicity of his interests, had prevented him from making any advantage out of his estates in Ireland, he was embarrassed for money. In 1595 he therefore sailed on a voyage of exploration with a view to conquest, on the coast of South America. The object was undoubtedly to find gold mines, and Raleigh had heard the wild stories of El Dorado which had been current among the Spaniards for long. His account of his voyage, *The Discoverie of Guiana*, published on his return, is the most brilliant of all the Elizabethan narratives of adventure, but contains much manifest romance. It was received with incredulity. He was now the most unpopular man in England, not only among the courtiers, but in the nation, for his greed, arrogance and alleged scepticism in religion. In 1590 he was named with the poet Marlowe and others as an atheist. At court he was not at first received. The share he took in the capture of Cadiz in 1596, where he was seriously wounded, was followed by a restoration of favour at court, and he was apparently reconciled to Essex, whom he accompanied on a voyage to the Azores in 1597. This cooperation led to a renewal of the quarrel, and Raleigh, as the enemy of Essex who was the favourite of the soldiers and the populace, became more unpopular than ever. In 1600 he obtained the governorship of Jersey, and in the following year took a part in suppressing the rebellion of Essex, at whose execution he presided as captain of the Guard. In 1600 he sat as member for Penzance in the last parliament of Elizabeth's reign. In parliament he was a steady friend of religious toleration, and a bold critic of the fiscal and agrarian legislation of the time.

The death of the queen and the accession of James I. were ruinous to Raleigh. James, who looked upon Essex as his partisan, had been prejudiced, and Raleigh's avowed desire for the prolongation of the war with Spain was utterly against the peace policy of the king. Raleigh was embarrassed for money, and had been compelled to sell his Irish estates to Richard Boyle, afterwards 1st earl of Cork, in 1602. He was expelled from Durham House, which was reclaimed by the bishop, dismissed from the captaincy of the Guard, deprived of his monopolies, which the king abolished, and of the government of Jersey. In his anger and despair he unquestionably took some part in the complication of conspiracies which arose in the first months of James's reign, and was committed to the Tower on the 19th of July 1603. Here he made what appears to have been an insincere attempt to stab himself, but only inflicted a small wound. His trial at Winchester, November 1603, was conducted with such outrageous unfairness as to shock the opinion of the time, and his gallant bearing in face of the brutality of the Attorney-General, Sir Edward Coke, turned public opinion in his favour. It is now impossible to reach the truth, but on the whole it appears probable that Raleigh was cognizant of the conspiracies, though the evidence produced against him was insufficient to prove his guilt. Much was kept back by the council, and the jury was influenced by knowing that the council thought him guilty.

The sentence of death passed on Raleigh, and others tried at about the same time, was in most cases not carried out.

Raleigh was sent to the Tower, where he remained till the 19th of March 1616. His estate of Sherborne, which he had transferred to his son, was taken by the king, who availed himself of a technical irregularity in the transfer. A sum of £8000 offered in compensation was only paid in part. Raleigh's confinement was easy, and he applied himself to chemical experiments and literature. He had been known as one of the most poetical of the minor lyric poets of an age of poetry from his youth. In prison he composed many treatises, and the only volume of his vast *History of the World* published. He also invented an elixir which appears to have been a very formidable quack stimulant. Hope of release and of a renewal of activity never deserted him, and he strove to reach the ear of the king by appealing to successive ministers and favourites. At last he secured his freedom in a way discreditable to all concerned. He promised the king to find a gold mine in Guiana without trenching on a Spanish possession. It must have been notorious to everybody that this was impossible, and the Spanish ambassador, Gondomar, warned the king that the Spaniards had settlements on the coast. The king, who was in need of money, replied that if Raleigh was guilty of piracy he should be executed on his return. Raleigh gave promises he obviously knew he could not keep, and sailed on the 17th of March 1617, relying on the chapter of accidents, and on vague intrigues he had entered into in Savoy and France. The expedition, on which the wreck of his fortune was spent, was ill-appointed and ill-manned. It reached the mouth of the Orinoco on the last day of 1617. Raleigh was ill with fever, and remained at Trinidad. He sent five small vessels up the Orinoco under his most trusted captain, Lawrence Keymis, with whom went his son Walter and a nephew. The expedition found a Spanish settlement on the way to the supposed mine, and a fight ensued in which Sir Walter's son and several Spaniards were killed. After some days of bush fighting with the Spaniards, and of useless search for the mine, Keymis returned to Sir Walter with the news of his son's death and his own utter ruin. Stung by Raleigh's reproach Keymis killed himself, and then after a miserable scene of recriminations, hesitations and mutiny, the expedition returned home. Raleigh was arrested, and in pursuance of the king's promise to Gondomar was executed under his old sentence on the 29th of October 1618. During his confinement he descended to some unworthy supplications and devices, but when he knew his end to be inevitable he died with serenity and dignity. His wife survived him, and he left a son, Carew Raleigh. His enmity to Spain made him a popular hero.

AUTHORITIES.—An edition of his *Works* in eight volumes was published in London in 1829. It contains a *Life* by Oldys and Birch, written with all the knowledge then available. A *Life of Sir Walter Raleigh* (London, 1806, 2nd ed.) was much used by Southey in his biography of Sir Walter Raleigh in vol. iv. of *The British Admirals* in the *Cabinet Cyclopaedia* (London, 1837). Two biographies appeared simultaneously, *Life of Sir Walter Raleigh* by J. A. Saint John, and *Life of Sir Walter Raleigh* by E. Edwards (London, 1868). Mr Edwards's work is in two volumes, of which the second contains the correspondence, and is still the best authority. Smaller lives, which in some cases contain new matter, are those by E. W. Gosse, "Raleigh" in *English Worthies* (1886); W. Stebbing, *Sir W. Raleigh* (London, 1891, and 1899); Martin Hume, *Sir Walter Raleigh* (London 1897); and H. de Selincourt, *Great Ralegh* (1908). For special episodes see Sir John Pope Hennessy, *Sir Walter Raleigh in Ireland* (London, 1883), and T. N. Brushfield, *Raleghana* (Ashburton, 1896). Two separate editions of Raleigh's poems have been published, *Poems, with biography and critical introduction* by Sir F. Brydges (London, 1813), and *Poems of Raleigh with those of Sir H. Wotton, &c.*, edited by J. Hannah (London, 1892). S. R. Gardiner made a careful examination of the events of Raleigh's life after 1603 in his *History of England from the Accession of James I. to the Outbreak of the Civil War* (1883–84). (D. H.)

RALEIGH, the capital of North Carolina, U.S.A., and the county-seat of Wake county, about 145 m. N. by W. of Wilmington. Pop. (1890) 12,678; (1900) 13,643, of whom 5721 were negroes; (1910, census) 19,218. Area 4 sq. m. It is served by the Southern, the Seaboard Air Line, the Raleigh & Southport, and the Norfolk Southern railways. The city lies about 360 ft. above sea-level on ground sloping gently in all directions from its centre, where there is a beautiful park of 4 acres known as Union Square, in which is the State Capitol and from which extend four broad streets. On the western border of the city is Pullen Park (about 40 acres), including the campus of the College of Agriculture and Mechanic Arts; it was named in honour of the donor, R. Stanhope Pullen, who was also a benefactor of the college. The State Capitol (1840) is surmounted by a dome and modelled to some extent after the Parthenon and other buildings of ancient Greece; the first Capitol (begun in 1794) was burned in 1831. In the vicinity are the Governor's Mansion, the Supreme Court Building, the State Library, the building of the State Department of Agriculture, housing the State Museum (of geology, mineralogy, agriculture and horticulture, botany, zoology, ethnology, &c.), and the Post Office. Elsewhere are the County Court House, the State Hospital for the Insane (1856), founded through the efforts of Dorothea Lynde Dix, situated on Dix Hill and having in connexion with it a colony for epileptics; a state school for white blind, deaf and dumb (1845), and a state institute for negro deaf mutes and blind (1867); the state penitentiary (with a department for the criminal insane); a National Cemetery and a Confederate Cemetery; a Methodist Orphanage (1900) and a Roman Catholic Orphanage, the St Luke's Home for old ladies (1895; under the King's Daughters), a State (Confederate) Soldiers' Home (1891), and three private hospitals and the Rex public hospital (1909). Raleigh is the seat of the North Carolina College of Agriculture and Mechanic Arts (1889), in connexion with which is an agricultural experiment station; of three schools for girls—Peace Institute (Presbyterian, 1857), St Mary's School (Protestant Episcopal, 1842) and Meredith College (Baptist, 1891); of the medical department of the University of North Carolina; and of two schools for negroes—Shaw University (Baptist, 1865), with 530 students in 1908–1909, and St Augustine's School (Protestant Episcopal, 1868), a training school, with 466 students in 1908–1909. In 1908 the State Library (founded 1841) contained 39,000 volumes, the Supreme Court Library (founded 1870) about 17,000 volumes and the Olivia Raney public library (founded 1901) 9250 volumes. The city is the see of a Protestant Episcopal bishop. The principal industrial interests are trade in leaf tobacco and cotton raised in the vicinity, and the manufacture of cotton goods, phosphate fertilizers, foundry and machine-shop products, wooden-ware, &c. The Seaboard Air Line and the Raleigh & Southport railways have repair shops here. In 1905 the factory product was valued at $1,086,671, 14·7% more than in 1900. Electric power is conveyed to the city from Buckhorn Falls, on the Cape Fear river, about 26 m. south of Raleigh, and from Milburnie on the Neuse river, 6 m. distant.

In 1788 the site of the city, then known as Wake Court House, was chosen for the capital of the state; and in 1792 the city was laid out and named in honour of Sir Walter Raleigh. In 1794 the state legislature met here for the first time. Raleigh was incorporated in 1795 and was reincorporated in 1803; its present charter dates from 1899. General William T. Sherman's army, on its march through the Carolinas, passed through the city on the 13th of April 1865. Raleigh was the birthplace of President Andrew Johnson; the house in which he was born has been removed to Pullen Park. By an extension of its boundaries the city nearly doubled its area and increased its population in 1907.

RALPH (d. 1122), archbishop of Canterbury, called Ralph de Turbine, or Ralph d'Escures from his father's estate of Escures, near Séez in Normandy, entered the abbey of St Martin at Séez in 1079, and ten years later became abbot of this house. Soon afterwards he paid a visit to England, where his half-brother, Seffrid Pelochin, was bishop of Chichester, and in 1100 he took refuge in England from the violence of Robert of Belesme, passing some time with his friends St Anselm and Gundulf. In March 1108 he succeeded Gundulf as bishop of Rochester. After Anselm's death in April 1109 Ralph acted as administrator of the see of Canterbury until April 1114, when he himself was chosen archbishop at Windsor. In this capacity he was very assertive of the rights of the archbishop of Canterbury and of the liberties of the English church. He claimed authority in Wales and Scotland, and he refused to consecrate Thurstan as archbishop of York because the latter prelate declined to profess obedience to the archbishop of Canterbury. This step involved him in a quarrel with the Papacy, and he visited Rome, but was unable to obtain an interview with pope Paschal II., who had left the city. In spite of peremptory orders from Paschal's successors, Gelasius II. and Calixtus II., the archbishop still refused to consecrate Thurstan, and the dispute was unsettled when he died on the 20th of October 1122.

RALPH DE GUADER, earl of Norfolk (fl. 1070), was the son of a Norman who had held high positions in East Anglia, perhaps that of earl, in the reign of Edward the Confessor (*c.* 1055). His son Ralph fought on the Norman side at Hastings, and was made earl of Norfolk by William the Conqueror. In 1075 the king's refusal to sanction his marriage with the sister of Roger, earl of Hereford, caused the two earls to revolt. They were easily defeated, though Ralph sent to Denmark for ships and went there himself to fetch them. Ralph forfeited his English lands, and took refuge in Brittany on his wife's estate. In 1076, having plotted against Duke Hoel of Brittany, he was besieged at Dol, and the Conqueror came to Hoel's aid; but Ralph finally made his peace. Both he and his wife took part in the first crusade (1099), and died on the road to Palestine.

RALPH OF COGGESHALL (d. after 1227), English chronicler, was at first a monk and afterwards sixth abbot (1207–1218) of Coggeshall, an Essex foundation of the Cistercian order. Ralph himself tells us these facts; and that his resignation of the abbacy was made against the wishes of the brethren, in consequence of his bad health. He took up and continued a *Chronicon Anglicanum* belonging to his house; the original work begins at 1066, his own share at 1187. He hoped to reach the year 1227, but his autograph copy breaks off three years earlier. Ralph makes no pretensions to be a literary artist. Where he had a written authority before him he was content to reproduce even the phraseology of his original. At other times he strings together in chronological order, without any links of connexion, the anecdotes which he gathered from chance visitors. Unlike "Benedictus" and Roger of Hoveden, he makes little use of documents; only three letters are quoted in his work. On the other hand, the corrections and erasures of the autograph show that he took pains to verify his details; and his informants are sometimes worthy of exceptional confidence. Thus he vouches Richard's chaplain Anselm for the story of the king's capture by Leopold of Austria. The tone of the chronicle is usually dispassionate; but the original text contained some personal strictures upon Prince John, which are reproduced in Roger of Wendover. The admiration with which Ralph regarded Henry II. is attested by his edition of Ralph Niger's chronicle; here, under the year 1161, he replies to the intemperate criticisms of the original author. On Richard I. the abbot passes a judicious verdict, admitting the great qualities of that king, but arguing that his character degenerated. Towards John alone Ralph is uniformly hostile; as a Cistercian and an adherent of the Mandeville family he could hardly be otherwise. Ralph refers in the *Chronicon* (*s.a.* 1091) to a book of visions and miracles which he had compiled, but this is no longer extant. He also wrote a continuation of Niger's chronicle, extending from 1162 to 1178 (printed in R. Anstruther's edition of Niger, London, 1851), and short annals from 1066 to 1223.

The autograph manuscript of the *Chronicon Anglicanum* is to be found in the British Museum (Cotton, Vespasian D. X.). The same volume contains the continuation of Ralph Niger. The *Chronicon Terrae Sanctae*, formerly attributed to Ralph, is by another hand; it was among the sources on which he drew for the *Chronicon Anglicanum*. The so-called *Libellus de motibus anglicanis sub rege Johanne* (printed by Martene and Durand, *Ampl. Collectio*, v. pp. 871–882) is merely an excerpt from the *Chronicon Anglicanum*. This latter work was edited for the Rolls series in 1875 by J. Stevenson. (H. W. C. D.)

RAM, PIERRE FRANÇOIS XAVIER DE (1804–1865), Belgian churchman and historian, was born at Louvain in 1804. He took orders early, and was appointed professor of poetry at the seminary of Malines, and archiviste of the diocese. During the years immediately before the revolution of 1830, Ram, who was much influenced by Lamennais, was active in bringing about a coalition of Liberals and Catholics against the Dutch government established by the Powers on the fall of Napoleon, and in endeavouring to give a democratic character to the policy of his church. He declined to stand as a member of the Belgian assembly, and applied himself wholly to teaching and to editing or composing historical books. As professor of philosophy at Malines he succeeded in bringing about the foundation of the Catholic university, which was transferred to Louvain in 1834. He was rector of the university till his death in 1865.

The best known of his publications is the *Documents relatifs aux troubles du pays de Liège 1455–1505*, published by the *Commission royale de l'Histoire de Belgique* (Brussels, 1844). A *Notice sur la vie et les travaux de Mgr P. F. X. de Ram*, by J. J. Thonissen, will be found in the *Annuaire de l'Académie royale de Belgique* (Brussels, 1866).

RAM, a male sheep, one kept for breeding purposes in domestication and not castrated, as opposed to the castrated "wether" (see SHEEP). For the ram as one of the signs of the zodiac, see ARIES. The word may be connected with O.Nor. *ramme*, strong, or with Sansk. *ram*, to sport. The butting propensities of the ram have given rise to the many transferred senses of the word, chief and earliest of which is that of a battering implement used before the days of cannon for beating in the gates and breaching the walls of fortified places (see BATTERING RAM). Many technical uses of the term have been developed from this, *e.g.* the weight of a pile-driving machine, the piston of a hydraulic press and other machines or portions of machines worked by water power (see HYDRAULICS). The ancient war-vessels were fitted with a beak (Lat. *rostrum*, Gr. ἔκβολον), projecting from the bows, and used to ram or crush in the sides of an opposing vessel; for the development of this in the modern battleship, see SHIP.

RAMAḌĀN, the month of the Mahommedan year in which absolute fasting from dawn to sunset is required. The law is laid down in Koran ii. 179–184, and is as follows: A fast had always been a part of religion. In Islām it was to fall in this month because in it the Koran was revealed, and it was holier than the others. It was to begin when the new moon was actually seen, and last until sight of the next new moon; to extend each day from the time when a white thread could be distinguished from a black one and until nightfall; to be absolute in that time as to food, drink, women. The daytime should be passed, by preference, in retreat (*i ʿtikāf*) in the mosque in pious exercises; during the night all otherwise lawful things to be lawful. The sick and those on a journey might be excused, but should fast thereafter an equivalent number of days. Unexcused breaking of the fast might be atoned for by feeding of the poor. The last ten days of the month are regarded as especially sacred; these Mahomet himself used to pass in retreat. In the course of them falls the "Night of Decree," or "of Power" (Koran xc. 1), but its exact date is not known. On it intercourse between heaven and earth is peculiarly open, and many wonders take place. Fasting in Ramaḍān is reckoned one of the five pillars, or absolute requirements, of Islām. It is followed by the Lesser Festival, the first three days of the month Shauwal (see BAIRAM). Naturally, during it all the activities of life are reduced to a minimum, and those who can afford it turn night into day as much as possible.

For details see Hughes, *Dictionary of Islam*, 533 ff.; Sell, *Faith of Islam*, 279 ff.; Sprenger, *Leben Moḥammads*, iii. 56 ff.; Snouck Hurgronje, *Mekka*, 51, 77 ff.; Meakin, *The Moors*, 247 ff.; Juynboll, *De Mohammedaansche Wet*, 108 ff. (D. B. MA.)

RAMBAUD, ALFRED NICOLAS (1842–1905), French historian, was born at Besançon on the 2nd of July 1842. After studying at the École normale supérieure, he completed his studies in Germany. He was one of that band of young scholars, among whom were also Ernest Lavisse, Gabriel Monod and Gaston Paris, whose enthusiasm was aroused by the principles and organization of scientific study as applied beyond the Rhine, and who were ready to devote themselves to their cherished plan of remodelling higher education in France. He was appointed "*répétiteur*" at the École des Hautes Études on its foundation in 1868. His researches were at that time directed towards the Byzantine period of the middle ages, and to this period were devoted the two theses which he composed for his doctorate in letters, *De byzantino hippodromo et circensibus factionibus* (revised in French for the *Revue des Deux Mondes*, under the title of "Le monde byzantin; le sport et l'hippodrome," 1871), and *L'Empire grec au X*^{e} *siècle, Constantin Porphyrogénète* (1870). This latter work is still accepted as a good authority, and caused Rambaud to be hailed as a master on the Byzantine period; but with the exception of one article on Digenis Akritas, in the *Revue des Deux Mondes* (1875), and one other on Michael Psellos, in the *Revue historique* (vol. iii., 1876), Rambaud's researches were diverted towards other parts of the East. The Franco-German War inspired him with the idea for some courses of lectures which developed into books: *La domination française en Allemagne; les Français sur le Rhin, 1792–1804* (1873) and *L'Allemagne sous Napoléon I. 1804–1811* (1874). He watched attentively the rôle played by Russia, and soon observed how much to the interest of France, a good *entente* with this power would be. He accordingly threw himself into the study of Russian history, staying in Russia in order to learn its language, institutions and customs. On his return, he published *La Russie épique*, a study of the heroic songs (1876), a short but excellent *Histoire de la Russie depuis les origines jusqu'à l'année 1877* (1878; 5th ed., 1900), *Français et Russes, Moscou et Sévastopol 1812–1854* (1876; 2nd ed., 1881), and finally the two important volumes on Russian diplomatic history in the *Recueil des Instructions données aux ambassadeurs* (vols. vii. and ix., 1890 and 1891). He was not improbably moved by considerations of foreign policy to publish his *Russes et Prussiens, guerre de Sept Ans* (1895), a popular work, though based on solid research. After teaching history in the Faculties of Arts at Caen (1871) and Nancy (1873), he was called to the Sorbonne (1883), where he was the first to occupy the chair of contemporary history. By this time he had already entered into politics; he had been *chef du cabinet* of Jules Ferry (1879–1881), though this did not distract him from his literary work. It was under these conditions that he composed his *Histoire de la civilisation française* (2 vols., 1885, 1887; 9th ed., 1901) and his *Histoire de la civilisation contemporaine en France* (1888; new ed. entirely revised, 1906), and undertook the general editorship of the *Histoire générale du IV*^{e} *siècle jusqu'à nos jours*. The plan of this great work had been drawn up with the aid of Ernest Lavisse, but the entire supervision of its execution was carried out by Rambaud. He contributed to it himself some interesting chapters on the history of the East, of which he had a thorough knowledge. In 1885 Rambaud published, in collaboration with J. B. Baille, a French translation of J. R. Seeley's *Expansion of England*, and in the preface he laid great emphasis on the enormous increase of power brought to England by the possession of her colonies, seeing in this a lesson for France. He was anxious to see the rise of a "Greater France," on the model of "Greater Britain," and it was with this idea that he undertook to present to the public a series of essays, written by famous explorers or political men, under the title of *La France coloniale, histoire, géographie, commerce* (1886; 6th ed., 1893). Having become senator for the department of Doubs (1895–1902), Rambaud held the position of minister of Public Instruction from 1896 to 1898, and in that capacity endeavoured to carry on the educational work of Jules Ferry, to whose memory he always remained faithful. He dedicated to his former chief a book (*Jules Ferry*, 1903), which is a valuable testimony to the efforts made by France to organize public education and found a colonial empire; but this fidelity also won him some enemies, who succeeded for some time in preventing him from becoming a member of the Institute. He was finally elected a member of the Académie des Sciences morales et politiques on the 11th of December 1897, in place of the duc d'Aumale, of whose life he wrote an account (vol. xxii., 2nd series, of the *Mémoires* of this academy). His many interests ended by wearing out even his robust constitution, and he died at Paris on the 10th of November 1905.

See the notices by Ernest Lavisse in the *Revue de Paris* for January 15th, 1906, and Gabriel Monod in the *Revue historique* (vol. xc., pp. 344–348).

RAMBERT, EUGÈNE (1830–1886), Swiss author, was born at Sâles near Swiss Clarens on the 6th of April 1830, the eldest son of a Vaudois schoolmaster, from whom he received his education. When in 1845 his father lost his post, owing to the religious disputes, Rambert became a teacher in Paris, and later a tutor in England and at Geneva. When the affairs of the family improved, Rambert was able to pursue his studies for the ministry, but he was more attracted by literature, and in 1845 became professor of French literature at the academy of Lausanne, and in 1860 at the Federal polytechnic school at Zürich, where he remained till 1881, when he again became professor at Lausanne. His principal work, *Les Alpes suisses* (5 vols., 1866–1875; republished with large additions, according to his own scheme, in 6 vols., 1887–1889), is a mine of miscellaneous information on the subject. He also published several volumes of poetry, as well as a volume entitled *Écrivains nationaux* (1874, republished 1889), and biographies of the pietist Vinet (1875), of the poet Juste Olivier (1879) and of the artist Alexandre Calame (1883). He died on the 21st of November 1886.

Rambert's *Dernières Poesies* were edited (1903) by Henri Warnery, whose *Eugène Rambert* (Lausanne, 1890) contains a critical estimate. (W. A. B. C.)

RAMBOUILLET, CATHERINE DE VIVONNE, Marquise de (1588–1665), a lady famous in the literary history of France, was born in 1588. She was the daughter and heiress of Jean de Vivonne, marquis of Pisani, and her mother Giulia was of the noble Roman family of Savelli. She was married at twelve years old to Charles d'Angennes, vidame of Le Mans, and afterwards marquis of Rambouillet. The young marquise found the coarseness and intrigue that then reigned in the French court little to her taste, and after the birth of her eldest daughter, Julie d'Angennes, in 1607, she began to gather round her the circle afterwards so famous. She established herself at the Hôtel Pisani, called later the Hôtel de Rambouillet, the site of which is close to the Grands Magasins du Louvre. Mme de Rambouillet took great trouble to arrange her house for purposes of reception, and devised suites of small rooms where visitors could move easily, and could find more privacy than in the large reception rooms of the ordinary house. The hôtel was rebuilt on these lines in 1618. It maintained its importance as a social and literary centre until 1650. Almost all the more remarkable personages in French society and French literature frequented it, especially during the second quarter of the century, when it was at the height of its reputation. There is abundant testimony to Mme de Rambouillet's beauty, though no portrait of her is known to exist. Her success as a hostess was due to many causes. Her natural abilities had been carefully trained, but were not extraordinary. Many people were, however, like herself, disgusted with the intrigues at court, and found the comparative austerity of the Hôtel de Rambouillet a welcome change. The marquise had genuine kindness and a lack of prejudice that enabled her to entertain on the same footing princes and princesses of the blood royal, and men of letters, while among her intimate friends was the beautiful Angélique Paulet. The respect paid to ability in her salon effected a great advancement in the position of French men of letters. Moreover, the almost uniform excellence of the memoirs and letters of 17th-century Frenchmen and Frenchwomen may be traced largely to the development of conversation as a fine art at the Hôtel Rambouillet, and the consequent establishment of a standard of clear and adequate expression. Mme de Rambouillet was known as the "incomparable Arthénice," the name being an anagram for Catherine, devised by Malherbe and Racan.

Among the more noteworthy incidents in the story of the Hôtel are the sonnet war between the Uranistes and the Jobistes—partisans of two famous sonnets by Voiture and Benserage—and the composition by all the famous poets of the day of the *Guirlande de Julie,* a collection of poems on different flowers, addressed in 1641 to Julie d'Angennes, afterwards duchesse de Montausier. Julie herself was responsible for a good deal of the preciosity for which the Hôtel was later ridiculed. Charles de Sainte Maure, who become in 1664 duc de Montausier, had been wooing her for seven years when he conceived the idea of the famous garland, and she kept him waiting for four years more.

The *Précieuses,* who are usually associated with Molière's avowed caricatures and with the extravagances of Mlle. de Scudéry, but whose name, it must be remembered, Madame de Sévigné herself was proud to bear—insisted on a ceremonious gallantry from their suitors and friends, though it seems from the account given by Tallemant des Réaux that practical jokes of a mild kind were by no means excluded from the Hôtel de Rambouillet. They especially favoured an elaborate and quintessenced kind of colloquial and literary expression, imitated from Marini and Gongora, and then fashionable throughout Europe. The immortal *Précieuses ridicules* of Molière was no doubt directly levelled not at the Hôtel de Rambouillet itself, but at the numerous coteries which in the course of years had sprung up in imitation of it. But the satire did in truth touch the originators as well as the imitators,—the former more closely perhaps than they perceived. The Hôtel de Rambouillet continued open till the death of its mistress, on the 2nd of December 1665, but the troubles of the Fronde diminished its influence.

The chief original authorities respecting Madame de Rambouillet and her set are Tallemant des Réaux in his *Historiettes,* and Antoine Baudeau de Somaize in his *Grand Dictionnaire des Précieuses* (1660). Many modern writers have treated the subject, notably Victor Cousin, *La Société française au xvii^e^ siècle* (2 vols., 1856), and C. L. Livet, *Précieux et Précieuses . . .* (1859). There is an admirable edition (1875) of the *Guirlande de Julie* by O. Uzanne.

RAMBOUILLET, a town of northern France, capital of an arrondissement in the department of Seine-et-Oise, 30 m. S.W. of Paris on the railway to Chartres. Pop. (1906) town, 3965; commune, 6165. Rambouillet derives its whole interest from the associations connected with the ancient château, dating originally from the 14th century, but often rebuilt. A great machicolated tower is all that remains of the medieval building; some apartments with good woodwork are also of interest. The château is surrounded by a beautiful park of 3000 acres and by an extensive forest. The gardens, partly in French, partly in English style, are picturesque, and have an avenue of Louisiana cypress unique in Europe. The park contains the national sheep-farm, where in the 18th century the first flock of merino sheep in France was raised, a school of sheep-farming, and, close to the latter, a small dairy built by Louis XVI. The shooting of the famous coverts of Rambouillet is reserved for the presidents of the Republic. The town is the seat of a sub-prefect and has a tribunal of first instance and a preparatory infantry school. Trade is in grain, wool, flour and wood. Watch-springs are manufactured.

Originally a royal domain, the lands of Rambouillet passed in the 14th century to the D'Angennes family, who held them for three hundred years and built the château. Francis I. died there in 1547; and Charles IX. and Catherine de Medicis found a refuge there in the Wars of Religion, as Henry III. did after them. The title became a marquisate in 1612, at which time it was held by Charles d'Angennes, husband of Catherine de Vivonne (*q.v.*), the famous marchioness of Rambouillet. Created a duchy and peerage in favour of the duke of Toulouse, son of Louis XIV., Rambouillet was subsequently bought and embellished by Louis XVI., who erected a model farm and other buildings. The place was a hunting-seat of Napoleon I. and Charles X., and it was here that in 1830 the latter signed his abdication.

RAMEAU, JEAN PHILIPPE (1683–1764), French musical theorist and composer, was born at Dijon on the 23rd of October 1683. His musical education, partly in consequence of his father's desire that he should study law, still more through his own wayward disposition, was of a desultory character. In 1701 his father sent him to Milan to break off a foolish love-match. But he learned little in Italy, and soon returned, in company with a wandering theatrical manager, for whom he played the second violin. He next settled in Paris, where he published his *Premier livre de pièces de clavecin,* in 1706. In 1717 he made an attempt to obtain the appointment of organist at the church of St Paul. Deeply annoyed at his unexpected failure, he retired for a time to Lille, whence, however, he soon removed to Clermont-Ferrand. Here he succeeded his brother Claude as organist at the cathedral.

Burning with desire to remedy the imperfections of his early education, Rameau diligently studied the writings of Zarlino, Descartes, Mersenne, F. Kircher and other theorists. He not only mastered their views but succeeded in demonstrating their weak points and substituting for them a system of his own. His keen insight into the constitution of certain chords, which in early life he had studied only by ear, enabled him to propound a series of hypotheses, many of which are now accepted as established facts. While the older contrapuntists were perfectly satisfied with the laws which regulated the melodious involutions of their vocal and instrumental parts, Rameau demonstrated the possibility of building up a natural harmony upon a fundamental bass, and of using that harmony as an authority for the enactment of whatever laws might be considered necessary for the guidance either of the contrapuntist or the less ambitious general composer. And in this he first explained the distinction between two styles, which have been called the "horizontal and vertical systems," the "horizontal system" being that by which the older contrapuntists regulated the onward motion of their several parts, and the "vertical system" that which constructs an entire passage out of a single harmony. From fundamental harmonies he passed to inverted chords, to which he was the first to call attention; and the value of this discovery fully compensates for his erroneous theory concerning the chords of the eleventh and the great (*Angl.* "added") sixth (see HARMONY).

Rameau first set forth his new theory in his *Traité de l'harmonie* (Paris, 1722), and followed it up in his *Nouveau système* (1726), *Génération harmonique* (1737), *Démonstration* (1750) and *Nouvelles réflexions* (1752). But it was not only as a theorist that he became famous. Returning to Paris in 1722 he first attracted attention by composing some light dramatic pieces, and then showed his real powers in his opera, *Hippolyte et Aricie*, founded on Racine's *Phèdre* and produced at the Académie in 1733. Though this work was violently opposed by the admirers of Lulli, whose party spirit eventually stirred up the famous "guerre des bouffons," Rameau's genius was too brilliant to be trampled under foot by an ephemeral faction and his ultimate triumph was assured. He afterwards produced more than twenty operas, the most successful of which were *Dardanus*, *Castor et Pollux*, *Les Indes galantes* and *La princesse de Navarre*. Honours were showered upon him. He was appointed conductor at the Opéra Comique, and the directors of the opera granted him a pension. King Louis XV. appointed him composer to the court in 1745, and in 1764 honoured him with a patent of nobility and the order of St Michael. But these last privileges were granted only on the eve of his death at Paris on the 12th of September 1764.

See biographies in Charles Poisset (1864), Nisard (1867), Pougin (1876).

RAMESES, or RAMESSES (Gen. xlvii. 11; Exod. xii. 37; Num. xxxiii. 3), or, with a slight change in the vowel points, RAAMSES (Exod. i. 11), the name of a district and town in Lower Egypt, is notable as affording the mainstay of the current theory that King Rameses II. was the pharaoh of the oppression and his successor Minephthas the pharaoh of the exodus. The actual facts, however, hardly justify so large an inference. The first three passages cited above are all by the priestly (post-exile) author and go together. Jacob is settled by his son Joseph in the land of Rameses and from the same Rameses the exodus naturally takes place. The older narrative speaks not of the land of Rameses but of the land of Goshen; it seems probable, therefore, that the later author interprets an obsolete term by one current in his own day, just as the Septuagint in Gen. xlvi. 28 names instead of Goshen Heroopolis and the land of Rameses. Heroopolis lay on the canal connecting the Nile and the Red Sea, and not far from the head of the latter, so that the land of Rameses must be sought in Wādi Tūmīlāt near the line of the modern fresh-water canal. In Exod. i. 11, again, the store-cities or arsenals which the Hebrews built for Pharaoh are specified as Pithom and Raamses, to which the Septuagint adds Heliopolis. Pithom also takes us to the Wādi Tūmīlāt. But did the Israelites maintain a continuous recollection of the names of the cities on which they were forced to build, or were these names rather added by a writer who knew what fortified places were in his own time to be seen in Wādi Tūmīlāt? The latter is far the more likely case, when we consider that the old form of the story of the Hebrews in Egypt is throughout deficient in precise geographical data, as might be expected in a history not committed to writing till the Israelites had resided for centuries in another and distant land. The post-exile or priestly author indeed gives a detailed route for the exodus (which is lacking in the older story), but he, we know, was a student of geography and might supplement tradition by what he could gather from traders as to the caravan routes.[1] And at all events to argue that, because the Hebrews worked at a city named after Rameses, they did so in the reign of the founder, is false reasoning, for the Hebrew expression might equally be used of repairs or new works of any kind.

It appears, however, from remains and inscriptions that Rameses II. did build in Wādi Tūmīlāt, especially at Tell Maskhūta, which Lepsius therefore identified with the Raamses of Exodus. This identification is commemorated in the name of the adjacent railway station. But Naville's excavations found that the ruins were those of Pithom and that Pithom was identical with the later Heroopolis. Petrie found sculptures of the age of Rameses II. at Tel Rotāb, in the Wādi Tūmīlāt west of Pithom, and concludes that this was Rameses. The Biblical city is probably one of those named Prameses, "House of Ramesses," in the Egyptian texts.

See PITHOM; and W. M. F. Petrie, *Hyksos and Israelite Cities*, p. 28 et sqq. (W. R. S., F. LL. G.)

RAMESWARAM, a town of British India, in the Madura district of Madras, on the island of Pambam in Palk Straits. It contains one of the most venerable Hindu shrines, founded, according to tradition, by Rama himself, which for centuries has been the resort of thousands of pilgrims from all parts of India. The great temple, with its pillared corridors 700 ft. long, is perhaps the finest example of Dravidian architecture.

RAMIE (RHEA, CHINA-GRASS), the product of one or more species of the genus *Boehmeria*, a member of the order Urticaceae and nearly allied to the stinging nettle genus (*Urtica*), from which, however, it differs in absence of stinging hairs. Some confusion has arisen in the use of the various terms China-grass, Ramie and Rhea. Two plants are concerned. One, *Boehmeria nivea*, China-grass, has been cultivated by the Chinese from very early times under the name *Tschou-ma*. The other, probably a variety of the same species (*Boehmeria nivea*, var. *tenacissima*), though sometimes regarded as a distinct species (*B. tenacissima*), is the Ramie (Malay *zāmī*) of the Malay Islands and the Rhea of Assam.

Boehmeria nivea is a shrubby plant with the growth of the common nettle but without stinging hairs, sending up each season a number of straight shoots from a perennial underground rootstock. The long-stalked leaves recall those of the nettle in their shape and serrated margin, but their backs are clothed with a downy substance and have a silvery appearance. The minute greenish flowers are closely arranged along a slender axis. This variety has been cultivated by the Chinese for many years, and the fibre, which is obtained from it by a tedious hand-process, has been used more or less as a substitute for silk.

The variety *tenacissima* differs in its more robust habit and larger leaves, which are pale green on the face and a very much paler green on the bark. They are not downy, however, and this affords a ready means of distinction from true China-grass. *Boehmeria nivea* is sometimes found wild in India, Malaya, China and Japan, and is probably a native of further India and Malaya. China-grass and ramie are widely cultivated not only in China, Formosa, Japan, India and Malaya, but also in Queensland, Mauritius, the Cameroons, the West Indies, Brazil, Mexico and the southern states of North America, and also in south Europe.

The plant, which attains a height of from 3 to 8 ft., is grown from seed, cuttings or layers, or by division of the roots. It is easy to cultivate, and thrives in almost any soil, but especially in a naturally rich, moist, light, loamy soil. For the best growth a good and equally distributed rainfall is necessary. Sudden changes of weather result in irregularities in growth, and these have a tendency to produce plants the fibres of which vary in strength. Liberal manuring is necessary, as the plant withdraws a large quantity of valuable constituents from the soil. The plants should be cut when the flower is beginning to fall and the seed to form.

It is stated that two to four crops per season may be obtained on suitable ground, each crop yielding about 4 tons of stems per acre. With only two crops per year, and a 4% yield of fibre, the resulting product would nearly reach one-third of a ton per acre. When proper attention is given to the choice of ground, and to planting, there is not much difficulty in the way of raising a good crop; the trouble arises in the extraction of the fibre.

The stems when ripe are cut down, and after the leaves and small branches have been removed, the outer cover and the layers of fibre are stripped off in the form of ribbons. These ribbons contain the bark, the fibre and a quantity of very adhesive gum. The Chinese remove this bark and as much of the gum as possible before the plant has dried. This hand-process is naturally a slow and tedious one, and many decorticators have been invented to supplant it. The action of all these decorticators is very similar. The ramie stalks are fed into the machine, and during their passage are beaten by 12 to 20 rapidly revolving blades. These break the stalks into small pieces, and leave the bark and fibre in long ribbons. At the same time, part of the gum is squeezed out between the beaters and the anvil. Up to the present, however, these machines have not been very successful. They usually bruise or otherwise injure the fibre, and they do not squeeze out the gum thoroughly. If the gum be allowed to dry on the ribbons it is difficult to remove it, and the chemicals employed in the degumming, if not thoroughly removed by washing, often injure the fibre to such an extent that the ultimate fabric or article is soon decomposed. If, however, the ribbons be degummed immediately, or soon after the plants are cut down, the gum will be much more easily extracted—indeed it might be possible to remove it then by boiling water or steam. The fibre cannot be expected to make much headway until the operations of decorticating and degumming are successfully carried out on or near the growing grounds; and, until a proficient decorticator is made, the fibre should be stripped by hand and the degumming operation begun immediately. By this method the least possible damage would result to the fibre, no waste material would be shipped, and a clean fibre would be placed on the market.

The fibre possesses some very valuable properties; it is not only much stronger than any other known fibre, but almost equals silk in its brilliance. This latter property, however, is now challenged by mercerized cotton. It successfully resists atmospheric changes, is easily dyed and is affected but little by moisture. On the other hand, articles manufactured from it are said to crack and break easily when sharply bent, and on account of their hairy character have not the same smart appearance as those made from flax. Although the fibre is in some cases 12 in. long, it varies considerably in length. This is one of the drawbacks in the preparing and spinning. It is impossible to make perfect yarns from fibres of various lengths; hence it is necessary either to separate the fibres into reasonable groups, or to cut them into satisfactory lengths. The latter method appears, on the whole, to be the better, and it is the method adopted by Messrs Greenwood & Batley Limited, Leeds, who make special machinery for the dressing, preparing and spinning of ramie and China-grass. If no special machinery be employed, the length of the fibre will decide the class of machinery to be used. The fibre has been prepared and spun on flax, wool and silk-waste machinery, but it must be understood that none of these systems are really suitable for the process. A fibre with special characteristics requires special machinery for its manufacture.

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[1] From the position of the words it is even not unlikely that "Pithom and Raamses" may be the addition of a redactor, and that the first author of Exod. i. 11 only spoke generally of store-cities.

When so many different opinions obtain as to which existing machinery is best adapted for the preparing and spinning of ramie, it is not surprising to find that different methods are employed in the process of manufacture. In general, however, we may say that, after decortication, the first process is that of degumming. This is usually done by immersing the fibre in a caustic soda solution, which is then heated in a closed vessel. The fibre is laid on galvanized trays, of which as many as forty-four can be fitted in a cage, which is then placed inside the boiling keir, the lid of which is screwed down and the necessary pressure of steam admitted. After having been boiled a sufficient time to remove the gum, the material is lifted out, the alkali neutralized, and the fibre thoroughly washed to remove all traces of chemicals. The bulk of the water is removed by a hydro-extractor. and the fibre is then hung up or laid on perforated plates to dry.

To facilitate the subsequent processes, the fibre is softened by passing it through a machine fitted with fluted rollers. Then follow the operations of dressing, roving, wet spinning and doubling, and finally the twisted thread is passed rapidly through a gas flame in order to remove all superfluous hairs.

In spite of the many disappointments which have been experienced in connexion with the treatment of this fibre, we are of the opinion that it will ultimately hold a good place amongst commercial fibres. It is at present spun in several European countries, but its use is still very limited. This is due, not to any imperfection of the fibre, but to its price and to the limited supply of raw material. It is at present chiefly used for gas mantles, for which it is particularly well adapted. It has also been used for paper-making, ropes, lines, nets, underwear, and for canvas and several other fabrics. If only a good supply of clean fibre could be obtained, there is not the least doubt that manufacturers and machine-makers would quickly provide means for dealing with it. (T. Wo.)

RAMILLIES, a village of Belgium, in the province of Brabant, 13 miles N. by E. of Namur, between the sources of the Little Gheete and of the Mehaigne. It is famous for the victory of the Allies under the duke of Marlborough over the French commanded by Marshal Villeroy on the 12th/23rd of May 1706. The position of the French on the high ground about Ramillies was marked by the villages of Autréglise (Anderkirch) on the left, Offuz on the left centre, Ramillies on the right centre and Taviers on the right close to the river Mehaigne. In front of the last was a smaller village, Franquenay, which was held as an advanced post. Between these *points d'appui* the ground was mostly open upland, and the position as a whole was defective in so far that the villages were barely within cannon-shot of each other. It was particularly strong on the flanks, which were protected by the marshy beds of the Mehaigne and the Little Gheete. Ramillies stands almost on the watershed of these adjacent valleys, and here Marlborough decided to deliver his main attack. The forces were about equal, and were at first equally distributed along the whole line of either party. Marlborough's local concentration of force at the spot where the attack was to be pressed home was made not before, but after the action had opened (cf. NEERWINDEN). Villeroy's left wing of cavalry and infantry was secure—and at the same time immobilized—behind the upper course of the Little Gheete, and the French commander allowed himself to be imposed upon by a demonstration in this quarter, convinced perhaps by the presence of the British contingent that a serious attack was intended. The morning was spent in arraying the lines of battle, and it was about 1.30 when the cannonade opened. Soon the first lines of infantry of the Allied centre and left (Dutch) opened the attacks on Franquenay and Taviers and on Ramillies, and, when after a severe struggle Taviers fell into the hands of the Dutch, their commander, Marshal Overkirk, led forward the whole of the left wing cavalry and fiercely engaged the French cavalry opposed to it. The ground was open, both parties had placed the greater part of their horse on this side, and it was only after a severe and prolonged engagement (in which Marlborough himself took part like a trooper and was unhorsed) that the Allies were definitely victorious, thanks to the arrival of a force of cavalry brought over from the Allied right wing. Meanwhile the principal attack on Ramillies had been successfully pressed home, the necessary concentration of force being secured by secretly and skilfully withdrawing some British battalions from the right wing. While Villeroy was trying to bring up supports from the left to take part in the cavalry battle, the French in Ramillies were driven out into the open, where the Allied cavalry, having now gained the upper hand, rode down many battalions. Most of the French cavalry from the other wing, having to force its way through the baggage trains of the army (these had been placed too near the fighting lines), arrived too late, and once Ramillies had fallen the whole line of the Allies gradually took up the offensive. It was not long before the French line was rolled up from right to left, and the retreat of the French was only effected in considerable confusion. Then followed for once a relentless pursuit, carried on by the British cavalry (which had scarcely been engaged) to Louvain, 20 m. from the field of battle. Marlborough's unequalled tactical skill and judgment thus sufficed not merely to win the battle, but to win it with so large a margin of force unexpended that the fruits of his victory could be gathered. The French army lost, in killed, wounded and missing, some 15,000 men, the Allies (amongst whom the Dutch had borne the brunt of the fighting) scarcely one-third as many.

RAMLER, KARL WILHELM (1725–1798), German poet, was born at Kolberg on the 25th of February 1725. After completing his studies in Halle, he went to Berlin, where, in 1748, he was appointed professor of logic and literature at the cadet school. In 1786 he became associated with the author, Johann Jakob Engel, in the management of the royal theatre, of which, after resigning his professorship, he became (1790–96) sole director. He died at Berlin on the 11th of April 1798. Ramler was a skilful but cold and uninspired versifier; and the reputation he enjoys as poet and critic is mainly due to his skill in imitating and reproducing in German, classical (mostly Horatian) metrical forms; and he had a reputation, not unfounded, of correcting his friends' writings out of recognition. His *Tod Jesu*, a cantata, is well known owing to its musical setting by Karl Heinrich Graun.

Ramler published *Geistliche Cantaten* (1760) and *Oden* (1767). A collection of his works was published by L. F. G. von Göckingk (2 vols., 1800–1801). See also Heinsius, *Versuch einer biographischen Skizze Ramlers* (1798); and K. Schüddekopf, *Karl Wilhelm Ramler, bis zu seiner Verbindung mit Lessing* (1886).

RAMMELSBERG, KARL FRIEDRICH AUGUST (1813–1899), German mineralogist, was born at Berlin on the 1st of April 1813. He was educated for the medical profession and graduated in 1837 at Berlin University. In 1841 he became *privatdozent* in the university, and in 1845 professor extraordinary of chemistry. This post he relinquished in 1851 to take the chair of chemistry and mineralogy at the Royal Industrial Institute. In 1874 he was appointed professor of inorganic chemistry, and director of the second chemical laboratory at Berlin. Distinguished for his researches on mineralogy, crystallography and analytical chemistry, he laboured also at metallurgy, and yet found time for a series of important textbooks, in which his learning and sound judgment were combined with a lucid and accurate statement of facts. He was author of *Handwörterbuch des chemischen Teils der Mineralogie* (2 vols., 1841; supp. 1843–53); *Lehrbuch der chemischen*

Metallurgie (1850); *Handbuch der Krystallographischen Chemie* (1855); *Handbuch der Mineralchemie* (1860); *Handbuch der Krystallographisch-physikalischen Chemie* (2 vols., 1881–82), some of the earlier works being incorporated in later and more comprehensive volumes with different titles. He died at Gross Lichterfelde, near Berlin, on the 28th of December 1899.

RAM MOHAN ROY (1774–1833), Indian religious reformer, and founder of the Brahma Samaj (*q.v.*) or Theistic Church, was born at Radhanagar, in the district of Hugli, Bengal, in May 1774. He was the son of a small landowner, and in his early life acquired a knowledge of Persian, Arabic and Sanskrit, besides his own vernacular, Bengali. At the age of sixteen he first assailed idolatry in his Bengali work, entitled *The Idolatrous Religious System of the Hindus.* This gave offence to his orthodox father, and Ram Mohan left home and spent some years in travel. At the age of twenty-two he began his study of the English language, and he also acquired a knowledge of other modern and ancient European languages. On the death of his father he obtained an appointment under the British government in 1800, from which he retired in 1814, settled down in Calcutta, and devoted himself to religious reform. He had already inaugurated a circle for discussing the absurdities of idol worship, and published a striking book in Persian called *Tuhfat-al-Muwahhiddin* ("A Gift to Monotheists"). On his settlement in Calcutta he established a little friendly society (*Atmiya Sabha*), which met weekly to read the Hindu scriptures and to chant monotheistic hymns. In 1820 he issued a selection from the Christian Gospels entitled *The Precepts of Jesus the Guide to Peace and Happiness.* He also wrote Bengali works on the Vedanta philosophy, translated some of the *Upanishads*, entered into controversies with Christian missionaries, and on the 23rd of January 1830 definitely established the Brahma Samaj "for the worship and adoration of the Eternal, Unsearchable, Immutable Being who is the Author and Preserver of the Universe." He gave his support to the governor-general, Lord William Bentinck, for the abolition of the suttee rite, *i.e.* the custom of permitting Hindu widows to burn themselves on the funeral pyre of their husbands. He also worked hard to spread education among his fellow-countrymen, and to improve the quality and the prestige of the native press. In 1830 the emperor of Delhi bestowed on Ram Mohan the title of raja, and sent him to England as his agent. Raja Ram Mohan Roy gave his evidence before the Select Committee of the House of Commons on the judicial and revenue systems of India. He presented petitions to the House of Commons in support of the abolition of the suttee rite, and had the satisfaction of being present in the House when the appeal against such abolition was rejected on the 11th of July 1832. As the first educated and eminent Indian who had come to England, he received a cordial welcome from learned men; and Bentham addressed him as an "intensely admired and dearly beloved collaborator in the service of mankind." Ram Mohan also visited France and contemplated a voyage to America, but a sudden attack of brain fever led to his death on the 27th of September 1833. He was buried at Bristol, where a tomb was erected by his friend Dwarka Nath Tagore.

RAMNAD, a town of British India, in the Madura district of Madras, at the base of the spit of land that projects towards the island of Pamban in Palk strait. Pop. (1901) 14,546. It is the residence of a raja of old family, head of the Maravar caste, whose title is setupathi, or lord of Adam's Bridge. The estate covers an area of 2104 sq. m., and pays a permanent land revenue of £25,000. It is a desolate and generally unfertile tract, traversed by the South Indian railway.

RÂMNICU SARAT (*Rîmnicu Sărat*), the capital of the department of Râmnicu Sarat, Rumania; on the railway from Buzeu to Focshani, and on the left bank of the Râmnicu, a tributary of the Sereth. Pop. (1900) 13,134, about 1500 being Jews. The town rises from a marshy plain, east of the Carpathians, and west of the cornlands of southern Moldavia. Salt and petroleum are worked in the mountains, and there is a considerable trade in agricultural produce and preserved meat. Râmnicu Sarat was the scene of battles between the Moldavians and the Walachians in 1434 and 1573, and between the Walachians and Turks in 1634. Here also, in 1789, an Austro-Russian army defeated the Turks. In 1854 the town was almost destroyed by fire and was rebuilt.

RÂMNICU VÂLCEA (*Rîmnicu Vâlcea*), or Rymnik, an episcopal city and the capital of the department of Vâlcea, Rumania; situated at the foot of the Carpathians, on the right bank of the river Olt, and on the railway from Caracal to Hermannstadt in Transylvania. Pop. (1900) 7317. Three monasteries in the Vâlcea department, those of Bistritza, Cozia and Horezu, are among the finest in Walachia. Besides wine, fruit, grain and timber, the surrounding uplands yield petroleum and salt. Within a few miles are the thermal springs of Olanestzi and the salt mines of Ocnele Mari. The city is said to be the ancient Castra Traiana, and many traces of old encampments bear evidence of this.

RAMPOLLA, COUNT MARIANO DEL TINDARO (1843–), Italian cardinal, was born on the 17th of August 1843, at Polizzi, in the Sicilian diocese of Cefalù. Having completed his studies in the Capranica College at Rome, and having taken holy orders, he studied diplomacy at the College of Ecclesiastical Nobles, and in 1875 was appointed councillor to the papal nunciature at Madrid. Two years later he was recalled to Rome and appointed secretary of the Propaganda for Eastern Affairs, and for Extraordinary Ecclesiastical Affairs. Consecrated titular archbishop of Heraclea in 1885, he returned to Madrid as nuncio, but was shortly afterwards created cardinal and appointed to the papal secretaryship of state. New to the Sacred College and free from traditional preconceptions, he was admirably fitted to carry out the papal policy under Leo XIII. (see PAPACY). Rightly or wrongly, he was held personally responsible for the *rapprochement* with France and Russia and the opposition to the Powers of the Triple Alliance; and this attitude had its effect on his career when Leo XIII. died. Rampolla was undoubtedly the favourite among the *papabili* cardinals; but the veto of Austria was interposed (see CONCLAVE), and the votes of the Sacred College fell to Cardinal Sarto, who on the 4th of August 1903 became pope as Pius X. Cardinal Rampolla at once resigned his office as secretary of state, being succeeded by Cardinal Merry del Val, and ceased to play any conspicuous part in the Curia.

RAMPUR, a native state of India, in subordination to the United Provinces. It lies in Rohilkhand, between the British districts of Moradabad and Pilibhit. Area, 893 sq. m. The country is level and generally fertile; being watered in the north by the rivers Kosila and Nahul, and in the south by the Ramganga. The chief crops are maize, rice and sugar cane. Pop. (1901) 533,212, showing a decrease of 3·3% in the decade. Estimated revenue, £234,000; military force, 2556 men, including two squadrons of Imperial Service lancers. The chief, whose title is nawab, is a Rohilla Pathan, representing the family which established their power over this part of the country in the 18th century. When the Rohillas were subjugated by the nawab of Oudh, with the assistance of a force lent by Warren Hastings, one of their number, Faiz-ullah Khan, from whom the present nawab traces his descent, was permitted to retain possession of Rampur. During the Mutiny of 1857 the nawab of Rampur rendered important services to the British, for which he received a grant of land assessed at £9000 in perpetuity, besides other honours. The state is crossed by the main line of the Oudh & Rohilkhand railway from Bareilly to Moradabad. The town of Rampur is on the left bank of the river Kosila, 620 ft. above the sea, with a railway station 39 m. N.W. of Bareilly. Pop. (1901) 78,758. There are manufactures of damask, pottery, sword-blades and sugar. It is partially, and was once completely, surrounded by a broad bamboo hedge, which formed a strong defence. In addition to a modern fort and several fine buildings, it contains an Arabic college, which attracts students from all parts of India.

There are two other towns in India called Rampur, one of which, the capital of the state of Bashahr in the Punjab, has given its name to the fine woollen shawls, widely known as Rampur *chadars*.

RAMPUR BOALIA, or BEULEAH, a town of British India, the administrative headquarters of Rajshahi district in Eastern Bengal and Assam; on the left bank of the Ganges. Pop. (1901) 21,589. It was originally chosen as a commercial factory for the silk trade, which is again being officially encouraged by the agricultural department. The town contains a government college, and an industrial school for sericulture. Most of the public buildings were severely damaged by the earthquake of the 12th of June 1897. There is a daily steamer service on the Ganges.

RAMSAY, ALLAN (1686–1758), Scottish poet, was born at Leadhills, Lanarkshire, on the 15th of October 1686. He was educated at the parish school of Crawford, and in 1701 was apprenticed to a wig-maker in Edinburgh. He married Christian Ross in 1712; a few years after he had established himself as a wig-maker (not as a barber, as has been often said) in the High Street, and soon found himself in comfortable circumstances. His first efforts in verse-making were inspired by the meetings of the Easy Club (founded in 1712), of which he was an original member; and in 1715 he became the Club Laureate. In the society of the members he assumed the name of "Isaac Bickerstaff," and later of "Gawin Douglas," the latter partly in memory of his maternal grandfather Douglas of Muthill (Perthshire), and partly to give point to his boast that he was a "poet sprung from a Douglas loin." The choice of the two names has some significance, when we consider his later literary life as the associate of the Queen Anne poets and as a collector of old Scots poetry. By 1718 he had made some reputation as a writer of occasional verse, which he published in broadsheets, and then (or a year earlier) he turned bookseller in the premises where he had hitherto plied his craft of wig-making. In 1716 he had published a rough transcript of *Christ's Kirk on the Green* from the Bannatyne MS., with some additions of his own. In 1718 he republished the piece with more supplementary verses. In the following year he printed a collection of *Scots Songs*. The success of these ventures prompted him to collect his poems in 1722. The volume was issued by subscription, and brought in the sum of four hundred guineas. Four years later he removed to another shop, in the neighbouring Luckenbooths, where he opened a circulating library (the first in Scotland) and extended his business as a bookseller. Between the publication of the collected edition of his poems and his settling down in the Luckenbooths, he had published a few shorter poems and had issued the first instalments of *The Tea-Table Miscellany* and *The Ever Green* (both 1724–1727). *The Tea-Table Miscellany* is "A Collection of Choice Songs Scots and English," containing some of Ramsay's own, some by his friends, several well-known ballads and songs, and some Caroline verse. Its title was suggested by the programme of the *Spectator*: and the compiler claimed the place for his songs "e'en while the tea's fill'd reeking round," which Addison sought for his speculations at the hour set apart "for tea and bread and butter." In *The Ever Green, being a Collection of Scots Poems wrote by the Ingenious before 1600*, Ramsay had another purpose, to reawaken an interest in the older national literature. Nearly all the pieces were taken from the Bannatyne MS., though they are by no means verbatim copies. They included his version of *Christ's Kirk* (*u.s.*) and a remarkable *pastiche* by the editor entitled the *Vision*. While engaged on these two series, he produced, in 1725, his dramatic pastoral *The Gentle Shepherd*. In the volume of poems published in 1722 Ramsay had shown his bent to this *genre*, especially in "Patie and Roger," which supplies two of the *dramatis personae* to his greater work. The success of the drama was remarkable. It passed through several editions, and was performed at the theatre in Edinburgh; its title is still known in every corner of Scotland, even if it be no longer read. Ramsay wrote little afterwards, though he published a few shorter poems, and new editions of his earlier work. A complete edition of his *Poems* appeared in London in 1731 and in Dublin in 1733. With a touch of vanity he expressed the fear lest "the coolness of fancy that attends advanced years should make me risk the reputation I had acquired." He was already on terms of intimacy with the leading men of letters in Scotland and England. He corresponded with Hamilton of Bangour (*q.v.*), Somerville (*q.v.*), Gay (*q.v.*) and Pope. Gay visited him in Edinburgh, and Pope praised his pastoral—compliments which were undoubtedly responsible for some of Ramsay's unhappy poetic ventures beyond his Scots vernacular. The poet had for many years been a warm supporter of the stage. Some of his prologues and epilogues were written for the London theatres. In 1736 he set about the erection of a new theatre, "at vast expense," in Carrubber's Close, Edinburgh; but the opposition was too strong, and the new house was closed in 1737. In 1755 he retired from his shop to the house on the slope of the Castle Rock, still known as Ramsay Lodge. In this house, called by his friends "the goose-pie," because of its octagonal shape, the poet died on the 7th of January 1758.

Ramsay's importance in literary history is twofold. As a pastoral writer ("in some respects the best in the world," according to Leigh Hunt) he contributed, at an early stage, to the naturalistic reaction of the 18th century. His *Gentle Shepherd*, by its directness of impression and its appreciation of country life, anticipates the attitude of the school which broke with neo-classical tradition. It has the "mixed" faults which make the greater poem of his Scots successor, Thomson, a "transitional" document, but these give it an historical, if not an individual, interest. His chief place is, however, as an editor. He is the connecting-link between the greater "Makars" of the 15th and 16th centuries, and Fergusson (*q.v.*) and Burns. He revived the interest in vernacular literature, and directly inspired the genius of his greater successors. The preface to his *Ever Green* is a protest against "imported trimming" and "foreign embroidery in our writings," and a plea for a return to simple Scottish tradition. He had no scholarly interest in the past, and he never hesitated to transform the texts when he could give contemporary "point" to a poem; but his instinct was good, and he did much to stimulate an ignorant public to fresh enjoyment. In this respect, too, he anticipates the reaction in England which followed securely on the publication of Percy's *Reliques*.

The Tea-Table Miscellany was reprinted in 1871 (2 vols., Glasgow; John Crum); *The Ever Green* in 1875 (2 vols., Glasgow; Robert Forrester); *The Poems of Allan Ramsay* in 1877 (2 vols., Paisley; Alex. Gardner). These volumes are uniform in size and binding, though issued by different publishers, *u.s.* A selection of the *Poems* appeared in 1887 (1 vol. 16mo, London; Walter Scott). There are many popular reprints of *The Gentle Shepherd*. (G. G. S.)

RAMSAY, ALLAN (1713–1784), Scotch portrait-painter, the eldest son of the author of *The Gentle Shepherd*, was born at Edinburgh in 1713. Ramsay manifested an aptitude for art from an early period, and at the age of twenty we find him in London studying under the Swedish painter Hans Huyssing, and at the St Martin's Lane Academy; and in 1736 he left for Rome, where he worked for three years under Solimena and Imperiali (Fernandi). On his return he settled in Edinburgh; and, having attracted attention by his head of Forbes of Culloden and his full-length of the duke of Argyll, he removed to London, where he was patronized by the duke of Bridgewater. His pleasant manners and varied culture, not less than his artistic skill, contributed to render him popular. In 1767 he was appointed to succeed Shakelton as principal painter to the king; and so fully employed was he on the royal portraits which the king was in the habit of presenting to ambassadors and colonial governors, that he was forced to take advantage of the services of a host of assistants—of whom David Martin and Philip Reinagle are the best known. His life in London was varied by frequent visits to Italy, where he occupied himself more in literary and antiquarian research than with art. But this prosperous career came to an end, his health being shattered by an accidental dislocation of the right arm. With unflinching pertinacity he struggled till he had completed a likeness of the king upon which he was engaged at the time, and then started for his beloved Italy, leaving behind him a series of fifty royal portraits to be completed by his assistant Reinagle. For several years he lingered in the south, his constitution finally broken. He died at Dover on the 10th of August 1784.

Among his most satisfactory productions are some of his earlier ones, such as the full-length of the duke of Argyll, and the numerous bust-portraits of Scottish gentlemen and their ladies which he executed before settling in London. They are full of both grace and individuality; the features show excellent draughtsmanship; and the flesh-painting is firm and sound in method, though frequently tending a little to hardness and opacity. His full-length of Lady Mary Coke is remarkable for the skill and delicacy with which the white satin drapery is managed; while in the portrait of his brown-eyed wife, the eldest daughter of Sir Alexander Lindsay of Evelick, in the Scottish National Gallery, we have a sweetness and tenderness which shows the painter at his highest. This last-named work shows the influence of French art, an influence which helped greatly to form the practice of Ramsay, and which is even more clearly visible in the large collection of his sketches in the possession of the Royal Scottish Academy and the Board of Trustees, Edinburgh.

RAMSEY, SIR ANDREW CROMBIE (1814–1891), British geologist, was born at Glasgow on the 31st of January 1814, being the son of William Ramsay, manufacturing chemist. He was for a time actually engaged in business, but from spending his holidays in Arran he became interested in the study of the rocks of that island, and was thus led to acquire the rudiments of geology. A geological model of Arran, made by him on the scale of two inches to the mile, was exhibited at the meeting of the British Association at Glasgow in 1840, and attracted the notice of Sir R. I. Murchison, with the result that he received from De la Beche an appointment on the Geological Survey, on which he served for forty years, from 1841 to 1881. He was first stationed at Tenby, and to that circumstance may be attributed the fact that so much of his geological work dealt with Wales. His first book, *The Geology of the Isle of Arran*, was published in 1841. In 1845 he became local director for Great Britain, but he continued to carry on a certain amount of field-work until 1854. To the first volume of the *Memoirs of the Geological Survey* (1846) he contributed a now classic essay, "On the Denudation of South Wales and the Adjacent Counties of England," in which he advocated the power of the sea to form great plains of denudation, although at the time he underestimated the influence of subaerial agents in sculpturing the scenery. In 1866 he published *The Geology of North Wales* (vol. iii. of the *Memoirs*), of which a second edition was published in 1881. He was chosen professor of geology at University College, London, in 1848, and afterwards lecturer in the same subject at the School of Mines in 1851. Eleven years later he was elected to the presidential chair of the Geological Society, and in 1872 he succeeded Murchison as director-general of the Geological Survey. In 1880 he acted as president of the British Association at Swansea, and in the following year retired from the public service, receiving at the same time the honour of knighthood. In 1860 he published a little book entitled *The Old Glaciers of Switzerland and North Wales*. The study of this subject led him to discuss the *Glacial Origin of Certain Lakes in Switzerland, the Black Forest, &c.* He dealt also with the origin of *The Red Rocks of England* (1871) and *The River Courses of England and Wales* (1872). He was especially interested in tracing out the causes which have determined the physical configuration of a district, and he devoted much attention to the effects produced by ice, his name being identified with the hypothesis, which, however, has never commanded general assent, that in some cases lake basins have been scooped out by glaciers. A master in the broader questions of stratigraphy and physical geology, he was a clear exponent of facts, but rather impatient of details, while his original and often bold theories, expressed both in lectures and in writings, stirred others with enthusiasm and undoubtedly exercised great influence on the progress of geology. His lectures to working men, given in 1863 in the Museum of Practical Geology, formed the nucleus of his famous *Physical Geology and Geography of Great Britain* (5th ed., 1878; 6th ed., by H. B. Woodward, 1894). He received a Royal medal in 1880 from the Royal Society, of which he became a fellow in 1862; he was also the recipient of the Neill prize of the Royal Society of Edinburgh in 1866, and of the Wollaston medal of the Geological Society of London in 1871. He died at Beaumaris on the 9th of December 1891.

See *Memoir*, by Sir A. Geikie, 1895.

RAMSAY, ANDREW MICHAEL (1686–1743), French writer, of Scottish birth, commonly called the "Chevalier Ramsay," was born at Ayr on the 9th of January 1686. Ramsay served with the English auxiliaries in the Netherlands, and in 1710 visited Fénelon, who converted him to Roman Catholicism. He remained in France until 1724, when he was sent to Rome as tutor to the Stuart princes, Charles Edward and Henry, the future cardinal of York. He was driven by intrigue from this post, and returned to Paris. He was in England in 1730, and received an honorary degree from the university of Oxford. The claim was nominally his discipleship to Fénelon, but in reality beyond doubt his connexion with the Jacobite party. He died at St Germain-en-Laye (Seine-et-Oise) on the 6th of May 1743. Ramsay's principal work was *Les voyages de Cyrus* (London, 1728; Paris, 1727), a book composed in avowed imitation of *Télémaque*. He also edited *Télémaque* itself (Paris, 2 vols., 1717) with an introduction, and wrote a *Histoire de la vie et des ouvrages de Fénelon* (The Hague, 1723), besides a partial biography (Paris, 1735) of Turenne, some poems (Edinburgh, 1728) in English, and other miscellaneous works.

RAMSAY, DAVID (1749–1815), American physician and historian, the son of an Irish emigrant, was born in Lancaster county, Pennsylvania, on the 2nd of April 1749. He graduated at Princeton in 1765, and M.B. at the University of Pennsylvania in 1773, and then settled as a physician at Charleston South Carolina, where he had a large practice. During the War of Independence he served as a field-surgeon (1780–1781), and from 1776 to 1783 he was a member of the South Carolina legislature. Having acted as one of the "council of safety" at Charleston, he was, on the capture of that city in 1780, seized by the British as a hostage, and for nearly a year was kept in confinement at St Augustine. From 1782 to 1786 he served in the Continental Congress, and from 1801 to 1815 in the state Senate, of which he was long president. In 1785 he published in two volumes *History of the Revolution of South Carolina*, in 1789 in two volumes *History of the American Revolution*, in 1807 a *Life of Washington*, and in 1809 in two volumes a *History of South Carolina*. He was also the author of several minor works. He died at Charleston on the 8th of May 1815 from a wound inflicted by a lunatic. His *History of the United States* in 3 vols. was published posthumously in 1816–1817, and forms the first three volumes of his *Universal History Americanized*, published in 12 vols. in 1819.

RAMSAY, ROBERT (1842–1882), Australian statesman, was a native of Hawick, Roxburghshire, but his parents emigrated to Victoria when he was a child of four, and he was educated at the Scottish college in Melbourne. He studied law at Melbourne University, and subsequently became a member of a well-known firm of solicitors in the city. He married in 1868 Isabella Catherine Urquhart, and in 1870 entered the assembly for East Bourke in the Conservative and free trade interest. He was a member of the government of James Goodall Francis in 1872–74. He was subsequently postmaster-general (1874–75) in the administration of George Biscoe Kerferd; he held the same office in conjunction with the ministry of education (1875–77) under Sir James M'Culloch; and for a short term in 1880 he was chief secretary and minister of education in the first administration of James Service. He died on the 23rd of May 1882.

RAMSAY, SIR WILLIAM (1852–), British chemist, nephew of Sir A. C. Ramsay, was born at Glasgow on the 2nd of October 1852. From 1866 to 1870 he studied in his native city, and then went to work under R. Fittig at Tübingen. Returning to Glasgow in 1872 he became assistant in the Young laboratory of technical chemistry at Anderson's College, and from 1874 acted as tutorial assistant in chemistry at the university. In 1880 he was appointed to the chair of chemistry at University College, Bristol, becoming principal in the following year, and in 1887 he succeeded A. W. Williamson as professor of chemistry at University College, London. His earlier work was mainly concerned with organic chemistry, and he published researches on picoline and its derivatives in 1876–78 and on quinine and its decomposition products in 1878–79. Later his attention was taken up with questions of physical and inorganic chemistry. With Sydney Young and others he investigated the critical state and properties of liquids and the relationship between their vapour pressures and temperature, and with John Shields he applied measurements of the surface tension of liquids to the determination of their molecular complexity. In 1894 he was associated with Lord Rayleigh in the discovery of argon, announced at that year's meeting of the British Association in Oxford, and in the following year he found in certain rare minerals such as cleveite the gas helium which till that time had only been known on spectroscopic evidence as existing in the sun. In 1898 his work with Morris William Travers (b. 1872), who from 1894 had assisted him at University College, London, and in 1903 was appointed professor of chemistry at University College, Bristol, enabled him to announce the existence in the atmosphere of three new gases, neon, krypton and xenon. Turning to the study of radioactivity, he noticed its association with the minerals which yield helium, and in support of the hypothesis that that gas is a disintegration-product of radium he proved in 1903 that it is continuously formed by the latter substance in quantities sufficiently great to be directly recognizable in the spectroscope. Among the books written by Sir William Ramsay, who was created K.C.B. in 1902, are *A System of Chemistry*, 1891, *The Gases of the Atmosphere*, 1896, and *Modern Chemistry*, vol. i. *Theoretical*, vol. ii. *Systematic*, 1901, and he edited a series of "Textbooks of Physical Chemistry."

RAMSAY, SIR WILLIAM MITCHELL (1851–), British archaeologist, was born on the 15th of March 1851. He was educated at the universities of Aberdeen, Oxford and Göttingen, and was a fellow of Exeter College, Oxford (1882; honorary fellow 1898), and Lincoln College (1885; honorary 1899). In 1885 he was elected professor of classical art at Oxford, and in the next year professor of humanity at Aberdeen. From 1880 onwards he travelled widely in Asia Minor and rapidly became the recognized authority on all matters relating to the districts associated with St Paul's missionary journeys and on Christianity in the early Roman Empire. He received the honorary degrees of D.C.L. Oxford, LL.D. St Andrews and Glasgow, D.D. Edinburgh, and was knighted in 1906. He was elected a member of learned societies in Europe and America, and has been awarded medals by the Royal Geographical Society, the Royal Scottish Geographical Society and the University of Pennsylvania. His numerous publications include: *The Historical Geography of Asia Minor* (1890); *The Church in the Roman Empire* (1893); *The Cities and Bishoprics of Phrygia* (2 vols., 1895, 1897); *St Paul the Traveller and the Roman Citizen* (1895; Germ. trans., 1898); *Impressions of Turkey* (1897); *Was Christ born at Bethlehem?* (1898); *Historical Commentary on Galatians* (1899); *The Education of Christ* (1902); *The Letters to the Seven Churches of Asia* (1905); *Pauline and other Studies in Early Christian History* (1906); *Studies in the History and Art of the Eastern Provinces of the Roman Empire* (1906); *The Cities of St Paul* (1907); *Lucan and Pauline Studies* (1908); *The Thousand and One Churches* (with Miss Gertrude L. Bell, 1909); and articles in learned periodicals and the 9th, 10th and 11th editions of the *Encyclopaedia Britannica*. His wife, Lady Ramsay, granddaughter of Dr Andrew Marshall of Kirkintilloch, accompanied him in many of his journeys and is the author of *Everyday Life in Turkey* (1897) and *The Romance of Elisavet* (1899).

RAMSBOTTOM, an urban district in the Heywood parliamentary division of Lancashire, England, 4 m. N. of Bury, on the Lancashire & Yorkshire railway. Pop. (1901) 15,920. It has iron and brass foundries, machine factories and textile establishments.

RAMSDEN, JESSE (1735–1800), English astronomical instrument maker, was born at Salterhebble near Halifax, Yorkshire, on the 6th of October 1735. After serving his apprenticeship with a cloth-worker in Halifax, he went in 1755 to London, where in 1758 he was apprenticed to a mathematical instrument maker. About four years afterwards he started business on his own account and secured a great reputation with his products. He died at Brighton on the 5th of November 1800. Ramsden's speciality was divided circles, which began to supersede the quadrants in observatories towards the end of the 18th century. His most celebrated work was a 5-feet vertical circle, which was finished in 1789 and was used by G. Piazzi at Palermo in constructing his well-known catalogue of stars. He was the first to carry out in practice a method of reading off angles (first suggested in 1768 by the duke of Chaulnes) by measuring the distance of the index from the nearest division line by means of a micrometer screw which moves one or two fine threads placed in the focus of a microscope. Ramsden's transit instruments were the first which were illuminated through the hollow axis; the idea was suggested to him by Prof. Henry Ussher in Dublin. He published a *Description of an Engine for dividing Mathematical Instruments* in 1777.

RAMSEY, a market-town in the Northern or Ramsey parliamentary division of Huntingdonshire, England, on the south-western border of the Fen country, on branch lines of the Great Northern and the Great Eastern railways, 13 m. S.S.E. of Peterborough. Pop. of urban district (1901) 4823. The fine church of St Thomas à Becket is transitional between Norman and Early English, and has a beautiful Norman east end. The tower was built in 1672 of stone from Ramsey Abbey. An old oak lectern, dating from the middle of the 15th century, carries a chained copy, in a Tudor binding of brass, of Dean Comber's (1655–99) book on the Common Prayer, and a black-letter copy of Erasmus's Paraphrase of the Gospels. There are many interesting tombs in the churchyard, and the church register contains several entries relating to the Cromwell family, who removed hither from Huntingdon and owned the abbey estates till 1674. Of the ancient Benedictine abbey, the only remains are a part of a gateway, a lodge (a beautiful Perpendicular relic) and some buttresses, while some broken stone arches and walls remain of the conventual buildings. The modern mansion of Ramsey Abbey contains many documentary relics of the abbey, as well as an early monument representing the founder.

According to a 12th-century chronicle of one of the monks, the name Ramsey is derived from the words "ram," referring to the tradition of a solitary ram having taken up its abode here, and "ey" meaning an island. Ramsey, however, was not completely insulated, like some of the monasteries of the Fen district. The abbey was founded by Ailwin, earl of the East Angles, in 969, and a charter of King Edgar granted lands and privileges for the purpose. Ramsey Abbey was noted for the school established within its walls, and for its library of Hebrew works. Its abbot was mitred. The lands were granted after the dissolution to Sir Richard Cromwell.

RAMSEY, a seaport and watering-place on the north-east coast of the Isle of Man, 15 m. N.N.E. of Douglas. Pop. (1901) 4729. It lies on the wide Ramsey Bay, at the mouth of the Sulby river, the estuary of which forms a small harbour. To the north and west the country is flat, but to the south the lower slopes of the North Ballure hill rise sharply. A creek of the Sulby river on the north side of the town is formed into a picturesque lake. The Queen's pier permits of the landing of passengers at all times, and Ramsey is served by frequent steamers from Liverpool and other ports. The shore of the bay is sandy and gently sloping, and excellent bathing is afforded. A golf links, a geological and antiquarian museum, the Mooragh Park by the side of the lake, and the palace or concert hall, are among the attractions to visitors. Ramsey is connected with Laxey, the summit of Snaefell, and Douglas by electric tramway, and has connexion with the western part of the island by the Manx Northern railway. The Albert tower, on a wooded hill above the town, commemorating a visit of the Prince Consort in 1847, is a favourite view-point. The harbour has some coasting and fishing trade.

RAMSGATE, a municipal borough, watering-place, seaport and member of the Cinque Port of Sandwich, in the Isle of Thanet parliamentary division of Kent, England, 79 m. E. by S. of London by the South Eastern & Chatham railway. Pop. (1901) 27,733. This is one of the most popular resorts on the Kent coast, well situated on the east coast of Thanet, practically contiguous with Broadstairs to the north, with which and Margate to the north-west it is united by an electric tramway. During the season steamers connect it with London and the intermediate watering-places on the north coast, and with Calais and Boulogne. The harbour has an area of 42 acres, and a considerable coasting and fishing trade is carried on. There is a fine sea front, and the beach is of firm sand. The promenade pier was erected in 1881. Near it an obelisk commemorates the departure of George IV. to Hanover from here, and his return, in 1821. The church of St George was built in 1826, its tower forming a conspicuous landmark, and the Roman Catholic church of St Augustine was built from the designs and at the expense of A. W. Pugin, who was long a resident here. The neighbouring Pegwell Bay, famed for its shrimps, is supposed to have been the scene of the landing of Hengist and Horsa, and at Cliff's End (Ebbs Fleet) a monolithic cross marks the landing-place of St Augustine in 596. On the summit of Osengal Hill, about a mile to the west of the town, a graveyard of early Saxon settlers was discovered during the cutting of the railway. The remains proved it to belong to the 5th and 6th centuries. Ramsgate was incorporated in 1884, and is governed by a mayor, 6 aldermen and 18 councillors. Area, 2304 acres.

Ramsgate (Ramesgate) was originally a small but comparatively prosperous place united until 1827 to the parish of St Lawrence. The charter of Charles II. mentions it as having been "time out of mind" a member of Sandwich. In 1884 it was incorporated by royal charter, under the title of mayor, aldermen and councillors. A commission of the peace was granted in 1893. Since then the jurisdiction of the Cinque Ports' justices has ceased within its limits, which include the parishes of Ramsgate and St Lawrence Intra. A daily market was obtained in 1784 by grant from George III. No fair was then held, but from 1792 onwards there has been one yearly on the 10th of August. Under Elizabeth, Ramsgate was still unimportant though possessed of a fair before the reign of Henry VIII. After 1668 the growth of trade increased its prosperity, and at the beginning of the reign of George I. the pier was enlarged and pier-wardens appointed to collect the *droits*. In 1749, having been selected as a Harbour of Refuge for the Downs, it underwent great improvements, and henceforward paid £200 yearly to Sandwich out of the *droits* for clearing the Channel and repairing the banks of the river Stour within the Liberty; but by 1790 the harbour was of small account.

RAMSONS, in botany, the popular name for *Allium ursinum*, a bulbous plant 6 to 18 in. high, with ovate-lanceolate stalked leaves tapering at the apex, surrounding a naked stalk bearing a flat-topped umbel of small white flowers. A rather pretty plant, common in woods and in hedgebanks in spring, but with a pungent garlic-like smell, which is characteristic of the genus (see ALLIUM).

RAMUS, PETRUS, or PIERRE DE LA RAMÉE (1515–1572), French humanist, was born at the village of Cuth in Picardy in 1515, a member of a noble but impoverished family; his father was a charcoal-burner. Having gained admission, in a menial capacity, to the college of Navarre, he worked with his hands by day and carried on his studies at night. The reaction against scholasticism was still in full tide; it was the transition time between the old and the new, when the eager and forward-looking spirits had first of all to do battle with scholastic Aristotelianism. Ramus outdid his predecessors in the impetuosity of his revolt. On the occasion of taking his degree (1536) he actually took as his thesis "Everything that Aristotle taught is false." This *tour de force* was followed up by the publication in 1543 of *Aristotelicae Animadversiones* and *Dialecticae Partitiones*, the former a criticism on the old logic and the latter a new textbook of the science. What are substantially fresh editions of the *Partitiones* appeared in 1547 as *Institutiones Dialecticae*, and in 1548 as *Scholae Dialecticae*; his *Dialectique* (1555), a French version of his system, is the earliest work on the subject in the French language. Meanwhile Ramus, as graduate of the university, had opened courses of lectures; but his audacities drew upon him the hostility of the conservative party in philosophy and theology. He was accused of undermining the foundations of philosophy and religion, and the matter was brought before the parlement of Paris, and finally before Francis I. By him it was referred to a commission of five, who found Ramus guilty of having "acted rashly, arrogantly and impudently," and interdicted his lectures (1544). He withdrew from Paris, but soon afterwards returned, the decree against him being cancelled through the influence of the cardinal of Lorraine. In 1551 Henry II. appointed him professor of philosophy and eloquence at the Collège de France, where for a considerable time he lectured before audiences numbering as many as 2000. He published fifty works in his lifetime and nine appeared after his death. In 1561, however, the enmity against him was fanned into flame by his adoption of Protestantism. He had to flee from Paris; and, though he found an asylum in the palace of Fontainebleau, his house was pillaged and his library burned in his absence. He resumed his chair after this for a time, but in 1568 the position of affairs was again so threatening that he found it advisable to ask permission to travel. Returning to France he fell a victim to his opponents in the massacre of St Bartholomew (1572).

The logic of Ramus enjoyed a great celebrity for a time, and there existed a school of Ramists boasting numerous adherents in France, Germany and Holland. As late as 1626 F. Burgersdyk divides the logicians of his day into the Aristotelians, the Ramists and the Semi-Ramists, who endeavoured, like Goclenius of Marburg, to mediate between the contending parties. Ramus's works appear among the logical textbooks of the Scottish universities, and he was not without his followers in England in the 17th century. There is even a little treatise from the hand of Milton, published two years before his death, called *Artis Logicae Plenior Institutio ad Petri Rami Methodum concinnata.* It cannot be said, however, that Ramus's innovations mark any epoch in the history of logic. His rhetorical leaning is seen in the definition of logic as the "ars disserendi"; he maintains that the rules of logic may be better learned from observation of the way in which Cicero persuaded his hearers than from a study of the *Organon*. The distinction between natural and artificial logic, *i.e.* between the implicit logic of daily speech and the same logic made explicit in a system, passed over into the logical handbooks. Logic falls, according to Ramus, into two parts—invention (treating of the notion and definition) and judgment (comprising the judgment proper, syllogism and method). This division gave rise to the jocular designation of judgment or mother-wit as the "secunda Petri." He is, perhaps, most suggestive in his emendations of the syllogism. He admits only the first three figures, as in the original Aristotelian scheme, and in his later works he also attacks the validity of the third figure, following in this the precedent of Laurentius Valla. Ramus also set the modern fashion of deducing the figures from the position of the middle term in the premises, instead of basing them, as Aristotle does, upon the different relation of the middle to the so-called major and minor term. On the whole, however, though Ramus may be allowed to have advanced logical study by the wholesome fermentation of thought which he caused, there is little ground for his pretentious claim to supersede Aristotle by a new and independent system.

See Waddington-Kastus, *De Petri Rami vita, scriptis, philosophia* (Paris, 1848); Charles Desmaze, *Petrus Ramus, professeur au Collège de France, sa vie, ses écrits, sa mort* (Paris, 1864); P. Lobstein, *P. Ramus als Theolog* (Strassburg, 1878); E. Saisset, *Les précurseurs de Descartes* (Paris, 1862); J. Owen, *French Skeptics of the Renaissance* (London, 1893); K. Prantl, "Über P. Ramus" in *Münchener Sitzungs berichte* (1878); H. Höffding, *Hist. of Mod. Phil.* (Eng. trans., 1900), vol. i. 185; Voigt, *Über den Ramismus der Universität Leipzig* (Leipzig, 1888).

RAMUSIO. The noble Italian family of Ramusio—the spelling adopted in the publication of the *Navigationi*, though it is also written Ramnusio, Rhamnusio, Rannusio, &c.—was one of note for literary and official ability during at least four generations. Its original home was in Rimini, and the municipality of that city has within the last few years set up a tablet on the town hall bearing an inscription which may be thus rendered: "The municipality of Rimini here records the claim of their city to the family of the Ramusios, adorned during the 15th and 16th centuries by the illustrious jurist and man of letters Paolo the elder, who rendered the work of Valturius, our fellow-citizen, into the vernacular; by the physician Girolamo, a most successful student of Oriental tongues, and the first to present Europe with a translation of Avicenna; and by Giovanni Battista, cosmographer to the Venetian republic and secretary to the Council of Ten, who bequeathed to the world that famous collection of voyages and travels, regarded in his own day as a marvellous work, and still full of authority among all civilized nations."

Paolo the Elder (*c.* 1443–1506), the first of those thus commemorated, migrated in 1458 from Rimini to Venice, where he obtained full citizenship, studied law and became a member of the magistracy, filling the offices of *vicario*, of judicial assessor, and of criminal judge under various administrators of the Venetian provinces on the continent. He continued, however, to maintain relations with the Malatesta princes of his native city, and in 1503 negotiated with them the cession of Rimini to the republic. The wife of Paolo, bearing the singular name of Tomyris Macachio, bore him three sons and four daughters. Paolo died at Bergamo on 19th August 1506 at the age of sixty-three, and was buried in S. Agostino at Padua. Paolo was the author of a variety of legal treatises and the like, and also published at Verona in 1483 both a corrected edition and an Italian translation of a once famous book, *Valturius, De re militari*, dedicating both to Pandolfo Malatesta of Rimini.[1]

Girolamo (1450–1486), younger brother of Paolo, had a notable history. After he had studied medicine at Padua public suspicion was roused against him in connexion with the death of a lady with whom he had had some love passages, and this ran so high that he was fain, by help of his brother Paolo, to whom he transferred his property, to make his escape (about 1481–1483) to Syria and to take up his abode at Damascus. In 1486 he removed to Beyrout, and died the same year, killed, as the family chronicler relates, by a surfeit of "certain fruit that we call *armellini* and *albicocche*, but which in that country are known as *mazzafranchi*," a title which English sailors in southern regions still give to apricots in the vernacular paraphrase of *killjohns*. During his stay in Syria Girolamo studied Arabic and made a new translation of Avicenna, or rather, we may assume, of some part of that author's medical works (the *Canon*?). It was, however, by no means the first such translation, as is erroneously alleged in the Rimini inscription, for the *Canon* had been translated by Gerard of Cremona (d. 1187), and this version was frequently issued from the early press. Girolamo's translation was never printed, but was used by editors of versions published at Venice in 1579 and 1606. Other works of this questionable member of the house of Ramusio consisted of medical and philosophical tracts and Latin poems, some of which last were included in a collection published at Paris in 1791.[2]

Gian Battista (1485–1557), the eldest son of Paolo Ramusio and Tomyris Macachio, was born at Treviso in 1485 (June 20). Having been educated at Venice and at Padua, at an early age he entered the public service (1505), becoming in 1515 secretary of the senate and in 1533 secretary of the Council of Ten. He also served the republic in various missions to foreign states, *e.g.* to Rome, to Switzerland and to France, travelling over much of the latter country by special desire of the king, Louis XII. He also on several occasions filled the office of *cancellier grande.* In 1524 he married Franceschina, daughter of Francesco Navagero, a noble—a papal dispensation being required on account of her being cousin to his mother Tomyris. By this lady he had one son, Paolo. In his old age Ramusio resigned the secretaryship and retired to the Villa Ramusia, a property on the river Masanga, in the province of Padua, which had been bestowed on his father in 1504 in recognition of his services in the acquisition of Rimini the year before The delights of this retreat are celebrated in the poems and letters of several of Gian Battista's friends. He also possessed a house at Padua in the Strada del Patriarcato, a mansion noted for its paintings and for its collection of ancient sculpture and inscriptions. These, too, are commemorated by various writers. A few days before his death Ramusio removed to this house in Padua, and there died, 10th of July 1557, at the age of seventy-two. He was, by his own desire, buried at Venice, in the tomb which he had made for his mother, in Santa Maria dell' Orto. His wife's death had occurred in 1536. In the work called *Museum Mazzuchellianum* (Venice, 1761, vol. i. pl. lxiv. No. 6) there is represented a 16th-century medal of Ramusio, which looks a genuine likeness, and a bronze example of which, without the reverse,[3] is preserved in St Mark's Library. There was a portrait of him, represented as in conversation with Andrea Gradenigo, in the Sala del Maggior Consiglio, but in 1577 this perished in a fire, as did also a portrait of his father, Paolo. A professed portrait of Gian Battista by Francesco Grisellini, in the Sala dello Scudo, appears to be, like the companion portrait of Marco Polo, a work of fancy. A public nautical school at Rimini received from the government the title of the Istituto Ramusio.

Ramusio was evidently a general favourite, as he was free from pushing ambition, modest and ingenuous, and, if it be safe to judge from some of the dissertations in his *Navigationi*, must have been a delightful companion; both his friend Giunti and the historian Giustiniani[4] speak of him with the strongest affection. He had also a great reputation for learning. Before he was thirty Aldus Manutius the elder dedicated to him his edition of Quintilian (1514); a few years later (1519) Francesco Ardano inscribed to him an edition of Livy, and in 1528 Bernardino Donati did the like with his edition of Macrobius and Censorinus. To Greek and Latin and the modern languages of southern Europe he is said to have added a knowledge of "Oriental tongues," but there is no evidence how far this went, unless we accept as such a statement that he was selected in 1530 on account of this accomplishment to investigate the case of one David, a Hebrew, who, claiming to be of the royal house of Judah, wished to establish himself at Venice outside of the Ghetto.[5] But Ramusio had witnessed from his boyhood the unrolling of that great series of discoveries by Portugal and Spain in East and West, and the love of geography thus kindled in him made that branch of knowledge through life his chief study and delight. He is said, with the assistance of friends touched by the same flame, to have opened a school for geography in his house at Venice. And it appears from a letter addressed to him by his friend Andrea Navagero, that as early as 1523 the preparation of material for his great work had already begun. The task had been suggested and encouraged, as Ramusio himself states in a dedicatory epistle to the famous Girolamo Fracastoro, by that scholar, his lifelong friend; an address to the same personage indeed introduced each of the three volumes, and in the first the writer speaks of his desire to bequeath to posterity, along with his labours, "a testimony to the long and holy friendship that had existed between the two." They were contemporaries in the strictest sense (Ramusio 1485–1557, Fracastorius 1483–1553). His correspondence, which was often devoted to the collection of new material for his work, was immense, and embraced many distinguished men. Among those whose names have still an odour of celebrity were Fracastoro, just mentioned, Cardinal Pietro Bembo, Damiano de Goez, and Sebastian Cabot; among lesser lights, Vettor Fausto, Daniel Barbaro, Paolo Manuzio, Andrea Navagero, the cardinals Gasparo Contarini and Gregorio Cortese, and the printer Tommaso Giunti, editor after Ramusio's death of the *Navigationi*.

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[1] Both works are in the British Museum.

[2] "Ramusii Ariminensis Carmina," in *Quinque Illustrium Poetarum . . . Lusus in Venerem.* Girolamo's are grossly erotic.

[3] The reverse is an amorphous map. The book is in the British Museum.

[4] *Rerum Venetarum . . . Historia*, bk. xiv.

[5] Ramusio's report on this Hebrew is preserved in the diaries of Marcus Sanudo, and is printed by Cigogna. It is curious. David represented himself as a prince of the Bedouin Jews who haunt the caravan-road between Damascus and Medina; he claimed to be not only a great warrior covered with wounds but great also in the law and in the cabala, and to have been inspired by God to conduct the dispersed tribes to the Holy Land and to rebuild the temple. In this view he had visited Prester John and the Jews in his kingdom, and then various European countries. David was dark in complexion, "like an Abyssinian," lean, dry and Arab-like, well dressed and well attended, full of pretensions to supernatural cabalistic knowledge, and with enthusiastic ideas about his mission, whilst the Jews regarded him as a veritable Messiah.

Two volumes only of the *Navigationi e Viaggi* were published during the life of Gian Battista, vol. i. in 1550, vol. iii. in 1556; vol. ii. did not appear till 1559, two years after his death, delayed, as his friend and printer T. Giunti explains, not only by that event but by a fire in the printing-office (November 1557), which destroyed a part of the material which had been prepared. It had been Ramusio's intention to publish a fourth volume, containing, as he mentions himself, documents relating to the Andes, and, as appears from one of the prefaces of Giunti, others relating to explorations towards the Antarctic.[1] Ramusio's collection was by no means the first of the kind, though it was, and we may say on the whole continues to be, the best. Even before the invention of the press such collections were known, of which that made by a certain Long John of Yprès, abbot of St Bertin, in the latter half of the 14th century was most meritorious, and afforded in its transcription a splendid field for embellishment by the miniaturists, which was not disregarded. The best of the printed collections before Ramusio's was the *Novus Orbis*, edited at Basel by Simon Grynaeus in 1532, and reissued in 1537 and 1555. This, however, can boast of no disquisitions nor of much editorial judgment. Ramusio's collection is in these respects far superior, as well as in the variety and fulness of its matter. He spared no pains in ransacking Italy and the Spanish peninsula for contributions, and in translating them when needful into the racy Italian of his day. Several of the pieces are very rare in any other shape than that exhibited in Ramusio's collection; several besides of importance—*e.g.* the invaluable travels of Barbosa and Pigafetta's account of Magellan's voyage—were not publicly known in any complete form till the present century. Of two important articles at least the originals have never been otherwise printed or discovered; one of these is the *Summary of all the Kingdoms, Cities, and Nations from the Red Sea to China*, a work translated from the Portuguese, and dating apparently from about 1535; the other, the remarkable Ramusian redaction of Marco Polo (*q.v.*). The *Prefatione*, *Espositione* and *Dichiarazione*, which precede this version of Marco Polo's book, are the best and amplest examples of Ramusio's own style as an editor. They are full of good sense and of interesting remarks derived from his large reading and experience, and few pictures in words were ever touched more delightfully than that in which he sketches the return of the Polo family to their native city, as he had received it in the tradition of the Venetian elders.

There were several editions of the *Navigationi e Viaggi*, and as additions continued to be made to the several volumes a good deal of bibliographical interest attaches to these various modifications.[2] The two volumes (i. and iii.) published in Ramusio's lifetime do not bear his name on the title-page, nor does it appear in the addresses to his friend Fracastorius with which these volumes begin (as does also the second and posthumous volume). The editions of vol. i. are as follows: 1550, 1554, 1563, 1588, 1606, 1613.[3] The edition of 1554 contains the following articles which are not in that of 1550: (1) copious index; (2) "Narr. di un Compagno di Barbosa"; (3) "Informationi del Giapan"; (4) "Alli Lettori di Giov. de Barros"; (5) "Capitoli estratti da di Barros." The edition of 1563 adds to these a preliminary leaf concerning Ramusio, "Tommaso Giunti alli Lettori." After 1563 there is no change in the contents of this volume, only in the title-page. It should be added that in the edition of 1554 there are three double-page woodcut maps (Africa, India and India extra Gangem), which do not exist in the edition of 1550, and which are replaced by copperplate maps in subsequent editions. These maps are often missing. The editions of vol. ii. are as follows: 1559, 1574, 1583, 1606. There are important additions in the 1574 copy, and still further additions in that of 1583. The additions made in 1574 were: (1) "Herberstein, Della Moscovia e della Russia"; (2) "Viaggio in Persia di Caterino Zeno"; (3) "Scoprimento dell' Isola Frislanda, &c., per due fratelli Zeni"; (4) "Viaggi in Tartaria per alcuni frati Minori"; (5) "Viaggio del Beato Odorico" (two versions). Further additions made in 1583 were: (1) "Navigatione di Seb. Cabota"; (2) at the end 90 ff. with fresh pagination, containing ten articles on "Sarmatia, Polonia, Lithuania, Prussia, Livonia, Moscovia, and the Tartars by Aless. Guagnino and Matteo di Micheovo." The two latest "editions" of vol. ii. are identical, *i.e.* from the same type, with a change of title-page only, and a reprint of the last leaf of the preface and of the last leaf of the book. But the last circumstance does not apply to all copies. In one, whilst the title bears 1606, the colophon bears "Appresso i Giunti, 1583." Vol. iii. editions are of 1556, 1565 and 1606.[4] There is no practical difference between the first two, but that of 1606 has forty-five pages of important new matter, which embraces the *Travels* of Cesare Fedrici or Federici in India, one of the most valuable narratives of the 16th century, and *Three Voyages of the Hollanders and Zealanders to Nova Zembla and Groenland.* Vol. iii. also contains (omitting maps and figures inserted in the text, or with type on the reverse) a two-page topographical view of Cuzco, a folding map of Terra Nova and Labrador, a two-page map of Brazil, a two-page map of Guinea, &c., a two-page map of Sumatra, a two-page pictorial plan of the town of Hochelaga in New France, and a general map of the New World in a hemisphere. Brunet's statement mentions issues of vol. ii. in 1564, and of vol. iii. in 1613; but these seem to have no existence. It would thus appear that a set of Ramusio, to be as complete as possible, should embrace—for vol. i., 1563 or any subsequent edition; for vol. ii., 1583 or 1606; for vol. iii., 1606.

Paolo (Girolamo Gaspare)[5] (1532–1600) was the only child of Gian Battista, and was born on the 4th of July 1532. Like his father, he maintained a large correspondence with many persons of learning and note. In 1541 Francesco Contarini, procurator of St Mark's, brought from Brussels a MS. of Villehardouin's *History of the Conquest of Constantinople*, which he presented to the Council of Ten. In 1556 they publicly ordered its translation into Latin, and gave the commission to Paolo Rannusio. His father also seems to have taken much interest in the work, for a MS. vernacular translation by him exists in the Marciana. Paolo's book was not completed till 1573, many years after the father's death, and was in fact a paraphrase enlarged from other sources, thus, according to Cigogna's questionable judgment, "converting the dry story of Villehardouin into an elegant (*fiorita*) historical work." It was not published till 1609, nine years after Paolo's death; nor was it ever really reprinted, though it became the subject of a singular and unintelligible forgery. For Jacopo Gaffarelli, who was sent to Venice to buy books for Richelieu, having apparently procured the "remainder" copies, removed the title and preliminary pages and substituted a fresh title with the date 1634, and a dedication to his master the cardinal.[1]

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[1] See in vol. iii. the end of Ramusio's *Discorso* on the conquest of Peru, and Giunti's "Alli Lettori" in the 3rd edition of the first volume.

[2] Brunet's statements on the subject are borrowed, and not quite accurate. The detail in Cigogna seems to be accurate, but it is vague as to the deficiencies of the earlier editions.

[3] All of these are in the British Museum.

[4] All at the British Museum.

[5] This person and his son affected the spelling Rannusio.

GIROLAMO GIUSEPPE (1555–1611), the son of Paolo, was born at Venice in 1555. He entered the public service in 1577, and was employed in connexion with various foreign missions. In 1601 he published at Lyons the French text of Villehardouin; and, besides an Italian translation of this old historian (who seems thus to have furnished occupation for three generations of Ramusios), he left behind him a *Storia o Cronaca di Casa Ramusia*, a folio MS still in St Mark's Library. He died at Padua in 1611, and his posterity did nothing to continue the reputation of the family, official or literary.

Besides the circumstances to be gathered from the *Navigationi* regarding the Ramusio family, see the *Iscrizioni Venete* of Emanuele Cigogna. There is also in the British Museum *Monografia letta il 14 Marzo 1883* . . . by Guglielmo Carradori (Rimini, 1883); but hardly anything has been found in this except the inscription quoted at the beginning of this article. (H. Y.)

RANADE, MAHADEO GOVIND (1842–1901), Indian lawyer, reformer and author, was born on the 16th of January 1842 at Niphad, in Nasik district, of a Chitpavan Brahman family. When his father was minister at Kolhapur he attended the Anglo-vernacular school in that town, and joined the Elphinstone Institute in Bombay at the age of fourteen. He was one of the first graduates of the Bombay University, taking the B.A. in 1862 and the LL.B. in 1866. Having entered government service he became presidency magistrate and then fourth judge of the small cause court at Bombay in 1871, first-class sub-judge at Poona in 1873, and judge of the Poona small cause court in 1884, after which, as special judge under the Deccan Agriculturists' Relief Act from 1887, he came into close contact with the difficulties of the agrarian classes. In 1886 he was a member of the finance committee appointed to report on the expenditure, both imperial and provincial, with a view to retrenchment. This service won him the decoration of C.I.E. He became a member of the legislative council of Bombay in 1885, and occupied that position until raised to the high court in 1893. Being an energetic social reformer, he directed his efforts against infant marriages, the shaving of widows, the heavy cost of marriages and other social functions, and the caste restrictions on travelling abroad. He strenuously advocated widow remarriage and female education. He was the founder of the social conference movement, which he supported till his death. In the political sphere he founded the Poona Sarvajanik Sabha, through which he frequently helped the government with sound advice. He was also one of the originators of the Indian National Congress. In Bombay University, where he held the offices of syndic and dean in arts, he displayed much organizing power and great intimacy with the needs of the student class. Himself a thorough Mahratti scholar, he encouraged the translation of standard English works, and tried, with some success, to introduce vernacular languages into the university curriculum. Though reared in the strictest tenets of Hinduism, his deep religious feeling and trained intellect craved something higher and broader than he could find in the traditional forms and orthodox teaching of his race. The same spiritual want being felt by many enlightened Hindus, he joined with his friends, Dr Atmaram Pandurang, Bal Mangesh Wagle and Vaman Abaji Modak, in founding a new sect in Bombay known as the "Parthana Samaj." This community resembles, in all essential points, the Brahma Samaj of Bengal. Its principles of enlightened theism are based on the ancient Vedas. He published books on Indian economics and on Mahratta history. He died on the 16th of January 1901. He left no children, but his widow continued his work of social and educational reform at Poona.

See G. A. Mankar, *Justice M. G. Ranade* (Bombay, 1902).

RANAVALO (RANAVALONA) **III.** (1864–), the last queen of Madagascar, born in 1864, was a great-niece of Radama I. Her name originally was Razàfindrahèty, but on succeeding to the throne of Madagascar after the death of Queen Ranavalo II., on the 14th of July 1883, she assumed the style of Ranavalo III. Although nominally queen, she took no share in the government, which her prime minister, Rainilaiarivony, had controlled since 1864. After placing her on the throne, he married her before the close of the year. Ranavalo became queen just after the French had revived their claim to a protectorate over the island. The Hova government refusing to admit the claim, war broke out, and several sharp engagements took place. The French bombarded the coast towns, but were unable to reach the interior of the island, where the strength of the Hova lay. In December 1885 a treaty was concluded by which it was agreed that the government of the French Republic should represent Madagascar in all foreign relations, but that in internal matters the Hova government should be independent, as formerly. During the next ten years French influence was quietly extended over the island, in spite of the efforts of Rainilaiarivony, who pursued an anti-French policy, encouraging English and American planters and traders. In 1894 differences on commercial and territorial questions arose between the Hova government and the French, which terminated in war. In 1895 a well-organized expedition was despatched from France to subjugate the island. Many of the inhabitants sympathized with the invaders, and even the Hova themselves were divided. Although Ranavalo endeavoured to arouse a martial spirit in her subjects, the French advanced on the capital without encountering any effective opposition. On the 30th of September they captured Antananarivo. Rainilaiarivony was sent into exile, where he died in the following year; but Ranavalo was suffered to remain as nominal head of the government, under a strict French protectorate. In August 1896, to avoid commercial difficulties with foreign powers, the island was declared a French colony; but no change was made in the internal administration. Later in the year, however, the civil governor was replaced by a military resident, General Gallieni. A formidable insurrection broke out, which Gallieni suppressed, executing or exiling several prominent members of the Hova administration. Finding that the court had been a centre of intrigue, he abolished the sovereignty by proclamation in February 1897, and exiled Ranavalo to Réunion. In March 1899 she was removed to Algiers. Her exile there was relieved by occasional visits to Paris.

RANC, ARTHUR (1831–1908), French politician and writer, was born at Poitiers on the 20th of December 1831, and was educated for the law. Implicated in a plot against Napoleon III. in 1853, he was acquitted, but shortly afterwards was imprisoned for belonging to a secret society; for his share in anti-imperialist conspiracies in 1855 he was arrested and deported to Algeria without a trial. The amnesty of 1859 permitted him to return to Paris, where he soon drew the attention of the police to his presence by his violent articles. During the siege of Paris he left the city in a balloon and joined Gambetta, for whom he organized a system of spies through which General Trochu was kept informed of the strength and disposition of the Prussians around Paris. He was elected to the National Assembly in February 1871, but resigned rather than subscribe to the peace. He had been elected mayor of the ninth arrondissement of Paris in the autumn of 1870, and in March was sent by the same district to the Commune, from which he resigned when he found no reconciliation was possible between the mayors and the Commune. In July he became a member of the municipal council of Paris, and in 1873 was returned to the National Assembly for the department of the Rhône, and took his place on the extreme Left. A month after his election the governor of Paris demanded his prosecution for his share in the Commune. The claim being granted by a large majority, he escaped to Belgium, where he issued a pamphlet defending his action during the Commune. On his failure to appear before the court he was condemned to death, and remained in Belgium until 1879, when he was included in the amnesty proclaimed by Grévy. During his exile he continued his active collaboration on *La République française.* In 1873 he fought a duel with Paul de Cassagnac, and he acted as second to Clémenceau more than once. He energetically defended the republic against the Boulangist agitation, and took an equally courageous part in the Dreyfus affair. In the Picquart-Henry duel he was second to Colonel Picquart. He succeeded Clémenceau as editor of the *Aurore*, in which Zola's letter "J'accuse" had appeared, and was president of the Association of Republican Journalists. In 1903 he became senator for Corsica, and died on the 10th of August 1908.

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[1] In the British Museum.

In addition to his purely political writings, Arthur Ranc published political novels of the Second Empire, *Sous l'empire* (1872) and *Le roman d'une conspiration* (1868).

RANCÉ, ARMAND JEAN LE BOUTHILLIER DE (1626–1700), founder of the Trappist Cistercians. He was born in Paris of a noble and influential family of Normandy; hence, being destined to the ecclesiastical state, he was when ten years old commendatory abbot of La Trappe and two other abbeys, prior of two priories, and canon of Nôtre Dame, Paris. At twelve he published a translation of Anacreon. He went through his course of theological studies with great distinction, defeating Bossuet at the Baccalaureat in theology. He was ordained in 1651, and embarked on the ambitious and worldly career of a court abbé in the days of Louis XIV. But after a few years he underwent a complete change of life, and in 1662 he retired to his abbey of La Trappe, of which he became regular abbot in 1664 and introduced an austere reform (see Trappists). The best known episode of his subsequent life was the "Contestation" with Mabillon on the lawfulness of monks devoting themselves to study, which De Rancé denied. He resigned his abbacy in 1695, owing to declining health, and died in 1700.

The best of the early lives is that of P. le Nain, his sub-prior (1715); the most recent is by M. Serrant, *L'Abbé de Rancé et Bossuet* (1903). A sufficient sketch is given by Helyot, *Histoire des ordres religieux* (1718), vi. c. 1. On the "Contestation" on Monastic Studies, see Maitland, *Dark Ages*, § x. (E. C. B.)

RANCH, a term in current usage among the English-speaking peoples for a large farm, particularly one for cattle or horse-breeding. The word came into use in this application in the western states of North America, and was an adaptation of the Spanish-American *rancho*, herdsmen's huts; in Spanish a gathering of people having their meals in common, a mess.

RANCHI, a town and district of British India, in the Chota Nagpur division of Bengal. The town, which is situated on the Chota Nagpur plateau, about 2100 ft. above sea-level, is the headquarters of both the division and the district. Pop. (1901) 25,970. It is an important centre of local trade and the headquarters of the German Lutheran mission. There are a high school and an industrial school, and it is proposed to found here a residential college for all Bengal. The cantonments, formerly called Doranda, accommodate a detachment of native infantry.

The District of Ranchi, formerly called Lohardaga after the town which was its headquarters, has an area of 7128 sq. m. It consists of two tablelands, of which the higher rises to about 2000 ft. The whole area is broken by hills and undulations, which are terraced for rice. The steep slopes are covered with a dense forest, where wild animals still abound, but no profit is derived from the timber. The principal rivers are the Subanarekhā and the North and South Koel. In 1901 the population was 1,187,925, showing an increase of 5·2% in the decade. Christians form 10% of the total. The district was affected by the famine of 1896–1897, and still more severely by that of 1900. Rice is everywhere the staple crop, with some millets and pulses. Tea cultivation has been introduced, but does not flourish. The only industry on a large scale is the manufacture of shellac. Myrobalans are also exported. Iron and soapstone are worked in small quantities. Hopes of profitable gold-mining in the quartz veins of the schist formation have proved abortive. There is no railway in the district, though surveys have been made to connect with the Bengal-Nagpur line.

See F. B. Bradley-Birt, *Chota Nagpur* (1903).

RAND, a Dutch word meaning border, edge, used in South Africa to designate a low rounded range of hills; specifically it is an abbreviated form of Witwatersrand, an elevated ridge in the southern Transvaal, forming the water-parting between the basins of the Orange and Limpopo. The Rand is famous for its gold-bearing reefs (see Gold), and the word is often used as a synonym for the mining industry carried on over a great part of its area, or for Johannesburg (*q.v.*), the city which that industry created.

RANDALL, SAMUEL JACKSON (1828–1890), American politician, was born in Philadelphia, Pennsylvania, on the 10th of October 1828. He was educated in the public schools and in the University Academy, Philadelphia. In 1858–1859 he was a Democratic member of the state Senate. During the Civil War he served as a private in the Union army for ninety days in 1861, and two years later took part in the Gettysburg campaign as a volunteer. From 1863 until his death he was a Democratic representative in Congress. During the session of 1874–1875 he first gained a national reputation by the masterful manner in which he prevented the Republican majority from passing the Force Bill or Federal Election law. Under his leadership discipline and party harmony were established among the Democrats for the first time after the Civil War. He was speaker of the House from December 1876 to March 1881, during a period marked by rancorous debates concerning the disputed Hayes-Tilden presidential election. With the disappearance of the Reconstruction questions and the emergence of the tariff issue, however, his influence began to wane. As the leader of the Protectionist wing of the party he was superseded by the tariff reform advocates, such as John G. Carlisle, William R. Morrison, and Roger Q. Mills, Carlisle defeating him for the speakership in 1883. He died in Washington, D.C., on the 13th of April 1890.

RANDAN, a name for a boat rowed by three persons, stroke and bow using a single oar each and the central person a pair of sculls. The word is of unknown origin, and can hardly be connected with a slang term for a row or spree, which is found as early as the beginning of the 18th century and is generally taken as a variation of "random," haphazard.

RANDAZZO, a town of Sicily, in the province of Catania, at the N. foot of Mount Etna, 43 m. N. by W. of Catania by rail, and 26 m. direct. Pop. (1901) 11,798. It has considerable remains of architecture of the 13th and 14th centuries, including three Norman churches and some interesting palaces. The former contain some fine sculptures and goldsmith's work (Mauceri in *L'Arte*, 1906, 185). It is the nearest town to the summit of Etna (9 m.), and is one of the points from which the ascent may be made.

RANDERS, a town of Denmark, capital of the *amt* (county) of its name in Jutland, on the Gudenaa at the point where it begins to widen into Randers Fjord, an inlet of the Cattegat. Pop. (1901) 20,057. The town is 15 m. from the open Cattegat and the harbour has 15 ft. depth on the bar. The chief exports are butter and eggs; the chief imports sugar, petroleum, coal and iron. Two railways run north to Aalborg, continuing the main East Jutland line from the south, and an eastward branch serves Grenaa and Aebeltoft on the coast. Though a place of considerable antiquity—being mentioned in 1086 as the meeting-place of insurgents against Knud, the saint —Randers has few remains of old buildings and bears the stamp of a compact, modern manufacturing town that owes its importance to its distilleries, manufactories of gloves, railway carriages, &c. St Marten's church dates from the 14th century, but was frequently altered and enlarged down to 1870. It has good woodwork of the 17th century. The high school is housed in a medieval monastery, which was restored in 1894–97. There is a statue to Steen S. Blicher (1782–1848), the national poet and novelist of Jutland.

Randers is best known in history as the scene of the assassination of Count Gerhard by Niels Ebbesön in 1340. In the middle ages it had six churches and four monastic establishments, the oldest a Benedictine nunnery (1170). The Grey Friars' building was turned into a castle (Dronningborg) after the Reformation; its church was burned down in 1698.

RANDOLPH, EDMUND [JENNINGS] (1753–1813), American statesman, was born on the 10th of August 1753, at Tazewell Hall, Williamsburg, Virginia, the family seat of his grandfather, Sir John Randolph (1693–1737), and his father, John Randolph (1727–84), who (like his uncle Peyton Randolph) were king's attorneys for Virginia. Edmund graduated at the College of William and Mary, and studied law with his father, who felt bound by his oath to the king and went to England in 1775. In August–October 1775 Edmund was aide-de-camp to General Washington. In 1776 he was a member of the Virginia Convention, and was on its committee to draft a constitution. In the same year he became the first attorney-general of the state (serving until 1786). He served in the Continental Congress in 1779 and again in 1780–82. He had a large private practice, including much legal business for General Washington. In 1786 he was a delegate to the "Annapolis convention," and in 1787–88 was governor of Virginia. He was a delegate to the Constitutional Convention of 1787, and on the 29th of May presented the "Virginia plan" (sometimes called the "Randolph plan").[1] In the Convention Randolph advocated a strongly centralized government, the prohibition of the importation of slaves, and a plural executive, suggesting that there should be three executives from different parts of the country, and refused to sign the constitution because too much power over commerce was granted to a mere majority in Congress, and because no provision was made for a second convention to act after the present instrument had been referred to the states. In October 1787 he published an attack on the Constitution; but in the Virginia convention he urged its ratification, arguing that it was too late to attempt to amend it without endangering the Union, and thinking that Virginia's assent would be that of the necessary ninth state. In 1788 he refused re-election as governor, and entered the House of Delegates to work on the revision and codification of the state laws (published in 1794). In September 1789 he was appointed by President Washington first attorney-general of the United States. He worked for a revision of Ellsworth's judiciary act of 1789, and especially to relieve justices of the supreme court of the duties of circuit judges, and advocated a Federal code; in 1791 he considered Hamilton's scheme for a national bank unconstitutional; and in 1792–93, in the case *Chisolm* v. *Georgia* before the supreme court, argued that a state might be sued by a citizen of another state. On the 2nd of January 1794 he succeeded Thomas Jefferson as secretary of state. In 1795 he wrote thirteen letters (signed "Germanicus") defending the President in his attack on the American Jacobin or democratic societies. He was the only cabinet member who opposed the ratification of the Jay treaty (his letters to the President on the subject are reprinted in *The American Historical Review*, vol. xii. pp. 587–599), and before it was ratified the delicate task of keeping up friendly diplomatic relations with France fell to him. Home despatches of the French minister, Joseph Fauchet, intercepted by a British man-of-war and sent to the British minister to the United States, accused Randolph of asking for money from France to influence the administration against Great Britain. Although this charge was demonstrably false, Randolph when confronted with it immediately resigned, and subsequently secured a retractation from Fauchet; he published *A Vindication of Mr Randolph's Resignation* (1795) and *Political Truth, or Animadversions on the Past and Present State of Public Affairs* (1796). He was held personally responsible for the loss of a large sum of money during his administration of the state department, and after years of litigation was judged by an arbitrator to be indebted to the government for more than $49,000, which he paid at great sacrifice to himself. He removed to Richmond in 1803, and during his last years was a leader of the Virginia bar; in 1807 he was one of Aaron Burr's counsel. He died at Carter Hall, Millwood, Clarke county, Virginia, on the 12th of September 1813.

Moncure D. Conway, in his *Omitted Chapters of History disclosed in the Life and Papers of Edmund Randolph* (New York, 1888; 2nd ed., 1889), greatly exaggerates Randolph's work in the Constitutional Convention; the commoner view underrates him and makes him a "hair-splitter," and a man of no decision of character.

RANDOLPH, JOHN (1773–1833), of Roanoke, American statesman. He was a member of an influential and wealthy Virginian family, and was the third and youngest son of John Randolph of Cawsons, Chesterfield county, where he was born on the 2nd of June 1773. He was a descendant of John Rolfe and his wife Pocahontas. His father having died in 1775, his early years were passed under the care of his mother and his stepfather, Mr St George Tucker, from whom, however, he eventually became estranged, as he did from almost every one with whom he was intimately associated. He attended a school at Williamsburg, Virginia, and for a short time studied at Princeton and at Columbia; but, although well read in modern works bearing on politics and philosophy, his own statement, "I am an ignorant man, sir," was in other respects not inaccurate. Both his religious and his political views were radical and extreme. At an early period he imbibed deistical opinions, which he promulgated with eagerness. He was also, though a mere boy when the new Federal government was organized in 1789, strongly opposed to the new Constitution of the United States. In order to assist in asserting the right of resistance to national laws, and to withstand the "encroachments of the administration upon the indisputable rights" of Virginia, he was in 1799 elected as a Republican to the national House of Representatives, of which he was a member, with the exception of two terms (1813–15 and 1817–19), until 1825, and again in 1827–29. After the accession of Jefferson to the presidency in 1801, Randolph was appointed chairman of the Committee of Ways and Means, and as such was naturally the leader of the Republican majority in the House. He took an active part in agitating for the reform of the judiciary, and in 1804 moved the impeachment of Judge Samuel Chase (*q.v.*), acting as the leader of prosecution in the trial before the Senate. Though an avowed Republican, he was far from being subservient to his party, and for several years after 1805 led a small faction, called "Quids," which sharply criticized Jefferson and attempted to prevent the selection of Madison as the presidential candidate of his party. In March 1807 he lost the chairmanship of the Ways and Means Committee. Possessing considerable wit, great readiness, and a showy if somewhat bombastic eloquence, he would undoubtedly have risen to high influence but for his strong vein of eccentricity and his bitter and ungovernable temper. The championship of state's rights was carried by him to an extreme utterly quixotic, inasmuch as he not only asserted the constitutional right of Virginia to interpose her protest against the usurpation of power at Washington, but claimed that the protest should be supported by force. From December 1825 to March 1827 he served in the United States Senate, and in April 1826 he was forced to fight a duel with Henry Clay, on account of his violent abuse of that statesman in the course of a debate. In 1830 he was sent by President Jackson on a special mission to Russia, but remained in St Petersburg only ten days, then spent almost a year in England, and on his return in October 1831 drew $21,407 from the United States Treasury for his services. He died of consumption at Philadelphia on the 24th of June 1833. Though his political life was full of inconsistencies—he was even capable of advocating the passage of a bill on one day and of opposing the passage of the same bill on the next—he generally adhered to the principles enunciated by the Republican party in its earliest years, and throughout his later career, in numerous speeches, he laboured to bring about the identification of slavery with the theory of states' rights. In this he was the natural precursor of Calhoun. His last will was disputed in the law courts, and the jury returned a verdict that in the later years of his life he was not of sane mind. He was always in theory opposed to slavery, and by the will which was accepted by the courts, freed his own slaves.

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[1] The plan was not drafted by Randolph, but he presented it because he was governor. It called for a legislature of two branches, one chosen by the people and based on free population (or on wealth) and the other chosen by the first out of candidates nominated by the state legislatures; a majority vote only was required in each house; and Congress was to have a negative on such state legislation as seemed to the Congress to contravene the articles of the Union. There was to be, under this plan, an executive chosen by the national legislature, to be ineligible for a second term, to have general authority to execute the national laws and to have the executive rights vested in Congress by the Confederation; and the executive with a convenient number of the national judiciary was to compose a Council of Revision, with a veto power on acts of the national legislature and on the national legislature's vetoes of acts of state legislatures—but the national legislature might pass bills (or vetoes of state legislation) over the action of the Council of Revision. The plan provided for a Federal judiciary, the judges to be appointed by the national legislature, to hold office during good behaviour, and to have jurisdiction over cases in admiralty and cases in which foreigners or citizens of different states were parties. The Virginia plan was opposed by the smaller states, Connecticut, New Jersey, Delaware and Maryland, which demanded equal representation in the legislature. It was too radically different from the Articles of Confederation. A draft of a constitution in Randolph's handwriting, discovered in 1887, seems to have been the report (6th August) of a Committee of Detail of five members (John Rutledge, Edmund Randolph, Nathaniel Gorham, Oliver Ellsworth and James Wilson). It is reproduced in facsimile in W. M. Meigs's *The Growth of the Constitution* (Philadelphia, 1900). Conway, who discovered it, exaggerated its importance and thought it had been drawn by Randolph alone and before the Convention.

The best biography is that by Henry Adams, *John Randolph* (Boston, 1882), in the "American Statesmen Series." There is also a biography, which, however, contains many inaccuracies, by Hugh A. Garland (2 vols., New York, 1851).

RANDOLPH, PEYTON (1721–1775), American politician, was born at Tazewell Hall, Williamsburg, Virginia, in 1721, a son of Sir John Randolph (1693–1737), the king's attorney for Virginia. He graduated at the College of William and Mary, studied law at the Inner Temple, London, and in 1748 was appointed the king's attorney for Virginia.[1] Randolph wrote the address of remonstrance to the king in behalf of the Burgesses against the suggested stamp duties in 1764. His policy was conservative and moderate, and in May 1765 he opposed Patrick Henry's radical "Stamp Act Resolutions." In 1766 he resigned as king's attorney and was succeeded by his brother John (1727–1784). In 1769 he acted as moderator of the privately convened assembly which entered into the non-importation agreement, and in May 1773 he became chairman of the first Virginia intercolonial committee of correspondence. He presided over the provincial convention of August 1774, and was a member of the First Continental Congress, of which he was president from the 5th of September to the 22nd of October 1774. He was re-elected to Congress in March 1775, and on the 10th of May was again chosen to preside, but on the 24th he left to attend a meeting at Williamsburg of the Virginia Burgesses. He then returned to Congress, of which John Hancock had meanwhile been made president. Randolph died of apoplexy in Philadelphia on the 22nd of October 1775. He was provincial grand-master of the Masons of Virginia, and was an intimate friend of Washington.

RANDOLPH, THOMAS (1523–1590), English diplomatist, son of Avery Randolph, a Kentish gentleman, was educated at Christ Church, Oxford, and in 1549 became principal of Pembroke College, Oxford, then known as Broadgates Hall. During the reign of Mary, Randolph, who was a zealous Protestant, sought refuge in Paris, where he cultivated the society of scholars. Returning to England after the accession of Elizabeth, he was soon employed as a confidential diplomatic agent of the English queen in Scotland. Here he succeeded in gaining the confidence of the Protestant party, with whom he became a person of great influence. Randolph's despatches from Scotland between 1560 and 1585 supply important materials for the history of the political intrigues of that period. Randolph, who had hitherto remained ostensibly on terms of friendship with Mary Queen of Scots, exerted his influence on instructions from Elizabeth to prevent Mary's marriage with Darnley; but in 1566 he was driven from Scotland on the charge of having fomented Murray's rebellion, and he then obtained government employment of secondary importance in England. In 1568 he undertook a mission to Russia which resulted in the concession by Ivan the Terrible of certain privileges to English merchants; and in 1570 he returned to Scotland, where, after the murder of the regent Murray in January of that year, he "succeeded," says Andrew Lang, "in making civil war inevitable; he himself was in high spirits, as always when mischief was in hand." After carrying through certain diplomatic business in France in 1573 and 1576, Randolph returned in January 1581 to Scotland, where the earl of Morton, the regent, had been arrested a few days previously. Randolph, acting on Elizabeth's instructions, intrigued with Angus and the Douglases in favour of a plot to seize the person of the young King James, and to save Morton by laying violent hands on the earl of Lennox. Douglas of Whittingham, who was employed in the intrigue, on being arrested made revelations which imperilled Randolph, and the latter prudently withdrew to Berwick before the execution of Morton in June 1581. In 1585, when he next visited Scotland, he was more successful, being instrumental in arranging a treaty between England and Scotland. For the next four years he was chancellor of the exchequer in England, and he died in London in June 1590. Randolph married, in 1571, Anne, daughter of Thomas Walsingham. He was a personal friend of George Buchanan, in whose *History of Scotland* he took a lively interest, and he has been credited, though on doubtful evidence, with the authorship of a *Life* of the historian in Latin.

See J. A. Froude, *History of England* (12 vols., London, 1881); Andrew Lang, *History of Scotland*, vol. ii. (4 vols., London, 1902–7); *Calendar of State Papers relating to Scotland* (1509–1603), edited by M. J. Thorpe (2 vols.); *Calendar of State Papers, Foreign Series of the Reign of Elizabeth*; Anthony à Wood, *Athenae Oxonienses* and *Fasti*, edited by P. Bliss (4 vols., London, 1813–20).

RANDOLPH, THOMAS (1605–1635), English poet and dramatist, was born near Daventry in Northamptonshire, and was baptized on the 15th of June 1605. He was educated at Westminster and at Trinity College, Cambridge. He took his B.A. degree in 1628, proceeded M.A. in 1632 and became a major fellow of his college in the same year. He soon gave promise as a writer of comedy. Ben Jonson, not an easily satisfied critic, adopted him as one of his "sons." He addressed three poems to Jonson, one on the occasion of his formal "adoption," another on the failure of *The New Inn*, and the third an eclogue, describing his own studies at Cambridge. He lived with his father at Little Houghton in Northamptonshire for some time, and afterwards with William Stafford of Blatherwick, at whose house he died before completing his thirtieth year. He was buried in Blatherwick church on the 17th of March 1634–35, and his epitaph was written by Peter Hausted, the author of *The Rival Friends*.

Randolph's reputation as a wit is attested by the verses addressed to him by his contemporaries and by the stories attached to his name. His earliest printed work is *Aristippus, Or, The Joviall Philosopher. Presented in a private shew, To which is added, The Conceited Pedlar* (1630). It is a gay interlude burlesquing a lecture in philosophy, the whole piece being an argument to support the claims of sack against small beer. *The Conceited Pedlar* is an amusing monologue delivered by the pedlar, who defines himself as an "*individuum vagum*, or the *primum mobile* of tradesmen, a walking-burse or movable exchange, a Socratical citizen of the vast universe, or a peripatetical journeyman, that, like another Atlas, carries his heavenly shop on's shoulders." He then proceeds to display his wares with a running satirical comment. *The Jealous Lovers* was presented by the students of Trinity College, Cambridge, before the king and queen in 1632. *The Muse's Looking-Glass* is hardly a drama. Roscius presents the extremes of virtue and vice in pairs, and last of all the "golden mediocrity" who announces herself as the mother of all the virtues. *Amyntas, or The Impossible Dowry*, a pastoral printed in 1638, with a number of miscellaneous Latin and English poems, completes the list of Randolph's authenticated work. *Hey for Honesty, down with Knavery*, a comedy, is doubtfully assigned to him.

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[1] In 1754 the Burgesses sent him to London to argue against the governor's demand for a fee of one pistole on every land patent; his plea was successful, but the governor superseded him with George Wythe, who resigned in Randolph's favour upon his return from England. The Burgesses voted Randolph £2500 with the grant of £20,000 to Governor Dinwiddie for Indian warfare; the governor would not approve this appropriation, however, until Randolph apologized for leaving his office without the governor's permission.

His works were edited by W. C. Hazlitt in 1875.

RANDOM (older forms *randon, randoun*; from the French, cf. *randir*, to run quickly, impetuously; generally taken to be of Teutonic origin and connected with Ger. *Rand*, edge, brim, the idea being possibly of a brimming river), an adjective originally meaning impetuous, hasty, hence done without purpose or aim, haphazard. The term "random work" is used, in architecture, by the rag-stone masons, for stones fitted together at random without any attempt at laying them in courses. "Random coursed work" is a like term applied to work coursed in horizontal beds, but the stones are of varying height, and fitted to one another (see MASONRY).

RANELAGH, formerly a popular resort by the Thames in Chelsea, London, England. About 1690 the land lying east of Chelsea Hospital, and bordering the river about the point where Chelsea Bridge now stands, was acquired by Richard, Viscount Ranelagh, later earl of Ranelagh (d. 1711). He built a mansion and laid out fine gardens, which, in 1742, were thrown open as a proprietary place of entertainment. A building called the Rotunda was erected for concerts, and the gardens quickly became a favourite resort of fashionable society. Balls and masquerades, exhibitions of fireworks, regattas and many other forms of amusement were provided; but by the close of the 18th century Ranelagh was ceasing to attract the public, and in 1803 the Rotunda was closed. The buildings were removed, and the grounds became the property of Chelsea Hospital. They are still included in the pleasant gardens belonging to that foundation, but no traces of the popular Ranelagh are preserved. There is, however, a fashionable modern club of the same name.

See Warwick Wroth, *London Pleasure Gardens of the Eighteenth Century* (London, 1896).

RANGE-FINDER, TELEMETER or POSITION-FINDER (Fr. *télémètre*; Ger. *Distanzmesser*; It. *Telemetro*; Russ. *Dalnomier*; Span. *Telémetro*; in the United States the word telemeter is sometimes applied to the stadia used in connexion with the tacheometer), an instrument, of which many varieties have been invented, for assisting the gunner and the infantry soldier in determining the distance or "range"[1] to their objective. Nearly all range-finders may be described as instruments which automatically solve a triangle. Usually it is a right-angled triangle, the length of the base of which is known, and one of the sides is the range it is desired to find. They are, in fact, goniometers, but the angle which they measure, whether it may be at the end of the measured base, or that subtended by it, is usually expressed as a function of the angle in terms of the measured base. Thus the range is recorded directly in metres or yards without calculation. It is proposed here to describe principally the range-finding instruments in the British services (1) as used in the fleet; (2) by the army in the field; (3) in harbour defence; and (4) to refer briefly to range-finders, not under these heads, of English and foreign design.

1. The necessity for a range-finder afloat caused the British Admiralty in 1891 to issue an advertisement in the press inviting inventors to produce an instrument which would, amongst other conditions, record ranges with an accuracy of within 3% at 3000 yds. The resulting competition was declared in favour of a range-finder which is the joint invention of Professor Barr of the Glasgow University and Professor Stroud of the Yorkshire College.

Barr and Stroud.

The naval range-finder consists of a tube[2] which contains two telescopes. It is carried on a frame by bearings, in which the tube is free to revolve about its longer axis. To the frame is attached a weight capable of movement within a tank. This weight balances the range-finder and frame upon knife-edges. By means of the handle on the left of the instrument and an altitude worm beneath it, the motion of the tube is governed, and the line of sight is directed on the objective. By partially filling the tank with water, the swinging of the weight in a seaway can be checked. The frame is supported on a pedestal and can rotate in azimuth upon it (fig. 1).

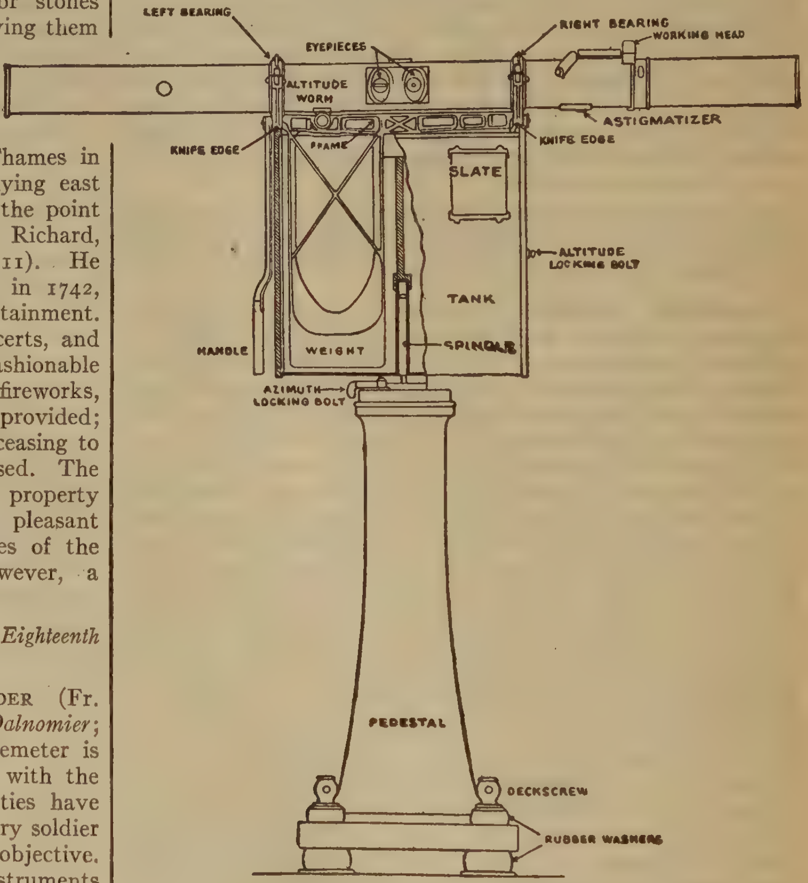

FIG. 1.—Barr and Stroud.

A rubber guard is fitted round the eye-pieces. Its functions are to guide the eyes of the observer into the correct position, and to protect them from side light and the distressing effect of wind. It also guards the forehead against the jar occasioned by firing heavy guns. The upper portion of the field presented to the left eye is used as a finder, the lower portion is occupied by the scale upon which the ranges are engraved. The finder is a low-power telescope of large field, to the centre of which the objective is brought. When the telescope is thus correctly aligned, the objective will be seen with the right eye largely magnified, but as two partial images separated by a thin black horizontal line. When coincidence of the images is effected by means of the working head, the range can be read off against a pointer from the scale seen with the left eye. For night use, means are provided for illuminating the scale. The range to lights may be ascertained by the use of the astigmatizer, an optical device by which a point of light is drawn out into a vertical streak. A beam of light from the objective falls on each reflector (fig. 2), and passing through the object-glasses, each is received by an arrangement of prisms about the centre of the tube, and reflected through the right eye-piece. Two partial images are thus seen. The images could be united by the rotation of one of the reflectors, but owing to the small base used the necessary movement would be so extremely small that it would be practically impossible to measure it. The difficulty has been surmounted by utilizing fixed reflectors and effecting coincidence by means of a prism of small angle. The deflecting prism is situated in the line of the beam of light from the reflector at the right-hand end of the tube. Its multiplying action is of great delicacy. The angle available for subdivision, to measure ranges between infinity and 250 yds., is only one-third of a degree. In a travel of 6 in. the prism renders accurate measurements possible within the required limits. To bring images of distant objectives into coincidence, the prism must be moved towards the eye-piece, and for near objectives in the opposite direction. The range scale is attached to the prism. A consequent advantage is that the accuracy of the instrument is not affected by back lash arising from wear, or irregularity in the actuating mechanism. When once installed, the instrument is always ready for use. Should adjustment be required it is readily and easily applied. It is not within the sphere of this article to enter into the detail of the adjusting mechanism. For further particulars the reader is referred to the *Proceedings of the Institution of Mechanical Engineers*, 30th January 1896. The working of the range-finder is so simple that its use is quickly learnt by any man who can read, and with little instruction and practice he can "take a range" in 8 to 12 seconds. Besides its principal purpose, in connexion with gunnery, there are minor uses in navigation and nautical surveying to which the range-finder can be applied.

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[1] The word "range," from O.Fr. *range*, from *ranger*, to place in a row or rank (*rang* being a variant of *ranc*, whence Eng. "rank"), meant properly a row or line of objects, as still in "mountain-range"; the secondary meanings of an area or space of ground, sphere of action, compass, extent, distance, are derived from the verb "to range," to stretch out in a line, to extend, to move about over a given area.

[2] The length of tube varies from 3 ft. in the smaller to 9 ft. in the larger instruments.

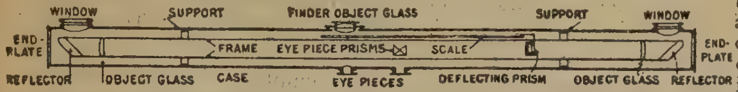


Fig. 2.—Barr and Stroud.

With the high speeds of modern war-vessels, guns and their objective approach each other so quickly that unless ranges can be communicated from the instrument to the guns with rapidity and accuracy the range-finder is deprived of much of its value. In connexion with the naval range-finder an apparatus is provided, which though not part of the range-finder is sufficiently important to claim passing notice. The apparatus consists of a transmitting and a receiving instrument of clockwork mechanism electrically controlled. In appearance they resemble the ordinary engine-room telegraph, on the dials of which ranges take the place of orders. The transmitter can communicate with a number of receiving instruments, disposed as required in different parts of the ship.

2. Before the introduction of the Marindin range-finder described below, the British army in the field used the "mekometer." The instruments used by the cavalry and infantry are smaller and lighter than those of the artillery pattern, but the principle involved is identical.

The mekometer is practically a box sextant. Two instruments are used simultaneously at the ends of a base of fixed length. One sextant, called the right-angle instrument, is fitted with index and horizon glasses permanently inclined at 45°. It consequently measures a right angle. In the other sextant, called the reading instrument, a graduated drum takes the place of the usual index arm and scale. The drum is graduated spirally with a scale of ranges. Both reading and right-angle instruments are fitted with a vane of gun metal with a white strip down the centre to facilitate observations. Telescopes of low power can be fitted to the instruments, and two cords of 50 (or 25½) yds. are provided with which to measure the base.

Mekometer.

Two observers attach the ends of the cord of fixed length (usually 50 yds.) to their instruments and separate until it is taut. The observer with the right-angle instrument moves into such a position that coincidence of image will be given between the objective and the vane of the instrument at the other end of the base, *i.e.* he makes ABC a right angle (fig. 3).

When the right angle is established, the observer at C turns the graduated drum of the reading instrument until the image of the vane of the right angle instrument coincides with the direction of the objective. The range AC is then read on the drum. The ranges on the drum are measures of the angle BAC when the base BC is 50 yds.

The mekometer is open to the objection which is common to all range-finders requiring more than one observer. There is always a danger that observers may cause coincidence on different objectives or on different parts of the same objective, and thus inaccuracy in the recorded range must result. The instruments are expected to give an accuracy of less than 2 % at 2000 yds. For ranges over that distance, *i.e.* for usual artillery ranges, it is desirable to use a double base (100 yds. in length), in which case the range registered on the drum must be doubled. This operation, although slight, is a distinct disadvantage, since it adds to the time of taking a range and is a possible source of error. For field artillery, however, a range-finder is only an auxiliary adjunct. The true range can be found by a process of trial and error (see Artillery) in as short a time as the mekometer observers take to report it. It must further be remembered that as shrapnel is the principal projectile of field artillery, not only the correct elevation but also the true length of time fuse has to be found. This the range-finder cannot do. Hence it is that the range-finder for field artillery, although a valuable auxiliary, is not of the same importance as in purely defensive positions, such as batteries for harbour defence, and land forts.

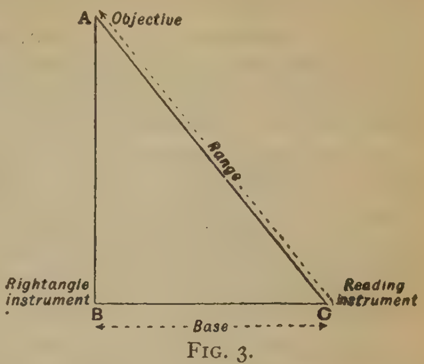


Fig. 3.

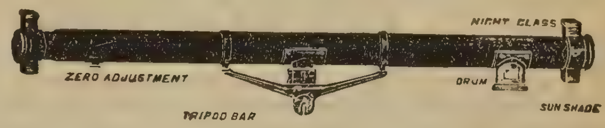
The Marindin range-finder was from 1908 gradually introduced in the infantry to replace the mekometer. It was the invention of Captain A. H. Marindin, of the Black Watch (Royal Highlanders).

The principle of the instrument is that of coincidence, as in the Gautier Christie, Le Cyre, Souchier, and Barr and Stroud. But it differs from the last mentioned in that the right prism is made movable, and this movement (necessarily extremely small) is a function of the recorded range.

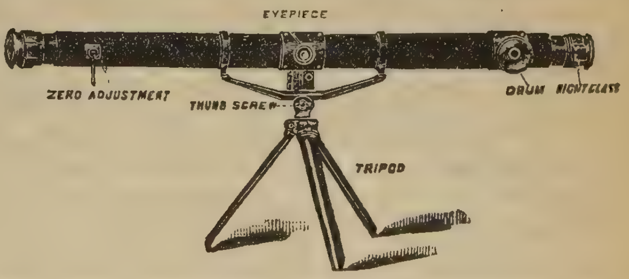
Marindin Range-Finder.

The steel tube, forming the base of the instrument, which carries the prisms, is supported inside an aluminium outer tube in such a way that no direct shock is communicated to it. The appearance of the outside of the instrument, together with the names of the various parts, is shown in fig. 4.

The instrument can be used in two main positions, viz. *horizontally*, for ranging on upright objects, or *vertically*, for ranging on horizontal targets.



Instrument closed.



Instrument ready for use.

Fig. 4.—Marindin Range-Finder.

For instance, in the diagram (fig. 5) of a road running uphill, the instrument could be held in any of the three positions indicated, and would give good ranges, but probably the best range would be obtained if held as at *c*. If it is required to use the instrument

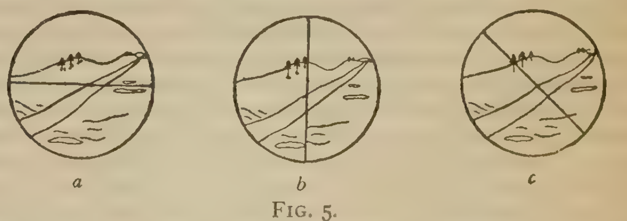


Fig. 5.

at night, the two caps of the night-glasses should be opened. On looking through the instrument, any lamp or other light will appear like a fine, bright line, and the range can be taken in the ordinary way.

This range-finder possesses the superlative advantage of the one-man instrument, and it is claimed for it that it can range on horizontal objects, such as the crest of a hill, which has no detail suitable for use with a mekometer, and that it can be adjusted on service with no greater difficulty than the setting of a watch.

3. For harbour defence, owing to the long range of naval guns, and the fast targets which war-vessels present, an accurate range-finder is of first importance. This is largely the case because "ranging" cannot be resorted to in the same manner as in the field, where the targets are comparatively motionless and the effective ranges are less. Successful artillery practice therefore depends, in a great measure, upon the range-finder.

The instrument used in harbour forts is known as the *depression* range-finder. As its name suggests, it solves a triangle in the vertical plane, of which the base is the height of the instrument above sea-level. Its appearance resembles some forms of theodolite (fig. 6). A framework, capable of rotating in azimuth on a vertical pivot, is supported on a plate carried by levelling screws, L, L, L. To the framework are pivoted two arms DC and FE, at C and E respectively. The arm EF is supported at F by a vertical screw H ending in a drum, upon which, in a spiral scale, the ranges are graduated. Motion in altitude is thus given to the telescope. The arm CD is supported by a slider G. This slider is set by a rack and pinion to the height above sea-level (represented on a scale of feet on EF) at which the instrument may be used. A telescope AB is suitably fitted in jaws at the top of the frame. There are spirit-levels at M and Q for adjusting purposes. The telescope is provided with cross wires which can be illuminated for night use. An azimuth circle X and pointer Y enable the direction of any vessel to be indicated, the range of which it is desired to know. The instrument rests on a base plate R, to which it is locked by the top-plate O. The observer directs the cross wires of the telescope upon the water-line of the objective, by means of the drum I and the azimuth handle P, the top of which just appears in the diagram. The reader watches the arrow on the drum and calls out the ranges as the figures arrive beneath it. The ranges are communicated to the officers at the guns by various devices, which differ according to local requirements.

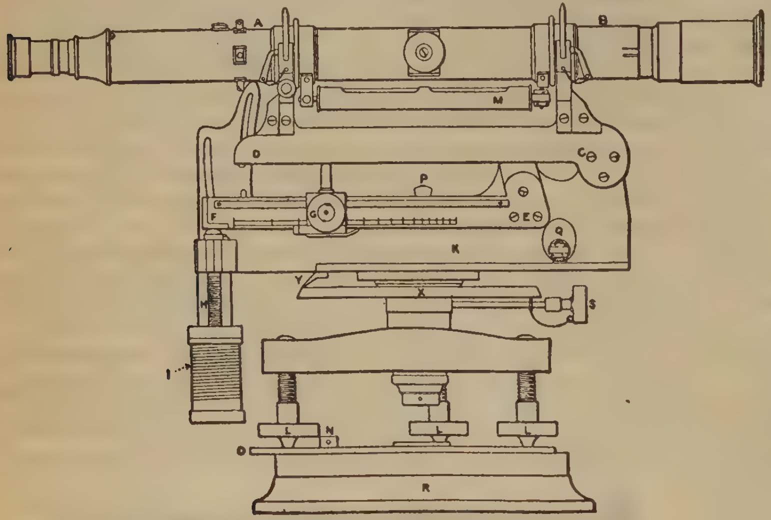


FIG. 6.—Depression Range-Finder.

Position-Finder.—The range-finding instrument known in the British service as the Position-Finder (invented by Colonel Watkin, C.B., R.A.) is practically a large depression range-finder. It posesses, however, certain additional appliances which render it capable of automatically recording, upon an oriented chart, the position or course of a vessel. And further, by electrical means it automatically records to a distant battery the range and bearing of the desired objective. The position-finder can therefore, from a concealed and safe position, automatically control the fire of a group of guns, whose detachments need not necessarily see the target engaged. As the observer follows the objective with the telescope of the instrument the range and bearing is simultaneously shown in the battery on convenient dials. The distance and direction thus communicated are the range and bearing from the guns, not as measured from the range-finder. The correction due to the displacement between gun and instrument is automatic. In localities where the height does not admit of using the depression system, an alternative arrangement is provided, known as the Horizontal Position-Finder. It is open to the objections common to two-man range-finders, and is only employed where necessity compels its use. Briefly, there are two observing stations at either end of a measured and electrically connected base. One is known as the transmitting and the other the receiving station; the latter contains the principal instrument, which usually is capable of independent use for medium and short ranges as a depression instrument.

Coast Defence Instruments.

It will be seen that the difference between the two systems is, that the first described solves the range triangle in the vertical, and the latter in the horizontal plane. There have been various methods proposed for using the position-finder. The best results are obtained by placing range and bearing dials on the gun-mounting in a position where they can be easily seen by the men elevating and training the gun. The gun is kept directed upon the objective and fired as quickly as it can be loaded. A position-finder can be used for firing mines in a mine field, and instruments are issued to the Royal Navy for this purpose.

In the United States of America the term "position-finder" is applied to a range-finder which gives direction as well as distance. This is substantially correct, but custom, in the British service, confines the use of the expression as defined above.

4. Various appliances, not strictly range-finders, are sometimes used to assist in estimating distance. The following examples are not without interest:—

Acoustic telemeters, depending upon the velocity of sound, are obviously unsuited to the requirements of modern warfare. The names of Thouvenin, Rédier and Le Boulengé are connected with such instruments—that of the last-named is perhaps the most convenient. It consists of a graduated glass tube filled with liquid, of suitable density, and containing a small metal traveller. At the flash of discharge of a gun or rifle the instrument is brought to a vertical position, and the traveller starts from zero; at the detonation, it is turned to a horizontal position and the traveller stops at the point on the scale indicating the range.

On this principle is the rough method of ascertaining the distance, in yards, of a thunderstorm, viz. multiply the number of seconds elapsing between the perception of the lightning and that of the thunder by the number of days in the year.

Optical or *perspective telemeters* determine the distance to any point by observing the size of some object of known dimensions, as seen in a graduated telescope. Porro's telemeter, Elliott's telescope and Nordenfelt's macrometer illustrate the principle. The chief defect of the system is that the objects most conveniently observed—men and horses—vary considerably in size, so that the assumption of a constant dimension may be productive of error.

Other Telemeters.

On the continent of Europe the perspective telemeter for military purposes has attracted more attention than in England. The French in their precise terminology call such an instrument "Stadia militaire," a term which at once distinguishes it from a "télémètre," and describes its nature. In rapid military sketching, in locating positions upon maps, &c., perspective telemeters find a use. The telescopes issued to field batteries and to coast forts in France are provided with a scale in the field of view. By comparing this scale with known heights, such as the average height of a man on foot, or the known height of funnels, masts, turrets, &c., of a war-vessel, distance can be estimated with fair accuracy.

The "jumelle Souchier," which can be used as an ordinary field-glass, is constructed on the stadia principle. By its means ranges can be estimated within an accuracy of 10%. A stand or rest, however, is necessary for good results.

General Percin of the French army has shown, in an interesting pamphlet, that a piece of wood or card cut to a known fraction of the distance between the eye and the end of the thumb, when the arm is fully extended, can be used to estimate distances. Thus it is easy to find a penny in good condition of which the thickness is $\frac{1}{400}$th part of the arm-length in a man of average height. Provided with such a coin an observer finds its rim to exactly cover a distant man 6 ft. (or 2 yds. high). The range therefore is $400 \times 2 = 800$ yds. Similarly, if the man's height appeared to be but half the thickness of the coin the range would be $4 \times 400 = 1600$ yds. With a little practice the eye estimates the proportion between the object of known height and the stadia used. General Percin gives many useful applications of this simple device.

Various range-finders have been produced in countries outside the British Isles which, as they are the outcome of similar necessity and required for identical purposes, naturally resemble, more or less, the instruments already described.

Field artillery officers of all countries usually claim their gun to be their best range-finder. This may be another way of saying that a durable, one-man range-finder, capable of instantaneously finding modern artillery ranges with accuracy, has yet to be invented. In France the "télémètre Goutier" for field artillery, a two-man instrument, corresponds with the Watkin mekometer.

The "Gautier," used by the Italian field artillery, is a one-man instrument, but requires a measured base-line. The "Aubry" telemeter, used by some of the Russian batteries in Manchuria, is very portable, but requires a measured base-line, and a slide rule to find the range. In the French and Russian infantry the "prisme-télémètre," the invention of Colonel Souchier, is used. It is small, very light, and can be carried in the same manner as field-glasses. French machine guns are ranged by the "télémètre instantané," an instrument of the Barr and Stroud type, with an aluminium base 1 metre in length.

For work in the field the modern tendency abroad is to follow Barr and Stroud. In Germany, Hahn, Goerz and Zeiss have produced handy and fairly light short base range-finders, in outward appearance more or less similar to Marindin's instrument.

The Zeiss range-finder, however, depends on the stereoscopic principle. It is open to the objection that best results can only be obtained with it by persons who are capable of seeing stereoscopically, and also, in individuals possessing this particular gift (a comparatively small proportion of the human race), stereoscopic vision may vary in power from day to day. Nevertheless the Zeiss range-finder has found favour in many countries, notably as the infantry range-finder in Italy. For naval and harbour defence purposes the Barr and Stroud range-finder is very largely used throughout the world. In Italy a Barr and Stroud instrument, with the large base of 5 metres, was in 1908 under trial for coast artillery.

Of the depression range-finder type in France, "le télémètre Dévé" is used at all heights of about 70 ft. and upwards.

Brazil possesses, in the invention of Captain Mario Netto, an excellent range-finder. It is supplied to the harbour defences of that country. It is accurate, handy, easily transported and re-erected where required, and is not affected by the concussion of heavy gun-fire. The German coast range-finder of Hahn closely resembles the earlier Watkin instruments. In Italy the Amici instrument is being replaced by the Braccialine. The latter inventor has also supplied his country with a horizontal base instrument.

After extended competitive trials in the U.S.A. the Lewis depression range-finder has been found superior to others presented to the Range-Finding Committee, and is recommended for adoption. It is a neat, workmanlike instrument, and gave an average mean error of 24 yds. in the ranges recorded during the trials. The maximum range was 12,000 yds. and the height of base $135\frac{1}{2}$ ft.

The details of position-finders abroad, as in the British service, are confidential, and but little is published of the "télémètre par recoupement" of the French coast batteries, or the "telegoniometro Sollier" of Italy. In the United States, B. A. Fiske has ingeniously adapted the principle of the Wheatstone bridge in the construction of the position-finder which bears his name.

See de Marré, *Instruments pour la mesure de distances* (Paris, 1880); *Abridgments of Specifications*, Class 97, Patent Office, London; *Handbooks and Instructions for Range-Finder*, published by the British War Office; Barr and Stroud, *Proc. Inst. Mech. Eng.*, 30th Jan. 1896; Zeiss pamphlet by Carl Zeiss of Jena, which gives a candid statement of the difficulty attending the stereoscopic principle, &c. (F. M. L.*)

RANGER, HENRY WARD (1858–), American artist, was born at Syracuse, New York, in January 1858. He became a prominent landscape and marine painter, much of his work being done in Holland, and showing the influence of the modern Dutch school. He became a National Academician (1906), and a member of the American Water Color Society. Among his paintings are, "Top of the Hill," Corcoran Gallery of Art, Washington, D.C.; and "East River Idyll," Carnegie Institute, Pittsburg.

RANGOON, the capital of Burma, situated on the left bank of the Hlaing or Rangoon river, 21 m. from the sea, in 16° 47′ N. and 96° 13′ E. In 1880 the city was detached from the main district, called Hanthawaddy, and formed into a separate district, with an area of 19 sq. m. Pop. (1901) 234,881, of whom just half were immigrants from India. Rangoon, from being a comparatively insignificant place, has within less than half a century risen to be the third seaport in British India, being surpassed only by Calcutta and Bombay in the volume of its trade. During the busy season of rice-export, which lasts from the end of December to the middle of May, the pool forming the port of Rangoon presents almost as crowded a scene as the Hugli at Calcutta. Rangoon has the double advantage of being situated near the sea and being served by a great river navigable for 900 m. behind it. The approach to the port is not difficult at any season of the year. With flat and shelving shores, the shoal-banks off the main mouths of the delta form the chief danger to shipping, and this is guarded against by a good service of lighthouses and lightships. For a length of seven or eight miles the river is from a mile to a mile and a quarter in breadth, so that there is plenty of accommodation for shipping. Here is concentrated the whole of the rich trade of the delta of the Irrawaddy. Great part of the river frontage is occupied with rice-mills, teak wharves and similar buildings. The rice exported from Rangoon in 1904–5 amounted to 28 million cwt. with a value of nearly 7 million sterling.

The city is dominated by the great golden pile of the Shwe Dagôn pagoda, the centre of Burmese religious life. Rising to a height of 368 ft., this magnificent building is loftier than St Paul's Cathedral in London, and its size is greatly enhanced by the fact that it stands on an eminence that is itself 168 ft. above the level of the city. It is covered with pure gold from base to summit, and once in every generation this gold is renewed by public subscription. Moreover, benefactions to this pagoda are one of the favourite methods of acquiring religious merit among the Burmese. The pagoda itself has no interior. It is a solid stupa of brick, in the form of a cone, raised over a relic chamber; and the place of worship is the surrounding platform with a perimeter of nearly 1400 ft.

Though traditionally a site of great sanctity, Rangoon owes its first importance to its rebuilding in 1753 by Alompra, the founder of the Burmese monarchy, who gave it the present name of *Yan Kon*, "the end of the war." An English factory was opened here about 1790. On the outbreak of the first Burmese War, in 1824, it was taken by the British, but subsequently restored. It was captured a second time in 1852, and passed along with the province of Pegu into the hands of the British. It was destroyed by fire in 1850, and serious conflagrations occurred again in 1853 and 1855. Since the last devastation Rangoon has undergone considerable improvements. Until 1874, when the existing municipality was constituted, the administration was in the hands of the local government, which devoted itself to raising the centre of the town above the river level, providing land fit for building purposes from the original swamp, which was flooded at spring-tides, and making roads, bridges, culverts and surface drains. In 1892 was introduced the sewage system, which now includes 6 m. of mains, 22 m. of gravitating sewers, $4\frac{3}{4}$ m. of air mains and 44 Shone's ejectors. The water supply, drawn from the Victoria Lake, 5 m. distant, has recently been supplemented by an additional reservoir, 10 m. farther off. The city proper of Rangoon with the Kemmendine suburb is laid out on the block system, each block being 800 by 860 ft., intersected with regular streets. In the extensions to the east and west it has been decided to have no streets less than 50 ft. wide. The roads are still lighted by kerosene oil lamps, but electric lighting is in comtemplation. Electric tramways run to Pazundaung in one direction and to Alôn and Kemmendine in the other, as well as to the foot of the Shwe Dagôn Pagoda hill. Latterly the erection of masonry buildings, instead of plank houses, has been insisted on in the central portion of the city, with the result that fires have decreased in number. There are two large maidans, or commons, which are used as military parade grounds and for racing, as well as for golf links and other purposes of amusement. There is a garden round the Phayre Museum, managed by the Agri-Horticultural Society, and an extremely pretty and well-kept garden in the cantonments under the pagoda. Beyond these lie the Royal Lake and Dalhousie Park, with 160 acres of water and 205 acres of well-laid-out and well-timbered park land. Dalhousie Park has recently been greatly extended, and the new Victoria Park, declared open on the occasion of the visit of the prince of Wales in 1906, is quite the finest in the East. There are two cathedrals, Church of England and Roman Catholic, and a Presbyterian church, besides the cantonment church buildings for worship. Religious buildings and lands, indeed, occupy an area in Rangoon out of all proportion to its size. Buddhists, Hindus, Mussulmans, Parsees, Armenians and Jews all own lands and pagodas, temples, mosques, churches and synagogues. The Buddhist monasteries, in particular, occupy wide spaces in very central portions of the town and cantonments. Burial-grounds are equally extensive, and exist in every direction in what were once the outskirts, but are now fast becoming central parts of the city. The chief educational institutions are the Government Rangoon college, the Baptist college and St John's college (S.P.G.). Besides the general hospital, a female hospital in connexion with the Dufferin Fund has recently been built, and there are hospitals for contagious diseases and for lepers in the suburbs. The staple industries are mills for husking rice and for sawing timber, and petroleum refineries. Carving in wood and ivory, and embossed silverwork are also carried on. There are three municipal and eight private markets, which are being improved and extended. Everything, from sacking to jewelry, is sold in them. The introduction of pure water and the establishment of compulsory vaccination have greatly improved the health of Rangoon. But the death-rate is still high, due partly to the swampy nature of the outskirts of the city proper, and still more to the mortality among Hindu immigrants from the Madras presidency. The total rainfall in 1905 was 104·96 in. Rangoon is the headquarters of a brigade in the Burma command of the Southern army. (J. G. Sc.)

RANGPUR, or Rungpore, a town and district of British India, in the Rajshahi division of Eastern Bengal and Assam. The town is situated on the little river Ghaghat. Pop. (1901) 15,960. There are a high school, a normal school and an industrial school. The earthquake of the 12th of June 1897 destroyed many of the public buildings and diverted the drainage channels.

The District of Rangpur, with an area of 3493 sq. m., is one vast plain. The greater part of it, particularly towards the east, is inundated during the rains, and the remainder is traversed by a network of streams which frequently break through their sandy banks and plough for themselves new channels over the fields. The river system is constituted by the Brahmaputra and its tributaries, chief of which are the Tista, Dharla, Sankos and Dudhkumar. The climate is generally malarious, owing to the numerous stagnant swamps and marshes filled with decaying vegetable matter. The annual rainfall averages 82 in. About three-fourths of the district is under continuous cultivation. Spare land can hardly be said to exist—even the patches of waste land yield a valuable tribute of reeds and cane. The staple crops are rice, oil-seeds, jute and tobacco. In 1901 the population was 2,154,181, showing an increase of 4.3% in the decade. Nearly two-thirds are Mahommedans. The Eastern Bengal railway has two branches, one of which crosses the district to the Brahmaputra, and the other runs north towards Assam.

The tract comprised within the district of Rangpur was formerly the western outpost of the ancient Hindu kingdom of Kamrup, which appears to have attained its greatest power and prosperity under Raja Nilambar, who was treacherously overthrown by Ala-uddin Hosain of Bengal at the close of the 15th century. Rangpur passed to the East India Company in 1765 under the firman of the emperor Shah Alam. Since then a great number of changes have taken place in the jurisdiction, in consequence of which the district area has been much diminished.

RANJIT SINGH, Maharaja (1780–1839), native Indian ruler, was born on the 2nd of November 1780, the son of Sirdar Mahan Singh, whom he succeeded in 1792 as head of the Sukarchakia branch of the Sikh confederacy. By birth he was only one of many Sikh barons and owed his rapid rise entirely to force of character and will. At the age of seventeen he seized the reins of government. He is said to have poisoned his mother, though it is more probable that he merely imprisoned her to keep her out of his way. At the age of twenty he obtained from Zaman Shah, the king of Afghanistan, a grant of Lahore, which he seized by force of arms in 1799. Subsequently he attacked and annexed Amritsar in 1802, thus becoming master of the two Sikh capitals. When Jaswant Rao Holkar took refuge in the Punjab in 1805, Ranjit Singh made a treaty with the British, excluding Holkar from his territory. Shortly afterwards acute difficulties arose between him and the British as to the Cis-Sutlej portion of the Punjab. It was Ranjit Singh's ambition to weld the whole of the Punjab into a single Sikh empire, while the British claimed the territory south of the Sutlej by right of conquest from the Mahrattas. The difference proceeded almost to the point of war; but at the last moment Ranjit Singh gave way, and for the future faithfully observed his engagements with the British, whose rising power he was wise enough to gauge. In 1808 Charles Metcalfe was sent to settle this question with Ranjit Singh, and a treaty was concluded at Amritsar on the 15th of April 1809. At this period a band of Sikh fanatics called "akalis," attacked Sir Charles Metcalfe's escort, and the steadiness with which the disciplined sepoys repulsed them, so impressed the maharaja that he decided to change the strength of his army from cavalry to infantry. He organized a powerful force, which was trained by French and Italian officers such as Generals Ventura, Allard and Avitabile, and thus forged the formidable fighting instrument of the Khalsa army, which afterwards gave the British their hardest battles in India in the two Sikh wars. In 1810 he captured Multan after many assaults and a long siege, and in 1820 had consolidated the whole of the Punjab between the Sutlej and the Indus under his dominion. In 1823 the city and province of Peshawar became tributary to him. In 1833 when Shah Shuja, flying from Afghanistan, sought refuge at his court, he took from him the Koh-i-nor diamond, which subsequently came into the possession of the British crown. Though he disapproved of Lord Auckland's policy of substituting Shah Shuja for Dost Mahomed, he loyally supported the British in their advance on Afghanistan. Known as "The Lion of the Punjab," Ranjit Singh died of paralysis on the 27th of June 1839.

In his private life Ranjit Singh was selfish, avaricious, drunken and immoral, but he had a genius for command and was the only man the Sikhs ever produced strong enough to bind them together. His military genius showed itself not so much in actual generalship as in the organization of his plans, the selection of his generals and his ministers, the tenacity of his purpose and the soundness of his judgment. The British were the one power in India that was too strong for him, and as soon as he realized that fact he was unwaveringly loyal to his engagements with them. His power was military aristocracy resting on the personal qualities of its founder, and after his death the Sikh confederacy gradually crumbled and fell to pieces through sheer want of leadership; and the rule of the Sikhs in the Punjab passed away completely as soon as it incurred the hostility of the British.

See Sir Lepel Griffin, *Ranjit Singh* (Rulers of India Series), 1892; General Sir John Gordon, *The Sikhs*, 1904; and S. S. Thorburn, *The Punjab in Peace and War*, 1904.

RANK (O.Fr. *ranc* or *renc*, mod. *rang*, generally connected with the O.E. and O.H.G. *hring*, a ring), a row or line, as of cabs or carriages, but especially of soldiers drawn up abreast in a line; in "rank and file" the "rank" is the horizontal line of soldiers, the "file" the vertical. From the sense of orderly arrangement "rank" is applied to grades or classes in a social or other organization, and particularly to a high grade, as in such expressions as a "person of rank." This word must be distinguished from the adjective "rank," overluxuriant, coarse, strong, generally connected with the Low Ger. *rank*, thin, tall (cf. Du. *rank*, upright). The O.E. *rinc*, warrior, *i.e.* full-grown man, may be also connected with the word; Skeat refers also to "rack," to pull out straight.

RANKE, LEOPOLD VON (1795–1886), German historian, was born on the 20th or the 21st of December 1795, in the small town of Wiehe, in Thuringia, which then formed part of the electorate of Saxony. His father, Gottlob Israel Ranke, was an advocate, but his ancestors, so far back as the family can be traced, had been ministers of religion. Leopold received his education first at Donndorf, a school established in an old monastery near his home, and then at the famous school of Schulpforta, whence he passed to the university of Halle and later to that of Berlin. His studies, both at school and university, were classical and theological. The great political events which occurred during his boyhood and youth seem to have had less effect on him than on many of his contemporaries, and he was not carried away either by enthusiastic admiration for Napoleon or by the patriotic fervour of 1813. Nor was he implicated in the political movements which during the following years attracted so many students; on the contrary, he already displayed that detachment of mind which was to be so characteristic of him. In 1818 he became a master in a school at Frankfort-on-the-Oder, thereby entering the service of the Prussian government. The headmaster of this school was Ernst Friedrich Poppo (1794–1866), a celebrated Grecian, and Ranke was entrusted with the teaching of history.

With the scholar's dislike of textbooks, he rapidly acquired a thorough knowledge of the ancient historians, quickly passed on to medieval times, and here it was that he formed as the ideal of his life the study of universal history, the works of God as displayed in the history of the human race. Here, too, he composed his first work, which deals with the period to which most of his life was to be devoted, *Geschichte der römanischen und germanischen Völker 1494–1514* (Berlin, 1824). To this was appended a critical dissertation on the historians who had dealt with the period (*Zur Kritik neuerer Geschichtschreiber*), which, showing as it did how untrustworthy was much of traditional history, was to be for modern history as epoch-marking as the critical work of Niebuhr had been in ancient history. A copy of the book was sent to the Prussian minister of education, Karl Albert Kamptz (1769–1849), the notorious hunter of democrats. Within a week Ranke received the promise of a post at Berlin, and in less than three months was appointed supernumerary professor in the university of that city, a striking instance of the promptitude with which the Prussian government recognized scientific merit when, as in Ranke's case, it was free from dangerous political opinions. The connexion thus established in 1825 was to last for fifty years. At the Berlin Library Ranke found a collection of MS. records, chiefly Italian, dealing with the period of the Reformation; from a study of them he found how different were the real events as disclosed in contemporary documents from the history as recorded by most writers; and the result of his researches was embodied in his second work, *Fürsten und Völker von Südeuropa im 16 und 17 Jahrhundert* (1827). In later editions the title of this book was altered to *Die Osmanen und die spanische Monarchie*. It was now his ambition to continue his exploration of the new world thus opened to him. The Prussian government provided the means, and in September 1827 he started for Italy. His first sojourn was in Vienna, where the friendship of Gentz and the protection of Metternich opened to him the Venetian archives, of which many were preserved in that city—a virgin field, the value of which he first discovered, and which is still unexhausted. He found time, in addition, to write a short book on *Die Serbische Revolution* (1829), from material supplied to him by Wuk Stephanowich, a Servian who had himself been witness of the scenes he related. This was afterwards expanded into *Serbien und die Türkei im 19 Jahrhundert* (1879). In 1828 he at last crossed the Alps, and the next three years were spent in Italy. The recommendations of Metternich opened to him almost every library except the Vatican; and it was during these three years of study in Venice, Ferrara, Rome, Florence and other cities, that he obtained that acquaintance with European history which was to make him the first historian of his time. At Rome, as he said, he learned to see events from the inside. He wrote nothing but a critical examination of the story of Don Carlos, but he returned to Germany a master of his craft.

For a time Ranke was now engaged in an occupation of a different nature, for he was appointed editor of a periodical in which Friedrich Perthes designed to defend the Prussian government against the democratic press. Ranke, contemptuous in politics, as in history, of the men who warped facts to support some abstract theory, especially disliked the doctrinaire liberalism so fashionable at the time. He hoped, by presenting facts as they were, to win the adhesion of all parties. We need not be surprised that he failed; men desired not the scientific treatment of politics, but satire and invective. Exposed thus to attack, his weakness, if not his venality, was long an article of faith among the liberals. He did not satisfy the Prussian conservatives, and after four years the *Historische Politische Blätter* came to an end. Two-thirds of the matter had been contributed by the editor, and the two stout volumes in which the numbers were collected contained the best political thought which had for long appeared in Germany. For Ranke the failure was not to be regretted; the rest of his life was to be wholly devoted to that in which he excelled. During 1834–36 appeared the three volumes of his *Die römischen Päpste, ihre Kirche und ihr Staat im 16 und 17 Jahrhundert* (Berlin, 1834–36, and many other editions), in form, as in matter, the greatest of his works, containing the results of his studies in Italy. Henceforth his name was known in all European countries; the English translation by Mrs Austin was the occasion of one of Macaulay's most brilliant essays. Before it was completed he had already begun the researches on which was based the second of his masterpieces, his *Deutsche Geschichte im Zeitalter der Reformation* (Berlin, 1839–47), a necessary pendant to his book on the popes, and the most popular of his works in his own country. In 1837 he became full professor at Berlin; in 1841 Frederick William IV., always ready to recognize intellectual eminence, appointed him Prussian historiographer. Stimulated by this, he brought out his *Neun Bücher preussischer Geschichte* (1847–48), a work which, chiefly owing to the nature of the subject, makes severe demands on the attention of the reader—he is the "Dryasdust" of Carlyle's Frederick; but in it he laid the foundation for the modern appreciation of the founders of the Prussian state. The nine books were subsequently expanded to twelve (Leipzig, 1874). He took no immediate part in the movements of 1848, but in the following years he drew up several memoranda for the king, whom he encouraged in his efforts to defend the character and identity of the Prussian state against the revolutionaries. Though never admitted into the inner circle of the king's associates, he found the king the most appreciative of readers and stimulating of companions, and the queen one of the most faithful of his friends; in biographical works and on other occasions he always defended the memory of the unfortunate monarch. A friend even more sympathetic he found in Maximilian II. of Bavaria, whom he advised in his expansive schemes for the promotion of learning and letters. In the quieter years that followed he wrote the third of his masterpieces, *Französische Geschichte, vornehmlich im 16 und 17 Jahrhundert* (Stuttgart, 1852–61), which was followed by his *Englische Geschichte, vornehmlich im 16 und 17 Jahrhundert* (1859–68). This, the longest of his works, added much to existing knowledge, especially as to the relations between England and the continent, but it lacked something of the freshness of his earlier books; he was over seventy when it was completed, and he was never quite at home in dealing with the parliamentary foundations of English public life. In his later years his small alert figure was one of the most distinguished in the society of Berlin, and every honour open to a man of letters was conferred upon him. He was ennobled in 1865, and in 1885 received the title of Excellenz. When the weakness of his eyes made it necessary for him to depend almost entirely on the service of readers and secretaries, in his eighty-first year he began to write the *Weltgeschichte* (9 vols., Leipzig, 1883–88). Drawing on the knowledge accumulated during sixty years, he had brought it down to the end of the 15th century before his death in Berlin on the 23rd of May 1886.

Ranke's other writings include *Zur deutschen Geschichte. Vom Religionsfrieden bis zum 30 jährigen Kriege* (Leipzig, 1868); *Geschichte Wallensteins* (Leipzig, 1869; 5th ed., 1896); *Abhandlungen und Versuche* (Leipzig, 1877; a new collection of these writings was edited by A. Dove and T. Wiedemann, Leipzig, 1888); *Aus dem Briefwechsel Friedrich Wilhelms IV. mit Bunsen* (Leipzig, 1873); *Die deutschen Mächte und der Fürstenbund. Deutsche Geschichte 1780–90* (1871–72); *Historisch-biographische Studien* (Leipzig, 1878); *Ursprung und Beginn der Revolutionskriege 1791–92* (Leipzig, 1875); and *Zur Geschichte von Oesterreich und Preussen zwischen den Friedensschlüssen zu Aachen und Hubertusberg* (Leipzig, 1875). He also wrote biographies of Frederick the Great and Frederick William IV. for the *Allgemeine Deutsche Biographie.*

Ranke married, at Windermere, in 1843, Miss Clara Graves, daughter of an Irish barrister. She died in 1870, leaving two sons and one daughter.

At the time of his death Ranke was, not in his own country alone, generally regarded as the first of modern historians. It is no disparagement to point out that the recognition he obtained was due not only to his published work, but also to his success as a teacher. His public lectures, indeed, were never largely attended, but in his more private classes, where he dealt with the technical work of a historian, he trained generations of scholars. No one since Heyne has had so great an influence on German academical life, and for a whole generation the Berlin school had no rival. He took paternal pride in the achievements of his pupils, and delighted to see, through them, his influence spreading in every university. While his own work lay chiefly in more modern times, he trained in his classes a school of writers on German medieval history. As must always happen, it is only a part of his characteristics which they learnt from him, for his greatest qualities were incommunicable. The critical method which has since become almost a formal system, aiming at scientific certainty, was with him an unexampled power, based on the insight acquired from wide knowledge, which enabled him to judge the credibility of an author or the genuineness of an authority; but he has made it impossible for any one to attempt to write modern history except on the " narratives of eye-witnesses and the most genuine immediate documents " preserved in the archives. From the beginning he was determined never to allow himself to be misled, in his search for truth, by those theories and prejudices by which nearly every other historian was influenced—Hegelianism, Liberalism, Romanticism, religious and patriotic prejudice; but his superiority to the ordinary passions of the historian could only be attained by those who shared his elevation of character. " My object is simply to find out how the things actually occurred." " I am first a historian, then a Christian," he himself said. In another way no historian is less objective, for in his greatest works the whole narrative is coloured by the quality of his mind expressed in his style. An enemy to all controversy and all violence, whether in act or thought, he had a serenity of character comparable only to that of Sophocles or Goethe. Apt to minimize difficulties, to search for the common ground of unity in opponents, he turned aside, with a disdain which superficial critics often mistook for indifference, from the base, the violent and the common. As in a Greek tragedy, we hear in his works the echo of great events and terrible catastrophes; we do not see them. He also made it a principle not to relate that which was already well known, a maxim which necessarily prevented his works attaining a popularity with the unlearned equal to their reputation among historians. But no writer has surpassed him in the clearness and brevity with which he could sum up the characteristics of an epoch in the history of the world, or present and define the great forces by which the world has been influenced. His classicism led to his great limitations as an historian. He did not deal with the history of the people, with economic or social problems—the dignity of history was to him a reality. He belonged to the school of Thucydides and Gibbon, not to that of Macaulay and Taine; he deals by preference with the rulers and leaders of the world, and he strictly limits his field to the history of the state, or, as we should say, political history; and in this he is followed by Seeley, one of the greatest of his adherents. The leader of modern historians, he was in truth a man of the *ancien régime.*

Many of Ranke's works have been translated into English. Among these are *Civil Wars and Monarchy in France*, by M. A. Garvey (1852); *History of England, principally in the 17th Century* (Oxford, 1875); *History of the Latin and Teutonic Nations*, 1494–1514, by P. A. Ashworth (1887) and again by S. R. Dennis (1909); *History of the Reformation in Germany*, by S. Austin (1845–47); *History of Servia and the Servian Revolution*, by Mrs A. Kerr (1847); *Ferdinand I. and Maximilian II. of Austria; State of Germany after the Reformation*, by Lady Duff Gordon (1853); *Memoirs of the House of Brandenburg and History of Prussia during the 17th and 18th Centuries*, by Sir Alexander and Lady Duff Gordon (1849); and *History of the Popes during the 16th and 17th Centuries*, by S. Austin (1840; new eds., 1841 and 1847), by W. K. Kelly (1843), and by E. Foster (1847–53). A collected edition of Ranke's works in fifty-four volumes was issued at Leipzig (1868–90), but this does not contain the *Weltgeschichte.*

For details of Ranke's life and work see his own *Zur eigenen Lebensgeschichte*, edited by A. Dove (Leipzig, 1890); and the article by Dove in the *Allgemeine deutsche Biographie.* Also Winckler, *Leopold von Ranke. Lichtstrahlen aus seinen Werken* (Berlin, 1885); W. von Giesebrecht, *Gedächtnisrede auf Leopold von Ranke* (Munich, 1887); Guglia, *Leopold von Rankes Leben und Werke* (Leipzig, 1893); M. Ritter, *Leopold von Ranke* (Stuttgart, 1895); Nalbandian, *Leopold von Rankes Bildungsjahre und Geschichtsauffassung* (Leipzig, 1901); and Helmolt, *Leopold Ranke* (Leipzig, 1907).

RANKINE, WILLIAM JOHN MACQUORN (1820–1872), Scottish engineer and physicist, was born at Edinburgh on the 5th of July 1820, and completed his education in its university. He was trained as an engineer under Sir J. B. Macneill, working chiefly on surveys, harbours and railroads, and was appointed in 1855 to the chair of civil engineering in Glasgow, vacant by the resignation of Lewis Gordon, whose work he had undertaken during the previous session. He was a voluminous writer on subjects directly connected with his chair, and, besides contributing almost weekly to the technical journals, such as the *Engineer*, brought out a series of standard textbooks on *Civil Engineering*, *The Steam-Engine and other Prime Movers*, *Machinery and Millwork*, and *Applied Mechanics*, which have passed through many editions, and have contributed greatly to the advancement of the subjects with which they deal. To these must be added his elaborate treatise on *Shipbuilding, Theoretical and Practical.* These writings, however, corresponded to but one phase of Rankine's immense energy and many-sided character. He was an enthusiastic and most useful leader of the volunteer movement from its beginning, and a writer, composer and singer of humorous and patriotic songs, some of which, as " The Three Foot Rule " and " They never shall have Gibraltar," became well known far beyond the circle of his acquaintance. Rankine was the earliest of the three founders of the modern science of Thermodynamics (*q.v.*) on the bases laid by Sadi Carnot and J. P. Joule respectively, and the author of the first formal treatise on the subject. His contributions to the theories of Elasticity and of Waves rank high among modern developments of mathematical physics, although they are mere units among the 150 scientific papers attached to his name in the Royal Society's *Catalogue.* The more important of these were collected and reprinted in a handsome volume (*Rankine's Scientific Papers*, London, 1881), which contains a memoir of the author by Prof. P. G. Tait. Rankine died at Glasgow on the 24th of December 1872.

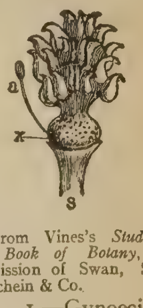
RANNOCH, a district of north-west Perthshire, Scotland, partly extending into Argyllshire. It measures 32 m. E. and W. and from 10 to 12 m. N. and S. and is surrounded by the districts of Badenoch, Atholl, Breadalbane, Lorne and Lochaber. Much of it is wild, bleak and boggy, and, saving on the E., it is shut in by rugged mountains. The chief rivers are the Tummel and the Ericht, and the principal lakes Loch Rannoch and Loch Lydoch, or Laidon (about 6 m. long, ¾ m. wide and 924 ft. above the sea). Loch Rannoch lies E. and W., measures 9¾ m. long by fully 1 m. broad, is 668 ft. above the sea, covers an area of nearly 7½ sq. m., and has a greatest depth of 440 ft. It receives the Ericht and many other streams, and discharges by the Tummel, draining a total area of 243½ sq. m. At the head of the lake is Rannoch Barracks, so named because it was originally built to accommodate a detachment of troops, under ensign (afterwards Sir) Hector Munro, stationed here to maintain order after the Jacobite rising of 1745. Two miles east is Carie, which was the residence of Alexander Robertson, 13th baron of Struan (1670–1749), the Jacobite and poet, who was "out" with Dundee (1689), Mar (1715) and Prince Charles Edward (1745), and yet managed to escape all punishment beyond self-imposed exile to France after the first two rebellions. Kinloch Rannoch, at the foot of the loch, is the principal place in the district, and is in communication by coach with Struan station (13 m. distant) on the Highland, and Rannoch station (6 m.) on the West Highland railway. Dugald Buchanan (1716–1768), the Gaelic poet, was schoolmaster of the village for thirteen years, and a granite obelisk has been erected to his memory.

RANSOM (from Lat. *redemptio*, through Fr. *rançon*), the price for which a captive in war redeemed his life or his freedom, a town secured immunity from sack, and a ship was repurchased from her captors. The practice of taking ransom arose in the middle ages, and had perhaps a connexion with the common Teutonic custom of commuting for crimes by money payments. It may, however, have no such historic descent. The desire to make profit out of the risks of battle, even when they were notably diminished by the use of armour, would account for it sufficiently. The right to ransom was recognized by law. One of the obligations of a feudal tenant was to contribute towards paying the ransom of his lord. England was taxed for the ransom of Richard the Lion Hearted, France for King John taken at Poitiers, and Scotland for King David when he was captured at Durham. The prospect of gaining the ransom of a prisoner must have tended to diminish the ferocity of medieval war, even when it did not reduce the fighting between the knights to a form of athletic sport in which the loser paid a forfeit. Readers of Froissart will find frequent mention of this decidedly commercial aspect of the chivalrous wars of the time. He often records how victors and vanquished arranged their "financing." The mercenary views of the military adventurers were not disguised. Froissart repeats the story that the English "free companions" or mercenaries, who sold their services to the king of Portugal, grumbled at the battle of Aljubarrota in 1385, because he ordered their prisoners to be killed, and would not pursue the defeated French and Spaniards, whereby they lost lucrative captures. The ransom of a king belonged to the king of the enemy by whom he was taken. The actual captor was rewarded at the pleasure of his lord. King Edward III. paid over instalments of the ransom of the king of France to the Black Prince, to pay the expenses of his expedition into Spain in 1367. Occasionally, as in the notable case of Bertrand du Guesclin, the ransom of a valuable knight or leader would be paid by his own sovereign. To trade in ransoms became a form of financial speculation. Sir John Fastolf in the time of King Henry V. is said to have made a large fortune by buying prisoners, and then screwing heavy ransoms out of them by ill-usage. The humane influence of ransom was of course confined to the knights who could pay. The common men, who were too poor, were massacred. Thus Lord Grey, Queen Elizabeth's lord deputy in Ireland, spared the officers of the Spaniards and Italians he took at Smerwick, but slaughtered the common men. Among the professional soldiers of Italy in the 15th century the hope of gaining ransom tended to reduce war to a farce. They would not lose their profits by killing their opponents. The disuse of the practice was no doubt largely due to the discovery that men who were serving for this form of gain could not be trusted to fight seriously.

Instances in which towns paid to avoid being plundered are innumerable. So late as the war in the Peninsula, 1808–14, it was the belief of the English soldiers that a town taken by storm was liable to sack for three days, and they acted on their conviction at Ciudad Rodrigo, Badajoz and San Sebastian. It was a question whether ransoms paid by merchant ships to escape were or were not among the *commercia belli*. In the early 18th century the custom was that the captain of a captured vessel gave a bond or "ransom bill," leaving one of his crew as a hostage or "ransomer" in the hands of the captor. Frequent mention is made of the taking of French privateers which had in them ten or a dozen ransomers. The owner could be sued on his bond. At the beginning of the Seven Years' War ransoming was forbidden by act of parliament. But it was afterwards at least partially recognized by Great Britain, and was generally allowed by other nations. In recent times—for instance in the Russo-Japanese War—no mention was made of ransom, and with the disappearance of privateering, which was conducted wholly for gain, it has ceased to have any place in war at sea, but the contributions levied by invading armies might still be accurately described by the name.

RANTERS, an antinomian and spiritualistic English sect in the time of the Commonwealth, who may be described as the dregs of the Seeker movement. Their central idea was pantheistic, that God is essentially in every creature, but though many of them were sincere and honest in their attempt to express the doctrine of the Divine immanence, they were in the main unable to hold the balance. They denied Church, Scripture, the current ministry and services, calling on men to hearken to Christ within them. Many of them seem to have rejected a belief in immortality and in a personal God, and in many ways they resemble the Brethren of the Free Spirit in the 14th century. Their vague pantheism landed them in moral confusion, and many of them were marked by fierce fanaticism. How far the accusation of lewdness brought against them is just is hard to say, but they seem to have been a really serious peril to the nation. They were largely recruited from the common people, and there is plenty of evidence to show that the movement was widespread. The Ranters came into contact and even rivalry with the early Quakers, who were often unjustly associated with them. The truth is that the positive message of the Friends helped to save England from being overrun with Ranterism. Samuel Fisher, a Friend, writing in 1653, gives a calm and instructive account of the Ranters, which with other relevant information, including Richard Baxter's rather hysterical attack, may be read in Rufus M. Jones's *Studies in Mystical Religion* (1909), xix. In the middle of the 19th century the name was often applied to the Primitive Methodists, with reference to their crude and often noisy preaching.

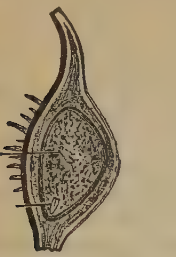
RANUNCULACEAE, in botany, a natural order of Dicotyledons belonging to the subclass Polypetalae, and containing 27 genera with about 500 species, which are distributed through temperate and cold regions but occur more especially beyond the tropics in the northern hemisphere. It is well represented in Britain, where 11 genera are native. The plants are mostly herbs, rarely shrubby, as in *Clematis*, which climbs by means of the leaf-stalks, with alternate leaves, opposite in *Clematis*, generally without stipules, and flowers which show considerable variation in the number and development of parts but are characterized by free hypogynous sepals and petals, numerous free stamens, usually many free one-celled carpels (fig. 2) and small seeds containing a minute straight embryo embedded in a copious endorsperm. The parts of the flower are generally arranged spirally on a convex receptacle. The fruit is one-seeded, an achene (fig. 3), or a many-seeded follicle (fig. 4), rarely, as in *Actaea*, a berry.



From Vines's *Students' Text Book of Botany*, by permission of Swan, Sonnenschein & Co.

FIG. 1.—Gynoecium of Ranunculus: *x*, receptacle with the points of insertion of the stamens, which have been removed.

The order falls into several well-defined tribes which are distinguished by characters of the flower and fruit; all are represented among British native or commonly grown garden plants.



From Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.

FIG. 2.—*Ranunculus arvensis.* Carpel in longitudinal section. (After Baillon, enlarged.)

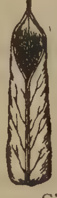


FIG. 3.—Single follicle showing dehiscence by the ventral suture.

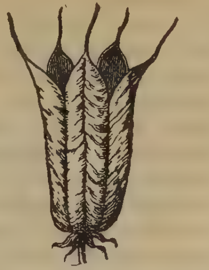


FIG. 4.—Fruit of Columbine (*Aquilegia*) formed of five follicles.

Tribe I. Paeonieae, peony group, are mostly herbs with deeply cut leaves and large solitary showy flowers in which the parts are spirally arranged, the sepals, generally five in number, passing gradually into the large coloured petals. The indefinite stamens are succeeded by 2–5 free carpels which bear a double row of ovules along the ventral suture. Honey is secreted by a ring-like swelling round the base of the carpels, which become fleshy or leathery in the fruit and dehisce along the ventral suture. There are only three genera, the largest of which, *Paeonia*, occurs in Europe, temperate Asia and western North America. *P. officinalis* is the common peony.

Tribe II. Helleboreae are almost exclusively north temperate or subarctic; there are 15 genera, several of which are represented in the British flora. The plants are herbs, either annual, *e.g. Nigella* (love-in-a-mist), or perennial by means of a rhizome, as in *Aconitum* or *Eranthis* (winter aconite). The leaves are simple, as in *Caltha*, but more often palmately divided as in hellebore (fig. 6), aconite (fig. 5) and larkspur. The flowers are solitary (*Eranthis*) or in cymes or racemes, and are generally regular as in *Caltha* (king-cup, marsh marigold), *Trollius* (globe-flower), *Helleborus*, *Aquilegia* (columbine); sometimes medianly zygomorphic as in *Aconitum* (monkshood, aconite) and *Delphinium* (larkspur). The carpels, generally 3 to 5 in number, form in the fruit a many-seeded follicle, except in *Actaea* (baneberry), where the single carpel develops to form a many-seeded berry, and in *Nigella*, where the five carpels unite to form a five-chambered ovary. There is considerable variety in the form of the floral envelopes and the arrangement of the parts. The outer series, or sepals, generally five in number, is generally white or bright-coloured, serving as an attraction for insects, especially bees, as well as a protection for the rest of the flower. Thus in *Caltha* and *Trollius* the sepals form a brilliant golden-yellow cup or globe, and in *Eranthis* a pale yellow star which contrasts with the green involucre of bracts immediately below it; in *Nigella* they are blue or yellow, and also coloured in *Aquilegia*. In Hellebore the greenish sepals persist till the fruit is ripe. *Aconitum* and *Delphinium* differ in the irregular development of the sepals, the posterior sepal being distinguished from the remaining four by its helmet-shape (*Aconitum*) or spur (*Delphinium*). In *Caltha* there are no petals, but in the other genera there are honey-secreting and storing structures varying in number and in form in the different genera. In *Trollius* they are long and narrow with a honey-secreting pit at the base, in *Nigella* and *Helleborus* (fig. 7) they form short-stalked pitchers, in *Aquilegia* they are large and coloured with a showy petal-like upper portion and a long basal spur in the tip of which is the nectary. In *Delphinium* they are also spurred, and in *Aconitum* form a spur-like sac on a long stalk (fig. 8). The parts of the flower are generally arranged in a spiral (acyclic), but are sometimes hemicyclic, the perianth forming a whorl as in winter aconite; rarely is the flower cyclic, as in *Aquilegia* (fig. 9) where the parts throughout are arranged in alternating whorls. In *Caltha*, where there are no petals, honey is secreted by two shallow depressions on the side of each carpel.

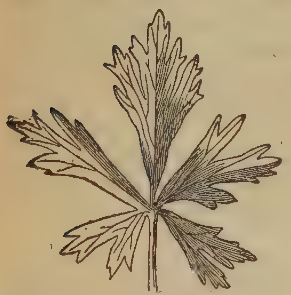


FIG. 5.—Five-partite leaf of Aconite.

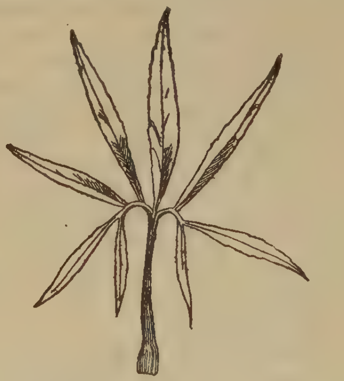


FIG. 6.—Pedate leaf of Stinking Hellebore (*Helleborus foetidus*). It is a palmately-partite leaf, in which the lateral lobes are deeply divided. When the leaf hangs down it resembles the foot of a bird, and hence the name.

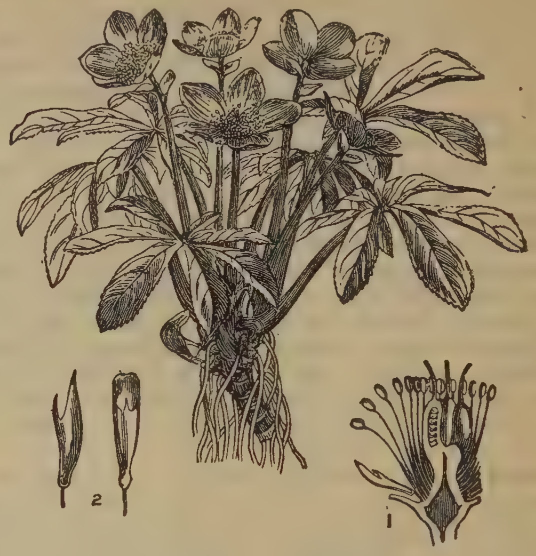


FIG. 7.—*Helleborus niger.* 1, vertical section of flower; 2, nectary, side and front view (nat. size).

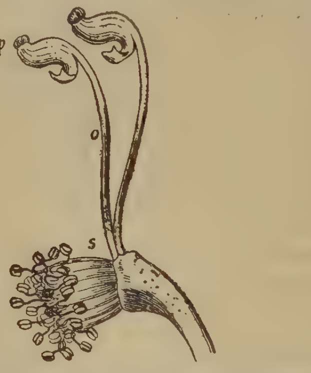


FIG. 8.—Part of the flower of Aconite (*Aconitum Napellus*), showing two irregular horn-like petals *p*, supported on grooved stalks *o*. These serve as nectaries. *s*, the whorl of stamens inserted on the thalamus, and surrounding the pistil.

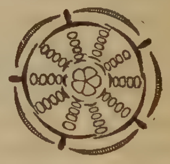


FIG. 9.—Floral diagram of Columbine (*Aquilegia*) showing regular cyclic arrangement.

Tribe III. Anemoneae, with 8 genera, are chiefly north temperate, arctic and alpine plants, but also pass beyond the tropics to the southern hemisphere. They differ from the two preceding tribes in the numerous carpels, each with only one ovule, forming a fruit of numerous achenes. They are annual or perennial herbs, erect as in *Anemone*, *Thalictrum* (meadow-rue) and many buttercups, or creeping as in *Ranunculus repens*; the section *Batrachium* of the genus *Ranunculus* (*q.v.*) contains aquatic plants with submerged or floating stems and leaves. The flowers are solitary, as in *Anemone Pulsatilla* (Pasque flower) and the wood anemone, or cymose as in species of *Ranunculus*, or in racemes or panicles as in *Thalictrum*. The parts are spirally arranged throughout as in *Myosurus* (mouse-tail), where the very numerous carpels are borne on a much elongated receptacle, or *Adonis* (pheasant's eye), or the perianth is whorled as in *Anemone* and *Ranunculus*. In *Anemone* there is a whorl of foliage leaves below the flower, as in *Eranthis*. In *Anemone* and *Thalictrum* there is only one series of perianth leaves, which are petaloid and attractive in *Anemone* where honey is secreted by modified stamens, as in *A. Pulsatilla*, or, as in *A. nemorosa* (wood anemone), there is no honey and the flower is visited by insects for the sake of the pollen; in *Thalictrum* the perianth is greenish or slightly coloured and the flower is wind-pollinated (*T. minus*) or visited for its pollen. In *Ranunculus* and *Adonis* a calyx of green protective sepals is succeeded by a corolla of showy petals; in *Ranunculus* (fig. 10) there is a basal honey-secreting gland which is absent in *Adonis*. In *Anemone* the achenes bear the persistent naked or bearded style which aids in dissemination; the same purpose is served by the prickles on the achenes of *Ranunculus arvensis*.

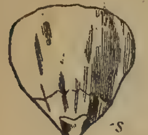


FIG. 10.—Petal of Crowfoot (*Ranunculus*), bearing at the base a honey gland protected by a scale, *s*.

Tribe IV. Clematideae comprise the genus *Clematis* (*q.v.*), characterized by its shrubby, often climbing habit, opposite leaves and the valvate, not imbricate as in the other tribes, aestivation of the sepals. The usually four sepals are whorled and petaloid, the numerous stamens and carpels are spirally arranged; the flowers are visited by insects for the sake of the abundant pollen. The fruit consists of numerous achenes which are generally prolonged into the long feathery style, whence the popular name of the British species, old man's beard (*Clematis vitalba*). The genus, which contains about 170 species, has a wide distribution, but is rarer in the tropics than in temperate regions.

Special articles will be found on the more important genera of *Ranunculaceae*, *e.g. Aconitum, Adonis, Anemone, Baneberry* (*Actaea*), *Clematis, Columbine, Hellebore, Ranunculus.*

RANUNCULUS, familiarly known as "buttercup," or crowfoot, a characteristic type of the botanical order Ranunculaceae. The Lat. name, which means a little frog or tadpole (dim. of *rana*, frog), was also given to a medicinal plant, which has been identified by some with the crowfoot. The Ranunculi are more or less acrid herbs, sometimes with fleshy root-fibres, or with the base of the stem dilated into a kind of tuber (*R. bulbosus*). They have tufted or alternate leaves, dilated into a sheath at the base, and very generally, but not universally, deeply divided above. The flowers are solitary, or in loose cymes, and are remarkable for the number and distinctness (freedom from union) of their parts. Thus there are five sepals, as many petals, and numerous spirally arranged stamens and carpels. The petals have a little pit or honey-gland at the base, which is interesting as foreshadowing the more fully developed tubular petals of the nearly allied genera *Aconitum* and *Helleborus*. The fruit is a head of "achenes"—dry, one-seeded fruits. The genus contains a large number of species (about 250) and occurs in most temperate countries in the northern and southern hemispheres, extending into arctic and antarctic regions, and appearing on the higher mountains in the tropics. About twenty species are natives of Great Britain. *R. acris, R. repens, R. bulbosus*, are the common buttercups. *R. arvensis*, found in cornfields, has smaller pale yellow flowers and the achenes covered with stout spines. *R. Lingua*, spearwort, and *R. Flammula*, lesser spearwort, grow in marshes, ditches and wet places. *R. Ficaria* is the pilewort or lesser celandine, an early spring flower in pastures and waste places, characterized by having heart-shaped entire leaves and clusters of club-shaped roots. The section *Batrachium* comprises the water-buttercups, denizens of pools and streams, which vary greatly in the character of the foliage according as it is submersed, floating or aerial, and when submersed varying in accordance with the depth and strength of the current. The ranunculus of the florist is a cultivated form of *R. asiaticus*, a native of the Levant, remarkable for the range of colour of the flowers (yellow to purplish black) and for the regularity with which the stamens and pistils are replaced by petals forming double flowers. *R. asiaticus* is one of the older florists' flowers, which has sported into numberless varieties, but was formerly held in much greater esteem than it is at the present time. According to the canons of the florists, the flowers, to be perfect, should be of the form of two-thirds of a ball, the outline forming a perfect circle, with the centre close, the petals smooth-edged, the colour dense, and the marking uniform.

The ranunculus requires a strong and moist soil, with a fourth of rotten dung. The soil should be from 18 in. to 2 ft. deep, and at about 5 in. below the surface there should be placed a stratum 6 or 8 in. thick of two-year-old rotten cow-dung, mixed with earth, the earth above this stratum, where the roots are to be placed, being perfectly free from fresh dung. The tubers are planted in rows 5 or 6 in. apart, and 3 or 4 in. apart in the rows, the turban sorts in October, the more choice varieties in February. They should be so close that the foliage may cover the surface of the bed. The autumn-planted roots must be sheltered from severe frost. The plants when in flower should be screened from hot sunshine with an awning; when the leaves wither, the roots are to be taken up, dried, and stored. The ranunculus is readily propagated from seed obtained from semi-double sorts, which are often of themselves very beautiful flowers. It is generally sown in boxes in autumn or spring. The young plants thus raised flower often in the second, and always in the third year.

The turban varieties, which are very showy for the borders, are of a few positive colours, as scarlet, yellow, brown, carmine, and white. The florists' varieties have been bred from the Persian type, which is more delicate.

Other species known in gardens are *R. aconitifolius* (white bachelor's buttons), with leaves recalling aconite, and white flowers; the double-flowered form is known in gardens as fair maids of France or fair maids of Kent. A double-flowered form of *R. acris* is grown under the name yellow bachelor's buttons. *R. bulbosus* also has a pretty double-flowered variety. Of dwarfer interesting plants there are *R. alpestris*, 4 in., white; *R. gramineus*, 6 to 10 in., yellow; *R. parnassifolius*, 6 in., white; and *R. rutaefolius*, 4 to 6 in., white with orange centre. Of the taller kinds mention may be made of *R. cortusaefolius*, a fine buttercup, 3–5 ft. high, from Teneriffe, and hardy in the mildest parts of Britain; and *R. hyalli*, known as the New Zealand water lily. It is a handsome species, 2 to 4 ft. high, with large peltate leaves often a foot in diameter, and with waxy white flowers about 4 in. across. It is not quite hardy, and even under the best conditions is a difficult plant to grow well.

RAO, SIR DINKAR (1819–1896), Indian statesman, was born in Ratnagiri district, Bombay, on the 20th of December 1819, being a Chitpavan Brahmin. At fifteen he entered the service of the Gwalior state, in which his ancestors had served. Rapidly promoted to the responsible charge of a division, he displayed unusual talents in reorganizing the police and revenue departments, and in reducing chaos to order. In 1851 Dinkar Rao became dewan. The events which led to the British victories of Maharajpur and Panniar in 1844 had filled the state with mutinous soldiery, ruined the finances, and weakened authority. With a strong hand the dewan suppressed disorder, abolished ruinous imposts, executed public works, and by a reduction of salaries, including his own, turned a deficit into a surplus. When the contingent mutinied in 1857, he never wavered in loyalty; and although the state troops also mutinied in June 1858 on the approach of Tantia Topi, he adhered to the British cause, retiring with Maharaja Sindhia to the Agra fort. After the restoration of order he remained minister until December 1859. In 1873 he was appointed guardian to the minor Rana of Dholpur, but soon afterwards he resigned, owing to ill-health. In 1875 the viceroy selected him as a commissioner, with the Maharajas Sindhia and Jaipur, and three British colleagues, to try the Gaekwar of Baroda on a charge of attempting to poison the British resident. He also served in the legislative council of India, and was frequently consulted by viceroys on difficult questions. An estate was conferred upon him, with the hereditary title of Raja, for his eminent services, and the decoration of K.C.S.I. He died on the 9th of January 1896. No Indian statesman of the 19th century gained a higher reputation, yet he only commenced the study of English at the age of forty, and was never able to converse fluently in it; his orthodoxy resented social reforms; he kept aloof from the Indian Congress, and he had received no training in British administration.

RAO, SIR T. MADHAVA (1828–1891), Indian statesman, was born at Combaconum in Madras in 1828. Madhava Rao created a new type of minister adapted to the modern requirements of a progressive native state, and he grafted it upon the old stock. He linked the past with the present, using the advantages of heredity, tradition and conservatism to effect reforms in the public administration and in Indian society. Sprung from a Mahratta Brahmin stock long settled at Tanjore, the son of a dewan of Travancore, he was educated in the strictest tenets of his sacred caste. But he readily imbibed the new spirit of the age. To mathematics, science and astronomy he added a study of English philosophy and international law, and a taste for art and pictures. Although a devout student of the Shastras, he advocated female education and social reform. Refusing to cross the sea and so break caste by appearing before a parliamentary commission, he yet preached religious toleration. A patron of the Indian Congress, he borrowed from the armoury of British administration every reform which he introduced into the native states. He was respected alike by Europeans and natives, and received titles and honours from the British government. As tutor of the maharaja of Travancore, and then as revenue officer in that state, he showed firmness and ability, and became diwan or prime minister in 1857. He found the finances disorganized, and trade cramped by monopolies and oppressive duties. He co-operated with the Madras government in carrying out reforms, and when his measures led to misunderstandings with the maharaja, he preferred honourable resignation to retention of a lucrative office in which he was powerless for good. In 1872 he was engaged at Indore in laying down a plan of reform and of public works which he bequeathed to his successor, when a grave crisis at Baroda demanded his talents there. The Gaekwar had been deposed for scandalous misrule, and an entire reorganization was needed. Aided by Sir Philip Melvill, Madhava Rao swept away the corrupt officials, privileged sirdars and grasping contractors who had long ruined Baroda. He wrote able minutes defending the rights and privileges of the Gaekwar from fancied encroachment, and justifying the internal reforms which he introduced. He resigned office in 1882, and in his retirement devoted his leisure to reading and writing upon political and social questions. He died on the 4th of April 1891.

RAOUL DE CAMBRAI, the name of a French *chanson de geste.* The existing romance is a 13th-century recension of a poem by a trouvère of Laon called Bertholais, who professed to have witnessed the events he described. It presents, like the other provincial *geste* of *Garin le Loherain*, a picture of the devastation caused by the private wars of the feudal chiefs. A parallel narrative, obviously inspired by popular poetry, is preserved in the chronicle of Waulsort (ed. Achery, *Spicilegium*, ii. p. 100 seq.), and probably corresponds with the earlier recension. Raoul de Cambrai, the posthumous son of Raoul Taillefer, count of Cambrai, by his wife Alais, sister of King Louis (d'Outre-Mer), whose father's lands had been given to another, demanded the fief of Vermandois, which was the natural inheritance of the four sons of Herbert, lord of Vermandois. On King Louis's refusal, he proceeded to war. The chief hero on the Vermandois side was Bernier, a grandson of Count Herbert, who had been the squire and firm adherent of Raoul, until he was driven into opposition by the fate of his mother, burned with the nuns in the church of Origny. Bernier eventually slew the terrible Raoul in single fight, but in his turn was slain, after an apparent reconciliation, and the blood-feud descended to his sons. The date of these events is exactly ascertainable. Flodoard (*Annales*, *Anno* 943) states that Count Herbert died in that year, and was buried by his sons at St Quentin, that when they learnt that Raoul, son of Raoul de Gouy, was about to invade their father's territory, they attacked him and put him to death. The identity of other of the personages of the story has also been fixed from historical sources. The second part of the poem, of which Bernier is the hero, is of later date, and bears the character of a *roman d'aventures.*

See *Li Romans de Raoul de Cambrai et de Bernier*, ed. E. le Glay (Paris, 1840); *Raoul de Cambrai*, ed. P. Meyer and A. Longnon (*Soc. des anc. textes fr.*, Paris, 1882); J. M. Ludlow, *Popular Epics of the Middle Ages* (London and Cambridge, 1865); H. Gröber, *Grundriss d. roman. Phil.* (ii. pp. 567 seq.).

RAOUL ROCHETTE, DÉSIRÉ (1790–1854), French archaeologist, was born on the 9th of March 1790 at St Amand in the department of Cher, and received his education at Bourges. He was made professor of history in the Collége de Louis-le-Grand at Paris (1813) and in the Sorbonne (1817). His *Histoire critique de l'établissement des colonies grecques* (4 vols., 1815) is now out of date. He was superintendent of antiquities in the Bibliothèque at Paris (1819–48), and professor of archaeology at the Bibliothèque (from 1826), a result of which may be seen in his *Cours d'archéologie* (1828). In 1829 appeared his *Monuments inédits*, a work of great value at the time. Still valuable are his *Peintures inédites* (1836) and his *Peintures de Pompéi* (1844). He contributed to the *Annali* of the Roman Institute, the *Journal des savants* and the *Académie des inscriptions.* At his death on the 3rd of July 1854 Raoul Rochette was perpetual secretary of the Academy of Fine Arts and a corresponding member of most of the learned societies in Europe.

RAOULT, FRANÇOIS MARIE (1830–1901), French chemist, was born at Fournes, in the Département du Nord, on the 10th of May 1830. He became *aspirant répétiteur* at the lycée of Rheims in 1853, and after holding several intermediate positions was appointed in 1862 to the professorship of chemistry in Sens lycée, where he prepared the thesis on electromotive force which gained him his doctor's degree at Paris in the following year. In 1867 he was put in charge of the chemistry classes at Grenoble, and three years later he succeeded to the chair of chemistry, which he held until his death on the 1st of April 1901. Raoult's earliest researches were physical in character, being largely concerned with the phenomena of the voltaic cell, and later there was a period when more purely chemical questions engaged his attention. But his name is best known in connexion with the work on solutions, to which he devoted the last two decades of his life. His first paper on the depression of the freezing-points of liquids by the presence of substances dissolved in them was published in 1878; and continued investigation and experiment with various solvents, such as benzene and acetic acid, in addition to water, led him to believe in a simple relation between the molecular weights of the substances and the freezing-point of the solvent, which he expressed as the "loi générale de la congélation," that if one molecule of a substance be dissolved in 100 molecules of any given solvent, the temperature of solidification of the latter will be lowered by 0·63° C. (See, however, the article SOLUTION.) Another relation at which he worked was that the diminution in the vapour-pressure of a solvent, caused by dissolving a substance in it, is proportional to the molecular weight of the substance dissolved—at least when the solution is dilute. These two generalizations not only afforded a new method of determining the molecular weights of substances, but have also been utilized by J. H. van't Hoff and W. Ostwald, among other chemists, in support of the hypothesis of electrolytic dissociation in solutions. An account of Raoult's life and work was given by Professor van't Hoff in a memorial lecture delivered before the London Chemical Society on the 26th of March 1902.

RAOUX, JEAN (1677–1734), French painter, was born at Montpellier in 1677. After the usual course of training he became a member of the Academy in 1717 as an historical painter. His reputation had been previously established by the credit of decorations executed during his three years in Italy on the palace of Giustiniani Sclini at Venice, and by some easel paintings, the Four Ages of Man (National Gallery), commissioned by the grand prior of Vendôme. To this latter class of subject Raoux devoted himself, nor did he even paint portraits except in character. The list of his works is a long series of sets of the Seasons, of the Hours, of the Elements, or of those scenes of amusement and gallantry in the representation of which he was immeasurably surpassed by his younger rival Watteau. After his stay in England (1720) he lived much in the Temple, where he decorated several rooms. He died in Paris in 1734. His best pupils were Chevalier and Montdidier. His works, of which there is a poor specimen in the Louvre, were much engraved by Poilly, Moyreau, Dupuis, &c.

RAPALLO, a seaport and winter resort of Liguria, Italy, in the province of Genoa. Pop. (1901) 5839 (town); 10,343 (commune). It occupies a beautiful and well-sheltered situation on the east side of the Gulf of Rapallo, 18½ m. E. by S. from Genoa by rail. It has a fine church, a medieval castle (now used as a prison) and a Roman Bridge, known as "Hannibal's Bridge." On the hills above the town is situated the church and abbey of the Madonna de Montallegro, whose miraculous picture attracts pilgrims from all parts of Italy. Olives and other fruit are grown, and a brisk trade is done in olive oil. A mile to the south is Santa Margherita Ligure (pop. 7051), another winter resort, with a large 16th-century church. Both places are also frequented for sea-bathing in summer. Lace is made, while the men go in May to the coral fisheries off the Sardinian coast. To the south again is the small seaport of Portofino (the Roman *Portus Delphini*) under the south-east extremity of the promontory of Portofino (2010 ft.). On the way from S. Margherita to Portofino is the suppressed monastery of Cervara, in which Francis I. of France was confined after the battle of Pavia on his way to Madrid. At all these places are beautiful villas.

RAPE (Lat. *rapum* or *rapa*, turnip), in botany.—Several forms of plants included in the genus *Brassica* are cultivated for the oil which is present in their ripe seeds. The one most extensively grown for this purpose is known as colza, rape or coleseed, in Germany as *Raps* (*Brassica napus*, var. *oleifera*): its seeds contain from 30 to 45% of oil. The leaves are glaucous and smooth like those of a swede turnip. For a seed-crop rape is sown in July or early August in order that the plants may be strong enough to pass the winter uninjured. The young plants are thinned out to a width of 6 or 8 in. apart, and afterwards kept clean by hoeing. The foliage may be eaten down by sheep early in autumn, without injuring it for the production of a crop of seed. In spring the horse and hand hoe must be used, and the previous application of 1 cwt. or 2 cwt. of guano will add to the productiveness of the crop. On good soil and in favourable seasons the yield sometimes reaches to 40 bushels per acre. The haulm and husks are either used for litter or burned, and the ashes spread upon the land. It makes good fuel for clay-burning. There is a "summer" variety of colza which is sown in April and ripens its seed in the same year. It does not yield so much oil as the "winter" kind, but it will grow on soil in poorer condition. Neither of these is much grown in Great Britain for the production of oil, but the "winter" variety is very extensively grown as green food for sheep. For this purpose it is generally sown at short intervals throughout the summer to provide a succession of fodder. It is peculiarly adapted for peaty soils, and is accordingly a favourite crop in the fen lands of England, and on recently reclaimed mosses and moors elsewhere. Its growth is greatly stimulated by the ashes resulting from the practice of paring and burning. Its highly nutritious leaves and stems are usually consumed by folding the sheep upon it where it grows, there is no green food upon which they fatten faster. Occasionally it is carried to the homestead, and used with other forage in carrying out the system of soiling cattle.

The wild form *Brassica campestris*, the wild coleseed, colza or kohlsaat, of the fields of England and many parts of Europe, is sometimes cultivated on the European continent for its seed, which, however, is inferior in value to rape as an oil-yielding product.

In addition to the previously mentioned rape, a variety of another species (or subspecies) of *Brassica*, namely, *Brassica rapa*, var. *oleifera* (*Rübsen* in Germany), is grown for its oil-yielding seeds. The leaves in a young state are not glaucous, but sap-green in colour and rough, being very similar to those of the turnip, to which the plant is closely related. Both winter and summer varieties are grown; they are rarely cultivated in Britain. The oil is similar to that in the true colza seeds but the plants do not yield so much per acre as the latter: they are, however, hardier and more adapted for cultivation on poor sandy soils.

RAPE (from Lat. *rapere*, to seize), in law, the crime of having carnal knowledge of a woman by a man, not her husband, forcibly and unlawfully against her will. Under the Mosaic law, rape was punished with death, if the damsel was betrothed to another man, and with a fine of fifty shekels if not so betrothed, while in this case, also, she was to be the wife of the ravisher all the days of his life (Deut. xxii. 25). The Roman civil law punished rape with death and confiscation of goods (Cod. L. IX. tit. 13). In England, under the Saxon law—adopted, probably, from a Teutonic code—death was also the penalty, but under the Normans this was changed to the loss of both eyes and castration; this punishment remained in force until after the time of Bracton (*de Coronâ*, f. 147). The statute of Westminster I. (1275) reduced the offence to a trespass, with a penalty of two years' imprisonment and a fine at the king's will. This lenity, it is said, produced terrible consequences, and, accordingly, the statute of Westminster II. (1285) again declared the offence a felony, with, however, benefit of clergy. This was the state of the law until 1575, when the punishment was made more severe by taking away the benefit of clergy. The offence remained capital until the Offences against the Person Act 1861, by which and subsequent amending acts it is now regulated. The present punishment is penal servitude for life or for not less than three years or imprisonment with or without hard labour for not over two years.

The law of England (differing in this respect from the civil law) regards as immaterial whether the woman is chaste or unchaste, married or single, provided the offence has been committed forcibly and without her consent. The offence is complete if consent is extorted by means of threats of death or immediate bodily harm, by fraud or by false pretences or representation, such as the impersonation of a woman's husband (Criminal Law Amendment Act 1885).

Since the passing of the Criminal Law Amendment Act 1885, it is a felony, entailing the same punishment as rape, to have carnal knowledge of a girl under 13 years, whether she consent or not. Between 13 and 16 years of age it is a criminal offence punishable by two years' imprisonment, whether consent is given or not, and even if there be solicitation; but if the jury is satisfied that the person charged has reasonable cause to believe the girl to be over 16 years, the accused is entitled to be acquitted. Prosecution must be within three months of the offence. The administration of any drug or matter, with intent, by producing stupor, to facilitate the accomplishment of the crime, is an offence punishable by two years' imprisonment. On indictment for rape there may be an acquittal on the actual charge, but a conviction either of the attempt or of an indecent assault.

In charges of rape, from the nature of the offence, the important witness is the woman, and it is essential, apart from medical evidence (see MEDICAL JURISPRUDENCE), that her story be corroborated by evidence implicating the accused. The following points have, of necessity, to be considered. (1) As to the general credibility of the witness and how far her story is to be believed; evidence, therefore, may be given to show that she is of immoral character. (2) As to whether she has made complaint immediately after the alleged outrage and to whom. (3) As to the place where the outrage was alleged to have been committed and the possibility of her being heard if she cried out.

In the United States, rape is universally treated as a felony, and the punishment is either death, imprisonment for life, or imprisonment for a number of years, varying in the different states. In the case of offences against young girls, there is a divergence in the various states as to the age of consent, though the trend of legislation has been to raise it. In North and South Carolina, and Georgia, the age of consent is as low as 10 years, and in Kentucky and Louisiana, 12 years. In nineteen states the age of consent is 14 years. In one (Texas) 15 years. In six, it is 16 years. In Wyoming, New York, Colorado and Kansas it is as high as 18 years.

The essential facts to be proven in order to constitute this crime are the same as in England, but in many of the states the uncorroborated evidence of the woman is sufficient to sustain a conviction. This is so in California, Arizona, Idaho, Missouri, Kentucky, Michigan, Illinois, Oklahoma, &c. [1904; *Brenton* v. *Territory*, 78 Pac. Rep. 83]. In New York corroboration is required [Penal Code §283]. In Nebraska also evidence corroborating the prosecutrix is necessary [1907; *Burk* v. *State*, 112 N.W. Rep. 573]. In Texas it is no defence for accused to prove that he believed the prosecutrix to be over 15 years of age, the age of consent [1907; *Robertson* v. *State*, 102 So. W. Rep. 1130], and the crime is punishable with death [1903; *Reyna* v. *State*, 75 So. W. Rep. 25], as also apparently it is in the Indian country [*U.S.* v. *Partello*, 48 Fed. R. 670 U.S. Rev. Stats. § 5345], also in Alabama [Criminal Code, § 5444].

In Hawaii there is no age of consent for rape, which is punishable by $1000 fine and imprisonment at hard labour for life; the carnal knowledge of females under 10 years is punishable with death or imprisonment for life [Rev. L. 1905, §§ 2927, 2928]. In Porto Rico the age of consent is 14 years and the punishment not less than five years [Pen. Code 1902, §255].

Authorities.—Stephen, *Digest of Criminal Law*; Russell, *On Crimes*: Archbold, *Criminal Pleading*; and for American law, May, *The Law of Crimes*, and Clark and Marshall, *Treatise on the Law of Crimes*.

RAPE, a territorial division of the county of Sussex, England, formerly used for various administrative purposes. There are now six of these divisions, Hastings, Pevensey, Lewes, Bramber, Arundel and Chichester, but the latter two apparently formed a single rape at the date of the compilation of Domesday Book. The word, which in England is peculiar to Sussex, is usually said to be closely related to the Icelandic *hrepp*, a small territorial division which in most, but not in all, cases is identical with the parish; but this explanation, which is unsatisfactory on institutional grounds, has also been declared impossible for philological reasons. As an alternative explanation it has been suggested, that "rape" is an early form of the word "rope"; and that the divisions were so called because they were measured and allotted by the rope. Some confirmation of this is to be found in the words of the Norman chronicler, Dudo of St Quentin, who states that Rollo in distributing Neustria "suis fidelibus terram funiculo divisit" (J. P. Migne, *Patrologiae Cursus completus*, tom. cxli. p. 652). It is possible that the rapes represent the shires of the ancient kingdom of Sussex, especially as in the 12th century they had sheriffs of their own. But there is no evidence of the existence of the rape before the Norman Conquest, except such as may be gathered from Domesday Book, and this is far from convincing. After the Conquest each rape had its own lord, and all the land within it, save that which belonged to the king or to ecclesiastical tenants, was held of the lord. Thus the rape as a lordship only differed from other honours and baronies by the fact that the lands of its knights were not scattered over England, but lay together in a continuous tract. In form the rapes were parallel bands of land running north and south, and each of them contained a different number of hundreds. The place in which the lord's castle was situate ultimately gave its name to the rape; but in Domesday Book the rapes are often described by the names of their lords, and this is always so in that work in the case of Bramber, which belonged to William de Briouze (*rapam Willelmi de Braoza*).

See the *Victoria County History, Sussex*, vol. i.; *New English Dictionary*; and M. A. Lower, *History of Sussex* (Lewes, 1870). (G. J. T.)

RAPE OIL, an important fatty oil, known also as "sweet oil," either expressed or extracted from the crushed seeds of cultivated varieties of the cruciferous genus *Brassica*, the parent form of the whole apparently being the wild navew, *B. campestris*. Under the general name "rape oil" is included the produce of several plants having distinct and fairly constant characters, and one of these oils—colza (*q.v.*)—is a very well-known commercial variety. In Germany, where the production of rape oil centres, two principal oil-seeds—rape and Rübsen—are well recognized. (See Rape.)

The oil yielded by these seeds is, in physical and chemical properties, practically the same, the range of fluctuations not being greater than would be found in the oil of any specific seed under similar varying conditions of production; the winter varieties of all the seeds are more productive than the summer varieties. Newly pressed rape oil has a dark sherry colour with, at first, scarcely any perceptible smell; but after resting a short time the oil deposits an abundant mucilaginous slime, and by taking up oxygen it acquires a peculiar disagreeable odour and an acrid taste. Refined by the ordinary processes (see Oils), the oil assumes a clear golden yellow colour. In specific gravity it ranges between 0·9112 and 0·9117 in the raw state, and from 0.9127 to 0.9136 when refined; the solidifying point is from −4° to −6° C.

The principal uses of rape oil are for lubrication and lighting; but since the introduction of mineral oils for both these purposes the importance of rape has considerably decreased. It is but little employed in soap-making, as it saponifies with difficulty and yields only an indifferent product. In Germany it is very considerably used as a salad oil under the name of Schmalzöl, being for that purpose freed from its biting taste by being mixed with starch, heated till the starch is carbonized, and filtered after the oil has cooled. The offensive taste of rape oil may also be removed by treatment with a small proportion of sweet spirit of nitre (nitrous ether). In the East Indies rape oil and its equivalents, known under various names, are the most important of oils for native use. They are largely consumed as food instead of ghi under the name of "metah" or sweet oil, but for all other purposes the same substance is known as "kurwah" or bitter oil. Most natives prefer it for the preparation of their curries and other hot dishes. Rape oil is the subject of extensive adulteration, principally with the cheaper hemp oil, rosin oil and mineral oils. These sophistications can be most conveniently detected, first by taste and next by saponification, rosin oil and mineral oil remaining unsaponified, hemp oil giving a greenish soap, while rape oil yields a soap with a yellow tinge. With concentrated sulphuric acid, fuming nitric acid, nitrous acid, and other reagents rape oil gives also characteristic colorations; but these are modified according to the degree of purity of the oil itself. The presence of sulphur in rape and other cruciferous oils also affords a ready means for their identification. Lead plaster (*emplastrum lithargyri*) boiled in rape oil dissolves, and, sulphide of lead being formed, the oil becomes brown or black. Other lead compounds give the same black coloration from the formation of sulphide.

RAPHAEL (Hebrew רפאל, "God heals"), an angel who in human disguise and under the name of Azarias ("Yahweh helps") accompanies Tobias in his adventurous journey and conquers the demon Asmodaeus (Book of Tobit). He is said (Tob. xii. 15) to be "one of the seven holy angels [archangels] which present the prayers of the saints and go in before the glory of the Holy One." In the Book of Enoch (c. xx.) Raphael is "the angel of the spirits of men," and it is his business to "*heal* the earth which the angels have defiled." In later Midrash Raphael appears as the angel commissioned to put down the evil spirits that vexed the sons of Noah with plagues and sicknesses after the Flood, and he it was who taught men the use of simples and furnished materials for the "Book of Noah," the earliest treatise on materia medica.

RAPHAEL SANZIO (1483–1520), the great Italian painter, was the son of Giovanni Sanzio or Santi, a painter of some repute in the ducal city of Urbino, situated among the Apennines on the borders of Tuscany and Umbria.[1] For many years both before and after the birth of Raphael (6th of April 1483) the city of Urbino was one of the chief centres in Italy of intellectual and artistic activity, thanks to its highly cultured rulers, Duke Federigo II. of Montefeltro and his son Guidobaldo, who succeeded him in 1482,[2] the year before Raphael was born. Giovanni Santi was a welcome guest at this miniature but splendid court, and the rich treasures which the palace contained, familiar to Raphael from his earliest years, were a very important item among the various influences which formed and fostered his early love for art. It may not perhaps be purely fanciful to trace Raphael's boyish admiration of the oil-paintings of Jan Van Eyck and Justus of Ghent in the miniature-like care and delicacy with which some of his earliest works, such as the "Apollo and Marsyas," were executed.

Though Raphael lost his father at the age of eleven, yet to him he certainly owed a great part of that early training which enabled him to produce paintings of apparently mature beauty when he was scarcely twenty years of age. The altar-piece painted by Giovanni for the church of Gradara, and a fresco, now preserved in the Santi house[3] at Urbino, are clearly prototypes of some of Raphael's most graceful paintings of the Madonna and Child. On the death of his father in 1494 Raphael was left in the care of his stepmother (his own mother, Magia Ciarla, having died in 1491) and of his uncle, a priest called Bartolomeo.[1]

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[1] See Pungileoni, *Elogio Storico di Raffaello* (Urbino, 1829); for a valuable account of Raphael's family and his early life, see also, Id., *Vita di Giov. Santi* (Urbino, 1822), and Campori, *Notizie e Documenti per la Vita di Giov. Santi e di Raffaello* (Modena, 1870).

[2] See an interesting account of the court of Urbino by Delaborde, *Études sur les B. Arts . . . en Italie* (Paris, 1864), vol. i. p. 145.

[3] The house of Giovanni Santi, where Raphael was born, still exists at Urbino in the Contrada del Monte, and, being the property of the municipality, is now safe from destruction.

First or Perugian Period.—In what year Raphael was apprenticed to Perugino and how the interval before that was spent are matters of doubt. Vasari's statement that he was sent to Perugia during his father's lifetime is certainly a mistake. On the whole it appears most probable that he did not enter Perugino's studio till the end of 1499, as during the four or five years before that Perugino was mostly absent from his native city.[2] The so-called *Sketch Book of Raphael* in the academy of Venice contains studies apparently from the cartoons of some of Perugino's Sistine frescoes, possibly done as practice in drawing.

This celebrated collection of thirty drawings, now framed or preserved in portfolios, bears signs of having once formed a bound book, and has been supposed to be a sketch-book filled by Raphael during his Perugian apprenticeship. Many points, however, make this tempting hypothesis very improbable; the fact that the drawings were not all originally on leaves of the same size, and the miscellaneous character of the sketches—varying much both in style and merit of execution—seem to show that it is a collection of studies by different hands, made and bound together by some subsequent owner, and may contain but very few drawings by Raphael himself.[3]

Before long Raphael appears to have been admitted to share in the execution of paintings by his master; and his touch can with more or less certainty be traced in some of Perugino's panels which were executed about 1502. Many of those who, like Crowe and Cavalcaselle, adopt the earlier date of Raphael's apprenticeship, believe that his hand is visible in the execution of the beautiful series of frescoes by Perugino in the Sala del Cambio, dated 1500; as does also M. Müntz in his excellent *Raphaël, sa vie*, Paris, 1881, in spite of his accepting the end of 1499 as the period of Raphael's first entering Perugino's studio, —two statements almost impossible to reconcile. Considering that Raphael was barely seventeen when these frescoes were painted, it is hardly reasonable to attribute the finest heads to his hand; nor did he at an early age master the difficulties of *fresco buono.* The Resurrection of Christ in the Vatican and the Diotalevi Madonna in the Berlin Museum are the principal pictures by Perugino in parts of which the touch of Raphael appears to be visible, though any real certainty on this point is unattainable.[4]

About 1502 Raphael began to execute independent works; four pictures for churches at Città di Castello were probably the earliest of these, and appear to have been painted in the years 1502–4. The first is a gild-banner painted on one side with the Trinity, and below, kneeling figures of S. Sebastian and S. Rocco; on the reverse is a Creation of Eve, very like Perugino in style, but possessing more grace and breadth of treatment. These are still in the church of S. Trinità.[5] Also for Città di Castello were the coronation of S. Niccolo Tolentino, now destroyed, though studies for it exist at Oxford and Lille (*Gaz. d. B. Arts*, 1878, i. p. 48), and the Crucifixion, now in the Dudley collection, painted for the church of S. Domenico, and signed **RAPHAEL VRBINAS P.** It is a panel 8 ft. 6 in. high by 5 ft. 5 in. wide, and contains noble figures of the Virgin, St John, St Jerome and St Mary Magdalene. The fourth painting executed for this town, for the church of S. Francesco, is the exquisitely beautiful and highly finished Sposalizio, now in the Brera at Milan, signed and dated **RAPHAEL VRBINAS MDIIII.** This is closely copied both in composition and detail from Perugino's painting of the same subject now at Caen, but is far superior to it in sweetness of expression and grace of attitude. The Temple of Jerusalem, a domed octagon with outer ambulatory in Perugino's picture, is reproduced with slight alterations by Raphael, and the attitudes and grouping of the figures are almost exactly the same in both. The Connestabile Madonna is one of Raphael's finest works, painted during his Perugian period; it is a round panel; the motive, the Virgin reading a book of hours, is a favourite one with him, as it was with his father Giovanni. This lovely picture was lost to Perugia in 1871, when Count Connestabile sold it to the emperor of Russia for £13,200.

Second or Florentine Period, 1504–1508.— From 1504 to 1508 Raphael's life was very stirring and active. In the first half of 1504 he visited Urbino, where he painted two small panels for Duke Guidobaldo, the St George and the St Michael of the Louvre. His first and for him momentous visit to Florence was made towards the end of 1504, when he presented himself with a warm letter of recommendation[6] from his patroness Joanna della Rovere to the gonfaloniere Pier Soderini. In Florence Raphael was kindly received, and, in spite of his youth (being barely of age), was welcomed as an equal by the majority of those great artists who at that time had raised Florence to a pitch of artistic celebrity far above all other cities of the world. At the time of his arrival the whole of artistic Italy was being excited to enthusiasm by the cartoons of the battle of Anghiari and the war with Pisa, on which Leonardo da Vinci and Michelangelo were then devoting their utmost energies. To describe the various influences under which Raphael came, and the many sources, from which he drank in stores of artistic knowledge, would be to give a complete history of Florentine art in the 15th century.[7] With astonishing rapidity he shook off the mannerisms of Perugino, and put one great artist after another under contribution for some special power of drawing, beauty of colour, or grace of composition in which each happened to excel. Nor was it from painters only that Raphael acquired his enlarged field of knowledge and rapidly growing powers. Sculptors like Ghiberti and Donatello must be numbered among those whose works helped to develop his new-born style.[8] The Carmine frescoes of Masaccio and Masolino taught this eager student long-remembered lessons of methods of dramatic expression.[9] Among his contemporaries it was especially Signorelli and Michelangelo who taught him the importance of precision of line and the necessity of a thorough knowledge of the human form.[10] From da Vinci he learnt subtleties of modelling and soft beauty of expression,[11] from Fra Bartolommeo nobility of composition and skilful treatment of drapery in dignified folds.[12] The friendship between Raphael and the last of these was very close and lasted for many years. The architect Baccio d'Agnolo was another of his special friends, at whose house the young painter enjoyed social intercourse with a large circle of the chief artists of Florence, and probably learned from him much that was afterwards useful in his practice as an architect.

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[1] The administration of Giovanni Santi's will occasioned many painful family disputes and even appeals to law; see Pungileoni, *El. Stor. di Raffaello.*

[2] Crowe and Cavalcaselle (*Life of Raphael*, vol. i., London, 1882) adopt the notion that Raphael went to Perugia in 1495, but the reasons with which they support this view appear insufficient.

[3] See an excellent critical examination of the *Sketch Book* by Morelli, *Italian Masters in German Galleries*, translated by Mrs Richter (London, 1882); according to Morelli, only two drawings are by Raphael. Schmarsow, "Raphael's Skizzenbuch in Venedig," in *Preussische Jahrbücher*, xlviii. pp. 122-149 (Berlin, 1881), takes the opposite view. But Kahl, *Das venezianische Skizzenbuch* (Leipzig, 1882), follows Morelli's opinion, which has been generally adopted.

[4] Parts of Perugino's beautiful triptych of the Madonna, with the archangels Raphael and Michael, painted for the Certosa near Pavia and now in the National Gallery of London, have been attributed to Raphael, but with little reason. Perugino's grand altar-piece at Florence of the Assumption of the Virgin shows that he was quite capable of painting figures equal in beauty and delicacy to the St Michael of the Certosa triptych. See Frizzioni, *L'Arte Italiana nella Gal. Nat. di Londra* (Florence, 1880).

[5] For an account of processional banners painted by distinguished artists, see Mariotti, *Lettere pittoriche Perugine*, p. 76 seq.

[6] This letter, which still exists, was sold in Paris in 1856, and is now in private hands.

[7] See Minghetti, "I Maestri di Raffaello," in the *Nuova Antologia*, 1st August 1881.

[8] See his sketch of St George and the Dragon, in the Uffizi, largely taken from Donatello's pedestal relief outside Or San Michele.

[9] See his cartoon of St Paul preaching at Athens (Victoria and Albert Museum).

[10] See many of his life-studies, especially the one he sent to Albert Dürer, now at Vienna.

[11] See the portrait of Maddalena Doni in the Pitti.

[12] See the Madonna del Baldacchino in the Pitti.

The transition in Raphael's style from his first or Perugian to his second or Florentine manner is well shown in the large picture of the Coronation of the Virgin painted for Maddalena degli Oddi, now in the Vatican, one of the most beautiful that he ever produced, and especially remarkable for its strong religious sentiment—in this respect a great contrast to the paintings of his last or Roman manner which hang near it. The exquisite grace of the angel musicians and the beauty of the faces show signs of his short visit to Florence, while the general formality of the composition and certain details, such as the fluttering ribands of the angels, recall peculiarities of Perugino and of Pinturicchio, with whose fine picture of the same subject hung close by it is interesting to compare it. Raphael's painting, though by far the more beautiful of the two, is yet inferior to that of Pinturicchio in the composition of the whole; an awkward horizontal line divides the upper group of the Coronation from that below, the apostles standing round the Virgin's tomb, filled with roses and lilies (Dante, *Par.* xxiii. 73), while the older Perugian has skilfully united the two groups by a less formal arrangement of the figures. The predella of this masterpiece of Raphael is also in the Vatican; some of its small paintings, especially that of the Annunciation to the Virgin, are interesting as showing his careful study of the rules of perspective.[1] Several preparatory sketches for this picture exist: fig. 1 shows a study, now at Lille, for the two principal figures, Christ setting the crown on His mother's head (see fig. 2). It is drawn from two youths in the ordinary dress of the time; and it is interesting to compare it with his later studies from the nude, many of which are for figures which in the future picture were to be draped. It was at Florence, as Vasari says, that Raphael began serious life studies, not only from nude models but also by making careful anatomical drawings from dissected corpses and from skeletons.

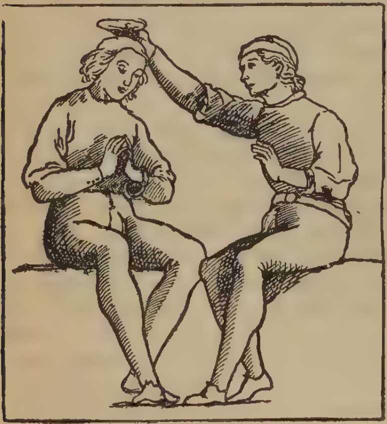

FIG. 1.—Silver-point study for the main figures in the Coronation of the Virgin (Vatican). In the Lille museum. Illustrating Raphael's use of draped models during his early period.

His first visit to Florence lasted only a few months; in 1505 he was again in Perugia painting his first fresco, the Trinity and Saints for the Camaldoli monks of San Severo, now a mere wreck from injury and restorations. The date **MDV** and the signature were added later, probably in 1521. Part of this work was left incomplete by the painter, and the fresco was finished in 1521 (after his death) by his old master Perugino.[2] It was probably earlier than this that Raphael visited Siena and assisted Pinturicchio with sketches for his Piccolomini frescoes.[3] The Madonna of S. Antonio was also finished in 1505, but was probably begun before the Florentine visit.[4] A record of his visit to Siena exists in a sketch of the antique marble group of the Three Graces, then in the cathedral library, from which, not long afterwards, he painted the small panel of the same subject now in Lord Dudley's collection.

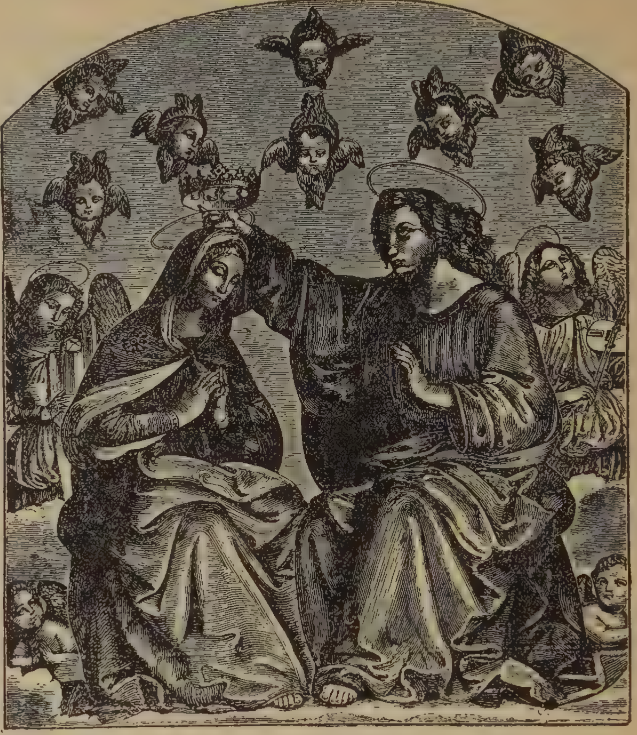

FIG. 2.—The group for which fig. 1 is a study.

In 1506 Raphael was again in Urbino, where he painted for the duke another picture of St George, which was sent to England as a present to Henry VII. The bearer of this and other gifts was Guidobaldo's ambassador, the accomplished Baldassare Castiglione (*q.v.*), a friend of Raphael, whose noble portrait of him is in the Louvre. At the court of Duke Guidobaldo the painter's ideas appear to have been led into a more secular direction, and to this stay in Urbino probably belong the Dudley Graces, the miniature "Knight's Dream of Duty and Pleasure" in the National Gallery (London),[5] and also the "Apollo and Marsyas," sold in 1882 by Morris Moore to the Louvre for £10,000, a most lovely little panel, painted with almost Flemish minuteness, rich in colour, and graceful in arrangement.[6]

Towards the end of 1506 Raphael returned to Florence, and there (before 1508) produced a large number of his finest works, carefully finished, and for the most part wholly the work of his own hand. Several of these are signed and dated, but the date is frequently very doubtful, owing to his custom of using Roman numerals, introduced among the sham Arabic embroidered on the borders of dresses, so that the I.'s after the V. are not always distinguishable from the straight lines of the ornament. The following is a list of some of his chief paintings of this period: the "Madonna del Gran Duca" (Pitti); "Madonna del Giardino," 1506 (Vienna); "Holy Family with the Lamb," 1506 or 1507 (Madrid); the "Ansidei Madonna," 1506 or 1507 (National Gallery); the Borghese "Entombment," 1507; Lord Cowper's "Madonna" at Panshanger, 1508; "La bella Giardiniera,"

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[1] While at Florence he is said to have taught the science of perspective to his friend Fra Bartolommeo, who certainly gave his young instructor valuable lessons on composition in return.

[2] The fresco of the Last Supper, dated 1505, in the refectory of S. Onofrio at Florence, is not now claimed as a work of Raphael's, in spite of a signature partly introduced by the restorer.

[3] Raphael probably had no hand in the actual execution of the paintings; see Schmarsow, *Raphael und Pinturicchio in Siena* (Stuttgart, 1880), and Milanesi, in his edition of Vasari, iii. p. 515 seq., appendix to life of Pinturicchio.

[4] This fine altar-piece, with many large figures, is now the property of the heirs of the duke of Ripalta, and is stored in the basement of the National Gallery, London.

[5] This missal-like painting is about 7 in. square; it was bought in 1847 for 1000 guineas. The National Gallery also possesses its cartoon, in brown ink, pricked for transference.

[6] In spite of some adverse opinions, frequently expressed with extreme virulence, the genuineness of this little gem can hardly be doubted by any one who carefully studies it without bias. Sketches for it at Venice and in the Uffizi also appear to bear the impress of Raphael's manner. See Delaborde, *Études sur les B. Arts . . . en Italie*, i. p. 236; Gruyer, *Raphaël et l'antiquité*, ii. p. 421; Eitelberger, *Rafael's Apollo und Marsyas* (Vienna, 1860); Batté, *Le Raphaël de M. Moore* (Paris, 1859); and also various pamphlets on it by its former owner, Mr. Morris Moore.

1508 (Louvre); the "Eszterhazy Madonna," probably the same year; as well as the "Madonna del Cardellino" (Uffizi), the "Tempi Madonna" (Munich), the "Colonna Madonna" (Berlin), the "Bridgewater Madonna" (Bridgewater House), and the "Orleans Madonna" (duc d'Aumale's collection). The "Ansidei Madonna" was bought in 1884 for the National Gallery from the duke of Marlborough for £70,000, more than three times the highest price ever before given for a picture.[1] It was painted for the Ansidei family of Perugia as an altar-piece in the church of S. Fiorenzo, and is a work of the highest beauty in colour, well preserved and very large in scale. The Virgin with veiled head is seated on a throne, supporting the Infant with one hand and holding a book in the other. Below stands S. Niccolo da Tolentino, for whose altar it was painted; he holds a book and a crozier, and is clad in jewelled mitre and green cope, under which appear the alb and cassock. On the other side is the Baptist, in red mantle and camel's-hair tunic, holding a crystal cross. The rich jewellery in this picture is painted with Flemish-like minuteness. On the border of the Virgin's robe is a date, formerly read as **MDV** by Passavant and others; it really is **MDVI** or **MDVII.** If the later date is the true one, the picture was probably begun a year or two before. A favourite method of grouping his Holy Families is that seen in the "Madonna del Cardellino" and the "Bella Giardiniera," in which the main lines form a pyramid. This arrangement is also used in the "Madonna del Giardino" and in the larger group, including St Joseph and St Elizabeth, known as the "Canigiani Holy Family," now at Munich, one of the least graceful of all Raphael's compositions. The "Entombment of Christ," now in the Galleria Borghese in Rome, was painted during a visit to Perugia in 1507 for Lady Atalanta Baglioni, in memory of the death of her brave and handsome but treacherous son Grifonetto, who was killed in 1500 by his enemies the Oddi party.[2] The many studies and preliminary sketches[3] for this important picture which exist in various collections show that it cost Raphael an unusual amount of thought and labour in its composition, and yet it is quite one of his least successful paintings, especially in colour. It is, however, much injured by scraping and repainting, and appears not to be wholly by his hand. The "Madonna del Baldacchino," one of the finest compositions of the Florentine period, owing much to Fra Bartolommeo, is also unsatisfactory in execution; being left unfinished by Raphael, it was completed by Ridolfo Ghirlandajo, by whom the ungraceful angels of the upper part and the canopy were wholly executed, and even designed. It was painted for the Dei family as an altar-piece for their chapel in S. Spirito, Florence. The "St Catherine" of the National Gallery was probably painted in 1507; its cartoon, pricked for transference, is in the Louvre. In colouring it much resembles parts of the Borghese "Entombment," being quiet and grey in tone. To the Florentine period belong some of his finest portraits, and it is especially in these that da Vinci's influence appears. The portraits of Angelo Doni and his wife Maddalena (Pitti) are vivid and carefully executed paintings, and the unknown lady with hard features (now in the Uffizi) is a masterpiece of noble realism and conscientious finish. The Czartoriski portrait, a graceful effeminate-looking youth with long hair and tapering hands, now moved to Cracow, is probably a work of this period; though worthy to rank with Raphael's finest portraits, its authenticity has been doubted. Very similar in style is the Herrenhausen portrait, once attributed to Giovanni Bellini, but an undoubted work of Raphael, in his second manner; it also represents a young man with long hair, close-shaven chin, a wide cloth hat and black dress, painted in half-length. The so-called Portrait of Raphael by himself at Hampton Court is a very beautiful work, glowing with light and colour, which may possibly be a genuine picture of about 1506. It represents a pleasant-looking youth with turned-up nose, not bearing the remotest resemblance to Raphael, except the long hair and black cap common to nearly all the portraits of this time.[4] A fine but much-restored portrait of Raphael by himself, painted at Florence, exists in the Uffizi; it represents him at a very early age, and was probably painted during the early part of his stay in Florence.

Third or Roman Period, 1508–1520.—In 1508 Raphael was painting several important pictures in Florence; in September of that year we find him settled in Rome, from a letter addressed in the warmest terms of affectionate admiration to Francia, to whom he sent a sketch for his "Adoration of the Shepherds," and promised to send his own portrait in return for that which Francia had given him.[5] Raphael was invited to Rome by his fellow-citizen (not relation, as Vasari says) Bramante, who was then occupied in the erection of the new church of St Peter, the foundation-stone of which had been laid by Julius II. on the 18th of April 1506. At this time the love of the popes for art had already attracted to Rome a number of the chief artists of Tuscany, Umbria and North Italy, among whom were Michelangelo, Signorelli, Perugino, Pinturicchio, Lorenzo Lotto, Peruzzi, Sodoma, and many others, and it was among this brilliant assembly that Raphael, almost at once, took a leading position.[6] Thanks to Bramante's friendly intervention, Julius II. (Della Rovere) soon became Raphael's most zealous patron and friend, as did also the rich bankers Agostino Chigi (the Rothschild of his time) and Bindo Altoviti, whose portrait, at the age of twenty, now at Munich, is one of the most beautiful that Raphael ever produced.

A series of rooms in the Vatican, over the Appartamenti Borgia, were already decorated with frescoes by Bonfigli, Perugino, Piero della Francesca, Andrea del Castagno, Signorelli and Sodoma; but so rapidly had the taste of the time changed that Julius II. decided to sweep them all away and re-cover the

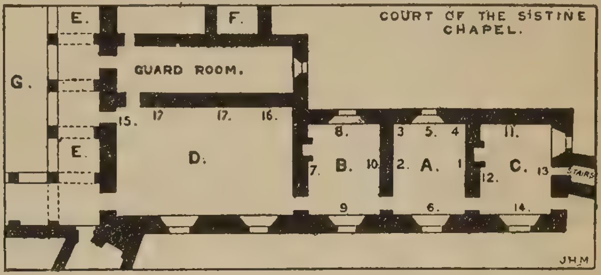

FIG. 3.—Plan showing position of Raphael's frescoes in the stanze.

A. Stanza della Segnatura (1509–11); 1, Disputa; 2, School of Athens; 3, Justinian giving his code to Trebonian; 4, Gregory IX. giving decretals to a jurist; 5 (over the window), Three Virtues; 6 (over the other window), Apollo and a group of poets on Mount Parnassus; vault with medallions of Poetry, Theology, Science, and Justice, and other paintings. B. Stanza d'Eliodoro (1511–14): 7, Expulsion of Heliodorus from the Temple; 8, Mass of Bolsena; 9, St Peter freed from prison; 10, Attila repulsed by Leo I.; vault with scenes from Old Testament, by pupils. C. Stanza dell' Incendio (1517), nearly all painted by pupils: 11, Burning of the Borgo; 12, Victory of Leo IV. over the Saracens at Ostia; 13, Coronation of Charlemagne by Leo III. in St Peter's; 14, Oath of Leo III. before Charlemagne. D. Sala di Costantino, painted by pupils (1520–24): 15 and 16, oil-paintings of Comitas and Justitia attributed to Raphael; 17, 17, great fresco of the Defeat of Maxentius. E E. Part of Raphael's loggia, by his pupils. F. Chapel of Nicholas V., painted by Fra Angelico. G. Cortile of Bramante.

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[1] It is engraved at p. 53, vol. ii., of Dohme, *Kunst und Künstler des Mittelalters* (Leipzig, 1878), a work which has many good reproductions of Raphael's paintings and sketches.

[2] See Symonds, *Sketches in Italy*, the chapter on Perugia, mainly taken from the contemporary chronicle of Matarazzo.

[3] These show that Raphael at first intended to paint a Deposition from the Cross, and afterwards altered his scheme into the Entombment; an excess of study and elaboration partly account for the shortcomings of this picture.

[4] To judge of the authorship of a portrait from internal evidence is especially difficult, as in so many cases the strong individuality of the person represented obscures that of the painter.

[5] Malvasia, *Felsina pittrice* (Bologna, 1678), was the first to publish this letter; see also Müntz, *Raphaël, sa vie, &c.*, p. 315 (Paris, 1881). Minghetti (*Nuova Antologia*, 1883) throws doubt on the date of this letter.

[6] Müntz, "Michel-Ange et Raphael à la cour de Rome," *Gaz. des B. Arts*, March and April 1882, and *Les arts à la cour des papes*, vol. iii. (Paris, 1884).

walls with paintings in the more developed but less truly decorative style of Raphael. It was not without regret that Raphael saw the destruction of this noble series of frescoes. One vault, that of the Stanza dell' Incendio, painted by his master Perugino, he saved from obliteration; it still exists, well preserved, a most skilful piece of decorative work; and he also set his pupils to copy a number of portrait-heads in the frescoes of Piero della Francesca before they were destroyed.[1] Fig. 3 shows the positions of Raphael's frescoes in the stanze, which, both from their size and method of lighting, are very unsuited for the reception of these large pictures. The two most important rooms (A and B) are small, and have an awkward cross-light from opposite windows.[2]

Stanza della Segnatura (papal signature room), painted in 1509–11 (A on fig. 3). The first painting executed by Raphael in the stanze was the so-called Disputa, finished in 1509. It is very unlike the later ones in style, showing the beginning of transition from his Florentine to his "Roman manner"; as a decorative work it is very superior to the other frescoes; the figures are much smaller in scale, as was suited to the very moderate size of the room, and the whole is arranged mainly on one plane, without those strong effects of perspective which are so unsuited to the decorative treatment of a wall-surface. In its religious sentiment, too, it far excels any of the later stanze paintings, retaining much of the sacred character of earlier Florentine and Umbrian art. As a scheme of decoration it appears to have been suggested by some of the early apsidal mosaics. Fig. 4 shows the disposition of its main masses, which seem to indicate the curved recess of an apse. Gold is largely used, with much richness of effect, while the later purely pictorial frescoes have little or none. The subject of this magnificent painting is the hierarchy of the church on earth and its glory in heaven.[3] The angels in the upper tier and the nude cherubs who carry the books of the Gospels are among the most beautiful figures that Raphael ever painted.

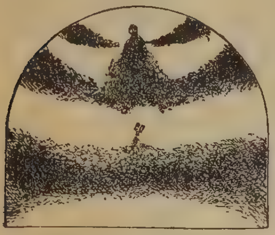

FIG. 4—Diagram to show main lines of the Disputa, suggesting an apse, with mosaic decoration.

The painting on the vault of this room is the next in date, and shows further transition towards the "Roman manner." In his treatment of the whole Raphael has, with much advantage, been partly guided by the painting of Perugino's vault in the next room (C). Though not without faults, it is a very skilful piece of decoration; the pictures are kept subordinate to the lines of the vault, and their small scale adds greatly to the apparent size of the whole. A great part of the ground is gilt, marked with mosaic-like squares, a common practice with decorative painters—not intended to deceive the eye, but simply to give a softer texture to the gilt surface by breaking up its otherwise monotonous glare. The principal medallions in each cell of this quadripartite vault are very graceful female figures, representing Theology, Science, Justice, and Poetry. Smaller subjects, some almost miniature-like in scale, are arranged in the intermediate spaces, and each has some special meaning in reference to the medallion it adjoins; some of these are painted in warm monochrome to suggest bas-reliefs. The fine painting of the "Flaying of Marsyas" is interesting as showing Raphael's study of antique sculpture: the figure of Marsyas is a copy of a Roman statue, of which several replicas exist. The very beautiful little picture of the "Temptation of Eve" recalls Albert Dürer's treatment of that subject, though only vaguely. Much mutual admiration existed between Raphael and Dürer: in 1515 Raphael sent the German artist a most masterly life study of two nude male figures (now at Vienna); on it is written in Albert Dürer's beautiful hand the date and a record of its being a gift from Raphael. It is executed in red chalk, and was a study for two figures in the "Battle of Ostia" (see below).

On the wall opposite the Disputa is the so-called School of Athens.[4] In this and the succeeding frescoes all notion of decorative treatment is thrown aside, and Raphael has simply painted a magnificent series of paintings, treated as easel pictures might have been, with but little reference to their architectural surroundings.[5] The subject of this noble fresco, in contrast to that opposite, is "Earthly Knowledge," represented by an assembly of the great philosophers, poets and men of science of ancient Greece. The central figures are Plato and Aristotle, while below and on each side are groups arranged with the most consummate skill, including the whole "filosofica famiglia" of Dante (*Infer.* iv. 133–144), and a number of other leaders of thought, selected in a way that shows no slight acquaintance with the history of philosophy and science among the ancient Greeks. Many interesting portraits are introduced—Bramante as the aged Archimedes, stooping over a geometrical diagram; a beautiful fair-haired youth on the left is Francesco Maria della Rovere, duke of Urbino; and on the extreme right figures of Raphael himself and Sodoma are introduced (see fig. 5, below). The stately building in which these groups are arranged is taken with modifications from Bramante's first design for St Peter's.

Over the window (No. 6 on fig. 3) is a group of poets and musicians on Mount Parnassus, round a central figure of Apollo; it contains many heads of great beauty and fine portraits of Dante and Petrarch. The former, as a theologian, appears also in the Disputa. Over the opposite window (No. 5) are graceful figures of the three chief Virtues, and at one side (No. 4) Gregory IX. (a portrait of Julius II.) presenting his volume of decretals to a jurist; beside him is a splendid portrait of Cardinal de' Medici (afterwards Leo X.) before his face was spoiled by getting too stout. This painting shows the influence of Melozzo da Forli.[6] On the other side Justinian presents his code to Trebonianus (No. 3); this is inferior in execution, and appears to have been chiefly painted by pupils.

The next room (B), called La Stanza d'Eliodoro, was painted in 1511–14;[7] it is so called from the fresco (No. 7 in fig. 3) representing the expulsion of Heliodorus from the Temple (2 Macc. iii.), an allusion to the struggles between Louis XII. of France and Julius II. The whole spirit of the subjects in this room is less broad and tolerant than in the first: no pagan ideas are admitted, and its chief motive is the glorification of the pontificate, with insistence on the temporal power. The main incident of this picture is the least successful part of it: the angel visitant on the horse is wanting in dignity, and the animal is poorly drawn, as is also the case with the horses of Attila's army in the fresco opposite. The group of women and children on the left is, however, very beautiful, and the figures of Julius II. and his attendants are most nobly designed and painted with great vigour. The tall standing figure of Marc Antonio Raimondi, as one of the pope's bearers, is a marvellous piece of portrait-painting, as is also the next figure who bears his name on a scroll—**IO . PETRO . DE . FOLIARIIS . CREMONĒN.** Behind, Giulio Romano is represented as another papal attendant. This picture was completed in 1512. Over the window (No. 8) is the scene of the Miracle at Bolsena of 1264, when the real presence was proved to a doubting priest by the appearance of blood-stains on the Corporal (see ORVIETO). Julius II. is introduced kneeling behind the altar; and the lower spaces on each side of the windows are filled with two groups, that on the left with women, that on the right with officers of the papal guard. The last group is one of the most masterly of all throughout the stanze: each face, a careful portrait, is a marvel of expression and power, and the technical skill with which the whole is painted to the utmost degree of finish, almost without any tempera touches, is most wonderful. The next fresco in date (No. 10) is that of the Repulsion of Attila from the walls of Rome by Leo I., miraculously aided by the apparitions of St Peter and St Paul; it contains another allusion to the papal quarrels with France. It was begun in the lifetime of Julius II., but was only half-finished at the time of his death in 1513; thus it happens that the portrait of his successor, the Medici pope Leo X., appears twice over, first as a cardinal riding behind the pope, painted before the death of Julius II., and again in the character of S. Leo, instead of the portrait of Julius which Raphael was about to paint.[8] Attila with his savage-looking army is not the most successful part of the fresco: the horses are very wooden in appearance, and the tight-fitting scale armour, put on in some impossible way without any joints, gives a very unreal and theatrical look to the picture. Part is the work of pupils. In 1514 he painted the "Deliverance of St Peter from Prison," with a further political allusion (No. 9). It is very skilfully arranged to fit in the awkward space round the window, and is remarkable for an attempt, not much suited for fresco-painting, to combine and contrast the three different qualities of light coming from the moon, the glory round the angel, and the torches of the sentinels.

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[1] How fine these portrait-heads probably were may be guessed from Piero's magnificent frescoes at Arezzo, in the retro-choir of S. Francesco.

[2] See Brunn, *Die Composition der Wandgemälde Raphaels im Vatican* (Berlin), and Gruyer, *Les fresques de Raphaël au Vatican* (Paris, 1859).

[3] It need hardly be said that the name Disputa is a misnomer; there could be no dispute among the saints and doctors of the church about so well-established a dogma as the real presence: the monstrance with the Host below and the figure of Christ above indicate His double presence both on earth and in heaven. Dr Braun, Springer, and Hagen have published monographs in German on this painting.

[4] See Trendelenburg, *Über Rafael's Schule von Athen* (Berlin, 1843), and Richter (same title) (Heidelberg, 1882); the title "School of Athens" is comparatively modern.

[5] He has shown great skill in the way in which he has fitted his end frescoes into the awkward spaces cut into by the windows, but they are none the less treated in a purely pictorial manner.

[6] Compare his fresco of Sixtus IV., now in the picture-gallery of the Vatican.

[7] The vault of this room is painted with scenes from the Old Testament on a harsh blue ground, much restored; they are probably the work of Giulio Romano, and in a decorative way are very unsuccessful—a striking contrast to the beautiful vaults of Perugino and Raphael in rooms C and A. The deep blue grounds so much used by Raphael's school are very liable to injury from damp, and in most cases have been coarsely restored. Those in the Villa Madama are untouched, and in parts the damp has changed the ultramarine into emerald green.

[8] A pen sketch in the Louvre by Raphael shows Julius II. in the place afterwards occupied by Leo X.; another difference in this sketch is that the pope is borne in a chair, not on horseback as in the fresco.

For room C Raphael designed and partly painted the "Incendio del Borgo" (No. 11), a fire in the Borgo or Leonine City, which was miraculously stopped by Leo IV. appearing and making the sign of the cross at a window in the Vatican. On the background is shown the façade of the old basilica of St Peter, not yet destroyed when this fresco was painted. One group on the left, in the foreground, is remarkable for its vigour and powerful drawing; the motive is taken from the burning of Troy; a fine nude figure of Æneas issues from the burning houses bearing on his back the old Anchises and leading the boy Ascanius by the hand. Some of the female figures are designed with much grace and dramatic power. Many studies for this picture exist. This is the last of the stanze frescoes on which Raphael himself worked. Others designed by him and painted by Giulio Romano, Gianfrancesco Penni, and other pupils were the "Battle of Ostia" (No. 12), a very nobly composed picture, and the "Oath of Leo III. before Charlemagne" (No. 14). The other great picture in this room (No. 13), the "Coronation of Charlemagne" (a portrait of Francis I. of France), is so very inferior in composition that it is difficult to believe that Raphael even made a sketch for it. The enormous fresco of the "Defeat of Maxentius by Constantine" (room D, No. 17) was painted by Giulio Romano, soon after Raphael's death, from a sketch by the latter; it is even more harsh and disagreeable in colour than most of Giulio Romano's early frescoes.[1] Among the other very inferior frescoes in this great hall are two female figures (Nos. 15 and 16) representing Comitas and Justitia, painted on the wall in oil colours, very harmonious and rich in tone; they are usually, though wrongly, attributed to Raphael himself.

Technical Methods employed in Raphael's Frescoes.—Having made many studies, both nude and draped, for single figures and groups, the painter made a small drawing of the whole composition, which was enlarged by his pupils with the help of numbered squares, drawn all over it, to the full size required,[2] on paper or canvas. Holes were then pricked along the outlines of the cartoon, and the design pounced through on to an undercoat of dry stucco on the wall, with pounded charcoal and a stiff brush. Over this, early in the morning, a patch of wet stucco was laid, about enough to serve for the day's painting; this of course obliterated the outline on the wall, and the part covered by the patch was again sketched in by freehand, with a point on the wet stucco, so as to be a guide for the outline traced with the brush and the subsequent painting. A line impressed on the wet stucco was easily smoothed out, but a touch of the brush full of pigment sank deeply into the moist stucco, and could not easily be effaced. It will thus be seen that in fresco painting the only use of pouncing the whole design on to the wall was to keep the general positions of the figures right, and was no guide as to the drawing of each separate part. Fig. 5 shows the portrait-heads of himself and Perugino (?), at the extreme right of the School of Athens; on this are visible many of the impressed sketch-lines, and also part of the "fresco edge" of the patch on which this part is painted. The heads in this figure are less than one day's work. It will be seen that there is no attempt at any accuracy of drawing in the impressed lines. Raphael, especially in his later frescoes, worked with wonderful rapidity: three life-sized busts, or half a full-length figure, more than life-size, was a not unusual day's work. In some of the frescoes the edges of each day's patch of stucco can easily be traced, especially in the Incendio del Borgo, which has a strong side light. In the Disputa much use was made of tempera in the final touches, but less was used in the subsequent frescoes, owing to his increasing mastery of the difficulties of the process.

The paintings in the stanze were only a small part of Raphael's work between 1509 and 1513. To this period belong the Madonna of Foligno (Vatican), painted in 1511 for Sigismondo Conti; it is one of his most beautiful compositions, full of the utmost grace and sweetness of expression, and appears to be wholly the work of his hand. It has suffered much from repainting. Of about the same date are the gem-like Garvagh Madonna (National Gallery, bought for £9000; once in the possession of the Aldobrandini family), the Diademed Virgin of the Louvre, and the Madonna del Pesce at Madrid. The last is a very noble picture but the design is more pleasing than the colour, which, like other paintings of Raphael's at Madrid, suggests the inferior touch of a pupil; it was executed in 1513 for S. Domenico in Naples. In addition to other easel pictures a number of his finest portraits belong to this period—that of Julius II. (Uffizi),[3] of which a good replica or contemporary copy exists in the National Gallery, the so-called Fornarina in the Palazzo Barberini, the Baldassare Castiglione of the Louvre, and the unfinished portrait of Federigo Gonzaga of Mantua.

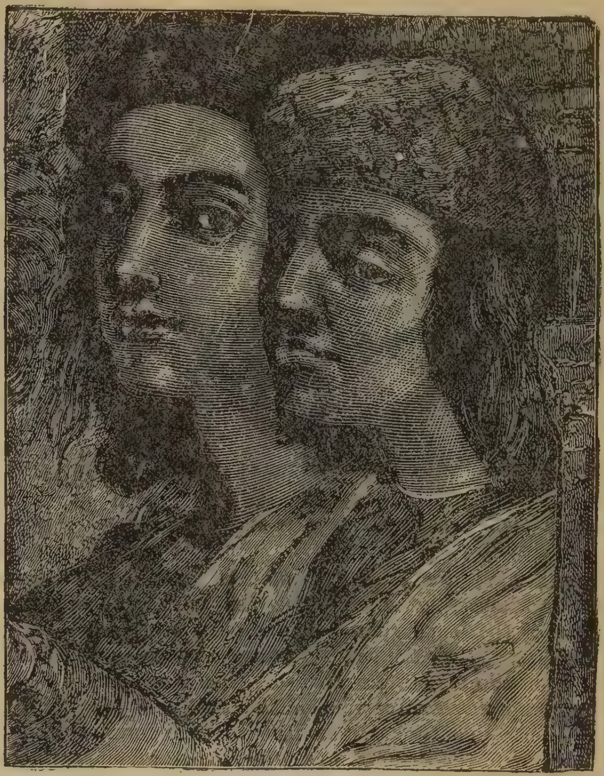

FIG. 5.—Heads of Raphael and Perugino (?), from the School of Athens, showing incised lines and "fresco edges."

When Giovanni de' Medici, at the age of thirty-eight, became pope as Leo X., a period of the most glowing splendour and reckless magnificence succeeded the sterner rule of Julius II. Agostino Chigi, the Sienese financier, was the chief of those whose lavish expenditure contributed to enrich Rome with countless works of art. For him Raphael painted, in 1513–14, the very beautiful fresco of the Triumph of Galatea in his new palace by the Tiber bank, the Villa Farnesina, and also made a large series of magnificent designs from Apuleius's romance of Cupid and Psyche, which were carried out by a number of his pupils.[4] These cover the vault and lunettes of a large loggia (now closed in for protection); in colouring they are mostly harsh and gaudy,[5] as is usually the case with the works of his pupils, a great contrast to the fresco of the Galatea, the greater part of which is certainly the master's own work.[6] For the same patron he painted (also in 1513) his celebrated Sibyls

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[1] See Montagnani, *Sala di Costantino* (Rome, 1834). Though he was never a good colourist, the great frescoes by Giulio Romano in the Palazzo del Tè, Mantua, show some improvement as compared with his Roman work.

[2] These three stages were usually distinguished as *study*, *sketch* and *cartoon*.

[3] A very fine ancient copy of this portrait is in the Pitti Palace; certain peculiarities in its execution show it to be by some Venetian painter, as was pointed out to Professor Middleton by Mr Fairfax Murray.

[4] Chiefly by Giulio Romano, Gianfrancesco Penni and Giovanni da Udine; much injury has been done to these frescoes by repainting, especially in the coarse blue of the ground.

[5] These and other frescoes by his pupils are much disfigured by the disagreeable hot tone of the flesh, very unlike the pearly tone of the flesh of Galatea.

[6] Dorigny, *Psychis et Amoris fabula a Raphaele, &c.* (Rome, 1693); and Gruner, *Fresco Decorations in Italy* (London, 1854), pls. 16–18. The group of the Triton and Nymph on the left of the composition was probably executed by Giulio Romano.

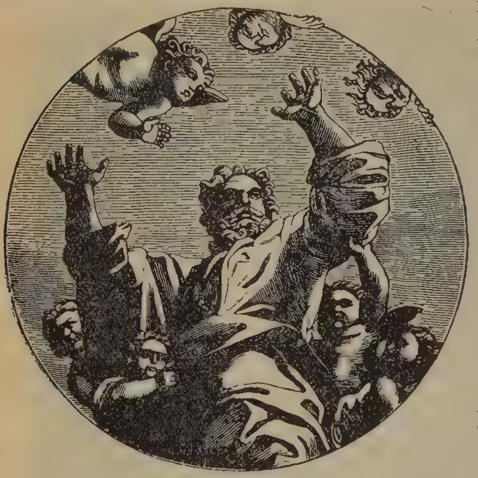

Fig. 6.—Mosaic of God creating the stars, from the Chigi chapel, in centre of dome, designed by Raphael.

in S. Maria della Pace,—figures of exquisite grace, arranged with perfect skill in an awkward space. It is not without reason that Vasari gives these the highest position among his fresco-paintings.[1] Agostino Chigi also employed Raphael to build for him a private chapel in S. Maria del Popolo, and to make a series of cartoons to be executed in mosaic on the inner dome.[2] The central medallion has a figure of God among clouds and angel boys, such as Raphael drew with unrivalled grace (fig. 6), and around are the eight planets, each with its pagan deity and directing angel.[3] He has not hampered himself by any of the usual rules which should apply to the designing of mosaic; they are simply treated as pictures, with almost deceptive effects of perspective. The execution of these brilliant mosaics was carried out by the Venetian Luigi della Pace, whose signature is introduced on the torch of Cupid in the panel representing the star Venus (Ludovico della Pace Veneziano fecit, 1516). These mosaics are still as perfect and brilliant as if they were the work of yesterday. Probably in the early years of Leo X.'s reign were painted the Madonna della Seggiola (Pitti), the S. Cecilia at Bologna (not completed till 1516), the miniature Vision of Ezekiel (Pitti) and three important pictures at Madrid. The latest of these, known as Lo Spasimo, from the church at Palermo, for which it was painted, is one of Raphael's finest compositions, representing Christ bearing His Cross. It bears signs of Giulio Romano's hand in its heavy colouring with unpleasant purple tones. The Madonna called Della Perla has much changed from the darkening of the pigments; in design it recalls Leonardo da Vinci.[4] The small Madonna della Rosa is the most perfect in colour of all the master's pictures in the Madrid Gallery, and is usually rather undervalued; it is a most graceful little picture. The portrait of Leo X. with Cardinals de' Rossi and de' Medici, in the Pitti, is one of his finest portrait-pictures, especially as regards the figure of the pope.[5] Little is known about the Madonna di S. Sisto, the glory of the Dresden Gallery; no studies or sketches for it exist. In style it much resembles the Madonna di Foligno; it is less injured by restoration than the latter.

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Among the latest works of Raphael are the large "St Michael and the Devil," in the Louvre, signed "Raphael Urbinas pingebat, MDXVIII.," and the very beautiful portrait of the Violin-player, in the Sciarra-Colonna Palace in Rome, also dated 1518; this last bears much resemblance to the painter himself. The British Museum possesses one of Raphael's finest portraits, though only a chalk drawing, that of his friend the painter Timoteo della Vite, a masterpiece of expression and vigour; it is executed in black and red, and is but little inferior in chromatic effect to an oil-painting; it is life size, and is executed with wonderful skill and evident keen interest in the subject.

The tapestry cartoons, seven of which are in the Victoria and Albert Museum, were painted by pupils from Raphael's designs. They are part of a set of ten, with scenes from the Acts of the Apostles, intended, when copied in tapestry, to adorn the lower part of the walls of the Sistine chapel. The tapestries themselves, worked at Brussels, are now, after many vicissitudes, hung in a gallery in the Vatican; the set is complete, thus preserving the design of the three lost cartoons. The existing seven, after being cut up into strips for use on the looms, were bought by Rubens for Charles I.[6] The tapestry copies are executed with wonderful skill, in spite of Raphael's having treated the subjects in a purely pictorial way, with little regard to the exigencies of textile work. The designs are reversed, and the colours far more brilliant than those of the cartoons, much gold and silver being introduced. The noble figure of Christ in the Delivery of the Keys to St Peter is in the tapestry much disfigured by the addition of a number of large gold stars all over the drapery, which spoil the simple dignity of the folds. The rich framework round each picture, designed by Raphael's pupils, probably by Penni and Giovanni da Udine, exists in the tapestries and adds greatly to their decorative effect. The cartoons were executed in 1515 and 1516, and the finished tapestries were first exhibited in their place in the Sistine chapel on the 26th of December 1519—a very short time for the weaving of such large and elaborate pictures. The three of which the cartoons are lost represent the Martyrdom of St Stephen, the Conversion of St Paul, and St Paul in Prison at Philippi. Probably no pictures are better known to have been more often engraved and copied than these seven cartoons.[7]

The Transfiguration.[8]—In 1519 Cardinal Giuliano de' Medici (afterwards Clement VII.), as bishop of Narbonne, ordered two altar-pieces for his cathedral—the one by Raphael, the other by Raphael's Venetian rival Sebastiano del Piombo. That by the latter painter is the noble Resurrection of Lazarus, now in the National Gallery, in the drawing of which the Venetian received important aid from Michelangelo. Several studies for Raphael's picture exist, showing that he at first intended to paint a Resurrection of Christ as a pendant to Sebastiano's subject, but soon altered his scheme into the Transfiguration. The eight or nine existing studies are scattered through the Oxford, Lille, Windsor and some private collections. A great part of the lower group was unfinished at the time of the painter's sudden death in 1520, and a good deal of the heavy colouring of Giulio Romano is visible in it. On the death of Raphael the picture became too precious to send out of Rome, and Cardinal de' Medici contented himself with sending the Resurrection of Lazarus to Narbonne. The Transfiguration was bequeathed by him to the monks of S. Pietro in Montorio, in whose church it remained till it was stolen by Napoleon I. It now hangs in the Vatican Gallery.

Architectural Work.[9]—Though he designed but few buildings, Raphael's great repute even in this branch of art is shown by the fact that Bramante, before his death in March 1514, specially requested that Raphael should be made his successor as chief architect of St Peter's. To this most important post he was appointed by a brief of Leo X., dated the 1st of August 1514. The progress of St Peter's was, however, too slow for him to leave much mark on its design. Another work of Bramante's completed, by Raphael, was the graceful Cortile di S. Damaso in the Vatican, including the loggie, which were decorated with stucco-reliefs and paintings of sacred subjects by his pupils under his own supervision, but only very partially from his designs.[1] The Palazzo dell' Aquila, built for Giovanni Battista Branconio, and destroyed in the 17th century during the extension of St Peter's, was one of Raphael's chief works as an architect. He also designed the little cross church, domed at the intersection like a miniature St Peter's, called S. Eligio degli Orefici, which still exists near the Tiber, almost opposite the Farnesina gardens, a work of but little merit. According to M. Geymüller, whose valuable work, *Raffaello come Architetto* (Milan, 1883), has done so much to increase our knowledge of this subject, the Villa Farnesina of Agostino Chigi, usually attributed to Peruzzi, was, as well as its palace-like stables, designed by Raphael; but internal evidence makes this very difficult to believe. It has too much of the delicate and refined character of the 15th century for Raphael, whose taste seems to have been strongly inclined to the more developed classic style, of which Palladio afterwards became the chief exponent. The Palazzo Vidoni, near S. Andrea della Valle, also in Rome, is usually attributed to Raphael, but an original sketch for this in Peruzzi's own hand has recently been identified among the collection of drawings at Siena; this, however, is not a certain proof that the design was not Raphael's. M. Geymüller has, however, shown that the Villa Madama, on the slopes of Monte Mario above Rome, was really designed by him, though its actual carrying out, and the unrivalled stucco-reliefs which make its interior one of the most magnificent palaces in the world, are due to Giulio Romano and Giovanni da Udine, as mentioned in Vasari's life of the latter.[2] The original design for this villa made by Raphael himself has been discovered by M. Geymüller. Another architectural work was the little Chigi chapel in S. Maria del Popolo, built in 1516, for the dome of which the above-mentioned mosaics were designed (see fig. 6). At the time of his death he was preparing to build himself a handsome palace near the church of S. Eligio; the deed for the purchase of its site was signed by him only a few days before his last short illness. Though not completed till 1530, the Palazzo Pandolfini at Florence was also designed by him; it is a dull scholastic building without any special beauty either in proportion or treatment of the mass; it is illustrated by Montigny and Famin, *Architecture Toscane* (Paris, 1815), pls. 33–36.

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[1] Thanks to Michelangelo's generous intervention, Raphael was paid the large sum for that time of 900 gold ducats for this fresco.

[2] Gruner, *Mosaici in S. Maria del Popolo* (Rome, 1839).

[3] In accordance with Dante's scheme in the *Paradiso*.

[4] La Perla, "the pearl" of the Spanish royal collection, was originally painted for Bishop Louis of Canossa; it was sold by Cromwell with the greater part of Charles I.'s collection at Hampton Court. The composition, though not the execution, of this picture belongs to Raphael's early years in Rome; it is very remarkable for its delicacy of touch and high finish.

[5] The magnificent portrait-heads of the Venetian scholars Navagero and Beazzano, now in the Doria Gallery in Rome, are worthy of Raphael at his best, and have for long been attributed to him. There are good contemporary copies at Madrid.

[6] Fortunately they were not sold with the bulk of Charles's collection, and remained at Hampton Court till a few years ago. See Koch, *Rafael's Tapeten im Vatican* (Vienna, 1878), and Müntz, *Hist. de la tapisserie italienne* (Paris, 1880).

[7] The name "arazzi" given by Italians to these tapestries is derived from Arras, where they were erroneously thought to have been woven; they were made at Brussels. It is much to be regretted that visitors to the Vatican are no longer allowed to see these priceless examples of textile work.

[8] See Morgenstern, *Über Rafael's Verklärung* (Leipzig, 1822), and Justi, *Die Verklärung Christi* (Leipzig, 1870).

[9] See Ojetti, *Discorso su Raffaello Architetto* (Rome, 1883), but more especially Geymüller's work mentioned in the text, and his *Projets primitifs pour la Bas. de S. Pierre* (Paris, 1875–80); also the works of Hofmann and Bloch (Dresden, 1900).

A sober criticism of Raphael's architectural works must force one to refuse him a high position in this branch of art. In the church of S. Eligio and the Chigi chapel he is merely a copyist of Bramante, and his more original works show but little power of invention or even mastery of the first principles of architectural design. His details are, however, often delicate and refined (especially in the Palazzo Pandolfini), and he was supremely successful in the decorative treatment of richly ornamented interiors when he did not, as in some of the Vatican stanze, sacrifice the room to the frescoes on its walls.

Sculpture.—That Vasari is right in attributing to him the model for the beautiful statue of Jonah in the Chigi chapel (fig. 7) is borne witness to by two important documents, which show that his almost universal talents led him to attempt with success the preliminary part of the sculptor's art, though there is no evidence to show that he ever worked on marble.[3] One of these is a letter written to Michelangelo to warn him that Raphael had been invading his province as a sculptor by modelling a boy, which had been executed in marble by a pupil, and was a work of much beauty. Again, after his death his friend Baldassare Castiglione, in a letter dated the 8th of May 1523, asks his steward in Rome "if Giulio Romano still possesses a certain boy in marble by Raphael and what his lowest price for it would be,"—"s'egli [Giulio Romano] ha più quel puttino di marmo di mano di Raffaello e per quanto si daria all' ultimo." A group in marble of a Dead Boy on his Dolphin Playfellow, now in the St Petersburg Hermitage, has been erroneously supposed to be Raphael's "puttino," which has also been identified with a statuette of a child formerly at Florence in the possession of Signor Molini.[4] The statue of Jonah was executed in marble by Lorenzetto, a Florentine sculptor; and it remained in his studio for many years after Raphael's death. The Victoria and Albert Museum possesses a small clay sketch for this beautiful group, slightly different from the marble; it is probably the original design by the master's own hand. The whole feeling of the group—a beautiful youth seated on a sea-monster—is purely classical, and the motive is probably taken from some antique statue representing Arion or Taras on a dolphin.[5] Being intended for a church it was necessary to give the figure a sacred name, and hence the very incongruous title that it received. There is no trace of Raphael's hand in the design of the other statue, an Elijah by Lorenzetto, though it also is ascribed to him by Vasari.

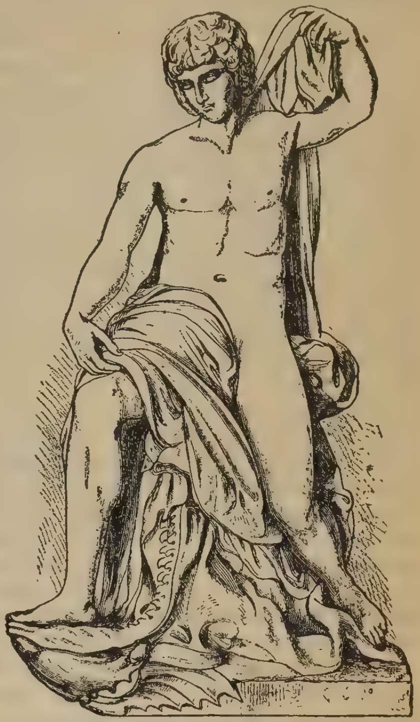

FIG. 7.—Statue of Jonah in the Chigi chapel, designed by Raphael, sculptured by Lorenzetto; heroic size.

Lesser Arts practised by Raphael.—Like other great artists, Raphael did not disdain to practise the lesser branches of art: a design for a silver perfume-burner with female caryatids is preserved in an engraving by Marco da Ravenna; and he also designed two handsome repoussé salvers for Agostino Chigi, drawings for which are now at Dresden. In designs for tarsia-work and wood-carving he was especially skilful; witness the magnificent doors and shutters of the stanze executed by his pupil Giovanni Barile of Siena.[6] The majolica designs attributed to him were by a namesake and relation called Raffaello di Ciarla;[7] and, though many fine dishes and ewers of Urbino and other majolica are decorated with Raphael's designs, they are all taken from pictures or engravings, not specially done by him for ceramic purposes. With the frivolity of his age Leo X. occasionally wasted Raphael's skill on unworthy subjects, such as the scenery of a temporary theatre; and in 1516 the pope set him to paint in fresco the portrait life-size of a large elephant, the gift of the king of Portugal, after the animal was dead.[8] This elephant is also introduced among the stucco reliefs of the Vatican loggie, with the poetaster Barrabal sitting in mock triumph on its back.

Though Raphael himself does not appear to have practised the art of engraving, yet this formed one of the many branches of art which were carried on under his supervision. A large number of his designs were engraved by his pupils Marcantonio Raimondi and Agostino Veneziano. These valuable engravings are from Raphael's sketches, not from his finished pictures, and in some cases they show important alterations made in the execution of the picture. Raimondi's engraving of the S. Cecilia of Bologna in design is very inferior to that of the actual painting. Several of Raphael's most important compositions are known to us only by these early engravings, *e.g.* the Massacre of the Innocents (engraved by Raimondi), which is one of his finest works, both for skilful composition and for masterly drawing of the nude. Another magnificent design is the Judgment of Paris, containing a large number of figures; the nude figure of Minerva is a work of especial force and beauty. A standing figure of Lucretia[1] about to stab herself is also one of his most lovely figures. Many of Raphael's studies for Marcantonio's engravings still exist.

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[1] See Mariani, *La Bibbia nelle Loggie del Vaticano* (Rome); Anon., *Dipinti nelle Loggie del Vaticano* (Rome, 1841); and Gruner, *Fresco Decorations* (London, 1854), pls. 1–5. Too great a share in the decoration of the loggie is usually given to Raphael; not only the harsh colour but also the feebleness of much of the drawing shows that he can have had but little to do with it.

[2] See Gruner, *Fresco Decorations, &c.* (London, 1854), pls. 6–12, and Raffaelle Santi, *Ornati della Villa Madama, &c.* (Rome, 1875). Two other little known but very beautiful architectural works, executed under Raphael's influence by his pupils, are the bathroom of Cardinal Bibbiena in the Vatican and the bathroom of Clement VII. in the castle of S. Angelo, both richly decorated with delicate stucco-reliefs and paintings, treated after a classical model.

[3] See note on p. 369, vol. iv., of Milanesi's edition of Vasari (Florence, 1879). To one branch of the sculptor's art, practised under Raphael's supervision, belong the elaborate and delicately executed stucco-reliefs of the loggie and elsewhere. Among these occur many panels with figure-subjects, large in scale and important in composition; those executed during his lifetime are free from the too pictorial character which is an obvious fault in the very magnificent reliefs of the Villa Madama.

[4] See Appendix, p. 406, vol. iv., of Milanesi's edition of Vasari; Rembadi, *Del putto . . . di Raffaello* (Florence, 1872); Gennarelli, *Sopra una Scultura di Raffaello* (Florence, 1873). The evidence which would attribute this piece of sculpture to Raphael is almost worthless. See on the St Petersburg group, Guédéonoff, *Über die dem Raphael zugeschr. Marmorgruppe* (St Petersburg, 1872).

[5] Compare this latter subject on reverses of the beautiful didrachms of Tarentum, *c.* 300 B.C.

[6] The very beautiful and elaborate choir-stalls of the church of S. Pietro de' Casinensi at Perugia, with panels carved in relief, executed in 1535 by Stefano da Bergamo, are mainly adapted from Raphael's designs.

[7] Campori, *Notizie Stor. d. Maiolica di Ferrara* (3rd ed., Pesaro, 1879), pp. 132–133.

[8] Under it was inscribed—"Raphael Urbinas quod natura abstulerat arte restituit."

Archaeology.—As an antiquary Raphael deserves to take the highest rank. His report[2] to Leo X. in 1518 is an eloquent plea for the preservation of ancient buildings. In 1515 he had been appointed by Leo X. inspector of all excavations in Rome and within 10 miles round. His careful study of the antique, both statues and modes of decoration, is clearly shown in many of his frescoes, and especially in the graceful stucco reliefs and painted grotteschi, of which he and his pupils made such skilful use in the decorations of the Vatican loggie, the Villa Madama and elsewhere.[3]

Raphael's Fame.—Among all the painters of the world none has been so universally popular as Raphael, or has so steadily maintained his pre-eminent reputation throughout the many changes in taste which have taken place in the last three and a half centuries. Apart from his combined merits as a draughtsman, colourist and master of graceful composition, he owes the constancy of admiration which has been felt for him partly to the wide range of his subjects, but still more to the wonderful varieties of his style. If the authorship of his paintings were unknown, who would guess that the Sposalizio of the Brera, the Madonna del Baldacchino of the Pitti, and the Transfiguration could possibly be the work of one painter? In the seventeen or eighteen years which composed his short working life he passed through stages of development for which a century would not have seemed too long, while other painters lived through the same changeful time with but little alteration in their manner of work. Perugino, who outlived his wonderful pupil, completed in 1521 Raphael's San Severo fresco in a style differing but little from his paintings executed in the previous century.

In versatility of power Raphael (as a painter) remains almost without a rival; whether painting an altar-piece for a church, a large historical fresco, a portrait or decorative scenes from classical mythology, he seems to excel equally in each; and the widely different methods of painting in tempera, oil or fresco are employed by him with apparently equal facility. His range of scale is no less remarkable, varying from a miniature, finished like an illuminated MS., to colossal figures in fresco dashed in with inimitable breadth and vigour.

His personal beauty, charm of manner and deep kindliness of heart endeared him to all who knew him.[4] His sincere modesty was not diminished by his admission as an equal by the princes of the church, the distinguished scholars and the world-famed men of every class who formed the courts of Julius II. and Leo X. In accordance with the spirit of the age he lived with considerable display and luxury, and was approached with the utmost deference by the ambassadors of foreign princes, whether their master desired a picture, or, as the duke of Ferrara did, sent to consult him on the best cure for smoky chimneys. To his pupils he was as a father, and they were all, as Vasari says, "vinti dalla sua cortesia"; they formed round him a sort of royal retinue, numbering about fifty youths, each talented in some branch of the arts.[5] Giulio Romano and Gianfrancesco Penni, his two favourite pupils, lived with him in the Palazzo di Bramante, a house near St Peter's, where he resided during the greater part of his life in Rome. This fine palace, designed by Bramante, was destroyed in the 17th century at the same time as Raphael's Palazzo dell' Aquila.

It is difficult to realize the grief and enthusiasm excited by the master's death on Good Friday (April 6th) 1520, at the age of thirty-seven exactly, after an attack of fever which lasted only ten days. His body was laid out in state in his studio, by the side of the unfinished Transfiguration, and all Rome flocked to the place for a last sight of the "divino pittore." His property amounted to about £30,000; his drawings and MSS. he left to Giulio Romano and Gianfrancesco Penni; his newly bought land to Cardinal Bibbiena, the uncle of the lady to whom he had been betrothed; there were liberal bequests to his servants; and the rest was mostly divided among his relatives at Urbino. He desired to be buried in the Pantheon, under the noble dome which he and Bramante had dreamed of rivalling. His body is laid beside an altar, which he endowed with an annual chantry, and on the wall over it is a plain slab, with an inscription written by his friend Cardinal Bembo. Happily his grave has as yet escaped the disfigurement of a pretentious monument such as those erected to Michelangelo, Dante and other great Italians; it has not, however, remained undisturbed: in 1833 it was opened and the bones examined.[6] In March 1883 a festival was held at Urbino, on the occasion of the 4th centenary of his birth, and on this occasion many interesting articles on Raphael were published, especially one by Geymüller, "Le IV^me^ centenaire de la naissance de Raphaël," 1483–1883, in the *Gaz. de Lausanne*, March 1883.

LITERATURE.—Comolli, *Vita inedita di Raffaello* (1790); Duppa, *Life of Raphael* (London, 1816); Braun, *Raphael . . . Leben und Werke* (Wiesbaden, 1819); Fea, *Raffaello . . . ed alcune di lui Opere* (Rome, 1822); Rehberg, *Rafael Sanzio aus Urbino* (Munich, 1824); Quatremère de Quincy, *Vita ed Opere di Raffaello*, trans. by Longhena (Milan, 1829) (a work marred by many inaccuracies); Rumohr, *Über Raphael und sein Verhältniss* (Berlin, 1831); Rio, *Michelange et Raphaël* (Paris, 1863); Gruyer, *Raphaël et l'antiquité* (Paris, 1864), *Les vierges de Raphaël* (Paris, 1878) and *Raphaël, peintre de portraits* (Paris, 1880); Grimm, *Das Leben Raphaels von Urbino* (Berlin, 1872) (intended specially to point out the errors of Vasari and Passavant, and not written in a very fair spirit); Gherardi, *Della Vita di Raffaello* (Urbino, 1874); Anton Springer, *Raffael und Michelangelo* (Leipzig, 1878); C. C. Perkins, *Raphael and Michelangelo* (Boston, 1878); Dohme, *Kunst und Künstler des Mittelalters* (Leipzig, 1878) (vol. ii. of this valuable work, with many illustrations, is devoted entirely to Raphael and Michelangelo); Alippi, *Il Raffaello* (Urbino, 1880); Clément, *Michelange et Raphaël* (5th ed., improved) (Paris, 1881); Eug. Müntz, *Raphaël, sa vie, son œuvre*, &c. (Paris, 1881) (with numerous well-chosen illustrations); Passavant, *Rafael und sein Vater* (Leipzig, 1839–58) (a valuable book, especially for its list of Raphael's works; a new edition translated by Guasti into Italian was published at Florence in 1882, but this edition is in no way superior to the French one of Lacroix (Paris, 1860), which is a great advance on the original German text); Crowe and Cavalcaselle, *Life and Works of Raphael* (London, 1882–85); Eug. Müntz, *Les historiens et les critiques de Raphaël* (Paris, 1883) (contains a good bibliography of the subject); Morelli, *Italian Masters* (in German, 1880; in English, 1882, and subsequently republished),—practically the starting-point of modern technical criticism; B. Berenson, *Central Italian Painters* (1897) (expert characterization and list of works).

Reproductions of Raphael's Works.—From the time of Raimondi downwards no painter's works have been so frequently engraved. The Calcografia Camerale (now called Regia) of Rome possesses an enormous number of copper-plates of his pictures by a great many good (and bad) engravers of the 18th and 19th centuries. Electrotypes of the old coppers are still worked, and are published by the Stamperia at very moderate prices; in the catalogue Nos. 736 to 894 are the works of Raphael, including several books of engravings containing whole sets, such as the Vatican loggie, &c. A very complete collection of photographs from these and other engravings was published by Gutbier and Lübke, *Rafael's Werke, sämmtliche Tafelbilder und Fresken* (Dresden, 1881–82), in three large volumes, divided into classes,—pictures of the Madonna, frescoes, stanze of the Vatican, tapestry cartoons, &c. The descriptive text and life of Raphael are by Lübke. The Malcolm, Oxford, British Museum, Lille, Louvre, Dresden and other collections of Raphael's drawings have mostly been published in photographic facsimile, and an enormous number of illustrated monographs on single pictures exist. Braun's autotypes of the stanze and Farnesina frescoes are especially good. (J. H. M.)

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[1] On a pedestal is inscribed in Greek—"Better to die than live basely."

[2] Published by Visconti, *Lettera di Raffaello a Leone X.* (Rome, 1840); see also Müntz, "Raphaël Archéologue," &c., *Gaz. des B. Arts*, October and November 1880.

[3] See Gruyer, *Raphaël et l'antiquité* (Paris, 1864).

[4] See the eloquent eulogy of his character at the end of Vasari's *Life*.

[5] See Minghetti, "Gli Scolari di Raffaello," *Nuova Antologia* (June 1880).

[6] See "Ritrovamento delle ossa di Raffaello," *Soc. Virtuosi al Panteone* (Rome, 1833); other pamphlets on this were published in the same year by Fea, Falconieri and Odescalchi.

RAPIER, the name given to two distinct types of sword. Originally the "rapier" (Fr. *rapière*) was a long two-edged and pointed weapon with a wide cup hilt, used together with the dagger in fencing and duelling chiefly as a thrusting weapon, the cut taking a secondary position. This was the typical duelling sword of the 16th and 17th centuries. In the 18th century the "small-sword" took its place; this was a pointed weapon only, the "cut" having entirely dropped out, and the dagger being discarded. The word rapier is of doubtful origin. Du Cange (*Glossarium, s.v.* "Rapparia") quotes an example of the word used as an adjective to qualify *espée* as early as 1474, and gives as a conjectural derivation Gr. *ῥαπίζειν*=Lat. *caedere*, to cut. Skeat (*Etym. Dict.*, 1910) follows the suggestion of Diez that *rapière* is from *raspière*, a rasper or poker, and was a name given in contempt by the old cut-and-thrust fencers to the new weapon. Spanish has *raspadera*, a raker, and there are several 16th and 17th century quotations alluding to the contempt with which the rapier was greeted, and to its Spanish origin (see FENCING and SWORD).

RAPIN, PAUL DE (1661–1725), sieur of Thoyras, French historian, was the son of Jacques de Rapin, *avocat* at Castres (Tarn), where he was born on the 25th of March 1661. He was educated at the Protestant academy of Saumur, and in 1679 became an advocate, but soon afterwards entered the army. The revocation of the Edict of Nantes in 1685, and the death of his father led him to come to England; but, unable to find employment there, he crossed to Holland and enlisted in the company of French volunteers at Utrecht commanded by Daniel de Rapin, his cousin-german. He accompanied the prince of Orange to England in 1688, and during the Irish campaign he took part in the siege of Carrickfergus and the battle of the Boyne, and was wounded at the battle of Limerick. Soon afterwards he was promoted captain; but in 1693 he resigned in order to become tutor to the earl of Portland's son. After travelling with his charge, he settled with his family in Holland, first at the Hague, then, for economy's sake, at Wesel, in 1707, where he began his great work, *L'Histoire d'Angleterre*. Though he was of a strong constitution, the seventeen years' application ruined his health. He died in 1725.

Rapin was also the author of a *Dissertation sur les Whigs et les Torys* (1717). *L'Histoire d'Angleterre*, embracing the period from the invasion of the Romans to the death of Charles I., was printed at the Hague in 1724 in 8 vols. It was translated into English and improved with notes by Tindal, in 2 vols. folio, 1725–31. Rapin's history of England was almost the only one available in France in the first half of the 18th century.

RAPOPORT, SAMUEL JUDAH LÖB (1790–1867), Jewish scholar, was born at Lemberg in 1790. After various experiences in business, Rapoport became successively rabbi of Tarnopol (1837) and of Prague (1840). He was one of the founders of the new learning in Judaism. His chief work was the first part of an (unfinished) encyclopaedia (*'Erekh Millin*, 1852). Equally notable were his biographies of the Gaon Saadiah, Nathan author of the *Arukh*, the Gaon Hai, Eleazar Kalir and others. He died at Prague in 1867. (I. A.)

RAPPAREE, properly a short pike (Irish *rapaire*); the term being hence applied in the war in Ireland from 1688–92 to the Irish irregular soldiers armed with this weapon. It thus became synonymous with robber or freebooter, and in 1707 appears in the title of an act (6 Anne, cap. 11) "for the more effectual suppression of . . . robbers and rapparees."

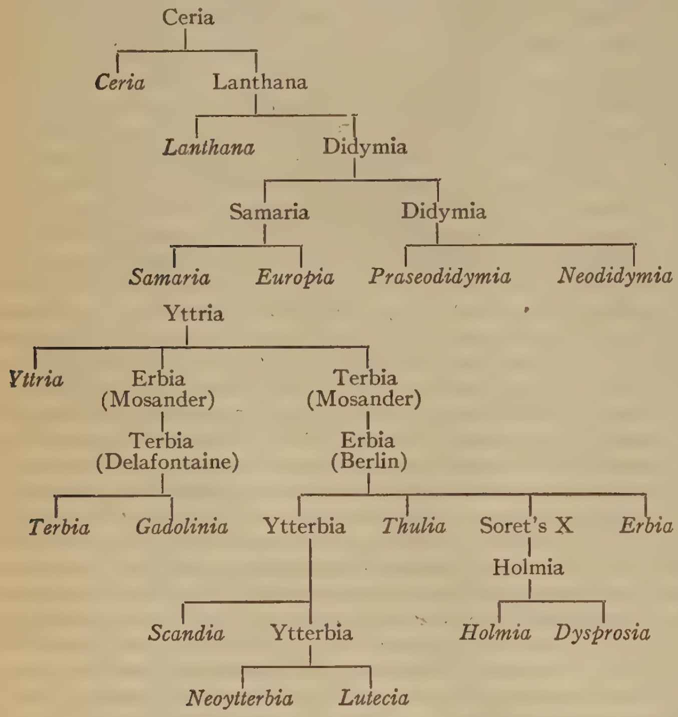
RAPPOLTSWEILER (French *Ribeauville*), a town of Germany, in the imperial province of Alsace-Lorraine. Pop. (1905) 5986. It lies at the entrance of the valley of the Strengbach, under the eastern slope of the Vosges mountains, 33 m. S.W. of Strassburg on the railway to Basel, being connected with its station on that line, 2½ m. distant, by a tramway. It is in part surrounded by ancient walls, and has many picturesque medieval houses, and two old churches, of St Gregory and St Augustine, both fine Gothic buildings. The town hall contains a valuable collection of antiquities. The Carolabad, a saline spring with a temperature of 64° F., which had a great repute in the middle ages, was rediscovered in 1888, and made Rappoltsweiler a watering-place. The industries include the spinning and weaving of cotton and wool, printing, dyeing and tanning, while there is a brisk trade in wine.

Rappoltsweiler, known in the 8th century as Rathaldovilare, passed from the bishops of Basel to the lords of Rappoltstein, who were among the most famous nobles in Alsace. The lord of Rappoltstein was the king or protector of the wandering minstrels of the land, who purchased his protection by paying him a tax. When the family became extinct in 1673 this office of king of the pipers (*Pfeiferkönig*) passed to the counts palatine of Zweibrücken-Birkenfeld. The minstrels had a pilgrimage chapel near Rappoltsweiler, dedicated to their patron saint, Maria von Dusenbach, and here they held an annual feast on the 8th of September. Near the town are the ruins of three famous castles, Ulrichsburg, Girsberg and Hohrappoltstein, which formerly belonged to the lords of Rappoltstein.

See Bernhard, *Recherches sur l'histoire de la ville de Rappoltsweiler* (Colmar, 1888); and Kube, *Rappoltsweiler, das Carolabad und Umgebung* (Strassburg, 1905). For the lords of Rappoltstein, see Brieger, *Die Herrschaft Rappoltstein* (Strassburg, 1907).

RARE EARTHS, in chemistry, the name given to a group of oxides of certain metals which occur in close association in some very rare minerals. Although these metals resemble each other in their chemical relationships, it is convenient to subdivide them into three groups: the cerium, terbium and ytterbium groups. The first includes scandium (Sc, 441·1), yttrium (Y, 89·0), lanthanum (La, 139·0), cerium (Ce, 140·25), praseodymium (Pr, 140·6), neodymium (Nd, 144·3), and samarium (Sa, 150·4); the second includes europium (Eu, 152·0), gadolinium (Gd. 157·3), and terbium (Tb, 159·2); and the third includes dysprosium (Dy, 162·5), holmium (Ho, ?) erbium (Er, 167·4), thulium (Tm, 168·5), ytterbium or neoytterbium (Yb, 172·0), and lutecium (Lu, 174·0); the letters and numbers in the brackets are the symbols and atomic weights (international). Although very rare, a large number of minerals contain these metals; they are chiefly found in Scandinavia, parts of the Urals, America and Australia, generally associated with Archean and eruptive rocks, and more rarely with sedimentary deposits. They are usually silicates, but many complex tantalates, niobates, phosphates, uranates and fluorides occur. The chief mineral species are monazite, a phosphate of the cerium metals, containing thorium (this mineral supplies the ceria and thoria employed in making incandescent gas mantles); cerite, a hydrated silicate of calcium and the cerium metals; gadolinite, a silicate of beryllium, iron, and the yttrium metals; samarksite, a niobate and tantalate of both the cerium and yttrium metals, with uranium, iron, calcium, etc.; and keilhauite, a titanosilicate of yttrium, iron, calcium and aluminium; other species are fergusonite, orthite, aeschynite, euxenite and thorianite.

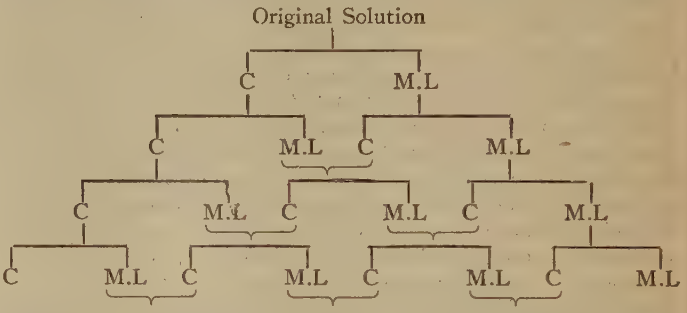
The chemistry of this group may be regarded as beginning with Cronstedt's description of the mineral cerite from Bastnaës in 1751, and the incorrect analyses published by T. O. Bergman and Don Fausto d'Elhuyar in 1784. Ten years later Gadolin investigated the mineral subsequently named gadolinite, which had been found at Ytterby in 1788 by Arrhenius. This discovery of a new earth was confirmed by A. G. Ekeberg in 1799, who named the base yttria. Cerite was examined simultaneously by Klaproth in Germany and by Berzelius and Hisinger in Sweden; and a new base was discovered in 1803 which the Swedish chemists named ceria. Both these oxides have proved to be mixtures. In 1839 Mosander separated "ceria" into true ceria and an earth which he termed lanthana (Gr. *λανθάνειν*, to lie hidden), and in 1841 he showed that his lanthana contained another base, which he called didymia (Gr. *διδύμοι*, twins). This didymia was separated in 1879 by Lecoq de Boisbaudran into a new base, samaria, and a residual didymia which was shown by Auer von Welsbach in 1885 to consist of a mixture of two bases, praseodidymia and neodidymia; moreover, samaria was split by Demarçay in 1900 into true samaria and a new base named europia. In 1843 Mosander also split yttria into two new bases which he called "erbia" and "terbia," and a true yttria, but in 1860 N. J. Berlin denied the existence of Mosander's "erbia," and gave this name to his "terbia." The new erbia has itself proved to be a mixture. Marignac in 1878 separated an ytterbia which was split by Nilson in 1879 into scandia (the metal of which proved to be identical with Mendeléeff's predicted eka-boron) and a new ytterbia, which, in turn, was separated by Urbain in 1907 into neoytterbia and lutecia (C. A. von Welsbach proposed for these elements the names aldebarianum and cassiopeium). Berlin's erbia was also examined by Soret in 1878 and by Cleve in 1879; the new base then isolated, Soret's X or Cleve's holmia, was split by Lecoq de Boisbaudran in 1886 into a true holmia and a new oxide dysprosia. The same erbia also yielded another base, thulia, to Cleve, in 1879, in addition to true erbia. The original erbia of Mosander was confirmed by M. A. Delafontaine in 1878 and renamed terbia; this base was split by Marignac in 1886 into gadolinia and true terbia. These relations are schematically shown below; the true earths are in italics, mixtures in Roman.



Methods of Separation.—The small proportions in which the rare earths occur in the mineral kingdom and the general intermixture of several of them renders their efficient separation a matter of much difficulty, which is increased by their striking chemical resemblances. While it is impossible to treat the separations in detail, a general indication of the procedure may be given. The first step is to separate the rare earths from the other components of the mineral. For this purpose the mineral is evaporated with sulphuric or hydrochloric acid, or fused with potassium bisulphate, and the residue extracted with water. The solution of chlorides or sulphates thus obtained is treated with sulphuretted hydrogen, to remove copper, bismuth and molybdenum, and the filtrate, after the ferrous iron has been oxidized with chlorine, is precipitated with oxalic acid. The oxalates (and also thorium oxalate) may be converted into oxides by direct heating, into nitrates by dissolving in nitric acid, or into hydroxides by boiling with potash solution. The thorium may be removed by treating the nitrate solution with hydrogen peroxide, and warming, whereupon it separates as thorium peroxide. The next step consists in neutralizing the nitric acid solution and then saturating with potassium sulphate. Double salts of the general formula $R_2(SO_4)_3 . 3K_2SO_4$ are formed, of which those of the cerium group are practically insoluble, of the terbium group soluble, and of the ytterbium group very soluble. The sulphates thus obtained may be reconverted into oxalates or oxides and the saturation with potassium sulphate repeated.

To separate the individual metals many different methods have been proposed; these, however, depend on two principles, one, on the different basicities of the metals, the other, on the different solubilities of their salts. Bahr and Bunsen worked out a process of the first type, which utilized the fractional decomposition of the nitrates into oxides on heating. The mixed oxalates are converted into nitrates, which are then mixed with an alkali nitrate to lower the melting-point, and the mixture fused. The nitrates decompose in order of the basicities of the metals, and after a short fusion the residue is extracted with boiling water, and the basic salt which separates when the solution is cooled is filtered off. This contains the most negative metal; and the filtrate, after evaporation and a repetition of the fusion and extraction, may be caused to yield the other oxides. A second method, based on the same principle, consists in the fractional precipitation by some base, such as ammonia, soda, potash, aniline, &c. The neutral nitrates are dissolved in water, and the base added in such a quantity to precipitate the oxides only partially and very slowly. Obviously the first deposit contains the least basic oxide, which by re-solution as nitrate and re-precipitation yields a purer product. To the filtrate from the first precipitate more of the base is added, and the second less basic oxide is thrown down. By repeating the process all the bases can be obtained more or less pure.

Many processes depending upon the different solubilities of certain salts have been devised. They consist in forming the desired salt and fractionally crystallizing. The mother liquor is concentrated and crystallized, the crystals being added to the filtrate from a re-crystallization of the first deposit. These operations are repeated after the manner shown in the following scheme; the letter C denotes crystals, the M.L mother liquor, whilst a bracket means mixing before re-crystallization.



Obviously the fractions contain salts which increase in solubility as one passes from the left to right, and with sufficient care and patience this method permits a complete separation. The salts which have been used include the sulphates, nitrates, chromates, formates, oxalates and malonates. R. J. Meyer (*Zeit. anorg. Chem.*, 1904, 41, p. 97) separates the cerium earths by forming the double potassium carbonates, *e.g.* $K_2Ce_2(CO_3)_4 . 12H_2O$, which are soluble in potassium carbonate solution, being precipitated in the order lanthanum, praseodymium, cerium and neodymium on diluting the solution; C. A. von Welsbach (*Chem. News*, 1907, 95, p. 196; 1908, 98, pp. 223, 297) separates the metals of the ytterbium group by converting the basic nitrates into double ammonium oxalates and fractionating; C. James (*ibid.*, 1907, 95, p. 181; 1908, 97, pp. 61, 205) formed the oxalates of the yttrium earths and dissolved them in dilute ammonia saturated with ammonium carbonate; by boiling this solution the earths are precipitated in the order yttrium, holmium and dysprosium, and erbium; he also fractionally crystallized the bromates (see, *e.g. Jour. Amer. Chem. Soc.*, 1910, 32, p. 517, for thulium). Complex organic reagents are also employed. Neish (*Jour. Amer. Chem. Soc.*, 1904, 26, p. 780) used meta-nitrobenzoic acid; O. Holmberg separates neodymium, praseodymium and lanthanum (and also thorium) with meta-nitrobenzene sulphonic acid, and has investigated many other organic salts (see *Abs. J. C. S.*, 1907, ii. p. 90), whilst H. Erdmann and F. Wirth (*Ann.*, 1908, 361, p. 180) employ the 1·8 naphthol sulphonates.

In order to determine whether any chosen method for separating these earths is really effective, it is necessary to analyse the fractions. For this purpose two processes are available. We may convert the salt into the oxalate from which the oxide is obtained by heating. A weighed quantity of the oxide is now taken and converted into sulphate by evaporating with dilute sulphuric acid. The sulphate is gently dried until the weight is constant, and from this weight the equivalent of the earth can be calculated. When repeated fractionation is attended by no change in the equivalent we may conclude that only one element is present. This process, however, is only rough, for the elements with which we are dealing have very close equivalents. A more exact method employs the spectra—spark, arc, phosphorescence and absorption; the evidence, however, cannot in all cases be accepted as conclusive, but when taken in conjunction with chemical tests it is the most valuable method.

Chemical Relations.—The rare earth metals were at first regarded as divalent, but determinations of the specific heats of cerium by Mendeléeff and Hillebrand and of lanthanum and didymium by Hillebrand pointed to their trivalency; and this view now has general acceptance. They are comparatively reactive: they burn in air to form oxides of the type Me_2O_3; combine directly with hydrogen at 200°–300° to form hydrides of the formula MH_2 or MH_3; nitrides of the formula MN are formed by passing nitrogen over the oxides mixed with magnesium; whilst carbides of the type MC_2 are obtained in the electrolytic reduction of the oxides with carbon. In addition to the oxides M_2O_3, several, *e.g.* cerium, terbium and neodymium, form oxides of the formula MO_2. The sesquioxides are bases which form salts and increase in basicity in the order Sc, Yb, Tm, Er, Ho, Tb, Gd, Sm, Y, Ce, Nd, Pr, La; the latter hissing with water like quicklime.

The placing of these elements in the periodic table has attracted much attention on account of the many difficulties which it presented. The simplest plan of regarding them all as trivalent and placing them in the third group is met by the fact that there is not room for them. Another scheme scatters them in the order of their atomic weights in the last four groups of the system, but grave objections have been urged against this plan. A third device places them in one group as a bridge between barium and tantalum. This was suggested by Benedick in 1904 (*Zeit. anorg. Chem.*, 1904, 39, p. 41), and adopted in Werner's table of 1905 (*Ber.* 38, p. 914), whilst in 1902 Brauner (*ibid.* 32, p. 18) placed the group as a bridge on a plane perpendicular to the planes containing the other elements, thus expanding the table into a three-dimensional figure. The question has also been considered by Sir William Crookes (*Jour. Chem. Soc.*, 1888, 53, p. 487; 1889, 55, pp. 257 et seq.), whose inquiries led him to a new conception of the chemical elements.

References.—For the general chemistry see R. Böhm, *Seltene Erden* (1905); Abegg, *Handbuch der anorganischen Chemie* (1906), vol. iii. (article by R. T. Meyer); H. Moissan, *Traité de chimie minérale* (1904), vol. iii. (article by G. Urbain); Roscoe and Schorlemmer, *Treatise on Chemistry* (1908), vol. ii.; P. E. Browning, *Introduction to the Rarer Elements* (1909); see also A. W. Stewart, *Recent Advances in Physical and Inorganic Chemistry* (1909). For the rare earth minerals see J. Schilling, *Das Vorkommen der seltenen Erden im Mineralreiche* (1904).

RAS, the Arabic for a "head," hence a cape, promontory or headland; a common word in place names.

RASCAL, a term originally used in the sense of a rabble, especially descriptive of camp-followers or the dregs of an army, or of the lowest of the people; now only of a single person, in the sense of a rogue or knave. The origin of O.Fr. *rascaille*, modern *racaille*, from which the word came into English, is uncertain. The word was early used, in hunting, for the weaker or poorer male deer of a herd; the word has been connected with O.Fr. *rascler*, mod. *racler*, to scrape, rake, in the sense of the off-scourings of the herd.

RASHBAM (1085–1174), Jewish scholar, so called from the initials of his full name, Rabbi Samuel ben Meir, was a leading member of the French school of Biblical exegesis. He was a grandson of Rashi (*q.v.*), but differed in his method of interpretation. He wrote commentaries on the Pentateuch and some other parts of the Scriptures. Rashbam adopts a natural (as distinct from a homiletical and traditional) method; thus (in agreement with the modern school) Rashbam (on Gen. i. 5) maintained that the day began at dawn and not from the previous sunset (as later Jewish custom assumed). Another famous interpretation was Rashbam's view that the much disputed phrase in Gen. xlix. 10 must be rendered "Until he cometh to Shiloh," and refers to the division of the kingdom of Judah after Solomon's death. Rashbam's notes on the Bible are remarkable for brevity, but when he comments on the Talmud—he wrote explanations on several tracts—he is equally noted for prolixity. (I. A.)

RASHI (1040–1105), Jewish scholar. Rabbi Solomon Izḥaqi (son of Isaac), usually cited as Rashi from the initials of those words, was born at Troyes in 1040 and died in the same town in 1105. Legends concerning him are many. Isaac's wife, shortly before the birth of their famous son, was walking one day down a narrow street in Worms, when two vehicles moving in opposite directions seemed about to crush her. As she leant hopelessly against a wall, it miraculously fell inwards to make a niche for her. So with his education. Legend sends the student to southern France, and even on a tour of the world. At an inn in the Orient he cured a sick monk, who later on, as bishop of Olmütz, returned the kindness by saving the Jews from massacre. In fact, Rashi never went farther than from the Seine to the Rhine; the utmost limit of his travels were the academies of Lorraine. Situated between France and Germany, Lorraine was more French than German, and French was the common language of Jew and Christian. This is shown by the glosses in Rashi's works, almost invariably in French. He seems to have passed the decade beginning with 1055 in Worms, where the niche referred to above is still shown. Within this, it is said, Rashi was wont to teach. A small edifice on the east of the synagogue is called the "Rashi Chapel," and the "Rashi Chair," raised on three steps in the niche, is one of the objects of the pious admiration of pilgrims. At Worms Rashi worked under Jacob ben Yaqar, and at Mainz under Isaac ben Judah, perhaps combining at the same time the functions of teacher and student. Besides the oral tuition that he received, the medieval schools habitually kept the notes of former teachers. From these Rashi learned much, and probably he incorporated some of these notes in his own works. In the middle ages there was a communism in learning, but if Rashi used some of the stones quarried and drafted by others, it was to his genius that the finished edifice was due.

Rashi was twenty-five years of age when he returned to Troyes, which town thenceforward eclipsed the cities of Lorraine and became the recognized centre of Jewish learning. Rashi acted as rabbi and judge, but received no salary. Not till the 14th century were Jewish rabbis paid officials. Rashi and his family worked in the vines of Troyes (in the Champagne); in his letters he describes the structure of the winepresses. His learning and character raised him to a position of high respect among the Jewries of Europe, though Spain and the East were long outside the range of his influence. As was said of him soon after his death: "His lips were the seat of wisdom, and thanks to him the Law, which he examined and interpreted, has come to life again." His posterity included several famous names, those of his grandchildren. Rashi had no sons, but his three daughters were women of culture, and two of the sons of Jochebed (see Rashbam and Tam), as well as others of his descendants, carried on the family tradition for learning, adding lustre to Rashi's fame. The latter part of Rashi's life was saddened by the incidents connected with the first Crusade. Massacres occurred in the Rhinelands. According to legend, Rashi and Godfrey of Bouillon—of the foremost leaders of the Crusade—were intimate friends. Rashi died peacefully in Troyes in 1105.

Rashi was the most conspicuous medieval representative of the Jewish spirit. A century later Maimonides was to give a new turn to Jewish thought, by the assimilation of Aristotelianism with Mosaism, but Rashi was a traditionalist pure and simple. He was in no sense a philosopher, but he exemplified in his person and in his works the stored up wisdom of the Synagogue. Yet through all that he wrote there runs a vein of originality. Besides minor works, such as a recension of the Prayer-Book (*Siddur*), the *Pardes* and *ha-Orah*, Rashi wrote two great commentaries on which his fame securely rests. These were the commentaries on the whole of the Hebrew Bible and on about thirty treatises of the Talmud. His commentary on the Pentateuch, in particular, has been printed in hundreds of editions; it is still to Jews the most beloved of all commentaries on the Mosaic books. More than a hundred supercommentaries have been written on it. Rashi unites homily with grammatical exegesis in a manner which explains the charm of the commentary. His influence in Christian circles was great, especially because of the use made of the commentary by Nicolaus de Lyra (*q.v.*), who in his turn was one of the main sources of Luther's version. Even more important was Rashi's commentary on the Talmud, which became so acknowledged as the definitive interpretation that Rashi is cited simply under the epithet of "the Commentator." It is no exaggeration to assert that the modern world owes its power to understand the Talmud to Rashi. In this field the "Commentator" is supreme. He practically edited the text of the Talmud besides explaining it, and the Talmud is never printed without Rashi's commentary on the margin. An important feature of Rashi's commentaries is the frequency of French translations of words. These glosses (*lo'azim*) have now been in part edited from the manuscripts of the late Arsène Darmesteter.

BIBLIOGRAPHY.—M. Liber, *Rashi* (1906), published as a memorial of Rashi on the 800th anniversary of his death. Rashi's commentary on the Bible has been translated into Latin by Breithaupt (1710–1714); and into German (Pentateuch) by Dukes (1833–38) and others. The foundation of recent investigation into Rashi's life is Zunz's *Salomon b. Isaac* (1823), to which I. H. Weiss added much in his (Hebrew) biography (in *Bet Talmud* ii., Nos. 2–10. See also Graetz, *History of the Jews* (Engl. trans., vol. iii. ch. ix.). A critical edition of Rashi's Pentateuch commentary was published by A Berliner (2nd ed., 1905). (I. A.)

RASHTRAKUTA, an Indian dynasty which ruled in the Deccan (*q.v.*) from about A.D. 750 to 973. The Rashtrakuta or Ratta clan are supposed to have held power during the historical blank before the 6th century; but they came to the front in A.D. 750, when Dantidurga overthrew the Chalukya dynasty and made himself ruler of the Deccan. He was succeeded by his uncle Krishna I. (*c.* 760), who completed his conquests, and whose reign is memorable for the execution of the Kailasa, the rock-cut temple at Ellora. His grandson Govinda III. (780–815) extended the power of the family from the Vindhya Mountains and Malwa on the north to Kanchi on the south. The next king, Amogavarsha, reigned for sixty-two years. The reign of Krishna III. was remarkable for a war with the Cholas, in which the Chola king was killed on the field of battle in 949. The last of the Rashtrakuta kings was Karka II., who was overthrown by the Chalukyas in 973.

See R. G. Bhandarkar, *Early History of the Deccan* (Bombay, 1884).

RASK, RASMUS CHRISTIAN (1787–1832), Danish scholar and philologist, was born at Brändekilde in the island of Fünen or Fyen in Denmark in 1787. He studied at the university of Copenhagen, and at once showed remarkable talent for the acquisition of languages. In 1808 he was appointed assistant keeper of the university library, and some years afterwards professor of literary history. In 1811 he published, in Danish, his *Introduction to the Grammar of the Icelandic and other Ancient Northern Languages*, from printed and MS. materials accumulated by his predecessors in the same field of research. The reputation which Rask thus acquired recommended him to the Arna-Magnaean Institution, by which he was employed as editor of the Icelandic *Lexicon* (1814) of Björn Haldorson, which had long remained in manuscript. Rask visited Iceland, where he remained from 1813 to 1815, mastering the language and familiarizing himself with the literature, manners and customs of the natives. To the interest with which they inspired him may probably be attributed the establishment at Copenhagen, early in 1816, of the Icelandic Literary Society, of which he was the first president.

In October 1816 Rask left Denmark on a literary expedition, at the cost of the king, to prosecute inquiries into the languages of the East, and collect manuscripts for the university library at Copenhagen. He proceeded first to Sweden, where he remained two years, in the course of which he made an excursion into Finland to study the language. Here he published, in Swedish, his *Anglo-Saxon Grammar* in 1817. In 1818 there appeared at Copenhagen, in Danish, an *Essay on the Origin of the Ancient Scandinavian or Icelandic Tongue*, in which he traced the affinity of that idiom to the other European languages, particularly Latin and Greek. In the same year he brought out the first complete editions of Snorro's *Edda* and Saemund's *Edda*, in the original text, along with Swedish translations of both *Eddas*. From Stockholm he went in 1819 to St Petersburg, where he wrote, in German, a paper on "The Languages and Literature of Norway, Iceland, Sweden and Finland," in the sixth number of the Vienna *Jahrbücher*. From Russia he proceeded through Tartary into Persia, and resided for some time at Tabriz, Teheran, Persepolis and Shiraz. In about six weeks he made himself sufficiently master of Persian to be able to converse freely. In 1820 he embarked at Bushire for Bombay; and during his residence there he wrote, in English, "A Dissertation on the Authenticity of the Zend Language" (*Trans. Lit. Soc. of Bombay*, vol. iii., reprinted with corrections and additions in *Trans. R. As. Soc.*). From Bombay he proceeded through India to Ceylon, where he arrived in 1822, and soon afterwards wrote, in English, "A Dissertation respecting the best Method of expressing the Sounds of the Indian Languages in European Characters," in the *Transactions of the Literary and Agricultural Society of Colombo*. Rask returned to Copenhagen in May 1823, bringing a considerable number of Oriental manuscripts, Persian, Zend, Pali, Sinhalese and others, with which he enriched the collections of the Danish capital. He died at Copenhagen on the 14th of November 1832.

During the period between his return from the East and his death Rask published in his native language a *Spanish Grammar* (1824), a *Frisic Grammar* (1825), an *Essay on Danish Orthography* (1826), a *Treatise respecting the Ancient Egyptian Chronology* and an *Italian Grammar*, (1827), and the *Ancient Jewish Chronology pervious to Moses* (1828). He also edited an edition of Schneider's *Danish Grammar for the use of Englishmen* (1830), and superintended the English translation of his *Anglo-Saxon Grammar* by Thorpe (1830). He was the first to point out the connexion between the ancient Northern and Gothic on the one hand, and the Lithuanian, Sclavonic, Greek and Latin on the other, and he also deserves credit for having had the original idea of "Grimm's Law" for the transmutation of consonants in the transition from the old Indo-European languages to Teutonic, although he only compared Teutonic and Greek, Sanskrit being at the time unknown to him. In 1822 he was master of no less than twenty-five languages and dialects, and is stated to have studied twice as many. His numerous philological manuscripts were transferred to the king's library at Copenhagen. Rask's *Anglo-Saxon*, *Danish* and *Icelandic Grammars* were brought out in English editions by Thorpe, Repp and Dasent respectively.

RASPBERRY, known botanically as *Rubus Idaeus* (nat. ord. Rosaceae, *q.v.*), a fruit-bush found wild in Great Britain and in woods throughout Europe, North Africa and in north and west Asia. The raspberry was known to classic writers, and is mentioned by Pliny as one of the wild brambles known to the Greeks as *Idea*, from Mt. Ida in Asia Minor on which it grew. Parkinson (*Paradisus*, 1629) speaks of red, white and thornless varieties as suitable for the English climate, and Gerarde (*Herbal*, 1597) figures and describes the Raspis or Framboise bush as one of the four kinds of bramble. It is propagated from suckers, which may be taken off the parent stools in October, and planted in rows 5 or 6 ft. apart, and at 3 ft. asunder in the rows. It is the habit of the plant to throw up from the root every year a number of shoots or canes, which bear fruit in the subsequent year, and then decay. In dressing the plants, which is done immediately after the crop is gathered, all these exhausted stems are cut away, and of the young canes only three or four of the strongest are left, which are shortened about a third. The stems, being too weak to stand by themselves, are sometimes connected together by the points in the form of arches, or a stake is driven in midway between the plants, and half the canes are bent one way and half the other, both being tied to the stake. Sometimes they are tied upright to stakes fixed to each stool. The best support, however, is obtained by fastening the points of the shoots to a slight horizontal rail or bar, placed a foot and a half on the south side of the rows, by which means the bearing shoots are deflected from the perpendicular to the sunny side of the row, and are not shaded by the annual wood. When this mode of training is adopted, the plan of planting 1 foot apart in the row and leaving one or two canes only to each shoot is preferable. The ground between the rows should never be disturbed by deep digging; but an abundant supply of good manure should be given annually in autumn as a dressing, which should be forked in regularly to a depth of 4 or 5 inches. All surplus suckers should be got away early in the summer before they have robbed the roots—five or six, to be reduced to the four best, being reserved to each root. Fresh plantations of raspberries should be made every six or seven years. The double-bearing varieties, which continue to fruit during autumn, require light soils and warm situations. These should be cut close down in February, as it is the strong young shoots of the current year which bear the late autumnal crops. The other varieties may be made to bear in autumn by cutting the stems half-way down at an early period in spring; but, as with all other fruits, the flavour of the raspberry is best when it is allowed to ripen at its natural season.

The following are some of the finer sorts now in cultivation:—

Baumforth's Seedling—a large summer-bearing red.
Carter's Prolific—a large summer-bearing red.
Fastolf or Filby—a large summer-bearing red.
M'Laren's Prolific—a large double-bearing red.
Northumberland Fillbasket—a large summer red.
October Red—a fine autumn-bearing red.
October Yellow—a fine autumn-bearing yellow.
Prince of Wales—a large summer-bearing red.
Red Antwerp—a large summer-bearing red.
Rogers's Victoria—a large autumn-bearing red.
Round Antwerp—a large summer-bearing red.
Semper Fidelis—an excellent bright red variety; heavy cropper.
Superlative—fruits rich red; perhaps the best raspberry in cultivation.
Sweet Yellow Antwerp—a large summer-bearing yellow.

The European raspberry, though admittedly of better quality, has been largely displaced in the United States of America by a closely allied native species, *R. strigosus*, the numerous varieties of which are hardier than the varieties of the European species and ripen their crop much more rapidly. The stems are more slender and flexible than in *R. Idaeus*, usually brown or reddish-brown in colour and beset with stiff straight prickles. The most important raspberry of cultivation in America is *R. occidentalis*, the black raspberry or thimbleberry, which is at once distinguished by its firm black, rarely yellow, fruit. The purple-cane raspberry, *R. neglectus*, with fruit varying in colour from dull purple to dark red or sometimes yellowish, is perhaps a hybrid between *R. strigosus* and *R. occidentalis*.

For a detailed account of the American species of *Rubus* see F. W. Card, *Bush-fruits* (1898).

The Loganberry is a hybrid between the raspberry (*Rubus Idaeus*) and the blackberry or bramble (*R. fruticosus*), and derives its name from its raiser, Judge Logan of the American Bar. It is a strong-growing plant, partaking more of the habit of the blackberry than the raspberry, and making shoots often 10 to 15 ft. long in the course of the year. These bear leaves with 5 leaflets, and fruit the following year. The fruiting shoots have leaves with only 3 leaflets; but young and old stems are densely covered with sharp crimson prickles. The fruits are borne profusely in loose trusses, and are ripe in southern localities in July, and about early August in northern parts. They are at first reddish like raspberries in a half-ripened state, but when fully ripe are deep purplish red, and much more palatable, each fruit being about 1¼ in. long, and shaped like a raspberry.

The Loganberry flourishes in heavy loamy soil, and is a useful plant for old fences or trellises, or even in waste places, where it is fully exposed to the sunshine. The old fruiting shoots should be cut away each winter, and in the spring the young shoots should have a foot or two taken off the ends, to induce the better and riper buds lower down to throw masses of white flowers, to be succeeded in due course by the fruits. Propagation is by means of suckers from the base.

RASPE, RUDOLF ERICH (1737–1794), the original author of the *Adventures of Baron Munchausen* (see MUNCHAUSEN), was born in Hanover in 1737, and studied at Göttingen and Leipzig. In 1762 he became a clerk in the university library at Hanover, and in 1764 secretary to the university library at Göttingen. He had become known as a versatile scholar and a student of natural history and antiquities, and he published some original poems and also translations, among the latter of Leibnitz's philosophical works and of Ossian's poems; he also wrote a treatise on Percy's *Reliques*. In 1767 he was appointed professor in Cassel, and subsequently librarian. He contributed in 1769 a zoological paper to the 59th volume of the *Philosophical Transactions*, which led to his being selected an honorary member of the Royal Society in London, and he wrote voluminously on all sorts of subjects. In 1774 he started a periodical called the *Cassel Spectator*. But having gone to Italy in 1775 to buy curios for the landgrave of Hesse, to whom he was keeper of the gems, he was found to have sold the landgrave's valuables for his own profit; and, on orders being issued for his arrest, he decamped to England. In London he employed his knowledge of English and his learning to secure a living by publishing books on various subjects, and English translations of German works, and there are allusions to him as "a Dutch savant" in 1780 in the writings of Horace Walpole, who gave him money and helped him to publish an *Essay on the Origin of Oil-painting* (1781). But he remained poor, and the Royal Society expunged his name off its list. He went to Cornwall in 1782, and till about 1788 was assay-master and storekeeper at the Dolcoath mine, where memories of his ingenuity remained to the middle of the 19th century. While there, he seems to have written the original version of *Munchausen*, which was subsequently elaborated by others. Between 1785 and 1790 he compiled a descriptive catalogue of James Tassie's collection of pastes and casts of gems, in two quarto volumes (1791) of laborious industry and bibliographical rarity. Raspe then went to Scotland, and in Caithness found a patron in Sir John Sinclair of Ulbster, whose mineralogical proclivities he proceeded to impose upon by pretending to discover valuable and workable veins on his estates; but Raspe had "salted" the ground himself, and on the verge of exposure he absconded. He next betook himself to Ireland, but died at Muckross in 1794, when he was only beginning some mining operations in Donegal. His career is interesting because of his connexion with the famous book of stories of Baron Munchausen (*q.v.*). His authorship was not known in his lifetime, except to his friend Gottfried August Bürger and possibly a few of his other intimates (such as Kästner and Lichtenburg) in his student days at Göttingen; and it was not till 1824 that the biographer of Bürger (who had been credited with writing *Munchausen* instead of only translating it, as he did in 1786) revealed the truth about the book.

RASSAM, HORMUZD (1826–1910), Assyriologist and traveller, was born at Mosul of native Christian parents. His first work was done as assistant to Sir A. H. Layard in his first expedition (1845–47). He subsequently came to England, studied at Oxford, and was again sent by the British Museum trustees to accompany Layard in his second expedition (1849–51). Layard having entered upon a political career, Rassam continued the work (1852–54) in Assyria under the direction of the British Museum and Sir Henry Rawlinson at Nimrud and Kuyunjik. In 1866 he was sent by the British government to Abyssinia, where, however, he was imprisoned for two years until freed by the victory of Sir Robert Napier. From 1876 to 1882 he was again in Assyria conducting important investigations, especially at Nineveh, and during the Russo-Turkish War he was sent on a mission of inquiry to report on the condition of the Christian communities of Asia Minor and Armenia. His archaeological work resulted in many important discoveries and the collection of valuable epigraphical evidence.

See *The Times*, Sept. 17, 1910.

RASTATT, a town of Germany, in the grand duchy of Baden, on the Murg, 4 m. above its junction with the Rhine and 15 m.

by rail S.W. of Karlsruhe. Pop. (1905) 14,404. The old palace of the margraves of Baden, a large Renaissance edifice in red sandstone, is now partly used for military purposes and contains a collection of pictures, antiquities and trophies from the Turkish wars. The chief manufactures are stoves, beer and tobacco. Until the end of the 17th century Rastatt was unimportant, but after its destruction by the French in 1689 it was rebuilt on a larger scale by Louis William, margrave of Baden, the imperial general in the Turkish wars. It was then the residence of the margraves until 1771. The Baden revolution of 1849 began with a mutiny of soldiers at Rastatt in May 1849, and ended here a few weeks later with the capture of the town by the Prussians. For some years Rastatt was one of the strongest fortresses of the German empire, but its fortifications were dismantled in 1890.

See Schuster, *Rastatt, die ehemalige badische Residenz und Bundesfestung* (Lahr, 1902); and Lederle, *Rastatt und seine Umgebung* (Rastatt, 1905).

Rastatt has been the scene of two congresses. At the first congress, which was opened in November 1713, negotiations were carried on between France and Austria for the purpose of ending the war of the Spanish succession. These culminated in the treaty of Rastatt signed on the 7th of March 1714. The second congress, which was opened in December 1797, was intended to rearrange the map of Germany by providing compensation for those princes whose lands on the left bank of the Rhine had been seized by France. It had no result, however, as it was ended by the outbreak of the European war, but it had a sequel of some interest. As the three French representatives were leaving the town in April 1799 they were waylaid, and two of them were assassinated by some Hungarian soldiers. The origin of this outrage remains shrouded in mystery, but the balance of evidence seems to show that the Austrian authorities had commanded their men to seize the papers of the French plenipotentiaries in order to avoid damaging disclosures about Austria's designs on Bavaria, and that the soldiers had exceeded their instructions. On the other hand, some authorities think that the deed was the work of French emigrants, or of the party in France in favour of war.

For fuller particulars of the two sides of this controversy see K. Mendelssohn-Bartholdy, *Der Rastadter Gesandtenmord* (Heidelberg, 1869); J. A. Freiherr von Helfert, *Der Rastadter Gesandtenmord* (Vienna, 1874); Böhtlingk, *Napoleon und der Rastadter Gesandtenmord* (Leipzig, 1883); and *Zum Rastadter Gesandtenmord* (Heidelberg, 1895); H. Hüffer, *Der Rastadter Gesandtenmord* (Bonn, 1896); and H. von Sybel, in Band 39 of the *Historische Zeitschrift.*

RASTELL (or RASTALL), **JOHN** (d. 1536), English printer and author, was born in London towards the end of the 15th century. He is vaguely reported by Anthony à Wood to have been "educated for a time in grammaticals and philosophicals" at Oxford. He became a member of Lincoln's Inn, and practised successfully as a barrister. He was also M.P. for Dunheved, Cornwall, from 1529 to the time of his death. He began his printing business some time before 1516, for in his preface to the undated *Liber Assisarum* he announced the forthcoming publication of Sir A. Fitzherbert's *Abbreviamentum librorum legum Anglorum*, dated 1516. Among the works issued from the "sygne of the meremayd at Powlysgate," where he lived and worked from 1520 onwards, are *The Mery Gestys of the Wydow Edyth* (1525), and *A Dyaloge of Syr Thomas More* (1529). The last of his dated publications was *Fabyl's Ghoste* (1533), a poem. In 1530 he wrote, in defence of the Roman doctrine of Purgatory, *A New Boke of Purgatory* (1530), dialogues on the subject between "Comyngs and Almayn a Christen man, and one Gyngemyn a Turke." This was answered by John Frith in *A Disputacion of Purgatorie.* Rastell replied with an *Apology against John Fryth*, also answered by the latter. Rastell had married Elizabeth, sister of Sir Thomas More, with whose Catholic theology and political views he was in sympathy. More had begun the controversy with John Frith, and Rastell joined him in attacking the Protestant writer, who, says Foxe (*Actes and Monuments*, ed. G. Townsend, vol. v. p. 9), did so "overthrow and confound" his adversaries that he converted Rastell to his side. Separated from his Catholic friends, Rastell does not seem to have been fully trusted by the opposite party, for in a letter to Cromwell, written probably in 1536, he says that he had spent his time in upholding the king's cause and opposing the pope, with the result that he had lost both his printing business and his legal practice, and was reduced to poverty. He was imprisoned in 1536, perhaps because he had written against the payment of tithes. He probably died in prison, and his will, of which Henry VIII. had originally been appointed an executor, was proved on the 18th of July 1536. He left two sons: William, noticed below, and John. The Jesuit, John Rastell (1532–1577), who has been frequently confounded with him, was no relation.

Rastell's best-known work is *The Pastyme of People, the Chronycles of dyvers Realmys and most specially of the Realme of England* (1529), a chronicle dealing with English history from the earliest times to the reign of Richard III., edited by T. F. Dibdin in 1811. His *Expositiones terminorum legum Angliae* (in French, translated into English, 1527; reprinted 1629, 1636, 1641, &c., as *Les Termes de la Ley*), and *The Abbreviacion of Statutis* (1519), of which fifteen editions appeared before 1625, are the best known of his legal works. Rastell was also the author of a morality play, *A new Interlude and a Mery of the IIII Elements*, written about 1519, which is no doubt the "large and ingenious comedy" attributed to him by Wood. The unique copy in the British Museum is incomplete, and contains neither the date nor the name of the author, identified with John Rastell on the authority of Bale, who catalogues *Natura Naturata* among his works, adding a Latin version of the first line of the piece. This interlude was printed in W. C. Hazlitt's edition of Dodsley's *Old English Plays*, by J. O. Halliwell-Phillipps for the Percy Soc. (*Early English Poetry*, vol. 22, 1848), and by Julius Fischer (*Marburger Studien zur englischen Philologie*, vol. v., 1903). See also an article on "John Rastell and his Contemporaries" in *Bibliographica*, vol. 11, 437 seq., by Mr. H. R. Plomer, who unearthed in the Record Office an account of a law-suit (1534–35) in connexion with Rastell's premises at the "Mermaid." For the books issued from his press see a catalogue by R. Proctor, in *Hand-Lists of English Printers* (Bibliographical Soc., 1896).

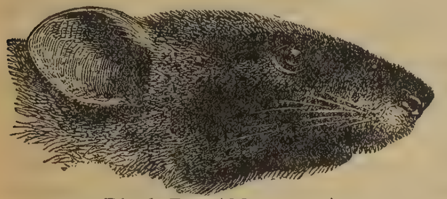
RASTELL, WILLIAM (*c.* 1508–1565), English printer and judge, son of the preceding, was born in London about 1508. At the age of seventeen he went to the university of Oxford, but did not take a degree, being probably called home to superintend his father's business. The first work which bears his own imprint was *A Dyaloge of Sir Thomas More* (1531), a reprint of the edition published by his father in 1529. He also brought out a few law-books, some poetry, an edition of *Fabyan's Cronycle* (1533), and *The Apologye* (1533) and *The Supplycacyon of Soulys* of his uncle Sir Thomas More. His office was "in Fletestrete in saynt Brydys chyrche yarde." He became a student at Lincoln's Inn on 12th September 1532, and gave up the printing business two years later. In 1547 he was appointed reader. On account of his Catholic convictions he left England for Louvain; but upon the accession of Mary he returned, and was made serjeant-at-law and treasurer of Lincoln's Inn in 1555. His patent as judge of the Queen's Bench was granted on the 27th of October 1558. Rastell continued on the bench until 1562, when he retired to Louvain without the queen's licence. By virtue of a special commission issued by the barons of the Exchequer on the occasion an inventory of his goods and chattels was taken. It furnishes an excellent idea of the modest nature of the law library (consisting of twenty-four works) and of the chambers of an Elizabethan judge (see *Law Magazine*, February 1844). He died at Louvain on the 27th of August 1565.

It is difficult to distinguish between the books written by him and those by his father. The following are believed to be his: *A Colleccion of all the Statutes* (1559), *A Table collected of the Yeares of the Kynges of Englande* (1561), both frequently reprinted with continuations, and *A Colleccion of Entrees, of Declarations, &c.* (1566), also frequently reprinted. The entries are not of Rastell's own drawing, but have been selected from printed and MS. collections; their "pointed brevity and precision" are commended by Story. He supplied tables or indexes to several law-books, and edited *La novel natura brevium de Monsieur Anton. Fitzherbert* (1534) and *The Workes of Sir T. More in the English Tonge* (1557). He is also stated to have written a life of Sir T. More, but it has not come down to us.

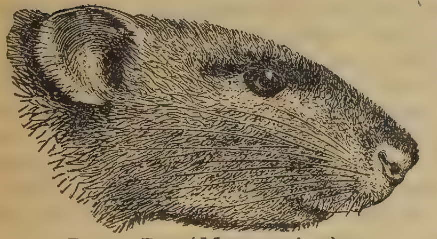
RASTENBURG, a town of Germany, in the province of East Prussia, lying in a flat sandy plain on the Guber, 64 m. S.E. of Königsberg by the railway to Prostken. Pop. (1905) 11,889. Its principal manufactures are flour, sugar, oil, beer and machinery. In the vicinity is Karlshof, a celebrated establishment for the cure of epileptic diseases.

See Beckherrn, *Mittheilungen aus Rastenburgs Vergangenheit* (Rastenburg, 1891); and Schaffer, *Chronik von Rastenburg* (Rastenburg, 1889).

RAT (a word common to Teut. and Rom. languages; probably first adopted in Teut.; the ultimate origin is not known; Skeat suggests the root *rad-*, to scratch; cf. Ger. *Ratte*, Dan. *rotte*, Fr. *rat*, &c.), probably in its original sense the designation of the British rodent mammal commonly known as the black rat (*Mus rattus*), but also applied indifferently to the brown or Norway rat (*M. norvegicus*), and in a still wider sense to all the larger representatives of the genus *Mus*, as to many other members of the family Muridae. In fact, as mentioned in the article Mouse, there is no possibility of defining the term "rat" when used in a sense other than as relating to the two species above mentioned; while there is also no hard-and-fast limit between the terms "rats" and "mice" when these are likewise employed in their now extended sense, "rats" being merely larger "mice," and vice versa. Rats have, however, generally more rows of scales on the tail (reaching to 210 or more) than mice, in which the number does not exceed 180. For the distinctive characteristics of the family Muridae and the genus *Mus*, to which true rats and true mice alike belong, see Rodentia. Of the two British species the brown, or Norway rat (*M. norvegicus*) is distinguished by its large size, brownish grey colour, short tail and ears, stout skull, and the possession of from 10 to 12 teats. It is fierce and cunning, and easily overcomes all allied species with which it is brought in contact. Its original home would seem to have been some part of Central Asia, an indigenous species from China, *M. humiliatus*, being so like it that in all probability the latter is the original race from which it has sprung. Thence it has spread to all parts of the world, driving out the house-haunting species everywhere, as it has in England all but exterminated the black rat. The brown rat migrated westwards from Central Asia early in the 18th century, and is believed to have first reached Great Britain about 1730. Its already evil reputation has been increased of late years by the fact that it is one of the chief disseminators of bubonic plague. Black phases are not uncommon. The black rat (*M. rattus*) is distinguishable from the brown rat by its smaller size, longer ears and tail, and glossy black colour. It shares the roving habits of the latter, frequenting ships and by these means reaching various parts of the world. On this account either the typical form or the tropical *M. rattus alexandrinus* is common in many places to which the brown species has not yet penetrated, for instance in South America. This long-tailed rat, originally a native of India, would seem to have first penetrated to all parts of the world and to have nearly or quite exterminated the indigenous rats. After this followed the advance of the more powerful brown rat. The black rat first reached Europe in the 13th century; but of late years another and still darker phase of the species, the Black Sea black rat (*M. rattus ater*) made its appearance in England. The Isle of Dogs and Yarmouth, in Norfolk, are reported to be the chief of the English strongholds of the black rat. Both species agree in their predaceous habits, omnivorous diet and great fecundity. They bear, four or five times in the year, from four to ten blind and naked young, which are in their turn able to breed at an age of about six months; the time of gestation being about twenty days.



Black Rat (*Mus rattus*).



Brown Rat (*M. norvegicus*).

See J. G. Millais, "The True Position of *Mus rattus* and its Allies," *Zoologist*, June 1905. (R. L.*)

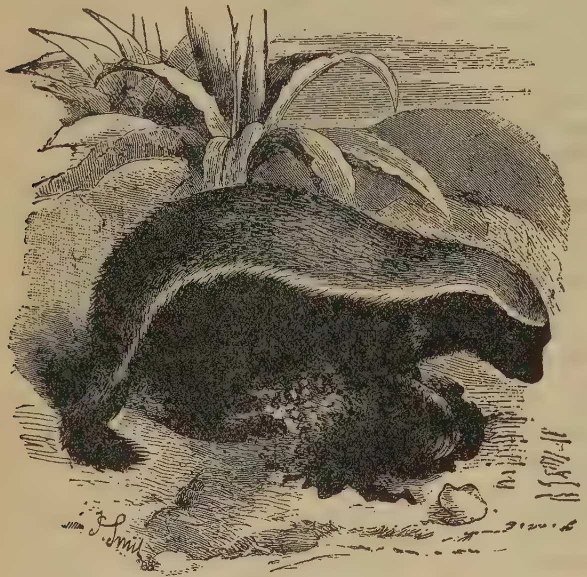
RATAFIA, a liqueur or cordial flavoured with peach or cherry kernels, bitter almonds, or other fruits; many different varieties are made. The same name is given to a flavouring essence resembling bitter almonds, and also to a light biscuit. The word is adapted from the French of the 17th century. Skeat (*Etym. Dict.*, 1910) quotes as a possible origin a combination of Malay *araq*, arrack, and *tafia*, rum.

RATE, a general term for proportion, standard, allowance, tax (Med. Lat. *rata*, from *pro rata parte*, *ratus* being the participle of *reri*, to think, judge). In England the term is specially applied to the levying of public money contributions for local purposes, as distinguished from the "taxes" raised for what are treated as general state purposes. The money required for local administration in England is raised (when the ordinary revenues are insufficient) by assessments on lands and buildings based on their annual rental value. The financial authority estimates what additional amount beyond revenue is required for the expenses of administration, and levies a rate to meet it. The earliest rate levied in England was that for poor relief, and of the great variety of rates now existing, the majority are based on the poor rate and levied with it, under the term of precept rates. Next to the poor rate came that for highways, and other special rates have been authorized from time to time, as for police, education, public lighting, cemeteries, libraries, sanitary purposes, &c. To distinguish the rate the name of the precepting authority is frequently added or the purpose for which it is levied specified, as county rate, watch rate, &c. The valuation list of a parish is the basis on which the poor rate is levied. This valuation list contains the gross estimated rental and rateable value of all rateable property in the parish. The gross estimated rental is the rent at which a property might reasonably be expected to let from year to year, the tenant paying tithes, rates and taxes. From this is deducted the average annual cost of repairs, insurance and renewals, the balance constituting the rateable value. The rateable value of the parish being known, so much on each pound of the rateable value as will equal the amount required to be raised is levied, and is known as the "rate." See further England, *Local Government*; Taxation.

Rating, in maritime vocabulary, is the classification of men according to rank, and was formerly employed to class ships of a navy according to strength. A sailor is said to be "rated A.B.," or in the navy "rated petty officer," "seaman," "gunner," and so on. The rating of ships began in the 17th century, and was at first done roughly by size and number of crew. Later the rating was by guns. Thus in 1741 in the British navy there were six rates: 1st, 100 guns; 2nd, 90; 3rd, 70 to 80; 4th, 50 to 60; 5th, 40; and 6th, 20. Sloops, fire-ships, bomb-vessels and royal yachts were said to be not rated. The classification of ships into six rates, and into rated and non-rated ships, continued during the existence of the old sailing fleets, with modifications in detail. The practice of other navies was similar to the British.

RATEL, or Honey-Badger, the name of certain Indian and African small clumsy-looking creatures of about the size and appearance of badgers, representing the genus *Mellivora* in the family Mustelidae (see Carnivora). Two species of ratel are commonly recognized, the Indian (*M. indica*), and the African (*M. ratel*), which ranges over Africa, but a black ratel from the Ituri forest has been separated as *M. cottoni*. Both the two former are iron-grey on the upper parts, and black below, a style of coloration rare among mammals, as the upper side of the body is in the great majority darker than the lower.

The body is stout and thickly built; the legs are short and strong, and armed, especially the anterior pair, with long curved claws; the tail is short; and the ears are reduced to rudiments. The skull is conical, stout and heavy, and the teeth, although sharper and less rounded than those of badgers, are less suited to a carnivorous diet than those of stoats, weasels and martens. The two ratels may be distinguished by the fact that the African species has a distinct white line round the body at the junction of the grey of the upper side with the black of the lower, while in the Indian this line is absent; the teeth also of the former are larger, rounder and heavier than those of the latter. The two are, however, so nearly allied that they might almost be considered geographical races of a single species. Dr T. C. Jerdon states that the Indian ratel is found throughout the whole of India, from the extreme south to the foot of the Himalaya, chiefly in hilly districts, where it has greater facilities for constructing the holes and dens in which it lives; but also in the north of India in alluvial plains, where the banks of large rivers afford equally suitable localities wherein to make its lair. It is stated to live usually in pairs, and to eat rats, birds, frogs, white ants and various insects, and in the north of India it is accused of digging out dead bodies, and several of the native names mean "grave-digger." Dr W. T. Blanford, in the *Fauna of British India*, is of opinion that the reproach is without foundation. Like its Cape congener it occasionally partakes of honey, and is often destructive to poultry. In confinement the Indian ratel becomes tame and even playful, displaying a habit of tumbling head over heels. (R. L.*)



The African Ratel (*Mellivora ratel*).

RATH, GERHARD VOM (1830–1888), German mineralogist, was born at Dinsburg in Prussia, on the 20th of August 1830. He was educated at Cologne, at Bonn University, and finally at Berlin, where he graduated Ph.D. in 1853. In 1856 he became assistant to Nöggerath in the mineralogical museum at Bonn, and succeeded to the directorship in 1872. Meanwhile in 1863 he was appointed extraordinary professor of geology, and in 1872 he became professor of geology and mineralogy in the university at Bonn. He was distinguished for his accurate researches on mineralogy and crystallography; he described a great many new minerals, some of which were discovered by him, and he contributed largely to our knowledge of other minerals, notably in an essay on tridymite. He travelled much in southern Europe, Palestine and the United States, and wrote several essays on petrology, geology and physical geography, on earthquakes and on meteorites. He died at Coblenz on the 23rd of April 1888.

His separate publications included *Ein Ausflug nach Kalabrien* (1871); *Der Monzoni im südöstlichen Tirol* (1875); and *Durch Italien und Griechenland nach dem Heiligen Land* (2 vols., 1882). See Obituary with bibliography by Professor H. Laspeyres, in *Sitzungsbericht des nat. Vereins der preussischen Rheinlande* (1888).

RATHENOW, a town of Germany, in the Prussian province of Brandenburg, on the Havel, 45 m. N.W. of Berlin on the main railway to Hanover. Pop. (1905) 23,095, including the garrison. The Protestant church of St Mary and St Andrew, originally a basilica, and transformed to the Gothic style in 1517–1589, and the Roman Catholic church of St George, are noteworthy. Rathenow is known for its "Rathenow stones," bricks made of the clay of the Havel, and for its spectacles and optical instruments, which are exported.

Rathenow received its incorporation as a town in 1295. In 1394 it was taken and partly destroyed by the archbishop of Magdeburg. It suffered much from the ravages of the Thirty Years' War, being occupied in turn by the Saxons and the Swedes, from whom in 1675 it was taken by the Brandenburgers, when most of the garrison were put to the sword.

See Wagener, *Denkwürdigkeiten der Stadt Rathenow* (Berlin, 1903).

RATIBOR (Polish *Raciborz*), a town of Germany, in the Prussian province of Silesia, pleasantly situated on the left bank of the Oder at the point where the river becomes navigable, 13 m. from the Austrian frontier and 97 m. by rail S.E. of Breslau, on the main line to Oderberg. Pop. (1905) 32,690. The most prominent buildings are the handsome law-courts by Schinkel and the imposing château of the dukes of Ratibor, which occupies a commanding position on the right bank of the Oder. The town is the seat of various industries, the chief products of which are machinery, railway gear, iron wares, tobacco, cigars, paper, sugar, furniture and glass. Trade is carried on in these and in coal, wood and agricultural produce, while hemp and vegetables are largely grown in the environs.

Ratibor, which received municipal privileges in 1217, was formerly the capital of an independent duchy, 380 sq. m. in extent, which existed from 1288 to 1532, and afterwards passed successively into the hands of Austria and Prussia. In 1821 a small mediate principality was formed out of the old lordship of Ratibor and certain ecclesiastical domains, and was conferred upon Victor Amadeus, landgrave of Hesse-Rotenburg, as compensation for some Hessian territory absorbed by Prussia. The title of duke of Ratibor was revived in 1840 for his heir, Prince Victor of Hohenlohe-Schillingsfürst (1818–1893).

See A. Weltzel, *Geschichte der Stadt und Herrschaft Ratibor* (2nd ed., Ratibor, 1881).

RATIONALISM (from Lat. *rationalis*, pertaining to reason, *ratio*), a term employed both in philosophy and in theology for any system which sets up human reason as the final criterion and chief source of knowledge. Such systems are opposed to all doctrines which rest solely or ultimately upon external authority; the individual must investigate everything for himself and abandon any position the validity of which cannot be rationally demonstrated. The rationalist spirit is, of course, coeval with human evolution; religion itself began with a rational attempt to maintain amicable relations with unknown powers, and each one of the dead religions succumbed before the development of rationalist inquiry into its premises. But the term has acquired more special connotations in modern thought. In its commonest use it is applied to all who decline to accept the authority of the Bible as the infallible record of a divine revelation, and is practically synonymous with free-thinking. This type of rationalism is based largely upon the results of modern historical and archaeological investigation. The story of the Creation in the book of Genesis is shown, from the point of view of chronology, to be a poetic or symbolic account by the discovery of civilizations of much greater antiquity. Again, the study of comparative religion (*e. g.* the study of the Deluge (*q.v.*), showing as it does that similar stories are to be found in primitive literature, both oriental and other) has placed the Bible in close relation with other ancient literature. The Bible, especially the Old Testament, is thus regarded even by orthodox Christians from a rationalist standpoint, very different from that of the early and medieval Church. Rationalism within the Christian Church differs, however, from that which is commonly understood by the term, inasmuch as it accepts as revealed the fundamental facts of its creed. Thoroughgoing rationalism, on the other hand, either categorically denies that the supernatural or the infinite—whether it exist or not—can be the object of human knowledge (see AGNOSTICISM), or else, in the mouth of a single person, states that he at least has no such knowledge. In addition to the difficulties presented by the Bible as an historical record, and the literary problems which textual and other critics have investigated, the modern freethinker denies that the Christianity of the New Testament or its interpretation by modern theologians affords a coherent theory of human life and duty. Apart from the general use of the term for a particular attitude towards religion, two more technical uses require notice: (i) the purely philosophical, (ii) the theological.

(i) Philosophical rationalism is that theory of knowledge which maintains that reason is in and by itself a source of knowledge, and that knowledge so derived has superior authority over knowledge acquired through sensation. This view is opposed to the various systems which regard the mind as a *tabula rasa* (blank tablet) in which the outside world as it were imprints itself through the senses. The opposition between rationalism and sensationalism is, however, rarely so simple and direct, inasmuch as many thinkers (*e.g.* Locke) have admitted both sensation and reflection. Such philosophies are called rationalist or sensationalist according as they lay emphasis specially on the function of reason or that of the senses. More generally, philosophic rationalism is opposed to empirical theories of knowledge, inasmuch as it regards all true knowledge as deriving deductively from fundamental elementary concepts. This attitude may be studied in Descartes, Leibnitz and Wolff. It is based on Descartes' fundamental principle that knowledge must be clear, and seeks to give to philosophy the certainty and demonstrative character of mathematics, from the a priori principle of which all its claims are derived. The attack made by David Hume on the causal relation led directly to the new rationalism of Kant, who argued that it was wrong to regard thought as mere analysis. A priori concepts there are, but if they are to lead to the amplification of knowledge, they must be brought into relation with empirical data.

(ii) The term "rationalism" in the narrow theological sense is specially used of the doctrines held by a school of German theologians and Biblical scholars which was prominent roughly between 1740 and 1836. This rationalism within the Church was a theological manifestation of the intellectual movement known as the Enlightenment (*Aufklärung*), and must be studied in close connexion with the purely philosophical rationalism already discussed. It owed much to the English deists, to the Pietistic movement, and to the French *esprits forts* who had already made a vigorous attack on the supernatural origin of the Scriptures. The crux of the difficulty was the doctrine of the supernatural, the relation between revealed and natural religion. The first great rationalist leader was J. S. Semler (*q.v.*), who held that true religion springs from the individual soul, and attacked the authority of the Bible in a comprehensive spirit of criticism. He ultimately reached a point at which the Bible became for him simply one of many ancient documents. At the same time he did not impugn the authority of the Church, which he regarded as useful in maintaining external unity. Among those who followed in Semler's path were Gruner Ernesti, J. D. Michaelis, Griesbach, J. G. Eichhorn. This spirit was exhibited on the philosophical side by Kant who in his *Die Religion innerhalb der Grenzen der blossen Vernunft* (1793) set forth his doctrine of rational morality (*Vernunftglauben*) as the only true religion. These two great rationalist movements, the critical and the philosophical, ultimately led to, or were accompanied by, the gradual reduction of religion to a system of morals based at the most on two or three fundamental religious principles. This is the rationalism known as *rationalismus vulgaris*, the period of which is practically from 1800 to 1833. Among its exponents were Wegscheider, Bretschneider and H. E. G. Paulus (*qq.v.*). The general attitude of German theology, however, became gradually more and more hostile, and the works of Schleiermacher, though in a sense themselves rationalist, renewed the general desire for a positive Christianity. Hase's *Hutterus Redivivus*, an exposition of orthodoxy in the light of modern development, called forth a final exposition of the rationalist position by Röhr. From that time the school as such ceased to have a real existence, though the results of its work are traceable more or less in all modern Biblical criticism, and its influence upon the attitude of modern theologians and Biblical critics can scarcely be overestimated.

See Ständlin, *Geschichte des Rationalismus* (Göttingen, 1826); Hase, *Theologische Streitschriften* in *Gesammelte Werke*, viii. (1892); Rückert, *Der Rationalismus* (1859); Tholuck, *Vorgeschichte des Rat.* (1853–1861) and *Geschichte des Rat.* (1865); Ritschl, *Christ. Lehre von der Rechtfertigung*, &c. (1870), vol. i.; Benn, *History of Rationalism* (1906). See also histories of philosophy and theology in the 19th century, and the valuable article *s.v.* by O. Kirn in Herzog-Hauck, *Realencyk.* xvi. (1905).

RATISBONNE, LOUIS GUSTAVE FORTUNÉ (1827–1900), French man of letters, was born at Strassburg on the 29th of July 1827. He studied at the school of his native town and at the Collège Henry IV. in Paris. He was connected with the *Journal des Débats* from 1853 to 1876; became librarian of the palace of Fontainebleau in 1871, and three years later to the Senate. Louis Ratisbonne's most important work was a verse translation of the *Divina Commedia*, in which the original is rendered tercet by tercet into French. *L'Enfer* (1852) was crowned by the Academy; *Le Purgatoire* (1857) and *Le Paradis* 1859) received the *prix Bordin*. He is also the author of some charming fables and verses for children: *La Comédie enfantine* (1860), *Les Figures jeunes* (1865) and others. He was literary executor of Alfred de Vigny, whose *Destinées* (1864) and *Journal d'un poète* (1867) he published. Ratisbonne died in Paris on the 24th of September 1900.

RATITAE (from Lat. *ratis*, a raft), the name given by B. Merrem (*Abh. Ak. Wiss.*, Berlin, 1812–1813; *Phys. Kl.*, p. 259) to the "flat-breasted birds," in opposition to the Carinatae, or those which normally possess a keeled sternum. In thus dividing the birds into two great equivalent groups, he was followed only by C. L. Nitzsch (1829), T. H. Huxley (1867), P. L. Sclater (1880), A. Newton (1884), R. B. Sharpe (1891), whilst in most of the other numerous classifications the Ratitae (vicariously named Struthiones, Cursores, Brevipennes, Proceres) were treated as of much lower rank.

A diagnosis covering all the Ratitae (*struthio, rhea, casuarius, dromaeus, apteryx* and the allied fossils *dinornis* and *aepyornis*) would be as follows—(i) terrestrial birds without keel to the sternum, absolutely flightless; (ii) quadrate bone with a single proximal articulating knob; (iii) coracoid and scapula fused together and forming an open angle; (iv) normally without a pygostyle; (v) with an incisura ischiadica; (vi) rhamphotheca compound; (vii) without apteria or bare spaces in the plumage; (viii) with a complete copulatory organ, moved by skeletal muscles.

The separation of the Ratitae from the other birds, and their seemingly fundamental differences, notably the absence of the keel and of the power of flight, induced certain authors to go so far as to derive the Ratitae from the Dinosaurian reptiles, whilst *Archaeopteryx* (*q.v.*) and the Carinatae were supposed to have sprung from some Pterosaurian or similar reptilian stock. Such vagaries require no refutation. But it is quite another question, whether the "Ratitae" form a natural group. Sir R. Owen was the first (*Comp. Anat. and Physiol. of Vertebrates*, ii. 1866) to indicate that the various Ratitae might be referable to various natural groups of the Carinatae. A. W. Forbes likewise had doubts about them. B. Lindsay (*P. Z. S.*, 1885, pp. 684–716, pls. lii.–lv.) found vestiges of a keel in a young rhea, and apteria in the embryonic ostrich, and she concluded that they were descendants of birds which originally possessed the power of flight. This has been settled by M. Fürbringer (*Untersuchungen* . . . 1888), and there is now no doubt that the absence of the power of flight is a secondary, not primitive, feature in the Ratitae as well as in the flightless *bona fide* Carinatae, *e.g. Didus*, and penguins. It had already been understood that the various genera of the Ratitae were the representatives of so many different groups, each of which was at least equivalent to ordinal rank, and that therefore, if the Ratitae were still to be considered a natural group, this common ancestry must be referred to a remote geological epoch. Fürbringer, however, separated *Apteryx* with *Dinornis* from the rest, combining his "Apteryges" with Crypturi and Galli as Alectorornithes, the latter being practically A. H. Garrod's Galliformes, of which his "Struthiones" form part together with the Tinamidae or Crypturi. Relationship of this otherwise typically carinate, neotropical family with the Ratitae had already been insisted upon by T. H. Huxley; hence his term Dromaeognathae for the Crypturi. L. Stejneger (*Standard Nat. Hist.*, iv., Boston, 1885) applied this term in a new wider sense to all the Ratitae, and recently W. P. Pycraft has revived this notion by his division of the Neornithes into Dromaeo- and Neognathae. At any rate we begin to see that some of the Ratitae, namely the Rheidae, may possibly be an early and then much modified offshoot of such of the Carinatae as are now represented by the Crypturi, whilst in another part of the world, and at a much later time, kiwis and moas have sprung from a somewhat more Galliform stock, which points to a descent from a still undivided Galliform-Tinamiform mass. Further, it is the opinion of competent ornithologists that there is affinity of the Australian emeus and cassowaries with the New Zealand moas and with the Malagasy *Aepyornis*. *Struthio* alone still stands aloof, possibly because it is the oldest and most specialized form. This genus was already typically developed in late Miocene times, and with a very wide geographical distribution (see Bird, *Fossil*), but of the affinities of the other mid- and early tertiary flightless birds we know nothing, and it must be emphasized that we should probably not be able to classify a truly ancestral Ratite, namely, a bird which is still to a certain extent carinate and not yet ratite. It is impossible to give a satisfactory diagnosis of such intermediate forms.

All the recent Ratitae still possess a considerable number of rather primitive characters, *e.g.* they are typically nidifugous; the simple structure of their neossoptiles; quintocubital; compound rhamphotheca; holorhinal nares imperviae; basipterygoid processes; simple articular facet of the quadrate; configuration of the palatal bones, including the large vomer; incisura ischiadica; simple hypotarsus; the thigh muscles; the copulatory organ.

We restrict the origin of the Ratitae to that great branch of still primitive Carinatae which, after separation of the Ratitae, has further developed into the legion of the Alectoromorphae, notably Tinami- and Galliformes, together with still low Gruiformes (see Bird, *Classification*). From such a *rudis indigestaque moles*, after it had attained an almost world-wide distribution, have arisen the various Ratitae, independently at various epochs and in various countries. Most of them are now restricted to widely separated countries of the southern hemisphere. Although loss of flight (correlated with more or less reduction of the wings and the sternal keel, and often compensated by stronger hind limbs) has occurred, and is still taking place in various groups of birds, it is quite impossible that a new Ratite can still come into existence, because the necessary primitive substratum, whence arose the true Ratitae, is no longer available. Consequently we are justified in retaining "Ratitae" in our classification, although they are a heterogeneous, not strictly monophyletic, assembly. (H. F. G.)

RATKE (RATCHIUS), WOLFGANG (1571–1635), German educationist, was born at Wilster, Holstein, on the 18th of October 1571, and educated at the university of Rostock. His system of education was based upon Bacon's philosophy, the principle being that of "proceeding from things to names," from the particular to the general, and from the mother tongue to foreign languages. In 1618 he opened schools at Augsburg and elsewhere, but at Köthen difficulties with the clergy led to his imprisonment for eight months, and after starting another school at Magdeburg in 1620 which failed, he became a wanderer and died at Erfurt on the 27th of April 1635. His ideas were far in advance of his time, but he lacked executive ability.

RATLAM (or Rutlam), a native state of central India, in the Malwa agency. Area, 902 sq. m. Its territory is closely interlaced with that of Sailana. It is held as tributary to Sindhia; but in 1819 an arrangement was made by which Sindhia engaged never to send any troops into the country or to interfere with the internal administration, and in 1861 the tribute was assigned to the British government in part payment of the Gwalior contingent. The population in 1901 was 83,773, showing a decrease of 6% in the decade; estimated revenue, £34,000; tribute, £2850. The chief, whose title is raja, is a Rahtor Rajput of the Jodhpur family. The chief Sujjan Singh succeeded in 1893, and attained full powers in 1898. The town of Ratlam is 1577 ft. above sea-level. Pop. (1901) 36,321. It is a junction on the Rajputana-Malwa railway, and an important centre of trade, especially in opium.

RATNAGIRI, a town and district of British India, in the southern division of Bombay. The town is on the seacoast, 136 m. S. of Bombay. Pop. (1901) 16,094. A leading industry is the sardine fishery, which usually takes place in January and February, and engages fleets of canoes.

The District of Ratnagiri has an area of 3998 sq. m. It forms a strip between the western Ghats and the sea, and its general character is rugged; nearly all the fertile land lies on the banks of the streams which intersect the country. The coast, about 150 m. in length, is almost uniformly rocky and dangerous. At intervals of about 10 m. a river or bay opens, sufficiently large to form a secure harbour for native craft, and the promontories at the river mouths are almost invariably crowned with the ruins of an old fort. The rivers and creeks are generally navigable for about 20 m., and afford facilities for a coasting trade. At the beginning of British rule there were no roads, and traffic was confined to places where there was water carriage; but a network of roads has been made, opening communication by hill passes with the Deccan. Ratnagiri formed part of the dominions of the peshwa, and was annexed by the British government in 1818 on the overthrow of Baji Rao. In 1901 the population was 1,167,927, showing an increase of 6% in the decade. Ratnagiri is the home of the influential class of Chitpavan Brahmans. It also supplies factory hands to Bombay and sepoys to the native army.

RATNAPURA (*i.e.* "The City of Gems"), the chief town in the province of Sabaragamuwa, Ceylon. It is the centre of a long established industry in digging for precious stones—rubies, sapphires, cat's-eyes, &c. There is also much rice and fruit cultivation and planting of tea in the district. Pop. of town (1901) 4084; of district 132,964.

RATON, a city and the county seat of Colfax county, New Mexico, U.S.A., in the N.E. part of the state, and about 193 m. by rail N.E. of Santa Fé. Pop. (1890) 1255; (1900) 3540 (337 foreign-born); (1910 census) 4539. Raton is served by the Atchison, Topeka & Santa Fé, the Saint Louis, Rocky Mountain & Pacific, and the Santa Fé, Raton & Eastern railways. The city lies immediately W. of the Raton Mountains, from which it derives its name, and has an elevation of 6400–6650 ft. above the sea. Among its institutions are a miners' hospital, maintained by the state, and a picturesque public park. The city lies within the Raton coal field, a southern continuation of the field of the same name in Colorado, and the richest coal-producing area in New Mexico. In 1907 70% of the total coal product of New Mexico came from Colfax county, in which this field is situated. Ores of gold, silver and lead have been mined in Colfax county. South and east of the city there is good farming land. Raton is a place of railway origin, and owes its development to its extensive railway shops, as well as to the proximity of mines. It was incorporated in 1891.

RATRAMNUS (d. *c.* 868), a theological controversialist of the second half of the 9th century, was a monk of the Benedictine abbey of Corbie near Amiens, but beyond this fact very little of his history has been preserved. He is best known by his treatise on the Eucharist (*De corpore et sanguine Domini liber*), in which he controverted the doctrine of transubstantiation as taught in a similar work by his contemporary Radbertus Paschasius. Ratramnus sought in a way to reconcile science and religion, whereas Radbertus emphasized the miraculous. Ratramnus's views failed to find acceptance; their author was soon forgotten, and, when the book was condemned at the synod of Vercelli in 1050, it was described as having been written by Johannes Scotus Erigena at the command of Charlemagne. In the Reformation it again saw the light; it was published in 1532 and immediately translated. In the controversy about election, when appealed to by Charles the Bald, Ratramnus wrote two books *De praedestinatione Dei*, in which he maintained the doctrine of a twofold predestination; nor did the fate of Gottschalk deter him from supporting his view against Hincmar as to the orthodoxy of the expression "trina Deitas." Ratramnus perhaps won most glory in his own day by his *Contra Graecorum opposita*, in four books (868), a valued contribution to the controversy between the Eastern and Western Churches which had been raised by the publication of the encyclical letter of Photius in 867. An edition of *De corpore et sanguine Domini* was published at Oxford in 1859.

See the article by G. Steitz and Hauck in Hauck's *Realencyklopädie für protest. Theologie*, Band xvi. (Leipzig, 1905); Naegle, *Ratramnus und die heilige Eucharistie* (Vienna, 1903); Schnitzer, *Berengar von Tours*; and A. Harnack, *History of Dogma*, v., pp. 309–322 (1894–9).

RATTAZZI, URBANO (1808–1873), Italian statesman, was born on the 29th of June 1808 at Alessandria, and from 1838 practised at the bar. In 1848 he was sent to the chamber of deputies in Turin as representative of his native town. By his debating powers he contributed to the defeat of the Balbo ministry, and for a short time held the portfolio of public instruction; afterwards, in the Gioberti cabinet, he became minister of the interior, and on the retirement of the last-named in 1849 he became practically the head of the government. The defeat at Novara compelled the resignation of Rattazzi in March 1849. His election as president of the chamber in 1852 was one of the earliest results of the so-called "connubio" with Cavour, *i. e.* the union of the moderate men of the Right and of the Left; and having become minister of justice in 1853 he carried a number of measures of reform, including that for the suppression of certain of the monastic orders. During a momentary reaction of public opinion he resigned office in 1858, but again entered the cabinet under La Marmora in 1859 as minister of the interior. In consequence of the negotiations for the cession of Nice and Savoy he again retired in January 1860. He was entrusted with the formation of a new ministry in March 1862, but in consequence of his policy of repression towards Garibaldi at Aspromonte he was driven from office in the following December. He was again prime minister in 1867, from April to October. He died at Frosinone on the 5th of June 1873. His wife, whom he married in 1863, was a remarkable woman. She was the daughter of Sir Thomas Wyse, British plenipotentiary at Athens, and Laetitia Bonaparte, niece of Napoleon I. Born in Ireland in 1833, she was educated in Paris, and in 1848 married a rich Alsatian named Solms; but the prince-president refused to recognize her, and in 1852 she was expelled from Paris. Her husband died soon after; and calling herself the Princesse Marie de Solms, she spent her time in various fashionable places and dabbled in literature, Eugène Sue and François Ponsard being prominent in her court of admirers. She published *Les Chants de l'exilée* (1859) and some novels. After Rattazzi's death, she married (1877) a Spaniard named Rute; she died in February 1902.

See Madame Rattazzi, *Rattazzi et son temps* (Paris, 1881); Bolton King, *History of Italian Unity* (London, 1899).

RATTLESNAKE. Rattlesnakes are a small group of the sub-family of pit-vipers (*Crotalinae*, see SNAKES; *Viperidae*), characterised by a tail which terminates in a chain of horny, loosely connected rings, the so-called "rattle." The "pit" by which the family is distinguished from the ordinary vipers is a deep depression in the integument of the sides of the snout, between the nostrils and the eye; its physiological function is unknown. The rattle is a complicated and highly specialized organ, developed from the simple conical scale or epidermal spine, which in the majority of snakes forms the termination of the general integument of the tail. The bone by which the root of the rattle is supported consists of the last caudal vertebrae, from three to eight in number, which are enlarged, dilated, compressed and coalesced (fig. 1, *a*). This bone is covered with thick and vascular cutis, transversely divided by two constrictions into three portions, of which the proximal is larger than the median, and the median much larger than the distal. This cuticular portion constitutes the matrix of a horny epidermoid covering which closely fits the shape of the underlying soft part and is the beginning of the rattle, as it appears in young rattlesnakes before they have shed their skin for the first time. When the period of a renewal of the skin approaches a new covering of the extremity of the tail is formed below the old one, but the latter, instead of being cast off with the remainder of the epidermis, is retained by the posterior swelling of the end of the tail, forming now the first loose joint of the rattle. This process is repeated on succeeding moultings—the new joints being always larger than the old ones as long as the snake grows. Perfect rattles therefore taper towards the point, but generally the oldest (terminal) joints wear away in time and are lost. As rattlesnakes shed their skins more than once every year, the number of joints of the rattle does not indicate the age of the animal but the number of exuviations which it has undergone. The largest rattle in the British Museum has twenty-one joints. The rattle consists thus of a variable number of dry, hard, horny cup-shaped joints, each of which loosely grasps a portion of the preceding, and all of which are capable of being shaken against each other. If the interspaces between the joints are filled with water, as often happens in wet weather, no noise can be produced. The motor power lies in the lateral muscles of the tail, by which a vibratory motion is communicated to the rattle, the noise produced being similar to that of a child's rattle and perceptible at a distance of from 10 to 20 yds.

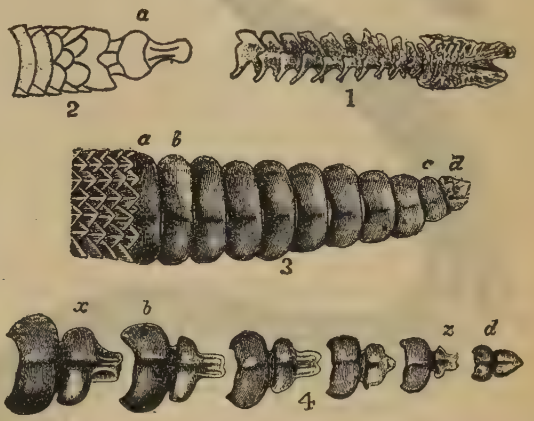


FIG. 1.—Rattle of Rattlesnake (after Czermak).

1. Caudal vertebrae, the last coalesced in a single bone *a*. 2. End of tail (rattle removed); *a*, cuticular matrix covering terminal bone. 3. Side view of a rattle; *c* and *d* the oldest, *a* and *b* the youngest joints. 4. A rattle with joints disconnected; *x* fits into *b* and is covered by it; *z* into *d* in like manner.

The habit of agitating the tail is not peculiar to the rattlesnake, but has been observed in other venomous and innocuous snakes with the ordinary tail, under the influence of fear or anger. It is significant that the tip of such snakes is sometimes rather conspicuously coloured and covered with peculiarly modified scales, notably in *Acanthophis*. The use of such a tail probably consists in attracting or fixing the attention of small animals, by slightly raising and vibrating the tip. The rattle no doubt acts as a warning, every snake preferring being left alone to being forced to bite. Many a man has been warned in time by the shrill sound, and this principle applies undoubtedly to other mammals. Moreover, rattlesnakes are rather sluggish, and comparatively not vicious. First they try to slink away; when overtaken or cornered they use every means of frightening the foe by swelling up, puffing, rattling and threatening attitudes; it is as a rule not until they are touched, or provoked by a rapid movement, that they retaliate, but then they strike with fury. They are viviparous, and as destroyers of rats, mice and other small rodents they are useful. The surest way of clearing a ground of them and any other snakes is to drive in pigs, which are sure to find and to eat them, without harm to themselves. They inhabit localities to which the sun has free access, prairies, rough stony ground, &c. Specimens of 5 ft. in length are not rare. Formerly common in the eastern parts of the United States, and still so in thinly inhabited districts, rattlesnakes, like the vipers of Europe, have gradually succumbed to the persecution of man.

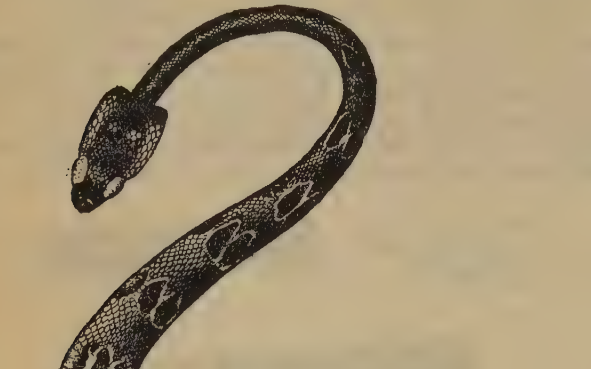


FIG. 2.—Rattlesnake (*Crotalus adamanteus* s. *durissus*).

Rattlesnakes are confined to the New World. North-American authors distinguish a great number of different kinds, S. W. Garman ("Reptiles and Batrachians of North America," *Harvard Mus. Zool. Mem.*, 1883, 4to) enumerating twelve species and thirteen additional varieties. E. D. Cope has split them into twenty; but all these species or varieties fall into two groups. One, *Sistrurus*, has the upper side of the head covered with the ordinary nine shields; only three species, of comparatively small size, in North America (*Sistrurus miliarius* from Florida to Sonora; *S. catenatus* in many of the middle states of the Union, and elsewhere, as far north as Michigan; *S. ravus* in Mexico).

The second group forms the genus *Crotalus*, in which the shields between and behind the eyes are broken up and replaced by small scales. This genus ranges throughout the United States through Central and South America into Patagonia, but is not represented on any of the West Indian islands. *C. horridus*, with the tail uniformly black, from Maine to Kansas and Louisiana to Florida. *C. adamanteus*, tail light, with black crossbands, body with a handsome pattern of rhombs with lighter centres and yellowish edges; chiefly south-eastern states, to Arizona and Mexico; the largest of rattlers, giants of 8 ft. in length having been recorded. *C. confluentus*, tail with brown or indistinct bands; with a continuous series of large brown or reddish rhomboidal spots on the back; Texas to California. *C. cerastes*, with a pair of horns above the eyes; the "sidewinder" of Arizona and California to Nevada. *C. terrificus*, easily distinguished by the possession of three pairs of symmetrical shields on the top of the muzzle, ranging from Arizona into Argentina. It is the only kind of rattlesnake in Central and South America. *C. triseriatus*, a small species, with a feebly developed rattle, on Mexican mountains, on the pic of Orizaba up to 12,500 ft. (ST G. M.; H. F. G.)

RAU, KARL HEINRICH (1792–1870), German political economist, was born at Erlangen on the 29th of November 1792. He studied from 1808 to 1812 at the university there, where he afterwards remained as a *Privatdozent*. In 1814 he obtained the prize offered by the academy of Göttingen for the best treatment of the question how the disadvantages arising from the abolition of trade gilds might be removed. His memoir, greatly enlarged, was published in 1816 under the title *Über das Zunftwesen und die Folgen seiner Aufhebung*. In the same year appeared his *Primae lineae historiae politices*. In 1818 he became professor at Erlangen. In 1822 he was called to the chair of political economy at Heidelberg where the rest of his life was spent, in the main, in teaching and research. He took some part, however, in public affairs: in 1837 he was nominated a member of the first chamber of the duchy of Baden, and in 1851 he was one of the commissioners sent to England on the part of the Zollverein to study the Industrial Exhibition. A result of this mission was his account of the agricultural implements exhibited at London (*Die landwirthschaftlichen Geräthe der Londoner Ausstellung*, 1853). He was elected a corresponding member of the French Institute in 1856. He died at Heidelberg on the 18th of March 1870.

His principal work is the *Lehrbuch der politischen Ökonomie* (1826–37), an encyclopaedia of the economic knowledge of his time, written with a special view to the guidance of practical men. The three volumes are respectively occupied with (1) political economy, properly so called, or the theory of wealth, (2) administrative science (*Volkswirthschaftspolitik*) and (3) finance. The two last he recognizes as admitting of variations in accordance with the special circumstances of different countries, whilst the first is more akin to the exact sciences, and is in many respects capable of being treated, or at least illustrated, mathematically. This threefold division marks his close relation to the older German cameralistic writers, with whose works he was familiarly acquainted. It is a consequence in part of his conformity to their method and his attention to administrative applications that his treatise was found peculiarly adapted for the use of the official class, and long maintained its position as their special text-book. He was the economic teacher, says Roscher, of the well-governed middle states of Germany from 1815 to 1848. The book has passed through many editions; in that of 1870 by Adolf Wagner it was transformed into a new book.

In the earlier part of his scientific life Rau tended strongly towards the relative point of view and an historical method in economics, but he never actually joined the historical school. To the end he occupied a somewhat indeterminate position with respect to that school; on the whole, however, he more and more subordinated historical investigation to immediate practical interests, and in his economic politics moved in the direction of limiting rather than extending the sphere of state action. His general merits are thoroughness of treatment, accuracy of statement, and balance of judgment; he shows much industry in the collection and skill in the utilization of statistical facts; and his exposition is orderly and clear.

Besides the publications already mentioned, he was author of the following:—*Ansichten der Volkswirthschaft*, 1821; *Malthus und Say über die Ursachen der jetzigen Handelsstockung*, 1821; *Grundriss der Kameralwissenschaft oder Wirthschaftslehre*, 1823; *Über die Kameralwissenschaft, Entwickelung ihres Wesens und ihrer Theile*, 1825; *Über die Landwirthschaft der Rheinpfalz*, 1830; and *Geschichte des Pfluges*, 1845.

Rau founded in 1834 the *Archiv der politischen Ökonomie und Polizeiwissenschaft*, in which he wrote a number of articles, afterwards issued in separate form: amongst them may be named those on the debt of Baden, on the accession of Baden to the Zollverein, on the crisis of the Zollverein in the summer of 1852, on the American banks, on the English poor law, on List's national system of political economy and on the minimum size of a peasant property.

RAUCH, CHRISTIAN DANIEL (1777–1857), German sculptor, was born at Arolsen in the principality of Waldeck on the 2nd of January 1777. His parents were poor and unable to place him under efficient masters. His first instructor taught him little else than the art of sculpturing gravestones, and Professor Ruhl of Cassel could not give him much more. A wider field of improvement opened up before him when he removed to Berlin in 1797; but he was obliged to earn a livelihood by becoming a royal lackey, and to practise his art in spare hours. Queen Louisa, surprising him one day in the act of modelling her features in wax, sent him to study at the Academy of Art. Not long afterwards, in 1804, Count Sandrecky gave him the means to complete his education at Rome, where William von Humboldt, Canova and Thorwaldsen befriended him. Among other works, he executed bas-reliefs of "Hippolytus and Phaedra," "Mars and Venus wounded by Diomede," and a "Child praying." In 1811 Rauch was commissioned to execute a monument for Queen Louisa of Prussia. The statue, representing the queen in a sleeping posture, was placed in a mausoleum in the grounds of Charlottenburg, and procured great fame for the artist. The erection of nearly all public statues came to be entrusted to him. There were, among others, Bülow and Scharnhorst at Berlin, Blücher at Breslau, Maximilian at Munich, Francke at Halle, Dürer at Nuremberg, Luther at Wittenberg, and the grand-duke Paul Frederick at Schwerin. At length, in 1830, he began, along with Schinkel the architect, the models for a colossal equestrian monument at Berlin to Frederick the Great. This work was inaugurated with great pomp in May 1851, and is regarded as one of the masterpieces of modern sculpture. Princes decorated Rauch with honours and the academies of Europe enrolled him among their members. A statue of Kant for Königsberg and a statue of Thaer for Berlin occupied his attention during some of his last years; and he had just finished a model of "Moses praying between Aaron and Hur" when he was attacked by his last illness. He died on the 3rd of December 1857.

RAUCOURT, MLLE (1756–1815), French actress, whose real name was Françoise Marie Antoinette Saucerotte, was born in Nancy on the 3rd of March 1756, the daughter of an actor, who took her to Spain, where she played in tragedy at the age of twelve. By 1770 she was back in France at Rouen, and her success as Euphémie in Belloy's *Gaston et Bayard* caused her to be called to the Comédie Française, where in 1772 she made her *début* as Dido. She played all the classical tragedy parts to crowded houses, until the scandals of her private life and her extravagance ended her popularity. In 1776 she suddenly disappeared. Part of the ensuing three years she was in prison for debt, but some of the time she spent in the capitals of northern Europe, followed everywhere by scandal. Under protection of the queen she reappeared at the Théâtre Français in 1779, and renewed her success in *Phèdre*, as Cleopatra, and all her former rôles. At the outbreak of the Revolution she was imprisoned for six months with other royalist members of the Comédie Française, and she did not reappear upon that stage until the close of 1793, and then only for a short time. She deserted, with a dozen of the best actors in the company, to found a rival colony, but a summons from the Directory brought her back in 1797. Napoleon gave her a pension, and in 1806 she was commissioned to organize and direct a company that was to tour Italy, where, especially in Milan, she was enthusiastically received. She returned to Paris a few months before her death on the 15th of January 1815. Her funeral was the occasion of a riot. The clergy of her parish having refused to receive the body, the crowd broke in the church doors, and were only restrained from further violence by the arrival of an almoner sent post-haste by Louis XVIII. She is buried at Père Lachaise.

RAUDNITZ (Czech *Roudnice nad Labem*), a town of Bohemia, Austria, 44 m. N. of Prague by rail. Pop. (1900) 7986, mostly Czech. It is situated on the Elbe, and its chief attraction lies in the interesting and valuable collections in its château, which has belonged to the princely family of Lobkowitz since the beginning of the 17th century. These include a library with a large number of the earliest specimens of printing and valuable MSS., together with a series of pictures from the time of Charles V. to the Thirty Years' War. In 1350 Cola di Rienzi, "the last of the tribunes," was confined by the emperor Charles IV. in the castle, which occupied the site of the present château, previous to his despatch under arrest to the pope at Avignon. In 1184 Raudnitz is mentioned as belonging to the see of Prague. The title of duke of Raudnitz was conferred on the head of the family of Lobkowitz by the emperor Joseph II. in 1786.

RAUMER, FRIEDRICH LUDWIG GEORG VON (1781–1873), German historian, was born at Wörlitz in Anhalt on the 14th of May 1781. His father (d. 1822), as *Kammerdirektor* in Anhalt, did excellent service to agriculture. After studying at the Joachimsthal Gymnasium, Berlin, and at the universities of Halle and Göttingen, Raumer began to practise law, and rose in the civil service under Hardenberg, the chancellor. He was made a professor at the university of Breslau in 1811, and in 1819 he became professor of political science and history at Berlin, holding the chair until 1847, and giving occasional lectures until 1853. In 1815 he had carried on historical investigations in Venice, and in the two following years he had travelled in Germany, Switzerland and Italy. In 1848 he was elected a member of the German parliament at Frankfort, where he associated himself with the right centre, supporting the proposal for a German empire under the supremacy of Prussia; and he was one of the deputation which offered the imperial crown to Frederick William IV. After the breakdown of the German parliament, Raumer returned to Berlin, where he was made a member of the first chamber of the Prussian parliament. He died at Berlin on the 14th of June 1873. Raumer's style is direct, lucid and vigorous, and in his day he was a popular historian, but judged by strictly scientific standards he does not rank among the first men of his time.

His first work, published anonymously in 1806, was entitled *Sechs Dialoge über Krieg und Handel*. This was followed by *Das britische Besteuerungssystem* (1810), *Handbuch merkwürdiger Stellen aus den lateinischen Geschichtschreibern des Mittelalters* (1813), *Herbstreise nach Venedig* (1816) and other books. His most famous works are *Geschichte der Hohenstaufen und ihrer Zeit* (1823–25; 5th ed., 1876) and *Geschichte Europas seit dem Ende des 15ten Jahrhunderts* (1832–50). In 1831 appeared *Briefe aus Paris und Frankreich im Jahre 1830* and *Briefe aus Paris zur Erläuterung der Geschichte des 16ten und 17ten Jahrhunderts*. He went to England in 1835, to Italy in 1839 and to America in 1843, and these visits led to the publication of various works—*England in 1835* (1836), *Beiträge zur neuern Geschichte aus dem Britischen Museum und Reichsarchive* (1836–39), *Italien, Beiträge zur Kenntniss dieses Landes* (1840), *Die Vereinigten Staaten von Nordamerika* (1845). Among his later books may be mentioned *Antiquarische Briefe* (1851), *Historisch-politische Briefe über die geselligen Verhältnisse der Menschen* (1860), *Lebenserinnerungen und Briefwechsel* (1861) and *Handbuch zur Geschichte der Literatur* (1864–66). In 1830 Raumer began the *Historisches Taschenbuch* published by Brockhaus, which from 1871 was continued by Riehl.

RAUPACH, ERNST BENJAMIN SALOMO (1784–1852), German dramatist, was born on the 21st of May 1784 at Straupitz, near Liegnitz in Silesia, a son of the village pastor. He attended the gymnasium at Liegnitz, and studied theology at the university of Halle. In 1804 he obtained a tutorship in St Petersburg. He preached at times in the German Lutheran church, wrote his first tragedies, and in 1817 was appointed professor of German literature and history at a training college in connexion with the university. Owing to an outburst of jealousy against Germans in Russia, culminating in police supervision, Raupach left St Petersburg in 1822 and undertook a journey to Italy. The literary fruits of his travels were *Hirsemenzels Briefe aus und über Italien* (1823). He next visited Weimar, but, being coldly received by Goethe, abandoned his idea of living there and settled in 1824 in Berlin. Here he spent the remainder of his life, writing for the stage, which for twenty years he greatly influenced, if not wholly controlled, in the Prussian capital. He died at Berlin on the 18th of March 1852.

Raupach was a prolific writer of both tragedies and comedies; of the former, *Die Fürsten Chawansky* (1818), *Der Liebe Zauberkreis* (1824), *Die Leibeigenen, oder Isidor und Olga* (1826), *Rafaele* (1828), *Der Nibelungenhort* (1834) and *Die Schule des Lebens* (1841), and of the latter *Die Schleichhändler* (1828) and *Der Zeitgeist* (1830) are pieces which have enjoyed great popularity owing to their skilful dramatic handling. On the other hand, the historical dramas with which his name is chiefly associated, *Die Hohenstaufen* (1837–38), a cyclus of 15 dramatic pieces founded on Friedrich von Raumer's *Geschichte der Hohenstaufen*, as also the trilogy *Cromwell* (1841–44), are superficial in treatment. Raupach had a great knowledge of theatrical effect and situations, but he contorts historical facts in order to suit his political hobby, which was the separation of church and state.

Raupach's collected dramas appeared under the title *Dramatische Werke ernster Gattung* (16 vols., 1830–43) and *Dramatische Werke komischer Gattung* (4 vols., 1829–35). For his life see Pauline Raupach, *Raupach, eine biographische Skizze* (1853); also K. Goedeke, *Grundriss zur Geschichte der deutschen Dichtung*, 2nd ed. (1905), vol. viii., pp. 646–668.

RAVAILLAC, FRANÇOIS (1578–1610), the assassin of Henry IV. of France, was born near Angoulême. He was of humble origin and began life as a *valet de chambre*, but afterwards became a lawyer and also teacher of a school. After having been imprisoned by his creditors, he sought admission to the recently founded order of Feuillants, but after a short probation was dismissed as a visionary. An application for admission to the Society of Jesus was equally unsuccessful in 1606. His disappointments fostered a fanatical temperament, and rumours that the king was intending to make war upon the pope suggested to him the idea of assassination, which he carried out on the 14th of May 1610. In the course of his trial he was frequently put to the torture, but persistently (and it is now believed truly) denied that he had been prompted by any one or had any accomplices. Sentence of death was carried out on the 27th of May following.

See Jules Loiseleur, *Ravaillac et ses complices* (1873), and E. Lavisse, *Histoire de France*, tome vi. (Paris, 1905).

RAVAISSON-MOLLIEN, JEAN GASPARD FÉLIX (1813–1900), French philosopher and archaeologist, was born at Namur on the 23rd of October 1813. After a successful course of study at the Collège Rollin, he proceeded to Munich, where he attended the lectures of Schelling, and took his degree in philosophy in 1836. In the following year he published the first volume of his famous work *Essai sur la métaphysique d'Aristote*, to which in 1846 he added a supplementary volume. This work not only criticizes and comments on the theories of Aristotle and the Peripatetics, but also deduces from them a modern philosophical system. In 1838 he received the degree of doctor, and became professor of philosophy at Rennes. From 1840 he was inspector-general of public libraries, and in 1860 became inspector-general in the department of higher education. He was also a member of the Academy, and of the Academy of Moral and Political Science, and curator of the Department of Antiquities at the Louvre (from 1870). He died in Paris on the 18th of May 1900. In philosophy, he was one of the school of Cousin, with whom, however, he was at issue in many important points. The act of consciousness, according to him, is the basis of all knowledge. These acts of consciousness are manifestations of will, which is the motive and creative power of the intellectual life. The idea of God is a cumulative intuition given by all the various faculties of the mind, in its observation of harmony in nature and in man. This theory had considerable influence on speculative philosophy in France during the later years of the 19th century.

Ravaisson's chief philosophical works are: "Les Fragments philosophiques de Hamilton" (in the *Revue des Deux Mondes*, November, 1840); *Rapport sur le stoicisme* (1851); *La Philosophie en France au dix-neuvième siècle* (1868; 3rd ed., 1889); *Morale et métaphysique* (1893). Eminent as a philosopher, Ravaisson was also an archaeologist, and contributed articles on ancient sculpture to the *Revue Archéologique* and the *Mémoires de l'Académie des Inscriptions*. In 1871 he published a monograph on the Venus of Milo.

See Renouvier, in *L'Année philosophique* (Paris, 1868); Dawriac, "Ravaisson philosophe et critique" (*La Critique philosophique*, 1885, vol. ii.).

RAVANASTRON, an Indian stringed instrument played with a bow, used by wandering pilgrims. A Hindu tradition affirms that the musical bow was invented before 3000 B.C. by Ravanon, king of Ceylon, and that the instrument for which he invented it was named after him Ravanastron.[1] Judging from precedent, it is probable that the ravanastron of the present day has changed little, if at all, for many centuries. It consists of half a round gourd, over which is fixed a sound-board of skin or parchment; to this primitive body without incurvation is attached a neck about twice the length of the body. The strings are either one or four in number, the pegs being set in the sides of the neck. The bridge is primitive and either straight or slightly arched, so that in bowing more than one string sounds at once.

The ravanastron is regarded by some writers as the first ancestor of the violin, on account of the alleged invention of the bow for use with it. This theory can only be accepted by those who consider the bow, which after all was common to such inferior instruments as the rebec, as of paramount importance, and the structural features of the instrument itself, the box sound-chest with ribs, which have always belonged to the most artistic types of instruments, such as the cithara and the guitar-fiddle, as of secondary importance.
(K. S.)

RAVELLO, a village of Campania, Italy, in the province of Salerno, about 3 m. N.N.E. of Amalfi by road, 1227 ft. above sea-level. It commands a magnificent view. Pop. (1901) 1851. The history of Ravello cannot be traced beyond the 9th century. In the 11th it was called Rebellum, because it refused to acknowledge the sovereignty of Amalfi, and in the 13th, when at the height of its prosperity, it had 36,000 inhabitants. The Palazzo Rufolo, begun in the 11th century, has two lofty towers and beautiful Saracenic decoration in the courtyard. The ex-cathedral of S. Pantaleo, almost entirely modernized, has fine bronze doors by Barisanus of Trani (1179), and two pulpits in Cosmatesque work. The larger, supported by six columns resting on the backs of lions, was made in 1272 by Nicolaus of Foggia; the bust over the entrance to it is said to be a portrait of Sigilgaita Rufolo. The smaller, of the same date, is simpler, and has curious representations of Jonah and the whale. The parish church of S. Giovanni in Toro, spoilt by restorations in the 18th century, contains a splendid pulpit in Cosmatesque work, supported on four pillars, and the crypt some 14th-century frescoes. In front of it is the porch of the Palazzo dell' Afflitto, composed of ancient fragments. S. Maria Immacolata is another Romanesque church.

See A. Avena, *Monumenti dell' Arte Meridionale* (Naples, 1902), i. 349 sqq.

RAVEN (O.E. *hræfn*, Icel. *hrafn*, Dan. *ravn*, Du. *raaf*, Ger. *Rabe*), the largest of the birds of the order Passeres, and a member of the family Corvidae, probably the most highly developed of all birds. Quick-sighted, sagacious and bold, the raven preys on the spoils of fishers and hunters, as also on weakly animals among flocks and herds. A sentiment of veneration or superstition has from remote ages and among many races attached to it. The raven is associated with various characters of history, sacred or profane—Noah and Elijah, Odin and Flokki, the last of whom by its means discovered Iceland. It is said to have played its part in the mythology of the Red Indian; and it has often figured in prose and verse, from the time of Shakespeare to that of Poe and Dickens. Superstition has been generally succeeded by persecution, which in many districts has produced extirpation.

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[1] An illustration appears in Sonnerat's *Voyages aux Indes orientales* (Paris, 1806), vol. i. p. 182.

The raven breeds very early in the year, in England resorting to its nest, which is usually an ancient if not an ancestral structure, about the middle or towards the end of January. Therein are laid from five to seven eggs of the common Corvine coloration (see CROW), and the young are hatched before the end of February. In more northern countries the breeding season is naturally delayed, but everywhere this species is almost, if not quite, the earliest breeder. The raven measures about 26 in. in length, and has an expanse of wing considerably exceeding a yard. Its bill and feet are black, and the same may be said of its whole plumage, but the feathers of the upper parts as well as of the breast are glossy, reflecting a bright purple or steel-blue. The species (*Corvus corax*) inhabits the whole of Europe, and the northern if not the central parts of Asia; but in the latter continent its southern range is not well determined. In America it is, or used to be, found from the shores of the Polar Sea to Guatemala if not to Honduras, but is said hardly to be found of late years in the eastern part of the United States. In Africa its place is taken by three allied but well-differentiated species, two of which (*Corvus umbrinus*, readily distinguished by its brown neck, and *C. affinis*, having its superior nasal bristles upturned vertically) also occur in south-western Asia, while the third (*C. leptonyx* or *C. tingitanus*, a smaller species characterized by several slight differences) inhabits Barbary and the Atlantic Islands. Farther to the southward in the Ethiopian region three more species appear whose plumage is varied with white—*C. scapulatus*, *C. albicollis*, and *C. crassirostris*—the first two of small size, but the last rivalling the real raven in that respect. (A. N.)

RAVEN-HILL, LEONARD (1867–), English artist and illustrator, was born on the 10th of March 1867. He was educated at Bristol grammar school and the Devon county school, and studied art at Lambeth and then in Paris under MM. Bougereau and Aimé Morot. He began to exhibit at the Salon in 1887, and in the Royal Academy in 1889. In 1893 he founded, with Arnold Golsworthy, the humorous and artistic monthly *The Butterfly* (1893–94, revived in 1899–1900). He contributed to many illustrated magazines, and began to work for *Punch*, with which he was afterwards prominently associated, in 1896. He illustrated Sir Walter Besant's *East London* (1901) and J. H. Harris's *Cornish Saints and Sinners*; he published the impressions of his visit to India on the occasion of the tour of the prince and princess of Wales as *An Indian Sketch-Book* (1903); and his other published sketch-books include *Our Battalion* (1902) and *The Promenaders* (1894).

RAVENNA, a city and archiepiscopal see of Emilia, Italy, capital of the province of Ravenna, standing in a marshy plain 13 ft. above sea-level, 6 m. from the sea and 45 m. by rail east of Bologna. Pop. (1906) 35,543 (town), 67,379 (commune)—a considerable increase, as the population of 1881 was only 34,270 (commune). The industries are few, the growing of wine, breeding of silkworms, making of agricultural instruments, printing and the manufacture of laces being the chief. The town is connected with the sea by the Corsini Canal, the two small rivers Ronco and Montone no longer serving as means of communication. Ravenna has railway communication with Bologna (via Castel Bolognese), Ferrara and Rimini, and by steam tram with Forli. At the mouth of the canal is a small harbour.

No other city in the world offers so many and such striking examples of the ecclesiastical architecture of the centuries from the 5th to the 8th. The style is commonly called Byzantine; but some of the most striking features of the churches of Ravenna—the colonnades, the mosaics, perhaps the cupolas—are not so much Byzantine as representative of early Christian art generally. The following are the most important churches of Ravenna, arranged in the order of the dates generally attributed to them:—

Church.	Builder.	Date.
1. Metropolitan Church, or Ecclesia Ursiana, and baptistery adjoining	S. Ursus	370–390(?)
2. S. Giovanni Evangelista	Galla Placidia	425
3. S. Agata	Gemellus	about 430
4. S. Pier Crysologo (chapel)	S. Peter Chrysologus	about 450
5. S. Giovanni Battista	Baduarius	"
6. SS. Nazario e Celso	Galla Placidia	"
7. S. Pier Maggiore (now S. Francesco)	Bishop Neon (?)	about 458
8. S. Teodoro (now Santo Spirito)—A.	Theodoric (?)	493–526
9. S. Maria in Cosmodin (Arian baptistery)—A.	"	"
10. S. Martino in Coelo Aureo (now S. Apollinare Nuovo)—A.	"	"
11. S. Vitale	Julianus Argentarius	about 530
12. S. Maria Maggiore	Bishop Ecclesius	"
13. S. Apollinare in Classe	Julianus Argentarius	about 535

(The churches marked A. were originally erected for the Arian worship.)

Almost the only sacred building previous to the 5th century of which we have any record is unfortunately lost. The cathedral of Ravenna, built by S. Ursus in 370–390, which had a nave and four aisles, was destroyed in 1734–44, only the (inaccessible) crypt and the round campanile remaining from the earlier structure; there are fragments of reliefs from a pulpit erected by Archbishop Agnellus (556–569) in the interior. A rare work on the earlier church (Buonamici, *La Metropolitana di Ravenna*) gives details of its construction. The present cathedral contains several early Christian marble sarcophagi, a silver cross of the 6th century (that of Agnellus), and the so-called throne of the Archbishop Maximian (546–552), adorned with reliefs in ivory, which, however, was really brought to Ravenna in 1001 by John the Deacon, who recorded the fact in his Venetian chronicle, as a present from the Doge Pietro Orseolo to the Emperor Otho III.

The period from the transference of the imperial residence to Ravenna to the death of Valentinian III. (404–455) was the first period of great building activity in Ravenna, when the archiepiscopal see of Ravenna attained great importance. It was to it that we owe the erection of the Basilica Petriana at Classe (396–425), which has entirely disappeared, of the churches of S. Giovanni Evangelista (425), of S. Agata (425–432), of the chapel of S. Pier Crisologo (433–449), of the tomb of Galla Placidia (440), the church of S. Pier Maggiore (now S. Francesco) (433–458), the baptistery of Neon (449–458), S. Giovanni Battista and S. Croce.

Rivoira, in the book cited below, shows that many of the characteristic architectural details can be traced back to a classical and in particular a Roman origin, and were not derived from the East, *e.g.* the use of blind arches as an external decoration, and of brick cornices with the points of the bricks projecting like the teeth of a saw, the use of pulvini (cushions) above the capitals of columns and under the spring of an arch, &c. &c., the use of round arches springing direct from these cushions, spherical pendentives, &c.

Of this group of churches, S. Giovanni Evangelista, erected by Galla Placidia in fulfilment of a vow made on her voyage from Constantinople, has been entirely rebuilt, though the columns are ancient (the Corinthian capitals are probably from a classical building), and the crypt may be original. The Gothic portal is fine, and the church contains a mosaic pavement of 1213 with curious representations and some frescoes by Giotto, painted during a visit to Dante between 1317 and 1320. S. Agata was almost entirely rebuilt in 1476–94. The chapel of S. Pier Crisologo in the archiepiscopal palace preserves its original mosaics, and so also does the tomb of Galla Placidia (SS. Nazario e Celso), a small structure in the form of a Latin cross with a dome (in which, as in the baptistery of Neon, the old cathedral, &c., the constructional use of amphorae is noteworthy), with a plain brick exterior, and rich mosaics on a dark blue ground within. The sarcophagus of Galla Placidia has, like the two others that stand here, been despoiled of its contents. The altar, like that at S. Vitale, is made of thin slabs of alabaster, behind which lamps were intended to be placed.

S. Francesco, as it has been called since 1261, when it came into the possession of the Franciscans, has been almost entirely modernized, except for the crypt and campanile (11th century). The baptistery adjacent to the cathedral was, according to Ricci, originally part of the Roman baths, converted to a Christian baptistery by the Archbishop Neon (449–452), though according to other authorities it is a Christian building dating from before A.D. 396. It is an octagon, with a dome; in the interior are two arcades one above the other. The mosaics of the 5th century, in the dome, are the earliest and perhaps the finest at Ravenna for their splendid decorative effect and rich colouring, and are less stiff and conventional than the later mosaics.

Of S. Giovanni Battista, also erected in this period, hardly anything remains after the restoration of 1683, and S. Croce has been overtaken by a similar fate.

After the death of Valentinian III. the activity in building for which Ravenna had been so remarkable suffered a check; but the reign of Theodoric (493–526) marks another era of magnificence. In the eastern part of the city he built for himself a large palace, which probably occupied about a sixth of the space now enclosed within the city walls, or nearly the whole of the rectangle enclosed by Strada di Porta Alberoni on the south, Strada Nuova di Porta Serrata on the west and the line of the city walls on the north and east. There still remains close to the first-named street and fronting the Corso Garibaldi a high wall built of square Roman bricks, with pillars and arched recesses in the upper portion, which goes by the name of Palazzo di Teodorico. Freeman, on account of the Romanesque character of the architecture, thought it probable that it really belongs to the time of the Lombard kings, and his opinion is shared by Ricci and Rivoira, who consider it to be a guardhouse erected by the exarchs, recent explorations having made it clear that it was an addition to the palace, while mosaic pavements and an atrium once surrounded by arcades really belonging to the latter were found in 1870 behind S. Apollinare Nuovo and in 1908 behind the so-called Palazzo at a lower level and a different orientation. A mosaic in the church of S. Apollinare Nuovo gives some faint idea of the palace. A more memorable and clearly authentic monument of Theodoric is furnished by his tomb, a massive mausoleum which stands still perfect outside the walls near the north-east corner of the city. It is circular internally and decagonal externally, in two storeys, built of marble blocks, and surmounted by an enormous monolith, brought from the quarries of Istria and weighing more than 300 tons. The plan is no doubt derived from that of a Roman tomb. In this mausoleum Theodoric was buried, but his body was cast forth from it, perhaps during the troublous times of the siege of Ravenna by the imperial troops, and the Rotunda (as it is now generally called) was converted into a church dedicated to the Virgin.

S. Apollinare Nuovo, the most important basilica in the town, was built by Theodoric to be the largest of Arian churches, and originally called S. Martino in Coelo Aureo (a name which it lost in the 9th century). The exterior is uninteresting, and the church lost both atrium and apse in the 16th century. The interior has twenty-four columns of marble (from Constantinople according to some, from Rome according to others), with almost uniform capitals. The walls of the nave are adorned with mosaics of the 6th century; the scenes from the New Testament above the windows date from the time of Theodoric, while the somewhat stiff processions below, of virgins on one side and of saints on the other, are substitutions of the latter half of the 6th century for representations which probably contained some allusion to Arianism or episodes in the life of Theodoric (so Ricci). The mosaics have been in parts much restored; but the earlier ones still show, like those which preceded them in Ravenna, classical forms, variety of treatment and freedom of colouring, while the processions are monotonous and inferior in execution, intended rather to produce a decorative effect than beauty of form. The pulpit appears to be of Byzantine origin (Rivoira). The campanile (850–878) is circular, and has perhaps the earliest example of the use of disks of coloured majolica as a decoration. This, like the other campanili of Ravenna, is later than the church to which it belongs. Those of the cathedral of S. Apollinare in Classe, S. Maria Maggiore and S. Agata, also circular, probably belong also to the 9th century, while the two square campanili of S. Giovanni Evangelista and S. Francesco probably belong to the early 11th century. The other churches erected by Theodoric are: S. Teodoro (or S. Spirito), erected by Theodoric for the Arian bishops, but entirely modified: the baptistery of this church (afterwards the oratory of S. Maria in Cosmedin) formed out of the octagonal hall of a Roman bath (?)—unless it is an originally Christian building—with mosaics of the 6th century imitating those of the baptistery of Neon, and freely restored; S. Maria Maggiore, founded by the Archbishop Ecclesius (521–534), but almost entirely rebuilt; and S. Vittore, which has suffered a similar fate. To the same period probably belong a few columns of the so-called Basilica of Heracles in the Piazza Vittorio Emanuele, with capitals like those of S. Apollinare in Classe.

The impulse given by Theodoric was continued by his successors, and during the regency of Amalasuntha and the reigns of Theodatus and Vitiges (526–539), S. Vitale and S. Apollinare in Classe were constructed by Julius Argentarius contemporaneously with S. Lorenzo in Milan and the cathedral of Parenzo—also S. Michele in Africisco, nothing of the original structure of which now exists. The former, well restored by Ricci in 1898–1900 (except for the dome with its baroque frescoes which has not been altered), is a regular octagon, with a vestibule, originally flanked by two towers on the west, a choir added on the east, triangular outside and circular within; it is surrounded within by two galleries interrupted at the presbytery, and supported by eight large pillars, the intervals between which are occupied by open exedrae. The mosaics of the choir (547) are due to Justinian, and, though inferior in style, are remarkable for their splendour of colouring and the gorgeous dresses of the persons represented, and also for their historical interest, especially the scenes representing the emperor and the empress Theodora presenting offerings. The marble screens of the altar are wonderfully finely carved. The marble mosaic pavement (11th century) is very effective. Remains of the original marble wall lining and stucco decoration also exist. The capitals are, in the lower order, the characteristic funnel-shaped rectangular Byzantine capitals, some of them with open work, bearing cushions; this is a type probably derived from the cushion itself, and developed in the East about the second half of the 5th century.

The architecture of S. Vitale (for plan see ARCHITECTURE, sect. *Early Christian*), according to Rivoira, was inspired not by Byzantium, where similar churches—S. Sofia and SS. Sergio and Bacco—are slightly later in date, but by the churches of Salonica (A.D. 495), while the plan is derived from a Christian baptistery, or from such a building as the so-called temple of Minerva Medica at Rome.

S. Apollinare in Classe, erected at the same time outside the walls of Classis, and now standing by itself in the lonely marshes, is the largest basilica existing at Ravenna. It has a nave and aisles with a closed vestibule on the west, and a fine round campanile of the 9th (?) century. The exterior brick walls are divided by shallow arches and pilasters, as in other churches of Ravenna. It has twenty-four columns of Carystian (cipollino) marble, with capitals probably of Byzantine work with swelling acanthus leaves; but the rest of the church is due to native architects. The lofty presbytery and the crypt under it belong to the 12th century. The walls of the interior were stripped of their marble panelling by Sigismondo Malatesta in 1449, for the adornment of his church at Rimini. The apse has mosaics of the 6th and 7th centuries. The 18th-century series of portraits of the archbishops of Ravenna is no doubt copied from an earlier original. There are a number of fine carved sarcophagi in the church (5th to 8th century). The building activity of the Gothic kings was continued by Justinian, to whose time we owe the completion of S. Vitale and S. Apollinare in Classe, and some of the mosaics in S. Appollinare Nuovo.

The buildings of a subsequent period are of minor importance, but the basilica of S. Maria in Porto near the ancient harbour (1096 sqq.), a basilica with open roof, with frescoes by masters of the Rimini school, may be noticed. The massive concrete substructures of the campanile are attributed to an old lighthouse. The tomb of Dante, who died at Ravenna in 1321, is close to S. Francesco; it is a square-domed structure, with a relief by Pietro Lombardo (1482) representing the poet, and a sarcophagus below, in an urn within which lie the poet's remains. Close by is a small court with early Christian sarcophagi, containing the remains of the Braccioforte family. The secularized monastery of Classe, in the town, built by the monks of S. Apollinare in Classe in 155 sqq. as a refuge from the malaria, which prevailed at Classe itself, with fine 17th-century cloisters, contains the important museum, which has Roman and Byzantine antiquities, inscriptions, sculptures, jewelry, &c.—including the possible remains of a suit of gold armour of Theodoric—and a collection of Italian woodcuts; also the library with rare MSS. and incunabula (among the former the best extant MS. of Aristophanes). The Accademia, close by, has a few pictures by local masters, *e.g.* N. Rondinelli (end of 15th century), of no great importance, and a fine recumbent statue of Guidarello Guidarelli, a condottiero of Ravenna, and a partisan of Caesar Borgia (d. 1501), by Tullio Lombardo (?) or Severo da Ravenna (?).

In the Piazza Vittorio Emanuele are two granite columns erected by the Venetians, in 1483, with statues of SS. Apollinaris and Vitalis. The cloisters of S. Maria di Porto erected in the town in the 16th century (owing to malaria, as in the case of those of Classe), and of S. Vitale, are pleasing 16th-century structures. The 15th-century castle in the north-east corner of the town erected by the Venetians is a picturesque brick building. The famous *pineto* or pinewood of Ravenna, which already existed in Odoacer's time, and has been sung by poets since Dante, lies some 5 m. south of Ravenna.

History.—Strabo mentions a tradition that Ravenna was founded by Thessalians, who afterwards, finding themselves pressed by the Etrurians, called in their Umbrian neighbours and eventually departed, leaving the city to their allies. Pliny, on the other hand, calls it Sabine. Throughout the valley of the Po the Gauls took the place of the Etrurians as a conquering power; but Ravenna may possibly have retained its Umbrian character until, about the year 191 B.C., by the conquest of the Boii, the whole of this region passed definitely under the dominion of Rome. Either as a colonia or a municipium, Ravenna remained for more than two centuries an inconsiderable city of Gallia Cisalpina, chiefly noticeable as the place in which Caesar during his ten years' command in Gaul frequently resorted in order to confer with his friends from Rome, and from which he started for his advance into Italy. At length under Augustus it suddenly rose into importance, when that emperor selected it as the station for his fleet on "the upper sea." Two hundred and fifty ships, said Dion (in a lost passage quoted by Jordanes), could ride at anchor in its harbour. At the same time Augustus conducted a branch of the Po (the fossa Augusta) through the city into the sea. It also became important for the export of timber from the Alps. Strabo, writing probably a few years after Ravenna had been thus selected as a naval arsenal, gives us a description of its appearance which certainly corresponds more closely with modern Venice than with modern Ravenna. "It is the largest of all the cities built in the lagoons, but entirely composed of wooden houses, penetrated in all directions by canals, wherefore bridges and boats are needed for the wayfarer. At the flow of the tide a large part of the sea comes sweeping into it; and thus, while all the muddy deposit of the rivers is swept away, the malaria is at the same time removed, and by this means the city enjoys so good a sanitary reputation that the government has fixed on it as a place for the reception and training of gladiators." On the other hand, good water was proverbially difficult to obtain at Ravenna—dearer than wine, says Martial, who has two epigrams on the subject. Trajan, however, built an aqueduct nearly 20 miles long, which was restored by Theodoric in 503. Of this some traces still exist in the bed of the Ronco above Ravenna. Flies and frogs were also complained of, and Sidonius, writing in the 5th century, complains bitterly of the "feculent gruel" (*cloacalis puls*) which filled the canals of the city, and gave forth fetid odours when stirred by the poles of the bargemen. The port of Ravenna, situated about 3 miles from the city, was named Classis. A long line of houses called Caesarea connected it with Ravenna, and in process of time there was such a continuous series of buildings that the three towns seemed like one. It was a municipium under the Empire, as the inscriptions show, but it seems to have had magistrates rather suited to a *vicus* or village, its importance being due entirely to the naval station (cf. the state of things at *Mediolanum*, Milan). It had large gilds of *fabri* (smiths and carpenters) and *centonarii* (firemen).

Of Roman Ravenna nothing remains above ground, though a little has been found by excavation, including a mosaic pavement at Classe near S. Severo (Ricci, *op. cit.* p. 50). Among the tombs many of the poorer under the Empire were simply formed of amphorae, in which the body was placed. A prehistoric station was found in 1894 at S. Zaccaria near Ravenna, belonging to a Terramare (E. Brizio in *Notizie degli Scavi*, 1896, 85). In A.D. 339 it is spoken of as having previously been the chief town of Picenum, but having recently been assigned to Aemilia. It was connected with Ariminum, 33 miles to the south by the coast road, the Via Popillia, which ran on north to Hatria, and joined the road between Patavium and Altinum at Ad Portum.

The great historical importance of Ravenna begins early in the 5th century, when Honorius, alarmed by the progress of Alaric in the north of Italy, transferred his court hither. From this date (404) to the fall of the Western Empire in 476 Ravenna was the chief residence of the Roman emperors. Here Stilicho was slain; here Honorius and his sister Placidia caressed and quarrelled; here Valentinian III. spent the greater part of his life; here Majorian was proclaimed; here the little Romulus donned his purple robe; here in the pinewood[1] outside the city his uncle Paulus received his decisive defeat from Odoacer. Through all these changes Ravenna maintained its character as an impregnable "city in the sea," not easily to be attacked even by a naval power on account of the shallowness and devious nature of the channels by which it had to be approached. Odoacer, like the emperors who had gone before him, made Ravenna his chief place of residence, and here he shut himself up when Theodoric the Ostrogoth had invaded Italy and defeated him in two battles. Theodoric's siege of Ravenna lasted for three years (489–492), and was marked by one bloody encounter in the pinewood on the east of it. The Ostrogoth collected a fleet and established a severe blockade, which at length caused Odoacer to surrender the city. The terms, arranged through the intervention of John, archbishop of Ravenna, were not observed by

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[1] The great pinewood to the east of the city, which is still one of the great glories of Ravenna, must therefore have been in existence already in the 5th century. Byron's description,

"[The] immemorial wood
Rooted where once the Adrian wave flowed o'er,"

is probably true; but there is no evidence that it was in historic time that this change took place. It may be conjectured that the *Pineta* grew on a large peninsula somewhat resembling the Lido of Venice.

Theodoric, who, ten days after his entry into the city, slew his rival at a banquet in the palace of the Laurel Grove (March 15, 493). Ravenna was Theodoric's chief place of residence, and his reign (493–526) may be considered the time of its greatest splendour.

Nine years after the death of Theodoric Justinian sent an army to destroy the Gothic monarchy and restore Italy to the empire. Long after the Goths had lost Rome they still clung to Ravenna, till at length, weary of the feebleness of their own king, Vitiges, and struck with admiration of their heroic conqueror, they offered to transfer their allegiance to Belisarius on condition of his assuming the diadem of the Western Empire. Belisarius dallied with the proposal until he had obtained an entrance within the walls of the capital, and proclaimed his inviolable fidelity to Justinian. Thus in the year 539 was Ravenna re-united to the Roman empire. Its connexion with that empire—or, in other words, its dependence upon Constantinople—lasted for more than 200 years, during which period, under the rule of Narses and his successors the exarchs, Ravenna was the seat of Byzantine dominion in Italy. In 728 the Lombard king Luitprand took and destroyed the suburb Classis; about 752 the city itself fell into the hands of his successor Aistulf, from whom a few years after it was wrested by Pippin, king of the Franks. By this time the alteration of the coast-line and the filling up of the lagoons had probably commenced, and no historical importance attaches to its subsequent fortunes. It formed part of the Frankish king's donation to the pope in the middle of the 8th century, though the archbishops, as a fact, retained almost independent power. It was an independent republic, generally taking the Guelph side in the 13th century, subject to rulers of the house of Polentani in the 14th, Venetian in the 15th (1441), and papal again in the 16th,—Pope Julius II. having succeeded in wresting it from the hands of the Venetians. St Romuald and St Peter Damian were both natives of Ravenna. From this time (1509) down to our own days, except for the interruptions caused by the wars of the French Revolution, Ravenna continued subject to the papal see and was governed by a cardinal legate. In 1849 Garibaldi's wife Anita, who had accompanied him on his retreat from Rome, succumbed to fatigue in the marshes near Ravenna. In 1859 it was one of the first cities to give its vote in favour of Italian unity, and it has since then formed a part of the kingdom of Italy.

Charles the Great carried off the brazen statue of Theodoric and the marble columns of his palace to his own palace at Aix-la-Chapelle. More than five centuries later (1320) Dante became the guest of Guido Novello di Polenta, lord of Ravenna, and here he died on the 14th September of the following year. The marble urn containing the body of the poet still rests at Ravenna, where what Byron calls "a little cupola more neat than solemn" has been erected over it. In 1512 (see below) the French army under Gaston de Foix fought a fierce battle with the Spanish, Venetian, and papal troops on the banks of the Ronco about two miles from Ravenna. The French were victorious, but Gaston fell in the act of pursuing the enemy. His death is commemorated by the Colonna dei Francesi erected on the spot where he fell. Lord Byron resided at Ravenna for eighteen months in 1820–21, attracted by the charms of the Countess Guiccioli.

Authorities.—The most important authority for the history of Ravenna is Bishop Agnellus, who wrote, about 840, the *Liber Pontificalis Ecclesiae Ravennatis*. The best edition is that by Holder-Egger in the *Monumenta Germaniae Historica* (1878). See also E. Bormann, in *Corpus Inscript. Latin.* xi. (Berlin, 1888), p. 1 sqq.; G. T. Rivoira, *Origini dell' Architettura Lombarda*, I. (Rome, 1901); C. Ricci, *Ravenna* (Bergamo, 1902). To the careful restorations of the last named the buildings of Ravenna owe much. (T. H.; T. As.)

Battle of 1512.—This battle, one of the principal events of the long Italian wars of Charles VIII., Louis XII., and Francis I. of France, is, like Marignano, interesting in a tactical sense, from the fact that the feudalism of the past and the expert soldiership of the future were strangely mingled. It arose out of the attempt of the Spanish and Italian forces to relieve Ravenna, besieged by Gaston de Foix, duke of Nemours. The most celebrated captains of these wars were present on either side—under Gaston de Foix were Bayard, Yves d'Allègre, La Palisse; and under Cardona the Spanish viceroy of Naples, Pedro Navarro the great engineer, and Pescara the originator of the Spanish tactical system. After some preliminary manœuvres the two armies drew up face to face on the left bank of the Roneo, the Spanish left and the French right resting on this river. The Spaniards were entrenched, with their heavy artillery distributed along the front, but, thanks to Navarro, they had a more mobile artillery in the shape of 200 *arquebuses à croc* mounted in groups upon carts, after the German fashion, and this was held ready to move wherever its services might be needed. The left wing was composed of the papal contingent, 6000 infantry and 800 gendarmes under Fabrizio Colonna; the centre, of half the Spanish contingent, 4000 infantry and 600 lancers under the viceroy; the right, of 1000 light horse under Pescara. Behind the centre was the rest of the Spanish contingent, 600 lancers and 4000 infantry. On the other side the right wing was commanded by the duke of Ferrara, who had like Navarro organized a mobile field artillery (the artillery material of this prince was thought to be the best conditioned in Europe). It consisted besides of 800 French gendarmes under Louis de Brézé and 5000 German landsknechts under Jakob Empser. In the centre were 8000 French infantry (the ancestors of the later Picardie and Piedmont regiments) under the seigneur de Molart, and 5000 Italian infantry. On the left were the light horse. A reserve of 600 gendarmes under La Palisse was behind the centre. The battle opened with a prolonged cannonade from the Spanish lines. For three hours the professional regiments of all sorts in the French lines rivalled one another in enduring the fire unmoved, the forerunners of the military systems of to-day, landsknechts, Picardie and Piedmont, showing the feudal gendarmerie that they too were men of honour. There was no lying down. The captains placed themselves in the front, and in the centre 38 out of 40 of them were struck down. Molart and Empser, drinking each other's health in the midst of the cannonade, were killed by the same shot. Sheltered behind the entrenchments, the Spaniards scarcely suffered, for they were lithe active troops accustomed to lie down and spring up from the ground. But after three hours, Pescara's light horse having meantime been driven in by the superior light horse of the enemy, the artillery-loving duke of Ferrara conceived the brilliant plan of taking his mobile field-guns to the extreme right of the enemy. This he did, and so came in sight of the prone masses of the Spaniards. Disciplined troops as they were, they resisted the temptation to escape Ferrara's fire by breaking out to the front; but the whole Spanish line was *enfiladed*, and on the left of it the papal troops, who were by no means of the same quality, filled up the ditch in front of their breastworks and charged forward, followed by all the gendarmerie. Once in the plain they were charged by the French gendarmes under Gaston himself, as well as by the landsknechts, and driven back. The advantage of position being thus lost, the Spanish infantry rose and flung itself on the attackers; the landsknechts and the French bands were disordered by the fury of the counterstroke, being unaccustomed to deal with the swift, leaping, and crouching attack of swordsmen with bucklers. But La Palisse's reserve wheeled in upon the rear of the Spaniards, and they retreated to the entrenchments as fast as they had advanced. The papal infantry, the gendarmes, and the light horse had already vanished from the field in disorder; but the Spanish regulars were of different mettle, and it was only after a long struggle that the landsknechts and the French bands broke into the entrenchments. A captain of landsknechts, Fabian by name, holding his long pike crosswise, brought it down with all his force upon the opposing spears, and at the cost of his life made a narrow gap through which the French broke into the mass of the enemy. Still the conflict continued, but at last La Palisse, with all the gendarmerie still in hand, rode completely round the entrenchments and charged the Spaniards' rear again. This was the end, but the remnant of the Spanish infantry retreated in order along the river causeway, keeping the pursuers at bay with their arquebuses. Gaston de Foix, recklessly charging into the midst of them, was killed. (C. F. A.)

RAVENNA, EXARCHATE OF, the official name of that part of Italy which remained in the allegiance of the Roman emperors at Constantinople from the closing years of the 6th to the middle of the 8th century. The civil and military head of these possessions, the exarch (*q.v.*), was stationed at Ravenna. The territory round the town, from the southern border of the modern Venetia to the beginning of the Pentapolis at Rimini, was under his direct administration and formed in a limited sense the exarchate. The other provinces were governed by dukes and *magistri militum*, titles which were generally, but not always, borne by the same person. But as all were subject to his authority, they were included in the exarchate of Ravenna, which was therefore another name for the province of Italy. The borders of these dominions varied according to the fortunes of the imperial authority in its long struggle with the Lombards. Sicily formed a separate government. Corsica and Sardinia belonged to the exarchate of Africa. The reorganization of the province of Italy into the exarchate was forced on the emperors by the Lombard invasion, which began in 568, and their permanent settlement. The Lombards thrust a wedge into Italy. Its base was in Venetia, and its point was advanced to the Tiber. From the early days of the conquest they spread to the south, and established the duchies of Spoletum and Beneventum in the modern kingdom of Naples. They may thus be said to have hollowed out the imperial, or Byzantine, possessions in Italy, the interior being under their power, and the coast remaining to the imperial officers. This illustration, however, is subject to two serious exceptions. As the Lombards spread they came into possession of many parts of the coast. Then a belt of imperial territory stretching from Rimini on the Adriatic, S.W. to the mouth of the Tiber, and including the duchies of Perugia and Rome, served to unite the immediate territory of Ravenna with the duchy of Naples, and to separate the two bodies under Lombard dominion, the kingdom in the north, and the southern duchies Spoletum and Beneventum. The organization of the exarchate is placed by modern investigators under the reign of the emperor Maurice (582–602), when the imperial government began to recognize the necessity of providing for a new and a long struggle. At the end of the 6th century the exarchate included Istria; the maritime part of Venetia as distinct from the interior which was in the hands of the Lombard kings at Pavia; the exarchate proper, or territory around Ravenna on the eastern side of the Apennines, to which was added Calabria, which at that period meant the heel and not the toe of the boot; the Pentapolis, or coast from Rimini to Ancona with the interior as far as the mountains; the duchy of Rome, or belt of territory connecting the Pentapolis with the western coast, the coast of Naples, with Bruttium the toe of the boot, the modern Calabria, and Liguria, or the Riviera of Genoa. The Piedmont, Lombardy, mainland of Venetia, Tuscany and the interior of Naples belonged to the Lombards. The advance of these barbarians was for a time checked during the anarchy which followed the death of Alboin, and was subject to other suspensions. The superior organization of the imperial government enabled it to regain lost territory and delay complete ruin. In 590 the empire regained much of Venetia. But these revivals were not permanent. The superiority of the empire was a mechanical one, and during the two centuries or so that the exarchate lasted it lost ground. In 640 the Ligurian seacoast fell under the power of the Lombards, and ceased to be an imperial province. About a century later the exarchate had been greatly reduced, though the imperial officials endeavoured to conceal the fact by retaining and transferring names when the reality of possession was lost. About 740 it consisted of Istria, Venetia (the maritime portion of which was ceasing to be a province and was becoming a protected state, the forerunner of the future republic of Venice), Ferrara, Ravenna (the exarchate in the limited sense), Pentapolis, Perusia, Rome, the coast of Naples and Calabria (in the sense of the toe and not the heel of the boot) which was being overrun by the Lombards of the duchy of Beneventum, which with Spoletum held the interior. In Rome the pope was the real master. These fragments of the "province of Italy," as it was when reconquered by Justinian, were almost all lost either to the Lombards, who finally conquered Ravenna itself about 750, or by the revolt of the pope, who separated from the empire on account of the iconoclastic reforms. The intervention of Pippin the Carolingian, who was called in by the popes to protect them against the Lombards and the Eastern emperors alike, made a revival of the exarchate impossible. It disappeared, and the small remnants of the imperial possessions on the mainland, Naples and Calabria, passed under the authority of the "patricius" of Sicily, and when Sicily was conquered by the Arabs in the 10th century were erected into the themes of Calabria and Langobardia. Istria was attached to Dalmatia.

In its internal history the exarchate was subject to the influences which were everywhere, in central and western Europe at least, leading to the subdivision of sovereignty and the establishment of feudalism. Step by step, and in spite of the efforts of the emperors at Constantinople, the great imperial officials became landowners, the owners of land —kinsmen or at least associates of these officials—intruded on the imperial administration, while the necessity for providing for the defence of the imperial territories against the Lombards led to the formation of local militias, who at first were attached to the imperial regiments, but gradually became independent. These armed men formed the *exercitus romanae militiae*, who were the forerunners of the free armed burghers of the Italian cities of the middle ages. The *exercitus* of Rome was divided into *scholae*, and had a chief or *patronus*, and its banner. Other cities of the exarchate were organized on the same model. Diehl is of opinion that the *exercitus* was formed of the ancient "possessores," or landowners and free townsmen, who were of a less rank than the *ordo senatorius*. The great landowners who were developing into feudal lords, and the smaller freemen who were becoming independent burghers, broke the imperial administration to pieces, and prepared the way for the final ruin of the exarchate.

See *Études sur l'administration Byzantine dans l'exarchat de Ravenne* (568–751), by Charles Diehl (Paris, 1888).

RAVENSBURG, a town of Germany, in the kingdom of Württemberg, pleasantly situated amid vine-clad hills on the river Schussen, 12 m. N. of Friedrichshafen on the lake of Constance, by the railway of Ulm. Pop. (1905) 14,614, the great majority of whom are Roman Catholics. Its aspect is medieval; it still retains its walls and nine picturesque towers, the most prominent of which, dating from the 15th century, is known as the "Mehlsack," or sack of flour. The town hall is a handsome 15th-century building. The manufactures include linen, cotton, embroidered muslins, pottery, glass and playing-cards. The fruit market is important, and there is trade in cattle, grain and timber. Ravensburg was founded in the 11th century by the Guelphs, and in their ancestral castle on the Veitsburg, which was partially restored in 1892, the Saxon duke, Henry the Lion, was born. In 1180 the town passed to the Hohenstaufens, and a century later it became a free town of the Empire. In the 15th century it was a flourishing commercial place, its chief industry being the manufacture of paper. Annexed to Bavaria from 1803 to 1810, it was ceded to Württemberg in the latter year.

See Hafner, *Geschichte von Ravensburg* (Ravensburg, 1887).

RAVENSCROFT, EDWARD (fl. 1671–1697), English dramatist, belonged to an ancient Flintshire family. He was entered at the Middle Temple, but devoted his attention mainly to literature. Among his pieces are *Mamamouchi, or The Citizen turned Gentleman* (Dorset Garden, 1671, pr. 1675); *The Careless Lovers* (Dorset Garden, 1673, pr. 1673), a comedy of intrigue; *Scaramouch a Philosopher, Harlequin a Schoolboy, Bravo a Merchant and Magician* (Theatre Royal, 1677); *English Lawyer* (Theatre Royal, 1678), an adaptation of George Ruggle's Latin play of *Ignoramus*, presented before James I. at Cambridge in March 1615; *The London Cuckold* (Dorset Garden, 1683), which became a stock piece, but was struck out of the repertory by Garrick in 1751; and *The Italian Husband* (Lincoln's Inn Fields, 1697). He wrote in all twelve plays, in which he adapted freely from Molière and others, confessing on one occasion that he "but winnowed Shakespeare's corn." He ventured to decry the heroic drama, and Dryden retaliated by satirizing his *Mamamouchi*, a foolish adaptation from Molière's *Bourgeois Gentilhomme* and *Monsieur de Pourceaugnac*, in the prologue to the *Assignation* (Dryden, *Works*, ed. Scott, iv. 345 seq.).

RAVI, a river of India, one of the "Five Rivers" of the Punjab. It rises in the Kulu subdivision of Kangra district, flows through Chamba state, and enters British territory again in Gurdaspur district. At Madhupur the head works of the Bari Doab canal draw off a large portion of its waters. Thence it flows through the plains of the Punjab, passing within a mile of Lahore, and finally falls into the Chenab after a course of about 450 m.

RAVINE, a deep, narrow gorge, cleft or valley in a mountain, worn by the violent rush of water, whence the name, which comes through Fr. from Lat. *rapina*, violent robbery or plunder (*rapere*, to seize). The doublet "ravin" or "raven," robbery, greed, has given place to the more learned form "rapine," but is still seen in "ravenous," greedy, voracious.

RAWALPINDI, a town of British India, which gives its name to a district and a division in the Punjab. The town is situated on the north bank of the little river Leh, 1726 ft. above the sea, 111 m. E. by S. of Peshawar, and 1443 m. N.W. of Calcutta. Pop. (1901) 87,688. It is chiefly notable as the largest military station in India, and the key to the British system of defence upon the North-West Frontier. Railways radiate to Peshawar, Kohat, and the Malakand Pass, and a road runs to the Abbotabad frontier. It is also the starting-point of the cart-road to the hill-station of Murree and of the route into Kashmir. It is protected by a strong chain of forts, connected by the Circular Road. It is the headquarters of the second division of the northern army with a strong force of all arms, and contains an arsenal. Besides the locomotive works of the North-Western railway, there are gas-works, a tent factory, an iron foundry, and a brewery. An annual horse fair is held in April.

The District of Rawalpindi has an area of 2010 sq. m., Attock having been separated from it and formed into a separate district in 1904. It is situated on the southern slopes of the north-western extremities of the Himalayas, including large mountain tracts with rich valleys traversed by mountain torrents. It contains the Murree hills with the sanatorium of that name, the chief hill-station in the Punjab. The Indus and the Jhelum are the chief rivers, and the climate is noted for its healthiness. The principal crops are wheat, barley, maize, millets, and pulses. The district is traversed by the main line of the North-Western railway, crossing the Indus at Attock, and also by a branch towards the Indus at Kushalgarh. The population in 1901 was 558,699, showing an increase of 4·7% in the decade.

The Division of Rawalpindi lies in the north-west of the Punjab. It consists of the five districts of Gujrat, Attock, Shahpur, Jhelum, and Rawalpindi. The total area is 15,736 sq. m. and the population in 1901 was 2,799,360.

RĀWENDIS, a Persian sect that took its name from a town Rāwend near Isfahan. Its origin is unknown, but they held ultra-Shiite doctrines (see Shiites). Under the year 158 (A.D. 775) Tabarī says that a man of the Rāwendis, called al-Ablaq (because he was leprous), asserted that the spirit that was in Jesus was in ʿAli, then in the imāms one after the other to Ibrahīm ibn Mahommed, and that thus these were gods. Asad ibn ʿAbdallah, then governor of Khorasan, put many of them to death. Under the year 135 (A.D. 752–3) the historian again mentions a rising of the Rāwendis of Talaqān, and its suppression. Under 141 (A.D. 758–9) he gives a fuller account of them. They believed in metempsychosis, or the transmigration of souls, and asserted that the spirit of Adam was in Othman ibn Nāhik, that the Lord who fed them and gave them drink was Abu Jaʿfar ul-Manṣūr, and that al-Haitham ibn Moawiyā was Gabriel. Accordingly they came to the palace of Manṣūr in Hashimīya and began to hail him as Lord. Manṣūr, however, secured their chiefs and threw them into prison. By means of a mock funeral they succeeded in reaching the prison and delivering their leaders. They then turned in wrath against Manṣūr and almost succeeded in capturing him, but were defeated and slain by al-Haitham. (G. W. T.)

RAWITSCH (Polish *Ravicz*), a town of Germany, in the Prussian province of Posen, lying near the Silesian frontier, 37 m. N. of Breslau, at the junction of railways to Posen and Liegnitz. Pop. (1905) 11,403. It contains a handsome Protestant church and a medieval town hall. The principal industry is the manufacture of snuff and cigars, and for the former it enjoys a considerable reputation. Trade is carried on in grain, wool, cattle, hides, and timber. Rawitsch was founded by Protestant refugees from Silesia during the Thirty Years' War. It passed to Prussia at the second partition of Poland in 1793.

RAWLINSON, GEORGE (1812–1902), English scholar and historian, was born at Chadlington, Oxfordshire, on the 23rd November 1812, being the younger brother of Sir Henry Rawlinson (*q.v.*). Having taken his degree at Oxford (from Trinity College) in 1838, he was elected to a fellowship at Exeter College in 1840, of which from 1842 to 1846 he was fellow and tutor. He was ordained in 1841; was Bampton lecturer in 1859, and Camden professor of ancient history from 1861 to 1889. In 1872 he was appointed canon of Canterbury, and after 1888 he was rector of All Hallows, Lombard Street. In 1873 he was appointed proctor in Convocation for the Chapter of Canterbury. He married Louisa, daughter of Sir R. A. Chermside, in 1846. His chief publications are his translation of the *History of Herodotus* (in collaboration with Sir Henry Rawlinson and Sir Gardner Wilkinson), 1858–60; *The Five Great Monarchies of the Ancient Eastern World*, 1862–67; *The Sixth Great Oriental Monarchy* (Parthian), 1873; *The Seventh Great Oriental Monarchy* (Sassanian), 1875; *Manual of Ancient History*, 1869; *Historical Illustrations of the Old Testament*, 1871; *The Origin of Nations*, 1877; *History of Ancient Egypt*, 1881; *Egypt and Babylon*, 1885; *History of Phoenicia*, 1889; *Parthia*, 1893; *Memoir of Major-General Sir H. C. Rawlinson*, 1898. He was a contributor to the *Speaker's Commentary*, the *Pulpit Commentary*, Smith's *Dictionary of the Bible*, and various similar publications; and he was the author of the article "Herodotus" in the 9th edition of the *Ency. Brit.* He died on the 7th of October 1902.

RAWLINSON, SIR HENRY CRESWICKE (1810–1895), English soldier and orientalist, was born at Chadlington, Oxfordshire, on the 11th of April 1810. In 1827 he went to India as cadet under the East India Company; and after six years' life with his regiment as subaltern, during which time he had become proficient in the Persian language, he was sent to Persia in company with some other English officers to drill and reorganize the Shah's troops. It was at this time that he was first attracted to the study of inscriptions, more particularly those in the hitherto undeciphered cuneiform character. In the course of the two years during which he was in its immediate neighbourhood he transcribed as much as he was able of the great cuneiform inscription at Behistun (*q.v.*); but the friction between the Persian court and the British government ended in the departure of the British officers.

He was appointed political agent at Kandahar in 1840. In that capacity he served for three years, his political labours being as meritorious as was his gallantry during various engagements in the course of the Afghan War; for these he was rewarded by the distinction of C.B. in 1844. A fortunate chance, by which he became personally known to the governor-general, led to his being appointed, at his own desire, as political agent in Turkish Arabia; thus he was enabled to settle in Bagdad, where he devoted much time to the cuneiform studies which attracted him. He was now able, under considerable difficulties and with no small personal risk, to make a complete transcript of the Behistun inscription, which he was also successful in deciphering and interpreting. Having collected a large amount of invaluable information on this and kindred topics, in addition to much geographical knowledge gained in the prosecution of various explorations (including visits with Layard to the ruins of Nineveh), he returned to England on leave of absence in 1849. He remained at home for two years, published in 1851 his memoir on the Behistun inscription, and was promoted to the rank of lieutenant-colonel. He disposed of his valuable collection of Babylonian, Sabaean, and Sassanian antiquities to the trustees of the British Museum, who also made him a considerable grant to enable him to carry on the Assyrian and Babylonian excavations initiated by Layard. In 1851 he returned to Bagdad. The excavations were carried on under his direction with valuable results, among the most important being the discovery of material that greatly contributed to the final decipherment and interpretation of the cuneiform character. An accident with which he met in 1855 hastened his determination to return to England, and in that year he resigned his post in the East India Company. On his return to England the distinction of K.C.B. was conferred upon him, and he was appointed a crown director of the East India Company. The remaining forty years of his life were full of activity—political, diplomatic, and scientific—and were mainly spent in London. In 1858 he was appointed a member of the first India Council, but resigned in 1859 on being sent to Persia as envoy extraordinary and minister plenipotentiary. The latter post he held only for a year, owing to his dissatisfaction with circumstances connected with his official position there. Previously he had sat in Parliament as M.P. for Reigate from February to September 1858; he sat again as M.P. for Frome, 1865–68. He was appointed to the Council of India again in 1868, and continued to serve upon it until his death. He was a strong advocate of the forward policy in Afghanistan, and counselled the retention of Kandahar. His views were more particularly expressed in *England and Russia in the East*, 1875. He was a trustee of the British Museum from 1876 till his death. He was created G.C.B. in 1889, and a Baronet in 1891; was president of the Geographical Society from 1874 to 1875, and of the Asiatic Society from 1878 to 1881; and received honorary degrees at Oxford, Cambridge, and Edinburgh. He married, in September 1862, Louisa Caroline Harcourt Seymour, who bore him two sons and died in 1889. He died in London on the 5th of March 1895. His published works include (apart from minor contributions to the publications of learned societies) four volumes of cuneiform inscriptions, published under his direction between 1870 and 1884 by the trustees of the British Museum; *The Persian Cuneiform Inscription at Behistun*, 1846–51, and *Outline of the History of Assyria*, 1852, both reprinted from the Asiatic Society's journals; *A Commentary on the Cuneiform Inscriptions of Babylon and Assyria*, 1850; *Notes on the Early History of Babylonia*, 1854; *England and Russia in the East*, 1875. He contributed to the *Encyclopaedia Britannica* (9th edition) the articles on Bagdad, the Euphrates and Kurdistan, and several other articles dealing with the East; and assisted in editing a translation of Herodotus by his brother, Canon George Rawlinson.

See G. Rawlinson, *Memoir of Henry Creswicke Rawlinson* (1898).

RAWLINSON, RICHARD (1690–1755), English antiquary and divine, was a younger son of Sir Thomas Rawlinson (1647–1708), lord mayor of London in 1705–6, and a brother of Thomas Rawlinson (1681–1725), the bibliophile. Born on the 3rd of January 1690, he was educated at St Paul's school, at Eton, and at St John's College, Oxford. In 1716 he was ordained, but as he was a nonjuror and a Jacobite the ceremony was performed by a nonjuring bishop, Jeremy Collier. Rawlinson then travelled in England and on the continent of Europe, where he passed several years, making collections of manuscripts, coins and curiosities. In 1728 he became a bishop among the nonjurors, but he hardly ever appears to have discharged episcopal functions, preferring to pass his time in collecting books and manuscripts, pictures and curiosities. He died at Islington on the 6th of April 1755. Rawlinson left his manuscripts, his curiosities, and some other property to the Bodleian Library; he endowed a professorship of Anglo-Saxon at Oxford, and was a benefactor to St John's College.

RAWLINSON, SIR ROBERT (1810–1898), English engineer and sanitarian, was born at Bristol on the 28th of February 1810. His father was a mason and builder at Chorley, Lancashire, and he himself began his engineering education by working in a stonemason's yard. In 1831 he obtained employment under Jesse Hartley in the engineer's office at the Liverpool docks, and for four years from 1836 he was engaged under Robert Stephenson as assistant resident engineer for the Blisworth section of what is now the London & North-Western main line from London to the North. Returning to Liverpool, he spent some years as assistant-surveyor to the corporation, and then in 1844 accepted an engineering post on the Bridgewater Canal. Three years later he returned to Liverpool, to superintend the design and construction of the famous brick-arched ceiling in the St George's Hall, in succession to his friend H. L. Elmes. During this period Rawlinson's reputation as a sanitarian had been growing, and when the Public Health Act was passed in 1848 he was appointed one of the first inspectors under it. He inspected many of the chief towns of England, and his reports on the sanitary conditions he found brought him in many cases into great unpopularity with the municipal rulers. Early in 1855 popular feeling was so aroused by the waste of life that was going on among the British troops in the Crimea through disease, and by the mismanagement of the campaign, that the Aberdeen ministry was forced to resign. Lord Palmerston, who then became prime minister, sent a sanitary commission, consisting of Rawlinson and two medical members (Dr John Sutherland and Dr H. Gavin), with full powers from the War Office, to do whatever it thought would lead to better hygienic conditions in camp and hospital. The commission reached Constantinople in March, and, by insisting on what now seem the most obvious precautions, succeeded within a few weeks in reducing the death-rate in the Levantine hospitals from 42 to 2¼%. Passing on to the Crimea, it effected a similar improvement there, and by the end of the year the health of the whole British army in the field was even better than it enjoyed at home. Rawlinson's next great public service, for which he was made C.B. in 1865, was in connexion with the distress caused in Lancashire by the collapse of the cotton-manufacturing industry consequent on the American Civil War. In 1863 it was suggested that, in order to provide employment for the starving operatives, the government should start works of "utility, profit and ornament," and Rawlinson being sent to make an official investigation into the question, reported, after visiting nearly 100 towns, that 1½ million sterling might be advantageously expended in providing water-supply and drainage, forming streets, &c., in those places. The result was that the Treasury was authorized to advance £1,200,000 the amount was afterwards increased) at 3½% for carrying out such works, which proved of enormous public benefit. In 1866 he acted as chairman of the Royal Commission on the Pollution of Rivers, and a few years later was appointed chief engineering inspector to the Local Government Board; on retiring from this position in 1888 he was promoted to be K.C.B. In 1894 he served as president of the Institution of Civil Engineers. He died in London on the 31st of May 1898.

RAWMARSH, an urban district in the Rotherham parliamentary division of the West Riding of Yorkshire, England, 7½ m. N.E. of Sheffield by the Midland railway. Pop. (1891) 11,983; (1901) 14,587. It is situated on the ridge of a hill above the valley of the Don. The church of St Lawrence was rebuilt in 1839 with the exception of the Norman tower. Rawmarsh has large iron-works, steel rolling-mills and potteries, and there are collieries in the neighbourhood. At the time of the Conquest the manor was granted to Walter d'Eyncourt, and in the 12th century it was divided among the three daughters of his tenant Ralph Paganel, who is supposed to have been the founder of the church.

RAWTENSTALL, a municipal borough in the Rossendale parliamentary division of Lancashire, England, 17½ m. N. by W. from Manchester by the Lancashire & Yorkshire railway. Pop. (1901) 31,053. This town is a modern creation of the cotton industry; at the beginning of the 19th century it was a secluded village in the wild hilly district of Rossendale Forest. The cotton and woollen industries employ the majority of the inhabitants, and there are stone quarries in the neighbourhood. The town was incorporated in 1891, and the corporation consists of a mayor, 6 aldermen and 18 councillors. Area, 9535 acres.

RAY (Lat. *raia*). The rays (*Batoidei*) together with the sharks (*Selachoidei*) form the suborder *Plagiostomi* of Elasmobranch fishes, and are divided into six families (see ICHTHYOLOGY).

The first family, Pristidae, contains only the saw-fishes (*Pristis*), of which five species are known, from tropical and subtropical seas. They frequent especially estuaries and river-mouths, and in some cases make their way over a hundred miles from the sea. Although saw-fishes possess all the essential characteristics of the rays proper, they retain the elongate form of the body of sharks, the tail being excessively muscular and the sole organ of locomotion. The "saw" (fig. 1) is a flat prolongation of the snout, with an endoskeleton which consists of three to five cartilaginous tubes; these are the rostral processes of the cranial cartilage and are found in all rays, though commonly much shorter. The integument of the saw is hard, covered with shagreen; and a series of strong teeth, sharp in front and flat behind, are embedded in it, in alveolar sockets, on each side. The saw is a formidable weapon of offence, by means of which the fish tears pieces of flesh off the body of its victim, or rips open its abdomen to feed on the intestines. The teeth proper, with which the mouth is armed, are extremely small and obtuse, and unsuitable for wounding or seizing animals. Saw-fishes are abundant in the tropics; in their stomachs pieces of intestines and fragments of cuttle-fish have been found. They grow to a large size, specimens with saws 6 ft. long and 1 ft. broad at the base being common.

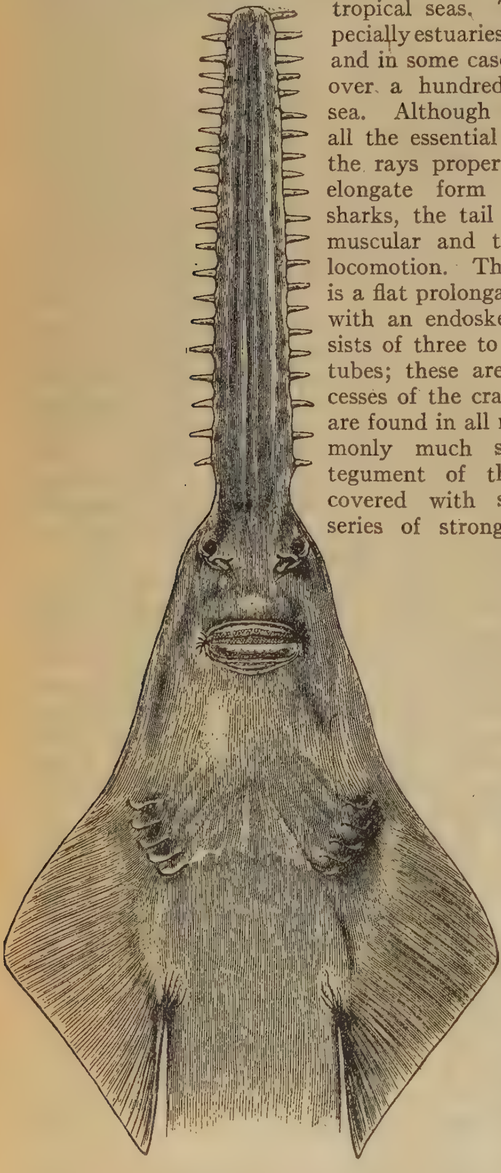

FIG. 1.—*Pristis perrotteti.*

The rays of the second family, Rhinobatidae, bear a strong resemblance to the saw-fishes, but lack the saw. Their teeth are consequently more developed, flat, obtuse, and adapted for crushing hard-shelled marine animals. There are about twenty known species, from tropical and subtropical seas.

The third family, Torpedinidae, includes the electric rays. For the peculiar organ (fig. 2) by which the electricity is produced, see ICHTHYOLOGY. The fish uses this power voluntarily either to defend itself or to stun or kill the smaller animals on which it feeds. To receive the shock, the object must complete the galvanic circuit by communicating with the fish at two distinct points, either directly or through the medium of some conducting body. The electric currents created in these fishes exercise all the other known powers of electricity: they render the needle magnetic, decompose chemical compounds and emit the spark. The dorsal surface of the electric organ is positive, the ventral negative. Shocks from a large healthy fish will temporarily paralyse the arms of a strong man. The species of the genus *Torpedo* are distributed over the coasts of the Atlantic, Pacific and Indian Ocean, and at least one reaches the coasts of Great Britain (*T. hebetans*). On the west coast of North America *T. californica* occurs, while on the Atlantic coast there is found the black crampfish (*T. occidentalis*). This latter is said to reach a weight of 200 lb, but such gigantic specimens are scarce, and prefer sandy ground at some distance from the shore, where they are not disturbed by the agitation of the surface-water. Seven genera with about fifteen species have been described, mostly from the warmer seas. All the rays of this family have, like electric fishes generally, a smooth and naked body.

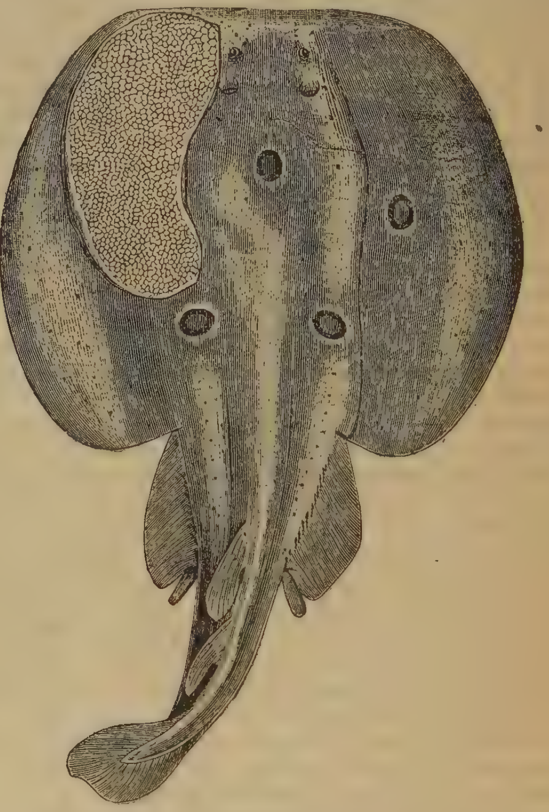

FIG. 2.—*Torpedo narce* (Mediterranean). A portion of the skin on the left side has been removed to show the electric organ.

The fourth family, Raiidae, comprises the skates and rays proper, or *Raia*. More than thirty species are known, chiefly from the temperate seas of both hemispheres, but much more numerously from the northern than the southern. A few species descend to a depth of nearly 600 fathoms, without, however, essentially differing from their surface congeners. Rays, as is indicated by their shape, are bottom-fishes, living on flat sandy ground, generally at no great distance from the coast or the surface. They lead a sedentary life, progressing, like the flatfishes, by an undulatory motion of the greatly extended pectoral fins, the thin slender tail having lost the function of an organ of locomotion, and acting merely as a rudder. They are carnivorous and feed exclusively on molluscs, crustaceans and fishes. Some of the species possess a much larger and more pointed snout than the others, and are popularly distinguished as "skates." The following are known as inhabitants of the British seas:—(*a*) short-snouted species: (1) the thornback (*R. clavata*), (2) the homelyn or spotted ray (*R. maculata*), (3) the starry ray (*R. radiata*), (4) the cuckoo or sandy ray (*R. circularis*); (*b*) long-snouted species: (5) the common skate (*R. batis*), (6) the flapper skate or jumbo skate (*R. macrorhynchus*), (7) the burton skate (*R. alba*), (8) and (9) the shagreen skates (*R. oxyrhynchus* and *R. fullonica*). A few deep-sea species are known, including *R. abyssicola* from 1588 fathoms off the coast of British Columbia. Most of the skates and rays are eaten, except during the breeding season; and even the young of the former are esteemed as food. The skates attain to a much larger size than the rays, viz. to a width of 6 ft. and a weight of 400 and 500 ℔.

The members of the fifth family, Trygonidae or sting-rays, are distinguished from the rays proper by having the vertical fins replaced by a strong spine attached to the upper side of the tail. Some fifty species are known, which inhabit tropical more than temperate seas, some species being found in great tropical rivers over 1000 m. from the sea. The spine is barbed on the sides and is a most effective weapon of defence; by lashing the tail in every direction the sting-rays can inflict dangerous or at least extremely painful wounds. The danger arises from the lacerated nature of the wound rather than from any specially poisonous property of the mucus inoculated. Generally only one or two spines are developed. Sting-rays attain to about the same size as the skates and are eaten on the coasts of the Mediterranean and elsewhere. One species (*Trygon pastinaca*) is not rarely found in the North Atlantic and extends northwards to the coasts of Ireland, England and Norway.

The rays of the sixth and last family, Myliobatidae, are popularly known under various names, such as "devil-fishes," "sea-devils" and "eagle-rays." In them the dilatation of the body, or rather the development of the pectoral fins, is carried to an extreme, whilst the tail is very thin and sometimes long like a whip-cord (fig. 3). Caudal spines are generally present and similar to those of the sting-rays. In the enormous "sea-devils," sometimes classed as a separate family (Mobulidae), the anterior part of the pectoral fin is detached and forms a "cephalic" lobe or pair of lobes in front of the snout. The dentition consists of perfectly flat molars, adapted for crushing hard substances. In some of the eagle-rays the molars are large and tessellated (fig. 4), in others extremely small. Of the twenty-seven species which are known, from tropical and temperate seas, the majority attain a very large and some an enormous size: one mentioned by Risso, which was taken at Messina, weighed 1250 ℔. A foetus taken from the uterus of the mother (all eagle-rays are viviparous), captured at Jamaica and preserved in the British Museum, is 5 ft. broad and weighed 20 lb. The mother measured 15 ft. in width and as many in length, and was between 3 and 4 ft. thick. At Jamaica, where these rays are well known under the name of "devil-fishes," they are frequently attacked for sport's sake, but their capture is uncertain and sometimes attended with danger. The eagle-ray of the Mediterranean and Atlantic (*Myliobatis aquila*) is occasionally found off the British coasts.

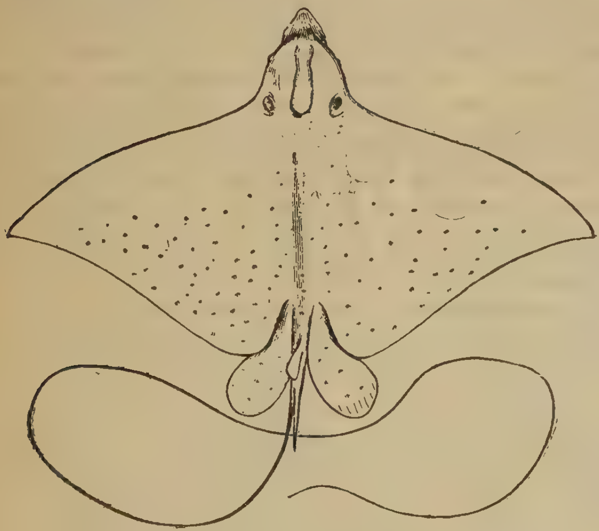

FIG. 3.—*Aetobatis narinari* (Indo-Pacific Ocean).

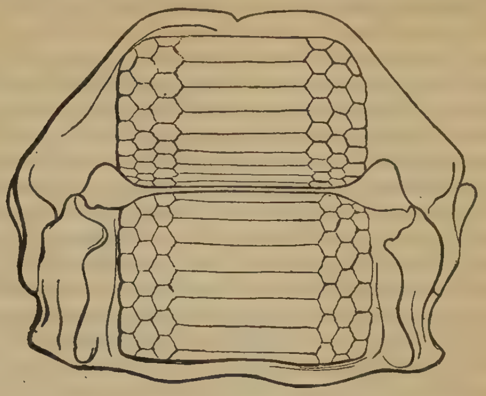

FIG. 4.—Jaws of an Eagle-Ray, *Myliobatis aquila*.

(A. C. G.; J. G. K.)

RAY (or WRAY, as he wrote his name till 1670), **JOHN** (1628–1705), sometimes called the father of English natural history, was the son of the blacksmith of Black Notley near Braintree in Essex, where he was born on the 29th of November 1628, or, according to other authorities, some months earlier. From Braintree school he was sent at the age of sixteen to Catharine Hall, Cambridge, whence he removed to Trinity College after about one year and three-quarters. His tutor at Trinity was Dr James Duport (1606–1679), regius professor of Greek, and his intimate friend and fellow-pupil the celebrated Isaac Barrow. Ray was chosen minor fellow of Trinity in 1649, and in due course became a major fellow on proceeding to the master's degree. He held many college offices, becoming successively lecturer in Greek (1651), mathematics (1653), and humanity (1655), praelector (1657), junior dean (1657), and college steward (1659 and 1660); and according to the habit of the time, he was accustomed to preach in his college chapel and also at Great St Mary's before the university, long before he took holy orders. Among his sermons preached before his ordination, which was not till the 23rd of December 1660, were the famous discourses on *The Wisdom of God in the Creation*, and on the *Chaos, Deluge and Dissolution of the World*. Ray's reputation was high also as a tutor; and he communicated his own passion for natural history to several pupils, of whom Francis Willughby is by far the most famous.

Ray's quiet college life closed when he found himself unable to subscribe to the Act of Uniformity of 1661, and was obliged to give up his fellowship in 1662, the year after Isaac Newton had entered the college. We are told by Dr Derham in his *Life* of Ray that the reason of his refusal "was not (as some have imagined) his having taken the 'Solemn League and Covenant,' for that he never did, and often declared that he ever thought it an unlawful oath; but he said he could not declare for those that had taken the oath that no obligation lay upon them, but feared there might." From this time onwards he seems to have depended chiefly on the bounty of his pupil Willughby, who made Ray his constant companion while he lived, and at his death left him £60 a year, with the charge of educating his two sons.

In the spring of 1663 Ray started together with Willughby and two other pupils on a tour through Europe, from which he returned in March 1666, parting from Willughby at Montpellier, whence the latter continued his journey into Spain. He had previously in three different journeys (1658, 1661, 1662) travelled through the greater part of Great Britain, and selections from his private notes of these journeys were edited by George Scott in 1760, under the title of *Mr Ray's Itineraries*. Ray himself published an account of his foreign travel in 1673, entitled *Observations topographical, moral, and physiological, made on a Journey through part of the Low Countries, Germany, Italy, and France*. From this tour Ray and Willughby returned laden with collections, on which they meant to base complete systematic descriptions of the animal and vegetable kingdoms. Willughby undertook the former part, but, dying in 1672, left only an ornithology and ichthyology, in themselves vast, for Ray to edit; while the latter used the botanical collections for the groundwork of his *Methodus plantarum nova* (1682), and his great *Historia generalis plantarum* (3 vols., 1686, 1688, 1704). The plants gathered on his British tours had already been described in his *Catalogus plantarum Angliae* (1670), which work is the basis of all later English floras.

In 1667 Ray was elected a fellow of the Royal Society, and in 1669 he published in conjunction with Willughby his first paper in the *Philosophical Transactions* on "Experiments concerning the Motion of Sap in Trees." They demonstrated the ascent of the sap through the wood of the tree, and supposed the sap to "precipitate a kind of white coagulum or jelly, which may be well conceived to be the part which every year between bark and tree turns to wood and of which the leaves and fruits are made." Immediately after his admission into the Royal Society he was induced by Bishop John Wilkins to translate his *Real Character* into Latin, and it seems he actually completed a translation, which, however, remained in manuscript; his *Methodus plantarum nova* was in fact undertaken as a part of Wilkins's great classificatory scheme.

In 1673 Ray married Margaret Oakley of Launton (Oxford); in 1676 he went to Sutton Coldfield, and in 1677 to Falborne Hall in Essex. Finally, in 1679, he removed to Black Notley, where he afterwards remained. His life there was quiet and uneventful, but embittered by bodily weakness and chronic sores. He occupied himself in writing books and in keeping up a wide scientific correspondence, and lived, in spite of his infirmities, to the age of seventy-six, dying at Black Notley on the 17th of January 1705. The Ray Society, for the publication of works on natural history, was founded in his honour in 1844.

Ray's first book, the *Catalogus plantarum circa Cantabrigiam nascentium* (1660, followed by appendices in 1663 and 1685), was written in conjunction with his "amicissimus et individuus comes," John Nid. The plants, 626 in number, are enumerated alphabetically, but a system of classification differing little from Caspar Bauhin's is sketched at the end of the book; and the notes contain many curious references to other parts of natural history. The stations of the plants are minutely described; and Cambridge students still gather some of their rarer plants in the copses or chalk-pits where he found them. The book shows signs of his indebtedness to Joachim Jung of Hamburg, who had died in 1657, leaving his writings unpublished; but a MS. copy of some of them was sent to Ray by Samuel Hartlib in 1660. Jung invented or gave precision to many technical terms which Ray and others at once made use of in their descriptions, and which are now classical; and his notions of what constitutes a specific distinction and what characters are valueless as such seem to have been adopted with little change by Ray. The first two editions of the *Catalogus plantarum Angliae* (1670, 1677) were likewise arranged alphabetically; but in the *Synopsis stirpium Britannicarum* (1690, 1696, also re-edited by Dillenius, 1724, and by Hill, 1760) Ray applied the scheme of classification which he had by that time elaborated in the *Methodus* and the *Historia plantarum*. The *Methodus plantarum nova* (1682) was largely based on the works of Caesalpinus and Jung, and still more on that of Robert Morison of Oxford. The greatest merit of this book is the use of the number of cotyledons as a basis of classification; though it must be remembered that the difference between the monocotyledonous and dicotyledonous embryo was detected by Nehemiah Grew. After dividing plants into flowerless and flowering, Ray says, "Floriferas dividemus in Dicotyledones, quarum semina sata binis foliis anomalis, seminalibus dictis, quae cotyledonorum usum praestant, e terra exeunt, vel in binos saltem lobos dividuntur, quamvis eos supra terrem foliorum specie non efferunt; et Monocotyledones, quae nec folia bina seminalia efferunt nec lobos binos condunt. Haec divisio ad arbores etiam extendi potest; siquidem Palmae et congeneres hoc respectu eodem modo a reliquis arboribus differunt quo Monocotyledones a reliquis herbis." But a serious blemish was his persistent separation of trees from herbs, a distinction whose falsity had been exposed by Jung and others, but to which Ray tried to give scientific foundation by denying the existence of buds in the latter. At this time he based his classification, like Caesalpinus, chiefly upon the fruit, and he distinguished several natural groups, such as the grasses, *Labiatae*, *Umbelliferae* and *Papilionaceae*. The classification of the *Methodus* was extended and improved in the *Historia plantarum*, but was disfigured by a large class of *Anomalae*, to include forms that the other orders did not easily admit, and by the separation of the cereals from other grasses. This vast book enumerates and describes all the plants known to the author or described by his predecessors, to the number, according to Adanson, of 18,625 species. In the first volume a chapter "De plantis in genere" contains an account of all the anatomical and physiological knowledge of the time regarding plants, with the recent speculations and discoveries of Caesalpinus, Grew, Malpighi and Jung; and Cuvier and Dupetit Thouars, declaring that it was this chapter which gave acceptance and authority to these authors' works, say that "the best monument that could be erected to the memory of Ray would be the republication of this part of his work separately." The *Stirpium Europaearum extra Britannias nascentium Sylloge* (1694) is a much amplified edition of the catalogue of plants collected on his own European tour. In the preface to this book he first clearly admitted the doctrine of the sexuality of plants, which, however, he had no share in establishing. Here also begins his long controversy with Rivinus (Augustus Quirinus Bachmann) which chiefly turned upon Ray's indefensible separation of ligneous from herbaceous plants, and also upon what he conceived to be the misleading reliance that Rivinus placed on the characters of the corolla. But in the second edition of his *Methodus* (1703) he followed Rivinus and J. P. de Tournefort in taking the flower instead of the fruit as his basis of classification: he was no longer a fructicist but a corollist.

Besides editing his friend Willughby's books, Ray wrote several zoological works of his own, including *Synopsis methodica Animalium Quadrupedum et Serpentini Generis* (1693), that is to say, both mammals and reptiles, and *Synopsis methodica Avium et Piscium* (1713); the latter was published posthumously, as was also the more important *Historia Insectorum* (1710), which embodied a great mass of Willughby's notes.

Most of Ray's minor works were the outcome of his faculty for carefully amassing facts; for instance, his *Collection of English Proverbs* (1670), his *Collection of Out-of-the-way English Words* (1674), his *Collection of Curious Travels and Voyages* (1693), and his *Dictionariolum trilingue* (1675, 5th edition as *Nomenclator classicus*, 1706). The last was written for the use of Willughby's sons, his pupils; it passed through many editions, and is still useful for its careful identifications of plants and animals mentioned by Greek and Latin writers. But Ray's influence and reputation have depended largely upon his two books entitled *The Wisdom of God manifested in the Works of the Creation* (1691), and *Miscellaneous Discourses concerning the Dissolution and Changes of the World* (1692). The latter includes three essays on "The Primitive Chaos and Creation of the World," "The General Deluge, its Causes and Effects," and "The Dissolution of the World and Future Conflagrations." The germ of these works was contained in sermons preached long before in Cambridge. Both books obtained immediate popularity, and the former, at least, was translated into several languages. In *The Wisdom of God, &c.*, Ray recites innumerable examples of the perfection of organic mechanism, the multitude and variety of living creatures, the minuteness and usefulness of their parts, and many, if not most, of the familiar examples of purposive adaptation and design in nature were suggested by him, such as the structure of the eye, the hollowness of the bones, the camel's stomach and the hedgehog's armour.

Authorities.—*Select Remains, Itineraries and Life*, by Dr Derham, edited by George Scott, 1740; notice by Sir J. E. Smith in Rees's *Cyclopaedia*; notice by Cuvier and A. Dupetit Thouars in the *Biographie universelle*; all these were collected under the title *Memorials of Ray*, and edited (with the addition of a complete catalogue of his works) by Dr Edwin Lankester, 8vo (Ray Society), 1846; *Correspondence* (with Willughby, Martin Lister, Dr Robinson, Petiver, Derham, Sir Hans Sloane and others), edited by Dr Derham, 1718; *Selections*, with additions, edited by Lankester (Ray Society), 1848. For accounts of Ray's system of classification, see Cuvier, *Leçons hist. s. Sci. Nat.*, p. 488; Sprengel, *Gesch. d. Botanik*, ii. p. 40; Sachs, *Gesch. d. Botanik*; also Whewell, *Hist. Ind. Sci.*, iii. p. 332 (ed. 1847), and Wood, art. "Classification" in Rees's *Cyclopaedia*. (D. W. T.)

RAYAH (Arabic *ra'iyah*, peasants, subjects, flock, herd, *ra'a*, to pasture, cf. "ryot," an Indo-Persian variant of the same word), the name given to the non-Moslem subjects of a

Mahommedan ruler; all who pay the *haraj* or poll-tax levied on unbelievers. Five classes of rayahs existed under Turkish rule,—(1) the Greek, or *Roum milleti*; (2) the Armenian, or *Emeni milleti*; (3) the Catholic Armenians—*eremeni gatoliki milleti*; (4) the Latin Christians, or *Roum gatoliki milleti*; and (5) the Jews, or *ichondi milleti*. The name rayah is most commonly used of the peasants, but it does not apply only to the agricultural populations. It depended on status, fixed by religious faith.

RAYLEIGH, JOHN WILLIAM STRUTT, 3rd baron (1842–), English physicist, was born in Essex on the 12th of November 1842, being the son of the 2nd baron.[1] Going to Trinity College, Cambridge, he graduated as senior wrangler in 1865, and obtained the first Smith's prize of the year, the second being gained by Professor Alfred Marshall. He married in 1871 a sister of Mr A. J. Balfour, and succeeded to the title in 1873. From 1879 to 1884 he was Cavendish professor of experimental physics in the university of Cambridge, in succession to Clerk Maxwell; and in 1887 he accepted the post of professor of natural philosophy at the Royal Institution of Great Britain, which he resigned in 1905. His early mathematical and physical papers, written under the name of J. W. Strutt, made him known over Europe; and his powers rapidly matured until, at the death of Clerk Maxwell, he stood at the head of British physicists, Sir George Stokes and Lord Kelvin alone excepted. The special feature of his work is its extreme accuracy and definiteness; he combines the highest mathematical acumen with refinement of experimental skill, so that the idea of ranking him as higher in one department than another does not arise. His experimental investigations are carried out with plain and usually home-made apparatus, the accessories being crude and rough, but the essentials thoughtfully designed so as to compass in the simplest and most perfect manner the special end in view. A great part of his theoretical work consists in resurveying things supposed superficially to be already known, and elaborating their theory into precision and completeness. In this way he has gone over a great portion of the field of physics, and in many cases has either said the last word for the time being, or else started new and fruitful developments. Possessing an immense range of knowledge, he has filled up lacunae in nearly every part of physics, by experiment, by calculation, and by clear accurate thought. The following branches have especially felt his influence:—chemical physics, capillarity and viscosity, theory of gases, flow of liquids, photography, optics, colour vision, wave theory, electric and magnetic problems, electrical measurements, elasticity, sound and hydrodynamics. The numerous scientific memoirs in which his original work is set forth were collected under his own editorship in four large volumes, the last of which was published in 1903. His most extensive single work is a book on *Sound*, which, in the second edition, has become a treatise on vibrations in general. His familiarity with the methods of mathematical analysis and a certain refinement of taste in their application have resulted in great beauty of form. His papers are often difficult to read, but never diffuse or tedious; his mathematical treatment is never needlessly abstruse, for when his analysis is complicated it is only so because the subject-matter is complicated. Of discoveries superficially sensational there are few or none to record, and the weight of his work is for the most part to be appreciated only by professed physicists. One remarkable discovery, however, of general interest, was the outcome of a long series of delicate weighings and minute experimental care in the determination of the relative density of nitrogen gas—undertaken in order to determine the atomic weight of nitrogen—namely, the discovery of argon, the first of a series of new substances, chemically inert, which occur, some only in excessively minute quantities, as constituents of the earth's atmosphere. Lord Rayleigh had an interest in abnormal psychological investigations, and became a member and vice-president of the Society for Psychical Research. He was one of the original members of the Order of Merit, instituted in connexion with the coronation of King Edward VII. In 1904 he was awarded a Nobel prize, and at the end of 1905 he became president of the Royal Society, of which he had been elected a fellow in 1873, and had acted as secretary from 1885 to 1896. He remained president till 1908, in which year he was chosen to succeed the 8th duke of Devonshire as chancellor of Cambridge University.

For a popular but authentic account of some of Lord Rayleigh's scientific work and discoveries, see an article by Sir Oliver Lodge in the *National Review* for September 1898.

RAYMOND, HENRY JARVIS (1820–1869), American journalist, was born near the village of Lima, Livingston county, New York, on the 24th of January 1820. He graduated from the university of Vermont in 1840. After assisting Horace Greeley (*q.v.*) in the conduct of more than one newspaper, Raymond in 1851 formed the firm of Raymond, Jones & Co., and the first issue of the *New York Times* appeared on the 18th of September 1851; of this journal Raymond was editor and chief proprietor until his death. Raymond was a member of the New York Assembly in 1850 and 1851, and in the latter year was speaker. He supported the views of the radical anti-slavery wing of the Whig party in the North. His nomination over Greeley on the Whig ticket for lieutenant-governor in 1854 led to the dissolution of the famous political "firm" of Seward, Weed and Greeley. Raymond was elected, and served in 1854–56. He took a prominent part in the formation of the Republican party, and drafted the famous "Address to the People" adopted by the Republican convention which met in Pittsburg on the 22nd of February 1856. In 1862 he was again a member, and speaker, of the New York Assembly. During the Civil War he supported Lincoln's policy in general, though deprecating his delays, and he was among the first to urge the adoption of a broad and liberal attitude in dealing with the people of the South. In 1865 he was a delegate to the National Republican Convention, and was made a member, and chairman, of the Republican National Committee. He was a member of the National House of Representatives in 1865–67, and on the 22nd of December 1865 he ably attacked Thaddeus Stevens's theory of the "dead" states, and, agreeing with the President, argued that the states were never out of the Union, inasmuch as the ordinances of secession were null. In consequence of this, of his prominence in the Loyalist (or National Union) Convention at Philadelphia in August 1866, and of his authorship of the "Address and Declaration of Principles," issued by the convention, he lost favour with his party. He was removed from the chairmanship of the Republican National Committee in 1866, and in 1867 his nomination as minister to Austria, which he had already refused, was rejected by the Senate. He retired from public life in 1867 and devoted his time to newspaper work until his death in New York city on the 18th of June 1869. Raymond was an able and polished public speaker; one of his best known speeches was a greeting to Kossuth, whose cause he warmly defended. But his great work was in elevating the style and general tone of American journalism. He published several books, including a biography of President Lincoln—*The Life and Public Services of Abraham Lincoln* (1865), which in substance originally appeared as *A History of the Administration of President Lincoln* (1864).

See Augustus Maverick, *Henry J. Raymond and the New York Press for Thirty Years* (Hartford, Conn., 1870); and "Extracts from the Journal of Henry J. Raymond," edited by his son, Henry H. Raymond, in *Scribners' Monthly*, vols. xix. and xx. (New York, 1879–80).

RAYMOND OF SABUNDE, or SABIENDE (fl. 1434), Spanish scholar, was a teacher of medicine and philosophy and finally regius professor of theology at Toulouse. His *Liber naturae sive creaturarum, &c.* (written 1434–36), marks an important stage in the history of Natural Theology. The book was directed against the position then generally held, that reason and faith, philosophy and theology were antithetical and irreconcilable. Raymond declares that the book of Nature and the Bible are both Divine revelations, the one general and immediate, the other specific and mediate. The *Editio Princeps* of the book, which found many imitators, is undated but probably belongs to 1484; there are many subsequent editions, one by J. F. von Seidel as late as 1852. In 1595 the *Prologus* was put on the Index for its declaration that the Bible is the only source of revealed truth. Montaigne (*Essays*, bk. ii. ch. xii., " An Apologie of Raymond Sebond ") tells how he translated the book into French and found " the conceits of the author to be excellent, the contexture of his work well followed, and his project full of pietie. . . . His drift is bold, and his scope adventurous, for he undertaketh by humane and naturall reasons, to establish and verifie all the articles of Christian religion against Atheists."

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[1] The barony was created at George IV.'s coronation in 1821 for the wife of Joseph Holden Strutt, M.P. for Maldon (1790–1826) and Okehampton (1826–1830), who had done great service during the French War as colonel of the Essex militia. He died in 1845, his wife, the baroness, predeceasing him in 1836. Their son (d. 1873) was the 2nd baron.

See D. Beulet, *Un Inconnu célèbre: recherches historiques et critiques sur Raymond de Sabunde* (Paris, 1875).

RAYMUND, prince of Antioch (1099–1149), was the son of William VI., count of Poitou. On the death of Bohemund II. of Antioch (*q.v.*), the principality devolved upon his daughter, Constance, a child of some three years of age (1130). Fulk, the king of Jerusalem, and, as such, guardian of Antioch, was concerned to find a husband for her, and sent envoys to England to offer her hand to Raymund, who was then at the court of Henry I. Raymund accepted the offer, and stealing in disguise through southern Italy, for fear of apprehension by Roger of Sicily, who claimed the inheritance of Antioch as cousin of Bohemund I., he reached Antioch in 1135. Here he was married to Constance by the patriarch, but not until he had done him homage and fealty. The marriage excited the indignation of Alice, the mother of Constance, who had been led by the patriarch to think that it was she whom Raymund desired to wed; and the new prince had thus to face the enmity of the princess dowager and her party. In 1137 he had also to face the advent of the eastern emperor, John Comnenus, who had come south partly to recover Cilicia from Leo, the prince of Armenia, but partly, also, to assert his rights over Antioch. Raymund was forced to do homage, and even to promise to cede his principality as soon as he was recompensed by a new fief, which John promised to carve for him in the Mahommedan territory to the east of Antioch. The expedition of 1138, in which Raymund joined with John, and which was to conquer this territory, naturally proved a failure: Raymund was not anxious to help the emperor to acquire new territories, when their acquisition only meant for him the loss of Antioch; and John had to return unsuccessful to Byzantium, after vainly demanding from Raymund the surrender of the citadel of Antioch. There followed a struggle between Raymund and the patriarch. Raymund was annoyed by the homage which he had been forced to pay to the patriarch in 1135; and the dubious validity of the patriarch's election offered a handle for opposition. Eventually Raymund triumphed, and the patriarch was deposed (1139). In 1142 John Comnenus returned to the attack; but Raymund refused to recognize or renew his previous submission; and John, though he ravaged the neighbourhood of Antioch, was unable to effect anything against him. When, however, Raymund demanded from Manuel, who had succeeded John in 1143, the cession of some of the Cilician towns, he found that he had met his match. Manuel forced him to a humiliating visit to Constantinople, during which he renewed his oath of homage and promised to receive a Greek patriarch. The last event of importance in Raymund's life was the visit to Antioch in 1148 of Louis VII. and his wife Eleanor, Raymund's niece. Raymund sought to prevent Louis from going south to Jerusalem, and to induce him to stay in Antioch and help in the conquest of Aleppo and Caesarea. Perhaps for this end he acquired an influence over his niece, which was by some interpreted as a guilty intimacy. At any rate Louis hastily left Antioch, and Raymund was balked in his plans. In 1149 he fell in battle during an expedition against Nureddin. Raymund is described by William of Tyre (the main authority for his career) as handsome and affable; pre-eminent in the use of arms and military experience; *litteratorum, licet ipse illiteratus esset, cultor* (he caused the *Chanson des chétifs* to be composed); a regular churchman and a faithful husband; but headstrong, irascible and unreasonable, with too great a passion for gambling (bk. xiv. c. xxi.).

For his career see Rey, in the *Revue de l'orient latin*, vol. iv.

(E. Br.)

RAYMUND OF TOULOUSE (sometimes also called Raymund of St Giles, after a town to the south of Nimes), count of Provence, one of the leaders of the first Crusade. According to an Armenian authority, he had lost an eye on a pilgrimage to Jerusalem before the first Crusade; but the statement probably rests on the fact that he was one-eyed, *vir monoculus*. He is also recorded to have fought against the Moors in Spain before 1096; and it is certain that he was the first of the princes of the West to take the cross after Pope Urban's sermon at Clermont. The oldest and the richest of the crusading princes, the count of Provence started, at the end of October 1096, with a large company, which included his wife, his son, and Adhemar, bishop of Puy, the Papal Legate. His march lay by Ragusa and Scutari to Durazzo, whence he struck eastward, along the route also used by Bohemund, to Constantinople. At the end of April 1097 he was with difficulty induced to take a somewhat negative oath of fealty to Alexius; for the obstinacy which was one of his characteristics, coupled perhaps with some hope of acquiring new territories, made him reluctant to submit like the other crusaders to Alexius. He was present at Nicaea and Dorylaeum; but he first showed his hand in October 1097, when, as the army neared Antioch, and a rumour was spread that Antioch had been deserted by the Turks, he sent a detachment in advance to occupy the city—an action which presaged his future difficulties with Bohemund, the would-be prince of Antioch. In the siege of Antioch (which was far from having been deserted) Raymund played his part. When the city was taken by Bohemund (June 1098), the count garrisoned the *palatium Cassiani* (the palace of the emir, Yagi Sian) and the tower over the Bridge Gate. He lay ill during the second siege of Antioch by Kerbogha; but in his camp a great spiritualistic activity culminated in the discovery of the Holy Lance by the Provençals. The miracle stimulated the crusaders to defeat Kerbogha: the Lance itself, discovered by the Provençals and carried henceforward by their count, became a valuable asset in Raymund's favour; and he began to put difficulties in the way of Bohemund's retention of Antioch, obstinately alleging the oath to Alexius, and refusing to surrender the positions in the city which he had occupied. A struggle thus arose between the Provençals and the Normans, partly with regard to the genuineness of the Lance, which the Normans naturally doubted, and partly with regard to the possession of Antioch—the real issue at stake. Raymund was the first of the princes to leave Antioch, moving southward in the autumn of 1098 to the siege of Marra, but leaving a detachment of his troops in Antioch. With Bohemund left behind in Antioch; with the possession of the Holy Lance to give him prestige; and with the wealth which he had at his disposal, the count of Provence now definitely began to figure as the leader of the Crusade. If he could have consented to leave Bohemund in possession of Antioch and push southward, he might have achieved much. But he could not stomach the greatness of Bohemund; and when the Normans turned his troops out of Antioch in January 1099, he marched from Marra (which had been captured in December 1098) into the emirate of Tripoli, and began the siege of Arca (February 1099), evidently with the idea of founding a power in Tripoli which would check the expansion of Bohemund's principality to the south. The siege of Arca was protracted; and the selfish policy of the count, which thus deferred the march to Jerusalem, lost him all support from the mass of the crusaders. A wave of indignation in the ranks, and the inducements which the emir of Tripoli offered to the other princes, forced Raymund to desist from the siege (May 1098), and to march southwards to Jerusalem. After the capture of Jerusalem, Raymund was offered, but refused, the advocacy of the Holy Sepulchre. He alleged his reluctance to rule in the city in which Christ had suffered;

it is perhaps permissible to suspect that he hankered for the principality of Tripoli and the renewal of hostilities with Bohemund. As at Antioch, so at Jerusalem, he fell into strife with the new ruler; and it was only with difficulty that Godfrey was able to secure from him the possession of the Tower of David, which he had originally occupied. The grasping nature of Raymund again appeared after the battle of Ascalon, when his eagerness to occupy Ascalon for himself prevented it from being occupied at all; while Godfrey also blamed him for the failure of his army to capture Arsuf. It almost seems as if the count could not appear without becoming a centre of storms; and when he went north, in the winter of 1099–1100, his first act was one of hostility against Bohemund, from whom he helped to wrest Laodicea. From Laodicea he went to Constantinople, where he fraternized with Alexius, the great enemy of his own enemy Bohemund. Joining in the ill-fated Crusade which followed in the wake of the First, he was successful in escaping from the *débâcle*, and returning to Constantinople. In 1102 he came by sea from Constantinople to Antioch, where he was imprisoned by Tancred, regent of Antioch during the captivity of Bohemund, and only dismissed upon promising not to attempt any conquests in the country between Antioch and Acre. He broke his promise, attacking and capturing Tortosa, and beginning to build a castle for the reduction of Tripoli (on the *Mons Peregrinus*). In this policy he was aided by Alexius, who was naturally willing to see the erection of a tributary county of Tripoli to the south of Bohemund's principality. In 1105 Raymund died. He was succeeded by his nephew William, who in 1109, with the aid of Baldwin I., captured the town and definitely established the county of Tripoli. William was ousted in the same year by Raymund's eldest son Bertrand; and the county continued in the possession of his house during the 12th century.[1]

Raymund of Toulouse represents the Provençal element in the first Crusade, as Bohemund represents the Norman, and Godfrey and Baldwin the Lotharingian. Religiosity, obstinacy and greed seem curiously blended in his composition. The first quality appears in the episode of the Lance, and in his renunciation of the advocacy of Jerusalem: the second appears in the whole of his attitude to Bohemund: the third appears again and again, whenever the progress of the Crusades brought any new conquest. If in temperament he is the least attractive among the princes of the first Crusade, he was yet one of its foremost leaders, and he left his mark upon history in the foundation of the county of Tripoli.

Raymund of Agiles, a clerk in the Provençal army, gives the history of the first Crusade from his master's point of view. For a modern account of Count Raymund's part in the crusading movement, one may refer to Röhricht's works (see CRUSADES). (E. BR.)

RAYMUND OF TRIPOLI, the most famous of the descendants of Raymund of Toulouse, was a great-grandson of his eldest son Bertrand: his mother was Hodierna, a daughter of Baldwin II., and through her he was closely connected with the kings of Jerusalem. He became count of Tripoli in 1152, on the assassination of his father. In 1164 he was captured by Nureddin, and was only released in 1172 after a captivity of eight years. In 1174 he claimed the regency on behalf of Baldwin IV. (at once a minor and a leper), in virtue of his close relationship; and the claim was acknowledged. After two years the regency seems to have passed to Reginald of Châtillon; but Raymund, who had married the heiress of the county of Tiberias, continued to figure in the affairs of the kingdom. His great ability procured him enemies; for two years, 1180–1182, Baldwin IV. was induced by evil advisers to exclude him from his territories. But as Saladin grew more threatening, Raymund grew more indispensable; and in 1184 he became regent for Baldwin V., on condition that, if the king died before his majority, his successor should be determined by the great powers of the West. Raymund conducted the regency with skill, securing a truce from Saladin in 1185; but when Baldwin V. died, in 1186, all went wrong. Raymund summoned an assembly of the barons to Naplous to deliberate on the situation; but while they deliberated, the supporters of Guy de Lusignan (the husband of Baldwin IV.'s sister, Sibylla) acted, and had him crowned, in defiance of the stipulation under which Raymund had become regent. The rest of the barons came over to Guy; and Raymund, left in isolation, retired to Tiberias and negotiated a truce for himself with Saladin. His ambiguous position led contemporaries to accuse him of treasonable correspondence with Saladin; but his loyalty to the Christian cause was nobly shown in 1187, when he reconciled himself to Guy, and aided him in the battle of Hattin, which was engaged, however, in the teeth of his earnest advice. He escaped from the battle wounded, and ultimately retired to Tripoli, where he died (1187).

In the corrupt society of the latter days of the kingdom of Jerusalem, Raymund showed himself at least as disinterested as any other man, and certainly more capable than the rest of his contemporaries. He might have saved Jerusalem, if Jerusalem could have been saved; but his was the *vox clamantis in deserto*. "He is worthy of the throne," wrote a contemporary Arabic chronicler: "he seems destined for it by nature, who has given him pre-eminent wisdom and courage." (E. BR.)

RAYNAL, GUILLAUME THOMAS FRANÇOIS (1713–1796), French writer, was born at Saint-Geniez in Rouergue on the 12th of April 1713. He was educated at the Jesuit school of Pézenas, and received priest's orders, but he was dismissed for unexplained reasons from the parish of Saint-Sulpice, Paris, to which he was attached, and thenceforward he devoted himself to society and literature. The Abbé Raynal wrote for the *Mercure de France*, and compiled a series of popular but superficial works, which he published and sold himself. These—*L'Histoire du stathoudérat* (The Hague, 1748), *L'Histoire du parlement d'Angleterre* (London, 1748), *Anecdotes historiques* (Amsterdam, 3 vols., 1753)—gained for him access to the salons of Mme. Geoffrin, Helvétius, and the baron d'Holbach. He had the assistance of various members of the *philosophe* coteries in his most important work, *L'Histoire philosophique et politique des établissements et du commerce des Européens dans les deux Indes* (Amsterdam, 4 vols., 1770). Diderot indeed is credited with a third of this work, which was characterized by Voltaire as "du réchauffé avec de la declamation." The other chief collaborators were Pechméja, Holbach, Paulze, the farmer-general of taxes, the Abbé Martin, and Alexandre Deleyre. To this piecemeal method of composition, in which narrative alternated with tirades on political and social questions, was added the further disadvantage of the lack of exact information, which, owing to the dearth of documents, could only have been gained by personal investigation. The "philosophic" declamations perhaps constituted its chief interest for the general public, and its significance as a contribution to democratic propaganda. The *Histoire* went through many editions, being revised and augmented from time to time by Raynal; it was translated into the principal European languages, and appeared in various abridgments. Its introduction into France was forbidden in 1779; the book was burned by the public executioner, and an order was given for the arrest of the author, whose name had not appeared in the first edition, but was printed on the title page of the Geneva edition of 1780. Raynal escaped to Spa, and thence to Berlin, where he was coolly received by Frederick the Great, in spite of his connexion with the *philosophe* party. At St Petersburg he met with a more cordial reception from Catherine II., and in 1787 he was permitted to return to France, though not to Paris. He showed generosity in assigning a considerable income to be divided annually among the peasant proprietors of upper Guienne. He was elected by Marseilles to the States-general, but refused to sit on the score of age. Raynal now realized the impossibility of a peaceful revolution, and, in terror of the proceedings for which the writings of himself and his friends had prepared the way, he sent to the Constituent Assembly an address, which was read on the 31st of May 1791, deprecating the violence of its reforms. This address is said by Sainte-Beuve (*Nouveaux lundis*, xi.) to have been composed chiefly by Clermont Tonnerre and Pierre V. Malouet, and it was regarded, even by moderate men, as ill-timed. The published *Lettre de l'abbé Raynal à l'Assemblée nationale* (10th Dec. 1790) was really the work of the comte de Guibert. During the Terror Raynal lived in retirement at Passy and at Montlhéry. On the establishment of the Directory in 1795 he became a member of the newly organized Institute of France. He died in the next year on the 6th of March at Chaillot.

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[1] For the future history of the county, see under RAYMUND OF TRIPOLI and BOHEMUND IV.

A detailed bibliography of his works and of those falsely attributed to him will be found in Quérard's *La France littéraire*, and the same author's *Supercheries dévoilées*. The biography by A. Jay, prefixed to Peuchet's edition (Paris, 10 vols, 1820–1821) of the *Histoire . . . des Indes*, is of small value. To this edition Peuchet added two supplementary volumes on colonial development from 1785 to 1824. See also the anonymous *Raynal démasqué* (1791); Cherhal Montréal, *Éloge . . . de G. T. Raynal* (an. IV.); a notice in the *Moniteur* (5 vendémiaire, an. V.); B. Lunet, *Biographie de l'abbé Raynal* (Rodez, 1866); and J. Morley, *Diderot* (1891).

RAYNALD OF CHÂTILLON (d. 1187), a knight in the service of Constance, princess of Antioch, whom she chose for her husband in 1153, four years after the death of her first husband, Raymund (*q.v.*). One of Raynald's first acts was a brutal assault on the patriarch of Antioch; while two years later he made an unjustifiable attack on Cyprus, in the course of which the island was ravaged. The act brought its punishment in 1159, when he had to humiliate himself before the emperor Manuel, doing homage and promising to accept a Greek patriarch; and when Manuel came to Antioch in the same year, and was visited there by Baldwin III., Raynald led his horse into the city. Later in the year he was captured by the Mahommedans, during a plundering raid against the Syrian and Armenian peasants of the neighbourhood of Marash, and confined at Aleppo. His captivity lasted seventeen years. Released in 1176, he married Stephanie, the widow of Humphrey of Toron, and heiress of Krak and Mont Royal, to the S.E. of the Dead Sea—fortresses which controlled the trade-routes between Egypt and Damascus, and gave him access to the Red Sea. In November 1177, at the head of the army of the kingdom, he won a victory over Saladin, who only escaped with difficulty from the pursuit. But in 1181 the temptation of the caravans which passed by his fortress proved too strong, and in spite of a truce between Saladin and Baldwin IV. he began to plunder. Saladin demanded reparations from Baldwin IV. Baldwin could only reply that he was unable to coerce his unruly vassal. The result was a new outbreak of war between Saladin and the Latin kingdom (1182). In the course of the hostilities Raynald launched ships on the Red Sea, partly for buccaneering, partly, it seems, with the design of attacking Mecca, and of challenging Mahommedanism in its own holy place. His ships were captured by one of Saladin's officers; and at the end of the year Saladin himself attacked Raynald in his fortress of Krak, at a time when a number of guests were assembled to celebrate the marriage of his stepson, Humphrey of Toron. The siege was raised, however, by Count Raymund of Tripoli; and till 1186 Raynald was quiet. In that year he espoused the cause of Sibylla and Guy de Lusignan against Count Raymund, and his influence contributed to the recognition of Guy as king of Jerusalem. His policy at this crisis was not conceived in the best interests of the kingdom; and a step which he took at the end of the year was positively fatal. Hearing of a rich caravan, in which the sister of Saladin was travelling, he swooped down from his fortress upon it. Thus, for the second time, he broke a truce between the kingdom and Saladin. Guy could not extort from him the satisfaction which Saladin demanded: Raynald replied that he was lord in his lands, and that he had no peace with Saladin to respect. Saladin swore that Raynald should perish if ever he took him prisoner; and next year he was able to fulfil his oath. He invaded the kingdom, and, at the battle of Hittin, Raynald along with King Guy and many others fell into his hands. They were brought to his tent; and Saladin, after rebuking Raynald strongly for his treachery, offered him his life if he would become a Mahommedan. He refused, and Saladin either slew him with his own hands or caused him to be slain (for accounts differ) in the presence of his companions.

The death of Raynald caused him to be regarded as a martyr; his life only shows him to have been a brigand of great capacity. He is the apotheosis of the feudal liberty which the barons of the Holy Land vindicated for themselves; and he shows, in his reckless brigandage, the worst side of their character. Stevenson, *Crusades in the East* (Cambridge, 1907), takes a most favourable view of Raynald's career: cf. especially pp. 240–241. But his whole life seems to indicate a self-willed and selfish temper. (E. Br.)

RAYNAUD'S DISEASE, a malady first described by P. Edouard Raynaud in 1862 in a paper on "Local Asphyxia and Symmetrical Gangrene of the Extremities." The condition is said to be of central nervous origin, and cold, fright, or emotional disturbances are predisposing causes. It is a disease of childhood or early adult life, and females are more frequently affected than males. Raynaud attributed the symptoms to an arrest of the passage of blood to the affected parts, and considered this due to a spasm of the arterioles. If the spasm be sufficiently prolonged and intense to completely close the arterial channels gangrene of the part may be the result.

The local symptoms are divided into three well-marked stages. The first is *local syncope*, in which the affected parts become temporarily bloodless, white, cold, and anaesthetic. The condition is familiar in what is termed a "dead finger," and is usually bilateral. After a variable time the circulation may become restored with a tingling sensation, or the disease may progress to the second stage, that of *local asphyxia*. In this condition some part of the body, usually a finger, toe, or the whole hand or foot, becomes painful to the touch and is noticed to be dusky in colour, or bluish-purple or even mottled, and the surface is cold. This discoloration may deepen until the skin is almost black, the tactile sense being lost. After several hours the pain may subside, the attack of lividity pass off, and warmth return to the skin. Such attacks of local asphyxia may return every day for a time. Sometimes severe abdominal pain is present, accompanied by haematuria. The frequency of haematuria in this connexion was first noticed by Hutchinson in 1871. In the third stage, that of *local gangrene*, the involved areas assume a black and shrivelled appearance, livid streaks marking the course of the arteries; blebs may form containing bloody fluid. The degree of destruction varies from the detachment of a patch of soft tissue down to the loss of even a whole limb, the part becoming separated by a line of demarcation as in senile gangrene.

In Raynaud's disease the patients have been noticed to be very susceptible to cold and low temperatures; every effort should be made to keep the extremities warm; woollen underclothing and stockings should be worn, and the activity of the circulation roused by douches and exercise; by these means an attack may be prevented. Should local asphyxia have taken place, one of the best treatments to lessen pain and obtain the return of the natural colour is the application of the constant current. Sir T. Barlow directs its application, the limb being placed in a bath of warm salt and water. Cushing's method of inducing active hyperaemia has been attended with much success. This treatment is only applicable when the vascular spasm affects the extremities, and consists in the artificial constriction of the limb by the application of a tourniquet or Esmarch's bandage for a few minutes daily. This is followed by hyperaemia and increased surface temperature, and affords much relief to the pain of the stage of asphyxia. Drugs which dilate the peripheral vessels, such as amyl nitrite and trinitrine, have also been recommended. When gangrene occurs in the affected part it should be well wrapped in absorbent cotton and kept dry, and all active treatment should cease until a line of demarcation has formed and the gangrenous portion separated. The disease tends towards recovery with more or less loss of tissue if the stage of gangrene has been reached.

RAYNOUARD, FRANÇOIS JUSTE MARIE (1761–1836), French dramatist and *savant*, was born at Brignoles (Provence), on the 8th of September 1761. He was educated for the bar and practised at Draguignan. In 1791 he went to Paris as deputy to the Legislative Assembly, but after the fall of the Girondists, to whose party he was attached, he had to go into hiding. He was, however, discovered and imprisoned in Paris. During his imprisonment he wrote his play *Caton d'Utique* (1794). *Eléonore de Bavières* and *Les Templiers* were accepted by the Comédie Française. *Les Templiers* was produced in 1805, and, in spite of the protests of Geoffroy, had a great success Raynouard was admitted to the Academy in 1807, and from 1817 to 1826 he was perpetual secretary. He wrote other plays, in one of which, *Les États de Blois* (acted 1810), he gave offence to Napoleon by his freedom of speech, but, realizing that the public taste had changed and that the romanticists were to triumph, he abandoned the stage and gave himself up to linguistic studies. He was admitted to the Academy of Inscriptions in 1815. His researches into the Provençal dialect were somewhat inexact, but his enthusiasm and perseverance promoted the study of the subject. His chief works are *Choix de poésies originales des troubadours* (6 vols., 1816–1821), of which the sixth volume, *Grammaire comparée des langues de l'Europe latine dans leurs rapports avec la langue des troubadours* (1821), was separately published; *Lexique roman* (6 vols., 1838–1844). He spent the last years of his life at Passy, where he died on the 27th of October 1836.

RAZGRAD, the capital of the department of Razgrad, Bulgaria, on the river Bieli-Lom, 40 m. S.E. of the Danubian port of Rustchuk by the Varna-Rustchuk railway. Pop. (1906) 13,783, about one-third being Moslems. The railway station is at Inebektchi, 2 m. N. Razgrad possesses a fine mosque, built by Ibrahim Pasha in 1614. Many Turkish families emigrated after the Russo-Turkish War of 1877, but since then the population has again increased, and the town has a thriving agricultural and general trade. Carpet-weaving and viticulture are important local industries. On the 13th of June 1810 and the 14th of August 1877 Razgrad was the scene of battles between the Turks and Russians.

RAZIN, STEPHEN TIMOFEEVICH (d. 1671), Cossack hetman and rebel, whose parentage and date and place of birth are unknown. We first hear of him in 1661 on a diplomatic mission from the Don Cossacks to the Kalmuck Tatars, and in the same year we meet him on a pilgrimage of a thousand miles to the great Solovetsky monastery on the White Sea "for the benefit of his soul." After that all trace of him is lost for six years, when he reappears as the leader of a robber community established at Panshinskoe, among the marshes between the rivers Tishina and Ilovlya, from whence he levied blackmail on all vessels passing up and down the Volga. His first considerable exploit was to destroy the "great water caravan" consisting of the treasury-barges and the barges of the patriarch and the wealthy merchants of Moscow. He then sailed down the Volga with a fleet of thirty-five galleys, capturing the more important forts on his way and devastating the country. At the beginning of 1668 he defeated the voivode Jakov Bezobrazov, sent against him from Astrakhan, and in the spring embarked on a predatory expedition into Persia which lasted for eighteen months. Sailing into the Caspian, he ravaged the Persian coasts from Derbend to Baku, massacred the inhabitants of the great emporium of Resht, and in the spring of 1669 established himself on the isle of Suina, off which, in July, he annihilated a Persian fleet sent against him. Stenka,[1] as he was generally called, had now become a potentate with whom princes did not disdain to treat. In August 1669 he reappeared at Astrakhan, and accepted a fresh offer of pardon from the tsar there; the common people were fascinated by his adventures. The semi-Asiatic kingdom of Astrakhan, where the whole atmosphere was predatory and nine-tenths of the population were nomadic, was the natural *milieu* for such a rebellion as Stenka Razin's. In 1670 Razin, while ostensibly on his way to report himself at the Cossack headquarters on the Don, openly rebelled against the government, captured Cherkask, Tsaritsyn and other places, and on the 24th of June burst into Astrakhan itself. After massacring all who opposed him, and giving the rich bazaars of the city over to pillage, he converted Astrakhan into a Cossack republic, dividing the population into thousands, hundreds and tens, with their proper officers, all of whom were appointed by a *vyecha* or general assembly, whose first act was to proclaim Stephen Timofeevich their *gosudar* (sovereign). After a three weeks' carnival of blood and debauchery Razin quitted Astrakhan with two hundred barges full of troops to establish the Cossack republic along the whole length of the Volga, as a preliminary step towards advancing against Moscow. Saratov and Samara were captured, but Simbirsk defied all efforts, and after two bloody encounters close at hand on the banks of the Sviyaga (October 1st and 4th), Razin was ultimately routed and fled down the Volga, leaving the bulk of his followers to be extirpated by the victors. But the rebellion was by no means over. The emissaries of Razin, armed with inflammatory proclamations, had stirred up the inhabitants of the modern governments of Nizhniy-Novgorod, Tambov and Penza, and penetrated even so far as Moscow and Great Novgorod. It was not difficult to revolt the oppressed population by the promise of deliverance from their yoke. Razin proclaimed that his object was to root out the boyars and all officials, to level all ranks and dignities, and establish Cossackdom, with its corollary of absolute equality, throughout Muscovy. Even at the beginning of 1671 the issue of the struggle was doubtful. Eight battles had been fought before the insurrection showed signs of weakening, and it continued for six months after Razin had received his quietus. At Simbirsk his prestige had been shattered. Even his own settlements at Saratov and Samara refused to open their gates to him, and the Don Cossacks, hearing that the patriarch of Moscow had anathematized Stenka, also declared against him. In 1671 he was captured at Kagalnik, his last fortress, and carried to Moscow, where, on the 6th of June, after bravely enduring unspeakable torments, he was quartered alive.

See N. I. Kostomarov, *The Rebellion of Stenka Razin* (Rus.) (2nd ed., Petersburg, 1859); S. M. Solovev, *History of Russia* (Rus.), vol. ii. (Petersburg, 1895, &c.); R. N. Bain, *The First Romanovs* (London, 1905). (R. N. B.)

RAZOR (O.F. *rasor*, mod. *rasoir*, from *raser*, to scrape, rase, Late Lat. *rasare*, frequentative of *radere*, to scrape), a sharp-edged cutting instrument, used for shaving the hair and beard. The typical razor consists of a blade, usually curving slightly backward, folding into a handle, to which it is fastened by a tang and rivet. The back of the blade is thick and the sides are hollowed or slope to the fine edge (see CUTLERY). In modern times various forms of safety-razor have been invented, in which the blade fits into a fixed handle with a toothed or comb-like shield which protects the face from cutting.

RAZORBILL, or RAZOR-BILLED AUK, known also on many parts of the British coasts as the Marrot, Murre, Scout, Tinker or Willock—names which it, however, shares with the GUILLEMOT (*q.v.*) and to some extent with the PUFFIN (*q.v.*)—a common sea-bird of the North Atlantic,[1] resorting in vast numbers to certain rocky cliffs for the purpose of breeding, and returning to deeper waters for the rest of the year. It is the *Alca torda* of Linnaeus[2] and most modern authors, congeneric with the GARE-FOWL (*q.v.*), if not with the true Guillemots, between which two forms it is intermediate—differing from the former in its small size and retaining the power of flight, which that extinct species had lost, and from the latter in its peculiarly-shaped bill, which is vertically enlarged, compressed, and deeply furrowed, as well as in its elongated, wedge-shaped tail. A fine white line, running on each side from the base of the culmen to the eye, is in the adult bird in breeding-apparel (with rare exceptions) a further characteristic. Otherwise the appearance of all these birds may be briefly described in the same words—head, breast and upper parts generally of a deep glossy black, and the lower parts and tip of the secondaries of a pure white, while the various changes of plumage dependent on age or season are alike in all. In habits the razorbill closely agrees with the true guillemots, laying its single egg (which is not, however, subject to the same variety of coloration as in the guillemot) on the ledges of cliffs, but it is said as a rule to occupy higher elevations, and when not breeding to keep farther out to sea. On the east side of the Atlantic the Razorbill has its breeding stations from the North Cape to Brittany, besides several in the Baltic, while in winter it passes much farther to the southward, and is sometimes numerous in the Bay of Gibraltar, occasionally entering the Mediterranean, but apparently never extending east of Sicily or Malta. On the west side of the Atlantic it breeds from 70° N. lat. on the eastern shore of Baffin's Bay to Cape Farewell, and again on the coast of America from Labrador and Newfoundland to the Bay of Fundy, while in winter it reaches Long Island. (A. N.)

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[1] Steevy.

[1] Schlegel (*Mus. des Pays-Bas*, *Urinatores*, p. 14) records an example from Japan; but this must be in error.

[2] The word *Alca* is simply the Latinized form of this bird's common Teutonic name, *Alk*, of which Auk is the English modification. It must therefore be held to be the type of the Linnaean genus *Alca*, though some systematists on indefensible grounds have removed it thence, making it the sole member of a genus named by Leach, after Aldrovandus (*Ornithologia*, bk. xix. chap. xlix.), *Utamania*—an extraordinary word, that seems to have originated in some mistake from the no less extraordinary *Vuttamaria*, given by Belon (*Observations*, i. c. xi.) as the Cretan name of some diving bird, which could not have been the present species.

RAZZIA (an adaptation of the Algerian Arabic *ghāzīah*, from *ghasw*, to make war), a foray or raid made by African Moslems. As used by the Arabs, the word denotes a military expedition against rebels or infidels, and razzias were made largely for punishment of hostile tribes or for the capture of slaves. English writers in the early years of the 19th century used the form *ghrazzie*, and Dixon Denham in his *Travels* (1826) styles the raiding force itself the ghrazzie. The modern English form is copied from the French, while the Portuguese variant is *gazia*, *gaziva*.

RE, the Egyptian solar god, one of the most important figures in the Pantheon. See EGYPT, section *Egyptian Religion*.

RÉ, ÎLE DE, an island of western France, belonging to the department of Charente-Inférieure, from the nearest mainland point of which it is distant about 2 m. The island has an area of nearly 33 sq. m., with a breadth varying from 1 to 4½ m. and a length of 15 m. It is separated from the coast of Vendée on the N. by the Pertuis Breton, some 6 m. broad, and from the island of Oléron on the S. by the Pertuis D'Antioche, 7½ m. broad. The coast facing the Atlantic is rocky and inhospitable, but there are numerous harbours on the landward side, of which the busiest is La Flotte. Towards the north-west extremity of the island there is a deep indentation, the Fier d'Ars, which leaves an isthmus only 230 ft. wide, strengthened by a breakwater. The north coast is fringed by dunes and by the salt-marshes which are the chief source of livelihood for the inhabitants. Some of them are employed in fishing, oyster-cultivation and the collection of seaweed for manure; the island has corn-lands and vineyards, the latter covering about half its surface, and produces good figs and pears. Apart from its orchards it is now woodless, though once covered by forests. There are two cantons, St Martin (pop. in 1906, 8362) and Ars-en-Ré (pop. 4711) forming part of the arrondissement of La Rochelle. St Martin, the capital, which has a secure harbour and trade in wine, brandy, salt, &c., was fortified by Vauban in 1681 and used to be the depôt for convicts on their way to New Caledonia. In 1627 it repulsed an English force after a siege of three months.

READE, CHARLES (1814–1884), English novelist and dramatist, the son of an Oxfordshire squire, was born at Ipsden, Oxfordshire, on the 8th of June 1814. He entered Magdalen College, Oxford, proceeded B.A. in 1835, and became a fellow of his college. He was subsequently dean of arts, and vice-president of Magdalen College, taking his degree of D.C.L. in 1847. His name was entered at Lincoln's Inn in 1836; he was elected Vinerian Fellow in 1842, and was called to the bar in 1843. He kept his fellowship at Magdalen all his life, but after taking his degree he spent the greater part of his time in London. He began his literary career as a dramatist, and it was his own wish that the word "dramatist" should stand first in the description of his occupations on his tombstone. He was dramatist first and novelist afterwards, not merely chronologically but in his aims as an author, always having an eye to stage-effect in scene and situation as well as in dialogue. His first comedy, *The Ladies' Battle*, appeared at the Olympic Theatre in May 1851. It was followed by *Angelo* (1851), *A Village Tale* (1852), *The Lost Husband* (1852), and *Gold* (1853). But Reade's reputation was made by the two-act comedy, *Masks and Faces*, in which he collaborated with Tom Taylor. It was produced in November 1852, and later was expanded into three acts. By the advice of the actress, Laura Seymour, he turned the play into a prose story which appeared in 1853 as *Peg Woffington*. He followed this up in the same year with *Christie Johnstone*, a close study of Scottish fisher folk, an extraordinary *tour de force* for the son of an English squire, whether we consider the dialect or the skill with which he enters into alien habits of thought. In 1854 he produced, in conjunction with Tom Taylor, *Two Loves and a Life*, and *The King's Rival*; and, unaided, *The Courier of Lyons*—well known under its later title, *The Lyons Mail*—and *Peregrine Pickle*. In the next year appeared *Art*, afterwards known as *Nance Oldfield*.

He made his name as a novelist in 1856, when he produced *It's Never Too Late to Mend*, a novel written with the purpose of reforming abuses in prison discipline and the treatment of criminals. He described prison life with a fidelity which becomes at times tedious and revolting; but the power of the descriptions was undeniable, and the interest was profound. The truth of some of his details was challenged, and the novelist defended himself with vigour against attempts to rebut his contentions. Five minor novels followed in quick succession,—*The Course of True Love never did run Smooth* (1857), *Jack of all Trades* (1858), *The Autobiography of a Thief* (1858), *Love Me Little, Love Me Long* (1859), and *White Lies* (1860), dramatized as *The Double Marriage*. Then appeared, in 1861, his masterpiece, *The Cloister and the Hearth*, relating the adventures of the father of Erasmus. He had dealt with the subject two years before in a short story in *Once a Week*, but, seeing its capabilities, expanded it; and the work is now recognized as one of the finest historical novels in existence. Returning from the 15th century to modern English life, he next produced another startling novel with a purpose, *Hard Cash* (1863), in which he strove to direct attention to the abuses of private lunatic asylums. Three more such novels, in two of which at least the moral purpose, though fully kept in view, was not allowed to obstruct the flow of incident, were afterwards undertaken,—*Foul Play* (1869), in which he exposed the iniquities of ship-knackers, and paved the way for the labours of Samuel Plimsoll; *Put Yourself in his Place* (1870), in which he grappled with the tyrannous outrages of trades-unions; and *A Woman-Hater* (1877), in which he exposed the degrading conditions of village life. The *Wandering Heir* (1875), of which he also wrote a version for the stage, was suggested by the Tichborne trial. Outside the line of these moral and occasional works Reade produced three elaborate studies of character,—*Griffith Gaunt* (1866), *A Terrible Temptation* (1871), *A Simpleton* (1873). The first of these was in his own opinion the best of his novels, and his own opinion was probably right. He was wrong, however, in his own conception of his powers as a dramatist. At intervals throughout his literary career he sought to gratify his dramatic ambition, hiring a theatre and engaging a company for the representation of his own plays. An example of his persistency was seen in the case of *Foul Play*. He wrote this in 1869 in combination with Mr Dion Boucicault with a view to stage adaptation. The play was more or less a failure; but he produced another version alone in 1877, under the title of *A Scuttled Ship*, and the failure was pronounced. His greatest success as a dramatist attended his last attempt—*Drink*—an adaptation of Zola's *L'Assommoir*, produced in 1879. In that year his friend Laura Seymour, who had kept house for him since 1854, died. Reade's health failed from that time, and he died on the 11th of April 1884, leaving behind him a completed novel, *A Perilous Secret*, which showed no falling off in the arts of weaving a complicated plot and devising thrilling situations.

Reade was an amateur of the violin, and among his works is an essay on Cremona violins with the title, *A Lost Art Revived.*

It was characteristic of Reade's open and combative nature that he admitted the public freely to the secrets of his method of composition. He spoke about his method in his prefaces; he introduced himself into one of his novels—"Dr Rolfe" in *A Terrible Temptation*; and by his will he left his workshop and his accumulation of materials open for inspection for two years after his death. He had collected an enormous mass of materials for his study of human nature, from personal observation, from newspapers, books of travel, blue-books of commissions of inquiry, from miscellaneous reading. This vast collection was classified and arranged in huge ledgers and notebooks. He had planned a great work on "the wisdom and folly of nations," dealing with social, political and domestic details, and it was chiefly for this that his collection was destined, but in passing he found the materials useful as a store of incidents and suggestions. A collector of the kind was bound to be systematic, otherwise his collection would have fallen into confusion, and Reade's collection contains many curiosities in classification and tabulation. On the value of this method for his art there has been much discussion, the prevalent opinion being that his imagination was overwhelmed and stifled by it. He himself maintained the contrary; and it must be admitted that a priori critics have not rightly understood the use that he made of his laboriously collected facts. He did not merely shovel the contents of his notebooks into his novels; they served rather as an atmosphere of reality in which he worked, so that his novels were like pictures painted in the open air. His imagination worked freely among them and was quickened rather than impeded by their suggestions of things suited to the purpose in hand; and it is probably to his close and constant contact with facts, acting on an imagination naturally fertile, that we owe his marvellous abundance of incident. Even in his novels of character there is no meditative and analytic stagnation; the development of character is shown through a rapid unceasing progression of significant facts. This rapidity of movement was perhaps partly the result of his dramatic studies; it was probably in writing for the stage that he learned the value of keeping the attention of his readers incessantly on the alert. The hankering after stage effect, while it saved him from dullness, often betrayed him into rough exaggeration, especially in his comic scenes. But the gravest defect in his work is a defect of temper. His view of human life, especially of the life of women, is almost brutal; his knowledge of frailties and vices is obtruded with repellent force; and he cannot, with all his skill as a story-teller, be numbered among the great artists who warm the heart and help to improve the conduct. But as a moral satirist, which was the function he professed over and above that of a story-teller, he did good service, both indirectly in his novels and directly in his own name.

See Charles L. Reade and Compton Reade, *Charles Reade, a Memoir* (2 vols., 1887); A. C. Swinburne, *Miscellanies* (1886); and some recollections by John Coleman, *Charles Reade as I knew him* (1903).

READING, a municipal, county and parliamentary borough and the county town of Berkshire, England, 36 m. W. by S. of London by the Great Western railway. Pop. (1901) 72,217. It is an important junction on the Great Western system, and has communication southward by a joint line of the South-Western and South-Eastern and Chatham companies. The Kennet and Avon canal, to Bath and Bristol, and the Thames, afford it extensive connexions by water. It lies in the flat valley of the Thames on the south (right) bank, where the Kennet joins the main river. The population more than doubled in the last thirty years of the 19th century, and the town is of modern appearance. All the ancient churches are much restored and in part rebuilt. Greyfriars church, formerly monastic, was completed early in the 14th century; and after the dissolution of the monasteries served successively as a town hall, a workhouse and a gaol, being restored to its proper use in 1864. St Mary's is said to have been rebuilt in 1551 from the remains of a nunnery founded by Ælfthryth in expiation of the murder of her stepson Edward the Martyr. St Lawrence's is a large Perpendicular building, and St Giles's, in various styles, was much damaged during the siege of the town in 1643 by the parliamentary forces, and is almost wholly rebuilt. A Benedictine abbey was founded at Reading in 1121 by Henry I., and became one of the richest in England, with a church among the largest in the country. Its founder was buried here, but his monument was destroyed in the time of Edward VI. The church was the scene of John of Gaunt's marriage to Blanche of Lancaster in 1359. By Henry VIII. the abbey was converted into a royal palace, and was so used until its destruction during the civil wars of the 17th century. Little remains of the foundation; only a gateway and a fragment of the great hall, the meeting-place of several parliaments, are of importance. The greater part of the site is occupied by public gardens.

The educational establishments are important. The site of an ancient hospice of St John is occupied by the University Extension College. It was opened in 1892, is affiliated to Oxford University, and has accommodation for 600 students, of both sexes, giving instruction in every main branch of higher university education, agriculture, &c. The grammar school, founded in 1485, occupies modern buildings and ranks among the lesser public schools. Archbishop Laud was educated here, and became a generous benefactor of the school. There are also a blue-coat school (1656), and other charitable schools of early foundation. The municipal museum, besides an art gallery and other exhibits, includes a fine collection of Romano-British relics from Silchester, the famous site not far distant in Hampshire. Besides the public grounds on the site of the abbey there may be mentioned Prospect Park of 131 acres, purchased by the Corporation, and Palmer Park, presented by a member of the firm of Huntley & Palmer, together with extensive recreation grounds.

The industry for which Reading is chiefly famous is the biscuit manufacture, the principal establishment for which is that of Messrs Huntley & Palmer, employing about 5000 hands. In the town and its vicinity are large seed warehouses and testing-grounds. There are also iron foundries, engineering works and factories for agricultural implements, and manufactures of tin boxes, sauces, velvet and silk, and sacking, together with riverside boat-building yards. Reading gives title to a suffragan bishopric in the diocese of Oxford. The parliamentary borough returns one member. The municipal borough is under a mayor, 10 aldermen and 30 councillors. Area, 5876 acres.

Reading (Redinges, Rading, Redding) early became a place of importance. In 871 the Danes encamped here between the Thames and the Kennet, and in 1006 it was burned by Sweyn. It consisted of only thirty houses at the time of the Domesday Survey. There is some reason to think that a fortification existed there before the Conquest, and Stephen probably built a masonry castle which Henry II. destroyed. On the foundation of Reading abbey the town, hitherto demesne of the crown, was granted to the abbey by Henry I. Henceforth, until the 16th century, the chief feature of its history was the struggle as to rights and privileges. This was carried on between the abbey and the merchant gild which claimed to have existed in the time of the Confessor, and the chief officer of which was from the 15th century styled warder or mayor.

A 16th-century account of the gild merchant shows that many trades were then carried on, but Leland says the town "chiefly stondith by clothing." The story of Thomas Cole, written by Deloney (d. *c.* 1600) and purporting to refer to the reign of Henry I., indicates that the industry was carried on at an early date. Archbishop Laud was the son of a Reading clothier. By the 17th century the trade was beginning to decline; the bequest of Kendrich "the Phoenix of worthy Benefactors" did little to revive it, and it was greatly injured by the Civil War. In the 18th century the chief trade was in malt. The first town charter is that given by Henry III. (1253) on behalf of the "burgesses in the Gild Merchant," which was confirmed and amplified by succeeding sovereigns. The governing charter until 1835 was that of Charles I. (1639) incorporating the town under the title of the mayor, aldermen and burgesses. Reading returned two members to parliament from 1295 to 1885, when it was deprived of one; until 1832 the Scot-and-Lot franchise was used. The town surrendered to the parliamentary troops, after a siege, in 1643; it was occupied subsequently by the forces of both parties: in 1688 a skirmish took place in the town between some Irish soldiers of James II. and the troops of William of Orange. The market, chiefly held on Saturday, can be traced to the reign of Henry III.; four fairs granted by the charter of 1562 are still held, that on the 25th of July dating originally from a grant of Henry II. to Reading abbey.

See C. Coates, *History of Reading* (1806); *Victoria County History, Berks.*

READING, a city and the county-seat of Berks county, Pennsylvania, U.S.A., in the S.E. part of the state, on the E. bank of the Schuylkill river, and about 58 m. N.W. of Philadelphia. Pop. (1880) 43,278; (1890) 58,661; (1900) 78,961, of whom 5940 were foreign-born; (1910, census) 96,071. Reading is served by the Pennsylvania and the Philadelphia & Reading railways, by the Schuylkill Canal, which carries freight to Philadelphia, and by electric railways to several villages in Berks county. The city occupies an irregular tract of land gradually descending from the base of Mt. Penn westward to the Schuylkill river, and therefore possesses excellent drainage facilities. The river, which is unnavigable and winding at this point, forms the western boundary of the city for more than 4 m., and is spanned by three public bridges and a number of railway bridges. Neversink Mountain (878 ft. high), lying to the S. of the city, and Mt. Penn (800 ft.), are pleasure resorts in the neighbourhood. On the neighbouring mountains are several summer hotels and sanatoria. Within the city is Penn Common, containing 50 acres, reserved by the Penns for the use of the town when it was first laid out, and since 1878 used as a public park. Mineral Spring Park, containing 63 acres, lies on the outskirts of the city. Other parks are maintained by the street railway companies. In Penn Common are a monument erected to the "First Defenders," to commemorate the fact that the "Ringgold Light Infantry," the first volunteer company to report at Washington for service in the Civil War, came from this city; a monument to President McKinley, and one to the volunteer fire companies of the city. Among interesting landmarks are the Federal Inn (1763), in which President Washington was entertained in 1794, and which has been used as a banking house since 1814; the old county gaol (1770), used as such until 1848; and the site of the "Hessian Camp," where some of the prisoners captured during the War of Independence were confined. Charitable institutions are numerous; among them are the Reading Hospital (1867), St Joseph's Hospital (1873), Homoeopathic Hospital (1891), the Home for Widows and Single Women (1875), the Hope Rescue Mission (1897) for homeless men, the Home for Friendless Children (1888), St Catharine's Female Orphan Asylum (1872), St Paul's Orphan Asylum for Boys, and the House of the Good Shepherd (1889). Other institutions are the public library, which from 1808 to 1898 was a subscription library; the Berks County Law Library; the Berks County Historical Society; and the Harmonie Maennerchor, organized in 1847 and one of the oldest singing societies in the United States.

Lying within the rich agricultural region of the Lebanon and Schuylkill valleys and near vast fields of anthracite coal and iron ore, Reading possesses unusual business and industrial advantages. The chief industry is the manufacture of iron and steel. There are large shops of the Philadelphia & Reading railway here. The total value of factory products in 1905 was $30,848,175 (in 1900 it had been $32,682,061), and the most important of these were the products of steel-works and rolling-mills; the products of railway repair shops; foundry and machine-shop products; hardware, hosiery and knitted goods; cigars and cigarettes, and felt hats. Other important manufactures are bicycles, brick and other clay products, brooms, brushes, and cotton and woollen goods.

Reading was surveyed and laid out as a town in 1748, in accordance with the plans of Thomas and Richard Penn, sons of William Penn, and was named Reading after the county town of Berkshire, England. The first settlers were mostly Germans, but the direction of municipal affairs until the outbreak of the War of Independence was in the hands of the English-speaking inhabitants. As the latter were largely of Loyalist sympathies during the war, the control of the local government then fell into the hands of the German inhabitants. German was long used in Reading; Pennsylvania German (or "Dutch") is still spoken in the surrounding country; and several German periodicals are published in the city, including among them the weekly *Adler* since 1796. During the War of Independence Reading was an inland depôt for supplies for the American army, and prisoners of war were sent here in large numbers. The development of the town dates from the opening in 1824 of the Schuylkill Canal, from Reading to Philadelphia. This was followed in 1828 by the Union Canal, running westward to Lebanon and Middletown, and in 1838 by the entrance into Reading of the Philadelphia & Reading railway. The establishment of these means of communication hastened the development of the natural resources of the region, and Reading early became an industrial centre. A system of water-works, established in 1821, was acquired by the municipality in 1865. Reading was incorporated as a borough in 1783, and was chartered as a city in 1847.

See M. L. Montgomery, *History of Reading, Pennsylvania, and the Anniversary Proceedings of the Sesqui-Centennial* (Reading, 1898).

READING BEDS, in geology, a series of marine and estuarine beds consisting of variegated plastic clays and bright-coloured sands, which form, with the Woolwich beds, a subdivision of the Lower Eocene (see WOOLWICH AND READING BEDS).

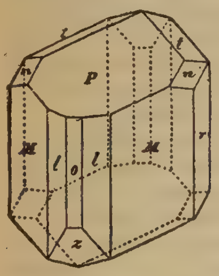
READYMONEY, SIR COWASJI JEHANGIR (1812-1878), "the Peabody of Bombay." Early in the 18th century three Parsee brothers moved from Nowsari, near Surat, in Gujarat, to Bombay, and became the pioneers of a lucrative trade with China. They gained the sobriquet of "Readymoney," which they adopted as a surname. Only Hirji Jewanji Readymoney left issue, two daughters, the elder of whom married a Banaji, and the younger a Dady Sett. The son of the former, Jehangir Hirji, married Mirbae, the daughter of the latter, and was made the heir not only of his grandfather, but of his two granduncles. The younger of their two sons was Cowasji Jehangir. His only English education was at the then well-known school kept by Serjeant Sykes in the Fort of Bombay. At the age of 15 he entered the firm of Duncan, Gibb & Co. as "godown keeper," or warehouse clerk. In 1837 he was promoted to the responsible and lucrative appointment of "guarantee broker" to two of the leading European firms of Bombay. In 1846 he was able to begin trading on his own account. He was made a J.P. for the town and island of Bombay, and a member of the board of conservancy; and in 1866 was appointed a commissioner of income tax, his tactful management being largely responsible for the fact that this tax, then new to Bombay and unpopular, was levied with unexpected financial success. He was made C.S.I. in 1871; and in 1872 he was created a Knight Bachelor of the United Kingdom, and his statue, by T. Woolner, R. A., was erected in the town hall. His donations to the institutions of Bombay amounted to close on £200,000. His health broke down in 1871, and he died in 1878, being succeeded by his son, Sir J. Cowasji Jehangir [Readymoney], who was created a Knight Bachelor in 1895, and a Baronet in 1908.

See J. Cowasji Jehangir, *Sir Cowasji Jehangir Readymoney* (1890).
(M. M. BH.)

REAGAN, JOHN HENNINGER (1818-1905), American politician, was born in Sevier county, Tennessee, on the 8th of October 1818. He removed to Texas in 1839, was deputy surveyor of public lands in 1839-1843, was admitted to the bar in 1846, was a member of the state House of Representatives in 1847–1848, served as district judge in 1852–1857, and in 1857–1861 was a representative in Congress. His political views were determined by the ultra-democratic influence of Andrew Jackson and the state-sovereignty philosophy of John C. Calhoun. In 1861 he was a member of the Texas secession convention, served in the Confederate provisional Congress, and on the 6th of March was appointed postmaster-general in President Davis's cabinet. He served in this capacity throughout the war, and for a short time before its close was also acting secretary of the treasury. He was captured with the Davis party on the 10th of May 1865, and was imprisoned in Fort Warren, Boston Harbour, until the following October. While in prison he wrote the "Fort Warren letter" (August 11th), in which he urged the people of Texas to recognize their defeat, grant civil rights to the freedmen, and try to conciliate the North. From 1875 to 1887, when he entered the U.S. Senate, he was again a representative in Congress, and from 1877 almost continuously to the close of his service he was chairman of the Committee on Commerce, in which capacity he had a prominent part in securing the passage of the Interstate Commerce Act of 1887. He was a member of the state constitutional convention of 1876. In state politics his sympathies were with the Radicals. In 1891, believing that his first duty was to his state, he resigned from the Senate to accept the chairmanship of the newly established state railway commission. In 1901 he retired from public service. From 1899 until his death he was president of the Texas State Historical Association. He died at his home, near Palestine, Texas, on the 6th of March 1905.

See his *Memoirs; with Special Reference to Secession and the Civil War* (New York, 1906), edited by W. F. McCaleb.

REALGAR, a mineral species consisting of arsenic monosulphide (AsS) and occurring as monoclinic crystals of a bright red colour. There is a perfect cleavage parallel to the plane of symmetry (*r* in fig.). The lustre is resinous, and the streak has the same colour as the crystals, namely, orange-red to aurora-red. The hardness is 1½–2 and the specific gravity 3·55. On exposure to light the crystals crumble to a yellow powder. The name realgar is of Arabic origin, and was used by the alchemists; the substance was known to Theophrastus under the name Σανδαράκη, and to Pliny as *Sandaracha*. The mineral usually occurs in association with the yellow arsenic sulphide, orpiment. Good crystals are found with ores of silver and lead in the mineral veins of Felsöbánya, near Nagy-Bánya, Kapnik-Bánya and Nagyág, near Déva, in Hungary; with blende in the white crystalline dolomite of the Binnenthal in Switzerland; and in a bed of sandy clay at Mercur in Utah. It is deposited by the solfataras near Naples and by the hot springs of the Yellowstone National Park. Realgar has been used as a pigment and in pyrotechny for producing a brilliant white fire; but it is now replaced by the artificially prepared compound.



The other native arsenic sulphide, As_2S_3, known as orpiment (Lat. *auripigmentum*, meaning "golden paint"), occurs as foliated masses of a lemon-yellow colour, the foliation being parallel to a direction of perfect cleavage. It is sectile and soft (H. = 1½–2), and has a specific gravity 3·4. Distinctly developed crystals are rare; they have usually been considered to be orthorhombic and isomorphous with stibnite (Sb_2S_3), but it is probable that they are really monoclinic. Orpiment is extensively mined near Julamerk in Asiatic Turkey. (L. J. S.)

REALISM (from Low Lat. *realis*, appertaining to *res*, things, as opposed to ideas and imaginations), a philosophical term used in two opposite senses. The older of these is the scholastic doctrine, traceable back to Socrates, that universals have a more "real" existence than things. Universals are, in scholastic language, *ante res, in rebus* and *post res*. Behind all numerous types of chairs there is in the mind the ideal chair of which particular chairs are mere copies. In the most extreme form realism denies that anything exists in any sense except universals. It is opposed to nominalism (*q.v.*) and conceptualism (*q.v.*). For the history of the doctrine, see SCHOLASTICISM. Realism in this sense has been called "an assertion of the rights of the subject" (cf. the Protagonean maxim, "Man is the measure of all things"). The modern application of the term is to the opposing doctrine that there is a reality apart from its presentation to consciousness. In this sense it is opposed to idealism (*q.v.*), whether the purely subjective or that more comprehensive idealism which makes subject and object mutually interdependent. In its crude form it is known as "Natural" or "Naive" Realism. It appears, however, in more complex forms, *e.g.* as Ideal Realism (or Real Idealism), which combines epistemological idealism with realism in metaphysics. Again, Kant distinguishes "empirical" realism, which maintains the existence of things in space independent of consciousness, from "transcendental" realism, which ascribes absolute reality to time and space.

In literature and art "realism" again is opposed to "idealism" in various senses. The realist is (1) he who deliberately declines to select his subjects from the beautiful or harmonious, and, more especially, describes ugly things and brings out details of an unsavoury sort; (2) he who deals with individuals, not types; (3) most properly, he who strives to represent the facts exactly as they are.

REALM, the dominions of a king, a kingdom. The O.Fr. *reaume* (mod. *royaume*) was the form first adopted in English, and the modern spelling does not appear fixed till the beginning of the 17th century. The word must be referred to a supposed Med. Lat. *regalimen*, from *regalis*, of or belonging to a *rex*, king.

REAL PROPERTY. The land law of England and of countries whose law is based upon that of England stands in a peculiar position, which can be understood only by an outline of its history.

History.—Such terms as "fee" or "homage" carry us back into feudal times. Rights of common and distress are based upon still older institutions, forming the very basis of primitive law. The conception of tenure is the fundamental ground of distinction between real and personal estate, the former only being strictly entitled to the name of estate (*q.v.*). The division into real and personal is coincident to a great extent with that into immovable and movable, generally used by systems of law founded on the Roman (see PERSONAL PROPERTY.) That it is not entirely coincident is due to the influence of the Roman law itself. The Greeks and the Romans of the republic were essentially nations of citizens; the Teutons were essentially a nation of land-folk; the Roman empire bridged the gulf between the two. It is probable that the English land law was produced by the action of the policy adopted in the lower empire, finally developed into feudalism, upon the previously existing course of Teutonic custom. The distinguishing features of the Teutonic system were enjoyment in common and the absence of private ownership, except to a limited extent. The principal features of the old English land law before the Conquest, from which the modern law has developed, were (1) liberty of alienation, either by will or *inter vivos*, of such land as could be alienated, chiefly, if not entirely, bocland, subject always to the limits fixed by the *boc*; (2) publicity of transfer by enrolment in the shire-book or church-book; (3) equal partition of the estate of a deceased among the sons, and failing sons among the daughters; (4) cultivation to a great extent by persons in various degrees of serfdom, owing money or labour rents; (5) variety of custom, tending to become uniform, through the application of the same principles in the local courts; (6) subjection of land to the *trinoda necessitas*, a burden imposed for the purpose of defence of the realm. The rudiments of the conceptions of tenure and of the crown as lord paramount were found in the old English system, and lænland was an anticipation of the limited interests which afterwards became of such importance.[1] The connexion of political privileges with the ownership of land is not peculiar to the pre-Conquest or any other period. It runs through the whole of English history.

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[1] The name has not remained as in Germany and Denmark. A fief is still *Lehen* in Germany, *Lehn* in Denmark.

The elements of feudalism so far existed in England under the Anglo-Saxon and Danish kings as to make it easy to introduce it in full at the Norman Conquest. What the Norman Conquest did was not to change all at once allodial into feudal tenure, but to complete the association of territorial with personal dependence in a state of society already prepared for it.[1] "Nulle terre sans seigneur" was one of the fundamental axioms of feudalism. There might be any number of infeudations and subinfeudations to mesne lords, but the chain of seigniory was complete, depending in the last resort upon the king as lord paramount. Land was not owned by free owners owing only necessary militia duties to the state, but was held of the king by military service of a more onerous nature. The folkland became the king's land; the soldier was a landowner instead of the landowner being a soldier. Free owners tended to become tenants of the lord, the township to be lost in the manor.[2] The common land became in law the waste of the manor, its enjoyment resting upon a presumed grant by the lord. On the other hand, the whole of England did not become manorial; the conflict between the township and the manor resulted in a compromise, the result of which affects English tenure to this day. But it was a compromise much to the advantage of the privileged class, for in England more than in any other country the land law is the law of the nobility and not of the people. One reason of this is that, as England was never so completely feudalized as were some of the European continental states, the burden of feudalism was not so severely felt, and has led to less agitation for reform.

The land forfeited to the Conqueror was regranted by him to be held by military service due to the king, not to the mesne lord as in European continental feudalism. In 1086 at the council of Salisbury all the landholders swore fealty to the crown. In the full vigour of feudalism the inhabitants of England were either free or not free. The free inhabitants held their lands either by free tenure (*liberum tenementum*, franktenement) or by a tenure which was originally that of a non-free inhabitant, but attached to land in the possession of a free man. Franktenement was either military tenure, called also tenure in knight service or chivalry (including barony, the highest tenure known to the law, grand serjeanty and the special forms of escuage, castle-guard, cornage and others) or socage (including burgage and petit serjeanty), or frankalmoign (*libera eleemosyna*) or divine service, by which ecclesiastical corporations generally held their land.[3] The non-free inhabitants were in Domesday Book *servi*, *cotarii* or *bordarii*, later *nativi* or *villani*, the last name being applied to both free men and serfs. All these were in a more or less dependent condition. The free tenures all exist at the present day, though, as will appear later, the military tenures have shrunk into the unimportant and exceptional tenure of grand serjeanty. The non-free tenures are to a certain extent represented by copyhold. The most important difference between the military and socage tenures was the mode of descent. Whether or not a feudal benefice was originally hereditary, it had certainly become so at the time of the Conquest, and it descended to the eldest son. This applied at once in England to land held by military service as far as regarded the capital fief. The descent of socage lands or lands other than the capital fief for some time followed the old pre-Conquest rule of descent. Thus in the so-called "Laws of Henry I." the lands other than the capital fief, and in Glanvill, who wrote in the time of Henry II., socage lands, if anciently partible (*antiquitus divisum*), were divided among all the sons equally. But by the time of Bracton (Henry III.) the course of descent of lands held by military service had so far prevailed that, though it was a question of fact whether the land was partible or not, if there was no evidence either way descent to the eldest son was presumed. Relics of the old custom still remain in the case of gavelkind. The military tenant was subject to the feudal incidents, from which the tenant in socage was exempt. These incidents, especially wardship and marriage, were often oppressive. Alienation of lands by will, except in a few favoured districts, became impossible; alienation *inter vivos* was restrained in one direction in the interests of the heir, in another in the interests of the lord. At the time of Glanvill a tenant had a greater power of alienation over land which he had purchased (*terra acquietata*) than over land which he had inherited. But by the time of Bracton the heir had ceased to have any interest in either kind of land. The lords were more successful. It was enacted by Magna Carta that a free man should not give or sell so much of his land as to leave an amount insufficient to perform his services to his lord. In spite of this provision, the rights of the lords were continually diminished by subinfeudation until the passing of the Statute of *Quia Emptores*. Alienation by a tenant in chief of the crown without licence was a ground of forfeiture until 1 Edw. III. st. 2, c. 12, by which a fine was substituted. The modes of conveyance at this time were only two, feoffment with livery of seisin for corporeal hereditaments, grant for incorporeal hereditaments. Livery of seisin, though public, was not officially recorded like the old English transfer of property. The influence of local custom upon the land law must have become weakened after the circuits of the judges of the King's Court were established by Henry II. Jurisdiction over litigation touching the freehold was taken away from the lord's courts by 15 Ric. II. c. 12.

The common law as far as it dealt with real estate had in the main assumed its present aspect by the reign of Henry III. The changes which have been made since that date have been chiefly due to the action of equity and legislation, the latter sometimes interpreted by the courts in a manner very different from the intention of parliament. The most important influence of equity has been exercised in mortgage and trusts in the doctrine of specific performance of contracts concerning real estate, and in relief from forfeiture for breach of covenant.

History of Real Estate Legislation.—The reign of Edward I. is notable for three leading statutes, all passed in the interests of the superior lords. The Statute of Mortmain (7 Edw. I. st. 2, c. 13) is the first of a long series directed against the acquisition of land by religious and charitable corporations. The statute *De Donis Conditionalibus* (13 Edw. I. c. 1) forbade the alienation of estates granted to a man and the heirs of his body, which before the statute became on the birth of an heir at once alienable (except in the case of gifts in frankmarriage), and so the lord lost his escheat. The statute *Quia Emptores* (18 Edw. I. c. 1) preserved those rights of the lords which were up to that time subject to be defeated by subinfeudation, by enacting that in any alienation of lands the alienee should hold them of the same lord of the fee as the alienor.[4] Since 1290 it has been impossible to create an estate in fee-simple to be held of a mesne lord, or to reserve a rent upon a grant of an estate in fee (unless in the form of a rent-charge), or to create a new manor. The statute, however, does not bind the crown. The practical effect of the statute was to make the transfer of land thenceforward more of a commercial and less of a feudal transaction. The writ of *elegit* was introduced by the Statute of Westminster II. in 1285 as a creditor's remedy over real estate. It has, however, been considerably modified by subsequent legislation. From 1290 to the reign of Henry VIII., there is no statute of the first importance dealing with real estate. The reign of Henry VIII., like the reign of Edward I., is signalized by three acts, the effects of which continue to this day. The one which has had the most lasting influence in law is the Statute of Uses, 27 Hen. VIII. c. 10 (see CONVEYANCING; TRUST). The Statute of Uses was intended to provide against secrecy of sales of land, and as a necessary sequel to it an act of the same year (27 Hen. VIII. c. 16) enacted that all bargains and sales of land should be duly enrolled. Bargain and sale was a form of equitable transfer which had for some purposes superseded the common law feoffment. It applied only to estates of inheritance and not to terms of years. The unforeseen effect of 27 Hen. VIII. c. 16 was to establish as the ordinary form of conveyance until 1841 the conveyance by lease and release.[1] Uses having become legal estate by the Statute of Uses, and therefore no longer devisable, 32 Hen. VIII. c. 1 (explained by 34 & 35 Hen. VIII. c. 5) was passed to remedy this inconvenience. It is still law as to wills made before 1838 (see WILL). In the reign of Elizabeth the acts of 13 Eliz. c. 5 and 27 Eliz. c. 4 avoided fraudulent conveyances as against all parties and voluntary conveyances as against subsequent purchasers for valuable consideration. Early in the reign of Charles II. the act of 1661 (12 Car. II. c. 24) turned all the feudal tenures (with the exception of frankalmoign and grand serjeanty) into tenure by free and common socage and abolished the feudal incidents. The Statute of Frauds (29 Car. II. c. 3) contained provisions that certain leases and assignments, and that all agreements and trusts relating to land, should be in writing (see FRAUD). The land registries of Middlesex and Yorkshire date from the reign of Anne (see LAND REGISTRATION). Devises of land for charitable purposes were forbidden by the Mortmain Act (9 Geo. II. c. 36). In the next reign the first general Inclosure Act was passed, 41 Geo. III. c. 109 (see COMMONS). In the reign of William IV. were passed the Prescription, Limitation and Tithe Commutation Acts; fines and recoveries were abolished and simpler modes of conveyance substituted by 3 & 4 Will. IV. c. 74; and the laws of inheritance and dower were amended by 3 & 4 Will. IV. cc. 105, 106. In the reign of Victoria there was a vast mass of legislation dealing with real estate in almost every conceivable aspect. At the immediate beginning of the reign stands the Wills Act. The transfer of real estate was simplified by 8 & 9 Vict. c. 106 and by the Conveyancing Acts of 1881 and 1882. Additional powers of dealing with settled estates were given by the Settled Estates Act 1856, later by the Settled Estates Act 1877, and the Settled Land Act 1882. Succession duty was levied for the first time on freeholds in 1853. The strictness of the Mortmain Act has been relaxed in favour of gifts and sales to public institutions of various kinds, such as schools, parks and museums. The period of limitation was shortened for most purposes from twenty to twelve years by the Real Property Limitation Act 1874. Several acts were passed dealing with the enfranchisement and commutation of copyholds and the preservation of commons and open spaces. The Naturalization Act 1870 enabled aliens to hold and transfer land in England. The Felony Act 1870, abolished forfeiture of real estate on conviction for felony. The Agricultural Holdings Acts 1883 and 1900, and other acts, gave the tenant of a tenancy within the acts a general right to compensation for improvements, substituted a year's notice to quit for the six months' notice previously necessary, enlarged the tenant's right to fixtures, and limited the amount of distress. By the Intestate Estates Act 1884 the law of escheat was extended to incorporeal hereditaments and equitable estates. Among other subjects which have been dealt with by legislation in the 19th century may be mentioned land transfer, registration, mortgage, partition, excambion, fixtures, taking of land in execution, declaration of title and apportionment. Hardly a year passes in which the land law is not altered to a greater or less degree.

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[1] "The relation of vassalage, originally personal, became annexed to the tenure of land" (Palgrave, *Rise and Progress of the English Commonwealth*, vol. i. p. 505).

[2] It is a disputed point whether the manor organization existed before the Conquest; but its full development seems to have been later than that event.

[3] Frankalmoign was not always regarded as a distinct tenure. Thus Littleton (§ 118) says that all that is not tenure in chivalry is tenure in socage.

[4] Tenants in chief of the crown were liable to a fine on alienation until 12 Car. II. c.

Real estate at the present day is either legal or equitable, a difference resting mainly upon historical grounds. The following observations apply in general to both kinds of estate. The usual classification of interests in real estate regards either the extent, the time or the mode of enjoyment. The division according to the *extent* is in the first instance into corporeal and incorporeal hereditaments, a division based upon the Roman law division of *res* into *corporales* and *incorporales*, and open to the same objection, that it is unscientific as co-ordinating subjects of rights with the rights themselves.[2] Corporeal hereditaments, says Blackstone, "consist of such as affect the senses, such as may be seen and handled by the body; incorporeal are not the objects of sensation, can neither be seen nor handled, are creatures of the mind, and exist only in contemplation." Corporeal hereditaments are all necessarily freehold;[3] an interest in land less than freehold, such as a term of years, is personalty only. There was no room for such an interest in the feudal gradation of tenure; it was regarded as a mere personal contract and was incapable of the incidents of tenure. By the Conveyancing Act 1881 the residue of a long term of years could in certain cases be enlarged into the fee-simple. A copyhold is in strict law only a tenancy at the will of the lord. Estates of freehold are either estates for life or in fee (called also estates of inheritance), the latter being in fee-tail or in fee-simple. An estate for life may be either for the life of the tenant or for the life of another person, the latter called an estate *pur autre vie*. The former kind of estate includes estates of dower and curtesy. An estate in fee is called a fee simply, an obvious sign of its feudal origin. Estates tail are either general or special, the latter being in tail male or (rarely) in tail female. There may also be a quasi-entail of an estate *pur autre vie*. An estate in fee-simple is the largest estate known to English law. Its ordinary incidents are an oath of fealty (never exacted), escheat, and (in a manor) suit of the court baron, and occasionally a small quit-rent and relief. All these are obviously relics of the once important feudal incidents. Incorporeal hereditaments consist chiefly, if not wholly, of rights *in alieno solo*. They are divided by Joshua Williams (*Real Property*, pt. ii.) into (1) reversions, remainders and executory interests, (2) hereditaments purely incorporeal, the last being either appendant, appurtenant or in gross. Examples are profits *a prendre* (such as rights of common), easements (such as rights of way),[4] seigniories, advowsons, rents, tithes, titles of honour, offices, franchises. Before 1845 corporeal hereditaments were said to lie in livery, incorporeal in grant. But by the Real Property Act 1845 all corporeal hereditaments are, as regards the conveyance of the immediate freehold thereof, to be deemed to lie in grant as well as in livery. With regard to the *time* of enjoyment, estates are either in possession or in expectancy—that is, in reversion or remainder or executory interests (see REMAINDER). With regard to the *mode* of enjoyment, estates are either joint, in common, in coparcenary or in severalty.

Exceptional Tenures.—It has been already stated that there are still to be found survivals of the old pre-Conquest customary law. They are found both in the tenure and in the conveyance of land. The only customs of which judicial notice is taken are gavelkind (*q.v.*) and borough-English (*q.v.*). Any other local customs, as in manors, must be proved by evidence. The tenures of frankalmoign and grand serjeanty were specially preserved by 12 Car. II. c. 24.

Title.—This is the name given to the mode of acquisition of rights over real estate. Title may arise either by alienation, voluntary or involuntary, or by succession. Voluntary alienation is either *inter vivos* or by will. The former branch is practically synonymous with conveyance, whether by way of sale, settlement, mortgage or otherwise. As a general rule alienation of real estate *inter vivos* must be by deed since 8 & 9 Vict. c. 106. Since that act a deed of grant has superseded the old forms of feoffment and lease and release. Considerable alterations in the direction of shortness and simplicity have been made in the law of transfer of real estate by the Conveyancing Acts 1881, 1882 and the Land Transfer Acts 1875 and 1897. The word "grant" is no longer necessary for a conveyance, nor are the old words of limitation "heirs" and "heirs of the body." It is sufficient to use the words "in fee-simple," "in tail," "in tail male," "in tail female." Many provisions usually inserted in deeds, such as covenants for title by a beneficial owner and powers of appointment of new trustees, obtain statutory sanction. Forms of mortgage, conveyance and settlement are appended to the act. The Solicitors' Remuneration Act 1881 was passed as a necessary sequel to the Conveyancing Act, and the remuneration of solicitors now stands upon a different and more satisfactory basis. For acquisition by will and succession, see WILL; INHERITANCE. Involuntary alienation is by bankruptcy (*q.v.*) and by other means of enforcing the rights of creditors over land, such as distress or execution. It may also arise by the exercise by the state of its right of eminent domain for public purposes, as under the Lands Clauses and other acts.[5]

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[1] From the reign of Edward IV. at latest up to the Fines and Recoveries Act of 1833 fines and recoveries were also recognized as a means of conveyance. They are so regarded in the Statute of Uses.

[2] In spite of this objection the division is adopted by the legislature; see, for instance, the Intestate Estates Act 1884.

[3] In the category of corporeal hereditaments are also included certain accessories to corporeal hereditaments proper, such as growing crops, fixtures, title-deeds, &c.

[4] It should be noticed that an easement in gross cannot exist.

[5] The right of the state to contribution from land for revenue purposes and to stamp duties on deeds perhaps falls under this head. These imposts are really involuntary alienations of part of the profit of the land.

Restraints on Alienation.—The alienation of real estate may be subject to almost any conditions, provided that such conditions do not contravene the law. As a general rule there can be no restrictions upon the alienation of an estate in fee-simple; the two ideas are incompatible. In the case, however, of a married woman a restraint on anticipation is allowed within certain limits (see RESTRAINT). In another direction the imposition of a course of devolution upon property is forbidden by the law against perpetuities (see PERPETUITY), while the accumulation of income is also forbidden with a few exceptions. Certain persons are by the general policy of the law disabled from exercising full proprietary rights, such as convicts, infants and lunatics.

Procedure.—In some cases rights attaching to real estate are protected by peculiar remedies. At an early period it became more convenient to try the right to the possession of, rather than the right to the property in, real estate. Possessory tended to supersede proprietary remedies, from their great simplicity and elasticity. The general mode of trying the right to both property and possession was from the time of Henry II. the real action, the form called "writ of right" (after Magna Carta gradually confined to the court of common pleas) being used to determine the property, that called "assise of novel disseisin" being the general means by which the possession was tried. About the reign of Elizabeth the action of ejectment became the ordinary form of possessory remedy. Real actions existed until the Real Property Limitation Act 1833, by which they were finally abolished, with the exception of writ of right of dower, writ of dower *unde nihil habet, quare impedit* and ejectment. Of these quare impedit (*q.v.*) appears to be the only one now in use. The assise of novel disseisin, the action of ejectment in both its original and its reformed stage, and finally the action for the recovery of land in use since the Judicature Acts are all historically connected as gradual developments of the possessory action. There are certain matters affecting real estate over which the court of chancery formerly had exclusive jurisdiction, in most cases because the principles on which the court acted had been the creation of equity. The Judicature Act 1873 assigned to the chancery division of the high court of justice all causes and matters for (*inter alia*) the redemption or foreclosure of mortgages, the raising of portions or other charges on land, the sale and distribution of the proceeds of property subject to any lien or charge, the specific performance of contracts between vendors and purchasers of real estates, including contracts for leases, the partition or sale of real estates, and the wardship of infants and the care of infants' estates. In the case of rent a summary mode of remedy by act of the creditor still exists (see DISTRESS, RENT).

Ireland.—The law of real estate in Ireland is the English law, which finally superseded the native law in James I.'s reign, as modified by subsequent legislation. The main difference is in the law of landlord and tenant, modified by the various land acts (see IRELAND) and the operation of the Irish Land Commission.

United States.—The law of real estate in the United States is the law of England modified to suit a different state of circumstances. The main point of difference is that in the United States the occupiers of land are generally wholly or in part owners, not tenants, as in England. This is to a great extent the effect of the homestead laws (see HOMESTEAD AND EXEMPTION LAWS). The traces of the feudal origin of the law are, as might be expected, considerably less prominent than in England. Thus estates tail are practically obsolete; in some states they are specially forbidden by the state constitutions. The law of descent is the same in real and personal estate. Manors do not exist, except in the state of New York, where they were created by the crown in colonial days (Bouvier, *Law Dict.*, "Manor"). Registration of deeds is general. In some states forms of deed are prescribed by statute. Conveyancing is for the most part simpler than in England. The holding of real estate by religious or charitable corporations is generally restricted by the act creating them rather than by anything like the English law of mortmain. Perpetuities are forbidden in most states. The right of eminent domain is at once acknowledged and limited by the Constitution of the United States. By art. 5 of the Amendments private property is not to be taken for public use without just compensation. A similar provision is found in many of the state constitutions. By an Act of Congress of 9th April 1866, c. 31, all citizens of the United States have the same right in every state and Territory as is enjoyed by white citizens thereof to inherit, purchase, lease, sell, hold and convey real and personal property. In most states aliens may hold land; but in some states they cannot do so without becoming naturalized or at least filing in the specified manner a declaration of intention to become naturalized.

International Law.—The law of the place where real estate is situated (*lex loci rei sitae*) governs its tenure and transfer. The laws of England and of the United States are more strict on this point than the laws of most other countries. They require that the formalities of the *locus rei sitae* must be observed, even if not necessary to be observed in the place where the contract was made. The *lex loci rei sitae* determines what is to be considered real estate. A foreign court cannot as a general rule pass title to land situated in another country. The English and United States courts of equity have to a certain extent avoided the inconvenience which this inability to deal with land out of the jurisdiction sometimes causes by the use of the theory that equity acts upon the conscience of the party and not upon the title to the foreign land. Thus in the leading case of *Penn.* v. *Lord Baltimore* in 1750 (1 Vesey, 444) the court of chancery on this ground decreed specific performance of articles for settling the boundaries of the provinces of Pennsylvania and Maryland. The difficulty always arises that, although the court professes to act upon the conscience, it must indirectly act upon the property, and that it cannot carry its decision into execution without the aid of the local tribunals.

REAM (either through Du. *riem*, or O.Fr. *rayme, reyme*, mod. *rame*, Med. Lat. *risma*, from Arabic *rizmah*, bale or bundle), a certain quantity of paper, viz. 20 quires containing 24 sheets each or 480 sheets; a "printer's ream" contains 21½ quires or 516 sheets. The word owes its introduction into Europe to the Moors, who were the originators of the paper manufactured in Spain. Its original meaning was simply bundle, applied either to paper or clothes.

REAPING (from O.E. *rīpan, rypan*, probably allied to "ripe," mature, *i.e.* "fit for reaping"; the cognate forms are found in other languages), the action of cutting ripe grain crops. Till the invention of the reaping machine, which came into practical use only about the middle of the 19th century, sickles and scythes were the sole reaping implements. Of the two the sickle is the more ancient, and indeed there is some reason to conclude that its use is coeval with the cultivation of grain crops. Among the remains of the later Stone period in Great Britain and on the European continent curved flint knives have occasionally been found, the form of which has led to the suggestion that they were used as sickles. Sickles of bronze occur quite commonly among remains of the early inhabitants of Europe. Some of these are deeply curved hooks, flat on the under side, and with a strengthening ridge or back on the upper surface, while others are small curved knives, in form like the ordinary hedge-bill. Among the ancient Egyptians toothed or serrated sickles of both bronze and iron were used. Ancient Roman drawings show that both the scythe and the sickle were known to that people, and Pliny makes the distinction plain.[1] Although both implements have lost much of their importance since the general introduction of mowing and reaping machinery, they are still used very extensively, especially in those countries like France where small agricultural holdings prevail. The principal modern forms are the toothed hook, the scythe book, the Hainault scythe and the common scythe.

The toothed hook, which was in general use till towards the middle of the 19th century, consisted of a narrow-bladed curved hook, having on its cutting edge a series of fine close-set serratures cut like file-teeth, with their edges inclined towards the heft or handle. The curve is that known to mathematicians as the "cissoid," where tangents at any point form equal angles with lines drawn to the middle of the handle: it has been called the "curve of least exertion" because experience has shown that it tires out the arm of the worker less than any other curve. Sickles were formerly made of iron edged with steel; but in recent times they came to be made of cast steel entirely. Towards the middle of the 19th century the toothed hook was gradually supplanted by the scythe hook or smooth-edged sickle, a somewhat heavier and broader-bladed implement, having an ordinary knife edge. Both these implements were intended for "shearing" handful by handful, the crop being held in the left hand and cut with the tool held in the right. A heavy smooth-edged sickle is used for "bagging" or "clouting," —an operation in which the hook is struck against the straw, the left hand being used to gather and carry along the cut swath. The Hainault scythe is an implement intermediate between the scythe and the sickle, being worked with one hand, and the motion is entirely a swinging or bagging one. The implement consists of a short scythe blade mounted on a vertical handle, and in using it the reaper collects the grain with a crook, which holds the straw together till it receives the cutting stroke of the instrument. The Hainault scythe was extensively used in Belgium. The common hay scythe consists of a slightly curved broad blade varying in length from 28 to 46 in., mounted on a bent, or sometimes straight, wooden sned or snathe, to which two handles are attached at such distances as enable the workman, with an easy stoop, to swing the scythe blade along the ground, the cutting edge being slightly elevated to keep it clear of the inequalities of the surface. The grain-reaping scythe is similar, but provided with a cradle or short gathering rake attached to the heel and following the direction of the blade for about 12 in. The object of this attachment is to gather the stalks as they are cut and lay them in regular swaths against the line of still-standing corn. The reaping scythe, instead of a long sned, has frequently two helves, the right hand branching from the left or main helve and the two handles placed about 2 ft. apart. The best scythe blades are made from rolled sheets of steel, riveted to a back frame of iron, which gives strength and rigidity to the blade. On the continent of Europe it is still common to mould and hammer the whole blade out of a single piece of steel, but such scythes are difficult to keep keen of edge. There is a great demand for scythes in Russia, chiefly supplied from the German empire and Austria. The principal manufacturing centre of scythes and sickles in the United Kingdom is Sheffield.

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[1] "Of the sickle there are two varieties, the Italian, which is the shorter and can be handled among brushwood, and the two-handed Gallic sickle, which makes quicker work of it when employed on their [the Gauls'] extensive domains; for there they cut their grass only in the middle, and pass over the shorter blades. The Italian mowers cut with the right hand only" (*H. N.* xviii. 67).

It was not until the beginning of the 19th century that any attempt was made to invent a reaping machine on anything like the lines that have been adopted since. In 1826 the Rev. Patrick Bell of Carmylie in Fifeshire brought out the first successful machine. He had worked at the making of it when a young man on his father's farm, and the principle he adopted, that of a series of scissors fastened on the "knife-board," was followed for a long time. There had been many trials during the thirty or forty years before his time both in this country and in America, but his invention was the first practical success.

After many modifications, however, the present or recent form of the common reaper was evolved by C. H. McCormick in America in 1831. A truck or carriage is carried on two travelling wheels some 30 to 36 in. high, with spuds or teeth on the circumference to make them "bite" the ground and thus give motion to the machinery without skidding; two horses are yoked in front with a pole between, with martingale and surcingle belts as part of their harness, to ease the backing of the machine by the horses; the knife-board is fixed out at right angles to the side of the carriage and in front, while the knives consist of a series of triangular "sections" on a bar which travels backwards and forwards in slots in the "fingers," as the dividing teeth are called. The motion was given to the knives by a connecting rod and crank driven by suitable gearing from the truck wheels. The cutting was thus done by a straight shearing action and not by clipping like scissors as in Bell's machine.

There were many modifications tried before the favourite form was ultimately adopted: thus the horses were yoked behind the truck or carriage of the machine so that they pushed it before them; a revolving web of cloth was placed behind the knives so as to deliver the cut corn in a continuous swathe at the side; revolving "sails" or "rakes" pushed the standing grain against the knives as the machine advanced—some of which arrangements have been revived in our modern string-binders—and so on.

In the early days—from about 1860 to 1870—machines were fitted with a tilting board behind the cutting bar which caught the corn as it fell, and it was held there until enough for a sheaf was gathered, when the load was "tilted" off by a suitable rake handled by a man who sat and worked the tilting board simultaneously with his foot and dropped the corn, to be lifted and tied into a sheaf by hand afterwards. The same machine was generally used for mowing (grass) by an interchange of parts, and the "combined" reaper and mower was in common use in the 'seventies and 'eighties. Later, various devices were adopted to do the tilting or sheafing mechanically, and the self end-delivery and self side-delivery have long been in use whereby through the adoption of revolving rakes on frames the sheaf-lots are delivered in sizes ready for tying up by hand. The subsequent tying or binding was done variously in different parts of the country. In the south of England it was customary for five men to make bands, lift the sheaf-lot, place in the band and tie, and leave the sheaf lying on the ground to be set up afterwards, the gang of five being expected to keep up on a reaper cutting round the four sides of a field. In the north and in Scotland the cutting was only done on one side at a time, the machine riding back empty, and three boys made the bands ("straps"), three women lifted the lots and laid them on the bands, and three men bound the sheaves and set up in stooks. Thus three gangs of three each were required to keep a machine going, and only about five acres per day could be reaped in this way.

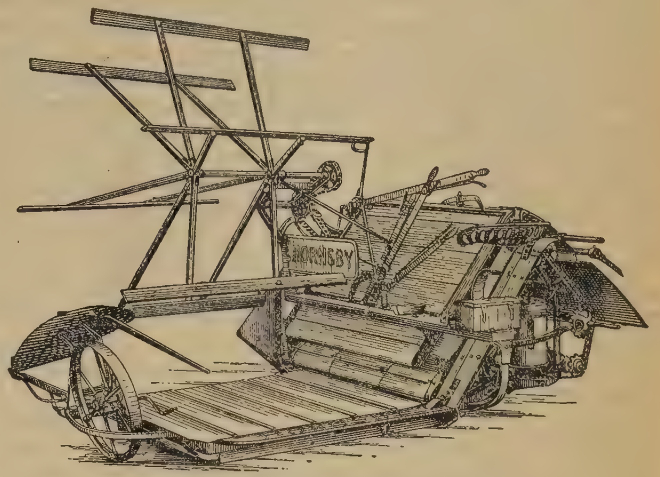

Fig. 1.—The Hornsby String-binder.

The development of the modern binder to reduce all this labour has been a very gradual process. There was no great difficulty in cutting the corn and delivering the stuff, but the tying of it into sheaves was the problem to be solved. As early as 1858 Marsh in America designed and carried out an arrangement whereby the cut grain crop was caught on revolving webs of canvas and carried up on to a table, where two men stood who made bands of its own material and bound it into sheaves as it fell in front of them, dropping the sheaves off on to the ground as made, while the machine travelled along. The invention of a tying apparatus was the next advance, and in the 'seventies the American firm of Walter A. Wood & Co. brought out an arrangement for tying the sheaves up with wire. So slow and expensive had been the process of evolution, however, that it was reported at the time that the above firm had spent £20,000 in invention and experiment before they had even a wire-binder fit to put on the market.

Binding with string, however, was the aim of all, and it was reserved for J. F. Appleby, an English inventor, to hit on the arrangement now in use, or which was the prototype of all the knotters now to be met with in different varieties of the string-binder throughout the world.

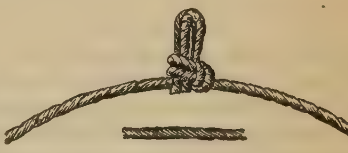

Fig. 2.—The Hornsby Knot as tied by the String-binder.

While the string-binder is now in universal use in Great Britain, the British Colonies, America and all countries where farming and farm work are advanced, and hand labour is only followed where peasant-farming or small farming obtains, it must be noted that in certain regions the system of reaping or harvesting of corn crops has developed a good deal beyond this. In Australia and some of the hotter districts in the west of the United States the "stripper" is in use, an implement which carries long grooved teeth which are passed through the standing grain crop and strip off the heads, leaving the straw standing. The heads are passed backwards to a thrashing (rubbing) arrangement, which separates the corn from the chobs, chaff, &c., and the grain is sacked up straight away. The sacks are dropped off the machine as the work proceeds and are picked up by wagon for transport afterwards. It is a significant fact that strippers worked by hand, though pushed through the crop by oxen, were in use on the plains of Gaul in the first century of our era, though this system seems to have been lost sight of till re-invented by the Australians.

Again, in the Western states of America, where the climate is not hot and dry enough for stripping purposes, the method followed is to cut the straw as short as possible—just below the heads—and these fall on to a travelling canvas and are carried up into a thrasher and the grain separated and sacked as the work proceeds. An immense combined implement is used for this reaping and thrashing purpose, taking a width of up to 40 ft. of crop at a time, and being propelled by a 50-horse-power traction engine running on broad roller-wheels, though smaller machines pulled by, say, 20 horses are also common. Sometimes the "heading" only is carried out, and the cut heads carried on a canvas up into a wagon travelled alongside, and then carted away for subsequent thrashing, the "header" thus being the form of reaper adopted also in the Western states of America. In these regions, as in many other places on the prairies in general, the straw is of no value, and therefore the whole is set fire to and burned off, thus returning a certain amount of fertility to the soil in the ashes.

In the normal and ordinary system of reaping with the string-binder in Great Britain the rule is to "open up" a field by cutting "roads" round it: that is, a headland or roadway is mowed by the scythe and tied up by hand. Then the string-binder is started to cut around and continued till a finish is made at the centre of the field. Sometimes the crop is partly lodged and can only be cut on three sides of the field, and the binder is "slipped" past the fourth side. It is customary in some parts to yoke three horses to the machine and keep these at work all day with an interval for the midday meal only, but a better plan is to allow two men and four horses to each, and put one couple on and one couple off for meals and resting alternately. By this means the binder is kept going continuously without any stoppage for perhaps 14 hours daily in fine harvest weather. With a six-feet cutting width an acre per hour is fair work, but some have exceeded that, especially with wider cutting widths. A ball of twine weighing 3 to 4 ℔ is the usual requisite per acre for binding the sheaves, and it ought to be of Manilla hemp: "sizal" fibre (derived from the American agaves and named after the port on the coast of Yucatan) is not so strong and good, though cheaper. Good twine is desirable, as otherwise frequent breakages leave many sheaves in a loose state.

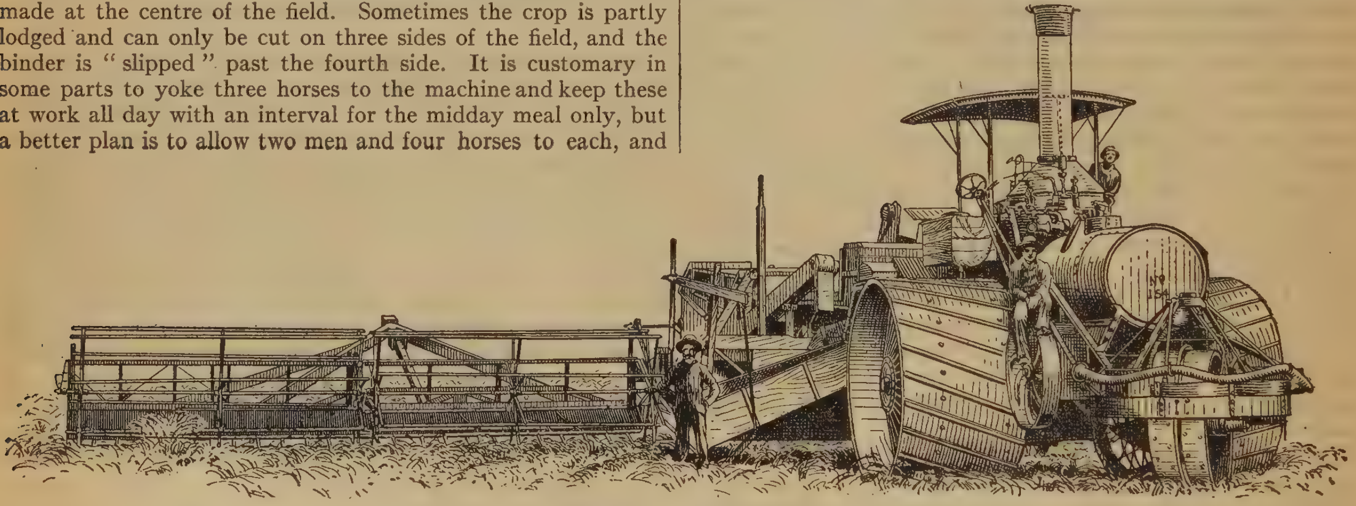

Fig. 3.—American Header and Thrasher.

The sheaves are dropped off on to the ground as tied, but some farmers use the "sheaf-carrier," which catches these as they are shot out from the binding apparatus, and dumps them in lots of six or so—sufficient to make a stook or shock. The stooking—that is, the setting up of the sheaves on end to dry—is a separate operation, and from two to three men can set up an ordinary good crop as fast as the binder can cut it. In this work the sheaves are set with their butts wide apart and the heads leaning against one another like the two legs of the letter A: a full-sized stook or "threave" is 24 sheaves—a relic of the days when the crop was all hand-reaped by piecework at so much per threave—but in practice now seldom more than 6 sheaves (3 each side) are put to each stook. When sufficiently dried or "fielded" the sheaves are then carried by cart or wagon to the stackyard, where they are built up sheaf by sheaf into round or oblong stacks: that is, they are stored until required for thrashing or foddering purposes. The drying may be a tedious affair, and wet weather in harvest time is a national disaster from the spoiling of the corn, both grain and straw.

The tremendous development in labour-saving in the matter of reaping the corn crops is well exemplified in a comparison of harvesting with the hand hook or sickle as compared with the string-binder. With hand-reaping six men (or women) cut the corn and laid it on the bands in sheaf-lots: one man came behind and tied the sheaves and set them up in stooks. Thus a gang of seven worked together and harvested about two acres per day. With the binder three or four men handle say twelve or fourteen acres daily: in other words, there is only one-tenth of the manual labour required now in reaping that was necessary only a generation ago, for the string-binder has revolutionized farming as a whole, and given the nations cheap bread. (P. McC.)

REAR, the back or hind portion of anything, particularly a military or naval term for that part of a force which is placed last in order, in opposition to "van." As the last word, shortened from "van-guard," is an aphetic form of Fr. *avant*, in front, Lat. *ab ante*, so "rear" is an aphetic form of "arrear," O. Fr. *arere*, mod. *arrière*, Med. Lat. *ad retro*, to the back, backward. From this word must be distinguished the verb "to rear," used in two main senses: of a horse, to stand up on its hind legs, and to raise up or lift, of the construction of a building or of the breeding and bringing to maturity of domestic or other animals, often used also of young children. The O.E. *rǣran*, of which it is the modern representative, is a doublet of the Scandinavian *reisa*, which has given English "raise," both being causative verb forms of "rise."

REAR VAULT (Fr. *arrière voussure*), the term in architecture employed for the vault of the internal hood of a doorway or window to which a splay has been given on the reveal; sometimes the vaulting surface is terminated by a small rib known as the scoinson rib (*q.v.*), and a further development is given by angle shafts carrying this rib, known as scoinson shafts.

REASON (Lat. *ratio*, through French *raison*), in philosophy, the faculty or process of drawing logical inferences. Thus we speak of man as essentially a rational animal, it being implied that man differs from all other animals in that he can consciously draw inferences from premises. It is, however, exceedingly difficult in this respect to draw an absolute distinction between men and animals, observation of which undoubtedly suggests that the latter have a certain power of making inferences. Between the higher animals and the lower types of mankind the distinction is so hard to draw that many psychologists argue that the difference is one of degree rather than of kind (see also Instinct). There can be little doubt, however, that inference by man differs from that of the brute creation in respect of self-consciousness, and, though there can be no doubt that some animals dream, it is difficult to find evidence for the presence of ideal images in the minds of any but the highest animals. In the nature of the case satisfactory conclusions as to the rationality which may be predicated of animals are impossible.

The term "reason" is also used in several narrower senses. Thus reason is opposed to sensation, perception, feeling, desire, as the faculty (the existence of which is denied by empiricists) by which fundamental truths are intuitively apprehended. These fundamental truths are the causes or "reasons" (ἀρχαί) of all derivative facts. With Kant, reason (*Vernunft*) is the power of synthesizing into unity, by means of comprehensive principles, the concepts provided by the intellect (*Verstand*). The reason which gives a priori principles Kant calls "Pure Reason" (cf. the *Kritik der reinen Vernunft*), as distinguished from the "Practical Reason" (*praktische Vernunft*) which is specially concerned with the performance of particular actions. In formal logic the drawing of inferences (frequently called "ratiocination," from Lat. *ratiocinari*, to use the reasoning faculty) is classified from Aristotle downwards as deductive (from generals to particulars) and inductive (from particulars to generals); see LOGIC, INDUCTION, SYLLOGISM. In theology, reason, as distinguished from faith, is the human intelligence exercised upon religious truth whether by way of discovery or by way of explanation. The limits within which the reason may be used have been laid down differently in different churches and periods of thought: on the whole, modern Christianity, especially in the Protestant churches, tends to allow to reason a wide field, reserving, however, as the sphere of faith the ultimate (supernatural) truths of theology.

The Greek words for reason are *νοῦς* and *λόγος*, both vaguely used. In Aristotle the *λόγος* of a thing is its definition, including its formal cause, while the ultimate principles of a science are *ἀρχαί*, the "reasons" (in a common modern sense) which explain all its particular facts.[1] Νοῦς in Plato and Aristotle is used both widely for all the meanings which "reason" can have, and strictly for the faculty which apprehends intuitively. Thus, in the *Republic*, *νοῦς* is the faculty which apprehends necessary truth, while *δόξα* (opinion) is concerned with phenomena.

For the Stoic and Neoplatonic uses of Λόγος, as also for those of Philo Judaeus and the Fathers, see LOGOS.

RÉAUMUR, RENÉ ANTOINE FERCHAULT DE (1683–1757), French man of science, was born on the 28th of February 1683 at La Rochelle and received his early education there. He was taught philosophy in the Jesuits' college at Poitiers, and in 1699 went to Bourges to study civil law and mathematics under the charge of an uncle, canon of La Sainte-Chapelle. In 1703 he came to Paris, where he continued the study of mathematics and physics, and in 1708, at the early age of twenty-four, was elected a member of the Académie des Sciences. From this time onwards for nearly half a century hardly a year passed in which the *Mémoires de l'Académie* did not contain at least one paper by Réaumur. At first his attention was occupied by mathematical studies, especially in geometry. In 1710 he was appointed to the charge of a great government work—the official description of the useful arts and manufactures—which led him to many practical researches that resulted in the establishment of manufactures new to France and the revival of neglected industries. For discoveries regarding iron and steel he was awarded a pension of 12,000 livres; but, being content with his ample private income, he requested that the money should be secured to the Académie des Sciences for the furtherance of experiments on improved industrial processes. In 1731 he became interested in meteorology, and invented the thermometer scale which bears his name. In 1735 family arrangements obliged him to accept the post of commander and intendant of the royal and military order of Saint-Louis; he discharged his duties with scrupulous attention, but declined the emoluments. He took great delight in the systematic study of natural history. His friends often called him the Pliny of the 18th century. He loved retirement and lived much at his country residences, at one of which, La Bermondière (Maine), he met with a fall from horseback, the effects of which proved fatal on the 17th of October 1757. He bequeathed his manuscripts, which filled 138 portfolios, and his natural history collections to the Académie des Sciences.

Réaumur's scientific papers deal with nearly all branches of science; his first, in 1708, was on a general problem in geometry; his last, in 1756, on the forms of birds' nests. He proved experimentally the fact that the strength of a rope is less than the sum of the strengths of its separate strands. He examined and reported on the auriferous rivers, the turquoise mines, the forests and the fossil beds of France. He devised the method of tinning iron that is still employed, and investigated the differences between iron and steel, correctly showing that the amount of carbon (sulphur in the language of the old chemistry) is greatest in cast iron, less in steel, and least in wrought iron. His book on this subject (1722) was translated into English and German. The thermometer by which he is now best remembered was constructed on the principle of taking the freezing-point of water as 0°, and graduating the tube into degrees each of which was one-thousandth of the volume contained by the bulb and tube up to the zero mark. It was an accident dependent on the dilatability of the particular quality of alcohol employed which made the boiling-point of water 80°; and mercurial thermometers the stems of which are graduated into eighty equal parts between the freezing- and boiling-points of water are *not* Réaumur thermometers in anything but name.

Réaumur wrote much on natural history. Early in life he described the locomotor system of the Echinodermata, and showed that the supposed vulgar error of Crustaceans replacing their lost limbs was an actual fact. In 1710 he wrote a paper on the possibility of spiders being used to produce silk, which was so celebrated at the time that the Chinese emperor Kang-he caused a translation of it to be made. He treated also of botanical and agricultural matters, and devised processes for preserving birds and eggs. He elaborated a system of artificial incubation, and made important observations on the digestion of carnivorous and graminivorous birds. His greatest work is the *Mémoires pour servir à l'histoire des insectes*, 6 vols., with 267 plates (Amsterdam, 1734–42). It describes the appearance, habits and locality of all the known insects except the beetles, and is a marvel of patient and accurate observation. Among other important facts stated in this work are the experiments which enabled Réaumur to prove the correctness of Peyssonel's hypothesis, that corals are animals and not plants.

REBAB, or RABAB (Persian *rubāb*;[2] Arabic *rabāb*, *rabāba*;[3] Sp. *ravê*, *rabê*,[4] *rabel*, *arrabel*, *arrabil*;[5] Fr. *rubèbe*; It. *rubeba*), an ancient stringed instrument, having a body either pear-shaped or boat-shaped and the characteristics of vaulted back and the absence of neck; also a generic modern Arabic term applied by the Mahommedans of northern Africa to various stringed instruments played with a bow.

As the rebab exercised a very considerable influence on the history of stringed instruments in Europe, and was undoubtedly the means through which the bow was introduced to the West, it is necessary to examine its construction before deciding whether it may be accepted as the ancestor of the violin in deference to the claim made for it by certain modern writers.[6]

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[1] The Schoolmen's distinction of *ratio cognoscendi* (a reason for acknowledging a fact) and *ratio essendi* (a reason for the existence of this fact).

[2] F. Rückert, *Grammatik, Poetik und Rhetorik der Perser, nach dem 7ten Bande des Heftes Kolzum* (Gotha, 1874), p. 80. This translation of the introduction to the *Seven Seas* contains a reference to musical instruments; the one translated *Laute* (lute) is rendered in Persian *rubâb*, a point ascertained through the courteous assistance of Mr A. G. Ellis, of the Oriental Department, British Museum.

[3] Al-Farabi, 10th century, translation into Latin by J. G. Kosegarten, *Alii Ispahenensis Liber. Cantilenarum . . . arabice editur adjectaque translatione adnotationibusque* (Greifswald, 1840), vol. i. pp. 36, 41, 105, 109, &c.

[4] See poem by Juan Ruiz, archipreste de Hita, 14th century, from MS. in library of the cathedral at Toledo, quoted by Mariano Soriano Fuertes, *Hist. de la Musica española* (Madrid), vol. i. p. 105.

[5] From the Arabic treatise of Mahamud Ibrain Axalchi, MS. No. 69, Escorial.

[6] See F. J. Fétis, *Antoine Stradivari . . . Précédé de recherches historiques et critiques sur l'origine et les transformations des instru-*

The two principal forms of rebab with which we are concerned as prototypes of European instruments of the middle ages are: (1) the long and narrow boat-shaped rebab, which may be traced back to Persia in the 8th century B.C., and is still in use in that country; and (2) the lute-shaped rebab, with rudimentary neck consisting of the gradual narrowing of the body, which has the outline of a longitudinal section of a pear. This variety became very popular in medieval Europe under the names of rebec, gigue, geige and lyra; the archetype has been traced back to 1000 B.C. The most characteristic feature in the construction of the rebab, and of all instruments derived from it, was the body, composed of a back originally scooped out of a solid piece of wood, to which was glued without the intermediary of ribs (an important structural feature of the violin) a flat sound-board of parchment or thin wood.

The *rebab-esh-sha'er*, or "poet's rebab," had a body consisting of an almost rectangular box covered with parchment and supported on an iron foot; the instrument was held like the modern violoncello. No evidence has yet been brought forward that the rebab-esh-sha'er was in use among the Arabs who conquered Spain in the 8th century; if the instrument was indeed ever introduced into Spain it has left no trace.

The bowed instruments of the middle ages fall naturally into two distinct classes, according to the principles observed in construction. One is the type having a body formed on the model of a Greek or a Roman cithara, from which it was evolved by the addition of a neck and finger-board (see Guitar and Guitar-Fiddle). Instruments of this type were at all times recognized as superior and belonging to the realm of art, whereas type 2, derived from the Eastern rebab, never attained to any artistic development, and at the time when the first type had nearly reached its apogee the second was placed beyond the pale of art.

According to Al-Farabi, the rebab had either one string, two strings or four, obtained by doubling these two; they were tuned most often in minor thirds or in major thirds.[1] The Arab scholar Ash-Shakandi, who flourished in Spain about A.D. 1200, states that the rebab had been known for centuries in Spain, but was not mentioned on account of its want of artistic merit. Juan Ruiz, archipreste de Hita, in his enumeration[2] of the musical instruments in use in his day (14th century), mentions two rebabs, and speaks of *il ravé gritador con su alta nota* and *il rabé morisco*; the "shrill rebab" (or rather rebec) "with its high note" is thus quoted somewhat contemptuously already in the 14th century.

The history of the origin of the rebab had until now not gone back beyond the 7th century A.D., and has been a matter of conjecture founded on the word *rubāb* or *rūbab*, which is of Persian origin, and on the statement that the Arabs themselves declare they obtained the instrument from the Persians. Recent archaeological discoveries, however, provide abundant evidence of archetypes of both pear-shaped and boat-shaped rebabs in high antiquity. We have at present no clue to the name of the archetype, but it is clear that the el-Oud or lute of the Arabs and the wide pear-shaped rebab were practically one and the same instrument, until the advent of the bow, which had probably also been made known to the Arabs through the Persians, since their word for the bow, *kamān*, is borrowed from the Persian, but at what date is unknown. Al-Farabi does not mention the bow,[3] and his chapter on the *rabâba* does not deal with the construction of the instrument so much as with the production of sound and the divisions of the scale.

As far as is known at present, the archetype of the rebab and lute family is the instrument shown in fig. 1. The terra-cotta figure of the musician discovered in Egypt (1905–6) by Professor Flinders Petrie during the course of excavations in the cemetery of Goshen [4] is Greek work of the post-Mycenaean age; it was found in surroundings assigned to the XXth Dynasty (*c.* 1000 B.C.), and shows the earliest pear-shaped instrument yet discovered. This statuette clearly establishes the origin of the instruments named by some *lyra*,[5] by others (including the present writer) rebab or rebec, common all over western Europe from the 11th century, whose main characteristic is an almost entire absence of neck. Two terra-cotta statuettes of musicians playing upon ancient Persian rebabs (see fig. 2) have been excavated from the Tell at Suza[6] amongst objects referred to the reign of Shutruk-Nakhounta, who was king of Elam *c.* 789 B.C. The pear-shaped instrument, wide at the base and elongated to form a neck, with the head bent back at right angles and the strings plucked by the fingers,—the lute of the 6th century A.D.,—is seen first on a frieze from Afghanistan, forming one of the risers of steps to the tope of Jamal-Garhi. These sculptures, preserved at the British Museum, are assigned to the 2nd or 3rd century, and are said to show traces of classical influence. The same instrument is found engraved on a Sassanian silver dish in the British Museum,[7] of workmanship assigned to a period not later than the 7th century A.D., but probably earlier, as well as on other dishes of similar origin; one in the Hermitage, St Petersburg, was found at Irbit in 1880, on which Eros is depicted playing the lute and riding on a lion.[8] A third, found at Perm, forms part of Count Stroganov's collection.[9]

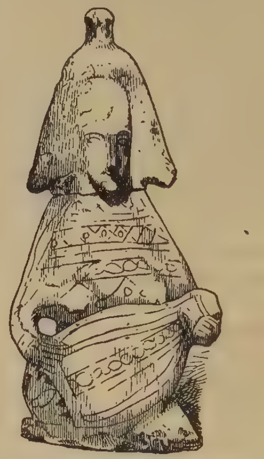

Fig. 1.—Prototype of Lute—Pear-shaped Rebab. 1000 B.C. Discovered by Professor Flinders Petrie in the cemetery at Goshen.

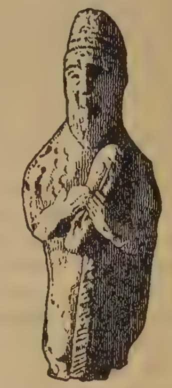

Fig. 2.—Boat-shaped Rebab. 789 B.C. From J. de Morgan, *Délégation en Perse*, by permission of Ernest Leroux.

Excavations carried out in ancient Khotan[10] or Ilchi (Turkestan, on the caravan route to Kashgar) have brought to light further evidence of the ubiquity of the rebab type in Asia. In addition to the two principal types of rebab (fig. 3) mentioned above there is also to be found the spoon-shaped instrument with no neck and large round head (fig. 4), sometimes seen in European medieval sculptures and MSS. of the 11th and 12th centuries.[11]

The pear-shaped rebab or lute appears also among the celebrated paintings in the Buddhist cave temples of Ajanta,[12] assigned to the 6th century A.D. A later example at the British Museum, a fragment of a dish found at Rhajes or Ray,[13] in northern Persia,

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ments à archet (Paris, 1856); Edward Heron Allen, *Violin-making as it was and is* (London, 1884); E. J. Payne, article "Violin" in Grove's *Dictionary of Music* (1st ed.). See also *The Instruments of the Orchestra* (London, 1910), part ii., "Precursors of the Violin Family," by Kathleen Schlesinger, where the evolution of the violin is traced from the cithara of the Greeks.

[1] See J. P. N. Land's paper, "Recherches sur l'histoire de la gamme arabe," *VI. Intern. Orient. Congress*, part ii. (Leiden, 1884) (Brit. Mus. press-mark, acad. 8806), p. 130, and also p. 56.

[2] See Mariano Soriano Fuertes, *loc. cit.*

[3] The copy of Farabi's MS., used for their translations by Kosegarten and Land, Escorial, No. 911, dates from the middle of the 12th century. See Michael Casiri, *Bibl. Arab. Hisp.*, vol. i. p. 347, and Forkel, *Allgemeine Litteratur der Musik* (Leipzig, 1792), p. 487; also R. G. Kiesewetter, *Die Musik der Araber nach Originalquellen dargestellt* (Leipzig, 1842), p. 64 and preface. Another MS. copy of Al-Farabi, in the Bibliotheca Ambrosiana in Milan, is described by Hammer von Purgstall in the *Bibliotheca Italiana*, tom. xciv. (Milan, 1839), p. 44; cf. preface in Kiesewetter, p. viii.

[4] Excavations carried out by the Brit. School of Archaeology in Egypt and by the Egyptian Research Account. See "Hyksos and Israelite Cities," by W. M. Flinders Petrie and J. Garrow Duncan, *Mem. Brit. Sch. of Arch.*, 1906.

[5] See Laurent Grillet, *Les ancêtres du violon, &c.* (Paris, 1901), tome i. p. 29. "Portail occidental de l'église de Moissac," 12th century.

[6] See *Délégation en Perse*, by J. de Morgan (Paris, 1900), vol. i. pl. 8, Nos. 8 and 9, text, pp. 130 and 131.

[7] See Ormonde M. Dalton, *The Treasures of the Oxus*, catalogue of the Franks bequest to the British Museum, 1905, pl. xxvi. No. 190.

[8] See for an illustration and description, *Comptes rendus de la commission impériale d'archéologie pour l'année 1881* (St Petersburg, 1883), text, p. 53, and atlas of the same date, pl. ii. No. 10.

[9] See J. R. Aspelin, *Antiquités du nord*, p. 141, No. 608.

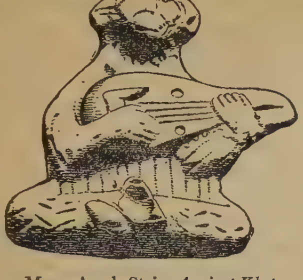
[10] See *Ancient Khotan*, a detailed report of archaeological explorations in Chinese Turkestan, carried out by H.M. Indian government, by Marc Aurel Stein (Oxford, Clarendon Press, 1907), vol. ii. pl. xlvi. Nos. Y0011k, Y0011d (spoon-shaped rebab), pl. xliii. Nos. Y0028 and Y009i.

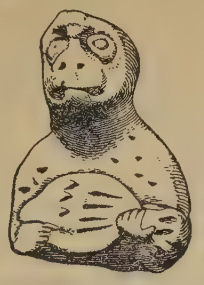
[11] See, for instance, Psalter of Labeo Notker, 10th century, Bibl. Stift St Gallen, on the top of left-hand gable pillar. Illustration in Kathleen Schlesinger, *The Instruments of the Orchestra* (London, 1910), part ii., "Precursors," pl. iv. p. 154.

[12] See reproductions by John Griffiths (London, 1896), vol. ii. pl. 105, cave I., 10, e.

[13] Brit. Mus., Ceramic Gallery, case A, Henderson Bequest, 1891.

destroyed by Jenghiz Khan in the 13th century, has the four pegs in the side of the head. Finally, we find the instrument on the doorway of the Hôpital du Moristan[1] (Cairo), carved work of the 13th century.





From Marc. Aurel. Stein, *Ancient Khotan*, by permission of the Clarendon Press.

FIG. 3.—Pear-shaped rebab, from Khotan.

FIG. 4.—Spoon-shaped rebab, from Khotan.

In all these examples it is noteworthy that the strings are vibrated by plucking them with the fingers, *not by means of the bow*, the use of which, in conjunction with those structural features, constitutes the violation of an acoustic principle, and therefore accounts for the failure of the instrument as Rebab and its successful development as Lute. There are, however, two early examples of bowed rebabs of Byzantine origin to be cited. A pear-shaped rebab, held like a violoncello and played by means of a very long and slender bow, is carved on one of the reliefs of an ivory casket of Italo-Byzantine work of the 8th or 9th century, belonging to the Carrand Collection, Florence (see REBEC). Another bowed instrument, of still earlier date, is to be seen among the wonderful mural paintings of the necropolis and monastery of Baouît,[2] assigned to the 8th century at the latest, but probably dating from the 6th or 7th.

The examination of all these representations of the rebab, ranging from 1000 B.C. to the 13th century A.D., tends to show that the instrument had its origin in the East, and was widely distributed over Asia Minor, India and Persia before the 6th century A.D. Similar archaeological documents of the middle ages suggest the possibility that we are not indebted to the Arabs alone for the introduction of the rebab and bow and of the lute into Europe by way of Spain, early in the 8th century, but that they had probably already made their way into southern and central Europe from the East through the influence of the Byzantine Empire and of the Christian East generally.

It is clear also that the instruments of the rebab type were at first twanged with the fingers, and the bow was apparently not invented for the rebab but only applied to it. All arguments in favour of including the rebab among the ancestors of the violin on the score of the bow lose their force, and as the rebab possessed no structural feature in common with the violin the question may be considered settled negatively.

For the European development of the rebab, see REBEC. (K. S.)

REBATE (Fr. *rabat*, from *rabattre*, to beat back), a term used in commerce, banking, &c. In banking, a rebate is an allowance made to a drawee taking up a bill of exchange before it is due. This allowance is the interest on the unexpired period of the bill, and in practice may be either a fixed or arbitrary rate; more often it is ½%, about the usual bank deposit rate. In commerce, rebate is sometimes used to mean a discount allowed for prompt payment; it is often equivalent to drawback, *i.e.* the repayment of part of the duty on imported goods when such goods are subsequently exported in their original or in another form. By the Customs Consolidation Act, 1853, a rebate or deduction is allowed at the custom-house from the fixed duties on certain kinds of goods, on account of damage or loss sustained in warehouses.

REBEC, or REBECK (Med. Fr. *rubèbe, rebelle, rebec, gigue*; Ger. *Rubeba, Rebek, Geige, Lyra*; Ital. *ribeba, ribeca, lyra*; Sp. *rabel, rabeca, ravé, rabê*), a medieval stringed instrument played with a bow, derived from the Oriental rebab. Like the rebab (*q.v.*), the rebec assumed at first one of two forms—the pear-shaped body with a wide base, strung with three strings, or the long, narrow pear- or boat-shaped body with two strings and, in addition, the other Oriental characteristics of the rebab, *i.e.* the vaulted back, the absence of ribs and pegs set in the back of the head. Except for the addition of a fingerboard, what is now recognised as the rebec underwent no structural development and never entered the domain of art. When the guitar-fiddle and the oval vielle with five strings made their appearance in Europe, apparently during the 11th century, a number of hybrids combining characteristics of both types of construction spread rapidly over western Europe.

A spoon-shaped instrument, in most cases without neck, the head being joined directly to the wide shoulders of the body, must not be confounded with these hybrids; the compass and capabilities of the instrument, which sometimes had but one single string, must have been extremely limited. What the name of the instrument was in the various ages is not known, but it may be classed with the rebab and rebec, from which it only differs in the outline of the body. The present writer discovered an Oriental archetype on a small terra-cotta figure[3] in the style of the Gandhāra school, unearthed at Yōtkan on the site of the ancient Khotan. The round head is fastened directly to the shoulders, the three strings are thrown into relief by deep indentations, the bridge tail-piece has three notches. The instrument (assigned to some period between the 5th and 8th centuries A.D.) may be compared with the European medieval type, such, for instance, as the bowed spoon-shaped rebec on the capital of the left pillar in the miniature[4] of King David and his musicians, belonging to the 10th-century psalter of Labeo Notker at St Gallen; also with the musicians' *lyra* on the western doorway of the church at Moissan;[5] and with the British Museum Add. MS. 17333, in which several of these spoon-shaped, neckless instruments are to be found.

The pear-shaped rebec with wide base was in all probability introduced into Europe through the Byzantine Empire, and the narrow boat-shaped by the Moors by way of Spain. The first of these types is represented on one of the sides of an ivory casket of Italo-Byzantine workmanship preserved among the Carrand Collection[6] in the Palazzo del Podesta in Florence. It belongs to the same group as the Veroli casket at the South Kensington Museum, all of which are assigned to the 9th century at the latest.

The pear-shaped rebec on the ivory casket, although like all rebecs it had no separate neck, was elongated to form one, and terminated in a lozenge-shaped head all in one piece with back and neck, the soundboard being cut to the same outline and glued to the back. There were four strings to these rebecs, of which there are many examples in English MSS. from the 11th century. One of the best known, sometimes described as the Anglo-Saxon *fythele*, is the one played by Jeduthun in the usual illustration of King David and his musicians prefaced to the Psalms in an Anglo-Saxon psalter (Cotton MS., Tib. C. VI., Brit. Mus.). Other examples are to be found in a Latin psalter illuminated by an English artist at the beginning of the 12th century (Lansd., 383, Brit. Mus.), in which the rebec has but one string and resembles the lyra teutonica mentioned above.[7]

Medieval documentary evidence points to the fact that the long boat-shaped rebec had survived in Spain and spread by way of France over western Europe. The much-quoted 14th-century poem by Juan Ruiz, archipreste de Hita,[1] containing an enumeration of the musical instruments of his day, includes *el ravé gritador con su alta nota* (the shrill rebec with its high note) and *el rabé morisco.* By a process of deduction we have no difficulty in identifying the long, narrow, boat-shaped instrument as *el rabé morisco*, since the instrument has survived almost unchanged among the Arabs of the present day[2] from the 13th century, and probably from the early centuries of our era. The shrill rebec (*el ravé gritador*) with thinner strings was the pear-shaped instrument. In the magnificent MS. known as the Cantigas di Santa Maria, assigned to the 13th century,[3] there are three of those boat-shaped rebecs played with a bow and one twanged by the fingers; they have finger-boards and two strings, and are held like the violoncello. Rebabs of this type, but without bows, were in use in ancient Persia, *c.* 789 B.C., as is demonstrated by some little terra-cotta figures of musicians unearthed in a *tell* at Suza.[4] Two of the instruments, held, however, like the violin, are unmistakably the archetypes of this rebec.

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[1] See Prisse d'Avennes, *L'Art arabe d'après les monuments du Caire du vii^{e} au xviii^{e} siècle* (Paris, 1877). The unnumbered plates are to be identified by the list given at the beginning of the work.

[2] For the illustration, see Jean Clédat, "Le monastère et la nécropole de Baouît," *Mém. de l'Inst. fr. d'archéol. orient. du Caire*, tome xii., 1904. Chapelle, xviii. pl. lxiv. (2). Descriptive text, p. 92. See also article "Baouît" by the same author, descriptive of the paintings in F. Cabrol's *Dict. d'arch. chrét. et de liturgie* (Paris, 1907), fasc. xii. B., p. 250b

[3] See Marc. Aurel Stein, *Ancient Khotan: Detailed Report of the Archaeological Explorations in Chinese Turkestan carried out by H.M. Indian Government* (Clarendon Press, 1907), vol. i. pl. xlvii. No. Y0011d.

[4] See Laurent Grillet, *Les ancêtres du violon* (Paris, 1901), vol. i. p. 29. The author calls these instruments *lyra*, which is a synonym of rebab.

[5] See Kathleen Schlesinger, *The Instruments of the Orchestra*, part ii., "Precursors of the Violin Family" (London, 1910), pl. iv. p. 154. The spoon-shaped instrument with a long neck on pl. v. (9th century) must be referred to the pandoura family.

[6] The casket has been reproduced by A. Venturi in *Gallerie Naz. Ital.*, vol. iii., 1897, p. 263; and *L'Arte*, vol. i. 1896, p. 24.

[7] See also English psalters of the 13th century in the British Museum, Lansd. MS., 420, and Arundel, 157, fol. 71^{b}.

The rebec did not escape the general tendency so noticeable in Europe from the 12th to the 15th century towards the ornamentation of musical instruments with grotesque heads. The socket of the chaunter of the bagpipe, the heads of the cittern and ghittern, the mandoline and the rebec, were all alike decorated with grotesque human or animal heads, which in England became proverbial as *cittern-heads.*

The boat-shaped rebec survived as the *sordino* or *pochette*,[5] an instrument widely used by dancing masters until the 19th century, when it was abandoned for the kit, a diminutive violin. The *pochette*, as its name in French and also in German (*Taschengeige*) indicates, was small enough to be carried in the pocket; it measured from 15 to 18 in: and was played with a correspondingly small bow. The 15th- and 16th-century rebec or *geige*, as the pear-shaped variety was called in Germany (*gigue* in France), is figured by Sebastian Virdung;[6] there were three strings tuned to G, D, A, and it had a finger-board cut in one piece with the sound-board in some cases and forming a step. Some writers consider that the addition of the finger-board constituted the difference between the geige and the rebec. Facts hardly support this theory, since the lyra teutonica in the 9th or 11th century already had a finger-board, and Farabi, the Arabic scholar of the 10th century, who was equally familiar with the Greek, Persian and Arabic musical systems, distinctly states that the rebab was also known as the *lyra.* The modern Greek rebec with three strings is to this day played by rustic musicians under the name of *lyra.* Moreover, in Germany, bowed instruments of all kinds were at first known as *geige*, in contradistinction to those whose strings were plucked, classed together as *cytharas* or some word derived from it, the most modern example of which is the zither. With the rise of the viols and later of the violin, which represent the most perfect type of construction for stringed instruments, the rebec tribe, inferior in every respect and without artistic merit, was gradually relegated beyond the pale,[7] and by the 18th century had fallen into disuse except in certain rural districts, where for outdoor music, their shrill, penetrating tone continues to endear them to itinerant and village musicians. (K. S.)

REBECCA RIOTS, the name given to some disturbances which occurred in 1843 in the counties of Pembroke, Carmarthen, Glamorgan, Cardigan and Radnor, after a slight outbreak of the same nature four years previously. During a period of exceptional distress the rioting was caused mainly by the heavy charges at the toll-gates on the public roads in South Wales, and the rioters took as their motto the words in Genesis xxiv. 60, "And they blessed Rebekah, and said unto her, Thou art our sister, be thou the mother of thousands of millions, and let thy seed possess the gate of those which hate them." Many of the rioters were disguised as women and were on horseback; each band was led by a captain called "Rebecca," his followers being known as "her daughters." They destroyed not only the gates but also the toll-houses, and the work was carried out suddenly and at night, but usually without violence to the toll-keepers, who were allowed to depart with their belongings. Emboldened by success, a large band of rioters marched into the town of Carmarthen on the 10th of June and attacked the workhouse, but on this occasion they were dispersed by a troop of cavalry which had hurried from Cardiff. The Rebeccaites soon became more violent and dangerous. They turned their attention to other grievances, real or fancied, connected with the system of landholding, the administration of justice and other matters, and a state of terrorism quickly prevailed in the district. Under these circumstances the government despatched a large number of soldiers and a strong body of London police to South Wales, and the disorder was soon at an end. In October a commission was sent down to inquire into the causes of the riots. It was found that the grievances had a genuine basis; measures of relief were introduced, and South Wales was relieved from the burden of toll-gates, while the few rioters who were captured were only lightly punished.

REBELLION, the act or continuance in act of a rebel or rebels (Lat. *rebellio, rebellis*, a compound of *re-*, against, and *bellum*, war). A rebel is one who engages in armed resistance to the government to which he owes allegiance. For the distinction between Civil War and Rebellion, see WAR, LAWS OF. Where individuals as distinguished from groups of men are concerned the character of rebel is easier to determine. That the alleged act of war was done by order of another cannot be in principle an excuse for a subject or citizen of any state taking arms against it. Under the rules of war adopted at the Hague in 1907, moreover, any excuse for doing so is removed by the provision that a belligerent is forbidden to compel nationals of the hostile party to take part in operations of war against their own country, "even if they were in the belligerent's service before the commencement of the war" (art. 123). In the case of *R.* v. *Louw*, known as the "Calvinia Flogging case" (Supreme Court of the Cape Colony, Feb. 18, 1904), the question of the validity of the excuse of acting under orders contrary to allegiance was discussed in an uncertain spirit, and in a previous case, the Moritz case, tried before the Treason Court at Mafeking (Nov. 7, 1901), the court held that insurgent nationals "who had joined the burghers must be placed on the same footing as burghers fighting against us." There may be special circumstances operating to qualify the application of a principle, but the above stated principle, as such, must be regarded as the only legal basis of argument on the subject. (T. BA.)

REBUS (Lat. *rebus*, "by things"), a sort of riddle consisting of the representation of some sentence or thing by means of pictures or words, or a combination of both. Rebuses first became popular in France, where they were at first called *rêbus de Picardie*, that province, according to G. Ménage (1613–1692), having been the scene of their origin, which he found in the satires written by the students and young clerks on the foibles of the day under the title "*De rebus quae geruntur.*" Camden mentions an instance of this kind of wit in a gallant who expressed his love to a woman named Rose Hill by painting in the border of his gown a rose, a hill, an eye, a loaf and a well; this, in the style of the rebus, reads "Rose Hill I love well." This kind of wit was happily ridiculed by Ben Jonson in the humorous description of Abel Drugger's device in the *Alchemist* and by the *Spectator* in the device of Jack of Newberry. The name is also applied to arrangements of words in which the position of the several vocables is to be taken into account in divining the meaning. Thus "I understand you undertake to overthrow my undertaking" makes the rebus

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[1] See Mariano Soriano Fuertes, *Historia de la Musica española* (Madrid, 1855), vol. i. p. 105. Aymeric du Peyrac, in his *Vita Caroli Magni* (13th century), mentions the rebec; see Du Cange, *Glossarium, s.v.* "Baudosa." Hieronymus of Moravia mentions the rubebe, and states that it has three strings, whereas the vielle had five (MS. Fonds Latin, No. 16 [663 actuel.], Paris Bibl. Nat.). In the *Minne Regel* ("Rules of the Minnesingers"), 1404, line 415: "Noch dan quinterna, gyge, videle, lyra, rubeba"; see *Der Minne Regel von Eberhardus Cercne aus Minden*, 1404, edited by Franz Xaver Woeber (Vienna, 1861), p. 24.

[2] For an illustration see Carl Engel, *Researches into the History of the Violin Family*, and E. Heron-Allen, *The Violin, and how to make it.*

[3] Edward Buhle is of opinion that the miniatures in these MSS. are the work of a 14th-century artist. See *Die Musik-instrumente in den Minaturhandschriften des Mittelalters* (Leipzig, 1903).

[4] See J. de Morgan, *La Délégation en Perse* (Paris, 1900), vol. i. pl. viii., Nos. 8 and 9.

[5] There is a pochette in the Galpin Collection, *c*, 1700; for an illustration see Kathleen Schlesinger, *The Instruments of the Orchestra*, part ii., "Precursors of the Violin Family," p. 201, fig. 158.

[6] *Musica getutscht und ausgezogen*, Basel, 1511, reprinted in *Publikationen d. Ges. f. Musikforschung*, Berlin, 1883, Bd. xi.

[7] Antoine Vidal in *La Lutherie et les luthiers*, to show the contempt with which the rebec was viewed in France in the 15th century, quotes from the charges of King Charles VIII., 1483, where the following entry occurs: "On donna sur son ordre 35 sols à une poure insensée qui jouoit du rebec." The lieutenant of Paris, in March 27, 1628, issued the following order: "Faisant défence à tous musiciens de jouer dans les cabarets et mauvais lieux des dessus, basses ou autres parties de violon ains seulement du rebec." A well-known passage in Chaucer testifies to a similar contempt in 14th-century England: "Brother, quod he, here woneth an old rebekke," &c. (*Freres Tale*, 7156).

stand take to taking
I you throw my;

or in French

pir vent venir
un vient d'un

may be read "un soupir vient souvent d'un souvenir." A still simpler French rebus is expressed by the two letters *G a*, which may be read, *J'ai grand appêtit* (*G grand, a petit*). "Rebus" (or "allusive arms"), in heraldry, is a coat of arms which bears an allusion to the name of the person,—as three castles for Castleton, three cups for Butler, three conies for Coningsby.

RÉCAMIER, JEANNE FRANÇOISE JULIE ADÉLAÏDE (1777–1849), a famous Frenchwoman in the literary and political circles of the early 19th century, was born on the 4th of December 1777 at Lyons. Her maiden name was Bernard. She was married at fifteen to the banker Jacques Récamier (d. 1830), who was more than old enough to be her father. Beautiful, accomplished, with a real love for literature, she possessed at the same time a temperament which protected her from scandal, and from the early days of the consulate to almost the end of the July monarchy her salon in Paris was one of the chief resorts of literary and political society that pretended to fashion. The *habitués* of her house included many former royalists, with others, such as Bernadotte and General Moreau, more or less disaffected to the government. This circumstance, together with her refusal to act as lady-in-waiting to the Empress Josephine and her friendship for Madame de Staël, brought her under suspicion. It was through Madame de Staël that Madame Récamier became acquainted with Benjamin Constant, whose singular political tergiversations during the last days of the empire and the first of the restoration have been attributed to her persuasions. Madame Récamier was eventually exiled from Paris by Napoleon's orders. After a short stay at Lyons she proceeded to Rome, and finally to Naples, where she was on exceedingly good terms with Murat and his wife, who were then intriguing with the Bourbons. She persuaded Constant to plead the claims of Murat in a memorandum addressed to the congress of Vienna, and also induced him to take up a decided attitude in opposition to Napoleon during the Hundred Days. Her husband had sustained heavy losses in 1805, and she visited Madame de Staël at Coppet in Switzerland. There was a project for her divorce, in order that she might marry Prince Augustus of Prussia, but though her husband was willing it was not arranged. In her later days she lost most of the rest of her fortune; but she continued to receive visitors at the Abbaye-aux-Bois, the old Paris convent to which she retired in 1814. Here Chateaubriand was a constant visitor, and in a manner master of the house; but even in old age, ill-health and reduced circumstances Madame Récamier never lost her attraction. She seems to have been incapable of any serious attachment, and although she numbered among her admirers Mathieu de Montmorency, Lucien Bonaparte, Prince Augustus of Prussia, Ballanche, J. J. Ampère and Constant, none of them obtained over her so great an influence as did Chateaubriand, though she suffered much from his imperious temper. If she had any genuine affection, it seems to have been for Prosper de Barante, whom she met at Coppet. She died in Paris on the 11th of May 1849.

There are well-known portraits of her by Louis David in the galleries of the Louvre, and by François Gérard in the possession of the préfecture of the Seine. In 1859 *Souvenirs et correspondances tirés des papiers de Madame Récamier* was edited by Mme Lenormant. See Mme Lenormant's *Madame Récamier. les amis de sa jeunesse et sa correspondance intime* (1872); Mme Mohl, *Madame Récamier*, with a sketch of the history of society in France (1829 and 1862); also Guizot in the *Revue des deux mondes* for December 1859 and February 1873; H. Noel Williams, *Madame Récamier and her Friends* (London, 1901); E. Herriott (Engl. trans., by Alys Hallard), *Madame Récamier et ses amis* (1904) (elaborate and exhaustive).

RECANATI, a city of the Marches, Italy, in the province of Macerata, 8 m. direct N.N.E. of the city of that name. Pop. (1901) 14,590 (town), 16,389 (commune). It has a station on the railway $17\frac{1}{2}$ m. S. of Ancona, and distant $4\frac{1}{2}$ m. from the town, which is built on a hill, 931 ft. above the sea, and retains portions of its 15th-century walls and gateways. It was the birthplace of the poet Leopardi (1798–1837), whose monument adorns the principal piazza and whose family has collected in the town a very interesting museum of Leopardiana; it also contains fine old mansions of the Leopardi, Mazzagalli, Massucci and Carradori in the main street, and a Gothic cathedral, built towards the close of the 14th century and dedicated to S Flavianus, patriarch of Constantinople. The churches of S Maria sopra Mercanti and San Domenico contain characteristic examples of the work of Lorenzo Lotto, as also does the new municipal palace, with a fine old battlemented tower, while the palace of Cardinal Venier has a fine Renaissance loggia by Giuliano da Maiano, who was probably responsible for the designs for the portals of S Agostino and S Domenico. The older buildings of the town are noteworthy for the curious terra-cotta work which adorns the majority of them.

Recanati appears as a strong castle in the 10th century or earlier. Round this gathered a community whose petty wars with Osimo (*Auximum*) called for the interference of Innocent III. in 1198. From Frederick II. it obtained the right of having a port on the Adriatic; and by Gregory IX. it was made a city and the seat of the bishopric transferred from Osimo. This oscillation between Guelf and Ghibelline continued characteristic of Recanati. Urban IV. abolished the "city" and bishopric; Nicholas IV. restored them. John XXII. again, in 1320, removed the bishopric and placed the city under interdict. The interdict was withdrawn in 1328 on payment of a heavy fine, but the bishopric remained in abeyance till 1357. Gregory XII., who on his deposition by the council of Constance was made papal legate of the sees of Macerata and Recanati, died in this city in 1417. The assistance rendered by Recanati to the popes in their struggles with the Sforza seems to have exhausted its resources, and it began to decline. Considerable damage was done by the earthquake of 1741; and the French, who were twice in possession of the city in 1797, pillaged it in 1799.

RECEIPT (M.E. *receite*, derived through Fr. from Lat. *recepta*, participle of *recipere*, to receive), in law, an acknowledgment in writing that a sum of money or other valuable considered has been received by the person signing the acknowledgment in discharge of a debt or other obligation. Such a receipt is prima facie evidence only of payment, and it may be shown, for example, that it was signed by mistake, or obtained by fraud or misrepresentation. By the Stamp Act of 1891, which repealed and re-enacted other acts, a duty of 1d. is imposed on every receipt or form of writing discharging a debt of £2 or upwards; the payment of the duty is denoted by affixing a penny stamp to the document, and the cancelling of the same by the person giving the receipt. By § 103 if a person gives a receipt, liable to duty, not duly stamped, or refuses to give a receipt, liable to duty, duly stamped or, on payment to the amount of £2 or upward, gives a receipt for a less sum than £2 or divides the amount paid with intent to evade the duty, he is liable to a fine of £10. A receipt not duly stamped may be stamped at the Inland Revenue Office within fourteen days on payment of a fine of £5 or within one month on payment of £10.

RECEIVER, in English law, an officer or manager appointed by a court to administer property for its protection, to receive rent or other income and to pay authorized outgoings. Receivers may be either appointed *pendente lite* or by way of equitable execution, *e.g.* for the purpose of enabling a judgment creditor to obtain payment of his debt, when the position of the real estate is such that ordinary execution will not reach it. Formerly receivers were appointed only by the court of chancery, but by the Judicature Act 1873 it is now within the power of all divisions of the High Court to appoint receivers. Their powers and duties are exhaustively set by Kerr, *On Receivers* (5th ed., 1905), who classifies the cases in which they may be appointed under the following heads: (*a*) infants; (*b*) executors and trustees; (*c*) pending litigation as to probate; (*d*) mortgagor and mortgagee; (*e*) debtor and creditor; (*f*) public companies; (*g*) vendor and purchaser; (*h*) covenanter and covenantee; (*i*) tenant for life and remainderman; (*j*) partners; (*k*) lunacy; (*l*) tenants in common; (*m*) possession under legal title, and (*n*) other cases. The appointment of receivers is entirely within the discretion of the courts, and the power may be exercised "in all cases in which it shall appear just and convenient." Application for a receiver is usually made by motion, and the court will appoint the fittest person, without regard to who may propose him, the appointment of a receiver being for the benefit of all parties. Under the Conveyancing Act 1881, when a mortgagee has become entitled to exercise his powers of sale, he may, by writing under his hand, appoint such person as he think fit to be receiver. In bankruptcy practice a receiver, termed official receiver, is an officer of the court who in this capacity takes possession on the making of a receiving order, of all a debtor's assets. He is also an officer of the Board of Trade with the duty of taking cognisance of the conduct of the debtor and administering his estates (see Bankruptcy).

Receiver-general is the title given to a chief receiver, more especially as applied to the collection of public revenue. The title survived in the Inland Revenue up to 1891, but it is now only used as the designation of an officer of the duchy court of Lancaster, who receives the revenues, &c., of the duchy.

RECEPT (from Lat. *recipere*, to take back), a philosophical term, used by Romanes (*Mental Evolution of Man*, ii. 36, 37), on the analogy of "concept and percept," for mental images assumed to be produced by the simple repetition of percepts. The process is supposed to be the gradual elimination of elements in which the percepts disagree, and the emphasizing of those in which they agree. Thus the final residuum is a unity in difference. Recepts are, in fact, "spontaneous associations, formed unintentionally as what may be termed unperceived abstractions," *i.e.* what are generally known as "generic images."

RECESS (Lat. *recessus*, a going back, withdrawal, from *recedere*, to withdraw), a term particularly used of a cessation of work or relief from duty, *e.g.* of the periods during the life of a parliament when it is not sitting. The word is also applied to an indentation in a line, especially of a small alcove sunk in the wall of a room. A particular use is the historical one for the acts and decrees of the Imperial Diet, the *recessus Imperii*, and also for those of the Hanseatic League. According to Du Cange (*s.v. Recessus*) the reason for the use of this word was that these decrees, &c. (*codex deliberationum*), were written out *antequam a conventibus recedant proceres congregati.*

RECHABITES, or Sons of Rechab, a sort of religious order among the Israelites in some respects analogous to the Nazarites (*q.v.*), with whom they shared the rule of abstinence from wine. They also eschewed the luxuries and pursuits of settled life, and lived in tents, refusing to sow grain as well as to plant vineyards. They represent a protest against the contemporary Canaanite civilization and a reaction towards the simplicity of life which was felt more strongly in Judah or to the east of the Jordan than in the northern kingdom of Israel. Their "father," or founder, was that Jehonadab or Jonadab, son of Rechab, who encouraged Jehu to abolish the Tyrian Baal-worship (2 Kings x.). The order founded by Jehonadab must from its constitution have soon become a sort of hereditary clan, and as such the "house of Rechab" appears in Judah after the fall of the northern kingdom and continued to observe the ordinance of Jehonadab till the approach of Nebuchadrezzar drove them for protection into Jerusalem (Jer. xxxv.). Jeremiah promised them as a reward of their obedience that they should never lack a man to represent them (as a priest) before Yahweh, whence perhaps the later Jewish tradition that the Rechabites intermarried with the Levites and so entered the temple service.

Later references to them probably indicate that the term was used as meaning merely ascetes (Euseb., *H. E.* ii. 23), the particular form of asceticism (*q.v.*) being less essential. One may compare the modern society of total abstainers known as the "Rechabites." In 1 Chron. ii. 55 the "house of Rechab" is associated with the Kenites (*q.v.*) as a family of scribes. Their origin is ascribed to Hammath (conceivably the Naphtalite city, Josh. xix. 35), but in 1 Chron. iv. 12 Rechab (so the LXX) is of Calebite descent.

RECHBERG-ROTHENLÖWEN, JOHANN BERNHARD, Count (1806–1899), Austrian statesman, was the second son of the Bavarian statesman Count Aloys von Rechberg-Rothenlöwen (1766–1849). Johann Bernhard was destined for the Bavarian public service, his elder brother being a hereditary member of the Upper House in the parliament of Württemberg. He was educated at the universities of Strassburg and Munich, but he incurred the displeasure of King Louis I. by the part he played as second in a duel, and in 1828 he transferred himself to the Austrian diplomatic service. After being attached to the embassies in Berlin, London and Brussels, he was appointed envoy at Stockholm (1841) and at Rio de Janeiro (1843). Returning to Europe in 1847, on the outbreak of the revolution of 1848 in Vienna he was of great service to Prince Metternich, whom he accompanied and assisted in his flight to England. In July 1848 he was appointed Austrian plenipotentiary in the German federal diet at Frankfort, in 1851 became Austrian *internuncius* at Constantinople, and in 1853 Radetzky's civilian colleague in the government of Lombardo-Venetia. In 1855 he returned to Frankfort as Austrian representative and president of the federal diet. As a pupil of Metternich he would have wished to preserve the good understanding with Prussia which seemed the necessary foundation for a conservative policy; he was, however, made the instrument for the anti-Prussian policy of Buol; this brought about constant disputes with Bismarck, at that time Prussian envoy at the diet, which were sharpened by Rechberg's choleric temper, and on one occasion nearly led to a duel. Bismarck, however, always expressed a high appreciation of his character and abilities. In May 1859, on the eve of the war with Italy, he was appointed Austrian minister of foreign affairs and minister president, surrendering the latter post to the archduke Rainer in the following year.

The five years during which Rechberg held the portfolio of foreign affairs covered the war with Italy and France, the insurrection in Poland, the attempted reform of the German Confederation through the Frankfort *Fürstentag*, and the Austro-Prussian war with Denmark. After the defeat of Magenta Rechberg accompanied the emperor to Italy, and he had to meet the crisis caused by a war for which he was not responsible. He began the concessions to Hungary and in the Polish question, and was responsible for the adhesion of Austria to the alliance of the Western Powers. In the German question Rechberg's policy was one of compromise. To the project of the *Fürstentag* he was altogether opposed. The project had been suggested to the emperor Francis Joseph by his son-in-law, the hereditary prince of Turn and Taxis, and by a pamphlet of Julius Fröbel, and the preliminary arrangements were made without Rechberg being informed. When at last he was told, he tendered his resignation, which was not accepted, and he accompanied the emperor to the abortive meeting at Frankfort (August 1863). The attempt made by Rechberg at the subsequent ministerial conference at Nuremberg to establish a German league without Prussia was equally unsuccessful, and he now returned to the policy, which in opposition to Schmerling he had throughout advocated, of a peaceful arrangement between Prussia and Austria as the indispensable preliminary to a reform of the Confederation.

At this juncture the death of King Frederick VII. of Denmark (15th of November 1863) opened up the whole Schleswig-Holstein question (*q.v.*). In the diplomatic duel that followed Rechberg was no match for Bismarck. It suited Austrian policy to act in concert with Prussia against Denmark; but Rechberg well knew that Bismarck was aiming at the annexation of the duchies. He attempted to guard against this by laying down as a condition of the alliance that the duchies should only be separated from Denmark by common consent of the two German powers. Bismarck, however, insisted that the question of the ultimate destination of the duchies should be left open; and, when he backed his argument with the threat that unless Austria accepted his proposal Prussia would act alone, Rechberg gave way. His action was made the object of violent attacks in the Austrian Lower House (28–30 January 1864), and when the war was victoriously concluded and Prussia's designs on the duchies had become evident, public opinion turned more and more against him, demanding that Austria should support the duke of Augustenburg even at the risk of war. Rechberg yielded so far as to assure the duke's representative at Vienna that Austria was determined to place him in possession of the duchies, but only on condition that he did not sign away any of his sovereign rights to Prussia. The outcome of this was that the duke refused the terms offered by King William and Bismarck.

On the 22nd of August there was a meeting of the emperor Francis Joseph and King William at Schönbrunn, both Rechberg and Bismarck being present. Rechberg himself was in favour of allowing Prussia to annex the duchies, on condition that Prussia should guarantee Austria's possession of Venice and the Adriatic coast. On the first point no agreement was reached; but the principles of an Austro-Prussian alliance in the event of a French invasion of Italy were agreed upon. This latter proposal was, however, received with violent opposition in the ministry, where Rechberg's influence had long been overshadowed by that of Schmerling; public opinion, utterly distrustful of Prussian promises, was also greatly excited; and on the 27th of October Rechberg handed in his resignation, receiving at the same time the order of the Golden Fleece from the emperor as a sign of special favour. He had been made an hereditary member of the Upper House of the *Reichsrat* in 1861, and as late as 1879 continued occasionally to take part in debates. He died at his château of Kettenhof near Vienna on the 26th of February 1899. He had married, in 1834, Barbara Jones, eldest daughter of the 6th Viscount Ranelagh, by whom he had one son, Count Louis (b. 1835).

See the biography by Franz Ilwof in *Allgemeine Deutsche Biographie*, B. 53. *Nachträge* (Leipzig, 1907).

RECIDIVISM (from Fr. *récidiver*, to relapse and fall again into the same fault, or repeat the same offence as one committed before), a modern expression for "habitual crime." The recidivist is now universally known to exist in all civilized countries as one who has adopted wrong-doing and law-breaking as a profession. His persistency is ceaseless and inextinguishable by the ordinary methods of combating crime. Penal justice as generally exercised is unavailing, and is little better than an automatic machine which draws in a vast number within its wheels and casts them out again practically unchanged in character to qualify again for the ineffective treatment. This dangerous contingent is for ever on the move, into prison and out of it and in again; a large proportion of it, the criminal residuum, the very essence of the criminality of a country, resists all processes devised for its regeneration and cure. Nothing will mend it; neither severity nor kindness, neither the most irksome restraints nor the philanthropic methods of moral and educational persuasion. This failure has encouraged some ardent reformers to recommend the system of indefinite imprisonment or the indeterminate sentence, by which the enemy once caught is kept perpetually or for a lengthy period, and thus rendered innocuous. Habitual offenders, it is argued, should be detained as hostages until they are willing to lay down their arms and consent to make no further attempt to attack or injure society. The theory is sound and has been adopted in part in several countries, especially in the United States.

It was not until 1909 that the system of preventive detention was put into operation in the United Kingdom, when, by the Prevention of Crime Act 1908, power was given to the courts to pass on habitual criminals a sentence of preventive detention in addition to one of penal servitude. This further period may range within limits of from five to ten years, according to the discretion of the court. The English system is hardly more than tentative at present; the machinery is admittedly capable of improvement. The charge of being an habitual criminal has to be inserted in the indictment on which the offender is to be tried, and this cannot be done without the consent of the director of public prosecutions and after certain notice has been given to the officer of the court trying the prisoner and to the offender himself. The decision to charge a prisoner with being an habitual criminal has hitherto rested on the local police authorities, and it has been felt that a more even and a more general application of such a drastic method of treatment would result if the decision were transferred to one authority, and some such reform was foreshadowed by the Home Secretary in a speech in the House of Commons on prison reform on the 20th of July 1910.

RECIFE, or **Pernambuco**, a city and seaport of Brazil, capital of the state of Pernambuco, in 8° 3′ S. and 34° 55′ W., near the extreme eastern point of South America. Pop. (1904 estimate) 186,000. Recife is frequently called the "Venice of America"; it is at the mouths of the rivers Beberibe and Capibaribe which unite to form a small lagoon or bay inside the sea beach. In the angle between the two rivers is the delta island of Antonio Vaz. The city is built on the southern extremity of the sandy sea beach, on the island of Antonio Vaz, and on the mainland to the westward, the river channels being crossed by numerous bridges. With the exception of the hills on which Olinda is built about 5 m. northward, the surrounding country is low and flat, the general elevation averaging 10 ft. As the tide rises about 6 ft., the general level of the city and neighbouring coast, which is wet and swampy to the southward, is too low to be generally healthy, and Pernambuco has a high death-rate (52½ per 1000 in 1904), with malaria as one of the principal causes of death. The climate is hot, although agreeably tempered by the S.E. trade winds; the temperature ranges from an absolute minimum of 61° to an absolute maximum of 99° (1904). The rainfall (1904) is 75·3 in. The three principal parishes of the city are known as São José do Recife, occupying the sandy peninsula or beach north of the outlet of the united rivers; Santo Antonio, on the island of Antonio Vaz, which was called Mauritia or Mauritzstad during the Dutch occupation; and Boa Vista, on the mainland to the westward, which is the most modern and the most rapidly growing part. The first is the oldest and most crowded section, and is now devoted chiefly to the commercial and financial interests of the port; here are the custom house, merchants' exchange (Praça do Commercio), shipping offices, banks and wholesale houses. Santo Antonio dates from the Dutch occupation. Prince Maurice of Nassau, when governor-general, built here his private residence (Fribourg House) and made it his capital. Its business edifices and residences are largely of Dutch architecture, with many storeys and steep roofs. The older part of Boa Vista dates from the 17th century. Recife has few public squares or gardens, and its streets are not usually well cared for. The older buildings are of the Portuguese type, usually plain, low and heavy, constructed of broken stone and mortar, and plastered and coloured on the outside. The city has gas and electric illumination, street and suburban railways, drainage and a public water supply drawn from a small tributary of the Beberibe about 7 m. to the N.W., in the direction of Caxangá. Among its notable public buildings and institutions are the old government palace in Santo Antonio built upon the foundations of the official residence of Prince Maurice of Nassau, with a pretty garden attached; a theatre facing upon the Praça da Republica, dating from the second empire; the palace of the Provincial Assembly in Boa Vista, built in 1860–66, surmounted by a high dome; the municipal palace, or prefecture, on Rua do Imperador, with the public library (Biblioteca Publica) occupying its third floor and containing about 30,000 volumes; the Gymnasium, a large plain building of two floors standing near the legislative palace; the Pedro II. hospital built between 1847 and 1861; a large penitentiary, insane asylum, orphans' asylum, and beggars' asylum; a law school, artisans' school (Lyceu de Artes e Officios), and archaeological institute; a normal school and school of engineering; and war and naval arsenals. One of the most attractive churches is that of Nossa Senhora da Penha, surmounted by two slender spires and a dome.

The port of Recife is one of the most important of Brazil, on account of its proximity to Europe and its convenience for vessels passing around the east shoulder of the continent. It is the landing-place for two transatlantic and one coastwise cable lines. Its harbour consists of an outer and inner anchorage, the former an open roadstead, which are separated by a remarkable stone reef running parallel with the shore-line, leaving an inside passage 400 to 500 ft. wide. The entrance to the inner anchorage, which has a depth of about 20 ft., is opposite Fort Brum in the northern part of the city, and is marked by a small Dutch fort (Picão) and a lighthouse at the northern extremity of the reef. This remarkable natural breakwater, which is about 50 ft. wide on top and has been repaired with masonry in some places, covers a considerable part of the coastline in this part of Brazil. It is not a coral reef, as is sometimes stated, but is a consolidated ancient beach, now as hard and firm as stone.[1] In 1910 contractors were at work on improvements to the port to cost about £1,666,000, under a decree of the 3rd of December 1908. The exports include sugar, rum, cotton, hides, skins, rubber, wax, fibres, dyewoods, cacáu, mandioca flour, pineapples and other fruits. Pernambuco is the principal sugar-producing state of Brazil, and Recife is therefore an important centre for this product. Its railway communications with the interior are good, and include the Sul de Pernambuco, Recife and São Francisco, Central de Pernambuco, and the Recife to Limoeiro lines, the first three now being under the management of the Great Western of Brazil Co. There are also suburban lines to Olinda and Caxangá, the latter providing communication with some of the prettiest suburbs about the city.

Recife was settled about 1535, when Duarte Coelho Pereira landed there to take possession of the captaincy granted him by the Portuguese crown. The site of Coelho's capital was Olinda, but Recife remained its port and did not become an independent *villa* (town) until 1710. Down to the close of the 18th century, when Rio de Janeiro became important, Recife was the second city of Brazil, and for a time its most important port. It was captured and plundered in 1595 by the English privateer James Lancaster. It was also captured by the Dutch in 1630 and remained in their possession till 1654, during which time the island of Antonio Vaz was occupied and the town greatly improved. At the end of the Dutch War the capital was removed from Olinda to Recife, where it has since remained.

RECIPE, a statement of the materials and ingredients used in the making and preparation of a dish for cooking, a receipt. This is the principal current use, which was first applied to medieval prescriptions from the custom of placing the word, meaning "take this" (imperative of Lat. *recipere*, to receive), often abbreviated R or ℞, at the head of the formula.

RECIPROCITY (Lat. *reciprocus*, returning back the same way, alternating, probably from *re* back and *pro* forward), the condition or state of being reciprocal, *i.e.* where there is give and take, mutual influence or correspondence between two parties, persons or things. In a more particular sense, reciprocity is a special arrangement between two nations under which the citizens of each obtain advantages or privileges in their trading relations with the other. This meaning of reciprocity, however, bears a different interpretation in European and in American usage. In the former, reciprocity between two nations usually means little more than the extension by one to the other of most favoured nation treatment, *i.e.* such advantages as it extends to any third country (see COMMERCIAL TREATIES). But in the United States reciprocity is the term applied to the concessions or arrangements made between that country and another without reference to any third country. Thus in the United States there are a maximum and minimum tariff, the rates of the maximum tariff being enforced on the goods of those countries which have no reciprocity treaty with the United States, and the rates of the minimum on certain products of those countries which have by a reciprocity treaty given special advantages or concessions to certain products of the United States.

RECITAL (from Lat. *recitare*, to read out, particularly of a public document), an account or repetition of the details of some act, proceeding, fact, &c., particularly, in law, that part of a legal document, such as a lease, which contains a statement of certain facts, *e.g.* the purport for which the deed is made. In music, the word is used of an instrumental performance given by a single person, and also of a performance of the works of a single composer.

RECKLINGHAUSEN, a town of Germany, in the Prussian province of Westphalia, 22 m. by rail N.W. of Dortmund on the railway to Münster. Pop. (1905) 44,396. In the neighbourhood are extensive coal-mines and brick-works, and the industries embrace the manufacture of linen, beer, spirits and tobacco.

The county of Recklinghausen belonged to the archbishopric of Cologne until 1803, when it passed to the duke of Arenberg. It was known as the Vest Recklinghausen. In 1810 it was divided by Napoleon between the grand duchy of Berg and France, but was, in 1815, restored to the duke of Arenberg as a fief under Prussian sovereignty.

See Ritz, *Die ältere Geschichte des Veste und der Stadt Recklinghausen* (Erzen, 1904).

RECLAMATION OF LAND. The boundaries between sea and land are perennially changing. In many sheltered bays and estuaries the sea is receding, while along other portions of the sea-coast it is continuously encroaching. The same causes operate to produce both results: the rivers carry down with them detritus and sediment from the higher ground; the sea, aided by wind and tide, is always eroding exposed portions of the seaboard; and even such lesser influences as rain and frost assist in disintegrating cliffs composed of softer strata.

The main object of reclaiming land from the sea is to increase the area of ground available for cultivation. Land which has been raised by accretion nearly to high-water level can be shut off from the sea by works of a simple and inexpensive nature, and the fresh alluvial soil thus obtained is generally very fertile.

Accretion in estuaries takes place very slowly under ordinary conditions. Although at any one time the sheltered areas may be large and the deposit of silt fairly rapid, not much permanent accretion will take place owing to the frequent shifting of the channels. Directly, however, a fixed channel is secured by longitudinal embankments or training walls, accretion progresses rapidly and uninterruptedly by the deposit of sediment in the slack-water behind the embankments and at the sides of the estuary; and this is especially the case if the training works are raised to the level of high water, for this has the effect of restricting the greater part of the scour of tide and fresh-water discharge to the one fixed channel. The rate of accretion varies with the shelter of the site and the amount of sediment carried by the water; but by degrees the foreshores, in the upper portion and at the sides of the embanked estuary, are raised sufficiently for samphire to make its appearance, and, later on, a coarse grass. Ultimately the time arrives when the water may be altogether excluded by the construction of enclosing embankments; these must be raised above the level of the highest tide, and should have a flat slope on the exposed side, protected, in proportion to exposure and depth of water, against the face with clay, sods, fascines or stone pitching.

In the intermediate stages of the process outlined above much may be done to promote the growth of accretion, or warping as it is termed, and to ensure the fertility of the reclaimed land. The deposit of warp is accelerated by anything which tends to reduce the flow and consequent scour of the ebb-tide over the foreshore: thus considerable advantage will accrue from placing rows of faggots or sods across the lines of flow; and banks, enclosing the higher portions of the foreshore, may often be constructed so as materially to increase the period of stagnation, near high tide, of the silt-bearing water upon the lower adjacent foreshore. The light, fertilizing alluvium only deposits in shallow water at high tide, and where there are no tidal currents. The final enclosure, therefore, should not be effected until this deposit has taken place. The enclosing works, also, should be so carried out that increasing shelter may favour the deposits of this alluvium during construction. A final and rapid deposit can sometimes be effected by making sluices in the banks: the turbid water is admitted near high tide, and retained until the whole of its silt has been deposited, the clear water being allowed to escape slowly towards low tide. Premature enclosure must be guarded against; it is more difficult, the cost greater, the reclaimed land is less fertile and, being lower, less easy to drain.

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[1] See J. C. Branner's *The Stone Reefs of Brazil* (Bul. Comp. Zoöl., Harvard Univ., xliv., Cambridge, 1904).

The practice of reclaiming land in British estuaries is a very ancient one. The Romans effected reclamations in the Fen districts; the enclosing of Sunk Island in the Humber was begun in the 17th century, and now produces an annual revenue of something like £10,000; large reclamations in the Dee estuary took place in the 18th century; and, in recent times, works have been carried out in the estuaries of the Seine, the Ribble and the Tees.

In the reclamation of land adjoining the sea-coast, sites where accretion is taking place are obviously the most suitable. Marsh lands adjoining the sea, and more or less subject to inundation at high tides, can be permanently reclaimed by embankments; but these, unless there is protection from sand dunes or a shingle beach, require to be stronger, higher, with a less steeply inclined and better protected slope than is required in estuaries. The width of the bank will generally prevent percolation of water at the base; but if there is any danger of infiltration, owing to unsuitability of material, a central core of puddled clay or a row of sheet-piling should be employed. Waves overtopping the bank will quickly cause a breach, and produce disastrous results; the height of the bank must, therefore, be calculated to meet the case of the severest on-shore gale coinciding with the highest spring tide. Undermining, caused by the recoil of waves on the beach, is liable to occur in exposed sites; this may be prevented by a line of sheet-piling along the outer toe of the bank.

Sea-coast embankments should not generally be constructed farther down the foreshore than half-tide level, as the cost of construction and maintenance would increase out of all proportion to the additional area obtained. It is, as a rule, more economical to reclaim a large area at one time, instead of enclosing it gradually in sections, as the cost varies with the length of embankment; it is, however, more difficult to effect the final closing of a bank, where a large area is thus reclaimed, on account of the greater volume of tidal-water flowing in and out of the contracted opening. The final closing of a reclamation embankment is best accomplished by leaving a fairly wide aperture, and by gradually raising a level bank across its entire length. The enclosed area may be left full of water to the height of the unfinished bank, or the tide-water may be allowed to escape and enter again by sluices in the finished sections. The embankments in Holland are closed by sinking long fascine mattresses across the opening; these are weighted with clay and stone, and effectually withstand the scour through the gap; the two terminal slopes of the finished sections are similarly protected.

There are many examples of sea-coast reclamation: Romney marsh was enclosed long ago by the Dymchurch wall (see fig. 1), and a large portion of Holland has been reclaimed from the sea by embankments (see fig. 2); the reclamation bank for the Hodbarrow iron mines (see fig. 3) illustrates the use of puddled clay to prevent infiltration.

The repair of a breach effected in a completed reclamation embankment is a more difficult task than that of closing the final gap during construction; this is owing to the channel or gully scoured out upon the opening of the breach. When a breach occurs which cannot be closed in a single tide, the formation of an over-deep gully may to some extent be prevented by enlarging the opening. Breaches in embankments have been closed by sinking barges across the gap, by piling and planking up, by lowering sliding panels between frames erected to receive them, and by making an inset wall or bank round the breach. By the last-mentioned method the new connecting bank can be formed on solid ground, and the necessary width of opening obtained to obviate excessive scour during the influx and efflux of the tide over the bank while it is being raised.

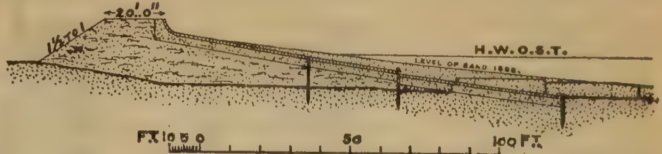

FIG. 1.—Sea-wall at Dymchurch.

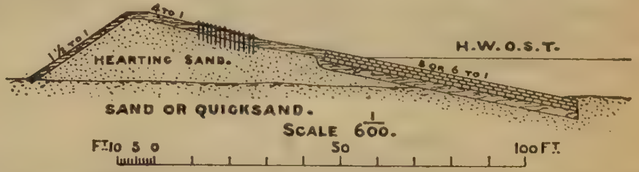

FIG. 2.—Dutch Reclamation Embankment.

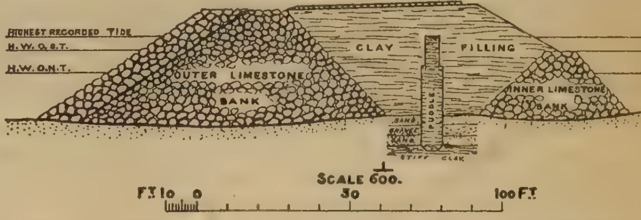

FIG. 3.—Reclamation Bank for the Hodbarrow Iron Mines.

The gradual drying of reclaimed land lowers the surface some two or three feet; the land therefore becomes more liable to inundation after reclamation than before. Accordingly, it is most important to prevent breaching of the bank by promptly repairing any damage caused by storms; and if a breach should occur, it must be closed at the earliest possible opportunity.

The protection of the coast-line from encroachment by the sea is a matter of considerable importance and great difficulty: the more rapid the erosion, the more exposed must be the site; and, consequently, the more costly will be the construction and maintenance of protective works. These are of two kinds: sea-walls or banks, and groynes.

Upright sea-walls with some batter on the face have been constructed along the frontage of many sea-side towns, with the double purpose of making a promenade or drive, and of affording protection to the town. A very sloping and also a curved batter breaks the stroke of the wave by facilitating its rising up the face of the wall, but the force of the recoil is correspondingly augmented. A wall with a vertical face offers more direct opposition to a wave, minimizes the tendency to rise, and consequently the recoil; while a stepped face tends to break up both the ascending and recoiling wave in proportion to the recession of the steps, but there is a corresponding liability to displacement of the blocks composing the wall. The concrete sea-walls erected in front of Hove, Margate, and the north cliff at Scarborough (see figs. 4, 5, 6) exhibit straight, stepped, and curved forms of batter. The curvature of the last-named wall, though diverting the coil at its base, did not prevent erosion of the shale bed on which it was founded, and a protective apron in front of the toe had to be added subsequently.

The Beaconsfield sea-wall at Bridlington (see fig. 7) is stepped and slightly curved; it has a stone face with concrete backing, strengthened at intervals by counterforts. The thickness of the wall varies from 11 ft. 6 in. at the base to 3 ft. at the top, and is surmounted by a dressed cornice and coping; the length is 340 yards. The work was constructed, in 1888, at a cost of £10,000, or £29, 8s. per lineal yard.

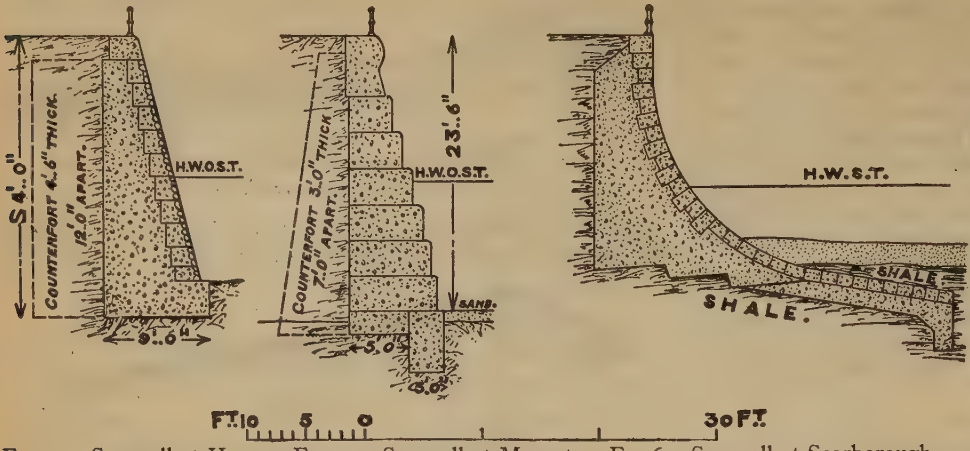

Fig. 4.—Sea-wall at Hove. Fig. 5.—Sea-wall at Margate. Fig. 6.—Sea-wall at Scarborough.

Walls with almost vertical faces, or slightly stepped, appear to be the best. Unless, however, the foreshore consists of hard rock, or a raised beach maintained by groynes, a wall of this kind should be protected by an apron, in order to prevent the destructive undermining to which such forms of wall are necessarily liable.

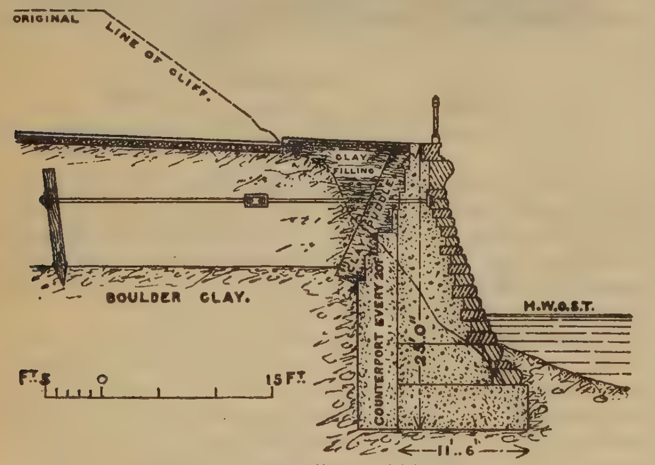

Fig. 7.—Sea-wall at Bridlington.

Where the coast is fringed with sand dunes, and the beach protected from erosion by a regular series of groynes, as at Ostend (Belgium), the sand dunes, or an embankment for a promenade in front of them, may be sufficiently protected by a simple slope, paved with brickwork or masonry, and having a maximum inclination of two to one. The paving requires to be laid on a bed of clay, rubble or concrete. Parts of the sea bank at Ostend (see fig. 8) have been carried out beyond high-water mark to gain a strip of land for the esplanade; and these portions have had to be protected from undermining at the toe with piles and planks, and an apron of concrete or pitching, laid on fascines, extending down the foreshore. For the parts above high-water mark a short paved slope, with moderate protection at the toe, has been found sufficient. The top face of these slopes is reflexed so as to protect the esplanade from surf during storms.

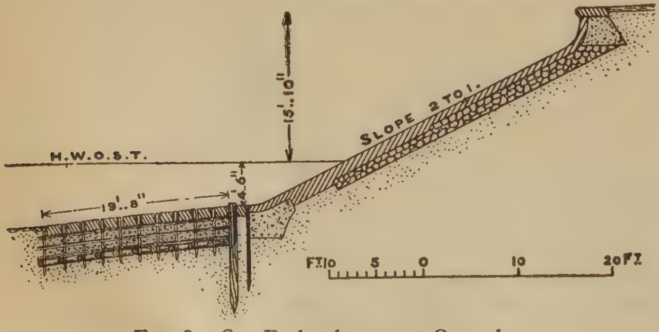

Fig. 8.—Sea Embankment at Ostend.

Sea-walls are very costly and, while temporarily resisting, do not diminish, but actually increase, the erosive action of the sea. In short, sea-walls are a most unsatisfactory type of protective work.

The protection afforded to the coast by groynes is based on a totally different principle, which may be summarized as that of promoting natural accretion by the construction of artificial shelter. Along most coasts there is a littoral drift of sand or shingle; by means of groynes, projecting from the coast-line down the beach, this drift may be intercepted so as to produce accretion to the foreshore, where previously there has been constant erosion. The problem, however, of coast protection by this method presents difficulties. Littoral drift is the product of erosion, and the fate of a large portion of this drift is to be deposited in deep water. Any scheme, therefore, of stopping erosion altogether by means of groynes would be purely chimerical; in the same way, partial failure of groynes, from lack of drift and inability to stop wastage, must be expected in many localities. Another difficulty may be illustrated by the action of such natural projections as Dungeness: this point, by completely arresting the easterly drift of shingle, causes a rapid accretion to the beach on the one side, but a corresponding denudation on the other. The old type of high groyne, erected at Cromer and Hastings, has produced the same undesirable result; moreover, the general effect of groyning certain portions of the foreshore is to render the adjacent unprotected portions more liable to erosion. Nevertheless, the benefit which may be derived locally from suitable groyning is very great. The timber groynes erected between Lancing and Shoreham raised the shingle beach sufficiently to cause high-water mark to recede 85 ft. seawards in the course of a few years.

The eroding action of the river Scheldt in front of Blankenberghe has been arrested by carrying out groynes at right angles to the coast-line, and down to below low water (see figs. 9, 10). These, on the average, are about 820 ft. long and 680 ft. apart: they are made wide, with a curved top raised only slightly above the beach, so as to minimize the scour from currents and wave action, and facilitate the ever

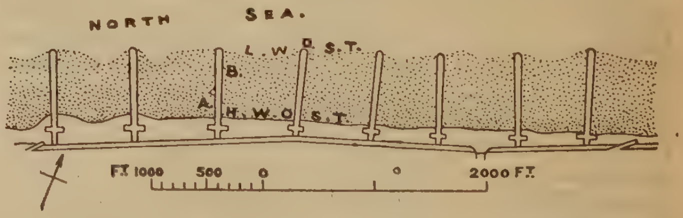

Fig. 9.—Groynes on North Sea coast at Blankenberghe.

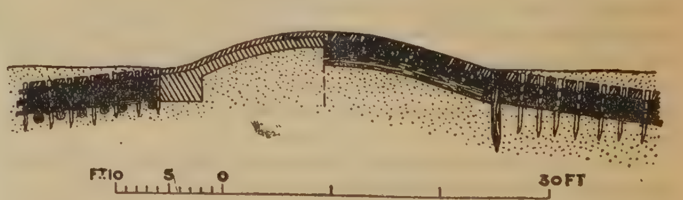

Fig. 10.—Sections of Groynes at Blankenberghe.

distribution of drift over the protected area. They are constructed with a foundation of fascines and concrete, faced with brickwork or stone pitching. The result has been the formation of a gently sloping beach which reduces wave action; such loss, too, as is still occasioned by storms is speedily made good by natural accretion in moderate weather. The Blankenberghe groynes are too expensive a type for ordinary use.

The beach at Bridlington, which rests on boulder clay, was rapidly disappearing owing to the increased scour due to the sea-walls. Accordingly, groynes (see figs. 11, 12) made of 14 ft. × 9 in. × 9 in. pitch-pine piles, and 11 in. × 4 in. planking, were erected along the foreshore. The piles originally projected about 6 ft.; but, to prevent heaping up of sand to windward with denudation to leeward, the planking was never raised more than two strakes above sand-level, fresh planks being added as the sand rose. The south-easterly gales are said to be the most erosive here, and prevalent during the winter months; on this account the groynes were given an inclination of 10° south of east, that is 10° from the perpendicular. It may be doubted whether this was the best angle, but the result has been very satisfactory. The cost of construction was from 12s. 3d. to 18s. per lineal foot.

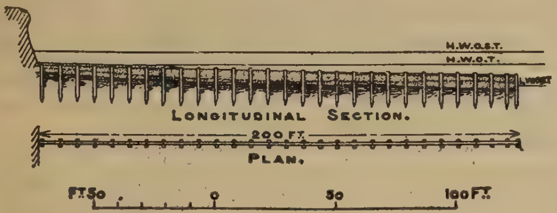

FIG. II.—Groynes at Bridlington.

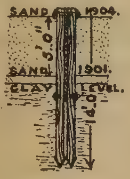

FIG. 12.—Enlarged cross-section of Groynes.

The sand-banks at the entrance to Poole Harbour have been protected by groynes (see fig. 13) inclined at slightly varying angles, some yielding better results than others. This is a good example of the important work which may be accomplished by groyning. Unprotected, a breach would soon have been effected in these sand-banks; with a double entrance to the bay the present deep channel would have silted up, and Poole Harbour would have been practically destroyed.

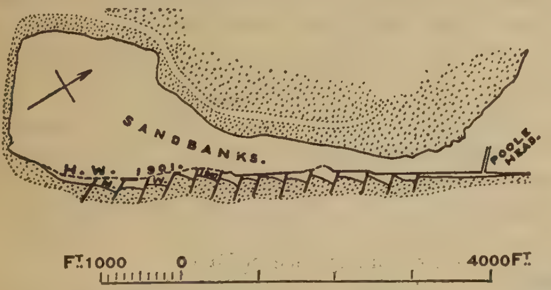

FIG. 13.—Groynes for Protecting the Sand-banks enclosing Poole Harbour.

It is evident that the efficacy of groynes in collecting drift is proportionate to the distance which they can be carried out seawards, and that they should always be extended to low-water mark; whilst, by raising them only slightly above the beach, the accumulation of drift to leeward is promoted, the passage of drift over the obstruction being facilitated and the scour of the waves diminished. By this means, and by gradually raising and extending the groynes as the drift accumulates, the general elevation of the beach can be secured. Drift generally travels in both directions along a coast, veering with the wind; thus the prevailing wind determines the preponderating travel of the drift. Groynes are usually constructed at right angles to the shore, but it is believed that increased benefit may be obtained by slightly inclining them to leeward of the prevailing wind. Some engineers have advocated the extension of groynes below low-water mark; and as wood when permanently submerged is specially liable, even when creosoted, to be attacked by the *teredo* and *limnoria*, the use of reinforced or ferro-concrete has been suggested as the most suitable material for submarine groyning. These suggestions, however, and many other current theories on groyning, require to be demonstrated by repeated experiments.

For a useful bibliography of the subject see British Parliamentary Reports, *Coast Erosion and the Reclamation of Tidal Lands*, Cd. 3684, Appendix No. X. pp. 146–158. (L. W. V.-H.)

RECLUS, JEAN JACQUES ELISÉE (1830–1905), French geographer, was born at Sainte-Foy la Grande (Gironde), on the 15th of March 1830. He was the second son of a Protestant pastor, who had a family of twelve children, several of whom acquired some celebrity either as men of letters, politicians or members of the learned professions. His education, begun in Rhenish Prussia, was continued in the Protestant college of Montauban, and completed at the university of Berlin, where he followed a long course of geography under Karl Ritter. Withdrawing from France in consequence of the events of December 1851, he spent the next six years (1852–57) visiting the British Isles, the United States, Central America, and Colombia. On his return to Paris he contributed to the *Revue des deux mondes*, the *Tour du monde* and other periodicals a large number of articles embodying the results of his geographical work. Among other works at this period was an excellent short book, *Histoire d'un ruisseau*, in which he traces the development of a great river from source to mouth. In 1867–68 he published *La Terre; description des phénomènes de la vie du globe*, in two volumes. During the siege of Paris, Reclus shared in the aerostatic operations conducted by M. Nadar, and also served in the National Guard, while as a member of the Association Nationale des Travailleurs he published in the *Cri du Peuple* a hostile manifesto against the government of Versailles in connexion with the Communist rising of the 18th of March 1871. Continuing to serve in the National Guard, now in open revolt, he was taken prisoner on the 5th of April, and on the 16th of November sentenced to transportation for life; but, largely at the instance of influential deputations from England, the sentence was commuted in January 1872 to perpetual banishment. Thereupon, after a short visit to Italy, he settled at Clarens, in Switzerland, where he resumed his literary labours, and, after producing the *Histoire d'une montagne* (a companion to *Histoire d'un ruisseau*), wrote nearly the whole of his great work, *La Nouvelle Géographie universelle, la terre et les hommes*, 19 vols. (1875–94). This is a stupendous compilation, profusely illustrated with maps, plans, and engravings, and was crowned with the gold medal of the Paris Geographical Society in 1892. An English edition appeared simultaneously, also in 19 vols., the first four by E. G. Ravenstein, the rest by A. H. Keane. Extreme accuracy and brilliant exposition form the leading characteristics of all Reclus's writings, which thus possess permanent literary and scientific value. In 1882 Reclus initiated the "Anti-Marriage Movement," in accordance with which he allowed his two daughters to marry without any civil or religious sanction whatever. This step caused no little embarrassment to many of his well-wishers, and was followed by government prosecutions, instituted in the High Court of Lyons, against the anarchists, members of the International Association, of which Reclus and Prince Kropotkin were designated as the two chief organizers. The prince was arrested and condemned to five years' imprisonment, but Reclus, being resident in Switzerland, escaped. After 1892 he filled the chair of comparative geography in the university of Brussels, and contributed several important memoirs to French, German and English scientific journals. Among these may be mentioned "The Progress of Mankind" (*Contemp. Rev.*, 1896); "Attila de Gerando" (*Rev. Géograph.*, 1898); "A great Globe" (*Geograph. Journ.*, 1898); "L'Extrême-Orient" (*Bul. Antwerp Geo. Soc.*, 1898), a thoughtful study of the political geography of the Far East and its possible changes; "La Perse" (*Bul. Soc. Neuchateloise*, 1899); "La Phénicie et les Phéniciens" (*ibid.*, 1900); *La Chine et la diplomatie européenne* ("L'Humanité nouvelle" series, 1900); *L'Enseignement de la géographie* (Instit. Géograph. de Bruxelles, No. 5, 1901). Shortly before his death Reclus had completed *L'Homme et la terre*, in which he set the crown on his previous greater works by considering man in his development relative to geographical environment. Reclus died at Thourout, near Bruges, on the 4th of July 1905.

RECOGNIZANCE (from Lat. *recognoscere*, to acknowledge), a term of English law usually employed to describe an obligation of record, entered into before some court or magistrate duly authorized, whereby the party bound acknowledges (recognizes) that he owes a personal debt to the Crown, with a defeasance, *i.e.* subject to a condition that the obligation to pay shall be avoided if he shall do some particular act—as if he shall appear at the assizes, keep the peace, or the like. The system of taking recognizances in favour of the Crown at an early date superseded the common law practice as to pledges and main-prize (see *re Nottingham Corporation*, 1897, 2 Q.B. 502, 514).

Blackstone's definition extends the term recognizance to bonds in favour of private persons. But at present it is rarely if ever used in this sense. Recognizances are now used almost solely with reference to criminal proceedings. In the Court of Chancery it was the practice to require recognizances from the guardian of a ward of court that the ward should not marry or leave the country with the privity of the guardian and without the leave of the court. The security given by a receiver appointed by the High Court is still in the form of a recognizance acknowledging a debt to named officers of the court, and securing it on the real and personal estate of the receiver.

By an act of 1360 (34 Edw. III. c. 1), extended to Ireland by Poyning's Act, and by the terms of the commission of the peace, justices of the peace have jurisdiction to cause to come before them or any one of them "all those who to any one or more of our people concerning their bodies or the firing of their houses have used threats to find sufficient security for the peace or their good behaviour towards us and our people; and if they shall refuse to find such security, then there in our prisons until they shall find such security to cause to be safely kept." The security taken is by recognizance of the party and his sureties, which can be forfeited on conviction of any offence which is a breach of the conditions of the recognizance.

The procedure under the act of 1360 and the commission is usually described as exhibiting articles of the peace or swearing the peace. The High Court (King's Bench Division) has the same power as justices in quarter sessions. This procedure is in practice superseded in England, so far as concerns courts of summary jurisdiction, by an equivalent but more modern procedure (42 & 43 Vict. c. 49, s. 25). Recognizances ordered under these enactments cannot be forfeited or as it is termed estreated without an order of court made upon proof of breach of the conditions, or of a conviction involving such breach. The procedure for estreats is governed by the Levy of Fines Acts 1822 and 1833, and by 16 & 17 Vict. c. 30, s. 2.

There is also a general jurisdiction on conviction of misdemeanour to put the offender under recognizances to keep the peace and (or) be of good behaviour in addition to or in substitution for other punishment. This power is specifically applied by the Criminal Law Consolidation Acts of 1861 to all indictable misdemeanours punishable under these acts, and power is given to put persons convicted of any felony (not capital) punishable under the acts under a recognizance to keep the peace. On refusal to enter into recognizances as above, the court may order imprisonment for the refusal, limited in cases within the acts of 1861 to twelve months, and in cases within the act of 1879 to six months.

The recognizances above described may be described as a form of punishment or a judicial security for good conduct. Recognizances are, however, most used with reference to proceedings before conviction and judgment. In preliminary inquiries into indictable offences the inquiring justices take recognizances to ensure the attendance of the accused if liberated during any adjournment, and on committal for trial take the recognizances of the accused (if allowed bail) to attend the court of trial and take his trial, and of the prosecutor and the witnesses for the prosecution or defence to attend and prosecute or give evidence. As to witnesses this power was first given in 1554 (1 Ph. & M. c. 13). The procedure is regulated by the Indictable Offences Act 1848 (11 & 12 Vict. c. 42) as amended in 1867 (30 & 31 Vict. c. 35) and the forms of recognizance are scheduled to the act of 1848. In the case of inquisitions of murder or manslaughter taken before a coroner a similar procedure is followed (Coroners Act 1887, 50 & 51 Vict. c. 71, s. 5). The recognizances taken are returnable under penalty to the court of trial, which orders their estreat in the event of breach of the conditions.

Similar powers as to the recognizances of persons prosecuted summarily are given by the Summary Jurisdiction Acts 1848 and 1879; and in the event of appeals to quarter sessions or by special case to the High Court from courts of summary jurisdiction, recognizances or security are required from the appellant (42 & 43 Vict. c. 49, ss. 31, 33). On the transfer of indictments from inferior to superior courts recognizances to pay the costs on conviction are also required (Crown Office Rules, 1906). In certain cases the police have authority to give bail to accused persons on their entering into a recognizance; and governors of prisons are allowed to release prisoners on bail on compliance with the terms on which it is allowed by the committing justices.

By the Land Charges Act 1900 (63 & 64 Vict. c. 26, s. 2 (1) a recognizance, whether obtained or entered into on behalf of the Crown or otherwise, does not operate as a charge on land or on any interest on land or on the unpaid purchase money for any land, unless a writ or order for the purpose of enforcing it is registered under s. 5 of the Land Charges, &c., Act 1888 (51 & 52 Vict. c. 51) in the office of the Land Registry. This enactment is clearly applicable to receivers' recognizances, *supra*; and on purchases of land search is made for registered recognizances and an official certificate can be obtained affirming or negativing the existence of a registered entry (Conveyancing Act 1882, s. 2). By s. 30 of the Bankruptcy Act 1883, a discharge in bankruptcy does not release the debtor from debts on a recognizance unless the Treasury certifies in writing its consent to the discharge.

By ss. 32, 34 of the Forgery Act 1861, it is made felony to forge recognizances, and to acknowledge them in the name of another without lawful authority is also felony (24 & 25 Vict. c. 98).

In Scotland the place of recognizances is filled by cautions; a caution in "law-burrows" corresponds very nearly to a recognizance to keep the peace.

In the United States recognizances are used for much the same purposes as in England. (W. F. C.)

RECONNAISSANCE (from Fr. *reconnaître*, to recognize, Lat. *recognoscere*), a military term denoting the reconnoitring or examination of an enemy's position or movements, or of a tract of ground. Reconnaissances naturally vary indefinitely according to the purposes for which they are undertaken. A topographical reconnaissance is practically a survey of a tract of country or route, comprising both a map and a report as to its advantages and disadvantages. All reconnoitring work of this character is done by officers with small patrols, escorts or assistants. Strategical reconnaissance is performed by contact squadrons, which send forward officers and patrols to find the enemy. Tactical reconnaissance falls to the lot of troops of all arms, whether in contact with the enemy or for self-protection. A reconnaissance by a large force of all arms with the idea of provoking an enemy into showing his hand, if necessary by fighting, is called a reconnaissance in force.

RECORD (Lat. *recordari*, to recall to mind, from *cor*, heart or mind), a verb or noun used in various senses, all derived from the original one of preserving something permanently in memory. In this article, however, we are only concerned with documentary records, or archives. In its accurate sense a record is a document regularly drawn up for a legal or administrative purpose and preserved in proper custody to perpetuate the memory of the transaction described in it; for the most part it forms a link in a complicated process, and unless the connexion between it and the other documents making up the process has been preserved, a portion of its meaning will have perished. The first care, therefore, of the custodian of records should be to preserve this connexion, where it exists. In the majority of countries a previous task awaits him; it has been his duty to collect and arrange his documents. There are few countries in which records have not passed through a period of neglect; each office of state has kept or rather neglected its own papers; each court of justice has been the keeper of its own records; the student has been paralysed by a multitude of repositories among which he vainly sought the documents he required. To this stage two systems have succeeded; the system of centralization both of records and of staff; and the system under which the records are left in local repositories and the staff is centralized. There are of course countries which cannot be brought under either of these formulae. But for the most part it will be found that the second system has prevailed; there are a central office for records of state, provincial offices for legal records and those of local administration, town offices for municipal records, and a staff of archivists depending more or less strictly upon the central office. In England the first system has been preferred; almost all the records that can be collected have been gathered into the central office. In the future, indeed, it is inevitable that collections of administrative records should grow up for each county; but there is at present no means of ensuring their arrangement and preservation. Many towns possess old and valuable collections of municipal archives, and over these also the central office has no control. It would be absurd to affirm that such control is needed for the preservation of the documents; but it is a curious fact that the English government, which has centralized records more freely than any other, should have refrained from establishing any system of administration for records in general. The following article is intended to give a full account of the administration and nature of the records of Great Britain, and brief notices of those of other countries concerning which information is obtainable. It may be noticed that the directory of the learned world published by Trübner at Strassburg under the title *Minerva* will be found a useful guide to the situation and staff of repositories of records.

England.

The most important repository of English records is the Public Record Office, Chancery Lane, London, established under the Act 1 & 2 Vict., c. 94. The head of the office is the Master of the Rolls for the time being; and the staff consists of the deputy-keeper, secretary, assistant-keepers and clerks, with a subordinate staff.

Until the establishment of this office, the records of the various courts of law and government offices were stored in separate places, mostly of an unsuitable nature, whose contents were inaccessible and unknown. The Tower of London contained the records of the Chancery, which were kept in fair order; the records of the Exchequer were scattered in many places, chiefly unsuitable; and other collections were almost as unfortunately bestowed: the only attempt to provide a special place of custody was made in the 17th century, when the State Paper Office was set up as a place of deposit for the papers of the secretaries of state. From time to time efforts were made, chiefly by means of committees of the House of Lords, to procure reforms in the custody of documents whose value was well understood. In the reign of Queen Anne, an attempt was made by Thomas Rymer to publish in the *Foedera* such documents as could be found bearing upon foreign politics; and this drew fresh attention to the question of custody. In 1731 the disastrous fire in the Cottonian Library produced a committee of the House of Commons and another report. But it was not until 1800 that any serious steps were taken. In that year a committee of the House of Commons presented a valuable report dealing with all the public records in repositories in England and Scotland. The result of this committee was the appointing of a royal commission charged with the arrangement and publication of the public records and the control of all public repositories. This commission was renewed from year to year and did not expire until 1837. It fell partly because of internal dissensions, but principally owing to gross extravagance and almost complete neglect of its duty, so far as the arrangement and custody of the records was concerned. The publications sanctioned by it are often badly designed and badly executed; but their most prominent characteristic was their expense. To this commission succeeded the Public Record Office, whose constitution has already been described. The first duty of the new office was the establishment of a central repository into which the scattered collections of records could be gathered; and the preparation of manuscript inventories of the documents so obtained. In 1851 the construction of the central repository was begun; and with the completion of each portion of it further groups of records were brought in. At first only those collections specified in the act of parliament were dealt with; but in 1852 the State Paper Office was placed under the control of the Master of the Rolls, and its contents removed to the Public Record Office. Other government departments in turn transferred to the same keeping papers not in current use; and at present the only important collections of papers not so treated are those of the India Office and the Privy Council Office, which are still kept apart.

The publications of the Record Office are of three kinds: reports, lists and indexes, and calendars. The reports are the annual reports of the Deputy Keeper, and now deal merely with the administrative work of the office; up to 1889 they also contained, in the form of appendices, inventories and detailed descriptions of various classes of records. In the present article these reports are referred to by number. The lists and indexes are either inventories of special classes with more or less detail, or indexes to the contents of certain documents grouped for that purpose; they are here cited by their number. The calendars are volumes containing full abstracts intended to make the consultation of the original document unnecessary except for critical purposes; they are equipped with full indexes. The contents of the Record Office are classified for the most part under the collections in which they were found. For a general account of the whole, see S. R. Scargill-Bird's *Handbook to the Public Records* (3rd ed. 1908). No student can afford to neglect C. Gross's *Sources and Literature of English History from the Earliest Times to about 1485*, which contains much information as to books and articles based upon English records.

We may now turn to the documents themselves, under the following heads:—

Exchequer Records.—The records of the administrative and judicial sides of the Exchequer (*q.v.*) are here described under its several divisions.

(1) Upper Exchequer, or Exchequer of Audit.—(*a*) *Lord Treasurer's Remembrancer's Office*, or office of final audit. The result of the final audit is recorded in duplicate on the *Pipe* and *Chancellor's Rolls.* These consist of a solitary (*Pipe*) roll for 31 Henry I., and a duplicate series extending from 2 Henry II. to 2 William IV. The Record Commission has printed the following rolls: *Pipe Rolls*, 31 Henry I., 2–4 Henry II., 1 Richard I.; *Chancellor's Rolls*, 3 John. The Pipe Roll Society has printed the *Pipe Rolls* for 5–24 Henry II.

Foreign Rolls or Rolls of Accounts.—These contain the records of the preliminary audit of accounts other than county accounts of the sheriffs; they run from 42 Edward III. to modern times: closely connected with them are the *Enrolled Accounts*, which deal with the more important accountants separately. It should be noted that the final audit is not recorded upon either *Foreign Rolls* or *Enrolled Accounts*, but must be sought on the *Pipe Roll*, unless the accountant is found to be quit or to have a balance due to him. The Record Office has published a classified list (No. XI.) of the Foreign and Enrolled Accounts taken from all the foregoing rolls of audit, but omitting the accounts of Customs and Subsidies.

Declared Accounts.—A list (No. II.) of these records with an introduction has been published by the Record Office. The series begins in the 16th century, and from the 17th century is fairly complete.

Originalia Rolls (20 Henry III. to 1837), or extracts from the Chancery Rolls communicated to the Exchequer for its information and guidance. Latin abstracts of the rolls from Henry III. to Edward III. were printed by the Record Commission as *Abbreviatio Rotulorum Originalium* (2 vols. folio).

Lord Treasurer's Remembrancer's Memoranda Rolls.—These contain the letters received and issued by the Exchequer and notes of the general business of the department. They run from 1 Henry III. to 1848. Edward Jones's *Index to the Records* contains a few scattered references to them; and many extracts will be found in the notes to Thomas Madox's *History of the Exchequer.*

Judicial.—The only judicial proceedings on the *Lord Treasurer's Remembrancer's* side are in cases connected directly with the revenue. These are enrolled upon the *Memoranda Rolls*; and for the period 35 Charles II. to William IV. there are Order Books.

(*b*) *King's Remembrancer's Office*, or office of preliminary audit. The most important financial records of this branch of the Exchequer are the class known as "Exchequer K. R. accounts, &c.," which comprise vouchers and audited accounts of expenditure. Of similar accounts relating to receipts, the Escheator's accounts have been listed in the 10th Report; but the inquisitions there described as filed with the accounts as vouchers are now kept separately, and are described with the *Chancery Inquisitions* in the calendars. Accounts and vouchers relating to *Subsidies* and *Customs* are at present only described in manuscript (see below under Special Collections).

King's Remembrancer's Memoranda Rolls (1 Henry III. to 13 Victoria).—These run parallel with those of the Lord Treasurer and to a large extent contain the same matter. Adam Martin's *Index to Exchequer Records* contains a certain number of references to them.

In the reign of Edward VI., returns were made into the Exchequer by commissioners appointed to take inventories of *Church Goods.* Volumes of these for several counties are being published by the Alcuin Club (see Mély et Bishop, *Bibliographie générale des inventaires imprimés*, vol. i. p. 245).

Judicial.—The court of Exchequer on the King's Remembrancer's side was a court of equity held before the lord treasurer, the chancellor of the exchequer and the barons. The usual records of a court of equity, Bills and Answers, Decrees and Orders, Affidavits and other subsidiary documents exist for it. Martin's *Index to Exchequer Records* contains references to the Decrees and Orders.

Of the proceedings under *special commissions* issuing from this court a descriptive catalogue (Elizabeth to Victoria) has been published in the 38th Report. *Depositions* taken by commission (Elizabeth to George III.) are catalogued in the Reports 38–42. A catalogue of the later depositions exists in manuscript.

(2) LOWER EXCHEQUER, or EXCHEQUER OF RECEIPT.—The principal financial records of this department are the *Receipt* and *Issue Rolls* showing the payments made to and by the Exchequer. The former consist of an exceptional roll for 14 John and a series from Henry III. to George III. The latter run from Henry III. to Edward IV. and from Elizabeth to George III. A translation of the issue rolls (2) for 44 Edward III. was published by F. Devon; who also published a volume of extracts from the issue rolls of the reign of James I., and another volume of extracts from the rolls for the period 41 Henry III. to 39 Henry VI. The other records of this department are very numerous.

(3) EXCHEQUER OF PLEAS.—The barons of the Exchequer without the lord treasurer had a court of their own, where process took place by common law. A list of the Plea Rolls of this court (20 Henry III. to 1855) will be found at p. 64 of the Record Office *List of Plea Rolls* (No. IV.). A partial index to the tithe-suits on these rolls is contained in the 2nd Report.

(4) EXCHEQUER OF THE JEWS.—Suits between Jews, or in which Jews were concerned, were tried before a special subordinate court. The Plea Rolls (3 Henry III. to 4 Edward I.) are listed in the Record Office *List of Plea Rolls.* For specimens see *Select Pleas, Starrs and Records of the Jewish Exchequer*, edited for the Selden Society and the Jewish Historical Society of England by J. M. Rigg.

(5) FIRST FRUITS AND TENTHS.—After the breach with Rome, the crown obtained a new source of revenue in the first fruits due to the pope from every holder of a benefice upon appointment, and from the tenths payable during his tenure of it. For a few years under Henry VIII. a special office administered this revenue. At the accession of Mary the business was transferred to a department of the Exchequer. The principal records are the following: *Bishop's Certificates of Institutions to Benefices; Composition books* giving the names of incumbents and the sums paid by them in lieu of first fruits; and documents relating to the valuation of livings. The most important entries touching valuation were printed by John Ecton in the *Liber Decimarum* (1711), which has passed through many editions under the titles of *Thesaurus Rerum Ecclesiasticarum* and *Liber Regis.* The first fruits and tenths are now transferred to Queen Anne's Bounty, and are managed by that office.

(6) VALOR ECCLESIASTICUS.—In 26 Henry VIII. a commission was issued for a valuation of all ecclesiastical property. The returns were made into the Exchequer and consist of eighteen volumes and three portfolios of rolls. Of these abstracts were made in three volumes known as *Liber Valorum* or *King's Books*, and a portion was copied in two volumes known as *Liber Regis.* The original returns for the diocese of Ely, most of that of London and part of those of Salisbury, Lincoln, Durham and York are not now known to exist, and are very imperfectly represented by the abstracts and copies mentioned above. From these materials the Record Commission compiled six volumes folio known as the *Valor Ecclesiasticus* provided with maps and indexes. The introduction and general map were published later (1834) in a separate octavo volume; but some copies were struck off in folio and inserted into Vol. I., which was published in 1810.

(7) COURT OF AUGMENTATIONS.—This office was instituted to administer the property of the suppressed monasteries and the revenues of the duchy of Cornwall. The records consist of the muniments of the suppressed houses taken over with them and of documents connected with their actual seizure and subsequent administration (for the former, see SPECIAL COLLECTIONS below; the latter are in great part calendared in the *Letters and Papers relating to the Reign of Henry VIII.*).

There was also a judicial side of the office, in which the proceedings were by bill and answer. In 38 Henry VIII. this court absorbed an earlier one known as the Court of General Surveyors of the King's Lands, which had been set up in 33 Henry VIII. A calendar of the decrees of the court will be found in the 30th Report. The court of augmentations was merged in the Exchequer in 1 Mary.

CHANCERY.—The records of the chancery are here treated in two divisions, administrative and judicial.

(1) *Chancery Administrative.*—These are either enrolments of letters issued under the great seal, documents forming part of the process of issuing such letters, or documents drawn up for the information of the chancery.

Enrolments.—The *Charter Rolls* (1 John to 8 Henry VIII.) contain the enrolments of the most formal letters. The Record Commission published one volume folio containing a transcript of the rolls for the reign of John; and a badly designed and executed calendar entitled *Calendarium Rotulorum Chartarum.* The Record Office has published three volumes of a complete calendar of the Charter Rolls from 11 Henry III. The *Patent Rolls* (3 John to the present day) contain enrolments of less formal letters addressed generally. The Record Commission published one volume folio containing a transcript of the rolls for the reign of John, with a valuable itinerary of that king. The Record Office has also printed in full the rolls for the period 1–16 Henry III. From this point over 30 volumes of a Calendar have been published, and the remaining gaps in the series are being closed. For these gaps the Record Commission's *Calendarium Rotulorum Patentium* is still useful, but only refers to a small proportion of the matter on the rolls. The rolls for the reign of Henry VIII. are calendared in the *Letters and Papers of Henry VIII.* The *Close Rolls* (6 John to the present time) contain the enrolments of letters directed to specified persons and also enrolments of deeds made according to statute or for safe custody. The Record Commission published two volumes folio containing a transcript of the rolls for the period from 6 John to 11 Henry III. The Record Office has also published several volumes of rolls for the reign of Henry III. From the reign of Edward I. eighteen volumes of a calendar have appeared. The *Fine Rolls* (1 John to 23 Charles I.) contain the record of judicial writs issued under the great seal with a note of the fine or fee paid; also of letters of appointment to offices and letters relating to the administration of the feudal incidents of tenure. The Record Commission published a transcript of the rolls for the reign of John under the title *Rotuli de Oblatis et Finibus*; for the reign of Henry III. they also published two volumes of *Excerpta e Rotulis Finium* consisting of the entries relating to the feudal incidents. There were also other rolls containing letters issued under the great seal relating to special countries and subjects. The most important of these are here mentioned. *French Rolls, Gascon Rolls,* and *Norman Rolls* deal with the affairs of the English dominions in France and with relations with that country. A catalogue of many of the entries on these rolls down to the reign of Edward IV. was published by Thomas Carte in two volumes folio. Of the *French Rolls* (16 Edw. III. to 26 Charles II.) those for the reign of Henry V. are briefly calendared in the 44th Report; and those for the reign of Henry VI. in the 48th Report. Of the *Gascon Rolls* (38 Henry III. to 7 Edw. IV.) the earlier rolls have been printed in full in the *Documents inédits* published by the French government under the care of MM. Francisque-Michel and Bémont. Of the broken series of *Norman Rolls* (1 John to 10 Henry V.) those for the reign of John and that for 5 Henry V. have been printed in full in one volume by the Record Commission; to the remainder a calendar will be found in the 41st Report. The books here mentioned deal with some rolls now placed in other classes.

Other rolls contain letters under the great seal relating to Ireland, Scotland and Wales. Of these the Record Commission printed the *Scottish Rolls* (19 Edward I. to 8 Henry VIII.) in full, omitting the numerous letters of protection contained in them. For the *Welsh* and *Irish Rolls* there is only a very partial calendar in Ayloffe's *Calendar of Ancient Charters.* The *Roman* and *Almain Rolls* have been used in *Foedera*, and many entries from the other chancery rolls will be found there. The *Liberate Rolls* (2 John to 14 Henry VI.) contain the enrolments of writs for the issue of money out of the Exchequer. The rolls for 2–4 John have been printed in full by the Record Commission.

Documents forming Part of the Process of issuing Letters under the Great Seal.—These are known as *Chancery warrants*, and consist of *Privy Seals, Signed bills* and other documents forming steps in the process. Series I. of these documents extends to the end of the reign of Richard III., and Series II. to the end of the reign of Henry VIII.; Series III. ends with the reign of Anne, and Series IV. with that of William IV., while Series V. is still in progress. Series I. and II. are arranged in chronological order (Series I. being also classified); the remainder are in monthly bundles. The warrants for the reign of Henry VIII. are calendared in the *Letters and Papers of Henry VIII.*; those for the first seven years of Charles I. are calendared in the 43rd Report. With these may be placed the *Inquisitions ad quod damnum.* Of these the Record Office has published a descriptive list (Nos. XVII. and XXII.) for the period 28 Henry III. to 2 Richard III.

Documents drawn up for the Information of the Chancery.—The most important of these are the inquiries held under writs issued from the chancery. The first series of these (Henry III. to Richard III.) is now arranged in three classes, *Inquisitions Post Mortem* including analogous documents relating to the feudal tenure of land, *Criminal Inquisitions* and *Miscellaneous Inquisitions.* The Record Office has published three volumes of a calendar of *Inquisitions Post Mortem.* The Record Commission calendars refer to the old arrangements of these inquiries into two series, known as *Inquisitions Post Mortem &c.* and *Inquisitions ad quod damnum &c.*, a distinction of title which concealed the identity of the documents described. Both calendars contain many inaccuracies and omit much useful information. To supply some of these defects for the period Henry III. to Edward I. the Record Office published the *Calendarium Genealogicum*, but this work does not attempt to deal with the lands mentioned in the inquiries. In the second series of these inquiries the three classes of inquisitions are all placed together. One volume of a calendar to the *Inquisitions Post Mortem* for the reign of Henry VII. has appeared. *Certificates of Gilds* are returns made under the statute of 12 Richard II. Those in English have been printed by J. and L. Toulmin Smith for the Early English Text Society. *Charitable Uses:* a list (No. X.) of all inquisitions and decrees of commissioners appointed under two statutes of Elizabeth to examine and rectify abuses of charitable bequests has been published by the Record Office. *Forests* (*Chancery*) contain perambulations and proceedings before the justices in eyre of the forest. The perambulations for certain counties have been printed by G. J. Turner in *Select Pleas of the Forest* (Selden Society).

Scottish Documents.—Five rolls relating to the policy of Edward I. towards Scotland. The first two contain the proceedings touching the claims to the crown of Scotland and are printed in *Foedera*, vol. ii. p. 762 (Record edition); the remaining three, known as *Ragman Rolls*, contain in triplicate the submissions of the Scottish nobility to Edward I., and were printed by the Bannatyne Club in 1834. Other chancery documents relating to Scotland are described in J. Bain's *Calendar of Documents relating to Scotland.* Most of these together with the earlier Forest proceedings are included in the *Miscellanea of the Chancery*, which contains numerous other detached documents and rolls. Many of those relating to foreign affairs are printed in the *Foedera.*

(2) *Chancery Judicial.*—These may be divided into *Proceedings*, or Bills and Answers, &c., filed by the parties; *Decrees and Orders* of the court; and *Affidavits* and other documents connected with the course of the action. The series known as *Early Chancery Proceedings* (Richard II. to Philip and Mary), comprising documents of all three classes, is arranged roughly in chronological order. The Record Office has published three volumes of a descriptive list (Nos. XII., XVI. and XX.) of the whole of this series; and the first two bundles have been printed in full in the Record Commission's *Calendar of Proceedings in Chancery, Elizabeth*; other specimens are printed in *Select Pleas of the Chancery* (Selden Society), edited by W. P. Baildon. For the reign of Elizabeth the Proceedings are arranged alphabetically under the plaintiff's name in two series. Series I. is calendared in the Record Commission volumes already mentioned for Series II.; the Record Office has published a descriptive list (Nos. VII. and VIII.) covering the years 1558–1621. To the Bills and Answers of the reign of Charles II. Messrs Phillimore and Fry have published in the *Index Library* of the British Record Society an index taken from Topham's manuscript index in the Record Office. The same society has reproduced in an alphabetical form an index to the proceedings in Reynardson's division for the years 1694–1714. These last indexes contain only the surnames of the parties, without reference to the nature of the suit. *Decrees and Orders* (36 Henry VIII. to the present time) are the entry-books of the orders of the court; with them may be classed the *Reports and Certificates* of the masters and chief clerks. The Affidavits, &c., date from 1611.

The chancellor formerly had a common law jurisdiction relating to certain matters touching feudal incidents and tenures, to repeals of letters patent, and to actions upon recognizances acknowledged in chancery or concerning officers of the court. No printed means of referring to these records exist.

Court of King's Bench.—The principal records of this court are the rolls recording its proceedings and judgments, of which classified lists are given in the Record Office List of Plea Rolls (No. IV.), under the following heads. *Curia Regis Rolls* (5 Richard I. to 56 Henry III.) include all the rolls of the king's court with the exception of a few *Eyre Rolls.* Of these the Record Commission printed those for 6, 9, 10 Richard I. and 1 John; and also published in the *Abbreviatio Placitorum* certain abstracts from a portion of the pleas on these rolls made in the 17th century. For specimens see Selden Society volumes, *Select Civil Pleas*, edited by W. P. Baildon, and *Select Pleas of the Crown*, edited by F. W. Maitland, who has also edited for the Pipe Roll Society four rolls of the reign of Richard I. From the end of the reign of Henry III. the rolls of the king's bench and those of the common pleas (see below) have been separated. The former, named *Coram Rege Rolls* (1 Edward I. to 13 William III.), divide from 1 Anne into two portions, *Judgment Rolls*, containing pleas between private persons, and *Crown Rolls*, containing crown business. References to some pleas on the *Coram Rege Rolls* will be found in the *Abbreviatio Placitorum*; the complete roll for 25 Edward I. has been printed by the British Record Society.

Assize Rolls, &c.—Under this head are grouped rolls containing the proceedings before justices in eyre, of assize, of oyer and terminer, of gaol delivery (a few) and before justices sent on special commission. References to some of these will be found in the *Abbreviatio Placitorum*; and specimens in the Selden Society volumes already mentioned. The *Eyre Roll* for Gloucestershire, 5 Henry III., has been published by F. W. Maitland. The pleadings taken under writs of *Quo Warranto* during the period Edward I. to Edward III. were published by the Record Commission. For specimens of *Coroners Rolls* (Henry III. to Henry VI.) see the Selden Society's volume edited by C. Gross. *Baga de Secretis* (since 17 Ed. IV.) contains the proceedings in trials for treason or felony held before the court of king's bench or special commissioners. An inventory and calendar will be found in the 3rd, 4th and 5th reports.

Court of Common Pleas.—The Plea Rolls of this court, known as *De Banco Rolls*, run from 1 Edward I., before which date pleas before justices of the common bench form part of the *Curia Regis Rolls*, to 24 Henry VII., from which date the Plea Rolls are known as *Common Rolls.* But in 25 Elizabeth all common recoveries and enrolments of deeds were transferred to a new roll called the *Recovery Roll*, the series of which extends to 1837. In the Year Books edited for the Rolls Series by L. O. Pike, and those edited for the Selden Society by F. W. Maitland, the cases reported have, when possible, been traced on to the *De Banco Rolls* and extracts from those rolls printed. *Feet of Fines* (up to 1835) are the official part of the triplicate document constituting the complete fine. Those for the period 7 Richard I. to 16 John have been printed by the Record Commission for the counties Bedfordshire to Dorset in alphabetical order. Four volumes printed for the Pipe Roll Society cover the years down to 10 Richard I. for all counties. The feet of fines are arranged in counties year by year up to the reign of Henry VIII. Afterwards they are arranged term by term in counties. *Notes of Fines* (since Edward I.) are the records of an earlier stage in the procedure; *Concords of Fines* (since 1559) form another stage; but to neither of these are there printed means of reference.

Court of Star Chamber.—The relation between the king's council sitting as a judicial body and the Court of Star Chamber set up by the act of 3 Henry VII., c. 1, is matter of controversy. The records of this court are nearly all of later date than this act. They consist of Bills, Answers, Depositions and similar documents, with a very few Decrees and Orders. The Record Office has published a descriptive list (No. XIII.) of a portion of these records; for specimens see Selden Society, *Select Cases in the Star Chamber, 1477–1509*, edited by I. S. Leadam.

Court of Requests.—The origin of this court and the manner in which it died out at the time of the Civil War are alike uncertain. The records that remain are of two kinds, *Proceedings* and *Books.* Of the former the Record Office has published a descriptive list (No. XXI.); and specimens will be found in *Select Cases in the Court of Requests*, edited for the Selden Society by I. S. Leadam. The *Books* contain among other matters the Decrees and Orders of the court.

Parliamentary Records.—The proceedings of parliament were recorded either on a roll prepared for each session, or on detached documents and petitions made up into sessional files. The files have now disappeared, although transcripts of some still exist, and in many cases their constituents can be traced among the *Ancient Petitions* (see below under Special Collections). The rolls known as *Parliament Rolls* form a broken series, 18 Edward I. to 48–49 Victoria. The rolls for Edward I. and Edward II. are among the Exchequer records, and the remainder are in the chancery. Of these rolls and files, and of certain pleadings found in the records of the King's Remembrancer, the Record Commission published what was meant to be a complete reprint. But the editors relied partly upon transcripts and partly upon original documents, and it is often difficult to determine the sources from which they drew. So prepared, the *Rolls of Parliament* (6 vols.) cover the period from 6 Edward I. to 1 Mary. The roll for 33 Edward I., unknown to them, has been edited (Rolls Series, vol. 98) by F. W. Maitland, with a valuable introduction and appendices; rolls for 18 Edward I. and 12 Edward II. are printed in H. Coles' *Documents Illustrative of English History.* The *Parliament Roll* includes enrolments of statutes among its contents. But from Edward I. to Edward IV. the statutes after receiving the royal assent were also enrolled upon the *Statute Roll* (chancery), of which only six rolls now remain. From these rolls and other sources the Record Commission prepared the volumes known as *Statutes of the Realm* on principles described in the introduction to that work. Unfortunately the editors made use of early printed texts, and translations based upon the inferior texts contained in *Exchequer K.R. Miscellaneous Books* 9, 10 and 11, and so diminished the value of their work. The *Statutes of the Realm* extend to the end of the reign of Queen Anne. Since then public general acts have been published in many forms; private acts ceased to be enrolled upon the *Parliament Rolls* during the 16th century; the originals are preserved in the House of Lords. The Record Office contains detached documents relating to parliamentary proceeding known as *Exchequer Parliamentary* and *Chancery Parliamentary*, but neither class has yet taken a final form.

State Papers.—This class contains the documents belonging to the offices of the secretaries of state, formerly deposited in the place of custody called the State Paper Office. This office was established about the year 1578, but the first attempt to arrange its contents seems to have been due to Sir Thomas Wilson, who in the reign of James I. divided the papers into two classes, *Domestic* and *Foreign*, to which at a later date the class of *Colonial Papers* was added. These series all come to an end at the year 1782, at which date the modern history of the office of Secretary of State begins.

Domestic.—Calendars of these papers have been published for the period 1547–1676, with special volumes dealing with the papers of the *Committee for Advance of Money* (1642–1656), and of the *Committee for Compounding* (1643–1660). Another series of volumes begins with the year 1689, and a third extends from 1760 to 1775; these last are called *Home Office Papers*, but are in no way different in character from the *State Papers Domestic*. The *Domestic Papers* relating exclusively to Ireland have been calendared under the title of *State Papers, Ireland*, for the years 1509–1601 and 1603–1665, with a special volume dealing with the papers concerning *Adventurers for Land*. From 1670 these papers are calendared in the *Domestic* volumes.

Scotland.—Originally there were in the State Paper Office two sets of papers relating to Scotland, *State Papers Domestic, Border Papers*, containing papers concerning the Council of the North and the Wardens of the Marches; and *State Papers Foreign, Scotland*, before the union of the two crowns. The first calendar of these was a *Calendar of State Papers, Scotland, 1509–1603*, containing brief notes of all the *State Papers Foreign, Scotland*, and of many of the *Border Papers* which were removed from their places without any record of the removal. Next came the *Calendar of State Papers Foreign*, in which were included apparently all the *Border Papers* for the period covered which had escaped the previous raid; notes, however, were made of the papers so taken. Out of the original 75 volumes of *Border Papers* only 36 remained. At a later date the papers drawn for the Foreign Calendar were restored and now form the first 19 volumes of the series, while the 36 volumes originally remaining have now become the final 23. At the same time the *State Papers Foreign, Scotland*, were annexed, and became *State Papers Domestic, Scotland*. In their present arrangement the *Border Papers* have been calendared in the following volumes: vols. 1–19 in the *State Papers Foreign 1547–1560*; vols. 20–42 in the Scottish General Register Office *Calendar of Border Papers 1560–1603*. The *State Papers Domestic, Scotland*, from 1547 onwards, are being fully calendared in the Scottish General Register Office *Calendar of Scottish Papers* with other material. Those from 1509 to 1547 are dealt with in the *Letters and Papers of Henry VIII*. (see below, Special Collections). A list of these three Classes has been published (No. III.).

Foreign.—Calendars of the *State Papers Foreign* have been published for the period 1547–1580. A few of these papers are also calendared in the first volume of the *State Papers Spanish* (see below under Spain). The Record Office has published a list of the *State Papers Foreign* (No. XIX.).

Colonial.—These papers are calendared in two sets, an "East Indies" (1513–1634, which has been continued to 1639 by the India Office in Miss E. B. Sainsbury's *Court Minutes of the East India Company*) and an "America and West Indies" (1574–1693, in progress).

Departmental Records.—From time to time all the government departments, with the exception of the India Office, deposit such papers as they wish to preserve in the Public Record Office; thus the *Treasury, Home Office, Foreign Office, Colonial Office, Admiralty, War Office, Local Government Board* and *Board of Trade* have all placed important papers in the care of the Master of the Rolls. A calendar of the earlier Treasury Papers, which extends from 1660 to 1668 and 1720 to 1745 has been published; also a list of the Admiralty Records (No. XVII.). For each department a limiting date is fixed from time to time; documents before that time are open to students; later ones are only accessible under special conditions.

Subordinate and Independent Jurisdictions.—*Palatinate of Durham.*—For the earlier records see G. T. Lapsley's *County Palatine of Durham* (Harvard Historical Series, vol. viii.), pp. 327–337. The letters sent out from the bishops' *chancery* are enrolled on the *Cursitors' Records*, Nos. 29 to 184. They are calendared in Reports 31 to 37 and 40. One of the registers (Bishop Kellawe's) has been printed in full in the Rolls series (No. 62) with additions from the register of Bishop Bury. The *Cursitors' Records* also include seven bundles of *Inquisitions Post Mortem* (Nos. 164–180), calendared in the 44th Report; and a volume (No. 2) contains transcripts of similar documents, calendared in the 45th Report. The records of the *Exchequer* of Durham, though deposited in the Public Record Office, are treated as the private records of the Ecclesiastical Commission, and are only accessible with a special permit. To the *judicial* records the only printed means of reference is the list of *Judgment Rolls* (20 Henry VII. to 7–8 Victoria) in the Record Office list of Plea Rolls (No. IV.)

Palatinate of Chester.—The letters sent out from the *chancery* are enrolled upon the *Chester Recognizance* Rolls (1 Edward II. to 34 Charles II. with a few rolls down to 1 William IV.) calendared in Reports 36–37 and 39. The financial records of the *Exchequer* of Chester are listed among the Ministers' Accounts (List No. V.) of the county of Chester. The *Inquisitions post Mortem* and *ad quod damnum* (Edward III. to Charles I.) are indexed in the 25th report. The *judicial* records consist of Pleas in the Exchequer, a court of equity. Its records are *Bills and Answers* (Henry VIII. to George IV.), calendared in the 25th Report up to Philip and Mary; and *Decrees and Orders*. The court of the justices of Chester was at common law; its *Plea Rolls* (44 Henry III. to 1 William IV.), with a separate series for Flint (from 12 Edward I.) are listed among the Plea Rolls (List No. IV.). The *Deeds, Inquisitions* and *Writs of Dower* upon these rolls for the period Henry III. to Henry VIII. are calendared in the 26th–30th Reports without an index. The *Assize Rolls* for the counties of Chester and Flint and for the honour of Macclesfield are listed among the other assize rolls (List No. IV.).

Wales.—The following are the principal records of the principality of Wales: *Ministers' Accounts* and *Court Rolls*, including those of the principality and of the honours and manors of the Lords Marchers, listed in Lists Nos. V. and VI. Of the *judicial* records of the Great Sessions of Wales, set up by the act 34 & 35 Henry VIII., c. 26, the *Plea Rolls* are listed in the list of Plea Rolls (No. IV). For an account of the Court of the Marches in Wales, see C. A. Skeel's *The Council in the Marches of Wales*.

The Duchy and Palatinate of Lancaster.—The duchy of Lancaster comprises all the estates of the duke of Lancaster; the palatinate is limited to the county of Lancaster. The records of the palatinate, transferred to the Public Record Office from Lancaster castle, related to the county and are either *enrolments of writs* or of a *judicial* nature. The records of the duchy, transferred from the office of the duchy at Westminster, include similar records and others dealing with the manorial and financial records of all the estates within and without the county. For the *Duchy Records* see the detailed list (No. XIV.), where the means of reference to this collection are fully described. Of the *Palatinate Records* the enrolments of writs are classified as *Patent* and *Close Rolls*. The former, a broken series from 5 John of Gaunt to 21 Henry VII., are calendared in the 40th Report; the latter (in 3 rolls, a broken series, 11 Henry IV. to 9 Edward IV.) in the 37th Report; but certain enrolments of the palatinate are among the duchy records. The *judicial* records of the *chancery* are not calendared; but the proceedings by way of appeal from that court to the Duchy Chamber at Westminster are dealt with in the duchy list. Proceedings under common law include *Plea Rolls* (2 Henry IV. to 11 Victoria) listed in the list of Plea Rolls (No. IV.); and for criminal proceedings there are palatinate *Assize Rolls* (Henry VI. to 6 Victoria), of which there is a list in the same place. But certain rolls which were among the Duchy Records will be found apart at pages 139–140 of the same list.

Bishopric of Ely.—The act 1 & 2 Victoria, c. 94, places the records of this palatinate under the charge of the Master of the Rolls. They have never been removed to the Record Office, but remain at Ely with the episcopal records, where they can be inspected. A valuable descriptive list has been published by Alfred Gibbons for private circulation.

Special Collections.—For the classification of the records hitherto described the knowledge preserved of their origin and purpose has been used. There exist, however, masses of records where this path is now inaccessible; these have been formed by putting together records of a similar nature either in ignorance of their history or without regarding it; the justification of this course of action must be found in the special circumstances of each case. These collections are as follows:—

Ministers' Accounts are the accounts of bailiffs, receivers, and other officers managing estates, including, first, those of the duchy of Lancaster; second, accounts of crown lands filed as vouchers in the King's Remembrancer's Office; third, accounts of monastic and other lands seized by the crown, or acquired by it by purchase, inheritance or marriage. A list of these accounts has been published by the Record Office (Nos. V. and VIII.) covering the period down to 1485. For the accounts of the duchy of Lancaster a list will be found in the 45th Report, extending to the reign of George III.

Court Rolls are records of the proceedings and profits of manorial and other private courts coming from the same sources as the Ministers' Accounts, and closely connected with them. For a list see Record Office, *Lists and Indexes*, No. VI.; and for specimens *Select Pleas in Manorial Courts*, edited for the Selden Society by F. W. Maitland.

Ancient Deeds.—In this collection are placed all documents which appear to have formed part of a title to land, some original royal charters and other analogous records. There are five series, A, B, C, D, and E, distinguished by their former place of custody. Documents too large for the ordinary method of packing have a double letter, *e.g.* A.A., and to those bearing fine seals the letter S is added, *e.g.* AS or AAS. There are thus in all fifteen classes. The A classes are derived from the *Treasury of Receipt*, or Chapter House at Westminster, and are largely monastic; the B classes are from the court of *Augmentations*; the C classes are *chancery* deeds, probably deposited as exhibits in suits or for enrolments; the D classes are from the *King's Remembrancer's* office; and the E classes are from the *Land Revenue* office. In 1907 five volumes of a descriptive catalogue had been published by the Record Office.

Ancient Correspondence consists of documents which in form are rather of the nature of a letter than a writ or petition. Most of them were found detached in the chancery records, but similar documents from other sources have been added. The introduction to the Record Office List (No. XV.) contains some account of the formation of the class, and the list gives references to printed collections based upon these documents. Vol. 53 contains letters of the Cely Family and is published (Camden Society, 3rd series, vol. i.).

Ancient Petitions.—The history of the formation of this class is obscure; an account of it is in the Record Office Index to the class (No. I.); but see also the Introduction to F. W. Maitland's *Memoranda de Parliamento* (Rolls Series, vol. 98), in which volume a number of these petitions are printed in full.

Diplomatic Documents.—In the Chapter House at Westminster was a collection of treaties and other documents connected with foreign affairs, and to these have been added other similar documents found there. Of these there is a descriptive list in the 45th and 49th Reports. A collection of so-called *Diplomatic Documents* from the chancery forms part of the *Chancery Miscellanea.*

Letters and Papers, Foreign and Domestic, of the Reign of Henry VIII.—This great collection of materials for the reign of Henry VIII. (Calendar of 20 volumes in 30) at present extends to the year 1547, and is intended to contain abstracts of all documents bearing upon that reign in the Record Office, the British Museum and other collections. Record Office documents dealt with in this Calendar have sometimes been left in their original place of custody and sometimes transferred to a series of bound volumes known as *Letters and Papers, Henry VIII.* References will be found in the Calendar to a previous series of *State Papers of the Reign of Henry VIII.*, printed by a Royal Commission for printing State Papers.

Miscellaneous Books.—The many books and registers preserved in the Record Office will be found described in the Handbook. The following have been printed:—

Exchequer King's Remembrancer

Vol. 2. *The Red Book of the Exchequer* (Rolls Series, No. 99).

Vol. 3. *Book of Aids.* (See *Feudal Aids*, published by Record Office.)

Vol. 4. *Book of Knight's Fees.* (See *Feudal Aids.*)

Vols. 5 & 6. *Testa de Nevill*; printed by the Record Commission.

Vol. 12. *Liber Niger Parvus*, printed by Thomas Hearne.

Vols. 13 & 14. *Taxatio Ecclesiastica*; printed by the Record Commission.

Vol. 17. A 16th-century transcript of an abstract of *Kirkby's Quest* for certain counties; used in *Feudal Aids.*

Vol. 24. Chartulary of Malmesbury Abbey (Rolls Series, No. 72).

Vol. 28. Chartulary of Ramsey Abbey (Rolls Series, No. 79).

Vol. 32. The *Book of Common Prayer* deposited under the Act of Uniformity.

Vols. 35 & 36. Accounts of the voyages of Martin Frobisher (Hakluyt's Voyages).

Exchequer Treasury of Receipt

Domesday Book.—Indexes and supplementary matter were printed by the Record Commission. Since then facsimiles of the text for each county have been issued.

Miscellaneous Books.

Vols. 16–55. Certificates of Musters. (See *Letters and Papers of the Reign of Henry VIII.*)

Vol. 69. Extents of Knights' Fees in the Honour of Richmond; printed in Gale's *Registrum Honoris de Richemond.*

Vol. 87. Abstracts of *Placita Coram Rege*, &c.; printed in *Abbreviatio Placitorum* (Record Commission).

Vol. 92. Statutes of the Order of the Garter. Cf. J. Anstis, *Register of the Order of the Garter.*

Exchequer Augmentation Office

Vol. 57. Rentals and *Custumals of Battle Abbey* (Camden Society, Series 2, vol. 41).

Vols. 179–184. Copies of Leases. Indexed in 49th Report.

Vols. 495–515. Inventories of Church Goods. For details of those printed, see Mély et Bishop, *Bibliographie Générale des Inventaires Imprimés.*

The following accounts of other collections of records are necessarily less detailed:—

Privy Council Office.—The registers of the Privy Council are still preserved in that office, with the exception of a few volumes which have strayed into other places. J. R. Dasent has edited for the Master of the Rolls a series of volumes containing *The Acts of the Privy Council*, from 1542 to 1604. The *Proceedings and Ordinances of the Privy Council, 10 Rich. II.–33 Henry VIII.*, edited for the Record Commission by Sir N. Harris Nicolas, are from documents in the Cotton MSS. and from transcripts made by Rymer from documents then at the Pells Office.

India Office.—The records of the India Office are preserved there. Complete printed lists exist for the whole collection, and the following documents have been published: *The First Letter Book of the East India Company*, edited by Sir G. Birdwood and W. Foster; *Letters received by the East India Company from its Servants in the East*, edited by F. C. Danvers and W. Foster (6 vols.). The records in India may be mentioned here. Each presidency and each province keeps its own; and this is the case also with the smaller subdivisions. No printed lists appear to exist for any of the collections. The following volumes have been published: *Letters, Despatches and other Papers of the Foreign Department of the Government of India, 1772–85*, edited by G. W. Forrest (3 vols., Calcutta); *Bengal 1756–1757*, edited by S. C. Hill (3 vols. 1905); and *Old Fort William*, edited by C. R. Wilson (3 vols., 1906–7).

Ireland.

The Public Record Office of Ireland was established in 1867 by the Act 30 & 31 Vict. c. 70, when the records of the various courts of law, all wills proved in Ireland, and certain financial records, were collected into one building. The State Paper Office remains a separate, though subordinate, department in one of the towers of Dublin Castle, whence the papers are only transferred to the Record Office by special order. The Deputy Keeper of the Irish Record Office publishes yearly reports with appendices. The most important calendar published in these is that of *Fiants* or warrants for the issue of letters under the Great Seal, Henry VIII. to Elizabeth, contained in Reports 7–9, 11–13, 15–18, with indices for each reign. A calendar of the *Deeds* of Christ Church, Dublin, is contained in the 20th, 23rd, 24th and 27th Reports. The *Wills* of the diocese of Dublin, down to the year 1800, are indexed under the names of the testators in the 26th and 30th Reports. The series of *Proclamations* by the lord lieutenant and council, and by the crown, which is among the records in the Record Tower of Dublin Castle, is catalogued in the 23rd and 24th Reports. Of the *financial* records very little has been published. In the 33rd Report there is a good account of the Books of the *Treasury* and *Accounting Departments* from the reign of Henry VIII. Scattered entries from the *Pipe Rolls* (13 Henry III.–33 Edward I.) are printed in the 33rd and 35th–38th Reports. Before the establishment of the Record Office the Irish Record Commission published a Latin calendar of the *Patent* and *Close Rolls* from Henry II. to Henry VII., and an incomplete calendar in English for the years 5–35 Henry VIII. Under the authority of the Master of the Rolls a calendar was published for the period Henry VIII. to Elizabeth, upon which some severe comments will be found in J. T. Gilbert's *The History . . . of the Public Records of Ireland.*

An English calendar for the reign of James I. was published by the Record Commission; and a calendar for the years 1–8 Charles I., under the authority of the Master of the Rolls. Two large folio volumes entitled *Liber Hibernie* should here be mentioned. The history and contents of this astounding work can be gathered from its introduction, and from an index to it in the 9th Report. *Inquisitions post mortem* and *on attainder*, for the provinces of Leinster and Ulster only, are dealt with in the Record Commission's *Inquisitionum in officio Rotulorum Cancellarie Hibernie asservatarum Repertorium.* Of strictly *judicial* records the Record Office has published one volume of an admirable calendar of the *Justiciary Rolls* (1295–1303).

Scotland.

The records of the kingdom are deposited in several places in Edinburgh. The principal repository is the General Register House, at present governed by the Act 42 & 43 Vict. c. 44. But certain records of the chancery and all the records of the court of teinds are in separate repositories. A general account of these records is given in M. Livingstone's *Guide to the Public Records of Scotland deposited in H.M. General Register House, Edinburgh*, with appendices describing those contained in other repositories.

Parliamentary.—The Record Commission of Great Britain published *The Acts of the Parliament of Scotland* (1124–1707), a text derived from many sources described in the introductory volume; *The Acts of the Lords Auditors of Causes and Complaints* (1466–1494), being the proceedings of the parliamentary committee for hearing petitions; and *The Acts of the Lords of Council* (1478–1495), being proceedings of a similar body.

Privy Council.—The register of the Privy Council of Scotland from 1545 is in course of publication at the General Register House.

Exchequer.—The Exchequer Rolls, corresponding to the Great Roll of the English Exchequer, are being printed in full from 1264 at the General Register House; and the accounts of the *Treasurer of Scotland* from 1473 are being published at the same office.

Chancery.—The enrolments of letters issued under the Great Seal of Scotland are contained in twelve rolls and a series of volumes. The Record Commission printed these registers in full for the period 1306–1424; and the General Register House is continuing the publication in an abridged form.

Court of Chancery.—Only the enrolments of letters under the Great Seal are transferred to the General Register House; the remainder are preserved in the court of chancery. The most important of these are the *Retours to Chancery.* To these the only printed means of reference is the *Inquisitionum ad capellam Domini Regis retornatarum abbreviatio* (16th and 17th centuries), published by the Record Commission.

Local Records.

To deal with the municipal and local records of Great Britain in any detail is quite impossible in this article. Fortunately the admirable work of C. Gross, entitled *The Bibliography of Municipal History* (Harvard Historical Studies), contains a complete account of the work done on municipal records up to 1897; while the *Report* of the Committee appointed to inquire as to the existing arrangements for the collection and custody of local records (1902) affords a complete view of the questions dealt with by it.

Private Collections.—The publications of the Historical Manuscripts Commission are in most cases the only printed means of reference to private muniments. The 17th Report of the Commission contains an index to all the collections of papers so far dealt with by them.

Wills.—Up to the date of the Probate Act (20 & 21 Vict. c. 77) the proving of wills was under ecclesiastical jurisdiction, and the wills themselves were scattered among peculiar courts—courts of the various bishops, and the prerogative court of Canterbury. By the passing of the act a general registry was established at Somerset House, to which were transferred all the wills of the prerogative court of Canterbury and of many of the other registries. But even at the present time there remains much confusion and uncertainty as to the place of deposit of the wills of any particular court; and for accurate information on this point the inquirer must be referred to the *Handbook to the Ancient Courts of Probate and Depositories of Wills*, by G. W Marshall.

British Colonies.

For the British colonies the most important records, historically speaking, are the Colonial Office papers deposited in the Public Record Office, London; and those colonies which have published the records relating to their history have usually gone to that source. In *New South Wales*, however, there is in the Colonial Secretary's office at Sydney a collection of records dating from 1789, which are included in the volumes published by that State *Cape Colony* possesses records dating from 1652; G. McCall Theal, historiographer of the colony, has also published important series of volumes of documents drawn from the Public Record Office and other European sources. *Canada* has recently centralized its records, of which a large part so far consists of transcripts made in Europe. For an account see E. C. Burnett's *List of printed guides to and descriptions of Archives and other repositories of Historical Manuscripts* (American Historical Manuscripts Commission Report, 1897). The Dominion Archivist submits yearly to the Minister for Agriculture a report, in which (in Appendices) are given many lists and accounts of records.

European Countries.

In dealing with Great Britain it has seemed desirable to give some account of publications dealing with the contents of the repositories described. In the remainder of the article this will not be attempted. For the most part the books mentioned are in themselves bibliographies and guides, and do not contain even abstracts or descriptions of actual documents. It is scarcely necessary to explain that much of the following information is based on the work of Langlois and Stein.

AUSTRIA AND HUNGARY.—The records of Austria-Hungary, Bohemia, and the other states under the same government, are still preserved locally. There are repositories of government records at Vienna, Budapest and Prague, and ten provincial places of deposit. Even at Vienna there is nothing resembling the English Public Record Office; the *Kaiserliches und königliches Haus-, Hof- und Staatsarchiv* contains the papers of the imperial family and the records of imperial administration and of that of foreign affairs. Of other departmental papers those at the Ministry of War are the most important. There is no complete inventory of all these records. At Budapest since 1875 have been collected the archives of Hungary, Transylvania, Croatia and the government of Fiume: for an account of the records in this and other Hungarian and Transylvanian repositories see Fr. Zimmermann's *Über Archiv in Ungarn; ein Führer durch ungarländische und siebenburgische Archive.*

BELGIUM.—The records are numerous and valuable.

State Records comprise all those of the central governments, of the modern kingdom, of the governments preceding it and of the various states such as Brabant, Flanders, Gueldres and Hainault out of which Belgium was formed. They are preserved partly at Brussels as *General Records of the Kingdom* and partly in provincial repositories. Thus at Ghent are archives of the county of Flanders, at Liége of the principality of that name and of the duchy of Limburg, at Mons of the county of Hainault, at Bruges of the liberty of Bruges and other jurisdictions of eastern Flanders; at Namur, Arlon, Hasselt and Tournai are repositories of less importance: at the same time the repository at Brussels contains many records of the same kind as those in the provincial offices and is the chief one of the country; the collection there has been formed from various collections in Belgium combined with records restored by the Austrian government and other acquisitions.

Archives Provinciales, the records of provincial administrations since 1794, are placed in the chief towns of each province: each collection falls into three periods, French (1794–1814), Dutch (1814–1830) and Belgian.

Municipal Archives.—The most important are those of Antwerp, Bruges, Ghent, Malines, Mons, Tournai and Ypres.

The best book of general bibliographical reference for Belgian records is Pirenne's *Bibliographie de l'histoire de Belgique.*

DENMARK.—At Copenhagen there has been, since 1889, a central Record office (*Rigsarchiv*) containing all the previously existing collections of records, and receiving those of the various ministries and offices. There are also repositories there, and at Odense and Viborg, for local records, municipal and others. The central office is publishing a series of inventories of documents in its charge.

FRANCE.—The best general work is *Les Archives de l'histoire de France*, by Langlois and Stein. The administration of the records is attached to the Ministry of Public Instruction, acting through a commission and inspectors.

Archives Nationales, in the Hôtel Soubise at Paris, are divided into three sections, *Historique, Administrative et Domaniale* and *Legislative et Judiciaire*, each including subsections distinguished by letters or groups of letters. The classification is by subject, not necessarily by origin or function; but some of the classes, *e.g.* the archives of the *Trésor des Chartes*, the *Parliament of Paris* and the *Châtelet*, represent real groups of records with a common history.

Archives des Ministères.—In theory the *Archives Nationales* should receive all government office records, except those in current use: actually several offices retain their own. Thus the Ministry of Foreign Affairs keeps its archives, divided into *Correspondance politique* and *Mémoires et Documents*: it also publishes series of *Inventaires analytiques des Archives du Ministère des Affaires étrangères*, and *Recueils des instructions données aux ambassadeurs et ministres de France depuis les traités de Westphalie jusqu'à la Révolution française.* The Ministries of War and the Marine likewise possess and administer their own archives.

Archives Départementales.—Each department possesses a special office for the custody of its records, which are in many cases of great importance, consisting partly of the records of the ancient provincial governments, private documents seized at the Revolution, muniments of religious houses, &c., and partly of modern administrative records. A system of uniform classification by subjects has been applied to these, coupled with a rule that documents having a common history and origin are not to be separated; it is understood that the intelligence of the archivists in charge has enabled them to disobey neither of these regulations. For a general view of the arrangement and contents of departmental repositories see *État général par fonds des archives départementales, ancien régime et période révolutionnaire* (1903), and the *Inventaires Sommaires* for the several departments. For the publication of local societies see *Manuel de bibliographie de l'histoire*, by Ch. V. Langlois, (1901) p. 385 seq.

Archives Municipales et Communales: the value of these arises largely from their having had an undisturbed history: inventories of most of the collections exist in print. (See Langlois and Stein, *op. cit.* pp. 278-442.)

Archives Hospitalières form an important body of records, for the most part undisturbed. For their classification, and a list of the repositories of them, see Langlois and Stein, p. 443 seq.; the many other places in France where records exist are mentioned in the same work; note, however, that the archives of the Bastille are now in the *Bibliothèque de l'Arsenal* at Paris. There are in the English Public Record Office seventy-three volumes of transcripts from French archives, taken partly from the *Archives Nationales* (Letters of Henrietta Maria, &c.) and partly from *Archives Départementales.* The Record Office *Calendar of Documents, France*, edited by J. H. Round, containing early monastic charters, is based on these.

GERMANY.—Unfortunately lists of German State archives (*Geheimes Archiv*) are not published. Repositories are very numerous: for their localities, see the *Hand- und Addressbuch der deutschen Archive* of C. A. H. Burkhardt (2nd ed., 1887). In Prussia, besides the central repository at Berlin, there are sixteen provincial ones of importance. The other kingdoms and states forming part of the German empire have each their repository, not always at the capital. Some account of their contents will be found in Langlois and Stein (*op. cit.*) and in Fr. von Löher's *Archivlehre. Grundzüge der Geschichte, Aufgaben und Einrichtung unserer Archive*: for the publication of State Records see Dahlmann-Waïtz, *Quellenkunde zur deutschen Geschichte;* and for Prussian archives in particular R. Koser's *Über den gegenwärtigen Stand der archivalischen Forschung in Preussen* (1900). For the numerous and valuable records of German towns reference may be made to the works already mentioned. Many of the towns, *e.g.* Cologne, publish volumes drawn from their archives, and even include in them documents from other sources. Of special interest to English students is Konstantin Höhlbaum's work upon the Hanse towns. The Record Office has a volume of transcripts from German archives.

HOLLAND.—There is one repository for each of the eleven states. That at the Hague, for south Holland, serves also as a central repository for the whole kingdom. This collection occupies a special building, and includes the records of Foreign Affairs, classed under the countries to which they relate, and certain documents acquired from the collection of Sir Thomas Phillips. There are many printed and manuscript lists, and access to the documents is easy. This is also the case with the other provincial archives, of which the most important are those at Arnheim, Hertogenbosch, Groningen, Haarlem, Maastricht, Middelburg and Utrecht.

Town archives are for the most part well preserved. Printed inventories generally exist, and in some cases, *e.g.* at Doesburg, the archives contain information as to the relations between the Hanse and England in the 14th century.

Dutch repositories have no administrative inter-connexion. Each archivist reports yearly to the archivist-in-chief of the kingdom, and since 1878 these *Verslagen omtrent Rijks oude Archieven* have been printed.

The English Public Record Office has four volumes of transcripts from Dutch archives.

ITALY.—The administration of the public records of the kingdom is attached to the Ministry of the Interior, for which office Signor Vazio published (1883) his *Relazione sugli archivi di stato italiani.* There are seventeen repositories, representing the ancient divisions of the kingdom. The most important are the following:—

Florence, containing records of the foreign correspondence of the dukes of Tuscany and the Florentine republic.

Genoa, records of the republic.

Milan, records of the duchy, in particular the registers called *L'Archivio Panigarola.*

Modena, records of the family of Este.

Naples, in particular the *Cancelleria Angioina*, records of the Angevin kings of Naples, containing documents relative to their extensive dominions in Provence, Anjou and elsewhere, for a bibliographical account of which see *Les Archives Angevines de Naples; études sur les registres du Roi Charles I^{er}*, by Paul Durrieu. Naples also possesses the important *Archivio Farnesiano*, mainly records of the duke of Parma, brought there by Charles I. of Bourbon on his accession to the throne of the Two Sicilies in 1735.

Palermo, the records of the island of Sicily.

Rome, the most important records of the *Archivio di Stato* are those relating to the papal government which were not transferred to the Vatican in 1871.

Turin, the archives of the house of Savoy, especially the letters from envoys at foreign courts, a series of very important reports.

Venice, the convent *dei Frari* contains probably the most interesting collection of records in Italy. Rawdon Brown, G. Cavendish Bentinck, and H. F. Brown have edited many of the principal documents relating to England in the *State Papers: Venetian* (Record Office), which are still in progress. The Record Office also possesses two hundred and ten volumes of transcripts from Venetian archives, mostly the reports and correspondence of ambassadors, together with Rawdon Brown's large collection of similar materials, mainly originals or early copies (see Report 46).

The Vatican.—For the history of the papal archives the work of H. Bresslau, *Handbuch der Urkundenlehre für Deutschland und Italien* (Leipzig, 1889), may be consulted. The best English account is contained in an article in the *American Historical Review* (October 1896), by C. H. Haskins. But certain of the prefaces to the Record Office Calendar mentioned below may be consulted; and the description given by Langlois and Stein (*op. cit.*) is useful. The Vatican archives have been open to students only since the year 1881. The chief portion of the collection is that called the *Archivio Segreto*, which may be divided into two heads, the original *Archivio Segreto* and the archives added to it from Avignon, from the castle of St Angelo and from special offices such as the Consistory, *Dataria Apostolica, Rota, Secretaria Brevium, Signatura Gratiae, Penitentiary*, and *Master of the Ceremonies.* The records of the congregations of the Index, the Holy Office and the Propaganda are not usually accessible to students.

Since 1881 the importance of the archives has attracted to Rome many bands of students. Most European governments have arranged for the publication of records dealing with their own countries. The classes of documents that have received most attention are the *Regesta*, or registers of bulls and briefs, issued by the papal chancery; the *Supplicationes*, or petitions; and the *Nuntiaturae*, or despatches received from the nuncios and instructions sent to them. An account of the numerous publications will be found in the works already mentioned. Here it is only possible to mention the English publications. The Record Office in London has published one volume of *Petitions*, 1342–1417, and a Calendar from the *Regesta*, which covers the period 1198–1431. The French government is publishing a complete Calendar of the *Regesta* up to the end of the 13th century. There are in the English Public Record Office one hundred and sixty-two volumes of transcripts from the Vatican archives arranged in two series.

NORWAY.—The records of Norway are preserved at Christiania, and include a collection of papers of Christian II., king of Denmark. For the contents of the collection, see *Diplomatarium Norvegicum*, by Lange and Unger (1849–1891); and *Norske Rigsregistranter tildeels i uddrag*, dealing with the 16th and 17th centuries.

PORTUGAL.—Portuguese royal records are in the monastery of São Bento at Lisbon. The collection suffered much during the earthquake of 1755. It includes the registers of the Chancery since the 13th century, and a large number of documents subsidiary to them. In addition to this repository there are collections at the various ministries; from the records of the Ministry for Foreign Affairs, Borges de Castro, and afterwards Judice Biker, published their *Collecção dos Tratados . . . entre a Corona de Portugal e as mais potentias.* There are three volumes of transcripts from Portuguese records in the English Public Record Office.

RUSSIA.—The records of the Russian government are distributed in various repositories in Moscow and St Petersburg. At the former are preserved the records of the foreign relations of Russia down to 1801; permission to use them can be obtained from the Minister for Foreign Affairs: there are no printed lists, but many in manuscript. At Moscow are also preserved the records of the Ministry of Justice. In vol. xliv. of the *Revue historique* (1890) there is an article by J.-J. Chemko and L.-M. Balffol on *Les Archives de l'empire russe à Moscow.* The records of government offices at St Petersburg are not open to students. There are minor repositories at various provincial capitals, and the records of the Grand Duchy of Finland are at Helsingfors. There are three volumes of transcripts from Russian records at the English Public Record Office.

SPAIN.—The nearest approach to a central Record Office for Spain is the *Archivo General Central*, established by a royal ordinance of 1858 at Alcalá de Henares, near Madrid. The collection there includes, in addition to the general administrative records of the kingdom, valuable historical matter concerning the Inquisition, the Jesuits, and other subjects. There is also at Madrid a repository known as the *Archivo Histórico Nacional*, which contains the archives of crown lands and suppressed monasteries, with a printed inventory. The remaining records are distributed locally in separate repositories containing the archives of the old kingdoms. Those of Castile are partly at Simancas and partly at Alcala de Henares. Those of Aragon are at Barcelona in the Palacio de los Condes. Those of Navarre are at Pamplona and difficult of access. The remainder are of small importance.

In addition to these there are two collections requiring notice, the *Archivo general de Indias* at Seville and the papers of the *Consulado del Mar* at Bilbao.

The English Public Record Office is publishing a Calendar of the papers relating to England in Spanish and other connected archives. The introduction to the first volume, edited by C. Bergenroth, contains a sketch of the records used by him; and the series, under the successive editorship of Bergenroth, Don Pasquale de Gayangos and Major Martin Hume, now extends from the reign of Henry VIII. to the year 1603. The Record Office possesses sixty-five volumes of transcript from Spanish archives.

SWEDEN.—The archives have not yet been centralized, and large collections exist at the various ministries. The most important records, however, are the Royal Archives (*Rigsarchivet*), preserved in the island of Riddarholmen, Stockholm. A great many publications have been based on these: there are for instance an inventory, *Middlelanden fran Svenska Rigsarchivet* ; a work bearing generally on Scandinavian history, *Handlingar rörande Scandinaviens historia* ; and the *Diplomatarium Suecicum*, which is still in progress. The English Record Office has seven volumes of transcripts from the Stockholm archives, with a report.

Private collections are numerous and valuable, and a society for exploring and publishing such records is supported by the state.

SWITZERLAND.—The Swiss records are of two kinds: records of the confederation, and records of the several cantons. The first are in the *Bundes-Archiv* at Berne, and date from 1798; see *General Repertorium der Acten des helvetischen Centralarchivs in Bern, 1798–1803*, and *Schweizerisches Urkunden-Register*, by B. Hidber, vol. ii. (Berne, 1877). The Cantonal records, some of them of very early date, are at the chief town of each canton, and for the most part are provided with manuscript inventories. For those of Geneva, see also *Les Archives de Genève*, edited by F. Turrettini and A. C. Grivel (1877). For the records of the Abbey of St Gall, see *Urkundenbuch der Abtei St Gallen*, edited by H. Wartmanne (1863–1882); and for those of Zürich, *Urkundenbuch der Stadt und Landschaft Zürich*, by P. Schweitzer and E. Escher (1889–1892).

There are in the English Public Record Office five volumes of transcripts from the *Bundes-Archiv.*

UNITED STATES OF AMERICA

The records, among which transcripts made in England, France, and Holland hold an important place, may be divided into: *Federal*, kept at Washington; those in *private collections*; and *State Records* at the various state capitals. The publication and care of all these are often the work of private bodies subsidized or recognized by government. Thus, although *Federal archives* are now centralized under the charge of the head of the division of Manuscripts in the Library of Congress, which office is acquiring important collections of the papers of former presidents, and may also have transferred to it departmental records not in current use, publication of guides is the concern of the historical section of the Carnegie Institution and of the Archives Commission of the Historical Association. The same association explores *private collections* through its Historical Manuscripts Commission; and numerous societies publish *state records.* Some states, however, have themselves published American and European documents relating to their history; and mention must be made of the large series of *American Archives* and *State Papers* published from 1832 onwards by Congress.

The best guide for Federal records is the work of Leland and Valentine; for a general bibliographical work of reference see E. C. Burnett's *List of Printed Guides . . .* (Historical MSS. Commission Report, 1897).

EXTRAVAGANTIA

In various ways records are apt to wander from their proper custody and to lose their legal character. But in spite of this loss the historian is bound to pursue them either into the hands of private collectors or on to the shelves of some museum. No attempt can be made to discuss private collections or the manuscripts of foreign libraries. Even among English libraries it must be sufficient to mention the British Museum as the principal destination of wandering records. Of the collections in that library the most important to the student of records are the *Cottonian*, the *Harleian* and the *Lansdowne*, all catalogued by the Record Commission; the *Additional*, catalogued from time to time as fresh matter accrues; the *Egerton*, catalogued with the *Additional*; the *Sloane* and the *Stowe*, both catalogued. No distinction is made between documents that have been technically "records" and others. The whole collection is divided technically into *Manuscripts*, by which are meant volumes, and *Charters and Rolls*, meaning detached documents. To the latter class an *Index locorum*, compiled by H. F. Ellis and F. B. Bickley, has been printed. (C. G. Cr.)

RECORDE, ROBERT (*c.* 1510–1558), Welsh physician and mathematician, was descended from a respectable family of Tenby in Wales. He entered the university of Oxford about 1525, and was elected fellow of All Souls' College in 1531. Having adopted medicine as a profession, he went to Cambridge, where he took the degree of M.D. in 1545. He afterwards returned to Oxford, where he publicly taught mathematics, as he had done prior to his going to Cambridge. It appears that he afterwards went to London, and acted as physician to Edward VI. and to Queen Mary, to whom some of his books are dedicated. He died in the King's Bench prison, Southwark, where he was confined for debt, in 1558.

Recorde published several works upon mathematical subjects, chiefly in the form of dialogue between master and scholar, viz.:—*The Grounde of Artes, teachinge the Worke and Practise of Arithmeticke, both in whole numbers and fractions* (1540); *The Pathway to Knowledge, containing the First Principles of Geometry . . . bothe for the use of Instrumentes Geometricall and Astronomicall, and also for Projection of Plattes* (London, 1551); *The Castle of Knowledge, containing the Explication of the Sphere both Celestiall and Materiall, &c.* (London, 1556); *The Whetstone of Witte, which is the second part of Arithmetike, containing the Extraction of Rootes, the Cossike Practice, with the Rules of Equation, and the Woorkes of Surde Numbers* (London, 1557). This was the first English book on algebra. He wrote also a medical work, *The Urinal of Physic* (1548), frequently reprinted. Sherburne states that Recorde also published *Cosmographiae isagoge*, and that he wrote a book *De Arte faciendi Horologium* and another *De Usu Globorum et Statu temporum*. Recorde's chief contributions to the progress of algebra were in the way of systematizing its notation (see ALGEBRA, *History*).

RECORDER, in its original sense, one who sets down or records. Hence applied to a person with legal knowledge who was appointed by the mayor and aldermen to "record" or keep in mind the proceedings of their court, as well as the customs of the city. The word is now chiefly used of the principal legal officer of a city or borough having a separate court of quarter sessions. He must be a barrister of five years' standing, appointed by the crown and holding office during good behaviour, and receiving "such yearly salary, not exceeding that stated in the petition on which the grant of a separate court of quarter sessions was made," as the sovereign directs (Municipal Corporations Act 1882, s. 163). The recorder holds, once in every quarter of a year, or oftener, if he thinks fit, a court of quarter sessions in and for the borough. He is sole judge of the court, "having cognizance of all crimes, offences, and matters cognizable by courts of quarter sessions for counties in England," except that he may not allow or levy any borough rate, or grant licences (s. 165). He is not eligible to serve in parliament for the borough, or to be an alderman or councillor, or stipendiary magistrate for the borough, though he may be revising barrister and is eligible to serve in Parliament except for the borough. He may be appointed recorder for two or more boroughs conjointly. He may, in case of sickness or unavoidable absence, appoint in writing a barrister of five years' standing to act as deputy recorder for him. A recorder is *ex officio* a justice for the borough.

The recorder of London is judge of the lord mayor's court, and one of the commissioners of the central criminal court. His salary is £4000 a year. He is appointed by the lord mayor and aldermen, but by the Local Government Act 1888, s. 42, sub-s. 14, after the vacancy next after the beginning of the act, no recorder may exercise any judicial function unless he is appointed by the sovereign to exercise such function. See QUARTER SESSIONS, COURT OF.

RECORDER, FIPPLE FLUTE or ENGLISH FLUTE (Fr. *flûte-à-bec*, *flûte douce*, *flûte anglaise* or *flûte à neuf trous*; Ger. *Block-* or *Plockflöte*, *Schnabelflöte*, *Langflöte*; Ital. *flauto dolce*, *flauto diritto*), a medieval flute, blown by means of a whistle mouthpiece and held vertically in front of the performer like a clarinet. The recorder only survives in the now almost obsolete flageolet and in the so-called penny-whistle. The recorder consisted of a wooden tube, which was at first cylindrical or nearly so, but became, as the instrument developed and improved, an inverted cone. The whistle mouthpiece has been traced in almost prehistoric times in Egypt and other Oriental countries. The principle of the whistle mouthpiece is based on that of the simplest flutes without embouchure, like the Egyptian *nay*, with this modification, that, in order to facilitate the production of sound, the air current, instead of being directed through ambient air to the sharp edge of the tube (or the lateral embouchure in the modern flute), is blown through a chink directly into a narrow channel. This channel is so constructed within the mouthpiece that the stream of air impinges with force against the sharp edge of a lip or fipple cut into the pipe below the channel. This throws the air current into the state of vibration required in order to generate sound-waves in the main column of air within the tube. The inverted cone of the bore has the effect of softening the tone of the recorder still further, earning for it the name of *flûte douce*. Being so easy to play, the recorder always enjoyed great popularity in all countries until the greater possibilities of the transverse flute turned the tide against it. The want of character which distinguishes the timbre of the whistle-flute is due to the paucity of harmonic overtones in the clang. The recorder had seven holes in front and one at the back for the thumb. As long as the tube was made in one piece the lowest hole stopped by the little finger was generally made in duplicate to serve equally well for right- and left-handed players, the unused hole being stopped with wax. Being an open pipe, the recorder could overblow the octave and even the two following harmonics (*i.e.* the twelfth and second octave). The holes produced the diatonic scale, and by means of harmonics and cross-fingering the second and part of a third octave were obtained.

The recorder is described and figured by Sebastian Virdung, Martin Agricola and Ottmar Luscinius in the 16th century, and by Michael Praetorius and Marin Mersenne in the 17th century. Praetorius mentions eight different sizes ranging from the small flute two octaves above the cornetto to the great bass. The lowest notes of the large flutes were provided with keys enclosed in perforated wooden or brass cases, which served to protect the mechanism, as yet somewhat primitive; the keys usually had double touch pieces to suit right- or left-handed players.

There are at least two fine sets of recorders extant: one is preserved in the Germanisches Museum at Nuremberg, consisting of eight flutes in a case and dating from the 17th century; the other is the Chester set of four 18th-century instruments, which are fully described and illustrated in a paper by Joseph C. Bridge.[1]

The recorder has been immortalized by Shakespeare in the famous scene in *Hamlet* (II. 3), which has been treated from the musical point of view in an excellent and carefully written article by Christopher Welch, the author of an equally valuable paper, "The Literature of the Recorder."[2]

The small whistle-pipe used to accompany the tabor (Fr. *galoubet*; Ger. *Stamentienpfeiff* or *Schwegel*), which had but three holes, belongs to the same family as the recorder, but from its association with the tabor it acquired distinctive characteristics (see PIPE AND TABOR). (K. S.)

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[1] "The Chester Recorders" in *Proc. Mus. Assoc.*, London, 1901.

[2] "Hamlet and the Recorder," *ibid.*, 1902 and 1898.

RECTOR (Lat. for "ruler," "guide," &c., from *regere*, "rule"), a title given to the bearers of certain ecclesiastical and academical offices. In the Roman empire, after Constantine, the title *rector* was borne by governors of provinces subordinate to the prefects or exarchs. In the middle ages it was given to certain secular officials, *e.g.* the podestas of some Italian towns, but more especially to the heads of the universities, the representatives and rulers of the *universitas magistrorum et scholarium*, elected usually for a very short time. After the humanistic movement of the Renaissance the style *rector* was also given to the chief masters of schools containing several classes, and in some parts of Germany (*e.g.* Saxony, Württemberg) it is still thus used instead of the more modern title of *Director*. Rector is also still the title of the heads of the Scottish universities (Lord Rector), who are elected for three years, and of the German universities (*Rector Magnificus*), in which the office is held for a year by a representative of each faculty in turn. In those German universities where the rectorship is held by the sovereign (*Rector Magnificentissimus*), the acting head is known as *Prorector*. "Rector" is also the title of the heads of Exeter and Lincoln Colleges, Oxford. The heads of all Jesuit colleges are "rectors."

As an ecclesiastical title *rector* was once loosely used for rulers of the Church generally, whether bishops, abbots or parish priests (see Du Cange, *Rectores ecclesiarum*). The *Rectores Apostolici Patrimonii* were clerics of the Roman Curia charged with the duty of looking after the interests of the patrimony of St Peter. The ecclesiastical title *rector*, however, became ultimately confined in certain parts of Europe (Poland, Spain and notably England) to the office of a priest having a cure of souls. In its English use it is thus synonymous with "curate" in the sense used in the Prayer Book. In the middle ages a large number of rectories were held by religious houses, which drew the bulk of the tithes and appointed vicars to do the work. Hence the modern distinction in England between rectors and vicars. A rector is incumbent of a benefice never held under a monastery, and he receives all the tithes; a vicar (*i.e.* of an ancient benefice) draws only such tithes as were left to the benefice by the religious house which held it. On the suppression of the monasteries the "great tithes" were often bestowed by the crown on laymen, who, as owning the rectorial tithes, were and are known as "lay rectors." It follows that, rectories being usually richer than vicarages, the style of "rector" is in England slightly more dignified than that of "vicar." In the American Protestant Episcopal Church the incumbents of churches are called rectors.

RECUSANT (from Lat. *recusare*, to refuse), the name, in English history, given in the 16th and 17th centuries to those persons who persisted in refusing to attend the services of the English Church, and particularly to those of the Roman Catholic faith (see Roman Catholic Church, § *English Law*).

REDAN, in fortification, a work of V-shape presenting a salient angle towards the expected attack. The gorge (rear) of a redan is open. When unsupported by other works, it has the disadvantage that its fire is divergent and but few guns can be brought to bear directly towards the front. Further, both its faces are usually open to enfilade. Redans were therefore almost always used in conjunction with other works, one of the most common forms being the "lines of redans" used as field works. These consisted of lengths of plain trenches facing the front, with redans at intervals along the line. In the present day the term redan is loosely applied to works merely possessing saliency, as in the case of the celebrated bastions Nos. 3 and 2 at Sevastopol in 1854–55, usually called the "Redan" and "Little Redan" respectively (see Crimean War). The "Redan" was a large work of irregular outline, generally resembling a redan, but having the salient angle blunted or rounded off and the side faces broken into several minor fronts so as to obtain a field of fire in many directions. (See Fortification and Siegecraft.)

RED BANK, a borough of Monmouth county, New Jersey, U.S.A., on an estuary known as Navesink river, at the head of navigation, about 6 m. W. of the Atlantic Ocean, and about 25 m. S. of New York City. Pop. (1905) 6263; (1910) 7398. Red Bank is served by the Central of New Jersey and the Pennsylvania railways, and by steamboats to New York, and is connected with the neighbouring towns by electric lines. It is a residential suburb of New York City and a summer resort. In the winter ice-boating is a popular amusement, and Red Bank has fish and oyster industries of some importance.

The name Red Bank was applied to this locality as early as 1734, and in 1781 there were several buildings within the limits of the present borough. Red Bank was incorporated as a town in 1870 and became a borough in 1908. Near Red Bank was established in 1843 the North American phalanx, a Fourierite community, with a capital of about $8000 and 112 members, on about 673 acres; it was financially the most successful and the longest lived of the Fourierist phalansteries in America, but broke up in 1855 because of internal dissensions, following a fire which destroyed the mills.[1]

REDBREAST,[2] or Robin, perhaps the favourite among English birds because of its pleasing colour, its sagacity and fearlessness of man, and its cheerful song, even in winter. In July and August the hedgerows of the southern counties of England are beset with redbreasts, not in flocks, but each individual keeping its own distance from the next[3]—all, however, on their way to cross the Channel. On the European continent the migration is still more marked, and the redbreast on its autumnal and vernal passages is the object of bird-catchers, since its value as a delicacy has long been recognized. Even those redbreasts which stay in Britain during the winter are subject to a migratory movement. The first sharp frost makes them change their habitation, and a heavy fall of snow drives them towards the homesteads for food. The redbreast exhibits a curious uncertainty of temperament in regard to its nesting habits. At times it will place the utmost confidence in man, and at times show the greatest jealousy. The nest is usually built of moss and dead leaves, with a moderate lining of hair. In this are laid from five to seven white eggs, sprinkled or blotched with light red.

Besides the British Islands, the redbreast (*Motacilla rubecula* of Linnaeus and the *Erithacus rubecula* of modern authors) is generally dispersed over the continent of Europe, and is in winter found in the oases of the Sahara. Its eastern limits are not well determined. In northern Persia it is replaced by a nearly allied form, *Erithacus hyrcanus*, distinguishable by its more ruddy hues, while in northern China and Japan another species, *E. akahige*, is found of which the sexes differ somewhat in plumage—the cock having a blackish band below his red breast and greyish-black flanks, while the hen closely resembles the familiar British species—but both cock and hen have the tail of chestnut-red. The genus *Erithacus*, as well as that containing the other birds to which the name "robin" has been applied, with the doubtful exception of *Petroeca*, belong to the sub-family Turdinae of the thrushes (*q.v.*).

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[1] The borough of Red Bank should be distinguished from a place of the same name in Gloucester county, New Jersey, about 6 m. below Camden, on the Delaware river, nearly opposite the mouth of the Schuylkill river, which was the site of Fort Mercer in the American War of Independence. Fort Mercer, with Fort Mifflin (nearly opposite it on an island in the Delaware), prevented the co-operation of the British navy with the army which had occupied Philadelphia in September. On the 22nd of October Fort Mercer, held by 600 men under Col. Christopher Greene (1737–1781), was unsuccessfully attacked by a force of about 2500 men, mostly Hessians, under Col. Carl Emil Kurt von Donop, the Hessians losing about 400 men, including Donop, who was mortally wounded. The British naval force was prevented by the "Pennsylvania navy" under John Hazelwood (*c.* 1726–1800) from taking part in the attack; two British ships were destroyed; and the fire from the American vessels added to the discomfiture of the Hessians. On the 15th of November Fort Mifflin was destroyed after a five days' bombardment from batteries on the Pennsylvania shore and from British vessels in the rear; and on the 20th Fort Mercer was abandoned before Cornwallis's approach and was destroyed by the British. Philadelphia was then put in touch with Admiral Howe's fleet and with New York City. Near Red Bank a monument to Christopher Greene was erected in 1829.

[2] English colonists in distant lands have applied the common nickname of the redbreast to other birds that are not immediately allied to it. The ordinary "robin" of North America is a thrush, *Turdus migratorius* (see Fieldfare), and one of the bluebirds of the same continent, *Sialia sialis*, is in ordinary speech the blue "robin"; the Australian and Pacific "robins" of the genus *Petroeca* are of doubtful affinity and have not all even the red breast; the Cape "robin" is *Cossophya caffra*, the Indian "robin" *Thamnobia* and the New Zealand "robin" *Miro*.

[3] It is a very old saying that *Unum arbustum non alit duos erithacos*—One bush does not harbour two redbreasts.

REDCAR, a watering-place in the Cleveland parliamentary division of the North Riding of Yorkshire, England, 8 m. N.E. of Middlesbrough, on a branch of the North-Eastern railway. Pop. of urban district (including the township of Coatham, 1901) 7695. Its long range of firm sands from Tees mouth to Saltburn, a distance of 10 m., has made it a popular summer resort. Race meetings are held here on Whit Monday and Tuesday, and in August. Redcar is close to the Cleveland iron-working district of which the centre is Middlesbrough, and is in great favour with the large industrial population of that district.

REDDITCH, a town in the eastern parliamentary division of Worcestershire, England, situated on an eminence near the Warwickshire border, 15½ m. S. of Birmingham by the Midland railway. Pop. of urban district (1901) 13,493. It is the centre of a district producing needles and fish-hooks. There are also motor-engineering works. The town possesses a literary and scientific institute (1850). In the modern church of St Stephen (1854) are preserved tiles from the former Cistercian abbey of Bordesley, founded in 1138, of which the site may be traced at Bordesley Park, 2 m. N.

REDESDALE, JOHN FREEMAN-MITFORD, Baron (1748–1830), English lawyer and politician, younger son of John Mitford (d. 1761) and brother of the historian William Mitford, was born in London on the 18th of August 1748. Having become a barrister of the Inner Temple in 1777, he wrote *A Treatise on the Pleadings in Suits in the Court of Chancery by English Bill*, a work of great value, which has been reprinted several times in England and America. In 1788 Mitford became member of parliament for the borough of Beeralston in Devon, and in 1791 he introduced the important bill for the relief of Roman Catholics, which was passed into law. In 1793 he succeeded Sir John Scott, afterwards Lord Eldon, as solicitor-general for England, becoming attorney-general six years later, when he was returned to parliament as member for East Looe, in Cornwall. In February 1801 Sir John Mitford (as he was now) was chosen speaker of the House of Commons. Exactly a year later, he was appointed lord chancellor of Ireland and was created a peer of the United Kingdom as Baron Redesdale. Being an outspoken opponent of Roman Catholic emancipation, Redesdale was unpopular in Ireland. In February 1806 he was dismissed on the formation of the ministry of Fox and Lord Grenville. Although Redesdale declined to return to official life, he was an active member of the House of Lords both on its political and its judicial sides. In 1813 he secured the passing of acts for the relief of insolvent debtors, and later he was an opponent of the repeal of the Test and Corporation Acts and of other popular measures of reform. Redesdale, who was a fellow of the Royal Society and a member of three commissions on the public records, died on the 16th of January 1830. In 1803 he married Frances (d. 1817), daughter of John, 2nd earl of Egmont. He took the additional name of Freeman in 1809 on succeeding to the estates of Thomas Edwards Freeman.

His only son, John Thomas Freeman Mitford (1805–1886), succeeded to the title. In 1851 he was chosen chairman of committees in the House of Lords, a position which he retained until his death, and in 1877 he was created earl of Redesdale. His chief interest was reserved for ecclesiastical questions, and he won some repute as a Protestant controversialist. He assisted to revive Convocation in 1853; was an active opponent of the disestablishment of the Irish Church; and engaged in controversy with Cardinal Manning on the subject of communion in both kinds. On his death, on the 2nd of May 1886, his titles became extinct. He wrote *Thoughts on English Prosody and Translations from Horace*, and *Further Thoughts on English Prosody* (Oxford, 1859), in addition to various pamphlets on ecclesiastical topics.

The earl bequeathed his estates to his kinsman, Algernon Bertram Freeman-Mitford (b. 1837), a great-grandson of William Mitford. He had been in the diplomatic service from 1858 to 1873, and had been secretary to the Office of Works from 1874 to 1886. From 1892 to 1895 he was member of parliament for the Stratford-on-Avon division of Warwickshire, and he was created Baron Redesdale in 1902. He was well known for his writings on Japan, *Tales of Old Japan* (1871), *The Attaché at Peking* (1900), &c.

See O. J. Burke, *History of the Lord Chancellors of Ireland* (Dublin, 1879); J. R. O'Flanagan, *Lives of the Lord Chancellors of Ireland* (1870); Sir J. Barrington, *Personal Sketches of His Own Times* (1869); Sir S. E. Brydges, *Autobiography* (1834); and C. Abbot, Lord Colchester, *Diary and Correspondence* (London, 1861).

REDFERN, a municipality of Cumberland county, New South Wales, Australia, adjoining the city of Sydney on the S.S.W. Pop. (1901) 24,282. It is a busy manufacturing centre, having numerous ironworks, coach factories, boot factories, printing works, iron and brass foundries, soap factories and extensive railway works.

REDGRAVE, RICHARD (1804–1888), English artist, was born at Pimlico on the 30th of April 1804, and worked at first as a designer. He became a student in the Royal Academy Schools in 1826, and was elected an Associate in 1840 and an Academician in 1851 (retired, 1882). His "Gulliver on the Farmer's Table" (1837) made his reputation as a painter. He began in 1847 a connexion with the Government Art Schools which lasted for a long term of years, and among other posts he held those of inspector-general of art in the Science and Art Department, and art director of the South Kensington Museum. He was greatly instrumental in the establishment of this institution, and he claimed the credit of having secured the Sheepshanks and Ellison gifts for the nation. He was also surveyor of the royal pictures. He was offered, but declined, a knighthood in 1869. Redgrave was an assiduous painter of landscape and *genre*; his best pictures being "Country Cousins" (1848) and "The Return of Olivia" (1848), both in the national collection, "The Sempstress" (1844), "Well Spring in the Forest" (1865). He died on the 14th of December 1888.

See the *Memoir* by F. M. Redgrave, 1891.

REDLANDS, a city of San Bernardino county, in southern California, U.S.A., 67 m. (by rail) E. of Los Angeles. Pop. (1900) 4797; (1910) 10,449. It is served by the Southern Pacific and the Atchison, Topeka & Santa Fé railways and by interurban electric lines. The city lies at an altitude of 1350–1600 ft. at the eastern end of the San Bernardino Valley, surrounded on three sides by mountains. To the east Grayback (11,725 ft.) and San Bernardino (11,600 ft.), to the south-east San Jacinto (10,805 ft.), and to the north-west Cajon Pass (4119 ft.) and San Antonio, of Old Baldy (10,142 ft.), are conspicuous landmarks. The city is a well-known tourist and health resort, with beautiful drives. Canyon Crest Park (Smiley Heights) contains about 300 acres, and Prospect Park 50 acres. The city has the A. K. Smiley Public Library, the gift of A. K. Smiley, and is the seat of the University of Redlands (Baptist; co-educational), incorporated in 1907 and opened in 1909. Redlands is one of the most famous orange-growing and shipping centres of California; it also ships other citrus fruits, olive oil, barley, wheat and stone. Olive oil and jam, marmalade and preserved fruits are manufactured. There are electric power plants in the mountains (three in Mill Creek Canyon and two in Santa Ana Canyon). A settlement called Lugonia was established within the limits of the present city in 1874, but Redlands dates from 1887, when it was settled by people from New England, and was chartered as a city.

REDMOND, JOHN EDWARD (1851–), Irish politician, son of W. A. Redmond, M.P., was born at Waterford in 1851.

He was educated at Trinity College, Dublin, and was called to the bar at Gray's Inn in 1886, and subsequently to the Irish bar, though he never practised. He was a clerk in the vote office of the House of Commons before he entered parliament in 1881 as member for New Ross. From 1885 to 1891 he represented North Wexford. As party whip he rendered great service to the Irish members by his thorough grasp of the procedure of the House. At the time of the rupture of the Irish party consequent on the Parnell scandals, Redmond was the most eloquent member of the minority who continued to recognize his leadership, and in 1891 he became the accredited leader of the Parnellites. In 1900 the two Nationalist parties were amalgamated under his leadership. He contested Cork unsuccessfully in 1891, but was elected for Waterford, where he was re-elected in 1906. (For the political events under his leadership of the Irish parliamentary party up to 1910, see IRELAND: *History*; ENGLISH HISTORY and allied articles.)

REDON, a town of western France, capital of an arrondissement in the department of Ille-et-Vilaine, 45 m. S.S.W. of Rennes by rail. Pop. (1906) 5170. Redon is situated on the right bank of the Vilaine, above the confluence of the Oust and on the canal from Nantes to Brest. The Church of St Sauveur, formerly belonging to an abbey, has a Romanesque central tower, square in form but with rounded angles. A fine tower of the 14th century with a stone spire stands isolated from the church, from which it was separated owing to the destruction of part of the nave by fire in 1782. The choir, with ambulatory and radiating chapels, forms one of the most remarkable examples of 13th-century architecture in Brittany. The abbey has been converted into an ecclesiastical college. Some 16th-century timbered houses have interesting carvings. The industries include the manufacture of emery and polish, agricultural implements and boat-building, tanning, brewing and flour-milling. The port is accessible at high tides for vessels of 600 to 700 tons. Redon grew up round a monastery founded in the first half of the 9th century. In the 14th century Jean de Tréal, one of the abbots, surrounded the town with walls, of which a remnant is still to be seen.

REDONDA, an island in the British West Indies. It is a dependency of Antigua, and lies 25 m. S.W. of it, in 25° 6′ N. and 61° 35′ W. Pop. (1901) 120. It is a rocky mountain, rising abruptly from the sea to a height of 1000 ft., and has an area of ½ sq. m. It is valuable for its phosphate of alumina (discovered in 1865), of which 7000 tons are exported every year to the United States.

REDONDELA, a town of north-western Spain, in the province of Pontevedra; 7 m. N.E. of Vigo, in a bend of the Vigo estuary, and at the junction of the Tuy-Vigo and Vigo-Pontevedra railways. Pop. (1900) 10,843. The river is only accessible for small coasting vessels; it is the headquarters of a prosperous fishing industry. In the neighbourhood are ruins of several medieval castles, and the fine hall of the Marquess Vega de Armijo.

REDOUBT (Fr. *redoute*, from Med. Lat. *reductus*, a place of retreat, refuge, *reducere*, lead back, retire; the intrusive *b* is due to the O. Fr. *redoubter*, to fear, Lat. *dubitare*, to doubt), a term in fortification for a small closed work of plain trace, generally used in conjunction with lines of infantry trenches (see FORTIFICATION AND SIEGECRAFT). The term "reduit" (Fr. *réduit*), often confused with "redoubt," is only used for a keep or interior refuge for the garrison of a larger work, corresponding, on a small scale, to the citadel of a fortress.

RED RIVER, the name of two American rivers, one emptying into the Mississippi near its mouth, and the other emptying into Lake Winnipeg.

1. The Red river, sometimes called the Red River of Louisiana, is the southernmost of the large tributaries of the Mississippi. It rises in northern Texas, in the northern part of the Staked Plains, or Llano Estacado, flows E. by S. in Texas, between Texas and Oklahoma, and to Fulton, in south-western Arkansas, there turns S.E. and continues in a general south-easterly direction through Louisiana to the bank of the Mississippi, where it discharges partly into the Mississippi and partly into the Atchafalaya. Its length is estimated at 1200 m. or more; its drainage basin has an area of at least 90,000 sq. m.; and its discharge ranges from 3500 cub. ft. to 180,000 cub. ft. per second. It is somewhat saline in its upper course, and in its middle and lower course is laden with a reddish silt from which it takes its name. From an elevation on the Staked Plains of about 2450 ft., the river plunges into a canyon which is about 60 m. long and has nearly perpendicular walls of sandstone and gypsum formation 500 to 800 ft. high. Immediately below the canyon the river spreads out over a broad and sandy bed and flows for about 500 m. through a semi-arid plain. It narrows on entering the alluvial bottom lands, through which it pursues a sluggish and meandering course for the last 600 m. At high stages, from December to June, it is continually shifting its channel in this part of its course, by eroding one bank and making deposits on the other, and as the upper portion is densely wooded the falling trees, unless removed, become an obstruction to navigation. In 1828 the trees which the river had felled formed the great "Red River raft" extending from Loggy Bayou, 65 m. below Shreveport, Louisiana, to Hurricane Bluffs, 27 m. above Shreveport. Congress began in that year to make appropriations for the removal of the raft, and by 1841 Henry M. Shreve had opened a channel. The river was neglected from 1857 to 1872 and another raft, 32 m. in length, formed above Shreveport. A channel was opened through this in 1872–73, and the complete removal of the obstruction a few years later so improved the drainage that a large tract of waste land was reclaimed. In its course through Louisiana the river has built up a flood-plain with silt deposits more rapidly than its tributaries, with the result that numerous lakes and bayous have been formed on either side, and Cypress Bayou was so flooded that boats plied between Shreveport, Louisiana and Jefferson, Texas, 45 m. apart; but with the improvement of the river these lakes have become shallow or dry. For the improvement of navigation here not only the removal of snags is necessary, but there must be dredging, closure of outlets, building of levees to narrow and deepen the channel, and revetment works to protect the banks. The cost of these works has been great (up to July 1909 more than $2,360,000 below Fulton, Arkansas, and more than $215,000 above Fulton), but they have rendered the river navigable, except at very low stages, by vessels drawing 3 ft. of water from its mouth to Fulton, Arkansas, a distance of 508·6 m., and at the highest stages,[1] in March and April, it is navigable to Denison, Texas, 292 m. farther up. The Ouachita and Black (one river), which is the principal tributary of the Red, joins it near its mouth and is navigable at high stages to Arkadelphia, Arkansas; and in 1910 a system of nine locks with movable dams was under construction by the Federal government for the purpose of securing a channel 6½ ft. deep at all stages to a point 10 m. above Camden, Arkansas, a distance of 360 m.

During the Civil War, in March and April 1864, Major-General Nathaniel P. Banks conducted a combined military and naval expedition up the Red river in an attempt to open a Federal highway to Texas, but on the 8th of April the vanguard of his army was repulsed with heavy loss at Sabine Cross-Roads by the Confederates under Lieutenant-General Richard Taylor and the expedition was abandoned; the gunboats commanded by D. D. Porter were held above Alexandria by the lowness of the river, but it was flooded by a hurriedly built dam, and they escaped.

See R. B. Marcy and G. B. McClellan, *Exploration of the Red River of Louisiana* (Washington, 1853), and the annual *Reports* of the Chief of Engineers of the U.S. Army.

2. The Red river, commonly called the Red River of the North, rises in the lake region of western Minnesota, not far from the headwaters of the Mississippi, flows north between Minnesota and North Dakota, continues northward through the Canadian province of Manitoba, and discharges into Lake Winnipeg. It has cut a gorge 20–50 ft. deep through clay deposits through-

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[1] The range between low water and high water at Fulton is 35·65 ft.

out the greater part of its course; it drains a region that is famous for the production of wheat; and much water power has been developed on its tributaries. The United States government has improved its channel from the international boundary to Breckenridge, Minnesota, a distance of 395·5 m., and occasionally the water reaches a height which permits small steamboats to ascend its S.W. branch to Lake Traverse and from there to descend the Minnesota river to the Mississippi.

RED RIVER SETTLEMENT, a Scottish colony founded in 1811 near the present city of Winnipeg by a philanthropic Scottish nobleman, Lord Selkirk, who at that time controlled the Hudson's Bay Company. Quarrels soon arose with the French and half-breed *employés* of the North-West Fur Company, and were fostered by its officials. On June 19, 1816, in a fight between the rivals, Governor Semple of the Hudson's Bay Company and twenty of his twenty-seven attendants were killed, an affair known as the Battle of Seven Oaks. New settlers were sent by Selkirk, and founded the village of Kildonan, now part of Winnipeg. In 1821 the rival companies united, and in 1836 repurchased from Selkirk's heirs all rights to the territory. In 1821 and in 1835 two forts, known as Lower and Upper Fort Garry, were built to command the junction of the Red and Assiniboine rivers, and around them grew up a mixed population of Scots, French and Indians. The purchase in 1869 of the territorial rights of the Company by the Dominion of Canada led to a rebellion, and the setting up of a provisional government under Louis Riel, which was dispersed by a force of British regulars under Colonel (later Lord) Wolseley.

See CANADA (*History*); also George Bryce, *Remarkable History of the Hudson's Bay Company* (1900).

REDRUTH, a market town in the Camborne parliamentary division of Cornwall, England, 17 m. E.N.E. of Penzance, on the Great Western railway. Pop. of urban district (1901) 10,451. It lies high, on the northward slope of the central elevation of the county, with bare rocky moors to the south. It is the chief mining town in Cornwall, and the bulk of the population is engaged in the tin mines or at the numerous tin-streaming works. The parish church of St Uny, of which only the tower is ancient (Perpendicular), stands outside the town to the west, at the foot of a rugged hill named Carn Brea. On the summit of this hill, besides a monument (1836) to Lord de Dunstanville and a small ancient castle, various prehistoric remains are traceable. A museum attached to the science and art schools and a miners' hospital are notable institutions in Redruth. A large quantity of the tin is sold by public auction at the mining exchange, the sales being known as tin-ticketings. There are manufactures of safety fuses, breweries, iron foundries and railway works. Tramways serve the neighbouring mines and the small port of Portreath on the north coast.

RED SEA, a narrow strip of water extending S.S.E. from Suez to the Strait of Bab el-Mandeb in a nearly straight line, and separating the coasts of Arabia from those of Egypt, Nubia and Abyssinia. Its total length is about 1200 m., and its breadth varies from about 250 m. in the southern half to 130 m. in 27° 45′ N., where it divides into two parts, the Gulf of Suez and the Gulf of Akaba, separated from each other by the peninsula of Sinai.

Depths.

The Gulf of Suez is shallow, and slopes regularly down to the northern extremity of the Red Sea basin, which has a maximum depth of 640 fathoms, and then over a shoal of 60 fathoms goes down to 1200 fathoms in 22° 7′ N. The Gulf of Akaba is separated from the Red Sea by a submarine bank only 70 fathoms from the surface, and in 28° 39′ N. and 34° 43′ E. it attains the depth of 700 fathoms. South of the 1200-fathom depression a ridge rises to 500 fathoms in the latitude of Jidda, and south of this again a similar depression goes down to 1190 fathoms. Throughout this northern part, *i.e.* to the banks of Suakin and Farsan in 20° N., the 100-fathom line keeps to a belt of coral reef close inshore, but in lower latitudes the shallow coral region, 300 m. long and 70 to 80 m. across, extends farther and farther seaward, until in the latitude of Hodeda the deep channel (marked by the 100-fathom line) is only 20 m. broad, all the rest of the area being dangerous to navigation, even for small vessels. In the middle of the gradually narrowing channel three depressions are known to exist; soundings in two of these are: 1110 fathoms in 20° N. and 890 fathoms in 16° N., a little to the north of Massawa. To the north-west of the volcanic island of Zebayir the depth is less than 500 fathoms; the bottom of the channel rises to the 100-fathom line at Hanish Island (also volcanic), then shoals to 45 fathoms, and sinks again in about the latitude of Mokha in a narrow channel which curves westward round the island of Perim (depth 170 fathoms), to lose itself in the Indian Ocean. This western channel is 16 m. wide in the Strait of Bab el-Mandeb; the eastern channel of the strait is 2 m. broad and 16 fathoms deep.

Area, volume and mean depth.

Murray estimates the total area at 158,750 sq. m., and its volume at 67,700 cub. m., giving a mean depth of 375 fathoms. Karstens gives the area at 448,810 sq. kilometres (130,424 sq. geographical m.) and the volume at 206,901 cub. kilometres (32,413 cub. geographical m.), which gives a mean depth of 252 fathoms. Both these computations, however, were made before the date of the Austrian exploring expeditions (1896–98). Bludau's measurements give the total area draining to the Red Sea at about 255,000 sq. geographical m. Krümmel's more recent calculations (see OCEAN) give values somewhat higher than those of Karstens.

Formation.

The Red Sea is formed by a line of fracture, probably dating from Pliocene times, crossing the centre of a dome of Archean rocks, on both flanks of which, in Egypt and Arabia, rest Secondary and Tertiary deposits. The granite rocks forming the core of the dome appear at the surface on the Red Sea coast, at the western end of the transverse line of heights crossing Nejd. Along the line of fracture traces of volcanic activity are frequent; a group of volcanic islands occurs in 14° N., and on Jebel Teir, farther north, a volcano has only recently become extinct. The margin of the Red Sea itself consists, on the Arabian side, of a strip of low plain backed by ranges of barren hills of coral and sand formation, and here and there by mountains of considerable height. The greater elevations are for the most part formed of limestones, except in the south, where they are largely volcanic. The coasts of the Gulf of Akaba are steep, with numerous coral reefs on both sides. On the African side there are in the north wide stretches of desert plain, which towards the south rise to elevated tablelands, and ultimately to the mountains of Abyssinia. The shores of the Red Sea are little indented; good harbours are almost wanting in the desert regions of the north, while in the south the chief inlets are at Massawa, and at Kamaran, almost directly opposite. Coral formations are abundant; immense reefs, both barrier and fringing, skirt both coasts, often enclosing wide channels between the reef and the land. The reefs on the eastern side are the more extensive; they occur in places as much as 25 m. from the land. It has long been known that the whole Red Sea area is undergoing gradual elevation, and much has been done in recent years in investigating the levels of raised beaches found in different localities.

Meteorology.

In the northern part, down to almost 19° N., the prevailing winds are north and north-west. The middle region, to 14°–16° N., has variable winds in an area of low barometric pressure, while in the southern Red Sea south-east and east winds prevail. From June to August the north-west wind blows over the entire area; in September it retreats again as far as 16° N., south of which the winds are for a time variable. In the Gulf of Suez the westerly, or "Egyptian," wind occurs frequently during winter, sometimes blowing with violence, and generally accompanied by fog and clouds of dust. Strong north-north-east winds prevail in the Gulf of Akaba during the greater part of the year; they are weakest in April and May, sometimes giving place at that season to southerly breezes. The high temperature and great relative humidity make the summer climate of the Red Sea one of the most disagreeable in the world.

Temperature.

The mean annual temperature of the surface waters near the head is 77° F.; it rises to 80° in about 22° N., to 84° in 16° N., and drops again to 82° at the Strait of Bab el-Mandeb. Daily variations of temperature are observable to a depth of over 50 fathoms. Temperature is, on the whole, higher near the Arabian than the Egyptian side, but it everywhere diminishes with increase of depth and latitude, down to 380 fathoms from the surface; below this depth a uniform constant temperature of 70·7° F. is observed throughout. In the Gulf of Suez temperature is relatively low, falling rapidly from south to north. The waters of the Gulf of Akaba are warmer towards the Arabian than the Sinai coasts; a uniform temperature of 70·2° is observed at all depths below 270 fathoms.

Salinity.

The salinity of the waters is relatively great, the highest recorded being 42·7 per mille (Gulf of Suez), and the lowest 36·2 (Perim harbour). The distribution is, speaking generally, the opposite to that of temperature; salinity increases from the surface downwards, and from the south northwards, and it is greater towards the western than the eastern side. This statement holds good for the Gulf of Suez, in which the water is much salter than in the open sea; but in the Gulf of Akaba the distribution is exceedingly uniform, nowhere differing much from an average of 40·6 per mille.

Circulation.

The movements of the waters are of great irregularity and complexity, rendering navigation difficult and dangerous. Two features stand out with special distinctness: the exchange of water between the Red Sea and the Indian Ocean, and the tidal streams of the Gulf of Suez. From the observations of salinity it is inferred that a surface current flows inwards to the Red Sea in the eastern channel of the Strait of Bab el-Mandeb, while a current of very salt water flows outward to the Indian Ocean, through the western channel, at a depth of 50 to 100 fathoms from the surface. In the Gulfs of Suez and Akaba, almost the only part of the Red Sea in which tidal phenomena are well developed, a sharply defined tidal circulation is found. Elsewhere the surface movements at least are controlled by the prevailing winds, which give rise in places to complex "transverse" currents, and near the coast are modified by the channels enclosed by the coral reefs. During the prevalence of the north and north-west winds the surface level of the northern part of the Red Sea is depressed by as much as 2 ft. The great evaporation going on from the surface probably causes a slow vertical circulation in the depth, the salter colder waters sinking, and ultimately escaping to the Indian Ocean. Extensive collections of the deposits forming the bed were made by the expeditions of the Austrian ship "Pola" (1896 and 1898). These were analysed by Dr K. Natterer, whose conclusions, however, have been disputed by a number of other investigators. The zoological collections of the "Pola" expeditions show that certain well-defined districts are extremely rich in plankton, while others are correspondingly poor; and it appears that the latter occur in districts surrounded by currents of relatively low temperature, while the richer parts are where the movements of water are blocked by irregularities in the coast-line.

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REDSHANK, the usual name of a bird—the *Scolopax calidris* of Linnaeus and *Totanus calidris* of modern authors—so called in English from the colour of the bare part of its legs, which, being also long, are conspicuous as it flies or runs. In suitable localities it is abundant throughout the greater part of Europe and Asia, from Iceland to China, mostly retiring to the southward for the winter, though a considerable number remain during that season along the coasts and estuaries of some of the more northern countries. Before the great changes effected by drainage in England it was a common species in many districts, but at the present day there are very few to which it can resort for the purpose of reproduction. The body of the redshank is as big as a snipe's, but its longer neck, wings and legs make it appear a much larger bird. Above, the general colour is greyish-drab, freckled with black, except the lower part of the back and a conspicuous band on each wing, which are white, while the flight-quills are black, thus producing a very harmonious effect. In the breeding season the back and breast are mottled with dark brown, but in winter the latter is white. The nest is generally concealed in a tuft of rushes or grass, a little removed from the wettest parts of the swamp whence the bird gets its sustenance, and contains four eggs, usually of a rather warmly tinted brown with blackish spots or blotches; but no brief description can be given that would point out their differences from the eggs of other birds, more or less akin, among which, those of the lapwing (*q.v.*) especially, they are taken and find a ready sale.

The name Redshank, prefixed by some epithet as Black, Dusky or Spotted, has also been applied to a larger but allied species—the *Totanus fuscus* of ornithologists. This is a much less common bird, and in Great Britain as well as the greater part of Europe it only occurs on its passage to or from its breeding-grounds, which are usually found south of the Arctic Circle, and differ much from those of its congeners—the spot chosen for the nest being nearly always in the midst of forests and, though not in the thickest part of them, often with trees on all sides, generally where a fire has cleared the undergrowth, and mostly at some distance from water. This peculiar habit was first ascertained by Wolley in Lapland in 1853 and the following year. The breeding-dress this bird assumes is also very remarkable, and seems (as is suggested) to have some correlation with the burnt and blackened surface interspersed with white stones or tufts of lichen on which its nest is made—for the head, neck, shoulders and lower parts are of a deep black, contrasting vividly with the pure white of the back and rump, while the legs become of an intense crimson. At other times of the year the plumage is very similar to that of the common redshank, and the legs are of the same light orange-red. (A. N.)

REDSTART, a bird well known in Great Britain, in many parts of which it is called firetail—a name of almost the same meaning, since "start" is from the Anglo-Saxon *steort*, a tail. This beautiful bird, *Ruticilla phoenicurus*, returns to England about the middle or towards the end of April, and at once takes up its abode in gardens, orchards and about old buildings, when its curious habit of flirting at nearly every change of position its brightly-coloured tail, together with the pure white forehead, the black throat, and bright bay breast of the cock, renders him conspicuous, even if attention be not drawn by his lively though intermittent song. The hen is much more plainly attired; but the characteristic colouring and action of the tail pertain to her equally as to her mate. The nest is almost always placed in a hole of a tree or building, and contains from five to seven eggs of a delicate greenish blue, occasionally sprinkled with faint red spots. The young on assuming their feathers present a great resemblance to those of the redbreast (*q.v.*) at the same age; but the red tail, though of duller hue than in the adult, forms even at this early age an easy means of distinguishing them. The redstart breeds regularly in all the counties of England and Wales. It also reaches the extreme north of Scotland; but in Ireland it is very rare. It appears throughout the whole of Europe in summer, and is known to winter in the interior of Africa. Several very nearly allied forms occur in Asia; and one, *R. aurorea*, in Japan.

A congeneric species which has received the name of black redstart, *Ruticilla titys*,[1] is very common throughout the greater part of the continent of Europe, where, from its partiality for gardens in towns and villages, it is often better known than the preceding species. It yearly occurs in certain parts of England, chiefly along or near the south coast, and curiously enough during the autumn and winter, since it is in central Europe only a summer visitor, and it has by no means the high northern range of *R. phoenicurus*. The males of the black redstart seem to be more than one year in acquiring their full plumage (a rare thing in Passerine birds), and since they have been known to breed in the intermediate stage this fact has led to such birds being accounted a distinct species under the name of *R. cairii*, thereby perplexing ornithologists for a long while, though now almost all authorities agree that these birds are, in one sense, immature.

More than a dozen species of the genus *Ruticilla* have been described, and the greater number of them seem to belong to the Himalayan sub-region or its confines. One very pretty and interesting form is the *R. moussieri* of Barbary, which allies the redstart to the stone-chats (see WHEATEAR), and of late some authors have included it in that genus. In an opposite direction the bluethroats, apparently nearer to the redstarts than to any other type, are placed in the genus *Cyanecula*, containing two or three distinguishable forms: (1) *C. suecica*, with a bright bay spot in the middle of its clear blue throat, breeding in Scandinavia, Northern Russia and Siberia, and wintering in Abyssinia and India, though rarely appearing in the intermediate countries, to the wonder of all who have studied the migration of birds; (2) *C. leucocyanea*, with a white instead of a red gular spot, a more Western form, ranging from Barbary to Germany and Holland; (3) *C. wolfi*, with its throat wholly blue—a form of comparatively rare occurrence. The first of these is a not infrequent, though very irregular, visitant to England, while the second has appeared there but seldom, and the third never, so far as is known. The redstarts with their allies mentioned in this article belong to the subfamily Turdinae of the thrushes (*q.v.*).

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[1] The orthography of the specific term would seem to be *titis* (*Ann. Nat. History*, ser. 4, x. p. 227), a word possibly cognate with the first syllable of titlark and titmouse.

In America the name redstart has been bestowed upon a bird which has some curious outward resemblance, both in looks and manners, to that of the Old Country, though the two are in the opinion of some systematists nearly as widely separated from each other as truly Passerine birds well can be. The American redstart is *Setophaga ruticilla*, belonging to the purely New-World family Mniotiltidae, and to a genus which contains about a dozen species, ranging from Canada (in summer) to Bolivia. (A. N.)

RED WING, a city and the county seat of Goodhue county, Minnesota, U.S.A., on the W. bank of the Mississippi river, near the head of Lake Pepin, about 40 m. S.E. of St Paul. Pop. (1905, state census) 8149, 2138 being foreign-born; (1910) 9048. It is served by the Chicago Great Western and the Chicago, Milwaukee & St Paul railways. Red Wing is the seat of the Lutheran Ladies' Seminary (1894) and the Red Wing Theological Seminary (Lutheran, 1885), and in the vicinity is the State Training School for Boys and Girls, originally the Minnesota State Reform School. In the city are the Carnegie-Lawther library, a Federal building, a municipal theatre, the T. B. Sheldon Memorial Auditorium, in connexion with which is a School of Music, a Y.M.C.A. building, a City Hospital, St John's Hospital (1902) and an old ladies' home. Red Wing is an important wheat market and shipping point.

In 1695 Le Sueur built a post on Prairie Island, in the Mississippi, about 8 m. above the site of Red Wing, for the purpose, according to Charlevoix, of interposing a barrier between the warring Dakotas and Chippewas; and in 1727 René Boucher built on the shore of Lake Pepin a fort which, after various vicissitudes, was abandoned in 1753. An Indian village occupied the site of Red Wing probably for many years before the arrival of the first whites, two Swiss missionaries, Samuel Denton and Daniel Gavin, who maintained a mission here in 1837–46. In 1848 another mission was established by the American Board. Red Wing (named from an Indian chief) was platted in 1853 and was chartered as a city in 1857.

REDWING (Swed. *Rödvinge*, Dan. *Röddrossel*, Ger. *Rotdrossel*, Du. *Koperwiek*), a species of thrush (*q.v.*), *Turdus iliacus*, which is an abundant winter visitor to the British Islands, arriving in autumn generally about the same time as the fieldfare (*q.v.*) does. This bird has its common English name[1] from the sides of its body, its inner wing-coverts and axillaries being of a bright reddish orange, of which colour, however, there is no appearance on the wing itself while the bird is at rest, and not much is ordinarily seen while it is in flight. In other respects it is very like a song-thrush, and indeed in France and some other countries it bears the name mauvis or mavis, often given to that species in some parts of Britain; but a conspicuous white streak over the eye at once affords a ready diagnosis. The redwing breeds in Iceland, in the subalpine and arctic districts of Norway, Sweden and Finland, and thence across Northern Russia and Siberia, becoming scarce to the eastward of the Yenisei, and not extending beyond Lake Baikal. In winter it visits the whole of Europe and North Africa, occasionally reaching Madeira, while to the eastward it is found at that season in Persia, and, it is said, at times in the north-western Himalayas and Kohat. Many writers have praised the song of this bird, comparing it with that of the nightingale (*q.v.*); but herein they seem to have been as much mistaken as in older times was Linnaeus, who according to S. Nilsson (*Orn. Suecica*, i. 177, note), failed to distinguish in life this species from its commoner congener *T. musicus*. Its nest and eggs a good deal resemble those of the blackbird, and have none of the special characters which distinguish those of the song-thrush. (A. N.)

REDWITZ, OSKAR, FREIHERR VON (1823–1891), German poet, was born at Lichtenau, near Ansbach, on the 28th of June 1823. Having studied at the universities of Munich and Erlangen, he was apprenticed to the law in the Bavarian State service (1846–49). He next (1849–50) studied languages and literature at Bonn, and in 1851 was appointed professor of aesthetics and of the history of literature at Vienna. In 1852, however, he gave up this post and retired to his estate of Schellenberg, near Kaiserslautern. The pious sentimentality of his romantic epic *Amaranth* (1849; 42nd ed., 1898) had already gained him enthusiastic admirers, and this work was followed, in 1850, by *Ein Märchen* and by *Gedichte* (1852) and the tragedy *Sieglinde* (1854). He next settled on his estates near Kronach, and here wrote the tragedy *Thomas Morus* (1856), the historical dramas *Philippine Welser* (1859) and *Der Zunftmeister von Nürnberg* (1860), of which the first two met with great success. Elected member of the Bavarian Second Chamber for the district in which he lived, he removed to Munich in 1862. In 1868 he published the novel *Hermann Stark, deutsches Leben*, and in 1871 *Das Lied vom neuen deutschen Reich* (which contains several hundred patriotic sonnets). In 1872 he took up his residence at Meran, but passed the last years of his life at a sanatorium for nervous disorders near Bayreuth, where he died on the 6th of July 1891.

See R. Prutz, *Die deutsche Literatur der Gegenwart* (1870), i. pp. 148 ff.; H. Keiter, *Zeitgenössische katholische Dichter Deutschlands* (1884); H. von Völderndorff, *Harmlose Plaudereien eines alten Müncheners* (1892); M. M. Rabenlechner, *O. von Redwitz' religiöser Entwicklungsgang* (1897).

REED, ANDREW (1787–1862), English nonconformist divine and philanthropist, was born in London on the 27th of November 1787. He entered Hackney Independent College in 1807 and was ordained minister of New Road Chapel in 1811. About 1830 he built the larger Wycliffe Chapel, where he remained until 1861. He visited America on a deputation to the Congregational Churches in 1834 and received the degree of D.D. from Yale. Reed's name is permanently associated with a long list of philanthropic achievements, including the London Orphan Asylum, the Infant Orphan Asylum and the Reedham Orphanage, which he undertook on non-denominational lines because the governors of the other institutions had made the Anglican Catechism compulsory. Besides these he originated in 1847 an asylum for idiots at Highgate, afterwards moved to Earlswood in Surrey with a branch at Colchester, and in 1855 the Royal Hospital for Incurables at Putney. He died on the 25th of February 1862. Besides an account of his visit to America (2 vols., 1834), he compiled a hymn-book (1841), and published some sermons and books of devotion.

His second son, SIR CHARLES REED (1819–1881), was a successful typefounder and a keen supporter of popular education. As a common councillor of the city of London he developed the Guildhall Library of the City of London School. He was elected M.P. for Hackney (1868 and 1874) and for St Ives, Cornwall (1880), and served as chairman of the London School Board (1873–1881) in succession to Lord Lawrence. He was interested in antiquarian research and in philanthropic work, being an associate of George Peabody and an active worker in connexion with the Sunday School Union, the Bible Society, the Religious Tract Society and the London Missionary Society. His eldest son, Charles Edward Baines Reed (1845–1884) was educated at Trinity College, Cambridge, and became Congregational minister at Warminster (1871) and a secretary of the British and Foreign Bible Society. He was killed by a fall in Switzerland. Sir Charles Reed's third son, Talbot Baines Reed (1852–1893), educated at the City of London School, became managing director of his father's firm, and was one of the founders and secretary of the Bibliographical Society. He is best known as the author of popular boys' books.

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[1] Many old writers assert that this bird used to be known in England as the "swinepipe"; but, except in books, this name does not seem to survive to the present day. There is no reason, however, to doubt that it was once in vogue, and the only question is how it may have arisen. If it has not been corrupted from the German *Weindrossel* or some other similar name, it may refer to the soft inward whistle which the bird often utters, resembling the sound of the pipe used by the swineherds of old when collecting the animals under their charge. Another form of the word (which may, however, be erroneous) is "windpipe." "Whindle" and "wheenerd" have also been given as old English names of this bird (*Harl. Miscellany*, 1st ed., ii. p. 558), and these may be referred to the local German *Weindrustle* and *Winsel*.

REED, ISAAC (1742–1807), English Shakespearian editor, son of a baker, was born on New Year's Day, 1742, in London. He was articled to a solicitor, and eventually set up as a conveyancer at Staple Inn, where he had a considerable practice. His first important work was the *Biographia dramatica* (2 vols., 1782), consisting of biographies of the dramatists and a descriptive dictionary of their plays. This book, which was an enlargement of David Erskine Baker's *Companion to the Playhouse* (2 vols., 1764), was re-edited (3 vols.) by Stephen Jones in 1811, and is a valuable authority. The original work by Baker had been based on Gerard Langbaine's *Account of the English Dramatick Poets* (1691), Giles Jacob's *Poetical Register* (1719), Thomas Whincop's "List of all the Dramatic Authors" (printed with his tragedy of *Scanderbeg*, 1747) and the MSS. of Thomas Coxeter (1689–1747), an industrious antiquary who had collected much useful material. Reed's *Notitia dramatica* (Addit. MSS. 25390–2, British Museum), supplementary to the *Biographia*, was never published. He revised Dodsley's *Collection of Old Plays* (12 vols., 1780). He also re-edited Johnson and Steevens's edition (1773) of Shakespeare. Reed's edition was published in 10 vols. (1785), and he gave great assistance to Steevens in his edition (1793). He was Steevens's literary executor, and in 1803 published another edition (21 vols.) based on Steevens's later collections. This, which is known as the first *variorum*, was re-issued ten years later. He died on the 5th of January 1807. His valuable library of theatrical literature was catalogued for sale as *Bibliotheca Reediana* (1807).

See John Nichol's *Lit. Anec. of the 18th Century* (vol. ii., 1812); and Edward Dowden, *Essays, Modern and Elizabethan.*

REED, JOSEPH (1741–1785), American politician, was born in Trenton, New Jersey, on the 27th of August 1741. He graduated at Princeton in 1757, studied law under Richard Stockton and, in 1763–65, at the Middle Temple, London, and practised in Trenton from 1765 until his removal to Philadelphia in 1770. He was president of the second Provincial Congress of Pennsylvania in 1775, was aide-de-camp and military secretary to General Washington in 1775–76, and was adjutant-general with the rank of colonel in 1776–77. He resigned his commission in the autumn of 1777, and in 1777–78 was a delegate to the Continental Congress. From December 1778 to October 1781 he was president of the state Executive Council. During his administration the proprietary rights of the Penn family were abrogated (1779), and provision was made for the gradual abolition of slavery (1780). During this time Reed led the attack on Benedict Arnold (*q.v.*) for the latter's administration of Philadelphia. Reed was elected to Congress in 1784, but died in Philadelphia on the 5th of March 1785.

The Life and Correspondence of Joseph Reed (2 vols., Philadelphia, 1874), by his grandson, William B. Reed, is based upon the family papers. It pictures Reed as an heroic patriot and statesman; George Bancroft, on the other hand, in the ninth volume (p. 229) of his *History* (1866) and in *Joseph Reed: an Historical Essay* (1867), pictures him as a trimmer of the most pronounced type. Bancroft's principal charge against Reed was based on a passage in Count Donop's diary referring to a Col. Reed protected by the British in 1776. In 1876, however, Mr W. S. Stryker discovered that the reference in the diary was really to Col. Charles Read (1715–*c.* 1780). Bancroft withdrew this definite charge in the 1876 edition of his *History*, in which, however, his tone towards Joseph Reed was unchanged.

Joseph Reed's son, JOSEPH REED (1772–1846), published the *Laws of Pennsylvania* (5 vols., 1822–24), continuing the work of Charles Smith, published in 1810–12, which began with the laws of 1700. His grandson, WILLIAM BRADFORD REED (1806–1876), graduated at the university of Pennsylvania in 1822, was a representative in the Pennsylvania legislature in 1834–35, attorney-general of the state in 1838, and a state senator in 1841. He was professor of American history in the university of Pennsylvania in 1850–56, United States minister to China in 1857–58, and in 1858 negotiated a treaty with China, proclaimed in 1860. Besides the biography of his grandfather mentioned above, he published one of Joseph Reed's wife, *Life of Esther De Berdt, afterwards Esther Reed* (1853).

W. B. Reed's brother, HENRY [HOPE] REED (1808–1854), graduated at the university of Pennsylvania in 1825, practised law in Philadelphia, and was assistant-professor of moral philosophy in the university of Pennsylvania in 1831–34 and professor of English literature and rhetoric there in 1835–54. He assisted Wordsworth in the preparation of an American edition of his poems in 1837, edited in America Christopher Wordsworth's *Memoirs of William Wordsworth* (1851) and published *Lectures on English Literature from Chaucer to Tennyson* (1855).

REED, THOMAS BRACKETT (1839–1902), American statesman, was born in Portland, Maine, on the 18th of October 1839. He graduated at Bowdoin College in 1860; was acting assistant-paymaster in the U.S. navy from April 1864 to November 1865; and in 1865 was admitted to the bar. He was a member of the Maine House of Representatives in 1868–69 and of the state Senate in 1870, was attorney-general of the state in 1870–72, and was city solicitor of Portland in 1874–77. He was a Republican member of the National House of Representatives from 1877 until 1899; was a member of the Potter Committee to investigate the disputed presidential election of 1876, and conducted the examination of Samuel J. Tilden; and he was Speaker of the House in 1889–91, and in 1895–99. He was a "strong" speaker in his control of the proceedings, and he developed an organized committee system, making the majority of the Committee on Rules consist of the speaker and chairman of the committees on ways and means and on appropriations. The "Reed Rules," drawn up by him, William McKinley and J. G. Cannon, were adopted on the 14th of February 1890; they provided that every member must vote, unless pecuniarily interested in a measure, that members present and not voting may be counted for a quorum, and that no dilatory motion be entertained by the speaker. His parliamentary methods were bitterly attacked by his political enemies, who called him "Tsar Reed." He greatly hastened the passage of the McKinley Bill in 1890, and of the Dingley Bill in 1897. His rules and methods of control of legislation were adopted by his successors in the speakership, and the power of the Rules Committee was greatly increased under Charles F. Crisp (1845–1896), Democratic speaker in 1891–1895. After the war with Spain Reed broke with the administration on the issue of imperialism. He resigned his seat in 1899 and practised law in New York City. He died in Washington on the 7th of December 1902. Reed was a remarkable personality, of whom many good stories were told, and opinions varied as to his conduct in the chair; but he was essentially a man of rugged honesty and power, whose death was a loss to American public life.

Reed's Rules were published as a parliamentary manual. He edited with others a *Library of Modern Eloquence* (10 vols., 1901). See the chapter on Reed in H. B. Fuller's *Speakers of the House* (Boston, 1909).

REED, a term applied to several distinct species of large, water-loving grasses. The common or water-reed, *Phragmites communis* (also known as *Arundo phragmites*), occurs along the margins of lakes, fens, marshes and placid streams, not only throughout Britain, but widely distributed in arctic and temperate regions. Another very important species in *Ammophila arenaria* (also known as *A. arundinacea* or *Psamma arenaria*), the sea-reed or marram-grass, a native of the sandy shores of Europe and N. Africa. Both species have been of notable geological importance, the former binding the soil and so impeding denudation, and actually converting swamp into dry land, largely by the aid of its tall (5 to 10 ft.) close set stems. The latter species, of which the branching rootstocks may be traced 30 or even 40 ft., is of still greater importance in holding sand-dunes against the sea, and for this purpose has not only been long protected by law, but has been extensively planted on the coasts of Norfolk, Holland, Gascony, &c. Other reeds are *Calamagrostis* (various species), *Gynerium argenteum* (pampas grass), *Deyeuxia*, &c., also *Arundo Donax*, the largest European grass (6 to 12 ft. high), which is abundant in Europe. Reeds have been used from the earliest times in thatching and in other branches of construction, and also for arrows, the pipes of musical instruments, &c. Reed pens are still used in the East. Plants belonging to other orders occasionally share the name, especially the bur-reed (*Sparganium*) and the reed-mace (*Typha*), both belonging to the natural order Typhaceae. The bulrushes (*Scirpus*), belonging to the natural order Cyperaceae, are also to be distinguished.

REEDBUCK (Dutch *rietbok*), the popular name of a foxy red South African antelope (*Cervicapra arundineum*) of medium size, with a moderately long bushy tail, a bare gland-patch behind the ear, and in the male rather short horns which bend forwards in a regular curve. There are several other species of allied African antelopes included in the genus *Cervicapra* to which the name of reedbuck is also applied, one of these ranging as far N. as Abyssinia, and another inhabiting W. Africa.

REED INSTRUMENTS (Fr. *instruments à anche*; Ger. *Blas-instrumente mit Zungen*; It. *Strumenti a ancia*), a class of wind instruments in the tubes of which sound-waves are generated by the vibrations of a reed mouthpiece. Reed instruments fall into two great classes: (1) those blown directly by the breath of the performer, who is thus able in all but a few obsolete instruments to express his emotional feelings in music; (2) those in which the wind supply is obtained by mechanical devices, such as the bag of bagpipe instruments or the bellows of such keyboard instruments as the regal, harmonium and kindred instruments.

Directly-blown reed instruments comprise the section of modern wind instruments known as the "wood wind," with the exception of flute and piccolo; they are classified according to the kind of reed vibrator of which the mouthpiece is composed. There are three kinds of reed mouthpieces: (1) the single or beating reed; (2) the double reed; (3) the free reed, all of which perform the function of sound-producer (see MOUTHPIECE and FREE REED VIBRATOR). The reed used consists of a thin tongue or strip of reed, cane or some elastic material, thinned gradually to a delicate edge. It is adapted to a resonating tube in such a manner that when it is at rest the opening at the mouthpiece end of the tube consists only of a very slight aperture or chink, which is periodically opened and closed by the pulsations of the reed when acted upon by the compressed breath of the player. This principle is common to all reed mouthpieces, and the difference in timbre is in a measure due to the manner in which the pulsations are brought about and the degree of elasticity secured.

The *double reed* consists of two blades of reed or laminae of elastic material tightly bound together by many turns of waxed silk, so that above the construction the tube has an oval section; below, where it communicates with the main bore of the instrument, the tube is strictly cylindrical. The chink here is formed by two thin walls of reed of equal elasticity (see OBOE, BASSOON). The double reed is common to the members of the oboe family, consisting, besides the oboe, of the cor anglais or tenor, of the fagotto or bassoon, and of the contra fagotto or double bassoon. The double reed mouthpiece is used besides on the sarrusophone family, instruments of brass but classed with the wood wind on account of the mouthpiece and fingering.

The *single* or *beating reed* consists of a single blade bevelled at the edge and placed over a table or frame communicating with the main bore of the instrument, against which it beats, causing a series of pulsations. The single reed is common to all the members of the clarinet family, consisting, besides the clarinet, of the basset-horn or tenor, and of the bass and pedal clarinets; of the batyphone, an early bass clarinet, and of the saxophone, a metal oboe with a beating reed instead of a double reed. The ancient Greek aulos was undoubtedly used with a beating reed during some period of its history.

The *free reed* is not represented among members of the modern wood wind, and, as adapted to a directly-blown instrument, only finds application in the Chinese cheng, the prototype of the harmonium, and in the mouth organ or harmonica.

The reed in wind instruments produces a peculiar tone quality to which it has given its name; it varies in the three different kinds of mouthpieces without losing the fundamental reedy timbre. In the single reed the impact against the hard wood or vulcanite of the table against which it beats produces a sound harsh and strident in inverse proportion to the degree of elasticity possessed by the vibrating tongue. In the clarinet the reed is carefully and delicately made of cane with due regard to the interdependence of reed and clarinet tube. The strong wooden or metallic beating reeds of the early organ reed pipes must have had an unpleasantly harsh timbre, which won for them in Germany the epithet *Schnarrwerk*.

In the double reed the two delicately shaped pieces of reed vibrate against each other, producing the somewhat nasal, reedy tone of the oboe family. In the free reed compressed air is the only buffer which the vibrator encounters while swinging through the aperture, alternately closing and reopening it; hence the soft and mellow timbre which it is possible to produce by proper treatment of the free reed. Experience has shown that the best results for the double reed are obtained when it is used in conjunction with a tube of conical bore, whereas the beating reed is heard to greater advantage in instruments with cylindrical bore, one notable exception in practice being, as already mentioned, the saxophone family. The double reed adapted to a conical tube confers upon the latter the acoustic properties of the open pipe, whose wave-length is equal to that of the tube and which is capable of overblowing the octave and successive harmonics (theoretically). Either a single or a double reed adapted to a cylindrical pipe converts it for all acoustic purposes into a closed pipe, in which the whole wave-length is twice the length of the tube, a node forming at the mouthpiece end. The fundamental note of such a tube will therefore be an octave lower than that of an open pipe of the same length, and it can only overblow the uneven numbers of the harmonic series, such as the third harmonic (or twelfth above the fundamental).

In order to overblow on instruments with reed mouthpieces, greater pressure of breath must be exerted, and the vibrating length of the reed must be decreased by the action of the lips upon it. This is what occurs in instruments of the oboe and clarinet type, which are blown directly from the mouth. There are, however, cases in which the reed is concealed within the instrument out of reach of the lips, either in a capsule, as in the old instruments hautbois de Poitou and cromorne, or else in a socket, as in the chaunter and drones of the bagpipe, or, again, as in the mouthpieces of organ reed pipes. In the last (each of which gives but one fixed note) the vibrating length of the reed tongue is fixed, as is also the pressure of the compressed air supply fed to them. The result in all these cases is similar: no harmonics can be obtained, and therefore the scale of the instrument depends solely on the number of holes and keys provided, whereas, where the lips control the reed, fewer holes are necessary to produce any given compass. The chaunters of bagpipes have double reeds, but the drones are as a rule provided with beating reeds and are of cylindrical bore, a combination which, for the reason explained above, gives them a note an octave deeper in pitch, the length of pipe being equal, than would be the case if the bore were conical. In the musette, in the cornemuse used in concert with the hautbois de Poitou, and in the Neapolitan surdelina (see BAGPIPE), both chaunter and drones had double reeds.

The aulos of the ancient Greeks and tibia of the Romans consisted in the older instruments of a cylindrical tube of very narrow bore, which facilitated the production of the harmonics. The aulos, though often erroneously translated flute, was an oboe or clarinet. Writers on musical instruments are not agreed as to which mouthpiece was in use on the aulos; the probability is that both were in use at one time or another, and that the double reed, being the most primitive and also the more adaptable, was the older contrivance. There is no sign of any suitable attachment for a beating reed on any of the pipes of ancient Greece extant, whereas among the ivory pipes recovered from the ruins of Pompeii there is a fragment which may have been a beak mouthpiece with beating reed similar to that of the modern clarinet.

The ancient Egyptians used the primitive beating reed familiarly known as "squeaker," obtained by making a slight lateral slit across a reed pipe or stem of straw, and with the knife splitting back longitudinally until a tongue was raised; the shorter the tongue the quicker the vibration and the higher the pitch. This small beating reed was then sunk some 3 or 4 in. within the main tube of the instrument; some of these reeds have been discovered in tombs by Professor Flinders Petrie.[1] It is certain that the ancient Greeks did not use the reed in this form in the aulos, for classical writers distinctly describe the effect produced on a reed by taking it into the mouth, but it is equally certain that they were acquainted with the principle of the drone.

The history of the keyboard instruments furnishes instances of the early use of reeds. In the modern English church organ the reed work is provided with beating reeds only, but in Germany, for the sake of obtaining the power of expression, a set of free-reed stops is nearly always added.[2] It is probable that some of the early pneumatic and hydraulic organs (see ORGAN) at the beginning of our era were provided with beating reeds in imitation of the bagpipe chaunter and drones. In the middle ages the regal (*q.v.*), a small, portative reed-organ fitted with beating reeds, was extremely popular in England and all over the continent of Europe, but more especially in Germany and Italy. (K. S.)

REEF (1) (Du. *rif*, cf. Ger. *Riff*, Swed. *ref*, &c., all from O. Nor. *rif*, *rib*), in physical geography, a narrow ridge of rock, shingle or sand culminating at or near the surface of the sea. In a transformed sense the word is used in mining of a vein or lode of gold-bearing quartz; (2) (Du. *reef*, *rif*, cf. Ger. *Reff*, Swed. *raf*, O. Nor. *rif*, possibly a transferred sense of rif, rib), a part of a sail which can be rolled or folded up, thus diminishing the amount of canvas spread to the wind. In square sails, "reefs" are taken from the top, in fore-and-aft sails from the foot.

REEL (O.E. *hrêol*, glossed by the Med. Lat. *alibrum* in *Aelfric's Glossary*, *c.* 1050; the word is of unknown origin; it does not appear in cognate languages, and Celtic forms such as Gaelic *ruidhil* are from English), a cylinder or apparatus of cylindrical shape on which a thread or line can be wound; *e.g.* the small wooden cylinder with projecting rims at either end on which sewing cotton or silk is wound for immediate use, the revolving "click-reel" attached to a fishing-rod, and the open revolving framework on which thread is wound as it is spun. The name of the Scottish dance (Gaelic *righil*, *ruithil*) is probably the same word (see DANCE). In architecture, an ornamental moulding consisting of spherical-shaped bodies alternating with flat reel-shaped disks placed on edge is known as a "bead and reel" moulding.

REES, THOMAS (1777–1864), Welsh Nonconformist divine, was born at Gelligron, Glamorgan, and educated at the Presbyterian College, Carmarthen. He entered the Unitarian ministry in 1807 at Newington Green Chapel, London, removing to Southwark 1813 and to Stamford Street, Blackfriars, in 1823. He had the degree of LL.D. of Glasgow (1819). He had a great knowledge of the history of anti-trinitarian opinion, especially during the 16th century. His scattered papers, chiefly in the *Monthly Repository* (1818–22), on such subjects as "Faustus Socinus and Francis David," "The Italian Reformation," "Memoirs of the Socini," are important. Financial troubles drove him to Spain in 1853, and he died in obscurity at Brighton on the 1st of August 1864.

Another THOMAS REES (1815–1885), a native of Pen Pontbren, Carmarthenshire, held pastorates at Aberdare (1840), Llanelly (1842), Cendl, Mon. (1849) and Swansea (1862), and became chairman of the Congregational Union of England and Wales, but died just before his term of office was to begin. His *History of Protestant Nonconformity in Wales* (1861; 2nd ed. 1883) is a sound and judicious piece of work.

REEVE, CLARA (1729–1807), English novelist, daughter of William Reeve, a Suffolk clergyman, was born at Ipswich in 1729. She was an industrious writer, and produced many works in prose and verse, including a history of the *Progress of Romance* (1785); but her only eminent success was the novel of *The Old English Baron* (1777), originally published under the title of *The Champion of Virtue.* In the history of the English novel she stands midway between Walpole and Mrs. Radcliffe. She died at Ipswich on the 3rd of December 1807.

REEVE, HENRY (1813–1895), English publicist, younger son of Henry Reeve, a well-known Whig physician and writer of Norwich, and nephew of Mrs. Sarah Austin, was born at Norwich on the 9th of September 1813. He was educated at the Norwich grammar school under Edward Valpy. During his holidays he saw a good deal of the young John Stuart Mill. In 1829 he studied at Geneva and mixed in Genevese society, then very brilliant, and including the Sismondis, Huber, Bonstetten, De Candolle, Rossil, Krasinski (his most intimate friend), and Mickiewicz, whose *Faris* he translated. During a visit to London in 1831 he was introduced to Thackeray and Carlyle, while through the Austins he made the acquaintance of other men of letters. Next year, in Paris, he met Victor Hugo, Cousin, and Scott. He travelled in Italy, sat under Schelling at Munich and under Tieck at Dresden, became in 1835–36 a frequenter of Madame de Circourt's salon, and numbered among his friends Lamartine, Lacordaire, De Vigny, Thiers, Guizot, Montalembert, and De Tocqueville, of whose books, *Démocratie en Amérique* and the *Ancien régime*, he made standard translations into English. In 1837 he was made clerk of appeal and then registrar to the judicial committee of the Privy Council. From 1840 to 1855 he wrote for *The Times*, his close touch with men like Guizot, Bunsen, Lord Clarendon, and his own chief at the Privy Council Office, Charles Greville, enabling him to write with authority on foreign policy during the critical period from 1848 to the end of the Crimean War. Upon the promotion of Sir George Cornewall Lewis to the Cabinet early in 1855 Reeve was asked by Longman to edit the April number of the *Edinburgh Review*, to which his father had been one of the earliest contributors, and in the following July he became the editor. His friendship with the Orleanist leaders in France survived all vicissitudes, but he was appealed to for guidance by successive French ambassadors, and was more than once the medium of private negotiations between the English and French governments. In April 1863 he published what was perhaps the most important of his contributions to the *Edinburgh*—a searching review of Kinglake's *Crimea*; and in 1872 he brought out a selection of his *Quarterly* and *Edinburgh* articles on eminent Frenchmen, entitled *Royal and Republican France*. Three years later appeared the first of three instalments (1875, 1885 and 1887) of his edition of the famous *Memoirs* which Charles Greville had placed in his hands a few hours before his death in 1865. A purist in point of form and style, of the school of Macaulay and Milman, Reeve outlived his literary generation, and became eventually one of the most reactionary of old Whigs. Yet he continued to edit and upon the whole to maintain the reputation of the *Edinburgh* until his death at his seat of Foxholes, in Hants, on the 21st of October 1895. He had been elected a member of "The Club" in 1861, and was made a D.C.L. by Oxford University in 1869, a C.B. in 1871, and a corresponding member of the French Institute in 1865. A striking panegyric was pronounced upon him by his lifelong friend, the duc d'Aumale, before the Académie des Sciences in November 1895.

His *Memoirs and Letters* (2 vols., with portrait) were edited by Sir J. K. Laughton, in 1898. (T. SE.)

REEVE (O. E. *gerefa*), an English official who in early times was entrusted with the administration of a division of the country. He was the chief magistrate of a town or district, and is the ancestor of the sheriff, the shire-reeve. In addition to the sheriff there were several kinds of reeves, and we are told in the body of laws known as the laws of Edward the Confessor that it is "multiplex nomen; greve enim dicitur de scira, de wapentagiis, de hundredis, de burgis, de villis." Thus we hear of port-reeves, burg-reeves, and tun-reeves, while the Anglo-Saxon Chronicle mentions high reeves. It was the tun-reeve or reve of the township who with four other men represented the township in the courts of the hundred and the shire. In free townships he was probably chosen by the inhabitants; in dependent townships by the lord. A little later there were manor reeves, these being elected by the villains; according to Fleta, their duties were to attend to the cultivation of the land, and to see that each villain performed his proper share of service. The reve of Chaucer's *Canterbury Tales* was doubtless a steward or bailiff, something equivalent to the grieve in Scotland to-day.

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[1] An illustration of one of these is given in T. L. Southgate's paper, "The Regal and its Successors," in *English Music*, 1604–1904, Music Story Series, 1906, p. 385.

[2] The addition dates from the very end of the 18th or the beginning of the 19th century, and is connected with the advent of the harmonium (*q.v.*).

In early English the word reeve was sometimes used as a translation for the prefect or governor of Roman and Jewish times. Some authorities have thought that there is some connexion between the Anglo-Saxon *gerefa* and the German *Graf*, but Max Müller (*Lectures on the Science of Language*, 1885) is inclined to doubt this. J. M. Kemble (*Saxons in England*, 1876), who goes at length into the history of the reeve, connects the word with *rófan* or *réfan*, to call aloud, this making him the original of the *bannitor*, or proclaimer of the court. At the present time the word reeve is sometimes used to describe a foreman or overseer in a coal mine. It is also used in Canada for the president of a village or town council.

REEVES, JOHN SIMS (1818–1900), English vocalist, was born at Woolwich on the 26th of September 1818, and received his musical education from his father, a musician in the Royal Artillery. At the age of fourteen he had progressed so far as to be appointed organist of North Cray church, and could play the oboe, bassoon, violin, and violoncello. He seems to have studied medicine for a year, but changed his mind when he gained his adult voice: it was at first a baritone, and he made his earliest appearance at Newcastle in 1839 in various baritone parts. He studied with Hobbs and T. Cooke, and, his voice having become a tenor, he appeared under Macready's management at Drury Lane (1841–43) in subordinate tenor parts in Purcell's *King Arthur*, *Der Freischütz*, and *Acis and Galatea*, when Handel's pastoral was mounted on the stage with Stanfield's scenery. Four years were spent in study on the Continent, under Bordogni in Paris and Mazzucato in Milan, and his *début* in Italian opera was made at the Scala as Edgardo in *Lucia*. He reappeared in London in May 1847 at a benefit concert for Vincent Wallace, and at one of the Ancient Concerts in the following month, his career on the English operatic stage beginning at Drury Lane in December 1847 in *Lucia*, under the conductorship of Hector Berlioz. In Balfe's *Maid of Honour* he created the part of Lyonnel in the same season. In 1848 he went to Her Majesty's Theatre, singing in *Linda di Chamounix*; and in the autumn of that year, at the Norwich Festival, made a great sensation in "The enemy said," from *Israel in Egypt*, a song in which the finest qualities of his ringing voice could be appreciated. From his first appearance at the Sacred Harmonic Society in the following November he was recognized as the leading English tenor; and in Costa's *Eli* and *Naaman* the tenor parts were written for him. His first Handel Festival was that of 1857, and the effect of his wonderful declamation in the Crystal Palace was a main attraction of this and of many subsequent festivals. His retirement from public life, at first announced as to take place in 1882, did not actually occur till 1891, when a farewell concert for his benefit was given at the Albert Hall. His savings were invested in an unfortunate speculation, and he was compelled to reappear in public for a number of years. He died at Worthing on the 25th of October 1900.

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